SeVeCOM Workshop
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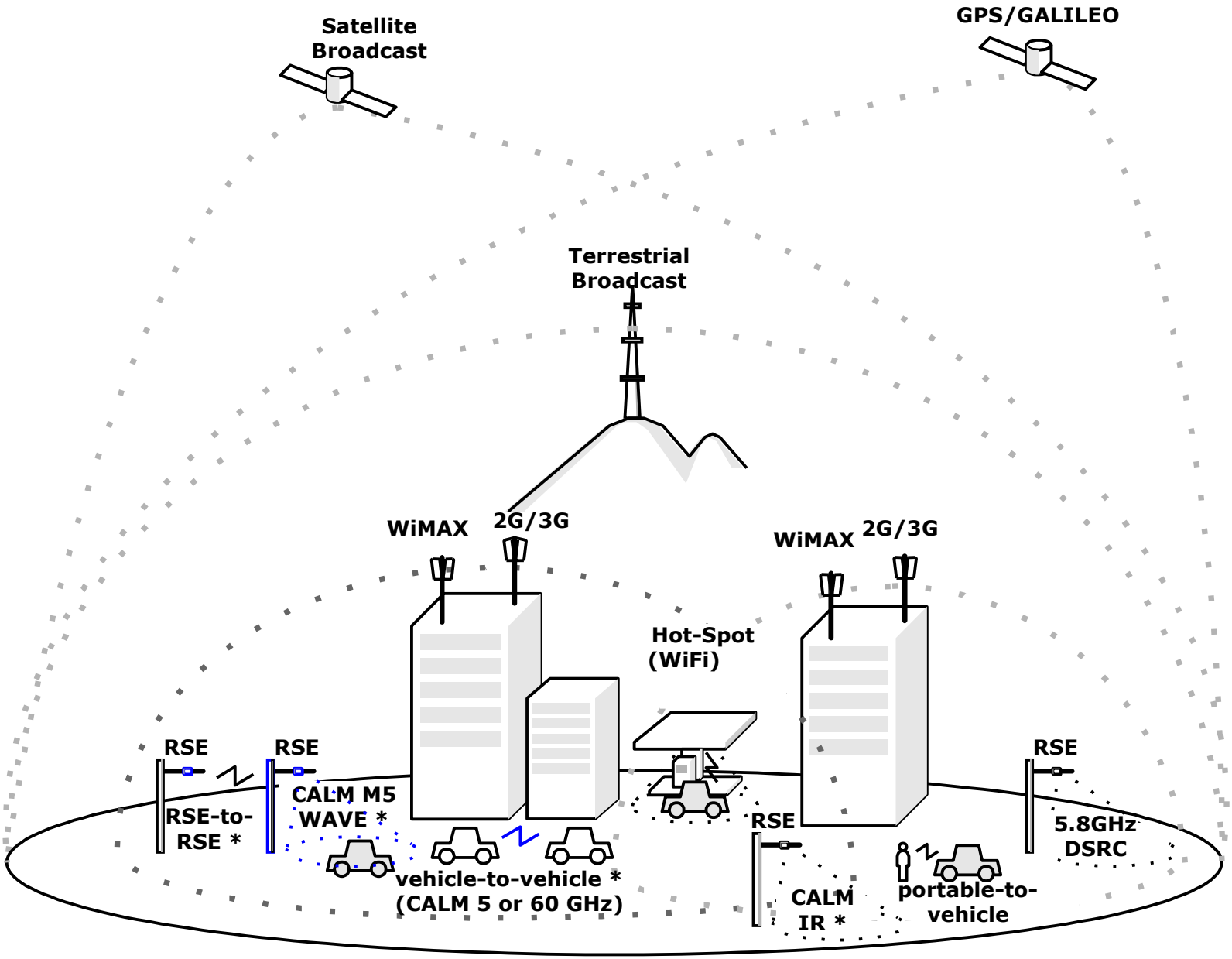
What is CALM?

CALM - Overall

- Continuous Air interface
  for Long and Medium distance

- **ISO** TC204/WG16 – Wide Area Communications
- Support user transparent continuous communications
- CALM is the first ***open*** way to combine GPRS with vehicle-optimized WLAN technology.
  - NOT a complicated collection of new, unproven radio technologies

CALM Communication Scenarios



CALM Applications

- Support of Internet services
- Support of traditional ITS apps – media independent through DSRC L7
- New generation of applications:
  - Major push in safety – Vehicle Safety Communication
  - New commercial applications made possible by high data rate & long range.

Services defined for 5 GHz medium - 1

CVO - Tractor-Trailer Interface
CVO - Rollover Warning
CVO - Electronic Border Clearance
CVO - Weigh Station Bypass Clearance
CVO - CVO Fleet Management
CVO - Onboard Safety Data Transfer
CVO - Tractor-Trailer Matching
CVO - Transit Vehicle Data Transfer
CVO - Vehicle Safety Inspection
CVO - Drivers Daily Log
OTHER SERVICES - Probe Data Collection
OTHER SERVICES - Access Control
OTHER SERVICES – Vehicle Manufacturer Info
PAYMENTS - Toll Collection
PAYMENTS - ITS Service Payment
PAYMENTS - Other ePayments
PAYMENTS - Rental Car Processing
PAYMENTS - Parking Payment
PAYMENTS - Food Payment
PAYMENTS - Fuel Payment
SAFETY - Vehicle-to-vehicle Data Transfer
SAFETY – Highway-Rail Intersection Warning

Traffic Information - Audio Transfer - Streaming
Traffic Information - Map Updates
Traffic Information - Mobile Internet
Traffic Information - Traffic Data
Traffic Information - Traveller Information
Traffic Information - Vehicle Registration (EVI)
Traffic Information - Transit Vehicle Priority
Traffic Information - Diagnostic Data Transfer
Traffic Information - Video Transfer - Block
Traffic Information - Audio Transfer - Block
Traffic Information - Video Transfer - Streaming
Traffic Information - Repair Service Record
Traffic Information - Vehicle Software Updates
VSC - OBU-to-OBU - Approaching Emergency Vehicle Warning
VSC - OBU-to-RSU - Emergency Vehicle Signal Pre-emption
VSC - OBU-to-RSU - Intersection Emergency Vehicle Approaching
VSC - RSU to OBU - Emergency Scene Data Networking
VSC - OBU-to-OBU - Emergency Scene Data Networking
VSC - OBU-to-OBU - Cooperative Collision Warning

Services defined for 5 GHz medium - 2

VSC - RSU to OBU - Map Downloads and Updates
VSC - RSU to OBU - Enhanced Route Guidance and Navigation
VSC - RSU to OBU - GPS Corrections
VSC - RSU to OBU - Adaptive Headlight Aiming
VSC - RSU to OBU - Adaptive Drivetrain Management
VSC - RSU to OBU - Merge Assistant
VSC - RSU to OBU - Sign Information (warning assistance)
VSC - RSU to OBU - Point-of-Interest Notification
VSC - RSU to OBU - Curve Speed Warning
VSC - RSU to OBU - Highway/Rail Collision Warning
VSC - RSU to OBU - Animal Crossing Zone Information
VSC - RSU to OBU - Low Bridge Warning
VSC - RSU to OBU - Work Zone Warning
VSC - RSU to OBU - Stop Sign Warning
VSC - RSU to OBU - Keep Clear' Warning
VSC - RSU to OBU - Wrong-way Driver Warning
VSC - RSU to OBU - Left Turn Assistant
VSC - RSU to OBU - Infrastructure Intersection Collision Warning
VSC - RSU to OBU - Pedestrian Crossing Information
VSC - RSU to OBU - Pedestrian/Children Warning
VSC - RSU to OBU - School Zone Warning
VSC - RSU to OBU - Stop Sign Movement Assistance
VSC - RSU to OBU - Traffic Signal Warning
VSC - RSU to OBU - Low Parking Structure Warning

VSC - OBU-to-OBU - Pre-crash Sensing
VSC - OBU-to-OBU - Intersection Collision Warning
VSC - OBU-to-OBU - Enhanced Differential GPS Corrections
VSC - OBU-to-OBU - Highway/Rail Collision Warning
VSC - OBU-to-OBU - Vehicle-based Road Condition Warning
VSC - OBU-to-OBU - Road Feature Notification
VSC - OBU-to-OBU - Curve Speed Warning
VSC - OBU-to-OBU - Visibility Enhancer
VSC - OBU-to-OBU - Electronic Brake Lights
VSC - OBU-to-OBU - Hybrid Intersection Collision Warning
VSC - OBU-to-OBU - Instant (Problem) Messaging
VSC - OBU-to-OBU - Blind Merge Warning
VSC - OBU-to-OBU - Post-Crash Warning
VSC - OBU-to-OBU - Merge Assistant
VSC - OBU-to-OBU - Lane Change Assistant
VSC - OBU-to-OBU - Left Turn Assistant
VSC - OBU-to-OBU - Stop Sign Movement Assistant
VSC - OBU-to-OBU - Cooperative Glare Reduction
VSC - OBU-to-OBU - Blind Spot Warning
VSC - OBU-to-OBU - Platooning
VSC - OBU-to-OBU - Cooperative Adaptive Cruise Control
VSC - OBU-to-RSU - Infrastructure-based Traffic Probes
VSC - OBU-to-RSU - SOS Services
VSC - OBU-to-RSU - Post-Crash Warning
VSC - OBU-to-RSU - Just-in-Time Repair Notification
VSC - OBU-to-RSU - Intelligent On-ramp Metering
VSC - OBU-to-RSU - Intelligent Traffic Lights
VSC - OBU-to-RSU - Blind Merge Warning

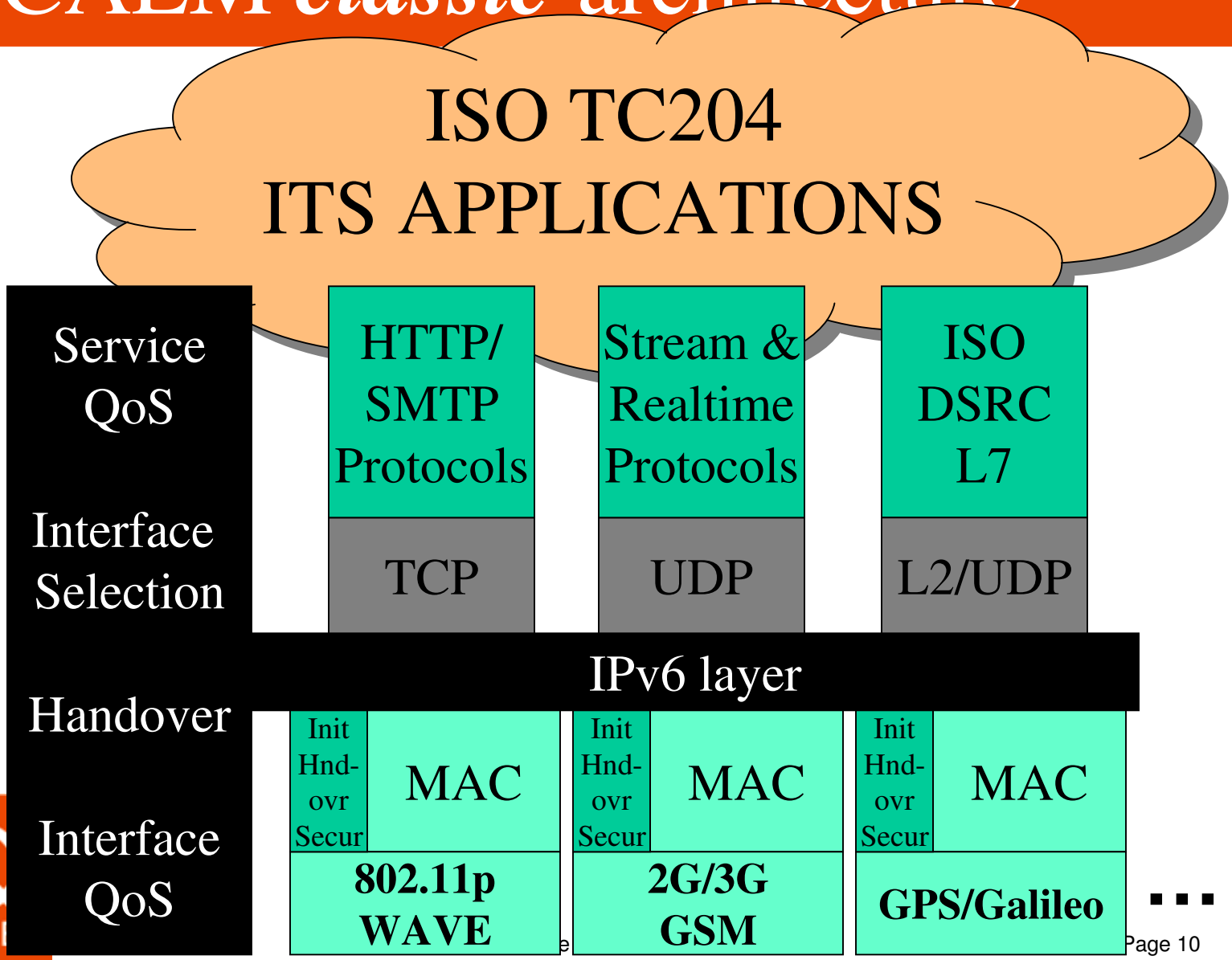
TC204/WG16 Co-operation

- IEEE 802.11p and P1609 – **W**ireless **A**ccess in the **V**ehicular **E**nvironment (WAVE)
  - Co-operation agreement with WG16
- ETSI ERM TG37 – 2G/3G standards, spectrum and test standards,…
- IETF – Internet Network Mobility (NEMO)
- ITU-R WP 8A – Global radio standards
- USA projects: VSCC and VII
- Japan projects: CALM Proof-Of-Concept,…
- Europe projects: C2C-CC, CVIS, SafeSpot,…

What is CALM?

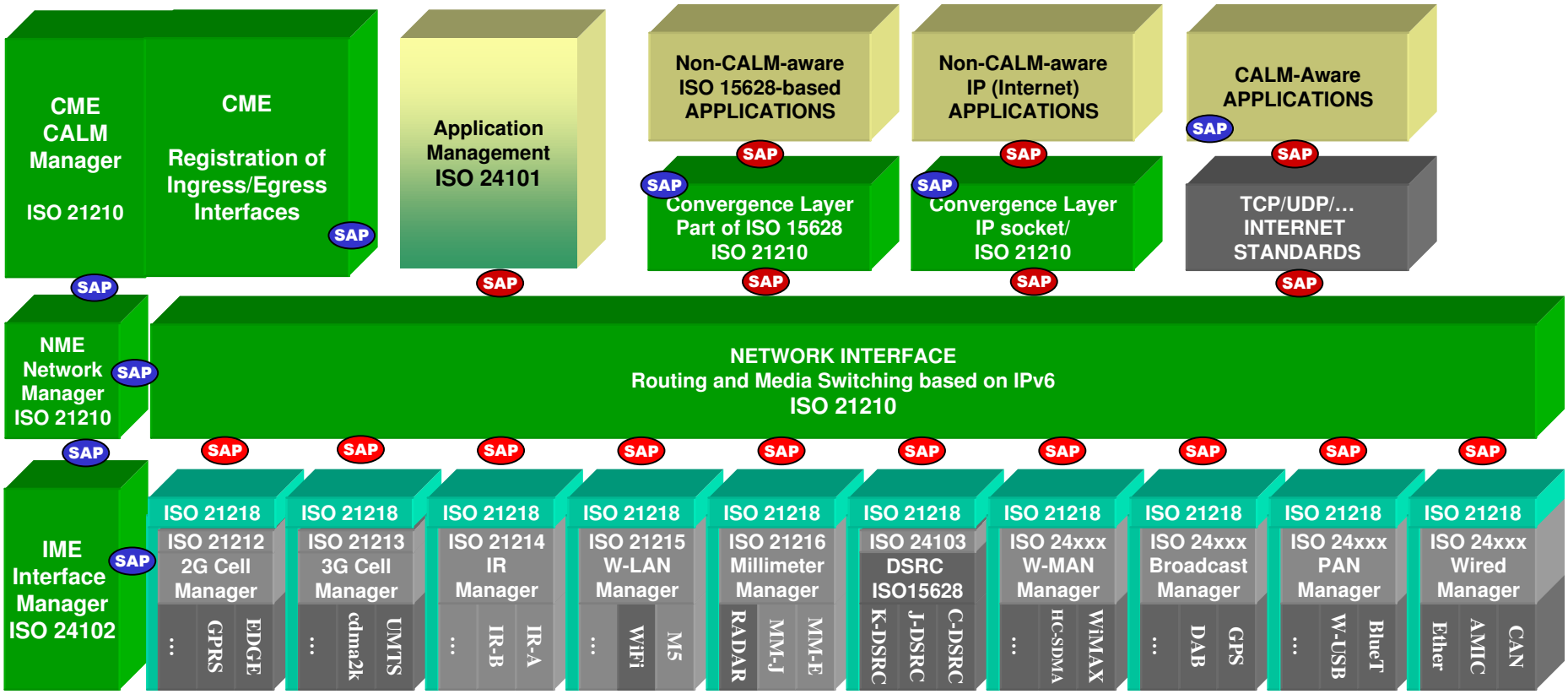
Technically!

CALM *classic* architecture



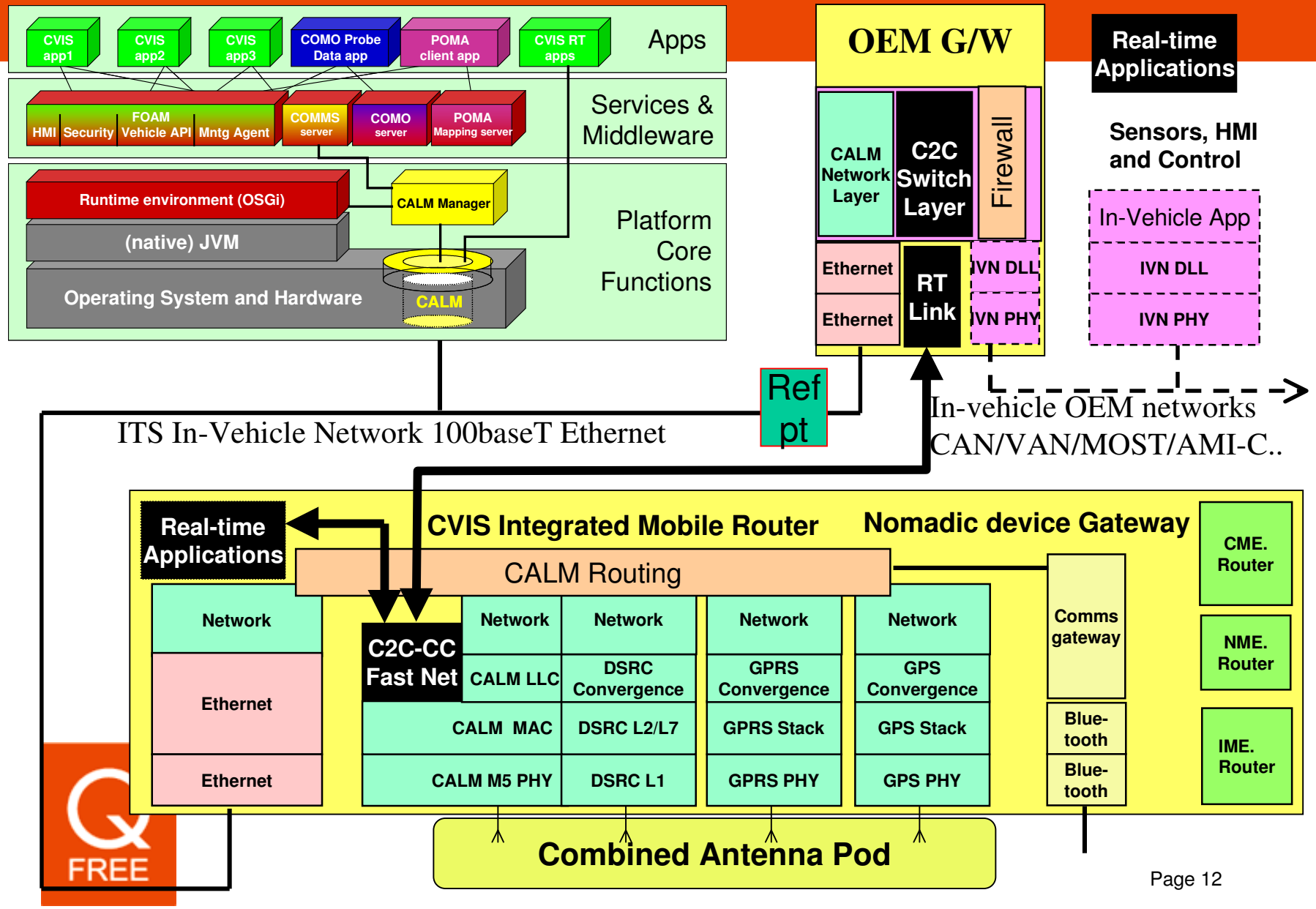
CALM System Architecture (21217)

(Rev. Geneva)



CALM Media | External Media | CALM Network | 21218 = LSAP | Applications

SAP Data SAP SAP Management SAP


CVIS app1
CVIS app2
CVIS app3
COMO Probe Data app
POMA client app
CVIS RT apps
Apps
HMI
Security
FOAM Vehicle API
Mntg Agent
COMMS server
COMO server
POMA Mapping server
Services & Middleware
Runtime environment (OSGi)
CALM Manager
(native) JVM
Operating System and Hardware
CALM
Platform Core Functions
OEM G/W
CALM Network Layer
C2C Switch Layer
Firewall
Ethernet
Ethernet
RT Link
IVN DLL
IVN PHY
Real-time Applications
Sensors, HMI and Control
In-Vehicle App
IVN DLL
IVN PHY
Ref pt
ITS In-Vehicle Network 100baseT Ethernet
In-vehicle OEM networks
CAN/VAN/MOST/AMI-C..
Real-time Applications
CVIS Integrated Mobile Router
Nomadic device Gateway
CALM Routing
Network
Ethernet
Ethernet
C2C-CC Fast Net
Network
CALM LLC
CALM MAC
CALM M5 PHY
Network
DSRC Convergence
DSRC L2/L7
DSRC L1
Network
GPRS Convergence
GPRS Stack
GPRS PHY
Network
GPS Convergence
GPS Stack
GPS PHY
Comms gateway
Blue-tooth
Blue-tooth
CME. Router
NME. Router
IME. Router
Combined Antenna Pod
FREE

Communication Scenarios

- CALM defines 5 communication scenarios:

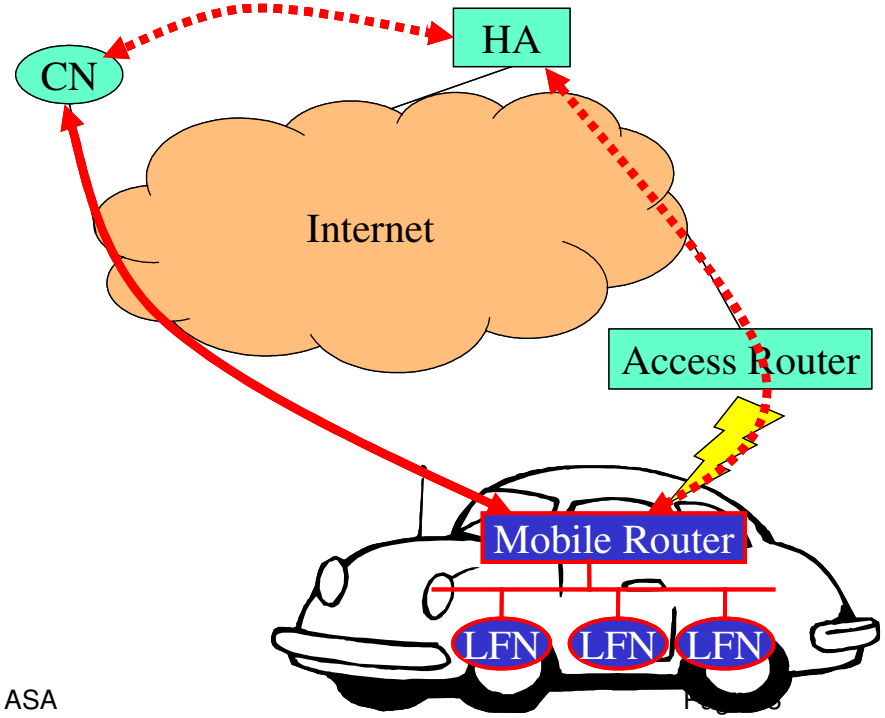
0 – V2I Non-IPv6 communications

1 – V2I/V2V Local IPv6

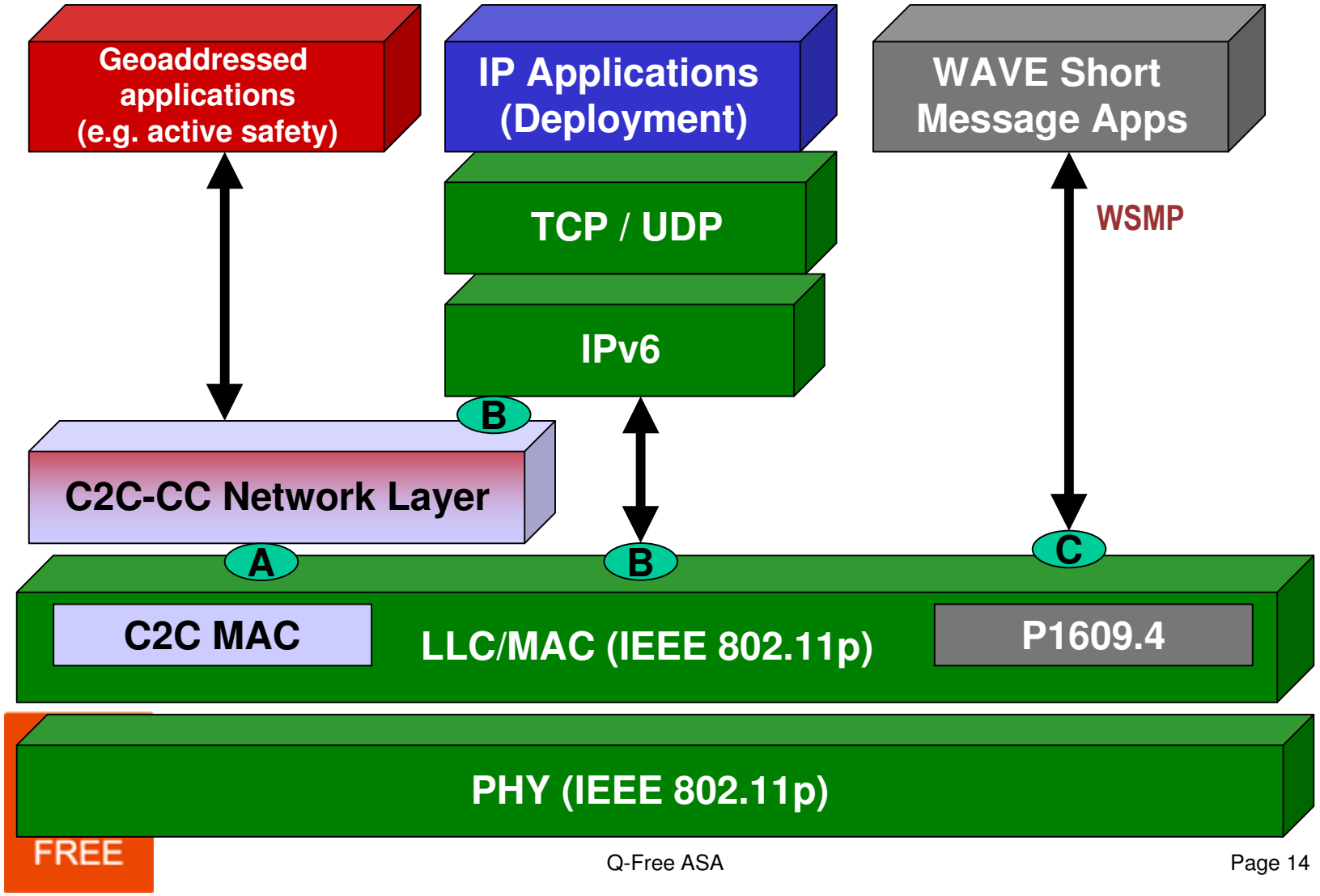
2 – V2I MIPv6

3 – V2I NEMO

4 – V2V Non-IPv6



CALM M5: C2C-CC & WAVE



What about IEEE?

Draft IEEE Standards

- IEEE 1609.1: WAVE Resource Manager
  - Defines "Basic Application Platform"
    - Application data read/write protocol between RSU and OBU
    - First application available for testing purposes
- IEEE 1609.2: 5.9 GHz Intelligent Transportation System (ITS) Radio Service Security
  - Defines 5.9 GHz DSRC Security (formerly IEEE 1556)
    - Anonymity, Authenticity and Confidentiality
- IEEE 1609.3: WAVE Networking Services
  - Provides description and management of the DSRC Protocol Stack
    - Application interfaces
    - Network configuration management
    - WAVE Short Message (WSM) transmission and reception

Draft IEEE Standards (cont'd)

- IEEE 1609.4: WAVE Multi-Channel Operation
  - Provides DSRC frequency band coordination and management
    - Manages Lower Layer usage of the seven DSRC channels
    - Integrates tightly with IEEE 802.11p
- IEEE 802.11p: Wireless LAN Medium Access Control (MAC) and physical layer (PHY) specifications: Wireless Access in Vehicular Environments (WAVE)
  - Defines the Lower Layers of the communications stack
    - Radio wave forms and wireless medium access procedures

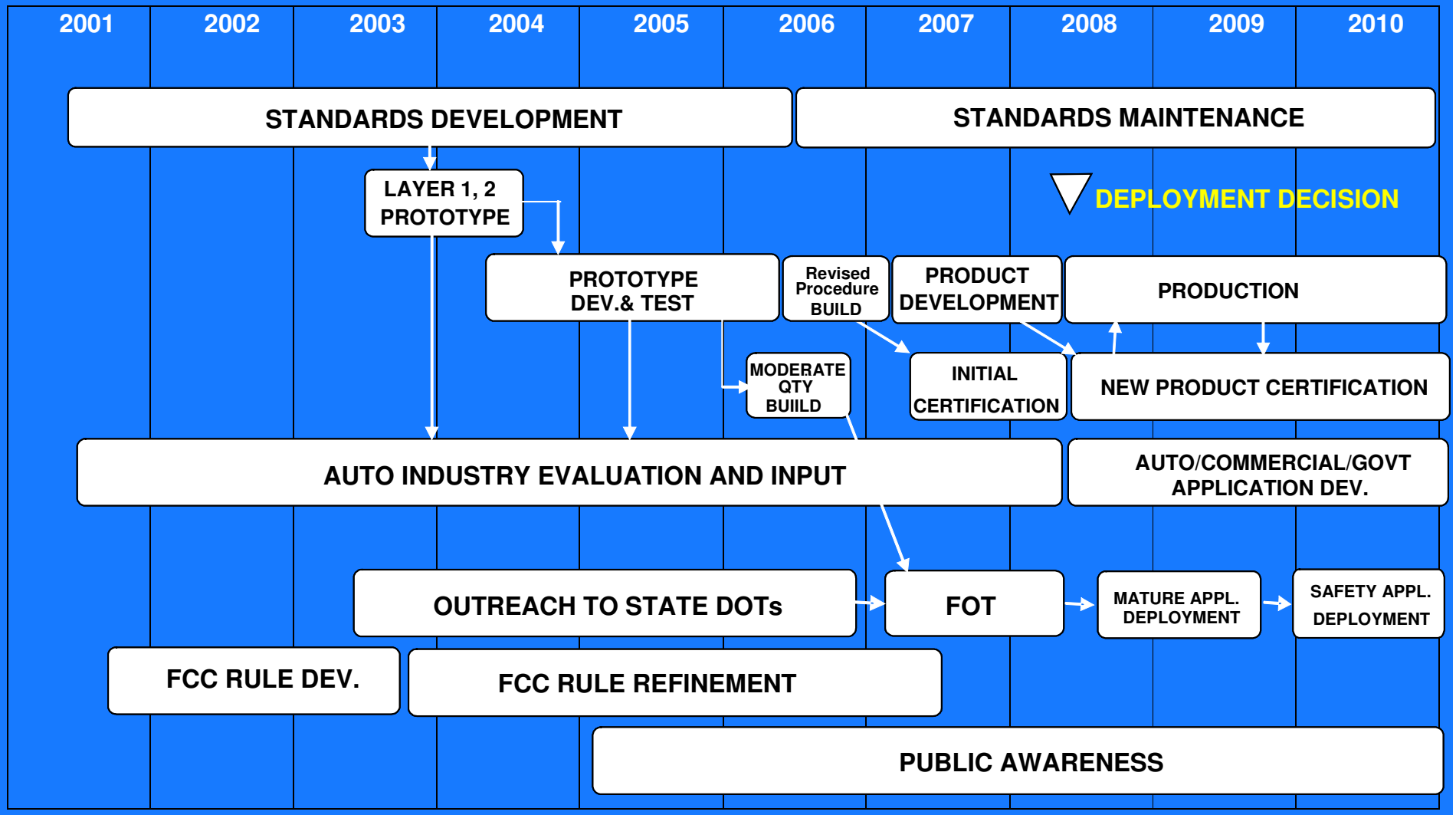
IEEE Standards Status

- Latest IEEE 1609 draft documents completed in December 2005
- IEEE 1609 status:
  - 1609.1 completed sponsor ballot, 500+ comments
  - 1609 part 2-4 launched mid-January for 30 days sponsor ballot. Many comments are expected
  - Project approval all parts expected June 2006.
- IEEE 802.11p is also progressing
  - Latest pre-Hawaii draft is D0.25
  - Possible ballot in March 2006? (IEEE 802.11)

IEEE Security Services

- 5.9 GHz DSRC uses Public Key Infrastructure (PKI) to sign and/or encrypt DSRC data
  - Anonymity (prevents tracking - Privacy)
    - MAC address randomization
    - Security certificates may also be periodically changed
    - Opt-in services may not require anonymity
  - Authenticity
    - Digital signatures protect against various malicious security threats
  - Confidentiality
    - Data may also be encrypted to provide data privacy
    - Safety messages broadcast from RSUs do not always require encryption (digital signatures are always required)

DSRC-WAVE Program Schedule



ARINC
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CALM and Security

- CALM relates to security as follows:
  - Interface specific for lower layers or low latency
  - Application or protocol specific for higher layers (ETC, IPSEC,…)
- There are no specific security means built into CALM
- Vehicle Probe Data (ISO 24100) has provisions for protection of privacy.
- CALM is interested in input from SeVeCOM.

Liaison?

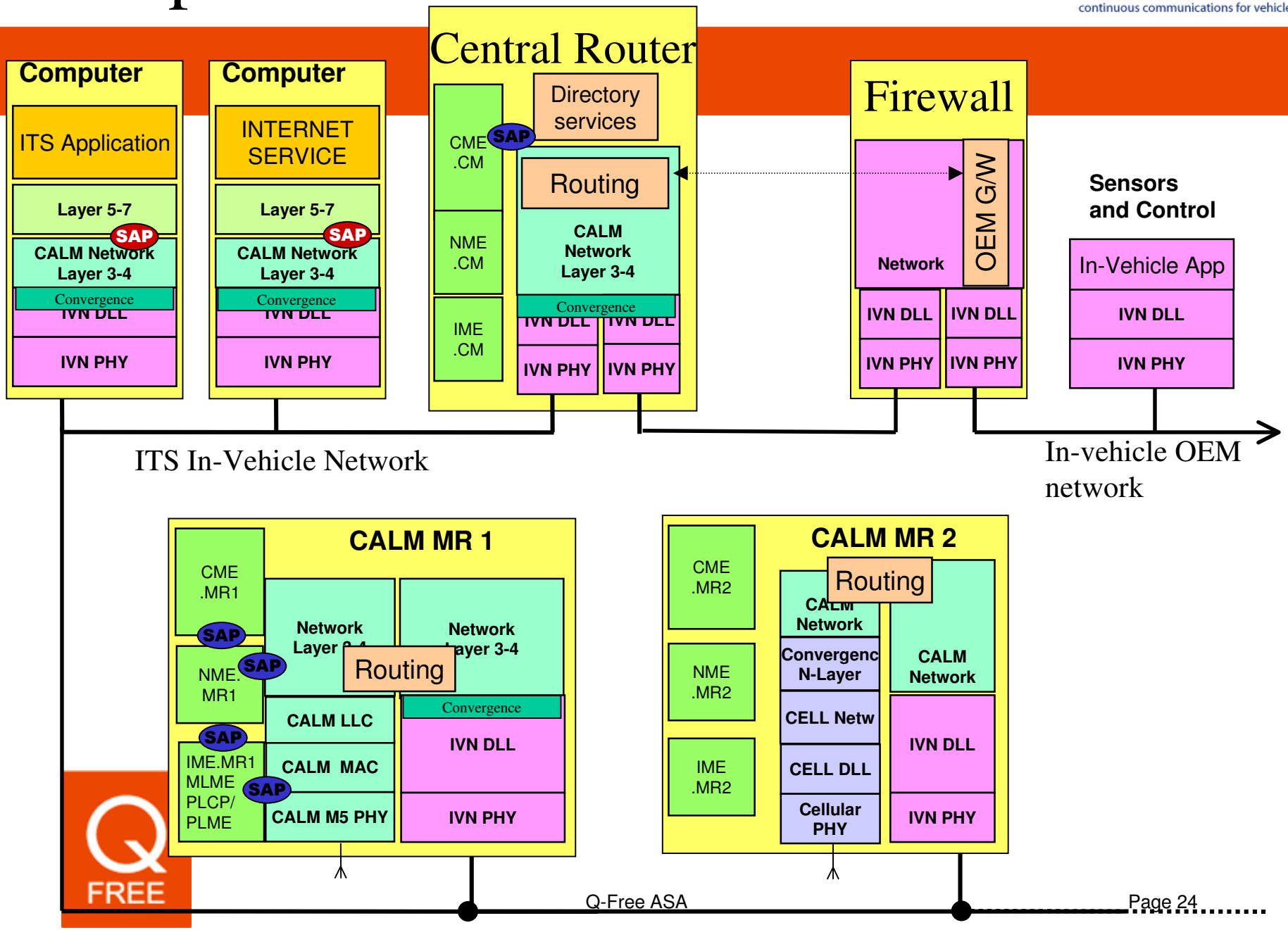
How to get more info

- ISO TC204/WG15 Convenor:
  T. Russel Shields TRS@ygomi.com
- ISO TC204/SG15.0 Convenor:
  Knut Evensen knut.evensen@q-free.com
- ISO TC204/SG15.1 Convenor:
  Bob Williams bw_csi@compuserve.com

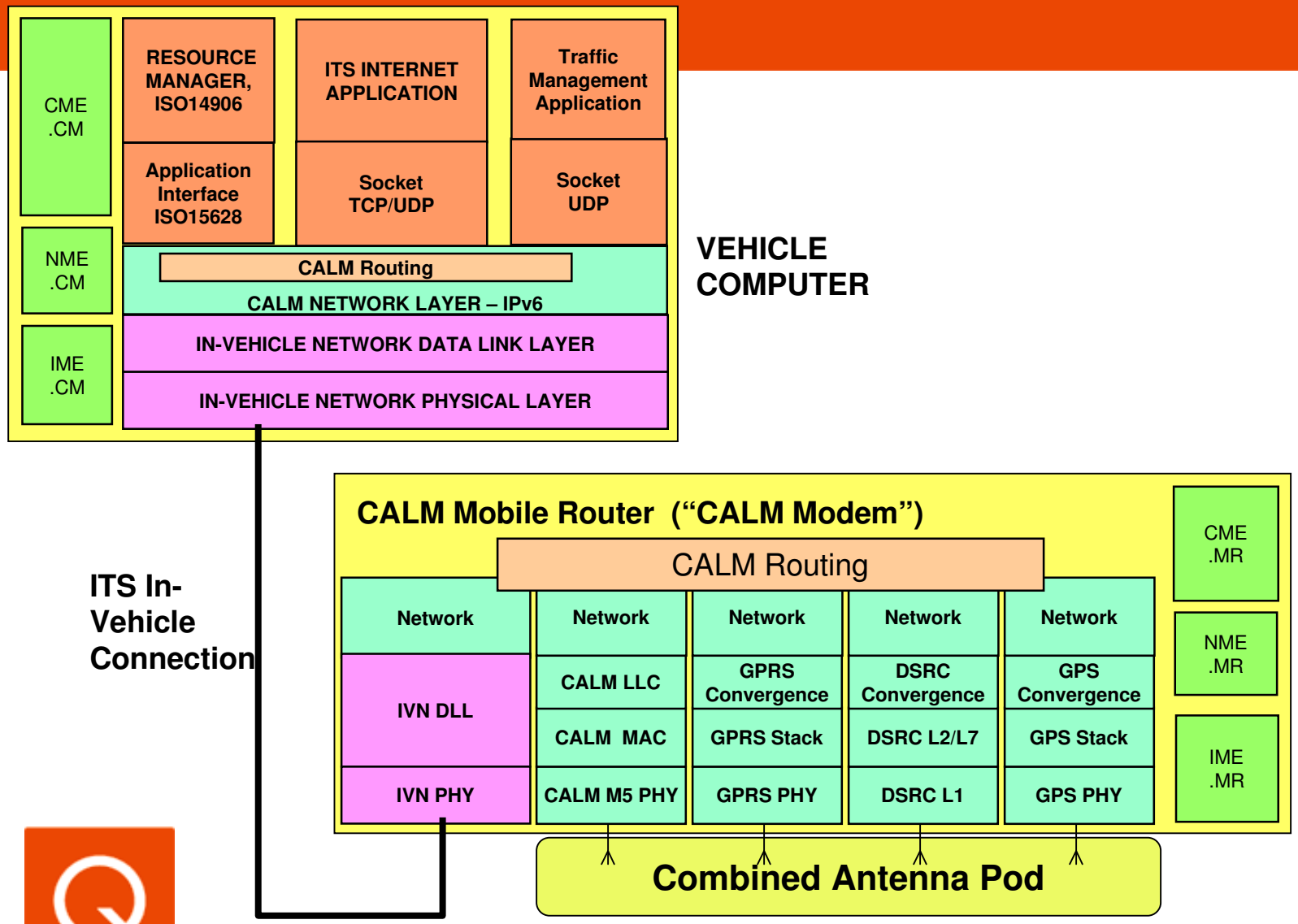
WWW.CALM.HU

Extra Slides

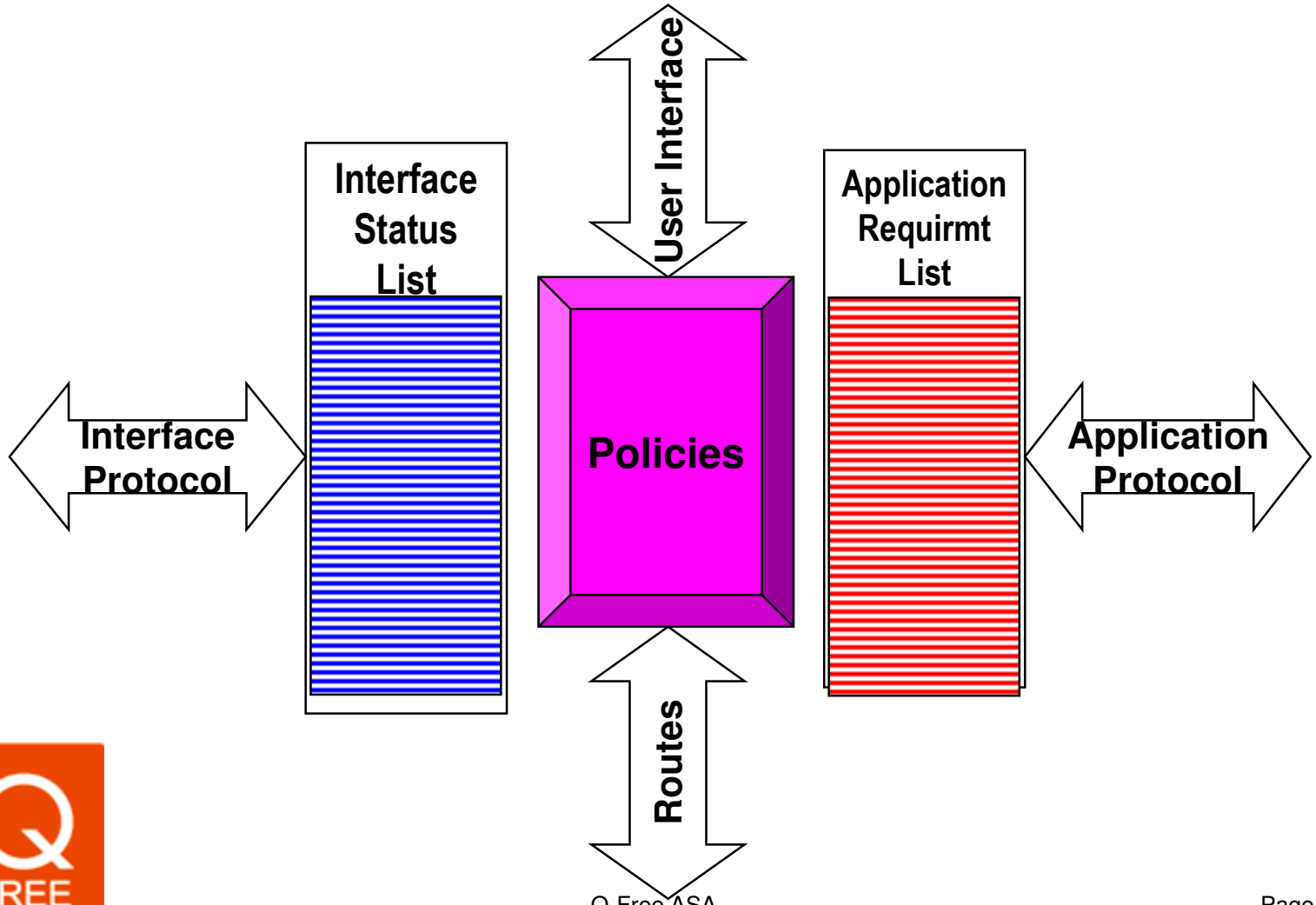
Example: Full Vehicle Architecture



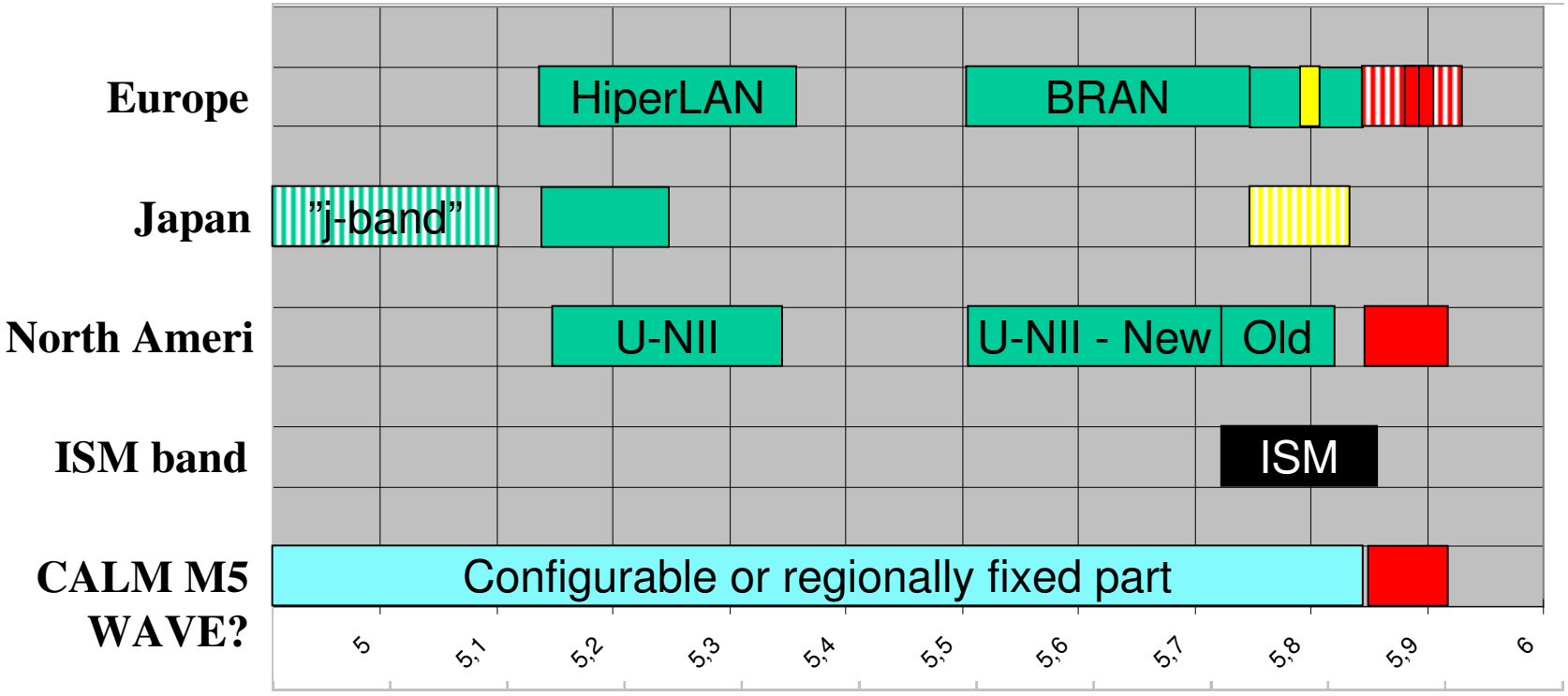
Example – Early Vehicle Architecture



CALM Manager



5 GHz Spectrum (not exact!)



Dedicated ITS (DSRC)

Requested : Global
ITS Safety allocation 5.85-5.925

What is CALM M5?

US DSRC (WAVE)

- WAVE is IEEE 802.11p
  Wireless Access for Vehicles
  - as required by US DoT/VSCC/VII/…
- WAVE is optimised for US channel plan
- WAVE protocols are optimised for current single-radio technology.
- No GSM or other technology is included.

CALM M5

- CALM M5 incorporate WAVE and adds:
  - Global (European) 5 GHz spectrum
  - Regulatory domain (border) management
  - Directivity and EMC control
  - CEN DSRC co-operation
  - Multiple radio/interface/antenna management
  - GPRS/UMTS network interconnectivity