



continuous communications for vehicles

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CALM Architecture and
CALM M5 Convenor

Dallas 14. November 2006

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Topics

- What is ITS – and why ISO?
- What is CALM?
- What are CALM Media? (ex: CALM M5)

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What is ITS?

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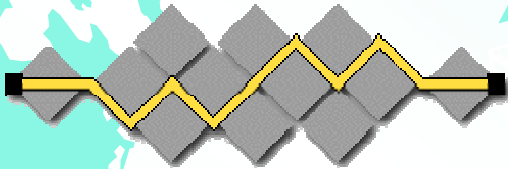


Intelligent Transport Systems

- Intelligent Transportation Systems, or ITS, encompass a broad range of wireless and wire-line communications-based information, control and electronics technologies.
- When integrated into the transportation system infrastructure, and in vehicles themselves, these technologies help monitor and manage traffic flow, reduce congestion, provide alternate routes to travelers, enhance productivity, and save lives, time and money.



ITS standards on the Global Level



I E T F

The Internet Engineering Task Force



International Telecommunications Union



Institute of Electrical and Electronics Engineers



ISO Standards



International
Organization for
Standardization

- **TC 204 Intelligent Transport Systems**
- TC8 Maritime
- TC 22 Road Vehicles
- TC 104 Freight Containers – ID and communication
- TC154 Business Processes and Data
- TC 211 Geographic Information

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What is CALM?

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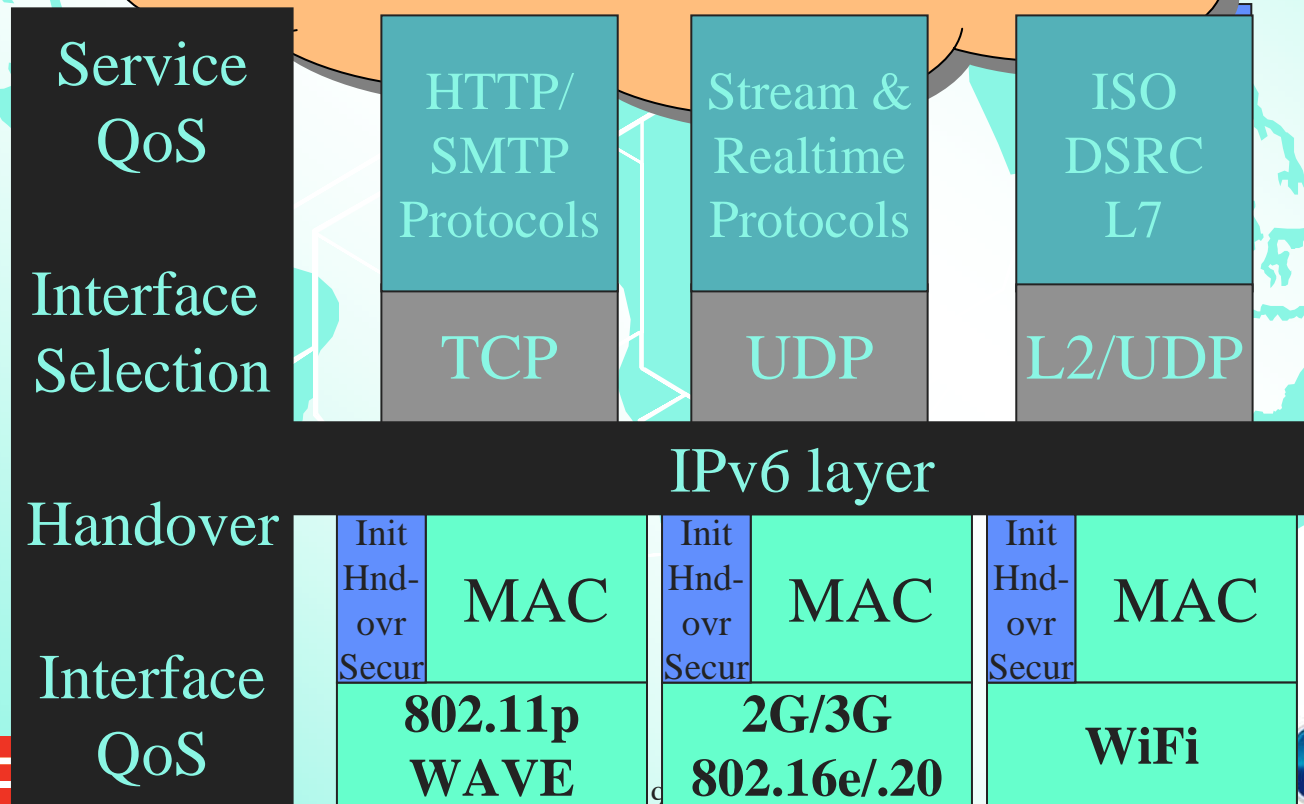
CALM - Overall

- CALM is the ISO approved framework for heterogeneous packet-switched communication in mobile environments
- CALM also refers to the set of international standards being developed to support this framework.
- The CALM framework supports user transparent continuous communications across various interfaces and communication media such 802.11, 802.11p, 802.15, 802.16e, 802.20, 2G/3G/4G cellular systems, national ITS systems,...
- CALM standards are being developed by **ISO TC204/WG16 – Wide Area Communications**



ITS Communications

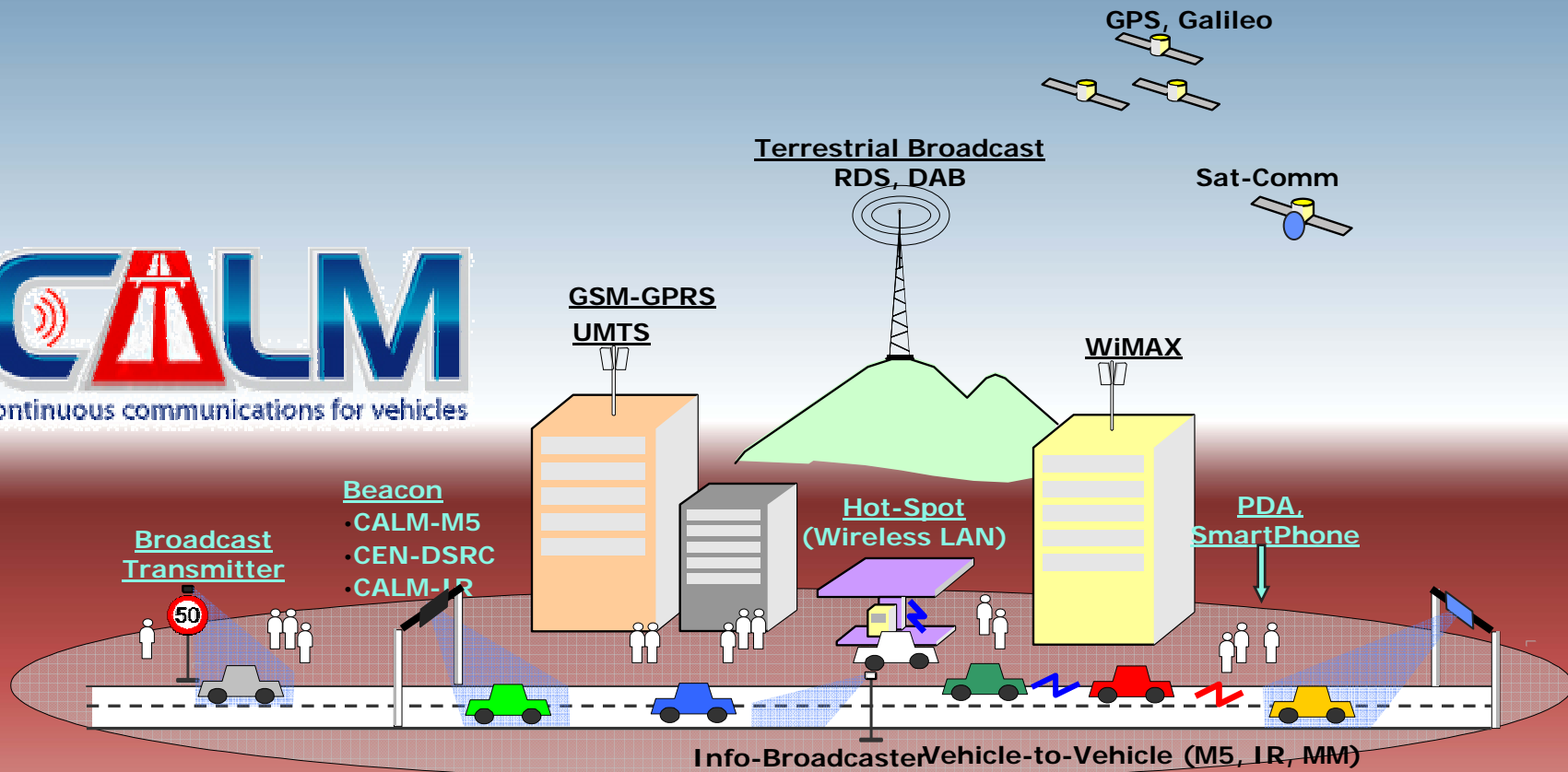
ALL ITS APPLICATIONS



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Some Examples of CALM Air Interfaces





CALM Applications

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



TC204/CALM and IEEE 802

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CALM and 802.11p

- **Excerpts from 802.11p PAR:**
- 5.5: ...”While there is a priority within North America to support the US National Intelligent Transportation System (ITS) Architecture, the intent is to develop an amendment to IEEE 802.11 that will be applicable on a global basis. The proposed project is coordinated with ISO TC204/WG16 to ensure global applicability.”...
- 7.1: ...”ISO TC204/WG16 Wide Area Communications is responsible for medium and long range communications. WG16 is working on ISO CD 21215 (CALM M5) with a similar scope. A working relationship between ISO and IEEE has been created to avoid overlap. WG16 will provide input, IEEE 802.11 will develop the basic standard, and CALM M5 will reference the final IEEE standard.”...



CALM and 802.11/15/16/20

- CALM includes all relevant parts of 802.11 in addition to .11p (WAVE mode), and is also interested in new developments for mobility aspects
- PAN systems are included via 802.15, in particular Bluetooth
- WAN from 802.16e and 802.20 are in final stages of CALM inclusion as ISO standards.



CALM and IEEE 802.21

- CALM includes similar functions to those being developed in 802.21.
 - Management of multiple media
 - Media independent handover
- CALM is not developing handover protocols
 - Relies on IETF IPv6 protocols for vertical handovers
 - Relies on medium-specific protocols for horizontal handover
- Open to cooperate with 802.21 with the goal to co-develop and harmonize primitives



TC204/WG16 Cooperative efforts

- ETSI ERM TG37 – 2G/3G standards, spectrum and test standards,...
- IETF – Internet Network Mobility (NEMO/MONAMI)
- ITU-R WP 8A – Global radio standards
- USA projects: Vehicle Infrastructure Integration and VIIC
- Japan projects: CALM Proof-Of-Concept,...
- European projects: C2C-CC, CVIS, SafeSpot,...



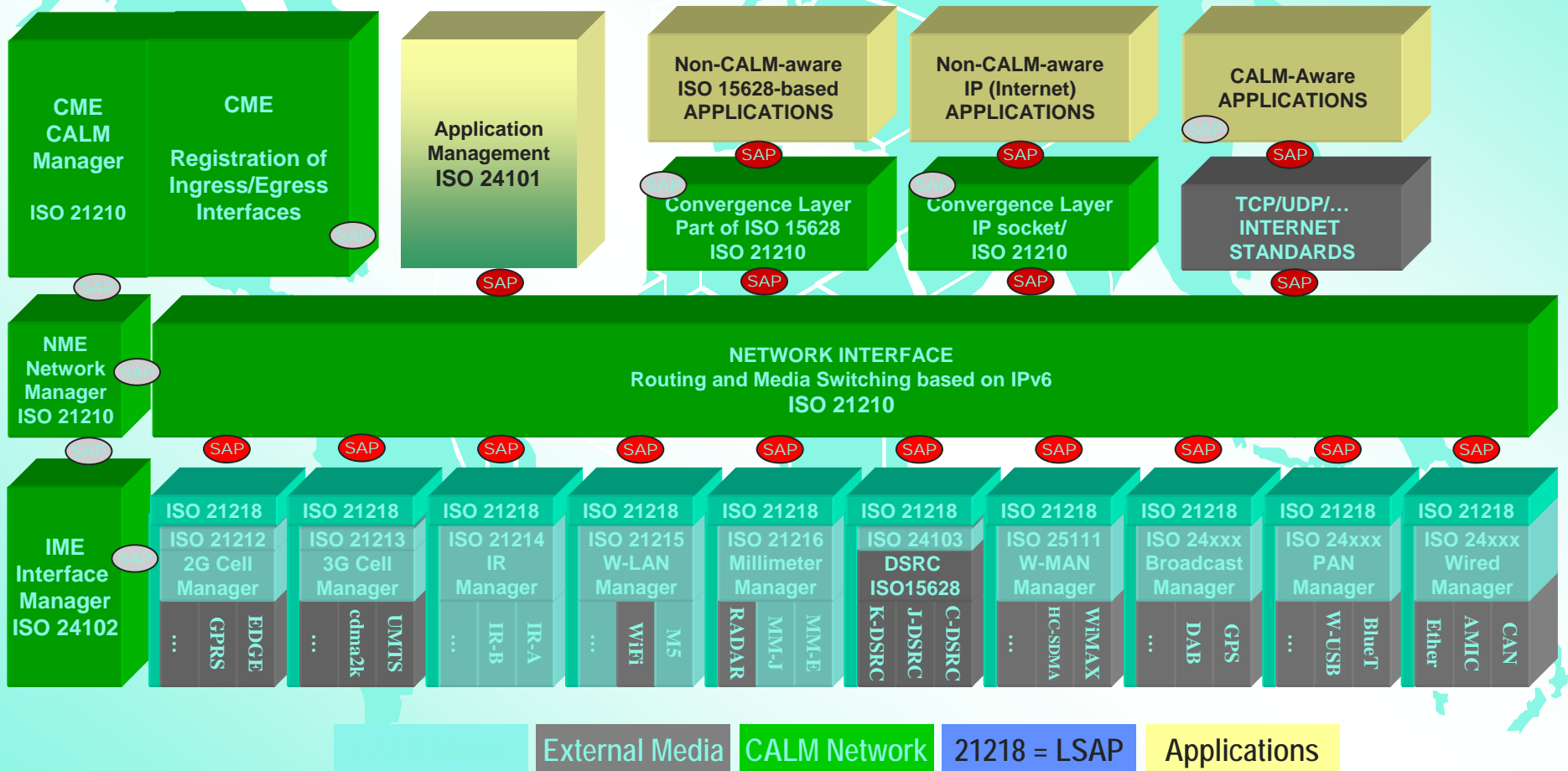
What is CALM?

Technically!

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CALM Architecture



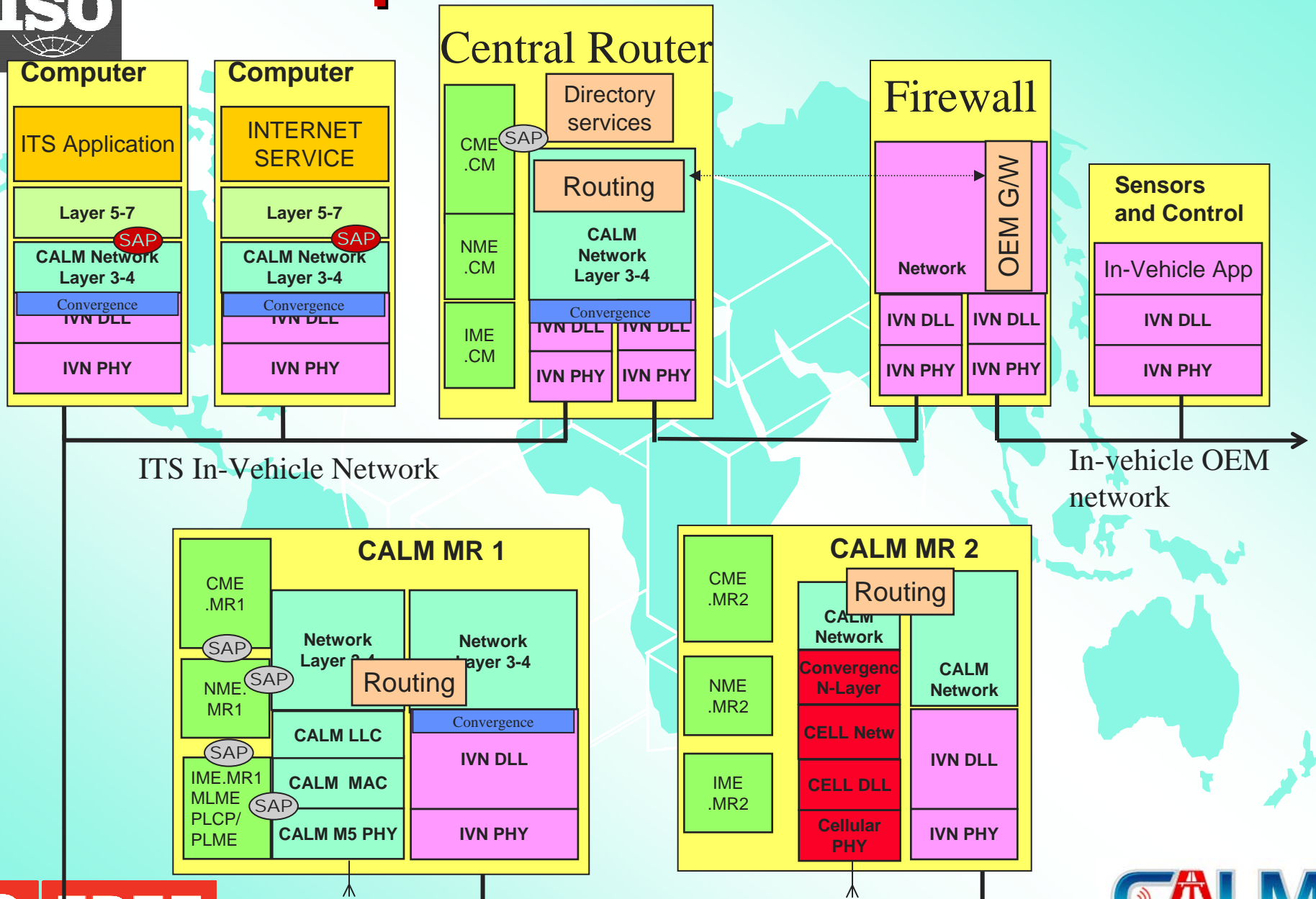
Data SAP Management SAP

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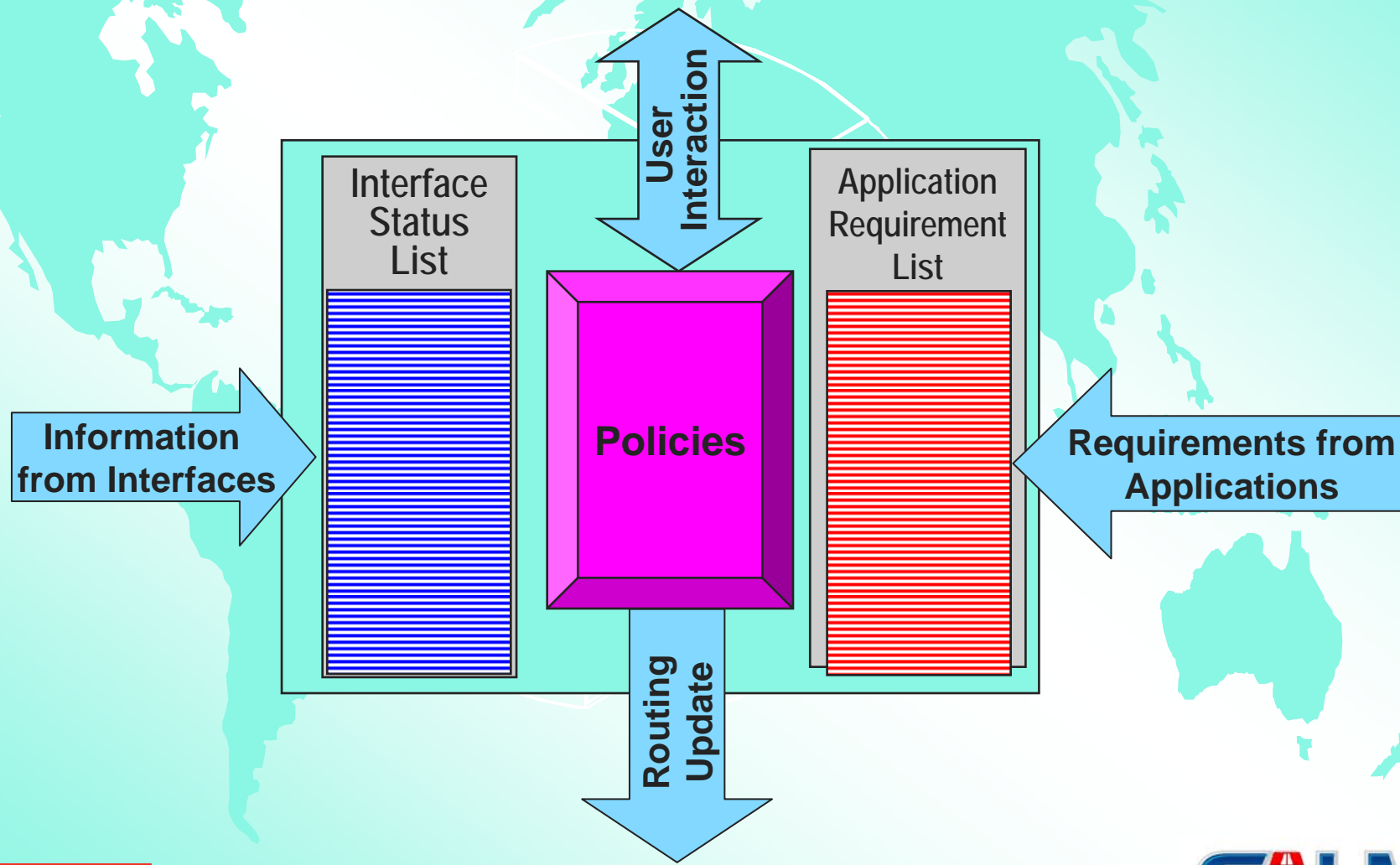


Example: Full CPE Architecture





CALM Manager



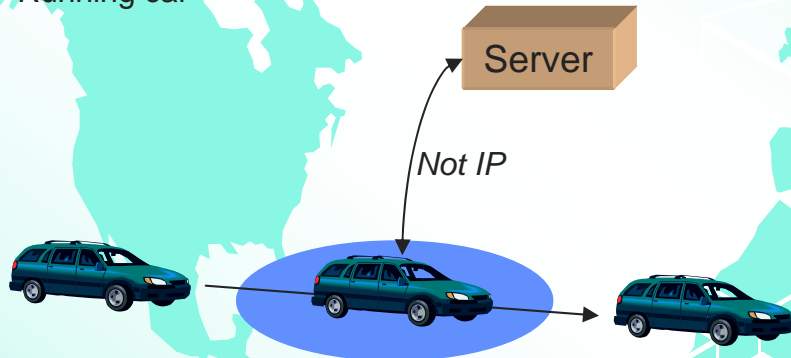
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CALM Scenarios (1/2)

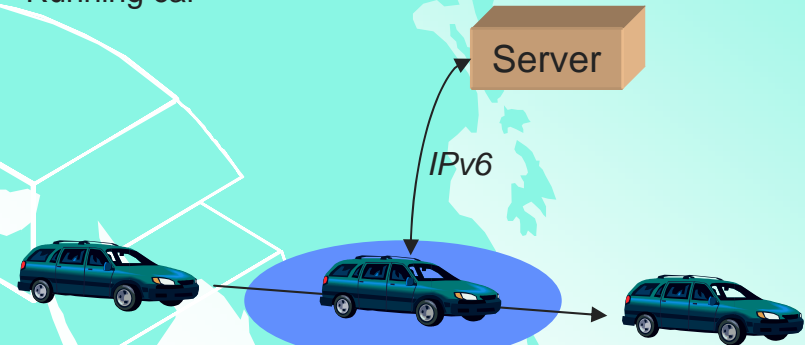
Scenario 0 (Fast comm)

- Single media
- Running car



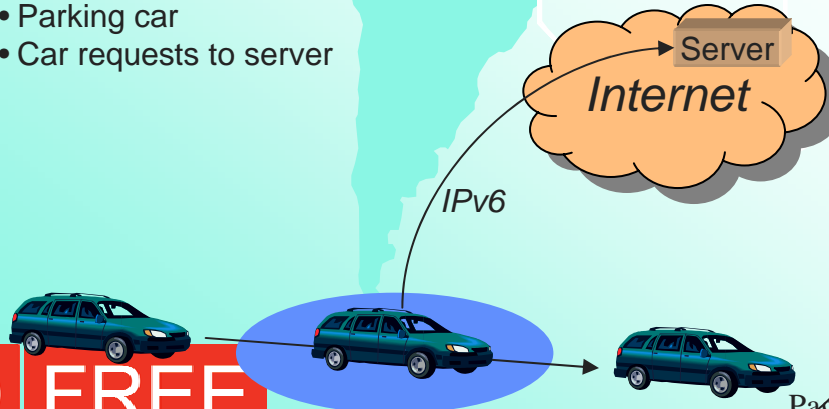
Scenario 1 (without Internet access)

- Single media
- Running car



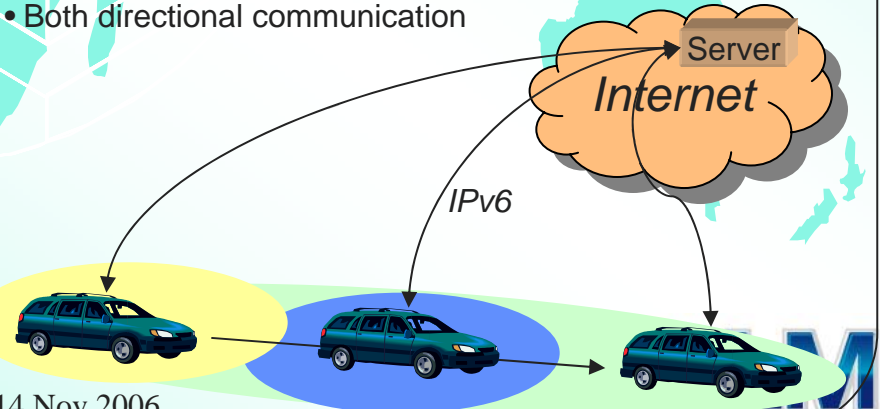
Scenario 2 (with Internet access without Media switching)

- Single media
- Running car with large range communication media
- Parking car
- Car requests to server



Scenario 3 (with Internet access with Media switching)

- Multiple Media
- Both of running car and parking car
- Both directional communication



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CALM Scenarios (2/2)

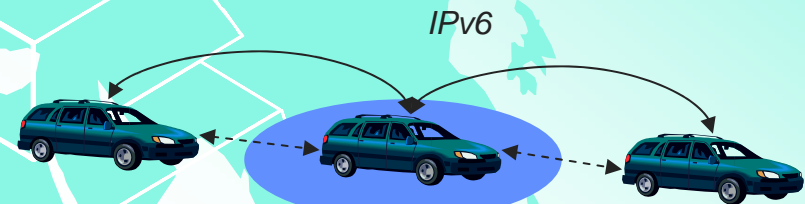
Scenario 4 (out of scope network protocol)

- Single media
- Single hop
- Running car



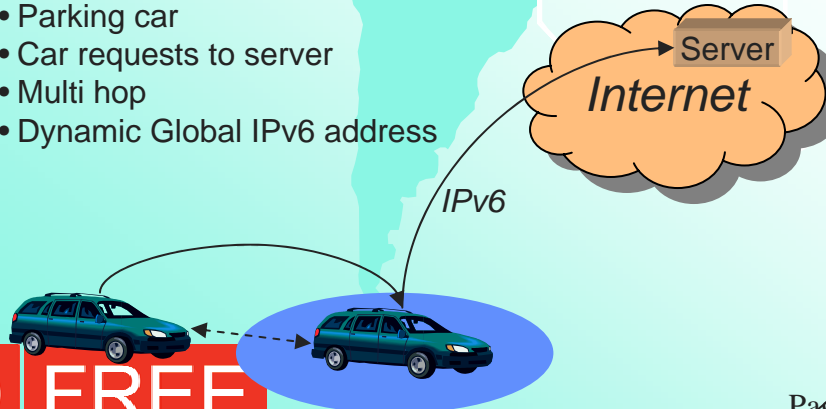
Scenario 5 (without Internet access)

- Single media
- Multi hop
- IPv6 Link local
- Running car



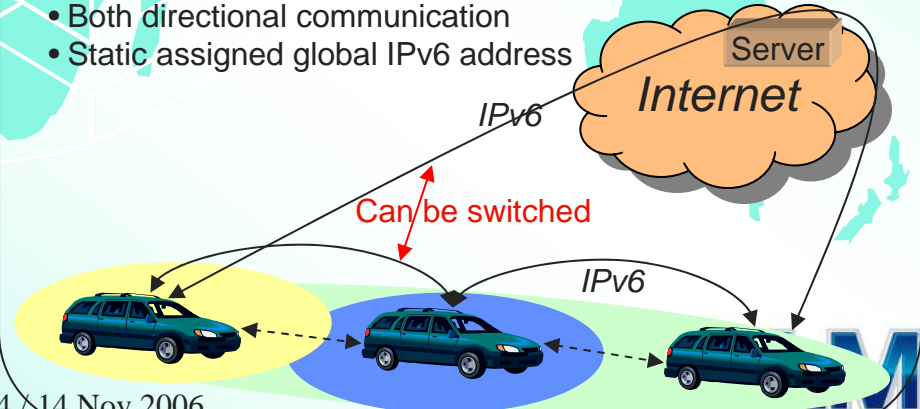
Scenario 6 (with Internet access)

- Single media
- Running car with large range communication media
- Parking car
- Car requests to server
- Multi hop
- Dynamic Global IPv6 address



Scenario 7 (with Internet access)

- Multiple Media
- Both of running car and parking car
- Both directional communication
- Static assigned global IPv6 address



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CALM handover scenarios

	Intra-Access Network	Inter-Access Network
Horizontal	<p>① IME based / Media specific handover</p> <ul style="list-style-type: none">• CME Policy and Parameter have to be same. In this case, IME or network system can handover autonomously.• If CME policy or parameter is different, it seems same to ③. <p>The diagram shows a single orange cloud representing the network, connected to a yellow box labeled 'AR'. Below 'AR' are two blue boxes labeled 'AP1' and 'AP2'. A blue car is shown moving from the coverage area of AP1 to the coverage area of AP2, indicated by a horizontal arrow.</p>	<p>② CME based handover</p> <ul style="list-style-type: none">• CME&NME initiates handover. <p>The diagram shows an orange cloud connected to two yellow boxes labeled 'AR1'. Below each 'AR1' is a blue box labeled 'AP1' and 'AP2'. A blue car is shown moving from the coverage area of AP1 to the coverage area of AP2, indicated by a horizontal arrow.</p>
Vertical	<p>③ CME based handover</p> <ul style="list-style-type: none">• IME requests to NME&CME and CME&NME performs it. <p>The diagram shows an orange cloud connected to a yellow box labeled 'AR'. Below 'AR' are two boxes labeled 'AP1' and 'AP2'. The 'AP2' box is red. A blue car is shown moving from the coverage area of AP1 to the coverage area of AP2, indicated by a horizontal arrow.</p>	<p>④ CME based handover</p> <ul style="list-style-type: none">• CME&NME initiates handover. <p>The diagram shows an orange cloud connected to two yellow boxes labeled 'AR1' and 'AR2'. Below 'AR1' is a blue box labeled 'AP1' and below 'AR2' is a red box labeled 'AP2'. A blue car is shown moving from the coverage area of AP1 to the coverage area of AP2, indicated by a horizontal arrow.</p>



What are CALM media?

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Selected CALM media

- ISO 21212: 2G Cellular (GSM)
- ISO 21213: 3G Cellular (UMTS)
- ISO 21214: InfraRed
- ISO 21215: M5 (802.11p)
- ISO 25112: WiMAX (802.16e)
- ISO 25113: HC-SDMA (802.20)
- ISO xxxxx: Bluetooth (802.15)
- ISO xxxxx: Ethernet (802.3)

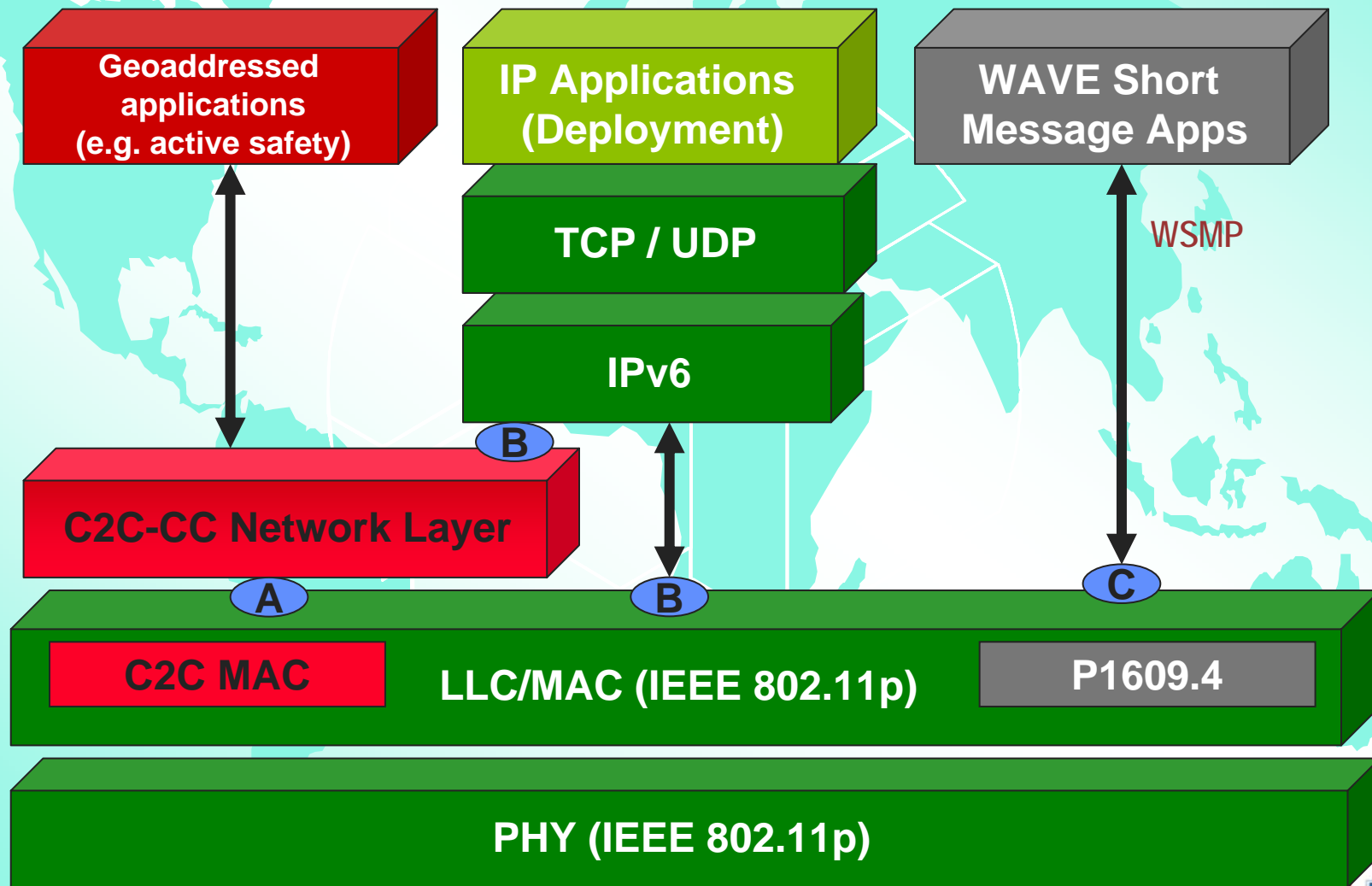


CALM M5 vs. 802.11p (WAVE)

- WAVE PHY/MAC is IEEE 802.11p
- CALM M5 incorporates WAVE and adds:
 - Global (European) 5 GHz spectrum
 - Regulatory domain (border) management
 - Directivity and EMC control
 - Regional DSRC cooperation
 - Multiple radios/interfaces/antenna management through network connection
 - GPRS/UMTS/+++ network interconnectivity



CALM M5: C2C-CC & WAVE





Standards Contact Points

- ISO TC204: www.isotc204.com
- ETSI: www.etsi.org
- CALM: www.calm.hu
- IETF: www.ietf.org



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- Chairman ISO TC204
Michael.Noblett@SEICCS.com
 - Knut.Evensen@q-free.com
Convenor WG16.0, Editor CALM M5

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Backup slides

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WG 16 Current Work Program - 1

ISO Work Item Number and ISO ID	Title	Current Stage	Started Current Stage	Target Dates	Project Leader	Project Control
ISO/DIS 15662 ID: 28014	TICS Wide Area Communication Message Management Information	60.00	20-06-06	In publication process	H Wakayama	Under Publication Process
ISO/CD 21210-1 ID: 35714	CALM Networking for Internet Connectivity	30.20	01-10-06	DIS: 2007-02	H Wakayama	
ISO/NP 21210-2 ID: 35714	CALM Networking for Direct Mode Connectivity	20.20	05-10-06	CD: 2007-10 DIS: 2008-10	H Wakayama	Approved 12 months extension at Cape Town Plenary
ISO/CD 21212 ID: 35717	CALM 2G Cellular	30.99	16-09-05	DIS: 2006-11	R Williams	DIS draft submitted to ISO CS on 3 November 2006 Waiting for DIS ballot dates



WG 16 Current Work Program - 2

ISO Work Item Number and ISO ID	Title	Current Stage	Started Current Stage	Target Dates	Project Leader	Project Control
ISO/CD 21213 ID: 35718	CALM 3G Cellular	30.99	16-09-05	DIS: 2006-11	R Williams	DIS draft submitted to ISO CS on 3 November 2006 Waiting for DIS ballot dates
ISO/IS 21214 ID: 41104	CALM IR	60.60			R Williams	Published Standard
ISO/PWI 21215 ID: 35720	CALM M5	00.20	09-11-06	NP/CD: 2007-11	K Evensen	Will be submitted as NP/CD ballot by 11-2007
ISO/NP 21216 ID: 35721	CALM MM	20.20	25-04-06	CD: 2007-07 DIS: 2008-07	M Fujise	Approved CD ballot request at Cape Town Plenary
ISO/CD 21217 ID: 35722	CALM Architecture	30.20	05-10-06	DIS: 2007-10	K Evensen	Approved 12 months extension at Cape Town Plenary Approved new resolution for a DIS ballot
ISO/CD 21218 ID: 35723	CALM Networking - Medium SAPs	30.20	01-10-06	DIS: 2007-07	H Fischer	Approved as CD (Ballot results: YES: 14 NO: 0 ABSTAIN: 3)



WG 16 Current Work Program - 3

ISO Work Item Number and ISO ID	Title	Current Stage	Started Current Stage	Target Dates	Project Leader	Project Control
ISO/CD 22837 ID: 36518	Vehicle Probe Data for Wide Area Communication	30.20	24-10-06	DIS: 2006-12	T Kishi	Approved as CD (Ballot results: YES: 15 NO: 0 ABSTAIN: 5 Approved DIS ballot request at Cape Town Plenary (pending on CD ballot results))
ISO/NP 24100 ID: 42017	Basic Principles for Personal Data Protection in Probe Vehicle Information Services	20.20	04-09-06	CD: 2007-03 DIS: 2008-02	Y Watanabe	
ISO/CD 24101 ID: 42018	CALM Application Management	30.20	02-11-06	DIS: 2007-12	M Ohyama	Approved as CD (Ballot results: YES: 14 NO: 0 ABSTAIN: 6 Approved DIS ballot request at Cape Town Plenary)
ISO/NP 24102 ID: 42019	CALM Interface Manager	20.20	06-11-06	CD: 2006-12 DIS: 2007-11	K Evensen	Approved as NP (Ballot Result: YES: 13 NO: 0 ABSTAIN: 5 Approved CD ballot request at Cape Town Plenary)
ISO/NP 24103 ID: 42020	CALM MAIL	20.20	04-09-06	CD: 2007-03 DIS: 2008-02	K Koga	Approved CD ballot request at Cape Town Plenary



WG 16 Current Work Program - 4

ISO Work Item Number and ISO ID	Title	Current Stage	Started Current Stage	Target Dates	Project Leader	Project Control
ISO/PWI 24977 ID: 42726	Mobile Phone Based e-Call	30.92	22-02-06		B Williams	Approach to be considered in November WG 16 meeting
ISO/PWI 24978 ID: 42727	Emergency Messages Data Registry	30.92	22-02-06	NP: 2007-02 CD: 2007-06 DIS:2007-09	B Williams	Approved NP/CD ballot request at Cape Town Plenary Approved title change to 'Emergency Messages Data Registry' request at Cape Town Plenary
ISO/CD 25111 ID: 42751	CALM WBB - General Support	30.20	01-10-06	CD: 2007-08 DIS: 2008-07	H Cho	
ISO/NP 25112 ID: 42752	CALM WBB – WiMAX	20.20	04-09-06	CD: 2007-03 DIS: 2008-02	TBD	Approved CD ballot request at Cape Town Plenary
ISO/NP 25113 ID: 42753	CALM WBB – Existing Systems	20.20	04-09-06	CD: 2007-03 DIS: 2008-02	J Wilson	Approved CD ballot request at Cape Town Plenary
ISO/NP 25114 ID: 42754	Probe Data Reporting Management	20.20	06-11-06	CD: 2007-11 DIS: 2008-11	R Bishop	Approved as NP (Ballot results: YES: 13 NO: 1 ABSTAIN: 4

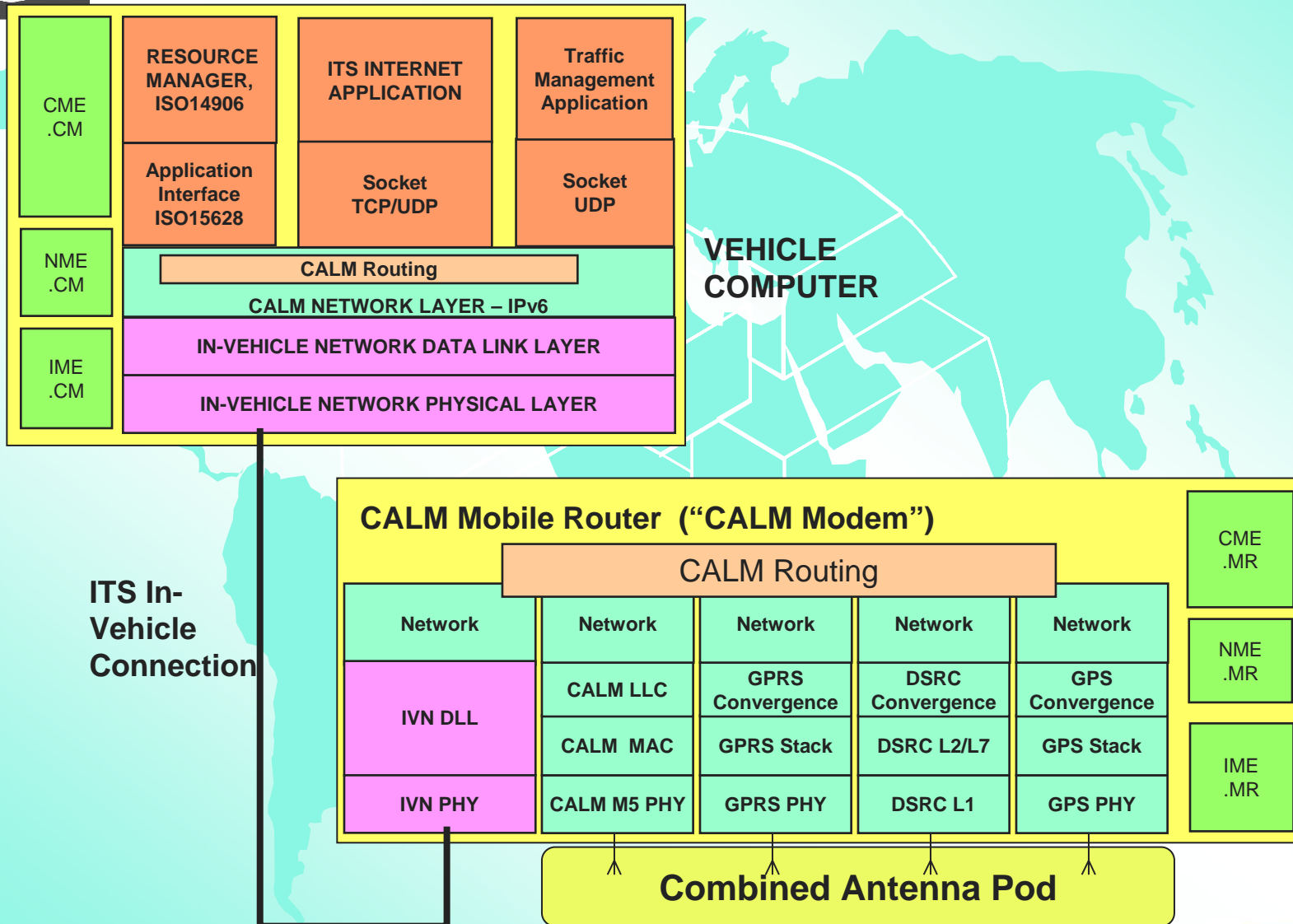


WG 16 Current Work Program - 5

ISO Work Item Number and ISO ID	Title	Current Stage	Started Current Stage	Target Dates	Project Leader	Project Control
ISO/PWI 29281 ID: 45379	CALM Architecture for non-IP type communication mechanism	00.20	02-10-06	NP: 04-2008 CD: 04-2009	T Sugiura	Approved as PWI at the Cape Town Plenary
ISO/PWI 29282 ID: 45380	CALM Applications using Satellite	00.20	02-10-06	NP: 04-2008 CD: 04-2009	B Williams	
ISO/PWI 29283 ID: 45381	CALM Applications using 802.20	00.20	02-10-06	NP: 04-2008 CD: 04-2009	J Wilson	
ISO/PWI 29284 ID: 45382	Event based Probe Vehicle Data	00.20	02-10-06	NP: 04-2008 CD: 04-2009	M Hauschild	Approved as PWI at the Cape Town Plenary



Condensed CPE Architecture





ETSI ERM TG37

- 2G/3G standards, eCall, Testing standards,...
- European frequency selection
- System Reference Document (SRD) in three parts:
 - Critical Safety - 2*10MHz bandwidth
 - Safety & Efficiency - 5*10MHz
 - Mobile use of unlicensed 5 GHz bands
- Allocation likely in 5.9 GHz band.
- Process involves several steps with ETSI – CEPT – national authorities.

Possible allocation of 5GHz frequencies early 2007?