Wireless technologies used today based on decades of work at Virginia Tech

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Jeff Reed, who holds the Willis G. Worcester Professorship of Engineering at Virginia Tech, directs Wireless@VT, a research center that has and continues to develop revolutionary approaches to the field of wireless communications. Credit: Virginia Tech Photo by Jim Stroup

Technologies used today by companies, such as Direct TV, Iridium Satellite, Bluetooth, and Globalstar, are based on satellite communications efforts started at Virginia Tech four decades ago in its Bradley Department of Electrical and Computer Engineering (ECE).

Beginning with their first NASA-funded project in 1971 and continuing through the 1990s, ECE Professors Charles Bostian and Warren

Stutzman led Virginia Tech's satellite communications efforts, building ground stations for global satellite communications and characterizing the propagation environment. "The work they started as members of Virginia Tech's Satellite Communications Group has impacted standards and real systems used by industry and government," said Jeff Reed, current director of Wireless@VT.

A defining moment for Virginia Tech's wireless researchers came when they started receiving major funding in 1993 from the Defense Advanced Projects Research Project Agency (DARPA). The first $1.7 million DARPA contract asked Virginia Tech to develop a revolutionary approach to wireless communications.

The Virginia Tech communications engineers combined new technologies in computer chips, antennas, and digital signal processing in a novel way, eventually allowing wireless devices to be extremely miniature, but able to adapt to interference in the radio channel. They accomplished their goals and increased the number of radio devices that could share a single radio frequency, thereby increasing the capacity of wireless users in a specific region of space.

"Companies spun out of this research," Reed said, including the first wireless communications company in Blacksburg, TSR Technologies, which later was sold to Grayson Electronics. In 1998, a second spin-off, Wireless Valley Communications Inc., was founded and later sold to Motorola for some $30 million. "People made their careers from the enabling technologies that we developed," Reed said.

In the 1990s, the wireless researchers at Virginia Tech began filing for patent after patent. Within a few years, some of the technologies they had developed included SIRCOM, an indoor channel modeling program; CELLSCOPE, a technology that identifies a person using a cellular phone; SMT, a site modeling tool for indoor communications that led to

Wireless Valley Communications; Stallion, a high-performance computing device for handsets; and Interactive Video, a wireless mechanism for users to order products they see advertised on TV. All were available for licensing through Virginia Tech Intellectual Properties Inc.

In one of the first highly publicized uses of CELLSCOPE, the FBI employed it in 1995 to track down Kevin Mitnick, the nation's most-wanted computer hacker, in Raleigh, N.C. The SMT software was licensed in its introductory year to leading communications companies, including Motorola, Ericsson, Hewlett Packard, Tellans, and Mobile System International.

Some of the other wireless projects the different groups were working on then are commonplace today, such as the creation of Bluetooth technologies that enable the wireless office emerging in the 21st century; software radio for wireless communication interoperability and smart antenna technologies to eliminate co-channel interference; and advanced wireless modems to support remote computing and high-data-rate wireless access to the Internet. They also were instrumental in improving cellular communications to prevent co-channel interference, and in allowing radio waves to penetrate into buildings. In the area of intelligent transportation systems, they were working on Global Positioning Systems more than a decade before they became popular Christmas presents for directionally challenged drivers.

MPRG founder Ted Rapapport authored the first textbook on modern wireless communications, called Wireless Communications: Principles and Practice in 1996. An instant classic in academia, some 30 universities from around the world adopted its use within the first 12 months, and thousands of engineers were trained using the knowledge coming from the Virginia Tech research laboratories.

As the wireless faculty moved into the 21st century, Virginia Tech became the leading research institution in the field of cognitive radios, called a new frontier for the world of wireless communications. Cognitive radios are intelligent radios that can determine the best way to operate in any given situation. "The new cognitive radios are similar to living creatures in that they are aware of their surroundings and understand their own and other users' capabilities and the governing regulatory constraints" and address the incompatible communications problems between emergency services, said Bostian, also an Alumni Distinguished Professor. They also hold promise for rapid deployment of emergency communication infrastructure in the event of a disaster.

Virginia Tech has led the charge in this new research field of cognitive radios, developing prototype radios and intellectual property in this area. "We are very optimistic that this technology will begin to show up in products within the next five years and be very common within 10 years," Reed said.

Source: Virginia Tech