

3 section three

Intelligent Transport Systems in Singapore



Transport systems and their associated infrastructure are vital elements to any vibrant economies in the world. This article introduces Intelligent Transport System (ITS) in general and illustrates the concept and need to comply with standards using the fully networked car and eCall initiatives in Europe as an example. A brief update of the local ITS development is given as well as how the ITS Technical Committee (ITSTC) plans to work with the stakeholders in Singapore to achieve the vision of having an open ITS architecture for the future.

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1 Introduction

Transport systems and their associated infrastructures are vital elements to any vibrant economies in the world. People need to travel and the demand to travel is such a pervasive activity in our daily life that we spend precious time moving from places to places, at times taking that for granted. It is thus essential that transport systems are designed to provide commuters with safe modes of travel that are convenient, predictable, efficient and value-for-money. Ideally, to have such desirable traits in a transport system and keeping it sustainable over a long term would imply a need to create an open architecture which allows transport and IT systems to interact without obstacles and the need to pay high prices for proprietary information. In other words, relevant traffic and travel information can also “commute” seamlessly among related transport systems to create an intelligent environment that would offer commuters up-to-date information and choices of travel, i.e., an Intelligent Transport System (ITS).

With the advent of advanced information, electronics and communications technologies, coupled with falling prices of such technologies over time, the dream to build a good ITS can be realised, if carefully planned and executed early. Today, many road authorities and operators around the world are already deploying sensors and computing infrastructure on the roads that are linked to a centrally located command and control operations centre to better monitor and provide value-added information or services to road users to enhance their overall travel experiences. Where appropriate, it is also not uncommon for road authorities or operators to recover funds invested to provide and maintain such extensive infrastructures or services in the form of tolls or fares. However, the costs of building

such infrastructures, usually with proprietary systems, can be very high and the effort taken may not be concerted or far-sighted enough to achieve interoperability among systems that will also cater for future needs and growth.

Consequently, here in Singapore, the newly established ITS Technical Committee (ITSTC¹), reporting to the Information Technology Standards Committee (ITSC), hopes to promote the awareness of international ITS standards and strives to work closely with local authorities and key stakeholders to help create national ITS standards for Singapore.

The first portion of this article aims to re-introduce ITS in general and illustrate the concept and need to comply with standards using the fully networked car and eCall initiatives in Europe as an example. The second part of the article attempts to provide a brief update of the local ITS developments, and finally a plan which the ITSTC is working on with stakeholders in Singapore to achieve the vision of having an open ITS architecture for the future.

Last but not least, the authors would like to express that the views and comments made in this article are solely the authors' personal views from their experience and participations in ITS works. They do not represent the views of any authorities or organisations.

With diverse application of technologies in the area of transportation, it is not surprising that there are numerous definitions of ITS in the literatures available today. Listed below are some of the often encountered definitions of ITS:

- The application of advanced electronics and communication technologies to enhance the capacity and efficiency of surface transportation systems, including traveller information, public transportation, and commercial vehicle operations.
Source: www.fhwa.dot.gov/innovativefinance/appf_04.htm
- The application of technology to goods and people movement in order to reduce delay and improve safety. The main applications of ITS in place today involve the monitoring of real time traffic flows and weather conditions and transmitting this information to the appropriate authorities and the motoring public.
Source: www.i395-rt9-study.com/08_glossary.html
- Technology that serves to enhance transportation mobility, conserves energy, protect the environment and improve safety. ITS technology includes electronic fare payment, continually updated traveller information and traffic signal controls.
Source: www.semco.org/TranPlan/TIPonline/TIPglossary.htm
- Technologies that are designed to more effectively move automobiles and transit, and to convey information to the travelling public. ITS can include devices that integrate with traffic signal systems and allow transit vehicles to have priority over other vehicles; global positioning technology that provides real-time schedule information to riders and electronic fare payment for greater customer convenience.
Source: www.cotafasttrax.com/glossary/glossary.php
- A broad range of diverse technologies such as information processing, communications, control, and electronics which can help transportation systems in many ways, including congestion management.
Source: www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/hot/glossary.htm

¹ More details on the ITSTC and its works can be obtained from its web portal at www.itstc.org.sg

2 The Emphasis of Standards in Transportation Systems

As shown in the previous section, the definition of ITS changes with the context of the person and/or organisation addressing it. But, a few common factors remain unchanged in most definitions. These are listed as follows:

- Roadway networks & infrastructure;
 - Roads
 - Warning signs
- Mobility management (fleet and private);
- Toll collection;
- Public transport management; and
- Emergency & support systems.

With increasing use of modern technologies in transport systems and commuters' growing awareness and expectations in safety, environmental and social, a whole new branch of interests has evolved over time to create the amalgamation of different technologies into an integrated and intelligent transport system. This field of interests is not merely about technologies, but how it is being used to create more value for every stakeholders, i.e. from systems owners to users, in the transport value chain. The areas of interests are:

- Architecture;
- Transport Information and Communication Systems (TICS) Database;
- Automatic vehicle and equipment identification;
- Integrated transport information, management and control;
- Traveller information systems;
- Route guidance and navigation systems;
- Short range and wide area communication systems; and
- Quality and reliability.

Hence, the need to create a common standard that could facilitate seamless information exchanges among numerous transport systems developed by different vendors (each has its own specialisations and strength) cannot be re-emphasised further. Currently, there are many standards bodies around the world that are working hard to develop common standards in the area of ITS, and thus there are many working standards that can be adopted for reference. In Singapore, the ITSTC has decided to monitor and track efforts made by the International Organisation for Standardisation (ISO), in particular, the Technical Committee 204 (TC 204) - Intelligent Transport Systems as it is represented by many countries across the globe.

The authors strive to provide a brief description of the ISO TC 204 structure in subsequent section and how the ITSTC is able to contribute to Singapore's effort towards an open ITS architecture in future.

3 International ITS Projects

There are numerous ITS projects and initiatives that are on-going internationally, and one such initiative among the major ones which the authors would like to quote is in the area of road safety. This is because road safety is the justification of major project initiatives under the umbrella of ITS.

Some of the projects in this regard are as follows:

- Event Data Recorder: short term data recorder for vehicle information - such as speed, which will be a deterrent to drivers from over-speeding, when compared to roadside radar detectors. However, such systems will have to address the privacy implications.
- Driver drowsiness detectors (Eye monitoring)/ Lane departure Warning Systems: that helps warn the drivers upon sensing bad driving due to the poor physical disposition of the driver.

Other projects which aim to meet the UN Road Safety Collaboration are:

- Tyre pressure monitoring; and
- Systems for driving with a flat tyre.

In ITS language, these initiatives and projects can be categorised in the following two areas:

- Advanced Driver Assistance Systems (ADASs): support driving tasks and include such devices as collision warning systems, adaptive cruise control, lane departure warning, lane change aids, and parking aids.
- In-Vehicle Information Systems (IVIS): provide electronic systems for telecommunications, infotainment systems and car diagnostics systems.

ISO through ISO/TC 22 (Road Vehicles) and ISO/TC 204 (ITS) is active in both the above-mentioned areas. The integration of such complex equipment needs compliance with the interchangeability requirements in at least the following two respects:

- Safety
- Reliability and maintenance

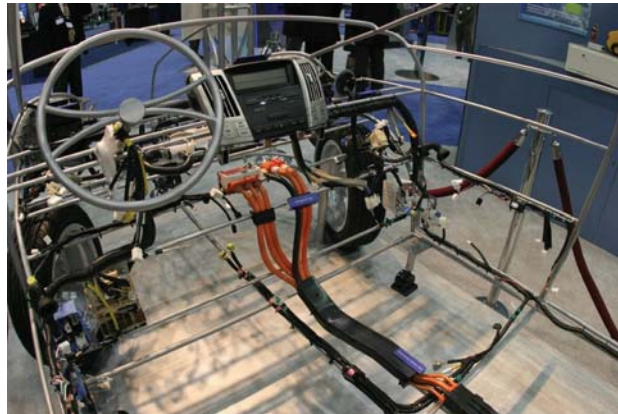
Further, such systems have to remain technologically relevant for a term of about 15 to 25 years. Concurrent with the standardisation efforts taken in in-vehicle components to provide more comfort and safety to drivers and passengers, there should also be the need to consider standardisation and regulatory works aimed at improving the "intelligence" of road infrastructures, signalling, road traffic management, the organisation of emergency assistance, and etc.

It is noted that the shift from proprietary systems to technology development and eventually to an open standard architecture is an important and necessary approach to leverage on technologies to implement solutions which will better address the primary needs of ITS. Here, an open standards architecture can only be achieved through non-proprietary hardware and software architectures with standardised internal interfaces and standardised

application programming interfaces (API). Imagine the potentials and business opportunities that an open ITS could offer when information can be delivered seamlessly to every commuter who owns a mobile phone, electronic organisers or portable computers.

4 The Fully Networked Car & eCall

Many key players now believe that the market for ITS telematics² will not take off without international standards as the key success of such ventures depends on the ability to integrate systems involving many stakeholders, some may not even be involved in transportation businesses or tracking the ITS standards.



Source: <http://www.mccullagh.org/photo/10d-20/networked-car>

Figure 1: A picture of a fully networked car (on frame of car to expose electronics)

The fully networked car of the near future is a good example to illustrate the point of integration among stakeholders. The fully networked car, as shown in the picture above, when fully functional has the ability to dial the emergency services automatically in a crash or other emergency situation. Such a facility requires the collaboration of a large number of stakeholders in the transport community.

Towards the aim of reducing car fatalities by 50% by the year 2010 in the EU, the eCall consortium was founded by the EU Commission along with the European Automobile Manufacturers Association (ACEA) and ERTICO, a public/private partnership for the introduction of ITS and associated service in Europe. The consortium is led by ETSI (European Telecommunications Standards Institute), and works in collaboration with ISO and the European Committee for Standardization (CEN). This initiative aims to work on the business case, and the technology architecture for in-vehicle emergency call (eCall). eCall is an emergency assistance service intended to bring rapid assistance to motorists involved in accidents anywhere in the European Union.

² ITS Telematics: The use of computers to control or monitor remote devices or systems using telecommunications or wireless technologies, combined with ITS to form the term most often used to describe these technologies.

In this example, the proposed architecture illustrates how standards are applied among systems. With short range communications and radar technologies being deployed in vehicles to avoid collisions among vehicles travelling on highways, accident rates can be reduced. If traffic incidents or accidents do occur, the in-vehicle devices will send out a distress signal automatically via telecommunications technologies such as dedicated microwave or Cellular networks, or even vehicle-to-vehicle communications technology to alert rescues and emergency teams of its positions (usually from the Global Navigation Satellite System) without human interventions.

The ISO/TC 204 (ITS) develops international standards for vehicles to interact with road side or telecommunications infrastructures, and other vehicles in the proximity. Here, successful implementation of ITS requires not only interactions among ITS service providers and vendors, it is also important for companies to foster partnerships and collaborations with telecommunications companies to establish an end-to-end working architecture.

5 ITS: From the Singapore Perspective

Despite its small geographic size, Singapore experiences its fair share of traffic congestions like any developed cities. To meet and maintain an expected level of mobility by commuters, the Singapore government has proactively put in place measures to alleviate congestions on the roads.

i-Transport System

The i-Transport System is a highly intelligent and autonomous system that integrates the various intelligent transportation sub-systems to bring traffic management to a greater height. One major innovation of i-Transport is the deployment of Expert System Inference techniques to automate decision support for traffic management. The system has been widely acclaimed for its interactive and unified operation platform designed to increase operational efficiency. The system has successfully integrated various ITS sub-systems such as the Expressway Monitoring and Advisory System (EMAS), Junction Electronic Eyes (J-Eyes), and Traffic Scan onto a unified platform. Its core capability is to support an efficient, fast and cost-effective means of coordinating traffic flow between expressways and arterial roads using an area-based traffic management concept. The incorporation of an expert system to provide automated decisions and traffic simulation system to aid in scenario planning and prediction have helped traffic controllers to manage traffic incidents swiftly and thus minimise disruption to traffic flow.

Apart from having higher efficiency, the implementation of i-Transport has also enhanced road safety and the coordination with public safety agencies. The various disparate systems managed by i-Transport System are:

- Centralised monitoring and reporting system;
- Emergency recovery system;
- Traffic surveillance system;
- Travel advisory system;
- Speed enforcement system;
- Toll collection system;
- Traffic light control system;
- Mobile telematics system; and
- GPS based fleet management system.

Traffic and other relevant information are sent via various public channels as follows:

- Internet;
- Radios and on-board units; and
- Handphones, pagers, information kiosks, and etc.

The main benefactors of this system are:

- Government agencies;
- Commercial operators; and
- Motorists/commuters.

Electronic Road Pricing

The introduction of Electronic Road Pricing in 1998 as a form of usage restraint measure has provided an effective means of managing traffic flow on congested roads where traffic management solutions are not viable.

The system uses a dedicated short-range communications technology, deployed at pricing points, to communicate with In-vehicle Units (IUs) installed in vehicles to deduct road usage charges based on the time of entry, location and vehicle classification. The charges levied are reviewed quarterly based on measured traffic flow over the selected stretch of congested roads.

Consequently, if a common standard for road pricing can be established to meet the local requirements, it would create more opportunities and value-added services on board vehicles in the next generation of ERP system.

Interoperability: A Necessity

From the examples stated so far, it can be observed that if transport systems are built using proprietary map databases, database formats, data communication protocols, information processing platforms and etc, it can result in disparate systems that are difficult and costly to integrate and upgrade. The final integrated solution, if found to be useful, can also be hard to replicate in other countries. Thus, building systems that comply with international standards will inherently help to resolve interoperability challenges faced when putting systems together over the long term.

More information on traffic management in Singapore can be found at:

http://www.onemotoring.com.sg/publish/onemotoring/en/traffic/traffic_management0.html

6 Structure of ISO TC 204 and Singapore Mirror Committee

The ISO TC 204 has an extensive number of country members worldwide³. Each country is represented by ITS experts who are actively participating and complementing each other within and among the various Working Groups (WGs) to develop international standards that could cover a comprehensive range of ITS applications, with details from high level architecture to low level interface protocol. The scope of ISO TC 204 can be quoted as follows,

"Standardisation of information, communication and control systems in the field of urban and rural surface transportation, including intermodal and multimodal aspects thereof, traveller information, traffic management, public transport, commercial transport, emergency services and commercial services in the ITS field."

As illustrated in Sections (2) and (3) earlier, ITS involves a very wide spectrum of know-how involving information systems, communications and electronics technologies. As such, various WGs have been set up under ISO TC 204 to address them adequately. There are currently 12 active WGs⁴ under TC 204 and they are as follows:

Committee	Title
TC 204/WG 1	Architecture
TC 204/WG 3	TICS database technology
TC 204/WG 4	Automatic vehicle and equipment identification
TC 204/WG 5	Fee and toll collection
TC 204/WG 7	General fleet management and commercial/freight
TC 204/WG 8	Public transport/emergency
TC 204/WG 9	Integrated transport information, management and control
TC 204/WG 10	Traveller information systems
TC 204/WG 11	Route guidance and navigation systems
TC 204/WG 14	Vehicle/roadway warning and control systems
TC 204/WG 15	Dedicated short range communications for TICS applications
TC 204/WG 16	Wide area communications/protocols and interfaces
TC 204/WG 17	A new WG to address standardisation requirements with respect to mobile, handheld and nomadic devices

³ Today, the ISO TC204 has 24 participating countries and 24 observer countries. Singapore is holding the observer status.

⁴ A new WG (WG17) is formed to cover standardisation requirements with respect to mobile, handheld and nomadic devices. WG17 expects to partner closely with related efforts including ISO TC22 and ERTICO Nomadic Forum.

The ISO TC 204 has to-date published over 27 ISO standards and the ITSTC is working to mirror the work of TC 204 and adopt or adapt their standards for use in Singapore. In April 2007, the ITSTC, for the first time, attended and participated in the ISO TC 204 WG and Plenary meetings held at Lexington, Kentucky, USA. The lessons learnt and updates gathered from the meeting were subsequently shared among ITSTC members in Singapore to ensure that members are kept abreast of the latest developments in ISO TC 204 standardisation work.

Whenever possible, the ITSTC invites experts who are involved in the ISO TC 204 standardisation process to share with local members on their experiences. For example, in early June 2007, experts from the Eikon AG were invited to give members a presentation on the works and activities of ISO TC204 WG16.

In the near future, the ITSTC hopes to work closely with local authorities and key industries players in ITS to help establish a national ITS architecture for Singapore. The works of the ITSTC also involves constant promotion of international standards and development of suitable standards that can be applied in Singapore. As a vision, the authors look forward to the day when local commuters and tourists would be able to receive real-time information on traffic and other value-added service effortlessly to help them plan their travel trips across various modes of transport conveniently.

7 Conclusion

The small geographical size and stable political climate of Singapore provides an ideal location for implementing pilot projects in the area of ITS. If Singapore publishes a national ITS architecture which adopts international ITS standards (such as those from ISO TC 204), it will provide the transport industries a clear direction of the country's ITS initiatives.

Coupled with active participations of ITSTC in tracking the international standards development and their collaborations with key stakeholders, it will inevitably encourage participations of local and foreign companies as well as academic institutions to research and develop innovative ITS concepts and solutions that can be tested in Singapore.

Here, a positive cycle is possible, i.e. creative solutions that work will encourage more adoptions and participations in ITS standardisation which will in turn create more open solutions. Eventually, open systems will be ubiquitous and that will put Singapore in the world map as our "Made in Singapore" ITS solutions are trial and tested, and can be readily exported to other countries that also adopt international standards.

8 Acknowledgements

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