MINISTRY OF URBAN DEVELOPMENT

GUWAHATI TRAFFIC MANAGEMENT & INFORMATION CONTROL CENTRE AND NATIONAL URBAN TRANSPORT HELPLINE

OPERATIONS DOCUMENT

NOVEMBER, 2016

SUPPORTED BY:

OPERATIONS DOCUMENT

Guwahati TMICC & NUTH

Prepared by

Delhi Integrated Multi-Modal Transit System Ltd. (Lead Partner)
In association with
Transport Research Laboratory, UK and
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November 2016

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Abbreviations

Acronym	Definition/Description
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ASDMA	Assam State Disaster Management Agency
ASTC	Assam State Transport Corporation
AVL / AVLS	Automatic Vehicle Location System
CCTV	Closed Circuit TV
DIMTS	Delhi Integrated Multi-Modal Transit System Limited
DIWT	Directorate of Inland Water Transport, GoA
DPR	Detailed Project Report
ETA	Estimated Time of Arrival
GEF	Global Environment Facility
GMA	Guwahati Metropolitan Area
GMC	Guwahati Municipal Corporation
GMDA	Guwahati Metropolitan Development Authority
GMR	Guwahati Metropolitan Region
GoA	Government of Assam
GoI	Government of India
GPS	Global Positioning System
ISO	International Organization for Standardization
IT	Information Technology
ITS	Intelligent Transport System
IVR/IVRS	Interactive Voice Response (System)
JnNURM	Jawaharlal Nehru National Urban Renewal Mission of GoI
MoU	Memorandum of Understanding
MoUD	Ministry of Urban Development, GoI
NUTH	National Urban Transport Helpline
NUTP	National Urban Transport Policy
PIS	Passenger Information System
PMU	Project Management Unit
PPP	Public Private Partnership
PWD	Public Works Department, GoA
RLVDS	Red Light Violation Detection System
SEMP	Systems Engineering Management Plan

Acronym	Definition/Description
SMS	Short Message Service
SUTP	Sustainable Urban Transport Project
TMICC	Traffic Management and Information Control Centre
VMS	Variable Message Sign(s)

EXECUTIVE SUMMARY

1. Project Background

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

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

- Traffic Management and Information Control Centre (TMICC)
- National Urban Transport Helpline (NUTH)

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

2. ITS, TMICC and NUTH Concepts

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

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

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

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

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

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

3. Scope of the Project/ Document

This document is a concept level document and not a Detailed Project Report (DPR). The city will need to prepare DPR in due course as and when they decide to implement the proposed systems. As the concept is new to the Indian cities and will require additional support from organisations having required expertise, the Ministry of Urban Development (MoUD) has empanelled a set of consultants who may be engaged by the city for seeking assistance in conceptualising, preparing DPR, designing, procuring and monitoring the implementation of TMICC and NUTH in the city. A communication in this regard has already been sent by MoUD to all States including Assam. The indicative scope of services for the city specific project consultancy is as set out in Annexure 6.

4. Guwahati City Characteristics and Transport Sector Interventions Proposed

Guwahati is the capital city of Assam State. It is located on the banks of the Brahmaputra River. It is also the largest commercial, industrial and educational centre of the North-Eastern region of India.

The population of Guwahati city is 9.6 lakh and that of Guwahati Urban Agglomeration is 9.7 lakh (Census of India, 2011). It has an area of 216 sq. km. under the jurisdiction of Guwahati Municipal Corporation (GMC) and 328 sq. km. as Guwahati Metropolitan Area (GMA). In accordance with the Master Plan for Guwahati Metropolitan Area – 2025, the population of GMA is projected between a low of 19.10 lakhs and a high of 22.50 lakhs in 2025. In order to cater to the increased demand for transportation and mobility, Master Plan has identified several interventions for the city. Some of the key interventions proposed in the Master Plan are listed below:

- Grade separators on major corridors such as Assam trunk road and G.S road.
- Road widening at Guwahati club junction, Deghali Pukhri junction etc.
- Parking facilities
- Junction redesign and improvement: Guwahati club junction Deghali Pukhri junction etc.
- Bus terminals, Bus stops and Depot
- Public transport augmentation: both bus and rail based systems

Many of the above interventions have also been proposed in the Comprehensive Mobility Plan (2008) for the city wherein approximate capital cost of implementing the mobility plan has been estimated at about Rs. 8,475 Crores.

Guwahati has well developed road, rail and air connectivity with major cities in India. According to the 2011 census, population density of Guwahati was 4,444 (persons per sq. km.), which seems moderate but is showing an upward trend. In view of the increasing trend in population coupled with inequitable growth in the city infrastructure and road network, congestion on road network has been become order of the day.

Guwahati's public transport system is overburdened and challenged with an increasing demand. The rising prosperity of the population and the continued migration from different parts of Assam to Guwahati have added to the woes of the transport infrastructure of Guwahati. While the road network has remained relatively stagnant over the years, there has been a significant increase in population as well as the number of vehicles on the roads of Guwahati. Around 40,000 new vehicles are registered in Guwahati every year resulting in further pressure on the road network of the city. Modal share of public transport is only 8% while that of private vehicles is 48% in accordance with comprehensive mobility plan for the city. This clearly shows a high degree of dependence of people on private vehicles.

The second order effects of the crippled transport infrastructure are even more significant - the cost of business goes up dramatically as a result of traffic congestion, which results in a huge drain on the economy. The resulting elevated pollution levels due to the rising CO_2 emissions have huge ramifications on the health and environmental fronts as well. To combat these issues, GoA has proposed a Metro rail project in Guwahati.

As the interventions listed in master plan and mobility plan start getting implemented, ITS based initiatives will become increasingly important for the city in order to get the best out the investments made in infrastructure creation. However, ITS is also required which will help in monitoring and managing the whole system eventually resulting in optimisation of transportation infrastructure. It also helps in performance improvement, thus, serving the society better.

5. Need and Benefits of TMICC in Guwahati (Chapter 2.0)

Some of the areas related to traffic management where TMICC will be beneficial for Guwahati are identified as under:

A. Monitoring and Management of traffic

- **Traffic Enforcement**

  The proposed TMICC could either host these systems or develop interfaces with these so that traffic violation data could be captured and stored for analytical and planning purposes covering the following:

  - On-road checks
  - Speed violations
  - Red light violations

- Parking violations
- Entry restriction violations
- Handheld Device Based e-Challan System

- **Management and Monitoring of Traffic Junctions and Roadway Systems**
  - Signal Timing and Operations

    Existing signals in Guwahati city are working in isolated mode and mostly on fixed cycle timing. There is no traffic control room from where signals can be controlled and monitored. Isolated mode and fixed cycle timing based signal operations do not allow for optimisation of network traffic flow. The signals can be made adaptive to live traffic demand, interconnected, monitored and controlled from a central location through TMICC.
  - Road Network Surveillance
  - Traffic Management using
    - Adaptive signals
    - Queue alerts and dynamic rerouting (via VMS)

      At present there are no Variable Message Signs (VMSs) deployed on the city road network. As part of Guwahati TMICC, it is proposed to deploy VMSs at strategic locations. This would support disseminating traffic advisories and other messages to the road network users who are on the road helping them take appropriate route. This would lead to road users avoiding the stretches which are congested, where construction is going on or where some incident has occurred.

- **Monitoring the Functional Status of Various Field Traffic Equipment** and taking steps towards restoration of defective equipment, including,
  - Traffic signals
  - Pan-Tilt-Zoom (PTZ) surveillance cameras
  - Vehicle detection cameras
  - Variable message signs
- **Interfacing with Various Agencies** to obtain information impacting traffic flows
  - Parking agencies
  - Transit agencies
  - Construction / Maintenance agencies
  - Weather system
  - Incident/Events/ Disaster management agencies
- Support traffic management activities related to planned events in coordination and collaboration with other city agencies

B. Data Repository and Analysis: Currently there is no system for capturing and storing historical traffic data that could be used for planning purposes. Guwahati TMICC would act as a platform, where data from multiple sources would be

collected and stored: such as incidents, road construction and maintenance, parking, enforcement etc. Such data could be made available to various planning agencies for the purposes of planning and decision making related to various transportation and traffic interventions. NUTH would access the TMICC data servers containing such data while disseminating the information to public.

C. **Traffic Information Dissemination:** At present limited traffic information is being disseminated by the Guwahati City Traffic Police through website and social media (traffic advisories). Guwahati TMICC, through the proposed Guwahati NUTH, would disseminate a wider set of traffic related information to help individuals make more informed travel decisions, and thereby moderate the effects of traffic congestion on the road network. TMICC, through NUTH, will provide information such as congestion on roads, alternate routes, location of construction and maintenance activities, incident and events information. This is also expected to lead to increased efficiency in transport infrastructure utilisation.

Implementation of TMICC would lead to the following benefits for the city:

- Improvement in overall traffic flow by efficient traffic management thereby improving the efficiency of transportation network.
- Increased road user satisfaction driven by access to real-time traffic information.
- Reduction in traffic congestion.
- Capital expenditure on physical infrastructure build-up to cater to traffic requirements can be avoided or postponed.
- Reduction in energy consumption for transportation.
- Reduction in pollution and Green House Gas (GHG) emissions.
- Improvement in coordination amongst various agencies enabling faster responses to incidents.
- Support for traffic management during disasters.
- Improved planning for traffic management both, for short term measures as well as long term interventions based on data mining and analysis.
- Useful for accident data collection and analysis.
- Collected data can be used for traffic policy formulation for the city.

6. Need and Benefits of NUTH in Guwahati (Chapter 2.0)

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

A. **Unified System for Urban Transport Information System**: Guwahati NUTH would be a unified platform that would be accessible to public through multiple channels for providing all urban transport related information including the traffic, transit and parking related information.

- **Traffic Information Dissemination:** Currently very limited traffic information is provided by Guwahati Traffic Police through its website, social media pages and helpline. Guwahati NUTH would be accessible to public through multiple channels for providing the traffic related information.
- **Transit Information Dissemination:** Currently very limited transit information is provided by individual transit agencies for their respective modes. Guwahati NUTH would provide the transit related information pertaining to all transit agencies to public through multiple channels.
- **Parking Information Dissemination:** Currently no parking information is disseminated by parking agencies. Guwahati NUTH would be accessible to public through multiple channels for providing the parking related information covering location, timing, changes, etc.
- **Incident/ Construction and Maintenance Information Dissemination:** Currently incident related information is not being disseminated to public by Guwahati Traffic Police. The information related to construction/ maintenance is also not available. Guwahati NUTH through multiple channels would provide the incident/ construction and maintenance related information to public.

B. Multi-Modal Information Dissemination System: Presently transit agencies do not disseminate any meaningful transit related information for their respective modes (e.g. Assam State Transport Corporation (ASTC) and Directorate of Inland Water Transport (DIWT)). Information regarding the schedules and routes of public transport services is not available which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. NUTH would act as a single dissemination system from where users/general public can access information about all types of transportation modes in the city.

C. Reducing Traffic Congestion: NUTH would help individuals make more informed travel decisions thereby help in moderating the effects of traffic congestion on the road network. NUTH will provide information such as congestion on roads, alternate routes, construction and maintenance activities and incident information. This information would help users in taking alternate routes thereby preventing not just congestion from aggravating but also support in efficient utilisation of transport infrastructure.

D. Improvement in Public Transport Modal Share: NUTH will disseminate transit and traffic information to public to support informed travel. This would help in increasing the reliability of time taken for travel while using public transport and would also help in attracting people to shift to public transport leading to its enhanced share in overall transport trips.

7. Guwahati TMICC Concept Details

Details about the proposed TMICC are provided below:

A. Guwahati TMICC Project Elements (Chapter 4.0)

Guwahati TMICC would have the following elements:

- Traffic Enforcement System
- Traffic Signal Control (Adaptive)
- Road Network Surveillance System
- Interfaces with agencies
  - Interfaces with the Parking agencies
  - Interfaces with Transit agencies
  - Interfaces with Construction / Maintenance agencies
  - Interfaces with Weather System
  - Interfaces with Incident/Events/ Disaster management agencies
- Traffic Information Dissemination System

B. Guwahati TMICC Project Area (Chapter 4.0)

Proposed project area to be covered by the Guwahati TMICC is recommended to be the Guwahati Metropolitan Area (GMA).

C. Components of Proposed TMICC in Guwahati (Chapter 8.0)

Guwahati city has 49 signalised junctions functioning under fixed time and manually controlled system. These are proposed to be upgraded to an adaptive signalling system with control room connectivity along with other associated facilities. Considering the requirement of additional signalised junctions, a total of 60 junctions have been considered under the project. Table E-1 details the current status and the proposed components. Detailed listing of components has been provided in Chapter 8.0.

Table E-1: TMICC – Scope for Deployment

S. No.	Components of TMICC	Current Status	Proposed System
1.	Upgradation of signalised junctions – Existing 49 Nos.	Signal working in isolated mode	60 Nos.
2.	Variable Message Signs (VMS)	Nil	6 Nos.
3.	Vehicle Detection Cameras	Nil	240 Nos.
4.	PTZ cameras for junction surveillance	Nil	100 Nos.
5.	TMICC	NA	250 sq. mt.

D. Budget (Chapter 8.0)

For the key components mentioned in the Table E-1 (Section C above) and other associated components as detailed in the Section 8.2 (Chapter 8.0), an estimated budget of **₹ 22.2 crores** for Guwahati TMICC is proposed as capital cost and an annual budget of **₹ 5.4 crores** to meet operational and maintenance expenses. The project cost and sizing may undergo changes at the time of preparation of the detailed project report.

E. TMICC Implementing Agency (Chapter 7.0)

GMDA currently installs and maintains traffic signals in the city and Guwahati Traffic Police regulates and manages traffic in Guwahati. Guwahati Traffic Police also operates the traffic signals. Considering the current role of GMDA and Guwahati Traffic Police in the city, it is recommended that GMDA should setup and maintain TMICC and Guwahati Traffic Police should operate the TMICC. However, in case the GoA decides to entrust the complete responsibility for setting up and maintaining the TMICC upon Guwahati Traffic Police, it may do so.

It may be noted that in Mumbai, Ahmedabad and Pune, respective municipal corporations install and maintain traffic signalling system and the Traffic Police operates them. In case of Delhi, it is the Traffic Police that have the complete responsibility for installing, operating and maintaining the traffic signals.

F. Information Dissemination (Chapter 4.0 and Chapter 5.0)

TMICC would disseminate traffic related information to public so that they can plan their travel using the same. Such information would include road closures, event details, traffic congestion, traffic advisories etc. and the same would be disseminated through various channels: website, mobile app, social network (Twitter, Facebook) and variable message signs. The information would be disseminated through the proposed Guwahati NUTH.

8. Guwahati NUTH Concept Details

Details about the proposed Guwahati NUTH are provided below:

A. Guwahati NUTH Projects Elements (Chapter 5.0):

Guwahati NUTH is proposed to have the following elements:

- Transit Information Dissemination
- Traffic Information Dissemination
  - Congestion heat map
  - Construction / Maintenance Activities Information Dissemination
  - Incident / Accident/ Events/Disaster Information Dissemination
- Parking Information Dissemination
- Weather Information Dissemination
- Trip Planner/ Route/ Fare Planner

B. Guwahati NUTH Project Area (Chapter 5.0)

Proposed project area for Guwahati NUTH is recommended to be the Guwahati Metropolitan Area (GMA).

C. NUTH Implementing Agency (Chapter 7.0)

Transport Department (GoA) would be a key stakeholder for NUTH by virtue of it being the administrative department of the transit agencies (ASTC and DIWT) and its regulatory role in respect of road transport sector. In view of this, it is suggested that NUTH for Guwahati be set up and managed by Transport Department, GoA. The NUTH may be co-located within the TMICC facility.

D. NUTH Dissemination Modes (Chapter 5.0)

a. **Website:** Guwahati NUTH would have a well-designed website. The user interfaces would be designed in a manner that are intuitive, support easy navigation and enable faster access to the relevant information. High quality Geographical Information System (GIS) maps would be used to display routes, incidents, congestion information, road closure details etc. to enrich user experience. Website would have multimodal journey planning tool to support trip planning between various origin and destinations using several options such as modal preference, date, time, fastest, least transfers/ cost/ time/ walk etc.

b. **Mobile Application:** Guwahati NUTH would have a well-designed mobile application. The application would be designed for key mobile operating systems like iOS, Android, Windows, etc. GIS maps would be used to display route, incidents, congestion information, road closure details etc. to enrich user experience. Guwahati NUTH mobile app would have multimodal 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. Guwahati NUTH may, in addition, share information with private entities in standardised formats so that further mobile apps could be creatively designed to disseminate transit and traffic information to public. This would also help in popularisation of transit.

c. **Social Media:** Guwahati NUTH would set up social media pages such as those on Facebook and Twitter for providing information and updates, and reaching out to the public for their feedbacks.

d. **Phone helpline:** Guwahati NUTH would, in addition to other information dissemination channels, set up telephone helplines to provide information to public through Interactive Voice Response (IVR) and/or operators. The objective would be to provide most of the information on IVR mode. The IVR process flow would be designed in such a way that enables callers to access relevant information in the most efficient manner. Live customer support would also be provided.

E. Standardised & Simple Number: Currently, the public transport helpline number is a six digit number (155220) which has been allotted by Department of Telecom, GoI to MoUD for NUTH. It is desirable that the helpline number be convenient to remember and use for people from all walks of life and all sections of society. It is recommended that MoUD obtain a three digit number instead of a six digit one as that would be easy to remember and communicate and therefore, be more accessible (Chapter 5.0).

F. Budget: A budget of **₹ 6.8 crores** is required for implementation of Guwahati NUTH project based on the components listed in Section A above, which include the project development, systems engineering, hardware, software, systems integration, testing and commissioning. In addition, a budget of **₹ 1.8 crores** is required towards annual operations and maintenance expenses of the Guwahati NUTH (Chapter 8.0). The project cost and sizing may undergo changes at the time of preparation of detailed project report.

9. Funding (Chapter 8.0)

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

Multilateral or bilateral funding may also be secured at Central Government, State Government or City levels. Since the project supports 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 TMICC may be borne by the Guwahati Traffic Police and that of NUTH by Transport Department.

10. Recommendations

Considering that several interventions have been proposed by the city towards infrastructure creation and augmentation as part of its master plan as well as the mobility plan, it would be highly beneficial for the city to implement TMICC and NUTH systems as proposed in this report. These ITS initiatives have the potential to transform the way the city manages and monitors its transportation assets.

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

1.0 INTRODUCTION

1.1 Project Background

The Government of India (GoI) initiated the Sustainable Urban Transport Project (SUTP) with support of Global Environment Facility (GEF), United Nations Development Programme (UNDP) and World Bank (WB). The primary objectives of SUTP are to apply National Urban Transport Policy (NUTP) to achieve a paradigm shift in India's urban transportation system for more favourable sustainable developments and alternatives. The Ministry of Urban Development (MoUD) has been designated as the nodal agency for implementation of the project. SUTP *inter alia* aims at providing technical assistance to MoUD in order to improve capacity at National, State, and Local levels to implement the NUTP. As a part of component PC1B2 of SUTP, generic operations documents have been developed for:

- Traffic Management and Information Control Centre (TMICC)
- National Urban Transport Helpline (NUTH)

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

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

1.2 Report Context

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

Together with the Operations Documents, City Specific Documents are also to be prepared for the selected cities and the chosen concepts. Using Generic Operations Documents, this report provides the city specific plan for TMICC and NUTH for Guwahati.

This document is a concept level document and not a Detailed Project Report (DPR). The city will need to prepare DPR in due course when they decide to implement the proposed systems. As the concept is new to the Indian cities and will require additional support from organisations having required expertise, the Ministry of Urban Development (MoUD) has empanelled a set of consultants who may be engaged by the city for seeking assistance in conceptualising, preparing the DPR, designing, procuring and monitoring the implementation of TMICC and NUTH in the city. A communication in this regard has already been sent by MoUD to all States including Assam. The indicative scope of services for the city specific project consultancy is as set out in Annexure 6.

2.0 CITY CHARACTERISTICS

2.1 Guwahati

Guwahati is the capital of Assam State and lies on the Southern bank of the Brahmaputra River. Guwahati and its surrounding areas have been combined to create a local planning area termed as Guwahati Metropolitan Area (GMA) with a spread of 328 sq. km. It includes the Guwahati Municipal Corporation area, entire North Guwahati Town Committee area and some nearby villages. Guwahati is the tourism gateway to the North-East region of India. Additionally, large number of students and workers from the rest of the State and other parts of the north-east region visit/migrate to Guwahati on a regular basis. The growth in Guwahati is characterised by densification of the central core area and ribbon development along the main transportation corridors.

The GMA is in the process of being expanded to cover additional contiguous areas and is being termed as Guwahati Metropolitan Region (GMR) with total area of 2205 sq. km. The GMR has areas from five districts namely Kamrup, Darrang, Nalbari, Morigaon and Kamrup Metro and comprises 12 revenue circles and 11 urban areas. Figure 2-1[3] shows Guwahati and its nearby areas.

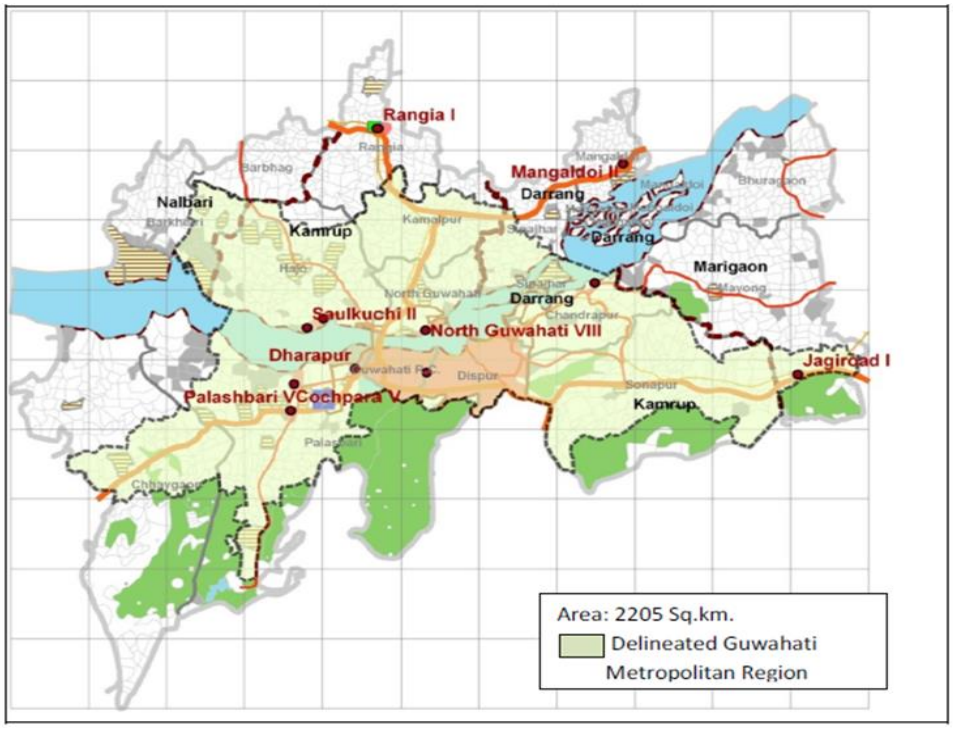


Figure 2-1: Guwahati Area (GMR)

[3] Source: Comprehensive Mobility Plan for Guwahati (2008)

2.1.1 Demographic Trends

The Guwahati city has an area of 216 sq. km. under the jurisdiction of Guwahati Municipal Corporation (GMC) with a population of 963,429 and 328 sq. km. as Guwahati Metropolitan Area (GMA) with a population of 968,549 (census 2011). The Guwahati Metropolitan Area is also known as the Guwahati Urban Agglomeration (Table 2-1). In accordance with the Master Plan for Guwahati Metropolitan Area – 2025, it is estimated that the population of GMA is projected to range from a low of 19.10 lakhs to a high of 22.50 lakhs in 2025.

Table 2-1: Guwahati Population and Area

Population and Area	
State	Assam
Population	0.963 million (Guwahati Municipal Corporation area) 0.968 million (Guwahati Urban Agglomeration) Source: Census of India (2011)
Area	216 sq. km. (Guwahati Municipal Corporation area) 328 sq. km. (Guwahati Metropolitan Area)

The population density of Guwahati has been steadily increasing. Figure 2-2 shows the growth trend experienced in population density since 1981.

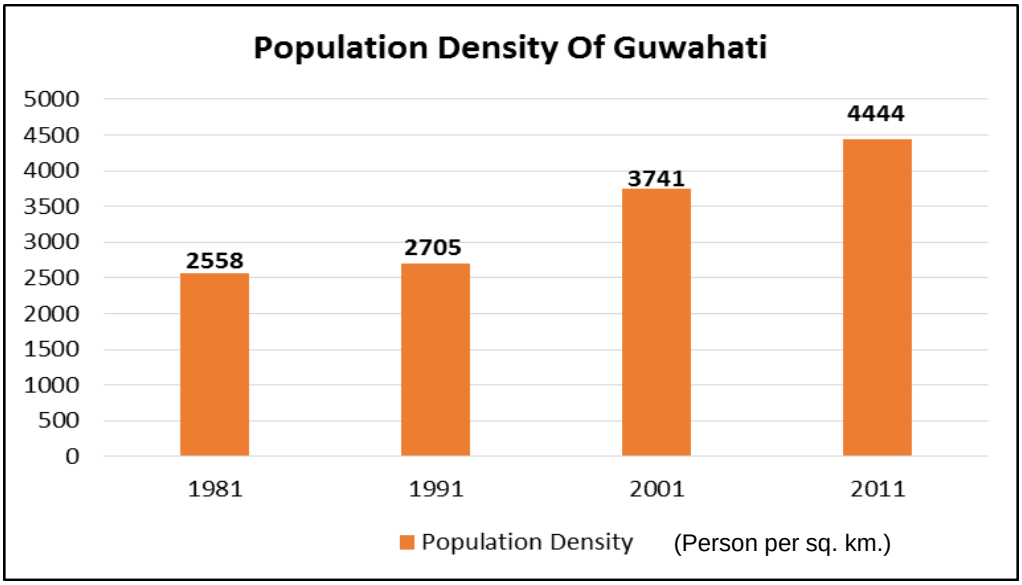


Figure 2-2: Decadal Growth in Population Density of Guwahati Metropolitan Area

The density of 4,444 (persons per sq. km.) in 2011 is moderate. The population density is showing an increasing trend as can be noted from the Figure 2-2. The growth experienced by the city has not been uniformly distributed and the same has largely been skewed resulting in congestion experienced in certain pockets. With increase in population, coupled with inequitable growth in the city, infrastructure and road network have been burdened and congestion has become order of the day.

2.1.2 Registered Motor Vehicles

Number of vehicles registered in Kamrup district in which Guwahati is located during the three years is provided in the Table 2-2[4]. From the statistics, it can be seen that close to 60,000 vehicles are getting registered annually.

Table 2-2: Registered Motor vehicles in Kamrup District

Year	No. of Vehicles Registered
2011-12	62,000
2012-13	58,638
2013-14 (till December)	46,934

2.1.3 Increasing Number of Accidents

The Table 2-3[5] represents the accidents data for the last five years in Guwahati city. The data shows that the number of accidents over each of the three years from 2011-2013 have remained over 1,000.

Table 2-3: Year wise Number of Accidents in Guwahati Municipal Corporation Area

Year	Non- Fatal	Fatal	Total
2009	475	201	676
2010	665	244	909
2011	806	279	1085
2012	844	234	1078
2013	844	242	1086
2014 (up to March)	211	72	283

[4] Source: District Transport Office, Kamrup (Metro)
[5] Source: Guwahati Traffic Police

2.2 Existing Traffic and Travel Characteristics

2.2.1 Per Capita Trip Rate

The per capita trip rate is calculated based on the total trips made in a day as against the total population in the city. The per capita trip rate for Guwahati is 0.98 for all types of modes[6].

2.2.2 Average Speed

The average speed on Guwahati roads is 20 kmph[7]. The congested corridors and junctions are highlighted in the figure given below.

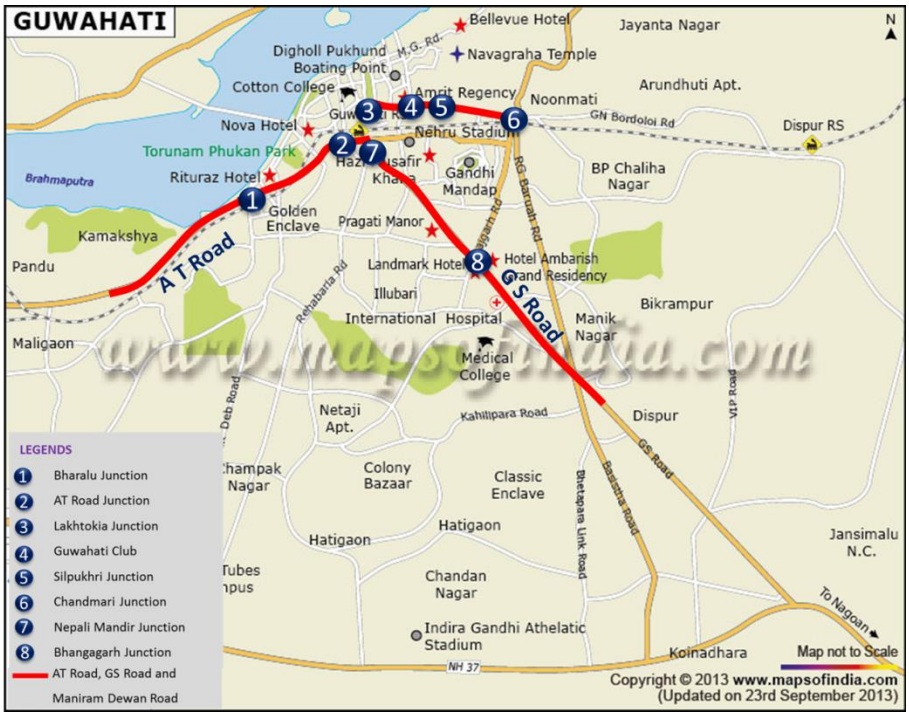


Figure 2-3: Congested Corridors and Junctions in Guwahati

The major congested corridors are G.S Road and A.T Road and almost all junctions in the city centre area are congested with Volume-to-Capacity Ratio (V/C)> 1.

2.2.3 Average Trip Length

Guwahati has an average trip length of 4.1 km for all modes combined.[8]

[6] Source: Study on Traffic and Transportation Policies and Strategies in Urban Areas of India, GoI (2008)
[7] Source: Comprehensive Mobility Plan (CMP), Guwahati (2008).
[8] Source: Study on Traffic and Transportation Policies and Strategies in Urban Areas of India, GoI (2008)

2.2.4 Modal Share

In Guwahati the number of trips by walk account for 21% of the total trips made daily. Public transport has a share of 8% of the total trips. Cars and two wheelers have a share of 18% and 20% respectively. The mode wise share of Guwahati has been presented in Table 2-4[9].

Table 2-4: Modal Share for Guwahati

Mode	Share
Walk	21%
Cycle	21%
Two Wheeler	20%
Public Transport	8%
Car	18%
IPT	12%

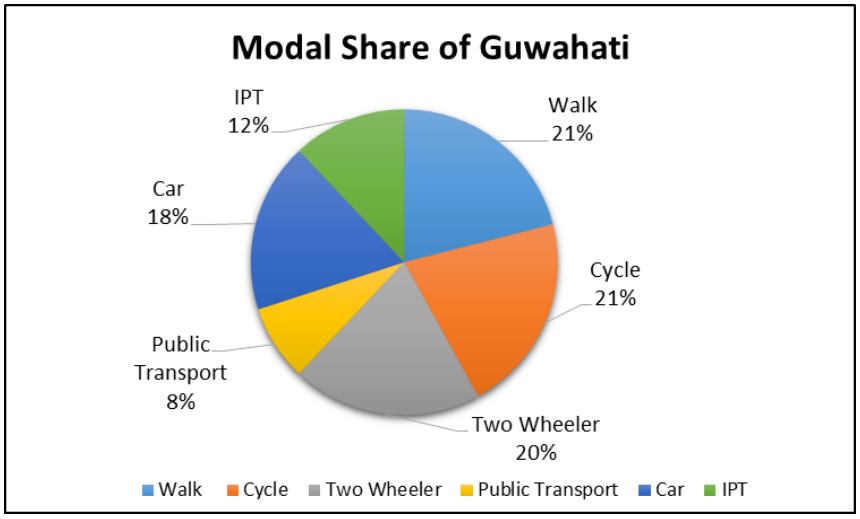


Figure 2-4: Mode-wise Distribution of Trips in a day

2.2.5 Existing Public Transport Provisions in Guwahati

A. Urban Public Transport

Guwahati has bus service managed and operated by Assam State Transport Corporation (ASTC) with a fleet of 232 buses of which 178 buses have been procured under JnNURM (2014). Another 400 buses have been sanctioned in January 2014 under JnNURM for the city. ASTC is operating the bus service in

[9] Source: Comprehensive Mobility Plan (CMP), Guwahati (2008)

Guwahati city as well as suburban areas in the entire Guwahati Metropolitan Area. ASTC has its control room at Roop nagar, Noonmati ISBT. There are over 800 buses being operated by the private operators under permit from the Transport Department, GoA.

Figure 2-5 shows the view of ASTC's Paltan Bazar bus terminal near the Guwahati Railway Station.

Figure 2-5: ASTC's Paltan Bazar Bus Terminal, Guwahati

In addition to the ASTC buses, there are private minibuses, 10-seater Trekkers and auto rickshaws that cater to the urban transport needs in the city. There are 1153 privately owned minibuses operating in the city. ASTC city service division is currently operating its buses within a radius of 35 kms. of the city. There are 1116 10-seater Trekkers which provide service along the secondary corridors in the city. There are 4462 auto-rickshaws that have permit to operate in Guwahati and several thousand cycle-rickshaws. These cycle-rickshaws are licensed by the Guwahati Municipal Corporation (GMC).

B. Rail Network

A broad gauge railway line connects Guwahati with other nearby major towns like Rangia, Bongaigaon, Khetri, Dibrugarh – Tinsukia etc. and further with the rest of the country.

C. Airport

Lokapriya Gopinath Bordoloi International Airport at Guwahati is the largest besides being the busiest airport in the entire north-eastern region. It connects Guwahati with the major cities like Delhi, Mumbai, and Kolkata as well as with other cities in Assam and the north-eastern region like Agartala, Imphal, Silchar, Dimapur and Dibrugarh. Guwahati airport caters to both private and national airlines and has been recently converted into an international airport with direct connectivity to south-east Asia.

D. Inland Waterways

The Brahmaputra River provides an opportunity for developing an inland waterways system for connecting Guwahati with the region as well as with the rest of the country. While the river has been declared National Waterways-2 by the Ministry of Shipping, the waterway has not been utilised properly for effecting the movement of goods and people. At present, Directorate of Inland Water Transport, GoA is operating ferry services across the Brahmaputra River. There are 22 ferry services operating from six river terminals serving over 8,000 passengers per day. However, the ferries used for carrying passengers are old and do not have the capacity to carry vehicles thereby reducing the effectiveness of the entire system.

Figure 2-6 shows the view of Kuchary Umananda Inland Water Transport Terminal in Guwahati.

Figure 2-6: Kuchary Umananda Inland Water Transport Terminal, Guwahati

2.3 Transport Performance Indices

According to the MoUD study in 2008, Transport Performance Indices for Guwahati for variables such as public transport, congestion, walkability, safety, parking and city bus transport supply were derived and the same are presented in Table 2-5[10]. Annexure 4 can be referred for more details regarding the approach adopted for computing the Transport Performance Indices.

Table 2-5: Transport Performance Indices

Index	Value	Remarks
Public Transport Accessibility Index	1.22	Represents whether public transport is available within 500 m; higher the value, better is the accessibility. Public Transport Accessibility Index is nearly equal to the national average of 1.2. This figure is lower as compared to cities like Delhi and Mumbai.
Congestion Index	0.33	Lower the value, better the speed. The average value is 0.25 and index below 0.25 is considered as good.
Walkability Index	0.39	Higher value shows better network and facilities for pedestrians. The average value of index is 0.52 and any value below it is considered as poor.
City Bus Transport Supply Index	4.2	Higher value refers to better bus supply; National average value is 14.5. Guwahati has lower bus supply index
Safety Index (1/Fatality per lac)	0.03	Safety level is low. Higher value implies better safety. The index value of 0.10 is considered reasonable.
Para Transit Index	52.5	This shows the number of para transit vehicles for 10,000 population. For Mumbai the value is 88.3. For Delhi the value is 75.6.
Slow Moving Vehicle Index	0.09	This shows lack of slow moving vehicle facilities. Value almost equal to national average of 0.07. Higher value refers to better facilities. Low value is due to non-availability of facilities like cycle lane etc. for slow moving vehicles (SMV) which discourages the use of SMV.

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

Index	Value	Remarks
On- Street Parking Interference Index (1/% of on-street parking on road length)	1.37	Higher value refers to better parking management. Value moderately higher than the national average of 1.3.

The above indices represent the efficiency of the transport system of a city. From the above table, it is seen that Guwahati has higher congestion index, probably because of slow moving traffic interference with the main traffic stream. It is observed that the transport performance indices of Guwahati are below average when compared to transport performance index of other 30 cities in India in accordance with the study.

2.4 Road Network Characteristics

Guwahati is at the junction of National Highway 31, National Highway 37 and National Highway 40. National Highway 31 connects Guwahati to the rest of the country in the west, while other National and State Highways connect Guwahati city with North-Eastern States of Tripura, Meghalaya, Mizoram, Manipur, Nagaland and Arunachal Pradesh.

The city has a well-developed connectivity with the rest of the country. The city acts as the gateway to the north-east region providing connectivity with Shillong, Mizoram and southern parts of Assam. The National Highway 31 connects the city with Bongaigaon, Dhuburi and enters West Bengal in the west. All the census towns and other important areas are located on or along the National Highways 31 and 37 (Figure 2-7).

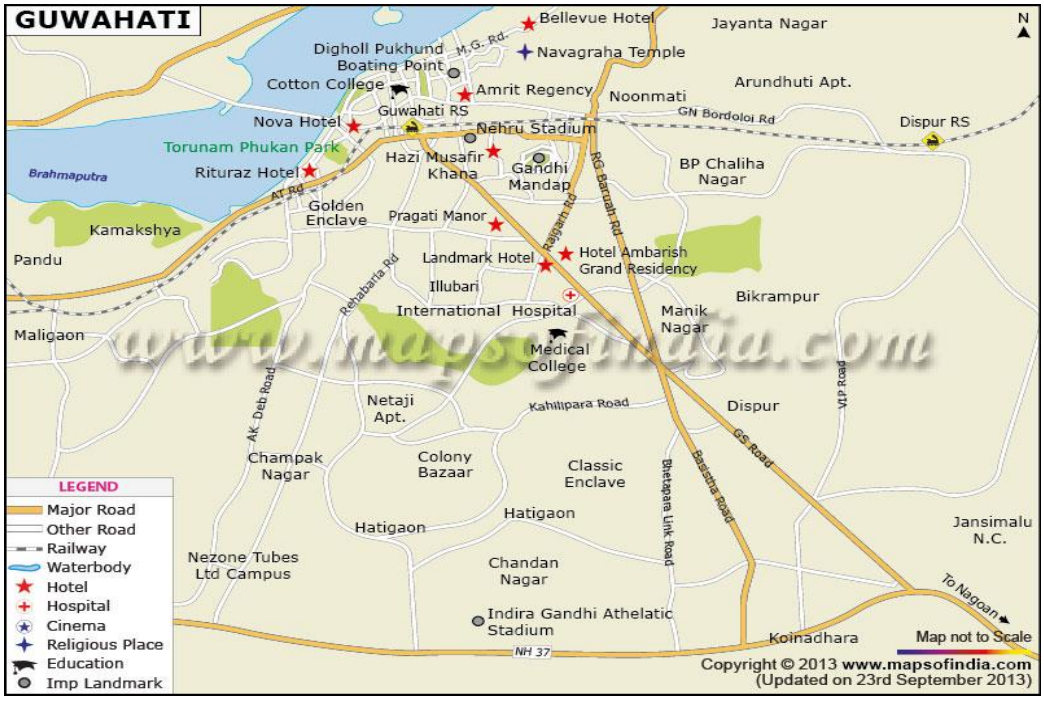


Figure 2-7: Guwahati Road Network

2.5 Travel Demand Forecast

In accordance with the MoUD study, the travel demand forecast for public transport and non-motorised trips in Guwahati is estimated to be the following (Table 2-6)[11].

Table 2-6: Travel Demand Forecast

Mode	Horizon Year Trips/Day					
	2011		2021		2031	
	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage
PV+ IPT	7.70	55.8	10.62	61.8	14.41	67.50
PT	0.59	4.28	0.65	3.82	0.80	3.75
NMT	5.50	39.89	5.89	34.3	6.13	28.75

PV: Private Vehicles, IPT: Intermediate Public Transport, NMT: Non-Motorised Transport

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

In order to cater to the increased demand for transportation and mobility, Master Plan for Guwahati Metropolitan Area – 2025 has identified several interventions that would support the projected transportation demand in the city. Some of the key interventions are listed below:

- Grade separators on major corridors such as Assam trunk road and G.S road.
- Road widening at Guwahati club junction, Deghali Pukhri junction etc.
- Parking facilities
- Junction redesign and improvement: Guwahati club junction Deghali Pukhri junction etc.
- Bus terminals, Bus Stops and Depot
- Public transport augmentation: both bus and rail based systems

Many of the above interventions have also been proposed in the Comprehensive Mobility Plan (2008) for the city wherein a capital outlay of Rs. 8,475 Crores has been proposed for various transportation sector projects.

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

2.6 Opportunities for Improvement in the Present Transport System

The issues identified with the existing transport system are as follows:

- **Centralised Signal Monitoring, Operation and Control:** Existing signals in Guwahati city are working in isolated mode and mostly on fixed cycle timing. There is no traffic control room from where signals can be controlled and monitored. Isolated mode and fixed cycle timing based signal operations do not allow for optimisation of network traffic flow. The signals can be made adaptive to live traffic demand, interconnected, monitored and controlled from a central location through TMICC.

- **Variable Message Signs:** At present there are no VMSs deployed on the city road network. As part of Guwahati TMICC, VMSs can be deployed at strategic locations. This would support disseminating traffic advisories and other messages to the road network users who are on the road helping them take appropriate routes. This would lead to road users avoiding the stretches which are congested, where construction is going on or where some incident has occurred.

- **Data Repository and Analysis:** Currently there is no system for capturing and storing historical traffic data that could be used for planning purposes. Once implemented, Guwahati TMICC would act as a platform, where data from multiple sources would be collected and stored. Such data could be made available to various planning agencies for the purposes of planning and decision making related to various transportation and traffic interventions.

- **Traffic Information Dissemination:** At present limited traffic information is being disseminated by the Guwahati City Traffic Police through website. Guwahati TMICC, through the proposed Guwahati NUTH, would disseminate a wider set of traffic related information to help individuals make more informed travel decisions, and thereby moderate the effects of traffic congestion on the road network. TMICC, through NUTH, will provide information such as congestion on roads, alternate routes, construction and maintenance activity, incident and events information. This is also expected to lead to increased efficiency in transport infrastructure utilisation.

2.7 Need Analysis

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

- City has congested network as is evident from the average traffic speed mentioned in Section 2.2.2. Congestion index of Guwahati is 0.33 which is higher than the national average of 0.25.

  Incremental growth in registered vehicles as mentioned in Section 2.1.2 is further degrading the traffic conditions. TMICC can help in optimally utilising the road network, thereby reducing congestion on roads.

- As found from studies referred to in Section 2.1.1, Guwahati city is registering a rapid growth in population density over previous several decades. This is reflecting on the city roads leading to compromising safety and congestion issues. TMICC system will help in mitigating congestion and enhancing traffic safety.
- Table 2-3 shows that traffic accident related injuries are on an upward trend. TMICC system will help in analysing the spots where accidents are occurring frequently and suggest measures for enhancing safety and reducing accidents.
- Section 2.5 has statistics obtained from "Study on Traffic & Transportation Policies and Strategies in Urban Areas in India, GoI (2008)" that show that trips by private vehicles are expected to grow to about 67.5% by the year 2031 in Guwahati. This is likely to further degrade the congestion levels in the city. Therefore, a focused attention towards popularising the public transport is a need and NUTH, as a transport information dissemination system, can support the same.
- Availability of information about public transport also affects its usage. NUTH will disseminate information related to various modes of public transport in Guwahati to public.
- Information regarding schedules and routes of public transport services in Guwahati is not available which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. An effective integrated information dissemination system in the form of NUTH would facilitate planning of multimodal journeys, minimise wait times at stations, and increase the overall satisfaction of public with the public transport services.

2.8 Project Benefits

Considering that several interventions have been proposed by the city towards infrastructure creation and augmentation as part of its master plan as well as the mobility plan, it would be highly beneficial for the city to implement TMICC and NUTH systems as proposed in this report. These ITS initiatives have the potential to transform the way the city manages and monitors its transportation assets.

2.8.1 Guwahati TMICC Benefits

The Guwahati TMICC is expected to lead to improved transport asset utilisation, savings in investments required for transport/road infrastructure, enhanced safety, reduction in congestion, better compliance with traffic rules, fuel savings and reduce the negative impacts of traffic and travel thereby mitigate environmental impact. The benefits would accrue at multiple levels: individuals, public at large, commercial and other organisations etc.

The United States Department of Transportation (USDOT) which has been measuring and documenting transportation benefits associated with ITS deployment has developed a matrix for potential benefits, as is shown in Table 2-7.

Table 2-7: Potential Benefits and Measurements

Type of Benefits	Typical Measurement and Description	Examples of Associated Technologies related to Traffic Management and Information Control Centre
Safety	Changes in crash rates or other surrogate measures, such as vehicle speeds, traffic conflicts, or traffic law violations	• Traffic Signal Control • Variable Message Signs • Support Police Enforcement • Road Weather Information and Management • Construction Management
Mobility	Travel time or delay savings, as well as travel time budget savings, and on-time performance.	• Variable Message Signs • Adaptive Signal Controls • Surveillance • Construction Management
Productivity	Cost savings to transportation providers, travellers, or shippers	• Road Weather Information & Management • Variable Message Signs
Energy and Environment	Fuel savings and reduced pollutant emissions	• Advanced Signal Systems • Variable Message Signs • Road Network Surveillance • Pre-Trip Information, • Speed / Congestion information
Efficiency	Management of transportation facilities to accommodate additional demand with increase in capacity or level of service	• Variable Message Signs • Signal Controls and coordination • Pre-Trip Information • Construction Management
Customer Satisfaction	Amount of travel in various modes, mode choices and quality of service as well as volume of complaints and/or compliments received	• Any of the ITS programmes

Implementation of TMICC would lead to the following benefits for the city:

- Improvement in overall traffic flow by efficient traffic management thereby improving the efficiency of transportation network.
- Increased road user satisfaction driven by access to real-time information regarding traffic.
- Reduction in traffic congestion.
- Capital expenditure on physical infrastructure build-up to cater to traffic requirements can be avoided or postponed.

- Reduction in energy consumption for transportation.
- Reduction in pollution and Green House Gas (GHG) emissions.
- Improvement in coordination amongst various agencies enabling faster responses to incidents.
- Support for traffic management during disasters.
- Improved planning for traffic management both, for short term measures as well as long term interventions based on data mining and analysis.
- Useful for accident data collection and analysis.
- Collected data can be used for framing traffic policy for the city.

2.8.2 Guwahati NUTH Benefits

Guwahati NUTH will have multiple benefits for the users which are tabulated below:

Table 2-8: NUTH Benefits

Information Dissemination	Benefits
Transit Information Dissemination	• **Receive** transit related information on various channels such as phones, mobile apps, web-portal etc. for various modes of transport from a single source • **Decide** on the most suitable transit mode(s) and routes for travel. • **Avoid** waiting time at transit stops, stations and terminals • **Improve** the reliability of access to public transport • **Enhance** travelling experience and quality of life
Traffic Information Dissemination	• **Receive** traffic information on various channels such as phones, mobile apps, web-portal etc. • **Decide** on the most suitable route for travel • **Avoid** congested routes • **Improve** journey time reliability • **Enhance** travelling experience and quality of life
Incident/ Construction and Maintenance Information Dissemination	• **Receive** incident information on various channels such as phones, mobile apps, web-portal etc. • **Decide** on the routes taking into consideration the incident/ construction information. • **Avoid routes** where incident/ construction are reported. • **Improve** journey time reliability by avoiding routes where incidents/ construction are reported. • **Reducing** the chances of congestion by providing information regarding incidents/ construction

Information Dissemination	Benefits
Parking Information	• **Receive** parking information on various channels such as phones, mobile apps, web-portal etc. • **Decide** the parking location based on the distance/convenience • **Avoid** undesired movements in finding parking space/site • **Improve** travel and parking experience, saving in time and effort • **Reduce** unnecessary trips and relieve congestion on road

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

- **Unified System for Urban Transport Information System**: Guwahati NUTH would be a unified platform that would be accessible to public through multiple channels for providing all urban transport related information including the traffic, transit and parking related information.
- **Multi-Modal Information Dissemination System:** Presently transit agencies (ASTC and DIWT) disseminate limited transit information through their respective channels for their respective modes only. Information regarding the schedules and routes of public transport services in Guwahati is not accessible to users which not only inconveniences the transit users but also discourages modal shift from private to public transport modes. NUTH would act as a single dissemination system from where users/general public can see information about the multiples transportation modes in the city.
- **Reducing Traffic Congestion:** NUTH would help individuals make more informed travel decisions thereby help in moderating the effects of traffic congestion on the road network. NUTH will provide information e.g. congestion on roads, alternate routes, construction and maintenance activity, incident activity information. This information would help users in taking alternate routes leading to preventing not just congestion from aggravating but also supporting in efficient utilisation of transport infrastructure.
- **Improvement in Public Transport Modal Share:** NUTH will disseminate transit and traffic information. Transit information will cover Estimated Time of Arrival (ETA), real time running status and routes on which particular transit is available, among others. This would help in increasing the reliability of time taken for travel while using public transport and would help in attracting public to shift to public transport leading to its enhanced share in overall transport trips.

3.0 REVIEW OF TRAFFIC AND TRANSIT ITS INITIATIVES

3.1 ITS Background and Initiatives

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

3.2 Traffic Related ITS Initiative: Traffic Signalling System

In line with its mandated role, Guwahati Police, through its Traffic Police wing, regulates and manages traffic in Guwahati. As part of this, Guwahati Traffic Police monitors and operates traffic signals in the city. Guwahati Metropolitan Development Authority (GMDA) installs and maintains traffic signals in Guwahati through contractors engaged for the purpose. There are 49 signalised intersections in the city all of which are operated and controlled locally through the signal controllers installed at the junctions. There is no centralised traffic control room for monitoring and controlling the traffic signals in the city. Most of the major junctions have CCTV cameras installed by Guwahati Police for security related surveillance. Figure 3-1 shows snapshots of CCTV system and traffic signals in Guwahati.

Figure 3-1: View of Traffic Signal and CCTV Cameras, Guwahati

The City Development Plan (2006) for Guwahati contains references to the status of traffic signals in the city (Figure 3-2) and recommends for installation of traffic actuated signals. Comprehensive Mobility Plan (2008) for Guwahati provides for introduction of area traffic control system in the city (Figure 3-3).

Traffic Signals: City Development Plan, Guwahati

Isolated Traffic Signals

While channelisation of approaches to intersections reduces the conflict area, they function only when the volume are low in nature and has large time and space headways in the cross traffic, sufficient for merging. These gaps decrease the volumes of flows thereby necessitating physical stoppage of one of the conflicting flows to facilitate the movement of the other. At present, within the city there are a number of fixed time signalised intersections which need to be replaced by traffic actuated signalised.

Signal system optimisation and Area traffic control

Even if the number of signalised intersections is increased, the overall delays may not be optimised unless all these signals are interconnected. If the signals are not integrated, management of traffic will become increasingly difficult within the city.

Source: City Development Plan, Guwahati (2006)

Figure 3-2: Traffic Signals: City Development Plan, Guwahati

Area Traffic Control Systems, Comprehensive Mobility Plan, Guwahati

The Area Traffic Control Systems shall link various elements of Intelligent Transport Systems such as vehicle actuated traffic signals, surveillance cameras, enforcement cameras etc., enabling decision makers to identify and react to an incident in a timely manner based on real-time data. The ATC will help reduce incident response times, lower incident rates (mainly secondary incidents), disseminate traveller information and hence reduce congestion and enhance safety.

Source: Comprehensive Mobility Plan, Guwahati (2008)

Figure 3-3: Area Traffic Control Systems, Comprehensive Mobility Plan, Guwahati

3.3 Traffic Information Dissemination System

3.3.1 Traffic Police Website

Guwahati City Traffic police has no separate website of their own. Their website is clubbed with the Guwahati city police website (http://guwahaticitypolice.gov.in/) (Figure 3-4). The website provides some traffic related information, rules and regulations and other general information such as number plate specification, accident data, fines collected. Press releases related to parking arrangements/restrictions, traffic diversions etc. are also uploaded on the website from time to time.

Figure 3-4: Guwahati Police Website

3.3.2 Social Media

Guwahati City Police also has a Facebook page (Figure 3-5, https://www.facebook.com/pages/Guwahati-City-Police/211606768891234) and Twitter page (Figure 3-6) for providing traffic advisory to the public. These pages are not currently functional and are not being updated. Guwahati City Traffic Police do not have their own social media pages and these are common for both Guwahati Police and Guwahati City Traffic Police.

Figure 3-5: Guwahati Police Facebook Page

Figure 3-6: Guwahati Police Twitter Page

3.3.3 Helpline Numbers

Guwahati City Traffic Police have a city police control room number (0361-2464557) calling on which entails normal call charges to the public.

3.4 Summary of Traffic ITS Initiatives

Table 3-1 provides a listing of traffic related ITS initiatives that have been undertaken in Guwahati and their relevance to the proposed TMICC.

Table 3-1: Guwahati - Traffic Related ITS Initiatives

ITS	Description	Status/Relevance for TMICC
Traffic Signalling System (Guwahati City Police/ GMDA)	• Isolated signals: 49 Nos	These would be monitored and controlled through the proposed TMICC
Traffic Information Dissemination: Website (Guwahati City Police) Website Address: http://guwahaticitypolice.gov.in/	• Common website with the Guwahati City Police. Provides details of number plate specification, accident data and fines collected	Operational Traffic information and advisory can be disseminated through NUTH
Traffic Information Dissemination: Social Media (Guwahati City Police)	• Common Facebook and Twitter account of Guwahati Police and Guwahati City Traffic Police • Provides news and events	Not operational and is not being updated regularly Traffic information and advisory can be

ITS	Description	Status/Relevance for TMICC
Address: https://www.facebook.com/pages/Guwahati-City-Police/211606768891234	updates • Provides notifications and press releases	disseminated through NUTH
Traffic Information Dissemination: Phone helpline Number: 0361-2464557	• For reporting issues • Seeking help • And any other information	Operational To be migrated to NUTH number to support queries related to NUTH

3.5 Transit Information Dissemination System

3.5.1 Assam State Transport Corporation

The city bus services in Guwahati are operated by Assam State Transport Corporation (ASTC) and private sector operators under permit from Transport Department, Government of Assam. ASTC operates 232 buses in Guwahati out of which 178 buses have been procured with JnNURM assistance. The ferry services are being managed and operated by the Directorate of Inland Water Transport, Government of Assam.

ASTC has a control room which is manually operated i.e. it is not computerised.

1. **Website**

ASTC has a website http://www.assamstatetransportcorporation.com (Figure 3-7) which provides information related to the type of services, stations, routes being operated by ASTC/private operators, initiatives undertaken, helpline numbers, form seeking suggestions and other bus service related details.

Figure 3-7: ASTC Website

2. Helpline

ASTC has 3 helpline numbers which are receiving about 3,000 calls per month. Normal standard charges are applicable to users calling to these helpline. Information about bus timing and route can be enquired on this number

3.5.2 Inland Water Transport, GoA (Ferry Service)

Directorate of Inland Water Transport (DIWT) is responsible for managing and operating ferries in the city. There is one control room at directorate office. GPS devices have been installed on two ferries and DIWT is planning to install GPS in remaining ferries. DIWT's control room in Guwahati provides real-time SMS alert on latest weather.

1. SMS based alert system: The system allow officials to check if a boat has reached a particular location, the vessel's likely time of arrival at a port.
2. Website: IWT, GoA has website that provide information about timing of ferry services, ferry terminal, advisory and updates (Figure 4-9, http://www.iwt.assam.gov.in/)
3. DIWT also has a helpline number (0361-2469885) with standard calling charges.

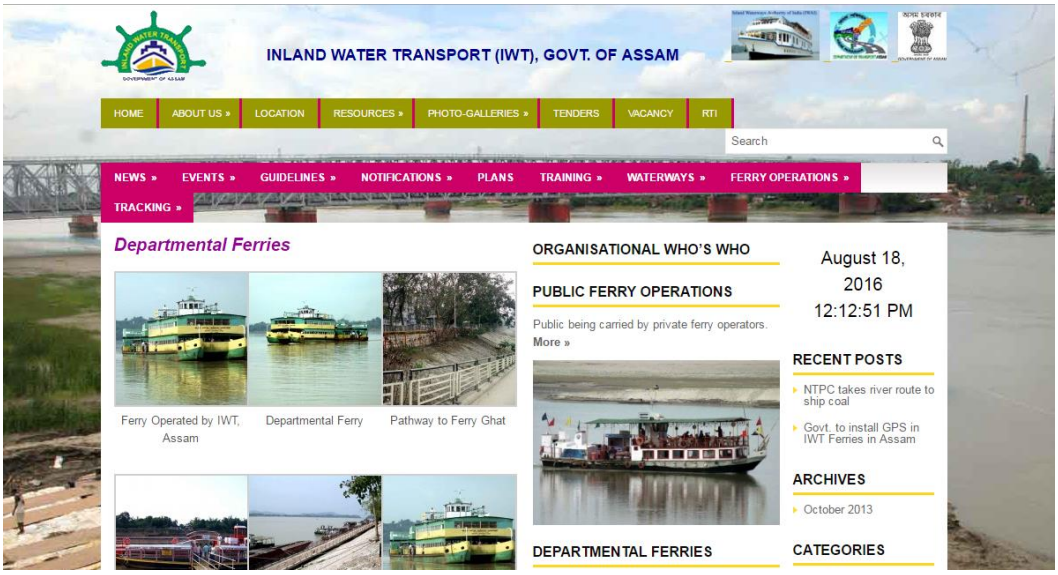


Figure 3-8: DIWT Website, GoA

3.5.3 Summary of Transit Information Dissemination Systems in Guwahati

An overview of Transit related information dissemination systems has been provided in Table 3-2 together with their relevance for Guwahati NUTH.

Table 3-2: Guwahati – Transit Related ITS Initiatives

ITS	Description	Status/Relevance for NUTH
Transit Information Dissemination: Website (ASTC) Website Address: http://www.assamstatetransportcorporation.com/	• Services information • Stations information • Schedule of ASTC buses, private operators	NUTH would disseminate transit information and make it available on a single platform.
Transit Information Dissemination: Helpline	• Timing of buses • Any other enquiry	Implemented and operational. NUTH would disseminate transit information and make it available on a single platform.
Transit Information Dissemination: Website Website Address: http://iwt.assam.gov.in	• Ferry services • Timing • Fare detail • Updates	Implemented and operational. NUTH would disseminate transit information and make it available on a single platform.
Transit Information Dissemination: SMS Based Alerts System for Ferries	• Only for official • Ferry likely time at terminal • Ferry location	Implemented and operational.
Transit Information Dissemination: Helpline Number: 0361-2469885	• Ferry Services • Timings	Implemented and operational. NUTH would disseminate transit information and make it available on a single platform.

3.6 Stakeholders Inputs

Minutes of meetings (Annexure 1A) and data collected from Guwahati Traffic Police (Annexure 1B), ASTC (Annexure 1C) and Directorate of Inland Water Transport (Annexure 1D) authority are available in annexures at the end of the report.

Based on the discussions and the information shared by the city stakeholders, it emerges that Guwahati city has undertaken a number of Traffic and Transit related ITS initiatives though they are limited in nature.

City stakeholders were explained the proposed TMICC and NUTH concepts and they expressed their keenness in implementing the TMICC and NUTH as proposed.

3.7 Conclusions

Based on the review of ITS initiatives and stakeholder inputs, following position emerges:

TMICC Related

- Traffic signals in Guwahati are isolated and fixed-time cycle type. GMDA installs and maintains the signal and Traffic Police operates signal in Guwahati.
- There is no centrally controlled signalling system in Guwahati.
- Present ITS initiatives do not address the traffic and transport issues identified in the city. There is need for TMICC in the city; the components required for setting up TMICC and costing details are provided in Chapter 4.0 and Chapter 8.0.

NUTH Related

- ASTC has phone helpline numbers for dissemination of transit related queries.
- ASTC has a website that disseminates some information related to its bus operations.
- DIWT, GoA has a website that disseminates ferry services timing, schedules and fares.
- Presently the transit operators ASTC and DIWT disseminate transit information through their respective channels for their respective modes.
- Guwahati Police has Facebook/Twitter pages which are not operational and are not being updated.
- Based on the above, there is clearly a need to establish a centralised traveller information system i.e. NUTH that will collect information from various agencies by developing suitable interfaces, process and then disseminate the same to public in an integrated manner. Components required for setting up NUTH and cost details are provided in Chapter 5.0 and Chapter 8.0.

4.0 GUWAHATI TMICC: PROPOSED PROJECT CONCEPT

4.1 Introduction

Typically, traffic management using IT based systems is achieved through a centralised facility with which various systems of the transportation network (traffic signal, cameras, detectors etc.) are connected and it is manned by operators who monitor the traffic conditions as well as the performance of the various traffic management systems. These centralised facilities or Traffic Management and Information Control Centres (TMICCs, also called TMC - Transportation Management Centre in certain countries) act as a hub or nerve centre of transportation management system. Based on the feed received from these systems, suitable interventions are initiated from the TMICC in order to manage the systems, reduce congestion, dealing with incidents, issuing advisories or disseminating information. Often, many of the agencies are also co-located at TMICC and work closely with each other in order to improve coordination.

4.2 Goals and Objectives

The main objectives of the Guwahati TMICC and the key activities performed to meet these objectives are as under:

- **Traffic Enforcement**
  - On-road checks
  - Speed violations
  - Red light violations
  - Parking violations
  - Entry restriction violations
  - Handheld Device Based e-Challan System
- **Monitoring and Management of Traffic**
  - Management and Monitoring of Traffic Junctions and Roadway Systems
    - Signal Timing and Operations
    - Road Network Surveillance
    - Traffic Management using
      - Adaptive signals
      - Queue alerts (via VMS)
      - Dynamic rerouting (via VMS)
  - Monitoring the functional status of various traffic equipment and taking steps towards restoration of defective equipment, including,
    - Traffic signals
    - PTZ Surveillance Cameras

  - Vehicle detection cameras
  - Variable message signs
- Interfacing with various agencies to obtain information impacting traffic flows
  - Parking systems
  - Transit agencies
  - Construction / Maintenance agencies
  - Weather system
  - Incident/Events/ Disaster management agencies
- Support traffic management activities related to planned events in coordination and collaboration with other city agencies
- Sharing of traffic data and information with various agencies such as transit, road construction and maintenance, police etc. to help such agencies to monitor and control their respective operations more efficiently.

- **Dissemination of Traffic Information to Public**
  - Dissemination of traffic information to public
    - En-route
      - Through Variable Message Signs (VMSs)
    - Pre-trip and en-route through NUTH
      - Website
      - Helpline
      - Mobile applications
      - Social media

- **Data Repository and Analysis**
  - Storage of traffic data and sharing the same with planning agencies in order to support transport planning measures in the city
  - Analysis of traffic related data to support infrastructure planning and design.
  - Traffic flow analysis
  - Providing inputs to road agencies in junction planning and layout design
  - Support traffic and law enforcement measures through analysis of data from automated detection and recording of traffic violations such as speed limits, red light violation, stop-line violation and illegal on-street parking
  - Identification and analysis of black spots in order to facilitate suitable measures to be taken.

4.3 Project Area

Guwahati and its surrounding areas have been combined under Guwahati Metropolitan Area (GMA) and the same is in the process of being expanded as Guwahati Metropolitan Region (GMR). In view of the aforesaid, following options emerge (Table 4-1) as regards coverage of project area for the Guwahati TMICC.

Table 4-1: Guwahati – Project Area Options

Option	Project Area	Description
1	Guwahati Municipal Corporation (GMC) Area	Area under the jurisdiction of Guwahati Municipal Corporation (GMC)
2	Guwahati Metropolitan Area (GMA)	Area under the jurisdiction of Guwahati Metropolitan Development Authority (GMDA)
3	Proposed Guwahati Metropolitan Region (GMR)	Proposed area under the jurisdiction of Guwahati Metropolitan Development Authority (GMDA)

There is a need to have TMICC for the entire Guwahati Metropolitan Region (GMR) as Mass Rapid Transit System (MRTS) is also proposed for the GMR area to be developed in phases. However, in view of the complexity involved due to multiple agencies, authorities, geographical spread, administrative issues and the fact that the GMR is yet to be notified, it is recommended that for TMICC and NUTH the proposed project area be taken as Guwahati Metropolitan Area (GMA) to begin with. In future, other areas of the GMR could be progressively added based on need.

4.4 Project Phasing

It is recommended to implement TMICC for GMA in a single phase in accordance with the details provided in Table 4-2 below.

Table 4-2: Guwahati TMICC: Project Outline

Parameter	Project Components / Details
TMICC Area	Guwahati Metropolitan Area (GMA)
Focus Areas	• Traffic Enforcement • Signal control (Adaptive) • Road Network surveillance • Traffic information dissemination`
Traffic Equipment	• Signals • VMS • PTZ cameras • Vehicle detection cameras

Parameter	Project Components / Details
Traffic Information Dissemination*	• Road Network Map • Road diversions / closures • Accidents / Incidents • Advisories and alerts • Parking Information • Weather Information • Construction/ maintenance • Speed/Congestion Information
Information Dissemination Modes*	• Website • Phone helpline • Mobile App • Social Media • VMS along roadways at strategic locations
Tools	• GIS based maps with zooming capability • Route Planner • Trip planner including fares for different modes
Interfaces	• Interfaces with the Parking systems • Interfaces with Transit agencies • Interfaces with Construction / Maintenance agencies • Interfaces with Weather System • Interfaces with Incident/Events/ Disaster management agencies

* Either directly or through NUTH.

4.5 Location of Guwahati TMICC

Guwahati Traffic Police, as part of Guwahati City Police, has the statutory responsibility to regulate and manage traffic in Guwahati. Guwahati TMICC facility could therefore, be set up at the existing Guwahati Traffic Police office if space and other requirements are being met. Alternatively, other suitable locations could be explored by the Guwahati Traffic Police in consultation with GMDA. A view of the Traffic Management Centre for Signal System in New York is provided in Figure 4-1.

Figure 4-1: Joint Traffic Management Centre – Signal System (New York)

4.6 Project Elements

Guwahati TMICC would have the following elements:

- Traffic Enforcement System
- Traffic Signal Control (Adaptive)
- Road Network Surveillance System
- Interfaces with Agencies
  - Interfaces with the Parking systems
  - Interfaces with Transit agencies
  - Interfaces with Construction / Maintenance agencies
  - Interfaces with Weather System
  - Interfaces with Incident/Events/ Disaster management agencies
- Traffic Information Dissemination System

These elements have been described in the Sections that follow.

4.7 Project Level Architecture

Guwahati TMICC would have Traffic Enforcement system, Traffic Signal Control system, Road Network Surveillance system, Interfaces with other agencies and Traffic Information Dissemination system (Figure 4-1). TMICC and NUTH may be integrated and will function within the joint TMICC. These systems and their interfaces with other systems have been described in the Sub-sections that follow.

Figure 4-2: Guwahati TMICC Concept Diagram

4.7.1 Traffic Enforcement System

Traffic enforcement activities are part of responsibilities of the Traffic Police in Guwahati. Typical applications of information sharing with traffic enforcement systems are listed below:

- On-road checks
- Speed violations
- Red light violations
- Parking violations
- Entry restriction violations
- Handheld Device Based e-Challan System

TMICC would need to exchange data with the enforcement systems. The backend systems pertaining to enforcement activities may either be hosted at the TMICC itself or if they are hosted at some other location, suitable interfaces would need to be developed to enable data exchange between TMICC and the enforcement systems. Typical applications of information sharing with traffic enforcement systems are listed below:

1. **On-road Checks:** On-road checks as a security and enforcement measure is a common phenomenon in the city. While the information cannot be published for general public, it could be used by the TMICC for re-routing emergency vehicles (like registered ambulances).
2. **Speed Violation Detection System:** Although the Speed Violation Detection System would be hosted by the Traffic Police enforcement wing, it should share data pertaining to speed violations with the TMICC. This data could be used for planning purposes.
3. **Red Light Violation Detection System (RLVDS):** The RLVDS would also be hosted by the Traffic Police enforcement wing. However, information of violations should be shared with the TMICC for analysis (e.g. correlation with accidents, vehicle category wise violations etc.) and planning corrective actions, if any.
4. **Parking Violations:** While parking areas are managed by the urban local bodies or transit agencies (bus terminal agencies, railways etc.), the enforcement of parking rules is carried out by the Traffic Police. The information of violations should be shared with the TMICC for analysis and planning corrective actions, if any (e.g. planning for additional parking, changes in parking rates etc.).
5. **Entry Restriction Violations:** Many stretches have entry restrictions pertaining to certain classes of vehicles during certain hours. These rules should be shared with the TMICC so that it can disseminate the information through various dissemination channels being managed by it. In certain instances, TMICC may also use the video feeds available through the enforcement system to cross-check or validate traffic related issues which have been reported to the TMICC.
6. **Handheld Device Based e-Challan System:** These systems are used by Traffic Police for traffic and transport related enforcement. Data from the e-Challan system should interface with TMICC and can be used by the TMICC for analysis.

4.7.2 Traffic Signal Control

The traffic signals are operated through controllers where signal plans are loaded. In case of adaptive signals, detectors and/or cameras also form part of the signal system. Signals would be connected to the Guwahati TMICC over communication networks. Two way communications would be required to manage and control the signals through TMICC. TMICC transmits signal plans to the controllers and the controllers in turn provide the operational and functional status to the TMICC (Figure 4-3).

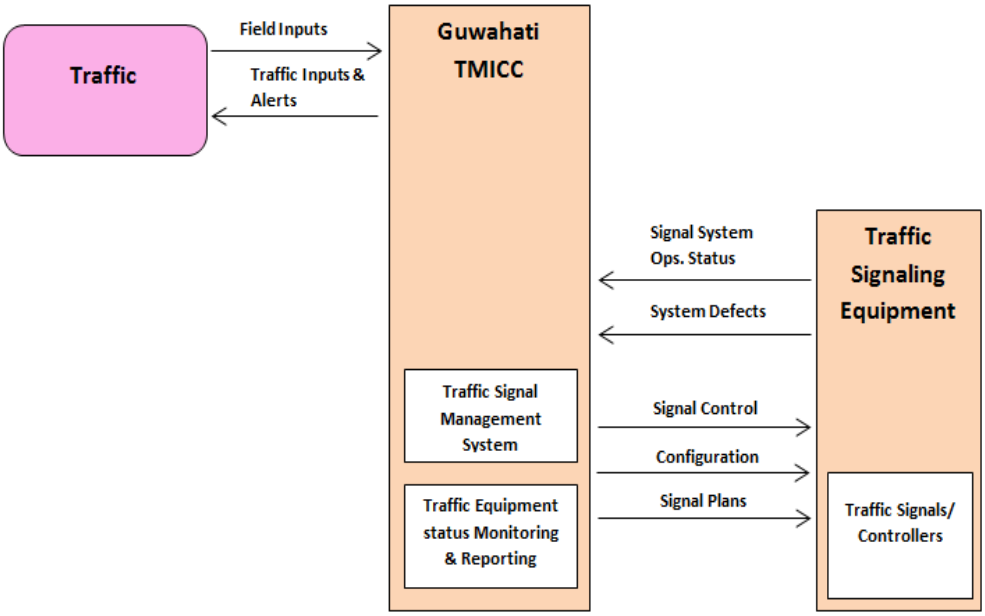


Figure 4-3: Signal Control

Signal timing and operations management is a very critical activity carried out as part of traffic monitoring and control in order to optimise the traffic flow. This activity is supported by specialised software at the TMICC and communication links between TMICC and the signal controllers located at junctions. As part of traffic monitoring activity undertaken by TMICC, inputs from a variety of sources are received and processed at the TMICC. The activities that the TMICC performs as part of signal timing and operations management are listed below:

- Controlling signals from TMICC that are connected to it through communication links
- Signal control plans creation based on surveillance and other inputs, and its implementation. The plans could be based on fixed time, coordinated or adaptive operations.
- Coordinate with other signalised junctions while creating, modifying and implementing the signal control plans
- Configure signal controllers to operate in various modes such as fixed time based, coordinated and adaptive
- Collect and monitor status update from signal controllers: such as fault data
- Clock synchronisation of signal controllers

4.7.3 Road Network Surveillance

Road Network Surveillance would be carried out through PTZ cameras and vehicle detection cameras that monitor the traffic conditions on the road network, capture

visuals and traffic characteristics from the field and transmit the same to the controllers and TMICC for review and analysis. The data collected by detectors is speed, volume, classification and occupancy whereas the cameras collect images and videos. Occupancy here means percent of time a point on the road is occupied.

TMICC transmits command and configuration details to these equipment and they send the captured data (images, videos), operational and functional status of the equipment to the TMICC (Figure 4-4). Vehicle detection cameras detect and monitor moving and stationary vehicles at signalised intersections. Vehicle presence information is transmitted to the traffic controllers so that signal timing can be adjusted dynamically. This way, vehicle waiting time at traffic signal can be reduced and traffic flows can be optimised by dynamically changing the cycle time on real time basis. Pan-tilt-zoom (PTZ) cameras capture surveillance information and provide flexible view selection as well as a wider observation range. This makes them suitable for vision-based traffic monitoring and enforcement systems.

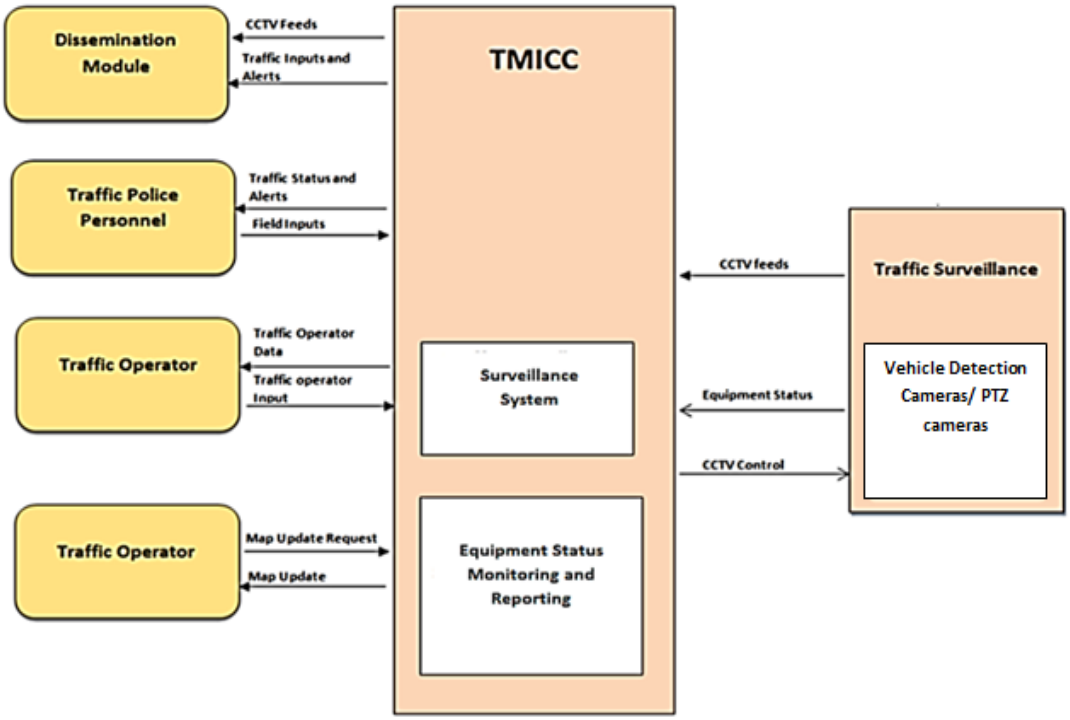


Figure 4-4: Road Network Surveillance

4.7.4 Interfaces with Other Agencies

A. Interfaces with Parking Systems

TMICC shall interface with and collect data from the Parking Management Systems of the major parking lots in the city such as those at malls, office complexes etc. TMICC would interface with these systems and share information that could be disseminated by the TMICC to public. Such information would include operational timings, capacity, parking rates, directions to

entrances and exits. Depending upon the availability of information, real time availability of parking slots could also be disseminated to public. This would lead to reduction in avoidable movement of vehicles searching for parking on the streets. This information would be disseminated through NUTH.

B. Interfaces with Transit Agencies

TMICC shall interface with and collect data from the Transit agencies (ASTC and DIWT). In addition, information related to any service disruptions in the transit agencies' operations that could impact traffic conditions can also be collected and disseminated through various information dissemination channels used by TMICC. TMICC would share traffic congestion information, incident/event information, construction information (along with details such as location, nature, and impact on traffic), road closure, diversions and incident updates with transit agencies which would help them in planning and scheduling their operations.

C. Interfaces with Construction / Maintenance Agencies

Information related to construction and maintenance activities pertaining to the transportation infrastructure and facilities that would be collected by TMICC and subsequently disseminated through Guwahati NUTH is as below:

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

In order to get such data, interfaces must be built with the systems of agencies which are responsible for construction and maintenance activities and/or the authorities who are required to be intimated prior to undertaking construction and maintenance activities on the transport network. Alternatively, TMICC operators would need to enter this data in the TMICC application software based on communication from such agencies.

D. Interfaces with Weather System

TMICC shall interface with and collect data from the Weather Monitoring Systems of the Metrological Department in Guwahati. This information would be disseminated through NUTH.

E. Interfaces with Incident/Disaster Management Agencies

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

4.7.5 Traffic Information Dissemination System

The objective of information dissemination is to provide the travellers with comprehensive, relevant, reliable, accurate and updated traffic information which is useful for them to plan their travel.

The idea is not to flood travellers with a barrage of information but to provide only such information that is required to make travel choices. Such information includes those relating to the factors that affect road network capacity, lead to congestion, affect travel times, require road closure or diversions. It is therefore, necessary that information about such factors is captured promptly and disseminated through suitable modes so that travellers can accordingly make/change their travel plans.

Traffic Information Dissemination System comprises elements that are used by Guwahati TMICC for dissemination of traffic related information and includes variable message signs, NUTH etc. TMICC sends traffic messages, commands and configuration details to the field equipment (variable message signs, fixed format displays, blinkers etc.) and they send the operational and functional status of the equipment back to the TMICC (Figure 4-5). As NUTH is also proposed in the Guwahati, traffic information could also be disseminated through NUTH as well.

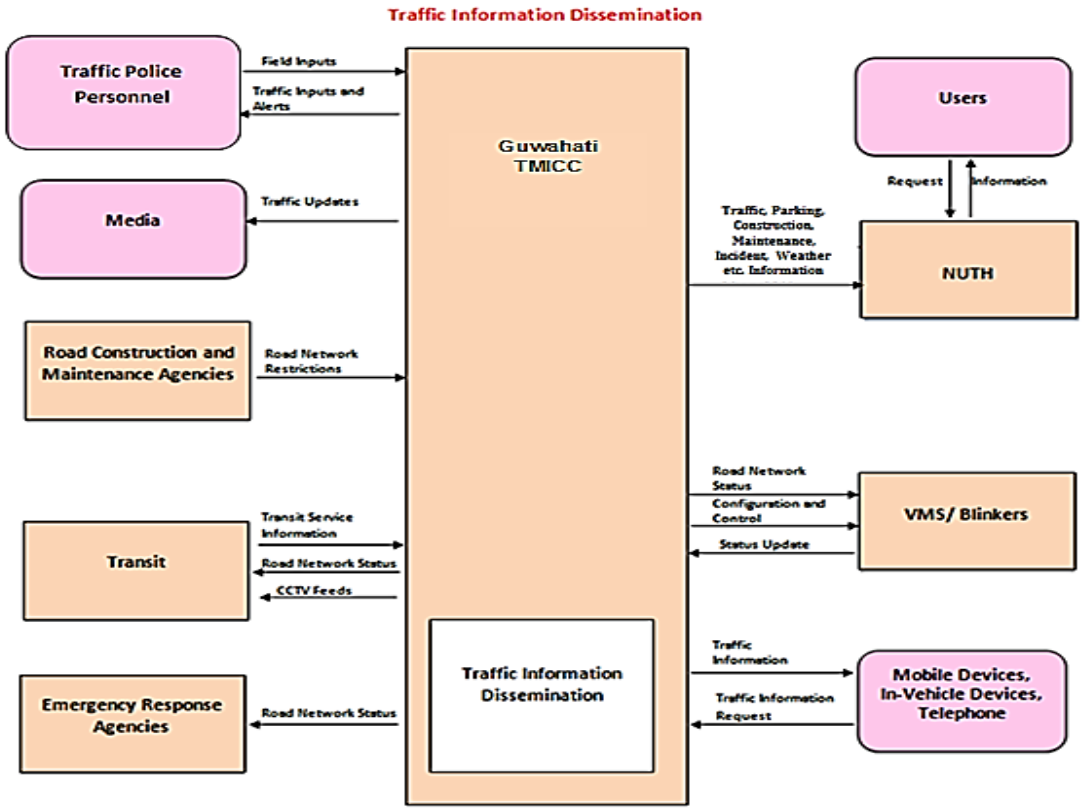


Figure 4-5: Traffic Information Dissemination

The information could be disseminated through various channels: web, mobile apps, social network, and variable message signs. Details of some of the key traffic related

information and dissemination channels that could be used for their dissemination are given in Chapter 5.0.

4.8 Data Warehousing and Analysis

Data Warehousing would deal with collection of data from multiple stakeholders, its storage, archival, management and retrieval for review and analysis in future. It would support querying, report generation and data mining using archived data. It will be a vital element that must be planned for as data mining activities would ride on the availability of and access to the archived data.

Transportation planning efforts in the city needs to be supported by Guwahati TMICC by way of sharing of information collected by it. The information collected and maintained by the TMICC could be accessed by other agencies in their planning exercise. Guwahati TMICC would act as a platform, where data from multiple sources would be collected and stored: such as incidents, road construction and maintenance, parking, enforcement etc. Such data could be made available to various planning agencies for the purpose of planning and decision making related to various transportation and traffic interventions. NUTH would access the TMICC data servers containing such data while disseminating the information.

As an example, the data could be used to carry out analysis leading to identification of black spots/accident-prone zones. TMICC staff could carry out a more detailed analysis of these spots and recommend design interventions to reduce accidents. Several State level transport organisations have either implemented or are in the process of deploying their own Road Accident Data Management System (RADMS). TMICC should coordinate and align with such agencies in relation to accident data.

Guwahati TMICC would also use the data collected to carry out impact analysis, such as,

- Micro-level impact of junction design
- Impact of TMICC initiatives on overall traffic flow
- Reduction in energy consumption
- Reduction in Green House Gas (GHG) emissions

It is recommended that the Guwahati TMICC should also have a software module to compute energy savings that have accrued owing to the initiatives taken by the TMICC, which could be further extrapolated to compute the reductions in GHG emissions.

TMICC will collect vast amount of data which is termed as Big Data. Such data stream would include traffic data, configuration data, images, videos etc. through the various devices and systems. The data mined from TMICC should be used for planning and optimising the system parameters and in addition, shared periodically and regularly with relevant stakeholders, as required.

4.9 Standards and Protocols

Traffic Management and Information Control Centres (TMICCs) are hub of information exchange not just between various entities but also from various connected equipment and other systems. In view of this, it is critical that the agencies participating in Guwahati TMICC follow various standards and protocols while setting up their respective systems in order that the interoperability among the various systems and subsystems including that with TMICC could be ensured and data exchange could be affected between them.

There is no common standard for data exchange used in India by traffic agencies and transit operators. Traffic agencies and transit operators in India are using data exchange protocols provided by their respective systems integrators. Internationally, many countries have communication standards for data exchange between TMICC and traffic systems. For example, National Transportation Communications for ITS Protocol (NTCIP) is widely used in USA as a communications standard to ensure interchangeability and interoperability between Intelligent Transport System (ITS) devices including traffic signal controllers. Similarly, in UK, Urban Traffic Management Control (UTMC) is used as a standard for communicating and sharing of information by ITS and traffic systems such as traffic signals, cameras, and variable messaging signs (VMS).

A more in-depth discussion on the standards and protocols has been undertaken in Chapter 3.0 and Chapter 5.0 of the Generic Operations Document for TMICC. Readers are advised to go through these chapters for further clarity. Some applicable standards to TMICC are given at the end of this report in Annexure-2 as a reference.

4.10 System Requirements

System requirements for Traffic Signal Control system, Road Network Surveillance system, Interfaces with Traffic Enforcement system and Traffic Information Dissemination system have been provided in the following Sub-sections. These requirements are general in nature and shall be finalised with the development and preparation of the Detailed Technical Reports through a systems engineering process during the tendering stage.

4.10.1 Traffic Signal Control

A. General

The Guwahati TMICC would have the following capability with respect to the traffic signal control activities:

- TMICC shall remotely control the signals that are connected to it through communication links
- TMICC shall create and update the signal plans in various modes such as fixed time, coordinated or adaptive

- TMICC shall coordinate with other signalised junctions while creating, modifying and implementing the signal control plans
- TMICC shall configure signal controllers to operate in various modes such as fixed time, coordinated, and adaptive
- TMICC shall collect and monitor operational data from the signal controllers connected to the TMICC
- TMICC shall collect and monitor fault data from signal controllers connected to the TMICC
- TMICC shall undertake clock synchronisation of signal controllers and other equipment connected to the TMICC
- TMICC shall maintain inventory of the signal equipment that are connected to it
- System should have capability to adapt to multiple standards and can be upgraded to latest technology in future.
- Signal equipment and infrastructure (including the mechanical, electrical and electronics comprising the system) to be designed and deployed in a manner that suits the specific requirements of Guwahati in terms of the weather conditions, operating environment, security etc. A system that is resilient to meet the city environment shall be designed and deployed.

B. Techniques

Traffic signal control may be operated in following ways:

i. Isolated Fixed Time Controller based Signalling (Figure 4-6):

- The signals work in isolated mode and are not connected to the control room
- Isolated Traffic Controllers are stored with multiple traffic plans to work on Time of Day (ToD) basis. These plans are loaded by the TMICC personnel.
- Any changes in traffic plans or parameters require visit by the TMICC personnel to the junction and to carry out changes through in the controller
- Traffic Police personnel generally visit and access the controller panel for manual operations
- Junction status/Health status can be known only upon visit to controller

Figure 4-6: Isolated Fixed Time Controller Based Signalling

ii. Fixed Time Controller with Control Room Connectivity based Signalling (Figure 4-7):

- The signals in this case are connected to the control room.
- Real time status of each junction along with its health (Current operational status) and signal timing plan details are available at control room on 24x7 basis.
- Signal timing plans can be changed on-line from the Control Room without any need to visit the junction.
- The system allows manual operations from visiting the controller as well as remote operations from the Control Room.
- Reports for post-analysis are available in this system.

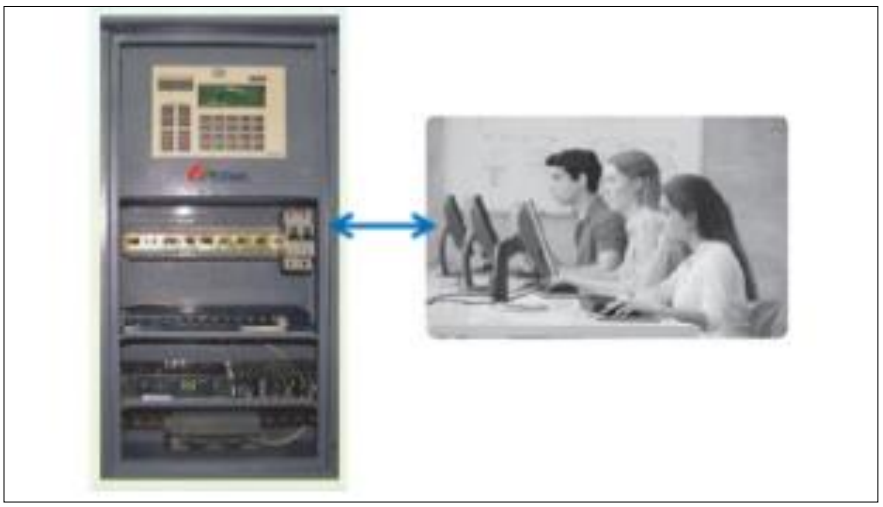


Figure 4-7: Fixed Time Controller with Control Room Connectivity

iii. Adaptive Signalling System (Figure 4-8):

- The signals in this case are connected to the control room.
- One vehicle detection camera per arm is deployed to detect real time traffic flow. Detection cameras are preferred over inductive loops because of their non-intrusive nature and easy deployment.
- Non-intrusive, weatherproof and easy to install vehicle detection cameras work on video image processing principle.
- Accurate positioning of multiple virtual loops in the field of view of camera provides an output to the signal controller whenever a vehicle is present in a detection zone or virtual loop.
- Presence/absence of vehicles enables dynamic changing of the signal cycle timing at the junction.
- Signal cycle timings, when operation is on pre-fixed signal cycle timing, can be revised based on experience gained and by examining the traffic volumes.

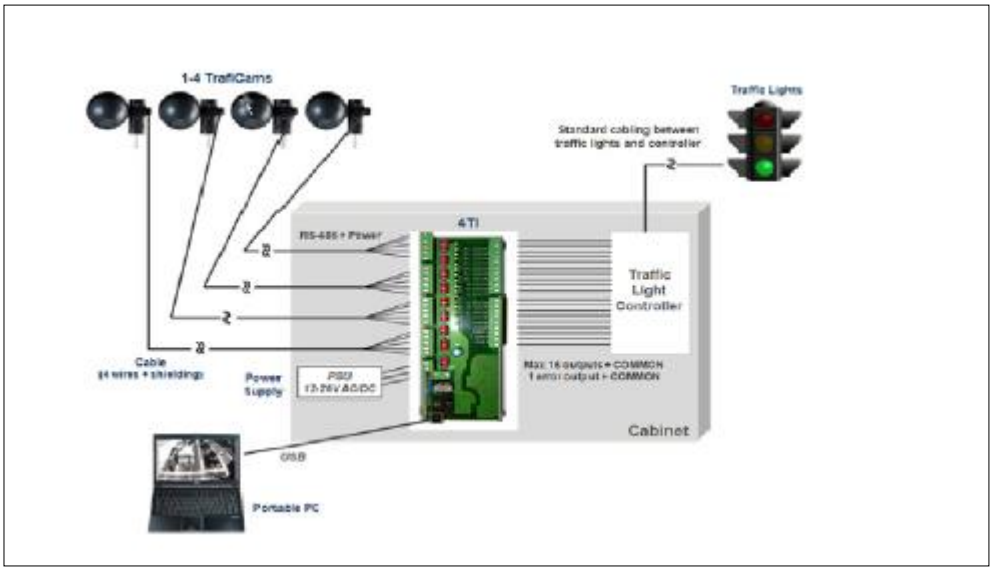


Figure 4-8: Adaptive Signalling System

Operation of Adaptive Controller with Control Room Connectivity

- Signal timings can be dynamically changed automatically by the system using the real time traffic volume captured by the cameras at the junctions. Need for manual intervention is reduced resulting in higher throughput at the junction.
- The adaptive system can be configured even to support requirements that need manual operations.
- Area Traffic Control System (ATCS) software of the Control Room coupled with various optimisation modules provide effective and efficient traffic management over the entire area.

- Real time status of each junction along with its Health & all Traffic parameter details/reports are available at control room on 24x7 basis.
- Signal timing plans or parameters of any junction can be changed on-line from the Control Room.
- The system allows manual as well as emergency operations remotely from the Control Room.
- Signals can be implemented in the best possible combination of manual, pre-fixed signal cycle timing or automatic mode based on traffic characteristics.
- Signal cycle timings, when operation is on pre-fixed signal cycle timing, can be revised based on experience gained and by examining the traffic volumes.

Comparative analysis between above basic three options is summarised in Table 4-3:

Table 4-3: Comparison - Modes of Signalling

S. No	Category	Fixed Time Controller Signalling System	Fixed Time Controller with Control Room Connectivity based Signalling	Adaptive Signalling System
1.	Flexibility	Less	Medium	High
2.	Control Room Connectivity	No control room connectivity	Control room connectivity is there	Control room connectivity is there
3.	Traffic Optimisation	Limited traffic optimisation through fixed signal timing plans based on time of day	Relatively better control than fixed signal timing plan as remote management of signal timing is possible	Dynamic optimisation based on actual traffic conditions
4.	Cost	Low	Medium	High
5.	O&M Cost	Low	Medium	High
6.	Security Issues	Less	Medium	High as cameras are costly
7.	Benefits	Low	Medium	High

Presently Guwahati has 49 fixed time isolated signals. It is recommended that these signals be upgraded to adaptive signalling system. As a part of this, vehicle detection cameras would be installed at junctions; the signals would work on adaptive mode and dynamically adjust the signal timing based on traffic conditions.

4.10.2 Road Network Surveillance

The Guwahati TMICC would have the following capability with respect to the road network surveillance activities:

- TMICC shall remotely configure and control the surveillance equipment that are connected to it through communication links.
- TMICC shall receive, process and store the images and videos captured through the CCTV cameras connected to the TMICC.
- TMICC shall disseminate the images and videos captured through the CCTV cameras connected to the TMICC.
- TMICC shall share with enforcement agencies the images and videos that are captured through the CCTV cameras connected to the TMICC.
- TMICC shall collect and monitor operational data from the surveillance equipment connected to the TMICC.
- TMICC shall collect and monitor fault data from the surveillance equipment connected to the TMICC.
- TMICC shall undertake clock synchronisation of surveillance equipment connected to the TMICC.
- TMICC shall maintain inventory of the surveillance equipment that are connected to it covering such aspects such as location, data type being captured, equipment ownership, etc.
- System should have capability to adapt to multiple standards and can be upgraded to latest technology in future.

4.10.3 Interface with Traffic Enforcement System

Guwahati TMICC would have the following capability with respect to interfacing with Traffic Enforcement system:

- TMICC shall receive, process and store the data captured through the traffic enforcement system of Traffic Police.
- TMICC shall share the data with planning agencies in suitable format.
- TMICC shall collect and monitor operational data from the traffic enforcement system (if the enforcement backend is hosted at TMICC).
- TMICC shall collect and monitor fault data from the traffic enforcement system (if the enforcement backend is hosted at TMICC).
- System should have capability to adapt to multiple standards and can be upgraded to latest technology in future.

4.10.4 Traffic Information Dissemination

A. General

Guwahati TMICC would have the following capability with respect to Traffic Information Dissemination activities:

- TMICC shall remotely configure and control the variable message signs that are connected to it through communication links.
- TMICC shall collect and monitor operational data from the variable message signs connected to the TMICC.
- TMICC shall collect and monitor fault data from the variable message signs connected to the TMICC.
- TMICC shall maintain inventory of the variable message signs that are connected to it.
- TMICC operators will monitor the messages that will go on the variable message signs. TMICC operators will only be able to choose a message from a pre-defined list; supervisors will have the ability to enter new messages.
- TMICC shall share traffic information with construction and maintenance agencies, field traffic personnel, NUTH, transit agencies and incident management authorities and general public.
- TMICC shall allow for configuring and controlling the nature of data that is to be shared with different entities.
- TMICC shall disseminate traffic information both in graphical as well as other formats making it easy to understand.
- TMICC shall make use of the road network characteristic, traffic data, weather conditions, traffic restrictions, road closures, diversions, alternate routes, etc.
- System should have capability to adapt to multiple standards and can be upgraded to latest technology in future.

B. Variable Message Signs

VMS is an important subsystem that is used to disseminate traffic, road, and weather conditions on the road to the drivers while en-route. It is one of the most effective measures for information dissemination since the information can be provided to every road user even when the vehicle and driver have no other devices to collect the information.

VMSs are typically installed at strategic locations such as:

- In advance of major decision points (alternate routes), to inform drivers of the upcoming roadway conditions.
- Prior to the areas of incident-prone locations to inform drivers of adverse conditions.
- Locations of major origins and destinations, such as an airport to show the travel time to city centre or to show the travel time to major destinations.

5.0 GUWAHATI NUTH: PROPOSED PROJECT CONCEPT

5.1 Introduction

NUTH is expected to be the information access system of choice related to the urban transportation infrastructure, facilities and services in Guwahati. Guwahati NUTH would collect process and thereupon disseminate transit, traffic, parking, construction, incident and event related information to public and other stakeholders. The information would be used by public to plan their travel, and obtain real-time transit/traffic information, and by agencies to bring about an improvement in system performance based on the feedback received. NUTH is also expected to help agencies to undertake coordinated planning to support the travel needs of the public. As TMICC and NUTH both are proposed in Guwahati, interfaces would be built up between NUTH and TMICC to facilitate dissemination of information.

5.2 Goals and Objectives

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

- Dissemination of transit, traffic and other relevant information that support public in making informed travel decisions. These would include:
  - Providing transit related information (refer Section 5.5.1 for details)
  - Providing traffic related information (refer Section 5.5.2 for details)
  - Providing parking related information (refer Section 5.5.3 for details)
  - Providing weather related information (refer Section 5.5.4 for details)
  - Providing incident/events related information (refer Section 5.5.5 for details)
  - Providing construction and maintenance related information (refer Section 5.5.6 for details)
  - Providing multi-modal trip planners to find out shortest route, cheapest journey, inclusion or exclusion of certain modes, least walk etc. (refer Section 5.5.7 for details)
  - Providing information through phone helpline, website, mobile application, and social media.
  - Supporting intermodal coordination among transit agencies
- Augmenting use of public transport
- Supporting the activities that promote environment and ecological aspects
- Supporting the activities that can reduce congestion and lead to time-saving for commuters

5.3 Project Phasing

The project area for NUTH is recommended to be the Guwahati Metropolitan Area (GMA). To begin with static information would be disseminated through NUTH and later on dynamic information would also be provided (Table 5-1).

Table 5-1: Guwahati NUTH Outline

Parameter	Project Outline
Geographic Area	• Guwahati Metropolitan Area (GMA)
Transit Information	• ASTC • Ferry services • Dynamic information based on availability • Addition of other services as they get launched
Traffic Information	• Guwahati Traffic Police • Dynamic based on availability
Trip planner	• Static multi-modal • Dynamic based on availability
Parking Information	• Static in years 1-2 • Dynamic based on availability.
Construction/ Maintenance /Incident/Disaster Activities Information	• GMA • Assam State Disaster Management Agency (ASDMA)
Weather Information	• GMA
Information Dissemination Modes	• Website • Phone helpline • Mobile App • Social Media

5.4 Guwahati NUTH Location

Looking at the profile of Guwahati city, the present transportation facilities and the ITS infrastructure, it is recommended that NUTH be hosted in the TMICC itself.

5.5 Project Elements

Guwahati NUTH is proposed to have the following elements:

- Transit Information Dissemination
- Traffic Information Dissemination
  - Congestion heat map
  - Construction / Maintenance activities

- Incident / Accident/ Events/Disaster related
- Parking Information Dissemination
- Weather Information Dissemination
- Trip Planner

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

5.5.1 Transit Information

Transit related information disseminated through Guwahati NUTH would be static and real-time information. Based on the availability of transit data, information would be provided to users progressively. This information would be provided from multiple dissemination systems, such as telephone service, website, mobile application and social media.

Table 5-2 lists the transit information that would be disseminated through Guwahati NUTH. Running status and estimated time of arrival for bus transit can be provided when the fleet has GPS device installed.

Table 5-2: Transit Information

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

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

Guwahati NUTH would need to interface with ASTC for bus service related information and DIWT for the ferry services. These agencies would also need to nominate their representatives to interact with Guwahati NUTH in order to facilitate effective communication and coordination.

Figure 5-1 shows as example the web page containing transit related information on the 511 website for the San Francisco Bay Area, USA (www.511.org). The information being disseminated through the website is nearby stops and routes, schedules and route maps, real time departures, transit service areas, announcements etc.

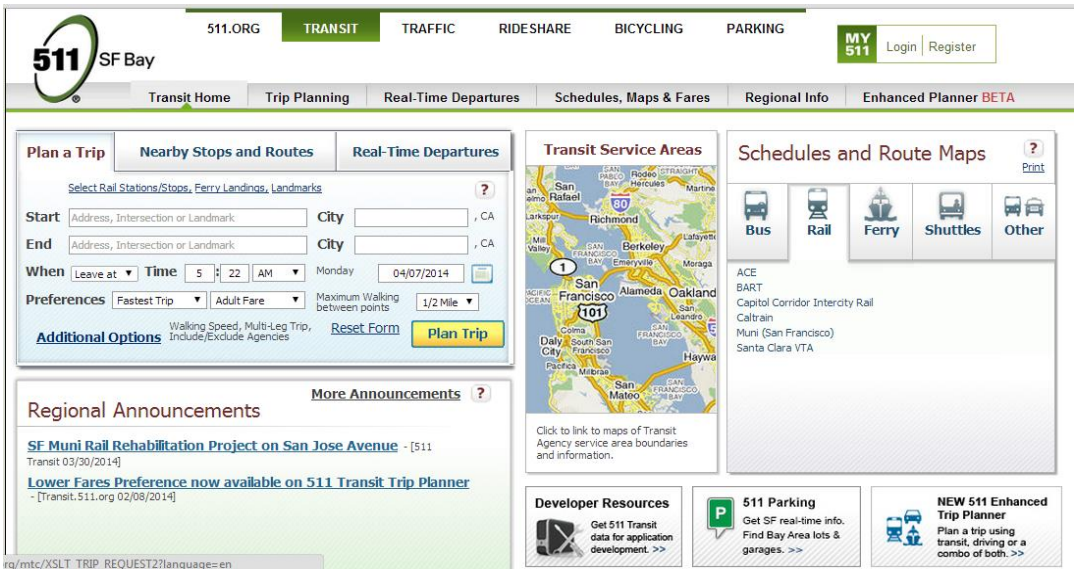


Figure 5-1: Transit web page, 511, San Francisco Bay Area

5.5.2 Traffic Information

Traffic information that could be disseminated through NUTH has been listed in Table 5-3. Such information is of relevance both prior to initiating a trip/ journey and while being en-route. While initiating a journey, traveller can view the congestion levels, incident information or construction information and accordingly choose the most appropriate options from among the various choices. Similarly while en-route, such information can help in taking detours to avoid certain stretches based on level of congestion etc. This would lead to improvement in journey time reliability and saving in travel time/ distance. It would help in mitigating negative environmental impact arising out of travel. It would further lead to optimal utilisation of transportation assets and potential reduction in capital outlays in augmenting the transport network capacity.

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

Table 5-3 lists the traffic information that would be disseminated through NUTH:

Table 5-3: Traffic Information

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

Real Time Information	
Information	**Description**
Road Congestion information	Speeds on road network
Travel time between major destinations	Travel time based on real time congestion level on roads
Trip planner based on dynamic data	Trip planning based on real time condition, speed level on road, construction and maintenance activity, incident, event etc.
Road conditions, closures, diversions	Real time road closure, diversion

Real Time Information	
Incidents and Events	Real time incident information
Parking availability status	Real time parking availability information, suggestions on optional nearest parking
Weather updates	Temperature forecast (hourly , daily, weekend, monthly), weather forecast such as rain and storm forecast
Live camera feeds	Live camera location and feed on GIS map, commuters can see the road condition by just clicking on the camera location
Construction and maintenance information	Real time updates on scheduled construction and maintenance, upcoming construction and maintenance and advisories

Figure 5-2 shows as example a screenshot of DIMTS PoochhO mobile app which provides traffic congestion updates to users.

Figure 5-2: Traffic Congestion Information on PoochhO App

Figure 5-3 shows as example the web page containing traffic related information on the 511 website (www.511.org). The information being disseminated includes construction, driving times (current as well as predicted), current traffic conditions in color coded form on the map, location of road closure, construction, incident, severe incident, events, traffic cameras, VMS, park & ride, high occupancy vehicle (HOV) lanes and toll plaza on the map.

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

- Green stands for free moving traffic. Roads highlighted in this colour are ideal to drive on.

- Blue stands for moderate traffic
- Pink stands for slow moving traffic
- Red stands for congested traffic. Traffic on such roads generally remains in congested situation. It'd be better to avoid these roads.

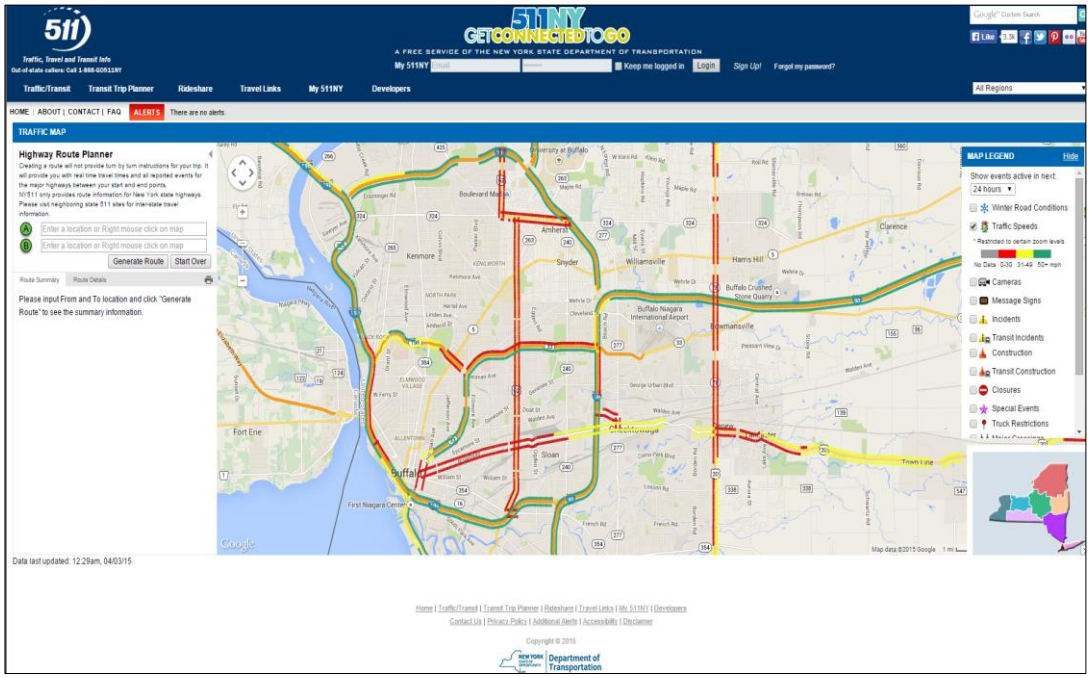


Figure 5-3: Traffic web page, 511, New York Area

5.5.3 Construction / Maintenance Activities

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

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

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

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

Information in respect of planned construction and maintenance activities would be provided in the form of calendar so that those planning for future travel could take these into account. Locations where construction and maintenance activities are underway could be shown on the map as well as in tabular/other suitable form.

In order to get such data, interfaces must be built with TMICC and/or the systems of agencies which are responsible for construction and maintenance activities and/or the authorities who are required to be intimated prior to undertaking construction and maintenance activities. Figure 5-4 shows a San Francisco Bay Area, 511 web page. Information being disseminated is scheduled construction and maintenance, and diversion.

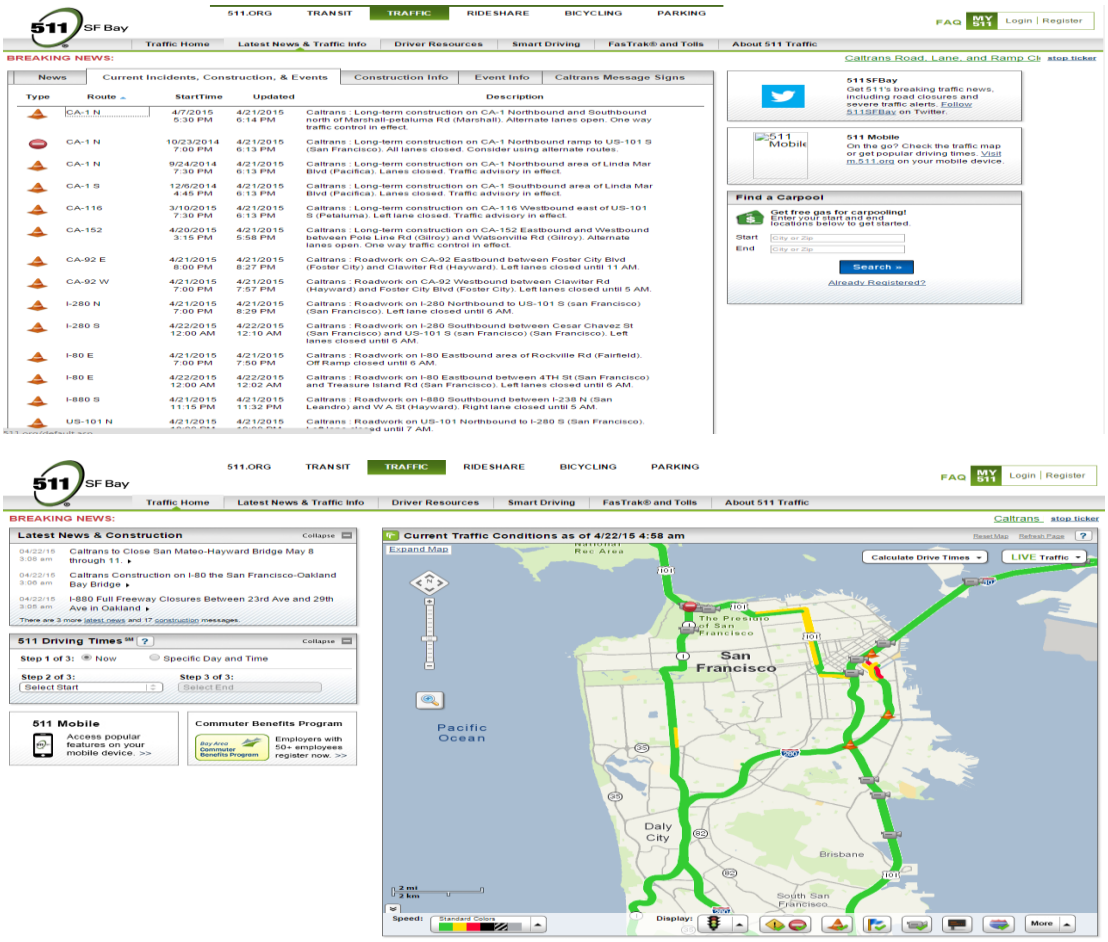


Figure 5-4: Construction and Maintenance Information, 511 webpage, SF Bay Area

5.5.4 Incident / Accident Information and Planned Events

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

- Road accidents, collisions, vehicle breakdowns

- Events
- Auto/taxi strikes etc.
- Transit service disruptions
- Political rallies
- Religious or social procession
- State ceremonies
- Others

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

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

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

In order to get such data, interfaces must be built with TMICC and/or the systems of the agencies which participate in managing and responding to the incidents or are required to be intimated prior to conducting any event.

Figure 5-5 shows a State of Alaska, 511 web page. Information being disseminated is update on road closures/ restrictions.

Figure 5-5: Event Updates, 511 Web page, State of Alaska

5.5.5 Parking

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

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

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

Figure 5-6 shows a San Francisco Bay Area, 511 web page. Information being disseminated is parking available nearby, parking charges and available space.

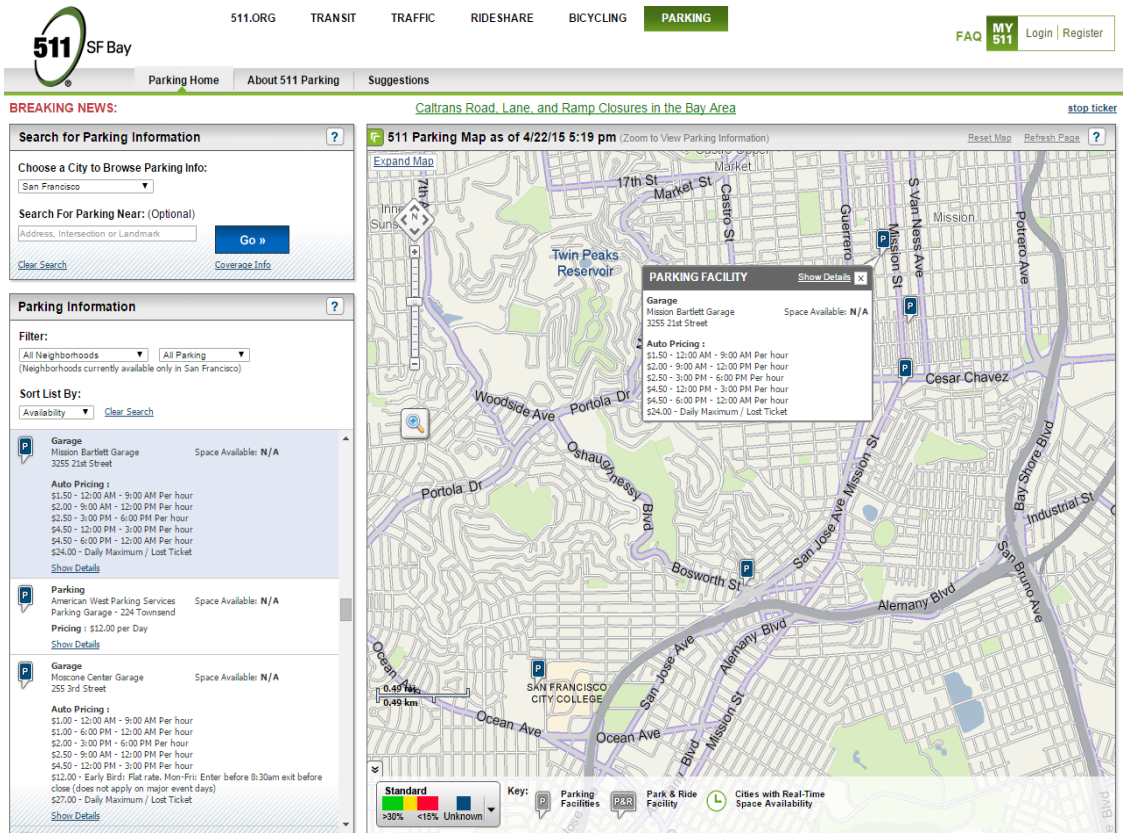


Figure 5-6: Parking Information, 511, SF Bay Area

5.5.6 Weather

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

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

Figure 5-7 shows State of Alaska, 511 web page. Information being disseminated is weather updates that can affect travel.

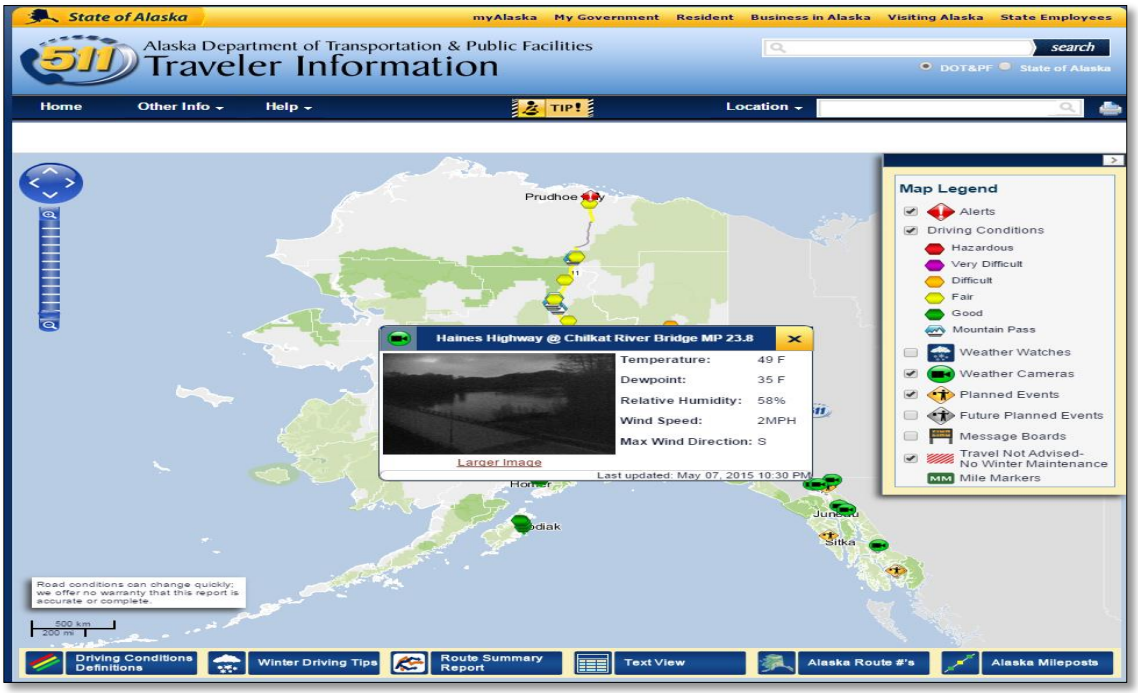
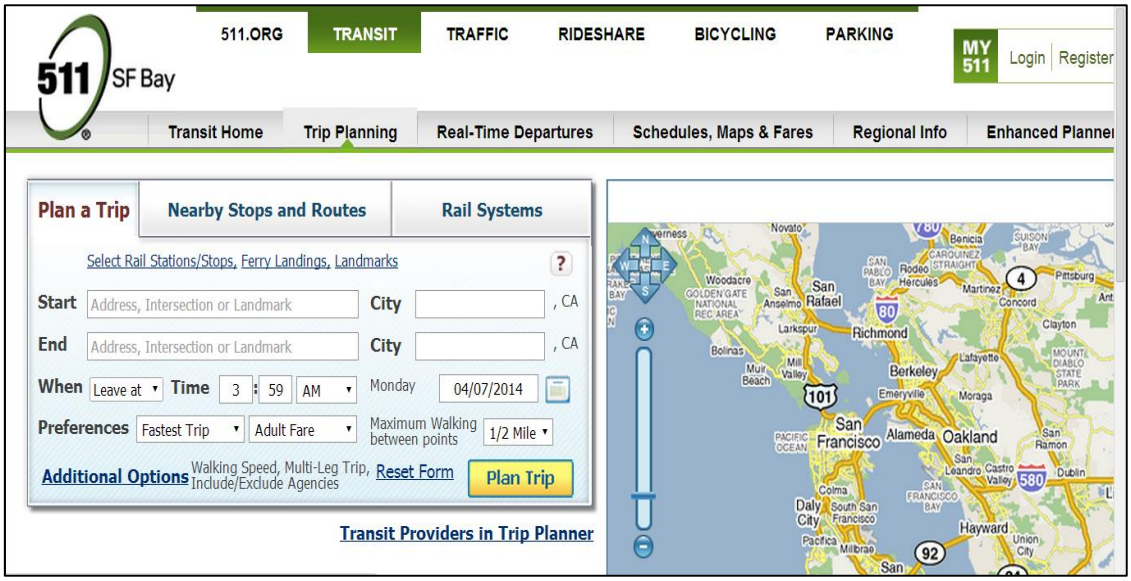


Figure 5-7: Weather Update, 511 web page, State of Alaska

5.5.7 Trip Planner

Guwahati NUTH would have multimodal trip planning tool to support travel planning between various origins and destinations using several options such as modal preference, date, time, fastest, least transfers/ cost/ time/ walk etc.

Figure 5-8 shows the web page containing trip planning tool on the 511 website (www.511.org) providing various options to users to choose from such as fastest trip, fewest transfers, less walking, lower fares.



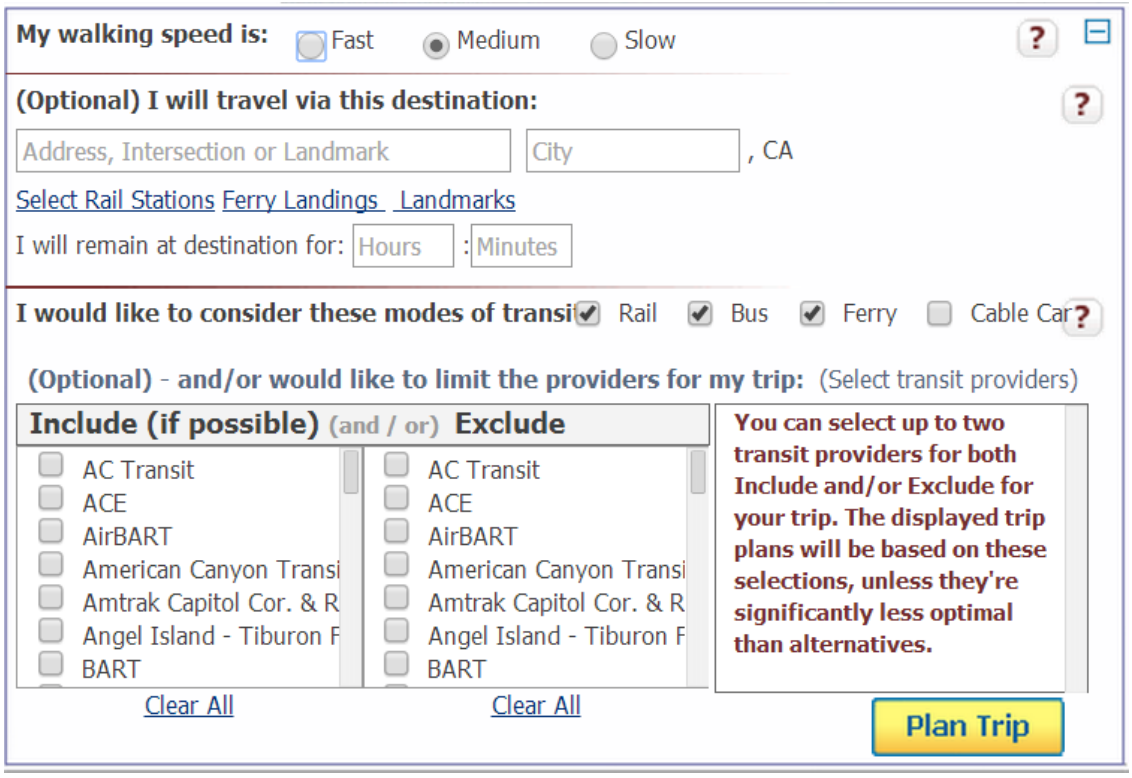


Figure 5-8: Trip Planner, 511, San Francisco Bay Area

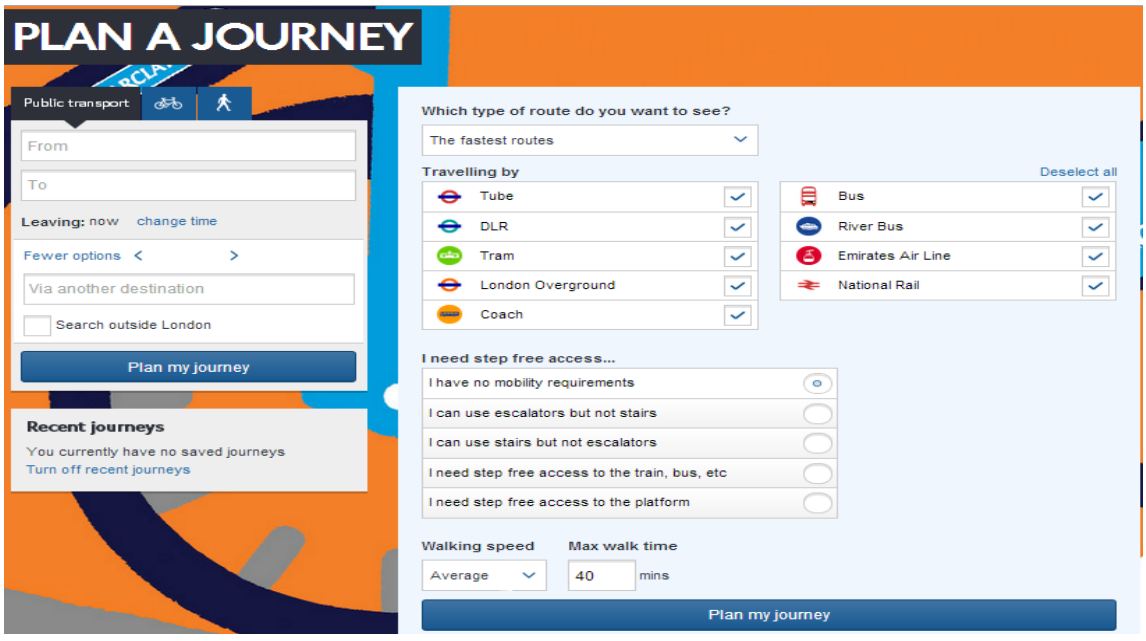


Figure 5-9: Journey Planner, Transport for London

Figure 5-9 shows the web page containing journey planning tool provided on the Transport for London's website (http://www.tfl.gov.uk) providing various options for users to choose from such as transport mode, mobility requirements, fastest route, fewest changes, least walking.

Figure 5-10 shows the web page containing journey planning tool for Cluster buses in Delhi being managed by DIMTS Limited.

Figure 5-10: Journey Planning Tool for Cluster Buses (DIMTS, Delhi)

5.6 Inter-agency and Inter-jurisdictional Coordination

Guwahati NUTH would need to interface with TMICC, 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/TMICC in order to facilitate effective communication and coordination. Further, as and when agencies upgrade their respective systems, the NUTH/TMICC information exchange interfaces with their systems must be checked for continuous flow of information. As TMICC facility is also proposed for Guwahati, NUTH would need to interface with TMICC in order to exchange information and disseminate the same to the public. TMICC must be informed prior to taking up any road construction, maintenance or road digging activity so that TMICC can share requisite information with the road users.

5.7 Project Level Architecture

An outline of the project level architecture and the associated interfaces for the Guwahati NUTH has been shown in Figure 5-11. A more comprehensive project level architecture, including all connectivity, standards and protocols would need to be developed as a part of the Systems Engineering Management Plan (SEMP).

NUTH can get traffic, construction and maintenance information, weather information, incident information, transit information through interfaces with the agencies providing this information. As TMICC is also proposed in Guwahati, it is recommended that interfaces be maintained between TMICC and NUTH. Most of the information could be made available to NUTH from TMICC.

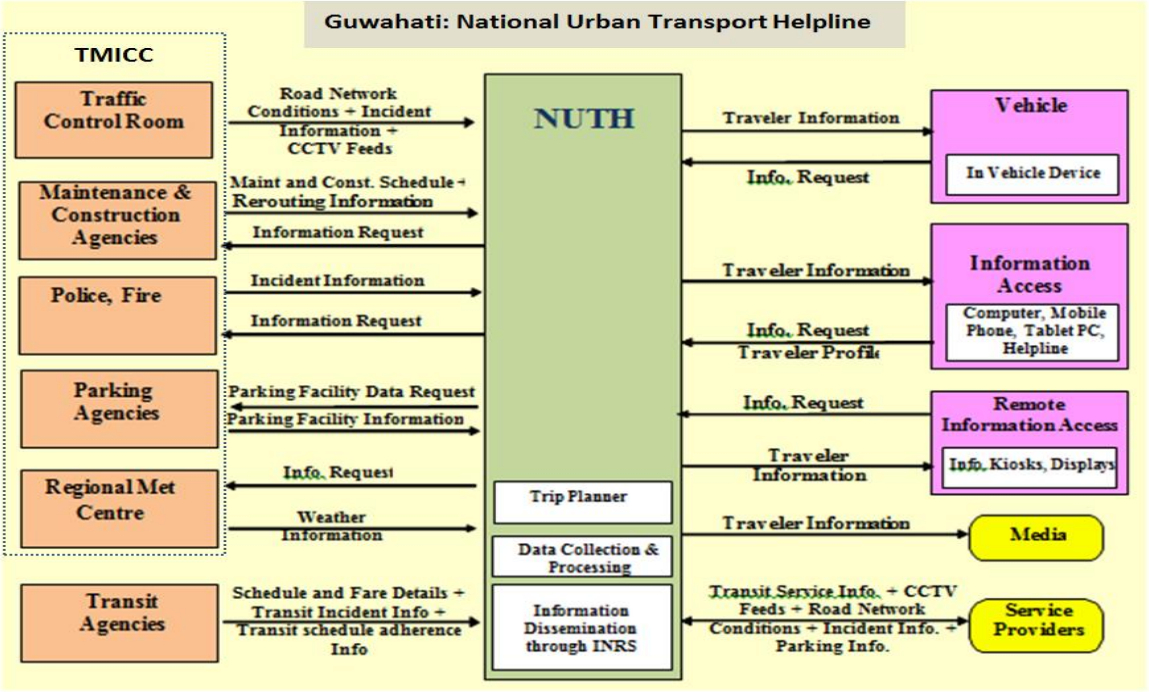


Figure 5-11: Guwahati NUTH Project Architecture

5.8 Standards and Protocols

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

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

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

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

List of some potential standards is given in the Annexure-2 for reference.

5.9 System Requirements

System requirements for NUTH have been covered under the following general categories. These requirements are general in nature and shall be finalised during the preparation of the Detailed Project Report:

- Data Collection, Processing and Storage
- Data Dissemination
- Trip Planner
- Information Alerts
- Personalised Traveller Information
- Remote Information Access
- NUTH Call Centre
- NUTH website
- Mobile Application
- NUTH Social Media pages
- MIS Reports

5.9.1 Data Collection, Processing and Storage Requirements

- NUTH shall collect, process, and store transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information (refer Section 5.5.1).
- NUTH shall collect, process, and store traffic information on roads, including congested routes, recommended routes, and current speeds on specific routes (refer Section 5.5.2)
- NUTH shall collect, process and store information that can impact traffic on roads e.g. event information, road closure etc. (refer Section 5.5.2).
- NUTH shall collect, process, and store maintenance and construction information, including scheduled maintenance and construction work activities (refer Section 5.5.3).
- NUTH shall collect, process, and store information related to events impacting transit and/or transit (refer Section 5.5.4).
- NUTH shall collect, process, and store parking information, including location, availability, and parking charges (refer Section 5.5.5).

- NUTH shall collect, process, and store current and forecast road conditions and weather conditions (refer Section 5.5.6).

5.9.2 Data Dissemination

- NUTH shall disseminate transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travellers (refer Section 5.5.1).
- NUTH shall disseminate traffic and road network condition information to travellers, including recommended routes, and current speeds on specific routes (refer Section 5.5.2).
- NUTH shall disseminate maintenance and construction information to travellers, including scheduled maintenance and construction work activities (refer Section 5.5.3).
- NUTH shall disseminate event information to travellers. (refer Section 5.5.4)
- NUTH shall provide the capability to support requests from the media for traffic and incident data (refer Section 5.5.4).
- NUTH shall disseminate parking information to travellers, including location, operational timings, availability, and fees (refer Section 5.5.5).
- NUTH shall disseminate weather information to travellers (refer Section 5.5.6).
- Data would be disseminated through various modes: website, call centre, mobile applications and social network.

5.9.3 Trip Planner

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

  Refer Section 5.5.7 for more details regarding trip planner.

5.9.4 Information Alerts

- Guwahati NUTH shall provide travel alerts for public as well as tourists travelling 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 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.

5.9.5 Personalised Traveller Information

- Guwahati 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.

5.9.6 NUTH Call Centre

- Guwahati NUTH call centre number is recommended to be simple three digit number (such as 555) as adopted by MoUD, GoI.

  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 nation-wide short code 155220 to be used as Public Transport Helpline Number. This number is a Universal Access Number (UAN) and can be used from any location in India and would be accessible from both landline as well as mobile phones.

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

  It is recommended that number 155220 be utilised for Guwahati NUTH until a simpler three digit number is approved and made available throughout the country.

- NUTH Call Centre shall provide the capability to process Dual-Tone Multi-Frequency (DTMF) based requests (touch-tone) for traveller information received on the NUTH telephone number.
- NUTH Call Centre shall provide information on traffic conditions in the requested voice format and for the requested location.
- NUTH Call Centre shall provide roadway maintenance information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide weather and event information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide transit service information in the requested voice format and for the requested location.
- NUTH Call Centre shall provide live customer support in language as may be decided by GoA.

  NUTH would also utilise live operator assistance for improved customer support. The number of agents and time periods for live customer support will depend on funding and customer needs. Typically, if a customer is unable to navigate an automated IVRS, then they can request a customer service. This option would allow more customised services. This is especially useful in the Indian context given the diversity of language and dialect needs. Again, depending on the need,

the number of agents can be adjusted. IVRS would be configured and structured in such a manner that most of the information is disseminated through IVRS mode and only a limited set of information is required to be disseminated through the live operators. Objective should be to support majority of the calls through IVRS. MoUD in its communication to the States has written that over 80% of the calls need to be supported through IVRS.

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

- Level 1: Main menu screen – Main screen with tabs for different traveller information services (e.g. Transit, Trip Planning, Parking, Traffic, Toll etc.). The default screen could be for the most often requested service.

- Level 2: Service menu screen – this would have the input fields (e.g. origin, destination, route 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.

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

  It may not be desirable and economical to have agent respond to each call that NUTH receives from public seeking information. In view of this, NUTH would provide for Interactive Voice Response System (IVRS) facility 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.

  As example, a typical IVRS logical flow (implemented by KSRTC at Mysore) has been provided below as reference. The complexity of the menu would, however, vary on a case-to-case depending upon:
  - Type of information such as traffic or transit etc.
  - Geographic coverage of the service
  - Number of languages
  - Number of transit modes
  - Number of service types under each transit mode (AC, non-AC, limited stop, etc.

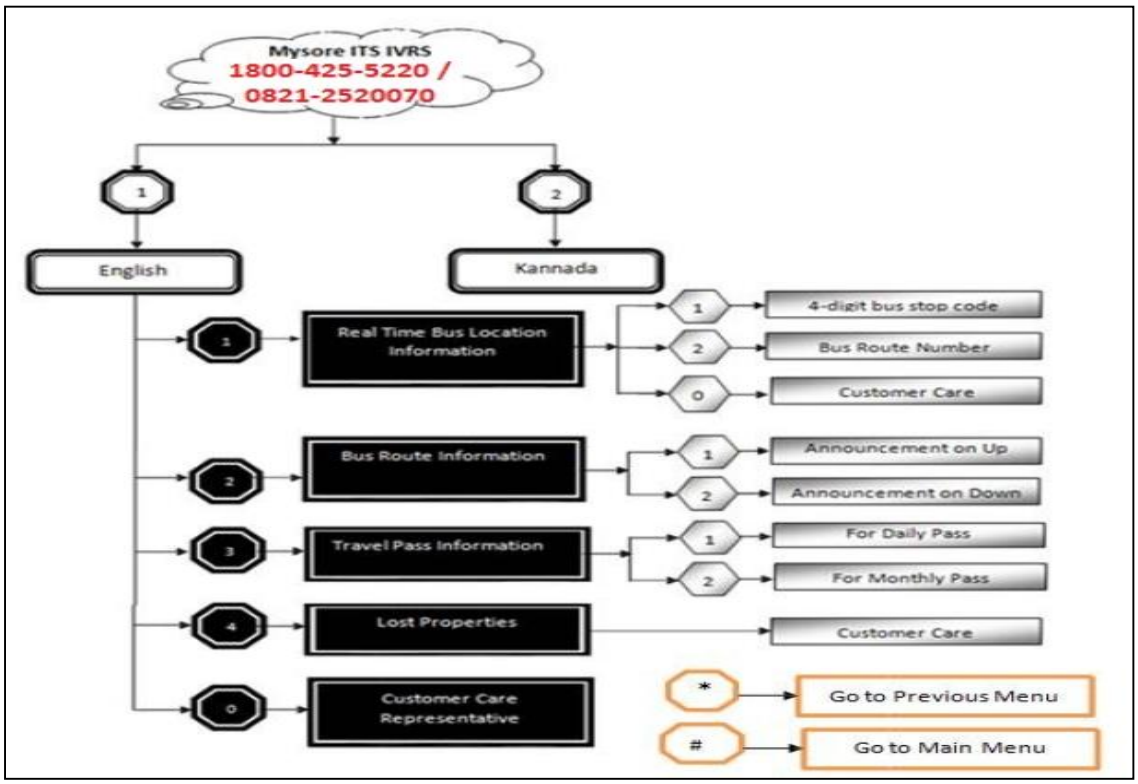


Figure 5-12: Typical IVRS Menu

5.9.7 Guwahati NUTH Website

Websites have emerged as a popular channel for accessing information. In view of this, Guwahati NUTH would also have well designed 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 on maps that are suitable for viewing on a large screen but may require higher bandwidth to access. The mobile versions of websites allow for 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 Guwahati NUTH website would provide multiple browser support. 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. Guwahati NUTH would also show details of the websites of stakeholders like ASTC, DIWT, GMDA, GMC, any other important stakeholders.

5.9.8 Mobile Applications

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

device OS/device sizes. To begin with android applications could be developed and later on iOS and Windows based applications could be developed.

Guwahati NUTH would have a well-designed mobile application. The application may be designed for all popular mobile interfaces such as iOS, Android, Windows etc. GIS maps would be used to display route, incident, congestion, road closures to enrich user experience. Guwahati NUTH mobile app would have multimodal journey planning tool to support trip planning between various origin and destinations using several options such as modal preference, date, time, fastest, least transfers/ cost/ time/ walk etc.

Guwahati NUTH implementing agency may share data with private sector entities in order to enable them to develop innovative applications for information dissemination. In the beginning such information could be shared with private sector entities without any cost with an option retained for levying of license fee and/or revenue share in future. The decision to opt for levying of license fee and/or revenue share could be taken by the implementing agency 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 implementing agency and initially the focus should be on developing the market for such services. Figure 5-13 shows as example view of 511 Mobile Application for the SF Bay area.

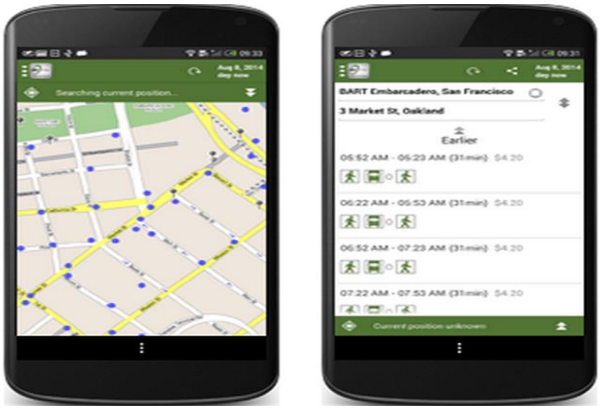


Figure 5-13: 511 Mobile Application, SF Bay Area

5.9.9 Guwahati NUTH Social Media

Considering its popularity, social media would also be used for information dissemination. Towards this, Guwahati NUTH would set up social media pages on Facebook, Twitter, etc. to disseminate certain types of information such as updates, alerts, events, service closures, incidents, accidents etc. Figure 5-14 shows Facebook page of 511 SF bay area to disseminate information.

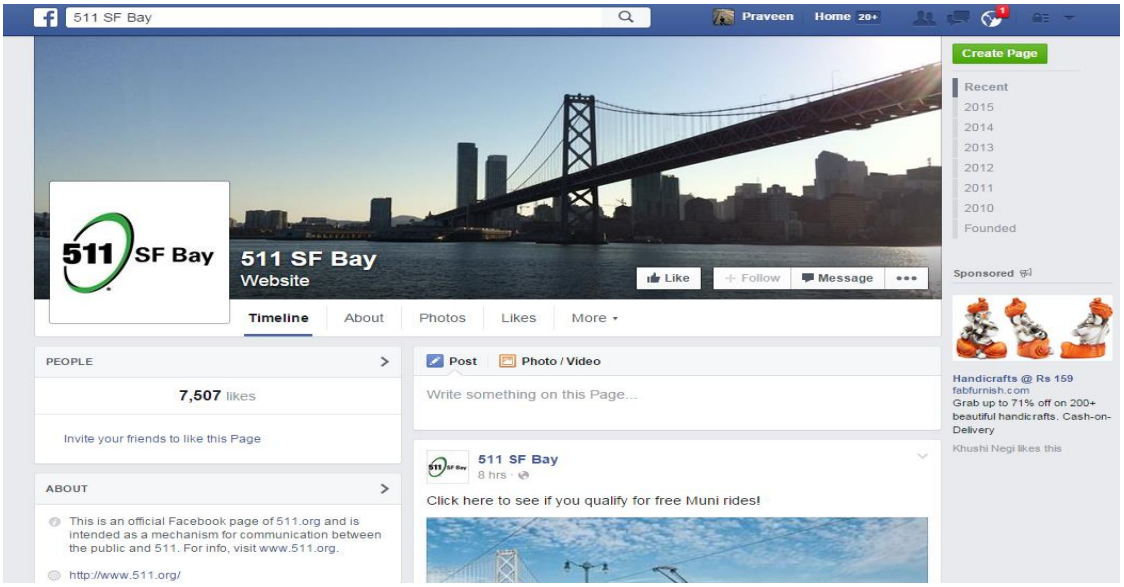


Figure 5-14: 511 SF Bay, Facebook page

5.9.10 Management Information Systems (MIS) Reports

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

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

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

5.9.11 Language Usage and Information Dissemination

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

6.0 TMICC AND NUTH: IMPLEMENTATION, OPERATION AND MAINTENANCE

6.1 TMICC and NUTH Implementation Process

Figure 6-1 outlines the steps involved during the TMICC and NUTH development process. In line with the international best practices, it is recommended that Guwahati city adopts Systems Engineering approach towards system design and implementation as detailed in the TMICC and NUTH Generic Operations Documents already prepared.

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

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

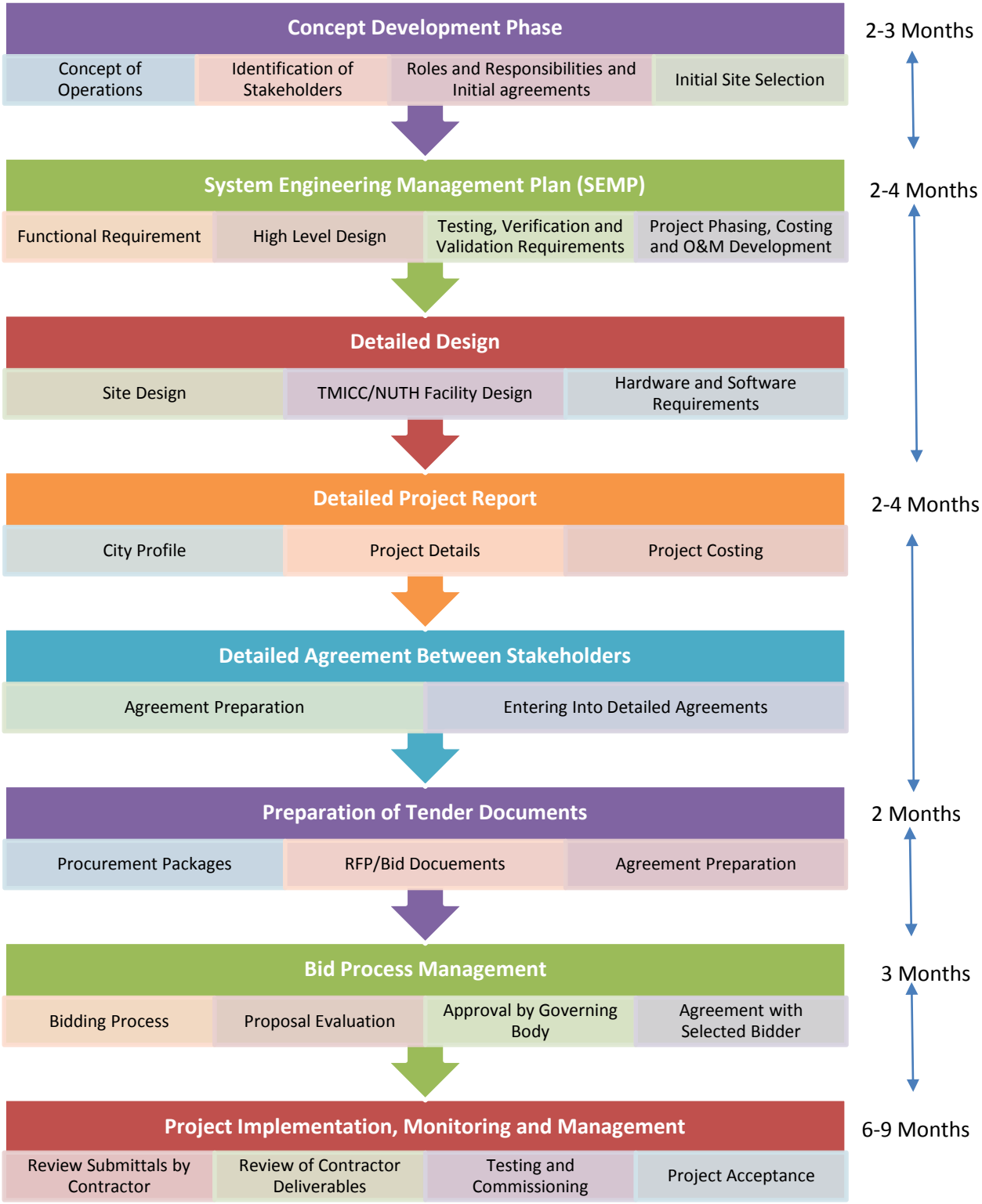


Figure 6-1: TMICC & NUTH Implementation Process and Estimated Time Schedule

6.1.1 Development of City Specific Concept of Operations Report

City Specific Concept Report or Concept of Operations would cover the following aspects:

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

  This activity would require identification and evaluation suitable site(s) for housing the TMICC/NUTH facility. Preliminary site design should consider functions within the TMICC/NUTH, number of staff and space requirements, and future expansion and growth. Once the site is finalised, high level design of the TMICC/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 TMICC/NUTH facility
  - Prepare business plan including financing for the TMICC/NUTH facility
  - Examine possibility of implementing the project/sub-projects on PPP format and draw up the broad structure for the same
  - Consideration for Operations and Maintenance budget
- 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 TMICC/NUTH.

6.1.2 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 the 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 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
  - Configuration management
- Systems engineering processes
  - Systems engineering steps to be followed for the project
  - Definition of all high-risk areas, including critical technologies that might pose some challenges 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 the SEMP or created as separate document and referred in the SEMP)
  - Interface Management and Control Plan
  - System Integration Plan
  - System, Subsystem and Components Verification Plan
  - Hardware and Software Development Plans
  - System Installation Plan
  - Training Plan
  - Operations and Maintenance (O&M) Plan
  - System Validation Plan
- Relevant project documents

6.1.3 Detailed Design

The detailed design would cover the following for the TMICC/NUTH:

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

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

6.1.4 Detailed Project Report

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

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

6.1.5 Detailed Agreements between Stakeholders

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

Guidance regarding detailed agreements between stakeholders for TMICC and NUTH has been provided in Section 7.3.4.

6.1.6 Preparation of Tender Documents

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

- 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 TMICC/NUTH.
- Preparation of bid documents for construction work.
- Preparation of agreements for various procurements in consultation with the TMICC/NUTH implementing agency. The agreements 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.

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

6.1.7 Bid Process Management

Based on the project structure and implementation plan finalised by the TMICC/ NUTH implementing agency, the project may require multiple bid processes. The various tasks involved during 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”.

6.1.8 Project Implementation, Monitoring and Management

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

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

6.2 Guwahati TMICC Operations and Maintenance

6.2.1 Field Equipment

A. **Systems of Participating Agencies:** Such systems and associated equipment will be maintained by the agencies to which they belong. The agencies may in turn maintain these systems and associated equipment either directly or through their contractor(s). TMICC system would generate alert as and when any of the requisite data feed from these systems is not reaching TMICC system and would report the same to the agency concerned so that the agency may get the equipment inspected and take corrective action within a reasonable time frame.

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

6.2.2 TMICC Backend

The TMICC backend system would consist of the following:

A. **Hardware:** Backend hardware would comprise servers, switches, operator consoles, storage, UPS, network and communication equipment that support TMICC operations. Such equipment would include those deployed at the primary

site as well as the ones deployed at the disaster recovery site. Such hardware would be maintained by the TMICC implementing agency or its contractor through the respective Original Equipment Manufacturer (OEM) or their authorised resellers, as the case may be. The maintenance should be subject to agreed service levels in terms of response and resolution times.

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

C. Application Software: TMICC application software would comprise the software that supports TMICC operations and will include traffic enforcement system, traffic management system, surveillance system, information dissemination system, emergency and incident management system and other specialised applications. The application software will also have the map of the regions which will have all the signals details, traffic information, operator interfaces to add incidents, construction events, VMS Interface, CCTV interface etc. Information from all other interfaces like police, parking, weather etc. will be visible here. Such software would include those deployed at the primary site as well as the ones deployed at the disaster recovery site. The 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.

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.

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 the TMICC, where applicable, could be maintained by the respective OEM/supplier/contractor. The maintenance should be subject to agreed service levels in terms of response and resolution times.

6.3 Guwahati NUTH Operations and Maintenance

6.3.1 Guwahati NUTH Operations

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

A. Data Collection

Data collection from various participating entities and other sources would be one of the most important operational activities undertaken by the Guwahati NUTH. 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.
- Association/collaboration with other data providers.
- Finalising the data exchange protocols between NUTH and agency systems.
- Deciding on the method of transmission of data.
- Deciding the periodicity of transmission of data and its update.
- Receiving and storing the data.
- Setting up, managing, operating and maintaining the data receiving and storage infrastructure and system.
- Coordinating with participating agencies for ensuring that the data is provided by them to NUTH in accordance with the understanding as set out in the MoU among the participating agencies. (sample of MoU is provided as Annexure 4).

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 following appropriate standards and protocols. NUTH and control centres of various participating agencies need to work closely with each other in order to provide transit, traffic and other related information to public.

As TMICC is also proposed in the Guwahati city, NUTH would interface with TMICC to collect information which can be provided by TMICC. TMICC, as part of its operations, would collect considerable amount of data related to traffic, transit, parking, construction etc. therefore, NUTH needs to collect these data through interfaces with TMICC. For certain other types of data such as live transit data, parking availability data etc., NUTH may directly connect to the agencies concerned for the purposes of information acquisition.

B. Data Processing and Fusion

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

- Data massaging to suitably format the data received.

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

C. Information Dissemination

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

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

D. Other Operational Aspects

Other operational aspects of Guwahati 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 information processing
- Performance evaluation

E. Guwahati NUTH Customer Feedback and Performance Evaluation

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

6.3.2 Guwahati NUTH Maintenance

There are various systems that would interface with Guwahati NUTH either directly or through TMICC. The ASTC, DIWT, GMC, GMDA, PWD system would provide data feed to NUTH either directly or through TMICC. NUTH backend would comprise hardware, software, networking and communication to host NUTH application software and standard software. There would be support systems such as power back up, air conditioning, access management, building management etc. and other utilities and services supporting the NUTH backend. Each of these must be maintained in proper state of upkeep and repair to the acceptable standards so as to support NUTH related activities. NUTH backend may be hosted at TMICC.

A. Systems Interfacing with NUTH: Systems of Participating Agencies

Such systems and associated equipment will be maintained by the agency to which they belong such as TMICC (proposed), ASTC, DIWT, GMC, and GMDA. 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.

B. Systems Interfacing with NUTH: TMICC

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

C. Guwahati NUTH Backend System: Hardware

Backend hardware would comprise servers, switches, storage, UPS, network and communication equipment that support NUTH operations. Such equipment would

include those deployed at the primary site as well as the ones deployed at the disaster recovery site. NUTH backend hardware could be maintained by the respective Original Equipment Manufacturer (OEM) or their authorised resellers, as the case may be. The maintenance should be subject to agreed service levels in terms of response and resolution times.

D. Guwahati NUTH Backend System: Standard Software

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

E. Guwahati NUTH Backend System: Application Software

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

F. Guwahati NUTH Backend System: Communication Links

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

G. Guwahati NUTH Backend System: Other Facilities

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

6.4 Standard Operating Procedures Outline

Guwahati TMICC/NUTH shall be a 24X7 operations centre and therefore, needs to be staffed with personnel in shifts, as required. The shifts would have varying personnel depending upon the peak and non-peak traffic patterns. It is expected that there would also be variations in staffing for weekdays as compared to weekends.

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

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

- Jurisdiction of the TMICC/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 TMICC/NUTH manuals

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

6.5 Awareness Campaign and Outreach

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

- Branding through professional help (a common branding by all agencies)
- NUTH number should be prominently displayed on:
    - the websites of transit agencies that are supported by NUTH

- all the vehicles, stations, bus stops, terminals and interchange points used by the transit agencies that are supported by NUTH.
- all the passenger information displays on all vehicles, stations, bus stops, terminals and interchange points used by the transit agencies that are supported by NUTH on a periodical basis.
- all the information brochure containing information about transit agencies that are supported by NUTH.

- NUTH may provide information feeds to television channels / FM radios / newspapers in exchange for advertising in kind. Such feeds while broadcast or published may contain references to NUTH.
- NUTH may be popularised through select government communications to public at large.
- NUTH may sponsor various MoUD and other government initiatives / events that are expected to receive wider media coverage.
- Stickers with NUTH logo on the cars, transit and other vehicles.

6.6 Obsolescence Management

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

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

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

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

6.7 Retirement and Replacement

The Guwahati TMICC/NUTH system components would need to be periodically reviewed with respect to their continued utility in supporting the then current user needs and their cost effectiveness as compared to other options. The system may need to 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 the system supports the current user needs better and/or is more cost effective

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

7.0 GUWAHATI TMICC AND NUTH: STAKEHOLDERS AND ORGANISATION

7.1 Introduction

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

7.2 Role of Various Levels of Governments in Transportation

Various levels of governments or agencies controlled by them have participation in provision of transportation services in Guwahati. Table 7-1 provides a brief overview of the role currently being played by various levels of governments or agencies controlled by them.

Table 7-1: Guwahati: Government & Its Agencies in Urban Transportation

Govt. Level	Entity	Description and Roles in Transportation
Central Government	Ministry of Urban Development, GoI	• Ministry of GoI • National Urban Transport Policy formulation, supporting its implementation by various States and Local Governments through funding schemes.
	North East Frontier Railway (Indian Railways)	• Part of Indian Railways which is controlled by GoI • Operates rail services through GMR • Licenses parking facilities at its stations and nearby areas
State Government	Guwahati Development Department, GoA	• Department of GoA • Administrative department for GMC, GMDA
	Transport Department, GoA	• Department of GoA • Administrative department for ASTC and Directorate of Inland Water Transport • Vehicle registration, licensing, permits, city bus routes • Operates ferry services through Directorate of Inland Water Transport • Regulates para-transit operators (taxis, auto rickshaws, trekkers) and stage carriage buses including notification of permit conditions
	Public Works Department (PWD),	• Department of GoA • Constructs and maintains State Highways,

Govt. Level	Entity	Description and Roles in Transportation
	GoA	National Highways and Major District Roads in GMA
	Guwahati Metropolitan Development Authority (GMDA)	• Constituted under the Guwahati Metropolitan Development Authority Act, 1985 • Prepares Master Plan for the GMA • Constructs and maintains roads in GMA • Installs and maintains the traffic signals in the GMA • Licenses parking facilities in GMA
	Assam State Transport Corporation (ASTC)	• Statutory corporation established under the provisions of Road Transport Corporation Act, 1950 • Administrative reporting to the Transport Department, GoA • Provides bus services in Guwahati and nearby cities. • Licenses parking facilities at its terminals and nearby areas • Operates a multilevel parking facility developed by ASTC
	Guwahati Traffic Police	• Part of the Guwahati Police organisation • Responsible for regulation and management of traffic including traffic signals in GMA • Traffic rules enforcement
	Fire & Emergency Services, Assam	• Set up under the Assam Fire Service Act, 1985 • It is under the administrative control of Assam Police • Maintains fire stations with necessary equipment to attend to any fire outbreak and attends to emergencies
Local Government	Guwahati Municipal Corporation (GMC)	• Established under the Guwahati Municipal Corporation Act,1971 • Constructs and maintains roads in GMC area • Licenses parking facilities in GMC area

There are several authorities/agencies in Guwahati engaged in the area of planning, traffic management, transit operations, parking, road construction and maintenance, and bus terminals operations as listed in Table 7-2.

Table 7-2: Guwahati: Agencies in Different Areas of Transportation

Area	Entities
Traffic	• Guwahati Traffic Police • Guwahati Metropolitan Development Authority (GMDA)
Transit	• Assam State Transport Corporation (ASTC) • Directorate of Inland Water Transport, Government of Assam (DIWT) • Transport Department, Government of Assam
Roads	• Public Works Department, Government of Assam • Guwahati Metropolitan Development Authority (GMDA) • Guwahati Municipal Corporation (GMC)
Parking	• Guwahati Metropolitan Development Authority (GMDA) • Guwahati Municipal Corporation (GMC) • Assam State Transport Corporation (ASTC) • North East Frontier Railway (Indian Railways, GoI)
Bus Terminals/ Ferry Terminals	• Assam State Transport Corporation (ASTC) • Directorate of Inland Water Transport (DIWT)
Emergency /Disaster Response	• Fire & Emergency Services, Government of Assam • Guwahati Police • Assam State Disaster Management Agency (ASDMA)

7.3 Institutional Set Up

7.3.1 Guwahati TMICC Implementing Agency

GMDA installs and maintains traffic signals in the city and Guwahati Traffic Police regulates and manages traffic in Guwahati. Guwahati Traffic Police also operates the traffic signals.

Table 7-3 below provides two options that could be explored regarding entrusting the responsibility for setting up and operating the TMICC for Guwahati

Table 7-3: Options for TMICC Implementing Agency

Option	Set-Up	Operate
1	GMDA	Guwahati Traffic Police
2	Guwahati Traffic Police	Guwahati Traffic Police

Considering the current role of GMDA and Guwahati Traffic Police in the city, it is recommended that GMDA sets up and maintains the TMICC including the associated

field equipment, and Guwahati Traffic Police operates the same. However, in case the GoA decides to entrust the complete responsibility for setting up and maintaining the TMICC upon Guwahati Traffic Police, then it may do so.

It may be noted that in Mumbai, Ahmedabad and Pune, respective municipal corporations install and maintain traffic signalling system and the Traffic Police operates these. In case of Delhi, it is the Traffic Police that has the complete responsibility for installing, maintaining and operating the traffic signals.

7.3.2 Guwahati NUTH Implementing Agency

There are three options (Table 7-4) that could be explored regarding entrusting the responsibility for setting up and operating the NUTH for Guwahati. These options should be explored and finalised during the development of the Concept of Operations. It is recommended that the implementing agency develop an integrated TMICC and NUTH system.

Table 7-4: Options for NUTH Implementing Agency

Option	Implementing Agency	Remarks
1	Transport Department, GoA	• Transport Department, GoA is the administrative department for ASTC (which operates bus services in Guwahati/Assam) and Directorate of Inland Water Transport (which operates ferry services). • Transport Department also regulates the stage carriage.
2	Guwahati Development Department, GoA	• Guwahati Development Department, GoA is the administrative department of GMC and GMDA. • Guwahati Development Department, however, has no control over ASTC (bus services) and DIWT (ferry services)
3	Assam State Transport Corporation (ASTC)	• ASTC is currently operating buses in Guwahati. However, there is a proposal to set up city specific Special Purpose Vehicle (SPV) to operate and manage bus services in Guwahati. • Transport Department, GoA is the administrative department for ASTC

There are discussions underway to establish Unified Metropolitan Transport Authority (UMTA) for Guwahati. Additionally, Special Purpose Vehicle (SPV) to operate and manage buses procured through JnNURM assistance in Guwahati is also under consideration. The SPV is proposed to have shareholding from ASTC, GMC and GMDA.

Currently ASTC is operating buses in Guwahati and DIWT is operating ferries, both of which are under the administrative control of Transport Department, GoA. Further,

as and when the city specific SPV is set up, it is also likely to have shareholding from ASTC. In view of this, it is suggested that NUTH for Guwahati be set up and managed by Transport Department, GoA.

7.3.3 Stakeholders, Roles and Responsibilities

Table 7-5 shows the suggested roles and responsibilities of the key stakeholders associated with the Guwahati TMICC and NUTH.

Table 7-5: Roles and Responsibilities

Area	Entities	Roles and Responsibilities
Traffic	• Guwahati Traffic Police	• To operate TMICC • To enter into agreement/MoUs with various agencies associated with TMICC, as needed • To coordinate with various agencies associated with TMICC • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
	• Guwahati Metropolitan Development Authority (GMDA)	• To setup and maintain TMICC • Signals and other traffic equipment installation and maintenance • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
Transit	• Assam State Transport Corporation (ASTC) • Directorate of Inland Water Transport (DIWT)	• To manage and monitor transit operation • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
	• Transport Department, GoA	• To setup and operate NUTH • To enter into the arrangement with various agencies associated with NUTH
Roads	• Public Works Department, GoA • Guwahati Metropolitan Development Authority (GMDA) • Guwahati Municipal Corporation (GMC)	• Road construction and maintenance • Managing the contracts and relationships with the contractors responsible for construction and maintenance of road network • To provide right of way on its roads/area for installation of traffic equipment • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH

Area	Entities	Roles and Responsibilities
Parking	• Guwahati Metropolitan Development Authority (GMDA) • Guwahati Municipal Corporation (GMC) • Assam State Transport Corporation (ASTC) • Directorate of Inland Water Transport (DIWT) • North East Frontier Railway, (Indian Railways, GoI)	• Manage the parking facility • To provide right of way on its roads/area for installation of traffic equipment • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
Bus / Ferry Terminals	• Assam State Transport Corporation (ASTC) • Directorate of Inland Water Transport (DIWT)	• Manage the Terminals • To provide right of way for installation of traffic equipment • To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
Emergency /Disaster Response	• Fire & Emergency Services, GoA • Guwahati Police • Assam State Disaster Management Agency (ASDMA)	• To share data and updates as listed in Section 7.3.4 with TMICC and NUTH
Weather	• Regional Meteorological Centre, Guwahati	• To share data and updates as listed in Section 7.3.4 with TMICC and NUTH

7.3.4 Data Sharing by Project Stakeholders

Data and information sharing is an important element of TMICC and NUTH implementation. In order to support data and information exchange, a project level architecture must be developed and applicable standards for information exchange should be established and adopted by each participating agency.

Table 7-6 below provides the details of the data sharing by transit agencies for the Guwahati TMICC/NUTH.

Table 7-6: Entities Sharing Transit Data with Guwahati TMICC/NUTH

Transit Related Data	ASTC, Transport Department	DIWT
Contact details, website details	Y	Y
Services: Express, Ordinary, AC, Non AC, Night services	Y	Y
Routes: Details of the routes operated	Y	Y
Fare Details, Ticketing Options, Pass Details	Y	Y
Schedule Data: Frequency during peak/off-peak hours, Timings	Y	Y
Real time status, Departures scheduled from various terminals	Y	Y
Timing of operations: First and last service on various routes	Y	Y
Details of Bus terminals, Bus Stops, Ferry Terminals	Y	Y
Inter-modal transfer options: connecting routes, interchange terminals	Y	Y
Tourism related information with connecting transit options to tourist spots	Y	Y
Service delay, disruptions	Y	Y
Information on new services, discontinuation of any service etc.	Y	Y
Rerouting	Y	Y
GPS probe data	Y	Y
Incidents & Events	Y	Y

Table 7-7 below provides the details of the data sharing by traffic related agencies for the Guwahati TMICC/NUTH.

Table 7-7: Entities Sharing Traffic Data with Guwahati TMICC/NUTH

Traffic Related Data	Guwahati Traffic Police, GMDA	Road Owning Agencies (GMC, GMDA, PWD)
Road attributes: name, number of lanes, width, whether one-way or two-way, GIS maps etc.	Y	Y
Location of various traffic related equipment: signalised junctions, cameras, variable messages signs etc.	Y	

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

Table 7-8 below provides the details of the data sharing by parking related agencies for the Guwahati TMICC/NUTH.

Table 7-8: Entities Sharing Parking Data with Guwahati TMICC/NUTH

Entities	Data Sharing
• Guwahati Metropolitan Development Authority (GMDA) • Guwahati Municipal Corporation (GMC) • Assam State Transport Corporation (ASTC) • North East Frontier Railway (Indian Railways, GoI) • Directorate of Inland Water Transport (DIWT), GoA	**Parking Facility Details** • Capacity • Availability • Type of vehicles that can be parked • Operational hours • Parking charges • Mode of payment • Operating agency • Contact details

Table 7-9 below provides the details of other entities sharing data with the Guwahati TMICC/NUTH.

Table 7-9: Other Entities Sharing Data with Guwahati TMICC/NUTH

Area	Entities	Data Sharing
Emergency / Disaster Response	• Fire & Emergency Services, GoA • Guwahati Police • ASDMA	• Incident data • Accident data • Location of the emergency response facilities • Contact details • Periodical updates to the above
Weather	Regional Meteorological Centre, Guwahati	• Weather updates • Temperature, wind speed, fog, visibility details, humidity, rainfall

7.3.5 Guwahati TMICC and NUTH Organisation

As with any operating entity, organisational structure of the Guwahati TMICC/NUTH project directly impacts its ability to operate effectively. Looking at the city profile and transport infrastructure in Guwahati, it is recommended that the TMICC and NUTH be hosted in the same facility. Figure 7-1 shows indicative organisation structure of the Guwahati TMICC and NUTH.

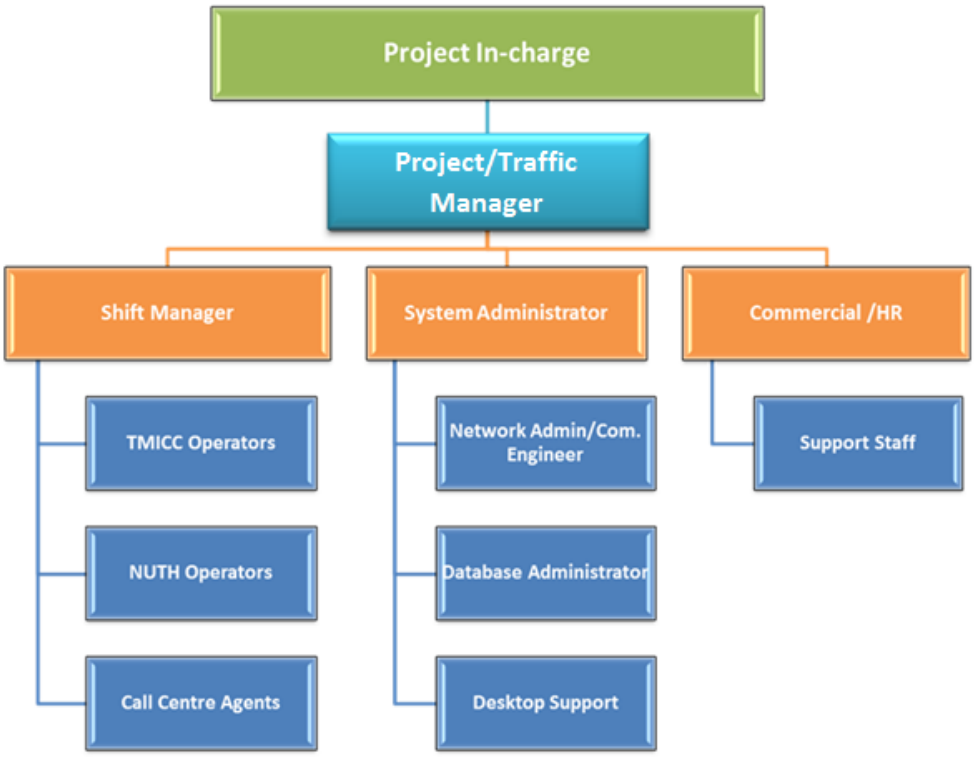


Figure 7-1: Organisation Structure of Guwahati TMICC and NUTH

Table 7-10 provides the details of key positions in the project organisation together with associated role description. The actual position and role description may vary depending on the approach followed by the implementing agency.

Table 7-10: Positions and Role Description

Positions	Role Description
Project In-Charge	• Responsible for overall management, monitoring and operation of the TMICC/NUTH • Should ideally be Traffic Engineer with an additional degree in Management • Formulation of procedures governing TMICC/NUTH operations • Point of contact for authorities, media and other external agencies
Project/Traffic Manager	• Reports to Project In-Charge • Should be a Traffic Engineer • Responsible for day to day operation of the TMICC/NUTH • Responsible for assigning and deployment of the operators in shifts • Coordinates with field and data centre team • Plans for the scheduled maintenance of the field and back office system components in coordination with suppliers, Shift Manager and the System Administrator • Training of Shift Managers
Shift Manager	• Reports to Project Manager • Responsible for day to day operation of the TMICC/NUTH • Responsible for supervision of the operators/call centre agents deployed during the shift • Coordinates with field and data centre team • Training of Operators
Call Centre Agents	• Receiving and responding to calls from public / other stakeholders
TMICC Operator	• Reports to Shift Manager • Operates and manages the system through operator console • Configures and controls field devices • Reports any down time in field devices and backend system • Coordinates with other agencies which are part of workflow being managed by the Operator • Shares information with and reports events to agencies/entities concerned in accordance with policies and procedures • Data analytics
NUTH Operator	• Reports to Shift Manager

Positions	Role Description
	• Operates and manages the system through operator console • Configures and controls field devices • Reports any down time in field devices and backend system • Coordinates with other agencies which are part of workflow being managed by the operator • Shares information with and reports events to agencies/entities concerned in accordance with policies and procedures
System Administrator	• Reports to Project Manager • Responsible to manage the data centre and associated IT environment such as network, communication, security, firewall, desktop support etc. • Monitors and supervises the team comprising network administrator, database administrator, desktop support personnel, communication engineer etc. • Configures the computing and other IT system • Implements policy giving role based access to various personnel for accessing the IT systems • Manages and monitors security of the IT systems • Coordinates with vendors and suppliers for maintenance and support of the hardware and software deployed in TMICC/NUTH
Commercial / HR Manager	• Contract management • Invoicing and payments • Recruitment • Training • General administration and facilities maintenance

Table 7-11 contains the typical profile of the personnel deployed at the TMICC.

Table 7-11: TMICC: Typical Profile of Deployed Personnel

S. No.	Designation / Specialisation	Background / Experience
1	In-charge	Traffic Engineer with an additional degree in Management with relevant experience of at least 10 years
2	Project/Traffic Manager	Traffic Engineer with relevant experience of at least 8 years
3	Maintenance Manager / System Administrator	MCA or Graduate in IT or Electronics Engineering with relevant experience of at least 8 years
4	Network Administrator/Communications Engineer	MCA or Post Graduate in IT or Electronics Engineering with relevant experience of at least 7 years

S. No.	Designation / Specialisation	Background / Experience
5	Database Administrator	MCA or Post Graduate in Computer Engineering with relevant experience of at least 7 years
6	Shift Manager	MCA or Post Graduate in Computer Engineering with relevant experience of at least 7 years
7	Call Centre Agents	Graduate in any discipline having relevant experience of at least 8 years
8	Shift Supervisor	Graduate in any discipline having relevant experience of at least 8 years
9	Desktop Support	Graduate in any discipline with relevant experience of at least 5 years
10	Operator	Graduate in any discipline with relevant experience of at least 5 years
11	Human Resource Manager	Post Graduate in any discipline with relevant experience of at least 8 years
12	Commercial / Finance Manager	CA or Post Graduate in Commerce/Accounting with relevant experience of at least 10 years

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

7.3.6 Agreements between Stakeholders

A. Guwahati TMICC

GMDA and Guwahati Traffic Police, as implementing agencies for TMICC, need to establish suitable arrangements with various stakeholders in order to seek their participation in TMICC and towards sharing the requisite data/information.

GMDA and Guwahati Traffic Police through Chief Secretary, GoA may issue necessary directions to the other departments of the GoA or agencies where GoA has control such as PWD, GMC, GMDA, ASTC, and DIWT for participating in TMICC and/or sharing the requisite data/information.

GMDA and Guwahati Traffic Police through Chief Secretary, GoA may establish suitable arrangements with departments or agencies of GoI (North Eastern Frontier Railway). As required, suitable agreements and/or MoUs could be entered into in this behalf a sample of which is provided as Annexure 3.

B. Guwahati NUTH

Transport Department, GoA, as implementing agency for NUTH, would need to issue necessary directions to ASTC and DIWT for participating in NUTH and sharing the requisite data/information.

Transport Department through Chief Secretary, GoA may issue necessary directions to the other departments of the GoA or agencies where GoA has control such as Guwahati Traffic Police, PWD, GMC, and GMDA for participating in NUTH and sharing the requisite data/information.

Transport Department, GoA, through Chief Secretary, GoA may establish suitable arrangements with departments or agencies of GoI (North Eastern Frontier Railway). As required, suitable agreements and/or MoUs could be entered into in this behalf a sample of which is provided as Annexure 4.

As and when UMTA is constituted for Guwahati, UMTA may coordinate with various stakeholders in order to facilitate and secure their cooperation in implementing the TMICC and NUTH for Guwahati.

8.0 PROJECT COST, REVENUE AND FUNDING STREAMS

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

8.1 Key TMICC components in Guwahati

Guwahati city has 49 signalised junctions functioning under fixed time or manually controlled system. These are proposed to be upgraded into a centrally controlled adaptive signalling system along with other facilities. Considering the additional requirement for signalised junctions, a total of 60 junctions have been considered under the project. Table 8-1 details the current status and scope of the proposed system. Details of various components and their costing have been provided in Section 8.2.

Table 8-1: TMICC: Scope for Deployment

S. No.	Components of TMICC	Current Status	Proposed System
1	Upgradation of signalised junctions (Existing 49 Nos.)	Signals working in isolated mode	60 Nos.
2	Variable Message Sign (VMS)	NA	6 Nos
3	Vehicle Detection Cameras	NA	240 Nos
4	PTZ cameras for traffic surveillance and junctions and other locations	NA	100 Nos
5	TMICC	NA	250 sq. mt

8.2 Guwahati TMICC Cost Estimates

Guwahati TMICC system cost would include the cost of upgradation of signalised junctions, variable message signs (VMS), vehicle detection cameras, PTZ surveillance cameras, control centre civil works, video wall, operator consoles, servers and other IT infrastructure, TMICC software applications etc.

The estimated cost of Guwahati TMICC implementation is approximately ₹ 22 crores and the estimated annual O&M cost is approximately ₹ 5.4 crores (Table 8-2). The project cost and sizing may undergo changes at the time of preparation of detailed project report.

Table 8-2: Guwahati TMICC System Deployment and O&M Cost

S. No.	Items	Rate (Rs.)	UOM	Qty.	Amount (Rs.)
I	**Implementation Cost**				
1	Signalised Junctions Upgrade				
	ATCS compatible controller, LED Lamps, and Cabling etc.)	6,00,000	per Jn.	60	3,60,00,000
2	Variable Message Signs (VMS) (VMS and Uni-pole Gantry etc.)	18,00,000	per unit	6	1,08,00,000
3	Vehicle Detection Cameras	1,50,000	per unit	240	3,60,00,000
4	PTZ Surveillance Camera (at Junctions and midblock section)	3,00,000	per unit	100	3,00,00,000
5	Control Centre including Civil Works	1,00,000	per sq. mt.	250	2,50,00,000
6	Video wall (3x3 Rear Projection)	75,00,000	per unit	2	1,50,00,000
7	Operator consoles	80,000	per unit	6	4,80,000
8	Systems for TMICC staffs	70,000	per unit	14	9,80,000
9	Servers	4,00,000	per unit	4	16,00,000
10	TMICC Software Application (includes developing interfaces with police enforcement, transit agencies, construction and maintenance agencies, incident/event/disaster agencies, parking data collection)		L.S.	1	2,00,00,000
	Sub Total – A				**17,58,60,000**
1	Systems Engineering & Design	10%	of A		1,75,86,000
2	Programme/Construction Management, System Integration	15%	of A		2,63,79,000
3	Training and Capacity Building	1.25%	of A		21,98,250
	Sub Total – B				**4,61,63,250**
	Grand Total (A+B)				**22,20,23,250**
II	**O&M Cost**				
1	Manpower Cost	15%	(refer Staffing		1,58,40,000

S. No.	Items	Rate (Rs.)	UOM	Qty.	Amount (Rs.)
			Cost in Table 8-4)		
2	Other Operations Cost (per annum) (including electricity, water, printing, communication, housekeeping, security, etc.)		residual of 15%		1,05,39,000
3	45 Mbps Annual leased line for control room			1	11,00,000
4	2 Mbps annual leased line cost	1,50,000	per junction	60	90,00,000
5	Maintenance Cost (per annum)	10%	of A		1,75,86,000
	Total O&M Cost (per annum)				**5,40,65,000**

8.3 NUTH Sizing

Sizing of NUTH will depend upon the following factors:

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

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

8.4 Guwahati NUTH Cost Estimates

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

The estimated cost of Guwahati NUTH implementation is approximately **₹ 6.8 crore** and the estimated annual O&M cost is approximately **₹ 1.8 crore** (Table 8-3). The project cost and sizing may undergo changes at the time of preparation of detailed project report.

Table 8-3: NUTH System Deployment and O&M Cost

S.No.	Items	Unit Rate (₹)	UOM	Qty.	Amount (₹)
I	**Implementation Cost**				
1	NUTH System (including the development of interfaces) a. Data Collection, Processing and Storage b. Data Dissemination • NUTH Call Centre • NUTH website • Mobile Applications • NUTH Social Media pages c. Trip Planner		L.S.	1	5,00,00,000
2	Backend System maintenance console	80,000	per unit	1	80,000
3	Servers and storage	7,00,000	per unit	5	35,00,000
	Sub Total - A				**5,35,80,000**
4	Systems Engineering & Design	10%	of A		53,58,000
5	Programme/Implementation Management, System Integration	15%	of A		80,37,000
6	Training and Capacity Building	1%	of A		6,69,750
	Sub Total - B				**1,40,64,750**
	Total Implementation Cost (A+B)				**6,76,44,750**
II	**O&M Cost (Annual)**				
1	Operations Cost (including lease line)	15%	of A		80,37,000
2	Maintenance Cost	10%	of A		53,58,000
3	NUTH Operator (refer Table 8-4)				6,00,000
4	Call Centre Personnel (refer Table 8-4)				36,00,000
	Total O&M Cost (per annum)				**1,75,95,000**

8.5 Staffing Cost

Indicative cost of staff to be employed for Guwahati TMICC and NUTH is provided in Table 8-4.

Table 8-4: Staffing Cost of TMICC and NUTH

S. No.	Personnel	Number	Shift	Cost/Month (Rs.)	Cost/Annum (Rs.)
1	Project In charge	1	1	85,000	10,20,000
2	Traffic Manager	1	3	70,000	25,20,000
3	System Administrator	1	2	50,000	12,00,000
4	Network Administrator/ Communication Engineer	1	2	50,000	12,00,000
5	Database Administrator	1	2	40,000	9,60,000
6	Desktop Support	1	2	30,000	7,20,000
7	Commercial/HR	2	1	50,000	12,00,000
8	Shift Manager	1	3	45,000	16,20,000
9	TMICC Operator	6	3	25,000	54,00,000
10	NUTH Operator	1	2	25,000	6,00,000
11	Call Centre Agents	4	3	25,000	36,00,000
	Total Cost				**2,00,40,000**

8.6 Summary of Financial Budget

Table 8-5 provides a summary of the estimated budget for the Guwahati TMICC and NUTH project.

Table 8-5: Overall Planning Level Budget for Guwahati TMICC and NUTH Project

Sl.	Description	Implementation Cost (₹)	O&M Cost - Annual (₹)
1	TMICC	22,20,23,250	5,40,65,000
2	NUTH	6,76,44,750	1,75,95,000
	Total	**28,96,68,000**	**7,16,60,000**

Based on this summary, a budget of **₹ 29 crores** is required for implementation of Guwahati TMICC and NUTH project. In addition, a budget of **₹ 7.2 crores** is required towards annual operations and maintenance of both the systems.

8.7 Revenue Streams

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

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

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

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

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

8.8 Funding of Guwahati TMICC/NUTH

Central Government may use any of its programmes for supporting such initiatives. Funding for setting up of the TMICC may be secured with the support of the State Government under the centre's on-going or future schemes. Central government has launched the Smart Cities Mission[12]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[13] and the city may avail funding from one or both these schemes.

Multilateral or bilateral funding may also be secured at Central Government, State Government or City levels. Since these projects support environment management as well, national and international programmes providing funding support for

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

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 TMICC may be borne by the Guwahati Traffic Police and that of NUTH by the Transport Department.

8.9 Implementation Structure

Considering the limited revenue potential, it is recommended that Guwahati TMICC/NUTH be implemented by Government agencies (refer Section 7.3). Funding of the project should be met out of budgetary resources of the government.

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

9.0 RESOURCES, REFERENCES AND CONTACT DETAILS

9.1 Resources & References

The following is a list of documents and resources 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 on any specific topic.

- Master Plan for Guwahati Metropolitan Area – 2025, Guwahati Metropolitan Development Authority (2009)
- State of the Art Report: Preparation of Operations Document for TMICC and NUTH, Ministry of Urban Development, Government of India (2013)
- TMICC Operations Document, Ministry of Urban Development, Government of India (2016)
- NUTH Operations Document, Ministry of Urban Development, Government of India (2016)
- City Development Plan for Guwahati (2006)
- Comprehensive Mobility Plan for Guwahati (2008)
- Guwahati Traffic Police Website (http://guwahaticitypolice.gov.in/)
- Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, MoUD, GoI (2008)
- Smart Cities- Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)
- Atal Mission for Rejuvenation and Urban Transformation (AMRUT) - Mission Statement & Guidelines, Ministry of Urban Development, Government of India (June 2015)

9.2 Contact Details

S. No.	Name	Designation & Contact Details	Organisation
1.	Mr. Swapan Majumdar	Sr. Dy. Chief Accounts Officer Mob: 9864109128 Off: (0361) 2542995	Assam State Transport Corporation (ASTC)
2.	Mr. A.C. Barman	Dy. General Manager (Operations) Mob: 9854034277 Email: astc@gmail.com	Assam State Transport Corporation (ASTC)
3.	Mr. P.K. Gogoi	I/C. Joint Director & Exec. Engineer, IWT Div. Mob: 9864374646 Email: pankajgogoi54@gmail.com	Dept. of Inland Water Transport (DIWT)

S. No.	Name	Designation & Contact Details	Organisation
4.	Mr. D.J. Sarma	AEE(T/C) I/C, IWT Directorate Mob: 9864012016	Dept. of Inland Water Transport (DIWT)
5.	Mr. Biswa Sarma	A.E.E, IWT Mob: 9864077488	Dept. of Inland Water Transport (DIWT)
6.	Mr. Panab Jyoti Goswami	Superintendent of Police (Traffic) Mob: 9435025425 Email: sptrafficguwahati@gmail.com	Traffic Police
7.	Mr. R. M. Das	Consultant (Ropeway & Water Body) Mob: 9864046288 Off: (0361) 2529824/2529650 Email: ramani_m_das@yahoo.co.in	Guwahati Metropolitan Development Authority (GMDA)
8.	Mr. Dhiraj Choudhury	Secretary Mob: 9435105939 Off: (0361) 2529650/ 2529824 Email: dhirajchoudhurysecretary@gmail.com	Guwahati Metropolitan Development Authority (GMDA)
9.	Mr. H. Bora	Consultant (Ropeway & Water Body) Mob: 9864046288 Off: (0361) 2529824/2529650 Email: ramani_m_das@yahoo.co.in	Guwahati Metropolitan Development Authority (GMDA)
10.	Mr. Dalim Kumar Gogoi	Consultant, GMDA Mob: 9864077488 Email: dalim.gogoi@yahoo.in	Guwahati Metropolitan Development Authority (GMDA)
11.	Mr. Amitabh Barthakur	PE, GMDA Mob: 9864031196	Guwahati Metropolitan Development Authority (GMDA)
12.	Ms. Seema Rabha	AE, GMDA Mob: 9706419639	Guwahati Metropolitan Development Authority (GMDA)
13.	Mr. Debraj Katilai	TP, GMDA Mob: 9854090011	Guwahati Metropolitan Development Authority (GMDA)
14.	Mr. Mintujit Bhoi	AE, GMDA Mob: 9854752045	Guwahati Metropolitan Development Authority (GMDA)

S. No.	Name	Designation & Contact Details	Organisation
15.	Mr. Gunadhar Das	Asst. Commissioner of Transport Mob: 9435024843 Email: gunadhar.das121@gmail.com	Transport Department, GoA
16.	Mr. Diganta Deka	MVI, DTO (M), Kamrup Mob: 9435185819	Transport Department, GoA

Annexure 1(A): Minutes of Meetings with Guwahati Stakeholders

SUTP PC1B2- Meeting to Discuss TMICC and NUTH Concepts for Guwahati

Project Title	Consultancy services to develop operations documents for Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH)	Date of Discussion 29 Apr 2014
Subject	Meeting to discuss and present TMICC and NUTH Concept for Guwahati	
Location	Guwahati Metropolitan Development Authority Statfed Building, Bhangagarh, GMCH Road, Guwahati-781005	
Present	In accordance with the list attached	**DIMTS** Mr. K. Jayakishan, EVP Mr. Rakesh Jain, AVP Mr. Vinod Puranik, AVP Mr. Saumya Bhattacharya, SM

Discussion Points

- DIMTS presented the City report on the Guwahati TMICC and NUTH
- DIMTS informed that its team undertook site visit of facilities of various stakeholders in Guwahati on 28th April 2014. As part of this, DIMTS team met officials from Assam State Transport Corporation (ASTC), Guwahati Traffic Police, and Directorate of Inland Water Transport. DIMTS team also visited the control room of Guwahati police from where CCTV camera feeds were being monitored.
- Concept of Guwahati TMICC was explained by DIMTS as below:
  - The concept of TMICC and some international examples were shown by DIMTS
  - Guwahati Traffic Police to be the nodal agency for implementation of Guwahati TMICC supported by other stakeholders
  - Key applications of TMICC to be Traffic Signal Control system, Road Network Surveillance system, Traffic Rules Enforcement system, Traffic Incident Management support system, Traffic Information Dissemination system
  - TMICC Project phasing was presented
- Concept of Guwahati NUTH was explained by DIMTS as below:
  - The concept of NUTH and some international examples were shown by DIMTS
  - Transport Department to be the nodal agency for implementation of Guwahati NUTH supported by other stakeholders
  - Both transit as well as traffic information would be disseminated by Guwahati NUTH
  - Guwahati NUTH would have website, phone, mobile app as well as social media component (Twitter, Facebook)

  - To begin with GMC area could be considered and later on other adjoining areas could be considered
  - NUTH Project phasing was presented

- DIMTS explained that as Unified Metropolitan Transport Authority (UMTA) for Guwahati is not yet set up, Transport Department (GoA) or any of its designated agencies could be considered as implementing agency for the NUTH.
- GMDA suggested the following:
  - Information about the private stage carriage bus routes in the city may also be disseminated through the NUTH
  - The project area under Phase 1 could be Guwahati Metropolitan Region in place of Guwahati Municipal Corporation area as there is not much difference in the two areas. DIMTS confirmed that they would incorporate this in the city report.
- ASTC informed that GPS is not yet installed on its buses. PIS display boards are available on the buses procured under JnNURM.
- DIWT suggested that information about the ferry services in the city may also be disseminated through the NUTH.
- GMDA informed that they are responsible for installation and maintenance of the signals and Guwahati Traffic Police operates these.
- GMDA enquired regarding the mechanism for funding these initiatives. DIMTS informed that the same could be through JnNURM or any other scheme as decided by Government of India
- Guwahati Traffic Police informed the following:
  - There are 49 signals in the city. The signals have been installed and are being maintained by contractor engaged by GMDA.
  - They do not currently have a control room
  - Signals are not connected to the backend and are being operated through local controllers
  - CCTV camera feed is going to the police control room as the cameras have been installed for security surveillance and not for traffic monitoring activities
  - They have a single common website along with the Guwahati police.
- GMDA and Guwahati Traffic Police informed that they would be able to arrange space for setting of the TMICC and NUTH
- DIMTS informed that they would update the report based on the information provided and suggestions given.
- GoA representatives requested DIMTS to mail them the presentation.

Abbreviations: **TMICC**- Traffic Management and Information Control Centre**, NUTH** – National Urban Transport Helpline**, ITS** – Intelligent Transport System, **DIMTS –** Delhi Integrated Multi Modal Transit System Limited, Delhi, **GMDA** – Guwahati Metropolitan

Development Authority, **ASTC** – Assam State Transport Corporation, **DIWT** –Directorate of Inland Water Transport, GoA, **UMTA** – Unified Metropolitan Transport Authority, **GoA** – Government of Assam, **JnNURM** - Jawaharlal Nehru National Urban Renewal Mission

List of Attendees

Assam State Transport Corporation (ASTC)	
Mr. A.C. Barman Dy. General Manager (Operations) Mob: 9854034277 Email: astc@gmail.com	
Dept. of Inland Water Transport (DIWT)	
Mr. P.K. Gogoi I/C. Joint Director & Exec. Engineer, IWT Div. Mob: 9864374646 Email: pankajgogoi54@gmail.com	**Mr. Biswa Sarma** A.E.E, IWT Mob: 9864077488
Traffic Police	
Mr. Panab Jyoti Goswami Superintendent Of Police (Traffic) Mob: 9435025425 Email: sptrafficguwahati@gmail.com	
Guwahati Metropolitan Development Authority (GMDA)	
Mr. Dalim Kumar Gogoi Consultant, GMDA Mob: 9864077488 Email: dalim.gogoi@yahoo.in	**Mr. H. Bora** PE, GMDA Mob: 9435116612
Mr. Amitabh Barthakur PE, GMDA Mob: 9864031196	**Mr. R. M. Das** Consultant (Ropeway & Water Body) Mob: 9864046288 Off: (0361) 2529824/2529650 Email: ramani_m_das@yahoo.co.in
Mr. Debraj Katilai TP, GMDA Mob: 9854090011	**Ms. Seema Rabha** AE, GMDA Mob: 9706419639
Mr. Rohan Mohanta, Intern, GMDA Mob: 8876713990	**Mr. Mintujit Bhoi** AE, GMDA Mob: 9854752045
Transport Department, GoA	
Mr. Gunadhar Das Asst. Commissioner of Transport Mob: 9435024843 Email: gunadhar.das121@gmail.com	**Mr. Diganta Deka** MVI, DTO (M), Kamrup Mob: 9435185819

SUTP PC1B2- Meeting to Discuss TMICC and NUTH Concepts for Guwahati

Project Title	SUTP India: PC1B 2 City Specific Operations documents for Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH)
Subject	Presentation of the City Specific Operations Document for Guwahati to the city stakeholders
Location	Conference Hall, NEDFi House, Guwahati
Date	30th June 2015
Time	11:00 Hrs to 14:00 Hrs
Key Attendees	• Meeting Chaired By: Shri. MGVK Bhanu, Addl. Chief Secretary to CM, GoA • Shri. V. S. Bhaskar, Additional Chief Secretary, Tourism and IT Department, GoA • Shri. Dhiren Baruah, Chairman, GMDA • Shri Anurag Singh, CEO, GMDA • Shri. Montu Bora, P.E, GMDA • Shri. Mukesh Agarwal, Police Commissioner, Guwahati • Shri. S.S Roy, DCP Border, Guwahati • Shri Pranab Jyoti Goswami, DCP (Traffic) & ADCP (Traffic) • Dr. J. Balaji, Commissioner of Transport, Transport Department • Shri. D.K. Pathak, SE PWD and CE GMDA, • Shri. Syed Md. Bhakir, Chief Engineer, PWD • Shri. B. Pathak, Additional Commissioner of Transport • Shri. D. Chakravarty, Assistant Commissioner of Transport • Shri. Dr. S.O.Shaw, Director, Regional Meteorological Department, Guwahati • Shri. Musafir Rahman, Joint Director, I.W.T, Assam • DIMTS Team, Delhi • Project Management Unit (PMU) Team, MoUD, Delhi • Project Management Consultant (PMC), Delhi

Background: Ministry of Urban Development (MoUD), Government of India had identified Guwahati for preparation of City Specific Document of TMICC and NUTH. During the course of preparation of the City Specific Document for Guwahati, M/s. Delhi Integrated Multi-Modal Transit System Limited (DIMTS), the consultant engaged by MoUD, had earlier visited Guwahati during 28.04.2014 to 29.04.2014 and attended the meeting organised by GMDA with city stakeholders where the city specific concept for Traffic Management and

Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH) was presented by DIMTS. Based on the discussions and feedbacks, City Specific Operations Document for Guwahati was updated and the same was shared by MoUD with GMDA on 9th June 2015 with a request for organising a workshop to present the updated the City Specific Document to the city stakeholders.

Purpose of the Workshop: The workshop was organised with a view to present the updated the City Specific Operations Document and to seek feedback and suggestions from the city stakeholders on the same.

Workshop Proceedings:

- CEO, Guwahati Metropolitan Development Authority (GMDA) welcomed the participants and briefed the attendees about the TMICC & NUTH project explaining their benefits.
- Addl. Chief Secretary to CM Shri. Bhanu welcomed the initiative and stated that all stakeholders and in particular GMDA and Traffic Police should support its planning and implementation in the city.
- Mr I.C. Sharma, NPM, PMU provided a brief background and overview of the SUTP initiative and the projects that have been taken up under SUTP. He informed the participants that MoUD has created a panel of consultants who may be engaged by the city at the stage of preparing DPR for the project.
- The presentation of the City Specific Operations Document by DIMTS started with thanks to the chair. The presentation covered the following aspects:
    - Concepts of ITS, TMICC & NUTH
    - Initiatives of TMICC & NUTH in India and world over
    - Components of TMICC and NUTH
    - City Characteristics of Guwahati
    - Review of ITS initiatives in Guwahati
    - Project Description, Architecture, Elements and Benefits of TMICC & NUTH in Guwahati
    - Stakeholder Roles and Responsibilities, Organisation Structure of TMICC & NUTH
    - Implementation, Operations & Maintenance aspects
    - Project Cost, Revenues and Funding Streams
- The following suggestions on the report were made during the meeting:
    - Report is to be finalised after interaction and collection of sufficient information specific to Guwahati.
    - Scope should be broadened; public awareness is to be included. Aim should be “to move people not the vehicle”.

- The study should also report manpower required for implementation of the project.
- 3 week time is suggested for interaction by the nodal officers.
- Field study/ survey to be done.
- The system should be able to detect major violations such as speed violation etc.
- The time limit of the project up to implementation should not be more than 18-24 months.
- Out of the models presented by the officials of MoUD, a model most suitable in case of Guwahati will be selected.
- Report should provide specifically which department will provide what kind of information.
- In case of NUTH Transport Department shall be the implementing agency.
- In case of roads, Police Department should be added.
- ASDMA should be added.
- Capacity Building initiatives should form part of the project.
- Operations and maintenance of TMICC and NUTH may be part funded using fines collected by the Traffic Police through the enforcement measures.
- GMDA and Traffic Police may be the agencies responsible to implement the TMICC
- Transport Department to implement the NUTH
- TMICC and NUTH may be located at a single facility
- Area of the project may be retained as GMA that is under the jurisdiction of GMDA
- Number of surveillance cameras may be increased from the proposed 20 Nos.
- Depending upon the scope of the project, other measures such as road widening, flyovers, and engineering interventions may also be suggested

- The following officers of various departments of Govt. of Assam were nominated to provide further feedback, if any, on the report:
  - Shri Paban Kumar Borthakur, Principal Secretary, Urban Dev, Guwahati Dev and Soil Conservation Departments.
  - Shri Pranab Jyoti Goswami, DCP (Traffic) & ADCP (Traffic)
  - Dr. J. Balaji, Commissioner of Transport, Transport Department
  - Shri Anurag Singh, CEO GMDA and Shri. Montu Bora, P.E GMDA

SUTP PC1B2- Meeting to Discuss TMICC and NUTH Concepts for Guwahati

Project Title	SUTP India: PC1B 2 City Specific Operations documents for Traffic Management and Information Control Centre (TMICC) and National Urban Transport Helpline (NUTH)
Subject	Presentation of the City Specific Operations Document for Guwahati to the city stakeholders
Date	20-21 July 2015
Time	20th July, 15:00 Hrs to 17:00 Hrs (21st July 2015)
Attendees	• Shri. Dhiren Baruah, Chairman, GMDA • Shri Anurag Singh, CEO, GMDA • Shri. Montu Bora, P.E, GMDA • Shri. Mukesh Agarwal, Police Commissioner, Guwahati • Shri Pranab Jyoti Goswami, DCP (Traffic) & ADCP (Traffic) • DIMTS Team, Delhi • Project Management Unit (PMU) Team, MoUD, Delhi • Project Management Consultant (PMC), Delhi

- Meeting was held with the Traffic Police on 20th July 2015, wherein the following points were discussed:
  - TMICC could be located at Pan Bazar office of the ADGP.
  - Current status of the traffic signals in Guwahati was discussed. It was brought to the notice that currently 15 signals are functional out of a total of 45 signals in the city.
  - The initiatives taken by Traffic Police in the area of parking were also briefed to the consultants.
  - DCP (Traffic) expressed the need for revamping the entire traffic circulation pattern of the city. The consultants supported the need but conveyed that traffic circulation plan for the city is not within the scope of the current project.
- Meeting was held with GMDA on 20th July 2015, wherein the following were discussed:
  - Consultants briefed to GMDA about the scope of current project and way forward.
  - GMDA enquired about the funding pattern of the project. Consultants mentioned that fines collected by the Traffic Police through the enforcement measures and parking charges collected from users may be shared with TMICC.
  - Consultant also informed that the quantum of funding available from the fines collected may go down progressively as the compliance to traffic rules improves which in any case is the end objective for implementing the enforcement measures.

- Meeting was held with Transport Department on 20th July 2015, wherein the following were discussed:
  - Consultant briefed Transport Department about the project.
  - Consultant briefed regarding the role of Transport Department in implementing NUTH.
  - Commissioner, Transport Department expressed the importance of NUTH
  - Consultants briefed that ASTC is operating buses in Guwahati and DIWT is operating ferries, both of which are under the administrative control of Transport Department, GoA. As and when the city specific SPV is set up, it is also likely to have shareholding from ASTC. In view of this, it is suggested that NUTH for Guwahati be set up and managed by Transport Department, GoA.
- The following suggestions on the report were made during the meeting held on 21st July 2015:
  - Details of manpower cost may be provided
  - Sources of funding from central government, if any, may be provided

Annexure 1(B): Data Collected from Guwahati Traffic Police

Items	Parameter	Status /Details
Operation Area	Area being serviced (GMC, GMA, GMR etc.)	GMA
Control Room	Whether traffic control room has been set up	No
	Whether traffic control room is IT enabled having consoles, video wall, operators etc.	There is no Traffic Police control room
	Whether decentralised or a single centralised control room	NA
	Activities being performed from the control room (signal control, CCTV footage monitoring, enforcement etc.)	NA
Traffic Equipment (Field)	Number. of signals	49
	Number. of CCTV cameras	There are about 200 CCTV security surveillance cameras installed at various junctions and other important locations in the city. Traffic Police has no role in either installing the cameras or monitoring their feeds.
	Number. of speed violation detection cameras	Nil
	Number. of red light violation detection cameras	Nil
	Number. of variable message signs (VMS)	Nil
	Any other	
Signals	Number. of signals working on adaptive mode	Nil
	Number. of signals connected to the control room	NA
	Mode of connectivity (leased line, OFC etc.)	NA
	Which entity installs signals	GMDA through contractors
	Which entity maintains signals	GMDA through contractors
CCTV	Whether all junctions have CCTV cameras	No. About 200 CCTV cameras have been installed by Guwahati police at major junctions and other strategic locations for the purpose of security

Items	Parameter	Status /Details
		surveillance. Traffic Police has no role in either installing the cameras or monitoring their feeds.
	Whether CCTV cameras are installed at locations other than junctions also	Yes. Near Railway stations, markets, bus terminals etc.
	Whether CCTV camera feed is being monitored	Yes. By the Guwahati Police. Traffic Police has no role in the CCTV monitoring.
	Which entity installs CCTV cameras	Guwahati Police
	Which entity maintains CCTV cameras	Guwahati Police
	Which entity bears the installation, O&M cost of the CCTV cameras	Guwahati Police
Backend Application	Whether any backend applications have been deployed in the control room	No control room and backend system for signals. There is, however, a police control room of the Guwahati Police where CCTV camera feed is being monitored by the Guwahati Police.
	Type of system for which backend system exists (such as signal control, CCTV footage monitoring, red light violation detection, speed limit violation detection, enforcement, incident detection, video analytics etc.)	Guwahati police control room of the Guwahati Police has CCTV camera feed monitoring system.
	Activities that have been computerised and are being done through IT systems	None except the CCTV camera system installed by the Guwahati Police.
Information Dissemination (website)	Whether GIS map is used to display road network, signals, CCTV cameras, VMS etc.	No. Map is, however, used to view the area of jurisdiction of various police stations in Guwahati.
	Type of static information being provided through website (road network, speed limits, no entry zones etc.)	• Traffic Police has no separate website of their own. Their site is together with the Guwahati police website. (http://guwahaticitypolice.gov.in/) • Basic information such as number plate specification, accident data, fine collected are being provided in the website. • Press releases related to parking arrangements/restrictions, Traffic diversions etc. are uploaded
	Type of real time information being provided through website (congestion map, road closures, construction/maintenance details,	Nil

Items	Parameter	Status /Details
	incident details, traffic advisories etc.)	
	SMS alerts being provided, if any	No
	Email alerts being provided, if any	No
	Whether journey planner is there on the site	No
Phone Helpline	Number	(0361) 2525638/2522113/ 2464557
	Whether normal number, toll free or short number (provide details)	Normal
	Call charges (free, normal, premium)	Normal
	Number of calls received (monthly)	NA
Mobile App	Whether mobile app exists	No
	Type of static information being provided through app (road network, speed limits, no entry zones etc.)	NA
	Type of real time information being provided through app (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	NA
Social Media	Whether Facebook page exists	Yes. There is a common Facebook page of Guwahati police and Guwahati Traffic Police (https://www.facebook.com/pages/Guwahati-City-Police/211606768891234)
	Whether Facebook page being regularly updated	No. Not since Oct 2013.
	Whether Twitter page exists	Yes. There is a common Twitter page of Guwahati police and Guwahati Traffic Police (https://twitter.com/GhtyCityPolice)
	Whether Twitter page being regularly updated	No. Not since Oct 2013.
	Whether any other social media page exists	No
	Whether the page being regularly updated	NA
Information Feeds	Whether traffic information feed is being provided to any agency	No
	If yes, type of traffic information feed is being provided, frequency, mode,	NA

Items	Parameter	Status /Details
	whether any charges being collected for the data feeds	
	The data exchange protocols being followed	NA

Annexure 1(C): Data Collected from ASTC, Guwahati

Items	Parameter	Status
Buses	Number of buses	Total 232 buses are deployed for the city out of which 178 are JnNURM buses
	Number of buses with AVL/GPS	Nil. AVL/GPS is not yet installed on the buses
	Number of buses with ETM system	Nil. Ticketing is manual and paper based
	Number of buses having PIS	Yes, this facility is available in JnNURM buses. It is yet to be made operational.
	Number of buses having CCTV cameras	Nil. CCTV system is not yet installed on the buses
Terminals	Number of bus terminals	10 bus terminals
	Whether managed by the agency itself or some other agency manages it	These are managed by ASTC itself
	Whether CCTV system has been installed	No. CCTV system is not yet installed at the terminals
Passengers Operation Area Control room	Number of passengers being served	7 lakh passengers/month
	Area / cities being serviced	GMA and other adjoining areas
	Whether control room has been set up	Yes, there are control rooms at Roop nagar, Noonmati ISBT
	Control room is there at depot level or at a central location	Control room is at depot level
	Whether the control room is manually operated or is automated and IT enabled	It is manually operated
Backend Application	Whether any backend applications have been deployed	No, there are no backend applications
	Type of system for which backend exists (such as ETM, AVL, bus routing, scheduling, duty allocation etc.)	Not applicable
	Activities that have been computerised and are being done through IT systems	Online ticketing facility is for long distance
GPS in buses / AVL system	Whether Installed	No
	Number of buses having GPS	Not applicable
	PIS installed at bus stops	No

Items	Parameter	Status
	ETA being shown at bus stops	Not applicable
	PIS installed inside buses	Yes. PIS displays are there on the JnNURM buses. These are not yet made operational.
	Next stop announcement inside buses	No
Electronic ticketing	Whether ticketing is through ETMs	No. Ticketing is manual paper based.
	Number of buses with ETM based ticketing	Not applicable
	Real time ticketing data being sent to the backend	Not applicable
	Whether card based payment is there	No
Information Dissemination (website)	Whether GIS map is used to display bus stops, routes, terminals etc.	No, this facility is not available
	Type of static information being provided through website (routes, schedules, fare, pass details etc.)	Only PNR information & booking is available for long distance busses Website: http://www.assamtransport.com/
	Type of real time information being provided through website (ETA at a bus stop, delays, cancellations, departures scheduled from terminals etc.)	No there is no such information available
	SMS alerts being provided, if any	No, this facility is not available
	Email alerts being provided, if any	No, this facility is not available
	Whether route/journey planner is there on the site	No, this facility is not available for the city services
Phone Helpline	Number	3 helpline numbers are there
	Whether normal number, toll free or MoUD NUTH number (155220)	These are normal numbers
	Call charges (free, normal, premium)	Normal call charges are applicable
	Number of calls received (monthly)	3,000 approximate
Mobile App	Whether mobile app exists	No, mobile app facility is not available
	Type of static information being provided through app (routes, schedules, fare, pass details etc.)	Not applicable
	Type of real time information being	Not applicable

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

Annexure 1(D): Data Collected from Directorate of Inland Water Transport

Items	Parameter	Status
Ferries	Number of ferries	22 ferries are Available
	Number of ferries with AVL/GPS	GPS has been partly installed on the ferries
	Number of ferries with ETM system	Nil. There is no such system available
	Number of ferries having PIS	Nil. There is no such system available
	Number of ferries having CCTV cameras	Nil. There is no such system available
Terminals	Number of ferry terminals	6 terminals
	Whether managed by the department itself or some other agency manages it	These are managed by the department itself
	Whether CCTV system has been installed	No. CCTV system is not yet installed.
Passengers	Number of passengers being served	There are 8450 passengers being served per day on an average
Operation Area	Area / cities being serviced	Guwahati- North Guwahati Guwahati- Rajaduwar Guwahati – Madhyakhanda Guwahati – Kurwa Sunsali – Kurwa, Guwahati Auniati – Silsaka, Guwahati
Control room	Whether control room has been set up	Yes. The control room is at Directorate of Inland Water Transport, Govt. of Assam, Guwahati
	Control room is there at terminal level or at a central location	It is at central location
	Whether the control room is manually operated or is automated and IT enabled	It is manually operated with few ferries (2) with GPS
Backend Application	Whether any backend applications have been deployed	Yes. GPS application has been partially deployed.
	Type of system for which backend exists (such as ETM, AVL, ferry routing, scheduling, duty allocation etc.)	GPS has been installed in few ferries. On remaining, the system is being implemented.
	Activities that have been computerised and are being done through IT systems	Not applicable
GPS	Whether Installed	Yes, Two vessels fitted with GPS

Items	Parameter	Status
		monitoring. Proposed for remaining fleet as well.
AVL system	Number of ferries having GPS	2 ferries
	PIS installed at ferry terminals	No.
	ETA being shown at ferry terminals	No, there is no such facility available
	PIS installed inside ferries	No. PIS are not there inside ferries
	Next stop announcement inside ferries	No such facility is available
Electronic ticketing	Whether ticketing is through ETMs	No, there is no ETM system available. Ticketing in manual paper based through counters set up on the ferry terminals.
	Number of ferries with ETM based ticketing	Not Applicable
	Real time ticketing data being sent to the backend	No such system available
	Whether card based payment is there	No, there is no such facility available
Information Dissemination (website)	Whether GIS map is used to display routes, terminals etc.	No, GIS maps are not available
	Type of static information being provided through website (routes, schedules, fare, pass details etc.)	Time table is available on the link below: http://103.8.249.102/iwtasm/wp/wp-content/uploads/timetable.pdf
	Type of real time information being provided through website (ETA at a terminal, delays, cancellations, departures scheduled from terminals etc.)	• No. This facility is not available • ASTC looking to have an SMS-based alert system which will help to monitor the ferries • This system will allow officials to check if a boat has reached a particular location, the vessel's likely time of arrival at a port, besides defining its boundary of operation and other such details
	SMS alerts being provided, if any	• SMS alerts not sent to passengers but snapshot of per ferry operation like no. of passenger boarded, luggage loaded is sent to specific server at AMTRON as SMS • IWTs' control room in Guwahati provides real-time SMS alert on latest weather report to various subdivisions based on information from the Regional Meteorological Centre, Guwahati located at the Lokapriya Gopinath Bardoloi

Items	Parameter	Status
		International Airport.
	Email alerts being provided, if any	No. This facility is not available
	Whether route/journey planner is there on the site	No. This facility is not available
Phone Helpline Mobile App	Number	Yes. Phone helpline is available
	Whether normal number, toll free or MoUD NUTH number (155220)	0361-2469885, normal number
	Call charges (free, normal, premium)	Normal charges applicable
	Number of calls received (monthly)	Information not available
	Whether mobile app exists	No. There is no mobile application available
	Type of static information being provided through app (routes, schedules, fare, pass details etc.)	Not applicable
	Type of real time information being provided through app (ETA at a terminal, delays, cancellations, departures scheduled from terminals etc.)	Not applicable
Social Media	Whether Facebook page exists	No
	Whether Facebook page being regularly updated	Not applicable
	Whether Twitter page exists	No
	Whether Twitter page being regularly updated	Not applicable
	Whether any other social media page exists	No
	Whether the page being regularly updated	Not applicable
Information Feeds	Whether transit information feed is being provided any agency	No information is provided to any other agency
	If yes, type of information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable
Data Digitisation IT enablement	Routes	No
	Stops	No

Items	Parameter	Status
	Ferry Terminals	No
	Ferries	No
	Crew	No
	Duties/ Trips	No
	Incidents / Accidents	No
	Maintenance	No
	Scheduling	No
	Duty allocation	No
	Ticketing	No

Annexure 2: List of Applicable Standards

Standard No: Year of Adoption	Description [14]
ISO 10711:2012	Defines protocols and message sets between traffic detectors and traffic signal controllers. It is applicable to the various types of traffic detector technologies currently in use for real-time traffic signal controls. It defines message sets that contain data collection and control protocol for three different types of detectors of traffic signal control systems: • detectors that deal with occupancy information; • detectors that deal with image information; and • detectors that deal with vehicle identification. ISO 10711:2012 is limited to parameter generation to be used for traffic signal controls and for the interface between traffic signal controllers and detectors.
ISO 14813-5:2010	Requirements for the description and documentation of the architecture of Intelligent Transport Systems (ITS) in standards dealing with ITS. It also gives the definitions of terms to be used when documenting or referencing aspects of architecture description in those standards
ISO 14813-6:2009	Provides a formal means to enact the ISO/TC 204 decision by resolution to use Abstract Syntax Notation One (ASN.1) for data definitions within ITS International Standards. This provides a common message form to enable interoperability and reuse. It provides consistency of use so that where other aspects of ASN.1 (defined within ISO/IEC 8824 and ISO/IEC 8825), such as transfer rules, are selected to be used, they are used in a common and consistent way in order to maximise interoperability and reuse. ISO 14813-6:2009 also provides a means where particular ITS sector requirements, or existent International Standards, that require particular message forms and procedures that are expressed in other notations (EDIFACT, XML, etc.), may be referenced and reused by other ITS applications. Thus it presents an unambiguous system for identifying all the different data types and describing them in ITS International Standards in a common way.
ISO 14817:2002	Specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and Data Dictionaries, the registration process to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry.

[14] Source: International Standards Organization (ISO)

Standard No: Year of Adoption	Description [14]
	Specifically, ISO 14817:2002 specifies: • framework used to identify and define all information exchanges; • framework used to extend standardised information exchanges to support local customisations and combinations; • information modelling method for defining ITS/TICS data concepts, when used; • meta attributes used to describe, standardise and manage each of the data concepts defined within this framework; • requirements used to record these definitions; and • formal procedures used to register these definitions within the Data Registry. The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.
ISO 14819-Part 1 to 6:2003-2008	Specifies the coding protocol for Radio Data System - Traffic Message Channel (RDS-TMC) - RDS-TMC using the ALERT-C protocol that is designed to provide mostly event-orientated road driver information messages.
ISO 14825:2011	Specifies the conceptual and logical data model and physical encoding formats for geographic databases for Intelligent Transport Systems (ITS) applications and services. It includes a specification of potential contents of such databases (data dictionaries for Features, Attributes and Relationships), a specification of how these contents shall be represented, and of how relevant information about the database itself can be specified (metadata). The focus of ISO 14825:2011 is on ITS applications and services and it emphasises road and road-related information. ITS applications and services, however, also require information in addition to road and road-related information. Typical ITS applications and services targeted by ISO 14825:2011 are in-vehicle or portable navigation systems, traffic management centres, or services linked with road management systems, including the public transport systems.
ISO 14827-1:2005	Defines the format that should be used to document those end-application messages that are to be exchanged between/among central systems. The format is protocol-independent to the extent practical. For example, this one format can be used to define data exchanges that may apply to DATEX-ASN, Common Object Request Broker Architecture (CORBA), or other Application Protocols. In general, each system can be viewed as consisting of the following interfaces: 1. Application Interface 2. Operator Interface 3. Communication Interface 4. Database Interface

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ISO 14827-1:2005	Allows different systems to exchange relevant data. The relevant data will be contained in end-application messages. Each end-application message will be formally defined as either a "subscription" or a "publication", according to the format as specified in ISO 14827-1:2005. DATEX-ASN defines how these end-application messages are packaged to form a complete data packet and also defines the rules and procedures for exchanging these data packets. Systems using DATEX-ASN are free to implement additional end-application functionalities according to the user requirements.
ISO 15628:2007	Road transport and traffic telematics, Dedicated Short Range Communication (DSRC) application layer
ISO 15628:2007	Specifies the application layer core which provides communication tools for applications based on DSRC. These tools consist of kernels that can be used by application processes via service primitives. The application processes, including application data and application-specific functions, are outside the scope of ISO 15628:2007.
ISO 15662:2006	Provides information as a checklist to consider handling messages that are defined by the application working groups of ISO/TC204, installing systems and selecting suitable wide area communication systems for providing ITS application services.
ISO 15784-1 to 3:2008	Provides principles and documentation rules of application profiles used for exchange data and messages between a traffic management centre and roadside modules used for traffic management. The application profiles it specifies are used to exchange data and messages between a traffic management centre and roadside modules for traffic management and between roadside modules used for traffic management.
ISO 17267:2009	Specifies an Application Programming Interface (API) for navigation systems. It specifies the data that may be retrieved from the map database and defines the interface for access. This International Standard specifies a set of function calls. It also specifies the design of the API and gives examples of its intended use. Furthermore, it gives the criteria to determine whether a data access library is in accordance with this International Standard. ISO 17267:2009 is applicable to the following functional categories of navigation applications: • positioning; • route planning; • route guidance; • map display; • address location; • services and Point Of Interest (POI) information access.
ISO 17572, Parts 1 to 3:2008	Specifies Location Referencing Methods (LRM) that describes locations in the context of geographic databases and will be used to

Standard No: Year of Adoption	Description [14]
	locate transport-related phenomena in an encoder system as well as in the decoder side. It defines what is meant by such objects, and describes the reference in detail, including whether or not components of the reference are mandatory or optional, and their characteristics. It specifies two different LRMs: • pre-coded location references (pre-coded profile); • dynamic location references (dynamic profile). It does not define details of the Location Referencing System (LRS), i.e. how the LRMs are to be implemented in software, hardware, or processes. ISO 17572-1:2008 specifies the following general LRM related sections: • requirements to a Location Referencing Method; • conceptual Data for Location Referencing Methods; • inventory of Location Referencing Methods; • examples of Conceptual Data Model Use; • description of selected UML Elements; • comparison of Definitions with ISO/TC 211; • introduction to the TPEG Physical Format.
ISO 22837:2009	Relates to vehicle probe data for wide are communications. It specifies the following. • Reference architecture for probe vehicle systems and probe data, which provides a general structure for probe vehicle systems within which a wide range of actual probe vehicle systems can be built whose physical characteristics may differ (e.g., in their choice of communications medium). The reference architecture is used to: ○ clarify the major building blocks and logical interconnections of probe vehicle systems for which this standard will be used; ○ categorise probe data in accordance with the information model described below. • Basic data framework for probe data elements and probe data, which defines probe data elements and probe messages, and specifically provides: ○ rules for mapping information models (as defined in ISO 14817) of probe data to probe data elements/messages. The information models show the logical structure of entities and concepts involved in probe data; ○ the required characteristics of probe data elements and probe data messages; ○ the notation for probe data elements/messages (in XML); ○ rules for using core data elements and basic data elements (see below), and extensions of data elements in each application domain. • Core data element definitions, which are basic descriptive

Standard No: Year of Adoption	Description [14]
	elements, intended to appear in every probe message, i.e. the location and the time at which the probe data was sensed. • Initial set of probe data elements, which are commonly used in typical probe data, enabled application domains, such as traffic, weather, and safety. • Example probe messages, which define how probe data elements are combined to convey information to probe processing centres.
ISO 22951:2009	Relates to systems that use priority signal control functions to help emergency vehicles operate. This type of system is composed of a traffic management centre, in-vehicle units, roadside communication units, and roadside units. Public transport vehicles such as buses are also targeted to receive priority signal control service. The scope of standardisation includes message sets and data dictionary related to the communications as follows: • between a roadside communication unit and each in-vehicle unit, • between a roadside communication unit and other roadside units, • between in-vehicle units and roadside units. ISO 22951:2009 concerns only information related to priority signal control and does not deal with information provision such as that of the situations at scenes. Since it is necessary to handle public transport vehicles in accordance with the conditions of individual cities and regions, the section in the messages and the data dictionary that are concerned with priority signal control for the vehicles are treated as an option. Furthermore, the standardisation does not depend on the type of communication medium used.
ISO 24097-1:2009	Establishes a Service-Oriented Architecture (SOA) for the realisation of interoperable ITS web services (WS). Web service behaviour is described at the metadata level (i.e. a higher level of abstraction) to enable auto-generation of both a "Service requestor" programme, as well as a "Service provider" programme.
ISO 24099:2011	Defines the data structures and protocol(s) used in Intelligent Transport System (ITS) applications for the delivery and update of map-related data from Service Centre (SC) to users [(In-vehicle Systems (IVS)]. The map centre specified in ISO 24099:2011 represents the supplier of map data and the Service Centre provides data and services to user devices. The term protocol as used in ISO 24099:2011 is a temporal sequence of map-related data interactions between system components that implement map-related data delivery and update. The delivery and update of map-related data rely on existing communication technology.

Standard No: Year of Adoption	Description [14]
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 systems. 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. ISO TR 25100:2012 describes processes for harmonisation of such data concepts to arrive at preferred definitions for use in formal standards, specifications, technical reports and information models. It is based on consideration of a harmonisation process used by international groups involved in the ITS sector and in the wider sector of transport and logistics information and control systems.
ISO TS 18234-1 to 12:2006 to 2013	Provides set of TPEG applications and specifications. It allows the indexing of new applications as they are added to the TPEG applications family, by defining their Application Identification (AID).
ISO/TR 13184-1:2013	Specifies guidance information protocol to provide real-time decision support system to drivers or pedestrians using personal ITS stations: 1. Reference architecture for real-time decision support systems This reference architecture provides a general structure for real-time decision support systems and the method of message exchange between the personal ITS station and the roadside ITS station. This reference architecture is used to build the interconnections between personal ITS stations and roadside ITS stations. 2. Design method of application protocols for light-weighted devices. This method is a flexible application protocol for safety

Standard No: Year of Adoption	Description [14]
	warning and parking guidance services. Unlike many other application protocols in the ITS and Telematics domains, this protocol makes the client part independent of use cases for supporting light-weighted devices. 3. Use cases at the road and parking bays for warning and parking guide ISO/TR 13184-1:2013 describes the use cases applicable to the communication services between personal ITS stations and roadside ITS stations for the purposes of providing safety warning and parking guidance.
ISO/TR 13185-1:2012	Specifies the communications architecture and generic protocol to provide and maintain ITS services to travellers (including drivers, passengers and pedestrians), using nomadic and portable devices.
ISO/TR 17452: 2007	Gives guidelines for using the Unified Modelling Language (UML) for defining and documenting interfaces between Intelligent Transport Systems (ITS) and Transport Information And Control Systems (TICS). It presents these guidelines in the context of a case study for the creation of an ITS/TICS data dictionary and submissions to the ITS/TICS data registry.
ISO/TR 21707: 2008	Specifies a set of standard terminology for defining the quality of data being exchanged between data suppliers and data consumers in the ITS domain. This applies to Traffic and Travel Information Services and Traffic Management and Control Systems, specifically where open interfaces exist between systems. It may of course be applicable for other types of interfaces, including internal interfaces, but this Technical Report is aimed solely at open interfaces between systems. ISO/TR 21707:2008 identifies a set of parameters or meta-data such as accuracy, precision and timeliness etc. which can give a measure of the quality of the data exchanged and the overall service on an interface. Data quality is applicable to interfaces between any data supplier and data consumer, but is vitally important on open interfaces. It includes the quality of the service as a whole or any component part of the service that a supplying or publishing system can provide. For instance this may give a measure of the availability and reliability of the data service in terms of uptime against downtime and the responsiveness of the service or it may give a measure of the precision and accuracy of individual attributes in the published data. ISO/TR 21707:2008 is suitable for application to all open ITS interfaces in the Traffic and Travel Information Services domain and the Traffic Management and Control Systems domain.
ISO/TR 24529:2008	Deals with the use of UML within International Standards, Technical Specifications and Technical Reports and related documents. It discusses the application of the Unified Modelling Language (UML) to the development of standards within the context of ITS.
ISO/TS 14823:2008	Presents a system of standardised codes for existing signs and pictograms used to deliver traffic and traveller information (TTI). The

Standard No: Year of Adoption	Description [14]
	coding system can be used to form messages to be handled by respective media systems, graphic messages on on-board units, and media system information on TTI dissemination systems [Variable Message Signs (VMS), Personal Computers (PC), Public Access Terminals (PAT), etc.] (Including graphic data).
ISO/TS 15624:2001	Transport information and control systems -- Traffic Impediment Warning Systems (TIWS) System requirements
ISO/TS 15624:2001	Transport information and control systems -- Traffic Impediment Warning Systems (TIWS) System requirements.
ISO/TS 20452:2007	Describes the functional requirements and Logical Data Model for PSF and API and the Logical Data Organisation for PSF that were completed under ISO/NP 14826. It does not specify a Physical Data Organisation.
ISO/TS 24530-1 to 4:2006	Establishes the top-level "containers" for TPEG messages in XML and the common data types that are used by tpegML applications (e.g. tpeg-ptiML). Inherently, tpegML is designed to "map" the TPEG binary (ISO/TS 18234 series), however, additional tags are provided to create a message and message set structure to facilitate internet file delivery.
ISO/TS 25114:2010	Provides a common framework for defining Probe Data Reporting Management (PDRM) messages to facilitate the specification and design of probe vehicle systems and gives concrete definitions of PDRM messages. ISO/TS 25114:2010 also specifies reference architecture for probe vehicle systems and probe data which incorporates PDRM, based on the reference architecture for ISO 22837, and basic data framework for PDRM instructions, which defines specifically necessary conditions for PDRM instructions, and notations of these instructions (in XML).
GTFS General Feed Specifications	Google, for example has a General Transit Feed Specification (GTFS) reference that can be used as a guideline for transit feed application. This specification can be found at https://developers.google.com/transit/gtfs/reference

Annexure 3: Draft Sample Memorandum of Understanding (TMICC)

DRAFT SAMPLE MoU

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

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

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

and

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

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

Transit Agencies • *Assam State Transport Corporation* • *Directorate of Inland Water Transport, GoA*	***Traffic Agencies*** • *Guwahati Traffic Police* • *Guwahati Metropolitan Development Authority*
Road Owning Agencies • *Guwahati Metropolitan Development Authority* • *Guwahati Municipal Corporation* • *Public Works Department, GoA*	***Parking Agencies*** • *Guwahati Metropolitan Development Authority* • *Guwahati Municipal Corporation* • *Assam State Transport Corporation* • *North East Frontier Railway*

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

WHEREAS

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

B. It has been agreed by the Parties that service delivery to public at large could be substantially augmented and provided in a more effective and efficient manner if the

Parties collaborate, work together, share and disseminate information that are of interest to public;

C. In order to give effect to the above, it has been decided by the Parties to collaborate with each other in order to set up, operate, manage and maintain the Traffic Management and Information Control Centre (TMICC) for the city;

D. TMICC would be the control centre to support traffic management, monitoring and control activities to facilitate smooth traffic flow on the road network of the city;

E. TMICC would collect data/information from various participating entities and disseminate the same to public through various channels including through the existing transit/ traffic information disseminating systems;

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

NOW THEREFORE, IT IS AGREED AS FOLLOWS:

1.0 PURPOSE

1.1 The objective of establishing TMICC are as under:

- To support traffic management, monitoring and control activities to facilitate smooth traffic flow on the road network of the city
- To collect, synthesise and disseminate travel and traffic related information to public that would optimise the travel behaviour in the city and lead to efficient utilisation of city transport assets.

1.2 The purpose of this MoU is to document the understanding reached between the Parties for setting up, operating, managing and maintaining TMICC for the Guwahati Metropolitan Region (GMR) and matters connected therewith and incidental thereto.

2.0 ROLES & RESPONSIBILITIES OF PARTIES

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

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

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

(b) To provide periodical updates to the aforesaid data

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

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

(e) To provide right of way on its roads/area for installation of traffic equipment

(f) Any other responsibility as mutually agreed

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

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

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

(c) Any other responsibility as mutually agreed

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

3.0 RELATIONSHIP BETWEEN THE PARTIES

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

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

4.0 VALIDITY AND TERMINATION

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

5.0 GENERAL

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

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

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

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

Party	**For Implementing Agency**	**For Participating Agency**
Signature		
Name		
Designation		

Appendix A

Details of Information and Data Sharing

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

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

Annexure 4: Draft Sample Memorandum of Understanding (NUTH)

DRAFT SAMPLE MoU

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

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

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

and

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

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

Transit Agencies • *Assam State Transport Corporation* • *Directorate of Inland Water Transport, GoA*	***Traffic Agencies*** • *Guwahati Traffic Police* • *Guwahati Metropolitan Development Authority* • *Guwahati Municipal Corporation*
Road Owning Agencies • *Guwahati Metropolitan Development Authority* • *Guwahati Municipal Corporation* • *Public Works Department, GoA*	***Parking Agencies*** • *Guwahati Metropolitan Development Authority* • *Guwahati Municipal Corporation* • *Assam State Transport Corporation* • *North East Frontier Railway*

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

WHEREAS

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

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

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

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

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

NOW THEREFORE, IT IS AGREED AS FOLLOWS:

1.0 PURPOSE

1.1 The objective of establishing NUTH is to be able to collect, synthesise and disseminate travel, traffic and transit related information to public that would optimise the travel behaviour 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 between the Parties for setting up, operating, managing and maintaining NUTH for Guwahati Metropolitan Region and matters connected therewith and incidental thereto.

2.0 ROLES & RESPONSIBILITIES OF PARTIES

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

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

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

(b) To provide periodical updates to the aforesaid data

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

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

(e) Any other responsibility as mutually agreed

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

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

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

(c) Any other responsibility as mutually agreed

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

3.0 RELATIONSHIP BETWEEN THE PARTIES

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

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

4.0 VALIDITY AND TERMINATION

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

5.0 GENERAL

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

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

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

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

Party	**For Implementing Agency**	**For Participating Agency**
Signature		
Name		
Designation		

Appendix A

Details of Information and Data Sharing

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

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

Annexure 5: Transportation Performance Index[15]

- **Public Transport Accessibility Index**: It is calculated as the inverse of average distance (in km) to the nearest bus stop/railway station (suburban/metro). Higher the index betters the public transport accessibility.
- **Congestion Index**: To access the existing travel condition of the roadway facility and how effectively users can perform the journey can be measured by this index.

  Congestion Index= 1-(A/M)

  Where, M is desirable average journey speed on major road network of a city during peak hour, which is assumed as 30 KMPH. A is average journey speed observed on major corridors of the city during peak hours.
- **Walkability Index:** As the name suggests, the index is to evaluate the walkable space availability in city. It is calculated considering availability of footpaths on major corridors and overall facility rating by pedestrians

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

  Where W1 and W2 are parametric weights, assumed 50% for both.
- **City Bus Supply Index:** Only standard buses are considered to derive the city bus supply index for any city.

  City Bus Supply Index = City Bus Fleet (Public + Pvt.) for 1,00,000 population
- **Safety Index:** Data collected from Police department of city helps in developing a road safety index.

  Road Safety Index = 1/AFR

  AFR is Accident Fatality Index
- **Para Transit Index:** Para transit play major role in transportation for medium sized cities.

  Para Transit Index = Number of para transit vehicles for 1,00,000 population
- **Slow Moving Vehicle Index:** This index is calculated on the basis of availability and percentage of SMV trips

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

  Where W1 and W2 are parametric weights, assumed 50% for both.
- **On- Street Parking Interference Index:**

  Parking Interference Index = 1 / (W1 x % of major road length used for on-street parking + W2 x on-street parking demand on major roads)

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

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

Annexure 6: Indicative Terms of Reference

The Consultant shall follow the Generic Operations Documents for TMICC and NUTH (as applicable for the city) prepared by the MoUD for preparing the city specific documents. The Generic Operations Documents shall be made available on the MoUD's website. This 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 applications 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 systems in line with the respective Generic Operations Documents
ii. Based on the above, compare different technical requirements and draw up the detailed technical requirement of the system (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. Parceling 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 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 as per 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

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Report prepared by DIMTS Limited in association with Transport Research Laboratory (UK) and Kimley Horn Consulting & Engineering India Private Limited for Ministry of Urban Development, Government of India.