DRIVE C2X

Accelerate cooperative mobility

ETSI G5 technology: the European approach

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SEVENTH FRAMEWORK PROGRAMME

Outlines

- Background
- Motivations
- Technical insignts
- Conclusion

project start date: 01.01.2011 | end date: 30.06.2014

Background

- C-ITS is main candidate for improving road safety, traffic efficiency and sustainable applications.
- Standardization is essential for C-ITS.
- Large scale field operational test is one important step leading towards C-ITS deployment.
- I2V and V2V applications will help to stimulate the penetration rate.
- New stakeholders in the value chain.

Motivation - why an European Approach for C-ITS

- Communication Interoperability:
  - **Standardized communication protocol** is the starting point.
- Application requirements:
  - Stakeholders such as C2C-CC selected a set of day 1 V2V applications.
  - Amsterdam Group selected a set of I2V applications.
  - Added value services for market introduction.
- Modular architecture:
  - Support multiple applications, multiple technologies, and multiple product development strategy.
- System performance/security:
  - Common minimum performance requirements and standard profiling.
  - Security and PKI infrastructure
- Compliance assessment:
  - Standard conformance test, system compliance assessment.
- …

Motivation: allocated spectrum

5,875 – 5,905 (ITSG5A) spectrum has been allocated in EU for road safety and traffic efficiency application. However, C-ITS may use other technologies such as cellular, Wi-Fi.

Source: ETSI

ITS G5 technologies:

- Quick media access → *low latency broadcast/unicast communication*
- Ad hoc communication → *no infrastructure requirements*
- Allocated spectrum for ITS → *communication reliability*
- 200-800m communication range → *extended view for vehicle compared to RADAR, LIDAR*

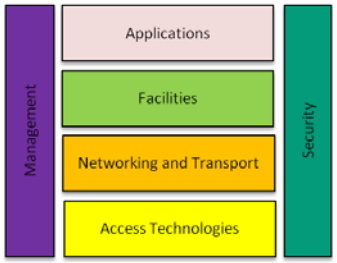
ITS G5 is under standardization in ETSI.

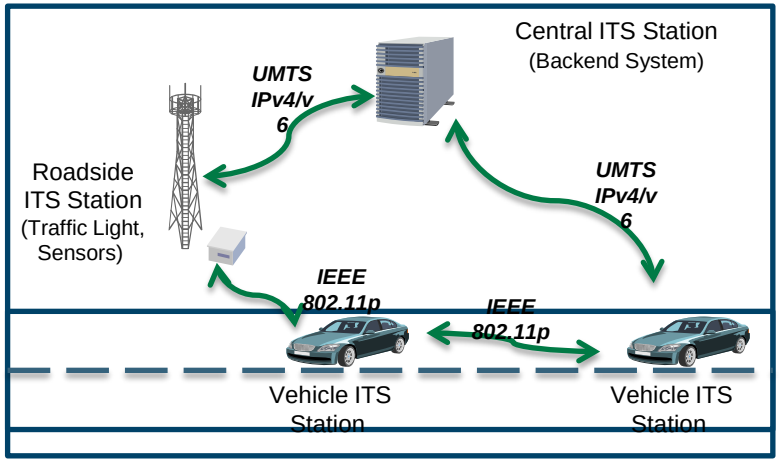
ITS G5 is considered as main candidate for road safety applications by European C2C-CC

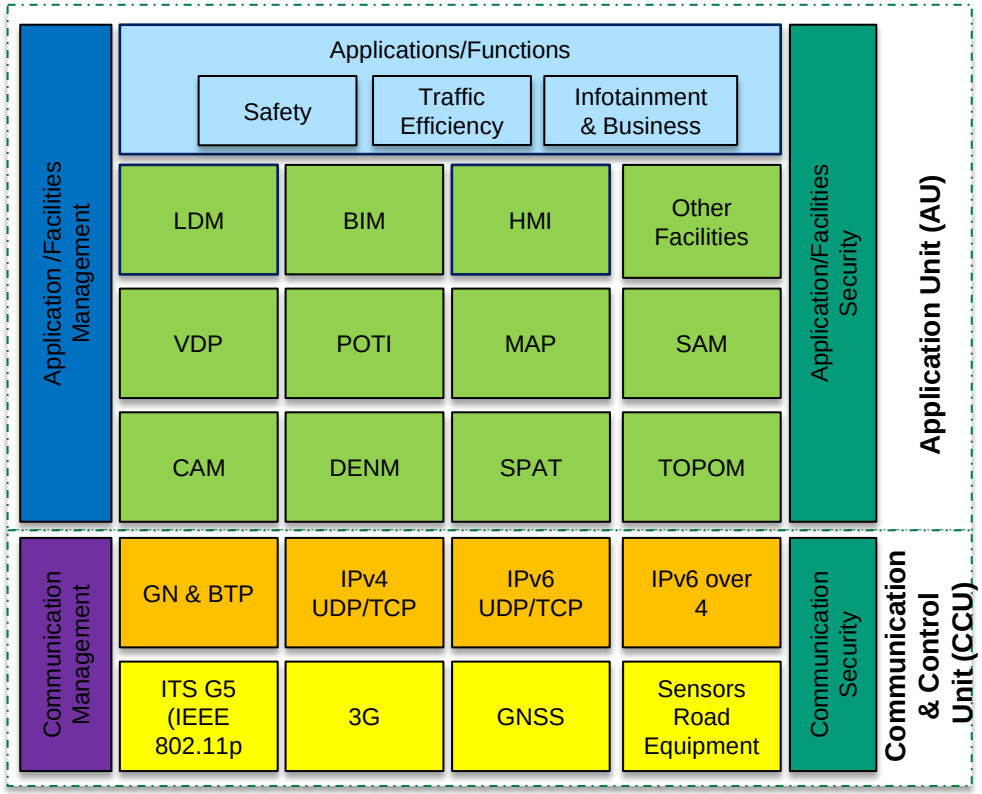
C2C-CC: car to car communication consortium

DRIVE C2X System architecture

- Implementation of standardized components.
- SW Reference implementation of components, ported to different hardware platforms
- Integrated and tested in laboratory environment, then integrated into vehicles and roadside installations and verified





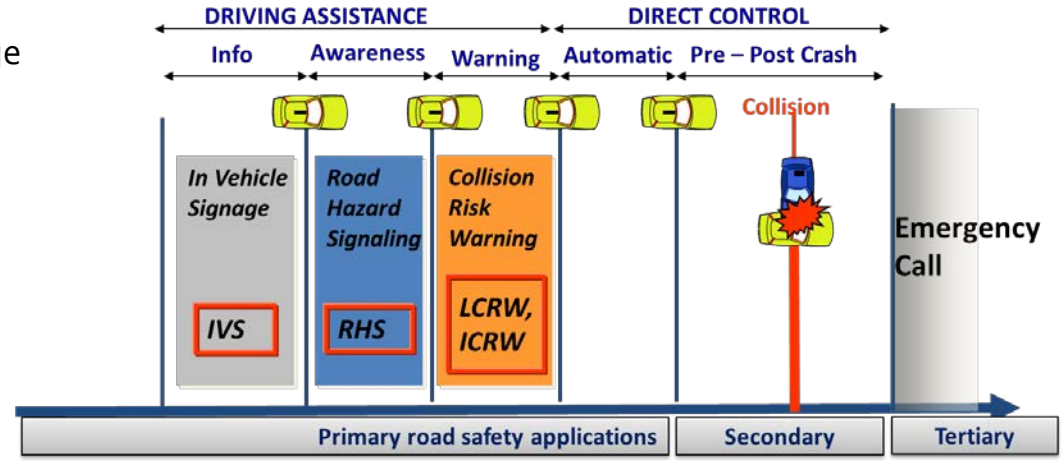


Applications

- "Information and awareness" application :
  - Road hazard signaling applications based on G5.
  - Traffic efficiency applications based on G5 or existing technologies.

- Application requirements:
  - Mainly focused on transmitting vehicle
    - When and how to transmit information to others.
    - What information to be transmitted.
    - Requirements on communication and security.

- Technology agnostic, but application requirements may result in specific choice of technologies:
  - Reliability
  - Communication coverage
  - Latency
  - Interoperability

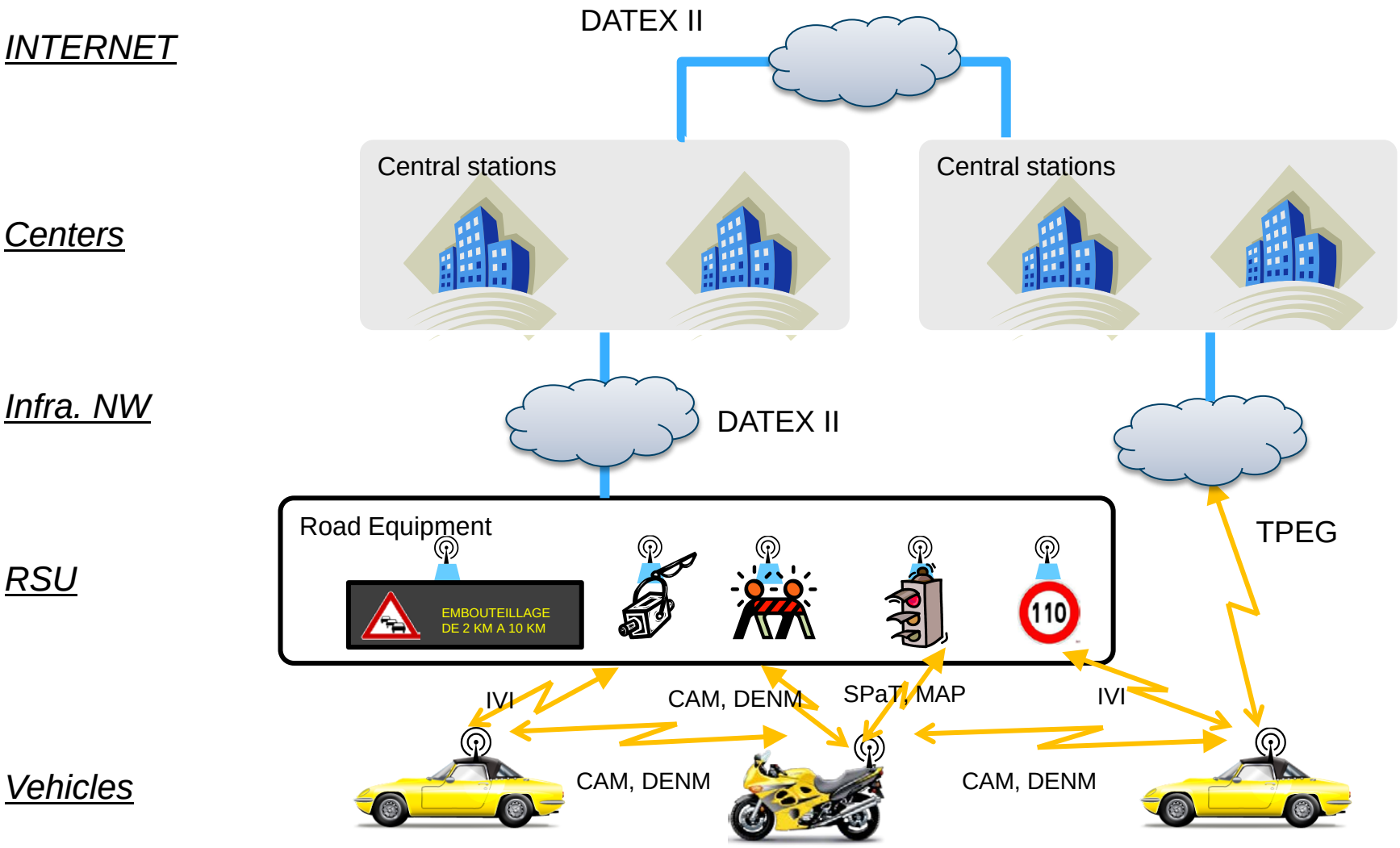


Source: ETSI

Networking and transport layer

- Basic transport protocol: BTP in ITS ad hoc network
  - BTP-A for interactive packet transport; and
  - BTP-B for non-interactive packet transport (used for CAM, DENM).
- GeoNetworking:
  - Packet dissemination with geographical position
  - Multi addressing mode: geobroadcast, geounist, geoanycast.
  - Multihop support:
    - Basic greedy forwarding and advanced forwarding scheme
    - Forwarding node selection based on distance and time factor.
    - Store and forward for low density network.
  - Location service: beaconing, location service and location table.
  - Media dependent functionalities based on estimated data traffic volume:
    - Interval control, range control.
- ENs are close to finalization.

Data exchanges protocols: overview



Facilities layer: Cooperative Awareness

- Facilities layer core message, independent to application
  - High frequency update of vehicle position and status.
  - Possibility for further extension (e.g. RSU).
- 1-10Hz transmission
  - Generation rules based on vehicle mobility (speed, distance, acceleration, drive heading change)
  - Consider the potential packet lost.
  - Interaction with congestion control mechanism
- Support multiple vehicle types, including public transport, safety car, truck with dangerous goods.
- Strong collaboration between ETSI and SAE BSM.
- Compact message size to adapt to ITS G5 transmission.
- EN document approved by ETSI, public enquiry is about to start.

Facilities layer: Decentralized Environmental notification

- Event driven message, always triggered by application
  - Event position, event type, event duration, event related information.
- 1-10Hz transmission, controlled by application.
- Unique event identification by combining station ID and a sequence number.
- Protocol for event information management:
  - New event, event information update, event cancellation, event termination.
  - Optional keep alive functionality.
- Location referencing: map format independent location referencing.
  - Vehicle path history
  - List of waypoints leading towards event position based on map data base.
- Harmonization of event types with TPEG TEC specifications (telematics service protocol)
- EN approved by ETSI, public enquiry is about to start.

Security and management

Security:

- Message signing and verification at geoNetworking stack
  - End to end security, hop by hop verification.
- Cross layer pseudo identity management
- TS 103 097: Security header and certificate formats
  - Based on IEEE 1609.2 with C2C-CC contributions.
- Public Key Infrastructure PKI:
  - Long term and short term certificates are distributed by PKI.
  - Updates of pseudonym certificates: protocol and procedure.

Management:

- Decentralized Congestion Control:
  - Dynamic assignment of DCC profile for message transmission based on channel congestion level:
    - Transmission power control, transmission rate control, transmission interval control, channel switching, traffic class

System requirements: profile standards

- Profile standards by C2C-CC:
  - System requirements for selected set of applications (day 1 applications)
  - Basic system setting.
  - Selection of standard features to ensure interoperability.
  - Minimum system requirements:
    - Communication performance.
    - Message data quality: in vehicle data, position and time.
    - Message transmission: DENM triggering conditions.
  - Security and PKI
- Upward compatibility.
- Compliance assessment.

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Testing

Testing:

- Interoperability testing
- System performance compliance assessment
- Standardized test specifications are required.

Testing supports SW & system integration and enables interoperability

- Testing individual components before integration
- Testing reference system implementations (ITS stations) under real conditions incl infrastructure:
  - System test site in Helmond to hold test events (integration and interop tests)
  - Test events at functional test sites planned

DRIVE C2X linked to ERTICO/ETSI Plugtests events

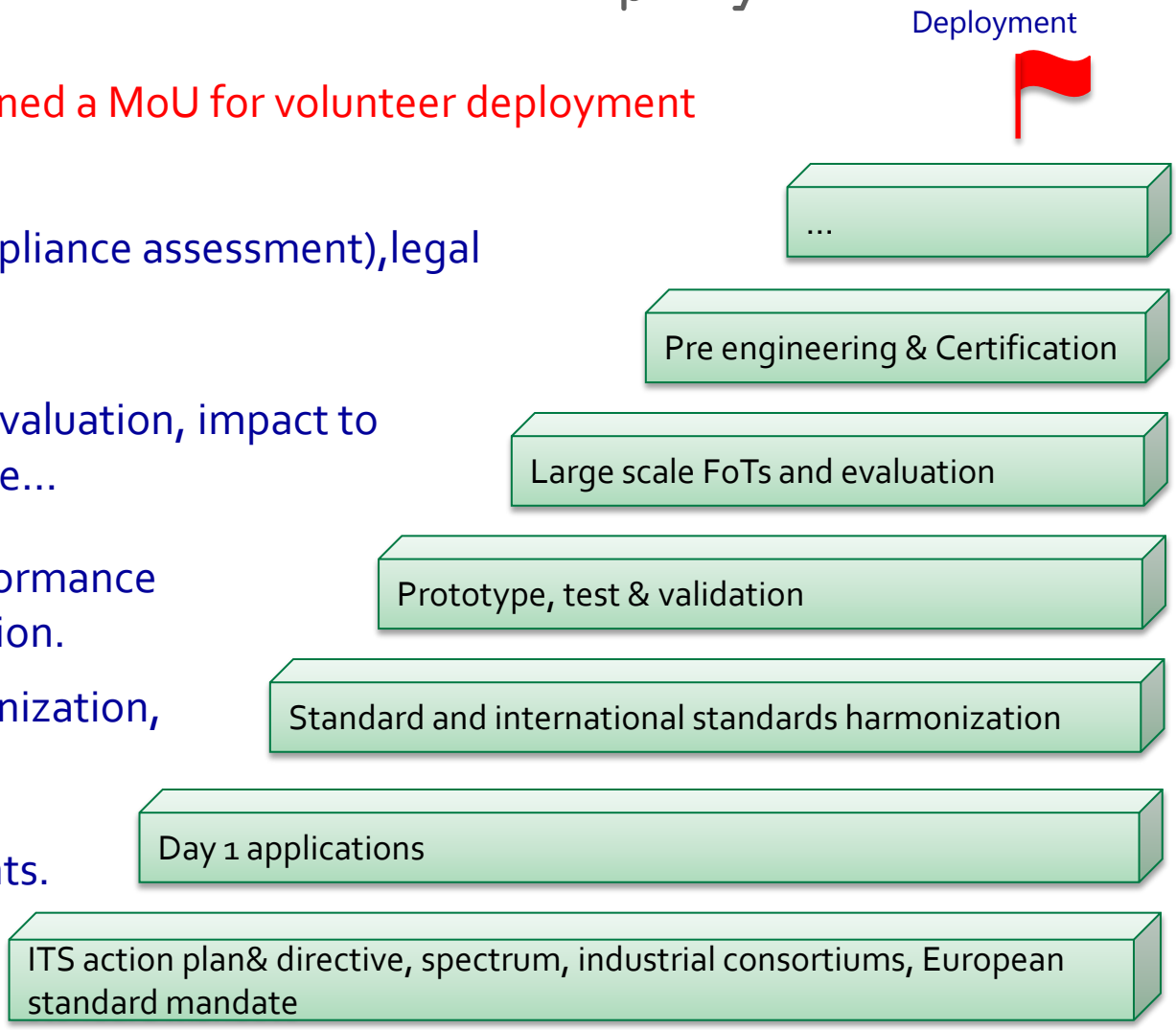
- 1st event - 14.to 18. November 2011 at TNO in Helmond
- 2nd event - 11 to 15 June 2012 at IFSTTAR in Versailles

Supported by

Conclusion: Pave the road for deployment

Car makers in C2C-CC have signed a MoU for volunteer deployment from 2015 on.

- Security, certification (compliance assessment),legal framework.
- Application effectiveness evaluation, impact to real traffic , user acceptance…
- Standard compliance, performance validation, system integration.
- Interoperability and harmonization, system requirements
- Minimum app. requirements.
- Strategic support.



Thank you

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