

IPv6 in Intelligent Transport Systems (ITS)

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Jared Ring (QUT)

j.ring@qut.edu.au



Outline

- About This Talk
- What is ITS
- ITS Communications
- Use of IPv6 in CALM/ITS
- Standards Relating to IPv6
- What Does ITS Require of IPv6
- Outstanding Questions and Problems
- Questions

About This Talk

- What This Talk Is
 - An overview of Intelligent Transport Systems (ITS)
 - An introduction to the Australian IPv6 community to the networking environment of an ITS
 - The beginning of a dialogue between the ITS community and the IPv6/network operator community
- What This Talk Isn't
 - A guide to building, deploying and maintaining an ITS or IPv6 Network
 - Overly Technical (hopefully)
 - Boring (again, hopefully)

What is ITS

- The single biggest change to transport since the introduction of the internal combustion engine
- Utilise ubiquitous communications to and between vehicles to create a connected mobility environment that:
 - Reduces or eliminates fatalities and serious accidents
 - Manages and reduced congestion on traffic networks
 - Reduce emissions linked with congestion and inefficiencies in the road network
 - Turn every vehicle into a sensor that enables real time analysis and modelling of the road network

What is ITS (ISO TC 204 WGs)

- TICS – Transport and Information Control Systems
- Automatic Vehicle and Equipment Identification
- Fee and Toll Collection
- Fleet Management and Freight
- Public Transport and Emergency Response
- Traveller Information Systems
- Route Guidance and Navigation
- Vehicle/Roadway Warning and Control Systems
- Communications Protocols and Interfaces
- Nomadic Devices
- Cooperative Systems

ITS Applications

- Safety – The Priority
 - Warnings: Intersections, highway, emergency braking, lane change, blind spot/corner, hazards
 - Identify Obstacles
 - Collision Avoidance
 - Applying Brakes Automatically
 - Report Accidents
 - Emergency Call

ITS Applications

- Driver Assistance
 - Parking, active cruise control, lane keeping, road sign recognition
- Policing
 - Speed limit warnings, restricted entry, pull over commands
 - But NOT enforcement
- Pricing and Payments
 - Tolling, parking, transit lanes

ITS Applications

- Traffic Management
 - Variable speed limits, interactive traffic signals, green lighting and clear pathing
- Directions and Route Optimisation
 - Travel time, distance, fuel consumption, cost (toll and congestion charges)
- Traveller Information
 - Maps, business locations, car services, petrol stations, etc
- Fleet and Freight Management
 - On board mass detection vs traditional weighbridge
 - Automatic notification to road authorities on placard goods

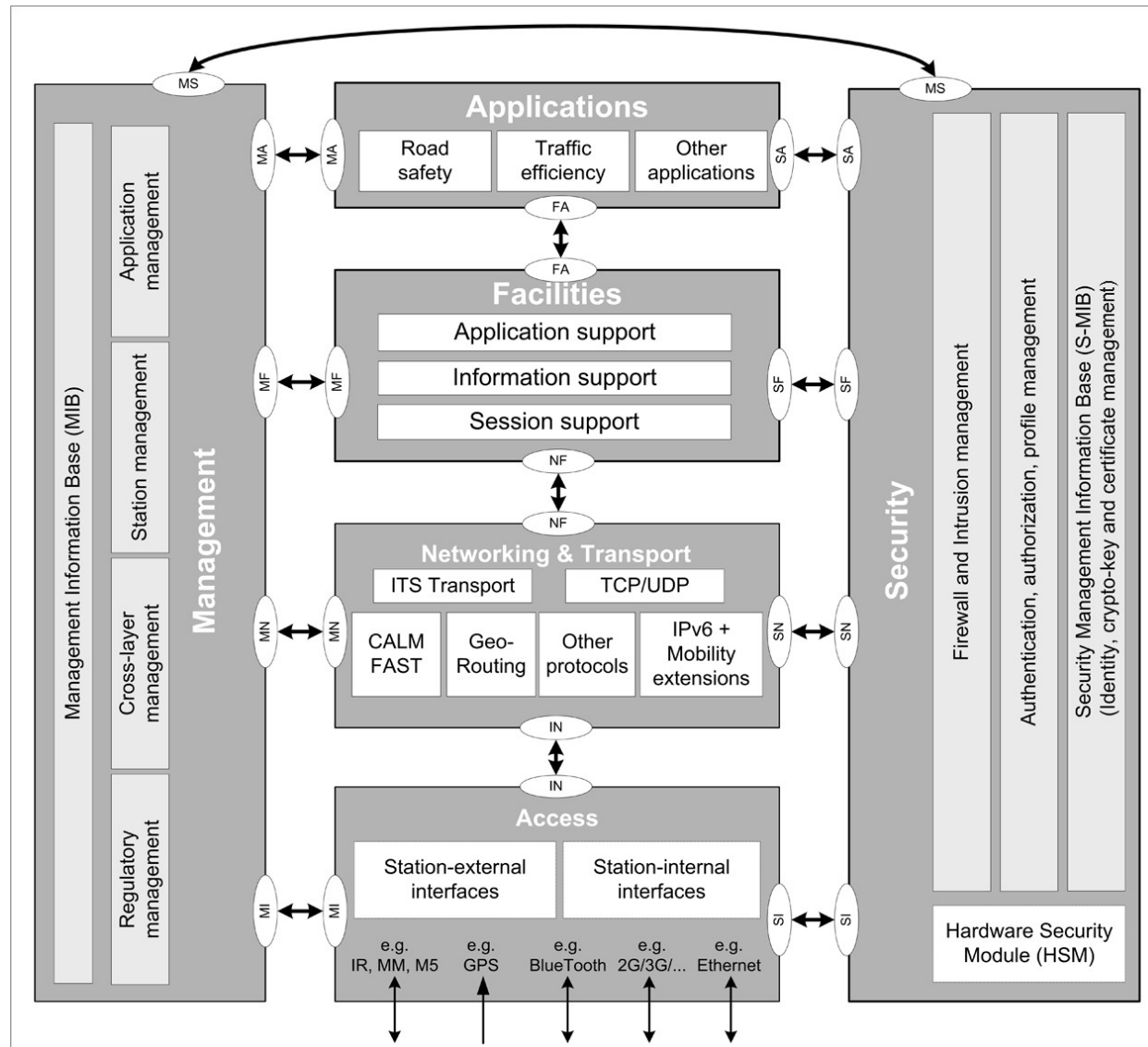
ITS Communications

- Long Range
 - GNSS – GPS, Galileo, GLONASS, etc
 - GPRS, WCDMA, UMTS, etc
 - Satellite
 - Digital Broadcast
- Mid Range
 - IEEE 802.16 (WiMAX) and Related Standards
- Short Range
 - IEEE 802.11p/ISO 21215 – 5.9Ghz WLAN-like (DSRC)
 - AS 4962 and Others (E-Toll)

What is DSRC

- Dedicated Short Range Communications
- A term that means different things in different countries
- In Europe it means 5.8Ghz Tolling (e-Toll)
- In the US, and to an extent Australia, it means 5.9Ghz 802.11p/ISO 21215 based Vehicle to Vehicle/Vehicle to Infrastructure Communications
- An amendment to IEEE 802.11-2007 for vehicular environments operating at 5.9Ghz (5850 to 5925 MHz)
- Originally based on ASTM E2213-03

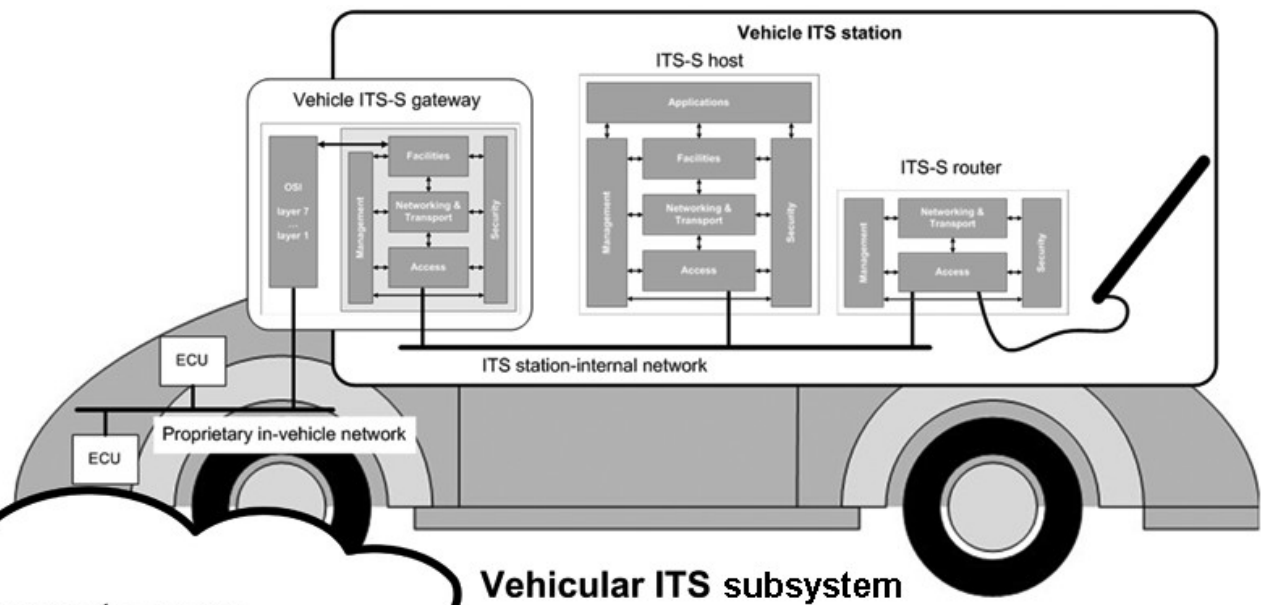
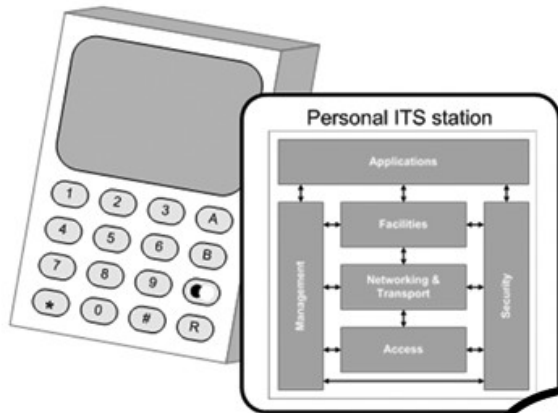
ITS Station Reference Architecture



Entities in an ITS “Network”

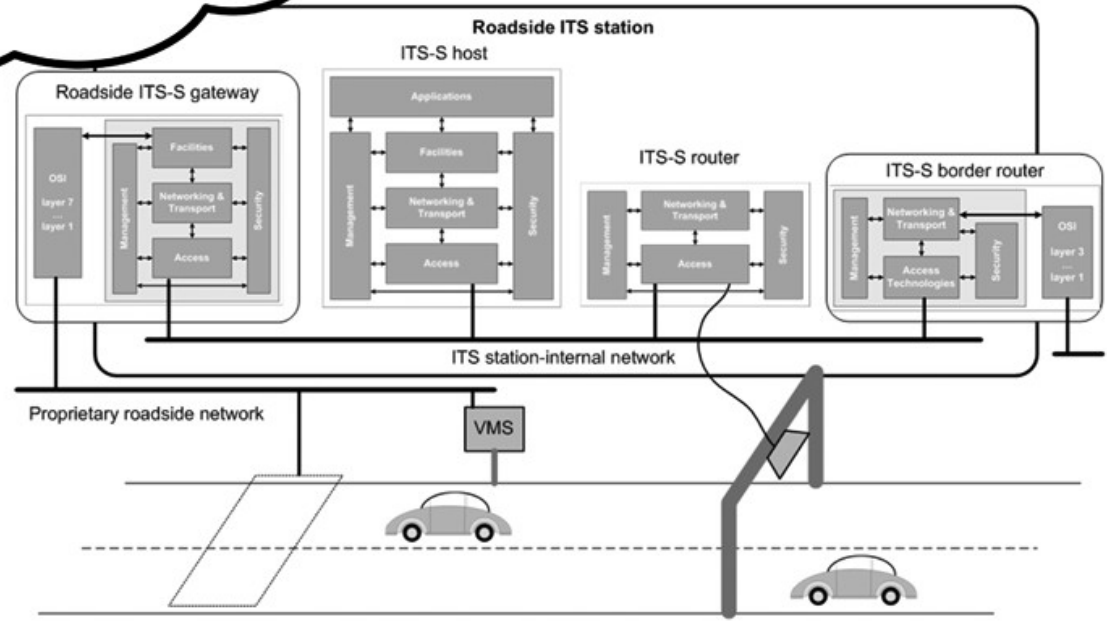
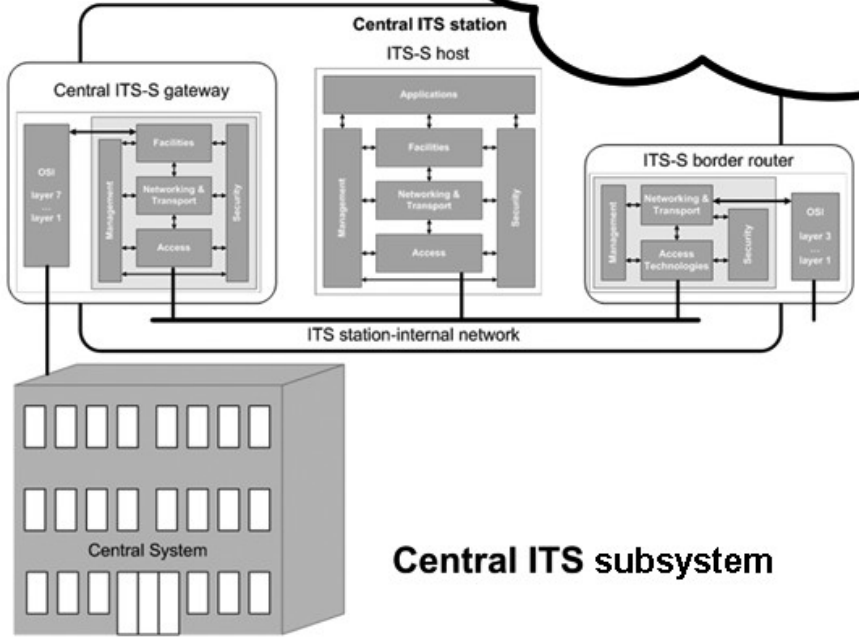
- The road infrastructure
 - Signs, traffic lights, freeway/tunnel/bridge control systems, tolling
- The vehicles
 - Cars, trucks, public transport, taxis, motorcycles, etc
- The people
 - Passengers of vehicles, and public transport
 - Pedestrians and Cyclists
- Traffic Management Centres and Fleet/Freight Operators
- Things that interact (interfere?) with the road network
 - Railways, waterways (draw bridges), etc

Personal ITS subsystem



Vehicular ITS subsystem

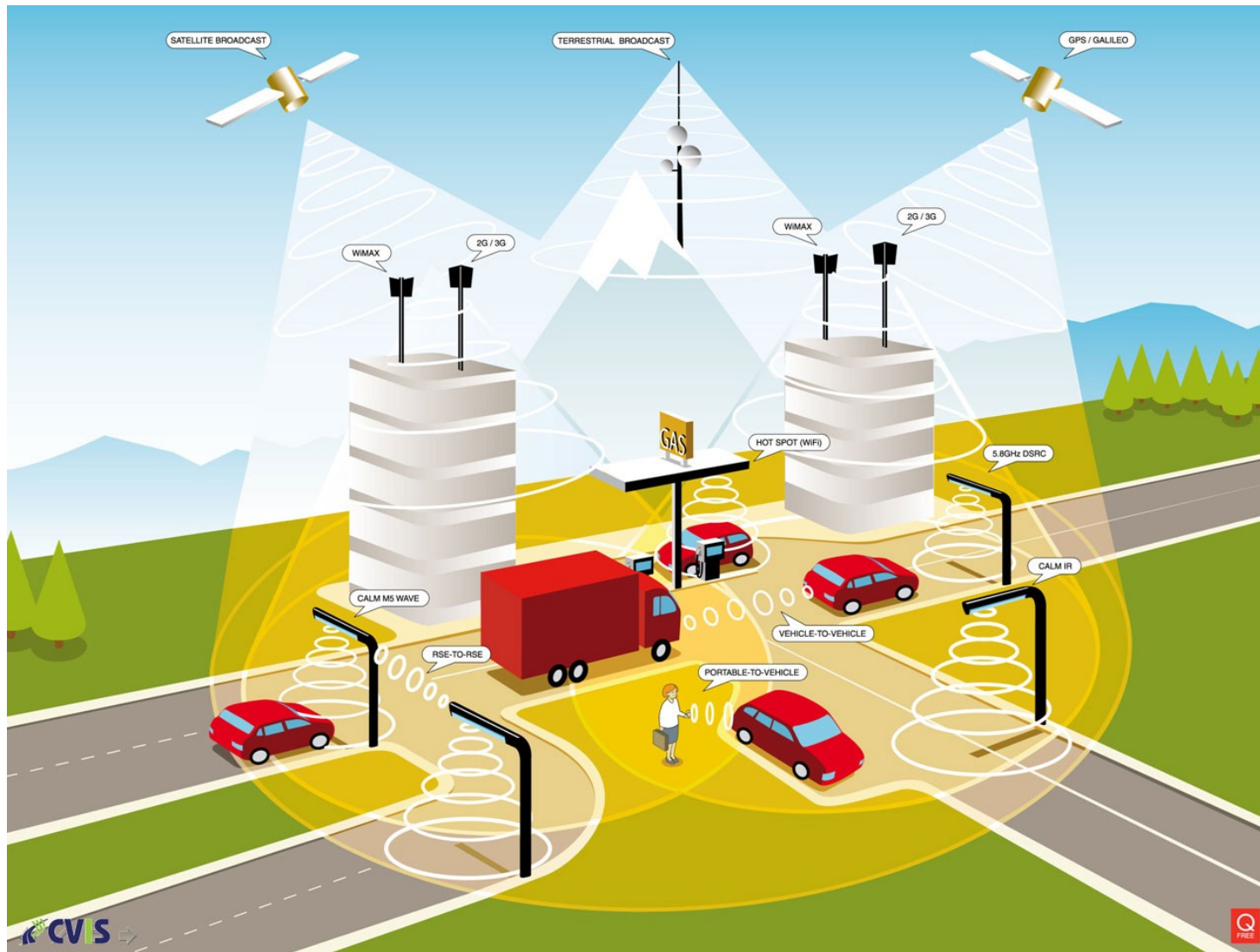
Roadside ITS subsystem



Central ITS subsystem

Source: ISO FDIS 21217: CALM Architecture

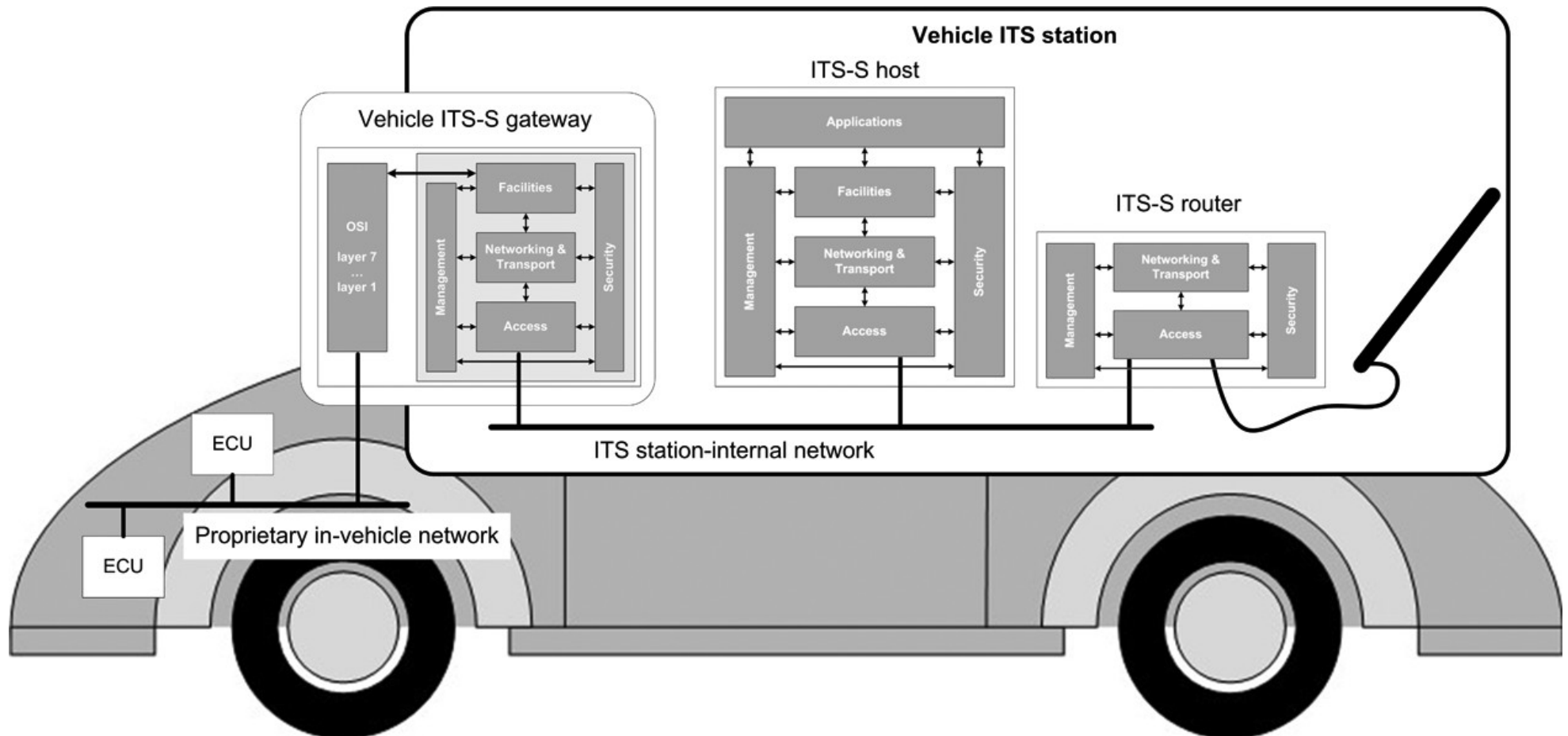
ITS Communication Architecture



CALM in Vehicle Communication

- Gigabit Ethernet In-Car Network
- May be IPv6 based
- Has any number of external interfaces, called routers
- Has any number of interfaces to the vehicle systems, called gateways
- Has any number of CALM Hosts
- A CALM Host may be a router and gateway and host in one

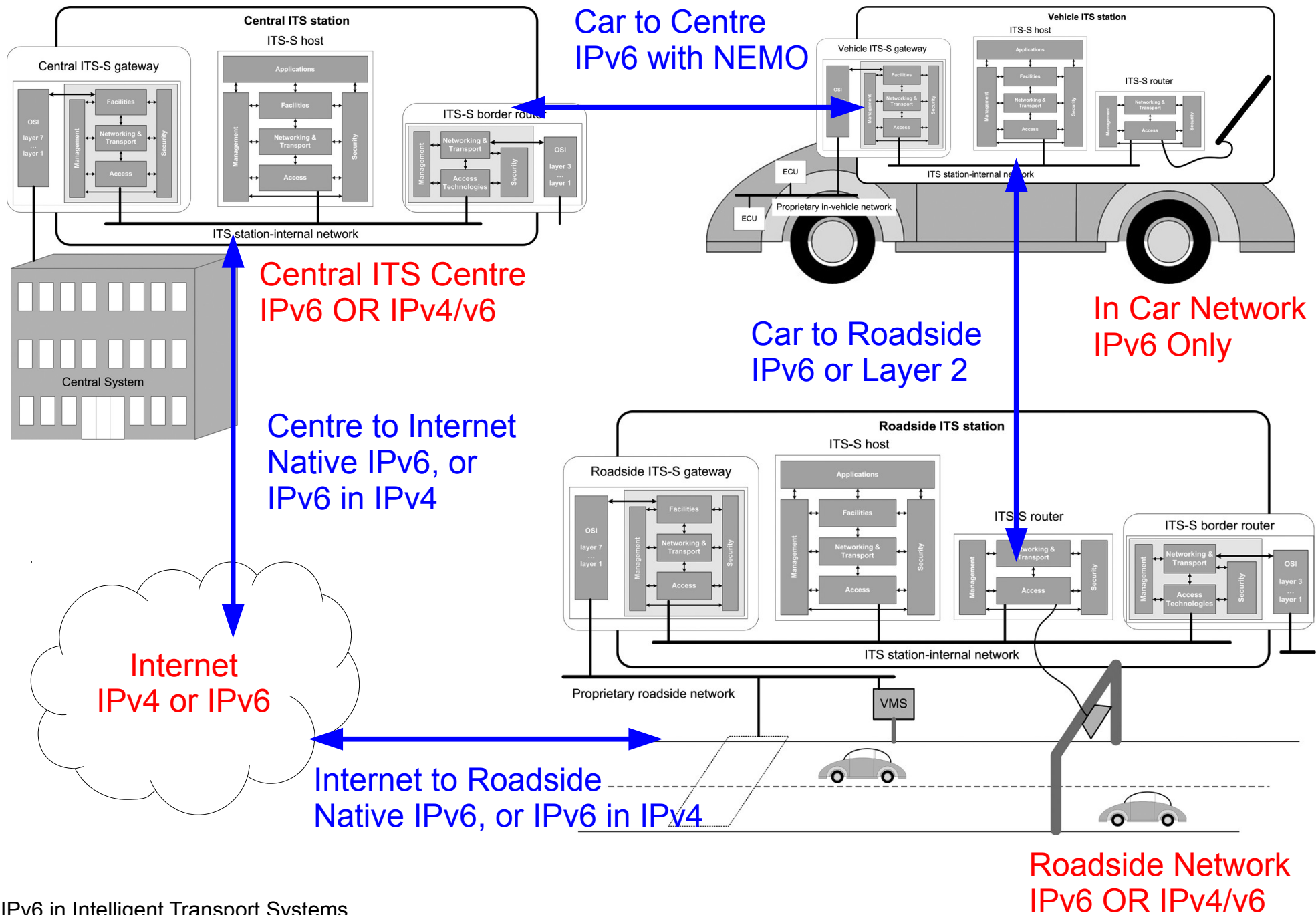
CALM In Vehicle Network



Source: ISO FDIS 21217: CALM Architecture

Use of IPv6 in CALM and ITS

- Why IPv6? Capacity
- 600+ million cars in the world, multiple IP addresses required per vehicle
- Every traffic signal becomes addressable
- Every electronic road sign becomes addressable
- Every sensor in the vehicle or road becomes addressable
- Every passenger becomes addressable
- Every geographic coordinate becomes addressable



Standards Relating to IPv6

- ISO FDIS 21217 – CALM Architecture
- ISO DIS 21210 – CALM Networking
- IEEE 1609.3 – Networking Services
- IETF RFC 768, User Datagram Protocol (UDP)
- IETF RFC 793, Transmission Control Protocol (TCP)
- IETF RFC 1042, IP over IEEE 802 Networks
- IETF RFC 2401, Security Architecture for Ipv6
- IETF RFC 2460, Internet Protocol Version 6 Specification
- IETF RFC 2461, Neighbour Discovery for Ipv6
- IETF RFC 2462, Ipv6 Stateless Address Autoconfiguration

Standards Relating to IPv6

- IETF RFC 2463, ICMPv6
- IETF RFC 2473, Generic Packet Tunnelling in Ipv6
- IETF RFC 3315, DHCPv6
- IETF RFC 3587, Ipv6 Global Unicast Address Format
- IETF RFC 3753, Mobility Related Terminology
- IETF RFC 3963, Network Mobility (NEMO)
- IETF RFC 4243, ICMP
- IETF RFC 4291, Ipv6 Addressing Structure
- IETF RFC 4294, Ipv6 Node Requirements for ICMPv6

Standards Relating to IPv6

- IETF RFC 4885, Network Mobility Support Terminology
- IETF RFC 4429, Optimistic Duplicate Address Detection
- IETF RFC 5268, Mobile IPv6 Fast Handovers (FMIPv6)
- IETF RFC 5555, Mobile Ipv6 Dual Stack Hosts and Routers (DSMIPv6)
- IETF Draft – MeXT WG – Multiple Care of Addresses Registration
- IETF Draft – MeXT WG – Flow Distribution Rule Language for Multi-Access Nodes
- IETF Draft – MeXT WG – NEMO MIB
- IETF Draft – MeXT WG – DHCPv6 Prefix Delegation for NEMO

What Does ITS Require of IPv6 Networks

- A communications infrastructure to the roadside
 - Traffic Signals
 - Electronic Message Signs
 - Already exists but uses proprietary protocol stacks
- An IPv6 aware roadside network
- Roadside infrastructure to be NEMO aware and capable
- Roadside network able to linked to the central traffic management and control system
 - Either via tunnels over the Internet or directly
 - ITS back haul is a perfect application for the NBN

Outstanding Issues

- Who will be the authority for Addressing (Globally)
 - By Manufacturer (Auto Maker) like MAC Addresses?
 - By Service Provider like the current Internet?
 - By Road Operator/Regulator?
 - Advantage of linking a Vehicle through registration, or a driver through licensing
 - Implications for privacy?
 - Do Road Operators Become ISP's in the eyes of IANA and RIRs

Outstanding Issues

- Who will be the authority for certificates?
 - Message integrity and confidentiality is based on Elliptic Curve Cryptography and digital signatures
 - Do we use existing CA's for ITS devices
 - Will vehicle manufacturers want to do business with current CAs?
 - Will transport licensing officers and road regulators recognise the authority of current CAs?
 - Again, do Road Operators Become CA's?
 - In some ways this is ideal as drivers and vehicle owners already have a proven relationship through a drivers license and vehicle registration.
 - How do you revoke or reissue a certificate to a vehicle?

Outstanding Issues

- Can we use DNSSEC?
 - Store certificates in the DNS and use that to alleviate some of the CA problems?
 - Again, who will be the authority?
 - Do we want a new gTLD for ITS?
 - Who has the authority over this domain?
 - Do Road Operators become DNS Registrars too?

Summary

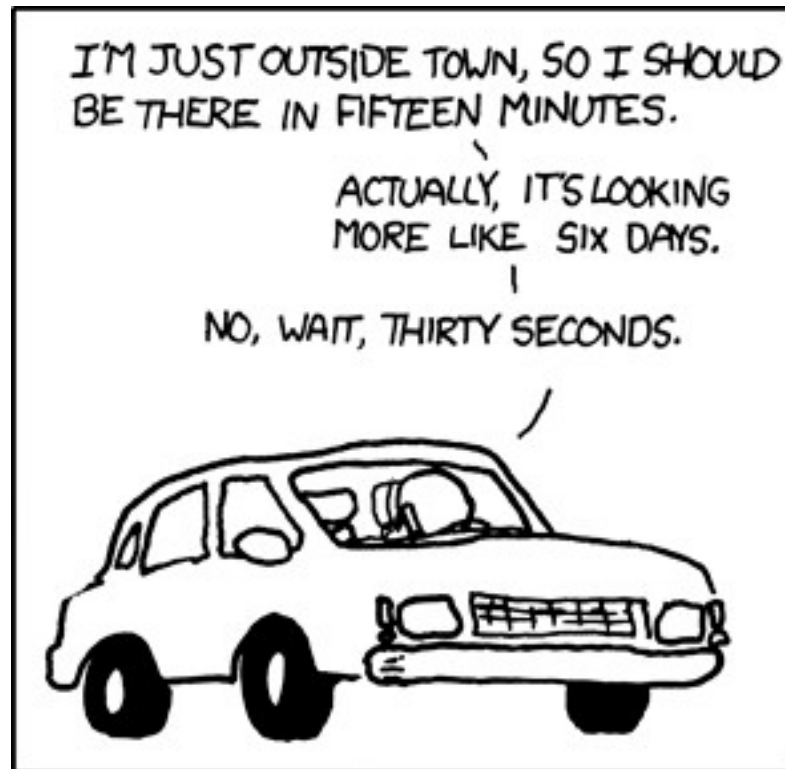
- ITS is rapidly being standardised
- Manufacturers, OEMs, Road Operators all want it
- Expect the first vehicles to have radios factory installed within the next 5 years
- A number of issues around governance need to be addressed
- ITS will save lives and it will reduce the carbon footprint of the transport industry, but it needs a network to operate
- Lets build that network

Links and References

- http://www.iso.org/iso/iso_technical_committee?commid=54706
- <http://www.calm.hu/>
- <http://www.its.dot.gov/index.htm>
- <http://www.its-australia.com.au/main/>
- <http://www.cvisproject.org/>
- <http://www.coopers-ip.eu/>
- <http://www.safespot-eu.org/>
- <http://www.path.berkeley.edu/>
- <http://www.ausdsr.com.au/>
- <http://www-roc.inria.fr/imara/dw/ipv6-its>
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Questions

- Feel free to ask any questions about ITS, CALM and the related standards work



THE AUTHOR OF THE WINDOWS FILE COPY DIALOG VISITS SOME FRIENDS.