Tutorial for

ISO CALM Lower Layers and FAST mode

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Communications Architecture for Land Mobile environment
CALM Architecture

- Variable Message Sign
- Hot-Spot (Wireless LAN)
- Beacnon
- CALM-M5
- CEN-DSRC
- CALM-IR
- CALM-M5
- CEN-DSRC
- CALM-IR

- Terrestrial Broadcast: RDS, DAB
- GPS, Galileo
- Sat-Comm

- GSM-GPRS
- UMTS
- WiMAX

- Broadcast Transmitter
- Info-Broadcaster
- Vehicle-to-Vehicle (M5, IR, MM)
- PDA, Smartphone
- Variable Message Sign
Putting puzzles together

ISO TC204 WG16

EU project CVIS
Content

- CALM Communications Kernel
- The concept of "Virtual Interfaces"
- CALM Management Entity
- FAST Communications Scenarios
- FAST Services
- FAST DLL and Networking Details
CALM

Communications Kernel
CVIS Vehicle System

CVIS

CALM Communications Kernel

Mobile Router
Vehicle Host
Vehicle Gateway
Control
SENSOR
SENSOR
The CCK constitutes a CVIS mobile router.

The CCK is part of every CVIS host.
The CCK constitutes a CVIS mobile router. The CCK is part of every CVIS host.
CALM Communications Kernel

As specified in IEEE P1609.3

WAVE Network
It is intended to harmonize WAVE and CALM FAST as much as possible!
ISO CALM IPv6 Network

Developed in cooperation with IETF
CALM Communications Kernel

Such as:
G2 / G3, WiMax, ...
CALM-M5 /-MM /-IR
WAVE IEEE P1609.4 – 802.11p
...
Broadcast receivers
GPS / GALILEO
...
Bluetooth

Wireless Communications Interfaces
Technology not defined so far:
- IP based network
- predicted FAST network

Wired Communications Interfaces – In-car LAN
CALM Communications Kernel

Station Management

- CME
  (supervisor and adjuncts)
  > SNMP
  > Service Initialization
  see P1609.4 WSA

- NMEs
  > Routing

- IMEs
  > Virtual Interfaces
CALM
Communication Interface (CI)
Station Management
no distinction between
PLME, MLME and
LLME

Communications Protocol Stack

LLC
MAC
PHY

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CALM communication interface
wired / wireless

An existing radio
CALM communication interface
wired / wireless

CALM Adaptation

Communication Interface

Interface Management Entity (IME)

CI Management Adaptation Entity (CI-MAE)

CI Management Entity (CI-ME)

Communication Adaptation Layer (CAL)

Communication Interface Protocol Layers (CIPL)

CALM Network Layer
CALM Virtual CI
CALM Virtual CI

Compare with MAC channel coordination in P1609.4

Transmitter Profile in P1609.4

This functional description allows prioritizing at MAC as is in P1609.4
**CI Identifier**

<table>
<thead>
<tr>
<th>MedID</th>
<th>Randomly assigned unique identifier of medium, e.g. IR, M5, MM, G2 / G3, ...</th>
</tr>
</thead>
</table>
| SerialNumber   | 0 - physically available CI  
|                | >0 - virtual instance of CI                                                  |

![Diagram showing CI-ID structure]

**Diagram Description:**
- **MedID**: One octet unsigned integer (LSB ... MSB)
- **SerialNumber**: Three octet unsigned integer (LSB ... MSB)
CALM Communications SAP
SAP address: Used to identify the used / select the required networking protocol, e.g. IPv6, FAST IPv6, CALM FAST, WSMP, position based addressing, OEM, ...
CALM

Interface Management Entity
CALM Interface Management Entity
CALM
CI Management SAP
CALM management services
Set parameters

CIMAE-SETPARAM.request (CI-ID, Sequence of Param)

Used also to trigger action at Communication Interface.

CIMAE-SETPARAM.confirm (CI-ID, Sequence of Result OPTIONAL)
CALM management services
Get parameters

CIMAE-GETPARAM.request (CI-ID, Sequence of Param.No)

CIMAE-GETPARAM.confirm (CI-ID, Sequence of Param)

Param.No = 255 used for error notification
CALM management services
Get parameters

**Param**

SEQUENCE (SIZE (1..255)) OF
SEQUENCE
{
Param.No INTEGER(1..255),
Param.Value OCTET STRING
}

**Result**

SEQUENCE (SIZE (1..255)) OF
SEQUENCE
{
Result.No INTEGER(1..255),
Result.Code
}

Result.Code Enumeration

0: SUCCESS

1-5: specified failures

6-255: reserved for future use
CALM management services
SERVICE parameters

CIMAE-SERVICE.request (  
  CI-ID,  
  <medium specific parameters>  
)

CIMAE-SERVICE.confirm (  
  CI-ID,  
  <medium specific parameters>  
)

Medium-specific management service. Enabling future media with specific management needs.
CALM FAST scenarios
See WAVE Announcement Frame in P1609.4
CALM FAST exchange of data

Service Initialisation Phase
- CVIS Roadside Installation
- RSIF
- VSCF

Service Operation Phase
- CVIS Vehicle Installation
- Request #1
- Response #1
- Request #n
- Response #n

Vehicle Service Context Frame
CALM FAST frame details
Instead of the CALM FAST NW header, a NW header for other FAST protocols, such as WSMP, can be applied.
### Service Information Table

<table>
<thead>
<tr>
<th>Optional Geographical Source Location</th>
<th>Optional Probe Data</th>
<th>Optional SIT</th>
<th>Optional IP-based Service Advertisement</th>
</tr>
</thead>
</table>

### Service Context Table

<table>
<thead>
<tr>
<th>Optional Geographical Source Location</th>
<th>Optional Probe Data</th>
<th>Optional SCT</th>
<th>Optional IP-based Service Response</th>
</tr>
</thead>
</table>
### CALM FAST mode

#### Service information table

<table>
<thead>
<tr>
<th>Element</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>messageType</td>
<td>BIT STRING (SIZE(2))</td>
<td>'00' : <strong>SIT</strong></td>
</tr>
<tr>
<td>stationType</td>
<td>BOOLEAN</td>
<td>0: Mobile station 1: Fixed station</td>
</tr>
<tr>
<td>stationID</td>
<td>BIT STRING (SIZE(48))</td>
<td>a unique station identifier (e.g. MAC address)</td>
</tr>
<tr>
<td>serviceList</td>
<td>SEQUENCE (SIZE(0..255)) OF SEQUENCE</td>
<td>list of services offered</td>
</tr>
<tr>
<td></td>
<td>{</td>
<td></td>
</tr>
<tr>
<td></td>
<td>serviceID INTEGER(0..127,...),</td>
<td>(registered) unique SID</td>
</tr>
<tr>
<td></td>
<td>serviceData OCTET STRING</td>
<td>optional</td>
</tr>
<tr>
<td></td>
<td>serviceNWref INTEGER(0..255)</td>
<td>optional NW header information for data exchange</td>
</tr>
<tr>
<td></td>
<td>serviceChannel INTEGER(0..255)</td>
<td>optional channel info for data exchange phase, medium specific</td>
</tr>
<tr>
<td></td>
<td>}</td>
<td></td>
</tr>
</tbody>
</table>
### Service context table

<table>
<thead>
<tr>
<th>Element</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>messageType</td>
<td>BIT STRING (SIZE(2))</td>
<td>'01': <strong>SCT</strong></td>
</tr>
<tr>
<td>stationType</td>
<td>BOOLEAN</td>
<td>0: Mobile station</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: Fixed station</td>
</tr>
<tr>
<td>stationID</td>
<td>BIT STRING (SIZE(48))</td>
<td>a unique station identifier (e.g. MAC address)</td>
</tr>
<tr>
<td>contextList</td>
<td>SEQUENCE (SIZE (0..255)) OF</td>
<td>List of service contexts</td>
</tr>
<tr>
<td></td>
<td>SERVICE CONTEXT SEQUENCE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>{</td>
<td></td>
</tr>
<tr>
<td></td>
<td>serviceID INTEGER(0..127,...),</td>
<td>(registered) unique SID</td>
</tr>
<tr>
<td></td>
<td>serviceContext OCTET STRING,</td>
<td>context of the related service.</td>
</tr>
<tr>
<td></td>
<td>serviceNWref INTEGER(0..255)</td>
<td>NW header information for data exchange</td>
</tr>
</tbody>
</table>
## CALM FAST mode
### Data exchange

<table>
<thead>
<tr>
<th>Element</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>messageType</td>
<td>BIT STRING (SIZE(2))</td>
<td>'10': Request</td>
</tr>
<tr>
<td></td>
<td></td>
<td>'11': Response</td>
</tr>
<tr>
<td>data</td>
<td>OCTET STRING</td>
<td>Data dedicated to service / application</td>
</tr>
</tbody>
</table>

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CALM FAST mode
DLL details
MAC source address: Individual address, either universal or locally administered.

MAC Destination Address: Broadcast address.

SAP Source Address: e.g. FAST: 0xBA
WSMP: 0xF6
0xF6 corresponds to EtherType 0x88DC, see P1609.4

SAP Destination Address: e.g. FAST: 0xBA
WSMP: 0xF6
MAC source address: Individual address, either universal or locally administered.

MAC Destination Address: Individual address, either universal or locally administered. Same value as MAC Source Address received in RSIF / VSIF.

SAP Source Address: e.g. FAST: 0xBA
                        WSMP: 0xF6
0xF6 corresponds to EtherType 0x88DC, see P1609.4

SAP Destination Address: e.g. FAST: 0xBA
                         WSMP: 0xF6
CALM FAST mode

Exchange of Data - DLL details

MAC source address: Individual address, either universal or locally administered. Value as known from Service Initialisation Phase.

MAC Destination Address: Individual address, either universal or locally administered. Value as known from Service Initialisation Phase.

SAP Source Address: e.g. CALM FAST: 0xBA
                      WSMP: 0xF6
                      0xF6 corresponds to EtherType 0x88DC, see P1609.4

SAP Destination Address: e.g. CALM FAST: 0xBA
                         WSMP: 0xF6
CALM FAST mode Networking details
Source Network Header - serviceNWref:  
Efficient single octet header, acting as a reference pointer.  
0: Entity located in IME that is in charge of managing RSIF / VSIF, and optionally RSCF / VSCF  
All other values may be assigned dynamically at run-time. This assignment shall be done under control of the CME supervisor upon registration of applications (services) and modems.

Destination Network Header:  
See above for source network header.

The mechanism / protocol used to forward a packet through a possible local network is not defined here. Just the reference pointer is specified. A dynamically managed look-up table in the network layer shall provide all information needed to forward packets, i.e. including optional network protocol conversion. The details are implementation specific.
Putting puzzles together

Thank you for listening

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