Chattanooga, TN, a Future Wireless GigCity

A team of researchers and administrators from the University of Tennessee-Chattanooga (UTC), City of Chattanooga, TN, Chattanooga City Department of Transportation, Electric Power Board (EPB) of Chattanooga, and Chattanooga Enterprise Center, will actively contribute to an exciting project called *Chattanooga, TN, a Future Wireless GigCity.* The immediate objective of the project is to upgrade the city of Chattanooga from a *GigCity* to a *Wireless GigCity* utilizing Chattanooga's current fiber optics. This project also aims to provide a fundamental and intelligent infrastructure for smart citywide applications and services, together with the utilization of a global environment for network innovations (GENI) available at UTC. Using intelligent transportation as an example, we will demonstrate significant advancements and great benefits to the city's modern transportation systems. Starting with the existing city of Chattanooga regional intelligent transportation system (ITS) implementation plan for the advanced transportation management system, transit prioritization, the closed circuit television camera system, connected vehicle pilot deployment environment, and accessible transportation technology research initiative, we will explore and further develop the future transportation system including transportation automation and analytics, personalized transportation, and transportation electrification.

Transportation is one of the fields that can greatly benefit from recent advances in big data analytics. Integrating historical data and real-time data can provide predictive and prescriptive solutions for current ITS. Meanwhile, real-time data analytics will play a crucial role in decision making and transportation management. Hence, in order to support real-time data ingestion, transmission and analytics, and to make research outcomes and technologies benefit both industry and residents, it is imperative to build a smart high-speed wireless communication infrastructure with high-capacity, reliability, and secure connectivity in Chattanooga

Therefore, to implement the *Chattanooga, TN, Future Wireless GigCity* project, we plan to develop a citywide smart high-speed wireless communication infrastructure consisting of millimeter wave (mmWave) communications and small cell networks. Millimeter wave communications provide all-spectrum access capabilities and fiber-like data rates wirelessly. Compatible with mmWave communications, small cell networks can support wireless connectivity with high performance, especially in densely populated areas. In this context, our smart high-speed wireless communication infrastructure will be a software-defined infrastructure with hyper-dense small cell access networks and wireless mesh back-haul networks to data ingest and transfer at unprecedented rates between mobile/fixed devices and fiber backbone. The availability of GENI at UTC provides a means to support adaptability and flexibility of this system.

We will address several research and development questions: 1) How to perform dynamic spectrum access for shared spectrum in software defined infrastructure? 2) How to associate users dynamically? 3) How to design dynamic load balancing and dynamic routing in software defined infrastructure using GENI? 4) How to implement dynamic network function virtualization and dynamic service provisioning with multi-dimensional performance metrics? 5) Can mmWave communication with all spectra be deployed citywide? Research in mmWave communications with access to all spectrum ranges is still under development. Therefore, we need to demonstrate the potential of this infrastructure for future wireless cities. We intent to ask EPB for access to towers for cell sites. Our project will answer the research questions listed above and provide proof of concept for feasibility of a citywide implementation.

The principal investigators of this project consist of faculty from the Computer Science and Engineering (CSE) Department and the Graduate Program in Computational Engineering (CmE) at UTC, Technologist in Residence at the Chattanooga Enterprise Center, and Traffic Engineer of the City of Chattanooga. Dr. Mina Sartipi will lead this project. Currently, she is working on projects such as mmWave communications, intelligent transportation, and smart cities. Other faculties from the CSE department include Drs. Farah Kandah, Joseph Kizza, and Li Yang. Dr. Kandah's research interests include stationary wireless/wired networks, mobile ad-hoc networks, and cloud computing. Dr. Kizza is the department head of the CSE. His area of research includes social computing, computer network security, computer forensics, and big data analytics. Dr. Yang's research interests include electronic vehicle simulation and animation, network and information security, and massive data mining. Dr. Reinhold Mann is the interim director of SimCenter and CmE. Dr. Mann has been leading multi-disciplinary R&D teams since 1986 and developed several R&D efforts in intelligent robotics, human-machine interactions, and advanced information processing. Mr. Andrew Rodgers is the Technologist in Residence at the Chattanooga Enterprise Center, a central agency to provide support across municipal and organizational boundaries in the city of Chattanooga. He has worked in the Industrial Automation and Information Technology sector for over 8 years. Mr. Kevin Comstock is a Traffic Signal Systems Engineer at the City of Chattanooga. He has developed and administered strategic and long range planning programs such as the Chattanooga's comprehensive transportation network plan, ITS master plan and congestion management Plan.