PREPARED BY

MINISTRY OF URBAN DEVELOPMENT

# NATIONAL URBAN TRANSPORT HELPLINE (NUTH)

## OPERATIONS DOCUMENT

.



NOVEMBER, 2016

SUPPORTED BY:

# OPERATIONS DOCUMENT FOR NATIONAL URBAN TRANSPORT HELPLINE (NUTH)

Ministry of Urban Development,
Government of India,
Nirman Bhawan, New Delhi - 110008

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सत्यमेव जयते

The Ministry of Urban Development (MoUD) is the apex authority of Government of India at the national level to formulate policies, sponsor and support programme, coordinate the activities of various Central Ministries, State Governments and other nodal authorities and monitor the programmes concerning all the issues of urban development in the country. This operations document has been developed as part of GEF-Sustainable Urban Transport Project (GEF-SUTP) of MoUD.

SUTP
Sustainable Urban Transport Project
(India)

Sustainable Urban Transport Project (SUTP), an initiative of Ministry of Urban Development, launched in May 2010, underlines the principles of National Urban Transport Policy (NUTP), 2006. SUTP aims at building capacity in Indian cities and undertake pilot projects with the concept of giving priority to moving people over moving vehicles. It is financed by Government of India, participating States & Cities and is aided by World Bank, GEF and UNDP. The project's funding, about INR 17.5 billion, is used for building capacity in urban transport planning pan India and for demonstration of six projects in different cities. Under the GEF-SUTP component of SUTP, a series of guidance documents is being developed to improve capacity at National, State and Local levels to implement NUTP, and this Operations Document is one of them.

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Delhi Integrated Multi-Modal Transit System (DIMTS) Ltd. (Lead Consultant), along with Transport Research Laboratory (TRL) and Kimley Horn Consulting & Engineering India Private Limited, has developed this document. DIMTS is an equal equity joint venture of Govt. of NCT of Delhi and IDFC Foundation with focus on urban transportation. DIMTS provides consultancy services that span from Concept to Commissioning, Intelligent Transport System solutions and Urban Transport asset management services.

## Foreword

The use of advanced Information and Communication Technologies (ICT) in transport sector including telematics, navigation systems, information dissemination systems and others fall under the aegis of Intelligent Transport Systems (ITS). The main aim of using such technologies in transport is to alleviate concerns relating to traffic congestion, air pollution and noise pollution by using data driven strategies for addressing the transport-related issues. Over the past two decades, India has established itself as a leader in Information Technology (IT) and telecommunication sectors. The economic growth witnessed by the country has led to an exponential increase in motorisation, urban traffic congestion and deterioration of air quality in the Indian cities. With a robust IT and telecom infrastructure in place, India stands to gain from the use of ITS to alleviate many transport related urban issues. Such technologies can be deployed either at a vehicular level or at the infrastructural level.

Developed countries have shifted their priority from infrastructure and capital-intensive transportation strategies to a more balanced and sustainable transportation solutions and ITS implicitly holds the promise of supporting sustainability. As our economy grows and urbanisation in the cities increases, the use of ITS and its importance will increase commensurately.

National Urban Transport Helpline (NUTH), as a transport information dissemination system, is one of the most widely used public interface ITS applications. It provides transit and traffic information to travellers and helps 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 the 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 website, mobile apps and social media.

There is clearly a need to establish such systems for various Indian cities. The aim of developing the NUTH Operations Document is to encourage cities towards planning and implementing NUTH with a view to provide multi-modal transport related information to public and thereby encouraging use of public transport. This document not only envisages to provide an insight into the NUTH concept but also act as a guide for cities in deciding the future course of action. It would be of immense assistance to various government organisations and public authorities in India embarking on the process of planning and establishing NUTH.

Armed with the knowledge related to the benefits of NUTH and various aspects related to its planning and implementation, cities are expected to take earnest steps in implementing these systems.

November 2016

## Preface

The National Urban Transport Helpline (NUTH) Operations Document has been developed as a part of the Sustainable Urban Transport Project (SUTP) undertaken by the Ministry of Urban Development (MoUD), Government of India with support from 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 to achieve a paradigm shift in India's urban transportation system for more favorable sustainable developments and alternatives.

This document has been prepared under the guidance of MoUD with the primary objective of assisting various government organisations and public authorities in India embarking on the process of establishing NUTHs. It is also intended to assist ITS practitioners towards proper implementation of NUTHs in Indian cities. It is developed as a reference guide for the various organisations working towards planning, designing, procuring, establishing, managing and monitoring the NUTHs. This document is also intended to be a reference for the consulting organisations advising on planning and design of the NUTH facilities in various cities/towns in India.

This document relies upon the state-of-the-art review exercise undertaken by the consultants. As part of the review, several overseas and Indian cities were studied and the practices followed by them were reviewed. The outcome of the review was shared with various cities during the workshops and their feedbacks received have also shaped the development of this document. This document has also benefited from the experience of setting up similar facilities in the USA, Europe and Asia.

It has benefited considerably from the insights provided, feedback given and the reviews undertaken by the World Bank, Project Management Unit (PMU) and Project Management Consultants (PMC) engaged by the Ministry of Urban Development (MoUD), GoI.

Chapter 3.0 and Chapter 4.0 are the core parts of the document which provide details regarding ITS architecture, standards and NUTH applications. Chapter 5.0 and Chapter 9.0 provide details regarding NUTH planning and designing aspects, and responsibilities of various city agencies during implementation and operation of NUTH.

The Ministry and the consultancy team led by Delhi Integrated Multi Modal Transit System Limited and supported by Transport Research Laboratory, UK, and Kimley Horn Consulting and Engineering India Pvt. Limited hope that this document will facilitate the city authorities in setting up and managing the NUTH.

November 2016

## Acknowledgements

National Urban Transport Policy (NUTP) of the Government of India (GoI) has been framed with the objective to work towards sustainable urban transport in Indian cities. Ministry of Urban Development (MoUD), GoI is undertaking the Sustainable Urban Transport Project (SUTP) with the support of the Global Environment Facility (GEF), World Bank (WB) and United Nations Development Programme (UNDP) to create a platform for working together with State/Local Governments towards implementation of the NUTP.

The Project Management Unit (PMU), Project Management Consultant (PMC) and the Consultants express their deep gratitude to MoUD for entrusting the responsibility for preparing the NUTH Operations Document to facilitate development of NUTH in Indian cities as part of the SUTP.

The Consultants are grateful to Secretary, MoUD for providing direction and guidance to the team from time to time. The Consultants are also grateful to the Additional Secretary, OSD - UT & Ex-Officio Joint Secretary, and Director (Urban Transport) from MoUD for their many useful suggestions, guidance and inputs during the course of development of this document.

The Consultants are grateful to the National Project Manager (PMU team), Project Leader (PMC team) and the entire World Bank, PMU and PMC teams for their unstinted support and untiring efforts in painstakingly reviewing the NUTH Operations Document and providing valuable suggestions and inputs during the course of development of the document.

The Consultants are also grateful to all the cities which participated in the workshops organised by MoUD as a part of this project. Their valuable suggestions have contributed immensely in the development of this document.

The Consultants also want to thank the four pilot cities (Delhi, Mumbai, Ahmedabad, and Guwahati) which were chosen by MoUD for preparing the city specific concept documents. Their reviews and suggestions were very critical and have led to refining of this document from the city perspective.

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## Abbreviations

| Acronym | Definition/Description |
|---|---|
| API | Application Programming Interface |
| ASN.1 | Abstract Syntax Notation One |
| AVL/AVLS | Automatic Vehicle Location System |
| BOT | Build Operate Transfer |
| BRT | Bus Rapid Transit |
| CCTV | Closed Circuit TV |
| CEO | Chief Executive Officer |
| CMTS | Cellular Mobile Telecom Service |
| COI | Constitution of India |
| CORBA | Common Object Request Broker Architecture |
| DBFOT | Design Build Finance Operate Transfer |
| DIMTS | Delhi Integrated Multi Modal Transit System Ltd. |
| DOT | Department of Telecommunication, Government of India |
| DSRC | Dedicated Short Range Communication |
| DTMF | Dual-Tone Multi-Frequency |
| ETA | Estimated Time of Arrival |
| GEF | Global Environment Facility |
| GIS | Geographic Information System |
| GoI | Government of India |
| GPS | Global Positioning System |
| GTFS | General Transit Feed Specification |
| IEC | International Electro-technical Commission |
| ISO | International Organization for Standardization |
| ISP | Information Service Providers |
| ITS | Intelligent Transport Systems |
| IUC | Interconnection Usage Charge |
| IVR/IVRS | Interactive Voice Response (System) |
| MoU | Memorandum of Understanding |
| MoUD | Ministry of Urban Development, Government of India |

| Acronym | Definition/Description |
|---|---|
| MoRTH | Ministry of Road Transport and Highways, Government of India |
| NGO | Non-Government Organisation |
| NLD | National Long Distance |
| NHAI | National Highways Authority of India |
| NUTH | National Urban Transport Helpline |
| O&M | Operation and Maintenance |
| OEM | Original Equipment Manufacturer |
| PIS | Passenger Information System |
| PLMN | Public Land Mobile Network |
| POI | Point of Interest |
| PRS | Premium Rate Service |
| PSTN | Public Switched Telephone Network |
| PMU | Project Management Unit, SUTP India |
| PWD | Public Works Department |
| RFPs | Request for Proposals |
| SDCA | Short Distance Charging Area |
| SEMP | Systems Engineering Management Plan |
| SMS | Short Message Service |
| STD | Subscriber Trunk Dialing |
| SOP | Standard Operating Procedures |
| TMICC | Traffic Management and Information Control Centre |
| TRAI | Telecom Regulatory Authority of India |
| UAN | Universal Access Number |
| UAS | Unified Access Service |
| UK | United Kingdom |
| UMTA | Unified Metropolitan Transport Authority |
| UML | Unified Modelling Language |
| UNDP | United Nations Development Programme |
| USA | United States of America |

| Acronym | Definition/Description |
|---|---|
| UTF | Urban Transport Fund |
| VoIP | Voice over Internet Protocol |
| VMS | Variable Message Sign(s) |
| WB | World Bank |

# EXECUTIVE SUMMARY

Efficient transportation is an important enabler for a country's overall development and it has a strong correlation with its economic deveopment. In the urban context, where efficient transportation results in direct savings in travel times, it leads to improvements in the quality of life of city residents and enhances the productivity of manpower.

Policy makers, transport planners, traffic engineers, and the private sector organisations engaged in developing new technologies are constantly looking for solutions to reduce energy consumption, optimise land usage, mitigate congestion, eliminate casualties, and arrange funds required to build new transportation infrastructure. Developed countries have shifted their priority from creating new and capital intensive transportation infrastructure to adopting sustainable transportation solutions in the form of Intelligent Transport Systems (ITS) that enable efficient utilisation of the exisiting infrastructure. In order to cater to the increased demand for transportation and mobility, cities typically prepare mobility plans that identify various interventions that would be needed to support the projected transportation demand in the city. IT based interventions are required to be planned alongside to increase the efficiency of such transportation sector investments and to get the best out of the investments made in infrastructure creation.

National Urban Transport Helpline (NUTH), as a transport information dissemination system, is one of the most widely used public interface ITS applications. It provides transit and traffic information to travellers which helps them to plan their journey across various modes, as required. 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 telephone helpline, website, mobile apps and social media. The information is used by public to plan their travel and by agencies to bring about an improvement in their system's performance based on feedback received.

Traveller information systems such as NUTH have emerged as an integral part of multi-modal transit and traffic information dissemination services worldwide. In India, none of the cities have established multi-modal transit and traffic information dissemination services yet. There is clearly a need to establish NUTH facilities for various Indian cities to provide both multi-agency/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 systems.

In the Indian context, the MoUD is encouraging cities to set up NUTH as a common platform for disseminating multi-modal transit and traffic information using various dissemination channels such as telephone helpline, website, mobile apps and social media.

## 1. Benefits of NUTH

Some of the benefits of the NUTH are listed below:

**A. Unified System for Urban Transport Information Dissemination**: NUTH would be a unified platform that would be accessible to public through multiple channels for providing all urban transport related information as described below:

- **Traffic Information Dissemination**: Generally traffic information is provided by Traffic Police of the city through its website, social media pages, helpline and mobile apps. NUTH would be a platform that would be accessible to public through multiple channels for providing traffic related information as a single unified source.
- **Transit Information Dissemination**: Transit information is typically provided by individual transit agencies of the city for their respective modes. NUTH would provide transit related information for all the transit agencies of the city to public through multiple channels.
- **Parking Information Dissemination**: Parking information is usually provided by individual parking agencies for their respective sites in a limited way. NUTH would be accessible to public through multiple channels for providing parking related information for various parking agencies.
- **Incident/ Construction and Maintenance Information Dissemination**: Incident related information is generally provided by the Traffic Police or any other agency concerned through its website, social media pages, helpline and mobile apps. Information related to construction/maintenance is shared with the police for diverting the traffic, as needed. This information is generally provided by the agency responsible for construction/maintenance. NUTH would be a common platform that would be accessible to public through multiple channels for providing incident/ construction and maintenance related information as a single unified source.

**B. Multi-Modal Information Dissemination System:** Presently various transit agencies disseminate transit information through their respective channels for their respective modes (e.g. Bus service, Suburban Railways, Metro, Monorail) only. Information regarding the 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. NUTH would act as a unified system from where users/general public can get information about various transportation modes in the city.

**C. Reducing Traffic Congestion:** NUTH would help individuals make more informed travel decisions and thereby help in moderating the traffic congestion on the road network. NUTH will provide traffic related information e.g. congestion on roads, alternate routes, construction and maintenance information, incident information etc. It would help users in taking alternate routes and prevent not just congestion from aggravating but would also support in efficient utilisation of the transport infrastructure.

**D. Improvement in Public Transport Modal Share:** 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 a particular transit is available, among others. This would help in increasing the reliability of public transport and would support in attracting commuters to shift to public transport leading to its enhanced share in overall transport trips.

## 2. NUTH Objectives (Chapter 2.0)

NUTHs would need to be set up within the context of specific city/region requirements and, therefore, would have objectives that support the respective stakeholders' needs. NUTHs typically would be set up with the objectives as set out below:

- Dissemination of transit, traffic and other relevant information that supports public in making informed travel decisions. It would include:
  - Provide both static and dynamic multi-modal transit information
  - Provide multi-modal trip planners
  - Provide events related information and updates that have an impact on traffic and/or transit systems
  - Provide construction/maintenance related information and updates with respect to road and transit network
- Support intermodal coordination among transit agencies
- Augment use of public transport

## 3. NUTH Applications (Chapter 4.0)

NUTH would have the following applications for information dissemination:

- Transit information system
- Traffic information system
- Transit trip planner
- Multi-modal trip planner
- Driving time prediction application
- Ride share application
- Parking information system
- Bicycle trip planner

## 4. NUTH Components (Chapter 5.0)

Each NUTH would have system components that would be driven by its design and operational needs. NUTH will house all the necessary equipment and systems for receiving, processing, storing and disseminating the required data/information. The typical major equipment and systems in an NUTH will include, but not be limited to, the ones listed in the table below:

**Table E1: NUTH Components: Backend**

| BACKEND COMPONENTS (DATA CENTRE) | |
|---|---|
| **Information Dissemination Applications**<br>• Transit information system<br>• Traffic information system<br>• Transit trip planner<br>• Multi-modal trip planner<br>• Transit schedule application<br>• Driving time prediction application<br>• Ride share application<br>• Parking information system<br>• Bicycle trip planner<br>**Front-end Interface Applications**<br>• IVRS software (including call agent screens)<br>• Mobile app<br>• NUTH website | **Backend Hardware**<br>• Computers/ Operator consoles<br>• Servers (application, communication, information dissemination etc.)<br>• Switches/routers<br>• Printers<br>• Storage |
| **Backend Standard Software**<br>• Operating System software<br>• Anti-virus software<br>• Database<br>• Data archival and retrieval system | **Utilities**<br>• Air conditioning<br>• Access control<br>• Power and backup facilities<br>• Fire suppression |

**Table E2: NUTH Components: Field**

| FIELD COMPONENTS | |
|---|---|
| **Field Equipment**<br>• None | **Communication**<br>• Hardwired, such as fiber optic, twisted pair, coax cable etc.<br>• Wireless, such as microwave, spread spectrum, cellular, Wi-Fi etc.<br>• Leased options, including both wireless (cellular) and wire line |

## 5. NUTH Implementation Process (Chapter 6.0)

Since the complexity of NUTH will depend on the size of the city, the number of agency interfaces and specific applications; the total time for implementation would vary and could

range between 17-25 months. The figure below outlines the typical steps for the NUTH development process.

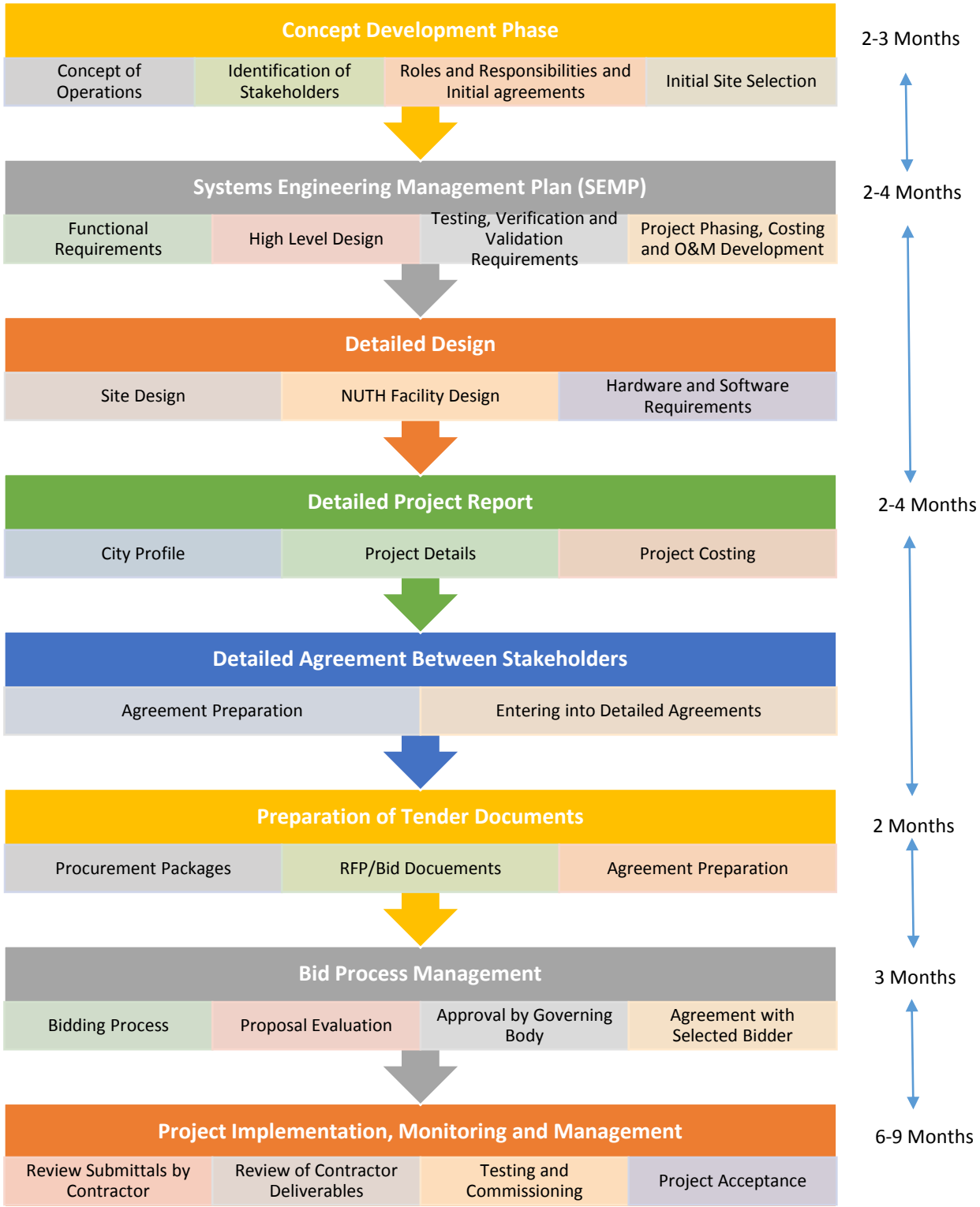



**Figure E1: NUTH Implementation Process**

As the concept is new to the Indian cities and will require additional support from organisations having required expertise, Ministry of Urban Development, GoI has identified and empanelled a set of consultants who may be engaged by the cities for seeking assistance in conceptualising, designing, procuring and monitoring the implementation of the NUTH in the city. The indicative scope of services for the city specific project consultancy is set out in Annexure 8. In line with the international best practices, it is recommended that the cities adopt Systems Engineering approach towards design and implementation of the system.

## 6. Project Phasing (Chapter 11.0)

It may not be necessary or desirable to set up NUTH with full functionality or for the entire urban agglomeration from the beginning and the system could be implemented in phases. NUTH applications to be implemented and time period for various phases may be decided based on city specific situation.

It is recommended that the NUTH be initially set up in a few select pilot cities. Once the key services have been successfully implemented in these cities, the system could then be replicated in other cities across the country.

While the Department of Telecom, GoI has allotted two 6-digit short codes for the urban transport helpline, a simpler number such as 555 (subject to availability and allotment by Department of Telecom, GoI) is recommended as a nationwide NUTH helpline number.

## 7. Participating Agencies (Chapter 9.0)

In line with the nature of information to be disseminated through the NUTH, agencies participating may come from diverse set of backgrounds. NUTHs that are providing information pertaining to road network, traffic and transit services of a region would have participating entities providing services in the region while those responsible for providing information pertaining to a metropolitan region would have participating agencies providing services in the metropolitan region.

For an NUTH, the participating agencies could be as under:

- Unified Metropolitan Transport Authority (UMTA) or the entity performing this role
- Traffic Agency: Traffic Police
- Transit Agencies: Bus operator, Metro operator, Suburban Rail operator (Indian Railways), operator of any other mode
- Road Construction & Maintenance Agencies: Municipal Corporations/ Urban local bodies, PWD, Development Authorities and other road owning agencies
- Event Monitoring Authority: Police, Fire Department
- Weather department
- Any other relevant agency

While planning and designing NUTH, identification of agencies together with review of their systems (both existing and the planned ones) and the information that would be provided by them must be taken into consideration (refer table below). These aspects may have a bearing on the information receiving and processing mechanism, NUTH system requirements, resource deployment, time to deploy the system, cost of deployment and the expertise required.

**Table E3: Entities Sharing Data with NUTH**

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| Transport & Traffic | • Unified Metropolitan Transport Authority or the entity performing this role | • Details of various public transit modes / operators in the region both current as well as planned<br>• Periodical updates to the aforesaid data<br>• Details of transport sector initiatives | |
| Traffic | • Municipal Corporation (traffic signal team)<br>• Other agencies managing traffic signals | • Location of various traffic related equipment: signalised junctions, cameras, variable message signs etc. on map and as list | • Plans and schedules for construction & maintenance<br>• Updates on the construction & maintenance |
| | • Municipal Corporation (roads team)<br>• State PWD<br>• Central PWD<br>• National Highways Authority of India (NHAI)<br>• State Road Development Corporations<br>• Municipal Corporations<br>• Cantonment Board | • Road network details including Geographic Information System (GIS) maps<br>• Location of various traffic related equipment: signalised junctions, cameras, variable message signs etc. on map and as list<br>• Road attributes: name, number of lanes, width, weight restrictions, height restrictions, turn restrictions, etc.<br>• New roads planned | • Changes in road attributes on a periodic basis<br>• Plans and schedules for construction & maintenance<br>• Updates on the construction & maintenance<br>• Temporary restrictions |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | • Development Authorities<br>• Other Road owning agencies | | |
| | • Traffic Police | • Road attributes: name, number of lanes, whether one-way or two-way, speed limit, entry restrictions, weight restrictions, height restrictions etc.<br>• Location of various traffic related equipment: signalised junctions, cameras, variable message signs etc. on map and as list<br>• Location of red light enforcement cameras, speed enforcement cameras<br>• Speed limit on various road sections<br>• Entry restrictions such as one way, no entry, time based entry, no U-Turn etc.<br>• Accidents / Incidents prone areas. | • Changes in road attributes<br>• Changes in location of traffic equipment and enforcement rules<br>• Incident information and updates<br>• Event information and updates<br>• Road closures, diversions<br>• Live surveillance camera feeds and access to historical feeds, live messages being displayed on the variable message signs<br>• Live traffic volume data, Congestion Information and details of public notices on traffic etc. |
| Transit | • Bus including BRT (City Transport Corporations, State Transport Undertakings, city bus SPVs, Municipal | • Operators details: Name, modes operated, contact details, website details<br>• Modes: Bus, Metro, Monorail, Tram etc.<br>• Services: Express, Ordinary, AC, Non AC, Night services<br>• Routes: Details of the routes operated | • Running status<br>• Departures scheduled at bus terminals, bus stops, metro stations<br>• Estimated Time of Arrival (ETA)<br>• Service delay, disruptions |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | Transport Undertakings)<br>• Rail<br>• Metro<br>• Monorail<br>• Other modes, if any | • Schedule Data: Frequency during peak/off-peak hours, Timings<br>• Timing of operations: First and last service on various routes<br>• Fare structure: Normal fares, special fares, concessions for various category of commuters<br>• Pass Details: Pass charges for various category of commuters, validity rules<br>• Bus terminals, Bus Stops, Metro Stations details<br>• Details of parking facility: capacity, vehicle types that can be parked, operational hours, charges, mode of payment, operating agency, contact details<br>• Inter-modal transfer options: feeder services, connecting routes, interchange stations/terminals<br>• Transit trip planner: intra-modal as well as inter-modal based on static data<br>• Tourism related information with connecting transit options to tourist spots | • Information on new services, discontinuation of any service etc.<br>• Rerouting<br>• Transit trip planner<br>• GPS feed data<br>• Transit Incidents & Events<br>• Schedules for construction & maintenance<br>• Updates on the construction & maintenance |
| Parking | • Municipal Corporation<br>• Other agencies managing parking facilities | • Details of parking facility 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)<br>• Updates on construction/ maintenance activities<br>• Updates on facility closure |
| Bus Terminus | • Department of Transport | • Details of services operated from the bus terminus | • Updates on bus arrivals, platform docking information |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | • State Transport Undertakings<br>• Other entities managing such facilities | • 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<br>• Updates on construction/ maintenance activities |
| Emergency Response | • Fire<br>• Police | | • Incident information updates<br>• Event information updates |
| Weather | • Regional Meteorological Centre | | • Weather updates<br>• Temperature, wind speed, fog, visibility details, humidity, rainfall etc. |
| Tourism | • Tourism department or Tourism development corporation | • Details of tourist spots<br>• Information related to tourist spots such as locations, brief details, ticketing details, operational timings, contact details, transit connection, route map etc. | |
| Pollution | • Pollution control board | | • Air quality data such as sulphur dioxide, nitrogen dioxide, particulate matter, ozone, lead, carbon monoxide |

## 8. Organisational Structure (Chapter 9.0)

Organisational structure of the NUTH directly impacts its ability to operate effectively. The suggested typical NUTH organisation structure has been presented below:

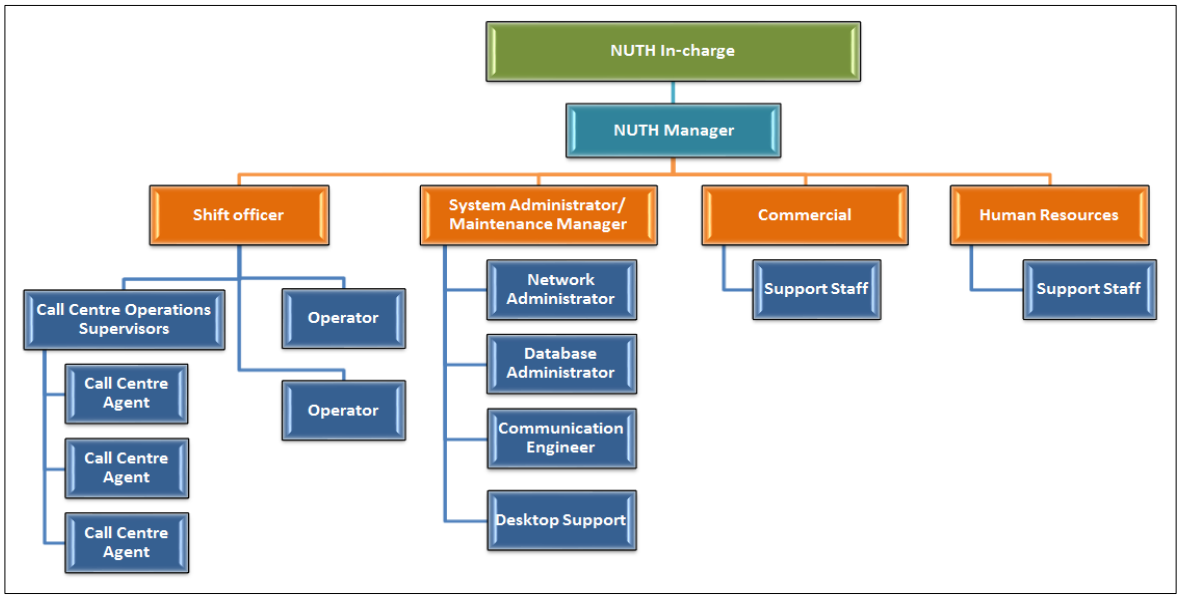



**Figure E2: Typical NUTH Organisational Structure**

The above structure is are for guidance purposes only and the same would need to be reviewed and refined to meet the requirements of specific NUTHs.

## 9. Revenue Streams (Chapter 11.0)

NUTH may not be able to generate any significant 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 data plans for accessing the system or making calls to the transport helpline number. It is recommended that a similar model may be adopted in India with users bearing the cost of data plans for accessing the system or making calls while the services are provided to users without any charges.

Some of the revenue streams that could be assigned to NUTH or explored from NUTH related activities to defray part of the O&M costs are as under:

- Fines collected through enforcement measures.
- Parking charges collected from users.
- Receipts from private entities for sharing data.
- Receipts from media for sharing data.

- Receipts from users for providing personalised information sent through mailers, Short Message Service (SMS), mobile apps or providing personalised access to certain information.
- Receipts from advertisers against grant of right to display advertisements on website.
- Receipts from advertisers against grant of right to display advertisements on mobile apps.
- Receipts from advertisers against grant of right to undertake advertisements on helpline.
- Receipts from sponsorship by corporates in lieu of exclusive right to co-brand.
- Receipts from mobile apps downloads.
- Receipts from subscription services offered on mobile apps.

It may be noted that there may be an overlap between the revenue streams identified for NUTH, as above, and the revenue streams identified for TMICCs in the TMICC Operations Document. The common revenue streams should, therefore, need to be accounted for in any one system but not in both.

## 10. Funding of NUTH (Chapter 11.0)

Central Government may use any of its programmes for supporting such initiatives. Funding for setting up of the NUTH system may be secured by 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 cities 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 shared by the respective State Government and the Transit Agencies/Urban Local Bodies / City Urban Transport Fund (UTF). Central Government may also support the O&M of such initiatives on a need basis.

[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)

## 11. Overview of Implementation Models (Chapter 11.0)

The typical implementation models that may be examined for establishing and operating the NUTHs are listed in the table below.

**Table E4: Implementation Structure Options**

| Implementation Options | Investment | O&M Cost |
|---|---|---|
| Option 1 | Public | Public |
| Option 2 | Public | Private |
| Option 3 | Private | Private |

Considering the limited revenue potential from such projects, it is recommended that such projects are taken up in the government/public authority domain (Option 1).

The private sector players could be engaged by government agency /public authority for design, supply, installation, testing, commissioning, maintaining and operating such facilities. In addition, call centre services could also be availed from the private sector players.

# 1.0 INTRODUCTION TO THE DOCUMENT

## 1.1 Purpose of Document

This National Urban Transport Helpline (NUTH) Operations Document has been developed to assist various government organisations/public authorities in India embarking on the process of planning and establishing an NUTH.

This document is intended to be a reference guide for such organisations and their staff working towards planning, designing, procuring, establishing, managing and monitoring NUTH.

It would also be a useful reference document for the consultants who would be advising for planning and design of the NUTH in various cities/ towns in India.

## 1.2 Intended Audience

One of the core activities of the NUTH is dissemination of transport, traffic and transit information covering all modes. In view of this, the proposed Unified Metropolitan Transport Authority (UMTA), which is likely to be entrusted with responsibility for multi-modal transport co-ordination; transport/traffic agencies having responsibility to manage traffic; and, transit agencies managing the transit operations and associated facilities are the primary targets for whom this document has been developed.

This document has been developed to assist these organisations as they will generally lead or participate in the initiatives for planning and establishing of the NUTH. It would also be a useful reference guide for the Intelligent Transport Systems (ITS) practitioners and consultants who would be advising the UMTA/traffic agencies/transit agencies in matters connected with the planning and design of the NUTH.

## 1.3 Document Development Method

This document was prepared under the guidance of Ministry of Urban Development (MoUD), Government of India to assist the agencies and ITS practitioners for proper implementation of NUTH concepts in Indian cities.

This document was also developed based on the state-of-the-art review exercise undertaken by the consultants. As part of the review, several overseas and Indian cities were studied and the practices followed by them for transport information dissemination were reviewed. The outcome of the review was shared with various cities during the workshops conducted by MoUD and the feedback received during the workshops has also shaped the development of this document.

This document has also benefited considerably from the insights provided, feedback given and the reviews undertaken by the World Bank, Project Management Unit (PMU) and Project Management Consultants (PMC) engaged by MoUD.

## 1.4 Organisation of NUTH Operations Document Content

The overview and organisation of NUTH Operations Document is as set out below:

- **Chapter 2.0** undertakes an overview of NUTH, the objectives of setting of an NUTH and the various aspects to be considered with respect to implementation and operation of an NUTH.
- **Chapter 3.0** deals with the concept of ITS architecture and standards including associated details such as Project Requirements, Functional Architecture, Physical Architecture, and Project Definitions.
- **Chapter 4.0** provides the details of the various NUTH applications such as transit information dissemination, traffic information dissemination, parking information dissemination, construction/maintenance information dissemination, incident/event information dissemination, trip planner, ride share etc.
- **Chapter 5.0** covers the planning and design considerations while setting up NUTHs.
- **Chapter 6.0** covers the topic of project management covering various aspects such as Project Planning, NUTH Implementation Process, Project Monitoring and Control, Risk Management, Configuration Management and application of Systems Engineering concepts.
- **Chapter 7.0** deals with system operational procedures and undertakes an overview of NUTH Activities, Operations, Incidents and Events, Citizen Inputs and Requests, System Reports and Data Storage and System Documentation.
- **Chapter 8.0** covers maintenance procedures covering aspects such as NUTH related assets maintenance, System Start-Up and Shut-Down Procedures, Types of Maintenance, Spare/Backup Equipment, Emergency Operations, Maintenance contracting approaches such as Agency Maintenance and Contract Maintenance.
- **Chapter 9.0** provides an overview of the institutional framework in the Indian context and provides details of Stakeholders, Potential Agencies in NUTH, NUTH Organisation structure, Training Requirements and agreements amongst project stakeholders.
- **Chapter 10.0** takes a look at performance monitoring aspects of NUTH.
- **Chapter 11.0** deals with the sizing, phasing and costing of NUTH.
- **Chapter 12.0** provides the details of resources and references used in preparing this document.

## 1.5 How to Use the Operations Document

This document may be used as a reference manual by the agency's team that is contemplating setting up of NUTH or is in the process of establishing one. While the chapters have been arranged to provide a flow of understanding on the subject, each chapter of the document is designed to be a self-contained one and, therefore, chapters can be read on a need basis without the necessity to follow any particular order.

## 1.6 Relationship to Other Manuals, Policies and Procedures

This document is intended to serve as a guideline for agencies and ITS practitioners to apply good and reasonable measures to the planning, design and implementation of NUTH for local, regional, state-wide or other geographical areas. This guideline provides concept of some of the best practices in NUTH and Intelligent Transport Systems (ITS) standards and implementation.

TMICC and NUTH are both Intelligent Transport Systems with several interfaces for information exchange. While TMICC focuses on managing roadway traffic movement in an overall sense, the NUTH is focused on providing travellers information pertaining to journey planning – generally for public transport modes, but could also cover intermediate public transport and private modes. Therefore, TMICC focuses on Centre-to-Field and Centre-to-Centre interfaces while the NUTH focuses on Centre-to-Public interfaces. However, since both are ITS, some of the aspects are common, such as: application of Systems Engineering concepts, ITS architecture and standards, project management framework, maintenance procedures, operational procedures, stakeholders, institutional framework etc. These aspects have been covered in both, the TMICC Operations Document and the NUTH Operations Document, with modifications as relevant for each system.

# 2.0 OVERVIEW OF NATIONAL URBAN TRANSPORT HELPLINE

## 2.1 What is NUTH?

Efficient transportation is an important enabler for a country's overall development and it has a strong correlation with its economic deveopment. The link between economic well-being and good transportation is a well-established and widely accepted fact. In the urban context, where efficient transportation results in a direct savings in travel times, it leads to improvements in the quality of life of city residents and enhances the productivity of manpower.

Policy makers, transport planners, traffic engineers, and the private sector organisations engaged in developing new technologies are constantly looking for solutions to reduce energy consumption, optimise land usage, mitigate congestion, eliminate casualties, and arrange funds required to build new transportation infrastructure. Developed countries have shifted their priority from creating new and capital intensive transportation infrastructure to adopting sustainable transportation solutions in the form of Intelligent Transport Systems (ITS) that enable efficient utilisation of the exisiting infrastructure. In order to cater to the increased demand for transportation and mobility, cities typically prepare mobility plans that identify various interventions that would be needed to support the projected transportation demand in the city. IT based interventions are required to be planned alongside to increase the efficiency of such transportation sector investments and to get the best out of the investments made in infrastructure creation.

National Urban Transport Helpline (NUTH), as a transport information dissemination system, is one of the most widely used public interface ITS applications. It provides transit and traffic information to travellers which helps them to plan their journey across various modes, as required. 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 telephone helpline, website, mobile apps and social media. The information is used by public to plan their travel and by agencies to bring about an improvement in their system's performance based on feedback received

In the Indian context, the MoUD is planning to set up an urban transport helpline system with a nation-wide common phone number for dial-in enquiries. In addition, website, mobile apps and social media are also proposed to be used for urban transport related information dissemination.

## 2.2 NUTH Objectives

NUTH would need to be set up within the context of city/region requirements and, therefore, would have objectives that support the respective stakeholders' needs. NUTHs typically would be set up with the objectives as set out below:

- Dissemination of transit, traffic and other relevant information that supports public in making informed travel decisions. It would include:
  - Provide both static and dynamic multi-modal transit information which is accurate and reliable
  - Provide multi-modal trip planners
  - Provide event related information and updates that have an impact on traffic and/or transit systems
  - Provide construction/maintenance related information and updates with respect to road and transit network
- Support intermodal coordination among transit agencies
- Augment use of public transport

Figure 2-1 contains the mission statements of 511 services being provided in the San Francisco Bay Area by Metropolitan Transportation Commission. Figure 2-2 has objectives of traveller information system being provided in UK by Traveline Information Limited.

**511 Service Mission Statements**

- The 511 program must cost-effectively provide traveller information that customers both want and are prepared to act on, thereby enhancing the efficiency and maximizing the capacity of the Bay Area transportation system.
- This information should be accurate, reliable, multimodal, comprehensive and regional in scope.
- Responsibility for the gathering, processing and dissemination of 511 information should be regionally coordinated and rationally allocated to Bay Area transportation organizations — in both the public or private sectors — according to institutional interest, ability and wherewithal.

***Source: Metropolitan Transportation Commission, San Francisco Bay Area***

**Figure 2-1: 511 Service Mission Statements, MTC, San Francisco Bay Area**

**Traveline Objectives**

To promote public transport passenger growth and enable the delivery of high quality mobility information across a mix of channels in a way that represents best value to our stakeholders.

***Source: Traveline Information Limited, UK***

**Figure 2-2: Traveline (UK) Objectives**

## 2.3 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 respective 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/regions 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)
- GTFS (USA and many other countries)

Street and building names in India are not uniform across Indian cities and these are based on numbering as well as naming system which have evolved over a period of time and does not follow any structured approach at City, State or National level.

NUTH relies on extensive data exchange with various transit operators, traffic authorities and data providers including with 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.

A more in-depth discussion on the Standards and Protocols has been undertaken in Chapter 3.0.

## 2.4 NUTH Planning and Designing

Planning and implementation of an NUTH system must be carried out in a systematic manner adopting a Systems Engineering approach. A detailed description of the Systems Engineering approach has been provided in Annexure 5.

It is also important to sequence the development process in a systematic manner. A flow-chart setting out the various steps for implementation of the NUTH has been provided in Chapter 6.0.

Chapter 4.0 provides details about a number of NUTH applications. However, given the nascent status of development of transit and traffic management systems in Indian cities, it is neither possible nor recommended to undertake the implementation of the full suite of systems. A phased roll-out and the estimated costing for setting up of NUTH have been provided in Chapter 11.0.

## 2.5 Institutional Considerations for Implementation of NUTH

Various levels of governments have roles to play in the urban transport sector in India. The framework governing the responsibilities of various entities has been outlined in the Constitution of India (COI).

The division of responsibilities between various levels of government in India is governed and guided by the Constitution of India (COI). Article 246 of the COI deals with this matter and contains references to Seventh Schedule containing List I (Union List), List II (State List) and List III (Concurrent List). Article 243 (W) deals with provisions regarding power, functions and other incidental matters related to municipalities.

There are several key considerations from an institutional perspective when establishing the NUTH:

- The agency that could set up and manage NUTH website component as well as NUTH number.
- The agencies that need to be considered for possible association.
- The nature of association required such as data sharing, cost sharing, roles to be played by the agency etc.
- Responsibilities being discharged by the agencies in accordance with law, government directives or under any other contract / arrangement.
- Level of readiness of the agency such as ITS equipment deployment, automation of the systems, manual or electronic monitoring systems.

The roles currently being played by various levels of governments or agencies controlled by them and the suggested roles with respect to setting up and operation of the NUTH has been detailed in Chapter 9.0 of the report.

## 2.6 Personnel, Training and Capacity Building

NUTH could either be managed by staff from the participating government agencies/authorities or they could alternatively be managed by staff deployed by the contractors engaged by such agencies.

In case the government agencies/authorities choose to deploy their own staff, the staff would need to be recruited and trained since very limited capacity exists in these organisations for managing such systems. In case there is a limitation in hiring of staff by the government agencies/authorities, then contractors could be engaged to deploy manpower for operation of the NUTH. The contractor staff in such case would work under the control and supervision of the government agencies/authorities.

## 2.7 Consultants and Contractors

Considering the capacity limitations in government agencies / statutory authorities towards implementing such systems, it is recommended that help and assistance may be sought from professional consultants who have relevant experience while conceptualising, designing, developing, procuring and programme managing the implementation of the NUTH.

As the concept is new to the Indian cities and will require additional support from organisations having required expertise, Ministry of Urban Development, GoI has identified and empanelled a set of consultants who may be engaged by the cities for seeking assistance in conceptualising, designing, procuring and monitoring the implementation of the NUTH in the city. The indicative scope of services for the city specific project consultancy is set out in Annexure 8.

In addition to the consultants, there will also be a need to engage a contractor whose role could entail undertaking detailed design, supply, installation, testing, commissioning, maintaining and operating the NUTH. The decision making role of government/public authority could be suitably embedded in such procurements at various stages such as system requirements, design, testing etc. Table 6-7 of this report provides an overview of the role allocation amongst various project related entities (system owner, consultant and contractor).

A list of potential contractors is provided in Annexure 1 at the end of this report for various types of equipment. It is an illustrative list and not an exhaustive one.

# 3.0 ITS ARCHITECTURE AND STANDARDS

## 3.1 Introduction

### 3.1.1 What is an ITS Architecture?

Intelligent Transport System (ITS) Architecture provides a framework for any type of technology related project in the transport sector. The system architecture is broadly a description of services, ITS components, interconnections and information flow mapping for various systems and sub-systems that encompass the ITS project. ITS architecture's goal is to simplify, rather than complicate the deployment of ITS applications. It is a mapping of services and the future ITS applications.

With a properly developed architecture, the owners and the stakeholders can identify both the services required by the end users, the data for these services and the interconnections among the different sub-systems. The architecture goal is to also describe how a system can be optimised, structured and coordinated among various systems and show how the data/information can be used for a common benefit of the end users.

ITS Architecture is a strategic business analysis, focusing on users and user services, providing the big picture plan for current and future services and facilities and the functional linkages.

ITS Architecture has the desired ability to improve and enhance system deployments. Specifically, it can:

- Promote compatibility
- Allow expandability
- Allow interoperability
- Improve and enhance systems integration
- Promote standardisation

Through proper sharing of data, information and services, the overall cost of system components can be reduced, enabling multiple systems to work together. This will also allow systems to communicate and share information at lower costs than will be required to build new systems to collect similar data and services. It reduces systems' inefficiencies and allows maximum collaboration and cooperation among public sector agencies and private entities. Through identification of services, data flows and interconnections, appropriate standards can also be identified to allow common platform for data and information sharing, which will support standardised systems planning and architecture.

The primary purpose of ITS Architecture is to dissect all the requirements and details of technology project so that the project can be understood, tested and verified to ensure that the "intent of the project" is satisfied. In addition, it will allow the use of standardisation and interoperability in project development and design. The intent of this chapter is to provide guidance to the public agencies and private sector consultants to understand the ITS Architecture concepts and use these concepts as a step by step process for development of the NUTH through the use of a Systems Engineering process as described in Annexure 5.

### 3.1.2 ITS Architecture in Other Countries

Typically an ITS Architecture is a set of framework developed at a national and a regional level to describe all of the ITS functionalities that encompass the ITS technology realm. Many countries have developed a national level architecture, typically through a multi-year process, to provide a comprehensive perspective to the ITS development in the country. An ITS Architecture at a national level needs to be supported by a national level ITS Master Plan that describes all existing as well as future ITS vision for the country and for particular regions.

The United States, European Union, Japan, South Korea, and certian other countries have all developed a national level ITS Architecture to support the development and realisation of ITS vision for their respective countries/region. These efforts are a multi-year process which involves all or most stakeholders, trade unions, and private stakeholder industry to become meaningful. Without a comprehensive public input into the process, the programme will have minimal impact and will not be followed by project sponsors.

Furthermore, ITS Architecture is supported by the concepts of standardisation and use of standard technologies and protocols. The use of standards and crucial enabling components of the ITS Architecture support effective use of technologies and allow interoperability and data/information sharing. Consequently, the participation of the private sector, the technology vendors and the software/hardware/systems integrator community is as important in developing and maintaining a national level ITS Architecture/Standards platform.

### 3.1.3 ITS Architecture in India

ITS planning and deployment is in its infancy in India. There are a number of noteworthy achievements in ITS applications in India, primarily in transport technology, traffic management, fare collection and toll collection systems. However, at the present time, there is no national ITS Plan or ITS Architecture that has been developed. Therefore, the burden of developing an ITS Architecture, will fall on the project sponsors and proponents. The lack of a national ITS Architecture does not mean that this step is not required nor recommended. In fact, it becomes more important to understand and apply the concept of ITS Architecture through a Systems Engineering approach, which has been described in more detail in this chapter.

For each project concept, it is critical that the project sponsor evaluates, describes and details out the Architecture requirements to ensure that all of the systems and sub-systems are properly identified, described and data/information flows are identified and described. In this respect, the project sponsor can rely on best approaches in planning, designing, and implementing a system that would consider the best industry practices in formulating the ITS project.

In fact, the World Bank recommends that for those nations and regions that have not yet developed a national or regional ITS Architecture, a step-by-step, or project-level ITS Architecture is the recommended process in beginning a national ITS Architecture. A culmination of a number of ITS Architecture that follow this process, can allow the beginning framework for development of a national level ITS Architecture and Standards development.

### 3.1.4 Benefits of ITS Architecture

The benefits of establishing sound ITS architecture includes coherence in development process, added value in system identification and cost savings in proper implementation of solutions that benefit the end users.

Development of ITS architecture at logical and functional levels will include a comprehensive analysis of the data underlying each service, identification of commonalities and a sound technical approach to data flows, data sharing, integration and interface standards so that multiple agencies, as well as the private sector, can be assured that the ITS services and products are compatible and interoperable with other ITS products and services.

Once these elements are correctly identified, the systems integrators can leverage the ITS architecture to develop and create efficient system designs in which the services will avoid unnecessary redundancies and inherent incompatibilities. Compatible systems enable each technology to serve multiple functions as a common platform, providing cost savings and ease of use by multiple end users.

The use of ITS architecture will likely result in lower system development cost; lower operational and maintenance costs; ease of upgrade and expansion; improved life-cycle costs; and greater end user benefits.

Some of the key benefits of ITS Architecture can be summarised as follows:

- Allows common understanding of assumptions by all parties across various system components
- Provides a unified approach to planning, designing and implementing ITS projects at regional and national levels
- Provides clarity to planning, design and implementation process,
- Permits evolution of technology and system component replacements and upgrades
- Facilitates sharing of information across multiple platforms

- Facilitates interoperability of hardware, software and system components
- Facilitates more open marketplace so that multiple systems and vendors can compete for services and products, reducing overall costs
- Allows collaboration among various vendors for services and products
- Permits economies of scale for system implementation
- Promotes investments by developers and vendors through a greater level of certainty in the future
- Enables multiple vendors and sub-systems to be built by separate contractors
- Allows for improved future operational costs planning
- Reduces development time and costs
- Reduces duplication of efforts, and
- Enables information sharing between sub-systems, enabling a regional, national, multi-modal and sustainable transport policy implementation.

### 3.1.5 ITS Architecture Components

Systems Architecture provides the framework for the ITS Architecture for any given project, system or sub-system. The ITS Architecture can be broadly described and categorised into the following components:

- **User Services:** User services describe the activities related to the ITS system or sub-system and applications that support those services. Examples of User Services include Traveller Information Systems, Parking Information etc.
- **Functional Architecture:** Functional Architecture or Logical Architecture describes a system from a functional perspective. It focuses on the functional processes and information flows of a system. The functional architecture can also be described as entities where these functions exists, such as a traffic management centre, a public transport system, a parking management centre, etc. A functional architecture describes the specifications or functionalities of a system and how they should work and process the information. It defines the final product or deliverable. A functional description is different from the description of a technology, such as a Global Positioning System (GPS) unit. A GPS unit is a technology component, but providing the physical location of an asset is the functional description of this technology.
- **Physical Architecture:** Physical Architecture describes the physical view of the system. The physical architecture describes how the systems should provide the required functionalities. It defines the data flows that originate from one sub-system to another sub-system or group of systems. The physical architecture also describes the desired communications and interactions between different agencies

and organisations. The movement of information is described as the data flows. These data flows also provide the basis for the standards identification.

- **Institutional Framework:** An ITS Architecture would not be complete, unless the institutional frameworks are also identified. As important as the functional or physical layers or interactions are in the "technology" realm, a system would not be functional or operate at optimal level, if the "human" side of the equation is not considered. In fact, today, due to increased complexity of ITS technologies, multiple stakeholders, both from public agency and private entities, are involved in developing a complete ITS solution. Identification, interaction and agreements between these entities are critical in developing complete ITS solutions, especially in the areas of NUTH and traveller information systems.

Figure 3-1 depicts the framework of the ITS Architecture from a project level perspective.

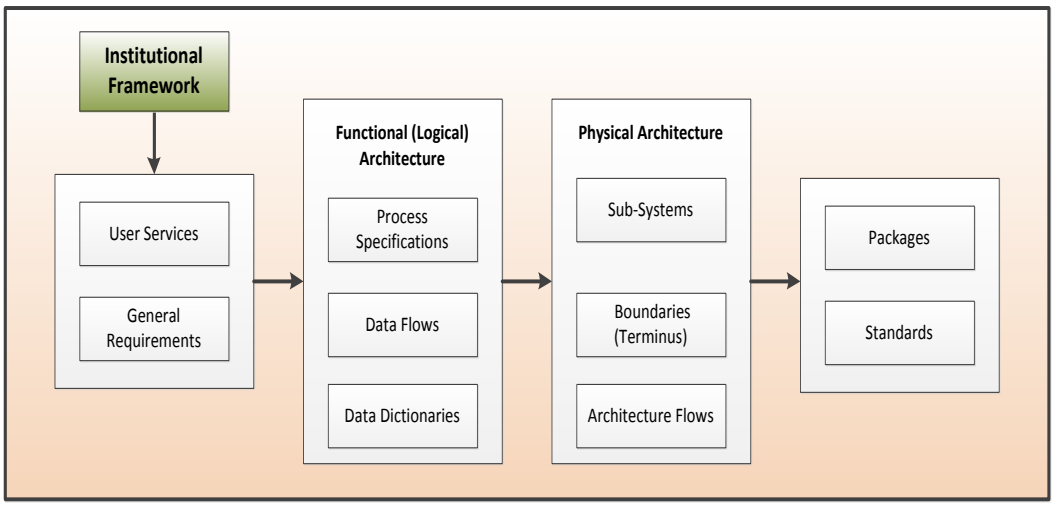



**Figure 3-1: ITS Architecture Flow Diagram**

## 3.2 Project Requirements

### 3.2.1 User Services

In the US National ITS Architecture, for example, there are eight groups of User Services. These eight services can be broadly defined as follows:

- Travel and Traffic Management,
- Public Transportation Management,
- Information Management,
- Maintenance and Construction Operations,
- Electronic Payment,

- Commercial Vehicle Operations,
- Emergency Management, and
- Advanced Vehicle Safety Systems.

The goal of User Services is identification of what level of services are to be provided to the users or to the public. The user services attempt to address problems and needs associated with the specific user services. These services are not static and can be modified if other types of services, technologies or needs are identified.

Once the User Services are identified, it is important to develop requirements for these services, so that the functionalities are correctly identified and then mapped to the Logical and Physical Architecture requirements. These will then allow a complete description of the Project Definition and the associated Standards that are required to allow interoperability and standardisation.

### 3.2.2 Requirements

Requirements do not state how the system will be implemented, but defines what the system is to do; how well it is to do it; and under what conditions. These requirements are detailed and documented. The systems requirements are further refined at the high level design stages that define the system level architecture and are then assigned to the sub-systems of hardware, software, database and people.

Requirements for each sub-system element are documented the same way as for the system level requirements. The process is repeated until the system is fully defined and decomposed. Each layer will have its own set of interfaces defined. Each layer will require an integration step that is needed when the sub-system interfaces with the other sub-system. These steps are further defined in Annexure 5 of this document.

The following is an example of Requirements for a Public Bus Transit management sub-system for an NUTH system:

- The GPS Devices fitted on the buses shall send updates of the location, speed at intervals of 10 seconds to the AVL backend system;
- The AVL backend system shall have a detailed GIS map of the city with bus route definitions and bus stop geocodes;
- The AVL backend system shall process the location updates from the bus to estimate the time of arrival of the bus at a particular stop on the route assigned to such bus;
- The AVL backend system shall publish the ETA information on the transit operator website;
- The AVL backend shall also share the updates of location, speed received from the buses as well as the ETA information with the NUTH system in real time;

- A commuter wanting to know the ETA of buses on a particular route at a particular bus stop should be able to access such information through a mobile application which is available on both Android or iPhone platforms;
- The NUTH Mobile Application shall have a screen to input the following data: bus stop name, bus stop id, bus route id, destination name. The input shall be from a drop-down menu with an auto-fill feature. The auto-fill feature shall populate the drop down list based on the first 3 characters filled by the user;
- The NUTH Mobile App shall also have a map feature for selection of the bus stop. Upon selection of the bus stop through a map interface, the User shall have to fill in the bus route id or the destination name through a drop-down menu with an auto-fill feature;
- The User must fill in the bus stop name and either bus route id or the destination name for a valid query to the NUTH backend system;
- The NUTH Mobile Application shall fetch the information from the NUTH backend system and display the ETA of the buses of the particular route at the particular bus stop. The ETA shall be displayed for all buses of the particular route arriving at the bus stop in the next 20 minutes;
- The ETA shall be displayed both, in tabular form and on the map.

## 3.3 Functional Architecture

The functional (logical) architecture defines the more detailed layers of the architecture in terms of setting out the physical sub-systems. The logical architecture aims to define and illustrate the configuration of services. The logical architecture starts with the functions specifications and takes the form of a series of data flow diagrams that depict the logical processes, the data flows and the definitions of the data requirements, or Data Dictionaries. It is a graphical tool to organise complex entities and relationships. It focuses on the functional processes and the information (data) flows of sub-systems and the system as a whole. A logical architecture helps to identify the system function and guides the development of the overall requirements of the system and/or upgrades. A logical architecture is independent of institutional framework and technology, but is supported by the institutional arrangements and goals.

Figure 3-2 is an example of a representative NUTH Functional Architecture. It depicts those services that are anticipated and required for the particular project. Not all of these services are necessary for all NUTH applications, and would need to be customised to the particular agency requirements and needs.

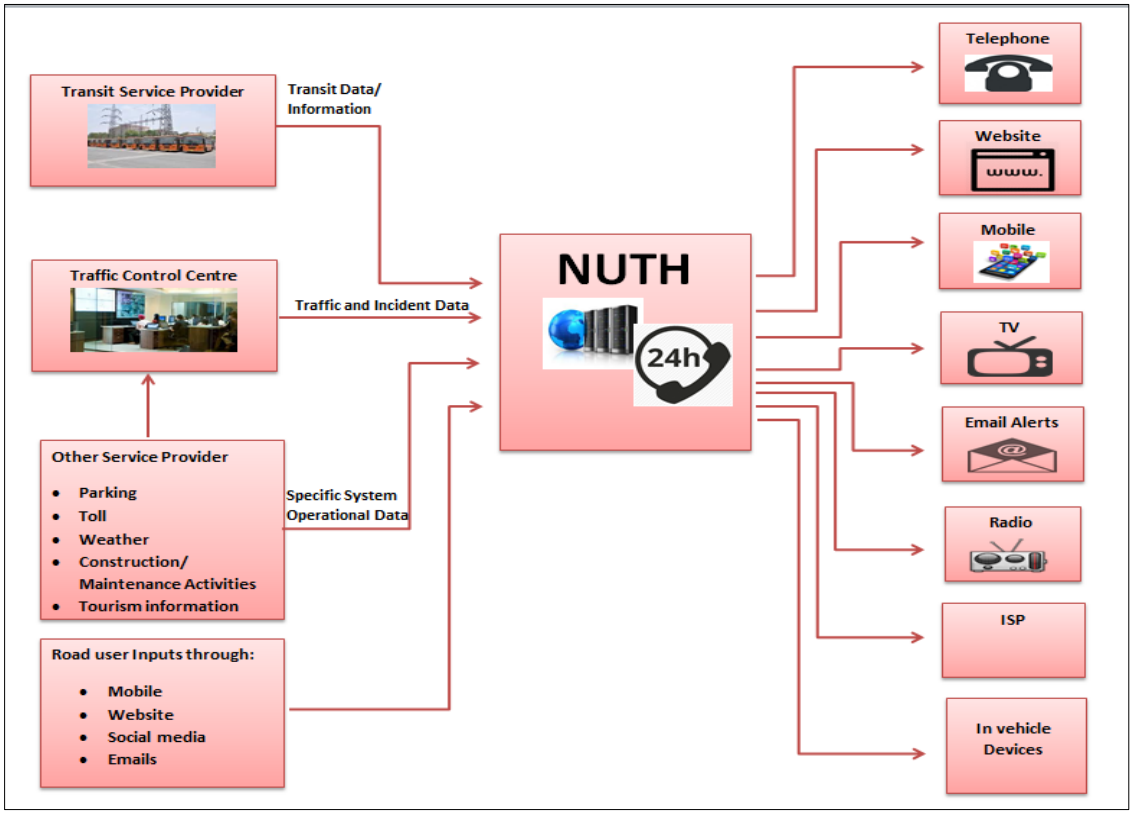



**Figure 3-2: Representative NUTH Functional (Logical) Diagram**

### 3.3.1 Process Specifications

Process specifications are detailed description of the functionalities for all of the activities that will take place in the project. Table 3-1 shows examples of these functional descriptions for a typical NUTH project.

**Table 3-1: Representative Process Descriptions for NUTH[3]**

| Functional Areas | Description |
|---|---|
| Interface with Transit Operations Data | This process interfaces with transit services data that will be used to create broadcast or interactive messages to travellers and other operations centres as well as support trip planning and route guidance applications. Data quality checks should be performed on all collected data. This process should collect transit service information including schedules, fares, deviations, incidents, and transfer points from the transit service provider. The process should load the incoming data into the transit traveller data. The data can be provided to the process either via direct request from the process or as a result of periodic (unrequested) updates. |

[3]Adapted from US ITS Architecture. These functional areas are not complete set of requirements, but are shown as examples of descriptions that need to be developed for all of the envisioned functionalities.

| Functional Areas | Description |
|---|---|
| | This process provides the media with transit information. This process exchanges information with Other Information Service Providers (ISPs). The process selects the appropriate subset of data which will be sent to each ITS application or entity that is requesting data. The process provides all of the received information to the ISP Operator Interface process and receives the data collection parameters (to define exactly what data should be retrieved as a result of each request) from the operator interface process. Upon receipt of traveller information alert subscriptions, this process should output relevant transit alerts. |
| Provide Trip Planning Information to Traveller | This process obtains all the information needed to fulfill the traveller's request for a trip. The process supports the request for trips that require the use of one or more modes of transport, and uses the preferences and constraints specified by the traveller in the trip request, plus data from the store of trip planning parameters, to select the most appropriate modes. It sends details of the trip requirements to the specialised processes that provide route information for the different modes of transport. When route data is received back from these processes, this process ensures that the whole trip is covered by one coherent route for which all the data such as costs, arrival times, and modal (and intra-modal) transfer points are known. The information provided to the traveller by the process should be sufficient to enable the traveller to understand the routing, modes and cost of the trip. The trip information should be stored for possible use in subsequent trip confirmation. The process also includes parking lot data. This data is used in transactions requiring electronic payment of parking lot services, as well as for a traveller making a parking lot reservation. This process should exchange all input and output data from and to the traveller with the appropriate traveller interface process. The traveller sends parking lot data, traveller trip requests, and traveller current condition requests to the archival process. |
| Provide ISP Operator Interface for Trip Planning Parameters | This process manages the data store containing parameters used by the trip planning processes. These parameters govern the way in which multimodal trips are planned by other processes within Provide Trip Planning Services. This process accepts inputs from the ISP Operator to define or update trip planning parameters. This process outputs these trip planning parameters to the ISP Operator. |
| Inform Traveller | This process provides the traveller with data about all requested trip, traffic, transit, yellow pages services, border crossings, or event information, confirmation of any requested reservations, and payments made as part of confirmed trip plans. This process also receives information concerning evacuation situations and wide area alerts to be provided to travellers. The data is sent by the process to an interface process that is responsible for its actual output to the traveller. |

| Functional Areas | Description |
|---|---|
| Provide Traveller Telecomm Information | This process provides a voice-enabled traveller telephone information system (e.g. 555) with region-specific data, including traffic conditions, work zone and roadway maintenance information, roadway environment conditions, weather and event information, transit schedules, deviations, and fares, yellow pages information, border crossing information, current ferry and rail schedules, and airport status. The process receives specific caller requests from a 555-type system as well as requests for bulk upload of regional traveller information. The process then requests this data from other ITS processes and return it to the voice-based traveller information system, filtered and sorted based on the traveller's request. Both the request from the voice-based system and the returned traveller information may be specially formatted by this process for voice. |
| Provide Multimodal Route Selection | This process manages the creation of multimodal routes (e.g. routes where travellers use one or more transportation modes) in response to traveller's trip or route requests. It supports on-line route guidance for travellers using personal devices, route guidance for vehicles, selection of specialised vehicle based routes for other ITS functions, (such as Manage Commercial Vehicles), and selection of multimodal routes in response to trip planning requests from travellers. The multimodal routes provided by the process take into account of the traveller's preferences and constraints. Constraints can include the access needs of those with disabilities. Preferences can include minimising waiting time at modal interchange points, level of traveller security, or minimum cost. Trip requests, traveller route requests, and traveller route acceptances should be sent to the data archival process. |
| Process Vehicle Location Data | This process provides the vehicle's current location to other processes within the vehicle. It receives the precise location from a Location Data Source terminator. The terminator may base its data on one or more sources of position data such as GPS, DGPS, odometer and differential odometers, and may refine its calculations using techniques such as map matching, etc. |
| Provide Driver with Personal Travel Information | This process provides in-vehicle advisory, broadcast, traveller information alert, and trip planning data for output to drivers and travellers aboard vehicles. Data broadcast to the driver (from both centres and short range communications field equipment) includes traffic related data (incidents and link data), transit, weather, event, parking, multimodal, border crossings, and price data. Data broadcast to the driver also supports emergency information including evacuation and wide area alert information, as well as data from the vehicle itself. This vehicle data includes vehicle conditions, environmental probe data, safety and position warnings, and enhanced vision images. Data broadcast can also include in-vehicle signage messages, which include roadside traffic indicator outputs, fixed signage (e.g., Stop signs, yield signs), roadside Dynamic |

| Functional Areas | Description |
|---|---|
| | Message Sign (DMS) information, local conditions warnings identified by local environmental sensors, and work zone intrusion warning messages. Safety and warning messages should be prioritised by the process to supersede advisory and broadcast messages. The process also provides travellers in vehicles with the status and confirmation of their request for trip plans and reservations for other services such as non-motorised transportation information, and event information. |
| Determine Personal Portable Device Guidance Method | This process acts as the interface for personal guidance requests received from travellers with personal portable devices. The process selects the best method for personal guidance based on data in the traveller's request. Two methods are available to the process, comprising dynamic infrastructure based guidance is provided to the personal portable device), and autonomous (the personal portable device uses only locally available data- there is no information provided by the infrastructure) If the communications link to the central source fails, the process uses the last set of guidance data that was received, and if this is not sufficient for the traveller to reach the requested destination, automatically revert to the use of autonomous guidance using local data only. |

### 3.3.2 Data Flows

Information exchanges between the processes and functional specifications are called data flows. Data flows follow all activities that exchange information in one or both directions. Data flows follow the Process Specifications. Data flows are aggregated together to form high-level architecture flows in the physical architecture as will be discussed later. Figure 3-3 shows a representative data flow for an NUTH system. . (Note that not all flows are shown).

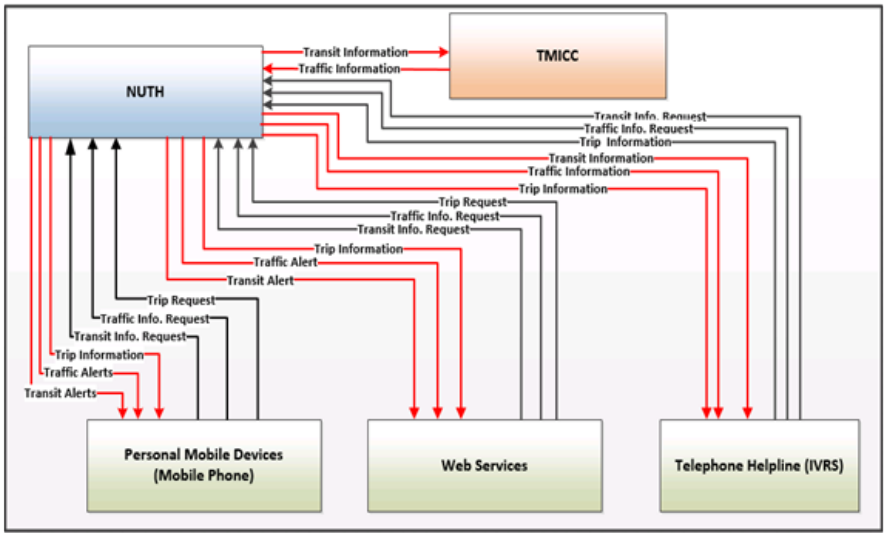



**Figure 3-3: Representative Data Flow for an NUTH System**

### 3.3.3 Data Dictionaries

Every data flow included in the logical architecture should have a defined data dictionary. Each data dictionary entry should contain a description of the data flow and identify any lower level data elements that make up the data flow. In this fashion, all data requirements can be identified. For example, in Expected Arrival Module, the data requirements would include, current GPS location, Speed, bus route, geo-code of the bus stop.

## 3.4 Physical Architecture

The physical architecture is a physical representation of the sub-systems and the complete system. This provides a physical representation of how the system should provide the required functionalities. This is a line drawing representation and should not be a detailed level design.

The physical architecture takes the processes identified in the functional architecture and assigns them to physical entities. The data flows that originate in the functional architecture are grouped together in the physical architecture flows. This architecture also identifies the communication requirements and the interfaces that are required between sub-systems. This would include preliminary identification of desired communications and interactions between different transportation systems and organisations.

### 3.4.1 Sub-Systems

Most of the National ITS Architectures have identified four major categories to represent physical entities for typical public transport systems. These include Centres, Field Equipment, Vehicles (Including automobile, transit vehicles and commercial vehicles) and Travellers or Human interface. From the communications perspective there are a number of options that can connect various sub-systems. These include both wire-line (hardwired) and wireless systems. Wire-line systems include all types of physical communications media, such as fibre optics, twisted wire-pair and coaxial cable. Wireless options include microwave, spread spectrum, mobile applications, dedicated short range communications, and other similar media. Figure 3-4 is a depiction of potential connection options between various sub-systems in the four areas of transport system and various communication media.

A physical architecture supports multiple sub-systems or functionalities from multiple sub-systems. This is particularly important for the centre sub-system, which is not in particular a physical building. A centre can represent any location that collects data, fuses data and disseminates the data to the end users. A centre can also function for multiple purposes. For example, a Traffic Management Centre can act as both as a traffic management function as well as traveller information system or NUTH system. A centre can also function as a multi-agency system, housing both the traffic management as well as the transit management functions.

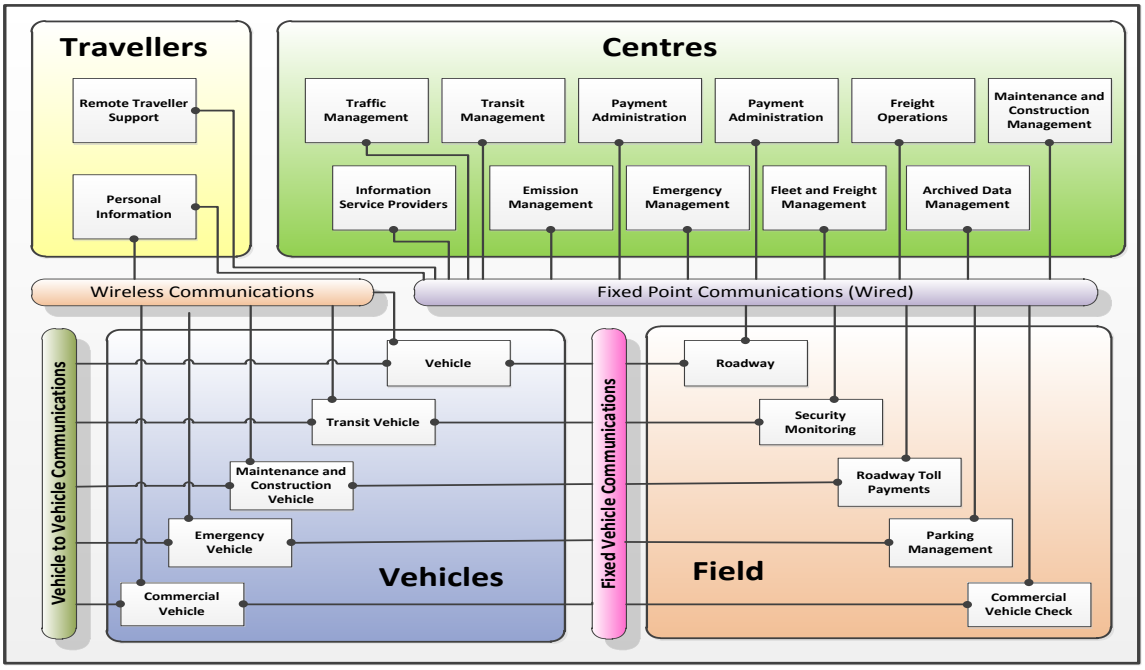



**Figure 3-4: Physical ITS Architecture Sub-Systems and Communications[4]**

Figure 3-5 shows a representative NUTH application and the communication flow diagram.

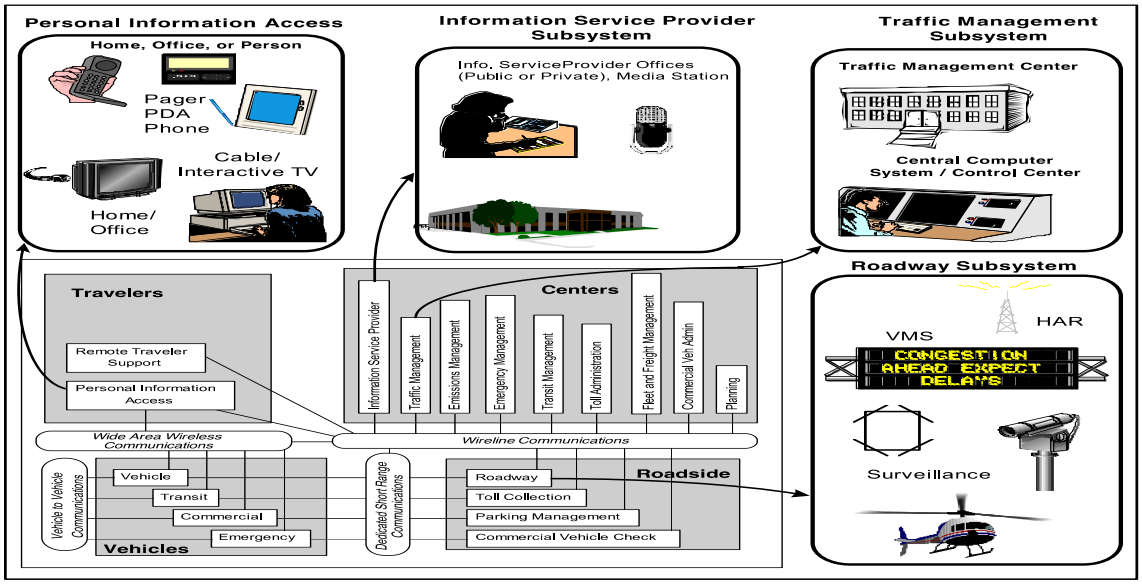



**Figure 3-5: Representative NUTH Communications Diagram**

[4] Source: US National ITS Architecture

### 3.4.2 Boundaries (Terminus)

Boundaries or Terminus are the interfaces to the real world and the end users. The physical architecture defines interfaces to the terminus, but does not define functionality for the terminators. Terminus can be humans, environments, and systems.

In an NUTH system, for example, the telecommunication phone service that provides the caller interface and voice processing (voice recognition/synthesis) that supports voice-enabled traveller telephone information systems is a terminator. It provides wire-line and wireless caller access to NUTH systems and other telephone access mechanisms. It represents the boundary of the architecture where a call is received and processed and includes voice portal capabilities in scenarios where a distinct voice portal exists between ITS Centres and telecommunications providers. The terminus gathers traveller information, alerts, and advisories from information service provider(s) and uses this information to support voice-based interactions with a traveller.

Annexure 2 at the end of the report provides examples of different boundaries (terminators) for human, environment and systems.

### 3.4.3 Architecture Flows

Information that is exchanged between subsystems and terminus in the physical architecture are the architecture flows. Architecture flows and their communication requirements define the interfaces which form the basis for much of the standards that need to be defined. Data flows described earlier in the Logical Architecture are aggregated together to form architecture flows.

Figure 3-6 shows a typical architecture flow for a traveller advisory system in an NUTH system.

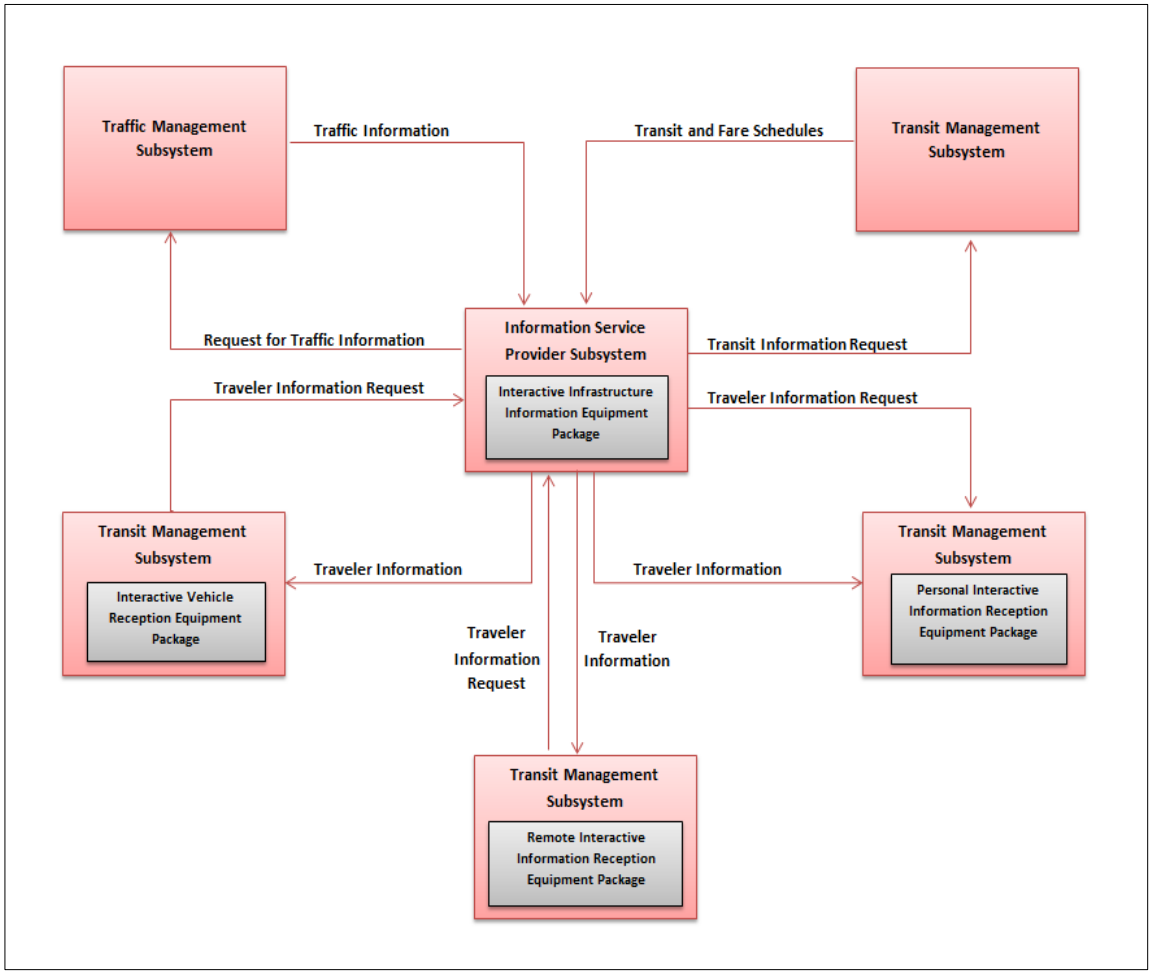



**Figure 3-6: Architecture Flows for a Typical Transit Traveller Information Sub-System**

## 3.5 Project Definitions

Project definitions are the outcome of the 4-step process described earlier. It will become a textual, graphical and description of the project components. In a fully developed national ITS Architectures, these are defined as Market or Service Packages or similar terminologies. However, the step by step process will result in a fully developed ITS Architecture framework.

### 3.5.1 Packages

Project packages are groups of sub-systems that work together to form an implementable package of hardware and software capabilities. The group of functions takes into account the user services and the need to accommodate various levels of functionalities.

These groups of functionalities or "packages" include a description of the following components:

- Functionalities
- Inputs and Outputs
- Security Considerations (information and data protection)
- Sub-Systems Interface Diagrams
- Boundaries (Terminus) Interface Diagrams

Packages can be a number of sub-systems or a complete sub-system, such as a Traffic Control system or Transit Traveller Information system. In an NUTH system, there will be several packages that would comprise the full scale of the proposed project. Project packages can be grouped together as a "Service Packages".

The following are examples of Service Packages related to NUTH project development:

1. Broadcast Traveller Information
2. Interactive Traveller Information
3. Autonomous Route Guidance
4. Dynamic Route Guidance
5. ISP Based Trip Planning and Route Guidance
6. Transportation Operations Data Sharing
7. Travel Services Information and Reservation
8. Dynamic Ridesharing
9. In Vehicle Information System
10. Short Range Communications Traveller Information
11. ITS Data Archives

This list is not an exhaustive set of service packages and depending on the project requirements, there can be other functions, such as environmental management, electronic fare collection, emergency management etc.

### 3.5.2 ITS Standards

One of the primary functions of an ITS Architecture is to help define ITS standards, particularly at the interfaces between major ITS components.

The ITS standards are important, because as of now in India, there are no mandatory standards in place when implementing advanced technologies into transportation implementations. There are currently, a number of activities in India to adopt standards, such as Automatic Fare Collection System, Electronic Toll Collection System and Bus Technologies.

The use of standards is important, because the four main system types in the architecture classes: centre, field, vehicle, and traveller, must be able to communicate with each other across many systems. The "centre" must be able to remotely access what is going on in the "field", while the "vehicles" and "travellers" must be able to understand the signs and directions given by the new Intelligent Transport Systems.

The current "best" source of ITS standards for application in India is the International Organization for Standardization (ISO). The list of potential ISO Standards that could be used is provided in Annexure 3. Specifically ISO TC204 has developed an architecture that defines the ITS standards activities. Since this is relatively simple architecture, it can serve as a base model for the ITS architecture activities.

ISO TC204 provides recommendations for standardisation of information, communication and control systems in the field of urban and rural surface transportation, including inter-modal and multi-modal systems, traveller information, traffic management, public transport, commercial transport, emergency services and commercial services. Annexure 3 is a summary of applicable standards that are related to the NUTH application. Not all standards are shown, such as, In-Vehicle Systems, and Freight systems. The listed standard should be evaluated and used if appropriate to the application and circumstances. Since there are no mandates or requirements established by any of the Indian Government agencies, these standards are advisory and shall be treated as such.

### 3.5.3 Use of Standards in Project Implementation

There are a number of activities that can be undertaken to enhance the use of ITS Architecture and Standards. These include the following:

- Developing a common data model
- Establishing communications standards
- General communication technologies

#### A. Common Data Model

ITS applications are dependent on the availability and use of many types of data, including traffic, transport, weather, tourism and other information. The data is often created by many organisations and without a common uniformity. Therefore, it would be important to establish uniformity in data formats to make the information consistent among various systems. One approach is to use ISO standards or use the XML (Extensible Mark-up Language), which has become a standard in IT for information exchange, especially in the Internet domain.

#### B. Communications Standards

Communications standards include both the data dictionaries, message set specification and the protocols which the packages of information is transmitted and received. Protocols are frequently standardised by the telecommunications industry. Data dictionaries, on the other hand, are an organised collection of data

elements, which describes the meaning, format and the use of the elements. Defining these elements will be extremely important in establishing a protocol of information exchange.

### C. Communications Technologies

Using standardised communication technologies can benefit ITS deployment and ease of use. Almost all ITS applications can use existing communication infrastructure (e.g. Mobile Radio Services, conventional and cellular telephones, internet, FM subcarriers, digital audio broadcast, etc.). Many traffic information service operations through the internet and cellular telephone technology is often used for communication between centres and field equipment. Initial capital costs, as well as on-going operational costs for leased telecommunication systems must be evaluated during the Systems Engineering process to address the life-cycle needs of the project.

# 4.0 NUTH APPLICATIONS

## 4.1 Introduction

This chapter provides an overview of the key operational areas and applications supported by the NUTH. The topics that have been covered in this chapter are Inter-agency and Inter-jurisdictional Coordination, NUTH Applications, System Requirements, Information Dissemination Modes, Language for Information Dissemination, User Interface, Accessibility Standards, Central Systems and Data Warehousing.

## 4.2 Inter-agency and Inter-jurisdictional Coordination

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

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

- Operating and managing transit
- Road construction and maintenance
- Parking facility owners/operators
- Traffic management
- Weather information services

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. Since the TMICC is expected to be the repository of all traffic related information, where TMICC exists, NUTH would need to interface with TMICC also in order to exchange information related to traffic and events/incidents. Further, as and when agencies upgrade their respective systems, the NUTH information exchange interfaces with their systems must be checked to ensure continuous flow of information.

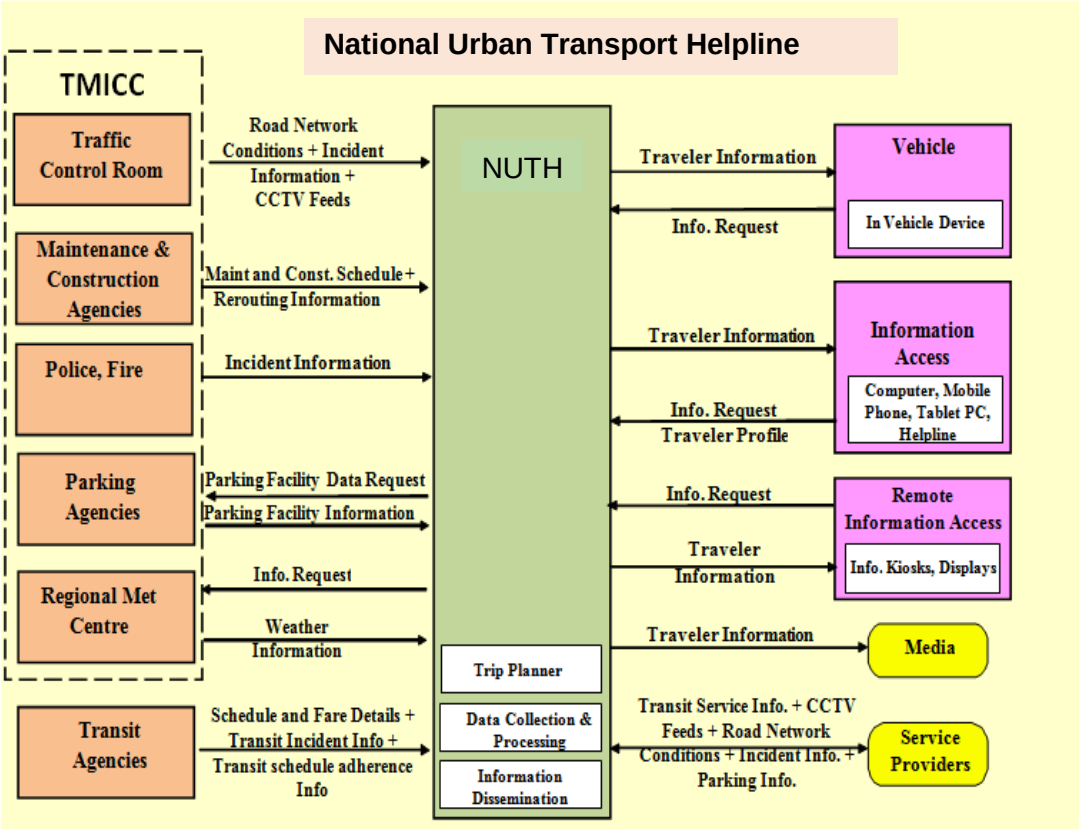



**Figure 4-1: NUTH Architecture**

Depending on the type of information being exchanged, the information flow could be on a real-time basis. There would thus be a need for coordination between NUTH and the participating stakeholders on a sustained basis to ensure continuous transmission of information. When information about other jurisdictions also needs to be disseminated through the NUTH, need for similar coordination with agencies from those jurisdictions would arise.

Intermodal coordination among transit agencies would also be needed covering the following:

- In relation to service planning such as feeder services, unified schedule, intermodal transfers, common ticketing etc.
- Integrated information dissemination to travellers such as multi-modal trip planners, journey time etc.
- In relation to any events or incidents by way of arranging alternate fleet, rerouting fleet, adjusting schedules, as needed.

These activities would typically be carried out in consultation with the Unified Metropolitan Transport Authority (UMTA), where it has been seet up, as it would have the mandate to coordinate for multi-modal transportation.

## 4.3 NUTH Applications

### 4.3.1 Transit Information

Transit related information disseminated through NUTH could be static as well as dynamic /real-time information. Based on the availability of transit data, services could be provided to users in phases. Real-time information is among the highly sought-after information by users. Table 4-1 lists some of the transit information that could be disseminated through NUTH:

**Table 4-1: Transit Information**

| TRANSIT INFORMATION | |
|---|---|
| **Static** | **Real time** |
| Modes, Operator Details | Running Status |
| Terminals, Stops | Departure Time |
| Routes | Estimated Time of Arrival |
| Trip planner based on static data | Trip planner based on real time data |
| Service types | Rerouting |
| Schedules | Delays and disruptions |
| Fare, Pass Details | Dynamic information on journey costs |
| Operational Hours | Information of new services, changes |
| Parking | Parking availability |
| Scheduled construction and maintenance | Updates on construction and maintenance |

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 includes trip planner, nearby stops, routes, schedules and route maps, real time departures, transit service areas, announcements etc.

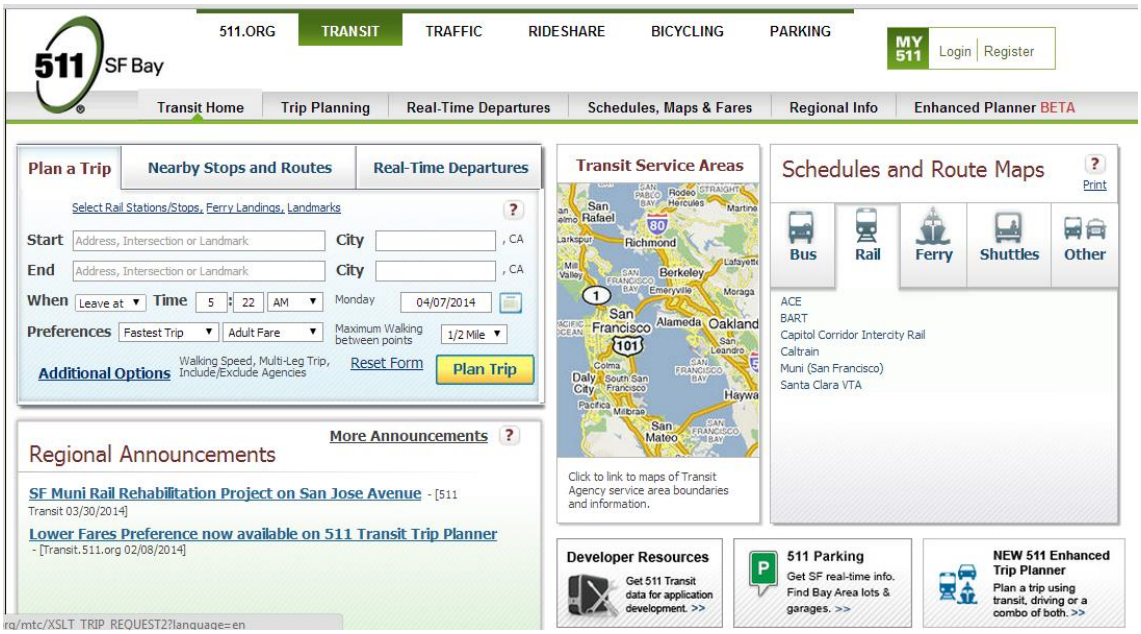
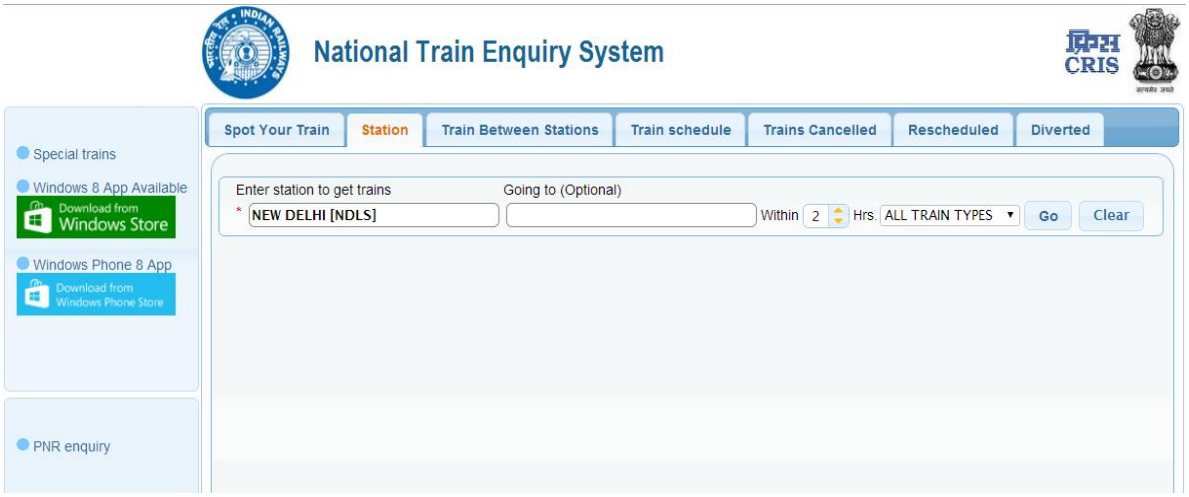



**Figure 4-2: Transit web page, 511, San Francisco Bay Area**

Figure 4-3 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 includes 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.




Train SSB-PWL 10 CAR EMU [64014] started SHAKURBASTI on 2 May

| | Station | Sch Day | Sch Arr | Sch Dep | ETA/ATA | Delay | ETD/ATD | Delay | Distance |
|---|---|---|---|---|---|---|---|---|---|
| 1. | SHAKURBASTI(SSB) | 1 | | 13:10 | | | 13:10 | RT | 0 |
| 2. | DAYABASTI(DBSI) | 1 | 13:16 | 13:17 | 13:18 | 2 min | 13:19 | 2 min | 5 |
| 3. | VIVEKANAND PURI HALT(VVKP) | 1 | 13:20 | 13:21 | U.A. | | U.A. | | 6 |
| 4. | DELHI KISHANGNJ(DKZ) | 1 | 13:24 | 13:25 | 13:25 | 1 min | 13:26 | 1 min | 8 |
| 5. | SADAR BAZAR(DSB) | 1 | 13:26 | 13:27 | 13:27* | 1 min* | 13:28* | 1 min* | 10 |
| 6. | NEW DELHI(NDLS) | 1 | 13:49 | 13:50 | 13:49* | RT* | 13:50* | RT* | 12 |
| 7. | SHIVAJI BRIDGE(CSB) | 1 | 13:56 | 13:57 | 13:56* | RT* | 13:57* | RT* | 13 |
| 8. | TILAK BRIDGE(TKJ) | 1 | 14:00 | 14:01 | 14:00* | RT* | 14:01* | RT* | 14 |
| 9. | HAZRAT NIZAMUDDIN(NZM) | 1 | 14:06 | 14:07 | 14:06* | RT* | 14:07* | RT* | 19 |
| 10. | OKHLA(OKA) | 1 | 14:13 | 14:14 | 14:13* | RT* | 14:14* | RT* | 23 |
| 11. | TUGLAKABAD(TKD) | 1 | 14:21 | 14:22 | 14:21* | RT* | 14:22* | RT* | 30 |
| 12. | FARIDABAD(FDB) | 1 | 14:36 | 14:37 | 14:36* | RT* | 14:37* | RT* | 40 |
| 13. | FARIDABAD NW TN(FDN) | 1 | 14:50 | 14:51 | 14:50* | RT* | 14:51* | RT* | 44 |
| 14. | BALLABGARH(BVH) | 1 | 14:57 | 14:58 | 14:57* | RT* | 14:58* | RT* | 48 |
| 15. | ASAOTI(AST) | 1 | 15:07 | 15:08 | 15:07* | RT* | 15:08* | RT* | 58 |
| 16. | PALWAL(PWL) | 1 | 15:30 | | 15:30* | RT* | | | 69 |

**Figure 4-3: National Train Enquiry System website, Indian Railways**

### 4.3.1.1 Static Data and Information

Transit related static data, and information based on the same, could cover the following:

- Operators details: Name, modes operated, contact details, website details.
- Modes: Bus, Metro, Monorail, Tram etc.
- Services: Express, Ordinary, AC, Non AC, Night services.
- Routes: Details of the routes operated.
- Schedule Data: Frequency during peak/off-peak hours, Timings.
- Timing of operations: First and last service on various routes.

- Fare structure: Normal fares, special fares, concessions for various category of commuters.
- Pass Details: Pass charges for various categories of commuters, validity rules.
- Bus terminals, Bus Stops, Metro Stations details.
- Inter-modal transfer options: feeder services, connecting routes, interchange stations/terminals.
- Transit trip planner: intra-modal as well as inter-modal based on static data.
- Tourism related information with connecting transit options to tourist spots.
- Scheduled construction and maintenance.
- Any other relevant information.

The static information would require periodical updates based on any changes that may have taken place in any data element. In order to provide correct, updated and accurate information, necessary processes must be established in order to ensure that these are periodically reviewed by the respective transit or other information providing agencies for their correctness and updated status. Failure to follow a disciplined approach may lead to different data being disseminated on NUTH and the transit agency's own website / helpline.

The information could be displayed in the most appropriate manner based on the channel/device used to access the information.

#### 4.3.1.2 Dynamic or Real-Time Data and Information

Transit related dynamic data, and information based on the same, could cover the following:

- Running status at a terminal or bus stop.
- Departures at bus terminals, bus stops, metro stations at any given point in time.
- Estimated Time of Arrival (ETA) at a terminal or bus stop.
- Service delay, disruptions based on the current or anticipated operational status.
- Information on new services, discontinuation of any service etc.
- Rerouting of any service and related details.
- Transit trip planner: intra-modal as well as inter-modal based on current traffic / transit conditions.
- Updates on construction and maintenance at any transit facility or on any transit route.

### 4.3.2 Traffic Information

Traffic information that could impact travel could be disseminated through NUTH. Such information could be both static as well as dynamic. Based on availability of the traffic data, services could be provided to users in phases. In terms of road network coverage, based on the objective, the data could be provided for urban major roads. Table 4-2 lists some of the traffic information that could be disseminated through NUTH.

**Table 4-2: Traffic Information**

| TRAFFIC INFORMATION | |
|---|---|
| **Static** | **Real time** |
| Road Network Map | Congestion information |
| Location of signalised junctions | Travel time between locations |
| Location of CCTV cameras | Trip planner based on dynamic data |
| Location of VMS | Road conditions, closures, diversions |
| Location of parking facilities | Incidents, Events |
| Trip planner based on static data | Parking availability status |
| Road attributes (name, number of lanes, one way/two way etc.) | Weather updates |
| Entry, weight, height restrictions | Live camera feeds |
| Scheduled construction and maintenance | Updates on construction and maintenance |

Figure 4-4 shows the web page containing traffic related information on the 511 website (www.511.org). The information being disseminated is latest news and 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, Variable Message Signs (VMS), park & ride, High-Occupancy Vehicle (HOV) lanes and toll plaza on the map.

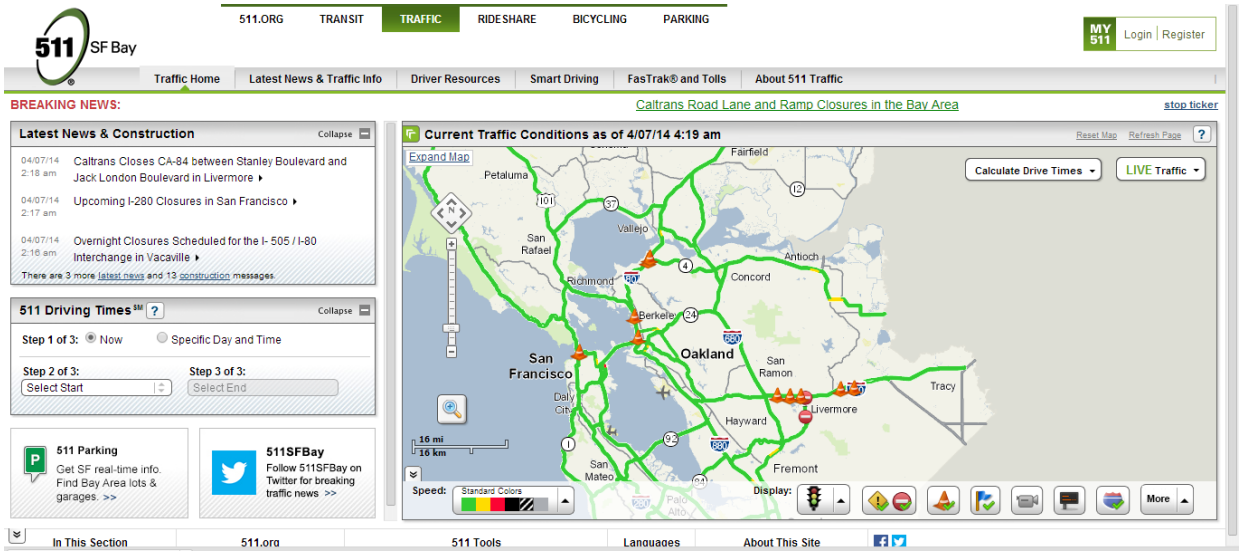



**Figure 4-4: Traffic web page, 511, San Francisco Bay Area**

### 4.3.2.1 Static Data and Information

Traffic related static data and, information based on the same, could cover the following:

- Road network details including Geographic Information System (GIS) maps.
- Location of various traffic related equipment: signalised junctions, cameras, variable message signs etc. on map and as list.
- Road attributes: name, number of lanes, width, whether one-way or two-way, speed. limit, entry restrictions, weight restrictions, height restrictions etc.
- Incident information.
- Details of parking facilities.
- Trip planner based on static data such as road network, attributes etc.
- Planned construction and maintenance.

### 4.3.2.2 Dynamic or Real-time Data and Information

Traffic related real-time data and, information based on the same, could cover the following:

- Congestion information: speeds on road network.
- Travel time between given origin and destination.
- Trip planner based on real time traffic and road network conditions.
- Incident information with location and impact details.
- Real time parking availability at parking facilities.

- On-going construction and maintenance with location and impact details.
- CCTV camera live feeds from key junctions / locations.
- Road diversions along with related details.
- Road closures along with related details.
- Weather details.

Parking, construction / maintenance activities, incidents and events update, weather and tourism related information have been further detailed in later sections.

The traffic information could be displayed in the most appropriate manner based on the channel/device used to access the information.

### 4.3.3 Parking Information

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 TMICC and/or the systems of the parking facilities. Figure 4-5 provides a snapshot of the parking web page of the 511 website of the San Francisco Bay Area (www.511.org).

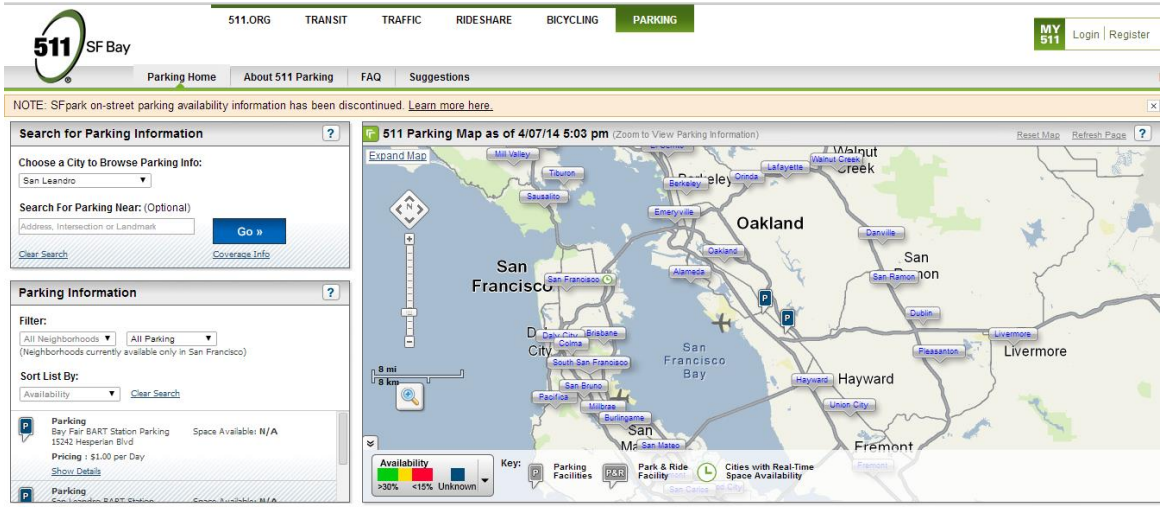



**Figure 4-5: Parking web page, 511, San Francisco Bay Area**

The parking information disseminated is generally for public car parks only, which includes number of parking spaces and the real-time parking spaces available (via use of detectors or parking ticketing systems). In the Indian context, public parking is also includes on-street or open parking. The information of real-time parking availability in this scenario would primarily be through sharing of information by the electronic ticketing systems deployed at such sites.

For private car parks (retail mall, office), the information could be provided through a specific agreement between the private entity and the NUTH/City Government (setting out the data formats, frequency of updates and commercial terms, if any). This would enable the office goers/mall users to know the availability of parking at these destinations, thereby helping make an informed choice on mode of transport and the trip destination. While it would be difficult for legacy systems to share this information with the NUTH, it would be possible for the new developments to share such information, if the data sharing formats and terms are standardised. This would enable new developments to provide car parking information to the NUTH by installing suitable parking systems.

### 4.3.4 Construction /Maintenance Activities Information

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 as below:

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

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

- Brief details
- Location: road, section, spot
- Direction of travel affected
- Impact: lane closure, diversion, congestion
- Alternate routes
- Expected time to restore normal traffic

Information in respect of planned construction and maintenance activities could 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 TMICC and/or the systems of the 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.

### 4.3.5 Incidents and Events Information

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

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

The information that could be provided to travellers in relation to incidents/events is as below:

- Incident/event details
- Location: road, section, spot
- Direction of travel affected
- Impact: lane closure, diversion, congestion
- Alternate routes
- Time during which traffic would be affected
- Expected time to restore normal traffic

Information in respect of planned events could 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.

### 4.3.6 Weather Information

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

In order to get such data, interfaces must be built with TMICC and/or other channels for getting such information (from regional meteorological stations or other agencies) must be established. Media could be another source of getting weather information and updates.

### 4.3.7 Tourism Related Information

Tourism related information such as important tourist places, their locations, brief details, ticketing details, operational timings, contact details etc. could be provided. This would also include trip planning tools.

### 4.3.8 Trip Planner

NUTH should 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. Figure 4-6 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.

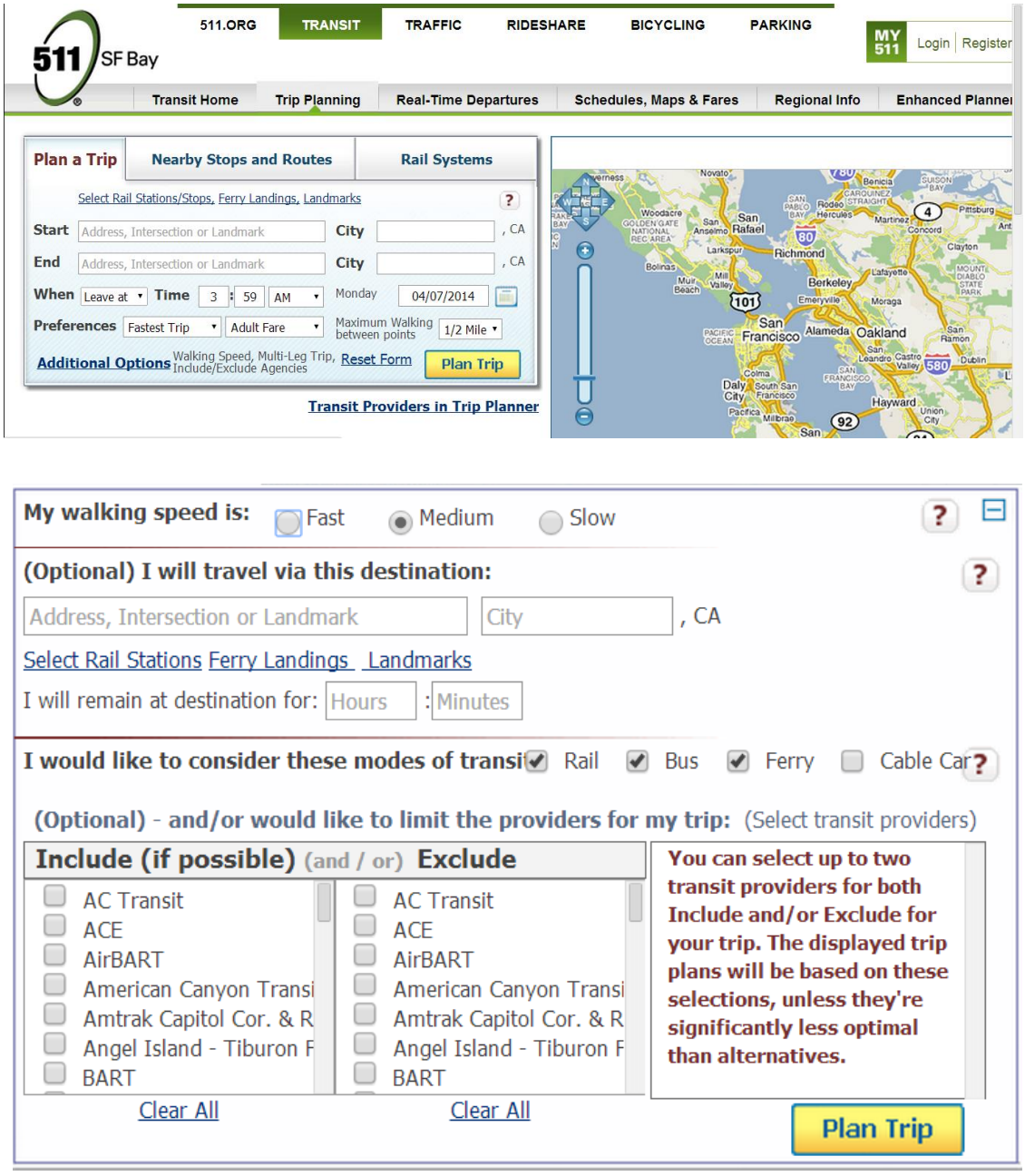



**Figure 4-6: Trip Planner, 511, San Francisco Bay Area**

Figure 4-7 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 etc.

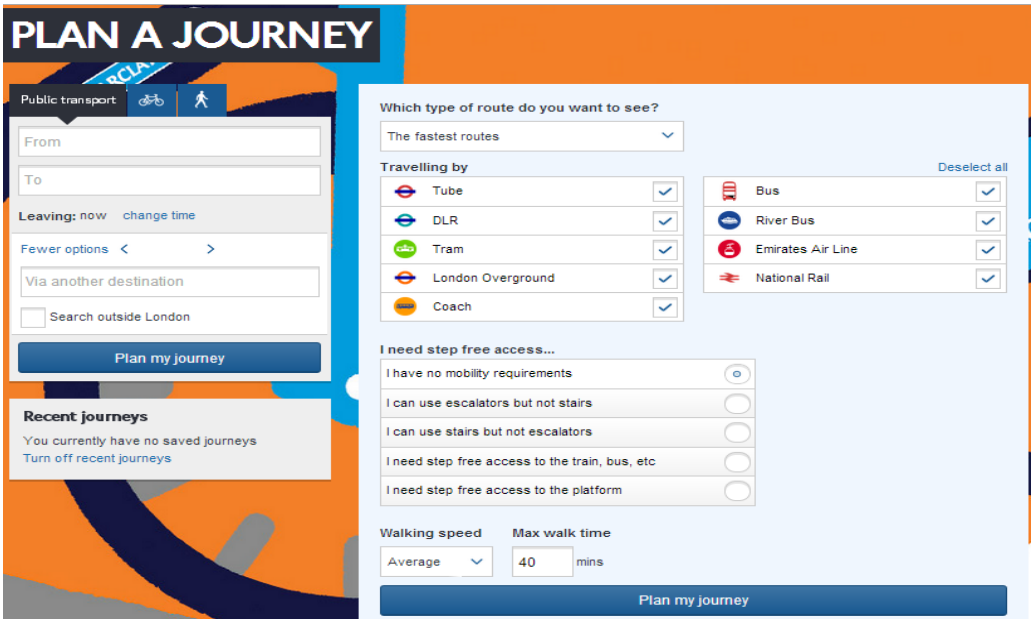



**Figure 4-7: Journey Planner, Transport for London**

### 4.3.9 Bicycle Trip Planner

Based on state of development of bicycle network and associated infrastructure, NUTH could provide a bicycle journey planning tool to support bicycle trips between various origins and destinations using several options such as cycle only route, routes where part of the journey can be made on bicycle (with facility for bicycle parking at transit station) and the rest using transit, transit stations where bicycle could be parked for onward transit journey, routes shown on the map, location of bicycle parking/hiring facilities, type of route (such as on plane, downhill, uphill, hilly, high traffic, low traffic, lakeside, seaside, green level), route with bicycle hiring facilities etc. Figure 4-8 shows the web page containing trip planning tool provided on the Transport for London website (www.tfl.gov.uk) providing various options to users to choose from such as bicycle only route, taking bicycle on public transport, leaving bicycle at a particular station and option to use Barclays Cycle Hire.

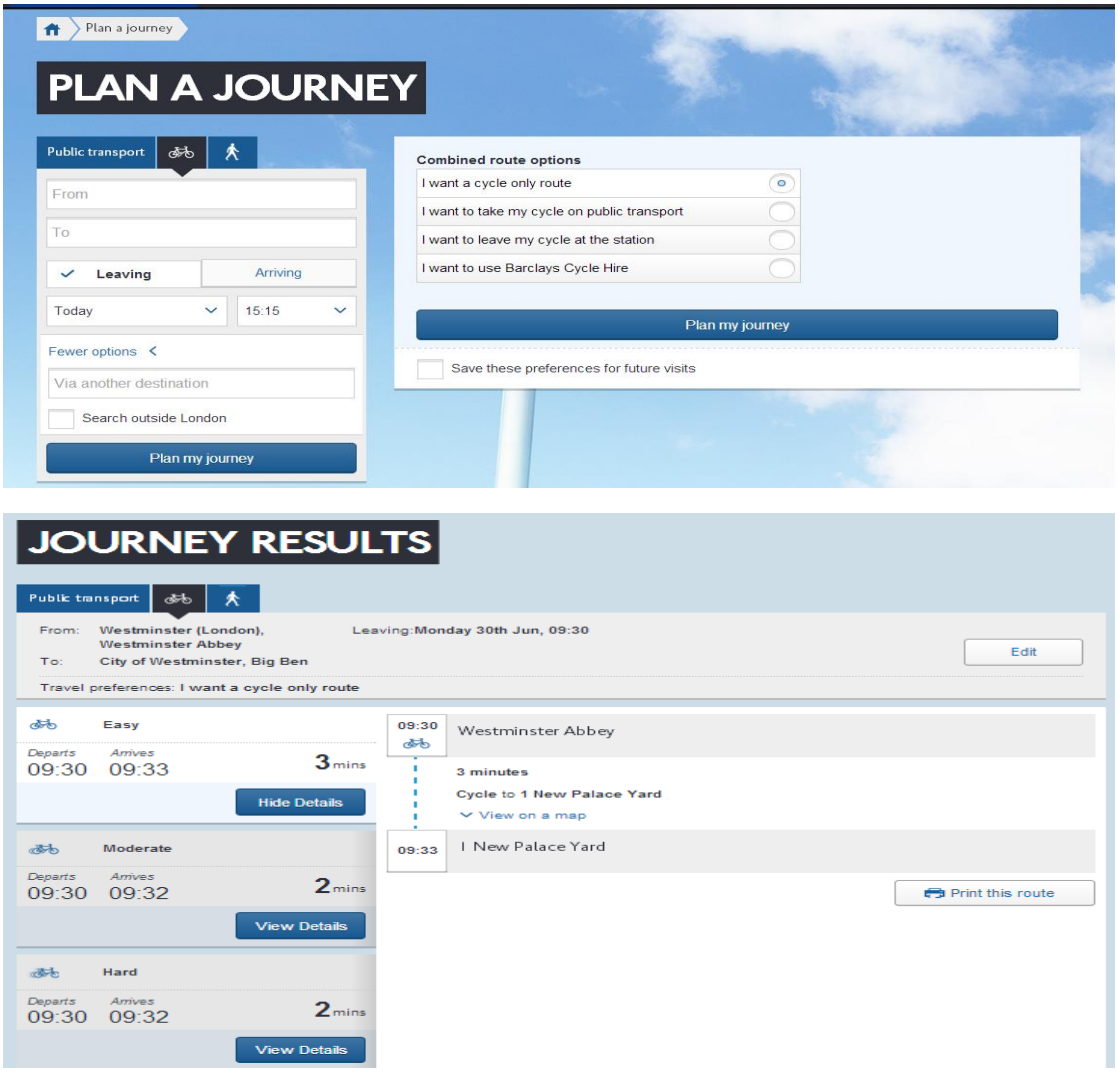



**Figure 4-8: Bicycle Journey Planner, Transport for London**

Greater Wellington's Cycling & Walking Journey Planner is provided on website (www.journeyplanner.org.nz) as well as mobile application. Its features as listed on its website are provided in Figure 4-9.

**Greater Wellington's Cycling & Walking Journey Planner Features**

- Suggests a route which is short, but avoids the hilliest terrain
- Route highlighted on a map and a clear set of directions provided
- Ability to zoom in and out of the map and overlay a satellite image
- Ability to click and drag your highlighted route to a different path
- Display of facilities such as street lights, toilets and bike racks
- Weather forecast for the part of the region you selected
- An altitude graph and calorie counter
- Ability to share your journey via email, Facebook or Twitter

***Source: www.journeyplanner.org.nz***

**Figure 4-9: Greater Wellington's Cycling & Walking Journey Planner Features**

### 4.3.10 Ride Share

Rideshare applications support and catalyse ride matching and ride sharing by creating a platform that enables people to share their travel details (such as day, timing, route, vehicle, travel preference, drive only, ride only etc.) and based on such details facilitate pooling of cars and other personal transport vehicles with a view to promote high occupancy in vehicles that are being used for personal transport.

Figure 4-10 shows the web page containing ride sharing tool on the 511 website (www.511.org) providing various options to users to choose from such as match preference (your company only or everyone), carpool preference (ride or drive, drive only, ride only), vanpool preference (for riding, for driving, need riders for an existing vanpool), need bike buddy (yes, no), days of commute. NUTH should encourage ride sharing in the city by providing ride sharing application that could bring together people who are using personal transport but would be open to participate in ride sharing programme. NUTH should also involve in the ride share programme employers who have large number of employees that use cars or other personal transport modes to commute to and from work.

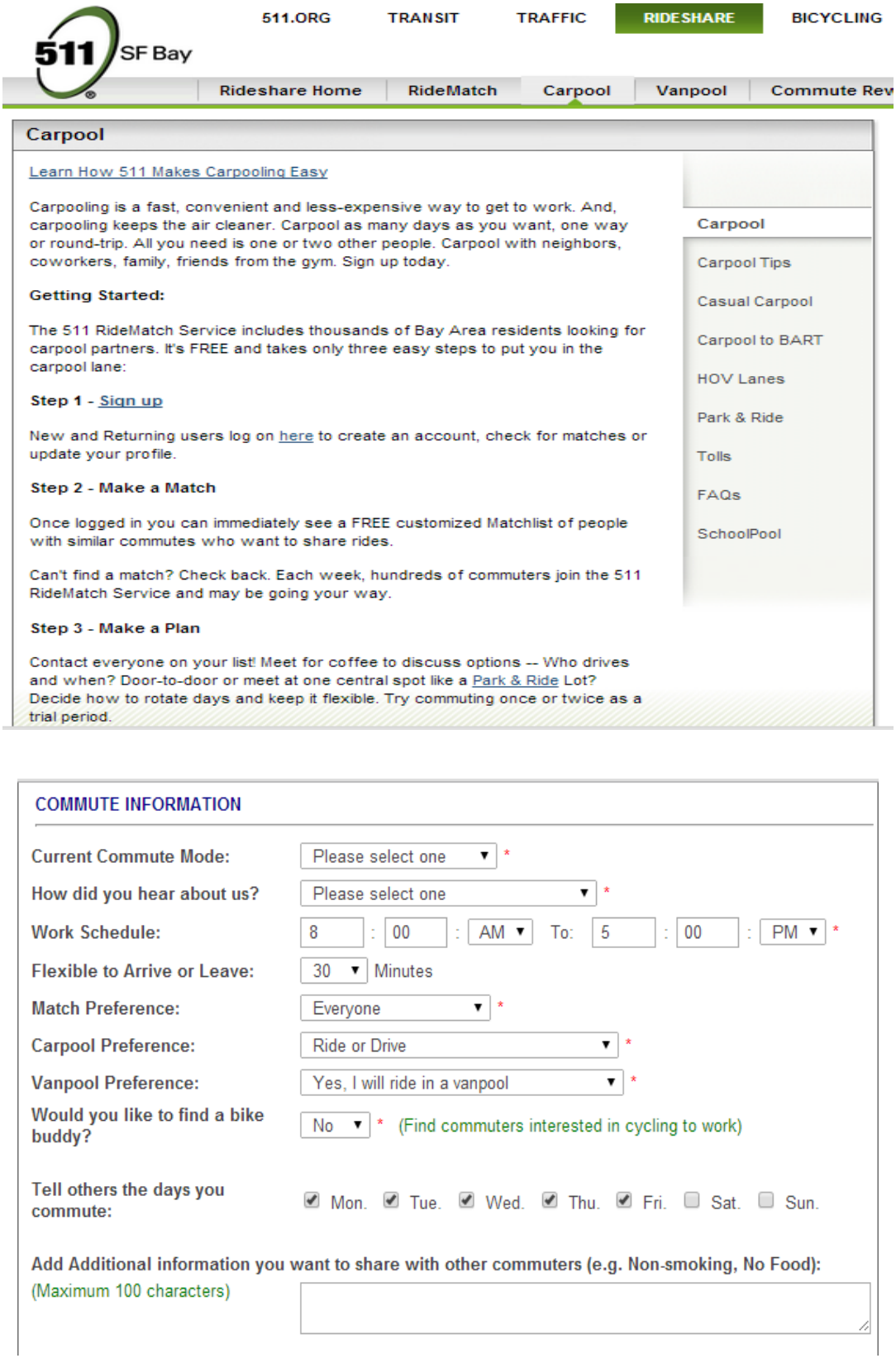



**Figure 4-10: Ride Share web page, 511, San Francisco Bay Area**

## 4.4 System Requirements

System requirements have been covered under the following general categories. These requirements are general in nature and would need to be finalised along with the development and preparation of the detailed technical reports through Systems Engineering process 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

### 4.4.1 Data Collection, Processing and Storage

The NUTH should build interfaces to collect and subsequently, process, and store the following:

- Transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information.
- Traffic, road network condition information, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.
- Parking information, including location, availability, and parking charges.
- Information related to alternative transportation modes, such as bicycle routes, park and ride locations, and carpool/vanpool information.
- Tourism information and major tourist attractions.
- Maintenance and construction information, including scheduled maintenance and construction work activities.
- Current and forecast road conditions and weather conditions.
- Information related to event impacting transit and/or transit.

### 4.4.2 Data Dissemination

The NUTH should disseminate the following:

- Traffic and road network condition information to travellers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.
- Links to regional travel information, including railway, airport and regional bus system.
- Tourism related information, including major attraction and travel information for tourism.
- Maintenance and construction information to travellers, including scheduled maintenance and construction work activities.
- Transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travellers.
- Parking information to travellers, including location, availability, and fees.
- Alternative transportation mode, including bicycle routes, park and ride lots, and carpool/vanpool information to travellers.
- Weather information to travellers.
- Event information to travellers.

The requirements for data dissemination should meet the following:

- Provide the capability to support requests from users for traffic and incident data.
- Provide the capability for a system operator to control the type and update frequency of broadcast traveller information.
- Data would be disseminated through various modes: website, call centre, mobile applications, social network and roadway/transit informational signs.

### 4.4.3 Trip Planner

NUTH trip planner should meet the following requirements:

- NUTH shall generate trips based on the use of one or more than one mode of transport.
- NUTH shall generate trip plans based on bus, metro rail, suburban rail, or other multimodal transportation data.
- NUTH shall use the preferences and constraints specified by the traveller in the trip request to select the most appropriate mode(s) of transport.
- NUTH shall generate trip plans to support tourism in the region, including national and international information to major tourist destinations.

- 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 provide the capability for NUTH personnel to control route calculation parameters.

### 4.4.4 Information Alerts

NUTH should meet the following requirements with regard to providing information alerts:

- NUTH shall provide travel alerts for travellers traveling to and from the region.
- 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 personalise ride share (carpool/vanpool) alerts
- 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.

### 4.4.5 Personalised Traveller Information

NUTH should meet the following requirements with regard to providing 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.

### 4.4.6 Remote Information Access

NUTH should meet the following requirements with regard to providing 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.

### 4.4.7 NUTH Call Centre

NUTH Call Centre should meet the following requirements:

- 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.
- IVRS should 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.
- NUTH Call centre shall provide live customer support with language translation capabilities for major local languages, during high volume periods of operations

## 4.5 Information Dissemination Modes

Static and real time transit/ traffic information including their updates could be disseminated through suitable channels such as the following:

- Telephone with large part of information dissemination over IVRS mode
- Website – both normal as well as mobile device version
- E-mail updates

- SMS-based updates
- Mobile Apps
- Social Media such as Twitter, Facebook, Google, etc.
- TV Channels
- Radio/FM channels, Newspapers
- Web chat

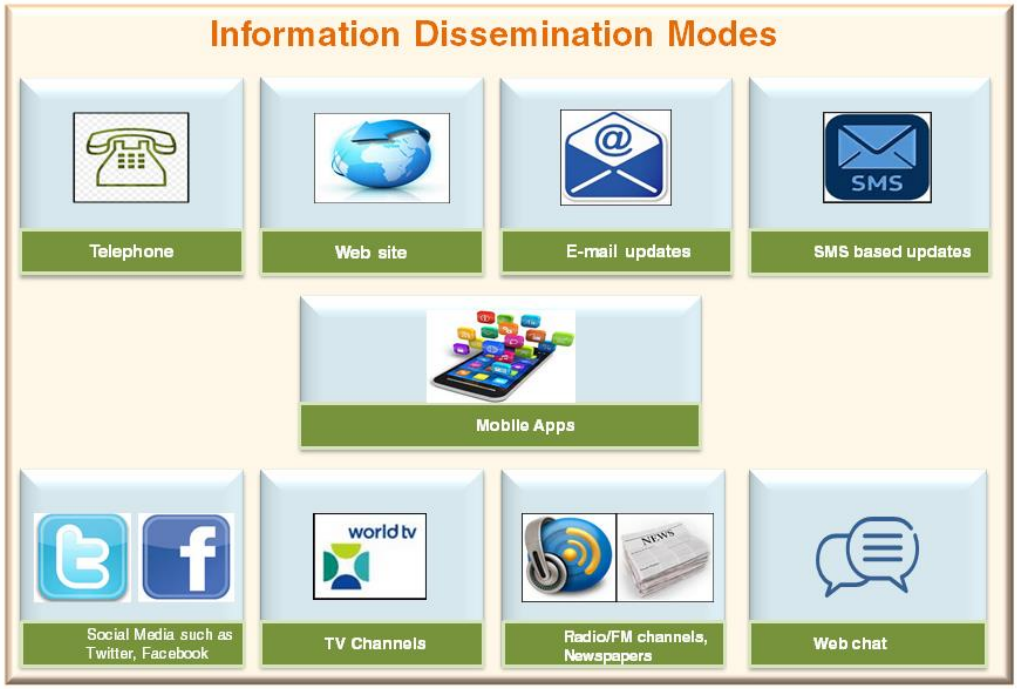



**Figure 4-11: Information Dissemination Modes**

Figure 4-11 provides an overview of information dissemination modes. Based on the type of information being accessed, users may have preference for a particular channel. User preference would need to be monitored on a periodical basis to understand these aspects and then presentation of information could be tailored to support such preferences.

A good NUTH programme will include a number of methods for information dissemination. The current trend is towards mobile and web applications, as more users are interested in getting real-time and even static information using smart phone or mobile applications.

### 4.5.1 Telephone System

#### A. Nation-wide Short Codes

To facilitate access to information on public transport, based on Ministry of Urban Development, Government of India (MoUD) initiative, Department of Telecommunication, Government of India (DOT) has allotted two nation-wide short codes (155220 &155221) that are to be used as Public Transport Helpline Numbers. MoUD has decided to use 155220 for providing basic information and 155221 for providing value added information.

All the States/Public Transport Operators have been advised by MoUD to implement these Helpline numbers in their States and give wide publicity to these Helpline numbers.

These numbers are Universal Access Numbers (UAN) and can be used from any location in India and would be accessible from both landlines as well mobile phones.

While the Department of Telecom, GoI has allotted two 6-digit short codes for the urban transport helpline, a simpler, uniform number, such as 555 (subject to availability and allotment by Department of Telecom, GoI) is recommended for Indian NUTH application.

#### B. Voice over Internet Protocol

The Voice over Internet Protocol (VoIP) services in India are regulated by the Department of Telecom, Government of India. The current regulations permit Unified Access Service (UAS) licensees and Cellular Mobile Telecom Service (CMTS) licensees to provide internet telephony.

A subscriber is currently permitted to use PC/adapter to dial Public Switched Telephone Network (PSTN) /Public Land Mobile Network (PLMN) abroad. However, Internet Service Providers are not permitted to have interconnection with PSTN/PLMN exchanges to provide Internet telephony within India.

#### C. Interactive Voice Response System

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 should 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.

The 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. A typical IVRS logical flow (implemented by KSRTC at Mysore) has been provided below as reference (Figure 4-12). The complexity of the menu would, however, need to be drawn up on a case-to-case depending upon:

- 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.)
- Type and details of information to be provided

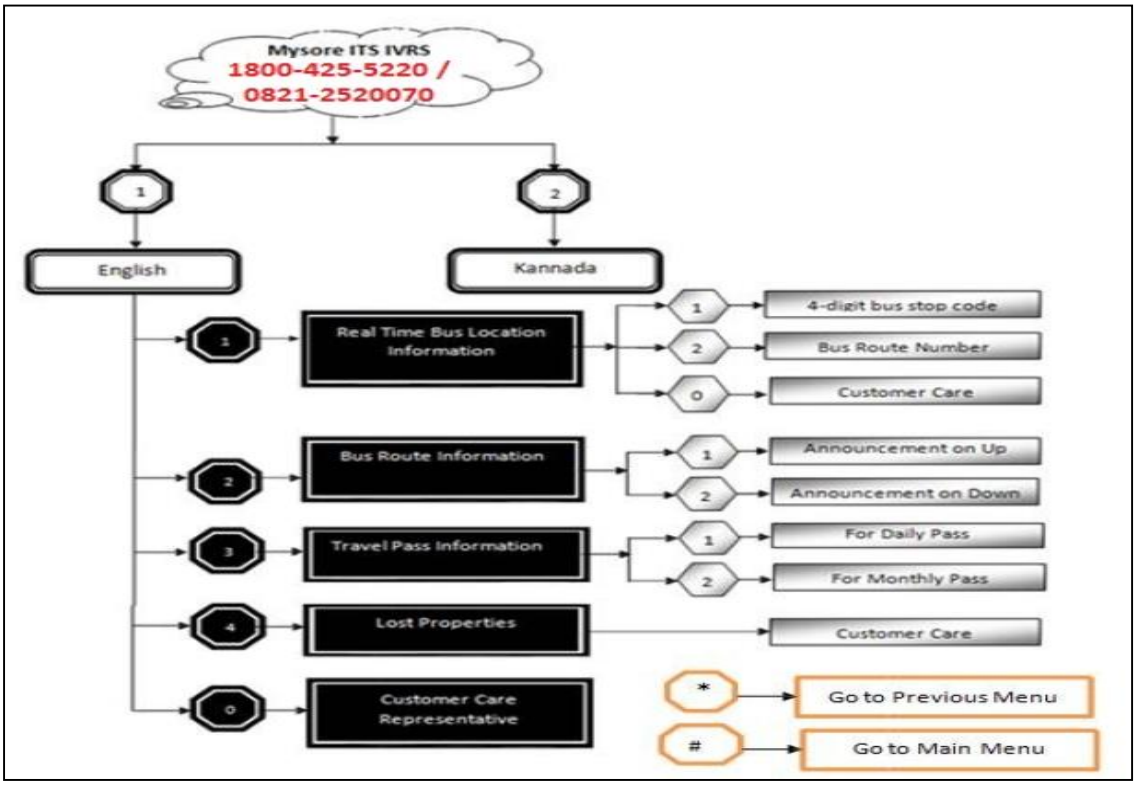



**Figure 4-12: Typical IVRS Menu**

### D. Live Operator Assistance

Agencies should also consider utilising live operator assistance for improved customer support. This option is especially useful in a larger metropolitan region, where more personal customer support may be required. The number and time periods for live customer support will be dependent on the funding and customer needs. Typically, if a customer is unable to navigate an automated IVRS, then they can request a personal customer service. This option would allow more customised services, especially if multiple language options are desired. Translators or native

speakers can be employed to serve special needs. This is especially useful in the Indian context given the diversity of language and dialect needs. Again, depending on the need, the number of translators can be adjusted based on the need. IVRS should 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.

Although, it is expected that call centres would be set up either at the city-level or the regional telecom circle level, it is recommended that the call agent screens be standardised. The following structure could be adopted:

Level 1: Home Screen - Map of India with functionality to select city

Level 2: 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 3: Service menu screen – this would have the input fields (e.g. origin, destination, route no., 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 the NUTH system would be a new service and the diversity in languages and accents in India, it would be appropriate to assume 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 can handle to about 100 calls per hour. It is recommended that call centre operations may be outsourced so that scaling up or down could be done smoothly.

### 4.5.2 Websites

Websites have emerged as the most popular channel for accessing information. In view of this, NUTH must also have accompanying websites (regular as well as mobile version) through which information could be disseminated in the most appropriate form and manner.

Regular websites provide flexibility to offer rich content in different formats such as tables, graphs, dash board, maps etc. that are suitable for viewing on a large screen but may require higher bandwidth to access. The mobile versions of websites enable 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 could 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 layout of the website could be the same as that set out in 4.5.1.D above.

### 4.5.3 Mobile Devices

In India adoption of mobile devices is on the rise with urban areas already reaching saturation levels. The types of mobile devices commonly being used is conventional mobile phones, smart phones, phablets, tablets etc. Most of such devices support mobile internet and such services are being widely used by various sections of the public. It is, therefore, important that NUTH content is made accessible from such devices. The manner in which such content could be made accessible is having, in addition to the conventional website, mobile version of the website as well as mobile apps that support accessing NUTH content. Alerts through automatic SMS could also be provided to those subscribing for the same. This would entail cost to the agency implementing NUTH unless a premium service short code is used where users are charged for sending SMS at a rate that is higher as compared to the normal SMS charges.

### 4.5.4 Mobile Apps

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. The mobile apps are an area where a public-private partnership could be beneficial. Public agencies that collect information can provide their data and information to third party software developers and/or Value Added Service (VAS) providers to allow the open market to provide useful information to the public. Typically, an agreement is executed with third party developers to provide this information. Most often this is provided free of charge, with restricted use for the information and data, with an option to charge for data in future with notice. Figure 4-13 contains screen shot of the mobile applications of the 511 services in the San Francisco Bay Area, USA.

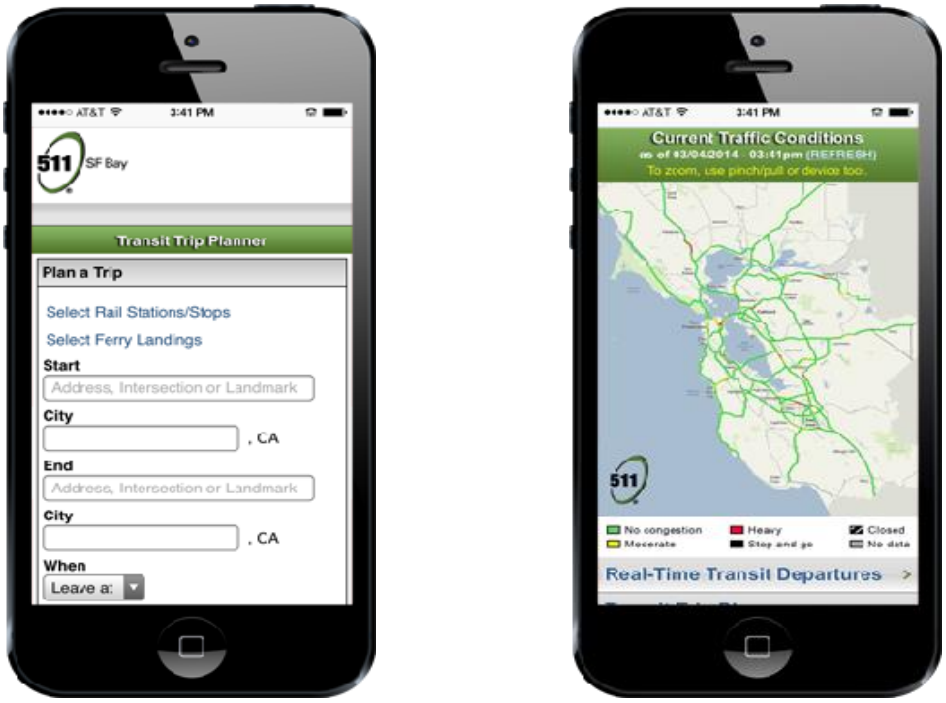



**Figure 4-13: Mobile Application, 511, Bay Area, USA**

### 4.5.5 Social Media

Social media could also be used as information dissemination channel for certain types of information such as updates, alerts, events, service closures, incidents, accidents etc. Figure 4-14 provides a snapshot of the Twitter and Facebook pages of the 511 services in Bay Area, USA.

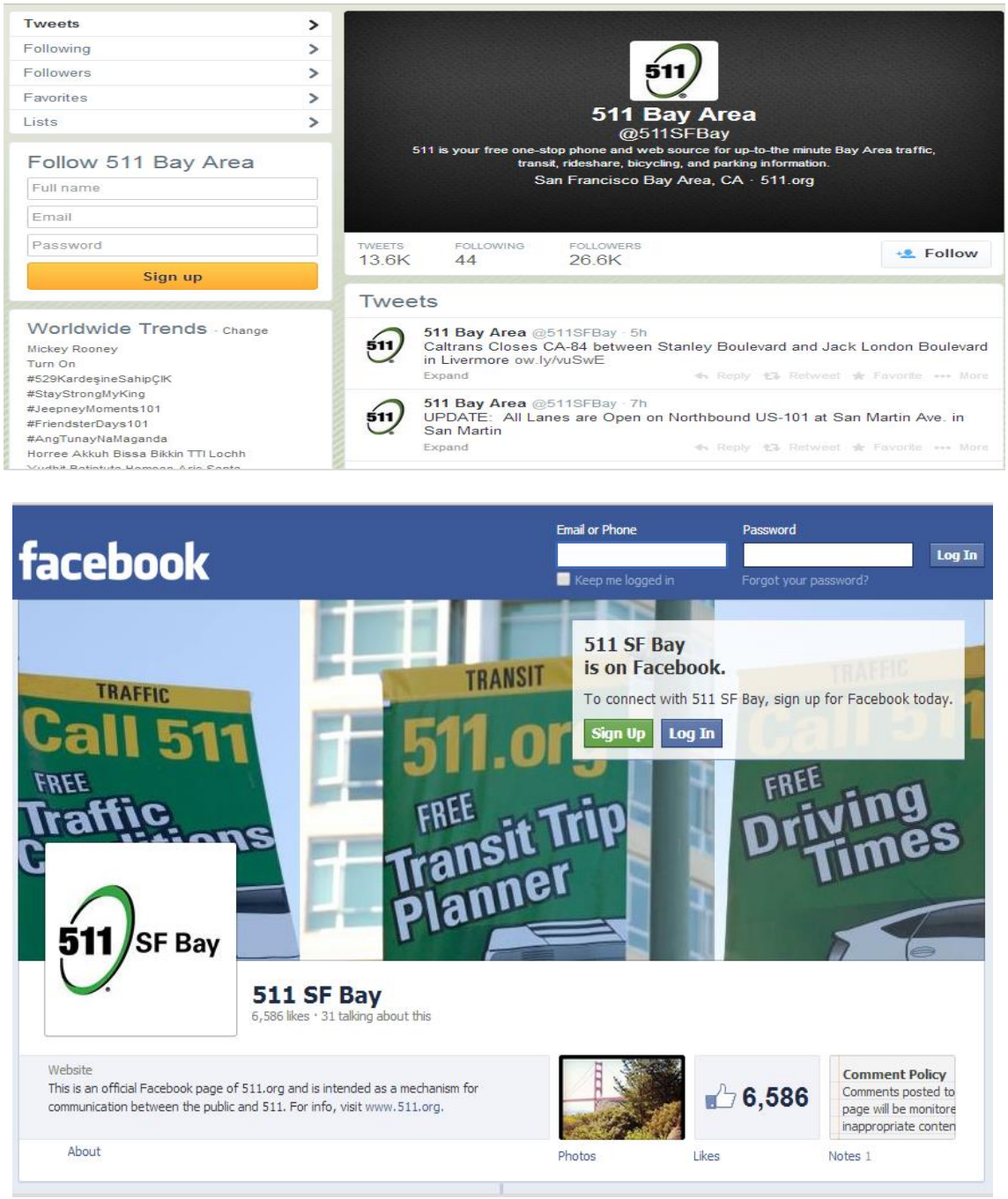



**Figure 4-14: Twitter and Facebook Pages of 511 Bay Area**

### 4.5.6 Web Chat

Web chat could also be used to provide information to users who have complex set of queries that require agent response.

### 4.5.7 Typical NUTH Disclaimers

While disseminating information through the various NUTH channels outlined above, care should be taken to publish appropriate disclaimers in order to make clear to the users, the terms and conditions governing the usage of information that is provided through the NUTH. Figure 4-15 and Figure 4-16 provide examples of the disclaimers that are being used for such systems.

**Limitations and Disclaimers (511 San Francisco Bay Area, USA)**

The Sites and the Services may allow you to access various content, including without limitation traffic and transit announcements, transit schedules, map data, traffic conditions, estimated driving or other transit times, estimated parking availability, and other transit- and trip-related information. You acknowledge and agree that this type of content is provided for general planning purposes only; and you acknowledge and agree that weather conditions, construction projects, closures, or other events or circumstances may cause schedules or other information to differ from what is presented through the Sites or the Services. Additionally, the Sites or the Services may provide information or direct you to information on transportation-related services or programs such as School Pool, carpools and vanpools, casual carpooling, and Bike to Work Day. Participants in such programs or those that act on the information provided do so at their own risk. You agree to exercise all reasonable judgment and take all appropriate steps, including without limitation consulting additional sources of information and taking all appropriate safeguards, in relation to your use of any such information or participation in any such programs. YOU AGREE THAT WE ARE NOT LIABLE FOR YOUR USE OF OR RELIANCE ON THE SITES OR THE SERVICES OR PARTICIPATION IN ANY PROGRAMS DESCRIBED ON THE SITES.

WE PROVIDE THE SITES AND THE SERVICES “AS IS,” WITHOUT WARRANTY OF ANY KIND; AND TO THE MAXIMUM EXTENT ALLOWED BY LAW, WE DISCLAIM ANY EXPRESS OR IMPLIED WARRANTY REGARDING THE SITES OR THE SERVICES —INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF ACCURACY, FREEDOM FROM INTERRUPTION OF SERVICE OR AVAILABILITY, FREEDOM FROM VIRUS OR OTHER HARMFUL CODE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT

*Source: http://511.org/terms.asp*

**Figure 4-15: Limitations and Disclaimers (511 San Francisco Bay Area, USA)**

**Disclaimer (Transport for London, UK)**

These websites are provided "as is" without any representation or endorsement made and without warranty of any kind whether express or implied, including but not limited to the implied warranties of satisfactory quality, fitness for a particular purpose, compatibility, non-infringement, accuracy and security. We do not guarantee or represent that the content and/or facilities available or accessible via these websites will always be accurate, complete or current or that access to the websites will be uninterrupted.

To the extent permitted by law we expressly disclaim all liability for any direct, indirect or consequential loss or damage occasioned from the use or inability to use these websites, whether directly or indirectly resulting from inaccuracies, defects, viruses, errors - whether typographical or otherwise, omissions, out of date information or otherwise.

Accessing these websites and the downloading of material from them is done entirely at your own risk. You, and not TfL, will be entirely responsible for any resulting damage to software or computer systems and/or any resulting loss of data even if we have been advised of the possibility of such damage.

*Source: www.tfl.gov.uk*

**Figure 4-16 Disclaimer (Transport for London, UK)**

## 4.6 Language for Information Dissemination

NUTH systems would be accessed by a large section of public. Considering the multiplicity of languages spoken in various regions of India, it is recommended that NUTH should disseminate information in languages as decided by the respective government authorities.

## 4.7 User Interface

Information needs to be presented or displayed in a manner that is easy to comprehend for the general users. User interfaces for both website as well as phone component would be the first point of contact for the user with the system. These should be designed to support efficient and effective access to information. User interface design is a critical element and key determinant of user acceptance of the system and, therefore, professional help could be sought in designing of these.

On the website or other visual interfaces, the information could be displayed using tables, graphs, charts, maps, dash boards, line diagram etc. The relevant information on the website could be displayed on the GIS maps with features such as PAN, Zoom, Toggle feature to turn a layer on/off, relevant information on clicking a node/link. The information that could be displayed in such manner could include routes, bus stops, stations, terminals, location of signals, location of cameras etc.

When the information is being provided through IVRS, the IVRS menu should be carefully designed with proper structure and hierarchies. The idea is that the user should

be able to access the desired information with minimal inputs. The option to use voice based inputs from users could also be explored.

## 4.8 Accessibility Standards

The Persons with Disabilities Act, 1995 governing accessibility requirements in India provides that the government agencies shall, within the limits of their economic capacity, shall take special measures for the benefit of persons with disabilities.

The Rights of Persons with Disabilities Bill, 2012 is currently under drafting stage. This would replace the current the Act with a new rights based law in line with the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD). The said Bill provides that appropriate governments and establishments shall ensure that all services and facilities provided by them are available to persons with disabilities on an equal basis with others; and that such services are provided in such mode or format which is responsive to the needs of persons with disabilities but at no extra cost to them. It can be seen that once the Bill becomes law, the agencies would be under an obligation to ensure that all their services are available to persons with disabilities on an equal basis with others.

The agencies should also consider adoption of standards for the hearing and visually impaired individuals to maximise usage. In US, for example, accessibility is regulated through the American with Disability Act (ADA). The ADA rules and regulations require a similar level of information availability and accessibility to people with disability. The International Electro-technical Commission (IEC) has recommended standards that apply to electronic dissemination of audio visual information to the public. IEC/TC 100 addresses many areas of audio, video and multimedia equipment standardisation. Two of their publications that may be helpful in applying good standards include:

- ISO/IEC 25062:2006, Software product quality requirements and evaluation (SQuaRE) –Common Industry Format (CIF) for usability test reports
- ISO/IEC TR 29138-1:2009, Information technology – Accessibility considerations for people with disabilities – Part 1: User needs summary

Consideration for technologies for accessibility will include text options only for web applications (without graphical use) and teletype for hearing impaired for telephone service. A Telecommunications Relay Service (TRS) for example, in which an individual with a hearing or a speech disability connects to a TRS communications assistant using an Internet Protocol-enabled device via the Internet, rather than the public switched telephone network. Internet-based TRS may or may not include the use of a Text Telephone (TTY) over an interconnected voice over Internet Protocol service.

The NUTH should be able to highlight the disable-friendly facilities within the trip enquiry, for example, in London, the tube line information specifies which stations have disable-friendly facilities and which stations do not, so that the people with special needs could

plan their trip accordingly. This would require all transport service providers (transit services, parking, road owning agencies etc.) to first detail out the disable-friendly facilities pertaining to their respective services (for example, the number of parking slots reserved for disabled persons, which foot-over bridges have elevators etc.). This information would need to be shared with the NUTH for incorporating into the attributes of each transport facility asset so that it can be disseminated to the commuters. The transport agencies would also need to intimate any change in status of these facilities (e.g. temporary shutdown for maintenance, addition of new facilities etc.).

These issues must be considered in the Systems Engineering steps as the requirements of the project are developed.

## 4.9 Central Systems

The back office of NUTH could be hosted at TMICC (if it exists) or alternatively it could be hosted at any other location or at a professional data centre service provider. The back office of NUTH would comprise the following:

- **Hardware:** NUTH backend hardware would consist of servers, switches, storage, UPS, network and communication equipment that support NUTH operations.
- **Standard Software:** Back office standard software would consist of operating systems, database, firewalls, anti-virus, office suites, map engine, IVRS etc. that support NUTH operations.
- **Application Software:** NUTH application software would consist of various application software that receive, process and disseminate the transit and traffic data through various channels. Such application software would include transit information system, traffic information system, transit trip planner, transit schedule application, multi-modal trip planner, driving time prediction application, ride share application, parking information system, bicycle trip planner etc.
- **Communication Links:** Communication links would include lease lines, PSTN lines, SMS gateways etc. to support NUTH operations.
- **Other Facilities:** Other facilities that could be shared by NUTH and TMICC back offices (if it exists) include fire-prevention and control equipment, air conditioning, power back up, false flooring & ceiling, furniture & fixture and civil structure.

## 4.10 Data Warehousing

Data Warehousing deals with collection of data, its storage, archival, management and retrieval for review and analysis in future. It supports query, report generation and data mining using archived data. It is a vital element that must be planned for as data mining activities would ride on the availability of and access to the archived data.

# 5.0 PLANNING AND DESIGN CONSIDERATIONS

## 5.1 Introduction

This chapter deals with NUTH objectives, NUTH structure, NUTH components and phasing. Setting up of objectives is very important for any project before its initiation. These objectives define the goals to achieve. Objectives may be different for different states, country or place. The objectives for the transport helpline could range from providing traffic and transit information covering all modes for a city, to providing the same for a region with all or limited set of modes, or it could go farther and cover providing similar information on pan-India basis. The transport systems covered could cover intra-city services or may include inter-city services as well. When planning and designing NUTH it is important to keep in mind the purpose for which it is being set up, modal coverage, whether intra-city/inter-city as well as its geographical coverage.

NUTH structure is a very important aspect while designing and planning NUTH. Various aspects of structuring the NUTH in Indian scenario are identified in this chapter. This chapter also provides possible structuring option with their respective pros and cons. It also covers content management and its update which highlights the issues related to update of data. NUTH call centre development and management section highlights the scope of work of the call centre provider.

The NUTH components section identifies the applications, backend software, backend hardware and utilities. This section also identifies the essential and optional NUTH components. This chapter hence aims to identify the important aspects which are required for planning and designing the NUTH system.

## 5.2 NUTH Structures

### 5.2.1 Structure Objectives

One of the key objectives of setting up NUTH is that it should present a single unified view to public for providing multi-agency /multi-modal urban trabsport related information. There should be single universal access NUTH number on which calls could be made from anywhere in India. NUTH website in any case would be accessible from any location worldwide. In the USA, 511 is the single nationwide number used for providing traffic and transit information to the public. Most of the 511 services being provided have, in addition to the phone based component, a website as well. The 511 services are, however, being provided and managed by various Local/State agencies for their respective areas. Indian Railways have set up train enquiry system which can be accessed using helpline number 139. Figure 5-1 provides an overview of some of the key features of 139 services.

**139 Train Enquiry System of Indian Railways**

- One Nation-wide Enquiry Number for all the Rail Passenger Enquiries
- All basic enquiries of train running and reservation related enquiries like PNR Status, Accommodation (General & Tatkal) availability,
- Train Arrival & Departures etc., can be known by dialing 139 on IVRS (Inter active Voice Response System).
- Accessible from all telephones (Landline, Mobile, WILL Services etc.) and from all Service Providers.
- The subscriber can access these Services by making Local Call (without requiring STD facility) throughout the Country.
- Information can be obtained in Regional languages also other than English & Hindi.
- Enquiries can also be made through SMS to 139. Premium Charges of ` 3/- per SMS are applicable

***Source: Indian Railways***

**Figure 5-1: 139 Train Enquiry System of Indian Railways**

The challenge in India, as the experience elsewhere also shows, is to structure NUTH phone helpline as this would need to be supported by the national telecom network where provisioning of telecom services is governed by area based licenses and there are many licensees for each license area, termed as telecom circles. Given this, telecom sector structure would be a very important element affecting structuring of NUTH.

The objectives of the structuring NUTH could be as below:

- It must take into account both the mobile subscribers as well as those accessing the helpline on wire-line mode from India. It should be possible to call NUTH number:
  - from any land line number in India
  - from any mobile number in India
- Preferably, the caller upon calling NUTH should get information that pertains to the city from which the call was originated by default.

  For example, a Delhi resident, while he/she is in Mumbai makes a call to NUTH number from his/her Delhi registered mobile number, he/she should get Mumbai related information. Similarly, callers making calls made from a landline connection of a city should get access to information that is relevant for his/her location.

  This requirement specifically needs to be discussed with the mobile telecom service providers as the system would need to know the location of the caller, which is the subject matter of privacy and the service providers may be under obligation not to

disclose this. The aspect of privacy, where caller identity/location would be used in providing services, would require full and proper disclosure to the subscriber and consent of the subscriber would need to be obtained in accordance with governing regulations.

In case of Traveline, UK, when one calls Traveline from a landline he/she will be connected to a call centre which specialises in the area one is in. If the caller is enquiring about another part of the UK he/she will be put through to the relevant call centre.

- It is desirable for a caller to connect to NUTH and seek information for any of the Indian cities covered through the helpline. Typically, calling the NUTH number will connect you to the local /regional traveller information system. However, it is desirable that the caller should also be able to reach other major cities/destinations.

  For example, if a Mysore resident, while he/she is in Mysore (or in some other city) desires to know the relevant information for Delhi, it should be possible for him/her to do so. This can be achieved either by a transfer mechanism or dialing an appropriate code.

  In case of Traveline, UK, if one wishes to dial straight to the remote call centre of any particular location in UK, he/she is required to dial the standard helpline number (0871 200 22 33) and upon connecting one has to press the applicable code number for the city/region.

- It should be possible for NUTH operator to transfer calls to the specific transit operators to whom the query pertains if the nature of query is such that the transit staff would be best positioned to answer and address the query.

  For example, lost and found function which is an important current operation can be better dealt by the concerned transit operator itself rather than the NUTH operator.

- It should be technically feasible and fit within the current telecom sector regime covering aspects such as telecom circle, switching, interconnection and IUC regime.

- It should be economical and efficient from commercial standpoint to not just those delivering the telecom services but also to those who are availing it. The objective should be to minimise the cost of providing and availing NUTH services at system level.

- It should not be administratively too cumbersome to implement the structure.

- It is desirable that the system be designed in such a way that it could support VoIP as and when the same is permitted in India. This is also subject to such services supporting dialing short code numbers, which is expected to be NUTH phone number. VoIP calls to any landline or mobile number in India are currently not permitted by Indian regulations.

### 5.2.2 Structuring Options

In the USA, 511 services have largely been structured at the State level. There are, however, some examples of metropolitan region (San Francisco Bay Area) and a group of States (Nebraska, Montana, South Dakota and North Dakota) also that have jointly implemented the helpline.

There are several ways NUTH could be structured in India. One way could be based on geographical area viz. City, State or Nation. Alternatively NUTH services could also be structured based on telecom circles. Table 5-1 provides some of the options for structuring NUTH in India together with the associated positives and concerns:

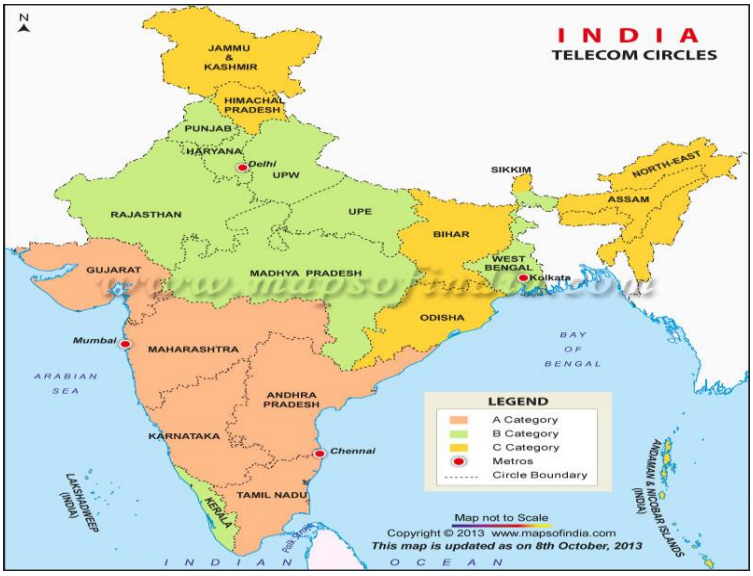
**Table 5-1: Options for Structuring NUTH**

| Option | Advantages | Disadvantages |
|---|---|---|
| Nationwide | • Single system and software at a national level<br>• Cost effective as compared to other options<br>• No need to transfer calls and information about all cities could be provided<br>• Economies of scale may be realised | • Complex system with large number of stakeholders and data interfaces<br>• Language support issues could be there<br>• Difficult to manage<br>• Downtime may affect country as a whole<br>• Cost allocation and distribution among various stakeholders could be a challenge<br>• Higher telecom cost due to National Long Distance (NLD) calls to the helpline. In case user is required to bear only the local call charges, the rest of the cost will have to be borne by the other stakeholders |
| Statewide | • Single system and software at a State level<br>• Cost effective as compared to a City wide option<br>• Easier support for regional languages | • Downtime may affect State as a whole<br>• Economies of scale may not be fully realised as compared to the national set up<br>• Higher telecom cost for the land line calls. In case user is required to bear only local call charges, the rest of the cost will have to be borne by the other stakeholders for the land line callers |

| Option | Advantages | Disadvantages |
|---|---|---|
| Municipal Areas | • Managed and monitored directly by the city agencies concerned<br>• Lesser coordination issues considering limited number of stakeholders<br>• Better control and management<br>• Easier support for regional languages | • Economies of scale may not be realised as compared to a State level set up<br>• Costly to implement and maintain<br>• Financial capacity of participating agencies could be an issue<br>• Aggregate cost of nationwide implementations likely to be high |
| Based on mobile telecom circles | • Single system and software at a telecom circle level<br>• Cost effective as compared to a city wide option<br>• Less Complex system from telecom implementation perspective<br>• Easier support for regional languages<br>• Optimum telecom cost for the mobile calls. | • Economies of scale may not be fully realised<br>• Downtime may affect telecom circle as whole<br>• Call from land line to NUTH helpline number from outside Short Distance Charging Area (SDCA) would be treated as Subscriber Trunk Dialing (STD). In case user is required to bear only the local call charges, the rest of the cost will have to be borne by the other stakeholders for the land line callers |
| Based on Short Distance Charging Area (SDCA) or Subscriber trunk dialing (STD) areas | • Simpler system<br>• Easier to manage<br>• Easier support for regional languages<br>• Calls from mobile as well as landline from within SDCA would be treated as local calls<br>• Mobile calls from beyond the SDCA but within the mobile telecom circle would be treated as local calls | • Economies of scale may not be realised as compared to a State level set up<br>• Costly to implement and maintain<br>• Financial capacity of participating agencies could be an issue<br>• Aggregate cost of nationwide implementations likely to be high<br>• Very few landline connections in India as compared to mobile connections for which the system is architected |

| Option | Advantages | Disadvantages |
|---|---|---|
| | • Downtime would affect a limited area | |

Figure 5-2 provides the map of the telecom circles in India. Chennai now is no longer a Metro circle and has been merged with Tamil Nadu telecom circle. Table 5-2 contains the list of telecom circles in India. The telecom circles have been categorised by Telecom Regulatory Authority of India (TRAI) based on their revenue potential for telecom services and reflect that penetration of mobile services is expected to be highest in Metro circles followed by Category A, B and C respectively. From NUTH perspective, it is indicative of the telecom density of the areas where NUTH facilities are proposed to be set up.




Source: http://www.mapsofindia.com.

**Figure 5-2: Mobile Telecom Circles in India [5]**

**Table 5-2: Mobile Telecom Circles in India**

| Sl. No. | Name of Service Area | Areas covered |
|---|---|---|
| 01. | West Bengal Service Area | Entire area falling within the Union Territory of Andaman & Nicobar Islands and area falling within the State of West Bengal and the State of Sikkim excluding the areas covered by Kolkata Metro Service Area. |

[5]Chennai has now been merged with Tamilnadu telecom circle

| Sl. No. | Name of Service Area | Areas covered |
|---|---|---|
| 02. | Andhra Pradesh Service Area | Entire area falling within the State of Andhra Pradesh. |
| 03. | Assam Service Area | Entire area falling within the State of Assam. |
| 04. | Bihar Service Area | Entire area falling within the re-organised State of Bihar and newly created State of Jharkhand pursuant to the Bihar Re-organisation Act, 2000 (No.30 of 2000) dated 25th August, 2000. |
| 05. | Gujarat Service Area | Entire area falling within the State of Gujarat and Union Territory of Daman and Diu, Silvassa (Dadra & Nagar Haveli). |
| 06. | Haryana Service Area | Entire area falling within the State of Haryana except Panchkula town and the local areas served by Faridabad and Gurgaon Telephone exchanges. |
| 07. | Himachal Pradesh Service Area | Entire area falling within the State of Himachal Pradesh |
| 08. | Jammu & Kashmir Service Area | Entire area falling within the State of Jammu & Kashmir including the autonomous council of Ladakh. |
| 09. | Karnataka Service Area | Entire area falling within the State of Karnataka |
| 10. | Kerala Service Area | Entire area falling within the State of Kerala and Union Territory of Lakshadweep and Minicoy. |
| 11. | Madhya Pradesh Service Area | Entire area falling within the re-organised State of Madhya Pradesh as well as the newly created State of Chhattisgarh pursuant to the Madhya Pradesh Re-organisation Act, 2000 (No:28 of 2000) dated 25th August, 2000. |
| 12. | Maharashtra Service Area | Entire area falling within the State of Maharashtra and Union Territory of Goa, excluding areas covered by Mumbai Metro Service Area. |
| 13. | North East Service Area | Entire area falling within the States of Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Manipur and Tripura. |
| 14. | Orissa Service Area | Entire area falling within the State of Orissa. |
| 15. | Punjab Service Area | Entire area falling within the State of Punjab and Union territory of Chandigarh and Panchkula town of Haryana. |

| Sl. No. | Name of Service Area | Areas covered |
|---|---|---|
| 16. | Rajasthan Service Area | Entire area falling within the State of Rajasthan. |
| 17. | Tamilnadu Service Area (including Chennai Service Area) | Entire area falling within the State of Tamilnadu and Union Territory of Pondicherry including Local Areas served by Chennai Telephones, Maraimalai Nagar Export Promotion Zone (MPEZ), Minzur and Mahabalipuram Exchanges |
| 17A. | Tamilnadu Service Area (excluding Chennai Service Area) | Entire area falling within the State of Tamilnadu and Union Territory of Pondicherry excluding Local Areas served by Chennai Telephones, Maraimalai Nagar Export Promotion Zone (MPEZ), Minzur and Mahabalipuram Exchanges |
| 17B. | Chennai Service Area | Local Areas served by Chennai Telephones, Maraimalai Nagar Export Promotion Zone (MPEZ), Minzur and Mahabalipuram Exchanges |
| 18. | Uttar Pradesh (West) Service Area | Entire area covered by Western Uttar Pradesh with the following as its boundary districts towards Eastern Uttar Pradesh: Pilibhit, Bareilly, Badaun, Etah, Mainpuri and Etawah. It will exclude the local telephone area of Ghaziabad and NOIDA. However, it will also include the newly created State of Uttaranchal pursuant to the Uttar Pradesh Re-organisation Act, 2000 (No.29 of 2000) dated 25th August, 2000. |
| 19. | Uttar Pradesh (East) Service Area | Entire area covered by Eastern Uttar Pradesh with the following as its boundary districts towards Western Uttar Pradesh: Shahjahanpur, Farrukhabad, Kanpur and Jalaun. |
| 20. | Delhi Service Area | Local Areas served by Delhi, Ghaziabad, Faridabad, NOIDA, and Gurgaon Telephone Exchanges |
| 21. | Kolkata Service Area | Local Areas served by Calcutta Telephones. |
| 22. | Mumbai Service Area | Local Areas served by Mumbai, New Mumbai and Kalyan Telephone Exchanges |

*Source: Guidelines for Grant of Unified License, Department of Telecom, GoI, dated 19th August 2013.*

An analysis of the mobile telecom circles reveals that there are 22 circles with three metro service areas (Delhi, Mumbai and Kolkata) which for Delhi and Mumbai also cover satellite towns in the surrounding area. Since movement to and from such satellite towns

to Delhi and Mumbai is substantial, from NUTH perspective also it is logical that they are served together.

It can also be seen that in certain circles (Madhya Pradesh service area, North East service area and Uttar Pradesh (West) service area) more than one State is covered. It would help in optimising the telecom cost as calls to NUTH number would (for mobile users) be local call from any of the States within the circle.

Uttar Pradesh has been divided into two circles Uttar Pradesh (West) service area and Uttar Pradesh (East) service area.

In accordance with Telecom Subscription Data released by Telecom Regulatory Authority of India (TRAI), as on 30th September, 2013, over 96.75% (870.58 Mn) of the telecom subscribers in India are on wireless services with wire-line subscribers accounting for only 3.25% (29.28 Mn). It is evident that almost the entire telecom user base in India has moved on to the wireless network.

Given the mobile penetration, telecom licensing regime in India, the systems woven around this and the pricing of intra and inter-circle calls, it would be most appropriate to structure the helpline based on mobile telecom circles. In case a centralised national set up is planned, the calls made from outside the circle location of the call centre would become long distance calls and at a system level telecom cost would be higher (they would attract additional interconnection usage charges) even if the users are only charged at local call rates. This additional cost would have to borne by the entities managing NUTH.

### 5.2.3 NUTH Content Management and Update

Content is central to the management of NUTH. It is very critical, therefore, to ensure that the relevant content is not just made available through NUTH but is also updated and kept current. It may be desirable to provide time stamp with the content so that those accessing data/information are made aware regarding the date and time when the content was last updated in the system.

The content provided through NUTH is largely local in nature and pertains to city transit services and traffic characteristics. These are managed by the city transit and traffic agencies. In view of this, these agencies are best positioned to provide their respective content that could be disseminated through NUTH – both through the website as well as phone based NUTH.

The city agencies could provide their respective content to the UMTA, wherever it has been established. UMTA may in turn engage contractors to perform the task of coordinating with city agencies for data acquisition and other associated activities. The details of data to be provided by different agencies have been discussed in Chapter 9.0.

### 5.2.4 NUTH Call Centre Development and Management

NUTH call centre could either be set up and be operated by the implementing agency or the implementing agency could in turn engage a professional call centre service provider for undertaking these activities. Considering the flexibility required in responding to the call volumes both in terms of human resource deployment as well as information and communication technology infrastructure, it is recommended that the NUTH implementing agency engage a professional call centre service provider to establish, operate and maintain the NUTH call centre. The implementing agency may undertake the process of selection of the call centre service provider on its own or it could engage a consultant, including from among the MoUD empanelled consultants, to assist it in the selection process. The scope of work of the call centre service provider would typically include:

- Establish, operate, manage and maintain NUTH helpline using NUTH telephone number designated for the purpose
- Receive helpline requests through landline telephone, mobile phones, emails and Short Message Service (SMS), as may be decided by the implementing agency
- Respond to the helpline requests and undertake such other customer contacts as may be decided by the implementing agency through telephone, emails and Short Message Service (SMS)
- Provide requisite office space for setting up the call centre and associated infrastructure
- Deploy the requisite hardware for the call centre comprising servers, phone instruments, operator consoles, communication, networking, and technology infrastructure etc.
- Deploy the requisite software for the call centre for call logging, recording, Interactive Voice Response System (IVRS), Automatic Call Distribution (ACD), Customer Relationship Management (CRM), Computer Telephony Integration (CTI), generating various standard and custom performance reports etc.
- Take Primary Rate Interface (PRI) line connection of appropriate number of channels to support the call volume
- Establish Short Message Service Centre (SMSC) gateway
- Establish leased line of required bandwidth for connecting to the internet
- Deploy suitable qualified and experienced call centre agents in numbers commensurate with the call volume
- Train call centre agents in running the helpline process through various channels
- Provide all amenities, utilities, power including its backup, furniture, fixture and services required for running the call centre services

The phone component of NUTH will ride on the national telecom network. There is, however, a need to have call centres which support both Interactive Voice Response

System (IVRS) based communication as well as those that are agent based. The objective should be to provide a large part of information through IVRS mode with agent based response kept to a minimum to optimise cost.

The call centre could be set up based on mobile telecom circle with each circle having a single call centre supporting all the cities of that circle which are attached to NUTH. Considering that the call centre in such cases would support multiple cities, either the State (or any one of them if the circle has more than one State) concerned or any one of the UMTAs of that circle (preferably of the city where the call centre would be set up), if it has been set up, could either set up the call centre or engage contractors to perform this task. The mechanism for sharing of cost would need to be worked out among the participating States/Cities.

There does not seem to be any need to set up any call centre at the national level as it is recommended that these be set up at City/State/regional levels considering the nature of information and lingual preferences in various regions of India.

NUTH call centre should support English, Hindi and one or more local/region specific languages that are widely understood in the city/region.

### 5.2.5 NUTH Website Management

The city specific NUTH website and its content could be managed by the UMTA (or any other implementing agency chosen) which has jurisdiction over their city. UMTA/implementing agency may in turn engage contractors to perform this task. UMTA/implementing agency would need to seek the content from the respective transit and traffic agencies.

## 5.3 NUTH Components

### 5.3.1 NUTH Components: General

Each NUTH would have system components that would be driven by its design and operational needs. NUTH will house all the necessary equipment and systems for receiving, processing, storing and disseminating the required data/information. Equipment requirements for each NUTH will depend on the functional requirements and a Systems Engineering study. The typical major equipment and systems in an NUTH will include, but not limited to, the equipment and systems listed in Table 5-3 and Table 5-4.

**Table 5-3: NUTH Components: Backend**

| BACKEND COMPONENTS (DATA CENTRE) | |
|---|---|
| **Information Dissemination Applications**<br>• Transit information system<br>• Traffic information system<br>• Transit trip planner<br>• Transit schedule application<br>• Multi-modal trip planner<br>• Driving time prediction application<br>• Ride share application<br>• Parking information system<br>• Bicycle trip planner<br><br>**Front-end Interface Applications**<br>• IVRS software (including call agent screens)<br>• Mobile app<br>• NUTH website | **Backend Hardware**<br>• Computers/ Operator consoles<br>• Servers (application, communication, information dissemination etc.)<br>• Switches/routers<br>• Printers<br>• Storage |
| **Backend Standard Software**<br>• Operating System software<br>• Anti-virus software<br>• Data Base software<br>• Data archival and retrieval system | **Utilities**<br>• Air conditioning<br>• Access control<br>• Power and backup facilities<br>• Fire suppression |

**Table 5-4: NUTH Components: Field**

| FIELD COMPONENTS | |
|---|---|
| **Field Equipment**<br>• None | **Communication**<br>• Hardwired, such as fiber optic, twisted pair, coax cable, etc.<br>• Wireless, such as microwave, spread spectrum, cellular, Wi-Fi, etc.<br>• Leased options, including both wireless (cellular) and wireline |

### 5.3.2 Essential and Optional NUTH Components

Components of a typical NUTH would depend on the functional design and requirements of each NUTH. These requirements are developed based on the needs of the agencies, the number of agencies that will be associated with the NUTH, the functional requirements of the NUTH, and the number of personnel working for the NUTH. However, the following spaces are basically an essential part of the operation, while others may be optional. The essential areas and systems can be generally categorised as the following:

- Main Floor Area, including the telephone operators and operations consoles
- All software and hardware components
- Communication and Network components
- Equipment Area, including HVAC, Fire Suppression and Other Equipment
- Data Centre
- Management Offices
- Area for administration and amenities (cafeteria, eating areas and/or vending machines, restrooms)
- Vehicle Parking Areas

Optional areas may include:

- Conference Room and Assembly Areas
- Back Up Power Generation Area
- Locker Room, Showers, Sleeping Areas and Exercise Rooms for special centres including emergency management operations

It is important that NUTH facility should be sized properly to meet the specific need of the project. The size of the facility is related to three major factors:

- Is the facility an independent facility
- Is the facility also a call centre operation
- Is the facility co-located with a Traffic Management and Information Control Centre (TMICC)

In all situations, as discussed above the NUTH facility must have sufficient capacity for the operators, supervisors and the supporting staff. If the facility includes call operators, provisions should be included to accommodate the operators and their communication equipment. Other facilities within the centre should include a conference room for strategy discussions and tactical meetings, an operation manager facility and the server room. Other facility and amenities would include a pantry, toilets and eating area for the operators.

The following diagram represents a typical NUTH operation area layout with typical sizes for each area.

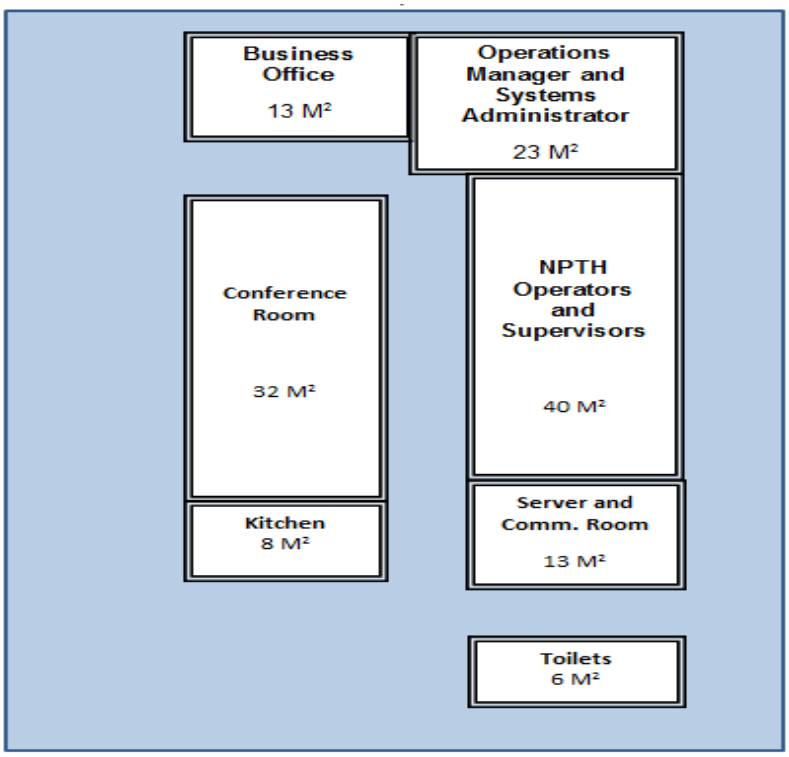



**Figure 5-3: Layout of Typical NUTH Centre**

The size of the operations rooms typically depends on the functionality of the centre. If the centre is also a customer assistance centre, i.e. with a call centre, where public can call and talk with an operator, then the facility must be sized to accommodate the number of operators and other system functionalities. A typical Information Centre, without the call-centre operator would include the following:

- Operators and Supervisor Work Space Area
- Work Space Area for other staff such as NUTH In-charge, NUTH Manager, Systems Administrator etc.
- Data centre
- Utilities area
- Meeting/Conference Room
- Restrooms

## 5.4 Resources and Resource Constraints

NUTH is a new concept in India and as such limited capacity exists in India for planning, designing, operating and managing such facilities. There are, however, various other types of helplines being managed or supported in India. GVK Emergency Management and Research Institute (EMRI) is managing 108 services in several States of India for providing mainly ambulance (and police and fire) services. Indian Railways have set up an integrated train enquiry system which can be accessed using helpline number 139.

Setting up NUTH would require personnel with skills in the area of Systems Engineering, IT, web-page development, networking, data communications, telecom, information technology experts, transit, traffic, intelligent transport systems, transport planning, experts and other general management skills.

NUTH relies on extensive set of data acquisition, handling, processing, fusion and dissemination capabilities in order to work effectively, most of which in the context of NUTH are currently non-existent in India. Some of the transit agencies have set up their individual helplines that provide information related to their respective services. ITS deployments in the transit sector, specially buses, is also in its infancy and it is only now that the transit bus operating agencies have started implementing the ITS-based projects for fleet monitoring and management. It would be pertinent to note that both technical as well financial resources would be required to set up and manage any NUTH facility for a city / region and, therefore, planning for these must also be undertaken as part of resource planning.

Further, Municipal Corporations, other road owning agencies, transit agencies and the Traffic Police – the most important constituents of any NUTH set up in India, are hard pressed for financial and human resources. Any agency embarking on the exercise for setting up NUTH would need to carefully assess not just the initial cost of setting up such facilities but also the on-going costs of operating, maintaining and managing these facilities. The manpower requirements have been discussed in greater detail in Chapter 9.0 and the approximate cost for implementation and subsequent O&M has been detailed in Chapter 11.0.

## 5.5 Technology Evolution and Integration

NUTHs work and interface with a variety of systems deployed by the participating agencies in many diverse areas. Moreover the technologies and standards in many of these areas are still evolving thereby creating a challenge towards system integration as well as to the personnel managing these systems.

Since NUTH system is designed to be a long term facility, over its life, it may be exposed to many generations of technologies and systems all of which need to be integrated with NUTH systems for sharing of data. Moreover, as and when any participating transit agency updates its system, the interfaces with NUTH would need to be updated as well.

Further, as newer data sources become available they also need to be integrated with NUTH to enhance its utility.

The technology evolution road map and integration aspects must be kept in mind while designing and establishing NUTH systems.

## 5.6 ITS Architecture Needs

Many countries/regions such as USA, Europe, Japan etc. have their own national ITS architecture that provide a framework for defining the services, systems, system elements and information exchanges among a variety of systems, centres, vehicles and stakeholders in the transportation system. Various cities and region are expected to follow the ITS architecture while planning ITS deployments in the transportation sector in order to become eligible for seeking government funding. The availability of ITS architecture has also led to usage of phased but scalable deployments, common terminologies, data dictionaries and adoption of information exchange protocols. Users of such systems in turn are able to experience some degree of uniformity from the systems developed using the ITS architecture and this, in turn, has led to wider support from the user community.

In India, there is no such national ITS architecture in place currently and as such ITS projects in India as of now do not need to follow any such requirements. There are some specific guidelines though, such as the MoUD guidelines on urban bus specifications which have ITS elements also covered. The Ministry of Road Transport and Highways (MoRTH), GoI have also issued guidelines on the Electronic Toll Collection Systems.

As and when national ITS architecture in India is put in place, which is expected to be a long term initiative considering the international experience, NUTH project proponents would be advised to understand its implications on such projects and plan and design the projects based on the same.

A more in-depth discussion on the ITS Architecture has been undertaken in Chapter 3.0.

## 5.7 Obsolescence Management

Obsolescence of the system needs to be managed in a structured manner. Based on the current approach being followed in similar projects, it is seen that during the contract period, the contractor has the responsibility to support and maintain the systems supplied and to ensure that spares are available for providing such support. In such cases, responsibility to manage the obsolescence of the system is that of the contractor over the contract duration.

Post expiry of the initial contract, the procurement process for support services is undertaken by the implementing agencies. In such cases agencies often end up selecting a contractor which is different from the one who supplied the system. In such cases, responsibility to manage the obsolescence of the system is that of the new

contractor. In some cases, agencies are either not able to find contractors willing to undertake support of the system or the same turns out to be expensive or sub-optimal.

Some of the ways in which agencies can deal with obsolescence are as below:

- Undertaking selection of technology keeping in mind the stage at which the technology is, it's projected phase-out and availability of 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 planned time frame to phase out the system/technology.

# 6.0 NUTH PROJECT MANAGEMENT

## 6.1 Introduction

NUTHs are typically conceptualised and designed to interface with a number of systems that are operated and maintained by various traffic, transit and other agencies of the city/region. These facilities often additionally act an information exchange mechanism supporting collaboration and information sharing among various participating agencies.

NUTH projects are complex ITS initiatives and, therefore, these projects would need to be developed using a blend or traditional and the Systems Engineering approach.

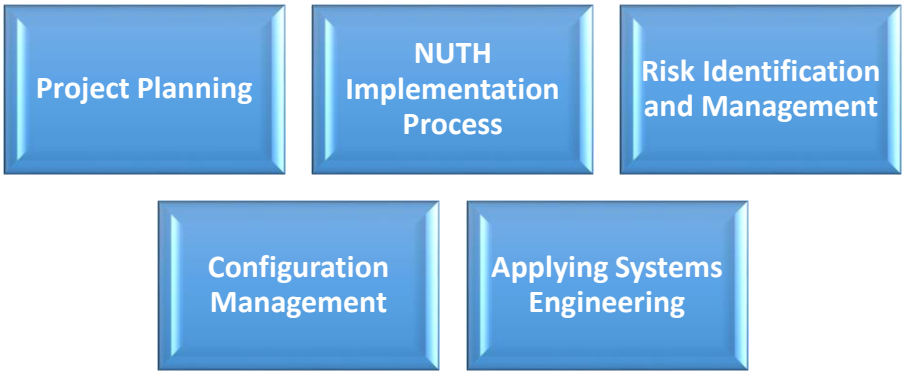



**Figure 6-1: Key Project Management Activities**

Figure 6-1 provides an overview of the key project management activities which have been detailed in later sections of this chapter.

## 6.2 Project Planning

The process of project planning deals with creation of activity schedule, working out interdependencies, preparing timelines, undertaking budgeting, drawing up responsibility matrix and planning for resources. It begins in the early phase of the project and leads to creation of Project Plan (PP) and Systems Engineering Management Plan (SEMP).

These documents need to be written in a manner such that they provide clear view of the project scope, key stakeholders, division of responsibilities among various project stakeholders, the project team, the timelines being pursued and budgeting.

Depending upon the nature and size of the project, some other documents may get attached to the PP or SEMP or will need to be created separately.

### 6.2.1 Project Plan

The Project Plan (PP) details the various project related aspects from the view point of project management and control covering the following elements:

- Project overview.
- Project milestones and deliverables.
- Project schedule.
- Project organisation chart along with roles and responsibilities.
- Detailed work plans covering technical and administrative activities with dependencies.
- Budgeting covering the monthly /quarterly / annual funds inflow and outflow and sources of funding.
- Schedule and periodicity for holding review meetings.
- Key performance parameters that will be monitored and tracked to review the schedule, physical and financial performance.
- Relevant project documents.

The PP will be prepared either by the project owner or by the contractor at the project commencement stage. The PP needs to be approved by all key stakeholders before the commencement of the project.

### 6.2.2 Systems Engineering Management Plan

The Systems Engineering Management Plan (SEMP) is a high level plan document 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 could be incorporated in the Project Plan (PP) itself for smaller projects but the same should be developed as a separate document for bigger and complex projects. It must be ensured, however, that the SEMP and PP are in consonance with each other.

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 (see Section 6.5 for details)
  - Configuration management (see Section 6.6 for details)
- 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, Sub-system 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

Table 6-1 provides a general description of a typical SEMP document as a guiding outline for ITS practitioners. Again, the degree of detailing of the report needs to be mapped to the complexity of the project and not all chapters or sections may be required for every project. For a simple Variable Message Sign (VMS) installation, the SEMP document may be only a few pages, but for a complex NUTH project, the SEMP document will have to be a detailed document considering various aspects of the project.

**Table 6-1: Systems Engineering Management Plan Guidebook [6]**

| Section | Suggested Content |
|---|---|
| Title Page | Typically, the title page follows the Agency's procedures or style guide. At a minimum, it contains the following information:<br>• Date on which the document was approved<br>• The organisation responsible for preparing the document<br>• Internal document control number, if available<br>• Revision version and date issued |
| 1.0 Purpose of Document | This section is a brief statement of the purpose of this document and the plan for the Systems Engineering activities with special emphasis on the engineering challenges of the system to be built. |
| 2.0 Scope of Project | This section gives a brief description of the planned project and the purpose of the system to be built. Emphasis is placed on the project's complexities and challenges that must be addressed by the Systems Engineering efforts.<br>This section also describes the environment in which the project will operate. It identifies the organisation structures that encompass all stakeholders. It gives a brief description of the role to be played by each stakeholder. This includes ad hoc and existing management work groups and multi-disciplinary technical teams that should be formed or used to support the project. Such teams are critical to reaching successful system deployment.<br>This section defines the general process for developing the SEMP, including the draft framework version prepared by the transportation implementing agency or their Systems Engineer and the complete version prepared in conjunction with the Systems Engineer and Development Teams. |
| 3.0 Technical Planning and Control | This section lays out the plan for the Systems Engineering activities. It must be written in close synchronisation with the project's Project Plan. However, it is often necessary to put further expansion of the Systems Engineering effort into the SEMP even if they are already described at a higher level in the Project Plan. Even within the SEMP, an effort may need to be described at a higher level in the draft SEMP framework. Then it may need to be expanded further in the final version of the SEMP. An example would be the Configuration Management Plan, to be described below.<br>The purpose of the section is to describe the activities and plans that will act as controls on the project's Systems Engineering activities. |

[6]Adopted from Systems Engineering Guidebook For ITS by California Department of Transportation

| Section | Suggested Content |
|---|---|
| | For instance, this section identifies the products of each Systems Engineering activity, such as, documentation, meetings, and reviews. This list of required products will control the activities of the team performing the activity and will control the satisfactory completion of the activity. Some of these plans may be defined in the SEMP. For other plans, the SEMP may only define the requirements for a particular plan. The plan itself is to be prepared as one of the subsequent Systems Engineering activities, such as may be the case with a Verification Plan or a Deployment Plan. Almost any of the plans described below may fall into either category. It all depends on the complexity of the particular plan and the amount of up-front Systems Engineering that can be done at the time the SEMP is prepared.<br><br>The first set of required activities/plans relates primarily to the successful management of the project. These activities are likely to have already been included in the Project Plan, but may need to be expanded here in the SEMP. Generally, they are incorporated into the SEMP; but, on occasion, may be developed as separate documents.<br><br>• Work Breakdown Structure (WBS) is a list of all tasks to be performed on a project, usually broken down to the level of individually budgeted items<br><br>• Task Inputs is a list of all inputs required for each task in the WBS, such as source requirements documents, interface descriptions, and standards.<br><br>• Task Deliverables is a list of the required products of each task in the WBS, including documents, software, and hardware<br><br>• Task Decision Gates is a list of critical activities that must be satisfactorily completed before a task is considered completed<br><br>• Reviews and Meetings is a list of all meetings and reviews of each task in the WBS<br><br>• Task Resources is identification of resources needed for each task in the WBS, including for example, personnel, facilities, and support equipment<br><br>• Task Procurement Plan is a list of the procurement activities associated with each task of the WBS, including hardware and software procurement and, most importantly, any contracted services, such as Systems Engineering services or development services<br><br>• Critical Technical Objectives is a summary of the plans for achieving any critical technical objectives that may require |

| Section | Suggested Content |
|---|---|
| | special Systems Engineering activities. It may be that a new software algorithm needs to be developed and its performance verified before it can be used. Or a prototyping effort is needed to develop a user-friendly operator interface. Or a number of real-time operating systems need to be evaluated before a procurement selection is made. This type of effort is not needed for all projects<br>• Systems Engineering Schedule is a schedule of the Systems Engineering activities that shows the sequencing and duration of these activities. The schedule should show tasks [at least to the level of the WBS], deliverable products, important meetings & reviews, and other details needed to control and direct the project. An important management tool is the schedule. It is used to measure the progress of the various teams working on the project and to highlight work areas that need management intervention.<br>The second set of plans is designed to address specific areas of the Systems Engineering activities. They may be included entirely in the SEMP or the SEMP may give guidance for their preparation as separate documents. The plans included in the first set listed above are generally universally applicable to any project. On the other hand, some of the plans included in this second set are only rarely required. The unique characteristics of a project will dictate their need.<br>• Software Development Plan describes the organisation structure, facilities, tools, and processes to be used to produce the project's software. Describes the plan to produce custom software and procure commercial software products<br>• Hardware Development Plan describes the organisation structure, facilities, tools, and processes to be used to produce the project's hardware. It describes the plan to produce custom hardware (if any) and to procure commercial hardware products<br>• Technology Plan if needed, describes the technical and management process to apply new or untried technology to an ITS use. Generally, it addresses performance criteria, assessment of multiple technology solutions, and fall-back options to existing technology<br>• Interface Control Plan identifies the physical, functional, and content characteristics of external interfaces to a system and identifies the responsibilities of the organisations on both sides of the interface |

| Section | Suggested Content |
|---|---|
| | • Technical Review Plan identifies the purpose, timing, place, presenters & attendees, subject, entrance criteria, [a draft specification completed] and the exit criteria [resolution of all action items] for each technical review to be held for the project<br>• System Integration Plan defines the sequence of activities that will integrate software components into sub-systems and sub-system into entire systems. This plan is especially important if there are many sub-systems produced by a different development team<br>• Verification Plan is almost always required. This plan is written along with the requirements specifications. However, the parts on tests to be conducted can be written earlier<br>• Verification Procedures are developed by the Development Team and this defines the step by step procedure to conduct verification and must be traceable to the verification plan<br>• Installation Plan or Deployment Plan describes the sequence in which the parts of the system are installed [deployed]. This plan is especially important if there are multiple different installations at multiple sites. A critical part of the deployment strategy is to create and maintain a viable operational capability at each site as the deployment progresses<br>• Operations & Maintenance Plan defines the actions to be taken to ensure that the system remains operational for its expected lifetime. It defines the maintenance organisation and the role of each participant. This plan must cover both hardware and software maintenance<br>• Training Plan describes the training to be provided for both maintenance and operation<br>• Configuration Management Plan describes the development team's approach and methods to manage the configuration of the system's products and processes. It will also describe the change control procedures and management of the system's baselines as they evolve<br>• Data Management Plan describes how and which data will be controlled, the methods of documentation, and where the responsibilities for these processes reside<br>• Risk Management Plan addresses the processes for identifying, assessing, mitigating, and monitoring the risks expected or encountered during a project's life cycle. It identifies the roles & responsibilities of all participating organisations for risk management |

| Section | Suggested Content |
|---|---|
| | • Other plans that might be included are for example, a Safety Plan, a Security Plan, a Resource Management Plan, and/or a Validation Plan<br><br>This list is extensive and by no means exhaustive. These plans should be prepared when they are clearly needed. In general, the need for these plans become more important as the number of stakeholders involved in the project increases. |
| 4.0 Systems Engineering Process | This section describes the intended execution of the Systems Engineering processes used to develop the system. These processes are generically identified in the "V" life cycle technical development model. The SEMP describes the processes specifically needed for a project. It defines them in sufficient detail to guide the work of the Systems Engineering and development teams.<br><br>The following factors should be discussed in the SEMP:<br><br>• Identification of portions of the ITS<br><br>• Identification of participating agencies and their roles & responsibilities<br><br>• Requirements definitions<br><br>• Analysis of alternative system configurations and technology options to meet requirements<br><br>• Procurement options<br><br>• Identification of applicable ITS standards and testing procedures<br><br>• Procedures and resources necessary for operations & maintenance of the system<br><br>This section will contain a description of the Systems Engineering procedures tailored to the specific project. There are four areas of analysis that need to be described:<br><br>• System Requirements Analysis describes the methods to be used to prepare the Concept of Operations and the top-level system requirements documents. The analysis techniques that may be used include: peer reviews, working groups, scenario studies, simulation, and prototyping. The amount of analysis required increases with the risk of the specific requirement. The process for approving the resulting documents will be described, including who is involved, whether technical reviews are necessary, and how issues and comments are resolved so the baseline can be defined<br><br>• Sub-system (Functional) Analysis describes the methods to be used to identify sub-systems and to allocate the system [top- |

| Section | Suggested Content |
|---|---|
| | level] requirements to the sub-systems. It is often necessary, at this step, to expand the top-level requirements into a complete description of the functions of the system, for instance, details of an operator interface. It also may be necessary, at this time, to define internal interfaces [sub-system to sub-system] to the same level of detail as the external interfaces [interfaces to other systems]. The SEMP should describe the methods for analysis and the tools required. Budget and schedule constraints, as well as completion criteria, should be included<br>• Design Synthesis describes the methods to be used by the development teams to translate the functional requirements into a hardware and software design. A number of tools and methodologies exist for this. The specific ones to be used by the development team should be identified, along with the necessary resources. Describe the products to be produced as this process unfolds and the design review steps to be taken<br>• System Analysis describes the methods to be used for any required technical trade-off studies, cost/benefit decisions, and risk mitigation alternative analysis. The methodologies used should provide a rigorous basis for selecting an alternative, a quantifiable basis for comparing the technical, cost, and schedule impacts of each alternative, and comprehensive description of the risks involved with each alternative. |
| 5.0 Transitioning Critical Technologies | This section will describe the methods and processes to be used to identify, evaluate, select, and incorporate critical technologies into the system design. Since this may represent an area of considerable impact to the project, this is one of the major efforts of risk management.<br>The need for a critical technology may be based on a performance objective. It may also be based on other factors; the desire to reduce acquisition or maintenance costs; the need to introduce standard compliance; or the need to meet an operational objective. In some cases, the need may move away from a technology that is obsolete and no longer supported by industry.<br>Identification of candidate technologies hinges on a broad knowledge of the technologies and knowledge of each technology's status and maturity. In other words, build on a thorough understanding of the pros and cons of each available technology. Obtaining the resource[s] capable of performing this step is one of the major risks encountered by project management.<br>Sufficient analysis of the risks and benefits of a particular technology may become a major effort involving acquiring the technologies, modifying the technology to meet system requirements, and |

| Section | Suggested Content |
|---|---|
| | developing methods to test and evaluate the various technologies that need to be considered. Each of these steps can introduce considerable risk.<br><br>Finally, incorporation of a technology into an operational system may involve considerable work, especially establishing the support and maintenance environment for the technology.<br><br>All of these aspects of technology introduction, especially introduction of novel technology, need to be carefully and fully addressed in the SEMP. |
| 6.0 Integration of the System | This section describes the methods to be used to integrate the developed components into a functional system that meets the system requirements and is operationally supportable. The Systems Engineering process steps to be detailed here include: integration, verification, deployment, and the training necessary to support operations & maintenance. Plans for validation of the system should also be covered. For each step, the resources [tools and personnel] are identified and products and criteria for each step defined. |
| 7.0 Integration of the Systems Engineering Effort | This section addresses the integration of the multi-disciplinary organisations or teams that will be performing the Systems Engineering activities. Obviously, the larger the number of such organisational teams, the more important the integration of their efforts is. Each team will have both primary and support tasks from the WBS. Each team will have to be aware of the activities of other teams, especially those activities that immediately precede or follow their own primary tasks. Representatives of most teams will have to be involved in critical technical reviews, and in the review of baseline documentation. Likewise, up-front teams (e.g. requirements and design) must be available to support the ending activities, such as, integration, verification, deployment, and training. |
| 8.0 Applicable Documents | This section lists the applicable documents which are inputs to the project [i.e., needed but not produced by the project]. Such documents may include: the regional ITS architecture description, planning documents describing the project, agency procedures to be followed, standards & specifications, and other descriptions of interfacing external systems. Other applicable documents may be required by a specific project. |

## 6.3 NUTH Implementation Process

Figure 6-2 outlines the steps involved during the NUTH development process. The process steps have been explained in detail in the sub-sections below. In line with the

international best practices, it is recommended that the city adopts Systems Engineering approach towards system design and implementation.

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 NUTH planning, procurement and implementation.

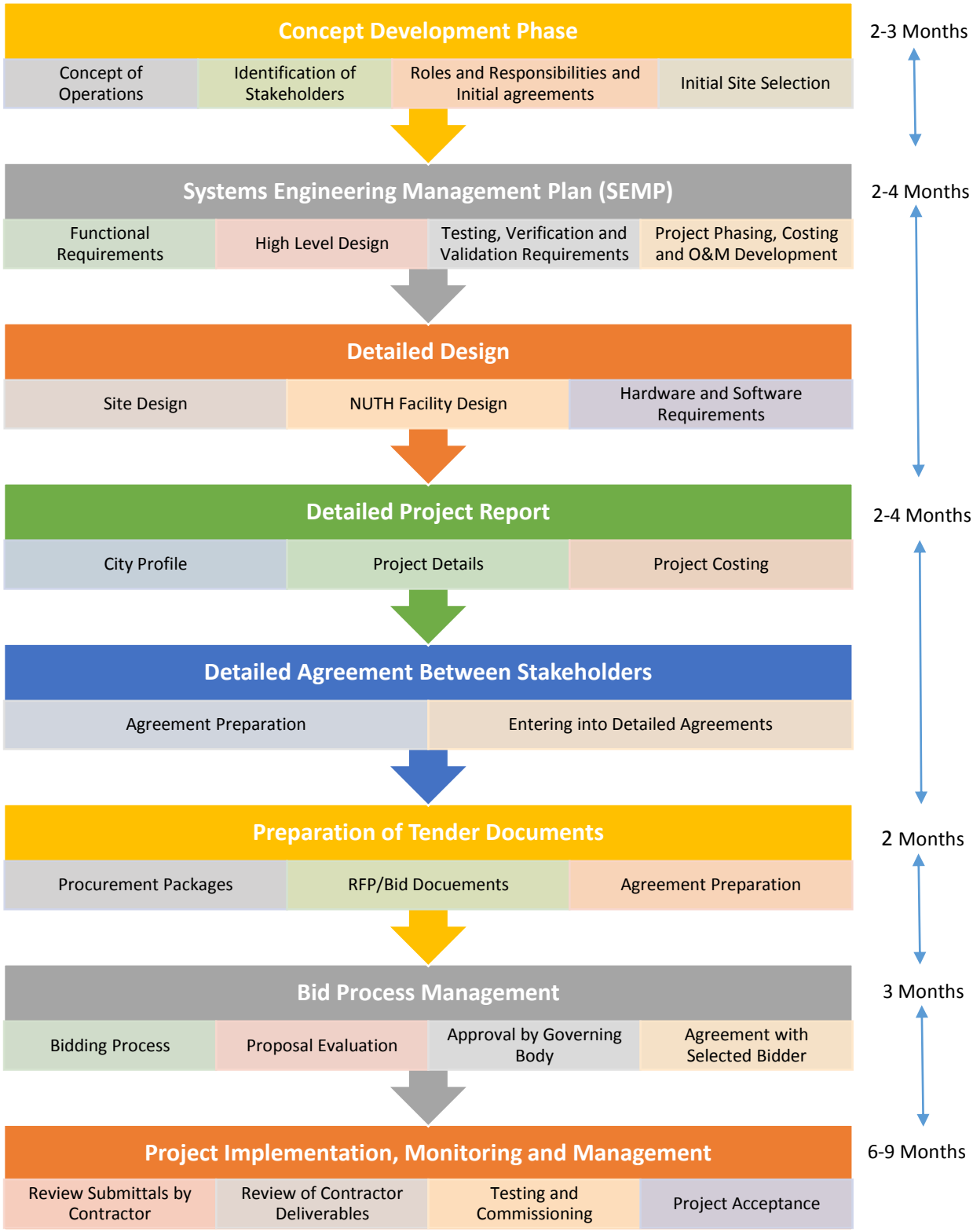



**Figure 6-2: NUTH Implementation Process**

As the concept is new to the Indian cities and will require additional support from organisations having required expertise, Ministry of Urban Development, GoI has identified and empanelled a set of consultants who may be engaged by the cities for seeking assistance in conceptualising, designing, procuring and monitoring the implementation of the NUTH in the city. The indicative scope of services for the city specific project consultancy is set out as Annexure 8.

### 6.3.1 Development of City Specific Concept of Operations Report

Concept of operation is a description of system requirements. It defines that 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. 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:

- NUTH Concept Plan covering:
  - Identification of ITS & NUTH needs for the city based on data analysis and collection.
  - Identification of stakeholders providing the data inputs
  - Drawing up of implementation role of various stakeholders
  - Identification of ITS application and NUTH system design to support the applications
  - Plan for administration and management of the system
  - Broad costing for setting up of the NUTH – upfront and ongoing
  - Sources of revenue
- Site selection and preliminary design of NTPH facility

  This activity would require identification and evaluation of 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 NUTH system
  - Prepare business plan including financing details for the NUTH system
  - 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
- 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 NUTH.

The city implementing agency and the consultant engaged by it may refer to the NUTH Operations Document and City Specific Operations Documents, available with MoUD while preparing city specific concept reports.

### 6.3.2 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 the Systems Engineering steps and tasks. The activities related to the SEMP have been covered in Section 6.2.2.

### 6.3.3 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.)
- NUTH facility design
- Hardware design
- Software design

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 are developed by the city.

### 6.3.4 Detailed Project Report

Prior to NUTH implementation, city will need to develop a Detailed Project Report (DPR). An indicative template for DPR is provided in Annexure 6. The DPR would cover both technical as well as 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
- Annexures

### 6.3.5 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 agreements would clearly set out the roles and responsibilities of each stakeholder and funding allocation and responsibilities based on the project requirements. Guidance regarding agreements between stakeholders for NUTH has been provided in Section 9.11.

### 6.3.6 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:

- Parceling 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 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 various procurements 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.

### 6.3.7 Bid Process Management

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, as 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

### 6.3.8 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 payments 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

## 6.4 Project Monitoring and Control

Project monitoring and control is performed through project tracking and reviews which have been described in the subsections below.

### 6.4.1 Project Tracking

The project tracking can be undertaken by way of measuring the parameters that are indicative of project progress. The parameters could relate to project management aspects or deal with the progress of the project on technical front. The PP and SEMP contain details of the performance measures that would be used for project monitoring and tracking. Table 6-2 provides some examples of performance measures.

**Table 6-2: Performance Measures Examples**

| Area | Parameters | Performance Measures |
|---|---|---|
| Project Management | Physical Progress | • Number of activities planned vs. Number of activities completed<br>• Number of sub-systems planned for completion vs. Actual number of sub-systems completed |
| | Financial | • Budgeted spending during the period vs. actual spending during the period<br>• Budgeted cost vs. actual cost |
| | Schedule | • Planned start for an activity vs. Actual start for the activity<br>• Planned date for achieving a milestone vs. Actual schedule for achieving the milestone<br>• Planned duration for a task vs. Actual duration for the task<br>• Planned completion date for an activity vs. Actual completion date for the activity |
| Technical Aspects | System Development | • Number of requirements captured vs. predicted number of requirements<br>• Number of software elements designed vs. total number of software elements to be designed<br>• Number of software elements finished vs. total number of software elements<br>• Number of acceptance test cleared vs. Number of acceptance test conducted |

| Area | Parameters | Performance Measures |
|---|---|---|
| | System Performance | • Predicted vs. Actual failure rate<br>• Number of faults reported by system component vs. Total number of system component faults<br>• Actual database storage usage vs. space allocated<br>• Actual average response time vs. target response time |

The performance measures needs to be tracked periodically or at specific stages. This will lead to any potential issues being discovered in time so that corrective actions could be planned and taken. The project management related measures may lead to taking course correction steps on the project schedule, resource augmentation, task re-assignment and other process related aspects. Technical measures may lead to design review, test plan review, resource deployment and allocation and engineering process related aspects.

### 6.4.2 Project Reviews

The project reviews provide a forum where stakeholders take stock of project progress, discuss the feedback provided based on review of the various outputs, take decision on moving to the next steps and plan for any interventions that may be required to address any specific issue discovered pursuant to the review. The project reviews must have participation from all the key people associated with the aspects being reviewed. Where contractors are engaged, they also need to participate in the project reviews.

The project review can be carried out from the perspective of project management or from a technical standpoint. The project management review would cover aspects such as progress, schedule, milestone achievements, resource deployment, budget and other related aspects.

From Systems Engineering point of view, the reviews are required upon completing a "V" process step leading to decision points which needs to be successfully cleared for moving on to the next "V" process step. In line with the "V" process steps, the reviews which could be conducted for a project would include:

- Project Planning Review
- Concept of Operations review
- Requirements review
- High-Level Design review
- Detailed Design review

- Implementation reviews
- Test Readiness review
- Operational Readiness review

Beyond the specific “V" process decision-point reviews, other reviews may also be undertaken on a need basis with participation from team members concerned on any specific matters or issues identified.

## 6.5 Risk Identification and Management

The objective of risk management exercise is to put in place a framework for dealing with any potential issues that could adversely impact the project progress or performance. Figure 6-3 provides an overview of the Risk Management Processes which have been detailed in subsequent sections.


**Figure 6-3: Risk Management Process**

### 6.5.1 Identifying Risks

In this step, potential risks to the project progress and performance are identified by the project stakeholders in the early stage of the project.

Risks can be categorised into the several areas such as Technical, Institutional, Schedule, Cost, Quality, Funding, Personnel, Commercial, Security, Communication etc. (Table 6-3).

**Table 6-3: Risk Identification**

| Area | Nature of Risk |
|---|---|
| Technical | • Requirements not properly worked out leading to project not achieving the desired outcome |
| | • Obsolescence |

| Area | Nature of Risk |
|---|---|
| Institutional | • All institutions whose support is critical for project success are not on board, or if on board, not fully supportive |
| Schedule | • Delay in any phase of project or overall completion |
| Cost | • Project cost overrun |
| Quality | • Quality of project assets / processes not up to the mark |
| Funding | • Funding for the project activities not forthcoming in a timely manner leading to delay |
| Personnel | • Availability of personnel is an issue |
| | • Training of personnel is an issue |
| Commercial | • Funding of the gap between project cost and likely revenues |
| Security | • Physical security of project assets |
| | • Data security |
| Communication | • Availability and adequacy of means of communication between various equipment, personnel and other stakeholders |

Toolkit for Public Private Partnership in Urban Transport, Ministry of Urban Development, Government of India (July 2008) provides a framework for identifying various risks under different type of contracts and method of allocating these between different entities.

### 6.5.2 Analysing Risks

In this step the risks identified are analysed with respect to the probability of their occurrence and the impact if they occur as depicted in Figure 6-4.

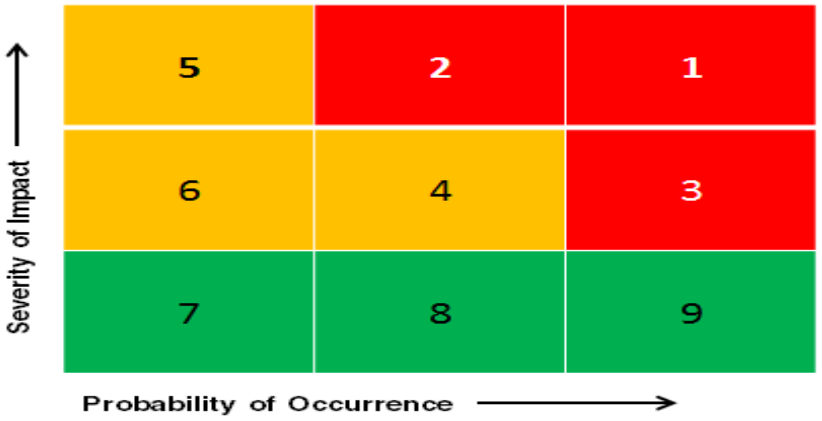



**Figure 6-4: Risk Prioritisation Matrix**

Risks falling under the category 1, 2, and 3 are very important and need to be managed on priority. Subsequently, based on resource availability, management of risks falling under the category4, 5, and 6, can also be considered. Table 6-4 provides a sample of prioritisation matrix. The project risk prioritisation matrix would differ from project to project based on specific situation.

**Table 6-4: Risk Prioritisation Example**

| Area | Nature of Risk | Risk Category |
|---|---|---|
| Technical | • Requirements not properly worked out leading to project not achieving the desired outcome | 1 |
| | • Obsolescence | 3 |
| Institutional | • All institutions whose support is critical for project success are not on board, or if on board, not fully supportive | 1 |
| Schedule | • Delay in any phase of project or overall completion | 3 |
| Cost | • Project cost overrun | 3 |
| Quality | • Quality of project assets / processes not up to the mark | 4 |
| Funding | • Funding for the project activities not forthcoming in a timely manner leading to delay | 5 |
| Personnel | • Availability of personnel is an issue | 3 |
| | • Training of personnel is an issue | 5 |
| Commercial | • Funding of the gap between project cost and likely revenues | 2 |
| Security | • Physical security of project assets | 2 |
| | • Data security | 2 |
| Communication | • Availability and adequacy of means of communication between various equipment, personnel and other stakeholders | 5 |

### 6.5.3 Risk Mitigation

The next important task in risk management is to find ways to deal with risks identified and their analysis carried out earlier.

There are several ways in which the risk could be dealt with as set out below:

- Avoiding the risk completely by changing any of the project related aspects such as change in design, technology, location, stakeholder, scope, requirements etc.
- Taking measures to bring down the probability or severity such as building a prototype or proof of concept, resource management etc.
- Accepting the risk without taking any action for low probability/severity risks

Table 6-5 provides a sample of the mitigation measures. These would differ from project to project based on specific situation.

**Table 6-5: Risk Mitigation Example**

| Area | Nature of Risk | Risk Category | Mitigation Measures |
|---|---|---|---|
| Technical | • Requirements not properly worked out leading to project not achieving the desired outcome | 1 | • Professional consultants could be engaged<br>• Systems Engineering approach to be adopted<br>• Key project stakeholders to be involved during system planning and design stage |
| | • Obsolescence | 3 | • Suitable provisions in the procurement documents to ensure that the system support and spares are available over the system lifecycle |
| Institutional | • All institutions whose support is critical for project success are not on board, or if on board, not fully supportive | 1 | • Understanding be established among the participating institutions as regards their role and support |
| Schedule | • Delay in any phase of project or overall completion | 3 | • Close and continuous monitoring, timely inputs and approvals, timely payments to vendors |
| Cost | • Project cost overrun | 3 | • Project planning with professional help, clarity and stability in project scope |
| Quality | • Quality of project assets / processes not up to the mark | 4 | • Suitable vendor selection process with appropriate qualification criteria containing quality certification requirements, appropriate |

| Area | Nature of Risk | Risk Category | Mitigation Measures |
|---|---|---|---|
| | | | warranty and support requirements |
| Funding | • Funding for the project activities not forthcoming in a timely manner leading to delay | 5 | • Funding to be tied up prior to procurement |
| Personnel | • Availability of personnel is an issue | 3 | • Identify the personnel / positions that would be involved in various stages of the project |
| | • Training of personnel is an issue | 5 | • Identify the training needs of the personnel that would be involved in various stages of the project and subject these personnel to training |
| Commercial | • Funding of the gap between project cost and likely revenues | 2 | • Funding for any likely deficit to be tied up |
| Security | • Physical security of project assets | 2 | • Appropriate security measures to control physical access to project assets, CCTV surveillance |
| | • Data security | 2 | • Appropriate security measures to control access to project systems such as role based access to the system through password, monitoring the access to the system, firewall, antivirus, disaster recovery centre. A brief note on data security is added as Annexure 7. |
| Communication | • Availability and adequacy of means of communication between various equipment, personnel and other stakeholders | 5 | • Identify the most suitable means of communication for various project requirements: data, voice, wired, wireless etc.<br>• Check for their availability and reliability and plans for backup arrangements |

### 6.5.4 Risk Monitoring

In a dynamic project environment, the character of risk in terms of its probability and/or impact may change during the course of project progress. It is also possible that the project may now be subjected to any new risk which was not affecting the project earlier.

It is, therefore, important to keep track of the risks on a periodical basis during the project review meetings so that action could be initiated in order to deal with the changing situation.

## 6.6 Configuration Management

Systems are composed of specific versions of sub-systems and components. Configuration Management (CM) process helps in ensuring system integrity by establishing the baseline and managing any changes made to the baseline.

The typical activities that form part of CM process are as under:

- **Planning:** This activity deals with preparing a CM Plan covering aspects such as the system elements that are to be controlled to define the system configuration, changing a configuration parameter, approvals required, keeping track of the changes made, audit and verification
- **Identification:** Hardware, software, tools and documents to be tracked and the physical and functional aspects thereof that needs to be tracked
- **Managing Changes:** Controlling change to the items and their characteristics that are subject to configuration management
- **Keeping Track:** Keeping record of the current configuration and also the details of changes completed, approved or proposed
- **Auditing:** To verify that the CM requirements are being adhered to by all concerned and that the documents reflect the system status correctly

## 6.7 Applying Systems Engineering

### 6.7.1 Procurement and Systems Engineering

Based on the procurement approach adopted for project, different entities (System Owner,Consultant or Contractor) could be responsible for carrying out the various Systems Engineering steps. An overview of role allocation options has been provided in Table 6-6. The Owner typically decides on the requirements, and may even do preliminary and detailed design, if they have qualified staff for the work. Typically, this work is done by a qualified consultant team. The Owner can also do development work, but typically this work is done by an outside contractor.

**Table 6-6: Options for Role Allocation**

| Activity | Options for Role Allocation |
|---|---|
| Requirements | System owner, consultant |
| Preliminary Design | System owner, consultant |
| Detailed Design | System owner, consultant |
| Development/Construction | System owner, contractor |
| Testing | System owner, consultant, contractor |
| Deployment | contractor |
| Operation | System owner, contractor |
| Maintenance | System owner, contractor |

A typical allocation of responsibility among various entities followed by government organisations in India for IT/ITS projects is provided in Table 6-7. The owner will always have oversight responsibility for all phases of the project.

**Table 6-7: Distribution of Responsibilities**

| Activity | System Owner | Consultant | Contractor (Systems Integrator) |
|---|---|---|---|
| Requirements | S | Y | |
| Preliminary Design | | Y | |
| Detailed Design | | Y | Y (1) |
| Development | | | Y |
| Testing | | S | Y |
| Deployment | | | Y |
| Operation | O | | O |
| Maintenance | O | | -O |

Y: The entity concerned is primarily responsible for the activity

S: The entity concerned would support the entity having primary responsibility for the activity

O: Either of the entity could take on the responsibility for the activity

1: For Design-Build or Public-Private Partnership projects, the Contractor can also do final design, provided appropriate preliminary design documents have been developed.

The system owner is required to be involved in each activity irrespective of the responsibility allocation among the various entities and will have some specific role to play in each activity such as giving inputs, monitoring, approvals, reviews etc.

### 6.7.2 Selecting a Development Strategy

There are several different strategies for implementing a system driven by the factors such as clarity of requirements, budget constraints and evolving system requirements based on user feedback. Given these factors, there are three broad approaches that the system owner could follow:

- **Implement the entire system at one go**: This approach could be followed if the requirements are known and they are not likely to undergo any major changes; and funding for undertaking full scale deployment is available.
- **Implement the system incrementally:** This approach could be followed when the requirements are known but the system is to be designed and deployed in phases due to funding or other constraints.
- **Implement the system with initial capability and then build additional capabilities based on user feedback:** This approach could be followed when there is limited understanding of the user needs and it is expected that user needs would evolve based on their experience in using the system built with initial set of capabilities. The system is developed and released with initial set of requirements. Based on user experience with the system and their feedbacks, their needs are captured, requirements are worked out, system design is undertaken and the system is rolled out.

### 6.7.3 Customising the Systems Engineering Approach for the Project

The “V” model of Systems Engineering process and the steps comprising the model have been described in Annexure 5 of this document. The manner in which these processes are followed, the degree of detailing, the documentation created and the requirement to follow formal processes vary from project to project depending on its size and complexity.

Irrespective of the project size, all the steps must be followed in the manner assessed most suitable by the project team. It is, however, useful to have the requirements that are documented and to put in place formal design and verification related processes.

# 7.0 NUTH OPERATIONS

## 7.1 Introduction

In complex systems such as NUTHs where several systems and subsystems belonging to different agencies interface to provide services to users, it would be useful to have well-documented procedures that would lay down detailed guidelines for handling various identified activities and events. Such procedures would cover the roles to be discharged by the various personnel, agencies and other stakeholders, the timelines to be adhered to, reporting requirements, escalation matrix, communication and other related aspects. In the case of multiple agencies, protocols and standards for information exchange must be developed in the Systems Engineering process and adopted by all agencies, especially as they upgrade or modify their systems to ensure continuous compatibility with all other affected systems.

## 7.2 NUTH Activities

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

### 7.2.1 Data Collection from Stakeholders

Data collection from various participating entities and other sources is one of the most important operational activities undertaken by NUTH. NUTHs work with and rely upon various data inputs from variety of sources. Various data inputs and their sources need to be planned for at the design stage itself based on the then available data sources and those planned to be implemented. Such data could be of static nature or dynamic nature. Examples of static data are road network, signal locations, terminal locations, transit routes, parking facility details etc. Dynamic data could be location of transit vehicle, departures scheduled at various terminals/bus stops, traffic volume, incidents, feed from cameras etc.

The actual data elements that would need to be received and processed by any NUTH would be driven by the services to be provided and the participating agencies. Some of the activities that relate to this function are listed below:

- Identification of participating agencies.
- 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.
- Tying up 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 as set out in the MoU amongst the participating agencies. (Sample of MoU is provided as Annexure 4 at the end of 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.

For the cities which already have a TMICC or are planning to implement the same, 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/TMICC, 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/TMICC 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.

### 7.2.2 Data Processing & Fusion

As part of this activity, the data collected from various participating entities is analysed, correlated and fused with other data and information. The framework for the data exchange, the type of analysis and data fusion and massaging would be detailed at the detailed design stage itself. During the operations phase, the system developed based on the detailed designed would be pressed into “Go-Live” mode. Some of the key activities that are undertaken as part of this exercise are as 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. The NUTH system developer is responsible for monitoring the integrity of the data and conduct performance evaluation and error checking to validate the integrity of data through both data analytics and/or human interface.

### 7.2.3 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 as below:

- Setting up, managing, operating and maintaining the data dissemination infrastructure and system
- Managing the interface with users of the NUTH
- Setting up, updating and maintaining the website and mobile app
- Setting up, managing and operating the call centre facility
- Tying up with media and private sector entities for data dissemination

### 7.2.4 Other Operational Aspects

Other operational aspects of 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 catalyze its regular use by public
- Financial management

- Human resource management
- Managing relations with media
- Feedback from the public and taking remedial measures
- Performance evaluation

## 7.3 Operations

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

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

- Jurisdiction of 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
- 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.

## 7.4 Incidents and Events

NUTHs are expected to undertake information dissemination related to real-time traffic and transit information as well as incidents and events that require several city agencies to come together, participate and discharge their respective roles in responding to the same. The need for information dissemination becomes very critical in such situations. The role of NUTH during various types of incidents and events must be agreed upon upfront so that it is able to have access to required resources to provide support during such situations.

It would be desirable that standard operating procedures are laid down with respect to information flow and dissemination mechanism while dealing with any incidents and events. During such times the traffic flow to NUTH is also likely to increase, therefore, where capacity of the system becomes a constraint, the same must be conserved to support such surge in traffic based on agreed procedures.

## 7.5 Citizen Inputs and Requests

Since citizens are one of the most important stakeholders of NUTH, being the key recipient of the services being provided by NUTH, it is critical that a system is created for receiving their request for services, feedbacks, inputs, suggestions, complaints and event & incident reporting etc. in a suitable manner.

Such inputs from citizens must be recorded and processed in a structured manner with carrying out activities such as logging, review, action taken thereon and response to citizen.

Based on the feedbacks received from the citizens new services could be introduced, existing services could be modified / enhanced and the activities of NUTH could be tailored to meet the citizen expectations. Logs of all citizens' requests must be maintained to allow an effective management procedures.

## 7.6 System Reports

NUTH system should be designed in such a manner that it is capable of supporting generation of various types of reports and their dissemination to the stakeholders concerned. System should support automatic generation and distribution of various identified reports. 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:

- 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.
- Statistical Analysis: Website visitors volume and trends, call volumes and trends, analysis of data on feedbacks etc.

## 7.7 Data Storage

The data storage policy of NUTH would need to be defined based on utility of data points, entity owning the data, storage space requirements, need to access data, legal and statutory aspects etc.

## 7.8 System Documentation

Documentation for NUTH system, including the system design, operations and management must be developed and maintained during the life of the project. These documentations are often a part of the contract documents related to the design and implementation of the system. The agencies must ensure that proper documentation are developed and update on an annual basis.

Details of all documents, policies, plans and programmes as well as the documents themselves must be readily accessible to responsible staff and other stakeholders on an as-needed basis. The indicative list of various types of documents that may be associated with any NUTH is as below:

- City Development Plans
- Mobility Plan of the City
- Agreements among participating agencies
- Agreements with Suppliers and Contractors
- NUTH Operations Document
- NUTH Concept of Operation document
- NUTH Operations Manuals
- NUTH Maintenance Manuals

- System Requirements
- System design documents
- Project ITS Architecture
- Business Continuity & Disaster Recovery Plan
- Standard Operating Procedures
- Relevant Laws and Statutes
- NUTH Equipment specifications
- Manuals provided by suppliers

# 8.0 NUTH MAINTENANCE PROCEDURES

## 8.1 Introduction

The back-end of NUTH would reside within a TMICC, if it exists, or at any other suitable location. There are various sub-systems that would interface with NUTH. Some, such as field equipment, would provide data feed to the TMICC which would be processed by the TMICC application software and then fed to NUTH. Alternately, the field equipment would send data to the associated backend system (e.g. transit management system, parking management systems) which would in turn send data to the NUTH backend. Some sub-systems would consist of the components used to host NUTH application software and other standard software and support networking and communication. Then there would be remaining sub-systems that manage the environment, power back up or are part of utilities & services supporting the centre where NUTH back-end resides. Each of these must be maintained in proper state of upkeep and repair to the acceptable standards so as to support NUTH related activities.

## 8.2 NUTH Related Assets Maintenance

### 8.2.1 Systems Interfacing with NUTH

#### A. Systems of Participating Agencies

Such systems and associated equipment will be maintained by the agency to which they belong. 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 alert 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. For example, NUTH would alert the transit agencies in case of break in transit ETA data.

#### B. TMICC Systems

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

### C. Hosted Services

An NUTH system can also be hosted by a third party. These types of systems can be maintained by a private party, at a monthly or annual fee, similar to other Internet Hosting services. These types of arrangements typically include all of the hardware and potentially the software that fuses and disseminates the information for the users.

## 8.2.2 NUTH Backend System

The NUTH backend system would consist of the following:

### A. Hardware

NUTH backend hardware would be maintained by the respective Original Equipment Manufacturers (OEMs) or their authorised resellers, as the case may be. The backend hardware would include the servers, storage, routers, switches and desktops for the NUTH. Apart from the desktops for NUTH staff, the NUTH would also have consoles for call centre operators. These consoles would also need to be maintained through the respective Original Equipment Manufacturers (OEMs) 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.

### B. Standard Software

NUTH Backend standard software (such as operating systems, database system etc.) 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.

### C. Application Software

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. In both situations, the O&M costs for software maintenance need to be considered in the life-cycle costs for the project.

### D. 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. The O&M costs for software maintenance need to be considered in the life-cycle costs for the project, especially if the communication links are based on leased solutions instead of agency owned options. Leased costs, such as cellular service can be expensive in the long run. If an agency owned communication

system is selected in the Systems Engineering analysis, appropriate trained staff is required for system maintenance.

**E. 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 OEMs/ suppliers/ contractors. The maintenance should be subject to agreed service levels in terms of response and resolution times.

## 8.3 System Start-Up and Shut-Down Procedures

Since NUTH related systems, sub-systems and equipment support several processes and provision of various services, all such processes and services would get affected whenever there in any change in status of any of these elements.

As and when any system, sub-system or equipment is to be shut down for maintenance or other requirements, a well laid down process must be followed covering the following:

- To the extent possible shut-down must be planned in advance in accordance with agreed schedules preferably during lean hours
- Communication must be sent to all the users of NUTH who would get affected by such shut-down. Such communication must contain all the relevant details:
  - Nature of issue being addressed
  - Commencement time
  - Completion time
  - The services and the processes that would be affected
  - Period of time the equipment is not expected to be available
  - Contact details of the key personnel responsible for maintenance / shut down activities
  - Any other relevant information, in accordance with the agreed procedure
- Start-up communication must also be sent to all the stakeholders concerned.

## 8.4 Types of Maintenance

### 8.4.1 Routine Maintenance

Routine maintenance are activities of periodic nature required to be carried out for the general upkeep of any system, hardware, software, equipment against normal wear and tear during its usage. The activities and their frequency (daily, weekly, monthly etc.) are

typically based on the equipment manufacturer's recommendations as provided in the equipment maintenance manual.

Depending upon the arrangement with the contractor, such activity would either be undertaken by the contractor or by the agency personnel.

Such activities may include equipment cleaning, lens cleaning, adjustment/calibration, battery replacement, bulb replacement, minor component replacement etc.

### 8.4.2 Preventive Maintenance

Preventive maintenance is carried out in order to pre-empt any equipment failure by proactively and systematically examining various equipment based on recommendations of the respective equipment manufacturer.

Preventive maintenance is defined set of activities that are typically carried out by skilled personnel at pre-specified schedules. Depending upon the arrangement with the contractor, such activity could either be undertaken by the contractor or by the agency personnel who are generally trained by the equipment manufacturer to carry out such tasks.

Such activities may include detailed inspection of the equipment, replacement of major/minor components etc.

## 8.5 Spare/Backup Equipment

Spares and back up equipment may be required to be provided for in order to support desired service levels based on recommendations of the equipment manufacturer.

Depending upon the critical nature of the service, spares and back up equipment must be stored close to their location of usage.

The spares and back up equipment would be maintained by the agency to which the equipment belongs directly through its personnel or through respective equipment manufacturer.

## 8.6 Emergency Operations

In case any equipment or any other component of the system fails leading to an unplanned shut-down, several processes and services may get affected.

For dealing with such situations, emergency operations procedures must be established, covering the following:

- Alternate arrangement to fully /partially support the affected services to the extent possible.
- Communication must be sent to all the stakeholders concerned who would get affected by such shut-down containing the relevant details.

- Start-up communication must be sent to all the stakeholders concerned post restoration and their confirmation must be obtained regarding proper functioning of the systems, sub-systems or equipment concerned.

## 8.7 Maintenance Contracting

### 8.7.1 Agency Maintenance

Based on availability of trained personnel and capacity within the various agencies, they may decide to undertake different levels of maintenance on their own. Routine maintenance activities may be undertaken by the agency personnel with minimal training but for carrying out any major maintenance, the agency personnel would need to be trained by the equipment manufacturer. Continuous and periodic training should be planned and carried out to maintain a high level of expertise for the staff. It is suggested that, to begin with, the NUTH should have a small maintenance team which is responsible for routine level maintenance of the backend systems (hardware and 3rd party software). Depending upon capability build-up within the NUTH, responsibility of carrying out routine maintenance of additional systems may be considered in the longer term.

### 8.7.2 Contract Maintenance

In case the agency does not have trained personnel or in-house capacity or it otherwise decides to outsource the maintenance activities, it may do so under suitable arrangement with the equipment supplier or their authorised service partners.

The agreements with such entities must cover the detailed scope of maintenance activities, coverage including exclusions (if any), contract period, payment terms, performance standards, response and resolution times, penalties and reward structure, as mutually agreed. The agencies must include provisions in the contract to ensure that the third party providers provide continuous and on-going training for the staff. Maintenance manuals should be prepared for all aspects of the project and be available to the agency staff, as well as the contract employees.

# 9.0 ORGANISATIONAL SETTING

## 9.1 Introduction

As NUTH functions involve exchange of data and information among various agencies having their respective mandates and jurisdictions, the establishment, operation and management of an NUTH involves interplay, collaboration and cooperation among several agencies.

In order to work towards meeting the objectives of NUTH, the relevant agencies working in the area of transportation, transit and traffic need to come together and cooperate at several levels ranging from its planning to be a part of its operational set up.

The agencies concerned must get involved in establishment of NUTH right from the beginning and evolve concept of operations jointly so that the services and associated facilities are developed keeping in mind their expectations from NUTH (in terms of NUTH's objectives, operational and managerial role of various entities, the nature and extent of information & data sharing, space requirements and the like).

In order to give the arrangements among various agencies an institutional shape, agencies may need to enter into suitable agreements, contracts or Memorandum of Understanding (MoU) outlining their roles, responsibilities and other related aspects of their cooperation.

## 9.2 Applicable Laws and Regulations

Development and operation of NUTH would in any case need to be within the legal framework governing such activities in India. Some of the specific laws, regulations or government order that would have bearing on NUTH activities are listed below:

- Information Technology Act 2000 with regard to matters such as privacy, theft, legal admissibility of electronic communication etc.
- Copyright Act, 1957 with regard to protection of Intellectual property
- Motor Vehicles Act, 1988 with regard to the traffic violations
- Acts or executive orders governing setting up of Unified Metropolitan Transport Authority participating in the project
- Police Act with regard to the role of State police in traffic activities
- Municipal Acts governing the municipal body of the city
- Fire Services Act governing the fire agency of the city
- The Road Transport Corporation Act, 1950

- The Metro Railways (Construction of Works) Act, 1978
- The Delhi Metro Railway (Operation & Maintenance) Act, 2002
- The Railways Act, 1989
- Telecom Commercial Communications Customer Preference Regulations, 2010
- Telecom Tariff Order and amendments thereto notified by Telecom Regulatory Authority of India from time to time with respect to the telecom service charges
- The Persons with Disabilities Act, 1995
- Government guidelines in setting up NUTH facilities, if any

The list above is not intended to be an exhaustive one and the agency implementing the project must take into account the extant legal regime that would apply to their projects and specific situations.

## 9.3 Role of Central, State and Local Governments

Various levels of governments play roles in the urban transport sector in India. The framework governing the responsibilities of various entities has been outlined in the Constitution of India (COI).

### 9.3.1 Constitutional Provisions

The division of role between various levels of government in India is governed and guided by the Constitution of India (COI). Article 246 of the COI deals with this matter and contains references to Seventh Schedule containing List I (Union List), List II (State List) and List III (Concurrent List). Article 243 (W) deals with provisions regarding power, functions and other incidental matters related to municipalities.

Indian Parliament has exclusive power to make laws with respect to any of the matters enumerated in Union List. The Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters enumerated in State List. Indian Parliament and the Legislature of any State also have power to make laws with respect to any of the matters enumerated in Concurrent List. In accordance with Article 248 of COI, Indian Parliament has exclusive power to make any law with respect to any matter not enumerated in the Concurrent List or State List.

Union List entries that have relevance in relation to NUTH:

- Delimitation of cantonment areas, local self-government in such areas, the constitution and powers within such areas of cantonment authorities and the regulation of house accommodation (including the control of rents) in such areas.
- Railways.
- Highways declared by or under law made by Parliament to be national highways.

- Shipping and navigation on inland waterways, declared by Parliament by law to be national waterways, as regards mechanically propelled vessels; the rule of the road on such waterways
- Airways; aircraft and air navigation; provision of aerodromes; regulation and organisation of air traffic and of aerodromes; provision for aeronautical education and training and regulation of such education and training provided by States and other agencies
- Carriage of passengers and goods by railway, sea or air, or by national waterways in mechanically propelled vessels.
- Posts and telegraphs; telephones, wireless, broadcasting and other like forms of communication
- The Survey of India, the Geological, Botanical, Zoological and Anthropological Surveys of India; Meteorological organisations
- Extension of the powers and jurisdiction of members of a police force belonging to any State to any area outside that State, but not so as to enable the police of one State to exercise powers and jurisdiction in any area outside that State without the consent of the Government of the State in which such area is situated; extension of the powers and jurisdiction of members of a police force belonging to any State to railway areas outside that State.

State List entries that have relevance in relation to NUTH:

- Police (including railway and village police) subject to the provisions of entry 2A of List I.
- Communications, that is to say, roads, bridges, ferries, and other means of communication not specified in List I; municipal tramways; ropeways; inland waterways and traffic thereon subject to the provisions of List I and List III with regard to such waterways; vehicles other than mechanically propelled vehicles
- Local Government, that is to say, the constitution and powers of Municipal Corporations, improvement trusts, districts boards, mining settlement authorities and other local authorities for the purpose of local self-government or village administration
- Taxes on goods and passengers carried by road or on inland waterways
- Taxes on vehicles, whether mechanically propelled or not, suitable for use on roads, including tramcars subject to the provisions of entry 35 of List III.

Concurrent List entries that have relevance in relation to NUTH:

- Shipping and navigation on inland waterways as regards mechanically propelled vessels, and the rule of the road on such waterways, and the carriage of passengers

and goods on inland waterways subject to the provisions of List I with respect to national waterways

- Mechanically propelled vehicles including the principles on which taxes on such vehicles are to be levied

The aforesaid provisions deal with division of power between Central and State Governments only. Provisions relating to Municipalities dealing with their formation, power, functions and other matters were incorporated in the Seventy-fourth Amendment of the COI which came into force on 1st June, 1993. In accordance with Article 243 (W) of the COI, the Legislature of a State *may*, by law, endow the Municipalities with such powers and authority as may be necessary to enable them to function as institutions of self-government and such law may contain provisions for the devolution of powers and responsibilities upon Municipalities, subject to such conditions as may be specified therein with respect to, *inter alia* the performance of functions and the implementation of schemes as may be entrusted to them including those in relation to the matters listed in the Twelfth Schedule. The matters related to NUTH listed in the said Schedule are:

- Urban planning including town planning.
- Planning for economic and social development.
- Roads and bridges.
- Fire services.
- Protection of the environment and promotion of ecological aspects.
- Public amenities including street lighting, parking lots, bus stops and public conveniences.

### 9.3.2 Existing Role of Various Levels of Governments in Transportation

In line with the constitutional mandate, various levels of governments or agencies controlled by them have participation in provision of transportation services. Table 9-1 provides a brief overview of the role currently being played by various levels of governments or agencies controlled by them.

**Table 9-1: Key Roles of Various Levels of Governments in Transportation**

| Government Level | Entity | Current Roles in Transportation |
|---|---|---|
| National | Indian Railways | Inter-city rail services, suburban rail services, Metro rail services |
| | Metro Rail Corporations under JV with State Governments | Operation of Metro Rail services |
| | National Highways Authority of India | Developing and Managing the entrusted National Highways in India |

| Government Level | Entity | Current Roles in Transportation |
|---|---|---|
| | Inland Waterway Authority of India | Developing and Managing National Waterways in India |
| | Airport Authority of India | Developing and Managing Airports in India |
| | Ministry of Road Transport and Highways | Developing and Managing National Highways in India, Motor Vehicle legislation, administration of Motor Vehicles Act, 1988 |
| | Ministry of Urban Development | National Urban Transport Policy formulation, supporting its implementation by various states and Local Governments through various funding schemes such as JnNURM. |
| State | State Transport Corporations | Inter-city and urban bus services |
| | City Bus Companies (shareholding through development authorities, infrastructure board and other parastatals) | Urban bus services |
| | Metro Rail Corporations including those under JV with Central Government | Metro Rail Services in metropolitan areas of the State |
| | Public Works Department | Developing and Managing State Highways in the State |
| | Transport Department | Vehicle registration, licensing, permits, stage carriage permits, city bus routes, river ferry services (where applicable) |
| | State / Development Authorities | Concessions for Metro Rail / Monorail |
| | Police including Traffic Police | Management of traffic signals, regulation of traffic, traffic rules enforcement, Accident Management and law & order issues connected with traffic/transport. |
| | State Fire Services (most States) | Fire services, Incident response due to road traffic accidents, flood, rescue etc. |
| Local | Municipal Corporations / their undertaking | Urban bus services |

| Government Level | Entity | Current Roles in Transportation |
|---|---|---|
| | City Bus Companies (shareholding by Municipal Corporations) | Urban bus services |
| | Municipal Corporations | City roads, bus stops, signal installation and maintenance, Fire services (in some states) |

### 9.3.3 Suggested Roles for National, State and Local Governments

Notwithstanding the constitutional provisions mentioned in Section 9.3, the Central Government can and it does influence various transport sector initiatives taken up by the State and Local Governments through various central funding and assistance schemes requiring the States/Local Governments to undertake certain reforms by making these reforms as pre-condition for seeking funding. In addition, as detailed in Section 9.3.2 Central Government has set up joint venture companies with State Government to provide metro rail services in a few cities (Delhi, Bengaluru, Chennai, Jaipur, Kochi) and through Indian Railways, it also provides sub-urban rail services in some cities (Mumbai, Chennai, Delhi etc.).

Given the constitutional provisions, transport entities managed or controlled by the various levels of governments and the persuasive role of the Central Government, the suggested roles of the Central, State and Local Governments in matters connected with setting up of NUTHs in India has been set out in Table 9-2.

**Table 9-2: Suggested Roles of National, State and Local Governments**

| Level | Suggested Roles |
|---|---|
| National | • Guiding ITS Architecture development for India with respect to the urban transport, traffic and related matters<br>• Setting standard protocols for data exchange related matters between various TMICCs, NUTHs, traffic and transportation agencies<br>• Standardising the look and feel of NUTH websites on a nationwide basis<br>• Standardising the data dissemination parameters through NUTH websites / call centre on a nationwide basis<br>• Facilitating institutional development (such as UMTA)<br>• Ensuring participation and support of Central Government departments and agencies as well private entities working under contract with Central Government/ its agencies in NUTH in |

| Level | Suggested Roles |
|---|---|
| | accordance with requirements by way of data sharing, content updates and other matters<br>• Launching scheme for funding NUTH initiative on a nationwide basis with applicable guidelines<br>• Provide capital as well as Operation & Maintenance (O&M) funding support for NUTH initiatives either directly or through the agencies controlled by Central Government<br>• Capacity building of the various stakeholders connected with NUTH in coordination with State and Local Governments |
| State | • Establish institutions or facilitate institutional development<br>• Following the standards, protocol, architecture and guidelines developed by Central Government with respect to NUTH and other urban transport, traffic and related matters<br>• Ensuring participation and support of State Government departments and agencies as well private entities working under contract with State Government/ its agencies in NUTH in accordance with requirements by way of data sharing, content updates and other matters<br>• Provide capital as well as Operation & Maintenance (O&M) funding support for NUTH initiatives either directly or through the agencies controlled by State Government<br>• Capacity building of the various stakeholders connected with NUTH in coordination with central and Local Governments<br>• Setting up State level website and call centre to operate telephonic component of NUTH for the State. Cooperate with other states for this if a common website /call centre is to be set up to support more than one State. |
| Local Government | • Facilitating inter-agency coordination and resolving issues, if any<br>• Following the standards, protocol, architecture and guidelines developed by Central Government with respect to NUTH and other urban transport, traffic and related matters<br>• Ensuring participation and support of Local Government departments and agencies as well private entities working under contract with Local Government / its agencies in NUTH in accordance with requirements by way of data sharing, content updates and other matters |

| Level | Suggested Roles |
|---|---|
| | • Provide capital as well as Operation & Maintenance (O&M) funding support for NUTH initiatives either directly or through the agencies controlled by Local Government<br>• Capacity building of the various stakeholders connected with NUTH in coordination with Central and State Governments |

## 9.4 Existence of Multiple Stakeholders/Joint Operations

In line with the nature of information to be disseminated through the NUTH, agencies participating may come from diverse set of backgrounds. NUTHs that are providing information pertaining to road network, traffic and transit services of a region would have participating entities providing services in the region while those responsible for providing information pertaining to a metropolitan region would have participating agencies providing services in the metropolitan region.

For an NUTH, the participating agencies could be as under:

- Unified Metropolitan Transport Authority (UMTA) or the entity performing this role
- Traffic Agency: Traffic Police
- Transit Agencies: Bus operator(s), Metro Rail operator, Suburban Rail operator (Indian Railways), operator of any other mode
- Road Construction & Maintenance Agencies: Municipal Corporations/ Urban local bodies, PWD, Development Authorities and other road owning agencies
- Event Monitoring Authority: Police, Fire Department, State Transport Department
- Weather department
- Any other relevant agency

Depending upon the jurisdiction, the transit agencies, road owning agencies and other agencies from the contiguous area could also participate in NUTH.

While planning and designing NUTH, identification of agencies together with review of their systems (both existing and the planned ones) and the information that would be provided by them must be taken into consideration. These aspects may have a bearing on the information receiving and processing mechanism, NUTH system requirements, resource deployment, and time to deploy the system, cost of deployment and the expertise required.

Meeting and discussion between stakeholders are important to find out the needs of customers and to add different important features important to customers.

## 9.5 Service Providers and Stakeholders

Considering the diverse nature of activities and the scope of NUTH functions, a very wide set of stakeholders and entities may have interest in or emerge as potential candidates that NUTH may need to get associated with in order to make it efficient and effective. Such entities could be from any level of government (Central, State or Local) or could be from private sector or even Non-Government Organisations (NGOs) as long as they have some meaningful role to play and their association supports the objectives set for NUTH.

Potential agencies that need to get associated with NUTH would be driven by the objectives of NUTH. For any city specific NUTH, representation from the city related stakeholders would suffice. However, when the geographical coverage of NUTH extends beyond the city and includes adjoining areas/cities as well, a much broader set of stakeholders may need to get involved. Table 9-3 below provides a list of entities that could be considered for possible association with NUTH:

**Table 9-3: Entities for Possible Association with NUTH**

| Area | Entities |
|---|---|
| Transport & Traffic | • Unified Metropolitan Transport Authority or the entity performing this role |
| Traffic | • Municipal Corporation<br>• Cantonment Board (as needed)<br>• Traffic Police<br>• Other agencies managing traffic signals/ other infrastructure |
| Transit | • Bus including Bus Rapid Transit (BRT) - City Transport Corporations, State Transport Undertakings, city bus Special Purpose Vehicles (SPVs), Municipal Transport Undertakings<br>• Rail<br>• Metro<br>• Monorail<br>• Other modes, if any |
| Roads | • State PWD<br>• Central PWD<br>• National Highways Authority of India (NHAI)<br>• State Road Development Corporations<br>• Municipal Corporations<br>• Cantonment Board<br>• Development Authorities |

| Area | Entities |
|---|---|
| | • Other Road owning agencies |
| Parking | • Municipal Corporation<br>• Other Parking facility management entities |
| Para-transit | • State Department of Transport |
| Bus Terminus | • State Department of Transport<br>• State Transport Undertakings |
| Emergency Response | • Fire<br>• Ambulance<br>• Police |
| Weather | • Regional Meteorological Centre |
| Pollution | • Pollution Control Board |
| Tourism | • Tourism department or Tourism development corporation |
| Media | • Newspapers<br>• FM Radio Channels<br>• TV Channels |

The nature of association would differ depending upon the role envisaged for an entity. The role of most of the agencies would include information sharing, some may additionally participate in design, setting up and managing NUTH and/or share the cost of setting up and managing NUTH.

## 9.6 Potential Agencies Participation

In view of the role currently being performed by Transit Agencies, Traffic Police and Municipal Corporations by virtue of the existing legal framework in transit/traffic management activities, these entities would be central to setting up and managing the NUTHs. Additionally, given the proposed structure of Unified Metropolitan Transport Authority (UMTA) and its constituent stakeholders, wherever it has been established, it should also be made part of the core NUTH stakeholders together with Transit Agencies, Traffic Police and Municipal Corporation. UMTA would have to lead the effort in getting all the NUTH stakeholders on board most of which in any case would be part of UMTA organisation. However, since the UMTA is yet to become fully operational in many cities/states, it is suggested that this role of bringing the stake-holders together and setting up of the NUTH could be undertaken by any one of the transit/traffic agency. State/City may finally choose an implementing agency based on the roles assigned to the various agencies in the city and their capacity.

There are several agencies identified in Section 9.5 above most of which may have some or the other information that could be shared with NUTH and several of these would have interest in the activities to be undertaken by NUTH. Based on the assessment of NUTH objectives, many of these agencies may be considered for possible association with NUTH.

Table 9-4 below provides the details of agencies in a typical NUTH, which may need to share data and the type of data that may need to be shared. Some of the data may be shared directly with NUTH while the remaining could be provided through TMICC.

**Table 9-4: Entities Sharing Data with NUTH**

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| Transport & Traffic | • Unified Metropolitan Transport Authority or the entity performing this role | • Details of various public transit modes / operators in the region both current as well as planned<br>• Periodical updates to the aforesaid data<br>• Details of transport sector initiatives | |
| Traffic | • Municipal Corporation (traffic signal team)<br>• Other agencies managing traffic signals | • Location of various traffic related equipment: signalized junctions, cameras, variable messages signs etc. on map and as list | • Plans and schedules for construction & maintenance<br>• Updates on the construction & maintenance |
| | • Municipal Corporation (roads team)<br>• State PWD<br>• Central PWD<br>• National Highways | • Road network details including Geographic Information System (GIS) maps<br>• Location of various traffic related equipment: signalized junctions, cameras, variable | • Changes in road attributes on a periodic basis<br>• Plans and schedules for construction & maintenance<br>• Updates on the construction & maintenance |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | Authority of India (NHAI)<br>• State Road Development Corporations<br>• Municipal Corporations<br>• Cantonment Board<br>• Development Authorities<br>• Other Road owning agencies | messages signs etc. on map and as list<br>• Road attributes: name, number of lanes, width, weight restrictions, height restrictions etc.<br>• New roads planned | |
| | • Traffic Police | • Road attributes: name, number of lanes, whether one-way or two-way, speed limit, entry restrictions, weight restrictions, height restrictions etc.<br>• Location of various traffic related equipment: signalized junctions, cameras, variable messages signs etc. on map and as list<br>• Location of red light enforcement cameras, speed enforcement cameras<br>• Speed limit on various road sections<br>• Entry restrictions such as one way, no entry, time based entry, no U-turn etc. | • Changes in road attributes<br>• Changes in location of traffic equipment and enforcement rules<br>• Incident information<br>• Event information<br>• Road closures, diversions<br>• Live surveillance camera feeds and access to historical feeds, live messages being displayed on the variable messages signs,<br>• Live traffic volume data, Congestion Information, details of public notices on traffic etc. |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| Transit | • Bus including BRT (City Transport Corporations, State Transport Undertakings, city bus SPVs, Municipal Transport Undertaking)<br>• Rail<br>• Metro<br>• Monorail<br>• Other modes, if any | • Operators details: Name, modes operated, contact details, web site details<br>• Modes: Bus, Metro, Monorail, Tram etc.<br>• Services: Express, Ordinary, AC, Non AC, Night services<br>• Routes: Details of the routes operated<br>• Schedule Data: Frequency during peak/off-peak hours, Timings<br>• Timing of operations: First and last service on various routes<br>• Fare structure: Normal fares, special fares, concessions for various category of commuters<br>• Pass Details: Pass charges for various category of commuters, validity rules<br>• Bus terminals, Bus Stops, Metro Stations details<br>• Details of parking facility: capacity, vehicle types that can be parked, operational hours, charges, mode of payment, operating agency, contact details<br>• Inter-modal transfer options: feeder services, connecting routes, | • Running status<br>• Departures scheduled at bus terminals, bus stops, metro stations<br>• Estimated Time of Arrival (ETA)<br>• Service delay, disruptions<br>• Information on new services, discontinuation of any service etc.<br>• Rerouting<br>• Transit trip planner<br>• GPS feed data<br>• Incidents & Events<br>• Schedules for construction &maintenance<br>• Updates on the construction & maintenance |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | | interchange stations/terminals<br>• Transit trip planner: intra-modal as well as inter-modal based on static data<br>• Tourism related information with connecting transit options to tourist spots | |
| Parking | • Municipal Corporation<br>• Other agencies managing parking facilities | • Details of parking facility 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)<br>• Updates on construction/ maintenance activities<br>• Updates on facility closure |
| Bus Terminus | • Department of Transport<br>• State Transport Undertakings<br>• Other entities managing such facilities | • Details of services operated from the bus terminus<br>• 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 bus arrivals, platform docking information<br>• Updates on service delay /disruptions /facility closure<br>• Updates on construction/ maintenance activities |
| Emergency Response | • Fire<br>• Police | | • Incident information<br>• Event information |
| Weather | • Regional Meteorological Centre | | • Weather updates<br>• Temperature, wind speed, fog, visibility details, humidity, rainfall etc. |
| Tourism | • Tourism department or | • Details of tourist spots | |

| Area | Entities | Data Sharing | |
|---|---|---|---|
| | | Static | Dynamic |
| | Tourism development corporation | • Information related to tourist spots such as locations, brief details, ticketing details, operational timings, contact details, transit connection, route map etc. | |
| Pollution | • Pollution control board | | • Air quality data such as sulphur dioxide, nitrogen dioxide, particulate matter, ozone, lead, carbon monoxide |

The list of entities and the requirement for data sharing outlined above is indicative in nature. Depending upon the objectives of the NUTH, readiness of agencies, availability of data and the role to be played by an agency, the final set of entities as well as data sharing requirements would need to be worked out.

## 9.7 Third Party Data Providers

Worldwide there are private organisations that are in the business of collecting, processing and providing traffic, transport and weather related data. These organisations obtain data / information from several sources:

- Field equipment deployed and managed by the organisations themselves
- Field equipment deployed and managed by the other organisations
- Receiving data from agencies having access to probe data
- Installing equipment along the agency corridors through agreements with the agencies
- Using probe data, such as mobile phones, to gather relevant information

These organisations, in addition to sourcing data also process and fuse the data so collected, derive information and intelligence from the same, package and then sell such data to interested agencies / authorities. They also maintain repository of historical data and provide details of trends over various time periods for various parameters.

In India, the market for data services has not yet evolved. Therefore, the government agencies responsible for the managing the road networks and the transit agencies (most of which are owned or controlled by various levels of governments) would have to take lead in data generation activities. There are a few entities which are collecting probe data such as Google, Navteq and CE Info Systems Private Ltd (MapmyIndia), which could be accessed under mutual agreed arrangements.

## 9.8 Roles and Responsibilities

The roles and responsibilities of the agencies associated with NUTH need be allocated in such a manner that each participating agency continues to discharge its functions mandated by law, its charter or the governing contracts. This is important in order to preserve and ensure institutional integrity and to avoid any legal, constitutional and contractual issues that may arise if the roles assigned to an entity do not conform to the underlying contracts, established order or the statues, as applicable.

The role allocation amongst various parties needs to be agreed upon early in the planning phase of the project. This will ensure that each party is aware of its roles and discharges these in the agreed manner. Keeping this in mind, Table 9-5 shows the examples of suggested roles and responsibilities of the key NUTH stakeholders. These roles could be different for the agencies based on specific circumstances.

**Table 9-5: Examples of Roles and Responsibilities of Entities Associated with NUTH**

| Area | Agencies | Role and Responsibilities |
|---|---|---|
| Transport & Traffic | • Unified Metropolitan Transport Authority or the entity performing this role | • To set up NUTH<br>• To depute its personnel for NUTH<br>• To enter into agreement/MoUs with various agencies associated with NUTH<br>• To coordinate with various agencies associated with NUTH<br>• To share data and updates as listed in Section 9.6 |
| Traffic | • Municipal Corporation (traffic signal team)<br>• Other agencies managing traffic signals | • Signals and other traffic equipment installation and maintenance<br>• 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 |

| Area | Agencies | Role and Responsibilities |
|---|---|---|
| | | • To share data and updates as listed in Section 9.6 |
| | • Municipal Corporation (roads team)<br>• State PWD<br>• Central PWD<br>• National Highways Authority of India (NHAI)<br>• State Road Development Corporations<br>• Municipal Corporations<br>• Cantonment Board<br>• Development Authorities<br>• Other road owning agencies | • Road construction and maintenance<br>• Managing the contracts and relationships with the contractors responsible for construction & maintenance of road network<br>• To share data and updates as listed in Section 9.6 |
| | • Traffic Police | • Managing and optimising signal cycle<br>• Monitoring surveillance cameras<br>• Taking lead role in managing traffic incidents including coordinating with other internal and external stakeholders such as Fire, Police, Ambulance etc.<br>• Traffic enforcement<br>• Traffic related information dissemination to public, media and other internal and external stakeholders<br>• Managing the contracts and relationships with the contractors responsible for installation, maintenance and upkeep of the traffic related ITS equipment deployed by the Traffic Police<br>• To share data and updates as listed in Section 9.6 |
| Transit | Transit Operators | • To manage and monitor transit operation<br>• To provide agreed data / information as listed in Section 9.6 in desired form and frequency |

| Area | Agencies | Role and Responsibilities |
|---|---|---|
| Parking | • Municipal Corporations<br>• Other Parking facility management entities | • Manage the parking facility<br>• To provide agreed data / information as listed in Section 9.6 in desired form and frequency |
| Bus Terminus | • Department of Transport<br>• State Transport Undertakings<br>• Other entities managing such facilities | • Manage the parking facility<br>• To provide agreed data / information as listed in Section 9.6 in desired form and frequency |
| Emergency Response | • Fire<br>• Police | • To provide agreed data / information as listed in Section 9.6 in desired form and frequency |
| Weather | • Regional Meteorological Centre | • To provide agreed data / information as listed in Section 9.6 in desired form and frequency. |
| Pollution | • Pollution control board | • To provide agreed data / information as listed in Section 9.6 in desired form and frequency |
| Tourism | • Tourism department or Tourism development corporation | • To provide agreed data / information as listed in Section 9.6 in desired form and frequency |
| Media | • Newspapers<br>• FM Radio Channels<br>• TV Channels | • Disseminating traffic related information and advisories to general public<br>• Providing inputs on any unscheduled road blockage, accidents, incidents noticed by media personnel |

The role and responsibility outlined above in relation to various entities is indicative and, depending upon the exact role being played by an entity and mutual agreement, the same may need to be developed to suit each city/region requirements.

## 9.9 NUTH Organisation

As with any operating entity, organisational structure of the NUTH directly impacts its ability to operate effectively. Figure 9-1 shows a typical NUTH organisation structure.

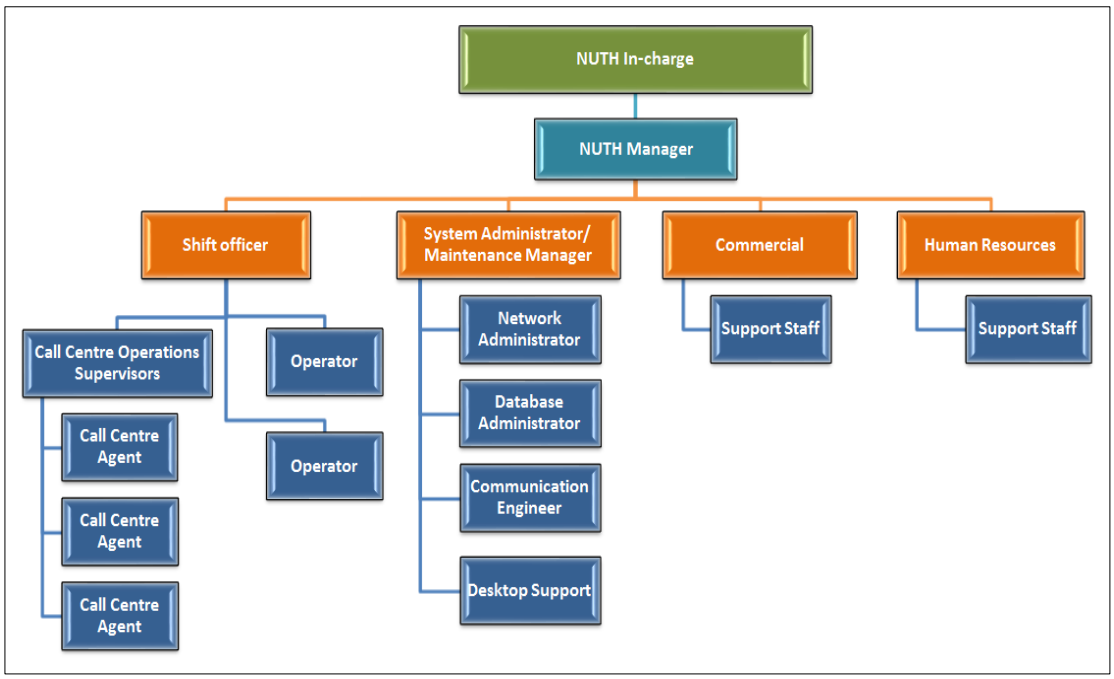



**Figure 9-1: Typical NUTH Organisational Structure**

The general structure of an NUTH can be described as follows:

- **Decision-Making Authority.** The level of decision-making authority for the NUTH operations is driven by the agency policies. These are typically approved by the competent authorities and defined in the Standard Operating Procedures (SOP).
- **Supervision.** The number of levels of supervision and the reporting relationships can strongly influence both the quality of NUTH activity and its ability to respond rapidly to changing conditions. Typically, there is a single supervisor responsible for control room operations to whom the operators report directly.
- **Staffing.** The number of staff required is one of the most important elements of the NUTH operations. This must reflect all elements of the workload, including how the team is organised and deployed. There are no absolutes regarding the number of personnel per transit system length, number of transit vehicles, or centreline kilometre of roadway. The primary determining factor is the set of functions which the staff are employed to deliver. The responsibilities may include traveller information functions for transit or traffic or both, interaction with transit/traffic agencies, and other functions such as coordination with contractors. The NUTH would be 24x7 operations centre. However, the staffing would vary across peak and off-peak hours, both at the backend data centre and at the call centre. In the off-peak hours (especially night shift), the staffing could be

reduced substantially since the call enquiry intensity would be low. While it would be impractical to have prescriptive ratio of personnel in peak-to-off peak, in order to enable such reduction in manpower, the control room application should be flexible to allow for varying the elements being monitored by each operator console.

Table 9-6 provides the details of key positions in a typical NUTH organisation together with associated role description. The actual position and role description may vary for an NUTH depending on its size and the nature of activities being discharged by the NUTH.

**Table 9-6: NUTH: Typical Positions and Role Description**

| Positions | Role Description |
|---|---|
| NUTH In-Charge | • Responsible for overall management, monitoring and operation of the NUTH<br>• Formulation of procedures governing NUTH operations<br>• Point of contact for authorities, media and other external agencies |
| NUTH Manager | • Reports to NUTH In-Charge<br>• Responsible for day to day operation of the NUTH<br>• Responsible for assigning and deployment of the operators in shifts<br>• Plans for the scheduled maintenance of system components in coordination with suppliers, Shift Officer and the system administrator<br>• Training of Shift Officers |
| Shift Officer | • Reports to NUTH Manager<br>• Responsible for day to day operation of the NUTH during a shift<br>• Responsible for supervision of the operators deployed in a shift<br>• Coordinates with Call Centre Supervisor and Operators<br>• Training of operators and quality control of call centre |
| Operators | • Reports to Shift Officer<br>• Operates and manages the system through operator console<br>• Reports any down time in applications and data exchanges<br>• Coordinates with other agencies which are part of workflow being managed by the Operator<br>• Shares information and reports events with agencies/entities concerned in accordance with policies and procedures |
| Call Centre Supervisor | • Reports to Shift Officer<br>• Responsible for day to day operation of the call centre<br>• Responsible for supervision of the call centre agents<br>• Coordinates with call centre agents |

| Positions | Role Description |
|---|---|
| | • Training of call centre agents |
| Call Centre Agent | • Receiving and responding to calls from public / other stakeholders |
| System Administrator (also responsible for routine maintenance of the backend systems) | • Reports to NUTH Manager<br>• Responsible to manage the data centre and associated IT environment such as network, communication, security, firewall, desktop support etc.<br>• To monitor and supervise the team comprising network administrator, database administrator, desktop support personnel, communication engineer etc.<br>• Responsible to configure the computing and other IT system<br>• To implement policy giving role based access to various personnel to the IT systems<br>• To manage and monitor security of the IT systems<br>• Coordinate with vendors and suppliers for maintenance and support of the hardware and software deployed in NUTH |
| Commercial / Finance Manager | • Contract management<br>• Invoicing and payments |
| Human Resources Manager | • Recruitment<br>• Training<br>• General administration and facilities maintenance |

The above recommended profiles are for guidance purposes only and may be refined based on local manpower availability and skill sets best suited for the proposed NUTH in a city.

## 9.10 Training and Capacity Building

There would be a need for extensive training initially in the areas of planning and designing of NUTH and later progressively in the areas of operating and managing such facilities. As technologies evolve, these may also drive the need for imparting training to the personnel working on NUTH and related initiatives.

While some of the consultants empanelled by MoUD, GoI, as part of this assignment have received some exposure to NUTH concepts and would disseminate the learning as part of their advisory engagements with the cities, the need for such training would be there on an on-going basis.

The training would cover a broad range of topics including:

- Background of NUTH and purpose of the system
- Operational procedures
- Non-standard operations (special events, emergency conditions)
- Use of the computer system/ NUTH applications
- System administration
- Capabilities of the field equipment
- Equipment maintenance, testing, debugging, and repair
- Coordination with other agencies

The personnel to be trained and the indicative topics to be covered during training would be as set out in Table 9-7:

**Table 9-7: Coverage of Training**

| Positions | Coverage of Training |
|---|---|
| City Managers | • Background of NUTH and purpose of the system |
| NUTH In-Charge | • Background of NUTH and purpose of the system<br>• Operational procedures<br>• Use of the NUTH Backend Applications<br>• Contract Management<br>• Financial management |
| NUTH Manager | • Background of NUTH and purpose of the system<br>• Operational procedures<br>• Use of the NUTH Backend Applications<br>• Contract Management |
| Shift Officer | • Background of NUTH and purpose of the system<br>• Operational procedures<br>• Use of the NUTH Backend Applications |
| Operator | • Background of NUTH and purpose of the system<br>• Operational procedures for the application assigned to the operator<br>• Use of the NUTH Backend Application assigned to the operator |
| Call Centre Supervisor | • Background of NUTH and purpose of the system<br>• Operational procedures pertaining to call centre |

| Positions | Coverage of Training |
|---|---|
| | • Use of the NUTH Backend Applications for call centre |
| Call Centre Agents | • Background of NUTH and purpose of the system<br>• Operational procedures for the application designated to the call agent<br>• Use of the NUTH Backend Application assigned to the call centre agent |
| System Administrator | • System management training by OEM supplier(s)<br>• Technical SLA Management |

Training can be categorised as either initial training or an on-going training.

A. **Initial Training.** The initial training should be carried out for at least one-week, or any other suitable duration depending on the NUTH function, and should be repeated semi-annually during the first two years of the NUTH operations. New hires are given tours of the project area to gain familiarity with the transit /road network during the "new hire" training period.

   Since training and documentation are critical for operations, it is important to create user-friendly documentation that is consistent and complete, which will improve the quality of operator performance, and will enhance training of personnel. While undertaking procurement of system and field equipment, agencies should specify the training requirements as part of scope of the supplier in the respective procurement documents.

B. **On-Going Training.** The agency should plan for on-going training on an annual basis, after the two-year initial period. Few systems are implemented completely in a single programme. Instead, most systems both grow and evolve, reflecting the success of their operation, the lessons learned during system stabilisation, and the changes in technology that become available overtime. Thus, training materials will require periodic updates. An element of the organiszation should be identified who will be tasked with this upkeep as a primary level duty.

   The Ministry of Urban Development (MoUD) can be a facilitator for on-going NUTH training in India. These can be accomplished by retaining a combination of international and Indian university experts to provide on-going and periodic training to the governmental agencies in India, including relevant topics on Best Practices and New Technologies. Typical topics for training can include, but not limited to, the following major areas:

   - Development and updates of Concept of Operations
   - Applying Systems Engineering Principals
   - Hardware and Software Maintenance

- Document Maintenance
- Organisational Management
- Data Archival Systems
- ITS Architecture Maintenance and Update
- ITS Standards and Protocols

Another important aspect of the NUTH is the document maintenance. The concept of operations should identify what documents will be required for system planning, design, implementation, operations, and maintenance, and should identify how and when each will be developed or maintained. Some thought is appropriate at this point regarding the form which each document will take, i.e., should it be printed or available electronically, and if electronic, from which workstations or systems should it be accessible. This process of identifying the core documents (including training documents) will ensure that each step of the system development and operation process will be thoroughly documented and supported. Guidelines regarding documents may be established within the concept of operations, such as naming the parties involved in document review. Commitments may be made by the participating agencies regarding their response to draft documents under review. This identification of documents will also support the funding of the complete documentation set, and will support consideration of standards for the document tools (word processors, charting, graphic arts) which will be used in their preparation and maintenance.

## 9.11 Agreements, Contracts, and Memoranda of Understanding

Many of the arrangements and cooperation envisaged in NUTH may not be mandated by law or the charter of the participating agencies involved. In view of this and in order to reach a long term understanding on the nature, extent and specifics of cooperation, it is recommended that the agencies enter into suitable agreement or MoU that would not just capture these but also result in deepening the commitment of the agencies involved and lead to stable and long term relationship in the context of NUTH. Typically, the MoU can be an initial step in establishing relationships among agencies to define the overall goals and objectives of association. Once an association and goals of the cooperation has been established, the agencies can move towards a contract or a binding agreement to formalise their association. Binding agreements would entail detailed roles and responsibilities, financing and other contractual nature of cooperation.

Many cities and states are contemplating setting up the Unified Metropolitan Transport Authority (UMTA) with the coordinating role, among others, during planning and implementation of urban transport initiatives of all modes in the cities. Since UMTA is proposed to have participation from all the key agencies/stakeholders from the Transportation sector of the respective cities, it could also be used as forum for establishing the relationship and details relating to cooperation among various agencies. The UMTA would be a good entity to set up, operate and manage NUTH.

The agreements and MoUs entered into would be high level cooperation documents that would outline the nature, extent and principles of co-operation. A sample of the MoU is provided as Annexure 4 at end of the report. From these would flow the detailed operating agreements that would deal with various subsidiary matters in a more granular fashion.

The agreements and MoUs entered into would be living documents and would require periodical changes to reflect the emerging environment and evolving objectives of NUTH.

## 9.12 Operating Agreements

The agreements and MoUs entered into between the agencies set the stage and context within the confines of which detailed operating agreements need to be evolved that provide for the specifics of cooperation.

The operating agreements would cover in detail the information and data that need to be exchanged, the manner and frequency in which the same would be exchanged, the format, protocol and other technical details relating to such exchange. Financial aspects of cooperation are typically detailed in the agreement, including on-going operations, management and maintenance of system and functionalities. Other issues, such as performance measurements, enhancements, growth, and replacement and retiring of system, i.e. the entire life-cycle of the programme needs to be stipulated in the agreements. Legal issues, liabilities and indemnification for each party may also need to be suitably addressed in the agreements based on the agency policies.

## 9.13 Advisory Functions of Other Related Organisations

In order for a multiple agency system to operate, there may be a need for other adjunct parties to participate in the decision making and collaboration process. As most transit and traffic system operating agencies engage contractors and solution providers to deploy and maintain their ITS equipment, it would be useful to take their feedback and inputs at NUTH planning stage itself so that the interfaces to such systems are suitably provided for in NUTH, including on-going coordination needs.

# 10.0 PERFORMANCE MONITORING

## 10.1 Introduction

NUTHs need to be developed with clearly defined set of objectives. From the objectives, various performance measures could be derived in order to assess the success of NUTH over a period of time.

The performance measures and their target levels should be set keeping in mind the following:

- They should support and be consistent with the goals and objectives of NUTH.
- They should be easy to understand and be meaningful to the relevant stakeholders.
- They should be easily and economically measurable.
- They should be measured over an appropriate time frame.
- The performance thresholds targeted should be realistic and achievable.

## 10.2 Performance Measures

Performance measures could be classified broadly as an outcome, output or an input measure. While outcome based measures are mostly qualitative, the output and input based measures could be quantified.

Some of the measures that could be used to assess the performance of NUTH are as under:

- Number of modes / services covered by NUTH
- Number of data attributes being disseminated
- Coverage of roads under NUTH as proportion of total major roads in the area
- Coverage of transit agencies under NUTH as proportion of total number of transit agencies in the area
- Number of incidents reported by NUTH
- Number of updates reported by NUTH
- Number of systems connected to NUTH
- Number of agencies associated with NUTH
- Number of visitors supported by NUTH website
- Number of calls supported by NUTH
- NUTH site downtime

- NUTH number downtime
- Uptime, downtime, mean time between failure of the equipment
- Financial performance vis-à-vis budget estimates of NUTH
- Citizen surveys and rating

## 10.3 Data for Performance Measurements

The data for capturing performance measures would come from the following sources:

- Data collected from other systems by the NUTH system
- NUTH budget documents
- Data captured and logs created by the NUTH system
- Data collected from various agencies by the NUTH
- User feedbacks

## 10.4 Presenting and Reporting Performance Data

The performance reports related to NUTH would largely be system generated. The system is typically designed to support generation of a variety of performance reports. Their presentation and formats are also generally finalised during the system design stage. The frequency of report generation could be configurable and the same could be decided by the user at the time of report generation.

The performance reports need to be displayed in the most appropriate manner based on the channel/device used to access the same. The information needs to be displayed in a manner that is easy to understand and could be in the form of tables, graphs, charts, maps, dash boards, line diagram etc.

The agencies must evaluate the performance reports on a periodic basis and plan improvements and corrections to the system to continuously enhance and maintain a proper system. A system that consistently provides wrong information or inaccurate data will soon be abandoned by the public and the investments will be lost as the public will lose trust and faith in the system. Therefore, it is critical that the performance reports are reviewed periodically in order to ensure that the system continues to meet the user expectations.

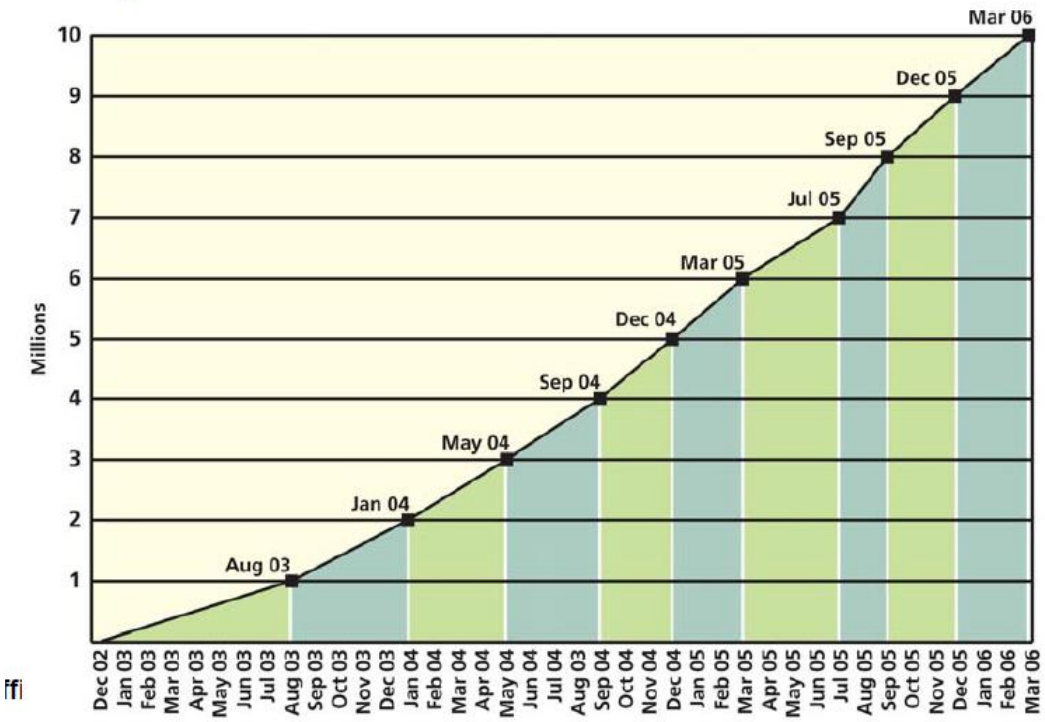



Figure 10-1, Figure 10-2, Figure 10-3, Figure 10-4, Figure 10-5 and Figure 10-6 provide examples of the performance reports pertaining to 511 San Francisco Bay Area, USA.

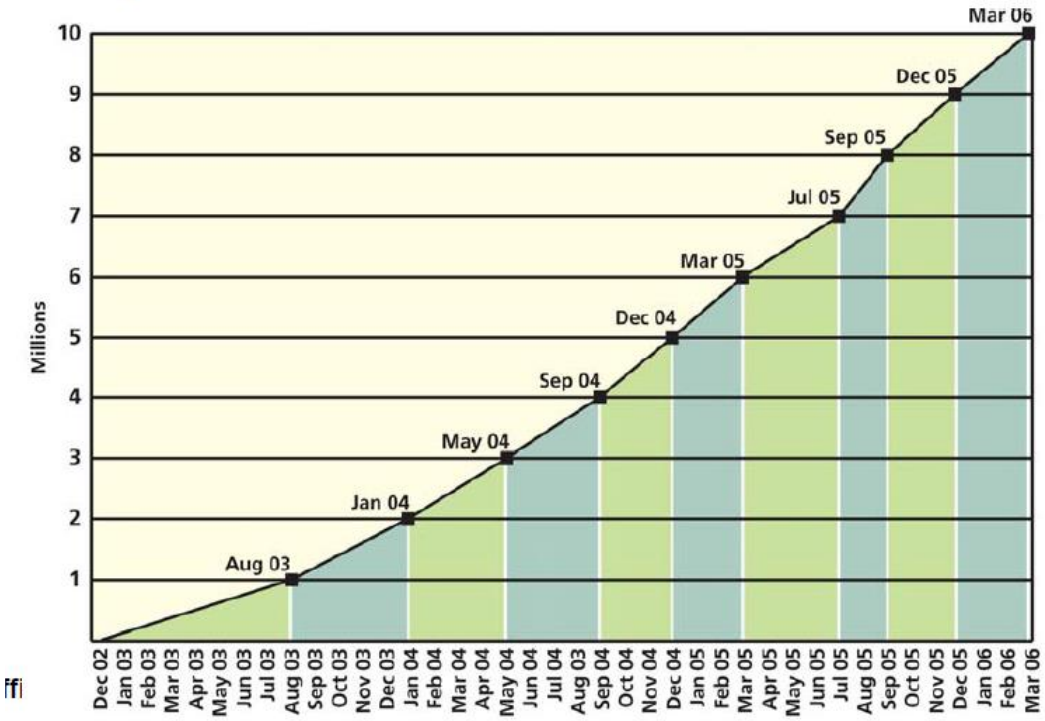



Figure 10-1 shows the monthly call volumes.

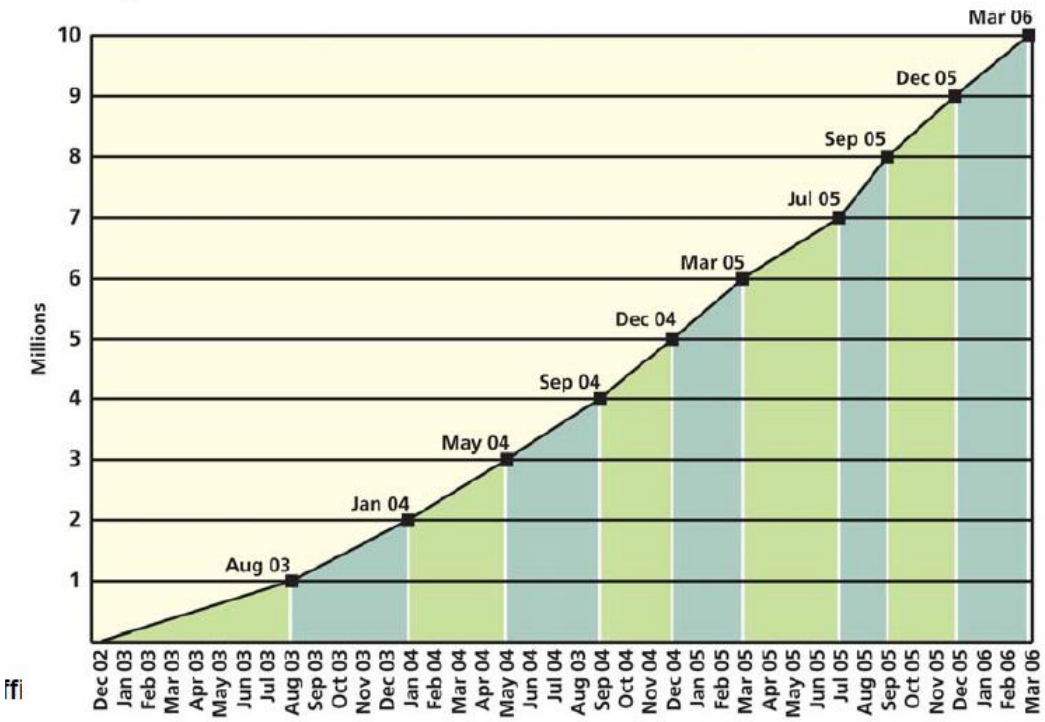



**Figure 10-1: Monthly Call Volumes (511 SF Bay Area, USA)**

Figure 10-2 shows the comparison of volume of traffic information requests using web and phone.

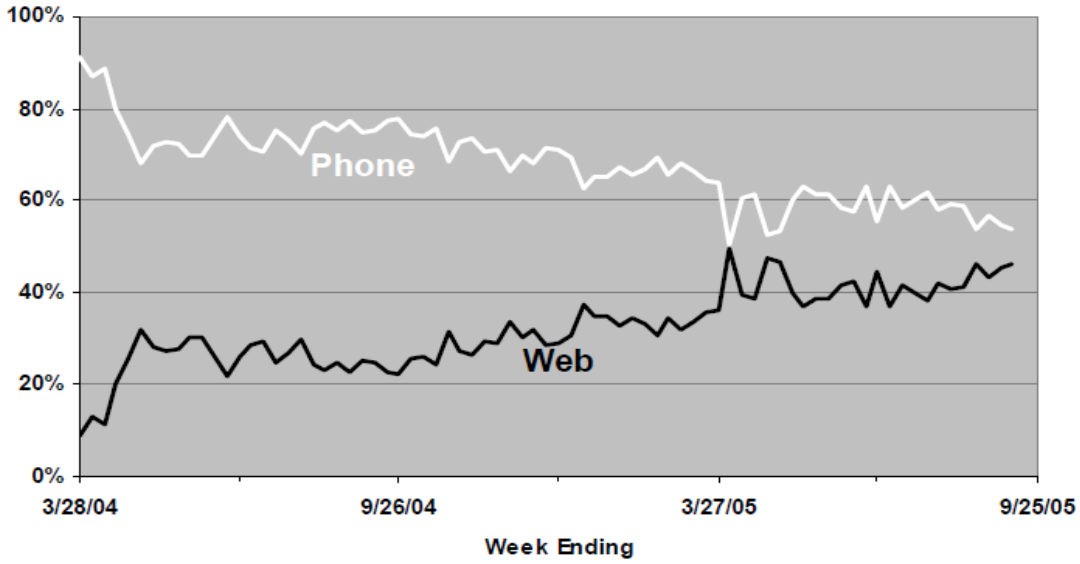



**Figure 10-2: Traffic Information Requests by Web vs. Phone (511 SF Bay Area, USA)**

Figure 10-3 shows the comparison of volume of transit information requests using web and phone.

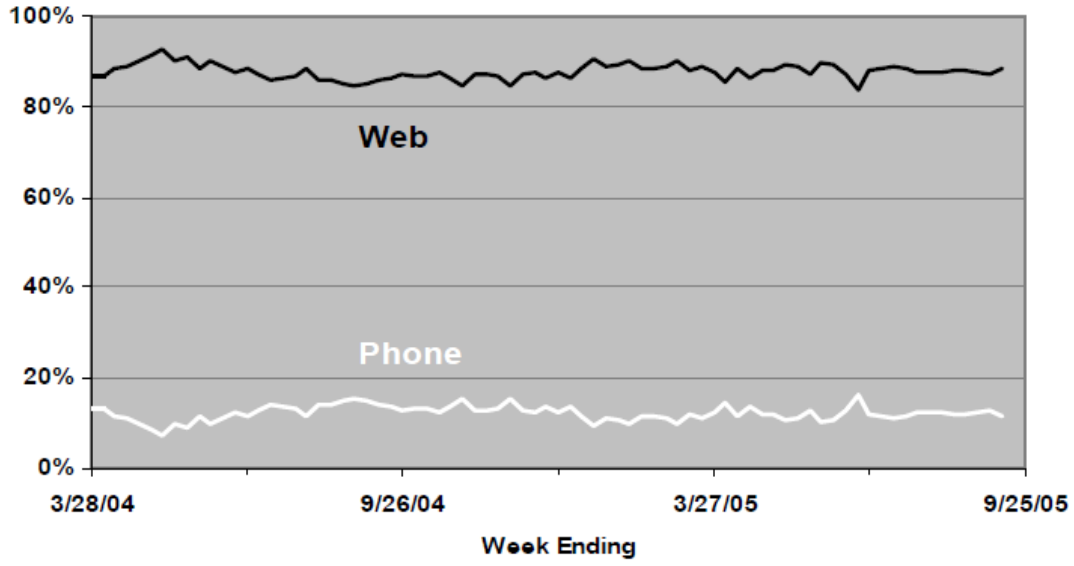



**Figure 10-3: Transit Information Requests by Web vs. Phone (511 SF Bay Area, USA)**

Figure 10-4 and Figure 10-5 show types of traffic information typically sought via phone and website respectively.

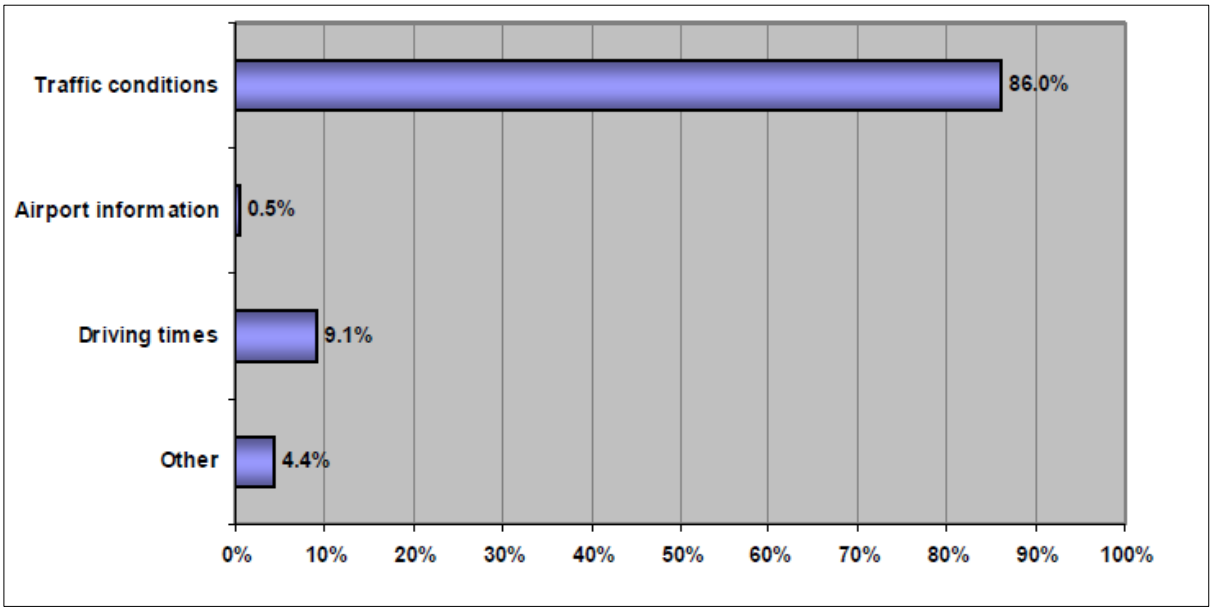



**Figure 10-4: Traffic Information Typically Sought via Phone (511 SF Bay Area, USA)**

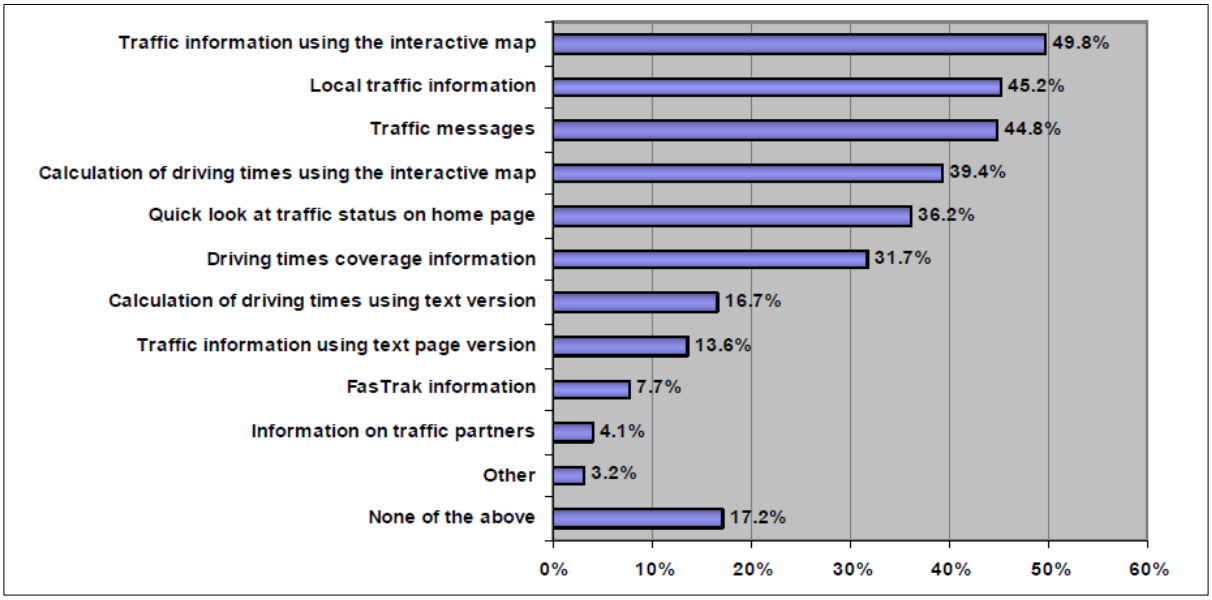



**Figure 10-5: Traffic Information Typically Sought via Website (511 SF Bay Area, USA)**

Figure 10-6 shows types of transit information typically sought via website.

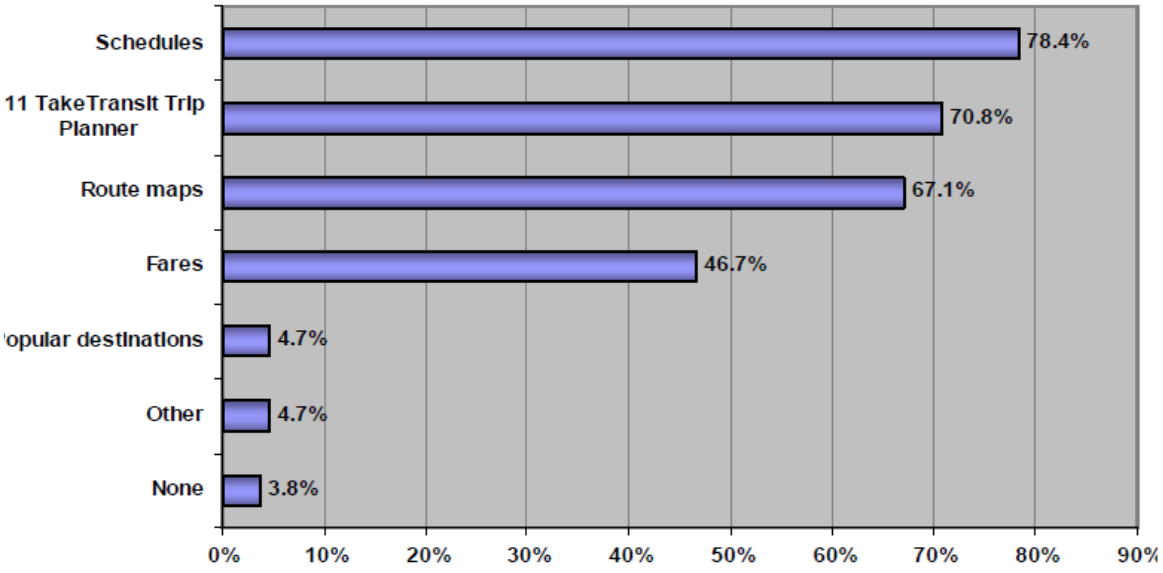



**Figure 10-6: Transit Information Typically Sought via Website (511 SF Bay Area, USA)**

# 11.0 SIZING, PHASING AND COST ESTIMATION

## 11.1 Project Phasing

It may not be necessary or desirable to set up NUTH with full functionality or for the entire urban agglomeration from the beginning as such areas may have varying levels of public transport coverage, ITS deployment and associated facilities. The transit and traffic agencies for various cities/areas may also be under the purview of different State agencies and/or Local Governments. In view of this, it is recommended that NUTH be introduced in phases (indicative) as set out below:

**Table 11-1: NUTH Indicative Implementation Phasing**

| Parameter | Phase-1 (2 years) | Phase-2 (2-4 years) | Phase-3 (4-6 years) |
|---|---|---|---|
| Geographic Area | • City Corporation area | • City Corporation area plus nearby municipalities in the city development authority area | • City development authority area / urban agglomeration |
| Transit Information | • Static information<br>• Dynamic information<br>– Bus<br>– Suburban rail services<br>– Metro | • Static information<br>• Dynamic information<br>– Bus<br>– Suburban rail services<br>– Metro | • Static information<br>• Dynamic information<br>– Bus<br>– Suburban rail services<br>– Metro<br>– Monorail |
| Traffic Information | • Dynamic information of traffic of the NUTH area covered under Phase-1. | • Dynamic information of traffic of the NUTH area covered under Phase-2 | • Dynamic information of traffic of the NUTH area covered under Phase-3 |
| Trip planner | • Dynamic Multi-modal | • Dynamic Multi-modal | • Dynamic Multi-modal |
| Parking Information | • Static in years 1-2<br>– City Corporation area<br>• Dynamic from year 3 | • City Corporation area plus nearby municipalities in the city development authority area | • City development authority area/ urban agglomeration |
| Weather Information | • City Corporation area from year 3 onwards | • City Corporation area plus nearby municipalities in the city | • City development authority area/ urban agglomeration |

| Parameter | Phase-1 (2 years) | Phase-2 (2-4 years) | Phase-3 (4-6 years) |
|---|---|---|---|
| | | development authority area | |
| Information Dissemination Modes | • Website<br>• Phone helpline<br>• Mobile App<br>• Social Media | • Website<br>• Phone helpline<br>• Mobile App<br>• Social Media | • Website<br>• Phone helpline<br>• Mobile App<br>• Social Media |

Ideally, the NUTH should be initially set up in a few select pilot cities. Once the key services have been successfully implemented in these cities, the system could then be replicated in other cities across the country.

Time period of phasing may undergo changes based on city specific situation including on account of scope of services to be covered under the project, readiness of participating agencies etc.

## 11.2 Funding and Revenue

### 11.2.1 Funding of NUTH

NUTH project is service oriented government initiative aimed at improving the quality of life of public at large. Considering the worldwide experience, it is not expected that users of this service would be inclined to pay for the same. In large measure, NUTH projects would, therefore, need to be funded by the government agencies.

Funding for setting up of NUTH projects may be shared by the Central Government and the respective State Governments. In case of Union Territories, Central Government may fund the entire project implementation cost.

Table 11-2 lists some of the options for meeting the funding requirements of NUTH projects.

**Table 11-2: Funding of NUTH Initiatives**

| Project Element | Central Govt. | State Govt./ State UTF | Transit Agencies/ Urban Local Bodies / City UTF |
|---|---|---|---|
| **Funding for Setting Up** | | | |
| Option 1 | ✓ | ✓ | ✓ |
| Option 2 | ✓ | ✓ | |
| Option 3 | ✓ | | |

| Project Element | Central Govt. | State Govt./ State UTF | Transit Agencies/ Urban Local Bodies / City UTF |
|---|---|---|---|
| **Funding for Setting Up** | | | |
| **Funding for O&M** | | | |
| Option 1 | ✓ | ✓ | ✓ |
| Option 2 | | ✓ | ✓ |
| Option 3 | | | ✓ |

Central Government may use any of its programmes for supporting such initiatives. Funding for setting up of the NUTH projects may also 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[7]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[8] and the cities 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 shared by the respective State Government and the Transit Agencies/Urban Local Bodies / City Urban Transport Fund (UTF). Central government may also support the O&M of such initiatives on a need basis.

### 11.2.2 Revenue Streams

As mentioned earlier, NUTH project may not be able to generate any significant 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 data plans for accessing the system or making calls to the transport helpline number. It is recommended that a similar model may be adopted in India with users bearing the cost of data plans for accessing the system or making calls while the services are provided to users without any charges. In the USA for example, the data being collected is shared with various entities (including the private sector) currently without any charges, even though an option to charge for the data has been retained by the government entities. The idea

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

behind this approach is that wider dissemination of information would support public good. NUTH implementing agencies in India 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.

Some of the revenue streams that could be assigned to NUTH or explored from NUTH related activities to defray part of the O&M costs are as under:

- Fines collected through enforcement measures.
- Parking charges collected from users.
- Receipts from private entities for sharing data.
- Receipts from media for sharing data.
- Receipts from users for providing personalised information sent through mailers, Short Message Service (SMS), mobile apps or providing personalised access to certain information.
- Receipts from advertisers against grant of right to display advertisements on website.
- Receipts from advertisers against grant of right to display advertisements on mobile apps.
- Receipts from advertisers against grant of right to undertake advertisements on helpline.
- Receipts from sponsorship by corporates in lieu of exclusive right to co-brand.
- Receipts from mobile apps downloads.
- Receipts from subscription services offered on mobile apps.

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 NUTHs.

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

It may also be noted that there may be an overlap between the revenue streams identified for NUTH as above and the revenue streams identified for TMICCs in the TMICC Operations Document. The common revenue streams should, therefore, need to be accounted for in any one system but not in both.

## 11.3 Implementation Structure

### 11.3.1 Overview of Implementation Models

The typical implementation models that may be examined for establishing and operating the NUTHs are listed in Table 11-3.

**Table 11-3: Implementation Structure Options**

| Implementation Options | Investment | O&M Cost |
|---|---|---|
| Option 1 | Public | Public |
| Option 2 | Public | Private |
| Option 3 | Private | Private |

Revenue potential of the project is a key determinant in choosing an implementation structure for the project. In case the project is not expected to generate adequate revenue from user fees, the implementing agency would need to bear the cost of providing services and investments. Considering the limited revenue potential from such projects, it is recommended that such projects are taken up in the government/public authority domain (Option 1). Within this broader framework, Public-Private Partnership (PPP) models could be explored as outlined in Section 11.3.2.

The private sector players could be engaged by government agency /public authority for design, supply, installation, testing, commissioning, maintaining and operating such facilities. In addition, call centre services could also be availed from the private sector players.

Unified Metropolitan Transport Authority (UMTA), where it exists, could be the entity that may take up the role of implementing agency. Alternatively, any one of the transit/ traffic agency may be designated as a nodal agency and entrusted with the task of implementing the NUTH till such time the UMTA is set up for the city/region. Once UMTA is set up, the NUTH activities could be transferred to it followed by handholding UMTA for some duration.

### 11.3.2 PPP Options

Some of the commonly used Public-Private Partnership (PPP) models and the typical role of private partner and public entity are as set out in Table 11-4.

**Table 11-4: Key PPP Models**

| PPP Model | Typical Role of Private Partner | Typical Role of Public Entity |
|---|---|---|
| Build Operate Transfer (BOT)/ Design Build Finance Operate Transfer (DBFOT) | • Design, supply and implementation<br>• Investment in the project<br>• Operation, maintenance and management of the project<br>• Recovery against cost and investment through revenues realised by charging users against the services availed<br>• Project assets transferred to public entity at the end of contract period | • Grant right and authority to the private partner to implement the project, levy user charges, provide right of way<br>• Define the user charges<br>• Monitor the performance of the private partner |
| BOT Annuity | • Design, supply and implementation<br>• Investment in the project<br>• Operation, maintenance and management of the project<br>• Recovery against cost and investment through periodical payments (monthly, quarterly or annual) from the public entity<br>• Project assets transferred to public entity at the end of contract period | • Grant right and authority to the private partner to implement the project, provide right of way<br>• Monitor the performance of the private partner<br>• Make periodical payments to the private partner |
| Supply and/or Service Contract | • Could be one or more from among design, supply, build, operate, maintain and manage the project or any part thereof<br>• Recovery against the cost incurred through periodical (monthly, quarterly or annual) and/or milestone linked payments from the public entity | • Investment in the project<br>• Monitor the performance of the private partner<br>• Make periodical and/or milestone linked payments to the private partner<br>• Project assets ownership is with public entity |

While PPP models such as BOT/DBFOT/BOT-Annuity have their advantages in setting up large infrastructure facilities, these arrangements are complex to set up and cumbersome to administer and manage considering the large number of stakeholders involved such as concessionaire, financiers, public authority, public etc. BOT/DBFOT/BOT-Annuity models may often turn out to be not the most appropriate models for NUTH implementations due to the following:

- There is relatively small revenue stream that can be generated from NUTH system to satisfy the concessionaire or financiers requirements.
- The size and scale of NUTH projects is likely to be relatively small

- The nature of activities being discharged through NUTH requires high level of coordination with transit agencies most of which are in government domain.
- NUTH facilities are not in the nature of services being provided to public where-under they can be made to pay while they avail the services.
- Administration of such arrangements is likely to be cumbersome in terms of the contract administration and management

In view of the above, the supply and/or service contract could be the model of choice while undertaking NUTH implementations in India, as it is the case abroad, where such facilities have been set up.

## 11.4 Awareness Campaign and Outreach

One of the central objective of setting up NUTH is dissemination of traffic and transit related information that is widely used by the public to plan their travel. Professional support should, therefore, be sought in creating brand awareness. The necessary provision must be kept in the project budget to support this activity. 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
- 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

## 11.5 Indicative Costing Detail

### 11.5.1 Indicative Cost of NUTH Implementation and O&M

Indicative cost of implementing, operating and maintaining NUTH is provided in Table 11-5. The figures given are for representative in nature and actual project cost would differ based on project specific factors.

Note: The quantity and costs are for illustration only. Actual cost may vary depending on project scope and infrastructure needed.

**Table 11-5: NUTH Implementation and O&M - Indicative Cost**

| S.No. | Items | Unit Rate (Rs.) | UOM | Case 1 (Population up to 2 Mn) | | Case 2 (Population 2-5 Mn) | | Case 3 (Population >5 Mn) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) |
| **A** | **Implementation Cost** | | | | | | | | |
| 1 | NUTH System (Including development of interfaces)<br>a) Data Collection, Processing and Storage System<br>b) Data Dissemination System<br>▪ NUTH Call Centre<br>▪ NUTH web site<br>▪ NUTH Mobile Applications<br>▪ NUTH Social Media pages<br>c) Trip Planner | | L.S. | 1 | 5,00,00,000 | 1 | 7,00,00,000 | 1 | 10,00,00,000 |
| 2 | Call Centre Personnel and Operator Consoles | 80,000 | per unit | 5 | 4,00,000 | 10 | 8,00,000 | 20 | 16,00,000 |
| 3 | Systems for other NUTH Staff | 80,000 | | 8 | 6,40,000 | 8 | 6,40,000 | 8 | 6,40,000 |

| S.No. | Items | Unit Rate (Rs.) | UOM | Case 1 | | Case 2 | | Case 3 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | (Population up to 2 Mn) | | (Population 2-5 Mn) | | (Population >5 Mn) | |
| | | | | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) |
| 4 | Servers and Storage | 10,00,000 | per unit | 5 | 50,00,000 | 15 | 1,50,00,000 | 20 | 2,00,00,000 |
| 5 | NUTH Civil Works | 1,00,000 | per SQM | 130 | 1,30,00,000 | 150 | 1,50,00,000 | 175 | 1,75,00,000 |
| | ***Sub Total – A*** | | | | ***6,90,40,000*** | | ***10,14,40,000*** | | ***13,97,40,000*** |
| | | | | | | | | | |
| 6 | Systems Engineering & Design | 10% | of A | | 69,04,000 | | 1,01,44,000 | | 1,39,74,000 |
| 7 | Programme/Implementation Management, System Integration | 15% | of A | | 1,03,56,000 | | 1,52,16,000 | | 2,09,61,000 |
| 8 | Training and Capacity Building | 1.25% | of A | | 8,63,000 | | 12,68,000 | | 17,46,750 |
| | **Sub Total – B** | | | | **1,81,23,000** | | **2,66,28,000** | | **3,66,81,750** |
| | | | | | | | | | |
| 9 | **Total Implementation Cost – Rs. (A+B)** | | | | **8,71,63,000** | | **12,80,68,000** | | **17,64,21,750** |
| | | | | | | | | | |

| S.No. | Items | Unit Rate (Rs.) | UOM | Case 1 | | Case 2 | | Case 3 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | (Population up to 2 Mn) | | (Population 2-5 Mn) | | (Population >5 Mn) | |
| | | | | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) | Qty. | Amount (Rs.) |
| **B** | **O&M Cost (per annum)** | | | | | | | | |
| 1 | Operations Cost | 15% | of A | | 1,03,56,000 | | 1,52,16,000 | | 2,09,61,000 |
| 2 | Staff cost | | | | | | | | |
| *2(a)* | *Call Centre Personnel + Operator* | 25,000 | *per seat/ shift /month* | *15* | *45,00,000* | *30* | *90,00,000* | *60* | *1,80,00,000* |
| *2(b)* | *Other Staff cost* | | *refer staff cost in Section 11.6.2* | | *69,60,000* | | *69,60,000* | | *69,60,000* |
| | Total Staff cost (a+b) | | | | 1,14,60,000 | | 1,59,60,000 | | 2,49,60,000 |
| | | | | | | | | | |
| 3 | Maintenance Cost | 10% | of A | | 69,04,000 | | 1,01,44,000 | | 1,39,74,000 |
| **4** | **Total O&M Cost (per annum)** | | | | **2,87,20,000** | | **4,13,20,000** | | **5,98,95,000** |

### 11.5.2 Staff Cost

Indicative staff cost for NUTH is provided in Table 11-6. This number may undergo changes based on the requirements. These staff cost is based on the organisation structure given in Section 9.9:

**Table 11-6: Indicative 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 Manager | 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** |

# 12.0 RESOURCES AND REFERENCES

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


- America's Travel Information Number, Implementation and Operational Guidelines for 511 Servicers, Version 3.0, 511 Deployment Coalition, September 2005.
- Applying a Regional ITS Architecture to Support Planning for Operations, A Primers, USDOT, Federal Highway Administration, prepared by SAIC, February 2012.
- Audio, Video and Multimedia Systems and Equipment Activities and Considerations related to Accessibility and Usability, International Electro technical Commission Report, IEC/TR 62678, edition 1.0, 2010-10.
- Developing Traveller Information Systems Using the National ITS Architecture, USDOT, prepared by Mitreteck Systems, August 1998.
- International Standards Organisation, Information available from website: http://www.iso.org/iso/home.html,
- ITS System Architecture for Developing Countries, Technical Note 5, World Bank Publication, July 2004.
- Systems Engineering for Intelligent Transportation Systems, USDOT, Office of Operations, Publication No. FHWA-HOP-07-069, January 2007.
- Systems Engineering Guidebook for ITS, Version 1.1, California Department of Transportation, prepared by Siemens ITS, February 2005.
- Transit, Call Centres and 511: A Guide for Decision Makers, TCRP Report 134, Transportation Research Board, 2009.
- US National ITS Architecture, USDOT, version 7.0, prepared by Iteris, Information from website: http://www.iteris.com/itsarch/
- Toolkit for Public Private Partnership in Urban Transport, Ministry of Urban Development, Government of India (July 2008)
- Transportation Management Center, Concepts of Operation, Implementation Guide, U.S. Department of Transportation (December 1999)
- U.S. Department of Transportation (US DOT) (http://www.itslessons.its.dot.gov/)

# Annexure 1: List of Contractors

The list of contractors provided below for various types of equipment is an illustrative one and is not intended to be an exhaustive list. The reference to any contractor, vendor, systems integrators, technology providers or suppliers in the table below does not constitute or imply their endorsement or recommendation by the consultants or MoUD or Government of India.

| Equipment | Systems Integrators /Technology Providers |
|---|---|
| CCTV Surveillance System | • Delhi Integrated Multi Modal Transit System Limited<br>• Indigo Vision Limited<br>• Turbo Consultancy Services Private Limited<br>• Almighty Techserv Private Limited<br>• Polixel Security Systems Private Limited<br>• Tyco Fire & Security India Private Limited (Tyco)<br>• Himachal Futuristic Communications Limited (HFCL)<br>• Indra Sistemas India Private Limited<br>• Vayam Technologies Limited (VAYAMTECH)<br>• Videonetics Technology Private Limited |
| Variable Message Signs | • ORTANA/Trafitek Solutions Private Limited<br>• Swarco Traffic Limited<br>• Delhi Integrated Multi Modal Transit System Limited<br>• CMS Traffic Systems Limited<br>• Envoys Electronics Private Limited<br>• MIC Electronics Limited (MICELE)<br>• SA Traffic<br>• Micromax Instruments Private Limited |
| Communication/Leased Line | • Tata Communications Limited<br>• Reliance Communications Limited<br>• Tulip Telecom Limited<br>• Bharat Sanchar Nigam Limited (BSNL)<br>• Mahanagar Telephone Nigam Limited (MTNL)<br>• Bharti Airtel Limited (Airtel) |

| Equipment | Systems Integrators /Technology Providers |
|---|---|
| Control Room Server/Workstation & Other Computing Hardware | • Hewlett Packard India Sales Private Limited (HP)<br>• Dell India Private Limited (Dell)<br>• IBM India Private Limited (IBM) |

# Annexure 2: List of Boundaries

### Annexure 2(A): Boundaries (Human Interface) Definitions

| Title | Description [9] |
|---|---|
| Archived Data Administrator | The operator who provides overall data management, administration, and monitoring duties for the ITS data archive. |
| Driver | Human entity that operates a vehicle on the roadway. Included are operators of private and transit, vehicles where the data being sent or received is not particular to the type of vehicle. |
| Maintenance and Construction Centre Personnel | The people that directly interface with the systems in the Maintenance and Construction Management subsystem. These personnel interact with fleet dispatch and management systems, road maintenance systems, incident management systems, work plan scheduling systems, and work zone management systems. |
| Maintenance and Construction Field Personnel | The people that perform maintenance and construction field activities including vehicle and equipment operators, field supervisory personnel, field crews, and work zone safety personnel. |
| Parking Operator | Human entity that may be physically present at the parking lot facility to monitor the operational status of the facility. |
| Pedestrians | Provides input (e.g. a request for right of way at an intersection) from a specialised form of the Traveller who is not using any type of vehicle (including bicycles) as a form of transport. Pedestrians may comprise those on foot and those in wheelchairs. |
| Traffic Operations Personnel | The human entity that directly interfaces with vehicle traffic operations. These personnel interact with traffic control systems, traffic surveillance systems, incident management systems, work zone management systems, and travel demand management systems to accomplish ITS services. |
| Transit Operations Personnel | The human entities are responsible for fleet management, maintenance operations, and scheduling activities of the transit system. These different roles represent a variety of individuals in the transit industry. |
| Transit Vehicle Operator | The human entity that receives and provides additional information that is specific to operating the ITS functions in all types of transit vehicles. |
| Traveller | Any individual who uses transportation services. The interfaces to the traveller provide general pre-trip and en-route information supporting trip planning, personal guidance, and requests for assistance in an emergency that are relevant to all transportation system users. |

[9] Adapted from US National ITS Architecture

## Annexure 2(B): Boundaries (Environment Interface) Definitions

| Title | Description[10] |
|---|---|
| Environment | The natural surroundings in which the ITS operates. These surroundings include conditions such as snow, rain, fog, pollution, dust, temperature, humidity, solar radiation, and man-made electromagnetic (RF) effects |
| Obstacles | Any object that possesses the potential of being sensed and struck and thus also possesses physical attributes. |
| Roadway Environment | The physical condition and geometry of the road surface and the conditions surrounding the roadway. The geometry of the roadway and the road surface characteristics must be sensed and interpreted to support automated vehicle control services. |
| Secure Area Environment | The environment around any area that is monitored by surveillance or sensor equipment. These areas include public areas frequented by transit users or travellers as well as transportation facilities and infrastructure. |
| Traffic | The collective body of vehicles that travel on surface streets, arterials, highways, expressways, or any other vehicle travel surface. Traffic depicts the vehicle population from which traffic flow surveillance information is collected (average occupancy, average speed, total volume, average delay, etc.), and to which traffic control indicators are applied (intersection signals, stop signs, ramp meters, lane control barriers, variable speed limit indicators, etc. |
| Vehicle Characteristics | The external view of an individual vehicle. It includes vehicle characteristics such as height, width, length, weight, and other properties (e.g., magnetic properties, number of axles) that allow an individual vehicle to be detected and measured or classified. |

[10] Adapted from US National Architecture

## Annexure 2(C): Boundaries (Systems Interface) Definitions

| Title | Description [6] |
|---|---|
| Alerting and Advisory Systems | The alerting and advisory systems that provide alerts, advisories, and other potential threat information that is relevant to surface transportation systems. It provides intelligence about potential, imminent, or actual attacks on the transportation infrastructure or its supporting information systems, including all types of emergencies including natural hazards (floods, hurricanes, tornados, earthquakes), accidents (chemical spills, nuclear power plant emergencies) and other civil emergencies such as child abduction alerts that impact transportation system operation and/or require immediate public notification. |
| Archived Data User Systems | The systems users employ to access archived data. |
| Archives | Distributed archived data systems or centres whose data can be accessed and shared with a local archive. The interface between the Other Archives Terminator and the Archived Data Management Subsystem allows data from multiple archives to be accessed on demand or imported and consolidated into a single repository. |
| Asset Management | The systems that support decision-making for maintenance, upgrade, and operation of physical transportation assets. Asset management integrates and includes the pavement management systems, bridge management systems, and other systems that inventory and manage the infrastructure and other transportation-related assets. |
| Driver Identification Card | The portable entity (e.g., a smart card) that enables the transfer of electronic identification information about a driver. This may include license information, biometrics, and other data to identify the driver. |
| Emergency Telecommunications System | These systems transparently support priority wire-line and wireless caller access to the emergency information system. |
| Equipment Repair Facility | The facilities that configure, service, and repair vehicles and other support equipment used in roadway infrastructure construction and maintenance. |
| Event Promoters | Special Event Sponsors that have knowledge of events that may impact travel on roadways or other modal means. Examples of special event sponsors include sporting events, conventions, motorcades/parades, and public/political events. |
| Financial Institution | The organisation that handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service. |
| Government Reporting Systems | The system and associated personnel that prepare the inputs to support government transportation data reporting requirements (e.g. Performance Monitoring System, Fatality Analysis Reporting System) using data collected by ITS. |

| Title | Description [6] |
|---|---|
| Information Service Providers (ISP) | Representing other distinct Information Service Providers, this terminus is intended to provide a source and destination for ITS data flows between peer information and service provider functions. |
| Location Data Source | Systems which use GPS, terrestrial trilateration, or driver inputs are all potential examples of Location Data Sources. |
| Maintenance and Construction Administrative Systems | Various administrative systems that support the operation of ITS for maintenance and construction operations. |
| Maintenance and Construction Vehicle | A specialised form of the Basic Vehicle used by maintenance fleets. |
| Maintenance and Construction Management Centre | Maintenance and Construction Management centre or subsystem, this terminus is intended to provide a source and destination for ITS information flows between maintenance and construction management functions. |
| Map Update Provider | A provider of map databases used to support ITS services. It supports the provision of the databases that are used by travellers (e.g., navigable maps used for route guidance and display maps used at traveller information points) as well as those that are used by system operators (e.g., map data used by Traffic Operators to monitor and manage the road network, map data used by Fleet Managers to manage a vehicle fleet). |
| Media | The information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media. |
| Motor Vehicle Department | A specific public organisation responsible for registering vehicles. |
| Multimodal Transportation Service Provider | The interface through which Transportation Service Providers can exchange data with ITS. They are the operators of non-roadway transportation systems (e.g. airlines, ferry services, passenger carrying heavy rail) and providers of non-motorised transportation facilities. |
| Other Data Sources | Represents the myriad systems and databases containing data not generated from subsystems that can provide predefined data sets to the ITS archive. The terminator can provide economic, cost, demographic, land use, law enforcement, and other data that is not collected by ITS and would otherwise be unavailable within an ITS data archive. |
| Parking | Representing another parking facility, system or subsystem, this terminus provides a source and destination for information that may be exchanged between peer parking systems. |
| Police (Enforcement Agency) | The systems that receive reports of violations detected by various ITS facilities including individual vehicle emissions, toll violations, excessive speed, etc. |

| Title | Description [6] |
|---|---|
| Rail Operations | Centralised control point for a substantial segment of a freight railroad's operations and maintenance activities. It is roughly the railroad equivalent to a highway Traffic Management Centre. |
| Railroad Crossings | The control equipment that interfaces to a non-road based transportation system at an interference crossing with the roadway. |
| Roadway | Representing another roadway system or subsystem, this terminus supports 'field device' to 'field device' communication and coordination, and provides a source and destination for information that may be exchanged between roadway subsystems. |
| Storage Facility | Facilities that provide storage and forward staging for equipment and materials used in maintenance and construction operations. It provides status information on the types and quantities of materials and equipment that are available at the facility. |
| Surface Transportation Weather Service | Providers of value-added sector specific meteorological services. These providers utilise Weather Service data and predictions, road condition information and local environmental data provided by the traffic management or maintenance organisations, and their own models to provide surface transportation related weather observations and forecasts including pavement temperature and conditions. |
| Telecommunications System for Traveller Information | The caller interface and voice processing (voice recognition/synthesis) that supports voice-enabled traveller telephone information systems. It provides wire-line and wireless caller access to NUTH systems. |
| Traffic Management Centre | Representing another Traffic Management centre, system or subsystem, this terminus is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) traffic management functions. |
| Transit Management Centre | Representing another Transit Management centre, system or subsystem, this terminus is intended to provide a source and destination for ITS data flows between peer (e.g. inter-regional) transit management functions. It enables transit management activities to be coordinated across geographic boundaries or different jurisdictional areas. |
| Transit Vehicle | A specialised form of the Basic Vehicle that interfaces with and hosts ITS electronics. The Basic Transit Vehicle may be a bus, light rail vehicle, or other vehicle designed to carry passengers. |
| Travel Services Provider | Individual organisations that provide any service oriented towards the Traveller. Example services that could be included are petrol, food, lodging, vehicle repair, points of interest, and recreation areas. It also includes services specifically directed toward bicyclists and pedestrians such as bicycle shops and parking locations and bicycle and pedestrian rest areas. |
| Traveller Card | The entity that enables the actual transfer of electronic information from the user of a service (I.e. a traveller) to the provider of the service. This may include the transfer of funds through means of an electronic payment |

| Title | Description [6] |
|---|---|
| | instrument. The device, like a smart card, may also hold and update the traveller's information such as personal profiles or trip histories. |
| Vehicle | The basic vehicle platform that interfaces with and hosts ITS electronics. It provides an interface to drive train, driver convenience and entertainment systems, and other non-ITS electronics on-board the vehicle. This interface allows general vehicle systems (e.g., the stereo speaker system) to be shared by ITS and non-ITS systems. It also allows monitoring and control of the vehicle platform for advanced vehicle control system applications. |

# Annexure 3: List of Potential Standards

| Standard No: 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.<br><br>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.<br><br>Specifically, ISO 14817:2002 specifies:<br><br>• framework used to identify and define all information exchanges;<br>• framework used to extend standardised information exchanges to support local customisations and combinations;<br>• information modelling method for defining ITS/TICS data concepts, when used;<br>• meta attributes used to describe, standardise and manage each of the data concepts defined within this framework;<br>• requirements used to record these definitions; and<br>• formal procedures used to register these definitions within the Data Registry. |

| Standard No: Year of Adoption | Description |
|---|---|
| | 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. |
| 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).<br><br>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.<br><br>In general, each system can be viewed as consisting of the following interfaces:<br><br>1. Application Interface<br>2. Operator Interface<br>3. Communication Interface<br>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 |

| Standard No: Year of Adoption | Description |
|---|---|
| | 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 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.<br>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:<br>• positioning;<br>• route planning;<br>• route guidance;<br>• map display;<br>• address location;<br>• services and Point of Interest (POI) information access. |

| Standard No: Year of Adoption | Description |
|---|---|
| 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:<br>• pre-coded location references (pre-coded profile);<br>• dynamic location references (dynamic profile).<br>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.<br>ISO 17572-1:2008 specifies the following general LRM related sections:<br>• requirements to a Location Referencing Method;<br>• conceptual Data Model for Location Referencing Methods;<br>• inventory of Location Referencing Methods;<br>• examples of Conceptual Data Model Use;<br>• description of selected UML Elements;<br>• comparison of Definitions with ISO/TC 211;<br>• introduction to the TPEG Physical Format. |
| ISO 22837:2009 | Relates to vehicle probe data for wide are communications. It specifies the following.<br>• 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:<br>– clarify the major building blocks and logical interconnections of probe vehicle systems for which this standard will be used;<br>– categorise probe data in accordance with the information model described below.<br>• Basic data framework for probe data elements and probe data, which defines probe data elements and probe messages, and specifically provides:<br>– 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; |

| Standard No: Year of Adoption | Description |
|---|---|
| | – the required characteristics of probe data elements and probe data messages;<br>– the notation for probe data elements/messages (in XML);<br>– rules for using core data elements and basic data elements (see below), and extensions of data elements in each application domain.<br>• 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.<br>• Initial set of probe data elements, which are commonly used in typical probe data, enabled application domains, such as traffic, weather, and safety.<br>• 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.<br>The scope of standardisation includes message sets and data dictionary related to the communications as follows:<br>• between a roadside communication unit and each in-vehicle unit,<br>• between a roadside communication unit and other roadside units,<br>• between in-vehicle units and roadside units.<br>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 behavior 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. |

| Standard No: Year of Adoption | Description |
|---|---|
| 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)].<br><br>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.<br><br>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. |
| 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.<br><br>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. |

| Standard No: Year of Adoption | Description |
|---|---|
| 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:<br>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.<br>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.<br>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 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.<br>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 |

| Standard No: Year of Adoption | Description |
|---|---|
| | 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.<br><br>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.<br><br>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<br><br>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 of probe vehicle systems and gives concrete definitions of PDRM messages.<br><br>ISO/TS 25114:2010 also specifies reference architecture for probe vehicle systems and probe data which incorporates PDRM, based on the reference |

| Standard No: Year of Adoption | Description |
|---|---|
| | 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 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<br><br>It caters for specifications related to transit feeds based on parameters like agency, stops, routes, trips, stop times, calendar, fare etc. |

# Annexure 4: Sample Memorandum of Understanding

## DRAFT SAMPLE MoU

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

**City Municipal Corporation {AGENCY},** being a statutory body constituted under the _____ having its office at _____, represented by **Commissioner** (hereinafter referred as "**CMC**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the First Part;

and

**City Traffic Police {AGENCY OR DEPARTMENT}** a department of _____State Government having its office at _____, represented by **DCP/ACP, Traffic, ____City** (hereinafter referred as "**CTP**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the Second Part;

and

**City Metro Rail Corporation {AGENCY}** [a statutory corporation constituted under the _____] **OR** [a company incorporated under the Companies Act, 1956] having its office at _____ represented by **Managing Director/CEO,** (hereinafter referred as "**CMRC**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the Third Part.

and

**City Transport Corporation {AGENCY}** [a statutory corporation constituted under the _____] **OR** [a company incorporated under the Companies Act, 1956] having its office at _____ represented by **Managing Director/CEO,** (hereinafter referred as "**CTC**", which expression unless repugnant to the context or meaning thereof includes its successors and permitted assigns) of the Fourth Part.

*[Change the names, designation and other details as required. Add details if any other entity is also party to the MoU such as UMTA]*

CMC, CTP, CMRC and CTC 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 an NUTH for the _____city;

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 objectives of establishing NUTH are to be able to collect, synthesise and disseminate travel, traffic and transit related information to public that would optimise the travel behavior on the cities and lead to efficient utilisation of city transport assets.

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

1.3 Based on the requirements as ascertained by High Level Committee (refer clause 3.0 of the MoU) more entities could be added to this MoU that support the objectives of NUTH.

## 2.0 ROLES & RESPONSIBILITIES OF PARTIES

2.1 Subject to clause 2.6 hereunder, Parties agree to work together and discharge various responsibilities as outlined in clauses 2.2 to 2.5 hereunder for and in relation to supporting the city NUTH.

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

(a) Signalling system installation, maintenance and upkeep

(b) Monitoring the uptime of signalling system

(c) To provide updates on construction/ maintenance activities of the roads

(d) To provide updates on installation/ maintenance of the equipment relating to NUTH

(e) Managing the contracts and relationships with the contractors responsible for installation, maintenance and upkeep of the signalling system and other ITS equipment deployed by the CMC

(f) Managing the contracts and relationships with the contractors responsible for construction, maintenance and upkeep of the road network of the CMC

(g) Cooperate and work with Parties both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(h) Cooperating with each other in responding to incidents, accidents and other emergency situations

(i) Any other responsibility as mutually agreed

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

(a) To set up NUTH (if it is to be located at their premises)

(b) To depute its personnel at NUTH, as needed

(c) To deploy ITS equipment on its fleet such as Passenger Information System (PIS), Closed Circuit TV (CCTV) cameras etc.

(d) To deploy, operate and maintain various equipment and associated systems that provide data feeds to NUTH

(e) To collect and provide agreed data / information in desired form and frequency

(f) To collect and provide updates on construction/ maintenance activities

(g) To provide updates on service delay /disruptions /facility closure

(h) Cooperate and work with Parties both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(i) Cooperating with each other in responding to incidents, accidents and other emergency situations

(j) Any other responsibility as mutually agreed

2.4 CTC agrees to discharge the following responsibilities {modify as required}:

(a) To set up NUTH (if it is to be located at their premises)

(b) To depute its personnel at NUTH, as needed

(c) To deploy ITS equipment on its fleet such as Automatic Vehicle Location System (AVLS), PIS, CCTV cameras etc.

(d) To deploy, operate and maintain various equipment and associated systems that provide data feeds to NUTH

(e) To collect and provide agreed data / information in desired form and frequency

(f) To collect and provide updates on construction/ maintenance activities

(g) To provide updates on service delay /disruptions /facility closure

(h) Cooperate and work with Parties both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(i) Cooperating with each other in responding to incidents, accidents and other emergency situations

(j) Any other responsibility as mutually agreed

2.5 CTP agrees to discharge the following responsibilities {modify as required}:

(a) Managing and optimising signal cycle

(b) Monitoring surveillance cameras

(c) Taking lead role in managing incidents including coordinating with other internal and external stakeholders such as Fire, Police etc.

(d) Traffic enforcement

(e) To provide agreed data / information in desired form and frequency

(f) Traffic related information dissemination to public, media and other internal and external stakeholders

(g) Managing the contracts and relationships with the contractors responsible for installation, maintenance and upkeep of the ITS equipment deployed by the CTP

(h) Cooperate and work with Parties both at strategic and operational levels in order to ensure that NUTH achieves its objectives

(i) Cooperating with each other in responding to incidents, accidents and other emergency situations

(j) Any other responsibility as mutually agreed

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

## 3.0 ADMINISTRATIVE ARRANGEMENT

### 3.1 High Level Committee

3.1.1 High Level Committee (HLC) shall have representation from the senior most officer heading the administration of the Party as under:

| Party | Representative |
|---|---|
| City Municipal Corporation | Commissioner |
| City Metro Rail Corporation | MD/CEO |
| City Transport Corporation | MD/CEO |
| City Traffic Police | DCP/JCP (Traffic) |

3.2 HLC shall meet as and when needed (at least once every quarter) and shall be responsible for the following:

(a) To act as high level decision making body on the matters connected with NUTH

(b) Provide advice to Unified Metropolitan Transport Authority (UMTA) having jurisdiction over the city on various aspects related to NUTH

(c) Resolving any administrative issues that are faced at NUTH

(d) Decision regarding associating with other entities in relation to NUTH

(e) Finalising the cost sharing mechanism and ratio amongst the Parties regarding setting up, managing, operating and maintaining NUTH

(f) Any other role assigned to the HLC by the UMTA.

### 3.3 Technical Committee

3.3.1 Technical Committee (TC) shall report to the HLC and shall have representation from the Parties as under:

| Party | Representative |
|---|---|
| City Municipal Corporation | Nominee of the HLC Member of the Party |
| City Metro Rail Corporation | --- do----- |
| City Transport Corporation | --- do----- |
| City Traffic Police | --- do----- |

3.3.2 Technical Committee shall meet as and when needed (at least once every month or as necessary) and shall be responsible for the following:

(a) To act as technical body supporting the decision making role to be played by the HLC

(b) Providing advice to HLC on various aspects such as conceptualising, planning, designing, roll out, operation, maintenance and management of NUTH

(c) Resolving any technical issues that are faced at NUTH

(d) Any other role assigned to the TC by the HLC.

3.4 High Level Committee (HLC) shall, right at the project commencement stage, evolve decision making policy to be followed by HLC as well as Technical Committee (TC). The method of arriving at decisions by these committees could be based on voting, consensus, capital/operational cost sharing etc. as may be decided by HLC. The HLC may also frame policy regarding entry of new members, exit of members, methods of budget determination and apportionment of capital and operational costs to members.

## 4.0 RELATIONSHIP BETWEEN THE PARTIES

4.1 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/Parties.

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

## 5.0 VALIDITY AND TERMINATION

5.1 Unless terminated earlier or extended by the Parties, this MoU shall remain valid for a period of Ten (10) years from the date of execution of the MoU.

## 6.0 GENERAL

6.1 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.

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

6.3 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 CMC | For CTP |
|---|---|---|
| Signature | | |
| Name | | |
| Designation | | |

| Party | For CMRC | For CTC |
|---|---|---|
| Signature | | |
| Name | | |
| Designation | | |

# Annexure 5: Systems Engineering for ITS Projects

## 1. Introduction

ITS are typically conceptualised and designed to interface and operate with a number of information technology & communication systems, equipment and processes that are managed, operated and maintained by various agencies of the city/region. NUTHs are complex ITS projects having very large technological element comprising information and communications technologies supporting collaboration and information exchange among various traffic, transit, other participating agencies and law enforcement bodies. The exchange of information happens both within the system, its subsystems and components as well as with systems of other organisations.

In order to follow a structured process in planning and delivering complex ITS initiatives, Systems Engineering approach has been widely used and adopted by various organisations worldwide. All government funded ITS initiatives in the USA, for example, are now required to follow the Systems Engineering approach.

It is recommended that the NUTH projects also follow the Systems Engineering approach. This chapter provides a brief overview of the Systems Engineering approach for undertaking system development.

The agencies developing these projects could take assistance from professional consulting organisations on a need basis to secure support from them. Further, as the agencies would typically engage one or more contractors for designing and delivering the systems, it is important that the Request for Proposals (RFPs) created for such procurement includes the requirement for the contractors to follow the Systems Engineering approach.

## 2. Systems Engineering

The Systems Engineering is an interdisciplinary approach and means to enable the realisation of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem:

- Operations
- Cost & Schedule
- Performance
- Training & Support
- Test
- Manufacturing
- Disposal

Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

[As defined by The International Council on Systems Engineering (INCOSE)]

## 3. Benefits of Systems Engineering Approach

The primary benefits of following Systems Engineering is that its structured approach would reduce the risk of project schedule and cost overruns and support development of system of higher integrity. There are several advantages of following this approach:

- It is a structured and disciplined approach to implement complex ITS projects such as NUTH or other ITS projects.
- This approach leads to creation of various project related documents covering details such as concept of operations, system requirements, design, test plans, operational plans. These not just help in designing, testing, implementing and operating the projects but also ensure traceability between outputs and inputs encompassing all stages.
- The process by design requires stakeholders to participate at various phases of the project thereby ensuring that system is created based on their participation and inputs meeting their expectations.
- Since the IT systems evolve with time and change based on stakeholder expectations, and availability of new generation technologies, among others, following this approach would support easier upgrade of system
- It would help in ensuring continued system operation and support in case of any change in a contractor
- Leads to lesser rework and, therefore, lesser delivery times as each stage requires acceptance/approval from the relevant stakeholders before the project moves on to the next stage.

## 4. Systems Engineering: Key Principles

Some of the key principles of the Systems Engineering approach in undertaking any project development exercise are as below:

- Stakeholder participation
- Defining the project objectives in the beginning
- Decomposing the system into manageable subsystems and components
- Keeping the end objectives in mind
- Ensuring traceability

### A. Stakeholder Participation

NUTH projects would require participation from various agencies such as those managing bus services, metro rail services, Municipal Corporations, PWD, development authorities, police, Traffic Police etc. Further, officers from various departments, levels and with varying expected roles are going to participate at various stages of implementation of the project.

Success of such initiatives would largely be driven by the active participation by such stakeholders in the project development. Systems engineering provides a structured framework and ensures that each of the stakeholder participates and provides relevant inputs, feedbacks and/or approvals during various stages of the project development exercise.

### B. Defining the Project Objectives in the Beginning

The project objectives should drive the solution. Any preconceived solution should not drive project definition and objectives. The Systems Engineering process starts with defining first the objectives that are sought to be achieved by the solution and thereafter identification and evaluation of various solution options is carried out to determine the most appropriate solution.

### C. Decomposing the System into Manageable Subsystems and Components

Systems have varying levels of complexities, scope and sizes. For large and complex projects, Systems Engineering approach is to break the system into smaller subsystems and components. Such smaller subsystems and components are easier to comprehend, visualise, define, design, develop and test. Further, following this approach also supports managing and monitoring the project more effectively.

### D. Keeping the End Objectives in Mind

The success of any system could be measured in a number of ways. It is critical that the end objectives and the associated performance measures are clearly defined and understood by all the stakeholders in the beginning. This will ensure that there is an agreed measure to assess the project performance once the same is delivered and implemented.

### E. Ensuring Traceability

It is necessary that the project is developed in accordance with defined and agreed set of objectives and requirements. In order to ensure this it is important that at each stage of the project there is a proper correlation between outputs (products/components) and inputs (requirements). Systems engineering provides a framework to ensure traceability or correlation.

## 5. The "V" Systems Engineering Model

### A. The "V" Model Overview

Several models have been developed by the experts that provide an overview of the Systems Engineering steps in implementing projects. The "V" model, Figure A shown in is a widely used one and has been adopted and recommended by transport authorities.

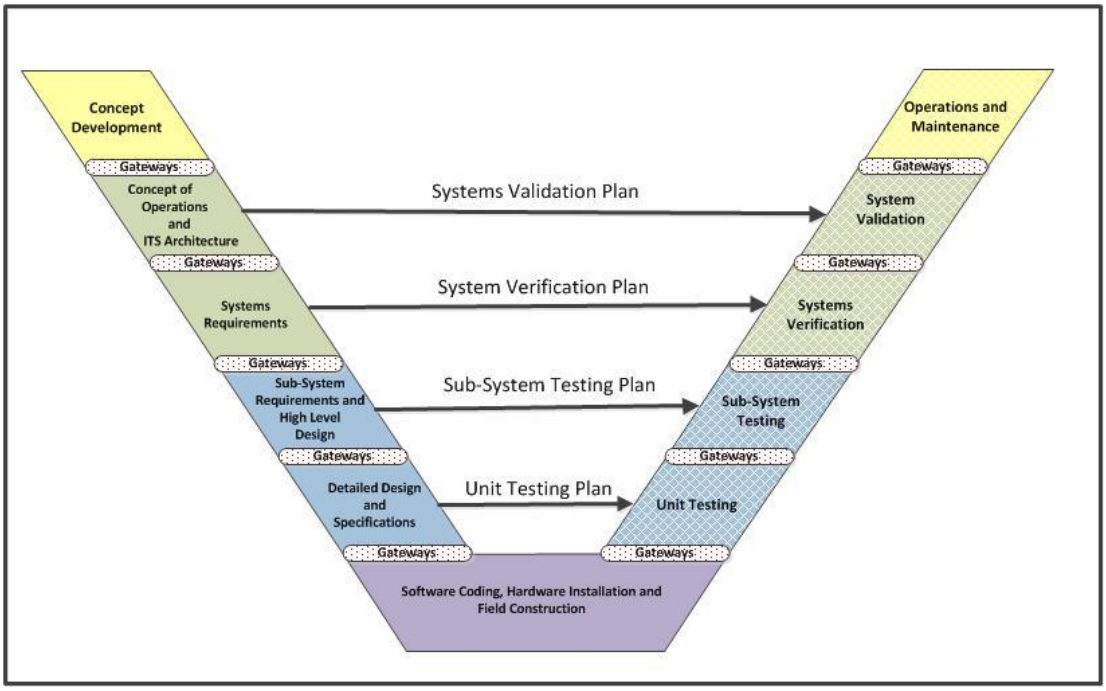



**Figure A: The "V" Model in Systems Engineering**

### B. Interfacing between the Left and Right Arms

Systems engineering process outlined in the model is a framework for ensuring that the requirements generated in following the processes represented by the left arm are verified by following processes represented on the right. Concept of Operations, for example, on the left that is used to capture the user needs and agreed system performance parameters is validated for delivery through the system validation exercise on the right. The connecting arrow between these two arms similarly provide for verification of the requirements created in the left part with the system delivery on the right.

### C. Decision Points

The process provides for decision points or gateways between various stages. The project moves to the next stage only when the outputs from the earlier stage have been approved based on the agreed parameters.

### D. Traditional Approach to ITS Deployment

Without a Systems Engineering process, traditionally an approach to ITS began with a Feasibility Study, proceeding to Detailed Project Report (DPR) and traditional implementation phase. This process may be adequate for traditional roadway and traffic projects; however, with complex NUTH or ITS projects, appropriate system checks and requirements would need to be taken into account and these projects typically fail if implemented with the traditional approaches. Figure B shows the traditional process and each phase of project development correspond with the Systems Engineering process.

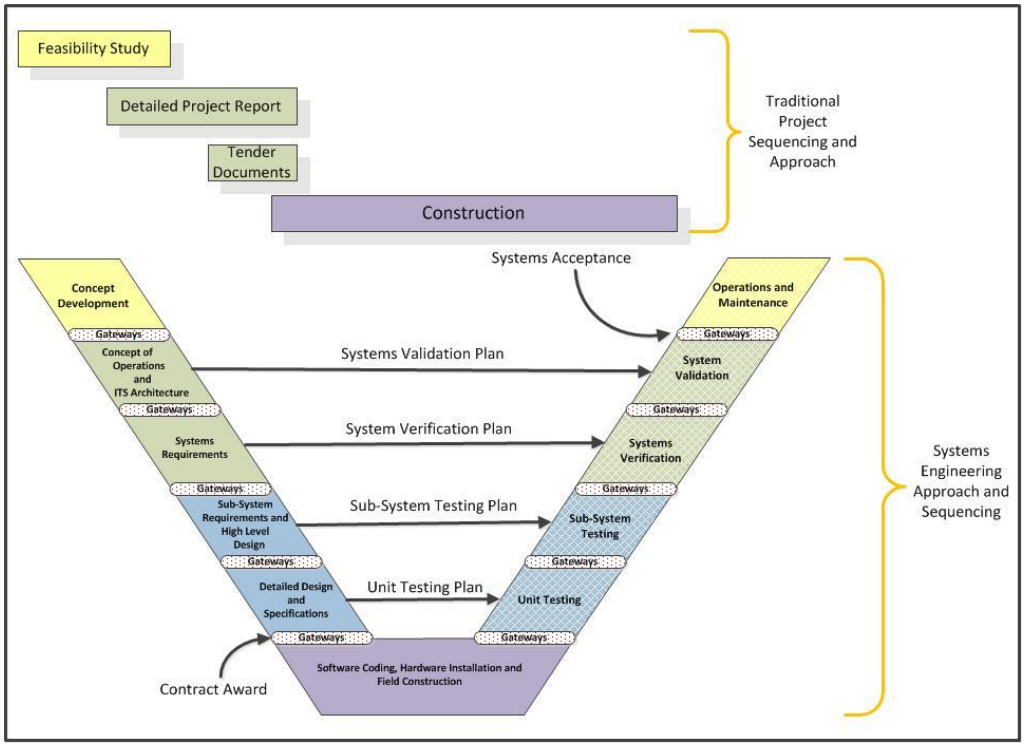



**Figure B: Traditional vs. the Systems Engineering Approach**

## 6. ITS Technical Process

### A. Regional ITS Architecture

ITS projects often work as part of network which has many other systems connected. If available, the regional ITS architecture provides the context within which an ITS project is to be developed, the positioning of the project in the transportation system for the city /region and the nature and degree of integration that is required to be considered. It is a framework that outlines the institutional agreement reached on the framework for implementation of ITS projects in the city/region, their functions, their inter-linkages and information exchange among them. USA has national ITS architecture in place which has gone through several iterations. Various states in the

USA are following the national ITS architecture in developing regional ITS architecture for the state.

The ITS projects must be planned keeping in mind the requirements outlined in the regional ITS architecture, if one exists. In India, the national as well as regional ITS architectures are not yet in place. Chapter 5.0 provides guidance in developing a project level architecture, in the absence of a regional architecture.

### B. Feasibility Study and Concept Development

The project, under this step, is evaluated for its technical, operational and economic/ financial feasibility. Various options for implementing the project are examined and evaluated at a high level. This step is distinct from the Concept of Operations step lined up next in the "V" model which needs to be developed for a chosen option.

A feasibility study typically covers the following aspects:

- Brief overview and objectives for taking up the project
- Options considered, details of evaluation and the chosen option
- Brief description of the chosen option with high level technical and operational details
- Implementation structure
- Financial model and proposed sources of funding

### C. Concept of Operations

In this stage, the Concept of Operations document is created for the chosen project implementation option covering the following details:

- Objectives of the project
- Details of the project stakeholders together with their needs
- Role of the project stakeholders during various stages
- Memoranda of Understanding and/or Agreements amongst parties
- Project description and features at high level
- Project coverage in terms of geographical area, cities covered, modes covered, exclusions etc.
- High level project plan containing details and sequence of activities and their inter-dependencies
- Implementation structure covering the approach for design, development, operation, maintenance and procurement

### D. System Requirements

In this step of the "V" model, system requirements are defined and documented. The objective in this step is to define what the system would do and not how it would do it which is the scope of system design step coming up next. System requirements govern the way the system would eventually be designed and developed. The requirements worked out and documented in this step are used by the system developer while designing and developing the system.

The stakeholder's needs documented as part of Concept of Operations stage is used as a point of reference for developing the system requirements. The requirements need to be captured in a structured way, analysed, prioritised, validated (for completeness, accuracy and consistency), and documented.

Together with capturing and documenting the requirements, a plan for system verification vis-à-vis the requirements is also prepared capturing the method of verification for each requirement. The verification methods typically used are system review and analysis, inspection, testing and/or demonstration by the system developer.

### E. System Design

The earlier steps in the "V" model had the objective of defining what the system is required to do. In this step, the objective is to create design of the system that would meet the requirements outlined pursuant to and in accordance with which the system would be developed and implemented in the next step of the "V" model.

Design is typically carried out in two stages: System architecture definition or high level design and detailed design.

The high level design defines the system architecture covering hardware, software, equipment, systems, other project components and their interfaces over the communication network. Detailed design contains detailed specification for project hardware, software, equipment, systems, other components and communication network so that these project elements could be developed, manufactured or provided in compliance with the system requirements.

### F. Software and Hardware Development and Testing

This stage follows the design stage and is preceded by integration, verification and validation steps that follow it. The project elements identified in the design stage are developed/procured meeting the specifications outlined in the design. The system hardware, software and other elements that are standard commercial-off-the-shelf in nature are procured and combined with the custom built elements to deliver the system in accordance with design.

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

- Create plan for hardware and software development
- Create development set-up with required tools and resources

- Undertake development of hardware and software
- Undertake unit and/or device testing

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 and verification. The documents generated during this process would typically include the Hardware and Software development plans, development environment and unit test plan and results.

### G. Integration and Verification

This is an iterative process under which the various system components are progressively integrated into subsystems and then subjected to verification vis-à-vis the requirements. First, the individual system components are subjected to verification to assess their compliance with the requirements. Subsequently these components are integrated and assembled into sub-systems which are then subjected to verification against the requirements. This process of integration continues 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 is the inverse of the process followed during the requirements and design stages earlier where the system was 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.

### H. Initial Deployment

The system has so far been tested and verified in the controlled environment. In this stage, the system is deployed and installed at the deployment site and checked. The system is transferred by the development team for the Operations and Maintenance (O&M). The transfer also entails handing over the applicable documents, imparting training and supporting the deployment.

The system is subjected to acceptance tests to confirm that the system is performing as intended in the field environment.

The output of this stage is a deployed, installed and operational system at the operations site.

The following documents are generally created under this stage:

- Final system documentation
- O&M Plan
- Inventory of hardware and software with version details

- Transition Plan and associated checklists
- Training materials
- Delivery and installation plan
- Test plan and procedures, duly updated

### I. System Testing and Validation

The system owner in this stage conducts tests to determine if the deployed system is meeting the needs during the Concept of Operations stage.

In Systems Engineering, a distinction is drawn between verification and validation processes. Verification is to check if the system meets the stipulated requirements. Validation on the other hand is carried out to see whether the system meets the identified needs. It would be evident that majority of the system verification could be performed prior to system deployment. Validation, however, can be performed only post system deployment when the system is operational and it is being used by the intended users.

Any system owner would be uncomfortable on discovering that it built a system that does not meets user needs. In order to avoid this, the Systems Engineering approach framework validates each of the intermediate outputs leading up to the final system to minimise the chances of system failing the validation test in the end.

The system validation should be carried out throughout the lifecycle of the system and not just post initial deployment and operation phase. Some of the ways in which validation is carried out listed below:

- Stakeholder feedbacks to assess whether their needs are being met or not
- Status of key outcome parameters pre and post system deployment whether collected by the system or captured through surveys
- User satisfaction surveys to find how out if they are satisfied with the system
- Measures collected as a part of normal system operation

The desired performance measures need to be properly documented in the system requirements in order to ensure that the measures, to the extent possible, are captured by the system in the normal course as a part of system operation.

As an output of this process, a validation report document is prepared based on the analysis of data gathered from the exercise to ascertain system performance vis-à-vis the user needs, the feedbacks received and the issues that are needed to be addressed. These are then used as input while updating or upgrading the system.

### J. Operations and Maintenance (O&M)

During the O&M phase, the system is being operated and maintained by the system owner. The phase lasts till the time the system is replaced or is retired from service.

Based on review and feedbacks, the system is periodically updated and upgraded. The key activities that are performed during the O&M phase are:

- O&M of the system
- Collection of operational data
- Feedback to the development/support team
- Updates and upgrades
- System support
- Configuration control

## K. Retirement and Replacement

Systems engineering requires planning for the entire lifecycle of the system. As part of this, the planning for system retirement and/or replacement is also carried out. 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

The system is periodically reviewed with respect to its continued utility in supporting the then current user needs and its cost effectiveness as compared to other options. Based on the analysis, a decision is taken either for continuation of the system or for retiring it from the service.

Once a decision is taken to retire the system, a retirement plan is developed containing the following details:

- An inventory of all hardware, software and other system elements
- Asset ownership details
- Alternative use of the system components elsewhere
- Details regarding the system operational status
- System and documentation and configuration details
- Disposal of system documentation
- Erasing the data from storage media subject to any need to retain data
- Applicable contracts and mechanism for their closure, as needed

# Annexure 6: Model DPR Template

# Model Template

# Detailed Project Report for National Urban Transport Helpline (NUTH)

# Organisation Name

Date

# EXECUTIVE SUMMARY

*Provide the executive summary highlighting important aspects covered in various chapters of the report.*

# 1. PROJECT BACKGROUND

## 1.1. Overview of the Project

*A brief description on the project background covering the details like, size of city, transport infrastructure, population, expectation & horizon year etc.*

## 1.2. Purpose

*A brief description of the purpose/use of the document, guiding on the parameter like capacity required to be built, tangible and intangible benefits.*

## 1.3. Approach

*Brief discussion regarding the approach and methodology adopted while developing the detailed project report covering the requirements of primary data, secondary data, information sources and dissemination.*

## 1.4. Chapters Outline

*Brief outline of each of the chapter detailing the topics covered in the respective chapter.*

# 2. CITY PROFILE

## 2.1. Background

*This section provides the city background and shall cover brief history of city, ranking of city, any specific information, spatial growth and regional setting, Climate, Linkages & Connectivity, Economy and profile.*

## 2.2. Demographic Trends

*This section illustrates the population, population growth rate and population density in the city.*

### 2.2.1. Population

*This section provides the details regarding population of the city and related facts and figures.*

### 2.2.2. Population growth rate

*This section provides data regarding the population growth rate in the city over the last few decades.*

### 2.2.3. Population density

*This section shall cover brief details of population density, direction of change, analysis, with related table/figure/graph.*

## 2.3. Registered Motor Vehicles

*This section shall cover details regarding vehicle registration data in the city for last 5 years along with the analysis of data and relevance to NUTH.*

## 2.4. Environmental Parameters

*This section shall cover details regarding environmental data for the last 5 years along with the analysis of data and relevance to NUTH.*

## 2.5. Traffic Safety

*This section shall cover details regarding accident data in the city for last 5 years along with the analysis of data.*

## 2.6. Travel Demand Forecast

### 2.6.1. Travel and Traffic Characteristics

*This section shall provide Travel and Traffic Characteristics of the city*

### 2.6.2. Per Capita Trip Rate

*Details of per capita trip rate, analysis of data, with relevant tables and figures.*

### 2.6.3. Average Speed

*Details of average speed in the city, analysis of data along with relevant tables and figures.*

### 2.6.4. Average Trip Length

*Details of average trip length, analysis of data, relevant table and figure, how average trip length may be impacted, factor which may impact average trip length.*

### 2.6.5. Modal Share

*Details of modal shares, analysis of data, relevant table and figure.*

### 2.6.6. Summary

*This section shall provide summary of the above analysis and justification for NUTH*

## 2.7. Transport Network Characteristics

*Details of transport network characteristics, road network details, major intersections, traffic safety.*

### 2.7.1. Road Network Characteristics

*Details of road network characteristics, provide table/figure/maps, volume/ capacity ratio of road network, services and utilisation over the roads and under the roads.*

### 2.7.2. Major Intersections

*This sub-section shall include the names of major intersections, number of signalised and non-signalised intersections, and any other specific information for the same.*

## 2.8. Public Transport Characteristics

*This section shall provide details of the available/proposed public transportation facilities in the city. (Note: Information on Mass Rapid Transit Systems (MRTS) such as Metro Rail system, BRTS, Light Rail, Monorail, Tram, PRT, existing/proposed city bus system and Intermediate Para-Transit system to be covered in the given sub-sections below.), Mass Rapid Transit System (Metro/Mono/Light Rail, if any), Bus Rapid Transit System (if any), Bus System (if any), Intermediate Public Transport and other modes, Ridership for PT and secondary viable options to be accommodated.*

## 2.9. Transport Sector Interventions Proposed

*This section shall deal with review of comprehensive mobility plans, infrastructure plan and Master plan etc.*

## 2.10. Key Stakeholders

*This section shall list out stakeholders in the city along with their roles that are related to NUTH.*

## 2.11. Project Need Analysis

*This section shall include the assessment/ need for NUTH in the city with relevant table/figures etc., as required. Refer Chapter 4.0 and Chapter 5.0 of the NUTH Operations Document for guidance.*

# 3. NUTH CONCEPT OVERVIEW

## 3.1. NUTH Overview

*This section provides an overview of NUTH. For detail content Refer NUTH generic Operations Document.*

## 3.2. NUTH Objectives

*Define objectives of the NUTH for the city.*

### 3.3. NUTH Benefits

*List benefits that can be realised from implementing the NUTH.*

# 4. REVIEW OF ITS INITIATIVES IN THE CITY

### 4.1. ITS Background and Initiatives

*This section explains the present ITS scenario and key ITS initiatives undertaken in the city and provides a context within which the NUTH for the city is proposed with Table/Figures/Graph/Charts/Images, as required.*

### 4.2. ITS Initiatives in Traffic

*This section provides brief regarding traffic related ITS initiatives undertaken in the city, brief analysis of each initiative, sources of its funding, implementing agency, and usefulness of the initiative for NUTH along with Table/Figures/Graph/Charts, as required.*

### 4.3. ITS Initiatives in Transit

*This section provides a brief regarding transit related ITS initiatives undertaken in the city, brief analysis of each initiative, sources of its funding, implementing agency, and usefulness of the initiative for NUTH along with Table/Figures/Graph/Charts, as required.*

### 4.4. Stakeholders Inputs

*Details of user interactions, data collections from various stakeholders in the city with Table/Figures/Graph/Charts, as required.*

### 4.5. Summary and Conclusions

*This section shall provide summary of all the earlier sections giving an overall analysis of the present scenario, requirements of the proposed NUTH based on city characteristics and review of ITS initiatives in the city, conclusions drawn, system to be interfaced with NUTH and defining the need for the city, with Table/Figures/Graph/Charts, as required.*

# 5. PROJECT CONCEPT

### 5.1. Introduction

*This section shall provide a brief regarding the concept of NUTH.*

## 5.2. Goals and Objectives

*This section shall provide the goals and objectives set out for NUTH in the city. Refer Chapter 2.0 of the NUTH Operations Document for more detail*

## 5.3. Project Area

*This section shall provide the details of the geographical/ planning area that would be addressed by the NUTH with Table/Figures/Graph/Charts, as required.*

## 5.4. Project Phasing

*This section provides the details of phasing of NUTH applications for the coverage area(s). Refer Chapter 11.0 of the NUTH Operations Document for more detail.*

## 5.5. Project Components and Specifications

*Detail out the project component and specification along with Table/Figures/Graph/Charts, as required. Refer Chapter4.0 of NUTH Operations Document for guidance.*

## 5.6. Location of NUTH Facility

*This section shall provide the details of the location where NUTH would be set up. In addition, also provide size, location etc. with Table/Figures/Graph/Charts, as required*

## 5.7. Project Elements

### 5.7.1. Transit Information

*This section contains list of transit information to be disseminated, logical flow concept diagram, Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.2. Traffic Information

*This section contains list of traffic information to be disseminated, logical flow concept diagram, Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.3. Parking

*This section contains list of parking information to be disseminated, logical flow concept diagram (as required), Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.4. Construction/Maintenance Activities

*This section contains list of Construction/Maintenance Activities information to be disseminated, logical flow concept diagram (as required), Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.5. Weather

*This section contains list of weather information to be disseminated, logical flow concept diagram (as required), Table/Figures/Graph/Charts etc. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.6. Incident/Accident Information and Planned Events

*This section contains list of Incident/Accident Information and Planned Events information to be disseminated, logical flow concept diagram (as required), Table/Figures/Graph/Charts etc. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.7.7. Trip Planner

*This section contains Trip Planner tool details, trip planning options, logical flow concept diagram, Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

## 5.8. Data Warehousing and Analysis

*In this section define the system, specify the system technology, as required, operations of this component with NUTH, Interfaces with NUTH, Insert logical flow concept diagram with Table/Figures/Graph/Charts, as required. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

## 5.9. Standards and Protocols

*Details of different standards and protocols applicable for the NUTH in the city with Table/Figures/Graph/Charts, as required. Refer Chapter 3.0 of the NUTH Operations Document for guidance.*

## 5.10. System Requirements

### 5.10.1. Transit Information

*This section shall deal with the requirements of the system with respect to dissemination of the transit information. Refer Chapter 4.0 of the Generic Operations Document for guidance.*

### 5.10.2. Traffic Information

*This section shall deal with the requirements of the system with respect to dissemination of the traffic information. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.3. Parking

*This section shall deal with the requirements of the system with respect to dissemination of the parking information. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.4. Construction/ Maintenance Activities

*This section shall deal with the requirements of the system with respect to dissemination of the information related to Construction/ Maintenance Activities. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.5. Weather

*This section shall deal with the requirements of the system with respect to dissemination of the weather information. Refer Chapter 4.0 of Generic Operations Document for guidance.*

### 5.10.6. Incident / Accident Information and Planned Events

*This section shall deal with the requirements of the system with respect to dissemination of the information related to Incident / Accident Information and Planned Events. Refer Chapter 4.0 of Generic Operations Document for guidance.*

### 5.10.7. Trip Planner

*This section shall deal with the requirements of the system with respect to trip planner. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.8. Data Collection, Processing and Storage Requirements

*This section shall deal with the requirements of the system with respect to Data Collection, Processing and Storage. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.9. Data Dissemination

*This section shall deal with the requirements of the system with respect to data dissemination. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.10. Information Alerts

*This section shall deal with the requirements of the system with respect to disseminating the Information Alerts. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.11. Personalised Traveller Information

*This section shall deal with the requirements of the system with respect to disseminating the Personalised Traveller Information. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

### 5.10.12. NUTH Call Centre

*This section shall deal with the requirements of the NUTH call centre. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

#### 5.10.13. NUTH Website

*This section shall deal with the requirements of the NUTH website. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

#### 5.10.14. Mobile Application(s)

*This section shall deal with the requirements pertaining the mobile application(s). Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

#### 5.10.15. NUTH Social Media

*This section shall deal with the requirements of the system with respect to its presence on Social Media. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

#### 5.10.16. Management Information Systems (MIS) Reports

*This section shall deal with the requirements for the system with respect to MIS Reports. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

#### 5.10.17. Language Usage and Information Dissemination

*This section shall deal with the requirements for the system with respect to language(s) to be supported. Refer Chapter 4.0 of the NUTH Operations Document for guidance.*

# 6. PROJECT IMPLEMENTATION, OPERATION AND MAINTENANCE

## 6.1. Project Implementation Process and Timelines

*This section shall provide brief description on Project Implementation and Timelines.*

### 6.1.1. Detailed Project Report

*This section shall include brief description on the DPR.*

### 6.1.2. Agreements between Stakeholders

*This section shall include approach for drawing up and entering into the detailed agreements between the various stakeholders related to NUTH. The ideas is to clearly set out the roles and responsibilities of each stakeholder and funding allocation and responsibilities based on the project requirements, as required. Refer Chapter 6.0 of NUTH Operations Document for guidance including sample draft of agreement.*

### 6.1.3. Preparation of Tender Documents

*This section shall include approach for Tender document preparation to carry out the bidding process for selection of contractors for various items of work, as required. Refer Chapter 6.0 of NUTH Operations Document for guidance.*

### 6.1.4. Bid Process Management

*This section shall include details regarding the bid packages. Based on the project structure and implementation plan finalised by the city authority, the project may involve multiple bid processes, as required. Refer Chapter 6.0 of the NUTH Operations Document for guidance.*

### 6.1.5. Project Implementation, Monitoring and Management

*This section shall include approach for project monitoring and management. After successful completion of the bidding process, project monitoring and management would be required to ensure that contracted deliverable are submitted and obligations are discharged by the selected contractors in accordance with their respective agreements. Refer Chapter 6.0 of the NUTH Operations Document for guidance*

## 6.2. Procurement Approach

### 6.2.1. Procurement Options and the Recommended Option

*This section shall include Procurement approach adopted for project, Rationale for the approach adopted with Table/figures/flow chart etc., as required. Refer Chapter 6.0 of the NUTH Operations Document for guidance.*

### 6.2.2. Risk Identification and Allocation

*This section shall include the objectives of risk management process, Risk Identification and Allocation, Refer Chapter 6.0 of the NUTH Operations Document for guidance.*

## 6.3. Project Implementation, Operations and Maintenance

### 6.3.1. Project Implementation

*This section shall include the brief about the project implementation. Refer Chapter 9.0 of the NUTH Operations Document for guidance*

### 6.3.2. Project Operation

*This section shall include the details of project operation. Refer Chapter 7.0 of NUTH Operations Document for guidance.*

### 6.3.3. Project Assets Maintenance

*This section shall include approach for assets management. Refer Chapter 8.0 of NUTH Operations Document for guidance.*

### 6.3.4. Standard Operating Procedures

*This section shall include Standard Operating Procedure. Refer Chapter 7.0 of NUTH Operations Document for guidance.*

### 6.4. Awareness Campaign and Outreach

*This section shall define the approach for branding and promotion of NUTH related activities and to create awareness.*

### 6.5. Obsolescence Management

*This includes a brief explanation of the issues related with obsolescence, Outline the approach to deal with obsolescence management. Refer Chapter 5.0 of NUTH Operations Document for guidance.*

### 6.6. Retirement and Replacement

*This section shall include approach for planning for system retirement and/or replacement. Refer Annexure 5 of NUTH Operations Document for guidance.*

## 7. PROJECT STAKEHOLDERS AND ORGANISATION

### 7.1. Introduction

*This section shall include brief Introduction to the chapter*

### 7.2. Role of Various Agencies in Transportation

*Details regarding agencies in the transportation sector in the city, roles of various agencies in transportation. Refer Chapter 9.0 of NUTH Operations Document for guidance.*

### 7.3. Project Implementing Agency

*This section shall identify the implementing agency based on institutional structure in the city. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.4. Project O&M Agency

*This section shall identify the O&M agency based on institutional structure in the city. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.5. Stakeholders, Roles and Responsibilities

*This section shall include Identification of stakeholders in transportation, defining Roles and responsibility of the various stakeholders in NUTH. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.6. Data Sharing by Project Stakeholders

*This section shall include the identification of data to be shared by various stakeholders with the NUTH. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.7. Project Organisation

*This section shall include the details regarding requirement of staff for the NUTH, organogram etc. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.8. Agreements between Stakeholders

*This section shall include the details of the agreements between NUTH implementing agency and various stakeholders for data sharing, operations, roles and responsibility, Sample agreement provided in the NUTH Operations Document. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

### 7.9. Training and Capacity Building

*This section shall outline the training and capacity building programme for NUTH staff and associated stakeholders. There would be a need for extensive training initially in the areas of planning and designing of the NUTH and later progressively. Refer Chapter 9.0 of the NUTH Operations Document for guidance.*

## 8. PROJECT SIZING, COSTS, REVENUE AND FUNDING

### 8.1. Introduction

*This section shall include the brief description on financial outlay.*

### 8.2. Details of Project components in the city including sizing/quantity

*This section shall provide Phasing of the components of NUTH, rationale for the adopted phasing. Refer Chapter 11.0 of the NUTG Generic Operations Document.*

### 8.3. NUTH Facility

*This section shall detail out the location and size of the facility for NUTH, providing table, pictures, layout etc., as applicable. Refer chapter 11.0 of the NUTH Operations Document for guidance.*

#### 8.3.1. Equipment at NUTH Facility

*This section shall detail out the equipment required at the NUTH, Insert table, picture, layout etc., as required. Refer chapter 11.0 of the NUTH Operations Document for guidance.*

#### 8.3.2. Field Equipment (if any)

*This section shall detail out the equipment to be required at field for NUTH, Insert table, picture, layout etc., as required. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

## 8.4. Project Cost Estimates

*Brief explanation regarding the approach adopted for cost assessment.*

### 8.4.1. Capital Cost

*This section shall include detailed estimates of components with relevant table. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

### 8.4.2. O&M Cost

*This section shall include detailed costing of each component with relevant table. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

### 8.4.3. Summary

*This section shall summarise the cost.*

## 8.5. Revenue Streams

*This section shall detail out the revenue sources for NUTH, rationale for suggestions, relevant tables, figures etc., as required. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

## 8.6. Implementation Structure

### 8.6.1. Implementation Options

*This section shall include the available options for implementation, PPP options, detailing out the feature of the various options. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

### 8.6.2. Recommended Implementation Option

*This section shall include the adopted implementation structure. Refer Chapter 11.0 of the NUTH Operations Document for guidance.*

## 8.7. Sources of Funding Project Implementation and O&M

*This section shall include the options available for funding and the adopted funding structure. Refer chapter 11.0 of the NUTH Operations Document for guidance.*

# 9. RESOURCES, REFERENCES AND CONTACT DETAILS

## 9.1. Resources & References

*This section shall include details of resources and references, reference heading, publication number, if any, author /organisation, place, month YYYY etc.*

## 9.2. Contact Details

*Provide contact details with name, contact details, organisation, position held etc. of the people/officers who were consulted during the preparation of the DPR.*

# 10. Annexure

## 10.1. Annexure 1: Minutes of Meetings with City Stakeholders

*Insert minutes of meeting(s) with attendance details.*

## 10.2. Annexure 2: Data Collected from City Stakeholders

*Insert data collected from stakeholders*

*Insert table etc*.

## 10.3. Annexure 3: List of Applicable Standards

*Insert list of applicable standards for NUTH*

## 10.4. Annexure 4: Draft Memorandum of Understanding

*Provide draft of MoU with the agencies*

# Annexure 7: Data Security

## 1. Security Architecture

Security can be characterised as a system's ability to resist unauthorised access while still providing its services to legitimate users. An attempt to breach security may be an unauthorised attempt to access data or services or to deny services to legitimate users. Security Management is the process of protecting and maintaining the Confidentiality, Integrity and Availability of data.

As part of security management, following security issues will be addressed for system:

- Services must only be available to authorised staff
- Data must be available only to authorised staff and only at agreed times
- Services must be recoverable within the agreed confidentiality and integrity parameters
- Services must be designed and operated within IT security policies
- Controlled access to hardware or software

Security management in the system will be implemented by providing non-repudiation, confidentiality, integrity, availability, and auditing. Security will address various type of threats such as unauthorised access to the application, network, data and virus etc.

The solution will address security areas such as:

**A. Application Security:** Including user authentication, authorisation, audit trails and DB security.

**B. Network Security:** The Data Centre network security design will be multi-tier architecture and it will be divided in multiple zones. For securing the Data Centre, DDoS protection will take care of denial of services attacks for Network as well as Application level. Next Generation firewall will control and inspect the all inbound and outbound traffic, the Intrusion prevention systems will carry out full inspection and multiple layers of Firewalls will manage the access control.

Security zones will be defined at the Data Centre with security levels defined for each zone to minimise the impact in case of an attack. The access between zones will be controlled with firewalls and routers. Further application and database tiers will be secured by limiting the user access to web servers only.

Specific content level scanning products like Anti-Spam, proxy servers & network anti-virus gateways will be provisioned at appropriate points to ensure content level scanning, blocking and access.

**C. Storage Security:** The master and transactional data stored will be secured by controlling access through application and network security measures such as securing the storage from internal threats by controlling access through proper authorisations, isolating each storage environment from other storage environment etc.

**D. OS Hardening and Vulnerabilities security:** Appropriate Enterprise Security software will be deployed for OS hardening policies. The software shall protect specific operating system platforms from security vulnerabilities that could compromise the confidentiality, integrity, and/or availability of data that is stored and transmitted network.

Appropriate security policies and third party audits will be put in place to ensure and guarantee security of the data and the system.

## 2. Backup and Archiving Strategy

### A. Backup Strategy

A well-defined backup strategy facilitates minimum loss of information in case of an accidental deletion, corruption of data, system failure etc. Data back-up on secondary media is done in addition to the replication of the data on DR site. Backup strategy depends on size of database and rate of growth of database.

The backup strategy will include a sequence of incremental and full back up of data on object store, as described in Table below:

**Data Backup Strategy**

| S. No | Backup Type | Description of Backup |
|---|---|---|
| 1 | Onsite Backup | • Daily Incremental Backup – 6 copies<br>• Weekly Incremental Backup – 4 copies<br>• Monthly Full Backup – 3 copies<br>• Quarterly Full Backup – 4 copies |
| 2 | Archive Backup | • Monthly Full Backup 5 years |

### B. Archival Strategy

Considering the large data size and data's importance, archival strategy will support offline storage of data for meeting legal requirements, fulfilling long-term regulatory compliances and for business continuity.

Considering the volume of the data which will be generated as part of the system, it will not be possible to store all the data for a long period in database. As such, transactional data after a specified period will be archived in accordance to the archival strategy. In order to effectively manage archival and retrieval of data, the archival strategy could include the following:

- Data of all vehicles belonging to one transit agency may be kept together.
- Data of specified category of vehicles can be grouped together.

# Annexure 8: Indicative Terms of Reference

The Consultant shall follow the Generic Operations Document for TMICC and NUTH prepared by the MoUD for preparing city specific documents. The Generic Operations Documents shall be made available on the MoUD's website. These Terms of Reference (TOR) cover 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 work 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 multimodal 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 of the facility.

**Task 1d:** Project Structuring

i. Phasing of the build-out of the TMICC-NUTH facility

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 respective Generic Ooperations Documents

ii. Based on the above, compare different technical requirements and draw up the detailed technical requirements of the systems (including hardware specifications)

iii. Detailed design of the facility (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 the scope listed under Items 1 and 2 above. The Consultant shall also include a chapter in the Detailed Technical Report, outlining a plan regarding 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 TMICC/NUTH. The agreements would clearly set out the roles and responsibilities of each stakeholder.

**4. Preparation of Tender Documents**

The Consultant would be responsible for assisting the implementing agency nominated for setting up of the TMICC/NUTH 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/NUTH.

v. Preparation of agreement for procurement in consultation with the implementing agency. The agreement would comprise 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.

## 5. Bid Process Management

The Consultant shall assist the implementing agency 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 the implementing agency in preparation of responses to the queries received.

**Task 5b**: The Consultant shall carry out the following on behalf of the implementing agency 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 the 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 submissions 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 according to the provisions of the RFP.

**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 implementing agency, 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 implementing agency. This would include the following:

i. Finalisation of Functional Requirements and System Requirements Specification in consultation with the implementing agency

ii. Vetting of the Implementation Plan submitted by the Vendor

iii. Monitoring the progress of implementation and variations from the plan

iv. Monitoring, testing and certifying quality of implementation

v. Examining the impact of Change Requests and providing recommendations on the same

SUSTAINABLE URBAN TRANSPORT PROJECT (SUTP)

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