IPv6 in the ITS Station Reference Architecture

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Cooperative ITS: Vision

- **Communicating vehicle**
- **Communication scenarios diversity** (V2V, V2I, I2V, Internet)
- **Communications diversity** (WiFi, DSRC, 3G, Satellite, ...)
- **Application diversity** (road safety, road efficiency, comfort/mobility)
Type 1: **Broadcast** communications between vehicles & roadside infrastructure (V2V / V2R) in geographic area

- Vehicular adhoc networks (VANET): WiFi 802.11p (ITS specific)
- Communications well adapted for dense traffic areas
- ITS application type: **road safety** (immediate danger notification)
- ITS services with strong time contraints (**time critical**)

Cooperative ITS: Communications 1/2
Cooperative ITS: Communications 2/2

• Type 2: **Point-to-Point** communications between vehicle & control centre (V2C)
  • 3G/HSPA/LTE & WiFi 802.11b/g/p networks (non ITS-specific access network)
  • Communications well adapted for **sparse traffic** areas
  • ITS application types: **traffic efficiency, mobility & comfort** (EV battery charging, fleet management, Internet)
• **Non time critical** ITS services
Cooperative ITS: Scenarios
Cooperative ITS: ITS Station Architecture

- EC ITS Directive & Standardization Mandate M/453: 65 standards to be developed by ETSI/CEN (2009-2012)

- ETSI/ISO Reference Architecture supporting a diversity of:
  - ITS stations (vehicle, roadside, central, personal)
  - media (802.11p, 2G/3G, 802.11n)
  - applications (road safety, traffic efficiency, mobility/comfort)
  - Communication protocols: Internet Protocol (IPv6) and non-IP (GeoNetworking)
Cooperative ITS: IPv6 convergence
Cooperative ITS: IPv6 Convergence

- IP is required in Cooperative ITS standards
  - For traffic efficiency / comfort mobility / non time-critical safety applications

- IPv4 cannot meet ITS requirements
  - 1200 millions vehicles by 2030 at current trend
  - Only $2^{32} = 4\,294\,967\,296$ addresses for all usages
  - Currently being replaced by new IP version: IPv6

- IPv6 provides:
  - IPv6 $2^{128} = 3\,911\,873\,538\,269\,506\,102$ per $m^2$
  - New features required for scalable ITS deployment
  - Natural convergence (ITS sectors and non-ITS sectors)
Cooperative ITS: IPv6 Convergence

• IPv6 enables convergence / interoperability
  • Between all ITS sectors & stakeholders for all use cases
    – CooperativeMobility / EcoMobility / InfoMobility / SafeMobility
      • EV: Electric Vehicle / ElectroMobility
      • Multi-modal transport / all modes of transport (inc. pedestrians)
      • Fret & Freight
      • Fleet management
  • With everything that needs to exchange information with ITS
    • eHealth / eHouse / Green IT
    • Future of the Internet / Internet of Things
ITS Station: IPv6 Networking

- IPv6 + mobility extensions:
  - SLAAC
  - NEMO
  - MCoA

SAP with other layers:
- MN-SAP / SN-SAP
- IN-SAP / NF-SAP
ITS Station: IPv6 Networking Standards

- ITS Station Reference Architecture (ISO/ETSI)
  - ETSI TR 101 555 *Analysis of IPv6 for networking* ongoing
  - ISO 21210 “IPv6 Networking” new version to be published 2012
    - IPv6 networking suite of protocols including mobility features (NEMO)
    - IPv6 support over ITS-G5 media with GeoNetworking capabilities
  - ISO 16788 *IPv6 Networking Security* to be sent to CD ballot 2012/04
  - ISO 16789 *IPv6 Networking Optimisation* to be sent to CD ballot 2012/04
ITS Station: **IPv6 Stack - ITSSv6**

- **IPv6 ITS Station Stack** for Cooperative ITS FOTs
  - FP7 STREP – Grant n° 270519
  - Call 2009-6: ICT for Mobility, Environmental Sustainability and Energy Efficiency
  - Duration: 36 months (Feb. 2011 – Jan. 2014)
  - Budget / EC funding: 2.5 M€ / 1.8 M€ - 218 PMs
  - Partners: INRIA, Institut Telecom, Univesidad de Murcia, lesswire, SZTAKI, BlueTechnix, IPTE
  - http://www.itssv6.eu: public material will be available from March 2012

- **Objective:** Provide C-ITS FOTs with a robust, performant and secure implementation of ISO/ETSI ITS station IPv6 networking

- ITSSv6 builds the IPv6 ITS station stack on existing standards from ETSI, ISO & IETF and IPv6 software available from CVIS & GeoNet projects.
IPv6 in Cooperative ITS: Summary

- Deployment of cooperative ITS based on the ISO/ETSI ITS station reference architecture
- ISO/ETSI standards
  - Are only referring to IPv6 (not IPv4)
  - Are specifying the use of IPv6 for Cooperative ITS
- IPv6 is essential for
  - Communications between ITS stations
  - Maintaining information flow over any available media (11p, 11n, cellular, satellite, digital broadcast, ...)
  - Interoperability with various ITS & non-ITS sectors
Thank you for your attention!

FP7 ITSSv6
IPv6 ITS Station Stack for Cooperative ITS FOTs
http://www.itsssv6.eu

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Additional slides for more information on the ISO/ETSI ITS Station Types and Nodes
ITS Stations: Types
ITS Stations: Types

• All ITS stations (vehicles, roadside, central, …) possibly made of several networked components (nodes)
  • Router
    – (OBU/RSU) managing communications
  • Host(s)
    – Application Units (AU) running ITS applications
    – Hand-held devices running multimedia applications
    – Gateway between IP and CAN and proprietary networks
    – Comfort sensors
ITS Station: ITS station-internal network
Vehicle ITS Station

- **Hosts** (application clients), **Mobile Router** and **Gateway**

- IPv6 necessary for all communications with the central ITS station and non time-critical safety applications with the roadside ITS station
Roadside ITS Station

- **Hosts** (application clients or servers), **Access Router, Border Router and Gateway**

- IPv6 necessary for communications with the vehicle ITS station and the central ITS station
Central ITS Station

- **Hosts** (application servers e.g. HA), **Border Router** and **Gateway**

- IPv6 necessary for communications directly with the vehicle
Additional slides for more information on the ISO/ETSI ITS Station Networking & Transport Layer
ITS Station: Networking & Transport

Communication architecture
- Allows both IP & non-IP communications

Non-IP
- V2V safety communications
- Proprietary communications

IPv6
- Non time-critical road safety
- Traffic efficiency
- Infotainment

IPv6 + mobility extensions:
- SLAAC
- NEMO
- MCoA
ITS Station: GeoNetworking

- GeoBroadcast
  - Packets are forwarded from the source to all the nodes located within the geographical area.
  - *Geo-flooding mechanism*
ITS Station: IPv6 GeoNetworking