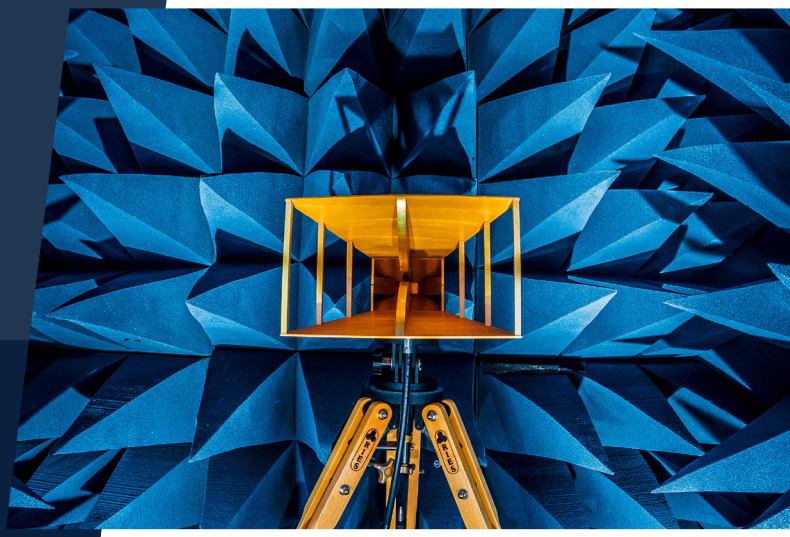
Fostering a collaborative approach to wireless technology research and radio spectrum access



The University of Notre Dame develops innovative approaches to wireless technologies and radio spectrum access through research, education, workforce development, and policy engagement.

About

Many industries are expanding their use of wireless technologies. New wireless applications, increasingly connected people and things, and the use of wider bandwidths and higher frequencies means more demand for access to the radio spectrum. Because the radio spectrum is regulated by government organizations at the national and international levels, successful technology and policy innovations that benefit society require collaboration on the part of business leaders, engineers, scientists, economists, lawyers, regulators, policymakers, and more.

Drawing upon a combination of policy and technology expertise, the University of Notre Dame is driving wireless research forward. Its work is at the forefront of several fields, including:

- broadband and wireless internet access, from antennas to networks;
- power-efficient millimeter wave transceiver architectures;
- radio spectrum sensing and sharing; and
- new applications of these technologies.

The University of Notre Dame has been a pioneer in wireless technology research since the late 1800s. Faculty first sent signals room to room in the University's old Science Hall, and eventually sent what is believed to be the first wireless signal in the U.S., using an antenna suspended from the University's Basilica of the Sacred Heart all the way to Saint Mary's College - the distance of almost a mile.

Today, these efforts have a home in the Wireless Institute in the University's College of Engineering. Since 2010, the Institute has leveraged the faculty's extensive experience and Notre Dame's distinctive mission to tackle important, interdisciplinary problems and be a force for good in the world.

Learn More

wireless.nd.edu

Contact Us

wireless@nd.edu

WIRELESS TECHNOLOGIES AND RADIO SPECTRUM ACCESS

Wireless researchers at Notre Dame utilize key facilities and laboratories, including:

- Organizational, technical, and administrative support through the Wireless Institute, as well as leading SpectrumX, the National Science Foundation (NSF) Spectrum Innovation Center
- Over 5,000 square feet of space with the following specializations:
  - Radio and Sensing Prototyping Lab
  - Advanced Millimeter Wave Antennas and Circuits Lab
  - Polarimetric Antenna Arrays Lab
  - Specific Absorption Rate and Exposure Lab
  - Efficient Power Conversion Lab
  - Radio Teaching Lab
- Multiple field research vehicles
- Campus and City collaborations around deployed wireless networks

Faculty and students across the Departments of Computer Science and Engineering (CSE), Electrical Engineering (EE), Finance, and Sociology, as well as The Law School, collaborate to address both the challenges and opportunities presented by ever-evolving wireless technologies and capabilities.

Wireless and Radio Spectrum Capabilities at the University of Notre Dame

At the University of Notre Dame, groundbreaking initiatives in wireless technology include:

Sensing

- RadioHound: ND researchers have built a pervasive, persistent spectrum sensor that leverages in-house designed, low-cost software-defined radios (SDR) suitable for mobile deployment. The node maps the entire spectrum from 25MHz to 6GHz, with capability being developed to 18GHz.
- Dynamic Sensing and Sharing: ND's researchers are actively engaged in finding and developing system models, sensing algorithms, and signaling schemes for more efficiency.

Next-Generation Wireless

- 1-Bit: ND engineers are exploring nontraditional, nonlinear radio architectures at millimeter wave frequencies to create electronics and circuits that can be very low-power and low-cost, without compromising data rates or performance.
- Beam-Scanning Antennas: With hardware developed to address challenges of millimeter wave systems' increased path loss at high frequencies, ND researchers are collaborating to demonstrate that beam scanning at millimeter frequencies can be very efficient from both power consumption and cost perspectives.
- Limiting Exposure: Researchers examine how to harness the expanding feature capabilities of smartphones, while constraining the phone's operation to satisfy specific absorption radiation (SAR) exposure limits.

Workforce Development

- RadioWare: Students are learning digital radio communication system design and debugging from ND faculty and putting their skills into practice through hands-on laboratory exercises. Through the RadioWare project, educational materials and low-cost lab radio kits are being developed to lower the barriers to entry and grow interest in the field. Curriculum is being created with partner institutions to refine offerings from sixth grade to graduate level studies.
- Advanced Wireless Research Experiences (AWaRE) for Undergraduates: ND's Wireless Institute conducts a 10-week summer undergraduate research program, providing opportunities for undergraduate CSE and EE majors to experience hands-on, innovative research in wireless systems and networking, connected robotics and drones, and mobile computing alongside faculty, graduate students, and staff.
- SpectrumX: Notre Dame is the lead institution for SpectrumX, a five-year, $25 million grant that connects 41 founding researchers and staff within 27 member universities and institutions across the United States. The focus of SpectrumX is spectrum and wireless, and includes participants from passive and active scientific sensing, aerospace applications, telecommunications, defense, and advanced wireless components and systems. Researchers are engaging in interdisciplinary collaborations across these fields.