

# Mass Transit in India: A Need for Change

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**Abstract**—The urban population forms a major segment of the entire population of a region or nation. The consistent sprawl of the urban agglomerations demands the requirement of a means of public transportation to serve this population. Most of the Indian cities are expanding radially and commercial activities are likely to be distributed all throughout the city. Mass transportation or public transportation refers to the movement of people within an urban area using group travel technologies such as buses and trains. The mass transit systems or MRT are a vital part of these urban transit modes. The importance of MRT systems can be understood from the fact that ridership of the MRT in Singapore surged from 740,000 in 1995 to about 2,762,000 in 2014, an increment of about 375% in comparison with the population rise from 3.524 million to 5.47 million, which is just about 155%.

These mass transit systems such as the metros have less effects on the pollution levels and reduce them by 50%, reduce the number of road accidents, they are among the most cost-effective means of improving urban mobility, reduce road congestion and stimulate development. These high capacity MRTS systems are justified on the logic that they can carry up to 60,000 passengers per hour per direction. Also there is a saving of 2 million man hours per day due to the reduced journey time. The first modern rapid transit in India was the Kolkata Metro and started its operation in 1984. The Delhi Metro in New Delhi is India's second operational metro which started operating in 2002. The Namma Metro of Bengaluru is India's third operational rapid transit and started operating in 2011. Currently, mass rapid transit systems have been deployed in these cities and several are under construction or in the planning process in several major cities of India.

## 1. INTRODUCTION

With the growing urbanization, issues regarding urban mobility are also growing. Urban congestion is a serious problem afflicting India and has multiple effects on the urban economy. Mumbai has been rated as the second most densely populated city in the world. With such a rapid increase in the population, the demand for mobility alternatives has also increased. Estimates show that India's vehicle population underwent the second-largest growth rate, up by 8.9% to 20.8 million units compared with 19.1 million in 2009. The per capita trip rate for all the modes of transport is expected to increase from 0.8%-1.55% in 2007 to 1%-2% by 2030.

Congestion on roads is a regular phenomenon in India especially in the metropolitan regions. Delhi's Master Plan 2021 aims to attract about 80% of the road traffic to public

transport by 2020. An estimate indicates that by the year 2021, the travel demand in Delhi will increase to 27.9 million passenger trips as compared to 13.9 million passenger trips in 2001. It clearly implies that in future public transport will have to cater to 22.3 million passenger trips.

The total number of vehicles in Bangalore and Hyderabad are around 6.8 million out of which 70% are two-wheelers. Four wheelers such as cars, jeeps, tempos, magic, taxis, and auto-rickshaws, account for around 25% while buses account for only 0.7% of the total motorized vehicles registered in Hyderabad and Bangalore. The use of public transport needs to be encouraged thereby reducing the two wheelers running on the road.

A piece of statistic from the Mumbai Traffic Police web site illustrates the magnitude of the problem: While length of roads in Mumbai increased two times between 1951 and 2007, the population increased 5.4 times and the number of vehicles a whopping 43 times.

Table 1: Growth Statistics of Mumbai

Factors	1951	2007	Increase
Road Length (Kms.)	837	1900	2.27
Population (Lakhs)	29.9	160	5.35
No. of vehicles '000	35	1503	42.94

## 2. NEED OF MRT IN INDIA

Indian cities are fast emerging as engines of economic growth with an estimated 60% of the country's Gross Domestic Product originating from the urban areas and thereby generating money, jobs and a better lifestyle for all. Due to the high level of economic growth of the country, there has been an increased migration from the rural areas to the cities. Currently, about 30% of the population lives in the urban areas and this situation is expected to grow to 40% by 2021. Increasing urbanization along with unplanned and unregulated growth has put an immense pressure on the urban infrastructure especially on the urban transport. Also the increase in the income level of the people has led to an increased ownership of private vehicles thereby contributing to increased congestion on the roads.

It is estimated that an investment of over Rs.900 billion is planned for rail-based Mass Rapid Transit System projects in 10 cities over the next five years. The city planners in 19th century, England were among the first people to understand the need for a standardized, massive and efficient system of transport for the growing cities. Their first innovation came to be known as the London Underground, also known as the Tube Rail System. It took us more than 37 years, since our independence, to build our first metro system i.e., the Kolkata Metro Railway System. Chennai and Mumbai MRTS projects were also started but they could not compete with the immediate requirement of the city. The Delhi metro system is also a running MRTS project provided by the DMRC and the Namma metro is in the process of becoming a major mode of transportation in the city of Bengaluru.

Mass Rapid Transit System is probably the best way to decongest traffic. However, a number of considerations should be kept in mind in order to run a successful MRTS. "Viability of metro projects depend upon correct defining of traffic corridors, technology adopted, availability of land, volume of traffic carried, capacity utilisation and acceptance of the mode by the commuters," Architect Jit Kumar Gupta mentions.

MRT systems in India consist of the systems with their modes as the metro trains or the diesel/electric multiple units (DMUs/EMUs/MEMUs/DEMs). The nation's first MRT system was the Kolkata Metro Rail which began its service in 1984.

With the beginning of the twenty first century, the country has been subjected to the establishment of MRT systems in various cities like Delhi, Mumbai, Chennai, Bengaluru, Gurgaon, etc. These systems are either based on the broad gauge track or the standard gauge track. A major benefit towards using the broad gauge is the increase of room it provides inside the coach.

The Union government's National Urban Transport Policy highlights about the billions of man hours lost due to people stuck in traffic. This adversely affects their efficiency. The reason towards this could be the rapid surge in the urbanization along with the mismatch of pace of growth between the number of vehicles on the road and its right of way. This maximization of the number of vehicles gives birth to the carbon emissions and is the prime cause of environmental degradation.

The costs of travel and transportation incurred by the marginalized section in the Indian metropolises is setting new records. It has become almost impossible to adopt for the sustainable modes like walking and cycling due to immense congestion and traffic within the cities, supplemented by the urban sprawl.

With all these challenges that the Indian cities face today, mass rapid transit systems pose sustainable solutions towards reducing the traffic, congestion and environmental degradation. These can either be underground, surfaced or

elevated. The MRTS now coming up are usually a combination of these.

In order for a city to become sustainable, the public transportation share must be somewhat around 70%, whilst it averages near about 35% in Indian agglomerations. The rising energy consumption and depleting natural resources pose another threat towards the planet. The increase in the number of road accidents over past few decades and the deficiency of land in urban areas are among other few obstacles which support the implementation of mass rapid transportation.

### 3. MASS TRANSPORTATION SYSTEMS IN INDIA

India consists of a variety of MRT systems, some of which are under the legislation of Indian Railways, while others under government organizations. Few important ones of these have been mentioned. Except for them Chennai and Delhi Suburban Rail Systems, Bengaluru, Mumbai, Jaipur and Hyderabad Metro, are among other mass transportation systems operational/under planning/construction in India.

#### 3.1 Kolkata Metro

The first rapid transit system for the ancient capital of the nation, Kolkata Metro forms the seventeenth zone of the Indian Railways. The first North – South line of 28kms is operational from Dum-Dum to Tollygunj. It was sanctioned in 1972. This along with other lines together constitutes to 98kms. The remaining 70kms is under construction. The extension of the number of lines will see the country's first underwater metro along the East – West corridor from Salt Lake City to Howrah. This is the only metro train system which functions directly under the Indian Railways. Kolkata Metro is the first and the only underground railway project implemented in India.

Kolkata had faced a serious problem with only 8% of the land being available for road transport as compared to 25%–30% of land available for road transport in other cities, thereby reducing the scope for increasing the existing road area. Therefore an underground route was envisaged with five rapid transit lines comprising a route length of 97.5 km. While the phase 1 of the North South (NS) axis commenced its services in 1995, Phase 2 and Phase 3 were recently opened in 2009 and 2010 respectively.

Several steps have been taken to improve the existing conditions of the MRTS. The existing metro stations would undergo renovation and introduce Fare Collection, Passenger Control system with Radio Frequency Identification based Flap Gates, Integrated Security System, new air-conditioned rakes and Automatic Signaling system.

#### 3.2 Chennai Metro

The first phase of the rapid transit system in the capital of Tamil Nadu is under construction. It consists of two corridors, together covering a length of about 45kms of which almost

half is underground and other half elevated. The system upon completion will take over the existing Chennai MRTS. It is owned by a government entity named Chennai Metro Rail Limited.

### 3.3 Mumbai Suburban Railway

The system uses exclusive inner urban railway lines to serve the entire Mumbai Metropolitan Region through a network about 465kms long. It has a daily ridership of approximately 7.5 million commuters and forms the busiest rapid transit system of the world. The system is operated by the Western Railways (Western line) and Central Railway (Central line, Harbor line, Trans – harbor line and the Vasai – Diva – Panvel line) zones of the Indian Railways. It uses AC powered electric multiple units or the mainline electric multiple units.

### 3.4 Hyderabad Multi-modal Transport System

Abbreviated as MMTS, it is a suburban rail system which serves the twin cities of Hyderabad and Secunderabad operated by the South Central Zone of the Indian Railways. The phase I expands to over 43kms and connects Hyderabad with Secunderabad along with Lingampally, Umdanagar and Manoharabad. The phase II of this system is 107km long and will connect Patancheru, Tellapur, Bibinagar and Rajiv Gandhi International Airport.

### 3.5 Delhi Metro

The system which started its operation in 2002 is currently about 193kms long, whereas 350kms is under construction. The MRTS serves the city of Delhi along with satellites towns of Faridabad, Ghaziabad, Gurgaon and Noida. The Rapid Metro Rail Gurgaon links with the Delhi Metro System. Delhi Airport Metro Express (DAME) allows swift connectivity from the city to the Indira Gandhi International Airport. The complete metro system in Delhi has six lines along with a total ridership of about 2.01 million.

Delhi Metro aims to provide connectivity to all the parts within the National Capital Region. It has a great combination of elevated, at-grade and underground lines and uses both the broad gauge and standard gauge tracks. It lies under the ownership of the Delhi Metro Rail Corporation (DMRC) within the Ministry of Urban Development, Government of India.

The services under operation use four, six or eight coaches. The Metro system in Delhi is the first ever railway project in the world to get carbon credits for reducing greenhouse gas emissions and it reduces pollution levels in the city by 6.3 lakh tons every year. It has assisted in removing about 3.9 lakh vehicles from the roads within Delhi.

A marvelous achievement of Delhi Metro has been its successful completion within the deadlines. Currently, phase III of the system is under construction. Delhi Metro provides services as frequent as within 2m30sec. It offers a completely

barrier free system for the physically challenged, and feeder services.

The immense success of the Delhi Metro Rail systems owes to the managing director of DMRC and a great coordination and collaboration between all the stake holders involved. Instead of providing connectivity and accessibility options just within the city, the system targeted for a regional connectivity. The construction and implementation process recruited highly skilled and experienced people. No shortage of finance was ensured and political interference was disregarded. The project is a clear example of the adoption of proper planning measures. During construction, there used to be meeting at regular intervals to discuss the progress and preparation of detailed project reports (DPRs). Proper considerations were given to the environment. A pivotal positive of the Delhi Metro system is the adoption of the state of the art technologies like high class security systems, stations fitted with seismic sensors, completely automatic ticketing, automatics computerized system for power supply,

Some of the problems faced during the implementation were due to land acquisition and relocation of people.

### 3.6 Kolkata Suburban Railway

The Suburban rail system plays a major role in the public transport system of several Indian cities by connecting the central business districts and the suburbs and attracting a large number of people on a daily basis. These are known as suburban trains or local trains and one such excellent example is the Kolkata Suburban Railway.

The Kolkata Suburban Railway started operating in the year 1854 with 5 lines running through a length of 1182 kilometers. The Kolkata suburban railways are operated by the Eastern Railway and South Eastern Railway. They serve the south western suburbs of Greater Kolkata through destination stations which lie in the south western part of Howrah district like Santragachi, Shalimar, Andul, Uluberia, Bagnan, Amta, in the East Midnapore district like Digha, Tamluk, Haldia, Panskura, Kolaghat, Mecheda and in the eastern and southern part of West Midnapore district like Balichak, Kharagpur, Midnapore and Jhargram.

## 4. ALTERNATIVES TO MRT

India is a developing country. In order to enhance the economic development our cities need to become smart and sustainable. This has become indispensable seeing the rapid growth of population, urbanization and industrialization. The rising levels of migration pose pressure on the urban areas. As the public transportation forms the core of an agglomeration, it ought to be smart and sustainable too, convenient, comfortable, and most importantly affordable.

Of all the different kinds of means of urban public transport found in the world, a limited kind of public transportation modes can be observed in India. These include City Bus

services and Bus Rapid Transit Systems, Mass Rapid Transit Systems (Metro trains and suburban railways), Light Rail Transit Systems (all of which are under construction), Mono Rails (only one operational and rest under construction), Tempos and Trams (operational only in Kolkata).

The world today talks about smart cities. But should smart cities always contain of metro trains? Are MRT systems the only solution?

The answer to these questions is 'No'. There is a serious need in India to choose for that modes of urban transportation which go well with the size of the city and population. Following mentioned means of urban transportation, as already deployed in the other parts of the world, can be adopted by the Indian cities.

### 5.1 Medium Capacity Rail Transport System (MCS)

This differentiates with the light rail and heavy rail systems. If the needs of an area depict a ridership which falls between the light rail and the heavy rail system, a MCS system is indicated. Such systems are beneficial for connecting the areas with frequently changing demography. An MCS system is usually grade separated, and has an exclusive right-of-way. It is also beneficial for branch line connections and to act as feeder service to the heavy rail systems.

### 5.2 Trams

Albeit Kolkata Tram is already existent, Tram systems can be developed across many medium sized cities in India. Also known as street cars, trolleys, etc. their basic characteristic is that they usually runs along the urban public streets, and rarely have dedicated right-of-ways. Tramways are powered by electricity. Tram lines connecting two different cities have also been observed, and at times, trams do carry freight too. Diesel operated trams are found very occasionally. The trams are light and shorter than the light or heavy rail. In lieu of this, tramways can be easily upgraded into a rapid transit line.

### 5.3 Skybuses

Skybuses are the new rail system which consist of an elevated track with car suspended below the track. Heavy 60kg per meter rails are placed at a standard gauge held in a 8m x 2m concrete box enclosure. These rails are supported over 1m diameter columns which are 10 metres tall, spaced at 15-20m intervals on pile foundation.

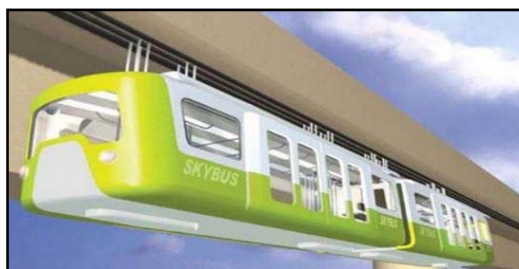


Fig. 1: Skybus Metro

This structure is constructed in the divider space between road lanes. Sky Buses follow the existing road routes without disturbing the existing traffic.

### 5.4 Trolleybuses

A trolleybus is basically an electric bus which draws its electricity from the overhead wires which are generally suspended from the road posts. Currently 300 trolley buses operate in 43 countries. (Webb, 2012) The trolleybus was initially started in 1882, when Dr. Ernst Werner von Siemens ran his "Elektromote" in a Berlin suburb. Max Schiemann took the biggest step on 10 July 1901 with the cration of the world's first passenger-carrying trolleybus operated at Bielatal in Germany. Schiemann built and operated the Bielatal system and is credited with developing the under-running trolleybus system. Leeds and Bradford became the first cities to run trolleybuses in Great Britain on 20 June 1911. (Dunbar, 1967)

Trolleybuses can share the overhead wires and other electrical infrastructure such as substations with tramways. Trolleybuses are present in various parts of the world with 8 systems running in North America, 9 in South America, 85 in Russia, 43 in Ukraine and 1 in New Zealand. In India trolleybuses operated in Delhi from 1935 to 1962, in Mumbai from 11 June 1962 to 24 March 1971 and in Kolkata it ran on a trial basis with a single trolleybus running on a short test line in 1977.

### 5.5 Personal Rapid Transit System (PRT)

The Personal Rapid Transit (PRT) system is a unique and sustainable transportation solution to the emerging problems of traffic and congestion. These are all small vehicle technologies designed to carry four to six people on an elevated guideway with off-line stations. Ultra PRT is a PRT system which was initially built at the Heathrow Airport in London in June 2011. The entire length of the route was 3.8km. The Heathrow PRT system connects terminal 5 with a long term car park. The world's oldest and most extensive PRT system is in Morgantown, West Virginia which has been in continuous operation since 1975. Several other PRT systems have been proposed but not implemented.

### 5.6 Group Rapid Transit System (GRT)

The Group Rapid Transit (GRT) system is an advanced rapid transit system. The first system known as a Personal Rapid Transit system, at West Virginia University in Morgantown is actually a Group Rapid Transit (GRT) system. GRT systems feature larger vehicles which can hold up to 25 passengers and can be installed both in line and network configurations. It uses small automated electric 'Cyberbuses' to provide scheduled and demand responsive feeder and shuttle services. For e.g. a parking lot with a major transport terminal and other facilities such as a shopping or exhibition center.

The system is rather like a lift or elevator in which the passenger presses a button at the stop to call the vehicle and then another on the vehicle to select the destination. The

'Cyberbus' will arrive and then go directly to the selected destination unless called by other users to pick them up or set down along the way. It also ensures that waiting times are kept low and vehicles are only used when there is a demand.

GRT provides a flexible alternative to shuttle bus schemes, has highly efficient operation as cyberbuses only operate when there is a demand, has low operating costs compared to bus or tram schemes as drivers are not required, both scheduled and on-demand services are possible depending on the need, simple accessible services for all, has low waiting time, enables pollution reduction as vehicles are automated, electric and quiet.

### 5.7 Funicular

A Funicular railway is a cable railway which uses the technology of an elevator and the technology of a railroad to run. It was devised in the 15th century as a way of getting people and things up steep hillsides. In the United States, they are often referred to as incline railways. The funicular functions in a unique way. Firstly the car is pulled up the mountain by a cable and the wheels just guide the car up the mountain. The funicular uses two cars at the same time i.e., one on each side of the top pulley. At any one time, one car is balancing the weight of the other. The descending car's weight helps pull the ascending car up the mountain and the ascending train keeps the speed of the descending train from going out of control. There is still a motor powering the pulley but it only has to provide enough force to overcome the difference in weight between the two cars and to overcome the friction in the system. In India the Funicular railways are operated in Tamil Nadu, Palani Murugan Temple, Bhira and Bhivpuri road in Maharashtra. The Private Tata group operates funicular railways in India.

### 5.8 Cable propelled transit (CPT)

Cable-Propelled Transit (CPT) is a transit technology that moves and carries people in motor-less, engine-less vehicles that are propelled by a steel cable. There are two types of Cable Propelled Transit systems: top supported and bottom supported.

Top supported systems which are also known as aerial cable systems are supported from above via a cable. Aerial cable technologies include: monocable detachable gondola, bicable detachable gondola, tricable detachable gondola, aerial tram, funifor, funitel and pulsed gondola. Bottom supported systems are supported by tracks or rails underneath, yet are still propelled by a cable. Bottom supported cable technologies include: heritage cable car, funicular, hybrid funicular, cable liner and mini metro. Currently only a few cities in the world have CPT system: Caracas, Venezuela; Constantine, Algeria, Rio de Janeiro, Brazil and Medellin. Colombia was the first city to install them for mass transit purposes.

### 5.9 Ferries

Ferries form a major part of the public transport systems of many waterside cities and islands. These ferries enable a direct transit between points at a capital cost much lower than bridges or tunnels. However, ship connections of much larger distances such as over long distances in water bodies like the Mediterranean Sea may also be called ferry services especially if they carry vehicles.

The Staten Island Ferry in the United States shuttles commuters between Manhattan and Staten Island in New York City, the world's busiest ferry route.

Ferries are as well very popular in India. The water transport in Mumbai consists of ferries, hovercrafts and catamarans which are operated by various government agencies as well as private entities. The Kerala State Water Transport Department (SWTD), operating under the Ministry of Transport, Government of Kerala, India regulates the inland navigation systems in the Indian state of Kerala and provides inland water transport facilities. It stands for catering to the passenger and cargo traffic needs of the inhabitants of the waterlogged areas of the Districts of Alappuzha, Kottayam, Kollam, Ernakulam, Kannur and Kasargode. SWTD ferry service is also one of the most affordable modes to enjoy the beauty of the scenic Kerala backwaters.

## 5. ACKNOWLEDGEMENT

The work has been inspired by the works of great scholars and eminent planners who have tried to bring a revolution in the field of transportation in India by their innovative techniques, new and alternative means of public transport to reduce the amount of traffic and congestion on the roads.

## REFERENCES

- [1] C. K. Kumar, "Articles: Economic Times," 23 February 2012. [Online]. Available: [http://articles.economictimes.indiatimes.com/2012-02-23/news/31091210\\_1\\_metro-rail-mass-rapid-transit-urban-transport-policy](http://articles.economictimes.indiatimes.com/2012-02-23/news/31091210_1_metro-rail-mass-rapid-transit-urban-transport-policy).
- [2] "Trains: Walk Through India," [Online]. Available: <http://www.walkthroughindia.com/walkthroughs/trains/nine-rapid-transit-metro-rail-projects-in-indian-cities/>.
- [3] "Business: Rediff," 20 August 2013. [Online]. Available: <http://www.rediff.com/business/slide-show/slide-show-1-indias-remarkable-metro-rail-systems/20130820.htm#3>.
- [4] "Reports: NBMCW," October 2011. [Online]. Available: <http://www.nbmcw.com/reports/construction-infra-industry/25784-metro-rail-transport-system-in-india.html>.
- [5] "MRT System in India," October 2011. [Online]. Available: <http://www.nbmcw.com/reports/construction-infra-industry/25784-metro-rail-transport-system-in-india.html>.
- [6] "Working Group on Automotive Sector, Government of India, New Delhi," [Online]. Available: [http://planningcommission.nic.in/aboutus/committee/wrgrp12/wg\\_auto1704.pdf](http://planningcommission.nic.in/aboutus/committee/wrgrp12/wg_auto1704.pdf).

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- [7] "MRTS/LRTS," [Online]. Available: [http://www.hccinfrastructure.com/ourbusiness/trans\\_mrts.aspx](http://www.hccinfrastructure.com/ourbusiness/trans_mrts.aspx).
- [8] M. A. A. a. F. Ahmed, "URBAN TRANSPORT SYSTEMS AND CONGESTION: A CASE STUDY OF INDIAN CITIES," *Transport and Communications Bulletin for Asia and the Pacific*, 2013.
- [9] A. Chatterjee, "Tech, Travel and Talks," 5 March 2014. [Online]. Available: <http://techtravelandtalks.blogspot.in/2014/03/mass-rapid-transit-systems-in-india.html>.
- [10] J. Sausanis, "World's Vehicle Population Tops 1 billion units, Wardsauto," 15 August 2011. [Online]. Available: [http://wardsauto.com/ar/world\\_vehicle\\_population\\_110815%E2%80%99t-controlgrowth-private-vehicle-official.html](http://wardsauto.com/ar/world_vehicle_population_110815%E2%80%99t-controlgrowth-private-vehicle-official.html).
- [11] S. Barnwal, "Slideshare," 23 February 2013. [Online]. Available: <http://www.slideshare.net/SaurabhBarnwal123/delhi-metro-rail>.
- [12] V. Bardia, "Slideshare," 26 January 2012. [Online]. Available: <http://www.slideshare.net/vinaybardia/delhi-metro-project>.
- [13] "About Us: Delhi Metro Rail Corporation," [Online]. Available: [http://www.delhimetrorail.com/about\\_us.aspx#Introduction](http://www.delhimetrorail.com/about_us.aspx#Introduction).
- [14] C. S. Dunbar, "Buses, Trolleys and Trams," Paul Hamlyn Ltd., 1967.
- [15] M. Webb, "Jane's Urban Transport Systems 2012–2013," Jane's Information Group, Coulsdon, Surrey (UK), 2012.
- [16] Y. Singh, "Performance of the Kolkata (Calcutta) Metro Railway: A Case study," Swets and Zeitlinger, Lisse, New Delhi, 2002.