

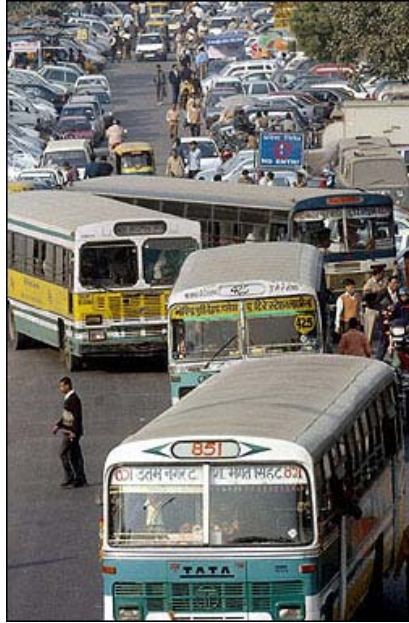
## Chapter – 11 : Review of Road Network and Transport System



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# CHAPTER - 11 REVIEW OF ROAD NETWORK AND TRANSPORT SYSTEM

## 11.1 INTRODUCTION



Delhi being the capital city is the center of socio economic, cultural and political activities of the country. The city also acts as a major center of trade and commerce and is the nodal point for five national highways and intercity rail corridors, carrying large volumes of heterogeneous passenger and goods traffic. The national highways and other major road network carry intra city and intercity traffic traversing to and from the different parts of the country.

The transport system of Delhi consists of a well-developed transport network system, based on ring and radial pattern, large fleet of buses (DTC & CNG) and a suburban rail system including MRTS. The majority share of travel needs of Delhi commuters is met by road based transport systems.

There has been a major improvement in transport infrastructure in recent years in terms of flyovers, road widening, new roads development and development of metro rail corridors along major routes of travel in the city. Due to continuous increase in population, employment opportunities and number of vehicles, there is a constant increase in demand over the years; and infrastructure has not grown in adequate proportions making the existing network system function beyond its capacity. This has led to serious traffic problems of congestion, delays, safety, pollution and system management.

The transportation system being multidisciplinary and multidimensional requires integration and co-ordination amongst the various agencies. Multi agency planning and implementation add to overall inefficiency due to interagency interests and conflicts. The major activities and agencies involved in this sector are presented in Table 11.1.

**Table 11.1: Activities & Agencies in Transport Sector**

S.No.	Activities	Agencies Involved
1.	Construction & Maintenance of roads, flyovers/ ROB /RUB, Pedestrian subways etc.	Delhi Development Authority Public Works Department Municipal Corporation of Delhi New Delhi Municipal Committee Delhi Cantonment Board Irrigation & Flood Control Dept. Delhi Tourism & Tpt. Dev. Corp.

S.No.	Activities	Agencies Involved
2.	Protection of Right of Way from encroachment	Delhi Development Authority Public Works Department Municipal Corporation of Delhi New Delhi Municipal Committee Delhi Cantonment Board JJ & Slum Dept. Delhi Police
3.	Shifting & Rehabilitation of services and structures from footpaths and roads	Public Works Department Municipal Corporation of Delhi New Delhi Municipal Committee Delhi Vidyut Board Mahanagar Telephone Nigam Ltd. Delhi Police Delhi Jal Board Gas Authority of India Limited Irrigation & Flood Control Dept.
4.	Detailed Planning for Road & Infrastructure Dept.	Ministry of Urban Development Delhi Development Authority Public Works Department Municipal Corporation of Delhi New Delhi Municipal Committee Delhi Cantonment Board Delhi Transport Corporation Delhi Urban Arts Commission Indian Railways Trans Yamuna Dev. Board
5.	Regulation and control of mss transport system	State Transport Authority Indian Railways Delhi Metro Rail Corporation Delhi Transport Corporation Inland Waterways Authority of India Delhi Multimodal Integrated Transport Systems Ltd.
6.	Control of ribbon development	Ministry of Urban Development Delhi Development Authority Land and Building Dept. GNCTD Transport Authority Ministry of Road & Transport

The main agencies involved in managing the transport sector are

- State Transport Authority --- registration of vehicles, routing of public transport services
- P.W.D., M.C.D. --- Construction and maintenance of roads,
- D.T.C. - operating public bus transport system,
- D.D.A. --- Construction of roads in newly planned areas
- N.H.A.I. --- Construction and maintenance of National Highways
- D.M.R.C. is responsible for Metro Rail

- Delhi Integrated Multimodal Transport system limited (DIMTS), a new agency, has been created for management of new public transport systems in the city of Delhi with a budget of 150 crore<sup>1</sup>. However, the scope of this agency is limited to mass transport systems in Delhi --- there is an urgent need for Delhi Unified Metropolitan Transport Authority whose scope can even be extended to DMA and NCR towns for coordination and implementation of projects and priorities. Until such an agency/authority is established a policy level committee may be set up involving various agencies.

## 11.2 SITUATION ANALYSIS - TRANSPORT NETWORKS

Delhi is predominantly dependant on road based transport systems as the railways caters to only about 1% of local traffic demand. The poly-nucleated urban structure of Delhi has a hierarchical system of commercial and shopping centers besides well-distributed industrial areas. Widespread distribution of employment centers all over the urban space of Delhi has contained the growth in length of trips. The residential areas are located around the economic activities. The shorter trip lengths and inadequate public transport system has fueled the growth of private modes of travel at a rapid rate in the city.

Transport network of Delhi consists of road network and rail network catering to intra city and inter city movement of traffic. The freight traffic is also substantial as Delhi acts as collection and distribution center.

### 11.2.1 Road Network

The road network in Delhi is being developed and maintained by NHAI, DDA, PWD, MCD, NDMC and Delhi cantonment Board. There are nine major inter urban corridors catering to major intercity traffic. These are NH1, NH2, NH8, NH10, NH24, NH24



BYPASS, NH58, NH57 and Loni road (SH) connecting Delhi to DMA & NCR Towns and to the rest of the country. In addition, traffic enters the city through other arterials and sub arterials roads at more than forty locations.

The road network in Delhi was 28,500 Km. in March 2001<sup>2</sup>. The road network has increased from 8380 Km. in 1971-72 to 28,500 Km. in 2001 (three times). The road network can be categorized into four types i.e. Arterial roads, sub arterial roads, minor arterial roads and collector roads. About 1100 Km. of road length are provided with right of way 30 m and above, while another 1000 Km. form the major links carrying the traffic in Delhi. Road network accounts for about 21% of the total area, which is above average of 12 to 15 % for urban areas. This translates into a road density of 19.2 Km. per Sq. Km (for 1483 sq. kms); and 38 kms per Sq. Km, considering the current urban area of 750 sq. kms. Being already on the high side, this limits the potential for increase in road length.

<sup>1</sup> For the construction and implementation of one corridor of the High Capacity Bus System

<sup>2</sup> Data presented in this section has been extracted from secondary sources. The latest data available at the overall city level has been used (source and year have been mentioned ).

The road network comprising of ring and radial pattern has C.P. as focal point with Mathura road, Lal Bhadur Shastri Marg, Aurobindo Marg, Rao Tula Ram Marg, Gurgaon Road (NH-8) Patel road, Shankar road, Rohtak Road, G.T.Road ( NH1 ), Loni road, Shahadra road, NH 24 bypass forming the radials whereas Mahatma Gandhi Road ( Ring Road ), Outer Ring road, Noida road- Bund road forming the prominent rings. These radial and ring roads serve as major arterials carrying bulk of traffic in the city.

The expansion of the road network and the growth of vehicular traffic in Delhi has resulted in the installation of traffic signals at short distances. There are more than 700 signalized intersections located all over Delhi to control traffic operations and ensure smooth flow of traffic. These signalized intersections have led to excessive time and fuel consumption for all vehicular trips. The Delhi Traffic Police has introduced Area Traffic Control (ATC) System in Central Delhi covering about 48 intersections to provide real time green phases to cater to changing traffic needs.

To provide uninterrupted movement of traffic, a special program to construct flyovers was initiated in Delhi. During the 9th five-year plan, 11 flyovers/ROB/Grade separators were constructed in Delhi by various agencies (PWD, DDA, DTTDC and MCD). This program of construction of flyovers has been continuing in the 10th Five Year Plan and 10 flyovers were constructed and 12 flyovers are under construction at various locations in Delhi. However, the absence of right turning loops at many of the flyovers are causing enormous delays for right turning traffic.

#### **REGIONAL CONNECTIVITY**

Existing road network for connectivity of Delhi with rest of the region is a four lane or six lane divided carriageway. NHAI is converting the road connecting Delhi to Gurgaon into an eight-lane Toll expressway that is of 28 Km. length (18 Km. in Haryana and 10 Km. in Delhi). The project is being constructed on BOT basis. DMA towns of Faridabad, Rohtak, Sonapat, Gaziabad, NOIDA are well connected with Delhi having multiple road linkages. To reduce the load of intercity traffic through in nature and for speedy interaction between NCR towns and Delhi new ring road / peripheral road projects are under process of implementation as follows :

- i) Faridabad - NOIDA - Gaziabad - This is an Eastern Peripheral Expressway with a total length of 106 Km. and is being implemented by formation of SPV between NCRPB,MOUD,ILFS and state Govt. of Haryana,U.P.and Delhi.
- ii) Palwal - Manesar - Kundli - This is Western Peripheral Expressway and is being implemented by NHAI connecting NH 1, 8 and 10.

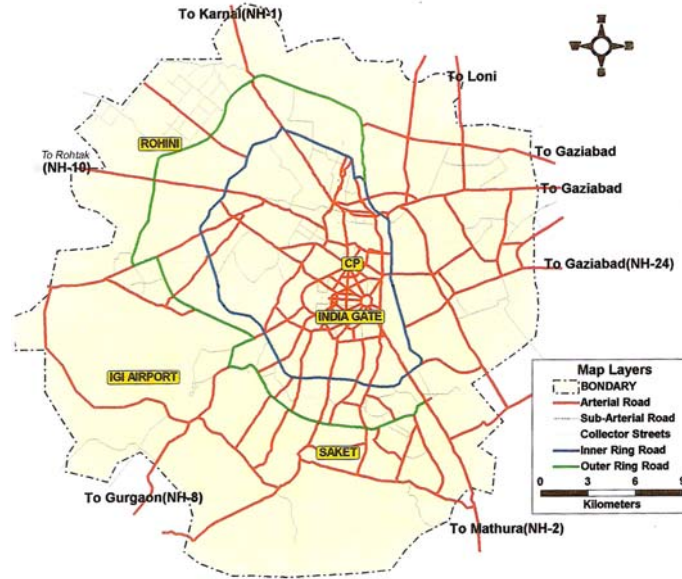


Figure 11.1 : Road Network Map of Delhi

### 11.2.2 Rail Network

The rail network consists of both broad gauge and meter gauge railway lines. Delhi is a major junction on the rail map of India linked with all the metropolitan cities directly. Delhi is connected by 8 radial lines extending to suburban areas spreading to states of U.P. and Haryana. These radials are:

- a) Delhi Gaziabad Khurja
- b) Delhi Gaziabad Hapur
- c) Delhi Gaziabad Meerut
- d) Delhi Shahadra Shamli
- e) Delhi Sonapat Panipat
- f) Delhi Nangloi Rohtak
- g) Delhi Gurgaon Rewari
- h) Delhi Nizamuddin Okhla Palwal.



The rail network has two specifically identified lines known as the Goods Avoiding Lines (GAL) and Delhi Avoiding Lines (DAL) forming a ring in the city and ring rail system in Delhi. The GAL provides a direct entry from Gaziabad to New Delhi bypassing the congested Delhi Railway Station Complex. The DAL provides a direct passage from the major yards- Tughlakabad and Gaziabad directly into the Delhi - Ambala Kalka section and through Lajpat Nagar, Patel Nagar, Daya Basti and Azadpur link. There are four main railway stations at New Delhi, Old Delhi, Hazrat Nizamuddin and Sarai Rohilla besides container depots at Patparganj and Tuglakbad.

To improve connectivity of Delhi with the region rail projects for commuter travel have been identified as a part of regional rapid transit system. The

priority corridors in the projects include Delhi Palwal, Delhi Panipat, and Delhi Gaziabad. Besides there are proposals to extend the metro corridors to NOIDA and Gurgaon to cater to the demand of travel. These projects are under various stages of implementation. Two IRBT corridors of movement from Pul Bangash-Subzi Mandi -Narela and Badarpur to Tilak Bridge are included as a part of IMMRTS plan to be implemented by Railways by 2010.

### 11.3 TRAFFIC CHARACTERISTICS

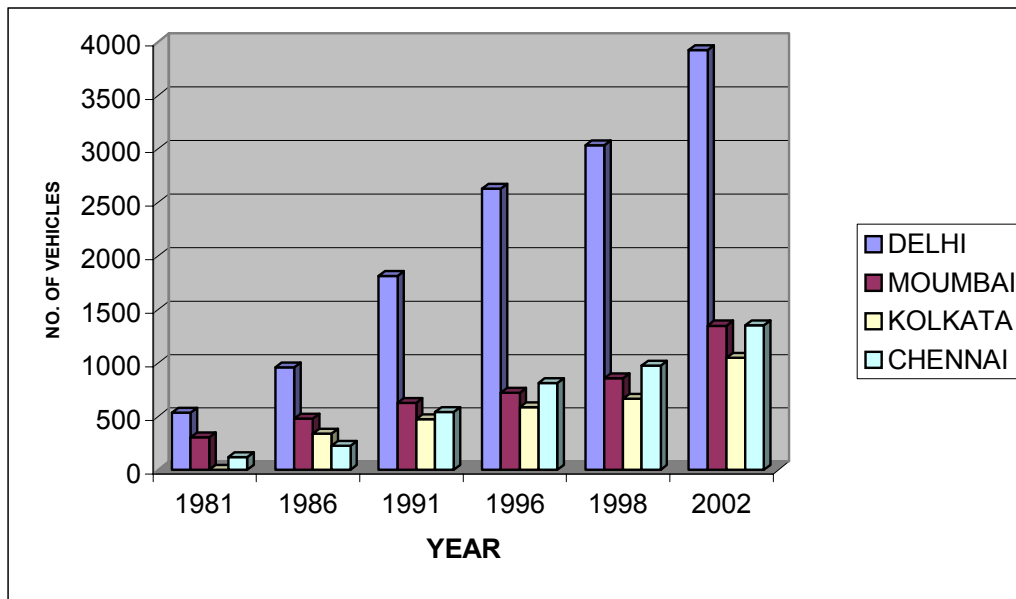
#### 11.3.1 Vehicular Growth Trends

There has been an exponential growth in number of vehicles on the road in Delhi, which increased from 2.14 lakh in 1971 to 5.36 lakh in 1981, 17.64 lakh in 1991, 34.54 lakh in 2001 and 45.5 lakh in 2005. This represents an annual compound growth of 6.5%, while the road length has increased at a rate of 2 % per annum. The total number of vehicles in Delhi is more than the total no. of vehicles in other three major metropolitan cities of Mumbai, Calcutta and Chennai, with a predominance of two wheelers and cars, used as private passenger vehicles. The growth trends of motor vehicles at National and mega city levels are presented in Table 11.2 and Figure 11.2.

**Table 11.2: Growth Trends of Motor Vehicles- India & Megacities (in '000)**

Year	All India	Delhi	Mumbai	Kolkata	Chennai
1981	5371	536	307	-	120
1986	10577	961	480	339	228
1991	21374	1813	629	475	544
1996	33783	2630	724	588	812
1998	40939	3033	860	664	975
2002	58924	3925	1350	1051	1354

Source : Motor transport Stat. of India, MoST



**Figure 11.2 : Trends in Growth of Motor Vehicles in four Metropolises**

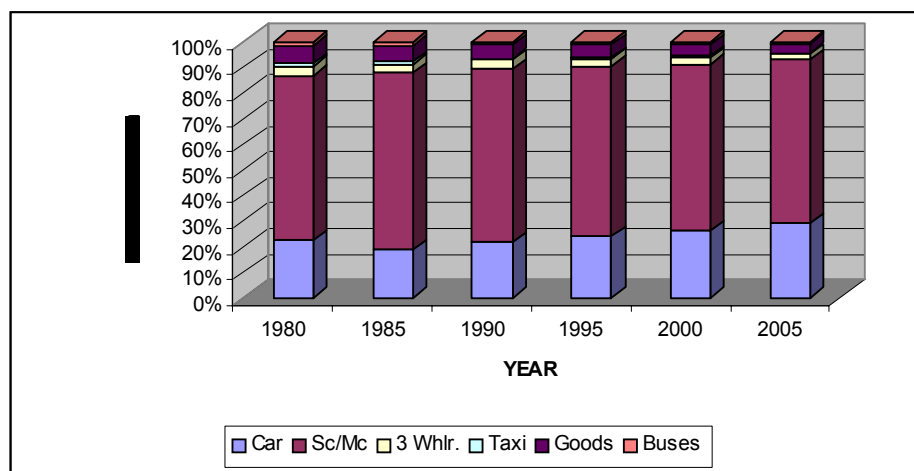
The trends of registered motor vehicles in Delhi is presented in Table 11.3. It can be observed that decennial growth rate is substantially higher in case of private vehicles (94.54%) as compared to commercial vehicles (18.22%). In the category of private vehicles, cars and jeeps has registered a decennial growth of 142.92%, which is highest among all categories of vehicles followed by two wheelers with 77.61%. In the commercial category of vehicles, buses have registered a decennial growth rate of 62.5% followed by taxies (33.33%) and goods vehicles (16.24%). Though there is decline in animal drawn vehicles; the number of slow moving vehicles is continuously on the increase, owing to the addition of cycles and cycle rickshaws every year.

The percentage distribution of categories of motor vehicles in Delhi shows that there has been a rapid increase in the number of cars during the decade while there has been a decline in the other categories of vehicles. About two third of motor vehicles are two wheelers though a decreasing trend in that share has been observed since 1990. On the other hand, due to the arrival of low priced small cars and easy financing mechanisms, there is an indication towards a shift from two wheelers to cars. The share of cars has increased from 22% in 1991 to 31% in 2005.

**Table 11.3: Trends of Registered Motor Vehicles in Delhi (In '000)**

Year	Car	Sc/Mc	3 Whlr.	Taxi	Goods	Buses	Total
1980	117	334	20	6	36	8	521
1985	175	637	31	9	59	14	925
1990	384	1191	62	10	99	19	1765
1995	618	1708	78	13	132	28	2576
1998	805	2077	86	17	149	35	3167
2000	910	2262	90	18	161	39	3480

Source : Delhi Statistical Handbook & Tpt. Dept.



**Figure 11.3 : Percentage Distribution of motor vehicles in Delhi**

The growth of private vehicles has resulted in an increased number of vehicles on the streets of Delhi increasing traffic densities, congestion, vehicle emissions and associated problems on road.

### 11.3.2 Road Accident Trends

The heterogeneity and magnitude of vehicle population, the unpredictability of human behavior, poor road geometry, deficiencies in vehicle and road design, and economic constraints are some of the factors leading to road accidents in Delhi. High growth rate of population & motor vehicles and road traffic vis-à-vis the road system and greater complexity of vehicular traffic on roads have contributed to the increasing number of accidents and especially the fatality rates. Table 11.4 shows the traffic accident trends in Delhi between 1980 and 2001. It can be observed that there are 28 accidents per day and 4 fatalities per day due to accidents.



Details of accidents reveals that pedestrians, cyclist and two wheeler riders are the most vulnerable road users accounting for 55%, 10% and 24% of total casualties in 1999. Fatalities mostly occurred among pedestrians followed by two wheeler riders. One of the most vulnerable groups w.r.t. irresponsible driving is the school child. The major killer roads (1999) include Ring Road, Outer Ring Road, Najafgarh road, Mathura road and Rohtak road. In the absence of adequate infrastructure facilities and procedural delays, accidents handling causes traffic hold ups and related pollution effects.

**Table 11.4: Trends in Accidents on Delhi Roads**

Year	Population ( Lakh )	No. of Vehicles (Lakh )	Road Deaths	Fatality Rate		Total Accident s
				Per lakh populatio n	Per 1000 vehicles	
1980	60.35	5.21	747	12.37	14.32	4300
1985	74.63	9.25	1269	17.0	13.71	6254
1990	89.10	17.65	1670	18.74	9.11	7659
1995	110.61	25.76	2070	18.71	8.04	10138
1998	122.81	31.67	2123	17.28	6.70	10217
2001	137.8	37.0	1842	13.37	4.98	9744

Source : Delhi Statistical Handbook

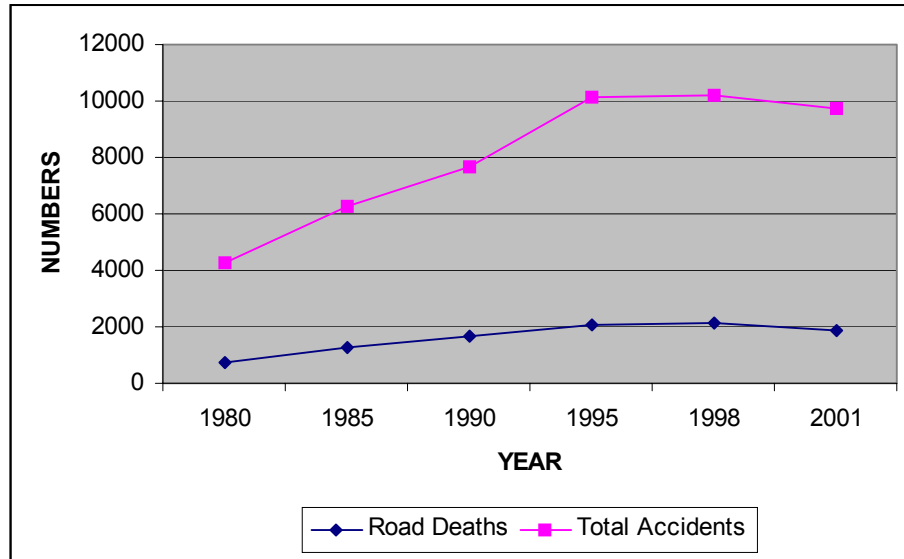


Figure 11.4 : Road Accidents Trends on Delhi roads

### 11.3.3 Traffic Characteristics

Delhi transport needs are basically met by road-based systems while the rail-based systems serve marginal needs. The basic modes of traffic in Delhi are buses, private vehicles, taxis, auto rickshaws, cycle rickshaws and cycles. The inadequacy of public transport becomes evident during peak hours when buses carry crush loads on them with passengers hanging on footboards and roads are choked with traffic moving at very low speeds.

#### Traffic Volume

Traffic intensities on the major roads of Delhi show constant increase. The construction of flyovers at various locations has only slowed down the process of congestion and delay. The adverse conditions have shifted from intersections to other locations. The roads capacities have reduced by encroachments and parking. A study was conducted on the city wide network in 2002 by C.R.R.I. for Govt. of India to assess urban road traffic. The traffic volumes recorded at 51 locations of Delhi are presented in Table 11.5. It can be observed from the Table that roads are carrying more than one lakh vehicles in the inner and middle areas of Delhi. Traffic is most critical on bridges across Yamuna - I.T.O. Bridge carrying the maximum traffic followed by Nizamuddin Bridge. The traffic is constantly increasing at a rate of about 2.5% per annum and heavy intensity of traffic is adding to the environment degradation of the city and in fact traffic is the largest contributor to pollution levels in Delhi.

After the construction of Metro corridor from Connaught Place to Ashok Nagar and new signature bridge near Wazirabad the traffic across river Yamuna is expected to ease out on existing bridges.

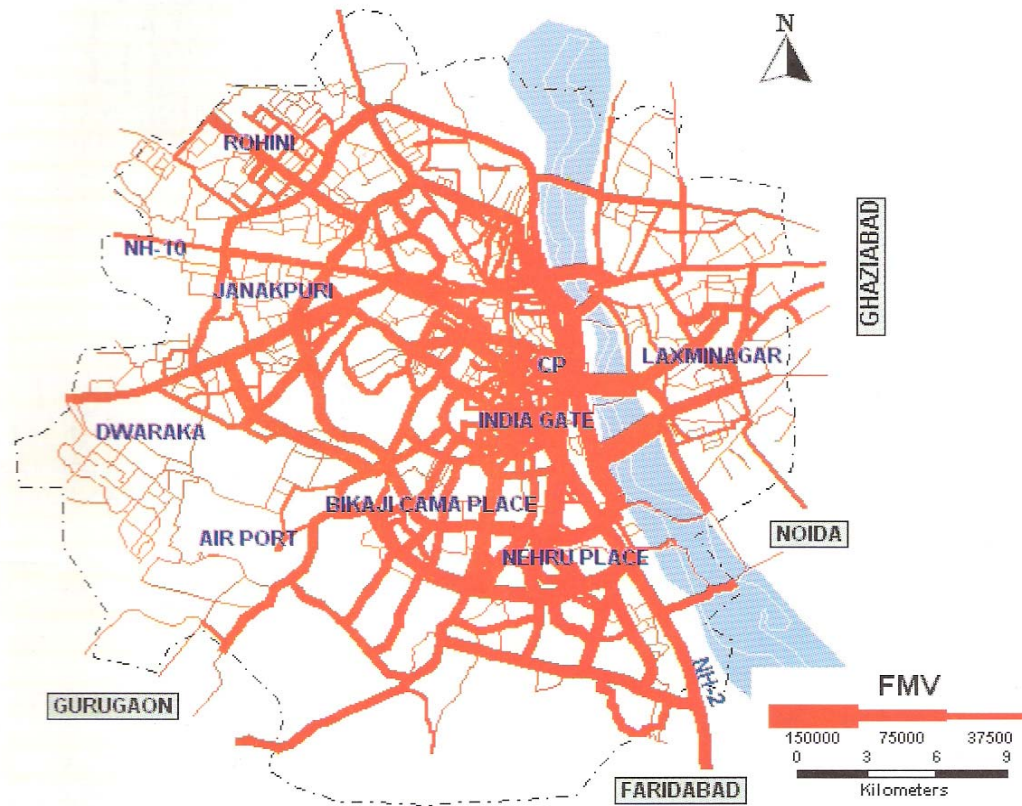


Figure 11.5 : Traffic Flow Pattern on road network in Delhi

### Traffic Composition

A broad analysis of the composition of vehicles in the inner, middle and outer areas are presented in Figure 11.6. It can be observed that proportion of cars has increased throughout Delhi and proportion of Intermediate Public Transport (IPT) modes like auto rickshaws / taxis has gone down from 1991 to 2002. The proportion of two wheelers has remained more or less same during the decade.

Table 11.5: Traffic Volumes on Major Arterial Roads in Delhi

S.No.	Location	Duration (Hours)	Traffic Volume	Traffic Composition (in percentage)					
				Cars	Auto	2 Whlr	Bus	Goods	Slow
1	Minto Road	16	98417	33.0	19.9	36.4	4.6	1.4	4.7
2	Punchkuin Road	16	90728	26.8	24.4	40.5	2.3	1.3	4.8
3	SBS Marg	16	36319	31.7	14.3	35.3	12.4	0.8	5.5
4	Sansad Marg	16	28329	33.7	16.0	31.8	14.6	0.7	3.2
5	Janpath	16	54634	51.1	18.9	23.4	2.8	0.6	3.1
6	Bara Khamba Road	24	39471	39.8	22.7	25.6	8.9	0.8	2.1
7	Netaj Subhash Marg	16	80671	22.5	24.1	27.9	10.8	1.1	13.6
8	Ring Road ( Rajghat )	24	111455	38.9	13.0	32.6	5.9	9.1	0.5

9	Tilak Marg	16	53932	36.6	19.1	32.1	6.3	0.8	5.1
10	Zakir Hussain Marg	16	96712	48.7	11.9	28.6	3.6	4.7	2.5
11	Mathura Road	16	110454	45.7	11.1	34.6	3.7	2.0	2.9
12	India Gate	16	108525	53.6	11.6	28.9	3.1	2.0	0.8
13	Lala Lajpat Rai Road	24	135411	49.9	12.5	31.2	2.4	2.5	1.5
14	Ring Road (Safdarjung )	16	72962	32.7	15.7	34.5	9.7	1.4	5.9
15	Aurobindo Marg	16	97085	47.8	14.4	26.8	8.4	1.2	1.3
16	Ring Road ( Naraina)	16	75813	40.2	8.3	37.2	5.9	5.9	2.5
17	Sardar Patel Road	16	62239	44.8	11.7	31.3	4.8	3.1	4.4
18	Shankar Road	16	78086	51.8	8.8	31.8	4.4	1.5	1.7
19	New Rohtak Road	16	88759	32.2	16.2	38.8	4.4	3.8	4.5
20	Ashok Vihar Road	16	53429	46.5	7.0	31.5	1.6	2.3	11.0
21	Sham Nath Marg	16	66479	43.3	9.6	31.9	9.4	2.5	3.3
22	Wazirabad Road	16	64965	17.2	9.9	26.7	13.7	10.6	22.1
23	ISBT Flyover	16	114379	15.7	11.3	39.8	5.5	6.7	21.1
24	G.T. Shahdra Road	16	67184	11.8	21.8	44.0	0.4	1.9	20.2
25	I.T.O. Bridge	16	166175	30.5	12.0	42.7	6.8	2.3	5.1
26	Nizamuddin Bridge	16	154955	48.2	5.7	35.6	3.8	2.8	4.0
27	Patpadganj Road	16	39634	17.4	7.1	34.3	4.5	1.6	35.1
28	Maa Anandmai Marg	16	76533	35.8	11.7	36.1	4.	4.7	7.7
29	Madangir road	16	80252	24.7	13.4	22.2	5.7	3.	31.0
30	Press Enclave Road	16	53984	48.4	9.7	28.4	3.2	2.2	8.2
31	Janak Setu	16	88450	46.9	7.0	38.1	5.5	1.4	1.1
32	Pankha Road	16	60501	20.8	6.2	29.0	6.9	2.3	35.0
33	Old Gurgaon Road	16	19056	26.8	3.3	31.3	8.3	11.8	18.4
34	Najafgarh Road	16	87202	20.5	5.8	39.8	5.2	2.0	26.7
35	Qutabgarh Road	16	36802	11.7	3.0	35.1	5.1	7.8	37.3
36	Auchandi Road	16	14735	13.9	3.5	27.4	7.8	12.4	34.9
37	Loni Road	16	91027	5.2	14.9	22.0	1.1	2.1	54.6
38	Ghazipur Road	16	31188	17.5	7.1	35.2	3.5	4.1	32.5
39	Pusa Road	16	65214	43.4	16.1	26.5	10.3	1.9	1.9
40	Ring Road(Ashram F.O)	24	51979	45.6	11.3	27.3	7.2	7.1	1.6
41	Africa Avenue	24	62863	44.6	10.7	31.2	5.2	3.5	4.8
42	C.P. ( Outer Circle )	24	68918	39.8	23.0	27.2	6.4	1.2	2.4
43	Mehrauli Road	24	59859	56.3	0.2	25.4	1.2	9.1	7.6
44	Rajokri Border ( NH 8 )	24	63851	50.6	0.4	28.8	3.4	13.1	3.8
45	Rohtak Road ( NH 10 )	24	25203	31.6	1.0	28.5	4.9	17.1	16.9
46	Karnal Road ( NH 1 )	24	30735	44.8	0.3	11.9	7.4	32.3	3.3
47	G.T.Road ( Old NH 1 )	24	33621	27.9	1.8	30.0	3.8	21.9	14.7
48	NH 24 Bypass	24	52329	33.4	6.7	28.0	2.4	6.9	22.6
49	NOIDA Link Road	24	62173	41.4	4.4	27.9	2.7	15.8	7.8
50	Mathura Road ( NH 2 )	24	84195	39.2	1.9	29.6	2.7	14.6	11.9
51	Wazirabad Road	24	29713	23.1	3.2	25.5	3.3	12.2	32.7

Source : C.R.R.I. Study 2002

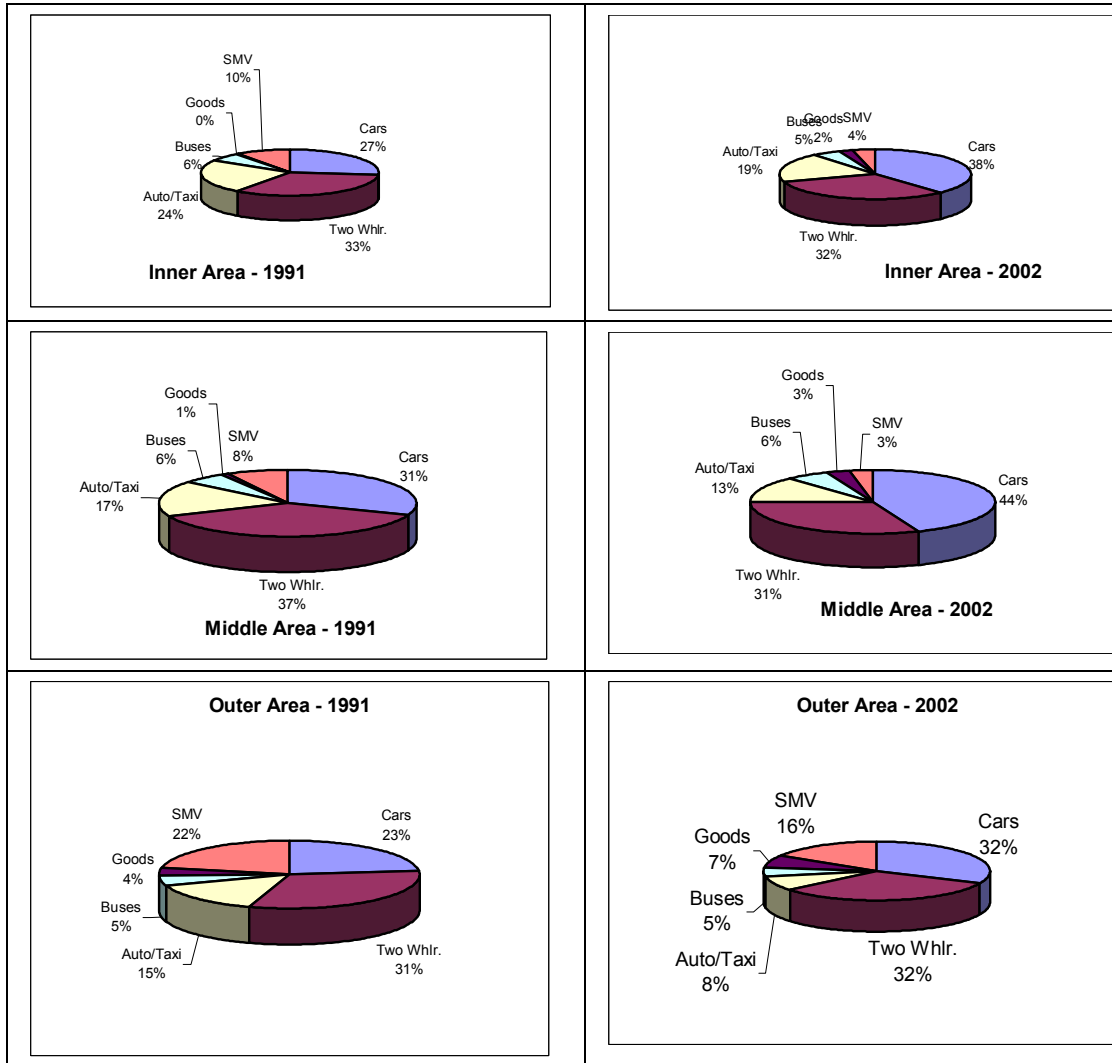


Figure 11.6 : Comparison of Traffic Composition on major arterial roads in Delhi-1991 & 2002

### Peak Hour Traffic Characteristics

Peak Hour Traffic volumes of Ring Road are presented in Table 11.6 and peak hour traffic on some prominent roads in the Central areas is given in Table 11.7. The traffic pattern on the Inner Ring shows that there is a steady increase in the v/c (volume / capacity) ratio from 1990 to 2004. In Central areas the volumes have reached saturation levels on major roads.

Heavy traffic is observed at all major locations on the outer cordons of Delhi and most of the locations are choked with traffic in peak hours. This is evident from Table 11.8 - it can be observed that the v/c ratio during peak hours at most of the prominent locations is more than one. The traffic characteristics at these urban arterials highlights the intense interaction of Delhi with Gurgaon, Faridabad, Noida, Loni and Gaziabad. Intercity traffic enters Delhi from 87 locations, of which 42 locations have tolling stations of GNCTD.

Table 11.6: Peak Hour Traffic Volumes on Ring Road

S.No.	Segment	Peak Volume ( PCU per hour )		Volume / Capacity Ratio	
		1990	2004	1990	2004
1.	Dhola Kuan to Raja Garden	6200	10726	0.78	1.34
2.	Raja Garden to Azadpur	6200	9904	0.56	0.90
3.	Azadpur to I.S.B.T.	5700	6503	0.52	0.59
4.	I.S.B.T. to B.S.Gurudwara	5800	7714	0.53	0.70
5.	B.S.Gurudwara to AIIMS	7300	12493	0.66	1.14
6.	AIIMS to Dhola Kuan	6100	13617	0.55	1.24

Source : P.W.D.-1990 & IL &FS-2004

**Table 11.7: Peak Hour Traffic Volumes in Central Areas**

S.No.	Location	Volume / Capacity Ratio	
		Morning Peak	Evening Peak
1.	Ashoka Road	0.91	0.89
2.	Bara Khamba Road	0.96	0.94
3.	Janpath	0.84	0.92
4.	Outer Circle, C.P.	0.93	0.87
5.	Sansad Marg	0.63	0.54
6.	K.G.Marg	0.63	0.61
7.	Inner Circle C.P.	0.71	0.87
8.	Punchkuin Road	1.04	0.98
9.	Tolstoy Marg	0.57	0.58
10.	Rajpath Road	0.31	0.34

Source : RITES survey 2005.

**Table 11.8: Peak Hour Traffic Volumes on Outer Cordons of Delhi**

S.No.	Location	Peak Volume ( PCU per hour )		Volume / Capacity Ratio	
		Morning	Evening	Morning	Evening
1.	Singhu Border( NH1)	2539	4463	0.53	0.93
2.	Badarpur Border (NH1)	5453	4554	1.13	0.94
3.	Rajokai Border(NH8)	4514	7020	0.63	0.97
4.	Shahadra ( NH24)	4959	3763	1.03	0.78
5.	Kalindi Kunj	5951	6411	1.24	1.34
6.	M.G.Road(Aaya Nagar )	7358	6794	1.02	0.94
7.	Old Gurgaon Road	3603	4805	0.75	1.00
8.	Tikri Border ( NH10)	3125	5444	0.65	1.13
9.	Gazipur ( NH24 Bypass )	4522	4200	0.84	0.77
10.	Mohan Nagar Border	3769	6937	0.69	1.28
11.	Loni Border	7559	5781	1.05	0.80
12.	NOIDA link Road	4595	5287	0.96	1.10

Source : RITES Survey, 2005

### Traffic at Intersections

City main intersections are loaded with traffic much beyond their handling capacities leading to heavy stopped delays especially in peak hours. Most intensely loaded intersections in terms of number of vehicles are I.T.O. intersection (1,98,970), Moti Nagar intersection (176,866), Jhandewalan Intersection (1,70,296), Jageer Palace intersection (1,69,935), Laxmi Nagar intersection (1,55,852), Madhuban Chowk (1,46,693), Azadpur Intersection (1,42,163), Tagore Park intersection (1,40,613), Ashram Chowk (1,39,749) and Africa Avenue -Outer Ring Road Intersection (1,37,986). The traffic volumes were recorded in 12 hour duration in 2002 by CRRI in their study for Auto Fuel Policy for GOI.

#### 11.3.4 Traffic speeds

Speed characteristics on the major arterial road network of city are presented in Table 11.9. It can be observed that during morning and evening peak hours 55 % to 60 % of the major arterials have travel speeds less than 30 kmph, while in even off peak hours 40 to 45 % of major arterials have travel speeds less than 30 kmph. About 20% or more of the arterial road network is operating under highly congested conditions with travel speeds falling below 20 kmph throughout the day. There is very little change in speeds during peak and off peak periods and the network is operating at its capacity. Any disturbance in traffic flows create long queues and delays to traffic.

**Table 11.9: Speeds on Major Arterial Roads in Delhi**

Speeds	Morning peak		Evening Peak		Off Peak	
	Direction 1	Direction 2	Direction 1	Direction 2	Direction 1	Direction 2
< 50 Kmph	4.87	3.76	1.8	4.15	5.42	6.68
45-50 Kmph	4.42	3.01	1.44	6.06	4.93	3.02
40-45 Kmph	11.05	7.26	5.54	8.47	8.02	13.61
35-40 Kmph	18.63	13.67	15.78	11.08	19.09	14.99
30-35 Kmph	17.62	13.31	18.99	1.07	19.73	18.23
25-30 Kmph	1.93	20.37	15.52	17.15	12.91	12.68
20-25 Kmph	18.54	17.4	13.9	15.62	10.67	11.91
> 20 Kmph	13.94	21.21	27.03	19.4	19.23	18.89

Source : CRRI Study, 2006. Note : All values are in percentage

### 11.3.5 Parking

Daily trips made by personalized modes require parking spaces at both ends of the trip. There is a huge gap in the demand and supply of parking spaces which leads to spill over of parking on the road. There is lack of proper planning and management of parking facilities. Inadequate and inefficient public transport systems leads to greater use of private modes of transport. A car is parked for 90 to 95% of time at residence or place of work. Land resources in the city are limited and scarce, while the increase in parking demand is high. Inadequate parking adds to congestion and delays on major arterial roads. Current parking demand and supply at some of the prominent locations of the city are presented in Table 11.10.



**Table 11.10: Parking Demand at Prominent Locations in Delhi**

S. No.	Location	Peak Demand ECS	Peak Supply ECS	Shortfall (%)
1.	Connaught Place	5342	2986	44%
2.	Outside Connaught Circus	5894	3282	44%
3.	Nehru Place	7713	3717	52 %
4.	Lajpat Nagar	2604	1598	39%
5.	Chandani Chowk	4572	2102	54%
6.	Sadar Bazar	1762	1113	37%
7.	Kamla Nagar	3333	1806	46%
8.	Ajmeri Gate	2176	1217	44%
9.	Darya Ganj	5423	3100	43%
10.	Krishan Nagar	1297	1091	16%
11.	Karol bagh	5352	3585	33%
12.	South Extension	2357	1584	33%
13.	Bikaji Cama Place	3940	2040	48%

ECS = Equivalent Car Space

Right of way on roads in most of the residential areas is encroached for on street parking as the vehicle ownership levels have gone very high. The space for parking in the private plots as per code/bylaws provisions is being used for other purposes putting a stress on the city infrastructure.

## 11.4 TRAVEL CHARACTERISTICS

### 11.4.1 Intra Urban Movements

As per the household survey in the study area conducted in 2001 by RITES Limited, a total of 176 lakh trips are being performed per day. The per capita trip rate in the study area has been estimated at 1.27 (PCTR of 1.1 in 1993-94). The per capita trip rate for vehicular trips is observed to be 0.87 compared to 0.76 PCTR in 1993-94. PCTR of inter zonal trips is estimated at 0.76 while that of intra zonal trips is 0.51.

The modal share of passenger trips in the study area is presented in Table 11.11. About 33% of total trips are walk trips, while among the vehicular trips 60% of trips are performed by buses including chartered and school buses plying in the area. Personalised vehicle trips have a share of 27 % of vehicular trips in the study area.

**Table 11.11: Modal Share of Passenger Trips**

S. No.	Mode	Passenger Trips ( in % age )
		2001
1.	Bus	59.8
2.	Car/Jeep	10.3
3.	Two - Wheeler	17.2
4.	Auto Rickshaw	3.1
5.	Cycle	5.3
6.	Train	0.7
7.	Other	3.6

Source : RITES Survey, 2001

The average travel time in the city by all modes is observed to be 30 minutes. Average travel time by public transport including bus, chartered bus and train is observed to be 49 minutes and more, while travel time by other private modes is between 15 minutes to 30 minutes. Distribution of trips by mode and travel time is presented in Table 11.12.

**Table 11.12: % Distribution of Trips by Mode and Travel Time**

Mode	Travel Time ( in minutes )					Average
	< 15	15-30	30-60	60-90	> 90	
Sc/Ms	18.9	44.72	31.05	4.84	0.40	27
Car	17.4	42.75	34.07	4.96	0.74	32
Auto	20.1	49.45	25.34	4.36	0.73	29
Cycle	34.3	40.37	18.80	4.93	1.54	25
Rickshaw	42.4	54.87	2.59	-	0.11	16
Bus	2.94	23.42	42.77	24.01	6.86	49
S.Bus	8.43	43.13	43.64	3.97	0.83	32
C.Bus	1.46	10.77	55.66	24.82	7.29	55
Train	8.64	1.23	58.03	25.93	6.17	51
Walk	81.1	18.59	0.19	-	0.10	10

Source : RITES Survey, 2001

The modal share of public transport system has to be increased and given priority in all our plans and policies to meet the increasing demands of traffic. Walk trips also constitute for more than one third of the total trips performed per day and accordingly pedestrian facilities need to be improved from place of origin to destination.

#### 11.4.2 Intercity Movements

The outer cordon surveys conducted at 15 locations of Delhi border revealed that 1.53 million trips were performed on an average day. Out of these 67% are performed by public transport and the rest were by private modes. About 13 %

of total intercity trips were estimated to be passing through the city with neither origin nor destination in the city. O-D Pattern of trips at outer cordons is presented in Table 11.13.

**Table 11.13: O-D Pattern of Trips at Outer Cordons**

MODE	NUMBER OF TRIPS PER DAY			
	Internal to External	External to Internal	External to External	Total
BUSES	458031(44.5)	441103(42.8)	130330(12.7)	1029464 (100.0)
CAR	152302 (43.8)	147314(42.4)	47765(13.8)	347381 (100.0)
TWO WHLR.	67281(42.9)	67169(42.8)	22323(14.2)	156773 (100.0)
TOTAL	677614 (44.2)	655586(42.7)	200418(13.1)	1533618 (100.0)

Source : RITES survey,2005

Survey at 43 railway stations in Delhi revealed that about 1.0 million trips were performed by rail per day. Out of these about 9% trips were moving within the city while the rest 91% were intercity trips.

### FREIGHT MOVEMENT

Rail Terminals are controlling a bulk of freight traffic which terminates at various locations in Delhi like Tuglaqabad, Delhi Cantt., Narela, Ghevra, I.P.Depot, Naya Azadpur, Shakurbasti and Delhi Safdarjung. A large share of freight movement by road is handled by entry points at NH-8, NH-1, NH-24 and Kalindi Kunj. On an average day (in 2004) about one lakh goods vehicles crossed the Delhi Borders with an average day payload of 1.5 lakh tones. Freight movement on major arterials is presented in Table 11.14. It can be observed that modal share of goods traffic is varying from 4% to 33 % at different locations.

**Table 11.14: Goods Traffic Movement in Delhi**

S.No.	Location	Goods Traffic	Total traffic	Modal Share of Goods ( %)
1	G.T.Karnal Road	15991	48897	33%
2	Mathura Road	9126	72906	13%
3	Rajokari Border	12555	80438	16%
4	G.T.Road,Shahdra	9989	57993	17%
5	Kalindi Kunj	10880	95565	11%
6	MGRoad,Aaya Nagar	3661	95306	4%
7	Mandoli Border	5211	54470	10%
8	Kapashera Border	6714	50011	13%
9	Rohtak Road	7729	42771	18%
10	Gazipur Border	6198	66806	9%
11	MohanNagar	3045	74299	4%
12	Loni Border	4718	84915	6%
13	Challa Barrage	4592	64140	7%
	Total	100409	888517	11%

Source : RITES survey,2005

#### 11.4.3 Public Transport & Para Transit System

In any large city, mass transport facilities play an important role in catering to travel demand for work, education and social activities. The present mass

transport system in Delhi comprises of bus service by Delhi Transport Corporation; private operators and contract carriages; and rail services through ring railway and suburban trains operated by Northern Railway; and Delhi Metro Rail operated by Delhi Metro Rail Corporation. The existing public transport system is grossly inadequate in terms of quality, quantity and coverage, and can not cope with ever increasing travel demand.

#### 11.4.4 City Bus Service

Till 1992, Delhi Transport Corporation (DTC) was the primary agency for providing the mass transport service, when private buses under the control of the Transport Department were first introduced to supplement the DTC fleet. Today DTC operates 786 city and 131 inter state routes with average route length of 22.4 Km. and 296.4 km. respectively. As per records, in January 2000 the fleet strength of DTC comprised of 3088 DTC buses; and 2593 private buses under DTC operation, totaling to 5681. The present DTC fleet is plagued with overage buses resulting in inefficiency in operation and economic loss.

Besides DTC, intercity bus service is also provided by nearly 2600 individually owned private buses. The existing system suffers from:



- Lengthy, zigzag and overlapping destination oriented routes:
- Maldistribution, low frequency of buses along different routes
- Absence of published information
- Disorganized private bus operation
- Fierce competition, over speeding and non-observance of traffic rules by private operators
- Inadequate enforcement and regulatory machinery.

A new corridor of High Capacity Bus System is being implemented from Ambedkar Nagar to Moolchand Hospital in 2006. Also a new company has been formed by Transport Department Govt. of Delhi to integrate mass transport by various modes of travel, named Delhi Integrated Multimodal Transport Systems Ltd. (DIMTS).



#### 11.4.5 Ring Railway

The ring railway was constructed in the 1930's as the goods avoiding line but its role in intra-urban service is being emphasized since last 40 years. The existing

system which was built at the cost of 340 million rupees and was expected to cater about 12% of the total commuter load, has proved a non-starter, catering to less than 1% of the load. The reason for this are;

- Dependence on availability of goods avoiding lines
- Absence of integration with feeder bus operations
- Absence of commuter facilities at stations
- Inconvenient access of platforms to commuters.
- Lack of development along the railway corridor
- Unattractive fare structure
- Competitive and attractive parallel bus service

The ring railway service could be significantly improved by integrating it with radial lines and MRTS systems.

#### 11.4.6 Delhi Metro Rail



As many as 35 studies were conducted by various agencies since 1960 to find a lasting solution to the transport problems of Delhi but none of them reached any purposeful stage .The first decisive step to introduce an MRTS was taken after the feasibility study by RITES, which was completed in 1990. It recommended a rail based system, comprising of a network of underground, elevated and surface

corridors aggregating to 198.5 Km to meet the travel demands.

#### 11.4.7 MRTS Phase-I

The Mass Rapid Transit System (MRTS) is an ambitious project that aims at providing a non- polluting and efficient rail-based transport system, properly integrated with the road transport system. The first phase of the Metro with a total length of 65.1 km. has been completed at an estimated cost of Rs. 10571 crore, and put to operations in March 2006. The details of the corridors is shown in Table 11.15:

**Table 11.15: Details of Metro Corridors - Phase I (Completed) and Phase II (on-going)**

Phases	Lines Nos	Corridors Description	Length (Km)
Phase-1 (2001-	1	Shahdara-Trinagar-Rithala	22.00

2005)			
	2	Vishwa Vidyalay- Central Secretariat	11.00
	3	Barakhamba Road-Cauuaught Place- Dwarka	22.80
	3 Extn.	Extension of Line No 3 Barakhamba Road- Indraprastha	2.80
<b>Phase – 1A</b>	3A	Extension of Line No. 3 into Dwarka Sub-city	6.50
		<b>Total</b>	<b>65.1</b>
<b>Phase-2 (2006-10)</b>	2A	Extension of line 2 from Vishwa Vidyalay to Jahangirpuri	6.88
	2B	Extension of line No 2 from Central Secretariat to Qutab Minar	10.77
	3B	Extension of Line No 3 from Indraprastha to New Ashok Nagar	8.07
	4	Shahdara to Dilshad Garden	3.09
	5	Kirtinagar to Mundka	18.50
	6	Yamuna Bank to Anand Vihar ISBT	6.20
		<b>Total</b>	<b>53.51</b>

### MRTS Phase-II

On completion of Phase-I, Phase-II work has been started which includes corridors with a total length of 53.51 km and is expected to be completed by 2010. The estimated cost of completion, at current prices, is Rs. 8500 crore. The details of the corridors are presented in the table above.

Metro rail is a high capacity mode and will serve the main traffic corridors in Delhi. There are a large number of other corridors that require medium capacity modes as feeders to Metro or otherwise.

The metro is being funded through a loan from the Japan Bank for International Cooperation.

#### 11.4.8 Proposed Integrated Multi Modal Transport System For Delhi

To be effective, public transport has to be integrated, multi modal, and environmentally, socially and financially sustainable. The Metro forms part of a larger Integrated Multi Modal Transport System proposed for the city, including also the following transport systems:

<u>Modes</u>	<u>Corridors</u>	<u>Length</u>
Metro	6	118.6 Km

At-grade HCBS	26	294 Km
Elevated LRT	6	74 Km
Elevated Monorail	3	48 Km
IRBT	2	44 Km

The 6 Metro corridors and the 2 IRBT corridors from a part of the existing DMRC and the NCCRPB plans respectively. The 6 Metro corridors remain unchanged except in the case of two corridors that are proposed to be extended. The proposed network includes 14 corridors that are in the nature of collector routes to serve areas at some distance from the planned major public transport routes. Another 16 corridors are radial that normally would be direct origin to destination routes and hence will meet the objective of minimum interchanges. There are 13 circular routes that will interchange with the radial routes. The overall network of radials and circular corridors has formed a grid and hence most commuters should not need more than or two interchanges to reach their destination. There will be 42 major and 77 minor interchange locations on the proposed network. Common ticketing and passenger information display are proposed to be developed.

With the modal split of 80% public transport is expected to carry 24 million trips by 2021. Metro rail and IRBT, if implemented as planned, are estimated to carry about 15 million trips per day; and the balance 9 million trips are to be catered to by other public transport systems.

#### 11.4.9 Intermediate Public Transport System

Intermediate public transit in Delhi mainly comprise of Mini buses, RTV and Phat phat sewa, while the Personalised public transport services includes cycle rickshaws, three wheeler and taxis. These paratransit modes play a major role in catering to the intra urban travel demand of the city. Though their modal share of trips is only 3.1%, it will remain an integral part of the urban transport system. The cycle rickshaws, though a menace on some of the arterial roads of the city, provide a vital low cost pollution free service, which is most appropriate for certain localities.

#### 11.4.10 Interstate Bus Terminals

Delhi attracts significant movement of passengers primarily from DMA towns and NCR towns besides some other towns of neighboring states. Interstate bus operations were started from Kashmiri Gate ISBT in 1975. High growth of interstate bus operations led to the development of two new ISBT's at Sarai Kale Kan and Anand Vihar in 1998 and a total of three ISBT's are operating at present. These three ISBT's cater to an average 3.70 lakh passengers and 5235 bus trips per day. Two more directional ISBT's at Dwarka and Narela are proposed, while the ISBT at Sarai Kale Khan is proposed to be upgraded to higher standards.

Apart from above terminals interstate buses operate from Bhajanpura, R.K.Puram, NDRS, Karampura, Safdarjung, Shivaji Stadium, Nehru Place, Narela, Karol Bagh and ITO, besides several roadside bus stops. Bus operation

and termination at points other than terminals affects the viability of bus terminals and also creates congestion on the roads.

#### **11.4.11 Inland Water Transport**

The Inland Waterways Authority of India (IWAI) conducted studies for navigational potential of river Yamuna for passenger and cargo service, development of water sports, recreational activities and for the improvement of the environment in Yamuna. No action in this regard could be taken as water level goes down to almost nil in summers making it difficult for the introduction of this kind of facility.

#### **11.5 EMERGING ISSUES**

- i. High growth rate of vehicles and heavy vehicular volumes on road causing congestion, delay, safety, pollution.
- ii. Ineffective utilization of road space- on street parking, encroachments, lack of pedestrian facilities.
- iii. Improper road design - No consideration for disabled and pedestrians on road.
- iv. Inadequate and inefficient public transport system - need to address transport system for masses according to their affordability.
- v. Lack of integration of land use & transport system.
- vi. No provision for environment friendly modes like cycles and cycle rickshaws in road design.
- vii. Inadequate parking at major commercial areas and work centers and lack of proper parking policy.
- viii. Intermixing of local and regional passenger and goods traffic.
- ix. Lack of coordination in implementing agencies at city as well as regional context.
- x. Lack of user system interface and transport information.
- xi. Lack of adequate enforcement and implementation of planned schemes.