Relating the intelligent cargo concepts and technology into the CVIS platform

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Q-FREE
LEADING THE WAY
IN ROAD USER CHARGING AND TRAFFIC SURVEILLANCE

Short introduction to Q-Free

- Established in 1984
- Present in 18 countries
- 270 employees
- Publicly listed at Oslo Stock Exchange - QFR
- Head office in Trondheim, Norway

- Main business is systems for Road User Charging / Electronic Tolling
  - DSRC
  - ALPR
  - GNSS
  - Roadside equipment
  - Central systems

● **Q-Free Offices**

Purpose of Presentation

Show how the concepts of intelligent cargo can be integrated with the concepts of intelligent cooperative transportation systems.

Show how this integration enables several new cooperative ITS applications, resulting in freight transport that is more efficient, environmental friendly and safe.

Agenda

- Introduction – ITS, Cooperative ITS, CVIS
- Intelligent Cargo Enhancements
- New ITS Applications and Services for Transport Logistics
- Conclusions

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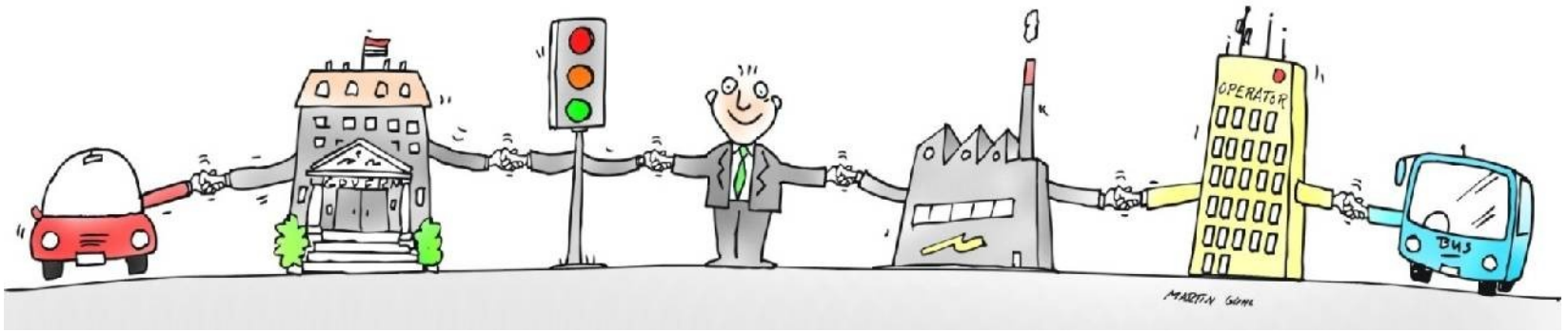
About ITS and Traffic Management

- *ITS (Intelligent Transport Systems)*
  - *Use of Information and Communications Technology (ICT) to the field of transportation*
  - *i.e. very generic term, but often limited to road based transportation: car, trucks, buses, tram (trolley car)*
- *ITS typically consists of*
  - *Mobile stations (systems)*
  - *Roadside stations (systems)*
  - *Central systems*
  - *Electronics and software*
  - *Sensors: inductive road sensors, position/speed detectors, infra-red detectors for pollution/fog*
  - *Communication facilities*

ITS objectives

- monitor and manage traffic flow
- reduce congestion
- enhance productivity
- save lives, time and money
- commercial services

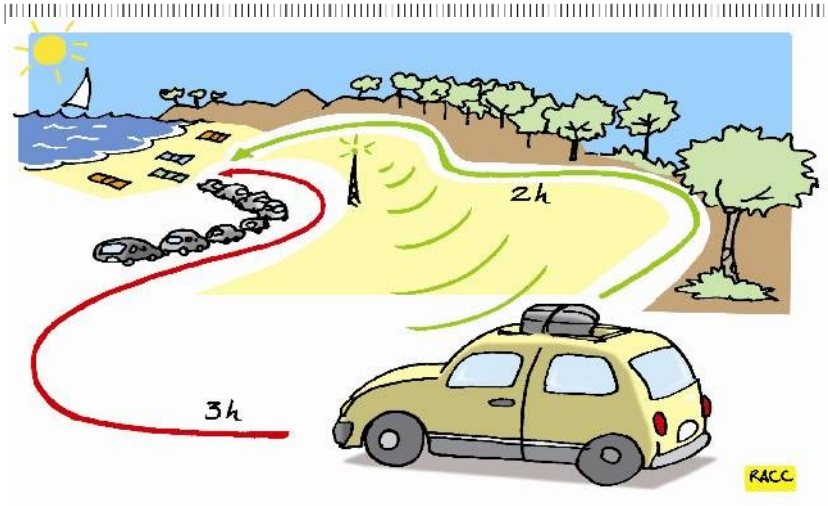


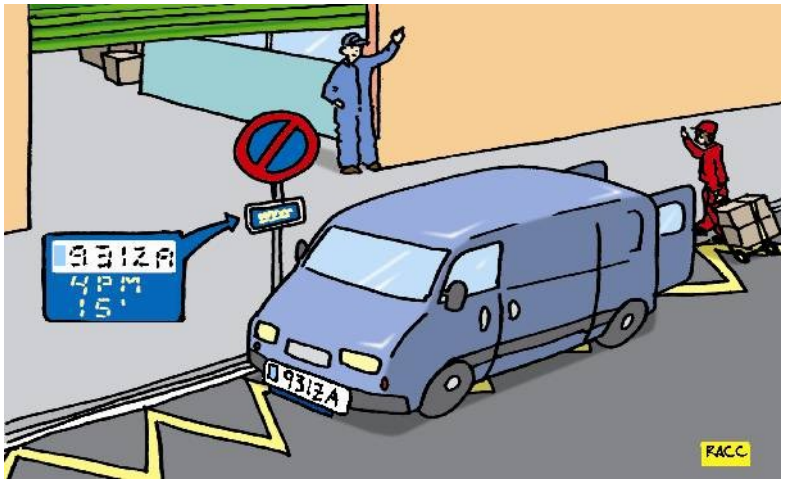
What are Intelligent Cooperative Systems?

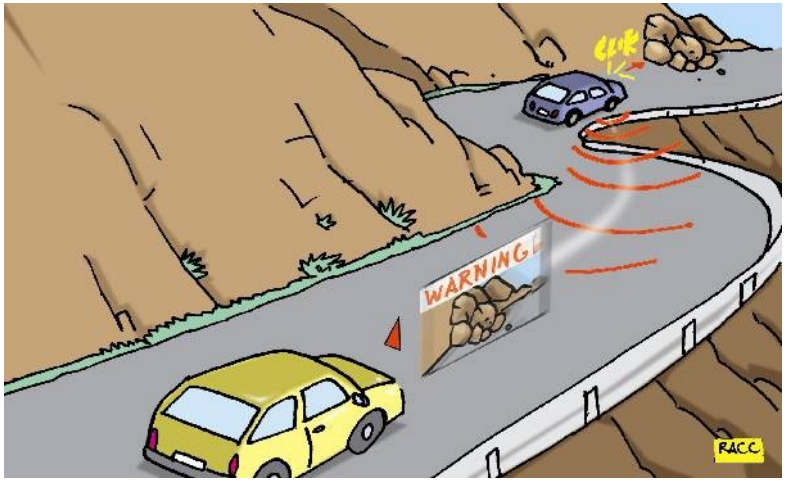
Introduction

- Intelligent Cooperative Systems are based on Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication
  - (also used: C2C, V2R, C2X, V2X, R2R, ...)
- increases quality, reliability, and "time horizon" of information
- drivers:
  - enhanced information about immediate environment, other vehicles and other road users
  - enhances safety and mobility efficiency
- infrastructure and road operators:
  - increased information about the vehicles, their location and the road conditions
  - optimized and safer use of the available road network, and better response to incidents and hazards.

Cooperative ITS scenarios/use-cases (1/2)

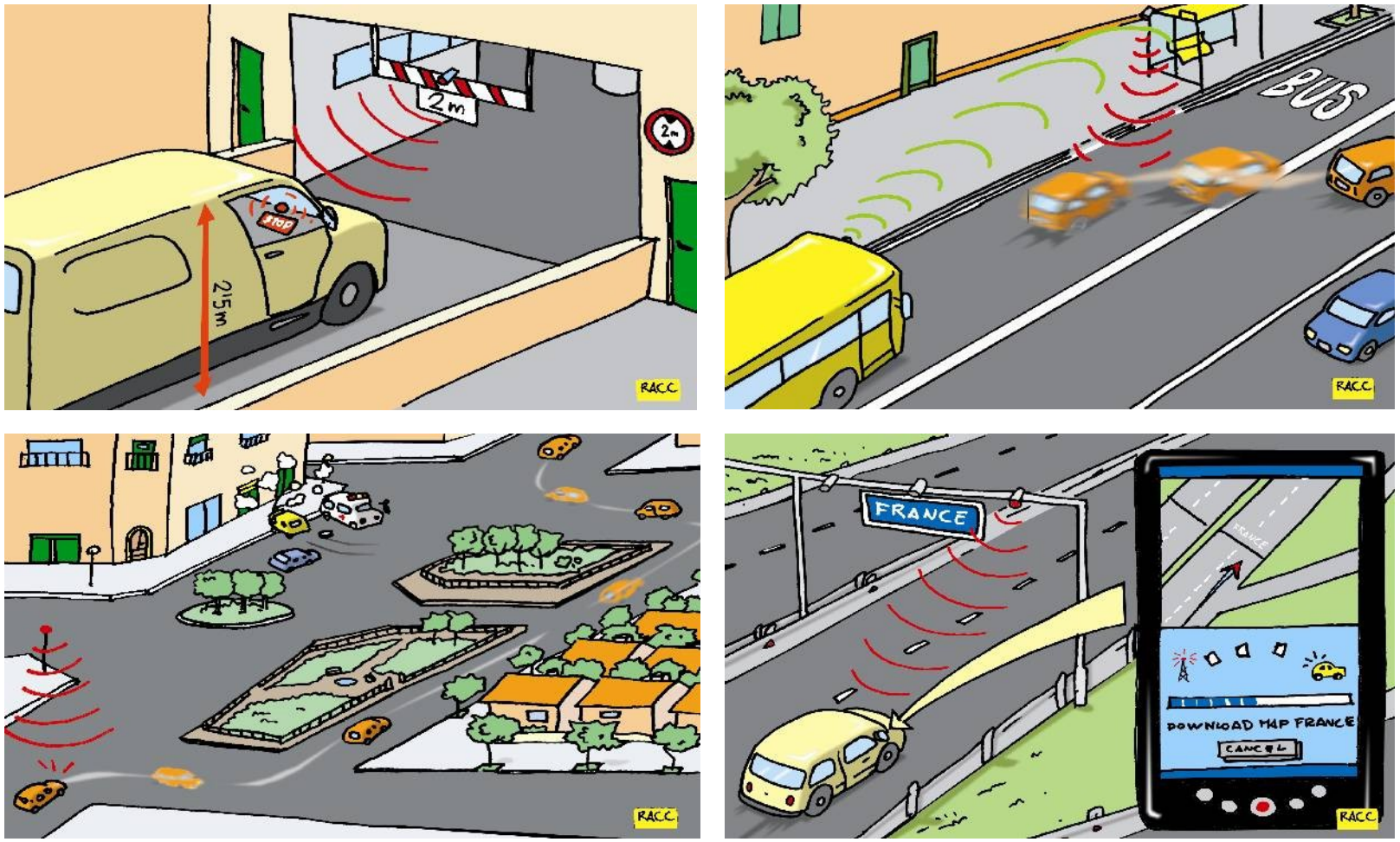






Source: CVIS – Cooperative Vehicle Infrastructure Systems, EU FP6

Cooperative ITS scenarios/use-cases (2/2)



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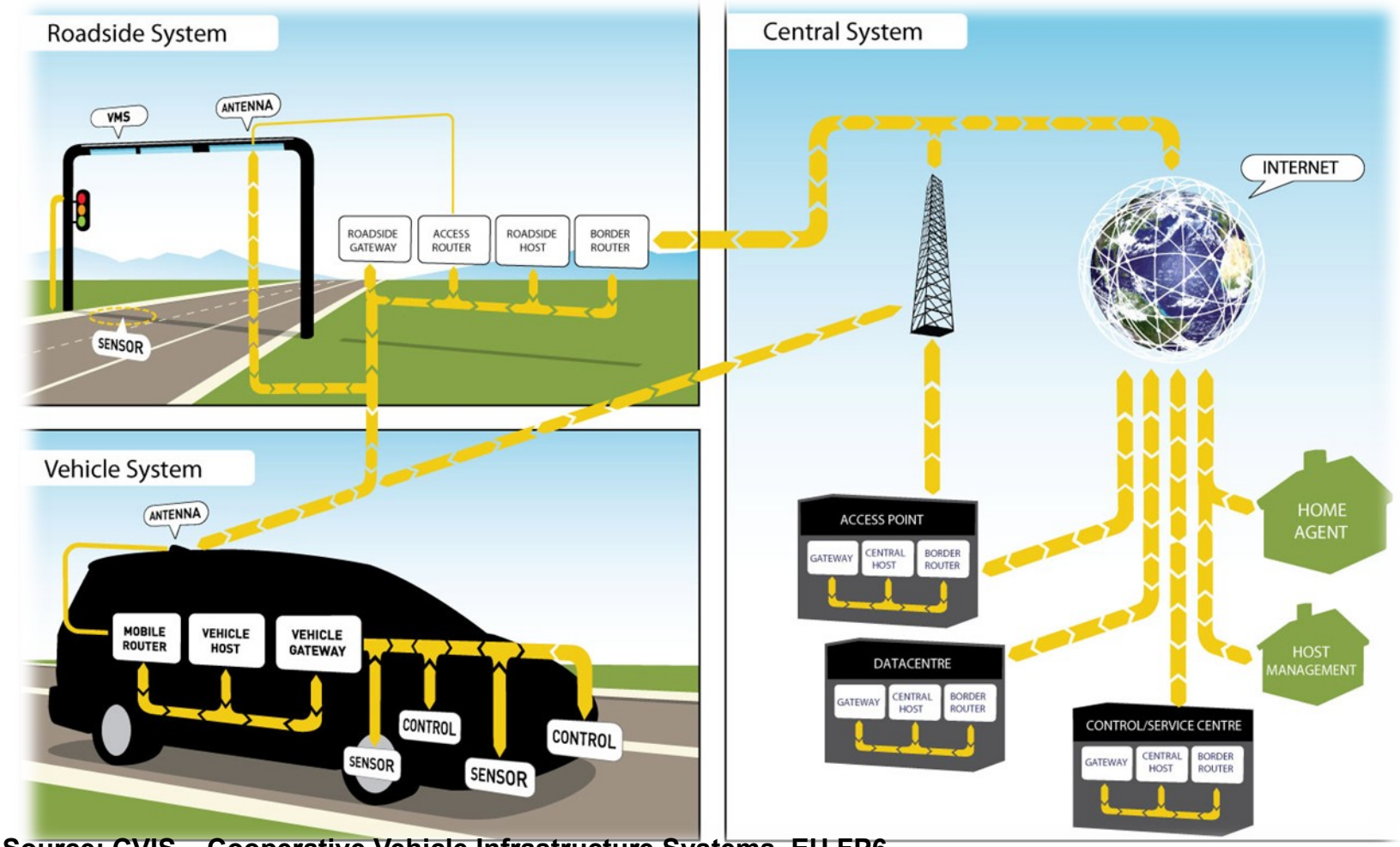
Cooperative Systems Architecture



Source: CVIS – Cooperative Vehicle Infrastructure Systems, EU FP6

Current Research Platform – CVIS Reference Execution Platform

CVIS Reference Antenna

2-6 GHz Antenna 1

GSM/UMTS Antenna

2-6 GHz Antenna 2

GPS Antenna

CEN DSRC Antenna

CVIS Sensor & M5 card

Gyro

Accelero-meter

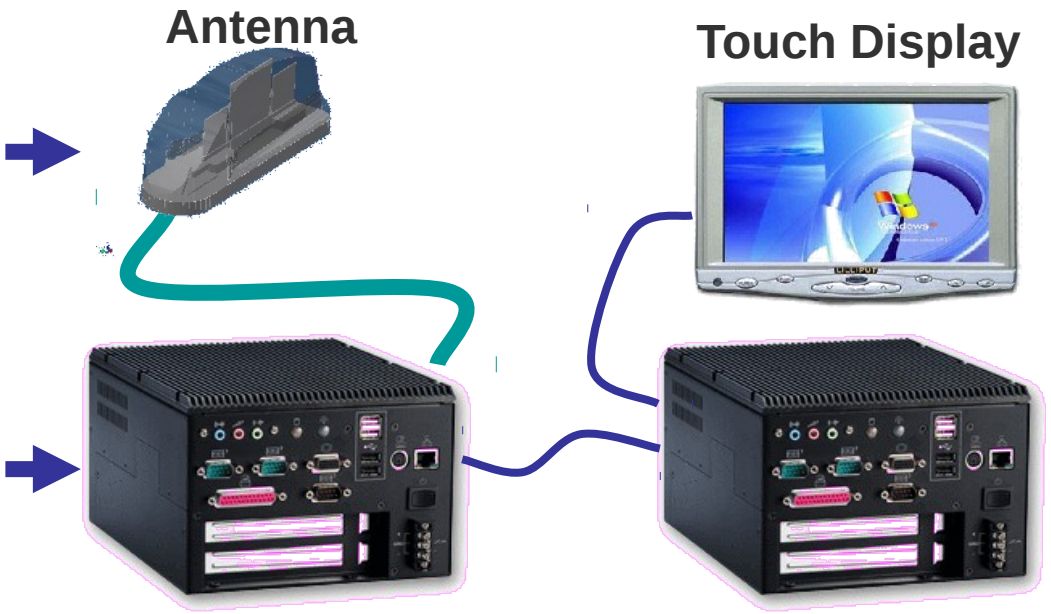
20ch GPS

OBD-II CAN Bus

CEN DSRC

2.5 / 5 GHz 802.11 radios modified for:
- Euro 802.11p
- DSRC RT sync
- GPS time sync

FPGA: PCI, Serial ports & softcore CPU
Realtime GPS & DSRC sync, sensor fusion/timestamp



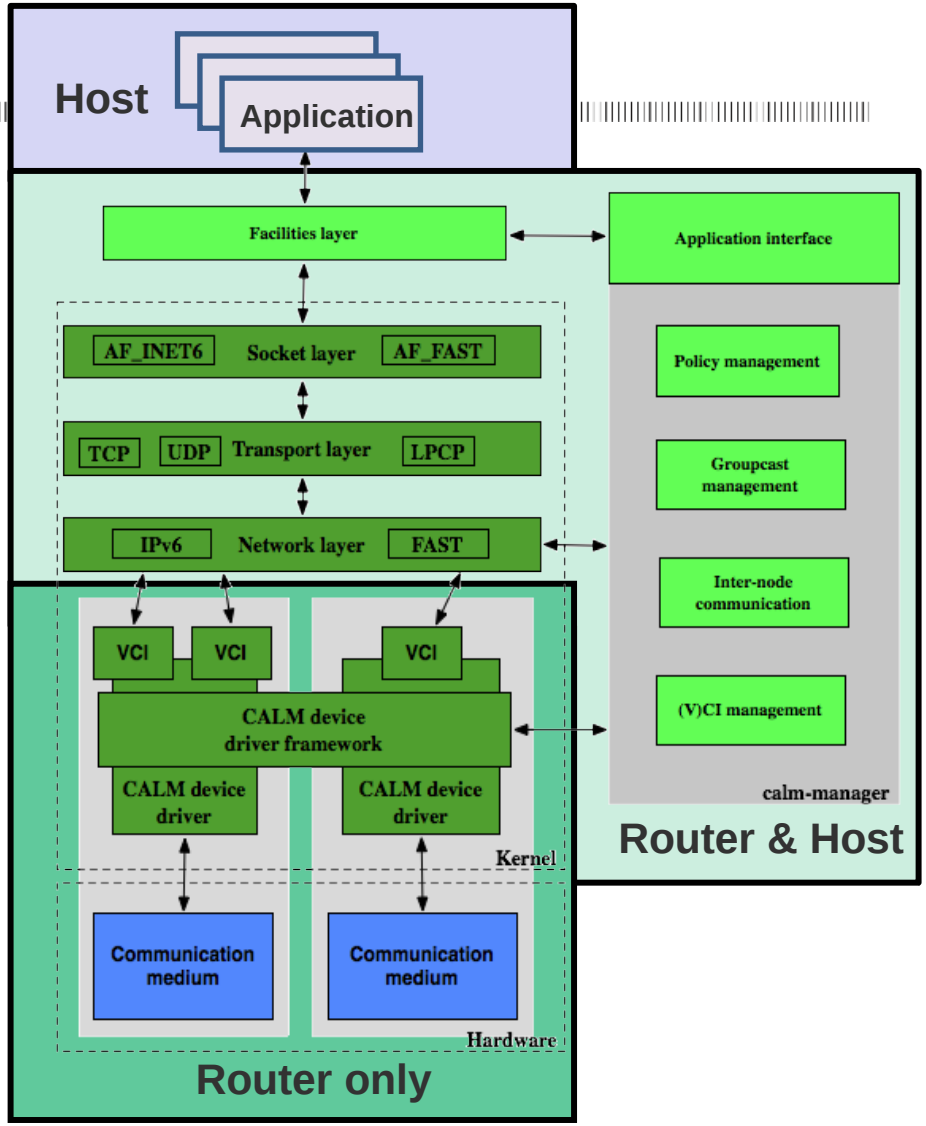
Roadside is SYMMETRICAL (except antennas)

Key Activities

- CVIS (Cooperative Vehicle-Infrastructure System)
  - EC-funded FP6 Integrated Project (Feb2006-Jun2010)
  - Continuous and transparent communication using different media
  - 60 partners from 12 countries, €41mill budget, 6 test sites
- CALM (Communication Access for Land Mobiles)
  - ISO TC 204 WG 16
  - Set of standards (20) for wireless communication targeting ITS services and applications
  - Air interface protocols and management procedures
- SMARTFREIGHT
  - Smart Freight Transport in Urban Areas
  - EC-funded FP7 STREP (Jan2008-Dec2010)
  - 10 partners from 7 countries, €3mill budget

CALM implementation from CVIS

- Implemented communication media
  - 2G/3G, CALM M5 (amend 802.11p), Infrared, 802.11a/b/g, (CEN DSRC)
- Provide seamless wireless connection
- Actual medium used depend on situation
- Uses IPv6/NEMO
- Implemented on GNU/Linux



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- **Intelligent Cargo Enhancements**
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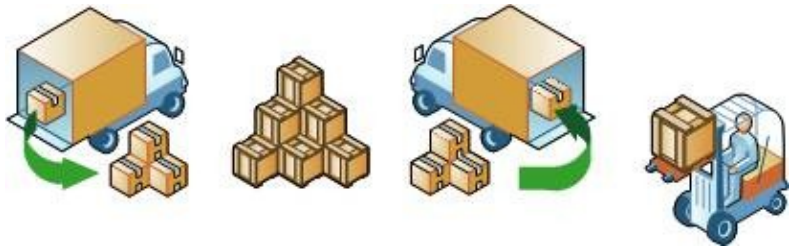
Intelligent cargo objectives

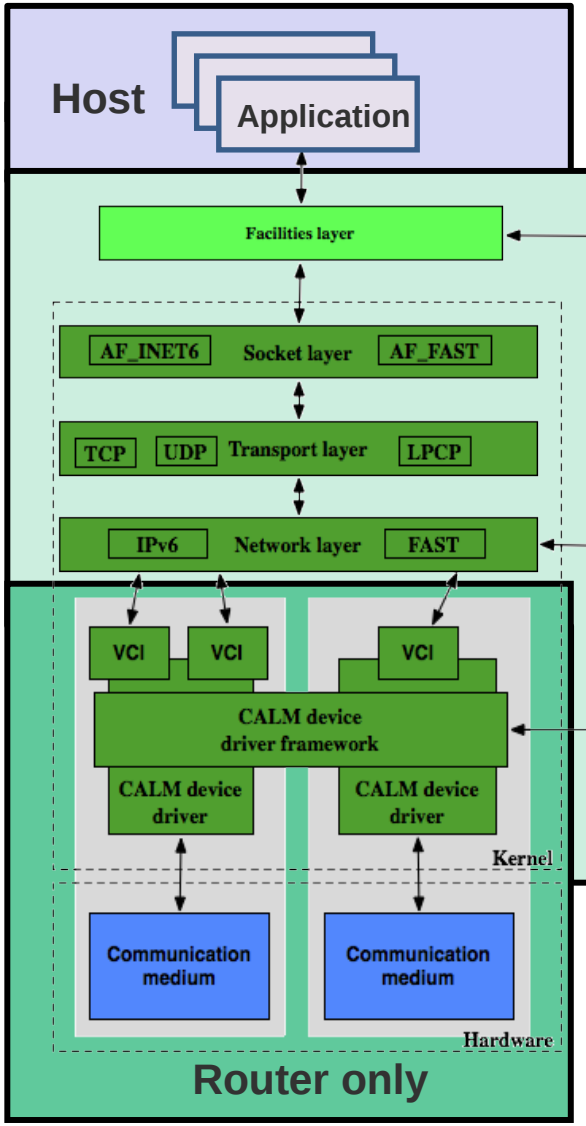
- improve logistic performance
  - tracking
  - anomaly detection
  - analysis
  - prediction
  - documentation of quality
  - customs
- secure transport chains
- make transport more environment friendly
- support modal shift and door-to-door inter-modal services



Ref: http://www.euridice-project.eu/

CALM enhancements for Intelligent Cargo

- Enable the use of CEN DSRC as a CALM communication media
- Implementation of CALM MAIL
  - ISO 24103 – Intelligent Transport Systems — Communication Access for Land Mobiles (CALM) — Media Adapted Interface Layer (MAIL)
- Cargo to Vehicle communication
- New intelligent on-cargo hardware

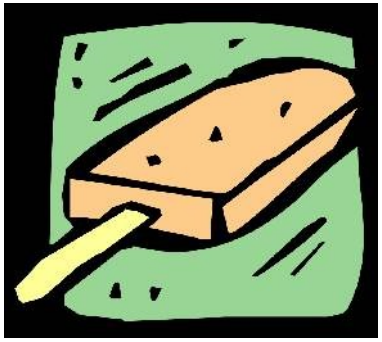


SMARTFREIGHT On-Cargo Unit

- Based on CVIS positioning platform
- Feature set
  - Acceleration Sensors (3 axis)
  - Temperature Sensor
  - FPGA for communication R&D
  - Positioning Sensors
    - Magnetic Compass (3 axis)
    - Gyroscope
    - u-Blox GPS receiver (compatible with Galileo)
  - Battery operation
- Current On-Cargo Unit is a research tool
  - It could be made as small as 40 x 60 mm
  - Price comparable with tolling tags (≈30 €)

Environmental detection and logging

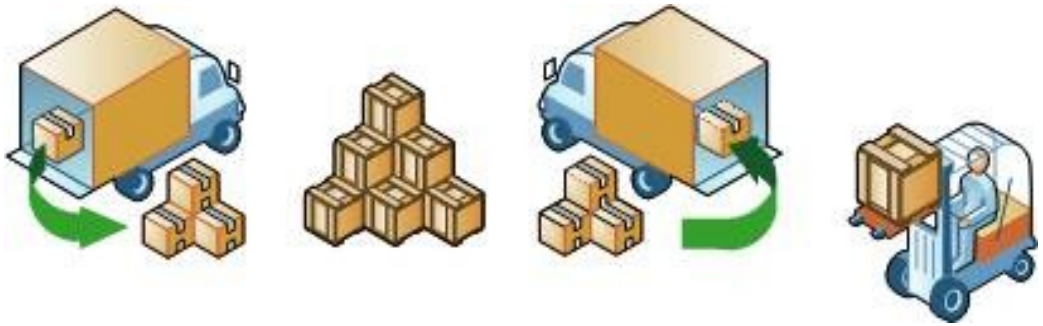
- Tilt Detection – “This side up”
- Shock and impact
  - Detects peeks on accelerometer
- Temperature
  - Detects temperature peeks over and under preset limits
- Events are logged to non-volatile memory on sensor board
  - Stores date/time
  - Communicates with vehicle when in radio range



Intelligent Cargo Tracking in Vehicle

- Challenge
  - Assess location of goods relative to vehicle
  - Include all good in vehicle
  - Exclude goods outside vehicle
- Mitigation
  - Directional antenna
  - Measure phase, signal strength and quality
  - While loading, signal parameters will have high dynamic

CALM MAIL



Result – Vehicle knows its Goods

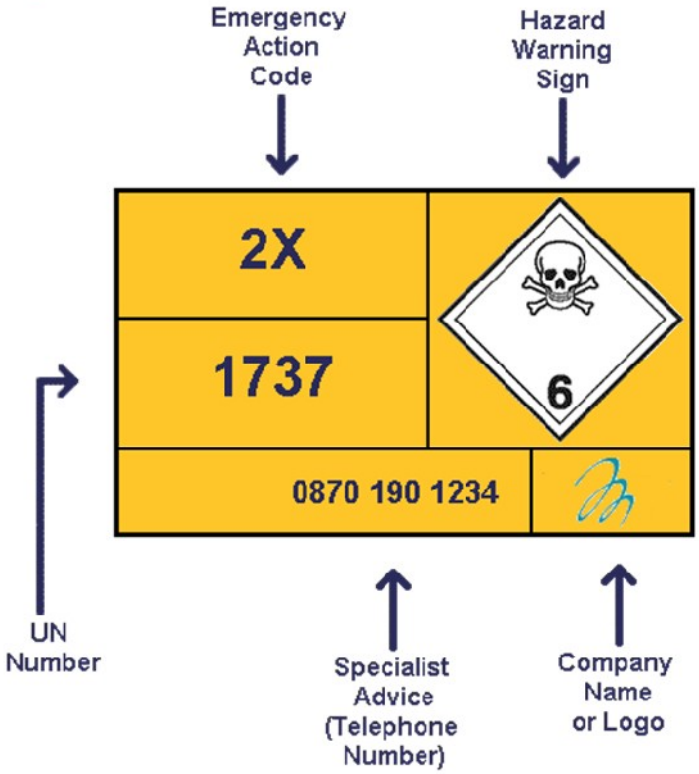
Intelligent Cargo Enhancements

- List of Goods
  - Environmental conditions (from sensors)
  - Goods manifest (from central systems)

And … Vehicle knows about itself

Intelligent Cargo Enhancements

- List of Goods
  - Physical properties – Dynamically adjusted for goods
  - Emissions
  - Dangerous Goods Codes



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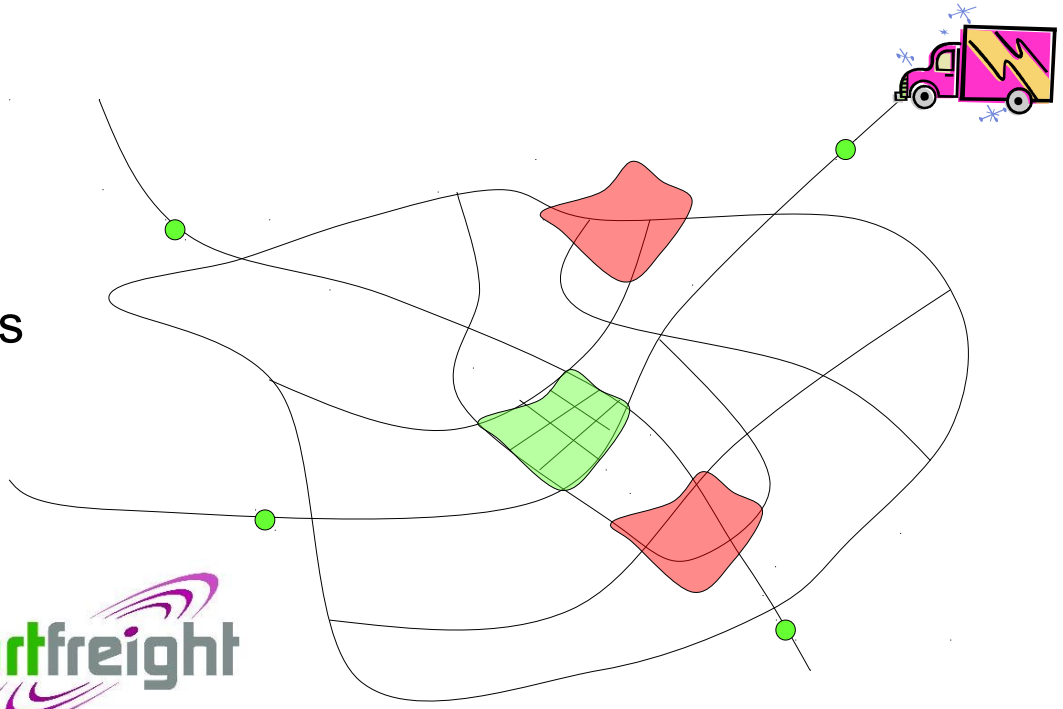
New information enables new applications

New ITS Applications and Services

- Access control
  - Green zones
  - Enforcement
- Dangerous goods
  - policy enforcement – allowed areas
  - tracking
  - accident handling
- Resource booking (loading/unloading/parking)
- Eco-driving support including adaptive traffic signals
- Environmental based truck tolling
- Cooperative Weigh-in-Motion

Access Control

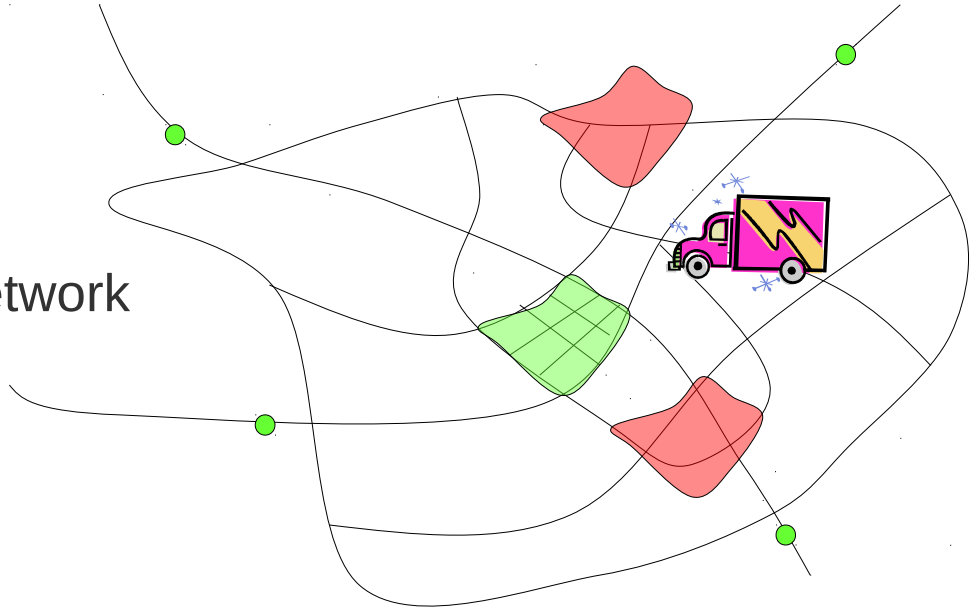
- Access Policy is defined on a central server by the Traffic Management Centre (TMC)
- Zones with properties
  - Geographical area
- Access Limitations
  - Vehicle physical properties
  - Vehicle class
  - Emissions
  - Dangerous Goods



smartfreight

Access Control – Implementation

- Each approach to a city is controlled by Road Side Equipment (RSE)
- Vehicles will get the applications
- Vehicles will get the city policy
- As the vehicle roam on the road network
  - It will assess if it is approaching a controlled zone
  - Evaluate the access policy based on current vehicle properties and goods
- Information is provided to driver
- Violations are reported to central system for statistical purpo and possible enforcement



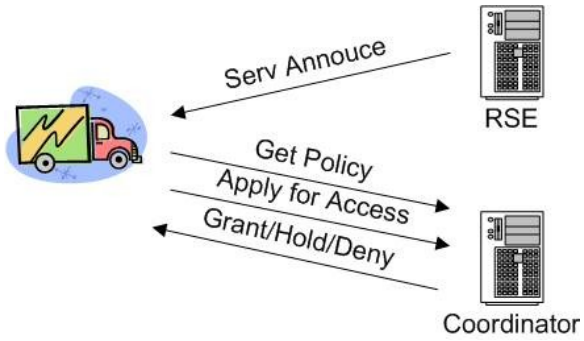
Dangerous Goods in Tunnels

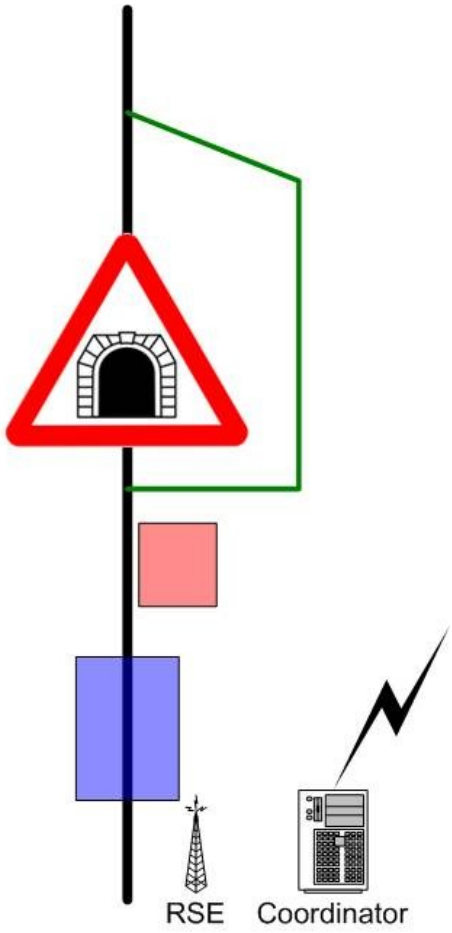
New ITS Applications and Services

- A need to limit and track dangerous goods in tunnels
- Accident handling – What is the content of the tunnel in case of accidents?

Dangerous Goods in Tunnels – Implementation

- Tunnel Policy
  - Vehicle properties
  - Cargo class and amount
- Tunnel Coordinator
  - Distributed approach
  - Manages tunnel queue
  - Knows DG contents of tunnel
- Events
  - Vehicle receives tunnel policy
  - Negotiates with Coordinator in approach (blue)
  - Holding Area (red)
  - Bypass road (green)

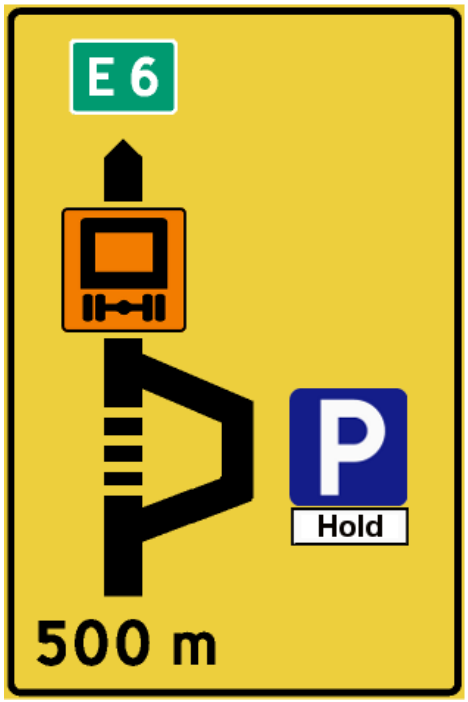




Dangerous Goods in Tunnels – Implementation

New ITS Applications and Services

HOLD

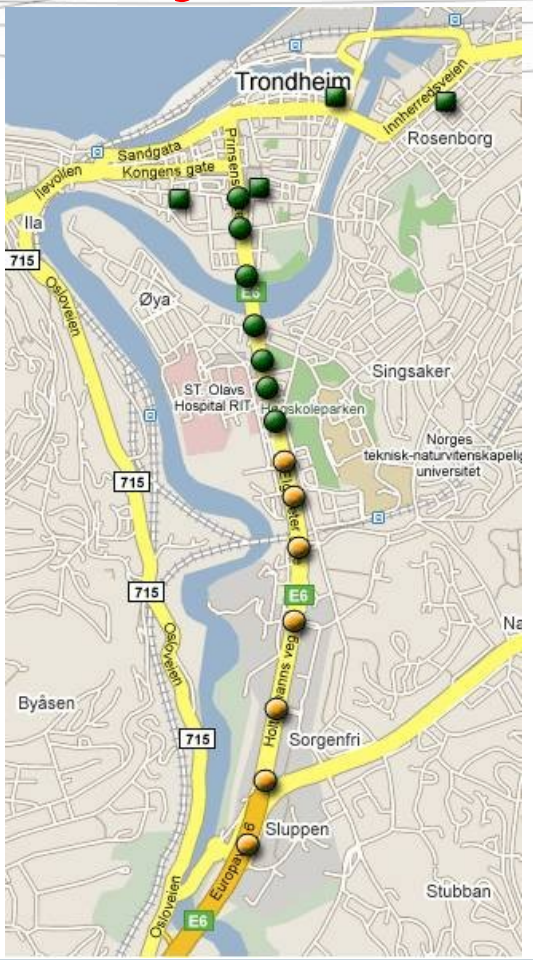


DENIED
USE BYPASS

PROCEED

Test Site Norway

- Primary Norwegian site for testing and validation of new ITS technology, applications and services
- Includes the main road network in the city of Trondheim
- Instrumented roads with wireless communication technologies based on CALM, including support for 5.9 GHz vehicle-to-roadside communication.
- Instrumented vehicles



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SINTEF

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Conclusions

- The intelligent cargo concepts has been integrated with the concept of Cooperative ITS
- Enables more efficient, environmental friendly and safe freight transport
- But this requires an agreed architecture and standardised interfaces
  - How do we move away from, and avoid company, internal proprietary solutions?


Thanks for your attention…
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IN ROAD USER CHARGING AND TRAFFIC SURVEILLANCE