Automotive Connectivity
Master Course @ UNIMORE

Carlo Augusto Grazia

Assistant Professor

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



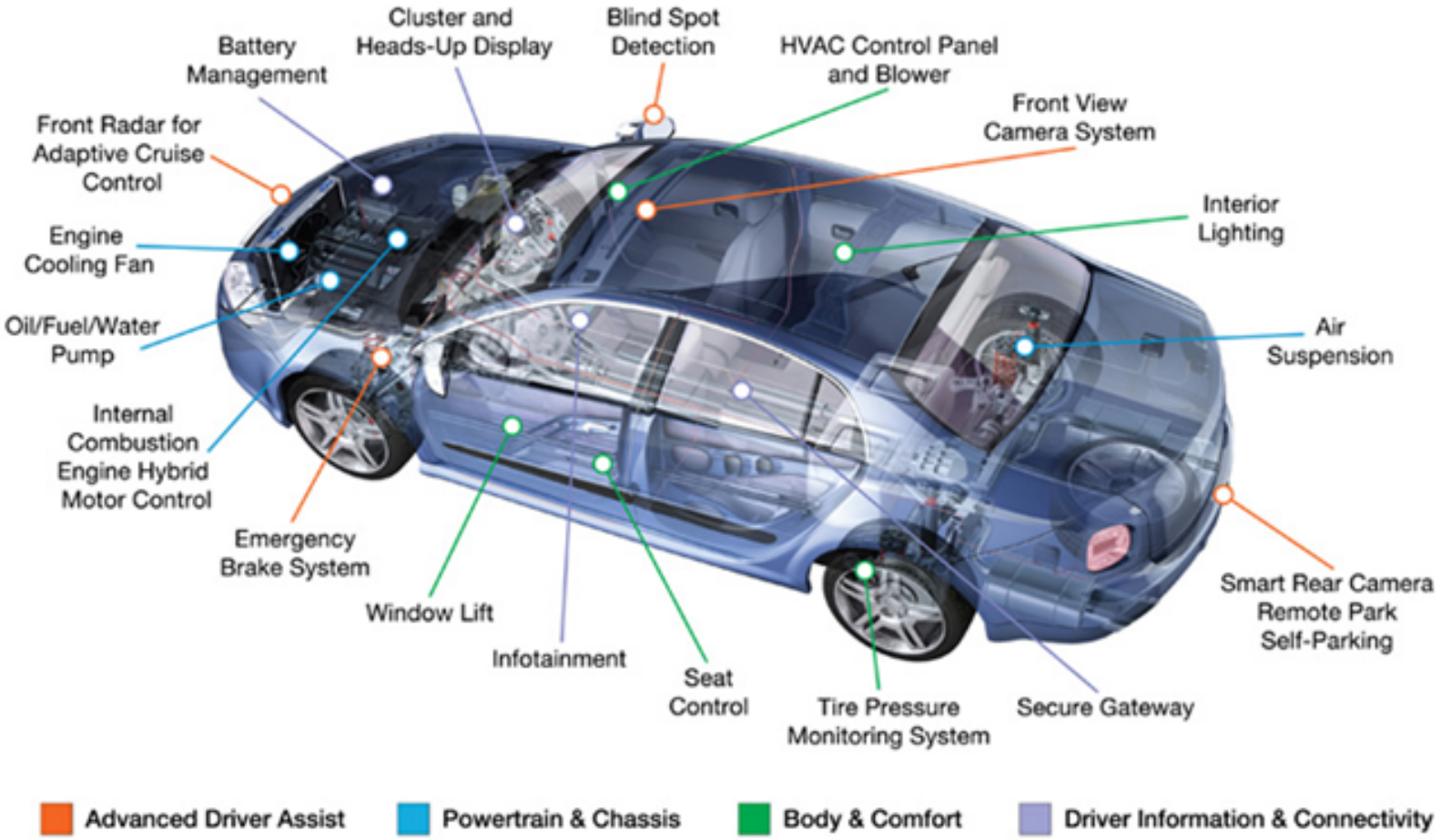
Modena, 10th May 2018

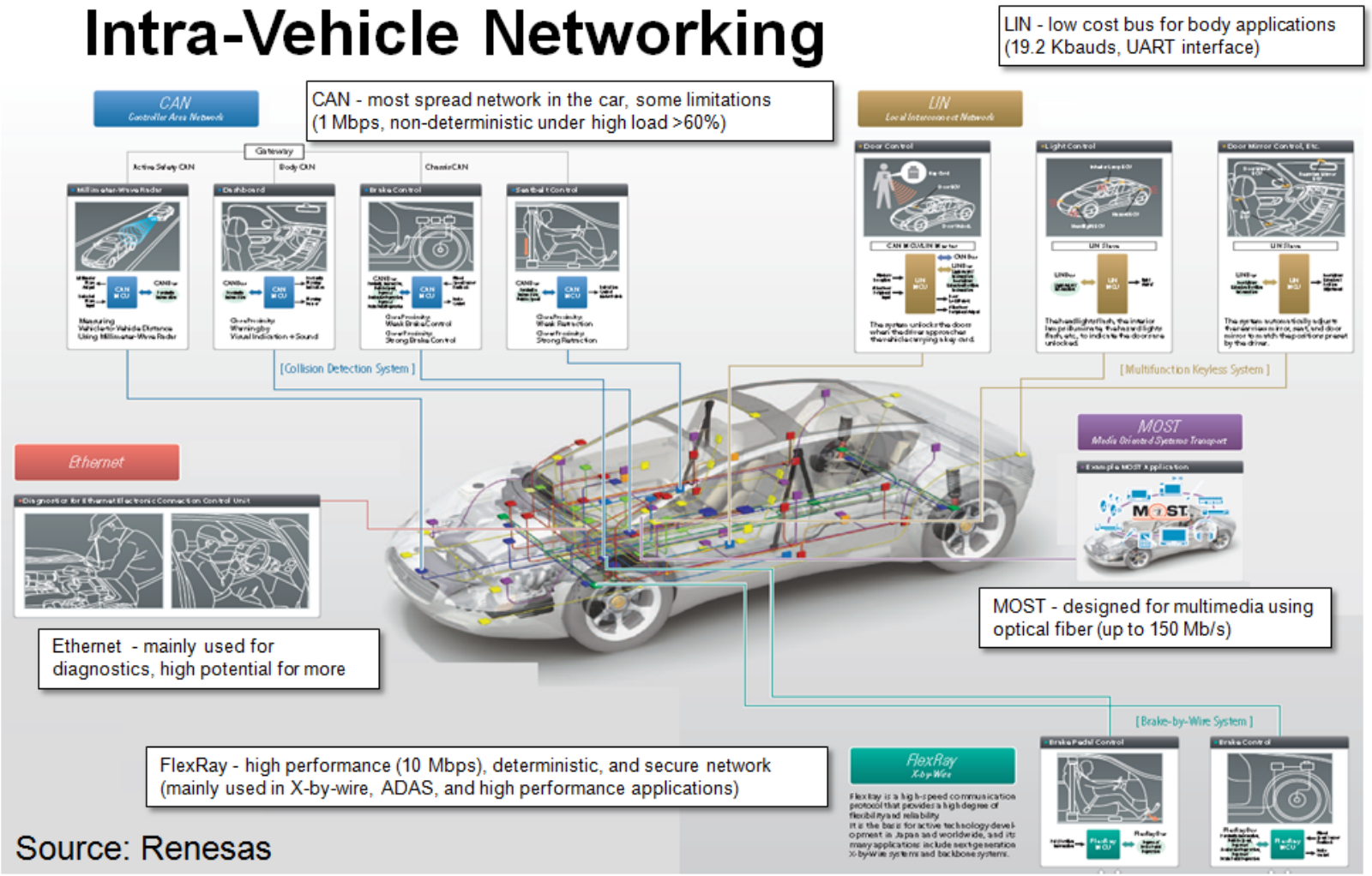
Target of the course

September 2018

- Master's Degree in Electronics Engineering: II Year
- Master's Degree in Advanced Automotive Electronic Engineering: II Year
- Master's Degree in Computer Engineering: II Year

Part 1: In-Car Networking



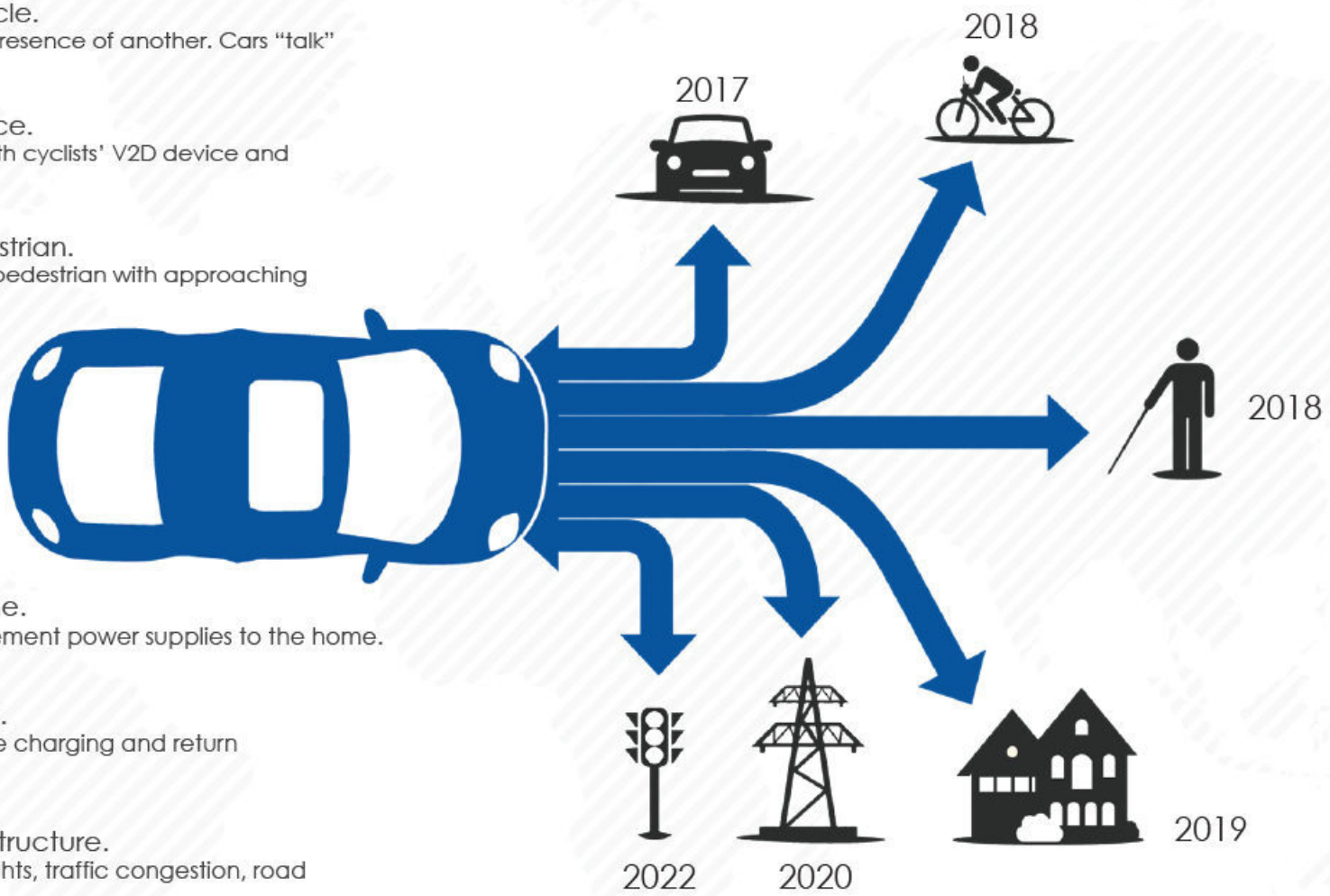

Intra-Vehicle Networking
LIN - low cost bus for body applications (19.2 Kbauds, UART interface)
CAN
Controller Area Network
CAN - most spread network in the car, some limitations (1 Mbps, non-deterministic under high load >60%)
LIN
Local Interconnect Network
Gateway
Active Safety CAN
Body CAN
Chassis CAN
Millimeter-Wave Radar
Dashboard
Brake Control
Seatbelt Control
Door Control
Light Control
Door Mirror Control, Etc.
[Collision Detection System]
[Multifunction Keyless System]
Ethernet
MOST
Media Oriented Systems Transport
MOST
MOST - designed for multimedia using optical fiber (up to 150 Mb/s)
Ethernet - mainly used for diagnostics, high potential for more
[Brake-by-Wire System]
FlexRay
X-by-Wire
FlexRay - high performance (10 Mbps), deterministic, and secure network (mainly used in X-by-wire, ADAS, and high performance applications)
Source: Renesas

Part 2: Car-to-X Networking

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.

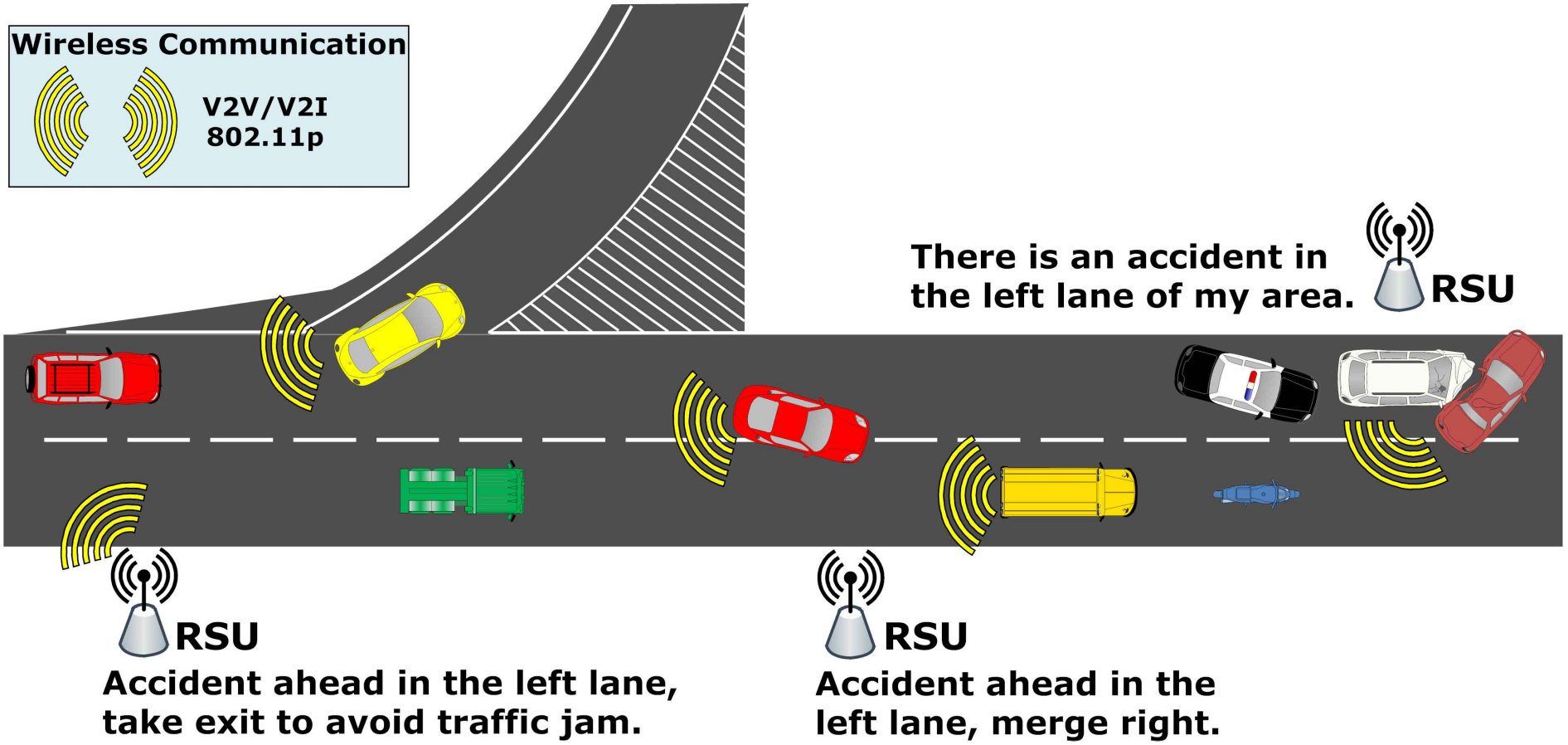


V2H - Vehicle-to-Home.
Vehicles will act as supplement power supplies to the home.

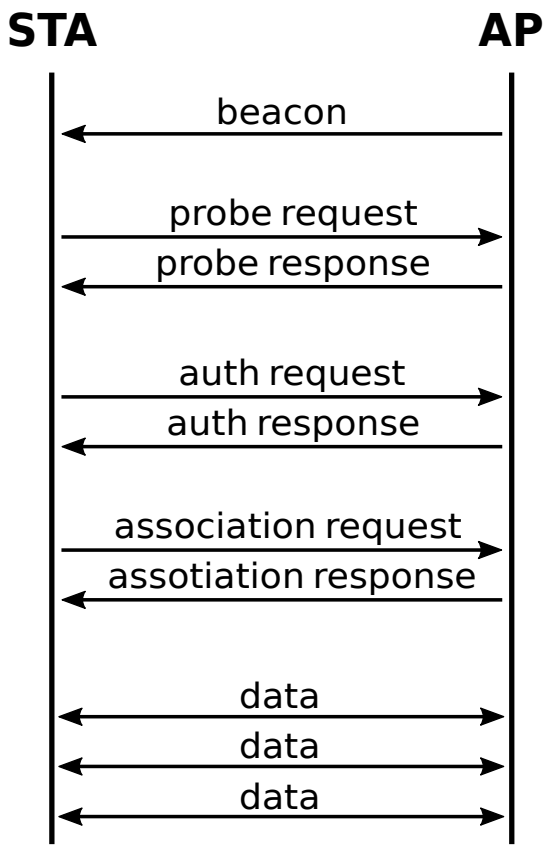
V2G - Vehicle-to-Grid.
Smart grid controls vehicle charging and return electricity to the grid.

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

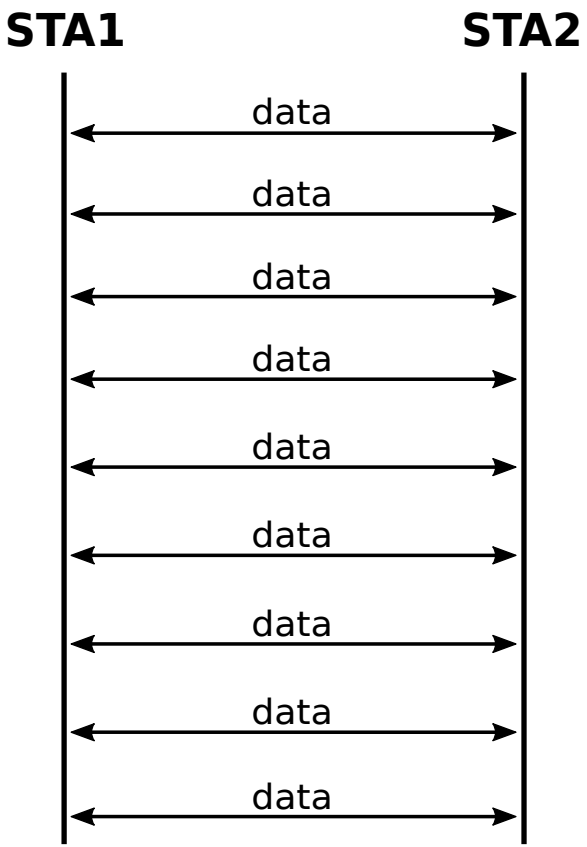
Part 2: Car-to-X Networking



802.11p standard: Outside Context of BSS

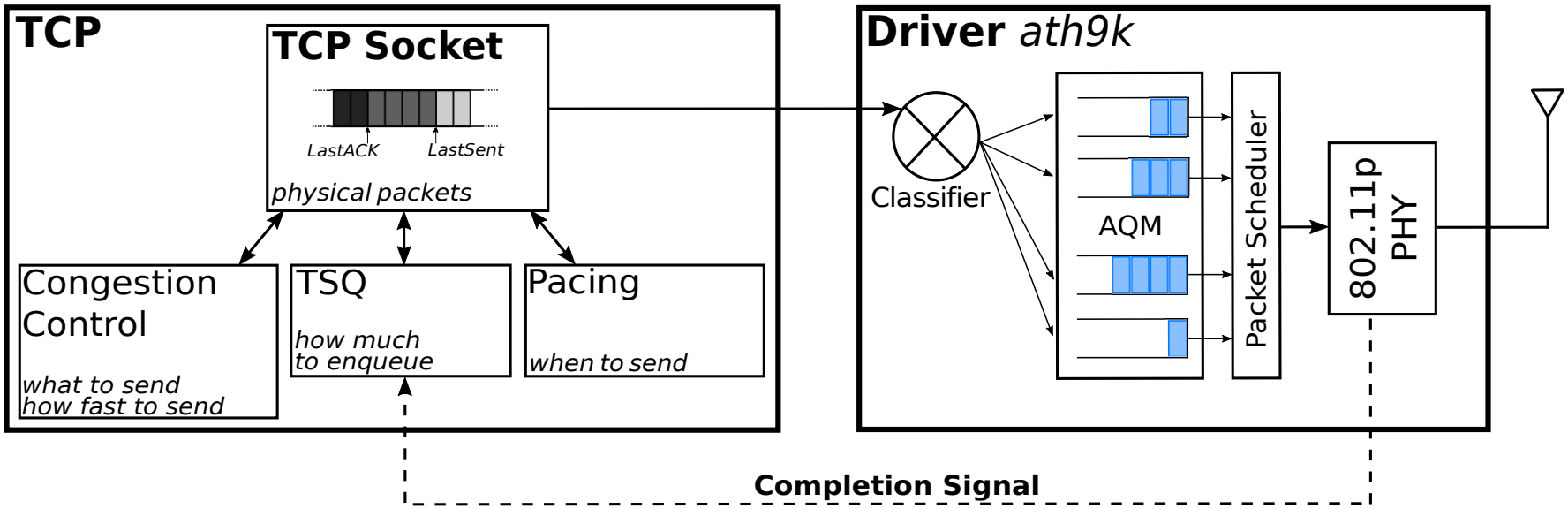


802.11 comm.

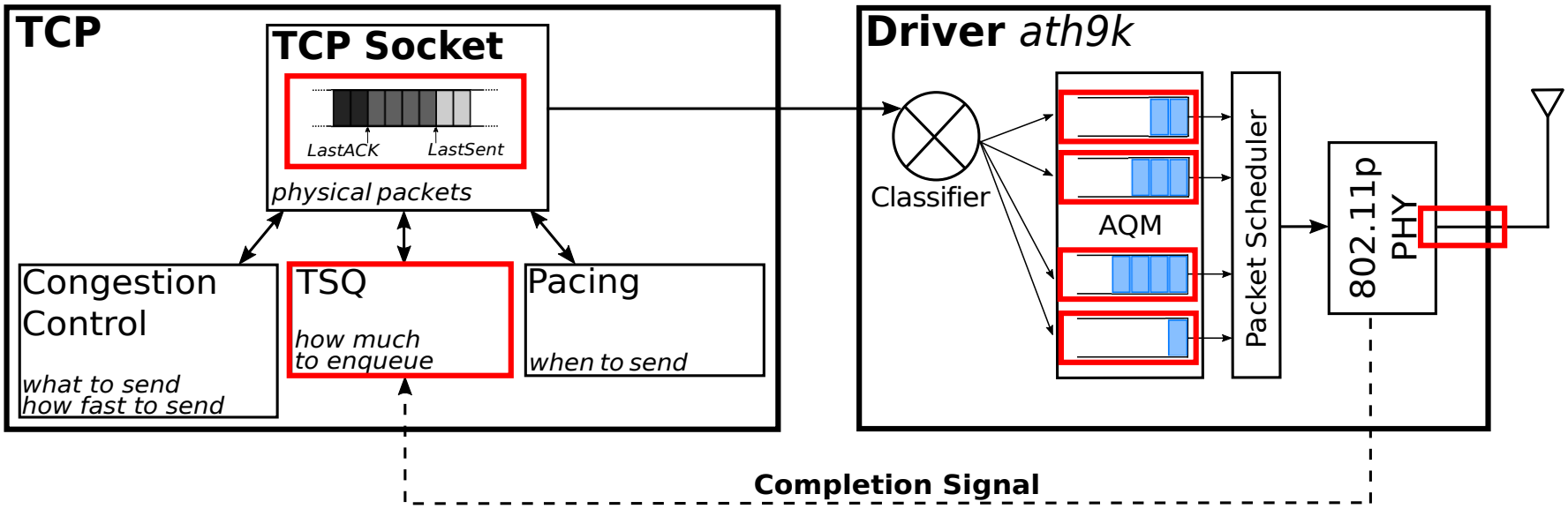


802.11p OCB

802.11p OCB on Linux Kernel



802.11p OCB on Linux Kernel



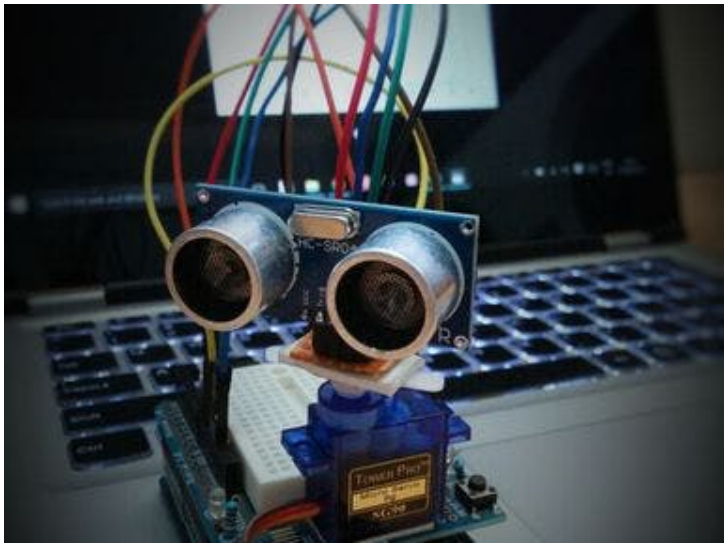
- Again queues...queues everywhere!

Laboratory: ArduinoYun-Based 802.11p Network

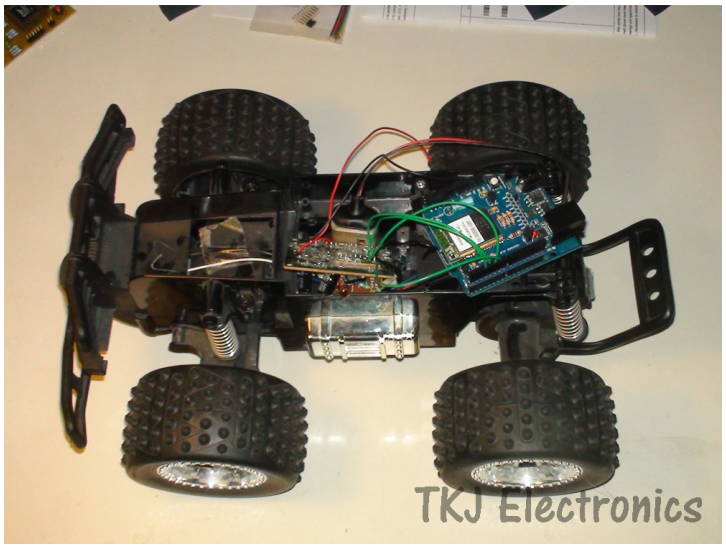


Atheros AR9331 processor, running Linux and the OpenWrt wireless stack

NON-mandatory extra projects: Arduino Yun



Sonar for Distance Measurement

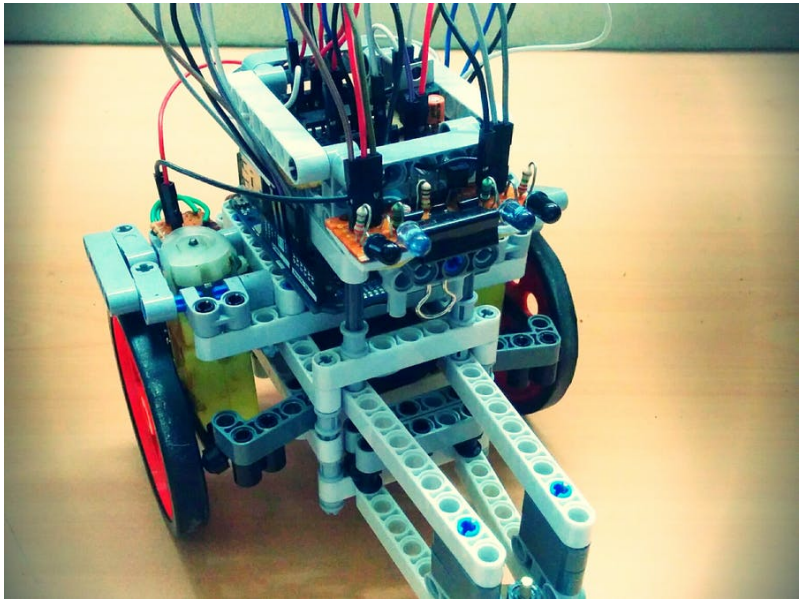


Yun-based Car

NON-mandatory extra projects: Arduino Yun

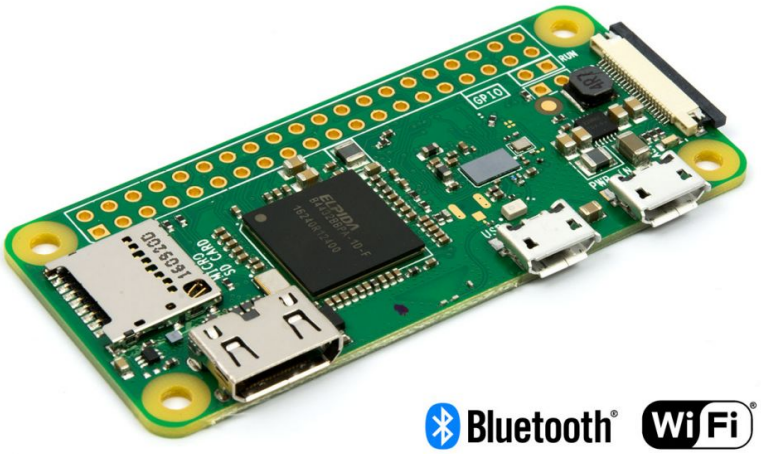


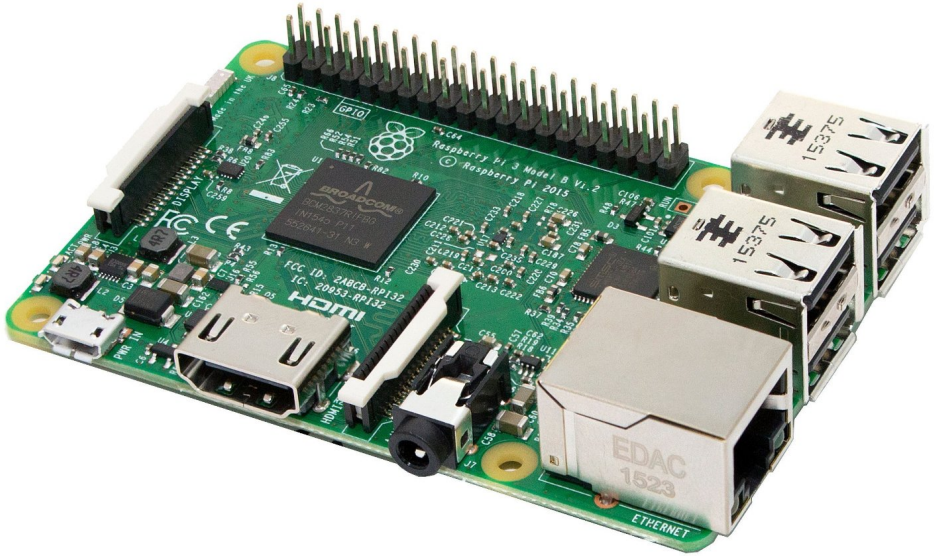
Yun-based Drone



Yun-based Robot

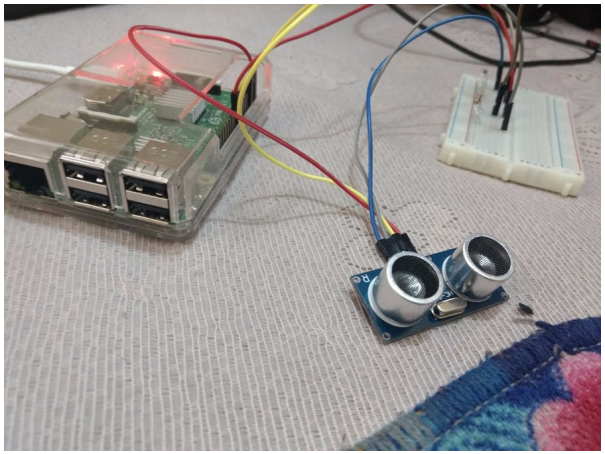
Laboratory Extras: RaspberryPi-Based Projects



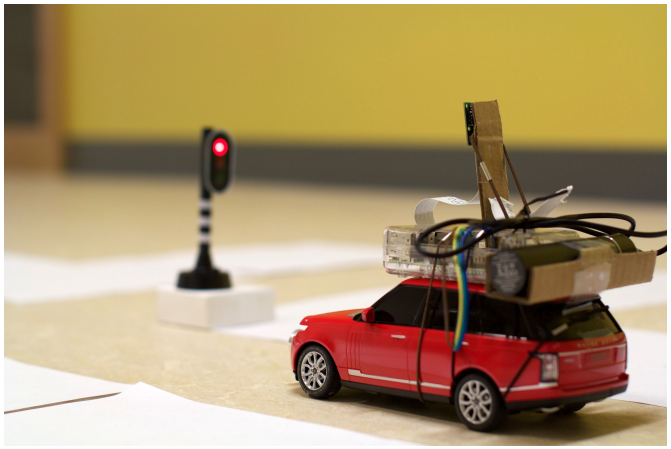


V2X Mesh Network (non 802.11p)

*The Raspberries will be used also for **non-mandatory** extra projects*



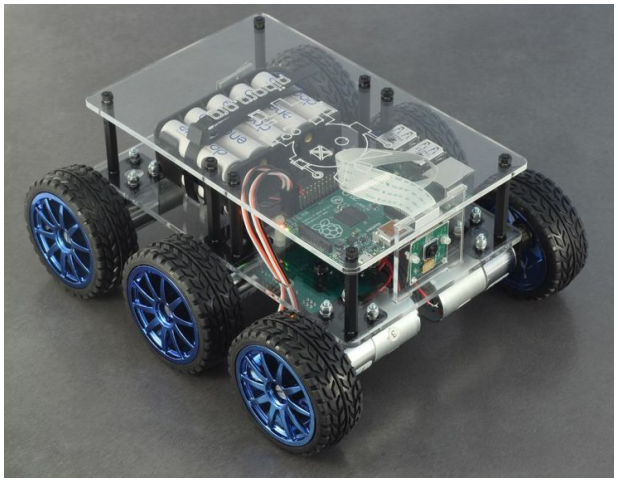
Sonar for Distance Measurement



Autonomous Drive



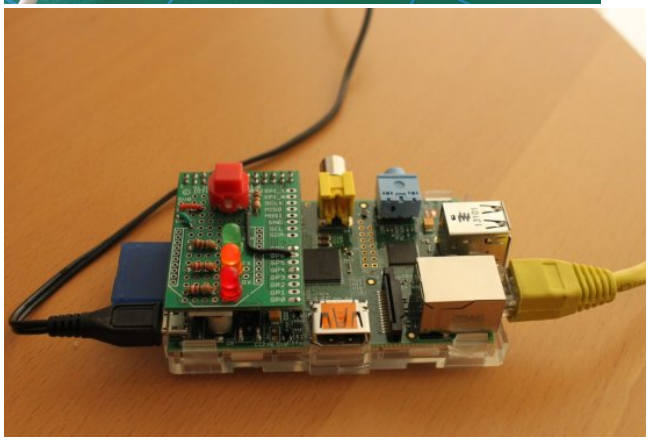
Smart Vehicular Entertainment



Rover Drone



LoRa WAN Connectivity



Traffic Light Monitor

thank you
for your attention



carloaugusto.grazia@unimore.it