University of Modena and Reggio Emilia
Department of Engineering "Enzo Ferrari"

NetLab topics presentation

31 May 2022

Carlo Augusto Grazia, PhD, Assistant Professor (Automotive Connectivity)

Prof. Ing. Maurizio Casoni, PhD

Martin Klapez, PhD

5G Vehicular and Public Safety Communications

UNIMORE Networking Lab

V2X Communications

- Focus on safety-related applications
- Analysis of application-level performance
- Field tests and real GPS-based messages

Partners: ALSTOM SA, JRC
Applications: connected and autononomous vehicles

Linux Wi-Fi Stack

- Wi-Fi protocols and modules
- Learning-based Congestion Controls (TCP)
- Real testbeds!

Applications: Home & Lab Wi-Fi access networks

Public Safety Networks

- 4G and 5G Networks in the aftermath of a disaster
- Earthquake Early Warning Systems

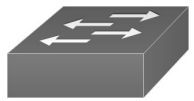
Applications: natural and man-made disasters

Green & Secure communications

- Reducing energy consumption in 5G networks
- Energy savings in SDN appliances
- ML at radio access for (D)DoS detection

Applications: 5G network architectures and SDN

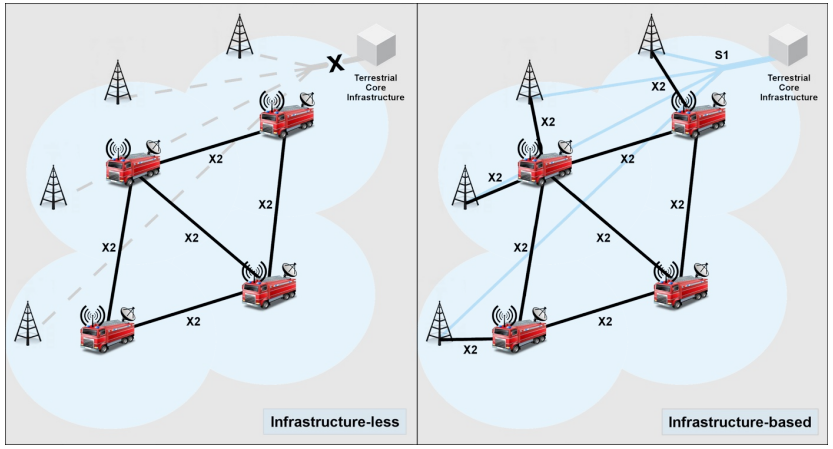


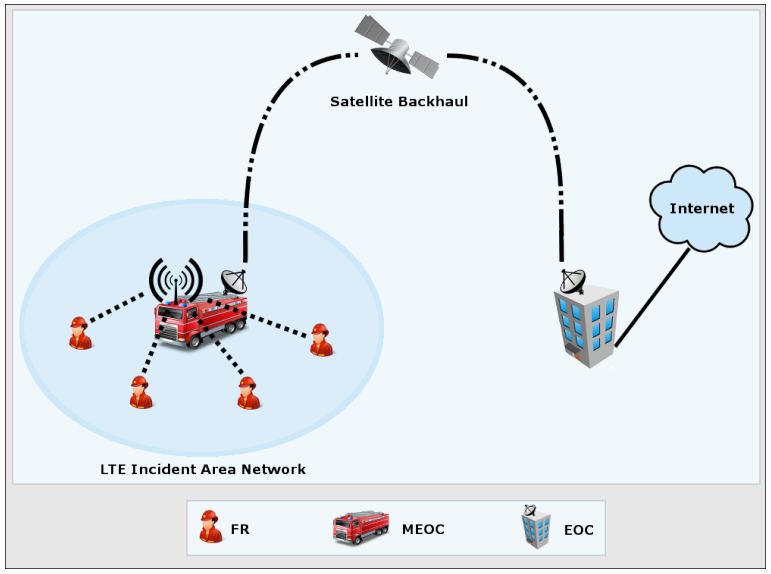




Public Safety Networks

Applications: **4G and 5G Networks** in the aftermath of natural or man-made **disasters**









Funded by:

- EU FP7 PPDR-TC
- EU FP7 ESPONDER

PPDR TCenter

eSPONDER

UNIMORE Networking Lab - netlab.unimore.it

5G/DSRC V2X Communications

Applications: connected and autononomous vehicles

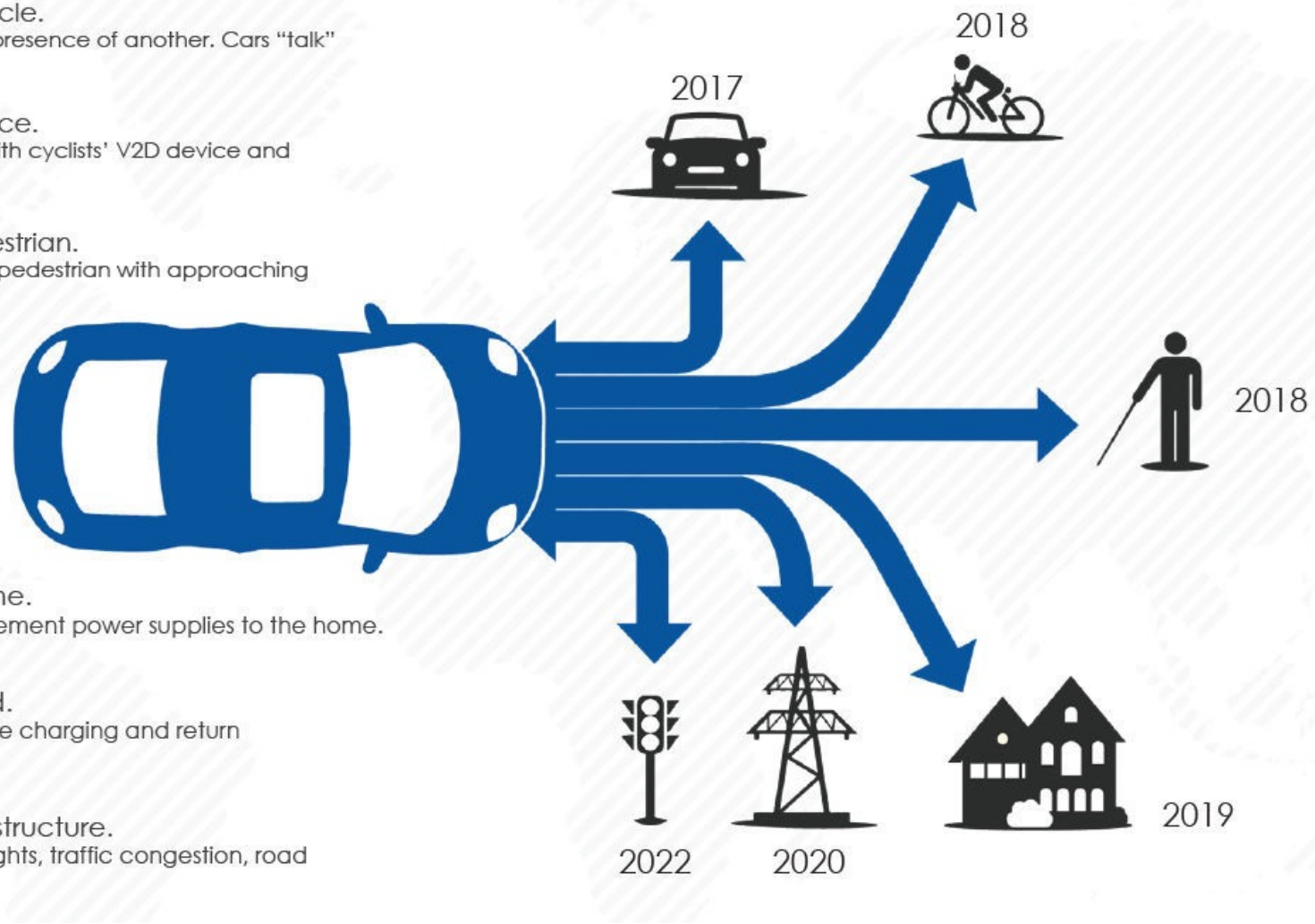
Partners: ALSTOM SA

Internship Partners: Maserati, Ducati, CNH, EDAG

V2V - Vehicle-to-Vehicle.
Alerts one vehicle to the presence of another. Cars "talk" using DSRC technology.

V2D - Vehicle-to-Device.
Vehicles communicate with cyclists' V2D device and vice versa.

V2P - Vehicle-to-Pedestrian.
Car communication with pedestrian with approaching alerts and vice versa.



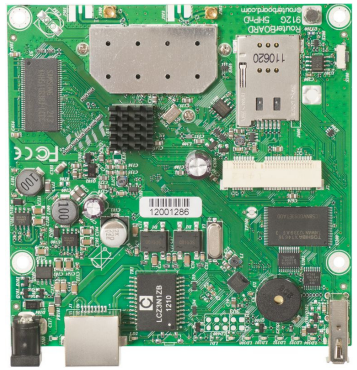
V2H - Vehicle-to-Home.
Vehicles will act as supplement power supplies to the home.

V2G - Vehicle-to-Grid.
Smart grid controls vehicle charging and return electricity to the grid.

V2I - Vehicle-to-Infrastructure.
Alerts vehicles to traffic lights, traffic congestion, road conditions, etc.

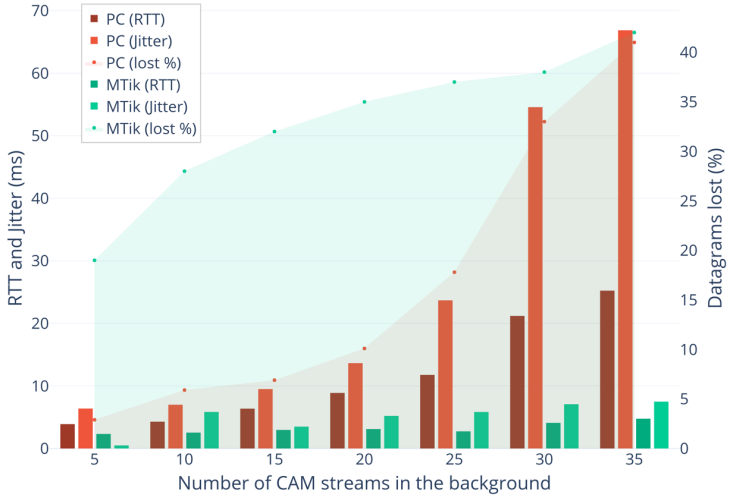
5G/DSRC V2X Communications: Field Tests

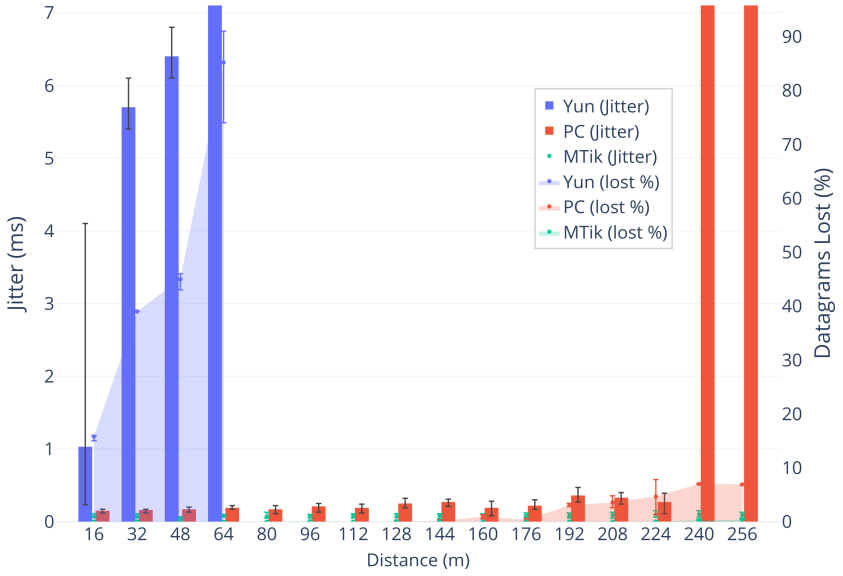
Focus on **safety-related** applications



Analysis of application-level, **real-world performance**





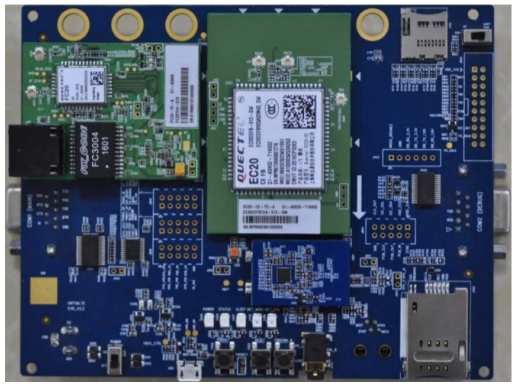




UNIMORE Networking Lab - netlab.unimore.it

Vulnerable Road Users: GPS-based Awareness Messages

Focus on **cooperative awareness messages**

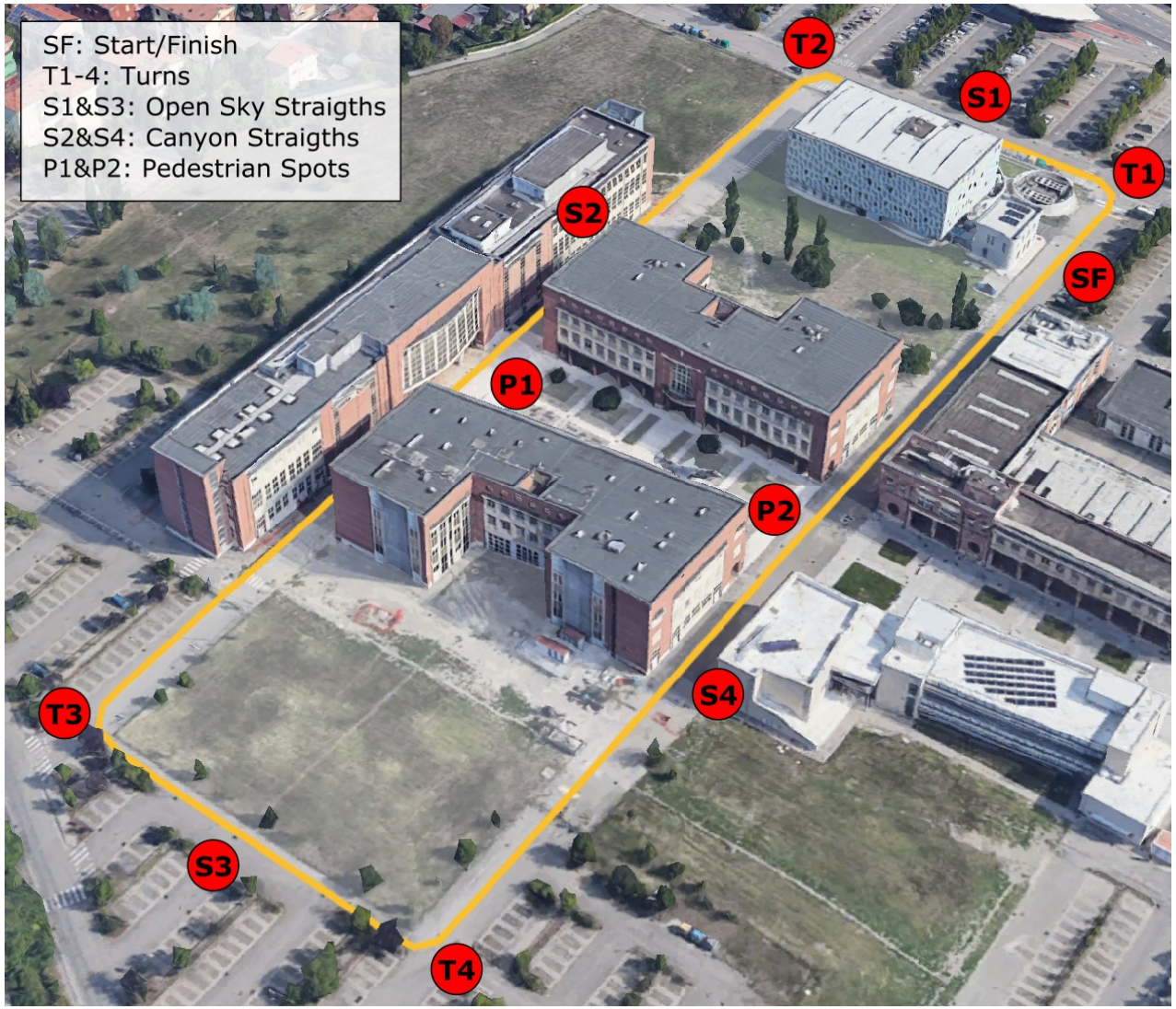




Analysis of application-level, **real-world performance.**

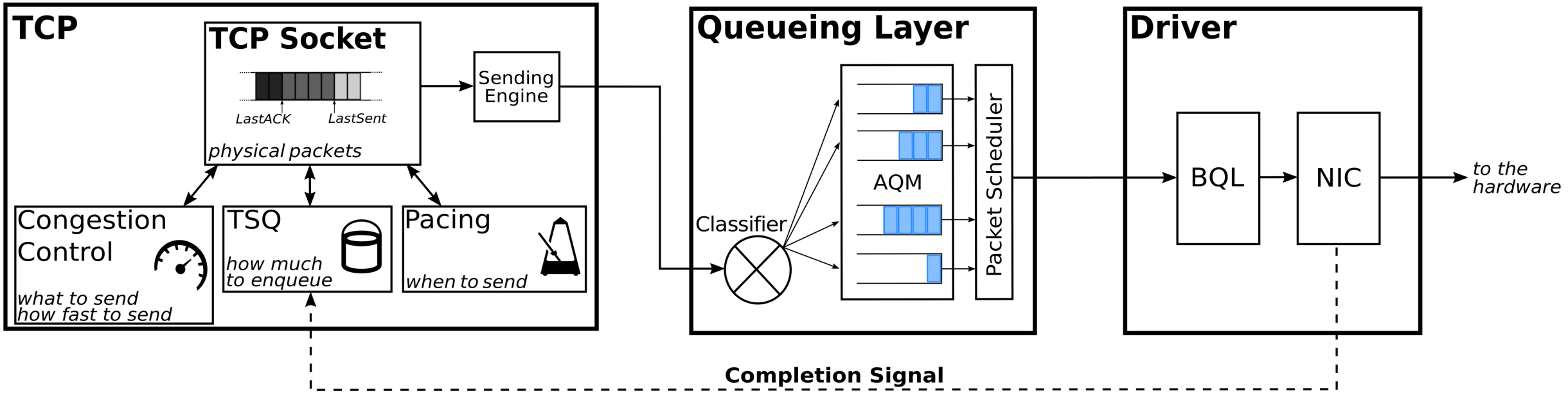


Analysis of the GPS accuracy role in the packets' triggering



Wi-Fi protocols on Linux

Improved solutions proposed by Google (TSQ, BBRv 1.0)
Enhanced the performance in Wi-Fi environments

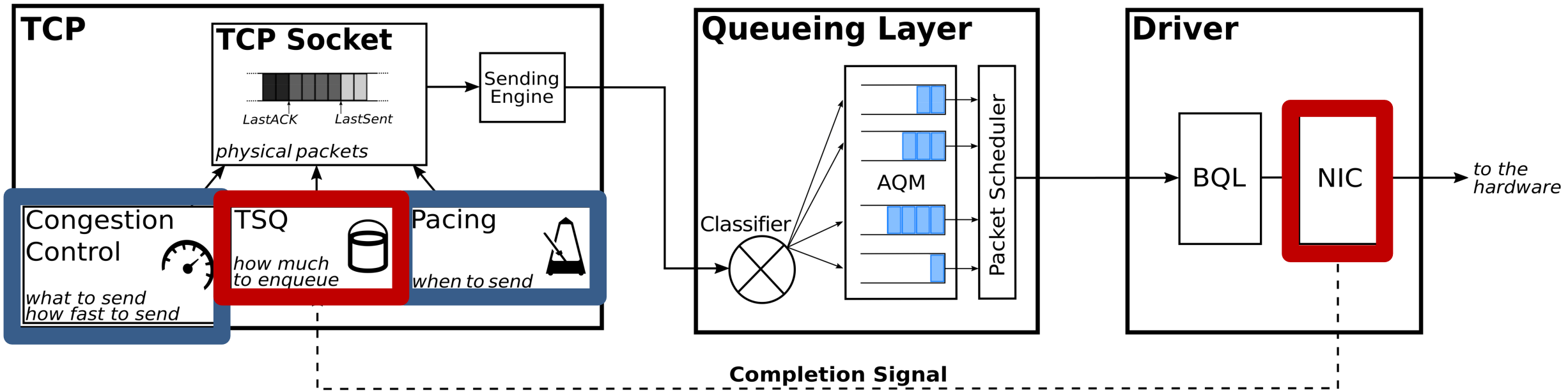


Wi-Fi protocols on Linux

BBR v2.0 patch

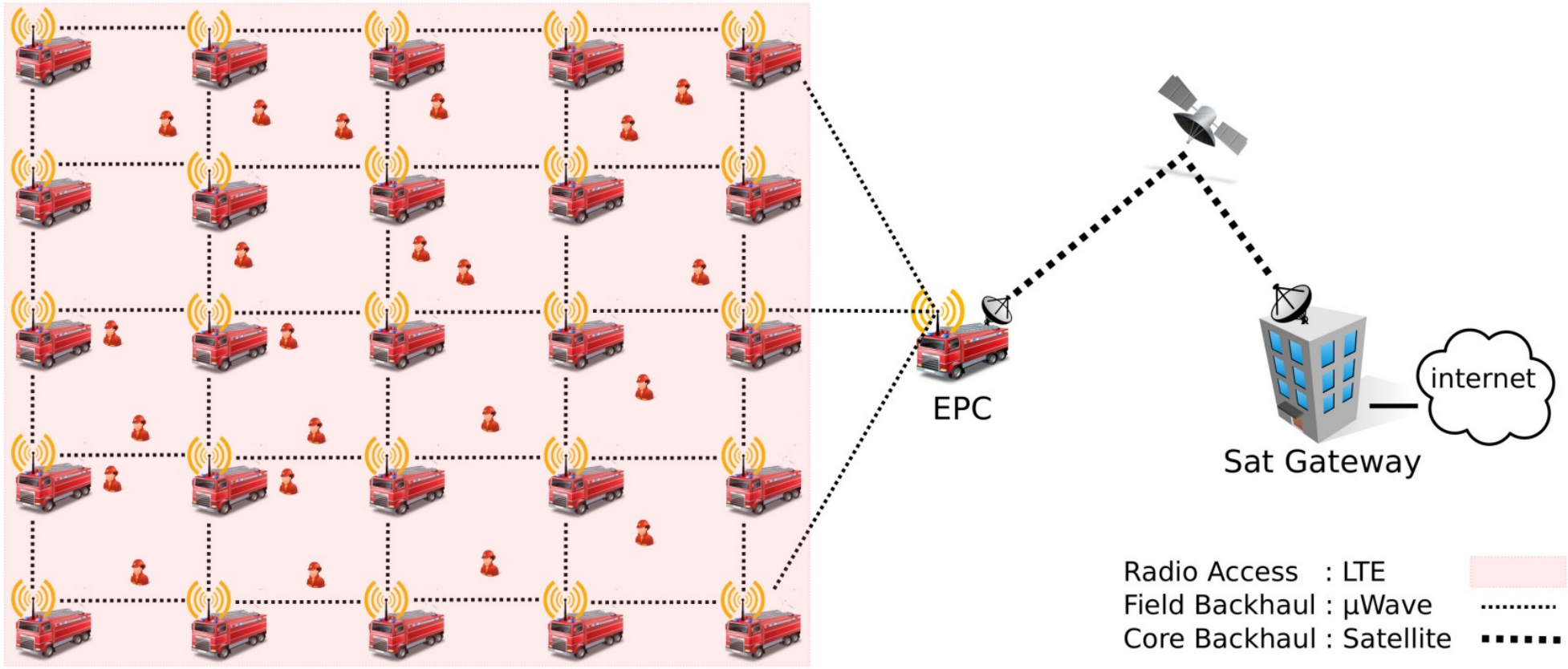
TSQ patch (ath9k and ath10k)

Both available on kernel 5.x



Routing & Coverage in Mesh Emergency Networks

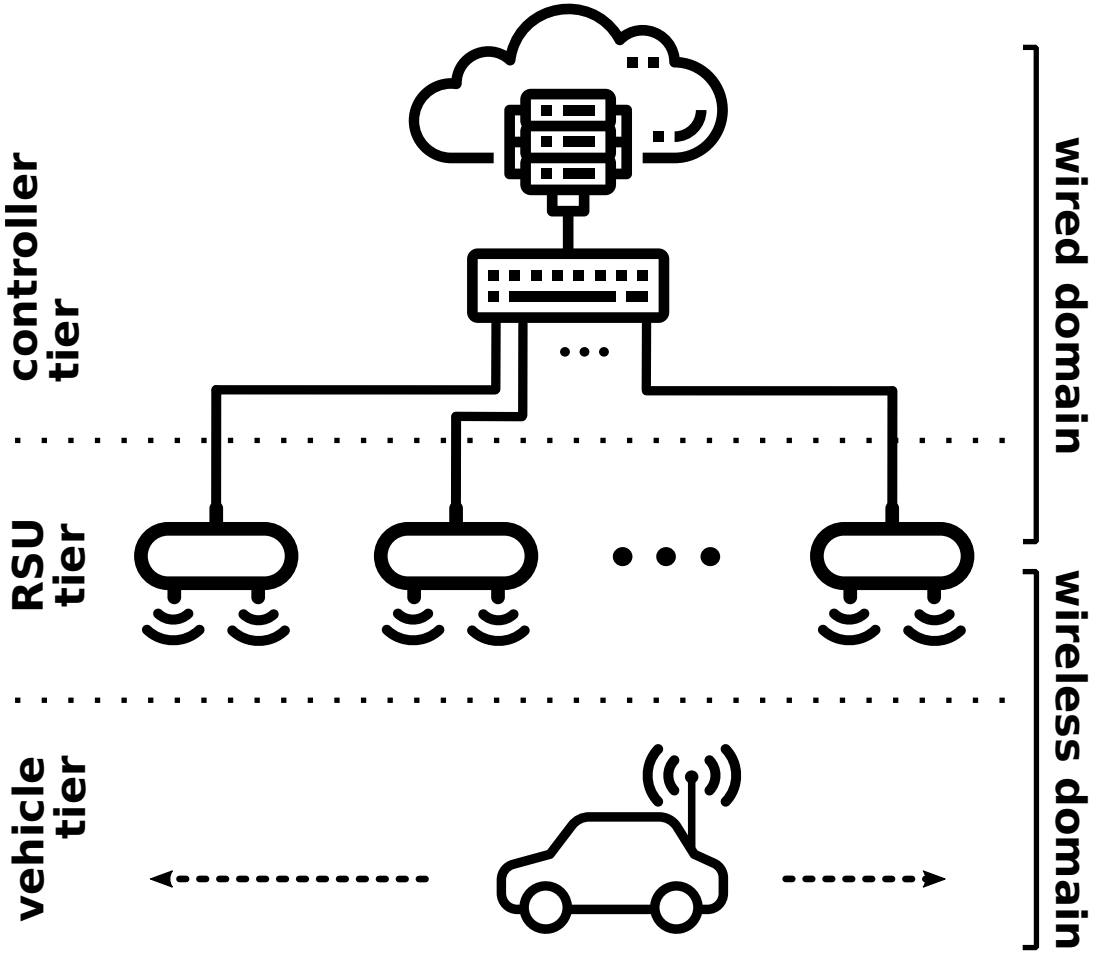
- Simulations
- Mesh Routing
- OLSR vs BP-MR



Routing & Coverage in Vehicular Networks

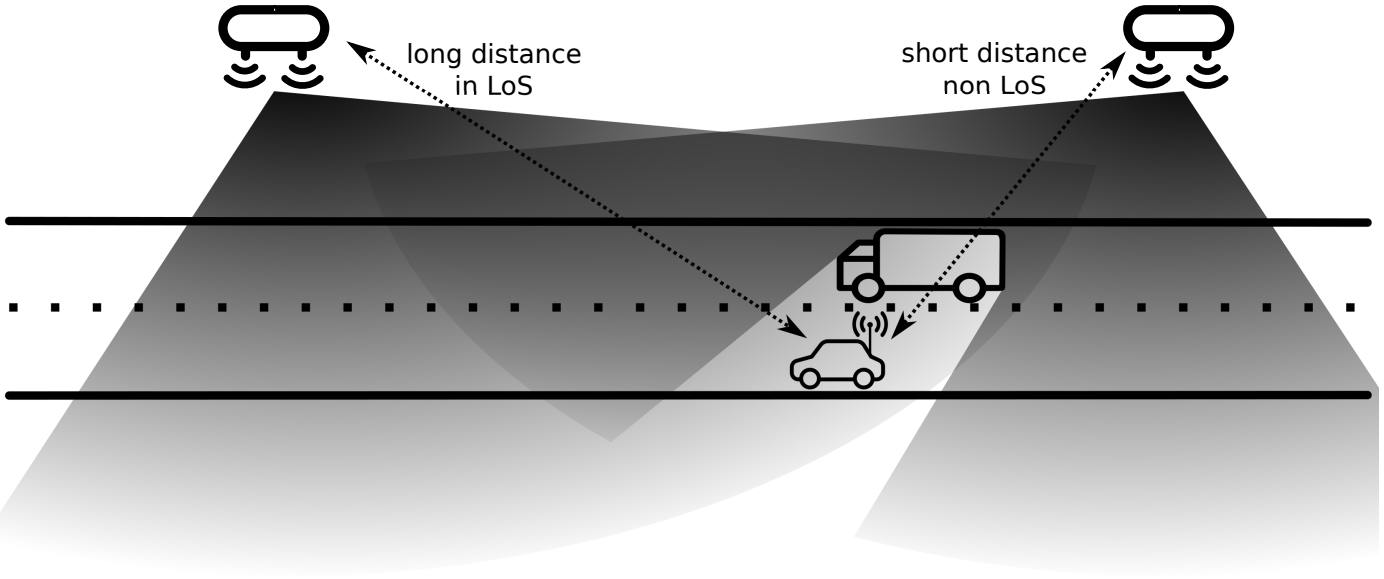


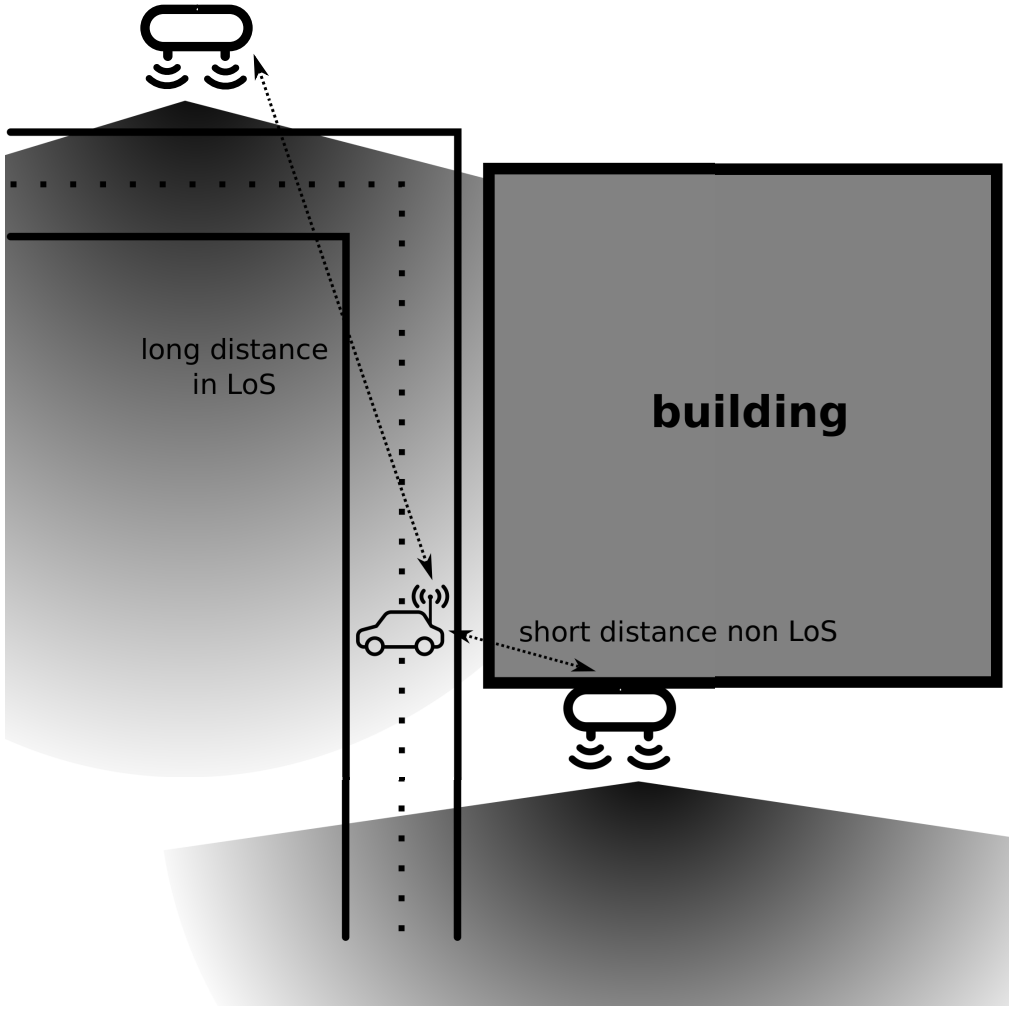
- Real Tests
- V2X Routing
- IRONMAN vs BATMAN vs HWMP



Routing & Coverage in Vehicular Networks

GPS vs RSSI





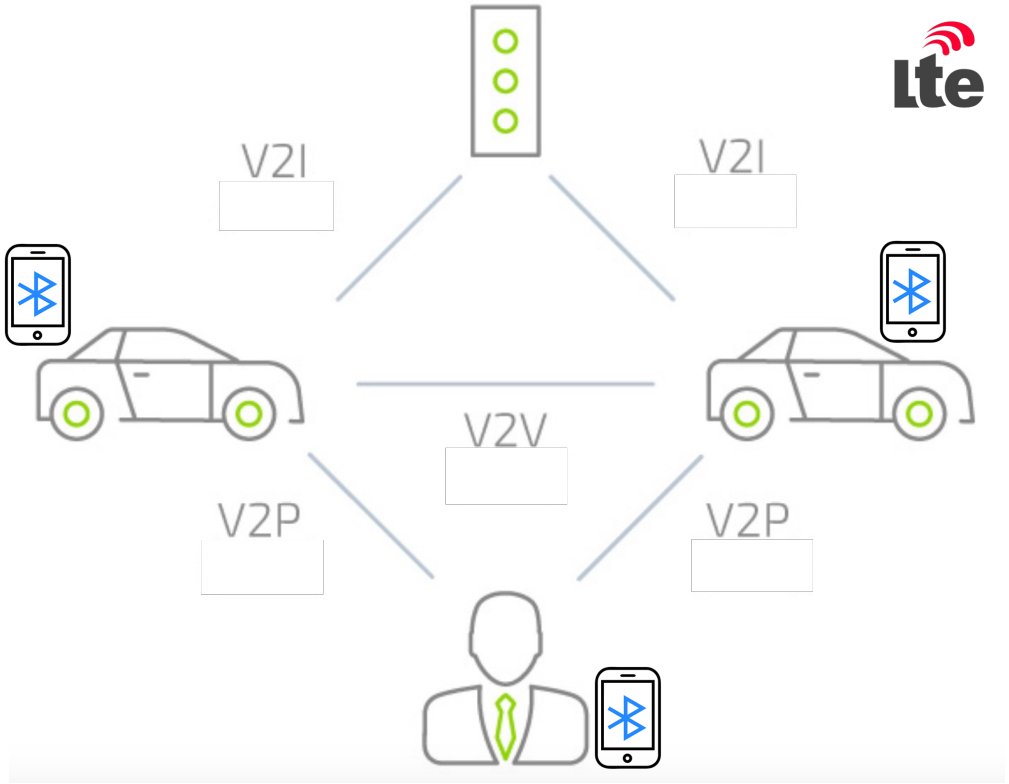
Suitable indoor, for industrial processes

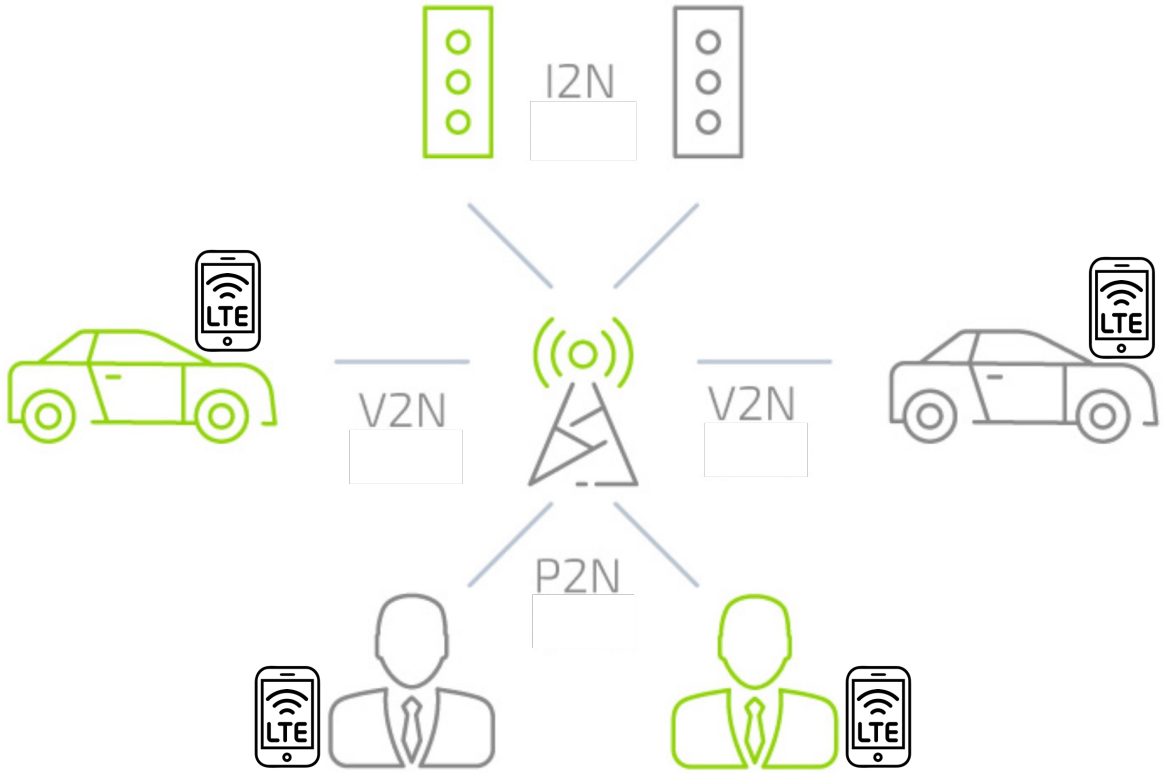
Bluetooth in V2X

Smartphone as OBU

Bluetooth as V2V

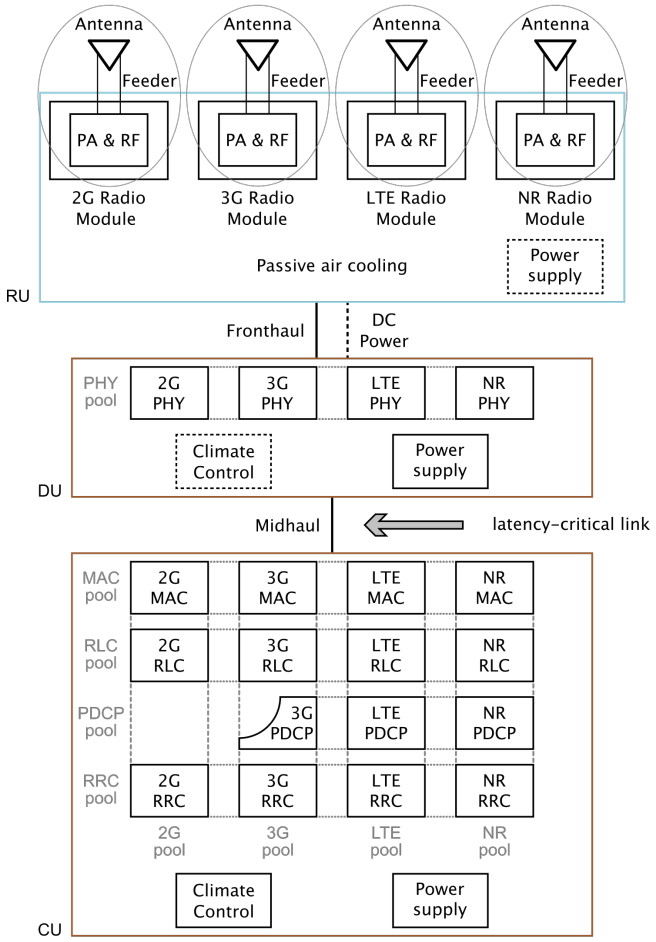
LTE for V2I



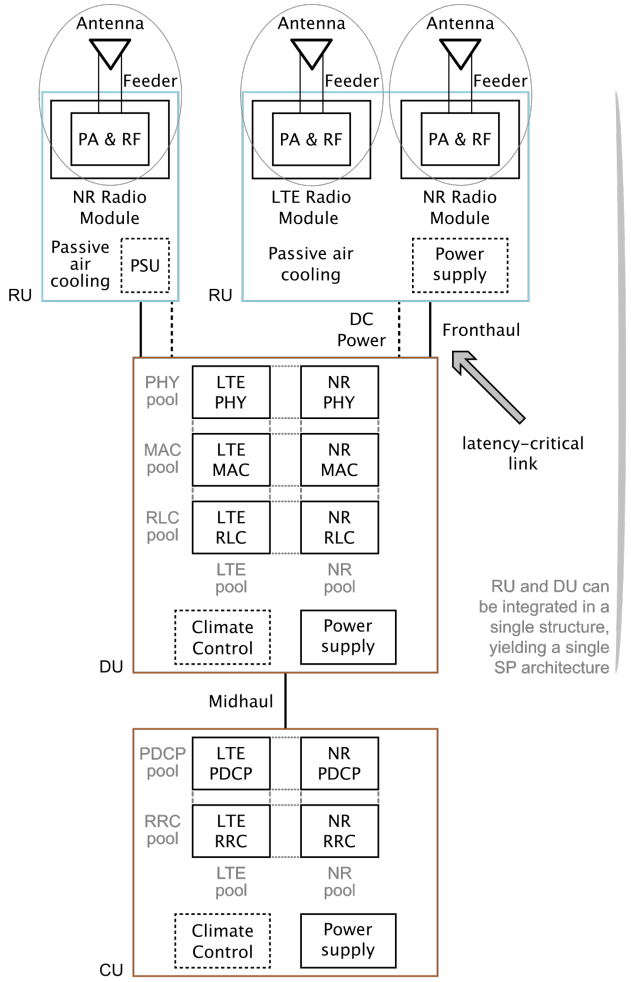


VEHICLE-TO-EVERYTHING

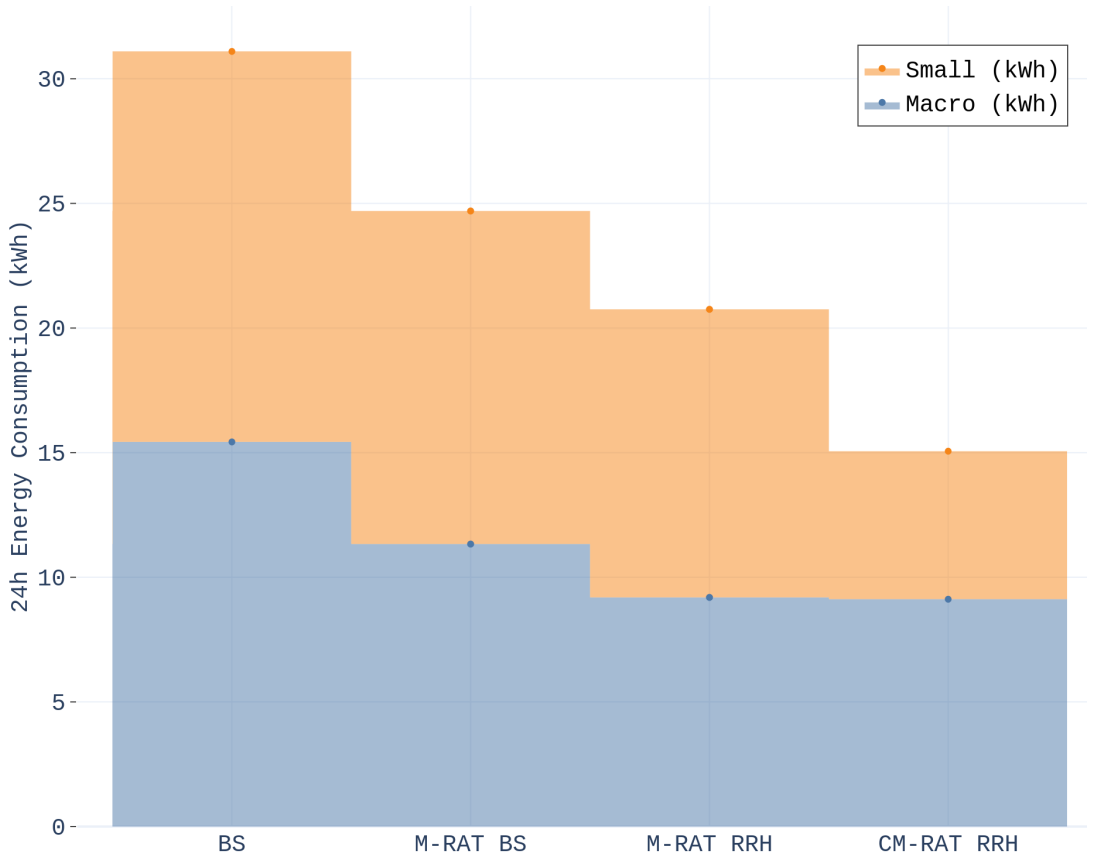
5G: Architectures For Energy Efficiency



(a) 5G M-RAT with double split architecture for low loads / Control Plane

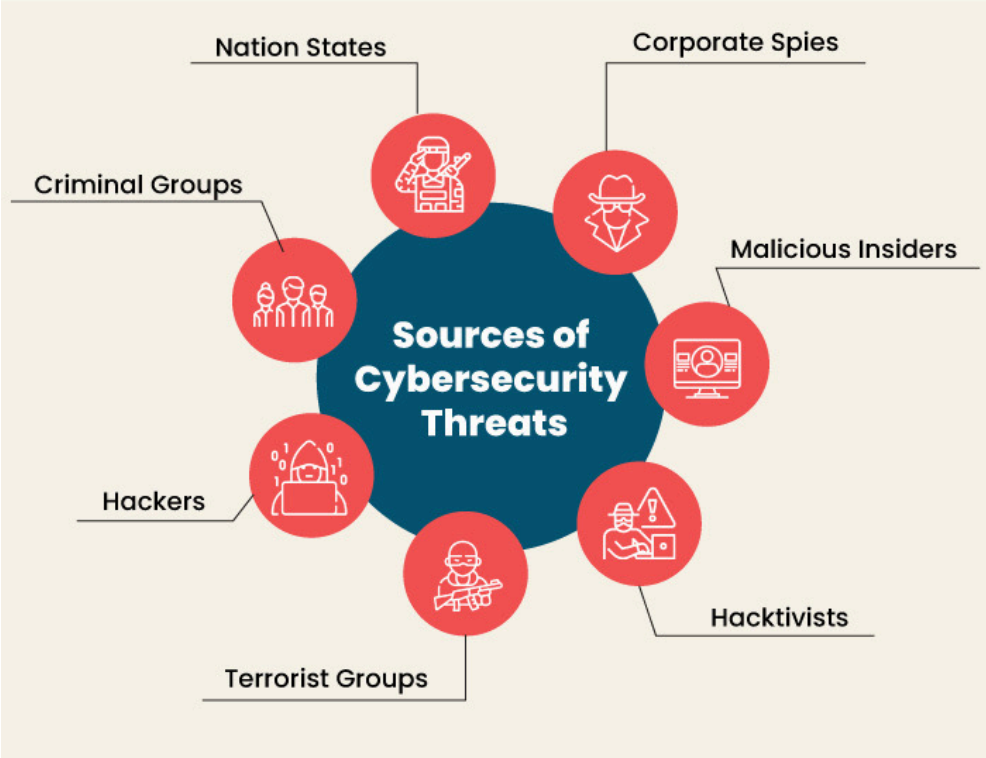


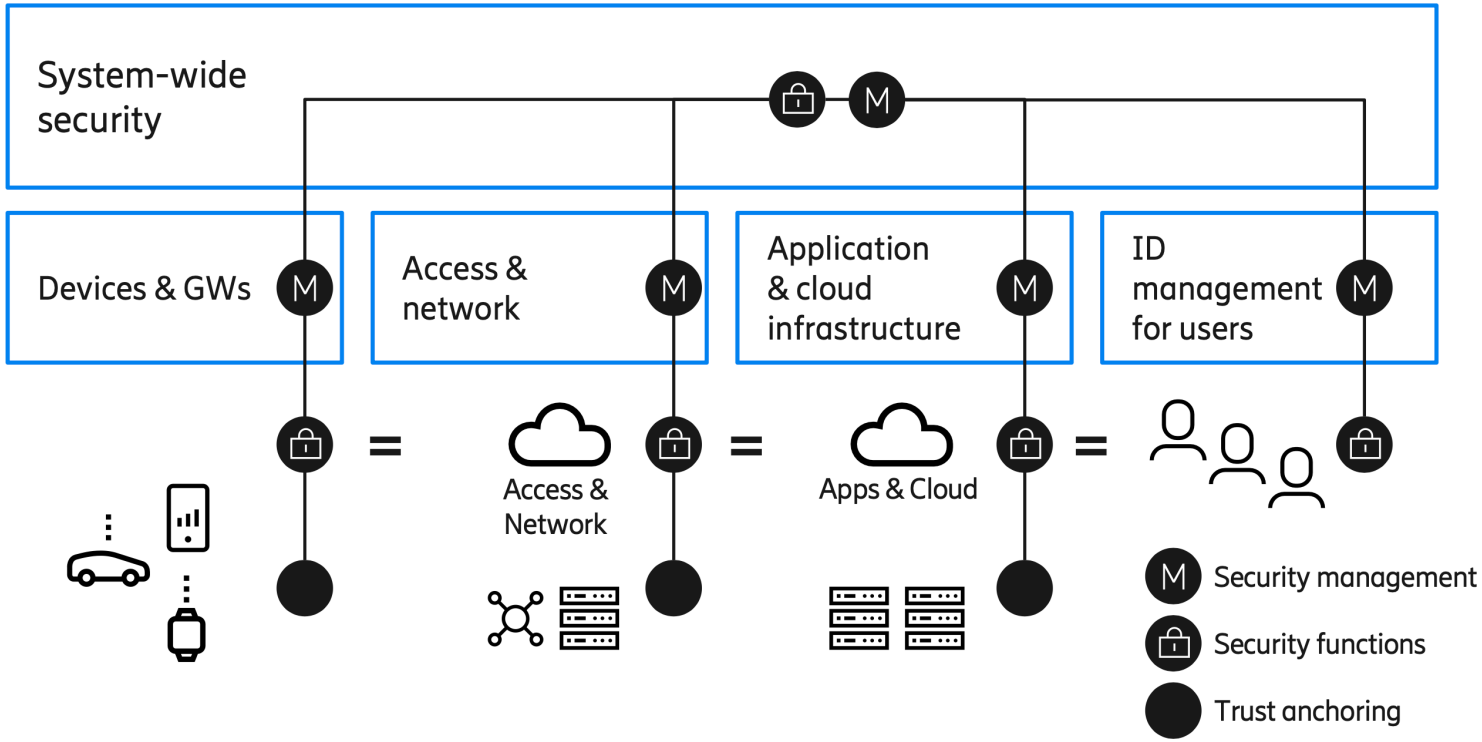
(b) 5G M-RAT with double / single split architecture for high loads / Data Plane



UNIMORE Networking Lab - netlab.unimore.it

5G: Security


Nation States
Corporate Spies
Criminal Groups
Malicious Insiders
Sources of Cybersecurity Threats
Hackers
Hacktivists
Terrorist Groups


System-wide security
M
Devices & GWs
Access & network
Application & cloud infrastructure
ID management for users
Access & Network
Apps & Cloud
Security management
Security functions
Trust anchoring

UNIMORE Networking Lab: Current Master Thesis available

The Master Thesis list is refreshed frequently. Current available topics are:

- V2X: Broadcast Suppression Algorithm; real implementation on devices
- V2X: Decentralized Congestion Control; real implementation on devices
- V2X: CAM/VAM Dissemination and GPS-related messages; real sampling
- ML-CC: Linux tests on TCP, standard CCs vs ML-CCs
- SDN/ML: Mitigation of DoS on radio access

Thank you

Carlo Augusto Grazia
Assistant Professor
carloaugusto.grazia@unimore.it

Dept. of Engineering "Enzo Ferrari"
University of Modena and Reggio Emilia
Via Pietro Vivarelli, 10/1 - 41125 - Modena - Italy
Building 26, floor 2, room 28
Tel.: +39-059-2056323