

**Ph.D. in Information Technology
Thesis Defense**

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Kai DONG – XXXIV Cycle

Beam-type communication for the 6G vehicle-to-everything systems

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Abstract:

In the coming Sixth Generation (6G) networks, advanced vehicle-to-everything (V2X) communication technologies will accelerate the evolution of Intelligent Transportation Systems, with the goal of improving safety and traffic efficiency. The Society of Automotive Engineers specified different automation levels, from level 0 (i.e., no automation) to level 5 (i.e., full automation) for autonomous driving. The higher the level of automation, the more critical Quality of Service is in the V2X systems. To support the advanced use cases of the evolving 6G V2X system, ultra-reliable low-latency communication is required. However, the severe propagation loss of Electromagnetic signals operating in the Millimeter Wave and sub-THz frequency bands limits the coverage range and makes the beam-type communication links susceptible to being blocked. Although the Multiple Input Multiple Output (MIMO) system can compensate for this high path loss by beamforming, there are still some challenges to be addressed in the 6G V2X systems, such as efficient Initial Access (IA), blockage modelling and mitigation. Inspired by the non-uniform distribution of the communication angles constrained by the road typologies in urban scenarios, the Probabilistic Codebook based beams are designed to speed up the IA procedure in vehicular networks. Furthermore, we proposed a novel vehicular blockage modelling approach for an arbitrary Vehicle-to-Vehicle sidelink in a multi-lane highway scenario to derive an analytical model of Signal-to-noise Ratio (SNR) distribution for link-level performance prediction before communications. In the case of the V2X communications links being blocked, candidate blockage mitigation solutions, e.g., advanced relaying technologies, are required for reliable link connectivity. We proposed two different relaying strategies, conformal metasurface and advanced smart repeater, for blockage mitigation and performance enhancement in the 6G V2X networks.

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