UNIT 5 INTRODUCTION TO SMART URBAN TRANSPORTATION SYSTEMS

Structure

5.1 INTRODUCTION

Transportation influences the form of cities and their livability, their economic, social, and environmental characteristics. The increasing transportation demand creates more and more mobility-related problems. Most of the big cities are facing the problem of traffic congestion. As urban transit have great possibilities for reducing traffic congestion, offering alternative transportation modes, and contributing greatly to the quality of urban life, urban

A smart transit system is processed from strategic planning, tactical planning, operational planning, and transit evaluation to marketing and policy. The question on which is better, less expensive, etc. must depend on the unique city characteristics (demand mainly) and choice of Right of Way, but must at least be put to the test rather than ignored or effectively side stepped by a very light assessment and rejection. Public Transport (PT) modes serve many roles in cities throughout the world. There are different elements of PT in each city; some having the full complement of bus in mixed traffic, bus in dedicated road environments, light rail in mixed traffic or a dedicated corridor, and heavy rail. Despite the plea for a rational debate on the role of alternative PT modes, to ensure that the service levels offered represent best value for money and deliver on key criteria such as connectivity, frequency and visibility within a network, there is often great resistance to some options on essentially ideological and emotional grounds.

5.2 BUS TRANSPORTATION SYSTEM

Transportation plays a crucial role in cities as it significantly impacts the quality of people's lives and is often the key means of accessing education, employment and essential services. At the same time, transportation is the sector where global green house gas (GHG) emissions are rising most quickly. In 2010, the transport sector accounted for 27% of final energy use, and CO2 emissions from the sector could almost double by 2050 if steps are not taken to counter this trend. As emissions from private motor vehicle use rise, adopting measures to shift these trips to public transit is critical.

As one of the main components of a comprehensive public transportation system that may include motorized and non-motorised elements, Bus Rapid Transit (BRT) delivers significant benefits to cities, while requiring significantly less time and resources to build and begin operation than other comparable alternatives. ABRT is a high quality bus based transit system that delivers fast, comfortable, and cost effective services at metro level capacities at a fraction of the cost. It can be expanded in phases as funding becomes available allowing costs to be dealt with over time and is faster to implement than other rapid transit services (metro, light rail etc.).

The BRT Standard is to be applied to specific BRT corridors rather than to a BRT system as a whole. This is because the quality of BRT in cities with multiple corridors can vary significantly.For the purposes of the BRT Standard, a BRT corridor is defined as: A section of road or contiguous roads served by a bus route or multiple bus routes with a minimum length of 3 kilometers (1.9 miles) that has dedicated bus lanes.The primary reason for defining the corridor in this way is that in some cities BRT is not prioritized over automobile traffic, an essential element in rapid transit that improves both efficiency and cost. To avoid rewarding corridors that do not make this political choice, the corridor needs to be defined as including dedicated bus lanes.

As a growing transport solution in both developed and developing countries, BRT and improved bus-way systems already have a combined daily ridership of more than 32 million people in 200 cities around the world.

The Institute for Transportation & Development Policy (ITDP) has identified number of crucial design elements that are associated with high performing BRT systems. As such, when cities wish to implement BRT systems, these elements should be assessed and included in order to deliver systems that maximize the benefits of Bus Rapid Transit. A basic set of general principles to follow in order to develop a good BRT system and reduce GHG emissions are

1. Develop a greater degree of integration between spatial and transport planning to encourage compact development patterns, to reduce car use and promote more sustainable travel patterns;
2. Ensure improved alternatives to the use of private car are provided, including more sustainable, higher occupancy modes of transport (e.g. mass transit/ public transport and non-motorised transport modes); and
3. Establish better management of road space and the transport demand (e.g. via parking policy, congestion pricing, incentives, raising awareness of sustainable forms of travel).

Dedicated right-of-way

Dedicated BRT lanes ensure that buses can bypass traffic jams. The separated right-of-way can be enforced through the use of delineators, colourised pavement, or camera enforcement.

Bus way alignment

Median-aligned busways minimise the risk of delays caused by turning movements and parked vehicles such as shown in following figure 5.1.

Figure 5.1: Typical BRTS Lane Implementation in an Urban Corridor

Off-board fare collection

Off-board fare collection reduces boarding time and prevents revenue leakage. Barrier-controlled systems employ turnstiles or flap gates that allow access when users tap their smart cards. Proof-of-payment systems can be employed on routes that extend beyond trunk BRT corridors.

Intersection Treatments

Forbidding turns across the bus lanes and simplifying signal cycles reduce delays. Traffic-signal priority activated by an incoming BRT vehicle can increase speeds in low-frequency systems.

Platform level Boarding

The bus floor and station platform should be at the same height to minimise boarding and alighting times. Reducing vehicle-to-platform gaps ensures easy access for the disabled and the elderly.

SAQ 1

a) Define BRT and its typical characteristics.
b) How to align BRT on an urban corridor.
c) Detail about principles to be followed in developing a BRT system.

5.3 METRO RAIL SYSTEM

Metro rail system is another type mass transit system operational across the world. In India, it has been in operation in cities like Delhi, Chennai, Kolkata, Hyderabad etc. Based on a number of Traffic and Transportation studies conducted by various agencies, the then Government of Andhra Pradesh (GoAP) approved development of Hyderabad Metro Rail (MRTS) project in three high density traffic corridors of the city spanning across 72 km in phase-I. Detailed Project Reports (DPRs), Traffic Survey Reports, and other related reports were prepared by Delhi Metro Rail Corporation (DMRC) for the project.

The three corridors spanning a length of approximately 72 km to be taken up in phase-I are as under.

- Corridor I: Miyapur – LB Nagar : 29 kms; 27 stations.
- Corridor II: JBS – Falaknuma : 15 kms; 15 stations.
- Corridor III: Nagole – Raidurg : 28 kms; 24 stations.

The Metro Rail system in Hyderabad is a completely elevated system (Fig. 5.2), generally run in the central median of the road. The viaduct structure for the elevated system is a box girder carrying two tracks on a single pier located on the median of the road.

The track gauge is a Standard Gauge (1435 mm) and the electrical traction is 25 kV AC, 50 Hz overhead traction system. The signaling system caters to the needs of a designed speed of 80 KMPH, with state-of-the-art features consisting of Automatic Train Control (ATC), Automatic Train Protection (ATP) and upgradation facility to Automatic Train Operation (ATO).

The system is designed to cater to 50,000 PHPDT for Corridors I and III and 35,000 PHPDT for Corridor II. It will have to be built, operated, maintained and transferred at the end of the Concession Period as per the provisions of the Concession Agreement. The performance specifications and safety standards are enunciated in the Manual of Specifications & Standards (MSS), a well deliberated and published document of GoAP, based on "output oriented" performance philosophy. The miss provides scope for enough design flexibility and innovation, and it forms part of the Concession Agreement.

Salient Features of the Project

Figure 5.2: Snapshot of Metro System

(Source: https://hmrl.co.in/metro-advantages.html)

It is an elevated metro rail, with two tracks (up and down lines) on a deck erected on pillars generally in the central median of the road, without obstructing the road traffic. Stations are located at an average interval of 1KM – elevated stations with passenger access through staircases, escalators and lifts.

Adequate parking space and circulating areas are being provided for multi modal integration at the stations. It is estimated that with a frequency of 3 to 5 minutes during peak hours, the system is expected to carry about 17 lakh passengers per day by 2017 and 22 lakh by 2024. The travel time by metro rail from one end to another are as follows on various corridors.

- 45 minutes for Corridor I (Miyapur-L.B.Nagar – 29Kms) as against 1 hr 46 minutes by bus.
- 22 minutes for Corridor II (Jubilee Bus Station-Falaknuma - 15 Kms) as against 1 hr 10 minutes by bus.
- 39 minutes for Corridor III (Nagole-Raidurg - 28 Kms) as against 1 hr 26 minutes by bus.

The other major features of Hyderabad Metro are:

- Rails will be continuously welded to minimize noise levels.
- Power supply will be through 25 kV AC, 50 Hz overhead traction system.
- Coaches will be air-conditioned with automatic door-closures and many other safety features.
- Signaling system ensures safety and specified speeds through Automatic Train Control (ATC), and Automatic Train Protection (ATP).
- Telecommunication facilities will be state of the art, facilitating continuous communication between Central Control, train drivers and station masters.
- Good inter-modal integration will be provided at all the rail terminals, bus stations, and the MMTS (existing joint venture of GoT and Railways) stations.
- All stations will have air conditioned "Merry go round" mini-bus services, connecting nearby colonies, business establishments and other popular places.
- Different categories of aesthetic stations are being designed to reflect the local architecture, latest trends, and to avoid/ minimise demolitions. As far as possible, parking and circulation areas will be developed on nearby Govt. lands.
- Eco-friendly Travel Mode – it will reduce air and noise pollution in the city.
- Smart card-based Automatic ticketing & gate systems for passenger convenience and seamless travel.
- Standard gauge track (1435 mm) to allow sharper curves and gradients.

The major advantages associated with Metro rail system are as follows:

- The Metro Rail System has proven to be most efficient in terms of energy consumption, space occupancy and numbers transported.
- High-capacity carriers – very high volumes of peak hour peak direction trips.
- Eco-friendly – causes no air pollution, much less sound pollution.
- Low energy consumption – 20% per passenger km in comparison to road-based systems.
- Greater traffic capacity – carries as much traffic as 7 lanes of bus traffic or 24 lanes of car traffic (either way).
- Very low ground space occupation – 2 meter width only for elevated rail.
- Faster – reduces journey time by 50% to 75%.

SAQ 2

a) Detail typical characteristics of metro rail system.
b) Brief about advantage associated with metro rail systems.

5.4 MONO RAIL SYSTEM

A monorail is a railway in which the track consists of a single rail or a beam. The term is also used to describe the beam of the system, or the trains traveling on such a beam or track. Colloquially, the term "monorail" is often used to describe any form of elevated rail or people mover.

The Chembur-Wadala-Jacob Circle monorail network (Fig. 5.3) has begun operations in Mumbai during March 2019. Stretched over 19.54 kilometre this network will be India's first monorail system. The third longest monorail network in the world,aims to change the commuting experience of Mumbai. Mono Rail typically carries 7,500 commuters per hour per direction and has the capacity to carry 1.5 to 2 lakh commuters daily. Many parts of the city which are not connected by suburban rail system or Metro rail will be connected by Monorail. Besides, Mono Rail will be connected to suburban rail system at Wadala, Curry Road and Chembur. Likewise, Metro-II will be connected at V.N. Purav marg station. The Mono Rail will be an efficient feeder transit system benefiting commuters and will offer efficient, safe, air-conditioned, comfortable and affordable public transport. The monorail project was seen as a better solution in areas where roads are unable to be widened due to structures on the sides. It reduces property loss to residents, as well as lowering land acquisition costs for the government.

Figure 5.3 Mumbai Mono Rail System at the Time of Inauguration

The monorail is eco-friendly and easily accessible and causes less noise pollution compared to metro rail systems. It also reduces traffic congestion and offers high reliability and manoeuvrability for passengers. Passengers travelling to suburban locations are benefitted as the monorail provides interconnectivity to suburban railway stations, including Mahalaxmi Lower Parel, Curry Road, Dadar and Wadala.

Monorail tracks are a little lighter and narrower than standard rail tracks, meaning overhead monorail structures can sometimes be a little less expensive and imposing than overhead Metros, and much less imposing than the pre-war els of Chicago, Philadelphia, and New York (Fig. 5.4). Beyond the shape of trains and tracks, most Americans' experiences with monorails come from tourist encounters in Disney or Las Vegas, where the polish of privately-owned-and-operated trains ridden strictly during vacation inevitably beats the experience of day-to-day commuting in public. It's true that elevated monorails can be less expensive than elevated standard rails. Unfortunately, the track structure of monorails force elevated-like construction even for ground level or subway lines. There is a narrow set of circumstances where monorails are the most sensible option. If the technical details align, that is when you have a mostly elevated line that doesn't need many switches, and there's not a strong incentive to match an agency's equipment, then the positives of monorails can outweigh the negatives. That just doesn't happen very often, and for the remaining 99% of cases, monorails aren't worth the headache. Monorail tracks are a little lighter and narrower than standard rail tracks, meaning overhead monorail structures can sometimes be a little less expensive and imposing than overhead Metros.

Figure 5.4: Snapshot of Elevated Mono Rail Section

SAQ 3

a) What is monorail and how it is different from metro rail system?

b) Detail typical locations around the world where monorail system has been implemented.

5.5 REGIONAL RAIL TRANSIT SYSTEM

National Capital Region Transport Corporation (NCRTC), a Joint Sector company of Government of India and States of Delhi, Haryana, Rajasthan and Uttar Pradesh, is developing a rail based suburban transport system i.e. Regional Rapid Transit System (RRTS) for National Capital Region (NCR). The goal is to offer a rail based Sustainable Urban Transport System, to increase the quality of life and better access to goods, services, creating employment opportunities and sustainable development, climate change mitigation resulting in a livable city environment i.e. health supportive environment with more allocation of road space to people rather than vehicles. 2. The proposed RRTS (Delhi-Ghaziabad-Meerut) corridor originating from Sarai Kale Khan in the State of Delhi and ending at Modipuram in Uttar Pradesh will be a double line standard gauge, rapid railway system, built on elevated viaducts and going underground in heavily populated areas. As per the final alignment, out of total length of 82.15 Km, 14.15 Km is in underground section and balance 68 Km is in elevated section. One stabling yard near Sarai Kale Khan (Jungpura) and two maintenance depots (one depot at Modipuram and another depot at Duhai) have been planned. The proposed stabling yard and the depots will be constructed at grade. To ease the traffic movement during construction, NCRTC has started strengthening and blacktopping of the national highway (erstwhile NH- 58) at the locations where the RRTS alignment is placed on the median of the road. As on date 9.7 kms (Chainage 23.900 to 33.600 upto Duhai) in Ghaziabad section has already been completed and the remaining 30 kms (Chainage 33.600-63.600 upto Shatabdi Nagar) in Meerut section is in progress. A due diligence report for this road strengthening and blacktopping has been prepared confirming using of existing RoW without any impact on private properties. A Social Safeguard Due Diligence report (SSDR) has been prepared and appended to this resettlement plan.

In short, Regional Transit can be defined as long bus or rail transit lines with few stations and high operating speeds that primarily serve long trips within metropolitan regions, as distinguished from city transit and short-haul transit.

A highly functioning regional rail system includes five critical components:

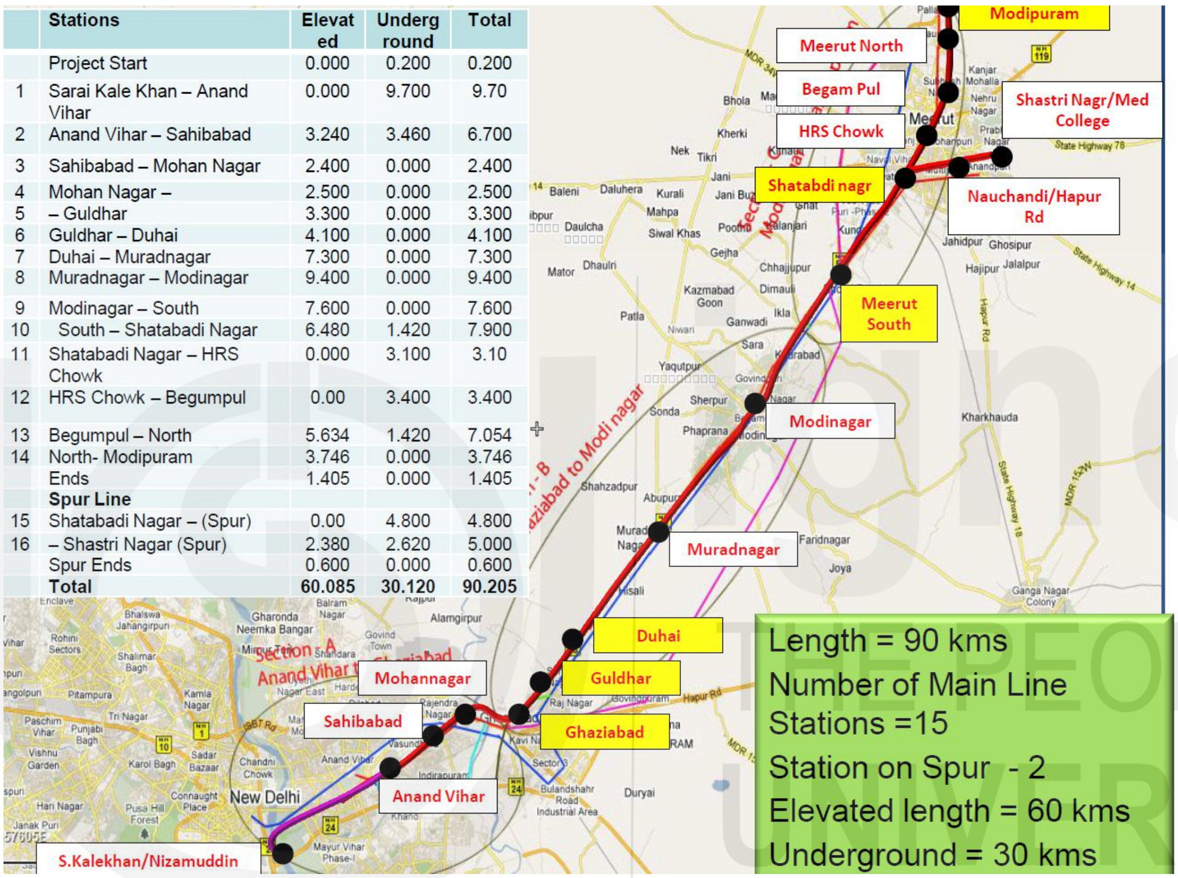
- Systemwide electrification and the purchase of high-performance electric trains.
- High platforms, providing universal access and speeding up boarding for everyone.
- Strategic infrastructure investments to relieve bottlenecks.
- Frequent service all day: every 30 minutes in the suburbs and every 15 minutes in denser neighborhoods.
- Free transfers between regional trains, subways, and buses, and fare equalization with the subway in the subway's service area.

National capital region (NCR) is a multi-state region with the National Capital as its centre. This region, spread over an area of about 35,000 km2, comprises the entire National Capital territory of Delhi and some parts of the neighboring states of Haryana, Uttar Pradesh and Rajasthan. The National Capital Region Planning Board (NCRPB), in order to enhance the connectivity within the NCR, has proposed to connect urban, industrial (SEZs/industrial parks), regional and sub-regional centers through a fast rail based Regional Rapid Transit System (RRTS). The objective of this system is to reduce dependence of commuters on road based transportation. The NCRPB conducted a study on Integrated Transportation Plan for NCR projecting figures for 2032 and has identified eight rail based rapid transit corridors to enhance the efficacy of the transportation system in the NCR. In addition to the rail system there will also be provisions made for facilities including road network enhancements

The eight identified RRTS corridors are:

- Delhi – Gurgaon – Rewari – Alwar [DGRA – Project Corridor]
- Delhi – Ghaziabad – Meerut
- Delhi – Sonipat – Panipat
- Delhi – Faridabad – Ballabhgarh – Palwal
- Delhi – Bahadurgarh – Rohtak
- Delhi – Shahadra – Baraut
- Ghaziabad – Khurja
- Ghaziabad – Hapur
- The NCRPB has decided to implement RRTS in the following three corridors on priority:
- Delhi – Gurgaon – Rewari – Alwar;
- Delhi – Sonipat – Panipat; and
- Delhi – Ghaziabad – Meerut.

The proposed corridors radiate from National Capital Territory Delhi (NCTD) across the NCR area and terminate at Rest of NCR (RNCR) towns which are the exit nodes of NCR. A typical corridor of this project is as shown in Figure 5.5. The RRTS network is expected to provide fast, safe and comfortable commuter systems at a reasonable fare for intra-regional movement of passengers. NCR is experiencing the flow of nearly 3.5 lakh passenger cars commuting every day and RRTS will help reduce travel delays and congestion created by movement of these vehicles. UMTC has been chosen for providing its consultancy services for a feasibility study of Delhi – Gurgaon – Rewari – Alwar RRTS corridor, followed by preparation of Detailed Project Report (DPR).



	Stations	Elevated	Underground	Total
	Project Start	0.000	0.200	0.200
1	Sarai Kale Khan – Anand Vihar	0.000	9.700	9.70
2	Anand Vihar – Sahibabad	3.240	3.460	6.700
3	Sahibabad – Mohan Nagar	2.400	0.000	2.400
4	Mohan Nagar –	2.500	0.000	2.500
5	– Guldhar	3.300	0.000	3.300
6	Guldhar – Duhai	4.100	0.000	4.100
7	Duhai – Muradnagar	7.300	0.000	7.300
8	Muradnagar – Modinagar	9.400	0.000	9.400
9	Modinagar – South	7.600	0.000	7.600
10	South – Shatabadi Nagar	6.480	1.420	7.900
11	Shatabadi Nagar – HRS Chowk	0.000	3.100	3.10
12	HRS Chowk – Begumpul	0.00	3.400	3.400
13	Begumpul – North	5.634	1.420	7.054
14	North- Modipuram	3.746	0.000	3.746
	Ends	1.405	0.000	1.405
	Spur Line			
15	Shatabadi Nagar – (Spur)	0.00	4.800	4.800
16	– Shastri Nagar (Spur)	2.380	2.620	5.000
	Spur Ends	0.600	0.000	0.600
	Total	**60.085**	**30.120**	**90.205**

Figure 5.5: Proposed Alignment of Delhi-Meerut Corridor of RRTS

> **SAQ 4**
> a) What is Regional Rail Transit System?
> b) Illustrate with an example typical RRTS.

5.6 PERSONAL RAPID TRANSIT SYSTEM

Personal rapid transit (PRT), also referred to as pod-cars or guided/railed taxis, is a public transport mode featuring small automated vehicles operating on a network of specially built guide ways. PRT is a type of automated guideway transit (AGT), a class of system which also includes larger vehicles all the way to small subway systems. In terms of routing, it tends towards personal public transport systems.

PRT vehicles are sized for individual or small group travel, typically carrying no more than three to six passengers per vehicle. Guide ways are arranged in a network topology, with all stations located on sidings, and with frequent merge/diverge points. This allows for nonstop, point-to-point travel, bypassing all intermediate stations.

Personal rapid transit systems attempt to eliminate these wastes by moving small groups nonstop in automated vehicles on fixed tracks. Passengers can ideally board a pod immediately upon arriving at a station, and can — with a sufficiently extensive network of tracks — take relatively direct routes to their destination without stops.

The low weight of PRT's small vehicles allows smaller guide ways and support structures than mass transit systems like light rail. The smaller structures translate into lower construction costs, smaller easements, and less visually obtrusive infrastructure.

As it stands, a citywide deployment with many lines and closely spaced stations, as envisioned by proponents, has yet to be constructed. Past projects have failed because of financing, cost overruns, regulatory conflicts, political issues, misapplied technology, and flaws in design, engineering or review.

PRT is a concept based on driver-less vehicles which operate on a segregated track, travelling from point to point rather than using a fixed route. These vehicles are typically lightweight and battery powered which means that any necessary structures are much cheaper than those for a conventional transit system, and that emissions at point of use are virtually zero. If clean energy sources can be used to generate electricity then such systems can be effectively carbon-neutral.

The advantages of personal rapid transit compared to conventional transit are that it is highly flexible (each vehicle goes straight to the desired destination), and that it offers privacy (passengers don't have to share with other passengers). PRT schemes are more cost-effective than light rapid transit or other traditional options.

The personal rapid transit system adopts small, fully automated, battery-powered electric vehicles. Each vehicle has 500kg payload and 40kph operating speed. The designed maximum gradient could be up to 20%. The system infrastructure includes flexible and aesthetic guide ways and stations. In addition, the highly intelligent control system provides passengers with comfortable and convenient travelling experience. They do not have to wait for vehicles; there are no transfer needed and no routes to memorize either.

Other benefits of the personal rapid transit system include:

- 24-hour availability if required
- On-demand service, with no transfers
- Zero on-site emissions
- Extremely low overall energy use
- Minimal visual and acoustic impacts

The pilot PRT scheme at Heathrow Airport (UK) which is scheduled to open late Spring 2010, is the first implementation of PRT in the world (Fig. 5.6). It provides transport for travellers between the business car park and the new Terminal 5, about 2 km away. 21 automatic electric podcars, each with room for 4 persons and their luggage, transport users along a segregated guideway at up to 40kph. The trip takes about 5 minutes, the podcars operate on-demand, but are usually waiting so that waiting times are zero for 70% of users and very low for the others. The capital cost is reckoned to be about half that of an equivalent tram scheme and with the potential to provide a similar passenger carrying capacity

Key Benefits of PRT are

- Highly efficient “on-demand” operation;
- Low operating costs as drivers are not required;
- Personal public transport;
- Pollution reduction as vehicles are automated, electric and quiet;
- Direct origin to destination stop services, i.e. no intermediate stops;
- Simple, accessible services similar to a lift;
- Very short waiting time congestion-free transport due to operating on a segregated guideway.

The main application areas of PRT in the areas of

- Airports;
- Tourist attractions;
- Shopping parks and malls;
- University and hospital campuses;
- Industrial business parks;
- Eco towns;
- New urban city developments;
- Park & ride;
- Extension of existing modes.

PRT provides a new system of public transport offering personal, on-demand and direct origin to destination services similar to a taxi. These advantages offer great potential for achieving modal shift, and combine with the safety and cost savings arising from automated i.e. driver-less operation.

Significant benefits are therefore:

- Potential for high public acceptance and modal shift;
- Reduced operating costs from driver-less operation and the more efficient use of vehicles which are only used when there is a demand;
- Low waiting times and hence time savings for passengers;
- Reduced noise and environmental pollution locally from using electric vehicles.

PRT therefore provides a potentially sustainable and convenient solution for urban mobility. India will finally have their pod taxi as Reliance Industries Ltd (LTD) will finalize the site for the country’s first personal rapid transit driver-less transport system,

Ultra (Urban Light Transit) is a personal rapid transit PODCAR system developed by the British engineering company Ultra Global PRT (formerly Advanced Transport Systems).

The only public system opened at Heathrow Airport in London in May 2011. It consists of 21 vehicles operating on a 3.9-kilometre (2.4 miles) route connecting Terminal 5 to its business passenger car park, just north of the airport.

To reduce construction costs, Ultra largely uses off-the-shelf technologies, such as rubber tyres running on an open guideway. The approach has resulted in a system that Ultra believes to be economical: the company reports that the total cost (vehicles, infrastructure, and control systems) is between £3 million and £5 million per kilometre (0.62 miles) of guideway. By contrast, the Heathrow deployment cost £30 million for 3.8 kilometres (2.4 mi) of guideway. The fleet of 21 pods, each capable of carrying four passengers and their luggage, travel along a dedicated guideway, reaching speeds of up to 25mph on the mainly elevated route.

For airport operator BAA the on-demand vehicles improve passengers' experience of the airport and help reduce emissions by replacing a fleet of shuttle buses.

Figure 5.6: Personal Rapid Transit in London Heathrow Airport

> **SAQ 5**
> a) What are the conditions favoring a personal rapid transit system?
> b) Justify the use of personal rapid transit in India with an example.

5.7 LIGHT RAIL TRANSIT SYSTEM

LRT systems can operate safely on rails, in tunnels and on overpasses; Access time to LRT stops is generally longer than to BHLS stops; LRT vehicles need less space both in stations and on tracks.

In the case of LRT, the trains run along their own right-of-way and are often separated from road traffic. Stops are generally less frequent, and the vehicles are boarded from a platform.

Between tram and LRT there is a significant overlap of technology. Many LRT systems have a combination of the two, with both mixed and segregated right of way.

LRT is a low cost, low axle load, eco-friendly, electrically propelled system with no local pollution and low noise and vibrations. Light rail vehicles (LRV) generally have a top speed of around 100 km/h though mostly operating at much lower speeds, more akin to road vehicles. LRT features include:

- Steel wheel vehicles operating on steel rails and are almost universally operated by electricity delivered through overhead lines. Electric power provides greater acceleration, making it suitable for operation with closely-spaced stations.

- Grooved steel rails laid flush with road surface or ballasted like normal railway track, making light rail the only system which can operate on both city roads and jointly with conventional rail services.
- Sharp road bends up to 25m radius, minimizing need for property acquisition and hence ideal for urban environment.
- Steeper inclines than heavy rail
- Shares its operational space with other road vehicles (e.g. automobiles) and often runs on, across or down the center of city roads.
- Grade separation only in exceptional circumstances.

LRT differs from the Metro rail in that the train length is short, segregated right of way is not essential, may have road level crossings, coaches can go round sharp bends and no signaling and train control is essential. All these features limit the speed and the capacity of the LRT. When all these constraints are removed, the LRT becomes akin to Metro rail. Indeed LRT is a flexible mode that fits between the bus and the metro rail, and can behave like either of them. Additionally LRT, in comparison with a metro rail, is cheaper to build and operate. Ability to go round sharp road bends reduces the need to acquire roadside property and hence the project cost. Use of low axle load of 11 tonnes compared to 17 tonnes of Metro rail saves operating cost. LRT is similar to BRT in that it requires a share in the road space and will affect traffic flow on the road both during and after construction. BRT is of relatively recent origin born out of the need to discipline and to improve the performance of bus services and to provide mass rapid transport at low cost. It is reported to be operational in about 150 cities around the World and many more cities are in the process of planning. LRT however scores over BRT in terms of capacity and requirement of road space.

Figure 5.6: Snapshot of Typical Light Rail Transit

SAQ 5

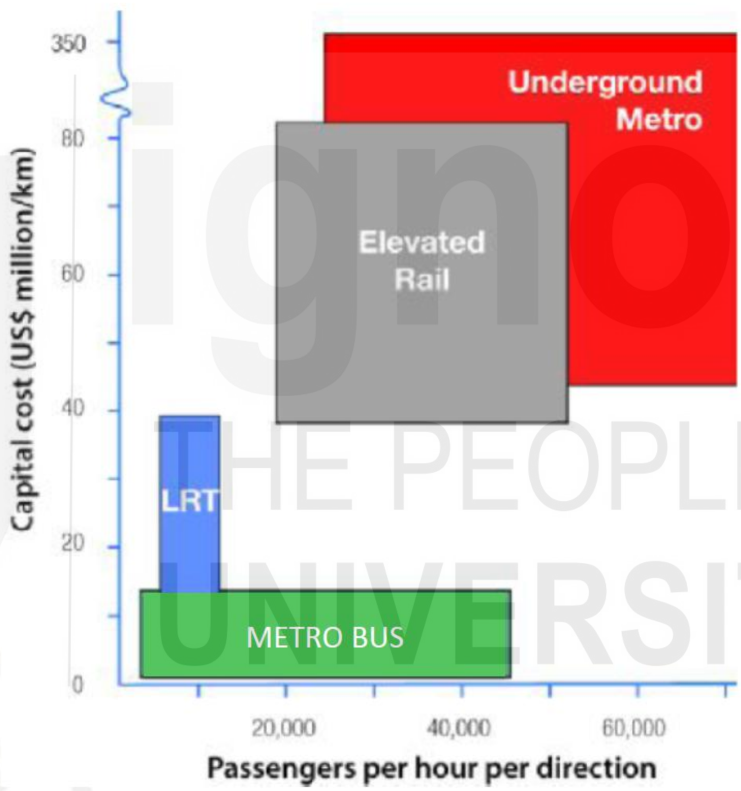
a) What is LRT and how it is different from other modes of public transport?

b) Detail about typical characteristics of LRT system.

5.8 SUMMARY

The construction choice between two different transport systems in urban areas, as in the case of Light-Rail Transit (LRT) and Bus Rapid Transit (BRT) solutions, is often performed on the basis

of cost-benefit analysis and geometrical constraints due to the available space for the infrastructure. Key features of high quality transit should include safe and easy step less boarding, electronic fare payment system, real time passenger information etc. As per the BRT planning guide, the capital investment cost for various modes of public transport against passengers per hour per direction is depicted in the following figure. LRT is the most economical of all and underground metro is the most costliest system. The choice of the system depends on geographical characteristics, availability of carriageway, economic and environmental considerations.



(Source: Bus Rapid Transit: Planning Guide, 2007)

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