University of Modena and Reggio Emilia
Department of Engineering ‘‘Enzo Ferrari’’

NetLab topics presentation

31 May 2023

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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

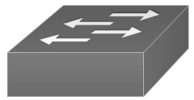
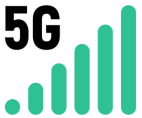
- 4G and 5G Networks in the aftermath of a disaster
- Earthquake Early Warning Systems

Applications: natural and man-made disasters

Green & Secure communications

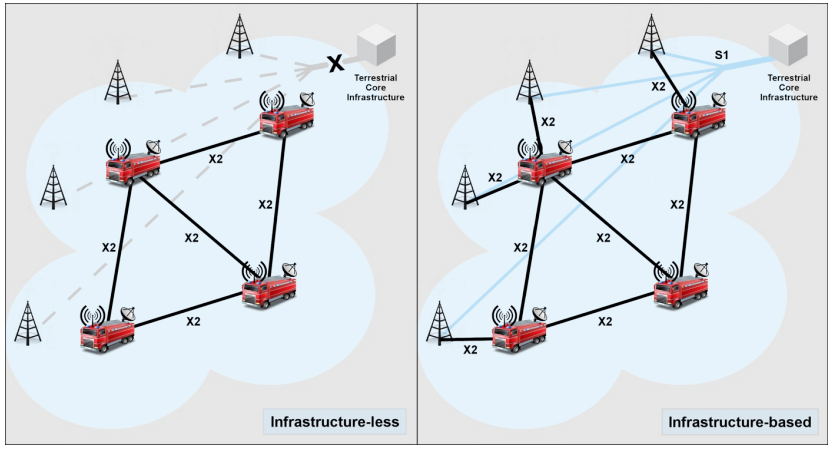
- Reducing energy consumption in 5G networks
- Energy savings in SDN appliances
- ML at radio access for (D)DoS detection

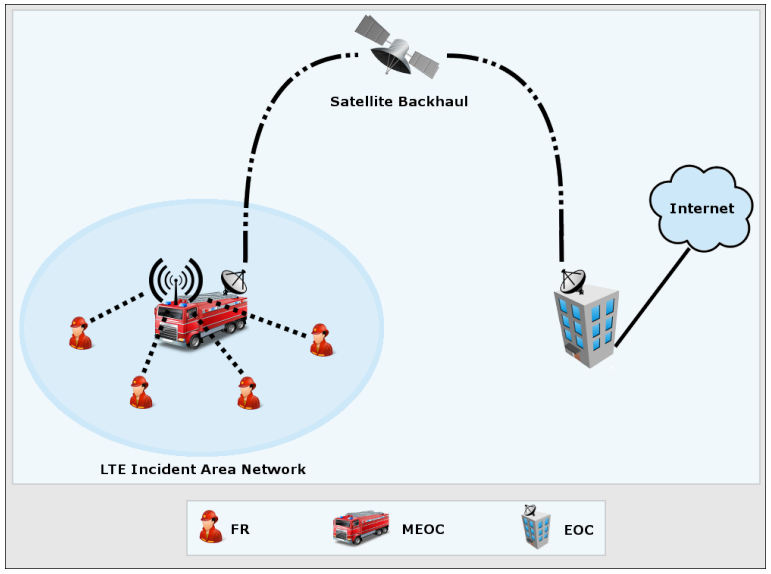
Applications: 5G network architectures and SDN

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

5G/DSRC V2X Communications

Applications: connected and autononomous vehicles

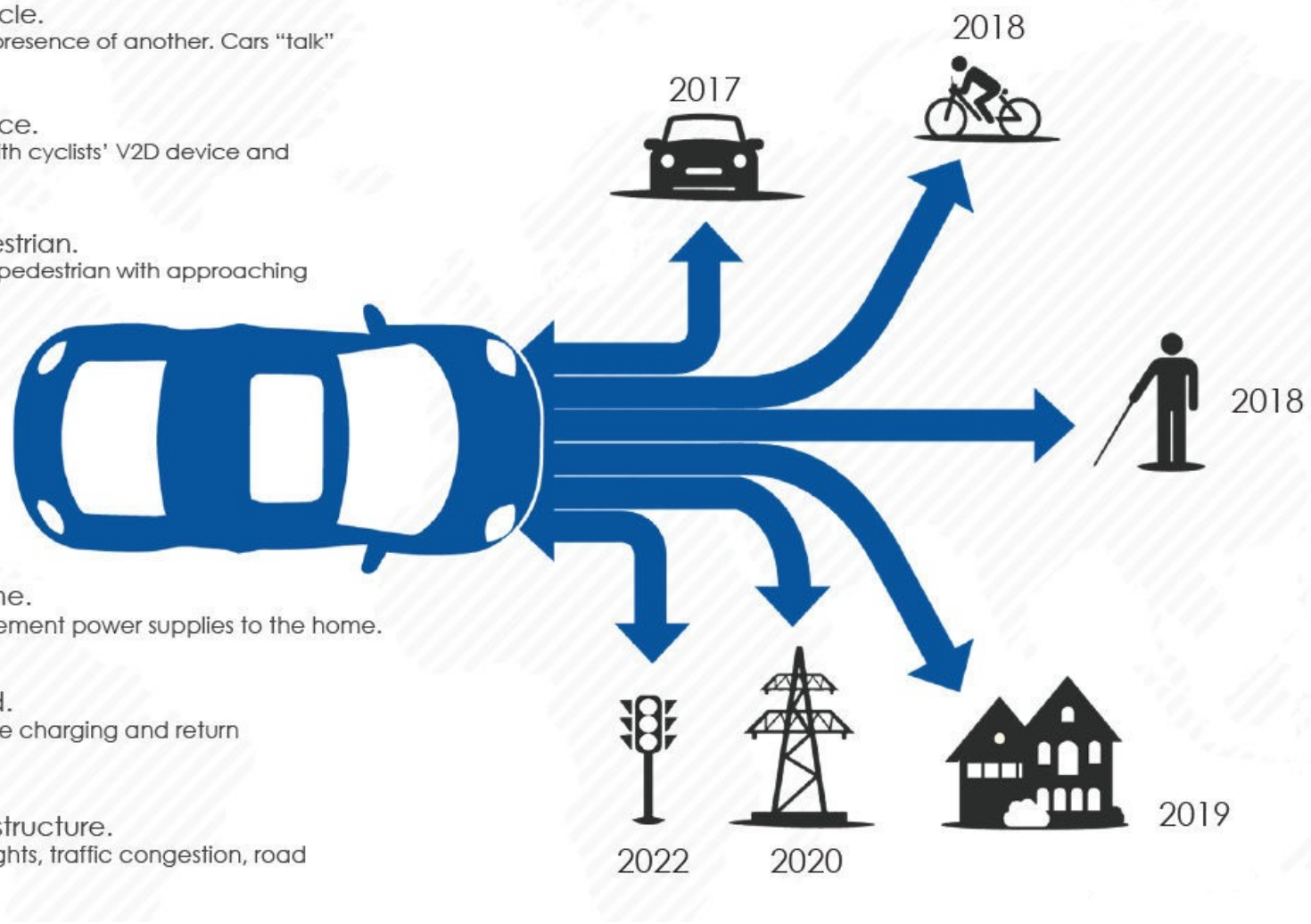
Partners: ALSTOM SA

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.



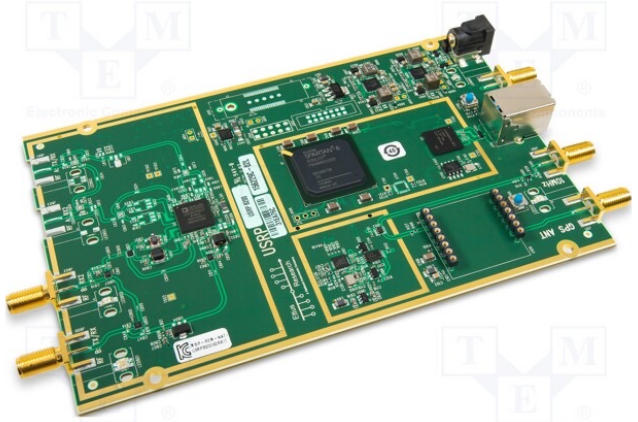
V2H - Vehicle-to-Home.
Vehicles will act as supplement power supplies to the home.

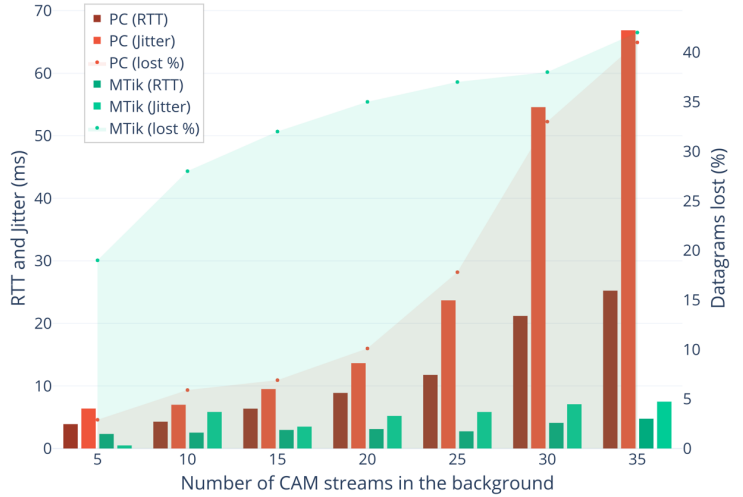
V2G - Vehicle-to-Grid.
Smart grid controls vehicle charging and return electricity to the grid.

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

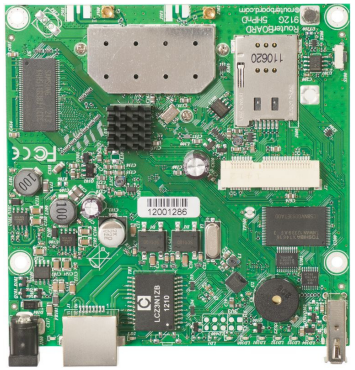
5G/DSRC V2X Communications: Field Tests

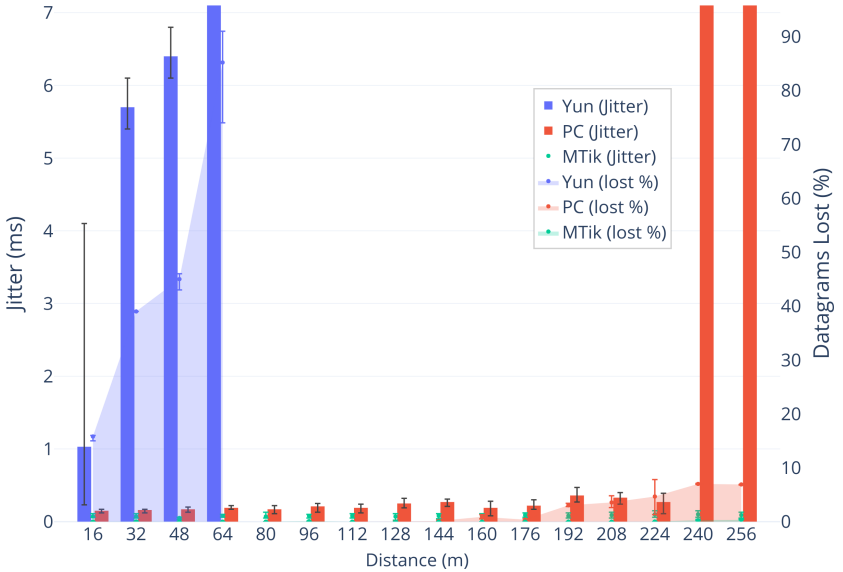
Focus on safety-related applications
SDR-based congested scenario





Analysis of application-level, real-world performance





STA1 5G ALSTOM

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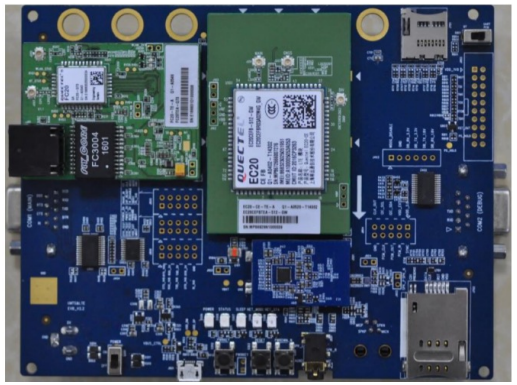
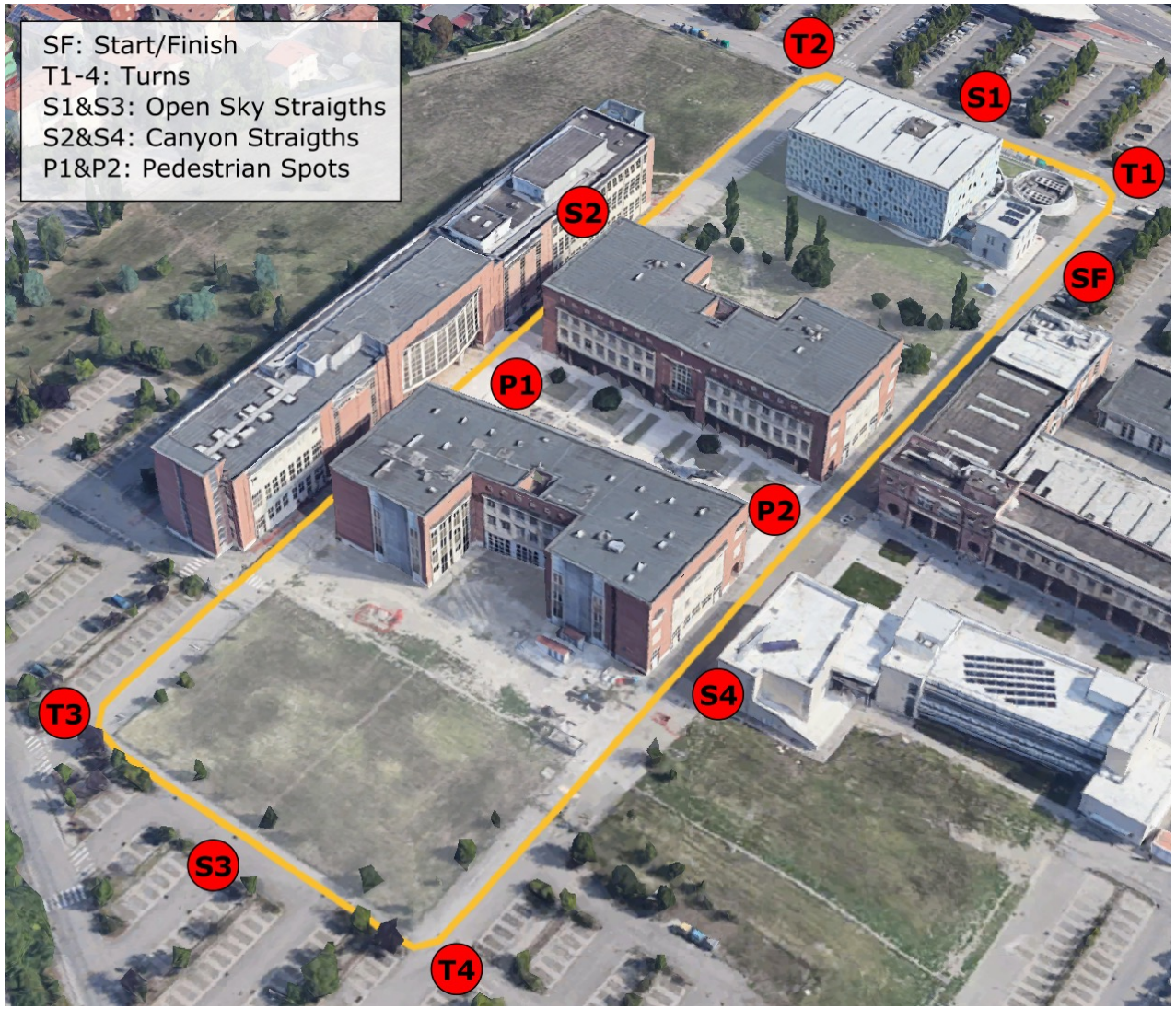
Vulnerable Road Users: GPS-based Awareness Messages

Focus on cooperative awareness messages

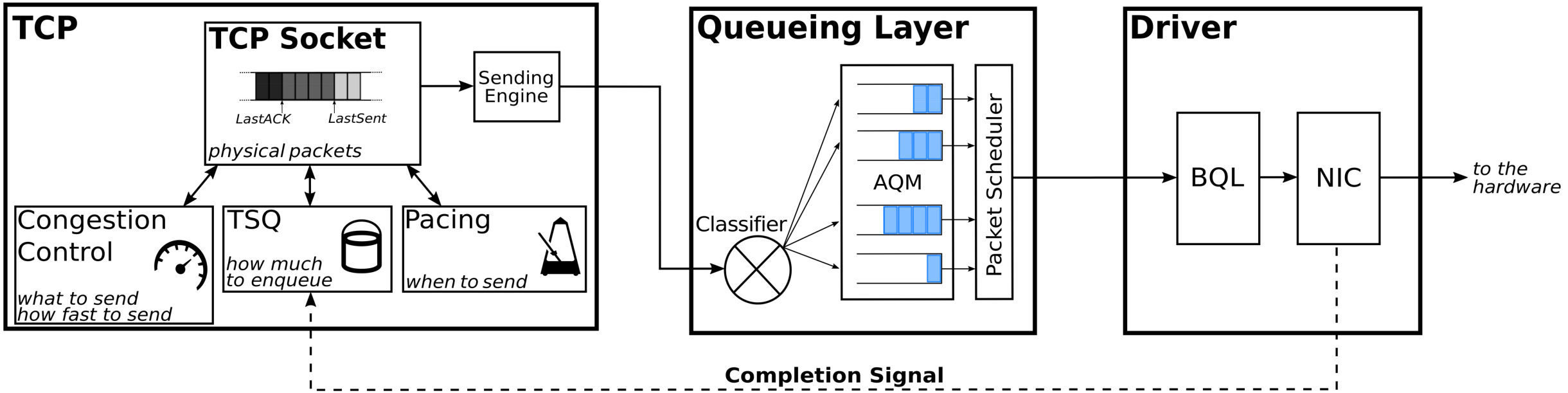


Analysis of application-level, real-world performance.

Analysis of the GPS accuracy role in the packets' triggering



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

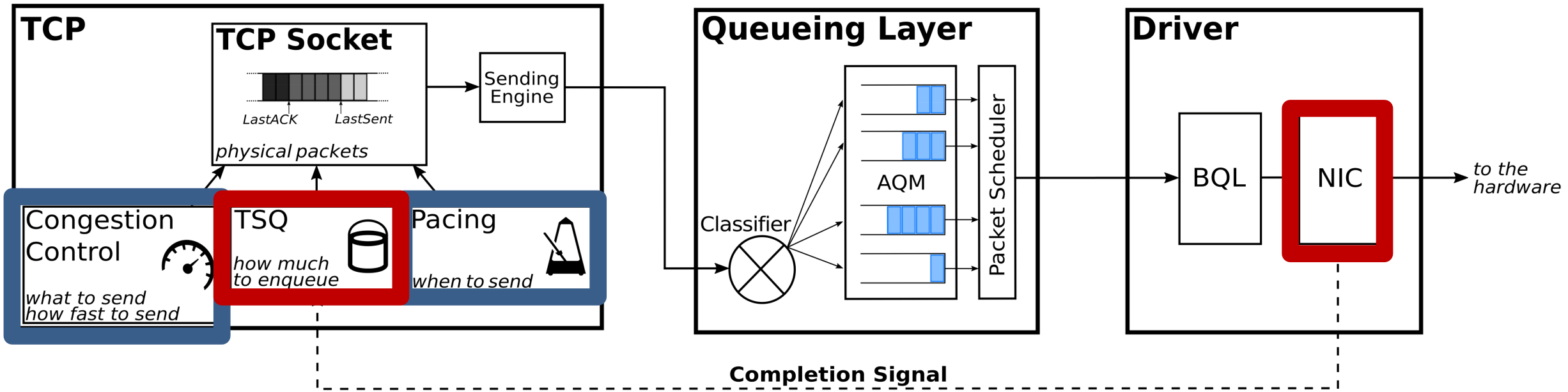


Wi-Fi protocols on Linux

BBR v2.0 patch

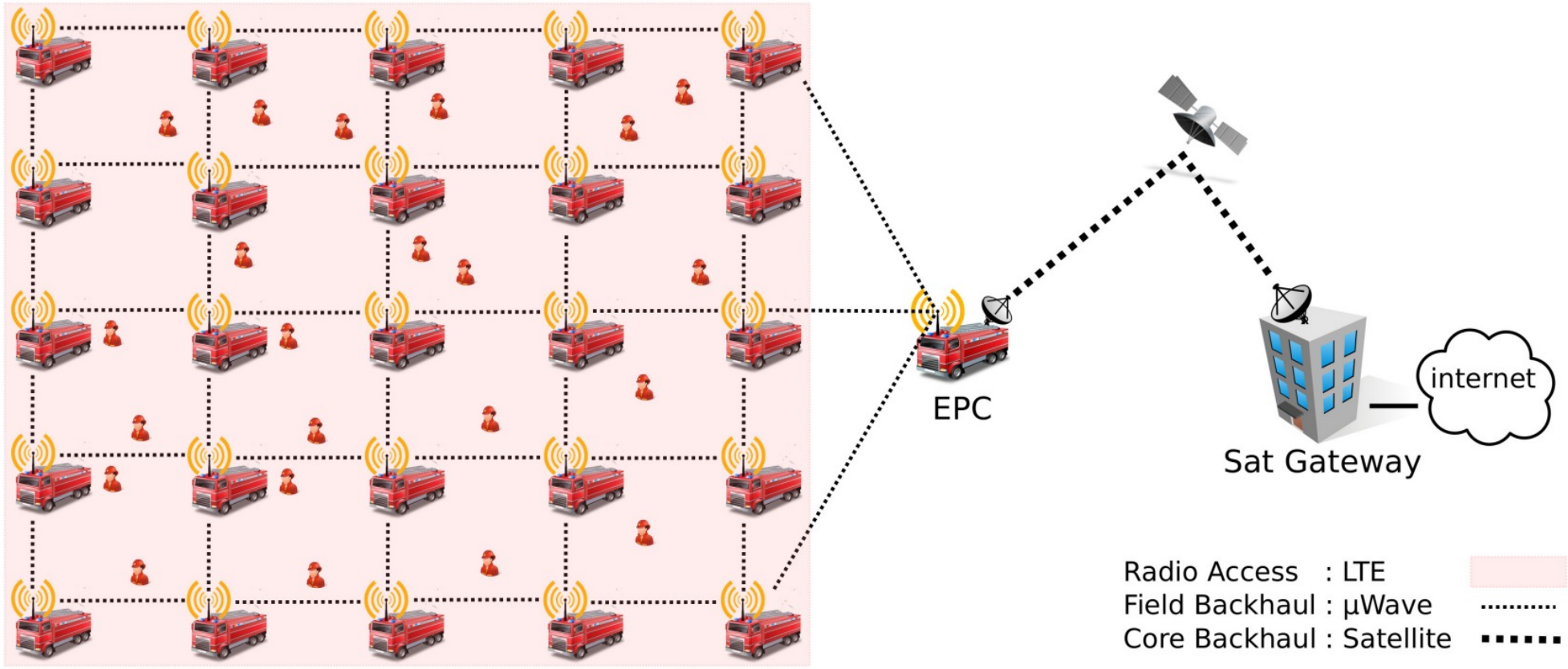
TSQ patch (ath9k and ath10k)

Both available on kernel 5.x



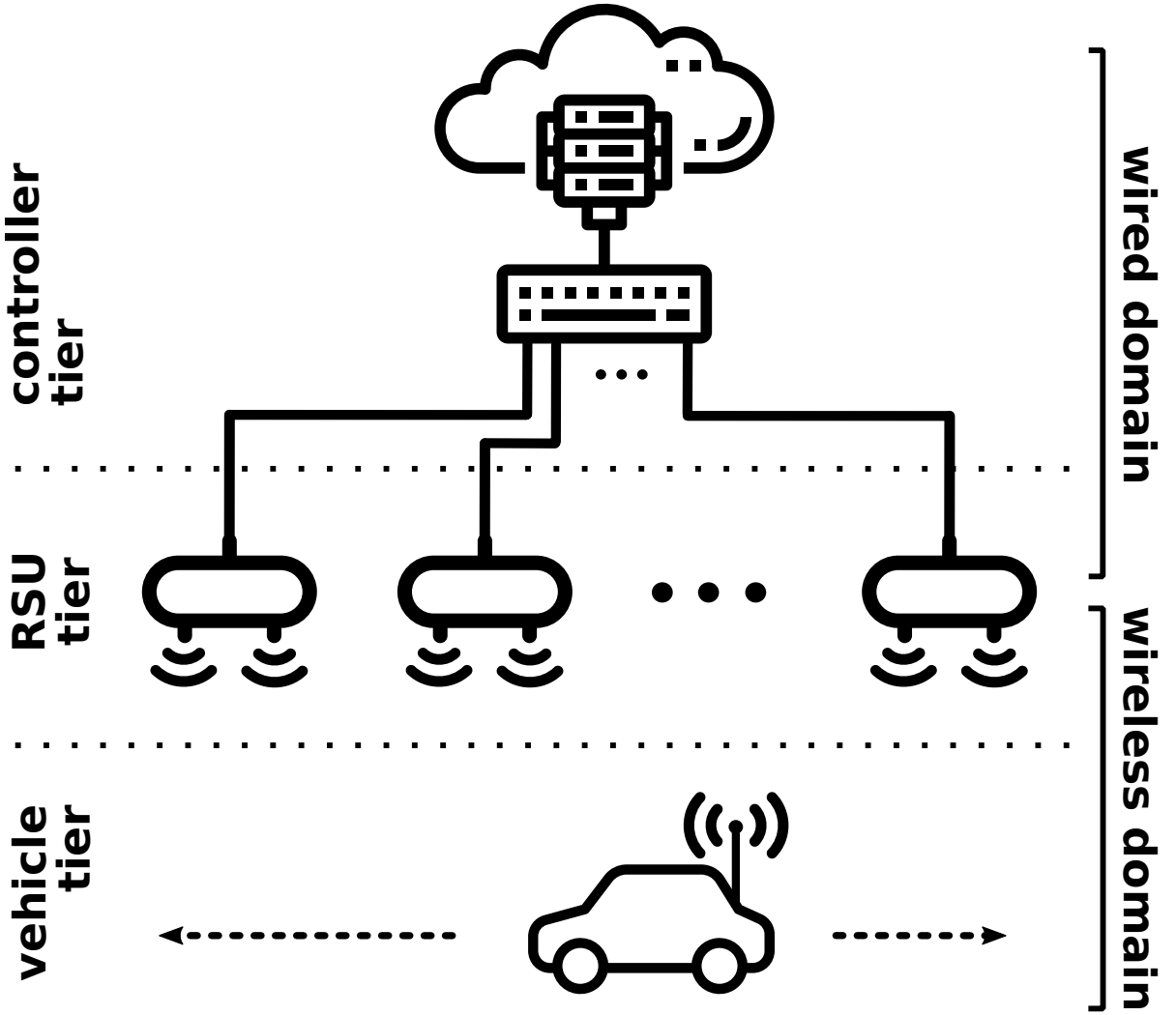
Routing & Coverage in Mesh Emergency Networks

- Simulations
- Mesh Routing
- OLSR vs BP-MR



Routing & Coverage in Vehicular Networks

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

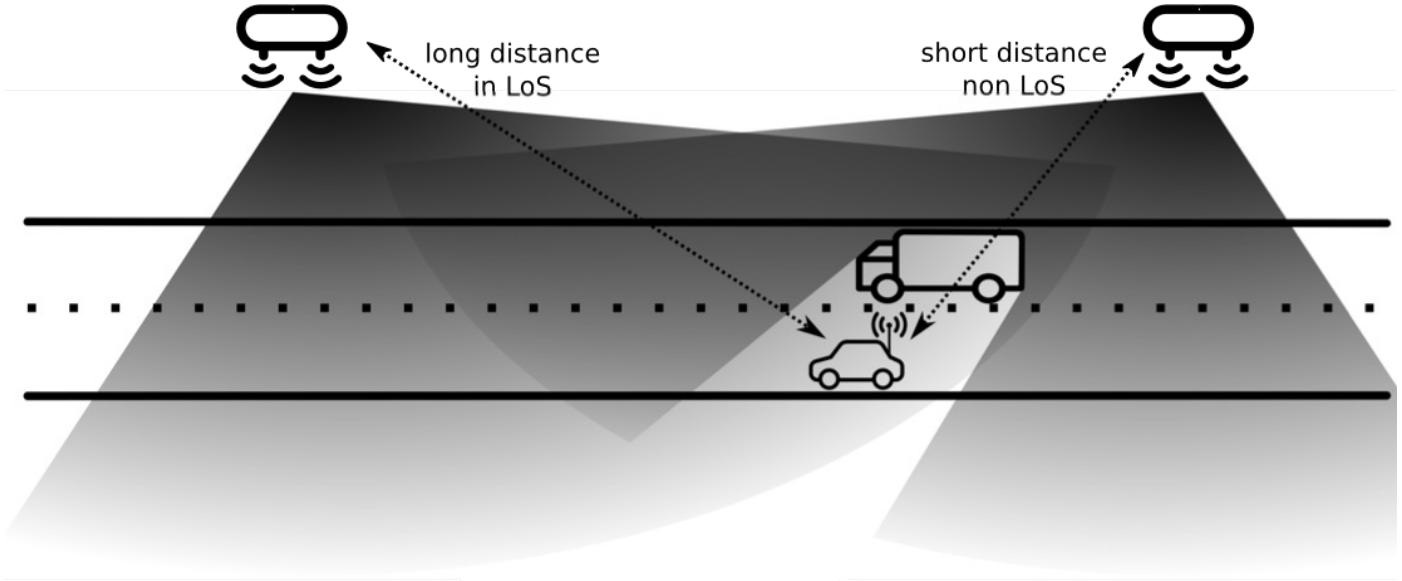


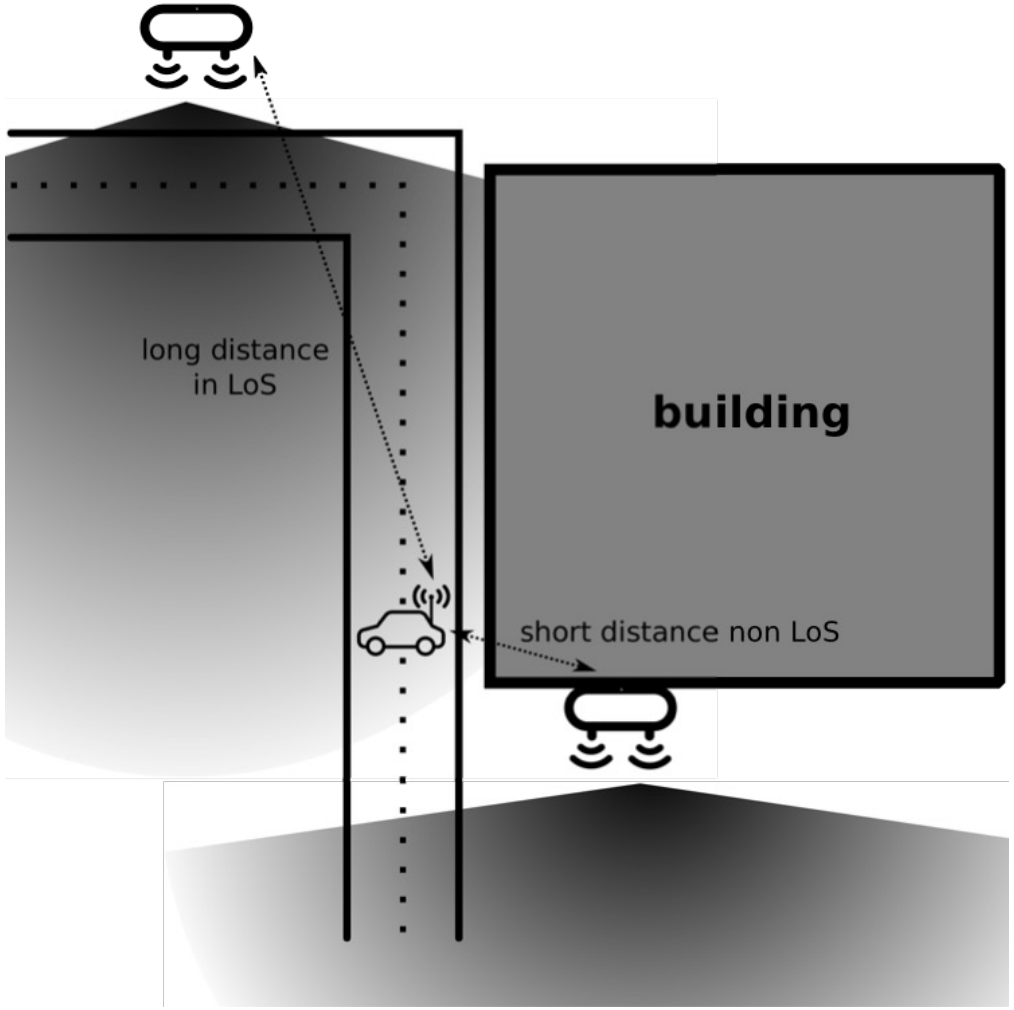
ARDUINO

VEHICLE-TO-EVERYTHING

Routing & Coverage in Vehicular Networks

GPS vs RSSI





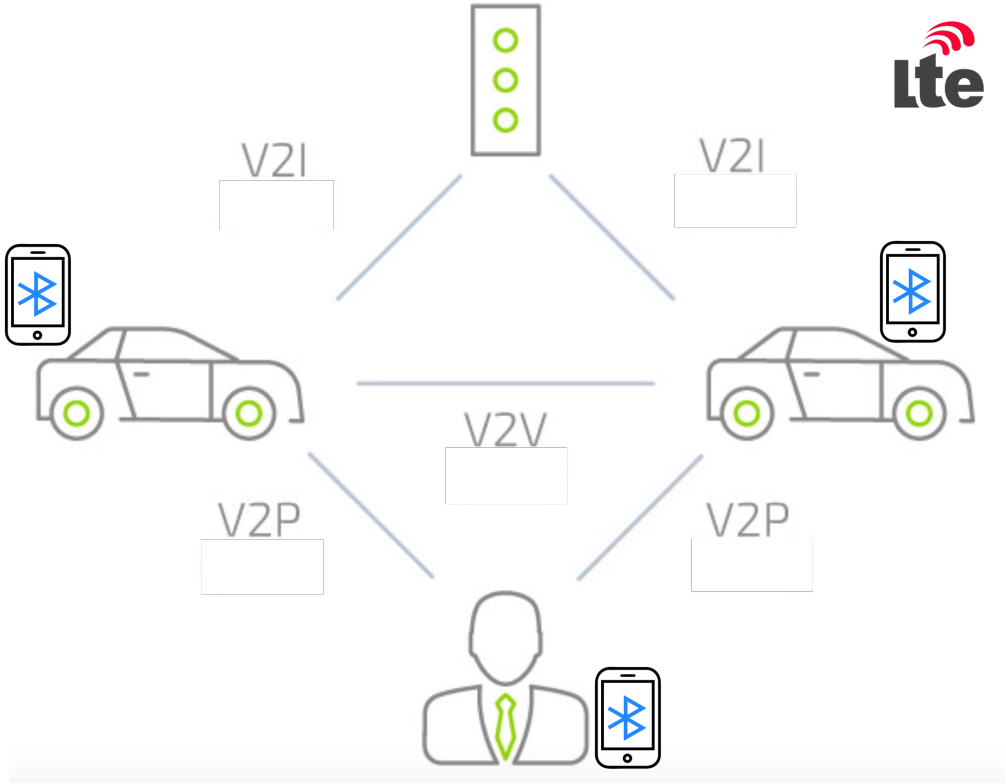
Suitable indoor, for industrial processes

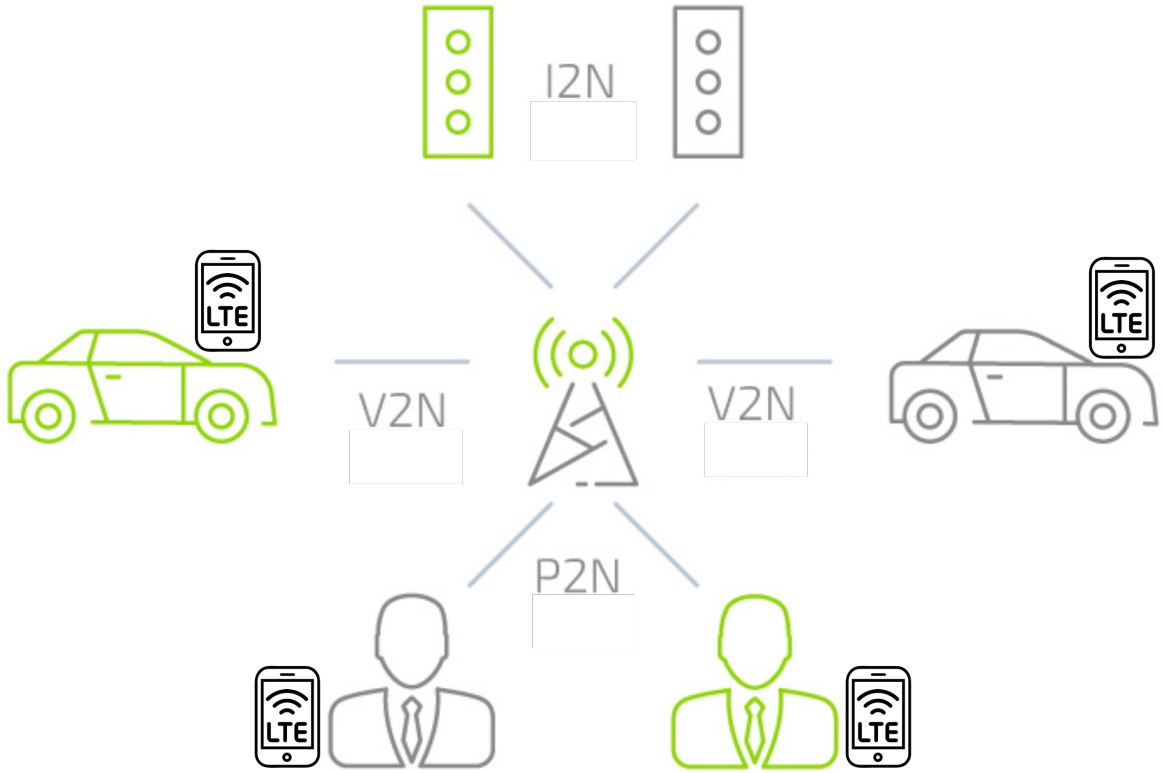
Bluetooth in V2X

Smartphone as OBU

Bluetooth as V2V

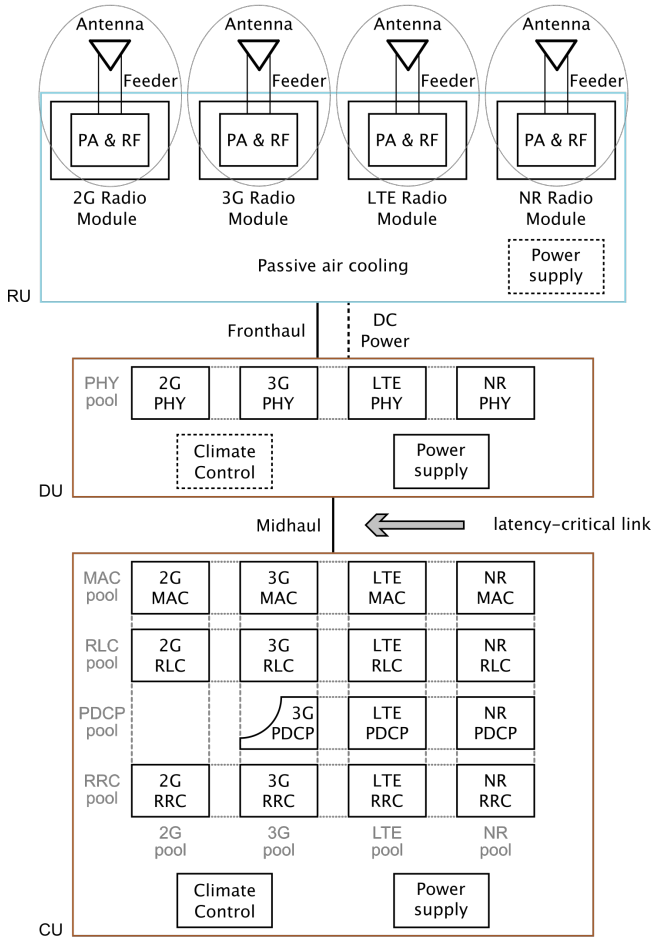
LTE for V2I



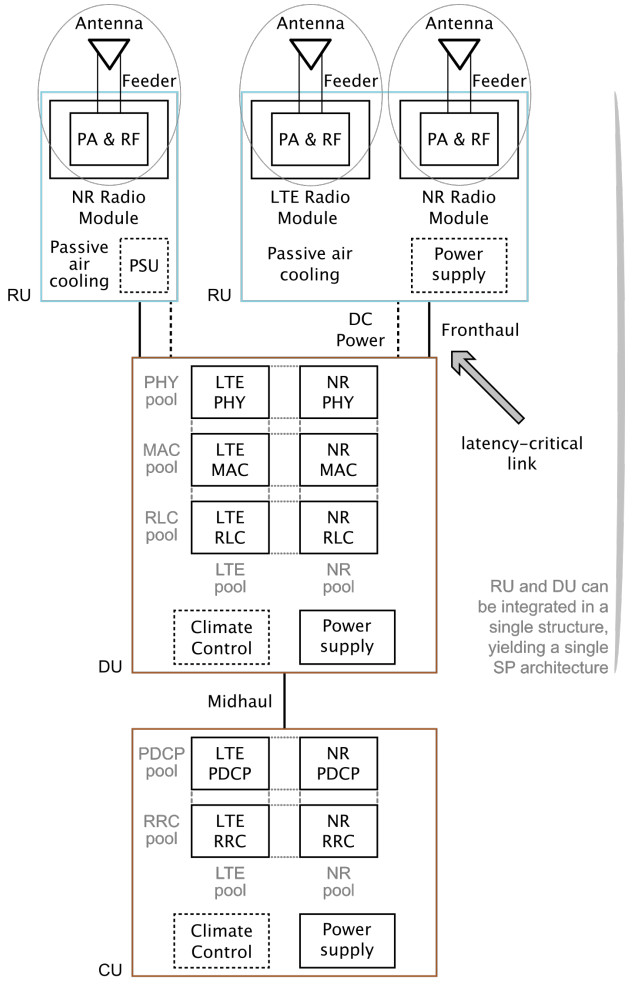


VEHICLE-TO-EVERYTHING

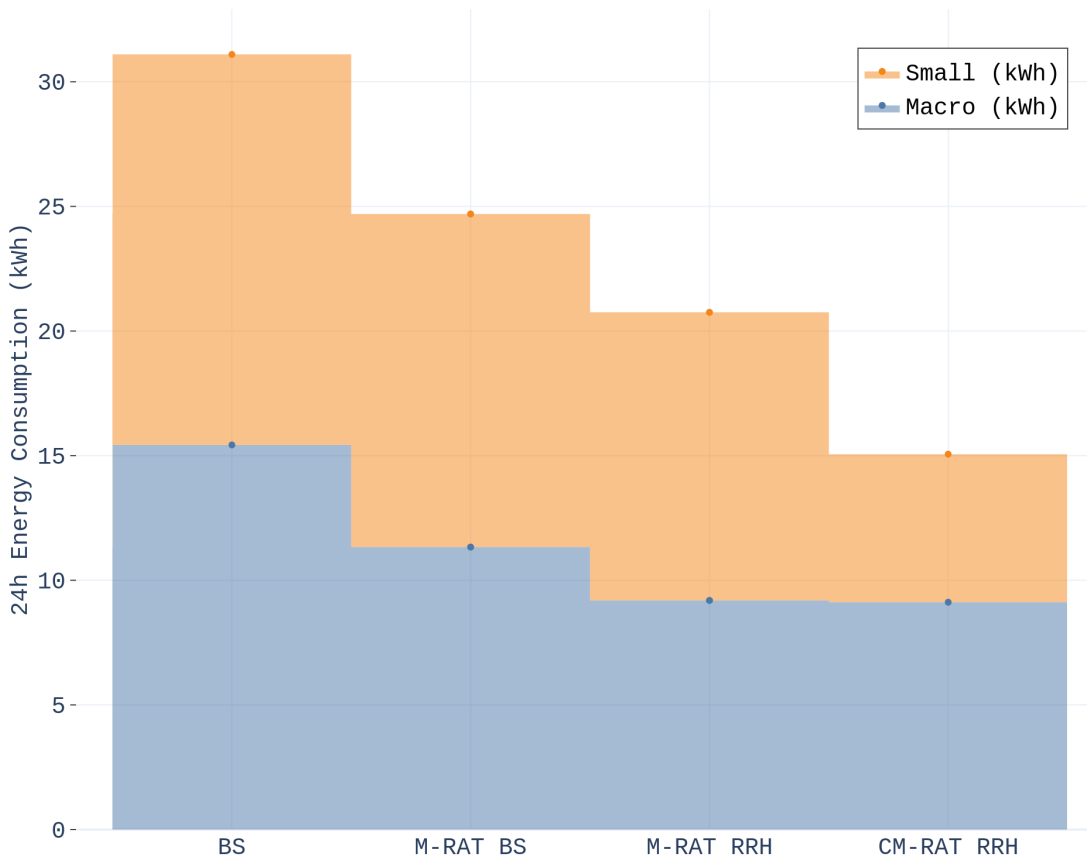
5G: Architectures For Energy Efficiency



(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



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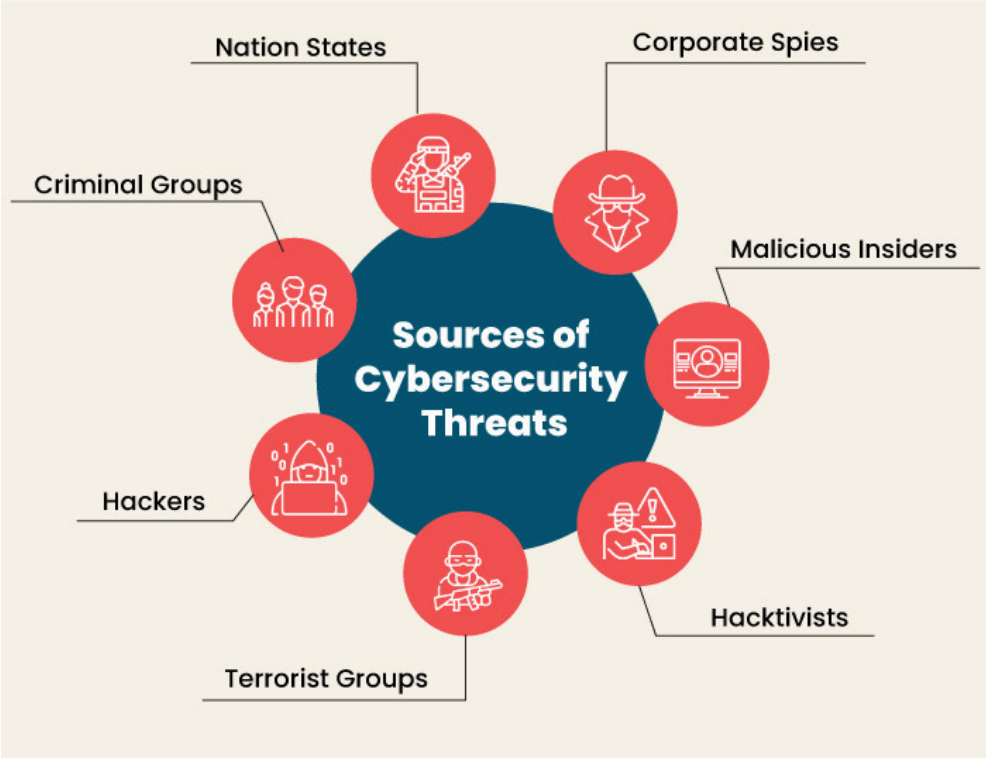
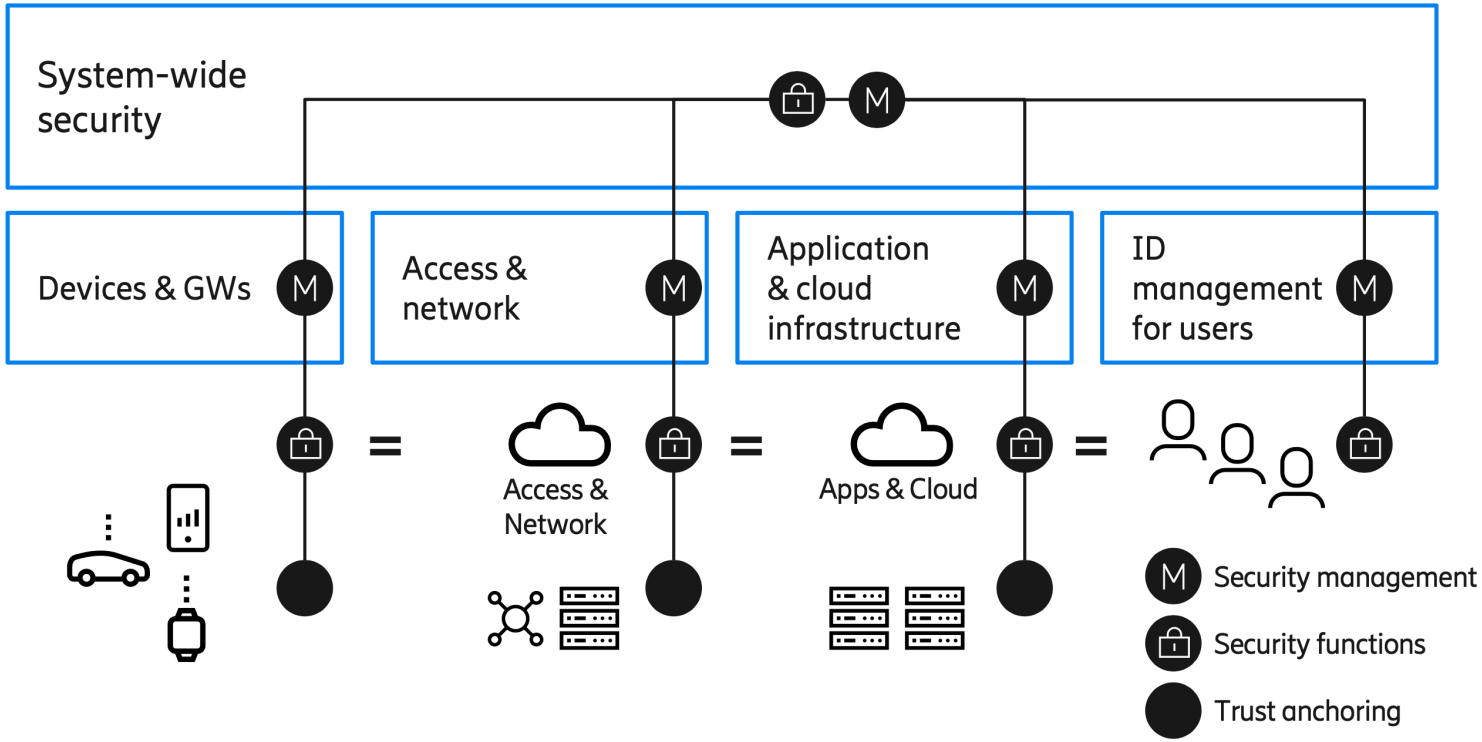
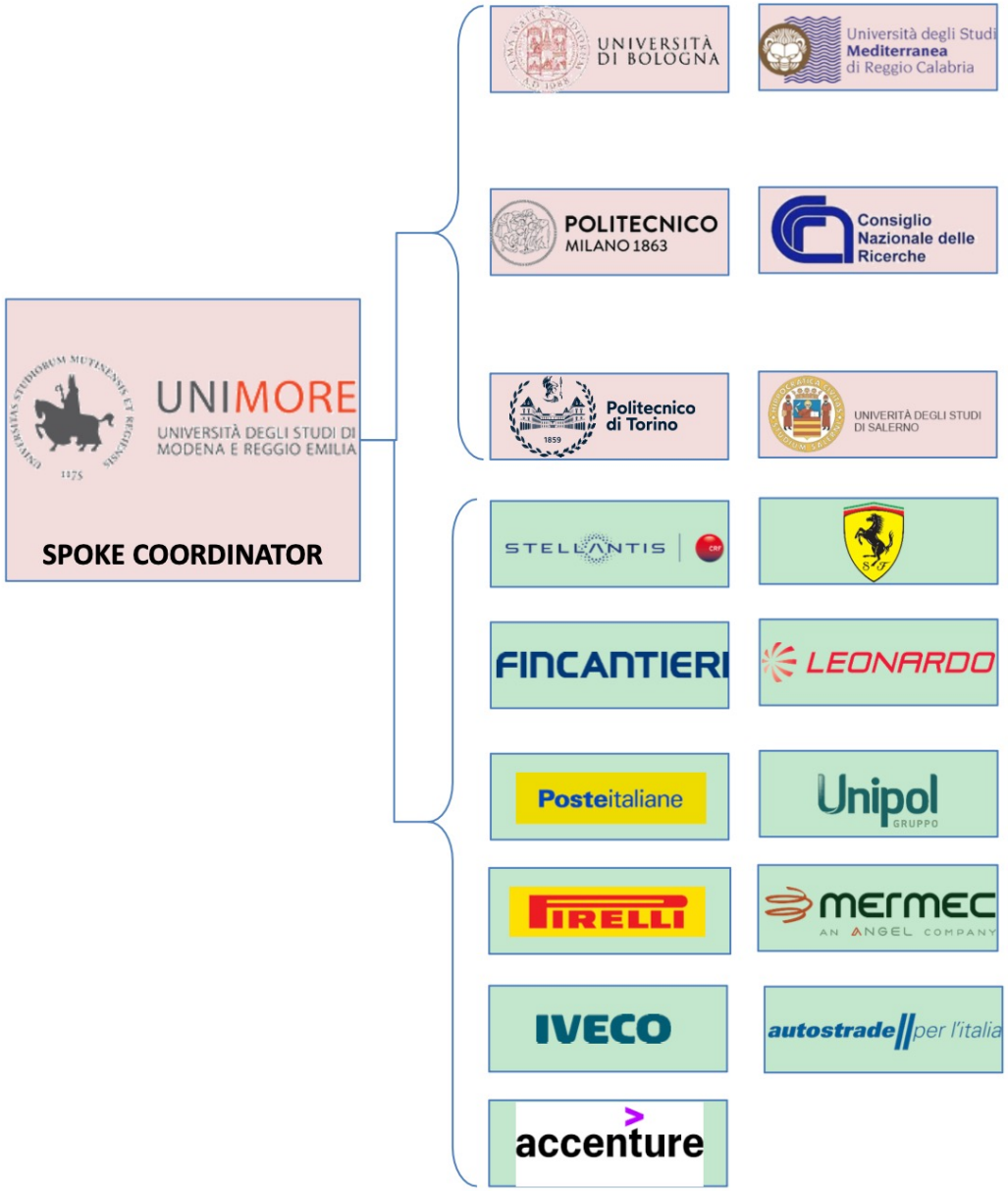
5G: Security


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

Running Projects: Started



PNRR Spoke 6

[CNMS] Centro Nazionale Mobilità Sostenibile

Running Proposals: Submitted

- **POR-FESR IGNITE 5.0:**
  IntelliGent *and* ***secure Networking*** *in IndusTrial Environments: towards Industry* ***5.0***
  In partnership with UniBo.

- **ESA ESTEC**:
  Standardized Ground ***Software Components*** *for* ***Orchestrating*** *High Throughput* ***Satellite*** *Services.*
  In partnership with University of Rome "Tor Vergata”

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**
- **V2X: Congestion through SDR, from small to large-scale**

- **TCP-IP Linux: Flowgrind vs Flent, which tool is better for testing networks**
- **ML-CC: Linux tests on TCP, standard CCs vs ML-CCs**
- **SDN/ML: Mitigation of DoS on radio access**

- **SDN/NFV applied to Satellite networking (terrestrial nodes)**