

TOOLKIT ON CROSS-SECTOR INFRASTRUCTURE SHARING



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Foreword

The World Bank's ICT Sector Unit initiated and sponsored the development of this web-based *Cross-Sector Infrastructure Sharing Toolkit* which complement the existing Broadband Strategies Toolkit. It will serve as a neutral and comprehensive resource for all stakeholders in the joint use of passive infrastructure by telecommunications operators and public utilities and provide both a reference point and learning tool. It can be used to educate and assist a range of stakeholders in the telecommunications and other sectors in identifying and evaluating opportunities for cross-sector infrastructure sharing and addressing common challenges. The overall objective of this toolkit is to mainstream cross-sector infrastructure sharing to capitalize on synergies that will reduce costs, enhance competition and increase access to connectivity in the telecommunications sectors of developed and developing countries. The toolkit includes a comprehensive analysis of common opportunities and challenges faced by utilities, telecommunications network operators, policymakers and regulators and offers solutions which have been successfully employed to pursue these opportunities and address these challenges. This core analysis is supplemented and enriched with 18 case studies that demonstrate cross-sector infrastructure sharing, highlighting successes, failures and lessons learned.

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A team from Macmillan Keck prepared the main body of the toolkit, while a joint team from Macmillan Keck and the Columbia Center on Sustainable Investment prepared 18 supporting case studies, including 15 business and project case studies and three country case studies.

Macmillan Keck is an international legal and consulting firm which concentrates on public-private partnerships, infrastructure projects, restructurings, privatizations, competition matters, licensing and corporate and commercial transactions in the telecommunications sector. The firm has represented government policymakers and regulators, state-owned enterprises, development banks, multilateral institutions and investor-owned businesses in connection with cross-sector infrastructure sharing matters. The Macmillan Keck team contributing to this project included partners Richard Keck and Rory Macmillan, of counsel Jason Blechman, and outside individual consultants Danie Botha, Tom Jackson, Jey Jeyapalan and Andrew Johnson.

The Columbia Center on Sustainable Investment is a joint center of Columbia Law School and the Earth Institute at Columbia University in New York City. The Columbia Center is the only applied research center and forum dedicated to the study, practice and discussion of sustainable

international investment, and has significant experience in shared use of infrastructure in developing countries. The Columbia Center team contributing to this project included Perrine Toledano, Nicolas Maennling, Sophie Thomashausen and Chris Hunter.

We thank Richard Keck, who authored the main body of the toolkit based on over 31 years of experience with cross-sector infrastructure sharing. He received valuable support and assistance in research, writing and editing from colleagues Rory Macmillan and Jason Blechman. Chris Hunter of the Columbia Center provided invaluable support on the tedious and thankless task of cite checking and conforming citations.

We thank the authors of the toolkit case studies:

- **Richard Keck: United States**
- **Jason Blechman: Lesotho Electricity Company, RailTel (India), Baltic Optical Network (Estonia), Kennedy Interchange (United States), Bombay Gas (India), Electricity Supply Company of Malawi, Tokyo Metropolitan Government (Japan), Ghana's Electricity Transmission Line Fiber, and Lithuania**
- **Rory Macmillan: Tunisian Railways and SOGEM**
- **Nicholas Maennling: Adif (Spain) and Portugal's Rapid Increase in Fiber Access**
- **Sophie Thomashausen: CEC Liquid Telecom (Zambia) and KOSTT (Kosovo)**
- **Perrine Toledano: Information Broadband Infrastructure System (Poland) and South Africa**

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¹ Available at <http://vibconinc.com/pipeline/> (last visited 14 Feb 2017).

² Available at <https://www.flickr.com/photos/beigephotos/41580887/in/photolist-4F7xR-sUACB-9j7wvM-4m8Y78-sUBGE-ay6WBw-sUAUY-sUB5h-bBAPS-sUBfz-sUALn-sUAvS-sUAnW-sUAfS-bL3T2k-av5T7z-5FnAuZ-ef6oG7-7StJ6o-2jX73J-6Gs8a2-nJPE3T-ad9sA5-37EiMv-6N1b4g-64TXu3-52oAHw-oe1UTn-6N1bJP-6N5nvf-86gmW6-wdT2-6N1aSR-5LojY-6N1bhD-6N1cXi-6N1bvH-6N5nGS-bxg4oB-64PETF-BAysUD-r3dkCn-n7eCJM-QvXMc1-rAU2M6-ASV1rA-wKBocH-vARAPZ-tFbehL-dAF9ms> (last visited 20 Feb 2017).

³ Available at <https://www.flickr.com/photos/aljanabi/6062008878/sizes/l/in/photostream/> (last visited 14 February 2017).

CROSS-SECTOR INFRASTRUCTURE SHARING



Introduction

1. *Cross-sector infrastructure sharing* broadly refers to the sharing of infrastructure – primarily real property fixed assets comprising land, improvements and fixtures – across different sectors of the economy. For example, cross-sector infrastructure sharing might encompass the use of the same bridge to carry both a roadway and a railway across a river, or the placement of roadways and electric distribution lines in the same corridors.⁴
2. The discussion of cross-sector infrastructure sharing in this toolkit focuses exclusively on joint use of infrastructure by telecommunications network operators and owners of infrastructure developed primarily for purposes other than the provision of public telecommunications services. Intra-sector infrastructure sharing among telecommunications operators has also grown in significance since the introduction of competition in the sector. *Intra-sector infrastructure sharing* is addressed in Module 2 of the Broadband Strategies Toolkit.⁵ Cross-sector infrastructure may, however, include telecommunications facilities whose primary purpose is to support internal communications needs of an infrastructure owner whose primary business is not the provision of telecommunications services.
3. Generally, the opportunity for cross-sector infrastructure sharing to support public telecommunications networks is greatest with infrastructure owners in various network sectors.⁶ These may include owners of roadways, railways, water and sewer systems, electricity transmission and distribution systems, and petroleum and gas pipelines.⁷
4. Several types of infrastructure used in the network sectors are useful for sharing with commercial telecommunications network operators. The universally appealing assets are the land corridors established for roads, railways, electricity transmission lines and pipelines. In addition, the improvements and fixtures in these corridors are also sometimes good candidates for sharing. These include the ducts, conduits, poles and towers used for electricity lines, the inside of pipes used for water, sewer, steam or gas transport, water towers, radio towers used for the private radio networks of utilities, and excess dark fiber in the internal networks installed by utilities and other infrastructure owners. Such sharable infrastructure can concurrently support telecommunications access and backbone networks. In addition, due to the potential for cross-sector sharing of

⁴ For purposes of this toolkit, *real property* generally includes both *land* and all improvements and fixtures on the land. *Improvements* are permanent structures, such as buildings, and other additions and changes to the real property, such as grading or clearing, that typically increase its usefulness and cannot easily be removed. Like improvements, *fixtures* are items of tangible property, such as towers, masts, aerial cable or buried cables, which are permanently affixed to real property, but which may be more easily removed. The distinction between improvements and fixtures is generally not material for the purposes of this discussion of cross-sector infrastructure sharing. A *corridor* refers to a defined lateral tract of land within which improvements and fixtures are or can be installed. Corridors vary in width, and are usually be as wide as required for the intended improvements and fixtures to be installed. For example, a highway corridor is often wider than a railway or pipeline corridor.

⁵ For more information about intra-sector sharing, see sections 2.2.2.4 and 2.2.2.5 in Module 2 of Broadband Strategies Toolkit.

⁶ As used in this toolkit, *network sectors* generally refers to industries which provide lateral carriage of people, goods and commodities. Cross-sector infrastructure sharing is also possible with other industries on a more limited and *ad hoc* basis. For example, rooftops have long been shared for use as mobile radio base station tower sites. However, this toolkit's focus is on the potential for strategic infrastructure sharing across sectors which have strong synergies with the telecommunications sector.

⁷ Access to *on premises* infrastructure, such as vertical risers, ducts and equipment rooms, is also important for telecommunications operators to reach customers within a building or complex, particularly in landlord-tenant scenarios where the landlord may have entered into exclusive or preferential arrangements with a competing telecommunications operator. These *on premises* access issues, while vitally important, are outside the scope of cross-sector infrastructure sharing as addressed in this toolkit.

corridors, many corridors which are controlled by one infrastructure owner are also used by other infrastructure owners. For example, a roads authority will often control both a road reserve⁸ and the roadway established in the road reserve. With permission from the roads authority, other infrastructure owners may construct or install additional improvements and fixtures within the road reserve. These include water, sewer and gas utilities which may have buried their pipes along or under the road and installed access shafts and manholes in or along the road. They also include electric utilities which have buried ducts for their power lines under or along the road and/or installed poles or towers for overhead electricity lines within the road reserve. Where these layers of separately owned and operated infrastructure exist, cross-sector sharing with the telecommunications sector may require separate formal sharing relationships between a telecommunications operator and each separate owner of infrastructure as well as the controller of the corridor. A broadband operator wishing to hang fiber optic cable on electric utility poles, for example, may need to obtain permission from the roads authority to locate its cables and equipment within the road reserve and permission from the electric utility to attach the cables and equipment to the utility's poles.

5. Sharing of corridors and other infrastructure reduces unnecessary duplication and costs and speeds up deployment. This creates greater efficiencies for the sharing parties, including both the telecommunications operator and the infrastructure owners. Infrastructure sharing also benefits the greater public and the environment. By reducing the frequency, scope and duplication of civil works projects, infrastructure sharing can reduce the proliferation of dedicated corridors, which exclude or limit other uses of land, as well as related improvements and fixtures, which create congestion within those corridors and may adversely impact the enjoyment of adjoining land. By reducing the number and scope of such projects, infrastructure sharing mitigates potential disruption or displacement of economic and social activities (by, for example, disrupting vehicle traffic), population relocation or displacement, health and safety risks, and negative environmental impact.

6. Some of the broadband strategies discussed elsewhere in this toolkit focus on squeezing additional years of life out of *existing* copper-based telecommunications facilities, such as providing DSL over twisted copper pairs or cable modem service over coaxial cable. In this toolkit, the focus of the discussion of cross-sector infrastructure sharing is on building *new* broadband networks by leveraging existing infrastructure from other sectors. This will primarily involve the development of fiber optic networks and, to a lesser degree, wireless tower sites.

7. This toolkit on cross-sector infrastructure sharing is intended as a guide for infrastructure owners, broadband access network and wholesale telecommunications network operators, policymakers, lawmakers, regulators, international economic development institutions and other stakeholders interested in harnessing the potential of cross-sector infrastructure sharing to facilitate broadband development. As in the other Modules of the Broadband Strategies Toolkit, particular emphasis is placed on providing a guide for stakeholders in developing countries.

8. Cross-Sector Infrastructure Sharing Toolkit develops several themes. It first focuses on what, why and how. Introduction section has briefly introduced what is meant by cross-sector infrastructure sharing. Executive Summary section provides a brief summary of all the topics covered in this toolkit, which can provide an introductory overview for the reader who intends to

⁸ *Road reserve* is a common term used to refer to a corridor established for roads.

dig in deeper by reading all of the toolkit or a substitute for the reader who seeks only a high level summary of its contents. Module 1 briefly traces the origins and development of cross-sector infrastructure sharing and provides an overview of cross-sector infrastructure sharing today, in both cases providing some insight into what infrastructure has been shared, why the parties have chosen to share it, and how it has been shared. Module 2 discusses the financial and other motivations of broadband network operators, infrastructure owners, and lawmakers, policymakers and regulators. Module 3 describes some of the more common business models that have been employed in cross-sector infrastructure sharing.

9. The toolkit then turns to the issues and challenges which may suppress the benefits of cross-sector infrastructure sharing in facilitating broadband development. Module 4 identifies and discusses disincentives and impediments commonly encountered by infrastructure owners. Similarly, Module 5 identifies and discusses disincentives and impediments commonly faced by telecommunications network operators. Identifying and exploring these disincentives and impediments is meant to assist market participants in selecting infrastructure sharing business models and strategies which help mitigate or overcome them. Module 6 identifies and develops key approaches which may be adopted by lawmakers, policymakers and regulators to remove or reduce these disincentives and impediments. Module 7 identifies and discusses ways in which international economic development institutions may also help.

10. To supplement the general themes discussed in Modules 0 through 7, this toolkit also includes 18 separate case studies. Module 8 discusses 15 different cross-sector infrastructure sharing businesses or projects covering a diverse range of geographies, infrastructure types, business models, commercial or regulatory challenges and solutions. Countries covered by these case studies include Estonia, Ghana, India, Japan, Kosovo, Lesotho, Malawi, Mali, Mauritania, Poland, Portugal, Senegal, Spain, Tunisia, the United States and Zambia. Infrastructure types include electricity distribution, electricity transmission, piped gas distribution, railways, roadways and sewer systems. Module 9 takes a more holistic look at the cross-sector infrastructure markets and regulatory frameworks in three countries, including Lithuania, South Africa and the United States. In addition to these 18 case studies, the main body of this toolkit includes numerous other examples of specific cross-sector infrastructure sharing scenarios, issues or solutions.

11. Finally, as an aid to the reader and for use as a desk reference, Module 10 provides a glossary of common cross-sector infrastructure sharing terminology used in this toolkit.

Executive summary

12. Cross-Sector Infrastructure Sharing Toolkit is intended as a guide for infrastructure owners, network operators, policymakers, lawmakers, regulators, international economic development institutions and other stakeholders interested in harnessing the potential of cross-sector infrastructure sharing to facilitate broadband development. As in the other Modules in the Broadband Strategies Toolkit, particular emphasis is placed on providing a guide for stakeholders in developing countries.

Origins and development of cross-sector infrastructure sharing

13. From the inception of commercial telecommunications, network operators sought to partner with owners of existing or planned network corridors and infrastructure to reduce costs and accelerate network rollout. Telecommunications networks which share network and infrastructure have also supported the internal communications needs of these network operators.

14. ***The telegraph and railroads paved the way for infrastructure sharing beginning in the mid-Nineteenth Century.*** These two industries become so intertwined they were called *Siamese twins of commerce*. The railways had established corridors with room to accommodate parallel telegraph lines and train stations which could support telegram delivery offices. The telegraph offered significant benefits to railroad owners, enabling telegraph operators to barter services for use of corridors and stations. Sharing was based on mutual interest, without legal mandate.

15. ***The telephone followed the telegraph's example in sharing road corridors and utility poles.*** Because telephone communications require direct connectivity to every user, telephone companies preferred roadway corridors over railway corridors. The introduction of insulated and shielded telephone cable eventually enabled the sharing of utility poles with electric utilities. In some developed countries, coaxial cable television networks later followed the telephone lines – routed along roads and hung from utility poles. These practices have continued until today.

16. Telephone companies initially co-located their intercity long distance lines on telegraph poles in railroad rights of way. After the introduction of insulated and shielded cables, long distance lines were often buried, but still along railway lines. Cable television was fed content by terrestrial antennae or satellite earth stations and therefore had no need for intercity links.

17. ***The growing introduction of wireless communications from the mid-Twentieth Century onward eroded demand for new lateral infrastructure.*** Microwave links replaced telephone cables on major intercity links, and satellite provided connectivity to more isolated locations. The introduction and growth of wireless cellular access networks enabled the proliferation of networks without any new lateral infrastructure. Digital cellular networks led to widespread displacement of fixed-line telephone networks. In some developing countries, mobile networks became the ubiquitous medium and fixed-line networks disappeared. Mobile network operators increasingly built end-to-end wireless infrastructure, comprising cellular access networks, microwave backhaul and transmission links, and satellite international links.

18. ***But the end-to-end wireless trend has not lasted.*** The advent of fiber optic cables and surging demand for bandwidth have renewed the need for infrastructure sharing in a competitive landscape. *Fiber optics has become the new primary medium for every element of fixed networks and all elements of mobile networks except the link from radio tower to end user.*

19. ***Like the early telegraph and telephone, fiber requires end-to-end lateral corridors.*** Cross-sector infrastructure sharing has again become a mainstay of improving economic feasibility and accelerating deployment. However, the landscape is now different. Competing facilities-based network operators aggressively seek infrastructure sharing to keep their costs competitive. Infrastructure owners have greater internal communications needs. Fiber optic technology enables sharing by multiple users across more infrastructure types and conditions.

20. ***Network operators seeking to share infrastructure also face greater challenges and opportunities than in the past.*** Existing land corridors are more congested. Burying fiber optic cable in modern cities is difficult and expensive. Facilities-based competition means more network operators want to share the same infrastructure, adding to congestion. The infrastructure which broadband network operators today seek to share includes the traditional list – corridors, conduits, ducts, towers and poles – plus excess dark fiber controlled by non-telecommunications owners. Creative solutions, such as multiple stakeholders sharing fiber in the same cable, are available and needed.

21. ***Cross-sector sharing has become a component of many national and multinational broadband development policies.*** Policymakers, lawmakers and regulators increasingly seek to require or encourage infrastructure sharing to accelerate deployment, decrease costs and enhance competition. Most countries have begun to address infrastructure sharing in their telecommunications laws. Some efforts have been effective, while others have not. Economic development institutions also increasingly seek to encourage cross-sector infrastructure sharing.

Financial and other motivations for sharing

22. The motivation of broadband network operators to access and use infrastructure built for other sectors is driven by the need for cost-effective upgrades of their networks to satisfy bandwidth demand growth which requires exponential increases in Internet throughput capacity. Meeting this demand requires fiber networks. It also requires additional mobile towers. These investments require extensive new civil works or the use of existing land corridors and infrastructure. Network operators who share infrastructure within or across sectors to support fiber rollout may more quickly achieve benefits of scale by reducing their fixed costs. Sharing existing electricity transmission towers, water towers or other infrastructure for mobile radio base stations can reduce costs and regulatory barriers for new tower sites.

23. ***Cross-sector infrastructure sharing provides significant benefits to infrastructure owners.*** It presents a strategic opportunity for utilities to monetize the latent value of existing infrastructure, including excess dark fiber. It offers public utilities the opportunity to reduce the external capital required to install or upgrade their communications networks.

24. ***Policymakers, lawmakers and regulators often seek to intervene in the cross-sector infrastructure sharing market to stimulate broadband investment and competition.*** Fiber and lateral infrastructure sharing can reduce telecommunications bottlenecks and intra-sector discrimination through fostering competitive market entry by utilities, which are generally more competitively neutral than vertically integrated network operators. Sharing tower space in existing *noxious use corridors*, such as electricity transmission towers and water towers, can mitigate public health, safety and environmental concerns to ease the permitting process for new towers.

Common business models

25. ***The common business models adopted by infrastructure owners for cross-sector infrastructure sharing take many forms and can be designed around the unique circumstances and needs of participating infrastructure owners and network operators.*** These business models are not mutually exclusive, nor is every model appropriate for every infrastructure owner.

26. The ***joint development business model***, where infrastructure owners and network operators coordinate in planning and constructing or refurbishing infrastructure, is the most efficient form of sharing. It is not a business model *per se*, and typically involves another business model to address ownership and use rights. It is only practical if host infrastructure is being developed or refurbished.

27. In the ***hosting business model***, the infrastructure owner hosts third-party telecommunications equipment by authorizing a network operator to install its own telecommunications facilities on the infrastructure. The infrastructure owner serves as a passive landlord.

28. The ***dark fiber business model*** involves the provision of dark fiber by an infrastructure owner to network operators, either on a long-term IRU basis or short-term lease basis. This often is the least risk, highest reward option for a utility. The host provides passive infrastructure only, and neither an operating network nor telecommunications services.

29. In the ***joint venture business model***, the infrastructure owner provides a network operator partner with use of existing infrastructure, including excess existing fiber, to provide commercial telecommunications services on a profit-sharing basis. The financial arrangements between the joint venture parties can vary widely based on commercial and regulatory considerations.

30. In the ***wholesale telecommunications services business model***, the infrastructure owner provides wholesale telecommunications services to network operators. This business model involves much higher risk, in relation to potential rewards, for the utility than other business models. Its chances of success depend heavily on the owner's ability to develop technical and business capabilities to operate in a highly competitive and fast-moving environment.

31. Regardless of the primary business model adopted, infrastructure owners often supplement their lateral infrastructure offerings with ***ancillary services*** such as the provision of co-location space, tower sites and various field crew and on-site support services.

Disincentives and impediments for infrastructure owners

32. ***Infrastructure owners typically face several disincentives and impediments which deter or prevent them from actively pursuing or entering into sharing arrangements.***

33. ***First, their core business regulators often seek to offset sharing revenues by reducing the allowed revenue from the core business.*** In the worst case, all revenue received from infrastructure sharing is deducted from the utility's revenue requirements for setting tariffs in its core business – resulting in a zero-sum outcome which removes all financial incentive to share. Progressive policymakers and regulators can protect utility ratepayers, and increase financial incentives for utilities to share, by aligning the regulatory approaches of the two sectors.

34. ***Second, cross-sector infrastructure sharing provisions of telecommunications laws often deter sharing and investment through a combination of imposing ex ante price regulation absent market dominance, mandating market entry and requiring non-discrimination.*** These provisions do not align with accepted best regulatory practice within the telecommunications sector, which requires a finding of market dominance as a condition precedent to *ex ante*

regulation. The combined impact of utility ratemaking principles and cost-based price regulation of infrastructure sharing can have a draconian impact on the financial incentives of utilities to share infrastructure or invest in making it more attractive to access seekers. Permitting non-common-carrier arrangements without regulatory intervention in the absence of dominance is generally the regulatory approach most conducive to optimizing infrastructure sharing.

35. ***Third, institutional silos for infrastructure investment present additional barriers to engaging in cross-sector planning and construction activities.*** One source of such silos is the disbursement conditions and procurement rules applicable to infrastructure owners which receive donor funding, which currently leave little room for cross-sector planning. Another source is institutional capacity limitations of the owner, such as lack of experience with telecommunications or joint use of infrastructure and lack of a budget to hire experienced personnel within the scope of their regulated revenues and earnings.

36. ***Fourth, state ownership of host infrastructure significantly impacts the potential for cross-sector infrastructure sharing with potential joint users of the infrastructure.*** Establishing infrastructure sharing arrangements with state actors and state-owned enterprises requires the parties to deal with a variety of contracting restrictions, including regulation of public procurement, disposition of public assets, public-private partnerships or public concessions. Political interference further complicates the ability of infrastructure owners and telecommunications operators to enter into long-term, mutually beneficial sharing relationships. State-owned enterprises also have strict limitations on their permitted scope of business activities, which may need to amend their charters before entering an infrastructure sharing business.

37. ***Fifth, tight financial constraints and inflexible governance structures often deprive management of rate-regulated public utilities, particularly state-owned enterprises, of sufficient financial and human resources to pursue infrastructure sharing opportunities.*** They typically do not have any discretionary budget to devote significant internal or external resources to develop a non-core business opportunity such as infrastructure sharing. Senior management's lack of relevant experience and capital, and the sometimes unrealistic or disconnected recommendations of internal communications personnel, often creates a paralysis of indecision. Joint use of infrastructure can be impeded by a lack of standards, particularly where telecommunications equipment can cause operational issues for the infrastructure owner.

Disincentives and impediments for telecommunications operators

38. ***Telecommunications operators also face several disincentives and impediments to entering into sharing arrangements with infrastructure owners.*** These often reflect the impact of institutional restraints and shortcomings of infrastructure owners in pursuing sharing opportunities. They are exacerbated by network operator unfamiliarity with regulated utility culture.

39. ***First, network operators who have attempted to initiate a dialogue about sharing opportunities often report frustration due to lack of a clear path of engagement with the infrastructure owner.***

40. ***Second, insufficiency of a utility's land use rights to cover the access seeker, and the sometimes greater difficulty a telecommunications operator has in perfecting rights outside of road reserves, presents a threshold challenge to deploying telecommunications networks along other lateral corridors.*** In many instances, investor-owned mobile operators in developing

countries do not enjoy rights of eminent domain over private land, or such rights are required to be exercised through a public authority unwilling to support the mobile operator's timetable or business needs. These limitations on land use rights present impediments to piggybacking on existing utility infrastructure. The process of perfecting rights of way, which may require administrative or judicial proceedings, can lead to significant delays.

41. ***Third, telecommunications operators require a high standard of reliability for wholesale infrastructure and services that are key inputs to their retail services.*** The ability of a utility offering wholesale bandwidth services to deliver high reliability, and deploy new routes quickly in response to the evolving needs of telecommunications operators, will require a significant commitment to incur fixed costs – upfront and recurring – *before* signing any customers. Many utilities are therefore not well-positioned to pursue the telecommunications services business model, and may more prudently seek to commercialize excess dark fiber and pole space.

How policymakers, lawmakers and regulators can help

42. ***Policymakers and regulators can facilitate cross-sector infrastructure sharing by using carrots and sticks.*** The carrot approach fosters conditions conducive to voluntary, market-based sharing by replacing disincentives with incentives. The stick approach intervenes where market-based activities fail, and typically involves mandated access or regulation of access terms. An optimal policy and regulatory equilibrium can employ the following carrots and sticks:

43. ***First, infrastructure sharing can be increased by reducing financial disincentives from core business rate regulation.*** One form of *incentive regulation* allows the regulated utility to share infrastructure sharing revenues with its core business rather than allocate sunk core business costs to its infrastructure sharing business. Revenue sharing can be calibrated by adjusting the allocation percentages to properly incentivize management while protecting utility ratepayers.

44. ***Second, reforms can ensure that telecommunications operators have access to land corridors established for other public or private purposes.*** Effective laws affording network operators access to land corridors are a fundamental component of ensuring optimal infrastructure sharing. They should ensure that access is open, non-discriminatory and efficiently administered. The substantive and procedural requirements for access will differ depending on whether public, private or tribal land is involved.

45. ***Access to the corridors established for public roads and highways is critical to the development of almost every broadband network.*** Road reserves often offer the only viable last mile route to the customer premises for wired networks or to towers for wireless networks. Reforms may include one-stop shopping, streamlined and harmonized permitting and approval processes, better planning and coordination, management of congestion, requiring coordination among competing users, and installing ducts during roadway construction or renewal.

46. ***Access to private roads and other private land comprising part or all of an existing corridor has been less adequately addressed in many jurisdictions than access to public roads.*** While a network operator will generally not be prohibited from acquiring private easements or other rights of use in private roads or other private lands, its ability to obtain such rights on fair and reasonable terms can be very tenuous without a right of *compulsory acquisition* of easements on private land.

47. ***Third, policymakers, lawmakers and regulators should tread carefully in regulating cross-sector access to facilities other than land.*** Access to improvements and fixtures, such as poles, ducts, conduits, towers and fiber, generally merits separate treatment from access to land. Access

by a network operator to improvements and fixtures often creates significant burdens for the infrastructure owner and introduces operational risks to the safety, reliability and efficiency of the facilities. Joint use of facilities also requires significantly greater ongoing cooperation and interaction between the network operator and infrastructure owner than does the use of a land corridor. Infrastructure owners and access seekers often have relatively equal bargaining power and can reach voluntary market arrangements. Regulatory intervention presents significant risk of inherent regulatory bias unless the infrastructure owner and network operator are both regulated by the same multi-sector regulator. It is therefore usually better policy to rely to the greatest extent possible on voluntary commercial arrangements, rather than regulated access.

48. ***Treating a utility entering the infrastructure sharing market with the level of regulation appropriate to the nature of the shared use and the owner's market power in the relevant market is generally the most pro-competitive and pro-investment policy.*** Experimental infrastructure sharing should be permitted and encouraged rather than mandated and regulated. For other types of sharing, the key question for policymakers and regulators is when to apply *ex ante* remedies and when to limit regulation to *ex post* remedies. This should be based on a market assessment to define relevant markets and assess market power in relevant markets. Generally, *ex ante* regulation is appropriate only when the infrastructure owner has been found to be dominant and its practices are an abuse of such dominance or where there is evidence of collusion.

49. ***If price regulation is necessary, regulators should not establish prices which force a utility's core business customers to cross-subsidize telecommunications market customers.*** This can cause market distortions by shifting economic value between sectors. Where an infrastructure sharing law is overbroad in allowing price regulation absent dominance, the regulator should consider forbearance from price regulation absent evidence of dominance or collusion.

50. ***Fourth, policymakers, lawmakers and regulators should address regulatory restrictions and institutional structures of state organs and enterprises which hinder infrastructure sharing.*** Corporatizing state-owned enterprises so they operate under the same principles as private enterprises is a positive first step. Another positive step is to provide some *relief from public enterprise laws* for qualifying state-owned enterprises. The financial discipline of *separate accounting* can also ensure that the utility operates more like a business.

51. ***Fifth, policymakers and other stakeholders can facilitate greater information exchange and dialogue to raise awareness of cross-sector infrastructure sharing opportunities and points of entry into state-owned infrastructure owners.*** Mapping resources can be utilized to create an accessible database of opportunities for infrastructure sharing. Government and state-owned enterprises can collect, compile and supply this information to network operators and establish a process for requests for information. The telecommunications regulator can facilitate requests for information and sharing by publishing a list of government departments and utilities that administer relevant infrastructure. The telecommunications regulator or ministry can support stakeholders in establishing a chamber of commerce or other trade group among telecommunications operators and infrastructure owners.

52. ***All market interventions should be tailored to local conditions.*** One size will not fit all.

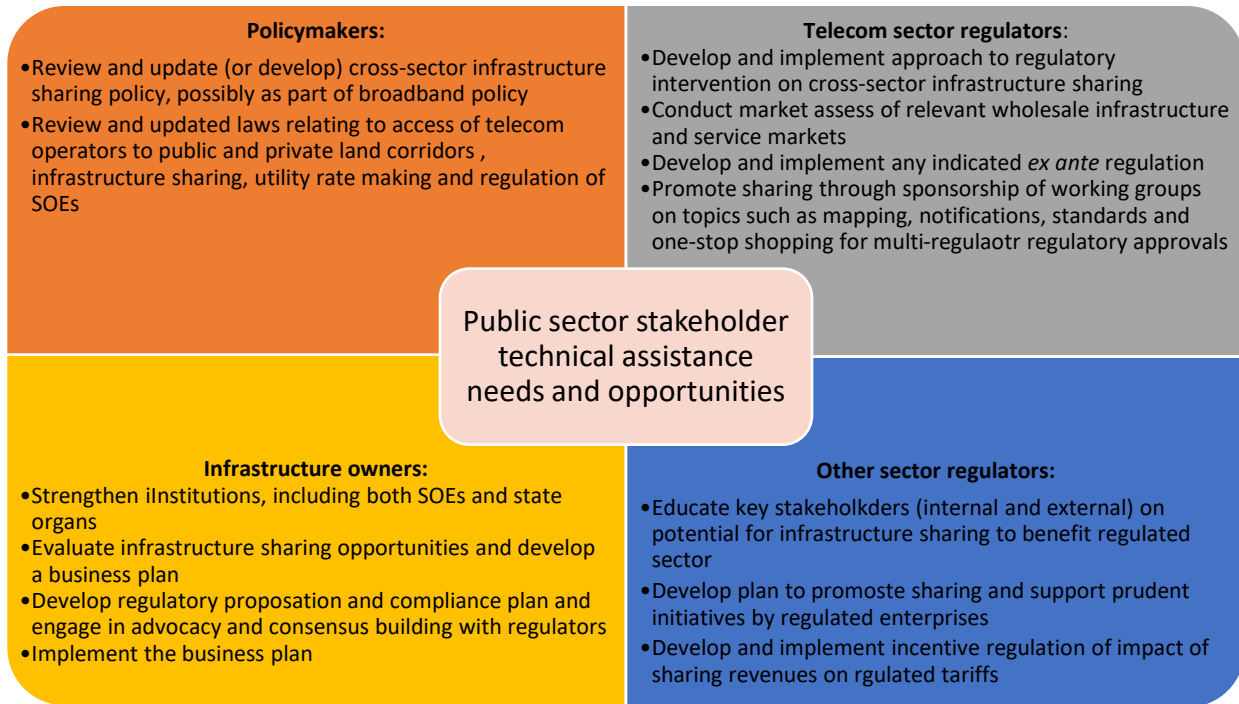
How international economic development institutions can help

53. ***International economic development institutions stand in a key position to encourage cross-sector infrastructure sharing because they provide a significant portion of the funding for sharable infrastructure in developing countries.***

54. ***First, they can encourage neutral and decentralized passive infrastructure ownership.*** They are rightly wary of investing in the establishment of monolithic wholesale providers which create a high risk of either creating significant market concentration or investing wastefully in failed projects. Fiber optic cable, when coupled with a smart approach to cross-sector infrastructure sharing, presents a unique opportunity to continue facilities-based competition for broadband network deployment in an economically viable manner. Development and ownership of the underlying fiber optic cable by utilities in other sectors can offer a competitively neutral landlord which can also benefit from core business uses of fiber and the opportunity to monetize excess capacity and reinvest in its core business. The potential for utilities to possess market dominance in wholesale dark fiber markets is often currently limited. Where utilities are dominant, either a competition authority or an empowered telecommunications sector regulator can step in to regulate pricing and access terms. The infrastructure sharing market thus presents significant checks and balances to ensure that market-based pricing is reasonable and the inherent neutrality of the infrastructure owners vis-à-vis telecommunications operators. Development institutions can optimize continued private sector investment in upgrading telecommunications infrastructure for broadband, while sustaining the facilities-based competition model which has worked so well for wireless networks, by fostering the development and sharing of dark fiber by infrastructure owners whose core businesses or services are not telecommunications. This approach reduces the need for development investment in standalone telecommunications networks and frees up resources.

55. ***Second, international institutions can provide or fund technical assistance to public sector stakeholders.*** By underwriting targeted technical assistance, international institutions can leverage their investments and serve as a catalyst for market-based development of broadband networks. These limited market and regulatory interventions can have a significant positive impact on the availability of shared infrastructure. Relevant stakeholders include state-owned enterprises and government organs which own or manage sharable infrastructure, sector regulators, policymakers and lawmakers. Key disciplines in which infrastructure owners may benefit from technical assistance include legal, regulatory, commercial, technical and financial. Other public stakeholders can benefit from technical assistance in assessing existing policy, legal and regulatory frameworks for friendliness for cross-sector infrastructure sharing and benchmarking them against best practices. Technical assistance can also support development of standards to govern joint use of infrastructure. Collaboration between similarly situated infrastructure owners in a region can also be a useful and efficient way to develop and share standards and best practices. Figure 1 illustrates public sector stakeholder technical assistance needs and opportunities:

Figure 1: Matrix of candidates and topics for technical assistance



56. **Technical assistance from development institutions also needs to be provided in the manner most suitable for the client.** Technical assistance sometimes takes the form of an assignment executed by the development institution itself. At other times, development institutions provide financial support and guidance for recipients to procure and engage their own advisers directly. In the case of advisory services to policymakers and regulators, both approaches can be beneficial. In the case of infrastructure owners, it is fundamentally important to provide for recipient-executed procurement of technical advisers to ensure advice is client-focused, advisers do not have conflicts of interest, and the recipient will respect and trust the advice. Because the development institution’s objectives and agenda tend to be policy-based and look at macro impact, advice provided to infrastructure owners though such institutions is inherently likely to compromise the infrastructure owner’s own interests for the greater good sought. In a market-based approach to development, policy must rely on each individual actor pursuing its own best interest, within a framework of rules to ensure fair play, and therefore each market participant should have its own advisers who are independent, selected by the client and not a third party.

57. **Third, international institutions can plan for cross-sector sharing in all new infrastructure projects.** Opportunities for sharing of new infrastructure can be enhanced by planning for sharing activities when it is developed. This requires proactive and inclusive planning by development institutions which finance the infrastructure and the implementing agencies of the recipient governments. Development institutions have historically organized their approach to infrastructure investments by sector. While useful for other reasons, the sector-based approach has created silos which reduce multi-sector opportunities. The World Bank and other institutions have recently begun to take a cross-sector approach to their institutional structure and their projects. These nascent cross-sector planning efforts would benefit from continued and increased focus on leveraging investments for multiple sectors.

1 The origins and development of cross-sector infrastructure sharing

58. From the very beginning, the entrepreneurs who have established and operated telecommunications networks have sought to partner with the owners of existing or planned network corridors and infrastructure as a means to reduce their costs and accelerate the rollout of their networks. Also, from the very beginning, telecommunications networks which share network corridors and infrastructure have been used to support the internal telecommunications needs of the network operator as well as to provide public telecommunications services.

1.1 The telegraph and railroads paved the way

59. In 1837, British inventor and entrepreneur William Cooke demonstrated an early telegraph to officials of the London & Birmingham Railway and built an experimental telegraph link of 1-1/4 miles in length between the Euston and Camden Town stations. He then proposed to establish a telegraph system for both public and railway use linking London to Birmingham, Manchester, Liverpool and Holyhead. The London & Birmingham Railway rejected his plans. Cooke then approached the Great Western Railway, from whom he secured funding to build an initial 13-mile link from Paddington to West Drayton. In 1843, when the Great Western Railway declined to spend its own money to extend the telegraph line, Cooke himself funded an 18-mile extension to Slough. Under the arrangements with the Great Western Railway, Cooke was permitted to “make the telegraph available to the public, on the condition that railway messages were carried for free.”⁹

Figure 2: Public demonstration of Cooke’s telegraph at Paddington Station in 1840



Source: Connected Earth¹⁰

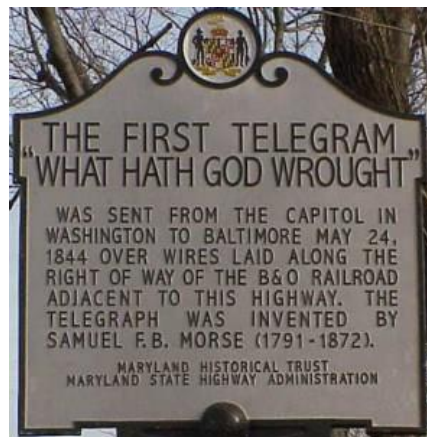
60. Meanwhile, American inventor and entrepreneur Samuel Morse obtained an appropriation from the US Congress in 1842 to establish a 40-mile commercial telegraph line along a railway connecting Washington and Baltimore. “The Baltimore & Ohio Railroad Company . . . granted

⁹ Tom Standage.1998. *The Victorian Internet: The Remarkable Story of The Telegraph and the Nineteenth Century’s On-Line Pioneers* at 43-45 (New York: Bloomsbury USA 1998).

¹⁰ Available at <http://www.connected-earth.com/Journeys/Firstgenerationtechnologies/TheTelegraph/TheTelegraphicagedawns/index.htm> (last visited 13 Feb 2017).

permission on the condition that the line could be built ‘without embarrassment to the operations of the company’ and . . . demanded free use of the telegraph”¹¹

Figure 3: Marker commemorating Morse’s first telegraph line



*Source: This Day in Tech History, 24 May 1844*¹²

61. Though they had to install their own poles and lines, telegraph operators universally used existing network corridors. Pioneered by the early work of Cooke in England and Morse in the United States, telegraph operators had a strong preference for sharing corridors with railroads, but would use roadways and other corridors when necessary.

62. The advantages of sharing railway corridors were readily apparent to the telegraph operators. Telegraphy was being introduced primarily as a means of high-speed intercity communications. The railways had established corridors with ample room to accommodate a parallel telegraph line and had also established centralized train stations in each city and town of any size. The railway corridors were superior to roadway corridors for the placement of telegraph lines due to the relative absence of obstructions and incompatible uses between the railway stations. The railways also provided a more efficient means than roadways to transport the poles and wires needed to erect the telegraph lines and to maintain those lines once installed. The railway stations themselves offered the telegraph operators prime centralized locations for placement of a telegraph office and established local transport connections for the carriage of telegrams to recipients.

63. Moreover, the telegraph offered significant potential benefits to railroad owners, which would enable the telegraph operators to barter services in exchange for use of the railway corridors and stations. Access to the telegraph enabled railway operators to ensure better safety on single-track railroads through synchronization of clocks and proper sequencing of rail traffic, to monitor delays and to communicate weather and other conditions.

64. Not all railway operators immediately recognized the mutual benefits of sharing their rights of way and stations with telegraph operators or of using the telegraph for internal railway-related communications. However, as the nascent telegraph industry matured, railway operators soon understood the mutual benefits of sharing rights of way and other infrastructure, and telegraph lines came to be installed primarily along railway lines.

¹¹ Tom Standage. *The Victorian Internet* at 47.

¹² Available at https://thedayintech.files.wordpress.com/2013/05/1-st_telegraph_1844-295x300.jpg (last visited 13 Feb 2017). The message “What God Hath Wrought” was the first telegram sent over Morse’s telegraph line from Baltimore to Washington.

Box 1: Rails and telegraph as the Siamese twins of commerce

In the mid-twentieth century, historian Robert Luther Thompson chronicled the evolution of the symbiotic relationship between railway and telegraph lines throughout the United States, Europe and the rest of the world¹³:

The introduction of the railroad into the United States parallels so closely the advent of the telegraph that the story of the one cannot be told properly without touching upon that of the other. . . . Telegraph leaders had become aware almost at once of the advantages to be derived from constructing their lines along the railroads, but the restrictions with which the Baltimore & Ohio hedged its first telegraph agreement gave evidence that the railroad, far from seeing any value in the telegraph, barely suffered it to build along the railroad right of way. In fact, many less liberal railroads refused to be bothered with electric wires along their roadbeds. Some years were to pass before the natural affinity of wire and rail came to be recognized by the conservative railway managements. . . .

. . . It was during the next decade – 1850 to 1860 – when sober consolidation began to bring order out of enthusiastic chaos, that the railroad and the telegraph came to be recognized as the indispensable “Siamese twins of commerce. . . .”

Because of the comparative ease and lower cost of construction, telegraphic development rapidly eclipsed railroad growth during the period. “Lightning lines” reached out to embrace every town and city connected by rail, and then pushed on beyond the railroad frontiers. In most parts of the West, the “iron cord” preceded the “iron horse.” Hiram Sibley [founder of Western Union Telegraph Company] succeeded in pushing a “lightning line” all the way to the Pacific, eight years in advance of the railroad. . . .

That the telegraph was the natural complement of the railroad had been quickly recognized in Europe, where wires were commonly strung along the railroad rights of way. C.A. Saunders, secretary of the British Great Western Railway Company, testified that Cooke and Wheatstone’s telegraph had been brought into actual operation upon the Great Western Railway as early as 1839 and its capabilities severely tested. Shortly thereafter, the Yarmouth & Norwich Railway issued a circular explaining at length Cooke’s new system of train dispatching by telegraph which the road had adopted in 1844. Through the use of this system, the railway officials claimed that they had been free from accidents arising from trains meeting or overtaking one another, even though the Yarmouth & Norwich was a single-track line. . . .

Despite the evident need for some system of determining the location of trains along the route, railroaders were reluctant to trust the telegraph for the movement of their trains It took several years to perfect the telegraph lines to the point where they were worthy of the full confidence of the railroad officials. . . .

Gradually, the advocates of a railroad-telegraph alliance began to overcome the opposition of conservative railway managements. In a circular letter dated July 1852, Henry O’Reilly tried to show the many benefits which a railroad might enjoy through the use of telegraphic facilities. “The necessity for increased safety in conjunction with the increased speed in Railroad traveling, as well as the general convenience of transacting business among employees along railroad

¹³ Robert Luther Thompson, *Wiring a Continent: The History of the Telegraph Industry in the United States, 1832-1866* (Princeton University Press 1947).

routes, should turn Public Attention promptly and strongly upon the vast importance of Telegraphic facilities in connection with Railroad operations,” explained O’Reilly. A “well-arranged telegraph for railroad purposes would, each and every year, render sufficient benefits to counter-balance the whole cost of construction. . . .”

By 1855, the advantages of a railway telegraph system were becoming too obvious to be ignored by the railroads any longer. In his report to the Erie directors for that year, D.C. McCallum . . . declared: “A single track railroad may be rendered more safe and efficient by a proper use of the telegraph than a double track railroad without its aid. . . . It would occupy too much space,” he went on, “to allude to all the practical purposes to which the telegraph is applied in working the road; and it may suffice to say that without it, the business could not be conducted with anything like the same degree of economy, safety, regularity, or dispatch.”

McCollum’s report spread far beyond the narrow confines of the Erie management. His words were carefully weighed in railroad circles, and leading companies began to see the telegraph in a new light. During the next decade and a half, the use of the telegraph became almost universal, and some of the most perplexing problems of railway operation were solved.

By the close of the nineteenth century, “every railroad in every country and clime” made manifold use of the telegraph. Its weather reports aided officials in guarding against danger from approaching storms. By giving prompt warning of damage by wind or flood, it prevented disaster in many ways. It moved trains promptly and safely, and practically doubled the capacity of every single-track road. It brought the most distant stations and diverse patrons of the company into close relationship with the management, and united the officers and employees of a great railroad system into one compact and well-organized army. It transmitted observatory standard time automatically to every station at the same instant. It gave steady employment to thousands of persons. All this, and much more, was done by the railway telegraph at a cost of less than 3 percent of the total expense of the operation and maintenance of the railway. The railway telegraph had, indeed, come into its own; it had become an absolute necessity for the safe and efficient operation of the railroad.

65. By early in the Twentieth Century, telegraph networks had achieved near universal service in developed countries. The following decades saw the gradual demise of the telegraph network which coincided with the continued rise of the copper telephone network (discussed in Submodule 1.2 below). Western Union, an operator of telegraph lines which once held a monopoly over 90% of the US market, faced stiff and increasing competition after the advent of the telephone. Telegraph use peaked during the war years of the 1940s, and subsequently declined until Western Union eventually discontinued its telegram/telegraph service in 2006. Throughout the world one can still see abandoned telegraph lines in place along many rural railways. These relics stand as monuments to the advent of cross-sector infrastructure sharing.

66. The early infrastructure sharing experience of telegraphs and railways, following a circumspect courtship, resulted in a strong marriage of interests. However, it was perhaps a simpler time – occurring early enough in the history of both industries that regulators of telegraph and railway operators did not involve themselves in the cross-sector relationship. This suggests that sharing did not require a legal mandate but simply the absence of legal and regulatory interference.

1.2 The telephone followed by sharing road corridors and then utility poles

67. The invention and commercialization of the telephone followed closely on the heels of the telegraph, with the first telephone exchange opening in New Haven, Connecticut in 1878.¹⁴ The United States and Europe again played a leading role in the development of the telephone, and related cross-sector infrastructure sharing activities.

68. In addition to obvious technological differences, the telegraph and telephone also presented very different commercial opportunities and different cost structures. These influenced and were reflected in differences in how the telegraph and telephone companies entered and developed their markets. While the telegraph was primarily used for long distance intercity communications, the telephone offered the opportunity for local communications within a single community as well as long distance communications, because it was designed to be used directly by end users, who could communicate by voice at a distance.

69. Driven by technology, cost and market factors, the development of telephone networks initially focused on local communication.

70. First, while the telegraph did not require very high signal quality because transmission was digital and at relatively low speeds, the analog telephone, on the other hand, required a higher data transmission rate and much higher signal quality. Thus, through the early 1880s, when both telegraph and telephone used unshielded iron wiring with a single live wire and a ground return, the telegraph could carry traffic much greater distances than the telephone. During this time, the telephone only supported commercial service over relatively short distances due to signal attenuation and interference.

71. Intercity telephone connectivity was initially inadequate for commercial service. Overcoming this challenge involved the introduction of a series of technological solutions, each designed to reduce signal attenuation and/or interference, but each also adding to the cost of telephone line construction. These solutions, which were developed in the late 1880s and introduced over the next two decades, included using an end-to-end pair of wires (doubling the wiring needed), twisting the pairs to cancel induction which otherwise caused cross-talk and using copper rather than steel to reduce signal attenuation.¹⁵

72. Second, because the telegraph generated asynchronous written messages, they could be transcribed and carried to recipients within a reasonable proximity of the telegraph office by physical means of transport, such as foot, horse or automobile. Telegraph messages could also be repeated (at the risk of introducing errors) at intermediate telegraph offices to extend the distance traversed.

73. Because the telephone was inherently a synchronous means of live voice communication between two individuals, however, both persons would need to be simultaneously present at a telephone device connected to the telephone line. This therefore limited the usefulness of the telephone as a communications device unless a large number of people had direct access to telephones connected to a single network or set of interconnected networks.

¹⁴ “Telephone Transmission,” *Engineering and Technology History Wiki*. Available at http://ethw.org/Telephone_Transmission (last visited 13 Feb 2017).

¹⁵ *Id.*

74. The network effect required a sizeable number of connected customers to make a telephone system useful and profitable. Also, because each line required a separate circuit, telephone lines needed to run up and down every street and they required as many wires as premises passed. This led the telephone companies quickly to identify roadways as their preferred corridors for co-locating lines for local exchanges.

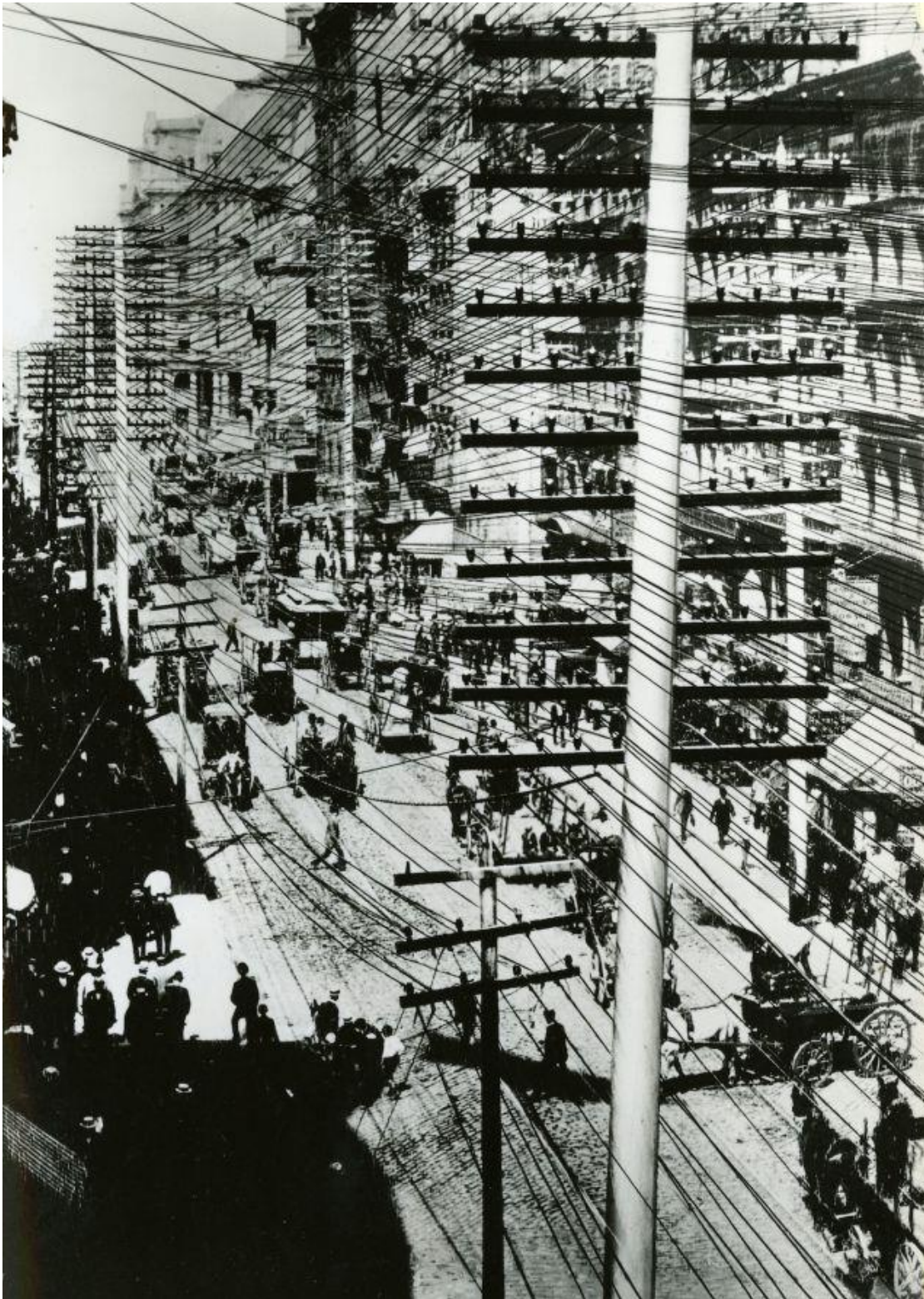
75. As long as telephone technology relied on uninsulated conductors in the same way as the telegraph, telephone companies had to install poles with cross bars and many, many wires. These open, overhead lines were susceptible to weather conditions and interference, unsightly and became a public nuisance.

Figure 4: Telephone and telegraph line clutter in Stockholm in 1890



Source: Tekniska Musset (The Swedish National Museum of Science and Technology)

Figure 5: Open telephone lines in New York City circa 1903



Source: Library of Congress Prints and Photographs¹⁶

76. Sharing of poles with electric utilities was out of the question during these early years of the telephone due to safety concerns. Contact between electricity and telephone lines could result in

dangerous transmission of current across a telephone line. Even without physical contact, electromagnetic fields generated by the electricity lines could act on nearby parallel lines, such as telephone lines, inducing potentially dangerous current or static charges. Modern communications lines are shielded and attached at a safe distance from electricity lines to avoid these effects.¹⁷ They are also installed and maintained in accordance with rigorous safety codes which have been developed and refined by industry participants over many years.¹⁸

77. Eventually, telephone companies faced pressure to improve quality of service and reduce the clutter by burying their lines in densely populated areas. For example, New York City required all telegraph and telephone operators to bury their cables in 1889. In Europe, the move toward buried cable began earlier, when the telegraph was still the only (or primary) electronic communications medium. In London, when the Post Office was nationalized in 1871, it had already begun the work of placing the City's telegraph networks underground.¹⁹ Throughout Great Britain, the pace of replacing and transferring telegraph lines underground quickened after a heavy snowstorm in 1886 disrupted services and made the dangers of unanchored overhead wires apparent.²⁰ In Germany, an extensive network of underground telegraph lines was constructed in 1870 and, by 1881, Germany had 5,500 km of underground lines, by far the most in Europe.²¹

Figure 6: Access cover for buried telegraph cable in the United Kingdom



Source: Norman Ball²²

¹⁶ Available at <https://www.loc.gov/item/2002697630/> (last visited 13 Feb 2017).

¹⁷“Inductive coordination,” *The Free Dictionary* by Farlex. Available at <http://encyclopedia2.thefreedictionary.com/inductive+coordination> (last visited 11 Feb 2017).

¹⁸ See, e.g., IEEE Standards Association, *National Electrical Safety Code* (2012 ed.). Available for purchase at <http://standards.ieee.org/about/nesc/> (last visited on 11 Feb 2017).

¹⁹ Ken Beauchamp. 2001. *History of Telegraphy* at 90-91 (Herts: The Institution of Engineering and Technology United Kingdom 2001). Available at <https://books.google.com/books?id=k3XCkncd83AC&printsec=frontcover&dq=History+of+Telegraphy&hl=en&sa=X&ved=0ahUKewiDu47QoojSAhWKTSYKHXLnA6oQ6AEIHDA#v=onepage&q=History%20of%20Telegraphy&f=false> (last visited on 11 Feb 2017).

²⁰ Ibid. at 91.

²¹ Ibid. at 91-92.

²² Available at <https://parisianfields.com/page/17/> (last visited 13 Feb 2017).

78. The public and government pressure to bury telephone lines in densely populated areas and to reduce the clutter created by above-ground telephone lines in less densely populated areas created pressure for improvements in telephone technology to enable bundling of multiple telephone lines into cables which could be buried or which, when hung overhead, took up much less space than hanging each strand separately.

79. A period of innovation ensued. By 1914, it was reported that telephone engineers had designed a new type of cable which contained 2,400 wires capable of serving 1,200 telephone circuits and that the cable could be used in underground ducts with a minimum three-inch diameter. This new cable design was meant to solve overhead congestion issues at local exchanges in dense areas.²³

80. The introduction of the telephone cable, which was insulated and shielded, not only enabled the burial of lines in conduits in densely populated areas, but also enabled the sharing of utility poles between power companies and telephone companies because many telephone lines could be connected through a single cable, which was insulated against conducted and induced electrical currents and charges. Thus, in the early Twentieth Century, electric utilities and telephone companies began to share poles systematically, particularly in the United States, where the population was spread over vast distances and buried lines were generally not economically viable. This is a practice that has continued until this day.

81. As for intercity long distance, the telephone companies initially co-located their long distance lines on existing telegraph poles in railroad rights of way. This presented great problems of inductive interference between the telegraph signals and phone calls due to the continued use of open wiring and single strands with grounding. Even still, it was a start in intra-sector infrastructure sharing, with both telecommunications network operators also sharing the same cross-sector infrastructure. In addition, the railways along which the telegraph lines were installed began to recognize the benefits of supplementing their internal telegraph communications with internal telephone service. Following the introduction of telephone cables as a replacement for open telephone lines, long distance lines were buried, still often following the same railway lines. In 1914, AT&T reported successfully completing construction and beginning operations of a buried 430-mile long distance line from Boston to Washington.²⁴

82. However, the new telephone cables were relatively expensive and were unnecessary unless there were a large number of users or a large volume of traffic on a line. Therefore, in many areas, particularly in developing countries or rural areas of developed countries, telephone lines continued to be installed as open, uninsulated lines on their own poles. In developing countries, this pattern persisted until the open telephone lines were abandoned after the introduction of wireless mobile networks. Fixed line telephone networks in these areas therefore never shared poles with electric utilities.

²³ *Telephony, The American Telephone Journal*, Vol. 68, No.1 at 22 (2 Jan 1915). Available at

<https://books.google.com/books?id=pytGAQAAMAAJ&pg=RA14-PA19&dq=Telephony,+The+American+Telephone+Journal,+Vol.+68,&hl=en&sa=X&ved=0ahUKEwj3k9qNo4jSAhWD5iYKHUuRCV0Q6AEIHDA#v=onepage&q=Telephony%2C%20The%20American%20Telephone%20Journal%2C%20Vol.%2068%2C&f=false> (last visited 11 Feb 2017).

²⁴ *Id.*

Box 2: Telephone evolved from competition to franchised monopoly

The infrastructure sharing practices which developed and persisted around the telephone must also be understood in the non-competitive environment in which the telephone business operated until recent decades. Following an initial wave of boundless competition among competing telegraph and telephone operators, investors and policymakers alike sought ways to ensure financial success of the enterprises and stable and broad service coverage for the population. This led to the view that the telegraph and telephone were natural monopolies. In Europe and much of the rest of the world, these monopolies were seen as natural extensions of the business of the post office and so were brought under the control of the government-owned postal system.

In the United States, however, the monopoly over telephone service was franchised under private investor ownership. As an influential development in this outcome, the American Bell Telephone Company, forerunner of AT&T, succeeded in convincing US federal and state authorities that telephone service should be treated as a natural monopoly. In public advocacy before state legislatures and regulators, AT&T committed to focus on universal service, with regulated tariffs, as the *quid pro quo* for a monopoly franchise. The company also succeeded in warding off repeated efforts by the US Postmaster General to nationalize phone lines under the auspices of the Post Office.

The history of the telephone industry in the United States for the better part of a century was therefore of a single regulated investor-owned monopoly in every service territory, with AT&T and its subsidiaries dominating all the major markets and smaller companies serving as monopolies in the smaller and rural markets. Elsewhere in the world, the monopoly model was also embraced, but government ownership through the post office (via what came to be known as the Post, Telephone and Telegraph office, or PTT) was more often the norm outside the United States. As a result, much of the early regulation of telephone rates and charges was pioneered in the United States as the only developed country with privatized telephone service.

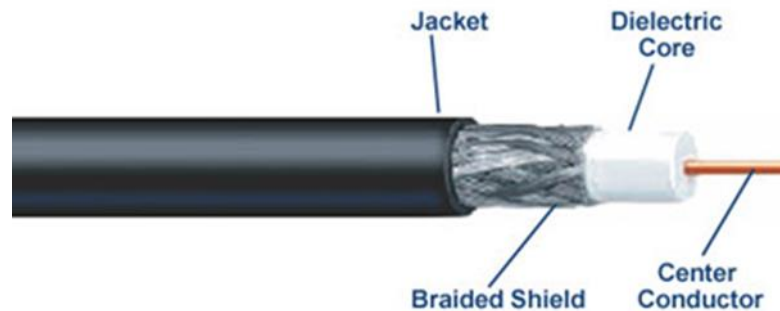
The franchisement of the perceived *natural monopoly* of telephone companies over voice communications and telegraph companies over data communications persisted for many decades. During the monopoly era, the primary investment activity of telephone companies, extending lines ever deeper into less populated areas as part of their universal service pledge made to secure monopoly status, involved extending the use of the same types of cross-sector infrastructure, but not much innovation in new infrastructure owners or infrastructure types. There was little need for innovation, because there was only one telephone company in each service territory and it was assured of full cost recovery for its infrastructure through regulated tariffs (in the United States) or the tariffs set by government owners outside the United States.

83. In some developed countries, the telephone network was later joined by the coaxial cable television network as a second communication line. Cable television originated in the United States in 1948 to enhance poor reception of television signals in mountainous and geographically remote areas.²⁵ Through a network initially known as community antenna television (CATV), community antennas were erected on mountain tops or other high points to receive television transmissions and then local homes were connected to these antennas using shielded coaxial

²⁵ "History of Cable," *California Cable and Telecommunications Association*. Available at <http://www.calcable.org/learn/history-of-cable/> (last visited 11 Feb 2017)

copper cable. By 1950, there were 14,000 cable television subscribers in the United States.²⁶ Cable television spread throughout the developed and urban areas in parts of the developing world. The number of cable television subscribers in the United States peaked at approximately 69 million in 2000²⁷ and had declined to approximately 54.4 million by 2013.²⁸

Figure 7: Typical CATV shielded cable



Source: PerfectVision Manufacturing²⁹

84. During this time, developments in cross-sector infrastructure sharing were limited to measures to accommodate improvements in telephone technology and continued rollout of telephone coverage. Throughout the world, copper telephone lines and coaxial cable television lines made extensive use of roadways, along which they were either buried or hung from poles. In the more prosperous regions, open telephone lines were replaced with insulated telephone cables. This enabled extensive joint use of electricity distribution facilities, with which they frequently shared duct systems (for buried lines) or poles (for aerial lines).

85. For example, in the United States, electric utilities and telephone companies universally and voluntarily shared poles in smaller metropolitan areas (where cables were not buried) and suburban areas (where open wiring was no longer adequate) from the time of introduction of telephone cables – with power companies attaching their facilities to telephone poles and telephone companies attaching their facilities to power poles. The United States case study in Submodule 9.3 offers the reader a fuller discussion of this example.

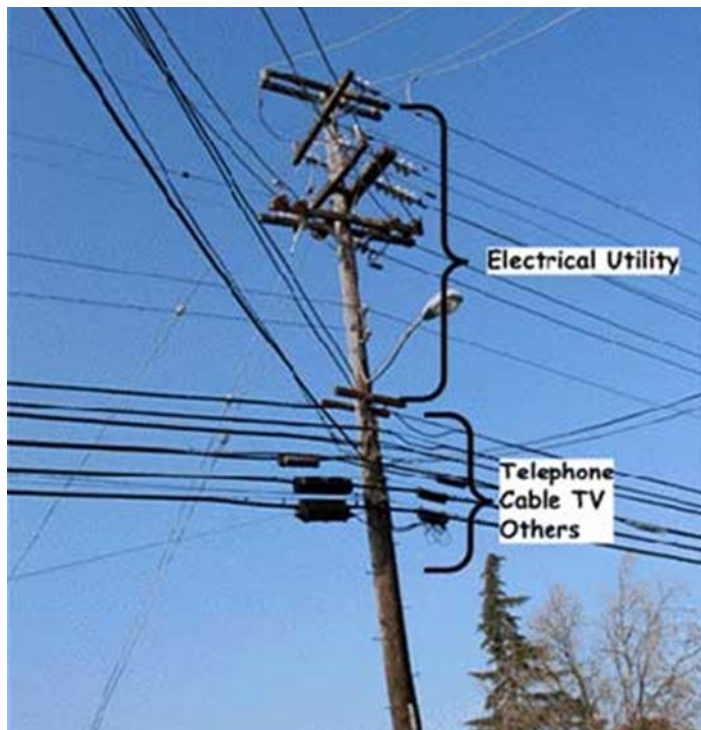
²⁶ Federal Communications Commission website, “Evolution of Cable Television,” (as of Dec 2015).

²⁷ “8th Annual Video Competition Report.” Federal Communications Commission. 14 January 2002. p. 87. Available at https://apps.fcc.gov/edocs_public/attachmatch/FCC-01-389A1.pdf (last visited 11 Feb 2017).

²⁸ “16th Annual Video Competition Report.” Federal Communications Commission. 31 March 2015. p. 10, note 13. Available at <https://www.fcc.gov/document/fcc-adopts-16th-video-competition-report> (last visited 11 Feb 2017).

²⁹ Included in the PerfectVision Manufacturing Coaxial Cable Guide, <https://www.perfect-vision.com/PerfectVision/CoaxialCableGuide.aspx> (last visited 13 Feb 2017).

Figure 8: Typical utility pole shared for aerial installation of electric, telephone and cable television lines



Source: US Department of Transportation, Federal Highway Administration³⁰

1.3 Wireless ended telephone monopoly and reduced infrastructure sharing need

86. Wireless communications grew up with the telegraph and telephone, but did not play a significant role in commercial telecommunications until the middle of the second half of the Twentieth Century, beginning soon after the end of World War II.

87. The US Army Corps of Engineers introduced a mobile AM radio receiving device in 1938. The first two-way mobile device, known as a *walkie talkie*, with a 25-pound SCR-300 radio transceiver, was introduced by the Corps of Engineers in 1940 for use by troops to communicate during combat. But the SCR-300 never saw any combat time because it was replaced in 1942 by Motorola's 5-pound SCR-536.³¹ These devices communicated with each other, without any radio base stations, and therefore only permitted calls between users within a small radius of each other.

88. The first *mobile phone network* was introduced by Southwestern Bell, an AT&T subsidiary, in St. Louis, Missouri in 1946 using technology developed by Bell Labs.³² Unlike the walkie talkie, the mobile network enabled wider area coverage and long distance calling between coverage areas, as well as calls between mobile phones and fixed-line phones. By 1948, mobile

³⁰ Included in the US Department of Transportation, Federal Highway Administration *Telecommunications Handbook for Transportation Professionals: The Basics of Telecommunications*, Ch. 8, Construction, https://ops.fhwa.dot.gov/publications/telecomm_handbook/chapter8.htm (last visited 13 Feb 2017).

³¹ See Ginva.com, "The Evolution of the Cell Phone between 1938-2011" (May 2011). Available at <http://ginva.com/2011/05/the-evolution-of-the-cell-phone-between-1938-2011/#> (last visited 7 Feb 2017).

³² See "The Foundations of Mobile and Cellular Technology," *Engineering and Technology History Wiki* (updated Sep 2015). Available at http://ethw.org/The_Foundations_of_Mobile_and_Cellular_Telephony (last visited 7 Feb 2017).

phone service was available in almost 100 cities and highway corridors across the United States. However, the relatively high cost and cumbersome equipment limited the primary users to those with special needs for mobile communications, including *utility work crews*, trucking fleets and news reporters.³³ Thus, utilities in non-telecommunications sectors were once again early adopters of telecommunications technology. However, in contrast with telegraphs and fixed-line telephone networks, mobile phone access networks did not need to use any utility infrastructure for the last mile of service between the tower and the end user because the link was wireless.

Figure 9: Motorola ad comparing WWII-era analog handset to 1994 mobile phone



Source: Printed Motorola Advertisement

89. In parallel with the introduction of wireless access networks, the introduction of microwave technology also began to reduce demand for utility infrastructure for the backhaul and long distance links in both fixed-line and wireless communications beginning in the middle of the Twentieth Century. These new microwave wireless transmission links significantly increased the capacity which could be carried on a route at much lower cost than cabling. A significant part of the cost savings derived from avoiding the need to install and maintain cable infrastructure in lateral corridors. In avoiding lateral infrastructure, these wireless links also obviated the need for using lateral corridors and hence for continued cross-sector infrastructure sharing for long distance communications.

90. An Anglo-French consortium first tested a microwave communications link across the English Channel in 1931. The technology was significantly improved though the development of radar systems in World War II. After four years of planning and testing by Bell Labs, AT&T in 1947 deployed the world's first commercial microwave transmission network for long distance telephone calls between Boston and New York City.³⁴ In 1951, replicating the coast-to-coast electronic communications link first made by the telegraph 90 years earlier, AT&T linked voice

³³ *Id.*

³⁴ "Telephone Transmission," *Engineering and Technology History Wiki*. Available at http://ethw.org/Telephone_Transmission (last visited 7 Feb 2017).

traffic from New York to San Francisco by microwave using 107 towers spaced 30 miles apart at an initial investment of USD 40 million (equivalent to approximately USD 386 million in 2017).³⁵ The use of microwave rather than cabling for long distance and backhaul links would soon become ubiquitous throughout the United States and the rest of the world. During the 1950s, AT&T converted a majority of its long distance lines in the United States from cable to microwave.

Figure 10: Microwave tower used in first commercial long distance telephone relay system



Source: AT&T Archives and History Center³⁶

91. A third wireless development which further depressed demand for cross-sector infrastructure sharing was the introduction of satellite communications. It was less expensive than submarine cables for trans-oceanic links, and also enabled landlocked cities to send international and domestic intercity communications without any long corridors of cabling.

92. Satellite also served as a substitute for both fixed-line and mobile access networks in extremely remote and sparsely populated regions. Canada was the first nation to use domestic satellites to provide telephone access to poorly served rural areas.³⁷ Starting with Indonesia in

³⁵ See The Telecommunications History Group, Inc., “Calling a Country Far, Far Away: How long distance calls work,” Virtual Museum (undated). Available at <http://www.telcomhistory.org/vm/scienceLongDistance.shtml> (last visited 7 Feb 2017).

³⁶ The pictured microwave relay tower was located on Jackie Jones Mountain, New York, and was one of seven towers used on AT&T’s original New York-Boston microwave radio relay transmission system of 1947. The picture is reprinted courtesy of AT&T Archives and History Center in “Telephone Transmission,” *Engineering and Technology History Wiki*. Available at http://ethw.org/Telephone_Transmission (last visited 7 Feb 2017).

³⁷ Communications Satellites,” *Engineering and Technology History Wiki*. Available at http://ethw.org/Communications_Satellites (last visited 11 Feb 2017).

1976, many developing nations purchased or leased satellites to avoid building ground-based telephone, radio or television networks.³⁸

93. Ultimately, however, satellite would prove to have limited application as a substitute for terrestrial cabling and terrestrial wireless networks due to its much higher signal latency (caused by the large distance the radio signals must travel to and from the satellites) and its limited bandwidth. Satellite has retained an enduring role to the present day in reaching remote and sparsely populated areas, where it can offer a more economical solution to coverage, both in providing wireless backhaul from mobile towers and as a substitute for terrestrial mobile or fixed wireless access networks.³⁹

94. Despite the significant inroads made by microwave and satellite networks on the need for intercity cabling, mobile networks continued to have limited impact on demand for fixed-line telephone networks for the first three decades after commercial mobile service was introduced. Then, in 1973, Motorola introduced the first wireless mobile phone for personal use (which was vastly smaller and less expensive than the mobile phones first introduced in 1946). By the late 1970s, mobile networks were in operation around the world. In 1983, Ameritech, an AT&T subsidiary, deployed the first generation (1G) *cellular* radio access network in Chicago using Advanced Mobile Phone System (AMPS) technology.⁴⁰ Deployment of AMPS cellular networks quickly spread throughout the world.

95. With these technology improvements, wireless cellular access networks become affordable and convenient for end users. And they were much less expensive for network operators than fixed networks because they required no lines or lateral infrastructure. In addition to the wireless link from the cell tower to the customer, the backhaul transmission networks were also wireless, powered by the same microwave technology pioneered for landline long distance networks. It therefore became possible to construct an entire telecommunications network without using any lateral infrastructure. For the first time, entry barriers and scale were sufficiently reduced to enable end-to-end *facilities-based competition*.

96. Digital cellular phones, known as second generation (2G) cellular, were introduced in the 1990s. This resulted in substantial call quality improvements over analog mobile phones and users began substituting mobile voice for fixed voice. This led to widespread displacement of fixed-line telephone networks with 2G wireless networks in developing countries, where operators were able to achieve much greater geographic coverage at a much lower unit price. The introduction of 2G mobile phones also coincided with the introduction or enhancement of competition in the mobile voice markets in the United States and the United Kingdom, as was soon followed by the rest of Europe and other developed countries around the world. Mobile networks also brought improved population coverage to most developed countries. Copper-based fixed networks continued in widespread use, but were rapidly supplemented by 2G wireless networks. For the first time in the

³⁸ *Id.*

³⁹ See, e.g., Gilat Satellite Networks Ltd., *Satellite Backhaul vs Terrestrial Backhaul: A Cost Comparison* (2015). Available at http://www.gilat.com/dynimages/t_whitepapers/files/Satellite%20Backhaul%20vs%20Terrestrial%20Backhaul_A%20Cost%20Comparison.pdf (last visited 7 Feb 2017).

⁴⁰ See AT&T, “Milestones in AT&T History” (2004). Available at https://www.thocp.net/companies/att/att_company.htm (last visited 7 Feb 2017).

history of the telecommunications industry, there was little need for infrastructure sharing to facilitate *new investment* in deploying telecommunications networks.

97. The disruptive force of cellular, microwave and satellite wireless technologies thus began a radical change in the landscape for telecommunications access networks and reduced the demand for infrastructure sharing over the ensuing quarter century. Although telegraph, telephone and cable television operators continued to share infrastructure with railways, roadways and electric utilities, mobile network operators were viably able to build their own end-to-end infrastructure, comprising wireless cellular access networks, wireless microwave backhaul and transmission networks and satellite for international and very long domestic distances. The entire network was wireless.

98. The growth of wireless also firmly replaced the monopoly paradigm with the competition paradigm for the telecommunications industry.

1.4 Fiber renews need for infrastructure sharing in a competitive landscape

99. But the trend of wireless domestic backhaul and international connections for wired networks and end-to-end wireless networks did not last. Even as microwave links once served a major role in national backbone networks and more recently found a new place in supporting wireless transmission networks for cellular radio access networks, the volume of traffic on the main arteries of both wired and wireless networks began to exceed the capacity of microwave. Telecommunications operators needed more advanced technology and an alternative medium to handle the greater throughput requirements. This led to the development and commercial deployment of fiber optic cable technology.

100. Inventors had been experimenting with using light as a transmission medium for as long as they had experimented with the technology of the telegraph and telephone. In 1880, four years after inventing the telephone, Alexander Graham Bell and his assistant invented and patented an optical voice communication system known which he dubbed a *photophone* and which used a beam of light as a carrier wave, although it did not use glass as a wave guide and had other technical flaws which precluded its commercial use.⁴¹ It would be a while before using light as a carrier wave would become technically and commercially feasible.

101. In 1970, some 90 years after Mr. Bell's invention of the photophone, a team of researchers at Corning Glass patented a *fiber-optic wire* or *optical waveguide fibers* capable of carrying 65,000 times more information than copper wire, through which information carried by a pattern of light waves could be decoded at a destination even a thousand miles away."⁴² Commercial use of this invention came soon thereafter.

102. In 1977, General Telephone and Electronics (GTE) deployed the world's first live telephone traffic through a fiber network in California.⁴³ AT&T followed one month later with an optical

⁴¹ See World History Project, *June 3 1880: First Transmission on Alexander Graham Bell's Photophone* (undated). Available at <https://worldhistoryproject.org/1880/6/3/first-transmission-on-alexander-graham-bells-photophone> (last visited 7 Feb 2017).

⁴² Vivek Alwayn, "Fiber-Optic Technologies" (Cisco Press, Apr. 23, 2004). Available at <http://www.ciscopress.com/articles/article.asp?p=170740> (last visited 11 Feb 2017).

⁴³ Ibid.

telephone system installed in downtown Chicago covering a distance of 2.4 km.⁴⁴ In 1983, long distance company MCI (whose corporate acronym, ironically, stood for “Microwave Communications Incorporated”) deployed a commercial fiber optic cable system between New York and Washington, DC, which AT&T soon followed with a competitive line.⁴⁵ During the 1980s, telephone companies in the United States continued to deploy fiber links to replace their existing microwave links in connecting major cities. By the mid-1980’s fiber optic installations had expanded rapidly all over the globe.⁴⁶

103. The introduction of fiber optic cable, and exponential growth of data as a major component of communications, thus enabled the gradual replacement of microwave-based national backbone networks with terrestrial fiber and of international satellite links with fiber optic submarine cable systems. More recently, growth in data use has also led to the replacement of metro microwave links and copper cables with fiber. Now, following the introduction and growing use of broadband devices, and the resulting exponential growth in demand for data throughput, the preferred material for intercity transmission networks, for mobile transmission networks and for last mile wired access networks is now also fiber.

104. The invention and introduction of wireless broadband access technologies and fiber optic networks eventually precipitated the current decline and pending abandonment of copper telephone and coaxial cable television copper networks, even in developed countries where they had remained alongside the newer wireless networks.

105. In contrast with wireless technologies, fiber networks, like telegraph and telephone lines, require the use of lateral corridors. The shift to fiber has therefore generated renewed interest in cross-sector infrastructure sharing as being less costly and leading to more efficient and rapid deployment. The advent of fiber as a preferred communications medium has thus renewed interest in cross-sector infrastructure sharing in developing countries and introduced it for the first time in many developing countries.

106. For example, in the in the United States intercity fiber deployment was accelerated by the Internet and data applications:

During the mid to late 1990s, the growth in the use of the Internet and other data applications resulted in the use of traditional long-distance communications carriers such as AT&T, MCI, and Sprint being supplemented by a number of newly formed communications carriers such as IXC Communications, Quest Communications, and Level 3 Communications. The newly formed companies installed more than 50,000 route miles of fiber along gas, railroad, and electric utility right of ways to develop their own long distance networks.⁴⁷

107. There are already millions of route miles of existing terrestrial fiber optic cable in service around the world.⁴⁸ With the notable exception of the dry cable segments at submarine cable

⁴⁴ “Milestones in AT&T History,” *AT&T Website*. Available at <http://www.corp.att.com/history/milestones.html> (last visited 11 Feb 2017); Vivek Alwayn, “Fiber-Optic Technologies.”

⁴⁵ “Fiber Optics,” *Engineering and Technology History Wiki*. Available at http://ethw.org/Fiber_Optics (last visited 11 Feb 2017).

⁴⁶ *Id.*

⁴⁷ G. Held, “Chapter 7: Fiber-Optic and Satellite Communications” in *Understanding Data Communications* (6th ed.), reprinted in Microsoft Tech-Net (2017). Available at <https://technet.microsoft.com/en-us/library/bb962026.aspx> (last visited 7 Feb 2017).

⁴⁸ This excludes submarine fiber optic cables as they are generally not candidates for cross-sector infrastructure sharing.

landings, where new corridors often have to be acquired and cleared, virtually all existing fiber optic cable systems have made some use of existing corridors. Terrestrial fiber optic cables are almost always hosted in corridors previously established for roadways, railways, pipelines or electricity transmission lines. New fiber optic cable installations also make use of improvements and fixtures from other sectors located in the same corridors whenever possible. They are sometimes installed in duct systems built for electricity lines or steam, sewer pipes or on electricity transmission towers or distribution poles.

108. However, this time the landscape is much different than when the telegraph and telephone were introduced.

109. First, policymakers and consumers worldwide have experienced the benefits of competition in the telecommunications sector and will not accept a return to a monopoly environment. This means that there will now be multiple competing telecommunications operators vying for access to shared infrastructure. Because they are competing, and are not assured of recovery of their capital investments and operating costs as the monopolies once were, telecommunications operators today are constantly seeking every possible way to cut costs, both to gain an edge on their competitors and to ensure they can viably carry on their business. They are highly motivated to pursue infrastructure sharing opportunities.

110. Second, the growing importance of information and communication technology to every business and public service has driven all providers of transport services to recognize the need to provide telecommunications connectivity to the major components of their infrastructure. This enables them to monitor, measure and control the operation of their infrastructure and the volume and direction of traffic flowing through it. Today, every network sector needs robust internal communications, including electricity, roadways, railroads, water and sewer, pipelines, and others.

111. Third, the nature of the technology also enables a much broader range of infrastructure types to be shared. While land corridors remain as important as ever, the nature of fiber optic cables enables them to be run closer to power lines without interference or induction of electric current and to be placed in wet or damp environments without risk of electrical shorts or interference. Today, fiber optic cables can be installed within electricity lines, as is the case with [OPGW](#), and they can be installed in water-filled sewer lines.

112. Thus, although the motivations for infrastructure sharing are no different today than in the early days of the telegraph and telephone, the possibilities are much greater and there is much more drive to share, due to the presence of a competitive environment, the broader range of infrastructure owners who also want their own fiber networks, and the broader range of sharable infrastructure due to nature of the technology.

113. However, the challenges faced by telecommunications operators seeking to share infrastructure from other sectors are in some ways greater than they were in the days of the telegraph and the telephone.

114. First, existing land corridors are more congested. Burying fiber optic cable in modern cities is much more difficult than burying telegraph and telephone lines once was due to significant underground congestion and the duty of any installer of new facilities not to disturb existing facilities.

Figure 11: Illustration of unshared infrastructure below a city street

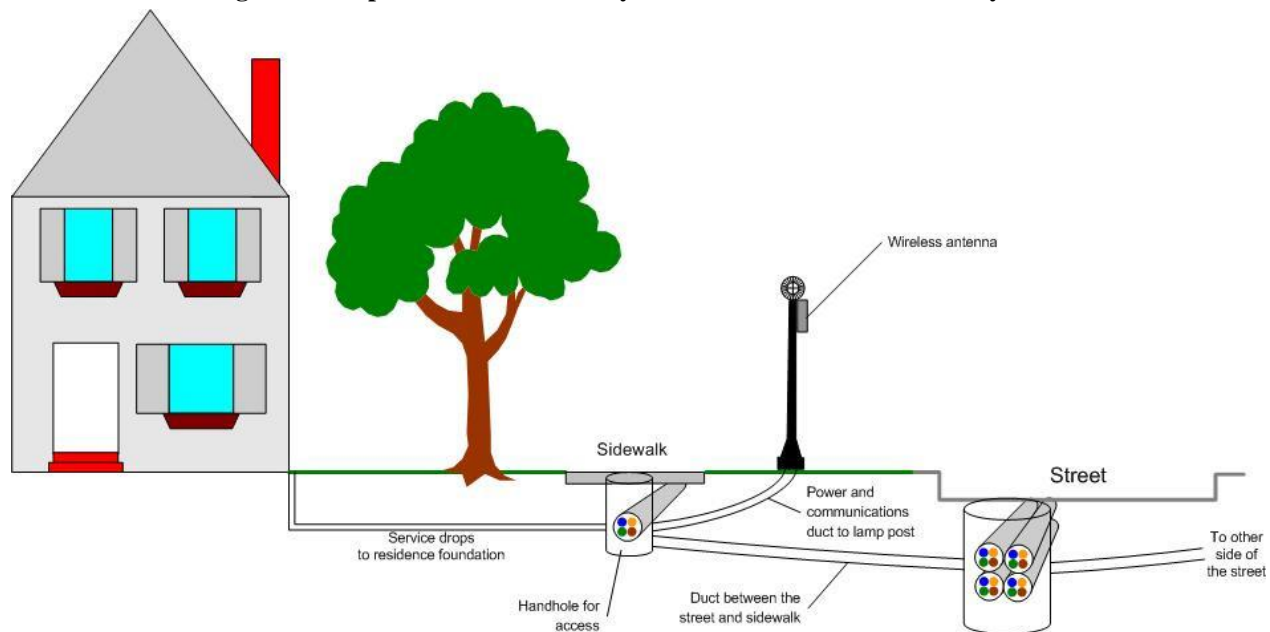


Source: American Public Works Association⁴⁹

115. These challenges cannot be solved by the telecommunications operators and individual owners of improvements and fixtures alone. They require proactive intervention and planning by the municipal and national governments which own or control the road reserves to rationalize the use of the limited space available and to serve as a traffic cop among the multiple users of the space.

⁴⁹ This diagram was included in Paul Devaney, UPROW Committee, *Rights-of-Way Management* at 3-3 (Oct. 2001). Available at http://www2.apwa.net/documents/ResourceCenter/Rights-of-Way_Mgt.pdf (last visited 11 Feb 2017).

Figure 12: Depiction of shared utility and telecommunications duct system



Source: Seattle City Light⁵⁰

116. Second, with more telecommunications operators and infrastructure owners interested in sharing, and more infrastructure potentially sharable, stakeholders face the challenge, and opportunity, to forge creative solutions to solving congestion to enable construction of much-needed fiber installations to proceed. One approach, for example, has been the use of sanitary and storm sewers as conduits for fiber. Others have included using abandoned steam ducts or abandoned gas pipes.

Box 3: Installation of fiber optic cables in sewers and abandoned gas pipes

Tokyo's sewer system provides an example of installation of fiber optic cables in sewer conduits. The [Tokyo Metropolitan Government](#) began installing a fiber optic network in its existing sewage conduits in the late 1980s to support an unmanned sewage management system. The network had far more capacity than the sewer system needed for its internal uses. Accordingly, it now leases unused dark fiber to major telecommunications operators and also leases space in existing fluid conduits for third parties to install additional fiber optic cables.

The city of Mumbai, India provides an example of installation of fiber optic cables in unused, obsolete gas pipes. [Bombay Gas](#) owns pipes, conduits, service-pipes and other infrastructure installed under streets and bridges over 150 years ago for the delivery of piped gas in what is now the city of Mumbai. In the mid-1980s, the piped gas business was discontinued at the direction of the Government of India, which favored development of natural gas. However, about a decade ago, investors realized the potential to utilize Bombay Gas's existing but dormant rights of way and pipes to lay fiber optic cable. By mid-2015, Bombay Gas had installed over 100 km of fiber

⁵⁰ See Columbia Telecommunications Corporation, *Evaluation of Potential Risks and Benefits of Municipal Broadband: prepared for Seattle City Light* (Nov. 2008). Available at <http://www.seattle.gov/Documents/Departments/Broadband/2008-11-12SCL-FTTP-ReportOct2008FinalDraft111208Rev2.pdf> (last visited 11 Feb 2017).

optic cable, enabling it to lease dark fiber to many of India's major telecommunications network operators.

117. Third, the growth of wireless broadband access networks has introduced a pressing need for locating new tower sites, in addition to lateral wired infrastructure. In the wireless segments of the telecommunications sector, cross-sector infrastructure sharing, on a strategic scale, is a relatively new phenomenon. Until recently, most cell towers were built as standalone installations. Some were opportunistically installed on roofs of buildings or water towers, but this was the exception rather than the rule. Today, however, new tower sites are increasingly finding their way to the tops of electricity transmission towers and distribution poles and water towers.

Figure 13: Installation of cellular antenna on electric transmission tower



Source: Wireless Estimator, Inc.⁵¹

⁵¹ Available at <http://wirelessestimator.com/content/articles/?pagename=Hurricane%20Ike%20Telecom> (last visited 13 Feb 2017).

Figure 14: AT&T distributed antenna system installed atop electricity distribution pole in California



Source: Jumbleye⁵²

118. This changed environment and these new challenges have created a renewed need and opportunity for infrastructure sharing. The infrastructure which broadband network operators today seek to share includes the traditional list – corridors, conduits, ducts, towers and poles – plus, for the first time, excess dark fiber in fiber optic cables owned by non-telecommunications owners. All of this infrastructure, including fiber optic cables, can readily be shared between owners and telecommunications network operators.

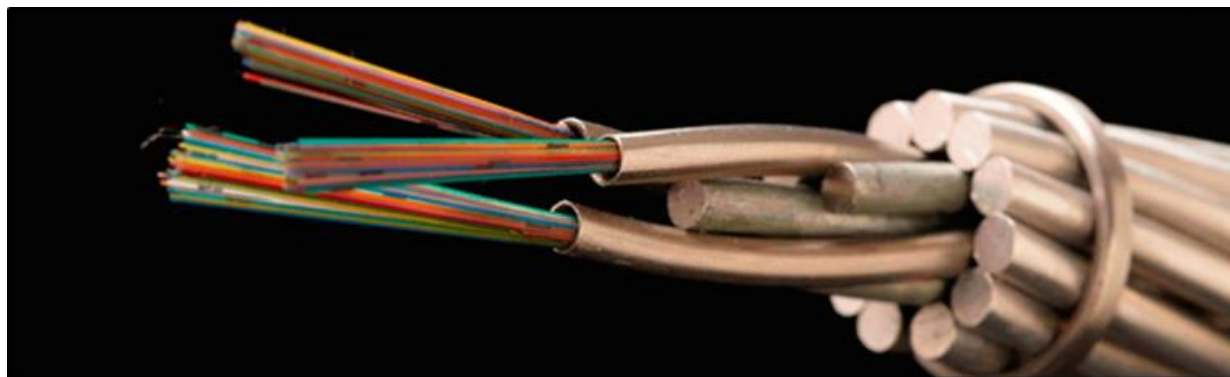
119. The Figure 15 below lists some of the more common lateral broadband infrastructure sharing options that have been employed. The figure intentionally excludes sharing of utility-owned dark fiber, which would typically have been installed using one of the options listed. It also excludes co-location space, which is typically bundled with the other infrastructure shared. For example, owners of lateral infrastructure which allow telecommunications operators to install their own fiber or provide dark fiber to telecommunications operators will typically provide space at the fiber access points along a route where the telecommunications operator can install equipment, power systems and interconnect with fiber which is not on the shared infrastructure. Figure 16 below illustrates an optical ground wire (OPGW) which can be used to install fiber in the static wire on an electricity transmission line.

Figure 15: Matrix of common broadband cross-sector infrastructure sharing options

Land corridors established for roads, rails, electric or pipes	Electric transmission and distribution lines, electrified railway overhead lines	Ducts and pipes (purpose built, repurposed or shared)	Water towers
<ul style="list-style-type: none"> • Aerial fiber • Buried fiber • Supporting infrastructure such as ducts or poles 	<ul style="list-style-type: none"> • Fiber in the electric space (OPGW, OPPC, wrap) • Underhung fiber (ADSS) • Mounting of cellular and microwave antennae 	<ul style="list-style-type: none"> • Conduits for fiber 	<ul style="list-style-type: none"> • Mounting of cellular or microwave antennae

⁵² Available at <http://www.jumbleye.com/2012/att-das-antennas-palo-alto-locations/> (last visited 13 Feb 2017).

Figure 16: Electricity transmission OPGW for containing fiber optic cable



Source: Lamifil⁵³

120. Notwithstanding the greater options which exist today, the challenges faced by telecommunications operators seeking to share infrastructure from other sectors are in some ways greater than they were in the days of the telegraph and the telephone.

121. Cross-sector infrastructure sharing has therefore become a key component of many national and multinational broadband development policies. Lawmakers, policymakers and regulators in developed and developing countries have increasingly looked for ways to require or encourage such sharing as a means of accelerating telecommunications network deployment, both in order to increase viability, decrease deployment costs and enhance competition. Today, most countries with recently enacted or updated telecommunications laws have addressed infrastructure sharing in those laws. Some of these efforts at market intervention have been very effective in stimulating greater cross-sector infrastructure sharing, while other efforts have been less effective or even counterproductive. Similarly, economic development banks and institutions have also increasingly sought to encourage cross-sector infrastructure sharing. Modules 6 and 7 provide some insights into how best these public sector stakeholders can increase the incidence of cross-sector infrastructure sharing.

⁵³ Previously available at www.lamifil.be/

2 Financial and other motivations

122. All stakeholders have strong financial and other motivations to share infrastructure across sectors. The following submodules describe some of their primary motivations. The disincentives and impediments faced by market participants, and potential ways to address them, are discussed in Modules 3 through 6.

2.1 Motivations of broadband network operators

Worldwide broadband demand is growing exponentially

123. Recent and projected growth in customer Internet demand requires exponential increases in Internet throughput capacity. If voice communications were once the main course of modern telecommunications services, they are now merely a side dish. Over the past several years, telecommunications service traffic has evolved from primarily voice to primarily data, and customer demand for data throughput has grown exponentially.

124. The 80 kbps of throughput required to support a voice line is being dwarfed by the throughput speeds required for retail telecommunications customers to watch videos, download and upload files, access content-rich websites and social media posting, and engage in the full variety of communications supported by the Internet. Business communications today requires a high-bandwidth, always on, data channel to the Internet cloud. In addition, the growing “Internet of Everything,” in which inanimate objects increasingly interact with humans and with each other through the Internet, requires virtually every device to be connected to a network and adds significantly to the coverage and throughput requirements of networks.

125. The number of users of broadband is also growing exponentially from the wealthiest to the poorest countries across the world. In 2016, Ericsson estimated there were 3.7 billion mobile broadband subscriptions worldwide, and projected this number to increase to 7.7 billion by the end of 2021.⁵⁴ In 2016, the ITU estimated there were 884 million fixed broadband subscriptions, and the Broadband Commission projects this number will increase to one billion by 2019.⁵⁵

126. This phenomena have impacted the planning and investment activities of operators of wired and wireless networks. Both fixed and mobile network operators face pressing and growing needs to upgrade their networks.

Wired networks must become fiber from end to end

127. End-to-end copper telephone access networks using DSL technology and coaxial cable television systems using cable modem technology can no longer support the required throughput to meet consumer and business growth in data demand. The gap between capacity demanded and the capacity supported by this infrastructure will continue to grow over the coming years. The last mile of twisted copper and coaxial cable access networks in virtually every developed country which still has such networks in place must either be replaced with fiber or with wireless broadband links. In 2016, end-to-end fiber-to-the-premises (FTTP) networks) and partially fiber and partially copper or coaxial cable networks, known as fiber-to-the-X (FTTx) networks, together served

⁵⁴ See Ericsson, *Ericsson Mobility Report* at 2 (June 2016). Available at <http://www.ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf> (last visited 8 Feb 2017).

⁵⁵ Broadband Commission, *The State of Broadband 2016: Broadband catalyzing sustainable development* at 22 & 27 (Sep 2016). Available at <http://broadbandcommission.org/Documents/reports/bb-annualreport2016.pdf> (last visited 8 Feb 2017).

nearly half of the total market for fixed broadband, a fraction that is growing steadily.⁵⁶ In developing countries where the copper network has already been decommissioned, or has limited coverage, fixed broadband must be built from scratch using either fiber or wireless solutions for the last mile. In every country, all upstream metropolitan, intercity and international backhaul links for fixed networks must also be replaced with fiber if they are not fiber already.

128. Cross-sector infrastructure sharing is strategically important to broadband operators building new FTTP networks or adding FTTx links to their legacy networks. Not only do network operators want to use existing lateral corridors, they today also want to share a wider variety of improvements and fixtures in those corridors than in the past. Such sharing can substantially reduce broadband network construction costs and barriers to new market entry. By sharing existing infrastructure, broadband network operators can build or expand networks much more quickly and at much lower cost. For example, passive infrastructure can constitute 70-80% of the cost of an overall investment in a fixed access telecom network.⁵⁷ According to the European Commission, civil engineering works constitute the dominant part in overall network deployment costs, with estimates as high as 80% for certain technologies.⁵⁸

Wireless networks require fiber to the tower to support 4G/LTE and 5G

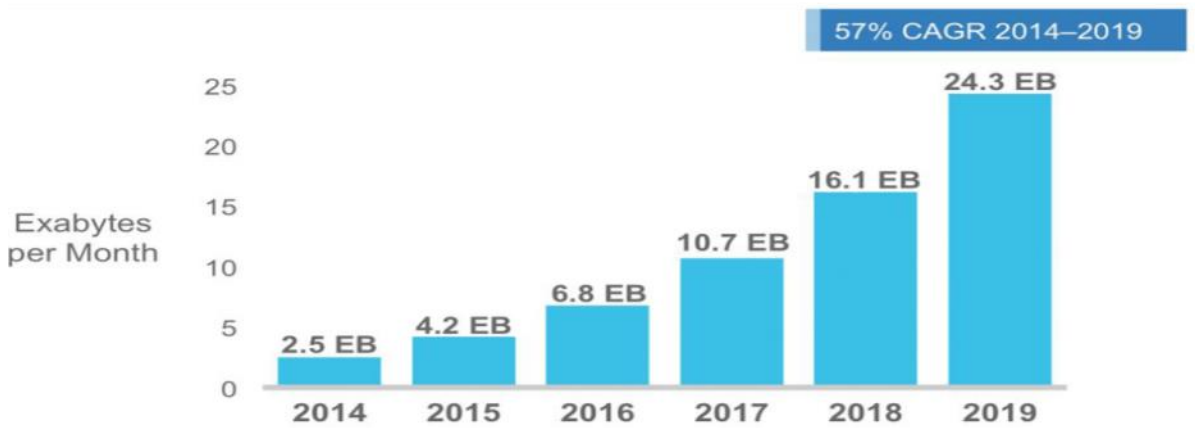
129. Today's investors in broadband wireless access networks can no longer avoid investing in heavy infrastructure as investors in 2G networks once did. Subscribers now expect mobile operators to support devices like smartphones and iPads as well as applications such as Facebook, YouTube and Netflix in both developed and developing countries. Mobile data throughput has steadily increased since 2002, and is forecasted to increase exponentially over the coming years. As indicated in Figure 17 below, Cisco has forecasted 10X growth in global mobile data traffic volumes in the five years from 2014 through 2019.

⁵⁶ Broadband Commission, *The State of Broadband 2016*, *supra*, at 27.

⁵⁷ Broadband Commission, *The State of Broadband 2014: broadband for all* at 72-73 (Sep 2014). Available at <http://www.broadbandcommission.org/documents/reports/bb-annualreport2014.pdf> (last visited 8 Feb 2017).

⁵⁸ European Commission, *Proposal for a Regulation of the European Parliament and of the Council on Measures to Reduce the Cost of Deploying High-Speed Electronic Communications Networks* (26 Mar 2013). Available at <http://ec.europa.eu/digital-agenda/en/news/proposal-regulation-european-parliament-and-council-measures-reduce-cost-deploying-high-speed> (last visited 8 Feb 2017).

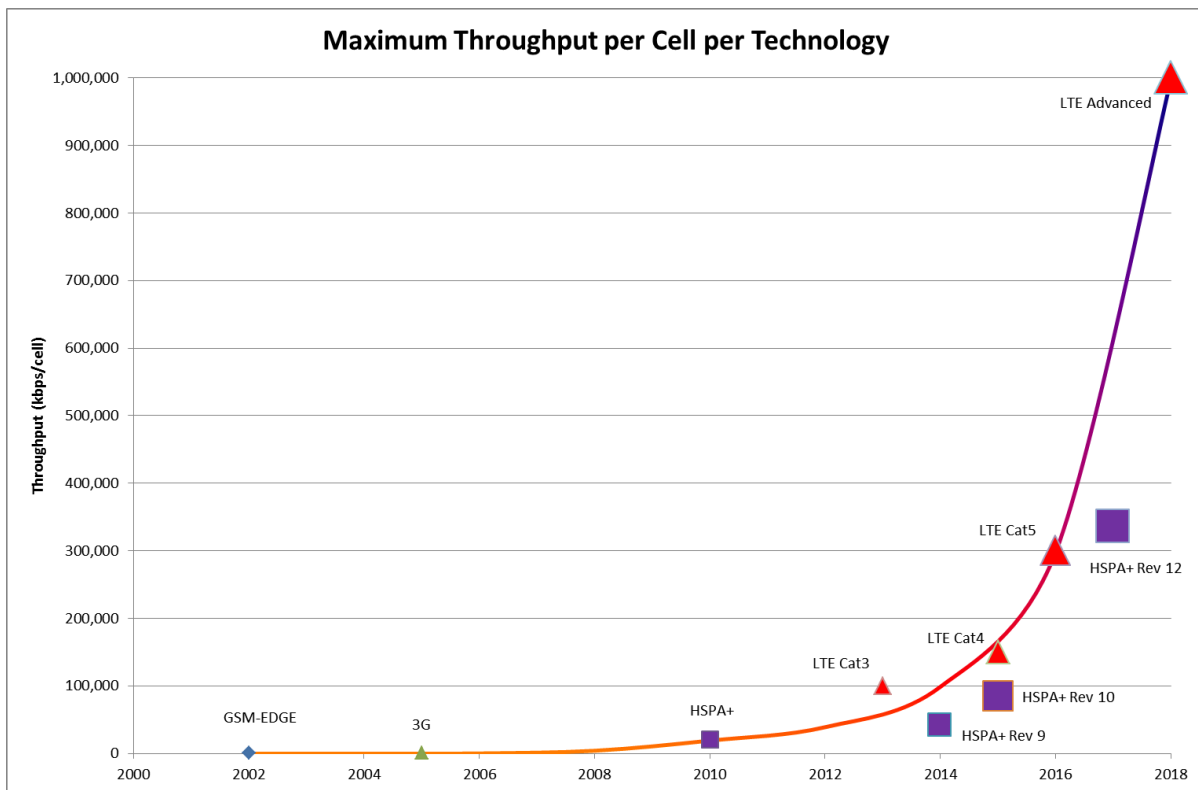
**Figure 17 : Growth in monthly mobile data traffic volumes throughput worldwide
CISCO forecast of monthly mobile data traffic worldwide through 2019**



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2014-2019⁵⁹

130. Mobile network operators must upgrade and infill their radio base stations to meet increased demand on their radio networks. Figure 18 illustrates the impact of traffic and bandwidth growth on required throughput capacity for each radio base station.

Figure 18: Trend in maximum throughput per cell by technology



Source: Andrew Johnson

⁵⁹ Available at <https://www.mvndynamics.com/2015/02/05/cisco-visual-networking-index-vni-mobile-forecast-projects-10-fold-global-mobile-data-traffic-growth-years/> (last visited 13 Feb 2017).

131. In turn, mobile network operators must therefore upgrade their transmission networks from microwave to fiber to realize the potential offered by their upgraded LTE mobile networks, because the growth in cell throughput will eclipse the ability of existing microwave transmission links to handle the maximum traffic loads on individual broadband-equipped cell sites. To support the deployment of 4G/LTE or 5G technology, network operators must build or retrofit their networks with fiber-to-the-tower. Again, mobile network operators benefit greatly in terms of cost and speed to market

Broadband upgrades and deployment thus require infrastructure sharing

132. The broadband revolution thus requires extensive new investments in fiber optic cable networks by both fixed and mobile operators and in 4G/LTE and WiFi wireless networks by mobile and some fixed operators. These infrastructure investments require extensive civil works and must rely heavily, to be viable and practical, on using existing land corridors and infrastructure.

133. In building out their mobile and fixed broadband networks, operators often face a difficult challenge in making the economics work. Such potential investments must achieve minimum viable scale and aspire to achieve minimum efficient scale as quickly as possible. In economic terms, minimum viable scale means the level of output at which total revenue exceeds total cost. Minimum efficient scale means the smallest level of output at which average costs are minimized. These challenges are present in both developed and developing countries.

134. Broadband network operators who share infrastructure within or across sectors may more quickly achieve benefits of scale by reducing their fixed costs. In a developing country, where domestic fiber optic cable investments to support mobile broadband expansion face very challenging market economics, cross-sector infrastructure sharing can often make the difference between viability and non-viability.

135. Wireless broadband network operators face an additional challenge today: growing public concerns about the impact of cell towers on health, safety and aesthetics. These concerns are increasingly restricting the supply of new cell tower sites. At the same time, operator demand for new cell tower sites has reached an all-time high as operators must decrease cell size, and therefore increase the number of cells, in order to upgrade their networks to deliver 4G/LTE services and soon 5G services.

136. All fixed and mobile broadband network operators are anxious to embrace cross-sector infrastructure sharing as a means to reduce the cost of rolling out the fiber needed for their broadband networks and, where applicable, siting new towers for their 4G/LTE networks.

2.2 Motivations of infrastructure owners

137. Cross-sector infrastructure sharing can also provide significant benefits to infrastructure owners. It presents a strategic opportunity for utilities to monetize the latent value of their existing infrastructure to generate alternative revenue streams. In developing countries, where utilities are often state-owned and capital constrained, these additional revenue sources are very important. They can be used to offset expenses of construction or maintenance of their existing infrastructure or construction of new infrastructure.

138. Infrastructure sharing also offers public utilities the opportunity to reduce the external capital required to install or upgrade their internal communications networks. Whereas in the days when the telegraph was developed, the railroads were the only corridor owners with identifiable need for internal communications networks, virtually every infrastructure owner today requires high-

speed and ubiquitous internal networks. Figure 19 below illustrates the potential internal communications needs of host infrastructure owners. While many of these applications do not require the high throughput levels offered by fiber, infrastructure owners have learned that fiber is a cost-efficient and often more reliable alternative to other means of connectivity.

Figure 19 : Common core business telecommunications needs of infrastructure owners

Owner’s core business	Communications needs of infrastructure owner
Roads and highways	<ul style="list-style-type: none"> • intelligent transportation systems • signaling • traffic monitoring • dynamic signage and road user information • connectivity to public safety and work crews
Railways	<ul style="list-style-type: none"> • signaling • switching • rail track safety management and train control • internal voice and data links • wireless connectivity to rolling stock
Electric power	<ul style="list-style-type: none"> • network protection • SCADA systems • load management • outage detection • self-healing grids • management of bi-directional electricity flows • video surveillance and security • smart metering • internal voice and data links • connectivity to line crews
Water and sewer	<ul style="list-style-type: none"> • connectivity to pumping, treatment and control facilities • SCADA systems
Oil and gas pipelines	<ul style="list-style-type: none"> • SCADA systems • connectivity to well head, control points and delivery points

139. The potential for fiber to improve an infrastructure owner’s operating efficiency, reliability and safety provides a strong incentive for all new facilities to include fiber and, where practical, to retrofit existing facilities with fiber. Cross-sector infrastructure sharing can typically improve an infrastructure owner’s business case for deploying fiber.

140. For example, electric utilities in most countries now routinely install fiber optic cable on all new or refurbished electricity transmission grids to support network protection, SCADA and many other potential applications. Similarly, railway operators routinely install fiber optic cables along their railways to manage signaling, switching and rail track safety equipment. Although roadways have lagged behind electric grids and railways in deploying fiber, the increasing congestion and demand for intelligent transportation systems is exerting pressure on roads and highway authorities to include ducts and fiber in all construction projects. Likewise, metropolitan pipes projects, such

as water, sewer and natural gas, as well as intercity pipes projects, such as water, sewer, petroleum and natural gas pipelines, all can benefit greatly from the inclusion of ducts and/or fiber being installed whenever there is a new build or refurbishment of a line.

141. Many public utilities and other infrastructure owners have already deployed (or planned to deploy) their own fiber on existing infrastructure for their own internal use. The available capacity on these fiber optic cables usually greatly exceeds the capacity needed by the utility. Excess capacity, often in the form of unused dark fiber, can be sold or leased to telecommunications operators, allowing them to avoid the costs and commercial risks of fiber deployment.

2.3 Motivations of lawmakers, policymakers and regulators

142. Lawmakers, policymakers and regulators are today very focused on stimulating investment and competition in the provision of broadband services. They often seek to intervene in the market for cross-sector infrastructure sharing to support their broadband policy goals. Their objectives are to increase the viability and efficiency of new broadband investments and to ensure effective competition in the provision of broadband services.

143. Like broadband network operators, policymakers have observed that data growth trends quickly eliminate all options other than fiber for all wired networks and every part of every wireless network up to the tower. As noted by the Broadband Commission in 2014, a number of national broadband policies, when planning for the deployment of nationwide infrastructure, have identified fiber as “a more ‘future proof’ investment” than the alternatives.⁶⁰

144. The emergence of fiber as the primary medium for network design has significant implications for competition policy in the telecommunications sector. Convergence toward fiber is bringing a return of non-replicable *critical facilities* in the sector. Mobile networks, once almost entirely wireless from end to end, must now be upgraded with fiber all the way to the tower – making the cost of redundancy in transmission networks prohibitive in all but the very wealthiest markets. Similarly, twisted copper pair and coaxial cable wired networks must eventually be replaced with fiber from end to end, again placing new importance on the wired network.

145. Though fiber and equipment costs have declined in relative terms, the costs of the works required for physically installing and maintaining fiber optic facilities have increased dramatically. The construction and operation of a fiber optic telecommunications network requires a significant upfront capital investment in fixed assets and ongoing fixed operating expenses. A significant part of these costs reflect investments in infrastructure, such as ducts, fiber optic cable, cell towers and equipment. Most of these infrastructure costs are fixed and do not vary with the volume of services provided (or vary only with large increases in the volume of services). Variable costs of providing telecommunications services typically comprise only a small percentage of overall costs. Sharing infrastructure, across sectors and within the telecommunications sector itself, is the best way to reduce each network operator’s costs. The societal impact is to remove barriers to entry, improve financial viability and efficiency, and accelerate the deployment of broadband at a lower cost basis.

146. High fixed costs means new entrants face much higher average costs than incumbents because they initially have fewer customers over which to spread their fixed costs. Because these upfront fixed investments represent sunk costs, established incumbents have an incentive to price aggressively in the face of new entry. This possibility may deter new firms from entering the

⁶⁰ Broadband Commission, *The State of Broadband 2014*, *supra*, at 72.

market to compete based on the concern that market entry will prove unprofitable. Due to the economies of scale for fiber-based networks, overbuilding one fixed wired network with another is still considered economically prohibitive in most geographic areas, with the exception of very dense commercial or business districts.

147. Such *essential facility bottlenecks* lead to market concentration and potential abuse of dominance by the operator which builds its fiber network first. This can lead to a small number of network operators with their own duplicate infrastructure. A vertically integrated network operator with its own infrastructure may be unwilling to provide wholesale access to competing retail suppliers or may only be willing to do so on unfavorable terms. This is an intra-sector infrastructure sharing issue, not a cross-sector infrastructure sharing issue, and it is quite challenging because the infrastructure owner has motive and opportunity to discriminate or deny access to its competitors.

148. Cross-sector infrastructure sharing is particularly attractive to regulators and policymakers as an alternative means of reducing telecommunications infrastructure bottlenecks and intra-sector discrimination by fostering wholesale market entry in competition with telecommunications network operators who are dominant in infrastructure. As a neutral market participant whose only focus is to maximize revenue from infrastructure sharing, an infrastructure owner whose core business is not telecommunications has a strong incentive, even without regulatory mandate, to share its infrastructure with all requesting telecommunications operators on a non-discriminatory basis.

149. For example, multiple wireless and wired network operators can share a single fiber optic cable installed on electricity or railway facilities, with each operator having its own fiber pair in a multi-fiber cable. It is possible for each network operator to have exclusive use of its own dark fiber pair in a single fiber optic cable and install and operate its own equipment at the co-location facilities where there are fiber access points. This limits the concentration of market power.

150. As a relatively new phenomenon, mobile radio towers are now also becoming good candidates for cross-sector infrastructure sharing, as they can be installed on infrastructure or in corridors of other sectors. Demand for a range of macro cells and pico cells, capable of providing 4G/LTE and WiFi coverage, is quickly growing. Radio towers, which were once easily and inexpensively replicated, have increasingly become bottlenecks.

151. This is being driven by two factors. The first is a strong industry-wide drive to reduce capital costs, which is leading to a reduction in the replication of towers and a corresponding development of tower companies. But even the tower companies are having limited impact on the shortage of new tower sites.

152. The second factor is increasing public concern over health, safety and environmental considerations, which has led to increased regulation and enforcement. One trending approach is for regulators and planning authorities to restrict the placement of new towers by imposing a requirement that tower sharing opportunities first be explored and exhausted before new towers will be permitted. Even where mobile network operators enter into voluntary infrastructure sharing arrangements, as they are increasingly doing, they may exclude or discriminate against some competitors, and they still face a shortage of new tower sites to provide infill coverage as they upgrade their networks from 2G/3G to 4G/LTE.

153. Sharing of infrastructure from other sectors, particularly in existing *noxious use corridors*, such as electricity transmission towers and water towers, can mitigate public concerns over radiation or aesthetics and ease the permitting process for new towers. In the United States, local zoning laws frequently require that mobile operators provide evidence, before constructing new towers, that they have made efforts to co-locate on existing nearby radio base station towers and other suitable structures, including in particular electricity transmission towers and water towers.⁶¹

154. This sharing of infrastructure from other sectors can also reduce the motive to discriminate and ease the shortage of towers – bringing down prices and increasing the options for better coverage.

155. Legislative and regulatory intervention has in some cases gone beyond identification and removal of barriers and disincentives to entry and ensuring fair competition. Some mandatory sharing laws, though well-intentioned, impose obligations and potentially heavy regulation, but leave barriers to entry and disincentives intact. Hence, past legislative or regulatory efforts to mandate telecommunications operator access to utility infrastructure will typically benefit from periodic review and assessment, which can provide the basis for improvements and other reforms where appropriate. Suggestions for improving the effectiveness of government intervention are set out in Module 5.

⁶¹ See, e.g., Brevard County Board of County Commissioners, Notice to applicants for a conditional use permit for wireless telecommunications facilities and broadcast towers (2 Oct 2014). Available at <http://www.brevardcounty.us/docs/default-source/planning-and-development/notice-to-applicants-for-towers.pdf?sfvrsn=4> (last visited 11 Feb 2017); Sherburne County Minnesota Zoning Ordinance, Section 16.5, Subdivision 5 (2001). Available at http://www.co.sherburne.mn.us/scip_web_files/zoning_upload/zoning/ordinance/413149c1222d22565.pdf (last visited 11 Feb 2017).

3 Common business models

156. Cross-sector infrastructure sharing arrangements take many forms and are often designed around the unique circumstances and needs of participating infrastructure owners and telecommunications network operators. This module generically describes and provides examples of some of the more common business models. These business models are not mutually exclusive, nor is every model appropriate for every infrastructure owner. An infrastructure owner and the telecommunications network operators with whom it shares infrastructure can take advantage of more than one at a time, or combine them into hybrid forms.

3.1 Joint planning and construction of infrastructure

157. The most efficient form of infrastructure sharing involves joint planning and construction of infrastructure. This business model typically also involves the adoption of an additional business model for the relationship between the parties and the infrastructure following the planning and construction phase. Even where each participant will separately own and control its improvements, fixtures and equipment, this business model inherently involves ongoing sharing of the same lateral corridor. Through joint planning and construction, infrastructure owners and telecommunications operators can coordinate the deployment or refurbishment of infrastructure. By working together in this way, the participants save on costs and can produce a superior outcome in terms of infrastructure suitability and flexibility, with less disruption to economic and social activities in the area of construction than may be created by separate projects at different times.

158. Under this model, because sharing is considered beforehand, there is a greater potential to maximize the possible efficiencies. Infrastructure sharing can be built into the design to most efficiently address the needs of all participating parties, including telecommunications operators. In contrast, after-the-fact sharing often requires additional expenditures to modify or supplement the existing infrastructure, such as the cost of extending connectivity from the infrastructure access points to where telecommunications operators need it. After-the-fact sharing also often requires telecommunications operators to accept suboptimal technical or geographic conditions that could have been optimized if sharing had been anticipated when the existing infrastructure was constructed or refurbished.

Box 4: Roads and urban planning authorities can provide leadership in proactive planning

An excellent example of joint planning and construction of infrastructure is the [Kennedy Interchange](#), a successfully completed roadway construction project in Cobb County, Georgia, USA. In that project, the Georgia Department of Transportation managed construction of a new four-lane roadway, including a bridge and an overpass, to provide access to local businesses and land that would later be developed from major highways. To obtain some contribution toward its own construction costs, the Department of Transportation involved local electric utilities, telecommunications operators and cable television companies in the planning process. Following a joint planning exercise, the utilities and network operators agreed to share the cost of the construction of a duct system in the median of the new road that would house their electricity lines and fiber optic cables.

By including these parties in the planning and construction process, the Department of Transportation ensured a more efficient and less costly investment by all participants. The telecommunications operators, cable television companies and electric utilities avoided the cost of separately burying their own cables alongside the roadway and hanging them from the side of the

roadway's bridge and overpass. In turn, the Department of Transportation avoided the need for disruption of traffic and damage to its new infrastructure which otherwise would have been necessary. The Department of Transportation also reduced its required investment in constructing the new roadway by sharing costs with participating utilities and telecommunications operators who also benefited from cost savings.

Government planning agencies can also ensure that new infrastructure is constructed to allow for future sharing. One example is the Abu Dhabi Urban Planning Council, a statutory government agency created in 2007 to address Abu Dhabi's urban development.⁶² In 2014, the Council issued an extensive Utility Corridors Design Manual⁶³ to provide roadway planners, developers and engineers with guidelines for the location and width of underground corridors for utilities such as water and pipes, electricity lines, and fiber optic cables beneath newly constructed roads.⁶⁴

159. Where practical, joint planning and construction projects obviously benefit all parties involved. However, they inherently have limited potential, and are only practical when the host infrastructure is being developed or refurbished. Where sharable infrastructure already exists, and is not slated for refurbishment any time soon, broadband networks which share infrastructure must do so by being retrofitted on the existing infrastructure.⁶⁵

3.2 Hosting third-party telecommunications facilities

160. Another common business model for infrastructure sharing is for the infrastructure owner to host third-party telecommunications facilities installed by network operators in, on or under the owner's existing infrastructure. This is the business model previously employed by railways in hosting telegraph poles and lines in their rights of way and still employed by electric utilities in hosting copper telephone lines, coaxial cable television lines and fiber optic cables on their distribution poles. It is the oldest and most common form of cross-sector infrastructure sharing between the telecommunications sector and other network sectors.

161. Under this business model, the host infrastructure owner authorizes a telecommunications network operator to install its own facilities on the host infrastructure. The compensation to the infrastructure owner may comprise a combination of cash payments (which could be one-time and/or recurring), in-kind use of excess capacity on the telecommunications facilities installed, or the provision of telecommunications services by the operator to the infrastructure owner.

162. The host infrastructure owner's role is limited to being a passive landlord through allowing defined use of its land corridors and the improvements and fixtures in those corridors. The host is not required to invest in or own any telecommunications facilities or provide any telecommunications services to the guest network operator. Although the specific arrangements may vary, the telecommunications network owner is essentially leasing space for the installation of facilities. Often, much of the value to the telecommunications network operator is the ability

⁶² Abu Dhabi Urban Planning Council, *Mandate* (undated). Available at <http://www.upc.gov.ae/about-us/mandate.aspx?lang=en-US> (last visited 9 Feb 2017).

⁶³ Abu Dhabi Urban Planning Council. *Abu Dhabi Utility Corridors Design Manual* (Version 1, undated). Available at http://www.upc.gov.ae/template/upc/pdf/UCDM_Version-1-En.pdf (last visited 9 Feb 2017).

⁶⁴ Roberta Pennington, "Paving the way for pedestrian-friendly streets in Abu Dhabi," *The National* (23 Apr 2014). Available at <http://www.thenational.ae/uae/transport/paving-the-way-for-pedestrian-friendly-streets-in-abu-dhabi> (last visited 9 Feb 2017).

⁶⁵ "Retrofitting," as used here, refers to the installation of new elements on, or partial replacement of existing elements of, existing infrastructure to permit its joint use for telecommunications.

to piggyback on the existing rights of way of the host infrastructure, such as an existing road, railway, pipeline or electricity transmission line, and possibly to make use of the host owner's other improvements and fixtures, such as ducts, poles or towers.

Box 5: Utilities can host third-party telecommunications facilities

One example of an infrastructure owner that hosts third-party telecommunications facilities is [Lesotho Electricity Company](#) (LEC). LEC is a state-owned monopoly provider of electricity transmission and distribution services in Lesotho. LEC's distribution grid is extensive and distributes electricity to all of its retail customers. Responding to the commercial need of Vodacom Lesotho, one of two mobile network operators in Lesotho, to connect its mobile radio base stations with fiber optic cable, in 2015 LEC authorized Vodacom to install fiber optic cable on its electricity distribution poles. Vodacom has completed the first phase of installing [ADSS](#) cable below the electric cables on the poles, and plans to install additional cables in later phases as it extends fiber to more towers.⁶⁶

Vodacom is compensating LEC for the pole attachment authorization through three components. First, Vodacom will pay a one-time upfront fee for any "make ready" work required by LEC to make a pole ready to allow telecommunications attachments. Second, Vodacom will pay LEC an annual fee for each pole used. Third, Vodacom will provide LEC with free use of one dark fiber pair in each cable for internal electric utility use. LEC plans to use the dark fiber pair to support the implementation of *smart grid* technology in its electricity business which will allow pre-pay customers to recharge their accounts from the premises being served. LEC has also offered to provide additional operations and maintenance services to Vodacom, whereby LEC's line crews can, on request, provide additional ancillary maintenance and repair services, such as switching over lines to new poles when a pole has to be replaced or moved.

Another example of an infrastructure owner that hosts third-party telecommunications facilities is found in Tokyo's sewer system. The [Tokyo Metropolitan Government](#) began installing fiber optic cables in its existing sewage conduits in the late 1980s to be able to control sewage treatment plants remotely. Subsequently, the Tokyo Government began to authorize third-party telecommunications network operators to install fiber in its sewer system.

3.3 Commercializing excess utility dark fiber

163. Another common business model for cross-sector infrastructure sharing is the provision by the infrastructure owner to telecommunications network operators of use of dark fiber installed and owned by the infrastructure owner. In common telecommunications industry parlance, *dark* fiber has not been connected to transmission equipment, whereas *lit* fiber has been.

164. The dark fiber business model is often adopted by infrastructure owners which have already installed (or planned to install) fiber optic cable for internal use. Increasingly, infrastructure owners install their own fiber optic cables for internal communications purposes. For example, electric utilities around the world now routinely install fiber optic cable on all new or refurbished electricity transmission grids to enable network protection, [SCADA](#) activities, and better load management through interaction between supplies and loads on the grid. Railway operators also

⁶⁶ In a hybrid approach, LEC has employed the hosting business model on the electricity distribution system, and the dark fiber business model (discussed in the next submodule) on the electricity transmission grid, providing Vodacom with an end-to-end fiber solution for every tower in its mobile network.

routinely install fiber optic cables along their railways to manage signaling, switching and rail track safety equipment. Though less common, road authorities and pipeline operators sometimes install fiber optic cable to enable management of their various transport networks.

165. Fiber optic cable usually contains multiple fibers, which are typically lit and used in pairs with a separate fiber carrying traffic in each direction. The capacity of fiber to carry large amounts of data at high speed, and the relatively small bandwidth needs of infrastructure owners, result in the utility or other infrastructure owner typically needing only one or two *fiber pairs* for internal use. For example, electric utilities typically require two fiber pairs, one for protection and the other for all other internal communications. However, fiber optic cable used in terrestrial applications (as opposed to submarine fiber optic cable) typically contains well more than two pairs of fiber, with, for example, the total fiber count in optical ground wire (OPGW) cables used by electric utilities ranging from ranging from 12 to 144 fibers (i.e. six to 72 pairs). This inherent excess capacity of dark fiber means virtually every utility which has installed fiber optic cable on its infrastructure is in a position to share dark fiber with commercial telecommunications network operators.

166. In some older fiber optic cable installations, infrastructure owners tended to install cable with the minimum fiber count available, but this was still more than necessary for the owner's internal needs. As utilities have begun to recognize the opportunity to commercialize excess dark fiber, many now install cable with higher fiber counts than the minimum. This is because the marginal cost of the additional fibers is minimal in relation to the project investment and the additional fiber expands the utility's opportunities to commercialize its spare dark fiber without running out.

167. In these transactions, ownership of dark fiber is typically not sold by the utility to the telecommunications operator, as the fiber remains an integral part of the fiber optic cable installed on the host infrastructure and used in the utility's core business. However, the dark fiber can be made available for use by telecommunications network operators on either:

- a capital lease basis (long-term right of use with a large portion of the total consideration being paid up front as a *purchase price* for the right of use and a smaller increments of the total consideration being paid on a recurring basis as *operations and maintenance fees*); or
- an operating lease basis (short-term right of use, typically renewable, with the total consideration being paid on a recurring basis as *rent* or *service fees*).

168. Where dark fiber is made available on a capital lease basis, the typical interest granted is called an *indefeasible right of use* (or *IRU*). An IRU is a unique form of property right conceived in the early 1960s and first noted in a regulatory proceeding to enable AT&T to obtain authorization for the TAT-4 copper-based submarine cable system from the US Federal Communications Commission.⁶⁷ In that proceeding, AT&T agreed to share *ownership interests* in the channels on the cable with multiple operators, each of which would be assured of long-term availability and predictable pricing, as a condition for securing the requested cable landing license.

169. An IRU is analogous to a capital lease, although different in certain respects. For example, the owner of an IRU in a fiber pair in a cable is usually only granted access rights to the fibers at the end points of each segment of cable where the fiber may be connected to equipment or spliced

⁶⁷ *In re American Telephone & Telegraph Co.*, Memorandum Opinion and Order, 37 F.C.C. 1151, 1161 (1964).

or patched to other fiber. An IRU purchaser typically does not take *possession* of the property acquired, and does not have rights to access or interfere with the fiber optic cable containing the fiber in which an IRU is purchases except at the segment endpoints.

170. The acquisition of an IRU is usually considered a *purchase of a property interest* which is fully vested for a variety of purposes. These include bankruptcy and insolvency, where the IRU owner has rights under the contract establishing the IRU which are perfected and not executory, and therefore cannot be rejected or avoided by the IRU grantor's estate as an executory obligation. An IRU is also considered a property interest under property and contract law, where the IRU owner's rights are treated as an equitable interest in the fiber optic cable enforceable against subsequent owners of the fiber optic cable who may not be bound by contracts entered into by the IRU purchaser with the previous owners of the cable. Of significant importance to many telecommunications operators is that an IRU, if properly drafted, is treated as the purchase of a capital asset for financial accounting purposes.

171. A dark fiber lease is treated as the *provision of a service* pursuant to an executory contract. It subjects the customer to risks of provider insolvency and third-party transfers, and payments are accounted as an operating expense. On the other hand, the dark fiber customer typically does not pay in advance for more than a year of service (and the recurring payments may also be quarterly or monthly), so the risks from insolvency or third-party transfers are minimal. While loss of capital expenditure treatment can adversely impact the customer's profit and loss statements, a dark fiber lease offers the advantage of requiring significantly less financial commitment by the dark fiber customer.

172. In the case of either a dark fiber IRU or dark fiber lease, a distinguishing aspect of a dark fiber is that the cable owner makes the fiber available without equipment. The telecommunications operator must install, operate and maintain its own equipment to enable the dark fiber to be used as a fiber optic network.

173. Although the host retains ownership of the fiber optic cable in which fiber is offered to third-party telecommunications network operators on an IRU basis, the host only *offers passive infrastructure* and, where an IRU is involved, the host *sells a property interest* in that infrastructure. For this reason, the law in many (but not all) jurisdictions treats dark fiber transactions as not involving the provision of telecommunications, and therefore not requiring a license to provide telecommunications or electronic communications services. However, the host may nonetheless be regulated in respect of offering dark fiber, but as a utility or infrastructure owner offering mandated access to utility installations or infrastructure rather than as a telecommunications or electronic communications services licensee.

174. Unfortunately, even where the law appears to have contemplated this regulatory framework, some regulators have treated dark fiber IRUs and dark fiber leases as the provision of telecommunications or electronic communications services and insisted that infrastructure owners obtain a license as a prerequisite to sharing their infrastructure.

Box 6: Utilities can commercialize excess capacity on existing fiber networks

One example of an infrastructure owner which has implemented the dark fiber business model is [Administrador de Infraestructuras Ferroviarias](#) (Adif) in Spain. Adif is a state-owned enterprise which owns and manages of 15,130 km of railway lines and the associated rights of way. Adif installed fiber optic cable along its long-haul and metropolitan railway lines for internal use. To

generate alternative revenue sources from its fiber investment, Adif leases dark fiber to telecommunications network operators. As of 2014, Adif was Spain's largest neutral dark fiber operator, managing 25% of the commercialized dark fiber in Spain.

A second example of the dark fiber business model was implemented by Southern Telecom in the United States. Southern Telecom is the telecommunications subsidiary of Southern Company, a public utility holding company which owns electric utility operating subsidiaries serving customers in the states of Alabama, Florida, Georgia and Mississippi. Southern Telecom was established to commercialize excess dark fiber on the transmission grids of Southern's electric utility operating subsidiaries. Today, Southern Telecom's fiber network comprises 1,300 route miles, including fiber routes on the transmission grid of other electric utilities which Southern Telecom has obtained through fiber swaps, and it provides long-haul and metropolitan dark fiber connecting Atlanta with other smaller cities throughout the southeastern United States.⁶⁸ Its primary customers are major telecommunications operators.

A third example of the dark fiber business model has been implemented by [Lesotho Electricity Company](#) (LEC), which, as noted in Submodule 2.2, has adopted a hosting model on its distribution system to supplement its offering of dark fiber on its transmission grid. LEC had invested heavily in constructing an internal fiber optic network along its transmission grid to support teleprotection, [SCADA](#) and internal voice and data communications. LEC installed [ADSS](#) fiber on its lines around the capital, Maseru, in 2002 and had a more extensive national fiber roll-out in 2012 using [OPGW](#) fiber. All of LEC's installed fiber optic cables had 12 core fibers (6 pairs) each, but LEC only requires one fiber pair for its own use, leaving 5 pairs available for commercialization.

In 2015, LEC entered into an agreement to sell Vodacom Lesotho, a mobile network operator, 15-year indefeasible rights of use of three separate bundles of dark fiber pairs to be put into service over a three-year period. The first bundle, to be put in service immediately after signing, comprises a dark fiber pair on all existing fiber optic cable installed on LEC's transmission grid located in metropolitan Maseru, the capital city of Lesotho. The second bundle, to be put in service a year after signing, comprises a dark fiber pair on all existing fiber optic cable installed on LEC's national transmission grid. The third bundle, to be put in service two years after signing, comprises a dark fiber pair on specified metropolitan and national route segments of LEC's transmission grid on which LEC committed to install fiber optic cable prior to the agreed ready-for-service date.

Under the agreement, LEC maintains ownership and responsibility for operations and maintenance of the dark fiber in which Vodacom has purchased IRUs. The consideration paid by Vodacom to LEC comprises an upfront purchase price paid for the IRU and an annual maintenance fee payable after the first year. LEC plans to use part of the proceeds of the sale of the IRUs in the first two bundles to finance its construction of the fiber optic cable required for the third fiber bundle, which will also expand the footprint of LEC's internal network to close critical gaps.

A third example of this business model is the dark fiber leasing business conducted by [Bombay Gas](#). This example is distinct from the others in that the fiber installed on the host infrastructure was intended to be commercialized and was never used by Bombay Gas for internal purposes. Rather, Bombay Gas owns pipes, conduits, service-pipes and other infrastructure installed under

⁶⁸ Southern Telecom, Inc., "About us: Background" (undated). Available at <http://www.southern-telecom.com/about-us/home.cshtml> (last visited 9 Feb 2017).

streets and bridges over 150 years ago for the delivery of piped gas in what is now the city of Mumbai. In the mid-1980s, the piped gas business was discontinued at the direction of the Government of India, which favored development of natural gas. However, about a decade ago, investors realized the potential to use Bombay Gas's existing but dormant rights of way and pipes to install fiber optic cable. By mid-2015, Bombay Gas had installed over 100 km of fiber optic cable, from which it leases dark fiber to many of India's major telecommunications network operators. Such leasing provides an attractive alternative for the network operators, which would otherwise have to bury or hang their own fiber networks in congested Mumbai, where burying fiber in public streets is costly and difficult and where aerial fiber, the likely alternative, is vulnerable to vandalism, traffic accidents, the elements and other risks.

3.4 Utility joint venture with a third-party telecommunications operator

175. Another common business model is for an infrastructure owner to enter into a joint venture with a third-party telecommunications network operator. In this business model, the host infrastructure owner provides its existing utility infrastructure, including the excess capacity in any existing fiber optic cable facilities. Either or both of the parties may provide the capital to fit out the existing excess fiber or new fiber as an operating telecommunications network, although the telecommunications operator will typically assume that responsibility. In addition, the telecommunications operator will assume responsibility for operating the network, marketing and sales of services, providing services and customer support, billing and collections. The financial arrangements between the joint venture parties can vary widely depending on the relative contribution each makes, how those contributions are valued, the market potential of the business, the preferences of the parties, and the regulatory environment.

Box 7: Utilities can establish joint ventures with experienced telecommunications operators

One example of the joint venture model is the telecommunications business of [CEC Liquid Telecom](#), a joint venture of the Copperbelt Energy Company Plc (CEC) and Liquid Telecommunications Holdings Limited of Mauritius (Liquid Telecom). CEC is a Zambian electric utility that owns and operates transmission and distribution systems to supply electricity to mining companies based in the "Copperbelt" region of Zambia. CEC has installed [OPGW](#) fiber optic cables on its electricity transmission lines. Liquid Telecom is a major telecommunications network operator in Eastern, Central and Southern Africa serving Africa's largest mobile network operators, [ISPs](#) and businesses with fixed international and domestic telecommunications services.

Liquid Telecom sought to expand its business into Zambia and CEC was seeking a partner with telecommunications expertise and a customer portfolio. The two businesses formed a joint venture in 2011. CEC transferred control of its existing telecommunications infrastructure to the joint venture. The joint venture operates a commercial telecommunications business in Zambia. CEC still operates and maintains the fiber optic cable network for an arm's-length service fee. The joint venture primarily offers wholesale capacity to telecommunications operators between points of presence on CEC's electricity grid, but is expanding coverage to include a FTTP network in some heavily populated areas.

Another example of the joint venture model is the telecommunications business of [Electricity Supply Corporation of Malawi](#) (ESCOM), Malawi's monopoly provider of electricity generation, transmission and distribution services. In 2004, ESCOM established a fiber optic unit tasked with providing reliable fiber connections between substations and power stations to support teleprotection applications, a [SCADA](#) system and internal communications. The fiber installed on

the transmission system comprised 6-pair [OPGW](#) on the transmission grid and 6-pair [ADSS](#) on the distribution system. Two pairs were reserved for ESCOM's internal use, leaving four spare pairs.

Several years later, ESCOM's fiber optic unit decided to commercialize this existing unused fiber. Facing competition from the partially privatized former fixed-line operator, which had itself established an extensive fiber optic intercity and metropolitan network in Malawi, ESCOM initially leased two dark fiber pairs to telecommunications operators. ESCOM then decided to use its remaining two pairs of excess dark fiber to provide wholesale telecommunications services rather than leasing the dark fiber. To accomplish this, ESCOM entered into a 10-year joint venture with Globe Internet, a Malawi [ISP](#). Under the terms of their partnership, Globe is responsible for ESCOM's network expansion and provision of telecommunications services.

The joint venture does not encompass all telecommunications-related activities of the two parties in Malawi. ESCOM may still offer dark fiber leasing on its pre-existing lines without involving Globe. Globe may separately enter into arrangements with customers that do not involve ESCOM's network. As of 2014, the Globe/ESCOM partnership had overtaken incumbent Malawi Telecommunications Limited to capture the largest share of the *carrier's carrier* market in Malawi, with all major [ISPs](#) and several large telecommunications operators as customers.

3.5 Utility provision of wholesale telecommunications services

176. Another common business model for cross-sector infrastructure sharing involves the host infrastructure owner building out its own commercial telecommunications network and providing wholesale telecommunications services to telecommunications network operators. In some sense, this model does not actually involve the sharing of infrastructure. Rather, it involves the provision of telecommunications services using utility infrastructure. However, it fundamentally achieves the same purpose – availing the telecommunication sector of the benefit of the infrastructure.

177. This business model requires a significantly bigger step into the telecommunications sector by the owner utility than any of the other models discussed. To enter this business, the infrastructure owner must invest in a fiber optic cable network, including the design, procurement and installation of equipment, as well as fiber, to enable the system to operate as a carrier grade fiber optic network. The owner must obtain the requisite licenses to operate a commercial telecommunications network and provide commercial telecommunications services, and will be subject to the associated regulation by the telecommunications sector regulator. The owner must operate and maintain the network, and, importantly, do so to the exacting standards and service levels required by its wholesale customers. This business model thus involves substantial investment by the owner in upfront capital expenditures and fixed recurring operation expenses, even before earning any revenue.

178. This business model thus involves much higher risk, in relation to potential rewards, for the utility than the other business models. Its chances of success depend heavily on the owner's ability to develop technical and business capabilities, and a culture, within its telecommunications business unit to operate in a highly competitive and demanding environment in a sector outside the infrastructure owner's core business. Experience shows that host infrastructure owners are often quite adept at building, owning and operating backbone telecommunications networks. However, because they are typically monopolies in their core business, they often struggle to thrive in competitive telecommunications markets. Nonetheless, numerous successful implementations of this business model exist.

Box 8: Utilities can enter the market for wholesale telecommunications services

One example of the wholesale telecommunications services model is the fiber business of [RailTel Corporation of India Ltd.](#) (RailTel). RailTel is a wholly owned subsidiary of Indian Railways, the state-owned railway company of India with over 65,000 route km of railway track in India. When RailTel was formed in 2000, Indian Railways assigned RailTel an irrevocable right to use its rights of way. By early 2015, RailTel had laid over 45,000 route km of 12-pair fiber optic cable in ducts along these rights of way, reaching over 4,300 towns and cities across India, including many in remote and rural areas.

In each cable, four fiber pairs are reserved for internal use by Indian Railways. The remaining fiber is available to RailTel for commercial services. RailTel initially adopted the dark fiber business model. RailTel later refocused its business on wholesale telecommunications services. RailTel's decision was based on its determination that wholesale telecommunications services would be more profitable and also concerns that dark fiber customers would use their dark fiber to compete against RailTel for other potential dark fiber customers. Today, in addition to wholesale bandwidth services for telecommunications network operators, RailTel has further expanded to offer retail telecommunications and data center services to large institutional customers, including business enterprises, banks, educational institutions and government organs and agencies.

Another example of a utility embracing this wholesale telecommunications model is Interconexión Eléctrica S.A. E.S.P. (ISA), a majority-state-owned electric utility based in Medellín, Colombia. ISA's core business is electricity transmission. It was established in 1967 to construct, maintain and administer Colombia's high voltage electric transmission grid. As of 2017, ISA owned over 70% of Colombia's national grid, and had become one of the largest electricity transmission operators throughout Central and South America.

ISA established its first fiber optic telecommunications network in 1998. ISA transferred its telecommunications network assets to its subsidiary Internexa, S.A. in 2001. Internexa's core business was built around installation of fiber optic cable telecommunications systems on electric transmission lines owned by ISA, its subsidiaries and other electric utilities. Through its subsidiaries and partnerships, Internexa has expanded its operations beyond Colombia to operate networks in Argentina, Brazil, Chile, Ecuador, Peru and Venezuela. Internexa offers a variety of wholesale data transport, IP and IT services to customers in these markets.

3.6 Providing co-location space, tower sites and ancillary services

179. The previous submodules have focused on various basic business models for cross-sector sharing of lateral infrastructure, such as the land corridors and the fixtures and improvements in those corridors, including fiber assets. This infrastructure supports fiber connectivity from point to point, but does not address the need to install equipment and other facilities at the various fiber access points. Therefore, regardless of the business model selected, infrastructure owners often supplement their lateral infrastructure offerings with ancillary services such as the provision of co-location space and tower sites to telecommunications operators. Though such ancillary infrastructure often has relatively low value in its own right, offering shared use of it in conjunction the lateral infrastructure can enhance the value of the lateral infrastructure to telecommunications operators and can generate additional revenue for the infrastructure owner.

180. For example, to lease dark fiber or sell an IRU in dark fiber, a utility may need to make co-location space for the telecommunications operator at the fiber access points in electricity or water

substations, or transport junctions, and possibly at other points throughout the network. This is necessary to enable the telecommunications operator to use the dark fiber by installing equipment in property of the infrastructure owner at the fiber access points. Further, if the telecommunications operator operates a metropolitan or access network from the network access point at the substation provided by the utility, the utility may be able to supply infrastructure such as a duct between the substation and the property boundary, or lease the customer the right to erect a structure or mast for wireless equipment.

181. The utility may also generate revenues through constructing and leasing co-location buildings providing a suitable environment for onsite telecommunications equipment, or allowing the telecommunications operators to install such buildings for payment of an agreed ground rental, with suitable power for the equipment to be installed.

182. Access to land on or around a utility's substations also offers other ancillary opportunities for sharing. The utility may lease space for installation of towers for telecommunications operator cell tower ([BTS](#)) sites. These can even be fenced off separately within the utility's land area but with a separate entrance allowing the operator's staff to enter it directly from outside without having to pass through usual security control.

183. Electricity utilities may be able to provide low-voltage power for telecommunications equipment interfacing with the electronic equipment, as well as for cellular base station equipment, back-up batteries, and physical space for back-up generators.

184. A utility will typically already operate its own security and maintenance services for internal purposes, and can also offer these activities to telecommunications operators as a separate service. The incremental costs of providing these services to third parties are relatively low because the utility already needs security and maintenance at its substations for its own electricity operations. Adding to these to the degree necessary for the telecommunications operators will represent very little extra resources and costs. Similarly, some utilities sharing infrastructure with telecommunications operators may also provide "hands and eyes" services, whereby they provide customers with 24-hour readiness to carry out visual checks and various basic physical interventions under instructions from the customer (e.g., cycling power on the equipment, replacing hardware and changing cables).

185. Some utilities also offer their telecommunications operator customers with emergency and routine repair and maintenance services. This involves having utility work crews perform basic field repair and maintenance functions for the network operator to correct failures they observe while servicing the utility's own facilities. For example, an electric utility which hosts telecommunications lines on its utility poles may agree to reattach or move those lines when it replaces or repairs a worn out or damaged pole. This can save the network operator the cost of a separate truck roll, reduce the risk or duration of an outage or damage to the hosted telecommunications facilities, and increase the speed of restoration.

4 Owner disincentives and impediments

186. This submodule identifies and discusses some of the more common disincentives and impediments which deter or prevent infrastructure owners from actively pursuing or entering into sharing arrangements with telecommunications network operators. It is not necessarily exhaustive, but focuses on recurring themes which are capable of being addressed effectively.

4.1 Suppression of financial incentives by utility ratemaking

187. As discussed in Submodule 2.2, the prospect of bringing in alternative revenue sources should provide a strong incentive for most infrastructure owners to share their infrastructure with telecommunications operators. However, regulators of the owner's core business may seek to offset these infrastructure sharing revenues by reducing the allowed revenue from core business activities. Most notably, where the infrastructure owner is a rate-regulated public utility⁶⁹ with a monopoly franchise or dominant market position, rate regulation of the host utility's core business can significantly suppress these financial incentives. In the worst case scenario, all revenue received from infrastructure sharing is deducted from the host utility's revenue requirements for setting tariffs in its core business – resulting in a zero sum outcome which removes all financial incentive to share infrastructure.

188. Understanding these financial disincentives first requires a deeper dive into the ratemaking rules for regulated public utilities. A typical revenue requirement formula for cost-of-service regulation of a regulated public utility is similar to the formula applied to Hawaiian Electric Company in the Figure below.⁷⁰

⁶⁹ While not all infrastructure owners are rate-regulated public utilities, many are. These usually include electric utilities, railways, water and sewer companies, gas companies, some pipeline operators and private toll road operators. Typically, the only infrastructure owners which are not rate-regulated public utilities are public roads authorities and some pipeline operators.

⁷⁰ For a discussion of the history and application of cost of service ratemaking in the United States, see Karl McDermott, *Cost of Service Regulation in the Investor-Owned Electric Utility Industry: A History of Adaptation* at 8-12 (Edison Electric Institute, June 2012). Available at http://www.eei.org/issuesandpolicy/stateregulation/documents/cosr_history_final.pdf (last visited 10 Feb 2017).


Figure 20: Typical ratemaking formula

Ratemaking Formula

$$RR = O + T + D + r (RB)$$

Where:

- RR = Revenue Requirements
- O = Operations & Maintenance Expense
- T = Tax Expense
- D = Depreciation Expense
- r = Rate of Return on Rate Base
- RB = Rate Base

 Hawaiian Electric Company
Maui Electric Company
Hawaii Electric Light Company

9

Source: Hawaiian Electric Company⁷¹

189. Under this formula, which is used to calculate a rate-regulated utility’s revenue requirements for tariff-setting purposes, the utility is permitted to recover its investment in infrastructure through three components of the revenue requirement:

- infrastructure operations and maintenance expenses;
- infrastructure depreciation expenses based on historical cost; and
- return on investment (based on the “rate base,” which represents investment which has not yet been recovered through depreciation).

190. The allowed tariff is computed by forecasting the revenue yield curve across various rates, accounting for elasticity of demand, and selecting the rate which is expected to meet the utility’s revenue requirements for a given period. All such tariffs must be approved by the sector regulator based on approved revenue requirements. Future rate adjustments may take account of any revenue surplus or shortfall from the previously approved rate, although utilities are sometimes allowed to retain any such gains earned before the next rate case, when core business tariffs may be reduced. The regulatory goal is to ensure that the utility receives exactly the full amount of its approved revenue requirements, but no more and no less.

191. Although the approach to ratemaking applied in a specific sector and country varies, and has progressed beyond traditional cost-of-service regulation in many jurisdictions, particularly in Europe, virtually all rate regulation of monopoly service providers continues to base the allowed rates on the utility’s regulatory asset base.⁷² This continued focus on the regulatory asset base

⁷¹ Hawaiian Electric Company *et al.*, Informational Briefing for Senate Committee on Commerce and Consumer Protection and Senate Committee on Energy and Environment, Slide 9 (29 Jan 2013). Available at <http://www.slideshare.net/civilbeat/puc-heco-presentations> (last visited 10 Feb 2017).

⁷² Although such rate regulation is manifested in a wide variety of forms, European rate regulation of power and gas utilities also generally follows a regulatory asset base model, which in most cases calibrates permissible rates to the utility’s regulatory asset

limits permissible rates to returns which bear some relationship to the utility's investment in in-service assets used to provide regulated services.

192. When a rate-regulated utility allows joint use of its infrastructure by telecommunications network operators, these commercial activities generate revenue in addition to the utility's approved tariffs through ancillary use of infrastructure which was also included in the rate base or regulated asset base in determining its revenue requirements or permissible tariffs. This would appear to provide the utility with a windfall at the expense of its core business customers. The utility's regulator will therefore want to determine what impact, if any, these ancillary commercial activities should have on the utility's revenue requirements and approved tariffs.

The most common approach is to treat the shared infrastructure as having been partially removed from the rate base (or regulatory asset base) and hence reducing the utility's recoverable costs of service accordingly. Under this approach, revenue derived from infrastructure sharing is not applied toward meeting the utility's revenue requirements, but expenses associated with the infrastructure removed from the rate base (or regulatory asset base) are *excluded* in calculating its revenue requirements or permissible rates. This approach therefore reduces the utility's allowed revenue requirements for operations and maintenance, depreciation and return on investment.

193. The cost-allocation approach creates two inherent disincentives for the utility to share infrastructure. First, the reduction in regulated revenue allowed may offset all or a significant part of the revenue received from infrastructure sharing. This reduction of regulated revenue allowed has the potential to undermine the entire financial benefit of the alternative revenue sources from infrastructure sharing. The reduction in regulated revenue could even exceed the additional revenue from infrastructure sharing.

194. Second, the cost-based approach is a fundamentally flawed methodology in this context. Calculation of the operation and maintenance cost of shared infrastructure to be excluded and the capital cost of shared infrastructure to be removed from the rate base (or regulatory asset base) present great practical difficulty. This is because there are no accepted or discernible principles for allocating costs between two distinct uses of the same asset. The requirement to allocate costs of shared infrastructure between the regulated and unregulated businesses creates significant regulatory uncertainty (both for the utility and its sector regulator) as to (1) what costs should be removed from the utility's revenue requirements for operations and maintenance, depreciation and return on investment and (2) the impact on its permissible rates however otherwise determined.

195. At first blush, the separate accounting requirement may appear deceptively straightforward.⁷³ All external revenue related to the utility's core regulated business is for the account of that business and all external infrastructure sharing revenue is for the account of a

base. See Ernst & Young, *Mapping power and utilities regulation in Europe* (2013) (surveying utility regulation in Belgium, Czech Republic, Finland, France, Germany, Greece, Italy, the Netherlands, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey and the United Kingdom). Available at [http://www.ey.com/Publication/vwLUAssets/Mapping_power_and_utilities_regulation_in_Europe/\\$FILE/Mapping_power_and_utilities_regulation_in_Europe_DX0181.pdf](http://www.ey.com/Publication/vwLUAssets/Mapping_power_and_utilities_regulation_in_Europe/$FILE/Mapping_power_and_utilities_regulation_in_Europe_DX0181.pdf) (last visited 10 Feb 2017).

⁷³ In general, all income generated by a utility's provision of regulated services is *regulated income*, and must be accounted for separately from all other income so that it can be compared to the revenue requirements on which the utility's approved tariffs are based. Similarly, all costs included in the revenue requirement formula are *regulated expenses* and must also be accounted for separately from all other expenses so that revenue requirements for the provision of regulated services can be properly calculated. Thus, under applicable accounting separation rules, the utility's sector regulator will typically require it to separate all revenues and costs associated with its infrastructure sharing business from its regulated core business.

separate business which is not regulated by the infrastructure owner's sector regulator (but which may, as discussed in the next submodule, be regulated by the telecommunications sector regulator). Each of these separate businesses should also bear its own costs. Dealing with incremental costs incurred by the infrastructure sharing business is relatively easy. If the infrastructure sharing business needs equipment or personnel to provide services to external customers, then it bears those costs, whereas if the core utility business needs equipment or personnel to support its business, then it bears those costs.

196. However, one encounters great intellectual and practical difficulty in trying to apply the separate accounting rules to shared infrastructure which is used and useful in both the core utility business and by third-party telecommunications network operators. This infrastructure may include such fixed assets as land, rights of way, towers, poles, ducts, conduits, structures and fiber optic cable. If these assets were all acquired prudently by the utility for use in its core utility business and remain used and useful in that business, they should be fully included in its rate base (or regulatory asset base) prior to sharing them with third parties. However, if they prove also to be potentially sharable, there is no generally accepted criteria for apportioning their capital expenditure cost between the core business and the ancillary business. Similarly, there is not generally accepted criteria for apportioning operations and maintenance costs for shared infrastructure between the core business and the infrastructure sharing business. Nor is there any criteria for determining whether the allocation percentages should be the same for both capital expenditures and operating expenses in respect of shared infrastructure.

197. The difficulty of apportioning baseline capital and operating costs of shared infrastructure between the owner's rate-regulated business and its infrastructure sharing business is easily demonstrated. Consider a non-telecommunications utility (such as an electric utility or railway operator) which has installed fiber optic cable to enhance its core business and later decides to lease excess capacity on the fiber to telecommunications operators. How should the utility apportion the costs of the fiber?

198. Apportioning fiber cost is conceptually difficult. One could say that the core business bears all the cost of the fiber optic cable except for the fiber leased to third parties, and that the infrastructure sharing business bears the cost of the leased fiber. It is possible to ascertain the depreciated cost of the fiber optic cable and apportion it among the total fiber count. However, does one apply this apportionment starting when the third party actually commences use of the fiber or when the infrastructure sharing business first starts offering the fiber in the market? What about the cost of spare fiber which is neither used in the core business nor leased to third parties? The core utility business has no use for spare fiber while the infrastructure sharing business is arguably holding all spare fiber in inventory to solicit additional third-party customers. On the other hand, the infrastructure sharing business has a very limited number of potential customers, and a significant portion of a utility's excess dark fiber may never be used by anyone. The core business would have incurred the costs of the unused fiber in any event. Also, because third-party use is limited in duration and other respects, should there be some discount from the depreciated cost to reflect the fact that less than the full bundle of rights is being shared?

199. Apportioning the cost of shared towers, poles, conduits, rights of way, land and buildings presents even more difficult conceptual challenges than apportioning the cost of fiber. But such an allocation of cost must be made to comply with the accounting separation requirements because the shared fiber benefits from joint use of this other infrastructure. In most cases, if one were to apportion the cost of these host assets 50-50 between core business uses and infrastructure sharing

uses, they would yield such high costs for the infrastructure sharing business that the utility would not be able to charge telecommunications operators who share the fiber enough to recover the costs which have been excluded from its core business revenue requirements. The utility would lose more than it gains by sharing its infrastructure. Even if the third-party revenue, net of the incremental costs of the utility's infrastructure sharing business, were viewed by the utility's sector regulator as a *cap* on the reduction in the revenue requirements of its core business, this approach may still reduce the profits from the infrastructure sharing business to zero or near zero. These difficulties and uncertainties remove any financial incentive for the utility to enter the infrastructure sharing business, effectively returning all profits from that business to the utility's core business customers through reduced tariffs. Management and shareholders of the utility would have little incentive to go to the trouble and incur the risks of entering the infrastructure sharing business under such circumstances.

200. If, instead, one were to propose apportioning the costs of shared infrastructure on some basis other than 50-50 between the two uses, then this begs the question of what other basis. There are no generally accepted or self-evident principles on which to develop such an allocation. Moreover, unless the utility is able to obtain its sector regulator's prior confirmation of how these commercial activities will be accounted for, the utility will be unable to treat any proceeds as free and clear cash available to spend. From a prudent utility planning perspective, the revenues from infrastructure sharing are sufficiently encumbered as to provide little incentive to pursue such a business absent advance regulatory certainty that a reasonable portion of such revenues will benefit the utility by being available for discretionary spending.

201. While the foregoing problem arises in the regulation of the utility's core business market, another problem with basing the allocation of commercial gain between the regulated core business and infrastructure sharing business on some fixed allocation of baseline costs arises in the telecommunications market. Any potential income from infrastructure sharing is typically earned in a competitive market, where potential customers have other options for telecommunications infrastructure, some of which may be more attractive than the utility's infrastructure and therefore have higher market value. In conducting an infrastructure sharing business, the utility faces commercial challenges that lead to market prices for joint use of infrastructure which do not bear any direct relationship to its baseline costs (however they may be apportioned) or market prices for competing infrastructure. The portion of shared infrastructure costs a utility is effectively forced to bear by its core business regulator, through removal of those costs from its core business revenue requirements, may put the utility at a significant disadvantage in the telecommunications market.

202. Requiring a utility to reduce its core business revenue requirements by a specified share of costs, without regard to the market value of the sharable assets, risks reducing its revenue requirements by more than the market value of the shared infrastructure. This cannot be good for the utility, its ratepayers or the telecommunications operators and their customers who are denied access to potentially sharable infrastructure as a result.

203. Such regulatory disincentives do not exist by design, but rather by the unintended consequences of the interaction between two different sectors which face different market structures and regulatory environments. When brought together, these produce a result that does not exploit the latent value of the infrastructure for optimal economic and social benefit.

204. The lack of regulatory certainty requires a prudent utility to assume and plan for the worst. This, of course, stymies incentives to enter the infrastructure sharing business. Even where the law attempts to mandate or regulate sharing, the lack of regulatory certainty regarding the impact on core business rates and tariffs may create incentives to resist or undermine requests for access.

205. Progressive policymakers and regulators have developed ways to protect the interests of utility ratepayers, while providing stronger incentives for rate-regulated utilities to pursue cross-sector infrastructure sharing opportunities. As discussed in Submodules 7.1 and 7.2, it is not sufficient simply to allow or mandate infrastructure sharing. The approaches of the two sectors (utility core business and telecommunications) must be aligned so that the regulation of rates in the utility's core business does not have this restraining effect beyond its own sector.

206. Notwithstanding the significant financial disincentives created by traditional regulated utility ratemaking principles, one can find examples where utilities have nonetheless shared infrastructure voluntarily under such circumstances. However, policymakers and regulators can increase the incidence of infrastructure sharing by reducing or removing these financial disincentives.

Box 9: A self-interested utility may voluntarily share infrastructure even if ancillary revenues are offset by reductions in regulated rates

For example, in the [United States](#), without any legal or regulatory compulsion to do so, electric utilities and telephone companies historically shared poles used to support electricity distribution lines and telephone lines. From the early days of both businesses until 1996, electric utilities and telephone companies were regulated monopolies subject to similar ratemaking proceedings (which were, in most states, applied by the same regulator, often known as a *public service commission* or *public utilities commission*). Electric utilities and telephone companies found sufficient benefit to engage in comprehensive joint use of poles even though it required significant coordination and added to the cost of each company in servicing its poles. They did this because it reduced the potential for conflict between separate lines installed in the same corridors (primarily along roadways) and reduced the capital required for each to extend its lines into new coverage areas.

This voluntary pole sharing in the United States continued through 1996, when the US Congress passed legislation opening up local telephone service to competition. At that time, the telephone companies ceased investing further in poles. Though the former monopoly telephone companies continued to maintain their existing poles, the electric utilities thereafter assumed responsibility for pole replacements and for the installation of poles on all new lines. The telephone companies previously could recover their investment in poles through regulated telephone tariffs. They ceased investing in poles because the sunk costs of investing in a new pole would now put them at a competitive disadvantage to new entrants, who received the benefit of pole attachment rights (both to electric and telephone poles) under a formula which allocated most costs to the pole owner. This is a clear signal from the market to regulators that the mandatory pole sharing laws were inequitable to pole owners and provided a strong disincentive to sharing as well as investing.

4.2 Suppression of financial incentives by infrastructure access regulation

207. Led by the developed countries, mandatory infrastructure sharing legislation and related rate regulation has proliferated around the world over the past two decades.⁷⁴ For example, in the

⁷⁴ See Wall Communications Inc., *A Study of Wholesale Costing Methodologies in Selected Countries prepared for the Canadian Radio-Television and Telecommunications Commission* (2 Oct 2012) (comparing, among other things, regulation of rates for

United States, Congress has since 1978 regulated the rates electric utilities and incumbent telephone companies may charge cable television companies for joint use of their utility poles. In 1996, the regulation of rates was extended, and mandatory access obligations imposed, to protect competitive new entrants in the telecommunications sector as part of the introduction of competition in local telephone services. In recent decisions, the United States Federal Communications Commission has extended the benefit of regulated access to electric utility poles to the former incumbent telephone companies. The development and practices and policies in the regulation of utility pole attachments in the United States are discussed in detail in the United States case study included in this toolkit.

208. Similarly, Ghana’s Electronic Communications Act of 2008 directs that “[w]here a network operator requests the use by its network of a utility installation owned by a public utility it shall have the right to use the installation in accordance with this section and where any public utility requests the use of facilities of a network operator, the public utility shall have the rights of the network operator under this section.”⁷⁵ A “utility installation” is broadly defined as “any physical component of a system owned or operated by a public utility to provide water, gas or electricity.”⁷⁶ Among other things, the Act empowers Ghana’s National Communications Authority to “regulate the rates, terms and conditions for access to a facility or utility installation, and ensure that the rates, terms and conditions are just and reasonable and to the greatest extent possible, based on a cost-sharing formula.”⁷⁷

209. Accepted best practice for *intra*-sector infrastructure sharing within the telecommunications sector suggests that a regulator should define the relevant markets and assess competition in those markets *before* intervening in those market. Particular attention should be given to whether infrastructure owners or their affiliates have significant market power or dominance in the relevant markets for telecommunications infrastructure or are engaging in anticompetitive behavior. The results of this assessment should inform the nature and degree of any regulatory intervention and whether such intervention should be *ex ante* or *ex post*.

210. Unfortunately, the provisions empowering telecommunications sector regulators to regulate *cross*-sector infrastructure sharing often do not follow this best practice of limiting *ex ante* regulation to persons found to have been dominant in a relevant market. The approach to regulation presented in such provisions is sometimes arbitrary and excessive, from a competition policy perspective. As in the above examples from the United States and Ghana, it is not uncommon for mandatory cross-sector infrastructure sharing provisions of telecommunications sector laws to direct that the infrastructure owner use *cost-based pricing* and to empower the sector regulator to enforce this requirement. In contrast with the provisions of such laws limiting price regulation of telecommunications services to circumstances where a finding of dominance in a relevant market has been made, the infrastructure sharing provisions often direct or permit regulators to regulate prices and access terms without regard to dominance. Such legislation

mandated access to “support structures,” comprising primarily ducts and poles, in Australia, France, Germany, Sweden, the United Kingdom and the United States). Available at <http://www.crtc.gc.ca/eng/publications/reports/rp121002.htm#t31> (last visited 11 Feb 2017).

⁷⁵ Ghana Electronic Communications Act of 2008, §21(2). Available at <http://www.moc.gov.gh/sites/default/files/downloads/Electronic%20Communications%20Act-775.pdf> (last visited 11 Feb 2017).

⁷⁶ *Id.* §101.

⁷⁷ *Id.* §21(6).

effectively deems all infrastructure owners to be dominant *per se* in the relevant infrastructure markets and provides no mechanism by which they can rebut that presumption. Such laws also seldom offer guidance for when a telecommunications regulator should exercise the discretion to forbear from regulating infrastructure sharing. These provisions are typically buried deep in telecommunications sector laws and received little attention during drafting, debates and passage of the law.

211. As a matter of good public policy, the decision to impose mandatory access, rate regulation and/or non-discrimination requirements on an infrastructure owner, and the manner in which such requirements are applied, should always consider (1) whether the activity, if unregulated, is likely to have a positive or negative impact on investment and competition in the telecommunications sector and (2) how and whether the market intervention would enhance investment and competition.

212. For example, where an infrastructure owner with existing dark fiber is a potential new entrant attempting to compete with wholesale dark fiber or bandwidth offerings of a dominant incumbent telecommunications operator, the regulator should encourage entry by the infrastructure owner, on an unregulated or lightly regulated basis, to foster competition in the wholesale dark fiber market. The infrastructure owner's competitive entry in the dark fiber market should benefit competition and counterbalance the dominance of the incumbent. The regulator can therefore forebear from regulating the new entrant's rates and access terms, and reserve its regulatory power for *ex post* intervention if necessary. Nurturing competition in wholesale infrastructure markets can increase sector-wide capacity, route diversity and geographic coverage while reducing downstream costs. This can benefit retail telecommunications consumers by improving access and speed and reducing prices. The non-dominant scenario thus presents a strong case for limiting regulatory interference in the relevant wholesale markets.

213. On the other hand, if a utility infrastructure owner is dominant in the relevant wholesale market, or is likely to be dominant on market entry, then some form of *ex ante* regulation of the utility may be appropriate. This may be the case, for example, where the utility controls non-replicated and economically non-replicable infrastructure which is essential for the deployment of broadband telecommunications facilities.

214. The existing cross-sector infrastructure sharing provisions in many jurisdictions (both developed and developing) have not yet adopted the competition-based approach to *ex ante* regulation as widely as in intra-sector regulation. For example, the Ghana Electronic Communications Act does not limit the National Communications Authority's power to regulate rates for access to utility installations to circumstances where the utility has significant market power in a relevant market or is otherwise engaged in anticompetitive conduct. In contrast, the Act provides for tariffs for electronic communications services to be "determined by service providers in accordance with the principles of supply and demand" except where the Authority is expressly authorized to regulate tariffs,⁷⁸ and in turn limits that power to situations where the network operator has a monopoly or significant market power or engages in anti-competitive

⁷⁸ Ghana Electronic Communications Act of 2008, §25(1).

pricing or unfair competition.⁷⁹ This double-standard for rate regulation provides a significant disincentive for utilities to enter the infrastructure sharing market voluntarily.

215. The European Parliament and the Council of the European Union recently issued a Directive requiring Member States to require most utilities which own infrastructure to grant reasonable requests from public communication networks for access under “fair and reasonable terms.”⁸⁰ Again, the Directive presumptively regulates terms of access, including rates, without any requirement of a showing of dominance or anti-competitive behavior.

216. Another aspect of these laws, as reflected in this EU Directive, is that the infrastructure owner is generally prohibited from declining to enter the market for infrastructure sharing. For example, Article 39 of [Lithuania’s](#) Law on Electronic Communications establishes procedures for providers of public communications to access “electronic communications infrastructure,” which is defined to include passive infrastructure such as pipes, ducts, towers, masts, buildings, structures and other facilities. Although Article 39 encourages the access seeker and infrastructure owner to negotiate terms of access directly without regulatory intervention, if the access seeker cannot obtain access or if the cost of access is disproportionately high, the Communication Regulatory Authority may eventually compel the infrastructure owner to share its infrastructure on reasonable and non-discriminatory terms.

217. The combined impact of utility ratemaking principles and cost-based price regulation of infrastructure sharing even in the absence of dominance can have a quite draconian impact on the financial incentives of utilities to share their infrastructure and to invest in making that infrastructure more attractive to telecommunications network operators.⁸¹ In principle, this dual price regulation limits the utility’s maximum price for sharing infrastructure to the same amount which must be removed from its core business revenue requirements. The only possible financial benefit from infrastructure sharing for a utility subject to these dual requirements is the potential to accelerate its cash flows by selling indefeasible rights of use (IRUs) in the shared infrastructure, which represents an upfront capital payment equal to the discounted present value of the cost-based rent. Such an arrangement may enable the utility to accelerate its cash flows from infrastructure investment, but would not increase its return on that investment, so the net present value to the utility of sharing its infrastructure would still be zero.

218. Cross-sector infrastructure sharing regulations also sometimes, in addition to mandating *open access*, require non-discriminatory pricing and terms and compliance with other similar regulatory mandates. Such provisions effectively treat the utility as an infrastructure *common carrier*.⁸² While this may seem laudable in principle, it is difficult if not impossible in practice

⁷⁹ *Id* §25(2).

⁸⁰ European Parliament and the Council of the European Union. *Directive 2014/61/EU of the Parliament and of the Council of 15 May 2014 on Measures to Reduce the Cost of Deploying High-Speed Electronic Communications Networks*. Directive, Art. 3 (2014). Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0061> (last visited 11 Feb 2017).

⁸¹ Cost-based price regulation of infrastructure sharing also begets the same lack of principles and regulatory uncertainty regarding cost allocations for shared assets as was discussed in Submodule 4.1. This engenders even further regulatory uncertainty as to the combined impact of both sets of regulations, and creates the risk of inconsistent cost allocations by the two sector regulators (core utility sector and telecommunications sector).

⁸² A common carrier, in a common law country, refers to a telecommunications operator that holds itself out to the general public to provide communications services, and is accordingly subject to heightened regulatory requirements such as an obligation to provide non-discriminatory service. A common carrier corresponds to a “public carrier” in civil law countries. A non-common carrier arrangement, also sometimes referred to as contract carriage or private carriage, is one in which the provider is not treated

for the market participants or the regulator to follow or administer. Often, the telecommunications operators which are large enough to use utility infrastructure are so differently situated that there are no two which could reasonably be considered to be in the same customer class. However, the existence and potential application of the common carrier principles creates legal and regulatory uncertainties for both utilities and telecommunications operators who participate in infrastructure sharing transactions. These legal and regulatory risks in turn suppress the level of infrastructure sharing commercial activity and investment (by both infrastructure owners and access seekers).

219. A public utility typically has very few potential infrastructure sharing customers, all of whom are differently situated, and the infrastructure itself is often tremendously complex and not purpose-built for sharing. The infrastructure package desired by each telecommunications operator depends on a variety of factors. These include, for example, the operator's specific needs for infrastructure, where the infrastructure is needed, the operator's avoided costs of self-provisioning its own infrastructure, the availability of other existing or planned infrastructure that may be substitutable, the costs of adapting the utility's infrastructure to the operator's existing and planned networks, and the overall financial health of the telecommunications sector. The operator may also wish to barter certain telecommunications services to the utility in full or partial consideration for access to and use of the utility's infrastructure. In general, the utility's baseline costs, and the arrangements it has made with other operators, have little bearing on the commercial arrangements which may be mutually most attractive to the operator or the utility.

220. Permitting non-common-carrier arrangements whereby a telecommunications operator and a utility can jointly fashion an individually tailored commercial arrangement under such circumstances is generally the regulatory approach most conducive to optimizing infrastructure sharing. The regulator's authority to intervene should be *ex post*, where the parties are unable to conclude an agreement, and the aggrieved party is able to demonstrate some form of anticompetitive conduct. Where an agreement has been voluntarily concluded by the parties, any *ex post* intervention should be limited to circumstances where a third party complains that the agreement was anticompetitive. Subject to this exception, the parties to a commercially negotiated infrastructure sharing arrangement ought to be allowed to select a dispute resolution forum which they believe will be fair and impartial, which may be the sector regulator, if they so choose, or may be an arbitral tribunal selected in accordance with procedures agreed by the parties.

221. For example, in the case of dark fiber, which is frequently a relatively competitive market, it is impractical for a utility which owns fiber to offer a general tariff or reference offer (at least insofar as price is concerned). Dark fiber transactions between utilities and telecommunications operators are nearly always concluded on highly customized terms which fit the unique circumstances of the utility and the telecommunication operator and the interplay between those circumstances.

4.3 Institutional silos for infrastructure investment in developing countries

222. In addition to the financial disincentives to sharing infrastructure, utilities in many developing countries also face additional institutional barriers to engaging in cross-sector planning and construction activities with telecommunications operators (which was discussed as one of the common business models in Submodule 3.1). Utility infrastructure investment in developing

as a common carrier. Allowing contract carriage in the provision of wholesale infrastructure is generally considered to be economically more efficient than trying to standardize offerings by requiring common carriage.

countries has extremely long planning cycles with many actors and rules which constrain the ability of the utility to plan and coordinate with potential infrastructure sharing partners.

223. First, much new infrastructure in developing countries is funded by development banks and other donor organizations. The funding units of these institutions are typically organized into sector silos, such as electricity, water and sewer, roadways, railways and pipelines. There has historically been little cross-sector planning within these institutions. Potential infrastructure sharing opportunities which require joint planning and construction are therefore often missed. Even when infrastructure projects include fiber, as many power and railway projects now do, telecommunications operators build their own fiber instead of waiting for the utility fiber. They do this because they are not made aware that the new fiber is being constructed, the timetable for completion, whether it will be available for their use, and the terms and conditions on which it will be made available. By missing out on this planning stage dialogue, the infrastructure owner also often loses the opportunity to plan additional drop-off points and co-location space for its new fiber, which may improve the fiber's commercial value to telecommunications operators.

224. Second, the disbursement conditions and procurement rules applicable to infrastructure owners which receive donor funding currently leave little room for cross-sector planning. The construction of a major infrastructure project typically involves long planning cycles with the input of various technical consultants and ultimately a competitive tender for the supply of materials and construction. By the time this phase of a major infrastructure project is reached, it is difficult to vary the specifications to accommodate a joint planning exercise with a telecommunications operator without setting back the underlying procurement process (and potentially requiring repetition of steps for which the fixed-price technical consultants have already completed their scope of work and no further advisory funding is available).

225. In addition, competitive bidding requirements often make it difficult for the infrastructure owner to engage in direct contracting with a telecommunications operator during the procurement stage of the infrastructure project. Thus, for example, while it may seem obvious that planning for conduit and duct systems or even fiber should be coordinated with the construction or refurbishment of a roadway, these disbursement conditions and procurement rules applicable to the roadway project present serious and seemingly insurmountable obstacles to such joint planning and construction.

226. Third, because the infrastructure owner for a developing country project is almost always a state organ or state-owned enterprise, it will be subject to a variety of constraints (discussed more fully in the next submodule). In addition, ministerial portfolios and board appointments for state-owned enterprises generally follow the same silo approach as that followed by development institutions. The shareholder representatives and board therefore often have no experience with telecommunications or joint use of utility infrastructure. While helpful in achieving subject matter expertise for the infrastructure owner's core business, this silo approach to governance tends to suppress interest and experience in cross-sector planning.

227. Fourth, infrastructure owners often do not have a ready means to engage telecommunications operators as potential collaborators in co-deployment of new infrastructure. They do not typically have personnel who are trained or experienced in facilities sharing and do not have the budgets to hire such personnel within the scope of their regulated revenues and earnings.

4.4 Restrictions on activities of state actors and state-owned enterprises

228. State ownership of host infrastructure significantly impacts the potential for cross-sector infrastructure sharing with potential joint users of the infrastructure.

229. In most countries, at least some sharable infrastructure is held by government organs or state-owned enterprises. In many developing countries, virtually all sharable cross-sector infrastructure is under state ownership and control. This infrastructure is sometimes held directly by a state organ. For example, roadways and water/sewer infrastructure are typically under direct control of transport ministries or agencies. Other infrastructure, particularly electricity and railway infrastructure, is sometimes also held through a corporatized state-owned enterprise.

230. Establishing infrastructure sharing arrangements with state actors and state-owned enterprises requires the parties to deal with a variety of contracting restrictions, including regulation of public procurement, disposition of public assets, public-private partnerships and public concessions. These legal requirements can be quite cumbersome and clumsy when trying to establish infrastructure sharing arrangements. They typically were not adopted with projects of the nature and scale of infrastructure sharing in mind. Their potential application to such projects uncovers ambiguities and anomalies, may involve a third-party agency tasked with regulating such transactions, and can raise costly delays or insurmountable hurdles. The prospect of public enterprise regulation can often deter telecommunications operators from investing the time, money and effort to attempt infrastructure sharing arrangements. It can also frustrate infrastructure owners and policymakers.

231. For example, where the number of telecommunications operators in a country is small, and one is dominant, the best commercial option, and coincidentally the best policy option, for infrastructure sharing may be for the state-owned host to partner with a non-dominant telecommunications operator, if the host were to adopt the joint venture business model. This would introduce competition with the dominant operator. Yet, the strict rigors of public enterprise transactions may dictate a contrary outcome. They may require a form of open and equal access by all telecommunications operators to the opportunity through a competitive selection process, which may allow the dominant telecommunications operator to interfere with entry or expansion by its competitors. These laws may thus force the state to invite the dominant operator to bid for the right to partner with the host infrastructure owner.

Box 10: Correcting for unintended consequences

With funding from the World Bank under the Regional Connectivity Infrastructure Program (RCIP), the Malawi Public-Private Partnership Commission sought to introduce greater competition in international fiber routes. At the time, Malawi, which is a landlocked country, was served by a single terrestrial fiber route from its border with Mozambique through to submarine cables along the east coast of Africa. The Mozambique segments were owned and operated by TDM, the state-owned Mozambique incumbent fixed-line operator, which had a monopoly and was beyond the reach of Malawi's telecommunications regulator. In addition, the Malawi segments from the border to the two major cities, Blantyre and Lilongwe, were controlled by MTL, the recently privatized former state-owned Malawi incumbent fixed-line operator.

The Public-Private Partnership Commission sought to encourage the construction of a competing route with geographic diversity to existing routes which would pass through Tanzania to the coast, thereby breaking the monopoly of TDM over the terrestrial segments outside Malawi. It also

hoped to attract a new wholesale backbone operator to enter the market in Malawi. These goals would be accomplished by tendering the procurement by the Government of a block of international capacity for Government use, to be made available in Lilongwe and at certain other drop-off points. By having the Government serve as an anchor tenant in this way, the Commission hoped to improve the financial viability of the investment in the new route, thereby creating an alternative supply of international capacity as well as making the domestic portion of the cable available for transit and backhaul purposes

The Commission also sought to improve the financial viability of the new fiber route by ensuring the availability of two separate options for infrastructure sharing, one involving the installation of buried or aerial fiber along existing roadway reserves and the other involving the retrofitting of fiber on existing electric transmission lines owned and operated by state-owned ESCOM.

The Government's investment as an anchor tenant in the new infrastructure was governed by the World Bank's Procurement Guidelines (and otherwise would have been governed by similar requirements under Malawi's recently enacted Public-Private Partnership Act). The worthy principles of open and competitive bidding in these Guidelines (and the Act), which were not designed with the circumstances at hand in mind, seemingly clashed with the Government's objective (fully supported by the World Bank) of introducing greater competition in international routes. The Procurement Guidelines did not permit the Government to exclude either TDM or MTL, the two dominant operators on different segments of providing international connectivity to Malawi, and with whom the Government sought to introduce competition, from the bidding process. Yet, if they were to participate and win, then no competition would be introduced.

Precluded from ensuring the introduction of competition, the Commission instead addressed the issue by requiring each bidder not only to bid a price for the Government's capacity purchase but also to commit to offering various new international capacity products commercially and to bid price caps for these international capacity sales. In this way, the Commission was able to achieve a second-best solution in the project design through the use of *competition for the market* as a substitute for *competition in the market*. The World Bank was also able to support this approach by allowing a weighted price evaluation which considered both the price offered for the services being procured by the Government and for the services required to be offered by the winning bidder to the market. Thus, the Commission arranged to secure the benefits of competition over pricing in the tender itself rather than relying on achieving it through operation of the market once the infrastructure was installed.

As it turned out, neither TDM nor MTL submitted bids, and the Commission was able to secure competitive entry as well as ensure competitive wholesale pricing. Absent the creative solution to overcoming the unintended consequences of the Procurement Guidelines, however, the Commission may have been unable to achieve the objective of diversifying the ownership of infrastructure and hence reducing market concentration.

232. Political interference, as well as the mere possibility of political interference, further complicates the ability of infrastructure owners and telecommunications operators to enter into long-term, mutually beneficial sharing relationships. Political decisions can stem from a variety of motivations, some more worthy of intervention than others, but all leading to interference with commercial arrangements between infrastructure owners and telecommunications operators.

233. One form of political interference is an inclination to favor the incumbent state-owned telecommunications operator for backbone infrastructure projects even when other state-owned

utilities or investor-owned operators are better positioned to develop these facilities. Driven by nostalgia for a state-owned operator which is a flagship of successful state enterprise or by a political mandate to shore up state enterprises slated for privatization, favoritism for the state-owned telecommunications operator is more common than it would be if selection of partners were based on commercial objectives.

234. An alternative manifestation of the same genre of political interference is an inclination to disfavor the existing state-owned telecommunications operator. This may result in the establishment of a separate state-owned enterprise to undertake new backbone infrastructure projects, to disqualify the existing state-owned operator from participating or to overregulate the incumbent such that it is unable to secure financing or discouraged from making new investments.

235. A third alternative is to favor and impose centrally planned decisions for collaboration rather than to foster conditions conducive to voluntary collaboration and allow market forces to work. This form of interference is now fashionable under the mantra of *public-private partnerships*. Where centrally planned public-private partnerships are favored, state-owned public utilities may be overtly prohibited or more subtly dissuaded from pursuing their own activities or may have these projects taken away from them.

236. None of these forms of political interference achieves policy goals of encouraging investment and fostering diversity and competition in the provision and use of shared infrastructure.

237. Examples of the challenges presented by the realities of politics can be seen where state-owned utilities were originally proactive in pursuing infrastructure sharing in Ghana, South Africa and Zambia. In each of these countries, utility management had taken the initiative to establish an infrastructure sharing business. Subsequently, in each country, government transferred the business to another state-owned enterprise. In Ghana and Zambia, a significant part of the electric utility's dark fiber was transferred to the incumbent fixed-line telecommunications operator immediately prior to its privatization. In both cases, the dark fiber fell under control of a vertically integrated telecommunications operator whose new owners were less motivated to continue sharing with the operator's competitors than the electric utility had been. In South Africa (see Box 11 below), the fiber assets of electric utility Eskom and Transnet Freight Rail were transferred to a new national broadband backbone company, under separate political control.

238. Each of these three countries, in hindsight, appears to have suppressed the level of infrastructure sharing from what was originally promised by the efforts of the four utilities involved. Centralized government planning and unnecessary political interference is seldom a good substitute for market forces (including the market activities of corporatized state-owned enterprises with entrepreneurial management).

Box 11: If it isn't broken, don't fix it.

In South Africa, both the state-owned railway, Transnet Freight Rail, and electric utility, Eskom, had been very entrepreneurial and active in developing cross-sector infrastructure sharing opportunities. They had achieved significant success in collaboration with investor-owned telecommunications operators for sharing infrastructure. In about 2009, the Government of [South Africa](#) decided to transfer these assets to the newly formed Broadband Infraco SOC Ltd (BBI), an umbrella state-owned infrastructure company established to share the fiber optic infrastructure of the state-owned electric and railway utilities. BBI was a manifestation of government policies to expand access to electronic communications and broadband infrastructure deployment,

particularly in underdeveloped and underserved areas that are not commercially viable, to the private sector. BBI was established to provide wholesale long-distance high-capacity connectivity to other licensed fixed and mobile network operators and [ISPs](#) under a legislative mandate.

The Government caused all excess capacity in the telecommunications assets of Eskom and Transnet Freight Rail to be transferred to BBS. As a result, BBI acquired over 12,000 km of fiber routes hosted on rail and electric transmission infrastructure to commercialize. BBI decided to offer bandwidth services rather than dark fiber. Although BBI owns a number of fiber pairs on each route, Eskom and Transnet Freight Rail remain responsible for the maintenance of the physical fiber networks.

For the first three years of its operation, BBI was required to lease most of its network to Neotel to facilitate Neotel's expansion as a second national fixed-line operator. In 2010, BBI's management wanted to expand its commercial services to other telecommunications operators. However, during a significant period of delay while this proposition was debated by BBI's government shareholders, the Department of Public Enterprises and the Department of Communications, other wholesale providers developed their own fiber networks and captured potential BBI customers.

BBI has struggled to build a reliable and effective network meeting the requirements of commercial customers. Much of the company's network has reached end-of-life status on its fiber optic equipment as well as the fiber itself and is in need of replacement. BBI has encountered financial difficulties and in late 2015 requested a cash injection of R243 million (approximately USD 16.6 million) to remain afloat.

BBI has been criticized as generating inefficiencies due to monopoly pricing, duplication of infrastructure and unproductive political competition between state-owned enterprises. The private sector has reacted to these inefficiencies with alternative arrangements. Rather than having increased the incidence of infrastructure sharing following the transfer of assets from Eskom and Transnet, the BBI initiative appears to have foreclosed much sharing that might otherwise have happened.

239. The potential for sharing to be impeded by political decisions is a reality of any effort to increase the incidence of infrastructure sharing. Political motivations must be understood and, where they lead to suboptimal results, countered with strong policy and commercial arguments. Where the political interference is from the executive branch, some checks and balances from legislative or judicial intervention may also be helpful. However, in a parliamentary system where the distinction between executive and legislative branches is relatively weak, legislation is more likely to be used as a tool to implement political interference rather than prevent it.

240. An additional problem faced by state-owned enterprises stems from limitations on their permitted scope of business activities. The charters⁸³ of state-owned enterprises are often much more narrowly drawn than those of investor-owned utilities. The permitted objects of state-owned enterprises usually limit their permitted business pursuits to the core business for which they have been established. These limitations add further barriers for infrastructure sharing pursuits,

⁸³ The term *charter* is used broadly to refer to any legal instrument forming the constitution of state-owned enterprise which sets out its permitted objects, including memorandum of association, articles of incorporation, statutory authorization or executive order.

sometimes requiring the utility to amend its charter before it may enter an infrastructure sharing business. This in turn would typically require prior political approval by one or more ministers, who may question why the utility is venturing into a new business and who, in any event, are likely to slow down the decision to proceed. If such approvals are requested for a pending infrastructure sharing transaction, then the utility risks seeing the telecommunications operator make alternative plans during the delay.

Box 12: City Water & Electric Board required City Charter amendment to lease dark fiber

In 1999, the Water & Electric Board of the City of Eugene, Oregon, USA completed construction of a 70-mile fiber optic cable network connecting 25 metro-area power substations and three bulk power stations, at a cost of USD 15 million, which was funded through the issuance of municipal bonds. Although the network was primarily constructed for internal use in operating the Board's electricity and water systems, the Board envisioned from the outset that it would commercialize excess capacity in the network. But this was not as simple as securing a license and entering the business. The City's voters first had to approve an amendment to the City Charter to authorize the Board to provide telecommunications-related services. A year elapsed following completion of the fiber network before the City Charter amendment was approved in May 2000. Nearly another year elapsed before the Board obtained authorization from the Oregon Public Utility Commission to provide telecommunications-related services in February 2001. Yet another year passed while the Board considered various business models and ultimately decided on a dark fiber model due to highly competitive market conditions. During this time, the Board also evaluated various pricing methods for its dark fiber and settled on a methodology which provided three different rates, one for schools, one for other public agencies and one for commercial telecommunications operators. These initial rates were approved in 2002 – some three years after the fiber network was originally completed. As of March 2013, the Board had granted dark fiber IRUs to PeaceHealth, Oregon Medical Group, School District 4J, Springfield Utility Board, Zayo Group, Verizon, and Light Speed Networks.⁸⁴

241. State-owned monopolies often develop a culture that lacks an appreciation of market dynamics. They may also behave as organizations of civil servants with politically appointed boards and senior management. Their focus is on the core business as understood in terms of the underlying cost of their assets and of providing core business services rather than on market values and alternative revenue streams that can be extracted from those assets. This mindset can only be changed by exposure to greater commercial and entrepreneurial experiences, and may require greater corporatization of the state-owned host or a partnership with an experienced telecommunications operator. This is one of the reasons why separate incorporation of an entity to manage the assets to be shared can be important to success. For example, this need was recognized for management of the fiber of the [Tunisian railway system](#). Nonetheless, keeping the separate business entity under the dominion of the infrastructure owner, typically as a wholly owned subsidiary, is preferable to establishing it as a sister state-owned enterprise. The former approach maintains the financial incentives of the infrastructure owner to support the new

⁸⁴ Memorandum from Debra Smith, Assistant General Manager, and Dean Ahlsten, Compliance Officer, Eugene Water & Electric Board, to Commissioners Simpson, Brown, Helgeson, Manning and Mital re: Rate Adjustment for Dark Fiber Lease (Mar. 8, 2013). Available at http://www.eweb.org/public/commissioners/meetings/2013/130319/ws1_rateadjustmentfordarkfiberlease.pdf (last visited on 11 Feb 2017).

business, while the latter approach removes them entirely (which was likely an additional problem encountered by BBI in South Africa).

Box 13: State-owned utilities may require partnerships with experienced private operators

In around 2009, the fiber optic unit of [Electricity Supply Corporation of Malawi](#) (ESCOM), Malawi's monopoly provider of electricity generation, transmission, distribution services, sought to commercialize its existing fiber assets. ESCOM hired Globe Internet, a Malawi [ISP](#) and telecommunications service provider, as a consultant to advise it on commercialization of its fiber. However, in part due to institutional limitations and regulatory restrictions, very little materialized over the next two years with only two telecommunications operators leasing dark fiber on ESCOM's network.

According to Globe's senior management, ESCOM's lack of experience and credibility as a telecommunications operator required a partnership with an experienced player in order to offer bandwidth services. Aware of its muted success, ESCOM entered into a 10-year revenue sharing partnership with Globe to sell wholesale capacity. Under the terms of their partnership, Globe is responsible for ESCOM's network expansion and for the provision of bandwidth services using that network. Globe expanded ESCOM's fiber network, and, as of 2014, the Globe/ESCOM partnership had the largest share of the *carrier's carrier* market in Malawi, with all major [ISPs](#) and operators Airtel, TNM and Access as customers.

4.5 Lack of resources to pursue infrastructure sharing

242. The tight financial constraints and inflexible governance structures of rate-regulated public utilities, particularly state-owned enterprises, often deprive management of sufficient financial and human resources to pursue infrastructure sharing opportunities. Rate-regulated utilities must account for every item of revenue and expense and often do not have any discretionary budget to devote significant internal or external resources toward developing a new, non-core business opportunity such as infrastructure sharing. In addition, when they are state-owned enterprises, rate-regulated public utilities rarely have the internal financial resources to engage external advisers for a non-core business activity.

243. State-owned enterprises are typically controlled and governed by sector ministers and politically appointed boards chosen for their perceived expertise in the core business sector, and not telecommunications experience or expertise. Senior management is often groomed up through the infrastructure owner's business and therefore also has no telecommunications experience or expertise. Internal communications personnel, if employed by the infrastructure owner, are often not part of senior management. These personnel are sometimes inclined to provide senior management and the board with ambitious plans for a standalone telecommunications services business requiring capital which is unavailable and involving operating risk to which the infrastructure owner is institutionally averse. This may result in a vacuum of advice which is properly gauged to the utility's resources and appetitive for risk.

244. Senior management's lack of relevant experience and capital, coupled with the sometimes unrealistic or disconnected recommendations of internal communications personnel, often creates a paralysis of indecision. The utility is afraid to move ahead with any of the common business models discussed in Module 3 for fear it may adopt a suboptimal model. Sometimes, if it is able to accumulate or receive a grant or appropriation of necessary funds, the utility may seek guidance from experienced outside advisers. This decision alone can be years in the making and then take

another lengthy period to execute. Each step in the process requires another cycle through the utility's management team, board of directors and responsible minister(s). A special appropriation to procure outside advisers may need to be approved. The selection and contracting of the advisers must be carried out through competitive bidding under public procurement rules applicable to the state-owned enterprise. This is further complicated by the utility not even having sufficient experience and expertise to properly prepare the terms of reference for procurement of outside experts. Meanwhile, any infrastructure sharing opportunities which may have initially prompted this exercise evaporate as the potential telecommunications operator customers make alternative plans to source their fiber networks.

245. Some infrastructure owners have successfully overcome these barriers and established successful telecommunications commercialization activities. One excellent example is Internexa in Colombia, which is highlighted in Box 18.

246. Another impediment to cross-sector infrastructure sharing is a lack of standards for joint use of infrastructure. Installation of telecommunications equipment on some host infrastructure can cause operational issues for the infrastructure owner and potential conflicts between the owner's use and the telecommunications operator's use of the infrastructure. For example, in the electricity sector, the attachment of cables to transmission towers carrying high voltage lines is potentially dangerous and requires skilled workers.⁸⁵ In the network sector, installation of cables in ducts along high-speed highways similarly raises safety issues for workers.⁸⁶ In both cases, beyond safety issues, decisions need to be made about whether and how to disrupt the primary use of the infrastructure to accommodate the installation process (as well as later maintenance and repairs).

247. In the case of electricity transmission infrastructure, if there is a power outage, the presence of the telecommunications attachments may impede the restoration of power and also present utility crews with conflicting priorities of whether to delay power restoration while repairing damage to telecommunications facilities or to restore power without repairing the telecommunications facilities. Countries with less experience with such joint use (and sectors that have less experience hosting telecommunications equipment) tend to have fewer resources to guide parties in determining allocation of responsibility and proper procedures.

248. For example, when Lesotho Electricity Company and Vodacom Lesotho entered into a pole attachment agreement, they looked to South Africa and the ITU for safety standards. Lacking any personnel skilled and experienced in the installation of fiber on electric distribution lines with the power on (a common practice in many countries), they had to design the construction project to proceed with the power turned off during installation. This raised issues about mitigating the adverse impact with the electricity regulator and electricity customers of the planned power outages. It also resulted in a loss of electricity revenues for the electric utility. While these issues did not stop the project, they added unnecessary financial cost, political and public relations issues, and project complexity, and they slowed down the construction timetable.

⁸⁵ For example, such joint use is addressed in the IEEE Standards Association, National Electrical Safety Code (2012). Available for purchase at <http://standards.ieee.org/about/nesc/> (last visited 11 Feb 2017).

⁸⁶ For example, such joint use is addressed in Transportation Research Board of the National Academies, *National Highway Research Program Synthesis 462: Managing Longitudinal Utility Installations on Controlled Access Highway Right-of-Way* (2014). Available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_462.pdf (last visited 11 Feb 2017).

5 Operator disincentives and impediments

249. Telecommunications operators also face disincentives and impediments to entering into sharing arrangements with infrastructure owners. These disincentives and impediments often reflect the impact of the institutional restraints and shortcomings of infrastructure owners in pursuing sharing opportunities. They can also be exacerbated by the unfamiliarity of telecommunications operators with the regulated utility culture. Modules 6 and 7 suggest steps which may be taken by policymakers, lawmakers, regulators and development institutions to provide better incentives and remove impediments for optimal sharing.

5.1 No clear path of engagement with infrastructure owners

250. The initiation of a cross-sector infrastructure sharing arrangement does not depend on the infrastructure owner. Indeed, telecommunications operators, who stand to realize significant cost savings in deploying and expanding their networks, have historically initiated the dialogue with infrastructure owners. However, these dialogues only go so far unless the host infrastructure owner is institutionally predisposed to such arrangements and all other conditions for sharing have been met.

251. Telecommunications operators who have attempted to initiate a dialogue about sharing opportunities often report frustration due to lack of a clear path of engagement with the infrastructure owner. Within the infrastructure owner's organization, unless it has previously embraced infrastructure sharing on a strategic scale, there is typically no designated individual with overall responsibility for infrastructure sharing. There is no shingle hung out to offer infrastructure sharing, and no clearly appropriate point of contact. The absence of these simple things can be significant in deterring engagement.

252. When approached by a telecommunications operator, senior management of a utility which has not established plans for infrastructure sharing may be caught off guard and unable to give an official response. Referrals of queries to the infrastructure owner's internal communications unit often do not yield a business proposition which has the backing of senior management or which is within a utility's approved financial means. Management of the utility's internal communications unit also sometimes view telecommunications operators who request access to the utility's infrastructure as competitors for use of their facilities. Their response can be cold unless senior management has articulated that infrastructure sharing is a strategic focus of the utility.

253. In addition, where planning activities of the infrastructure owner (such as the installation of new infrastructure or the rehabilitation of existing infrastructure) create windows of opportunity for more economical infrastructure sharing, telecommunications operators would not be in a position to initiate discussions if this information is unknown and unavailable to them. These opportunities will be missed unless the utility opens an infrastructure sharing or joint use department which is empowered and motivated to identify and pursue joint use opportunities.

254. While a legal mandate to share infrastructure may open the door to dialogue, it often will not sufficiently overcome the underlying disincentives and impediments to lead to an optimal level of infrastructure sharing. Access requests may be referred to the utility's legal department rather than its communications department, but the response may still be cold and unwelcoming.

255. Even where a clear path of engagement with the infrastructure owner exists, telecommunications operators report frustration with the slow pace at which infrastructure owners move forward. The operators come from the context of a highly competitive market where

significant decisions must be made and executed promptly. In contrast, the infrastructure owners come from a culture of long-term planning and risk aversion. Even when infrastructure owners are prepared to move ahead, they often must navigate a lengthy process of internal governance approvals, regulatory approvals and public procurement review.

256. Unless a utility engages telecommunications operators early about a potential sharing opportunity, more often than not the operators will build their own infrastructure, either because they are not aware of the opportunity or because they cannot than wait for the utility.

5.2 Limitations on infrastructure owner's land use rights

257. Since the inception of telecommunications in the mid-Nineteenth Century, land use rights have presented a threshold challenge to telecommunications operators seeking to deploy or expand their networks. Linear infrastructure by its very nature crosses a country's land mass in corridors dedicated to the use of the host infrastructure. Locating commercial telecommunications facilities on host infrastructure within existing corridors is intuitively more efficient and reduces environmental impact. However, land law does not necessarily recognize these efficiencies, and telecommunications operators must have sufficient legal rights to acquire access to existing corridors and, where necessary, to establish their own corridors.

258. Sometimes an infrastructure owner has exclusive rights over a corridor, such as a road authority's rights to control the use of a road reserve, but other times an infrastructure owner may only have non-exclusive rights over a corridor, such as an electric utility's or pipeline owner's rights under easements running across public or private lands. In the latter case, though the legal nature of the infrastructure owner's rights of use of the corridor may vary across and within jurisdictions, these rights generally include the right to clear and grade the corridor, the right to install, operate and maintain specified improvements and fixtures for specified purposes within the corridor, and the right to quiet enjoyment through the exclusion of incompatible uses.⁸⁷ All residual rights in the corridor are retained by the underlying landowners. Thus, for example, an electric utility with rights of way in a corridor which crosses farmland may have the right to exclude farmers from erecting buildings inside the corridor, but not to exclude the cultivation of crops or establishment of irrigation ponds under the power lines.

259. Developed countries have addressed these needs by affording telecommunications operators with privileges of access to public rights of way and the power of eminent domain (compulsory acquisition) to acquire easements over private land on payment of just compensation to the landowners. In many developing countries, when the original telegraph and telephone networks were built, land rights were less of an impediment because the networks were often built, owned and operated by organs of the state or state-owned enterprises. Even in recent decades, when investor-owned operators entered developing markets to build, own and operate mobile networks, land rights were also not a prerequisite to network deployment because the new entrants did not need lateral corridors for their wireless networks.

260. However, since the 1990s, land rights issues have resurfaced in developed countries where telecommunications operators have piggybacked on the easements of railways and electric transmission utilities but did not obtain separate easements from underlying landowners. As

mentioned in Introduction section, the right to allow such overlapping uses may not be entirely vested in the owner of the improvements and fixtures in the corridor – or at least the rights of the infrastructure owner in this regard may not be clear. The owner of the improvements and fixtures will usually have the negative right to disallow incompatible uses, but may not have the positive right to allow compatible ones. This depends on the nature and scope of the infrastructure owner’s land use rights to the corridor. Those rights are usually less than full ownership, and some other actor often has residual rights in the land traversed.

261. These issues did not arise until recent decades, even though they have likely persisted since the inception of telecommunications. This can be attributed to the growing sophistication of landowners and the legal system in developed countries. For over a century, telegraph lines shared rights of way with railroads. While there was much attention given to the grant of rights by the railroads to the telegraph companies, little or no attention was paid to whether any permission was required from the underlying landowners. This absence of conflict appeared to change in the mid-1980s in the United States, when cable television companies began installing overlapping networks along private roads and stepped up a few years later when long-haul fiber optic networks were installed along railways and electric transmission lines. The sleeping rights holders awoke and began asserting their land rights.

Box 14: Multiple layers of rights in the land

The use of railway rights of way for buried fiber optic cable has been the subject of extensive litigation over scope of rights to use easements throughout the United States for nearly two decades.

One United States federal court described these developments in a 2012 report of litigation over use of railway rights of way to host fiber optic cable owned by telecommunications operators: “This case concerns Maine’s part in a nationwide phenomenon in which telecommunications companies bargained with railroads for the right to place fiber optic cables through rights of way owned by the railroads. In the 1990s, owners of property underlying the railroads’ rights of way began taking action against what they perceived to be trespass by the telecommunications companies on their property. Whether or not there was a trespass was informed by the grant of rights to the railroads, which often did not include a right to use the right of way for non-railroad purposes. In some cases, the right of way may have even lapsed through disuse and all rights once owned by the railroad may have reverted to the owners of the fee underlying the right of way. . . . Decades of litigation in numerous jurisdictions involving various railroads and telecommunications companies ensued.”⁸⁸

262. With the rising need for fiber to support mobile operator backhaul networks, access to public and private land has also increasingly become an issue in developing countries. Access to public rights of way is often unclear or limited, and was not necessarily included in the bundle of rights and privileges afforded to mobile network operators under the telecommunications laws or their licenses. In addition, in many instances, investor-owned mobile operators in developing countries do not enjoy rights of eminent domain over private land, or such rights are required to be exercised

⁸⁸*Cascade Corporation v. Sprint Communications*, No. 2:11-cv-125-JAW, Court’s Report of Telephone Conference. (US Dist. Ct. Maine 2012). Available at http://www.med.uscourts.gov/Opinions/Torresen/2012/NT_02152012_2_11cv125_Cascade_v_Sprint.pdf (last visited 11 Feb 2017).

through a public authority which may not be particularly interested in the mobile operator's timetable or business needs or may not wish to be seen to be favoring one participant in a competitive marketplace. Thus, mobile operators in some developing countries are now discovering that they do not have the rights they need to acquire access to public and private land corridors.

263. These limitations on telecommunications operator land use rights in both developed and developing countries can thus present impediments to their taking full advantage of piggybacking on existing utility infrastructure. If the scope of the land use authorization held by the infrastructure owner does not include the right to install and use commercial telecommunications facilities, then the telecommunications operator will require additional rights, from the person who owns or controls the corridor or the lands it traverses, in order for the operator to install or operate commercial telecommunications facilities (or to convert excess fiber owned by a utility to commercial telecommunications use). In some instances in countries which recognize broadly dedicated public utility easements, the telecommunications operator may already possess such rights independently of the infrastructure owner by virtue of holding a license to provide public telecommunications services. But such occasions are rare.

264. In many cases, the telecommunications operator must obtain independent or additional authorization from the party with control over the residual use of the land corridor occupied by the owner of infrastructure improvements and fixtures. Thus, while a utility may have secured its right to use land for its purposes under legislation applicable to its sector (e.g., electricity, water or rail transport), or through voluntary or compulsory acquisitions of easements from private landowners, the telecommunications operator may effectively have to start all over again to obtain the necessary incremental land use rights for commercial telecommunications facilities. This may be the case even if those facilities are integrated with the facilities of a public utility operating in another sector.

265. Where the owner of the improvements and fixtures in a corridor does not control the land use rights in the corridor, the process of obtaining rights of use for a telecommunications operator is sometimes referred to as *perfecting* the right of way to allow its use for commercial telecommunications facilities. Depending on the circumstances and the legal and regulatory framework, either the owner of the infrastructure improvements, the telecommunications operator or both may need to lead the process of perfecting the rights of way.

266. The process must begin with mapping the corridor to be shared and, through land records or information in public view, identifying the person or persons who own or have authority over the uses of the land in the corridor. As a further complication, if the infrastructure owner is or once was a state-owned enterprise or state organ, it may not have complete or adequate records of the rights it does have in the land corridors traversed by its infrastructure. This makes it difficult to ascertain what rights it can convey to the access seeker and/or to identify the underlying parcels so that residual landowners can be contacted. Even where the infrastructure owner has complete land records, they often speak as of the date its easements were acquired. While these records can reveal the extent of rights held, they are frequently not adequate to enable contact with the underlying landowners due to the likelihood that some parcels may have changed hands many times in the interim. The infrastructure owner and telecommunications operator will need to search the land records or make site visits to establish current ownership. This can be a time-consuming, costly and daunting process.

267. The set of actors with underlying rights over land corridors, in addition to those held by the owner of infrastructure improvements and fixtures, may include:

- national or local government ministries or authorities in the case of public lands, particularly road reserves;
- a chief or similar tribal authority in the case of traditional or tribal lands⁸⁹; and/or
- private landowners in the case of private lands.

268. The rights of the land owner or controller, and the process and substantive rights for perfecting right of way, will differ for each type of landowner or controller.

269. Public lands, including road reserves, typically afford the telecommunications operator the greatest certainty of the ability to perfect its rights. But the process may nevertheless present significant bureaucratic hurdles and significant unanticipated costs. Roads authorities or municipal governments have a variety of legitimate reasons to require all users of public rights of way to be properly authorized. Among these are ensuring that all works (whether installation, modification or maintenance) do not adversely and unnecessarily impact traffic flows, that they do not endanger public safety or health, that they are for public rather than private purposes, and that they are not incompatible and do not interfere with other existing or planned uses of the rights of way. In addition, joint use of public rights of way can be a source of revenue for roads authorities or municipal governments, so the permitting process provides a basis for registering the user and ensuring that the user thereafter contributes any required fees or other charges. On the other hand, authorization to use shared public rights of way can protect the telecommunications operator by affording it rights against other users of the rights away.

270. The ability and cost to secure a telecommunications operator's rights of use of a corridor over private lands is more difficult to generalize. Very much depends on the law of the jurisdiction in which the corridor is located and the existing easements or other rights of the utility which owns the existing improvements or fixtures to be shared with the telecommunications operator.

271. The telecommunications operator may be able to secure rights of use of the land in the corridor under the telecommunications legislation applicable to access to land or through its own voluntary or compulsory acquisitions of easements which overlap those of the utility. Quite importantly, the telecommunications operator may in some cases have to pay additional compensation for such additional rights of use. The incremental compensation payable for an additional use of an established corridor is usually much less than it would be for the acquisition of a new corridor. Typically, the utility's existing authorizations have stripped the landowner of

⁸⁹ As used in this discussion, traditional or tribal lands refers to lands recognized as being under communal control of indigenous peoples rather than under the dominion of the sovereign government or private ownership. Because land corridors used for intercity and international links often traverse large swaths of countryside, they occasionally must cross through traditional or tribal lands. Examples of this category of land rights can be found in many countries and in every continent. For example, tribal and communal land rights are common throughout sub-Saharan Africa. In North America, both Canada and the United States recognize Indian Reservations as separate quasi-sovereigns with their own dominion over land ownership and use within the borders of these countries. In South America, Brazil recognizes the concept of "indigenous lands" (*Terras Indígenas*) and the Constitution confers to "Indians" having possession of lands that they traditionally occupy and where they live on a permanent basis. In Europe, Norway recognizes certain land rights for the Sami, an indigenous group living in the north of the country. In Asia, India recognizes 461 ethnic groups as "Scheduled Tribes" that have rights to land and self-governance. Australia recognizes the concept under the Native Title Act 1993, which affords Indigenous Australians certain communal rights in native lands. These are but a few examples, and a full listing is beyond the scope of this work.

90-95% of the value the land may otherwise have (and for which the infrastructure owner or its predecessor would likely have paid compensation to the current landowner or its predecessor). The incremental use sought by the telecommunications operator is thus likely to require payment of compensation, if any, which is significantly less than the value of surrounding land. In addition, if the telecommunications operator only requires a narrow path within the corridor, the land use rights required may be even less expensive.

272. In the best scenario, the telecommunications operator will have a statutory right of compulsory acquisition of an easement upon payment of fair and reasonable compensation to the underlying landowner. Armed with such a right, the operator can usually negotiate a voluntary arrangement with most underlying landowners. Still, a telecommunications operator must secure its own land use rights in the corridor before installing any new facilities or beginning to use any shared existing facilities (even dark fiber) to provide commercial telecommunications services, and a single holdout landowner along a lateral right of way can block or delay an entire network.

273. The process of seeking and obtaining these rights, which may require administrative or judicial proceedings, can lead to significant delays before works or use may lawfully begin. The details will be very context-specific and depend on the constitutional and legal framework, as well as prevailing practices, for land use in a particular country. For example, in many countries, the telecommunications operator will need to ensure that it secures necessary traditional or tribal land rights. Such rights may not be easily determined by a standard search of land records, requiring more extensive due diligence through route surveys and interviews. In some instances, there may be conflicts between land records for private property and claims by the occupiers of traditional lands. These unresolved issues may seriously impact the ability of a telecommunications operator, especially if owned by private investors, to perfect title. Lacking the prerogative and backing of the state, the operator may have to abandon its plans to cross the disputed lands. Despite the differences across countries and jurisdiction, the need for the telecommunications operator to ensure it has sufficient land use rights is universal and fundamental.

274. However, where the operator's rights are more limited, perhaps only allowing use of private property with permission of the owner, the telecommunications operator may not be able to assemble end-to-end rights in a corridor which crosses lands of multiple different owners. One recalcitrant landowner can block the entire project or extort unreasonable compensation from the operator. There may simply be no recourse in such circumstances and the operator may be forced to abandon its plans to use part or even the entire particular corridor, or may be required to change its proposed route. In such circumstances, the operator may fall back on plans to use public rights of way, but this may foreclose the planned use of a more efficient route (such as following a railway or pipeline) or existing infrastructure (such as excess dark fiber in an overhead electric transmission line).

275. Apart from casting a cloud over the infrastructure owner's ability to convey to the telecommunications operator good title to the rights to use the shared infrastructure improvements and fixtures, the topic of land use rights also often presents a sticking point in negotiations between the infrastructure owner and the telecommunications operator. Understandably, the infrastructure owner does not want to assume the risk or burden of perfecting rights of use in the underlying land corridor. Conversely, the telecommunications operator may balk at paying for rights to share infrastructure unless the owner can assure that these rights are sufficient to avoid the requirement to pay third parties for use of the corridor. Better understanding of these land use issues, together with effective legislation to extent compulsory acquisition rights to telecommunications operators,

are key to overcoming these challenges. Appropriate land use legislation is discussed in Submodule 6.2.

5.3 Reliability of the operation and maintenance of the infrastructure

276. Telecommunications operators require a high standard of reliability for wholesale infrastructure and services that are key inputs to their retail services. For example, for backbone transmission networks, telecommunications operators routinely require contractual commitments of at least 99.9% service availability, requiring bandwidth management equipment and skilled staff to operate the network and respond to outages 24x7x365. The utility's ability to deliver this quality of service, and to deploy routes quickly in response to the rapidly evolving needs of telecommunications operators, will require a commitment to a significant level of fixed costs, including both upfront capital investment and recurring fixed operating costs, which must be incurred or contractually committed *before* signing any customers. For this reason, many utilities are not well-positioned to pursue the business model of providing telecommunications services over networks that use their infrastructure. Where they nonetheless are convinced to do so, but lack the financial means or commitment to build a sufficiently robust organization, their apparent inability to deliver may impede the interest of telecommunications operators in cross-sector infrastructure sharing. Financial failure may result.

277. This has led many utilities to pursue the approach of commercializing dark fiber as discussed in Submodule 3.3 rather than entering the wholesale telecommunications services markets directly. Most utilities have a fairly reliable track record of reliability for dark fiber, and this business model is typically readily embraced by telecommunications operators.

278. Still, some utilities have inherently more reliable fiber infrastructure than others due to the nature of their core business and the location of the fiber. For example, the risk of service outages of [OPGW](#) fiber is extremely low due to the highly secure nature of the cable, which is located in the electricity space on the transmission towers. In contrast, fiber installed on distribution poles is much less secure because it is underhung below the power lines, and can be damaged by wind, accidents, vandalism and theft. The reliability of fiber on distribution poles therefore may or may not compare favorably to the reliability of buried fiber along the same route. For this reason, utilities are generally not well-advised to install their own fiber on distribution poles unless there is a compelling core business need to do so. Otherwise, the better business model is usually to allow telecommunications operators to install their own fiber, via pole attachment rights, and to bear and manage the risk themselves.

6 How policymakers, lawmakers and regulators can help

279. Policymakers, lawmakers and regulators can facilitate cross-sector infrastructure sharing in two ways. The first is to foster conditions conducive to more voluntary, market-based sharing through removal of disincentives and the possible introduction of positive incentives. This is the *carrot approach*. The second way is to intervene where market-based activities fail or are considered very likely to fail to achieve desired levels of infrastructure sharing. This approach, which may involve mandated access or regulation of access terms, is the *stick approach*. The optimal policy and regulatory equilibrium likely requires a combination of carrots and sticks in most countries.

280. As a general theme, in the view of the author of this toolkit, existing interventions in many countries put too much emphasis on the sticks and too little on the carrots. Even where the sticks are the appropriate tool, existing approaches often overregulate (use a bough when a twig will do) or focus on the wrong behavior to regulate (hitting the wrong person with the stick).

281. Starting with the carrot approach, some general themes are relevant. Fostering the voluntary collaboration necessary for cross-sector infrastructure sharing requires mutual understanding by stakeholders of internal institutional constraints, incentives and dynamics within their own organizations and those of other stakeholders. Similarly, based on such an understanding, policymakers and regulators can take proactive steps to facilitate infrastructure sharing by removing disincentives and impediments. Unless understood and properly addressed by policymakers and regulators, such constraints can impede the business and policy goals of increasing the incidence of cross-sector infrastructure sharing. Failure to properly understand such institutional differences and limitations can also lead to unintended negative consequences.

282. Turning to the stick approach some other general themes are relevant. First, with respect to land use rights, individual landowners whose land lies under existing utility corridors typically have little strategic interest in approving the addition of telecommunications facilities to the existing infrastructure, and even where many voluntarily approve such a project, one holdout can stop an entire project or hold it hostage to an unreasonable demand. The stick of telecommunications operators having eminent domain rights is therefore an essential element of any cross-sector infrastructure sharing policy. Second, where infrastructure is owned by state organs, as opposed to fully corporatized state-owned enterprises, financial incentives are sometimes inadequate motivators for those state organs to support infrastructure sharing requests in a timely and cooperative manner. Some additional sticks are therefore also useful in this context. This is particularly the case with respect to municipal governments and state authorities with control over roadways. Third, corporatized state-owned utilities, on the other hand, are often motivated to act commercially if regulatory and financial barriers are removed and they are provided with sufficient leeway to invest some resources in an infrastructure sharing department. These actors therefore deserve some deference before the sticks are bought in, and in many cases this can be reserved for intervention when they are found dominant in a relevant market or otherwise to be engaging in anticompetitive behavior.

283. Above all else, it is crucial to develop a harmonized and holistic approach across all distinct government actors, including policymakers, regulators and those responsible for state-owned enterprises. This can be reflected as a component of a country's broadband policy. This module examines some key options available to lawmakers, policymakers and regulators to improve the

incidence and outcomes of cross-sector infrastructure sharing through an optimal combination of carrots and sticks.

6.1 Remove financial disincentives via infrastructure owner's sector regulator

284. Submodule 4.1 discussed the financial disincentives to infrastructure sharing created by applying traditional rate regulation principles. The incidence of infrastructure sharing can be increased by applying an approach to rate regulation of utility infrastructure owners which removes the financial disincentives for sharing, while still properly balancing the interests of their core business customers and shareholders. In some cases, regulators may have discretion to pursue these options within existing statutory frameworks, while in other cases lawmakers may first need to amend the statutory framework. Education and clear articulation of a policy are also very important elements.

285. One approach to such incentive regulation is for the regulated utility to share revenues from its infrastructure sharing business with the core business rather than share costs of the shared infrastructure.⁹⁰ This approach aligns the interest of the utility (or its shareholders, if investor-owned) and its core business ratepayers, while achieving greater regulatory certainty and reducing accounting difficulty and discretion. This approach can be tailored to each individual situation by adjusting the percentage of the revenue share. Under this approach, the core business continues to bear the baseline fixed and variable costs of infrastructure which it would have incurred in any event (whether the infrastructure is shared or not) and the infrastructure sharing business only bears the incremental fixed and variable costs incurred due to the shared use.

286. Revenue sharing is an efficient and effective means of allocating risks and rewards between rate-regulated and non-rate-regulated business units. It achieves absolute regulatory certainty as to the financial and accounting impact of various related-party and third-party transactions. It is very straightforward to administer. In addition, it can be calibrated, by adjusting the percentages of revenue to be allocated to the relevant business units, to take account of such factors as the level of investment and risk assumed by the ancillary business (such as investment in equipment to provide telecommunications services), the minimum percentage of revenue needed to allocate to the ancillary business to properly incentivize management, and other market and institutional factors.

Box 15: Revenue sharing between core and non-core businesses can improve the financial incentive for utilities to share infrastructure

The following are examples of revenue sharing arrangements approved by regulators which recognize the benefits of establishing equitable methods of sharing rewards between utilities and their ratepayers and which also achieve regulatory certainty and provide stronger incentives for utility management to pursue alternative revenue sources. Two cases are from the United States, one state and one federal, and one case is from India.

⁹⁰ Revenue sharing as described in the main text has been expressly approved by utility regulators in some jurisdictions. In other jurisdictions, such as some European countries, where it has not yet been considered as an option, revenue sharing is consistent with the developing policy of incentive-based rate regulation. See Ernst & Young, *Mapping power and utilities regulation in Europe* supra at 7.

In 2014, Southern California Edison, a rate-regulated electric utility, obtained approval from the California Public Utilities Commission, of a proposed revenue sharing arrangement for dark fiber leases. The decision referenced prior approval of revenue sharing for conduit and pole leases. All these infrastructure sharing transactions were entered into by the electric utility with telecommunications operators. Under the approved arrangements, *gross revenue* from *passive services* would be allocated 70% to shareholders (i.e. as unrestricted income of the electric utility) and 30% to ratepayers (i.e. to reduce revenue requirements from electricity tariffs), while *gross revenue* from *active services* would be allocated 90% to shareholders and 10% to ratepayers. The decision indicated that revenue from dark fiber leasing was considered active service revenue.⁹¹

In 2007, Pacific Gas & Electric Company, also a rate-regulated electric utility, obtained approval from the US Federal Energy Regulatory Commission of a 50-50 sharing arrangement for *net revenues* (i.e. gross revenues less the incremental costs of the ancillary business activity) between shareholders and ratepayers for a variety of ancillary uses of the electric utility's assets by telecommunications operators. These ancillary revenue sources included right-of-way use for telecommunications lines and facilities, attachment of fiber optic cable to transmission towers and distribution poles, and attachment of wireless antennas to transmission towers.⁹²

In India, the Electricity Act 2003 codified the revenue sharing approach by requiring electric transmission utilities to share a proportion of ancillary revenue to reduce transmission and wheeling charges. In a 2007 decision applicable to all electric transmission utilities in Central India, the New Delhi Central Electricity Regulatory Commission interpreted how revenue should be shared in the case of right-of-way and/or tower use for buried fiber optic cable and aerial [OPGW](#). The Commission's decision applied a fixed monetary amount per kilometer, rather than a percentage of revenue received from the telecommunications operator, as the required revenue share. Thus, while the Electricity Act progressively embraced revenue sharing over cost sharing, the regulator appears to have reverted to a cost sharing approach and imposed its own view of the costs that should be apportioned. By mimicking a baseline cost sharing approach rather than a revenue sharing approach, the Indian regulator's decision appears to have limited the usefulness of the approach intended by the legislature in calibrating the internal payments to the value of the external commercial transaction.⁹³

287. An *edge case* variation of the revenue sharing approach is for the utility to *retain all incremental revenue* from infrastructure sharing while not reducing its core business revenue requirements. This would apply to infrastructure which has been prudently acquired and remains used or useful in the core business. Under this approach, the core business would continue to bear all baseline fixed and variable costs which it would have incurred in any event with or without use of that passive infrastructure to provide external telecommunications services. The infrastructure sharing business would only bear any incremental fixed or variable costs incurred to make the

⁹¹ See Southern California Edison. 2014. *Status of Advice Letter*. 146 IEC (Corp ID 6096). Available at <https://www.sce.com/NR/sc3/tm2/pdf/146.pdf> (last visited 11 Feb 2017); plus an earlier filing providing more history for the ruling, which traces back to 1999: Southern California Edison. 2010. *Advice 14-13-E* (U 338-E). Available at <https://www.sce.com/NR/sc3/tm2/pdf/1413-E.pdf> (last visited 11 Feb 2017).

⁹² United States of America Federal Energy Regulatory Commission. 2007. Available at <https://www.ferc.gov/whats-new/comm-meet/2007/111507/E-10.pdf> (last visited 11 Feb 2017).

⁹³ Central Electricity Regulatory Commission, *In the Matter of Sharing of Revenue Derived from Utilisation of Transmission Assets for Other Business – Framing of Regulations And in the matter of Consideration of Objects/Comments/Suggestions*, No. 54/2005 (2007). Available at <http://cercind.gov.in/03022007/Sharing-of-revenue-regulations.pdf> (last visited 11 Feb 2017).

excess capacity available for joint use in the telecommunications sector. In many jurisdictions, this is the approach followed between rate cases, while the utility's allowed regulated core business revenues are reduced during the next rate case. Extending the *zero-impact-on-tariffs approach* indefinitely (or at least for an extended period) would increase the financial motivation for sharing, and may also be appropriate to enable undercapitalized state-owned enterprises to accumulate working capital which can be reinvested in the core business.

288. This approach would maximize regulatory financial incentives by allowing the utility to retain all net income from the infrastructure sharing business. In many cases, the incremental costs of joint use of passive infrastructure, such as rights of way, towers, poles, ducts and dark fiber, may be zero or relatively small with respect to both fixed costs and variable costs. The infrastructure sharing business would thus receive all revenue from the infrastructure leases and against that revenue would charge the costs of its personnel, office space and equipment and various other administrative and professional costs, but would realize a significant profit from the endeavor. This would provide the strongest financial motivation for infrastructure sharing.

289. Though this approach appears to disband with reducing the utility's regulated tariffs to offset any of the gain from the infrastructure sharing business, it still benefits core business customers by providing the utility with an additional source of working capital and larger sums of capital for reinvestment in its core business. This is particularly the case for state-owned enterprise utilities where a state shareholder is unable or unwilling to fund capital investment and the utility does not otherwise have access to equity capital markets. Unfortunately, the incidence of infrastructure sharing in some developing countries is recent and clear embracement of these incentives by utility sector regulators is lacking in most developing countries. There is much opportunity for improvement.

6.2 Ensure open, equal and efficient telecommunications access to corridors

290. A key component of any public policy designed to facilitate cross-sector infrastructure sharing is to ensure that telecommunications operators have access to existing and planned land corridors established for other public or private purposes. Without the ability to acquire or perfect end-to-end land rights, a telecommunications operator will be unable to build a new network, extend an existing network or commercialize excess capacity on an existing internal utility network. From the standpoint of the motivations for infrastructure sharing, it is much more efficient and economical to ensure that telecommunications operators have access to corridors already established or planned for other purposes than to require them to assemble their own corridors. But they need well-defined legal rights to do this.

291. Effective laws providing for telecommunications operators to have access to land corridors are a fundamental component of ensuring optimal cross-sector infrastructure sharing. Such laws are sometimes found in lands acts, in provisions of laws of general applicability to public service utilities or sector-specific laws or a combination of these. To be effective, they should ensure that such access is open, non-discriminatory and efficiently administered. Thoughtful laws and regulations will seek to balance the competing interests of the telecommunications operator and landowner in accordance with constitutional principles of the relevant country regarding rights of private property owners. When so drafted and reasonably applied, such laws and regulations can play an important and helpful role in facilitating sharing of established corridors for use by telecommunications operators.

292. As noted in Submodule 5.2, the land in the relevant corridors may be under *public*, *private* or *tribal* (traditional) ownership and control or a combination thereof. The substantive and procedural requirements for access by a telecommunications operator will need to be different depending on whether public, private or tribal land is involved. Traditional and tribal land use rights may require another layer of procedures.

293. Access to the corridors established for *public* roads and highways is critical to the development of almost every broadband network, as the road reserves often offer the only viable option for the *last mile* to reach the customer premises (for wired networks) or the communications tower (for wireless networks). Most jurisdictions afford licensed telecommunications operators with rights of access to public roads and rights of way, but these rights of access are too often subject to a wide array of different required approvals and oversight by multiple government authorities. Encountering unexpected delays or hurdles during the planning and construction process is not uncommon. Policymakers, lawmakers and regulators can often do more than they have done to facilitate efficient and beneficial use of public roads and highways for telecommunications facilities. Relevant measures may include providing for one-stop shopping, streamlining and harmonizing permitting and approval processes, better planning and coordination of public works, managing of congestion, requiring coordination among competing users, and the anticipating and preparing for telecommunications (and other compatible) uses through the installation of ducts during construction or renewal.

294. To undertake works that require digging or disturbance of the roads and/or the road reserve, a telecommunications operator must typically obtain authorization from the relevant administrator of the roads. In many countries, these may be under different authorities depending on whether the roads are national, provincial or municipal. Existing procedures will typically exist, but may be slow and burdensome, may involve time limits, evaluation procedures and costly fees, and will often require restoration of the roads to their original condition. Some countries even require advance notice running into years. Legislation may assist in enabling sharing to occur more effectively and efficiently if it directs the relevant authorities responsible for such approvals to cooperate in requests for works by telecommunications operators that involve digging in or along the roads under their authority. Such legislation could also provide for greater advance notice of, and a right to coordinate works with, roadway improvement projects which may afford telecommunications operators more efficient and less costly alternatives for installing infrastructure in roadways and road reserves. For example, this would facilitate the installation of telecommunications ducts at the time of the construction or widening of a roadway. Regulatory initiatives within existing statutory frameworks are also possible.

295. Access to road infrastructure must of course be balanced with the importance of ensuring that road works are managed in an orderly fashion. For example, it may not be appropriate to allow telecommunications operators to dig up roads that have very recently been built or restored. Such restrictions on digging up roads are not unusual, and serve to preserve public property and resources and avoid the extensive nuisance that works and digging entail for the general public and for other users of the roadway reserve. Such objectives are common.

296. Most potential impediments that such restrictions may cause can be addressed through coordination among relevant public authorities, telecommunications operators and other corridor users. They could further be addressed by establishing clear guidelines, to be transparently administered, for acceptance or rejection of applications for works. Such guidelines can provide objective criteria to help road administrators balance the objective of preserving public property

and minimizing public nuisance (by avoiding repeated or unnecessary digging and damage to roads and risks to other corridor users) with the objective of facilitating the build-out of a modern telecommunications infrastructure (by allowing necessary digging in or along the roadways). Such criteria can specify the conditions under which a request to dig may be rejected and require the relevant administrator to articulate the reasons for rejection. One example of such coordination policies is the National Joint Utility Notification System adopted by utilities, roads authorities and telecommunications operators with 13,000 participating enterprises in 28 states in the United States.⁹⁴

297. Legislation can also be directed to the relevant traffic management office, police or their equivalent and municipalities to ensure that each such administrator is officially instructed to cooperate in requests for approved works involving disruption of traffic on the roads and streets under its authority.

298. In addition to coordination and approval of temporary works, new telecommunications installations also frequently require permission for permanent occupancy and use of public or private property. Many cross-sector infrastructure sharing opportunities for telecommunications operators involve the installation of buried or aerial fiber optic cable under or above public land. Thus, where a telecommunications operator plans to install fiber optic cable in utility ducts or pipes or on utility distribution poles located in public rights of way, the operator must also obtain authorization from the relevant public administrator to use and occupy the public land.

299. In some cases, the roadway reserve may already comprise a dedicated easement in which all compatible public uses are permitted, provided that subsequent users do not jeopardize or compromise the earlier uses. Public easements may exist along most or all streets and roads. Subject to proper approval and carrying out of the public works by the telecommunications operator, these rights of use may be sufficient, subject only to the approval of the relevant ministry or utility to use its fixtures or improvements. In other cases, the telecommunications operator may require express approval to place permanent facilities in the roadway. This may be in the form of route-specific permits or blanket approval for all streets in a particular geographic area.

300. Pricing of access to public roads and highways varies widely from one jurisdiction to the next. In some countries, access to these public rights of way is considered a significant and reasonable revenue-generating opportunity for public authorities.

Box 16: Charging of recurring fees for telecommunications use of public streets

In the United States, where use of public streets and rights of way for fixed-line access networks (as well as other utility installations) generally requires authorization from municipal authorities (city, town or county governments), it is common practice for many such authorities to grant a blanket authorization (commonly known as a *franchise*) to install, operate and maintain telecommunications facilities along or under public streets in consideration of the operator's commitment to pay a *franchise fee* equal to a percentage of all revenue generated by the operator's business in the municipality. The percentage varies, but typically does not exceed 5% (which is the cap on franchise fees for cable television operators allowed under US federal law⁹⁵). Similarly, in the United States, state and federal roads authorities often charge a per-mile per year fee for

⁹⁴ See National Joint Utility Notification System (NJUNS) website at <http://web.njuns.com/> (last visited 11 Feb 2017).

⁹⁵ 47 U.S.C. §542.

telecommunications facilities installed along state and federal highways (which is typically higher in urban areas than in rural areas).⁹⁶

301. On the other hand, in many jurisdictions, access to public rights of way is provided at no charge (other than administrative charges for permitting and supervision of works). These jurisdictions consider use of public rights of way for the installation of facilities to provide public telecommunications services as a permitted public use which benefits public welfare and therefore should not require payment of any fee.

302. Access to *private roads* and other *private land* comprising part or all of an existing corridor is a subject which has been less adequately addressed in many jurisdictions than access to public roads. Access to private roads is often important to achieving last mile access network connectivity. The number and importance of private roads has grown significantly in recent decades, with such roads serving gated communities or office parks in suburban and rural settings and limited access areas in urban settings. Access by telecommunications operators to these private roads is essential as part of the last mile connection to reach customers in the communities, office parks and other areas served by the roads.

303. Not infrequently, the developer of a project which is served by a private road may have established utility easements in the road but only granted access to specified utilities and telecommunications operators at the time of developing the project. The developer may not have made provision for subsequent access by other telecommunications operators, particularly if the project was completed prior to the introduction of competition in fixed telecommunications markets, or may have delegated this power to the property manager or homeowners association. The subsequent owner(s) or association with authority over access to the road may attempt to exclude new entry by telecommunications operators, possibly even as part of an exclusive arrangement entered into with their competitors. Where a private road serving a community is not under the control of a single community association, but is instead owned by all the abutting landowners with some mutual rights of ingress and egress (a structure often employed in back alleyways in some cities), then a single landowner may prevent access by a telecommunications operator even if all other landowners have consented to use of the corridor.

304. Private lands, other than roads in private communities, are more likely to be important to intercity corridors, such as those followed by railways, electric transmission lines and pipelines. Private lands may also be an issue for limited access toll roads. In many cases, the corridor was established by the railway, electric utility, pipeline or toll road owner acquiring easements or similar legal rights that run across hundreds or even thousands of parcels of land, each with a separate owner or owners. Some of the traversed land may also be encumbered by mortgage or lien holders who may have approval rights over granting further easements.

305. It is important to emphasize, as discussed in Submodule 5.2, that a railroad, utility, pipeline company or toll road operator with an existing installation in an intercity corridor does not control the underlying land unless it has purchased full ownership of that land (which would be unusual). While the utility will necessarily have received rights to traverse and use the land for purposes of its own infrastructure (such as a railroad, electric transmission line, pipeline or roadway), these

⁹⁶ See, generally, National Transportation Infrastructure Authority, National Association of Regulatory Utility Commissioners & National Association of Telecommunications Officers and Advisors, *50-State Survey of Rights-of-Way Statutes* (undated). Available at <https://www.ntia.doc.gov/legacy/ntiahome/staterow/rowtable.pdf> (last visited 11 Feb 2017).

rights will typically not encompass the right to install or operate commercial telecommunications facilities, even if they contemplate internal telecommunications, especially in the case of older rights of way. Moreover, where a state-owned utility is the existing user of a long-established corridor, there may be little or no documentation setting out the scope of its rights of use. Those rights may be presumed to be limited to its core utility business and to exclude commercial telecommunications services.

306. Indeed, to the extent a railroad, utility or pipeline company relied on rights of compulsory acquisition to assemble rights of way in a land corridor in the first instance, it would have been unable to acquire rights to construct and operate any improvements and fixtures other than those relating to the public service business which afforded it the right of compulsory acquisition. Such easements are also often not divisible or assignable so that any rights the utility may have received from the underlying landowner to install and operate commercial telecommunications facilities may not be capable of being divided from the utility's rights to operate its core business infrastructure or of being assigned (in whole or in part) to a telecommunications operator which wants to share its improvements and fixtures in the corridor. Under these typical circumstances, the telecommunications operator will need to secure its own rights of use of the land in the corridor directly from the underlying owner.

307. While a telecommunications operator will generally not be prohibited from acquiring easements or other rights of use in private roads or other private lands, its ability to do so, and its ability to obtain such rights on fair and reasonable terms, can be very tenuous unless it has a right of *compulsory acquisition* of easements over private land. Moreover, where a corridor traverses multiple parcels with different owners, a single holdout can block an entire project or extort an unreasonable price for easement rights. Many countries afford such compulsory acquisition rights to telecommunications operators. Some also provide for intervention of the sector regulator to aid the operator in reaching agreement with landowners without recourse to legal proceedings. For example, Samoa's Telecommunications Act 2005 provides that where a service provider requires access to private land to install facilities but cannot reach agreement with the owner, the Office of the Regulator will mediate between the parties. If no agreement is reached, the service provider may then proceed to the Courts for consideration.

308. In most countries, land ownership and other private property rights typically have constitutional protections against expropriation or involuntary taking. Where telecommunications operators have been provided with compulsory taking rights, these are usually relatively narrow and limited in scope. As a prerequisite, the telecommunications operator will need to demonstrate that the taking is for a proper public purpose, which should expressly include the establishment of a public telecommunications network or facility. The operator will also be required to pay the owner fair and reasonable compensation. In this respect, fair and reasonable compensation generally means recovery of market value, not cost, and, if the owner and operator cannot reach agreement voluntarily, would typically be determined by a court or administrative tribunal in a hearing in which both parties are entitled to present evidence.

309. Usually, the additional compensation payable by a telecommunications operator to perfect rights of way in an existing corridor over private lands is relatively nominal in comparison with the compensation which would be payable by the utility which originally acquired the easement from the landowner if it were to acquire the rights of way at the same time. For example, where electric transmission lines have been installed over private lands, the value of the landowner's residual rights may have been reduced to only 5% of the value before installation of the facilities.

This is because the remaining compatible uses have been severely limited. This means the utility will already have compensated the landowner for 95% of the land's original value when acquiring its easement. Therefore, any compensation required from a telecommunications operator proposing to acquire an overlapping easement would primarily go to the utility rather than the underlying landowner. The latter point is often overlooked in existing mandatory sharing laws directed at utilities which specify a cost-based rather than value-based formula. In some jurisdictions, these laws may conflict with constitutional protections of private property.

310. In many countries, in addition to public and private ownership, a telecommunications operator must consider whether and how traditional and tribal land use rights may be implicated as part of cross-sector infrastructure sharing, which is more likely in intercity transit networks. The particular nature of these rights varies substantially from jurisdiction to jurisdiction and a detailed examination is beyond the scope of this toolkit.

6.3 Tread carefully in regulating cross-sector joint use of facilities

311. Access to improvements and fixtures, such as poles, ducts, conduits, towers and fiber, generally merits separate treatment from access to land corridors. Any successful infrastructure sharing partnership must be designed to result in a win-win for both the telecommunications operator and infrastructure owner. It cannot just be a win for the telecommunications operator, although this is the approach taken by many infrastructure sharing laws. It should be clear that what the telecommunications operator's business case does not offer to the infrastructure owner cannot easily be overcome by enacting a legal mandate. If the infrastructure owner's refusal to allow shared use is due to inadequacy of the compensation offered or available, or other valid operational or commercial considerations, then a legal mandate to share will not improve the value to the owner or solve the owner's other objections. The mandate will be met with resistance.

312. The circumstances attending joint use scenarios are usually much more complex than those relating to access to land. In many cases, access by a telecommunications operator to third-party improvements and fixtures creates significant burdens for the infrastructure owner and creates additional operational risks to the safety, reliability and efficiency of the infrastructure owner's facilities and hence its ability to meet service level commitments to its core business customers (which, if it is a monopoly provider, often have no alternative). Joint use of facilities also requires significantly greater ongoing cooperation and interaction between the telecommunications operator and infrastructure owner, such as in respect of operations, maintenance and restoration, than does the use of a land corridor.

313. Moreover, in contrast with land corridors, access to improvements and fixtures, while beneficial to a telecommunications operator in terms of cost savings and accelerating deployment time, are less likely to be essential to the technical feasibility of network buildout or to achieving financial viability. On the other hand, due to the growing need of most infrastructure owners to have their own telecommunications networks, joint use of facilities offers infrastructure owners strategic as well as monetary value. In other words, in contrast with access to land, in the case of facilities, the owner has more interest in attracting the telecommunications joint user and the telecommunications joint user has less interest in the owner's facilities (because it may have other options). This is much more likely to establish relatively equal bargaining power between owner and user and therefore is more conducive to voluntary market arrangements.

314. Providing for regulatory intervention for cross-sector joint use also presents significant risk of inherent regulatory bias. Unless the infrastructure owner and telecommunications operator are

both regulated by the same multi-sector regulator, enforcement of mandatory sharing legislation must be entrusted to the regulator either of the infrastructure owner's sector (such as electricity, water or railways) or the telecommunications sector. In either case, the enforcing regulator will have expertise in only one of the two sectors involved and will typically also have a statutory mandate to promote the development and performance of the sector over which it has regulatory authority. Under these circumstances, the regulator is prone to be less sensitive to the needs of the party in the other sector and to favor the party of the sector it regulates in reaching a decision. In many countries, enforcement of mandatory cross-sector facilities sharing is endowed upon the telecommunications regulator and there is evidence of regulatory bias in favor of telecommunications operators over infrastructure owners. A better model would consider the best interests and policy objectives relating to both impacted sectors. For example, while this toolkit extols the benefits for broadband of infrastructure sharing (and how best to achieve those benefits), an equally compelling narrative could extol the benefits to other sectors and how best to achieve those benefits. Policymakers should take a holistic view of all those narratives and sector regulators need to be directed to focus on the common good by harmonizing and coordinating their interventions.

315. For these reasons, it is therefore usually better policy to approach cross-sector joint use of facilities carefully, relying to the greatest extent possible on voluntary commercial arrangements, rather than mandatory access.

316. Legislative and administrative practices in respect of cross-sector sharing of improvements and fixtures vary considerably across jurisdictions. Although the differing approaches form a range from *no regulation* to *heavy regulation*, for simplicity, they can be considered as falling into four major categories.

317. The first category is those jurisdictions which make no provision in their laws for joint use of infrastructure across sectors. This is the case in a surprisingly large number of many developing countries otherwise known for have a progressive and proactive legal and regulatory climate, such as Kenya and the Bahamas.⁹⁷

318. The second category is those jurisdictions whose laws state that a telecommunications operator has a right to use existing improvements and fixtures *with the permission of the owner*. In these jurisdictions, the telecommunications operator's remedies, if it cannot reach agreement with the owner, may be limited to seeking intervention by the sector regulator as a mediator or to no remedy at all. In these jurisdictions, neither the access seeking operator nor the regulator has actual legal authority to force the infrastructure owner to allow shared use. While they may appear weak, such infrastructure sharing laws establish the principle of sharing, and therefore may provide impetus and foundation for infrastructure owners to anticipate and prepare for sharing. They also afford telecommunications operators and regulators with some leverage in their discussions and negotiations with infrastructure owners, while still leaving the making of deals to situations where both participants find mutual benefit.⁹⁸

⁹⁷ See Kenya Information and Communications Act, 1998. Available at <http://www.ca.go.ke/index.php/sector-legislation> (last visited 17 Feb 2017); Bahamas Communications Act, 2009. Available at <http://www.urcabahamas.bs/download/088554800.pdf> (last visited 17 Feb 2017)

⁹⁸ See Liberia Telecommunications Act 2007, §§66-67. Available at <http://www.lta.gov.lr/doc/LTA%20Act%20%202007.pdf> (last visited 17 February 2017); Saudi Arabia Telecom Act (2001), Chapter 9. Available at

319. In the third category of approaches, the telecommunications operator may have a right of compulsory access, within defined parameters based on administrative or judicial intervention, but only after the telecommunications operator first exhausts reasonable efforts to negotiate a voluntary commercial arrangement with the infrastructure owner. These laws will typically not empower the regulator to impose *ex ante* regulation on the infrastructure owner, but rather only to impose *ex post* remedies in the case of failed negotiations at the request of the telecommunication operator seeking access.

Box 17: *Ex post* remedy approach to mandated infrastructure sharing

One example of mandated infrastructure sharing legislation that limits regulatory intervention to *ex post* remedies is Article 39 of [Lithuania's](#) Law on Electronic Communications. Article 39 grants providers of public communications a means of accessing “electronic communications infrastructure,” which includes passive infrastructure such as pipes, ducts, towers, masts, buildings, structures and other facilities. The Law encourages telecommunications operators and infrastructure owners to negotiate the terms of access without intervention. However, under Article 39, the Communication Regulatory Authority may ultimately compel an infrastructure owner to share its infrastructure on non-discriminatory terms, so long as the sharing is cost efficient and does not require significant additional work.

Another example of infrastructure sharing legislation that limits regulatory intervention to *ex post* remedies, although exhibiting some scope creep into *ex ante* regulation, is the 2014 EU Directive requiring Member States to ensure that owners of most non-telecommunication physical infrastructure grant reasonable requests from public communication networks for access under fair and reasonable terms, which specifically includes “price.”⁹⁹ Refusal of access must be based on objective, transparent and proportionate criteria as outlined in the Directive. By outlining criteria, the Directive itself imposes some *ex ante* regulation of infrastructure sharing.

320. The fourth category of mandatory access legislation empowers a regulator, often the telecommunications sector regulator, to promulgate *ex ante* regulation of infrastructure sharing as well as to impose *ex post* remedies. This is the heaviest form of intervention, and often involves *ex ante* price regulation (without any requirement to determine whether the infrastructure owner is dominant or has significant market power in the relevant market) as well as comprehensive regulation of the procedures for assessing and responding to access requests. Ghana and the United States both fall within this category of regulation of utility installations.

321. The authors of this toolkit are not aware of any comprehensive comparative economic study of the impact of these four different approaches to joint use of facilities. Such a study may be useful in providing an economic impact assessment of alternative approaches to the topic. Absent such analyses, the authors suggest that the optimal approach is the following hybrid of the second, third and fourth categories:

- The second category (voluntary-only sharing with regulatory mediation where agreement cannot be reached) would be applied where a particular type of joint use is experimental or

http://www.citc.gov.za/en/RulesandSystems/CITCSys/Docs/LA%20_001_E_%20Telecom%20Act%20English.pdf
(last visited 17 Feb 2017).

⁹⁹ European Parliament and the Council of the European Union, *Directive 2014/61/EU* (2014). Available at <http://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex%3A32014L0061> (last visited 14 Feb 2017).

not well-developed and/or poses significant operational risk to the infrastructure owner. One example would be broadband over power lines technology, where a telecommunications operator uses the electrical conductors of an electricity transmission or distribution lines as wave guides for high frequency communications carrier frequencies (in a similar manner to how DSL uses phone lines and cable modem uses coaxial cable television cables).

- The third category (mandatory sharing but with regulatory intervention limited to *ex post* remedies after voluntary efforts have been exhausted) would be applied in situations where the type of joint use of a particular type of facility is well-developed and poses relatively little operational risk to the infrastructure owner.
- The fourth category (mandatory sharing with both *ex ante* and *ex post* regulatory intervention) would be applied where an infrastructure owner has been determined by a regulator based on a market assessment to be dominant or has been found by the regulator to have engaged in anti-competitive conduct.

322. The breakdown of infrastructure owners, infrastructure types and types of joint use among these three categories of regulatory intervention will necessarily be context-specific and so will inherently vary from one jurisdiction to the next.

323. Regulators should closely monitor and police infrastructure owner conflicts of interest, which are particularly likely to occur where the infrastructure owner, or its affiliate or commercial partner, is itself a licensed telecommunications operator which competes with potential infrastructure sharing customers. Host infrastructure owners have increasingly established commercial telecommunications divisions, subsidiaries or partnerships. When the infrastructure owner is affiliated or in partnership with a telecommunications operator, then this may form the commercial basis for excluding other telecommunications operators from gaining access to the same infrastructure. That may not be a bad policy result if the infrastructure owner's resources are used to counterbalance another dominant telecommunications operator in the market. But it may suppress competition where the host's affiliate is dominant in the relevant market, such as intercity and backbone fiber networks. Some regulatory scrutiny is therefore merited in these circumstances before deciding whether regulatory intervention is or is not warranted. This requires a market assessment in which the infrastructure owner may be considered as operating in some of the same relevant telecommunications markets as its customers and therefore subject to operator-to-operator scrutiny for sharing.

324. Even where stronger telecommunications operators seek access to shared utility infrastructure, the decision whether to regulate the infrastructure owner should be based on its market power, not the market power of its customers, as long as it does not enter into exclusivity or non-compete agreements which restrain it from offering similar infrastructure sharing arrangements to the competitors of its earlier customers. For example, in the case of [Société de Gestion de l'Énergie de Manantali \(Society for the Management of the Energy of Manantali\)](#) (SOGEM), the three member-country incumbent telecommunications operators sought sharing of dark fiber with SOGEM. This had the positive impact of significantly increasing the national backbones in Senegal, Mauritania and Mali, and increasing the international connectivity of the Western African region as a whole. As long as the infrastructure owner is not restrained from offering its remaining available capacity to competitors of these incumbents, it has every financial motivation to do so in order to maximize its revenue from infrastructure sharing.

325. Even where strong enforcement capacity is present, excessively intrusive sharing laws may result in inefficiencies and frustrate voluntary arrangements. They may also lead to disinterest or reluctance by infrastructure owners to promote their infrastructure for sharing. Where one-sided legislation is present, even when telecommunications operators call on host utilities to share their infrastructure, the utilities can be recalcitrant and difficult partners, believing they are receiving the short end of the arrangement.

326. When it can function competitively, a market where the potential for profit serves as the primary incentive for entry and competition serves as the primary regulator of behavior is preferable to a market governed by legal mandates. Most utilities in developing countries are starving for revenue and investment capital. They often have to cut their budgets because the sector regulator will not approve recovery of all the investments proposed when establishing revenue requirements in their rate cases. Moreover, due to capital constraints, they do often not have access to the capital to invest even if they could include the investment in their rate base. They rely almost entirely on donor grants and loans, or government appropriations, and to a much lesser extent on their limited ability to accumulate capital from earnings. The infusion of cash from an infrastructure sharing deal provides much-needed oxygen.

6.4 Apply competition law principles to assess need for *ex ante* regulation

327. Treating a utility entering the telecommunications infrastructure sharing market with the level of regulation appropriate to its degree of market power in such infrastructure market is generally the most pro-competitive and pro-investment policy approach. This is generally the case whether the utility provides passive infrastructure such as towers or dark fiber or offers telecommunications services. In particular, the incentive for the utility to enter the market at all may depend on not imposing heavy *ex ante* regulation on its offer. It is much easier for a conservative utility, which already faces significant regulation of its core business, to avoid the regulatory uncertainty and adversity of entering a new market with questionable financial upside than to do so and then find itself unable to exit.

328. Leaving aside *experimental infrastructure sharing*,¹⁰⁰ which the authors believe should be encouraged rather than regulated, the key question for policymakers and regulators is when to apply *ex ante* remedies and when to limit regulation to *ex post* remedies. For purposes of this discussion, this distinction should be considered both in respect of remedies imposed by the legislature and those imposed by sector regulators or competition authorities (i.e. those which flow from their statutory authority). The first step in selecting between *ex post* and *ex ante* regulation should be based on a market assessment to define the relevant markets and assess the market power of infrastructure owners in the relevant markets.

329. Submodule 4.2 discussed the financial disincentive to infrastructure sharing created by price regulation in mandatory infrastructure sharing laws. Economically unjustified regulation of infrastructure sharing prices is usually counterproductive if the aim is to increase the incidence of

¹⁰⁰ One example of experimental infrastructure sharing is broadband over power lines. Originally introduced through a series of technology trials in the late 1990s (and even deployed commercially in a limited number of areas), broadband over power lines employed electric power line conductors as wave guides for high frequency radio transmissions, which could be used as carrier waves for telecommunications, much in the same way as copper lines and coaxial cables are used as wave guides for DSL and cable modem services. More recently, AT&T has announced technology trials to use the electric field around power lines as a wave guide. See Aaron Pressman, "AT&T Says It Has a New Take on Fast Internet over Power Lines," *Fortune* (20 Sep 2016). Available at <http://fortune.com/2016/09/20/att-internet-over-powerlines/> (last visited 14 Feb 2017).

infrastructure sharing. Generally, infrastructure sharing price regulation is appropriate only when the infrastructure owner has been found to be dominant and its pricing is an abuse of such dominance or where there is evidence of collusion between the infrastructure owner and others with similar infrastructure.

330. Dominance should be determined by sector regulators based on general competition law principles in accordance with traditional economic tests of market power. Most telecommunications laws which have been updated to reflect best practices have established standards and procedures for assessing market power in the context of telecommunications services. These same standards and procedures can and should be applied to the wholesale markets for passive infrastructure.

331. Regulators should consider available substitutes for the infrastructure being considered in defining the relevant market and determining the market power of the infrastructure owner. For example, where an electric utility has available dark fiber running between two cities, the available substitutes would typically be considered by telecommunications operators as including all other existing fiber connecting the same two cities directly or indirectly, whether following the same or different routes and regardless of differences in distance traversed. Available substitutes would also typically be considered as including the possibility of constructing new fiber between the same two cities along an existing roadway, railway or other right of way. As long as there is reasonable possibility of self-provisioning by an operator between the same two points, which is typically the case in respect of buried fiber along a roadway, this should be considered a reasonable substitute for the utility's fiber which limits its ability to exercise market power.

332. Where price regulation of cross-sector infrastructure sharing is necessary, regulators or courts must take care in setting regulated price levels. As discussed in Submodule 4.1, there is no principled basis for allocating costs between core business and telecommunications uses of shared infrastructure. This requires some level of arbitrary allocation based on policy considerations, which should respect the public policy in both sectors, as well as the interest of each party's shareholders and customers. In making this determination, policymakers, regulators and courts should endeavor not to establish prices by which the customers of a utility's core business are forced to cross-subsidize the telecommunications operator's customers. Price regulation which is heavily skewed in favor of telecommunications operators can cause significant market distortions, forcing the customers and shareholders of the infrastructure owner to subsidize the telecommunications operator, shifting economic value to its customers and shareholders. Such laws sometimes take unfair advantage of the first mover status of infrastructure owner, rather than following traditional economic principles for determining market definition, assessing dominance and regulating prices.

333. Where an infrastructure sharing law is currently overbroad in allowing price regulation absent dominance, the regulator should consider exercising its prosecutorial discretion to forbear from promulgating and/or enforcing price regulations against infrastructure owners absent evidence of dominance or collusion.

334. From a public policy perspective, providing proper financial incentives and introducing competition in passive infrastructure sharing can obviate the need to impose price regulations and other heavy regulatory burdens on infrastructure owners that strain the capacity of a country's telecommunications sector regulator and do not properly motivate, and sometimes demotivate, utility infrastructure owners – which is often a major concern in developing countries.

6.5 Address regulatory restrictions that impede sharing by state utilities

335. As noted in Submodules 4.3 and 4.4, many utilities that might share infrastructure are state organs or state-owned enterprises, and the silo structure of government and development agencies often hinders infrastructure sharing opportunities that might otherwise arise. In such situations, the infrastructure in question is considered public property many legal systems.

336. As previously discussed, infrastructure sharing is often hampered by the institutional structure of such state-owned utilities. State organs are rarely run like businesses and state-owned enterprises only sometimes are. They may lack formal corporate governance structures and processes. They also generally have no experience operating in competitive markets, and may not have the institutional culture to thrive. Where strong corporate governance mechanisms are lacking, state ownership may lead to commercial decisions being driven by government policy goals, rather than the requirements of the market, or may be subject to other political interference. In addition, state organs and state-owned enterprises are often subject to public enterprise regulation, which governs public procurement, disposition of public assets and partnerships and concessions with the private sector. Thus, mitigating these adverse consequences of state ownership can play a significant role in increasing the incidence of cross-sector infrastructure sharing.

337. Many countries have improved the business performance of state-owned enterprises through corporatization. In these countries, state-owned enterprises which were once chartered by special statute have been reincorporated under the commercial company law or business corporation law. This is a positive first step in *corporatizing* state-owned enterprises so that they operate under the same principles as private enterprises. This includes moving the management of their business under the stewardship of an independent board of directors with statutory fiduciary duties of care and loyalty rather than having the management being under a government department or ministry. Nonetheless, one or more government ministries or departments will usually still retain some level of oversight over the enterprise through the role of representing the government as a shareholder. If these ministries and departments limit their involvement to the annual appointment of board members and if they appoint directors with the proper skillsets and experience, then the corporatization can limit political interference and provide more business-like management to the state-owned enterprise. However, where ministerial or departmental involvement in day-to-day management continues, then these reforms may have a more limited impact.

338. Another positive step taken in some countries is to provide full-scale or limited exemption from public enterprise laws (such as those governing public procurement, disposition of state assets and public-private partnerships) for qualifying state-owned enterprises. Where this has been done, the utility or its infrastructure sharing subsidiary (if structural separation is desired or required) is freed from the shackles of laws meant to restrain government when acting as government and not government when acting as a market participant. The financial discipline of separate accounting can also ensure that the utility operates like a business rather than a government department.

Box 18: Freeing state-owned enterprises from the shackles of public enterprise laws

Colombia-based ISA S.A. E.S.P. (ISA), a majority-state-owned enterprise, operates one of the largest cross-sector infrastructure sharing groups of businesses in South America. ISA's group owns and operates electricity transmission lines, roads and fiber optic networks, and makes great use of cross-sector infrastructure sharing across all three lines of business. As of 2017, ISA's,

telecommunications subsidiary Internexa S.A. boasts 29,000 km of fiber optic telecommunications facilities in Argentina, Brazil, Chile, Colombia, Ecuador, Peru and Venezuela.¹⁰¹ The group's slogan is "linear infrastructure systems that boost continental development."

Parent company ISA is fully corporatized (hence the S.A. suffix in its company name) but remains subject to public enterprise regulation (hence the E.S.P. suffix in its company name) of its electricity transmission business, which generally has a monopoly in the markets served.¹⁰² In contrast, subsidiary company Internexa S.A., which operates the fiber optic telecommunications business, is also fully corporatized and has further obtained exemption from public enterprise regulation (and hence the absence of the E.S.P. suffix in its company name). Exemption from public enterprise regulation affords Internexa flexibility and efficiency in entering into partnership and other contractual arrangements with infrastructure owners, suppliers and customers, and thereby has enabled it to grow successfully in the highly competitive markets in which it operates.

In Ghana, the Public Procurement Act, 2003 governs procurement by government, ministries, departments, agencies and institutions. The Act only applies to state-owned enterprises to the extent they utilize public funds.¹⁰³ In addition, the Act allows the Minister for Finance the ability to deviate from the requirements of the Act if it is in the national interest.¹⁰⁴ However, there is no existing interpretation of the extent to which infrastructure sharing activities of a state-owned public utility in Ghana would involve public funds, such as where the shared assets were purchased with a mix of public funding and private finance, nor has the Minister of Finance issued any ruling allowing deviation from these principles. Thus, the planned activities of Ghana Grid Company in sharing its infrastructure with telecommunications operators (see case study on [Ghana's Electricity Transmission Line Fiber](#)) would currently be subject to the full scope of Ghana's Public Procurement Act.

6.6 Facilitate information exchange and dialogue

339. Telecommunications operators are proactive in designing and constructing their networks and will often make unsolicited approaches to owners of existing infrastructure about possible sharing opportunities. These overtures can and do lead to completed infrastructure sharing transactions. Likewise, some infrastructure owners have proactively entered the sharing business, hung out their shingles and call on prospective customers in the telecommunications sector. However, some infrastructure owners have not entered the sharing market and telecommunications operators also sometimes face a daunting array of public institutions without clearly identified points of entry to begin a conversation about infrastructure sharing.

340. Policymakers and other stakeholders can help address these impediments by facilitating greater information exchange and dialogue to raise awareness and understanding of cross-sector infrastructure sharing opportunities (and obligations) and points of entry into state-owned infrastructure owners. This can be accomplished by fostering meaningful dialogue between

¹⁰¹ Internexa, "Home" on website (undated). Available at, <http://www.internexa.com/en-us/Pages/home.aspx> (last visited 11 Feb 2017).

¹⁰² ISA, *Good Governance Code* at 12 (2007). Available at <http://www.isa.co/en/press/Documents/our-company/good-governance-code.pdf> (last visited 11 Feb 2017).

¹⁰³ Public Procurement Act, 2003, Act. 663 of 2003 (Ghana), §14(2)(e). Available at <http://www.ppghana.org/documents/Public%20Procurement%20Act%202003%20Act%20663.pdf> (last visited 11 Feb 2017).

¹⁰⁴ *Id.* §14(1)(a).

telecommunications operators and infrastructure owners. In addition, infrastructure mapping resources can be utilized to create an accessible database of opportunities for passive infrastructure sharing.

341. In many countries, public utilities do not publish information about their infrastructure and are not accustomed to handling requests for information. Government and state-owned enterprises may help by collecting, compiling and supplying this information to telecommunications operators and establishing a process for requests for information about existing and planned public infrastructure. The procedures can ensure that requests relate to genuine telecommunications network planning.

342. Telecommunications regulators may also facilitate requests for information and sharing by compiling, publishing, updating and maintaining for public inspection a list of government departments and utilities that administer infrastructure that might be attractive for sharing and such other information as the regulator considers necessary or useful. This would be done in coordination with such government departments and utilities.

343. In many countries, reliable maps of infrastructure either do not exist or are not publicly available. Even though much of the infrastructure is in plain view, the lack of data including geographic coordinates and corresponding data about the infrastructure adds significant cost and uncertainty to desk-top planning exercises by telecommunications operators who may otherwise want to share infrastructure. The operators frequently must conduct their own surveys of underground and above-ground infrastructure on public properties. They also have to take the initiative to identify ownership and, once the owner is identified, the proper person with whom to communicate. Until a utility formally enters the infrastructure sharing business, the chances are slim that the utility will have assigned responsibility for infrastructure sharing to anyone inside its organization. Telecommunications operators face an uphill battle in trying to start and advance discussions of infrastructure sharing in these circumstances.

344. The telecommunications regulator or ministry can support stakeholders in establishing such an information exchange and dialogue. A growing trend among telecommunications regulators has been to require or facilitate chambers of commerce or other trade groups among telecommunications operators. These groups have in some cases become valuable sources of information exchange and dialogue within the industry. Where they exist, these industry groups can and should be encouraged to expand their constituency to include infrastructure owners. This would prompt each participating owner to designate a representative, create greater awareness of infrastructure sharing opportunities through this representative, and provide a conduit for telecommunications operators to make contact with infrastructure owners.

345. Another contribution which can be supported by such an industry group is to coordinate infrastructure owners and telecommunications operators in preparing and periodically updating infrastructure maps or databases. These can include route and location maps, with geographic coordinates, and related records showing access points, infrastructure type, size and age, the identity of owners and users and any other pertinent information. Government ministries or regulators may serve as a catalyst for such a project by suggesting or directing that it be undertaken, providing meeting space and perhaps with seed funding from Government or an economic development institution.

346. Telecommunications regulators can also assist by collecting, compiling, maintaining and publishing the identity and contact information for all relevant public infrastructure owners, as

well as any applicable legal or regulatory procedures, guidelines and instructions for accessing and using such infrastructure. Where infrastructure owners are uncooperative, the regulator may use its statutory powers to compel compliance.

Box 19: Coordination efforts can be led by regulators or industry coalitions

In 2009, after a substantial amount of preparation time, the Lebanon Telecommunications Regulatory Authority published a Study on Use of Public Properties, which was followed by a draft Rights of Way Decree intended to address shortcomings in the existing access rights and availability of access to these public properties.¹⁰⁵ The Study aimed to help accelerate the deployment of broadband networks and services by facilitating telecommunications operator access to Lebanon's extensive public property portfolio, which included telecommunications ducts, poles, towers, rooftops and rights of way along highways, streets, roads, power lines and pipelines.

An equally proactive approach has been taken by a national coalition of utilities in the United States to reduce the complexity and uncertainty of joint use notifications. As is with most change in the utility industry, electronic pole transfer notification came about as the result of a tragic accident involving a pole transfer. During the course of the litigation, in 1989, it was decided that Georgia Power and BellSouth needed a better means to notify each other of pending pole replacements. The Claims Departments of both companies initiated the effort to improve communication.

Discussions between the two companies led the team to decide that certified letters and phone calls were not the way to continue the operation and the companies decided to use new technology to provide the transmission medium for notices. They implemented a system using batch modem entry with automated fax delivery. This was the same technology that was being used by many one-call centers around the United States. It was named The Electronic Notification Pole Transfer Program (ENPT). Ticket number 1 was created May 28, 1990 in Savannah, Georgia.

The Georgia Utilities Protection Center (UPC) hosted the software and database. Utility pole owners in Georgia entered "tickets" in the system, which in turn broadcast faxed them to all affected parties. Each company or distribution area was represented by a 5-6 character member code associated with a fax modem. As work was completed, each member updated the ticket via modem entry. The process was a great improvement over the manual method, and soon word began to spread to other states about the program.

A utility contract company employee was given the task of maintaining the system for both BellSouth and Georgia Power. In 1991 she was hired as a full-time employee of the Georgia UPC with responsibility for maintaining the ENPT system. In 1995, the participants decide to upgrade the system to use the Internet for ticket delivery. At that time, most member companies had to seek special permission from their top management and IT departments to allow employees to have Internet access at their desk.

With the new technology, the system was given a new name, to reflect the spread of membership across the country. The name *National Joint Utilities Notification System* (NJUNS) was formally adopted in 1997. NJUNS has subsequently continued to improve its communication system and

¹⁰⁵ Lebanon Telecommunications Regulatory Authority, *Rights of Way Draft Decree (Based on the Study on Use of Public Properties)* (2011). Available at <http://www.tra.gov.lb/Study-on-Use-of-Public-Properties> (last visited 11 Feb 2017).

participation, and today has been adopted by 13,000 infrastructure owners and telecommunications operators in 28 states.

Figure 21 : NJUNS participating states



Source: NJUNS website¹⁰⁶

347. Publication of information about infrastructure may give rise to concerns about national security or public safety, particularly given the potential vulnerability of *critical infrastructure* to attacks. Some information may appropriately be kept confidential, and only divulged to telecommunications operators who demonstrate they are properly licensed and undertake to respect confidentiality requirements. However, much infrastructure is already in plain view so maps and databases reveal little that is not already known. Rather, they provide additional information which is primarily of use to potential lawful users of the infrastructure, and, importantly, they reduce the cost of information acquisition and processing by potential user of shared infrastructure.

348. Some jurisdictions have established infrastructure mapping initiatives. These resources allow stakeholders to access a comprehensive database of existing passive infrastructure in a particular geographic area. These databases can provide a shared resource through which infrastructure owners can supply information about their infrastructure and telecommunications network operators can identify potential host infrastructure for construction or expansion of their networks. These resources can also be particularly useful in congested areas in helping to avoid unnecessary duplication of infrastructure or conflicts between different infrastructure installations. They can also be useful in providing more precise data on the location and nature of infrastructure.

Box 20: Developing an infrastructure database in Lithuania

In [Lithuania](#), the Communication Regulatory Authority (*Lietuvos Respublikos ryšiųreguliavimo tarnyba*) (RRT), has led the creation of a web-based [GIS](#) resource (<http://e-infrastruktura.lt/lt>) which serves as a single information point for mapping systems covering telecommunications and other utility infrastructure.¹⁰⁷ The project was initiated in 2010 after RRT's analysis concluded that infrastructure mapping in Lithuania needed improvement. Although RRT leads the project,

¹⁰⁶ See <http://web.njuns.com/about/> (last visited 14 Feb 2017).

¹⁰⁷ European Commission. 2015. *Implementation of the EU Regulatory Framework for Electronic Communication - 2015*. Commission Staff Working Document, Brussels: 197. Available at <https://ec.europa.eu/digital-agenda/en/download-scoreboard-reports> (last visited 11 Feb 2017).

municipalities are responsible for their own data collection and sharing. RRT developed the dedicated website, which centralizes access to the information managed by local municipalities.

The [GIS](#) resource has been implemented in Lithuania's four largest cities. The maps are available online to registered users. While plans exist to expand the resource to cover additional municipalities, costs and unreliable data present barriers for more rural municipalities. In 2014, the Ministry of Agriculture established a working group to set out mandatory obligations for all municipalities regarding mapping, including collection, access, exchange and validation of data.

In Poland, the Ministry of Infrastructure and other agencies have developed the [Information Broadband Infrastructure System](#) (SIIS), an electronic [GIS](#) mapping system implemented in late 2012. SIIS gathers and presents information on infrastructure deployment in the county with the objective of accelerating deployment of broadband infrastructure.

SIIS allows local governments to obtain geo-referenced information to support public investment in broadband infrastructure. This information provides government institutions with a common understanding of the current level of broadband deployment in a given area and identify locations that lack access to broadband and would benefit from public intervention. SIIS also enables telecommunications operators to identify network access points and passive telecommunications infrastructure for sharing to optimize broadband deployment. SIIS provides operators with detailed information to make business decisions on new investment projects, modification of existing infrastructure and market competitiveness.

SIIS has also been used by businesses and investors to evaluate potential business locations by providing information on access to existing telecommunications technologies. As of early 2016, SIIS did not yet gather information regarding non-telecommunications infrastructure, such as electric distribution and transmission facilities or railways, but this was expected to be added within two years.

6.7 Tailor intervention to local conditions

349. The likelihood and benefits of, and approach to, market interventions to facilitate cross-sector infrastructure sharing remain highly contextual and must be adjusted to each country and the other variables that prevail in a given geographic market. One size will not fit all. Some of the more significant relevant variables include:

- existing telecommunications infrastructure, gaps and market conditions;
- existing host infrastructure (electric, roads, rails, pipes);
- the relevant country's geography, topology, population distribution, GDP, demand and similar metrics;
- ownership and market structure of telecommunications operators and infrastructure owners;
- full state ownership of sharable infrastructure and its permutations (ministry, corporatized parastatal or management concession);
- partial state ownership of sharable infrastructure and the degree of autonomy of the enterprise;
- private sector ownership of sharable infrastructure;
- regulatory framework, enabling legislation and regulatory capacity in utility and other infrastructure owner sectors and the telecommunications sector
- nature of land use rights and existing legal system for land law;

- country history in all relevant sectors; and
- the financial condition of telecommunications operators and infrastructure owners.

7 How international economic development institutions can help

350. Development banks and other donor organizations provide a significant portion of the funding for sharable infrastructure in developing countries. They stand in a key position to contribute toward an increased incidence of cross-sector infrastructure sharing. The following three submodules present key ways in which economic development institutions can improve the incidence of infrastructure sharing with relatively little incremental public expenditure while sustaining and encouraging facilities-based competition in the telecommunications sector.

7.1 Encourage neutral and decentralized passive infrastructure ownership

351. The rise of successful and competitive mobile operators in most developing countries over the past 20 years has demonstrated the benefits of investor-led growth in the telecommunications sector. It has also demonstrated the ability of emerging markets to support facilities-based competition. The rising need for fiber optic networks to support fixed and mobile broadband deployment need not portend a return to facilities bottlenecks. As they should be, international economic development institutions are wary of approaches to infrastructure development which lead to market concentration and monopoly. Investing development funding in the establishment of monolithic wholesale providers of intercity and metropolitan bandwidth services, whether wholly state-owned or public-private, creates a high risk of either creating significant market concentration (particularly if policymakers bow to pressure to require retail access network operators to subscribe to these wholesale services exclusively in order to ensure the financial success of the enterprise) or investing wastefully in failed projects (if retail access network operators bypass these wholesale services).

352. Fiber optic cable facilities, when coupled with a smart approach to cross-sector infrastructure sharing, present an historic opportunity to continue facilities-based competition for broadband network deployment in an economically viable manner. Fiber optic cables contain multiple dark fiber pairs which can be used by multiple competing retail access network operators and wholesale operators, each of which can install and operate its own active infrastructure. The IRU form of ownership developed for copper-based submarine cables in the early 1960s, when applied to dark fiber, provides a time-tested method of allocating shared long-term ownership of telecommunications facilities and infrastructure among multiple network operators, each assured of uninterrupted use and control of its own separate network at fixed prices.

353. At the same time, development and ownership of the underlying fiber optic cable by utilities in other sectors can offer competitively neutral landlords¹⁰⁸ which can also benefit from core business uses of the fiber and the opportunity to monetize the excess capacity and reinvest the proceeds in their often cash-starved core businesses.

354. The potential for utilities to possess market dominance in wholesale dark fiber markets is often currently limited. Existing and easily erected microwave networks will continue to be viable substitutes for fiber on many routes in many developing countries for several years to come. The desire of infrastructure owners who enter the sharing market to monetize their excess infrastructure capacity quickly, while faced with continuing competition from microwave, restrains their ability

¹⁰⁸ The neutrality of the infrastructure owner assumes the owner, and its affiliated enterprises, do not compete with its customers in the provision of downstream wholesale or retail services. In the case of state-owned enterprises, this determination must consider whether the boards and management of the infrastructure owner overlap with those of any other state-owned enterprises in the telecommunications sector.

to charge monopoly rents for IRUs. Many existing fiber owners, such as electric utilities and railways, also face competition from the ability of network operators to self-provision buried or aerial fiber along roadways. In addition, as more infrastructure owners enter the sharing market, they will increasingly compete with each other for the relatively small number of telecommunications network operators who require fiber.

355. Where such competition does fail, either a competition authority or an empowered telecommunications sector regulator can step in to regulate pricing and access terms. In short, the infrastructure sharing market presents significant checks and balances to ensure that market-based pricing is reasonable and to preserve the inherent neutrality of infrastructure owners vis-à-vis telecommunications operators which compete with each other.

356. With these matters in mind, development institutions can optimize continued private sector investment in upgrading telecommunications infrastructure for broadband, while sustaining the facilities-based competition model which has worked so well for wireless networks, by fostering the development and sharing of dark fiber by infrastructure owners whose core businesses or services are not telecommunications. The added benefit of this approach is that it reduces the need for development investment in standalone telecommunications networks. It frees up development resources for two key activities to foster the development of neutral passive infrastructure which can be funded and supported by development institutions at much lower incremental cost. These are (1) to provide technical assistance to public sector stakeholders and (2) to plan for cross-sector infrastructure sharing in all new infrastructure projects. These activities are discussed in the following two submodules.

7.2 Provide technical assistance to public sector stakeholders

357. By underwriting targeted technical assistance, international economic development institutions can leverage their investments to serve as a catalyst for market-based development of broadband intercity, metropolitan and last-mile access networks. These limited interventions to address market and regulatory shortcomings or failures can have a significant positive impact by facilitating and promoting greater cross-sector infrastructure sharing.

358. All the elements to support this economic development model are already in place in many developing countries. Private sector inward investment money is already available and flowing. In most developing countries today, investor-owned mobile network operators have already made significant capital investments in national mobile voice coverage and are continuing to invest heavily in upgrading their networks for broadband. They often reinvest 15-25% of revenue in in-country capital expenditures. The private sector is also beginning to invest in fixed FTTP infrastructure in denser markets in some developing countries.

359. Much sharable infrastructure is also already in place, but it is often not being fully exploited for the reasons discussed in Modules 4 and 5. Emerging market infrastructure owners, which are often state-owned enterprises or state organs, seldom have a strategy for infrastructure sharing or a business unit to pursue such a strategy. Their sharable infrastructure is likely to remain dormant until they can and do develop and implement a sharing business.

360. Providing technical assistance to these public sector infrastructure owners, and to other relevant public sector stakeholders, in developing countries can have a huge positive impact on fostering the availability of shared infrastructure. The relevant stakeholders include state-owned enterprises and government organs which own or manage sharable infrastructure, the sector

regulators of these infrastructure owners (where they are regulated), telecommunications sector regulators, policymakers in relevant sectors, and lawmakers. In contrast, telecommunications operators who are investing in broadband retail access networks are usually investor-owned, quite sophisticated and do not require external financial resources for technical support.

361. In developing countries, state-owned infrastructure owners seldom have the discretionary financial resources to explore their options for infrastructure sharing or to develop a strategy and business plan. They also often do not have sufficient knowledge and experience to understand what opportunities they are missing, what steps to take to capitalize on these opportunities or even what advice to seek. Even when they are able to self-fund and undertake such planning exercises, their initial terms of reference often ask for advice on topics of little relevance, while overlooking much more fundamental matters. Development institutions, if attuned to the needs of such infrastructure owners, with whom they usually have established relationships in the core business sector, can therefore help by providing funding for technical assistance and by aiding the infrastructure owner in designing the terms of reference for procurement of advisers.

362. Key disciplines in which infrastructure owners may benefit from technical assistance include legal and regulatory, commercial, technical and financial. The mix will vary based on the identity of the client and its role in the potential infrastructure sharing eco-system.

363. Infrastructure owners typically need highly specialized legal and regulatory advice to address the regulatory and legal disincentives described in Modules 4 and 5. They also need legal advice to structure their infrastructure sharing business, including such topics as whether to conduct the business through a separately incorporated entity, how to structure the selected business model and how to structure relationships with customers. They also need regulatory advice to ensure that they understand and obtain required licenses and approvals and to ensure they establish and perform customer relationships within applicable regulatory constraints. There is often a need for advocacy in these roles as the law and regulatory environment in many emerging markets is relatively undeveloped on many aspects of infrastructure sharing, and is often an impediment to economically efficient sharing.

364. Because most infrastructure owners operate in a dominant market position in their core business, they need commercial advice and training to help them understand and prepare to operate in a competitive infrastructure sharing market. Commercial advice is also critical to help guide infrastructure owners in selecting a business model appropriate to their specific circumstances and appetite for risk. They will also require significant guidance in developing a market entry strategy and in establishing and negotiating pricing and other terms of service.

365. Technical support can help infrastructure owners understand the nature and usefulness of their sharable infrastructure, how it may meet telecommunications operator needs, and the required technology investment for each alternative business model discussed in Module 3.

366. Financial advice is of critical importance for any infrastructure owner considering and planning entry into the sharing business. At the outset, an infrastructure owner needs some financial analysis of the market opportunities and risks presented by each potential business model. This analysis should include consideration of the owner's financial circumstances (such as available capital and access to additional capital), the revenue potential and risks for each potential business model, the required fixed costs (capital and operating) and variable costs for each business model, and other relevant factors, as well as the regulatory impact on core business tariffs and likely infrastructure sharing revenues. Once the infrastructure owner has selected a business model

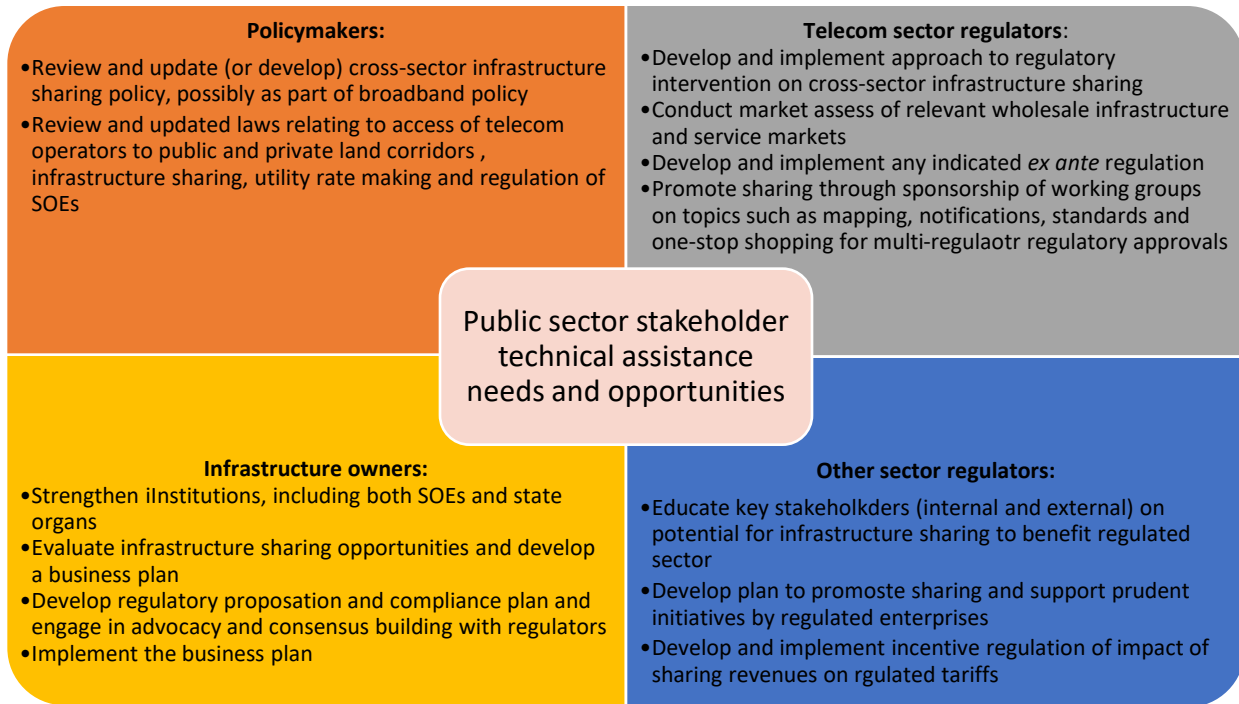
based on a comparative analysis of options, it will require support in developing an investment plan and pro forma operating income statements and cash flow statement so it can fully understand the financial consequences of the new business. Finally, the modelling needs to consider the impact of the new business on the utility's revenue requirements and tariffs in its core business. This will enable the utility to understand what portion, if any, of the net earnings from its ancillary business will be available for reinvestment or other purposes, and what portion will be offset by reduced tariffs.

367. Other potential beneficiaries of technical assistance include sector regulators of infrastructure owners, telecommunications regulators and relevant government policymakers. These public stakeholders can benefit from technical assistance in assessing the existing legal, policy and regulatory framework from the standpoint of its friendliness for cross-sector infrastructure sharing and benchmarking this assessment against best practices. This assessment and benchmarking exercise can lead to advice for legislative, policy and regulatory reforms consistent with the suggestions discussed in Modules 6.

368. Technical assistance can also be used to develop standards to govern joint use of infrastructure. As mentioned in Submodule 4.5, such standards are often deficient or absent in developing countries or in sectors that do not have a history of sharing infrastructure with telecommunications operators. These standards are necessary to address safety and other operational concerns, including allocating responsibility between the infrastructure owner and a third party installing telecommunications equipment. While exemplary standards abound in the wealthier developed countries, and even some developing countries such as South Africa, standards for infrastructure sharing must usually be localized in order to account for local variations and practices in sharable infrastructure. These efforts are typically carried out through collaboration by industry participants and regulators. Technical assistance funding by a development institution might be provided through a telecommunications or other sector regulator or a state-owned utility which can serve as a catalyst for setting up and leading such a standards development effort. Collaboration between similarly situated infrastructure owners in a region can also be a useful and efficient way to develop and share standards and best practices.

369. The key potential public sector stakeholders who could benefit as recipients of technical assistance, and key topics to target, could include those identified in the following table:

Figure 22: Matrix of candidates and topics for technical assistance



370. Technical assistance from development institutions also needs to be provided in the manner most suitable for the client. Technical assistance sometimes takes the form of an assignment executed by the development institution itself (either with its own personnel or outside advisers procured for the assignment). At other times, development institutions provide financial support and guidance for recipients to procure and engage their own advisers directly. In the case of advisory services to policymakers and regulators, both approaches have their pros and cons, but are potential options. By executing the technical assistance itself, the development institution has more control and influence over the recommended policy outcomes and is therefore able to ensure that the recommendations are consistent with best practices. On the other hand, some public institutions resist advice coming directly from development institutions, and may be more likely to follow and implement regulations if provided by independent advisers.

371. In the case of infrastructure owners, it is fundamentally important to provide for recipient-executed procurement of technical advisers to ensure that advice is client-focused, that the advisers do not have *conflicts of interest* (e.g., are clear that their mission is to support the infrastructure owner's role and not a broader policy or regulatory agenda), and that the recipient will respect and trust the advice. Because the development institution's objectives and agenda tend to be policy-based and look at macro impact, advice provided to infrastructure owners though such institutions is inherently likely to compromise the infrastructure owner's own interests for the greater good sought. The infrastructure owner will be participating in the marketplace and regulatory environment. In a market-based approach to development, policy must rely on each individual actor pursuing its own best interest, within a framework of rules to ensure fair play, and therefore each market participant should have its own advisers who are independent, selected by the client and not a third party. Otherwise, the advice is likely not to promote the best interest of the individual client, and will likely not be trusted or followed by the client. Such reports end up in a drawer or waste bin and nothing changes.

7.3 Plan for cross-sector sharing in all new infrastructure projects

372. While a market-based approach, supplemented with technical assistance to stakeholders, may be all that is needed to optimize cross-sector sharing of existing infrastructure, the opportunities for sharing of new infrastructure can be enhanced by planning for sharing activities when it is developed. This requires proactive and inclusive planning by development institutions which finance the infrastructure and the implementing agencies of the recipient governments.

373. Such cross-sector planning and implementation currently falls short of optimal, often far short. Historically, development institutions have organized their approach to infrastructure investments into sectors, such as roads, railways, power, water and sewer, and telecommunications. This has been a sensible and efficient approach for several reasons. It facilitated focus and specialization within the teams in these institutions. It enabled greater affinity and better relationship building between the development institutions and their counterparts in recipient countries.

374. However, the sector-based approach has also created silos which reduce cross-sector interaction for efficiency through joint pursuit of multi-sector infrastructure investments. Project managers are not tasked with considering opportunities for a project in one sector to be leveraged to support another sector. Procurement plans and procurement guidelines, and deliverable-specific funding grants and trusts from upstream donors, do not allow much flexibility to expand or change project scope to include outcomes for other sectors.

375. To some degree, the growing need for telecommunications technology to support the operation and maintenance of a wide variety of infrastructures has already begun the process of developing more sharable infrastructure. For example, electricity transmission lines, which require telecommunications facilities for network protection, [SCADA](#) and other internal uses, have for a number of years routinely been constructed or replaced with built-in fiber optic cables. As electric utilities, and their funders, have become more aware of the potential of excess fiber to generate alternative revenue streams from commercialization, they have tended to install cables with ever larger fiber counts.

376. There have already been some international development institution efforts to break down barriers between sectors once sharable infrastructure with fiber has been installed. For example, in 2009 through 2010, the World Bank commissioned a project to assess the feasibility of leveraging excess dark fiber installed on electric transmission lines of the West African Power Pool (WAPP) to support the development of regional fiber networks in West Africa. It was positioned as a feasibility project, so did not amount to full-scale technical assistance as discussed in the previous submodule, but the project did stimulate greater planning for cross-sector sharing. The project led to recommendations for WAPP to form a dark fiber leasing consortium and appoint a management company to lead the effort to commercialize the dark fiber. WAPP's members endorsed this approach but the relatively slow moving process within this multi-country organization has left it still in the planning stages, having not yet gone to market. The World Bank renewed its efforts to stimulate cross-sector infrastructure sharing within West Africa in 2016 by commissioning another project along the lines of the original WAPP feasibility study. The results of that undertaking have not yet been published at the time of preparation of this toolkit.

377. On the other hand, the WAPP project has influenced various member countries to pursue dark fiber leasing and other infrastructure sharing activities within their own countries. These include [Société de Gestion de l'Énergie de Manantali \(Society for the Management of the Energy](#)

[of Manatali](#)) (SOGEM) in Mali, Mauritania and Senegal, also supported by the World Bank, and Ghana Grid Company, which has been self-funded by the state-owned enterprise. While these World Bank efforts to stimulate infrastructure sharing came after the transmission lines had been built, rather than during or before construction, they demonstrate the potential and commitment of such institutions to begin taking a multi-sector view to infrastructure investment.

378. More recently, the World Bank undertook a major internal reorganization which offers the potential for better cross-pollination during the planning and development stages of infrastructure projects. Other development institutions are also looking to break down the historical cross-sector barriers. These steps can facilitate greater advance coordination and planning. Projects can be designed and built with greater sharable capacity – for example, by installing OPGW on new or rebuilt transmission lines with high fiber counts rather than low fiber counts. Similarly, road projects can routinely include the installation of a [duct bank](#) along the roadway whether needed for the transportation system or not. Projects, and institutional rules, can also be evolved to allow more flexibility to embrace multi-sector needs within and around the same project.

379. These cross-sector planning efforts are currently only in a nascent stage and would benefit from continued and increased focus on the potential to leverage investment in one sector to benefit economic development in other sectors.

380. One approach is to plan, each time lateral infrastructure is being deployed or rehabilitated, to deploy fiber and/or ducts with ample excess capacity, whenever possible. This creates an alternative revenue source for the utility or other infrastructure owner, and also improves the options for telecommunications operators. Typically, the costs of doing so within the overall budget of the project are negligible, and the availability of communications infrastructure along these lateral corridors can provide continuing benefits to the operation and maintenance of the core activity of the infrastructure.

8 Business and project case studies

381. This module sets out 15 examples of cross-sector infrastructure sharing projects throughout the globe.

8.1 Lesotho Electricity Company

8.1.1 Introduction

382. This case study examines (1) the planning process by which Lesotho Electricity Company (Proprietary) Limited (LEC), a vertically integrated provider of electricity transmission and distribution services, decided to commercialize telecommunications access to its sharable infrastructure and (2) LEC's early stages of implementation.¹⁰⁹ For the reasons discussed, LEC adopted a business model of leasing dark fiber installed in its transmission grid and hosting third-party fiber optic cable installed on utility poles used in its distribution system.

8.1.2 Background on LEC

383. Lesotho is a small, mountainous country, located at a high altitude, with a land area of roughly 30,000 km² and a population of just over 2 million people with a relatively low growth rate. It is landlocked and bordered by South Africa on all sides.

384. LEC is the enfranchised monopoly provider of electricity transmission and distribution services in most inhabited areas of Lesotho. LEC was originally established in 1969 as a parastatal enterprise that combined both the operational and regulatory functions of transmitting and distributing electricity. In 2006 and 2007, through the passage and implementation of the Lesotho Electricity Authority (Amendment) Act 2006, the Government separated the regulatory and operational functions, with the “new” corporatized LEC succeeding to all transmission and distribution operational functions. The regulatory functions were conferred on a newly established regulator, the Lesotho Electricity Authority, which was subsequently also endowed with authority to regulate water supply and renamed as the Lesotho Electricity and Water Authority (LEWA). LEC remains wholly state-owned, but is fully corporatized and operates on a financially independent and sustainable basis as a standalone enterprise.

385. LEC's electricity system comprises a transmission grid comprising 1,041 km in transmission lines and 42 substations and an above-ground distribution system comprising 1,720 km in distribution lines and approximately 18,000 utility poles. LEC's transmission grid is interconnected with the transmission grid of Eskom of South Africa at the western, northern and eastern borders of Lesotho. LEC's electricity distribution system operates at 11 kV across Lesotho from the various transmission substations. With few exceptions, the distribution system is concentrated in the western lowlands of Lesotho.

386. Beginning in 2002, LEC invested heavily in constructing an internal fiber optic network on its transmission grid to improve the reliability, efficiency and safety of its transmission grid and to support its other internal communications needs. In the first phase, LEC installed 64 km of [ADSS](#) fiber on its 33kV transmission lines. This installation was concentrated around greater Maseru, the capital city of Lesotho and the area of highest concentration of LEC customers. In 2012, LEC completed a second rollout of 383 km of fiber on its 132kV transmission and 33kV transmission lines using [OPGW](#). LEC's fiber optic network was built to serve its requirements for teleprotection

¹⁰⁹ Information for this case study was provided by LEC.

and telecontrol of the transmission grid as well as voice and data communication between its control center and substations.

All of these fiber optic cables have 12-core fibers (6 pairs). LEC did not require high capacity telecommunications bandwidth, but did require extremely high availability and security for its telecommunications circuits. LEC used only one fiber pair for its own requirements on each of its installed fiber optic route segments, and has reserved another fiber pair as a spare. After completion of these two phases of construction, LEC's fiber network covered 447 km of its 1,041 km of transmission lines and connected 29 of its 42 substations. LEC had plans to eventually complete the network to cover its entire transmission grid but first had to address other priorities for capital expenditures from its limited available funding sources.

8.1.3 Telecom business of LEC

Demand for fiber in Lesotho's telecommunications sector

387. As of 2015, Lesotho's telecommunications markets were dominated by two network operators. One was Econet Telecom Lesotho (Pty) Ltd (ETL). ECL was 70% owned by Zimbabwe-based Econet and 30% owned by the Government. At the time of its partial privatization, ETL (then known as Telecom Lesotho) had been the monopoly fixed-line operator. It was subsequently issued a mobile license. ETL has an extensive terrestrial fiber optic network in Lesotho which it uses to provide backbone and metropolitan transport services for its own fixed-line and mobile networks and to provide wholesale services to other operators. ETL's fiber network is primarily installed above-ground on its own utility poles located in roadway corridors. ETL has invested significantly in its fiber network but has experienced frequent network availability issues due to vandalism, theft and other hazards to its poles and the lack of ring architecture. The resulting network outages repeatedly impacted the reliability of ETL's services to its customers, including the Government, which had a long-term contract for data transport over ETL's fiber network. Reports on the extent and quality of ETL's fiber suggested that installing fiber on its own poles was not a practice ETL would continue as it expanded its network, because the network could not meet international standards for high availability of broadband networks. In the interim, ETL had no competition so its customers had no alternatives for a fixed fiber service provider, and ETL had not cost-effective options for installing its fiber (as burying fiber would have been significantly more expensive and would not necessarily have improved reliability).

Figure 23: ETL pole on route to Mohale’s Hoek which was cut down by thieves or vandals



Source: Anders Engvall¹¹⁰

388. The other large network operator in Lesotho is Vodacom Lesotho (Pty) Ltd (VCL), which is a wholly owned subsidiary of Vodafone Group plc. VCL operates a mobile network and does not have a fixed network. VCL had no fiber network of its own and relied primarily on microwave links to transport the bulk of the backhaul traffic to and from the tower sites used in their mobile access networks. These links are usually reliable but cannot handle the volumes of data required for 3G or 4G mobile broadband as demand and use begin to rise. Nor could VCL compete for the data transport business of the Government. By 2014, VCL had begun a multi-year process of upgrading all its mobile sites in Lesotho to 4G/LTE, starting first in the greater Maseru area. VCL knew it would eventually also need to upgrade its transmission network to handle the increased traffic volumes and anticipated employing a fiber network to do so.

389. In addition to ETL and VCL, Lesotho also had several small ISPs which mostly served business customers. Their networks were almost entirely wireless from end-to-end and their existing traffic volumes and near-term growth projections did not yet justify an investment in fiber. The primary exception was a link from Maseru to the border interconnection with South Africa for international traffic, for which the ISPs purchased data transport services from ETL.

390. In addition to these licensed commercial network operators, the Government also operated an internal network, the Lesotho Government Data Network (LGDN), which it had recently established under a 5-year contract with ETL. The network was mainly fiber-based and connected all districts in Lesotho. However, the cost of the LGDN service was very high, partly due to the high cost of fiber and partly due to lack of competition for ETL. The Government was therefore very interested in seeing competitive fiber optic facilities brought to market in order to reduce

¹¹⁰ This photograph was taken on a road between Mafeteng and Mohale’s Hoek, Lesotho.

costs, increase reliability and gain greater control over its infrastructure (by procuring its own dark fiber rather than bandwidth services on someone else's fiber).

LEC's motivations for establishing a telecommunications business

391. Over time, LEC began to receive repeated requests from VCL, ETL and the Government to lease excess capacity on its existing fiber network. LEC had not contemplated commercialization of excess capacity when it procured its fiber network, did not have a plan for market entry and had not evaluated the options and requirements for doing so. So LEC initially demurred when it received these requests.

392. The pressure on LEC to make its excess fiber assets available for use in the telecommunications sector mounted. The Lesotho National Development Corporation (LNDC) began to lobby for Government to require LEC to open up its fiber network. According to LNDC, high broadband prices and limited international connectivity were undermining efforts to attract and retain garment manufacturing firms (which needed to be able to receive design changes electronically and were unable to do so). LNDC advocated that this had a significant adverse impact on Lesotho's economy because garment manufacturing was one of the top export industries for Lesotho and the only one which created a large number of skilled jobs.

393. LNDC hired an international consulting firm to study options and make recommendations for addressing Lesotho's pressing and growing need for a national fiber network. In their report, the consulting firm recommended the formation of an independent fiber company to which LEC, VCL, ETL and the Government would contribute all their existing fiber assets and in which they would all have joint ownership. These recommendations were not considered attractive by any of the network operators, LEC or Government. In LEC's case, apart from being commercially unattractive, the proposed arrangement would have compromised LEC's control over the efficiency, reliability and safety of its electricity transmission grid and potentially compromised one potential source of revenue that could have supported LEC in its continued financial independence and efficiency.

394. In addition to pressure to open up its fiber network, LEC had also come under pressure, from ETL in particular, to provide access to and use of its electricity distribution facilities so telecommunications operators could install their own fiber on LEC's distribution poles. Based on its negative experience with pole cuts, ETL preferred to use LEC's electricity distribution poles to install new fiber. By sharing poles, ETL hoped to increase reliability (because electric utility poles are much less likely to be cut due to the high voltages they carry on open lines) and reduce its costs and delay (because sharing existing poles would be cheaper and faster than installing new poles or ducts).

395. Making matters worse for VCL and ETL, Lesotho's Communications Act 2012 did not provide licensed telecommunications operators with sufficient rights of access and use of public and private properties to enable them easily to install their own fiber facilities other than in the roadway corridors. As a result, VCL, ETL and all other licensed telecommunications operators in Lesotho had no legal means of accessing further private property to build, operate and maintain their networks, and could only use public properties if authorized to do so by the relevant authority (with no recourse under the Communications Act if such authorization were denied or granted on unreasonable terms and conditions). This left them relatively weak in their ability to assemble the lateral corridors required for backbone fiber optic installations or for extensions from these backbone networks to their radio base stations. In contrast, LEC continued to enjoy rights of use

and compulsory acquisition of public and private lands under the Lesotho Electricity Authority Act 2002, as amended.

396. Faced with this mounting pressure, and a sense of public duty, LEC's management and board decided that LEC should undertake necessary planning, obtain any required licenses and enter the market for infrastructure sharing in Lesotho. This, of course, only began the process and would not result in immediate availability of LEC's infrastructure to the telecommunications sector.

397. In November 2012, before undertaking its planning exercise, LEC requested a license from the telecommunications regulator, the Lesotho Communications Authority (LCA), to authorize it to provide wholesale data transport services. Then, in late 2013, LEC engaged external advisers to assist with strategy and planning for a telecommunications business.

LEC's explored options for establishing an infrastructure sharing business

The first task for LEC and its external advisers was to assess the condition, coverage and capacity of its existing fiber network and other sharable infrastructure, evaluate market demand for that fiber and infrastructure among the small number of potential customers, analyze the commercial, financial, operational and regulatory implications of various business models for commercializing its existing fiber and other infrastructure, and to develop a market entry and business development strategy. Among other things, this assessment process confirmed that LEC's fiber and other transmission and distribution assets had significant latent value which could be monetized from commercialization.

Evaluating and selecting business models

Selecting dark fiber leasing for LEC's transmission grid

398. LEC's management and board faced the threshold decision of selecting a business model for commercializing existing fiber on its transmission grid and monetizing the latent value of the remainder of its transmission grid for telecommunications use. From the market research and due diligence carried out with its external advisers, LEC expected that VCL needed to upgrade its transmission network from microwave to fiber to support 4G/LTE bandwidth requirements. LEC also expected ETL to gradually supplement or replace segments of its fiber network to increase redundancy and reach new points of presence, although LEC did not expect ETL's initial demand for fiber on the transmission grid to be nearly as great as VCL's. LEC also expected that both VCL and ETL would eventually want to begin linking their towers using fiber, starting with the higher traffic sites first.

399. LEC identified four potential business model options to address these market needs: (1) host third-party fiber optic cable on LEC's transmission grid; (2) install LEC's own fiber optic cable on the electricity transmission grid and provide dark fiber to third parties; (3) install and operate LEC's own fiber optic network on the transmission grid and provide bulk data services to third parties; or (4) a combination of these options. Following a thorough review and comparison of the four options, and assessment of the appetite of LEC's potential customers for each option, LEC chose the dark fiber leasing business model (option 2) for monetizing the latent value of its transmission grid. LEC made this choice for the following reasons:

400. LEC was able to dismiss the feasibility of providing bulk data services rather quickly. A bulk data service would have required significant upfront and recurring investment in equipment and personnel, and expenditures and expenses would precede revenues. This would have created significant and prolonged negative cash flow for LEC's telecommunications business and

substantially increased its financial risk, even if LEC did not invest in expanding its existing fiber footprint. LEC did not have access to retained earnings or external capital to fund such an investment, nor did it have the appetite for the associated commercial risks. In contrast, if LEC leased dark fiber or hosted third-party fiber, these activities would generate significant revenue (which could be accelerated if LEC entered into long-term indefeasible right of use (IRU) arrangements).

401. LEC also believed it had a significant comparative disadvantage to its customers and competitors in providing bulk bandwidth services. LEC had no commercial experience in this business, whereas VCL and ETL were both sophisticated telecommunications network operators. ETL already operated a large fiber optic data network in Lesotho. VCL was part of an international group with significant fiber optic data network experience in other markets. Offering bulk data services would only improve LEC's return in comparison with a dark fiber offering if LEC were able to implement and operate the data network less expensively and more effectively than its wholesale customers. Though this may have been the case if LEC had a large number of small potential customers, none of which could achieve its own economies of scale, it was an unlikely scenario in the case of VCL and ETL. Also, unlike the efficiencies of multiple users of separate dark fiber pairs in the same fiber optic cable, there were less potential efficiency gains from operators as large as VCL and ETL sharing the same equipment (directly or through LEC as a service provider). Any marginal inefficiency of having separate equipment would be outweighed by the flexibility and independence this would afford each operator in planning, modifying and operating its own data network.

402. Finally, LEC believed that entering the market as a dark fiber provider would not undermine its ability to offer a bulk data service to [ISPs](#) and other wholesale customers in the future.

403. Having concluded that option 3 (bulk data services) should be excluded, where LEC had already installed and maintained fiber optic cable its transmission grid, the decision also to exclude option 1 (hosting third-party fiber) was easy. This left dark fiber leasing as the obvious choice. LEC had existing fiber on some of the most sought after segments on its transmission grid and so its dark fiber inventory was immediately attractive to the market. This fiber had withstood the test of time and had proved to be extremely reliable. The existing fiber optic cable had sufficient excess dark fiber to meet the demand of all potential customers in the market. So, LEC was ready to meet the highest market needs for fiber along its transmission line routes.

404. On the remainder of its transmission grid, however, LEC still had the option to host third-party fiber rather than install its own fiber. The business case for LEC to extend its own fiber to the remainder of its transmission grid therefore required some analysis. Fiber installation requires significant capital investment and additional operating expense

405. Intuitively, hosting third-party facilities involved less risk for LEC than new fiber builds by shifting investment risk to the customer. Hosting third-party installations would allow LEC to release at least some of the latent value of its transmission grid. If LEC had little or no existing fiber on its transmission system, hosting third-party fiber installations may have been the optimal business model for LEC's transmission grid. However, because LEC had already invested significantly in fiber on the most valuable segments of its transmission lines, a third party was unlikely to invest in building fiber on many of the remaining segments. Under these circumstances, LEC would optimize its return (both in terms of internal network requirements) and maximizing financial returns from third parties by continuing to install its own fiber over time

to close the gaps on its transmission grid. There was therefore synergy from reinvesting proceeds from leasing existing dark fiber in continuing to build out LEC's fiber network on the remainder of its transmission grid. As the network was completed, LEC would also gain excess capacity, again in the form of unused dark fiber, along the new route segments. This in turn could also be used to generate additional revenue by adding to the dark fiber leasing portfolio

406. LEC also held the unique position of being the only likely catalyst for bringing VCL, ETL and/or another operator together for joint use of a single fiber optic cable. As such, LEC's incremental investment would be significantly less than the combined avoided costs of the multiple network operators who would lease dark fiber or buy services from LEC. This shared use improved the original business case for installing the dark fiber, and effectively positioned LEC as the catalyst for the shared use. LEC's role as catalyst added significant value across the market.

407. By installing its own fiber on the new transmission system routes, rather than allowing a network operator to do so, LEC would thereby acquire and retain the excess dark fiber in the new cable. This inventory would enable LEC to multiply its return on investment and preserve its future upside by allowing competing network operators to "share" use of the same fiber optic cable as dark fiber customers.

Selecting third party hosting for LEC's distribution system

408. For its electricity distribution system, LEC selected a business model of hosting third-party telecommunications attachments on its utility poles. LEC's incremental cash investment required to offer shared use of its distribution poles was modest in absolute terms and insignificant in comparison with the costs avoided by network operators who would use it. The infrastructure already existed, had been paid for and was being maintained with revenue received from electricity customers.

409. LEC's incremental cash investment in offering access and shared use of its distribution poles was thus limited to setting up, staffing and maintaining a small organizational unit to handle the business. LEC would also face modest incremental operating costs in initially preparing its poles for hosting and thereafter in maintaining its electricity systems, but only as and when it hosted telecommunications facilities. LEC also confirmed with potential customers that it would be possible to require that these [make ready costs](#) be prepaid, so LEC would not be out of pocket.

410. Moreover, LEC's existing distribution system had tremendous latent value that could be released and realized as revenue by making it available for shared use by network operators as a hosting facility for commercial fiber optic networks. The exponential increase in end user demand for data volumes was forcing both VCL and ETL to install fiber optic links between their radio base stations, network operations centers and international gateways. Both VCL and ETL had confirmed their need for fiber optic backhaul and their intention to build out fiber to every broadband-enabled tower in their mobile access networks as quickly as they could support it with their capital budgets.

411. LEC chose not to install its own fiber on its distribution lines. In contrast with its transmission grid, LEC had no current or near term strategic need for fiber on its distribution system. LEC therefore did not want to invest its own capital (whether derived from dark fiber leases on the transmission grid or another source to install fiber on the distribution system). The initial commercial value of such links was also currently quite limited to only those distribution lines which connected to mobile radio cell towers. With the multitude of potential route segments

on its distribution system, LEC was unlikely to have more than one wholesale telecommunications customer on most segments. The network operators would likely pick and choose among these route segments to build only those feeder lines necessary to connect their cell towers. There was therefore no viable business case for LEC to install its own fiber on distribution lines or to provide bulk data services over a network installed on its distribution lines.

Developing a financial and investment plan

412. Based on its overall analysis of the commercial opportunities and its own internal planning needs, LEC established completion of its internal communications network as its initial objective. In the immediate future, this objective entailed completion of the fiber network on its transmission grid and potentially adding additional electric utility applications and connectivity that take full advantage of that network.

413. LEC was already using the fiber on existing routes to support teleprotection applications, a [SCADA](#) system and internal voice and data communications. However, the fiber network and these applications covered only 19 of LEC's 42 substations and lacked redundancy between some of those it connected.

414. As its longer term objective, after completing its internal network, LEC planned to use the earnings from its infrastructure sharing business to provide future rate relief to electricity customers and generate unrestricted income to reinvest in underfunded electricity projects. To the extent completing and maintaining the internal communications network, including enhanced electric utility applications, improved efficiency of LEC's electricity systems and operations, LEC's primary objective would already provide some element of rate relief to electricity customers.

415. In addition, some of the income from LEC's commercial telecommunications activities could be used to offset revenue requirements and hence flow through as rate relief for its electricity customers in future rate setting. At the same time, some of the income from LEC's commercial telecommunications activities might also be treated as "unrestricted income" for purposes of its regulated electricity business allowing it to be reinvested in projects that had not been approved for recovery through electricity rates.

Nature of LEC's current businesses

416. In 2015, at the request of the electricity regulator, LEC formed a wholly owned subsidiary, LEC Communications (Pty) Ltd (LECC), to conduct its commercial telecommunications infrastructure sharing business. LECC has been vigorously pursuing cross-sector infrastructure sharing opportunities for LEC.

VCL fiber-to-the-tower arrangements

417. LEC and LECC signed their first infrastructure sharing arrangement with VCL in mid-2015. This arrangement will provide VCL with end-to-end fiber-to-the-tower using LEC's infrastructure, and appears to be the first such arrangement between an electric utility and telecommunications operator in sub-Saharan Africa.

418. The LEC/LECC-VCL arrangement has the following attributes:

- VCL will acquire indefeasible rights of use (IRUs) in 643 km of dark fiber on LEC's electricity transmission grid and install its own on LEC's electricity distribution poles to provide end-to-end high bandwidth connectivity to all of VCL's 4G-equipped radio base

stations in Lesotho. Vodacom's fiber extensions will interconnect with LEC-provided fiber at LEC's substations.

- The infrastructure will be placed in service in three phases between 2015 and 2017. The first phase will extend fiber to all of VCL's towers in metropolitan Maseru. The second will extend fiber to a large portion of VCL's towers across Lesotho. The third phase, which will follow LEC's installation of 185 km of additional transmission line fiber, will enable VCL to reach all its 4G-equipped towers and provide fiber-backed 4G service to its customers in Lesotho.
- The additional installations of 185 km of fiber, made possible by the sharing arrangement with VCL, will extend the reach of LEC's existing 447 km internal fiber network to meet the requirements of its electricity businesses.
- VCL's fiber attachments to LEC's poles will use [ADSS](#) cable and be underhung below the electric space and above the minimum ground clearance area. As part of the infrastructure sharing arrangement, VCL will provide LEC with use of one dark fiber pair in VCL's cables installed on LEC's electricity distribution poles, which are expected to cover about 10% of LEC's 18,000 distribution poles. This will facilitate LEC's future deployment of systems to enable real-time electronic meter reading and other smart grid applications.
- LEC will continue to own all existing and new fiber network on its transmission grid, and conduct all maintenance required to keep this fiber optic network in good working order.
- Payment for the IRU will have two main components, an upfront IRU payment structured to account for the phased rollout of the fiber network as a whole and a hosting and maintenance component, which will be paid annually upfront. Payment for pole attachments will include an upfront make ready fee and annual pole rentals.
- The expansion of the network was based on the shared priorities of LEC and VCL.
- VCL's access to LEC's transmission line fiber will be at transmission substations and other defined access points.
- The initial term of the IRUs will be 15 years, with renewal options for VCL, and the term of the pole attachments will be automatically renewable annually at VCL's option.

ETL infrastructure sharing arrangements

419. At the time of preparation of this toolkit, LEC, LECC and ETL are engaged in ongoing discussions around ETL leasing dark fiber on an annual renewable basis on selected routes to supplement ETL's existing fiber network. LEC, LECC and ETL are also in discussions around ETL leasing pole attachment space on LEC's distribution poles.

8.1.4 Legal, regulatory and policy issues

420. LEC had held a telecommunications license to operate a private mobile radio (PMR) network for many years. The licensed radio frequencies were and are used by LEC to operate a mobile communications system to support the activities of its utility line crews.

421. In anticipation of providing commercial telecommunications services to third parties, however, LEC had requested a license from the telecommunications regulator, the Lesotho Communications Authority (LCA), in late 2012. The LCA prepared and supplied LEC a draft

telecommunications license based on LEC's indication at the time that it intended to offer bulk data and Internet services to other network operators at wholesale. However, this draft license did not properly reflect the passive infrastructure business model that LEC had eventually chosen in 2014.

422. On its face, the Communications Act 2012 did not require LEC to possess a telecommunications services license in order to engage in a passive telecommunications infrastructure business. However, the LCA has expressed its position that a license is required under the Act. On this basis, LECC has applied for the requisite license.

423. The purpose of LEC establishing LECC as a separate telecommunications subsidiary, as requested by LEWA, the electricity regulator, was to facilitate structural and accounting separation of the infrastructure sharing business from the electricity businesses. Under Lesotho's regulatory framework, all income generated by the LEC's electricity businesses or the use of electricity rate base assets is *regulated income*, and generally must be accounted for as income of the electricity businesses and applied toward LEC's revenue requirements on which its LEC's electricity tariffs are based. On the other hand, all telecommunications income is generally *unregulated income* which is not taken into account in meeting LEC's revenue requirements or establishing its future electricity tariffs, and can generally be used by LEC for any lawful purpose.

424. However, because the business involves passive infrastructure which will continue to be jointly used by LEC, ownership and control of the infrastructure will remain in LEC. The subsidiary, LECC, will primarily act as a commercial agent of LEC in dealing with passive infrastructure customers.

425. LEC has proposed to LEWA that it approve incentive regulation whereby revenue from the passive infrastructure business be shared between LEC and its electricity ratepayers rather than trying to calculate a proportion of the cost of the shared infrastructure to remove from the regulatory asset base. As of this writing, LEC has not yet received confirmation from LEWA as to whether the regulator will require cost sharing or will instead substitute revenue sharing as requested by LEC.

8.1.5 Lessons learned

LEC is a great example of an electric utility commercializing its passive infrastructure, in the form of excess fiber on its transmission lines and space on its distribution poles. LEC carefully studied market demand and shaped its commercial offerings to meet the services that the country's telecommunications operators needed while remaining mindful of its own strengths and weaknesses. The entire transaction between VCL and LEC was planned and negotiated entirely voluntarily without legal compulsion, serves the commercial and strategic interests of both parties, and is probably one of the more innovative cross-sector infrastructure sharing transactions that has been agreed in sub-Saharan Africa.

8.2 RailTel (India)

8.2.1 Introduction

426. This case study examines the telecommunications business of RailTel Corporation of India Ltd. (RailTel), a wholly owned subsidiary of Indian Railways.¹¹¹ It focuses on the history of and context for the establishment by Indian Railways of RailTel as a separate entity for the commercialization of telecommunications assets deployed along rights of way of Indian Railways and highlights RailTel's commercial success with cross-sector infrastructure sharing in India.

8.2.2 Background on RailTel

427. Indian Railways is the state-owned railway company of India with over 65,000 route-km of railway track.¹¹² It operates the largest railway track network in Asia and the second largest under common management globally.¹¹³ RailTel is a wholly owned subsidiary of Indian Railways, which in turn is wholly owned by the Government of India through the Ministry of Railways.

428. Indian Railways was initially reliant entirely on the Department of Telecommunications, the former state-owned monopoly provider of telecommunications, for its internal communications needs. In the early 1970s, Indian Railways began deploying its own internal communications systems to increase circuit efficiency on its rail lines. It utilized overhead telephone lines, quad cables, microwave systems and other available technologies. In 1983, the Railway Reforms Committee decided to replace the existing communications systems and install a dedicated fiber optic telecommunications network with the goal of increased safety, reliability, availability and serviceability.

429. In 1988, Indian Railways commissioned its first fiber optic network, located in Mumbai. The network comprised 60 route-km across 28 stations and was used for train operation and control. The expansion of the Indian Railways fiber optic network was slow, growing to only approximately 4,000 route-km over the next decade. Although Indian Railways was only using a small portion of the available capacity, it was unable to commercialize its excess capacity under the existing regulatory and policy environment.

8.2.3 Telecommunications business of RailTel

Decision to enter into telecommunications business

430. Motivated by the Government of India's New Telecom Policy, 1999 (described below), Indian Railways decided to form a separate entity to market and exploit remaining capacity on its fiber optic network, generate additional revenues and use these revenues to further expand the network. The creation of a new telecommunications subsidiary would permit Indian Railways to maintain its focus on its core activity of rail operations.

431. In September 2000, RailTel was formed as a commercial public sector undertaking, independent from Indian Railways, with a mandate to modernize the Indian Railways communications network and to significantly contribute to the realization of the goals and objectives of the New Telecom Policy, 1999. The existing fiber optic network of Indian Railways,

¹¹¹ Unless otherwise indicated, information included in this case study was provided by RailTel.

¹¹² Indian Railways, "Track/Route Kilometres" (as of Dec 2015).

¹¹³ Indian Railways, "Evolution" (as of Dec 2015)

then approximately 4,500 route-km, was transferred to RailTel on its formation in 2000 in exchange for 100% of the equity of RailTel. The equity would be held by the President of India through the Ministry of Railways. Indian Railways did not receive any cash or other compensation in the transaction.

Telecommunications network of RailTel

432. On its formation, Indian Railways assigned RailTel an irrevocable right to use the rights of way of Indian Railways, comprising approximately 65,000 route-km of railway track and passing through 7,000 railway stations across India. The original rights of way granted to Indian Railways were primarily for laying tracks, but also included the rights to use incidental infrastructure, such as construction of communication towers and the laying of cables for signaling and other communication functions. No modification to the scope of these rights of way was necessary to permit RailTel to lay additional fiber cables or provide commercial telecommunications services over these cables.

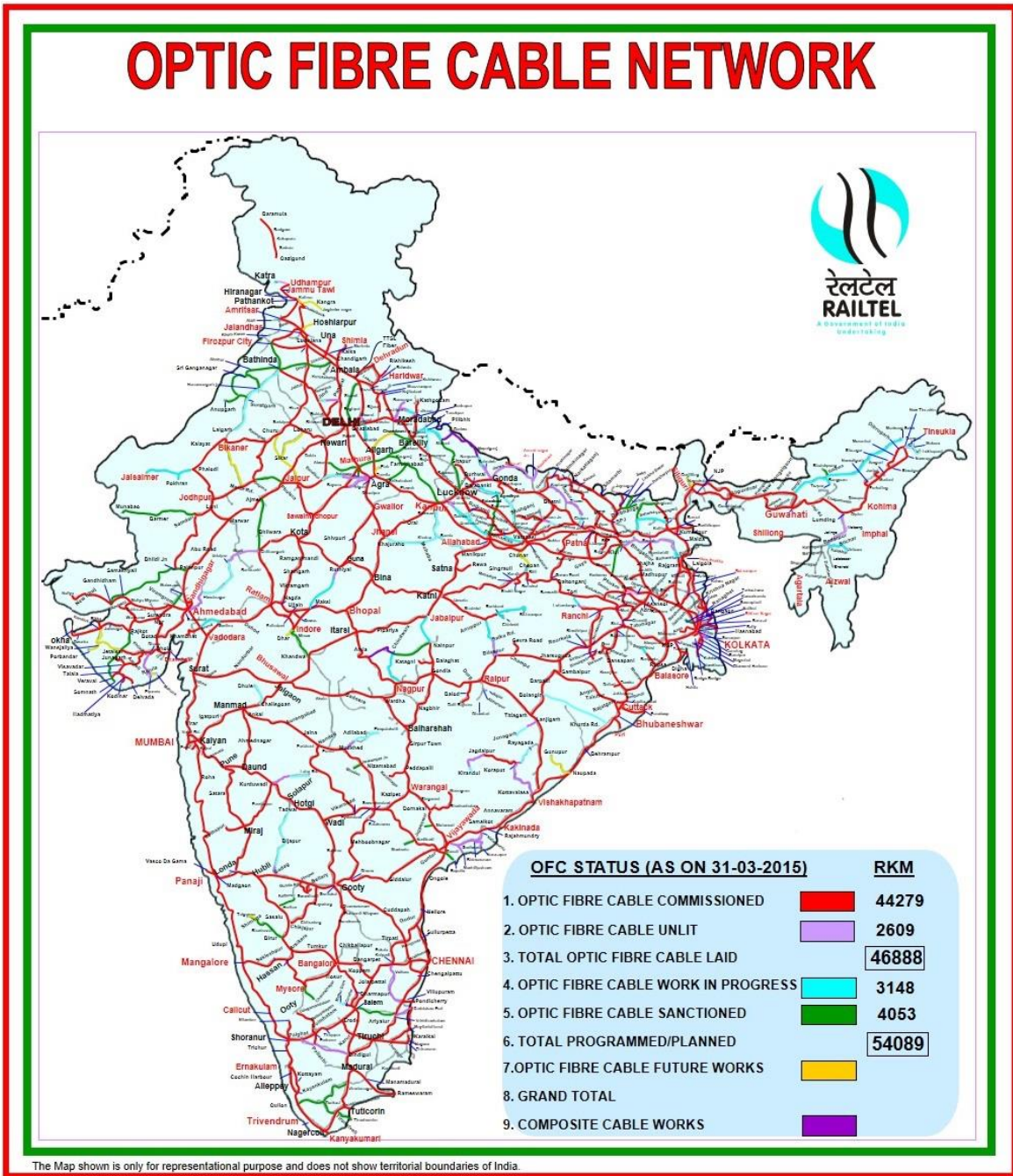
433. In 2001, RailTel began rolling out fiber optic cable along national railway routes, laying over 25,000 route-km by 2006 and over 45,000 route-km by early 2015. As of April 2015, RailTel was in the process of deploying another 5,000 route-km. For its last mile and other access networks, RailTel has acquired rights of way directly from local authorities. As of April 2015, RailTel's network reached over 4,300 towns and cities across India, including many in remote and rural areas.

434. RailTel's fiber optic network consists of armored 24-fiber cables deployed in ducts. Four fibers in each cable are dedicated for use by Indian Railways though they are maintained by RailTel. A centralized network management system in New Delhi manages the network with a backup system in Secunderabad/Kolkata.

435. In addition to its fiber optic backbone network, RailTel has rolled out:

- an MPLS-IP backbone network with points of presence in 40 cities to provide [virtual private network services](#), broadband Internet access and multicast services;
- a Next Generation Network in 36 cities for carrying voice-based traffic as well as data and value added services; and
- a fiber access network in over 100 major cities in India.

Figure 24: Map of RailTel's fiber optic network



Source: RailTel Corporation of India

Nature of RailTel's business

436. In 2002, RailTel began offering wholesale bandwidth services to telecommunications network operators.¹¹⁴ RailTel promoted its services through direct marketing and sales to India's

¹¹⁴ Railtel Corporation of India Ltd., "Milestone" Railtel, <http://www.railtelindia.com/profile/milestones.html> (last visited 11 Feb 2017).

telecommunications operators. The initial services utilized by these operators were [leased line services](#) and co-location of telecommunications equipment on its fiber network and its towers.

437. RailTel initially leased dark fiber on its backbone network to telecommunications customers. However, it subsequently decided against offering dark fiber on its backbone network for two reasons. First, dark fiber leasing generated less revenue than the [leased line services](#) for which there was ample demand. Second, RailTel's network became attractive to enterprise customers, in part because of the exclusive rights of way it acquired from Indian Railways. Leasing dark fiber to telecommunications operators would allow them to utilize the network to compete against RailTel for these same enterprise customers.

438. RailTel's fiber optic infrastructure was initially used extensively by all of India's mobile network operators to roll out their networks. Operators continued to rely heavily on RailTel's network until around 2008 when increased competition and the introduction of new operators led to a significant decrease in mobile tariffs. Many operators resorted to building their own networks, which would incur costs in the short term but ensure long term sustainability by eliminating network and infrastructure leasing. Many of these operators, as well as other entities, have since built competing fiber optic networks along public roads. Yet nearly all major mobile network operators still use RailTel's network to at least provide redundancy along a separate route.

439. RailTel's telecommunications operator customers as of December 2015 include all major telecommunications operators in India.

440. In 2005, RailTel launched the first STM-16 network in India. It also began offering services to non-telecommunications customers, including:

- [virtual private network services](#) to enterprises, banks education institutions and government entities;
- dedicated Internet bandwidth to enterprises and education institutions; and
- dark fiber leasing to cable television operators.

441. More recently, RailTel has added other services to its portfolio, including:

- data center services;
- audio/video conferencing (telepresence) services in facilities in major cities;
- Railwire, a retail broadband initiative that utilizes partnerships with local network operators; and
- consultancy services for execution of IT and telecommunications projects.

442. As RailTel is ultimately owned by the Government of India, it naturally plays a role in furtherance of the Government's telecommunications policy initiatives. For example, RailTel is one of the implementing partners in laying fiber optic cable in furtherance of the National Optical Fiber Network. This project is led by the newly formed state-owned Bharat Broadband Network Limited (BSNL). Its goal is to provide connectivity to all the 250,000 Gram panchayat's (village-

level units of local government) utilizing existing fiber optic cable of public utilities, including RailTel, Power Grid Corporation (India's state-owned electric transmission utility) and BSNL.¹¹⁵

443. One of RailTel's objectives is to modernize the telecommunications network of Indian Railways for safer and more efficient train operations. Every station on RailTel's network has been provided with fiber based links to support Indian Railways' data connectivity needs, including its passenger reservation and ticketing systems. RailTel also provides data connectivity among Indian Railways' field organizations and offices of the Ministry of Railways, among other services. By outsourcing most of its communications needs to RailTel, Indian Railways is able to focus on its core activities and avoid major telecommunications capital expenditures.

444. As of late 2015, Indian Railways is in the process of introducing Wi-Fi services at its stations. RailTel is serving as implementation partner and will lead the design, operation and maintenance of the new services, including facilitating marketing and revenue collection. To achieve this, RailTel has partnered with Google, making its passive infrastructure available for use.¹¹⁶

Finances of RailTel

445. RailTel's network roll-out was financed with Rs 4 billion from a consortium of banks led by the State Bank of India and Indian Railway Finance Corporation¹¹⁷, the dedicated financing arm of the Ministry of Railways. These loans were repaid in full by January 2013, and as of 2015, RailTel is debt free, does not receive any funding from the Government of India, and uses its own revenues to finance network expansion.

446. Because RailTel is independent from Indian Railways, its sole shareholder, it files its own annual reports in accordance with Indian accounting rules. In its 2014-15 financial year, RailTel declared total gross revenues of Rs 5.55 billion with a net profit of Rs 1.21 billion.

447. Initially, RailTel was required to share 4% of its gross revenue¹¹⁸ with Indian Railways plus a fixed amount of Rs 113.4 million as compensation for use of its rights of way. This formula proved too burdensome to RailTel and was revised in 2006 to eliminate the fixed amount and increase the percentage of gross revenue share to 7%. For RailTel's 2014-15 financial year, this revenue share amounted to Rs 192.7 million. RailTel also pays annual dividends to Indian Railways. The revenue sharing and dividends are the sole compensation that RailTel pays to Indian Railways.

448. As Indian Railways utilizes four fibers in each of RailTel's 24-fiber cables, it bears a proportionate cost of capital expenditures for network deployment. In most cases, Indian Railways will initiate a project to lay fiber cable along portions of its track. Indian Railways will then pay RailTel for the cost of laying the cable plus a 13% execution charge. Railways will then transfer 20 fibers on the cable to RailTel in exchange for additional equity. Less often, RailTel will initiate a project to lay cable based on its own business requirements and will transfer four fibers to Indian Railways at cost with no execution charge. Under both scenarios, RailTel performs maintenance

¹¹⁵ <http://www.bbnl.nic.in/index1.aspx?sid=249&lev=2&lid=21&langid=1> (last visited 11 Feb 2017)

¹¹⁶ Khan, Danish. 2015. "Google, RailTel joins hands for one of the world's largest Wi-Fi projects." *The Economic Times*. September 28. Available at http://articles.economictimes.indiatimes.com/2015-09-28/news/66957816_1_railwire-google-mumbai-central-station (last visited 11 Feb 2017).

¹¹⁷ <http://irfc.nic.in/index1.asp?lang=1&linkid=1&lid=3> (last visited 11 Feb 2017)

¹¹⁸ Gross revenue excludes licensing fees paid by RailTel.

on all of the cables and Indian Railways pays RailTel for one-sixth (4 fibers/24 fibers) of that maintenance cost.

449. RailTel did not achieve its first profitable year until 2007, seven years after it began operations.¹¹⁹ This was primarily due to expenditures made on procurement of equipment during the initial roll out of its services and expansion of its network and the burdensome revenue share with Indian Railways which was later reduced. Since 2007, its annual profits have grown each year.

8.2.4 Legal, regulatory and policy factors

450. The formation of RailTel was motivated largely by policies in India that encouraged cross-sector infrastructure sharing. In particular, as part of the New Telecom Policy, 1999, the Government of India opened up national long distance services to private operators, introducing competition in the market. To support this new competitive environment, the Government encouraged cross-sector infrastructure sharing by public utilities:¹²⁰

Usage of the existing backbone network of public and private power transmission companies / [Indian] Railways / GAIL, ONGC etc. shall be allowed immediately for national long distance data communication and from January 1, 2000 for national long distance voice communications.

451. While no government entity regulates cross-sector infrastructure sharing *per se*, the Telecom Regulatory Authority of India (TRAI) is India's telecommunications sector regulator. The TRAI sets ceilings on the tariffs that can be charged for [leased line services](#). However, as of April 2015, RailTel claims that its tariffs have high discount structures and therefore are effectively freely negotiated in the market. RailTel's pricing is not otherwise directly regulated. However, its telecommunications operator customers have aspects of their pricing to customers and other operators regulated, and this regulation has an impact on how RailTel can price its services to these customers.

452. The Department of Telecommunications, under the Department of Communications & Information Technology, is responsible for granting telecommunications licenses. RailTel obtained an Infrastructure Provider Category-II (IP-2) license in 2002 which permitted it to offer leased line services to other licensed operators and enterprises. IP-2 licenses were discontinued in 2005 and the rights it granted were absorbed into the National Long Distance (NLD) license. RailTel holds a NLD license, for its provision of [leased line](#), voice transit and [virtual private network services](#), and an Internet Service Provider (Category-A)¹²¹ license, for its provision of Internet services across India.

453. RailTel is also an Infrastructure Provider Category I, which allows it to provide passive assets for telecommunications use such as dark fiber, rights of way, duct space and towers. No license is required, but registration with the Department of Telecommunications is mandatory.¹²²

¹¹⁹ Railtel, "Milestone" Railtel, <http://www.railtelindia.com/profile/milestones.html> (last visited 11 Feb 2017).

¹²⁰ India, Department of Telecommunications, "New Telecom Policy, 1999," Government of India: s3.5. Available at <http://www.trai.gov.in/about-us/acts-policies/new-telecom-policy-1999> (last visited 11 Feb 2017).

¹²¹ Category A covers the entire geographical region of India.

¹²² India, Department of Telecommunications, "Infrastructure Provider," Government of India, <http://www.dot.gov.in/infrastructure-provider> (last visited 11 Feb 2017).

454. As a wholly state-owned entity, RailTel is subject to procurement policies and falls under the jurisdiction of the Central Vigilance Commission, a government body established to prevent corruption in government institutions and public administration.¹²³ However, RailTel claims that these obligations have not hampered its ability to move quickly and effectively in a dynamic and competitive market.

455. A Telecommunications Dispute Settlement and Appellate Tribunal has been established to adjudicate disputes, including those between two or more service providers or between a service provider and a group of consumers.¹²⁴ However, RailTel has never been involved in a dispute before this Tribunal.

8.2.5 Lessons learned

456. RailTel's cross-sector infrastructure sharing experience has been widely considered a success. This success was only possible due to the policy and legislative actions of the Indian Government which encouraged cross-sector infrastructure sharing by public utilities.

457. RailTel claims it is the only example in India of a public utility successfully commercializing its rights of way for cross-sector infrastructure sharing. It credits this unique success to RailTel's structural and accounting separation from Indian Railways. While other utilities created internal departments to commercialize telecommunications assets, RailTel was able to focus entirely on its telecommunications businesses with its own sales and marketing efforts.

458. The experience has also benefitted Indian Railways, which is able to focus exclusively on operating a railway system. In addition, it has been able to leverage RailTel's expertise to improve its services. For example, Indian Railways expects up to 400 railway stations to have access to Wi-Fi as a result of the current partnership between RailTel and Google.¹²⁵

459. RailTel's extensive fiber network has permitted telecommunications operators to provide services in large areas of the country that were previously unserved or underserved with limited capital expenditures. Even today, when most major telecommunications operators rely on their own fiber optic networks buried along public roads, RailTel's network provides redundancy along a separate route. It has also expanded its service offerings to include a wide range of IT and telecommunications services for retail and wholesale customers. RailTel credits itself as a major contributor of proliferation of telecommunications services in India.

8.3 CEC Liquid Telecom (Zambia)

8.3.1 Introduction

460. This case study examines the telecommunications business of CEC Liquid Telecom, an equal joint venture of the Copperbelt Energy Company Plc (CEC) and Liquid Telecommunications Holdings Limited of Mauritius (Liquid Telecom).¹²⁶ It focuses on CEC's experience as an

¹²³ Central Vigilance Commission. *Annual Report 2013* at viii (2013). Available at <http://cvc.nic.in/ar2013.pdf> (last visited 11 Feb 2017).

¹²⁴ Telecom Regulatory Authority of India, "History," Government of India, <http://www.trai.gov.in/about-us/history> (last visited 11 Feb 2017).

¹²⁵ Khan, Danish. 2015.

¹²⁶ Unless otherwise indicated, information included in this case study was provided by CEC Liquid Telecom.

electricity transmission and distribution company entering into a telecommunications business, Liquid Telecom’s entry into the Zambian telecommunications market, and the ensuing joint venture between the two companies to commercialize the telecommunications assets of CEC.

8.3.2 Background on CEC and Liquid Telecom

The Copperbelt Energy Corporation Plc (CEC)

461. CEC is a Zambian power transmission electricity distribution company that owns and operates high-voltage transmission and distribution systems. CEC supplies electricity to Zambia’s mining companies based in the “Copperbelt” region of Zambia, known for its copper deposits, and more recently, a copper mine in the Democratic Republic of Congo (DRC).¹²⁷ Since 2005, it has also diversified into fiber optic telecommunications.

462. In 2014, CEC accounted for 39% of Zambia’s electricity generation. Its electricity generation capacity is set out in the Figure below:

Figure 25: CEC’s electricity generation capacity

Business element	2013	2014
Electricity sales to the mines	4,281GWh	4,208GWh
Transmission losses	2.84%	2.93%
Standby generation capacity	60MW	80MW

Source: CEC

463. CEC was originally formed in 1952 as the Northern Rhodesia Power Corporation to secure a power supply to Zambia Consolidated Copper Mines Limited (ZCCM), which operated a number of copper mines in Zambia’s Copperbelt.¹²⁸ In 1954, it was renamed the Rhodesia-Congo Border Power Corporation, with a mandate to supply reliable power to mines in Zambia and neighboring Congo¹²⁹ by interconnecting separately-run thermal power stations in the mining belt at the time.¹³⁰ In furtherance of this mandate, it constructed a 220 kV power line in 1956 from the Congo’s Katanga province to Kitwe in Zambia bringing hydroelectric power to Zambia’s mining industry for the first time.¹³¹

464. At Zambia’s independence in 1964, the Rhodesia-Congo Border Corporation was renamed the Copperbelt Power Company, which it remained until 1986, when it was incorporated into ZCCM as its power division. It became CEC in 1997 when it was sold off to Cinergy Global Power (U.S.) and the National Grid (U.K.) in a privatization, which together owned 77% of the

¹²⁷ Energy Regulation Board. 2014. *Energy Sector Report 2014*. Energy Regulation Board, Zambia: 11. Available at <http://www.erb.org.zm/reports/EnergySectorReport2014.pdf> (last visited 11 Feb 2017).

¹²⁸ CEC (Copperbelt Energy Corporation), “Milestones,” Copperbelt Energy Corporation, <http://cecinvestor.com/about-us/milestones/> (last visited 11 Feb 2017).

¹²⁹ The Congo was later known as Zaire (1965-1997), and since 1997, as the Democratic Republic of the Congo (DRC).

¹³⁰ Chanda, Davies M.M. 2014. “CEC: Zambia’s Oldest Private Owned Power Company.” *Times of Zambia*, October 23, 2014. Available at <http://www.times.co.zm/?p=40309> (last visited 11 Feb 2017).

¹³¹ Ibid.

newly-formed company. In 2007, the company was again sold to Zambian Energy Corporation. In 2008 it listed 25% of its shares on the Lusaka stock exchange.

Figure 26: Summary of the history of CEC

CEC over the years
1950s: Rhodesia Congo Border Power Corporation
1964-1982: Post-independence: Copperbelt Power Company (CPC)
1982-1997: ZCCM Power division
1997-present: Copperbelt Energy Company Plc

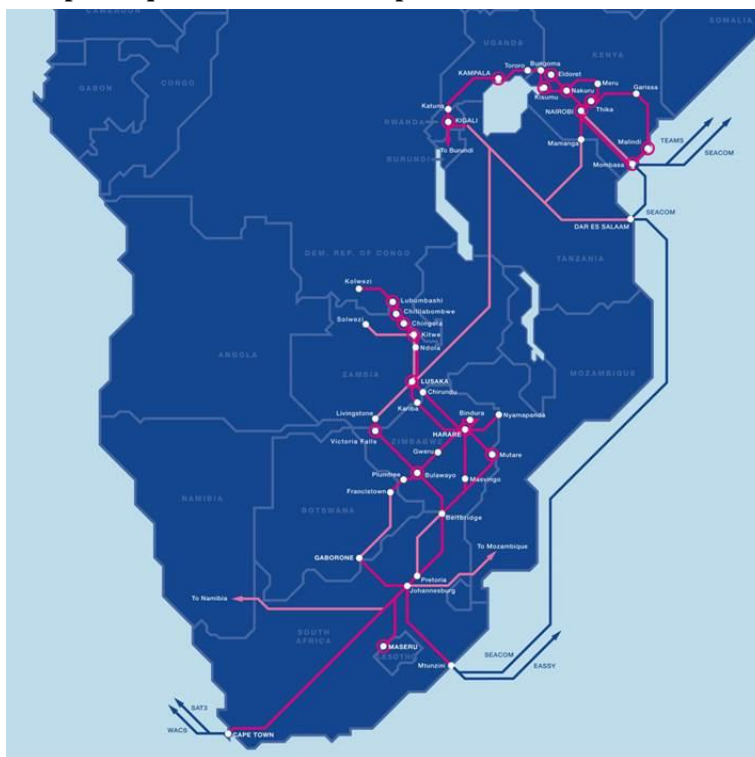
465. Today CEC’s majority shareholder is Zambian Energy Corporation (Ireland) Limited (ZECI), which owns a 52% stake of the company. ZCCM Investments Holdings PLC (ZCCM-IH), which is the successor company to ZCCM, still holds a 20% stake in CEC.

Liquid Telecom

466. Liquid Telecom, a subsidiary of Econet Wireless, is a major data, voice and IP services provider in Eastern, Central and Southern Africa that supplies fiber optic, satellite and international carrier services to Africa’s largest mobile network operators, [ISPs](#) and businesses of all sizes.¹³² It also provides payment solutions to financial institutions and retailers, as well as data storage and communication solutions to businesses.

¹³² Liquid Telecom, “About Us,” Liquid Telecom, <http://liquidtelecom.com/about-us> (last visited 11 Feb 2017).

Figure 27: Map of Liquid Telecom’s fiber optic cable network in Sub-Saharan Africa



Source: Liquid Telecom

467. Liquid Telecom was founded in 2004 as a privately-owned, Mauritius-based holding company. Originally a satellite and voice operator, in 2009 the company launched a high-speed, cross-border fiber optic cable network linking various countries in Southern Africa to the United Kingdom.¹³³ As of 2015, it has operations with wholesale, enterprise and retail operations in 15 locations across Africa and beyond. As of 2017, its fiber network stretched over 40,000 km.¹³⁴ Its wholesale network offers connectivity to five major submarine cable systems in the region, WACS, EASSy, SEACOM, SAT 3 and TEAMS.

468. When CEC Liquid Telecom was formed, Liquid Telecom had a presence in neighboring Botswana and Zimbabwe, as well as in Kenya, Lesotho and South Africa, but not yet in Zambia. The joint venture with CEC facilitated Liquid Telecom’s entry into the Zambian market, connecting the country’s existing fiber optic cable network with submarine cable systems landing in Zimbabwe.

¹³³ Liquid Telecom, “Our history,” Liquid Telecom, <https://www.liquidtelecom.com/about-us/our-history.html> (last visited 11 Feb 2017).

¹³⁴ Liquid Telecom, “A network link no other,” Liquid Telecom, <https://www.liquidtelecom.com/about-us/network-map.html> (last visited 11 Feb 2017).

8.3.3 Telecommunications business of CEC Liquid Telecom

CEC's initial entry into the ICT sector

469. One of the conditions of CEC's privatization in 1997 was that the purchasers of CEC would be required to invest in telecommunications infrastructure by retrofitting the entire existing telecommunications network with optic fiber.¹³⁵

470. In 2005, CEC made the decision to commercialize its fiber optic cable network in order to diversify its business. The new telecommunications business was initially operated by a telecommunications department within CEC. However, in 2006, CEC decided that it needed to find a fully-fledged company to run the telecommunications side of its business. It engaged Realtime Technology Alliance Africa (Pty) (Realtime), a well-established [ISP](#), which provided retail telecommunications services to most of Zambia's large corporate entities, as its partner and bought a 50% stake in the company.

471. No additional license or right of way was required to retrofit CEC's power lines with fiber optic cables. CEC had already been granted the right of way by means of a wayleave pursuant to section 15 of the 1995 Electricity Act from the Zambian Ministry of Lands.¹³⁶

Formation of the joint venture

472. By 2011, Realtime was not in a position to commit to the additional investment required to regionalize the fiber optic network, let alone to manage the telecommunications requirements of larger mobile phone customers that could come with the planned expansions.¹³⁷ As a regional fiber infrastructure builder and operator, with a terrestrial fiber network linked to the submarine cable networks, Liquid Telecom was a natural partner for such a venture. In 2011, CEC entered into the joint venture with Liquid Telecom. This partnership would help extend CEC's backbone infrastructure throughout Zambia and provide international connections to its fiber optic network.

473. From Liquid Telecom's perspective, CEC's established presence in Zambia, its existing fiber cable network, and the potential for leveraging its regional power transmission lines around the Copperbelt to lay further fiber optic cables were motivating factors for entering into the joint venture. Zambia was also seen as a strategic market for Liquid Telecom given its central location in Sub-Saharan Africa, and its potential to become a "nerve center of communication for the region."¹³⁸

474. The equal joint venture between CEC and Liquid Telecom was announced in early 2011 and received clearance from Zambia's Competition and Consumer Protection Commission in July of that year. CEC and Liquid Telecom each committed an initial investment of US\$15 million in the joint venture. CEC additionally contributed its customer base and transferred its existing telecommunications infrastructure to the new entity under an indefeasible right of use (IRU) arrangement, although ownership of the power transmission infrastructure remained with CEC.

¹³⁵ Interview conducted with CEC Liquid Telecom.

¹³⁶ Ibid.

¹³⁷ Ibid.

¹³⁸ Liquid Assets. 2014. "TBY talks to Andrew Kapula, Managing Director of Liquid Telecom on fiber-optic networks, increasing ICT efficiencies, and the growth of Zambian communications." *The Business Year*. Available at <https://www.thebusinessyear.com/zambia-2014/liquid-assets/interview> (last visited 11 Feb 2017).

While the new entity runs the commercial telecommunications business of both CEC and Liquid Telecom in Zambia, CEC carries out the operation and maintenance of the fiber optic cable network for an arm's-length service fee. Given that it is Liquid Telecom rather than CEC bringing its telecommunications portfolio and expertise into the joint venture, CEC's role in operating and maintaining the cable network helps to ensure the 50:50 balance in the relationship between the two shareholders.

475. After the joint venture was formed, Realtime and CEC Liquid Telecom were operated as separate companies, with CEC owning a 50% share in each company. In 2012, the CEC Liquid Telecom board decided to merge CEC Liquid Telecom and Realtime, a transaction that was finally completed in May 2015 when Liquid Telecom acquired the remaining 50% shares of Realtime.¹³⁹

Nature of CEC Liquid telecom's business

476. Since its formation in 2011, CEC Liquid Telecom has constructed a fiber optic network within the main commercial centers in Zambia and provided two international links to submarine fiber optic cables through Zimbabwe to South Africa, linking Zambia to other African countries and other continents. As of 2015, CEC Liquid Telecom is in the process of constructing a third fully redundant route out of Zambia through Livingstone as part of its Lusaka-Livingstone-Victoria-Falls fiber project. As of 2015, CEC Liquid Telecom has become one of Zambia's main carriers of international Internet traffic.

477. CEC Liquid Telecom operates primarily as a wholesaler of [transmission capacity services](#), with its backbone infrastructure in Zambia now spanning from Chirundu along the Zambezi River that marks the border between Zimbabwe and Zambia to Kasumbalesa, the border town between Zambia and the DRC's Katanga province. In an interview, the CEO of CEC Liquid Telecom noted that the company had already rolled out 683 kilometers of backbone fiber in Zambia, had retrofitted around 520 km of [OPGW](#) owned by CEC in the Copperbelt, and was in the process of rolling out a further 560 km of fiber optic cable nationally to connect all provincial towns to the network, with the bulk of the investment being spent on laying fiber cables along railway lines.¹⁴⁰ CEC Liquid Telecom also provides some last mile fiber to residential homes in Lusaka and the Copperbelt as part of its fiber to the home (FTTH) project.¹⁴¹

8.3.4 Legal, regulatory and policy factors

478. Zambia's telecommunications sector was first liberalized in 1994. At the time, the state-owned Posts and Telecommunications Corporation (PTC) operated both the postal and telecommunications services in Zambia and also regulated these sectors. The 1994 Telecommunications Act (1994 Act) dissolved the PTC, established a separate regulator, the Communications Authority of Zambia (CAZ) to regulate the telecommunications and postal sectors, and created two new state-owned entities, the Zambia Telecommunication Company

¹³⁹ TeleGeography. 2015. "CEC Liquid Telecom acquires Zambian ISP Realtime." *The Telecomist*, May 15. Available at <http://telecomist.com/2015/05/cec-liquid-telecom-acquires-zambian-isp-realttime/> (last visited 11 Feb 2017).

¹⁴⁰ TeleGeography. 2014. "CEC Liquid Telecoms to Spend USD15m on Infrastructure Upgrade." *The Telecomist*. January 30. <http://telecomist.com/2014/01/cec-liquid-telecoms-to-spend-usd15m-on-infrastructure-upgrade/> (last visited 11 Feb 2017).

¹⁴¹ CEC. 2015. *Sens Announcement*, by Julia C Z Chaila. Investor disclosure, Lusaka. Available at <http://www.luse.co.zm/wp-content/uploads/2015/03/CEC-2014-Full-Year-Results-SENS.pdf> (last visited 11 Feb 2017).

(ZAMTEL) and the Zambia Postal Corporation (ZAMPOST) to run telecommunications and postal services in Zambia, respectively.

479. The 1994 Act also opened up the telecommunications market to new entrants in all segments except the public switched telephone network and the international gateway, which were maintained as the preserve of ZAMTEL.¹⁴² However, little progress was made in improving the breadth and quality of telecommunications coverage in the country following the liberalization of the sector. After an extensive multi-stakeholder consultation with the private sector, civil society, academia, and government, a National ICT Policy was adopted in 2006¹⁴³ by the Ministry of Transport, Works, Supply, and Communications with the aim of promoting investment and building human capacity in the telecommunications sector to further the country's sustainable national development and policy reduction goals.¹⁴⁴

480. Improved access to and uptake of telecommunications services through the creation of a competitive and inclusive telecommunications sector has been a national priority in Zambia since the country's 2005 five-year national development plan. A National ICT Policy was adopted in 2006 to guide the development of the sector.

481. In 2009 the Zambian government enacted the Information and Communication Technologies Act (No. 15) (ICT Act), which replaced the 1994 Act. The ICT Act sought to “provide a conducive and enabling regulatory environment that will foster a competitive and efficient ICT sector in Zambia.” It implemented some improvements to the legal and regulatory framework in relation to the regulation and licensing of the telecommunications sector, and facilitated the sharing of infrastructure through open access and colocation provisions, as well as a simplified procedure for obtaining access to public or private land for the purpose of laying fiber optic cable.¹⁴⁵ The ICT Act renamed the CAZ as the Zambia ICT Authority (ZICTA) and empowered it as an independent legal body to regulate the telecommunications sector with a broader mandate and greater autonomy from the Ministry of Transport, Works, Supply, and Communications.

482. In 2010, the Government issued Statutory Instrument No 34 of 2010, which effectively ended ZAMTEL's monopoly on the international gateway by drastically reducing the cost of the license fee to operate internationally and thereby encourage private sector companies operating in the telecommunications sector to connect with telecommunications infrastructure in the region.¹⁴⁶

¹⁴²Research ICT Africa. 2010. *Zambia ICT Sector Performance Review 2009/2010*, by Shuller Habeenzu. Policy Paper, Zambia. Available at http://www.researchictafrica.net/publications/Policy_Paper_Series_Towards_Evidence-based_ICT_Policy_and_Regulation_-_Volume_2/Vol%20%20Paper%2017%20-%20Zambia%20ICT%20Sector%20Performance%20Review%202010.pdf (last visited 11 Feb 2017).

¹⁴³ Zambia, Ministry of Communications and Transport. 2006. *National Information and Communication Technology Policy*. Policy, Lusaka. Available at <http://unpan1.un.org/intradoc/groups/public/documents/unpan/unpan032690.pdf> (last visited 11 Feb 2017).

¹⁴⁴ ICT was included as a priority sector in Zambia's Fifth National Development Plan 2006-2010 with a view to promoting “a stable, fair and competitive investment climate that facilitates the development of Zambia as the hub for meteorology, information and communications technology in the region”.

The policy is available at: International Monetary Fund. 2007. *Zambia: Poverty Reduction Strategy Paper*. Strategy Report, Washington, D.C. Available at <https://www.imf.org/external/pubs/ft/scr/2007/cr07276.pdf> (last visited 11 Feb 2017).

¹⁴⁵ See sections 41, 43, 61, and 63 of the ICT Act (No. 15) of 2009.

¹⁴⁶ Research ICT Africa. 2010. *Zambia ICT Sector Performance Review 2009/2010*.

483. Since its establishment, ZICTA has been promoting the sharing of infrastructure to accelerate the laying of fiber optic cables, as well as the connection of Zambia’s fiber optic cable network with regional networks. This has facilitated CEC Liquid Telecom’s retrofitting of CEC’s power transmission lines with fiber optic cable, as well as its 2014 expansion of its fiber optic cable network in North Western Province in Zambia and to all the provincial capitals by capitalizing, in large part along existing railway lines.¹⁴⁷ While ZICTA has encouraged shared use, open access and colocations of telecommunications infrastructure, it has not coordinated, or required the coordination of the investments in fiber optic cable networks of the public utilities across the country.

8.3.5 Lessons learned

484. CEC Liquid Telecom’s cross-sector infrastructure sharing experience in Zambia has been considered a success. The policy and legislative actions of the Zambian Government to promote the ICT sector reduced the regulatory barriers to expansion of CEC Liquid Telecom’s optic fiber network along existing infrastructure rights of way. However, CEC Liquid Telecom’s success is also an example of a successful commercially driven arrangement between parties with common interests. It also shows the value of an infrastructure owner partnering with an experienced telecommunications operator to effectively commercialize telecommunications assets.

8.4 Baltic Optical Network (Estonia)

8.4.1 Introduction

485. This case study examines the structure and formation of the Baltic Optical Network (BON), a commercial alliance comprising a regional fiber optic network spanning Estonia, Latvia and Lithuania.¹⁴⁸ It also provides detail on the Estonian portion of the BON, operated by Televõrgu Limited (Televõrgu).

8.4.2 Background on BON

Overall network

486. Established in August 2002, the BON is a commercial alliance among three telecommunications operators from three countries: Televõrgu from Estonia, Latvenergo AS (Latvenergo) from Latvia and Data Logistics Center from Lithuania.¹⁴⁹ This commercial alliance allows each of these three operators to provide telecommunications services to customers across three [OPGW](#) networks constructed by each country’s state-owned electric utility. Each operator is thus able to provide coverage to customers across the entire region.

487. The three networks comprising the BON have collectively over 8,000 km of [OPGW](#) (up to 24 fiber pairs) installed along electric transmission lines in Estonia Latvia and Lithuania.¹⁵⁰ The transmission capacity of this [OPGW](#) network is STM-16 (2.5 Gbps).¹⁵¹

¹⁴⁷ TeleGeography. 2015. “CEC Liquid Telecoms to Spend USD15m on Infrastructure Upgrade.”

¹⁴⁸ Unless otherwise indicated, information included in this case study was provided by Televõrgu.

¹⁴⁹ BON (Baltic Optical Network) website, *BON*, Baltic Optical Network (as of Dec 2015).

¹⁵⁰ *Ibid.*

¹⁵¹ *Ibid.*

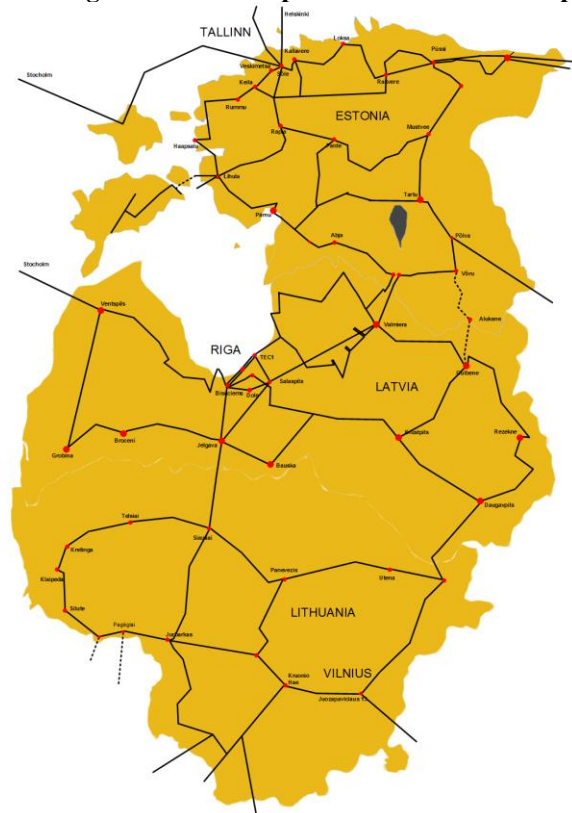
BON in Estonia

488. The Estonian portion of the BON utilizes infrastructure owned by Eesti Energia AS (Estonian Energy), the Estonian state-owned energy company. In 2000-01 Estonian Energy updated its electricity infrastructure and installed [OPGW](#) on its electricity transmission lines. The [OPGW](#) was installed for internal uses, including operation of a [SCADA](#) system and provision of internal telecommunications.

489. Initially the [OPGW](#) network was operated by an internal department of Estonian Energy that was previously responsible for operating the existing copper line telecommunications infrastructure. In 2001, Estonian Energy formed Televõrgu as a wholly owned subsidiary responsible for management and operation of the [OPGW](#) network, staffed with the same personnel that had operated the internal department.

490. At the same time, the Estonia's telecommunications sector was in the process of liberalization. The monopoly of the state-owned telecommunications operator was terminated and competition was introduced into the sector. Televõrgu saw an opportunity to provide commercial telecommunications services in addition to the services it provided to Estonian Energy. It entered the market as a wholesale provider of capacity to mobile operators and [ISPs](#). By 2010, only 25% of its business was dedicated to servicing Estonian Energy.

Figure 28: Baltic Optical Network route map



Source: Televõrgu

491. In 2012, Estonian Energy decided to sell Televõrgu to focus on its primary electricity business. It was purchased by Tele2 Estonia AS, a mobile operator that was one of Televõrgu's primary customers.

492. At the time of writing, Televõrgu’s network includes over 2,700 km of [OPGW](#) installed on Estonian Energy’s electricity infrastructure. Estonian Energy continues to own the [OPGW](#), but Televõrgu retains the rights to operate and manage it.

493. Televõrgu’s fiber networks extend beyond the [OPGW](#) infrastructure to include other networks in Estonia, including metro fiber networks in urban areas. Televõrgu operates as a carrier’s carrier, providing backbone [transmission capacity services](#) to television service providers, [ISPs](#), state owned companies and traditional telecommunications operators, including competitors of its parent company.

Figure 29: Televõrgu’s network



Source: Televõrgu

Brief description of BON in Latvia and Lithuania

494. The Latvian portion of the BON is operated by Latvenergo AS (Latvenergo), a public utility company engaged in generation of electricity and thermal energy and provision of telecommunication and information technology services.¹⁵²¹⁵³ Latvenergo provides approximately 90% of all electricity generated in Latvia, satisfying more than a half of the electricity demand in Latvia.¹⁵⁴ All shares of Latvenergo are owned by the government and held by the Ministry of Economics.¹⁵⁵

495. The Lithuanian portion of the BON is operated by Data Logistics Center, which was established in 2010. Data Logistics Center is part of Lietuvos Energija group, a state-controlled

¹⁵² Latvenergo, “Structure,” Latvenergo, http://www.latvenergo.lv/eng/about_us/briefly_about/structure/ (last visited 11 Feb 2017).

¹⁵³ Baltic Optical Network, *About us* (as of Dec 2015).

¹⁵⁴ Latvenergo, “Generation,” Latvenergo, http://www.latvenergo.lv/eng/about_us/generation/ (last visited 11 Feb 2017).

¹⁵⁵ Latvenergo, “Business card,” Latvenergo, http://www.latvenergo.lv/eng/about_us/briefly_about/business_card/ (last visited 11 Feb 2017).

entity which operates power and heat distribution and supply, natural gas trade and distribution as well as construction and maintenance of power plants and the electricity grid in Lithuania.¹⁵⁶

8.4.3 Commercial structure

496. The BON is not a legal or commercial entity. Rather, it is a commercial alliance among three separate and independent telecommunications operators. Customers engage with one of the operators to find solutions that may span the networks of these three operators under the alliance. In some sense they operate as competitors, as customers may compare the specific solutions and pricing offered by each of the three operators. The three operators meet frequently to coordinate their services and resolve technical and commercial issues that arise.

8.4.4 Legal, regulatory and policy issues

497. As a purely commercial alliance of three separate telecommunications operators in three countries, there are no specific regulatory or policy developments that apply specifically to the BON. However, each operator is subject to the domestic policies and regulatory frameworks in its home country, including requirements of the EU.

8.4.5 Lessons learned

498. BON is an excellent example of regional sharing of electricity infrastructure for telecommunications use. Within each country, existing [OPGW](#) resources held by public utilities are made available for commercial telecommunications services. The formation of BON as a transnational alliance was not driven by policy or regulatory forces, but rather by the commercial desire of three telecommunications operators to extend the reach of their networks beyond the confines of their respective nations' borders.

8.5 Kennedy Interchange (United States)

8.5.1 Introduction

499. This case study examines the construction of the Kennedy Interchange, a roadway construction project in Atlanta, Cobb County, State of Georgia, United States. This project was unusual, if not unique, in that two electrical utilities and several telecommunications utilities jointly constructed a [duct bank](#) in a road construction project and shared in the cost this construction. The joint construction benefited taxpayers and ultimately the utilities' rate payers by reducing the costs of the project.

8.5.2 Background on the Kennedy Interchange

500. In the late 1980's, the Kennedy family¹⁵⁷ wanted to sell an undeveloped tract of land that they owned in Atlanta. The property was located near the intersection of I-75 and I-285, two major interstate highways.¹⁵⁸ This intersection was in one of the busiest areas of Atlanta near a local

¹⁵⁶ Lietuvos Energija, Energy Company Group, "About the Lietuvis Energija group" (undated). Available at <http://www.le.lt/en/about-us/408> (last visited 11 Feb 2017).

¹⁵⁷ The Kennedy Interchange was ultimately named after the family that owned the property which, to the authors' knowledge, has no immediate relationship to the well-known American political family.

¹⁵⁸ Unless otherwise indicated, information included in this case study was provided by Thomas Jackson, former Manager of Joint Use and DOT at Georgia Power Company from 1995 to 2001 and Supervisor Joint Use and DOT from 1989 to 1995.

shopping mall and the Galleria complex, a collection of hotels and shops. It was generally a very desirable location for future real estate development. However, it was difficult for the Kennedy family to market the property as ripe for development for a number of reasons.

501. First, there was no direct road connection to or from I-75 or I-285. Only Akers Mill Road, a two-lane road, provided limited access to the property. It could not be easily expanded and directed to one of the highways because it ran adjacent to an electrical substation owned by Georgia Power Company (GPC), the local electricity transmission and distribution company. Moving the substation was cost prohibitive.

502. Creating new road access would also be difficult. The property was blocked on one side by the Rottenwood Creek National Scenic Area, which, under federal law, could not be disturbed. This made construction of an entirely new road impossible. The property was also located at the bottom of a large hill, about 40 feet below the surrounding terrain. The elevation change was abrupt making access difficult, even from the existing Akers Mill Road.

503. The businesses in the shopping mall and the Galleria complex also desired better access to the area from I-75 and other locations in that direction. Under a development regime created by the State of Georgia, these businesses had previously formed a special tax district, the Cumberland Development Authority (CDA). The CDA had been collecting a one-percent sales tax on customers, the proceeds of which could be used for development of roadways and infrastructure that were approved by the State.

504. The Kennedy family and the CDA saw an opportunity to cooperate for mutual benefit. They agreed to work together to construct a new four-lane road that would connect the Kennedy family property and the shopping mall and surrounding businesses with I-75. The family agreed to donate the rights of way required for the road to traverse their property to connect with the shopping mall and the businesses. The CDA agreed to provide funding for the project, by directly providing resources and organizing any shortfall from other sources. They jointly engaged an engineering firm to develop plans for the area.

505. The plans were soon developed into a proposal which the CDA submitted to the Georgia Department of Transportation (DOT), the state agency responsible for, among other things, planning, constructing, maintaining and improving the State of Georgia's roads and bridges.¹⁵⁹ DOT agreed to be the project manager and provide limited funds, with the balance of the funding coming from CDA and Cobb County. CDA, using the funds from the sales tax, and Cobb County, using infrastructure funds, would provide the rest. The estimated cost of the project was US\$100 million.

8.5.3 Joint construction of infrastructure

Motivation for construction of the [duct bank](#)

506. Several utilities had existing underground facilities that would have to be relocated if a new road was constructed in the area. These included telecommunications utilities Bell South and AT&T, cable television utility Smyrna Cable and electric utilities GPC and Cobb EMC. GPC also had above-ground 115 kV distribution lines that extended from the substation and were installed

¹⁵⁹ Georgia Department of Transportation, "About Georgia DOT" (date). Available at <http://www.dot.ga.gov/AboutGDOT> (last visited on 11 Feb 2017).

on a right of way that ran along the Kennedy property. These would have to be moved to accommodate a new road.

507. Once the plans were approved by DOT, it was time to approach the utilities that owned facilities in the area about the potential conflicts. GPC was the primary concern, as it owned the substation, the 115 kV electric distribution lines serving the substation and related rights of way and buried duct lines carrying electric distribution lines. The estimated cost for relocating just GPC's ducts and the distribution lines exceeded US\$3 million.

508. It soon became apparent that additional utilities would need to install ducts. AT&T had a switching center located near I-75 that would be accessible from the new road and an overpass crossing I-75. Many utilities needed access to the AT&T facility because it was a major switching center in the area.

509. Finding an appropriate place to locate the new ducts lines was challenging. The nature of the terrain prevented any construction along the edge of the road, the location where the ducts would typically be buried. As a result, the only place to install the new duct lines was in a [duct bank](#) in the median of the new road.

Cost sharing for joint construction

510. DOT contacted the utilities to see if they were interested in participating in a [duct bank](#). By bringing in other utilities, and requiring them to contribute to construction costs, DOT could reduce its costs of construction. The [duct bank](#) would complicate the project because safety codes mandated that electrical and telecommunications ducts required separate "vaults," the places where necessary periodic connections were made along the duct. On the new bridge, space was limited in the median so the ducts would have to run along each side of the bridge, not the best of locations for future work or maintenance.

511. On one section of the road, there the telecommunications companies wanted, collectively, 26 ducts and GPC wanted 8 for a total of 34 ducts on that section. On other sections, fewer utilities participated.

512. It was agreed that the cost of construction of the [duct banks](#) would be shared by the participants based on the percentage of the ducts a company wanted in that section of the road. For example, if a utility wanted 4 ducts in the section that had 34, then it would pay 4/34ths of the construction cost. The telecommunications companies would be responsible for the cost of construction for the telecommunications vaults, and Georgia Power Company and Cobb EMC would be responsible for cost to construct the electrical vaults.

513. Construction of the four-lane road and bridge began in 1996 and took about two years to complete, including relocating all of the ducts and the 115 kV electric distribution lines. The entire project was known as the Kennedy Interchange. The new four-lane road, eventually named Cumberland Boulevard, allowed easier access to shopping mall and the Galleria complex. With the new road in place, Cobb County was later able to construct a convention center in the area. The Kennedy family was soon able to sell their property. After donating the rights of way across their property to the project, about 70 acres remained for development. As of 2015, there have been three multistory buildings constructed on the land that comprised their property, with space remaining for future development.

8.5.4 Lessons learned

514. The project was a success and provides an excellent example of how utilities from multiple sectors, including direct competitors, can work together to costs on an infrastructure project. In addition, the leadership of the DOT, a state agency, helped to bring together these various stakeholders to allow for cooperation and cost sharing.

8.6 Bombay Gas (India)

8.6.1 Introduction

515. This case study examines the telecommunications business of Bombay Gas Co. Ltd (Bombay Gas), which utilizes piped gas infrastructure buried under Mumbai, India to lay fiber. This case study is unusual in that the existing non-telecommunications passive infrastructure had not been used for its original purpose in decades.

8.6.2 Background on Bombay Gas

516. Bombay Gas, a privately owned company based in Mumbai, India, was formed in 1863 to install and operate piped gas infrastructure in what was formerly the Presidency of Bombay.¹⁶⁰ Bombay Gas deployed pipes, conduits, service-pipes and other infrastructure under streets and bridges in what is now the city of Mumbai. The completed infrastructure network included 478 km of spigot and soffit cast iron gas distribution mains of diameters varying between 75 mm and 600 mm. The infrastructure construction was entirely funded by the owners of Bombay Gas and did not receive any government or other external funding.

517. Bombay Gas delivered coal-based piped gas to homes and businesses in Mumbai for over a century. In the mid-1980s, the piped gas business was discontinued at the direction of the Government of India. The Government favored development of natural gas, which had greater availability and less environmental issues associated with it than coal-based gas. The infrastructure has not been used for distribution of gas since then. Bombay Gas is now owned and managed by the Jalan family, an Indian family with various interests in real estate, finance, electrical design and equipment manufacturing in India and the United Kingdom.

8.6.3 Telecommunications business of Bombay Gas

Decision to enter into telecommunications business

518. About a decade ago, Bombay Gas recognized the utility of its existing gas infrastructure and rights of way for laying fiber optic cable. It tried to market its infrastructure to telecommunications operators and had negotiations with at least one. However, at the time there was not sufficient demand for fiber in Mumbai to justify a dense fiber infrastructure that the gas infrastructure would provide.

519. While Mumbai's residents largely obtain natural gas in cylinders, Mahanagar Gas Limited (MGL), a natural gas distribution company, is currently rolling out new gas ducts to service homes and businesses in Mumbai. Bombay Gas considered offering its infrastructure to MGL to retrofit the existing pipeline with new ducts for natural gas distribution. However, MGL was ultimately

¹⁶⁰ Unless otherwise indicated, information included in this case study was provided by Bombay Gas.

not interested. Bombay Gas believes this is primarily because its piped gas infrastructure has been unused and unmonitored for 30 years and would require extensive work to make it usable by MGL. Much of the distribution infrastructure requires repair or replacement and some sections have been removed to accommodate water mains or stolen. Bombay Gas also cites commercial differences with MGL.

520. Ultimately, Bombay Gas decided to launch its own telecommunications business, using the existing gas infrastructure and rights of way to lay fiber optic cable throughout Mumbai. There was no government policy encouraging or incentivizing this use. Rather, the idea came to the owners from a foreign investment banker who saw the potential of monetizing the rights of way.

Telecommunications network of Bombay Gas

521. In 2012, Bombay Gas laid its first 4 km of fiber as a proof of concept. As of May 2015, it had laid a total of 106 km of fiber. Five cables were deployed in most ducts, except where space was limited and only three cables could be accommodated. Except for 1.5 km of 96-core cables used in the initial rollout, all of the cables deployed are 144-core. Hand holes are created every 50 to 100 meters along the route to ensure easy access for building connectivity and creating new spurs. The deployment of the telecommunications infrastructure was privately funded by the Jalan family.

522. Bombay Gas has relied mostly on the original rights of way granted in the Gas Company Act of 1963. No modifications to the rights of way were required to accommodate the telecommunication equipment installed in the existing infrastructure or its usage. Most of the existing rights of way were for use underneath footpaths alongside roads. However, as roads have expanded over the last 150 years, some of the infrastructure that was originally installed under footpaths along the side of a road are now located near the center of the road. The Municipal Corporation of Greater Mumbai, the primary agency responsible for urban governance in Greater Mumbai¹⁶¹, does not permit Bombay Gas to use the gas infrastructure in the center of roads to minimize disruption to traffic during installation and in case of maintenance or repairs. In those situations, Bombay Gas has been able to acquire new rights of way under the new footpath. Bombay Gas also obtained new rights of way for portions of the network that could not use the existing infrastructure.

Nature of Bombay Gas' business

523. As of May 2015, the main business of Bombay Gas is leasing dark fiber to India's telecommunications operators for backhaul and trunk connectivity. Bombay Gas provides point to point routes with connectivity to specific towers or network operation centers along the route. As of mid-2015, its customers include Vodafone India and Idea Cellular, with Bharti Airtel expected shortly. To avoid competing with its customers, Bombay Gas does not provide or expect to provide any enterprise services or even its own Wi-Fi services to retail users.

524. The pricing of its dark fiber leasing is not publicly available. It is negotiated on a case by case basis and depends on quality, length of the lease and other factors. Initially Bombay Gas priced its dark fiber leasing at a deep discount to attract customers.

¹⁶¹ Municipal Corporation of Greater Mumbai, "Municipal Corporation of Greater Mumbai," Municipal Corporation of Greater Mumbai, <http://www.mcgm.gov.in/irj/portal/anonymous?NavigationTarget=navurl://c4b79f15e55f98176905a7c2c7d910ee> (last visited 11 Feb 2017).

525. Bombay Gas currently has limited competition. Indian mobile network operators are laying their own fiber networks in Mumbai, but face right-of-way issues and are often limited to using aerial fiber which is more likely to succumb to vandalism and the elements. MGL is not rolling out fiber as it constructs its new natural gas infrastructure.

526. Bombay Gas plans to offer additional services over time. As of May 2015, it plans to start offering [transmission capacity services](#) to telecommunications operators allowing for backhaul on demand. To address a shortage of available spectrum, Bombay Gas also plans to offer [BTS hoteling](#) with remote shared microsites. This technology allows telecommunications operators to use and reuse spectrum more efficiently through the use of microcells that only operate over short distances in high density areas. In the next 1-2 years, Bombay Gas plans to roll out blanket Wi-Fi coverage for operators to use for [traffic offloading](#). Finally, in 2-3 years Bombay Gas hopes to offer [carrier neutral dark fiber](#) to the home with speed capabilities of up to 1 Gbps.

8.6.4 Legal, regulatory and policy issues

527. The Telecom Regulatory Authority of India (TRAI) is India's telecommunications sector regulator. The Department of Telecommunications, under the Department of Communications & Information Technology, is responsible for granting telecommunications licenses. Bombay Gas is an Infrastructure Provider Category I, which allows it to provide passive assets for telecommunications use such as dark fiber, rights of way, duct space and towers. No license is required, but registration with the Department of Telecommunication is mandatory.¹⁶²

8.6.5 Lessons learned

528. The success of Bombay Gas demonstrates that cross-sector infrastructure sharing can extend to use of repurposed non-telecommunications infrastructure that is no longer in service. It also provides an example of the use of passive infrastructure owned by the private sector to deploy a telecommunications network.

8.7 Electricity Supply Corporation of Malawi

8.7.1 Introduction

529. This case study examines the decision of Electricity Supply Corporation of Malawi (ESCOM), Malawi's monopoly provider of electricity generation, transmission, distribution services, to establish and operate a commercial telecommunication business. It highlights ESCOM's decision to enter into a partnership with a Globe Internet, a Malawi [ISP](#).¹⁶³

8.7.2 Background on ESCOM

530. ESCOM is the state-owned electric utility in Malawi, incorporated as a private company in 1988. It has exclusive control over electricity generation, transmission and distribution in Malawi. Nearly 95% of Malawi's electricity supply is provided by hydropower from hydroelectric power

¹⁶² Government of India, Department of Telecommunications, "Infrastructure Provider," <http://www.dot.gov.in/infrastructure-provider> (last visited 11 Feb 2017).

¹⁶³ Unless otherwise indicated, information included in this case study was provided by ESCOM.

plants. These plants, plus a diesel plant and standby thermal plants, yield a total installed capacity of 288 MW.¹⁶⁴

531. ESCOM's transmission system spans 2,395 km, with 1,121 km of lines operated at 66 kV and 1,274 km of lines operated at 132 kV. The lines are constructed on both wood and steel structures. The system does not interconnect with the transmission system of neighboring countries, other than by supplying electricity to small cross-border towns in Mozambique and Zambia through ESCOM's distribution system.¹⁶⁵ ESCOM distributes electricity to approximately 325,000 customers.¹⁶⁶

532. In 2004, ESCOM established a fiber optic unit tasked with providing reliable fiber connections between substations and power stations to support a [SCADA](#) system, teleprotection applications and internal voice communications. The unit installed fiber on a small portion of the transmission system. The installations were part of line refurbishments, so the true cost of the installation is not known to ESCOM. The fiber installed on the transmission system was 12-core [OPGW](#) at the transmission level and 12-core [ADSS](#) at the distribution level. Two pairs were reserved for ESCOM exclusive use.

8.7.3 Telecommunications business of ESCOM

ESCOM's initial entry into the telecommunications sector

533. In around 2009, ESCOM's fiber optic unit became motivated for commercial reasons to commercialize its existing fiber assets. It hired Globe Internet (Globe), a Malawi [ISP](#) and telecommunications service provider, as a consultant to advise it on commercialization of its fiber. However, in part due to institutional limitations and regulatory restrictions, very little materialized over the next two years. Near the end of this period, two telecommunications operators, Telekom Networks Malawi (TNM) and Access Communications (Access), each leased a dark fiber pair between Blantyre and Lilongwe from ESCOM.

ESCOM's partnership with Globe

534. Six months after entering into the initial dark fiber leases with two customers, ESCOM decided to provide [transmission capacity services](#) instead of leasing dark fiber. To facilitate this change, ESCOM entered into a 10-year revenue sharing partnership with Globe.

535. ESCOM senior management has explained this shift in strategy as due to a lack of available fiber pairs on their 12-core fiber. Also, ESCOM was concerned that telecommunications operator customers who leased dark fiber would make substantial returns by selling unused bandwidth in competition with ESCOM. To address this latter issue with its existing fiber leasing customers, ESCOM required that those customers only carry their own traffic. However, ESCOM believed that this might not be a viable option for smaller operators. According to Globe senior management, in addition to these motivations, ESCOM's lack of experience and credibility as a telecommunications operator required a partnership with an experienced player.

¹⁶⁴ ESCOM (Electricity Supply Corporation of Malawi), "Generation Directorate," ESCOM, <http://www.escom.mw/generation.php> (last visited 11 Feb 2017).

¹⁶⁵ ESCOM, "Transmission," ESCOM, <http://www.escom.mw/transmission.php> (last visited 11 Feb 2017).

¹⁶⁶ ESCOM, "Distribution and Customer Services Directorate," ESCOM, <http://www.escom.mw/distribution.php> (last visited 11 Feb 2017).

536. Under the terms of their partnership, Globe is responsible for ESCOM's network expansion and provision of bandwidth services. ESCOM is still able to offer dark fiber leasing on its pre-existing lines and Globe is able to enter into arrangements with customers that do not involve ESCOM's network. Globe senior management has described their arrangement with ESCOM as a public private partnership. Globe, as a major [ISP](#), considers itself a customer of ESCOM, in addition to its partner.

537. Globe has expanded ESCOM's fiber network to the borders with Zambia and Mozambique using [ADSS](#) installed on ESCOM lines and has established a metro fiber extension in Blantyre on 11 kV lines with 36-core [ADSS](#). As of 2014, ESCOM had 700 km of fiber in total, though most of its substations are still not connected by fiber.

538. As of 2014, according to ESCOM senior management, ESCOM's fiber optic revenue is derived 30% from dark fiber leasing and 70% from [transmission capacity services](#) under its partnership with Globe. However, these figures may not accurately capture the revenue breakdown as it is not clear if they take into account the revenue sharing arrangement with Globe on [transmission capacity services](#). Also as of 2014, the Globe/ESCOM partnership had overtaken incumbent Malawi Telecommunications Limited to acquire the largest share of the "carrier of carriers" market in Malawi, with all major [ISPs](#) and operators Airtel, TNM and Access as customers.

539. Although ESCOM does not require a telecommunications license for internal communications, to conduct its fiber optic business it has obtained a carrier of carriers license, an [ISP](#) license and an interconnect license.

8.7.4 Lessons learned

540. ESCOM's success in Malawi is an example of a public utility partnering with an experienced telecommunications services provider to help it succeed in entering the telecommunications services business.

8.8 Adif (Spain)

8.8.1 Introduction

541. This case study examines the dark fiber business of Administrador de Infraestructuras Ferroviarias (Adif) and its recent agreement with Red Eléctrica de España (REE) to manage its network.

8.8.2 Background on Adif and REE

Background on Adif

542. Adif is a state-owned utility under the Ministry of Transport and Public Works. It is the owner and manager of 15,130 km of railway lines and owns all of the corresponding rights of way. Adif is the legal successor to Red Nacional de los Ferrocarriles Españoles (RENFE), which was established in 1941 as part of a nationalization of Spain's railways.¹⁶⁷

543. Adif began operations in 2005 as a result of the Spanish Railway Sector Law, which divided RENFE into the newly formed RENFE Operadora, which would have the responsibility for

¹⁶⁷ Unless otherwise indicated, information included in this case study was provided by Adif.

railway operations, and Adif, which would have the responsibility for railway infrastructure. This legislation was passed in compliance with the European First Railway Directive 91/440/EC, which requires member states to separate the organizations that operate the infrastructure from the ones that operate the services.

544. Adif has a fiber optic network that was traditionally used for internal railway uses. It has commercialized excess capacity on that network for use by telecommunications companies. As of 2014, Adif was Spain's largest provider of dark fiber. It managed 25% of Spain's commercialized dark fiber optic network throughout the country (17,868 km), consisting of 11,793 km along the long haul trunk railway lines, 3,036 km along urban metro networks and 3,039 km along the high-speed railway network. Its network also connects to Spain's islands and to the telecommunication networks in France and Portugal. Because of the expansion of residential broadband and mobile data in metropolitan areas, Adif has invested in expansion of its network along the metropolitan railway rings of Madrid and Barcelona, as well as Bilbao, Seville and Valencia. In addition, Adif owns 6,600 square meters of co-location facilities equipped for communication equipment located in a total number of 158 points and 430 telecommunications towers.

545. In 2014, Adif tendered a concession to manage and use its fiber optic network. This excluded the fiber optic capacity required for the rail operations. Neo Sky and REE submitted tenders, with the latter winning with a €433.7 million bid for a 20-year concession.¹⁶⁸ Under the negotiated agreement, Adif continues to own its fiber optic network.

Background on REE

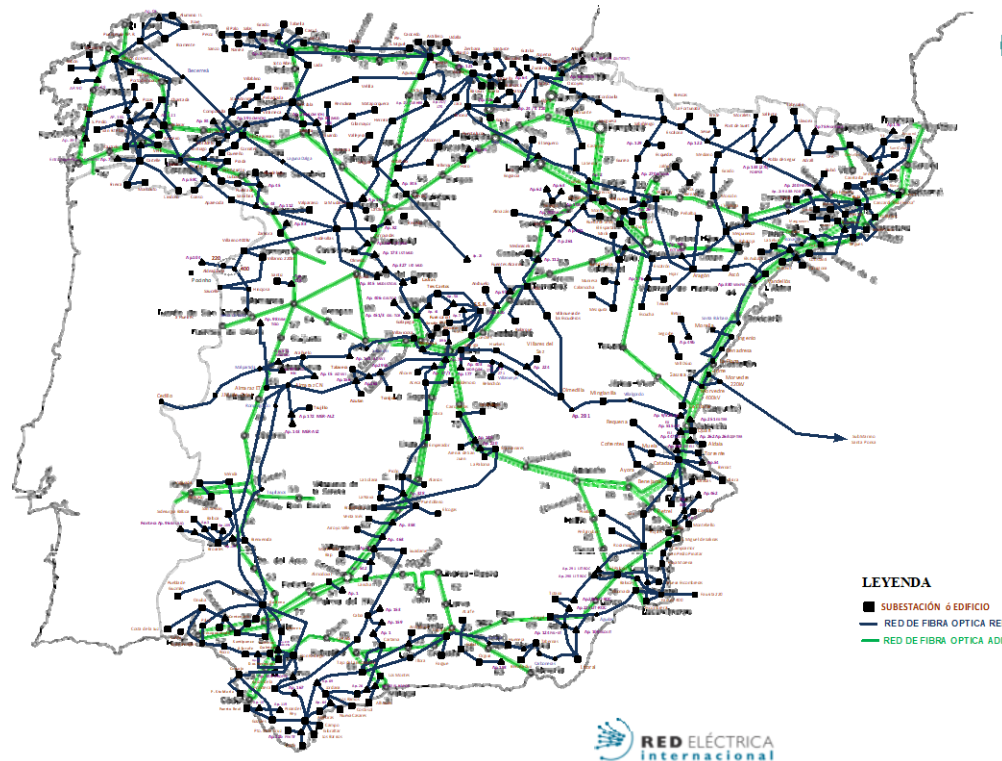
546. REE is a partly state-owned and public limited Spanish corporation that was founded by the Government in 1985 to operate the Spanish electricity transmission system. REE started to deploy fiber optic cables along electricity transmission lines in 1989 and commercialized excess fiber optic capacity after the liberalization of the telecommunications sector in 1998.

547. With the new concession to manage Adif's network, REE doubled its network under management to 32,000 km (Figure 30 below shows Adif's network in green and REE's network in black).¹⁶⁹ Apart from taking over operations, REE will also gain Adif's costumers, which include Al-Pi, British Telecom, Cableuropa, Cogent, Colt, Islalink, Jazztel, Orange, Telefónica, Vodafone and VSNL. In order to manage, commercialize and lease the dark fiber optics network, REE created the Red Eléctrica Infraestructuras de Telecomunicación (Reintel) subsidiary in 2015.

¹⁶⁸ Red Eléctrica de España. 2014. "Red Eléctrica acquires the rights to use and manage the fiber optic network owned by ADIF." Red Eléctrica de España. Available at <http://www.ree.es/en/press-office/press-release/2014/11/red-electrica-acquires-rights-use-and-manage-fibre-optic-network-owned-by-Adif> (last visited 11 Feb 2017).

¹⁶⁹ Red Eléctrica Corporación. *Hacia la Red 21: Un modelo energético sostenible. Resultados 2014, Plan Estratégico 2014-2019* (2015).

Figure 30: Fiber optic networks of Adif and REE



Source: Red Eléctrica Corporación (2015) *Hacia la Red21: Un modelo energético sostenible. Resultados 2014, Plan Estratégico 2014-2019*

8.8.3 Motivations for the Adif-REE agreement

548. Prior the concession agreement with REE, Adif’s fiber optic network commercialization division was its most profitable entity.¹⁷⁰ It was estimated to have contributed to annual earnings before interest, taxes, depreciation and amortization of €49.5 million.¹⁷¹

549. REE re-contracted Adif to provide maintenance on its leased dark fiber network under a servicing agreement for an annual fee of €9.5 million per annum for the 20-year concession.¹⁷² According to Adif the concession agreement with REE was part of a broader restructuring process to offload non-core railway network activities. Additional funds were also desperately needed to finance in the expansion of its high-velocity railway network (Adif’s debt is expected to be above €17.3 billion at the end of 2015).¹⁷³ Adif believes that the servicing agreement makes economic sense for both parties given that Adif already has to service its fiber optic network related to the

¹⁷⁰ Collantes, Pau. 2015. “REE contrata a ADIF para que gestione la fibra óptica privatizada por la empresa pública” *El Diario*, January 5. Available at http://www.eldiario.es/economia/REE-contrata-Adif-gestione-privatizada_0_342616270.html (last visited 11 Feb 2017).

¹⁷¹ Bernad JL. 2014 “Letter to Spanish Securities Market Commission,” April 10. Available at http://www.ree.es/sites/default/files/06_ACCIONISTAS/Documentos/Hechos%20relevantes/2014/ingles/100414_adquisicion_activos_ADIF_eng.pdf (last visited 11 Feb 2017).

¹⁷² Two additional contracts were signed as part of the agreement for Adif to support the management of the network (€3.1million per annum for 6 years) and further services under the provision by Adif High Speed mandatory services (€4.3 million per annum for 20 years)

¹⁷³ Collantes, Pau. 2015.

railway operations (which was not outsourced). Hence there are significant economies of scale that led to this servicing agreement.¹⁷⁴

8.8.4 Legal, regulatory and policy issues

550. In 2014, Spain passed the telecommunications act 9/2014, which encourages the provision of telecommunication infrastructure in urban development projects and civil works funded with public resources. The Government will make this telecommunications infrastructure available to potential telecommunications operators on a non-discriminatory basis.

551. Furthermore, the process to acquire licenses has been simplified and licenses are not required except for use of scarce resources. Development of other facilities and infrastructure generally only requires a statement of compliance. No authorization is needed for execution of technological innovation improvements that do not alter the underlying infrastructure.¹⁷⁵

552. The Comisión Nacional de los Mercados y la Competencia (CNMC), the independent national regulatory authority, which replaced the Comisión del Mercado de las Telecomunicaciones (TMC) in 2013, is responsible for implementing the new act. Apart from the telecommunications sector, it also regulates the audiovisual, transport, postal and energy sectors.

8.8.5 Lessons Learned

553. Both Adif and REE are examples of non-telecommunications utilities whose commercialization of excess dark fiber has been very profitable.

8.9 Tokyo Metropolitan Government (Japan)

8.9.1 Introduction

554. This case study examines the communications business of the Tokyo Metropolitan Government.¹⁷⁶ It focuses on the history and the context for the establishment by its Bureau of Sewerage of an optical fiber network throughout Tokyo, Japan and commercialization of excess capacity and excess space in existing fluid conduits.

8.9.2 Background on the Tokyo sewage system

555. Construction of Tokyo's sewage system began in 1884 and today it extends to all of Tokyo's special wards. It includes 13 water reclamation plants, two sludge plants, 15,700 km of sewers and 84 pumping stations. The system controls flooding, opens and closes tide gates and provides efficient wastewater management. The plants treat approximately 5.5 million cubic meters of sewage each day.

556. In the 1980s, the city found itself burdened by a shortage of skilled manpower to maintain the sewers. A sewer treatment plant operator's strike in 1998 further strained the system. Policymakers reacted with an innovative plan to deploy fiber optic cables to connect sewage pumping stations, treatment plants, control structures, and other system facilities. This fiber

¹⁷⁴ Ibid.

¹⁷⁵ Losana, Ana. 2014. "Telecommunications Act 9/2014 of 9 May: The five major changes." *Gómez-Acebo & Pombo Abogado*, May 16. Available at <http://www.lexology.com/library/detail.aspx?g=d6735ebb-bd1e-422a-a84e-5f61bd388ff2> (last visited 11 Feb 2017).

¹⁷⁶ Information from this case study was provided by Dr. Jey K. Jeyapalan, P.E., who served as a consultant to CityNet Telecom and Nippon Hume for the transfer of knowledge and experience on sharing conduits for multiple functions.

network provided the communications infrastructure to support the functioning of an unmanned sewage management system capable of providing 24/7, reliable operations at a much lower cost.

557. Instead of laying new conduits for the new fiber optic network, which would require new construction in highly trafficked city streets, Tokyo Metropolitan Government embraced deployment of cables in existing fluid conduits. Tokyo Metropolitan Government and its wholly owned subsidiary, Tokyo Metro Sewer Service Corporation promoted this concept widely as their Sewer Optical Fiber Teleway Plan. The deployment of the cables commenced in 1988, and by 2001, the Tokyo sewage system had more than 1050 km of 12-pair fiber cables in the sewer.

8.9.3 The telecommunications business of Tokyo Metropolitan Government

Shared usage of fluid conduits

558. Shared use of fluid conduits is not a new concept. Early attempts were made in Paris over a century ago but poor results led to abandonment of the concept of installing multiple utilities in the same underground tunnels. There also were a number of projects in the United States in the twentieth century where telephone companies were permitted to lay their cables inside of drinking water lines. The idea of using existing fluid conduits for additional functions not originally intended, emerged again in 1983 in dams in the States of West Virginia and Virginia in the United States.

Nature of Tokyo Metropolitan Government's business

559. The fiber optic cable installed in Tokyo's sewage system has far more capacity than needed to operate the sewage management system. Accordingly, Tokyo Metropolitan Government recognized the potential for additional revenues in commercializing the excess capacity. Unused dark fiber is leased to major telecommunications operators such as Nippon Telephone and Telegraph and KDDI. In addition to leasing dark fiber, Tokyo Metropolitan Government also leases space in existing fluid conduits needed to install additional fiber optic cables.

Figure 31: Fiber optic cable network in Tokyo's sewage system



Source: Japan Sewer Optical Fiber Technological Association. 2001. "Sewer Optical Fiber Networks-Helping to Make Your Community More Advanced in Telecommunications."

8.9.4 Lessons learned

560. Tokyo Metropolitan Government has taken advantage of an innovative technology to share existing infrastructure and deploy fiber optic cables throughout the city of Tokyo with minimal disruptions. This has allowed it to generate additional revenues to support the sewage system. It has also allowed telecommunications operators to access a fiber optic network that has wide reach within a congested urban area.

8.10 Ghana's Electricity Transmission Line Fiber

8.10.1 Introduction

561. This case study examines the Government of Ghana's interventions in the market for [OPGW](#) installed by the Volta River Authority (VRA) on its electric transmission lines.

8.10.2 VRA commercializes excess internal network capacity

562. VRA is a state-owned enterprise established on 26 April 1961 under the Volta River Development Act. Originally, VRA's core business included both generation and transmission of electricity.¹⁷⁷ VRA had installed [OPGW](#) on its electricity transmission lines for internal use in providing protection, SCADA and other services in the operation of its transmission business. VRA's [OPGW](#) network was established to provide operational telecommunications services for the electricity transmission network, such as teleprotection, signaling, voice and data transmission.

¹⁷⁷ Volta River Authority, "About Us," Volta River Authority, http://www.vra.com/about_us/index.php.

At the time, VRA had 2,000 km of [OPGW](#) with a minimum of 18-fiber cores (9 fiber pairs) installed on its transmission lines, but typically only required a maximum of three fiber pairs on each transmission line. In 2004, VRA established Voltacom as a wholly owned subsidiary to commercialize the excess capacity on its fiber network.¹⁷⁸

8.10.3 Government restructures VRA's role in electricity sector

563. In 2006, the Government began a process of restructuring the electricity sector, which would include, among other steps, separating VRA's electricity transmission functions from its power generation and other functions. As part of this electricity sector restructuring, VRA's electricity transmission assets and functions were to be transferred to Ghana Grid Company Limited (GRIDCo), which was newly incorporated as a wholly state-owned enterprise to serve as the designated national electricity transmission provider pursuant to the Volta River Development (Amendment) Act 2005.¹⁷⁹ GRIDCo began operations in 2008 following the completion of the transfer of core transmission staff and power transmission assets from VRA to GRIDCo.

564. Today, GRIDCo is by law the sole electricity transmission licensee in Ghana and is regulated as an enfranchised monopoly in its rates and activities. GRIDCo owns and operates about 5,000 km of high voltage transmission lines across Ghana. As part of the West African Power Pool integrated regional transmission grid, GRIDCo's electricity transmission grid interconnects with the electricity transmission grids in Cote d'Ivoire, Togo and Benin and construction of a new transmission line to link GRIDCo's grid to the grid in Burkina Faso has also commenced.

8.10.4 Government restructures then privatizes VRA fiber business

565. As early as January 2004, Government officials indicated publicly their intention to remove ownership and control of the fiber provided by Voltacom from VRA.¹⁸⁰ The Government also mentioned similar plans to separate ownership and control of the fiber assets of Ghana Telecommunications Company Ltd (Ghana Telecom), which was the state-owned former incumbent fixed line monopoly operator.¹⁸¹ The intention was to establish an open access national backbone utility which was independent of any operator.

566. In keeping with these intentions, during the process of transitioning VRA's electricity transmission assets (including its OPGW assets) to GRIDCo, the Government approved the transfer of rights of use of VRA's fiber assets to a state-owned new national fiber optic backbone operator. For this purpose, in late 2007, the Government established National Communications Backbone Company (NCBC) as a wholly state-owned enterprise. NCBC took over management of the excess fiber on the electricity transmission grid (then still operated by VRA), which had been managed by Voltacom since 2004. NCBC was granted a right of use 10 of VRA's then-existing 18 [OPGW](#) fiber cores. No consideration was provided to VRA in exchange for the transfer

¹⁷⁸ GNA. 2004. "VOLTACOM to be Independent." *Modern Ghana*. January 8. Available at <http://www.modernghana.com/news/47178/1/voltacom-to-be-independent.html> (last visited 11 Feb 2017).

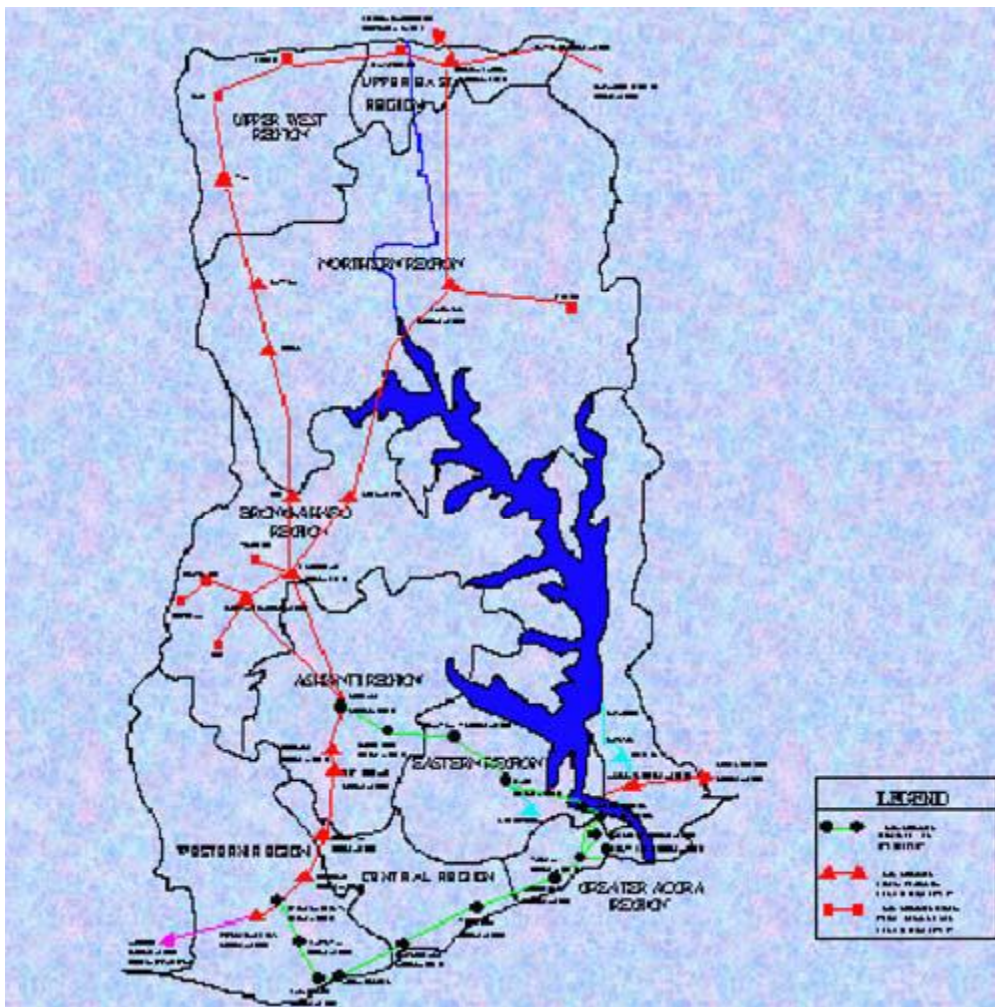
¹⁷⁹ GRIDCo, "Overview," GRIDCo, <http://www.gridcogh.com/en/about-us/overview.php> (last visited 11 Feb 2017).

¹⁸⁰ See "Voltacom to be independent," *Modern Ghana* (MG Media Group, Jan. 8, 2004). Available at <http://www.modernghana.com/news/47178/1/voltacom-to-be-independent.html> (last visited 11 Feb 2017).

¹⁸¹ Eric Osiakwan, *The Case for "Open Access" Communications Infrastructure in Africa: The SAT-3/WASC cable – Ghana case study* at §5 (National backhaul infrastructure) (Association for Progressive Communications, May 16, 2008). Available at https://www.apc.org/en/system/files/APC_SAT3Ghana_20080516.pdf (last visited 11 Feb 2017).

of rights of use of its spare OPGW fibers to NCBC. VRA therefore lost the opportunity to recover capital or operating income from commercialization of fiber on its transmission grid.

Figure 32: Map of VRA fiber network in mid-2008 (existing in green, planned in red)



Source: Eric Osiakwan

567. During the same timeframe, the Government had in June 2006 signed a US\$ 100 million loan agreement with the Chinese government to provide funding to expand the OPGW fiber network. Drawing on the loan facility with the Chinese Government, NCBC also contracted with Huawei to upgrade and expand the OPGW fiber network, and the first phase was completed in December 2007.

568. As of May 2008, one author summarized the Government’s intentions for NCBC as follows: “The network will be run by a private enterprise on behalf of the Ghanaian government, which wants it to be considered an essential national utility, similar to roads, water and electricity. This is in line with the open access model adopted by some governments around the world.”¹⁸²

569. However, the Government’s plans for NCBC changed during the process of privatizing Ghana Telecom. Thus, rather than transferring Ghana Telecom’s fiber assets to NCBC, in August

¹⁸² Ibid.

2009, the Government transferred 100% ownership of NCBC to Ghana Telecom pursuant to the purchase and sale agreement by which the Government privatized a 70% stake in Ghana Telecom to Vodafone Group plc.¹⁸³ In addition, as part of the transaction, VRA was contractually required not to compete with NCBC for five years, ending in 2013. However, VRA retained responsibility for operation and maintenance of the OPGW as part of its transmission grid. These rights and responsibilities in respect of the fiber on the transmission grid were transferred to GRIDCo together with VRA's transmission assets in 2008 as part of the electricity sector restructuring.

570. The partial privatization of Ghana Telecom to Vodafone resulted in public outcry over alleged irregularities in the process and the transaction documentation. Among other aspects of the transaction, the inclusion of NCBC was highly criticized. A national election occurred soon after and the previous minority party acquired a majority position in Government. Fulfilling a campaign pledge, in May 2009, the new Government appointed an inter-ministerial review committee to review the transaction and report its findings. The committee completed its work and reported its findings to Government several months later. The Government published the report in full in October 2009.

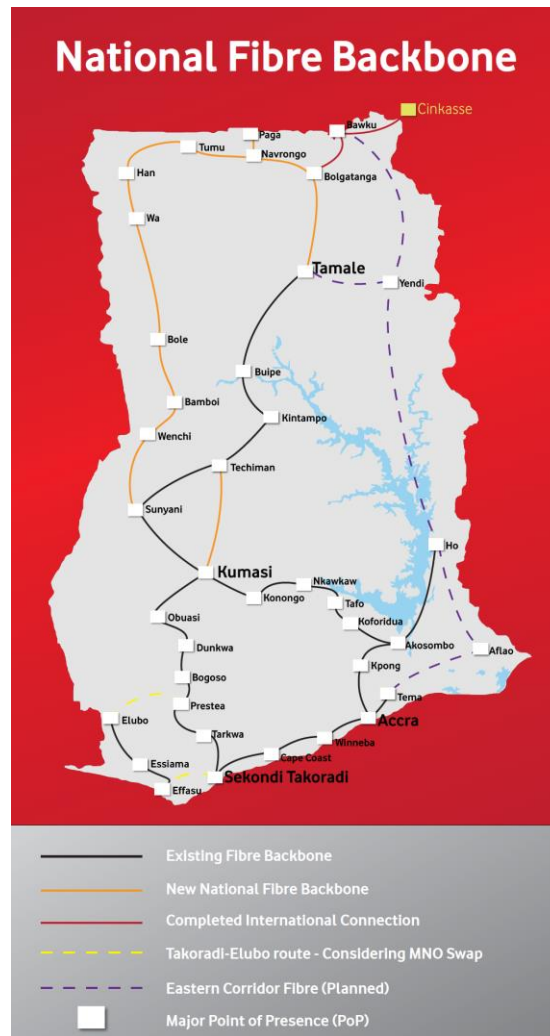
571. Among other conclusions, the Vodafone review report concluded, as one of 18 separate findings, that: "The National Communications Backbone Company (NCBC) which was added to create the Enlarged GT [Ghana Telecom] Group was grossly undervalued. The fibre optic network is a strategic national asset and should have remained an independently operated infrastructure as originally intended." The committee recommended that "The NCBC must be decoupled from the Enlarged GT Group and a public entity established with a nationalistic mandate and given the resources to complete and expand the backbone to all socially and economically necessary locations to enable it act as the foundation for Government's ICT Policy." For its part, the Government said it "has taken note of the Committee's findings and recommendations, and will soon make public its position on the recommendations."¹⁸⁴ In the end, not action was taken to reverse the inclusion of NCBC as part of the package of assets partially privatized to Vodafone and it remains part of Vodafone's Ghana operations, now rebranded as Vodafone Wholesale.

Subsequent to its acquisition of Ghana Telecom, Vodafone has caused former Ghana Telecom, now branded as Vodafone Ghana, to continue investing in fiber in addition to the fiber it inherited from Ghana Telecom and NCBC in 2008. Today, Vodafone has significant national coverage in Ghana as depicted in the following map.

¹⁸³ Vodafone Wholesale, "Company Profile," Vodafone Wholesale. Available at <http://wholesale.vodafone.com.gh/index.php/who-we-are/company-profile> (last visited 11 Feb 2017).

¹⁸⁴ See "Full text of Vodafone Review Report released by the government," *Modern Ghana* (MG Media Group, Oct. 16. 2009). Available at <https://www.modernghana.com/news/244104/1/full-text-of-vodafone-review-report-released-by-th.html> (last visited 11 Feb 2017).

Figure 33: Vodafone Wholesale fiber network



Source: Vodafone Wholesale¹⁸⁵

572. Vodafone Wholesale acts as a wholesale capacity provider of fiber optic services in Ghana and beyond in West Africa to [ISPs](#) and mobile network operators. It offers both national fiber backbone products and international IP and international private [leased line services](#).¹⁸⁶

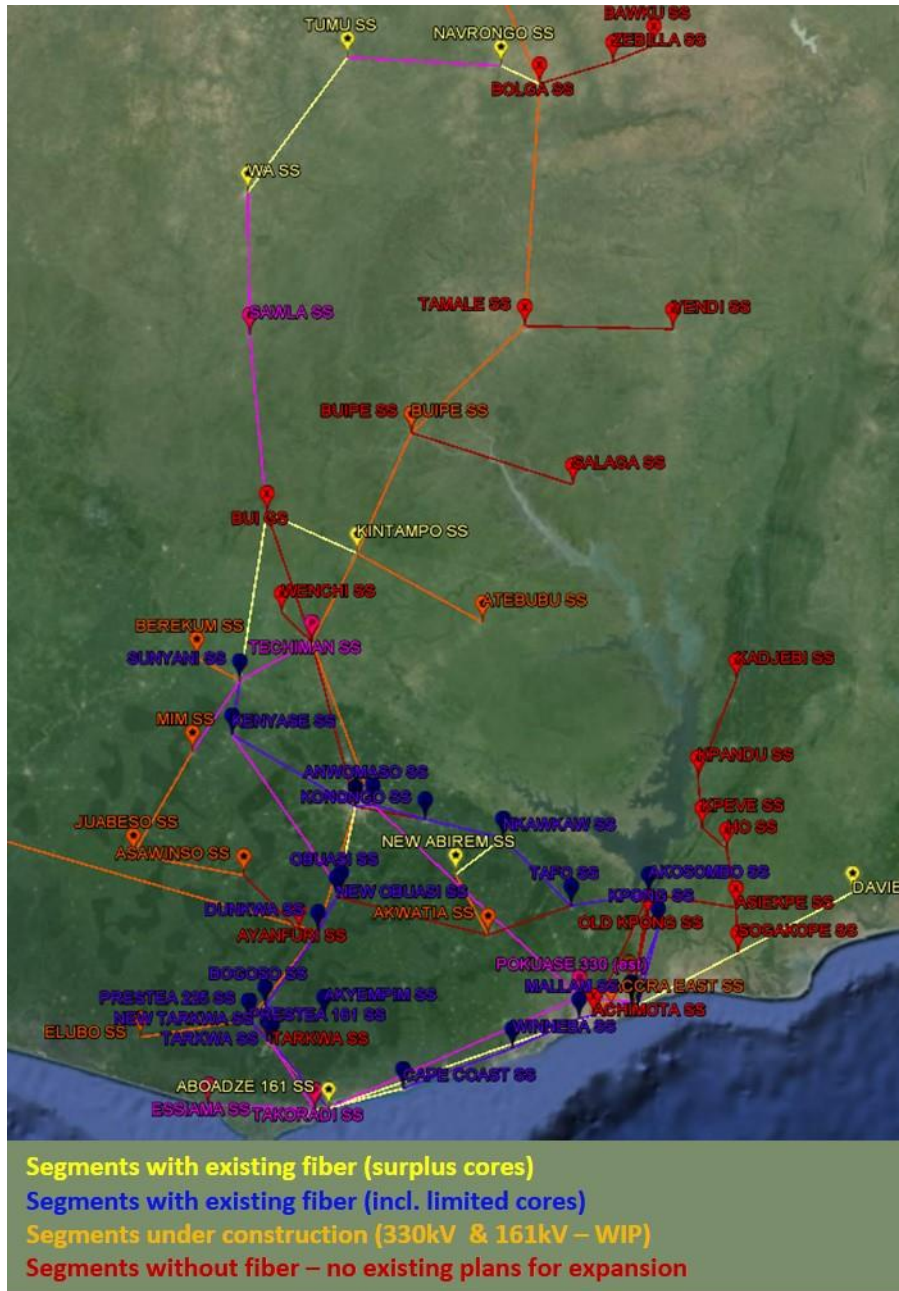
573. Meanwhile, the non-compete applicable to GRIDCo as VRA’s successor has expired. Based on inquiries from Vodafone’s competitors in the retail access markets, and with encouragement from the Government, GRIDCo has undertaken to prepare a Telecommunications Master Plan which envisions that GRIDCo will enter the wholesale market to provide dark fiber and/or bandwidth services as well as continue to develop its own internal communications network. Since 2008, GRIDCo has constructed several new transmission lines and replaced some of its older lines, and all of these new or rebuilt transmission facilities include OPGW, giving GRIDCo as

¹⁸⁵ Available at <http://wholesale.vodafone.com.gh/index.php/who-we-are/coverage> (last visited 13 Feb 2017).

¹⁸⁶ See “Full text of Vodafone Review Report released by the government,” *Modern Ghana* (MG Media Group, Oct. 16, 2009). Available at <https://www.modernghana.com/news/244104/1/full-text-of-vodafone-review-report-released-by-th.html> (last visited 11 Feb 2017).

substantially larger footprint than that covered by the fiber it hosts for Vodafone. In addition, GRIDCo has several additional new or replacement transmission lines in the planning stages, and these will continue to enlarge its footprint. GRIDCo's entry into the wholesale market, planned for 2016, will provide increased competition for Vodafone Wholesale and more options (both in terms of providers and routes) for Ghana's telecommunications network operators. While Ghana's wholesale fiber market may have fared worse during the intervening years from 2008 through 2016 than it would have had NCBC remained independent, GRIDCo's entry into the market may yield a better result going forward than would have subsisted with a single open access national backbone company. Time will tell.

Figure 34 : Map of GRIDCo fiber (existing and construction in process) in late 2015



Source: Andrew Johnson based on data supplied by GRIDCo

8.10.5 Lessons learned

The Government of Ghana may have had good intentions in implementing two major telecom policies, first, by creating a national backbone operator and transferring ownership and control of excess dark fiber capacity on the transmission grid, and, second, in including the national backbone operator in the package when the state-owned incumbent operator was partially privatized.

However, the political interference with the fiber commercialization activities of the state-owned electricity transmission utility resulted in a loss of a much-needed revenue source for the utility. The subsequent sale of the national backbone operator, coupled with a non-compete from the national electricity transmission utility, precluded it from re-entering the market with any remaining existing fiber or new fiber for a period of years.

Moreover, by selling the national backbone operator to the parent company of one of the country's mobile operators, Government forced other mobile operators to choose between purchasing wholesale fiber capacity from their competitor or building their own fiber networks. Apparently, both consequences have occurred to varying degrees. Mobile operators in Ghana have complained about high prices for access to Vodafone Wholesale's fiber network. In addition, GRIDCo was prevented from commercializing its valuable excess capacity for a minimum of five years. Fortunately, GRIDCo appears now to be undeterred by the past as it makes plans to re-enter the wholesale market for fiber. It hopes not to encounter any further political interference this time around.

8.11 Tunisian Railways

8.11.1 Introduction

574. This case study examines the decision of the Tunisian Railways (*Société Nationale des Chemins de Fer Tunisiens*, SNCFT) to expand its traditional activity of managing the Tunisian railways network and become an alternative supplier of fiber optic infrastructure.

8.11.2 Background on SNCFT

575. SNCFT is a financially autonomous public company whose mission is to manage, maintain and operate the Tunisian railways network. The network is 2,153 km long, consisting of 23 lines and 200 stations, and reaches remote areas of the country.¹⁸⁷

576. Although Tunisia enjoys one of the most advanced ICT network infrastructures in the region, the country faces significant challenges in providing broadband Internet access to its population at a reasonable cost. This is particularly the case in isolated rural areas. The World Bank estimates that that on average, a family in the lowest 40 percent income bracket in Tunisia would need to spend over 40 percent of disposable income to cover the cost of fixed broadband and nearly 45 percent to cover the cost of mobile broadband.¹⁸⁸

¹⁸⁷ Unless otherwise indicated, information included in this case study was provided by SNCFT.

¹⁸⁸ Gelvanovska, Natalija, Rogy, Michel, Rossotto, Carlo Maria. 2014. *Broadband Networks in the Middle East and North Africa, Accelerating High-Speed Internet Access*. Directions in Development Series. Washington, DC: World Bank: 39. Available at <https://openknowledge.worldbank.org/handle/10986/16680> (last visited 11 Feb 2017).

8.11.3 Telecommunications business of SNCFT

Telecommunications network of SNCFT

577. SNCFT has fiber optic infrastructure laid along portions of its network of railway lines. As of late 2014, SNCFT's fiber optic network is approximately about 1,000 km long¹⁸⁹ and is deployed in underground pipes along the railway lines¹⁹⁰. The deployment was financed by the SNCFT's own funds. The fiber optic network is mostly deployed along railway lines in the west and south of Tunisia. It connects the main urban centers in the country, including many technical sites that are very useful for installing broadband equipment by telecommunications operators. SNCFT is also in the process of extending its network, by connecting it with the fiber networks of the national electricity and gas grid, *Société Tunisienne d'Electricité et du Gaz*, and the national highway company, *Tunisie Autoroutes*, with a view to building a national backbone. SNCFT is also examining a potential extension project to Algeria.

578. Originally, SNCFT's fiber optic network was only used by SNCFT for its own railway management needs. However, in response to the legislative changes that permitted use in the telecommunications sector, SNCFT decided to commercialize the excess capacity on its network for use by telecommunications operators. SNCFT's fiber optic network now provides an alternative to those of traditional telecommunications operators. It also offers customers redundancy in international connectivity via its access to submarine cables.

¹⁸⁹ As of late 2014, 500 km were under construction and 800 km are planned after 2015.

¹⁹⁰ As of late 2014, SNCFT planned to erect pylons for carrying future cables rather than burying them to reduce costs.

Figure 35: SNCFT fiber optic network



Source: Gelvanovska, N., Rogy, M., Rossotto, C.M. 2014. *Broadband Networks in the Middle East and North Africa, Accelerating High-Speed Internet Access, Directions in Development*. Washington, DC: World Bank.

Nature of SNCFT's business

579. In commercializing its fiber optic network, SNCFT elected to offer dark fiber leases rather than [transmission capacity services](#). It found that operators generally do not wish to purchase IRUs (indefeasible rights of use) and rather prefer dark fiber leases. Sixteen fibers are available for 10-year leases on the links of SNCFT's South Network, and 4 are available on the Tunis–Sousse–Sfax links. SNCFT directly markets the dark fiber to licensed telecommunications operators. Under the terms of its offer, the leased fiber may not be released to third parties. Operators must

provide their own interconnection links to the access points located in the technical offices of SNCFT. Operators can have cable access every 500 meters.

580. Rates for dark fiber leases vary by segment. They are lower in the inland areas of the country, where demand for dark fiber is lower. The fees charged to the customer is calculated according to a base rate for two dark fibers and by connection. Fees are annual and invoiced by linear meter, but payment is quarterly and payable in advance. SNCFT does not directly maintain its fiber optic network itself. Rather, maintenance is performed by a third party and is paid in part by the operator customers.

581. As of late 2014, only two operators had leased dark fiber from the SNCFT network, Ooredoo and Orange.

8.11.4 Legal, regulatory and policy factors

582. Tunisian policymakers have encouraged the use of telecommunications infrastructure belonging to public utility companies in the transport and electricity sectors. In 2013, the Telecommunications Code was amended to integrate alternative fiber optic infrastructures into the telecommunications sector. These alternative infrastructures would be subject to the same rules and conditions that apply to the public telecommunications networks.

8.11.5 Lessons learned

583. Although considered a success, SNCFT has faced some challenges. In particular, it has found that the typically slow pace of decision making of the public sector, of which SNCFT is a part, is at odds with the constantly dynamic telecommunications market. SNCFT is considering whether operating its dark fiber leasing business through a separate commercial entity, which could have greater autonomy and flexibility, might be able to more effectively respond to the expectations of customers.

8.12 SOGEM (Mali, Mauritania, Senegal)

8.12.1 Introduction

584. This case study examines the decision of *Société de Gestion de l'Énergie de Manantali* (Society for the Management of the Energy of Manantali) (SOGEM) to commercialize unused capacity on [OPGW](#) installed on its electricity transmission network.¹⁹¹

8.12.2 Background on SOGEM

585. The Manantali Dam is a 1,460 meter dam on the Senegal River in Mali that regulates water flow to generate hydroelectric energy, provide irrigation resources and ensure navigability.¹⁹² The electricity generated by the dam provides power to Senegal, Mali and Mauritania, three Member States of *Organisation de la Mise en Valeur du Fleuve Senegal* (Organization for the Development of the Senegal River) (OMVS) through a network of transmission lines. SOGEM plans to eventually expand the electricity network into Guinea, the remaining Member State of OMVS.

¹⁹¹ Unless otherwise indicated, information included in this case study was provided by SOGEM.

¹⁹² SOGEM (Société de Gestion de l'Énergie de Manantali), "Barrage de Manantali," SOGEM, <http://www.sogem-omvs.org/barrage.html> (last visited 11 Feb 2017).

Figure 36: SOGEM's OPGW network



Source: SOGEM

586. SOGEM was established in 1997 as a public company owned in equal shares by Senegal, Mali and Mauritania. It is responsible for the maintenance and operation of the dam, and the generation of and transmission of electricity along the network.¹⁹³

8.12.3 Telecommunications business of SOGEM

Motivation to commercialize excess capacity

587. SOGEM's electricity network has 1,728 km of 6-pair OPGW fiber optic cables installed. The installation was financed jointly by the incumbent telecommunications operators in its three constituent countries: Sotelma in Mali, Mauritel in Mauritania, and Sonatel Orange in Senegal. In return, these three telecommunications operators were each granted a right to use a single fiber pair until January 2018. SOGEM believes they are likely to wish to continue using SOGEM's fiber thereafter. SOGEM currently has two fiber pairs that are unused, and may be able to make an additional pair available in 2018.

588. SOGEM's unused fiber presents a significant strategic economic opportunity and has substantial financial value. Its fiber network could be used to transmit telecommunications traffic to and from existing submarine cable landing stations in Dakar, Senegal and Nouakchott, Mauritania and inland to Bamako, Mali. It could thus improve access to international communications networks and the global Internet in all three SOGEM countries.

589. As of late 2015, SOGEM plans to extend its network with an additional 1,960 km of transmission lines by 2019, including lines to Conakry, Guinea and other lines in Senegal, Mauritania and Mali. These extensions could also be equipped with OPGW, enlarging the reach of SOGEM's fiber network. In addition SOGEM's electricity network is interconnected with the West Africa Power Pool network, a regional institution that connects the electricity networks of 14 ECOWAS countries,¹⁹⁴ and so offers a potentially wide regional reach.

590. The particular strategic economic value of SOGEM's fiber network arises from the limited amount of alternative open-access backbone networks in the three countries it crosses. As of late 2015, these are effectively controlled by the Orange and Maroc Telecom groups. The lack of

¹⁹³ SOGEM, Société de Gestion de l'Énergie de Manantali, "Profil de la SOGEM," SOGEM, <http://www.sogem-omvs.org/profil.html> (last visited 11 Feb 2017).

¹⁹⁴ WAPP (West Africa Power Pool), "Home," WAPP, <http://www.ecowapp.org/> (last visited 11 Feb 2017).

competition in providing international bandwidth results in very high prices for international bandwidth and Internet access, particularly in Mali. Being a landlocked country, Mali depends on other countries for its access to the submarine cable landing stations. Making SOGEM's fiber optic cable available for telecommunications services could greatly increase competition among telecommunications service providers addressing the retail market. As a result, the prices of international calls, Internet access and other international data services in the three countries would be expected to decline significantly, boosting usage by the population, businesses and governments of these services.

591. There is likely to be substantial demand and readiness among telecommunications service providers to pay to use excess capacity on SOGEM's network. Mobile operators and international carrier companies in the region will likely benefit from significant cost savings and business opportunities from using SOGEM's network.

Considering potential business models

592. In 2014-15, the World Bank financed a consultancy to assist SOGEM in considering several business models for commercializing unused fiber on its network. These ranged from the very simplest in the telecommunications sector value chain all the way up to providing a full set of [transmission capacity services](#). In considering these alternatives, SOGEM was cautious in recognizing that it had no experience as a telecommunications service provider. Its comparative advantage lay in the rights of way, pylons and fiber optic cable itself. It had little comparative advantage in venturing into the market to become a telecommunications service provider, which would present significant risk and cost. Higher levels of involvement in the market therefore would necessitate increasing dependence on partners that had sufficient expertise, experience and even established businesses and customers.

593. SOGEM narrowed the possible business model options to four that met several criteria. The models considered had to respond to the actual demand of the telecommunications market in a manner that would be technically efficient and financially prudent. Each model needed to allow SOGEM to respect its existing contractual obligations to and potential future relations with the incumbent telecommunications service providers. Finally, each model had to minimize unnecessary administrative and regulatory hurdles and ensure that SOGEM itself has sufficient flexibility and motivation to advance the project.

Model No. 1: Dark fiber leasing

594. The first model considered was at the most basic end of the value chain. SOGEM could simply lease the right to use the fiber directly to telecommunications service providers without SOGEM installing any equipment or providing any service. The asset is referred to as "dark fiber" and "passive infrastructure" because it would not involve SOGEM installing or operating any electronic equipment. Under this model a customer would be entirely free to use the leased fiber pair as it wished.

Model No. 2: Dark fiber leasing with customer obligations

595. The second model was based on the first but introduced an obligation on the customer to offer wholesale bulk data services on the fiber in its market. This obligation would address the problem that the number of customers seeking to use SOGEM's network exceeded the small number of available fiber pairs on it. This model would help unlock competition in the wholesale bulk data services market.

596. Both the first and second models had the strong benefit of simplicity, alignment with SOGEM's comparative advantage in providing dark fiber and avoidance of risk.

Model No. 3: DWDM wavelength leasing

597. The third model increased the involvement of SOGEM in the telecommunications market. SOGEM could install electronic "multiplexing" equipment enabling it to divide the capacity on a fiber optic pair into a large number of wavelengths and lease each of these to the telecommunications service providers (referred to as "DWDM wavelengths").

598. Under this business model, SOGEM would establish a subsidiary to run the DWDM wavelength leasing business, which would enlist the technical support of an experienced telecommunications expertise in the fiber services market. The cost of installation of the necessary equipment in all substations would be rather modest.

599. This model would put fiber optic wavelengths directly onto the market without a new intermediary telecommunications licensee. SOGEM would thus participate in, and have an opportunity to capture some of the economic benefits of, the higher layer of the value chain. The model minimized SOGEM's disadvantages by outsourcing key aspects of design, operation and marketing to a partner. However, this model introduced the challenging problem of establishing a new subsidiary, hiring personnel to run the business and experts in sales and marketing, engaging a technical partner, and obtaining telecommunications licenses in each country.

Model No. 4: Transmission capacity services

600. The fourth model considered required SOGEM's fullest level of involvement and highest level in the value chain. Equipment could be installed on SOGEM's network that would enable the provision of a full range of transmission capacity services to telecommunications service providers. SOGEM would address the operational and cost disadvantages, and commercial and financing risks, of a bulk data model by involving a third party as a partner. For example, an international telecommunications operator could bring its experience of developing, commercializing and managing transmission capacity services. A telecommunications operator might also bring capital to fund the investment, as well as many cost efficiencies not available to SOGEM through discounts on equipment procurement and employment of existing human resources.

601. The partner, through offering disaggregated transmission capacity services (instead of leasing or selling dark fiber pairs) would be able to meet market demand. Instead of simply granting the use of the asset at a price fixed today, SOGEM would participate in the growth of the market under the leadership of an experienced operator. The most obvious structure for this scenario would be for SOGEM to grant a 10 to 15-year concession contract over the dark fiber pairs to the international partner's affiliate(s) and for SOGEM to receive a percentage of the revenues over the course of the concession.

602. This model also had the advantage that it involved bringing in a new entrant telecommunications operator perhaps from outside the region to act as a carrier's carrier, thereby boosting the region's wholesale market in international capacity and backhaul services. The impact on the market – competition, reduced prices and economic growth – would likely be high. Although the profitability to SOGEM would depend entirely on what SOGEM would be able to negotiate with the partner, this model would also have substantial economic value to SOGEM. It

would benefit from the synergies and economies of scale and scope of an international operator while limiting SOGEM's economic investment and risk.

Further developments

603. At time of writing, SOGEM has selected the fourth model, [transmission capacity services](#) led by a partner telecommunications operator, and is beginning to explore this model more deeply and move towards implementation. Its decision was based on both the high potential profitability of this model as well as the ability to meet market demand and spur economic growth in the region.

8.12.4 Lessons learned

604. SOGEM is still in the initial stages of establishing a commercial telecommunications business. However, it has carefully considered a wide range of potential business models and evaluated them with its own goals, strengths and weaknesses in mind. This careful evaluation process should increase SOGEM's chances of success.

8.13 Information Broadband Infrastructure System (Poland)

8.13.1 Introduction

605. This case study examines the development in Poland of the Information Broadband Infrastructure System (SIIS), an electronic [GIS](#) mapping system that gathers and presents information on infrastructure deployment in the country.

8.13.2 Background on SIIS

606. By the mid-2000's, Poland lagged behind its neighbors in broadband deployment. With a broadband penetration rate of 13 connections for every 100 inhabitants, Poland had one of the lowest broadband penetration rates in Europe.¹⁹⁵ It also had a telecommunications infrastructure gap estimated at over €1.5 billion.¹⁹⁶

607. In 2007, the European Structural Fund allocated over €4.5 billion to Poland in order for the country to increase broadband deployment.¹⁹⁷ Using a portion of these resources, the Polish Ministry of Infrastructure, in collaboration with the National Institute of Telecommunications and the Office of Electronic Communications (OEC), Poland's communications regulator, launched a program to support the development of broadband networks in Poland. This program resulted in the development SIIS, an electronic system that gathers, processes, presents and shares information about existing telecommunications infrastructure, public telecommunications networks, collocation buildings and broadband telecommunications services. Development of SIIS began in 2009 and was completed in late 2012.

608. The primary purpose is to accelerate deployment of broadband infrastructure through information sharing. For example, SIIS enables local governments to obtain geo-referenced information to support public investment in broadband infrastructure. This information allows the various levels of government to have a common understanding of the current level of broadband

¹⁹⁵ OEC (The Observatory of Economic Complexity). June 2011. Presentation sent from the NaN PT TRIS Meeting, Riga, Latvia, 21-22.

¹⁹⁶ Ibid.

¹⁹⁷ Ibid.

deployment in a given area and identify locations that lack access to broadband and would benefit from a public intervention.¹⁹⁸ SIIS also enables telecommunications operators to identify network access points and passive telecommunications infrastructure for sharing to optimize broadband deployment. Specifically, SIIS provides operators with detailed information to make business decisions on new investment projects, modification of existing infrastructure and market competitiveness. In addition, SIIS has also been used by non-telecommunications businesses and investors to evaluate potential business locations by providing information on access to existing telecommunications technologies.

609. At the time of writing, SIIS does not yet gather information regarding non-telecommunications infrastructure, but this is expected to be added within the next two years.¹⁹⁹

8.13.3 *Legal, regulatory and policy issues*

610. Once the development of SIIS began, it became clear that there were several obstacles for gathering infrastructure information. For example, there were no harmonized rules among local governments, utilities and operators regarding how to assess existing infrastructure. To make matters worse, some operators were reluctant to share information on infrastructure because they feared that there were inadequate legal protections in place to protect the confidentiality of their information.²⁰⁰ Many of these obstacles were addressed in the *Act on supporting the development of telecommunications services and networks* (Broadband Act), enabling legislation enacted in May 2010.²⁰¹

611. Article 29 of the Broadband Act provides “a legal basis of drawing up the inventory of existing telecommunications infrastructure and public telecommunications networks on the territory of Poland (in electronic form) with a separate indication of coverage of the country by optic links, wireless networks and building to enable collocation.”²⁰² Article 29 further obligates most state and local government entities, public utilities, telecommunications operators and others to send the OEC information related to telecommunications infrastructure. Regulations issued under the Broadband Act clarify which specific information must be provided. This includes routes of backbone and distribution telecommunications networks (indicating the type of technology used), locations of telecommunications nodes, connection points with public telecommunications networks, and collocation buildings, among other telecommunications infrastructure information. These entities are also required to review the information they submitted once each year and submit any updates. Article 29 is limited to telecommunications infrastructure and does not address infrastructure of entities from other sectors.

612. To give comfort to private operators who are often reluctant to share information on their infrastructure, the Broadband Act preserves the confidentiality of the information collected. The SIIS user interface does not enable the user to identify the operators’ infrastructure.²⁰³ Rather, when a user wants to access information on infrastructure identified through SIIS, the user contacts

¹⁹⁸ OEC. 2014. “Best practice and plans regarding passive infrastructure mapping,” Presentation.

¹⁹⁹ Interview with the Office of Electronic Communications.

²⁰⁰ NaN PT TRIS meeting in Riga, Latvia, 21-22 June 2011.

²⁰¹ European Commission. 2013. *The Act of 7 May 2010 on Supporting the Development of Telecommunications Services and Networks – Poland*. Commissioners Report, Brussels.

²⁰² OEC. 2014. “Best Practice and Plans Regarding Passive Infrastructure Mapping,” Presentation.

²⁰³ Interview with Polish Regulator.

OEC. OEC then in turn contacts the infrastructure owner to obtain permission to share its information. If the infrastructure owner objects, which rarely happens in practice, the OEC tries to find alternative solutions.

8.13.4 Impact of SIIS

613. By the time of writing, SIIS has achieved a large increase in the quantity and quality of information held by OEC on existing telecommunications infrastructure. For example, SIIS has resulted in the identification of over 2,800 locations able to provide collocation of telecommunications equipment. The percentage of villages with no telecommunications node has declined by more than 9 percentage points, but according to OEC this is not the result of increased deployment. Rather it reflects more accurate information collection. SIIS has not yet had a measurable impact on broadband deployment.²⁰⁴

8.13.5 Lessons learned

614. Through the development and implementation of SIIS, Poland has begun to assemble a comprehensive and living archive of all telecommunications infrastructure in the country. Implementation of SIIS required a number of regulatory changes necessary to mandate information provision, harmonize rules on infrastructure assessment, and protect confidentiality. Although there has not been a measurable impact on broadband deployment, SIIS is still in its infancy. SIIS is still gathering information on telecommunications infrastructure, and expects to incorporate non-telecommunications infrastructure beginning in the next two years. The effects on broadband deployment need to be monitored over the next few years to measure its success.

8.14 KOSTT (Kosovo)

8.14.1 Introduction

615. This case study examines the steps currently being taken by KOSTT j.s.c (KOSTT), Kosovo's state-owned electricity transmission, system and market operator, to commercialize excess capacity on its [OPGW](#) network.

8.14.2 Background on KOSTT

616. Established in 2006, KOSTT is responsible for, among other things the planning, operation, maintenance, and development of Kosovo's electricity transmission system.²⁰⁵ KOSTT has already deployed [OPGW](#) along its high voltage transmission network which covers Kosovo's main urban areas (Pec, Prizren, Pristina, and Mitrovica) and is in the process of retrofitting its international connections to Albania, Montenegro, Serbia, and Macedonia. KOSTT's [OPGW](#) was installed for its internal use. The map in the Figure below shows KOSTT's transmission lines as of 2013.

²⁰⁴ Republic of Poland, The Office of Electronic Communications. 2013. "Report on the Coverage of the Republic of Poland with the Existing Telecommunications Infrastructure, Investment Projects Implemented in 2012 and Planned for 2013, as well as with Buildings Enabling Collocation." Communications Report, Warsaw.

²⁰⁵ KOSTT, "About KOSTT," KOSTT, http://www.kostt.com/website/index.php?option=com_content&view=article&id=150&Itemid=337&lang=en (last visited 11 Feb 2017).

619. KOSTT has not previously commercialized its fiber capacity due to a lack of technical and commercial knowledge of the telecommunications sector. To overcome these difficulties, MED requested the assistance of the World Bank in 2014. With the help of a World Bank-directed technical assistance program supported by Public Private Infrastructure Advisory Facility (PPIAF), MED has now conducted market studies of the broadband sector to forecast demand for the broadband market and assist KOSTT in developing a viable business model.

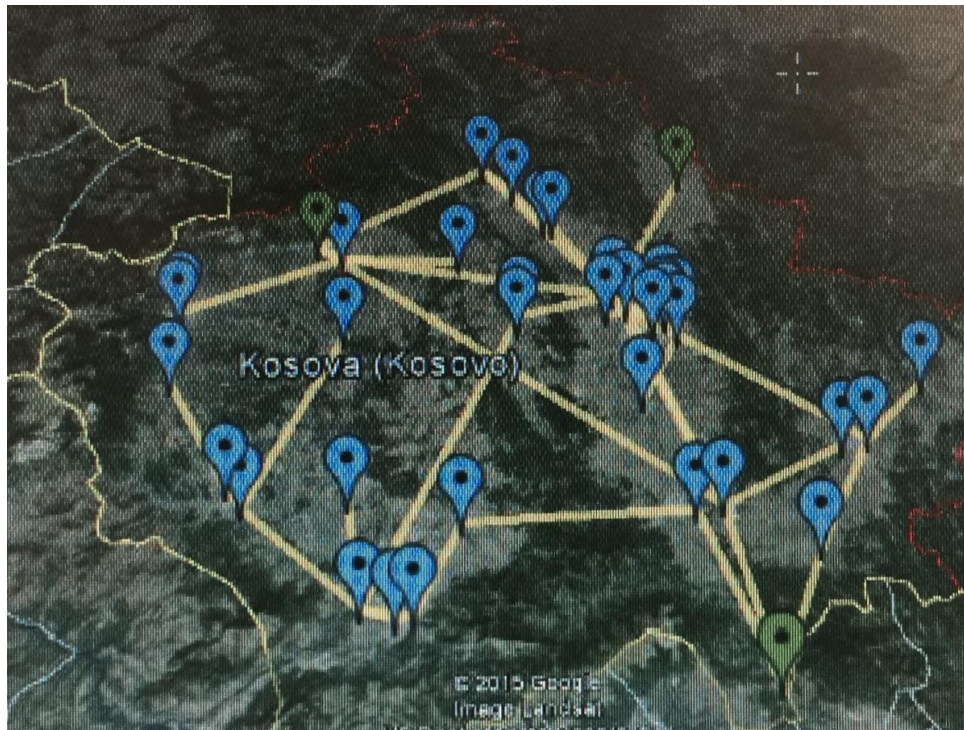
Selecting a business model

After assessing potential business models, KOSTT has opted to lease dark fiber capacity to telecommunications operators to be used in their backbone networks. Given the layout of KOSTT's network, as shown in the Figure below, KOSTT has concluded that its transmission network is best suited to provide backbone services to telecommunications operator rather than to provide "last mile access."²¹⁰ Little additional capital investments above and beyond what network expansion is already planned would be required to lease dark fiber on its network. The only additional expenses will be operational expenditures in the form of hiring staff to support additional control in installations and handle the commercialization of the optic fiber.

With the help of the World Bank-directed technical assistance, KOSTT has developed a long run incremental cost (LRIC) model to ensure that the excess dark fiber is leased at prices that ensure a positive return on the investment. This cost analysis of the relevant infrastructure assets was based on KOSTT's internal information as well as regional pricing data. A benchmark of dark fiber price analysis was performed to ensure that KOSTT's deployment costs are aligned with other similar countries in the Balkans. Using this information, KOSTT prepared a draft reference offer price, but at the time of writing this has not yet been made public.

²¹⁰ Ibid.

Figure 38: Layout of KOSTT's fiber network and nodes



Source: Deloitte and World Bank

620. Kosovo's existing telecommunications operators are KOSTT's potential customers for excess capacity, but may also serve as its main competitors to the extent they maintain and deploy telecommunications networks using their own infrastructure. Currently the three major telecommunications operators have deployed their own transport networks, and the Kosovo Electricity and Distribution and Supply is also leasing excess capacity to telecommunications operators.

621. Existing backbone networks will, in many regions operate parallel to KOSTT's fiber optic cables, but market studies conducted in 2015 have concluded that there are opportunities for all players to operate profitably in the market.²¹¹ Most of the 50 existing broadband providers in Kosovo are likely to be leasing capacity on the infrastructure from Kosovo's major telecommunications operators, and would likely consider KOSTT's infrastructure as an alternative. KOSTT's nationwide network and cross-border interconnections can also offer local telecommunications operators the opportunity to expand their coverage to new parts of the country and to connect to networks in neighboring countries. Finally, the major telecommunications operators may be interested in leasing excess fiber from KOSTT to ensure network redundancy. This is especially critical for operators providing services to enterprises who usually demand service level agreements which include strict terms regarding network failures and therefore require operators to have redundant capacity. Once KOSTT's transmission lines to the borders are retrofitted with [OPGW](#), other telecommunications operators may also be interested in gaining access to international interconnections.

²¹¹ Deloitte and World Bank. 2015. *Technical Report on the Facilitation of Efficient Infrastructure Sharing in Kosovo*.

8.14.4 Legal, regulatory and policy issues

622. While there is broad support for infrastructure sharing and the commercialization excess capacity in the fiber networks of public utilities, including KOSTT, MED has struggled to operationalize infrastructure sharing. This has been attributed to a variety of reasons including lack of an operational framework, poor information sharing among public utilities and private telecommunications companies about the opportunities for sharing infrastructure, and a lack of technical capacity in government (policymakers and regulators) to implement shared infrastructure projects.²¹² As described above, MED has requested assistance from the World Bank to overcome these difficulties. In addition, MED is also receiving assistance from the World Bank to develop a [GIS](#) atlas that will serve as an inventory of existing and planned infrastructure assets so that the scope and opportunities for the sharing of infrastructure can be better visualized by public utilities and telecoms companies.²¹³

623. The Authority of Electronic and Postal Communications (*Autoriteti Rregullator i Komunikimeve Elektronike dhe Postare*) (ARKEP) is Kosovo's national regulator for electronic communications and postal services. ARKEP was established in 2004 as an independent regulatory agency and is responsible for, among other things, licensing and supervising the providers of telecommunications services in Kosovo, encouraging the private sector participation and competition in the these sectors, and setting standards for all service providers in Kosovo.²¹⁴ In 2014 KOSTT notified ARKEP of its intention to commercialize its dark fiber and has subsequently received regulatory approval.²¹⁵

624. While Kosovo has not yet regulated access to or use of dark fiber, the existing European Commission regulatory framework requires access and backhaul network segments to be priced on the basis of LRIC modelling and mandate a reference interconnection offer.²¹⁶ It is expected that any legislation Kosovo enacts in relation to dark fiber will follow the existing legislation in the European Union.

8.14.5 Lessons learned

625. KOSTT is in the process of developing a promising commercial dark fiber leasing business. This is a direct result of the Government's policies to stimulate cross-sector infrastructure sharing, including through seeking technical assistance from the World Bank. At time of writing, market study reports have been completed and an LRIC cost model and draft reference offer price have been developed. Next steps include identifying potential customers and preparing a public reference offer. KOSTT's efforts will need to be evaluated once the business is launched.

²¹² Deloitte and World Bank. 2015. *Technical Report on the Facilitation of Efficient Infrastructure Sharing in Kosovo*.

²¹³ PPIAF (Public-Private Infrastructure Advisory Facility), "KOSOVO: Facilitation of Efficient Infrastructure Sharing for Kosovo," The World Bank Group.

²¹⁴ RAEPK (Regulatory Authority of Electronic and Postal Communications), "History," Telecommunications Regulatory Authority, <http://www.arkep-rks.org/?cid=2.28> (last visited 11 Feb 2017).

²¹⁵ Interview with World Bank representative.

²¹⁶ Directive 97/33/EC (June 30, 1997) outlines the charges for interconnection and that prices should be based on a price closely linked to the LRIC, and Recommendation 98/195/EC (January 8, 1998) recommends the use of LRIC to assess costs oriented interconnection tariffs for terminating access.

8.15 Portugal's Rapid Increase in Fiber Access

8.15.1 Introduction

626. This case study examines the contributing factors that led to the rapid increase in access to fiber optic networks in Portugal beginning in 2009.²¹⁷ It focuses on three likely contributing causes:

- Autoridade Nacional de Comunicações (ANACOM)'s implementation of statutory powers to ensure access to the infrastructure of incumbent telecommunications operator Portugal Telecom²¹⁸ (PT) and ANACOM's subsequent regulation of access prices;
- a restructuring of the telecommunication market following PT's spin-off of its cable television (CATV) business, which encouraged PT to invest in expansion of its fiber optic network to homes and buildings (FTTH/B); and
- the implementation of a symmetric regulatory framework that mandated open access to all public infrastructure and established a Centralized Information System (CIS) to coordinate access to and construction of civil works.

8.15.2 Background on Portugal's increase in fiber access and ANACOM

627. Since 2009, Portugal has seen a rapid increase in broadband access, with access to fiber networks increasing by 35% on an annual basis (see the first Figure below). While still lagging behind many of its EU neighbors in terms of broadband penetration,²¹⁹ its FTTH/B access rate is significantly higher. Portugal also performs among the top four countries when it comes to the speed of broadband access (see the second Figure below). This can largely be traced back to the expansion of fiber optic networks, which has increased by around 50,000 customers per quarter.²²⁰ In Portugal FTTH/B technology makes up 22% of total broadband access, while the average among EU Member States is only 8%.²²¹

628. As of the second quarter of 2015, there are 56 registered providers of fixed internet access providers in Portugal with three operators dominating the market. These are PT (operating under the MEO brand) (51%), NOS Comunicações, S.A. (35.5%) and Vodafone (13.2%).

629. ANACOM is the postal and electronic communications regulatory of Portugal established in 1989. Its key responsibilities include regulating the telecommunications sector to ensure transparent and equal open access to infrastructure, promote competition among the telecommunication operators and grant rights to operators entering the sector.

²¹⁷ Unless otherwise indicated, information included in this case study was provided by the Autoridade Nacional de Comunicações (ANACOM).

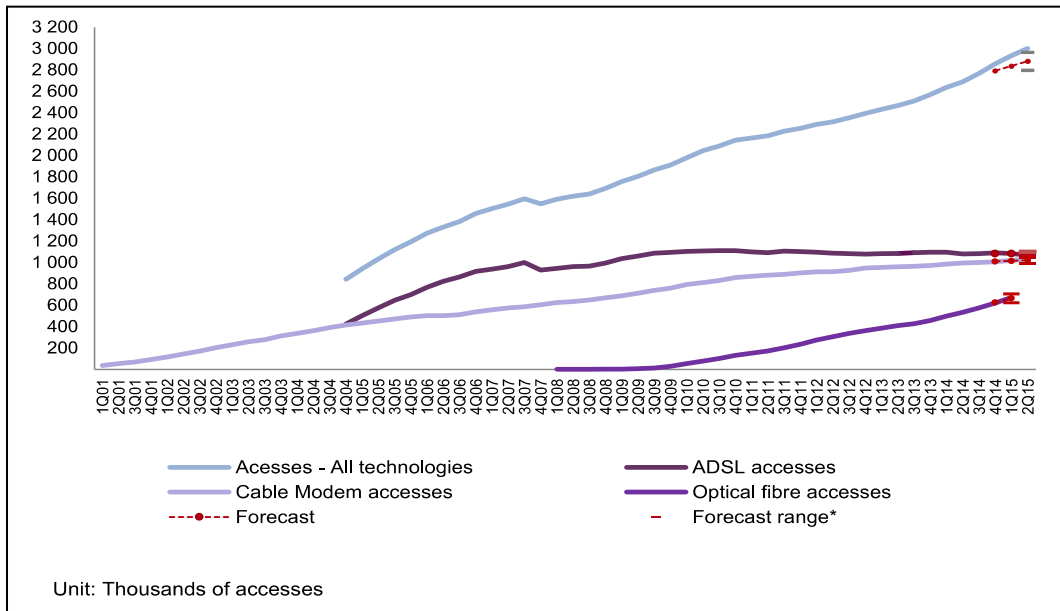
²¹⁸ PT was acquired by Altice Group in June 2015. Although PT currently operates under the brand MEO (Serviços de Comunicações e Multimédia), for the sake of clarity this case study will refer to PT as such. See, "Portugal Telecom continues transformation as MEO brand replaces TMN" *European Communications*. 28 January 2014. Available at <http://www.eurocomms.com/industry-news/9585-portugal-telecom-continues-transformation-as-meo-brand-replaces-tmn#> (last visited 11 Feb 2017).

²¹⁹ In January 2015, broadband penetration was 27.4 per 100 inhabitants as compared to the EU28 average of 31.1 per 100 inhabitants.

²²⁰ See, ANACOM (Autoridade Nacional de Comunicações). 2015. *Statistical Information: Internet Access Service - 2nd Quarter 2015*. Statistical Report, Lisbon.

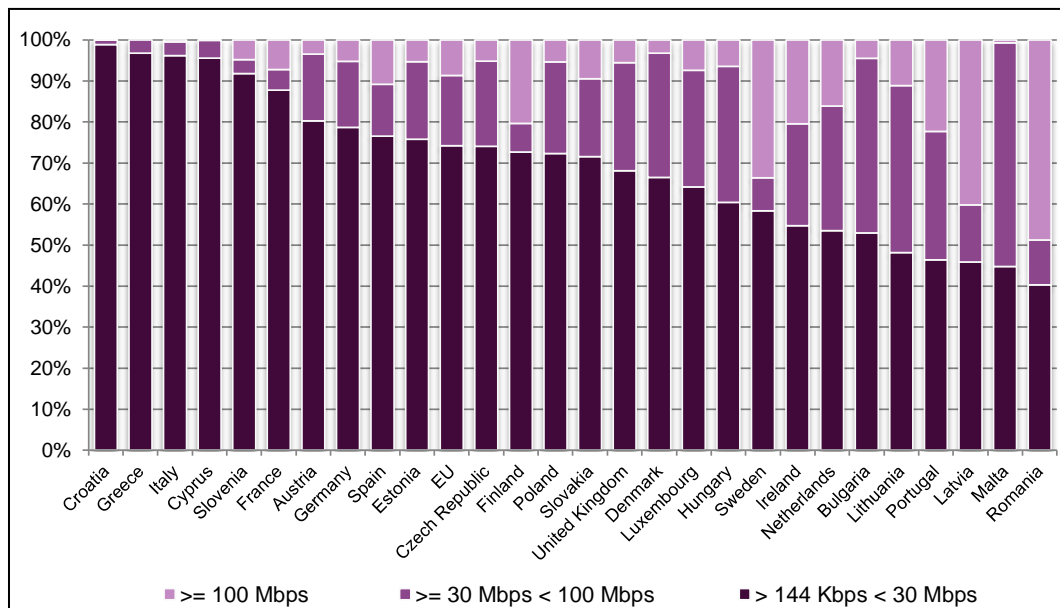
²²¹ This constitutes 722,000 households and is the preferred means of access for new customers.

Figure 39: Number of Fixed Broadband Access in Portugal



Source: ANACOM (2015)²²²

Figure 40: Fixed Broadband Access in EU28 by Download Speed (January 2015)



Source: CE, Digital Agenda Scoreboard, January 2015²²³

²²² ANACOM Statistical Information: Internet Access Service - 2nd Quarter 2015. Available at https://www.anacom.pt/streaming/IAS2quarter2015.pdf?contentId=1366618&field=ATTACHED_FILE (last visited 13 Feb 2017).

²²³ As included in ANACOM Statistical Information: Internet Access Service - 2nd Quarter 2015. Available at https://www.anacom.pt/streaming/IAS2quarter2015.pdf?contentId=1366618&field=ATTACHED_FILE (last visited 13 Feb 2017).

8.15.3 Contributing factors to the increase in fiber access

Factor 1: ANACOM's statutory powers to ensure access to the infrastructure of PT and regulatory authority to regulate prices

630. ANACOM's statutory powers to regulate access to the infrastructure of PT were a contributing factor to Portugal's recent increase in fiber access. Article 26 of the 2004 Electronic Communications Law granted ANACOM the authority to regulate access to the telecommunications infrastructure of PT. Specifically, ANACOM was able to mandate that PT create a wholesale reference offer for access to its infrastructure.

631. In July 2004, ANACOM issued a decision obliging PT to offer access to its ducts, poles and other related infrastructures to other telecommunications operators and to publish access price and conditions in a wholesale reference offer. The decision required PT to allocate at least 20% of the internal space within its ducts to operators that request access. The 2004 decision also obligated PT to inform ANACOM annually about its current network specifications and any expansion plans. These asymmetric requirements apply only to PT as the incumbent.

632. In addition, ANACOM has subsequently identified PT as having significant market power in the wholesale market for access to physical infrastructure. Since 2007, utilizing its regulatory authority under the Significant Market Power Regulation, ANACOM has imposed an additional obligation on PT to grant access to its ducts to telecommunications operators. Under this regulation, ANACOM has utilized its authority to review PT's access prices and determine whether they are excessive.

Factor 2: Restructuring of the telecommunications sector

633. The restructuring of Portugal's telecommunications sector was also a contributing factor to the recent increase in fiber access. In February 2006, Sonae, a large Portuguese company with a diverse portfolio of business, launched a hostile takeover bid of PT. One of the main reasons put forward by Sonae for its bid was that PT lacked competitors in the market. At the same time, ANACOM and Portugal's Competition Authority were applying pressure on PT to reduce its dominant position in the telecommunications sector. As a means of successfully defending against the takeover bid and satisfying these regulatory pressures, PT decided to spin off its successful CATV and broadband business.

634. Overnight PT lost its dominant position in the cable TV and broadband markets. It now had no CATV business and its remaining broadband business had a similar market share as that of the second largest operator. In order to stay competitive, PT decided that a high-speed triple play package product would be the best strategy to win back market share and rebranded itself as MEO. Rather than investing in ADSL technology, PT invested in expanding its FTTH/B network. Other operators, such as Vodafone, took advantage of PT's obligations to offer access to its ducts (described above) and piggy-backed on this expansion by installing their own fiber optic networks in these new ducts.

Factor 3: Implementation of a new symmetric regulatory framework

635. The implementation of a new symmetric regime also contributed to Portugal's recent increase in fiber access. In 2008, the Portugal's Council of Ministers signed resolution no. 120/2008, which established the promotion of next generation access networks as a strategic

priority of the country. Decree Law 123/2009 (2009 Law)²²⁴ and its amendments establish the legal and regulatory framework that governs construction and access to passive infrastructure for telecommunications use.

636. The 2009 Law imposes symmetric obligations on all owners of public infrastructure, telecommunications and non-telecom, to ensure open access to existing and planned infrastructure. Specifically, it mandated open and non-discriminatory access to all suitable public infrastructure buildings, including piping networks, masts, ducts, inspection chambers, manholes, cabinets or buildings, as well as any other infrastructure that may contain cabling or network equipment. Infrastructure owners were required to make public any future construction to give telecommunications operators the opportunity to participate. In addition, all new urban housing developments were required to include fiber optic cable for connections to fiber networks.

637. The 2009 Law also established CIS to maintain updated information regarding the existing infrastructures. CIS is a [GIS](#) tool that incorporates and shares the location, layout and ownership or management of civil infrastructure. It also includes information on planned civil infrastructure construction, allowing interested telecommunications operators to join in construction efforts.

638. ANACOM is charged with maintaining CIS and provide the information to interested parties. ANACOM launched an international tender for the management of CIS in late 2010, but it was closed in 2011 on procedural grounds.²²⁵ A new tender was launched in early 2014 with the contract awarded in December of that year. CIS is expected to be operational in 2016.

8.15.4 Lessons learned

639. Portugal's increased roll out of its fiber optics network in recent years has been impressive. The three factors discussed in this case study likely contributed to this increase by allowing for a more competitive telecommunications sector and reducing costs for operators to expand their fiber optic networks through telecommunications and cross-sector infrastructure sharing. Going forward, ANACOM is hoping to further increase sharing of infrastructure within the telecommunications sector and across sectors through the implementation of CIS.

²²⁴ ANACOM. 2009. *Decree-Law No. 123/2009 of 21 May*. ANACOM. Available at <http://www.anacom.pt/render.jsp?contentId=975261#.Vi7gTa6rRn4> (last visited 11 Feb 2017).

²²⁵ ANACOM. 2011. *Report on Regulation, Supervision and Other Activities 2011*. ANACOM. Available at <http://www.anacom.pt/render.jsp?contentId=1133549#.Vk0kxPmrTIU> (last visited 11 Feb 2017).

9 Country case studies

640. This module sets out three case studies that focus on the overall cross-sector infrastructure of sharing experience three countries: Lithuania, South Africa and the United States.

9.1 Lithuania

9.1.1 Introduction

641. This case study examines infrastructure sharing in Lithuania, which is rooted in Lithuania's regulatory framework. Widespread infrastructure sharing is credited with contributing to the high level of fiber deployment in the country. However, most infrastructure sharing still remains within the telecommunications sector and cross-sector infrastructure sharing has been limited.

9.1.2 Regulatory framework

642. In 1998, Lithuania enacted the Law on Telecommunications of the Republic of Lithuania (Telecommunications Law).²²⁶ This legislation included provisions regarding sharing of telecommunications infrastructure. The Telecommunications Law also established a new regulator, the Communications Regulatory Authority of the Republic of Lithuania (*Lietuvos Respublikos ryšiųreguliavimo tarnyba*) (RRT), and designated as the entity responsible for enacting regulations and resolving disputes among telecommunications operators regarding such sharing. RRT became operational in 2001.

643. In parallel with the enactment of the Telecommunications Law, Lithuania's incumbent state-owned fixed telecommunications operator, *Lietuvos Telekomas*, was privatized in 1998 when the consortium Amber Teleholding A/S, established by Swedish Telia AB and Finnish Sonera Oy, acquired 60 percent of its shares.²²⁷ The new entity, later renamed TEO LT, AB (Teo), was kept intact and not bifurcated into a service provider and an infrastructure owner, as had been done in other countries in the region. Subsequently, approximately 30% of Teo's shares were issued to employees or sold to local and international investors as part of an initial public offering.²²⁸ As of early 2016, TeliaSonera owned 88% of Teo.²²⁹

644. In 1998, Teo was granted a monopoly to provide fixed telecommunications services which expired at the end of 2002. Beginning in 2003, as part of a telecommunications sector liberalization prompted by Lithuania's anticipated entrance into the European Union, other operators were permitted to provide fixed telecommunications. In 2002, RRT enacted rules governing the common use of conduits, ducts, inlets, masts and towers of telecommunications operators. Reflecting the Telecommunications Law, these rules only governed sharing among telecommunication operators.

645. In 2004, Lithuania became a member of European Union and was required to harmonize its telecommunications regulatory framework with that of the European Union. Accordingly, in April 2004, Lithuania enacted the Law on Electronic Communications (EC Law) which contains

²²⁶ Unless otherwise indicated, information included in this case study was provided by the Communications Regulatory Authority of the Republic of Lithuania (RRT).

²²⁷ TEO website, "Historical Facts," (as of Dec 2015).

²²⁸ Ibid.

²²⁹ TEO, "TEO in Brief," (as of Dec 2015).

infrastructure sharing obligations for telecommunications as well as non-telecommunications infrastructure.

646. Articles 37 and 39 of the EC Law are most relevant for infrastructure sharing. Article 37 facilitates infrastructure sharing among telecommunications operators by requiring that parties engaged in the “construction of electronic communications networks” must “make public information about the start of construction works and about the possibility for other persons to participate in construction sharing.”

647. Article 39 facilitates shared use of infrastructure used for telecommunications and other in other sectors. It grants providers of public communications a means of accessing “electronic communications infrastructure” which is defined to include passive infrastructure such as pipes, ducts, towers, masts, and buildings, as well as other infrastructure such as pipelines, collectors, wells, pilings, structures bushings, and engineering systems of construction works, and other facilities. Ordinarily, the terms and conditions for infrastructure sharing are freely negotiated, and in practice, telecommunications operators are encouraged to contact the owners of the infrastructure directly and negotiate terms of access. However, under Article 39, if a provider of public communications cannot obtain the right to install its necessary electronic communications infrastructure or the costs of obtaining such right are disproportionately high, RRT may request that an infrastructure owner share its infrastructure on non-discriminatory terms, so long as the sharing is cost efficient and does not require significant additional work. Under Article 39 infrastructure owners are prohibited from refusing to conclude a contract for such use of the infrastructure except in limited circumstances.

648. In 2005, RRT enacted rules governing construction, installation of electronic communications networks and shared use of infrastructure. In 2011 provisions governing the marking of infrastructure were added to those rules. The regulations set out more detailed procedures to implement Articles 37 and 39 of the EC Law.

649. Lithuania is also subject to Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks (the Directive). Article 3 of the Directive requires undertakings providing gas, electricity, heating, water and sewer, or transport services (including rail, road, port and airport) to “meet all reasonable requests for access to its physical infrastructure under fair and reasonable terms and conditions, including price.” Under Article 13, Member States are required to adopt and publish laws, regulations and administrative provisions necessary to comply with the Directive by 1 January 2016. At the time of writing, Lithuania was in the process of transposing the requirements of the Directive into national law.

9.1.3 Lithuania’s Infrastructure sharing experience

650. Infrastructure sharing in Lithuania is widely considered a success. It has been a catalyst for increased broadband access and, in particular, a high rate of fiber deployment to the premises.

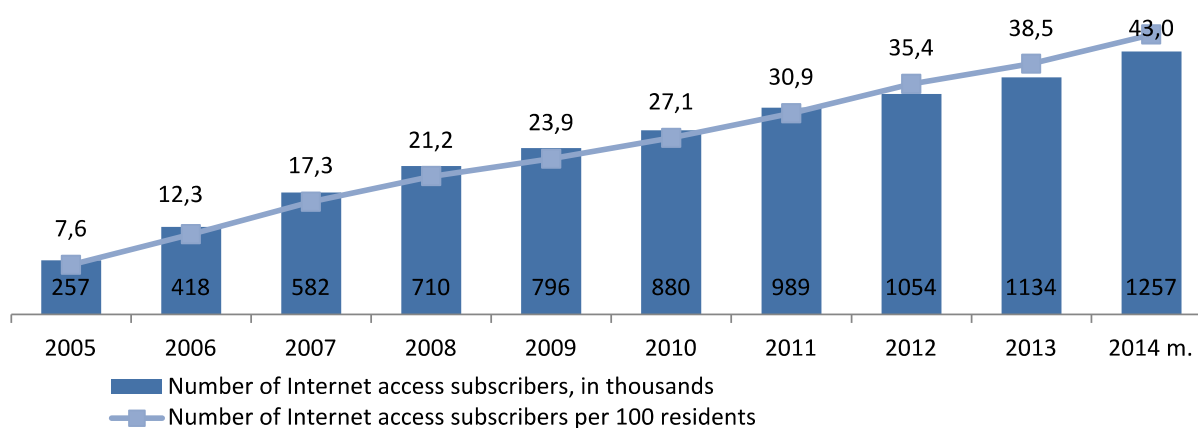
Increased fiber deployment

651. The introduction of the rules governing installation, construction and sharing of infrastructure drove deployment of cable TV networks and fiber to the building (FTTB) by alternative operators using both existing and new infrastructure. Telecommunications operators took advantage of the opportunity to share the existing ducts of Teo. Also, for several years, and until around 2007, Teo focused on xDSL technology and not on fiber deployment. Competing

service providers invested in construction of new fiber facilities to compete with Teo's xDSL service. Teo only followed suit a few years later in response to competitive pressure.²³⁰ In some instances, Teo has requested access to these new fiber facilities using the very regulatory framework that was designed to give access to its competitors. Fiber to the premises became the dominant broadband technology in Lithuania in mid-2008.²³¹

652. In 2014, 98% of households had fixed broadband coverage and 58% of households had fixed broadband take-up, as opposed to 97% and 70%, respectively in the overall EU.²³² By 2014, the number of broadband Internet access subscribers per 100 residents was 43, reflecting the continuation of a trend towards increasing penetration.²³³ A national broadband plan adopted on 30 October 2014 anticipates that by 2020 100% of households will have the ability to connect to the Internet at speeds of at least 30 Mbps.²³⁴

Figure 41: Number of broadband Internet access service subscribers and penetration rate



Source: RRT²³⁵

653. In 2014, fiber optic lines remained the main technology utilized for provision of broadband communications services,²³⁶ with over 0.477 million FTTH or FTTB fiber lines in Lithuania, a 9.1 percent increase from the year before.²³⁷ Mobile connections and wireless communications lines were the second and third most popular means of accessing broadband Internet.²³⁸

²³⁰ Gelvanovska, Natalija et al. 2014. *Broadband Networks in the Middle East and North Africa*.

²³¹ Ibid.

²³² European Commission. 2015. *Implementation of the EU Regulatory Framework for Electronic Communication*.

²³³ Republic of Lithuania, Communications Regulatory Authority. 2014. *RRT Annual Report 2014*.

²³⁴ European Commission. 2015.

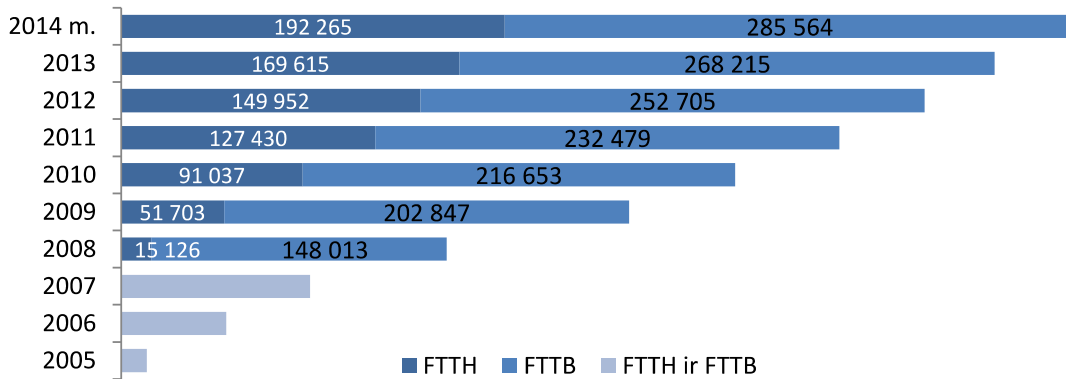
²³⁵ Republic of Lithuania, Communications Regulatory Authority. 2014. *RRT Annual Report 2014*.

²³⁶ Republic of Lithuania, Communications Regulatory Authority. 2014. *RRT Annual Report 2014*.

²³⁷ Ibid.

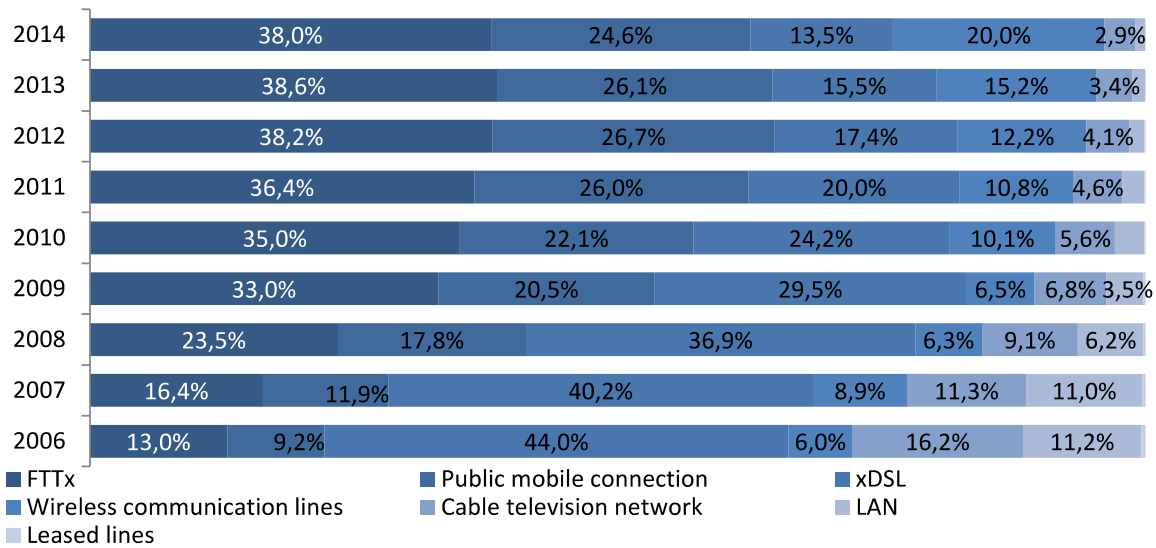
²³⁸ Ibid.

Figure 42: Provision of broadband Internet access using FTTH and FTTB



Source: RRT²³⁹

Figure 43: Provision of broadband internet access by technology



Source: RRT²⁴⁰

Limited infrastructure sharing across sectors

654. While infrastructure sharing among telecommunications operators has flourished in Lithuania, cross-sector infrastructure sharing has been much more limited. This is largely due to the fact that Teo’s duct infrastructure extends nationwide affording other telecommunications operators a convenient and accessible trove of passive infrastructure. In addition, non-telecommunications infrastructure owners have not been incentivized to promote sharing of cross-sector infrastructure as it results in limited revenues as compared to their primary businesses.

655. A major exception to this trend is the [Baltic Optical Network](#), a telecommunications network that traverses Estonia, Latvia and Lithuania. Lithuania’s portion of the BON utilizes the [OPGW](#)

²³⁹ Ibid.

²⁴⁰ Ibid.

network on the electricity infrastructure of Lietuvos Energija group, a state-controlled entity which, among other things, operates electricity infrastructure. In addition, there are some niche sharing opportunities, such as the leasing space on water supply towers from water treatment plants or space on chimneys of heating or electricity power plants for installation of base stations or other equipment.

Infrastructure mapping

656. To improve possibilities for cross-sector infrastructure sharing, RRT has led the creation of a [GIS](http://e-infrastruktura.lt/lt) resource (<http://e-infrastruktura.lt/lt>) which serves as a single information point for mapping systems covering telecom and other utilities' infrastructure.²⁴¹ The project was initiated in 2010 and requires municipalities to provide their own data on the nature and location of infrastructure. Success has been limited due to the difficulty of providing such information in a usable electronic form in many rural municipalities. At the time of writing, only the four largest of Lithuania's sixty municipalities, Vilnius, Kaunas, Klaipeda and Panevėžys (containing the four largest cities) are included in the [GIS](#) resource.

657. RRT has not seen any clear impact of this resource on cross-sector infrastructure sharing yet. This may be due to its limited reach, or the reality that demand for passive infrastructure is often satisfied by existing ducts of Teo or other telecommunications operators. Lithuanian policy makers are exploring new initiatives to bring additional municipalities into the [GIS](#) resource. For example, in 2014 the Ministry of Agriculture established a working group to create mandatory obligations for updating topographical information and converting it into a usable form that can be shared.

9.1.4 Lessons learned

658. Lithuania's strong legal and regulatory framework has encouraged infrastructure sharing both within the telecommunications sector and across sectors. This is largely credited with the widespread deployment of fiber to the home/building in Lithuania. However, cross-sector infrastructure sharing has been far more limited than sharing within the telecommunications sector, even despite initiatives by RRT. This not a likely not a result of any policy or regulatory shortcoming. Rather, it likely reflects the ample opportunities for and widespread practice of sharing an extensive network of passive infrastructure within the telecommunications sector.

9.2 South Africa

9.2.1 Introduction

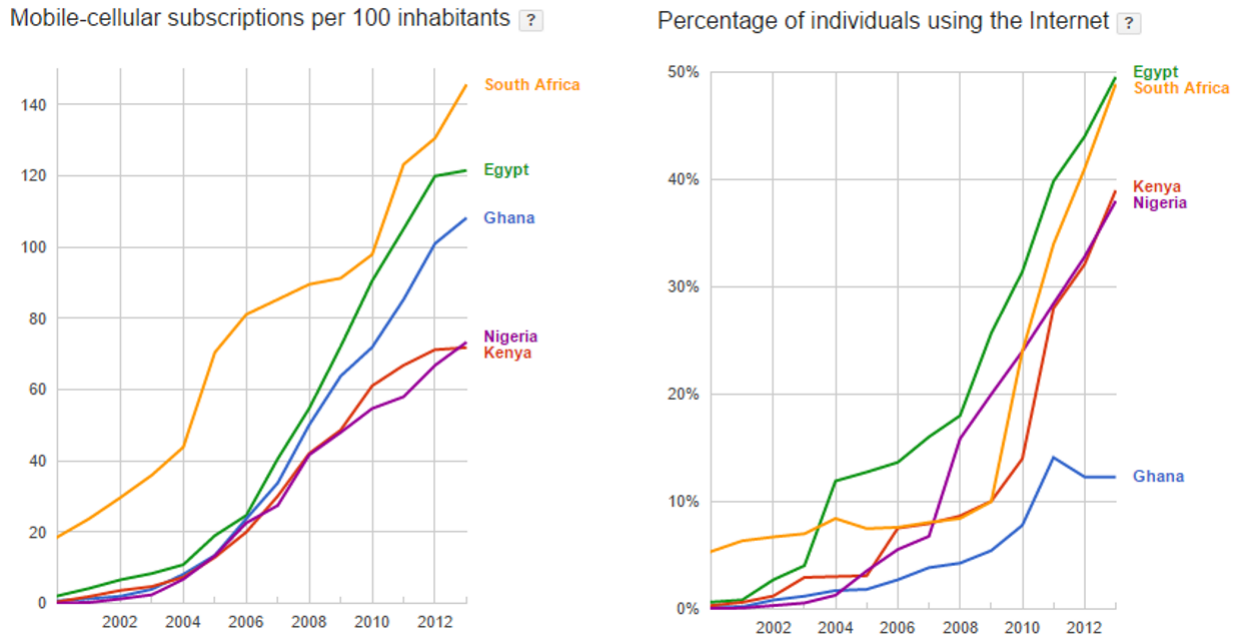
659. This case study examines the infrastructure sharing experience of South Africa. It summarizes the current telecommunications market and describes the regulatory and policy approach of the government. It then highlights three business models used to leverage shared infrastructure.

²⁴¹ European Commission. 2015.

9.2.2 Background on the South African telecommunications market

660. South Africa has the most developed telecommunications market in Africa, leading most African countries in mobile and Internet penetration.²⁴² At the time of writing, there are two fixed operators, four mobile operators and over twenty ISPs. South Africa has an extensive national fiber backbone network and terrestrial fiber links with Botswana, Lesotho, Mozambique, Namibia and Swaziland. It hosts landing points to five international submarine cable systems, serving as an access point for several of its land-locked neighboring countries. The fixed and mobile markets and the national fiber backbone networks are briefly discussed below.

Figure 44: Mobile and Internet penetration in South Africa



Source: ITU data collated by Andrew Johnson²⁴³

Fixed services

661. Until 2005, Telkom SA, the state owned provider of fixed telecommunications services, had a monopoly in the provision of fixed services. The monopoly was terminated after an investigation by the Department of Public Enterprises concluded that broadband development was hampered by high broadband costs attributable to the existence of a monopoly.²⁴⁴ In 2005, Neotel acquired a license to serve as the second national fixed operator. Originally and as discussed further below, the state owned companies, Eskom and Transnet collectively held a 30% stake in Neotel. In 2009, their shareholdings were sold to Tata Telecommunications which became the majority

²⁴² Deloitte, APC. 2015. *Unlocking Broadband For All. Broadband Infrastructure Sharing Policies and Strategies in Emerging Markets*. Policies and Strategies Report, New York. Available at <https://www.apc.org/en/pubs/unlocking-broadband-all-broadband-infrastructure-s> (last visited 11 Feb 2017).

²⁴³ Underlying ITU data available at <http://www.itu.int/net4/itu-d/icteye/>.

²⁴⁴ Broadband Infracore. 2008. *Annual report 2008*. Annual Report, Sandton.

shareholder.²⁴⁵ In July 2015, South Africa's regulator approved the acquisition of Neotel by Vodacom, making Neotel a fully private actor.²⁴⁶

Mobile services

662. South Africa's four mobile operators are Vodacom, MTN, Cell C and Telkom Mobile. Vodacom and MTN have the largest market shares, together holding more than 80% of South Africa's mobile market. Cell C and Telkom Mobile, a subsidiary of Telkom SA, share the remainder.²⁴⁷ In early 2014, MTN and Telkom SA entered talks regarding MTN taking over the management of the rollout and operation of Telkom's radio access network but South Africa's Competition Commission recently recommended prohibiting the proposed agreement.²⁴⁸

National fiber backbone network

663. South Africa's national fiber backbone network comprises a combination of fiber routes rolled out by the fixed operators Telkom SA and Neotel, mobile operators and public and private infrastructure companies. These can broadly be divided into public sector backbone networks (those established by public utilities) and private sector backbone networks (those established by private sector operators).

664. The public sector backbone networks comprise:

- Telkom SA's fiber optic network. This network consists of over 36,000 km of fiber optic cable, the largest network in Africa, connecting all major population centers. In 2013, Telkom SA also started investing R12 billion in a next generation broadband network.²⁴⁹
- A national long distance fiber optic backbone network of about 12,000 km belonging to state-owned companies Eskom, the national power utility, and Transnet (the national rail operator) and operated by Broadband Infracore SOC Ltd (BBI), an umbrella state-owned infrastructure company (further described below).²⁵⁰
- An extensive fiber network owned by the freight rail subsidiary of Transnet. This network is used by Transnet for its own railway purposes and has spare capacity that is currently not leased to anyone.²⁵¹

²⁴⁵ Their holdings were sold to Tata Telecommunications in 2009 and 2011. Until the takeover by Vodacom in 2015, Neotel was held by Tata (68.5%), Nexus Communications (19%), and Communitel (12.5%).

Neotel, "About US > About the Shareholders," Neotel, <http://web.archive.org/web/20070630221956/http://www.neotel.co.za/neotel/view/neotel/en/page128> (last visited 11 Feb 2017).

²⁴⁶ Van Zyl, Gareth, 2015. "Vodacom-Neotel deal should worry Telkom – analyst," Fin24tech, July 1. Available at <http://www.fin24.com/Tech/Companies/Vodacom-Neotel-deal-should-worry-Telkom-analyst-20150701> (last visited 11 Feb 2017).

²⁴⁷ Johnson, Andrew. 2013. *Brief overview and assessment of the South African ICT state-owned enterprises*. AfDB.

²⁴⁸ Ensor, Linda. 2015. "Competition Commission disapproves of MTN, Telkom deal." *Business Day*. August 17.

²⁴⁹ Deloitte, APC. 2015. *Unlocking Broadband For All*.

²⁵⁰ Ibid.

²⁵¹ Ibid.

- Eskom’s 2,600 km fiber optic network. This network links larger regional offices, generation stations, and transmission and distribution substations throughout South Africa and consists of [OPAC](#) and [OPGW](#) cable.²⁵²
665. The private sector backbone networks comprise:
- Neotel’s fiber optic network, which was state-owned until 2009. This network consists of 15,000 km of fiber optic cable. Neotel has been spending approximately R500 million a year on infrastructure since 2009.²⁵³
 - Dark Fibre Africa’s (DFA) 8,000 km of buried backbone fiber infrastructure along a route from Durban via Mtunzini and Mpumalanga to Johannesburg. DFA also has extensive intercity fiber between Johannesburg and Pretoria, as well as in other major cities in South Africa. Dark fiber on this network is leased to mobile operators and [ISPs](#).²⁵⁴
 - A 680 km national long-distance fiber network connecting Johannesburg, Cape Town and Durban owned by the NLD (National Long Distance) consortium, made up of MTN, Neotel, Vodacom and the National Roads Agency (SANRAL).²⁵⁵
 - FibreCo’s 2,400 km long network between Johannesburg, Bloemfontein, and East London. Established in 2010, FibreCo is a joint venture among Cell C, Convergence Partners, an investment firm, and Dimension Data, an information technology services company. FibreCo is also building a fiber route along the coast north and south of East London.²⁵⁶
 - The fiber networks of minor players. Liquid Telecom’s network is a short fiber network connecting to Zimbabwe and along a highway from Pretoria to Musina (483 km). Metrofibre Networx, Link Africa, SAS.²⁵⁷ Others operate in metropolitan areas.

²⁵² Johnson, Andrew. 2013.

²⁵³ Ibid.

²⁵⁴ DFA Open Access Network, “Home,” Dark Fibre Africa (Pty) Ltd., <http://www.dfafrica.co.za>.

²⁵⁵ Deloitte, APC. 2015.

²⁵⁶ FibreCo. 2015. Presentation.

²⁵⁷ Broadband Infracore. 2014.

Figure 45: Commissioned and planned private sector national long distance routes in South Africa



Source: BMI-T,2014

Legend: Red = Telkom, Green = Broadband Infraco, Light green = DFA, Orange = co-build NLD, Blue = FibreCo, Light blue = Liquid Telecom, Pink = SAS

Source: Tim Parle²⁵⁸

9.2.3 Legal, regulatory and policy framework

666. Currently in South Africa, infrastructure sharing is governed by commercial agreements between telecommunications operators. Those agreements are regulated by the 2005 Electronic Communications Act N. 36 (EC Act)²⁵⁹ and the 2010 facilities leasing regulations.²⁶⁰

667. There are no laws and regulations specifically governing cross-sector infrastructure sharing. However, as described below, South Africa’s national regulator, the Independent Communications Authority of South Africa (ICASA), recently began the process of developing an applicable regulatory framework.

The EC Act

668. The EC Act regulates infrastructure sharing among telecommunications licensees. Chapter 8 of the EC Act obligates telecommunications licensees to lease telecommunications facilities to other licensees upon request by negotiating and entering into a facilities leasing agreement. Chapter 8 also grants ICASA the authority to issue implementing regulations regarding facilities leasing agreements and resolve any disputes that may arise.

²⁵⁸ ,BMI-T 2014, “Update on fibre deployments in South Africa & drivers & inhibitors.” Presented at the FTTH Conference 2014, Johannesburg 28-29 October 2014.

²⁵⁹Electronic Communications Act 36 of 2005 (South Africa). Available at <http://www.mangaung.co.za/wp-content/uploads/2014/11/Electronic-Communications-Act.pdf> (last visited 11 Feb 2017).

²⁶⁰ Independent Communications Authority of South Africa. 2010. “Electronic Communications Facilities Leasing Regulations” No.R.468, May 31. Available at http://thornton.co.za/resources/gg33252_nn468_pg3-15.pdf (last visited 11 Feb 2017).

The Facilities Leasing Regulations

669. The facilities leasing regulations issued by ICASA address requirements of the facilities leasing agreements described in the Chapter 8 of the EC Act, including, agreement principles, timeframes and procedures to be followed by all parties for the submission, review and filling of agreements with ICASA. It also describes the dispute resolution processes and timeframes for filing disputes.

The National Broadband Policy

670. In 2013, South Africa issued a National Broadband Policy²⁶¹ forecasting that by 2020, 100% of South Africans would have access to broadband services priced no higher than 2.5% of South Africa's average monthly income. Moreover, the Government's 2013 national development plan (NDP)²⁶² foresees that by 2030 "a seamless information infrastructure will be universally available and accessible and will meet the needs of citizens, business and the public sector, providing access to the creation and consumption of a wide range of converged services required for effective economic and social participation at a cost and quality at least equal to South Africa's main peers and competitors."

671. To achieve South Africa's broadband goals, the National Broadband Policy has called on ICASA, to encourage cross-sector infrastructure sharing.²⁶³ To answer these demands, on September 2015, ICASA published a Notice Discussion Document regarding the development of an infrastructure sharing regulatory framework in the South African Gazette. The document invites inputs from the broader public on a regulatory framework that would bring certainty on infrastructure sharing, both within the telecommunications sector and between sectors, in the context of the access to broadband services in South Africa. The document calls for public comment on such questions as the objectives and benefits of infrastructure sharing for different stakeholders, the definitions of passive and active infrastructure and the need to devise incentives to encourage infrastructure sharing.²⁶⁴

Formation of BBI

672. A major policy choice of the Government was the formation of BBI, a state-owned enterprise established to share the fiber optic infrastructure of the state-owned electric and railway utilities. This is discussed in detail below.

9.2.4 Major Infrastructure Sharing Projects

673. As discussed above, infrastructure sharing in South Africa is largely achieved through negotiated commercial agreement, such as the electronic communications facilities leasing agreements, regulated under the EC Act. ICASA does not formally coordinate fiber rollouts. Rather, operators must obtain individual "wayleave" permissions from ICASA, other regulators

²⁶¹ Republic of South Africa. 2013. "South Africa's National Broadband Policy (Government Notice No. 953 of 2013)" *Government Gazette* 582 (December):1-64. Available at <http://www.greengazette.co.za/pages/national-gazette-37119-of-06-december-2013-vol-582-20131206-GGN-37119-003> (last visited 11 Feb 2017).

²⁶² South African Government, "National Development Plan of 2030," Government of South Africa. Available at <http://www.gov.za/issues/national-development-plan-2030> (last visited 11 Feb 2017).

²⁶³ Republic of South Africa. 2015. *Government Gazette* 603 (September):1-24. Available at <http://www.gpwonline.co.za/Gazettes/Gazettes/39208-15-9-ICASA.pdf> (last visited 11 Feb 2017).

²⁶⁴ Ibid.

and municipalities. However, South Africa has examples of several models for infrastructure sharing, including cross-sector sharing of fiber, sharing of the trench and sharing of the fiber. The cross-sector sharing of servitudes has largely been facilitated by the Government of South Africa in a goal to enable larger and affordable broadband access. This module explores South African examples of these three different models.

Cross-sector sharing of fiber: BBI

674. BBI is a state-owned enterprise established in 2009²⁶⁵ to provide wholesale long-distance high-capacity connectivity to other licensed fixed and mobile network operators and [ISPs](#) under a legislative mandate. BBI is a manifestation of government policies to expand access to electronic communications and broadband infrastructure deployment, particularly in underdeveloped and underserved areas that are not commercially viable to the private sector.

675. Upon its formation, the Government facilitated a transfer of telecommunications assets from Eskom and Transnet Freight Rail (a subsidiary of Transnet) to BBI. BBI now has access to 12,000 km of their combined fiber optic networks that it commercializes by leasing bandwidth services to private operators. Although BBI owns a number of fiber pairs on each route Eskom and Transnet Freight Rail remain responsible for the maintenance of the physical fiber networks.

676. For the first three years of its operation, BBI was required to lease most of its network to Neotel to facilitate its expansion as a second national fixed-line operator. Eskom and Transnet (a division of Transnet) participated in the formation of Neotel, collectively acquiring a 30% equity stake in the new operator.²⁶⁶

677. In 2010, BBI wanted to expand its commercial services to other private telecommunications operators but because of a lack of coordination between its government shareholders, the Department of Public Enterprises and the Department of Communications, other wholesale companies decided to develop their own fiber networks.²⁶⁷ Today it is clear that BBI has struggled to build a reliable and effective network meeting the requirements of commercial customers. Much of the company's network reaches end-of-life status on its fiber optic equipment as well as fiber itself and is in need of replacement.²⁶⁸ Furthermore the company is in financial difficulties and recently required an urgent cash injection of R243 million.²⁶⁹

Sharing the Trench: The NLD Consortium

678. For more than 12 years, Vodacom and MTN were subject to the monopoly pricing of Telkom SA, the state owned provider of fixed telecommunications services, and were paying R1 billion annually to for use of its infrastructure. In 2009, the two operators joined Neotel, which was using BBI's infrastructure (see above) and South Africa's national roads agency (SANRAL), to form the NLD consortium, sign a co-build agreement and invest together in a single common 680 km trench to lay their individual fiber optic networks. The investment cost approximately R270 million,

²⁶⁵ BBI was established by a legislative mandate set out in the Broadband Infraco Act.33 of 2007 and it then obtain its telecommunications services license of 2009.

²⁶⁶ Broadband Infraco. 2008. *Annual report 2008*. Annual Report, Sandton.

²⁶⁷ Deloitte, APC. 2015.

²⁶⁸ Johnson, Andrew. 2013.

²⁶⁹ News24wire. 2015. "Broadband Infraco begs for government bailout." *Engineering News*. September 22. Available at <http://www.engineeringnews.co.za/article/broadband-infraco-begs-for-government-bailout-2015-09-22> (last visited 11 Feb 2017).

shared equally among the three telecommunications entities, while SANRAL provided the right of way along the roads under which the cables are laid.²⁷⁰ This model leads to cost savings in civil works while preserving independence and flexibility for each operator in the installation of their own fiber.

679. The project is runs along two major roads, linking up with landing points for submarine cables such as SEACOM, which is currently being laid, and EASSy.²⁷¹ NLD has plans to build a 5,000 km network (total plan) and to lay fiber along a third major road linking Durban to Cape Town, but work on this appears to have been delayed.

Sharing the fiber: FibreCo

680. As explained above, FibreCo was established in 2010, as a joint venture among Cell C, Convergence Partners, an investment firm, and Dimension Data, an information technology services company, to sell dark fiber and broadband services to mobile operators and [ISPs](#). From the beginning, FibreCo operated under an “open access” principle, describing itself as a “carrier neutral, national network operator,” committed to generate economic and environmental benefits through infrastructure sharing.²⁷² At the time of writing, its network runs between Johannesburg, Bloemfontein, and East London and it is planning to build between Durban and Cape Town.

681. To enable the achievement of the national broadband policy goals at the regional level, FibreCo has devised a specific open access model that it has presented the government and that is pending approval at the time of writing. Under this model, fiber optic wholesale providers contribute fiber pairs to an open-access managed fiber network on a commercial basis in a cost effective way so as to minimize duplication and cost while strengthening the availability and reach of existing systems.²⁷³ This network would be owned by a SPV (Provincial NetCo), 100% owned by the Government, managed by a private sector entity (ManCo) that will be responsible for developing and managing the network, and financed by project finance as explained in Figure 46 below.

682. More specifically, in terms of deployment strategy, Provincial NetCo would rely on the most efficient approach to develop the required network assets with the goal to maximize returns and reduce risk. The options are:

- Lease fiber on available routes from other third party services
- Swap infrastructure on a like for like basis;
- Co-build by sharing infrastructure build costs with one or more party;
- Own-build in which NetCo would build and own the infrastructure alone.²⁷⁴

²⁷⁰ Deloitte, APC. 2015.

²⁷¹ SAinfo reporter. 2009. “MTN, Neotel to build national network.” *SouthAfrica.info*. Available at <http://www.southafrica.info/business/economy/infrastructure/mtnneotel-160109.htm#.VjYUOmcGIw#ixzz3qF8e5kYK> (last visited 11 Feb 2017).

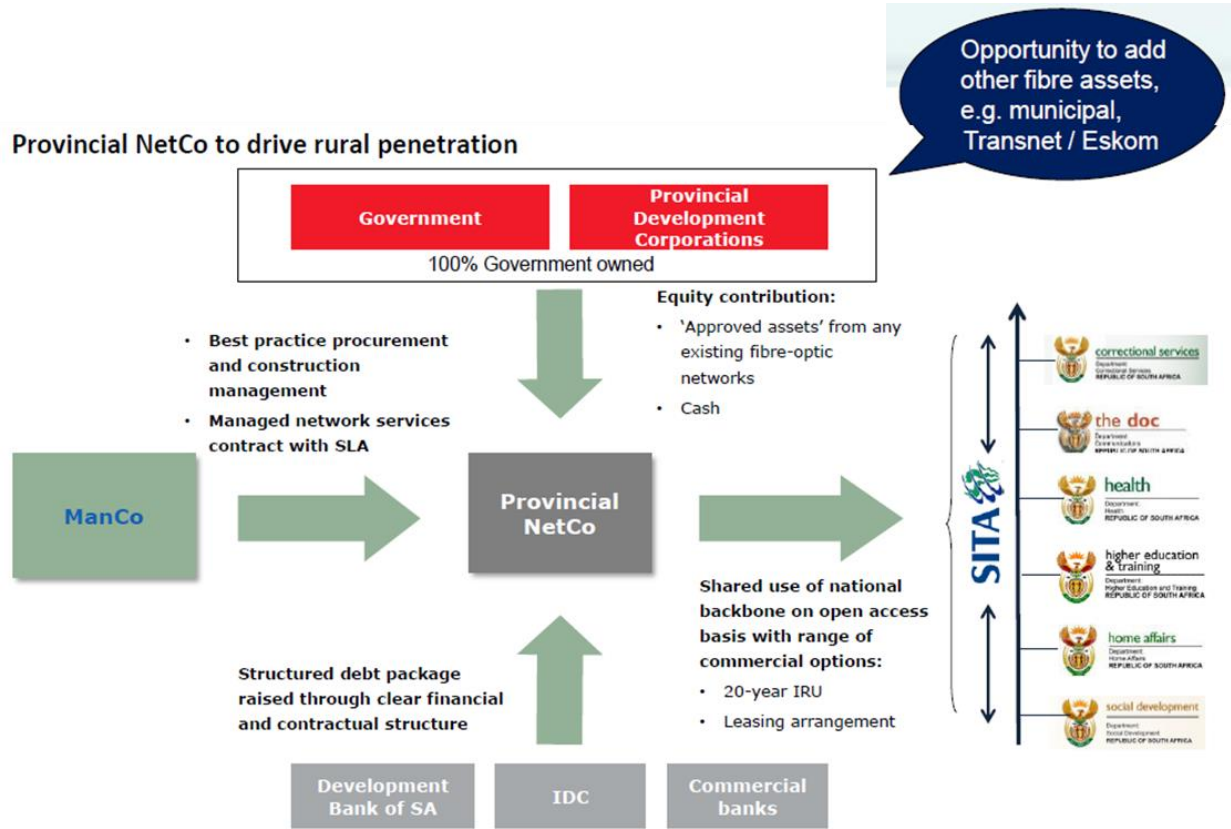
²⁷² FTTH Council, FibreCo Telecommunications, “The FibreCo difference” (undated). <http://fibreco.co.za/About/The-FibreCo-Difference.html> (last visited 11 Feb 2017).

²⁷³ Johnson, Andrew. 2013.

²⁷⁴ FibreCo. 2015. Presentation to Free State ICT Summit, June 4.

683. FibreCo notes that the last option would mainly be required in rural areas where there is limited attractiveness for commercial players. Provincial NetCo infrastructure would be viable due to of the aggregated demand from serving government requirements

Figure 46: FibreCo’s new business model



Source: Arif Hussein, FibreCo, 2015

9.2.5 Lesson learned

684. South Africa presents several interesting cases of infrastructure sharing, with some the result of government intervention on state owned companies and some the result of market forces. The regulatory framework is rather weak in terms of infrastructure sharing and has not played a role so far. It is however under reform to better enable cross- sector infrastructure sharing.

BBI, an example of cross sector infrastructure sharing resulting from government intervention, has generated a lot of inefficiencies due to monopoly pricing, duplication of infrastructure and unproductive political competition between state-owned enterprises. The private sector has reacted to these inefficiencies with alternative arrangements, including the co-build arrangement, wholesale providers of dark fibers and the multi-user open access arrangements. These alternative models of infrastructure sharing (largely within the telecom sector, except for land) seem to be the only viable solutions to the realization of the ambitious goals of rural broadband penetration of the National Broadband Policy. Cross-sector sharing has thus fallen short of its potential in South Africa.

9.3 United States

9.3.1 Introduction

685. This case study examines cross-sector infrastructure sharing in the United States, which has thrived since the genesis of telecommunications networks. It traces the development of cross-sector infrastructure sharing practices and policies, both voluntary and mandated, and provides several examples of significant modern cross-sector infrastructure sharing experiences. Due to the pioneering of modern telecommunications in the United States, the consistent tradition of private sector ownership of both telecom operators and infrastructure owners, and the relatively early and continuous legislative, regulatory and judicial involvement in defining the rights, privileges and duties of participants in cross-sector infrastructure sharing, a study of the United States provides valuable and nuanced insights for policymakers, regulators and other stakeholders elsewhere in the world who are today focused on ways to increase the incidence of infrastructure sharing to support the development of broadband.

9.3.2 Development of cross-sector infrastructure sharing practices and policies

686. As described below, the development of cross-sector infrastructure sharing practices and policies in the United States has involved a combination of financial inducements by government, voluntary sharing by market participants and sharing mandated by the government. From the outset of the telecommunications industry, the federal government provided significant financial incentives to spur innovation and investment. In addition, the federal and state governments have intervened in various ways within their respective roles under the federal system to afford telecommunications operators with sufficient land rights to build their networks. Since the latter part of the 20th Century, the federal government and a significant number of state governments have also mandated regulated access to utility poles through a complex system which allows states the option of administering access regulation, or, where states elect not to regulate access, confers authority to do so on the Federal Communications Commission (FCC). While access to other sharable infrastructure is also addressed to a lesser extent in federal and state law, the sharing of infrastructure other than land corridors and poles has largely been left by federal and state regulators to develop through a voluntary, market-based approach, and has worked sufficiently well that legislatures and regulators have typically taken a hands off approach.

The telegraph is introduced as a companion to the railroad

687. Cross-sector infrastructure sharing in the United States is as old as the telecommunications industry itself. In 1842, American inventor and entrepreneur Samuel Morse obtained an appropriation from the US Congress to establish a 40-mile commercial telegraph line along a railway connecting Washington and Baltimore. “The Baltimore & Ohio Railroad Company . . . granted permission on the condition that the line could be built ‘without embarrassment to the operations of the company’ and . . . demanded free use of the telegraph”²⁷⁵

States act to afford telegraph companies access to public and private lands

688. Following the introduction of the telegraph, state legislatures became quite active from the mid-1840s in their efforts to promote the expansion of this new means of communication. Led by

²⁷⁵ Tom Standage.1988. *The Victorian Internet: The Remarkable Story of The Telegraph and the Nineteenth Century’s On-Line Pioneers*. New York: Bloomsbury USA.

New York in 1845,²⁷⁶ a flurry of legislation was enacted to authorize the establishment and operation of telegraph companies.²⁷⁷

689. The early telegraph legislation was soon recognized as inadequate in several respects, including in respect of establishing the rights of telegraph companies to use existing public land corridors and to acquire easements over private lands to establish their own corridors. For example, New York's 1845 law simply provided that “[t]he proprietors of the patent rights of Morse’s electromagnetic telegraph may be and hereby are authorized to construct lines of said telegraph from point to point and across any of the waters within the limits of this state, by the erection of posts, piers or butments for sustaining the wires of the same: Provided that the same shall not in any instance be so constructed as to endanger or injuriously interrupt the navigation of such waters; and provided also, that the private right of individuals shall be in no wise impaired by the provision of this act.”²⁷⁸ Thus, while the law provided the right to traverse waters, it made no mention of traversing public corridors over land or of acquiring rights of use of private property.

690. Generally, installing permanent improvements and fixtures in public lands, such as telegraph poles and wires, is a privilege requiring express authorization in the United States. Similarly, the privilege to acquire easements over private land, where the owner will not voluntarily give consent, requires statutory conferring of the power of *eminent domain* (the American term for compulsory acquisition) in a manner consistent with constitutional protections of private property rights. The power of eminent domain is not inherent and must be conferred on a utility or telecom operator, whether investor-owned or government-owned, by legislation. Such rights of access to public and private lands were considered essential for the telegraph companies to establish and operate their infrastructure and networks.

691. In 1848, New York was again an early mover, this time enacting the first comprehensive legislation conferring on telegraph companies the privileges of use of public lands and rights of eminent domain over private lands as a quid pro quo for undertaking certain public service obligations.²⁷⁹ The application for a charter required the organizers to describe the general routes for the proposed telegraph lines and the points to be connected.²⁸⁰ When the charter was granted, the telegraph company’s required public service obligations included a duty to serve all requesting customers (including other telegraph companies), non-discrimination between customers, good faith, and the transmission of messages in the order received (but allowing priority for newspaper dispatches).²⁸¹ An 1850 amendment added a duty to maintain the privacy of messages.²⁸² Section 5 of New York’s 1848 Telegraph Act conferred upon a telegraph company incorporated under and subject to the Act the privilege to construct its telegraph lines “along and upon any of the public roads and highways, or across any of the waters within the limits of this state, by the erection of the necessary fixtures . . . provided the same shall not be so constructed as to incommode the public use of said roads or highways, or injuriously interrupt the navigation of said waters. . . .” Section

²⁷⁶ See Act of May 13, 1845 N.Y. Laws, c. 243, p. 264.

²⁷⁷ See, e.g., Act of Mar. 20, 1847, Va. Laws, 1846, c. 92, p. 79; Act of Jan. 28, 1847, Mich. Laws, No 4, p. 4 & Act of Mar. 5, 1947, Mich. Laws, 1847, p.41.

²⁷⁸ Act of May 13, 1845 N.Y. Laws, c. 243, p. 264.

²⁷⁹ See Act of Apr. 12, 1848, ch. 265, 1848 N.Y. Laws 392.

²⁸⁰ *Id.* §3.

²⁸¹ *Id.* §§11 & 12.

²⁸² Act of April 10, 1950, NY Laws, c. 340, p. 739.

6 of the 1848 Act prescribed procedures by which landowners would be compensated for the use of their lands by a telegraph company, implicitly conferring a limited power of eminent domain.

692. Due to New York's importance as the major center of commerce in the United States, its 1848 statute became a *de facto* model for similar legislation adopted in other important industrial states, including California (1850), Connecticut (1848), Illinois (1849), Maryland (1852), Michigan (1851),²⁸³ Missouri (1851) and Virginia (1852).²⁸⁴ In addition, a number of states did not model their laws after New York's, but nonetheless followed a similar approach of tying the conferring of privileges to the undertaking of public service obligations. These included Iowa (1851), Kentucky (1847), Louisiana (1848),²⁸⁵ Massachusetts (1849), New Jersey (1853), Pennsylvania (1849) and Wisconsin (1848).

693. Several states (and territories which were not yet states), mostly in the south and west, did not initially adopt comprehensive telegraph statutes which required the undertaking public service obligations as a condition to enjoyment of specified privileges, but nonetheless enacted laws providing telegraph companies with privileges to use public roads. These included Alabama (1855), Florida (1849), Georgia (1847), Kansas Territory (1859), North Carolina (also conferring the power of eminent domain, 1875), Minnesota (1860), Montana Territory (1870), Texas (1871) and Wyoming Territory (1869).

694. Ironically, the telegraph companies made relatively little use of the land rights conferred to them under these laws, usually limited to use of public streets in metropolitan areas. Instead, following Morse's early example, as the nascent telegraph industry flourished, telegraph lines continued to be installed primarily along railroad rights of way with the express permission of the railroads. As discussed in Module 1, there was a natural affinity between the railroad and the telegraph. Railroads also provided more efficient inter-city corridors for installing telegraph lines than roads and highways due to the lack of adjacent uses between cities and towns and the convenience of using automated railway cars to carry the poles and wires to construction sites. By obtaining permission of the railroad companies to piggyback on their existing land corridors, the telegraph companies were thus able to avoid the time and cost of assembling their own corridors using the privileges which had been conferred upon them by statute and had use of a more economical corridor. Nonetheless, the state telegraph laws developed in the mid-1850s established the principle of reciprocity between granting land use privileges to private enterprise, and the enterprise undertaking public service obligations, which would eventually form the foundation for land use rights by all telecommunications operators.

Federal Government acts to support telegraph expansion

695. During the westward expansion of the United States, Congress made the construction of a transcontinental telegraph line a national priority, so much that its completion *preceded* the construction of a transcontinental railroad. The first transcontinental telegraph line, funded by a grant from Congress under the Pacific Telegraph Act of 1860, connected then-existing eastern lines in Omaha, Nebraska with existing western lines in Carson City, Nevada.²⁸⁶ The new line,

²⁸³ Act of Mar. 26, 1851, Mich. Laws, No 59, p. 61.

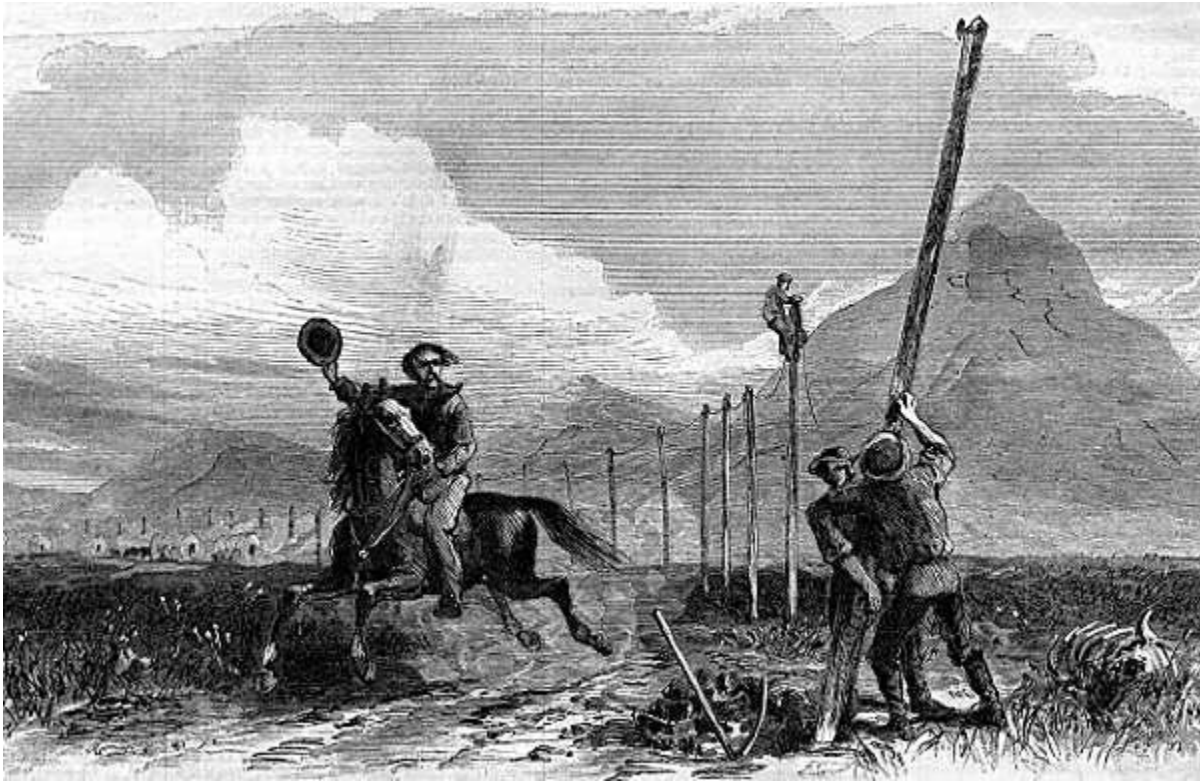
²⁸⁴ Act of May 26, 1852, Va. Laws, c. 149, p. 121.

²⁸⁵ Act of Dec. 20, 1848, La. Laws, No. 74, p. 49 (extra session).

²⁸⁶ Western Union website, "Our Rich History," (as of Dec 2015).

completed on 24 October 1861, was built by a consortium led by Western Union Telegraph Company in less than four months along a corridor used for horses and wagons.²⁸⁷

Figure 47: Wood engraving depicting construction of the US transcontinental telegraph in 1861

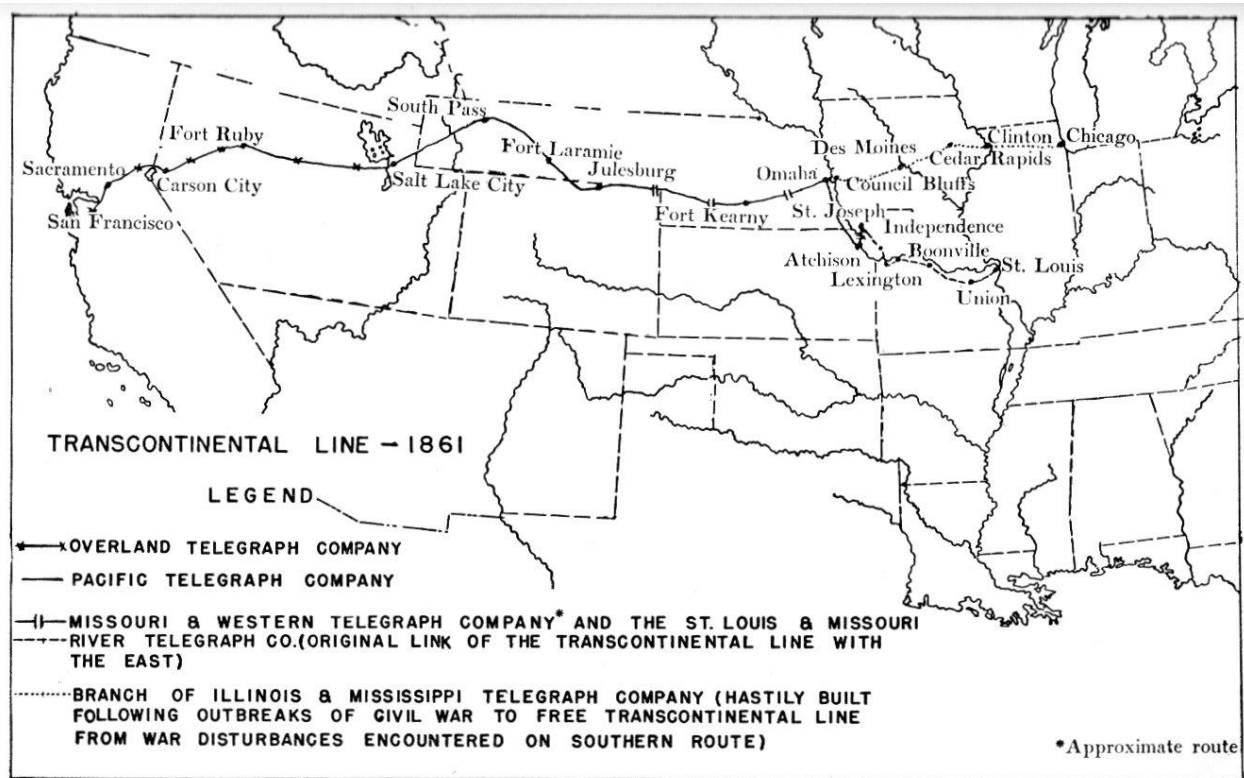


Source: *Harper's Weekly*²⁸⁸

²⁸⁷ "Milestones: Transcontinental Telegraph, 1861," *Engineering and Technology History Wiki*. Available at [http://ethw.org/Milestones:Transcontinental Telegraph, 1861](http://ethw.org/Milestones:Transcontinental_Telegraph,_1861) (last visited 11 Feb 2017).

²⁸⁸ 2 November 1867. Republished in *Engineering and Technology History Wiki*.

Figure 48: Map of final segments of first transcontinental telegraph line completed in 1861



Source: Robert L. Thompson²⁸⁹

696. Eight years later, prompted by a financial stimulus from the United States Congress, Western Union relocated its telegraph lines from the wagon trail to share a corridor with the first transcontinental railway.²⁹⁰ Congress induced this decision to co-locate railways and telegraphs through the grant of rights of way over public lands and appropriations made for the purchase of both transport and communications services. As part of an Act passed by Congress on 2 December 1861 and signed into law by President Abraham Lincoln on 1 July 1862, the United States Government had commissioned the combined construction of a new transcontinental railroad and telegraph lines to connect the Missouri River to the Pacific Ocean and to provide the Government with communications and transport for postal, military and other purposes.

697. Under the Pacific Railway Act, as it was known, the proprietors of the railroad were expressly authorized “to enter into an arrangement with the Pacific Telegraph Company, the Overland Telegraph Company, and the California State Telegraph Company, so that the present line of telegraph between the Missouri River and San Francisco may be moved upon or along the line of said railroad and branches as fast as said roads and branches are built; and if said arrangement be entered into, and the transfer of said telegraph line be made in accordance therewith to the line of said railroad and branches, such transfer shall, for all purposes of this act, be held and considered a fulfilment on the part of said railroad companies of the provisions of this act in regard to the

²⁸⁹ Robert L. Thompson, *Wiring a continent: the history of the telegraph industry in the United States, 1832-1866* (1947)

²⁹⁰ “Transcontinental Telegraph Line (U.S.),” *Engineering and Technology History Wiki*. Available at [http://ethw.org/Transcontinental Telegraph Line \(U.S.\)](http://ethw.org/Transcontinental_Telegraph_Line_(U.S.)) (last visited 11 Feb 2017).

construction of said line of telegraph.”²⁹¹ The original transcontinental telegraph was relocated to the transcontinental railway rights of way on their completion in 1869.²⁹²

Figure 49: Simultaneous construction of transcontinental railroad and adjacent telegraph poles in 1868²⁹³



THE BANCROFT LIBRARY, UNIVERSITY OF CALIFORNIA, BERKELEY

Source: *The Bancroft Library, University of California, Berkeley*²⁹⁴

²⁹¹ United States Congress, Act of 1 July 1862 (Pacific Railway Act) at §19, 12 Stat. 489. Archive available at [https://catalog.archives.gov/id/299953?q=*.:](https://catalog.archives.gov/id/299953?q=*.) (last visited 11 Feb 2017).

²⁹² Engineering and Technology History Wiki, Transcontinental Telegraph Line (U.S.). Available at [http://ethw.org/Transcontinental_Telegraph_Line_\(U.S.\)](http://ethw.org/Transcontinental_Telegraph_Line_(U.S.)) (last visited 11 Feb 2017).

²⁹³ In this photograph, one can see the poles for the telegraph lines which have already been installed along the right side of the railroad right of way.

²⁹⁴ As included in PBS, *American Experience*, Workers of the Central Pacific Railroad, <http://www.pbs.org/wgbh/americanexperience/features/general-article/tcrr-cpr/> (last visited 13 Feb 2017).

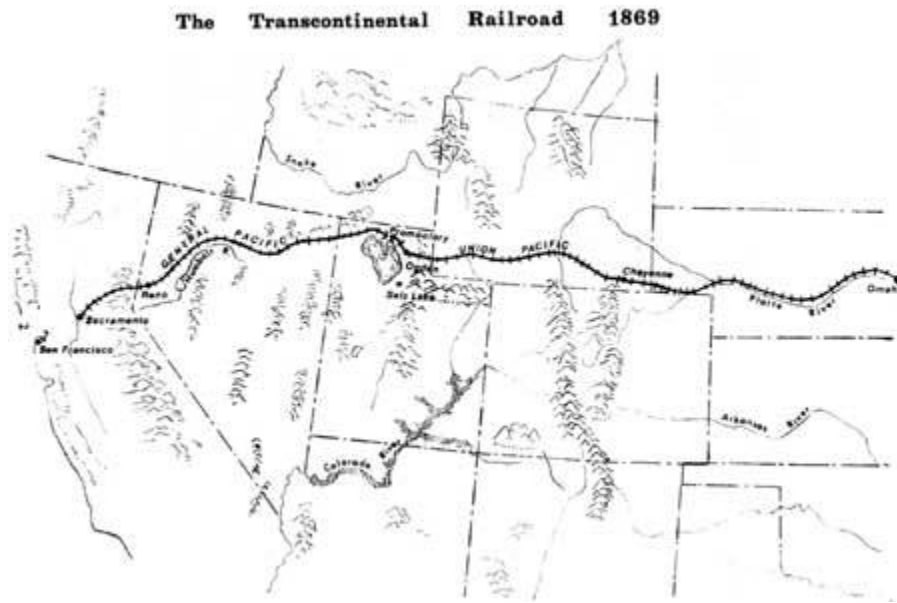
Figure 50: Installing the telegraph lines on poles along the railway



Source: Southern Pacific Railway, Alfred A. Hart Photograph²⁹⁵

²⁹⁵ Reprinted in A. Raymond and R. Fike, *Rails to Promontory: The Utah Stations*, United States Department of the Interior Bureau of Land Management Utah: Cultural Resource Series No. 8 (1981, reprint 1994). Available at https://www.nps.gov/parkhistory/online_books/blm/ut/8/sec1.htm Fig. 6 (last visited 28 Feb 2017).

Figure 51: Route of US combined transcontinental railroad and telegraph lines completed in 1869



Source: Robert Utley²⁹⁶

698. Just five years after passage of the Pacific Railway Act, Congress on 24 July 1866 passed a more generally applicable law entitled “An Act to aid in the construction of telegraph lines, and to secure to the government the use of the same for postal, military, and other purposes” (the 1866 National Telegraph Act or simply the 1866 Act).²⁹⁷ Among other things, the Act conferred upon telegraph companies the following rights under federal law²⁹⁸:

[A]ny telegraph company now organized or which may hereafter be organized under the laws of any state in this Union shall have the right to construct, maintain, and operate lines of telegraph through and over any portion of the public domain of the United States, over and along any of the military or post roads of the United States which have been or may hereafter be declared such by act of Congress, and over, under, or across the navigable streams or waters of the United States, *provided* that such lines of telegraph shall be so constructed and maintained as not to obstruct the navigation of such streams and waters, or interfere with the ordinary travel on such military or post roads. And any of said companies shall have the right to take and use from such public lands the necessary stone, timber, and other materials for its posts, piers, stations, and other needful uses in the construction, maintenance, and operation of said lines of telegraph, and may preempt and use such portion of the unoccupied public lands subject to preemption through which its said lines of telegraph may be located as may be necessary for its stations, not exceeding forty acres for each station; but such stations shall not be within fifteen miles of each other.

And be it further enacted, that telegraphic communications between the several departments of the government of the United States and their officers and agents shall, in

²⁹⁶ R. Utley, *Promontory Summit* in *The National Survey of Historic Sites and Buildings-United States Department of the Interior, National Park Service, Region 3, Santa Fe, New Mexico* (1960), reprinted in A. Raymond and R. Fike, *Rails to Promontory: The Utah Stations*, *supra*.

²⁹⁷ Ch. 230, 14 Stat. 221 (1866).

²⁹⁸ *Id.* §§1-4.

their transmission over the lines of any of said companies, have priority over all other business, and shall be sent at rates to be annually fixed by the Postmaster General.

And be it further enacted that the rights and privileges hereby granted shall not be transferred by any company acting under this act to any other corporation, association, or person, *provided, however*, that the United States may at any time after the expiration of five years from the date of the passage of this act, for postal, military, or other purposes, purchase all the telegraph lines, property, and effects of any or all of said companies at an appraised value, to be ascertained by five competent disinterested persons, two of whom shall be selected by the Postmaster General of the United States, two by the company interested, and one by the four so previously selected.

And be it further enacted, that before any telegraph company shall exercise any of the powers or privileges conferred by this act, such company shall file their written acceptance with the Postmaster General, of the restrictions and obligations required by this act.

699. As a condition to the rights conferred under the 1866 National Telegraph Act, a telegraph company had to accept the conditions it imposed by lodging a written acceptance with the Postmaster General. This was effectively a regulatory contract, or license, by which the telegraph company voluntarily submitted itself to federal regulation in exchange for benefitting from the privileges conferred under the Act. The conditions imposed by the Act required the telegraph company to give priority to U.S. government communications and charge the government rates fixed by the Postmaster General, and, and any time at least five years after the date of the Act, allowed the United States to purchase the telegraph company's assets at appraised value.

Early telegraph litigation over cross-sector infrastructure sharing

700. The courts were soon called upon to resolve disputes over access by telegraph companies to land corridors over public and private property. The following highlights some of the more significant cases during this period, decided by the United States Supreme Court, to provide a flavor of the competing arguments raised by telegraph companies and those who controlled existing land corridors, and how the courts resolved these issues.

701. Access to land corridors in the United States must be understood in the context of the division of powers and responsibilities between the federal government and the state governments. Broadly speaking, the federal government, through acts of Congress, has limited express powers under the United States Constitution. All matters of legislation and regulation not expressly granted to the federal government are reserved to the state governments. The view of the source and scope of federal powers has evolved and expanded over time. At the time of the Pacific Railway Act, the focus was limited to war powers and postal powers. After the end of the American Civil War in 1865, the understood scope of federal powers gradually expanded to include more overt references to interstate commerce (even when military and postal discourse were not involved). Reserved state powers were generally viewed throughout this time to include the power to regulate intrastate commerce and land rights involving private property.

702. The National Telegraph Act of 1866 was invoked not long after its passage in a dispute between Western Union Telegraph Company and Pensacola Telegraph Company which was eventually heard and decided by the United States Supreme Court.²⁹⁹ The core issues before the

²⁹⁹ See *Pensacola Telegraph Co. v. Western Union Telegraph Co.*, 96 U.S. 1 (1877).

Court stemmed from a conflict between the federal government's grant of operating rights to Western Union under the 1866 Act and the State of Florida's grant of exclusive operating rights to Pensacola Telegraph under an 1866 state law. However, the dispute also played out in litigation over land rights between the two competing telegraph operators and the successive owners of a railroad along which they both had installed telegraph lines.

703. In 1859, Pensacola Telegraph Company had erected a telegraph line from Pensacola, Florida to Pollard, Alabama along the right of way of the Alabama and Florida Railroad. Pensacola Telegraph operated the entire line until 1862, when its southern portion was removed during Confederate occupation in the American Civil War. Pensacola Telegraph abandoned the entire line in 1864 after Union Troops seized and occupied the area in which it was located.

704. A period of uncertainty over ownership and conflicting assertions of rights arose during the reconstruction period following the Civil War. The Florida legislature in December 1866 granted exclusive rights to a resurrected and newly recapitalized Pensacola Telegraph Company, as part of granting its corporate charter, to operate a telegraph line in the two westernmost counties of Florida. Soon thereafter, Pensacola Telegraph secured permission from the Alabama and Florida Railroad to use its rights of way and erected and began operating a telegraph line within the railroad rights of way. Meanwhile, in June 1867, Western Union notified the Postmaster General that it accepted the provisions of the Federal Act of 1866. The Florida legislature also later, in February 1873 and February 1874, granted renewed railroad rights to Pensacola and Louisville Railroad Company, which had acquired the assets of the defunct Alabama and Florida Railroad. These assets included the rights of way in which Pensacola Telegraph's lines were located. The Florida legislature's grant to the Pensacola and Louisville Railroad included the right to construct, maintain and operate a telegraph line along its railroad rights of way. This grant directly conflicted with the Florida legislature's 1866 grant to Pensacola Telegraph.

705. In June 1874, Pensacola and Louisville Railroad granted Western Union the right to use its rights of way to erect a new telegraph line, pursuant to the 1873 and 1874 Florida acts, and Western Union commenced construction immediately. Pensacola Telegraph promptly brought suit in July 1874 to enjoin Western Union from completing and operating its competing telegraph lines, relying on the Florida legislature's previous grant of exclusivity in 1866. The case was litigated for several years, leading to a decision by the United States Supreme Court in 1877. In a 5-3 decision, Chief Justice Waite, for the majority, after noting that the 1866 federal Act fell within Congress's undisputed power to regulate interstate commerce and post roads, made the following remarks regarding the land use rights conferred by that Act:

. . . The statute of July 24, 1866, in effect, amounts to a prohibition of all State monopolies in this particular. It substantially declares, in the interest of commerce and the convenient transmission of intelligence from place to place by the government of the United States and its citizens, that the erection of telegraph lines shall, so far as State interference is concerned, be free to all who will submit to the conditions imposed by Congress, and that corporations organized under the laws of one State for constructing and operating telegraph lines shall not be excluded by another from prosecuting their business within its jurisdiction, if they accept the terms proposed by the national government for this national privilege. To this extent, certainly, the statute is a legitimate regulation of commercial intercourse among the States, and is appropriate legislation to carry into execution the powers of Congress over the postal service. It gives no foreign corporation the right to enter upon private property without the consent of the owner and erect the necessary

structures for its business; but it does provide, that, whenever the consent of the owner is obtained, no State legislation shall prevent the occupation of post-roads for telegraph purposes by such corporations as are willing to avail themselves of its privileges.

It is insisted, however, that the statute extends only to such military and post roads as are upon the public domain; but this, we think, is not so. The language is, "Through and over any portion of the public domain of the United States, over and along any of the military or post roads of the United States which have been or may hereafter be declared such by act of Congress, and over, under, or across the navigable streams or waters of the United States." There is nothing to indicate an intention of limiting the effect of the words employed, and they are, therefore, to be given their natural and ordinary signification. Read in this way, the grant evidently extends to the public domain, the military and post roads, and the navigable waters of the United States. These are all within the dominion of the national government to the extent of the national powers, and are, therefore, subject to legitimate congressional regulation. No question arises as to the authority of Congress to provide for the appropriation of private property to the uses of the telegraph, for no such attempt has been made. The use of public property alone is granted. If private property is required, it must, so far as the present legislation is concerned, be obtained by private arrangement with its owner. No compulsory proceedings are authorized. State sovereignty under the Constitution is not interfered with. Only national privileges are granted.

706. In a dissenting opinion, Justice Field joined by Justice Hunt focused on the limited scope of land use rights granted by the 1866 federal Act and the prerogative of the Florida legislature to grant a limited period of exclusivity to incentivize private sector investment in telegraph lines. He offered the following reasoning:

There can be no serious question that the State of Florida possessed the absolute right to confer upon a corporation created by it the exclusive privilege for a limited period to construct and operate a telegraph line within its borders. . . . The exclusiveness of a privilege often constitutes the only inducement for undertakings holding out little prospect of immediate returns. The uncertainty of the results of an enterprise will often deter capitalists, naturally cautious and distrustful, from making an investment, without some assurance that, in case the business become profitable, they shall not encounter the danger of its destruction or diminution by competition. It has, therefore, been a common practice in all the States to encourage enterprises having for their object the promotion of the public good, such as the construction of bridges, turnpikes, railroads, and canals, by granting for limited periods exclusive privileges in connection with them. Such grants, so far from being deemed encroachments upon any rights or powers of the United States, are held to constitute contracts, and to be within the protecting clause of the Constitution prohibiting any impairing of their obligation.

The grant to the complainant [Pensacola Telegraph Company] was invaded by the subsequent grant to the Pensacola and Louisville Railroad Company. If the first grant was valid, the second was void, according to all the decisions of this court The court below did not hold otherwise, and I do not understand that a different view is taken here; but it decided, and this court sustains the decision, that the statute making the first grant was void, by reason of its conflict with the act of Congress of July 24, 1866.

With all deference to my associates, I cannot see that the act of Congress has any thing to do with the case before us. In my judgment, it has reference only to telegraph lines over and along military and post roads on the public domain of the United States. . . . The portion of the public domain which may be thus used is designated by reference to the military and post roads upon it. . . . The conclusion reached by the majority of the court . . . implies that Congress intended to give aid to the telegraph companies of the country, those existing or thereafter to be created, not merely by allowing them to construct their lines over and along post-roads upon the public lands, but also over and along such roads within the States which are not on the public lands, where, heretofore, it has not been supposed that it could rightfully exercise any power.

The only military roads belonging to the United States within the States are in the military reservations; and to them the act obviously does not apply. And there are no post-roads belonging to the United States within the States. The roads upon which the mails are carried by parties, under contract with the government, belong either to the States, or to individuals, or to corporations, and are declared post-roads only to protect the carriers from being interfered with, and the mails from being delayed in their transportation, and the postal service from frauds. The government has no other control over them. It has no proprietary interest in them or along them to bestow upon any one. It cannot use them, without paying the tolls chargeable to individuals for similar uses; it cannot prevent the State from changing or discontinuing them at its pleasure; and it can acquire no ownership or property interest in them, except in the way in which it may acquire any other property in the States, namely, by purchase, or by appropriation upon making just compensation. .

The public streets in some of our cities are post-roads, under the declaration of Congress . . . and it would be a strange thing if telegraph lines could be erected by a foreign corporation along such streets without the consent of the municipal and State authorities, and, of course, without power on their part to regulate its charges or control its management. Yet the doctrine asserted by the majority of the court goes to this length: that, if the owners of the property along the streets consent to the erection of such lines by a foreign corporation, the municipality and the State are powerless to prevent it, although the exclusive right to erect them may have been granted by the State to a corporation of its own creation.

If by making a contract with a party to carry the mails over a particular road in a State, which thus becomes by act of Congress for that purpose a post-road, Congress acquires such rights with respect to the road that it can authorize corporations of other States to construct along and over it a line of telegraph . . . , it must have the right to authorize them to condemn private property for that purpose. The act under consideration does not, it is true, provide for such condemnation; but if the right exist to authorize the construction of the lines, it cannot be defeated from the inability of the corporations to acquire the necessary property by purchase. The power to grant implies a power to confer all the authority necessary to make the grant effectual. It was for a long time a debated question whether the United States, in order to obtain property required for their own purposes, could exercise the right of eminent domain within a State. It has been decided, only within the past two years, that the government, if such property cannot be obtained by purchase, may appropriate it, upon making just compensation to the owner . . . ; but never has it been

suggested that the United States could enable a corporation of one State to condemn property in another State, in order that it might transact its private business there.

707. Following its decision in *Pensacola Telegraph*, the United States Supreme Court was asked in *St. Louis v. Western Union Telegraph* to decide whether a municipal government could charge a telegraph company for use of the public streets without violating the 1866 federal Act.³⁰⁰ The Court answered in the affirmative, explaining its ruling as follows:

. . . Has the city a right to charge this defendant [Western Union] for the use of its streets and public places? And here, first, it may be well to consider the nature of the use which is made by the defendant of the streets, and the general power of the public to exact compensation for the use of streets and roads. The use which the defendant makes of the streets is an exclusive and permanent one, and not one temporary, shifting, and in common with the general public. The ordinary traveler, whether on foot or in a vehicle, passes to and fro along the streets, and its use and occupation thereof are temporary and shifting. The space he occupies one moment he abandons the next to be occupied by any other traveler. This use is common to all members of the public, and it is a use open equally to citizens of other states with those of the state in which the street is situate. But the use made by the telegraph company is, in respect to so much of the space as it occupies with its poles, permanent and exclusive. It as effectually and permanently dispossesses the general public as if it had destroyed that amount of ground. Whatever benefit the public may receive in the way of transportation of messages, that space is, so far as respects its actual use for purposes of a highway and personal travel, wholly lost to the public. By sufficient multiplication of telegraph and telephone companies, the whole space of the highway might be occupied, and that which was designed for general use for purposes of travel entirely appropriated to the separate use of companies and for the transportation of messages.

We do not mean to be understood as questioning the right of municipalities to permit such occupation of the streets by telegraph and telephone companies; nor is there involved here the question whether such use is a new servitude or burden placed upon the easement, entitling the adjacent lot owners to additional compensation. All that we desire or need to notice is the fact that this use is an absolute, permanent, and exclusive appropriation of that space in the streets which is occupied by the telegraph poles. To that extent, it is a use different in kind and extent from that enjoyed by the general public. Now when there is this permanent and exclusive appropriation of a part of the highway, is there in the nature of things anything to inhibit the public from exacting rental for the space thus occupied? Obviously not. Suppose a municipality permits one to occupy space in a public park for the erection of a booth in which to sell fruit and other articles; who would question the right of the city to charge for the use of the ground thus occupied, or call such charge a tax, or anything else except rental? So in like manner, while permission to a telegraph company to occupy the streets is not technically a lease, and does not in terms create the relation of landlord and tenant, yet it is the giving of the exclusive use of real estate, for which the giver has a right to exact compensation, which is in the nature of rental. We do not understand it to be questioned by counsel for the defendant that, under the constitution

³⁰⁰ *St. Louis v. Western Union Telegraph*, 148 U.S. 92 (1893).

and laws of Missouri, the City of St. Louis has the full control of its streets, and in this respect represents the public in relation thereto.

It is claimed, however, by defendant [Western Union] that under the Act of Congress of July 24, 1866, and by virtue of its written acceptance of the provisions, restrictions, and obligations imposed by that act, it has a right to occupy the streets of St. Louis with its telegraph poles. . . .

It is a misconception, however, to suppose that the franchise or privilege granted by the act of 1866 carries with it the unrestricted right to appropriate the public property of a state. It is, like any other franchise, to be exercised in subordination to public and to private rights. While a grant from one government may supersede and abridge franchises and rights held at the will of its grantor, it cannot abridge any property rights of a public character created by the authority of another sovereignty. No one would suppose that a franchise from the federal government to a corporation, state or national, to construct interstate roads or lines of travel, transportation, or communication, would authorize it to enter upon the private property of an individual and appropriate it without compensation. No matter how broad and comprehensive might be the terms in which the franchise was granted, it would be confessedly subordinate to the right of the individual not to be deprived of his property without just compensation. And the principle is the same when, under the grant of a franchise from the national government, a corporation assumes to enter upon property of a public nature belonging to a state. It would not be claimed, for instance, that under a franchise from Congress to construct and operate an interstate railroad, the grantee thereof could enter upon the statehouse grounds of the state and construct its depot there without paying the value of the property thus appropriated. Although the statehouse grounds be property devoted to public uses, it is property devoted to the public uses of the state and property whose ownership and control is in the state, and it is not within the competency of the national government to dispossess the state of such control and use or appropriate the same to its own benefit or the benefit of any of its corporations or grantees without suitable compensation to the state. This rule extends to streets and highways; they are the public property of the state. While for purposes of travel and common use they are open to the citizens of every state alike, and no state can by its legislation deprive the citizens of another state of such common use, yet when an appropriation of any part of this public property to an exclusive use is sought, whether by a citizen or corporation of the same or another state or a corporation of the national government, it is within the competency of the state, representing the sovereignty of that local public, to exact for its benefit compensation for this exclusive appropriation. It matters not for what that exclusive appropriation is taken, whether for steam railroads or street railroads, telegraphs or telephones, the state may, if it chooses, exact from the party or corporation given such exclusive use pecuniary compensation to the general public for being deprived of the common use of the portion thus appropriated. . . .

Another matter is discussed by counsel which calls for attention, and that is the proposition that the ordinance charging five dollars a pole per annum is unreasonable, unjust, and excessive. Among other cases cited in support of that proposition is *Philadelphia v. Western Union* . . . , in which an ordinance similar in its terms was held unreasonable and void by the Circuit Court of the United States for the Eastern District of Pennsylvania. We think that question, like the last, may be passed for further investigation on the subsequent

trial. *Prima facie*, an ordinance like that is reasonable. The court cannot assume that such a charge is excessive, and so excessive as to make the ordinance unreasonable and void, for, as applied in certain cases, a like charge for so much appropriation of the streets may be reasonable. If, within a few blocks of Wall Street, New York, the telegraph company should place on the public streets 1,500 of its large telegraph poles, it would seem as though no court could declare that five dollars a pole was an excessive annual rental for the ground so exclusively appropriated, while, on the other hand, a charge for a like number of poles in a small village, where space is abundant and land of little value, would be manifestly unreasonable, and might be so excessive as to be void. Indeed, it may be observed, in the line of the thoughts heretofore expressed, that this charge is one in the nature of rental; that the occupation by this interstate commerce company of the streets cannot be denied by the city; that all that it can insist upon is, in this respect, reasonable compensation for the space in the streets thus exclusively appropriated, and it follows in the nature of things that it does not lie exclusively in its power to determine what is reasonable rental. The inquiry must be open in the courts, and it is an inquiry which must depend largely upon matters not apparent upon the face of the ordinance, but existing only in the actual state of affairs in the city.

708. Eleven years after upholding the right of municipalities to charge telecom operators for use of public rights of way, the Supreme Court reaffirmed a point made by both the majority and dissent in *Pensacola Telegraph*. Specifically, in *Western Union Telegraph Co. v. Pennsylvania Railroad Co.*,³⁰¹ the Court held that the 1866 Act did not divest a railway owner of its power to exclude a telegraph operator from using its rights of way.

709. In about 1864, Western Union had installed telegraph lines along Pennsylvania Railroad's right of way between Philadelphia and Jersey City. In September 1881, Western Union and Pennsylvania Railroad had entered into a 20-year contract (superseding all prior agreements) that permitted Western Union's continued use of Pennsylvania Railroad rights of way for its telegraph lines in consideration of US\$ 75,000 in annual rents, payable in monthly installments of US\$ 6,250, and the provision of concessionary messaging service for the railroad. The contract came up for renewal in September 1901, and following failed negotiations between the parties over the renewal rental, Pennsylvania Railroad notified Western Union in May 1902 that it was terminating the contract and demanded that Western Union remove its poles and lines within six months.

710. Finding itself suddenly without the necessary land rights for the continued operation of its existing telegraph lines, Western Union brought suit in federal court, relying on the 1866 National Telegraph Act as the primary basis for its claim. Among other allegations, Western Union contended that the lines along the Pennsylvania Railroad were essential to connect its western telegraph offices with the City of New York and that it had no alternative means to do. Because the agreement was meant to expire in September 1901, there was some disagreement between the parties over whether Pennsylvania Railroad had tacitly renewed the agreement by continuing to accept monthly payments from September 2001 through June 1902. Western Union also alleged that Pennsylvania Railroad had refused to renew the contract, and wanted Western Union's lines removed, because it intended to contract with a competing telegraph company to install its lines

³⁰¹ *Western Union Telegraph Co. v. Pennsylvania Railroad Co.*, 195 U.S. 540 (1904).

along the same route.³⁰² Though not mentioned in the case syllabus, it appears that Pennsylvania Railroad had received a better offer from Western Union's competitor for use of its rights of way. In this sense, Pennsylvania Railroad was not withdrawing joint use of its rights of way from the market, but rather was simply offering their continued use to the highest bidder.

711. Speaking for the majority opinion in a 7-1-1 decision, Justice McKenna confirmed that the privileges granted to Western Union under the 1866 Act did not override the property interests of Pennsylvania Railroad in its rights of way³⁰³:

. . . The right of way of a railroad is property devoted to a public use, and has often been called a highway, and as such is subject, to a certain extent, to state and federal control, and for this many cases may be cited. But it has always been recognized, as we have pointed out, that a railroad right of way is so far private property as to be entitled to that provision of the Constitution which forbids its taking, except under the power of eminent domain and upon payment of compensation. The right of way of a railroad was recognized as private property in the *Pensacola* case, and we are brought back to the main question – the interpretation of the Act of July, 1866, and upon that we have sufficiently dilated.

It follows from these views that the act of 1866 does not grant the right to telegraph companies to enter upon and occupy the rights of way of railroad companies, except with the consent of the latter, or grant the power of eminent domain. Nor does the statute of New Jersey make those rights of way public property so as to subject them to such occupation under the provisions of the act of 1866.

It is admitted that the statutes of New Jersey do not confer the right of eminent domain upon the telegraph company.

. . . On account of those restraints, it may be, and finding no impediment in the rights of property, interstate commerce by telegraph has marched to a splendid development, although in the acquisition of the means for its exercise it has relied on the consent of the owner of private property, or the power of eminent domain conferred by the states. We cannot but feel, therefore, that there is something inadequate in the argument which is based on the apprehension that the Act of July 24, 1866, construed as we construe it, gives a sinister power to railroad companies. It gives no power to those companies but that which appertains to the ownership of their property.

712. Thus, the United States Supreme Court in a series of four cases, including *Pensacola Telegraph v. Western Union*, *St. Louis v. Western Union*, *Western Union v. Ann Arbor Railroad* and *Western Union v. Pennsylvania Railroad*, had firmly established that state law governs the rights of telegraph operators to access state and municipal public rights of way and to acquire rights over private land by consent of the owner or by eminent domain.

³⁰² *Id.*, 195 U.S. at 542-46.

³⁰³ *Id.*, 195 U.S. at 573-75. See also *Western Union Telegraph Co. v. Ann Arbor Railroad Co.*, 178 U.S. 239 (1900).

Introduction of the telephone to the equation

713. The invention and commercialization of the telephone followed closely on the heels of the telegraph, with the first telephone exchange opening in New Haven, Connecticut in 1878.³⁰⁴ The United States again played a leading role in the development of the telephone, and related cross-sector infrastructure sharing practices and policies.

714. As was true around the world and has been discussed in Module 1, in the United States telephone lines in local exchanges were typically installed along roadways so they could easily reach customer premises. Early inter-exchange (intercity) telephone lines in the United States were typically co-located with existing telegraph lines along railways, typically using the same poles.

States act to support telephone company use of public and private land

715. As had been anticipated for the telegraph a few decades earlier, proprietors of the telephone required access to public streets and rights of way, and the privilege of eminent domain over private property, to ensure they could construct and operate their networks. Initially, there was no federal law governing the rights and responsibilities of telephone companies, and hence no federal right of eminent domain for them either. Thus, as telegraph companies had, telephone companies looked to state law for the right to obtain involuntary easements over private property when acquiring or perfecting the land corridors to build, operate and maintain their networks.

716. Most states responded to the need to support the development of the telephone as a medium of communication by legislative or judicial extension of statutory rights granted to telegraph companies to telephone companies.

Municipalities begin to regulate the use of public streets

717. Because intra-exchange and inter-exchange telephone lines were initially made of uninsulated wires, they could not share poles with electric distribution lines and could not be buried. As the telephone business grew, the number of aerial lines in public streets proliferated. Telephone companies faced increasing pressure to improve quality of service and reduce the clutter by burying their lines in densely populated areas.

718. As early as 1884, the City of New York had passed a law ordering all utilities – including electricity, telegraph and telephone – to bury their wires. Most utilities ignored the law, saying it was too expensive. Only Edison Illuminating Co. complied. However, following a blizzard in 1888, the City again ordered all utilities to bury their wires. In an order issued by the new mayor on 1 January 1889, the utilities were given 90 days to remove their poles and wires or they would be removed by the City. Compliance was limited.

³⁰⁴ “Telephone Transmission,” *Engineering and Technology History Wiki*. Available at http://ethw.org/Telephone_Transmission (last visited 11 Feb 2017).

Figure 52: New York City ordered burying of electric and telecom wiring after the Great Blizzard of 1888



Source: Baltimore Sun

719. As forewarned, in mid-April 1889, the City of New York began sawing down all remaining poles and rolling up and removing the wiring. Within a few months, all the poles and wires had been removed. Reportedly, Western Union had already installed a new set of telegraph lines in conduits, but allowed the City to remove its old poles and wires to avoid the cost of doing so itself.³⁰⁵

³⁰⁵ Frederick N. Rasmussen, “Back Story: In late 1800s, New York City buried wires after a natural disaster,” *The Baltimore Sun* (Jul. 12, 2012). Available at http://articles.baltimoresun.com/2012-07-12/news/bs-md-backstory-underground-wires-20120712_1_wires-poles-baltimore-gas (last visited 11 Feb 2017).

Figure 53: Removal of telegraph and telephone poles and lines in New York City in 1889



Source: *Harper's Weekly*³⁰⁶

Insulated telephone cables expand infrastructure sharing options

720. By 1914, it was reported that telephone engineers had designed a new type of cable which contained 2,400 wires capable of serving 1,200 telephone circuits and that the cable could be used in underground ducts with a minimum three-inch diameter. This new cable design was meant to solve overhead congestion issues at local exchanges in dense areas. At about the same time, AT&T had reported successfully completing construction and beginning operations of a buried 430-mile long distance line, using similar cable, from Boston to Washington.³⁰⁷

721. In addition, the railways along which the telegraph lines and inter-exchange telephone lines were installed began to recognize the benefits of supplementing their internal telegraph communications with internal telephone service. This prompted expansion of intercity telephone lines along railways. For example, in 1905, the Lehigh Valley Railroad completed the installation of telephone service by installing telephone lines on telegraph poles along all of its railway lines

³⁰⁶ *Harper's Weekly* 33, p.337. As included in *Going Wireless in the Belle Époque*, a photo essay by Erik Born, <https://medium.com/palais-des-beaux-arts-wien/going-wireless-in-the-belle-%C3%A9poque-4284a928dfd8#.abgfy9tiz> (last visited 13 Feb 2017).

³⁰⁷ *Telephony*, *The American Telephone Journal*, Vol. 68, No.1 at 22 (Chicago, Jan. 2, 1915). Available at <https://books.google.com/books?id=pytGAQAAMAAJ&pg=RA14-PA19&dq=Telephony,+The+American+Telephone+Journal,+Vol.+68,&hl=en&sa=X&ved=0ahUKEwj3k9qNo4jSAhWD5iYKHUbrCVoQ6AEIHDAA#v=onepage&q=Telephony%2C%20The%20American%20Telephone%20Journal%2C%20Vol.%2068%2C&f=false> (last visited 11 Feb 2017).

from New York City to Buffalo. The railroad also reported so-called composite lines where the same wiring was simultaneously used to transmit both voice and telegraph signals. That same year, the Baltimore & Ohio Railroad reported significant progress in installing telephones along its railway system.³⁰⁸

722. It should be noted that the telegraph did not disappear until long after the telephone was introduced. However, once the telegraph lines were built on all the major routes, there was very little activity which called for further development of infrastructure sharing practices and policies. For example, founded in 1851,³⁰⁹ by 1915 Western Union operated 1.6 million miles of telegraph wires³¹⁰, largely installed along railways. Although Western Union and competing telegraph companies gradually slowed the pace and eventually stopped installing new telegraph lines after the advent of the telephone, they had covered virtually every railroad line in the interim. The telephone would eventually overtake the telegraph, but not for nearly a century. Western Union did not discontinue its telegram/telegraph service in the United States until 2006. Throughout the United States, one can still see the abandoned telegraph lines in place along many rural railways, standing as monuments to early cross-sector infrastructure sharing.

Congress passes the first federal telephone legislation

723. In 1910, the Mann-Elkins Act of 1910 amended the Interstate Commerce Act of 1887 to include interstate “telegraph, telephone and cable companies (whether wire or wireless) engaged in sending [interstate] messages” as common carriers.³¹¹ These amendments required the rates of these carriers to be “just and reasonable.”³¹² The Interstate Commerce Commission, a regulatory body initially established under the Interstate Commerce Act to regulate railroads, was given jurisdiction to investigate complaints order carriers to comply with the Act.³¹³ These amendments were eventually superseded by the Communications Act of 1934. However, neither the Mann-Elkins Act or, as initially enacted, the Communications Act made any provision for telecommunications companies to have access to land corridors or to improvements and fixtures in those corridors. Land rights and access to cross-sector infrastructure were thus left to be dealt with as matters of state law only.

Voluntary sharing of poles by electric utilities and telephone companies

724. Following the introduction of insulated telephone cables, the tradition of voluntary infrastructure sharing by telephone companies in the United States extended from railways, roadways and telegraph companies to include electricity utilities. Voluntary utility pole sharing between electric utilities and local telephone companies can be traced back to the early 1900s. This development of telephone companies and electric distribution utilities voluntarily sharing poles came into practice after the use of insulated telephone cables reduced the risk of induction

³⁰⁸ “Railway Telephone Service,” *The Railway Age*, Vol. 39 at 73 (20 Jan 1905). Available at <https://books.google.com/books?id=m1JBAQAAMAAJ&printsec=frontcover&dq=the+railway+age+vol+39&hl=en&sa=X&ved=0ahUKEwizj8LiuIjSAhXJ6oMKHazYAc4Q6AEIGjAA#v=onepage&q=the%20railway%20age%20vol%2039&f=false> (last visited 11 Feb 2017).

³⁰⁹ Western Union website, “Our Rich History,” (as of Dec 2015).

³¹⁰ Maury Klein. 2007. *The Genesis of Industrial America, 1870-1920* at 77 (New York: Cambridge University Press 2007).

³¹¹ Mann-Elkins Act, Pub. L. No. 61-218, ch. 309, §7, 36 Stat. 539, 544-46, 551 (1910).

³¹² *Ibid.*

³¹³ *Id.* at §12.

or contact between uninsulated telephone wires and energized electricity lines. A strong affinity between telephone companies and electric utilities ensued.

725. The need to address safety and reliability issues arising from the systematic and pervasive sharing of utility poles by electric utilities and telephone companies quickly led to the development of common industry safety standards for joint use of poles. In 1914, to address the growing practice of pole sharing, the National Bureau of Standards prepared the first National Electrical Safety Code (NESC) for ensuring safety and reliability in joint use of poles. The NESC has to this day remained the standard which “sets the ground rules for practical safeguarding of persons during the installation, operation, or maintenance of electric supply and communication lines and associated equipment. It contains the basic provisions that are considered necessary for the safety of employees and the public under the specified conditions.”³¹⁴ The NESC became a consensus-based standard in 1960, and has since 1972 been administered by the Institute of Electrical and Electronics Engineers (IEEE), periodically being updated and improved to reflect new technologies for power and telecommunications and improved experience-based safety practices.

726. Without any federal or state legal or regulatory compulsion to do so, electric utilities and telephone companies continued voluntarily sharing poles used to support electricity distribution lines and telephone lines throughout the remainder of the 20th Century. Even the passage of the comprehensive Communications Act in 1934, which transferred federal authority over interstate telephone services from the Interstate Commerce Commission (under the Mann-Elkins Act) to the newly formed FCC, did not mandate or regulate the sharing of poles or other cross-sector infrastructure.

727. From the early days of both businesses until 1996, nearly all electric utilities and telephone companies were regulated monopolies subject to similar ratemaking proceedings (which were, in most states, applied by the same regulator, often known as a public service commission or public utilities commission). Both electric utilities and telephone companies found sufficient benefit to engage in comprehensive joint use of poles even though it required significant coordination and added to the cost of each company in servicing its poles. They did this because it reduced the potential for conflict between separate lines installed in the same corridors (primarily along roadways) and because it reduced the capital required for each to extend its lines into new coverage areas. Because they were similarly situated and regulated monopolies, each requiring and assured of recovery of costs prudently incurred, they were content with a simple cost-sharing arrangement and did not seek to profit from providing pole access.

728. The typical pole sharing arrangement between an electric utility and a telephone company would be established in a pole attachment agreement with symmetrical terms in which both parties were pole owners and pole users. These standard pole attachment agreements provided for each party annually to pay the other for half of the average annual carrying costs of all jointly used poles owned by the other party. Because both parties owned some poles used by the other, there was also a netting arrangement whereby the amounts owed by each party to the other were netted and the party with the larger liability to the other paid the net amount. While electric utilities typically owned more jointly used poles than telephone companies, both owned significant numbers, with telephone companies owning as many as a third of all jointly used poles in some geographic areas.

³¹⁴ See IEEE Standards Association, *Celebrating 100 Years of Safety and Interoperability: National Electrical Safety Code (NESC)* (2016). Available at <http://standards.ieee.org/about/nesc/100/> (last visited 11 Feb 2017).

Electric and telephone companies voluntarily share poles with CATV operators

729. The advent of cable television in the United States in the late 1940s brought the need to accommodate a third wire (or set of wires) to each customer premises. At the time, there was no competition between cable television and telephone, so all three wire owners (electric, telephone and cable) did not compete with each other and could in principle compatibly share the same poles on a voluntary basis in the same way that electric utilities and telephone companies had shared poles. Indeed, they did share poles, voluntarily. As noted by the Eleventh Circuit Court of Appeals in *Gulf Power Co. v. FCC*:

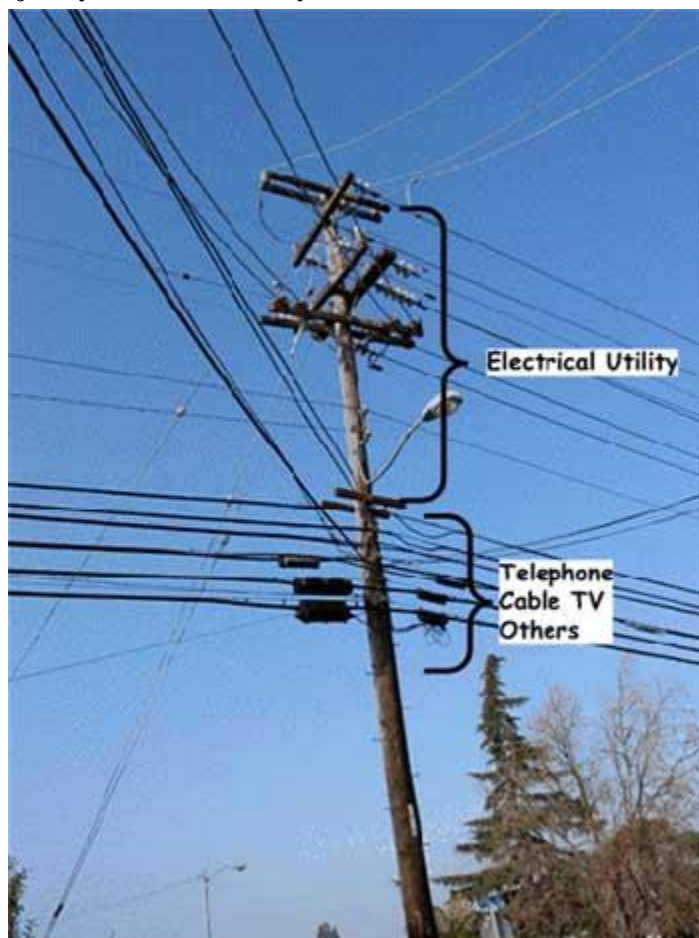
From its inception, the cable television industry has attached its cables to the utility poles of power and telephone companies. They have done so because factors such as zoning restrictions, environmental regulations, and start-up costs have rendered other options infeasible. Despite this dearth of alternatives, the attachment agreements between cable television companies and utility companies have generally been voluntary.³¹⁵

730. The prevailing practice of electric utilities and telephone companies had been to charge cable companies [make ready costs](#) plus an annual rental equal to one third of the carrying cost of the pole (including the incremental carrying costs incurred due to the presence of three attachers). Thus, with the exception of the one-time recovery of costs for modifying poles and installing cables, the annual rents charged by utilities were generally calculated in a similar manner to those which had been charged by electric utilities and telephone companies to each other.

731. Notably, from their entry into the market until 1984, cable television operators often enjoyed a *de jure* monopoly over the provision of cable television service in their service territories under the franchises awarded to them by municipalities authorizing the use of public streets. In any event, they almost always enjoyed a *de facto* monopoly because no cable operator was willing to overbuild another cable operator's system. These franchise agreements also authorized cable companies, if they wished, to install their own poles or ducts. Nonetheless, the cable television operators opted to share existing utility poles, at the rates offered by the electric utilities and telephone companies, because that was less expensive than their other options.

³¹⁵ *Gulf Power Co. v. FCC*, 208 F.3d 1263 (11th Cir. 2000).

Figure 54: Utility pole jointly used for electricity transmission and distribution and communications lines



Source: US Department of Transportation, Federal Highway Administration³¹⁶

Congress regulates utility pole sharing with cable television companies

732. Cable operators, through a well-organized trade association, continued to complain that the rates charged by pole owners who accommodated their attachments were excessive and they sought relief from Congress. “In response to arguments by cable operators that utility companies were exploiting their monopoly position by engaging in widespread overcharging, Congress in the Pole Attachments Act authorized the FCC to fill the gap left by state systems of public utilities regulation.”³¹⁷ The so-called Pole Attachment Act was enacted by Congress as part of the Communications Act Amendments of 1978, which added a new section 224 to the Communications Act of 1934.³¹⁸ Its passage marked the beginning of federal regulation of cross-sector infrastructure sharing in the United States.

³¹⁶ Included in the US Department of Transportation, Federal Highway Administration *Telecommunications Handbook for Transportation Professionals: The Basics of Telecommunications*, Ch. 8, Construction, https://ops.fhwa.dot.gov/publications/telecomm_handbook/chapter8.htm (last visited 13 Feb 2017).

³¹⁷ *FCC v. Florida Power Corp.*, 480 U.S. 245, 247 (1987).

³¹⁸ Pub. L. 95-324, 95 Stat. 33, 35-36, sec. 6, codified as amended at 47 U.S.C. §224.

733. As originally enacted, the Pole Attachment Act had a relatively narrow application, authorizing and directing the FCC to regulate the rates, terms and conditions for cable television attachments to electric and telephone utility poles. While articulated through a relatively complex set of nested definitions, the intended beneficiaries of the regulation were limited to owners of cable television systems, and the intended regulated entities were limited to investor-owned electric utilities and telephone companies, referred to as “utilities” in the Act.³¹⁹ On its face, the 1978 Act did not require a utility to grant a cable company access to its poles, but regulated the terms of access and rates if it did. As a practical matter, however, because all cable companies had already installed extensive attachments to electric and telephone poles under the existing voluntary arrangements, the utilities were left to choose between the unacceptable public relations option of ejecting those cable companies from their poles or succumbing to the new regulated rates.

734. Two features of the 1978 Pole Attachment Act are noteworthy. First, a reverse state-preemption provision declared the Act’s regulation of pole attachment rates, terms and conditions inapplicable “in any case where such matters are regulated by a State.”³²⁰ Any state relying on this exemption was required to certify to the FCC that it regulated pole attachment rates, terms and conditions, and that, in doing so, it considers the interests of cable television subscribers as well as electricity and telephone customers. This provision clearly reflected one of the many idiosyncrasies of the U.S. federal system, in its deference to the prerogative of states to regulate such matters, but it also had significant impact on the continuing development of practices and policies for cross-sector infrastructure sharing in the United States. In reliance on the Pole Attachment Act’s deference to state sovereignty, a significant number of states elected to continue (or begin) regulating pole attachments themselves.³²¹ This has led to multiple threads of law and regulatory policy which are not necessarily harmonized across the United States.

735. Second, the Act prescribed, for an initial five-year period, a mandatory range within which pole attachment rates would be considered “just and reasonable.” The minimum just and reasonable amount was a rate which “assures the utility the recovery of not less than the additional costs of providing pole attachments.” This floor effectively only allowed the pole owner to recover [make ready costs](#). These may include such items as the initial capital expenditures, if any, to make the pole ready for attachments, such as rearranging existing attachments to create space or avoid interference between attachments and strengthening the pole or its supports to handle the extra load. It would also include any ongoing increase in operation and maintenance costs, such as increased time for work crews in changing out damaged or aging poles. In short, the pole owner was not allowed to recover any of its sunk capital costs or existing operations and maintenance expenses from the attacher. Put another way, the pole owner would receive no compensation for use of its poles but simply an indemnity of any additional costs incurred by allowing use of them.

³¹⁹ The Act required the FCC to “regulate the rates and terms and conditions for pole attachments.” A “pole attachment” is defined as “any attachment by a cable television system to a pole duct, conduit or right-of-way owned or controlled by a utility.” “Utility” is defined as “any person whose rates or charges are regulated by the Federal Government or a State and who owns or controls poles, ducts, conduits, or rights-of-way used, in whole or in part, for wire communication” and expressly excludes “any railroad, any person who is cooperatively organized, or any person owned by the Federal Government or any State.” Pub. L. 95-324, sec. 6, text of sec. 224(a)(1), (a)(4) & (b)(1).

³²⁰ Pub. L. 95-324, sec. 6, text of sec. 224(c)(1).

³²¹ As of 2000, 18 states or territories had self-certified to the FCC that they regulated pole attachments. These included Alaska, California, Connecticut, Delaware, District of Columbia, Idaho, Illinois, Kentucky, Louisiana, Maine, Massachusetts, Michigan, New Jersey, New York, Ohio, Oregon, Utah, Vermont and Washington.

It was clearly an unsustainable rate if the pole owner were not otherwise compelled to install and maintain poles for its own business.

736. The maximum just and reasonable rate was “an amount determined by multiplying the percentage of the total usable space . . . which is occupied by the pole attachment by the sum of the operating expenses and actual capital costs of the utility attributable to the entire pole.” This formula, if applied to the sharing arrangements between the electric utilities and telephone companies, would have deemed the rates they had charged each other for 70 years to have been unjust and unreasonable. This is because the traditional sharing formula was based on dividing total costs between the actual number of pole users (two when it was only electric and telephone, and increasing to three when cable was added). The maximum rate permitted under the Pole Attachment Act, on the other hand, was based on the maximum theoretical number of pole users, rather than the actual number. Thus, if a pole could accommodate six attachers, then the cable company could only be required under the formula to pay a maximum of one-sixth of the total costs, rather than one-third, even if there were only three attachers.

737. The 1978 Pole Attachment Act directed the FCC to promulgate its regulations within 180 days after 21 February 1998, the date of enactment. On 8 August 1998 the FCC, in the first of a series of orders, adopted regulations defining a just and reasonable rate in the same way as the statute.³²² The FCC subsequently interpreted the statute to provide that when it acts to reduce the contract rate for pole attachments, it will only reduce to the maximum rate allowed under the statute, i.e., the recovery of fully allocated cost, including the actual cost of capital.³²³

738. Although municipal utilities were excluded from the definition of “utility” under the Pole Attachment Act, and thus not subject to regulation of pole attachments, they are nonetheless subject to some federal regulation of their pole attachment practices. In particular, the federal Communications Act of 1934 prohibits local governments from creating barriers to entry and are required to manage public rights of way on a competitively-neutral and non-discriminatory basis.³²⁴ Local government practices in respect of pole attachments therefore may potentially be subject to challenge by an aggrieved person before the FCC or the courts if they constitute unreasonable or discriminatory barriers to entry.

739. As initially enacted, section 224 applied to not only to attachments to utility poles, but also applied (and continues to apply) to any “duct, conduit or right of way controlled by a utility.” Notwithstanding the listing of these additional infrastructure types, which appear to have been added to the bill at the last minute, section 224 was in practice primarily intended and applied to regulate attachments of coaxial cable television cable and associated equipment to electric and telephone company utility poles. Because the electric utilities and telephone companies generally did not own the rights of way in the last mile streets where the cable companies sought access, the provision regulating access to rights of way was superfluous. Similarly, because cable companies operated predominantly in suburban and rural areas in 1978, where almost all electric and

³²² 68 FCC 2d 1585. The new 47 USC §1.409 adopted by the FCC in this First Report and Order states that a rate is just and reasonable “if it assures a utility the recovery of not less than the additional costs of providing pose attachments, nor more than an amount determined by multiplying the potential percentage of the total usable space, or the percentage of the total duct capacity, which is occupied by the pole attachment by the sum of the operating expenses and actual capital costs of the utility attributable to the entire pole, duct, conduit, or right of way.”

³²³ *FCC v. Florida Power Corporation*, 480 U.S. 245, 254 (1987).

³²⁴ 47 U.S.C. §253.

telephone facilities were installed above ground on poles, the provisions regulating access to existing electric and telephone ducts and conduits were also superfluous. However, these seemingly *dormant clauses* of the Pole Attachment Act would become more relevant over time, and the FCC would eventually begin to exercise its authority to regulate the use of ducts (and conduits) and rights of way.

740. In the ensuing years after passage of the 1978 Act, Congress made some relatively minor adjustments to the Pole Attachment Act. First, in 1982, prior to the expiration of the five-year sunset of the prescribed range of just and reasonable rates, Congress repealed the sunset provision in the Communications Amendments Act of 1982.³²⁵ This extended the statutory rate floor and ceiling indefinitely. Second, in 1984, Congress amended section 224(c), in the Cable Communications Policy Act of 1984, to restrict the ability of states to reverse-preempt FCC regulation of pole attachment rates where they had not issued effective rules and regulations to implement their authority or had failed to act on complaints within a timely manner.³²⁶

741. However, the more significant aspect of the Cable Communications Act of 1984, insofar as cross-sector infrastructure sharing was concerned, was its introduction of competition in cable television by prohibiting municipalities and states from granting exclusive franchises and its de-regulation of cable television rates.

Litigation over federal regulation of pole attachment rates

742. Section 224 required the FCC to regulate the rates and terms and conditions of attachments and to ensure that they were “just and reasonable.” Utilities could only recover a portion of the expenses and capital costs attributable to the pole, duct, conduit or right of way. This portion would equal the percentage of “usable space,” or space which could be used for attachments, occupied by the cable television operator’s attachment.

743. Both electric utilities and telephone companies believed the pole attachment fees permitted by the FCC in interpreting the Pole Attachment Act were highly skewed toward the cable television operators. The electric utility or telephone company could only recover the portion of usable space actually used by the cable television operator. If the usable space could accommodate more attachments, the costs of these were borne entirely by the utility or telephone company.

In 1986, following a heavy period of litigation before the FCC and the lower federal courts, Congress’s authority to mandate pole sharing with cable companies and the adequacy of the compensation allowed by the FCC to the regulated utilities were finally addressed by the United States Supreme Court in *FCC v. Florida Power*.³²⁷ In that case, the Court reviewed the decision of a lower court that the FCC’s regulation of pole attachment rates was a confiscatory taking of property in violation of the US Constitution. The Court noted that³²⁸:

The Pole Attachments Act . . . was enacted by Congress as a solution to a perceived danger of anticompetitive practices by utilities in connection with cable television service. Cable television operators, in order to deliver television signals to their subscribers, must have a physical carrier for the cable; in most instances underground installation of the necessary

³²⁵ Pub. L. 97-259, title I, §106, Sept. 13, 1982, 96 Stat. 1091.

³²⁶ Pub. L. 98-549, §4, Oct. 30, 1984, 98 Stat. 2801.

³²⁷ *Florida Power Corporation*, 480 U.S. 245.

³²⁸ *FCC v. Florida Power Corporation*, 480 U.S. at 247-248.

cables is impossible or impracticable. Utility company poles provide, under such circumstances, virtually the only practical physical medium for the installation of television cables. Over the past 30 years, utility companies throughout the country have entered into arrangements for the leasing of space on poles to operators of cable television systems. These contracts have generally provided for the payment by the cable companies of a yearly rent for space on each pole to which cables were attached, the fixed costs of making modifications to the poles and of physical installation of cables being borne by the cable operators. In many States the rates charged by the utility companies for these attachments have not been subject to regulation.

In response to arguments by cable operators that utility companies were exploiting their monopoly position by engaging in widespread overcharging, Congress in the Pole Attachments Act authorized the Federal Communications Commission to fill the gap left by state systems of public utilities regulation.

744. The Supreme Court’s reference to utility companies “exploiting their monopoly position” is understood as referring to their dominance over poles capable of joint use and not their enfranchised monopolies as electric distribution utilities and local telephone companies.

745. The Court ultimately overturned the lower court ruling and determined that the Act was not in violation of the US Constitution as it did not mandate access, it only regulated the price. Utilities were free to deny cable companies’ requests for attachments or terminate or refuse to renew existing attachment arrangements.³²⁹ In addition the Court found that it could not “seriously be argued” that the “recovery of fully allocated cost, including the actual cost of capital, is confiscatory.”³³⁰

746. As to the propriety of *ex ante* regulation, the *Florida Power* ruling accords with currently accepted international best practices. This is based on the premise that poles are [essential facilities](#) and that pole owners have a dominant market position. However, rather than being hard-coded in the law, the authors of this toolkit believe this determination ought to be a question periodically revisited by the FCC through a market assessment. This would allow the FCC to adjust its level of regulation based on the evolution of market conditions, which is today considered best practice for telecom regulators.

747. As to the level of compensation, however, it is hard to square the FCC’s formula, as approved by the Supreme Court, with accepted best practice for ensuring there are no mandated cross subsidies. As discussed above, the electric utility or telephone company could only recover the portion of usable space actually used by the cable television operator even if usable space could accommodate more attachments. Accordingly, despite the Court’s decision, on their face, the rates allowed by the FCC formula appear to be confiscatory.

Congress extends regulated pole access right to telecom operators

748. The regulation of pole attachments was eventually extended to reach all telecommunications operators in the Telecommunications Act of 1996,³³¹ and corresponding state legislation, and

³²⁹ *FCC v. Florida Power Corporation*, 480 U.S. at 290.

³³⁰ *FCC v. Florida Power Corporation*, 480 U.S. at 291.

³³¹ Pub. L. 104-104, title VII, §703, Feb. 8, 1996, 110 Stat. 149.

subsequent rulemakings and litigation involving the US Federal Communications Commission (the FCC) and state regulators.

749. The Telecommunications Act of 1996 introduced competition in local telephone services. To ensure new entrants in the liberalized telephone market had access to sharable infrastructure, Congress revisited and enlarged the scope of the Pole Attachment Act. It extended the benefits of section 224 beyond cable television operators to include all “telecommunications carriers.” However this term was defined to expressly exclude incumbent local exchange carriers (ILECs).³³² It also expanded the obligations of utilities beyond just and reasonable rates to mandatory “non-discriminatory access to any pole, duct, conduit, or right-of way owned by it,” except in limited circumstances.³³³

750. Under the expanded section 224, the FCC initially applied a different rate formula to telecom attachments than for cable attachments. Unlike the cable attachment rate, the telecom rate took into account the costs of “unusable” space on the pole, i.e., space which cannot be used for attachments, for example due to low height. This resulted in higher telecom attachment rates than cable attachment rates. In addition, the FCC in separate regulatory proceedings under the Communications Act of 1934 adopted the position that Internet access was neither a telecom service (which fetched the higher pole attachment rate) nor a cable service (which fetched the lower pole attachment rate), but instead an information service (the pole attachment rates for which were not regulated).

751. As both telephone companies and cable companies began to offer Internet, this created unanswered questions about the regulatory status of their pole attachments. This disparity, coupled with convergence in the industry, engendered numerous legal and regulatory controversies that continue today after nearly two decades. It has been criticized as an unnecessary subsidy to a now robust cable television industry at the expense of electricity rate payers. In addition, the provision of broadband Internet and other telecommunication services by cable television operators has raised questions about how to apply these rate formulas to cable television operators.

752. In 2002, the United States Supreme Court addressed the application by the FCC of cable rates to attachers which provided by cable television and high-speed Internet services in *National Cable & Telecommunications Association v. Gulf Power Company*.³³⁴ Leading up to the case, the FCC determined that such attachments were still considered attachments “by a cable television system” and therefore subject to regulation by the FCC under the Act.³³⁵ The Supreme Court agreed with the FCC’s statutory interpretation and found it to be reasonable, overruling a lower court.³³⁶ The Court noted that its interpretation was more sensible as a matter of policy³³⁷:

This result is more sensible than the one for which respondents contend. On their view, if a cable company attempts to innovate at all and provide anything other than pure television, it loses the protection of the Pole Attachments Act and subjects itself to monopoly pricing. The resulting contradiction of longstanding interpretation – on which

³³² 47 USC §224(a)(5)

³³³ 47 USC §224(f)

³³⁴ *National Cable & Telecommunications Association v. Gulf Power Company*, 534 U.S. 327 (2002).

³³⁵ *Gulf Power Company*, 534 U.S. 327 at 331-332.

³³⁶ *Gulf Power Company*, 534 U.S. 327 at 334.

³³⁷ *Gulf Power Company*, 534 U.S. 327 at 339.

cable companies have relied since before the 1996 amendments to the Act – would defeat Congress’ general instruction to the FCC to “encourage the deployment” of broadband Internet capability and, if necessary, “to accelerate deployment of such capability by removing barriers to infrastructure investment.” . . . This congressional policy underscores the reasonableness of the FCC’s interpretation: Cable attachments providing commingled services come within the ambit of the Act.

753. Even following *Gulf Power*, the convergence issues were further complicated as both telephone companies and cable companies began offering triple-play telephone, Internet and television programming such that they were direct competitors across all services offered, differentiated only in the technology they used but not the services they offered. There was increased pressure on the FCC to bring all pole attachment rates in line to a single rate for all communications attachers.

754. Most commentators and industry participants eventually expected the FCC to raise the cable rate to the telecom rate. However, in a surprising move in November 2015, the FCC reduced the telecom rate to the cable rate and added ILECs to the list of beneficiaries of the new uniform lower rates. This move restored competitive neutrality among telecom operators but also, so the electric utilities have contended, expanded the scope of the mandated cross-subsidy provided by electric utility customers and shareholders to telecommunications and cable customers and shareholders.

755. With permanently subsidized rates for pole attachments by all telecommunications attachers, electric utilities are now the only market participants who can afford to invest in poles. This is only because they are guaranteed a rate of return on their investment through their electricity tariffs. The potential eventually to move aerial infrastructure into ducts would seem therefore to have been permanently suppressed. Because they do not bear anywhere near the proportionate cost of the infrastructure they are using, all attachers to electric utility poles have no incentive to contribute toward a joint investment in a shared duct system as this would increase their costs. This is but one of many economic distortions of the market and of potential improvements in infrastructure which have flowed from the current regulation of pole attachment rates in the United States.

FCC extends pole attachment regulation to include wireless attachments

756. In *Gulf Power*, the Supreme Court also addressed whether wireless attachments, i.e., those used by wireless carriers, would be subject to the Pole Attachment Act. The Court held that such wireless attachments were pole attachments under the Act. The Court acknowledged that it relied on an entirely textual interpretation of the term “associated equipment” under the statute and the reasoning was divorced from a sensible economic analysis³³⁸:

Respondents must demand a distinction between prototypical wire-based “associated equipment” and the wireless “associated equipment” to which they object. The distinction, they contend, is required by the economic rationale of the Act. The very reason for the Act is that -- as to wires -- utility poles constitute a bottleneck facility, for which utilities could otherwise charge monopoly rents. Poles, they say, are not a bottleneck facility for the siting of at least some, distinctively wireless equipment, like antennas. These can be located anywhere sufficiently high.

³³⁸ *Gulf Power Company*, 534 U.S. 327 at 341.

The economic analysis may be correct as far as it goes. Yet the proposed distinction -- between prototypical wire-based “associated equipment” and the wireless “associated equipment” which allegedly falls outside of the rationale of the Act -- finds no support in the text, and, based on our present understanding of the record before us, appears quite difficult to draw. Congress may have decided that the difficulties of drawing such a distinction would burden the orderly administration of the Act. In any event, the FCC was not unreasonable in declining to draw this distinction; and if the text were ambiguous, we would defer to its judgment on this technical question.

757. As the Court appeared to acknowledge, in the case of wireless attachments, there is no evidence that utility poles are [essential facilities](#) (as they are in the case of wired cable television attachments) or that pole owners are in a dominant market position to justify *ex ante* regulation. In that sense, the Court’s decision to allow such an expansive reading of the statute, as well as the FCC’s decision to pursue *ex ante* regulation of wireless attachments, appear to be wrong both as a matter of economics and law.

Proliferation of telecom operators reopens debate over land access policy

758. The introduction of competition in local access networks initially resulted in public policy and legal questions about whether multiple competing service providers ought to severally have the powers of eminent domain. Generally, the answer has been yes.

759. However, the use of eminent domain in private development projects has stirred public outrage in some parts of the country. Although telecommunications are not typically the focus of this outrage, the overall sentiment has prevented state legislators from updating state eminent domain laws to the benefit of telecommunications operators.

760. Also, with the proliferation of telecommunications use of existing rights of way, private land owners have increasingly objected to the expansion of such granted rights to include telecommunications. Although telecommunications operators may obtain consent from a utility to use its existing rights of way through private land, such use may exceed the rights granted by the underlying owners of the land. For example, the use of railway rights of way for buried fiber optic cable has been the subject of extensive litigation over scope of rights to use easements throughout the United States for nearly two decades. As one court described the circumstances³³⁹:

This case concerns Maine’s part in a nationwide phenomenon in which telecommunications companies bargained with railroads for the right to place fiber optic cables through rights of way owned by the railroads. In the 1990s, owners of property underlying the railroads’ rights of way began taking action against what they perceived to be trespass by the telecommunications companies on their property. Whether or not there was a trespass was informed by the grant of rights to the railroads, which often did not include a right to use the right of way for non-railroad purposes. In some cases, the right of way may have even lapsed through disuse and all rights once owned by the railroad may have reverted to the owners of the fee underlying the right of way. . . Decades of litigation

³³⁹ *Cascade Corporation v. Sprint Communications*, No. 2:11-cv-125-JAW, Court’s Report of Telephone Conference. (US Dist. Ct. Maine 2012). Available at http://www.med.uscourts.gov/Opinions/Torresen/2012/NT_02152012_2_11cv125_Cascade_v_Sprint.pdf (last visited 11 Feb 2017).

in numerous jurisdictions involving various railroads and telecommunications companies ensued.

9.3.3 *Examples of modern cross-sector infrastructure sharing experiences*

Some of the most successful telecommunications networks in the United States can be traced to early deployment of telecommunications equipment on existing infrastructure from other sectors. Other initiatives have not led to the same level of commercial success, but have demonstrated the potential for collaborative activity involving infrastructure sharing. The following are a sample of noteworthy cross-sector sharing businesses and projects in the United States in recent years.

Sprint Corporation

761. Sprint Corporation (Sprint) is a global telecommunications company providing mobile and fixed voice and data services. At the time of writing, Sprint is the fourth largest mobile operator in the United States.³⁴⁰ Cross-sector infrastructure sharing utilizing railway rights of way is a critical part of Sprint's history.

762. Sprint traces its origins to the Brown Telephone Company, founded in 1899 by Cleyson Brown in Kansas.³⁴¹ However, a critical moment in the evolution of Sprint's network came in 1983 when its predecessor, GTE Corporation (GTE) acquired Southern Pacific Communications Corporations (SPCC) to form GTE Sprint Communications.³⁴²

763. SPCC was a division of the Southern Pacific Railroad, a major railroad system in the Southwestern United States founded in 1865 that eventually grew to encompass over 13,000 miles of rail.³⁴³ The Southern Pacific Railroad initially installed telegraph wires on poles along its tracks, enabling dispatchers to monitor trains and communicate with train engineers.³⁴⁴ This system was updated to carry voice communications, including the installation of switches and multiplexing equipment, and eventually became a sprawling long-distance network.³⁴⁵

764. SPCC was formed in 1970 to commercialize excess capacity on Southern Pacific Railroad's fiber network, which employees referred to internally as "Southern Pacific Railroad Internal Network Telecommunications (SPRINT)."³⁴⁶ As a result of regulatory changes allowing access to local exchanges, SPCC began providing long distance services in the late 1970s and by 1981 had 200,000 customers and was handling 60,000 long-distance calls per day.³⁴⁷

³⁴⁰ Trefis Team, "Weekly Carrier Notes: Sprint's Postpaid Growth, Chinese 4G Tie-Up Talks, Verizon's Content Deals." *Forbes* (10 Nov 2015). Available at <http://www.forbes.com/sites/greatspeculations/2015/11/10/weekly-carrier-notes-sprints-postpaid-growth-chinese-4g-tie-up-talks-verizons-content-deals/> (last visited 11 Feb 2017).

³⁴¹ Sprint website, "Milestone Events Making Sprint History: 1899 – 1989," (as of Dec 2015).

³⁴² Funding Universe, "Sprint Corporation History," Funding Universe, <http://www.fundinguniverse.com/company-histories/sprint-corporation-history/> (last visited 11 Feb 2017).

³⁴³ Union Pacific, "Southern Pacific Railroad," Union Pacific, https://www.up.com/aboutup/special_trains/heritage/southern_pacific/index.htm (last visited 11 Feb 2017).

³⁴⁴ Funding Universe, "Sprint Corporation History."

³⁴⁵ *Id.*

³⁴⁶ UtahRails.Net, "Southern Pacific Communications Company (SPCC)," Don Strack, <http://utahrails.net/sp/sprint.php> (last visited 11 Feb 2017).

³⁴⁷ *Ibid.*

765. In 1983, GTE acquired SPCC (and the SPRINT name) to expand its existing network.³⁴⁸ While the aging copper line network had been functionally replaced by a more economical microwave system, GTE was more attracted to the lateral corridors on the railway's rights of way which connected major cities.³⁴⁹ Access rights to these corridors was therefore included in the package of rights acquired with SPCC from Southern Pacific Railroad. In accordance with this plan, the new GTE Sprint Communications completed the installation of fiber optic cable along the routes started by SPCC.³⁵⁰ By 1988, the network was entirely fiber.³⁵¹ GTE eventually spun off its long distance network from its access networks, and the spun off entity's name was shortened to SPRINT.

Williams Telecommunications Systems, Inc.

766. In the early 1990s, Williams Telecommunications Systems, Inc. (WilTel), a subsidiary of The Williams Companies, Inc., was the fourth largest long distance carrier in the United States.³⁵² The success of WilTel can be traced back to cross-sector infrastructure sharing with petroleum pipelines.

767. Brothers S. Miller Williams, Jr. and David Williams founded a construction business in 1908 which later grew into a leading global pipeline engineering and construction firm.³⁵³ In 1985, WilTel began retrofitting decommissioned petroleum pipelines with fiber optic cable.³⁵⁴ By 1989, WilTel had approximately 11,000 miles of fiber optic cables, the fourth largest fiber network in the United States.³⁵⁵ The shielding provided by the pipelines helped make the network more reliable than those of most competitors.³⁵⁶

768. In 1995, WilTel sold the long distance portion of its telecommunications business to Long Distance Discount Service, which eventually became WorldCom and then MCI WorldCom.³⁵⁷ WilTel's parent company retained a small portion of its fiber optical cable which it transferred to another subsidiary. A new WilTel subsidiary emerged in 1998 focusing on wholesale markets and this business was acquired by Level 3 Communications Inc. in 2005.³⁵⁸

Major electric utility successfully employs 3 different business models

769. Southern Company is the largest public utility holding company in the United States, and is regulated under the federal Public Utility Holding Act of 1940 (PUHCA). It conducts a vertically integrated electricity supply business, engaging through its subsidiaries in electric power

³⁴⁸ Funding Universe, "Sprint Corporation History."

³⁴⁹ Ibid.

³⁵⁰ Ibid.

³⁵¹ Ibid.

³⁵² Funding Universe, "Williams Communications Group, Inc. History," Funding Universe, <http://www.fundinguniverse.com/company-histories/williams-communications-group-inc-history/> (last visited 11 Feb 2017).

³⁵³ Ibid.

³⁵⁴ Ibid.

³⁵⁵ Ibid.

³⁵⁶ Ibid.

³⁵⁷ Ibid.

³⁵⁸ Ibid. See also Level 3 Communications, "Level 3 to Acquire WilTel Communications," Level 3 Communications, <http://investors.level3.com/investor-relations/press-releases/press-release-details/2005/Level-3-to-Acquire-WilTel-Communications/default.aspx> (last visited 11 Feb 2017).

generation, transmission and distribution. It is entirely investor-owned and traded on the New York Stock Exchange. Southern Company's operating subsidiaries engaged in the electricity business are also regulated at the federal level by the Federal Energy Regulatory Commission and at the state level by the Public Service Commissions in Alabama, Florida, Georgia and Mississippi.

770. Southern Company conducts its electricity transmission business through Alabama Power Company, Georgia Power Company and Gulf Power Company. These operating companies have over 43,000 km of electric transmission lines and 3,700 substations with a service territory of over 310,000 km².

771. Beginning in the early 1990s, Southern Company's chief information officer began pursuing a strategy whereby Southern Company would seek to retrofit fiber optic cable on its entire electric transmission grid by partnering with telecom operators under the hosting model described in Module 1. Under these arrangements, the telecom operators would pay for the installation of fiber optic cable on existing electric transmission lines in exchange for the rights of use of a specified number of fiber pairs in the new fiber, provision of dark fiber to Southern Company for internal use and payment of cash compensation. As a result of these transactions, Southern Company's operating subsidiaries gradually began amassing a large footprint of excess dark fiber capacity on the electric transmission grid.

772. Under PUHCA, which had originally been enacted to curb excessive risk taking by public utility holding companies which was perceived as contributing to the Great Depression, public utility holding companies and their subsidiaries were generally prohibited from entering into new, non-core lines of business without the express permission of the federal Securities and Exchange Commission. As part of the Telecommunications Act of 1996, Congress partially repealed the PUHCA prohibition on public utility holding companies, expressly authorizing (and encouraging) them to enter the telecommunications sector through separately incorporated subsidiaries formed especially for that purpose.

773. Exercising this new authority under the 1996 liberalization of the telecommunications sector, Southern Company formed Southern Telecom, Inc in 1997 as a wholly owned subsidiary to commercialize excess dark fiber on the transmission grid and to pursue related "partnerships" with telecom operators. During the ensuing years, Southern Telecom and its electric utility affiliates planned and executed multiple partnerships with major telecom network operators for joint build-outs and shared use of fiber optic cables on the electric transmission lines of Southern Company's operating subsidiaries. These included aerial fiber installed in the transmission lines as OPGW and fiber buried in the transmission rights of way. Southern Telecom's counterparties included AT&T, BellSouth, Level 3 and other regional and national telecom operators. Through this process, Southern Company and its operating subsidiaries were able to develop an internal backbone telecom network connecting all its major facilities in four states with a zero capital budget. In addition, through Southern Telecom, the Southern Company group has been able to generate significant upfront and recurring revenues from commercial exploitation of its excess dark fiber and excess capacity in lit fiber.

774. Today, following the dark fiber model discussed in Module 3, Southern Telecom offers wholesale dark fiber and co-location space to telecommunications operators throughout the Southern Company service territory as well as in the service territory of other electric utilities in southern Florida. Its fiber network has over 1,300 route miles of backbone between the larger

metropolitan areas in Alabama, Florida and Georgia, plus numerous spurs from the backbone to smaller cities.³⁵⁹

775. Like all electric utilities, the operating subsidiaries of Southern Company required a robust wireless network with coverage in all areas where the electric utilities had facilities. Until recently, Southern Company had used wireless mobile radios with wide area coverage and its facilities required upgrading or replacement to meet the growing needs of its line crews. The company studied its options and determined that it could not rely on existing and then-planned network coverage from one of the commercial mobile radio service providers. Instead, Southern decided to build its own cellular network with redundant and robust systems. The original technology deployed was Motorola iDEN, and included handset features such as push-to-talk and group call as well as integration with the PSTN. It procured the new network through a separate wholly owned subsidiary, Southern Communications Services, Inc., which applied for and received a wireless license from the FCC.

776. After completing its wireless network, Southern Company decided to have Southern Communications, trading under the name SouthernLINC[®] Wireless, commercialize excess capacity on the wireless network as a retail wireless network operator. SouthernLINC[®] launched service as a public telecommunications network operator in February 1996. The target customers have similar needs as utility line crews, the need to communicate while mobile, often in remote locations where coverage on other commercial wireless networks is poor, the need for extremely reliable service, and group coordination and speed features such as push to talk and group call. The customer base includes emergency fire and ambulance services operated by municipal governments and private operators, mobile businesses and trades, and others.

777. During the ensuing years, SouthernLINC[®] has continued to modernize its network to include state-of-the-art technology. In an unprecedented move by an electric utility, however, the company in mid-2015 announced plans to upgrade its network to 4G/LTE over its entire coverage area in three stages, with completion expected by mid-2018.³⁶⁰ As was the original construction of the network, the upgrade is being driven by core electric utility business needs. According to Southern Company, its operating subsidiaries have thousands of devices in use across the existing iDEN network, utilizing either wireless voice or data communications. As a result, data needs continue to grow, specifically in the areas of network monitoring and control. In addition, because most homes and businesses throughout Southern's service territory have smart meters, an encrypted LTE network can provide security when accessing data. Similarly, because a significant portion of Southern's power distribution is managed digitally, other important benefits of constructing an LTE wireless network are the capability to guarantee a data priority level for utility data and the ability to keep that data secure.

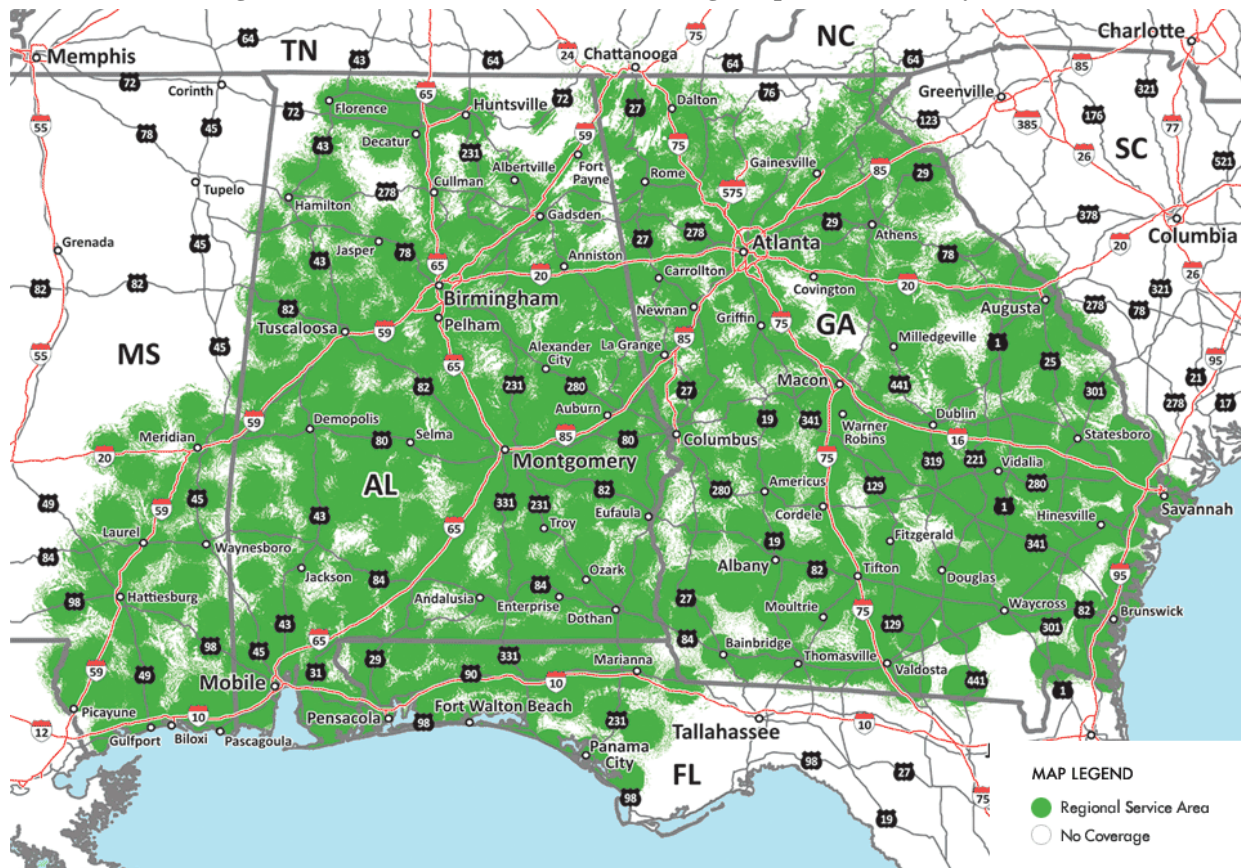
778. At the same time, the network upgrade will continue the attractiveness of SouthernLINC[®]'s commercial services offered to the public. The new 4G/LTE Advanced network will increase company's already strong history of reliability. Businesses and local government in Southern's service area will have the opportunity to transmit vital data across our new high-speed, highly reliable and encrypted LTE network. The new 4G/LTE Advanced network will offer end-to-end

³⁵⁹ <http://www.southern-telecom.com/about-us/home.cshtml> (last visited 11 Feb 2017).

³⁶⁰ See <http://www.prnewswire.com/news-releases/southernlinc-wireless-to-offer-mission-critical-4g-lte-advanced-data-services-to-birmingham-atlanta-and-tuscaloosa-businesses-in-2016-300124895.html> (last visited 11 Feb 2017).

network encryption over the air and from SouthernLINC®’s towers to the network’s core data centers, a level of security which Southern says is not currently provided by its competitors. In addition, the company is beefing up emergency backup power capabilities with hydrogen fuel cell technology at key locations and is adding main power and core data center redundancy to increase the reliability of the new network. Southern is positioning its network as a strong option for companies and local governments looking for ways to transmit data as securely as possible. As of January 2016, SouthernLINC® had extremely good coverage in its service territory and, when the new 4G/LTE network is complete, will offer the same level of wireless broadband coverage.

Figure 55: SouthernLINC® Wireless coverage map (circa February 2017)



Source: SouthernLINC®³⁶¹

Broadband over power lines was tried and failed

779. In the early 2000s, numerous electric utilities in the United States carried out broadband over power line (BPL) technology trials and some implemented small-scale commercial networks. To succeed commercially, this new technology required a concerted effort of stakeholders from the electric utility and telecom sectors, as well as from the nascent equipment vendor industry. Several electric utilities surveyed existing industry associations and coalitions and concluded that none was inclined or suitably organized to lead this effort. They therefore began an informal discussion group with representatives of five major US electric utilities and representatives of telecom operators, equipment vendors and other stakeholders. These discussions led to the formation of

³⁶¹ SouthernLINC® website, <https://www.southernlinc.com/coverage.aspx> (last visited 13 Feb 2017).

the Power Line Communications Association, which later changed its name to the Broadband over Power Line Industry Association (BPLIA). The BPLIA's mission was to promote a dialogue leading to mutually acceptable terms of engagement between electric utilities and telecom network operators, as well as to serve as a focal point for the nascent industry in advocating for a favorable regulatory environment, developing standards, and serving as a knowledge resource for stakeholders.

780. BPL was introduced to provide competition with DSL and cable modem service as a last-mile access network solution to support delivery of broadband Internet to residences and small businesses. BPL used existing shielded and unshielded electric power distribution lines as wave guides for high frequency radio transmission which could be used to carry packet-switched data using Internet protocol. The core technology was similar to both DSL and cable modem in using an electrical conductor as a wave guide. Due to the configuration of electricity distribution networks, BPL was more like cable modem in that it was a broadcast using signal routers to extract data rather than routing directly to the customer premises. The advantages of BPL over DSL and cable modem was the ubiquity of power distribution lines, connecting to virtually every premises in the United States, and the ability to use the premises electrical wiring to deliver Internet access at every electrical outlet in a connected building. The disadvantages of the technology were the high noise levels in electrical wiring (compared to telephone and cable), which caused interference and required expensive technology fixes. Because aerial power distribution lines are unshielded and uninsulated, there was also considerable concern about the possibility of leakage of BPL signals causing interference with radio communications. Amateur radio operators were particularly vocal in opposition to BPL.

781. From its inception in 2002 until the board decided to wind it up in 2007 because the new technology had been overtaken by other technology developments and changes in market conditions, the BPLIA provided vital leadership for the BPL industry in the United States. Among other things, the BPLIA undertook regulatory advocacy efforts which were quite successful. In October 2004, the FCC proposed rules to facilitate the deployment of BPL, and allowed experimental deployments pending adoption of its final rules. Notwithstanding vocal objections from amateur radio operators during the rulemaking proceedings, the FCC viewed the introduction of BPL as vital to attracting investment in competing broadband technologies and networks. The FCC's proposed rules did require BPL providers to investigate and correct any interference they cause. In August 2006, the FCC adopted a final memorandum and order bringing its BPL rules into effect. When the final rules were announced, FCC Commissioner Kevin Martin said BPL "holds great promise as a ubiquitous broadband solution that would offer a viable alternative to cable, digital subscriber line, fiber, and wireless broadband solutions."

782. Unfortunately, success of BPL required more than regulatory certainty and approval. It required sufficient commercial opportunity for the new technology to be viable against competing access technologies. In particular, as a nascent technology, it required sufficient scale of orders for the small number of equipment manufacturers who were producing early generation equipment to bring down their unit costs and to receive a sufficient return on investment to continue their research and development efforts. For a time in the early 2000s, BPL looked as if it was poised to obtain the necessary critical mass of take-up. However, despite its initial promise, BPL did not achieve sufficient commercial traction as a technology before its potential was overtaken by FTTP and 4G broadband. While DSL and cable modem continue to be viable, albeit gradually being replaced, the time window for BPL passed. By 2008, only two years after the FCC issued its final

rule, most of the serious vendors and would-be operators were closing down or turning to other technologies. BPL survived only as a form of in-building communications where networks use electrical wiring for broadband. Multiple vendors still provide equipment for this purpose and the standards have been developed and maintained under the Home Plug Alliance.³⁶²

783. During the period while BPL had promise, multiple electric utilities in the United States conducted trials and pilots of the technology with equipment vendors and telecom operators. Several electric utilities also moved ahead with full-scale commercial deployments, based on several variations of the alternative business models discussed in Module 2.

784. In 2004, Cinergy, an investor-owned electric utility which operated a distribution business in Kentucky, Indiana and Ohio, entered into two ventures with Current Communications Group, a supplier of BPL equipment and BPL network operator. Under one venture, Cinergy and Current were to install and operate a BPL network over Cinergy's electric distribution facilities. Under the other venture, Cinergy and Current would jointly install and operate a BPL network over the electric distribution facilities of the smaller municipal utilities and electric membership cooperatives in the same three states in which Cinergy had operations. The ventures would initially offer high-speed Internet access, and later add a VOIP offering. Cinergy also expected to use capacity on the BPL network for core business applications, such as network monitoring or internal communications. Cinergy and Current began deploying BPL network equipment on Cinergy's distribution facilities and offering commercial BPL services in a limited geographic area. However, competitive pressure and shrinking potential for BPL kept the coverage area from being expanded. No BPL facilities were ever installed on municipal and cooperative electric distribution facilities. Current exited the business in 2008.

785. In 2002, Indianapolis Power & Light Company (IP&L) signed what was perhaps the only hybrid hosting/dark wire model agreement for BPL with Franklin Park Communications, a start-up broadband operator. Under the arrangement, which was exclusive, Franklin Park would be permitted to install BPL equipment on IP&L's electric distribution facilities, interconnect the network with other networks, and transmit and receive communications over IP&L's electric distribution lines. In consideration of the access to and use of IP&L's facilities, Franklin Park would pay IP&L a revenue share and reimburse all incremental costs incurred by IP&L in supporting the installation and operation of the BPL network. The agreement had a 20-year term, subject to early termination by IP&L if Franklin Park did not commence operations within 12 months after signing. Franklin Park was in fact unable to secure funding and IP&L terminated the agreement on its first anniversary after signing.

786. Perhaps the most innovative and ambitious deployment of BPL was undertaken in Manassas, Virginia. In the early 2000s, the Electric Department of the City of Manassas, which operated a municipal electric distribution system in the City limits, entered into an arrangement with COMTek to deploy a BPL network to every home and business in the City. In 2008, the City took over the network's operations, purchasing it for US\$ 150,000 from COMTek, which was exiting the BPL business due to low returns. The City continued to operate the network for a few more years. However, in April 2011, facing high fixed operating costs, heavy competition from fiber, DSL and cable modem, and low penetration levels, the City of Manassas announced that it was

³⁶² See <http://www.homeplug.org/> (last visited on 11 Feb 2017).

exiting the business.³⁶³ At the time, the City was spending US\$ 170,000 annually to keep the network running and had revenues of only US\$ 156,000 annually from 520 subscribers at US\$ 25 per month. The City was expecting revenues to continue to decline in view of Verizon's plans to complete FTTP for the entire City by the end of 2011.

9.3.4 Lessons learned

787. The United States offers multiple examples and insights into voluntary cross-sector infrastructure sharing driven by the commercial needs of telecommunications operators and host infrastructure owners. The United States also offers insights into government intervention in the form of financial and other incentives, mandated sharing and regulation of sharing. Some of the country's major telecommunications network operators have their roots in early cross-sector infrastructure sharing, while virtually every owner of infrastructure, whether voluntarily or involuntarily, has participated in the vast expansion of intercity and access networks over the past century and a half.

³⁶³ See "Manassas to end broadband-over-power line internet service," *Washington Post* (April 8, 2010). Available at <http://www.washingtonpost.com/wp-dyn/content/article/2010/04/06/AR2010040603796.html> (last visited 11 Feb 2017).

10 Glossary

ADSS means all-dielectric self-supporting fiber optic cable, a type of fiber optic cable that is frequently suspended beneath electric distribution infrastructure. ADSS has lighter weight, is non-metallic and has lower installation costs than [OPGW](#). ADSS can be attached to existing or new poles.

BTS means base transceiver station, site from which radio signals are transmitted forming a part of a telecommunications network that facilitates wireless communication between devices and a network.

BTS hoteling is a method by which a single [BTS](#) is connected by fiber to a distributed antenna system comprising multiple small, easily installed antennas distributed across a geographic area, resulting in increased coverage and signal density.

Carrier neutral dark fiber means dark fiber offered on an open access for use by telecommunications operators.

Duct bank means a group of conduits or ducts designed to hold and consolidate buried cables.

DWDM wavelength means dense wavelength division multiplexing, a technology that allows separate light wavelengths to carry data on the same optical fiber.

Eminent domain means the compulsory acquisition of an easement or other rights of use of private land through legal process under a statutory procedure in which the landowner is entitled to payment of just compensation for the taking of his property.

Essential facilities means infrastructure or facilities without access to which competitors cannot provide services to customers and for which access should be regulated.

GIS means geographic information system, a system used to collect, store, present and analyze information on geographical information, such as the location of infrastructure.

ISP means Internet service provider.

Internet leased line services are a type of [transmission capacity services](#) whereby customers lease the use of dedicated connection to the Internet over fiber or other transmission technology.

Leased line services are a type of [transmission capacity services](#) whereby customers lease the use of a private connection between two points, typically for a monthly fee.

Make ready costs means the actual incremental costs of making poles ready to accept their attachments.

OPAC means optical attached cable, a type of fiber optic cable that is attached (wrapped or suspended) to a host conductor on overhead electric transmission and distribution lines, generally on phase conductors.

OPGW means optical ground wire, a type of fiber optic cable that is contained within the ground wire on electric transmission and distribution infrastructure. It is used more predominantly on higher voltage lines.

SCADA means a supervisory control and data acquisition system used to provide control of remote equipment.

Traffic offloading (also referred to as mobile data offloading or Wi-Fi offloading) means the use of alternative technologies, such as Wi-Fi, by mobile operators to carry data traffic that would otherwise be carried on a congested mobile network.

Transmission capacity services is used in this toolkit as a general term for services requiring a service provider to install electronic equipment on and operate a fiber (or other technology) network to offer customers capacity on the network. Transmission capacity services can be contrasted with dark fiber services, in which the service provider is not required to install electronic equipment or operate a network but rather offers customers the use of dark fiber and other passive infrastructure.

Virtual private network services means services that use encryption and other technologies over a shared or public network to provide users with the functionality and security of a closed, private network operating on dedicated lines.

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