MINISTRY OF URBAN DEVELOPMENT

MUMBAI NATIONAL URBAN TRANSPORT HELPLINE

OPERATIONS DOCUMENT

NOVEMBER, 2016

SUPPORTED BY:

OPERATIONS DOCUMENT

Mumbai National Urban Transport Helpline

Prepared by

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In association with
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Abbreviations

Acronym	Definition/Description
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AVL / AVLS	Automatic Vehicle Location System
BEST	Brihan-Mumbai Electric Supply & Transport Undertaking
CCTV	Closed Circuit TV
CIDCO	City and Industrial Development Corporation of Maharashtra Ltd.
DPR	Detailed Project Report
ETA	Estimated Time of Arrival
GEF	Global Environment Facility
GIS	Geographical Information System
GoI	Government of India
GoM	Government of Maharashtra
GPS	Global Positioning System
ISO	International Organization for Standardization
ITS	Intelligent Transport System
IVR/IVRS	Interactive Voice Response (System)
KDMT	Kalyan-Dombivali Municipal Transport
MBMT	Mira Bhayandar Municipal Transport
MCGM	Municipal Corporation of Greater Mumbai
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MoU	Memorandum of Understanding
MoUD	Ministry of Urban Development, GoI
MSRDC	Maharashtra State Road Development Corporation Ltd.
MSRTC	Maharashtra State Road Transport Corporation
NMMT	Navi-Mumbai Municipal Transport
NUTH	National Urban Transport Helpline
NUTP	National Urban Transport Policy
PIS	Passenger Information System

Acronym	Definition/Description
PPP	Public Private Partnership
PWD	Public Works Department
SMS	Short Message Service
SUTP	Sustainable Urban Transport Project
TMICC	Traffic Management And Information Control Centre
TMT	Thane Municipal Transport
TSR	Three Wheeler Scooter Auto Rickshaw (TSR)
UAN	Universal Access Number
UMMTA	Unified Mumbai Metropolitan Transport Authority
VMS	Variable Message Sign

EXECUTIVE SUMMARY

1. Project Background

The Government of India (GoI) has initiated the Sustainable Urban Transport Project (SUTP) with support of Global Environment Facility (GEF), United Nations Development Programme (UNDP) and World Bank (WB). The primary objectives of SUTP are to apply National Urban Transport Policy (NUTP) to achieve a paradigm shift in India's urban transportation system for more favourable sustainable developments and alternatives. The Ministry of Urban Development (MoUD) has been designated as the nodal agency for implementation of the project. SUTP *inter alia* aims at providing Technical Assistance to the MoUD in order to improve capacity at National, State, and Local levels to implement the NUTP.

As a part of this initiative, generic operations documents have been developed for:

A. Traffic Management and Information Control Centre (TMICC)
B. National Urban Transport Helpline (NUTH)

Together with the Generic Operations Documents, City Specific Documents have also been prepared for the selected cities and the chosen concepts. This report provides the city specific plan for NUTH in Mumbai.

2. ITS, TMICC and NUTH Concepts

Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH) are Intelligent Transport Systems (ITS) that focus on management of traffic systems and dissemination of transport related information respectively.

Intelligent Transport Systems have been deployed worldwide to manage and monitor the transportation infrastructure and facilities and to support their efficient utilisation. ITS is application of Information and Communication Technologies (ICT) and management strategies in an integrated manner to enhance efficacy and efficiency of the transportation systems. ITS works better once basic transport infrastructure is in place and is regularly maintained. ITS is an excellent monitoring system and will help in identifying gaps and issues in the infrastructure and would thereby facilitate objective and data driven planning.

Traffic Management and Information Control Centre (TMICC) is a centre with which various systems of the transportation network (traffic signal, cameras, detectors, VMS etc.) are connected and based on feed received from these systems, suitable interventions are initiated from the TMICC in order to manage the systems, reduce congestion, dealing with incidents, issuing advisories or disseminating information. Often, many of the agencies including Traffic Police are also co-located at TMICCs and work closely with each other in order to improve coordination.

National Urban Transport Helpline (NUTH) is one of the most widely used information dissemination system and public interface across the world. It provides transit and traffic

information to travellers which allows them to plan their journey across various modes, as required. It has emerged as one of the core information dissemination systems related to urban transportation infrastructure, facilities and services. It is where data relating to various transportation facilities and services is collected by building suitable interfaces with transport agencies, which is then processed and disseminated to public through several delivery channels such as web, mobile apps and social media.

Intelligent Transport Systems help in optimising the transportation infrastructure performance. These are added tools to improve the performance of the transportation systems. ITS on its own cannot solve the traffic and transportation issues but is deployed alongside and along with the infrastructure augmentation interventions to provide a holistic solution.

3. Scope of the Project/ Document (Chapter 1.0)

This document is a concept level document and not a Detailed Project Report (DPR). The city will need to prepare DPR in due course as and when they decide to implement the proposed system. As the concept is new to the Indian cities and will require additional support from organisations having required expertise, the Ministry of Urban Development (MoUD) has empanelled a set of consultants who may be engaged by the city for seeking assistance in conceptualising, preparing DPR, designing, procuring and monitoring the implementation of NUTH in the city. A communication in this regard has already been sent by MoUD to all States including Maharashtra. The indicative scope of services for the city specific project consultancy is as set out in Annexure 5.

4. Mumbai City Characteristics and Transport Sector Interventions Proposed (Chapter 2.0)

Mumbai, the capital city of Maharashtra, is considered to be the financial capital of India. Greater Mumbai Urban Agglomeration has a population of 18.4 million (2011 census) and an area of 4355 sq. km. (Mumbai Metropolitan Region - MMR). Mumbai has a population of 12.5 million (2011 census) and an area of 480.24 sq. km. under the jurisdiction of Municipal Corporation of Greater Mumbai (MCGM). The regions surrounding Mumbai register considerable inter-city daily transit commutes to central and other parts of Mumbai for job, education, business, shopping, recreational activities etc.

The public transport system in Mumbai/MMR comprises suburban rail services and buses. Brihan-Mumbai Electric Supply and Transport Undertaking (BEST) runs over 4,000 buses in Mumbai. Suburban rail services are being operated on several routes: Church Gate to Dahanu Road (124 kms), Mumbai CST to Panvel (51 kms), Mumbai CST to Kalyan (54 kms), Kalyan to Kasara (67 kms), Kalyan to Karjat (46 kms).

In order to cater to the increased demand for transportation and mobility, Comprehensive Transportation Study (CTS) for Mumbai Metropolitan Region, MMRDA (2008) has identified several interventions for the city. Some of the key interventions proposed in the CTS are listed below:

- 17 Inter-State/ Inter-City Bus Terminals
- 6 Inter-City rail Terminals
- 5 Major Truck Terminals
- 10 Mini Truck Terminals
- 13 Passenger Water Transport (PWT) Terminals
- Bus Rapid Transit/ EBL/ Monorail
- Multi-Modal Corridors
- Metro Rail
- Suburban Railway System

The Metro Rail on Versova-Andheri-Ghatkopar stretch of about 11 kms has started its operations in 2014. Monorail system between Chembur and Wadala on a corridor length of about 8.9 kms is also currently operational.

But like most metropolitan cities in India, Mumbai's public transport system is challenged with an increasing demand. The rising prosperity of the people and the continued migration from different parts of India to Mumbai has added to the burden of transport infrastructure of Mumbai. Road and rail length and the fleet capacity of the public transport have not kept pace with the increase in population and number of private vehicles on the roads of Mumbai.

These current infrastructure and new projects have to be augmented with more prudent ways to manage the current demand and induced demand that judiciously allocates the available capacity. It is in this dimension that Intelligent Transport Systems (ITS) such as National Urban Transport Helpline (NUTH) can play an instrumental role. With the rapid spread of ITS in tackling urbanisation issues across the globe, it is pertinent for Mumbai to embrace ITS to get the best out the investments made in infrastructure creation.

5. Need and Benefits of NUTH in Mumbai (Chapter 2.0)

Considering the presence of multiple modes and transit agencies in Mumbai, there is clearly a need to establish NUTH system for Mumbai in phases to provide both multi-agency and multi-modal transit information as well as traffic related information to public. It should provide both static and real time information related to both transit as well as traffic.

Need for NUTH and some of the benefits of the proposed NUTH for Mumbai are provided below:

- **Unified System for Urban Transport Information Dissemination:** Mumbai NUTH would be a unified platform that would be accessible to public through multiple channels for providing all urban transport related information such as traffic, transit and parking related information etc.

- **Traffic Information Dissemination:** Currently traffic information is provided by Mumbai Traffic Police through its website, social media pages, helpline and mobile

apps. Mumbai NUTH would be accessible to public through multiple channels for providing the traffic related information as a single unified source.

- **Transit Information Dissemination:** Currently transit information is provided by individual transit agencies for their respective modes. Mumbai NUTH would be a common platform that would provide transit related information for all the transit operators to public through multiple channels.
- **Parking Information Dissemination:** Currently parking information is provided by individual parking agencies for their respective sites in a limited way. Mumbai NUTH would be a platform that would be accessible to public through multiple channels for providing all urban transport related information including the parking related information for various parking agencies.
- **Incident/ Construction and Maintenance Information Dissemination:** Currently incident related information is provided by Mumbai Traffic Police through its website, social media pages, helpline and mobile apps. The information related to construction/maintenance is generally not available. Mumbai NUTH would be a common platform that would be accessible to public through multiple channels for providing all urban transport related information including incident/ construction and maintenance related information as a single unified source.
- **Multi-Modal Information Dissemination System:** Presently various transit agencies disseminate transit information through their respective channels for their respective modes (e.g. BEST, Mumbai Suburban Railways, Mumbai Metro, Mumbai Monorail) only. Information regarding the schedules and routes of public transport services in Mumbai is mostly fragmented and scattered across various sources which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. NUTH would act as a unified system from where users/general public can get information about various transportation modes in the city.
- **Reducing Traffic Congestion:** National Urban Transport Helpline (NUTH) would help individuals make more informed travel decisions thereby help in moderating the effects of traffic congestion on the road network. NUTH will provide information e.g. congestion on roads, alternate routes, construction and maintenance activity, incident activity information etc. This information would help users in taking alternate routes to preventing not just congestion from aggravating but would also support in efficient utilisation of transport infrastructure.
- **Improvement in Public Transport Modal Share:** Mumbai NUTH will disseminate transit and traffic information. Transit information will cover routes and schedules information for various transit modes, Estimated Time of Arrival (ETA), real time running status and routes on which particular transit is available, among others. This would help in increasing the reliability of public transport and would support in attracting public to shift to public transport leading to its enhanced share in overall transport trips.

6. Mumbai NUTH Concept Details

Details about the proposed NUTH are provided below:

A. Mumbai NUTH Projects Elements (Chapter 4.0):

NUTH is proposed to have the following elements:

- Transit Information Dissemination
- Traffic Information Dissemination
- Parking Information Dissemination
- Construction / Maintenance Activities Information Dissemination
- Weather Information Dissemination
- Incident / Accident/ Event/ Disaster Information Dissemination
- Trip Planner

The aforesaid would cover transit routes, transit schedules, trip planners, road closure details, event details, traffic congestion, traffic advisories etc. The information would be disseminated through various channels: phone helpline, website, mobile app and social network (Twitter, Facebook).

B. Mumbai NUTH Project Phasing (Chapter 4.0):

There is a need to have a multi-modal / multi-agency NUTH system for the entire Mumbai Metropolitan Region (MMR). The transit and traffic agencies for various cities/areas in MMR are under the purview of different State agencies and/or local governments. In order to expedite its implementation, it is recommended that NUTH be implemented in phases.

To begin with, in Phase-1, Greater Mumbai (MCGM area) is proposed to be covered through NUTH. Subsequently, other nearby municipal corporations in MMR are proposed to be added progressively, and, later on, remaining MMR areas are proposed to be brought under the purview of NUTH. Similarly, functionality is also proposed to be provided in a phased manner based on readiness of agencies to provide the required information.

C. Mumbai NUTH Information Dissemination Channels (Chapter 4.0):

I. **Website:** Mumbai NUTH would have a well-designed website. The user interfaces would be designed in such a manner that are intuitive, support easy navigation and enable faster access to relevant information. GIS maps must be used to display route, incidents, congestion information, road closure details etc. to enrich user experience. Website would have multi-modal journey planning tool to support trip planning between various origins and destinations using several

options such as modal preference, date, time, fastest, least transfers/ cost/ time/ walk etc.

II. **Mobile Application:** Mumbai NUTH would have a mobile application. The application would be designed for all popular mobile operating systems such as iOS, Android, Windows etc. Geographical Information System (GIS) maps would be used to display route, incident, congestion, road closure details etc. to enrich user experience. Mumbai NUTH mobile app would have multi-modal journey planning tool to support trip planning between various origins and destinations using several options such as modal preference, date, time, fastest, least transfers/ cost/ time/ walk etc. Mumbai NUTH may share information with private entities in standardised formats so that various mobile apps could be creatively designed to disseminate transit and traffic information to public. This would also help in popularisation of transit.

III. **Social Media:** Mumbai NUTH would set up social media pages on Facebook and Twitter for providing information and updates, and reaching out to the public for their feedback.

IV. **Phone Helpline:** Mumbai NUTH would, in addition to other information dissemination channels, set up telephone helpline to provide information to public through Interactive Voice Response System (IVRS) and/or operators. The objective would be to provide most of the information on IVRS mode. The IVRS process flow would be designed in such a way that enables callers to access relevant information in the most efficient manner.

D. **Standardised & Simple Number:** Currently, the public transport helpline number proposed is a six digit number (155220) which has been allotted to MoUD for NUTH. It is desirable that the helpline number be convenient to remember and use for people from all walks of life and all sections of society. A three digit number instead of a six digit one is recommended which would be easy to remember and communicate and, therefore, be more accessible.

E. **Agencies and Stakeholders (Chapter 6.0)**

UMMTA, Urban Development Department (GoM), Transport Department (GoM), Transit agencies (Western Railway, Central Railway, BEST and MMRDA), Mumbai Traffic Police, road owning agencies (MCGM, PWD-GoM, MMRDA, MSRDC, etc.) would be key project stakeholders. UMMTA would be an important stakeholder by virtue of its role in coordinating with transit agencies and other transport sector stakeholders. Most of these agencies would be required to share data with NUTH which would then be suitably disseminated by the NUTH. Considering that UMMTA has representation from all the transportation sector stakeholders in the MMR and it is headed by Chief Secretary of the Maharashtra State, it is recommended that UMMTA be entrusted with the responsibility for setting up and operating the NUTH. UMMTA could in turn set up the NUTH through MMRDA or any other entity.

F. Budget: A budget of ₹ 14.77 crores is envisaged for Phase 1 implementation of Mumbai NUTH project in accordance with components listed in Section A above and Section 7.2, which include project development, systems engineering, hardware, software, systems integration, testing and commissioning. In addition, a budget of ₹ 4.02 crores is required towards annual operations and maintenance of the NUTH. The project cost and sizing may undergo changes at the time of preparation of detailed report for the project. (Chapter 7.0).

G. Funding: Central Government may use any of its programmes for supporting such initiatives. Funding for setting up of the NUTH may be secured with the support of the State Government under the centre's on-going or future schemes. Central government has launched the Smart Cities Mission[1]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[2] and the city may avail funding from one or both these schemes.

Multilateral or bilateral funding may also be secured at Central Government, State Government or City levels. Since the project support environment management as well, national and international programmes providing funding support for undertaking environment related measures may also be accessed based on the requirements of such programmes.

The Operational & Maintenance cost of NUTH may be borne by UMMTA or the agency nominated by UMMTA.

7. Recommendations

Considering that several interventions have been proposed by the city towards infrastructure creation and augmentation including as part of the Comprehensive Transport Study (CTS) for Mumbai, it would be highly beneficial for the city to implement the NUTH system as proposed in this report. This ITS initiative has the potential to transform the way the city disseminates transport related information to the public and help in attracting people to use public transport.

[1] Smart Cities- Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)
[2] Atal Mission for Rejuvenation and Urban Transformation (AMRUT) - Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)

1.0 INTRODUCTION

1.1 Project Background

The Government of India (GoI) has initiated the Sustainable Urban Transport Project (SUTP) with support of Global Environment Facility (GEF), United Nations Development Programme (UNDP) and World Bank (WB). The primary objectives of SUTP are to apply National Urban Transport Policy (NUTP) to achieve a paradigm shift in India's urban transportation system for more favourable sustainable developments and alternatives. The Ministry of Urban Development (MoUD) has been designated as the nodal agency for implementation of the project. SUTP, *inter alia*, aims at providing Technical Assistance to MoUD in order to improve capacity at National, State, and Local levels to implement the NUTP.

As a part of component PC1B2 of SUTP, Generic Operations Document have been developed for:

A. Traffic Management and Information Control Centre (TMICC)
B. National Urban Transport Helpline (NUTH)

TMICC would be the control centre to support traffic management, monitoring and control activities to facilitate smooth traffic flow on the road network of the city. NUTH and its companion information dissemination systems are expected to disseminate public transport and other travel related information through various channels, such as telephone service, websites and mobile apps to facilitate travel planning by public.

NUTH Generic Operations Document consisting of system architecture and design, among other areas, can also be referred to while planning, designing, implementing and operating NUTH for Mumbai.

1.2 Report Context

MoUD has engaged Delhi Integrated Multi Modal Transit System (DIMTS) Ltd. To prepare Operations Document for Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH).

Together with the Generic Operations Documents, City Specific Operations Documents are to be prepared for the selected cities and the chosen concepts. Using Generic Operations Documents, this report provides the City Specific plan for Mumbai NUTH. This document is a concept level document and not a Detailed Project Report (DPR). The city will need to prepare DPR in due course as and when it decides to implement the proposed system. As the concept is new to the Indian cities and will require additional support from organisations having required expertise, the Ministry of Urban Development (MoUD) has empanelled a set of consultants who may be engaged by the city for seeking assistance in conceptualising, preparing the DPR, designing, procuring and monitoring the implementation of NUTH in the city. A communication in this regard has already been sent by MoUD to all States including Maharashtra. The indicative scope of services for the city specific project consultancy is as set out in Annexure 5.

2.0 CITY CHARACTERISTICS

2.1 Mumbai

Mumbai is often referred to as an island city as it is made up of a cluster of seven islands. Mumbai city or the Greater Mumbai consists of two different regions namely the island city and the suburbs. The principal part of the city is concentrated at the southern, claw–shaped end of the island known as South Mumbai; the Central Business District (CBD), the Jawaharlal Nehru Port, a number of warehouses, government and multinational offices are located in this part of Mumbai. Most of the residential areas of the city are located in the suburbs on the north of the city. The development of Mumbai city is constrained by the sea on the south, east and west. As a result, the total land area available for development of Mumbai is limited, and continued expansion has been taking place both to the North of the island city and to the east of the Thane Creek in what is now Navi Mumbai (Figure 2-1[3]).

Figure 2-1: Geographical Setting of Mumbai

The Suburbs are mostly residential areas though some business centres have developed there too as the island city area has become more congested. Road and rail infrastructure development in the city over the last 4-5 decades has struggled to

[3] Source: Comprehensive Transportation Study for Mumbai Metropolitan Region, MMRDA (2008)

keep pace with the growing demand for mobility. Inadequate road network is slowing down the traffic causing chronic road congestion and environmental pollution.

2.1.1 Regional Setting

The Mumbai Metropolitan Region (MMR) comprises Mumbai (480.24 sq. km.) and its surrounding areas (Figure 2-2)[4] adding up to total MMR area of 4,355 sq. km.

Figure 2-2: Map Showing MMR Area

[4] ibid

MMR comprises eight municipal corporations (including MCGM), nine municipal councils, and over 1,000 villages in Raigad and Thane districts of Maharashtra (Table 2-1)[5].

Table 2-1: Mumbai Metropolitan Region: General Details

Parameter	Details
Population[6]	18.41 million
Area	4,355 sq. km.
Municipal Corporations	• Greater Mumbai • Thane • Kalyan-Dombivali • Navi Mumbai • Ulhasnagar • Bhiwandi- Nizamapur • Vasai-Virar • Mira-Bhayandar
Municipal Councils	• Ambarnath • Kulgaon-Badalapur • Matheran • Karjat • Panvel • Khopoli • Pen • Uran • Alibaug
Other Area in MMR	Over 1,000 villages in Thane and Raigad districts of Maharashtra

2.1.2 Demographic Trends

Mumbai has grown exponentially in the past in terms of population and employment opportunities. It can be seen that there are 5 municipal corporations having population of over a million including Greater Mumbai which has population of over 12 million. The historical development of Greater Mumbai and scarcity of land led to an upsurge in growth of satellite towns such as Thane, Kalyan – Dombivili, Navi Mumbai. Greater Mumbai which consists of Island city, western and eastern suburbs have high concentration of settlements developed along the transport corridors. The population details of the municipal corporations in the MMR area has been presented in the Table 2-2[7].

[5] Source: MMRDA
[6] Source: Census of India, 2011
[7] Source: MMRDA

Table 2-2: Municipal Corporations in Mumbai Metropolitan region and Population

Municipal Corporations	Population (2011 Census)
Municipal Corporation of Greater Mumbai	12,478,447
Thane Municipal Corporation	1,818,472
Kalyan-Dombivali Municipal Corporation	1,246,381
Vasai-Virar Municipal Corporation	1,221,233
Navi Mumbai Municipal Corporation	1,119,477
Mira-Bhayandar Municipal Corporation	8,14,655
Bhiwandi-Nizampur Municipal Corporation	7,11,329
Ulhasnagar Municipal Corporation	5,06,937

The population of Greater Mumbai was 12.47 million according to 2011 census. Out of this, about 25 per cent is concentrated on the island city while the rest is spread across the suburbs. The population contribution of island city has decreased from 32 per cent in 1991 to 25 per cent in 2011.

2.1.3 Economic Profile

Mumbai is rapidly emerging as a world-class metropolis. Mumbai holds the pride of being the wealthiest city in the country, with the highest GDP of all the cities in South, West and the Central Asia. Mumbai has a deep natural harbour. Mumbai has been rated among the top 10 centres for commerce and is aptly known as the commercial and the entertainment capital of India. Mumbai accounts for 25% industrial output, 5% of India's GDP and also 70% of the capital transactions in the Indian economy. It is home to major financial institutions such as Reserve Bank of India, the National Stock Exchange of India and Bombay Stock Exchange etc. It also has the corporate headquarters of several prestigious Indian companies and various multi-national corporations. The increasing business opportunities offer the inhabitants of Mumbai, a better potential for a higher standard of living.[8]

2.1.4 Registered Motor Vehicles

There were 18.7 lakhs registered vehicles in the city till 31st March 2011. Mumbai experiences traffic congestion every day especially during peak hours losing valuable man hours. The number of vehicle of various types registered in Mumbai over the years has been presented in Table 2-3[9].

[8] Source: http://www.mumbai.org.uk/
[9] Source: IndiaStat.com

Table 2-3: Registered Motor Vehicles in Mumbai

Type	2007	2008	2009	2010	2011
Car	5,16,177	5,47,446	5,66,204	5,98,710	6,37,062
Two Wheeler	7,92,512	8,59,075	9,09,993	9,67,479	10,44,829
Auto	1,04,862	1,04,725	1,04,716	1,07,853	1,08,715
Bus	14,327	14,510	13,061	17,212	16,784
Goods	64,818	68,031	69,114	69,138	60,296
Others	7,301	7,523	7,667	7,582	2,355
Total	**14,99,997**	**16,01,310**	**16,70,755**	**17,67,974**	**18,70,041**

According to data from Regional Transport Offices (RTO) in Mumbai, a total of 25,02,673 vehicles have been registered at all three centres — Tardeo, Andheri, Wadala — till March 31, 2015. Long term vehicle number growth during 1991-2011 was observed to be 6.0% per annum which has now accelerated to over 7.5% per annum during the period from 2011 to 2015. The vehicle growth trend is shown in Figure 2-3[10].

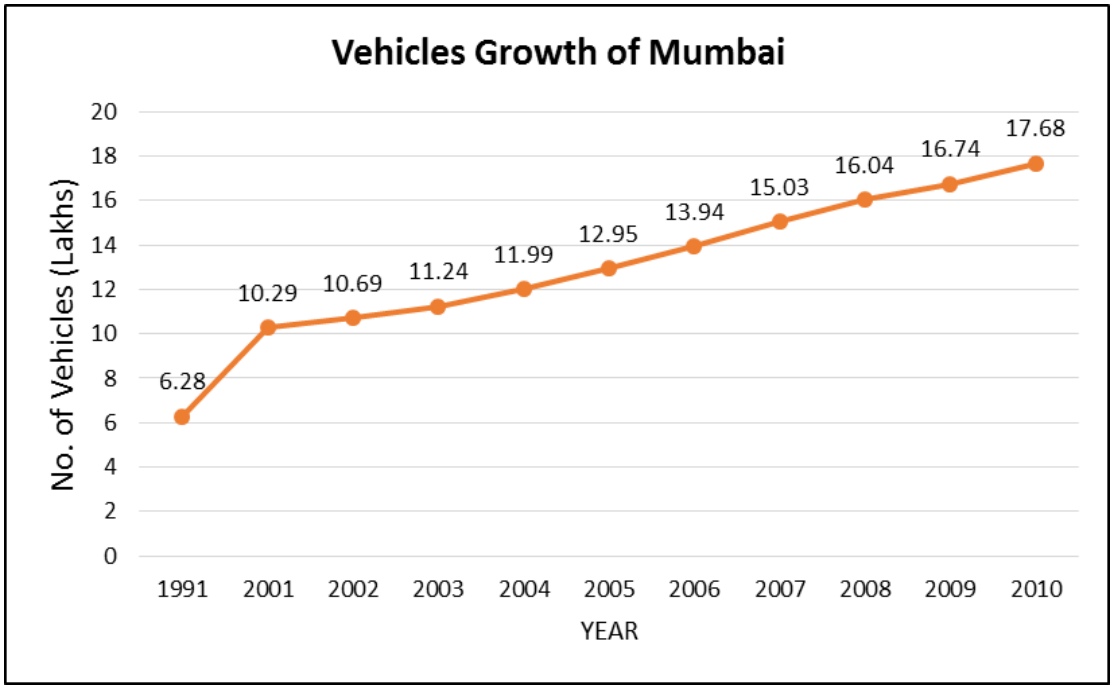


Figure 2-3: Vehicle Registration Growth in Mumbai

[10] ibid

Geographical constraint has limited the road network expansion in Mumbai to keep pace with the increasing travel demand. This has led to congestion being experienced on most roads in Mumbai.

2.1.5 Accidents Statistics

Table 2-4[11] represents the accidents data over the years in the Mumbai city. The data shows a general decreasing trend in number of accidents in the past few years, but the absolute number of accidents is still high.

Table 2-4: Year Wise Road Accident

Year	Non- Fatal	Fatal	Total
2012	3052	694	3746
2011	2921	743	3664
2010	3492	782	4274
2009	3438	772	4210
2008	3363	840	4203
2007	3962	891	4853

2.2 Existing Traffic and Travel Characteristics

MMRDA, MCGM and other municipal corporations in the MMR have been working towards providing a safe, sustainable, economic, people-friendly and efficient public transportation system in the city. Presently transport demand in the city is met by public, intermediate public transport and personalised modes. These include intra-city buses, Suburban Rail, Metro Rail, Monorail, auto rickshaws, hired cars and personalised modes such as cars and two-wheelers. Buses and Suburban Rail continue to be the most popular means of transportation for intra-city travel in the city.

2.2.1 Per Capita Trip Rate

Average Per Capita Trip Rate (PCTR) of MMR is about 1.65. By excluding the walk trips which are generally short in length, the PCTR is estimated to be 0.65 per day.

2.2.2 Average Trip Length

The average distance travelled by each mode varies; from 12 km by cars, 6 km by two wheelers, 8.9 km by buses and 23.8 km by Suburban rail[12].

[11] ibid
[12] Source: Comprehensive Transportation Study for Mumbai Metropolitan Region, MMRDA (2008)

2.2.3 Modal Share

The number of trips by walk account for 27% of the person trips made daily in Mumbai. Public transport has a share of 45% in the total trips. Car and two wheeler have a share of 8% and 7 % respectively. The mode wise trip share for Mumbai has been presented below in the Table 2-5[13].

Table 2-5: Modal Share for Mumbai

Type of Mode	Share
Walk	27%
Cycle	6%
Two Wheeler	7%
Public Transport	45%
Car	8%
IPT	7%

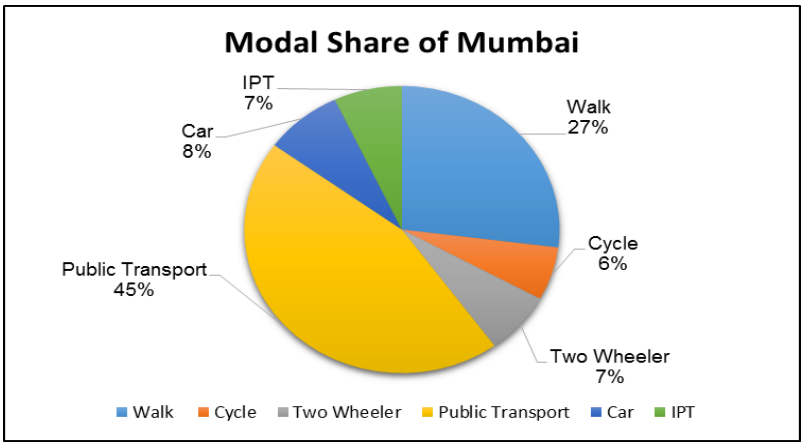


Figure 2-4: Mode-wise Distribution of Trips in a day

2.2.4 Existing Public Transport

The public transport system of Mumbai comprises suburban rail, BEST buses, Mumbai metro and Monorail. Mumbai has the distinction of a high modal share in favour of a public mass transport system in India. However, despite the high share of public transport, congestion on the city roads is a regular phenomenon. The daily ridership and percentage share, extracted and collated from the operational data of each system in January 2015 is provided in the Table 2-6:

[13] Ibid.

Table 2-6: Share of Public Transport systems in Mumbai

PT Systems	Daily Ridership	% Share
Suburban rail network	6.00	62.2%
BEST Buses	3.25	33.7%
Mumbai Metro	0.27	2.8%
Mumbai Monorail	0.12	1.2%
Total	**9.64**	**100.0%**

The role of existing suburban rail services is extremely important in the life of people of Greater Mumbai. The system carries about 6 million passengers every day and is complemented by the BEST (bus system) providing feeder services to many of its stations. The details of each of the public transport system is provided in the sub-sections that follow.

2.2.4.1 BEST

Brihan Mumbai Electric Supply and Transport (BEST) operates bus service in Mumbai which offers commuters an affordable public transport option in the city supporting about 3 million trips daily. BEST has fleet size of about 4000 buses which comprises CNG and Diesel fuel buses. BEST has routes covering all the parts of the Mumbai including to most of the suburban railway stations. BEST serves several feeder routes to the suburban railway services to and from the residential areas as well as business districts.[14]

2.2.4.2 Rail Transport: Suburban Rail Network

Mumbai is a good example of well-conceived suburban train lines which form the backbone of commuter's transport infrastructure currently supporting about 7.5 million trips daily. It is virtually the life line of the city and thus holds great importance in its development. The suburban system of Mumbai is being managed by Western Railway and Central Railway. The Western Railway line runs northwards from Church Gate terminus station in Island city along the west coast. The Central Railway line instead runs from CST situated very close to the Church Gate station and serves the central and eastern part of Mumbai. The harbour line connects the Western and the Central Lines. The present suburban network is shown in Figure 2-5[15].

[14] Source: Comprehensive Transportation Study for Mumbai Metropolitan Region, MMRDA (2008)
[15] Source: Techno-economic Feasibility Study for Personal Rapid Transit in Mumbai, MSRDC (2012)

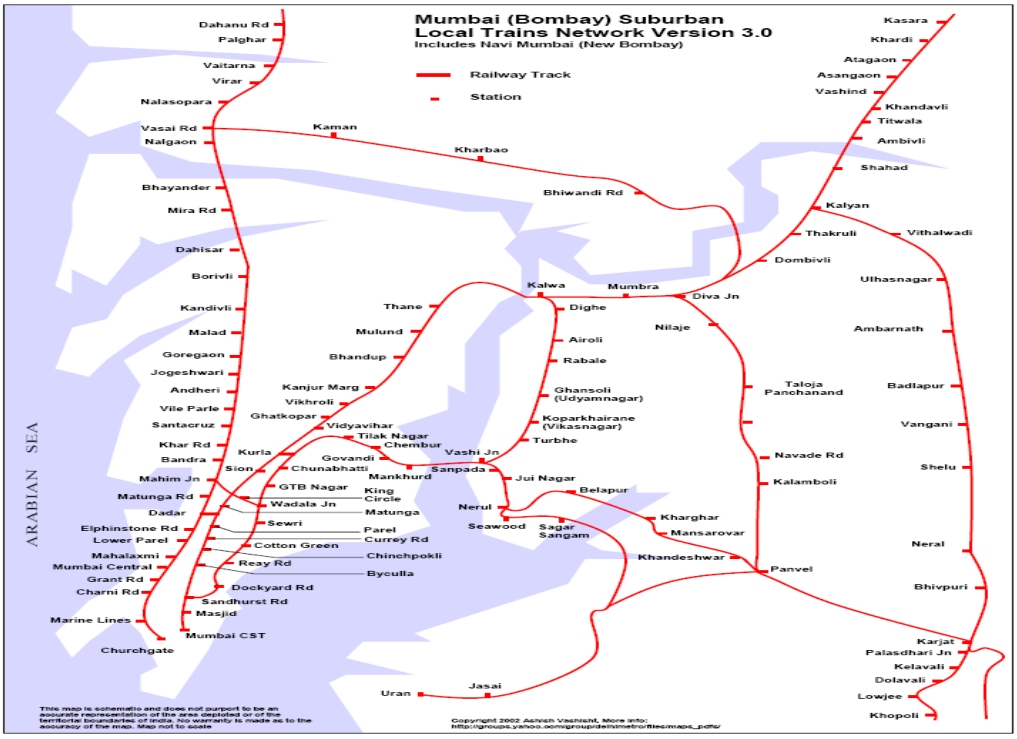


Figure 2-5: Suburban Rail Network

2.2.4.3 Mumbai Monorail

Mumbai Monorail is the first monorail in India and started operation in the year 2014. The first route that is operational is between Wadala Depot and Chembur, and has a route length of 8.93 km with 7 stations. Mumbai Monorail currently has an average daily ridership of about 16,000 passengers. Many parts of the city which are not connected by suburban rail system or Metro Rail are proposed to be connected by Monorail. The 11.2 km route from Wadala Depot to Gadge Maharaj Chowk/ Jacob's Circle is expected to be completed by December 2016. Mumbai Monorail routes have been presented in Figure 2-6[16].

[16] ibid

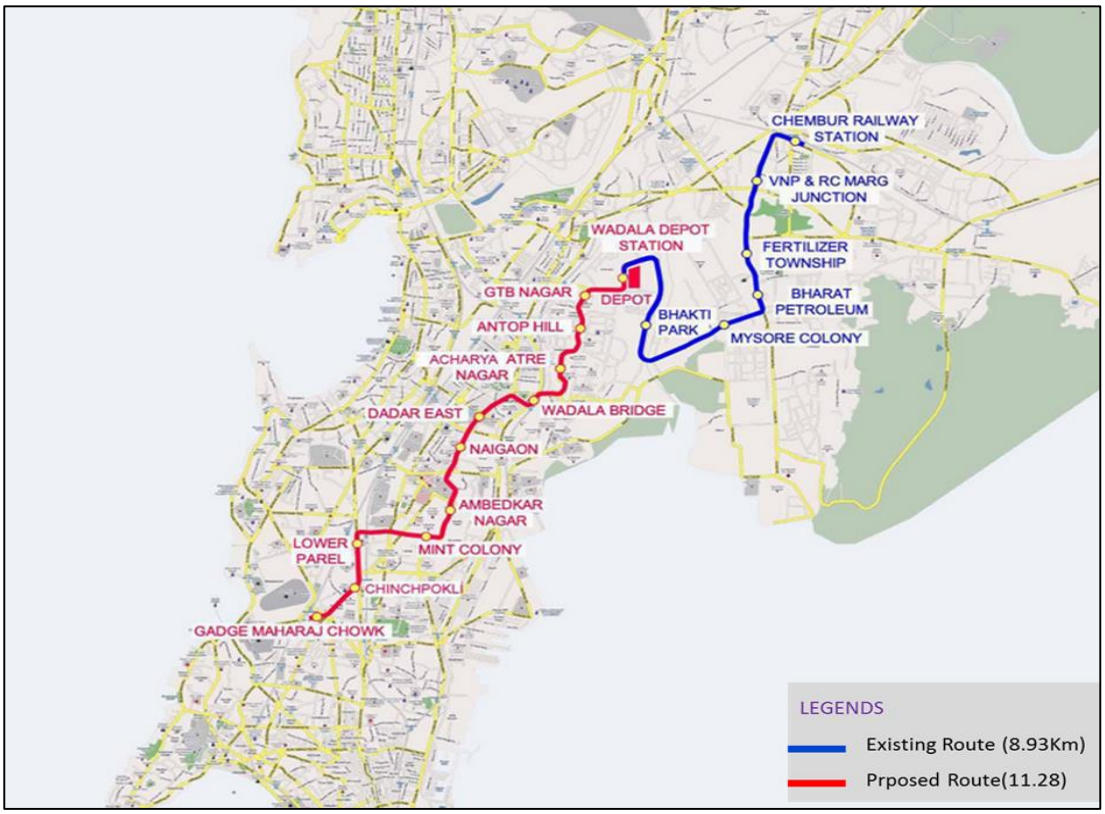


Figure 2-6: Mumbai Monorail Network

2.2.4.4 Mumbai Metro

In order to improve the traffic and transportation scenario in Mumbai, Government of Maharashtra (GoM) through MMRDA, has been exploring the viability of various alternative mass transit systems which are efficient, economically viable and environment friendly. DMRC (Delhi Metro Rail Corporation) that was engaged by MMRDA to prepare a master plan for Mumbai Metro has recommended various priority corridors from introduction of Metro Rail services. The GoM has declared the project as 'public vital infrastructure project' and designated MMRDA as Project Implementation Agency (PIA). The corridors identified in the Metro Master Plan and the influence area are presented in Figure 2-7[17]. The Metro line between Versova – Ghatkopar is operational since 2014 and has an average daily ridership of about 350,000 passengers. Work on remaining lines is under various stages of planning and/or implementation.

[17] Source: Mumbai Metro

Figure 2-7: Mumbai Metro Network

2.2.4.5 Operational Characteristics of Transport System

While Mumbai may be acknowledged as having one of the most extensive and efficient public transport network in India, its infrastructure is seen to be inadequate by world-class standards. It is not hard to conjure up images of traffic snarl-ups in the key arterial roads during peak hours, a desperate hunt for a parking spot and trains with people hanging out from all sides. To substantiate this with numbers: peak hour rail capacity averages more than 500 people per rail car on key sectors as against an capacity of 220 people per rail car compromising both comfort as well as safety of passengers. The major problem is inadequate transport capacity in the north-south direction creating severe congestion on the western and central railway lines and the key arterial roads (Western Express Highway SV Road).[18]

2.2.5 Transport Performance Indices

In accordance with the MoUD study (2008), transport performance indices were derived for variables such as public transport, congestion, walkability, safety, parking

[18] Source: Mumbai City Development Plan 2005-2025

and city bus supply and is presented in the Table 2-7[19]. For detailed description of indices, Annexure 4 may be referred.

Table 2-7: Transport Performance Indices

Index	Value	Remarks
Public Transport Accessibility Index	1.34	This index represents the availability of public transport within 500 m. Higher the value, better is the accessibility. Mumbai has a value higher than the national average of 1.2. This may be due to availability of a good public transport network in Mumbai.
Congestion Index	0.47	Lower the value, better the speed. Value for Mumbai is higher than the national average of 0.25
Walkability Index	0.85	Higher value shows better network and facilities for pedestrians. Mumbai has one of the highest value for Indian cities. Average value for Indian cities is 0.52. As compared to foreign cities, this is low. London has walkability index of 1.5.
City Bus Transport Supply Index	16.7	Higher value refers to better bus supply. Value is higher than the national average of 10.4. Public transport need for Mumbai is largely served by the efficient commuter rail system.
Safety Index (1/Fatality per lac)	0.25	Higher value shows better safety. Value is higher than the national average of 0.10
Para Transit Index – index for Intermediate Public Transport (IPT); mainly refers to Auto-Rickshaws	88.3	This shows the number of para transit vehicles for 10,000 population. Index is high when compared to other cities in India. Higher value shows better service.
Slow Moving Vehicle Index	0.03	Indicates lack of slow moving vehicle facilities. Higher value refers to better facilities. Value lower than the national average of 0.07.
On- Street Parking Interference Index (1/% of on-street parking on road length)	2.8	High value refers to better on-street parking management. Value, much higher than national average of 1.3.

[19] Source: Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, MoUD, GoI (2008)

Index	Value	Remarks
		This may be due to better on-street parking management, strict enforcement and availability of off-street parking facilities in Mumbai.

The above indices represent the efficiency of the transport system. According to this study, transport performance indices of Mumbai are above national average when compared to transport performance indices of other 30 cities in India given under the referred study. The reason identified were high use of suburban rail network by public and better transport strategies.

2.3 Road Network Characteristics

2.3.1 City Road Network

The road network in Mumbai is developed on the north-south alignment. This follows the development of the Island city in the earlier decades as an employment area and the northern suburbs as residential areas. The transportation corridors have, therefore, evolved as longitudinal routes through Greater Mumbai and very few east-west connectivity routes were initially developed. As the city started to expand in the suburban areas to the north and to the east of Island city, severe congestion was experienced at a number of places. As the growth of the suburbs became more significant, the need for development and strengthening of east-west linkages was recognised and several projects are now being implemented. The road network of Mumbai is shown in Figure 2-8.

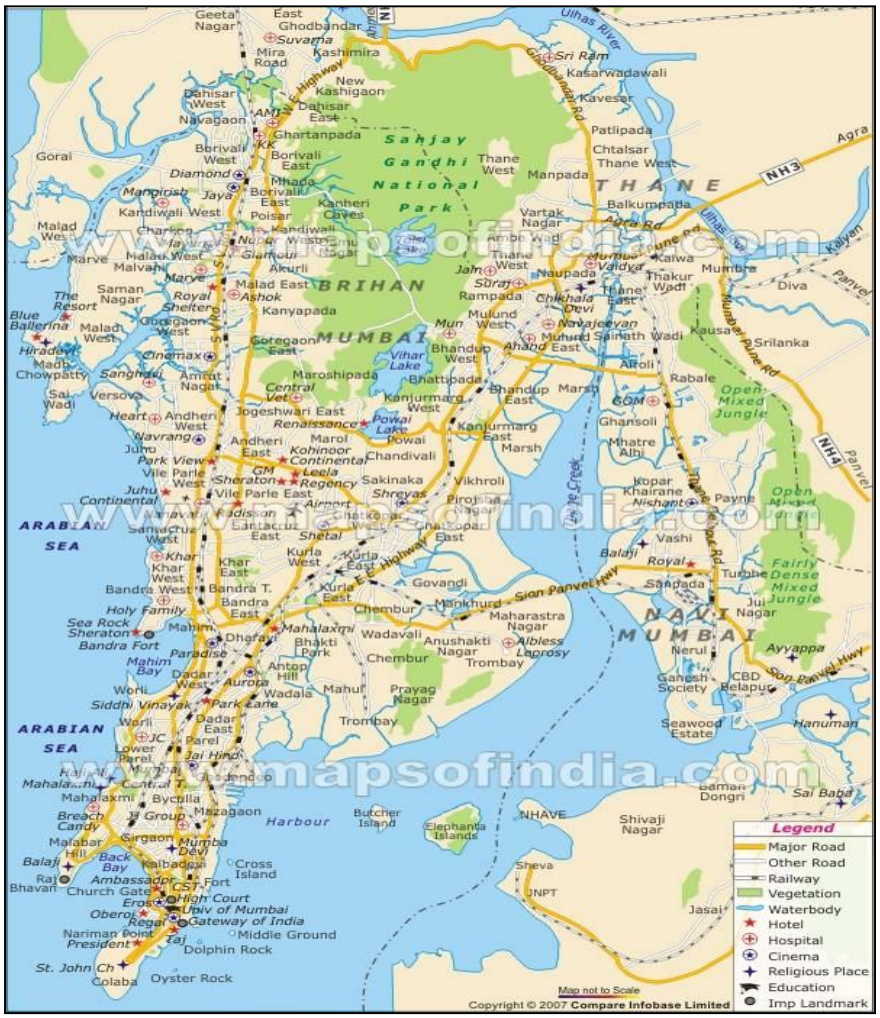


Figure 2-8: Mumbai Road Network

At regional level, traffic from the north through the NH-8 (Ahmedabad – Mumbai), north-east through the NH-3 (Indore-Nashik-Mumbai), south-east through the NH-4 and Mumbai – Pune Expressway and south via the NH-17 (Mumbai – Goa) enter/ exit at the outskirts of the city and get connected to the city road network. At city level there are three express highways in Mumbai serve as main arterial roads starting from Island city: the Western Express Highway (WEH), the Eastern Express Highway (EEH) and the Sion Panvel Express Highway. Besides these, Linking Road, Swami Vivekanand (SV) Road and Lal Bahadur Shastri (LBS) Marg run along the north-south alignment. The Eastern and Western Expressways are the most important corridors within this network both in terms of service area and traffic intensity. There are few, often in poor condition, cross connectors between these longitudinal corridors. The network configuration is such that there is a trend towards concentration of traffic along these few corridors.

2.3.2 Carriageway Width and Configuration

About 26% of the road network in Mumbai has two lane undivided carriageway, 21% has three lane undivided carriageway, 19% has six lane divided carriageway and about

12% of the road network has four lane divided carriageway. The carriage way width and configuration of the road network has been presented in Table 2-8:

Table 2-8: Distribution of Roads Based on Carriageway Configuration

Road Type	Greater Mumbai (%)
Single and Intermediate lane	1.66
Two lane undivided	26.72
Three lane undivided	21.78
Two lane divided	7.87
Four lane divided	12.21
Six lane divided	19.08
Eight lane and above divided	10.69
Total	**100.00**

2.4 Travel Demand Forecast

In accordance with the MoUD study (2008), the travel demand forecast for private vehicles, public transport and non-motorised trips in Mumbai is estimated to be the following (Table 2-9 [20]).

Table 2-9: Travel Demand Forecast

Mode	Horizon Year Trips/Day					
	2011		2021		2031	
	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage
PV+ IPT (In Nos.)	153.95	38.6	250.64	46.69	351.78	51.11
PT (In Nos.)	115.96	29.1	116.24	21.65	122.87	17.85
NMT (In Nos.)	128.7	32.3	169.92	31.66	213.56	31.03

From the table above, it is observed that the estimated share of private vehicle trips is projected to increase with respect to time, whereas the share of public transport and NMT trips are projected to decrease. Higher share of private vehicles in future is an issue as it may further aggravate the traffic congestion currently experienced by the city. In view of this, technological and policy level interventions are required for

[20] Source: Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, MoUD, GoI (2008)

improving the public transport, reducing congestion, and mitigating the harmful environmental impacts.

In order to cater to the increased demand for transportation and mobility, Comprehensive Transport Study (CTS) for Mumbai[21] has identified several interventions and proposals. Some of the key interventions proposed in the CTS are listed below:

- 17 Inter-State/ Inter-City Bus Terminals
- 6 Inter-City Rail Terminals
- 5 Major Truck Terminals
- 10 Mini Truck Terminals
- 13 Passenger Water Transport (PWT) Terminals
- Bus Rapid Transit/ EBL/ Monorail
- Multi-Modal Corridors
- Metro System
- Suburban Railway System

Approximate capital cost for implementing the proposals has been estimated at about Rs. 2,07,956 Crores.

2.5 Conclusion and Need Assessment

Based on the analysis of city characteristics, the following points emerge:

1. **Traffic Congestion:** The number of vehicles in Mumbai are increasing at a rate higher than the road network expansion. This has created congestion on the city roads and accordingly the average speed of vehicles on the city roads has slowed down. Vehicle composition indicates that the majority of registered vehicles are two wheelers (56 per cent) and cars & jeeps (34 per cent) in 2011. High number of two wheelers and cars is the major contributor to congestion on roads. Geographical constraints have limited the road network expansion in line with the increased travel demand resulting in congestion on roads.

   National Urban Transport Helpline (NUTH) is intended to help individuals make more informed travel decisions, and thereby moderate the effects of traffic congestion on themselves as well as on other travellers. NUTH will provide traffic related information e.g. congestion on roads, alternate routes, construction and maintenance activity, incident information. This information would help users take alternate route and save time. This would lead to reducing pressure on congested route and also lead to increased efficiency in utilisation of transportation assets in Mumbai.

2. **Travel Demand:** Population, economic growth, number of registered motor vehicles and traffic levels all show an increasing trend in the city. These indicators clearly highlight the trend towards growing travel demand in the city due to the changing profile of the city. This supports the need to put in place information dissemination system like NUTH which can disseminate traveller information such

[21] Source: Comprehensive Transportation Study for Mumbai Metropolitan Region, MMRDA (2008)

as congestion on routes, details of transit routes, schedules, fares, expected time of arrival of transit, running status, multi-modal trip planning, etc.

3. **Modal Share:** According to the CTS Mumbai study, 2008 the public transportation share in Mumbai is 45%. These figures reflect high use of public transportation.

   NUTH will cater to both, the users of public transport as well as private vehicles, as it will disseminate both transit and traffic information. Transit information will cover Estimated Time of Arrival (ETA), real time running status of transit, transit routes etc. This will help in increasing the reliability of public transport which will also lead to increase in use of public transport.

4. **Trip Rate:** The per capita trip rate for Mumbai is increasing due to socio-economic factors, higher number of work trips, education trips and recreational trips. Higher trip rate would lead to increased demand for transport and consequent congestion on roads. NUTH will support in making travel more informed by providing traffic and transit information.

5. **Public Transport Information Dissemination System:** The information regarding schedules and routes of public transport services is mostly fragmented and scattered across various sources which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. There is a need to have public information dissemination system for the commuters which can provide information regarding the public transport routes, traffic congestion on the roads, schedule of public transport systems etc. An effective public transport information dissemination system would enable potential users to plan multi-modal journeys, minimise wait times at stations, and increase the overall satisfaction with the public transport and help in catalysing its adoption.

6. **Integration of Transport Modes:** There is a need to have an information dissemination system such as NUTH that would provide a unified view of all public transport modes to the public and help in planning multi-modal journeys.

2.6 Project Benefits

Mumbai NUTH will have multiple benefits for the users as provided in Table 2-10:

Table 2-10: NUTH Benefits

Information Dissemination	Benefits
Transit information dissemination	• **Receive** transit related information through various channels such as phones, mobile apps, web-portal etc. for various modes of transport from a single source. • **Decide** on the most suitable transit mode(s) and routes for travel. • **Avoid** waiting time at transit stops, stations and terminals • **Improve** the reliability of access to public transport

Information Dissemination	Benefits
	• **Enhance** travelling experience and quality of life
Traffic information dissemination	• **Receive** traffic information through various channels such as phones, mobile apps, web-portal etc. • **Decide** on the most suitable route for travel • **Avoid** congested routes • **Improve** journey time reliability • **Enhance** travelling experience and quality of life
Incident/ Construction and maintenance information dissemination	• **Receive** incident information through various channels such as phones, mobile apps, web-portal etc. • **Decide** on the routes taking into consideration the incident/ construction information. • **Avoid routes** where incident/ construction are reported. • **Improve** journey time reliability by avoiding routes where incidents/ construction are reported. • **Reducing** the chances of congestion by receiving information regarding incidents/ construction
Parking information	• **Receive** parking information through various channels such as phones, mobile apps, web-portal etc. • **Decide** the parking location based on the distance/convenience • **Avoid** undesired movements in finding parking space/site • **Improve** travel and parking experience, saving in time and effort • **Reduce** unnecessary trips and relieve congestion on road

Some of the other benefits of Mumbai NUTH are given below:

- **Unified System for Urban Transport Information System:** Mumbai NUTH would be a unified platform that would be accessible to public through multiple channels for providing all urban transport related information including the traffic, transit and parking related information.
- **Multi-Modal Information Dissemination System:** Presently various transit agencies disseminate transit information through their respective channels for

their respective modes (e.g. BEST, Mumbai Suburban Railways, Mumbai Metro, Mumbai Monorail) only. Information regarding the schedules and routes of public transport services in Mumbai is mostly fragmented and scattered across various sources which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. NUTH would act as a single dissemination system from where users/general public can see information about multiples transportation modes in the city.

- **Reducing Traffic Congestion:** National Urban Transport Helpline (NUTH) would help individuals make more informed travel decisions thereby help in moderating the effects of traffic congestion on the road network. NUTH will provide information such as congestion on roads, alternate routes, construction and maintenance activity, incident information etc. Such information would help users in taking alternate routes leading to preventing not just congestion from aggravating but also supporting in efficient utilisation of the transport infrastructure.
- **Improvement in Public Transport Modal Share:** NUTH will disseminate transit and traffic related information. Transit information will cover routes and schedules for various transit modes, Estimated Time of Arrival (ETA), real time running status, transit routes, among others. This would help in increasing the reliability of time taken for travel while using public transport and would help in attracting public to shift to public transport leading to its enhanced share in overall transport trips.

3.0 REVIEW OF TRAFFIC AND TRANSIT ITS INITIATIVES

3.1 ITS Background and Initiatives

Sections that follow contain brief details of some of the key traffic and transit information dissemination related initiatives implemented and/or planned in Mumbai that are of relevance to the proposed Mumbai NUTH.

3.2 Traffic Related Information Dissemination Systems

Mumbai city is one of the early adopters of technology in monitoring and control of traffic signals from a central control room at a large scale. As part of Mumbai Area Traffic Control project, in 2011, Intelligent Traffic Adaptive Control Area (ITACA) system was implemented. There are several traffic information dissemination initiatives that have been undertaken in Mumbai as listed below and also summarised in Table 3-1:

3.2.1 Mumbai Traffic Police

1. **Website:** Mumbai Traffic Police have a website https://trafficpolicemumbai.maharashtra.gov.in/index.htm (Figure 3-1) to provide traffic bulletin, notifications, press releases, registering complaints against auto rickshaws and taxis, tariff details related to auto rickshaws and taxis, details of offences and penalties, contact numbers and email ID.

Figure 3-1: Mumbai Traffic Police Website

2. **Phone Helpline:** Mumbai Police have toll free number (1800-22-0110) to register any complaints against taxi and auto rickshaw drivers refusing to ferry. Any other issues can also be reported to Traffic Police through this number.

3. **Email Alerts:** Mumbai Traffic Police are providing email alerts to those who have registered with the Traffic Police for receiving traffic updates through email.

3.2.2 Municipal Corporation of Greater Mumbai

1. **Mumbai Area Traffic Control Project**

With a view to provide traffic related messages and updates to the commuters, Mumbai Traffic Police have installed about 39 electronic messaging boards or Variable Message Signs (VMSs) at various strategic locations in the city. These boards are connected to the Traffic Control Room from where messages and information regarding congestion, bottlenecks, diversion etc. are displayed on these boards. The objective of the system is to keep motorists informed and to assist them in taking decisions regarding their travel with a view to achieve effective traffic management.

Table 3-1 summarises the details of traffic related information dissemination that have been implemented and/or are under planning/ implementation in Mumbai.

Table 3-1: Mumbai – Traffic Related ITS Initiatives

ITS	Description	Status/ Relevance to Mumbai NUTH
Traffic Information Dissemination: Website (Mumbai Traffic Police)	• Traffic related information dissemination • Rules and regulations • Details of helpline • Web pages available in Marathi and English	• Implemented and operational • Mumbai NUTH can receive traffic related information from Mumbai Traffic Police
Traffic Information Dissemination: Phone Helpline (Mumbai Traffic Police) Number: 1800-22-0110	• Only for registering complaints	• Implemented and operational.
Traffic Information Dissemination: Email Alerts (Mumbai Traffic Police)	• Traffic information like congestion, diversion etc.	• Implemented and operational. • Mumbai NUTH can receive available traffic information from Mumbai Traffic Police
Mumbai Area Traffic Control Project (MCGM)	• Signal monitoring from control room • Adaptive signals on 255 junctions	• Implemented and operational. • Traffic information is currently available and can be used for

ITS	Description	Status/ Relevance to Mumbai NUTH
	• Overhead traffic detection cameras • Traffic Police Control Room at Traffic Police HQ with operator consoles, video walls, servers, applications etc. • Satellite information centre at MCGM office to monitor the equipment status	dissemination to public by Mumbai NUTH

3.3 Transit Information Dissemination Systems

3.3.1 Brihan-Mumbai Electric Supply and Transport Undertaking (BEST)

1. **Website:** BEST disseminates information through its website http://www.bestundertaking.com (Figure 3-2) information being disseminated includes and static information like buses between two area, bus routes and time table, priority buses through hospital, airport. Different services like normal, elite etc.

Figure 3-2: BEST, Mumbai Website

2. **Phone Helpline:** There is one phone based helpline of BEST (1800-22-7550) for providing general bus operation related information. This number is toll free and receives on an average about 700-1000 calls in a month.

3. **Mobile Applications:** Information being disseminated includes expected arrival time of BEST buses at bus stops and static information like routes and bus stops on routes (Figure 3-3).

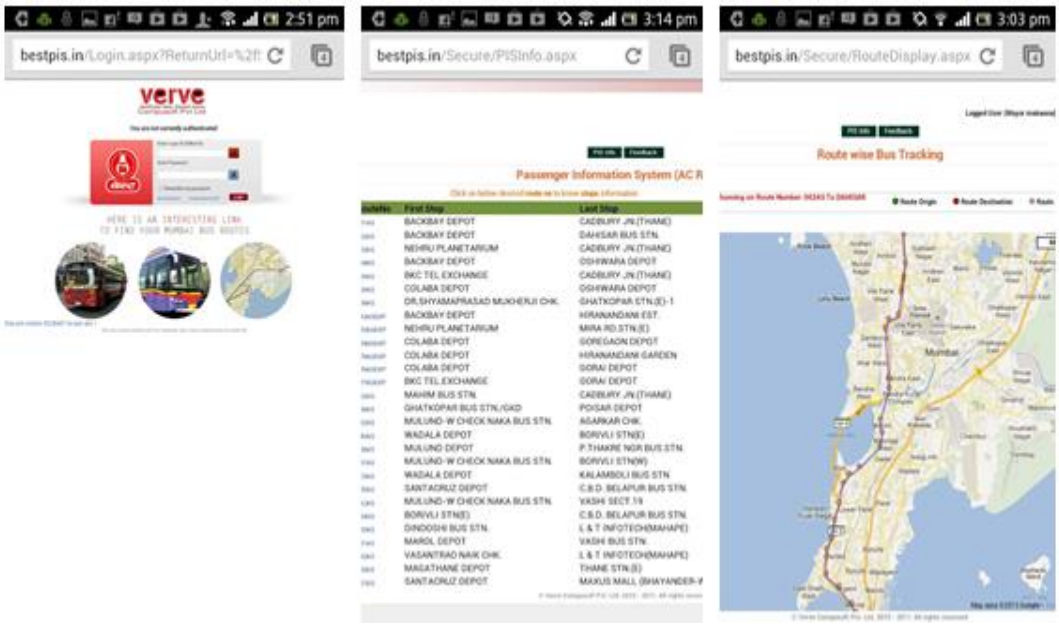


Figure 3-3: BEST, Mumbai Android Mobile App

4. **Best PIS Website:** BEST also has another website http://www.bestpis.in (Figure 3-4) to provide information related to the bus services being operated by it to users registered on the website. The information being disseminated through the site includes static as well as dynamic information such as details of bus stops on various routes, viewing the bus routes on the map, Estimated Time of Arrival (ETA) of buses at various bus stops etc.

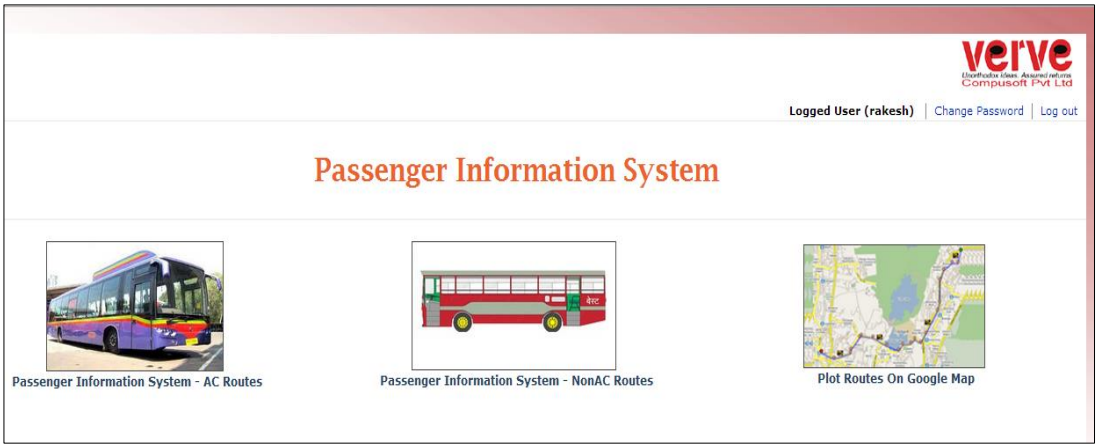


Figure 3-4: BEST PIS Website

5. **BEST SMS Service:** BEST has SMS (56677) service, user can get information about bus route, helpline, online bus tracking and other smart card status, pass registration and pass renewal.

3.3.2 Suburban Railways

1. **Western and Central Railway Website:** Western Railway and Central Railway have set up their respective websites (Figure 3-5, http://wr.indianrailways.gov.in/view_section.jsp?lang=0&id=0,6 and Figure 3-6, http://www.cr.indianrailways.gov.in/) to provide route, time table, services, fare, season ticket and other information related to the suburban rail services being operated by them.

Figure 3-5: Western Railway, Mumbai Suburban Website

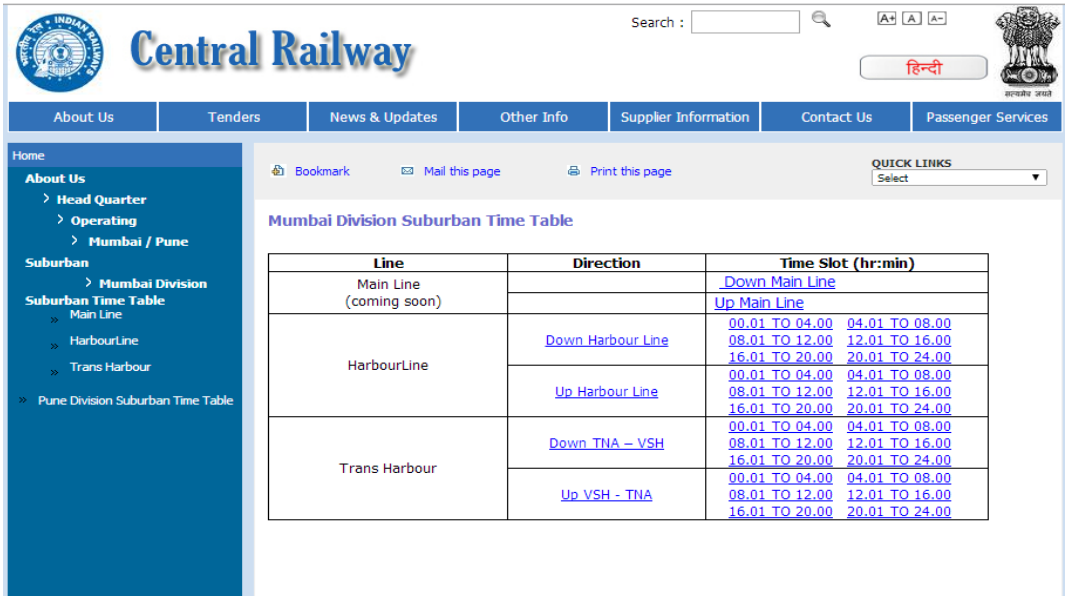
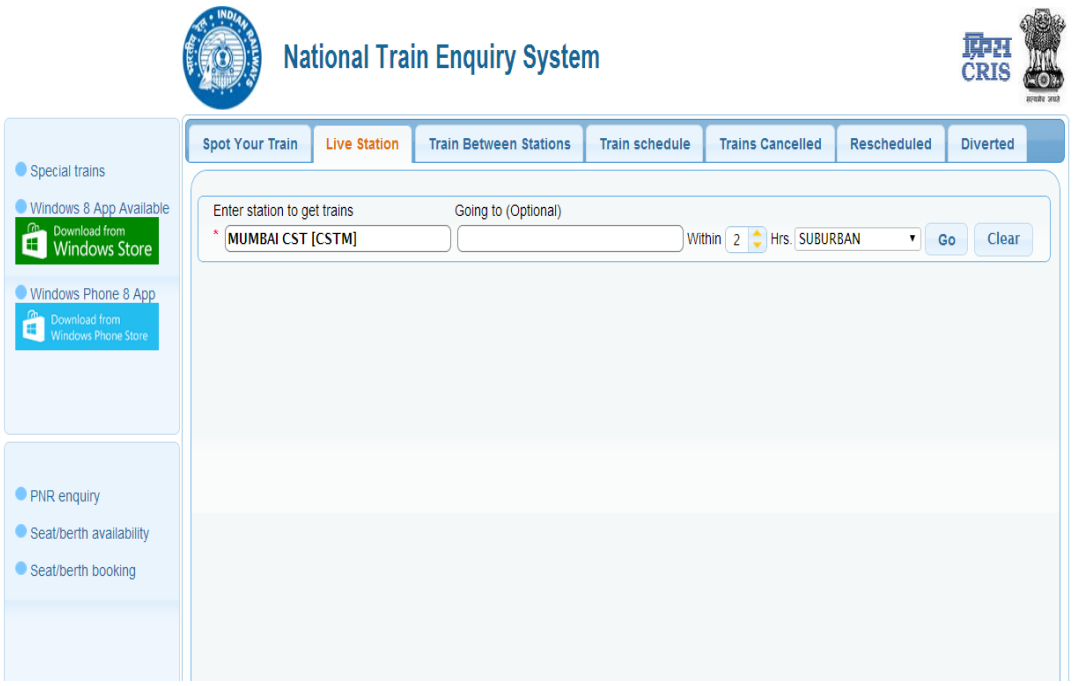


Figure 3-6: Central Railway, Mumbai Suburban Website

2. **National Train Enquiry System (NTES) Website:** Figure 3-7 shows the home page of National Train Enquiry System of Indian Railways (http://enquiry.indianrail.gov.in/ntes/). The information being disseminated through the website is train details, departures scheduled at any station up to next 8 hours, trains between any pair of stations, train schedule, trains cancelled, train

rescheduled, trains diverted, special trains, running status of trains etc. The site also provides information related to running status of suburban trains operated by the Central Railway and Western Railways.



Train K87 [95723] started MUMBAI CST on 19 May

	Station	Sch Day	Sch Arr	Sch Dep	ETA/ ATA	Delay	ETD/ ATD	Delay	Distance	PF
1.	MUMBAI CST(CSTM)	1		17:22			17:26	4 min	0	
2.	BYCULLA(BY)	1	17:29	17:30	17:32	3 min	17:33	3 min	5	
3.	DADAR(DR)	1	17:35	17:36	17:38*	3 min*	17:39*	3 min*	9	
4.	KURLA JN(CLA)	1	17:43	17:44	17:46*	3 min*	17:47*	3 min*	16	
5.	GHAT KOPAR(GC)	1	17:47	17:48	17:50*	3 min*	17:51*	3 min*	20	
6.	MULUND(MLND)	1	17:57	17:58	18:00*	3 min*	18:01*	3 min*	31	
7.	THANE(TNA)	1	18:02	18:03	18:05*	3 min*	18:06*	3 min*	34	
8.	KALVA(KLVA)	1	18:06	18:07	18:09*	3 min*	18:10*	3 min*	36	
9.	MUMBRA(MBQ)	1	18:12	18:13	18:15*	3 min*	18:16*	3 min*	40	
10.	DIVA(DIVA)	1	18:16	18:17	18:19*	3 min*	18:20*	3 min*	43	
11.	KOPAR ROAD(KOPR)	1	18:21	18:22	18:24*	3 min*	18:25*	3 min*	47	
12.	DOMBIVIL(DI)	1	18:24	18:25	18:27*	3 min*	18:28*	3 min*	49	
13.	THAKURLI(THK)	1	18:27	18:28	18:30*	3 min*	18:31*	3 min*	50	
14.	KALYAN JN(KYN)	1	18:34		18:37*	3 min*			54	

Figure 3-7: National Train Enquiry System website, Indian Railways

3. **NTES Mobile App:** This app (Figure 3-8) provides information like spot your train, live station, real time train arrival and departure, train schedule etc. It is available for Android, Windows, and iOS mobile operating systems.

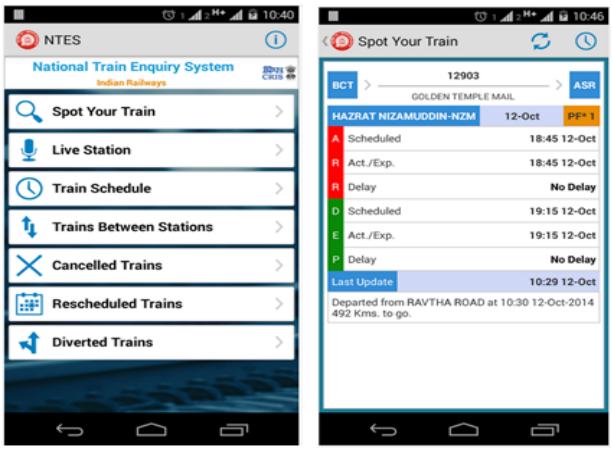


Figure 3-8: National Train Enquiry System (NTES) Mobile Application, Indian Railways

4. **139 Phone Helpline:** Railways has a helpline number 139 through which users can enquire about expected time of arrival of train, trains between stations, delays, service disruption including through live operator assistance.

3.3.3 Mumbai Monorail and Metro Rail

1. **Monorail Website:** Mumbai Monorail presently has no website.

2. **Mumbai Metro Rail Website:** Mumbai Metro Rail has a website (http://www.reliancemumbaimetro.com) that disseminates information such as route details, station details, route map, fare details, feeder bus details, parking (facility area, charges), time table, trip planner, commuter guides / brochures, public notices, helpline details (+91-22-30310900), e-mail address etc. (Figure 3-9).

Figure 3-9: Mumbai Metro Website

3. **Metro Rail Helpline:** Metro Rail has a helpline number +91-22-30310900. Users can enquire about services and related matters by calling on the helpline number.

3.3.4 Summary of Transit Information Dissemination Systems in Mumbai

All transit agencies in Mumbai have introduced some form of information dissemination systems related to their respective operations and services. An overview of Transit related information dissemination systems has been provided in Table 3-2 together with their relevance for Mumbai NUTH.

Table 3-2: Mumbai – Transit Related ITS Initiatives

ITS	Description	Status
Transit Information Dissemination – Website (BEST) Website address: http://www.bestundertaking.com/transport/route.asp	• Route details • Service details • Fare details • Pass details • Telephone helpline details	• Static/dynamic information available • The information would be made available by BEST to NUTH through interfaces for dissemination to public
Transit Information Dissemination: Through SMS (BEST) Number : 56677	• Next bus arrival time at bus stops for AC/some other buses	• Implemented and operational • The information would be made available by BEST to NUTH through interfaces for dissemination to public
Transit Information Dissemination: PIS website (BEST) Website address: http://www.bestpis.in/	• Bus stops on various routes • viewing the bus routes on the map, • Estimated time of arrival (ETA) of bus at various bus stops etc. • Bus route	• Implemented and operational • The information would be made available by BEST to NUTH through interfaces for dissemination to public
Transit Information Dissemination: Mobile application (BEST) Link to download app: http://www.bestpis.in/	• Bus stops on various routes • viewing the bus routes on the map, • Estimated time of arrival (ETA) of bus at various bus stops etc.	• Implemented and operational • The information would be made available by BEST to NUTH through interfaces for dissemination to public
Transit Information Dissemination – Website (Suburban Rail) Website address:	• Website (Western and Central Railway) • Route details • Route map • Time table	• Implemented and operational • The information would be made available by these agencies to

ITS	Description	Status
http://wr.indianrailways.gov.in/view_section.jsp?lang=0&id=0,6 http://www.cr.indianrailways.gov.in/		NUTH through interfaces for dissemination to public
Transit Information Dissemination: National train enquiry system Website/Mobile App (Indian Railways) Address: http://enquiry.indianrail.gov.in/ntes/	• Dynamic Information • Train timings • Train Delay • Train Location • Expected arrival time • Expected departure time • Live station information etc.	• Implemented and operational • The information would be made available by Railways to NUTH through interfaces for dissemination to public
Transit Information: Phone Helpline- (Indian Railways) Number: 139	• Dynamic Information • Train timings • Train Delay • Train Location • Expected arrival time • Expected departure time • Live operator assistance.	• Implemented and operational • The information would be made available by Railways to NUTH through interfaces for dissemination to public
Transit Information Dissemination – Website (Mumbai Metro Rail) http://www.reliancemumbaimetro.com/fares.html	• Route details • Station details • Interactive route map • Fares • Feeder bus • Parking (facility area, charges) • Metro timing • Time table • Trip Planner • Commuter guides / brochures • Public notices • Helpline (+91-22-30310900), e-mail address	• Implemented and operational • The information would be made available by Mumbai Metro to NUTH through interfaces for dissemination to public

3.4 Transit and Traffic Information Dissemination Systems in Mumbai

Most of the transit/ traffic agencies in Mumbai have made efforts towards implementing transit/traffic information dissemination systems. Monorail system which has commenced operation in February 2014 does not yet have a website, mobile phone

application or a helpline number. Table 3-3 provides a summary containing the status of implementation of transit and traffic information dissemination systems in Mumbai.

Table 3-3: Transit and Traffic Information Dissemination Systems in Mumbai

ITS Application	BEST	Western Railway	Central Railway	Mumbai Traffic Police	Mumbai Monorail	Mumbai Metro Rail
Transport Modes						
Bus	Y					
Suburban Rail		Y	Y			
Road transport				Y		
Metro/Monorail					Y	Y
Information Dissemination Channels						
Website: Static info	Y	Y	Y	Y		Y
Website: Live info	Y	Y	Y			
Mobile App	Y	Y	Y			
Phone Helpline	Y	Y	Y	Y		Y
SMS	Y					Y
Social Media						Y
Traffic Information						
Road network map	N.A.	N.A.	N.A	Y	N.A	N.A
Congestion map				Y		
Route Planner				Y		
Road closures						
Road diversions						
Traffic Incidents/ Events						
Construction and Maintenance						
CCTV Camera feeds						

ITS Application	BEST	Western Railway	Central Railway	Mumbai Traffic Police	Mumbai Monorail	Mumbai Metro Rail
Parking Information						
Bicycle Routes, Park and Ride Lots and Carpool/ Vanpool Information						
Variable Message sign				Y		
Transit Information						
Services	Y	Y	Y	N.A.		Y
Schedules	Y	Y	Y			Y
Route Map	Y	Y	Y			Y
Fare	Y	Y				Y
Pass/card details	Y	Y				Y
Distance		Y	Y			Y
Travel time		Y	Y			
Real time departure		Y	Y			
Transit tracker	Y		Y			
Live news: disruptions, delays, closures etc.		Y	Y			
Info on GIS map	Y					
Transit Trip Planner						
Single mode	Y	Y	Y	N.A.		
Multi-modal						
Based on static data	y	Y	Y			
Based on live conditions	Y	Y	Y			

ITS Application	BEST	Western Railway	Central Railway	Mumbai Traffic Police	Mumbai Monorail	Mumbai Metro Rail
Options: fastest, least transfer/ cost/ time/ walk etc.						

3.5 Stakeholders Inputs

Minutes of the meeting, participant suggestions during workshops and data collected from MCGM, BEST, Western Railways, and Central Railways are provided in Annexure 1(A), Annexure 1(B), Annexure 1(C), Annexure 1(D), Annexure 1I and Annexure 1(F).

3.6 Conclusions

Based on the review of ITS initiatives and stakeholder inputs, following conclusions can be drawn:

- BEST has a website, a PIS website, and mobile apps that disseminate static and dynamic information like bus route, bus schedule, bus stops on GIS maps, expected time of arrival at bus stops etc. Mumbai NUTH can get available information from BEST through suitable interfaces.
- Mumbai suburban railway disseminates static information like route, schedule etc. Indian Railways disseminate static information like route, schedule etc. as well as dynamic information like Estimated Time of Arrival (ETA) and Estimated Time of Departure (ETD), Service disruption on its National Train Enquiry System (NTES) mobile application and NTES website.
- Mumbai Monorail has no website currently and Mumbai Metro Rail has a website which disseminates only static transit information like route map, fare details, station information, schedule etc.
- MCGM traffic control centre has capability to capture traffic information such as vehicle volume. Currently they are providing some of the traffic information such as congested routes on Variable Message Signs (VMSs) to public. Mumbai NUTH can get available information from MCGM through suitable interfaces.
- Presently various transit agencies disseminate transit related information through their respective channels for their respective modes (e.g. BEST, Mumbai Suburban Railways, Mumbai Metro, Mumbai Monorail) only. Information regarding the schedules and routes of public transport services in Mumbai is mostly fragmented and scattered across various sources which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. NUTH would act as a single information dissemination system from where users/general public can see information about all modes of transportation in the city.

- Based on the above, there is clearly a need to establish a centralised traveller information system i.e. NUTH that will collect data/information from various agencies by developing suitable interfaces, process and then disseminate suitable information to public.

4.0 PROPOSED PROJECT CONCEPT

4.1 Introduction

The National Urban Transport Helpline (NUTH) is expected to be the information access system of choice related to the urban transportation infrastructure, facilities and services in Mumbai. NUTH would collect, process and thereupon disseminate transit, traffic, parking, construction related information, incident information to public and other stakeholders. NUTH would be used by public to plan their travel, and obtain real-time transit/traffic information, and by agencies to bring about an improvement in system performance based on the feedback received. NUTH is also expected to help agencies to undertake coordinated planning to support the travel needs of the public.

4.2 Goals and Objectives

Mumbai NUTH will be set up with the objectives set out below:

- Dissemination of transit, traffic and other relevant information that support public in making informed travel decisions. These would include:
  - Providing static and dynamic transit related information. (refer Section 4.5.1 for details)
  - Providing static and dynamic traffic related information. (refer Section 4.5.2 for details)
  - Providing static and dynamic parking related information. (refer Section 4.5.3 for details)
  - Providing construction and maintenance related information (refer Section 4.5.4 for details)
  - Providing weather related information(refer Section 4.5.5 for details)
  - Providing incident/events related information(refer Section 4.5.6 for details)
  - Providing multi-modal trip planners to find out shortest route, cheapest journey, inclusion or exclusion of certain modes, least walk etc. (refer Section 4.5.7 for further detail)
  - Providing information through phone helpline, website, mobile applications, and social media.
- Supporting intermodal coordination among transit agencies
- Augmenting use of public transport
- Supporting the activities that promote environment and ecological aspects.
- Supporting the activities that can reduce congestion and lead to time-saving for commuters

4.3 Project Area

Mumbai and its surrounding areas constitute the Mumbai Metropolitan Region (MMR). Besides Mumbai's residents, people from neighbouring cities such as Thane, Navi Mumbai, Kalyan, Dombivali, Vasai, Virar, Mira-Bhayanadar, Bhiwandi and Ulhasnagar travel to Mumbai for work, educational and recreational purposes adding to the traffic in Mumbai. As there is considerable movement of people between Mumbai and the nearby MMR cities, a number of options emerge (Table 4-1) as regards coverage of project area for the NUTH.

Table 4-1: Mumbai NUTH: Project Area Options

Option	Project Area	Description
1	Mumbai	MCGM area
2	Mumbai + other municipal corporation areas in the Mumbai Metropolitan Region (MMR)	Mumbai, Thane, Navi Mumbai, Kalyan, Dombivali, Vasai, Virar, Mira-Bhayanadar, Bhiwandi and Ulhasnagar
3	Mumbai Metropolitan Region (MMR)	Entire MMR area

There is a need to have multi-modal / multi-agency NUTH system for the entire MMR. However, in view of the complexities involved due to multiple agencies, authorities, geographical spread and administrative issues, it is recommended that NUTH for MMR be implemented in a phased manner. In order to expedite implementation of NUTH, the proposed project area for Phase-1 of the NUTH is recommended to be Mumbai. In Phase-2, adjacent cities such as Thane, Navi Mumbai, Kalyan, Dombivali, Vasai, Virar, Mira-Bhayanadar, Bhiwandi and Ulhasnagar could be added. In Phase-3, other areas of the MMR could be progressively added. The remainder of this report deals with Phase-1 i.e. NUTH for Mumbai.

4.4 Project Phasing

Mumbai Metropolitan Region (MMR) comprises cities and areas with varying levels of urbanisation, public transport coverage and facilities. The transit and traffic agencies for various cities/areas are also under the purview of the State / respective local governments. In view of this, it is recommended that NUTH be introduced in phases for the MMR as set out in Table 4-2.

Table 4-2: NUTH: Implementation Phasing

Parameter	Phase-1 (2 years)	Phase-2 (2-4 years)	Phase-3 (4-6 years)
NUTH Area	Greater Mumbai*	All municipal corporation areas in MMR	Entire MMR
Transit Information	Static/dynamic /or both information (as available) ○ BEST ○ Suburban rail services (Western Railway) ○ Suburban rail services (Central Railway) ○ Mumbai Monorail ○ Mumbai Metro Rail	Dynamic information ○ Phase -1 ○ Thane Municipal Transport (TMT) ○ Navi Mumbai Municipal Transport (NMMT) ○ Mira-Bhayandar Municipal Transport (MBMT) ○ Kalyan-Dombivali Municipal Transport (KDMT) ○ Vasai-Virar Municipal Transport (VVMT) ○ Ulhasnagar Municipal Transport (UMT)	Dynamic information ○ Phase-2 ○ Addition of other services as they get launched
Traffic Information	Available dynamic information to be integrated in Phase-1 ○ Mumbai Traffic Police	Dynamic information of NUTH area under Phase-2 ○ Mumbai Traffic Police ○ Thane Traffic Police ○ Navi Mumbai Traffic Police	Dynamic information of NUTH area under Phase-3 ○ Mumbai Traffic Police ○ Thane Traffic Police ○ Navi Mumbai Traffic Police ○ Maharashtra Police (Traffic wing) for remaining MMR
Trip planner	Static and dynamic multi-modal	Dynamic multi-modal	Dynamic multi-modal
Parking Information	Static in yrs. 1-2 ○ Greater Mumbai Dynamic from yr. 3	Dynamic Information ○ All municipal corporation areas in MMR	Dynamic information ○ Entire MMR

Parameter	Phase-1 (2 years)	Phase-2 (2-4 years)	Phase-3 (4-6 years)
Construction/ Maintenance Activities Information	○ Greater Mumbai	○ All municipal corporation areas in MMR	○ Entire MMR
Weather Information	○ Greater Mumbai	○ All municipal corporation areas in MMR	○ Entire MMR
Information Dissemination Modes	○ Website ○ Phone helpline ○ Mobile App ○ Social Media	○ Website ○ Phone helpline ○ Mobile App ○ Social Media	○ Website ○ Phone helpline ○ Mobile App ○ Social Media

* In Phase-1, BEST and Suburban rail operations in MMR areas beyond Greater Mumbai would also get covered.

4.5 Project Elements

NUTH is proposed to have the following elements:

- Transit Information Dissemination
- Traffic Information Dissemination
- Parking Information Dissemination
- Construction / Maintenance Activities Information Dissemination
- Weather Information Dissemination
- Incident / Accident/ Event/ Disaster Information Dissemination
- Trip Planner

Each project element has been detailed in the sub-sections that follow.

4.5.1 Transit Information

Transit related information disseminated through NUTH would be static as well as real-time information. Based on the availability of the transit data, information would be provided to users progressively in phases. This information would be provided from multiple dissemination systems, such as telephone service, website, mobile applications, and social media. This information would be very beneficial for city like Mumbai which has various transit modes available (BEST buses, Mumbai Monorail, Mumbai Metro, Mumbai Suburban railways). Accessing the transit information will have the following benefits for users:

- Useful especially for people unfamiliar with a route or a system.
- Information like running status, real-time location on map, expected time of arrival at bus stops, delays and disruptions will increase reliability of public transport.

Reliability of public transport would increase ridership and lead to potential increase in revenue for the transit operators.

- Transit information dissemination by various channels helps in reducing waiting time to access information as compared to traditional method of getting information only through helpline.

Table 4-3 lists the transit information that would be disseminated through Mumbai NUTH:

Table 4-3: Transit Information

TRANSIT INFORMATION	
Static Information	
Information	**Description**
Modes, Operator Details	Modes present in the city (e.g. Buses, Metro Rail, and Suburban railways. Etc. Operator details consist of name, modes operated, contact details, website details
Terminals, Stops	Terminals refer to bus terminal, metro station, bus stops on the map and in written format
Routes	Details of the routes operated (Service Maps)
Trip planner based on static data	Intra-modal as well as inter-modal based on static data
Service types	Express, Ordinary, AC, Non AC, Night services
Schedules	Frequency during peak/off-peak hours, Timings
Fare, Pass Details	Fare refers to normal fares, special fares, concessions for various categories of commuters Pass details refers to pass charges for various category of commuters, validity rules
Operational Hours	Hours of operation of transit service

Real Time Information	
Information	**Description**
Running Status	Current location of bus, delay etc.

Real Time Information	
Information	**Description**
Departures Scheduled	Departures scheduled at bus terminals, bus stops, metro stations, railway stations
Estimated Time of Arrival	Expected time of arrival of transit based on real time information like any delay, congestion on roads at bus stops etc.
Trip planner based on real time data	intra-modal as well as inter-modal based on current traffic / transit conditions
Parking Information/Availability	Real time parking information availability
Updates on construction and maintenance	Updates on construction and maintenance at any transit facility or on any transit route
Rerouting	Rerouting of any bus, metro, railway
Delays and disruptions	Real time delays and disruption of transit service
Any fare changes	Any fare update from operator
Information of new services, changes	Updates on introduction of new service and any change

Mumbai NUTH would need to interface with BEST buses, Mumbai Monorail, Mumbai Metro, Mumbai Suburban railways, etc. These agencies would also need to nominate their representatives to interact with Mumbai NUTH in order to facilitate effective communication and coordination.

Figure 4-1 shows the web page (http://businfo.dimts.in/businfo) of Cluster buses in Delhi which is managed by DIMTS Ltd. This web page provides information like route details, bus schedule, real time location of Cluster buses, estimated time of arrivals, location of nearest bus stops and Cluster buses trip planner.

Figure 4-1: NextBus Website (DIMTS, Delhi)

Figure 4-2 shows the web page containing transit related information on the 511 website (www.511.org). The information being disseminated through the website is nearby stops and routes, schedules and route maps, real time departures, transit service areas, announcements etc.

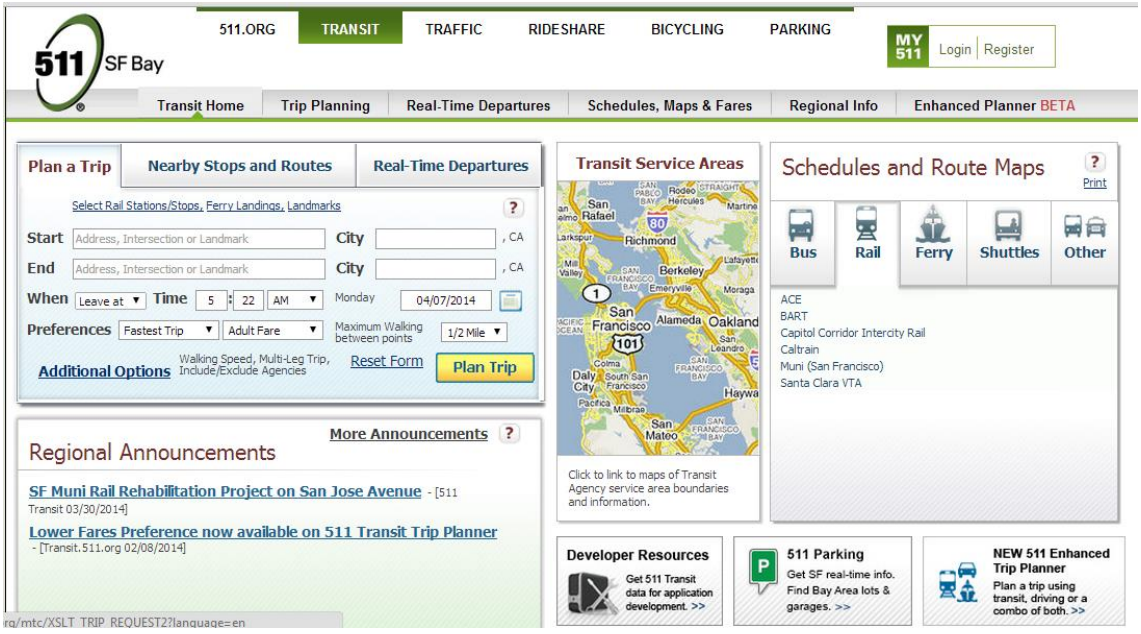


Figure 4-2: Transit web page, 511, San Francisco Bay Area

4.5.2 Traffic Information

Traffic information has been listed in Table 4-4. Such information is of relevance both prior to initiating a trip/ journey and while being en-route. While initiating a journey traveller can view the congestion levels, incident information or construction information and accordingly choose the most appropriate options from among the various choices. Similarly while en-route such information can help in taking detours

to avoid certain stretches based on level of congestion etc. This would lead to improvement in journey time reliability and saving in travel time/ distance. It would help in mitigating negative environmental impact arising out of travel. It would further lead to optimal utilisation of transportation assets and potential reduction in capital outlays in augmenting the transport network capacity.

Information disseminated would be both static and real time. Based on availability of the traffic data, information would be provided to users in phases. In terms of road network coverage, based on the objective, the information would be provided for urban major roads and sub arterial roads. This information would be provided from multiple dissemination systems, such as telephone service, website, mobile applications and social media, trip planner.

Table 4-4 lists the traffic information that would be disseminated through NUTH:

Table 4-4: Traffic Information

TRAFFIC INFORMATION	
Static Information	
Information	**Description**
Road Network Map	Road network details including Geographic Information System (GIS) maps
Location of signalised junctions	Location of signalised junctions on map and as list
Location of VMS signs	Location of variable messages signs on map and as list
Location of parking facilities	Details of parking facilities on map, nearest parking etc.
Trip planner based on static data	Trip planning tool based on static data
Speed Limits	Road attributes (Map): name, number of lanes speed limit, entry restrictions, weight restrictions, height restrictions etc.
Entry, weight, height restrictions	Road attributes (Map): name, number of lanes speed limit, entry restrictions, weight restrictions, height restrictions etc.
Scheduled construction and maintenance	Planned construction and maintenance

Real Time Information	
Information	**Description**
Road Congestion information	Speeds on road network
Travel time between major destinations	Travel time based on real time congestion level on roads
Trip planner based on dynamic data	Trip planning based on real time condition, speed level on road, construction and maintenance activity etc.
Road conditions, closures, diversions	Real time road closure, diversion
Incidents and Events	Real time incident information
Parking availability status	Real time parking availability information, suggestions on optional nearest parking
Weather updates	Temperature forecast (hourly , daily, weekend, monthly), weather forecast such as rain and storm, high tides forecast
Live camera feeds Live VMS feeds	Position of camera and VMS on GIS map, users can clink on link provided on GIS map and can see the traffic condition, weather etc.
Real time advisories and updates on construction and maintenance	Position of construction and maintenance activity on map, possible time for completion etc.

Figure 4-3 shows screen shot of DIMTS PoochhO mobile app providing traffic updates to users.

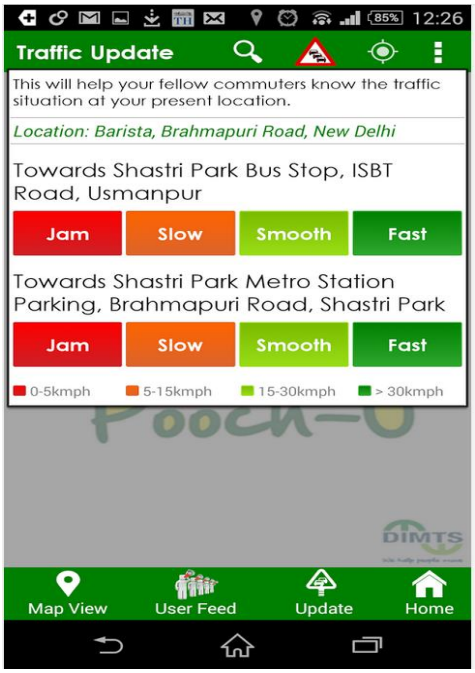


Figure 4-3: Traffic Congestion Information on PoochhO App

Figure 4-4 shows the web page containing traffic related information on the 511 website (www.511.org). The information being disseminated is construction, driving times (current as well as predicted), current traffic conditions in colour coded form on the map, location of road closure, construction, incident, severe incident, events, traffic cameras, VMS, park & ride, High Occupancy Vehicle (HOV) lanes and toll plaza on the map.

Colour coding can be decided based on criteria to be used by the agency concerned. In general following codes are referred:

- Green stands for free moving traffic. Roads highlighted in this colour are ideal to drive on.
- Blue stands for moderate traffic
- Pink stands for slow moving traffic
- Red stands for congested traffic. Traffic on such roads is generally bumper to bumper or at a complete standstill.

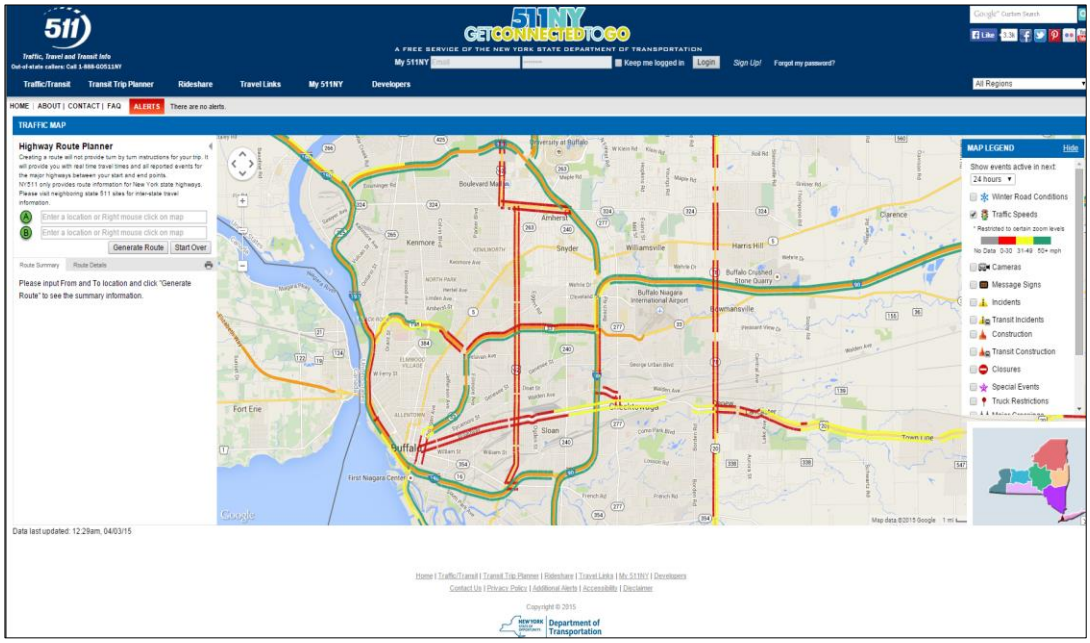


Figure 4-4: Traffic web page, 511, New York Area

4.5.3 Parking

Parking information may also be provided through NUTH so that those travelling by personal modes or looking for park and ride options could get to know the details of parking facilities as under:

- Location of various parking facilities: general parking, event related parking, park and ride facilities
- Details of parking facilities such as capacity, type of vehicles that can be parked, operational hours, charges, mode of payment, operating agency, contact details
- Parking availability status (real-time)
- Update on facility closure, construction and maintenance

The above details could be provided on the map as well as in tabular/other suitable form. In order to get such data, interfaces must be built with traffic management centre and/or the systems of the parking facilities.

Figure 4-5 shows a San Francisco Bay Area, 511 webpage. Information being disseminated is parking available in the nearby area, parking charges and available space.

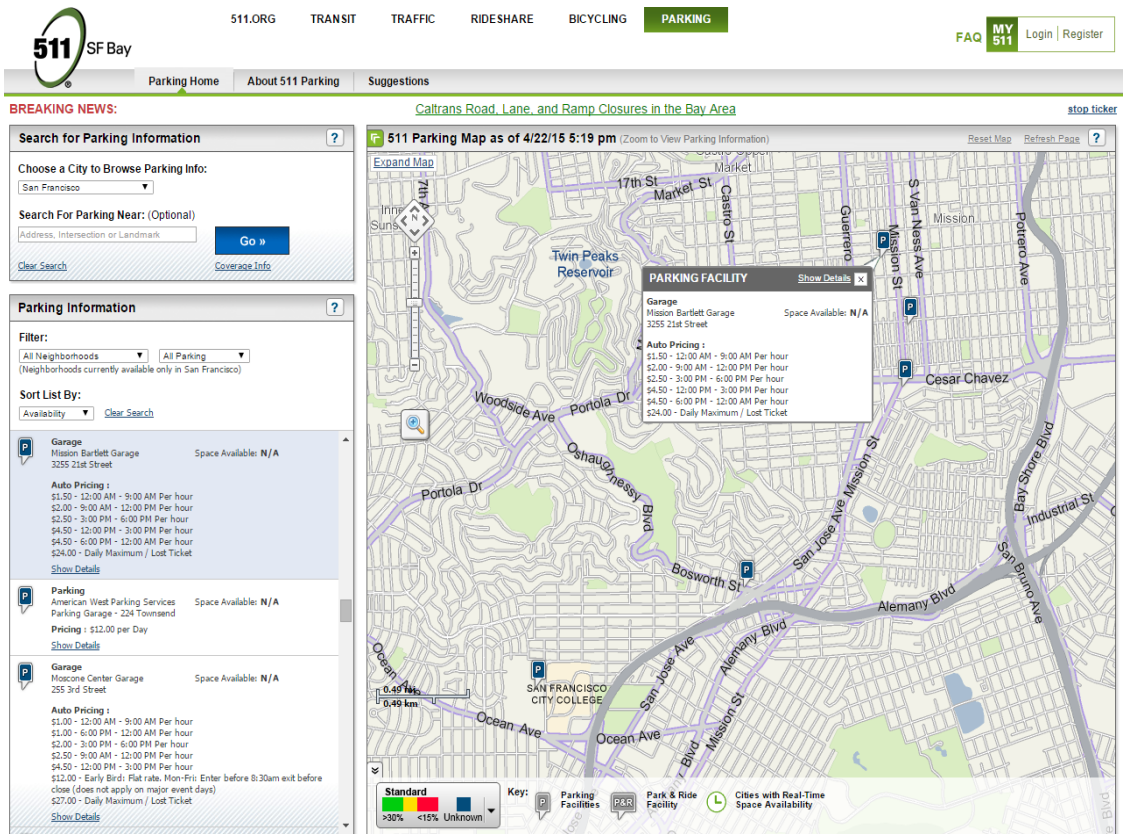


Figure 4-5: Parking information, 511, SF Bay Area

4.5.4 Construction / Maintenance Activities

Construction and maintenance activities affect road network capacity or even access to the network leading to travel delays. Information related to construction and maintenance activities pertaining to transportation infrastructure and facilities that may be disseminated through NUTH is listed below:

- Information of planned construction and/or maintenance
- Updates on the status of the construction and/or maintenance

The information that would be provided to travellers in relation to the construction and maintenance activities is listed below:

- Brief details
- Location: road, section, spot
- Direction of travel affected
- Impact: lane closure, diversion, congestion
- Alternate routes, per agency policies
- Expected time for activities and restoration of normal conditions

Information in respect of planned construction and maintenance activities would be provided in the form of calendar so that those planning for future travel could take these

into account. Locations where construction and maintenance activities are underway could be shown on the map as well as in tabular/other suitable form.

In order to get such data, interfaces must be built with the systems of agencies which are responsible for construction and maintenance activities and/or the authorities who are required to be intimated prior to undertaking construction and maintenance activities.

Figure 4-6 shows a San Francisco Bay Area, 511 webpage. Information being disseminated is scheduled construction and maintenance, and diversions.

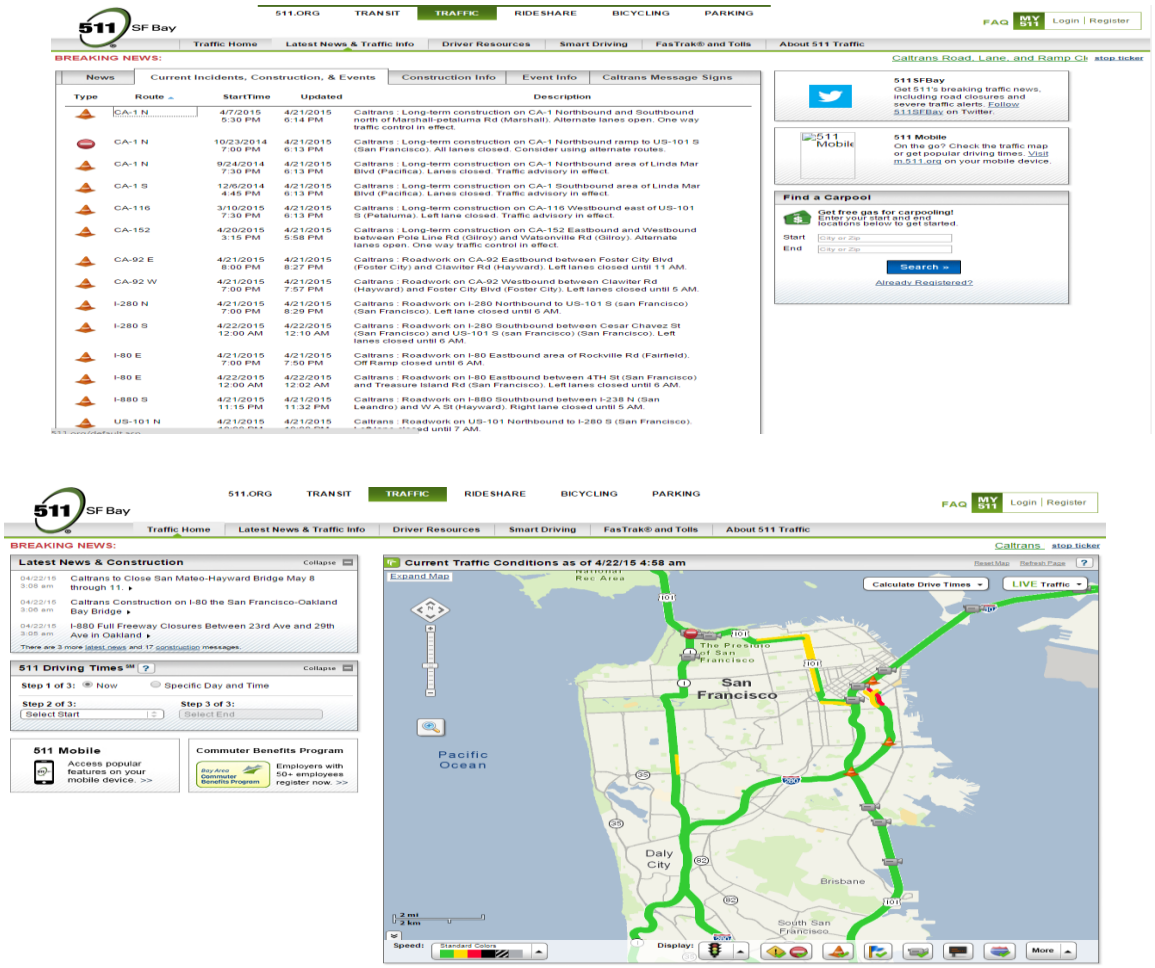


Figure 4-6: Construction and Maintenance Information, 511 webpage, SF Bay Area

4.5.5 Weather

Weather information such as wind speed, temperature, visibility, fog, rain etc. which may affect travel would be provided.

In order to get such data, interfaces must be built with regional meteorological stations or other organisations having such data.

Figure 4-7 shows State of Alaska, 511 web page. Information being disseminated is weather updates that can affect travel.

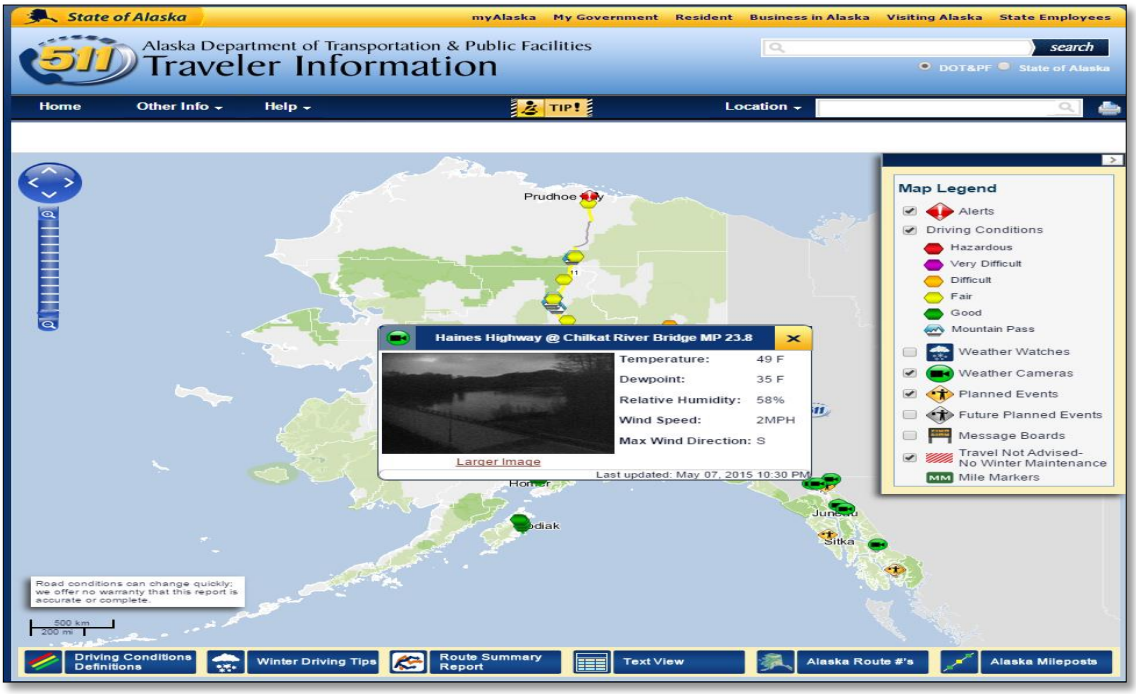


Figure 4-7: Weather Update, 511 web page, State of Alaska

4.5.6 Incident / Accident/ Event/ Disaster Information and Planned Events

It is one of the most important elements of traffic information that affects travel planning. Incidents may lead to congestion, require road diversions or closure. It is, therefore, necessary that information about incidents is captured promptly and disseminated through NUTH so that those travelling can plan their travel accordingly:

- Road accidents, collisions, vehicle breakdowns
- Events
- Auto/taxi strikes etc.
- Transit service disruptions
- Political rallies
- Religious or social procession
- State ceremonies
- Others

The information that would be provided to travellers in relation to incidents/events is listed below:

- Incident/event details
- Location: road, section, spot
- Direction of travel affected

- Impact: lane closure, diversion, congestion
- Alternate routes, in accordance with agency policies
- Time during which traffic would be affected
- Expected time to restore normal traffic

Information in respect of planned events would be provided in the form of calendar so that those planning for future travel could take these into account. Locations of incidents could be shown on the map as well as in tabular/other suitable form.

In order to get such data, interfaces must be built with TMICC and/or the systems of the agencies which participate in managing and responding to the incidents or are required to be intimated prior to conducting any event. Media could be another source of providing information related to any planned events, strikes, rallies, State ceremonies etc.

Figure 4-8 shows a State of Alaska, 511 web page. Information being disseminated is updates on the road closures/ restrictions.

Figure 4-8: Event Updates, 511 Web page, State of Alaska

4.5.7 Trip Planner

NUTH would have multi-modal trip planning tool to support travel planning between various origin and destinations using several options such as modal preference, date, time, fastest, least transfer/ cost/ time/ walk etc. Figure 4-9 shows the web page containing trip planning tool provided on the 511 website (www.511.org) providing

various options to users to choose from such as fastest trip, fewest transfer, less walking, lower fares etc.

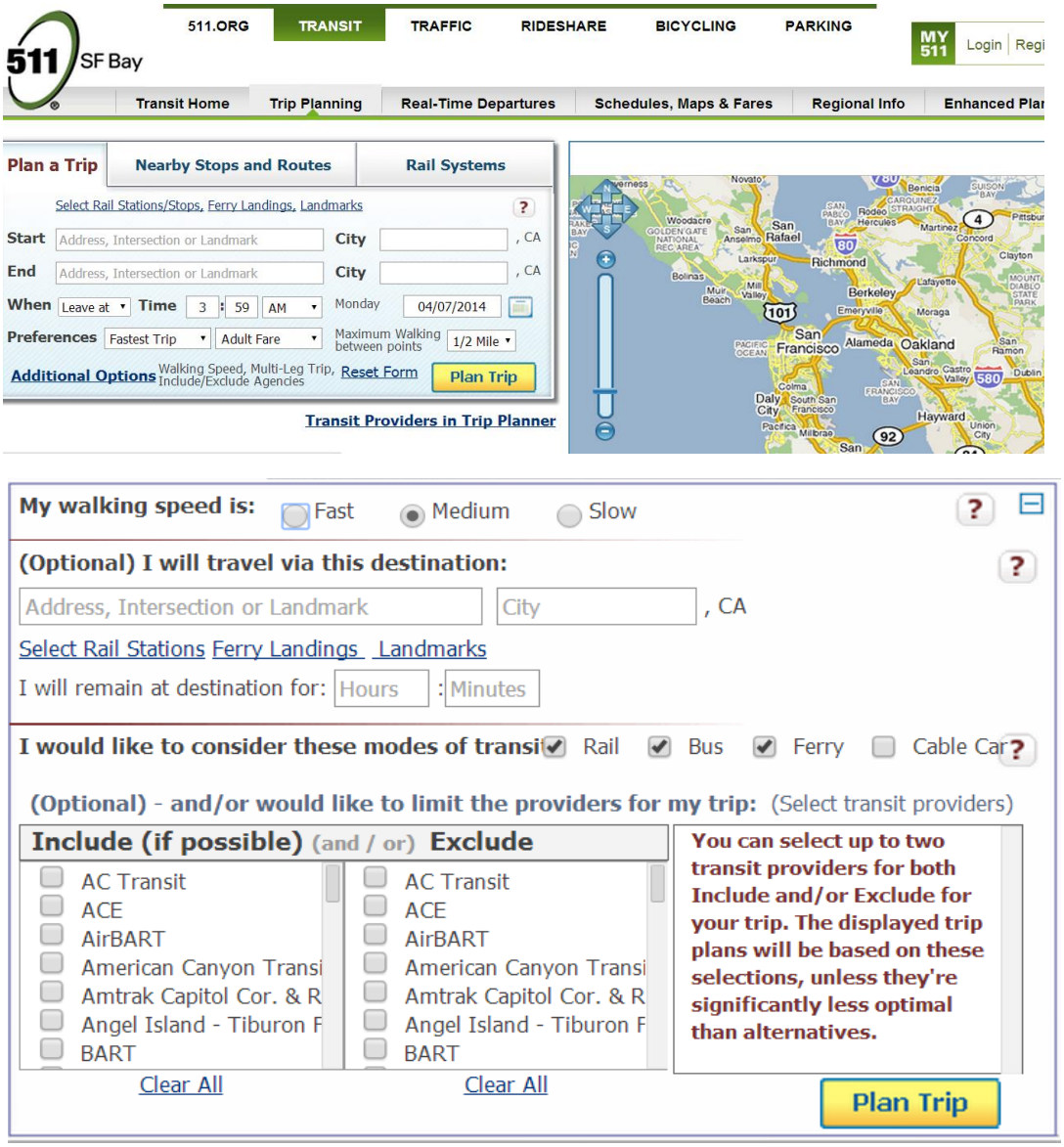


Figure 4-9: Trip Planner, 511, San Francisco Bay Area

Figure 4-10 shows the web page containing journey planning tool provided on the Transport for London's website (http://www.tfl.gov.uk) providing various options to users to choose from such as transport mode, mobility requirements, fastest route, fewest changes, least walking.

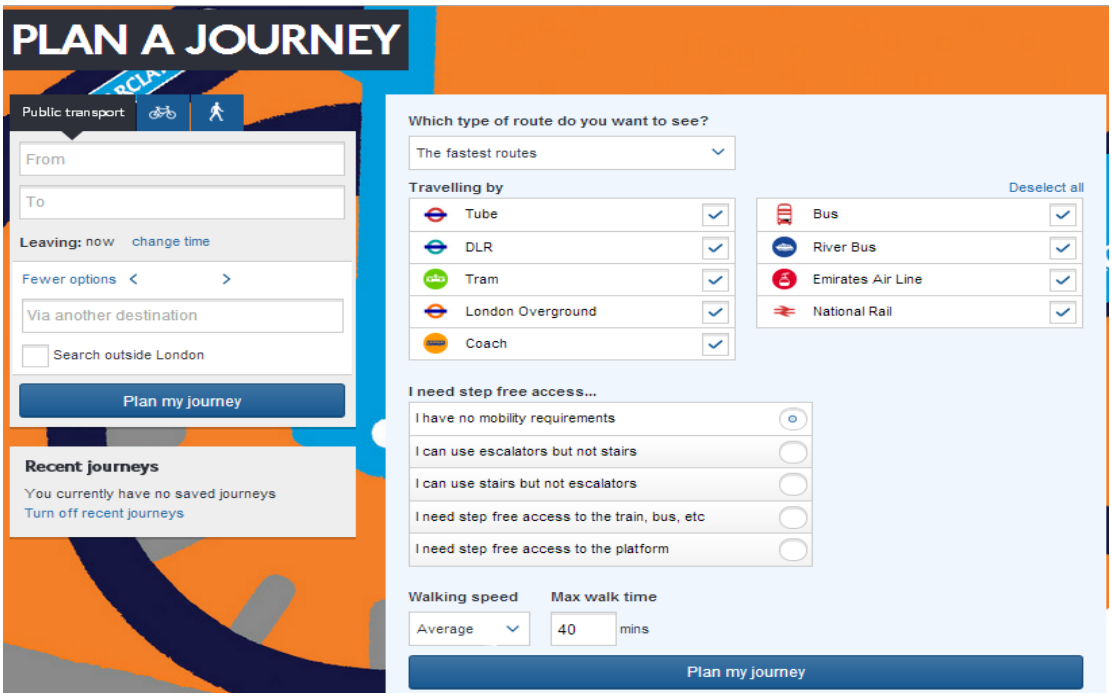


Figure 4-10: Journey Planner, Transport for London

Figure 4-11 shows the web page containing journey planning tool for Cluster Buses developed by DIMTS Ltd. in Delhi.

Figure 4-11: Journey Planning Tool for Cluster Buses, DIMTS-Delhi

4.6 Inter-Agency and Inter-Jurisdictional Coordination

Inter-Agency and Inter-Jurisdictional coordination would be a very important activity not just during the Mumbai NUTH design and conceptualisation stage but also during the operational phase of the Mumbai NUTH.

The functions entrusted with Mumbai NUTH entail dealing with several agencies having their respective role in transport and traffic related aspects listed below:

- BEST
- Suburban rail services (Western Railway)
- Suburban rail services (Central Railway)
- Mumbai Monorail
- Mumbai Traffic Police
- Mumbai Metro Rail

Mumbai NUTH would need to interface with transit agencies, parking agencies etc. to ensure exchange of information pertaining to these services. These agencies would also need to nominate their representatives to interact with NUTH in order to facilitate effective communication and coordination. As the traffic control room/TMICC would be a repository of all traffic related information, NUTH would need to interface with traffic control room/TMICC in order to exchange information related to traffic and events/incidents. Further, as and when agencies upgrade their respective systems, NUTH information exchange interfaces with their systems must be checked for continuous flow of information.

4.7 Project Level Architecture

An outline of the project level architecture and the associated connections for the Mumbai NUTH has been shown in Figure 4-12 . This architecture shall be finalised along with the development and preparation of the Detailed Technical Reports through a systems engineering process during design stage.

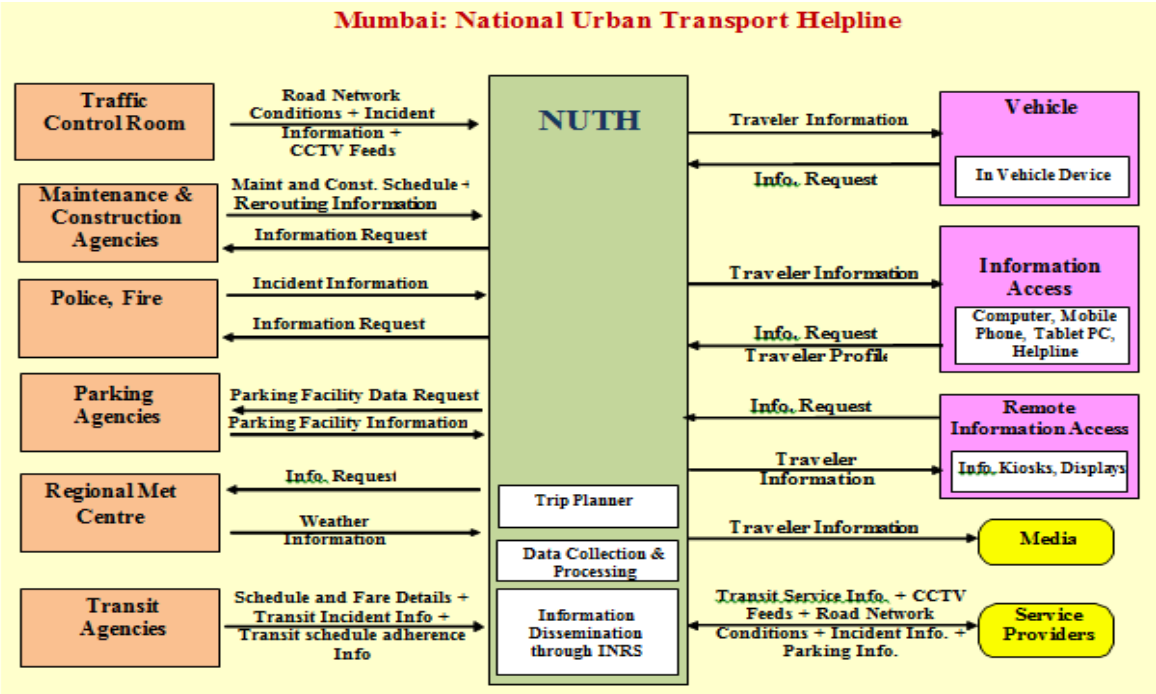


Figure 4-12: Mumbai NUTH Project Architecture

4.8 Standards and Protocols

There is no common standard for data exchange used in India by transit operators (including in the GPS/AVL systems deployed by the Indian transit operators). Each transit operator uses different/distinct data exchange protocols provided by their systems integrators. General Transit Feed Specification (GTFS) is one of the data exchange protocol that has been popularised by Google and which has been used by some of the transit operators in India and also internationally for disseminating transit schedule and operational details to general public using Google Maps. In India, Bangalore Metropolitan Transport Corporation (BMTC), Bengaluru; Namma Metro, Bengaluru and Metropolitan Transport Corporation (MTC), Chennai have used GTFS earlier for disseminating their transit schedule through Google Maps.

Some of the data exchange protocols used by different countries are:

- TransXChange (UK) as nationwide standard for exchanging bus schedules and related data
- Net Exchange (UK), JourneyWeb (UK) is the protocol used for Journey Planners to communicate,
- Network Exchange (NeTEx) and Service Interface for Real-time Information (SIRI) (Europe) and,
- GTFS (USA and many other countries).
- DATEX (USA and many other countries)
- XML (USA and many other countries)

NUTH relies on extensive data exchange with various transit, traffic and other data providers and their systems. In view of this, it is critical that the agencies participating in NUTH follow a common unified standard and information exchange protocol while setting up their respective systems. This will enable interoperability among the various systems and subsystems including with the NUTH.

List of some potential standards is given in the Annexure-3 for reference.

4.9 System Requirements

System requirements have been covered under the following general categories. These requirements are general in nature and shall be finalised with the development and preparation of the Detailed Technical Reports through a systems engineering process (refer Annexure 4) during the project procurement stage:

- Data Collection, Processing and Storage
- Data Dissemination
- Trip Planner
- Information Alerts
- Personalised Traveller Information
- Remote Information Access

- NUTH Call Centre
- NUTH website
- Mobile Applications
- NUTH Social Media pages
- MIS Reports

System should be develop and selected in such a way so that it can be integrated with the new systems introduced in future.

4.9.1 Data Collection, Processing and Storage

- NUTH shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information (refer Section 4.5.1).
- NUTH shall collect, process, and store traffic information on roads, including congested routes, recommended routes, and current speeds on specific routes (refer Section 4.5.2)
- NUTH shall collect, process, and store parking information, including location, availability (based on the availability of data feeds), and parking charges (refer Section 4.5.3).
- NUTH shall collect, process, and store maintenance and construction information, including scheduled maintenance and construction work activities (refer Section 4.5.4).
- NUTH shall collect, process, and store current and forecast road conditions and weather conditions (refer Section 4.5.5).
- NUTH shall collect, process, and store information related to event impacting transit and/or traffic (refer Section 4.5.6).

4.9.2 Data Dissemination

- NUTH shall disseminate transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travellers (refer Section 4.5.1).
- NUTH shall disseminate traffic and road network condition information to travellers, including recommended routes, and current speeds on specific routes (refer Section 4.5.2).
- NUTH shall disseminate parking information to travellers, including location, availability, and fees (refer Section 4.5.3).
- NUTH shall disseminate maintenance and construction information to travellers, including scheduled maintenance and construction work activities (refer Section 4.5.4).
- NUTH shall disseminate weather information to travellers (refer Section 4.5.5).
- NUTH shall disseminate event information to travellers. (refer Section 4.5.6)

- NUTH shall provide the capability for a system operator to control the type and update frequency of broadcast traveller information.
- Information would be disseminated through various modes: website, call centre, mobile applications, social network and roadway/transit informational signs

4.9.3 Trip Planner

- NUTH shall generate trip plans based on current and/or predicted conditions of the road network, scheduled maintenance and construction work activities.
- NUTH shall generate trip plans based on transit services, including fares, schedules, and requirements for travellers with special needs.
- NUTH shall generate trip plans based on current asset restrictions, such as height and weight restrictions, no entry restrictions, one way, etc., on roads, flyovers, underpasses and bridges.
- NUTH shall generate trip plans based on bus, metro rail, suburban rail, or other multi-modal transportation data.
- NUTH shall generate trips based on the use of more than one mode of transport.
- NUTH shall use the preferences and constraints specified by the traveller in the trip request to select the most appropriate mode of transport.
- NUTH shall provide the capability for NUTH personnel to control route calculation parameters.

Refer Section 4.5.7 for more detail on the trip planner

4.9.4 Information Alerts

- NUTH shall accept traveller profiles that establish recurring trip characteristics including route, mode, and timeframe information.
- NUTH shall accept traveller profiles that define alert thresholds that establish the severity and types of alerts that are provided to each traveller.
- NUTH shall disseminate personalised traffic alerts reporting congestion, incidents, delays, detours and road closures that may impact a current or planned trip.
- NUTH shall disseminate personalised transit alerts reporting transit delays and service interruptions.
- NUTH shall disseminate personalised parking alerts reporting parking availability and closures.
- NUTH shall disseminate personalised road weather alerts reporting adverse road and weather conditions.
- NUTH shall disseminate personalised event alerts reporting special event impacts on the transportation system.

- NUTH shall provide an operator interface that supports monitoring and management of subscribers and the content and format of alert messages.

4.9.5 Personalised Traveller Information

- NUTH shall disseminate customised traffic and road network condition information to travellers, including incident information, detours and road closures, recommended routes, and current speeds on specific routes upon request.
- NUTH shall disseminate customised maintenance and construction information to travellers, including scheduled maintenance and construction work activities upon request.
- NUTH shall disseminate customised transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travellers upon request.
- NUTH shall disseminate customised parking information to travellers, including location, availability, and fees upon request.
- NUTH shall disseminate customised weather information to travellers upon request.
- NUTH shall disseminate customised event information to travellers upon request.
- NUTH shall provide all traveller information based on the traveller's current location or a specific location identified by the traveller, and filter or customise the provided information accordingly.
- NUTH shall accept traveller profiles for determining the type of personalised data to send to the traveller.
- NUTH shall provide the capability to support requests from the media for traffic and incident data.
- NUTH shall provide the capability for a system operator to control the type and update frequency of traveller information.

4.9.6 Remote Information Access

- The public interface (for remote information access) for travellers shall receive traffic information from NUTH system and present it to the traveller upon request.
- The public interface for travellers shall receive transit information from NUTH system and present it to the traveller upon request.
- The public interface for travellers shall receive event information from NUTH system and present it to the traveller upon request.
- The public interface for travellers shall base requests from the traveller on the traveller's current location or a specific location identified by the traveller, and filters the provided information accordingly.

- The public interface for travellers shall provide digitised map data to act as the background to the information presented to the traveller.
- The public interface for travellers shall support traveller input in manual form.
- The public interface for travellers shall present information to the traveller in visual forms consistent with a kiosk.
- The public interface for travellers shall be able to store frequently requested data.

4.9.7 NUTH Call Centre

- NUTH call centre number is recommended to be simple three digit number (such as 555) for National traveller information access.

  To facilitate access to information on public transport, based on Ministry of Urban Development (MoUD), Government of India initiative, Department of Telecommunication (DOT), Government of India has allotted nation-wide short code 155220 to be used as Public Transport Helpline Number. This number is a Universal Access Number (UAN) and can be used from any location in India and would be accessible from both landline as well mobile phones.

  All the States/Public Transport Operators have been advised by MoUD to implement this helpline number in their States/services and give wide publicity to the helpline number.

  It is recommended that number 155220 be utilised for Mumbai NUTH until the simplified three digit number is approved and available throughout the country.
- NUTH Call Centre shall provide the capability to process Dual-Tone Multi-Frequency (DTMF) based requests (touch-tone) for traveller information received on the NUTH telephone number.
- NUTH Call Centre shall provide information on traffic conditions in the requested voice format and for the requested location.
- NUTH Call Centre shall provide roadway maintenance information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide weather and event information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide transit service information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide live customer support in languages as may be decided by the implementing agency.

  NUTH would also utilise live operator assistance for improved customer support. The number and time periods for live customer support will be dependent on funding and customer needs. Typically, if a customer is unable to navigate an automated Interactive Voice Response System (IVRS), then they can request a customer service. This option would allow more customised services. This is

especially useful in the Indian context given the diversity of language and dialect needs. Again, depending on the need, the number of agents can be adjusted. IVRS would be configured and structured in such a manner that most of the information is disseminated through IVRS mode and only a limited set of information is required to be disseminated through the live operators. Objective should be to support majority of the calls through IVRS. MoUD in its communication to the States has written that over 80% of the calls need to be supported through IVRS.

It is recommended that the call agent screens be standardised. The following structure could be adopted:

- Level 1: Main menu screen – Main screen with tabs for different traveller information services (e.g. Transit, Trip Planning, Parking, Traffic, Toll etc.). The default screen could be for the most often requested service
- Level 2: Service menu screen – this would have the input fields (e.g. origin, destination, route number, fare, schedule etc.) pertaining to selected service type.

The data entry fields on the screens should also have both, an auto-fill and drop-down lists to minimise the time taken by the call agent in data entry.

Given that NUTH system would be a new service and the diversity in languages and accents in India, it would be appropriate to assume an average call duration of 1 minute per call. However, over a period of time it may be possible to increase the number of calls that an operator to about 180-200 calls per hour. It is strongly recommended to outsource the call centre operations so that scaling up or down could be done smoothly.

- IVRS would be configured and structured in such a manner that most of the information would be disseminated through IVRS mode and only a limited set of information would be disseminated through the agents.

  It may not be desirable and economical to have agent respond to each call that NUTH receives from public seeking information. In view of this, NUTH would provide for Interactive Voice Response System (IVRS) where-under certain information and content that is amenable for this mode, could be disseminated through IVRS. The caller may be given an option to speak to an agent, on a need basis. The call in such case alternatively may be transferred (would entail cost to the agency) to the helpline number of the agency concerned or the caller may be provided the agency's number and requested to directly call the agency concerned.

  A typical IVRS logical flow (implemented by KSRTC at Mysore) has been provided below for reference. The complexity of the menu would, however, vary on a case-to-case depending upon:

  - Type of information traffic or transit etc.
  - Geographic coverage of the service
  - Number of languages

- Number of transit modes
- Number of service types under each transit mode (AC, non-AC, limited stop etc.

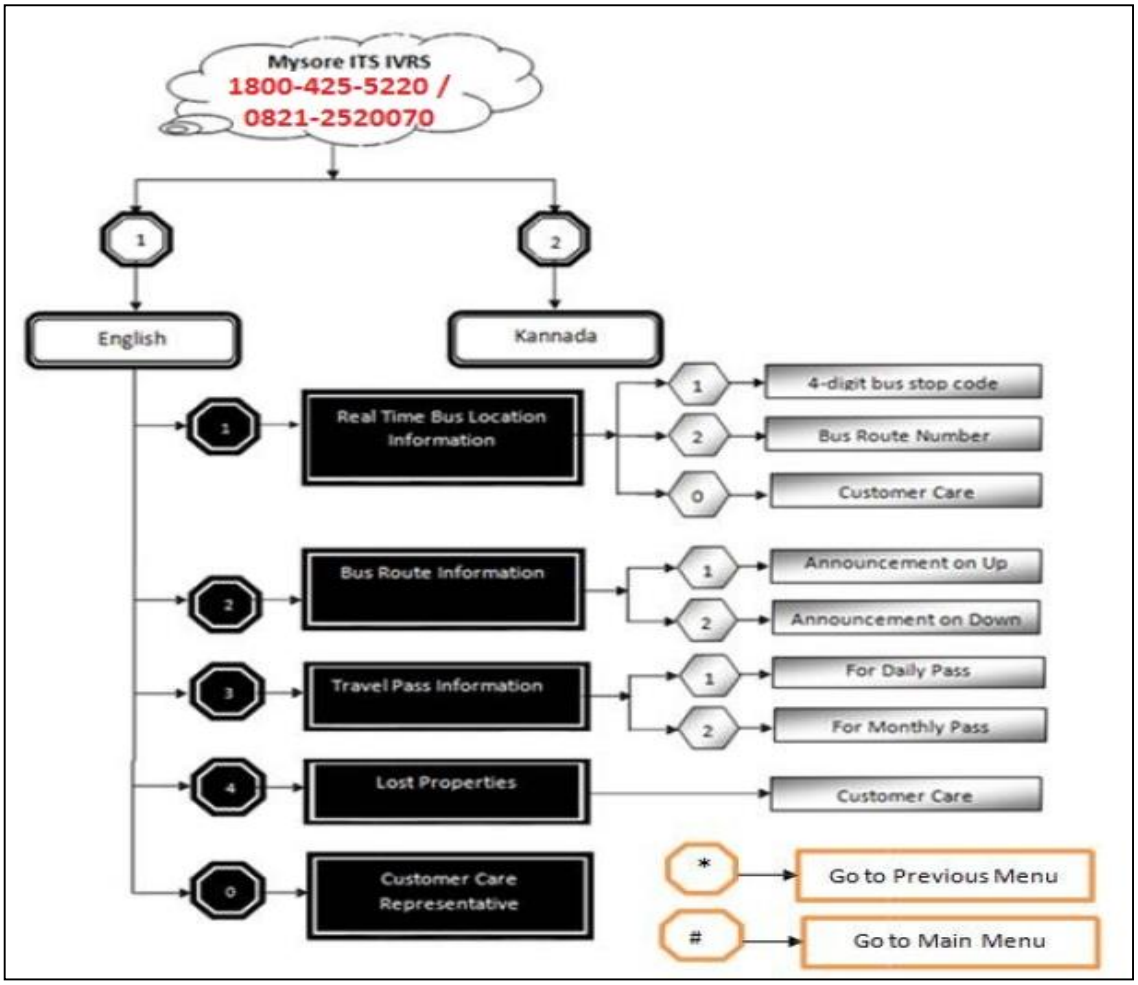


Figure 4-13: Typical IVRS Menu

4.9.8 NUTH Website

Websites have emerged as the most popular channel for accessing information. In view of this, Mumbai NUTH must also have accompanying website through which information could be disseminated in the most appropriate form and manner. Regular websites provide flexibility to offer rich content on maps that are suitable for viewing on a large screen but may require higher bandwidth to access. The mobile versions of websites allow accessing information over low band width. The content, however, would need to be customised and tailored to suit the regular and mobile versions of websites. The website should provide multiple browser support. The website may also have capability to provide personalised version of the web pages displaying content based on user preferences. Alerts through automatic e-mails could also be provided to those subscribing for the same. The user interfaces would be designed in such a manner which are intuitive, support easy navigation and enable faster access to relevant information. High quality GIS maps would be used to display route, incident,

congestion, road closures, camera, congestion charging zone etc. to enrich user experience. Website would have multi-modal journey planning tool to support trip planning between various origins and destinations using several options such as modal preference, date, time, fastest, least transfer/ cost/ time/ walk etc. Mumbai NUTH would also show detail of website of stakeholder like BEST, suburban rail services (Western Railway), Suburban rail services (Central Railway), Monorail, Mumbai Traffic Police etc.

4.9.9 Mobile Applications

Mobile apps have become quite popular with wider availability and adoption of mobile devices. The mobile apps provide user interfaces that support easy access to information on the mobile devices. There are various types and sizes of mobile devices in the market working on different operating systems such as iOS, Android, Windows; hence mobile app would need to be developed to support the desired device OS/device sizes.

Mumbai NUTH would have well designed mobile application. The application may be designed for all mobile interfaces such as iOS, Android, Windows, etc. To begin with Android application could be developed and later on iOS and Windows based applications could be developed. GIS maps would be used to display route, incident, congestion, road closure details, camera, congestion charging zone etc. to enrich user experience. Mumbai NUTH mobile app would have multi-modal journey planning tool to support trip planning between various origin and destinations using several options such as modal preference, date, time, fastest, least transfer/ cost/ time/ walk etc.

Mumbai NUTH implementing agency may share data with private sector entities in order to enable them to develop innovative applications for information dissemination. In the beginning such information could be shared with private sector entities without any cost with an option retained for levying of license fee and/or revenue share in future. The decision to opt for levying of license fee and/or revenue share could be taken by the agencies based on the earning potential of the applications developed and willingness of the customers to pay for such services. It is suggested that monetising of the services be explored later by the agencies and initially the focus should be on developing the market for such services. Figure 4-14 shows as example view of 511 Mobile Application for SF Bay area.

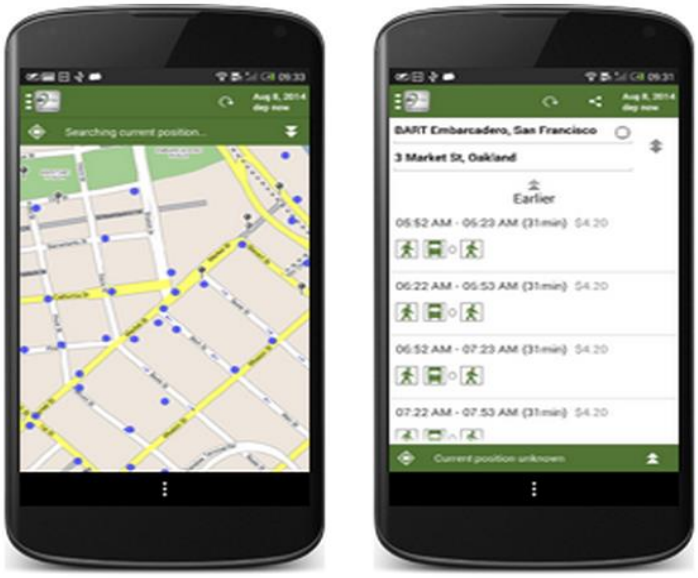


Figure 4-14: 511 Mobile Application, SF Bay Area

4.9.10 NUTH Social Media

Considering its popularity, in addition to other channels, social media would also be used for information dissemination. Towards this, Mumbai NUTH should set up Facebook and Twitter pages to disseminate certain types of information such as updates, alerts, events, service closures, incidents, accidents etc. Figure 4-15 shows Facebook page of 511 SF Bay area to disseminate information.

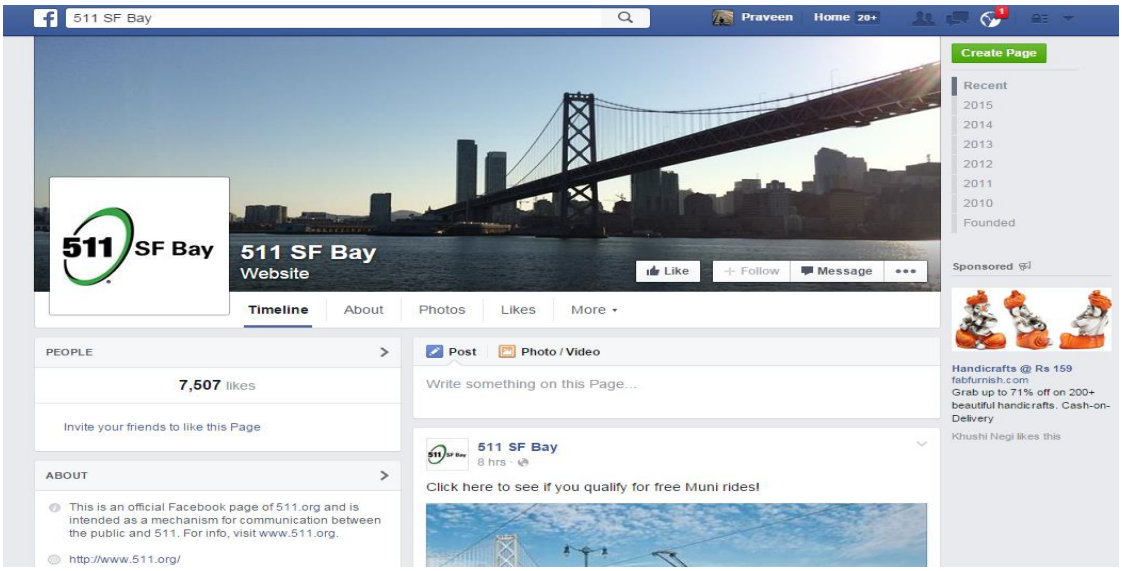


Figure 4-15: 511 SF Bay, Facebook page

4.9.11 Management Information Systems (MIS) Reports

Mumbai NUTH system would be designed in such manner that it is capable of supporting report generation of various types and their dissemination. System should support for automatic generation and distribution of various identified reports for internal management review and evaluation. Additionally, it should have reporting tool that can support generation of customised reports as well.

Such reports would capture the performance of various system elements as set out below:

- Statistical Analysis: Website visitors volume and trends, call volumes and trends, analysis of data on feedback etc.
- Mumbai NUTH Key Result Areas: Modal coverage, geographical, information coverage, number of visitors to site, number of calls received, customer satisfaction, data dissemination quality etc.
- Operational Activities: Number of incidents reported, number of system interfaces being managed etc.
- Maintenance & System Performance: Uptime, downtime, mean time between failure, response time etc.

4.9.12 Language for Information Dissemination

NUTH system would be accessed by a large section of public. Considering the languages spoken and understood in Mumbai, it is recommended that NUTH should provide information in the languages as may be decided by the Government of Maharashtra.

5.0 MUMBAI NUTH IMPLEMENTATION, OPERATIONS AND MAINTENANCE

5.1 NUTH Implementation Process

Figure 5-1 outlines the steps involved during NUTH development process. In line with the international best practices, it is recommended that Mumbai adopts Systems Engineering approach towards system design and implementation as detailed in the generic operations document already prepared.

The implementation process for the system would broadly include Concept Development Phase (2-3 months); Systems Engineering Management Plan (2-4 months); Detailed Design, Detailed Project Report and Detailed Agreement between stakeholders (2-4 months); Preparation of Tender Document (2 months); Bid Process Management (3 months); and Project Implementation, Monitoring and Management (6-9 months).

A total of 17-25 months period is projected for project planning, procurement and implementation.

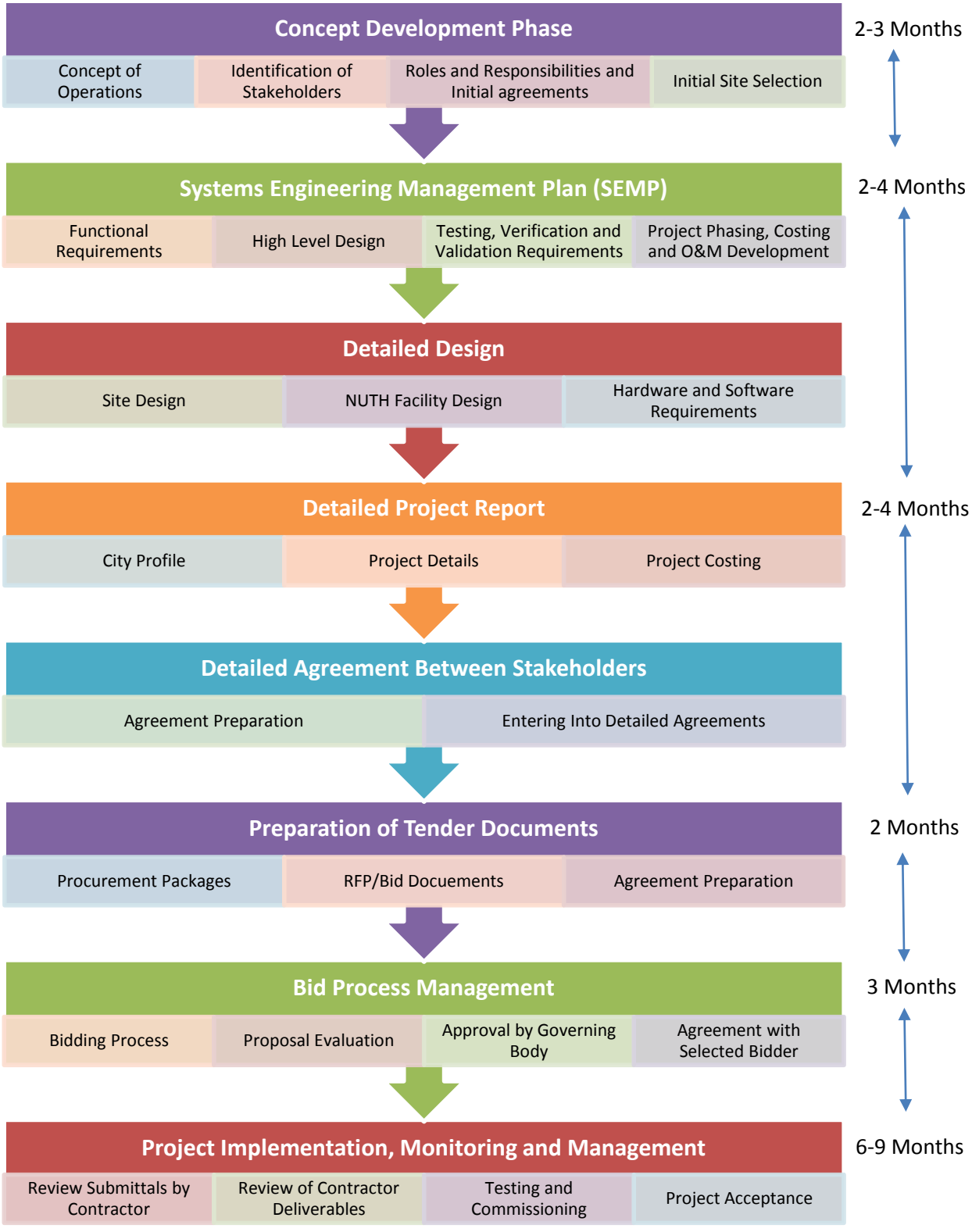


Figure 5-1: NUTH Implementation Process

5.1.1 Development of City Specific Concept of Operations Report

Concept of Operation is a description of system requirements. It defines how system will work in actual practice. It defines the clear sets of procedures and protocols to handle all sorts of queries. The Concept of Operation should be a plain language description of how the system should work in practice. It should describe how the system will function in a range of inquiries. Mumbai NUTH Concept of Operation Document should also describe all protocols and procedure for handling all type of queries by public. City Specific Concept Report or Concept of Operations should cover the following aspects:

- Mumbai NUTH Concept Plan covering:
  - Identification of ITS & NUTH needs for the Mumbai based on data analysis and collection.
  - Identification of stakeholders such as BEST, Suburban Railways, Mumbai Metro, Mumbai Monorail
  - Drawing up of implementation role of various stakeholders
  - Identification of ITS applications and NUTH system design to support the applications
  - Plan for administration and management of the system
  - Broad costing for setting up of the Mumbai NUTH – upfront and ongoing
  - Sources of revenue for Mumbai NUTH

- Site selection and preliminary design of NUTH facility

  This activity would require identification and evaluation suitable site(s) for housing the NUTH facility. Preliminary site design should consider functions within the NUTH, number of staff and space requirements, and future expansion and growth. Once the site is finalised, high level design of the NUTH facility, including building design and/or modifications, would be carried out based on site conditions.

- Project Structuring
  - Phasing of the build-out of the Mumbai NUTH facilities
  - Prepare business plan including financing details for the NUTH facility
  - Examine possibility of implementing the project/sub-projects on PPP format and draw up the broad structure for the same
  - Consideration for Operations and Maintenance budget and funding

- Identification of Stakeholders and Preliminary Agreements

  This activity would deal with identification of key stakeholders and drawing up of the preliminary set of agreements between the various stakeholders related to the Mumbai NUTH.

The city authority and the consultant engaged by the authority may refer to the operations document and city specific plan, available with MoUD while preparing city specific concept reports.

5.1.2 Systems Engineering Management Plan

Systems Engineering Management Plan (SEMP) is a high level plan dealing with the systems engineering side of the project and covers the implementation and monitoring aspects related to systems engineering steps and tasks.

The SEMP would typically contain the following:

- Project introduction (System description, Project schedule)
- Technical plan and control method
  - Engineering team, organisation chart, role and responsibilities
  - Plans for technical review, project monitoring reviews
  - Approach for system testing
  - Approach for performance measurements
  - Risk management
  - Configuration management
- Systems engineering processes
  - Systems engineering steps to be followed for the project.
  - Definition of all high-risk areas, including critical technologies that might pose some challenge for the system.
  - Details of the tools proposed to be used during the course of development activity (such as configuration management tool).
- Inputs from various engineering disciplines
  - Tasks requiring inputs from various engineering disciplines
  - Details of inputs required
  - Timing when the inputs would be required
  - Coordination mechanism
- Other Plans (either included in SEMP or created as separate document and referred in the SEMP)
  - Interface Management and Control Plan
  - System Integration Plan
  - System, Subsystem and Components Verification Plan
  - Hardware and Software Development Plans
  - System Installation Plan

- Training Plan
- Operations and Maintenance (O&M) Plan
- System Validation Plan

- Relevant project documents

5.1.3 Detailed Design

The detailed design would cover the following for the NUTH:

- Detailed technical requirements of the system (including hardware requirements)
- Detailed design of the centre (sizing, floor plan, data centre design, utilities design etc.)

The design life of the system should be at least 10 years after the system has been substantially installed. It must be noted that the design life of all equipment depends upon the availability and reliability of spare parts. It is worthwhile to adopt value engineering technique to ensure cost effectiveness and undertake a detailed analysis when detailed technical specifications would be developed by the city.

5.1.4 Detailed Project Report

Prior to NUTH implementation, city will need to develop a Detailed Project Report (DPR) and an indicative template for the same is provided in the generic operations document. The Detailed Project Report would cover both technical as well as the cost related details for the NUTH in accordance with the following structure:

- Project Background
- City Profile
- NUTH Concept Overview
- Review of ITS Initiatives in the City
- Project Concept
- Project Implementation, Operation and Maintenance
- Project Stakeholders and Organisation
- Project Sizing, Costs, Revenue and Funding
- Resources, References and Contact Details
- Annexure

5.1.5 Detailed Agreements Between Stakeholders

This activity would deal with drawing up and entering into the detailed agreements between the various stakeholders related to the NUTH. The agreement would clearly set out the roles and responsibilities of each stakeholder and funding allocation and responsibilities based on the project requirements finalised.

Sample MoU between stakeholders for NUTH has been provided in Annexure 2. Guidance regarding detailed agreements between stakeholders for NUTH has been provided in Section 6.3.5.

5.1.6 Preparation of Tender Documents

Tender documents would need to be prepared in order to carry out the bidding process for selection of contractors for various items of work. This would cover the following:

- Parcelling of work packages.
- Preparation of bid documents, setting out the scope of work, qualification and evaluation criteria of proposals in consultation with city specific government entity. It is recommended that some minimum quality certifications (e.g. ISO 9001, ISO 27001 and CMMI Level 3) be specified as part of the qualification criteria, so that quality conscious vendors are considered.
- Preparation of formats for bid submission.
- Preparation of and Request for Proposal (RFP) comprising the eligibility criteria, qualification criteria and evaluation methodology for selection of contractor(s) for the development/procurement of the NUTH.
- Preparation of bid documents for construction work
- Preparation of agreement for any procurement in consultation with the NUTH implementing agency. The agreement would cover roles and responsibilities of the stakeholders, payment terms, events of defaults, termination conditions, termination payments, design and construction requirements, O&M requirements (if any) etc.

Based on the project structure and implementation plan finalised, the project may require multiple bid processes and corresponding tender documents.

5.1.7 Bid Process Management

Based on the project structure and implementation plan finalised by the NUTH implementing agency, the project may involve multiple bid processes. The various tasks involved in the Bid Process Management activity would include the following:

- Conducting pre-bid conference, formulating and communicating responses to the potential bidders.
- Responding to questions from bidders and issuing clarifications and addenda, if necessary
- Evaluating the proposals submitted by the bidders in response to the tender process:
  - Scrutiny of Key Submissions
  - Evaluation of Qualification Information
  - Evaluation of Technical Proposal
  - Evaluation of the Financial Proposal

5.1.8 Project Implementation, Monitoring and Management

After successful completion of the bidding process, project monitoring and management would be required to ensure that contracted deliverables are submitted and obligations are discharged by the selected contractors in accordance with their respective agreements. This would entail the following:

- Finalisation of Functional Requirements and System Requirements Specification
- Reviewing and finalising the Implementation Plan and schedule submitted by the contractors
- Monitoring the progress of implementation and variations from the plans
- Monitoring and testing of various deliverables
- Reviewing and finalising the Change Requests
- Scrutiny of invoices and releasing payment to contractors
- Final project review and preparation of “punch list” (deficiency list)
- Review and acceptance of all corrective measures
- Testing and commissioning of the system components
- Final testing, verification and validation acceptance
- Final Project Acceptance

5.2 Software and Hardware Development and Testing

Software/ Hardware Development and Testing is typically carried out by the implementing agency either directly or through a contractor. This follows the design stage and is preceded by integration, verification and validation activities that follow it. The project elements should be identified through a systems engineering process during the design stage. The system hardware, software and other elements that are standard commercial-off-the-shelf in nature will be procured and combined with the custom built elements to deliver the system in accordance with the systems engineering process.

Key steps involved in this process are as set out below:

- Prepare a Concept of Operations Report
- Prepare a Systems Engineering and Management Plan
- Create plan for hardware and software development requirements
- Create development set-up with required tools and resources
- Undertake development of hardware and software
- Undertake unit and/or device testing
- Undertake systems validation, testing and acceptance

The outputs of this stage are hardware and software that have been subjected to unit and/ or device testing and are now ready for the next stage: integration, testing and verification. The documents generated during this process would include the Systems

Engineering Management Plan (SEMP) that would include the Hardware and Software development plans, development environment and unit test plans and test results.

5.3 Integration, Testing Verification and Validation

This will be an iterative process under which the various system components will be progressively integrated into subsystems and then subjected to verification vis-a-vis the requirements and the Systems Engineering and Management Plan (SEMP). First, the individual system components will be subjected to verification to assess their compliance with the requirements. Subsequently these components will be integrated and assembled into sub-systems which will then be subjected to verification against the requirements. This process of integration will continue till it reaches the overall system level by the end of which the entire system would have been subjected to verification against the requirements.

This process will be the inverse of the process followed during the requirements and design stages earlier where the system would have been broken down into various sub-systems and components.

This process entails integrating components and subsystems each of which typically may have associated configuration and versions. It is important to monitor and manage this and the configuration of each component/ test-case version should be duly verified and noted in the verification documents.

5.4 Awareness Campaign and Outreach

One of the central objectives of setting up NUTH is that it is widely used by the public at large. Professional support should be sought in creating brand awareness. In order to popularise NUTH and also to create awareness about this service, a number of initiatives could be undertaken as listed below:

- Branding through professional help (a common branding by all agencies)
- NUTH number should be prominently displayed on:
    - the websites of transit agencies that are supported by NUTH
    - all the vehicles, stations, bus stops, terminals and interchange points used by the transit agencies that are supported by NUTH
    - all the passenger information displays on all vehicles, stations, bus stops, terminals and interchange points used by the transit agencies that are supported by NUTH on a periodical basis
    - all the information brochure containing information about transit agencies that are supported by NUTH
- NUTH may provide information feeds to television channels / FM radios / newspapers in exchange for advertising in kind. Such feeds while broadcast or published may contain references to NUTH
- NUTH may be popularised through select government communications to public at large

- NUTH may sponsor various MoUD and other government initiatives / events that are expected to receive wider media coverage
- Stickers with NUTH logo on the cars, transit and other vehicles

5.5 Operations and Maintenance

5.5.1 Operations

NUTH's focus areas of operations are data collection, its processing, fusion and information dissemination. NUTH operations, therefore, revolve around these central themes.

A. Data Collection

Data collection from various participating entities and other sources would be one of the most important operational activities undertaken by the Mumbai NUTH. Some of the activities that relate to this function are listed below:

- Identification of participating agencies (BEST, Suburban railways, Metro Rail, Monorail, Traffic Police).
- Entering into suitable agreements or other arrangements with the identified agencies.
- Review of the relevant systems being managed by the agencies and the data collected/ generated that may be useful for NUTH.
- Deciding on the data to be provided by such agencies.
- Association/Collaboration with other data providers.
- Finalising the data exchange protocols between NUTH and agency systems.
- Deciding on the method of transmission of data.
- Deciding the periodicity of transmission of data and its update.
- Receiving and storing the data.
- Setting up, managing, operating and maintaining the data receiving and storage infrastructure and system.
- Coordinating with participating agencies for ensuring that the data is provided by them to NUTH in accordance with the understanding set out in the MoU among the participating agencies. (Sample of MoU is provided as Annexure 2 to this report).

Availability of information in electronic format from the control centres/systems of various participating agencies is a key pre-requisite for NUTH. It must, therefore, be ensured that the participating agencies provide information to NUTH in a digital mode using appropriate standards and protocols. NUTH and control centres/systems of various participating agencies need to work closely with each other in order to provide transit, traffic and other related information to public.

Traffic Police control room, as part of its operations, would collect considerable amount of information; therefore, NUTH need not replicate this part but should take these as input from Traffic Police control room for the purpose of dissemination. For certain other types of data such as live transit data, parking availability data etc., NUTH may directly connect to the agencies concerned for the purposes of information acquisition.

B. Data Processing and Fusion

As part of this activity, the data collected from various participating entities is analysed, correlated and fused with other data and information. Some of the key activities that are undertaken as part of this exercise are listed below:

- Data massaging to suitably format the data received.
- Data sorting in some required order or sequence and/or data classification.
- Data validation based on various rules to ensure that data received is valid, useful, meaningful, clean and correct.
- Data aggregation by way of combining data received from multiple sources
- Preparing data summaries.
- Data analysis to derive meaning out of data using software tools.
- Data fusion by integrating of multiple data, information and knowledge to provide a single unified view using software tools.
- Setting up, managing, operating and maintaining the data processing infrastructure and system.

C. Information Dissemination

This activity deals with presenting and disseminating information that was collected and processed as part of the earlier activities. Key activities that form part of this phase are listed below:

- Setting up, managing, operating and maintaining the data dissemination infrastructure and system.
- Designing user interface which is user friendly, aesthetic, appealing, easy to navigate and understand.
- Managing the interface with users of the NUTH.
- Setting up, updating and maintaining the website.
- Setting up, managing and operating the call centre facility.
- Tying up with media and private sector entities for data dissemination.
- Taking feedback from users and improving the system.

D. Other Operational Aspects

Other operational aspects of Mumbai NUTH are as set out below:

- Hosting of NUTH systems.
- Relationship management with transit and other participating agencies covering aspects such as entering into agreements (as desired), coordinating for data exchange etc.
- Contractor and consultants hiring and management.
- Licensing of data to private sector entities to enable data dissemination by such entities.
- Branding & promotion of the NUTH helpline to create awareness and catalyse its regular use by public.
- Financial management.
- Human resource management.
- Managing relations with media.
- Feedback from the public and taking remedial measures.
- Performance evaluation.

E. NUTH Customer Feedback and Performance Evaluation

Periodic customer surveys and feedback reviews may be undertaken to measure system performance from both the public perspective and systems accuracy and completeness. Performance measurement would include testing of accuracy, reliability and completeness of the information that is provided to the public. Appropriate measures must be undertaken to address any deficiency in the system and/or based on customer feedbacks.

5.5.2 Maintenance

There are various systems that would interface with NUTH. The BEST, Western and Central Railway systems (both managed by Centre for Railway information Systems), Monorail, Metro Rail system would provide data feed to NUTH. NUTH backend system would comprise hardware, software, networking and communication to host NUTH backend. There would be, in addition, support systems such as power back up, air conditioning, access management, building management etc. and other utilities and services supporting the NUTH backend. Each of these must be maintained in proper state of upkeep and repair to the acceptable standards so as to support NUTH related activities.

A. Systems Interfacing with Mumbai NUTH: Systems of Participating Agencies

Such systems and associated equipment will be maintained by the agency to which they belong such as BEST, Suburban railways Mumbai Metro Rail and Monorail. The agency may in turn maintain these systems and associated equipment either directly or through their contractor(s) engaged for the purpose. NUTH system would generate alerts as and when any of the requisite data feed from these

systems is not reaching NUTH system and would report the same to the agency concerned so that the agency may get the equipment inspected and take corrective action within a reasonable time frame.

B. Systems Interfacing with Mumbai NUTH: Traffic Control Room

Such systems and associated equipment will be maintained by the MCGM. The MCGM may, in turn, maintain these either directly or get these maintained by the contractor(s) engaged for the purpose. NUTH system would generate alerts as and when any of the requisite data feed for which the MCGM is responsible is not reaching NUTH system. MCGM or its contractor may get the system inspected and take corrective measures.

C. Mumbai NUTH Backend System: Hardware

Backend hardware would comprise servers, switches, storage, UPS, network and communication equipment that support NUTH operations. Such equipment would include those deployed at the primary site as well as the ones deployed at the disaster recovery site. NUTH backend hardware could be maintained by the respective Original Equipment Manufacturer (OEM) or their authorised resellers, as the case may be. The maintenance should be subject to agreed service levels in terms of response and resolution times.

D. Mumbai NUTH Backend System: Standard Software

NUTH backend standard software would comprise database, operating systems, firewalls, MS-Office etc. that support NUTH operations. Such software would include those deployed at the primary site as well as the ones deployed at the disaster recovery site. NUTH backend standard software would be maintained by the respective software owner or their authorised resellers, as the case may be. The maintenance should be subject to agreed service levels in terms of response and resolution times.

E. Mumbai NUTH Backend System: Application Software

NUTH Application software would comprise the application software that supports NUTH operations and would include those deployed at the primary site as well as the ones deployed at the disaster recovery site. NUTH Application software can be maintained by the respective software developer or the agency who has commissioned the development of the software. The maintenance should be subject to agreed service levels in terms of uptime, response and resolution times. In case of the agency maintained system, the agency needs to have qualified and dedicated staff in order to properly maintain the system.

F. Mumbai NUTH Backend System: Communication Links

Communication links would be maintained by the respective telecom service providers to agreed service levels in terms of uptime, response and resolution times.

G. Mumbai NUTH Backend System: Other Facilities

Other facilities such as fire-fighting equipment, air conditioning, power back up, false flooring & ceiling, furniture & fixture and civil structure pertaining to NUTH facilities, where applicable, could be maintained by the respective OEM/supplier/contractor. The maintenance would be subject to agreed service levels in terms of response and resolution times.

5.6 Standard Operating Procedures Outline

There needs to be clearly defined and documented procedures governing the daily operational activities to be carried out in relation to Mumbai NUTH.

It is recommended that standard operating procedures are laid down for the same covering the following:

- Jurisdiction of Mumbai NUTH with maps
- Organisation structure and reporting relationships
- Hours of operation, shift details, staff deployment during various shifts
- Emergency and other contact numbers
- Details regarding capturing log of various operational activities
- Responsibilities of various agencies
- Role description of various positions and level of decision making authority
- Coordination mechanism with various agencies
- Facility and building managements aspects such as utilities, services etc.
- Procedures for notifications
- Data backup and archival policies
- Asset custody and maintenance related procedures
- Access control mechanism
- Data and asset security
- Communication with media
- Communication infrastructure
- Procedure for bypassing any policy requirements
- Handling visitors
- Office administration
- Training requirements
- Other NUTH manuals

The Standard Operating Procedures (SOPs) would evolve with time and experience and also based on inputs from various stakeholders. Therefore, the SOP document would have to be updated in line with evolving procedures on a periodic basis. Training must be provided to the responsible staff on an annual basis or as otherwise needed.

5.7 Obsolescence Management

Obsolescence of the systems to be deployed in Mumbai NUTH needs to be managed in a structured manner. It is recommended that during the contract period, the contractor may be entrusted with the responsibility to support and maintain the systems supplied and to ensure that spares are available for providing such support. The responsibility to manage obsolescence of the system will be that of the contractor over the contract duration.

Post expiry of the initial contract, the procurement process for support services may be undertaken by the implementing agency.

Some of the ways in which Mumbai NUTH implementing agency or any consultant engaged by it can deal with obsolescence are listed below:

- Undertaking selection of technology keeping in mind the stage at which the technology is, it's projected phase-out, ecosystem to support the same (suppliers, support agencies etc.)
- Incorporating contractual provisions placing obligation on the contractors to ensure continued support over the expected life of the equipment
- Requiring contractors contractually to ensure availability of spares over the expected life of equipment
- As a part of procurement, requiring the bidders to obtain undertaking from the Original Equipment Manufacturer (OEM) to ensure continued support and availability of spares over the expected life of equipment
- Plan phasing out of the system in advance based on discussions with the OEM of the system regarding their time frame to phase out the system/technology.

5.8 Retirement and Replacement

The Mumbai NUTH system components would need to be periodically reviewed with respect to its continued utility in supporting the then current user needs and its cost effectiveness as compared to other options. The system could be retired or replaced due to several reasons:

- The system is no longer required and/or the user needs have either changed or are being supported in some other manner
- The system no longer meets the user needs
- It is no longer cost effective to operate and maintain the system
- Newer version of system supports the current user needs better and/or is more cost effective

Based on the analysis, a decision could be taken for its continuation or for retiring it from service.

6.0 NUTH STAKEHOLDERS AND ORGANISATION

6.1 Introduction

This chapter provides an institutional framework for implementing the NUTH system covering the recommended institutional set-up, stakeholders, their roles and responsibilities, and agreements.

6.2 Transportation Sector Organisational Structure

6.2.1 Role of Various Levels of Governments in Transportation

Various levels of governments or agencies controlled by them have participation in provision of transportation services in Mumbai. Table 6-1 provides a brief overview of the role currently being played by various levels of governments or agencies controlled by them.

Table 6-1: Mumbai: Government and Its Agencies in Urban Transportation

Govt. Level	Entity	Description and Roles in Transportation
Central Government	Western Railway	• Part of Indian Railways, GoI • Operates suburban rail services in Mumbai and nearby areas • Licenses parking facilities at its stations and nearby areas under its jurisdiction
	Central Railway	• Part of Indian Railways, GoI • Operates suburban rail services in Mumbai and nearby areas • Licenses parking facilities at its stations and nearby areas under its jurisdiction
	Mumbai Railway Vikas Corporation Ltd.	• A company registered under the Companies Act, 1956 by Ministry of Railways, GoI • Undertakes planning and development of Mumbai suburban rail system
	Ministry of Road Transport and Highways (MoRTH)	• Ministry of Government of India • Developing and managing National Highways in India, Motor Vehicle legislation, administration of Motor Vehicles Act, 1988
	Ministry of Urban Development, GoI	• Ministry of Government of India • National Urban Transport Policy formulation, supporting its implementation by States and local governments through various funding schemes.

Govt. Level	Entity	Description and Roles in Transportation
State Government	Mumbai Metropolitan Region Development Authority (MMRDA)	• Constituted under Mumbai Metropolitan Region Authority Development Act, 1974 • Prepares regional plans for the MMR and coordinates for execution of the projects and schemes in MMR • Is the concessioning authority for Metro Rail and Monorail services in Mumbai
	Unified Mumbai Metropolitan Transport Authority (UMMTA)	• Constituted through a GoM resolution • Chaired by the Chief Secretary, Government of Maharashtra • Multi-modal transportation coordination in MMR.
	Urban Development Department, GOM	• Department of Government of Maharashtra • Administrative department for urban local bodies in Maharashtra
	Transport Department, GOM	• Department of Government of Maharashtra • Vehicle registration, licensing, permits, city bus routes • Regulation of para-transit operators (taxi, auto rickshaws) and stage carriage buses including notification of permit conditions
	Public Works Department, GOM	• Department of GoM • Develops and maintains roads in Mumbai that are under its jurisdiction
	Maharashtra State Road Development Corporation (MSRDC)	• A company registered under the Companies Act, 1956 by GoM • Road development, operation and maintenance in Maharashtra State
	Maharashtra State Road Transport Corporation (MSRTC)	• Statutory corporation established under the Road Transport Corporation Act, 1950 • Operates bus services in MMR and rest of Maharashtra
	Maharashtra Industrial Development Corporation (MIDC)	• A corporation established under the Maharashtra Industrial Development Act, 1961 by GoM • Develops and maintains roads in the industrial areas under its jurisdiction • Licenses parking facilities in its area

Govt. Level	Entity	Description and Roles in Transportation
	City and Industrial Development Corporation of Maharashtra Ltd. (CIDCO)	• A company registered under the Companies Act, 1956 by GoM • Planning and development of towns in Maharashtra
	Mumbai Traffic Police	• Part of Mumbai Police organisation, reports to Home Department, Government of Maharashtra • Regulation and management of traffic in Mumbai • Operation of traffic signals • Traffic rules enforcement
Local Government	Municipal Corporation of Greater Mumbai (MCGM)	• Established under the Bombay Municipal Corporation Act, 1888 • Constructs and maintains roads, licenses parking facilities, installs and maintains traffic signals in its area of jurisdiction
	Brihan-Mumbai Electric Supply & Transport Undertaking (BEST)	• Undertaking of MCGM • Administrative reporting to MCGM Operates bus services in Mumbai and nearby cities in MMR.

There are several authorities/agencies in Mumbai engaged in the area of planning, traffic management, transit operations, parking, road construction & maintenance, and bus terminal operations as listed in Table 6-2.

Table 6-2: Mumbai: Agencies in Different Areas of Transportation

Area	Entities
Traffic Management	Mumbai Traffic Police
	Municipal Corporation of Greater Mumbai (MCGM)
Transit	Brihan-Mumbai Electric Supply & Transport (BEST)
	Maharashtra State Road Transport Corporation (MSRTC)
	Western Railway (Indian Railways)
	Central Railway (Indian Railways)
	Mumbai Metropolitan Region Development Authority (MMRDA) for Mumbai Monorail and Metro Rail
Roads Construction	Public Work Department (PWD), GoM
	Maharashtra State Road Development Corporation (MSRDC)
	Mumbai Metropolitan Region Development Authority (MMRDA)

Area	Entities
and Maintenance	Maharashtra Industrial Development Corporation (MIDC)
	Municipal Corporation of Greater Mumbai (MCGM)
Parking	Municipal Corporation of Greater Mumbai (MCGM)
	Mumbai Metropolitan Region Development Authority (MMRDA)
	Brihan Mumbai Electric Supply & Transport (BEST)
	Western Railway
	Central Railway
Bus Terminals	Maharashtra State Road Transport Corporation (MSRTC)
	Mumbai Metropolitan Region Development Authority (MMRDA)
	Brihan Mumbai Electric Supply & Transport (BEST)
Emergency /Disaster Response	• Fire & Emergency Services, Government of Maharashtra • Mumbai Police • Maharashtra Disaster Management Unit (MDMU)

6.3 Institutional Set Up

6.3.1 Implementing Agency

There are several options (Table 6-3) that could be explored regarding entrusting the responsibility for setting up and operating the NUTH for Mumbai.

Table 6-3: Options for Mumbai NUTH Implementing Agency

Option	Implementing Agency	Remarks
1	UMMTA	• UMMTA has the responsibility for multi-modal transportation coordination in the MMR area. • UMMTA is headed by Chief Secretary and has representation from Urban Development Department (GoM), Transport Department (GoM), MMRDA, MCGM, BEST, India Railways, among others. • All the entities that are playing role in transport sector in MMR are represented in UMMTA. • It is not a legal entity. Hence engaging contractors to carry out various activities could be an issue. • Capability to implement and operate ITS project such as NUTH could be an issue.

Option	Implementing Agency	Remarks
2	Urban Development Department, Govt. of Maharashtra	• Urban Development Department, GoM is the administrative department of all urban local bodies in Maharashtra. Most of the municipal corporations in the MMR operate bus services. • Urban Development Department, however, has no control over suburban rail services and MSRTC.
3	Transport Department, Govt. of Maharashtra	• Transport Department, GoM is the administrative department for MSRTC which operates bus services in Maharashtra. • Transport Department, however, has no control over urban local bodies (operating city bus services) and suburban rail services.
4	MMRDA	• It is a regional planning, monitoring and coordinating authority for execution of the projects and schemes in MMR. • Monorail and Metro Rail are being operated by the transit agencies under contract with MMRDA. • MMRDA, however, has no control over the remaining transit agencies in the MMR area. • Capability to implement and operate ITS project such as NUTH could be an issue.

Considering that UMMTA has representation from all the transportation sector stakeholders in the MMR and is headed by Chief Secretary of the Maharashtra State, it is recommended that UMMTA be entrusted with the responsibility for setting up and operating the NUTH. UMMTA could in turn set up the NUTH through MMRDA or any other entity.

6.3.2 Stakeholders, Roles and Responsibilities

Table 6-4 shows the suggested roles and responsibilities of the key stakeholders associated with the Mumbai NUTH.

Table 6-4: Roles and Responsibilities

Area	Entities	Roles and Responsibilities
Overall Transportation	• Unified Mumbai Metropolitan Transport Authority (UMMTA)	• To set up NUTH • To enter into agreement/MoUs with various agencies associated with NUTH, as required • To coordinate with various agencies associated with NUTH

Area	Entities	Roles and Responsibilities
Traffic	• Mumbai Traffic Police • Municipal Corporation of Greater Mumbai (MCGM)	• Signals and other traffic equipment installation and maintenance • Managing the contracts and relationships with the contractors responsible for installation, maintenance and upkeep of the signalling system and other traffic related ITS equipment deployed by the agency • To share data and updates as listed in Section 6.3.3
Transit	• Brihan Mumbai Electric Supply & Transport (BEST) • Western Railway • Central Railway • Maharashtra State Road Transport Corporation (MSRTC) • Mumbai Metropolitan Region Development Authority (MMRDA)	• To manage and monitor transit operation • To share data and updates as listed in Section 6.3.3
Roads	• Public Work Department (PWD), GoM • Maharashtra State Road Development Corporation (MSRDC) • Mumbai Metropolitan Region Development Authority (MMRDA) • Maharashtra Industrial Development Corporation (MIDC) • Municipal Corporation of Greater Mumbai (MCGM)	• Road construction and maintenance • Managing the contracts and relationships with the contractors responsible for construction & maintenance of road network • To share data and updates as listed in Section 6.3.3
Parking	• Municipal Corporation of Greater Mumbai (MCGM) • Mumbai Metropolitan Region Development Authority (MMRDA) • Western Railway • Central Railway • Maharashtra State Road Transport Corporation (MSRTC)	• Manage the parking facility • To provide agreed data / information in desired form and frequency as listed in Section 6.3.3

Area	Entities	Roles and Responsibilities
Bus Terminals	• Maharashtra State Road Transport Corporation (MSRTC) • Mumbai Metropolitan Region Development Authority (MMRDA) • Brihan Mumbai Electric Supply & Transport (BEST)	• Manage the bus terminals • To share data and updates as listed in Section 6.3.3
Railway Stations	• Western Railway (Indian Railways)	• Manage the suburban railway stations • To share data and updates as listed in Section 6.3.3
	• Central Railway (Indian Railways)	• Manage the suburban railway stations • To share data and updates as listed in Section 6.3.3
Weather	• Regional Meteorological Centre, Mumbai	• To share data and updates as listed in Section 6.3.3
Emergency /Disaster Response	• Fire & Emergency Services, GoM • Mumbai Police • Maharashtra Disaster Management Unit (MDMU)	• To share data and updates as listed in Section 6.3.3

6.3.3 Data Sharing by Project Stakeholders

Data and information sharing is an important element of NUTH. In order to support data and information exchange, a project level architecture must be developed and applicable standards for information exchange must be established and adopted by each participating agency. Table 6-5 below provides the details of the data sharing related to transit agencies for the NUTH.

Table 6-5: Entities Sharing Transit Data with NUTH

Transit Related Data	BEST / MSRTC	Western & Central Railway	MMRDA *
Contact details, website details	Y	Y	Y
Services: Express, Ordinary, AC, Non AC, Night services, Fast	Y	Y	Y
Routes: Details of the routes operated	Y	Y	Y
Schedule Data: Frequency during peak/off-peak hours, Timings	Y	Y	Y

Transit Related Data	BEST / MSRTC	Western & Central Railway	MMRDA *
Timing of operations: First and last service on various routes	Y	Y	Y
Fare structure: Normal fares, special fares, concessions for various category of commuters	Y	Y	Y
Pass Details: Pass charges for various category of commuters, validity rules	Y	Y	Y
Details of Bus terminals, Bus Stops, Railway Stations	Y	Y	Y
Inter-modal transfer options: feeder services, connecting routes, interchange stations/terminals	Y	Y	Y
Transit trip planner	Y	Y	Y
Tourism related information with connecting transit options to tourist spots	Y	Y	Y
Running status	Y	Y	Y
Departures scheduled at bus terminals, bus stops	Y	Y	Y
Estimated Time of Arrival (ETA)	Y	Y	Y
Service delay, disruptions	Y	Y	Y
Information on new services, discontinuation of any service etc.	Y	Y	Y
Rerouting	Y	Y	Y
GPS feed data	Y		
Incidents & Events	Y	Y	Y

* For the transit systems being operated under contract with MMRDA such as Monorail, Metro Rail.

Table 6-6 below provides the details of the data sharing by traffic related agencies for the NUTH.

Table 6-6: Entities Sharing Traffic Data with NUTH

Traffic Related Data	Mumbai Traffic Police	MCGM	Road Owning Agencies (MSRDC, PWD, MMRDA)
Road attributes: name, number of lanes, whether one-way or two-way, GIS maps etc.	Y	Y	Y

Traffic Related Data	Mumbai Traffic Police	MCGM	Road Owning Agencies (MSRDC, PWD, MMRDA)
Location of various traffic related equipment: signalised junctions, cameras, variable messages signs etc. on map and as list	Y	Y	
Location of red light enforcement cameras, speed enforcement cameras	Y	Y	
Speed limit on various road sections	Y		
Entry restrictions such as one way, no entry, time based entry, no U-Turn etc.	Y		
Incident information	Y		
Event information	Y		
Road closures, diversions	Y	Y	Y
Live surveillance camera feeds, live messages being displayed on the variable messages signs, traffic volume data, details of public notices on traffic etc.	Y	Y	
Plans and schedules for construction & maintenance and updates on the same	Y	Y	Y

Table 6-7 below provides the details of the parking data sharing by various agencies with the NUTH.

Table 6-7: Entities Sharing Parking Data with NUTH

Entities	Data Sharing
• Municipal Corporation of Greater Mumbai (MCGM) • Mumbai Metropolitan Region Development Authority (MMRDA) • Western Railway • Central Railway • Maharashtra State Road Transport Corporation (MSRTC)	**Parking Facility Details** • Capacity • Availability • Type of vehicles that can be parked • Operational hours • Parking charges • Mode of payment • Operating agency • Contact details

Table 6-8 below provides the details of other entities sharing data with the NUTH.

Table 6-8: Other Entities Sharing Data with NUTH

Area	Entities	Data Sharing
Bus Terminals	• Maharashtra State Road Transport Corporation (MSRTC) • Mumbai Metropolitan Region Development Authority (MMRDA) • Brihan Mumbai Electric Supply & Transport (BEST)	• Details of services operated from the bus terminals • Details of parking facility such as capacity, type of vehicles that can be parked, operational hours, charges, mode of payment, operating agency, contact details • Updates on service delay / disruptions / facility closure • Updates on construction/ maintenance activities
Emergency / Disaster Response	• Fire & Emergency Services, Government of Maharashtra • Mumbai Police • Maharashtra Disaster Management Unit (MDMU)	• Incident data • Accident data • Location of the emergency response facilities • Contact details • Periodical updates to the above
Weather	Regional Meteorological Centre, Mumbai	• Weather updates • Temperature, wind speed, fog, visibility details, humidity, rainfall

6.3.4 Mumbai NUTH Organisation

As with any operating entity, organisational structure of NUTH directly impacts its ability to operate effectively. Figure 6-1 shows a typical NUTH operations management structure.

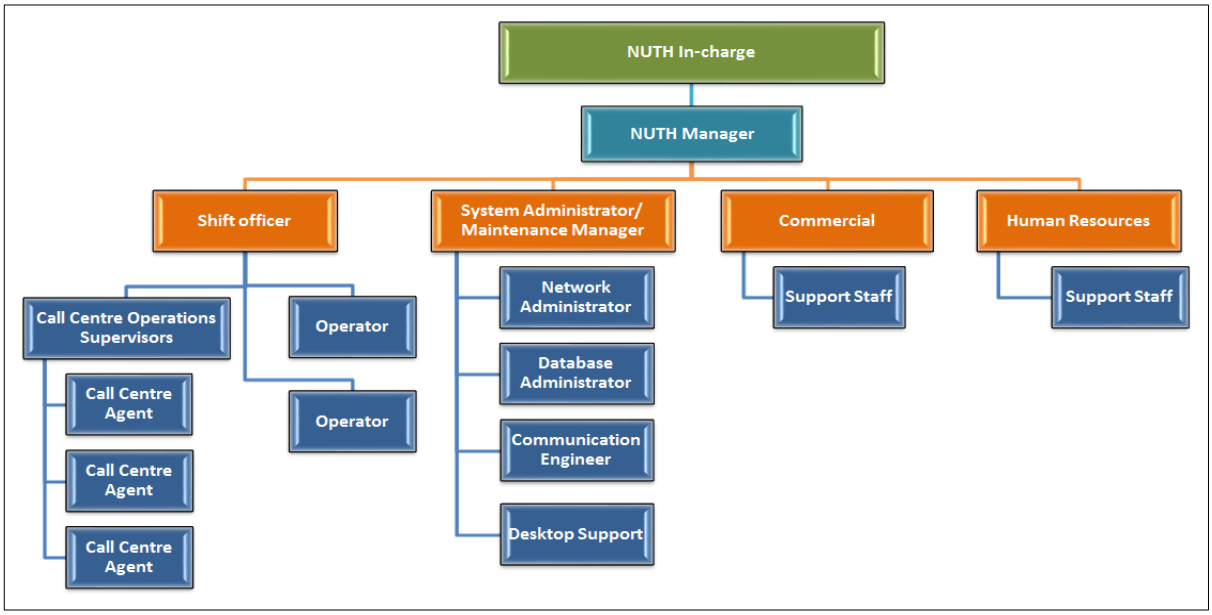


Figure 6-1: Mumbai NUTH Organisation Structure

Table 6-9 provides the details of key positions for Mumbai NUTH organisation together with associated role description. The actual position and role description may vary depending on the approach followed by the implementing agency.

Table 6-9: NUTH Typical Positions and Role Description

Positions	Description
NUTH In-Charge	• Should have at least 10-15 years of relevant experience • Should have degree in transport planning/transportation engineering • Responsible for overall management, monitoring and operation of the NUTH • Formulation of procedures governing NUTH operations • Point of contact for authorities, media and other external agencies
NUTH Manager	• Should have 8-12 years of relevant experience • Should have post graduate degree in computer science/MCA • Reports to NUTH In-Charge • Responsible for day to day operation of the NUTH • Responsible for assigning and deployment of the Operators in shifts • Plans for the scheduled maintenance of system components in coordination with suppliers, Shift Officer and the System Administrator • Training of Shift Officers
Shift Officer	• Should have 5-10 year of relevant experience

Positions	Description
	• Should have graduate degree in any field • Reports to NUTH Manager • Responsible for day to day operation of the NUTH during a shift • Responsible for supervision of the Operators deployed in a shift • Coordinates with Call Centre Supervisor and Operators • Training of Operators and quality control of call centre
Operator	• Should have 3-4 year of relevant experience • Should have graduate degree in computer application • Reports to Shift Officer • Operates and manages the system through operator console • Reports any down time in applications and data exchanges • Coordinates with other agencies which are part of workflow being managed by the Operator • Shares information and report events with agencies/entities concerned in accordance with policies and procedures
Call Centre Supervisor	• Should have 3-4 year of relevant experience • Should have graduate degree in any filed • Reports to Shift Officer • Responsible for day to day operation of the Call Centre • Responsible for supervision of the call centre agents • Coordinates with Call Centre Agents • Training of call centre agents
Call Centre Agent	• Should have at least 1 year of experience • Should have matriculation certificate and fluency in language • Receiving and responding to calls from public / other stakeholders
System Administrator (also responsible for routine maintenance of the backend systems)	• Should have at least 7-10 year of relevant experience • Should have graduate engineering degree in computer science/ information technology • Reports to NUTH Manager • Responsible to manage the data centre and associated IT environment such as network, communication, security, firewall, desktop support etc. • To monitor and supervise the team comprising network administrator, database administrator, desktop support personnel, communication engineer etc. • Responsible to configure the computing and other IT system • To implement policy giving role based access to various personnel to the IT systems • To manage and monitor security of the IT systems

Positions	Description
	• Coordinates with vendors and suppliers for maintenance and support of the hardware and software deployed in NUTH
Commercial / Finance Manager	• CA or Post Graduate in Commerce/Accounting with relevant experience of at least 10 years • Contract management • Invoicing and payments
Human Resources Manager	• Post Graduate in any discipline with relevant experience of at least 8 years • Recruitment • Training • General administration and facilities maintenance

The above recommended profiles are for guidance purpose only and may be refined based on local manpower availability and skill sets best suited for the proposed Mumbai NUTH. Generic Operations Document for NUTH may be referred for information regarding training and capacity building of these resources.

6.3.5 Agreements

UMMTA, as implementing agency, would need to issue necessary communications to BEST and other municipal transport undertakings, Western Railway, Central Railway, MSRTC, MMRDA, MSRDC, PWD (GoM), Traffic Police of the city and municipal corporations for participating in NUTH and sharing requisite information. Such communications could be sent directly by UMMTA or through the parent department / ministry. UMMTA may enter into suitable agreements and/or MoUs with various agencies in this behalf a sample of which is provided as Annexure 2.

7.0 PROJECT COST, REVENUE AND FUNDING

This chapter provides details of the indicative for the proposed Mumbai NUTH. The costs have been worked out based on costs of similar international and Indian deployments and are indicative in nature. The costs must be refined and finalised during the DPR stage and as part of systems engineering and design phases of the project.

7.1 NUTH Sizing

Sizing of NUTH will depend upon the following factors:

1. Amount of information to be collected and processed by NUTH
2. Number of servers, leased communication line, computer hardware etc. to be required to handle information collection and dissemination
3. Number of personnel deployed
4. Volume/duration of session seeking information request.

These aspects would be examined and detailed at the time of system design.

7.2 Financial Budget

7.2.1 NUTH Cost Estimates

Mumbai NUTH system cost would include the cost of NUTH backend system, Consoles, Servers, Systems Engineering & Design, and Programme Management/System Integration costs.

The estimated cost of NUTH is approximately **₹ 14.77 crore** for Mumbai and the estimated annual O&M cost is approximately **₹ 4.02 crore** (Refer Table 7-1). The project cost and sizing may undergo changes at the time of preparation of detailed project report.

Table 7-1: Mumbai NUTH system Deployment and O&M Cost

S.No.	Items	Unit Rate (Rs.)	UOM	Qty.	Amount (Rs.)
I	**Implementation Cost**				
A	**Components Cost**				
1	NUTH System (including the development of interfaces) a) Data Collection, Processing and Storage System b) Data Dissemination System ▪ NUTH Call Centre ▪ NUTH website ▪ NUTH Mobile Applications ▪ NUTH Social Media pages c) Trip Planner		L.S.	1	9,00,00,000
2	Call centre personnel and operator consoles	80,000	per unit	15	12,00,000
3	Systems for other NUTH staff	80,000	per unit	8	6,40,000
4	Servers and storage	7,00,000	per unit	10	70,00,000
5	NUTH Civil Works	1,00,000	per sq. m.	175	1,75,00,000
	Sub Total - A				***11,63,40,000***
B	**Project Design Management Cost**				
1	Systems Engineering & Design	10%	of A		1,16,34,000
2	Programme/Implementation Management, System Integration	15%	of A		1,74,51,000
3	Training and Capacity building	2%	of A		23,26,800
	Sub Total - B				***3,14,11,800***
	Total Implementation Cost (A+B)				***14,77,51,800***
II	**O&M Cost (per annum)**				
1	Operations Cost (including electricity, water, printing, communication, housekeeping, security, etc.)	7%	of A		81,43,800

S.No.	Items	Unit Rate (Rs.)	UOM	Qty.	Amount (Rs.)
2	Staff cost				
a	Call Centre Personnel + Operator	25,000	Man-months	45 x 12	1,35,00,000
b	Other staff cost		refer staffing cost		69,60,000
	Total Staff cost				2,04,60,000
3	Maintenance Cost	10%	of A		1,16,34,000
	Total O&M Cost (per annum)				***4,02,37,800***

7.2.2 Staff Cost

Indicative cost of staff to be deployed for the Mumbai NUTH is provided in Table 7-2:

Table 7-2: Staff Cost

S.No.	Personnel	Number	Shift	Cost/Month (Rs.)	Cost/Annum (Rs.)
1	NUTH In charge	1	1	85,000	10,20,000
2	NUTH manager	1	1	70,000	8,40,000
3	System/ Network administrator	1	1	50,000	6,00,000
4	Database administrator	1	1	40,000	4,80,000
5	Desktop support	1	1	30,000	3,60,000
6	Commercial/HR	1	1	50,000	6,00,000
7	Shift officer	1	3	50,000	18,00,000
8	Call centre supervision officer	1	3	35,000	12,60,000
	Total Cost				**69,60,000**

7.2.3 Summary of Financial Budget

Table 7-3 provides a summary of the estimated budget for the Mumbai NUTH project:

Table 7-3: Overall Planning Level Budget for Mumbai NUTH System

S.No.	Description	Implementation Cost (Rs.)	O&M Cost - Annual (Rs.)
1	NUTH	14,77,51,800	4,02,37,800

A budget of **₹ 14.77 crores** is required for Mumbai NUTH project, which includes the cost of project development, systems engineering, hardware, software, systems integration, testing and commissioning. In addition, a budget of **₹ 4.02 crores** is required towards annual operations and maintenance of the NUTH.

7.3 Revenue Streams

Mumbai NUTH project may not be able to generate any revenue by charging users. Worldwide also such services are provided by government entities free of cost to the users with users having to bear the cost of making calls to the transport helpline numbers providing information generated by the NUTH. The data being collected may be shared by Mumbai NUTH with various entities (including the private sector) without any charges to begin with, but with an option to charge for the same retained by the implementing agency.

Some of the funding sources that could be used and/or allocated for operating and maintaining the Mumbai NUTH are as under:

- Fines collected by the Traffic Police through the enforcement measures
- Parking charges collected from users
- From private entities for sharing data
- From advertisers for granting right to display advertisements on website, mobile, helpline apps providing information generated by NUTH
- Sponsorship by corporates in lieu of exclusive right to co-brand

One of the pre-requisites to the possibility of realisation of revenue from data is the utility, popularity and marketability of the data. Similarly, number of users accessing any particular channel (website, mobile app, helpline) would determine its appeal to advertisers. Content quality, brand perception and popularity of service would, therefore, be the key determinants of revenue realisation potential from data marketing/ information dissemination activities.

It may be noted that the quantum of funding available from the fines collected may go down progressively as the compliance to traffic rules improves which in any case is the end objective for implementing the enforcement measures.

7.4 Funding of Mumbai NUTH

Central Government may use any of its programmes for supporting such initiatives. Funding for setting up of the NUTH may be secured with the support of the State Government under the centre's on-going or future schemes. Central government has launched the Smart Cities Mission[22]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[23] and the city may avail funding from one or both these schemes.

Multilateral or bilateral funding may also be secured at Central Government, State Government or City levels. Since these projects support environment management as well, national and international programmes providing funding support for undertaking environment related measures may also be accessed based on the requirements of such programmes.

Funding for Operations & Maintenance (O&M) activities are critical as these projects require operational systems and functional teams to manage the O&M activities. The O&M cost of NUTH may be borne by the UMMTA or the agency nominated by UMMTA.

7.5 Implementation Structure

Considering the limited revenue potential, it is recommended that Mumbai NUTH be implemented by government agencies. Funding of the project should be met out of budgetary resources of the government.

In view of the capacity constraints, implementing agency may engage a service provider to develop, operate and maintain the system.

[22] Smart Cities- Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)
[23] Atal Mission for Rejuvenation and Urban Transformation (AMRUT) - Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)

8.0 RESOURCES, REFERENCES & CONTACT DETAILS

8.1 Resources & References

The following is a list of documents that have been used and referenced in the preparation of this report. These documents provide additional information to the readers if more in-depth information is needed on any specific topic.

- National Urban Transport Helpline (NUTH) Operations Document, Ministry of Urban Development, Government of India (2016)
- Traffic Management and Information Control Centre (TMICC) Operations Document, Ministry of Urban Development, Government of India (2016)
- State of the Art Report for TMICC and NUTH, Ministry of Urban Development, Government of India (2013)
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- Techno-economic Feasibility Study for Personal Rapid Transit in Mumbai, MSRDC (2012)
- Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, MoUD, GoI (2008)
- Smart Cities- Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)
- Atal Mission for Rejuvenation and Urban Transformation (AMRUT) - Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)
- Mumbai City Development Plan 2005-2025

8.2 Contact Details

Sl.	Name	Designation & Contact Details	Organisation
1.	Mr. Victor S. Nagoankar	Officer on Special Duty (OSD) Mob:9869313148, Email: osd@bestundertaking.com	BEST, Mumbai
2.	Mr. Chandrahas Tangsali	Dy. Chief Manager Traffic (Planning & Control) Off: 24185971/ 24186346 (127) Email: besttraf@bom7.vsnl.net.in	BEST, Mumbai
3.	Mr. Praveen Shetty	Traffic Officer, Planning	BEST, Mumbai

Sl.	Name	Designation & Contact Details	Organisation
		Mob: 9920735125 Email: pravinshetty67@gmail.com	
4.	Mr. Samir Unhale	Dy. Metropolitan Commissioner, MMRDA & OSD, JNNURM Mob:9867672412 Email: jnnurm.mah@gmail.com	MMRDA, Mumbai
5.	Mr. Anil Satav	Asst. Engineer (Traffic) Mob: 9869058765 Email: anil.7v@gmail.com	MCGM, Mumbai
6.	Mr. Vishal Kadam	Project Manager – Schneider Electronics Traffic Police Control Room, Worli Mob: 9320320728	Traffic Police, Mumbai
7.	Mr. Naresh Chandra	Director Technical Mob:9773193366 Email: dt@mrvc.gov.in, nareshchandra2001@yahoo.com	Mumbai Rail Vikas Corporation (MRVC), Mumbai
8.	Mr. Anoop Kumar Agrawal	Dy. Chief Electrical Engineer -I Mob: 9004444909 Email: dycee1@mrvc.gov.in	Mumbai Rail Vikas Corporation (MRVC), Mumbai
9.	Mr. Sunil Mathur	Chief Engineer-Rolling Stock Mob: 9004490307	Western Railway, Mumbai
10.	Mr. O.P. Kesari	Chief Electrical Engineer, Loco Mob: 9987640302	Central Railway, Mumbai
11.	Mr. Deepak Rathi	Sr.DEE (Operation), Western Railway	Western Railway, Mumbai
12.	Mr. S.S. Mathur	General Manager (CC)	Centre for Railway Information Services (CRIS), Ministry of Railways, Govt. of India, Delhi

Annexure 1(A): Minutes of Meeting with Stakeholders

SUTP PC1B2- Meeting to discuss and present NUTH Concept for Mumbai

Project Title	Consultancy services to develop operations documents for Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH)	Date of Discussion: 21 April 2014
Subject	Meeting to discuss and present NUTH Concept for Mumbai	
Location	Mantralaya, 4th floor, Main Building Urban Development Deptt., Madam Cama Road, Nariman Point, Mumbai – 400032	
Present	In accordance with the list attached	DIMTS Mr. Rakesh Jain, Vice President Mr. Alok Sethi, DGM

Discussion Points

- A copy of the Mumbai NUTH presentation was provided by DIMTS to Jt. Secy. (Urban Development).
- Concept of Mumbai NUTH was explained by DIMTS as listed below:
  - Both transit as well as traffic information would be disseminated by Mumbai NUTH
  - Mumbai NUTH would have website, phone, mobile app as well as social media component (Twitter, Facebook)
  - In respect of the NUTH phone component, the idea is to reduce agent based responses in order to minimise costs
  - To begin with MCGM area could be considered and later on other satellite town adjoining Mumbai could be considered
- DIMTS explained that Mumbai UMMTA could be considered as implementing agency for the NUTH as it has representation from all transport sector agencies in Mumbai.
- BEST confirmed that they would provide all the required data for Mumbai NUTH as and when it is implemented. BEST informed that through their website and helpline they are already disseminating information related to their bus services.
- MMRDA confirmed that they would provide all the required data pertaining to the transit services under their control for Mumbai NUTH as and when it is implemented.

- MCGM informed that they are responsible for installation and maintenance of the signals and Mumbai Traffic Police operate these.
- On a query from GoM regarding Railway's data, DIMTS informed that during a meeting with Centre for Railway Information Systems (CRIS), which manages the information systems of the entire Railways, CRIS has informed that they would provide data to the NUTH implementing agency based on direction from Railway Board, as and when the project is implemented.
- BEST informed that they are in the process of launching BEST helpline for their services and they are facing connectivity issues in implementing the short code 155220 in accordance with direction of MoUD, GoI.
- GoM representatives informed that decision on institutional structure for implementation would be taken by Chief Secretary / UMMTA at appropriate time.
- GoM representatives requested DIMTS to mail them the Mumbai NUTH presentation.

Abbreviations: BEST - Brihan Mumbai Electric Supply Undertaking, **CRIS** - Centre for Railway Information Systems, **DIMTS** - Delhi Integrated Multi Modal Transit System Limited, **GoM** - Government of Maharashtra, **GoI** - Government of India, **ITS** - Intelligent Transport System, **MMRDA** - Mumbai Metropolitan Region Development Authority, **MCGM** - Municipal Corporation of Greater Mumbai, **MoUD** - Ministry of Urban Development, **NUTH** - National Urban Transport Helpline, **OSD** - Officer on Special Duty, **TMICC** - Traffic Management and Information Control Centre.

List of attendees:

S. No.	Name and Designation	Organisation	Contact Details
1.	Ms. Seema Dhamdhere Joint Secretary	Urban Development Department, GoM	dhamdhere_seema@yahoo.co.in
2.	Mr. Victor S. Nagoankar Officer on Special Duty	BEST	osd@bestundertaking.com
3.	Mr. Samir Unhale Deputy Metropolitan Commissioner	MMRDA	jnnurm.mah@gmail.com
4.	Mr. Anil Satav Traffic Department	MCGM	anil.7v@gmail.com

Annexure 1(B): Suggestions by Mumbai Stakeholders

Suggestions Given by Mumbai Stakeholders During the Capacity Building Workshop on TMICC & NUTH held during 19-22 Jan 2015

1. Suggestions by BEST

Mr Victor Nagaonkar, Officer on Special Duty, BEST participated in the workshop from Mumbai. Mr Nagaonkar shared his experiences during the workshop. Following points were suggested by Mr. Nagaonkar:

a) Technical know-how is must in implementation of such kind of project.

b) This project seems to be complex and big, there is a need to implement in phases and can be gradually up scaled as the need arises.

c) There is need to identify roles and responsibilities of participating agencies and implementing agency.

2. Suggestions by MCGM

Pravin Thorat, MCGM presented the details regarding Mumbai Area Traffic Control project. Following points may be concluded from his presentation:

a) System should be developed in such a way so that it can be integrated to advanced technologies in future.

b) Success of the system depends upon the level of brainstorming and calibration done before the start of the project.

List of Participants from Mumbai:

S.No.	Name	Organisation	Contact Details
1.	Shri Sudhir S. Raut, General Manager (Transport)	Kalyan Dombivali Municipal Transport Undertaking	sudhirraut123@gmail.com
2.	Shri Pankaj S. Bhoir, A.E	Municipal Corporation Greater Mumbai	pankajbhoir45@gmail.com
3.	Shri Bhushan Shankar Kubal, Asstt. Engineer (ATU)	Municipal Corporation of Greater Mumbai	kbhushan1020@yahoo.com
4.	Shri Jitendra B. Patel, Executive Engineer	Municipal Corporation of Greater Mumbai	jbpatel.weekw@gmail.com
5.	Shri Pravin V Thorat, Asstt. Engineer	Municipal Corporation Greater Mumbai	pravinthorat.bmc@gmail.com

S.No.	Name	Organisation	Contact Details
6.	Shri Victor S. Nagaonkar, Officer on Special Duty	BEST Mumbai	victor.nagaonkar@gmail.com

Annexure 1(C): Data Collected from MCGM, Mumbai

Items	Parameter	Status /Details
Operation Area	Area being serviced (MCGM, MMR etc.)	MCGM
Control Room	Whether traffic control room has been set up	Yes, control room has been set up.
	Whether traffic control room is IT enabled having consoles, video wall, operators etc.	Yes, control room is IT enabled
	Whether decentralised or a single centralised control room	It is single centralised control room for 255 traffic intersections
	Activities being performed from the control room (signal control, CCTV footage monitoring, enforcement etc.)	Signal control, CCTV footage , monitoring, part enforcement
Traffic Equipment (Field)	Number of signals	670
	Number of CCTV cameras	225
	Number of speed violation detection cameras	Nil
	Number of red light violation detection cameras	Nil
	Number of Variable Message Signs (VMS)	39
	Any other	Nil
Signals	Number of signals working on adaptive mode	225 signal are working on adaptive mode
	Number of signals connected to the control room	255 signal are connected to control room
	Mode of connectivity (leased line, OFC etc.)	Leased line network
	Which entity installs signals	MCGM
	Which entity maintains signals	MCGM
CCTV	Whether all junctions have CCTV cameras	No, CCTV cameras are not available at all junctions
	Whether CCTV cameras are installed at locations other than junctions also	Yes, CCTV cameras are available at location other than junctions as well.
	Whether CCTV camera feed is being monitored	Yes, CCTV camera feed is monitored by Traffic Police
	Which entity installs CCTV cameras	MCGM is responsible for installation of CCTV cameras
	Which entity maintains CCTV cameras	MCGM is responsible for CCTV cameras maintenance

Items	Parameter	Status /Details
	Which entity bears the installation, O&M cost of the CCTV cameras	MCGM bears the cost of installation and O&M related to the CCTV cameras
Backend Application	Whether any backend applications have been deployed in the control room	Yes, backend applications have been deployed in the control room
	Type of system for which backend system exists (such as signal control, CCTV footage monitoring, red light violation detection, speed limit violation detection, enforcement, incident detection, video analytics etc.)	• Signal control • CCTV footage monitoring
	Activities that have been computerised and are being done through IT systems	• Signal control • CCTV footage monitoring
Information Dissemination (website)	Whether GIS map is used to display road network, signals, CCTV cameras, VMS etc.	No, this is not available
	Type of static information being provided through website (road network, speed limits, no entry zones etc.)	Not applicable
	Type of real time information being provided through website (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not applicable
	SMS alerts being provided, if any	Yes, SMS alerts are provided
	Email alerts being provided, if any	No, this facility is not available
	Whether journey planner is there on the site	No, this facility is not available
Phone Helpline	Traffic Control Room Number	022-24937746/47/55
	Whether normal number, toll free or short number (provide details)	This is a normal number
	Call charges (free, normal, premium)	Normal standard charges are applicable
	Number of calls received (monthly)	Information not available
Mobile App	Whether mobile app exists	No, mobile apps doesn't exist
	Type of static information being provided through app (road network, speed limits, no entry zones etc.)	Not applicable
	Type of real time information being provided through app (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not applicable
Social Media	Whether Facebook page exists	No

Items	Parameter	Status /Details
	Whether Facebook page being regularly updated	Not applicable
	Whether Twitter page exists	Yes, Twitter page exists
	Whether Twitter page being regularly updated	It is not being regularly updated
	Whether any other social media page exists	No
	Whether the page being regularly updated	Not applicable
Information Feeds	Whether traffic information feed is being provided to any agency	No, traffic information is not shared with any agencies
	If yes, type of traffic information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable

Annexure 1(D): Data Collected from BEST, Mumbai

Items	Parameter	Status
Buses	Number of buses	4289
	Number of buses with AVL/GPS	1301
	Number of buses with ETM system	4289
	Number of buses having PIS	1301
	Number of buses having CCTV cameras	3872
Terminals	Number of bus terminals	There are 51 bus terminals
	Whether managed by the agency itself or some other agency manages it	It is managed by BEST itself
	Whether CCTV system has been installed	No, there are no CCTV cameras installed at terminals
Passengers	Number of passengers being served	There are 36 lakh passengers being served by BEST on an average daily
Operation Area	Area / cities being serviced	• Mumbai • Mumbai Suburban • Thane • Navi Mumbai • Bhayandar
Control room	Whether control room has been set up	Yes, there is one control room
	Address of control room	1st Floor, New Bldg, Wadala Bus Depot, Mumbai -39
	Area of control room (approx. in sq. m.)	Ares is around 200 sq. m.
	How many persons are there in the control room	There are 27 person in control room
	Organisation structure inside control room - AVL related staff - ETM related staff - Managers + supervisors - IT Support - Others	There are no dedicated personnel allocated for specified activities. But in general following personnel are there • Senior Traffic Officer(1) • Traffic Officer(2) • Assistant Traffic Officer(2) • Supervisors(1) • Clerk(1) • Writers(17) • Miscellaneous(3)
	Whether Control room is there at depot level or only at a central location	Control room is at central location in Wadala
	Whether the control room is manually operated or is automated and IT enabled	Control is not fully IT enabled some of the activities are done

Items	Parameter	Status
		manually and some through IT system (Partly manual and partly IT enabled)
Backend Application	Whether any backend applications have been deployed	Yes, there are backend applications
	Type of system for which backend exists (such as ETM, AVL, bus routing, scheduling, duty allocation etc.)	Yes, there are backend applications for ETM, Bus routing, Scheduling, Duty allocation
	Activities that have been computerised and are being done through IT systems	All of above system activities done through IT
GPS in buses / AVL system	Whether Installed	Yes, GPS are installed on some buses
	Number of buses having GPS	There are around 1301 buses with GPS
	When was the GPS installed	GPS was installed in December 2011
	Who is the vendor	Verve Compusoft Pvt. Ltd.
	Has the communication protocol been shared with the Client	No communication Protocol has been shared with client
	Does the software have: - ETA calculation module. If so, how accurate is it? - Journey planning - Commuter interface	 90% Data ready Not given
	How is the performance of the software?	It is Good
	How much do they pay to AVL vendor?	Nil
	Will the vendor be open to customisations required for the NUTH?	Yes
	Are PIS installed at bus stops? How many?	PIS are not installed at bus stops
	How many bus stops don't have PIS	Not Applicable
	Is ETA being shown at bus stops	Not Applicable
	PIS installed inside buses	Yes, PIS are installed inside buses
	Next stop announcement inside buses	Yes, this facility is available
Electronic ticketing	Whether ticketing is through ETMs	Yes, ticketing is done through ETMs
	Number of buses with ETM based ticketing	All buses have ETM based ticketing

Items	Parameter	Status
	Real time ticketing data being sent to the backend	No such data being sent to backend
	Who is the vendor	Trimax IT system
	Is the project on BOT? If so, how many years	Yes, it is BOT project
	Has the communication protocol been shared with the Client	Yes, communication protocols been shared with client
	How is the performance of the software?	Good
	Will the vendor be open to customisations required for the NUTH?	Yes
	What will happen at end of contract period? Is there a transfer of s/w code?	Renewable
	Whether card based payment is there	Yes, this facility is available
Information Dissemination (website)	Whether GIS map is used to display bus stops, routes, terminals etc.	Yes, this is available on our website with address http://www.bestpis.in/
	Type of static information being provided through website (routes, schedules, fare, pass details etc.)	Bus Route (AC/ Non AC routes with bus stops, fares)
	Type of real time information being provided through website (ETA at a bus stop, delays, cancellations, departures scheduled from terminals etc.)	Yes, ETA at a bus stop.
	SMS alerts being provided, if any	No, there is no such facility available
	Email alerts being provided, if any	No. there is no such facility available
	Whether route/journey planner is there on the site	Yes, this is available
Phone Helpline	Number	1800 227 550
	Whether normal number, toll free or MoUD NUTH number (155220)	This number is Toll Free
	Call charges (free, normal, premium)	Free
	Number of calls received (monthly)	700-1000 calls per month
Mobile App	Whether mobile app exists	• Yes there is one mobile apps • It is developed by Verve Compusoft with a name Best TV • This app is freely available on BEST site, Google play website

Items	Parameter	Status
	Type of static information being provided through app (routes, schedules, fare, pass details etc.)	Static information like bus routes, schedules, bus stops
	Type of real time information being provided through app (ETA at a bus stop, delays, cancellations, departures scheduled from terminals etc.)	Expected time of arrival is provided
Social Media	Whether Facebook page exists	No, there is no Facebook page
	Whether Facebook page being regularly updated	Not applicable
	Whether Twitter page exists	No, there is no Twitter page available
	Whether Twitter page being regularly updated	Not applicable
	Whether any other social media page exists	No such page is available
	Whether the page being regularly updated	Not applicable
Information Feeds	Whether transit information feed is being provided to any agency	No
	If yes, type of information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable
Data Digitisation IT enablement	Routes	Yes
	Bus Stops	Yes
	Terminals	Yes
	Buses	Yes
	Drivers, conductors	Yes
	Duties/ Trips	Yes
	Incidents / Accidents	No
	Maintenance	Yes
	Scheduling	Yes
	Duty allocation	Yes
	Ticketing	Yes

Annexure 1(E): Data Collected from Western Railway, Mumbai

Items	Parameter	Status
Trains	Number of trains in suburban operation	97 rakes are there but on an average about 84 rakes are operated daily
	Number of trains having PIS	All trains have PIS
	Number of trains having CCTV cameras	Installation of CCTV cameras on suburban rail coaches is under proposal stage
Stations	Number of stations	36
	Number of stations where CCTV system has been installed	All stations have CCTV cameras.
	Number of stations having PIS	All stations have PIS displays installed.
Passengers	Number of passengers being served	35 Lakhs passenger per day
Operation Area	Area / cities being serviced (major stations)	• Churchgate, • Mumbai Central, • Dadar, • Bandra, • Andheri, • Borivali, • Virar, • Palghar, • Boisar, and • Dahanu Road Total length of above line is 124 Kms.
Control room	Whether control room has been set up	Yes
	Control room is centralised (common for long distance trains as well as suburban) or decentralised	Control room is centralised for all Western Railway trains including long distance trains
	Whether the control room is manually operated or is automated and IT enabled	Control room is automated & IT enabled
Backend Application	Whether any backend applications have been deployed	Yes, backend applications have been deployed
	Type of system for which backend system exists (such as routing, scheduling, duty allocation etc.)	Applications related to coach allocation, tracking, scheduling etc.
	Activities that have been computerised and are being done through IT systems	Signals, coach maintenance, engine maintenance, fault reporting

Items	Parameter	Status
Electronic ticketing	Whether ticketing is through ATVMs	Yes, this facility is available
	Whether all stations have ATVMs	Yes, this facility is available
	Whether card based payment is there	Yes, this facility is available
	Whether ticketing is through CVMs	Yes, this facility is available
	Whether all stations have CVMs	Yes, this facility is available
Information Dissemination (website)	Whether GIS map is used to display stations, routes etc.	No
	Type of static information being provided through website (routes, schedules, fare, season ticket details etc.)	Time Table, Fare List, Mumbai Suburban Info Booklet, Rules
	Type of real time information being provided through website (ETA at a station, delays, cancellations, departures scheduled from stations etc.)	No
	SMS alerts being provided, if any	No
	Email alerts being provided, if any	No
	Whether route/journey planner is there on the site	No
Phone Helpline	Number	1311 as security helpline for suburban passengers of Western Railway. Number 9004477777 is for SMS Complaint
	Whether normal number, toll free or any other number (provide details)	1311 has been allotted by Department of Telecom, GoI. Calling to this number is chargeable. It is accessible in Mumbai and Maharashtra Telecom Circle
	Call charges (free, normal, premium)	Normal Charges are applicable on calling 1311
Mobile App	Whether mobile app exists	No. There is no applicable for suburban rail services. There is an application available for long distance trains on Western Railway website.
	Type of static information being provided through app (routes, schedules, fare, season ticket details etc.)	Fare, routes, schedule
	Type of real time information being provided through app (ETA at a station,	Arrival status

Items	Parameter	Status
	delays, cancellations, departures scheduled from stations etc.)	
Social Media	Whether Facebook page exists	No, Facebook page doesn't exist
	Whether Facebook page being regularly updated	Not applicable
	Whether Twitter page exists	No. Twitter page doesn't exist
	Whether Twitter page being regularly updated	Not Applicable
	Whether any other social media page exists	No such page exists
	Whether the page being regularly updated	Not applicable
Information Feeds	Whether suburban rail information feed is being provided to any agency	No
	If yes, type of information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable
Data Digitisation IT enablement	Routes	Yes
	Stations	Yes
	Trains	Yes
	Duties/ Trips	Yes
	Incidents / Accidents	Yes
	Maintenance	Yes
	Scheduling	Yes
	Duty allocation	Yes
	Ticketing	Yes

Annexure 1(F): Data Collected from Central Railway, Mumbai

Items	Parameter	Status
Trains	Number of trains in suburban operation	Main line: 75 rakes Harbour Line: 39 rakes Trans Harbour Line: 10 rakes
	Number of trains having PIS	All trains have PIS
	Number of trains having CCTV cameras	Installation of CCTV cameras on suburban rail coaches is under proposal stage
Stations	Number of stations	Main line (Mumbai CST-Thane-Kalyan-Kasara/ Karjat-Khopoli): 49 stations Harbour line (Mumbai CST - Panvel): 32 stations Trans Harbour line (Thane – Vashi-Nerul): 8 stations (Some stations would be common in these lines)
	Number of stations where CCTV system has been installed	All stations have CCTV cameras.
	Number of stations having PIS	All stations have PIS displays installed.
Passengers	Number of passengers being served	About 40 Lakhs passenger per day
Operation Area	Area / cities being serviced (major stations)	Main line (Mumbai CST-Thane-Kalyan- Kasara /Karjat-Khopoli-): 121 Kms/115 Kms, (common 54 Kms from Mumbai CST to Kalyan) Harbour line (Mumbai CST - Panvel): 51 Kms Trans Harbour line (Thane - Vashi/Nerul): 19 Kms
Control room	Whether control room has been set up	Yes
	Control room is centralised (common for long distance trains as well as suburban) or decentralised	Control room is centralised for all Central Railway trains including long distance trains
	Whether the control room is manually operated or is automated and IT enabled	Control room is automated & IT enabled
Backend Application	Whether any backend applications have been deployed	Yes, backend applications have been deployed
	Type of system for which backend system exists (such as routing, scheduling, duty allocation etc.)	Applications related to coach allocation, tracking, scheduling etc.

Items	Parameter	Status
	Activities that have been computerised and are being done through IT systems	Signals, coach maintenance, engine maintenance, fault reporting
Electronic ticketing	Whether ticketing is through ATVMs	Yes, this facility is available
	Whether all stations have ATVMs	Yes, this facility is available
	Whether card based payment is there	Yes, this facility is available
	Whether ticketing is through CVMs	Yes, this facility is available
	Whether all stations have CVMs	Yes, this facility is available
Information Dissemination (website)	Whether GIS map is used to display stations, routes etc.	No
	Type of static information being provided through website (routes, schedules, fare, season ticket details etc.)	Time Table, Fare List, Mumbai Suburban Info Booklet, Rules
	Type of real time information being provided through website (ETA at a station, delays, cancellations, departures scheduled from stations etc.)	No
	SMS alerts being provided, if any	No
	Email alerts being provided, if any	No
	Whether route/journey planner is there on the site	No
Phone Helpline	Number	09833331111 & 1275
	Whether normal number, toll free or any other number (provide details)	1275 has been allotted by Department of Telecom, GoI. Calling to this number is chargeable. It is accessible in Mumbai and Maharashtra Telecom Circle
	Call charges (free, normal, premium)	Normal Charges are applicable on calling the helplines
Mobile App	Whether mobile app exists	No. There is no applicable for suburban rail services. There is an application available for long distance trains on Western Railway website.
	Type of static information being provided through app (routes, schedules, fare, season ticket details etc.)	Fare, routes, schedule

Items	Parameter	Status
	Type of real time information being provided through app (ETA at a station, delays, cancellations, departures scheduled from stations etc.)	Arrival status
Social Media	Whether Facebook page exists	No, Facebook page doesn't exist
	Whether Facebook page being regularly updated	Not applicable
	Whether Twitter page exists	No. Twitter page doesn't exist
	Whether Twitter page being regularly updated	Not Applicable
	Whether any other social media page exists	No such page exists
	Whether the page being regularly updated	Not applicable
Information Feeds	Whether suburban rail information feed is being provided to any agency	No
	If yes, type of information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable
Data Digitisation IT enablement	Routes	Yes
	Stations	Yes
	Trains	Yes
	Duties/ Trips	Yes
	Incidents / Accidents	Yes
	Maintenance	Yes
	Scheduling	Yes
	Duty allocation	Yes
	Ticketing	Yes

Annexure 2: Draft Sample Memorandum of Understanding

DRAFT SAMPLE MoU

This Memorandum of Understanding ("**MoU**") is entered into on _____ day of _____, 201X amongst:

NUTH Implementing Agency, _____having its office at _____represented by _____ (hereinafter referred as "**Implementing Agency**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the First Part;

[*Implementing Agency would be the entity entrusted with the role of setting up and operating the NUTH*]

and

NUTH Participating Agency, _____having its office at_____ represented by _____ (hereinafter referred as "**Participating Agency**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the Second Part.

Participating Agency would be the entity that provides information / data to the Implementing Agency or otherwise participates in the NUTH. Examples:

Transit Agencies • *BEST* • *Western Railway* • *Central Railway* • *MSRTC* • *MMRDA*	***Traffic Agencies*** • *Mumbai Traffic Police* • *MCGM*
Road Owning Agencies • *MCGM* • *MMRDA* • *MSRDC* • *PWD, GoM*	***Parking Agencies*** • *MCGM* • *MMRDA* • *MSRTC* • *Western Railway* • *Central Railway*

Implementing Agency and Participating Agency are hereinafter collectively referred to as **"Parties"** and individually as **"Party"**.

WHEREAS

A. There are several departments, authorities and corporations that are providing services to the citizens in the area of transportation, transit and traffic;

B. It has been agreed by the Parties that service delivery to public at large could be substantially augmented and provided in a more effective and efficient manner if the Parties collaborate, work together, share and disseminate information that are of interest to public;

C. In order to give effect to the above, it has been decided by the Parties to collaborate with each other in order to set up, operate, manage and maintain the National Urban Transport Helpline (NUTH) for the specified areas;

D. NUTH would collect data/information from various participating entities and disseminate the same to public through various channels;

E. Parties have accordingly agreed to enter into this MoU in order to record their understanding on the extent and nature of their cooperation.

NOW THEREFORE, IT IS AGREED AS FOLLOWS:

1.0 PURPOSE

1.1 The objective of establishing Mumbai NUTH is to be able to collect, synthesise and disseminate travel, traffic and transit related information to public that would optimise their travel behaviour and lead to efficient utilisation of city transport assets.

1.2 The purpose of this MoU is to document the understanding reached between the Parties for setting up, operating, managing and maintaining NUTH for the Mumbai/MMR and matters connected therewith and incidental thereto.

2.0 ROLES & RESPONSIBILITIES OF PARTIES

2.1 Subject to clause 2.4 hereunder, Parties agree to work together and discharge various responsibilities as outlined in clauses 2.2 and 2.3 hereunder for and in relation to supporting the NUTH.

2.2 Participating Agency agrees to discharge the following responsibilities {modify as required}:

(a) To provide agreed data / information in desired form and frequency as set out in Appendix A.

(b) To provide periodical updates to the aforesaid data

(c) To depute its personnel for coordination with Implementing Agency

(d) To cooperate and work with Implementing Agency and other participating agencies both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(e) Any other responsibility as mutually agreed

2.3 Implementing Agency agrees to discharge the following responsibilities {modify as required}:

(a) Implement the NUTH in coordination with Participating Agency and other participating agencies

(b) To depute its personnel for coordination with Participating Agency

(c) To cooperate and work with the Participating Agency and other participating agencies both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(d) Any other responsibility as mutually agreed

2.4 The roles and responsibilities of the Parties shall be subject to periodical review and amendment as may be discussed and mutually agreed.

3.0 RELATIONSHIP BETWEEN THE PARTIES

3.1 This MoU reflects the general understanding reached between the Parties for working together on the matters related to NUTH and does not authorise a Party to represent any other Party.

3.2 Except as otherwise agreed, the Parties shall bear their costs and expenses in relation to discharging their respective roles under the MoU.

4.0 VALIDITY AND TERMINATION

4.1 Unless terminated earlier or extended by the Parties, this MoU shall remain valid as long as the NUTH remains operational, unless otherwise mutually agreed.

5.0 GENERAL

5.1 This MoU shall not affect any existing agreement or any other arrangements that the Parties may have relating to the matters covered under the MoU.

5.2 Any amendments to this MoU shall be in writing and signed by the authorised representatives of the Parties.

5.3 The official and binding language of this MoU, as well as the official and binding language between the Parties in connection with the MoU will be the English language.

IN WITNESS WHEREOF, the Parties, by their duly authorised officers, have executed this MoU as given above.

Party	For Implementing Agency	For Participating Agency
Signature		
Name		
Designation		

Appendix A

Details of Information and Data Sharing

Participating Agency agrees to share the following information / data with the Implementing Agency in the form, manner and periodicity set out below:

[To be filled based availability of information with the Participating Agency]

Annexure 3: List of Applicable Standards

Standard Number: Year of Adoption	Description
ISO 14813-5:2010	Requirements for the description and documentation of the architecture of Intelligent Transport Systems (ITS) in standards dealing with ITS. It also gives the definitions of terms to be used when documenting or referencing aspects of architecture description in those standards
ISO 14813-6:2009	Provides a formal means to enact the ISO/TC 204 decision by resolution to use Abstract Syntax Notation One (ASN.1) for data definitions within ITS International Standards. This provides a common message form to enable interoperability and reuse. It provides consistency of use so that where other aspects of ASN.1 (defined within ISO/IEC 8824 and ISO/IEC 8825), such as transfer rules, are selected to be used, they are used in a common and consistent way in order to maximise interoperability and reuse. ISO 14813-6:2009 also provides a means where particular ITS sector requirements, or existent International Standards, that require particular message forms and procedures that are expressed in other notations (EDIFACT, XML, etc.), may be referenced and reused by other ITS applications. Thus it presents an unambiguous system for identifying all the different data types and describing them in ITS International Standards in a common way.
ISO 14817:2002	Specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and Data Dictionaries, the registration process to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry. Specifically, ISO 14817:2002 specifies: • framework used to identify and define all information exchanges; • framework used to extend standardised information exchanges to support local customisations and combinations; • information modelling method for defining ITS/TICS data concepts, when used; • meta attributes used to describe, standardise and manage each of the data concepts defined within this framework; • requirements used to record these definitions; and • formal procedures used to register these definitions within the Data Registry. The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.

Standard Number: Year of Adoption	Description
ISO 14819-Part 1 to 6:2003-2008	Specifies the coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) - RDS-TMC using the ALERT-C protocol that is designed to provide mostly event-orientated road driver information messages.
ISO 14825:2011	Specifies the conceptual and logical data model and physical encoding formats for geographic databases for Intelligent Transport Systems (ITS) applications and services. It includes a specification of potential contents of such databases (data dictionaries for Features, Attributes and Relationships), a specification of how these contents shall be represented, and of how relevant information about the database itself can be specified (metadata). The focus of ISO 14825:2011 is on ITS applications and services and it emphasises road and road-related information. ITS applications and services, however, also require information in addition to road and road-related information. Typical ITS applications and services targeted by ISO 14825:2011 are in-vehicle or portable navigation systems, traffic management centres, or services linked with road management systems, including the public transport systems.
ISO 14827-1:2005	Defines the format that should be used to document those end-application messages that are to be exchanged between/among central systems. The format is protocol-independent to the extent practical. For example, this one format can be used to define data exchanges that may apply to DATEX-ASN, Common Object Request Broker Architecture (CORBA), or other Application Protocols. In general, each system can be viewed as consisting of the following interfaces: 1. Application Interface 2. Operator Interface 3. Communication Interface 4. Database Interface
ISO 14827-1:2005	Allows different systems to exchange relevant data. The relevant data will be contained in end-application messages. Each end-application message will be formally defined as either a "subscription" or a "publication", according to the format as specified in ISO 14827-1:2005. DATEX-ASN defines how these end-application messages are packaged to form a complete data packet and also defines the rules and procedures for exchanging these data packets. Systems using DATEX-ASN are free to implement additional end-application functionalities according to the user requirements.
ISO 15628:2007	Road transport and traffic telematics, Dedicated Short Range Communication (DSRC) application layer
ISO 15628:2007	Specifies the application layer core which provides communication tools for applications based on DSRC. These tools consist of kernels that can be

Standard Number: Year of Adoption	Description
	used by application processes via service primitives. The application processes, including application data and application-specific functions, are outside the scope of ISO 15628:2007.
ISO 15662:2006	Provides information as a checklist to consider handling messages that are defined by the application working groups of ISO/TC204, installing systems and selecting suitable wide area communication systems for providing ITS application services.
ISO 15784-1 to 3:2008	Provides principles and documentation rules of application profiles used for exchange data and messages between a traffic management centre and roadside modules used for traffic management. The application profiles it specifies are used to exchange data and messages between a traffic management centre and roadside modules for traffic management and between roadside modules used for traffic management.
ISO 17267:2009	Specifies an Application Programming Interface (API) for navigation systems. It specifies the data that may be retrieved from the map database and defines the interface for access. This International Standard specifies a set of function calls. It also specifies the design of the API and gives examples of its intended use. Furthermore, it gives the criteria to determine whether a data access library is in accordance with this International Standard. ISO 17267:2009 is applicable to the following functional categories of navigation applications: • positioning; • route planning; • route guidance; • map display; • address location; • services and Point of Interest (POI) information access.
ISO 17572, Parts 1 to 3:2008	Specifies Location Referencing Methods (LRM) that describes locations in the context of geographic databases and will be used to locate transport-related phenomena in an encoder system as well as in the decoder side. It defines what is meant by such objects, and describes the reference in detail, including whether or not components of the reference are mandatory or optional, and their characteristics. It specifies two different LRMs: • pre-coded location references (pre-coded profile); • dynamic location references (dynamic profile). It does not define details of the Location Referencing System (LRS), i.e. how the LRMs are to be implemented in software, hardware, or processes. ISO 17572-1:2008 specifies the following general LRM related sections: • requirements to a Location Referencing Method; • conceptual Data Model for Location Referencing Methods; • inventory of Location Referencing Methods; • examples of Conceptual Data Model Use;

Standard Number: Year of Adoption	Description
	• description of selected UML Elements; • comparison of Definitions with ISO/TC 211; • introduction to the TPEG Physical Format.

ISO 22837:2009	Relates to vehicle probe data for wide are communications. It specifies the following.
	• Reference architecture for probe vehicle systems and probe data, which provides a general structure for probe vehicle systems within which a wide range of actual probe vehicle systems can be built whose physical characteristics may differ (e.g., in their choice of communications medium). The reference architecture is used to:
	  ○ clarify the major building blocks and logical interconnections of probe vehicle systems for which this standard will be used;
	  ○ categorise probe data in accordance with the information model described below.
	• Basic data framework for probe data elements and probe data, which defines probe data elements and probe messages, and specifically provides:
	  ○ rules for mapping information models (as defined in ISO 14817) of probe data to probe data elements/messages. The information models show the logical structure of entities and concepts involved in probe data;
	  ○ the required characteristics of probe data elements and probe data messages;
	  ○ the notation for probe data elements/messages (in XML);
	  ○ rules for using core data elements and basic data elements (see below), and extensions of data elements in each application domain.
	• Core data element definitions, which are basic descriptive elements, intended to appear in every probe message, i.e. the location and the time at which the probe data was sensed.
	• Initial set of probe data elements, which are commonly used in typical probe data, enabled application domains, such as traffic, weather, and safety.
	• Example probe messages, which define how probe data elements are combined to convey information to probe processing centres.

ISO 22951:2009	Relates to systems that use priority signal control functions to help emergency vehicles operate. This type of system is composed of a traffic management centre, in-vehicle units, roadside communication units, and roadside units. Public transport vehicles such as buses are also targeted to receive priority signal control service. The scope of standardisation includes message sets and data dictionary related to the communications as follows: • between a roadside communication unit and each in-vehicle unit, • between a roadside communication unit and other roadside units,

Standard Number: Year of Adoption	Description
	• between in-vehicle units and roadside units. ISO 22951:2009 concerns only information related to priority signal control and does not deal with information provision such as that of the situations at scenes. Since it is necessary to handle public transport vehicles in accordance with the conditions of individual cities and regions, the section in the messages and the data dictionary that are concerned with priority signal control for the vehicles are treated as an option. Furthermore, the standardisation does not depend on the type of communication medium used.
ISO 24097-1:2009	Establishes a Service-Oriented Architecture (SOA) for the realisation of interoperable ITS Web Services (WS). Web service behaviour is described at the metadata level (i.e. a higher level of abstraction) to enable auto-generation of both a "Service requestor" programme, as well as a "Service provider" programme.
ISO 24099:2011	Defines the data structures and protocol(s) used in Intelligent Transport System (ITS) applications for the delivery and update of map-related data from Service Centre (SC) to users [(In-vehicle Systems (IVS)]. The map centre specified in ISO 24099:2011 represents the supplier of map data and the Service Centre provides data and services to user devices. The term protocol as used in ISO 24099:2011 is a temporal sequence of map-related data interactions between system components that implement map-related data delivery and update. The delivery and update of map-related data rely on existing communication technology.
ISO 24100:2010	States the basic rules to be observed by service providers who handle personal data in probe vehicle information services. This International Standard is aimed at protecting the personal data as well as the intrinsic rights and interests of probe data senders, i.e., owners and drivers of vehicles fitted with in-vehicle probe systems.
ISO 24531:2013	Assists ITS standards developers and users of ITS standards who wish to use XML, by providing a consistent definition of the rules and rule references for the use of XML within ITS. ISO 24531:2013 defines consistent rules and rule references to provide a framework to be used when implementing XML-based applications in ITS, and particularly in specifying XML in ITS standards, ITS data registries and ITS data dictionaries. ISO 24531:2013 also provides guidance and examples in respect of the use of XML in ITS, and the elaboration of XML within the ASN.1 data definitions required by ISO 14813-6 and ISO 14817.
ISO 24978:2009	Provides a standardised set of protocols, parameters, and a method of management of an updateable "Data Registry" to provide application layers for "ITS Safety messages" using any available wireless media.

Standard Number: Year of Adoption	Description
ISO TR 24532:2006	Clarifies the purpose of CORBA and its role in ITS. It provides some broad guidance on usage, and prepares the way for further ISO deliverables on the use of CORBA in ITS.
ISO TR 25100:2012	Provides guidance on the harmonisation of data concepts that are being managed by data registry and data dictionaries such as those described in ISO 14817:2002. ISO TR 25100:2012 describes processes for harmonisation of such data concepts to arrive at preferred definitions for use in formal standards, specifications, technical reports and information models. It is based on consideration of a harmonisation process used by international groups involved in the ITS sector and in the wider sector of transport and logistics information and control systems.
ISO TS 18234-1 to 12:2006 to 2013	Provides set of TPEG applications and specifications. It allows the indexing of new applications as they are added to the TPEG applications family, by defining their Application Identification (AID).
ISO/TR 13184-1:2013	Specifies guidance information protocol to provide real-time decision support system to drivers or pedestrians using personal ITS stations: 1. Reference architecture for real-time decision support systems This reference architecture provides a general structure for real-time decision support systems and the method of message exchange between the personal ITS station and the roadside ITS station. This reference architecture is used to build the interconnections between personal ITS stations and roadside ITS stations. 2. Design method of application protocols for light-weighted devices. This method is a flexible application protocol for safety warning and parking guidance services. Unlike many other application protocols in the ITS and Telematics domains, this protocol makes the client part independent of use cases for supporting light-weighted devices. 3. Use cases at the road and parking bays for warning and parking guide ISO/TR 13184-1:2013 describes the use cases applicable to the communication services between personal ITS stations and roadside ITS stations for the purposes of providing safety warning and parking guidance.
ISO/TR 13185-1:2012	Specifies the communications architecture and generic protocol to provide and maintain ITS services to travellers (including drivers, passengers and pedestrians), using nomadic and portable devices.
ISO/TR 17452: 2007	Gives guidelines for using the Unified Modelling Language (UML) for defining and documenting interfaces between Intelligent Transport Systems (ITS) and Transport Information and Control Systems (TICS). It presents these guidelines in the context of a case study for the creation of an ITS/TICS data dictionary and submissions to the ITS/TICS data registry.
ISO/TR 21707: 2008	Specifies a set of standard terminology for defining the quality of data being exchanged between data suppliers and data consumers in the ITS domain. This applies to Traffic and Travel Information Services and Traffic

Standard Number: Year of Adoption	Description
	Management and Control Systems, specifically where open interfaces exist between systems. It may of course be applicable for other types of interfaces, including internal interfaces, but this Technical Report is aimed solely at open interfaces between systems. ISO/TR 21707:2008 identifies a set of parameters or meta-data such as accuracy, precision and timeliness etc. which can give a measure of the quality of the data exchanged and the overall service on an interface. Data quality is applicable to interfaces between any data supplier and data consumer, but is vitally important on open interfaces. It includes the quality of the service as a whole or any component part of the service that a supplying or publishing system can provide. For instance this may give a measure of the availability and reliability of the data service in terms of uptime against downtime and the responsiveness of the service or it may give a measure of the precision and accuracy of individual attributes in the published data. ISO/TR 21707:2008 is suitable for application to all open ITS interfaces in the Traffic and Travel Information Services domain and the Traffic Management and Control Systems domain.
ISO/TR 24529:2008	Deals with the use of UML within International Standards, Technical Specifications and Technical Reports and related documents. It discusses the application of the Unified Modelling Language (UML) to the development of standards within the context of ITS.
ISO/TS 14823:2008	Presents a system of standardised codes for existing signs and pictograms used to deliver Traffic and Traveller Information (TTI). The coding system can be used to form messages to be handled by respective media systems, graphic messages on on-board units, and media system information on TTI dissemination systems [Variable Message Signs (VMS), Personal Computers (PC), Public Access Terminals (PAT), etc.] (including graphic data).
ISO/TS 15624:2001	Transport information and control systems -- Traffic Impediment Warning Systems (TIWS) System requirements
ISO/TS 15624:2001	Transport information and control systems -- Traffic Impediment Warning Systems (TIWS) System requirements.
ISO/TS 20452:2007	Describes the functional requirements and Logical Data Model for PSF and API and the Logical Data Organisation for PSF that were completed under ISO/NP 14826. It does not specify a Physical Data Organisation.
ISO/TS 24530-1 to 4:2006	Establishes the top-level "containers" for TPEG messages in XML and the common data types that are used by tpegML applications (e.g. tpeg-ptiML). Inherently, tpegML is designed to "map" the TPEG binary (ISO/TS 18234 series), however, additional tags are provided to create a message and message set structure to facilitate internet file delivery.
ISO/TS 25114:2010	Provides a common framework for defining Probe Data Reporting Management (PDRM) messages to facilitate the specification and design

Standard Number: Year of Adoption	Description
	of probe vehicle systems and gives concrete definitions of PDRM messages. ISO/TS 25114:2010 also specifies reference architecture for probe vehicle systems and probe data which incorporates PDRM, based on the reference architecture for ISO 22837, and basic data framework for PDRM instructions, which defines specifically necessary conditions for PDRM instructions, and notations of these instructions (in XML).
GTFS General Feed Specifications	Google, for example has a General Transit Feed Specification (GTFS) reference that can be used as a guideline for transit feed application. This specification can be found at https://developers.google.com/transit/gtfs/reference

Annexure 4: Transportation Performance Indices

1. **Public Transport Accessibility Index:** It is calculated as the inverse of average distance (in km.) to the nearest bus stop/railway station (suburban/metro). Higher the index betters the public transport accessibility.

2. **Congestion Index:** To access the existing travel condition of the roadway facility and how effectively users can perform the journey can be measured by this index.

   Congestion Index= 1-(A/M)

   Where, M is desirable average journey speed on major road network of a city during peak hour, which is assumed as 30KMPH
   A is average journey speed observed on major corridors of the city during peak hours.

3. **Walkability Index:** As the name suggests, the index is to evaluate the walkable space availability in city. It is calculated considering availability of footpaths on major corridors and overall facility rating by pedestrians

   Walkability Index = [(W1 x Availability of footpaths) + (W2 x Facility Rating)]

   Where W1 and W2 are parametric weights, assumed 50% for both.

4. **City Bus Supply Index:** Only standard buses are considered to derive the city bus supply index for any city.

   City Bus Supply Index = City Bus Fleet (Public + Pvt.) for 1,00,000 population

5. **Safety Index:** Data collected from Police department of city helps in developing a road safety index.

   Road Safety Index = 1/AFR

   AFR is Accident Fatality Index

6. **Para Transit Index:** Para transit play major role in transportation for medium sized cities.

   Para Transit Index = Number of para transit vehicles for 1,00,000 population

7. **Slow Moving Vehicle Index:** This index is calculated on the basis of availability and percentage of SMV trips

   Slow movie vehicle index = [(W1 x Availability of cycle lanes) + (W2 x % of SMV trips)]

   Where W1 and W2 are parametric weights, assumed 50% for both.

8. **On-Street Parking Interference Index:**

   Parking Interference Index = 1 / (W1 x % of major road length used for on-street parking + W2 x on-street parking demand on major roads)
   Where W1 and W2 are parametric weights, assumed 50% for both.

Annexure 5: Indicative Terms of Reference

The Consultant shall follow the Generic operations document for TMICC & NUTH (as applicable for the city) prepared by the MoUD for preparing city specific documents. The generic documents shall be made available on the MoUD's website. The TOR covers scope of work for both TMICC as well as NUTH. In case the city is planning to implement only one of the systems, the TOR may be amended.

The indicative scope of the empanelled consultants is as follows:

1. Development of City Specific Concept Reports

Task 1a: Prepare TMICC Concept Plan, inclusive of:

i. Identification of ITS & TMICC needs for the city based on data analysis and collection
ii. Identification of stakeholders
iii. Drawing up of implementation role of various stakeholders
iv. Identification of ITS application and TMICC system design to support the applications
v. Plan for administration and management of the system
vi. Broad Costing for setting up of the TMICC – upfront and on going
vii. Sources of revenue

Task 1b: Prepare NUTH Concept Plan, inclusive of:

i. A city-wide vision for transit as a multi-modal resource
ii. Type of information to be disseminated to the users
iii. User friendly technologies for interactive voice response and web based systems
iv. Plan for administration and management of the system
v. Broad Costing for setting up of the NUTH – upfront and on going
vi. Marketing to the users
vii. Sources of revenue

Task 1c: Site selection and design of TMICC-NUTH facility

The Consultant would be expected to evaluate and suggest a suitable site(s) for housing the TMICC-NUTH. Once the site is finalised by the authority, the Consultant would be required to carry out detailed design for the facility.

Task 1d: Project Structuring

i. Phasing of the build-out of the TMICC-NUTH facilities
ii. Prepare Business Plan for the TMICC-NUTH facility
iii. Examine possibility of implementing the project/sub-projects on PPP format and draw up the broad structure for the same

2. Development of Detailed Technical Reports

The consultant shall draw up the following for the TMICC and the NUTH:

i. Detailed functional requirements of the system in line with the Chapter 4.0 of the generic operations document
ii. Based on the above, compare different technical requirements and draw up the detailed technical requirements of the system (including hardware specifications)
iii. Detailed design of the centre (sizing, floor plan, data centre design, utilities design etc.)
iv. Detailing of operating procedures and processes
v. Cost-benefit analysis and implementation phasing, if necessary
vi. Detailed cost estimates, for the purpose of the Tender Documents

The consultant shall adopt a Systems Engineering Approach towards delivery of scope listed under Items 1 and 2 above. The consultant shall also include a chapter in the Detailed Technical Report, detailing the plan on how to expand and/or upgrade the TMICC and/or NUTH in the future.

3. Agreements between Stakeholders

The Consultant shall be responsible for drawing up of the agreements between the various stakeholders of the traffic management centre. The agreement will clearly set out the roles and responsibilities of each stakeholder.

4. Preparation of Tender Documents

The consultant would be responsible for assisting the nodal agency nominated for setting up of the TMICC in carrying out a transparent bidding process for appointment of vendors. The consultant would be responsible for:

i. Parcelling of work packages and
ii. Preparation of bid documents, setting out the scope of work, qualification and evaluation criteria of proposals in consultation with city specific government entity.
iii. Preparation of formats for bid submission.
iv. Preparation of and Request for Proposal (RFP) comprising the eligibility criteria, qualification criteria and evaluation methodology for selection of Successful Bidder for the development/procurement of the TMICC.
v. Preparation Draft Agreement for any procurement in consultation with city specific government entity. The Draft Agreement would comprise roles and responsibilities of the stakeholder, payment terms, events of defaults, termination conditions, termination payments, design and construction requirements, O&M requirements (if any) etc.

5. Bid Process Management

The consultant shall assist the respective city specific government entity in bid process management and contract management for _____ *(item of work)*.

The various tasks involved in Bid Process Management may include the following:

Task 5a: Assistance in Pre-bid conference

The consultant shall provide the following assistance in the pre-bid conference,

a. Participate in the pre-bid conference
b. Prepare minutes of the pre-bid meeting and assist authority in preparation of responses to the Bidders.

Task 5b: The consultant shall carry out the following on behalf of authority as a part of evaluation of proposals:

Stage 1: Scrutiny of "Key Submissions"
Stage 2: Evaluation of "Qualification Information"
Stage 3: Evaluation of "Technical Proposal" and
Stage 4: Evaluation of the "Financial Proposal".

Stage 1: Scrutiny of "Key Submissions"

The Bidders would be required to submit documents as listed in RFP document along with supporting documents validating their eligibility, technical experience and financial capability. The Proposals submitted by Bidders would have to be checked for key submissions and responsiveness to ascertain that the documents required in accordance with the RFP are submitted. The key submission could include the following.

- Covering Letter for submission of proposal
- Details of Bidder
- Power of Attorney
- Memorandum of Understanding in case of Consortium
- Anti-Collusion Certificate
- Bid Security

Stage 2: Evaluation of "Qualification Information"

The responsive Proposals would then be evaluated on the basis of the Qualification Information, Technical Proposal and Financial Proposal criteria.

Stage 3: Evaluation of "Technical Proposal"

The Technical Proposals of the Bidders, who pass Stage 2 evaluation, as described above, would then be evaluated on various parameters that could be considered for the same.

Stage 4: Evaluation of "Financial Proposal"

The Bidder quoting the lowest Financial Proposal would be the Successful Bidder for development of the Project.

Based on the project structure and implementation plan finalised by the authority, the project may involve multiple bid processes.

6. Project Monitoring and Management

After successful completion of the bidding process, the Consultant would be required to carry out the project monitoring and management on behalf of the authority. This would include the following:

i. Finalisation of Functional Requirements and System Requirements Specification in consultation with the Vendor and Authority
ii. Vetting of the Implementation Plan submitted by the Vendor
iii. Monitoring the progress of implementation and variations thereof
iv. Monitoring, testing and certifying quality of implementation
v. Examining the impact of Change Requests and provide recommendations on the same

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