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Lecture 9: Urban public transportation

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Outline

- Classification of Transit Systems,
- Bus Transit System,
- Rail Transit Systems,
- Role of rail transit in sustainable development
- Rapid Transit or Metro,
- Fare structure and payment, route cycle time, terminal points, layover times
- Automated Guided Transit Systems,
- Regional and Commuter Rail,
- Special Technology Transit Systems,
- Transit Planning and Selection of Transit Modes,
- Present and Future Role of urban transport

ROW of transit modes

transit. This chapter covers public transportation systems. Transit modes are defined by their right-of-way (ROW) category, technology and types of operations. **Three ROW categories** are:

- **C - urban streets with mixed traffic**: Street transit modes include mostly buses, but also trolleybuses and tramways/streetcars.
- **B - partially separated tracks/lanes**, usually in street medians. Semirapid Transit, using mostly ROW B, requires higher investment and has a higher performance than street transit. It includes Light Rail Transit - LRT, as well as semirapid bus.
- **A - paths used exclusively by transit vehicles** comprise rapid transit mode or metro system. Its electric rail vehicles are operated in trains and provide the highest performance mode of urban transportation.

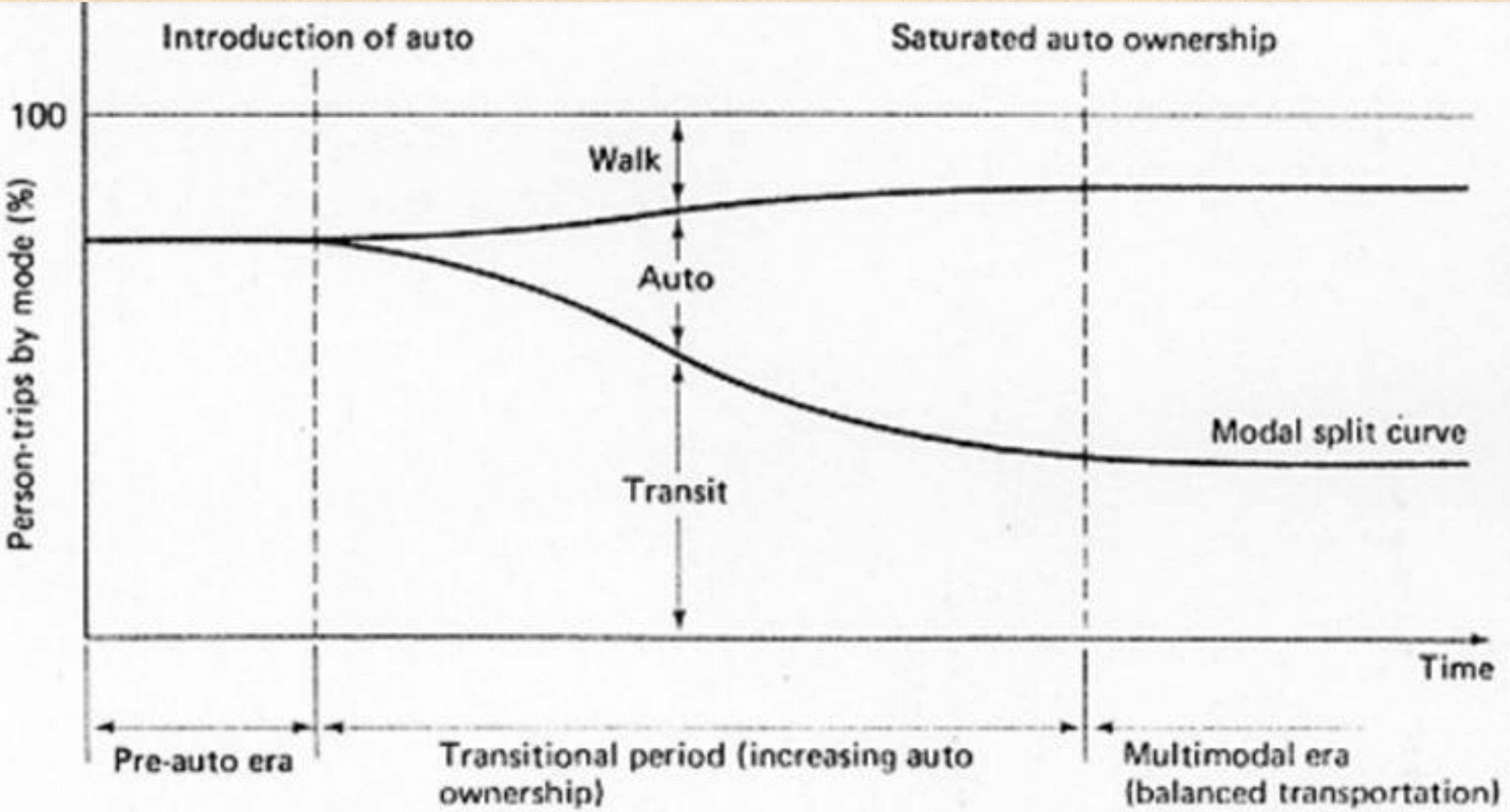


Figure 2.25. Conceptual diagram of modal split change due to introduction of private auto

1. Classification of Transit Systems

Urban transportation consists of a family of modes, which range from walking and bicycles to urban freeways, metro and regional rail systems. The basic classification of these modes, based on the type of their operation and use, is into three categories:

(a) ***Private transportation*** consists of privately owned vehicles operated by owners for their personal use, usually on public streets. Most common modes are pedestrian, bicycle and private car.

(b) ***Paratransit or for-hire transportation*** is transportation provided by operators and available to parties which hire them for individual or multiple trips. Taxi, dial-a-bus and jitney are the most common modes.

(c) ***Urban transit, mass transit or public transportation*** includes systems that are available for use by all persons who pay the established fare. These modes, which operate on fixed routes and with fixed schedules, include bus, light rail transit, metro, regional rail and several other systems.

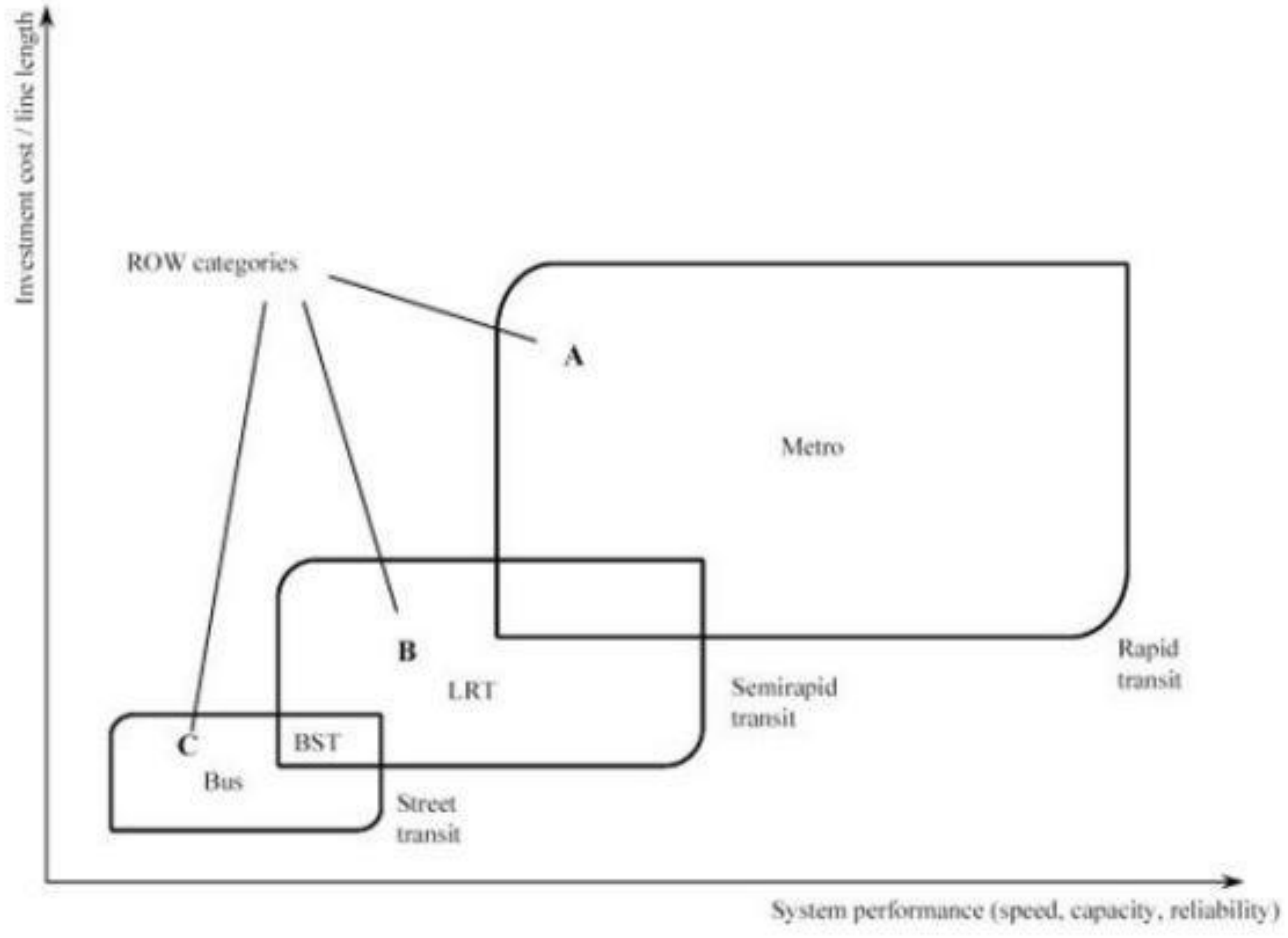


Figure 1: Right-of-way categories and generic classes of transit modes

2. Bus Transit System

Buses represent the most widely used transit technology. Virtually every city in the world that has transit service operates buses. Large cities with rail transit also operate extensive bus networks, usually on lines with lower passenger volumes or as feeders to rail lines.

Bus service is easy to introduce or modify: basic service requires only purchase of vehicles, garage and maintenance facilities, and organization of service. Stops along the lines can be simple. Therefore, buses represent the most economical transit mode for lightly traveled lines. This flexibility of bus routes is an advantage for any necessary changes, but it is a disadvantage for major bus lines: they lack permanence, efficiency in carrying heavy passenger volumes, and image of permanent, physically fixed routes desired by passengers.

Compared to paratransit modes, bus transit is very labor-efficient: one driver operates a vehicle with capacity of 50-150 spaces. Compared to rail transit, buses are labor-intensive and have no economy of scale: on heavily traveled lines, for every additional 40-120 passengers, one bus and one driver must be added to the service.


BUS
ONLY


BRT

2.2. Bus Travel Ways

The vast majority of buses operate on regular streets, ROW category C. Being in mixed traffic, their speed and reliability of service depend on traffic conditions. Their average speed is lower than the average speed of cars because they stop to pick up and drop off passengers. Buses are therefore not very competitive with car travel in the same corridor with respect to speed and reliability. Their advantages are much lower cost and convenience of not having to drive and park.

To make buses more efficient and attractive to passengers, bus preferential measures can be introduced. These include the following:

- **Preferential signals**: buses in a separate approach lane at intersections get the green signal before other lanes, so that they can proceed through the intersection ahead of other traffic;
- **Alternating stop locations** at near- and far-side of intersections (before or after cross street) so that buses clearing one intersection on green signal use the green at the following intersection before they make the next stop. Also, spacing between bus stops should typically be about 250-400 m.
- **Exclusive bus lanes**, which may be curb lanes or lanes in the median - ROW category B. This is the most significant improvement measure because it makes buses

independent of traffic conditions on the same street.

- **Buses on high-occupancy vehicle (HOV) lanes or roadways** are used when bus lines with frequent service follow freeway alignment for a rather long distance. HOV facilities usually have traffic control that prevents congestion, but they do not provide the image of an exclusive, independent transit facility.
- **Busway** - special roadways reserved for buses only (ROW category B or A). Since busways require very high investment costs, they are used for some sections of lines. If ROW category A is required for a large section of line, it is usually better to introduce a rail system, so that the investment in high quality ROW is better used for electrically powered trains, rather than single bus vehicles.

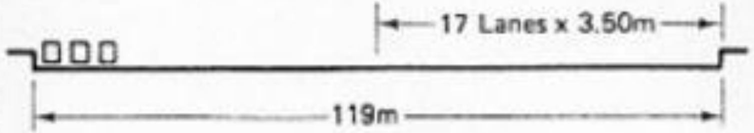
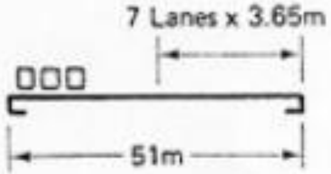
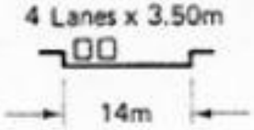
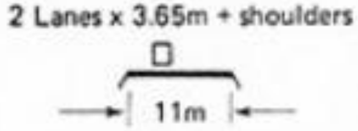
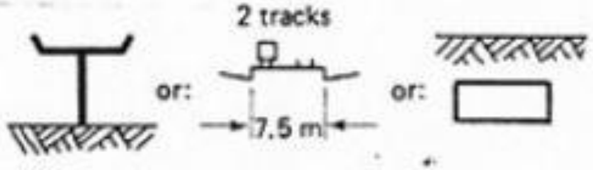
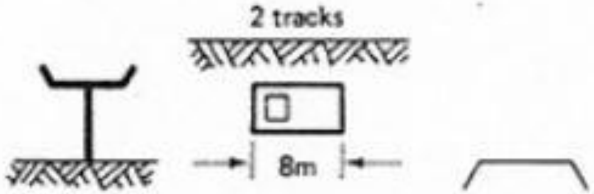
Mode	Schematic of R/W	Line capacity reserve	Terminal area requirements
Private autos on street (Persons/vehicle: 1.3 Maximum freq.: 700)	 17 Lanes x 3.50m; 119m	None	Parking: 23 m²/person For 15,000 people 34.5 ha (85 acres)
Private autos on freeway (1.3; 1800)	 7 Lanes x 3.65m; 51m	None	Same as above, plus interchanges
Regular buses (R/W C) (75; 100)	 4 Lanes x 3.50m; 14m	None (station and way capacities reached)	Each station 20 x 80 m on the surface
Semirapid buses (artic., R/W B) (100; 90)	 2 Lanes x 3.65m + shoulders; 11m	None (station capacity reached, way capacity not)	Each station 25 x 100 m on the surface
Light rail transit (2 artic. car trains) (400; 50)	 2 tracks; or:; 7.5 m; or:	33%	Each station from 12 x 50m on the surface to 20 x 90 grade separated
Rail rapid transit (1000; 25 RGR, 1000; 40 RRT)	 2 tracks; 8m	67-167%	Each station from 20 x 100 to 25 x 210m grade separated. No surface occupancy

Figure 2.21. Areas required for transporting 15,000 persons per hour by different modes

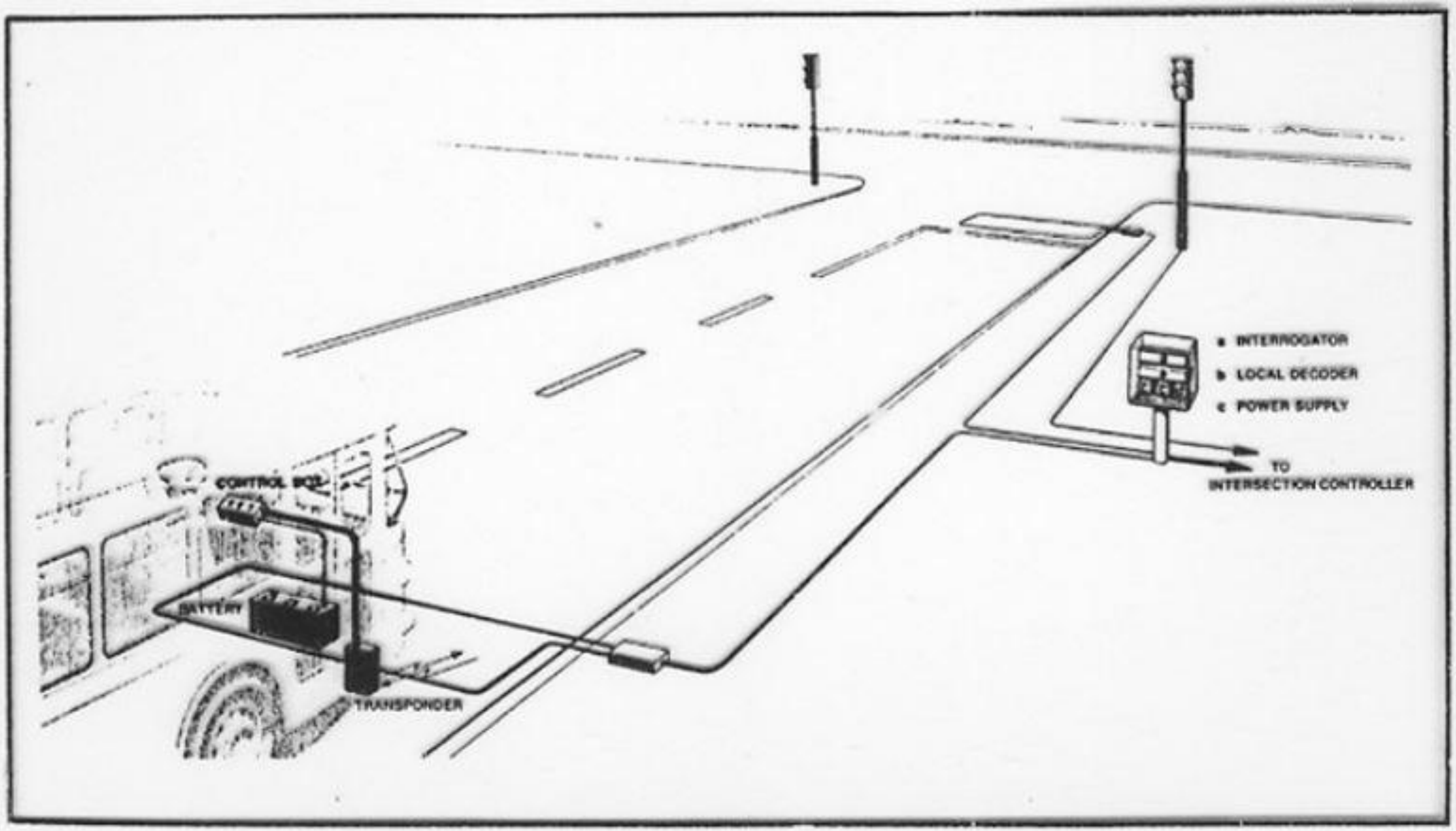


Figure 4.41. Recognition of transit vehicles for signal actuation: Philips' "Vetag" system (Courtesy of Philips, The Netherlands)

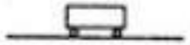
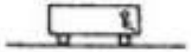
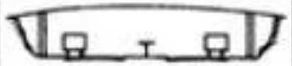
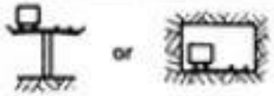
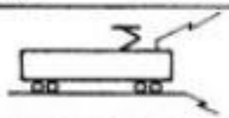
Step no.	Description	Sketch	Major improvements	Corresponding real world system
1	Paths, walking		—	Walking-pedestrians
2	Private motorized cabins		Speed Comfort Convenience	Private automobiles
3	Common carrier (rental) cabins		Service available to all people	Taxis
4	Widening of the paths		Capacity L/S	Arterials
5	Introduction of large cabins		Capacity Cost Comfort	Bus transit
6	Separation of modes		Capacity Reliability Speed of transit	Transit R/W category B
7	Guided technology		Capacity Electric traction Comfort Operating cost	LRT
8	Grade separated paths		Capacity Speed Safety Convenience	Freeways
9	Fully controlled common carrier R/W		Capacity Speed Reliability Area impact	R/W category A, rapid transit
10	Automated common carrier cabins		Frequency Operating cost Performance	Automated guided modes: AGT, RRT

Figure 2.12 Review of urban transport system evolution steps

Introduction of guided transit (LRT)

- 😐 Higher capacity and productivity due to operation of trains.
- 😐 Lower operating cost per unit of offered capacity,
- 😐 Electric traction possible,
- 😐 Greater reliability and safety (fail-sfae operation),
- 😐 Narrower R/W

- ☺ Operation in tunnels, on viaduct, and in park areas possible without significant environmental damage.
- ☹ Less compatible with other traffic in street operation,
- ☹ Limited to the guide-way network only, therefore uneconomical for extensive routing in low-density areas.

- ☹ Lower operational flexibility (rerouting, detours, etc.),
- ☹ Requires higher investment.

Kuala Lumpur Light Rail Transit (LRT) - Getting Around Kuala Lumpur – Go Guides

Visit

How trackless trams could help revitalize city suburbs | World Economic Forum

Visit

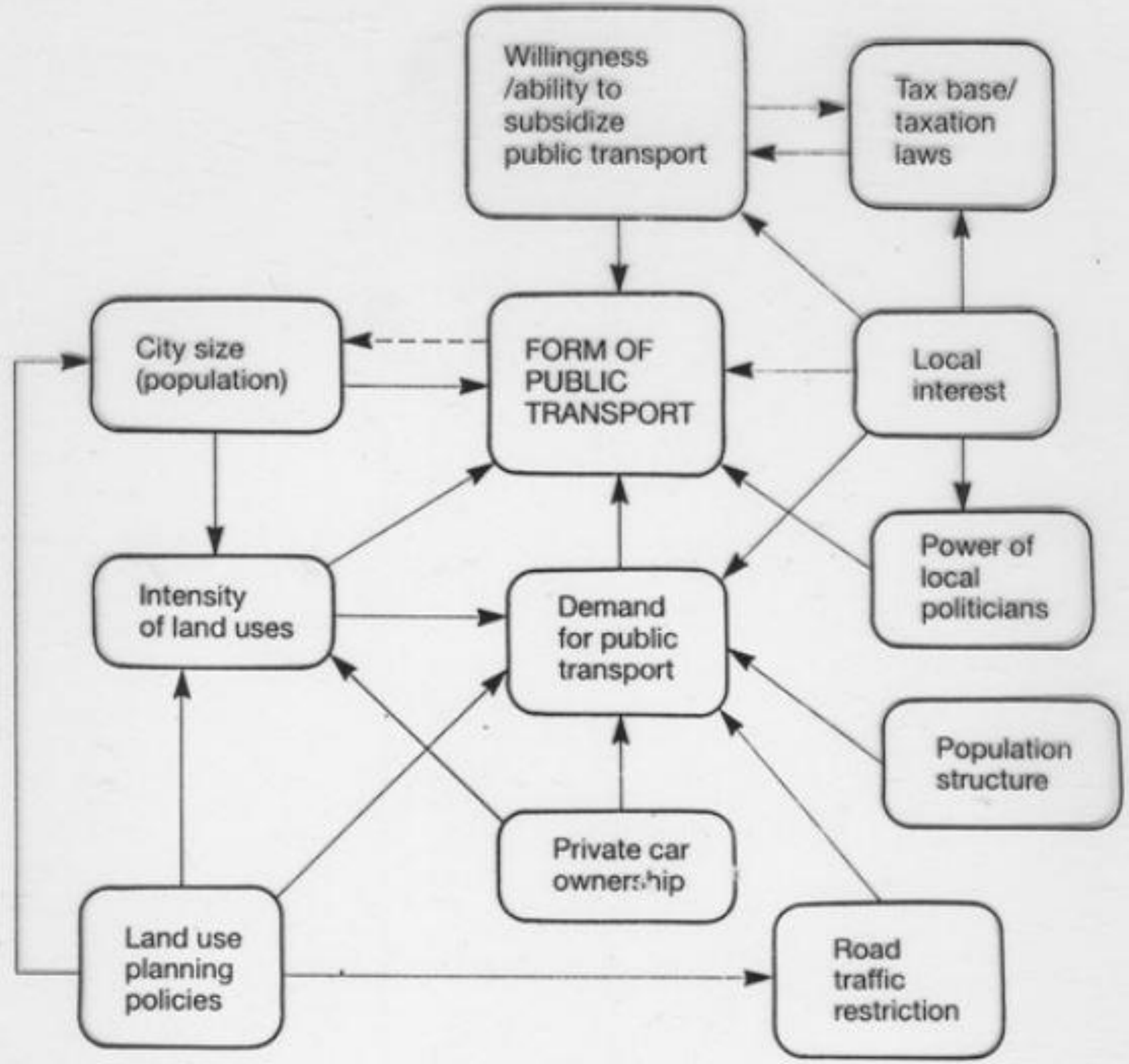


Figure 7.1 Some factors affecting choice of public transport policy.

Fare Structure and Payment Options

Bus service planning encompasses not only the calculation of where and when buses will arrive, but also how much each passenger will be required to pay and how the payment will be received. Poorly designed fare schedules and fare collection procedures can be a source of significant confusion and delay.

Fare Structure and Payment Options

Fare collection is another complicated issue, for which several solutions have been devised.

1. The driver can collect fares from each boarding passenger. While simple, this system causes large delays at every stop, as the driver must interact with each passenger as they board.

Fare Structure and Payment Options

2. A more equitable solution would be to adjust the fare based on the distance the user traveled on the network, but this system is prohibitively complex.

Fare Structure and Payment Options

3. Many transit authorities have decided on a compromise that charges users based on the number of zones that they travel through on a given route. Travel from zone "A" to zone "E" would cost the user more than the shorter trip from zone "A" to zone "C." This system is reasonably simple and much more equitable than the uniform fare system.

Fare Structure and Payment Options

Fare collection is another complicated issue, for which several solutions have been devised.

1. The driver can collect fares from each boarding passenger. While simple, this system causes large delays at every stop, as the driver must interact with each passenger as they board.

Fare Structure and Payment Options

2. To reduce delay, fare collection machines that accept payment from the passengers are commonly installed near the bus door. These machines allow the bus driver to focus on driving, and accelerate the boarding process considerably.

Fare Structure and Payment Options

3. Finally, fare card programs are becoming more and more common. These systems allow the transit user to purchase a magnetic card with a predetermined value. The fare is deducted when the passenger swipes the card through a reader at the bus door.

Fare Structure and Payment Options

This system is very efficient. In addition, it allows the transit authority to monitor the transportation habits of the cardholders by automatically recording the routes, stops, and times at which each card is used.

Route Cycle Times

Cycle time is the time it takes to drive a round trip on a route plus any time that the operator and vehicle are scheduled to take a break (layover and/or recovery time) before starting out on another trip.

Route Cycle Times

Typical service standards attempt to maximize the length of the route design per cycle time, while providing for the minimum amount of layover/recovery time allowed. Maximizing route length per cycle time utilizes equipment and labor power most effectively. However, other considerations make this optimization difficult to achieve.

Route Cycle Times

Other considerations that make optimization of labor and equipment difficult include:

1. the need to maintain consistent time between vehicles on a route (headway).
2. adjusting for changes in ridership and traffic during the day (for example, rush hour vs. non rush hour).
3. planning for vehicles to arrive at common locations so that passengers may make transfers to other routes (timed transfers).

Route Cycle Times

These considerations often require additional layover/recovery time beyond the minimum allowed.

Terminal Points

Terminal points are considered the "ends" of a line or route. These are the locations where vehicles generally begin and/or end their trips and operators usually take their layovers. For that reason, locations where there is safe parking and restrooms close by are considered desirable locations for terminal points.

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Intermediate Time Points

Intermediate time points are locations along the route, between the terminals, that indicate when the vehicle will be there. The term "node" is commonly used in computerized scheduling systems to denote a time point. Generally speaking, on public timetables, these intermediate time points, or nodes, are timed to be between 6 and 10 minutes apart.

Intermediate Time Points

In theory, when intermediate time points are too close together, there is a greater risk that the operator may arrive early and have to wait or "dwell" at that point to stay on schedule, causing passengers to become impatient. When time points are more than 10 minutes apart, some agencies believe that customers are more likely to be confused about when a vehicle will arrive at a particular stop, given the differences in individual operator driving habits

Intermediate Time Points

Where are intermediate time points typically located?

Physical location considerations also affect the selection of intermediate time points. Major intersections that are widely recognized and possess good pedestrian amenities like sidewalks and actuated traffic signals make good time points.

Intermediate Time Points

It is a good idea to locate intermediate time points at major trip generator locations such as shopping centers, hospitals, and government buildings. Time points are also useful at locations where time is critical, such as major employment centers and intersecting bus routes or rail centers.

Importance of Layover Times

Layover, while mentioned only casually in the schedule design discussion, is an important part of the schedule. The layover period serves a variety of functions.

First, it provides a window of time to compensate for vehicles that are running ahead of or behind schedule. The layover can be extended or shortened in order to keep vehicles on schedule.

Importance of Layover Times

Next, the layover time provides an opportunity for drivers to relax and prepare for the next run. In fact, labor unions usually require layover periods that are a certain percentage of the cycle length.

Finally, layover periods can be used to change drivers, or for other administrative purposes.

Preliminary Schedule Design

Designing a schedule can be quite complicated, so preliminary schedule design will be portrayed here in the form of an example.

Consider a transit route that connects a residential neighborhood to a central business district. The distance between the neighborhood and the downtown area is 5 miles. The transit vehicles average 12 miles per hour between the two terminal points. The goal is to provide transit service every 15 minutes along the route.

Preliminary Schedule Design

The first step is to determine the time required to travel from one end of the route to the other. The one-way trip time is given in the equation below:

One-Way Trip Time = Route Length / Average Operating Speed

One-Way Trip Time = 5 miles / 12 mph

One-Way Trip Time = 25 minutes

The total round-trip time is twice the one-way trip time, or 50 minutes.

Preliminary Schedule Design

The next step is to determine the number of vehicles required in order to operate at the desired level of service. Now suppose that the desired headway is 15 minutes. That is, the frequency of service is one vehicle every 15 minutes. How many vehicles would be required to provide this service?

Preliminary Schedule Design

Number of Vehicles Required = Total Round Trip Time / Headway

Number of Vehicles Required = 50 minutes / (15 min/vehicle)

Number of Vehicles Required = 3.33 or 4

The revised round-trip time can now be calculated.

Preliminary Schedule Design

Revised Round Trip Time = (Number of Vehicles)(Headway)

Revised Round Trip Time = (4 vehicles)(15 minutes/vehicle)

Revised Round Trip Time = 60 minutes

This leaves 10 minutes for recovery and layover time, since the actual round-trip running time is 50 minutes.

Preliminary Schedule Design

The capacity of the route can also be determined.

Capacity = (Vehicles)(Capacity/Vehicle)

Capacity = (4 vehicles/hour)(75 passengers/vehicle)

Capacity = 300 passengers/hour

Preliminary Schedule Design

Now suppose that the forecasted demand for this transit route is 400 passengers per hour at the peak loading point. We need to re-estimate the required vehicles because the capacity calculated above is insufficient to carry this projected demand.

Preliminary Schedule Design

Vehicles = (400 passengers/hour) / (75 passengers/vehicle)

Vehicles = 5.33 vehicles/hour

Headway = 60 minutes / 5.33 vehicles

Headway = 11.25 = 10 minutes/vehicle

Note that we use an even "clock headway" of 10 minutes, rather than the cumbersome and potentially confusing value of 11.25 minutes that we initially calculated.

Preliminary Schedule Design

Vehicles = (50 minutes + 10 minutes) / (10 minutes/vehicle)

Vehicles = 6

At this point, we have completed the preliminary calculations in schedule design. The final computations involve the development of the schedule and the vehicle 'blocks.' These computations are presented in the 'final schedule design and blocking' discussion.

Final Schedule Design and Blocking

The final computations in schedule design will produce a summary of the activity that will occur on the route during the period in question. We'll continue our example problem, which was introduced in the 'preliminary schedule design' section, to illustrate the steps and the desired result.

Final Schedule Design and Blocking

Our preliminary schedule design conclusions were that we needed 6 vehicles running with 10-minute headways to service the demand of 400 passengers/hour between ‘A’ and ‘B’. Let’s assume that these calculations were meant for the morning peak-period of 7:00 a.m. through 9:00 a.m.

Final Schedule Design and Blocking

First, we list the departure times from 'A' for each vehicle during the peak-period.

Leave 'A'
7:00
7:10
7:20
7:30
7:40
7:50
8:00
8:10
8:20
8:30
8:40
8:50

Final Schedule Design and Blocking

Next, since we know that it takes 25 minutes for each vehicle to proceed from 'A' to 'B', we can record the arrival times. Including 5-minutes of layover time at each terminal 'A' and 'B', we can include the departure times as well. Notice that the work so far has been vehicle-independent. We are only recording the times at which these events should occur, not which vehicle should be at each station at these times.

Final Schedule Design and Blocking

Leave 'A'	Arrive 'B'	Leave 'B'	Arrive 'A'
7:00	7:25	7:30	7:55
7:10	7:35	7:40	8:05
7:20	7:45	7:50	8:15
7:30	7:55	8:00	8:25
7:40	8:05	8:10	8:35
7:50	8:15	8:20	8:45
8:00	8:25	8:30	8:55
8:10	8:35	8:40	9:05
8:20	8:45	8:50	9:15
8:30	8:55	9:00	9:25
8:40	9:05	9:10	9:35
8:50	9:15	9:20	9:45

Final Schedule Design and Blocking

Now that we have a schedule of times, we can try to link together these times into routes that specific vehicles can follow. For example, if a vehicle were to leave ‘A’ at 7:00, it would arrive at ‘A’ again at 7:55. This vehicle could then start again with the 8:00 shift. Extending this process leads to the table below.

Final Schedule Design and Blocking

Vehicle Block	Leave 'A'	Arrive 'B'	Leave 'B'	Arrive 'A'
1	7:00	7:25	7:30	7:55
2	7:10	7:35	7:40	8:05
3	7:20	7:45	7:50	8:15
4	7:30	7:55	8:00	8:25
5	7:40	8:05	8:10	8:35
6	7:50	8:15	8:20	8:45
1	8:00	8:25	8:30	8:55
2	8:10	8:35	8:40	9:05
3	8:20	8:45	8:50	9:15
4	8:30	8:55	9:00	9:25
5	8:40	9:05	9:10	9:35
6	8:50	9:15	9:20	9:45

Final Schedule Design and Blocking

At this point, we can prepare the final vehicle block summary. This summary simply indicates the times that each vehicle will be in service and the vehicle block that the vehicle will be assigned to.

Final Schedule Design and Blocking

Vehicle	Vehicle Block	Time Block	Time In Service
A	1	7:00-8:55	1:55
B	2	7:10-9:05	1:55
C	3	7:20-9:15	1:55
D	4	7:30-9:25	1:55
E	5	7:40-9:35	1:55
F	6	7:50-9:45	1:55
Total			11:30

Commuter Rail

Commuter Rail systems typically operate along existing freight railroad rights-of-way, serving longer-distance trips between central cities, suburban activity centers and outlying areas.

Vehicles are configured to provide maximum seated capacity and comfort due to longer trips.

Commuter rail vehicles can operate in mixed traffic with freight trains.

Commuter Rail

Typical Commuter Rail Characteristics

- Capital Cost / Mile: $2-$9 million
- Long-distance service: 25 miles or longer
- Widely spaced stations: Stations every 2-10 miles
- Typical maximum speed: 65-80 mph
- Typical service frequency: 15-30 min. peak; 60 in. off-peak
- Seated capacity per car: 100 to 150 passengers
- Seated capacity per train (10 cars): Up to 1,500 passengers

Light Rail Transit

Light Rail Transit, known as LRT, is a railbased urban transit system. It has the flexibility to navigate sharp curves, and travel along streets, highways or in exclusive right-of-way. Since the rails are flush with the surface of the street, LRT can be operated in areas with pedestrian, cyclist, or automobile activity. LRT is powered by electricity from overhead wiring which is suspended from poles or buildings.

Light Rail Transit

Typical Light Rail Transit Characteristics

- Capital Cost / Mile: $20-$55 million
- Moderate distance service: 10 to 20 miles
- Frequent station spacing: Stations every ¼ to 2 miles
- Typical maximum speed: 55-65 mph
- Typical service frequency: 5-10 min. peak; 10-20 min. off-peak
- Capacity per car: 65 to 75 pass. Seated, 125 to 150 w/standees
- Capacity per train (4 cars): 250-600 passengers
- Cannot operate in mixed traffic with freight trains

Monorail

A monorail system consists of rubber-tired vehicles which operates along a single rail, or beam. The beam supports the vehicle and provides the electrical power source. Monorail can be designed for a variety of environments, including activity area circulation, shuttle service, and line haul transit. However, its most common application has been as circulators or shuttles at activity centers such as airports or theme parks.

Monorail

Typical Monorail Characteristics

- Capital Cost / Mile: $50-100 million
- Shorter distance service: 5 to 10 miles
- Frequent station spacing: Stations every ½ to 2 miles
- Typical maximum speed: 50 mph
- Typical service frequency: 5-10 min. peak, 10-20 min. off-peak
- Seated capacity per car: 30 passengers
- Seated Capacity per train (4 cars): 120 passengers
- Requires full grade separation, often elevated

Automated Guideway Transit

Automated Guideway Transit

Automated Guideway Transit (AGT) includes steel-wheel or rubber-tired vehicles that operate under automated control on an exclusive guideway, grade-separated from other vehicular traffic. AGT may utilize conventional electric propulsion, or alternative types such as linear induction and magnetic levitation. AGT has been implemented as line haul transit in medium to large metropolitan areas. Shuttle or circulator services for downtowns or airports represent the more common use of AGT. Automated operation allows for high service frequency and high passenger capacity, as frequent service offsets smaller vehicle size.


DUPONT
The miracle. of science
08
DUPONT

Automated Guideway Transit

Typical Automated Guideway Transit Characteristics

- Capital Cost / Mile: $50-70 million
- Short distance service: 1 to 10 miles
- Frequent station spacing: Stations every ¼ to 1 mile
- Typical maximum speed: 25 to 50 mph
- Typical service frequency: 1-10 min. peak/5-20 min. off-peak
- Seated capacity per car: 30 to 100 passenger
- Seated Capacity per train (4 cars): 120 to 400 passengers
- Requires full grade separation, often elevated
- High acceleration and deceleration rates

Heavy Rail

Heavy rail vehicles receive current from an electrified third rail. The system operates along an exclusive guideway and is grade separated from other vehicular or rail modes.

Subway or elevated alignments are the common applications. Heavy rail is appropriate for corridors or alignments with very high demand, as this technology can transport a very high volume of passengers per hour at a high average speed.

Operations can be very reliable because of complete grade separation of the alignment.

Heavy Rail

Typical Heavy Rail Transit Characteristics

- Capital Cost / Mile: $20-$250 million
- Variable distance service: 5 to 30 miles
- Frequent station spacing: Stations every ½ to 2miles
- Typical maximum speed: 60-80 mph
- Typical service frequency: 5-10 min. peak, 10-20 min. off-peak
- Capacity per car: 60 to 80 pass. Seated, 125 to 150 w/standees
- Capacity per train (8 cars): 480 to 1,200 passengers


0166
1,200 × 8

Bus / HOV Lanes

Bus/High-Occupancy Vehicle (Bus/HOV) lanes provide a dedicated travel lane for the exclusive use of buses, vanpools, private shuttles, carpools and other authorized vehicles. Bus/HOV lanes are designed to provide travel time savings and improve travel time reliability by offering a means to bypass traffic congestion in the adjacent general-purpose lanes. Increases in ridesharing and transit use in a travel corridor can be achieved when improvements in travel time and/or travel time reliability create significant incentives for individuals to choose higher-occupancy modes over driving alone. Carrying more people in fewer vehicles can increase the person-moving capacity of the roadway.


Peckham Victoria Marble Arch
Paddington 436
BUSES
AND
ONLY

Bus / HOV Lanes

Typical Bus/HOV Characteristics

- Capital Cost / Mile: $4-$8 million
- Variable system length: 5 miles or more
- Typical maximum speed: 65 mph (site specific speed limits)
- Typical service frequency: 5-15 minutes during the peak
- Seated capacity per bus: 35 to 65 passengers

Busway/BRT

Busways and Bus Rapid Transit (BRT) provide the speed and guideway advantages typically attributed to a rail line, with the added advantage of bus circulation within neighborhoods or other areas.

The Busway/BRT concept offers high capacity bus operation along an exclusive bus only roadway (busway or transitway) with on-line stations.

Buses do not have to physically leave the busway to pick-up and drop-off passengers, allowing for fast and efficient service.

Busway/BRT

Typical Busway/BRT Characteristics

- Capital Cost / Mile: $8-$25 million
- Variable system length: 5 miles or more
- Typical maximum speed: 55-75 mph, freeway, 25 to 35 mph, arterials
- Typical service frequency: 3-15 minutes during the peak
- Seated capacity per bus: 35-69 passengers

Busway/BRT

Personal Rapid Transit (PRT)

Personal Rapid Transit (PRT)

Personal Rapid Transit (PRT) is a concept that is intended to provide direct point-to-point, demand responsive transit service to individuals and small parties. The level of service would be competitive with private vehicle travel. An automated control system routes small vehicles along a grade separated guideway system, allowing passengers to reach selected destinations without stops. The PRT concept is most applicable to activity centers with multiple trip origins and destinations, where circulation patterns are not well served by a linear transit system. The PRT technology has not been proven in actual revenue service operation.

Personal Rapid Transit (PRT)

Typical PRT Characteristics

- Capital Cost / Mile: Unknown / Unproven
- Typical maximum speed: 25-45 mph
- Extremely frequent service: 10 seconds to 1 minute
- Seated capacity per vehicle: 2 to 5 passengers per vehicle
- Alignment would consist of large network supported by elevated structures
- Vehicles operate in single units

Assessment of Transit Technologies for Preliminary Alternatives Screening

Technology	Serves Long Distance Trips?	Appropriate for Range of Expected Ridership?	Exists in Revenue Service?
Commuter Rail	Yes	Yes	Yes
Light Rail Transit	Yes	Yes	Yes
Monorail	No	No	Yes
Automated Guideway Transit	No	No	Yes
Heavy Rail	Yes	No	Yes
Bus/HOV Lanes	Yes	Yes	Yes
Busway/BRT	Yes	Yes	Yes
Personal Rapid Transit	No	No	No

There are many ways to improve and encourage the use of *Public Transit*:

- ✓ Additional routes, expanded coverage, increased service frequency, and longer hours of operation.
- ✓ Lower and more convenient fares (such as discounts for frequent users).
- ✓ Commute Trip Reduction programs, Commuter Financial Incentives, and other TDM Programs that encourage use of alternative transportation modes.
- ✓ HOV Priority (bus or HOV lanes, queue-jumper lanes, bus-priority traffic signals, and other measures that reduce delay to transit vehicles).
- ✓ Comfort improvements, including bus shelters and better seats.
- ✓ Transit Oriented Development and Smart Growth, that result in land use patterns more suitable for transit transportation.

There are many ways to improve and encourage the use of *Public Transit* [cont'd]:

- ✓ Pedestrian and Cycling Improvements that improve access around transit stops.
- ✓ Improved rider information and Marketing programs.
- ✓ Improved Security for transit users and pedestrians.
- ✓ Services targeting particular travel needs, such as express commuter buses, Special Event service, and various types of Shuttle Services.
- ✓ Universal Design of vehicles, stations and pedestrian facilities to accommodate people with disabilities and other special needs.
- ✓ Park & Ride facilities.
- ✓ Bike and Transit Integration (bike racks on buses, bike routes and Bicycle Parking near transit stops).

Case Studies and Examples

Comsis (1993) and Pratt (1999) provide dozens of examples of successful transit improvements implemented and their effects on travel behavior. These examples include:

- ✓ Fare reductions.
- ✓ New fare options, particularly discounted tickets and passes.
- ✓ Free transit areas.
- ✓ New and expanded transit systems.
- ✓ More convenient routing (e.g., eliminating the need for transfers).
- ✓ Shuttle service, distributor routes, feeder routes.