स्वच्छ भारत
एक कदम स्वच्छता की ओर

सत्यमेव जयते

Digital India
Power To Empower

MINISTRY OF URBAN DEVELOPMENT

AHMEDABAD TRAFFIC MANAGEMENT AND INFORMATION CONTROL CENTRE

OPERATIONS DOCUMENT

NOVEMBER, 2016

SUPPORTED BY:

SUTP Sustainable Urban Transport Project (India)

gef

OPERATIONS DOCUMENT

Ahmedabad TMICC

Prepared by

Delhi Integrated Multi-Modal Transit System Ltd. (Lead Partner)
In association with
Transport Research Laboratory, UK and
Kimley-Horn Consulting & Engineering India Pvt. Ltd

November 2016

Table of Contents

List of Figures

List of Tables

Abbreviations

Acronym	Definition/Description
AMC	Ahmedabad Municipal Corporation
AUDA	Ahmedabad Urban Development Authority
AUA	Ahmedabad Urban Agglomeration
ACTP	Ahmedabad City Traffic Police
AMTS	Ahmedabad Municipal Transport Service
AJL	Ahmedabad Janmarg Limited
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ANPR	Automatic Number Plate Recognition
ATCC	Automatic Traffic Counter-cum-Classifier
AVL / AVLS	Automatic Vehicle Location System
BRTS	Bus Rapid Transit System
CCTV	Closed Circuit TV
DIMTS	Delhi Integrated Multi-Modal Transit System Limited
DPR	Detailed Project Report
ETM	Electronic Ticketing Machine
ETA	Estimated Time of Arrival
GAUA	Greater Ahmedabad Urban Agglomeration
GSRTC	Gujarat State Road Transport Corporation
GEF	Global Environment Facility
GoG	Government of Gujarat
GoI	Government of India
GPS	Global Positioning System
IRC	Indian Roads Congress
IT	Information Technology
ITS	Intelligent Transport System
JICA	Japan International Cooperation Agency
MoU	Memorandum of Understanding
MoUD	Ministry of Urban Development, GoI
MEGA	Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd
NMV	Non-Motorised Vehicle
NUTH	National Urban Transport Helpline
NUTP	National Urban Transport Policy

Acronym	Definition/Description
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
PIS	Passenger Information System
PMU	Project Management Unit
PPP	Public Private Partnership
RLVD	Red Light Violation Detection
SEMP	Systems Engineering Management Plan
SMS	Short Message Service
SUTP	Sustainable Urban Transport Project
TMICC	Traffic Management and Information Control Centre
VMS	Variable Message Sign

EXECUTIVE SUMMARY

1. Project Background

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

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

- 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 for Ahmedabad.

2. ITS, TMICC and NUTH Concepts

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

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

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

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

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

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

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

This document is a concept level document and not a Detailed Project Report (DPR). The city will need to prepare DPR in due course as and when they decide to implement the proposed 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 the TMICC in the city. A communication in this regard has already been sent by MoUD to all States including Gujarat. The indicative scope of services for the city specific project consultancy is as set out in Annexure 5.

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

Ahmedabad is the largest city of Gujarat State. It has a population of 5.57 million (2011 census) and an area of 466.06 sq. km. under the jurisdiction of Ahmedabad Municipal Corporation (AMC). Ahmedabad is one of the most important business centres in the western part of India.

Ahmedabad city has well connected bus based public transport such as Bus Rapid Transit (BRT) system and city bus service. Metro rail is also under implementation in Ahmedabad city. Ample investment is visible in modernising and managing public transport system in the city.

The number of vehicles on roads is increasing at a fast pace in Ahmedabad. There were 2.38 million registered vehicles in the city in 2009-10 which has increased to 2.82 million vehicles in 2011-12 registering a growth of 18.54% during the period. High growth in number of vehicles has increased congestion on the road network and worsened air pollution in Ahmedabad city. In order to cater to the increased demand for transportation and mobility, Integrated Comprehensive Mobility Plan for Greater Ahmedabad Urban Agglomeration (GAUA) has identified several interventions and proposals that would support the projected transportation demand in the city. Some of

the key interventions proposed in the Integrated Comprehensive Mobility Plan are listed below:

- Railways over bridges and underpasses
- Flyovers on major corridors
- Parking facilities
- Junctions redesign and improvement
- Pedestrian and Non-Motorised Vehicle (NMV) facilities
- Road safety and Traffic Management Initiatives
- Goods Terminal
- Integrated public transit plan

These Interventions will surely lead to decrease in traffic issues on roads but these projects require time to come up on field. However, Intelligent Transport System (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 Ahmedabad (Chapter 2.0)

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

A. Monitoring and Management of Traffic

- **Traffic Enforcement**

  The current traffic control centre in Ahmedabad does not have interfaces with the traffic enforcement systems implemented by Traffic Police. The proposed TMICC could either host these systems or develop interfaces with them 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 Ahmedabad city are working in isolated mode and mostly on fixed cycle timing. 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 is limited network of Variable Message Signs (VMSs) on the city road network. As part of Ahmedabad TMICC, it is proposed to expand the network of VMSs by way of installing more 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 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 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. Ahmedabad 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.

C. Traffic Information Dissemination: At present, limited traffic information is being disseminated by Ahmedabad City Traffic Police via social media (traffic advisories), WhatsApp (number 9979921095), and Traffic Helpline number 1095 (complaint registration, info about traffic jam etc.). Ahmedabad TMICC 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 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.

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 framing traffic policy for the city.

6. Ahmedabad TMICC Details

Details about the proposed TMICC are provided below:

A. Project Elements (Chapter 4.0)

Ahmedabad 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

Details of the above elements are covered in Chapter 4.0.

B. Project Area (Chapter 4.0)

Project area to be covered by the Ahmedabad TMICC is recommended to be Ahmedabad Municipal Corporation (AMC) area.

C. Key Components of the Proposed Ahmedabad TMICC (Chapter 4.0)

It is recommended that the existing traffic control room of AMC be upgraded to Ahmedabad TMICC facility. It will require all signals in the city to be connected to the proposed TMICC. In addition, as the space requirement for the TMICC would be large at about 4000 sq. ft. compared to the size of the current control room (approx. 600 sq. ft.), it is recommended that the Ahmedabad TMICC be set up at a new location and the systems currently deployed at the existing traffic control room be shifted to the proposed TMICC.

Ahmedabad city has 227 signalised junctions functioning under fixed time and manually controlled system. All these signals are proposed to be linked to and be controlled through the proposed TMICC. Considering the requirement of additional signalised junctions, a total of 270 junctions have been considered for the city. However, as the upgradation process for 186 junctions is currently underway, upgradation of remaining 84 junctions has been considered within the scope of the project. As installation of Pan-tilt-zoom cameras for junction/ key specific locations surveillance is not within the scope of on-going upgradation process, the same has been proposed for all junctions/key specific locations in the city. Table E-1 details the current status and the scope of future deployment. Details of various components and their costing have been provided in Section 7.2.

Table E-1:TMICC - Scope for Deployment

S. No.	Components of TMICC	Current Status	Proposed System
1.	Upgradation of signalised junctions – 270 Nos.	186 Nos. under upgradation process	84 Nos.
2.	Control room connectivity	3 signalised junctions connected currently. Remaining are proposed to be covered progressively.	84 Nos.
3.	Variable Message Signs (VMSs)	4 Nos.	17 Nos.
4.	Vehicle detection cameras	--	336
5.	PTZ cameras for junction surveillance	--	450
6.	TMICC facility	600 sq. ft.	4000 sq. ft.

D. Indicative Budget (Chapter 7.0)

For the key components mentioned in Table E-1 (Section C above) and other associated components as detailed in the Section 7.2 (Chapter 7.0), an estimated budget of **₹ 55.6 crores** is proposed as capital investment and a budget of ₹ **17.9 crores per annum** is proposed to meet the operational and maintenance expenses. The project cost and sizing may undergo changes at the time of preparation of the detailed project report.

7. Implementing Agency (Chapter 6.0)

As AMC has already set-up and is operating a traffic control room, it is recommended that AMC be entrusted with the responsibility for setting up and operating the proposed Ahmedabad TMICC. AMC may upgrade and expand the existing control room and, as required, relocate the facility to any other area. It is also recommended that Traffic Police personnel be co-located along with the AMC personnel at the TMICC to ensure effective coordination between AMC and the Traffic Police.

8. Implementation Structure (Chapter 6.0 and Chapter 7.0)

Supply and service contract is recommended as the most suitable model for implementing the Ahmedabad TMICC. The responsibility to implement, operate and maintain the Ahmedabad TMICC and all the traffic equipment connected therewith may be entrusted to a single systems integrator. There are currently two entities managing the signals in the city. It is recommended that the entire signal operation be progressively brought under a single unified TMICC.

9. Information Dissemination (Chapter 4.0)

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

10. Funding (Chapter 7.0)

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[1]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[2] and the city may avail funding from one or both these schemes.

[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)

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 the project requires operational systems and functional teams to manage the O&M activities. The O&M cost of the TMICC may be borne by AMC as is currently being done for the existing traffic control room.

11. 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 the TMICC system as proposed in this report. This ITS initiative has the potential to transform the way the city manages and monitors its transportation assets.

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

TMICC would be the control centre to support traffic enforcement, 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 mobile app, telephone service and website 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 Generic Operations Documents, City Specific Operations 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 for Ahmedabad.

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 Detailed Project Report (DPR), designing, procuring and monitoring the implementation of the TMICC in the city. A communication in this regard has already been sent by MoUD to all States including Gujarat. The indicative scope of services for the city specific project consultancy is as set out in Annexure 5.

2.0 CITY CHARACTERISTICS

2.1 Ahmedabad

Ahmedabad is seventh largest metropolis in India and the largest city in Gujarat. It is also very close to the State capital Gandhinagar. The Ahmedabad Urban Agglomeration (AUA) population has increased from 3.4 million in 1991 to 6.9 million in 2011. Ahmedabad is the commercial capital of the State and is also known as the textile capital of India. It lies in the cotton belt of Gujarat, 23 km south of Capital Gandhinagar, 552 km north of Mumbai and 96 km from the Gulf of Cambay. It has excellent connectivity through air, road and rail links with Mumbai and Delhi. Historically Ahmedabad has been one of the most important centres of trade and commerce in western India. The city has a great architectural tradition reflected in many exquisite monuments, temples and modern buildings. Figure 2-1 provides an overview of the population density of various areas in the city.

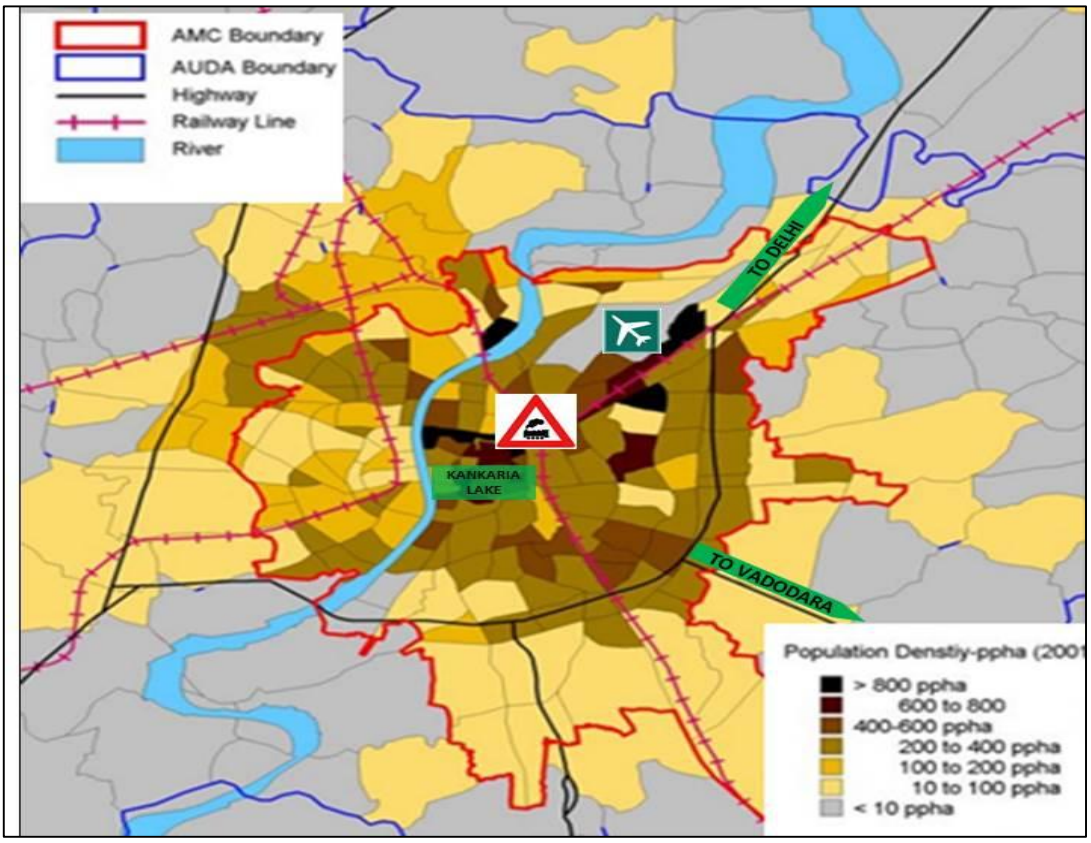

Figure 2-1: The City of Ahmedabad

2.1.1 Demographic Trends

The total population of Ahmedabad Urban Agglomeration according to Census of India, 2011 was about 6.9 million as compared to 4.6 million in 2001 (according to Census 2001). The population density of Ahmedabad is estimated to be 118.3

persons / ha. The details of population and decadal growth rates are provided in Table 2-1[3].

Table 2-1: Population Growth Rate

S. No.	Year	Population (Million)	Decadal Growth Rate %
1	1981	2.5	29
2	1991	3.4	36
3	2001	4.6	35
4	2011	6.9	50
5	2035 (projected)	10.9	21

The population within the Ahmedabad Municipal Corporation (AMC) area is growing at 2.5% per year and that at Ahmedabad Urban Development Authority (AUDA) area is growing at 3.62% per year. The increase in population within a given area/region results in denser settlements which in turn lead to generation of higher number of trips using various modes.

2.1.2 Economic Profile

Textiles, chemicals, agro & food processing industries and drugs & pharmaceuticals have been the major sectors of industrial base in Ahmedabad both in terms of investment as well as employment. Ahmedabad district accounts for 21.5% of factories and employs 18% of workers in the State. Over 14% of the total investments in all stock exchanges in India and 60% of the total industrial productivity are contributed by the district in the whole of Gujarat State[4].

Growth in economic activity reflects in growing demand for travel and need for adopting measures in dealing with this demand.

2.1.3 Registered Motor Vehicles

The number of vehicles on road is increasing at a fast pace in Ahmedabad. There were 2.38 million registered vehicles in the city in 2009-10 which has increased to 2.82 million vehicles in 2011-12 registering a growth of 18.54% during the period.

Table 2-2[5] presents data of registered vehicles in Ahmedabad from 2009 to 2012. In goods vehicle segment, other light commercial vehicles have registered maximum growth of 17.1% in 2011-2012. Similarly in passenger vehicles category, Maxi vehicles grown at almost 17% in year 2011-2012 compared to the previous year.

[3] Source: Integrated Mobility Plan for Greater Ahmedabad Region (2011, AUDA)
[4] Source: http://www.globalgujarat.com/images/ahmedabad-district-profile.pdf
[5] Source: rtoahmedabad-vahan.nic.in

High proportion of these categories of vehicles tends to reduce the average travel speed as these being slow moving and mostly run overloaded.

Table 2-2: Registered Motor vehicles in Ahmedabad 2009 till 2012

Vehicle Type	Volume	2009-2010	2010-2011	2011-2012
Two Wheelers	Total	17,28,522	18,75,658	20,22,424
	Growth (%)	-	8.51%	7.82%
Three Wheelers	Total	1,47,136	1,60,852	1,74,173
	Growth (%)	-	9.32%	8.28%
Four Wheelers	Total	3,52,064	3,96,597	4,45,290
	Growth (%)	-	12.65%	12.28%
Buses	Total	23,739	24,142	24,831
	Growth (%)	-	1.70%	2.85%
All Vehicles	**Total**	**23,81,453**	**26,00,572**	**28,23,022**
	Growth (%)	**-**	**9.20%**	**8.55%**

The above, read with population growth rates described earlier, indicates that growth rate in number of vehicles is nearly double the growth rate of population. Moreover growth rate of four wheelers is higher than that of two wheelers and that of buses.

2.1.4 Accident Related Data

The following Table 2-3[6] shows year-wise data pertaining to traffic accidents in Ahmedabad city for years 2011-2014. There is clearly a need to introduce measures for undertaking analysis of the trends and accident spots in order to minimise the accidents.

Table 2-3: Year wise Traffic Accidents in Ahmedabad

Year	Normal Injury	Serious Injury	Fatal	Total Number of Accidents
2011	1,436	362	222	2,020
2012	1,419	354	251	2,024
2013	1,522	333	230	2,085
2014	1,299	298	262	1,859

[6] Source: Ahmedabad City Traffic Police (http://ahmedabadcitypolice.org/services/traffic-police/)

Proposed TMICC would collect and analyse such data in a structured manner and support in identification of black spots so that suitable interventions could be initiated.

2.2 Existing Traffic and Travel Characteristics

Presently transport demand of city is met by public and intermediate public transport modes including intra-city buses, auto rickshaws, cycle rickshaws, hired cars and personalised modes. However, buses continue to be a popular means of transportation for intra-city travel.

Ahmedabad city is divided into two physically distinct eastern and western regions by Sabarmati River. Eastern bank of the River houses the old city which includes closely clustered buildings and numerous places of worship. It also has the railway station, congested market places, post office and old buildings of British era. The part of the city on western side of the River is relatively new and houses educational institutions, residential areas, shopping malls, multiplexes etc. These two parts are connected by a number of bridges across the River. Large number of trips using heterogeneous modes are made daily in both directions across the River. It results in mixed traffic moving at varying speeds aggravating the prevailing problem of inadequate capacity. TMICC will help in optimising the utilisation of available road space by way of providing information about congestion through various channels such as VMS, mobile app etc. Table 2-4 below shows traffic volumes on major roads in Ahmedabad[7].

Table 2-4: Traffic Volumes on Major Roads in Ahmedabad

S. No.	Location	Direction	Total PCU (16 hrs)	Total Vehicles (16 hrs)
1	Shilaj	Ambli to Vaishnavdevi	15,987	10,553
		Vaishnavdevi to Ambli	18,509	10,357
2	Thaltej	Gandhinagar to Sarkhej	42,387	47,209
		Sarkhej to Gandhinagar	33,116	39,727
3	Helmet Circle	IIM to RTO	28,012	33,672
		RTO to IIM	25,847	35,638
4	Vijay Char Rasta	Darpan to University	19,354	24,276
		University to Darpan	15,763	21,290

[7] Source: Integrated Mobility Plan for Greater Ahmedabad Region (2011, AUDA)

S. No.	Location	Direction	Total PCU (16 hrs)	Total Vehicles (16 hrs)
5	Stadium Cross Road	C.G Road to Ushmanpura	27,189	35,148
		Ushmanpura to C.G Road	23,189	31,581
6	Income Tax Cross Road	Paldi to RTO	33,447	41,696
		RTO to Paldi	50,773	55,259
7	Delhi Darwaja	Delhi Darwaja to Shahibagh	38,785	53,660
		Shahibagh to Delhi Darwaja	33,532	47,723
8	Premdarwaja Eidgah Road	Girdharnagar to Premdarwaja	19,027	23,085
		Premdarwaja to Girdharnagar	17,484	12,007
9	Amdupura	Kalupur to Naroda	25,576	34,580
		Naroda to Kalupur	28,319	39,892
10	Rakhial	Amdupura to Sukhramnagar	24,700	37,251
		Sukhramnagar to Amdupura	19,581	27,349
11	Bapunagar Tollnaka	Amraiwadi to Bapunagar	21,750	30,590
		Bapunagar to Amraiwadi	18,229	25,296
12	Soni Ni Chawli	Naroda to Narol	31,679	43,689
		Narol to Naroda	30,783	39,377
13	SP Ring Road	Gandhinagar to Vadodara	28,835	20,032
		Vadodara to Gandhinagar	24,160	18,360
14	Subhash Bridge	RTO to Shahibagh	49,769	67,611
		Shahibagh to RTO	47,138	65,253
15	Dr Ambedkar Bridge	Bhatta to Dhanilimda	19,677	23,826
		Dhanilimda to Bhatta	13,967	17,257
16	Vishala	CTM to Juhapura	30,467	25,020
		Juhapura to CTM	17,453	17,628

S. No.	Location	Direction	Total PCU (16 hrs)	Total Vehicles (16 hrs)
17	SPRR – Near Enasan	Nava Naroda to Zundal	14,428	12,612
		Zundal to Nava Naroda	12,810	10,331
18	Kamod	Odhav to Sarkhej	14,468	9,186
		Sarkhej to Odhav	17,985	11,611[8]

2.2.1 Per Capita Trip Rate

The per capita trip rate including walk, according to Gujarat Infrastructure Development Board (GIDB) Metro Rail study by Delhi Metro Rail Corporation (2003) was 1.16. The recent study (DPR for Janmarg BRTS, Ahmedabad in 2010) done by CEPT shows trip rate to be high at 1.79 (all trips) excluding walk up to 500 meters. This shows an increase in trip rate by almost 54% in 7 years, thereby indicating higher load on the roads.

2.2.2 Average Trip Length and Travel Time

The average trip length in Ahmedabad city is 6.2 km and an average travel time is 18 minutes. It shows an average speed of trips to be about 20.65 kmph.

2.2.3 Modal Share

In Ahmedabad, the number of trips by walk accounts for 32% of the person trips made daily. Two-wheeler has a share of 26% followed by public transport (11%) and car (8%) respectively. It is clearly seen that two-wheelers are the predominant mode of transportation in Ahmedabad. Public transport share is less than walk, cycle and two-wheeler based mode of transportation, whereas the Intermediate Public Transport (IPT) in the form of auto rickshaws has the lowest share among all the modes of transportation in Ahmedabad. The modal share of Ahmedabad (2007) has been presented in the Table 2-5[9].

Table 2-5: Mode Share in Ahmedabad

Mode	% Share
Walk	32
Cycle	15
Two wheeler	26

[8] Source: Integrated Mobility Plan for Greater Ahmedabad Region (2011, AUDA)
[9] Source: Study on Traffic & Transportation Policies and Strategies in Urban Areas in India (2008), MoUD

Mode	% Share
Public Transport	11
Car	8
Auto	7

2.2.4 Traffic Characteristics

The number of private vehicles has increased exponentially in the last two decades in the Ahmedabad city. Such high growth in number of vehicles has increased congestion on the road network and worsened the air pollution in Ahmedabad city. The traffic volume on major roads of Ahmedabad during morning and evening peak hours has been presented in the Figure 2-2. Ahmedabad TMICC would help in monitoring and regulating the flow of traffic and provide complete view of the traffic movement on the road network of the city.

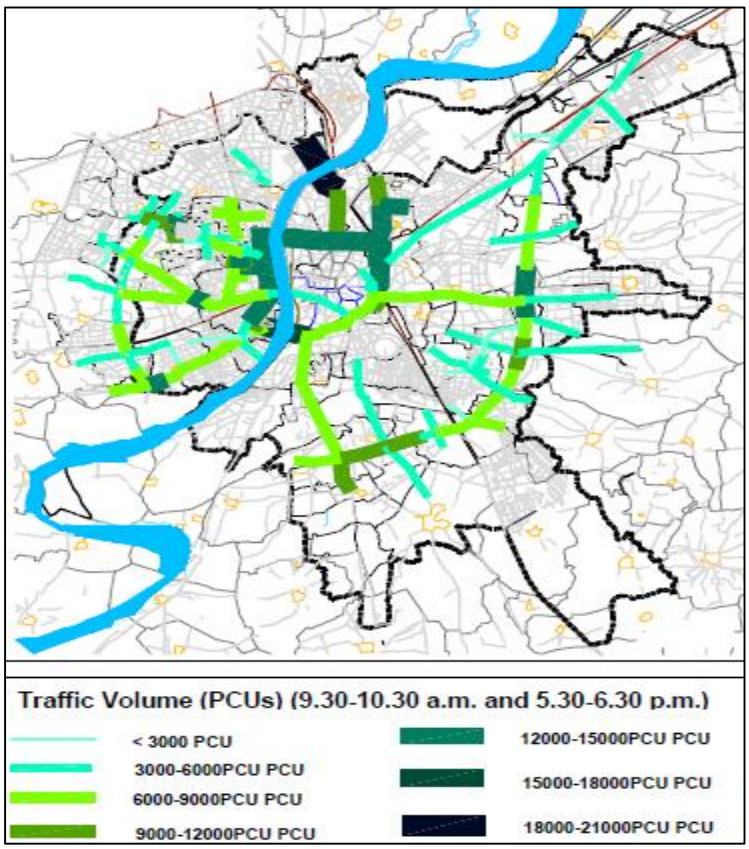

Figure 2-2: Traffic Volume at Various Locations in Ahmedabad [10]

[10] Source: Traffic Management Plan for Ahmedabad', CEPT University

2.2.5 Transport Performance Indices

Transport Performance Index values for Ahmedabad for variables such as public transport, congestion, walkability, safety, parking and city bus transport supply were derived and the same are presented in Table 2-6[11]. Annexure 4 can be referred for more details regarding the approach adopted for computing the Transport Performance Index values.

Table 2-6: Transport Performance Indices

Index	Value	Remarks
Public Transport Accessibility Index	2.49	Represents whether public transport is available within 500 m; higher the value, better is the accessibility. Ahmedabad has second highest accessibility index and is higher than the national average of 1.2
Congestion Index	0.30	Lower the value, better the speed. Value for Ahmedabad is higher than national average of 0.25.
Walkability Index	0.85	Higher value shows better network and facilities for pedestrians. One of the highest in Indian cities.
City Bus Transport Supply Index	10.3	Higher value refers to better bus supply. Value near to national average of 10.4.
Safety Index (1/Fatality per lac)	0.14	Higher value shows better safety. Value higher than national average of 0.10.
Para Transit Index	73.9	Index is high when compared to other cities in India. Higher value shows better service.
Slow Moving Vehicle Index	0.06	Indicates lack of slow moving vehicle facilities. Higher value refers to better facilities. Value, lower than national average of 0.7.
On- Street Parking Interference Index (1/% of on-street parking on road length)	2.03	Higher value refers to better on-street parking management. Value much higher than the national average of 1.3.

2.3 Road Network Characteristics

The road network in Ahmedabad may be classified as that of ring-radial form. Table 2-7[12] shows hierarchy of the road network in Ahmedabad. There are 20 well defined radials, which can be classified as arterials and collectors according to Indian Roads Congress (IRC). Out of 20 radials, 12 are in the west and 8 in the east. Ashram road

[11] Source: Study on Traffic & Transportation Policies and Strategies in Urban Areas in India (2008), MoUD
[12] Source: Ahmedabad Municipal Corporation, 2010

running along the Sabarmati River also functions as a north south radial. As the need to connect these roads to facilitate cross mobility arose, a series of rings / orbital were added to form ring roads. As defined by AUDA, there are five complete rings within the AUDA area.

Table 2-7: Hierarchy of Road Network in Ahmedabad

S. No.	Type	Road Length (km)	% of Total Road Network
1	Ring and radial roads (Arterials and Collectors)	347	14.2
2	Sub-arterials and collectors	923	37.9
3	Other roads	1166	47.9
	Total	**2436**	**100.0**

Table 2-8: Status of Roads in Ahmedabad Municipal Area

S. No.	Year	Road Length (km)	Percent Increase (Road Length)
1	1961	796.7	-
2	1971	819.5	2.86
3	1981	1054.3	28.65
4	1991	1214.0	15.15
5	2001	1271.7	4.76
6	2010	2436.0	91.55

Table 2-8[13] above shows the status of roads in AMC area. In Ahmedabad, area under roads is 7.91% as against the desirable 15-18%. It is also observed that road density reduced from 6.6 km. / sq. km. area to 5.2 km. / sq. km. area between 2007 and 2011. It further burdens the existing road network and presents the need for introducing non-conventional measures in managing the use of transport infrastructure optimally in Ahmedabad.

2.4 Travel Demand Forecast

According to the study on Traffic & Transportation Policies and Strategies in Urban Areas in India conducted by MoUD in 2008 for 30 cities; the travel demand forecast

[13] Source: Integrated Mobility Plan for Greater Ahmedabad Region (2011, AUDA)

for public transport and non-motorised trips in Ahmedabad was estimated to be the following (Table 2-9)[14].

Table 2-9: Travel Demand Forecast

Mode	Horizon Year Trips/Day					
	2011		2021		2031	
	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage	Value (Lakhs)	Percentage
PV+ IPT	47.08	42.87	68.53	45.46	93.47	48.96
PT	11.81	10.75	11.66	7.93	12.37	6.48
NMT	50.94	46.38	66.83	46.61	85.06	44.56

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

Motorised trips are expected to have 55.4% share in 2031 compared to 53.6% in 2011, indicating a need for prioritised attention in controlling such trips. In the year 2021, 2.59% of total trips are forecast to shift towards motorised transport as compared to 2011; while in 2031, around 1.82% of total trips would shift to motorised mode as is forecast, compared to the year 2011.

In order to cater to the increased demand for transportation and mobility, Integrated Mobility Plan for Greater Ahmedabad Region has several interventions and proposals that would support the projected transportation demand in the city. Some of the key interventions proposed in the Integrated Comprehensive Mobility Plan are listed below:

- Railway over bridges and underpasses.
- Flyovers on major corridors.
- Parking facilities.
- Junction redesign and improvement.
- Pedestrian and NMV facilities.
- Road safety and Traffic Management initiatives.
- Goods Terminal.
- Integrated public transit plan.

2.5 Opportunities for Improvement in the Present Transport System

Some of the areas where improvements could be undertaken are listed below:

A. Centralised Signal Monitoring, Operation and Control: Existing signals in Ahmedabad city are working in isolated mode and mostly on fixed cycle timing. Isolated mode and fixed cycle timing based signal operations do not allow for

[14] Source: Study on Traffic & Transport Policies and Strategies in Urban Areas in India (2008), MoUD

optimisation of network traffic flow. The signals can be made adaptive to live traffic demand, interconnected, monitored and controlled from central location through TMICC.

B. **Variable Message Signs:** At present there is a limited network of VMSs on the city road network. As part of Ahmedabad TMICC, it is proposed to expand the network of VMSs by way of installing 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.

C. **Traffic Enforcement Systems:** The current traffic control centre in Ahmedabad does not provide for interfaces with traffic enforcement system implemented by the Traffic Police. The proposed TMICC would need to either host the same or develop interfaces with these systems so that traffic violation data could be captured and stored for analytical and planning purposes.

D. **Data Repository and Analysis:** Currently there is no system for capturing and storing historical traffic data that could be used for planning purposes. Ahmedabad 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.

E. **Traffic Information Dissemination:** At present limited traffic information is being disseminated by Ahmedabad City Traffic Police via social media (traffic advisories), WhatsApp number 9979921095, and Traffic Helpline number 1095 (complaint registration, info about traffic jams etc.). Ahmedabad TMICC 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 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.

2.6 Need Analysis

Based on the above analysis of existing city characteristics, following points indicate the need for implementation of TMICC in Ahmedabad city:

1. City has a congested network as is evident from the average travel time, growing trip rates and transport performance index from Section 2.2.
2. As provided in Section 2.1.1, Ahmedabad city is registering rapid growth in population which grew at a decadal growth rate of about fifty per cent from 2001 to 2011. This gradual densification of the settlement is reflecting on the city roads in in the form of compromised safety (Section 2.1.4) and trip delay issues.

3. Exponential growth in registered vehicles as mentioned in Section 2.1.3 is further deteriorating the traffic conditions.
4. 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.
5. The average traffic speed is reducing, long queues are normal at intersections and bottlenecks.
6. An efficient traffic management system based on ITS is required to optimize utilisation of available transport network capacity in Ahmedabad.

2.7 Ahmedabad TMICC Benefits

The Ahmedabad 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 2-10.

Table 2-10: Potential Benefits and Measurements

Type of Benefits	Typical Measurement and Description	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 • Traffic 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 • Traffic Enforcement • Variable Message Signs

Type of Benefits	Typical Measurement and Description	Associated Technologies related to Traffic Management and Information Control Centre
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 the traffic policy for the city.

3.0 REVIEW OF TRAFFIC RELATED ITS INITIATIVES

3.1 Traffic Signalling System

Traffic in Ahmedabad is controlled by Ahmedabad City Traffic Police. Ahmedabad Municipal Corporation (AMC) is responsible to install and maintain traffic related equipment. As part of this, AMC has already established a traffic control room at Victoria Garden (Ahmedabad) which is progressively being connected to the traffic signals and cameras at junctions. The Traffic Police is responsible for operating signals and other traffic equipment as part of its mandated role of regulating and managing the traffic. The Traffic Police monitors and operates traffic signals in close coordination with AMC. Signal plans are changed by AMC based on requests from the Traffic Police.

AMC engages contractors to supply and maintain various traffic equipment such as signals, CCTV cameras etc. There are around 227 signalised junctions under the purview of AMC. Out of 227, signals on 3 junctions are working on adaptive mode. Ahmedabad city is in the process of upgrading its traffic signalling system infrastructure.

3.2 CCTV Security Surveillance System

Ahmedabad Municipal Corporation (AMC) has installed 554 CCTV cameras at 62 locations including V.S. Hospital, L.G. Hospital, Shardaben Hospital, Kankaria Lake Front, Vastrapur Lake, Manek Chowk, Uttam Nagar Garden, Prahladnagar Garden, Law Garden, Kalupur Railway Station, Maninagar Railway Station, Sabarmati Railway Station, various river bridges criss-crossing the city, various bus-stops of AMTS and BRTS etc. A view of AMC office, Surveillance Cameras, Signals and cameras on signal used for adaptive control purpose are shown in Figure 3-1.

Figure 3-1: AMC office, Surveillance camera, Adaptive Signals view

Surveillance monitoring centres have been set up for the purpose of CCTV based surveillance. These centres are not for traffic monitoring/controlling purposes.

3.3 Red Light Violation Detection (RLVD) system

A total of 226 Automatic Number Plate Recognition (ANPR) cameras have been installed at 82 strategic locations in Ahmedabad as part of the City Surveillance and Intelligent Traffic Monitoring System (CSITMS) project. These cameras transmit live feed to a central control room set up for the project. The backend of the RLVD system from this control room can dispatch either an automated or a manually generated e-challan to the addresses of the offenders based on violations recorded in the ANPR cameras. The system has interface with the vehicle registration database and locate the erring vehicle owner's residence.

3.4 Traffic Information Dissemination System

3.4.1 Traffic Police Website

Ahmedabad City Traffic Police has a webpage on the website of Ahmedabad Police (Figure 3-2).

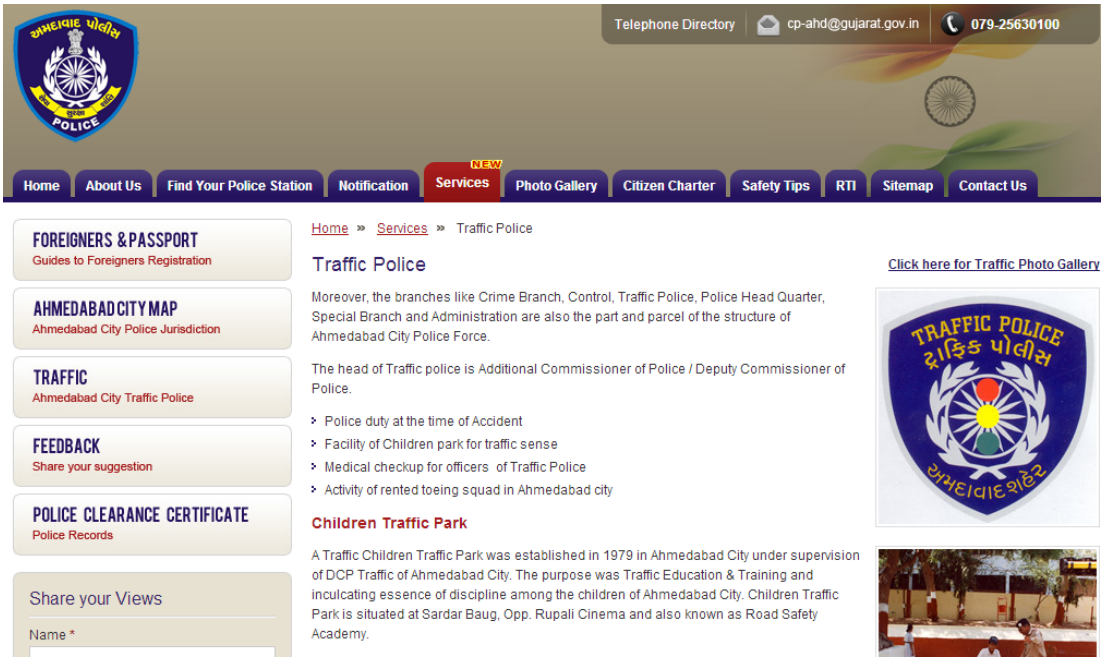

Figure 3-2: Ahmedabad City Traffic Police website

3.4.2 Traffic Police Social Media Presence

Ahmedabad City Traffic Police maintains a Facebook page (Figure 3-3) for providing alerts and messages to the public.

Figure 3-3: Ahmedabad City Traffic Police Facebook page

Ahmedabad police is available on WhatsApp also. The information on this app is limited to traffic issues only. Ahmedabad public can report any jams, parking accident and snarls, on the app. Public can also submit complaints about the misbehaviour of any police officer through the WhatsApp.

3.4.3 Variable Message Signs

AMC, with support from JICA, has installed the VMSs at the following locations:

- On the way to Shivrangini
- On the way to Anjali
- On the way to Delhi Darwaza
- On the way to Indian Institute of Management (IIM) Char Rasta

VMSs display congestion level on the route, weather information and advisories. The data feed is processed at the backend and then passed on to the VMSs for dissemination to the public. A view of a VMS and cameras at Shivrangini site captured during the city visit are shown in Figure 3-4.

Figure 3-4: View of VMS and Cameras Installed at Shivranjini, Ahmedabad

3.4.4 Traffic Police Helpline

Ahmedabad City Traffic Police has a helpline number 1095 for its control room, which is a toll free number.

3.5 Summary of Traffic ITS Initiatives

Table 3-1 lists traffic related ITS initiatives that have been implemented in Ahmedabad and others that are in the process of being implemented.

Table 3-1: Ahmedabad - Traffic Related Existing ITS Initiatives

Initiatives	Description	Status & Relevance
Traffic Signalling System (Ahmedabad Municipal Corporation - AMC)	• 227 existing signals being managed by 2 agencies • Control room at Victoria Garden for operating 186 signalised junctions	• 3 signals are connected to the control room • This control room may be upgraded and expanded as the proposed TMICC
Vehicle Detection Cameras (AMC)	• To support vehicle actuated real time signal monitoring and control	• Planned for 186 junctions in the city • These signalised junctions shall be connected to the proposed TMICC
CCTV Security Surveillance (AMC)	• CCTV cameras installed at strategic locations such as railway station, hospitals, BRTS, public gardens, bus stations etc. • To provide live feeds to the security surveillance rooms • All these cameras also connected via fiber optics to Police Commissioner office	• Implemented 554 CCTV cameras at 62 locations in the city • TMICC may be given access to the camera feeds
Red Light Violation Detection (RLVD) system	• 226 ANPR cameras installed at 82 locations	• Violation data to be shared with TMICC
Traffic Information Dissemination: Website (Traffic Police)	• Traffic police has a page on the city police website • Accident data is published	• TMICC may use the website to disseminate traffic information
Traffic Information Dissemination: VMSs (ATCC based), JICA funded	• Display traffic messages and advisories based on ATCC cameras • Standalone only	• Operational at 4 locations • Can be integrated with the proposed TMICC

Initiatives	Description	Status & Relevance
Traffic Information Dissemination: Social Media (Traffic Police)	• Facebook and Twitter pages • To disseminate traffic information to public	• Operational but not updated on regular basis • TMICC can receive information feeds

3.6 Meeting with Stakeholders

Minutes of meeting with stakeholders and the feedback provided by them are available in Annexure 1(A) and Annexure 1(B). The information collected from Ahmedabad Janmarg Limited (AJL), Ahmedabad City Traffic Police, and Ahmedabad Municipal Corporation is available in Annexure 1(C), Annexure 1(D) and Annexure 1(E) respectively.

Based on the discussions and the information shared by the city stakeholders, it emerges that Ahmedabad city has taken several ITS initiatives. These include connecting some signalised intersections to the traffic control room, VMSs for traffic information dissemination, CCTVs for surveillance at important junctions and public places etc.

City stakeholders were explained the proposed TMICC concept including project phasing and they expressed their keenness in implementing the TMICC for Ahmedabad as proposed.

4.0 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 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 reduce congestion, dealing with incidents, issuing advisories or disseminating information. Often, many of the agencies are also co-located at TMICCs and work with each other in order to improve coordination.

4.2 Goals and Objectives

The main objectives of the Ahmedabad TMICC and 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
    - Active 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
    - 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 through variable message signs, website, helpline, mobile application, social media etc.
- **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.
  - Support identification and analysis of black spots in case of accidents.

4.3 Project Area

Though, TMICC is required for the entire Greater Ahmedabad Development Area, its implementation is proposed in a phased manner. Proposed project area for Phase-1 of TMICC is Ahmedabad Municipal Corporation (AMC) area. In Phase-2, Ahmedabad Urban Development Authority (AUDA) area would be covered. In Phase-3, the entire Greater Ahmedabad Development Area is proposed to be covered. The remainder of this report deals with Phase-1 of the Ahmedabad TMICC. Details of various areas is provided in Table 4-1.

Table 4-1: Ahmedabad TMICC- Project Area

S. No.	Project Area	Description
1	Ahmedabad Municipal Corporation (AMC) area	Area under the jurisdiction of Ahmedabad Municipal Corporation [466.06 sq. km.]
2	Ahmedabad Urban Development Authority (AUDA) area	Area under the jurisdiction of Ahmedabad Urban Development Authority (AUDA) [Total 1877.7 sq. km. which includes AMC area of 466.06 sq. km.]
3	Greater Ahmedabad Development Area (GADA)	Proposed area under the jurisdiction of AMC, AUDA & Gandhinagar Urban Development Authority (GUDA) [4708 sq. km.]

4.4 Project Phasing

It is recommended to implement the project in a phased manner as provided in Table 4-2. The city may amend the phasing based on its assessment of the situation at the time of implementation of the project.

Table 4-2: Ahmedabad TMICC: Implementation Phasing

Parameter	Phase-1 (3-5 years)	Phase-2 (4-8 years)	Phase-3 (6-10 years)
TMICC Area	Ahmedabad Municipal Corporation (AMC) Area	Existing Ahmedabad Urban Development Authority Area (AUDA)	Greater Ahmedabad Development Area (GADA)
Focus Areas	• Traffic Enforcement • Signal control • Road Network surveillance • Basic traffic information dissemination	• Traffic Enforcement • Signal control coordination • Road Network surveillance • Traffic information dissemination	• Traffic Enforcement • Integrated corridor management • Road Network surveillance • Traffic information dissemination
Traffic Equipment	• Signals • VMS • Vehicle detection cameras	• Signals • VMS • Vehicle detection cameras	• Signals • VMS • Vehicle detection cameras

Parameter	Phase-1 (3-5 years)	Phase-2 (4-8 years)	Phase-3 (6-10 years)
Traffic Information that can be used for dissemination	• Roadway network map • Road diversions / closures • Advisories and alerts • Basic Parking Information • Construction/ maintenance • Weather Information	• Roadway network map • Road diversions / closures • Advisories and alerts • Parking Information • Weather Information • Construction/ maintenance • Speed/Congestion Information	• Roadway network map • Road diversions / closures • 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	• Website • Phone helpline • Mobile App • Social Media • Additional VMS along roadways	• Website • Phone helpline • Mobile App • Social Media • Additional VMS along roadways
Tools	• Trip planner	• Trip planner	• Trip planner
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	• 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	• 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

4.5 Location of Ahmedabad TMICC

It is recommended that the existing traffic control room of AMC at Victoria Garden being managed by DIMTS Ltd. be upgraded to Ahmedabad TMICC facility. It will require all signals in the city to be connected to the TMICC. In addition, as the space requirement for the TMICC would be large (about 4000 sq. ft.) as compared to the

size of the current control room (approx. 600 sq. ft.), it is recommended that the TMICC be set up at a new location and the systems currently being operated from the existing traffic control room be shifted to the TMICC. 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

Ahmedabad 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

Ahmedabad TMICC would have Traffic Enforcement system, Traffic Signal Control system, Road Network Surveillance system and Traffic Information Dissemination system (Figure 4-2). These systems and their interfaces with other systems have been described in the sub-sections that follow.

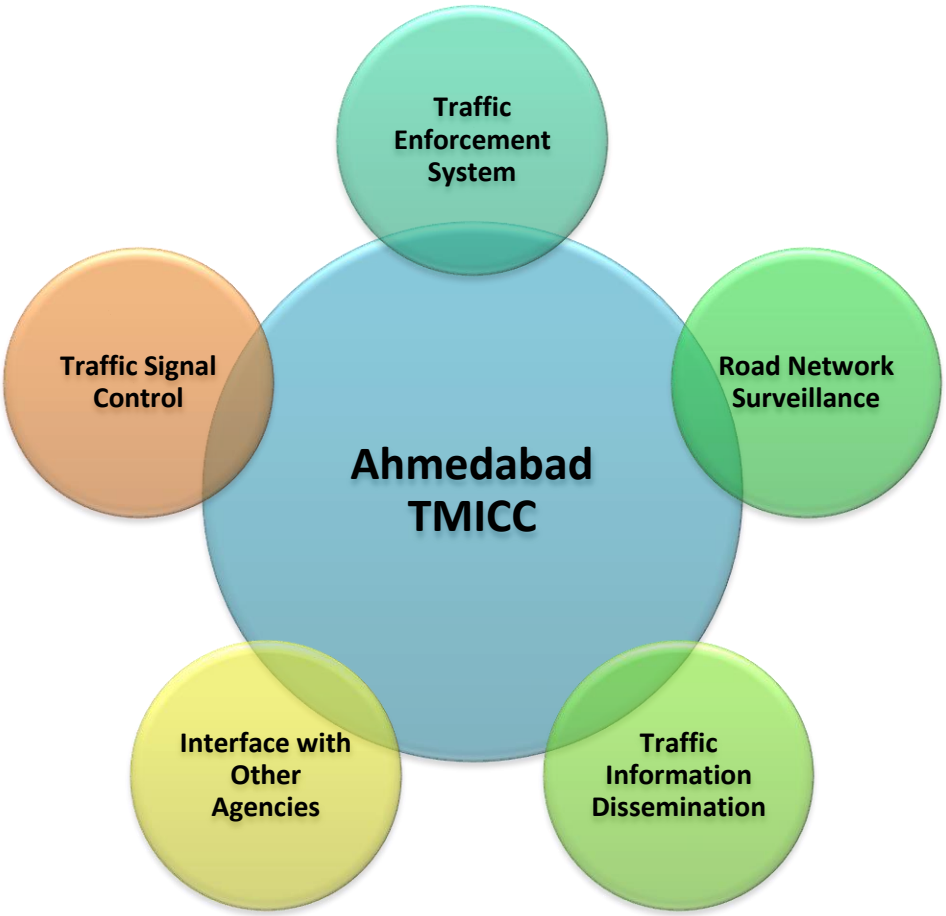

Figure 4-2: Ahmedabad TMICC Concept Diagram

4.7.1 Traffic Enforcement System

Traffic enforcement activities are part of responsibilities of the Traffic Police in Ahmedabad. Typical traffic enforcement related activities include the following:

- 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 security and enforcement measures are 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 (RLVD) System:** The RLVD system would also be hosted by the traffic police enforcement wing. However, information of violations should be shared with the TMICC for analyses (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 analyses 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 Ahmedabad TMICC over communication networks. Two way communications would be required to manage and control the signals through TMICC. The TMICC transmits signal plans to the controllers and the controllers in turn provide the operational and functional status to the TMICC (Figure 4-3).

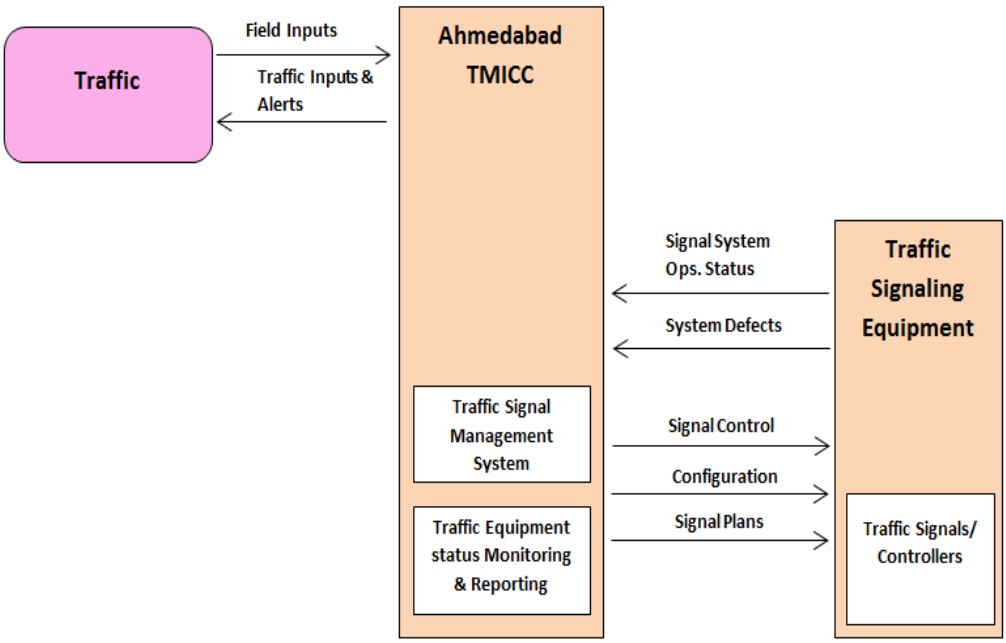

Figure 4-3: Signal Control

Signal timing and operations management is a very critical activity carried out as part of traffic monitoring and control in order to optimize 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 the 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 plan 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 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.

The TMICC transmits command and configuration details to these equipment and they send the captured data (speed, volume, classification, occupancy, 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.

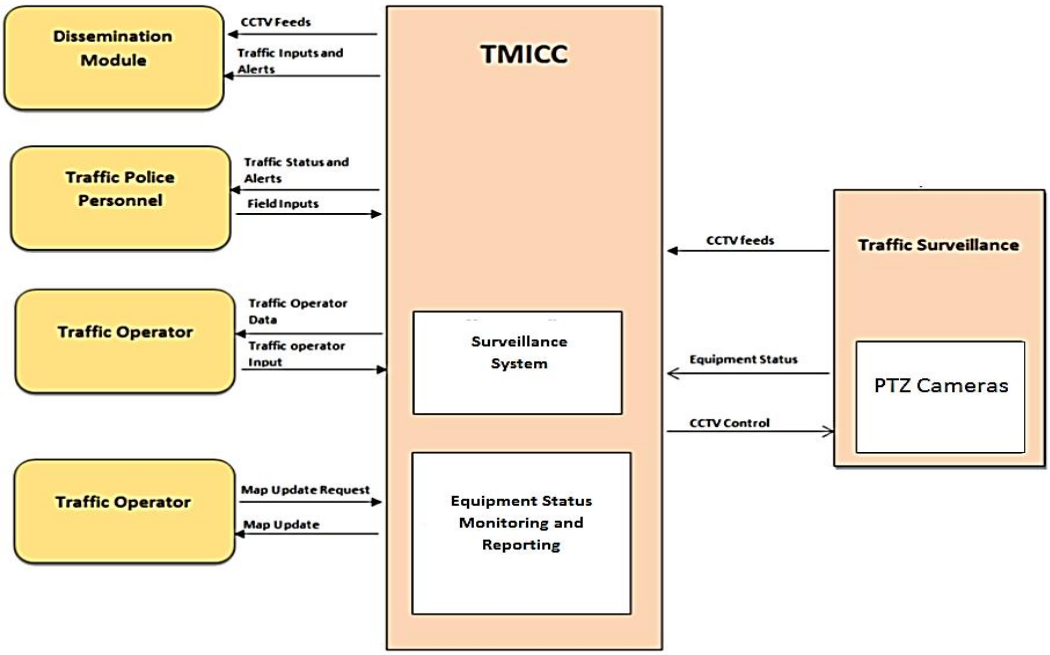

Figure 4-4: Road Network Surveillance

4.7.4 Interfaces with other Agencies

A. Interface 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 the various dissemination channels of TMICC.

B. Interfaces with Transit Agencies

TMICC shall interface with and collect data from the Transit agencies' systems such as AMTS, AJL and MEGA (when implemented). As AMTS and AJL have their fleet with GPS, speed data on various road sections could be collected from them. 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 website, helpline, mobile app, etc. would include:

- Information regarding 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, the 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 Ahmedabad. This information would be disseminated through dissemination channels of the TMICC.

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 dissemination channels of the TMICC. 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.

The information could be disseminated through various channels: website, mobile app, social network, variable message signs, helpline and NUTH.

Traffic Information Dissemination System comprises elements that are used by TMICC for dissemination of traffic related information and includes variable message signs, fixed format displays, blinkers, helpline, NUTH etc.

Ahmedabad TMICC shall focus on managing roadway traffic movement and collect traffic related data. The NUTH, as and when it is implemented, would interface with transit agencies for collecting and processing the transit related data from Ahmedabad BRTS, AMTS buses and Metro (when implemented). In addition NUTH would also interface with Ahmedabad TMICC for collecting the traffic related data available with TMICC.

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).

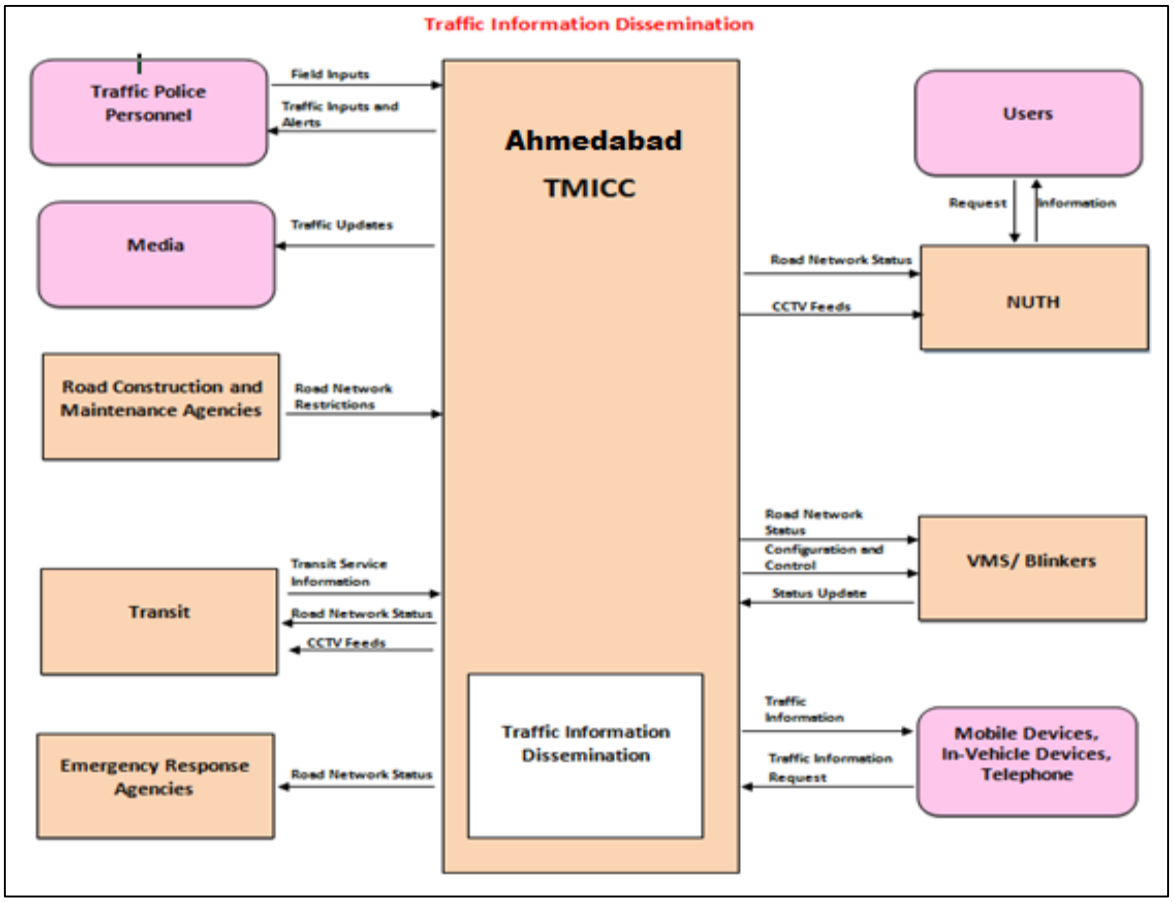

Figure 4-5: Traffic Information Dissemination

Details of some of the key traffic related information and dissemination channels that would be used for their dissemination are listed below:

4.7.5.1 Information Dissemination

A. Congestion

Road network congestion is an important piece of information that is taken into consideration by travellers while planning their travel. This information could be provided either on the variable message signs or through a map on website or mobile app with suitable colour coding indicating various speed ranges or through phone helpline where speed details could be provided for the selected road segments (Figure 4-6).

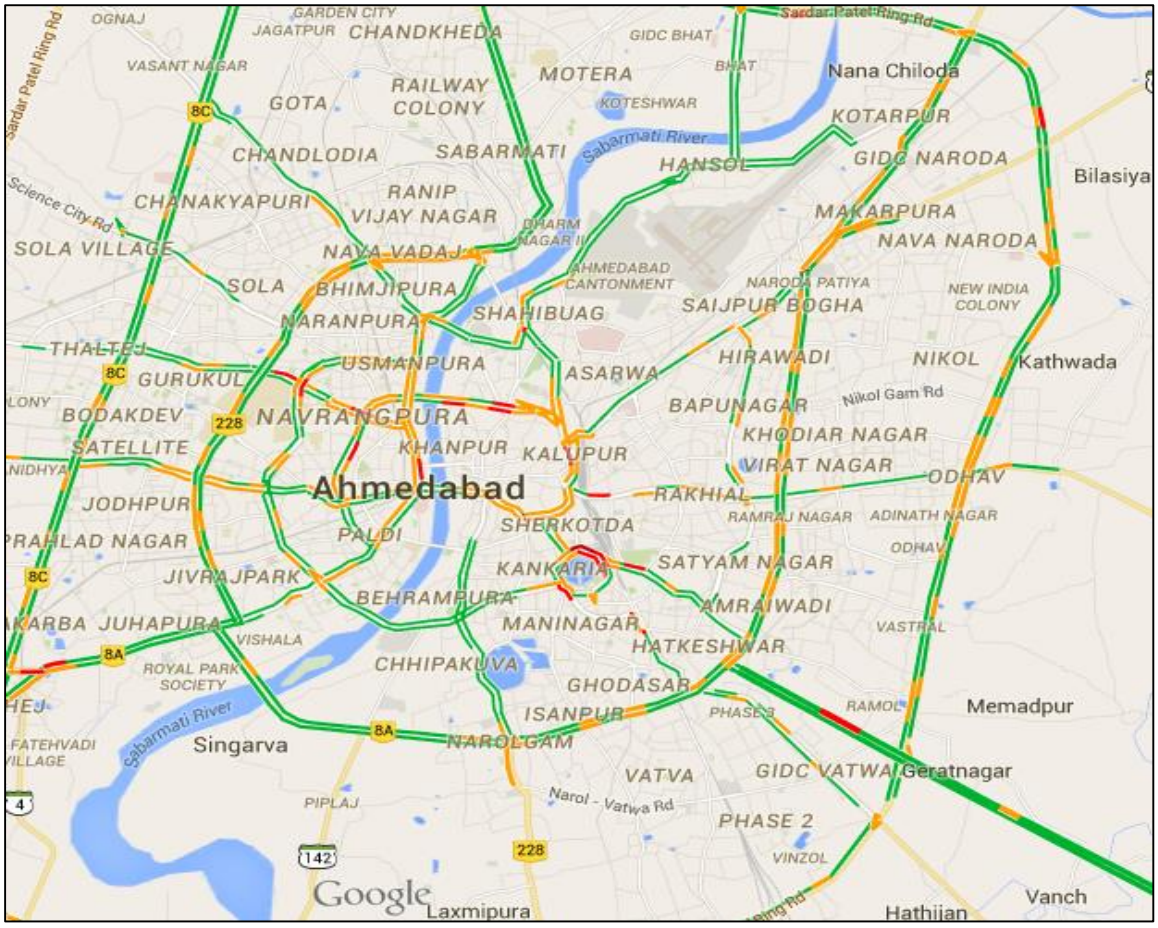

Figure 4-6: Example of Congestion Map

B. Incidents

Incidents information is one of the most important elements of traffic related 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. The information that could be provided to travellers in relation to the incidents is as below:

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

Information could be provided for various incidents / events as below:

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

Information in respect of planned events could be provided in the form of calendar so that travel planning for future could take these into account.

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

C. Construction / Maintenance Activities

Construction and maintenance activities also affect road network capacity or even access to the network. The information that could be provided to travellers in relation to construction and maintenance activities is as below:

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

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

In order to get such data, interfaces must be built by TMICC with the systems of the agencies such as AMC, AUDA and Roads and Building Department 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. The Figure 4-7 is an example showing construction/incident locations displayed on the map using different icons.

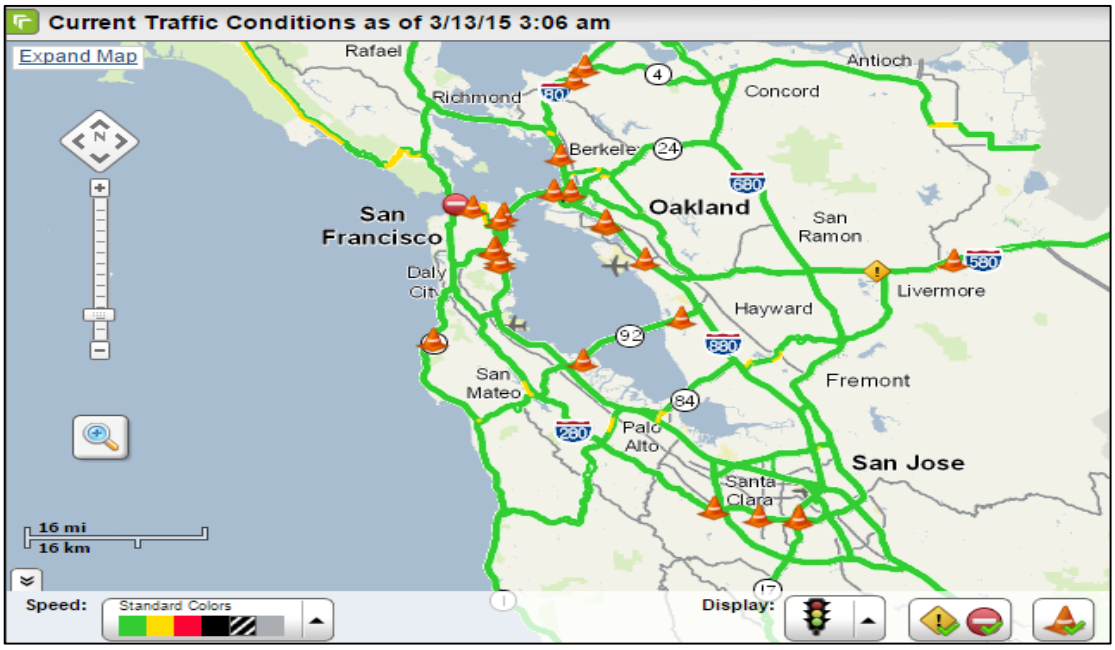

Figure 4-7: Map showing Construction/Incident Locations[15]

D. Parking Information

Parking information may also be disseminated 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
- Update on facility closure, construction and maintenance

The above details could be provided on a map as well as in tabular/other suitable form. In order to get such data, interfaces must be built with the systems of the parking facilities (Figure 4-8).

[15] Source: San Francisco Bay, 511 SF Bay (www.511.org)

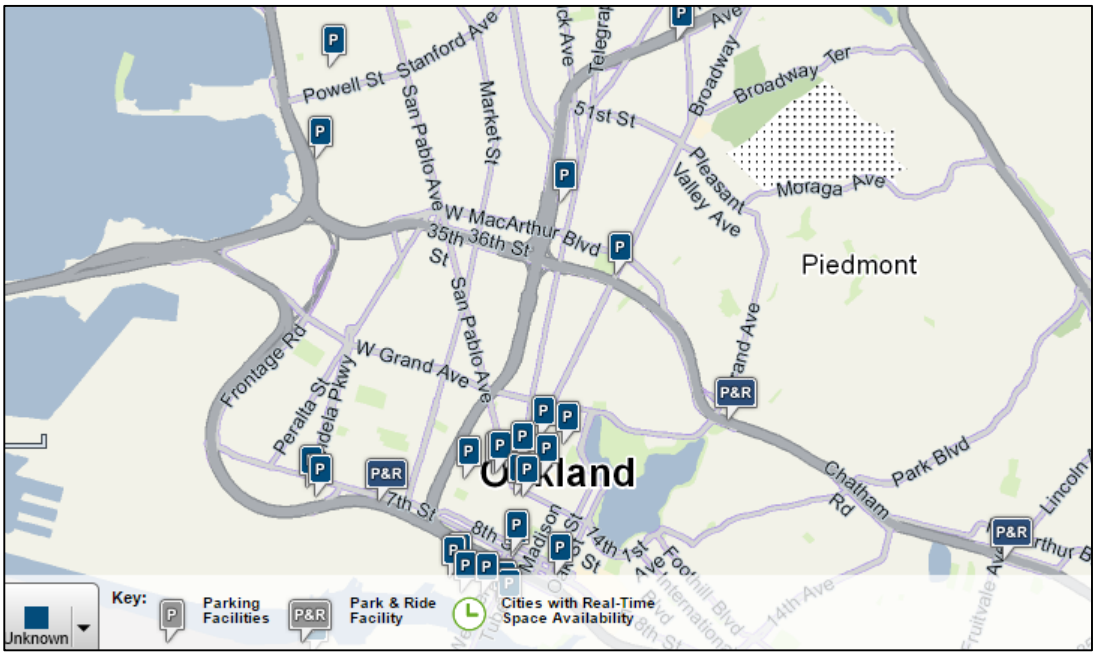

Figure 4-8: Parking Information on Map

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

E. Weather

Weather information such as wind speed, temperature, visibility, fog, rain etc. which may affect travel shall be provided. In order to get such data, interfaces shall be built with the Regional Meteorological Centre, Ahmedabad.

4.7.5.2 Information Dissemination Channels

A. Website

As websites have emerged as a popular channel for accessing information, the TMICC could develop its own website, use existing police website or rely upon NUTH website (as and when it is set up) for dissemination of information in the most appropriate form and manner.

The website could also have capability to provide personalised version of the web pages displaying content based on user preferences. Alerts through automatic e-mails could also be provided to those subscribing for the same. The traffic web page for San Francisco Bay Area has been provided as Figure 4-9:

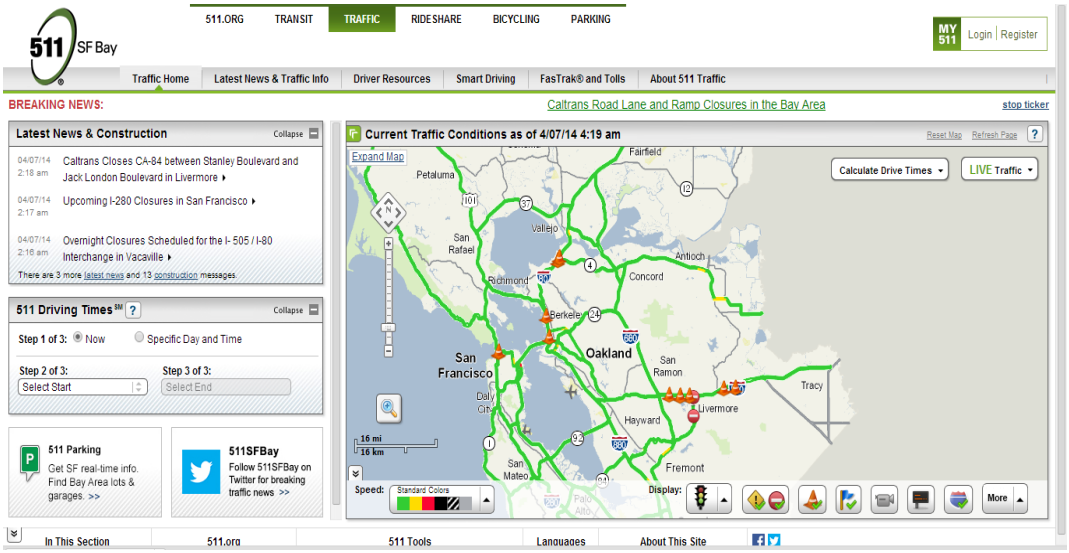

Figure 4-9: San Francisco Bay Area Traffic Web Page

B. Mobile Phone Application

Considering the wide adoption of mobile devices, it is important that the traffic information is also made accessible from such devices. Mobile apps have become quite popular as these provide user interfaces that support easy access of information on the mobile devices. There are various types and sizes of mobile devices in the market working on different Operating Systems (OS) such as iOS, Android, Windows; hence mobile app would need to be developed to support the desired device OS/ device sizes. Screen shots from Delhi Traffic Mobile App (Figure 4-10) are provided for reference.

Figure 4-10: Traffic Mobile App (Delhi Traffic Police)

The mobile apps are an area where public-private partnerships could be beneficial. Ahmedabad TMICC implementing agency can share the data and information collected with the third party software developers and/or Value Added Service (VAS) providers to allow the open market to provide useful information to the public. The data could be shared in an open-data format so that it could be used by multiple agencies/information service providers. An agreement may be executed with the third party software developers /VAS providers in a desired form which sets out the terms and conditions for providing the data. This may be provided free of charge, with restricted use for the information and data and an option to charge for data in future with notice.

C. Social Media

Social media (Facebook, Twitter etc.) should also be used by Ahmedabad TMICC as an information dissemination channel for certain types of information such as traffic updates, alerts, events, road diversions/closures, incidents, accidents etc.

D. Phone Helpline

Phone helpline should also be used by Ahmedabad TMICC as a traffic information dissemination channel.

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 query, 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 Ahmedabad 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. Ahmedabad 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.

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.

TMICC should 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 Ahmedabad TMICC should also have a software module to compute energy savings that have accrued owing to 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 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 the 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 Message Signs (VMSs).

A more in-depth discussion on the Standards and Protocols has been undertaken in Chapter 3.0 and Chapter 5.0 of the TMICC Generic Operation Document. Readers are advised to go through these chapters for further information. Some applicable standards to TMICC are given at the end of this report in Annexure 3 as a reference.

4.10 System Requirements

System requirements have been provided for Traffic Signal Control system, Road Network Surveillance system, Interface with Traffic Enforcement system and Traffic Information Dissemination system. It is important to select the technology that supports multiple standards so that system can be upgraded to latest technology in future. 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 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 signalized 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.

- TMICC shall provide inputs for junction design and carry out traffic flow analysis.
- 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 Ahmedabad 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 the following ways:

i. Isolated Fixed Time Controller based Signalling:

- The signals work in isolated mode and are not connected to the control room.
- Isolated Traffic Controllers are each stored with multiple signal timing plans to work on Time of Day (ToD) basis. These plans are loaded by the TMICC personnel.
- Any changes in the signal timing plans or parameters require visit by the TMICC personnel to the junction and to carry out changes in the controller.
- Traffic Police personnel generally visit and access the controller panel for manual operations (Figure 4-11).
- Junction status/Health status (Current operational status) can be known only upon visit to controller panel.

Figure 4-11: Isolated Fixed Time Controller Based Signalling

ii. Fixed Time Controller with Control Room Connectivity based Signalling:

- The signals in this case are connected to the control room (Figure 4-12).
- 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.

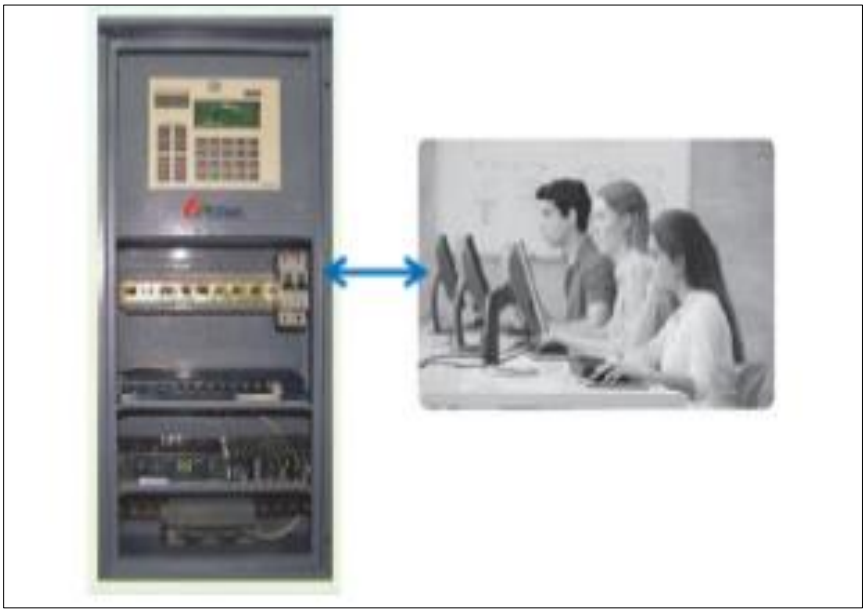

Figure 4-12: Fixed Time Controller with Control Room Connectivity Based Signalling

iii. Adaptive Signalling System:

- 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 (Figure 4-13).

- 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.

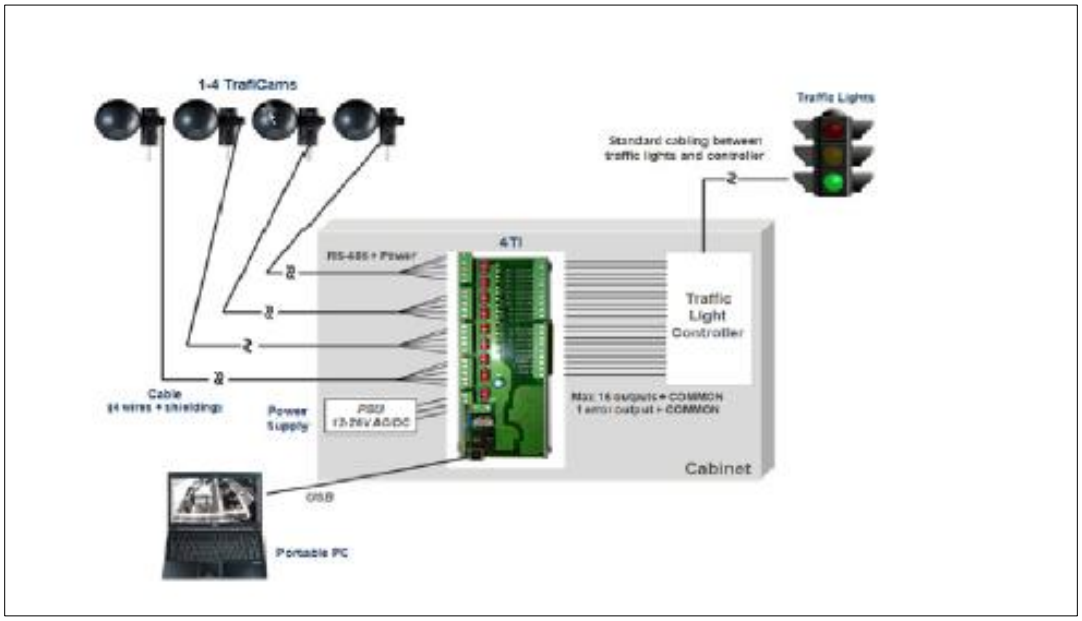

Figure 4-13: Adaptive Signalling System

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 provided 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	Fixed signal timing plan	Comparatively 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

It is recommended that the traffic signals in the city be upgraded to suitable and reliable adaptive signaling system which is also being contemplated by the city. As a part of this, vehicle detection cameras would be installed at junctions and the signals would work on the adaptive mode and dynamically adjust the signal timing based on traffic conditions.

4.10.2 Road Network Surveillance

The TMICC would have the following capabilities 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 traffic data such as traffic volume, speed, occupancy from the field equipment connected to the TMICC.
- TMICC shall receive, process and store 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 disseminate the road network status based on processing of detector and CCTV surveillance data.

- 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 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

The TMICC would have the following capability with respect to 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 formats.
- 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

Ahmedabad 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, 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 disseminate traffic information using multiple channels: website, social media, mobile apps, phone helpline.
- TMICC shall make use of the road network characteristic, traffic data, weather conditions, traffic restrictions, incident details, 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. Such information would include but not be limited to average speed, incident/construction/event ahead, road closure, alternate routes, weather information etc. VMS 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 has no other devices to collect the information. VMS is generally deployed for the following reasons:

- To provide en-route road users with information of road, traffic and weather conditions on major roads.
- To divert drivers to alternate routes from the congested routes.
- To provide information to every road user without any need for user to have specific devices.

VMSs are typically installed at following strategic locations:

- 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 TMICC IMPLEMENTATION, OPERATION AND MAINTENANCE

5.1 TMICC Implementation Process

Figure 5-1 outlines the steps involved during the TMICC development process. In line with the international best practices, it is recommended that Ahmedabad city adopts Systems Engineering approach towards system design and implementation as detailed in the TMICC Generic Operations Document already prepared.

TMICC implementation process would broadly include Concept Development phase (2-3 months); Systems Engineering Management Plan (2-4 months); Detailed Project Report (2-4 months); Detailed Agreement between Stakeholders and Preparation of Tender Document (2 months); Bid Process Management (3 months) and Project Implementation, Monitoring and Management (6-12 months).

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

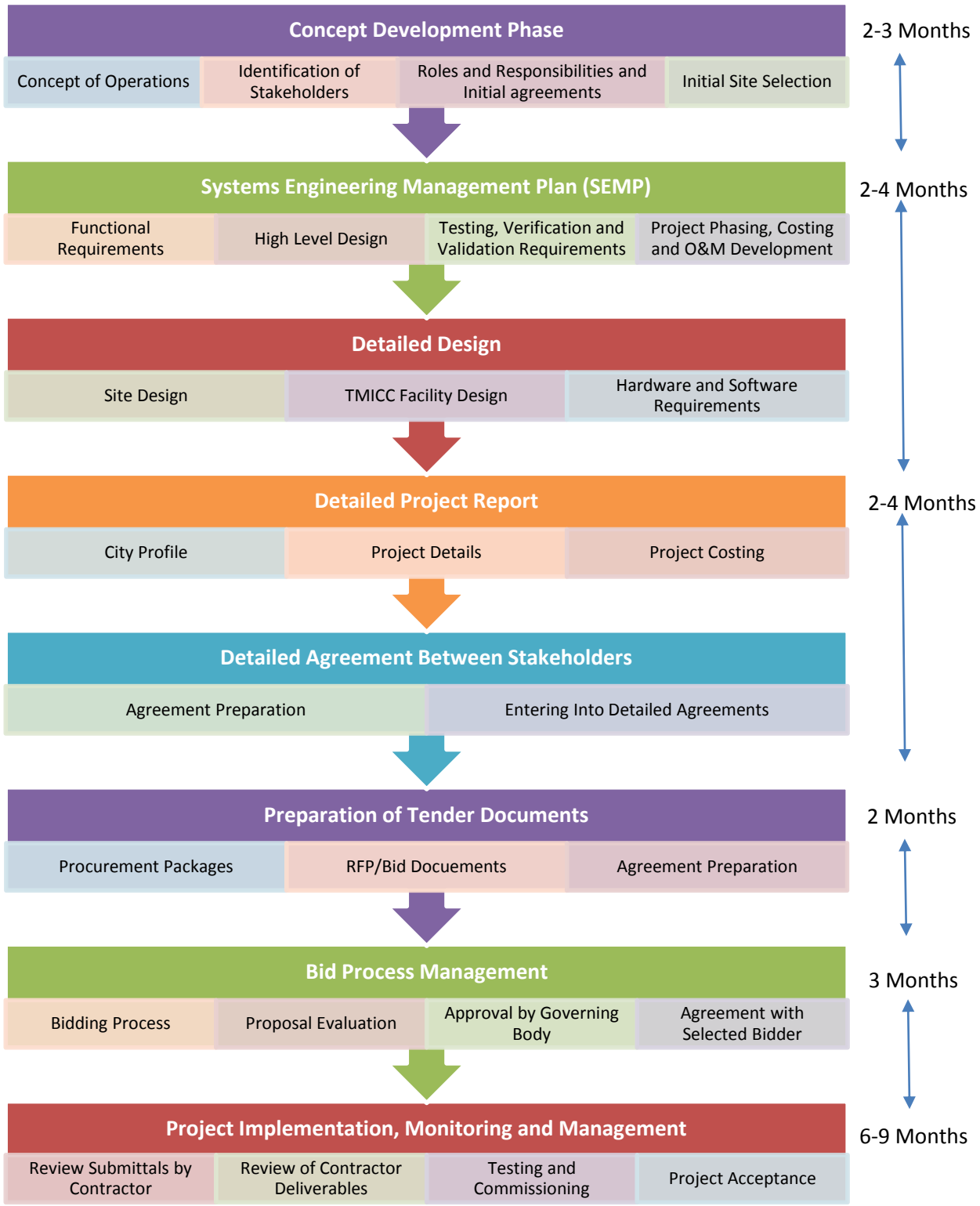

Figure 5-1: TMICC Implementation Process and Estimated Time Schedule

5.1.1 Development of City Specific Concept of Operations Report

City Specific Concept Report or Concept of Operations should cover the following aspects taking into account the city specific issues and requirements:

- TMICC Concept Plan covering:
  - Review existing traffic related ITS facilities in the city
  - Identification of TMICC needs for the city based on data analysis
  - Drawing up a city/State wide ITS plan
  - Identification of stakeholders
  - Drawing up of implementation role of various stakeholders
  - Identification of ITS application and TMICC system design to support the applications
  - Plan for administration and management of the system
  - Broad costing for setting up of the TMICC – upfront and ongoing
  - Sources of revenue, if any

- Site selection and preliminary design of TMICC facility

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

The city authority and the consultant engaged by the authority may refer to the TMICC Generic Operations Document and city specific plan, published by SUTP/MoUD while preparing city specific concept report.

5.1.2 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 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 to in the SEMP)
  - Interface Management and Control Plan
  - System Integration Plan
  - System, Subsystem and Components Verification Plan
  - Hardware and Software Development Plans

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

- Relevant project documents

5.1.3 Detailed Design

The detailed design would cover the following for the TMICC:

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

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

5.1.4 Detailed Project Report

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

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

5.1.5 Detailed Agreements between Stakeholders

Ahmedabad Municipal Corporation (AMC), as implementing agency for TMICC, needs to establish suitable arrangements with various stakeholders in order to seek their participation in TMICC and towards sharing requisite information.

Ahmedabad City Traffic Police, through Chief Secretary, GoG, may issue necessary directions to other departments of the GoG or agencies where GoG has control such as AMC, AUDA, AMTS, GSRTC, for participating in the TMICC and/or sharing requisite information.

Ahmedabad City Traffic Police, through Chief Secretary, GoG, may establish suitable arrangements with departments or agencies of GoI (Western Railway). As required, suitable agreements and/or MoUs could be entered into in this behalf, a sample of which is provided as Annexure 2.

5.1.6 Preparation of Tender Documents

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

- Parceling of work packages.
- Preparation of bid documents, setting out the scope of work, qualification and evaluation criteria of proposals in consultation with the Ahmedabad TMICC implementing agency. 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.
- Preparation of bid documents for construction work
- Preparation of agreements for various procurements in consultation with the Ahmedabad TMICC 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.

5.1.7 Bid Process Management

The various tasks involved during the bid process management 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 “Financial Proposal”.

5.1.8 Project Implementation, Monitoring and Management

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

- Finalisation of Functional Requirements and System Requirements 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 payments to contractors.
- Final project review and preparation of “punch list” (deficiency list).
- Review and acceptance of all corrective measures.
- Testing and commissioning of the system components.
- Final testing, verification and validation acceptance.
- Final Project Acceptance.

5.2 Operations and Maintenance

5.2.1 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.

5.2.2 TMICC Backend

The TMICC backend system would consist of the following:

A. **Hardware:** Backend hardware would comprise servers, switches, 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, office suites, 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 application 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.

5.3 Standard Operating Procedures Outline

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

- Jurisdiction of the TMICC 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 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.

5.4 Obsolescence Management

Obsolescence of the systems deployed at Ahmedabad TMICC 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 Ahmedabad TMICC 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, its projected phase-out, ecosystem to support the same (suppliers, support agencies etc.).
- Incorporating contractual provisions placing obligation on the contractors to ensure continued support over the expected life of the equipment.
- Requiring contractors contractually to ensure availability of spares over the expected life of equipment.
- As a part of procurement, requiring the bidders to obtain undertaking from the Original Equipment Manufacturer (OEM) to ensure continued support and availability of spares over the expected life of equipment.
- Plan phasing out of the system in advance based on discussions with the OEM of the system regarding their time frame to phase out the system/technology.

5.5 Retirement and Replacement

The Ahmedabad TMICC 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.

6.0 AHMEDABAD TMICC: STAKEHOLDERS AND ORGANISATION

6.1 Introduction

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

6.2 Role of Various Levels of Governments in Transportation

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

Table 6-1: Ahmedabad: Government and Govt. 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 various funding schemes.
State Government	Department of Port and Transport, Gujarat	• Department of GoG. • Transport Department of GoG is entrusted with the responsibility of providing an efficient public transport system, control of vehicular pollution, registration of vehicles in Gujarat, issuance of driving licences, issuance of various permits, and collection of road taxes. • The Transport Department is also entrusted with policy-making, co-ordination, implementation, monitoring and regulatory functions of road transport related aspects in Gujarat.
	Urban Development and Urban Housing Department, Gujarat	• Department of GoG. • The Department makes policy decisions in the matters related to urban development and urban housing and also monitors their implementation, issues guidance and orders related to urban development and urban housing. • Town Planning & Valuation Department, the Director of Municipalities, Gujarat Municipal

Govt. Level	Entity	Description and Roles in Transportation
		Finance Board, Gujarat Housing Board, Gujarat Urban Development Company Ltd etc. are working under the Urban Development & Urban Housing Department in the State.
	Gujarat State Road Transport Corporation (GSRTC)	• Statutory corporation established under the provisions of Road Transport Corporation Act, 1950. • Provides Bus services in Gujarat. • Licenses parking facilities at its terminals and nearby areas.
	Gujarat Police	• Manages and regulates traffic in Ahmedabad. • Traffic rules enforcement.
	Roads and Buildings Department, Gujarat	• Department of GoG. • Planning, construction and maintenance of roads and all Government owned buildings in Gujarat.
SPV	Ahmedabad Janmarg Ltd	• Company incorporated by Ahmedabad Municipal Corporation (AMC). • Implemented and is operating the BRTS in Ahmedabad.
Joint Venture	Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd	• Joint Venture of Government of India and Government of Gujarat. • Implementing mass-transit rail system for Gandhinagar and Ahmedabad.
Local Government	Ahmedabad Municipal Corporation (AMC)	• Established under The Bombay Provincial Act, 1949 • Construction & maintenance of roads • Street lighting • Public transport • Parks and gardens.
	Ahmedabad Urban Development Authority (AUDA)	• Established under The Gujarat Town Planning and Urban Development Act, 1976. • Physical plan for development of urban area. • Town Planning Scheme (TP Scheme) for detailed planning (Micro Level Planning) • Providing roads and other infrastructure facility.

Govt. Level	Entity	Description and Roles in Transportation
	Ahmedabad Municipal Transport Services (AMTS)	• Under the control of Ahmedabad Municipal Corporation (AMC). • Operates bus services in Ahmedabad.

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

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

Area	Entities	Jurisdiction
Traffic	Ahmedabad City Traffic Police	Ahmedabad
	Ahmedabad Municipal Corporation (AMC)	AMC area
Transit	Ahmedabad Municipal Transport Service (AMTS)	Ahmedabad
	Ahmedabad Janmarg Ltd (AJL)	Ahmedabad BRTS Corridor
	Gujarat Road Transport Corporation (GSRTC)	Gujarat
	Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd	Greater Ahmedabad Development Area
Roads	Ahmedabad Municipal Corporation (AMC)	AMC area
	Ahmedabad Urban Development Authority (AUDA)	Ahmedabad excluding area under AMC
	Roads and Building (R&B) Department	Gujarat
Parking	Ahmedabad Municipal Corporation (AMC)	AMC area
	Ahmedabad Urban Development Authority (AUDA)	AUDA area
	Gujarat State Road Transport Corporation (GSRTC)	Gujarat
Bus Terminals	Ahmedabad Municipal Transport Service (AMTS)	Ahmedabad
	Ahmedabad Janmarg Ltd (AJL)	Ahmedabad BRTS
	Gujarat State Road Transport Corporation (GSRTC)	Gujarat

6.3 Institutional Set Up

6.3.1 Implementing Agency

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

Table 6-3: Options for Ahmedabad TMICC Implementing Agency

Option	Implementing Agency	Existing Role	Proposed Roles and Responsibilities
1	Ahmedabad Municipal Corporation (AMC)	• Responsible for installing and maintaining traffic control equipment • Has established traffic control room[16] for monitoring of traffic signals and other equipment	• To install and maintain traffic control equipment • To implement and operate TMICC • To operate the traffic signals including undertaking any changes in signal phasing and timing in coordination with Traffic Police, as needed • Traffic enforcement to continue to remain with Traffic Police
2	Ahmedabad City Traffic Police (ACTP)	• Responsible for operating the traffic signals including proposing any changes in signal phasing and timing • Informs AMC for making any changes in the traffic signals phasing and timing and AMC in turn takes necessary action • Traffic police can also change the signals phasing and timing at the field as they have access to the signal controllers	• To install and maintain traffic control equipment • To implement and operate TMICC • To operate the traffic signals including undertaking any changes in signal phasing and timing in coordination with AMC, as needed • Traffic enforcement
3	Ahmedabad Municipal Corporation (AMC) +		**AMC** • To install and maintain traffic control equipment • To implement and operate

[16] Small-scale Traffic Control Centre at Victoria Garden (area approx. 600 sq. ft.), presently monitoring and controlling three signalised junctions

Option	Implementing Agency	Existing Role	Proposed Roles and Responsibilities
	Ahmedabad City Traffic Police (ACTP)		TMICC **Traffic Police** • To operate the traffic signals including undertaking any changes in signal phasing and timing in coordination with AMC, as needed • Traffic enforcement • Deploy personnel at TMICC

As AMC has already set-up and is operating the traffic control room, it is recommended that AMC be entrusted with the responsibility of setting up and operating the Ahmedabad TMICC. It is recommended that the existing traffic control room of AMC being managed by DIMTS be upgraded to Ahmedabad TMICC facility. In addition, as the space requirement for the TMICC would be large as compared to the size of the current control room, it is recommended that the TMICC be set up at a new location and the systems currently being operated from the existing traffic control room be shifted to the TMICC. It is also recommended that the required Traffic Police personnel are also co-located at the TMICC to ensure effective coordination between AMC and Traffic Police.

6.3.2 Stakeholders, Roles and Responsibilities

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

Table 6-4: Roles and Responsibilities

Area	Entities	Roles and Responsibilities
Traffic Management	Ahmedabad City Traffic Police	• To deploy its personnel at TMICC • To share data and updates as listed in Section 6.3.3
	Ahmedabad Municipal Corporation (AMC)	• To set up, operate and maintain TMICC • To enter into agreements/MoUs with various agencies associated with TMICC, as needed (Draft of MoU is provided in Annexure 2) • To coordinate with various agencies associated with TMICC • To undertake installation and

Area	Entities	Roles and Responsibilities
		maintenance of signals and other traffic equipment • To share data and updates as listed in Section 6.3.3
Transit	• Ahmedabad Municipal Transport Service (AMTS) • Ahmedabad Janmarg Ltd (AJL) • Gujarat Road Transport Corporation (GSRTC) • MetroLink Express for Gandhinagar and Ahmedabad (MEGA)	• To manage and monitor their respective transit operation • To share data and updates as listed in Section 6.3.3
Roads	• Ahmedabad Municipal Corporation (AMC) • Ahmedabad Urban Development Authority (AUDA) • Roads and Building Department, Gujarat	• Road construction and maintenance • Managing the contracts and relationships with the contractors responsible for construction & 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 6.3.3
Parking	• Ahmedabad Municipal Corporation (AMC) • Ahmedabad Urban Development Authority (AUDA) • Gujarat State Road Transport Corporation (GSRTC) • Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd • Western Railways, (Indian Railways)	• Manage the parking facility • To provide right of way on its roads/area for installation of traffic equipment • To provide agreed data / information in desired form and frequency as listed in Section 6.3.3
Bus Terminals	• Ahmedabad Municipal Transport Service (AMTS)	• Manage the Terminals • To provide right of way for

Area	Entities	Roles and Responsibilities
	• Ahmedabad Janmarg Ltd (AJL) • Gujarat State Road Transport Corporation (GSRTC)	installation of traffic equipment • To provide agreed data / information in desired form and frequency as listed in Section 6.3.3
Emergency Response	• Ahmedabad Municipal Corporation (AMC) • Ahmedabad Police • Gujarat State Disaster Management Authority	• To provide agreed data / information in desired form and frequency as listed in Section 6.3.3
Weather	• Regional Meteorological Centre, Ahmedabad	• To provide agreed data / information in desired form and frequency as listed in Section 6.3.3

6.3.3 Data Sharing by Project Stakeholders

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

Table 6-5 below provides the details of the data sharing by transit agencies for the TMICC.

Table 6-5: Entities Sharing Transit Data with TMICC

Transit Related Data	AMTS	AJL	MEGA*
GPS probe data	Y	Y	-
Incidents & Events	Y	Y	Y

* When it becomes operational

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

Table 6-6: Entities Sharing Traffic Data with TMICC

Traffic Related Data AMC	Ahmedabad City Traffic Police	AMC	Road Owning Agencies (AUDA)
Road attributes: name, number of lanes, width, whether one-	Y	Y	Y

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

Table 6-7 below provides the details of the data sharing by parking related agencies for the TMICC.

Table 6-7: Entities Sharing Parking Data with TMICC

Entities	Data Sharing
• Ahmedabad Municipal Corporation (AMC) • Ahmedabad Urban Development Authority (AUDA) • Gujarat State Road Transport Corporation (GSRTC) • Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd • Western Railways (Indian Railways)	Parking Facility Details • Capacity • Availability (real-time if available) • Type of vehicles that can be parked • Operational hours • Parking charges • Mode of payment • Operating agency • Contact details

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

Table 6-8: Other Entities Sharing Data with TMICC

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

6.3.4 Organisation

Organisational structure of the TMICC would directly impact its ability to operate effectively. Figure 6-1 shows the suggested organisation for Ahmedabad TMICC.

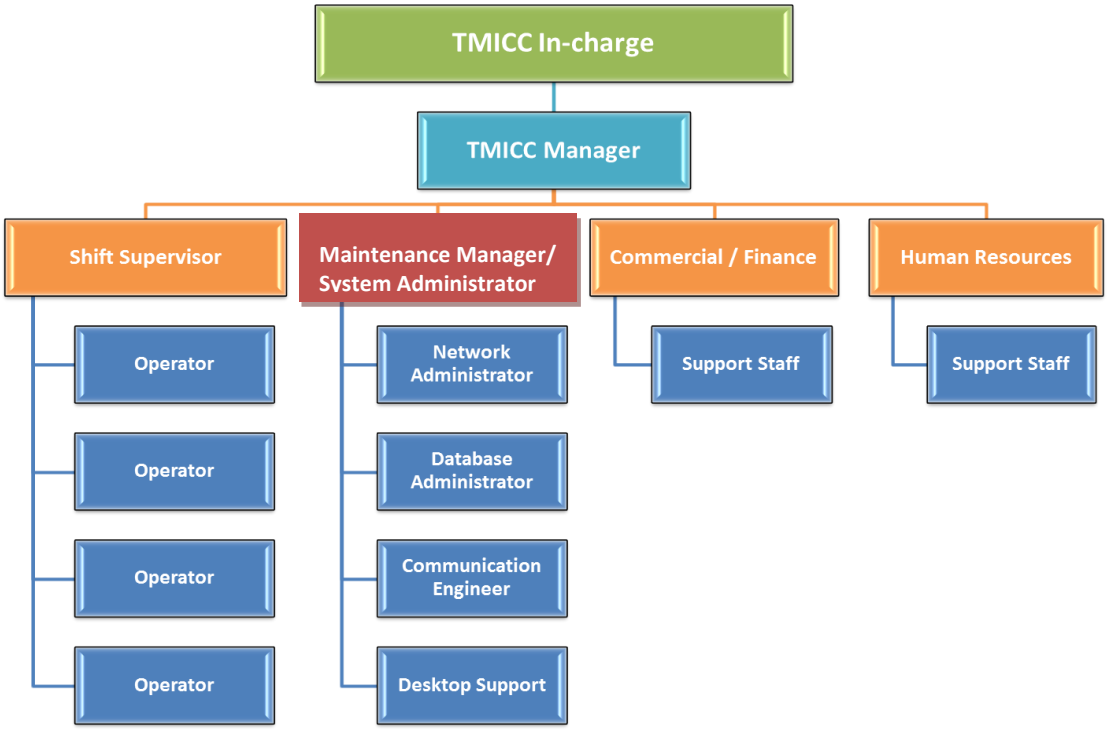

Figure 6-1: Typical TMICC Organisational Structure

Since the TMICC is a 24x7 operations centre, its staffing would vary across peak and off-peak hours. In the off-peak hours (especially night shift), the staffing could be reduced substantially since the traffic intensity would be low. While it would be

impractical to have prescriptive ratio of personnel in peak-to-off peak, in order to enable such reduction in manpower, the control room application should be flexible to allow for varying the elements being monitored by each operator console.

Table 6-9 provides the details of key positions in the Ahmedabad TMICC organisation together with associated role description.

Table 6-9: TMICC: Typical Positions and Role Description

Positions	Role Description
TMICC In-Charge	• Responsible for overall management, monitoring and operation of the TMICC • Should ideally be a Traffic Engineer with an additional degree in Management • Formulation of procedures governing TMICC operations • Point of contact for authorities, media and other external agencies
TMICC Manager	• Reports to the TMICC In-Charge • Should be a Traffic Engineer • Responsible for day to day operation of the TMICC • Responsible for assigning and deployment of the operators in shifts • Coordinates with field and data centre team • Provide support and inputs during procurement of TMICC equipment, their location and specifications of VMS, CCTV equipment • Creation and updating of signal plans • Preparing route diversion plans • Plans for scheduled maintenance of the field and back office system components in coordination with suppliers, shift supervisor and the system administrator • Monitoring and analysing the traffic volume and conditions • Training and guidance of shift supervisors
Shift Supervisor	• Reports to the TMICC Manager • Should be a Traffic Engineer • Responsible for day to day operation of the TMICC • Responsible for supervision of the operators deployed during the shift • Coordinates with field and data centre team • Creation and updating of signal plans • Preparing route diversion plans • Plans for scheduled maintenance of the field and back office system components in coordination with suppliers, TMICC Manager and the system administrator • Monitoring and analysing the traffic volume and conditions

Positions	Role Description
	• Training of operators

Operator	• Reports to the Shift Supervisor
	• Operates and manages the system through operator console
	• Configures and controls field devices
	• Reports any down time in the field devices and the backend system. Separate operators would need to be deployed for monitoring and managing various ITS sub-systems as below:
	  ○ Signalling system
	  ○ CCTV surveillance system
	  ○ Variable message signs
	• Coordinates with other agencies which are part of workflow being managed by the operator
	• Shares information with and report events to the agencies/ entities concerned according to the policies and procedures
	• Data analytics

System Administrator (also responsible for routine maintenance of the backend systems)	• Reports to the TMICC Manager • Responsible to manage the data centre and associated IT environment such as network, communication, security, firewall, desktop support etc. • To monitor and supervise the team comprising network administrator, database administrator, desktop support personnel, communication engineer etc. • Responsible to configure the computing and other IT system • To implement policy giving role based access to various personnel to the IT systems • To manage and monitor security of the IT systems • Coordinates with vendors and suppliers for maintenance and support of the hardware and software deployed in TMICC
Commercial / Finance Manager	• Contract management • Invoicing and payments
Human Resources Manager	• Recruitment • Training • General administration and facilities maintenance

Table 6-10 contains typical profile of the personnel deployed at the TMICC.

Table 6-10: TMICC: Typical Profile of Deployed Personnel

S. No.	Designation / Specialisation	Background / Experience
1	TMICC In-charge	Traffic Engineer with an additional degree in Management with relevant experience of at least 10 years
2	TMICC 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	MCA or Post Graduate in IT or Electronics Engineering with relevant experience of at least 7 years
5	Database Administrator	MCA or Post Graduate in Computer Engineering with relevant experience of at least 7 years
6	Communication Engineer	MCA or Post Graduate in IT/Electronics Engineering with relevant experience of at least 7 years
7	Shift Supervisor	Graduate in any discipline having relevant experience of at least 8 years
8	Desktop Support	Graduate in any discipline with relevant experience of at least 5 years
9	Operator	Graduate in any discipline with relevant experience of at least 5 years
10	Human Resource Manager	Post Graduate in any discipline with relevant experience of at least 8 years
11	Commercial / Finance Manager	CA or Post Graduate in Commerce/Accounting with relevant experience of at least 10 years

The above recommended profile is for guidance purposes only and may be refined based on local manpower availability and skill sets best suited for the proposed Ahmedabad TMICC.

6.3.5 Training and Capacity Building

There would be a need for training initially in the areas of planning and designing of the Ahmedabad TMICC, and later, progressively, in the areas of operating and managing the same. The personnel to be trained and the topics to be covered during the training would be as set out in Table 6-11:

Table 6-11: Coverage of Training

Positions	Coverage of Training
City Managers	• Background of TMICC and purpose of the system
TMICC In-Charge	• Background of TMICC and purpose of the system • Operational procedures • Non-standard operations (special events, emergency conditions) • Use of the TMICC Backend Applications • Capabilities of the field equipment • Contract Management • Financial Management
TMICC Manager	• Background of TMICC and purpose of the system • Operational procedures • Non-standard operations (special events, emergency conditions) • Use of the TMICC Backend Applications • Capabilities of the field equipment • Equipment maintenance, testing, debugging, and repair • Contract Management
Shift Supervisor	• Background of TMICC and purpose of the system • Operational procedures • Non-standard operations (special events, emergency conditions) • Use of the TMICC Backend Applications • Traffic Control and Management • Traffic flow analysis
Operator	• Background of TMICC and purpose of the system • Operational procedures for the application assigned to the operator • Non-standard operations (special events, emergency conditions) for the application designated to the operator • Use of the TMICC Backend Application assigned to the operator • Field equipment installation and functioning • Traffic Control and Management • Traffic flow analysis • Data analytics
System Administrator	• System management training by OEM supplier(s) • Technical Service Level Agreement (SLA) Management

TMICC Generic Operations Document may be referred for further information regarding training.

7.0 PROJECT COST, REVENUE AND FUNDING STREAMS

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

7.1 Key Components of Ahmedabad TMICC

Ahmedabad city has 227 signalised junctions functioning under fixed time or manually controlled system. All these signals are proposed to be linked to and be controlled through the proposed TMICC. Considering the requirement of additional signalised junctions, a total of 270 junctions have been considered for the city. However, as the upgradation process for 186 junctions is currently underway, upgradation of remaining 84 junctions has been considered within the scope of project. As installation of PTZ cameras for junction/ specific locations surveillance is not within the scope of current upgradation process, the same has been proposed for all junctions/other key locations in the city. The table below (Table 7-1) details the current status and scope of future deployment. Details of other components and their costing have been provided in Section 7.2.

Table 7-1: TMICC - Scope for Deployment

S. No.	Components of TMICC	Current Status	Proposed System
1	Upgradation of signalised junctions – 270 Nos.	186 Nos. under upgradation process	84 Nos.
2	Control room connectivity	3 signalised junctions connected currently. Remaining are proposed to be covered progressively.	84 Nos.
3	Variable Message Signs (VMSs)	4 Nos.	17 Nos.
4	Vehicle detection cameras	--	336
5	PTZ cameras for junction surveillance	-	450
6	TMICC	600 sq. ft.	4000 sq. ft.

As the existing control room is proposed to be upgraded to TMICC, the signals and other field equipment connected with the TMICC would become part of the proposed TMICC. However, the signals that are currently outside of the purview of TMICC

would require upgradation. Subsequent to this, all the signals would be operated and managed by the TMICC. Accordingly, the cost estimates given below provide for only the incremental investment that would be needed. The operation and maintenance cost has, however, been provided for the complete set of equipment and not just for the incremental system.

7.2 TMICC Cost Estimates

TMICC cost would include the cost of Signalised Junctions Upgrade, Variable Message Signs (VMSs), Vehicle Detection Cameras, Control Centre Civil Works, Video wall, Operator consoles, Servers, TMICC Software Applications, Systems Engineering & Design, and Programme Management/System Integration.

The cost estimates provided below may vary depending upon the number and status/ condition of equipment in place at the time of project implementation. The estimated cost of Ahmedabad TMICC (considering only the incremental capital investment) is approximately **₹ 55.6 crores** and the estimated annual O&M cost (for the entire system and not just the incremental system) is approximately **₹ 17.9 crores** (Table 7-2). The project cost and sizing may undergo changes at the time of preparation of the Detailed Project Report.

Table 7-2: TMICC System Deployment and O&M Cost

S.No.	Items	Rate (Rs.)	UOM	Qty.	Amount (Rs.)
I	**Implementation Cost**				
A.	**Components Cost**				
1	Signalised Junctions Upgrade				
	ATCS compatible controller, LED Lamps, and Cabling etc.)	6,00,000	per Jn.	84	5,04,00,000
2	Variable Message Signs (VMSs) (VMS and Unipole Gantry etc.)	18,00,000	per unit	17	3,06,00,000
3	Vehicle Detection Cameras	1,50,000	per unit	336	5,04,00,000
4	PTZ Surveillance Camera (at Junctions and specific locations)	3,00,000	per unit	450	13,50,00,000
5	Control Centre including Civil Works	10,000	per sq. ft.	4,000	4,00,00,000
6	Video wall (3x3 Rear Projection)	75,00,000	per unit	4	3,00,00,000
7	Operator consoles	80,000	per unit	8	6,40,000
8	Computer Systems for TMICC staffs	70,000	per unit	14	9,80,000
9	Servers	4,00,000	per unit	6	24,00,000
10	TMICC Software Applications		L.S.	1	10,00,00,000

S.No.	Items	Rate (Rs.)	UOM	Qty.	Amount (Rs.)
	Sub Total – A				**44,04,20,000**
B.	**Project Design & Management Costs**				
1	Systems Engineering & Design	10%	of A		4,40,42,000
2	Programme/Construction Management, System Integration	15%	of A		6,60,63,000
3	Training and Capacity Building	1.25%	of A		55,05,250
	Sub Total – B				**11,56,10,250**
	GRAND TOTAL (A+B)				**55,60,30,250**
II	**O&M Cost (Annual)**				
1	Manpower Cost	15% of A	(refer Staffing Cost in Table 7-3)		1,76,40,000
2	Other Operations Cost (per annum) (including electricity, water, printing, communication, housekeeping, security, etc.)		residual of 15% of A		4,84,23,000
3	45 Mbps leased line for control room			1	11,00,000
4	2 Mbps leased line cost	1,50,000	per line	450	6,75,00,000
5	Maintenance Cost	10%	of A		4,40,42,000
	Total O&M Cost (per annum)				**17,87,05,000**

7.3 Staffing Cost

Indicative cost of staff to be deployed at the TMICC is provided in Table 7-3.

Table 7-3: Staffing Cost

S.No.	Personnel	Number	Shift	Cost/Month (Rs.)	Cost/Annum (Rs.)
1	TMICC In charge	1	1	85,000	10,20,000
2	TMICC/Traffic Manager	1	3	70,000	25,20,000
3	Maintenance Engineer/System	1	2	50,000	12,00,000

S.No.	Personnel	Number	Shift	Cost/Month (Rs.)	Cost/Annum (Rs.)
	Administrator				
4	Network Administrator	1	2	50,000	12,00,000
5	Communication Engineer	1	2		
6	Database Administrator	1	2	40,000	9,60,000
7	Desktop Support	1	2	30,000	7,20,000
8	Commercial	3	1	50,000	18,00,000
9	HR	2	1	50,000	12,00,000
10	Shift Supervisor	1	3	45,000	16,20,000
11	TMICC Operator	6	3	25,000	54,00,000
12	**Total Cost**				**1,76,40,000**

7.4 Summary of Financial Budget

Table 7-4 provides a summary of the recommended planning level budget for the Ahmedabad TMICC project.

Table 7-4: Overall Planning Level Budget for Ahmedabad TMICC Project

S.No.	Description	Implementation Cost (Rs.)	O&M Cost - Annual (Rs.)
1	TMICC	55,60,30,250	17,87,05,000

A budget of **₹ 55.6 crores** is required for Phase 1 implementation of Ahmedabad TMICC project. In addition, a budget of **₹ 17.9 crores** per annum would be required for operations and maintenance of the TMICC.

7.5 Revenue Streams

Ahmedabad TMICC 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 TMICCs. The data being collected may be shared by Ahmedabad TMICC with various entities (including the private sector) without any charges to begin with, 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 Ahmedabad TMICC are as under:

- Fines collected by the Traffic Police through the enforcement measures.
- Parking charges collected from users.
- Receipts from private entities for sharing data.
- Receipts from advertisers against grant of right to display advertisements on website, mobile, helpline apps providing information generated by TMICC.
- Receipts from 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 by the Traffic Police through enforcement measures may go down progressively as compliance to the traffic rules improves, which, in any case, is the end objective of implementing the enforcement measures.

7.6 Funding of Ahmedabad TMICC

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[17]/ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[18] 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 is critical as the project requires operational systems and functional teams to manage the O&M activities. The O&M cost of the TMICC may be borne by the AMC as is currently being done for the existing traffic control room.

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

7.7 Implementation Structure

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

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

8.0 RESOURCES, REFERENCES & CONTACT DETAILS

8.1 Resources & References

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

- Master Plan for Ahmedabad Metropolitan Area – 2025, Ahmedabad Metropolitan Development Authority (2009)
- National ITS Architecture 7.0, USA
- City Development Plan for Ahmedabad (2006)
- Comprehensive Mobility Plan for Ahmedabad (2008)
- Integrated Mobility Plan for Greater Ahmedabad Region (2011, AUDA)
- Study on Traffic & Transportation Policies and Strategies in Urban Areas in India (2008, MoUD)
- NUTH Operations Document, Ministry of Urban Development, Government of India (2016)
- 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)
- 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)
- http://www.globalgujarat.com/images/ahmedabad-district-profile.pdf
- rtoahmedabad-vahan.nic.in
- Ahmedabad City Traffic Police (http://ahmedabadcitypolice.org/services/traffic-police/)
- Traffic Management Plan for Ahmedabad, CEPT University

8.2 Contact Details

S.No.	Person	Agency and Designation	Contact details
1.	Mr. M. Thennarasan	Deputy Municipal Commissioner, Ahmedabad Municipal Corporation	thennarasan@egoamc.com
2.	Mr. M.D. Jani	D.C.P. (Traffic), Ahmedabad City Police	dcp-traffic-ahd@gujarat.gov.in

S.No.	Person	Agency and Designation	Contact details
3.	Ms. Rakhi Trivedi	Additional City Engineer, Ahmedabad Municipal Corporation	rjtrivedi@egoamc.com
4.	Mr. Deepak Trivedi	General Manager, Ahmedabad Janmarg Limited	dvtrivedi@gmail.com
5.	Mr. Miten Rathod	Assistant Manager, Ahmedabad Janmarg Limited	
6.	Mr. Jagdeep Asari	Deputy City Engineer, Ahmedabad Municipal Corporation	9328148879

Annexure 1(A): Minutes of Meeting with Stakeholders

SUTP PC1B2- 1st Meeting to Discuss TMICC Concept Report for Ahmedabad

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	22nd & 23rd January 2015
Subject	Meeting to discuss and present TMICC Concept for Ahmedabad		
Agency Contacted	• AMC office, Mahanagar Seva Sadan Sardar Patel Bhavan, Danapith Ahmedabad - 380001 • AJL office Sardar Patel Bhavan Danapith Ahmedabad - 380001 • DCP, Ahmedabad City Traffic Police office Navrangpura	DIMTS Official	Mr. Saumya Bhattacharya Mr. Praveen Singh

- Discussion points that were taken up during the meetings are listed below:

S.No.	Discussion
1	• Ahmedabad City Traffic Police enquired about the concept of the project. DIMTS explained to commissioner the whole concept of the project. • Ahmedabad City Traffic Police informed DIMTS about the safe city project which had been initiated and assigned to L&T. • DIMTS explained the importance of TMICC for the city and how it can be built upon the current ITS implementations in Ahmedabad. • Ms. Rakhi Trivedi of AMC enquired about the project and DIMTS explained the project concept and how it is important for the city. • Mr. Miten Rathod of AJL updated DIMTS about the current ITS initiatives taken up by the AJL. • Mr. Miten Rathod of AJL showed DIMTS team the control room of AJL and explained the functioning of AJL. • Ms. Rakhi Trivedi of AMC briefed about the signalling system and informed that there is a plan to connect all the signals to the traffic control room. Task has been assigned to DIMTS. At present, 3 junctions are connected with the traffic control room. • AMC officials showed DIMTS team the traffic control room and explained how monitoring of the signals is done from the traffic control room.

SUTP PC1B2- 2nd Meeting to Discuss TMICC Concept Report for Ahmedabad

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	26th July 2015
Subject	Meeting to discuss and present TMICC Concept for Ahmedabad		
Agency Contacted	Mr. D.N. Baranda Additional City Engineer Traffic Project -AMC	DIMTS Team	

- Discussion points that were taken up during the meetings are listed below:

S.No.	Discussion
1	Meeting was held with Additional City Engineer, Traffic Project-AMC, where the following were discussed: • Concepts of ITS, TMICC & NUTH • Initiatives of TMICC & NUTH in India and world over • Components of TMICC and NUTH • City Characteristics of Ahmedabad • Review of ITS initiatives in Ahmedabad • Project Description, Architecture, Elements and Benefits of TMICC & NUTH in Ahmedabad • Stakeholder Roles and Responsibilities, Organisation Structure of TMICC & NUTH • Implementation, Operations & Maintenance aspects • Project Cost, Revenues and Funding Streams

Annexure 1(B): Suggestions Received on Document from AMC

By e-mail dated 28th July 2015

	Key Areas	According to Report	Suggestions
	Project Concept	• It is recommended that the existing traffic control room of AMC being managed by DIMTS be upgraded to Ahmedabad TMICC facility. • It will require all signals in the city to be connected to the proposed TMICC. • As the space requirement for the TMICC would be large at about 4000 sq. ft. as compared to the size of the current control room (approx. 600 sq. ft.), it is recommended that the Ahmedabad TMICC be set up at a new location and the systems currently being deployed at the existing traffic control room be shifted to the proposed TMICC. • Ahmedabad city has around 227 signalised junctions functioning under fixed time or manually controlled system. • These may be upgraded to become part of a centrally controlled Area Traffic Control System (ATCS).	There should be a centralised control room for traffic signal, the surveillance cameras and VMSs so that it can be more effective.

	Goals and Objectives	The Main objectives of the Ahmedabad TMICC and key activities performed to meet these objectives are as under:
		• **Monitoring and Management of Traffic**
		  • Management and Monitoring of Traffic Junctions and Roadway Systems
		  ○ Signal Timing and Operations
		  ○ Road Network Surveillance
		  ○ Active 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
		  ○ Cameras
			Should use the advanced and reliable technology for adaptive traffic management.

	Key Areas	According to Report	Suggestions
		○ Variable message signs • Interfacing with various agencies to obtain information impacting traffic flows ○ Traffic Enforcement ○ Parking Management and Operations ○ Weather Information System • 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 through variable message signs, website, helplines, mobile applications, social media etc. • **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 ○ Support identification and analysis of black spots in case of accidents	Educating public in Ahmedabad to follow traffic safety regulation should be key to the success. We should focus on making public aware of traffic rules. Traffic law enforcement by police should be mandatory.

<table>
<tr><th></th><th>Key Areas</th><th>According to Report</th><th>Suggestions</th></tr>
<tr><td></td><td>Proposed Components</td><td>
The table below details the additional needs and ITS equipment required to be added to the current system and to upgrade it into Ahmedabad TMICC.
<table>
<tr><th>S. No.</th><th>Components of TMICC</th><th>Current Status</th><th>Proposed System</th></tr>
<tr><td>1.</td><td>Upgradation [19] of signalised junctions – 270 Nos.</td><td>186 Nos. under upgradation process</td><td>84 Nos.</td></tr>
<tr><td>2.</td><td>Control room connectivity</td><td>3 signalised junctions connected currently. Remaining are proposed to be covered progressively.</td><td>84 Nos.</td></tr>
<tr><td>3.</td><td>Variable message signs (VMSs)</td><td>3 Nos.</td><td>17 Nos.</td></tr>
<tr><td>5.</td><td>Size</td><td>600 sq. ft.</td><td>4000 sq. ft.</td></tr>
</table>
</td><td>There are approx. 227 traffic signals in Ahmedabad.

There are 4 VMSs in Ahmedabad.</td></tr>
<tr><td></td><td>Project Area and Implementing Agency</td><td>
TMICC is required for the entire Greater Ahmedabad Development Area. Proposed project area for Phase-1 is Ahmedabad Municipal Corporation (AMC) area. In Phase-2, Ahmedabad Urban Development Authority Area (AUDA) would be covered. In Phase-3, the entire Greater Ahmedabad Development Area is proposed to be covered.
In phase 1, Ahmedabad city arterial roads, functioning as the primary network for carrying traffic and having signalised junctions under existing AMC area, would be covered through TMICC.
As AMC has already set-up and is operating a traffic control room, it is recommended that AMC be entrusted with the responsibility for setting up
</td><td>Some of the roads in old Ahmedabad are narrow and need to be widened to accommodate the traffic flow.</td></tr>
</table>

[19] *Restoration and configuration for remote control and central operation*

	Key Areas	According to Report	Suggestions
		and operating the Ahmedabad TMICC. • AMC may upgrade and expand the existing control room and, as required, relocate the facility to any other area. • It is also recommended that Traffic Police personnel are also co-located along with AMC personnel at the TMICC to ensure effective coordination between AMC and Traffic Police.	
	Implementation Structure	• Supply and service contract is recommended as the most suited model for implementing the Ahmedabad TMICC. • The responsibility to implement, operate and maintain the Ahmedabad TMICC and all the traffic equipment connected therewith may be entrusted to single systems integrator. • There are currently two entities managing the signals in the city. It is recommended that the entire signal operation be progressively brought under a single unified TMICC.	

Annexure 1(C): Data Collected from Ahmedabad Janmarg Limited

Ahmedabad Janmarg Limited (AJL)		
Items	**Parameter**	**Status**
Buses	Number of buses	163 old buses and 162 new busses to be added after Vibrant Gujarat Summit, 2015. Total 149 bus-stops.
	Number of Buses with AVL/GPS	All buses have GPS installed
	Number of Buses with ETM system	No on-board ETM but off board ticketing through Point of Sale Terminals
	Number of Buses having PIS	All buses have PIS
	Number of Buses having CCTV cameras	No buses have CCTV cameras
Routes	Number of existing and proposed routes	Nine existing and 4 proposed routes
Terminals	Number of bus terminals	Two terminals are there at present. Two new proposed.
	Whether managed by the agency itself or some other agency manages it	It is managed by a company named “Chartered Speed”
	Whether CCTV system has been installed	Not applicable
Passengers	Number of passengers being served	1.4 lac/ day
Operation Area	Area / cities being serviced	Ahmedabad
Control room	Whether control room has been set up	Yes, it is at AMC West Zone Office in Usmanpura
	Control room is there at depot level or at a central location	Control room is at central level
	Whether the control room is manually operated or is automated and IT enabled	Yes control is IT enabled with Automatic Vehicle Location System (AVLS), Automatic Fare Collection System (AFCS) and duty management facility
Backend Application	Whether any backend applications have been deployed	Yes
	Type of system for which backend exists (such as Electronic Ticketing Machine (ETM), AVL, bus routing, scheduling, duty allocation etc.)	AVL, AFCS, network observation, attendance of workers, call centre
GPS in buses /	Whether Installed	Yes, GPS is Installed in all buses

Ahmedabad Janmarg Limited (AJL)		
Items	**Parameter**	**Status**
AVL system	Number of buses having GPS	All buses have GPS
	PIS installed at bus stops	Yes, PIS is installed at all bus stops
	ETA being shown at bus stops	Yes
	PIS installed inside buses	Yes, all buses are installed with PIS inside
	Next stop announcement inside buses	Yes, all buses have stop announcement system
Electronic ticketing	Whether ticketing is through ETMs	No. Ticketing is through Point of Sale devices at Bus Stations
	Number of buses with ETM based ticketing	Not Applicable
	Real time ticketing data being sent to the backend	Yes, through the MPLS link at Bus Station
	Whether card based payment is there	Yes, system is in use
Information Dissemination (website)	Whether GIS map is used to display bus stops, routes, terminals etc.	Yes, facility available for passengers
	Type of static information being provided through website (routes, schedules, fare, pass details etc.)	Routes, schedules, fare, pass details etc.
	Type of real time information being provided through website (ETA at a bus stop, delays, cancellations, departures scheduled from terminals etc.)	No real time information is available on website
	SMS alerts being provided, if any	Yes, this facility is for staff members for circulation of messages about any breakdown and issue
	Email alerts being provided, if any	No such facility available
	Whether route/journey planner is there on the site	Yes, route planner is available on website
Phone Helpline	Number	Yes, 1800232030
	Whether normal number, toll free or MoUD NUTH number (155220)	This is a toll free number and works from 7 am to 10 pm
	Call charges (free, normal, premium)	There are no call charges
	Number of calls received (monthly)	Around 1800 calls
Mobile App	Whether mobile app exists	Yes, mobile apps are there

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

Annexure 1(D): Data Collected from Ahmedabad City Traffic Police

Ahmedabad City Traffic Police		
Items	**Parameter**	**Status /Details**
Operation Area	Area being serviced	AMC area.
Control Room	Whether traffic control room has been set up	Yes
	Whether traffic control room is IT enabled having consoles, video wall, operators etc.	No
	Activities being performed from the control room (signal control, CCTV footage monitoring, enforcement etc.)	Only to receive current traffic information from public and field Traffic Police personnel and for registering complaints.
Traffic Equipment (Field)	Number of signals	Under AMC purview
	Number of CCTV cameras	Under implementation
	Number of red light violation detection cameras	A total of 209 cameras are proposed to be installed out of which 187 have already been installed.
	Number of Variable Message Signs (VMSs)	3 VMSs have been installed
	Any other	
Signals	Number of signals working on adaptive mode	Signals are under AMC purview. Ahmedabad City Traffic Police (ACTP) operates them.
	Number of signals connected to the control room	Signals are under AMC purview. ACTP operates them.
	Mode of connectivity (leased line, OFC etc.)	Signals are under AMC purview. ACTP operates them.
	Which entity installs signals	Ahmedabad Municipal Corporation
	Which entity maintains signals	Ahmedabad Municipal Corporation
CCTV	Whether all junctions have CCTV cameras	No
	Whether CCTV cameras are installed at locations other than junctions also	Yes

Ahmedabad City Traffic Police		
Items	**Parameter**	**Status /Details**
	Whether CCTV camera feed is being monitored	Yes it has been planned to monitor it through control room
	Which entity installs CCTV cameras	Ahmedabad Municipal Corporation
	Which entity maintains CCTV cameras	Ahmedabad Municipal Corporation
	Which entity bears the installation, O&M cost of the CCTV cameras	Ahmedabad Municipal Corporation
Backend Application	Whether any backend applications have been deployed in the control room	Some backend applications have been planned
	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.)	CCTV footage monitoring
Information Dissemination (website)	Whether GIS map is used to display road network, signals, CCTV cameras, VMS etc.	GIS map is available on website but only shows the jurisdiction area
	Type of static information being provided through website (road network, speed limits, no entry zones etc.)	Not relevant
	Type of real time information being provided through website (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not relevant
	SMS alerts being provided, if any	No SMS alerts provided

Ahmedabad City Traffic Police		
Items	**Parameter**	**Status /Details**
	Email alerts being provided, if any	No Email alerts provided
	Whether journey planner is there on the site	No, journey planner on ACTP website
Phone Helpline	Number	1095
	Whether normal number, toll free or short number (provide details)	Toll free number
	Call charges (free, normal, premium)	Free
Mobile App	Whether mobile app exists	No, citizen can communicate on WhatsApp, the number is 979921095
	Type of static information being provided through app (road network, speed limits, no entry zones etc.)	WhatsApp services have been reserved for traffic issues. Locals, who face jams, parking, accidents and snarls, can report to police on the number. Locals have been also asked to complain if the Traffic Police, home guards and others on traffic duty misbehave or are found not managing traffic properly. Locals can also click photographs and videos of the traffic snarls or a fiasco with the police and send it to the police for quick reaction and disposal of the issue. This will ensure that wrong information about traffic jams.
	Type of real time information being provided through app (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not relevant
Social Media	Whether Facebook page exists	Yes (https://www.facebook.com/AhmedabadTrafficPolice?fref=nf)
	Whether Facebook page being regularly updated	Regularly updated
	Whether Twitter handle exists	Yes (https://twitter.com/ahdtraffic)
	Whether Twitter handle being regularly updated	Regularly updated

Ahmedabad City Traffic Police		
Items	**Parameter**	**Status /Details**
	Whether any other social media page exists	No other social media page
	Whether the page being regularly updated	Not relevant
Information Feeds	Whether traffic information feed is being provided to any agency	No such information is shared with any agency. With funding from JICA, cameras at 3 junctions have been installed on the few routes, data of which is monitored and analysed at the backend servers in Singapore and traffic update are disseminated through Variable message sign to public. These VMS are installed at Shivrangini, Anjali and Delhi Darwaza route
	If yes, type of traffic information feed is being provided, frequency, mode, whether any charges being collected for the data feeds	Not applicable
	The data exchange protocols being followed	Not applicable

Annexure 1(E): Data Collected from Ahmedabad Municipal Corporation

Ahmedabad Municipal Corporation, AMC		
Items	**Parameter**	**Status /Details**
Operation Area Control Room	Area being serviced	Ahmedabad
	Whether traffic control room has been set up	Yes
	Whether traffic control room is IT enabled	Yes
	Whether decentralised or a single centralised control room	Single centralised control room
	Activities being performed from the control room (signal control, CCTV footage monitoring, enforcement etc.)	Signal control using vehicle detection technology by CCTV camera
Traffic Equipment (Field)	Number of signals	227 signals
	Number of CCTV cameras	For signalling purpose cameras are installed at 3 junctions
	Number of speed violation detection cameras	Nil
	Number of red light violation detection cameras	Nil
	Number of variable message signs (VMSs)	3
Signals	Number of signals working on adaptive mode	3 signals
	Number of signals connected to the control room	3 signals are connected to control room
	Mode of connectivity (leased line, OFC etc.)	Leased line
	Which entity installs signals	DIMTS & Keltron install signals under contract with AMC
	Which entity maintains signals	DIMTS & Keltron maintain signals under contract with AMC
CCTV	Whether all junctions have CCTV cameras	No, not all junction have CCTV cameras
	Whether CCTV cameras are installed at locations other than junctions also	Yes, CCTV cameras (at about 150 locations) are installed at various location other than junction for security surveillance

Ahmedabad Municipal Corporation, AMC		
Items	**Parameter**	**Status /Details**
	Whether CCTV camera feed is being monitored	Yes, camera feed is being monitored by agency and feed is also provided to Police commissioner through leased line
	Which entity installs CCTV cameras	n-Code Solutions installs and maintains CCTV under contract with AMC
	Which entity maintains CCTV cameras	n-Code Solutions installs and maintains CCTV under contract with AMC
	Which entity bears the installation, O&M cost of the CCTV cameras	AMC
Backend Application	Whether any backend applications have been deployed in the control room	Yes
	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.)	CoSiCoSt (Composite Signal Control Strategy) developed by CDAC for signal monitoring and control
Information Dissemination (website)	Whether GIS map is used to display road network, signals, CCTV cameras, VMS etc.	Not Applicable
	Type of static information being provided through website (road network, speed limits, no entry zones etc.)	Not Applicable
	Type of real time information being provided through website (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not Applicable
	SMS alerts being provided, if any	No SMS alert facility
	Email alerts being provided, if any	No Email alert facility
	Whether journey planner is there on the site	No journey planner on the site
Phone Helpline	Number	18002332330 to receive civic complaints from citizens
	Whether normal number, toll free or	Toll free number

Ahmedabad Municipal Corporation, AMC		
Items	**Parameter**	**Status /Details**
	short number (provide details)	
	Call charges (free, normal, premium)	Free
	Number of calls received (monthly)	1000 calls per month
Mobile App	Whether mobile app exists	No there is no mobile app
	Type of static information being provided through app (road network, speed limits, no entry zones etc.)	Not applicable
	Type of real time information being provided through app (congestion map, road closures, construction/maintenance details, incident details, traffic advisories etc.)	Not applicable
Social Media	Whether Facebook page exists	Official Facebook page available https://www.facebook.com/ahmedabadmc
	Whether Facebook page being regularly updated	Yes, regularly updated
	Whether Twitter handle exists	Official Twitter page available https://twitter.com/amc_twit
	Whether Twitter handle being regularly updated	No
	Whether any other social media page exists	Official YouTube page available
	Whether the page being regularly updated	Updating is done as and when any relevant information available
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, whether any charges being collected for the data feeds	Not Applicable
	The data exchange protocols being followed	Not Applicable

Annexure 2: 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:

Traffic Agencies • *Ahmedabad City Traffic Police* • *Ahmedabad Municipal Corporation*	***Transit Agencies*** • *Ahmedabad Municipal Transport Service (AMTS)* • *Ahmedabad Janmarg Limited* • *Metro-Link Express for Gandhinagar & Ahmedabad (MEGA) Company Ltd*
Road Owning Agencies • *Ahmedabad Municipal Corporation* • *Ahmedabad Urban Development Authority* • *Roads and Buildings Department, GoG*	***Parking Agencies*** • *Ahmedabad Urban Development Authority* • *Ahmedabad Municipal Corporation* • *Gujarat State Road Transport Corporation* • *Western Railways*

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 in Ahmedabad;

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 Ahmedabad 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, synthesize and disseminate travel and traffic related information to public that would optimize 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 Ahmedabad 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 authorize 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 as long as the TMICC remains operational in the city, unless otherwise mutually agreed.

5.0 GENERAL

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

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

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

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

Party	For Implementing Agency	For Participating Agency
Signature		
Name		
Designation		

Appendix A

Details of Information and Data Sharing

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

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

Annexure 3: List of Applicable Standards

Standard No: Year of Adoption	Description [20]
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 maximize interoperability and reuse. ISO 14813-6:2009 also provides a means where particular ITS sector requirements, or existent International Standards, that require particular message forms and procedures that are expressed in other notations (EDIFACT, XML, etc.), may be referenced and reused by other ITS applications. Thus it presents an unambiguous system for identifying all the different data types and describing them in ITS International Standards in a common way.
ISO 14817:2002	Specifies the framework, formats, and procedures used to define information exchanges within the Intelligent Transport System/Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and Data Dictionaries, the registration process to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry. Specifically, ISO 14817:2002 specifies:

[20] Source: International Standards Organization (ISO)

Standard No: Year of Adoption	Description [20]
	• 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, standardize 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

Standard No: Year of Adoption	Description [20]
	3. Communication Interface 4. Database Interface
ISO 14827-1:2005	Allows different systems to exchange relevant data. The relevant data will be contained in end-application messages. Each end-application message will be formally defined as either a "subscription" or a "publication", according to the format as specified in ISO 14827-1:2005. DATEX-ASN defines how these end-application messages are packaged to form a complete data packet and also defines the rules and procedures for exchanging these data packets. Systems using DATEX-ASN are free to implement additional end-application functionalities according to the user requirements.
ISO 15628:2007	Road transport and traffic telematics, Dedicated Short Range Communication (DSRC) application layer
ISO 15628:2007	Specifies the application layer core which provides communication tools for applications based on DSRC. These tools consist of kernels that can be 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;

Standard No: Year of Adoption	Description [20]
	• address location; • services and Point of Interest (POI) information access.
ISO 17572, Parts 1 to 3:2008	Specifies Location Referencing Methods (LRM) that describes locations in the context of geographic databases and will be used to locate transport-related phenomena in an encoder system as well as in the decoder side. It defines what is meant by such objects, and describes the reference in detail, including whether or not components of the reference are mandatory or optional, and their characteristics. It specifies two different LRMs: • pre-coded location references (pre-coded profile); • dynamic location references (dynamic profile). It does not define details of the Location Referencing System (LRS), i.e. how the LRMs are to be implemented in software, hardware, or processes. ISO 17572-1:2008 specifies the following general LRM related sections: • requirements to a Location Referencing Method; • conceptual Data Model for Location Referencing Methods; • inventory of Location Referencing Methods; • examples of Conceptual Data Model Use; • description of selected UML Elements; • comparison of Definitions with ISO/TC211; • 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; ○ categorize 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

Standard No: Year of Adoption	Description [20]
	below), and extensions of data elements in each application domain. • Core data element definitions, which are basic descriptive elements, intended to appear in every probe message, i.e. the location and the time at which the probe data was sensed. • Initial set of probe data elements, which are commonly used in typical probe data, enabled application domains, such as traffic, weather, and safety. • Example probe messages, which define how probe data elements are combined to convey information to probe processing centres.
ISO 22951:2009	Relates to systems that use priority signal control functions to help emergency vehicles operate. This type of system is composed of a traffic management centre, in-vehicle units, roadside communication units, and roadside units. Public transport vehicles such as buses are also targeted to receive priority signal control service. The scope of standardisation includes message sets and data dictionary related to the communications as follows: • between a roadside communication unit and each in-vehicle unit, • between a roadside communication unit and other roadside units, • 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 [20]
ISO 24100:2010	States the basic rules to be observed by service providers who handle personal data in probe vehicle information services. This International Standard is aimed at protecting the personal data as well as the intrinsic rights and interests of probe data senders, i.e., owners and drivers of vehicles fitted with in-vehicle probe systems.
ISO 24531:2013	Assists ITS standards developers and users of ITS standards who wish to use XML, by providing a consistent definition of the rules and rule references for the use of XML within ITS. ISO 24531:2013 defines consistent rules and rule references to provide a framework to be used when implementing XML-based applications in ITS, and particularly in specifying XML in ITS standards, ITS data registries and ITS data dictionaries. ISO 24531:2013 also provides guidance and examples in respect of the use of XML in ITS, and the elaboration of XML within the ASN.1 data definitions required by ISO 14813-6 and ISO 14817.
ISO 24978:2009	Provides a standardised set of protocols, parameters, and a method of management of an updateable "Data Registry" to provide application layers for "ITS Safety messages" using any available wireless media.
ISO TR 24532:2006	Clarifies the purpose of CORBA and its role in ITS. It provides some broad guidance on usage, and prepares the way for further ISO deliverables on the use of CORBA in ITS.
ISO TR 25100:2012	Provides guidance on the harmonisation of data concepts that are being managed by data registry and data dictionaries such as those described in ISO 14817:2002. 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: • 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. • Design method of application protocols for light-weighted devices. This

Standard No: Year of Adoption	Description [20]
	method is a flexible application protocol for safety warning and parking guidance services. Unlike many other application protocols in the ITS and Telematics domains, this protocol makes the client part independent of use cases for supporting light-weighted devices. • 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.

Standard No: Year of Adoption	Description [20]
ISO/TS 14823:2008	Presents a system of standardised codes for existing signs and pictograms used to deliver Traffic and Traveller Information (TTI). The coding system can be used to form messages to be handled by respective media systems, graphic messages on on-board units, and media system information on TTI dissemination systems [Variable Message Signs (VMS), Personal Computers (PC), Public Access Terminals (PAT), etc.] (Including graphic data).
ISO/TS 15624:2001	Transport information and control systems -- Traffic Impediment Warning Systems (TIWS) System requirements
ISO/TS 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).

Annexure 4: Transportation Performance Index

- **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 30KMPH
  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.

Annexure 5: 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. These Terms of Reference (TOR) cover scope of work for both TMICC as well as NUTH. In case the city is planning to implement only one of the systems, the TOR may be amended.

The indicative scope of work of the empanelled consultants is as follows:

1. Development of City Specific Concept Reports

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

i. Identification of ITS & TMICC needs for the city based on data analysis and collection
ii. Identification of stakeholders
iii. Drawing up of implementation role of various stakeholders
iv. Identification of ITS 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 requirements of the systems (including hardware specifications)
iii. Detailed design of the facility (sizing, floor plan, data centre design, utilities design etc.)
iv. Detailing of operating procedures and processes
v. Cost-benefit analysis and implementation phasing, if necessary
vi. Detailed cost estimates for the purpose of the tender documents

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

3. Agreements between Stakeholders

The Consultant shall be responsible for drawing up of the agreements between the various stakeholders of the TMICC/NUTH. The agreements would clearly set out the roles and responsibilities of each stakeholder.

4. Preparation of Tender Documents

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

i. 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 the implementing agency as a part of evaluation of proposals:

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

Stage 1: Scrutiny of "Key Submissions"

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

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

Stage 2: Evaluation of "Qualification Information"

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

Stage 3: Evaluation of "Technical Proposal"

The Technical Proposals of the Bidders, who pass Stage 2 evaluation, as described above, would then be evaluated on various parameters according to the provisions of the RFP.

Stage 4: Evaluation of "Financial Proposal"

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

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

6. Project Monitoring and Management

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

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

For further information please contact:

Delhi Integrated Multi-Modal Transit System Ltd.
1st Floor, Maharana Pratap ISBT Building,
Kashmere Gate, Delhi - 110006
Tel: +91 11 43090100
Fax: + 91 11 23860966
Email: rakesh.jain@dimts.in

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.