

Degree Proposal
Master of Science in Wireless and Network Engineering
Institute for the Wireless Internet of Things
Department of Electrical and Computer Engineering
College of Engineering

Executive Summary

Since their inception, computer networks and the Internet have changed the way we live, from how we learn and work to how we shop, entertain, and interact with one another. In 2018, there were 3.9 billion Internet users (51% of the global population), a number expected to grow to 5.3 billion (66% of global population) by 2023. By the same time, the number of devices connected to the Internet will be more than three times the global population. Moreover, over 70% of the global population will have mobile wireless connectivity, 10% of which through 5G devices. Such wired and wireless networks will not design, deploy, and operate themselves (at least anytime soon), but will require a highly qualified workforce covering all the wireless and network engineering. To develop such a highly qualified workforce is the goal of this program.

The Institute for the Wireless Internet of Things (WIoT) and the Department of Electrical and Computer Engineering (ECE) in the College of Engineering (COE) propose a new Master of Science in Wireless and Network Engineering. This program is aimed at preparing highly qualified researchers and a specialized workforce that will lead the future of our hyperconnected society. The program will provide students with the necessary knowledge and skills to understand, design and implement present and future wireless and wired communication networks, through a combination of coursework, master thesis research and/or industry experience. From the expected growth in networked systems, the skills that the proposed program will provide to students are and will continue to be in high demand not only by industry, but also by any entity (federal agencies, national research labs, K-12 and higher education institutions, etc.) devoted to remaining meaningful in our future society.

In late Fall 2021 the leadership of the COE charged its departments to increase the size and scope of their graduate education plans through updated and new M.S. programs. A call for expansion of these programs to the NU global campuses is also advocated to help with implementing the college mandate. To this purpose, the chair of the department of ECE contacted the leadership team at WIoT and asked them to take ownership of updating and creating M.S. degrees that respond to the COE charge and to the general need for educational and workforce development requirements in the trending field of telecommunication and networking. Professors Melodia, Jornet, Basagni and Bernal Mor of WIoT started by updating content and scope of the concentration in Computer Network and Security (CNWS) of the current M.S. in Electrical and Computer Engineering. While working on this concentration, it occurred to the faculty of WIoT and to the chair of the ECE department and to the chair of the ECE Graduate Affairs Committee (GAC) that a full-fledged new M.S. degree in Network and Wireless Engineering would be more effective for attracting students to the field. This would also give the WIoT and the department the opportunity to make the topic more interdisciplinary, more rooted in the unique experimental resources available at WIoT, and palatable also to the communication and networking community at large (including also industry and governmental agencies) that participate to the WIoT activities. A proposal for a new M.S. in Wireless and Network Engineering was presented and enthusiastically approved by the ECE chair, by the ECE and College GACs and at the university level within set deadlines for new program approval.

Program Description

The Master of Science in Wireless and Network Engineering is structured as follows: a total of 32 semester hours (SH) are required, which students can obtain by following one of two tracks, namely, *course-only* and *thesis-course*. All students are required to complete 8 SH in *core courses* (two courses of 4 SH each out of a pool of 3 courses), and either 24 or 16 SH in *elective courses* for course-only and thesis-course options, respectively. Thesis-course students will complete their requirements by taking thesis credits (8 SH). The courses are primarily from the ECE graduate curriculum and cover all aspects of wireless and wired networking, ranging from hardware design and electromagnetic characterization to communication techniques and networking protocols for present and future network generations (from 5G to 6G and beyond). In addition, courses relating to network security in the CS graduate curricula have been identified and included as elective courses to complement the ECE offerings.

In terms of co-op opportunities, WIoT has strong relationships with several companies in the wireless, defense, computing, and manufacturing areas, which are sponsoring WIoT's research or partnering in various ways with WIoT faculty and researchers. These companies, which include AT&T, Raytheon, Verizon, MITRE, Interdigital, Mavenir, Dell, NVIDIA, Qualcomm, Draper, Facebook, Red Hat, Mathworks, JMA Wireless, VIAVI, Keysight, National Instruments, US Ignite, Intelligent Automation, Andro Computational Solutions, Airanaculus, will be targeted as co-op partners for the new program.

Through the combination of courses, industry training through co-op, and research experience at the WIoT, students who complete the Master of Science in Wireless and Network Engineering will be able to 1) Understand the state-of-the-art wireless and wired communication network architectures, including their building blocks, functionalities, and integration; 2) Design, implement and orchestrate wired and wireless communication networks, utilizing theoretical, numerical, and experimental tools; and 3) Anticipate and adapt to new distributed application requirements, networking architectures and communication techniques. These will be the three research outcomes that will be used to pursue accreditation of the program. Finally, besides Boston, it is the ultimate goal of WIoT, ECE and COE to offer this master across NU Regional Campuses.

Program Contribution to the University's Mission

The proposed program is well aligned with the department, college, institute, and university objectives. At the **department level**, the program builds on the strengths of both electrical engineering (communications, signal processing and control) and computer engineering (computer networking and security) and offers an integrated path for students who want to cover the entire protocol stack, from communications and signal processing to networking and application. Traditionally, this has not been the case, as students have been asked to choose one or the other. At the **college level**, the program builds on the existing strengths and international leadership of our faculty in research initiatives that continue to shape the future of our hyperconnected society. Wireless and Network engineering are foundational for any aspect of society. At the **institute level**, the WIoT is at the forefront of next generation wireless and wired communication networks, with emphasis on 6G wireless systems, the use of machine learning for network orchestration and management, and, overall, large scale experimental research. All these will be key components of the proposed program. Ultimately, at the **university level**, the program contributes to the mission of providing an innovative, experientially driven education to students who can make a positive impact on society. Students graduating from this program will be equipped with theoretical and experimental tools to address critical societal needs, such as the development of technologies to bridge the digital divide in our nation and in the world. The

program also contributes to the university plans to become a global institution as we plan to expand it to the NU regional campuses.