सत्यमेव जयते

REPORT OF THE HIGH POWERED COMMITTEE ON DECONGESTING TRAFFIC IN DELHI

Ministry of Urban Development
Government of India

Photo: India Gate, New Delhi


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SHYAM ARTS
POLICE
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Photo : Chandni Chowk, New Delhi

Message

Minister of Urban Development, Housing & Urban Poverty Alleviation and Parliamentary Affairs

Government of India

Cities are engines of economic growth. With urban population of 31%, cities contribute more than 60% of the national Gross Domestic Product (GDP). As an effort towards urban renaissance, my Ministry has initiated various missions for improving the urban infrastructure to serve the need for growing population.

Inadequate mobility facilities is a big constraint that badly hampers the creative hours of the urban population wasting time in the traffic congestion. The harrowing experiences on the roads severely dent the advantage of economic agglomeration. This problem is more so in the metropolitan cities like Delhi, Mumbai, Kolkata and Chennai. Concerned with the citizens challenges, I set up a High Powered Committee under the chairmanship of Secretary (Urban Development) in October, 2014 for suggesting measures for decongesting Delhi traffic.

I am happy that the Committee has done out-of-the-box thinking and made various innovative recommendations. The Committee has rightly recommended for improving public transport and reducing use of private vehicles. It has laid emphasis on improving walkability, use of non-motorised transport, multi-model integrated transport system, inter-linked city transport in National Capital Region (NCR), transit oriented development and capacity building. It has suggested strict enforcement of parking rules, junction improvements, removing choking points and improving network connectivity without laying more emphasis on flyovers, under-passes etc., which only provide short term solutions.

I had announced Rs.3,250 crore assistance from Urban Development Fund (UDF) in Nov. 2015 for undertaking junction improvements, providing missing link and removing choking points in Delhi. Works is in progress on these.

I am sure, if the recommendations are acted upon by Delhi Government and all concerned agencies within the indicated time frame, residents of Delhi will get great relief in moving across the city. This will usher good days ahead for Delhiites!

June 2016

Shri M. Venkaiah Naidu

Message

Union Minister of State
Urban Development,
Housing & Urban Poverty
Alleviation

Government of India

Urban transport plays a very important role in making cities liveable and sustainable. In absence of adequate facilities for mobility of people and movement of logistics, the city gives a depressive look. Delhi, despite having one of the highest density of roads in the world and state-of-the-art Metro Rail, faces a lot of congestion problem daily.

I am happy that on the directions of Hon'ble Urban Development Minister, the ministry has come out with a report on "How to Decongest Traffic in Delhi". The report has been prepared on the vision and objectives of the National Urban Transport Policy - 2006. It emphasizes on provision of NMT infrastructure, public transport, TOD, ITS, Parking Management to control vehicles on the road, freight movement etc. It has also deliberated upon connectivity in the National Capital Region, and construction of East-West & North-South corridors on priority so that unwanted traffic does not enter into Delhi.

I congratulate the Committee and all those who have contributed directly and indirectly to complete this task. I am very hopeful that the recommendations of the Committee will be implemented by Delhi Government and other concerned agencies in a time bound manner and provide relief to the citizens of Delhi and neighboring cities.

Best Wishes

June 2016

Shri Babul Supriyo

Acknowledgement

Ministry of Urban Development,
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For various global leaders, industrialists, financial investors, the Capital City of Delhi epitomizes our country. When they come to Delhi, the environs, the streets, the roads, the people of Delhi mould their perception about India. Delhi is the city of opportunities for its nearly two crore citizens. Post-independence, the city has grown very rapidly and a more liveable city, in size and its population. This report aims at clearly defining actionable steps, which will make Delhi congestion free.

Hon'ble Minister of Urban Development, Shri Venkaiah Naidu constituted a High Power Committee under the chairmanship of Secretary, Urban Development to study and suggest measures to decongest Delhi, in October 2014. The Hon'ble Minister guided the committee to focus on the "people" agenda and to keep the citizens of Delhi at the center of the thought process and deliberations of the committee.

Ministry of Urban Development is thankful to all the stakeholders who participated, deliberated and provided valuable suggestions and inputs in the making of this report. We wish to thank all Central Ministries namely Railways, Road Transport & Highways, Defence, Home Affairs, other Central organizations viz, Delhi Police, DDA, NCRPB, IUT, DMRC, NHAI and Government of National Capital Territory of Delhi for assisting in the preparation of this report, which we hope, will lead to many important initiatives and projects for decongesting traffic in the city of Delhi.

The contribution of leading newspapers in highlighting the issue of congestion in Delhi has been invaluable towards this report. The committee has referred to the concerns raised therein while formulating the initiatives in this report.

The Ministry would like to thank UTTIPEC & CGM who actively assisted the committee in the preparation and finalization of the report. The report has benefitted from the inputs of CSE, DIMTS, ITDP India and WRI India. A special thanks to Dr. O P Agarwal, Senior Urban Transport Specialist, World Bank for his inputs to the report.

Officers in the Urban Transport Division of the Ministry led by Shri Durga Shanker Mishra, Additional Secretary have worked very hard in consolidating and collating all ideas in a comprehensive implementable report.

The Ministry acknowledges the contribution of KPMG India in designing the report.

June 2016

Rajiv Gauba
Secretary

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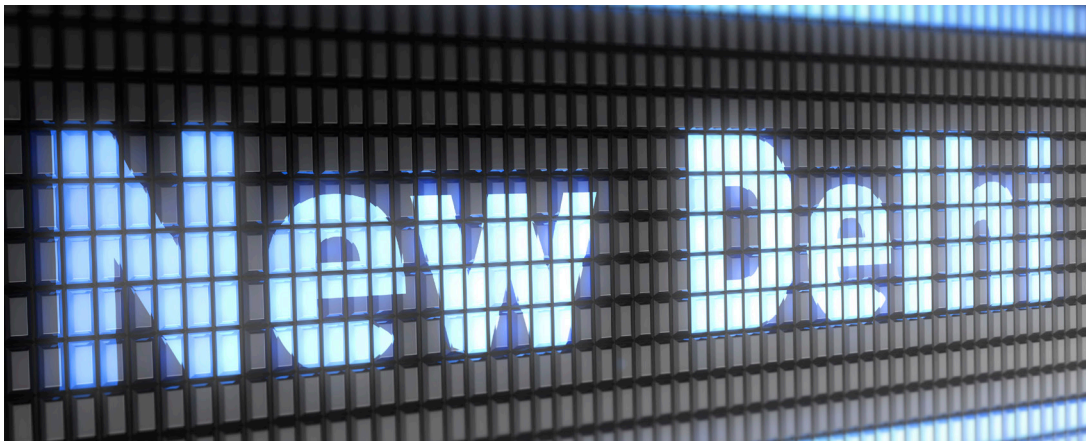
Glossary

AFCS	Automatic Fare Collection System
ANPR	Automatic Number Plate Recognition
APMS	Automated Parking Management System
BPTS	Bus based Public Transport System
BRTS	Bus Rapid Transit System
CCTV	Closed Circuit Tele Vision
CGM	Centre for Green Mobility
CNCR	Central NCR
CNG	Compressed Natural gas
CPCB	Central Pollution Control Board
DDA	Delhi Development Authority
DFCs	Dedicated Freight Corridors
DIMTS	Delhi Integrated Multi-modal Transit System
DMRC	Delhi Metro Rail Corporation
DOT	Department of Transportation (GNCTD)
DPCC	Delhi Pollution Control Committee
DTC	Delhi Transport Corporation
DUMTA	Delhi Unified Multi-modal Transport Authority
EE	External - External
EI	External - Internal
EPCA	Environment Pollution Control Authority
ETVMs	Electronic Ticketing / Ticket Verification Machines
EWS	Economically Weaker Section
FAR	Floor Area Ratio
FMP	Freight Master Plan
FOB	Foot Over Bridge
GCM	Gross Cost Model
GNCTD	Government of National Capital Territory of Delhi
GPS	Global Positioning System
HDFC	Housing Development Finance Corp. Ltd
HOV	High Occupancy Vehicle
IE	Internal - External
IMMTP	Integrated Multi-modal Transport Plan
IPT	Intermediate Public Transport
IPTN	Integrated Public Transport Network
IRC	Indian Road Congress
IRORC	Inner Regional Orbital Rail Corridor
ISS	Intelligent Signalling System
ITDP	Institute for Transportation and Development Policy
ITS	Intelligent Transport System
IUT	Institute of Urban Transport
IZP	Influence Zone Plans
JAM	Jandhan Aadhaar and Mobile System
LCV	Light Commercial Vehicle
LTA	Land Transport Authority
MCD	Municipal Corporation of Delhi
MLCP	Multi-Level Car Parking
MFZ	Multi-Functional Zone
MMI	Multi Modal Integration
MoUD	Ministry of Urban Development
MPD	Master Plan of Delhi
MRTS	Mass Rapid Transit System
MUZ	Multi-utility Zone
MV	Motorized Vehicle
NCM	Net Cost Model
NCR	National Capital Region
NCRPB	National Capital Region Planning Board
NCRTC	National Capital Region Transport Corporation
NCTD	National Capital Territory of Delhi
NDMC	New Delhi Municipal Council
NMSH	National Mission on Sustainable Habitat
NMT	Non-Motorized Transport
NMV	Non-Motorized Vehicle
NUTP	National Urban Transport Policy
OCC	Operations Control Centre
PHPDT	Peak Hour Per Direction Trips
PIS	Passenger Information System
PMD	Parking Management Districts
PPH	Persons Per Hectare
PPP	Public Private Partnership
PT	Public Transport
PWD	Public Works Department
RLSVDS	Red Light Camera and Stop Line Violation Detection System
RORC	Regional Orbital Rail Corridor
ROW	Right of Way
RRTS	Regional Rapid Transit System
RTV	Road Transport Vehicle
SPV	Special Purpose Vehicle
STIF	Syndicat des transports d'Île-de-France (Transport Syndicate of the Paris Region)
TDFS	Transport Demand Forecast Study
TFL	Transport For London
TOD	Transit Oriented Development
TSP	Transportation System Plan
TSR	Three-wheeled Scooter Rickshaws
UMTA	Unified Multi-modal Transport Authority
UTTIPEC	Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre
V/C	Volume/Capacity
VMS	Variable Message Sign
WRI	World Resources Institute

Introduction



BACKGROUND

The National Urban Transport Policy (NUTP) notified by MoUD states the objective that the goal of mobility in cities is on moving more people rather than vehicles more efficiently. Congestion caused by vehicles is a major problem in Delhi. Several newspapers, with the help of subject experts, highlighted the issue of congestion and pollution in Delhi and tried to bring the issue to the forefront. Honorable Minister of Urban Development constituted a High Powered Committee to prepare a Detailed Action Plan on "How to Decongest Delhi." Key stakeholders (Refer list on page 12) attended and deliberated on important issues and recommended strategies to decongest Delhi.

Master Plan of Delhi (MPD) 2021 notes that the period between 1981 and 2001 and subsequently 2011 has seen a phenomenal increase in the growth of vehicles and traffic in Delhi. There has been a rise in per capita trip rate (excluding walk trips) from 0.72 in 1981 to 0.87 in 2001 and exponentially more in 2011. Keeping in view the population growth, this translates into an increase from 45 lakh trips to around 118 lakh trips in 2001 and 144 lakh trips till 2008. As per the Transport Demand Forecast Study (TDFS) undertaken by GNCTD and approved by the UTTIPEC in 2011, it is seen that between 2001 and 2008, the private motor vehicle trips have increased from 28% to 35% and non-motorized vehicle trips from 9% to 15%; however, bus trips have decreased from 60% to 42% of the total number of trips. (Data source: TDFS 2007)

Besides the above, Delhi has developed as a seamless city with an urban continuum comprising of a number of rapidly growing towns in Haryana and UP. This has added to the flow and movement of traffic within Delhi.

Despite measures by way of increasing the length of the road network and road surface space through widening, construction of a number of flyovers / grade separators and, launching of the Metro, the traffic congestion has continued to increase unabated. Metro is currently about 211Km long with another 300Km under various stages of construction (Phase III) and planning (Phase IV) and carries about 26 lakh passengers per day. Buses in Delhi carry about 52 lakh passengers per day. In spite of this, Delhi faces huge congestion issues. This has its inevitable consequences in terms of accidents, pollution, commuting time, and wasteful energy / fuel consumption (Data Source: DMRC)

In a business-as-usual scenario, it is estimated that the total trips would rise to 280 lakh by the year 2021, including 257 lakh motorized trips and 23 lakh non-motorized trips (Refer Figure 2 & 3). In this context, it needs to be noted that roads already occupy approx. 21 percent of the total area of the city, which clearly limits the potential for increase in road space. In a sustainable future scenario (Figure 2), the share of public transport and NMT is 80%.

In addition, Delhi has lost the air quality gains of its first generation action that included large scale conversion of public transport buses and three wheelers to natural gas, relocation of polluting industries and improvement in emissions standards for vehicles among others. This is largely because of the explosive increase in vehicle numbers due to increased dependence on personal vehicles in the absence of adequate, comfortable and efficient public transport services and walking and cycling facilities. Air pollution levels have worsened in recent times. Both particulate levels (PM 10 and PM 2.5) as well as nitrogen oxides are increasing steadily in Delhi's air. The reference of PM 10 levels can be seen

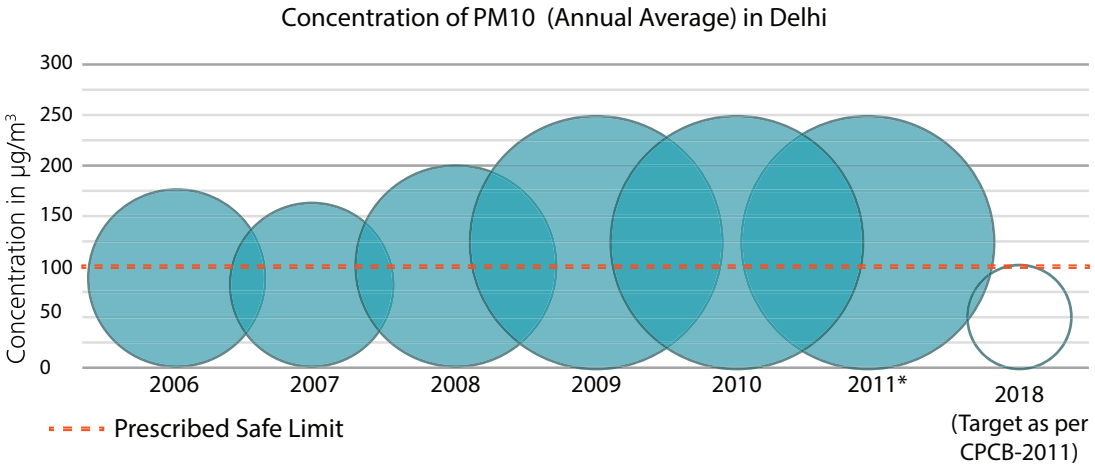
in Figure 1. Ozone which was not a problem earlier is rising again. During winter PM 2.5 levels are normally 3 to 4 times the standard and during smog episodes it can go as high as 7 to 8 times the standard. This has serious public health consequences.

Apart from the problems and requirements of transportation at the macro level, there are special problems in specific areas, particularly the old city, which deserve special attention.

The plan and strategy for transportation will have to be worked out in this background. The broad aim of this would be to ensure safe and economical commuting between place of origin and destination, convenient and quick access to all areas for all sections of the society, reduction of pollution and congestion, energy efficiency and conservation, safety for all sections of the road and transport users and, towards meeting these objectives, providing a significant increase in efficient rapid public transport systems and facilities with a corresponding reduction in individual private transport usage. This is in addition to pedestrianization and properly planned use of non-motorized transport systems throughout the city. The NUTP, 2006 has also recognised that people occupy center stage in our cities and all plans would be for their common benefit and well-being and recommended to make our cities more livable and to allow the cities to evolve into an urban form that is better suited to support the main socio-economic activities that take place in the city. In addition, the National Mission on Sustainable Habitat (NMSH), 2011 provides various parameters 'to address the issue of mitigating climate change by taking appropriate action with respect to the transport sector, such as evolving integrated land use and transportation plans, achieving a shift from private to public modes of transportation, and encouraging the use of non-motorized transport.

As per MPD 2021, the vision for Delhi is to have mobility transition which will deliver a sustainable urban transport system for the city that is equitable, safe, comfortable, affordable, energy efficient and environment-friendly, i.e., a system that satisfies the mobility needs of all sections of the population and enhances their quality of life.

To address the issue of congestion in Delhi, the



*2011 averaged for 5 stations of DPCC till Ocober 2006- 10 data of CPCB

Figure 1: Delhi losing Air Quality gains of CNG conversion, due to the exponential increase in private vehicles
Source: CPCB, 2011

THE SEVEN PRIMARY OBJECTIVES OF THE TRANSPORT POLICY AS MENTIONED IN MPD 2021, ARE AS FOLLOWS:

1. 80:20 modal share, favoring Public Transport excluding walk trips by 2021.
2. Reduction in vehicular emissions to meet the national ambient air quality standard.
3. Achieving Zero fatality through an uncompromising approach to reduction of fatalities of all road and transport users.
4. Safety and accessibility on roads for all through safe, convenient, comfortable and barrier-free movement.
5. Bringing about a more equitable allocation of road space for movement of people, rather than vehicles.
6. Affordability by providing range of mobility options for all users.
7. Efficiency in movement of people and goods.

Honorable Minister of Urban Development brought forward two significant steps: Announcement of fund to decongest Delhi and formation of a high powered committee on decongesting traffic in Delhi

ANNOUNCEMENT OF FUND TO DECONGEST DELHI

Hon'ble Minister of Urban Development, on 22 November, 2015, announced allocation of Urban Development Fund of Rs.3,250 Crore to various projects in Delhi to help decongest the city. The fund is to be used for the following projects like-

1. Decongestion of city roads by addressing different choke points through improvement of road geometry, construction of flyovers or underpasses;
2. Dwarka Expressway from UER-II to Northern peripheral road, Haryana with total length of 3.5Km;
3. Balance work of grade separator at Rani Jhansi road (flyover from St. Stephen Hospital, Tees Hazari to Filmistan, Karol Bagh);
4. Tunnel near Bhagya Vihar and Meet Vihar on UER-II with a length of 1.5Km;
5. Railway-over-bridge at Narela on UER-I with a length of 860m; and
6. Railway-under-bridge at Holambi for a length of 1Km and Railway-over-bridge at Mundka with a length of 1.4km on UER-II.

HIGH POWERED COMMITTEE ON DECONGESTING TRAFFIC IN DELHI

The High Powered Inter-Ministerial Committee on "Decongesting Traffic in Delhi"constituted under the directions of Hon'ble Minister of Urban Development, met several times after October 7, 2014. Deliberations took place among representatives of following departments/ministries from Delhi-

1. Ministry of Railways
2. Ministry of Road Transport and Highways
3. Ministry of Defense
4. Ministry of Home Affairs
5. National Highway Authority of India
6. PWD, Govt. of NCT of Delhi
7. Ministry of Urban Development, GNCTD
8. UTTIPEC, Delhi Development Authority
9. GNCTD, New Delhi
10. NCRPB, New Delhi.
11. New Delhi Municipal Corporation
12. Delhi Development Authority, New Delhi
13. Delhi Metro Rail Corporation
14. Delhi Police.
15. South Delhi Municipal Corporation, New Delhi.
16. North Delhi Municipal Corporation, New Delhi.
17. East Delhi Municipal Corporation, New Delhi.
18. Delhi Transport Corporation, New Delhi.
19. Institute of Urban Transport (India) New Delhi.

It was agreed unanimously by the Committee that the primary solution to decongesting Delhi is prioritization and promotion of public transport. While it is still essential to provide city level connectivity for all

modes (roads/rail/bus/cycle) in order to separate local travel from regional travel, the primary focus of the Government needs to be on inducing modal shift towards public transport.

To achieve the objectives, mobility, air quality and road safety targets need to be setup. The Committee decided on the four-pronged strategic approach to meet the objectives and to move forward on the path to decongest Delhi.

Strategy One: Improving Public Transport and Disincentivizing use of private vehicles
By promoting public transport and discouraging private transport, per capita emissions can be reduced drastically and will result in positive effects on health, environment and finance of the city of Delhi. Discouraging use of private vehicles by high parking charges and congestion pricing are effective measures to this effect. This was decided as the foremost priority in decongesting Delhi and would require coordination and support of all stakeholders and can be achieved by making public transport more attractive and enhancing the use of NMT.

Strategy Two: Road Safety and Traffic Management
The country witnesses close to 1.5 lakh deaths annually of which 60% are pedestrian and cyclist deaths. Road safety is thus the most important concern and is one that involves a high degree of involvement of the road users as well as the road designers. Traffic management by use of IT, improvement in junction design and densifying network of streets to have more pedestrian and cycle-only streets are important measures to be undertaken to reduce road fatalities. Other measures to enhance road safety could include improved driver training, measures for segregation of slow and fast moving vehicles and improved road signs. Improvements in the emergency response system would also contribute greatly in reducing fatalities. A freight audit of Delhi should to be carried out to understand the transport facilities and traffic management policies that are needed to cater to goods movement to / from and within the city.

Strategy Three: Enhancing Institutional Capacity
Urban transport, not being a subject of the Municipal Act, has often not received the focus it deserves. It has also not figured on priority at the state level since state transport department has been concerned about inter-city rather than intra-city. In order to provide the required attention to planning, design, financing and maintenance, a nodal body such as Unified Metropolitan Transport Authority (UMTA) needs to be setup with specific powers of planning and implementation. Moreover, institutional and individual strengthening is needed for the city officials to take on existing projects/ initiatives in urban transport.

Strategy Four: Transit Oriented Development
The past auto-centric planning of the city with segregated land use, large un-walkable block sizes, large right-of-ways and encroached footpaths, frequent construction of flyovers and clover-leafs within city limits, and auto-oriented urban design with more and more gated/ walled communities – has increasingly made the city dependent on private vehicles. This has made the life of public transport users more difficult. There is also an up-surge in private motor vehicle ownership, and a corresponding increase in pollution, congestion, loss of man-hours and increase in urban poverty. This situation, has grown to alarming proportions in the past two decades. Therefore, a paradigm shift is required in the way we plan and the principles of Transit Oriented Development need to become an integral part of the DNA of city planning.

Executive Summary

"Let us have a moment of silence for all those stuck in Traffic"

The High Powered Inter-Ministerial Committee on "Decongesting Traffic in Delhi"constituted under the directions of Hon'ble Minister of Urban Development, Government of India deliberated and finalized four primary ways of dealing with congestion. The committee came up with specific recommendations for each strategy including short and long term measures.

VISION, GOALS AND STRATEGIES

The Master Plan of Delhi (MPD) 2021 states that "The Vision for Delhi is to have a mobility transition which will deliver a sustainable urban transport system for the city that is equitable, safe, comfortable, affordable, energy efficient and environment-friendly; a system that satisfies the mobility needs of all sections of the population and enhances their quality of life."

To achieve the Vision set by MPD 2021 and to decongest Delhi, the following goals need to be achieved within the next 5 years -

1. Mobility Target – Preferably 80-20 modal share in favour of public transport (considering motorized trips only);
2. Air Quality Target – reduction in vehicular emissions to meet the national ambient air quality standard;
3. Road Safety Target – achieving Zero fatality through an uncompromising approach to reduction of fatalities amongst all road and transport users;
4. Safety and Accessibility – through safe, convenient, comfortable and barrier-free movement for all users;
5. Equity – through equitable access to transport systems for all regardless of age, income, gender and by way of equitable allocation of road space for all modes focusing on moving people rather than moving motor vehicles;
6. Affordability – by providing range of mobility options for all users; and
7. Efficiency – in movement of people and goods.

The "Prioritized Action Plan to Decongest Delhi', a 4-pronged strategy, is recommended by the High Powered Committee chaired by Secretary, Urban Development (UD), Government of India.

***Strategy One: Improving Public Transport and Disincentivizing use of private vehicles* |**
***Strategy Two: Road Safety & Traffic Management* |**
***Strategy Three: Enhancing Institutional Capacity* |**
***Strategy Four: Transit Oriented Development* |**

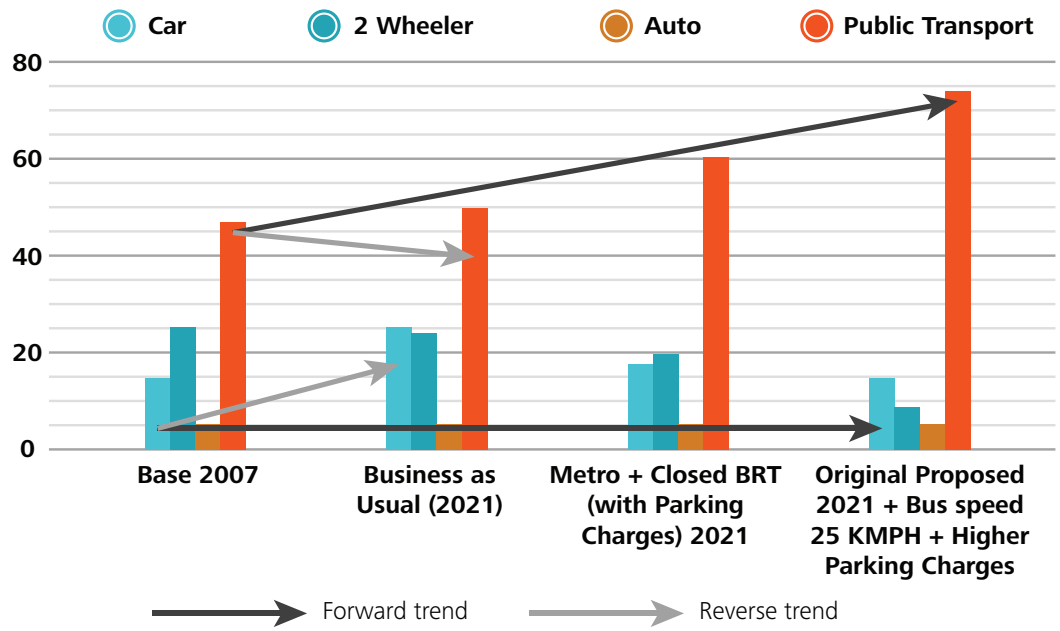


Figure 2: Modal Shift Scenarios

Source: GNCTD TDF Study, 2007

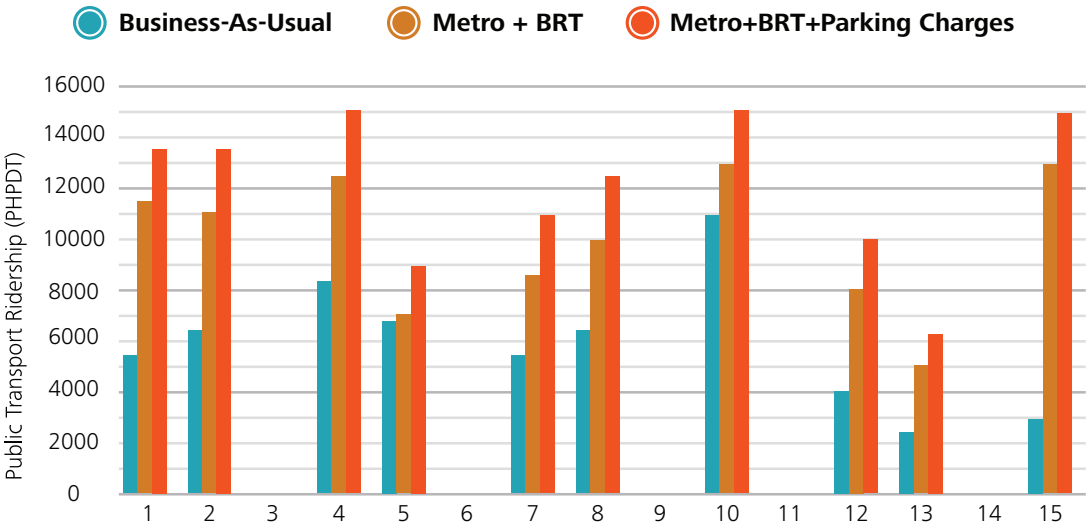


Figure 3: Modeled Public Transport ridership subject to dedicated BRT lanes & higher parking charges

Source: GNCTD TDF Study, 2007

Strategy One

Improving Public Transport and Disincentivizing use of private vehicles:

This can be achieved by-

1.1 Parking Pricing & Management
1.2 Multi-modal Integration & Intermediate Public Transport (IPT)
1.3 Enhancing walkability & use of Non-Motorized Transport (NMT)
1.4 Bus service Improvements
1.5 Improving regional connectivity

For achieving any significant improvement in decongesting Delhi, it is extremely important to follow the carrot & stick method of strengthening and making the public transport system attractive, i.e. enhancing the non-motorized transit infrastructure of Delhi while simultaneously discouraging the use of private vehicles through necessary means.

Public Transport, currently, carries more than one crore people daily (bus and metro) while cars carry just about 20% of that. Yet, a lot of public funding is currently directed towards car-oriented infrastructure, like road widening, flyovers, foot-over-bridges and underpasses. As shown in Figure 2, the Business-As-Usual scenario will result in a reverse modal share and increasing burden on the exchequer for greater and greater infrastructure demands while also having adverse impacts on energy, health, environment and social well-being. On the other hand, with progressive policies of charging for parking, congestion and making public transport easy and attractive, the demand for road space can be decreased, with positive results – economically and environmentally. Figure 3 shows how increased parking charges and provision of dedicated lanes for BRT (in combination with Metro) drastically increases feasibility and ridership of public transport modes.

There is also a general tendency to assume that development of car-oriented infrastructure may be allowed to continue along with augmentation of public transport. At the same time, negligible focus is given to pedestrian and NMT infrastructure since they are not perceived as modes of commuting.

As part of the Household and Metro users survey conducted by Transport Department, GNCTD in 2007, it was found that providing access to good public transport system coupled with higher parking fees, incentivizes a large number of people to shift to public transportation (Refer Box-I). Therefore, it is essential that parking pricing is implemented along with public transport augmentation in order to make people shift to non-private modes.

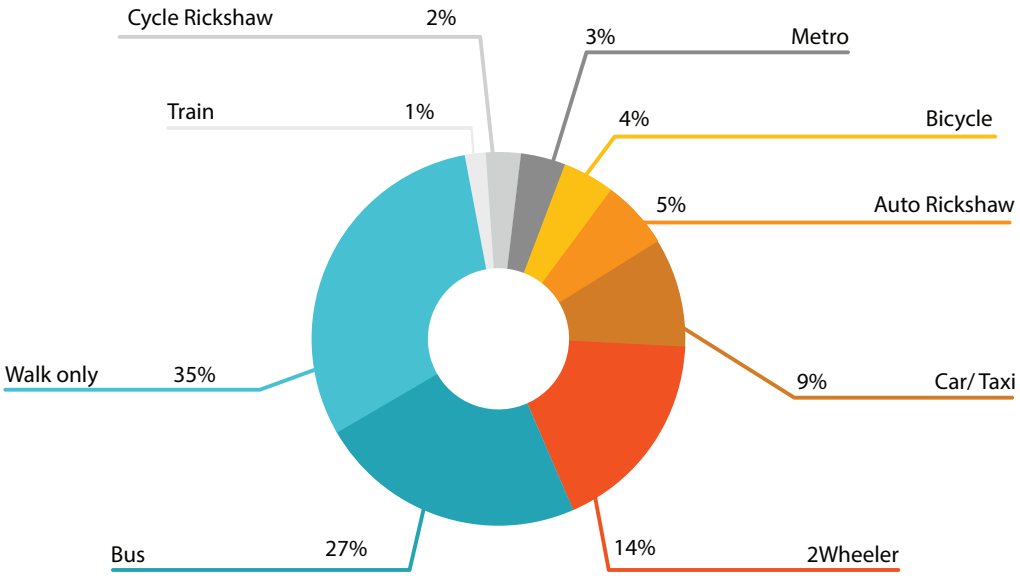
For both short (<3Km) and long (>10Km) trips, car/ two-wheeler is always the most convenient mode of transport, so PT and NMT can never compete if there is ease of use of private vehicles. Therefore, use of private vehicles needs to be disincentivized, while very clearly promoting strategies for use of public transport, NMT and walking.

Achieving an increase in the mode share of public transport, walking, and cycling will require a major expansion and improvement in the facilities provided for these modes. To maintain and grow the mode share for walking, Delhi needs high quality, accessible footpaths on all its arterial and sub-arterial streets—approximately 3,300Km. Road space is also currently encroached by illegally parked vehicles and it is essential to make it available to NMT users. To achieve this strategy, five distinct actions need to be performed as stated in the subsequent section.

BOX-I

Household and Metro users Survey (Dept of Transport, GNCTD, 2007) results:

- 97% people will shift to Public Transport system if there is a significant saving in travel time.
- 72% will shift if quality feeder system is available.
- For 93% workers acceptable walking distance is 200m.
- 45% of car users will shift to Public Transport if the parking fee is increased by 50%
- Most respondents need comfort and good frequency to shift to Public Transport



Total Trips: 219.87lakh trips

Figure 4: Modal Share of Delhi

Source: Dept of Transportation, GNCTD,2007

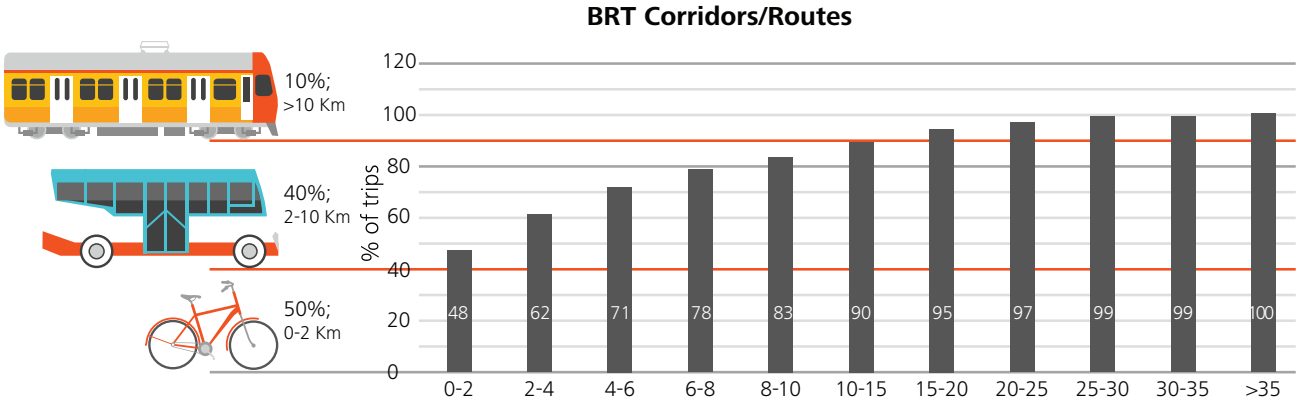


Figure 5: Trip lengths distributions in Delhi (Kms)

Source: Dept of Transportation, GNCTD,2007

1.1 Parking Pricing & Management

The premise of the section is based on the principle that Private vehicles must be parked on 'a fully-paid rented or owned' space, based on the 'user pays' principle. This section enumerates the importance of charging for parking as an important demand management tool for keeping check on congestion. Charges for parking should be set in a way that it discourages people to use their private modes and encourage the use of public transport. Parking charges should be set according to the location, size of vehicle, duration of parking, etc. On-street parking should be charged at a price higher than off-street. The section also explains the concept of having Parking Management Districts instead of stand alone parking sites.

1.2 Multi-modal Integration & Intermediate Public Transport (IPT)

This section enumerates multi-modal integration at metro stations to have seamless travel expereince of the daily commuter. The section provides detailed guidelines of feeder services, public transport services, parking zones, drop-off and pick-up places, cycle stations, public amenities and pedestrian connectivity for the metro station.

1.3 Enhancing walkability and use of Non-Motorized Transport (NMT)

Almost 60% of the trips in Delhi are less than 4Km and 80% are below 6Km which is an ideal distance for using non-motorized modes–walking & cycling (Refer Figure 5). In the absence of good public transport and comfortable walking and cycling facilities, private vehicles are used to cover these short distances, causing congestion. This section provides guidelines to enhance use of non-motorised modes for daily commute.

1.4 Bus service improvements

Buses are still a dominant mode of public transport with more than 60% trips made on them. Bus transport is cost effective and can provide similar comforts as a metro system. This section explains the issues plaguing bus transport and possible solutions to augment bus services and provide state-of-the-art passenger comfort on buses. Delhi needs to augment its bus fleet and its lack causes passenger delays and discomfort. An integrated bus route rationalization plan should be implemented that ties the high demand routes to lower demand ones such that feeder facilities can be integrated.

1.5 Improving regional connectivity

Regional Connectivity needs to be majorly enhanced and RRTS and other high-speed public transport systems need to be implemented in order to decentralize NCR and enable growth of Tier-2 & Tier-3 cities, which would in turn be the assured way to decongest Delhi. Refer Figure 6 for the Sub-Regional Transport Network Plan for Delhi. RRTS needs to be implemented with high capacity bus system, common mobility card and state-of-the-art passenger terminals.

Strategy Two

Road safety and traffic management can be achieved by-

2.1 Intelligent Transport System
2.2 Road network optmisation
2.3 Junction improvements
2.4 Freight audit of Delhi

Road safety has emerged as the most important issue in recent times, next to health and pollution. The number of deaths in Delhi have often been recorded as one of the highest in the country. Data from the Traffic Police shows that the deaths haven't decreased in recent times. The pedestrian and cyclists' deaths account for almost 60% of the total road fatalities in Delhi (Refer Table 1). Figure 9 shows the location of the 937 fatal accidents of pedestrians in Delhi in 2011, as provided by Delhi Police.

To enhance road safety and to have proactive traffic management in Delhi for both passenger and goods vehicles, there needs to be a well thought out strategy. As a part of this strategy, four distinct actions need to be performed as indicated below:

2.1. Intelligent Transport System (ITS)

For proper surveillance, penalties, monitoring and accident response, the key aspect is the implementation of an Intelligent Transport System (ITS) throughout the city for management of all roads and transportation systems. An ITS system would include the implementation of a surveillance system, automatic vehicle location system, public information system, red light camera and stop line violation detection system, automatic number plate recognition, automatic parking management system, intelligent signaling system and control centre. Also, data storage system should be taken on fast track; while including the setting up of the central control centre by GNCTD for the entire city of Delhi.

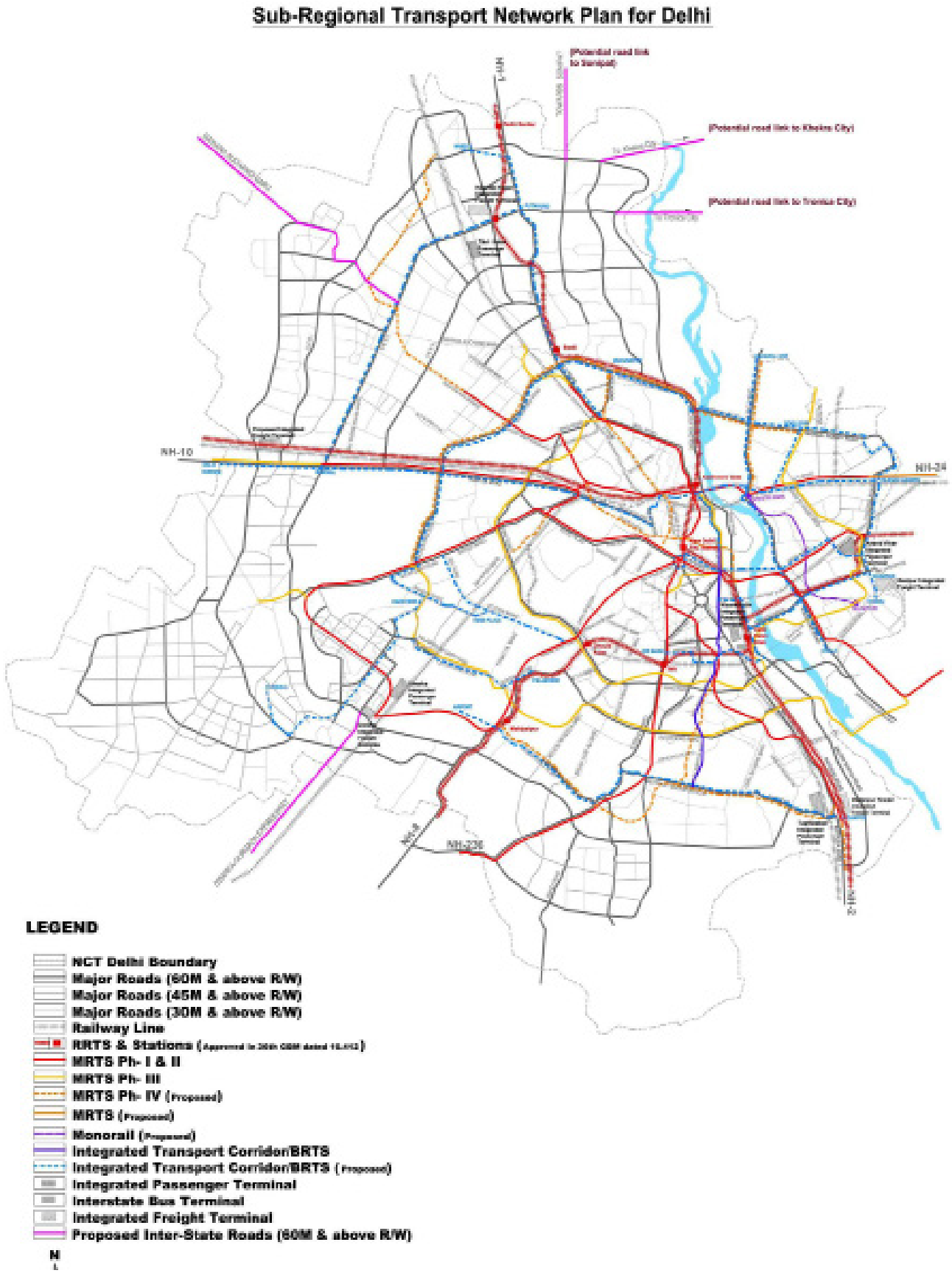


Figure 6: Sub-Regional Transport Network Plan for Delhi

Source: Dept of Transportation, GNCTD,2007

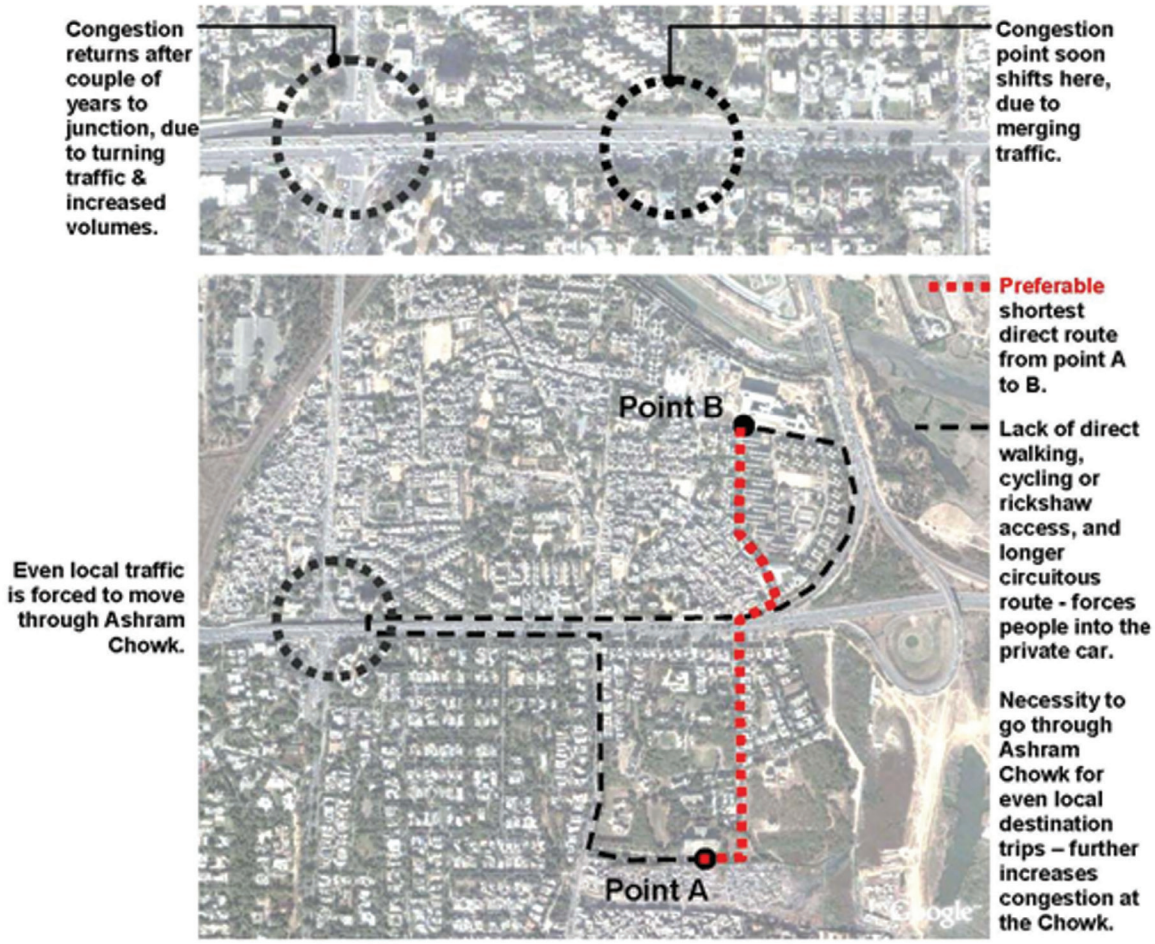


Figure 7: Study showing how closure of secondary networks has lead to increased congestion on already congested junctions at Ashram Chowk in Ring Road

Source: MPD, 2021

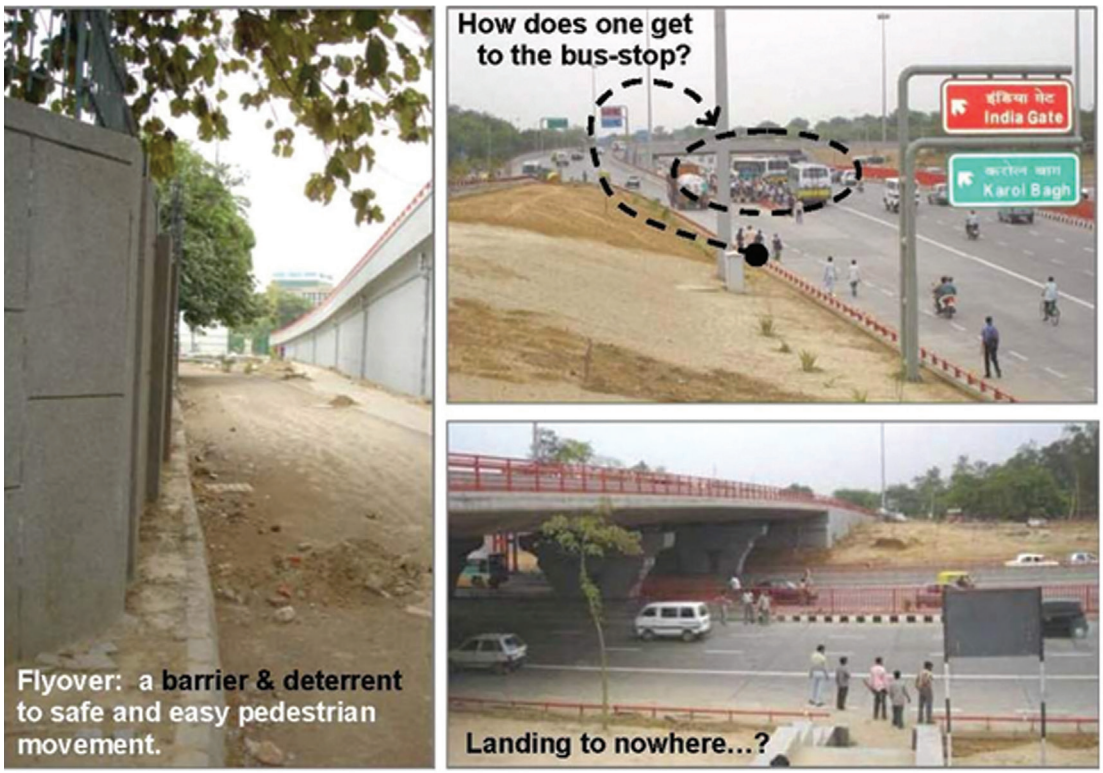


Figure 8: Photographs indicating the issues faced by pedestrians while crossing roads

Source: UTTIPEC

Table 1: Total Fatal Accidents in 2010-2011 as provided by Delhi Traffic Police to UTTIPEC

VICTIM	2010		2011	
	No. of ACCIDENTS	PERSONS KILLED	No. of ACCIDENTS	PERSONS KILLED
PEDESTRIAN	946	960	937	946
SCOOTER/ MOT.CYCLE	689	705	635	662
CYCLE	135	137	104	104
SELF	125	134	108	111
CAR PVT.	47	48	63	69
TSR	32	33	35	40
CYCLE RIKSHAW	29	29	27	27
DELIVERY VAN	19	20	19	19
HTV/ GOODS	11	11	9	11
TOTAL	**2033**	**2077**	**1937**	**1989**

2.2. Road network optimisation

Primary network should be complemented with a secondary network with pedestrian and cyclists' priority in order to facilitate short cuts, reduced trip length and reduced travel time for people. However, in Delhi, secondary networks have progressively been closed, removed, blockaded or gated, causing localized traffic to come on arterial roads for local movement, thus congesting them even further (Refer Figure 8). Providing a finer secondary road network would also enhance walkability and provide short cuts and shorter travel distances for cyclists & pedestrians, thus contributing to easier access to public transport, amenities, markets, schools and in turn reducing private vehicle dependency and vehicular congestion on arterial roads. The section provides guidance on the above aspects.

2.3. Junction improvements

In Delhi, a majority of localized traffic congestion problems as well as road fatality issues can be solved by better junction design, signal management and provision of proper crossing facilities for pedestrians and cyclists (Refer Figure 9), at all intersections and mid block crossings. To implement the same, the top 100 junctions in the city having congestion problems, should be taken up for retrofitting immediately. The section provides guidance on junction design and possible solutions to junction safety related issues.

2.4. Freight audit of Delhi

Delhi is a major trading hub in northern India. As per the 2013-14 report on the socio-economic profile of Delhi published by Planning Department of GNCTD, the capital state has about 1.56 lakh industrial units and 29 industrial estates. Some of the key industrial areas/ clusters and wholesale markets in Delhi include Patparganj, Okhla, Kadipur, Narela, Bawana, Sadar Bazaar, Chawri Bazaar, Khari Baoli, Azadpur and Daryaganj. These areas and markets serve as key trading hubs of Delhi and the surrounding states. (Refer Figure 10).

Delhi also has the highest GDP per capita amongst all the states in India. The increasing GDP per capita is an indicator of the increasing spending power of the citizens of Delhi. This translates to higher demand for consumables and this in turn will require more goods to be transported into Delhi from other regions of India.

Photo : India Gate, New Delhi

Figure 9: Map of Delhi Arterial/Collector roads showing locations of fatal accident of pedestrians & cyclists in 2011

Source: Delhi Traffic Police, 2012

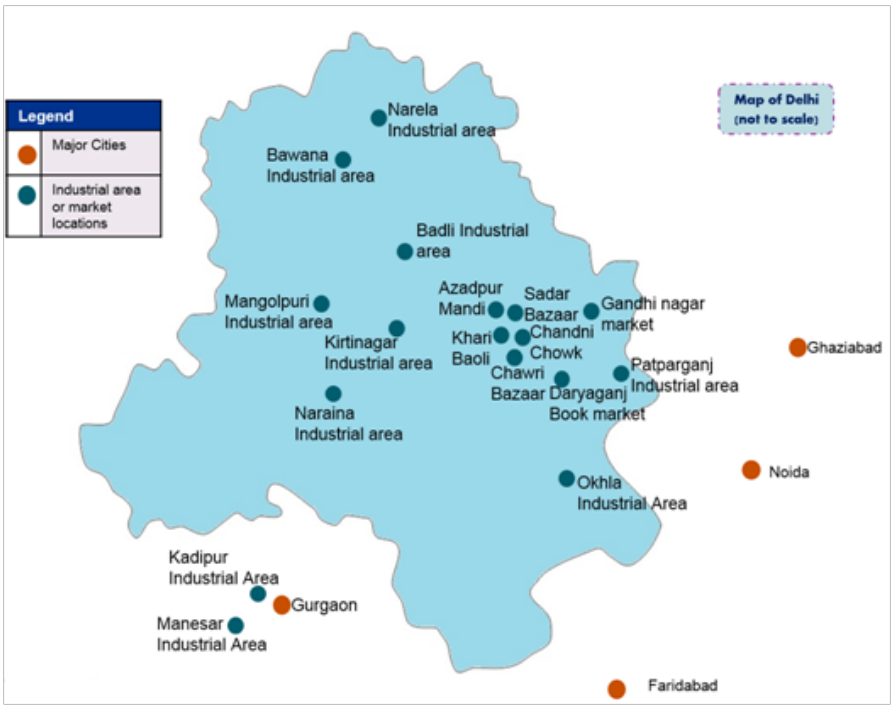


Figure 10: Industrial areas and market locations of Delhi

Source: Planning Department, GNCTD

In order to cater to the freight movement induced by trading, manufacturing and consumption activities, in a planned manner, a freight audit of Delhi needs to be conducted which will cover the following-

1. Analysis of the consumption pattern of Delhi to assess the requirement of movement of goods on a daily basis;
2. Assessment of the key facilities available in Delhi to cater to the goods movement; and
3. Development of freight supportive guidelines for movement of freight to and from Delhi and within Delhi, which is people and environment friendly.

Strategy Three

Enhancing institutional capacity: This can be achieved by -
3.1 Establishing DUMTA
3.2 Capacity Building

A key component of smart cities is "smart governance" and smart people, which need to work within smart systems. The key to achieve these aspects is to have a high level of inter-departmental coordination as well as high quality professionals in-house to provide day to day advise, output and project delivery. To achieve this, the following two key recommendations have been made-

3.1. Establishing DUMTA

This section talks about the need of establishing DUMTA and its role. Currently, transportation issues in Delhi are dealt with by several departments – at both central and state level. It is extremely important that these departments work in a well-coordinated way in-order to ensure smooth mobility in the city. Each of the allied functions such as public transport, NMT, traffic management and enforcement, road infrastructure & Transport Policy, etc. are dealt with by different agencies of the government, some of whom report to the Central Government and others to the State or local government. Many of these services are provided by private operators under limited regulation, and overarching integration at a policy and administrative level is missing. In view of the large number of agencies involved, coordination becomes difficult. To deal with this, it is essential to set up a single lead/ integrated agency that would take a comprehensive responsibility for managing the transport system in Delhi. The DUMTA is such a structure that has been recommended in sync with the already existing policy making body, UTTIPEC currently functioning under the Central Government.

3.2. Capacity Building

This section details the capacity gaps in the government and the ways to bridge them. All departments need to set up highly qualified, multi-disciplinary technical teams "in-house"which can plan both short-term and long-term and provide able assistance to all decision makers as well as the general public. In the absence of this, all decisions taken by various government departments, though well-meaning, may appear to be knee-jerk and reactive, rather than well-planned, phased and strategized for long term good of the city. The challenges for implementation, monitoring and formulation of policies and strategies is the most complicated. For any policy to be successfully implemented in Delhi, we need to circumvent the issue of "multiplicity of authorities".

Figure 11: Artist's impression showing the uniform distribution of built up area and population throughout the city increasing the time needed for people to reach the metro stations or major bus corridors

Source: UTTIPEC

Figure 12: Artist's impression showing how densification along MRTS corridors would allow more people to live, work and seek entertainment within walking distance of MRTS stations

Source: UTTIPEC

Strategy Four

Transit Oriented Development

This chapter explains the salient features of the TOD policy, recently modified by the Ministry of Urban Development as part of the Master Plan of Delhi-2021. It also explains how key challenges towards the implementation of TOD in Delhi need to be addressed and details out the recommendations of the Committee on the next steps to enable smooth implementation of the policy over the next few decades.

A transit-oriented development is essentially any (real estate) development, however large or small, that is focused around a transit node, and facilitates complete ease of access to that transit facility, thereby inducing people to walk and use public transportation over personal modes of transport. To put it in another way, TOD is underpinned by a vision of a city that is inclusive, egalitarian and environmentally sustainable. Ordinary pedestrians are placed at its center, rather than buildings, flyovers or cars, in a big shift from prevailing practice. TOD consists of a variety of high-density, mixed-use, mixed-income buildings, within a short distance of a rapid public transport network. Higher density within pre-specified zones near transit stations encourages more people to use public transport, and limits urban sprawl (Refer Figure 11 and 12). These forms of real estate development are very different from today's emphasis on gated communities and flyovers, which are explicitly automobile-based, and thus geared towards prioritizing the interests of the privileged, at the expense of the ordinary urban citizen.

TOD is the long-term strategy which will facilitate creation of a decentralized city/region and create an urban development pattern which would be more sustainable.

The following Chapters explain the details and implementation strategies of each of the sub-heads mentioned above, along with case studies/ references of implemented projects from around the country, relevant guidelines and codes as well as actionable points for easy implementation and budget allocation by the concerned departments, once the respective strategies are taken up for implementation.

Strategy One

Improving Public Transport & Disincentivizing use of private vehicles

- Parking Pricing & Management
- Multi-Modal Integration & IPT
- Enhancing Walkability & Use Of NMT
- Bus Service Improvements
- Improving Regional Connectivity

Strategy One

Improving Public Transport & Disincentivizing use of private vehicles

"God made us walking animals - pedestrians. As a fish needs to swim, a bird to fly, a deer to run, we need to walk, not in order to survive, but to be happy."

"One symbol of lack of democracy is to have cars parked on the sidewalk."

1.1. PARKING PRICING & MANAGEMENT

ISSUE

It is said that for every car sold, the city is committing to provide three parking places – one at the residence of the owner, one at his/her work place and one at a number of places that the owner may visit, such as shopping centres, movie halls, recreation centres, etc. Each of these parking places use up valuable urban land which comes at a very high price. This space would otherwise be adequate for the housing needs of a poor family. Apart from this, parking occupies a lot of road space on account of road-side parking. Pricing differentials are such that off street parking is priced higher than road side (on-street) parking. As a result high quality off street parking, built at a significant cost, lies vacant and the roadside parking ends up choking the right of way.

The recommendations of this chapter, therefore, seek to suggest measures that would: (1) Limit the amount of land used for parking, especially in areas that are well served by mass transit systems like the Delhi metro; (2) Ensure that the true cost of providing the parking space, including the cost of the land, is recovered; (3) The price differentials between road-side and off-street parking are so modified to make off-street parking more attractive and well used.

Experience has shown that lack of enforcement and inadequate policy interventions have resulted in growth of parking demand along with the growth of vehicles in the city. Also, the provisions related to parking within the plot area are normally not adhered to, resulting in vehicles spilling on to the roads and adding to congestion. As recommended by the Environment Pollution Control Authority (EPCA) for the NCR, the approach should be focused more on 'demand management' through enforcement and pricing policy rather than only increasing supply of parking.

RECOMMENDATION OF THE COMMITTEE

a. Pricing of parking should be based on 'user pay' principle, reflecting the cost of the public good – the precious urban space. Without proper pricing

of parking, it is impossible to manage the ever increasing demand for parking space. No government subsidized parking for private motor vehicles is to be provided in public spaces or on roads;

b. More parking spaces should not be created, as they attract more cars, except in commercial centres where they should be charged at par with the space rentals in the area. Delhi has one of the lowest parking charges. The parking charges should be enhanced especially in and around commercial centres, which will enable easier management of available parking space. Heavy penalties should be imposed on parking in unauthorized or undesignated parking spaces. A large percentage of parking spaces in institutional, residential and commercial areas should be available as "shared parking", to reduce total parking space demand and also so that the spaces can be utilized by other users when the building is not in use;

c. Parking on footpaths should be made a cognizable offense with heavy penalties and compounding. This should be done by utilizing the relevant provisions of the Municipal Act for public space encroachment as well as the Delhi Motor Vehicle Act & Delhi Police Act for endangering the life of citizens. Pune Municipal Corporation had issued a public notice to that effect in 2011 and similar steps may be taken concerned by DMCs in Delhi (Refer Box-2);

d. On-street and off-street parking on roads and parking lots should be clearly demarcated on the ground so that each parking space can be paid for, monitored and enforced (Refer Figure-13). Wherever parking lots are managed by parking operator, the street serving the parking lot should be clubbed in the off-street parking contract and the operator should manage both, the parking lot as well as the street on which the parking lot exists. Parking charges on-street should be at least 5 times of the off-street parking charges;

e. All multi-level/off-street designated parking lots should be developed as part of comprehensive area level plans for "Parking Management Districts (PMD)" (Refer Box-2)that deals with on-street, off-street, multi-level and no-parking zones with proper circulation plan and demarcated "on-street parking" and "no parking" areas. The pricing of on-street and off-street should be adjusted, dynamically or by fixed pricing, such that people take to use off-street more than on-street parking. Each PMD (composed of on-street, off-street, no-parking, multi-level parking and control centre) for an area should be managed and enforced by a single government agency and operated on PPP basis. If on-street parking is strictly enforced (by the private agency with the help of police), no incentives for the use of multi-level parking facilities would be required as it will become a viable business opportunity. Developers/ private entities should be permitted to provide pay-for-use public parking facilities within plots/ developments;

f. Standalone parking-only sites are not required. Parking lots are permissible in all land use zones (except green open space). Therefore, multi-level parking facilities could be provided by developers in any project such as commercial, social or industrial buildings and be made available to the public at a price. However, this would be viable only if street level parking is clearly demarcated, priced and strictly enforced;

g. Parking fee should be market-driven and vary around the city based on time, location and local demand/ congestion levels through the day. As a thumb rule – higher the congestion, higher the fee to be levied in the area to reduce parking demand (Refer Table 2). Premium rates should be charged for on-street parking in Central areas and congested commercial areas, as depicted in Table 2 showing the proposed area-based parking charges for NCT of Delhi, proposed as part of the TDFS study by Transport Department, GNCTD in 2011;

h. All multi-level or exclusive parking facilities for private parking must also provide at least 10% of total space provision for IPT modes, NMV and feeder buses, as per local requirement;

i. Approximately 70% of the total parking space/slots capacity to be kept for short term parking, primarily for shoppers/visitors, not for long term parking by shopkeepers or office goers. Typically, on-street parking should be priced at 3 times of off-street. On-street Parking to be priced for every half hour slots, increasing exponentially as per the formula (2X+10), where X is the charge for the previous hour, up to a maximum of three hours. Heavy penalties must be levied beyond 3 hours to discourage long term users like shopkeepers and office employees using on-street parking. Penalty for first one hour beyond the two hour slot could be an additional Rs.100 and beyond that a fine of more than Rs. 2000 and/or impounding of the vehicle;

j. Parking charges should be levied as per size of vehicle if two wheelers and auto-rickshaws are charged Rs.'A', cars and LCVs should be charged Rs.5 x 'A' and Trucks should be charged Rs.10 x 'A'. No parking charges should be levied for non-motorized vehicles;

k. In congested areas, "Park & Ride"/"Park and Walk" facilities may be planned in PMDs. Street

improvements such as pedestrianization plans, one-way circulation systems, demarcated park-and-pay streets, NMT-only streets, etc. should be implemented in about 10-minute walking catchment of such facilities to make it comfortable and convenient for commuters and shoppers. Several such conceptual PMD plans have been prepared in the past which are yet to be implemented. Details of few such projects undertaken in the very congested Karol Bagh and Nehru Place areas of Delhi are provided in this Chapter as part of Box 3 and 4, respectively.

l. It is recommended that a Committee may be set up under the chairmanship of Chief Secretary, Government of National Capital Territory of Delhi (GNCTD), of which all the ULBs should be a part of, to review and recommend the parking policy and pricing. Based on the recommendations of the Committee, the ULBs (MCD/ NDMC/ DDA) should come up with a zone-wise/ area-wise/ street-wise parking pricing strategy and implement the same. This function may be given to DUMTA once it is established.

Table 2: Proposed area-based parking charges for NCT of Delhi as part of the Transport Demand Forecast Study (TDFS) prepared by Dept Of Transport, GNCTD 2007

		Parking charges (Rs) per 8 hours		Parking Charges (Rs) per hour	
S.No.	Name of Area	Car	Two Wheeler	Car	Two Wheeler
1	Connaught Place, Chandni Chowk, Domestic & International Airport	500	250	63	31
2	Anand Parvat, Paharganj, Karol Bagh, District Center, Janak Puri, District center Rajinder Place, South Ext, INA Market, HUDCO Place, Lajpat Nagar Markets, Bikaji Cama Place, District Center Saket, Greater Kailesh Market, Nehru Place, Kalkaji Market, ISBT Sarai Kale khan, Laxmi Nagar Market, Shakarpur, Anand Vihar ISBT, I.P Extension Industrial Area, District Center Laxmi Nagar, Shahadara, Sarojini Nagar, Okhla Industrial Estate	300	150	37.5	19
3	Delhi University, Azad Pur Sabzi Mandi, Jahangirpuri Industrial Area, Puthkalan, Bawana Industrial Area, Badli Industrial Area, Netaji Subhash Place, Wazirpur, Civil Lines, Jhandewalan, Dev Nagar, West Patel Nagar, Kirti Nagar Market, Mansarover Garden, Punjabi Bagh, Janakpuri North, Uttam Nagar, Mahipalpur, Palam, Pusa Institute, Inderpuri, Naraina Industrial Area, Daryaganj, Nizzamuddin, Bhogal, Defence Colony, Malviya Nagar, Sheikh Sarai, Safdarjung Enclave, Hauz Khas, Vasant Vihar, Munirka, Chhatarpur, Khanpur, Tughlakabad Institutional Area, GK II and III, Shahpur Jat, Sriniwaspuri, Kalkaji, Mohan Co-operative Industrial Estate, Harkeshnagar, Badarpur, Zakir Nagar, Jamia MIlia Islamia, Sarita Vihar, CRRI, Apollo Hospital, Mayur Vihar Phase-I, Dallopura, Patparganj, Pandav Nagar, Vishwas Nagar, Gandhi Nagar, Raghubar Pura, Jhilmil Industrial Area, Vishwas Nagar, Vivek Vihar, Dilshad Garden, Nand Nagri, Bhajanpura, Yamuna Vihar, Naveen Shahadara, Gokalpuri, Karawal Nagar West, Chanakyapuri, Rashtrapati Bhawan, Supreme Court, India Gate, Prithiviraj Road, Jor Bagh, Netaji Nagar, Rohini Sec21, Sahibabad, Badil, Prashant Vihar, Barwala, Dwarka Sec.5,10,11, Maharani Bagh, New Friends Colony, IIT, Gulmohur Park, South Ex. Phase-2, Press Enclave Vasant Kunj Sec.C, Tughlakabad Extn, Lal Kuan, CGO Complex, Rajghat, 11 Murti, Krishna Nagar	250	100	32	12
4	Rest of Delhi	100	60	13	8

BOX-2

MASTER PLAN OF DELHI 2021 - Provisions for Parking Management District (PMD)

Parking Management District (PMD) provides comprehensive facilities for all modes including pedestrians, NMT, cycle tracks, NMT and IPT parking, vending zones, bus stops, public amenities, etc. in addition to on-street and/or off-street parking for private vehicles. PMDs are to be planned to improve availability of on-street and off-street parking and promote greater walking, cycling and public transport use. A PMD provides more net available parking space in an area by increasing parking turnover through good design, management and pricing strategies. A portion of the revenue generated could be used for local improvement of footpaths, cycle-tracks, and maintenance of facilities with involvement of the local communities.

Parking facilities to be provided as part of the overall PMD plan incorporating all modes, with a clear cut community benefit strategy.

Any development of multilevel parking facilities shall be strictly as per PMD plan.

Municipalities and/or planning bodies should develop detailed parking management plans for such districts, with physical design and demarcation of spaces on ground and strict enforcement. The following strategy should be applied:

i. Total parking capacity of the PMD to be defined based on ground surveys, capacity analysis and Transport Impact Assessment, if required.
ii. Encroachments and impediments to be removed to provide more space for pedestrians, NMT, vending zones and public amenities.
iii. 'Short-Term' and 'Long term' parking spaces with the PMD must be identified, demarcated and priced appropriately to reduce demand, and be managed by a single agency.
iv. Stringent provisions by way of fines and other penal actions need to be provided for violation of parking rules. Proper signage and markings must be provided to enable effective enforcement.
v. A graded parking fee structure should be evolved as a measure of parking demand management, and encouraging use of public transport.
vi. In congested areas, 'park and walk'/ 'park and ride' facilities may be planned in PMDs. Street improvements must be implemented in about 10-minute walking catchment of such facilities to make it comfortable and convenient for commuters/ shoppers.
vii. All existing areas of concentration of business/ commercial activity, where absence of adequate parking and congestion is visible, should be identified and listed based on studies of vehicle/ modal volumes. Comprehensive area level PMD plan must be prepared by local bodies in consultation with planning bodies, multi-disciplinary experts and local stakeholders.
viii. The development of multilevel parking facilities may be taken up, wherever feasible in a public private partnership framework, with private sector investment and involvement.
ix. Entire stretches of road or areas other than the demarcated/ designated/ managed parking areas, should be declared as 'no parking zones' in the PMDs. Enforcement agency/ traffic police to be responsible for penalizing, removing or taking action against violators.
x. Advanced public information systems regarding parking supply availability should be provided though websites, on-ground display and digital media, to guide people in making travel/ mode choices.

BOX-3

PUNE MUNICIPAL CORPORATION
Bombay Provincial Municipal Corporation Act 1949

By exercising the following section mentioned in the BPMC Act 1949, Pune has attempted to penalize for unlawful parking on footpaths.

Section XIV, Sub-section 208
Power to prohibit use of public streets for certain kinds of traffic

1. It shall be lawful for the Commissioner with the sanction of the Corporation to:
   a. Prohibit vehicular traffic in any particular public street vesting in the Corporation so as to prevent danger, obstruction or inconvenience to the public by fixing up posts at both ends of such street or portion of such street;
   b. Prohibit in respect of all public streets, or particular public streets, the transit of any vehicle of such form, construction, weight or size or laden with such heavy or unwieldy objects as may be deemed likely to cause injury to the roadways or any construction thereon, or risk or obstruction to other vehicles or to pedestrians along or over such street or streets, except under such conditions as to time, mode of traction or locomotion, use of appliances for protection of the roadway, number of lights and assistants, and other general precautions and the payment of special charges as may be specified by the Commissioner generally or specially in each case.
2. Notices of such prohibitions as are imposed under sub-section (1) shall be posted up in conspicuous places at or near both ends of the public streets or portions thereof to which they relate, unless such prohibitions apply generally to all public streets.

Figure 13: Example from Singapore showing demarcated parking
Source: UTTIPEC

BOX-4

KAROL BAGH PEDESTRINIZATION & PARKING MANAGEMENT STRATEGY, UTTIPEC 2010

A detailed proposal to decongest Karol Bagh market and to pedestrianize Ajmal Khan Road along with a one-way circulation system for the area was taken up by MCD in 2009 and approved by UTTIPEC in 2010. A pilot of 250m length of street was successfully executed by MCD. A trial run of the proposed one-way circulation system (Refer Figure 14) was also successfully undertaken by Delhi Traffic Police. The full project is awaiting implementation. The main features of the project included the following:

1. Pedestrianization of Ajmal Khan road and creation of street furniture & pedestrian facilities;
2. Public space improvement of major nodes such as Karol Bagh Metro station and Intersection of Ajmal Khan and Arya Samaj Road;
3. Parking management strategy for the whole area including identification of plots with multi-level parking structures in addition to planned & priced street parking;
4. Traffic flow pattern remodeling;
5. Improvement of open spaces and streets in the Karol Bagh market area;
6. Lighting, furniture and landscape planning for the area;
7. Public utilities plan; and
8. Water discharge plan.

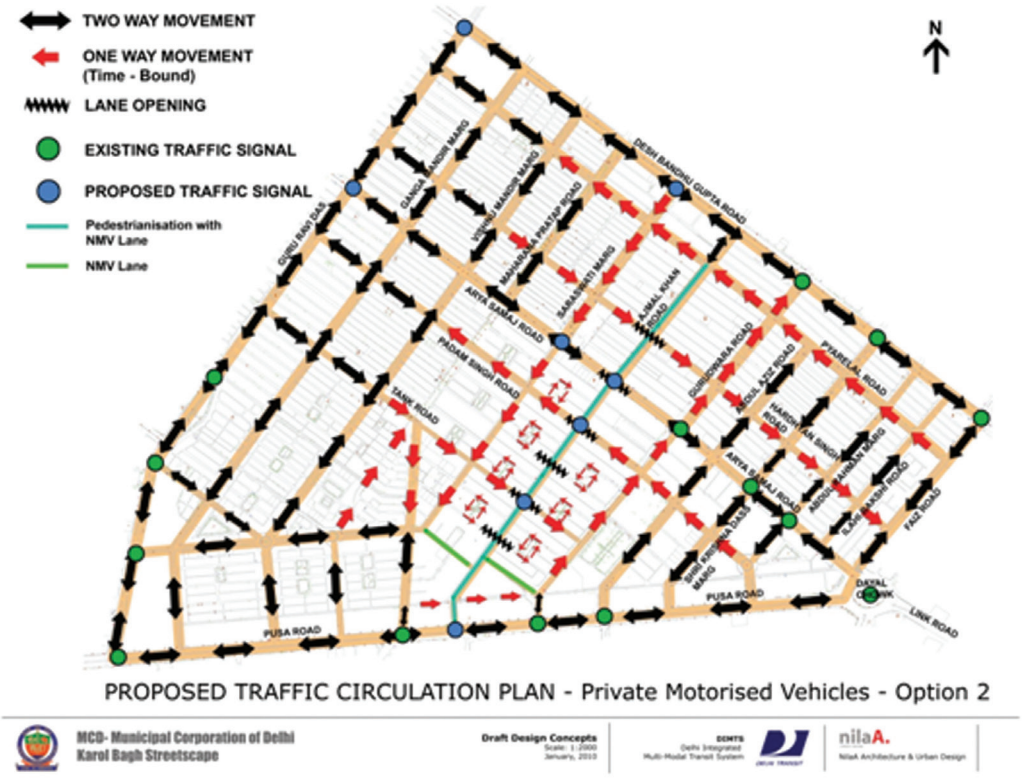


Figure 14: Plan showing one way circulation system to be implemented in Karol Bagh area, New Delhi

Source: Municipal Corporation of Delhi

BOX-5

NEHRU PLACE COMPREHENSIVE PARKING PLAN, UTTIPEC 2014

A comprehensive parking management plan, placemaking & area upgradation plan alongwith TOD strategy, Bus Depot planning, etc. was prepared by UTTIPEC in 2013. The proposal included a strategy for providing, managing, pricing and monitoring the parking provision in the area which is currently in a very unorganized and undesirable state. This was coupled with an adequate placemaking and TOD development strategy.

Nehru Place is one of the busiest District centres in Delhi attracting lakhs of people who come to visit the area from various other parts of Delhi/NCR. Being an employment hub for NCR, it is also a transit and multi-modal hub, having two metro stations, various bus routes which terminate in the area as well as a large amount of private vehicles (two/four wheelers) parking space which is provided in the area. The current situation in Nehru Place is quite unfriendly to pedestrians and public transport users, and most available ground space is used for rampant, unregulated, under-priced and haphazard parking, which is not only an inconvenience to private vehicle users, but also takes away valuable public space needed by other commuters, pedestrians and visitors of the area. In order to improve this situation and also improve the safety and round the clock usability of the area, UTTIPEC had prepared a comprehensive parking management plan, place making and area upgradation plan in 2013. The proposal also included a strategy for providing managing/pricing/monitoring the parking provision in the area, coupled with adequate placemaking and TOD based, retrofitting and re-development strategies. In Figure 15, the proposed plan shows all long term parking facilities accommodated in multi-level parking facilities. Limited on ground parking space is kept available for short term visitors at a steep hourly price. Thus, adequate public space is freed up for pedestrians (including differently abled) as well as the working population/ visitors of the area.

Figure 16 depicts the existing plan of Nehru Place showing the current situation of available ground space used for rampant, unregulated, under-priced and haphazard parking. Figure 17 depicts the three dimensional representation of the proposal for re-development of Nehru Place, New Delhi.

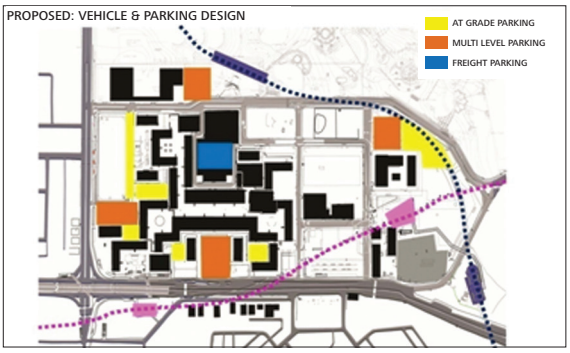


Figure 15: Nehru Place – Proposed plan

Source: UTTIPEC

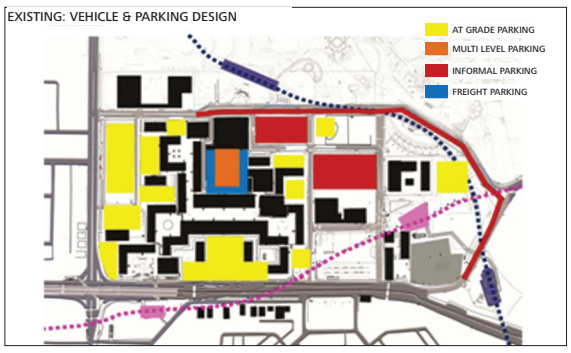


Figure 16: Nehru Place – Existing Plan

Source: UTTIPEC

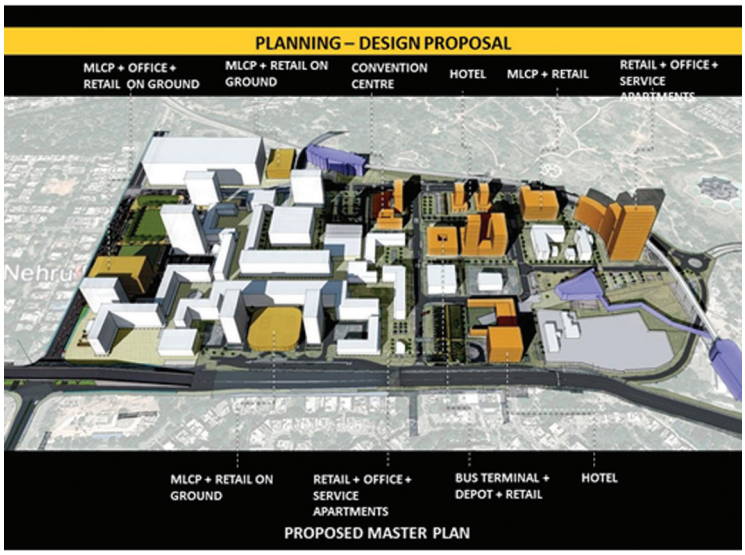


Figure 17: Nehru Place Proposed plan – Three dimentional representation

Source: UTTIPEC

BOX-6

PARKING STUDY FOR SAROJINI NAGAR, NEW DELHI, EPCA, 2012

Sarojini Nagar was one of the first multi-level car parking (MLCP) facilities created in a congested market of Delhi, based on the PPP model. The MLCP accommodates 824 cars/3789 sqm. It is fully automated and costs approximately Rs 8 lakh/ECS (i.e. Rs 110 crore for 1400 ECS)

A detailed study on study of the Sarojini Nagar market and various other markets was conducted in 2012 by EPCA, to assess the level of on-street and off-street parking demand and occupancy.

The data revealed that most parking space was occupied by the shopkeepers and the workers with very little parking available for visitors. Moreover, the off-street parking lots were vacant as abundant on-street free parking was available.

Moreover, it was found that construction of the automated parking itself was an expensive project and in order to recover even the Operations and Maintenance (O&M) costs of operating the parking, a very high rate of parking fee would need to be charged from the users. This would make it further unusable since on-street parking nearby is available at almost negligible rates.

Therefore, the conclusion of the study is that in order to make multi-level automated parking projects feasible, incentives such as allowing the MLCP parking operators to manage on-street and off-street parking, together is required in order to make parking management in the area implementable and feasible.

Table 3 shows proposed parking pricing for Sarojini Nagar which would be required for recovering the O&M costs of operating the MLCP, in case on-street parking is not clubbed with the operation and management of the multi-level parking garage.

Table 3: Sarojini Nagar – proposed parking pricing needed to recover MLCP O&M costs

	Details	Scenario 1: low occupancy	Rate Rs/hr	Scenario 2: High occupancy	Rate Rs/hr
Capital costs	Rs 80 Cr.	213 cars/day	100	2000 cars/day	36
Operational cost	Rs 3 Cr./yr.	213 cars/day	110	2000 cars/day	41
Rate/car/hr			210		77

ACTIONABLE POINTS

(i) The Master Plan of Delhi already lays out the detailed principles, concepts, policy frameworks & norms for parking provision, management and pricing in the city. However, parking pricing & management is essentially a Municipal function. Therefore, the detailed policy guidelines & strategy for operationlization of the parking policy of the Master Plan Delhi-2021 need to be laid out by the Municipal bodies in consultation with GNCTD so that a holistic implementation approach can be taken up in the city. For example, it is often found that in the same area, the municipal body may have raised the parking fee to control demand, but in the adjoining place, another Govt. agency is providing subsidized parking. This would defeat the entire purpose of having a comprehensive parking policy for the city.

(ii) Zero-tolerance for unauthorized parking in streets and especially footpaths should be declared and enforcement should be through surprise checks and heavy penalties throughout the city to the tune of Rs. 2000-Rs.5000.

(iii) In addition to the above, as recommended by the Committee regarding Parking Management Districts (PMDs), the PMDs in Table 4 would be taken up for implementation on priority basis.

Table 4: Implementation of Parking Management Districts

	Area	Action to be taken	Timeframe
1.	Connaught Place	• Parking structures already exist in these areas and only management plans need to be prepared by ULB. • Management of street parking and multi-level parking to be done by same agency, in order to achieve success.	Phase 1
2.	Nehru Place	• Conceptual plans have been prepared/ approved by UTTIPEC. • MCDs need to engage the consultant for preparation of the PMD plan. • Area level Parking Management Districts (PMDs) need to be financially self-sustaining and models shall be provided by the developer/manager.	Phase 1
3.	Karol Bagh		
4.	Kamla Nagar		
5.	Vikas Marg		
6.	Lajpat Nagar		
7.	Bhikaji Kama Place		

UTTIPEC informed the Committee that necessary plans have been prepared scientifically after studying the traffic movements and available spaces in the localities. These are available on UTTIPEC websites. Local Bodies (MCDs/NDMC) are therefore requested to implement these plans to decongest the concerned areas.

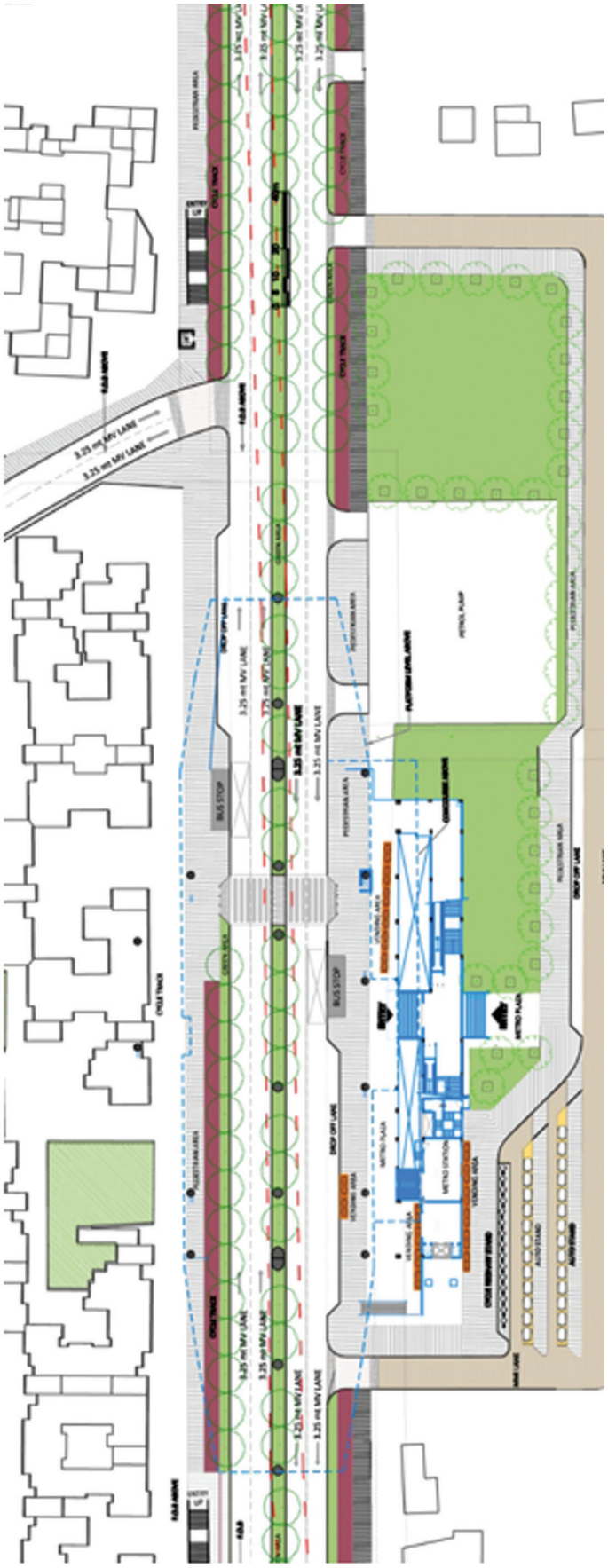


Figure 18: Multi-modal integration (MMI) guidelines laid out by UTTIPEC for planning of a station[1]

Source: UTTIPEC

1. *It shows Multi-modal integration (MMI) guidelines laid out by UTTIPEC for planning of a station. A drop off area has been created behind the station, away from the main road so that auto-rickshaws, e-rickshaws, cycle-rickshaws etc. dropping off passengers do not obstruct the traffic on the main arterial road. In addition, more exit staircases have been created at appropriate locations so that people coming by Metro can get off closest to their destination without having to cross the road at ground level. 68 such stations were taken up for planning by UTTIPEC and are currently under implementation by DMRC.*

1.2. MULTI-MODAL INTEGRATION & IPT

ISSUE

Multi-modal integration is key to providing passenger comfort and for providing seamless connectivity for transit services. The majority of Metro riders, almost 80% (people who access the Metro by foot, bus, cycle, cycle-rickshaw, e-rickshaw or auto-rickshaw) are the worst affected, due to lack of seamless connectivity. Last-mile connectivity and provision of safe and comfortable modal options for people must remain one of the primary objectives for the city.

With nearly 2.6 million people using the Delhi Metro every day, and with the future expansion the Delhi Metro shall soon be the city's life-line. Therefore, it is critical that a comprehensive strategy for affecting the modal share of the commuters goes hand-in-hand with metro development. Improved accessibility at the Metro stations for pedestrians and non-motorized transport must form a mandatory part of all Metro Station designs. The recent project in multi-modal integration at Phase-III metro stations looks specifically at the provision of essential facilities and amenities including Intermediate Para Transit (IPT) parking, vending zones, bus-stop locations, cycle-rental facilities, etc. within the immediate station area. Metro Rail Project (Phase-III) looks at improving the last mile connectivity within a 2Km zone of all Metro Stations to help people optimize travel trips in terms of time and money while providing efficient, comfortable and safe connectivity for all users. From the learning of earlier phases of Metro, the issue of last mile connectivity is being given priority in all subsequent phases with retrofitting of the previous ones.

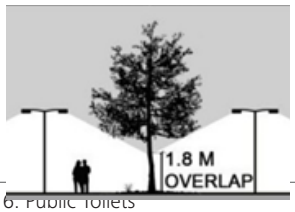
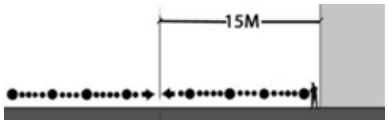
RECOMMENDATION OF THE COMMITTEE

- Provide well planned and properly designated spaces for all modes such as buses, e-rickshaws, cycle-rickshaws, auto-rickshaws, cycles, etc. within a 5 minute walking catchment of the stations;
- Provide basic amenities like toilets, proper signage, cafes, vendor-stands, lighting, trees, shading devices, etc. for commuters;
- Provide high quality walking environment including safe crossings/ skywalks/ well-shaded walkways/ footpaths, etc.;
- Provide safety and a sense of safety for all users especially women and children;

Figure 19: Artist's impression of the Multi-modal Integration (MMI) proposal at Mayur Vihar Phase-1, New Delhi interchange metro station showing creation of quality public spaces and proper infrastructure for pedestrians, cyclists and all types of commuters

Source: UTTIPEC

Table 5: UTTIPEC Guidelines – Facilities that should be provided near metro station for Multi Modal Integration

	Streets (Within MFZ)	Plaza, Parks
1. Universal Access	All public spaces to be barrier free and universally accessible.	
2. Climate comfort and shade: I. Trees II. Overhangs/arcades III. Artificial canopies IV. Cool, light-coloured High albedo materials	• At least 100 trees per/Km for streets with R/W smaller than 12m. At least 100 trees per/Km per footpath on streets with R/W greater than 12m. Spacing of trees at no place should be greater than 12m except at intersections. • Street level arcades are desirable for commercial frontages. • Overhangs from building facades over public realm is desirable upto a max. 2m to shade the footpath, etc.	At least 200 trees per sq.km. Trees should be planted along movement paths as well as in groups to shade seating/waiting areas, plazas, children play areas, tot-lots, etc. Temporary shade structures like pergolas, tensile shades, etc may be used at eye level & below in order to provide clear visibility and visual surveillance.
3. Seating to be provided in well watched, busy areas, well shaded by trees or artificial canopies – to provide safe pause place and climate protection	Seating to be provided in Multi-Utility Zones and not on footpaths.	They should be installed for groups (At least 10 people and preferably not in isolation, in order to provide a secure environment)
4. Dustbins	Source separated dustbins must be provided at each station exit, bus-stop, street intersection and entry/exits to public spaces.	
5. Lighting I. Basic lighting for safety & sustainabiity II. Accent lighting to define spaces 	• Lighting of Bus stops, Metro Station exits and elevated walkways=30 Lux. • Lighting of commercial streets, busy public spaces, plazas, parks and important street crossings=20 Lux. • Lighting of all other streets, walkways and public areas=10 Lux • Distance between lamps should be such to allow a vertical height distribution overlap of 1.8m, so that visual recognition is there. • Coordination of tree plantation and lighting plan required to avoid undesireable foliage shadows and patches of dark zones along streets • Provide glare free ambient street lighting plan required to avoid undesisrable foliage shadows and patches of dark zones along streets. • Provide glare free ambient street lighting for pedestrians, using full cut off fixtures for pedestrian zones. • Other lighting design standards as per Chapter 12 Street Design Standards.	
6. Public Toilets	Public toilets to be provided at every 500-800m along roads, and /or at every bus stop with minimum 1 WC for women.	Public toilets to be provided within a radius of 500m at all entry and exits points parks/ plazas, with minimum 1 WC for women.
	• In addition, one accessible toilet should also be provided to be marked as multi-use toilet to be used by senior citizens, families with young children and disabled persons. • Urinating in public spaces should be fined appropriately and heavily.	
7. Good design I. Scale spaces for natural surveillance II. Minimize areas and maximize trees/ planted areas. III. Plant or pave (as per requirement) all surfaces, to minimize dust/SPM pollution IV. Use deciduous trees to shade all surfaces, but allow sunlight access to spaces in winter	• Help create a sense of enclosure and placemaking on streets by creating relaxation spaces. • Flowering or deciduous trees create a changing seasonal urban experience on streets.	• In new projects, depth of plaza/park (community level and below) should not be greater than 30m in width. Due to the visibility limit (15m) of the human eye. • Park fences to use shrubs (50-70 cm high) in order to avoid interference in visibility and minimise territory division. • Dense tree area should be thinned out at eye level and below, for natural visibility. 

- Direct pedestrian crossovers/skywalks to all neighborhoods/destinations within the catchment so that people can walk to the metro station directly rather than coming on ground level and looking for motorized transport to cover short distances;
- Table 6 indicates the facilities that should be provided near the stations for effective Multi Modal integration (MMI); and
- The Multi-modal integration planning and design/ placemaking guidelines that were prepared and approved by Governing body of UTTIPEC, may be considered for station area planning purposes. The same is provided in the Table 6 along with illustrative examples in Figure 18 & 19. Table 5 gives the facilities that shoul be provided near the metro station.

ACTIONABLE POINTS

(i) Planning of Multi-modal integration for phase-III metro stations has almost been completed by UTTIPEC in consultation with all stakeholders. They need to be implemented by the major concerned agencies i.e. DRMC, PWD and DDA.

(ii) Plannig and implementation of MMI at Phase-I and II stations needs to be taken up by DMRC in a phased manner. Funds for the same need to be allocated. A phasing plan of the same as provided in the Table 7.

Table 6: UTTIPEC Guidelines enlisting the facilities and their location criteria, for effective Multi Modal integration (MMI)

Distance of level walk from station exit	Facility/Amenity and preferred Location
Within 50m	• Bus Stops; Vendor Zones; Cycle-Rental Station. • Locate within station premises and/or Multi-Functional Zone (MFZ) within Road R/Ws as per UTTIPEC Street Design Guidelines. • Provide cycle rental stands, also at nearby important destinations, like school, civic building, large offices, Malls, etc. and provide information signage at both end location.
Within 100m	• High occupancy Feeder Stop/Grameen Seva Stop. • Within Multi-Functional Zone (MFZ) within Road R/Ws, as per UTTIPEC Street Design Guidelines.
Within 150m	• Cycle-Ricksaw Stand; Cycle Parking Stand; IPT/Auto-ricksaw Stand. • Within Multi-Functional Zone (MFZ) within Road R/Ws. As per UTTIPEC Street Design Guidelines.
Within 150m	• Private Car/Taxi "Drop-off" location; Public Toilets. • Lighting of Bus Stops, underside of Metro stations and Elevated Walkways=10 Lux. • Lighting of commercial streets, busy public spaces and important street crossings=20 Lux. • Lighting of all other streets and public areas=30 Lux. • For footpaths, yellow light is recommended to allow visibility of tactile pavers.
Within 300m	• Signage/Way-Finding information, Maps. • At Station exits, display map of 500m influence zone around stations showing road network with names, major landmarks and destinations and location of all the above facilities within and outside station premises. • Road within 500m influence zone to have street name signage as per UTTIPEC guidelines. • All bus stops must display the route numbers and route description with list of major stops.
Within 300m (preferably)	• Validated Car Parking facility (Park & Ride). • Private car parking facility may be provided only at Terminal Stations and major interchange stations.

Table 7: Cost and Timeline for implementation of MMI and IPTs

	Area	Cost	Timeframe
Under implementation	78 Phase-III Metro Stations	Approx. 312 Cr. @approx. 4 Cr./per station	Phase 1
Second Phase: to be started	129 Ph-I & II Metro Stations	Approx. 645 Cr. @approx. 5 Cr./per station	Phase 2
To be implemented in Phases	6 Integrated Passenger terminals- i) Sarai Kale Khan ii) Bijwasan iii) Anand Vihar iv) Kashmere Gate v) Holambi Kalan vi) Tikri Kalan	Approx. 700 Cr. each • Budget contribution to be made by all participating departments, primarily including Railways, Transport Dept. GNCTD	First 3 in Phase 1, next 3 in Phase 2

Figure 20: Panoramic view showing lower levels of Berlin Central Station (Berlin Hauptbahnhof) with integrated regional and local rail, metro and bus services along with all facilities including stay, food, hospitality and entertainment for the passengers

Source: Wikimedia Commons

MULTI-MODAL INTEGRATION AT RAILWAY STATIONS/ISBT

ISSUE

In order to encourage use of public transport for long-distance travel, use of Railways/ RRTS/ Interstate Bus services, etc. and their integration with local intra-city public transport systems i.e. Metro, Buses, IPT and NMT needs to be made fast, convenient and seamless. This, along with 'Planetary Model' of Ministry of Railways for Delhi will allow the city to provide a viable alternative to motor vehicle users and decongest roads. These include,

- The Regional Rapid Transit System (RRTS) Corridors planned by NCRPB/ NCRTC is the most critical transit system that will reduce immigration into Delhi and facilitate growth of satellite towns with swift connectivity.
- Ring railway system is currently under-utilized public transport system. Though affordable for long distance commuters, it is not used due to bad connectivity to the station areas, lack of integration with Metro and Bus Stops.

RECOMMENDATION OF THE COMMITTEE

- For seamless integration of regional and city level modes, world class interchange facilities need to be developed on the lines of Waterloo station, London or Hauptbahnhof Station, Berlin (Refer Figure 20)
- Six Integrated Passenger terminals proposed in MPD-2021 which integrate national (airports/ railways) with regional (RRTS/ ISBT) and local (bus/ metro) traffic; need to be developed by Transport Department, GNCTD on priority basis. These include,
    i) Sarai Kale Khan (Central Delhi)
    ii) Anand Vihar (East Delhi)
    iii) Kashmere Gate (Central Delhi)
    iv) Bijwasan/ Dwarka Sector-21
    v) Holambi Kalan (North Delhi)
    vi) Tikri Kalan (West Delhi)
- Ring railway, which exists in Delhi, should be strengthened along with MMI at the stations for better connectivity.
- Areas around existing main Railway Stations to be decongested.
- Implementation of Planetary Model of Ministry of Railways to be expedited.

INTERMEDIATE PUBLIC TRANSPORT (IPT)

Intermediate Public Transport (IPT) are hired / shared modes of transport that may serve as feeders to trunk public transport systems or as another alternative to private transport use. IPT includes cycle-rickshaws, auto-rickshaws, e-rickshaws, taxis and any other vehicle type serving as a shared mode/feeder service that is also prescribed under the Motor Vehicle Act. Taxis play an important role in providing an integrated transport service which should also be available on roads like other metro cities for people who choose not to use a car and combine taxi with public transport for certain trips. Autorickshaws play an essential role as a shared or hired mode of public transport which provide door-to-door connectivity for a variety of trips and provide an affordable alternative to private modes. Adequate space for IPT, Bus, private bus, truck and commercial parking must be provided on all layout plans and road alignment plans.

The vehicular population of Delhi is 8.29 million vehicles (Delhi Statistical Handbook, 2014). The number of auto-rickshaws is approx. 91,840 (growth rate of 2% per annum). This is just 1.1% of the entire vehicular population, but yet, auto-rickshaws transport 3.6% of Delhi's commuters. As part of the modal shift improvement strategy to solve vehicular congestion, auto-rickshaws can contribute significantly towards the shift and improve component of the strategy. A study in 2001 revealed that auto-rickshaws are used for a variety of purposes by people to satisfy their mobility needs. 10% of the people used auto-rickshaws for work, 23% for education and 22% for health, shopping, etc. A single auto-rickshaw may serve at least 8-10 trips a day while a car would cover only two trips and occupy several parking spaces. Similarly, in case of cycle-rickshaws which play a similar role in the city, it is estimated that currently as high as 700,000 rickshaws are plying on Delhi roads, of which only 89,429 have a license.

Clearly auto-rickshaws and cycle-rickshaws can play an important role in decongesting the city if the right policy framework is in place. The various ways in which auto-rickshaws can help satisfy mobility needs are as follows-

1. Provide first and last mile connectivity thereby acting as feeders to mass transit systems;
2. Provide door to door connectivity thereby reducing the need to own a private vehicle.

RECOMMENDATIONS OF THE COMMITTEE

The Committee recognised that Intermediate Public Transport including cycle-rickshaws, auto-rickshaws, Taxis and Feeder Services have become an integral part of the public transport system, helping to meet diverse mobility needs.

Recommendations were made by the Committee under the following sub-heads:

Feeder Services

Feeder services in the form of smaller buses, vans including shared auto-rickshaws currently play an important role in the transportation system of the city, albeit mostly informally, connecting commuters to not only the Metro or the Bus for the first and last mile but also for the entire journey. Currently, a fleet of 120 Metro Buses and 6,153 Grameen Seva ply in the city. There is a need to regularise this sector to ensure safety, reliability, efficiency and comfort. For this, the following is recommended:

i. Plan regular city bus connectivity to a considerable extent in the form of feeder services to the Metro Rail Stations and the Ring Rail System;
ii. Recognise the role of informal feeder services currently serving the commuters in the city and regularise/ organise them to ensure provision of a safer, more convenient and reliable service;
iii. Plan, design and implement infrastructure to enable feeder services to become a meaningful and legal mobility option by providing dedicated stops and stands and terminals/stations, etc. even within employment and residential zones;
iv. Make use of non-polluting fuel mandatory for all feeder services, incentivised through grants to assist the transition;
v. Programmes such as driver training, certification etc. maybe explored to ensure safety on street for both the passenger and other co-roadspace users.

Taxi

The Committee recognised that taxis play an important role in providing an integrated transport service for people who choose not to use a car and combine taxi with public transport for certain trips. Currently 47,342 private operators are registered in the city. Improved facilities for taxis can help to reduce car-dependency. Taxis and autorickshaws complement each other in that the user groups of the two modes may differ.
The following steps are recommended to ensure improved services:

i. Maximise the above opportunity i.e. plan, design and implement infrastructure in the form of taxi-stands, pick-up / drop-off locations, etc. within terminals (stations and stops) and around demand areas (residential areas / employment centres and recreational / entertainment hubs) to improve taxi services in the city;
ii. Plan taxi stands as part of all developments at the Local Area level, within at least 5 minute walking distance of all homes and work places;
iii. Engage with 'hail a cab' service providers to ensure better, safer & comfortable service provision to citizens;
iv. Programmes such as driver training, certification, etc. maybe explored to ensure safety on street for both the passenger and other co-roadspace user.

Auto-rickshaw

The Committee recognised that auto-rickshaws are an essential and affordable option of non-shared public transport in the city and also the only

Figure 21: Top-Unplanned spaces for auto-rickshaws resulting in chaos; Bottom-well organized parking spaces for auto-rickshaws

Source: Centre for Green Mobility (top) PSDA (below).

mode, other than cycle-rickshaws, that one can hail in the city. In order to improve their efficiency and reliability, the following is essential-

i. Plan Auto rickshaw stands in all terminals (stations & stops) as well as trip attracting as per Multi-modal integration guideline;
ii. Undertake assessment of CNG filling stations to ensure adequate supply at multiple locations of choice;
iii. Encourage services such as 'dial an auto-rickshaw' to provide a wider and more efficient service to citizens.

Proper designated spaces for auto-rickshaws, cycle-rickshaws, etc. should be provided within the Right of Way of Roads preferably within the Multi-Utility Zone (MUZ), in order to prevent haphazard parking & idling on roads, which often leads to congestion. The pictures in Figure 21 on the adjoining page shows how this can be done

Cycle-rickshaw

The Committee recognised the role of the cycle-rickshaw as an important non-polluting, low energy consuming mode for goods and passenger movement within the city, particularly with reference to short and medium trips and one that provides employment to a large segment of the city's population. However, with a mixed type of fast-moving traffic on the roads, travel by cycle-rickshaws is currently very unsafe. In view of the above, the following actions are necessary-

i. Through Network Plans create a fine network of tracks shared/streets to ensure choice of direct, safe and comfortable routes with a target street grid of 80–100m. Recognise that the network addresses goods movement also and design accordingly.
ii. Provide fully segregated tracks for shared use with cycles on roads as per the Street Design Regulation of Master Plan Delhi 2021 with provision for safe NMT parking facilities and at-grade crossing as per UTTIPEC Street Design Guidelines. In addition, retrofit existing signal free corridors to ensure direct at-grade routes for cycle-rickshaws to enable easy movement
iii. Provide cycle rickshaw stands (for both passenger & goods) in new and retrofitted streets. For goods carrying rickshaws, parking spaces (both short and long term such as regular service bays and night parking shelters) at both ends – commercial/ distribution centres as well as within neighbourhoods – may be planned at the Local Area level.
iv. In specific areas, like the Walled City/Chandni Chowk/Sadar Bazar/Karol Bagh/Lajpat Nagar and Trans Yamuna Area, the use of cycles/rickshaw as a Non-Motorized mode of transport should be consciously planned along with pedestrianisation.
v. Alternatives to the manual passenger rickshaw may be explored through Pilot Projects in the city without forcefully removing, or rehabilitating the existing rickshaw puller population.

1.3. ENHANCING WALKABILITY & USE OF NMT

ISSUE

Walking is the most important and sustainable mode of transport. In Delhi, about 35% of the city comprises of commuters who only walk. (Refer Figure 4 for data on modal share distribution of Delhi including walk trips). These commuters are different from the ones who walk to access public transport. Therefore, in spite of the enormous motorization, the highest share of people still 'walk'. This is in spite of the poor walking environment and danger to life by walking on roads. Data shows that more than 60% fatalities on roads involve pedestrians. Safe walking environment is desirable and necessary for any society that is developing or in the developed world, as it provides for the basic right to commute. With increasing road widths, crossings at junctions are riskier and the space for walking is narrower than before, with the result that most activities happen on road even if the roads were not designed for them.

Since walking is so uncomfortable, most people prefer to drive or use private vehicles. Consequently, Delhi has more cars than the total cars in Mumbai, Chennai & Kolkata. Pollution levels in Delhi are almost double that of Mumbai, a city more populated than Delhi. Therefore, the right to walk safely is a non-negotiable condition. Data in Table 8 shows the comparison between the share of private motorized trips to non-motorized trips.

Shaded, continuous and levelled surface make for good walking expereince. INA Market.

Source: Centre for Green Mobility

Table 8: UTTIPEC Street Design Guidelines – Comparison of cities modal Share

	Model Share, percent		
City	Car + MTW	PT	W&C
Bristol, UK	65	12	23
Leeds, UK	61	36	3
Nantes, France	58	14	28
Helsinki, Finland	54	20	26
Marseille, France	53	12	35
Edinburgh, UK	52	29	19
Newcastle, UK	48	19	33
Brussels, Belgium	44	18	38
Frankfurt, Germany	42	21	37
Stuttgart, Germany	36	25	39
Amsterdam, Netherlands	32	16	52
MTW – Motorized Two Wheeler, PT – Public Transport W&C – Walking and cycling			
Delhi	23	33	44
Mumbai	15	52	33
Kolkata	12	58	30
Chennai	31	39	30

The data shows that even in cities where public transport availability and usage is high, the modal share of private transport is still high, due to low walking and cycling use. Therefore, promotion of walking and cycle infrastructure will help to shift short trips (1 – 4Km trips which constitute 60% of all trips in Delhi) to walk or non-motorized modes, thus bringing down private vehicle dependency.

The following aspects are important to consider for promoting walkability and cycling:

(i) Junction and Crossing improvements around Delhi (as per identification by Delhi Traffic Police):

- From transportation planning standpoint – More junctions mean better traffic dispersal. The reason for congestion in Delhi is due to lower number and poor design/management of junctions which greatly reduces the capacity of the road network to throughput and disperse traffic. Adequate number of junctions and proper geometric design with crossing and directional movement facilities – help disperse traffic efficiently in multiple directions, while ensuring safety of all road users.
- Poor design of junctions is the primary reason for traffic jams as well as pedestrian and cyclist fatalities on roads.

(ii) Footpath and crossing provision as a non-negotiable requirement on all roads. According to Traffic Police data (2010), maximum fatal accidents occur on signal free corridors and at the foot of flyovers. Ring Road has recorded the highest fatal accidents followed by Outer Ring Road, Rohtak Road, G.T.Karnal Road. The maximum casualty are of pedestrians and two-wheelers. The maximum accidents have occurred during the lean hours both in the morning and night.

The Traffic Police had cited the following reasons for these fatalities:

1. Signal-free high speed corridors
2. Insufficient/ no pedestrian crossing facilities
3. No speed breakers/ rumble strips on long stretches
4. Absence of dedicated lanes for slow moving vehicles
5. Heavy volume of traffic
6. Glaring during night

In view of the above, the implementation of the Street Design Guidelines have been taken up in Delhi in the last few years and proper facilities provided for all road users. Even in Chennai, implementation of such guidelines/standards have been taken up and the same is shown in Box-6.

RECOMMENDATIONS OF THE COMMITTEE

1. Road Design and Geometry improvement
   a. All roads must provide proper footpaths as per MPD street design regulations and adequate share of walking space within ROW.
   b. All pedestrian facilities should be barrier-free for universal access by all persons with reduced mobility including those with hearing and visual impairments.
   c. All impediments/ encroachments should be removed from footpaths all over the city to create safe walking environment in all colonies, office / shopping areas, terminal areas etc. which will encourage more people to walk. (Example in Figure 22)
   d. Planning, design, implementation and maintenance of pedestrians routes and facilities needs to be prioritized. Pedestrian oriented vehicle-free spaces throughout Delhi need to be created. Major work centres, where large number of pedestrian networks emerge and culminate, should have enhanced facilities for the pedestrians.
   e. New areas should plan for pedestrian zones, plazas, activity spaces based on locations of public transport nodes/stations, employment centres, residential communities and local/city level destinations. Minimum standard of footpath as per IRC codes needs to be 1.8m and the same has to be followed on all roads. Crossings need to be provided as per guidelines given under IRC Code 103:2012 for pedestrian facilities and UTTIPEC Street Design Regulations.
   f. Encroachment of footpaths should be made a cognizable offense under the Municipal Act. Pune Municipal Corporation has done the same by utilizing the provision of the BPMC Act-1949 and the details of the same are provided in Box-I, Chapter 1.1 Parking Pricing & Management
2. Junction Design and Management
   a. As mentioned in the NMSH Parameters (MOUD, 2011), at least five safe street-level crossing opportunities per kilometre of road with approximately 250m being maximum spacing between two crossings should be provided. Depending on context, these crossings may be signalized and/or traffic calmed to reduce vehicular speed and increase safety.
   b. Pedestrian Signals should be synchronized with the nearest full-traffic signals, for smooth movement of traffic along with safe pedestrian NMT crossing.
3. Way Finding
   a. Displaying street names, signage, names or important locations, distance meters, maps, direction signage, etc. at street-level for pedestrian use.
4. Safety (for all road users including women)
   a. Street-level activity and well-watched streets need to be created through mixed-use, avoiding opaque boundary walls, creation of hawking/vending zones and round-the-clock activities, to ensure safe environment for pedestrians.

BOX-7

Implementation of Street Design Standards has been taken up by Chennai Municipal Corporation (CMC) in the past few years. The primary goal was to provide safe walking facilities in addition to streamlined traffic movement. Figure 22 shows the streets before and after intervention by CMC. Before CMCs intervention, the streets had narrow, uneven footpath and hap-hazard parking. With CMCs intervention, these are now continuous and safe walking spaces and organized street parking. The re-designed streets look at providing proper facilities for bus stops, street vending, street furniture, and property entrances such that they do not hinder continuous walking experience of pedestrians.

Figure 22: Besant Nagar, Chennai – Redesigning of streets (before and after images)

Source: ITDP

Issues Of Cycling

With a mix of slow and fast moving traffic on the roads, travel by bicycle and rickshaws is very unsafe. Data has shown that although approx. 35% of population of Delhi owns cycles, only approx. 4.5% of them use cycles for commuting due to lack of safe cycling facilities or cycle-parking facilities (Refer Figure 23). Inadequate cycling facilities are slowly pushing the population to depend on the use of motorized private vehicles, thereby causing loss of environment, health and life in far greater numbers than was the case two decades earlier. With fewer cycling means, people tend to spend comparatively more money to reach the bus/metro station than on the bus/metro fare. The road fatalities of cyclists are on the rise every year and lack of dedicated cycling infrastructure, is enough incentive for them to switch to motorcycles.

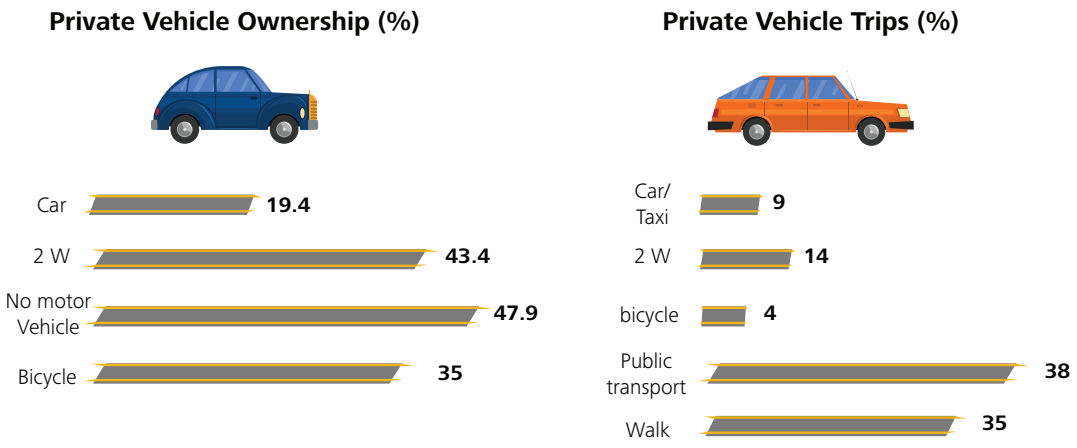


Figure 23: Delhi – Ownership of vehicles vs Use of vehicles

Source: Census 2011

Figure 24: Bicycle parking under the staircase of the Foot-over-bridge in Guangzhou, China

Photo: Centre for Green Mobility

Figure 25: Bicycle parking (bicycle sharing on left and stacked parking on right of walkway) on the street in Taipei, Taiwan

Photo: Centre for Green Mobility

RECOMMENDATION OF THE COMMITTEE

Good bicycle infrastructure needs to be provided and a convenient bicycle sharing system should be developed, which will help take shorter trips off the arterial roads (thereby reducing congestion). Encroachment of bicycle tracks and theft or vandalism of bicycle sharing infrastructure should be made a cognizable offence under the Municipal Act/MV Act or any other applicable Acts. The Figures 24 and 25 on the adjoining page and below show how multi-level cycle parking facilities can be easily accommodated in residential spaces throughout the city such as undersides of flyovers, staircases, FOB's, Metro viaducts, MUZs, etc. and therefore, do not have extensive space requirements.

- The bicycle infrastructure needs to be continuous, obstruction free and with clearly demarcated bicycle tracks or lanes with good signage, road marking, lighting, at least one line of tree shade and more bicycle parking areas. The bicycle infrastructure needs to be provided at a higher level with protected edges, to prevent monsoon flooding or encroachments by parked vehicles. Intersections need to have bicycle queuing arrangement and dedicated bicycle signals for easy cross over. For large junctions, rotaries and for obstruction by arterials or waterways or railways, special bicycle underpasses, bridges or ramps may be designed/ provided for.
  - Bicycle tracks should be a minimum of 2m wide for single direction and a minimum of 3m wide for both directions. For tracks having pedal rickshaw movement, a minimum of 2.5m wide for single direction and 4m wide for both directions should be provided.
- All streets above 30m right of way need to have dedicated bicycle tracks.
- The bicycle sharing system should be based on a dense network of stations placed approximately 300-400m apart and having fewer bicycles per station (10-50) with docks 1.5 times the number of bicycles in each station.
- The system with smart cycles should be able to communicate with the stations and the control center to help track them and make the checking out and checking in of cycles seamless.
- The cycle sharing system should be accessed by a common mobility card that will help make the system easy to use. The system should be procured by the government and will be run on long term basis by private operators who will be able to market and expand the system incrementally.
- The Street Design Guidelines, prepared by UTTIPEC, to be followed by road-owning agencies for retrofitting of existing Right-of-Ways and construction of new roads. A summarized checklist of UTTIPEC's street design guidelines is given in Table 9. Cost time line for implementing cycle share is given in Table 10 and phases of cycle tracks to be developed is given in Table 11.

Figure 26: Complete street visualization for Dwarka, New Delhi[2]

Source: Centre for Green Mobility

2. *Figure 26 shows tentative details of the proposed cycle sharing system proposed by DDA as well as the award winning project of cycle ks which were created in Diu in 2013 connecting various important destinations in the city.*

Table 9: Checklist of UTTIPEC's Street Design Guidelines

S.No.	Component	Sub-component	Non-negotiable requirement	Application by street type
1	Walking Zone	Clear Walking Zone should be 2.0m x 2.4m High		Mandatory on all roads above 12m. Roads with pedestrian traffic constituting greater than 60 percent of total traffic volume should be pedestrianized.
	01A	Minimum clear walking zone	2.0m minimum clear width 2.4m clear height (no obstructions allowable within this clear height; Tree branches within this height to be pruned with due permissions; All Advertisement panels, posts, poles, junction boxes, public utility structures etc. to be removed.)	
	01B	Walking zone width is provided as per landuse	2.0m for Residential Areas 2.5m minimum for Commercial/Mixed Use Streets 4.0m for Commercial Nodes.	
	01C	Maximum Kerb Height	Maximum height of a pavement (including kerb, walking surface, top-of-paving) shall not exceed 150mm (6"). 100mm (4") kerb height is preferable for Arterial Roads. All walking surfaces should be very rought/ mattfinish / anti-skid. Medians should be maximum 150mm high. In case the carriageway finished level is expected to rise during future re-carpeting, reduction in footpath level to 100mm or less is acceptable. But under no circumstances is the height of footpath to exceed 150mm. Finished top level and kerb height for all bus-stops to be 150mm (Except BRT).	All
	01D	Kerb Radius and Slip Road Treatment	Maximum corner radius of Kerb=12m It may be reduced to 6m in residential areas to slow down turning buses, trucks etc. With the provision of a corner mountable kerb for emergency vehicles. For intersections of R/Ws of 30m-30m or lesser, slip roads are prohibited. In cases where they already exists for intersections for intersection of 30m-45m and higher R/Ws, the following strategies may be employed: Option 1: Slip road can be removed wherever Pedestrian and NMV volumes are high. Option 2: Reduce corner radius of Kerb to calm traffic, and signalize the Slip road crossing (full or pelican signal), in order to make them safe for all users. Option 3: Introduce raised table top crossings at slip roads and minimum 20- second pedestirans signals – to allow pedestrians, cyclists and physically challenged people to cross the road comfortably at the same level. Option 4: Signalized turning pockets may be provided where left-turning volumers are high.	

S.No.	Component	Sub-component	Non-negotiable requirement	Application by street type
	01E	Continuous payment	Continuous barrier free movement corridor for NMTs and persons with disabilities. Avoid sidewalk interruptions by minimizing kerb cuts i.e. Minimize the number of driveways that cross the sidewalk – in order to support pedestrian safety and a continuous sidewalk. Maintain an even surface and elevation of the pavement at 150mm or less from surrounding road level. At entry points of properties – introduce "raised driveway" or "table-top" details – where pedestrian and cycle lanes continue at the same level, but the motorized vehicles have to move over a gentle ramp to enter the property. Remove all obstructions from the sidewalks. Consistency of designs elements, color and texture, help provide visual continuity and calm traffic, even at crossings.	All
	01F	High Albedo Materials	Pave with asphalt, apply a white aggregate as a chip seal layer, or a light-colored surface coating such as a zinc – oxide slurry mix.	All
	01G	Permeable Pavement	Pave for large hard surfaced areas like parking lots, driveway curb-cuts, large plazas, vendor zones, pedestrians only streets, etc. Should be permeable in order to reduce runoff and heat island effect, and increase ground water infiltration and recharge.	Wherever large paved areas exist
		Guard Rail	Not desirable in most instances on urban roads, except near intersections.	
2.	Dead Width	For sidewalks in commercial areas, an extra 1m should be added to the stipulated clear walking width. This extra width is called Dead Width. In other situations where sidewalks pass next to buildings and fences, a dead width of 0.5m can be added. In busy areas like bus stops, railway stations, recreational areas, the width of sidewalk should be suitably increased to amount for accumulation of pedestrians.		
3	Universal Accessibility features	Universal Accessibility is required for all sidewalks, crossings, parks public spaces and amenities. Please refer Guidelines Document for Details. http://uttipec.nic.in/StreetGuidelines-R1-Feb2011-UTTPEC-DDA/pdf		
	03A	Kerb Ramps	1:12 Minimum Slope at all level change points; 1.2 M Width of Ramp; Tactile warning strip to be provided at curbside edge of the slope	All
	03B	Raised Table-Top Crossings	All slip road pedestrian crossings; all non-signalized intersections and mid-block intersections should be raised to match the level of the connected footpaths (150m top of kerb)	All
	04C	Tactile Paving	All walking surfaces should have Tactile pavers (Guideline and warning path) to guide people with vision impairment	All
			Tactile pavers should be provided to lead persons with vision impairments to the lifts, crossings, toilets, bus stops, i.e. all public and road facilities.	All
	03D	Auditory Signals	All traffic signals should have red & green man symbols and auditory signals.	All
	03E	Accessible Infrastructure	All signage should be graphic or symbol based, rather than text based.	All
			Lifts should be minimum 1400x1400mm in size.	Wherever applicable
			All Lifts to have Braille buttons and audio announcement systems.	Wherever applicable

S.No.	Component	Sub-component	Non-negotiable requirement	Application by street type
4	Multi - Functional Zone (MFZ)	Multi-Functional Zones on a Street should be a minimum of 1.8m wide, and may locate any or all of the following functions within them: Tree Planting; Planning for Storm Water Management; Auto rickshaw Stands; Cycle-rickshaw Stands; Vendor Zones; Car Parking; Street Furniture; Bus Stops, Street lights/ pedestrians lights. Provision of MFZ is most critical otherwise the above uses/ components of streets would encroach upon pedestrian, cyclist or carriageway space. Common Utility Ducts and Duct Banks should not be located under the MFZ as there may be interference due to trees.		
	04A	Essential Planting	Deciduous Trees a must for shading and comfort of all road users in different seasons. At least 125 trees per/Km for streets with ROW smaller than 12m. At least 125 trees per/Km per footpath on streets with ROW greater than 12m. Spacing of trees at no place should be greater than 12m except at intersections.	
			Tree Planting and Lighting Plan must be prepared in conjunction so as to not obstruct each other.	All
			Trees must be pruned in order to maintain visual clearance for pedestrians (2.4m clear vertical zone).	All
			Under no circumstances should trees be placed within the 1.8m clear pedestrians (2.4m clear vertical zone).	All
	04B	Tree Pits and Tree Grates	1.8m x1.8m Tree Pit should be left for Tree roots to breathe;	All
	04C	Planting with Storm water management	The MFZ must accommodate Rain water harvesting features as per site context, on all road retrofitting projects	All
	04D	Aesthetic Planting	Trees themes by color of flowers, foliage, fruit-type, smells, and other aesthetic qualities in order to give a unique experience to road users	As feasible and suitable.
5	Bicycle & NMT Infrastructure			
	05A	Segregated Cycle + NMT Tracks	Cycle tracks are mandatory on roads of r/w above 30m. Cycle tracks are not mandatory on Roads of R/W 30m or below. It may be provided on 30m roads ONLY IF functioning as Arterial Road, with prior approval from UTTIPEC Cycle trakcs are prohibited on Roads of R/W 24m or below, such Roads must be traffic calmed to make them safe for cyclists & pedestrians, during off-peak hours Where provided, Cycle and NMT tracks should be of minimum 2.8m width in cement concrete, physically separated from Motorized vehicle 0.7m, within the existing ROW	
	05B	Bicycle and Cycle-Rickshaw Parking Facilities	Secure cycle parking must be provided at all MRTS/BRTS Stations, near bus stops, at markets at multiple locations, and within neighbourhoods within 300m of any home	
			Designated Cycle-Rickshaw parking is to be provided at all MRTS/ BRTS Stations, near bus stops, at markets at multiple locations	
			Cycle parking and cycle rickshaw parking should be accommodated within the Multi-functional Zone; minimum width required is 1.5m	
			The stands should allow at least the frame and ideally both wheels of the cycle, to be secured to them.	

S.No.	Component	Sub-component	Non-negotiable requirement	Application by street type
6	Crossings	Refer Typical Designs for Crossings at: http://uttipec.nic.in/writereaddata/linkimages/0137034636.pdf		
		Minimum 3m wide pedestrian crossing must be provided at all road crossings. A "set of 3" essentials components are required at each crossings:		All
		1) Universal Accessibility Features (for persons with disabilities, reduced mobility, vision and hearing impairment.)		
		2) Dustbin		
		3) Street Directional Signage		
	06A	At-grade Crossing	Minimum 3m wide signalized crossings at all intersections and T-Junctions.	All
			Width of crossing should be 6m where higher pedestrian/NMV volumes are expected due to abutting landuses.	
			Advance stop and yield lines should be considered at stop-or signal-controlled marked crossings with limited crossing visibility. Poor compliance , or non-standard geometrics.	
			Stop and yield lines can be used from 1 to 15m in advance of crossings, depending upon location, roadway configuration, vehicle speeds, and traffic control.	
			Traffic Calming Treatment starting at least 25m before the zebra/ table-top crossing is essential in Delhi due to unruly traffic. Refer UTTIPEC Typical Crossings Design Handbook. Way finding Signage for Pedestrian orientation and directional guidance must be provided at street intersections.	
	06B	Mid-Block Crossing	Mid-block crossings must be provided for blocks longer than 250m.	All
			Mid-block crossings must be provided at regular intervals as per the following standards: Residential Areas: Every 80m-250m and Coordinated with entry points of complexes; location of bus/ train stops, public facilities, etc. Commercial/ Mixed Use Areas: Every 80m-150m High intensity Commercial Areas: Make Pedestrian and NMT only, if possible.	
		Signalized Crossing	Pedestrian Signal phase of 20 seconds essential to allow pedes-trians, cyclists, rickshaws & persons with disabilities to cross the Road in a single phase.	
		Non-signalized Crossing	All non-signalized mid-block crossings are to have auditory pelican signals and/ or table top crossing provision with traffic calming.	
	06C	Raised Crossings	All slip road pedestrian crossings; all non-signlized intersections and mid-block intersection should be raised to match the level of the connected footpaths (150mm top of kerb)	All
	06D	Grade Separated Crossing (Foot Over Bridge, Subway, etc)	PROHIBITED on Roads of 45m or less.	Refer "FOB Consideration &Design Checklist" on UTTIPEC Website.
7	Medians	Medians and Pedestrian Refuge Islands are a must on streets wider than 24m. On streets of 24m or less, Medians are prohibited, unless approved by UTTIPEC for special cases.		All Streets above 24m
8	Street Lighting	Mid-Mast Lighting (10m-12m tall) – should be used for adequate lighting of all roads for both pedestrians & vehicles.		

S.No.	Component	Sub-component	Non-negotiable requirement	Application by street type
	08A	Pedestrian scale Low-Mast Street Lighting	Height of Light Pole is a function of Street Width. Narrower the Street Width, lower can be the Lamp Height.	All
			The lux level for the street lighting may be applied as per NBC/IRC standards. Lighting Plan must be prepared in conjunction with Tree Planting Plan.	All
	08B	Full Cut-Off Fixtures	Full cut off fixures which focus light downwards and allow no light towards the night sky, and also do not cause glare – are required for all public streets.	All
9	Public Amentities Toilets, Parking bays, Vendor Zones, Signage, dustbins, etc.			
	09A	Local Bus Stop	Bus Stop must be universally accessible and located clear of the 1.8m Walking zone; they can be located within the MFZ	All
	09B	Public Toilets	Public Toilets, including one for persons with disabilities – must be located every 500-800m.	All
	09C	Street-Direction Signage	Vector way fining Signage is essential at every street corner.	All; as feasible
	09D	Pelican Signals	Auditory Pelican Signals coupled with raised table top crossings must be provided at all T-junctions and non fully signalized mid-block crossings.	All
	09E	Dustbins	Dustbins with graphic explanation of source separation, must be provided at all street intersections and bus-stops	All
	09F	Vendor Zones	Vendor Zones must pe provided within the MFZ, near busy interactions, markets, bus-stops, Metro Station exits, etc. or other incidental spaces along a pedestrian pathway – within the overall RoW – but must be clear of all minimum walking RoW	All

Cycle tracks in Delhi

Source: SG Architects

ACTIONABLE POINTS

Tables 10 and 11 provide the approximate costs and timelines for implementing cycle tracks, junction improvements and cycle sharing systems in Delhi-

Table 10: Cost and Timeline for implementation of cycle sharing system in Delhi

Cycle Sharing and provision of tracks		Approx. Area	No. of cycle stations	No. of cycles	Cost	Timeframe
Phase 1	Dwarka	56sq.km.	315	4500	Approx. 60 Cr.	Within 2 yrs.
Phase 2	Entire West Delhi area	40sq.km.	500	6500	Approx. 60 Cr.	Within 5 yrs.
Phase 2	NDMC	45sq.km.	350	4500	Approx. 50 Cr	Within 5 yrs.
Phase 1	South Delhi area	70sq.km.	550	8500	Approx. 120 Cr.	Within 5 yrs.

Table 11: Cost and Timeline for provision of footpath, Cycle tracks and junctions

Cycle tracks (including RoW design)		Cost	Timeframe	Agency
Phase 1	200Kms of street length having cycle tracks	Approx.600 Cr. @approx. 3 Cr. per/Km	Within 2 yrs.	PWD, DDA
	70 junctions	Approx.70 Cr. @approx. 1 Cr. per/junction		
Phase 2	500Kms of street length having cycle tracks	Approx.1500 Cr. @approx. 3 Cr. per/Km	Within 5 yrs.	PWD, DDA
	200 junctions	Approx.200 crores @approx. 1 Cr. per/junction		

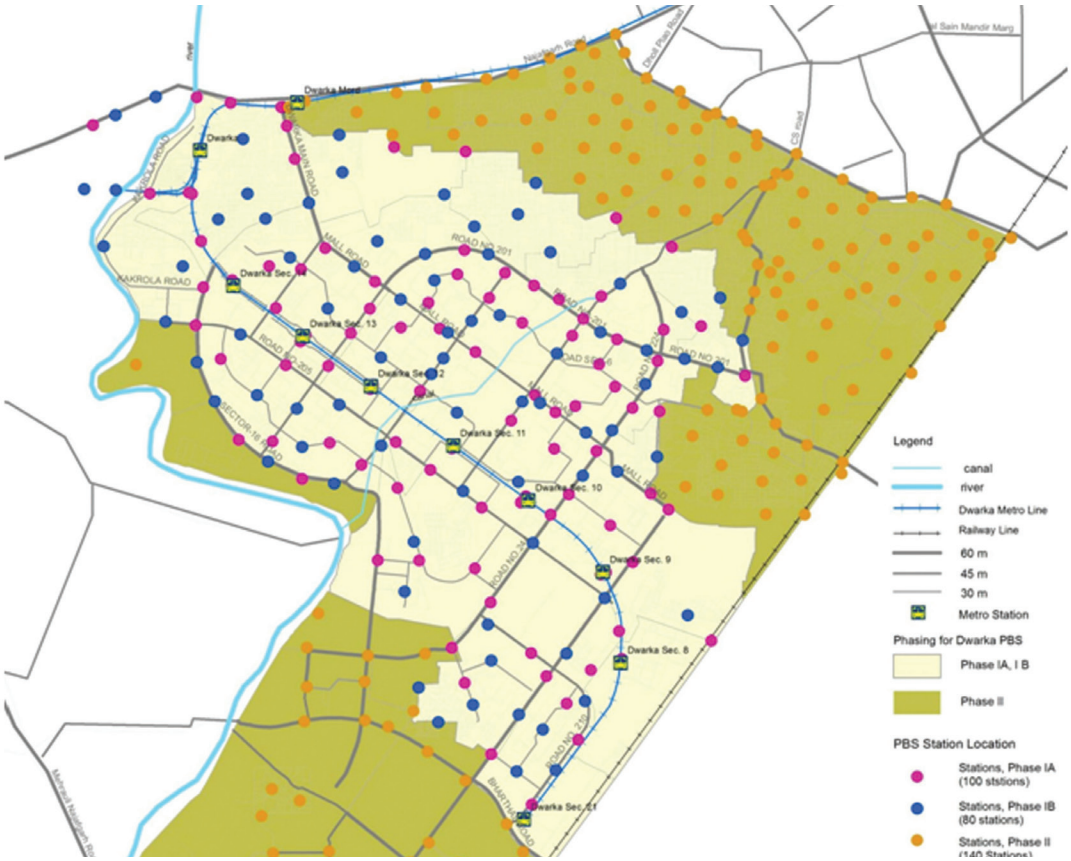


Figure 27: *(top)* Preliminary cycle sharing stations in Dwarka; *(below)* Example of a retrofitted street with cycle track in Union Territory of Diu

Source: Centre for Green Mobility

Figure 28: High Frequency Trunk Bus Corridors

Source: DIMTS, DTC, DTP; 2013

Figure 29: High Frequency high-speed bus corridor (Guangzhou BRTS)

Source: Urbancincy.com

1.4. BUS SERVICE IMPROVEMENTS

ISSUE

Rapid urbanization of Delhi and migration from neighbouring cities and other states has impacted mobility and transportation network in the city. With per capita income of Delhi being one of the highest in the country, there has been enormous increase in the number of personal vehicles with limited scope for expansion in road network leading to increased congestion and resultant traffic delays. In this backdrop, the Govt. of Delhi has planned various sustainable solutions to provide safe, affordable, quick, comfortable, reliable and safe access to the city's residents by investing in transport systems that would encourage greater use of public transport (especially buses and non-motorized mode) instead of personal motor vehicles.

The total passenger trips per day catered by buses are more than 60% of the total public transport trips in Delhi, which is a significantly higher share than the Metro, at fraction of its cost. In spite of the popularity and use of the bus, it is still seen as a poor man's vehicle and therefore is in ever greater need of modernization. Bus transport, throughout the world caters to more commuters per day than any other mode – even in cities of Singapore, Tokyo and Hong Kong which are known for their efficient metro systems. By providing a technological boost and making them more accessible to most residential and commercial places, buses can cater to heavy passenger loads and still maintain good reliable service that's comfortable and dependable. The bus stations, real time passenger information system, bus operations, bus priority signalling at junctions, comfortable bus docking arrangement on the street, and easy accessibility are assured ways of attracting more passengers to buses. In addition, corporatization of private stage carriage operations, introduction of ITS, Automatic Fare Collection System (AFCS) and a GPS based vehicle monitoring and passenger information system in all public buses, etc. would help modernize bus operations in Delhi.

The Bus Rapid Transit System (BRTS) of Delhi has faced flak from many sections of the society including experts and technical personnel, with the result that BRTS could never gain the ground it lost. The prominent opposition was from the private vehicle lobby which perceived the system as taking away the road space that was

Figure 30: BRTS Ahmedabad

Source: ITDP

Figure 31: BRTS Guangzhou

Source: ITDP

otherwise to be assigned to them. However, BRTS still carries significantly more people per hour than all the vehicles put together in the pilot corridor of BRTS, a fact that is important to note. BRTS is a high capacity bus system and therefore should have this integration with the regular bus system in terms of fare collection, interchange and also should be provided with depot and parking spaces. Delhi requires a large number of buses that should be prioritized over other expenditure. Bus Rapid Transit System, when designed & run as an efficient and integrated system, (for example Ahmedabad, Guangzhou BRTS in Figure 30 & 31) has shown across the world that it carries more passengers than any other mass transit system, even when more than one mass transit systems are present in the same city. In Delhi, on the pilot corridor, studies have shown that the speed of the bus increased thereby carrying more passengers per minute. Delhi still carries more than 60% of the passengers on buses from the overall mass transit ridership – much higher than Metro. With efficient and comfortable BRTS development, bus services will be able to provide greater comfort, reduce travel time and integrate with all systems to provide seamless travel experience. However, corridor development issues have to be addressed to make BRTS a success.

Five major issues were identified with respect to the bus service system of Delhi:

i. Access to bus service within walking distance of homes and with low floor buses for universal accessibility (at-level boarding and aligthing);
ii. Improving availability by rationalizing routes (Figure 28), scheduling and fleet enhancement. Air-conditioned buses to make it attractive to middle class (comfort is key to encourage public transport use). The bus system in Delhi carries about 52 lakh commuters every day. However, the demand for buses on certain routes at certain times is much higher than what is being provided. At present less than 5000 buses are available in the city while it is recommended that in a period of next 2-3 years it should be raised to 7000 buses and to 11000 buses in the long term. It is, therefore, essential that a judicious mix of high quality, air-conditioned buses along with non-AC buses as well as mini and feeder bus system; should be evolved in order to provide efficient and reliable public bus transport system;
iii. Cheap & easy to use–bus fares should be less than per/Km cost of two-wheeler use (therefore various cross-subsidy models are required);
iv. Footpaths & common mobility card (are primary requirement for efficient and safe last-mile connectivity); and
v. Reliability (ITS based public information system).

CURRENT STATUS

The Govt. of Delhi is in the process of augmenting the city bus fleet (stage carriage) upto 11,000 buses. The bus transport system is being revamped by introducing a big fleet of buses through corporate entities in the cluster scheme. Based on the commonality, the identified 657 routes have been aggregated into 17 distinct clusters of routes. The DTC and the private entity are to operate equal number of buses on each route.

RECOMMENDATION OF THE COMMITTEE

i. The Committee recommended that an "Urban Transport Fund" needs to be set up and the fund may be strengthened based on the following:
   a. Rationalization of the budgetary allocation to augment available funding for public transport;
   b. Tap different revenue streams related to transport, vehicles as well as transport demand management methods including parking, vehicle taxation, fuel taxes, advertisement revenue;
   c. Recurring cess from Transit Oriented Development (TOD) along MRTS corridors from private sector and direct funding for TOD developments by Transport Dept.;
   d. Development of Bus Depots as mixed use of developments which would maximize their development potential and consequently the revenue, which would in turn fund bus operations & maintenance; keep fare box at a low rate (so that more people can continue to afford using buses) and also generate funds to purchase & develop further depot lands to accommodate more buses & generate more revenue. Bangalore Metropolitan Transport Corporation (BMTC) has successfully implemented this model in the last decade and the same can be adopted for Delhi & other Metro cities;
   e. Purchase of buses to augment fleet to 11,000 buses. Purchase of 2000 buses in the short term and 4000 buses for the long term including replacing old scrapped fleet with new air-conditioned buses.
ii. Buses for outer Delhi - There is high growth and population density in parts of outer Delhi but most of

these colonies do not have a reliable and dedicated bus service. The same parts have unregulated Grameen Sewa and E-rickshaws that cause chaos. It is recommended that a reliable and adequate fleet of buses of smaller size, should be provided to deal with this in fringe areas;

iii. Feeder bus services to metro stations should be increased;

iv. Integrated Bus System;
   a. RITES and DIMTS had conducted an elaborate study of routing of DTC buses and route rationalization based trunk routes of high capacity. High frequency bus corridors must be implemented wherein buses are available at frequent intervals and are provided with priority signalling systems. These buses must be linked with smaller size buses, mini buses as well as feeder bus system which can work on an aggregator model;

v. Bus Fares;
   a. The bus routes should be subsidized especially with the view to increase usage by public and by implementing a robust public bus transport system. The number of commuters can increase from 45 lakhs to 80 lakhs per day in a few years' time and incentives for bus users can be implemented wherein usage of more than 25 days a month may provide 2-5 days of additional travel. Common mobility cards for easy use in bus, metro and taxi should be implemented along with the Passenger Information System (PIS);
   b. Time based ticketing should be introduced so that people changing between multiple bus routes to reach their final destination can travel on the same ticket with multiple interchanges. This provides a huge incentive to bus commuters in terms of time and monetary savings and should be considered on priority;
   c. Free bus days should be introduced in order to encourage private vehicle users to use public transport, even on non-working days, festival days, holidays, etc;
   d. Demarcated bus lanes should be implemented and enforced strictly with heavy penalties; and
   e. It must be ensured that per/Km bus fares are kept lower than the per/Km cost of using two-wheelers in order to prioritize bus travel.
   f. ITS such as GPS, PIS should be installed on buses and bus stops which should be connected to the Operation Control Centre.
   g. At-level boarding and alighting should be provided for universal accessibility.

vi. Bus Depot;
   a. As per norms of bus parking, adequate bus parking and terminal spaces should be provided in the city.
   b. The selection and allocation of depot lands needs to be planned in sync with the routing of both DTC and cluster buses, so that dead mileage and other losses to the transport agency may be minimized.
   c. To ensure optimum utilization of land, multi-level parking for buses is to be prioritized.
   d. As far as possible, all bus depots must function as Terminals as well.
   e. Large public parking facilities, underside of flyovers, wide arterial roads and underused areas of the city should be permitted for use in off-peak hours for parking of public/private buses and commercial vehicles, chargeable at appropriate rates.
   f. Planning and provision of space for private buses, private commercial vehicles, trucks and logistics terminals at the peripheries of the city, need to be planned at the Zonal level.

BRTS

Public Transport Network planning work was initiated by GNCTD on the basis of the TDF study by Transport Department in 2008. As per the plan, the total length of the Integrated Public Transport Network (IPTN) was 556.7Km of which BRT system comprised of 365.5Km. Thereafter, a revised IPTN of 843Km was proposed including a BRT system of 645Km. PWD agreed to implement 5 out of 14 approved corridors and the rest were to be implemented by DIMTS in 2011. However, due to design issues and limited length of corridor, BRT got a lot of flak from the public and the pilot corridor was recently dismantled.

A good BRT system should have the following features:

a. Providing median stations to reduce cost on operations and provide dedicated bus corridor (on lines of Ahmedabad system);
b. Providing high quality air-conditioned buses to make it attractive to middle class that can board at median stations and can be used out-of-corridor also (comfort and least no. of interchanges is key to encourage public transport use);
c. Ensuring 'at-level' boarding of all buses and 'off-board' ticketing at the BRT stations to save time and

Table 12: Timeline for implementation of Bus Upgradation in Delhi

	For Improvement of Bus System	Agency	Timeframe
1	ITS (OCC, PIS, Signalling, Management)	Transport Dept. GNCTD/ Tr. Police	Phase 1
2	High Quality, air-conditioned, low-floor, semi low floor, A/C and non-A/C buses	Transport Dept. GNCTD, DTC	Phase 1
3	Common Mobility Card	Transport Dept. GNCTD	Phase 1
4	Route Rationalization of all bus routes (DTC/ cluster/ BRT)	Transport Dept. GNCTD	Phase 1
5	Bus Parking and Depot space provision – make available all major roads which lie vacant at night, for night time bus parking. Innovative means need to be evolved for parking till more land for depots is made available. Parking at terminals having depots nearby, for maintenance, washing and upkeep can be a short term alternative. Bus depots should be appropriately monetized in order to make available more land for depots (through purchase and development).		

provide universal accessibility;

d. Retrofitting the corridor for easier passenger access through footpaths and cycle tracks on the BRTS corridor, such that BRTS is 'prioritized' over other motorized modes and is easily accessible;
e. Retrofitting the intersections for 'BRTS-priority' movement and greater passenger throughput. ;
f. Integrating BRTS operations with DTC bus operations under single authority and with fare integration;
g. Rationalizing all bus routes such that BRTS and buses function as a single unified network with few high capacity routes (called BRTS) and the rest, medium or low capacity routes;
h. A hybrid model of BRTS should be tried out for Delhi where the integration of DTC and BRTS buses can be such that buses also reach the outlying areas or cover the last mile. IT-based scheduling of buses should be done;
i. Operating BRTS and buses on Gross Cost Model (GCM) as opposed to Net Cost Model (NCM), as GCM-
    i. Ensures greater bus availability and wider service reliability of the system since profit is not linked to ridership
    ii. Ensures building in of incentives and penalties to the bus operator in the contract, thereby, improving operations
    iii. Ensures driver discipline and passenger safety is much higher
    iv. Helps to attract more private investment models for procurement and operation of buses
j. Provides Depot spaces and Bus Parking for BRTS and other buses such that dead-kilometres of the buses can be reduced for efficient functioning of the Model
k. Bus parking space should be encouraged in many commercial or non-commercial centres through incentives;
l. Provide IT-based Real-time Operations for BRTS and bus services;
m. Cheap & easy to use – bus fares should be less than per/Km cost of two-wheeler use (therefore various cross-subsidy models are required);
n. Common Mobility Card is a must for seamless travel experience (a primary requirement for efficient and safe last-mile connectivity); and
o. In order to keep the fare box fee/ticket price low, various subsidy/cross-subsidy models need to be explored.
p. Tentative Cost and Timeline for implementation of Bus System upgradation is indicated in Table 12 and that for Bus/BRTS Corridor is indicated in Table 13.

ACTIONABLE POINTS

The Tables 12 and13 show the various aspects and actionable tasks that need to be undertaken by various departments of Delhi for enabling modernization of the bus system in the city.

Table 13: Cost and Timeline for implementation of **Bus/** BRTS Corridor Development in Delhi

	For Improvement of BRTS System	Agency	Cost (Cr.)	Timeframe
1	BRTS Corridor Development including junction improvements	PWD		
	Karawal Nagar to Mori Gate (12.9Km)		193.5	Phase 1
	Gazipur NH-24 to National Stadium (12Km)		180	Phase 2
	Dilshad Garden Metro Station to Tikri Border (40Km)		600	Phase 2
	Badarpur Boarder to IGI Airport via Mahipalpur (26.1Km)		391.5	Phase 2
	Harsh Vihar to Janakpuri District Centre – Janakpuri D-Block (33Km)		495	Phase 2
2	BRTS Depot Development	DTC/ Transport Dept./GNCTD	-	Phase 2
3	ITS (OCC, PIS, Signalling, Management)	Transport Dept. GNCTD/ Tr. Police	400	Phase 1
4	• High Quality, air-conditioned (1000 buses)	Transport Dept. GNCTD	800	Phase 1
	• Non-AC Low Floor (1000 buses)	Transport Dept. GNCTD	500	Phase 1
5	Common Mobility Card	Transport Dept. GNCTD	PPP	Phase 1
6	Route Rationalization of all bus routes (DTC/ Cluster/ BRT/ Feeder)	Transport Dept. GNCTD	-	Phase 1
7	• High Quality, air-conditioned (4000 buses)	Transport Dept. GNCTD	3200	Phase 2

Differently-abled friendly bus entry. San Francisco.
Source: Centre for Green Mobility


CNG
Jai Jwala Maa

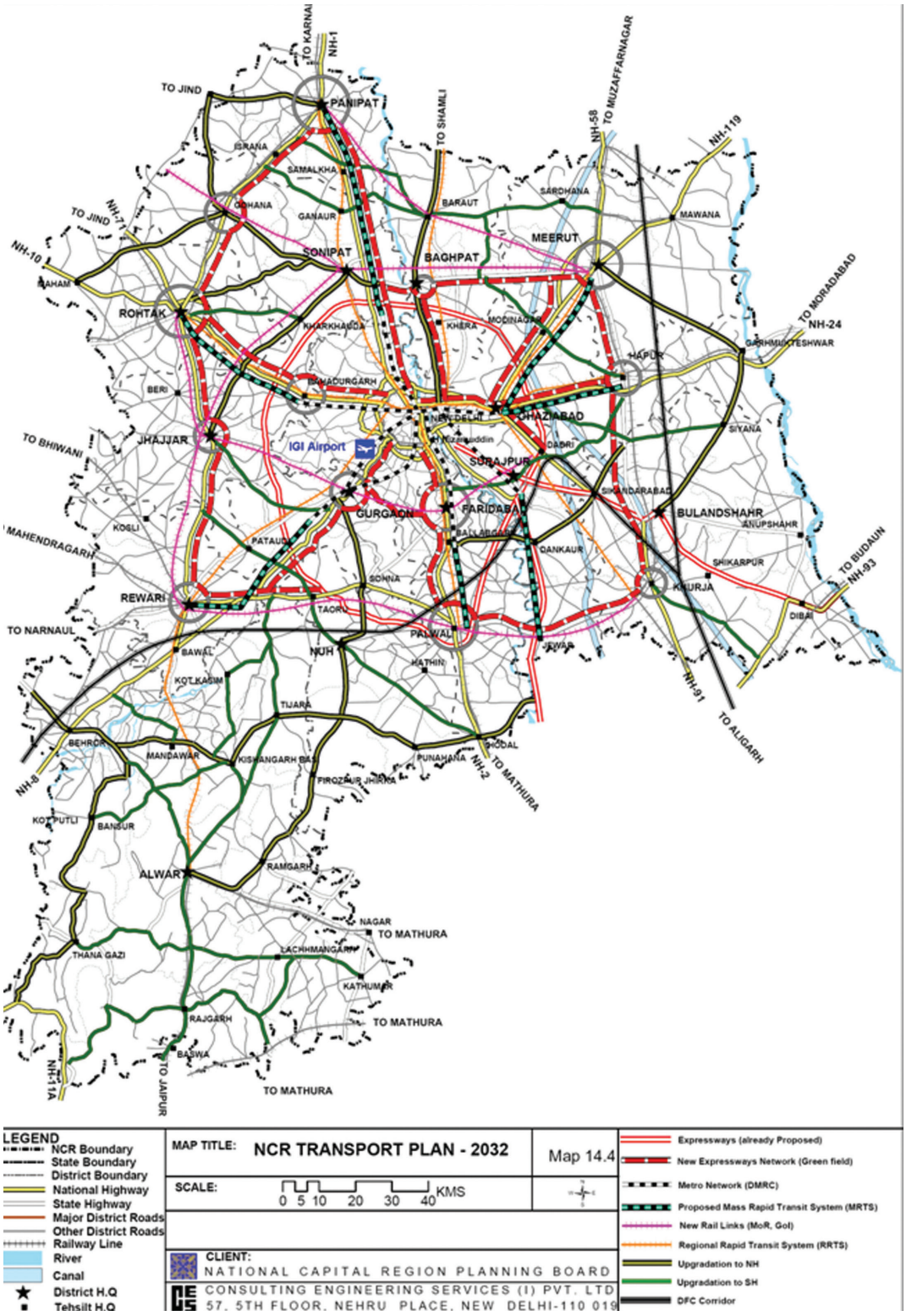


Figure 32: NCR Transport Plan – 2032

Source: NCR

1.5. IMPROVING REGIONAL CONNECTIVITY

ISSUE

National Capital Region Planning Board prepared the Regional Plan for the National Capital Region (NCR) with the perspective year 2021 for balanced and harmonized development of the region. One of the objectives of the Regional Plan-2021 is to provide efficient and economic rail and road based transportation systems (including mass transport systems) well integrated with the land use patterns for balanced regional sustainable development.

NCR Planning Board prepared the "Functional Plan on Transport for NCR" in 2009 with a perspective year 2032 for systematic development of transport system for sustainable development of NCR, with various proposals to enhance the Road / Rail connectivity and mobility in the region (Refer Figure-32 and Table 14). The plan proposals are to be implemented by the concerned departments/ agencies in the NCR Participating State Governments and Central Ministries.

Integrated Multi-modal Transport Plan (IMMTP) for NCR has been prepared which emphasizes on two aspects, namely, Integration and Multi-modality. The Network Plan provides for physical integration. Operational integration needs to be ensured while detailing the operational plan of the component systems.

The Integrated Multi-modal Transport Plan for NCR provides for:

Road System

The Plan provides for development of about 1000Km of Regional Expressway Network, up-gradation of about 1800Km of National Highways & State Highways and providing bypass system for various towns in NCR. It has also recommended development of Facility Centers, Logistic Hubs and Integrated Freight Complexes along NCR Road Network as support facilities. All these proposals are to be implemented up to year 2032, in a phased manner. It has further proposed, High Occupancy Vehicle (HOV) lanes on the Expressway and Regional Arterials (National Highways & State Highways).

Important Expressways, namely, Kundli-Manesar-Palwal and Palwal-Ghaziabad-Kundli in NCR which will have major impact in the reduction of the congestion on the Delhi roads is being implemented by Ministry of Road Transport & Highways and needs to be expedited. The project implementation is also being monitored by Hon'ble Supreme Court of India.

Regional Rail System

The plan has proposed development of Regional Rapid Transit System (RRTS) in NCR on eight corridors which will be operated on dedicated tracks, with electrification and modern signal and communication systems to enable safe, high speed and high frequency services (Refer Figure 33). The Plan proposes the following eight RRTS Corridors:

Table 14: Length wise details of RRTS

Sl. No.	Regional Rapid Transit System	Length (Km)
1	Delhi-Sonipat-Panipat	111*
2	Delhi-Ghaziabad-Meerut	90 *
3	Delhi-Gurgaon-Rewari-Alwar	180*
4	Delhi-Hapur	57
5	Delhi-Khurja	83
6	Delhi-Ballabgarh-Palwal	60
7	Delhi-Baghpat	56
8	Delhi-Rohtak	70

*As per Feasibility Study of RRTS

Feasibility Studies for the three prioritized corridors of RRTS, namely, Delhi- Sonipat-Panipat; Delhi-Ghaziabad-Meerut and Delhi-Gurgaon-Rewari-Alwar have been completed. These proposals are to be implemented and operated by National Capital Region Transport Corporation (NCRTC) which have already been incorporated in August, 2013.

The Plan proposes Regional Orbital Rail Corridor (RORC) connecting Panipat-Rohtak-Rewari-Palwal-Khurja-Hapur-Meerut-Panipat. Meerut-Khurja and Rohtak-Gohana-Panipat Corridors are existing corridors. Rohtak-Rewari rail link has been constructed. Rail link between Palwal-Khurja and Palwal-Bhiwadi-Rewari is to be developed by Indian Railways.

In addition to RORC, five other rail lines, within NCR, are proposed to strengthen the connectivity of the rail system which will form Inner Regional Orbital Rail Corridor (IRORC). They are Sonipat – Jhajjar, Jhajjar – Gurgaon, Gurgaon – Faridabad, Faridabad – Dadri, Meerut - Baghpat – Sonipat and Sonipat – Gohana

Figure 33: Maglev high speed rail, Shanghai
Source: Creative Commons

– Jind. Sonipat – Gohana – Jind corridor is under execution. Dadri-Ghaziabad-Meerut connectivity would be available through RRTS Corridors. This will connect most of the metro centres and regional centres in NCR. The proposed two Dedicated Freight Corridors (DFCs) run through the region and meet at Dadri. In addition to the rail terminal at Dadri, a major logistics and container terminal is proposed to be developed at Dadri. Further, such terminals would also be developed at Khurja, Palwal, Rewari, Rohtak, Panipat and Meerut.

Regional Mass Rapid Transit System (MRTS)
In addition to RRTS, the Plan has also proposed extension of Delhi Metro Rail System to Central NCR (CNCR) towns and Mass Transport System in NCR. Accordingly, Delhi Metro has been extended by Delhi Metro Rail Corporation to Noida, Gurgaon and Ghaziabad. Construction work for extending Delhi Metro to Faridabad and Bahadurgarh is in progress. It is proposed to provide MRTS connecting Regional Centres & Sub-regional Centres indentified in Regional Plan for NCR-2021 along the proposed Regional Arterial road corridor to accelerate the process of development in a later phase.

Bus System
Bus based Public Transport System (BPTS) has been conceptualized for the NCR area excluding intra-city transport needs of Delhi and other urban areas. Against an average of 71 buses per lakh persons country-wide, the NCR sub regions of Uttar Pradesh and Rajasthan have much lower densities with 46 and 43 buses respectively; Haryana has 64 and Delhi, 267 (2009).

It has assessed the requirement of 9,283 standard buses demand for intra region travel (2009) excluding demand within Delhi and the number will increase progressively to 37,734 in the horizon year 2032. These demand levels would further increase significantly if inter-state travel needs are considered. The requirement of buses is to be met by the concerned NCR Participating States within their respective sub-regions in a phased manner.

It has been proposed that all the buses are to be equipped with Intelligent Transport Systems (ITS)

comprising of GPS or GPRS related communication and other sub systems for on-line tracking of bus operations besides feeding the Passenger Information System (PIS). All buses are to be equipped with hand held Electronic Ticketing / Ticket Verification Machines (ETVMs). The ETVMs need to be GPS/ GPRS compatible for on-line identification of bus stops / fare stages and communication of requisite data (the way bill details, revenue collection, etc.) to the control rooms periodically.

Till the time RRTS comes up, the corridor can be utilized for running a High Speed Bus Service on dedicated lanes, which will help spur the development along the corridors and also help build a higher level of demand. The RRTS SPV can be bestowed with powers to run such a bus service on the RRTS corridors, for the interim or the longer term.

Bus Terminals

In a large region like NCR, passengers shift from one bus route to another, one transport mode to another, public transport buses to private transport buses to complete their end-to-end trips. This calls for seamless transfer facilities in the form of bus terminals/bus stations, to avoid inconvenience to the passengers. Mode / route interchange facilities in the form of bus terminals/bus stations is an important factor influencing efficiency of bus transport system.

It is proposed to have one bus terminal with adequate provision for future growth in every city. In Class I cities and above, a number of bus terminals at the rate of one commuter terminal for handling up to 1500 buses per day is suggested. A requirement of 50 bus terminals (minimum) is assessed. Development of bus terminals calls for large investments which are proposed to be obtained through Public-Private-Partnership (PPP), the public sector equity coming mainly as the land value of the bus terminals.

Environmental Pollution due to traffic will be a serious problem in NCR. Emission of Green House Gas (CO_2) by modes, were estimated based on vehicle kilometres, fuel consumption and CO_2 emission factors. It is estimated that a total of 15.52 Gg (1Gg = 106 Kg = 1000 M Tons) of CO_2 /day would be emitted at the 82 stations in NCR (2009). It indicates that if the rail based public transport system i.e. RRTS and Bus-based public transport system i.e. BPTS are not implemented in time-bound manner, it will have serious impact on Climate Change apart from affecting the health of the people in the region.

Hence, there is a dire need to construct/develop Integrated Multi-Modal Transport System in NCR with major emphasis on RRTS, Regional Orbital Rail Corridor and Inner Regional Orbital Rail Corridors public transport systems in a time-bound manner.

RECOMMENDATIONS OF THE COMMITTEE

1. Regional Connectivity to be enhanced and RRTS should be implemented in order to decentralize NCR and enable growth of Tier-2 & Tier-3 cities, which would inturn be the assured way to decongest Delhi;
2. RRTS would also provide high speed travel services between NCR Towns and reduce dependency on road based travel for long commutes;
3. Dedicated bus system to be augmented and implemented for regional corridors complete with ITS system and common mobility card; and
4. Bus terminals to be created with mixed use and multi facility for passenger comfort.

Strategy Two

Road Safety and Traffic Management

- Intelligent Transport System
- Road Network Optimisation
- Junction Improvements
- Freight Audit of Delhi

Strategy Two

Road Safety and Traffic Management

"Trying to solve congestion by widening roads is like trying to solve obesity by loosening the belt!"

2.1. INTELLIGENT TRANSPORT SYSTEM (ITS)

ISSUE

Intelligent Systems have long been the backbone of all successful public transport systems across the world and is responsible for efficient operations, inventory management, incidence control & management, fare collection system, passenger control and access, and numerous other applications that help streamline tasks. Performance and efficiencies of the systems can be dealt in an efficient and equitable manner with the integration of ITS. Intelligent systems are also very helpful in traffic management, control and for real time location mapping and providing information to the customers through means of different devices all powered by a central control monitoring system.

Intelligent Transport System (ITS) mainly helps in the following areas-

1. Reducing congestion through smart signal management and synchronization;
2. Improving Road Safety through better monitoring and management;
3. Providing reliable public services through smart Passenger Information System (PIS);
4. Improving operations, management of both traffic and public transportation; and

5. Integration of public transport system and use of ITS for its day-to-day, short and long term operations.

The following aspects of ITS need to be implemented:

i) **CCTV Surveillance and Information through Variable Message Sign (VMS)**

CCTV surveillance needs to be installed at critical intersections and critical roads. The traffic conditions can be monitored by CCTV and information of any unusual events can be reported to users. This will assist enforcement authority in incident management and serve as a guide for users to take alternative paths to avoid problem areas. The CCTV surveillance will also be helpful in detecting crimes in the area. Some of the advantages of having CCTV surveillance through VMS are given below-

- It is a very effective tool for transmitting timely, reliable and comprehensive advisory messages to motorists/ road users on traffic conditions;
- VMS helps in Traffic and congestion management in case of accidents, road work, lane closure, diversion, bad weather, special events, VIP movement etc; and
- It can also be used within Parking Guidance and information system to guide drivers about available car parking slots.

ii) **Automatic Vehicle Location System**

- Proposed ITS could have Automatic vehicle tracking system providing information on real time vehicle location on the network. This could be integrated with the control centre; and
- The information can be utilized to generate number of reports on efficiency of route operations including-
  - o Route-wise deviations;
  - o Time table deviations; and
  - o Operational time deviations etc.

iii) **Public Transport Information**

The Public transport/paratransit information system can be developed by tracking vehicles and informing users through PIS boards/voice communications etc. The information could be of various types such as :

- Operation schedule and status information provision; and
- Operation management.

iv) **Increasing efficiency in Road Management**

Efficiency of traffic management can be increased by sending the following information to control centres and displaying it to users-

- Road maintenance;
- Management of special vehicle; and
- Construction work related information management.

v) **Red Light Camera and Stop Line Violation Detection System (RLSVDS)**

Red Light Violation is one of the major causes for accidents at signalized intersections. This can be controlled by installation of Red Light Cameras at the traffic signals. RLSVD system comprising of Traffic Controller, Detection sensors, Video Camera, ANPR Camera and illuminator should be installed for reducing red light violations.

The proposed system should be capable of taking Snapshots with Number plate details and a three seconds video should also be provided as evidence from RLSVD Server which could be used to issue challans.

vi) **Speed Camera through Automatic Number Plate Recognition (ANPR)**

- Speed cameras are used to reduce over speeding and enhancing safety on roads. Speed is calculated and challans issued for over-speed vehicles;
- This can be done by using radar or IR technology in forward facing or rear facing mode to capture images of passing vehicles, based on trigger from detection sensors;
- Video system is supported with Automatic Number Plate Recognition (ANPR) digital technology;
- Number plates are digitally recorded at Entry & Exit camera points and the Central computer then arrives at average speed;
- In case average speed crosses preset threshold, this speed violation data is digitally stored on central computer.

vii) **Automated Parking Management System(APMS)**

The automated Parking Management and Guidance system helps in efficient utilization of parking system and also reduces vehicle search per km in the network. The component in this includes parking occupancy monitoring system, user guidance and information display system.

Figure 34: Operations Control Centre for bus operations

Source: DIMTS

viii) Intelligent Signalling System (ISS) with Control Centre connectivity

The purpose of this system is to improve intersection efficiency/ capacity and reduce delays. The system can be installed to manage, control and monitor junctions as well as traffic movement, in an integrated and coordinated manner; both at a junction- and at an area-wide level. It is recommended that the ANPR, APMS, ISS system should be such that all the signals are managed from control centre ensuring dynamic signal timing and queue management for efficient flow of traffic.

ix) Automatic Fare Collection System

Fare collection can be done using Electronic Ticketing Machines connected to the central server. The system will help in reducing revenue leakages and improve passenger convenience/commercial recovery significantly by providing facilities of card payments/ integrated ticketing etc. It is recommended that AFC should be implemented for all Public Transport and IPT modes by relevant authorities.

x) Control Centre & Data Storage

Control centre (Refer Figure 34) would integrate, control and manage the information system through a combination of hardware and software. This will be a monitoring centre for all ITS activities. Data storage facility is provided through the data centre which is part of the control centre. A digital transmission system capable of connecting and transmitting the data to control centre through uninterrupted communication system could be developed.

6. Mobile Application

Mobile application, which is compatible with all leading softwares, should be developed for the ease of use for the commuters. It should be linked with JAM (Jandhan Aadhaar and Mobile) system of the Government. Mobile application should be able to generate itineraries with other modes (Refer Figure 35)

RECOMMENDATIONS OF THE COMMITTEE

Intelligent transport system (ITS) should be installed to increase efficiency in road management for better enforcement and for provision of real time information to commuters. Intelligent traffic system will also help in automated parking of vehicle as well as easier vehicle location and help in decongestion of Delhi. Intelligent traffic system, however, should be outsourced to private vendors through PPP models to provide high end service as well as meet funding requirements. The PPP model shall become self-financing and can even help in collection of revenue which can fund not only the intelligent traffic system but can help in financing the signage and road maintenance. The following are key recommendations-

1. Implementation of Surveillance System, Automatic Vehicle Location system, public information system, red light camera and stop line violation detection system, automatic number plate recognition, automatic parking management system, intelligent signalling system and control centre and data storage system should be taken on fast track;
2. The control centre should be setup by GNCTD as a central centre for the entire city of Delhi;
3. The police should be given a live feed from the control centre so that they can survey real-time;
4. Common Mobility Card should be implemented by GNCTD for seamless integration across all public transport modes;
5. Integrating ITS with public transport system for daily operations, access and public information.
6. Control centre should be used for issuing automatic-challans and notices to violators; and
7. Transport department of Delhi to coordinate with Traffic Police for implementing ITS till DUMTA is formed.
8. Mobile application to be developed for convenience of access to commuters and to improve reliability.

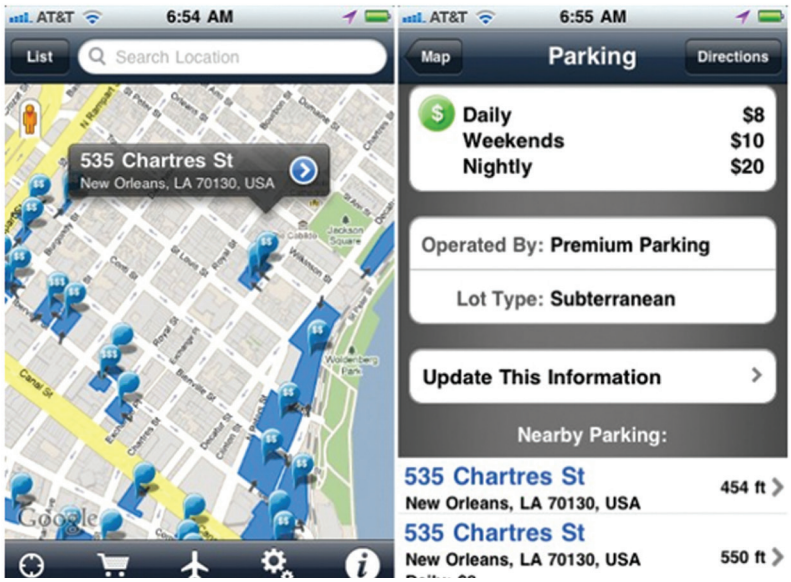


Figure 35: Phone app for parking location and operations

Source: DIMTS

2.2. ROAD NETWORK OPTIMISATION

ISSUE

While congestion is often sought to be dealt with increasing the road space, often this is counter-productive as it serves to increase the number of motor vehicles and results in increase in congestion with even higher volumes of traffic. Hence, the level of pollution and energy consumption overall increases leading to environmental and health issues. There are several choke points in the city that cause needless congestion for which low cost measures can be applied to ease out this situation.

Apart from this, traffic that is not destined for the city often enters the city as there is no other alternative. At times long travel distances between origin-destination pairs are necessitated due to sub-optimal regional links.

In view of the above, the recommendations in this chapter seek to use low cost measures to improve the situation in 44 of the most important choke points (Figure 37) in the city. The chapter also seeks to suggest short new links that will help reduce trip lengths and create local neighbourhood level linkages so that local traffic does not mix with & interfere with city level traffic movement.

There are three types of road network improvements that need to be implemented:

i) Local level Network Improvements impacting city traffic. In the current scenario, only arterial roads form the network system of the city. There is complete absence of a secondary road network system, which restricts the distribution of traffic over a network, resulting in concentration of even local traffic on arterial roads, which leads to congestion. This is due to the following reasons:

- Previous planning paradigm of creating less junctions and cul-de-sac based neighborhoods is such that people are forced to come on the major arterial roads even to access local destinations. Connections between colonies were also not planned to enable direct connectivity to markets, shops, schools, etc. forcing people to drive and come on to arterial roads to make even short local trips for daily needs. The Figure 38 shows how interconnected primary and secondary road networks need to be planned in order to provide short-cuts and easy access/mobility to all modes, including pedestrians and cyclists to avoid forcing them to take long detours to reach their destinations;
- Road-level signal free corridors created for movement of cars with closure of medians all along arterial/ sub-arterial roads – have restricted movement of traffic/ people between neighbourhoods on either side, leading to accidents and disruption between communities;
- Large tracts of land in the form of railway and drain corridors divide the city in segments. Railway corridors are especially big barriers as they do not provide enough underpasses/overpasses to enable traffic in the city to move in a proper network. Such archaic policies need to be modified; and
- In order to reduce congestion on the existing roads, it is proposed to identify additional/ alternative links and access corridors to augment the current network. Augmentation of road network is required to distribute high traffic volume over multiple roads, instead of stand-alone corridors. The capacity of the junctions should also be improved.

ii) Segregation of through traffic from local traffic - Bypassing of non-destined regional traffic.
Delhi being at the heart of NCR – experiences a lot of through traffic of trucks and workforce movement between NCR towns, even when very often the traffic is not destined to Delhi centres. Therefore multiple bypass routes are required in order to reduce traffic passing through the city.

Figures 36 & 37 throw light on the importance of a secondary network in reducing congestion. Figure 36 shows that in the absence of a secondary network people are forced to use primary network to cover short and long distances in rivate vehicles increasing time taken to reach destination, contributing to pollution and causing congestion. Figure 37 shows a secondary network (blue lines) that can be used by pedestrians/ cyclists, and the primary network (orange lines) can be used by larger vehicles, keeping them outside the core.

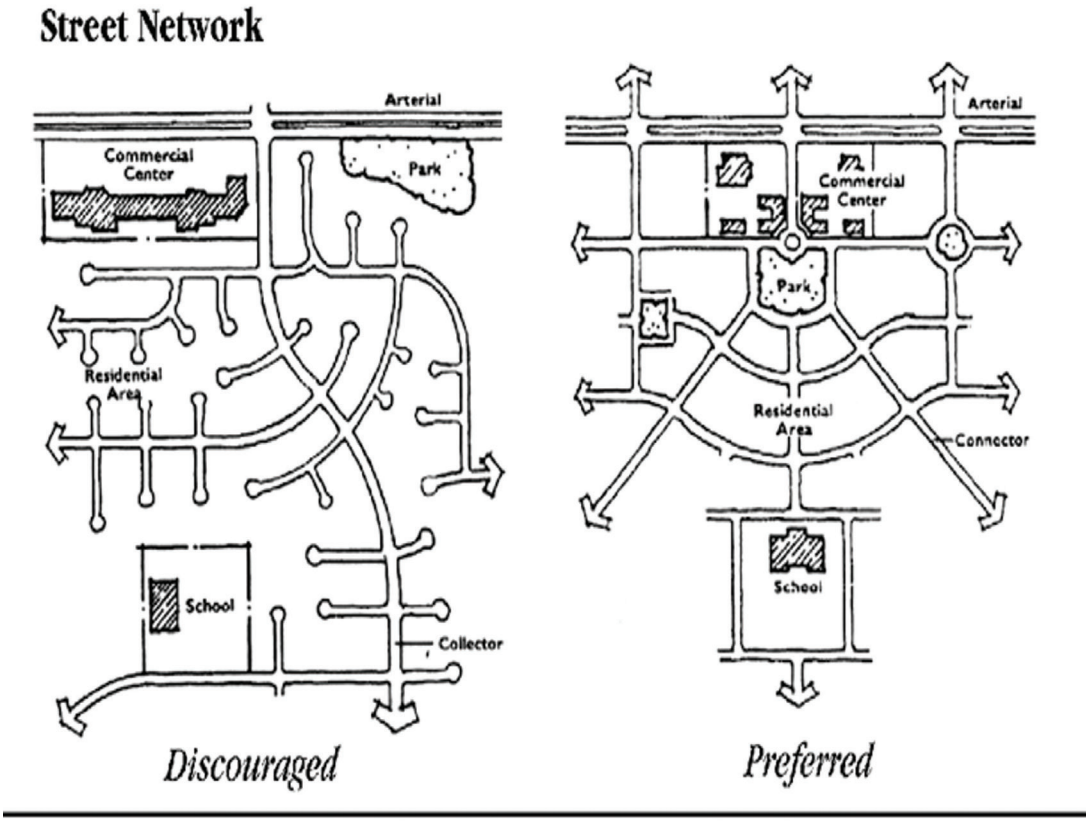


Figure 36: Interconnected street network grid

Source: Calthorpe Associates

Figure 37: Comparison of Secondary & Primary networks

Source: TOD Standard, ITDP

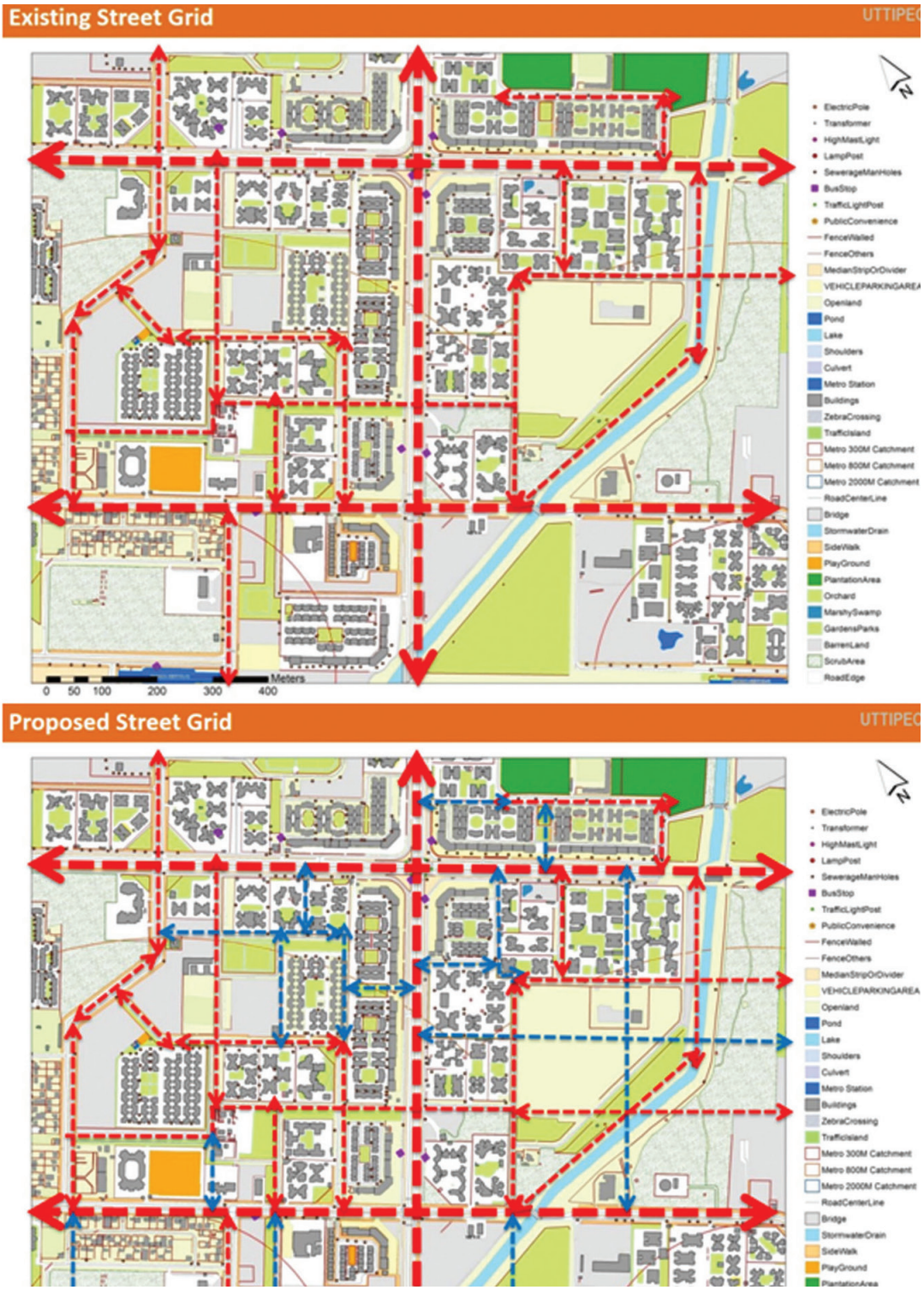


Figure 38: Scenario Comparison – Presence & Absence of a network[3]

Source: UTTIPEC, Dwarka Case Study

3. *Existing Street Grid depicts absence of a secondary network & Proposed Street Grid depicts presence of a secondary network*

RECOMMENDATIONS OF THE COMMITTEE

1. As per above, in order to reduce congestion on the existing roads, it is proposed to identify additional/ alternative links and access corridors to augment the current network. Road Networks to be planned with a vehicular route network of approximately every 250m and pedestrian network of approximately 100m. Additional thoroughfares should be provided as required.

a. It is proposed that area level network/connectivity plans be prepared in order to decongest major roads. Critical areas like Maharani Bagh, Greater Kailash, ITO, Lajpat Nagar, Karol Bagh, Vasant Kunj, Dwarka, etc. should be taken up on priority basis; and

b. Figure 36 shows the undesirable vs desirable road network requirement in the city. A sample analysis identifying missing networks was done by UTTIPEC in 2012 and is shown in Figure 38. The missing networks need to be linked.

2. Certain missing links and network improvements as below, are desirable to improve mobility in the city:

    i. Decongestion of city roads by addressing different choke points through improvement of road geometry, construction of flyovers/ underpasses, Dwarka Expressway from UER-II to Northern peripheral road, Haryana with total length of 3.5 km,

    ii. Balance work of grade separator and Rani Jhansi Road

    iii. Flyover from St. Stephens hospital Tees Hazari to Filmistan, Karol Bagh

    iv. Tunnel near Bhagya Vihar and Meet Vihar on UER-II with a length of 1.5 km

    v. Railway Over-bridge at Narela on UER-I with a length of 860m; and

    vi. Railway under-bridge at Holambi for a length of 1 km and Railway over-bridge at Mundka with a length of 1.4 km on UER-II.

3. Similar other missing links and network improvements can also be identified and addressed by the concerned agencies.

4. Additionally, a number of choke points need immediate relief to improve the flow of traffic on the roads. A list of choke points, as provided by Delhi Traffic Police, is mentioned in Table 15.

5. Further, other choke points across the city need to be identified by traffic police for improving geometry for smooth traffic movement and pedestrian/cyclist crossing the roads.

6. On all such choke points, concerned agencies need to work out the geometry in association with traffic police and field trials. These projects may also add CCTVs/ IT based systems for monitoring and traffic management at such points.

Table 15: List of major choke points/congestion points in Delhi which require interventions for immediate improvement

South/South-East Delhi

Sr No.	Congestion Point/Area	Suggested Action/Remedy
1.	Hauz Khas Metro Station near Panchsheel Flyover.	Multi-modal Integration, Creating space for TSR/Gramin Sewa halting points, Pick-up/Drop-off points for private vehicles, Shifting of Bus-stand
2.	Gurgaon Road - RR Hospital	Shifting median and creating additional lane in the carriageway coming towards Dhaula Kuan (space available), flyover/Underpass at Gurgaon Road/Station Road crossing
3.	Ashram Chowk – Maharani Bagh	Decongestion plan for C.V. Raman Marg
4.	Saket Metro Station	Multi Model Integration, acquire space for TSR/Gramin Sewa, Peak-up/ Drop-off points for private vehicles, shifting of bust stand, encroachment removal
5.	Khanpur T-point	Widening of Mehrauli – Badarpur Road by acquiring space and removal of encroachment, shifting of bus stand
6.	RTR – MotiBagh	Parallel Flyover, Alternative route/access to NH-8 (above Mahipalpur fly-over) through Nelson Mandela Marg/Mehrauli – Mahipalpur Road
7.	Lajpat Nagar Market	One way scheme, parking over covered drain on Feroz Gandhi Marg by construction of ramp, permanent central verge on Shiv Mandir Road and Veer Savarkar Road
8.	INA Market	Re-development of INA Market, creation of parking space
9.	Adhchini T-point	Construction of slip road through vacant piece of land from Aurobindo Marg to Shaheed Jeet Singh Marg
10.	Malviya Nagar – Aurobindo Marg T-point	Construction of slip road from Aurobindo Marg to Press Enclave Road. Permission for cutting of Keekar trees following due procedure
11.	Aurobindo Marg – Anuvrat Marg turning	Slip road through DDA land, connecting Aurobindo Marg to Anuvrat Marg
12	Under Mahipal Pur Flyover	Road widening through encroachment removal, solution for pedestrian crossing, extra space for bus stand
13	Rangpuri Round About	Construction of two way under pass near Shiv Murti for traffic coming from Dwarka going towards Gurgaon and vice-versa
14	C.R. Park area	Shifting of gas godown on Outer Ring Road, Regulation
15	Kalindi Kunj	Widening of Kalindi Bridge (UP area)
16	Chhatarpur Area – Bhati Mines	Widening of road near Y-Point, removal of encroachment

Central/New Delhi

Sr. No.	Congestion Point/Area	Suggested Action/Remedy
17	ITO crossing A-point	By-pass roads/alternate routes required, construction of Tunnel/underpass below Railway line to connect Tansen Marg with DDU Marg, Tunnel below Pragati Maidan to connect Bhagwan Das Road with Ring Road
18	W-point Tilak Marg	By-pass roads/alternate routes required, construction of Tunnel/underpass below Railway line to connect Tansen Marg with DDU Marg, Tunnel below Pragati Maidan to connect Bhagwan Das Road with Ring Road
19	Kamaal Ataturk Marg	Widening of road, Construction of alternate route connecting Vinay Marg with Aurobindo Marg (Elevated corridor possible)
20	Sarojini Nagar Market	Policy for use of Multilevel Parking
21	Kamal T-point	Design improvement for Military Road merging with New Rohtak Road, relocation of bus stands, construction of pedestrian corridor
22	Karol Bagh Market area	Creation of Multi Level Parking, effective policy for surface parking, proper vendors' policy
23	Patel Road	Relocation/Shifting of Bus Stand of Shadipur Metro Station, construction of footpath on Shadipur Flyover, proper road engineering, rationalization of cuts on main road, parking space for Shadi Khampur Village/Ranjit Nagar market

West/South-West Delhi

Sr.	Congestion Point/Area	Suggested Action/Remedy
24	Uttam Nagar Chowk	Shifting of fruit vendors/other vendors, parking space for DTC/cluster buses, design improvement inside the DTC bus terminal, construction of Foot Over Bridge for smooth pedestrian movement, construction of a fresh road along the drain
25	Peera Garhi Chowk	Halting space for RTVs/Gramin Sewa, space for pick up/drop off, relocation/creation of space for existing bus stands, FOBs/subways for pedestrian movement, construction of footpaths, removal of encroachment.
26	Dwarka Sector 1 / 2 crossing	Construction of slip roads, proper intersection design
27	Underpass Dwarka Link Road	Operationalization of Bijwasan Flyover
28	Kakrola Dwarka Mor	Multi Model Integration, creation of space for Gramin Sewa, shifting of RTV stand, creation of bus bays/proper space for DTC buses, multi road design in view of limited area, proper vendors' policy, earmarked space for fruit vendors/other vendors
29	New Moti Nagar – Ring Road crossing	Better road-design for right turning traffic coming from Moti Nagar, Regulation/control of Melas/functioning in Punjabi Bagh grounds, creation of parking space, cutting of existing trees on carriage by following due procedure

East/North-East Delhi

Sl. No.	Congestion Point/Area	Suggested Action/Remedy
30	Akshardham	Pick-up/drop-off space for TSRs as well as private vehicles for visitors to the temple, Relocation/shifting of Akshardham bus stand
31	Mayur Vihar Metro Station	Multi Model Integration, space for cycle rickshaw/e-rickshaw, space for pick-up/drop-off for private vehicles, utilization of vacant space of Metro Station for parking/halting, broadening of narrow bridge of Noida Link Road to Khudee Ram Boss Marg, covering of drain adjacent to Noida Link Road for creating parking space/halting space
32	Patparganj Road Nirman Vihar crossing	Removal of encroachment, earmarking of halting areas for Gramin Sewa/ RTVs
33	Vikas Marg	Removal of encroachment, proper vendors policy, Effective parking policy, creation of parking space in nearby areas
34	Noida Link Road	Completion of construction work of Delhi Metro at Mayur Vihar Phase-I, construction of parallel flyover for vehicles coming from Barapulla going towards Chilla Border, FOB near Nagarjun Apartments

North/North-West/Outer Delhi

Sl. No.	Congestion Point/Area	Suggested Action/Remedy
35	Chandni Chowk	Removal of encroachment
36	ISBT Kashmere Gate	Design improvement in entry and exit points for buses, creation of space for pedestrian movement, Access to pedestrian bridge directly from ISBT, Proper lane demarcation on Ring road, Road widening, Space for secondary transport (TSRs/Taxis/e-rickshaw), integration with local buses
37	Kudesia Ghat/Geeta Ghat / Shyam Ghat / Kalindi Ghat	Development of ghats with proper entry/exits and parking space, for events like Ganesh idols immersion, Durga idols immersion, Vishwakarmapujan and Chhath puja
38	Baraf Khana Chowk – Azad Market	Completion of Rani Jhansi flyover, Removal of encroachment
39	Wazirabad bridge	Completion of Signature Bridge
40	Azad Pur Mandi, GTK Road	Removal of encroachment from the main road, redesigning/creation of space inside Azadpur Mandi
41	Kohat Enclave – Road no. 41	Removal of encroachment, effective policy for surface parking.
42	Prem Bari flyover	Shifting/relocation of two petrol pumps/CNG stations, removal of encroachment on roads leading to Pitampura and Shalimar Bagh
43	Mukarba Chowk	Relocation of Roadways bus stand from GT Road, creation of space for buses and passengers, earmarking of space for vendors, removal of encroachment, creation of parking space and widening of road inside Sanjay Gandhi Transport Nagar
44	Anaj Mandi Narela	Removal of encroachment, proper road engineering at Y-Point (Bawana-Alipur Road), solution for Bawana Road Railway level crossing

NOTES:

(1) It may be noted that these choke points require engineering, design as well as neighbourhood level network planning improvement and most of the congestion points require intervention by more than one civic agency such as Delhi Metro, PWD, MCD etc.

(2) The High Powered Inter-Ministerial Committee observed strongly that active co-operation from Railways and Ministry of Defence would be required for preparation of the Detailed Project Report for these proposals and subsequently during their execution.

"The measure of a good city is one where a child on a tricycle or bicycle can safely go anywhere. If a city is good for children, it will be good for everybody else."

2.3. JUNCTION IMPROVEMENTS

ISSUE

Intersections and junctions are the most crucial components of a road network system as they allow directional traffic to move through the junctions, resulting in complex movements and conflict points for MV, NMV and pedestrian traffic. At the same time more the number of intersections in a street network, the better and faster the throughput of traffic would be through any area. Therefore, longer area network plans should be developed for various areas of Delhi along with proper design of all intersections & junctions. Intersections must be designed to reduce delays and increase safety for all road users, with a priority to non-motorized and public transport modes. The design of intersections with proper signalization and signage, markings, etc. is very important for regulated and safe movement of all modes. Concerned road owning agencies shall be responsible for installing the appropriate road signage and markings, and maintaining them on regular basis.

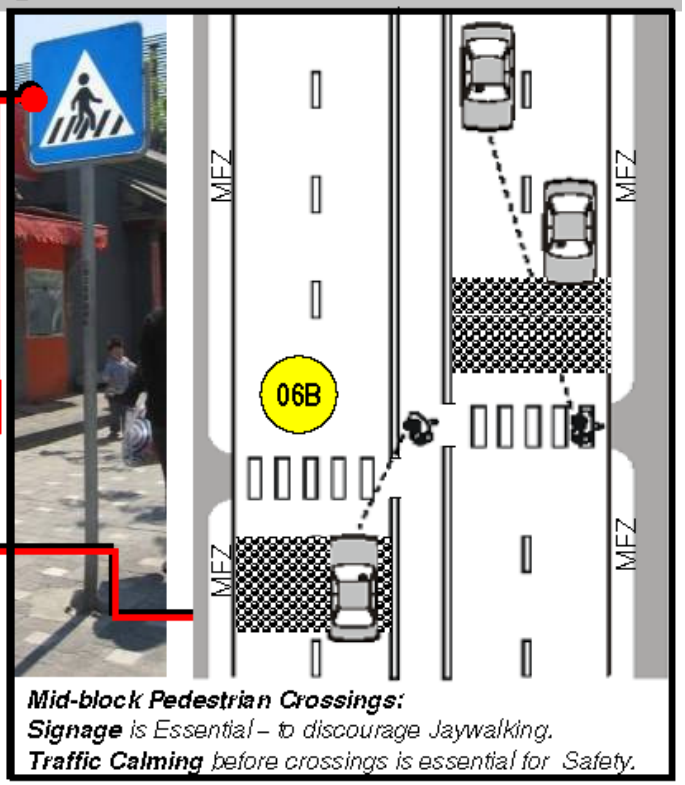
In Delhi, the average distance of signalized intersections allowing movement of all modes, is very large. This creates barriers to movement of pedestrians, cyclists and public transport users for crossing the road or interchanging between modes or accessing destinations. To facilitate easy interchange between modes and allow local trips to be made on NMT or foot, mid-block crossings need to be provided at approximately every 250 metres or less. The junction improvement for roads of different hierarchies is given in Table 16.

In addition, pedestrians including children, women, elderly and the differently-abled, must be given the shortest possible direct route to cross the street, therefore the most preferred crossing for them is "at-grade" with signalization, both at intersections and mid-block crossings. Refer Figure 39 for mid-block pedestrian crossings.

UTTIPEC has provided junction improvement techniques, in Street Design Guidelines, for retrofitting of various types of junctions and some details of the same are shown in Figure 41 and 42, and some implemented examples are illustrated at Figure 45.

06B Pedestrian Crossings (See also 03B for Table-top Crossings)

Pedestrian (and NMV) Crossings are located at mid-block* locations where the Median is punctured minimally to only allow pedestrians and non-motorized modes to cross the roads safely at-grade.



Mid-block Pedestrian Crossings:
***Signage** is Essential – to discourage Jaywalking.*
***Traffic Calming** before crossings is essential for Safety.*

Mid-block crossings must include the following:

- ☐ Signage visible from min. 100m away.
- ☐ Auditory signals are required to provide assistance to the differentially-abled.
- ☐ Traffic Calming Treatment **starting least 25 m** before the zebra/ table-top crossing.
- ☐ Minimum 20-second pedestrian signal – either as pelican or as a synchronized signal with the nearest full traffic signals.

Mid-block crossings to be provided at:

- ➢ Mid-block transit/ bus stop locations.
- ➢ Long blocks (>250M)
- ➢ Areas with pedestrian attractors with mid-block entries like shopping areas, schools and community centers.
- ➢ **<u>Mid-block crossings must be provided at regular intervals as per following standards</u>:**

Residential Areas:	**Spacing Range: Every 80 – 250m** Coordinated with entry points of complexes; location of bus/ train stops, public facilities, etc.
Commercial/ Mixed Use Areas:	**Spacing Range: Every 80 – 150m**
High Intensity Commercial Areas:	**Pedestrianize if possible.**

*Mid-block is a location along the Street where no intersecting road exists.

09

**Source: "American Association of State Highway and Transportation Officials", Pedestrian and Bicycle Safety, Lesson 12 Midblock Crossings

Figure 39: Technical guideline for creation of mid-block pedestrian crossing

Source: UTTIPEC Street Design Guidelines

Table 16: Junction improvements for roads of different hierarchies

Source: Code of Practice for Urban Roads (Part 2 - Intersections), IUT

Road Type	Arterial Roads	Sub - Arterial Roads	Distributor Roads	Access Streets
Arterial Roads	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade separated crossing for motor vehicles 4. Grade Separated Crossings for cyclists, along Arterial road (in case of 4 arm only)	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade separated crossing for motor vehicles 4. Grade Separated Crossings for cyclists, along Arterial road (in case of 4 arm only)	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade Separated Crossing for cyclists along Distributor road (4 arm only)	1. Traffic calmed crossing (3 arm only – access street opening on to an arterial road) 2. Grade Separated Crossing for cyclists along access road
Sub - Arterial Roads	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade separated crossing for motor vehicles 4. Grade Separated Crossings for cyclists, along Arterial road (in case of 4 arm only)	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade separated crossing for motor vehicles 4. Grade Separated Crossings for cyclists, along Arterial road (in case of 4 arm only)	1. Roundabouts (3,4 arm) 2. Signalized Crossings (3,4 arm) 3. Grade Separated Crossing for cyclists along Distributor road (4 arm only)	1. Traffic calmed crossing (3 arm only – access street opening on to an arterial road) 2. Grade Separated Crossing for cyclists along access road
Distributor Roads	1. Roundabouts 2. Signalized Crossings (3,4 arm) 3. Grade Separated Crossing for cyclists along Distributor road (4 arm only)	1. Roundabouts 2. Signalized Crossings (3,4 arm) 3. Grade Separated Crossing for cyclists along Distributor road (4 arm only)	1. Roundabouts 2. Signalized crossing	1. Roundabout 2. Unsignalized/ Traffic Calmed Crossing (3, 4 arm)
Access Streets	1. Traffic calmed crossing (3 arm only – access street opening on to an arterial road) 2. Grade Separated Crossing for cyclists along access road	1. Traffic calmed crossing (3 arm only – access street opening on to an arterial road) 2. Grade Separated Crossing for cyclists along access road	1. Roundabout (3, 4 arm) 2. Unsignalized/ Traffic Calmed Crossing (3, 4 arm)	1. Unsignalized/ Traffic Calmed Crossing (3, 4 arm) 2. Mini Roundabouts

Intersection designing based on the various road types

Roundabouts and Intersections - Pros and Cons

Roundabouts	Intersection
Pros	
• Reduces the number of conflicts to eight as against 32 in un-signalized intersections. • Ensures safety through speed reduction by design. This is particularly useful at late night hours when speeds are high and compliance of signals and traffic rules is low. • Minimal or no delays for all road users including cyclists.	Signalized intersections can handle high traffic volumes. This can be achieved by accommodating wider carriageway with more number of lanes.
Cons	
• Roundabouts are not very effective for more than two circulatory lanes. They have capacity limitations and may not be able to handle very high volume of traffic.	• Four times the number of conflicts than the roundabout. • Safety is ensured by eliminating conflicts through signalization – high dependence on enforcement. • Higher delays for all road users including cyclists.

Grade Separated NMV Crossing & At Grade NMV Crossing - Pros and Cons

Grade Separated NMV Crossing	At Grade NMV Crossing
Pros	
• Safety of cyclists is ensured through physical separation from high-speed vehicular traffic. • Reduces motorized vehicular delays (especially at mid block and not so much at intersections) by eliminating a single phase or the entire cycle.	• Convenient to use by cyclists. Requires less energy than negotiating level differences. • Inexpensive solution can be repeated at regular intervals within the built up areas or urban limits.
Cons	
• Grade separated solutions are capital intensive and thus cannot be repeated at close/regular intervals. • Grade separated crossing infrastructure for cyclists is very inconvenient to use because of higher energy requirements to negotiate steep ramps. This is particularly true for overbridges.	• Safety of cyclists can only be ensured through proper enforcement of signalization at the crossing. • May increase motorized vehicle delays, especially at mid block locations where a signal is added.

Ref: Code of Practice (Part 2) Intersections, Institute of Urban Transport, MoUD - 2013

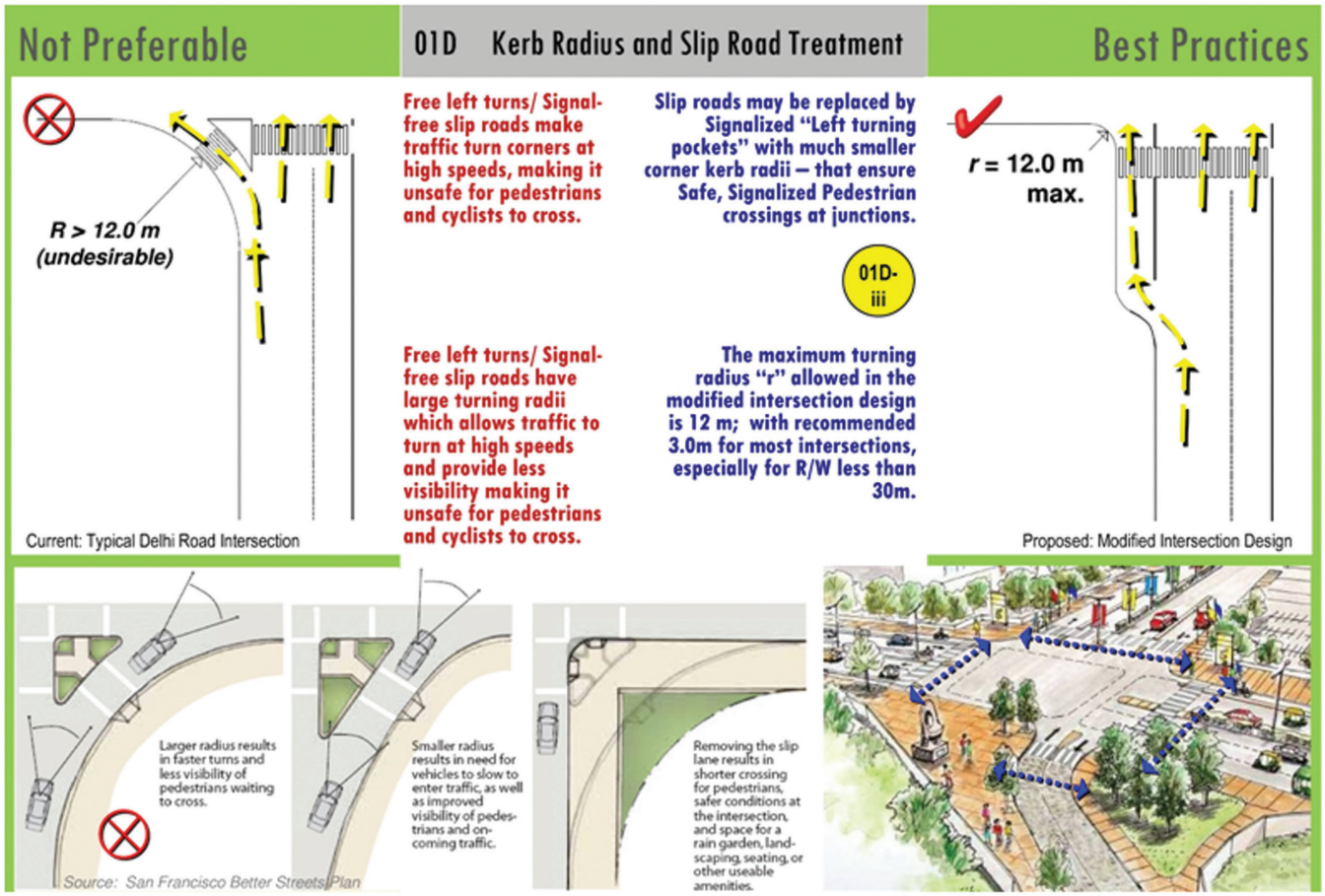


Figure 40: Delhi – ITO Junction

Source: UTTIPEC Street Design Guidelines

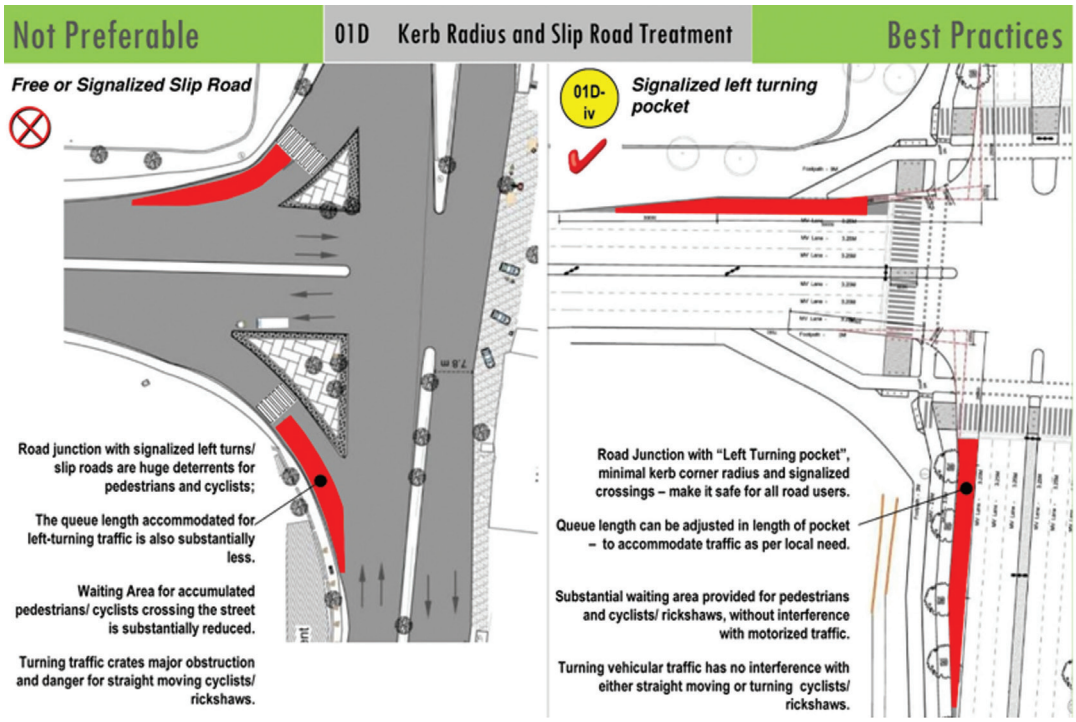


Figure 41: Excerpts from UTTIPEC Street Design Guidelines showing preferable junction treatment designs

Source: UTTIPEC

RECOMMENDATIONS OF THE COMMITTEE

1. The guidelines given in Table 16 & Figure 40 should be followed for design & management of various types of junctions in the city;
2. Intersections must be designed to increase safety for all road users, with a priority to non-motorized and public transport modes;
3. The design should be based on the lower design speed of the two intersecting roads. In the context of the maximum speed permitted on roads in the city, intersection solutions that encourage higher peak speeds, such as grade separated or other signal free solutions (contributing to long signal free corridors) should be avoided;
4. Additionally, in order to facilitate easy access to passengers and also to ensure minimized delays in interchanges, stops and stations must be located as close to the junction as possible;
5. Passive speed control measures such as traffic calming should be also included at all critical intersections including those on arterial roads to ensure safety during both peak and off-peak hours;
6. For major roads and junctions in the city carrying high volume of traffic including pedestrians and cyclists, sudden implementation of changes is likely to cause disruption. Therefore, it is recommended that for major junctions & roads, temporary installations, demarcations, signages and information campaigns should be used first to do trial runs for various design options. If these are successful, only then permanent geometric changes & construction work should be taken up by the road owning agency. An exercise was taken up by Ahmedabad Traffic Police in 2012-13 which was very successful and now permanent changes are under implementation by the local body. The details of this are provided in the Box-7 (Refer Figure 43). A similar exercise was also taken up by Delhi Traffic Police for Aurobindo Marg in Delhi which was very successful in bringing down road fatalities on this road from 13 to 1 within just one year. Details of this successful project are provided in Box-8;
7. Pedestrian crosswalk and bicycle crossings (bike boxes, bike signals) should be properly demarcated on ground and maintained on a regular basis as they tend to fade/wear and tear more easily;
8. Parking of vehicles should be banned in the arms of the junction for at least 80m length from crosswalk;
9. Bicycle boxes should be provided ahead of crosswalk, near the junction, to enable the cyclists

to have the first opportunity to cross the junction;

10. All junctions should be designed for pedestrian and cyclists priority and with proper calming measure;
11. Pedestrian signals should be synchronized with the nearest traffic signals, for smooth movement of traffic along with safe pedestrian/NMT crossing;
12. Foot Over Bridges (FOBs) are to be considered as an exception, not the rule. They are to be provided only under circumstances where no at-grade crossings are feasible. For rapid transit corridors, grade separated crossings such as FOBs may be considered in case no other solution is possible at grade. No FOBs should be considered within 80m of a junction as at grade crossings are an essential requirement at all junction of the city for public transport interchange;
13. In case grade separators are provided at junctions where thoroughfare traffic may be in high volume, care must be taken that local level connectivity at the ground level and safe at-grade crossings are provided for all modes as per the criteria of this Section. In any case, grade separators should not be implemented as a standalone project but as part of a comprehensive network plan with traffic circulation system and traffic management measures for an influence area around the junction; and
14. Intersections should necessarily be well-lit at nights and should have the required road markings and signages for the ease of the driver as well as the pedestrian. Well- designed signage along with display of information is helpful in increasing safety of users.
15. All major junctions should have enforcements/ CCTV cameras for traffic violation detection. Refer to Figure 45 for typical junction design considerations given in UTTIPEC's Street Design Guidelines.

ACTIONABLE POINTS

The improvement of critical junctions in Delhi would contribute quickly and immediately to traffic movement, road safety and reduction of congestion in the city.

Retrofiling of all junctions with proper walkways, as per relevant codes in order to reduce road fatalities and improve traffic movement is an urgent requirement and needs to be taken up in a phased manner throughout the city. The Committee recommends phase-wise implementation of junctions as given in Table 17.

Table 17: Phase wise estimated cost & timeline for junction improvements

Junctions Retrofitting (including design)		Approx. Cost (Rs.)	Timeframe (Yrs.)	Agency
Phase 1	200 junctions	Approx. 200 Cr. @approx. 1Cr. per/junction	within 2 yrs.	PWD, DDA, MCD, NDMC, Cantt. Board
Phase 2	400 junctions	Approx. 400 Cr.	within 5 yrs.	

BOX-8

THE CROSSWALK LAB Ahmedabad Traffic Police & Centre for Green Mobility

The Crosswalk Lab was initiated to address the issue of pedestrian safety and signal optimization to reduce delay at the intersections jointly with Traffic Police and Municipal Authority. Pop-up urbanism in the form of 'temporary installations' is a good way to experience and educate, and this method was employed under the Lab to experiment and build capacity in good junction management and design. The experiment successfully demonstrated the importance of junction geometric design in improving pedestrian safety and making the intersection more efficient with tightening of junction more pedestrian space was created and new signal phasing that refreshed the junction in 30% lesser time than before. This brought significant air quality impacts at intersection and also enhanced safety. The experiment has led to improving geometrics for 40 of Ahmedabad's junctions. Figure 41 & 42 depict the cross walk lab, a demonstration of tactical urbanisation where temporary installation of cones, barricades, road markings – improved intersection geometrics made junction more safe for pedestrians and made traffic flow more efficient.

Figure 42: The Crosswalk Lab at Vijay Crossing in Ahmedabad

Source: Centre for Green Mobility

Figure 43: Visualization showing improvements planned during the intervention at Ahmedabad[4]

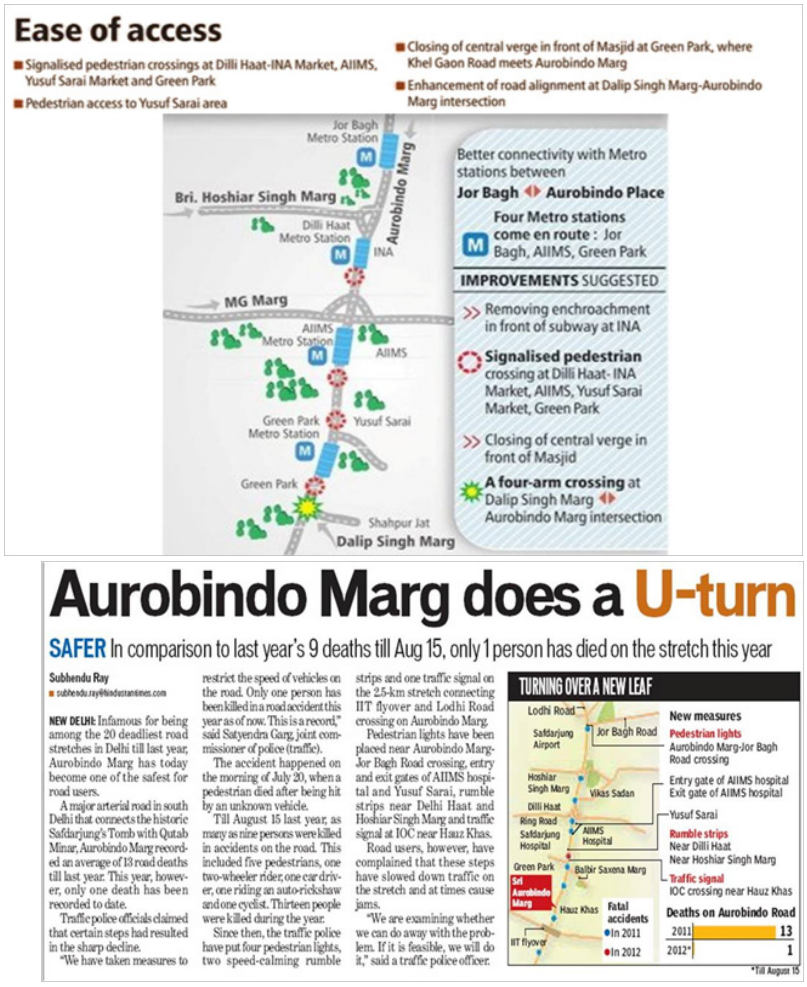
Source: Centre for Green Mobility

4. *The Crosswalk Lab – (top) existing junction; (middle) divider too far back, unguided space, landscaped/ inaccessible islands; (bottom) proposed modifications – removal of free left turns, freeing islands of barricades, improving geometry, broadening the crosswalk*

BOX-9

AUROBINDO MARG CROSSWALK IMPROVEMENTS, Delhi Traffic Police & UTTIPEC

Delhi Traffic Police initiated safety measures to reduce road fatalities on a number of roads in Delhi, of which, Aurobindo Marg was chosen as a pilot and the impact resulted in drastic reduction in road fatalities. The Delhi Traffic Police restricted the speed of vehicles by introducing pedestrian signals, marking pedestrian crossings, traffic calming measures and enforcements. A combination of measures resulted in bringing down the injury rate at the junctions and mid-block. Pedestrian crossings were introduced at every 250m. The success of the pilot encouraged the Traffic Police to implement these measures in virtually all the arterial roads and highways passing through Delhi city (Refer Figure 44).



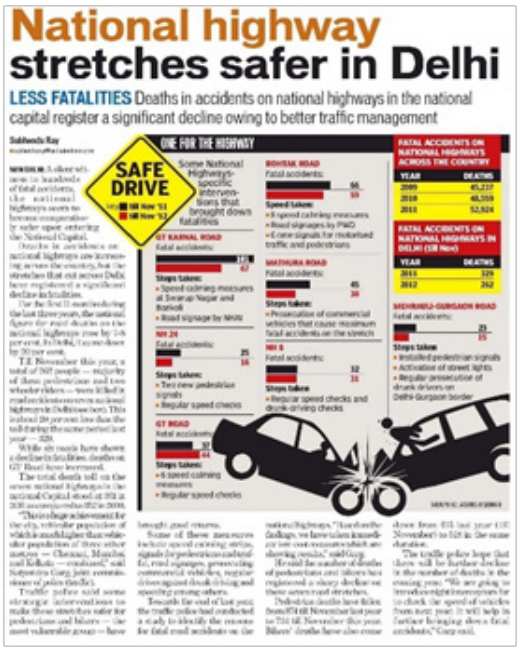


Figure 44: Aurobindo Marg, New Delhi – pedestrian safety initiative by the Delhi Traffic Police

Source: UTTIPEC

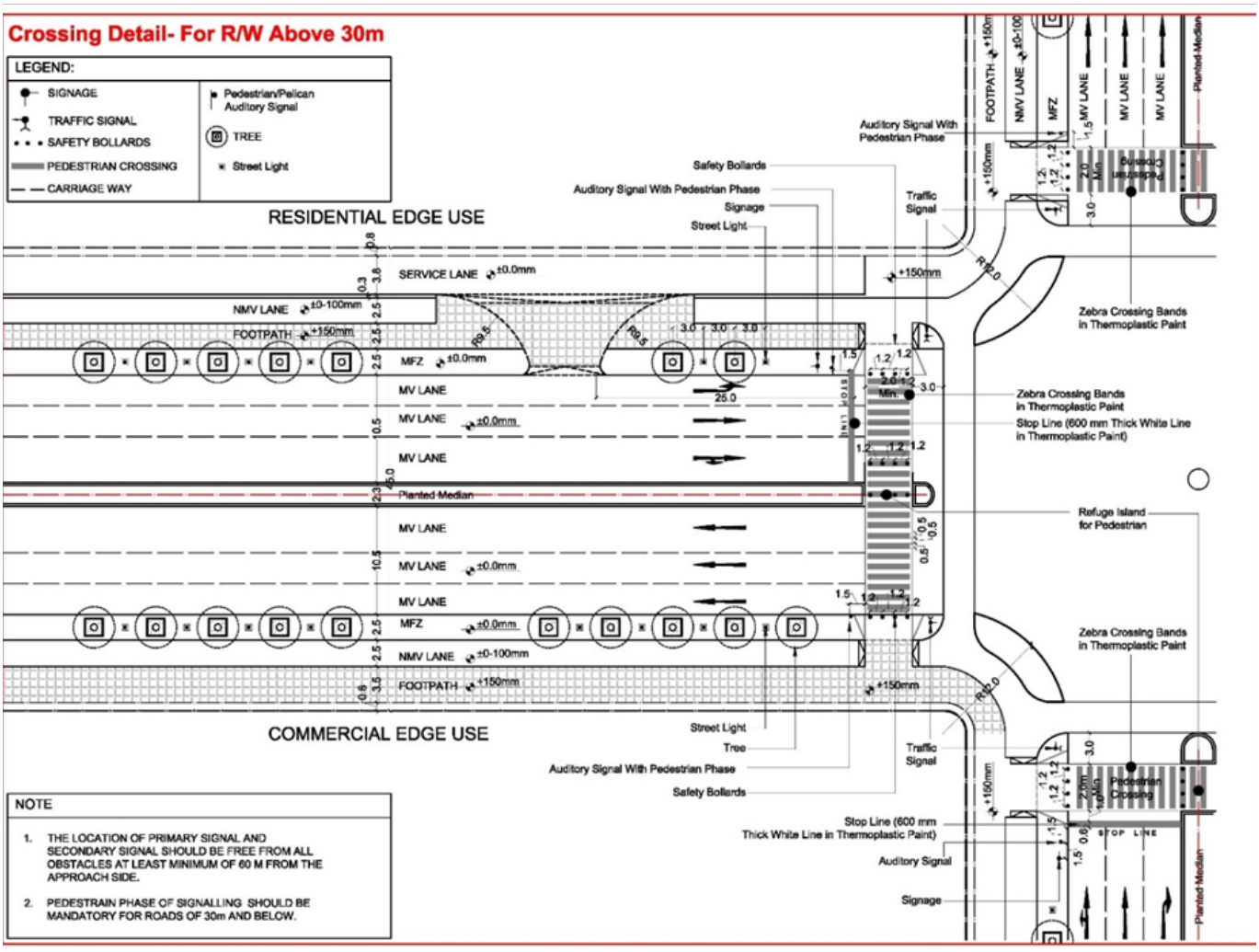


Figure 45: UTTIPEC Street Design Guidelines – Typical junction design considerations

Source: UTTIPEC

2.4 FREIGHT AUDIT OF DELHI

ISSUE

National Capital Region Planning Board (NCRPB), Ministry of Urban Development, Government of India conducted a study in 2009 for making the Functional Plan on Transport for NCR - 2032. In preparation of the report, traffic at various points across Delhi, NCR and nearby areas were studied.

Study of movement pattern for goods vehicles entering and leaving Delhi revealed that a total of 1, 03,853 goods vehicles crossed the count stations at the borders of Delhi in a day. Break-up of such vehicles is as follows (Refer Figure 46)-

- Internal-External (IE) : 30.5% (Origin within NCTD)
- External-Internal (EI): 38.6% (Destination within NCTD) - shown in Figure 46.
- External-External (EE): 29.9% (both origin and destination outside NCTD)

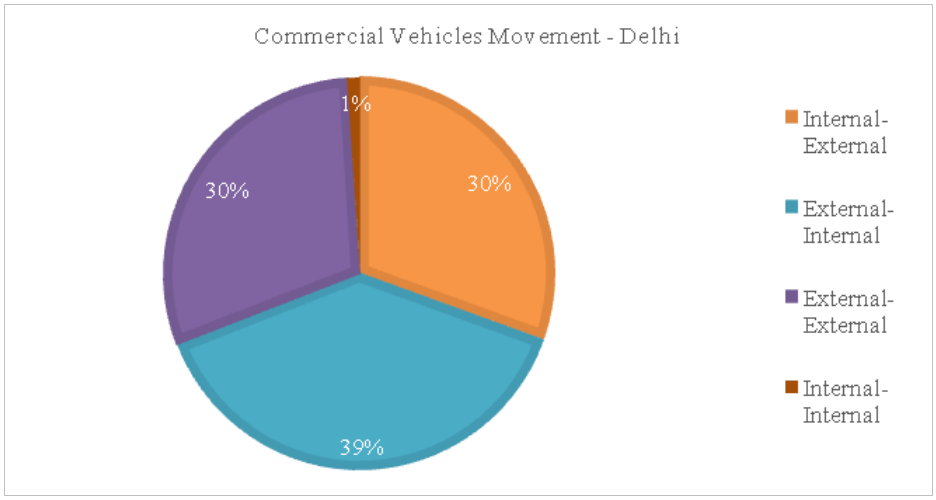


Figure 46: Break-up of Daily Commercial Vehicles movement in Delhi

Source: NCRPB (Functional Plan on Transport for NCR-2032)

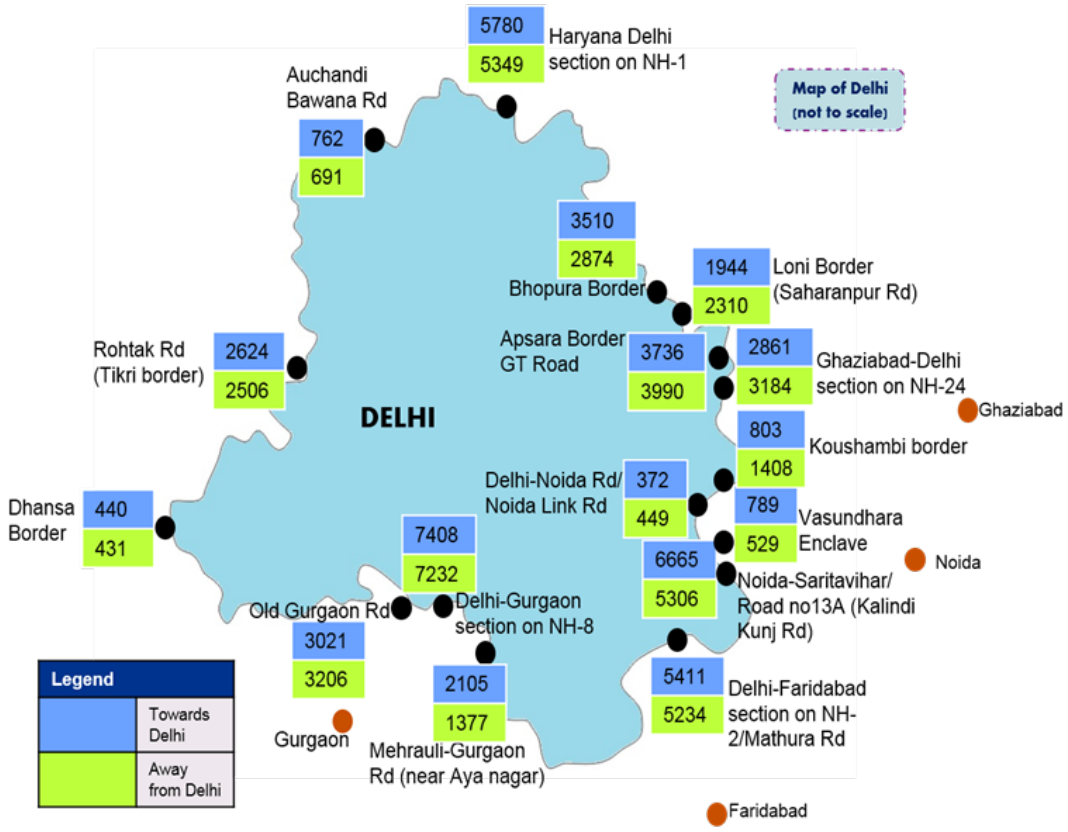


Figure 47: Commercial traffic movement in and out of Delhi at key border points

Source: NCRPB (Functional Plan on Transport for NCR-2032)

The map in Figure 47 shows the traffic counts as per the study report of NCRPB at various border points of Delhi. It is to be noted that as per the study, the non-destined traffic or External-External (EE) traffic is approximately 31,052 commercial vehicles.

Delhi has agricultural markets which handle large volumes daily (Refer Table 18 for indicative figures of the amount of agricultural produce movement in Delhi on a daily basis). Azadpur Mandi in Delhi is the largest wholesale market for fruits and vegetables. Every day thousands of trucks bring fresh produce to Azadpur Mandi from all over the country.

Table 18: Cargo movement at major agricultural markets in Delhi according to Economic Survey of Delhi, 2012-13

Agricultural markets	FY 11 (in lakh tonnes)	Daily average (in Metric Tonne)
Azadpur	45.32	12,416
Narela	6.4	1,753
Najafgarh	0.91	249
Shahdara	2.95	808
Keshopur	3.01	825
Gazipur	0.74	203
Mori gate	0.17	47
Total	**59.5**	**16,301**

With increasing population in Delhi and an increasing per capita income, the consumption volumes of goods and consumables is on an increasing trend. The freight and goods transportation system uses the same infrastructure that is used for moving people. A lack of conscious planning for the current and future freight movements, that is sustainable and environmental friendly, will lead to unstructured and hap-hazard solutions to handle freight traffic.

RECOMMENDATIONS OF THE COMMITTEE

1. The current report has focused on movement of people. As freight movement uses the same roads, a separate study needs to be done. The study – a freight audit – needs to focus on questions specifically related to freight;
2. The freight audit should seek answers to the following questions-
   a. What are main cities/regions that Delhi receives cargo traffic from? What are the main cities/ regions that cargo from Delhi is dispatched to?
   b. What is the mode of transport for the cargo and is that mode the most economic and environmental friendly?
   c. What are the volumes of cargo forecasted in the next ten years?
   d. What are the main facilities that exist to handle the existing cargo volumes? Are these facilities adequate to handle future needs?
   e. What are the main cargo centric areas in Delhi and are the streets/roads serving these areas designed from the perspective of handling the truck traffic?
   f. Are the vehicles that carry freight within Delhi appropriate? Do the regulations lead towards non-polluting choices to be made by transport/ truck operators?
3. Using the results of the freight audit, a freight master plan needs to be prepared. From Box-9 related to freight movement planning in the city of Portland in USA, it can be seen that the city has come up with clear street classifications for freight (the Freight Master Plan for Portland city is shown in Figure 48. See also Table 19); and
4. At a later phase, the freight audit for the entire NCR region needs to be undertaken as the freight facilities outside the capital city will play a key role in serving the needs of Delhi in the future.

BOX-10

FREIGHT MASTER PLAN OF PORTLAND CITY, OREGON, USA

The city of Portland is the largest city in the U S State of Oregon. As per U S Census Bureau, the population of Portland Metropolitan area is around 2.4 million. The City of Portland adopted its Freight Master Plan (FMP)– an element of the Transportation System Plan–in 2006. The FMP includes policies regarding the freight network and freight operations, strategies, and actions for improving freight movement to support the City's economic development goal. The city also developed a protocol for selection and monitoring of freight mobility projects. The TSP established the following street classifications for freight: Regional Truckway, Priority Truck Street, Major Truck Street, Truck Access Street, Local Truck Street and Freight District Street. (Source: Report in "Designing for Truck Movements and Other Large Vehicles in Portland", 2008, Office of Transportation, City of Portland)

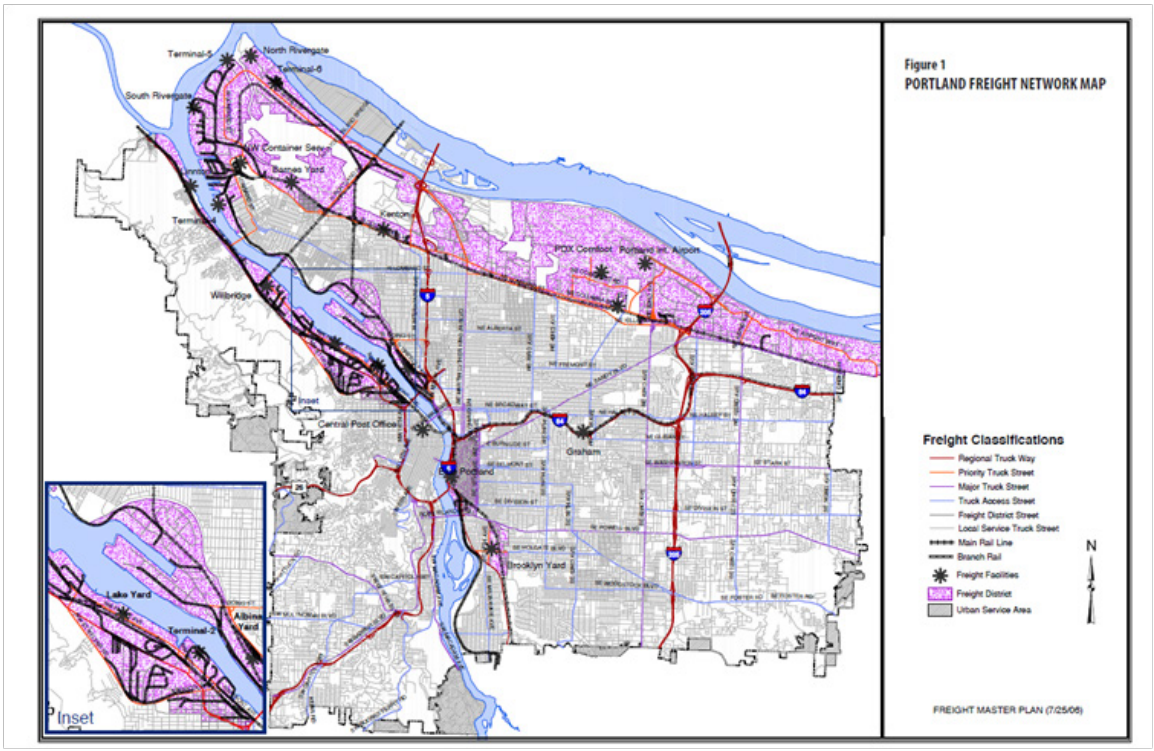


Figure 48: Freight Master Plan of Portland City

Source : Report in "Designing for Truck Movements and Other Large Vehicles in Portland", 2008, Office of Transportation, City of Portland

Table 19: Report on designing for truck movements and other large vehicles in Portland

Classification	Function	Design Objectives
Regional Truckway	Routes for interregional and interstate movement of freight. Provide for safe and efficient continuous-flow operation for trucks.	Design Regional Truckways to be limited access facilities and to standards that facilitate the movement of all types of trucks
Priority Truck Street	Serve as primary routes for access and circulation in Freight Districts, and between Freight Districts and Regional Truckways. Accommodate high truck volumes and provide high-quality mobility and access	Priority Truck Streets should be designed to facilitate the movement of all truck classes and over-dimensional loads, as practicable
Major Truck Street	Serve as principal routes for trucks in a Transportation District. Provide truck mobility and access to commercial and employment uses along the corridor.	Major Truck Streets should accommodate all truck types, as practicable.
Freight District Street	Freight Districts are determined by presence of industrial zoning. Freight District Streets are intended to provide safe and convenient truck mobility and access in industrial and employment areas serving high levels of truck traffic and to accommodate the needs of intermodal freight movement	Freight District streets should be designed to facilitate the movement of all truck types and over-dimensional loads, as practicable
Truck Access Street	Serve as access and circulation routes for delivery of goods and services to neighbourhoods serving commercial and employment uses. Provide access and circulation to land uses within a Transportation District. Non-local truck trips are discouraged from using Truck Access Streets	Design Truck Access Streets to accommodate truck needs in balance with other modal needs of the street
Local Truck Street	Provides local truck access and circulation for goods and service delivery to individual locations in neighbourhoods.	Should give preference to access individual properties and the specific needs of property owners and residents along the street. Use of restrictive signage and operational accommodations are appropriate.

STRATEGY THREE

Enhancing Institutional Capacity

- ESTABLISHMENT OF DUMTA
- CAPACITY BUILDING

Strategy Three

Enhancing Institutional Capacity

3.1. ESTABLISHMENT OF DELHI UNIFIED METROPOLITAN TRANSPORT AUTHORITY (DUMTA)

BACKGROUND

The transport system in Delhi comprises several components and each component is looked after by a different department and are often placed under different Government (Centre, State, Local) levels.

Among them are the following:

1. Transport Policy (DDA, GNCTD)
2. The metro rail system (DMRC)
3. The suburban rail system (Railways)
4. The public bus system (DTC/ Transport Dept.)
5. The cluster bus system (Transport Dept.)
6. The road network (PWD, MCDs)
7. The traffic management system (Traffic Police)
8. The vehicle and driver licensing system (Transport Dept., GNCTD)
9. The parking and parking management system (MCDs)
10. The street lighting system (PWD, MCDs)
11. The fare collection system (Transport Dept., MCDs)
12. The fixed infrastructure system (terminals, bus stops, etc) (Transport Dept.)
13. The operations control system (Transport Dept./ DIMTS)
14. The passenger information system (Transport Dept./ DIMTS)
15. The feeder system (Transport Dept.)
16. The Para Transit system (auto-rickshaws, taxis, radio taxis, taxi aggregators, etc) (Transport Dept.)
17. Cycle-Rickshaws, e-rickshaws
18. The land use planning system (DDA)

It is extremely important that the above-mentioned departments work in a well-coordinated manner in order to ensure smooth mobility in the city. Each of the above functions are performed by different agencies of the government, some of whom report to the Central Government and others to the State or local government. Many of these services are provided by private operators under limited regulation. In view of the large number of agencies involved, coordination becomes difficult. To deal with this, it is essential to set up a single lead agency that would take up the responsibility of managing a comprehensive responsibility for the transport system in Delhi.

Besides this, travel patterns in the region are crossing the boundaries of Delhi with more people beginning to reside and work on the fringes of Delhi - Gurgaon, Noida, Ghaziabad, etc. The Delhi metro is already crossing the Delhi boundary to connect to Gurgaon, Noida and Faridabad. This implies that coordination is required across agencies in 4 States – Delhi, UP, Haryana and Rajasthan.

POSSIBLE MODELS

There are several models that have been used around the world in establishing such lead institutions. The models vary in terms of their legal backing, their jurisdiction, their responsibilities, their powers and the manner in which they are financed. Some of the good examples of such lead institutions are Transport for London (TfL) in London, the Land Transport Authority (LTA) in Singapore, TransLink in Vancouver and STIF in Paris. While all of these are successful models, they vary in many respects, as shown in the Table 20.

Thus, despite variations, each of them has proved successful. This shows that no single model can be considered as a universal best practice and each model is set up in the context of its local situation. The main point is that it is important to have a single coordinating entity to be the lead agency for urban mobility in a city or metropolitan region.

Key features of the DUMTA for Delhi

Given the situation in Delhi, the suggested features of the DUMTA are given below-

FUNCTIONS

The DUMTA should, at a minimum, be responsible for the following functions:

- Prepare a 5 year investment plan for mobility in the city and the region;
- Identify the agencies that would implement the different components of this investment plan;
- Assign work to them, along-with necessary funds;
- Prepare estimates and a budget for meeting the transport needs of Delhi;
- Secure financing for these needs from the Government and other sources (in this context, all funds provided by the Central and State Governments for transport in Delhi, should be assigned to the DUMTA who would allocate this amongst the different agencies);

Table 20: Example of lead institutions

Lead Agency	Legal backing	Functions	Jurisdiction	Financing
STIF (Paris)	Generic Legislation on Organizing Authority for Public Transport in France	Strategic planning and oversight of public transport only	Paris region	Transport tax
Transport for London	Greater London Authority Act	Strategic planning and coordination of all transport systems. Service planning and management of common infrastructure	Greater London region	Government Grants
Land Transport Authority (LTA) of Singapore	LTA Act	Strategic planning and coordination of all transport systems. Service planning and management of common infrastructure	Singapore city and country	Transport tax, Fare-box revenue, Government grants & value-capture from assets
TransLink (Vancouver)	Greater Vancouver Transport Authority Act	Strategic planning and coordination of all transport systems. Service planning and management of common infrastructure	Greater Vancouver region	Property taxes and other taxes assigned to TransLink

- Undertake those tasks that no other agency is clearly responsible for taking up, or establish specific SPVs for such purposes (such as setting up intermodal terminals and managing intermodal fare cards, intermodal passenger information systems, and intermodal control systems);
- Prescribe standards for various needs, such as emission standards, safety standards, licensing standards, etc.;
- Coordinate the activities of the different agencies in the city and the respective state governments in the region;
- Manage a database for mobility in the city and the region;
- Function as a single face for mobility in the city and the region;
- Monitor implementation of projects and their maintenance and operations;
- Coordinate and monitor private transport operators
- Regulate fares; and
- Create an identity for public transport in the city of Delhi.

LEGAL BACKING

It would be best if the UMTA can be set up under an existing legislation. It is understood that the draft version of the new Motor Vehicle (MV) Act has provided for UMTAs. If this draft has since been approved, it would be best to set it up under the MV Act. Else the possibility of setting it up under the DDA Act needs to be examined.

Till such time as a suitable legal backing is identified for the UMTA, an executive order could be issued to notify it and operationalize it immediately.

JURISDICTION

Its jurisdiction should extend to Delhi and the entire NC Region, if it is to be meaningful. Given that travel patterns are increasingly extending to the entire NC region, having a lead agency that plans and coordinates across the region would make more sense. Therefore, it is recommended that the jurisdiction of the UMTA covers the entire NC Region.

COMPOSITION

The UMTA will have to include senior level representation from several key agencies. Among them would be the following-

- Ministry of Urban Development
- Ministry of Road Transport and Highways
- Ministry of Railways
- Transport Department of Delhi
- Delhi Development Authority
- Delhi Metro Rail Corporation
- Delhi Transport Corporation
- Delhi Integrated Multi-modal Transit System Ltd.
- Cantonment Board
- Public Works Dept of Delhi
- Municipal Corporation of Delhi
- New Delhi Municipal Council
- Delhi Traffic Police
- National Capital Regional Planning Board
- Representatives from the State Governments of Haryana, Rajasthan and UP
- Urban Transport Experts

The Authority should be serviced by a Secretariat that would be headed by a Chief Executive Officer (CEO). The CEO should be a qualified and experienced professional and would occupy a high position in the government hierarchy, such as Vice Chairman of the DDA (much like the Commissioner of Transport in London). To ensure a suitable term of office, he/she should be appointed on a contract for 5 years.

The UMTA would be an Authority that would take policy decisions, provide planning guidance and approve proposals. The Secretariat would implement its decisions.

The UMTA should have the powers to set up committees to examine specific issues and tasks, and make recommendations to the UMTA or oversee the implementation of specific tasks.

The Chairman of the DUMTA shall be the Lt. Governor of Delhi.

STAFFING

The Secretariat needs to be staffed by several professionals and they should be selected from the market at contracted salaries as determined by market conditions.

FINANCING

The financing of the UMTA will be the key to its success. It needs to be provided with funds on three accounts-

- For meeting its internal needs towards staff costs, studies and research, office expenses, etc;
- For meeting the capital investment needs; and
- For meeting the operational deficits of the different agencies providing transport services in the region.

It will need an annual budgetary grant from the Central and State Government for meeting its internal expenses. As for the capital investments, it will need to prepare 5 year investment plans which will need to be approved by the Government and funds allocated based on these approvals. The UMTA may then allocate these funds to the agency that it assigns to implement the specific project.

As for the annual operating deficits, UMTA would prepare an annual budget and obtain funds from the respective government (s) and allocate these to the relevant agency providing the services. It would however make efforts to ensure that the operating deficits are minimized by facilitating the raising of additional revenues from other sources like property development, etc.

In addition to the above, the UMTA may seek funds from lending agencies, multilateral development banks and also explore options for developing property which can earn an income to be used for financing transport investments in Delhi. The possibility of a Delhi Transport Finance Corporation, under the UMTA, needs to be explored.

RECOMMENDATIONS OF THE COMMITTEE

The High Powered Committee noted that UTTIPEC is an already existing policy-making and approval authority that resides under the Planning Authority for Delhi under the Central Government. Therefore, the functions of DUMTA and UTTIPEC should be clear and non-overlapping. While it is understood that DUMTA shall be an implementing, monitoring, coordinating, regulating body, UTTIPEC shall continue to be a policy-making and approval body having over-arching functions as detailed out in the Gazette Notification S.O.1903 (E) dated July 31, 2008. As per the notification, the functions of UTTIPEC are clarified as under:

1. To evaluate projects & to approve traffic and transportation projects;
2. To form policy – especially regarding land use and transport integration;
3. To act as repository of knowledge on traffic and transportation; and
4. To coordinate engineering and infrastructure aspects in the planning of sustainable public transportation projects.

An expert group would be set up to develop an institutional design and also a process manual for a Unified Metropolitan Transport Authority (UMTA) for Delhi under the chairmanship of the Chief Secretary, Delhi Government. It would include all other agencies involved with urban transport as well as some experts in the area of institutional development for the sector. This group would be required to submit its report in about 6 months and its recommendations will be discussed at stakeholder meetings to arrive at the model best suited to the Delhi context. The UMTA should be established within a period of one year.

3.2. CAPACITY BUILDING

ISSUE

This chapter enumerates the possible ways of building capacity and establishing a coordinated structure for planning managing, executing, operating transportation policy and projects in Delhi.

The Technical capacity issues have been and still are the biggest impediment to planning and successfully implementing of sustainable transportation projects in Delhi. Urban transport has never been a recognised area of work, until recently, and therefore much of the planning work is still being taken up by the engineering wing in which officials are trained in structural and traffic engineering and not transport planning or urban design/ planning. This has led to unplanned, short term and heavy-infrastructure based engineering solutions for even simple street up-gradation projects. For efficient use of resources and for having the benefits of initiatives reach the masses, it is important that all agencies dealing with transport have a high level of technical capacity to envision, propose, coordinate, implement and monitor transport projects for Delhi.

In order for the city to move towards becoming "smart", sustainable and self-sufficient in the future, all departments need to set up highly qualified, multi-disciplinary technical teams which can plan both for the short-term and long-term and provide able assistance to all decision makers and also general public. In the absence of this, all decisions taken by government may appear to be knee-jerk and reactive, rather than well-planned, phased and strategized for long term good of the city. The task for formulation, implementation and monitoring of policies and strategies is challenging and requires dedicated teams to spearhead and deliver. The issue of multiplicity of authorities may impede the pace of delivery and hence needs to be addressed in priority.

The current mode for operation in most government bodies is to have a team of engineers and administrative staff who run the day to day tasks of a department and most of the official work is limited to addressing complaints, court cases, public grievances, replies to other departments and internal clerical work. High-level decisions are taken by bureaucrats who often have to struggle due to lack of high level of technical expertise to support them from within the Department. In fact, for most technical matters, the departments tend to rely on external 'consultants' with very limited in-house capacity to monitor their work, provide guidance and to evaluate the consultants' work. For lack of technical capacity and ownership within the department, the officials are unable to take forward the work produced by the consultants in the longer term. Almost no government department has a systemized cell which is led and run by highly qualified technocrats with a technical team, which is able to work autonomously, based on sound data and ground realities.

RECOMMENDATION OF THE COMMITTEE

The Committee recommended that serious, long term Technical Capacity enhancement is required within the government in two key areas:

A. Planning of projects;
   a) Sensitization of Urban Transport needs;
   b) Envisioning & Conceptualizing projects;
   c) Planning, Design & Operations; and
   d) Contracting, Specifications & PPP.
B. Monitoring of projects;
   a) Procurement & Testing;
   b) Monitoring framework;
c) Management Information System;
d) Contract & Facility Management;
e) Project Management; and
f) Operations Management

The Committee recommends that high quality professionals should be attracted to the government so that the trend of losing qualified professionals to the private sector can be reversed. To do so, the 'typical government office' should become smart, by providing good quality work facilities to government officials, a transparent working system, commensurate salaries, a competitive work environment that installs a sense of pride and a higher dignity of work. Engagement of a few professionals from the market at market rates/ salaries on contract of 3 years/ 5 years could also be considered.

The Committee recommends that an annual budget towards capacity building exercises should be allocated and taken up on a regular basis by all government departments and attendance to such programs should be made mandatory for government personnel. The exercises should be designed in such a way that tangible, but not over-ambitious, results can be achieved at the end. The exercises should be specifically designed for the targeted officials and should not be general in nature so that it connects well with the personnel taking them. Capacity building exercises should be designed in a way that it tries to address the issues faced by the government personnel in their daily work

and provides them a fresh perspective to deal with them and instigates creative or innovative 'out-of-the-box' thinking method. The technical workshop/ exercises should be broken into small digestible pieces, with real case scenarios to help personnel crack difficult technical problems.

Figure 49 and 50 show some views of the Singapore Housing Development board (SHDB) and Singapore Re-development Authority's (SRA) office showing beautiful, well-equipped spaces where work done by the departments are displayed for the general public so that they may always be well in-sync with the work being undertaken by their government department.

Figure 49: Singapore House Development board (SHDB) and Singapore Re-development Authority's (SRA) office showing beautiful, well-equipped spaces

Source: UTTIPEC

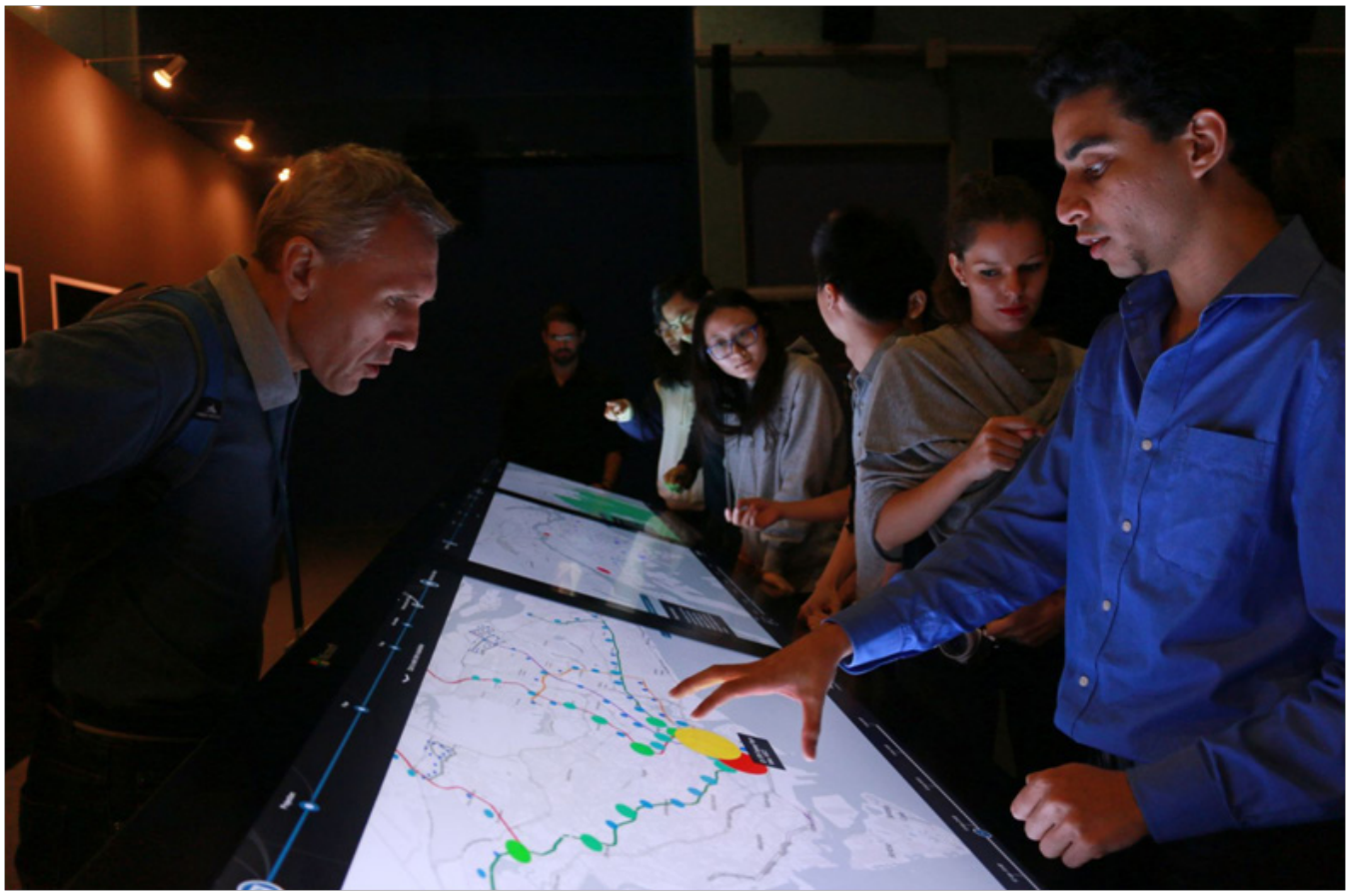


Figure 50: The Singapore Housing Development Board office – a smart facility for its public
Source: UTTIPEC

Strategy Four

Transit Oriented Development

Strategy Four

Transit Oriented Development

"A developed country is not where the poor use cars, but where the rich use public transport" – Mayor of Bogota

TRANSIT ORIENTED DEVELOPMENT

ISSUE

- In the present, people in Delhi tend to live far from their workplaces, due to segregated land use planning and high real estate costs, creating a need for increased daily travel to medium and long distances.
- Due to lack of travel options on foot, cycle and public transport, people are forced to use their cars/ two-wheelers (motorized vehicles) even for short trips, inadvertently increasing pressure on the already stressed roads (despite Delhi having the largest area under roads as compared to any city in India).
- The lack of easy connectivity and access to stations, abundant subsidized parking space as well as a lack of safety for pedestrians, cyclists and women in the city, has resulted in public transportation being no longer the preferred mode of travel in Delhi.
- The past auto-centric planning of the city with segregated land use, large un-walkable block sizes, large right-of-ways and encroached footpaths, frequent construction of flyovers and clover-leafs within city limits, and auto-oriented urban design with more and more gated/ walled communities – has increasingly made the city dependent on private-vehicles, making life of public transport users even more difficult. This has led to an up-surge in private motor vehicle ownership, and a corresponding increase in pollution, congestion, loss of man-hours and increase in urban poverty.
- This situation has grown to alarming proportions in the past two decades. It has a lot to do with the conventional land use planning strategy exclusive of transportation needs. Therefore, a paradigm shift is required to move people from private vehicles towards the use of public transportation, while still having all their daily, social and recreational needs met.
- The aim of this paradigm shift towards Transit Oriented Development is therefore meant to make it easier, safer, faster and more convenient for people to use public transportation, so that maximum people are incentivized to leave their private motor-vehicles at home and shift to the use of NMT, walking and public transport, without compromising their social life

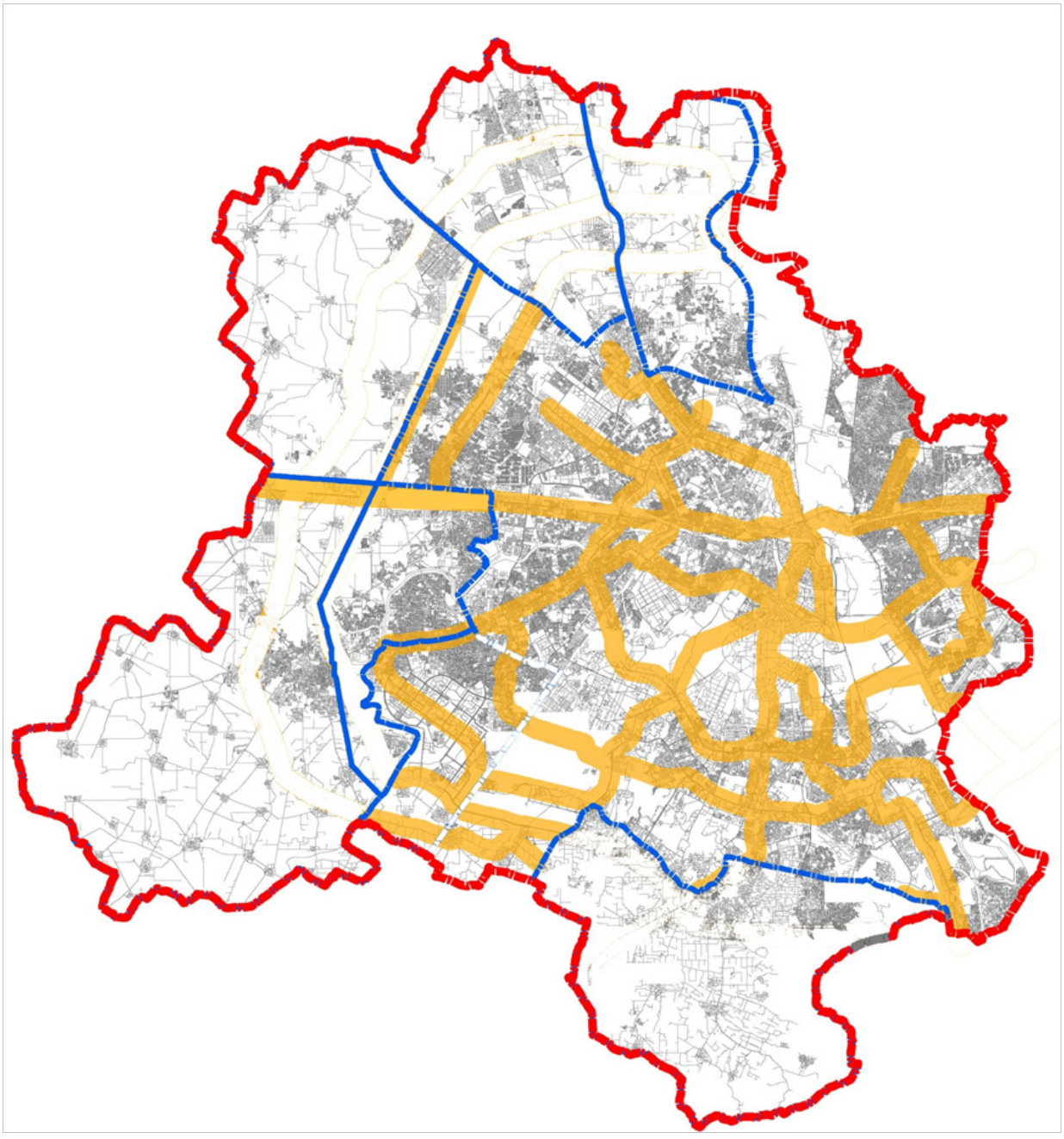


Figure 51: TOD zone applicability in Delhi[5]
Source: UTTIPEC

5. *The Figure 50 shows that TOD Zone is applicable to a maximum of 500 m. wide belt (i.e. approx. 5-minute walking distance) on both sides of centre line of the MRTS Corridors in Delhi. This entails approx. 20% of the total area of city of Delhi. The norms and development code applicable within TOD zone have already been notified by the Ministry of Urban Development vide S.O No 1914(E) dated 14.07.2015.*

Figure 52: Major portion of public realm showing distribution of road space between pedestrians, NMT, and public transport users in Dwarka, New Delhi[6]

Source: Center for Green Mobility

Figure 53: Equitable distribution of road space between Pedestrians, NMT and Public Transport users[7]

Source: Center for Green Mobility

6. *Major portion of public realm in Dwarka currently given to private vehicles, compromising the safety and convenience of pedestrian, NMT, and public transport users.*
7. *Equitable distribution of road Space – Pedestrians, NMT and Public Transport users are given clear priority in road design and junctions are modified to provide better traffic movement, traffic calming and safe crossings to all road users. This forms a key feature within TOD Zone.*

New Zones of Influence

TOD zone is a new landuse category which allows flexibility in mix of various possible uses, with the exception of polluting and potentially hazardous uses. Refer Figure 51 for map of Delhi showing approximate delineation of TOD Zone.

A max. Floor Area Ratio (FAR) of 400 and a max. density of 2000 Persons Per Hectare (PPH) is permissible. TOD norms of FAR and density may be availed through the preparation and approval of comprehensive integrated scheme of minimum size 1 Ha, with maximum ground coverage of 40%. The entire amalgamated plot will be considered for calculating the FAR and density. EWS FAR of 15% over and above shall be applicable. Additional FAR may be availed through TDR only, for schemes larger than 1Ha.

TOD norms will facilitate more people to live, work and seek entrainment within walking distance of stations. This will also seek to balance/redistribute densities over the city along MRTS corridors.

A new urban planning ideal

A transit-oriented development is essentially any (real estate) development, however large or small, that is focused around a transit node, and facilitates complete ease of access to that transit facility, thereby inducing people to walk and use public transportation over personal modes of transport.

To put it in another way, TOD is underpinned by a vision of a city that is inclusive, egalitarian and environmentally sustainable. Ordinary pedestrians are placed at its centre, rather than buildings, flyovers or cars, in a big shift from prevailing practice. *Interact with the city, do not shut it out from your buildings, and we will all be better off* - that's the thought behind the policy. TOD consists of a variety of high-density, mixed-use, mixed-income buildings, within a short distance of a rapid public transport network. Higher density within pre-specified zones near transit stations encourages more people to use public transport, and limits urban sprawl.

These forms of urban development are very different from today's emphasis on gated communities and flyovers, which are explicitly automobile-based, and thus geared towards prioritizing the interests of the privileged, at the expense of the ordinary urban citizen. The character of the TOD Zone needs to be strictly pedestrian dominated and priority needs to be given clearly to pedestrians, NMT and public transport users, through equitable allocation of road space (Refer Figure 52 and 53). Redesign of Junctions, provision of safe crossings and traffic calming, redesign of street edges, removal of superfluous service roads, creation of pedestrian and NMT dominated spaces and eyes on the street are some of the key changes that need to be brought about in the public realm within TOD Zones.

With increasing automobile congestion, traffic snarls and pollution, the quality of life for most people has declined severely over the years. By promoting mixed land-use, encouraging the use of public transport services and increasing safety by reducing distances to transit stops, TOD is the most sustainable way going forward. Studies have shown that such integrated development has proved to be successful at replacing vehicle kilometres travelled and reaping the efficiency benefits of density.

Figure 54: Typical mixed-use residential development in Hiranandani Complex, Mumbai[8]

Source: Web

Figure 55: TOD Building typology in Kolkata

Source: UTTIPEC

8. *The Figure 54 shows a typical mixed-use residential development – street facing shops/offices/guest houses provide street vibrancy and safety during the day, and residential quarters above provide safety through "eyes on the street" at night. In this way privacy and safety of residents is also ensured. The Figure 55 shows the TOD Building typology - in Kolkata with Active Street frontage, Zero Setbacks, Mixed Use (Commercial/ Civic/ Residential within same block) where in Privacy of residents are ensured.*

IMPACT

The scope of the proposed TOD policy is significant: TOD zone, as currently defined in the policy, would comprise approximately 20% of Delhi's 1,483 sq.km. All development (including re-development of existing buildings and plots) in these influence zones must necessarily conform to its TOD development control norms.

Even if the policy is introduced to the city in a phased manner over years, as currently envisaged, it will fundamentally alter the city's landscape. TOD would provide a shift to a more holistic paradigm of planning where all sectors work together – mobility, planning policy, urban design, infrastructure and economics – to deliver integrated planned model for growth of the city.

Placemaking and Safety

Biggest gains of TOD are the most intangible — the concept of place-making, or designing urban neighbourhoods in such a way that local communities can be formed, returning to traditional Indian concepts of shared public spaces and 'chowks'. Currently, the city does not have local public spaces in the city, which can be used by all classes of society.

In TODs, compact mixed-use, mixed-income developments where residential, commercial, civic or institutional establishments are located close to each other allow local communities to be formed, with vibrant round-the-clock active spaces for leisure and recreation. Figure 54 & 55 show the TOD mixed use building typology already been implemented in cities like Mumbai, Kolkata, Ahmedabad, etc. The captions on the pictures are self-explanatory.

Figure 56 and 57 on following pages demonstrate how creation of arcades and zero-setback buildings create an urban environment that is more comfortable, climate protected, well watched and safe for all pedestrians (especially women) within TODs.

Giving everyone a Home

Currently most conversations of housing delivery tend to focus on ownership housing for the high income bracket (above Rs.60,000 income per month) or the severely low income bracket (below 10,000 per month). Little focus is given on planning and designing housing typologies for the large majority (>70%) of middle income population of the city which resides in the unauthorized colonies and slums, and struggles for basic amenities, security and quality of life. TOD aims to accommodate the needs of this segment through Housing provision in the city.

Through increased FAR and density, TOD norms may provide a variety of housing types for a range of income brackets and demographic types in the city. This demographic segment is also most likely to use the MRTS system to work and walk/cycle for daily needs, given the opportunity to a better quality of life.

To facilitate this, in all TOD integrated schemes, a minimum of 30% of overall FAR shall be mandatory for residential use. Additionally, this mandatory residential component shall comprise of 50% units of size ranging between 32-40 sq.m. (1 BHK) and the balance 50% comprising of homes ≤65 sq.m. (1-2 BHK). EWS FAR of 15% over and above the permissible FAR will be applicable.

A minimum 10% of FAR for commercial use and minimum 10% of FAR community facilities is also mandatory. This component shall include the requirements population in that land parcel and also serve the people visiting/passing through the area. Mix of uses and FAR utilization for the remaining 50% FAR shall be as per the land use category designated in the Zonal Plan.

Preparation of Sustainability Plans and Decentralized Infrastructure shall be mandatory in TOD schemes/ projects. Water and Waste Water management strategy including recycling and re-use of waste water for both potable and non-potable water shall be included as part of the water-budgeting and spatial planning/ landscape design of each project. Rain water harvesting and ground water recharge strategies are to be integrated with the Landscape and Public Open Space Strategy of all projects.

Figure 56: A bio-swale filtration system for ground water recharge integrated within street design
Source: City of Portland website

Figure 57: A centralized Sewage Treatment system in a dense urban area which recycles water to create a greenbelt in Bhuj, Gujarat

WATER AND SERVICES

TOD development will also see a paradigm shift in the provision of water and sewer infrastructure by making the recycling and reuse of water more feasible and efficient, and reducing both – the overall potable water demand, as well as piping/infrastructure costs. The aim would be to efficiently utilize existing water supply without putting external pressure and accommodating more people to benefit from such strategies.

Through re-development high density and mixed use residential units shall be introduced in the city, within which local recycling and reuse shall become much more feasible. Residential units require more potable water (which can partly be recycled water) and generate less waste water. Comparatively, commercial developments require less potable water, but generate more waste water (which can be recycled). Therefore the two uses are symbiotic and complement each other. Due to this, approx. 60% of the overall water supplied can be recycled/reused even at local project level, with very little piping costs, thus significantly reducing the net additional potable water demand for TOD projects. In cases, extra recycled water can also be used for horticulture and local ground water recharge.

One more important feature of TOD developments is the use of "working landscapes" which shall be mandatory. Instead of decorative parks and concretized rainwater harvesting systems, it is proposed to use more biological/ plant based treatment systems. Landscapes shall serve as both relaxation areas as well as bioswales/ detention/ treatment areas. All public areas would use mainly native, drought resistant species, which hardly consume any water. All these strategies, once again shall bring down water demand, water treatment costs, increase local ground water levels and also benefit the city at large.

Figures 55 & 56 show examples of how working landscapes can be integrated with roads, parks and neighbourhoods of any scheme/area to deal with both storm water and sewage treatment in softer and cheaper landscape-based ways. Such methods often cut down costs of local water treatment and recycling by about 60-80%, and also are more sustainable and beneficial in recharging local ground water table of the areas when TOD developments take place.

Engaging the Private Sector to Build a Better City

TOD policy would open up development opportunity to the private sector to bring in investment into the city building, its growth and revenue, and also help cross-subsidize social amenities, affordable housing and public transport, using a variety of possible financial development models.

Low-income groups shall be provided space and shared amenities in integrated mixed-income communities within the vicinity, giving them easy access to jobs and services closer to station areas, thereby reducing further proliferation of gentrified slums and unauthorized colonies.

Preservation of the clear and comfortable, well-shaded walking space next to building edges with zero-setbacks on main roads – is a key component of TOD.

Figure 58: Curitiba-Street Edge with a continuous walking arcade-similar to Connaught place, New Delhi
Source: UTTIPEC

Figure 59: Curitiba-Entries for car parking from the road leading directly to the multi-level parking garage below the building
Source: UTTIPEC

STATUS OF DELHI TOD POLICY

The policy on Transit Oriented Development (TOD) for Delhi has been adopted by the Central Government on 14th July 2015 as part of the revised Master Plan of Delhi – 2021, as notified in the Gazette of India.

With the TOD Policy in place, the DDA is now moving towards the preparation of TOD Regulations and Guidelines to help operationalize the policy and make it easy for potential developer entities as well as public entities to come forward with TOD schemes.

DDA has also initiated two TOD Projects on 30 hectares of land at Karkardooma which have been approved by the authority. The projects are being taken up in partnership with NBCC.

OBSERVATIONS OF THE COMMITTEE

Delhi's TOD policy has been worked out as one of the strategies for optimum utilization of land, to reduce traffic congestion on roads through reduced car-dependency. In the chapter on "Transportation", this policy and development norms for Transit Oriented Development (TOD) has been included and finalized based on feedback from public.

The following summarizes the key features of the policy that shall re-shape Delhi into a more sustainable city in the coming decades:

1. TOD norms allow flexibility to provide a mix of all uses i.e. residential/ commercial/ PSP/ government/ transportation, etc. (except polluting ones) within the same scheme, within the ambit of the landuses as per approved Zonal plans;
2. Permissibility of mixed-use within all land uses will reduce car-dependency and reduce congestion on roads. It will also allow greater flexibility to the development to adapt to local context and market-based needs;
3. TOD norms will facilitate creation of finer road networks within neighbourhoods/ development areas for improved local connectivity and the increase in walking and cycling, thus reducing congestion on major arterial roads.
4. The TOD development code will greatly increase public safety for women and children, specially those using public transport or walking at night, through provision of new codes/norms for setbacks, boundary walls, built-to-edge buildings, active frontages, eyes-on-the-street, etc;
5. TOD norms provide a rationalization in parking norms with optimum use of shared parking facilities within developments, and strict regulation of on-street parking to reduce private vehicle dependency; and
6. TOD norms allow for mix of incomes within communities with shared public spaces/ greens/ recreational facilities/ amenities which will minimize gentrification and create more community oriented developments.

RECOMMENDATIONS OF THE COMMITTEE

1. Demarcation of Influence Zone in Zonal Plans of Delhi needs to be initiated as per MPD-2021 so that ambiguities can be avoided. There could be a fully automated self-evaluation system for any site/ scheme area, to be self-tested by potential applicants based on the eligibility criteria provided in the MPD-2021, so that red-tapism and timelines for development can be shortened;
2. Easy to use guidelines and design handbooks should be developed so that general public can understand the interpretation of the policy easily and designers/ developers/ builders can come up with designs/ developments that are compliant with the policy's vision and intent;
3. Parking Management District Plans need to be prepared and implemented in phases, as TOD schemes roll out gradually in the city;
4. In order to facilitate "ease of doing business" and fast-paced re-development, a computerized single window clearance system must be adopted for approval of all TOD projects, the details of which should be included in the regulations for operationalization of TOD policy which needs be notified by DDA;
5. Decentralized infrastructure systems including water recycling and reuse, use of working landscapes and energy demand reduction strategies should be made mandatory in all TOD developments. Further aspects such as co-generation, solar, decentralized STPs etc. should be highly incentivized;
6. Process of preparation of the Influence Zone Plans (IZP) or integrated schemes along MRTS corridors based on TOD norms should be initiated by the Delhi Development Authority. All aspects regarding electricity, water, sewer, roads, transportation, utilities, pollution, green areas etc. and disposal or reuse of debris etc. should be suitably dealt with by involving concerned agencies/ local bodies, during the preparation of the IZP;
7. Urban Design and connectivity aspects are the key to success of TOD. Therefore, the Authority should prepare/approve integrated TOD schemes and/or influence zone plans, indicating the ROW's, public

spaces, build-to lines and connectivity links to Metro Stations and probable areas where amalgamation can take place with land parcels of 1hectares or more. The guidelines for creating arcades, boulevards, paseos, woonerfs and other active streets shall be tentatively indicated in the influence zone plans prepared/approved by the authority so that even if development takes place gradually over time, the overall scheme and intent of the TOD re-development process is met over time;

8. Preparation of comprehensive and integrated Landuse-Transport System with Action Plan and Strategies for development of an integrated transport system and infrastructure for the city should be taken up on priority basis by the GNCTD and DDA; and
9. Implementation of Kadkardooma, Lake city, Dwarka, Rohini and Narela TOD projects should be taken up on priority by the concerned authority.

Summary of Costs & Recommendations

Report of High Powered Committee on Decongesting Traffic in Delhi

Summary of Costs & Recommendations

SUMMARY OF COSTS

The summary of costs of various strategies is given in Table 21 below and shown in Figure 60. These costs are preliminary and based on projections. However, a detailed technical study is needed to estimate actual requirements.

Table 21: Summary of estimated costs of each component

Sr. No.	Strategy	Phase 1 (in crores)	Phase 2 (in crores)
1	Parking Pricing and Management: Implementation of 7 pilot Parking Management Districts on PPP Basis	70	
2	Multi-Modal Integration at Metro Stations, Integrated Passenger Terminals	2,412	2,745
3	Cycle track & Footpath	670	1,700
4	Cycle sharing System	865	850
5	Bus Service Improvements and BRTS	1,893.5	4,866.5
6	Removal of Choke Points	1,250	
7	Missing links & Network improvement	1,800	
8	Junction improvement	200	400
9	Capacity Building	40	
	Total	**9200.5**	**10561.5**

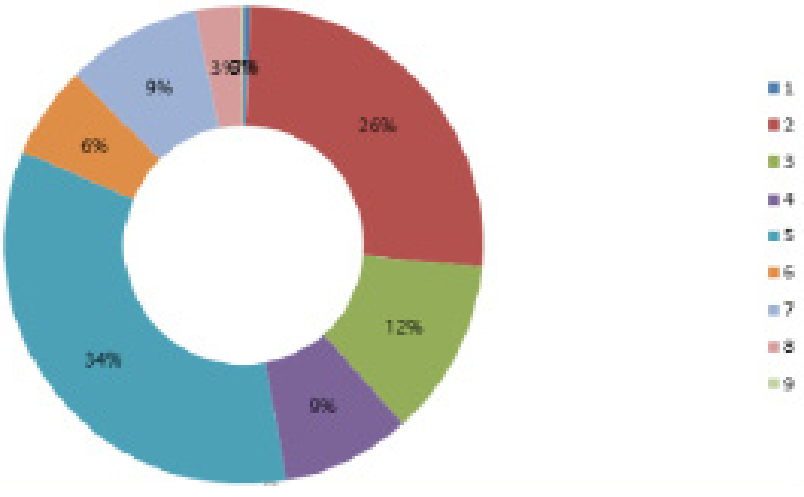


Figure 60: Summary of cost

SUMMARY OF RECOMMENDATIONS

Given below is the summary of recommendations, as explained in previous chapters.

1. Parking Pricing & Management

1. Private vehicle must be parked on 'a fully-paid rented or owned' space, based on the 'user pays' principle;
2. Parking should be charged as per duration, location in city and size of the vehicle;
3. Parking on footpaths should be made a cognizable offence under the Delhi Municipal Corporation Act;
4. On-street parking places should be physically demarcated and numbered for easy enforcement;
5. Parking Management Districts should be planned around all existing/ planned public parking facilities and on-street and off-street parking (including multi-level) facilities should be bundled for management by a single agency/ operator;
6. New stand-alone parking only sites are not required since parking is permitted in all use zones. Private entities should be permitted/ encouraged to provide pay-for-use public parking facilities within plots/ developments. On-street parking in any case should be designated and priced.
7. Parking places should have provision of 'shared parking' and parking for IPT-NMT modes and differently-abled;
8. Parking facilities within developments (e.g. commercial/ residential/ institutional) should have provision of 'shared parking' for enabling use by different types of users during different times of the day, thus bringing down total parking space demand.
9. Penalties related to parking should be charged 10 times the parking fee along with impounding of vehicles after a certain level of violation.

2. Multi-modal Integration & IPT

1. Provide well-planned and proper designated places for all public modes such as buses, rickshaws, bicycle sharing, etc. within 5 minute walking catchment of the stations;
2. Provide public amenities like toilets, etc. for commuters;
3. Provide high quality walking environment
4. Provide for safety with well-lit environment, especially for women;
5. Provide direct access to stations by walk or cycle;
6. Provide feeder services for last-mile connectivity;
7. Recognize the role of informal feeder services (e.g. IPT) and bring them into legal framework with proper regulations including providing driver-training, certification, etc. for cab, auto-rickshaw drivers;
8. Incentivize non-polluting feeder services; and
9. Provide fully segregated tracks for cycle-rickshaws and provide designated parking.
10. Decongest the area around main railway stations namely, New Delhi, Old Delhi, Hazrat Nizmuddin and Sarai Rohilla.
11. Take steps for optimum utlilization of Ring Rail for movement of traffic and freight in the city.
12. Expedite implementation of 'Planetary Model' for train stations by Ministry of Railways.

3. Enhancing walkability and use of NMT

1. Footpaths must be provided as a mandatory requirement on all roads, as per codes. Pedestrian to have the right of first use to the street space;
2. Street Design Guidelines prepared by UTTIPEC to be followed to provide for footpaths on all streets;
3. As against the 1-2 km block sizes currently existing in Delhi which leads to increased delay at a few junctions and increased pedestrian fatalities, more pedestrian/ NMT crossings should be provided at least every 250m, with pedestrian signals and signage, and these should preferably be at-grade;
4. Synchronization of signals should be implemented on priority with an integrated IT-based traffic management system so that inspite of having frequent at-grade pedestrian crossings, traffic can move swiftly across signals;
5. More secondary street networks need to be created (or made un-gated, as the case may be) so that more short-cuts for pedestrians and cyclists can be created/ enabled and vehicular traffic can be diverted/ redistributed from major junctions along multiple routes at the same time;
6. Signal free corridors should be avoided as more road-space only attracts more traffic. As seen worldwide, strategies such as congestion pricing, BRT systems, NMT systems need to implemented on priority to increase mobility speeds and pedestrian safety at the same time;
7. Dedicated and wide footpaths and cycle tracks (two-way) to be created on either side of the street, as per Street Design Guidelines, for safety of cyclists/ NMT on all arterial roads;
8. Road geometry to be improved for all streets to enhance pedestrian and cycling infrastructure;
9. Cycle sharing systems to be introduced and expanded to entire Delhi with fully automated

cycle access technology and integrated with the common mobility card; ; and

10. Pedestrian and cycle infrastructure to be made, obstruction free with clearly demarcated tracks with good shade, seating, dustbins, parking etc.

4. Bus Service Improvements

1. Access to bus service should be within walking distance from home or office with at-level boarding for universal accessibility;
2. Improve availability by rationalizing routes and fleet enhancement;
3. Bus fares should be priced less than per/Km cost of running a two-wheeler;
4. Footpaths on all roads to be mandatory for accessibility to bus stations;
5. Common mobility cards to be the mandatory access card for buses;
6. IT system to be housed in buses, bus-stops and control centre for enhanced quality and reliability of bus services, including passenger information systems for safety, reliability and usability of bus services;
7. To encourage use of bus services by people of various income and age groups, buses should be universally accessible and air-conditioned;
8. BRTS to be implemented in all high frequency routes and complemented with bus services with proper integration of routes, stations and terminals;
9. Urban Transport Fund to be created for Delhi and various revenue streams to be tapped like parking, fuel taxes, advertisement taxes, development taxes, etc. to help augment bus services in the city;
10. Bus parking should be made integral to urban planning. Multi-level bus parking to be provided in all depots to more efficiently use available land area;
11. Multi-modal, multi-use bus depots on PPP basis to be developed to provide high-class bus services and terminal experience to passengers.
12. Bus service needs to be augmented immediately. Out of the total requirement of 11000 buses, 2000 buses should be purchased immediately and 4000 in the next phase.
13. Quality of maintenance, upkeep and replacement of buses should be kept high, in order to ensure better life cycle of the fleet. Buses should be replaced from time-to-time as per their condition and service levels to have a high quality fleet available at all times and to ensure usability and reliability of the bus service.

5. Improving regional connectivity

1. Regional Rapid Transit System (RRTS) integrated with local transit systems should be implemented to provide seamless connectivity between regional and sub-regional centres of NCR;
2. Regional connectivity to be enhanced also by road systems;
3. Dedicated bus system to be augmented and implemented for regional corridors equipped with ITS system and common mobility card; and
4. Integrated Passengers terminals to be created with mixed use and multi-modal facilities for passenger comfort, integrating regional and local public transit systems.

6. Intelligent transport system

1. Implementation of Surveillance System, Automatic Vehicle Location System, Public Information System, Red Light Camera and Stop Line Violation Detection System, Automatic Number Plate Recognition, Automatic Parking Management System, Intelligent Signaling System and Control Centre and Data Storage System should be taken up on fast track mode;
2. The Operations Control Centre (OCC) to be setup by GNCTD as a Central Centre for the entire city of Delhi, integrating all modes;
3. The police should be given a live feed from the OCC set up for the city. Information from the OCC may be used by traffic police for real time monitoring/ management of traffic and issue of traffic advisories, alerts, guidance as well as auto-challans and notices to violators;
4. Common Mobility Card should be implemented by GNCTD for seamless integration across all transport modes;
5. Delhi Government may consider providing actionable information to any service providers, for creating integrated apps providing real-time information to the public using public transport to travel.

7. Road network optimisation

1. More intersections enable better dispersal of traffic and more safety;
2. Primary network should be complemented with a secondary network with priority given to pedestrian and cyclists';
3. Road Networks to be planned with a vehicular route network of approximately every 250m and pedestrian network of approximately 100m. Additional thoroughfares should be provided as required.
4. Choke points in the existing network/ junctions

should be removed;
5. The long-haul traffic (i.e. longer than 6 km) should be segregated from the local traffic (i.e. less than 6 km) so that local neighbourhood level trips do not mix with and congest arterial roads/ junctions;
6. Signal free corridors should be avoided and construction of flyovers, underpasses or footover-bridges should not be taken up unless it is over a river, a natural barricade, rail or no other solution is possible; and
7. Street density should be increased per sq.km. rather than increasing street area of a single street. Therefore, street widening should be avoided and smaller grid of streets should be carved out of existing easements of the city. This would enable people to take short-cuts for short trips without congesting city-level arterial roads.

8. Junction improvements

1. Geometry of all junctions should be retrofitted to provide/ improve for pedestrian and cyclists safety;
2. Signalized crosswalks should be located every 80-250m, with median cuts, properly aligned zebra crossings and sidewalks as well as signals/ pelican signals wherever required;
3. All junctions should be retrofitted with number plate recognition and other IT related hardware to enable efficient enforcement;
4. All junctions should have a zebra crossings (so that more pedestrians cross in lesser time) and a dedicated pedestrian signal for easy crossing of pedestrians and cyclists especially in a commercial and recreational areas;
5. Roundabouts should be provided wherever feasible, to provide greater traffic safety during off-peak hours, especially on low traffic volume streets;
6. Junctions to have appropriate traffic calming measures such as tighter turning radii, table top crossings, paving variations, mastic strips, signage, mini-roundabouts, etc.; and
7. Finer street network creates more junctions which allow better dispersal of traffic with moderate speeds.

9. Freight audit of Delhi

1. A freight audit study to be conducted for Delhi;
2. The freight audit study should cover the current and future cargo flows to and from Delhi and also the freight movement within Delhi. It should cover the transport facilities that are available in Delhi specifically for addressing freight traffic; and
3. Based on the freight audit, a freight master plan for Delhi needs to be prepared based on international best practices adapted to Indian conditions and ensuring that the freight movement happens to and from Delhi and inside Delhi in a sustainable, people and environment friendly manner.

10. Formation of DUMTA

1. Formation of a nodal body (DUMTA) with clear and different mandate from UTTIPEC should be formed for undertaking implementation, budgeting, and monitoring of all transport related projects;
2. The DUMTA should be made responsible for getting all transport related agencies under one umbrella for effective coordination and faster implementation of projects;

11. Capacity Building

1. Capacity of government agencies needs to be enhanced with focused programs on urban transport; and
2. Government needs to recruit/engage high quality professionals and make an in-house technical team, in each department, for envisioning and overseeing the projects.

12. Transit Oriented Development

1. Demarcation of Influence Zone in Zonal Plans of Delhi needs to be initiated as per MPD-2021 so that ambiguities can be avoided;
2. Easy to use guidelines and design handbooks should be developed so that general public can understand the interpretation of the policy easily and designers/ developers/ builders can come up with designs/ developments that are compliant with the policy's vision and intent;
3. Parking Management District Plans need to be prepared and implemented in phases, as TOD schemes roll out gradually in the city;
4. In order to facilitate "ease of doing business" and fast-paced re-development, a computerized single window clearance system must be adopted for approval of all TOD projects. The details of which should be included in the regulations for operationalization of TOD policy, which is being notified by DDA;
5. Decentralized infrastructure systems including water recycling and reuse, use of working landscapes and energy demand reduction strategies should be made mandatory in all TOD developments. Further aspects such as co-generation, solar, decentralized Sewage Treatment Plan (STPs) etc. should be incentivized;
6. Urban Design and connectivity aspects are the key to success of TOD. Therefore, the Authority should prepare/approve integrated TOD schemes and/or influence zone plans, indicating the ROWs, public spaces, build-to lines and connectivity links to Metro Stations and probable areas where amalgamation can take place with land parcels of 1 hectare or more; and
7. Preparation of a comprehensive and integrated Land-use Transport System with Action Plan and Strategies for development of an integrated transport system and infrastructure of the city should be taken up on priority basis by the GNCTD and DDA.

Way Forward

Way Forward

For delivery of Strategies (1-4) and to maximize benefits to the issue of traffic congestion, it is important that steps are taken in a time bound manner such that the multiplier effect of the solutions are visible and are felt by the citizens at large. Therefore, the Table 22 provides a broad timeline against tasks that should be taken up in priority. The list is not exhaustive.

Table 22: Proposed Short term and Long term projects with timelines.

SHORT TERM PROJECTS (Phase I, upto 2 years)

S. No.	Sub-strategies	Projects	Detail	Concerned Agency
1	**Parking Pricing and Management**	Implementation of Parking Management Districts	Connaught Place, Nehru Place, Karol Bagh, Kamla Nagar, Vikas Marg, Lajpat Nagar, Bhikaji Kama Place. For Connaught Place - parking structure already exist and only management plan needs to be prepared by the ULB.	MCDs, NDMC, DDA, Cantt. Board
2	**Multi-modal Integration**	Implementation of Phase III Metro stations	Implementation of First Phase – 78 Phase-III Metro stations	DMRC, PWD
		Implementation of Integrated Passenger Terminals	Sarai Kale Khan, Bijwasan & Anand Vihar.	Railways, Transport Dept., GNCTD
3	**Enhancing Walkability & use of NMT**	Implementation of Cycle Tracks & Footpaths	200km of street length covering arterial & sub-arterial roads and at least 70 junctions	MCDs, NDMC, DDA, PWD
		Implementation of Cycle sharing system	Implementation of Phase 1 – Dwarka & South Delhi area	SDMC, DDA

S. No.	Sub-strategies	Projects	Detail	Concerned Agency
4	**Bus Service Improvements**	Purchase of Buses	Purchase of 2000 buses	Transport Department, GNCTD
		Installing ITS	Central Operations Control Centre (OCC), PIS, Signaling, Management, GPS, Common Mobility Card, Website and Mobile application, etc.	Transport Department, GNCTD
		Bus Depot	Allocation of land for Bus Depot and creation of multi-level bus facility.	DDA, Transport Department, GNCTD
		Route Planning	Route rationalization of all bus routes – DTC, Cluster, BRTS, Feeder, etc.	Transport Department, GNCTD
		BRTS	Bus Corridor Development of Karwal Nagar to Mori Gate corridor	Transport Department, GNCTD
5	**Road Network Optimization**	Removing Choke Points	Improving congestion points at 44 locations as identified by DTP, as per Table 17	PWD, DDA, MCDs
		Missing links and Network improvement	Projects announced under Urban Development Fund scheme	PWD, DDA, MCDs, NDMC, NHAI, Cantt. Board
6	**Junction Improvements**	Retrofitting of junctions	Implementation of geometric improvement of 200 junctions along with IT system for surveillance and vehicle detection.	PWD, DDA, MCDs, NDMC, Cantt. Board
7	**Enhancing Institutional capacity**	Establishment of DUMTA	Formation of high powered committee to develop the institutional design of DUMTA. Notification of DUMTA.	GNCTD, DDA
		Capacity building	Allocation of budget for capacity building and design of capacity building workshops	All Government Agencies
8	**Transit-Oriented Development**	KKD and Lake city projects	Implementation of Kadkardooma and Sanjay Lake TOD projects	DDA

LONG TERM PROJECTS (Phase II, upto 5 years)

S. No.	Sub-strategies	Projects	Detail	Concerned Agency
1	**Multi-modal Integration**	Implementation of Phase I & II Metro stations	Implementation of 129 Phase-I & II Metro stations	DMRC, PWD
		Implementation of Integrated Passenger Terminals	Kashmere Gate, Holambi Kalan & Tikri Kalan	Railways, Transport Dept., GNCTD
2	**Enhancing Walkability & use of NMT**	Implementation of Cycle Tracks & Footpaths	500km of street length covering arterial & sub-arterial roads and 200 junctions	MCDs, PWD, NDMC, DDA, Cantt. Board
		Implementation of Cycle sharing system	Implementation of NDMC and West Delhi	NDMC, MCDs

S. No.	Sub-strategies	Projects	Detail	Concerned Agency
3	**Bus Service Improvements**	Purchase of Buses	Purchase of 4000 buses	Transport Department, GNCTD
		BRTS	Bus Corridor Development: Ghazipur NH24 to National Stadium Dilshad Garden metro station to Tikri border. Badarpur border to IGI airport Harsh Vihar to Janakpuri district center BRTS Depot Development	PWD, Transport Department, GNCTD
4	**Junction Improvements**	Retrofitting of junctions	Implementation of geometric improvement of 400 junctions along with IT system for surveillance and vehicle detection.	PWD, DDA, MCDs, NDMC
5	**Transit-Oriented Development**	New Cities projects	Implementation of Dwarka, Narela and Rohini TOD projects and projects initiated by other Government Agencies and private initiatives	DDA, GNCTD, DMRC

TASKS FOR VARIOUS DEPARTMENTS

In order that the work is carried out in coordinated manner, each department which is responsible for particular urban transport function should carry out the tasks and set priorities based on the guidance from the report on Decongesting Traffic in Delhi. Each chapter of the report elaborates on strategies and tasks (along with tentative costs) and provides a background of the required projects in the given timeline. Each government agency is expected to set up special task forces to take up projects on priority and achieve results in the desired/ mentioned timeline. For monitoring the overall implementation of the recommendations, a small group may be setup under the chairmanship of CS, GNCTD. Such projects may be implemented in short term and currently the projects may be taken up to be completed in 2-3 years. The key is close monitoring of projects from formulation, funding up till their timely execution.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