



LINKS ACTIVITIES ON VULNERABLE ROAD USERS

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LINKS FOUNDATION

- **Private research centre** funded by Compagnia di San Paolo and Politecnico di Torino
 - Formerly *Istituto Superiore Mario Boella*
 - Focus on applied research and exploitation of research results
- **Multi Layer Wireless solutions (MLW) Area** has been working on vehicular communications since 2008
 - Both theoretical and practical activities
 - 2 FP7 projects: GAIN and GLOVE
 - 3 H2020 projects: InDrive, **Autopilot** and **ICT4Cart**
 - 2 regional projects: IoT_|_Tol and LIMPID
 - 2 private collaborations
 - Participation in 1 ETSI STF (395) and contributions to other WGs; following ETSI MEC for vehicular use cases
 - Several scientific papers, books, etc...
- Continuous development of a **Proof of Concept** composed by several components:
 - On Board Unit (OBU) with hybrid communication (ETSI ITS G5 and cellular), precise positioning and advanced ITS event awareness for autonomous vehicles
 - **Road Side Unit (RSU) with image processing capabilities**
 - **OBU for bicycles**
 - OBU for drones
 - Decision Support System tool (with real-time geo information)

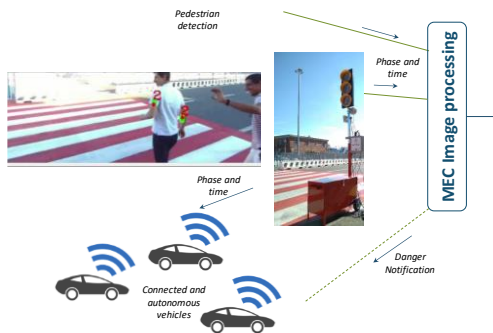


LINKS INTERESTS ON THIS MEETING

- LINKS is currently implementing several use cases involving VRUs
 - Pedestrians and cyclists
 - Mainly in the framework of H2020 Autopilot and ICT4CART projects
- We will be glad to present our current activities (see next slides) and to **exchange feedbacks**
- We are able to **rapidly implement and test new messages** even in the pre-standardization phase
- We are interested **to be updated about the STF activities** to implement new proposed approaches in current or new European projects

PEDESTRIAN DETECTION AT CROSSROAD

- Edge detection (on RSU) of VRUs crossing with red
 - Stereo-camera to **measure distances**
- Notification of jaywalking to autonomous vehicles via DENM
 - over ETSI G5 + SPAT/MAP messages
 - Which position if more than one pedestrian is detected? One DENM per pedestrian?
 - **Not only a generic danger warning but also information about which lane is busy**
 - Using DENM *À la carte* → *Lane position* field
 - More precise information can be useful but the camera precision is still under investigation
- Data are also sent to the cloud (oneM2M)



FALLEN BICYCLE



- Battery-powered OBU on bicycle
 - Sending CAM and DENM messages
- Integrating a GPS with accelerometers
 - Fill CAM with info about bicycle dynamics
 - **Automatic detection of falls**
- Notification sent via DENM message
- The DENM is automatically cancelled when the dangerous event is overcome

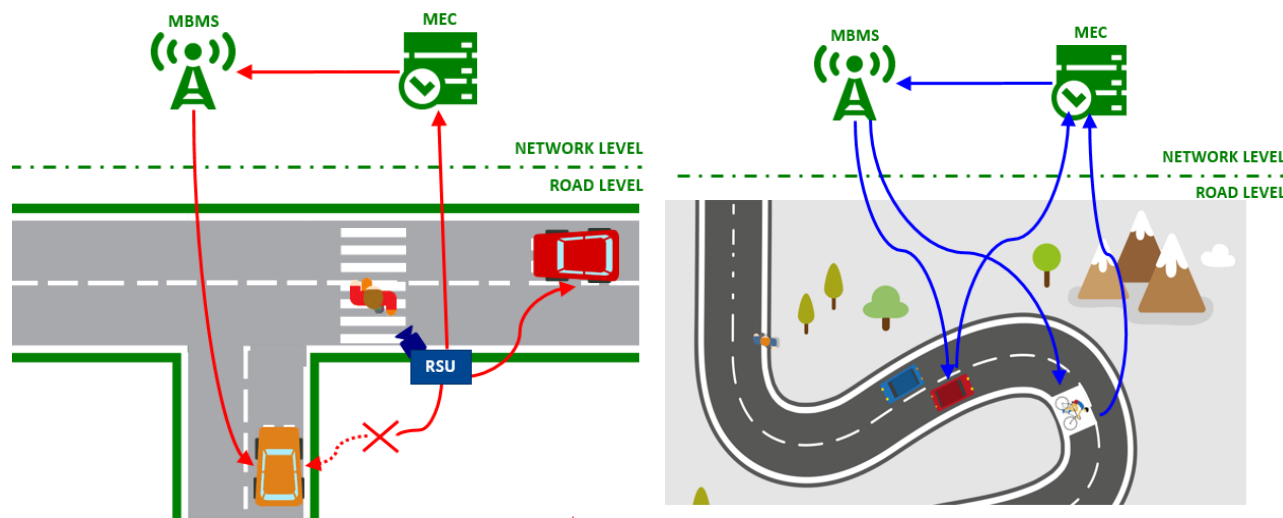


TORINO SMART ROADS PROJECT

- Torino is becoming an **open lab** for testing connected and autonomous vehicles
- Same detection but the elaboration will be performed in the edge of the LTE network (ETSI MEC)
 - Delays must be very low
- Planned in the third quarter of 2019

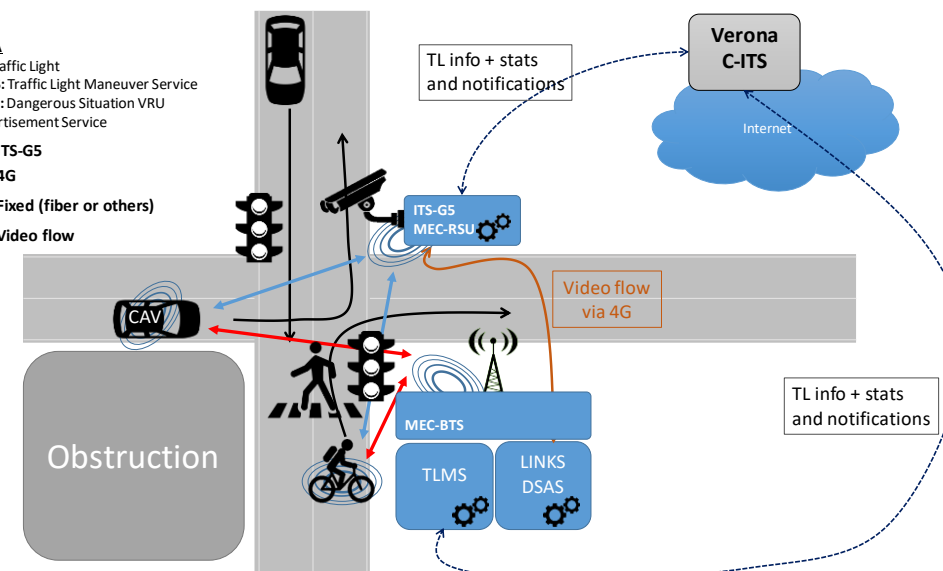
ICT4 CART PROJECT: VIRTUAL MIRROR

- Extension of the pedestrian detection use case
- Not only people but also any vehicle type
 - Focus on safety of VRUs and crossroads
- Comparison between edge computation in ETSI G5 RSUs versus LTE networks
- Messages via DENM or CPM
- Planned in late 2019 or beginning of 2020



LEGENDA

- TL: Traffic Light
 - TLMS: Traffic Light Maneuver Service
 - DSAS: Dangerous Situation VRU Advertisement Service
- ←→ ITS-G5
←→ 4G
- - - - - Fixed (fiber or others)
→ Video flow





CONTACTS

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