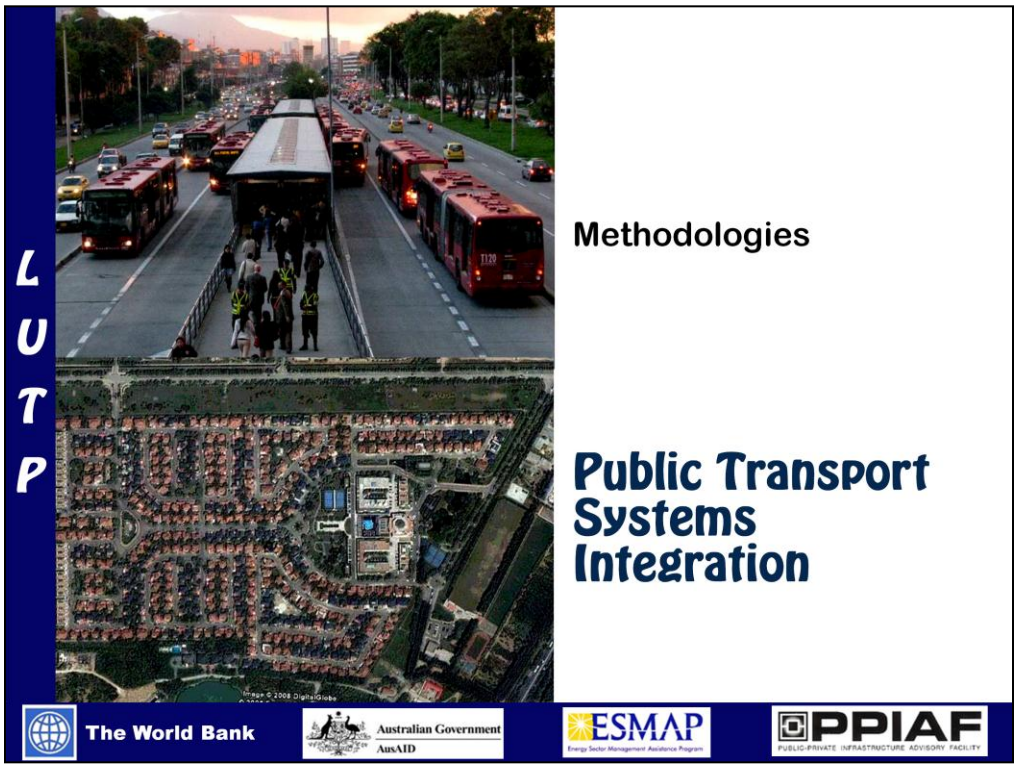

Cluster 2/Module 3 (C2/M3): Public Transport Systems Integration.

This presentation is one of the support materials prepared for the capacity building program ***Building Leaders in Urban Transport Planning (LUTP).***

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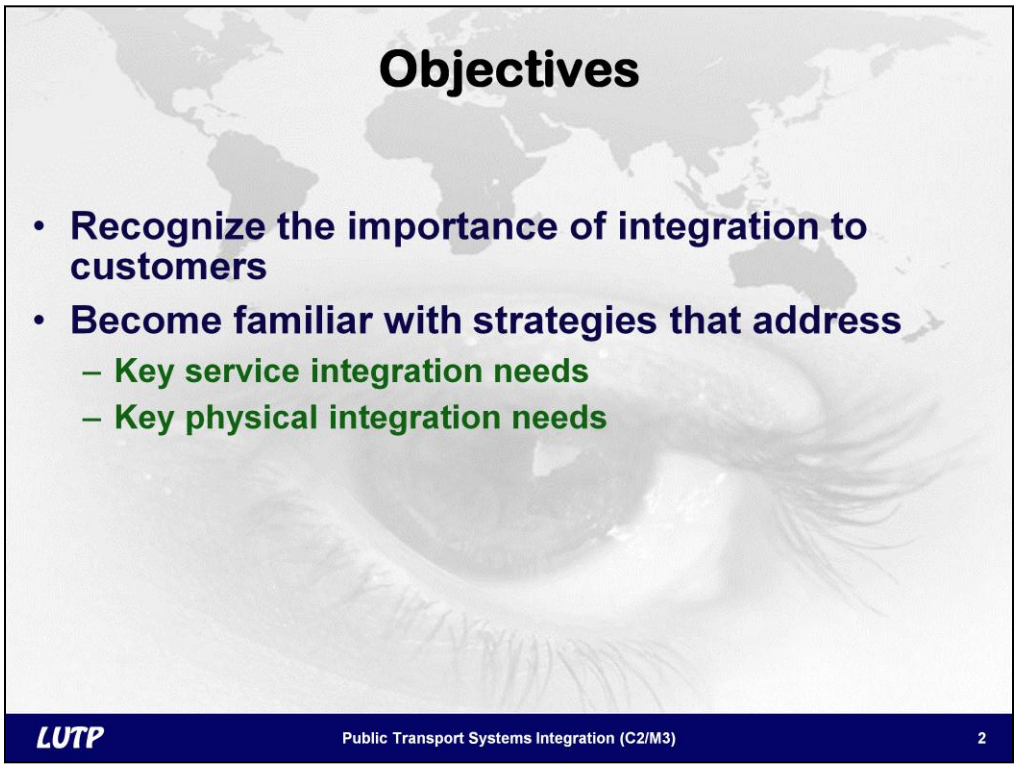
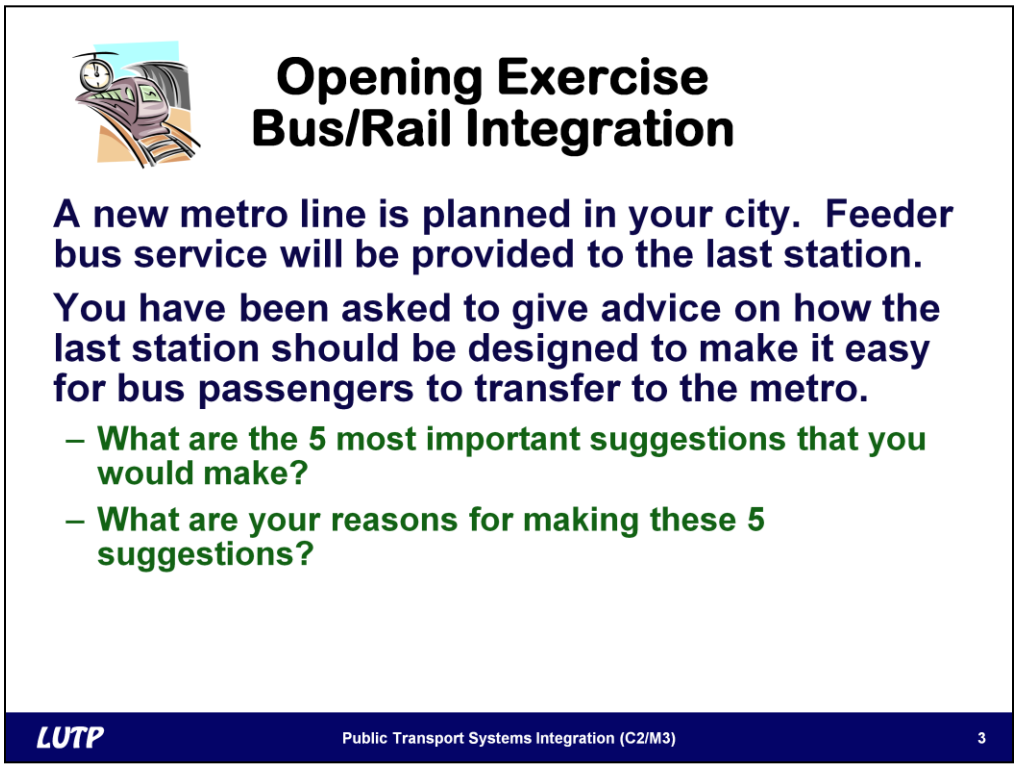


This presentation discusses the key aspects of public transport systems integration. Integration efforts are focused on making it easy for customers to use the network of services offered in a city. Integration is particularly important to customers who must use two or more routes when they make a trip.

This presentation covers the following topics:

- The importance of integration
- Strategies for addressing key service and physical integration needs



A new metro line is planned in your city. Feeder bus service will be provided to the last station.

You have been asked to give advice on how the last station should be designed to make it easy for bus passengers to transfer to the metro.

- What are the 5 most important suggestions that you would make?
- What are your reasons for making these 5 suggestions?

Please spend no more than 5 minutes on this exercise

Why is Integration Important?

- Passengers travel from actual trip origin to actual trip destination (O/D), door-to-door)
  - All trips involve changes from/to walking
  - A one-seat ride is not always possible
- Major issue in customer satisfaction

Why is integration important?

Because all passengers come in contact with integration issues every day.

Why?

Because public transport passengers travel from actual trip origin to actual destination and not from transport stop to stop. Thus, all passengers encounter how well the transport system is physically integrated with the surrounding community.

Also, a one-seat ride is not always possible and passengers may travel on several services to complete their trips. Most passengers, therefore, daily encounter how well the transport services are coordinated.

Experience has shown that integration is a major issue in customer satisfaction.

Common Customer Integration Concerns

- Walking
- Waiting
- Transferring
- Safety and security
  - especially for women
- Uncertainty

There are some integration issues that are common to most transport systems. People want to minimize the time that they spend walking, waiting, and transferring (getting off one route and changing to a second route). They also have difficulty reading schedules and figuring out how to transfer.

Safety and security also are issues when passengers are walking, waiting, and transferring. This is a particular concern for many women when they are traveling at night or in areas with few people.

Finally, uncertainty is a major concern. Many passengers have increased anxiety when they use two transport routes and must change or transfer between the routes. They are worried if they do not know everything that is needed to make the transfer.

Elasticities: Walking Time Relative to In-Vehicle Time*

Mode	Work	Leisure	Other
Car	1.37	1.74	1.55
Bus	1.67	1.66	2.02
Rail, Metro	1.99	1.97	1.37

Conclusion: Customers feel walking time more burdensome than in-vehicle time

*Source: The Demand for Public Transit, A Practical Guide, TRL, UK, 2004

Many studies confirm these observations. For example, surveys have been conducted to determine how travelers value walking time. This research shows that travelers feel that the time they spend walking to or from a bus or metro train is more burdensome (or irritating) than the time that they spend riding on the bus or metro train.

For example, people traveling to work by metro feel that every minute they spend walking is same as spending two minutes riding the metro train. This means that, if we can save users one minute of walking time, in their minds it is the same as saving two minutes that they spend riding the metro trains.

Total travel time (which includes walking time) is a major factor that people consider when deciding whether to use public transport. The research on walking times strongly suggests that efforts aimed at reducing walking times can encourage more people to use public transport.

Elasticities: Waiting Time Relative to In-Vehicle Time*

Mode	All Purposes
Car	2.1
Bus	1.6
Metro	1.2

Conclusion: Customers feel waiting time more burdensome than in-vehicle time

*Source: The Demand for Public Transit, A Practical Guide, TRL, UK, 2004

There are similar results in the studies of waiting times. The research shows that travelers feel that the time that they spend waiting for a bus or metro train is more burdensome (or irritating) than the time that they spend riding on the bus or metro train. For example, people traveling by bus feel that every minute that they spend waiting for a bus is the same as spending 1.6 minutes riding on the bus .

Waiting time is a component of travel time which is a major factor that people consider when deciding whether to use public transport. The research on waiting times strongly suggests that efforts aimed at reducing waiting times can encourage more people to use public transport.

In many situations, the walking and waiting environment probably is factor. This a bus stop is China along a main arterial road. There is no protection from the weather. The stop is located some distance from any employment or commercial activity. There are no sidewalks and people must walk in the roadway.

Is this a good walking and waiting environment?

Slide 9

Effect of a Transfer In Terms of In-Vehicle Time*

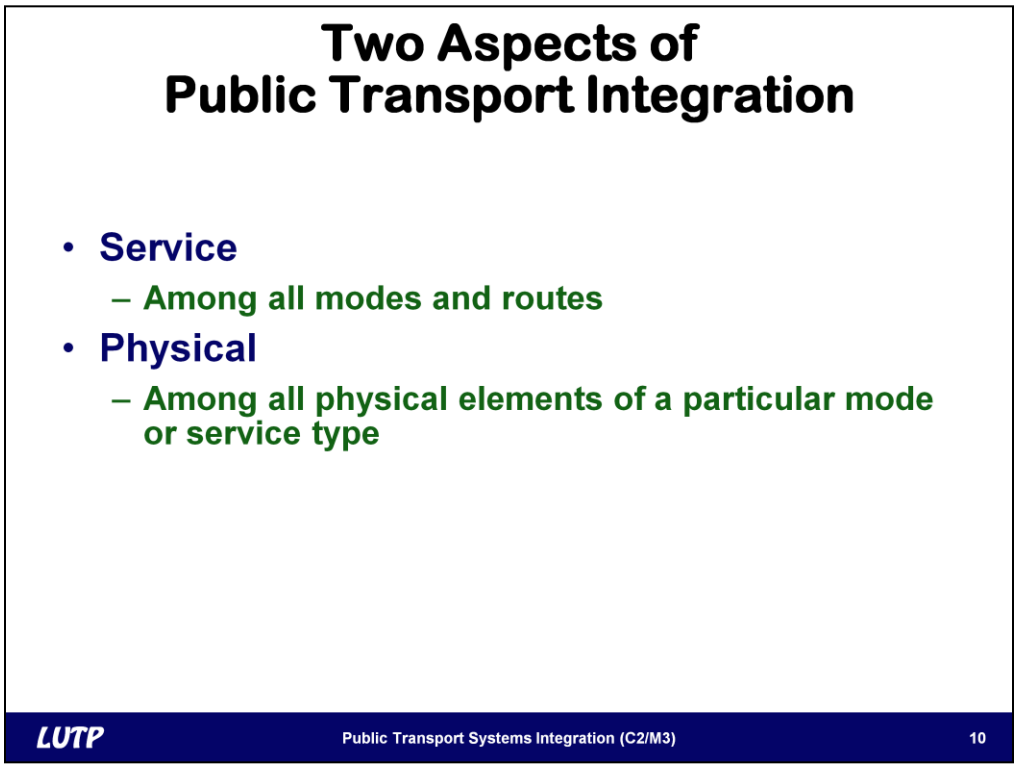
Mode	In-Vehicle Time Equivalent
Bus	20 Minutes
Suburban Rail	17 Minutes

Changing Lines, Shanghai Metro

*Source: The Demand for Public Transit, A Practical Guide, TRL, UK, 2004

We just talked about how passengers view the time spent waiting for a bus or metro. However, just the requirement to transfer between two routes is viewed by many travelers as onerous. This study found that travelers feel that having to make a transfer is the same as adding 17 to 20 minutes to their journey times.

This added penalty certainly is high. It may reflect past experience with wide intervals that sometimes are common, for example, on suburban rail services.



Let us now look at strategies to improve integration. One way to look at these strategies is to group them into two categories.

Service integration strategies apply to all modes and routes with a transport network. They address how the service schedules, route alignments, and fare structures are designed.

Physical integration strategies focus on the physical elements of a mode or type of service. They address how the stations, vehicles, running ways, and fare collection systems are designed.

Public transport planning must address both types of strategies to maximize the attractiveness of public transport service and, ultimately, ridership. Let us now look at some common approaches used by public transport systems.

Service Integration Objective

- **Coordinate multiple routes and modes to make service more customer friendly**
  - **Reduce total travel time**
  - **Increase passenger convenience**

Let us first look at service integration. The objective of service integration is to make the service more customer friendly by carefully coordinating multiple routes and modes. When this is done, it reduces total travel time and increases passenger convenience.

Service Integration Concerns

- **Network Structure**
  - **Route alignments**
  - **Stop locations**
    - **Interchanges**
    - **Terminals**
- **Levels of service, schedules**
- **Fare structures**
- **Passenger information**

There are several service integration areas that should be examined when efforts are made to improve service integration.

Network structure is an obvious concern. The route alignment should be designed to provide direct service to key destinations and thereby minimize travel time. The stops should be located to minimize walking times to and from residences, employment sites, and commercial activities. Terminals and interchange stations should be located to minimize indirect routing for travelers that must transfer between routes.

Good and detailed data are needed to design and update an effective service network. Ideally, detailed origin and destination should be used so that the routes are design to serve specific travel markets.

The other key integration parameters are the levels of service and schedules, fare structures, and passenger information which we will discuss next.

Schedule Integration

- **Consistent spans of service**
  - **Same hours for identical services**
  - **May differ by**
    - **Service type, e.g., commuter express versus local bus, commuter rail and metro**
    - **Locations served, e.g., urban core versus suburb**
- **Coordinate schedules so that waiting times at transfer points are minimized**

Schedule integration focuses on developing consistent and coordinated schedules. Quite often, different types of services are operated such as local buses, commuter expresses, metros and commuter rail. Within each service type, consistent minimum spans of service should be operated. For example, all local routes in the city would be operated at least from 5 am to 10 pm. This consistency helps passengers plan their trips since they know what to expect for each service type.

Schedules also should be coordinated so that waiting times are minimized at transfer points. Again, this is most effectively done when good origin-destination data are used.

For low frequency routes, “timed transfer” points might be designed where the services arrive and depart at same time.

Fare Integration

- **Minimize number of distinct payments/trip**
- **Importance**
  - **Passenger perspective**
    - Minimize waiting times and inconvenience
    - Reduces psychological impact of fare payment
  - **Operations perspective**
    - Minimize dwell times
      - Reduces vehicles and facility requirements
    - Minimize revenue shrinkage

While schedule coordination makes transfers more convenient so does fare integration. The objective should minimize the number of distinct payments per trip — ideally only one payment. Fare integration is important from both the passenger and operations perspective.

From the passenger perspective, fare integration minimizes waiting times and the inconvenience of making several payments. Users are sensitive to number of fare payments. Psychologically, fare integration reduces the negative impact of paying fares even if the same total fare is paid.

Operationally, fare integration can reduce dwell times at stops and stations and reduce vehicle and station requirements. In terms of revenue control, fare integration can minimize revenue shrinkage.

Integrated Passenger Information

- **Guiding principle**
  - **Travel is from origin to destination, not just stop-to-stop**
- **Provide information on**
  - **Service**
    - **Routing, stops**
    - **Schedules**
    - **Fares and fare payment**
  - **Walking access/egress**
    - **Origin to first transport service**
    - **Last transport stop to destination**
    - **Way-finding within terminals and interchanges**

Passenger information also is important component of service integration. People need travel information for their trips from their origins to their destinations. It also helps reduce uncertainty for people making new trips.

Public transport systems typically focus on providing service information to the public. This information covers routing and stops, schedules, and fares and fare payment. This is very important. Great strides have been made and now many systems provided automated information.

However, it also is important to provide information on the walking portions of a trip. This includes from the trip origin to first transport service and from the last transport stop to destination. It also includes way-finding within terminals and interchanges.

Large cities with multiple modes and tiers of services (e.g., Metro, commuter rail, BRT, bus) need to have a coherent passenger information strategy. Branding different types of services can be a useful approach in complex systems.

Passenger Information

Cover all services and providers using a variety of techniques that serve users at various locations

Brendan Finn

Modes
Local Bus, Urban Suburban Rail
↓
Media
Printed, Graphic, Internet, Telephone, Smart Phone
↓
Locations
At Home, At Work, At On Board, In/Near Stations and Terminals

Integrated passenger information covers all services and providers. It recognizes that the public uses a variety of media and no one approach meets everyone's needs.

Travelers need access to information at different locations when they are making their trip making decisions. Sometimes, travelers are making these decisions as they are taking their trips. Therefore, an integrated passenger information system will be able to provide travelers information at a variety of locations including at home, on board transport vehicles, and in or near stations and terminals.

Physical Integration

- Key physical elements
  - Stops/stations/terminals
  - Vehicles/trains
  - Running ways
  - Fare collection
- Key concepts
  - Service plan, expected demand should drive design
  - Make all elements consistent
  - Make physical elements “customer friendly” and coordinated

The second group of strategies address how the physical elements are designed.

Several key concepts should be considered. First, the service plan and expected passenger demand should drive design. This insures that the physical elements are “right-sized” and address key service needs such as efficient passenger loading and convenient transfers.

Second, all elements should have a consistent look and be readily identified by its design features. For example, a customer should quickly tell that the small blue buses are feeder buses.

The consistent look extends to customer use. For example, a customer should be able to go into any station and understand how to navigate through the system.

Finally, the design criteria should be “customer friendly” and coordinated. For example, the design criteria for the passenger loading zones and buses should be coordinated with the objectives of efficient passenger loading and entry to and exit from the loading zones.

Now let us look at some guidelines for physical integration.

Passenger Interchanges

- Locate to minimize indirection of travel/ back-tracking
- Minimize walking distances/ level changes between services
- Provide safe (e.g. off-street), secure (e.g. lighting) and weather-protected facilities

Passenger interchanges are locations where passengers change from one transport service to another. They should be located to minimize indirect travel from origin to destination including backtracking. Good origin/destination data are needed for this effort.

Interchange stations should be designed to minimize walking effort. The picture shows how a platform was designed in Bogota to provide convenient transferring between local and BRT buses.

The Bogota design does not require passengers to go up or down stairs when they transfer between buses. When the Bogota approach cannot be done and level changes are required, escalators and gradual ramps are important design tools.

Finally, interchange stations should be safe and secure and offer weather protection.

The two pictures show the Washington Pentagon interchange station. The buses arrive at ground level and passengers transfer to the underground metro. The bus and metro loading zones are located almost on top of each other to provide convenient transferring.

Most passengers use the escalators to make their transfers. However, as shown in the circle in Figure 1, elevator service is provided for people who cannot use the escalators.

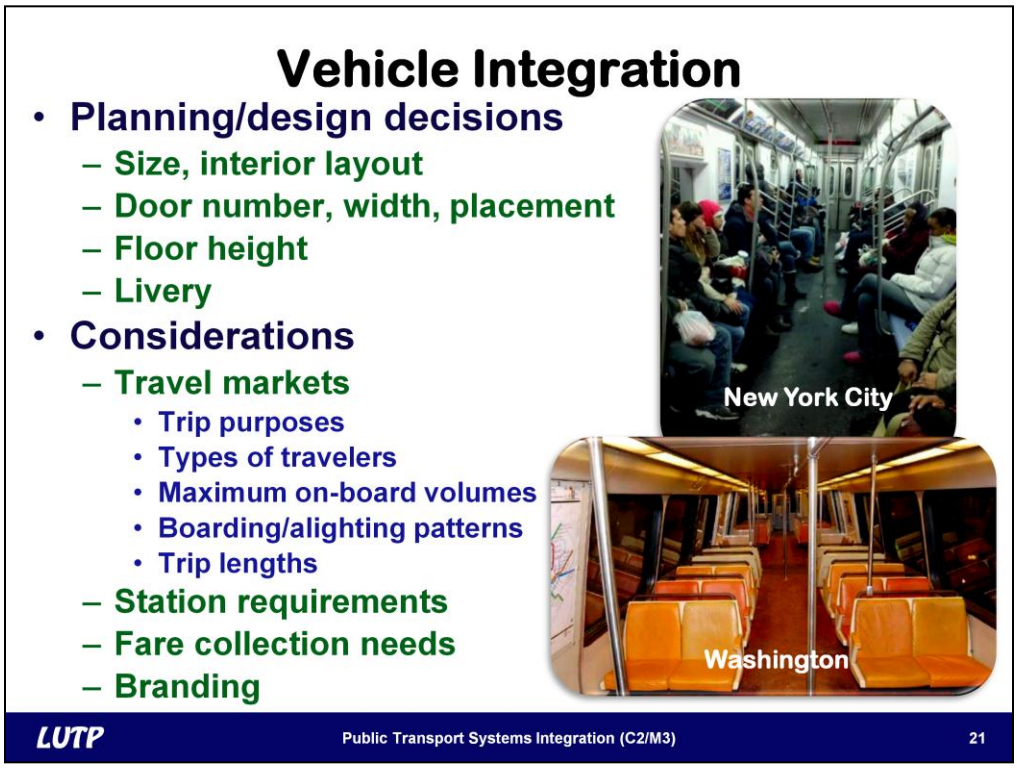
Interchange Integration

Design decisions based on market, service plan

- Number of vehicle stopping positions
- Vehicle layover space, driver comfort facilities
- Platform length, width, height
- Shelter sizes
- Walkway sizes and routing
- Fares and fare collection
- Passenger information about public transport services, way-finding

The travel markets to be served and the resulting service plan should drive decisions about interchange stations. Key design decisions include:

- Number of vehicle stopping positions for passenger loading and unloading.
- Layover space for vehicles including the provision of driver comfort facilities — often poorly-treated in many designs.
- Adequate platform lengths, widths, and heights to accommodate expected queuing and crowding
- Weather-protection for open-air areas.
- Sizes of walkways and their routing to minimize the distances walked by passengers
- Efficient fare collection for entering and leaving passengers.
- Passenger information about public transport services and way-finding through the stations.

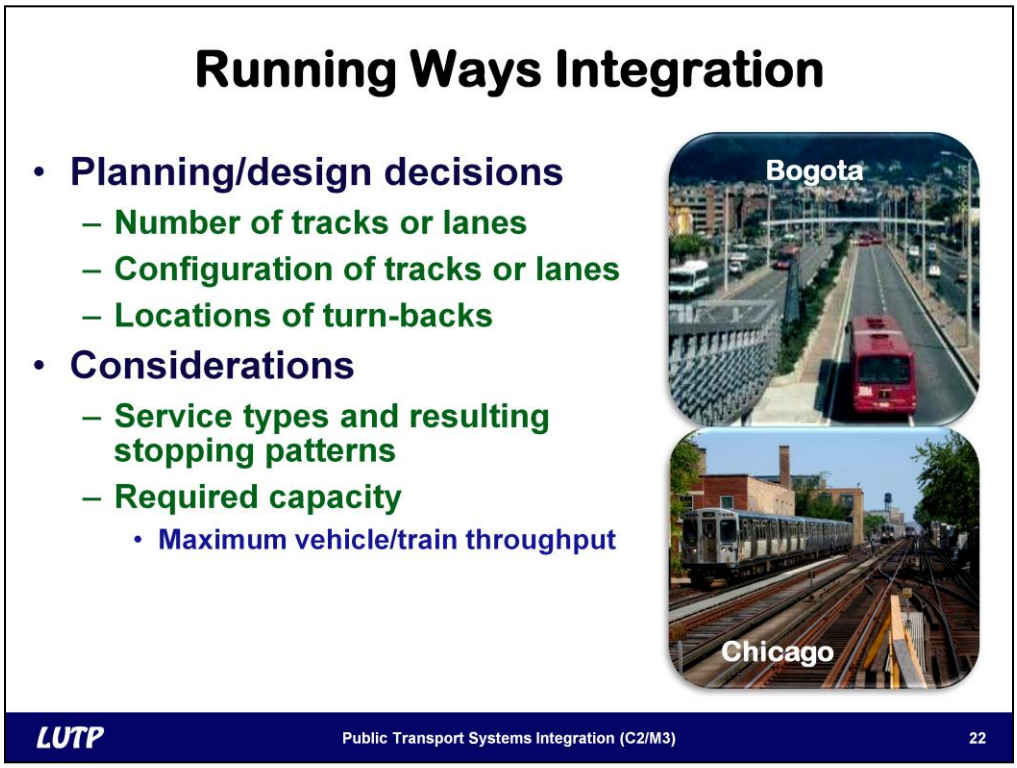


Vehicles are another key integration area. The key design decisions include:

- Size and interior layout. The two pictures show contrasting layouts. The New York design provides more standing room while the Washington design provides more comfortable seating
- Door number, width, and placement. More doors mean faster passenger loading. Less doors offer more passenger seating.
- Floor height. Low-floor buses provide faster, more convenient loading. High-floor buses offer more passenger capacity
- Livery. Different exterior designs help passenger identify different types of services. More liveries mean less flexibility in moving vehicles among routes.

There are many considerations. The travel markets being served are important. Key market information includes trip purposes, types of travelers, maximum on-board volumes, boarding/alighting patterns, and trip lengths. Like interchanges, vehicle decisions should be driven by the travel markets to be served and the resulting service plan.

Other considerations include how the vehicles will be integrated with interchange stations, fare collection, and branding approaches.



Running ways are needed for rail, metro, and BRT services. The key design considerations are:

- The number and configuration of tracks or lanes
- The locations of turn-backs. Turn-backs allow a train (or bus) to reverse direction in the middle of routes. Since not all trips have to be operated from one terminal to the other terminal, service can be scheduled to match demand along the route.

There are two main considerations. The types of service offered (local, limited, express) affects how vehicles are scheduled to meet passenger demand. The resulting stopping patterns then dictate the need for passing tracks or lanes at specific stations. The scheduling also will result in the determination of the capacity needed.

Like interchanges and vehicles, the service plan provides critical information for these considerations.

Fare Collection

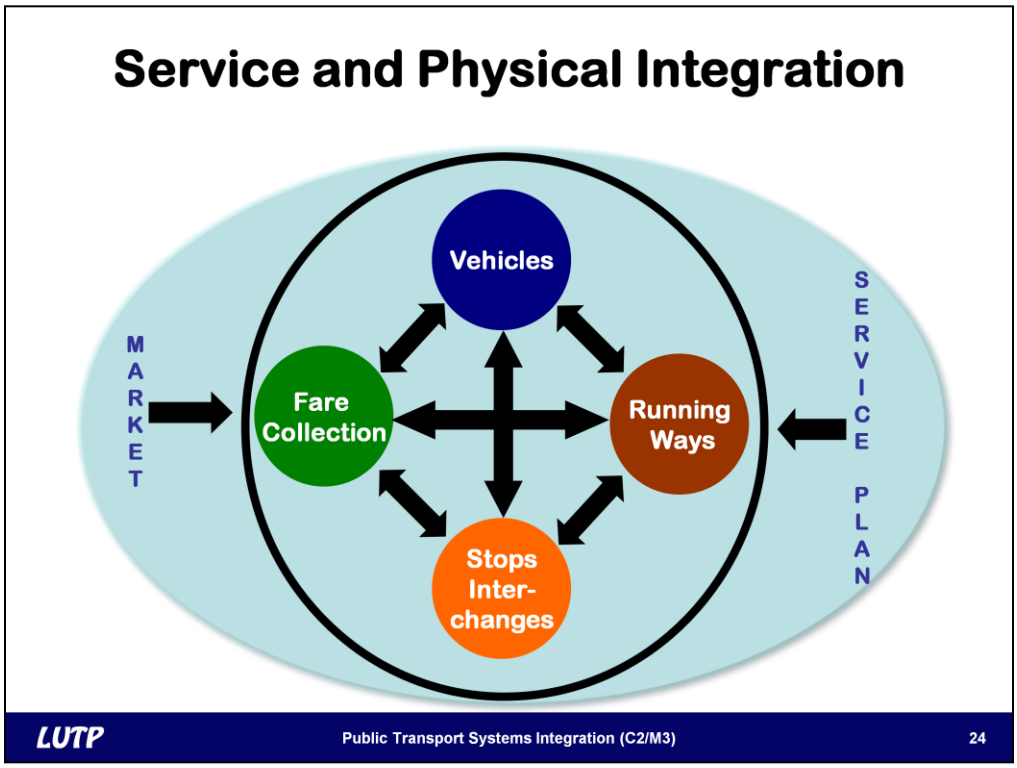
- **Planning/ Design Decisions**
  - On-board versus off-board
  - Types of fare media (cash/tickets/IC card)
  - Media sales locations
- **Considerations**
  - Passenger demand
  - Number of services at stations
  - Fare structure

Fare collection is the last integration area. The key design decisions concern:

- On-board versus off-board. Off-board collection speeds operations. On-board collection eliminates the need for investment in fare gates and/or station attendants
- Types of fare media (cash/tickets/integrated circuit (IC) card). Electronic payment provides customer convenience and improved revenue security. However, investment is needed in card readers, fare gates, and ticket machines.
- Media sales locations. Sales can be made on-board, off-board in stations, and through third-party outlets (e.g., commercial stores). More sales locations improve passenger convenience, but increase management oversight.

The key design considerations include:

- Passenger demand. How many daily transactions are made? How many customers are frequent users?
- Number of services provided at stations. Is there adequate space for ticket machines and fare gates?
- Fare structure. How many fare types? How are transfers priced?



Our discussion of the service and physical integration leads one conclusion: Integration requires coordinated planning and design of all elements in the context of the market and service plan.

Summary

- Service and physical integration is important for improving customer (passenger) satisfaction
- Market and service plan considerations should drive planning and design process
- Planning and design of all system elements are interrelated

This module provided an overview of public transport integration and addressed service and physical integration issues. Integration is important for improving customer (passenger) satisfaction by reducing passenger travel times and increasing passenger convenience.

In discussing each service and physical element, it is clear that market and service plan considerations should drive the planning and design process.

At the same time, the planning and design of all system elements are not independent, but interrelated.