Advanced Communications

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Nada Golmie, NIST Fellow

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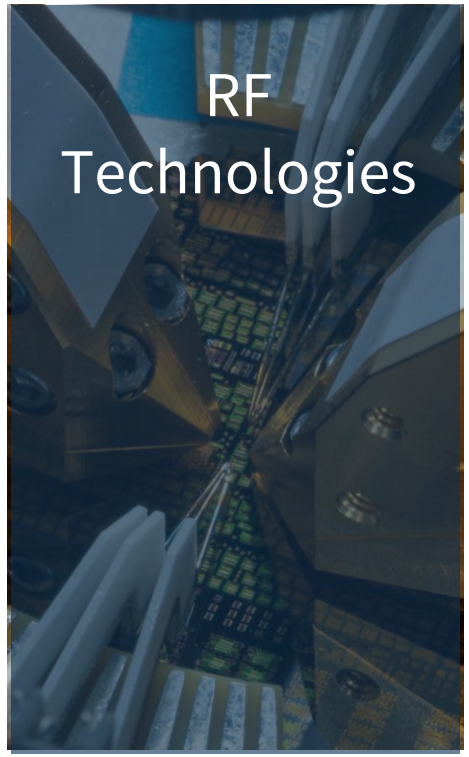
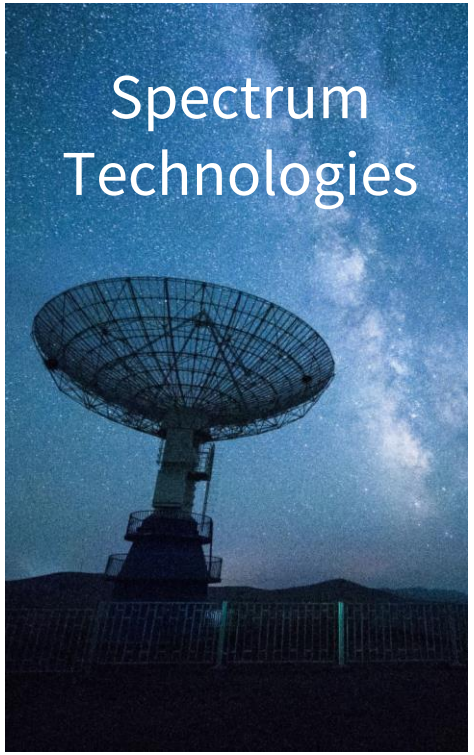
5 Key Research Areas





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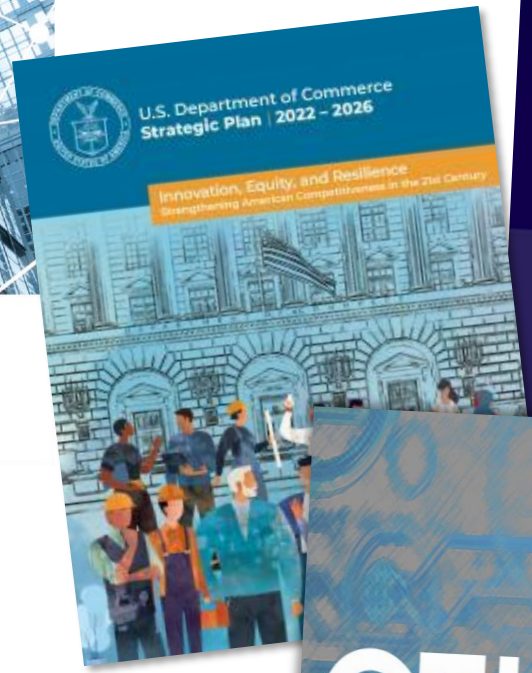
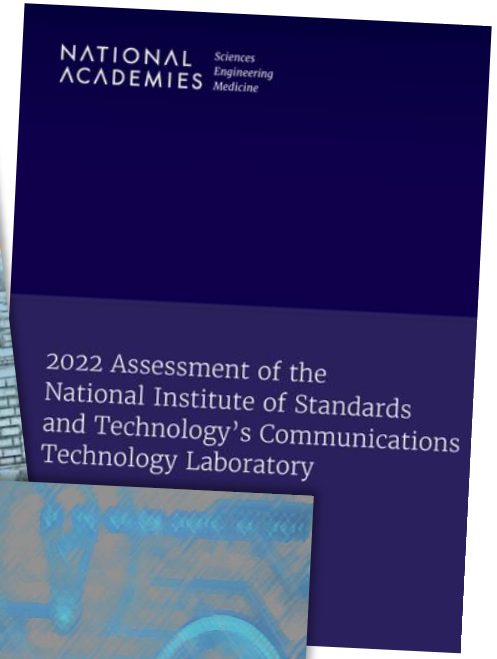
Strategy for Supporting Industry

Communications Research and Development Gaps Report

2023



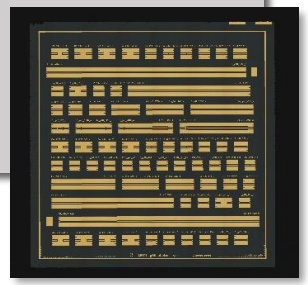


(Image Credit: White House)

Our role as an NMI

Standard Reference Instruments/Materials

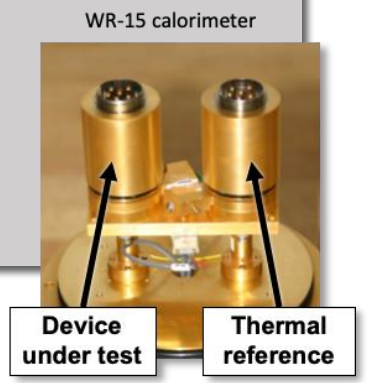
- SRI – The Programmable Josephson Voltage
  - 10V DC PJVS
  - 4V AC JAWS
- SRM *(in progress)* - dielectric permittivity for high-freq characterization (1-100 GHz) of 5G substrate materials



Credit: NIST/CTL

Measurement Standards

- S-parameters
- RF power
- Cross-frequency phase
- Antenna gain
- Thermal noise
- Field strength

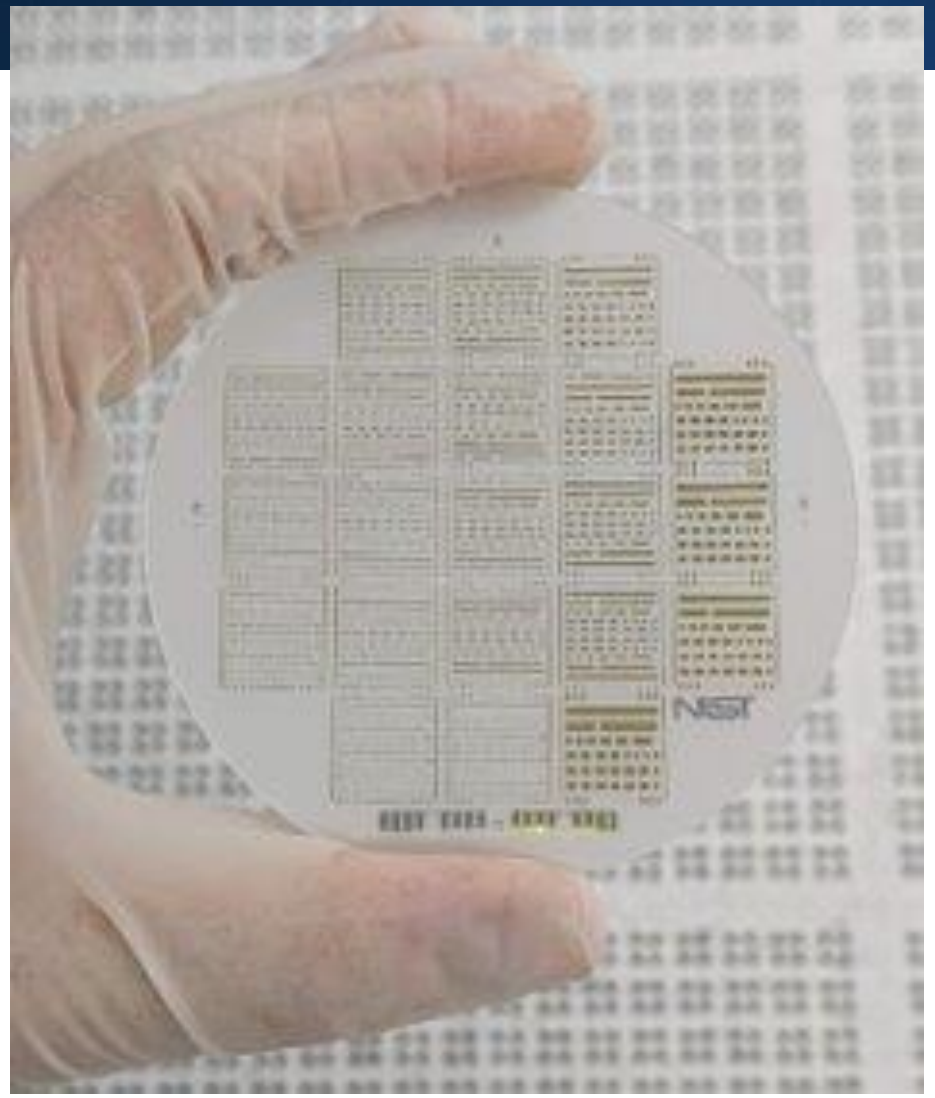


Credit: NIST/CTL

Documentary Standards

- IEEE P2822 – On-wafer measurements *(1 THz)*
- 3GPP – 5G/6G standard development
- ANSI C63.27 - Evaluation of Wireless Coexistence
- IEEE P3388 – Industrial Wireless systems

Credit: Adobe Stock



Credit: NIST/CTL

Leveraging NIST research to Advance CHIPS

Pioneering measurements for microwave substrates and thin films (1-1000 GHz)

- Developing Standard Reference Material for dielectric permittivity
- Optimizing on-wafer measurements and calibrations
- Develop High-Freq Transistor Models and Wireless Channel Models

New chip-based platforms:

- Developing quantitative measurements and standards to characterize the electromagnetic properties of composite materials, fluids, and soft materials

Spectrum Technology

NASCTN CBRS SEA

- Assess effectiveness of sharing between cellular networks and DoD radars
- Critical data resulted in operational changes, supported policy update

National Spectrum Strategy

- Directed antennae measurements to support repurposing of 6-7 GHz *(in collaboration with DoE)*
- Metrology for the Dynamic Spectrum Sharing Testbed (DSS)

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Public Safety Communications

Primary federal laboratory conducting R&D to advance public safety capabilities related to communications technology

Successfully transitioned their highly impactful launch (initial 5-year grant, 2017-2022) to a sustainable and growing program

Transformational approach combines internal/external research, phased prize challenges, and business accelerator programs

→ *Created 3000+ jobs, new companies, $570M added to the economy*

→ *483 standards contributions*

Ongoing research in 5 portfolios

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Laying the Foundations of 6G

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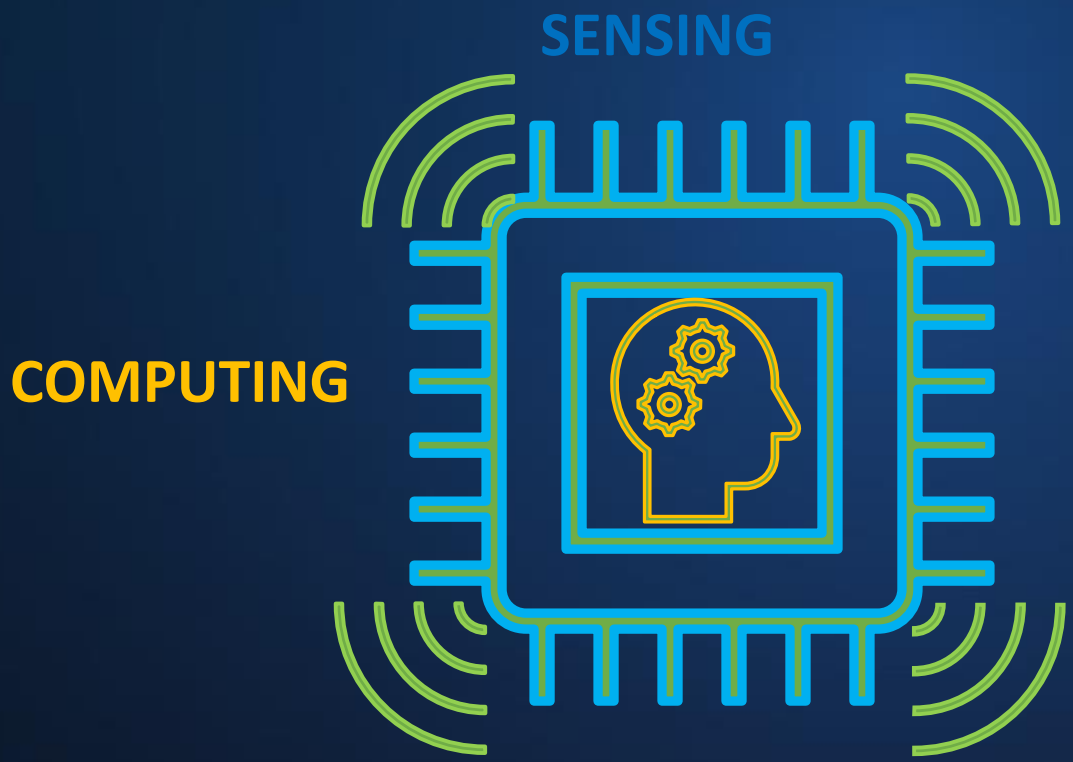
Sensing Using Communications Systems: Why?



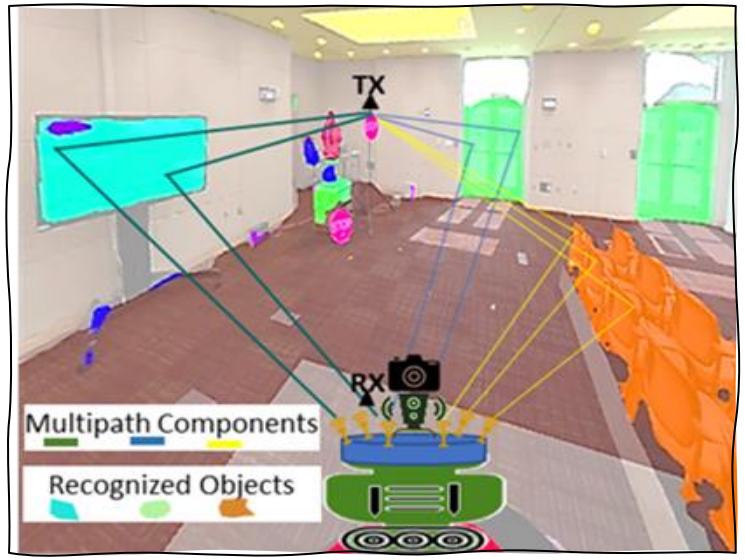
Credit: NIST/CTL

Wireless sensing- *acquiring environmental information using wireless signals*

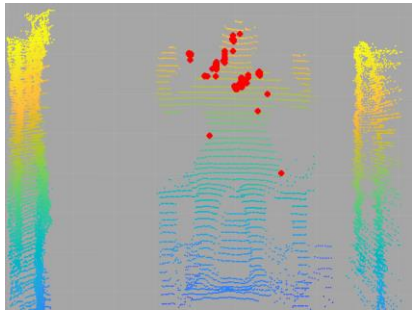
implemented using everyday consumer electronic devices equipped with a radio.

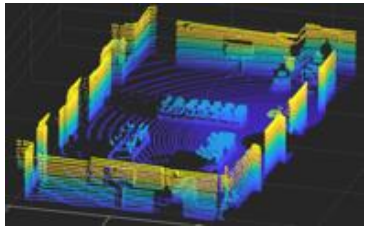
Towards Enhanced Intelligence

Integrated Sensing & Communications @ NIST



NIST Context-Aware RF Measurements & Modeling Tool Suite(s)





Credit: NIST/CTL

Data Dissemination & Collaborations

- **Designing and building measurement instruments**
- **Developing model abstractions for performance evaluation**
- **Using AI/Machine learning**
- **Disseminating models and measurement Datasets**

NextG Wireless Datasets: nextg.nist.gov

- Wireless datasets that captures both the environments and RF signals
- Reliable, organized, unbiased, and well-documented
- Formatted for seamless integration with AI and machine learning platforms.
- Enables the development, testing, and evaluation of innovative algorithms.

Partnerships Driving the Future of American Communications

FirstNet Authority

- Collaborating with FirstNet to serve as the primary R&D lab to advance public safety capabilities related to communications technology
- Designed and built the Public Safety Immersive Test Center (PSITC) at the FirstNet facility
- Teaming with Mountain Range Fire and FirstNet to develop a Fire Research Training Site in Colorado.

Public Safety Immersive Test Center

NextG Channel Model Alliance

- Measurement and Modeling Repository
- Best practice documents for wireless propagation measurements
- 350+ members representing over 180 institutions
- Industry incorporating models into commercial software

NextG Channel Model Alliance

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ATIS/NGA Joint Communications and Sensing Group

- Partnered with ATIS' NextG Alliance (NGA)
- Developing measurement & modeling techniques that support joint sensing and communications
- Contributing findings to 3GPP for the development of the 6G standard.

Channel Measurements and Modeling for Joint/Integrated Communication and Sensing