# Sensor-Assisted Vehicular Networks in Future Wireless Cities

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Future wireless cities present a rich and compelling opportunity to enhance numerous aspects of city life. One key area is transportation, where connectivity and automation will significantly improve safety and efficiency of travel. Connectivity creates an opportunity to coordinate and orchestrate traffic at the microscopic level of individual cars, bicycles, and pedestrians.

Such orchestration services require precise, sub-meter positioning, even in challenging environments such as urban canyons. They will increasingly rely on direct forms of communication to satisfy latency and dependability requirements. This creates new network workloads that need to be integrated into the network infrastructure. Moreover, automated vehicles can be expected to share and consume increasingly rich information such as video streams and will place unprecedented demand on wireless networks. Due to the high level of mobility, this presents a particularly challenging scenario.

Such data demands are unlikely to be satisfied by scaling current cellular architectures or incremental development of specialized vehicular communication networks. Smaller cells are undesirable for fast-moving vehicles due to increased handoffs and emerging DSRC vehicle-to-vehicle communication networks are designed primarily for exchanging small amounts of data such as vehicle position information (i.e. GPS coordinates). Current wireless access network can achieve high capacity when the clients are stationary but can often provide only significantly reduced capacity when transceivers are in motion.

This calls for novel wireless networking architectures that can satisfy future data demands by exploiting a broad set of spectrum resources with potentially short and uncertain availability. This includes novel unlicensed spectrum resources in the millimeter wave and visible light domain as well as dynamic spectrum access in lower-frequency licensed bands, where the system has to act as a secondary user. In the former case, availability is often short and uncertain because transmission at such high frequencies often requires line-of-sight or an otherwise benign environment. In the latter case, availability depends on the needs of the primary users. Advances in rich sensing and imaging can also be harnessed to optimize these communications and networks. Motion, camera, and lidar sensors in vehicles provide an opportunity to sense and predict availability of millimeter or visible light line-of-sight links, which allows optimizations across the network stack.

Such research should be supported through locally concentrated testbed infrastructure. A flock of sensor-equipped and programmable devices carried by vehicles and pedestrians would allow data collection and experimentation. Ideally, these devices would be concentrated in an area to achieve high density and represent challenging scenarios. The testbed could be further complemented with programmable city infrastructure such as base stations in phone booths, sensors in parking lots and garages, a software-defined network backhaul, and a rich array of IoT devices.

Biography:

Marco Gruteser is a Professor of Electrical and Computer Engineering as well as Computer Science (by courtesy) at Rutgers University's Wireless Information Network Laboratory (WINLAB). He directs research in mobile computing, is a pioneer in the area of location privacy and recognized for his work on connected vehicles. Beyond these topics, his more than hundred peer-reviewed articles and patents span a wide range of wireless, mobile systems, and pervasive computing issues. He has served as program co-chair or vice-chair for conferences such as ACM MobiSys, ACM WiSec, IEEE VNC and IEEE Percom. He was elected treasurer and member of the executive committee of ACM SIGMOBILE. He received his MS and PhD degrees from the University of Colorado in 2000 and 2004, respectively, and has held research and visiting positions at the IBM T. J. Watson Research Center and Carnegie Mellon University. His recognitions include an NSF CAREER award, a Rutgers Board of Trustees Research Fellowship for Scholarly Excellence, a Rutgers Outstanding Engineering Faculty Award, as well as best paper awards at ACM MobiCom 2012, ACM MobiCom 2011 and ACM MobiSys 2010. His work has been regularly featured in the media, including NPR, the New York Times, Fox News TV, and CNN TV. He is an ACM Distinguished Scientist.

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