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Spring 2015

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Improving emergency and vehicular communication systems drives computer science researcher

A wide range of road safety and driver assistive applications—Intelligent Transport Systems—could result from a collaborative research project that Dr. Ala Al-Fuqaha, WMU professor of computer science, is working on with Dr. Elyes Hamida at the Qatar Mobility Innovation Center and Dr. Bharat Bhargava at Purdue University.

Funded through a $900,000 research grant from the Qatar Foundation—a private, non-profit education and research organization that leads the human, social, and economic development of Qatar—the team plans to design, deploy, and evaluate a framework for adaptation of security and performance features within a standard compliant ITS platform. Additionally, a set of active road safety applications will be demonstrated in Doha, Qatar through small-scale deployments.

Official launch of the project is planned for spring 2015. Al-Fuqaha and his WMU team will focus on developing new mathematical formulations and Trusted Platform Module-based software solutions to optimize the delivery time of sensitive data to vehicles.

Al-Fuqaha said there is a good possibility that by the year 2020 the United States government will mandate that cars and trucks include a wireless modem to connect to vehicular networks that could help alert drivers to potential crashes and other hazards and to communicate with "smart" roads. The research collaborators are developing software to provide the communication protocols.

"Deploying this technology means ve¬hicles will be sharing data—the equipment that is currently available holds data, but does not share it," he said. "Of course, that brings up security issues. We need to put security measures in place so hackers don't have easy access to control vehicles. More security measures means it will take more time for the on-board computers to disseminate information. We need to find an intelligent balance between safety, security, and performance."

Over the next three years, the research team plans to meet once each year in Qatar to compile, review and analyze road test data and at a conference in the United States to share results. Graduate and undergraduate students are also expected to participate.

"In the U.S., we are developing things more on the software side," Al-Fuqaha said. "The software will be installed in Doha and will enable vehicles to autonomously communicate with other nearby vehicles or road infrastructures. It is still a futuristic technology."

The project was spurred by Dr. Lotfi Ben Othmane, who earned his Ph.D. at WMU with Professor Leszek Lilien in computer science. Othmane worked with Bhargava (who served on Ben Othmane's WMU dissertation committee) on several security and privacy issues, to develop the ideas for the project.

Before joining WMU and the CEAS faculty in 2004, Al-Fuqaha was active in research and development with Lambda Optical Systems and Sprint Telecommunications, where he contributed to the design and development of lambda's optical routing protocol. He also played a key role in the design and development of Lambda's Intelligent Network Management System for Dense Wavelength Division Multiplexing optical networks.

Expanding communication frequency spectrum

When Hurricane Katrina hit New Orleans in 2005, the emergency phone networks quickly experienced overload, while other parts of the communication frequency were wide open.

Tapping into those open frequencies could have expedited emergency calls and helped save lives, says Al- Fuqaha, WMU professor of computer science, who is also colaborating with Dr. B. Khan at City University of New York, as well as the University of Nebraska-Lincoln, to discover a solution.

"We hope to develop wireless devices able to intelligently hop from one frequency to another and not be stuck on a given channel," said Al-Fuqaha. "Had this technology been available when Katrina hit, cognitive radio could have allowed for dynamic switching so these users would have been routed to the available part of the frequency spectrum; this could have saved lives."

The project will be launched in spring 2015 and will include looking at animal behavior to guide the researchers in devising new technologies and algorithms to achieve dynamic spectrum access. "Animals forage and then consume," Al-Fuqaha said. "We would like to be able to monitor channels of the frequency spectrum—forage—and then switch to open channels— consume."

Al-Fuqaha is in charge of working on software and testbed development to produce experimental results for the National Science Foundation-funded collaborative effort. Khan, at City University of New York, is working on simulation, creating the experimental study, and answering two key questions: What does it mean for cognitive radio networks?; and, What is the efficacy? University of Nebraska-Lincoln contributes data collected from field studies of animal behavior.

Graduate students are also expected to participate, and Al-Fuqaha welcomes undergraduates to approach him about research opportunities. "I am passionate about involving students in my research," he said. "Conducting practical experiments is one of the most important and effective tools for students to learn."

Learn more about Dr. Ala Al-Fuqaha on this webpage.