EIT Digital – Industrial PhD position proposal

PhD thesis information

PhD Thesis – Title	**Vehicle to Everything: opportunities and constraints in leading the automotive world to 5G**
PhD Thesis – Short summary	Intelligent Transport Systems (ITS) applications are supported by several communication technologies, each with its own frequency range and specific features. Evaluating the performance of different network options for V2X communication that ensures optimal utilisation of resources is a prerequisite when designing and developing robust wireless networks for ITS applications. 5G networks are expected to leverage virtualisation of network resources in order to serve over the same infrastructure applications and services characterised by highly heterogeneous requirements – the so called verticals. The thesis will investigate the potentialities introduced by the 5G network for the automotive domain, identifying use cases and scenarios, and deriving requirements for the M(V)NO. The identified solution will be experimentally validated in a lab environment (Hardware in the loop or simulated scenarios) and in a more realistic conditions.
Rationale/challenge	The automotive industry is currently undergoing key technological transformations as new communication networks are being developed with design goals so ambitious that they could redefine the ITS application portfolio. Being informed and connected, vehicles are aware of the context in which they move, relying not only on their own sensors but being part of a complex interconnected world. In order to deal with complex scenarios, vehicles must be aware of the context they're moving in, relying not only on their own sensors, but also on the information available in the digitalised world they are part of. Data has to be available practically everywhere, not necessarily stored but transferred fast and efficiently from central and local points to various destinations – in particular to vehicles on the move. In other words the enablers of inter-vehicular communication are those technologies which can guarantee low latencies and a direct Device-2-Device Communication. Traditionally IEEE802.11p based technologies have been the unique and best candidate, but the arrival of 5G technology could change the scenario and increase the number of options available.
Innovation	IEEE 802.11p Wi-Fi technologies (DSRC and ITS-G5) have been considered as the primary communication option for ITS safety applications but the use of other wireless technologies (e.g., Wi-Fi, LTE) allow longer range communications and throughput requirements that could not be supported by 11p alone. However, the rapid consumption of wireless data continues to outpace the industry's ability to meet demand and existing technologies do not provide sufficient performance to a new network which requires enhanced broadband, ultra-reliable low latency

	communication, and massive Internet of Things (IoT). The novel network virtualisation solutions need to be devised in order to address the requirements of the automotive use cases. This includes combination of inter technology (Wi-Fi and LTE) resource management and slicing solutions as well as the use of recent Mobile Edge Computing and Fog Computing advances.
Research focus/topics	The proposed PhD program will cover the following topics: • To identify the most important 5G applications and use cases in the automotive domain and to isolate their requirements; • To investigate network slicing as a way to support those applications in heterogeneous (Wi-Fi and LTE) networks; • To study use cases, scenarios, and requirements; • To devise new radio resource management solution across different RATs (Wi-Fi and LTE); • To experimentally validate the proposed solution in a relevant lab environment as well as in more realistic conditions.
Expected outcome	The research activity is expected to unveil the potentialities of 5G technology for the automotive domain, answering the following questions - Where and how is 5G needed for the automotive vertical domain (use cases and scenarios)? - What are the KPIs for each application (parameter/value)? - What requirements are needed for the network operator? - Where and how 5G can be substituted by other wireless technologies (e.g IEEE 802.11p, A-LTE) - How could 5G integrated in the vehicle?
Action Line	**Digital Cities**

Partnership

Industrial partner	Centro Ricerche Fiat S.c.p.a. (CRF)
Academic/research partner	Fondazione Bruno Kessler
HEI granting the title	ICT International Doctoral School – University of Trento
DTC location	Trento
PhD duration	3 years