section three

3

What's New in Intelligent Transport Systems Standards?

"**This article reviews the state of Standards development** for Intelligent Transport Systems (ITS), it considers especially those aspects that are likely to have significant impact for Singapore, and looks to likely developments in the future. The article concludes that where, with the exception of Singapore's ERP system, most current ITS systems are internal or use one way communications links, the next generation of ITS services will use bi-directional links between vehicles, and between vehicles and the infrastructure, and the standards to enable this are now emerging. The article also concludes that there are many tools already available to help ITS developers."

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Convenor WG 16.1 (CALM Media)
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1 INTRODUCTION

Intelligent Transport Systems (ITS) are not new. In fact they have been with us for a long time. Particularly in cities like Singapore, where there are sophisticated traffic and transport control systems, complex and interconnected public transport, and congestion management, ITS, at various stages of evolution, is at the heart of what we think of more as 'everyday living' than the futuristic sounding 'Intelligent Transport Systems'. But both within the infrastructure and within the vehicles, the use of ITS systems has become commonplace. And as each year moves on, ITS becomes more and more integrated into our travelling experience.

So called 'greenwave' traffic control systems such as Singapore's Green Link Determining (GLIDE) System for dynamic traffic light control are some of the vital components within the island's transportation network, where traffic moving on a major road at the legal speed can expect sequenced flows through traffic lights. Singapore's Electronic Road Pricing (ERP) congestion control system, one of the first electronic road pricing schemes in the world, its overall traffic management, and in particular the Expressway Monitoring and Advisory System (EMAS), managed from the ITS centre in River Valley Road where incident management is co-ordinated, are all part of daily life. Within our vehicles, GPS satellite navigation (sat-nav) systems, forward and read obstacle warning systems, and now parking assistance systems, aid our daily driving experience and improve road safety.

Singapore commuters have easy access to real time traffic information to make better travel decisions. Information collected automatically from various sources such as taxis equipped with GPS and video-based road sensors is processed using innovative algorithms for dissemination onto the Internet, handheld devices and roadside electronic signboards. In 2006, i-transport, a zone-based traffic management system was implemented to further integrate existing ITS into a unified, intelligent and interactive platform. The system helps manage roads more efficiently and more safely for commuters.

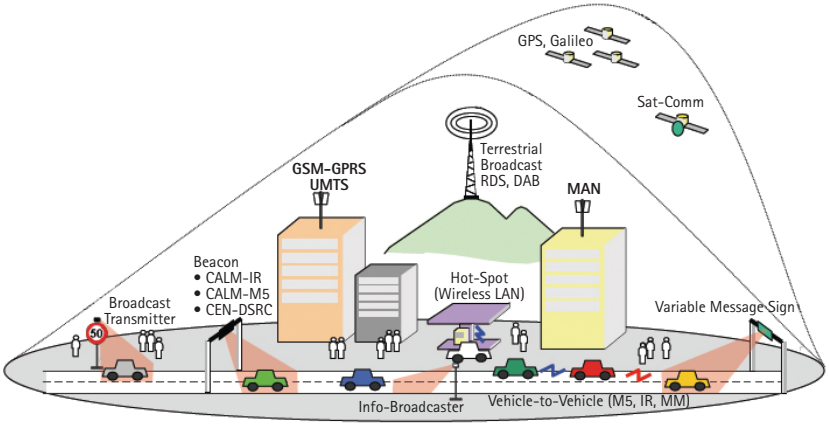


Figure 1: The CALM vision for the multi-media ITS world

Figure 2: Singapore's ERP Gantry

In the past, most of these systems have been 'internal' self contained systems, systems that operate on their own, or within a closed system environment. But as we move into the 21st century, we have an increasing need for these systems to interoperate, and to communicate with each other, in order to provide a better and safer travelling experience.

If you get the opportunity, you should try to visit the Singapore's Land Transport Gallery[1], which presents Singapore's land transport development to facilitate understanding and appreciation of the challenges, solutions and approaches in land transport planning.

Figure 3: Exhibits in Singapore Land Transport Gallery

The Gallery not only provides interactive exhibits on Singapore's land transport progress from the olden days to the current land transport landscape but an interactive experience of the vision and potential for Singapore's land transport in the future.

Developed at a cost of S$2 million, and housed within LTA offices at Hampshire Road. The Gallery's 700-square metre floor space includes six thematic area exhibitions which trace the various stages of Singapore's land transport development - Journeys, Memories, Formative Years, Land Transport Today, Vision/Aspirations and a 'Challenge Theatre' where visitors interactively participate in choosing land transport outcomes, and where the probable results of the interactive decisions can be seen.

Here you can see the possible combinations of public/private transport as Singapore expands its population to achieve its future success. In this world, vehicles 'talk' to each other and to the infrastructure to manage safety and traffic management and to improve the transportation experience.

But of course, while in the past, ITS systems have been self-contained, and discrete systems, this future world requires vehicles to interact with each other - to avoid collisions, to maximise traffic flows on busy roads, to co-ordinate public and private transport. And here we move out of the world of discrete and self contained systems. A collision avoidance system from General Motors is of limited use if it cannot successfully communicate with a Toyota or Hyundai, or Mercedes. It is improbable that an 'ice alert' system - where a vehicle that encounters ice on the roads warns other approaching vehicles (one of the first communicating ITS systems currently being trialled) - will ever be much help in Singapore, but the same technology can also warn of flooding or obstacles on the road, will warn when an overtaking vehicle is in your 'blind spot', and in the near future will actually prevent collisions. Part of the LTA gallery is dedicated to coordination between public and private transport, and improving the public transportation experience and this too requires communication between public transport vehicles, and their users.

[1] The Land Transport Gallery opens from Tuesdays to Sundays, from 9am to 5pm. Interested organisations, corporations and members of the public can contact via email LTGallery@lta.gov.sg or call 6396 2550.

2 ITS STANDARDS

Standards are clearly necessary to achieve these objectives. ITS Standards are not a new development in themselves - ISO has been developing ITS standards since 1994, and CEN since 1991, but new generations of Standards are being developed to enable these vehicle-vehicle (V2V or C2C) / vehicle-infrastructure (V2I or VII) systems to operate, and most of the major vehicle manufacturers, transport management system providers and operators, and highway infrastructure operators are heavily involved, together with the aspiring technology providers. Singapore's LTA has had a watching brief for some years and the recently formed ITS Technical Committee, chaired by Eddie Lim Sing Loong also from LTA (eddie_lim@lta.gov.sg), demonstrates the City States' growing interest and involvement in the development and use of ITS and its Standards, and Singapore has recently hosted meetings for ISO TC204 WG 1 (System Architecture) and WG 4 (Automatic Vehicle Identification). Singapore also hosted the 9th Intelligent Transport Systems Asia-Pacific Forum & Exhibition in 2008, ITS AP 2008.

Over the past decade international standards have been developed in the areas of ITS Architecture; Database Technology; Automatic Vehicle and Equipment Identification; Fee and Toll Collection; General Fleet Management and Commercial-Freight, Public Transport-Emergency; Integrated Transport Information, Management, Control; Traveller Information Systems; Route Guidance and Navigation Systems; Vehicle-Roadway Warning and Control Systems; Dedicated Short Range Communications; and Wide Area Communications-Protocols and Interfaces. Some 71 standards and deliverables have been published and 92 standards and deliverables are at some stage of development or under ballot. The current detailed lists can be found at the TC204 secretariat's home site for ISO TC204.

- http://www.tiaonline.org/standards/secretariats_tags/iso_tc204/index.cfm; and
- Published standards can be obtained from www.iso.org.

But ITS Standards do not live in isolation, they are of course a specialised instance of communications standards, so ITS systems also use generic communications standards such as 2G/3G/Bluetooth even WiFi, and in the future will use WiMax, as well as dedicated systems centred on safety. A detailed summary of the specific ITS standards and generic standards used by, or likely to be useful for, ITS system implementation can be found in 'Intelligent Transport Systems Standards', by this author, published recently (May 2008) by Artech House, ISBN13:978-1-59693-438-2. This book, available both as a hard copy and a CD, provides not only a summary of the ITS Sector and a summary for each of more than a thousand ITS and ITS related standards and deliverables from ISO, CEN, ITU, SAE, IEEE, and other standards bodies from around the world, but also provides web links as to where these standards can be freely downloaded or purchased, and probably provides the most complete summary of the sector.

3 WHAT THEN IS NEW, AND WHAT ARE THE HOT TOPICS IN ITS STANDARDISATION?

Along with the general development of ITS systems, early standards were more concerned with the generic behaviour of in-vehicle systems, or the management and transfer of data around land based networks. The emphasis today is on communications with and between vehicles, the use of Electronic Registration for vehicles and the use of such systems for recognition and security, and, in Europe, the use of ITS for so called 'eSafety' systems such as 'eCall' where your car automatically contacts the emergency services in the event of a crash or incident and tries to get you in voice contact with the emergency support services where that is possible, and provides key data about your location to the emergency services.

Another area of intense activity is to use V2V and V2I technologies for driver advisory messaging and information, such as the flood, ice and 'obstacle in the road' warning systems, and warnings of approaching overtaking vehicles described above, and to warn of the approach of emergency vehicles en-route to an incident. Lane departure warning systems, and common features to enable drivers to move between vehicles and still easily operate such systems, are another area of great interest, and not only are standards being developed for such systems, but major research programmes - for example CVIS (www.cvisproject.org), SAFESPOT (www.safespot-eu.org) and COOPERS (www.coopers-ip.eu) in Europe; VII in USA (www.its.dot.gov/vii); and SMARTWAY (www.its.go.jp/ITS/topindex/topindex_smartway.html) in Japan are providing research development demonstrators for the technology - are testing the ITS draft standards and making recommendations for requirements for new standards.

But while we may wish to see single choice types of decision, regulation and standardisation for the introduction and operation of ITS services, the situation presents a conundrum. In summary, we have to understand and meet the following requirements.

a) Provide systems that enable (quasi) continuous communications between vehicles and the infrastructure, and between vehicles, in an environment where the vehicle marketplace is global with a limited number of large manufacturers providing vehicle models on a global basis with the minimum of variation to meet local national requirements.

b) Provide systems, with a useful Standardisation lifetime of 10-20 years, where vehicles may be operational for 20+ years. Thus we are looking at systems functioning to 2040 and beyond.

c) Recognise that the lifecycle of telecommunication systems, is shorter than the lifetime of vehicles and is getting shorter, and several future possibilities are now apparent, and it is clear that other new technologies, not yet envisaged, will be developed in the period 2008-2040 and may be appropriate. Current communications systems, such as 2G and 3G cellular are unlikely to still be used in 2040.

d) Governments and system providers will not make common decisions about the base media permitted in their countries, yet vehicle manufacturers make products that are sold and expected to work internationally.

e) The characteristics of different media vary according to the properties of that media. Different media are better or less well suited to different applications.

f) Vehicles frequently travel cross border and operate in countries other than their home country. This is particularly true for commercial vehicles, and for all vehicles within Europe.

g) Manufacturers want to equip vehicles with a single global solution. They do not want the complexity, and risk, of too many uncoordinated communications systems providing different services.

h) ITS Standards are being developed as the technology develops.

i) It is the role of the Standardiser to enable the market, not to determine it.

4 COMMUNICATIONS ACCESS FOR LAND MOBILES (CALM)

The most comprehensive standards work in respect of these communications are within the so called "CALM" initiative. CALM - "Communications Access for Land Mobiles" standards have been under development for a number of years, and are now coming to fruition.

The fundamental principles of the CALM concept, and the architecture and standards that embody it, is predicated on the principle of making "best" use of the resources available. The resources are the various communications media available, and "best" is defined by the objectives to be achieved and their relative cost. Flexibility, adaptability, and extensibility are the keys to its success, and what is "best" will change over time.

The CALM concept is therefore developed to provide a layered solution that enables continuous or quasi continuous communications between vehicles and the infrastructure, or between vehicles, using such (multiple) wireless telecommunications media that are available in any particular location, and have the ability to migrate to a different available media where required. Media selection is at the discretion of user determined parameters.

CALM combines several communication media in an open manner in accordance with International Standards that provide:

- Openness, since the standards are available to everybody
- Stability, since there is a formal body responsible
- Visibility and credibility of the specifications
- An open way to influence the next phases of standards
- Extensibility

By separating the application services from the medium/media over which the service is provided, and with an architecture that will compatibly support most available media, and can incorporate new media as they emerge, the CALM concept will enable the equipment installed in any vehicle to be able to communicate over any medium/media that is available locally. This is of course not fundamentally different from internet architectures where the service provider usually has no means of knowing whether the user is connecting via broadband, ADSL or WiFi. Wherever possible, CALM is based on IPv6 (Internet Protocol Version 6) which means that it is fully compatible with Internet services, while at the same time not being restricted by the addressing shortcomings of the current IPv4 protocols.

Since the CALM concept was first proposed in 2000, it is coincidental, but very useful that newer proposals for 4G/IMS (IP Multimedia Subsystem) architectures, and indeed many new communications architecture concepts, now propose a similar approach.

For time critical safety services, where processing or radio protocols are not rapid enough to support IPv6 protocols, there is a "CALM-FAST" mode of operation which enables very rapid transmission of short messages.

A summary update of this length does not have the opportunity to list all of the CALM Standards, so the reader is directed to one of the sources provided above for further information. However, for a good overview of CALM, the CALM Architecture Standard, ISO 21217 is recommended.

5 EMERGING ITS STANDARDS

The use of Nomadic Devices to support ITS Service and Multimedia Provision in Vehicles (ISO 10992) is a current hot topic under development. This work recognises the trend in the automotive sector to enable users to plug in their own devices to the vehicle, rather than duplicate them in the vehicle. Its focus is, at present, more in infotainment than safety, and it will be some time before a standard is agreed.

The area of vehicle recognition has long been the subject of ITS Standards and a number of Automatic Vehicle Identification (AVI) standards have been developed over the years. However, since 9/11, there has been renewed, largely government led, initiatives for the development of Electronic Registration Information (ERI) standards, and ISO 24535 (Basic ERI) has recently been published and 24534 (ERI) parts 1-5 are in the process of publication, having passed ballot in 2007/2008. These standards include security provisions.

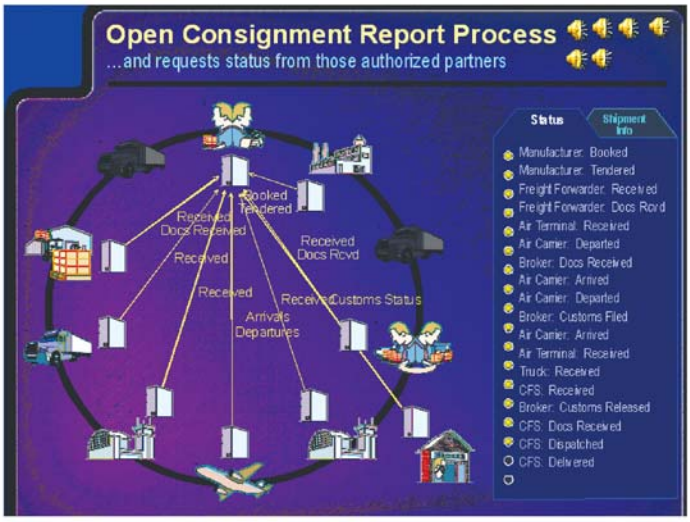
In the area of 'Vehicle-Roadway Warning and Control Systems' a number of Standards are currently under development, although many aspects are awaiting the results of the research development projects described above. Principal areas of activity are 'Low speed following (LSF) systems - Performance requirements and test procedures', 'Full speed range adaptive cruise control (FSRA) systems - Performance requirements and test procedures', 'Extended Range Backing Aid Systems', 'Manoeuvring Aids for Low Speed Operation (MALSO) - Performance requirements and test procedures' (Revision), 'Adaptive Cruise Control Systems (ACC) - Performance requirements and test procedures' (Revision).

I am often asked why the emphasis is on in vehicle and advisory systems, rather than control systems, but this is a matter of evolution, and such systems will only become feasible when the majority of vehicles have some ITS communications capability, so standardisation is premature at this stage.

Another area producing deliverables and attracting attention is that of so called 'Probe data', collecting anonymous information about vehicles to assist traffic information and management. Key deliverables in the ballot process include 'Probe Data Reporting Management', 'Vehicle Probe Data for Wide Area Communication', and 'Event based Probe Vehicle Data'. Associated with these, 'Basic principles for personal data protection in probe vehicle information services' is also in ballot.

The subject of Privacy is an important aspect to be addressed if ITS systems are to be accepted by the general public. ISO TC 204 is about to ballot ISO TR 12859 'Data Privacy Aspects in ITS Standards' and will provide guidance in this important area of civil protection. WG 1 of ISO TC 204 has also produced a number of Standards and technical reports of general use in the ITS Sector in a number of 'Using' guides and Standards. 'Using Web Services in ITS' is currently under ballot, and recently published are 'Using XML in ITS', 'Using UML in ITS Architecture Description', 'Using ASN.1 in ITS Standards and Systems' has recently been revised. A number of technical reports of use to ITS systems implementers include 'Training requirements for ITS System Architecture', 'Business justification for ITS Architecture', 'ITS Use Case pro forma Template', 'User guide for harmonisation of data concepts'.

An area of potential significant interest for Singapore is the development of ISO 24533, "Data dictionary and message set to facilitate the movement of freight and its intermodal transfer" which is being developed in combination with the USA led "Columbus Electronic Freight Management (CEFM) Deployment Test", and uses ITS and ICT technologies to provide a secure global freight transport environment (http://projects.battelle.org/fih/).



Source: CSI Library

Figure 4: Open Consignment Report Process

6 CONCLUSION

As mentioned above, ITS Standards do not just come from ISO, although this is the main source. I have mentioned the CEN Standards for eCall currently under development, but also ETSI, SAE, IEEE and to a lesser extent ITU-R are producing ITS Standards. You may well ask how all of this is co-ordinated, and of course this is a problem. ITU-T therefore lead a Committee ITU-T APSC TELEMOV, a cross standards organisation group dedicated to assisting standards organisations to work together better and provide a cross organisation reference point for users. ITU-T APSC TELEMOV also has a useful website which shows which of the major Standards Development Organisations are working in which areas of ITS Standardisation (www.itu.int/ITU-T/special-projects/apsc/).

This short article has tried to provide a summary of the ITS scene and provide an update on the key areas of ITS Standardisation activity. Of course, it is a moving goal, and the emphasis will move over time, probably towards applications and control systems, as the work on communications systems, advisory systems, recognition, and probe data are completed. But the subjects covered in this article are likely to remain the key focus areas for some time to come before the focus moves on.