ITS
Intelligent Transportation Systems

Report 2021

INTELLIGENT TRANSPORT SYSTEM ASSOCIATION OF MALAYSIA
Level 2, Highway Planning Unit, Ministry of Works
Jalan Sultan Salahuddin, 50580 Kuala Lumpur
Tel: 03-2771 4201   Fax: 03-2711 3975   Email : itsmalaysia18@gmail.com

CONTENTS

1   WHAT ARE INTELLIGENT TRANSPORT SYSTEMS?

Intelligent Transport Systems (ITS) involves the use of information and communications technologies in improving, responding to, mitigating and/or solving various transportation problems and issues. ITS applications and solutions have wide ranging impacts in increasing safety, security, reliability of journeys, in enhancing improved decisions on journey times, routes and mode choices; as well as the attendant impacts to reducing congestion, pollution and losses in productivities. The spectrum of ITS applications is therefore, by definition, exceedingly broad based and covers latest advancements and emerging applications in areas such as Artificial Intelligence (AI), Internet-of-Things (IOT), 4th Industrial Revolution (IR 4.0), Smart City developments, Connected and Automated Vehicles (CAVs), connected and cooperative systems, among others. ITS is also necessarily embedded in any substantial discourse in the areas of big data analytics, 6G communications, climate action, with specific reference to COP 26 goals, and various advocacies for sustainable mobility such as Mobility-as-a-Service ("MaaS) and resilient, livable developments.

The importance and the need for embedding ITS in our transport infrastructure grew in tandem with Malaysia's rapidly expanding highway networks, which started in early 1990's. Recognising the increasingly significant role of ITS, a Strategic Plan for ITS was formulated in 1999 by the Road Engineering Association of Malaysia (REAM). This seminal work was subsequently followed-up with the ITS Master Plan Study and the National ITS System Architecture Study by the Ministry of Works, Malaysia in the period 2003 to 2007. More recently, the Ministry of Works completed and published the Malaysian ITS Blueprint 2019-2023 which charts the way forward for wider collaboration and integration for development of ITS in Malaysia.

Why is ITS important?

World population has breached 7 billion. Private car ownership has topped 1 billion and is practically inelastic. Building more road space will only attract more traffic, resulting in even greater gridlock. Among the few alternatives available towards sustainable mobility is increasing reliance on ITS.

… ITS is an inescapable growth industry…

2   ABOUT MALAYSIA

Wikipedia lists Malaysia as the 66th largest country in the world by land area, at 329,847 sq. kms. The country's two major land masses comprising Peninsular or West Malaysia (comprising 11 states) and East Malaysia (comprising the 2 Borneo States of Sabah and Sarawak) are separated by the South China Sea. Malaysia can be classified as an upper middle-income country, with a GNI per capita of USD 10,580 (2020). This essentially ranks Malaysia with the 3rd highest GNI per capita, after Singapore and Brunei in the 10 member countries forming ASEAN.

Malaysia's population of 32.67M, as at 2021, comprise 30M (citizens) and 2.65M (non-citizens). The 3 largest ethnics groups making up 99% of the population comprise Bumiputera (69,.8%), Chinese (22.4%) and Indians (6.8%). About 75% of the population reside in urban centers, with States of Selangor, Johor and Perak being the most populous, drawing in about 50% of the total population in Peninsular Malaysia. In terms of economic activities, evidenced by GDP contribution, the three highest ranked States comprising Selangor, Johor, Penang and the Federal Territory of Kuala Lumpur account for over 70% of the country's GDP.

The high urbanization rate is exemplified in the Greater Klang Valley ("GKV") with an estimated population of over 7M which, in many ways, is identified as the cultural, financial and economic center for the country; an area that is roughly bounded by 50kms E-W and 40km N-S. It is noteworthy that about 2/3 of the number of tolled highways in Malaysia serve the GKV; as well as the main urban rail system comprising MRT, LRT, Monorail, ERL, and KTM commuter services.

It is also in the GKV that the first ITS-focused, regional wide project was commissioned. The project known as the Integrated Transport Information System ("ITIS") was completed in 2005 and remains to this day as the primary hub for traffic monitoring, control, analytics and response for City Hall of Kuala Lumpur. The purpose built ITIS Transport management Center ("TMC") was identified in the Malaysia ITS Blueprint 2019-2030 for re-purposing into the National Intelligent Transportation Management Centre ("NITMC"). The NITMC will serve as a physical focal point for multi-agency, cross-jurisdictional collaboration for all matters related to traffic control, management and analytics.

Early Adopters of ITS

"… Tolled roads and facilities tend to be early adopters of ITS technology because of a desire to add value. Toll highway concessions have a need to show road users that their facilities are somehow preferable to non-tolled options and the use of technology and the perceived better traffic management and information services become a compelling case against non-tolled public roads …"

Malaysia remains a "car-centric" nation with over 32M registered vehicles (2020), with a significant portion being motorcycles (14.9M) in 2020. It is not surprising that Malaysia has an extensive road network of over 250,000kms which are largely paved and about 2,000 kms of tolled expressways. The catalyst for much of the development of ITS in Malaysia had been the expansion of the tolled highway network spanning over the past three decades, particularly in the areas of traffic control and surveillance systems (TCSS) and electronic tolled collection systems (ETC) and related technologies. The country achieved full ETC on all 31 privatized highways across 177 toll plazas in 2017. More recently, PLUS, the largest tolled highway concessionaire in Malaysia, announced plans to at least one RFID with ANPR toll lane at all its toll plazas in 2022. The phased rollout of RFID for ETC is part of the Government's staged development towards multi-lane free flow, possibly as early as 2026.

The country also has an extensive rail network spanning about 1800kms, of which close to 50% are electrified. With the intent to shift modal share towards greater public transport use, significant investments in the rail network has over the last several years out-paced investments in road infrastructure.

Since 2016, about RM 80B has been invested into the construction of MRT lines 1 and 2, extensions to two existing LRT lines, a new LRT 3. Additionally, a further RM 50B+ will be expended for the construction of the 660km ECRL linking the Kota Bahru on the east coast to Port Klang on the west coast of Peninsular Malaysia and about RM 3.7B for the Johor Bahru-Singapore Rapid Transit System Link ("RTS"), both of which are planned for completion in 2026.   The 3rd MRT line for the GKV is currently being planned with an estimated cost of RM 50B.

Concurrent with the greater emphasis towards public transport in recent years, Iskandar Malaysia ("IM"), located in the State of Johor is working towards an operationalised Bus Rapid Transit ("BRT"), with an emphasis on smart mobility, starting from 2023-2024, and at an investment of about RM 2.6B. The IMBRT project, recently rebranded as the Iskandar Rapid Transit ("IRT"), in its initial roll-out will span 51kms along 3 main routes, with a fleet of feeder services that eventually extends the overall network coverage to about 2,000kms, including links to the JB-Gemas double tracking and the RTS. It is envisaged that the trunk routes will be operated using 18m Autonomous Rapid Transit System ("ART").

The total cost of these rail projects when completed will exceed RM 180B. In contrast, the cost for construction of major on-going road projects such as the 2000km Pan-Borneo Highway, 300km Central Spine Road, and the 233km West Coast Expressways is about RM 27B; and no more than about RM 80B overall will likely be invested in road infrastructure until 2030.

Apart of the trunked infrastructure of roads and rails; Malaysia via the 5-year "*Jalinan Digital Negara*" ("JENDELA") initiative has established a national aspiration of achieving over 96% 4G coverage nationwide by 2022, with over 80% of premises having access to gigabit speed broadband. As ITS applications are underpinned by access to reliable, consistent, high-speed, low latency communications, the successful roll-out of the JENDELA programme, and with it, the expansion of nationwide 5G connectivity will help spur greater advancement, adoption and test-bedding of ITS applications. It is expected by 2025, there will be 100% 4G coverage in populated areas, and availability of 5G broadband speeds of up to 100MBps, up from about 20-30 MBps typically from 4G networks.

"… ITS is one of the largest industries in the world that few people have heard of …"

… Scott Belcher, President, ITS America

3 ABOUT ITS MALAYSIA

The Road Engineering Association of Malaysia ("REAM") was the driver and initiator of ITS in Malaysia. In 2008, the Intelligent Transport Association of Malaysia ("ITS Malaysia") was established with a protem committee led by Y. Bhg. Dato' Ir. Chua Soon Poh, who was at the time the Director-General of the Malaysia Highway Authority, before handing over the reins to the newly formed ITS Malaysia and its 1st elected council in the same year. The founding President of ITS Malaysia was Y. Bhg. Dato'. Ir. Hj. Mohamad B. Husin, who was also the Deputy Director-General (Business Sector), Public Works Department, Malaysia. Dato' Ir. Mohamad B. Husin continued to serve for a second two-year term before retiring in 2012.   2008 was also the year that ITS Malaysia organized the inaugural ITS Seminar which attracted over 400

The primary objectives of ITS Malaysia are as follows:

| To facilitate knowledge and information exchange. | To represent the industry in dealings with Government and external agencies. | To facilitate and foster greater cross-disciplinary collaboration. | To serve as a bridging point between the local ITS players with other international ITS related organizations, agencies, and/or trade associations. | To identify, encourage and nurture new areas of research and development in ITS |

participants.

Since 2012, the presidency of ITS Malaysia has been held by Datuk Seri' Ir. Hj. Ismail bin Md Salleh, who was the former Director-General of the Malaysia Highway Authority. In recognition of Datuk Seri' Ir. Ismail bin Md Salleh's work and advocacy for rational and systematic and transformational deployment of ITS in Malaysia since the early and formative years of ITS in the region, he was awarded the ITS Asia Pacific Hall of Fame Lifetime Achievement Award at the 24th ITS World Congress in Montreal in 2017. The World Congress Hall of Fame Awards recognises the highest standards in achievement from the Americas, Europe and Asia-Pacific in the high-tech transportation community across the categories of Industry, Local Government and Lifetime Achievement.

ITS Malaysia is an active participant in the annually held ITS Asia Pacific Forum and Exhibition, and ITS World Congresses. In 2011, during the PIARC International Seminar on ITS, which was attended by over 500 delegates with representations from over 20 countries, MoUs were inked with ITS France, UK, New Zealand, Australia and Taiwan.

In 2012, ITS Malaysia hosted the highly successful 12th ITS AP Forum and Exhibition which drew-in 70 technical presentations and 11 country reports. Delegates had the opportunity to listen to speakers from over 16 countries, with keynote presentations from the Presidents of IT Japan, ITS America and Ertico (ITS-Europe). The event also provided a showcase for over 50 exhibitors for their ITS products and services for the

800+ delegates. This was the 2nd time Malaysia has hosted the ITS AP Forum after a gap of 13 years (3rd ITS AP Forum, 1999).

In 2017, ITS Malaysia hosted an international seminar with the clarion call for a pivotal change in ITS – themed "Driving ITS to a New Normal". It was almost foretelling that 2 years after that event, we were faced with a global pandemic which called a 'new normal" in our daily lives. The keynote address for the 2017 International Seminar was made by the Chief Secretary of the nation, Y.B. Tan Sri Dr. Ali bin Hamsa, who delivered a stern message for greater cooperation between public, private and academia; particularly to break data silos and to get the nation back on-track to meet the challenges of the new digital age. It was at this event that the Ministry of Works was tasked with the job of drafting the National ITS Blueprint.

Over the last 2 years of the pandemic, ITS Malaysia has continued with joint virtual activities, via various webinars. In 2021, the collaborations with ITS Canada and UK were renewed, via separate events, which involved joint 2-day webinars; as well as participation in other ITS AP member activities such as Taiwan, Singapore and Indonesia.

In 2022, ITS Malaysia looks towards hosting an international ITS Symposium focusing on the harmonization of ITS applications and deployments. The symposium will hopefully be a step towards partial re-normalisation of physical meetings, interactions and networking among ITS professionals, researchers, practitioners and from associated special interest groups.

ITS Malaysia, as of 2021, has 286 individual members and 34 corporate members, which is governed by a Council comprising 4 office bearers, 11 elected members, and 6 co-opted members. Members of the Council are drawn from Government, private sector, and academia.   ITS Malaysia is also part of a grouping of 11 member countries forming ITS Asia-Pacific, with ITS Japan, as secretariat. ITS Malaysia participates in various international collaborations, and more particularly, at the annual ITS Asia-Pacific Forums, and ITS World Congresses.

4

<div style="background-color:maroon; color:white;">**CURRENT STATUS**</div>

ITS Strategic Plan

In 1999, the Government of Malaysia endorsed the ITS Strategic Plan as a guide for the development and deployment of ITS in Malaysia.   The Strategic Plan, developed by the Road Engineering Association of Malaysia (REAM), was presented at the 3rd ITS Asia-Pacific Forum held in Kuala Lumpur.   Among the catalysts for the plan were the mandatory implementation of Traffic Control and Surveillance systems by the Malaysia Highway Authority (in 1994) and the increasing numbers of new tolled highways.   It was also during this period that the number of privatized toll concessionaires had increased to a point where inter-operability of ETC systems were becoming a matter of concern.   The completion of a JICA Study on the Integrated

Transport Information System for the Klang Valley and Multi-Media Super Corridor helped establish greater awareness and mainstreaming of ITS into local context.

ITS Master Plan

The ITS Master Plan progresses the groundwork of the ITS Strategic Plan and helped establish in greater detail the key strategies, direction and framework for the development and deployment of ITS in Malaysia. The Master Plan identified among others, a structured deployment programme for various priority ITS strategic projects in key sectors such as Advanced Traffic Management System, Advanced Traveler Information System, Advanced Public Transport Systems, Commercial Vehicle Operations, Safety Systems, Electronic Payment Systems, Advanced Vehicle Control Systems, Emergency Management Systems and Information Warehousing Systems.

Evolution from a Single ETC System

By 2001, Malaysia had two competing Electronic Toll Collection ("ETC") systems based on DSRC and IR technologies. With more tolled expressways coming into operation, it became critical for the Government to provide direction for consolidation into single ETC system; failing which users were faced with the impractical prospect of having multiple on-board units or tags for different tolled highways. A decision to go with the IR system was made in 2003 and by 2004 the Touch 'n Go card and SmartTAG were synonymous with ETC in Malaysia, providing nationwide inter-operability for all tolled concessionaires in the country. ETC penetration has since exceeded 60% of toll users in the country with an installed base of over 1,200 toll lanes across 30 tolled highways; including 7 toll plazas operating at full 100% ETC mode.

To this day, Touch n' Go is the sole ETC "operator" for all tolled highways in Malaysia, and the Touch 'n Go card is accepted for all major transport in GKV. It has expanded its operations to include RFID linked payments, parking, and e-wallet retail payments. In 2019, it ranked only second to GrabPay as having the highest number registered users (6.8 million) and 120,000 merchants. Touch 'n Go and Touch 'n Go eWallet are under TNG Digital Sdn Bhd, a joint venture between Touch 'n Go Sdn Bhd and China's Ant Group. As such the fintech leverages on Alibaba Cloud's distributed computing, AI/ML technologies and with potential deeper integration into the Alipay system.

Formation of ITS Malaysia

One of the key recommendations of the ITS Master Plan was to establish a National ITS Association. In 2006, the pro-tem committee for ITS Malaysia was formed, and in 2008, ITS Malaysia held its 1st AGM and election of Council members.

Integrated Transport Information System

In 2001-2002, the Government via City Hall Kuala Lumpur embarked on a pilot ITS project to manage traffic congestion along major key roadway corridors in the Klang Valley. The Integrated Transport Information System ("ITIS"), budgeted at USD 100M, was completed in stages in 2004 and was fully handed over in 2005 under a design-build contract. Key objectives of the system are the early detection of disruptive traffic incidents and, in collaboration with first responders, to clear the blockages so that normal traffic flows can be restored expediently. The system operates 140 variable message signboards (VMS) and a wide array of automated traffic counters to provide a real time view of the overall traffic network. The system leverages heavily on Advanced Traffic Management and Advanced Traveller Information services as platform technologies.

In 2012 ITIS was revitalised and upgraded in tandem with changes in technology and systems. ITIS 2.0 was hence conceived, but this time, was let out under a six-year USD 70M leasing scheme whereby the payments are made only for equipment that are LIVE under a strict key performance index (KPI) regime supervised by City Hall Kuala Lumpur.

In 2020, there were announcements that Kuala Lumpur City Hall and the Malaysia Digital Economy Corporation ("MDEC") would be collaborating with China's Alibaba on its cloud computing infrastructure for various intelligent traffic management applications. The project was dubbed "City Brain", and would use various data from ITIS for big data analytics, Machine-learning and AI, for real time analysis, traffic demand forecasting and improved traffic control and management.

The purpose built ITIS Transport management Center ("TMC") was also identified in the Malaysia ITS Blueprint 2019-2030 for re-purposing into the National Intelligent Transportation Management Centre ("NITMC"). The NITMC will serve as a physical focal point for multi-agency, cross-jurisdictional collaboration for all matters related to traffic control, management and analytics.

Despite being a relatively aged development that was conceived in 2001, ITIS, under the astute management of Kuala Lumpur City Hall, has continued to successfully evolve and keep relatively close pace with latest ITS advances, and remains a key test bed for many emerging ITS applications.

ITS Systems Architecture

The ITS System Architecture Study was a progression of the ITS Master Plan that as completed in 2003. The System Architecture study, completed in 2006 was intended to provide a unified framework for the coordinated deployment of ITS in Malaysia by providing detailed descriptions of interactions between travelers, vehicles, roadside devices and control centers.   The Architecture also described the information and communication requirements, the data structures to be shared between interacting systems, and the standards required for data exchange.

Arguably, the complexity of the Study, particularly at a level where executive stakeholder understanding and engagement was needed, made it difficult for wide adoption. Notwithstanding, many of the elements of the architecture remains relevant despite competing technologies, standards and new advancements, and there are opportunities to renew the architecture to help harmonise and provide direction for new ITS deployments in the country.

SMART (Storm Water Management and Road Tunnel)

The world's first combined storm water management and road tunnel (SMART) was completed in 2007; and has since become of Malaysia's finest engineering showcase to-date. The project was featured in Discovery Channel's Extreme Engineering, and ITS was innovatively deployed for the 5km motorway tunnel linking the city center with the southern gateway, including a 9.7km stormwater tunnel.   SMART is also equipped with a state-of-the-art operations control room with the latest systems in operations management, surveillance and maintenance.

Recently, in Dec 2021, the SMART tunnel was instrumental in preventing a more catastrophic flooding in Kuala Lumpur when it diverted a record 5 million cubic meters of flood waters out of the city center, over a period of 22 hours.

Malaysia Highway Authority and Implementation of the Multi-Lane Free Flow System

The Malaysia Highway Authority ("MHA"), established in 1980, is a statutory body under the Ministry of Works that is charged with the responsibility for regulating,

supervising and monitoring all tolled highways and expressways in Malaysia. In relation to ITS, it has traditionally focussed on ATMS / TCSS, ATIS, EMS and ETC.

The MHA also operates its own Traffic Monitoring Center (TMC) which is linked to various toll concessionaires. Via the MHA TMC, various integrated services related to traffic advisory and information will be rolled-out to road users.

MHA's TMC, established in 2007, collates and coordinates traffic information for various toll operations at a national and regional level. As the regulator of tolled highways, MHA also underpins the scoping and specification for ITS related works including traffic control and surveillance systems and toll collection systems.

In early 2021, the MHA published its Strategic Plan for the period 2021 to 2025. Among various improvement and digitalization measures, the plan enunciates a staged target for all toll plazas to be 50% RFID by 2023 and 100% RFID by 2025. The 100% target rollout of RFID is a precursor to the implementation of multi-lane free flow. Proof of concepts are currently being undertaken at selected toll plazas in the GKV. The timing and changeover from the present toll barrier-system to a full MLFF system is dictated primarily by commercial, enforcement and policy issues.

Although there has been a protracted period for its implementation, with the 1st POCs done in 2008, there have been notable progress including in the achievement of 100% ETC operations in 2017, which was promptly followed-up with new pilots with RFID tolled lanes in 2020. It is expected that all toll plazas will have at least one RFID lane by 2022.

PLUS Traffic Monitoring Center

PLUS is Asia's largest public listed tolled expressway operator; with close to 1000kms of tolled expressway in Malaysia alone. The PLUS TMC was commissioned in 2009 and has over the years, been expanded and imbued with newer technologies. The TMC operates 24x7 to provide traffic and incident reporting, and driver assistance.

The PLUS TMC manages over 2600 CCTVs, 900+ emergency telephone systems, as well as coordinates with the response teams, 1-800 calls, social media feeds, and MERS 999, among others. It has been reported that the TMC manages over 1500 calls on normal days which escalates to 3000 calls during festive periods when the highways cope with exodus of traffic out of the cities, and an average of 35 accidents and 500 vehicles breakdowns requiring attendance daily.

A significant revamp of the TMC was started in 2019, via an initiative called "PLUSOne" to automate and consolidate various data streams into a data lake for which AI / ML would be applied for improved customer response and user experience. An AI program that uses natural language processing, called "PUTRI" was operationalized in 2019 to ensure calls are responded to quickly and, where appropriate, are directed to manned operators for faster attendance to emergency situations.

The PLUSOne initiative included the establishment of a new dynamic IP based, high-resolution, video wall system that provided enhanced dashboard cues for operators. The road to digitalization, including applications using unmanned aerial dones, weigh-in-motion systems and using LIDAR to detect oversized vehicles, with the TMC as the nexus, continues as PLUS looks at deeper data driven decision making based on big data analytics coupled with AI/ML technologies.

Integrated Transport Terminals (ITT)

The ITT is a new generation of high-tech multi-modal integrated transport terminals. The ITT in Bandar Tasek Selatan commenced operations in 2011 and serves buses plying the southern connectors to the city. The ITT also serves as a main interchange for heavy rail, commuter and express rail, and light rapid transit systems. Various applications in ITS enables the use of an integrated ticketing system and bus arrival information in enhancing passenger comfort and security.

Establishment of Special ITS Unit, Public Works Department

In recognition of the increasingly pervasive deployments of ITS in Malaysia, the Public Works Department has formed a special unit to provide oversight of ITS development, scoping, planning and integration with relevant and impacted projects under the Highway Planning Unit, Ministry of Works Malaysia. This is an important first step towards greater harmonization of forward planning, execution, management and operations of ITS components in various state and national level projects.

Automatic Enforcement System

The ITS Master Plan identified Intelligent Enforcement as a way to help the various agencies to enforce road and traffic regulations without the need to deploy valuable human resources to the field. The Automated Enforcement System ("AES"), with a target installation of over 800 AES camera sites, deployed via a privatisation model under the Road Transport Department, commenced in 2012 with the objective for stronger, more effective and consistent enforcement to help reduce road accidents. The RM 700M private-financed initiated AES was however soon halted in 2013 due to public concerns over the privatisation framework.

Since 2018, the operations, maintenance and enforcement of AES, now called the Automated Awareness Safety System ("AWAS"), has been under the purview of the Road Transport Department ("JPJ") under the Ministry of Transport. The Malaysia Institute of Road Safety and Research ("MIROS") works with JPJ and PDRM to use their database of accident prone locations in determining suitable locations for AWAS cameras and in monitoring the effectiveness of the system. It is understood that system currently comprise 29 speed detection cameras along highways and 16 red light cameras.

Google, Moovit and PULSE for GKV

Google (Malaysia) launched their traffic maps for the Klang Valley in May 2012, followed closely by launches for Penang, Ipoh and Melaka in December 2012; and Johor Baru in October 2013. Google traffic's crowd-sourced data from Android smartphones, among other sources, superseded the congestion map developed for Kuala Lumpur under the ITIS programme in 2005 using fixed road based traffic counters and detectors.

In 2013, Google acquired WAZE, a social mapping location start-up. By 2013, Waze had already chalked up 1.5 million users in Malaysia (out of 50 million worldwide), making us the largest Waze community in the Asia Pacific region and among the top 15 countries among 200 countries that has a Waze presence.

In 2020 Rapid Bus Sdn Bhd ("Rapid Bus"), which operates Rapid KL, Go KL and SMART Selangor buses, announced a data sharing arrangement with the Google Maps application bringing real time bus data information into a more complete multi-modal trip planning. Rapid Bus is the largest bus operator in Malaysia with its operations mainly in the GKV, Penang and in Kuantan. It operates a fleet of about 1400 buses with an annual ridership of about 380,000+ per day (Oct 2021), reportedly a decline of about 40% from 2020 and about 70% from the pre-pandemic level in 2019.

Rapid Bus and Rapid Rail (which operates the LRT, Monorail and MRT lines), are wholly-owned subsidiaries of Prasarana Malaysia Berhad ("Prasarana"). The twin bus and rail operations of Rapid Bus and Rapid Rail are branded are "Rapid KL".

A similar collaboration for data sharing was inked between Rapid KL and Moovit, an Intel-owned Mobility as a Service solutions provider in Aug 2020.

Interestingly, Prasarana has also since launched its own journey planner app called PULSE which provides info on the status of each service and the estimated time of arrival (ETA), based on the real-time location of buses and trains.

The collaboration between Prasarana via Rapid KL and Google and Moovit is a potential catalyst and pivot point for wider (open) data sharing among public transport operators. In 2022, a pilot project under the sponsorship of MIGHT, working in collaboration with Prasarana, will target at expanding the network of non-Prasarana routes and services in the GKV with the aspiration to provide a more holistic journey planning app that could include micro-mobility services. This effort recognises that there remains a significant lack of information and fragmentation of services in non-Prasarana serviced routes, which, by some estimates could be roughly equal to Prasarana serviced routes.
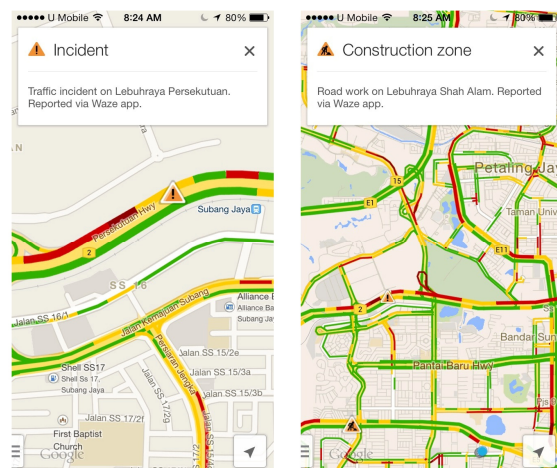
Performance Monitoring Hub System

The Land Public Transport Commission (LPTC) was set up in June 2010 with the goal of ensuring that the people have access to reliable, efficient, integrated and safe public transport. LPTC, renamed as APAD, helped develop the National Land Public Transport Master Plan which provides a long term programme to address the current deterioration in public transport with plans to execute high impact, effective delivery initiatives for 20-year sustainable quality public transport service for the nation. It is the goal of public transport to drive forward the ambition of Vision 2020 and 1Malaysia. These have the vision for Malaysia to achieve industrialized and fully developed nation status by sustaining growth of 7% per annum. It is expected that ITS and in particular Advanced Public Transport Systems (APTS) will play a large role in the roll-out of such future services and capabilities. Presently LPTC is embarking on the deployment of a Performance Monitoring Hub whereby stage buses would be fitted with the GPS for real time tracking and monitoring of bus services; including the delivery of ETA information at key stops.

National Transport Policy 2019-2030

A country's transport infrastructure is often expressed as being the economic backbone or lifeline of a nation. As such national transport policies typically establishes the agenda, vision, direction, priorities and/or roadmap to move the country forward to meet emerging challenges that needs to be addressed in the immediate, near and long term.

Malaysia's National Transport Policy 2019-2030 ("NTP 2030") was formally launched in 2019 on the basis of 5 policy thrusts and 23 strategies. The five policy thrusts aim to:

- Strengthen the governance to create a conducive environment for the transport sector;
- Optimize, build & maintain transport Infrastructure, services and networks for efficiency;
- Enhance safety, integration, connectivity & accessibility for seamless journey
- Advance towards green transport ecosystem; and
- Expand global footprint and promote internationalization of transport services.
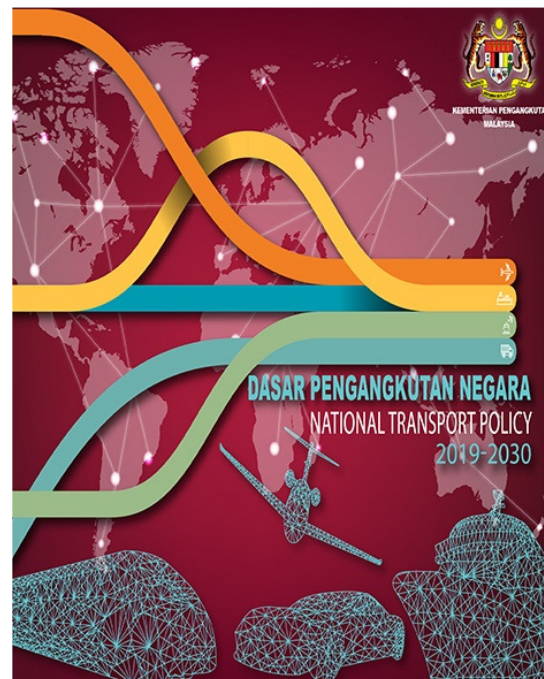
The NTP 2030 looks, among others, at addressing basic issues such as the fact that Malaysians spend a significant portion of their disposable income on transportation compared with other countries and that traffic congestion is a drag to the GDP.

The policies takes cognizance of, and seeks to align with the following key trends:

- Growing and increasingly ageing population, projected to be 9% by 2030;

- Increasing urbanization, projected to reach 80% by 2030;

- Advances in real time information and digitalization, particularly with a focus on trends towards shared mobility services and e-hailing paltforms;

- Expansion of e-commerce market;

- Shift towards environmentally sustainable transport, as reflected in the trend towards de-carbonisation of the transport system, in particular adoption of EV and next-gen vehicles;

- Move towards bigger vessels, consolidation and containerization;

- Increasing passenger travel and impact of Low Cost Carriers; and

- Proliferation of new technology, such as in the areas of CAVs, AI/ML. IR4.0, IoT, cloud computing, etc.

The NTP is an aspirational document which advocates for greater alignment and coordination between different policies and guidelines from different Ministeries and a greater adoption of public transport, with a goal of public transport modal share of 40% by 2030, as compared to the 20% present day modal share.

Malaysia ITS Blueprint 2019-2023

The idea for the ITS Blueprint was initiated during the keynote address for the 2017 International Seminar (organized by ITS Malaysia), by the Chief Secretary of the nation, Y.B. Tan Sri Dr. Ali bin Hamsa. It was at this event that the Ministry of Works was tasked with the job of drafting the National ITS Blueprint. The ITS Blueprint was the culmination of a two year effort that involved broad engagement with many dialogues and engagement with various public agencies, industry and academia. The ITS Blueprint establishes 4 strategic pillar, and 11 focus areas underpin by 5 main foundations.
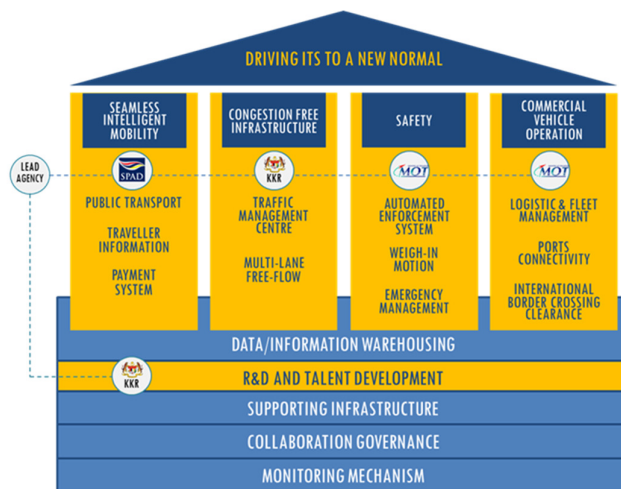
The 5 key action plans integral to the ITS Blueprint relate to the establishment of a National Intelligent Transportation Management Centre ("NITMC"), and with it, the concept of Data Centre as a Service ("DCaaS"), staged development of the multi-lane free flow system for tolled highways, weigh-in-motion, speed enforcement and on-board unit ("OBU") based fleet management.

The NITMC is envisaged to be a multi-agency collaborative framework, similar to the previous coordinated "blue ocean strategy" adopted by City Hall Kuala Lumpur in resolving a wide spectrum of daily traffic management issues at cross-jurisdictional boundaries. The NITMC, once operationalized, will be an important cogwheel to the National Disaster Management Agency ("NADMA") as well with other traffic control and management centers spread across various highways, local authorities, and agencies.

The multi-lane free flow system is part of the MHA's Strategic Plan 2021-2025 with a target for 100% RFID at all toll plazas by 2025. Malaysian company, Green Packet Bhd together with Taiwan's FETC International ("FETCi") expect to commence proof-of-concept ("POC") of a barrier-free, gantry based MLFF at the Besraya Highway in the GKV in 2022. The start of POC, albeit on a simpler open toll system, will be an important technical milestone towards understanding real world field challenges such as RFID detection and transaction reliability, capacity and speeds under different conditions, stability of low latency communications, and accuracy of ANPR that can meet MHA's requirements. Issues related to operations, financial, legal and enforcement that require multiple stakeholders with different concession agreements, to a common platform; as well as the changeover from the existing ETC system, will be continuing challenges that will need to be resolved.

Overloading of heavy vehicles, as well as over-sized loads, is a bane to Malaysian roads resulting in significant pavement damage and pavement life and consequently high cost of repair and maintenance, as well as closure of traffic during such works. Overloaded and/or over-sized loads are also a danger and a hazard to other road users. Weigh-in-motion ("WIM") systems are intended to capture axle weights and gross vehicle weights ("GVW") installed on trafficked lanes. WIM data, combined with ANPR, can be used to automatically red-flag potential violations that can then

be directed to an off-site weighing station, without disruption to regular traffic. The use of WIM is also part of the extended services under the PLUS TMC transformation programme.

The expansion of the existing AWAS for wider speed enforcement across the country, as well as the OBU on commercial vehicles that link-up to various regulatory, licensing and monitoring agencies also expressed ambitions of the ITS Blueprint to be progressed by 2023.

National Automotive Policy 2020

The National Automotive Policy 2020 ("NAP 2020") is a follow-up to the NAP 2014. NAP 2020 aims to make Malaysia become a regional leader in automotive engineering and manufacturing with deeper focus on Next Generation Vehicles ("NxGV"), Mobility as a Service ("MaaS") and Industrial Revolution ("IR 4.0").

NP 2020 envisages market availability of NxGV, classified as energy-efficient vehicles ("EEV") that are equipped with a minimum of Level 3 vehicle automation, by 2025. MaaS is a concept that integrates various types of services and transport modes into one centralized service through a digital platform. This includes private and public transport journey planning, micro-mobility, ride-sharing, and payment systems on a single platform. This is envisaged to be a paradigm shift away from car ownership towards a system of shared resources. IR 4.0 is encapsulated in the (2018) National Policy on Industry 4.0, enunciated by the Ministry of International Trade and Industry ("MITI"), in the (2020) Malaysia Digital Economy Blueprint by the Economic Planning Unit ("EPU"), Prime Minister's Office, and more recently National 4IR Policy (2021) with the common objective of transforming the country into a high income, high growth nation underpinned by technology and digitalization.

NAP 2020 establishes 3 directional thrusts (technology and engineering, investment and market expansion), 3 strategies (value chain development, human capital development, safety and environment), 4 roadmaps (value chain, technology, talent and aftermarket in automotive and mobility) and 3 blueprints (Mobility as a Service, Robotics and IoT in automotive).

5G Roll-Out

At the start of the pandemic in 2019, various Movement Control Orders ("MCO") compelled many to work (virtually) from home; including remote schooling. During this period, internet traffic in Malaysia increased by 30-70%, with internet usage shifting to residential homes by 50 to 70%. The high demand led to decrease in internet speeds by 30-40% resulting in high customer dissatisfaction. Close to 90% of the population are internet users, and the number of smartphones, at 98%, are near saturation levels.

The major and rapid shift away from physical workplaces and schools brought to light the digital divide and an urgent need for new policies to improve broadband connectivity for all. The Jalinan Digital Negara ("Jendela") plan, under the purview of MCMC, was formulated in Aug 2020 to improve the country's digital connectivity and set the nation's foundation for 5G technology.

5G is seen as a "catalytic enabler" of Malaysia's digital transformation. An early testbed for 5G by Telekom Malaysia ("TM") was done in Langkawi in 2020. Subsequently, pilot roll-outs commenced in 2021 at selected locations in parts of Kuala Lumpur, Putrajaya and Cyberjaya; with a target penetration of 80% by 2024. The roll-out is part of the Malaysia Digital Economy Blueprint ("MyDigital"), launched in 2021.
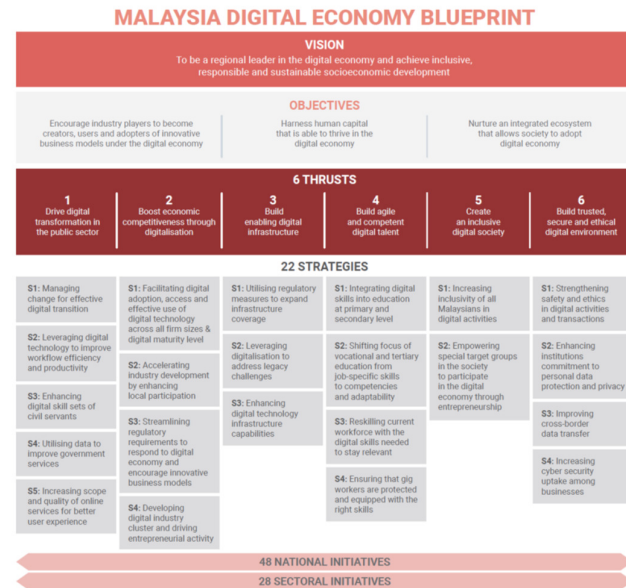
To this end, *Digital Nasional Berhad* ("DNB") was subsequently established to deliver on the outcomes of MyDigital including the roll-out of 5G, with DNB generally envisaged as the sole entity owning the Single Wholesale Network ("SWN"); to design, build, maintain the nation's 5G infrastructure and 3GPP multi-operator core network.

DNB is formed under the Ministry of Finance but is regulated by the Malaysian Communications and Multimedia Commission ("MCMC").

The roll-out of 5G for is important to support next-generational connected ITS applications in Malaysia; particularly in respect of traffic control and management with data sourced from denser network of road sensors, visual analytics, and from connected vehicles. The network will also faster scaling, denser detectorization of traffic sensors in the road infrastructure which are important for various smart city applications. The faster, more stable, low latency network promised by 5G will also facilitate more efficient adoption of cloud infrastructure; which will also help accelerate further investments into data centers in the country as well as smart city development.

Smart Cities

The Malaysia Smart City Outlook 2021-2022 produced by the Malaysian Industry-Government Group for High Technology (MIGHT) shows Kuala Lumpur as being ranked 54 on the Global Smart City Index 2020, and second, behind Singapore, among ASEAN member countries.

MIGHT is a non-profit organisation under the purview of the Ministry of Science, Technology and Innovation (MOSTI) and serves as a think-tank to build and drive platform public-private partnerships in various areas of science and technology. There are 26 pilot smart city projects in the ASEAN Smart City Network ("ASCN"), of which 4 are in Malaysia, namely Kuala Lumpur, Kota Kinabalu, Kuching and Iskandar Malaysia. Additionally, there are smart city initiatives variously themed as Georgetown Smart City, Shah Alam Intelligent City, Cyberjaya Low Carbon City, Putrajaya Intelligent Garden City, Bandar Melaka Green Technology City and Iskandar Malaysia Smart City, including community based, SDG-driven approaches such as the Majlis Perbandaran Subang Jaya's vision for "Vibrant City by 2030".

Smart City Initiatives in Malaysia
Source: MIGHT Analytics, Malaysia Smart City Outlook 2021-2022
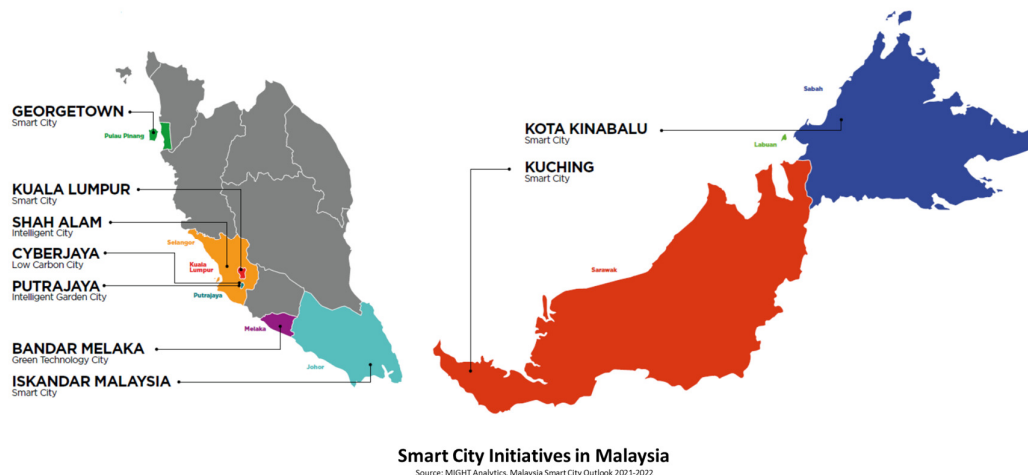
Similar to ITS, navigating the smart city landscape in Malaysia can be challenging. At the National Level, there is the Malaysia Smart City Framework, while strategies and "blueprints" are published at different State and regional levels such as the Smart Selangor Blueprint, Penang 2030, Sarawak Digital Economy Strategy, Smart City Iskandar Malaysia. Local authorities such as Putrajaya has its own smart city blueprint while Cyberjaya promulgates a smart low-carbon city. Notwithstanding, "smart mobility" and "smart traffic management" are common elements in the service and systems layer, respectively, that underpins much of these ambitions. Putrajaya's Smart City Blueprint, for example lays out the framework for applications in parking guidance, traffic system and road safety, transit and traffic information, smart bus stops, micro-mobility and next-gen vehicles.

Strategic Technologies to Implement Smart Mobility
Source: Malaysia Smart City Outlook 2021-2022
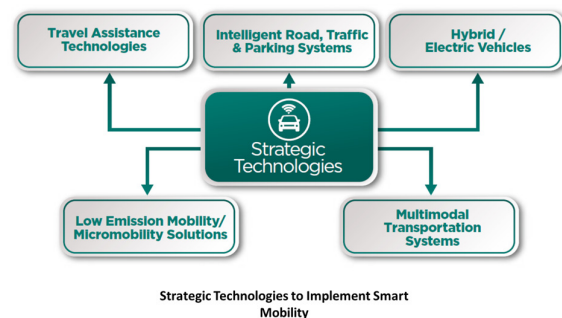
Malaysia Institute of Road Safety and Research

Malaysia's track record on road safety has not been exemplary; and had at one time (2014) been unenviably ranked as among the top 25 most dangerous countries for road users in the world. With the country, mostly in a state of lockdown with restrictions in inter-state and inter-district travel for last two years (2020 – 2021), the number of road fatalities had reduced by about 25% in 2020, compared to the pre-pandemic 2019 of 6167 fatalities.

The arduous work for the advocacy for improved road safety via R&D, education and assistance with policy making is under the purview of the Malaysian Institute of Road Safety Research (MIROS), an agency established in 2007, under the Ministry on Transport Malaysia. Representation by MIROS in ITS Malaysia since its formative years, underpins the significance and importance of ITS in road safety.

IN 2014, the ASEAN Transport Ministers had appointed MIROS as the ASEAN Road Safety Centre. MIROS hosts the New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP), with its own crash lab located in Melaka, that assesses the safety aspects of test vehicles based on a star-rated system. The assessment protocols are periodically reviewed, with the latest (3rd) effected for the period 2021-2025. Additionally, there are plans to build a 1-km test track, in the vicinity of the Sepang International Circuit, to carry out autonomous emergency braking ("AEB") tests.

Malaysia Automotive Robotics and IoT Institute

The Malaysia Automotive, Robotics and IoT Institute (MARii), an agency under the Ministry of International Trade and Industry ("MITI"), has been taking an increasingly pivotal role in ITS in Malaysia in recent years, particularly in the areas of connected mobility, in the formulation of and consequently, the launch and execution of National Automotive Policies in 2014 (NAP 2014) and the recently updated edition of the policy, NAP 2020.

MARii works closely with all stakeholders to spur technology adoption, innovation and capacity building for Malaysian businesses and talent within the automotive and overall mobility sector, through the strategic policy research and deployment technology programmes catered to various levels of business and social strata, in a multitude of sectors such as advanced design, smart manufacturing, data sciences, intelligent transport systems and Mobility-as-a-Service (MaaS).

Since its inception in 2020, MARii has played a key role in the development of intelligent transportation, not only from a consumer awareness standpoint, but in the various aspects of manufacturing, aftersales, product development and technology adoption that contributes to intelligent transportation. As for the ITS, MARii acts as the think tank not only to boost the development of Next Generation Vehicle (NxGV), but also to enhance the adoption of technologies within the communication and infrastructure (V2X), where it will connect most of the stakeholders within the scope of transportation and communication.

Through the NAP, Malaysia has developed a formidable ecosystem of automotive component suppliers and relevant talent, that are ready to take the next step into the future automotive industry. The policy has established a roadmap towards the holistic development of critical components, technologies and is adding to the already rich infrastructure to accommodate design, smart manufacturing, and component development through the various centers of excellence established by the government over the last decade.

With connectivity at the heart of this transition, technologies such as manufacturing execution systems, telematics, high performance cloud computing, big data management, intelligent city management and many digital technologies were developed within MARii's walls. As trends developed towards the fourth industrial revolution, MARii also deployed numerous technologies to ensure industry access to technologies such as additive manufacturing, simulations, big data analytics, augmented reality, cloud computing and others.

At the same time, numerous Malaysian standards and regulations have been established for next generation of vehicles (many more are currently under development), to ensure that those vehicles that will be running are compliant with global safety standards.

MARii spearheaded these efforts not only through its strategic research and policy framework development capabilities, but implemented the development through its various centers of excellence that include MARii Design Center, MARii Academy of Technology, National Emission Test Center (NETC), MARii Simulation & Analysis Center (MARSAC).

The agency's next undertaking is the development of Centre of Excellence for Future Industry (CoeFI) where it will house the Electric Vehicle Interoperability Center (EVIC) and Mobility Test Bed which will be the focal point for testing of various technologies in the EV eco-system and Next Generation Vehicle (NxGV). The centre also will also be having BDA Centre, Robotics Centre, and AI Park for catering the needs of future industry.

The country's 1st autonomous testing route, over a distance of about 7km, on public roads was established in Cyberjaya in 2019, under a National Regulatory sandbox initiative. The project, developed by Futurise (a wholly owned subsidiary of Cyberview Sdn Bhd) involves various other agencies such as Sepang Municipal Council, Road Transport Department Malaysia ("JPJ", "MOT"), Land Public Transport Agency ("APAD"), Malaysian Institute of Road Safety Research ("MIROS"), and Universiti Teknologi Malaysia (ADC, UTM). eMoovit Technology Sdn Bhd ("eMoovit") is the first

company to receive approval to use the route for the testing of their autonomous car. In April 2020, Celcom demonstrated a self-driving Proton Exora as part of a 5G showcase.

MARii is also keenly involved in the greater adoption of EVs and in the country's preparation for the entire EV eco-system including, among others, power generation, charging infrastructure and human capital development.   In the Government's Budget 2022, tabled in Parliament in Oct 2021, buyers of EVs in 2022 will enjoy full exemption of import duties, excise duties and sales tax, as well individual income tax relief of up to RM2,500 on the cost of purchase, installation, rent, hire purchase as well as subscription fees for EV charging facilities.

These incentives, if continued, will help spur increasing adoption of electric mobility and seed new collaborations in this area. For example, in Aug 2021, SOCAR Mobility Malaysia (SOCAR) and Tenaga Nasional Berhad (TNB) announced a joint collaboration to leverage on shared data on electric vehicle (EV) usage in Malaysia.   The collaboration allows TNB to leverage on SOCAR's data on vehicle usage and travel behaviour to identify strategic locations along key travel routes for the installation of charging infrastructure. This data would help plan the location, number and type of chargers for installation, including direct current (DC) fast chargers.

In 2015, the Malaysian Green Technology Corporation ("Greentech Malaysia") published the National Electric Mobility Blueprint, that established a goal of 25,000 EV charging stations by 2020.   As of 2021, it is estimated that are about 500 public AC charging stations, and only a handful of DC fast charging stations. The slow start may be pivoting to a faster pace with the incentives for EV in Budget 2022 and with new entrants to the EV charging market space, such as EV Connection Sdn Bhd ("EVC"), that would augment the ChargeEV network under Greentech Malaysia.

Global Future Cities Programme

The Global Future Cities Programme ("GFCP"), a part of the UK cross-government Prosperity Fund, identified Iskandar Malaysia and Melaka as 2 of the 19 cities across 10 countries to be studied with the aim of promoting evidence based sustainable development, specifically in the area of innovative, smart mobility projects. Mott MacDonald ("MM") appointed as the delivery partner and UN-Habitat as the global strategic partner for the two year programme that started in 20920.

The MM team developed a Smart Integrated Mobility Management System ("SIMMS") for the Iskandar Regional Development Authority ("IRDA"), which is envisaged to be a software platform that integrates static and real-time data gathered from various sources including GIS, GTFS. traffic controls, and feeds from multiple transport and transit operators. The objective of SIMMs is to improve data driven decision making and use of big (transportation) data analytics to various operational and strategic planning and for policy making; including a link to the Iskandar Malaysia Urban Observatory ("IMUO"); and consequently an immediate comparison of various metrics to the other (urban observatory) cities.

In Melaka, a designated UNESCO Heritage City, the MM team is developing a Green Bus Network ("GBN") as part of the sustainable mobility. The GBN will be served by a renewable energy-fuelled bus fleet and innovative public transport technologies, such as smart traffic management and smart ticketing, including identification of suitable locations for and the promotion of park and ride facilities.

Smart Selangor

The Smart Selangor Delivery Unit ("SSDU"), established in 2016, is an entity mandated by the Selangor State government to spearhead the implementation of "smart initiatives" with the objective of providing advanced solutions and technologies that improve livability, economic productivity and environmental sustainability for the State. The 4 key focal areas are "Smart Government", "Smart Economy", "Smart Community", and "Smart Digital Infrastructure". Some of these initiatives include establishment of a C5i operations center, advanced CCTV analytics, Intelligent Traffic Management System, Smart Selangor parking, Selangor Smart Bus and Smart Selangor Bus Stop, among others. The Smart Selangor Bus is a free bus service (except for foreigners who pay a nominal fare) tracked by GPS, with real time journey planning via the Moovit app or the Selangor Intelligent Transport System ("SITS") app.

PROBLEMS AND CHALLENGES

"… The ability of technology to transform transportation systems is well ahead of governments' capability to utilise it … For governments the big question is how to deal with these rapid changes … "

Challenge # 1: Millennial Generation

This is the Millennial generation (those born between 1980 and 2000). We have never before faced such vast disunion between public and private utlitisation of technology.

Millennials adopt technology at a high rates. Smartphones are how they connect to the world and if the device offers an application (of which there are many choices) that they like, they will use it.

Public agencies are no longer in the dominant position of deciding how, when and what technology will be used by the Millennials. Social media, smartphones and such applications have completely disrupted the manner in which information is collected, processed and disseminated. Public agencies no longer have the luxury of making consumer decisions, and to some extent also lack similar ability to influence adoption.

What is needed is for Government to liberalise their data and to fund open data streams so that application developers would be encouraged to find new innovative ways to process and monetize such data. Competition drives innovation.

Challenge # 2: Obsolescence and Technology Disruptors

How do we implement public centered systems timely without suffering obsolescence by the time they are deployed. A system that is being studied and planned in 2015, scoped and specified in 2016, with bids invited in 2017 and rolled out in 2018, or 2019 – a period of say 4 to 5 years after first being mooted can be expected to be largely dated by the time the full system is implemented.

On the other hand, technology disruptors such as Google can completely make an expensive public funded initiative obsolescent, redundant or unnecessary in far

shorter time. This is the age of smart phones and wearable devices – both of which have the capabilities to fast eclipse current in-vehicle technologies in the near future.

What is needed is a new model for public/private cooperation and/or procurement that provides funding for regular technology refreshment so that Government, the solutions provider and end-users can converge to shared outcomes.

The economics of transportation and how ITS plays a role in this is constrantly changing. Government and industry should consider outsourcing models and other means of achieving a lean cost efficient organizational structure and procurement model – so that they are not bound by long term supply chain contracts and other legacy obligations that can hinder their ability to transform and keep costs to minimum.

Challenge # 3: Information Silos vs Unified Systems

Different agencies manage different siloed systems. There is significant work ahead to reconcile and harmonise these disparate systems and databases into a common back-end / data warehouse to a unified system so that the intelligent analytics and be mined from such data – allowing for optimal planning and execution – and also mitigation of overlapping efforts and costly unnecessary redundancies.

Challenge # 4: Smartphones / Wearables are the New Wallet

Harmonised transportation systems are inevitably underpinned by unified payment systems – which can be leveraged for far more pervasive micro payments across a wide spectrum of commercial activities.

An account-based (open payment) processing of toll and transit fares will be fundamental shift at the macro level from prepayment where cash is collected before travel. This shifts the intelligence from the card reader to the back office. The creation of a validated customer account (at back-end) as opposed to an anonymous pre-paid account 9deductions made at the front end) allows for a host of services to be made available across different hardware and platforms and / or mobile devices. The shift of intelligence to the back-end will also open up a wide range of opportunities – such as payment of toll using smartphones, and cheaper and less complicated equipment that needs to be deployed in the field.

Ref: http://www.itsinternational.com/sections/nafta/features/new-thinking-needed-on-the-transportation-front/

Challenge # 5: Plan and prepare for Change – Just don't make predictions

We have no strong visibility as to where technology and adoption rates will trend in the long term; over time horizons exceeding say 5 years. We can and should however, plan for capacity and change; and this includes funding to innovate, educate and inter-link and harmonise systems; and especially data – so that there can be continuity in how data is ware-housed, migrated or integrated across different platforms and mined for the future.

Government should:

- identify and plug gaps,
- provide an ITS vision that binds different agencies to shared outcomes (or goals),
- liberalise and make available as much data streams as possible,

- fund test-beds,
- encourage innovation (with some tolerance for "contained" failure),
- seed short to mid-term catalytic ITS projects that can help the industry move incrementally to larger or up-sized ITS deployments.

Challenge # 6: Engaging the "Rakyat"

One of the key shortcomings by both private and public sectors is the lack of citizen engagement and the often wide gap in interest between commercial gain and the public good. This is the age of social media. One person's complaint can rapidly escalate to public outrage. The rules for public engagement are no longer the same.

The public and citizens expect to be engaged. They expect to be actively solicited for feedback, inputs and suggestions – and usually via similar social media channels. They expect to be heard and responded to before they buy-in to a private or public initiative.

Challenge # 7: Too much time thinking; not enough doing

The industry and the Government have many shared aspirations in regards to ITS. There is a strong desire to nurture, encourage participation and to expand ITS so that we can compete with other "smart cities" in tandem with An expanding knowledge based economy. However, there is a lack of coherence is the way these aspirations are being actualized.

The industry is looking for commercial opportunities to launch new initiatives that can plug a social need, for either a commercial profit or for strategic interests. The Government is being looked to by industry for guidance, leadership and direction. This may include providing a platform for data creation, supporting legislation, standards, and perhaps seed funding for projects with view to upscaling upon success.

Industry is looking to Government to establish an ecosystem as well as an operating and funding environment that allows ITS to take root. For example,

- articulating clear statement of needs or desired outcomes, e.g. what kind of system or infrastructure is Government looking for that:

  - that will save tax payer's money;
  - accelerate economic growth;
  - spur new economic activities;
  - encourage "migration" of knowledge workers to our cities, and their retention?
  - improve the quality of our lives – cleaner, safer, more "livable" and healthier?

- defining the supporting legislation and enforcement for compliance for road rules;

- articulate a total plan for the long term broad mobility options (car, bus, rail, taxis, bikes, pedestrianisation etc) that Government will be investing or funding.

- defining transport equity funds or models where relevant

- establishment of a strategic plan to bind (and hormanise) different ITS related databases and to liberalise specific data streams to allow private sector to plan and design more innovative tools for real time information dissemination;

- establishment of one-stop agency to help cut through the myriad of competing jurisdictional and related issues needed to actualize ITS projects.

- providing seed funding for ITS projects and test-bed applications and R&D.

- providing long term commitment and funding for replacing, renewing and inter-locking aging legacy systems. It usually makes sense to tend and finetune an imperfect but otherwise operational system than to allow it to deteriorate to state of disuse, disrepair and disrepute; only to replace it with another system– which reestablishes a vicious cycle of obsolescence and public incredulity.

- pulling different and disparate ITS deployments to an evolving demonstration site to showcase "best of deployments"; and to provide a focal point that we can all point to say there is where our future or vision lies.

- broadening outreach and public (citizen) engagement for strong buy-ins.

6 PROPOSED ACTION PLANS

"We cannot build our way out of congestion"

A car-hungry nation

The world of ITS is moving boldly ahead towards a ubiquitous future of autonomous vehicles that self-drive based on vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communications.

In 2010, four electric autonomous vans successfully drove 8000 miles from Italy to China. As of 2013, four U.S. states (Nevada, Florida, California and Michigan) have passed laws permitting autonomous cars. In Europe, cities in Belgium, France, Italy and the UK are planning to operate transport systems for driverless cars. Germany, Netherlands and Spain have allowed testing robotic cars in traffic. Finland is planning on passing a law before year 2015.

As far back as the 2014 World Congress in Detroit, two key questions that will be posed at the High Level Policy Round Table are:

1. *What are you doing to prepare for changes in our surface transportation system?*

2. *What are you doing to prepare for connected and autonomous vehicles?*

Our progression towards ITS will likely be steadily paced and measureable. Our primary tasks in preparing for the ubiquitous ITS are as follows:

Action 1

We need to identify stakeholders and bind them to a cooperative framework. Oftentimes, ITS components are embedded within road, rail or other infrastructure projects and the full potential for important ITS elements via integration with other services are not fully harnessed or perhaps not even recognised.   A central coordinating body at the highest level of Government should be established to ensure that our legacy and future systems can be sufficiently integrated across different technology platforms such that important data sets can be cross-linked for intelligent analytics. Systems need to be intelligently networked.

> The future of ITS is defined by connectivity – and the network effect.
>
> Smart vehicles, smart cities, smart roadways define the roadmap for V2I - V2V integration.

Action 2

We need strategic plans to map out a coherent growth chart for V2X applications. Presently, there are different and uncoordinated efforts in the deployment of such as the following:

- **Advanced public transport systems**

  Prasarana Malaysia Bhd is leading the ITS effort in improvements in public transport infrastructure via its multitude of on-going projects such as the Ampang and Kelana Line LRT extension projects, the Sunway BRT project, RapidKL bus fleet tracking system, bus scheduling and driver rostering system, cashless bus ticketing system, passenger information display system, MyRapid Journey Planner, Rapid Rail Integrated Control Center, and the Rapid Rail Automatic Fare Collection System.

  Binding these different initiatives and disseminating the data across a wider holistic surface transport infrastructure and across different agencies such as APAD, JPJ, City Hall KL, PDRM, MOT and other service preoviders remains challenging.

- **Commercial vehicle systems**

  CVS applications includes projects such as the centralised taxi service system, and the proposed electronic cargo tracking system for containers underpinning green lane ASEAN cross border shipment of goods. There are already many commercial vehicles (including taxis and buses) that are now equipped with GPS for real time tracking and route variance monitoring to deliver enhanced services for users.

  ITS systems such as latest weigh-in-motion technologies can be gainfully deployed to detect overloading of heavy vehicles. It had been estimated that gross vehicle weight violations could occur in 1 out of every 3 commercial vehicles. Such non-compliant vehicles reduce the lifespan of our roadways, and are road hazards. Overweight vehicles are more susceptible to rollovers, have greater maneuvering difficulties with lane changing, weaving and braking, and increases driver fatigue – all of which increase the danger levels for other road users.

> We should be pushing for a better engagement and understanding at the decision making level.
>
> One of the biggest barriers to ITS is institutional. There are viable and practical ITS solutions in most situations, but bringing different organisations from dis-connected jurisdictions to a common technology platform can come against some very entrenched attitudes and operational barriers rather quickly.

"… a quarter of accident fatalities in Malaysia involve heavy vehicles…", *ref. Degree of Vehicle Overloading and its Implication on Road Safety in Developing Countries, Civil and Environmental Research, Mohamed Rehan Karim et. Al, 2013.*

The Government spends a significant portion of its annual infrastructure budget on road network and bridge maintenance, much of which could be saved if road damage caused by overweight vehicles can be avoided or at least minimized via stronger measures using ITS for detection and monitoring.

- **Electronic toll collection**

ETC implementation is regulated by the Malaysian Highway Authority. Recently, we have migration towards full ETC (at seven toll plaza locations), and there is an inevitable migration towards Multi-Lane Free Flow System (MLFF). The implementation of MLFF will be a natural test bed for the eventual deployment of Electronic (Area) Road Pricing system for Kuala Lumpur.

- **Advanced Traffic Management and Advanced Traveler Information Systems**.

City Hall Kuala Lumpur has reinvigorated the Integrated Transport Information System with over 1000 new cameras and vehicle detectors (dubbed ITIS 2.0). Together with the area traffic control systems operated by City Hall KL and the various local authorities, the telemetric system operated by the Highway Planning Unit, Ministry of Works, and the multitude of vehicle detectors along 30 odd tolled highways; there is a significant opportunity to provide a wide area network of real time detectors throughout the country.

"Malaysian expressways are not ITS cohesive in that traffic information are not tightly coordinated or integrated across the network."

Opportunities to embed more ITS detectors into new road upgrading works and junction improvements will see a progressive increase the level of detectorization that will have important V2I applications in the near future.

There remains large untapped opportunities to manage the entire network of expressways from a data-centric perspective coupled with intelligent analytics to help policy makers visualize the impacts of new highways and changes arising from demand management strategies.

There are at least 10 upcoming major expressways with investments in the billions – each with its own system of Traffic Control and Surveillance (TCSS) – and although linked to the MHA TMC – remain largely run and operated as individual tolled expressways with interests that may not always be compatible with that of a network.

UPCOMING EXPRESSWAY PROJECTS

Ref. The Edge Malaysia, August 18 2014
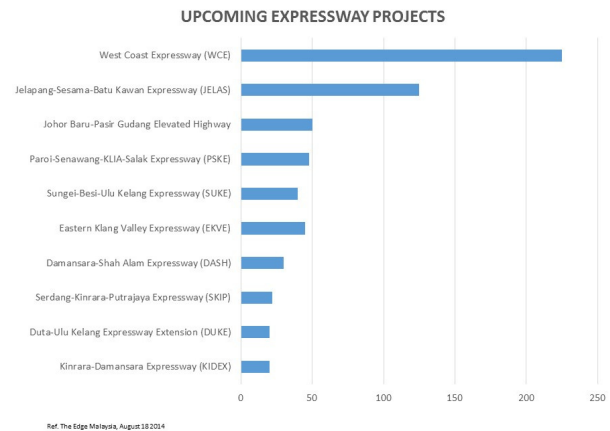
▪ **Road Safety and Enforcement**

"Malaysia has 17th most dangerous roads in the world", ref. the STAR, 22 Feb 2014.

According to research by the University of Michigan, Malaysia is among the top 25 most dangerous countries for road users, with 30 fatalities per 100,000 individuals, as compared to the world average of 18 deaths per 100,000.

ITS provides solutions for the enhancement safety at the vehicle and road level via the following:

Vehicle	Electronic stability control
	Lane departure warning
	Adaptive cruise control
	Adaptive lighting
	Lane keeping system
	Collision avoidance system
	Pedestrian detection
	Enhanced night time vision
	Attention / Fatigue warning system
	Blind spot detection
	Driver smart card entry
	eCALL
Road infrastructure	Illuminated road studs
	Variable speed limits
	Automated enforcement
	Traffic monitoring
	Rapid / emergency response systems
	Black spot warning
	Incident information

Compliance with road rules in Malaysia is poor. As part of continuing efforts to combat low compliances, City Hall KL has started a pilot project that issues pre-recorded audible warning messages when vehicles stop inside the yellow boxes at junctions. The system is integrated with cameras, siren, beacons and Public Address system.

" … A smart road design that features glow in the dark tarmac and illuminated weather indicators are proposed to be installed in the Netherlands in 2013. The first few hundred meters will be installed in the province of Branbant followed by priority induction lanes, interactive lights that switch on as cars pass and wind powered lights within the next 5 years. A photo luminising powder will replace road markings. It charges up during sunlight giving it up to 10 hours of glow in the dark time come nightfall…"

Wired.com

- **Emissions**

"In 2013, … the fuel subsidy cost of RM 28.9 billion was 61.9% of the total subsidy bill and 13.4% of the budget's operating expenditure", ref. the EDGE MALAYSAIA, 25 August 2014.

ITS has been shown to have a significant potential to reduce fuel consumption (and consequently greenhouse gas emissions) by optimising travel logistics, as well as controlling, managing and policing traffic restraint and demand management.

Fuel consumption and/or emissions could be monitored and feedback given to optimise driving style and vehicle behaviour. This is especially useful for commercial vehicles. We are seeing new sensors that are smaller, cheaper and more versatile and their deployment in intelligent, interacting networks is opening up a new age of environmental monitoring. Increasing the intelligence in the infrastructure, coupled with increased sensing, processing and communications capability will lead to new paradigms on how the transport network is managed, controlled and operated in the future.

- **Legislation**

" … At European Union level, both the Council and the European Parliament have been active in developing legislation that involves deployment of ITS. The EU is also aiming to create a single market for ITS services ...", ref. The Potential of Intelligent Transport Systems for reducing road transport related greenhouse gas emissions, European Commission, DG Enterprise & Industry.

Touch 'n Go

Touch 'n Go is of developing a new **On-Board Based Unit** based on **RFID technology**. In the public transportation sector, Touch 'n Go is collaborating with the Government to implement an **Integrated Cashless Payment System** to further enhance mobility for users. Not to be left behind in the mobile technology, Touch 'n Go has also embarked on other exciting innovations utilizing **Near Field Communications ("NFC")** capabilities in smart phone for mobile payment as well as enabling over-the-air reload.

The deployment of new technologies need to be supported by new legislation such as in the areas of enforcement, compliances, data and privacy protection. One of the issues with the deployment of the Automated Enforcement System (AES aka AWAS) related to perception of weaknesses in laws enabling the enforcement and prosecution of traffic offences under the AES; as well as some overlap in jurisdictions between the Road Transport Department and the Police.

The emergence of e-hailing has also challenged the current modes of regulating the traditional taxi industry in Malaysia.

There are opportunities and lessons to be learnt from the EU who have progressed far in terms of legislation and the establishment and promotion of a vibrant market for ITS products and services.

Self-drive lorries 'to get UK test'

Last updated Aug 18, 2014, 9:01 PM GMT+8

By Dave Lee
Technology reporter, BBC News

Autonomous driving technology has been tested on European roads

Fleets of self-driving lorries could be tested on UK roads as soon as next year, according to reports.

The technology allows a convoy of lorries to travel just a few feet from each other, with just the driver at the front in control.

- **Smart Cities**

  The concept of smart cities, like ITS, is defined by the use of information and communication technologies in a new form of management and governance that optimizes the use a city limited resources such as water, utilities, transportation, and energy. ITS help cities:

  ❖ Disseminate real time travel information to provide drivers and commuters the tools necessary to make timely mode and route choices

  ❖ Helps agencies project commuter demand to optimize capacity and minimize congestion

  ❖ Coordinate resources to improve safety and enhance the traveller's experience

- **Digital Malaysia**

  "…Digital Malaysia seeks to advance the country towards a developed digital economy by 2020 by creating an ecosystem that promotes the pervasive use of ICT in all aspects of the economy … resulting in increased Gross National Income, enhanced productivity and improved standards of living…", ref. www.digitalmalaysia.my

  Malaysia is pushing towards a digital economy and nurturing a knowledgeable and innovative workforce. ITS has not yet been fully recognized for its role in the creation of a Digital Malaysia. There are many

untapped opportunities to mainstream ITS into other similar initiatives by Government.

- **ASEAN Connectivity**

The ASEAN Strategic Transport Plan 2011-2015 places significant emphasis on transport infrastructure development using ICT for physical and institutional connectivity, to deepen economic integration, reduce the costs of international trade in goods and services such as services link costs and network set-up costs.

ITS can play a significant role in ASEAN Connectivity such as via the deployment of Electronic Cargo Tracking System ("ECTS"). In this scheme, cargo from any originating location will be allowed unhindered green lane cross-border travel as long as the shipment is electronically secured and tracked. ECTS provides a means for faster customs clearance, significantly reduced deployment of manned resources, enhanced security and cargo visibility at all stages of movement.

7 CLOSING REMARKS

In this Document, ITS MALAYSIA has put forth generally the current state of development of the ITS industry in Malaysia as of 2021. Although the country took an early lead in the development of its expressways, and despite having established the early ITS Strategic, Master Plan and Architectural Plans, the nation has not been able to bring about a cohesive and actionable development strategy.

There are many isolated ITS deployments over the years, but without proper linkage and/or a communications strategy that pulls it all into a cooperative framework, Malaysia will not be able to enjoy the full potential and benefits of ITS. Despite this, it is inevitable that there will be continuing significant ad hoc investments in areas such as Traffic Control and Surveillance Systems, Advanced Traffic Management Systems, Commercial Vehicle Operations, Advanced Public Transport Systems and Advanced Traveler Information Systems by different agencies in attempting to keep up technological advancements. Some of these developments will be either promoted by vendors and/or initiated by agencies inspired by developments in other cities or countries.

To ensure that investments in ITS in Malaysia bring about the optimal benefits, the Government should take a leadership role, to set directions and to create cohesion among different stakeholders with the primary singular goal being to establish a cooperative platform for V2I readiness.

Government needs to establish a vision for a near to mid-term strategy for the development of ITS in the country. What follows will then be a set of action plans coupled with tangible outcomes or deliverables that will help benchmark the level of success for each plan.

ITS is oftentimes embedded too deeply into other infrastructure projects to be properly recognized and for which much valuable information or data is then lost or not shared. Government needs to establish a coordinating body with broad oversight into various projects to identify ITS components and to pull out those parts that can be gainfully shared within a cooperative network or platform with other related or impacted agencies. It is no longer tenable for projects to be implemented by single user agencies that are isolated and unnecessarily fire-walled from other agencies who may be able to benefit from selective shared data.

Key Planning / Policy Documents

1. 12th Malaysia Plan, 2021 - 2025

2. Cyberjaya Smart Low Carbon City Action Plan 2025

3. Green Technology Master Plan 2017 - 2030

4. Highway Network Development Plan, 2030

5. ITS Master Plan

6. ITS Strategic Plan

7. ITS System Architecture

8. LLM Strategic Plan 2021-2025

9. Low Carbon Mobility Blueprint

10. Malaysia Digital Economy Blueprint (MyDigital)

11. Malaysia ITS Blueprint 2019-2023

12. Malaysia Smart City Handbook 2021

13. Malaysia Smart City Outlook 2021-2022

14. National 4IR Policy 2021

15. National Automotive Policy 3030

16. National Electric Mobility Blueprint

17. National Policy on Industry 4.0 (Industry4wrd)

18. National Transport Policy 2019-2030

19. Smart Selangor Action Plan to 2025

20. Putrajaya Smart City Blueprint

Key Stakeholders

APAD	*Agensi Pengangkutan Awam Darat* (Land Public Transport Agency)
DBKL	City Hall Kuala Lumpur
DNB	Digital Nasional Berhad
EPU	Economic Planning Unit
HPU	Highway Planning Division
IEM	Institution of Engineers Malaysia
IM	Iskandar Malaysia
IRDA	Iskandar Regional Development Authority
IRT	Iskandar Rapid Transit
ITSM	Association of Intelligent Transport System (ITS) Malaysia
JENDELA	*Jalinan Digital Negara*
JKR	*Jabatan Kerja Raya* (Public Works Department)
JPJ	*Jabatan Pengangkutan Jalan* (Road Transport Department)
KPKT	*Kementerian Perumahan dan Kerajaan Tempatan* (Ministry of Housing and Local Government)
LLM	*Lembaga Lebuhraya Malaysia* (Malaysia Highway Authority)
MARii	Malaysia Automotive, Robotics and IoT Institute
MCMC	Malaysian Communications and Multimedia Commission
MDEC	Malaysia Digital Economy Corporation
MGTC	Malaysia Green Technology and Climate Change Corporation
MHA	Malaysia Highway Authority
MIGHT	Malaysian Industry-Government Group for High Technology
MIROS	Malaysian Institute of Road Safety Research
MITI	Ministry of International Trade and Industry
MOF	Ministry of Finance
MOSTI	Ministry of Science, Technology and Innova on
MOT	Ministry of Transport
MOW	Ministry of Works
MRT Co	Mass Rapid Transit Corporation
MSCA	Malaysia Smart Cities Alliance
PDRM	*Polis Diraja Malaysia* (Royal Malaysia Police)
PLUS	PLUS Expressways Berhad
PSKLM	*Persatuan Syarikat Konsesi Lebuhraya Malaysia* (Association of Highway Concessionaires Malaysia)
Prasarana	Prasarana Malaysia Berhad
Rapid KL	Collection of bus and rail systems under Prasarana as part of the Klang Valley Integrated Transit System
REAM	Road Engineering Association of Malaysia
SIRIM	Standard and Industrial Research Institute of Malaysia
SSDU	Smart Selangor Deliery Unit / Smart Selangor
TM	Telekom Malaysia
TNG Digital	Touch n'Go, e-wallet

ABBREVIATIONS

AEB	Autonomous Emergency Braking
ASCN	ASEAN Smart City Network
ASEAN	Association of Southeast Asian Nations
AES	Automatic Enforcement System
AI	Artificial Intelligence
ANPR	Automatic Number Plate Recognition System
AP	Asia Pacific
APAD	*Agensi Pengangkutan Awam Darat* (Land Public Transport Agency)
APTS	Advanced Public Transport System
ART	Autonomous Rapid Transit System
AWAS	Automated Awareness Safety System
BRT	Bus Rapid Transit
CAV	Connected and Automated Vehicles
DCaaS	Data Center as a Service
DNB	Digital Nasional Berhad
ECRL	East Coast Railway Line
ECTS	Electronic Cargo Tracking System
EPU	Economic Planning Unit
ETC	Electronic Toll Collection
EV	Electric Vehicles
EVIC	Electric Vehicle Interoperability Center
GBN	Green Bus Network
GDP	Gross Domestic Product
GIS	Geographical Information System
GKV	Greater Klang Valley
GNI	Gross National Income
GTFS	General Transit Feed Specification
GVW	Gross Vehicle Weight
IoT	Internet-of-Things
IM	Iskandar Malaysia
ITIS	Integrated Transport Information System
JENDELA	*Jalinan Digital Negara* (National Digital Network)
JICA	Japan International Cooperation Agency
IMUO	Iskandar Malaysia Urban Observatory
IR 4.0	Industrial Revolution 4.0
IRDA	Iskandar Regional Development Authority
IRT	Iskandar Rapid Transit
ITT	Integrated Transport Terminal
JPJ	*Jabatan Pengangkutan Jalan* (Road Transport Department)
LPTC	Land Public Transport Commission
LRT	Light Rapid Transit
MaaS	Mobility as a Service
MARii	Malaysia Automotive, Robotics and IoT Institute
MCO	Movement Control Order
MCMC	Malaysian Communications and Multimedia Commission

ABBREVIATIONS

MDEC	Malaysia Digital Economy Corporation
MHA	Malaysia Highway Authority
MIGHT	Malaysian Industry-Government Group for High Technology
MIROS	Malaysian Institute of Road Safety Research
MITI	Ministry of International Trade and Industry
ML	Machine Learning
MLFF	Multi-Lan Free Flow
MM	Mott MacDonald
MOSTI	Ministry of Science, Technology and Innova on
MoU	Memorandum of Understanding
MRT	Mass Rapid Transit
NADMA	National Disaster Management Agency
NAP 2020	National Automotive Policy 2020
NCAP	New Car Assessment Program
NITMC	National Intelligent Transport Management Center
NTP 2030	National Transport Policy 2019-2030
NxGV	Next Generation Vehicles
REAM	Road Engineering Association of Malaysia
RFID	Radio Frequency Identification
RTS	Rapid Transit System link
PDRM	*Polis Diraja Malaysia* (Royal Malaysia Police)
PIARC	Permanent International Association of Road Congresses
POC	Proof of Concept
SIMMS	Smart Integrated Mobility Management System
SITS	Selangor Intelligent Transport System
SMART tunnel	Stormwater Management and Road Tunnel
SSDU	Smart Selangor Delivery Unit
SWM	Single Wholesale Network
TCSS	Traffic Control and Surveillance System
TM	Telekom Malaysia
TNB	Tenaga Nasional Berhad
TMC	Transport Management Center
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
VMS	Variable Message Sign
WIM	Weigh-in-Motion

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Ir. Mohd Fairuz bin Mamat

INTELLIGENT TRANSPORT SYSTEM ASSOCIATION OF MALAYSIA
Level 2, Highway Planning Unit, Ministry of Works
Jalan Sultan Salahuddin, 50580 Kuala Lumpur
Tel: 03-2771 4201 Fax: 03-2711 3975 Email : malaysia.its@gmail.com