MALAYSIAN ITS BLUEPRINT 2019-2023

MINISTRY OF WORKS MALAYSIA

MALAYSIAN iTSBLUEPRINT 2019-2023

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CONTENTS

LIST OF FIGURE

FOREWORD

> The Blueprint accentuate on the need for multiple agencies collaboration in nine (9) ITS sectors. A lot of efforts such as workshops and meetings were held in the process of materialising the Blueprint. ITS can be a centralised platform to collect, analyse and store transportation data.
>
> YB Baru Bian
> MINISTER OF WORKS
> MALAYSIA

Ministry of Works has taken a step ahead towards realisation of Intelligent Transport System (ITS) in Malaysia through the publication of Malaysian ITS Blueprint (2019-2023).

Nowadays, traffic congestion is the main problem in our cities. This can be minimised by utilising ITS starting with journey planning, disseminate real-time traffic condition, alternative route suggestions and also parking space information. Besides that, ITS also promotes the usage of public transport among citizens by providing fast and reliable information on bus or train arrival time and estimated travel time to commuters as they can plan their journey early.

In the future, cities will turn into smart cities. Malaysia has been progressing on this smart city concept, especially in major cities, economic development zones as well as new urban housing areas. The seven (7) components that support a strong foundation to construct a smart city are Smart Economy, Smart Government, Smart Living, Smart Environment, Smart People, Smart Mobility, and Smart Digital Infrastructure.

The way forward after the blueprint is the establishment of the National Intelligent Transportation Management Centre (NITMC) which ideally will serve as a traffic management and data centre. Other agencies would also benefit from this effort to form data exchange and Big Data analysis.

ACKNOWLEDGEMENT

The Malaysian ITS Blueprint (2019-2023) is made possible through the help and support from everyone, including:

ITS COUNCIL

Ministry of Works

Ministry of Transport

Ministry of International Trade & Industry

Ministry of Energy, Science, Technology & Climate Change

Ministry of Housing & Local Government

Ministry of Federal Territories

Ministry of Finance

Ministry of Home Affairs

Ministry of Economics Affair

Ministry of Health

Ministry of Communication & Multimedia

Prime Minister's Department

Malaysian Administration Modernisation & Management Planning Unit

Public Works Department Malaysia

Royal Malaysia Police

Road Transport Department Malaysia

Malaysia Highway Authority

Putrajaya Corporation

Kuala Lumpur City Hall

Royal Malaysian Customs Department

Malaysian Communications & Multimedia Commission

Malaysian Institute of Road Safety Research

MIMOS Berhad

Malaysia Digital Economy Corporation

Malaysian Industry-Government Group for High Technology

Intelligent Transport System Association of Malaysia

Construction Industry Development Board Malaysia

Scientific & Industrial Research Institute of Malaysia

Malaysia Automotive Robotics And IoT Institute

University of Malaya (Faculty Of Engineering)

University of Science Malaysia

Mara University of Technology (Faculty Of Civil Engineering)

EXECUTIVE SUMMARY

The Malaysian ITS Blueprint (2019-2023) is a document that charts the way forward for collaboration and integration in the development of ITS in Malaysia. Prior to this, the ITS System Architecture completed in 2007, form as a basis for the ITS Development in Malaysia. However, only the traffic and electronic tolling sectors were the main focus. ITS in this blueprint comprises all the nine (9) sectors.

The blueprint states the need for inter agency collaboration in the Government in implementing the different action plans under the different Ministries and other Government agencies in ensuring progress in the Intelligent Transport System. The nine (9) ITS sectors are spread among many agencies, thus the need for integration and interactions between agencies in the Government as well as between the Government and the private sectors.

Data sharing among the agencies is the vital link in progressing with the implementation of ITS in Malaysia. Data collected, if shared can meet the objectives of several agencies and this will stop duplication of expenditure for the collection of the same data. Big Data analytics is a challenge in the future, especially when data have to be shared and analysed.

The blueprint states the need for different agencies to implement the action plans related to ITS under their own agencies. This will support the 5 year plan in implementing ITS in Malaysia.

The blueprint tooks into considerations other Malaysia's policy/guidance documents such as The Eleventh Malaysia Plan Book 2016-2020, the National Land Public Transport Master Plan (SPAD), the National Internet of Things Strategic Roadmap (MITI), the Logistics and Trade Facilitation Masterplan (2015-2020) (EPU), as well as the National Transport Strategy as a basis for the development of Intelligent Systems which is a big part of the 4th Industrial Revolution.

1.0 INTRODUCTION

Intelligent Transport System (ITS) is a system in which information and communication technologies are applied in the field of road transport, and in traffic management and mobility management, as well as for interfaces with other modes of transport.

In 1999, the ITS Strategic Plan was formulated as a guide for the development of ITS in Malaysia. Among the catalysts for the plan were the mandatory implementation of Traffic Control and Surveillance Systems of the Malaysia Highway Authority (in 1994) and the increasing number of new tolled highways.

Moving further, in 2004, the ITS Master Plan was published in order to progress the work of the ITS Strategic Plan and to establish in greater detail the key strategies, direction and framework for the development and deployment of ITS in Malaysia.

Then, ITS in Malaysia was further developed in 2007, the Ministry of Works published the ITS Systems Architecture, as a progression of the ITS Master Plan. The System Architecture provided a unified framework for the coordinated deployment of ITS in Malaysia by providing detailed descriptions of interactions between travellers, vehicles, roadside devices and control centres. One of the purpose of the system architecture is the seamless integration of ITS programs within the public and private sectors across modes throughout Malaysia. The Architecture was adopted as a basis in the development of this Malaysian ITS Blueprint. Figure 1 shows the development of Malaysian ITS Blueprint since 1999.

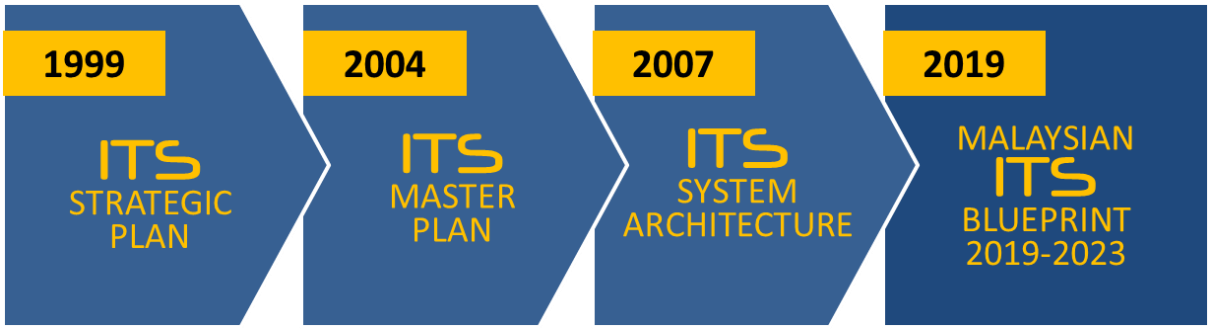


Figure 1: Malaysian ITS Blueprint Development

2.0 VISION

For connecting mobility, safety, and sustainable living, both in the urban and rural setting in Malaysia.

3.0 MISSION

To foster Big Data analytics in planning, implementation and operation of the National and regional transportation, mobility and logistics movement.

4.0 OBJECTIVE

The objectives of this ITS Blueprint are to chart the way forward for ITS in Malaysia. There are five (5) objectives that are to be achieved within this Blueprint:

1. Seamless Intelligent Mobility
2. Congestion-Free Network
3. Safety
4. Commercial Vehicle Operation
5. Collaboration Between Agencies

The integration of public transport and highways in the daily travel has taken a different perspective in this new world involving technology. It is a new norm that a traveller now insists on planning their journey efficiently, whether to go on public transport, mixed travel between private and public transport or totally using a private vehicle. Whatever their choices, the Authority is obliged to provide seamless intelligent mobility to save travel time and to provide comfort to travellers.

With the increase in public transportation facilities provided by the Authorities, it is expected that there will be modal change from private mode to public transport. In the urban setting the reduction in private vehicles in the traffic stream is only one of many factors that may contribute to the reduction in the city congestion. ITS shall be used in the management of traffic to ensure efficient use of the facilities.

Thirdly, safety is high on the agenda in managing traffic and transportation assets. There are many ITS efforts in terms of improving safety on the road network, some are already implemented and others are carefully researched.

Fourthly, ITS is applied to improve highway safety and freight mobility for commercial and passenger vehicles. It is so important that overloading of commercial vehicles is monitored automatically to ease monitoring and enforcement activities.

Lastly, it shall be ensured that collaboration between government agencies and also between government agencies and the private sectors shall take place in order for ITS to be implemented. Each government agency then, in their own Strategic Plans shall include any ITS component in their planning. Data sharing between agencies is the vital link in ensuring the success of ITS in Malaysia.

Each agency is responsible in implementing the ITS component and these efforts to be reported to the ITS Council on a regular basis. As and when requested by the ITS Chairman.

5.0 ELEVENTH MALAYSIA PLAN (2016-2020)

There are six (6) strategic thrusts in the 11th Malaysia Plan, of which under the Strategic Thrust 4 of pursuing green growth for sustainability and resilience, will be the game-changer in bringing Malaysia towards a sustainable socio-economic development path where quality in life is in harmony with the sustainability of the environment.

In Strategic Thrust 4, low carbon mobility is encouraged through utilisation of energy efficient vehicles and public transport. The modal change from private vehicles to public transport not only will reduce congestion, but also will reduce the environmental pollution. Figure 2 shows the excerpts from the 11th Malaysia Plan.

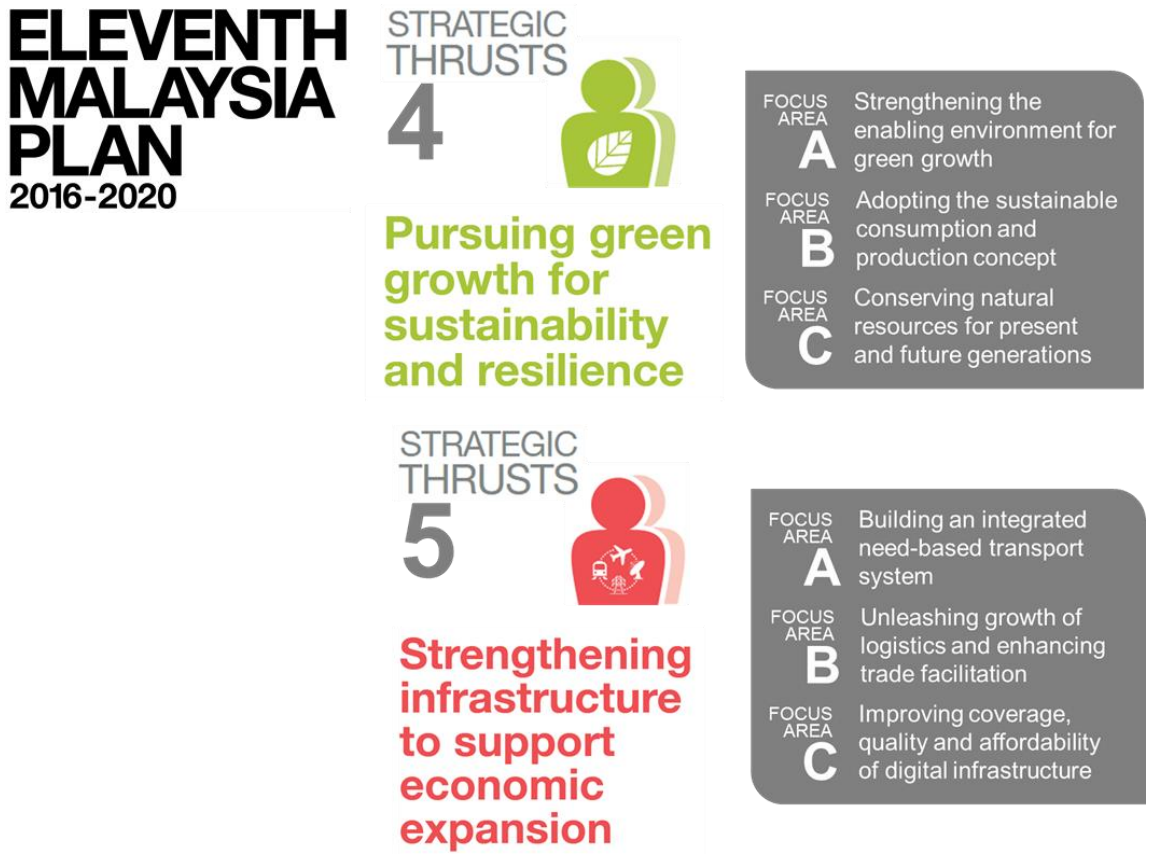


Figure 2 : Strategic Thrust 4 and 5 (Source : Eleventh Malaysia Plan)

Inline with Strategic Thrust 4, which pursues green growth for sustainability, ITS applications have the potential to achieve a sustainable environment by reducing both pollution from vehicles and traffic congestion in the cities through Advanced Traffic Management Systems and the seamless integration of different modes of transport.

Strategic Thrust 5 in the 11th Malaysia Plan is the strengthening of infrastructure to support economic expansion, focusing on building an integrated need-based transport system (Focus Area A) as stated in Figure 3. Initiatives will be taken to provide seamless transportation system and enhance connectivity and mobility of people. Good infrastructure is therefore the foundation of social inclusion, economic expansion and growth.

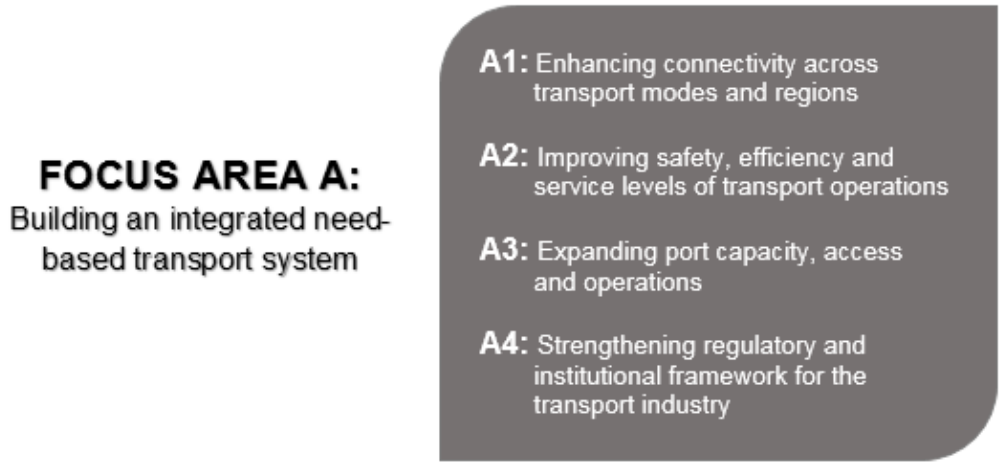


Figure 3 : Focus Area A in Strategic Thrust 5 (Source : Eleventh Malaysia Plan)

ITS will enhance the efficiency of the transportation system, greater utilisation of existing facilities with emphasis on better delivery, quality of services and capacity improvement. Moreover, an efficient infrastructure lowers the cost of doing business, which in turn improves national competitiveness and productivity. ITS plays important roles in the integration of different transport modes, creating seamless movement for people and goods.

Focus Area B as in Figure 4, is towards the improvement of logistics and trade facilitation. ITS implementation in the area is abundant. The monitoring and

management of logistics can be improved by using ITS. The transport industry, the warehousing, the customs can all benefit from the use of ITS in the industry.

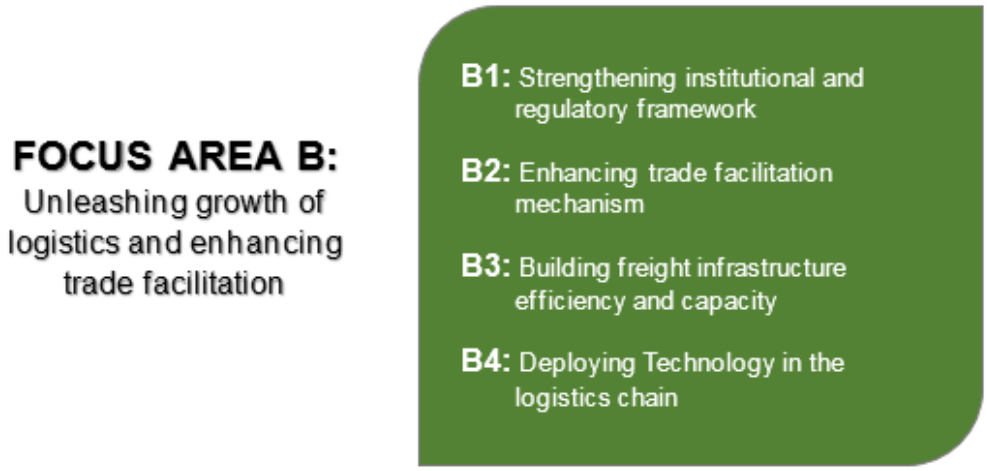


Figure 4 : Focus Area B in Strategic Thrust 5 (Source : Eleventh Malaysia Plan)

Focus Area C in the 11th Malaysia Plan focuses on improving the coverage, quality and affordability of internet connectivity as shown in Figure 5. Taking into consideration the future demand of the next generation technologies and innovation, internet connectivity is a necessity to enable the supply and demand of smart applications and system for transportation.

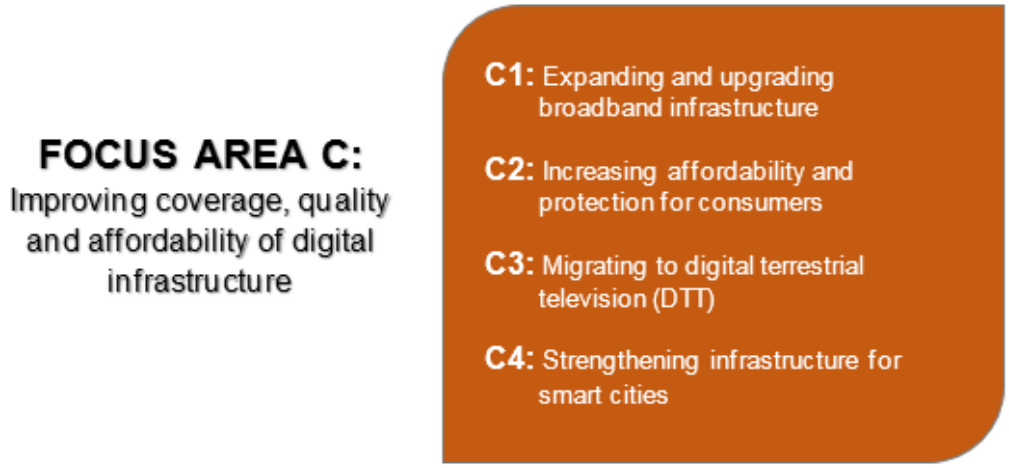


Figure 5 : Focus Area C in Strategic Thrust 5 (Source : Eleventh Malaysia Plan)

Internet connectivity plays significant role in the implementation of ITS. The rollout of high speed broadband enables effective implementation of smart technologies in transportation sector, including Vehicle-to-Infrastructure (V2I) and Vehicle-to-Centre (V2C).

6.0 STAKEHOLDERS COLLABORATION

The successful implementation of ITS in Malaysia can only be achieved with close collaboration between agencies. To date a majority of the ITS activities that has been implemented are on the highway and transportation sectors. Nevertheless the future sees ITS being implemented in the emergency management, commercial vehicle operating system and many others. Thus, this will involve many agencies.

Some of the ITS programs or activities requiring integration between multiple agencies. Those identified are government agencies related to planning, government agencies related to regulating and enforcement, Highway Concessionaires, Municipalities, Transport Operators, ICT Service Providers and Commercial Institutions. The collaboration between agencies is crucial in achieving the same objective of positioning ITS in the country. Among the government stakeholders are listed below:

- **MOW** : Ministry of Works
- **MOT** : Ministry of Transport
- **MESTECC** : Ministry of Energy, Science, Technology, Environment & Climate Change
- **MITI** : Ministry of International Trade and Industry
- **KWP** : Ministry of Federal Territories
- **KPKT** : Ministry of Housing and Local Government
- **MOF** : Ministry of Finance
- **MOH** : Ministry of Health
- **MDEC** : Malaysia Digital Economy Corporation
- **MAMPU** : Malaysia Administrative Modernisation & Management Planning Unit
- **RMP** : Royal Malaysia Police
- **CUSTOMS** : Royal Malaysian Customs Department
- **MCMC** : Malaysian Communications and Multimedia Commission

7.0 ITS SYSTEM ARCHITECTURE FOR MALAYSIA

The development of this blueprint is also based on the original ITS System Architecture For Malaysia (2007). The Malaysian ITS System Architecture was created with inputs from the previous studies, ITS Strategic Plan For Malaysia: A Way Forward' (1999) and 'ITS Master Plan Study For Malaysia' (2004). The assessment reflects the policies, master plans and stakeholder's needs in the country. Figure 6 shows the ITS System Architecture for Malaysia.

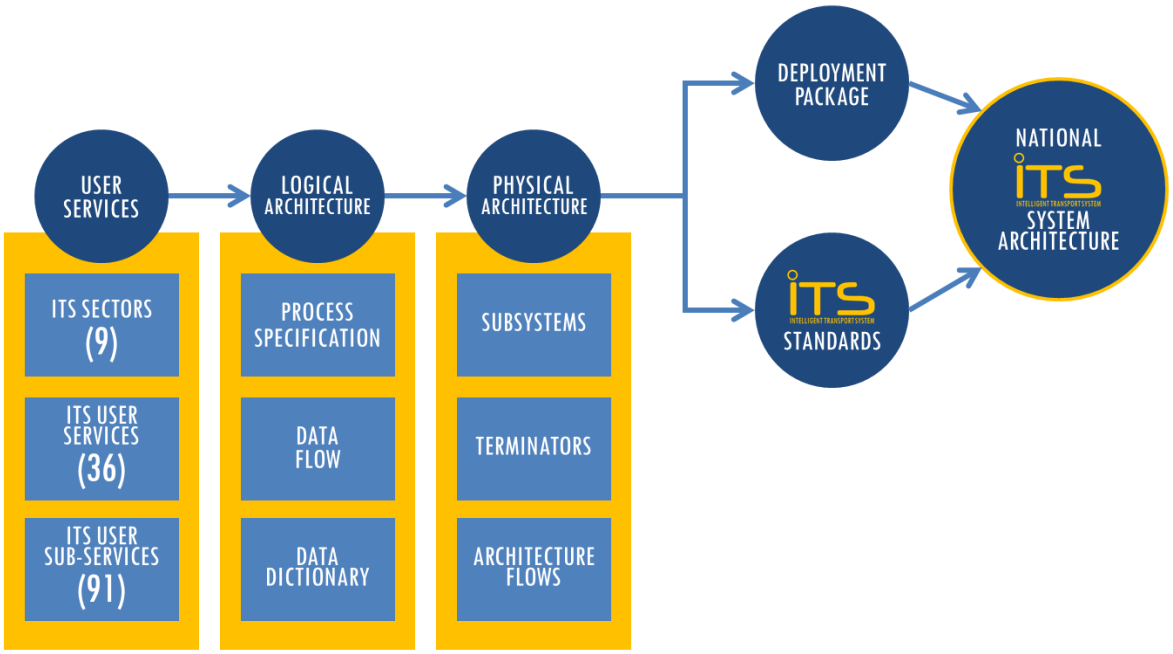


Figure 6: ITS System Architecture for Malaysia (2007)

The Architecture comprises the Logical Architecture and the Physical Architecture. The Logical Architecture represents a functional view of the User Services and User Subservices. The Logical Architecture also serves as a support to the Physical Architecture. It defines the Architecture boundary, the functions to be performed and data flow between functions. The Logical Architecture does not define where the functions are performed or how the functions are implemented.

The Physical Architecture comprises four elements. There are the centres, the roadsides, vehicles and the travellers as seen in Figure 7. The Physical Architecture takes the processes identified in the Logical Architecture and assigns them to subsystems.

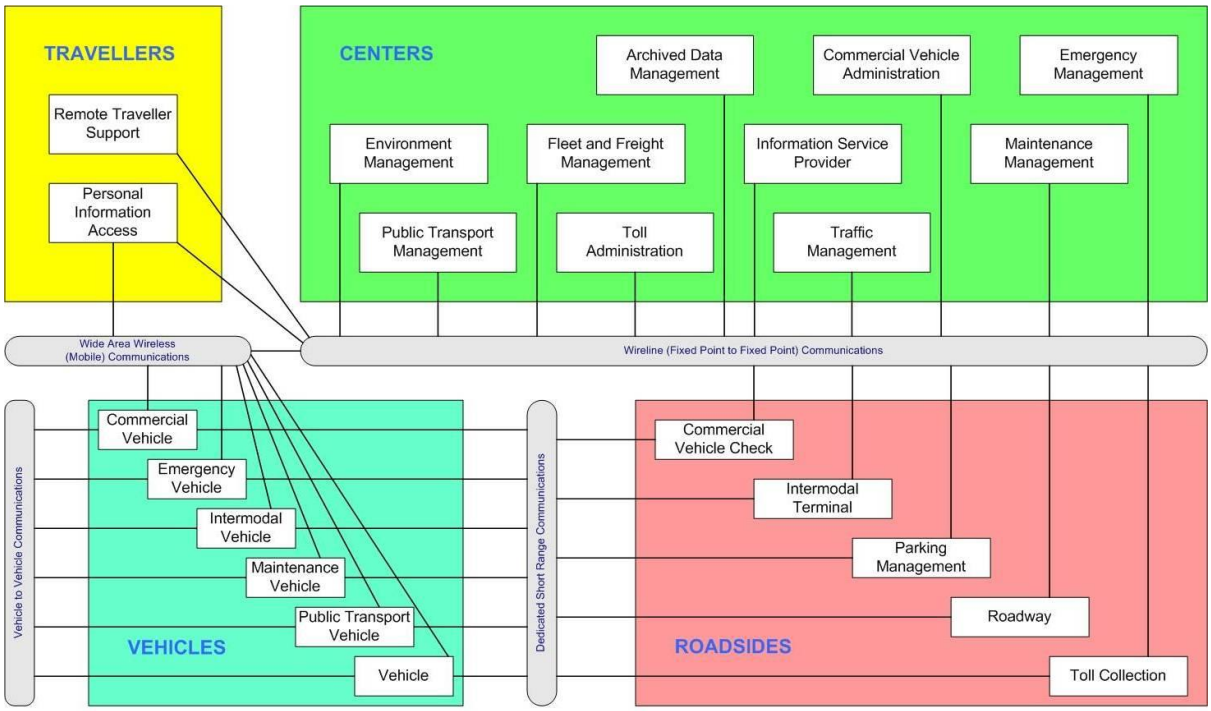


Figure 7: Physical Architecture (Source : ITS System Architecture for Malaysia)

Information and communication technologies are necessities for ITS due to their capacity to gather, process, analyse and disseminate considerable amount of data that can increase the efficiency of the ITS system elements in terms of resource consumption and services.

The convergence of technologies (such as mobile broadband, Internet of Things - IoT, advanced robotics, artificial intelligence and Big Data analytics from telecommunications, broadcasting, and multimedia sectors) is the key enabler towards successful ITS development.

IoT is one of the catalysts since it has the potential of merging the physical world and the virtual world through providing the internetworking between devices (such as sensors and actuators) that interfaces with physical objects (such as vehicles, buildings and other 'things') with the powerful and disruptive computing world (such as the mobile, social, Big Data, cloud computing, machine intelligence and others) by virtue of their connectivity via the Internet.

This leads to new scenarios that would not be possible before such as intelligent buildings, real time predictive analytics and control, smart manufacturing, autonomous vehicles, personal assistants and robots, high quality speech recognition and others.

ITS deployment would require a reasonable amount of consideration on the specification of the communication network to ensure seamless ITS operation and the interoperability with other devices. The ITS Master Plan Study for Malaysia includes a total of nine (9) ITS Sectors as shown in Figure 8.

Figure 8: Nine (9) ITS Sectors

These ITS Sectors are supported by 36 User Services as shown in Figure 9. The User Services are divided into logical groups that define the ITS functions to be performed by ITS applications. It is clear that the objective of the ITS Architecture is to provide a unified framework for integration of various ITS applications.

ITS Sectors	User-Services		
ITS Sector No.1: Advanced Traffic Management Systems	1	1.1	Urban Traffic Control
	2	1.2	Incident Detection and Management
	3	1.3	Travel Demand Management
	4	1.4	Environmental Conditions Management
	5	1.5	Operations and Maintenance
	6	1.6	Non-Vehicular Road User Safety
	7	1.7	Multi-Modal Junction Safety and Control
ITS Sector No.2: Safety Systems	8	2.1	Improved Accident Data Collection
	9	2.2	Automated Dynamic Warning and Enforcement
ITS Sector No.3: Advanced Public Transport Systems	10	3.1	Public Transport Operations Management
	11	3.2	Public Transport En-Route Information
	12	3.3	Demand Responsive Public Transport
	13	3.4	Public Travel Security
ITS Sector No.4: Advanced Traveller Information Systems	14	4.1	Pre-Trip Traveller Information
	15	4.2	Route Guidance and Navigation
	16	4.3	Ride Matching and Reservation
	17	4.4	Traveller Services and Reservations
ITS Sector No.5: Electronic Payment Systems	18	5.1	Electronic Payment Services
ITS Sector No.6: Commercial Vehicle Operations Systems	19	6.1	Commercial Fleet Management
	20	6.2	Commercial Freight Management
	21	6.3	Commercial Vehicle Electronic Clearance
	22	6.4	Automated Roadside Safety Inspection
	23	6.5	On-board Safety Monitoring
	24	6.6	Commercial Vehicle Administrative Processes
ITS Sector No.7: Advanced Vehicle Control Systems	25	7.1	Vehicle-Based Collision Avoidance
	26	7.2	Infrastructure-Based Collision Avoidance
	27	7.3	Sensor-Based Driving Safety Enhancement
	28	7.4	Safety Readiness
	29	7.5	Pre-Collision Restraint Deployment
	30	7.6	Automated Vehicle Operation
ITS Sector No.8: Emergency Management Systems	31	8.1	Emergency Notification and Personal Security
	32	8.2	Hazardous Material Planning and Incident Response
	33	8.3	Disaster Response and Management
	34	8.4	Emergency Vehicle Management
ITS Sector No.9: Information Warehousing Systems	35	9.1	Weather and Environmental Data Management
	36	9.2	Archived Data Management

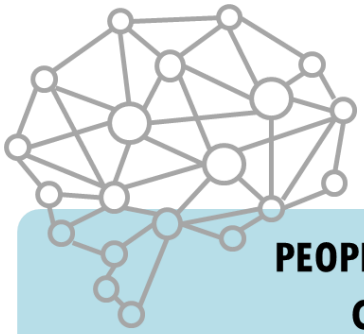
Figure 9: ITS Sectors and User Services

8.0 INDUSTRIAL REVOLUTION

The Industrial Revolution began in the late 18th century with the invention of steam and water power by replacing human and animal power to generate machines. The 2nd stage of the revolution continues through the introduction of a division of labor and mass production with the help of electrical energy. The 3rd Industrial Revolution also known as Digital Revolution is the change from mechanical and analogue electronic technology to computer and automation.

Today, a Fourth (4th) Industrial Revolution is transforming economies, jobs, and even society itself. Under the broad title Industrial Revolution 4.0, physical and digital technologies are combining through analytics, artificial intelligence, cognitive technologies, and the Internet of Things (IoT) that are interconnected and capable of more informed decision-making.

Many believe that cyber-physical systems will drive the 4th Industrial Revolution. Cyber-physical systems aim to realize more intelligent production by linking physical equipment with cyber systems (computing science that involves the virtual world, such as cloud computing). In order to realize such architectures, cloud and other computer systems need to accumulate more information on real world equipment.



PEOPLE-FRIENDLY COMMUTING

To provide new information services via mash up data created from existing and planned multimodal transport systems and associated services to commuting travellers or tourists on items such as traffic information, food, shops, travel routes/mode choices and places of interest in real-time via smart devices.

Source :
National Internet-of-Things Strategic Roadmap

8.1 Internet-of-Things

The Internet-of-Things (IoT) is a convergence of smart devices that generate data through sensors to create new information and knowledge to boost human intelligence, efficacy and productivity to enhance the quality of life. *(Source: National Internet-of-Things Strategic Roadmap)*

IoT is envisioned to improve productivity, safety, quality of life in various industries such as manufacturing, transportation and others. In the context of ITS, IoT will help to link smart objects by having some form of sensing and detection technologies to realize intelligent recognition of the tagged traffic object, tracking, monitoring, managing and processed automatically in a secure environment.

Improvement of connectivity and the deployment of IoTs may allow the broader transportation community (including public agencies and private organisations) to be more equipped to address how individuals experience transportation. The paradigm in which we can balance between individual decision making and system-optimal transportation management is within grasp. As shown in Figure 10, a committee of stakeholders proposed to be set up to ensure the development of IoT for the benefit of ITS led by MITI.

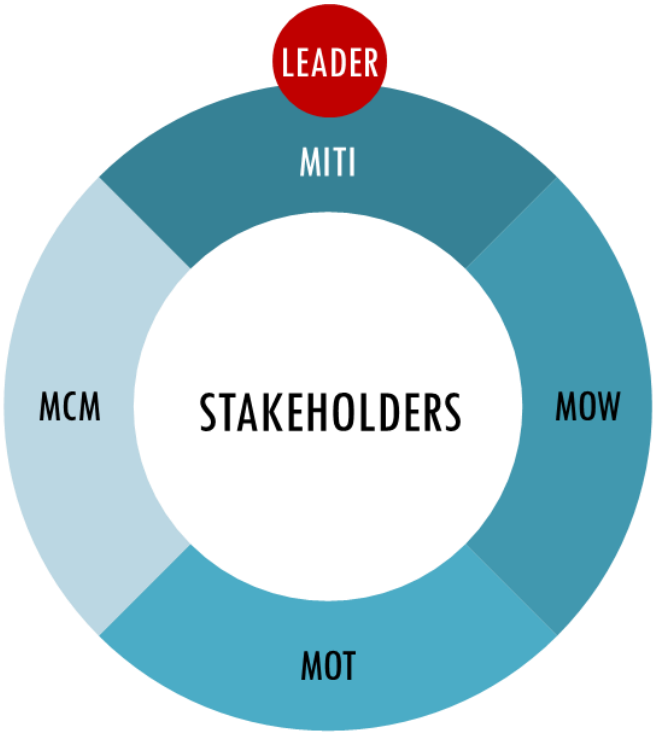


Figure 10 : Stakeholders for IoT

8.2 System and Data

Malaysia has ventured into several systems such as:

- Advanced Traffic Management System
- Safety System
- Advanced Public Transport System
- Advanced Traveller Information System
- Electronic Payment System
- Commercial Vehicle Operations System
- MHROADS for accident data collection and data analysis on highways
- Advance Passenger Surveillance System
- Parking Management System

Each system is based on different platforms and the applied system does not integrate with each other. As the nation is venturing into new connected centres, a standard platform should be available for any related projects as a base. Systems need to be intelligently networked and shared.

These systems should also share ITS data to the public (subject to terms and conditions) so that other software developers can design products that are powered by ITS services and to ease interfacing with other system.

As the government is now embracing into the digital economy, it is important to conduct studies on how to collect the data from IoT, store and perform Big Data analysis. In deployment, there is a need to understand how to extract data and aggregate from other Big Data sources to enable monetization or research topics across broad areas. A common platform based on agreed standards too should be considered as a reference on kicking off ITS related projects.

Archiving, compilation, integration, analysis and forecasting of traffic data from existing Traffic Management Centre (TMC) are required in Research, Development and Innovation to strategize the future of ITS Industry. To date, the existing control centre has gathered a lot of data as it was intended, but end up being kept for the

respective agencies. This kind of situation should be overcomed by communicating all existing control centres, either old system or updated system. In order to curb this situation further, a provision to develop a future platform is mandatory to ensure all current systems can be upgraded to a system with common basic to ease the connection between them.

The incorporation of safety elements such as total internet security, firewall and encryptions should be considered as well. As Malaysia progresses more seriously into the implementation stage, a mutual understanding among all agencies should be forged to tackle various issues like the type of shared data and hence, data security by standardizing the sensitivity of data. A committee of stakeholders proposed to be set up to ensure the development of System and Data for the benefit of ITS led by MITI, as shown in Figure 11.

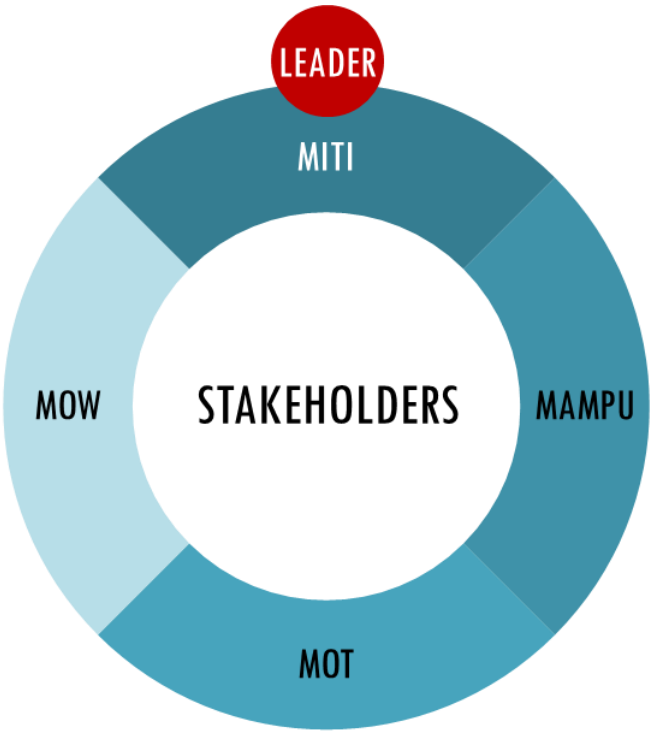


Figure 11 : Stakeholders for System and Data

Furthermore, the transportation industry is a leader in terms of volume and variety of data being generated by the various systems like Passenger Counting System, Vehicle Location System, Ticket/Fare Collection System, Asset Management System and a multitude of web and mobile applications that must be interconnected with the ITS system.

8.3 Vehicle Identification System

The growth of vehicle ownership along with overwhelming amounts of vehicle data has created a demand for automated, highly secure, and reliable Vehicle Identification Systems. The national government recognises the importance of implementing a more advanced system in order to increase safety and security and ensure regulatory compliance.

Vehicle Identification System is a widely used technique in transportation data collection. Planning become necessary to forecast the characteristics and types of transportation systems that is needed to serve the trip demand of the growing population and accuracy of data is important. The vehicle identification system would be able to store registration information about vehicles, connects to an Electronic Toll Collection (ETC) system, a useful system for law enforcement and to integrate with smart parking solution.

Types of Vehicle Identification System are Global Navigation Satellite System (GNSS) based, cellular phone data, sensors, radars and electronic transponders such as active and passive Radio Frequency Identification (RFID), Automatic Number Plate Recognition (ANPR) and vehicle's on-board unit system.

8.3.1 Radio Frequency Identification (RFID)

Vehicle Identification System using RFID with radio waves to automatically identify vehicles or track personnel and materials. The world's first passport that featured RFID in 1998 was from Malaysia. In many countries, RFID tags can be used to pay for mass transit fares on bus, trains, or subways, or to collect tolls on highways. RFID also has the capability to store vehicle information and details of the owner.

MOT is also currently exploring the possible adoption of RFID technology in the development of their Vehicle Entry Permit (VEP) system. The main objective of this system is to record and monitor all foreign vehicles entering, operating and exiting Malaysia through all of her land entry points/borders.The system will record and detect any foreign vehicles that have committed road traffic offences including the use of any unauthorised or smuggled vehicles through the unique RFID allocated to each vehicle.

A committee consisting of stakeholders will be set up to ensure the successful development of RFID for the benefit of ITS led by MOW, as shown in Figure 12.

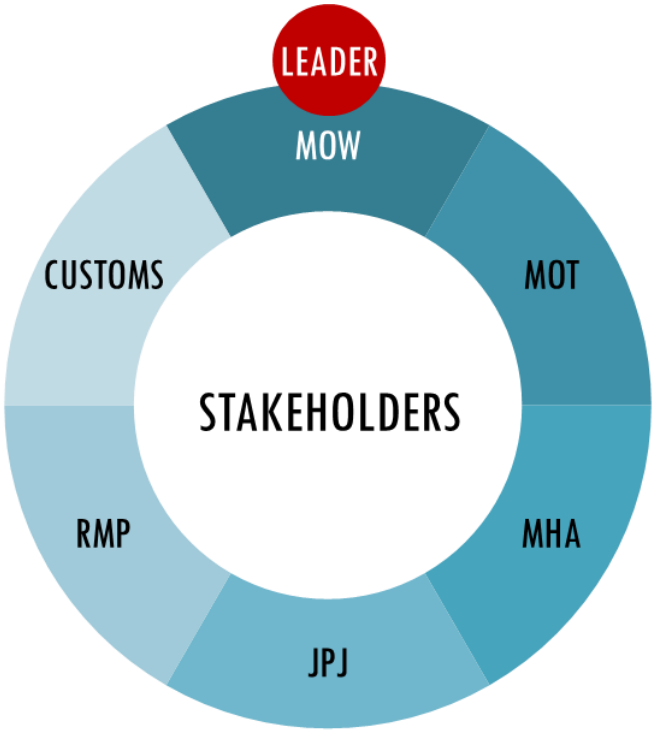


Figure 12 : Stakeholders for RFID

8.3.2 On-board Vehicle System (Commercial Vehicle)

In some developed countries, every vehicle is equipped with an on-board unit (OBU) which is intended for several purposes. The current technology is capable of producing a unit consists of in-vehicle navigation and journey recording, vehicle monitoring and service due date information. Most of this unit also equipped with GNSS and internet service. GNSS receivers (Global Positioning System-GPS, GLONASS, Galileo or Beidou system) are used in various applications. The first systems were developed in the 20th century, mainly to help military personnel find their way, but civilian applications soon became numerous.

Information on the vehicle movement is transmitted to the Central Monitoring Authority, either online or 'batch processing' utilising communication infrastructure (connectivity). A support for the journey plan also available depending on the installed OBU. The OBU may function to alert the driver for any rules violation via notification and road related charges.

The OBU also capable to function as a data collection system for Origin-Destination (O-D) survey and Vehicle-to-Vehicle (V2V) communication and also for fleet management purpose which could include parameter fencing and vehicle and driver monitoring. The data collected may be sent to the related control centres.

The automatic vehicle tracking or identification facility delivers the flexibility, scalability, and responsiveness that today's organizations need. It provides accurate, up-to-date minute information, high speed communication, and powerful analysis features required to make better decisions faster. The vehicle tracking system may be linked to the transport owners as well as the JPJ for monitoring purposes.

Vehicle telematics enables vehicle monitoring via GNSS through computer devices and mobile communication technology. As vehicles are equipped with such capability, it offers huge potential benefits to the economic, environmental and societal. Vehicle telematics applications are various including vehicle tracking, road pricing as well as safety and emergency warning systems. For this purpose, real-time data will be generated in a massive scale, including collecting and storing individual data such as driving behaviour and personal data.

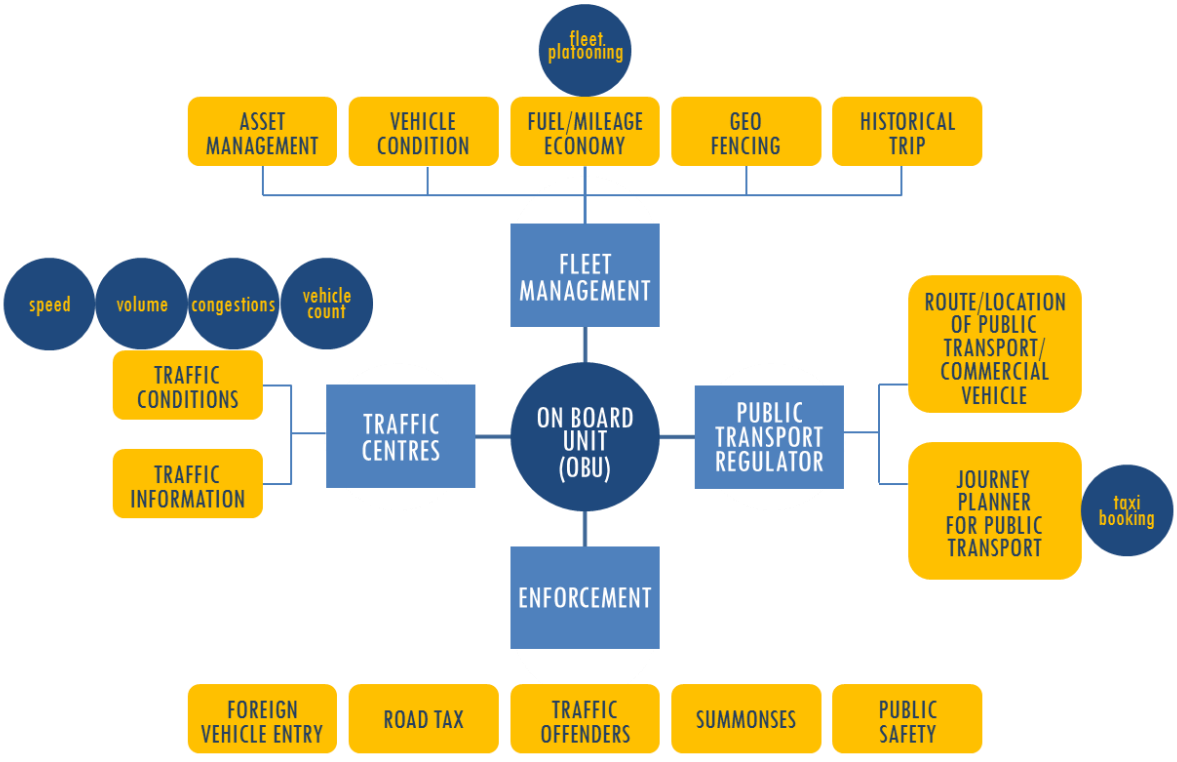


Figure 13 : Potential Usage of OBU

There are numerous benefits of installing OBUs in vehicles. The installation of OBUs in commercial vehicles will improve fleet management, public transport, data to traffic centres for traffic management purposes, public safety, enforcement of traffic violations, and foreign vehicle entry at International borders. Figure 13 shows the potential usage of installing OBUs in the vehicle. A committee of stakeholders proposed to be set up to ensure the development of OBU for the benefit of ITS led by MOT, as shown in Figure 14.

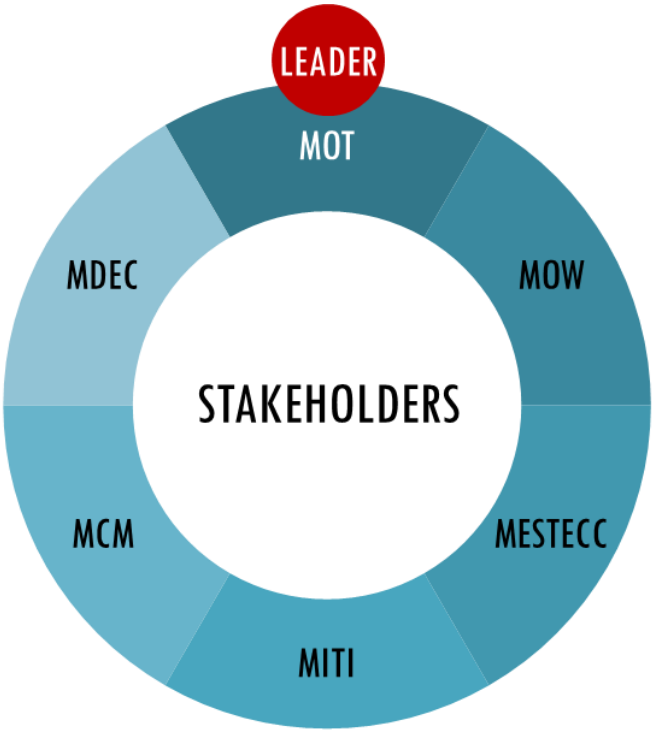


Figure 14 : Stakeholders for OBU

8.4 Roadside Communication Infrastructure

The roadside infrastructure to provide wireless communication with vehicles and management centres is crucial in the successful implementation of ITS. ITS includes several components which are wireless connection, data collection, data analysis and information dissemination.

The roadside communication infrastructure will enable traffic data to be collected. Related agencies to facilitate and allocate resources for communication infrastructure. For example, land allocation for cellular towers erection and fibre optic cable installation to ensure infrastructure readiness for connectivity and continuous cellular coverage along highways. The allocation of resources shall be incorporated in the planning stage. With proper infrastructure, data can be processed and applied to advance traffic management, safety management, automated enforcement, security and public transport system.

The installed sensors and camera could also function as a vehicle registration number detector to enforce speed violations (Automated Awareness Safety System - AwAS). In addition, it works as traffic data collection system, security at international border check points and infrastructure for enforcing of overloading (Weigh-in-Motion, WiM). Roadside infrastructure also plays a vital role in the public transportation. Data collected through infrastructure is analysed to give information in journey plan application or added application to assist in modal choice to continue the journey in order to avoid the congested area. The communication between Vehicle-to-Infrastructure (V2I), Vehicle-to-Vehicle (V2V), Vehicle-to-Centre (V2C) and the latest development Vehicle-to-Everything (V2X) including mobile devices are vital.

For the Multi Lane Free Flow (MLFF) system to be successfully implement, 100% internet connectivity is a requirement, failing which the implementation of MLFF will be stalled. The captured data on each data transaction will be sent to the managing centre in real time or otherwise in batches. Construction of gantries to provide the infrastructure e.g. installation of reader, cameras etc. may be required or the efficient use of existing gantries can be studied.

8.4.1 Video Image Processing

Video Image Processing is a versatile video surveillance system using existing or new closed circuit television (CCTV), that employs advanced video analytics to automatically analyze the scene of interest and extract information for traffic surveillance and control. Video Image Processing will analyse video feeds to provide situational awareness and offline forensics as a standalone or integrated system. Some analytics suitable for ITS would include Automatic Number Plate Recognition (ANPR), automatic vehicle classification, automatic vehicle counting and automatic vehicle make and model detection.

8.4.2 Infrastructure for Autonomous Vehicle (AV)

Autonomous Vehicle (AV) is supposed to able to detect road marking and nearby obstacles when the AV is on the move. A clear and fresh road marking is important so the vehicle can determine which direction to go and avoid causing danger to other road users. Besides that, road signage detection is also one of the AV features. The direction sign will navigate the AV to the pre-set destination smoothly. The direction signs must have a unique GPS coordinates and also destination information such as distance and name of the places.

Current speed limit signage is placed at the roadside for eyesight only. However, it can be improved by installing sensors that will inform the AV to drive within the permissible speed limit and alert AV if they are driving exceeding the speed limit. The speed limit signboards should be categorized by type of the road in accordance with the current gazetted roads.

In Malaysia, each of the bridges has their own limit of maximum allowable loading for a vehicle to pass through. Therefore, AV has an advantage because it can store data of maximum allowable loads for bridges and the location. The AV, especially heavy trucks are already aware of its own loading and the capacity of each bridge before the system decides the vehicles to pass through or not. In some special cases like heavy trucks platooning, the lead vehicle will determine the number of trucks to pass through first before letting the rest of them to resume crossing of the bridge.

The emergence of AV technology can boost the potential and efficiency of NITMC by auto-detecting road damages. The sensor may detect any uneven surfaces to a certain degree that it will analyse the reading as potholes, rutting or cracks. The data from detection of the road damages can trigger the relevant authority to repair the road in a shorter time as compared to the previous conventional way which is by inspecting the road manually. In addition, the data also can be recorded for prediction of road lifecycle data so the relevant authority can set an appropriate schedule for road maintenance by taking cost and manpower into consideration.

On the other hand, once the schedule of road maintenance is set, the schedule can be shared with the public so they are aware of the road repair before they start their journey. Hence, it will benefit both parties, the authority and the public by smoothen the road repair process and reduce congestion at the same if the public received the information earlier.

8.5 Crowdsourcing

Crowdsourcing is a cost effective and easy way to anonymously obtain information from publicly available data on the internet regarding Malaysian transport services. These data can be analysed to measure overall sentiments of our transport services quality for agencies to take actions promptly.

Crowdsourcing is also a way to obtain information from hardly accessible area such remote area with the help of a smartphone. The public can share data on the site like accidents, natural occurrences and any emergency response needed at the time. In addition, through crowdsourcing, we can measure also the Malaysian traffic patterns and traffic crowdedness to allow related agencies to be able to manage traffic congestions in a more effective manner.

9.0 STANDARDS, POLICIES AND REGULATIONS

9.1 Standards

ITS standards define how ITS systems, products, and components can interconnect, exchange information, and interact to deliver services within a transportation network. ITS standards are designed to promote interchangeability and interoperability. The use of standards assures transportation agencies that components from different manufacturers will work together.

Results include greater efficiency, improved mobility and safety, compatibility and interoperability within the industry. As there are already international standards related to ITS, adoption of the appropriate standard should be considered. For future merging and integration, the best way is always to develop a common standard and platform for every aspect of usage. Related international standards should be thoroughly selected and adopted in characterising platform to be developed. Common platform shall cater for any upgrading in the future. Currently under TC204, there are 12 active working groups as shown in Figure 15 below:

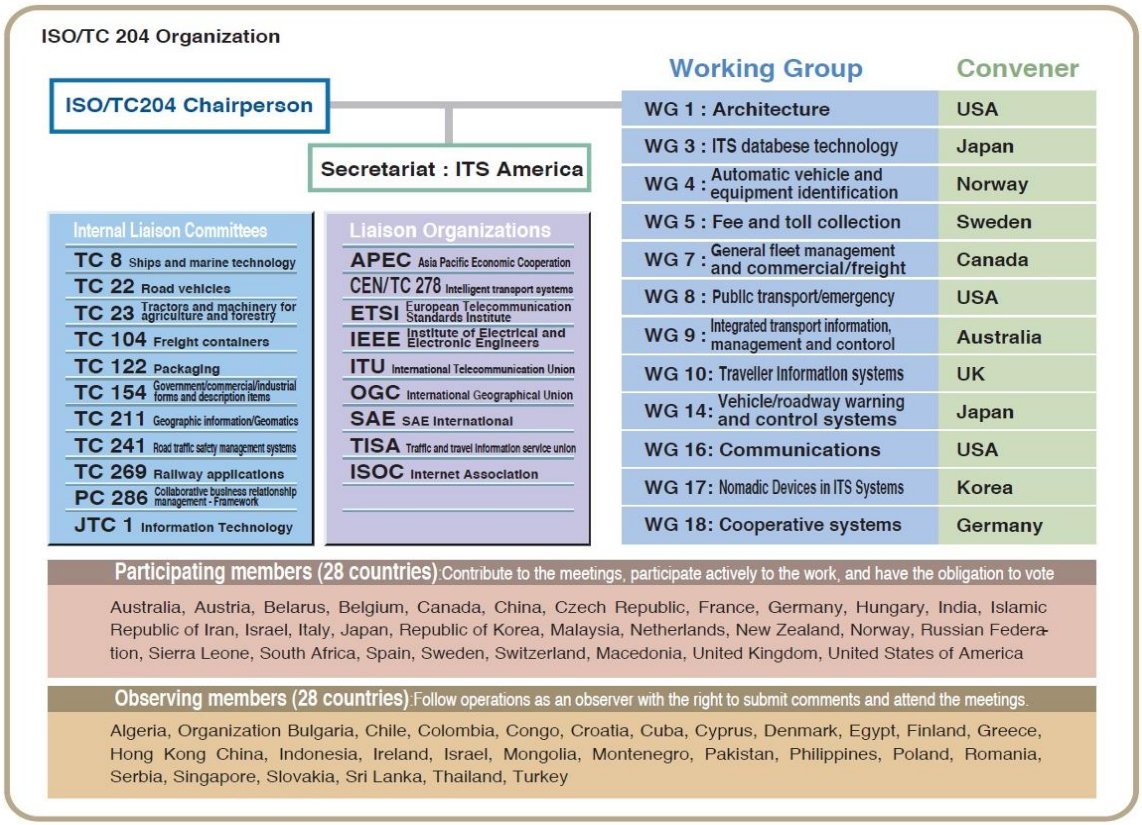


Figure 15 : ISO TC 204 Working Group Structures (Source: ITS Standardization activities)

A committee of stakeholders proposed to be set up to ensure the development of Standards for the benefit of ITS led by MITI, as shown in Figure 16.

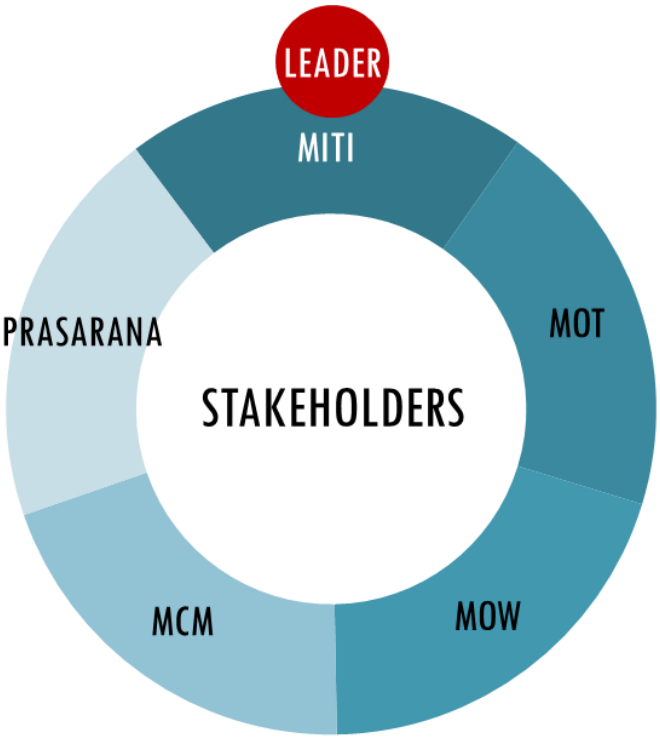


Figure 16 : Stakeholders for Standards

9.2 Policies and Regulations

The Malaysian ITS Blueprint (2019-2023) shall be used in charting the future of ITS in Malaysia. It has to be set as a National Policy that any ITS development has to be in phase with the ITS Blueprint.

Every agency shall include in their plans, policies to cover and cater on early plans by including the following:

- By adding ITS approach in every transport related effort.
- 'The needs to work with each other'.
- Openness in data sharing that benefits each other.

Different government agencies have their very own policies towards development in their areas of expertise based on their strategic plans and ITS shall be a component of their plans. For example, the National Transportation Policy that is currently being finalise by the Ministry of Transport will be inclusive to cover all transportation sectors in Malaysia. Harmonization of policies will have to take place in order for Malaysia to set foot in expanding ITS.

The followings are codes, policies and regulations understudied for the implementation of ITS:

- National Automotive Policy (NAP)
- Digital Signature Act
- Dasar Angkasa Negara 2030
- Data Protection Act in terms of use of personal data and security
- Reuse of Public Sector Information Regulations 2005
- Data Retention (EC Directive) Regulations 2007
- Privacy & Electric Communications Directive 2002
- Privacy and Electronic Communications (EC Directive) Regulations 2003.
- Code of Practice on Vehicle Tracking and Automatic Number Plate Recognition (ANPR)
- Privacy issues in wider telematics and ITS
- Data exploitation, licensing and interoperability present structural and contractual challenges.
- European Commission of e-Safety Policies on data sharing between government agencies
- Industry Code Of Practise (ICOP) safety guideline

In order for ITS to be successfully implemented in Malaysia, several acts or traffic rules may need to be reviewed as follows;

- Akta Jalan-Jalan Persekutuan (Pengurusan Persendirian) 1984 (Akta 306)
- Akta Polis 1967 (Akta 344)
- Akta Pengangkutan Jalan 1987 (Akta 333)
- Akta Lembaga Perlesenan Kenderaan Perdagangan 1987 (Akta 334)
- Akta Pengangkutan Awam Darat 2010 (Akta 715)
- Peraturan-Peraturan Panduan Undang-Undang Jenayah – mengandungi Kanun Prosedur Jenayah (Akta 593)
- Akta Keterangan 1950 (Akta 56)

A committee of stakeholders proposed to be set up to ensure the development of Policies and Regulations for the benefit of ITS led by MCM, as shown in Figure 17.

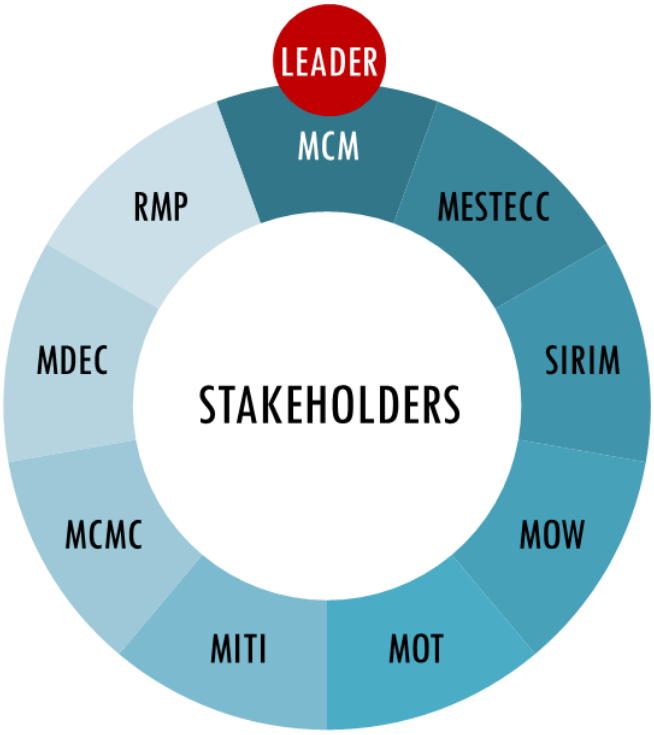


Figure 17 : Stakeholders for Policies and Regulations

10.0 DRIVING ITS TO A NEW NORMAL

Since the early days of ITS implementation in Malaysia, the most common ITS application that is currently being practiced are as below:

- Area Traffic Control System (ATCS)
- Electronic Tolling Collection
- Traffic Control and Surveillance Systems (TCSS) for Toll Highways
- Integrated Transport Information System (ITIS) DBKL
- PLUS Traffic Monitoring Centre
- MHA Traffic Management Centre
- Bandar Tasik Selatan Integrated Transport Terminal
- Storm Water Management & Road Tunnel (SMART)
- Automatic Awareness Safety System (AwAS)
- Performance Monitoring Hub System (PMHS), APAD
- Rapid KL Public Transport Information System
- Automated Passenger Fare System
- Integrated Common Payment System (ICPS)

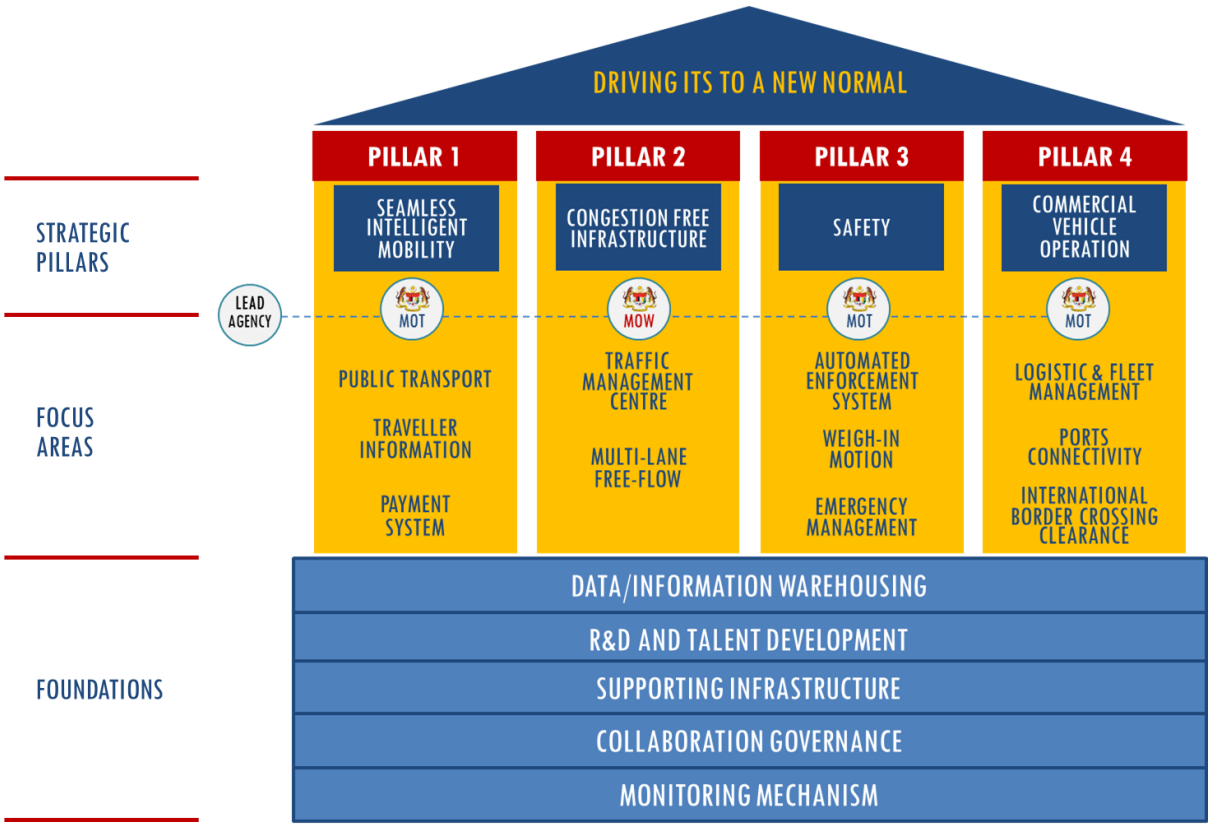


Figure 18 : Four (4) Strategic Pillars for Malaysian ITS

As shown in Figure 18, there are 4 Strategic Pillars, i.e. Seamless Intelligent Mobility, Congestion Free Infrastructure, Safety and Commercial Vehicle Operation. Under each pillars are focus areas. The pillars and focus areas are supported by integrated foundations consisting of Data/Information Warehousing, R&D and Talent Development, Supporting Infrastructure, Collaboration Governance and Monitoring Mechanism.

PILLAR 1 : SEAMLESS INTELLIGENT MOBILITY

Intelligent Mobility is focused on connecting people, places and goods across all modes of transport. Seamless Intelligent Mobility will be achieved by enhancing three (3) focus areas, i.e. Public Transport, Traveller Information and Payment System that will help more people to travel safer and quicker, with a better experience.

PILLAR 2 : CONGESTION FREE INFRASTRUCTURE

A suitable infrastructure could help to reduce congestion with traffic flow and accident reduction that will provide a better routing of traffic around the road network. Two main focus areas has been listed to improve traffic flow in the cities are Traffic Management Centre (TMC) and Multi Lane Free Flow (MLFF).

PILLAR 3 : SAFETY

ITS offers significant opportunities through 3 focus area namely Automated Enforcement System, Weigh-in-Motion and Emergency Management, to save lives by using a technology available today. Technology embedded in or adjacent to roadways plays a key role in improving driver, passenger, and pedestrian safety.

PILLAR 4 : COMMERCIAL VEHICLE OPERATION

Three (3) focus area has been outlined to enhance Commercial Vehicle Operation with ITS technology consists of Logistic & Fleet Management, Ports Connectivity and International Border Crossing Clearance.

10.1 Seamless Intelligent Mobility

The global transport system is evolving to create intelligent and integrated systems that work across multiple forms of transport. By realizing current approaches to transport will not be sufficient for our future needs, Seamless Intelligent Mobility being mapped to faced with the combined challenges of an ageing global population, rapidly increasing urbanisation and the corresponding strain on the environment.

Imagine a world where journeys are seamless, transport is smart and connected, and delays and congestion are a thing of the past. Intelligent Mobility is focused on connecting people, places and goods across all modes of transport. As shown in Figure 19, Seamless Intelligent Mobility will be achieved by enhancing three (3) focus area, including Public Transport, Traveller Information and Payment System that will help more passengers travel safer and quicker, with a better experience.

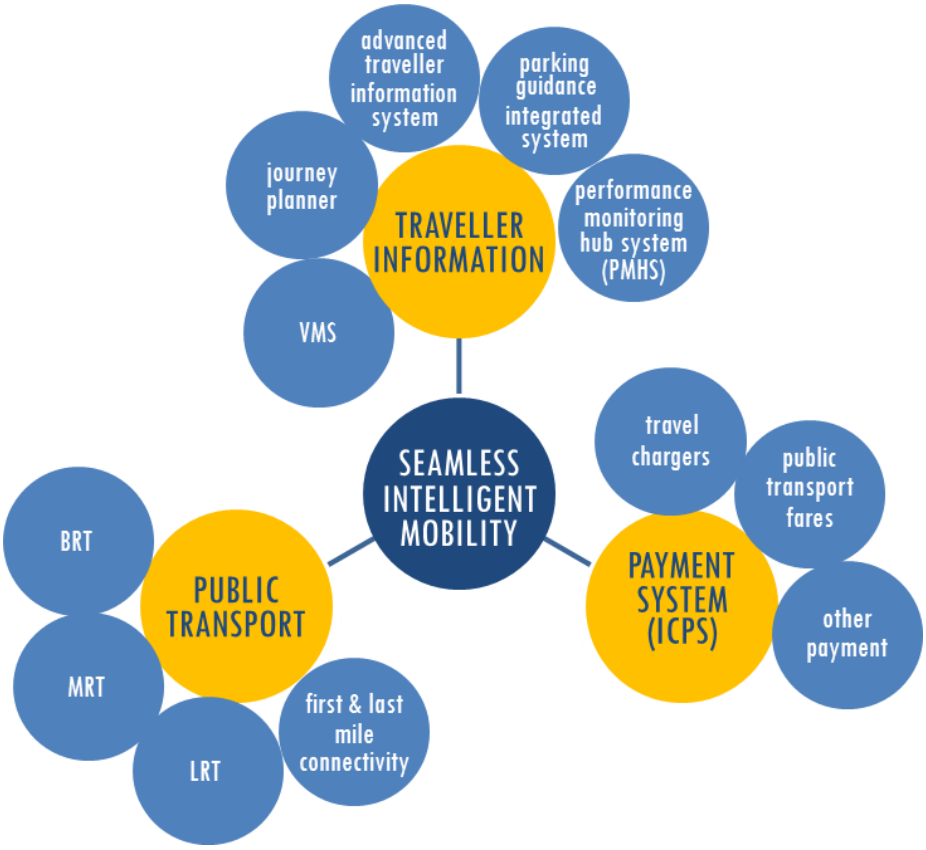


Figure 19 : Seamless Intelligent Mobility Focus Area

10.1.1 Public Transport

As stipulated in the Eleventh Malaysia Plan, a seamless transportation system and enhance mobility of people can be achieved through the development of transport infrastructure and services.

The Land Public Transport Commission (SPAD) was formed in 2010 and has been given the responsibility to lead the transformation of Malaysia's land public transport. Previously, SPAD has formulated the National Land Public Transport Master Plan (NLPTMP) which sets out the vision and direction for public transport in Malaysia.

Now, Land Public Transport Agency / Agensi Pengangkutan Awam Darat (APAD) is responsible in integrating the rail, bus and taxi services in providing and enabling smooth public transportation to the public. The effectiveness of managing public transport cannot be achieved without ITS.

Greater Kuala Lumpur's (GKL) backdrop of heavily congested highways is a favorable environment for wider public transport adoption as (and if) adequate – i.e. safe, reliable, well targeted-public transport.

Source:
Crafting Malaysia's National Transport Strategy

The purpose of ITS in the public transport sector is numerous. It commences from the scheduling of the services, integration of the different modes and up to the payment system.

As stated in the 'Greater KL/Klang Valley Land Transport Master Plan', Urban Rail Development (URDP), is one of six subsidiary plans of the Greater Kuala Lumpur/Klang Valley Master Plan. The URDP establishes the basis for the development of regional rail in the Greater Kuala Lumpur/Klang Valley region while the Bus Transformation Plan (BTP) is to set the basis for the development and integration of bus services in the Greater Kuala Lumpur/Klang Valley region.

Currently, ten (10) railway line has been established consisting of KTM Komuter, Light Rapid Transit (LRT), Mass Rapid Transit (MRT) as in Figure 20, Express Rail Link (ERL) and Monorail to provide the main spine of URDP. Bus Rapid Transit (BRT) has marked its existence as a secondary corridor to fill in the gaps of rail networks.

Figure 20 : Mass Rapid Transit - MRT (Source :www.thesundaily.my)

An ideal public transport system will not be completed without considering the first and last mile modes for travellers. Integration of the first and last mile modes requires facility for walking and cycling, linkages of feeder bus services, real-time passenger information with proper stations and parking facilities.

10.1.2 Traveller Information

10.1.2.1 Journey Planner

Journey Planner service/application allows users to plan their journeys via online, across different modes of transport from the comforts of their home. Additionally, users can compare and find out which mode of transportation is more cost-effective and time-consuming either via public transport, private vehicles or mix mod.

Journey Planner can be accessed via website/web application/mobile applications that provide information about real-time updates on public transport arrival times. The application prompts a user to input an origin and a destination, which support door-to-door planning.

Bus location information is collected and processed at the traffic info centre and user can check such information through mobile and at the bus stop in the real-time. Information of bus location, arrival time and departure time can be distributed thus increase the satisfaction of the user and vitalizing in public transport.

With both the voice broadcast system and LCD display in the bus able to inform passengers of the next stop. This is particularly useful for elderly, disabled travellers and tourists or passengers who are travelling the route for the first time.

Journey Planner also gives a real time for rail scheduling. This service will show the bus and rail network to the user if they intend to use bus and rail as a transport to reach the destination. The journey planner will give the public the seamless travel that they need. It can become an encouragement to move from private cars.

10.1.2.2 Performance Monitoring Hub System (PMHS)

On the other hand, there is a need of monitoring mechanism that can monitor and review the performance of public transport transformation at a macro level. To ensure comprehensive macro-level monitoring, a Performance Monitoring Hub System (PMHS) has already been set up to ensure that key data is captured to monitor land public transport systems throughout the country, and to identify specific challenges and areas that need enhancement.

However, integration between the public transport and road traffic management has to be in place for the effectiveness of both public transport and highway system.

10.1.2.3 Variable Message System (VMS)

VMS is beneficial to all road users as it shows real-time and informative message to road users as they can plan their journey more efficiently. Traffic jams, accidents, road blocks and suggestions of alternative routes can be displayed on VMS, so the road user can avoid congestions, diverting incoming traffic from adding more traffic jams and also ensuring the safety of the road user if there is a blockage caused by accidents or road blocks ahead of them. VMS can also be used to display the current speed of the moving vehicles as an alert to them to control their vehicle speed. Dynamic road signage as shown in Figure 21.

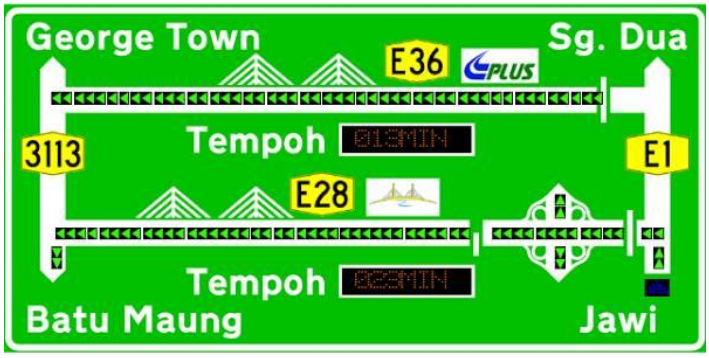


Figure 21 : Dynamic road signage on Jambatan Sultan Abdul Halim Mu'adzam Shah

10.1.2.4 Parking Guidance Integrated System

Parking system can utilise the VMS by providing real-time information on displaying the amount of vacant parking space. The measurement of available parking lots can be achieved using either Video Image Processing (VIP) on open parkings or IoT sensors on closed parkings. In addition, parking booking system via mobile application is one of the ways to display parking information and enhanced with the feature to book the parking spot in certain allocated time. This will help reduce travel time of driver and decrease fuel combustion of vehicle which means reduced air pollution.

10.1.2.5 Advanced Traveller Information System

A committee of stakeholders proposed to be set up to ensure the development of Advanced Traveller Information System for the benefit of ITS led by MOT, as shown in Figure 22. The Advance Traveller Information System comprises many components as listed below:

- Integration of E-hailing and Existing Taxi Network Operators System
- Passenger Information Display at bus and rail station
- Centralised Taxi Service System (CTSS)
- Bus and Rail Network Optimization (Eg: Bus Network Revamp-BNR)
- Traveller Origin-Destination (O-D) Survey
- Traffic Movement Pattern Information
- Bus and Rail Scheduling

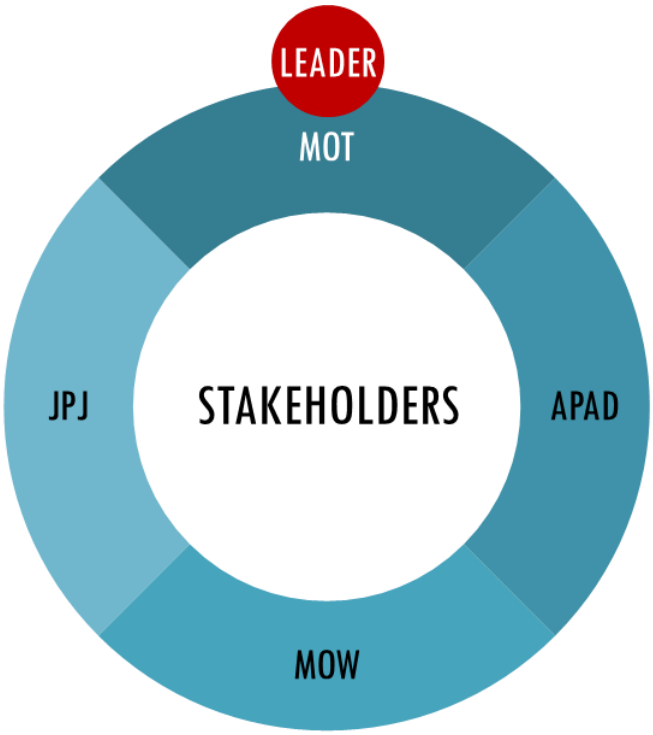


Figure 22 : Stakeholders for Advanced Traveller Information System

- Bus Priority Lane and Junction
- Real-time Bus Location
- Taxi Performance Monitoring
- Ehailing Services
- Communication Network Infrastructure
- Parking Information Display

10.1.3 Payment System

10.1.3.1 Electronic Tolling Collection (ETC)

The ETC development in Malaysia started in 1994. The system is now 100% implemented nationwide. The main aim of the ETC is to eliminate the delays on toll roads at the toll booths and at the same time faster journey time, reduce congestion and pollution.

As planned by the Malaysia Highway Authority (MHA), highway tolling in Malaysia will embrace the Multi Lane Free Flow (MLFF) method, thus making each car compulsory to have a transponder. The transponder's personalised signal would be picked up when the car passes through the toll gantry, and then relayed to a central computer which would calculate the charge according to the toll location and the time of day and add it to the car owner's account. The Electronic Payment System provides travellers with a common electronic payment medium for all transportation modes and services.

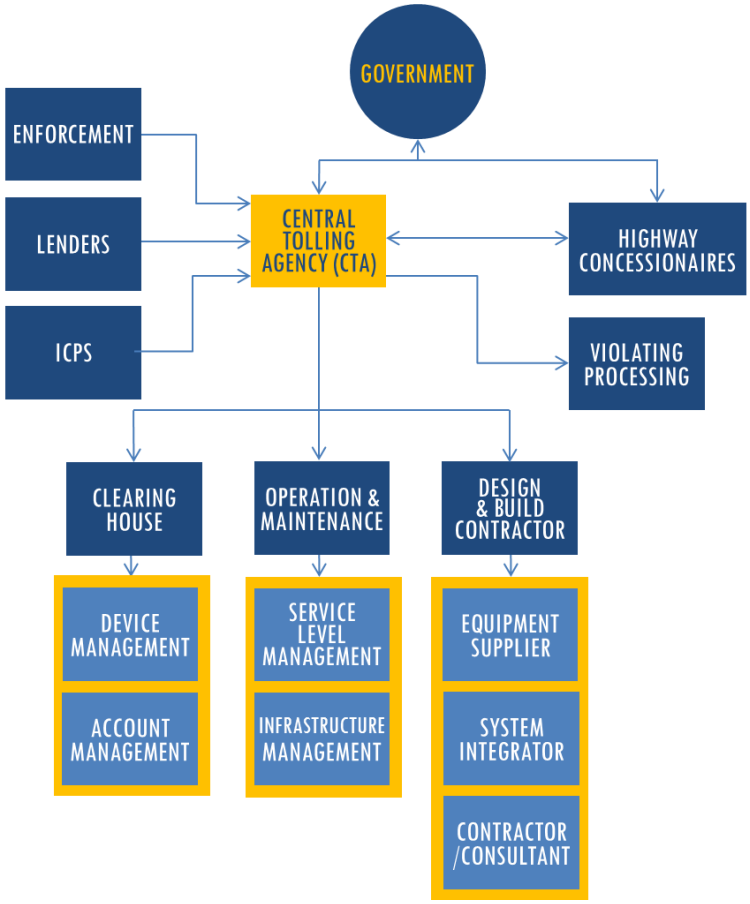


Figure 23 : Central Tolling Agency (CTA) Structure

A Central Tolling Agency (CTA) shall be appointed for the process of implementing Single Lane Free Flow (SLFF) and Multi-Lane Free Flow (MLFF) which act as a central agent for toll collection. The role of the CTA also includes providing infrastructure for toll collection, operation and maintenance of the infrastructure. The CTA Structure is shown in Figure 23. A committee of stakeholders proposed to be set up to ensure the development of Electronic Tolling Collection for the benefit of ITS led by MOW, as shown in Figure 24.

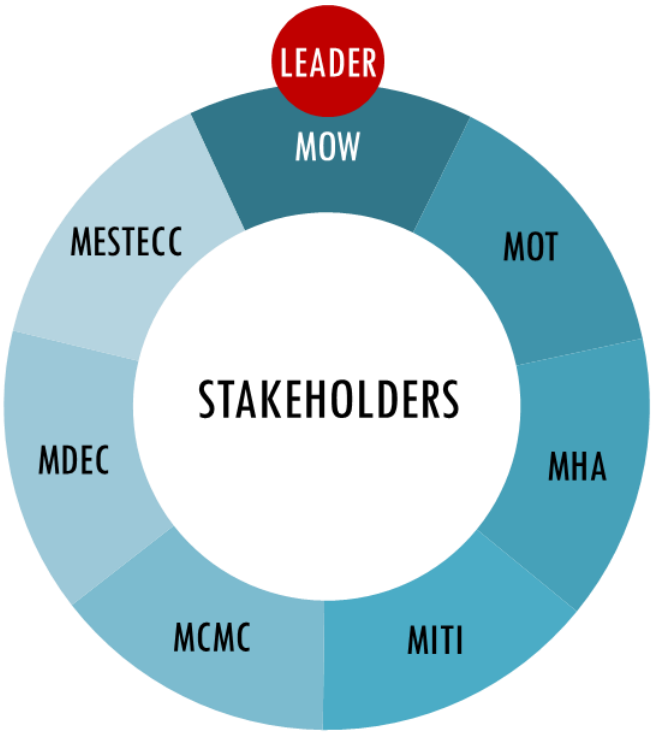


Figure 24 : Stakeholders for Electronic Tolling Collection

10.2 Congestion-Free Infrastructure

Congestion is most often associated with road transport and occurs when the volume of traffic approaches the available capacity. This leads to queuing, resulting in journey times becoming longer and more unpredictable.

Congestion-Free Infrastructure is an important element to counter this problem. Certainly, a suitable infrastructure could help with traffic flow and accident reduction. With a better routing of traffic around the network could also greatly help reduce congestion. Two main infrastructures which are still in planning to improve traffic flow in the cities are Traffic Management Centre (TMC) and Multi Lane Free Flow (MLFF) as shown in Figure 25.

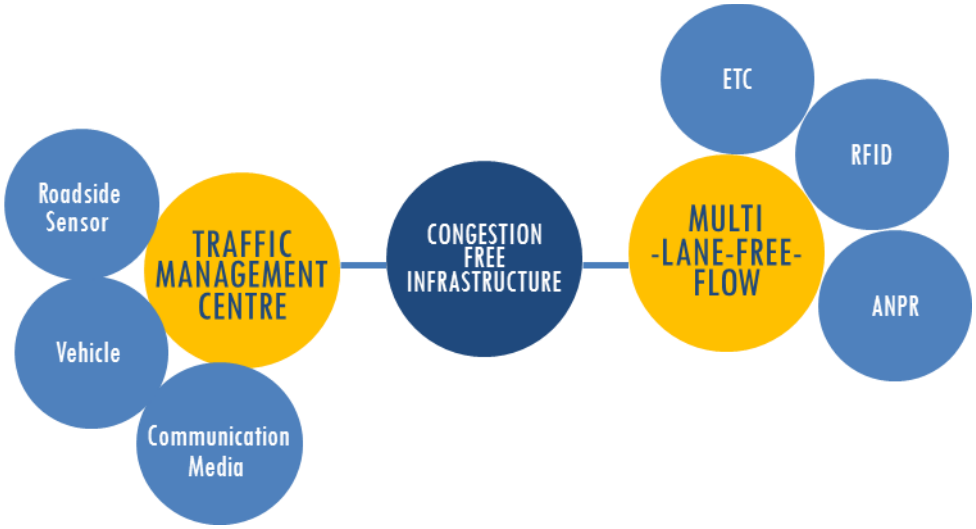


Figure 25 : Congestion Free Infrastructure Focus Area

10.2.1 National Intelligent Transportation Management Centre (NITMC)

The objective of developing National Intelligent Transportation Management Centre (NITMC) is to integrate and centralise traffic and other data information to be shared and disseminated to relevant agencies for purposes of traffic, transport management, safety and disaster management.

According to Malaysia Economic Monitor: Transforming Urban Transport report by The World Bank in June 2015, total loss due to congestion was estimated about RM 13.09 billion per year with sum of total wage loss (RM 10.82 billion/year),

total fuel loss (1.08 billion/year) and total loss on environmental impact (RM 1.19 billion/year). With NITMC in place, about 30% of reduction are estimated with a value of RM 4 billion/year. Hence, the reduction of losses due to congestion is about RM 40 billion in 10 years duration. The NITMC estimated impact on reducing congestion are shown in Figure 26.

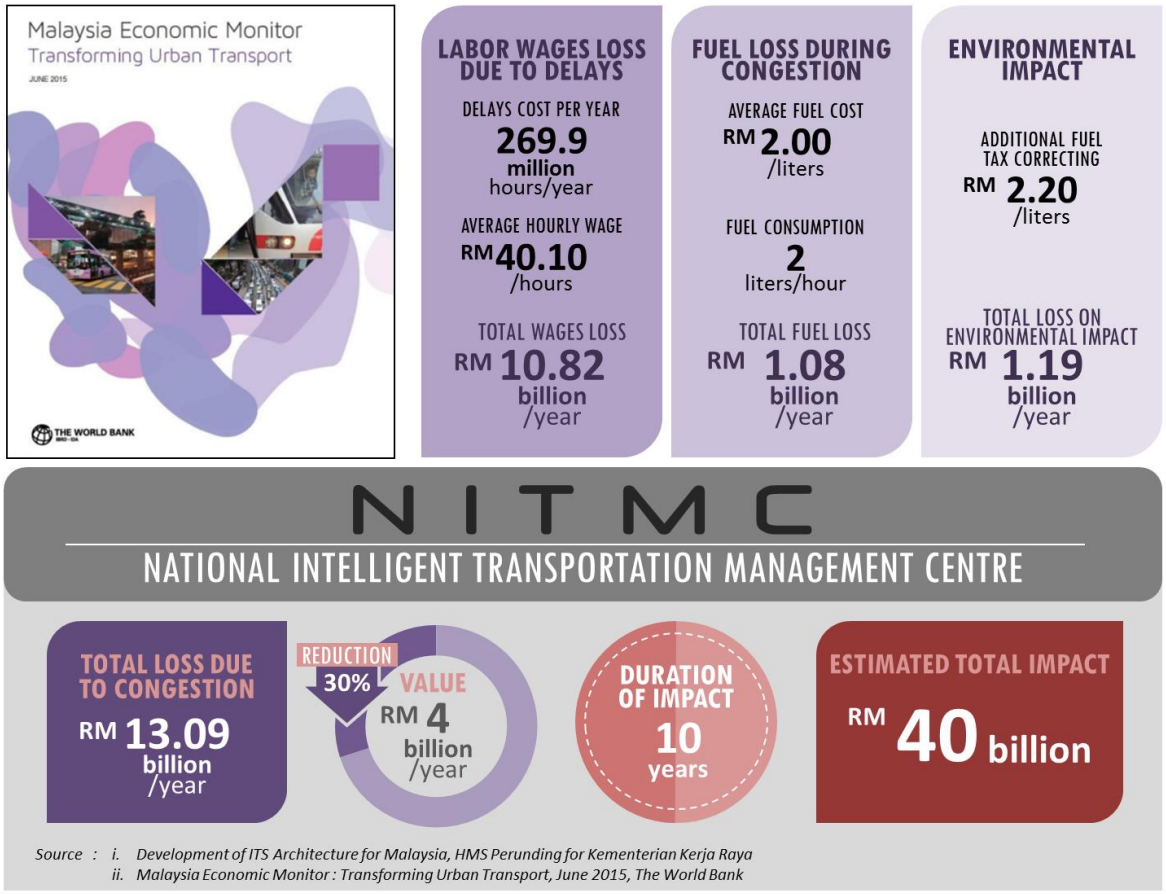


Figure 26 : NITMC Estimated Impact on Reducing Congestion

NITMC which operates by using Video Image Processing (VIP) will provides real time data for traffic monitoring, incident detection and traffic data collection functions to facilitate traffic management. As VIP systems can be utilised for other purposes, the cost can often be defrayed across two or more departments. At certain locations where the traffic volumes are moderate, other technologies such as Bluetooth or Wi-Fi Tracking System would be applied. This system is a fraction of the cost of the VIP.

The establishment of a control centre is generally intended to collect data in the first place and relay back responses that need to be carried out at a location where situations arise. Currently, there are several control centres in Malaysia focus first on its specific purpose upon setup. However, these centres are not fully utilised as it only runs to meet its own objectives. Integrated Transport Information System (ITIS), DBKL in Figure 27 is an established control centre that monitor traffic in Kuala Lumpur.

Figure 27 : ITIS, DBKL
(Source : www.thestar.com.my)

The next focus is on data sharing between agencies, as gazetted by MAMPU. As this understanding being applied to all agencies, data sharing between the existing control centres also should take place. The most common data should be shared between the control centres and the data shall be archived as part of a data warehouse initiative. This initiative may benefit the nation via Big Data analysis. In order for the government to improve the services, NITMC should also leverage the use of crowd-source data such as traffic and social media data to benefit in three areas:

- Diverse solutions,
- Resource maximisation and,
- Increased engagement.

In relation to ITS application, Data Centre as a Service (DCaaS) approaches are beginning to gain popularity due to low cost setting up. As the existing control centre will continue to run their current task, the suggested DCaaS will play role as a centre of collecting data and bridge between one control centre to another. NITMC should support the autonomous data collection from various sources such as wireless sensors, VIP, OBU and even crowdsource data. Data Flow Structure for NITMC as shown in Figure 28, consisting of Data and Security, Data Processing, Internet of Things (IoT), Roadside Communication, Crowdsourcing and Integration with Agencies. It can be seen that Transportation Services involving the 9 sectors of ITS is separated between government and citizen centric.

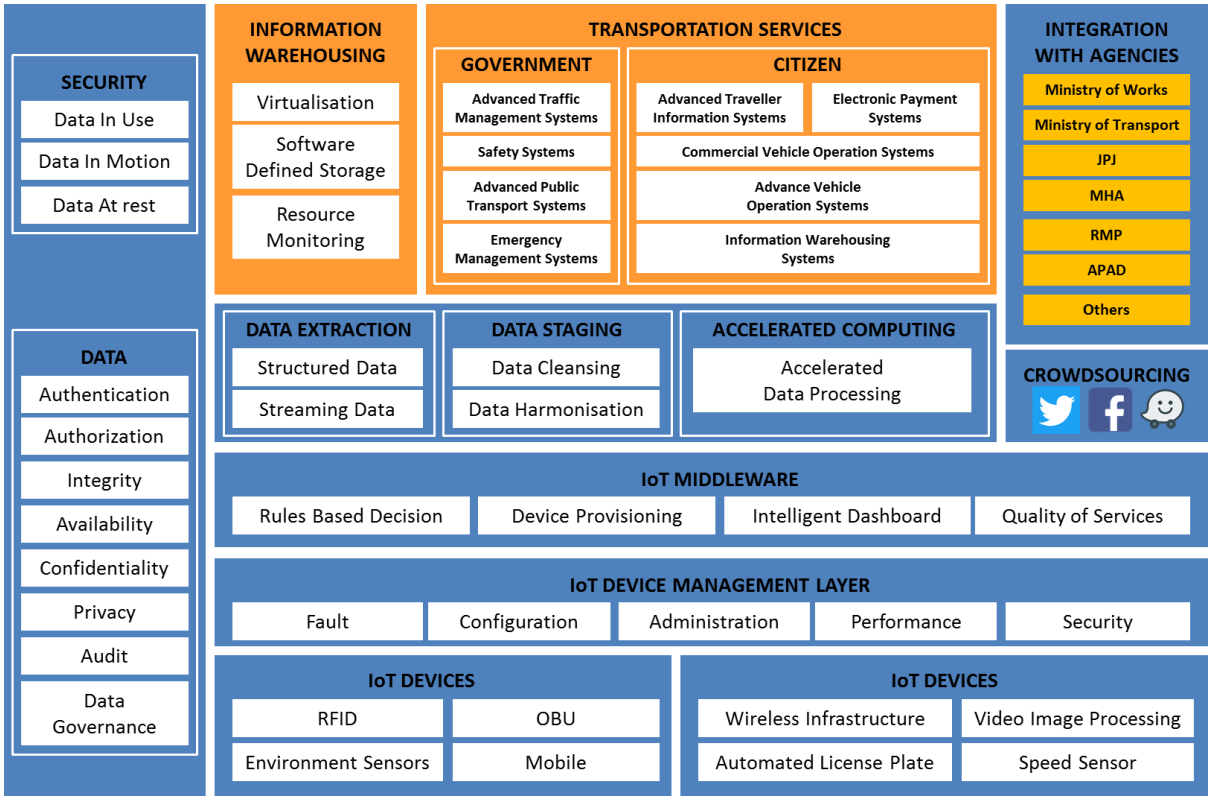


Figure 28 : Data Flow Structure for NITMC

NITMC at the national level should involve agencies such as the Ministry of Works, the Ministry of Transport, APAD, the Ministry of Housing and Local Government, Dewan Bandaraya Kuala Lumpur, Putrajaya Corporation and the Royal Malaysian Police. When the agencies involved are under one organization, then any traffic control centre of each agency will be integrated under a single master control centre. It can simultaneously solve the problems of the implementation.

A committee of stakeholders proposed to be set up to ensure the development of NITMC for the benefit of ITS led by MOW, as shown in Figure 29.

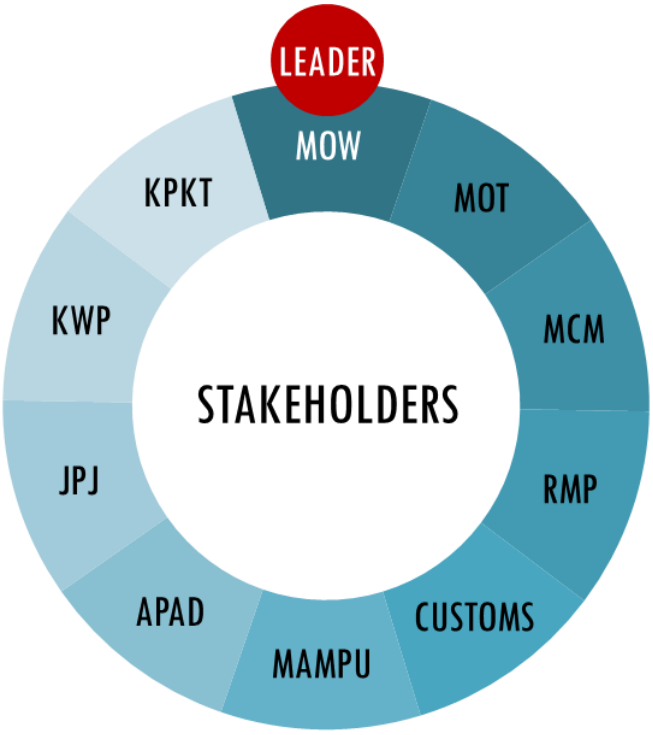


Figure 29: Stakeholders for NITMC

10.2.2 Multi Lane Free Flow (MLFF)

As the number of traffic increases, congestion at toll booths occurs. To alleviate this congestion at toll booths, the way forward is by implementing the Multi Lane Free Flow (MLFF).

The first phase or transitional phase in implementing MLFF is by addressing it using the Single Lane Free Flow (SLFF). In the early stages of SLFF implementation, Smart Tag lanes and Touch n Go lanes are still available and gradually the alley will be converted to RFID passage. Migration to Multi Lane Free Flow (MLFF) will involve several phases of implementation and depicted in the Figure 30 below:

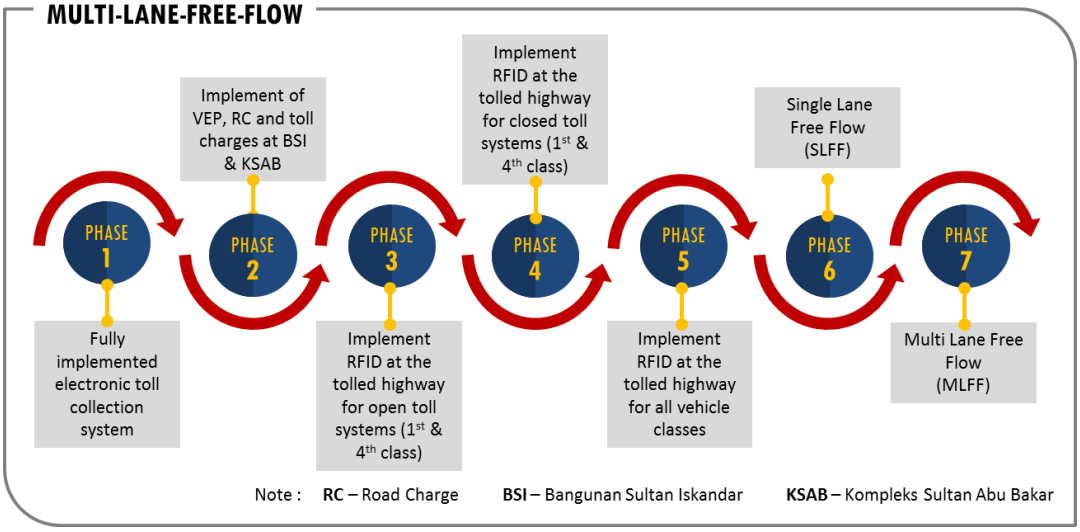


Figure 30 : MLFF Implementation

The MLFF system solution is based on the efficient combination of Electronic Tolling Collection (ETC) and RFID system and video processing. The MLFF system architecture is based on identification, detection, classification of the vehicle, charging the vehicle and finally enforcement. The toll collection systems via ETC and RFID include various components:

- The roadside system to communicate and perform correct transactions;
- The RFID in the passing vehicles;
- The vehicle detection, camera and classification system;
- The payment system;
- The enforcement system for non-compliance cases.

With the usage of RFID, different agencies would also have the opportunity to utilise this device. For instance, JPJ has started using RFID on the foreign vehicles for the Vehicle Entry Permit. JPJ together with MHA have progressively worked together for the usage of an integrated RFID tag.

Currently, advance testing using an RFID system for toll is underway at several highways in the Klang Valley. The RFID system initially utilises Touch 'n Go new back-end i.e. account-based payment system, accessible via mobile applications which can also be used for payment in retail, e-commerce and other financial services in the future.

To support the RFID concept, Automatic Number Plate Recognition (ANPR) should be incorporated with the RFID as a countermeasure to ensure the smoothness of the system. Actions should be taken against vehicle owners with plate numbers that do not comply with standard plate numbers and also placement of plate number that are not visible to the ANPR camera. All the transmission of data from RFID devices shall be encrypted and comply with National Cryptography Policy.

Rules and regulations related to the flow of money upon collection of toll payment, should be in place and be reviewed in parallel with the current activities that is taking place. A committee of stakeholders proposed to be set up to ensure the development of MLFF for the benefit of ITS led by MOW, as shown in Figure 31.

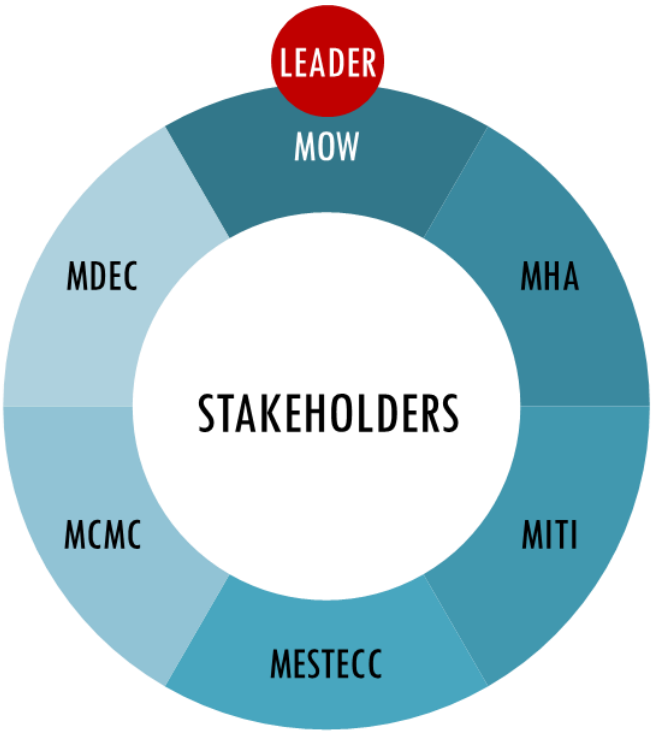


Figure 31 : Stakeholders for MLFF

10.3 Safety Systems

Roadway safety is a serious public health issue in Malaysia. ITS offers significant opportunities to save lives by using a technology available today to make vehicles and roadways safer. Technology embedded in or adjacent to roadways plays a key role in improving driver, passenger, and pedestrian safety. As shown in Figure 32, ITS offers significant enhancement in Safety System by outlining three (3) Focus Area, namely Automated Enforcement, Weigh-in-Motion and Emergency Management.

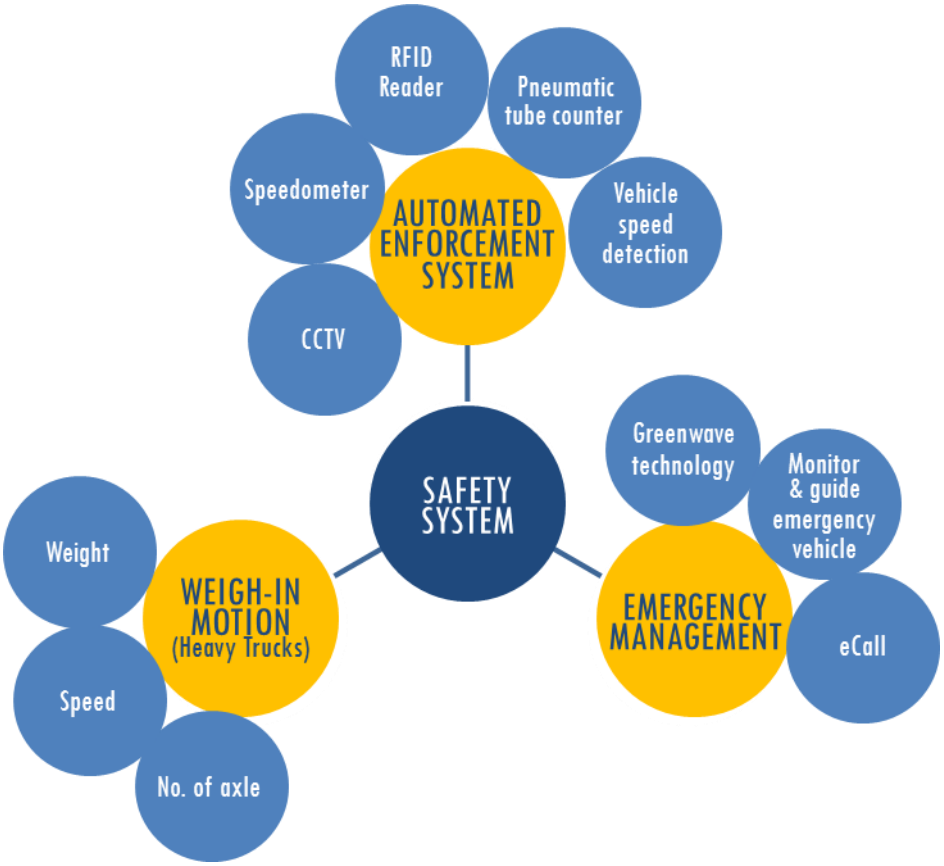


Figure 32 : Safety System Focus Area

10.3.1 Automated Awareness Safety System (AwAS)

One of the contributing factors to accidents is speeding. The result of vehicle speed can change the severity of accidents from damage only to could be a fatal accident. Speeding violation is one of the most common violations by road users. The Government has recently implemented the automated enforcement on speeding violation known as Automated Awareness Safety System (AwAS).

Sensors are placed within the roadway to record vehicles with speeding violations. An image is captured for the purpose of using as evidence on issuance of summonses. Currently the summonses issued are not totally automatic, but with a vehicle identification system in the future the summonses on the automated enforcement system can be fully automatic.

10.3.2 Weigh-in-Motion (WiM)

Currently, there are weighbridge stations built all over the country, but a more efficient way of curbing overloading is by installing the Weigh-in-Motion (WiM) system. WiM can be installed on the roadway without having the personnel to stop the heavy vehicles in order to issue summonses. It can be supported at the back end, thus making it an automated enforcement to prevent overloading vehicles.

A committee of stakeholders proposed to be set up to ensure the development of WiM for the benefit of ITS led by MOW, as shown in Figure 33.

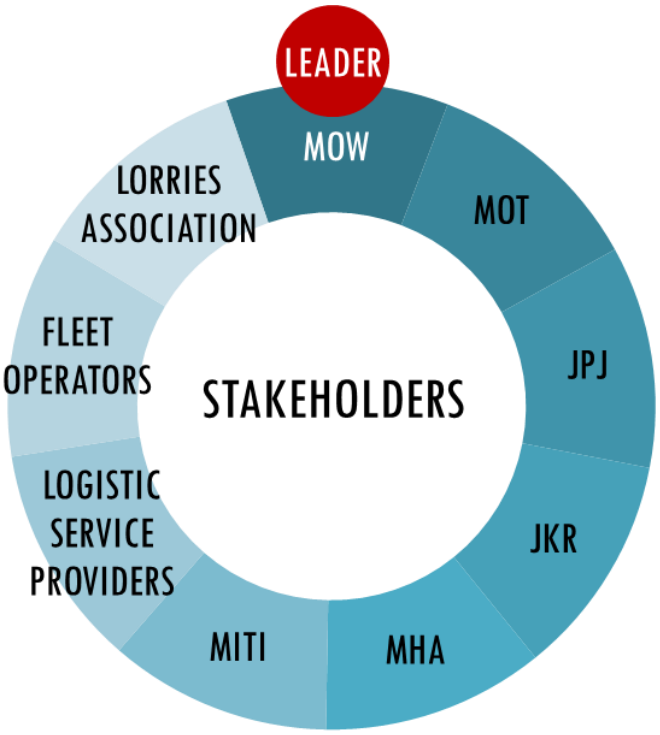


Figure 33 : Stakeholders for WiM

10.3.3 Emergency Management

10.3.3.1 Disaster Management

Disasters are considered to be large-scale events that affect regions and may require regional-level or even national-level response.

The Disaster Management deployment package comprises of the following:

- Emergency Response Management
- Emergency Vehicle Routing
- Personal Security and Mayday Support
- Disaster Command and Control
- Disaster Information Dissemination

The deployment package shall ascertain that the Central Coordination Disaster Centre shall have access to data from the other related agencies as well as the transportation agency. This includes coordination of emergency management and maintenance management fleets and activities, the use of public transport assets to support evacuation and the exchange of information with traffic management to control roadway usage. It shall also support routing for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles.

The information that is disseminated can include evacuation guidance to travellers via traffic management and information service providers. Information can also include a specific disaster response status for the operational needs of various transportation and emergency management agencies.

Currently, the National Disaster Management Agency (NADMA) is a government body that specializes in managing disaster cases in Malaysia. They will collect information from government agencies and statutory bodies, private sector and voluntary organizations.

The MERS 999 is a call centre, which combine and coordinate all of the emergency agencies such as Ministry of Health, The Royal Malaysian Police (RMP), Fire and Rescue Department of Malaysia (BOMBA), Malaysian Maritime Enforcement Agency (MMEA) and Malaysia Civil Defence Force (APM).

Nevertheless, these agencies are working independently of one another, even though the public can have their assistance through one common number which is 999. This will help the public to easily memorize the number and get assistance in shorter time.

An application shall be built for the use of an ambulance, Fire Rescue Department of Malaysia (BOMBA) and Royal Malaysia Police (RMP) indicating the location of the accident or incident. ITS can give the best route choice considering the flow of traffic, travel time to the location, travel restriction (road closure) and other information.

The sources of the data are tapped into the NITMC and from other TMCs, Performance Monitoring Hub System of APAD that encompasses public transport and Fleet Management System data. The movement of these emergency teams should be consolidated with the Priority Intersection Control to reach their destination within the shortest time frame.

Another area of disaster monitoring and reporting are the occurrence of flooding and slope failures. Information on flooding and slope data is gathered from Public Works Department Malaysia (JKR) and from MHA for highway asset. Information on the weather conditions are available from the Malaysian Meteorological Department that may be tapped into the NITMC. The identified information then will be diverted to the National Disaster Management Agency (NADMA). Data interchange concept with identified agencies as shown in Figure 34.

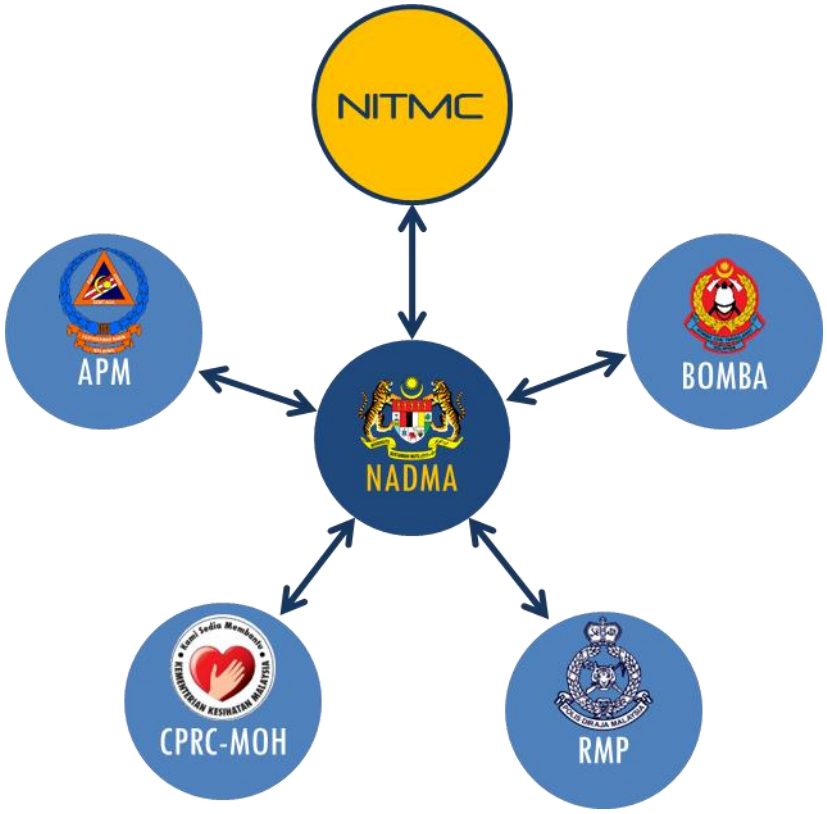


Figure 34 : Data interchange concept including disaster condition

A committee of stakeholders proposed to be set up to ensure the development of Disaster Management for the benefit of ITS led by NADMA, as shown in Figure 35.

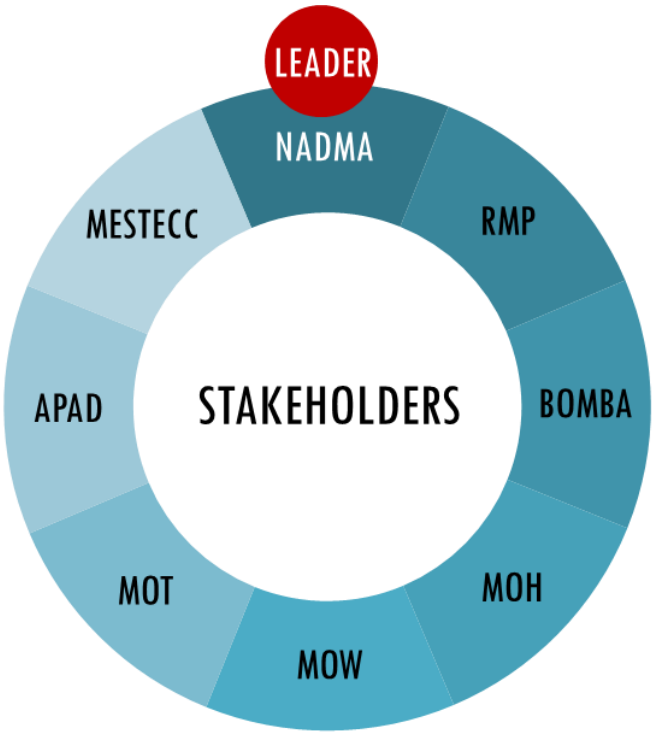


Figure 35 : Stakeholders for Disaster Management

10.4 Commercial Vehicle Operation

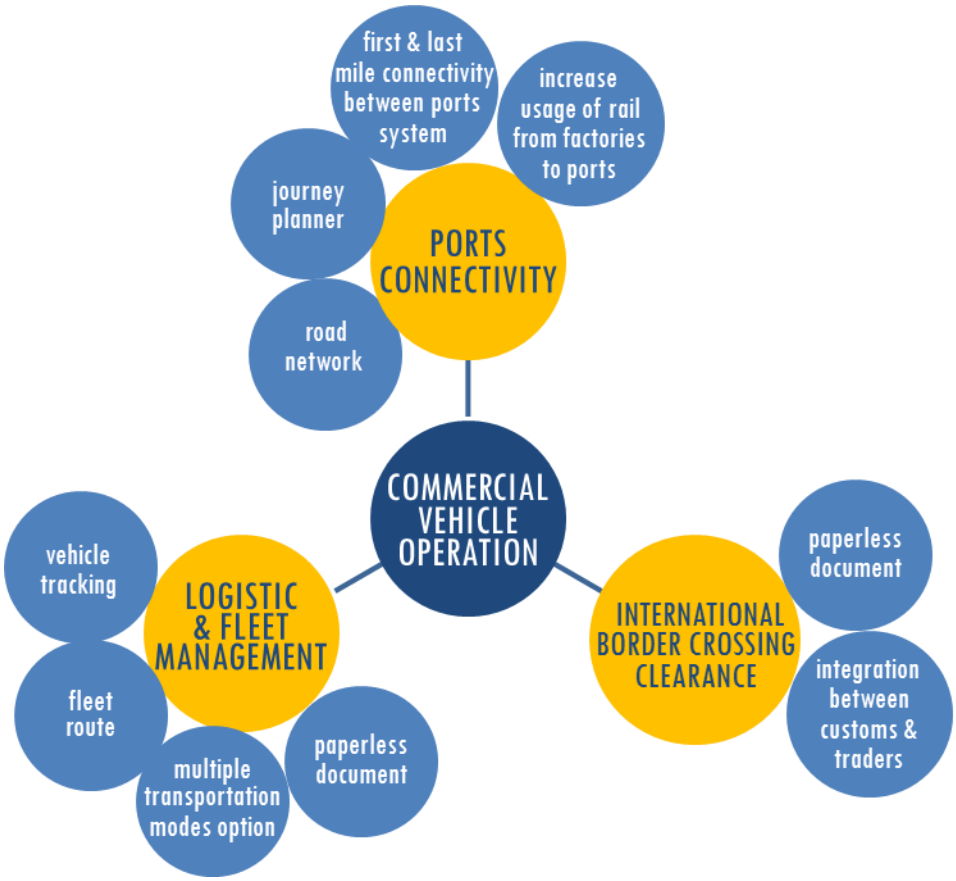


Figure 36: Commercial Vehicle Operation Focus Area

Commercial vehicle operators are always dealing with regulations, inspections, driver fatigue, and the need for efficient transport on highways. Commercial Vehicle Operations will benefit through the application of Intelligent Transport Systems (ITS) with governmental services and regulations within intermodal transport management centres. Three (3) focus area has been identified, including Ports Connectivity, Logistic & Fleet Management, and International Border Crossing Clearance as shown in Figure 36.

10.4.1 Logistics and Fleet Management

In the Logistics and Trade Facilitation Master plan (2015-2020), five strategies were identified in order to achieve growth of logistics and trade facilitation. Figure 37 shows the five strategies, among which in Strategy 4 there is the need to deploy

technology in the logistics chain in order to enhance efficiency in transport movements. Strategy 4 focuses on leveraging of ICT to provide seamless cargo movement, facilitate cargo clearance and enhance logistics services. Intelligent systems are required to continuously improve and accredit to raise the quality of the logistics service providers in the country.

LOGISTICS AND TRADE FACILITATION MASTERPLAN (2015-2020)

Five strategic shifts will be implemented to improve overall productivity and better connect industries with their markets, both locally and internationally. The strategic shifts are as follows:

- **Strategic Shift 1: Strengthening the institutional and regulatory framework**
  Strengthen the institutional structure and simplify or streamline the regulations to reduce inefficiencies and duplications.

- **Strategic Shift 2: Enhancing trade facilitation mechanisms**
  Increase the efficiency of trade facilitation mechanisms, particularly through improvements in the cargo clearance system, paperless trading and security of trade documents. This will boost trading activities and reduce the cost of doing business.

- **Strategic Shift 3: Developing infrastructure and freight demand**
  Consolidate cargo volume through a well-defined 'hub and spoke' system, provide better connectivity to entry points, optimise usage of existing infrastructure and promote modal shift from road to rail.

- **Strategic Shift 4: Strengthening technology & human capital**
  Enhance the adoption of technology to reduce the exchange of manual documentation and optimise transport movements. This strategic shift also emphasises on enhancement of human resource capabilities by attracting, nurturing, and retaining skilled talent within the logistics industry.

- **Strategic Shift 5: Internationalising logistics services**
  Enhance capabilities of logistics service providers by strengthening internal capabilities and external readiness to enable them to compete at a global level.

Figure 37 : Strategies for Enhancement of Logistics and Trade Facilitation (Source: Logistics and Trade Facilitation Masterplan 2015-2020)

Integration between transport chain and the supply chain will bring greater efficiency with respect to reduction in fuel consumption due to properly planned journeys. Many more benefits can be reaped if the commercial vehicles are equipped with the appropriate technologies.

This can be achieved by enhancing road-rail intermodal connectivity to promote modal shift from road to rail freight. Rail transport is capable to haul large quantities of long distance freight. Keretapi Tanah Melayu Berhad (KTMB) need to increase efficiency of cargo handling and number of train services because the existing rail freight is underutilise. Utilisation of rail transport will reduce road congestion and damage to the roads due to overloading of commercial vehicles. In addition, establish Public Private Partnership (PPP) for rail operations and infrastructure in upgrading and maintenance of rail assets and infrastructure may be an option.

Through the fleet management system, a strong return on investment and key performance indicators which enable to set aims for the business and help to get efficient fleet management system can be created.

With fleet management system, it can easily and quickly plan for day, week or month trips with a live overview of state and condition. It also helps in optimize operations and save costs by ensuring that smart and cost-effective scheduling in place and manage the driver's allocation and shift.

10.4.2 Logistics Database

One of the many action plans is to enforce quarterly data collection to gather the data from each transportation. The availability of data will support evidence based planning in the industry. Optimizing and efficiency of freight movement can be achieved by adopting good fleet movement. Real-time vehicle information will revolutionize the control and logistical organization with significant vehicle fleets.

This can be done by installing a tracking device in the commercial vehicles and the real-time data of origin-destination obtained from tracking device can also flow into the NITMC where it is integrated and processed.

Real-time routing information and access databases containing vehicle and/or freight equipment locations as well as carrier, vehicle, freight equipment and driver information. The information provides the capability for fleet managers to monitor the safety and security of their commercial vehicle drivers and fleet.

In a global marketplace where productivity is crucial to success, vehicle fleet operators use vehicle management systems as a formidable tool to drive down costs and increase the value of their service. A committee of stakeholders proposed to be set up to ensure the development of Logistics Database for the benefit of ITS led by MOT, as shown in Figure 38.

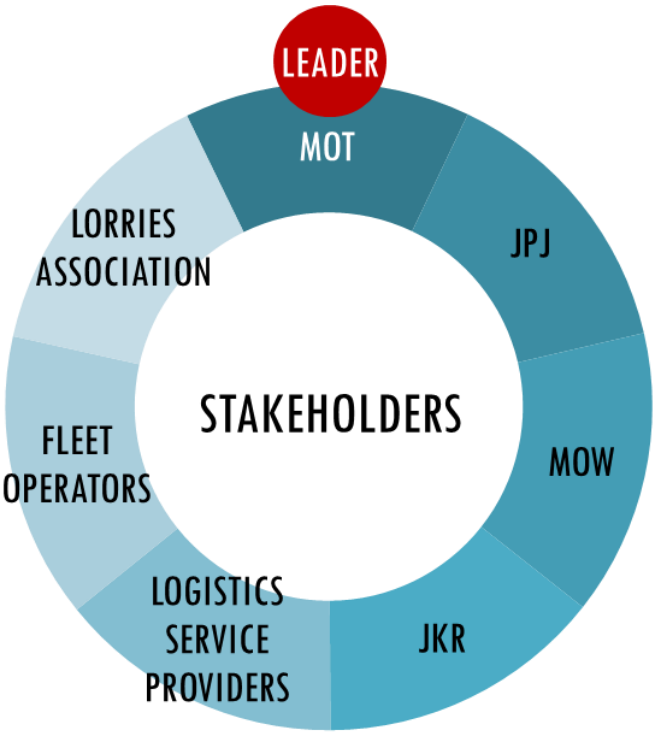


Figure 38 : Stakeholders for Logistics Database

10.4.3 Ports Connectivity

The Ministry of Works and Ministry of Transport are given the responsibility to look into the first and last mile connectivity to major ports, should it be by rail or road. Poor road connectivity to major ports causes delays and results in higher inland transportation and handling costs. It would be beneficial for the related agencies to be able to measure the road conditions automatically using the latest technology such as Video Image Processing and gyro-based sensors mounted on OBU. Integration of other transport modes will complement each other and eliminate last

mile connectivity problem. The Ministry of Works in its planning for new networks and upgrading works, has included the first and last mile connectivity to ports and airports.

On the other hand the need to transport freight via rail must be studied. This is in view of the roads being damaged by overloading of vehicles. The Government has invested in infrastructure facilities and yet having to spend a large amount on maintenance due to the damage done. As shown in Figure 39, a committee of stakeholders proposed to be set up to ensure the development of Ports Connectivity for the benefit of ITS led by MOT.

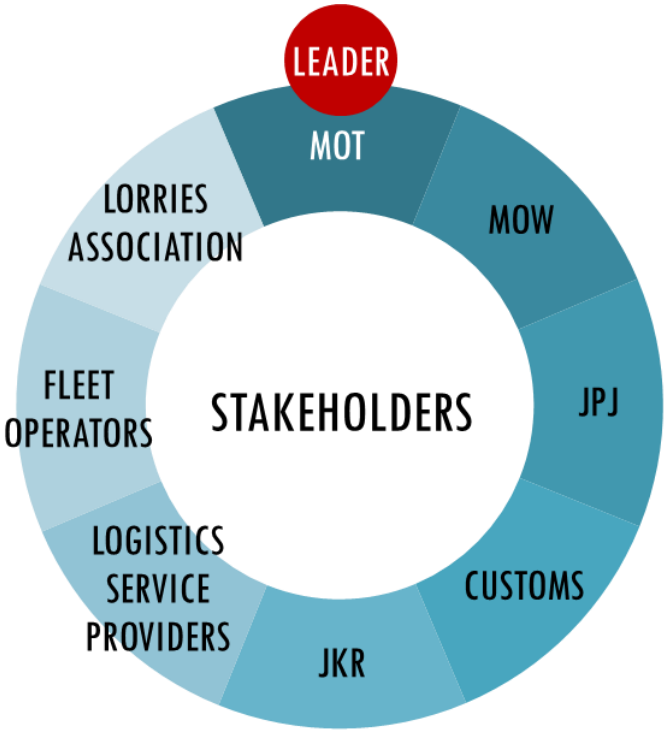


Figure 39 : Stakeholders for Ports Connectivity

10.4.4 International Border Crossing Clearance

ITS systems will enable to identify and control vehicle traffic entering and departing terminal, guide vehicles to loading and unloading points, maintain site security and monitor container integrity, provide an interface to Customs and acknowledge container pickup and drop-off. Lack of coordination between border management agencies cause clearance process become longer. Application of ITS will hasten the clearance process at border for both domestic and international border clearances. It also can resolve connectivity where there is only limited accessibility and connectivity to hinterland areas and poor integration with other transport modes.

This deployment package provides for automated clearance specific to international border crossings for both commercial and private vehicles. This package augments the electronic clearance package by allowing interface with customs-related functions.

ITS can be used to expedite processes and reduce bottlenecks at the entry points and at ports. It may enhance efficiency of the import / export process including security. A committee of stakeholders proposed to be set up to ensure the development of International Border Crossing Clearance for the benefit of ITS led by Customs, as shown in Figure 40.

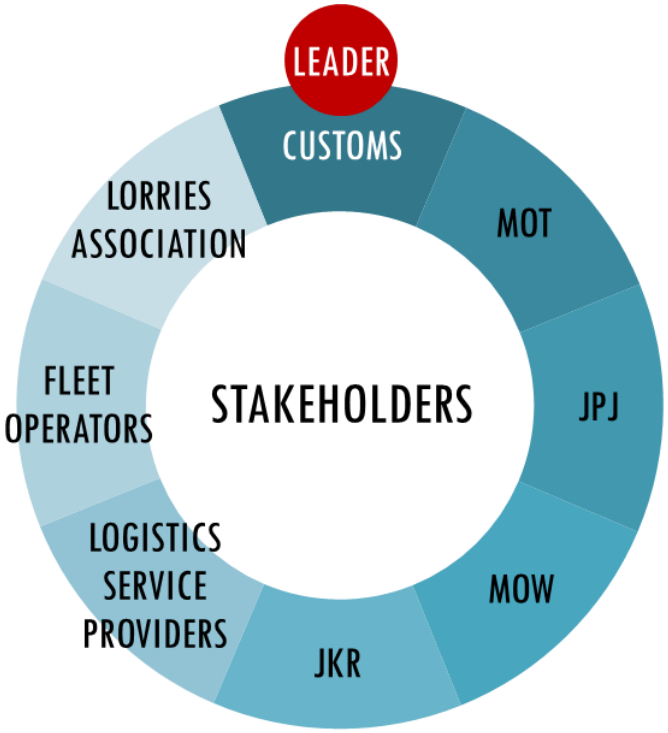


Figure 40 : Stakeholders for International Border Crossing Clearance

10.5 Data Sharing

10.5.1 Data and Information Warehousing

With the current technology advancement, it is now possible to generate transportation data from various sources such as static image and video feed. In addition, crowdsourcing is also a part of the transportation data sources with the usage of smartphone, which enable the smartphone user to transmit data like current location (GPS coordinates) and traffic report. In addition, road users can discuss among themselves using the online platform (social media or navigation applications) whenever they are stuck in the congestion or accidents. The data generated from these online platforms, then will be channelled to the data/ information warehousing.

Some of the transportation data are collected and stored by transportation operators, government agencies related to transportation, automobile manufacturers, and public by using their smartphone. On the other hand, more type of data can be collected, processed and analysed to generate a new set of data for transportation

development. For example, telco data and emergency data, such as accident and natural disaster can be transformed via data processing and analysis to become a new and useful data for the transportation system. After that, these data can be collected and stored in a common data centre. The common data centre is accessible by many parties either from government or private sectors to retrieve any data they needed.

Therefore, it shows the need to establish the common data centre at national level called National Intelligent Transportation Management Centre (NITMC). NITMC will act as a common platform to collect, process, analyse and disseminate transportation data from one party to another.

As shown in Figure 41, data and information from Information Warehousing are extracted from heterogeneous production data sources as they are generated, or in periodic stages, making it simpler and more efficient to run queries over data. With Big Data Analytics, data are turned into high-quality information to meet all enterprise reporting requirements for all levels of users. Interactive content can be delivered to anyone in the extended enterprise – customers, partners, employees, managers, and executives – anytime, anywhere.

Figure 41 : Information Warehousing using Big Data

The NITMC will gather information from three main sources; internal, external and through crowdsourcing. Real time data/information from JPJ, RMP, DBKL, MHA and APAD will be tapped directly into the NITMC. Video wall display will be available at the NITMC and available dashboard displaying data analytics for analysis. The data will be processed to extract traffic count, traffic classification, speed of vehicle and Average Annual Daily Traffic (AADT) for each site. The conventional traffic signal system using time based system will be replaced with video based detection, which are adapted to the condition of the real-time traffic condition.

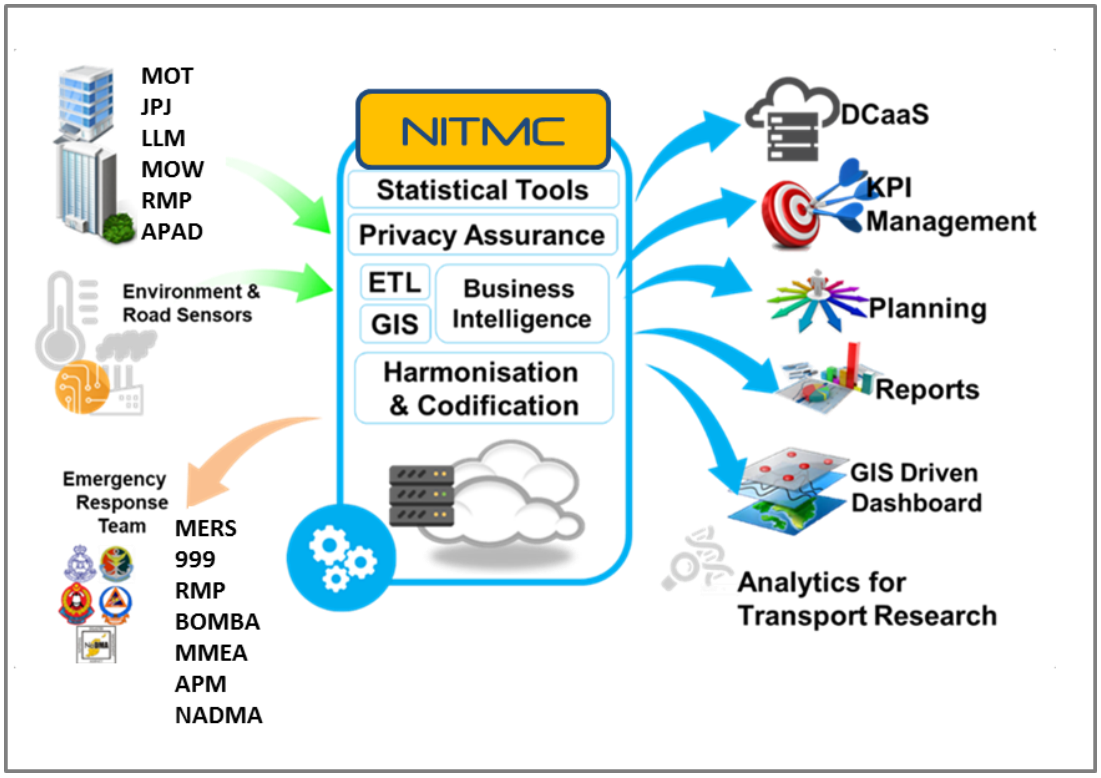


Figure 42 : Information Warehousing

After data standardization and harmonization, specified data will be available for road users through mobile applications and web portal. These applications will display useful data for road users to look into the traffic condition, Estimated Time of Arrival and different public transport available (based on real time data). Apart from these, MHROADS can be as part of the Information Warehousing initiatives whereby data from other sources can also be collated and analysed. The Information Warehousing correlation as shown in Figure 42.

10.5.2 R&D and Talent Development

With the various data received from multiple sources and methods, opportunity for research and talent development become wide open for those especially academician who has a deep interest to find and discover a new set of data.

Mobile technology advancement opens door for mobile application designer to create transportation-based mobile application. The mobile applications are designed to able to collect and disseminate data to the public. These mobile application is expected to help the government to generate a new set of data which is connected with NITMC established by the government.

The future of ITS industry is a vast. The relevant authorities and associations shall look into the needs for research in the industry. Nowadays, there are lacking research activities in ITS. It should be initiated by relevant parties because there is a huge area of ITS that can be discovered to improve in all aspects. Active participation and collaboration with multiple parties namely, citizens, public agencies, industry players, academic and research institutions as shown in Figure 43 will play a crucial role in supporting and promoting transportation innovations for a more sustainable transport ecosystem.

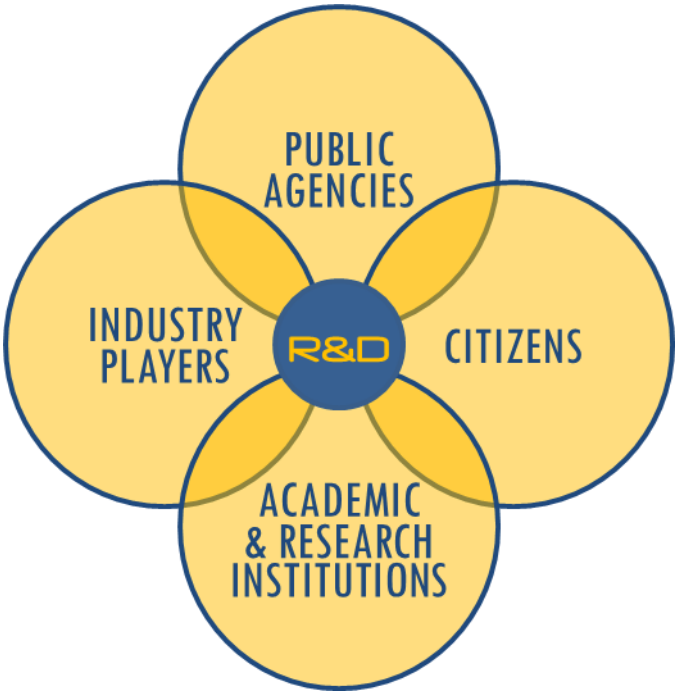


Figure 43 : ITS Research Quadruple Helix

10.5.3 Supporting Infrastructure

In Malaysia, infrastructure for supporting ITS implementation has already built and in operation. The infrastructure is owned and operated by multiple agencies, mainly local authority and highway concessionaires. The latter is placed under Malaysian Highway Authority (MHA)'s authority.

For example, highway operation consists of monitoring road and traffic, road maintenance, and collect tolls thru electronic toll collection (ETC). MHA establishes Traffic Management Centre (TMC) for each highway to ensure smooth traffic flow on highway and safety of the highway users.

Furthermore, ITS implementation is further improved by introducing RFID tags on the vehicle. In 2018, MHA has been working on a Proof-of-Concept (POC) where 200 exempted vehicles are installed with RFID tags and dedicate a lane at each toll plaza with a RFID reader. The POC purpose is to study the efficiency and potential of RFID tags and also act as a starter towards Multi Lane Free Flow (MLFF) at all highways nationwide. RFID also useful to store the vehicle's data, such as ownership and law violations record.

Besides that, WiM can be implemented in parallel with RFID project. WiM will detect any overload vehicles on the road and RFID will be go in hand by finding the owner of the vehicle on the spot. This will trigger the authority to issue summons to the law violators.

On the other hand, Kuala Lumpur City Hall (DBKL) as a local authority in urban areas, is in charge to provide efficient facilities and promote a safe environment to the public. In order to achieve these, DBKL has established Integrated Transport Information System (ITIS). The main function of ITIS is to obtain real-time traffic information and disseminate the information to the public. Besides that, DBKL also has installed approximately 200 cameras around Kuala Lumpur city to detect unusual incident occurrences such as accident and crime.

In addition, public transport can be improved by enforcing bus to install GPS so their driving behaviour and the route taken can be monitored and recorded. Apart from that, current technology promotes usage of social media and this can be a platform for the public to send reports and receive any information from others. Government can use this opportunity to share useful and informative data to the public since it is effective and cost-efficient.

Therefore, all of the data from sources as mentioned, which are TMC, RFID, WiM and ITIS must be channelled to NITMC and can be used to generate a new set of data. In addition, goods transportation, especially by rail and social media data can also contribute data to NITMC.

10.5.4 Collaboration Governance

Collaboration between government departments and agencies is a must with each party should be prepared in sharing the data and information needed. The data/information (as long as not categorized as limited or confidential) need to be shared across the departments/agencies including private sectors.

10.5.5 Monitoring Mechanism

To ensure the implementation of the ITS system maintains in its form; a monitoring mechanism needs to be established to ensure that all the data collected by data owners are up-to-date. Since data integration will involve various agencies, a solid data platform also needs to be established. Any possible data that are inaccurate will be monitored via online and being cross-checked with the information from social media. It is undoubtedly that social media (online) plays a vital role through on its crowd-source data that provided by the service provider.

All data collected by the system developed for NITMC as well as the data/information recipient will be used for specific purposes. The inaccurate/unreliable data will be reviewed and revise to purify the data/information. Then, any unreliable data need to be discarded from the analysis.

11.0 WAY FORWARD

'Smart Cities' is a next generation approach or future city approach to urban management with solutions to improve the quality of life of urban dwellers. Smart Cities is not just about intelligent data & digital platforms, Citydata must lead to informed decision & efficient implementation.

The world is moving to cities, fast and for the long term. In a cognitive era, cities themselves are moving, evolving, ever-changing, not fixed on a marked destination. We are at an important point in that evolution, as new forces emerge and combine to create new ways for cities to work. Social media flourishes in this environment, revolutionizing the way leaders interact with citizens. The data that drives the smarter city must be secure, to safely fuel unhindered progress.

As national governments increased focus on national issues, cities must take greater advantage of the most advanced technologies to update service delivery. New business models target the creation of radical new efficiencies for long-standing challenges.

The National Urbanization Policy (NUP) goals is to drive and coordinate sustainable urban development planning that emphasized on a balanced physical, environment, social and economic development in Malaysia. The NUP has recognized the smart city initiatives through its 3rd Principles ;

- To generate a competitive urban economy,
- Strengthening digital application by improving the readiness of its urban services through digital applications
- Encourage digital application through information dissemination and hands on training.

Cognitive computing and its capacity for building citizen engagement introduces fresh opportunities for government organizations to improve citizens' lives and the business environment, deliver personalized experiences, and optimize the program and service outcomes.

The Malaysia Smart City Framework (2018-2025) reiterates the Government's commitments and focus on cities development. The document serves as a guideline and reference for cities, agencies and other stakeholders for a systematic implementation of Smart City development in Malaysia. Its mission statement is to use ICT and technological advancement to address urban issues, including to improve quality of life, promote economic growth, develop sustainable and safe environment, and encourage efficient urban management practices.

The seven (7) component of Smart Cities under the framework are Smart Economy, Smart Government, Smart Living, Smart Environment, Smart People, Smart Mobility, and Smart Digital Infrastructure. The development of the ITS Blueprint and its implementation will complement the Smart Mobility component under the framework.

11.1 Smart Infrastructure

11.1.1 Public Transport

Efficient public transport is an element of a smart city. Advanced and efficient public transport in urban area is on top of the list to ensure the community can commute from one location to another in a fast and comfortable way. A series of actions were previously set out in the National Land Public Transport Master Plan produced by the Land Transport Commission (SPAD) to achieve a land public transport modal share of 40 per cent in urban areas.

Malaysia is on the verge of becoming a smart nation where cashless system is adopted in transactions. Commuters are encouraged to use cashless system by using an electronic card for fare payment as to reduce congestion at station gates and also commuters can monitor their transactions through online. However, tokens are provided for commuters who do not have electronic card and was previously used by Light Rail Transit (LRT) system and KL Monorails. Information about estimated time of arrival of trains is displayed at several locations at the train station so commuters can plan their journey ahead.

Bus also plays an important role as public use the bus service to transit between home to the train station (first and last mile). However, punctuality of bus arrival is hard to achieve if the bus shares the same road lane with another mode of vehicle. DBKL has taken measures to overcome this problem by providing a separate lane for buses and taxis so passengers can be dropped-off safely and on time.

11.1.2 Parking System

On the other hand, parking system can be further improved by providing real-time information on displaying the amount of vacant parking space. The measurement of available parking lots can be achieved using either Video Image Processing on open parkings or IoT sensors on closed parkings. Later, this information can be shared to public through mobile applications and VMS. This will help reduce travel time of driver and decrease fuel combustion of vehicle which means reduced air pollution.

11.1.3 Variable Message System (VMS)

Variable Message System (VMS) is beneficial to all road users as it spreads real-time and informative message to road users as they can plan their journey more efficiently. Traffic jams, accidents, road blocks and suggestions of alternative routes can be displayed on VMS, so the road user can avoid congestions, diverting incoming traffic from adding more traffic jams and also ensuring the safety of the road user if there is a blockage caused by accidents or road blocks ahead of them. VMS can also be used to display the current speed of the moving vehicles as an alert to them to control their vehicle speed.

11.1.4 Bicycle Sharing System

In Malaysia, bicycle sharing system has been introduced by a few states which is Malacca and Penang meanwhile some other states are following their footsteps in support to cleaner environment awareness. Malacca has started the bicycle sharing system in 2016 and has 3 stations located in tourist attraction. On the other hand,

Penang public can rent the bike at 25 locations as a short distance transit vehicle to reduce the use of private vehicles, traffic congestion and also air pollution. This system is very helpful for commuter benefit as first and last mile transport.

In Klang Valley, bicycle sharing system has already launched where the user only needs to download the free application to use the service. With this application, the user only need to scan the lock with the built-in barcode scanner within the application and it unlocks the bicycle. The service is a station-less where we don't need a physical station to lock the bikes. The lock is to be integrated into the bike itself as shown in Figure 44.

Figure 44 : Bicycle Sharing System with integrated lock

11.2 Smart Environment

Energy-efficient-vehicle (EEV) which currently developed by Malaysia Automotive Robotics and IoT Institute (MARii) as in Figure 45, are designed to support environmental friendly vehicle that will contribute to reduce CO^2 gas emission and reduce the use of fuel from non-renewable resources. In addition, EEV also include the use of IoT in the vehicle to create a smart, safe and connected vehicle. Several state governments are currently implementing electric bus equipped with disabled facility, CCTV cameras, LED panels and Wi-Fi. The electric bus can cater approximately 60 passengers at a time. The purpose is to reduce greenhouse gas (GHG) emission.

Besides that, several countries such as France, the United Kingdom and Republic of Korea (ROK) have been researching and implementing on-the-road-charging. The pavement is made of retrofitting photovoltaic panels that transform traditional asphalt into conductive asphalt which harvests and conducts electricity.

Figure 45 : Electric vehicle by MARii

This technology helps to charge the electric vehicle on the move and also eliminate the need to use allocated space and time taken just for charging the vehicle. Another option for EEV charging is by installing a canopy with solar panels and direct charging stations which minimise the land use and able to charge several EEV at the same time. Besides that, it is also economical because no fuel is needed to generate electricity.

Smart cities are also includes green technology like using solar powered street lights, using LED in traffic lights and street lights, also providing rainwater harvesting systems. For example, the UK has developed and using a solar-powered sidewalk by painting a glow-in-the-dark paint onto the surface so public can walk on it at night under dim lights. This method is very economic as it will also save electrical energy of the lights.

Malaysia as a tropical climate country can benefit the all-year sunlight to allow solar panel to absorb as much solar energy as possible. Furthermore, harvesting the rainwater for outdoor domestic use such as washing cars, watering the plants, maintaining football or golf field turf will decrease the clean water demand, hence save money on the bills too.

11.3 Smart Living

11.3.1 Mobility as a Service

Mobility as a Service (MaaS) offers flexible, reliable and easy-to-use everyday travel without having to own a car. Users can plan and pay for all modes of public and private transport within the city - be it by train, taxi, bus, car sharing, or bicycle sharing. Users can either pre-pay for the service, or pay as they go using cash or payment account linked to the service. Personal mobility device (e.g. Segway or hover board) could be used in designated areas such as zero carbon emission area.

Car sharing is the next version of the car rental service, where people rents car for a short period of time from a few hours, a day to several days with booking procedure, pickup and return is all self-service. It can be accessed through apps on smartphones as part of a larger smart mobility trend. Car sharing may suits those who want the freedom of driving without the burden of costs and responsibilities associated with car ownership. Car sharing will reduce the car ownership and contributing to a better environment with lower congestion, reduced gas emission and timely effective mobility.

11.3.2 E-hailing Service

E-hailing have become an integral part of the Malaysian transport system where there is a high demand on e-hailing services. Commuters prefer using this method due to its flexibility compared to the early day's public transport. Due to this shift, the government needs to set out ground rules for these new services. E-hailing service drivers are not only opened to personal car users, but also taxi drivers could be part of the team.

Localize e-hailing service implemented by the Joint Management Committee is an approach that should be introduced to provide transport for the community to a nearby public transport station. An advantage for gated residences is this service is provided from their doorstep to the nearby station.

11.3.3 Autonomous Vehicles (AV)

As the number of road casualties remains high every year throughout the world, there is a strong need to improve the road safety. Human error remains as the primary cause of road crashes and advances in autonomous technology are hailed as the breakthrough that can potentially reduce or eliminate road crashes.

With the advent of Autonomous Vehicles (AV), or simply known as self-driving vehicles, the concept that initially seems futuristic may turn into reality in the near future. In recent years, car manufacturers and technology giants have announced their plans for autonomous driving and presented with various AV prototypes.

Impacts of AV are significant. At the advanced stage, vehicle navigation will be fully automated thus making driver control as unnecessary. Drivers therefore, may not need to pay attention to the traffic anymore, completely altering the driving experience. Disabled people, elders or people without valid driver's license, could safely travel for long distances.

It is estimated that self-driving cars could reduce the number of road crashes by 90%, saving many lives and reduce the cost of road crashes. On the other hand, with the increasingly congested road networks all over the world, existing road infrastructure will be insufficient to meet the growing traffic demands. Through the use of autonomous technology, vehicles can travel safer, choose the route more optimally, and increase the road throughput. In order for AV to be successfully implemented in the country, several policies and regulations shall need to be planned, initiated or revised as shown in Figure 46.

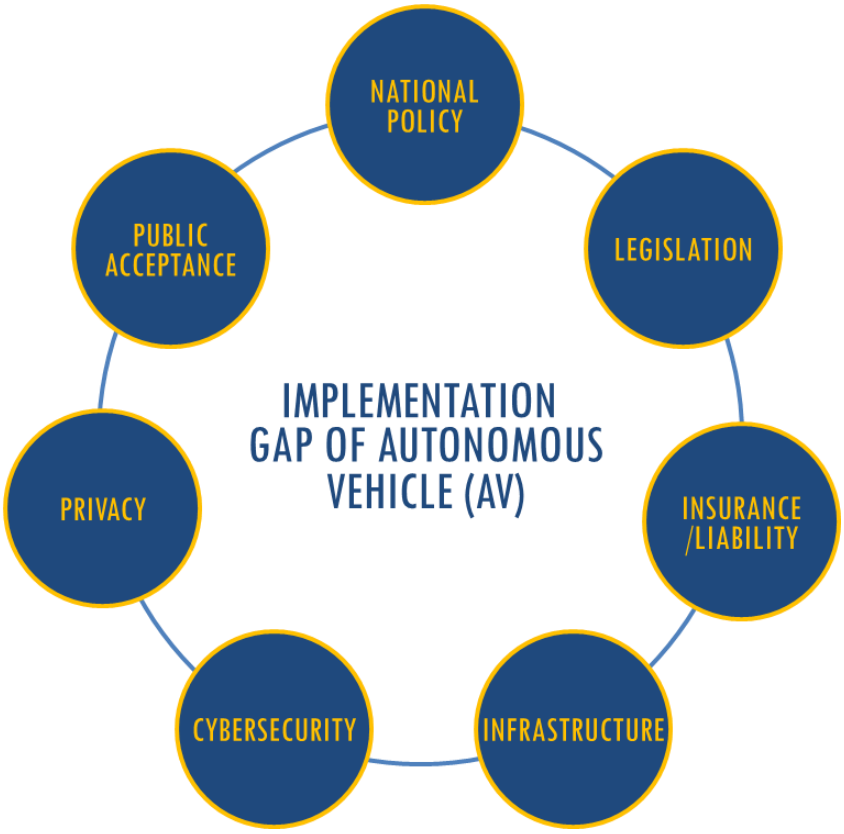


Figure 46: Implementation Gap of AV (Source : MIROS)

Availability of national policy will encourage and accelerate the industry. Aspects of legislation shall be drafted and revised to allow for AV to be operated on public roads. A committee of stakeholders proposed to be set up to ensure the development of Autonomous Vehicle for the benefit of ITS led by MOT, as shown in Figure 47.

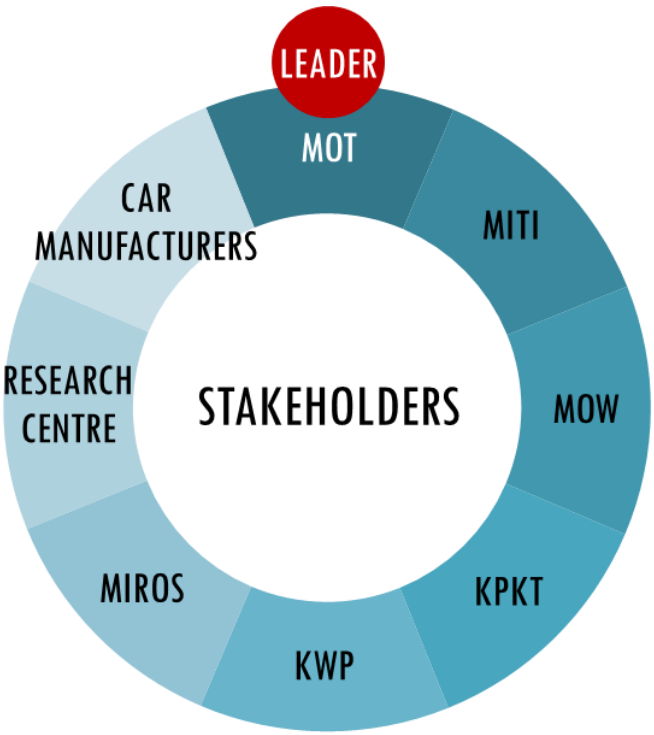


Figure 47 : Stakeholders for Autonomous Vehicle

12.0 ACTION PLANS

Malaysian ITS Blueprint (2019-2023) has outlined four (4) Strategic Pillars consisting of Seamless Intelligent Mobility, Congestion-Free Infrastructure, Safety, and Commercial Vehicle Operation towards Driving ITS to a New Normal. Subsequently, eleven (11) Focus Areas have been identified and five (5) Action Plans have been developed. This includes National Intelligent Transportation Management Centre, Multi Lane Free Flow, Weigh-in-Motion, Automated Enforcement System Development and Fleet Management.

In ensuring the success of this blueprint, further effort is required for more action plans to be developed by the respective leaders and stakeholders. Figure 48 gives a summary of initiatives with regards to the agencies involved.

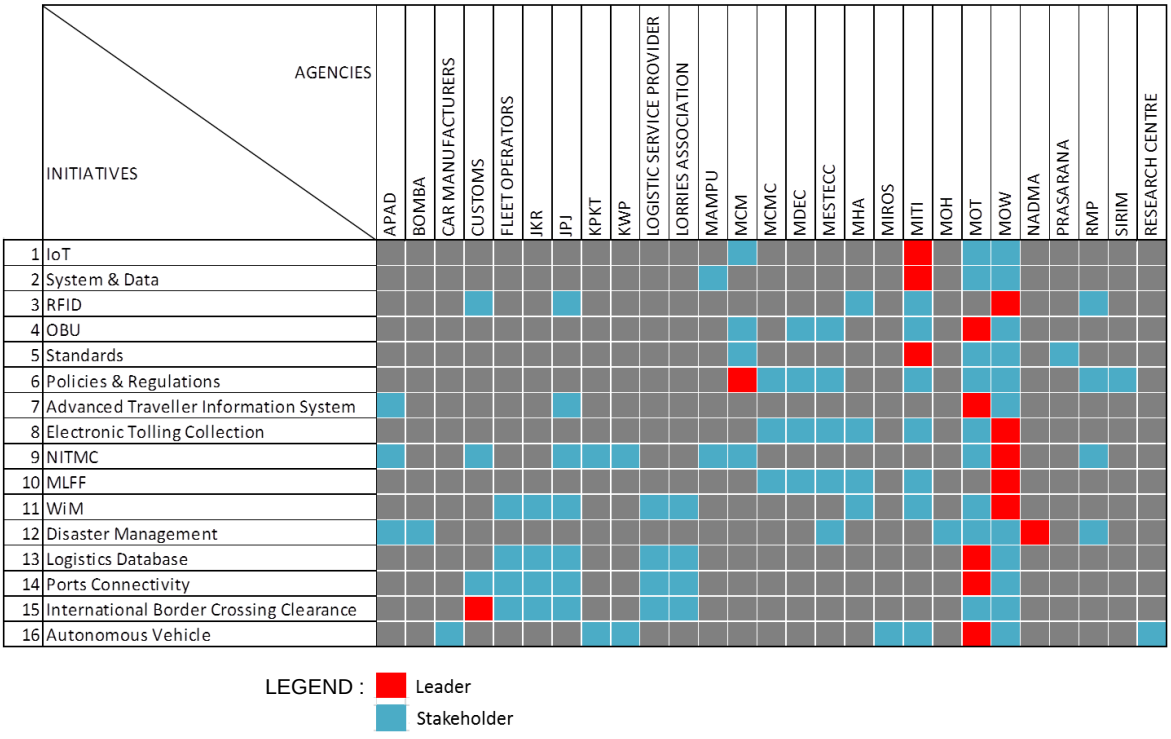
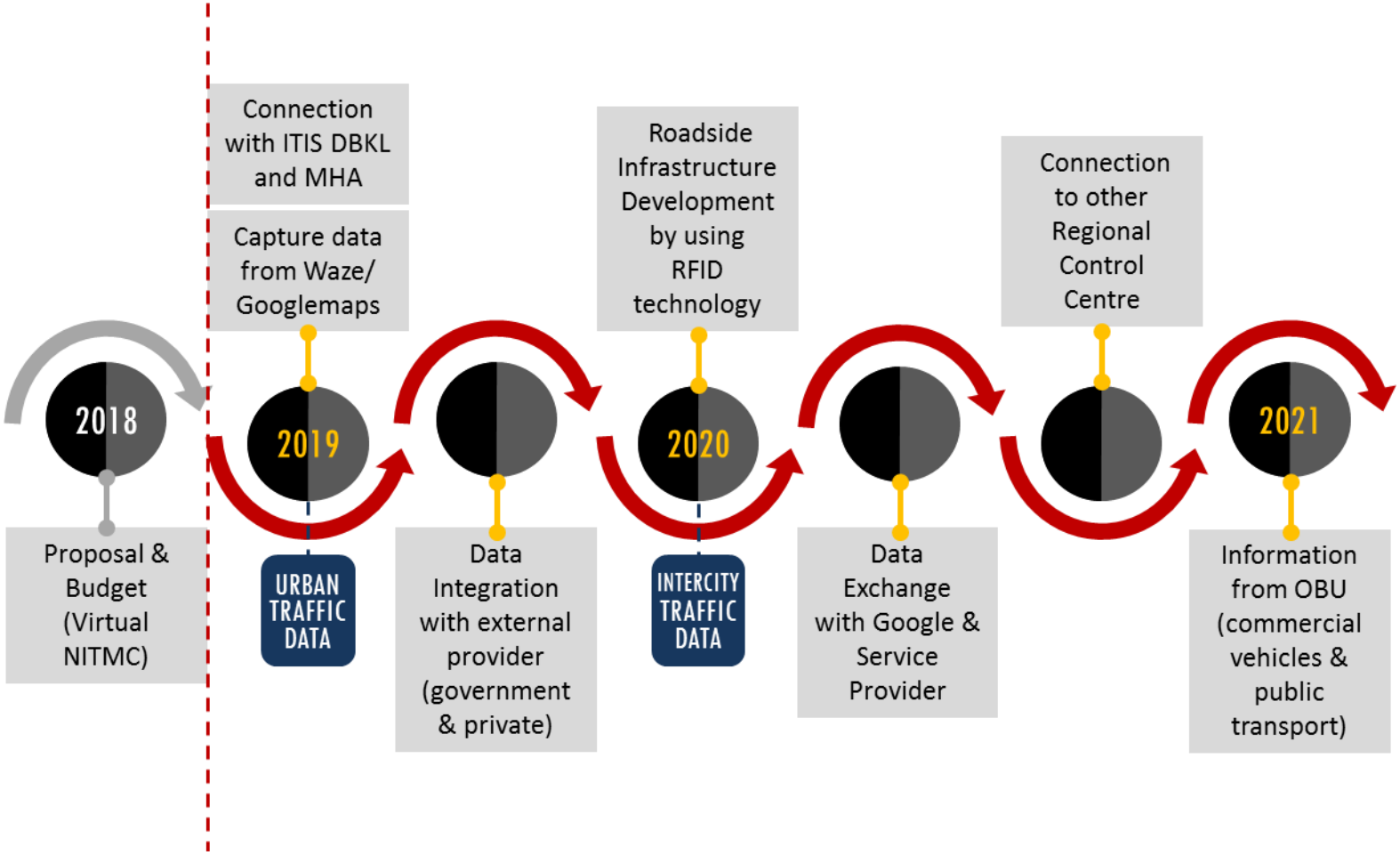
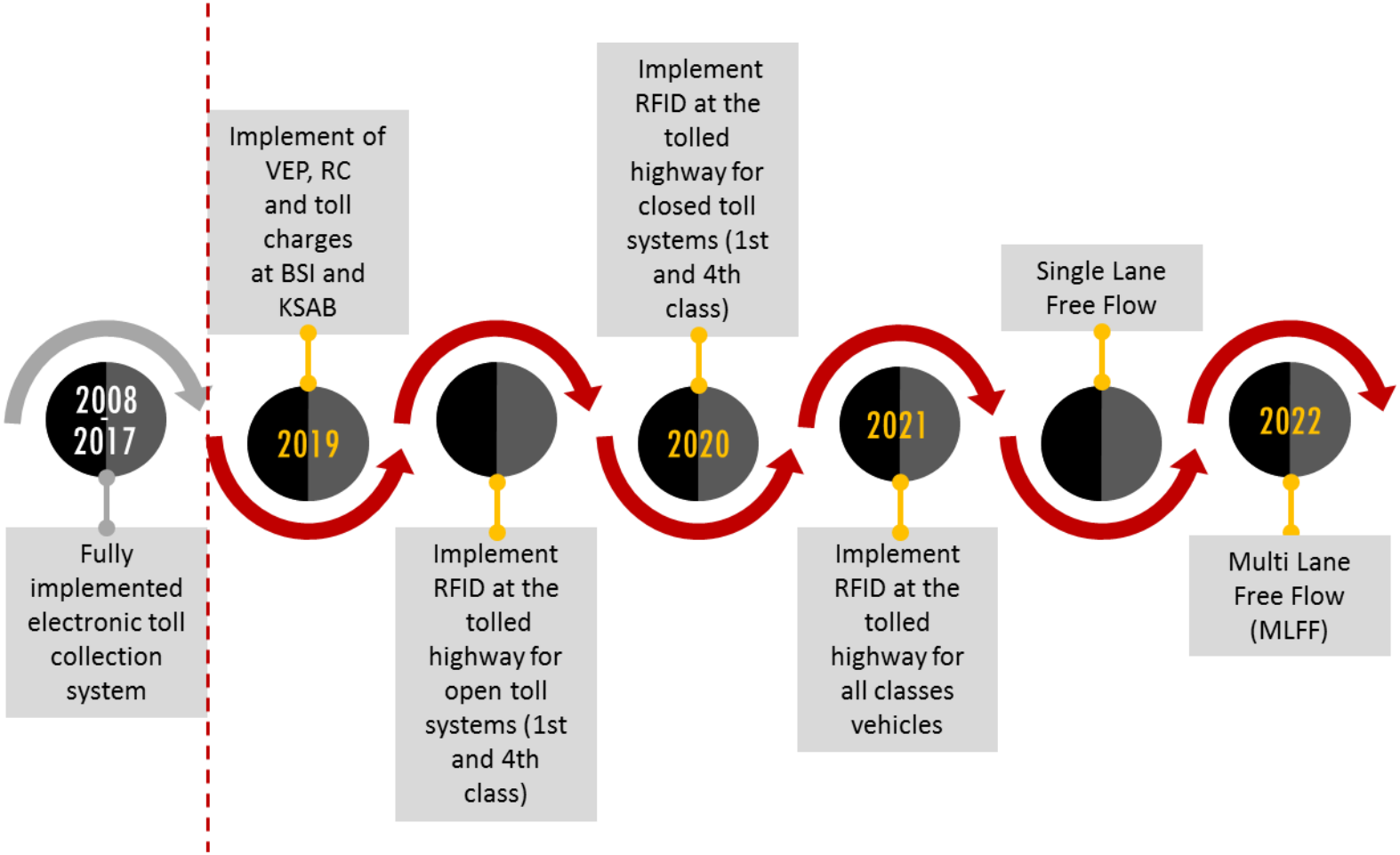


Figure 48 : Summary of leader/stakeholder involvement with regards to initiatives

12.1 National Intelligent Transportation Management Centre (NITMC)

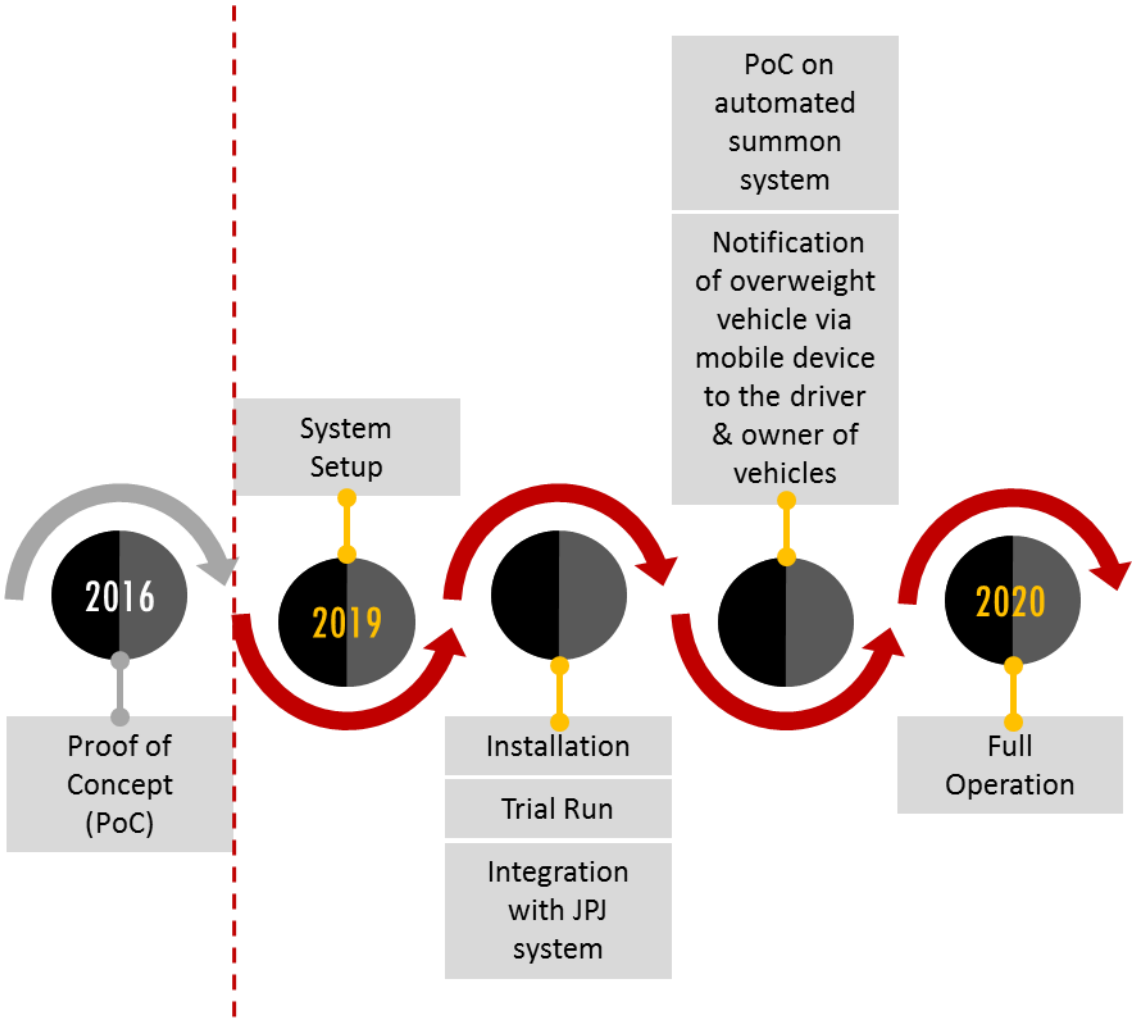


12.2 Multi Lane Free Flow

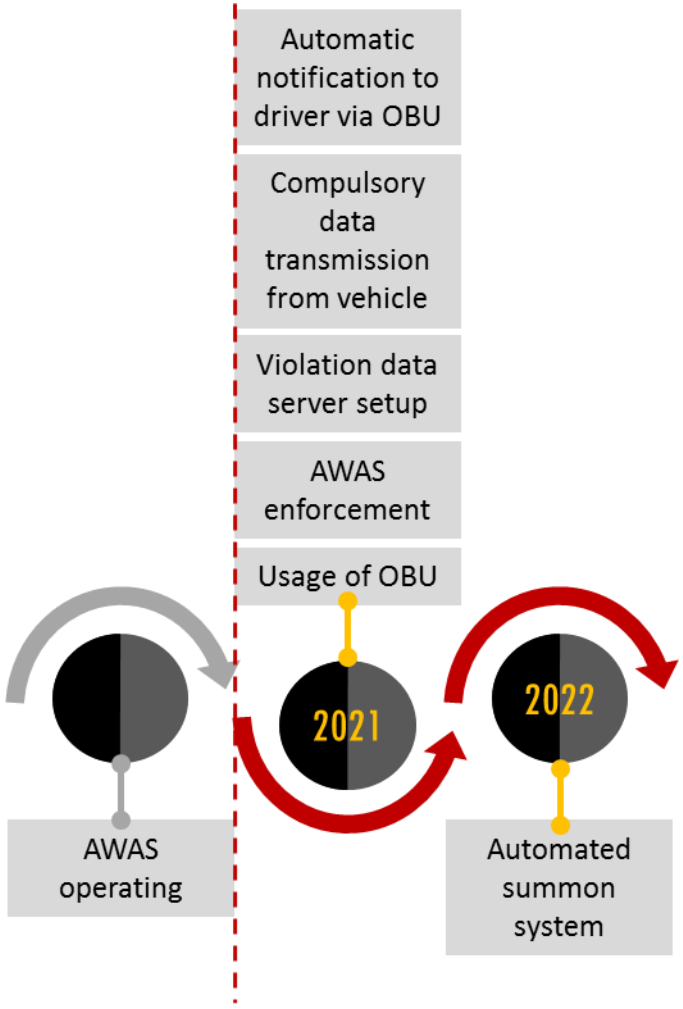


Note:
RC – Road Charge
BSI – Bangunan Sultan Iskandar
KSAB – Kompleks Sultan Abu Bakar

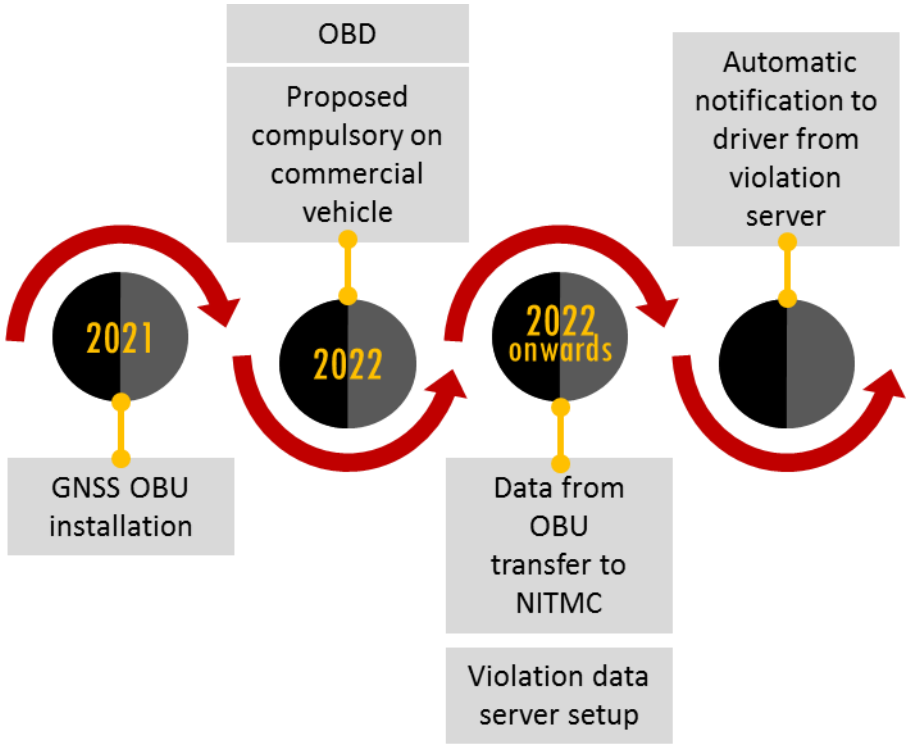
12.3 Weigh-in-Motion



12.4 Automated Enforcement System Development (for Commercial and Passenger Carrying Vehicle)



12.5 Fleet Management



13.0 CONCLUSION

The Malaysian ITS Blueprint (2019-2023) shall be the document for the government agencies as well as the private sector to use as a benchmark for the way forward for ITS in Malaysia.

A collaboration between government agencies and also between government agencies and the private sectors must be achieved in order for ITS to be implemented.

Sharing of data between government agencies shall take place such that government's investment in data collection will benefit as many agencies as possible. This will minimise duplication in expenditure spent by different agencies on the same data. Lastly, each agency is responsible in implementing the ITS initiatives by bidding for funding accordingly under their own Ministries.

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Crafting Malaysia's National Transport Strategy

ABBREVIATIONS

AADT	Average Annual Daily Traffic
ANPR	Automatic Number Plate Recognition
APAD	Land Public Transport Agency
APM	Malaysia Civil Defence Force
AV	Autonomous Vehicles
AwAS	Automated Awareness Safety System
BNR	Bus Network Revamp
BOMBA	Fire and Rescue Department of Malaysia
BRT	Bus Rapid Transit
CCTV	Closed-Circuit Television
CO^2	Carbon Dioxide
CPRC	Crisis Preparedness and Response Centre
CTA	Central Tolling Agency
CTSS	Centralised Taxi Service System
DBKL	Dewan Bandaraya Kuala Lumpur
EEV	Energy-Efficient-Vehicle
EMV	Europay, Mastercard and Visa
EPU	Economic Planning Unit
ETC	Electronic Tolling Collection
GHG	Greenhouse Gas
GIS	Geographic Information System
GLONASS	Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICT	Information and Communication Technology
IoT	Internet-of-Things
ITIS	Integrated Transport Intelligent System
ITS	Intelligent Transport System
JPJ	Road Transport Department Malaysia
KPKT	Ministry of Housing and Local Government
KTMB	Keretapi Tanah Melayu Berhad
KWP	Ministry of Federal Territories
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOS	Level of Service
LRT	Light Rail Transit
MaaS	Mobility as a Service
MARii	Malaysia Automotive Robotics & IoT Institute
MAMPU	Malaysia Administrative Modernisation & Management Planning Unit
MCM	Ministry of Communication and Multimedia Malaysia
MCMC	Malaysian Communications and Multimedia Commission
MDEC	Malaysian Digital Economy Corporation
MERS	Malaysian Emergency Response Services
MESTECC	Ministry of Energy, Science, Technology, Environment & Climate Change
MHA	Malaysia Highway Authority
MHROADS	Malaysian Highway Road Accident Database & Analysis System
MITI	Ministry of International Trade and Industry

MLFF	Multi Lane Free Flow
MMEA	Malaysian Maritime Enforcement Agency
MOF	Ministry of Finance
MOH	Ministry of Health
MOHA	Ministry of Home Affairs
MOT	Ministry of Transport
MOW	Ministry of Works
NADMA	National Disaster Management Agency
NITMC	National Intelligent Transportation Management Centre
NLPTMP	National Land Public Transport Master Plan
OBU	On-Board Unit
OD	Origin-Destination
PMHS	Performance Monitoring Hub System
PPP	Public Private Partnership
RFID	Radio Frequency Identification
RMP	Royal Malaysia Police
ROK	Republic of Korea
SIRIM	Scientific and Industrial Research Institute of Malaysia
SLFF	Single Lane Free Flow
SMART	Storm Water Management & Road Tunnel
SPAD	Land Public Transport Commission
TCSS	Traffic Control and Surveillance Systems
TMC	Traffic Management Centre
TnG	Touch ‘n Go
UK	United Kingdom
VEP	Vehicle Entry Permit
VIP	Video Image Processing
VMS	Variable message system
V2C	Vehicle-to-Centre
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything
WiM	Weigh-in-Motion

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