Experimental evaluation of an open source implementation of IPv6 GeoNetworking in VANETs

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Introduction

Cooperative Intelligent Transportation Systems

- Various scenarios: V2V[1], V2R[2], V2I[3] …

- Various media type: Wifi (IEEE802.11b/g/n), IEEE802.11p, 2G/3G, satellite …

- Various applications: Road safety, Traffic efficiency, Infortainment
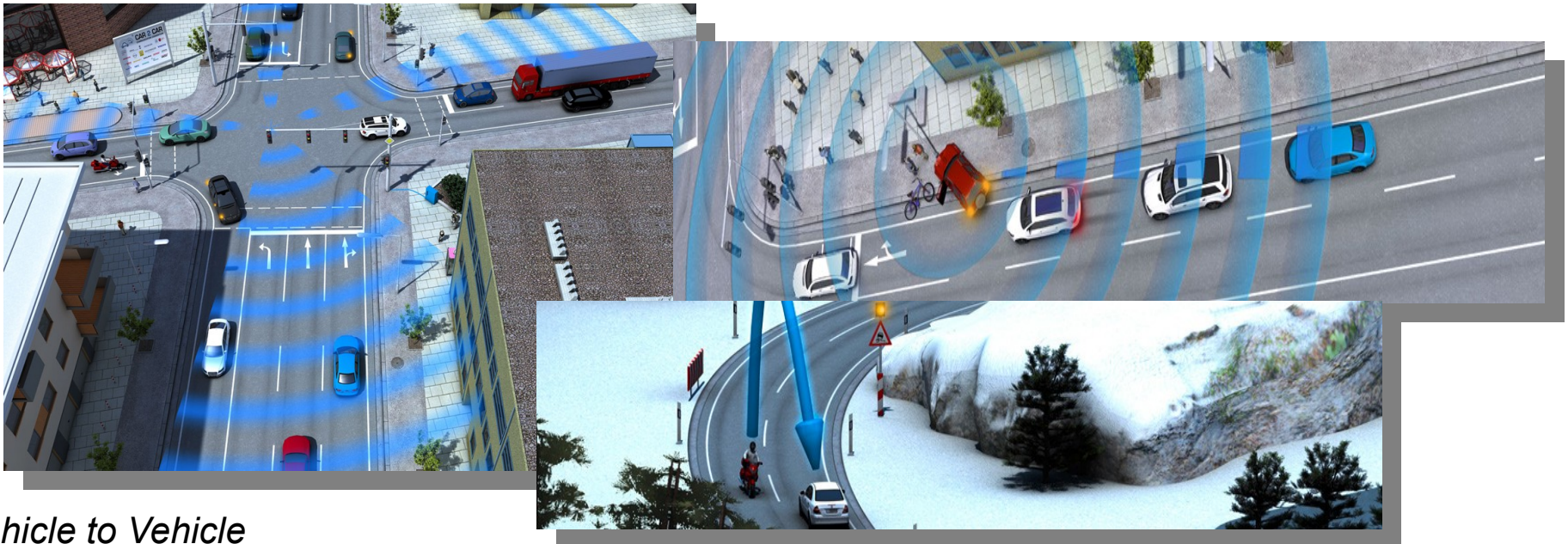
[1] *Vehicle to Vehicle*
[2] *Vehicle to Roadside*
[3] *Vehicle to Internet*

Inría
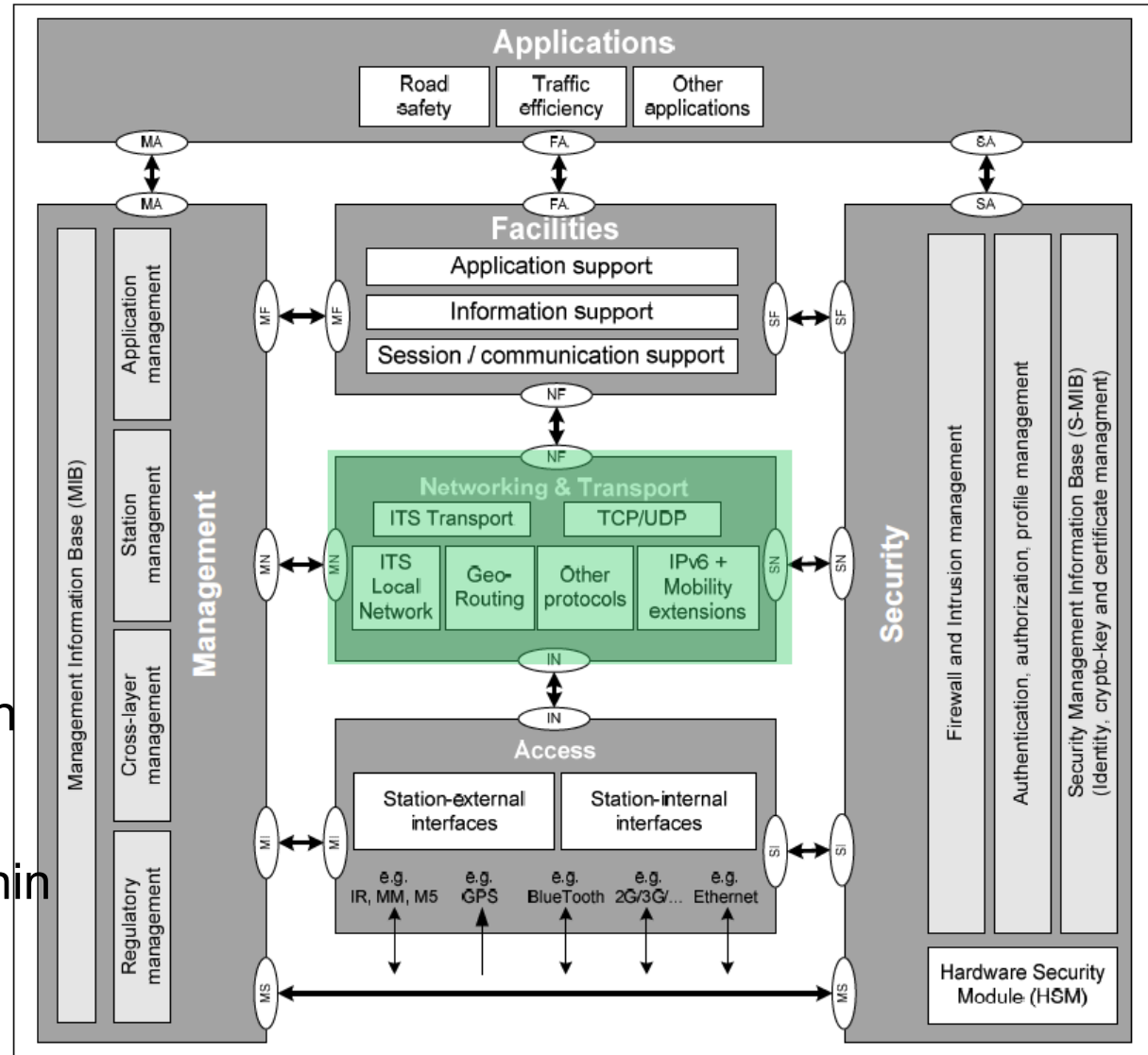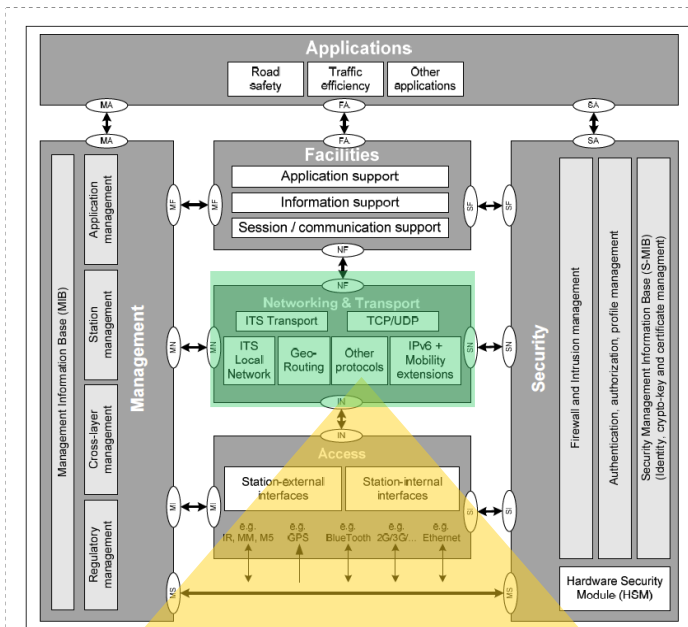INVENTEURS DU MONDE NUMÉRIQUE

Introduction
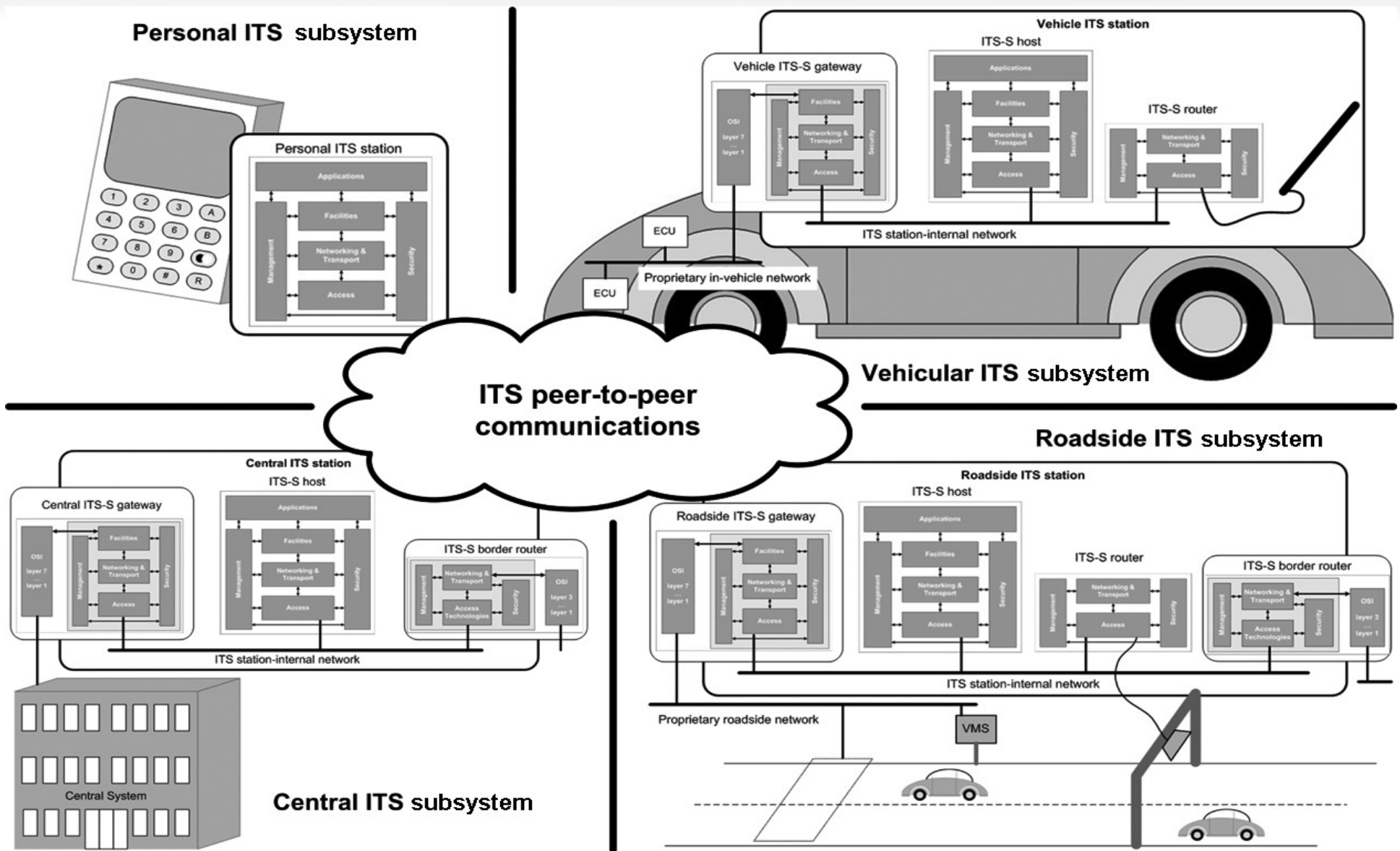
The ITS Station Reference Architecture

- Proposed European ITS Communication Architecture.

- Developed within the European Commission COMeSafety

- Coordinated and accepted within **ISO TC 204 – ETSI TC ITS**

The ITS Station Reference Architecture


- ◆ Geo-Scoped communications :
  - ◆ GeoUnicast
  - ◆ GeoAnycast
  - ◆ GeoBroadcast
  - ◆ TopoBroadcast

- ◆ Specification of a Car to Car communication protocol (C2CNet) based on the Geographic positions of vehicles.

- ◆ Specification and implementation of an IPv6 GeoNetworking protocol stack to enable V2V, V2R and V2I communications.
  - • *Limitations :* provided 2 proprietary implementations (NEC, HITACHI)
  - • Restraints the continuous validation of IPv6 GeoNetworking
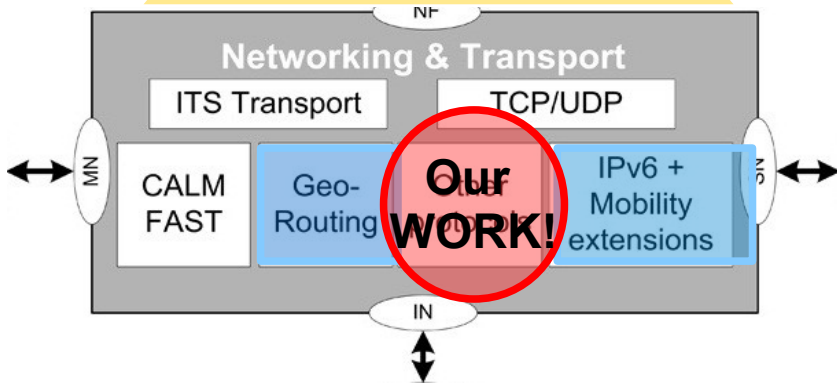
CarGeo6 overview

- **Linux-based Open source** implementation of **IPv6 GeoNetworking** conforming with GeoNet specification(D2.2) (*http://www.geonet-project.eu/*)

- Currently being modified to comply with **ETSI standards** on **IPv6 GeoNetworking** [ETSI TS 102 636-6-1]
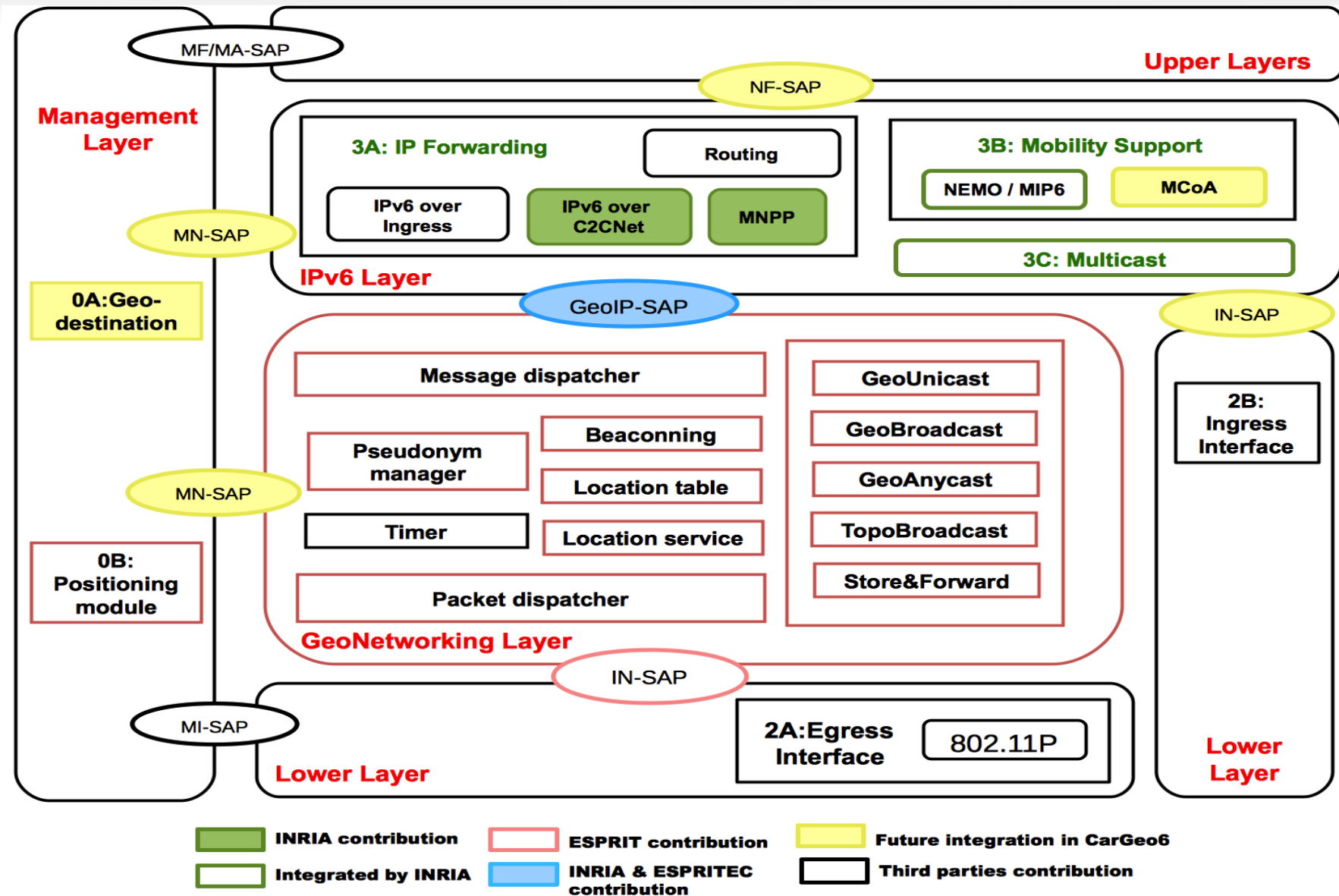
Contributors: ESPRIT and INRIA-Mines ParisTech

License: released under LGPLv2

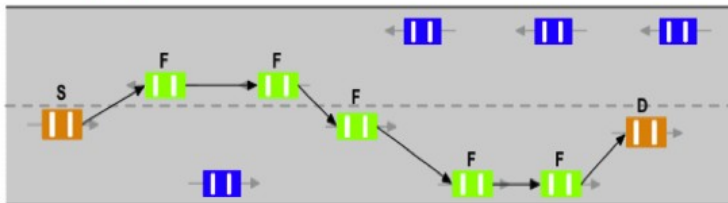**Web site:** *www.cargeo6.org*

CarGeo6 conceptual modules

GeoRouting in CarGeo6

CarGeo6 Packet format

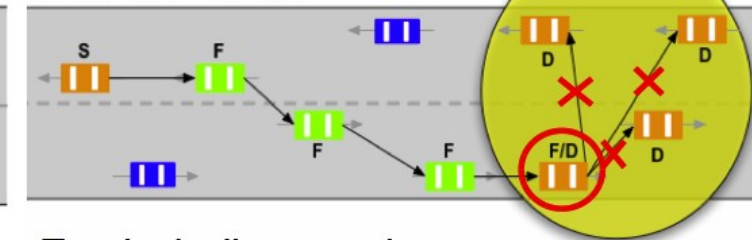| MAC	GeoNetworking	IPv6	Payload

- **A Linux-based Userland** software developed by **ESPRIT**
- Based on the **G**reedy **P**erimeter **S**tateless **R**outing **(GPSR)**
- **Location Service** mechanism for **Multihop** GeoRouting
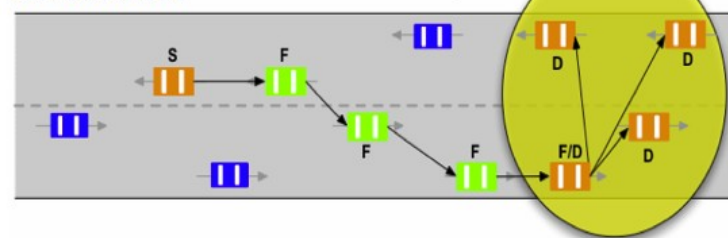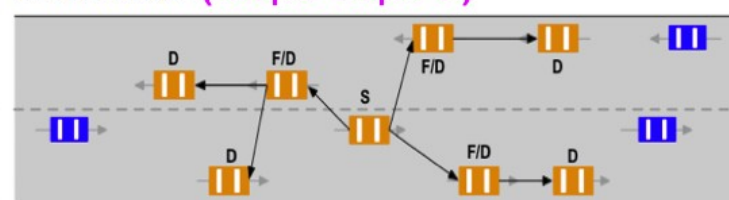- Relies on **4 GeoRouting schemes** :

Implementation design

- **IPv6 Unicast Packet → GeoUnicast**
- IPv6 Multicast Packet → GeoBroadcast
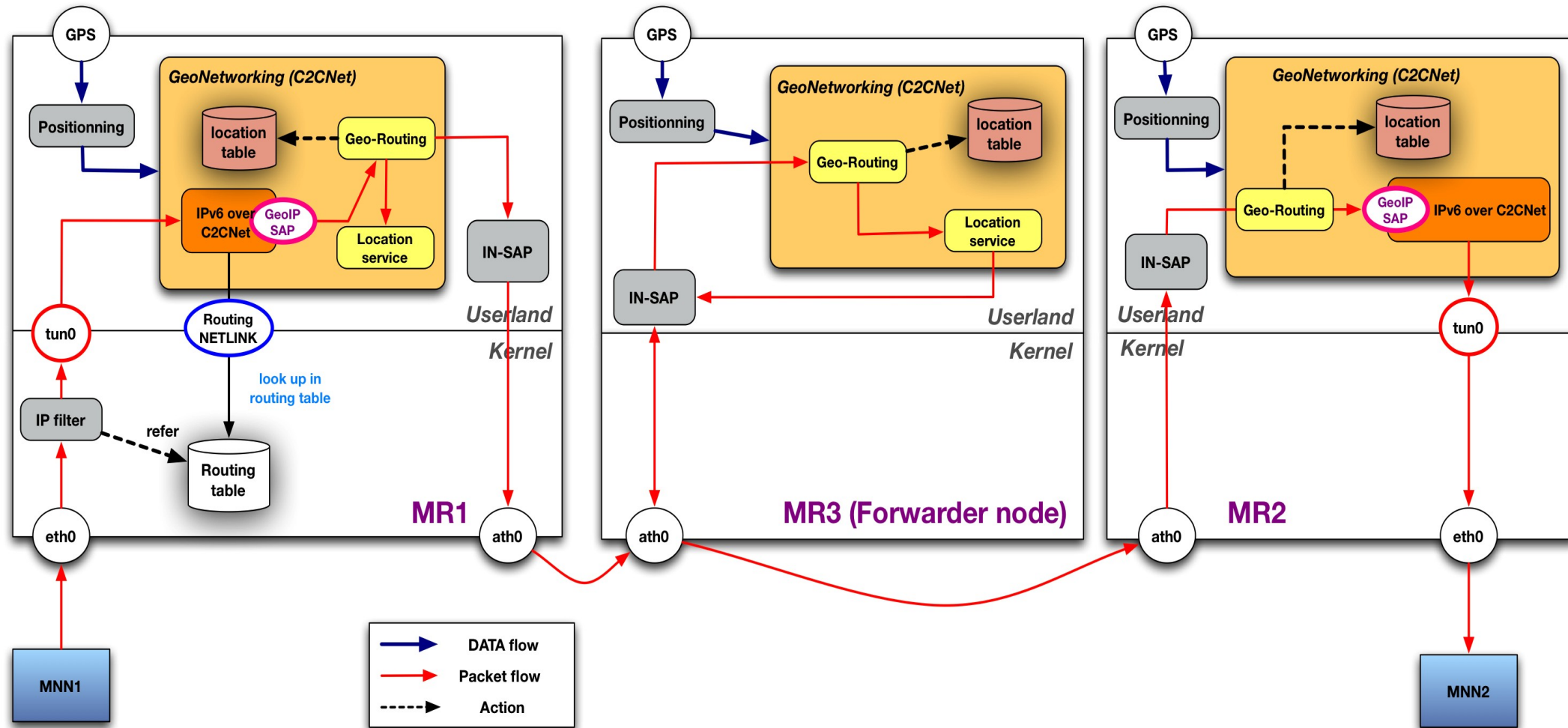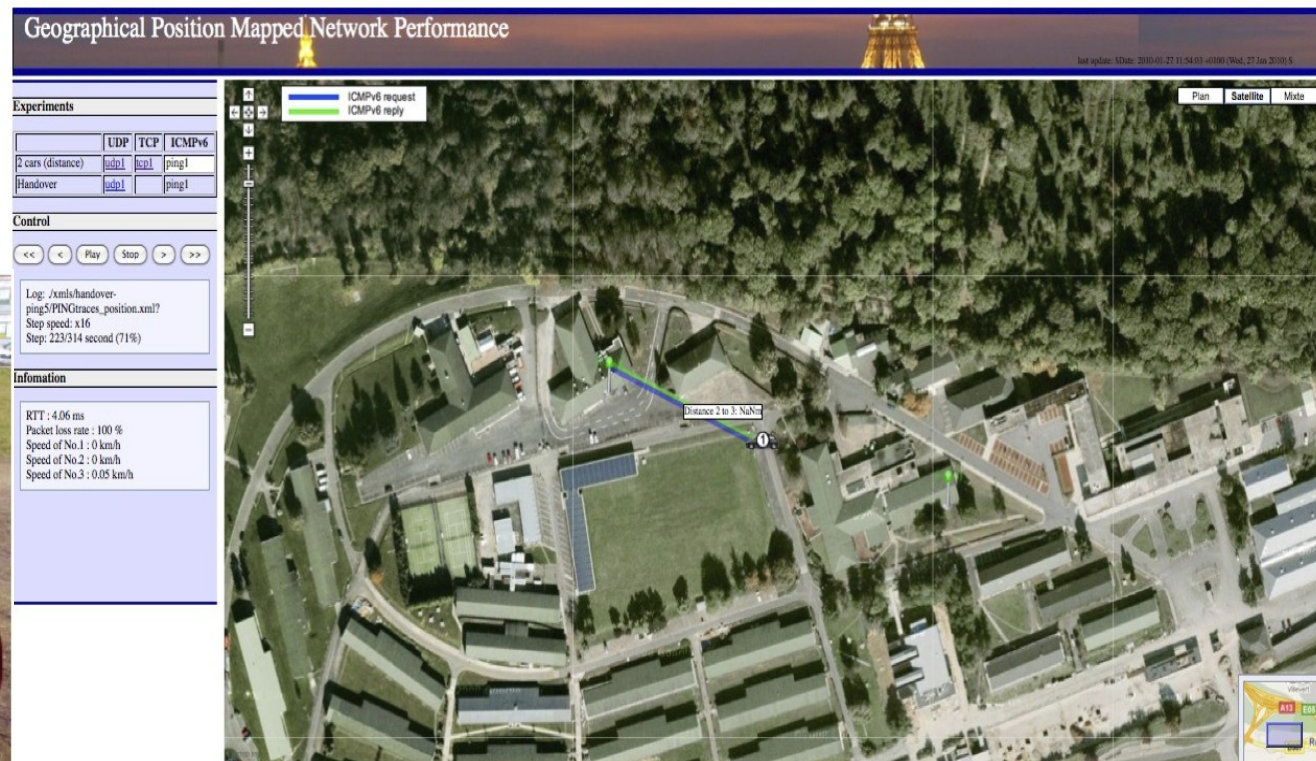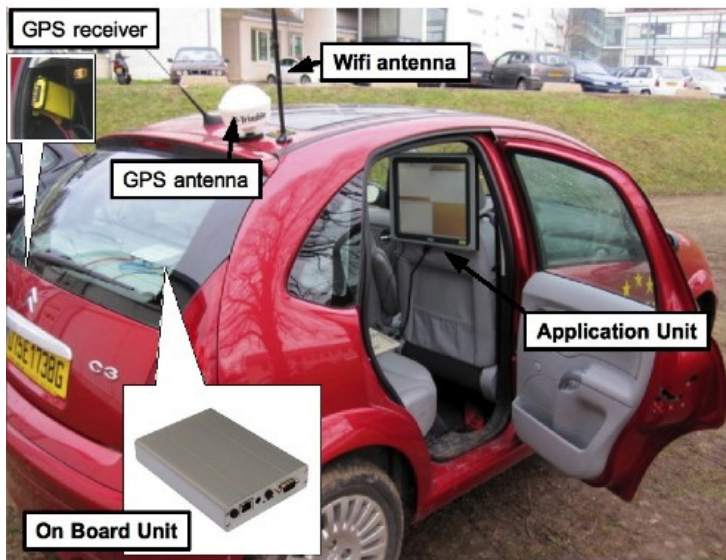
Testbed & Experiments results

Sample output for outdoor experiments (on vehicles)

- Results on Google maps shows metrics according to:

  - Movement
  - Distance
  - Obstacle

In-vehicle embedded platform

http://www-rocq.inria.fr/~tsukada/experiments/itsnet/

Testbed & Experiments results
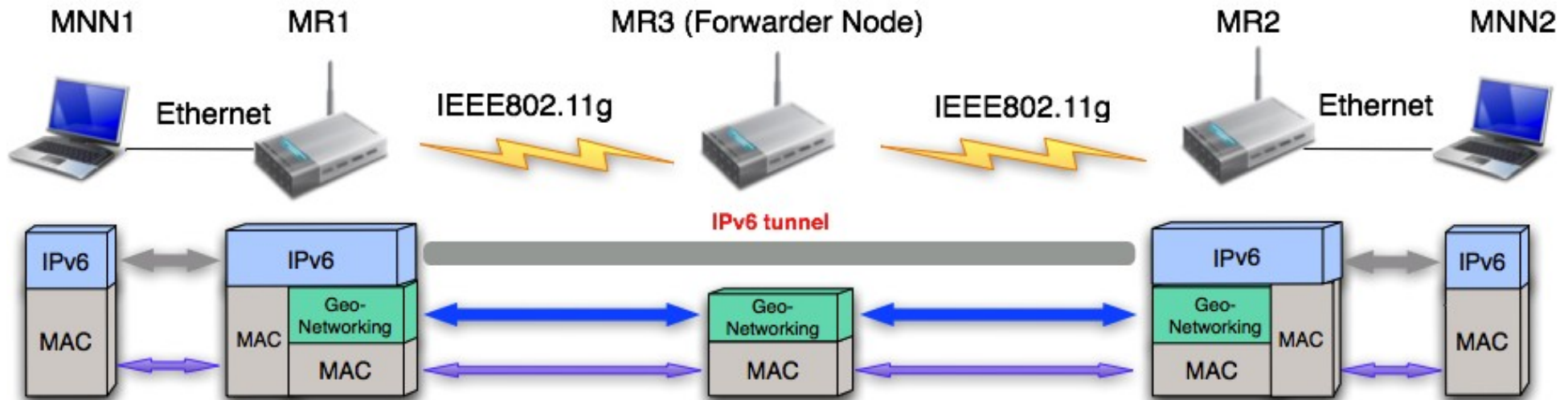
Indoor platform description

- **Mobile Router** :
  - Model: Alix3d3
  - CPU: AMD PCSi586 CPU 498.128 MHz
  - mini-pci wireless card (Atheros AR5413 802.11abg NIC)
  - OS : Ubuntu, kernel versions **2.6.29.6 / 2.6.31/ 2.6.32**
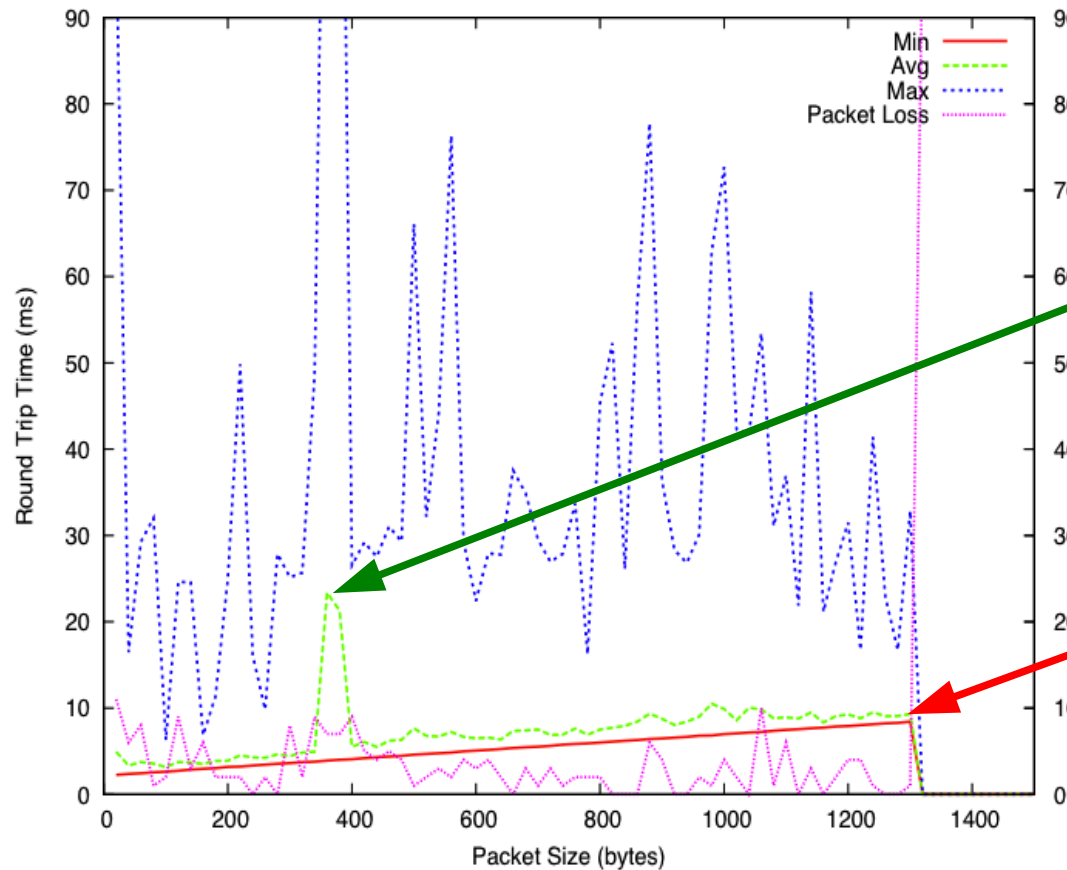- **Application Unit** : Ubuntu, kernel version 2.6.31-17

Network Performance analysis

ICMPv6 results – single hop scenario –

Configurable parameter	Evaluation metrics
• Packet size : 20Bytes to 1500Bytes • Packets/sending interval : 100 every 0,1ms	RTT, packet loss

AVG. RTT : between 2ms and 10ms
Packet loss : between 0% and 11%

- RTT 25ms RTT for P.Size 370Bytes

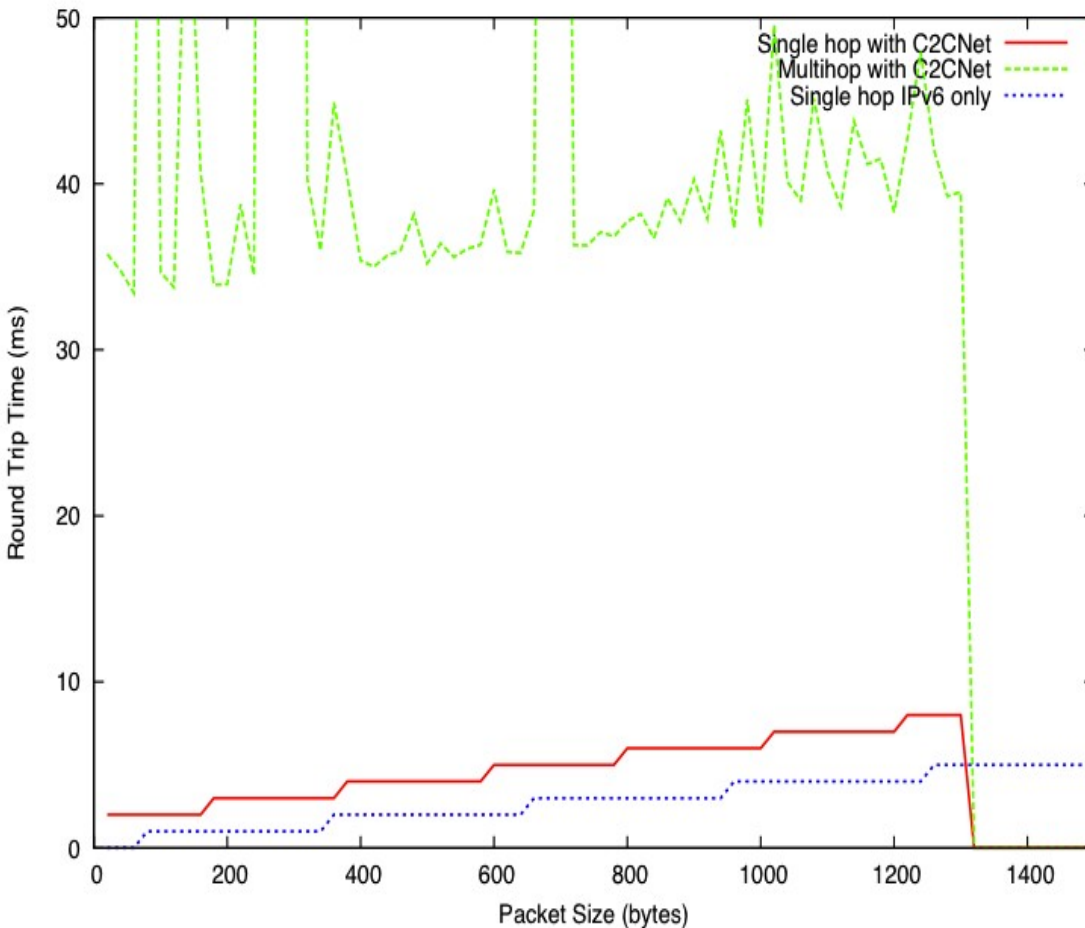→ We should investigate processing and buffering mechanisms at the GeoNetworking layer

→ Implement an **IP Next Hop cache**

- 100% packet loss for P.size > 1320Bytes

→ No **packet fragmentation mechanism** at the GeoNetworking layer (MaxMTU=1500Bytes)

Network Performance analysis

Overhead between IPv6 and IPv6 GeoNetworking

- About **3ms** overhead between IPv6 and GeoNetworking in **the single hop case**
- More than **30ms** overhead between Ipv6 and GeoNetworking in **the Multihop case**

→ Could be improved by the implementation of **Multihop beaconing mechanism instead of Location service**
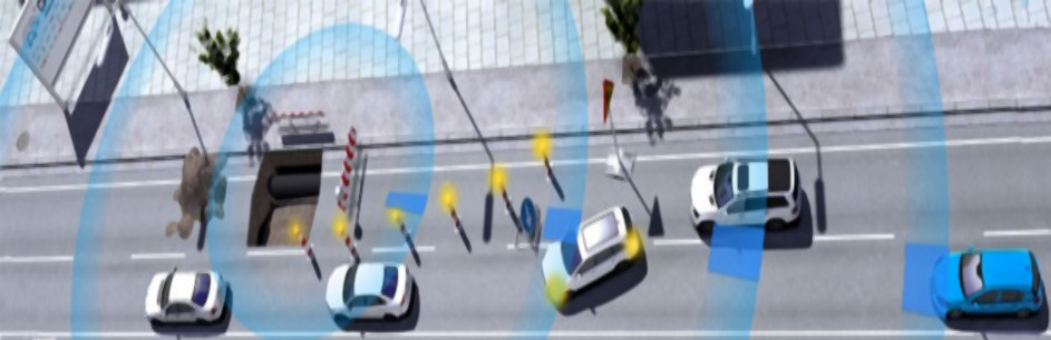
Conclusion & Perspectives

- CarGeo6 is an opportunity to provide a complete ITS station protocol stack, **thanks to open source !**

- Performance issues are under investigation :

    - Enhance Multihop GeoRouting mechanism (Location Service)

    - IP Next Hop cache to reduce processing delays

- Currently working on **IEEE802.11p** tests with CarGeo6 using the *GCDC patches for ath5k driver* (http://www.gcdc.net/)

Conclusion & Perspectives

- CarGeo6 will be experimented in the ***ITSSv6 project*** (*www.itssv6.eu*)

  - More tests are planned to test IPv6 Network Mobility Support (**NEMO**) performance over GeoNeworking.

  - Integration of extended IPv6 Routing features : **MCoA mechanisms**, **Multiple Routing tables** ...

- Specification work on the definition of the ITS station cross layer management and security functions between :

  - The Management Entity and the Network&Transport layer

  - The Security Entity and the Network&Transport layer

Thank you for your attention !

Questions ?

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