



Communications in Cooperative ITS

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Cooperative ITS: Vision

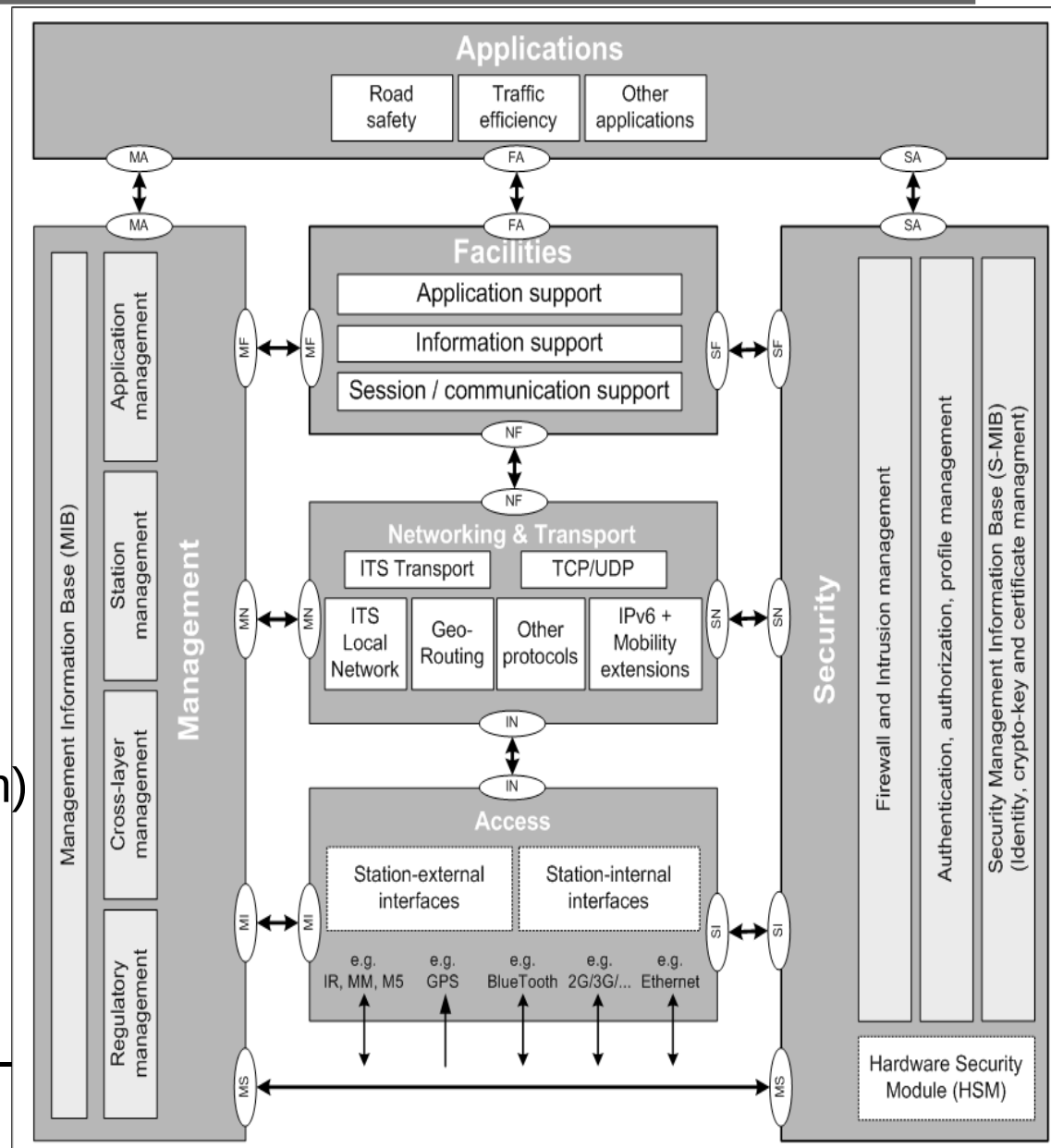
- **Communicating** vehicle

- **Communication scenarios diversity** (V2V, V2I, I2V, Internet)
- **Communications diversity** (WiFi, DSRC, 3G, Satellite, ...)
- **Application diversity** (road safety, road efficiency, comfort/mobility)



Cooperative ITS: Standards

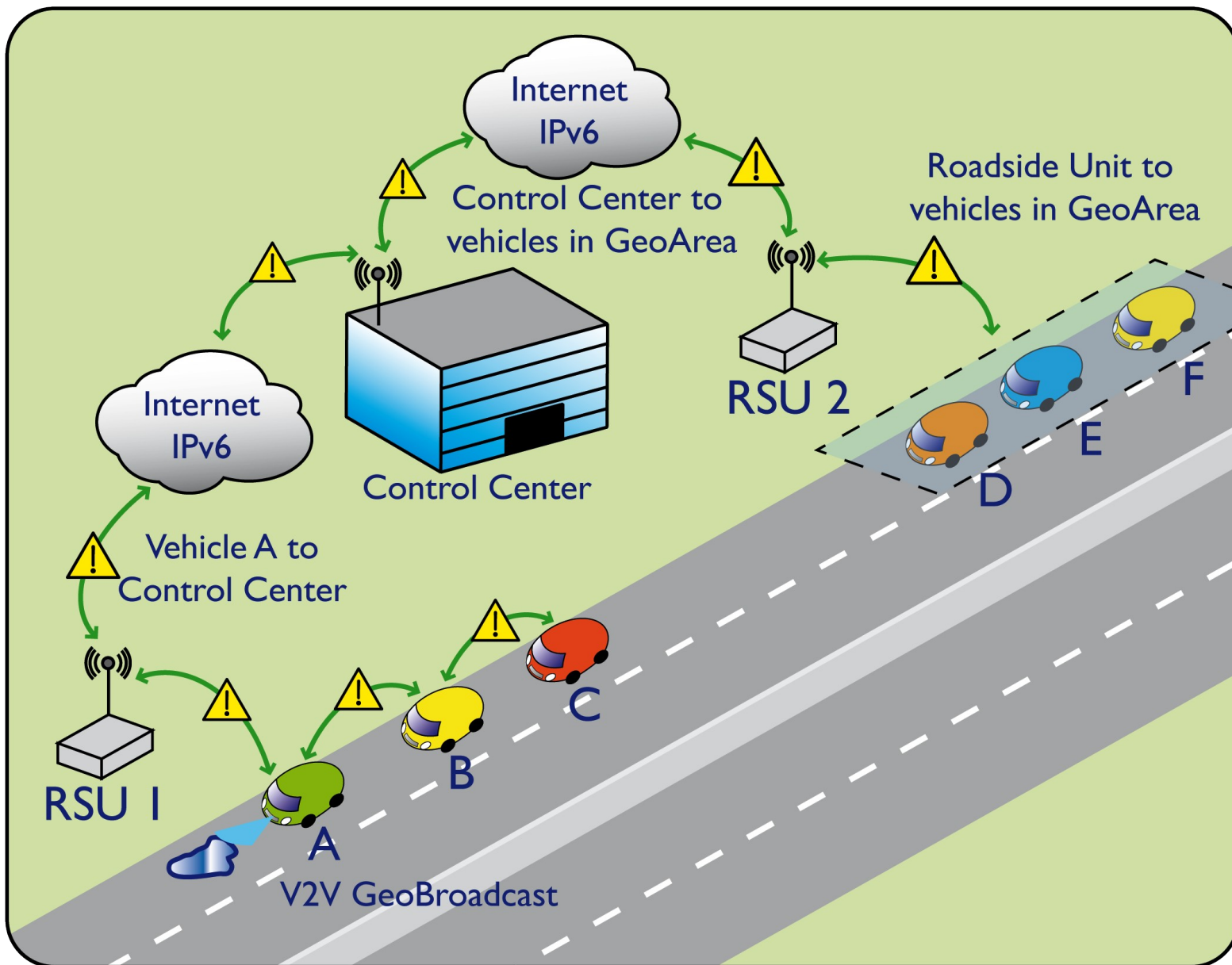
- EC ITS Directive & Standardization Mandate M/453: 65 standards to be developed by ETSI/CEN (2009-2012)
- ETSI/ISO Reference Architecture supporting a diversity of:
 - ITS stations (vehicle, roadside, central, personal)
 - media (802.11p, 2G/3G, 802.11n)
 - applications (road safety, traffic efficiency, mobility/comfort)
 - Communication protocols: Internet Protocol (IPv6) and non-IP (GeoNetworking)



- 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 constraints (**time critical**)

- 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

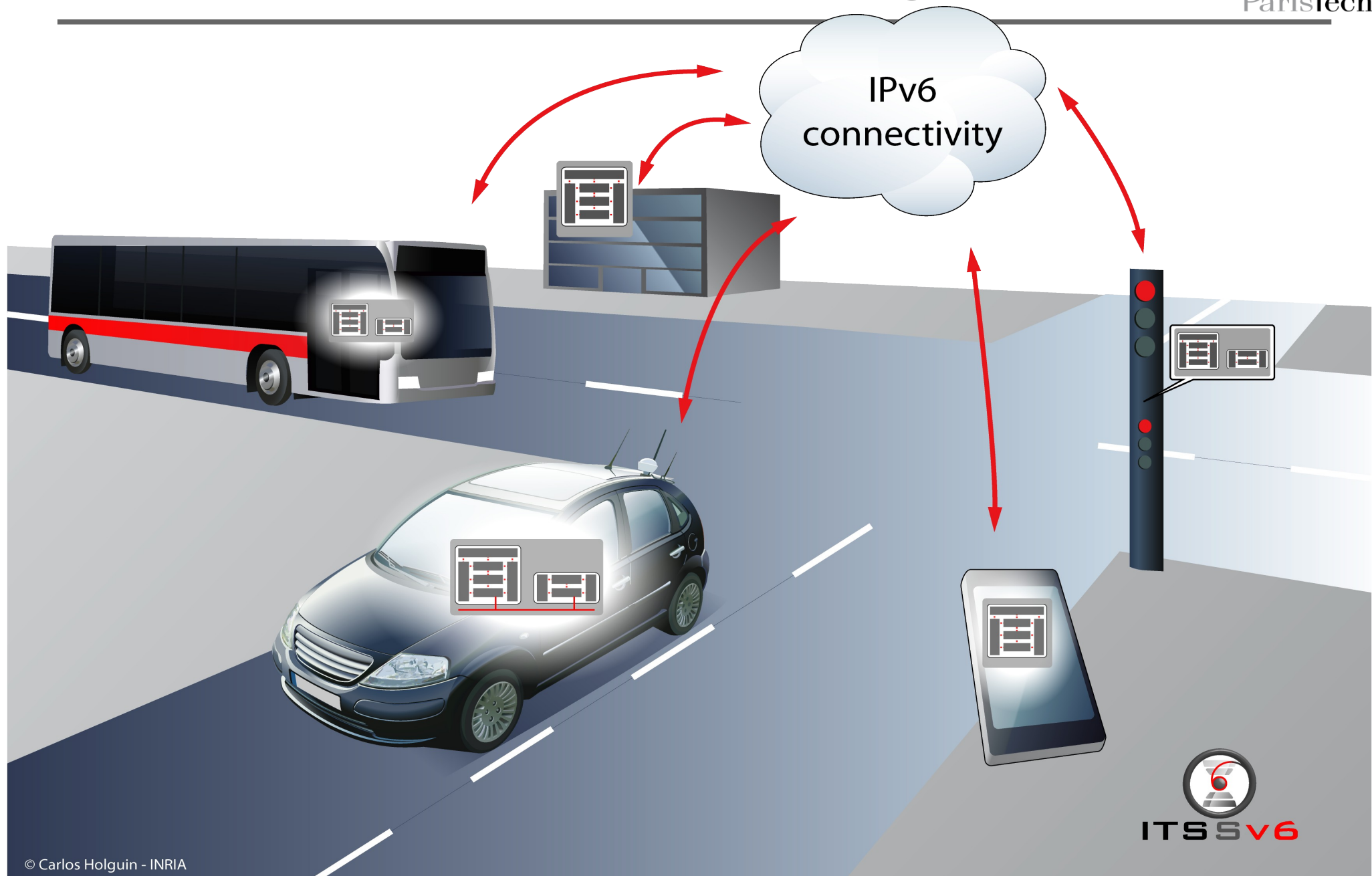


- All/Most **ITS stations** will once be connected to the Internet
- IP-based communications require **IPv6** *
 - IPv4 cannot meet ITS requirements
 - e.g. 1200 millions vehicles by 2030 at current trend
 - Only $2^{32} = 4\,294\,967\,296$ addresses for all usages
 - Only IPv6 is considered in Cooperative ITS standards
 - IPv6 $2^{128} = \text{up to } 3\,911\,873\,538\,269\,506\,102 \text{ @ / m}^2$
 - Provides new features required for scalable ITS deployment

*

- Avis du CGTI (Conseil Général des Technologies de l'Information): <http://www.cgti.org/avis/AVIS-2008-IPv6.pdf>
- Discours de Eric Besson sur le dossier IPv6: https://www.facebook.com/note.php?note_id=10150270529630940

Cooperative ITS: IPv6 convergence



- Deployment of cooperative ITS based on the ISO/ETSI ITS station reference architecture
- Cooperation between various access networks is essential
 - Broadcast multi-hop transmission using GeoNetworking over 802.11p
 - Point to point communications using IPv6 over all media (including 802.11p and cellular)
- IPv6 allows
 - Session continuity across networks
 - Cooperative ITS convergence

Thank you for your attention !

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