# Building a STAIRWAI to COSMOS

## An AI-enabled testbed for Wireless+AI

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# The COSMOS Testbed

# COSMOS: a city-scale testbed

## Part of the NSF-funded PAWR program


https://www.cosmos-lab.org/

The COSMOS testbed is a city-scale advanced wireless testbed for real-world experimentation with next-generation wireless technologies and applications.

COSMOS is a **community resource** consisting of reprogrammable SDRs (USRPs) for 5G/6G experimenation (including FR3).

Partners include New York City, CCNY, University of Arizona, Silicon Harlem, and IBM.

Connections to other international testbeds.

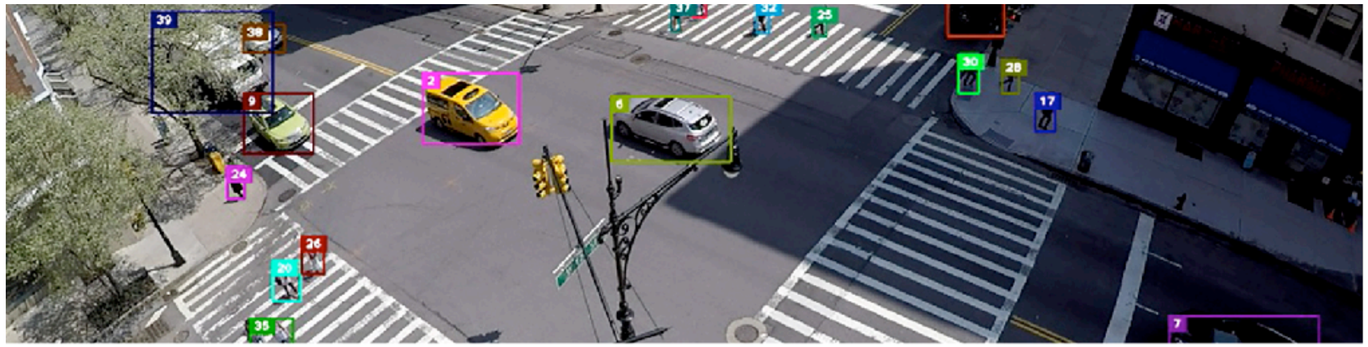
RUTGERS–NEW BRUNSWICK
School of Engineering
Wireless Information Network Laboratory

COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

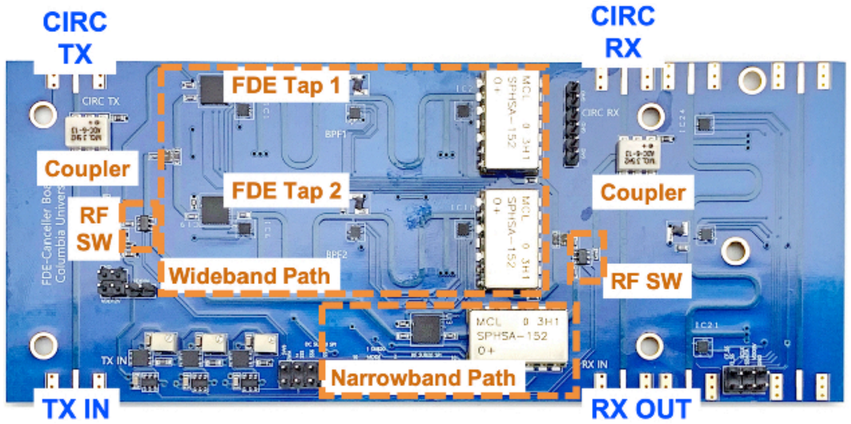
NYU TANDON SCHOOL OF ENGINEERING

# Resources and applications

## Experiments possible at many different layers

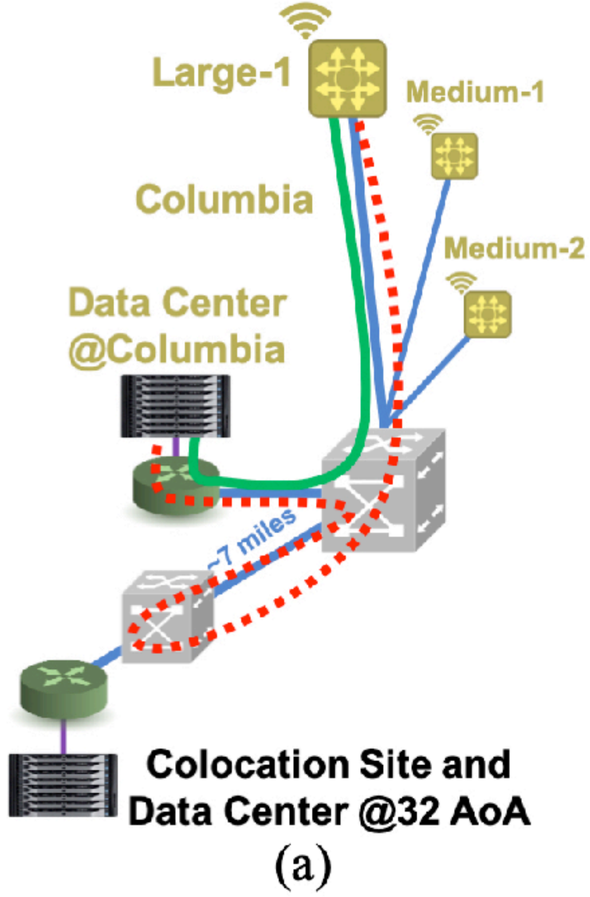


Smart City Intersections




Open-access full duplex

Augmented Reality




Optical x-haul for SDN

# Other NextG activities @ WINLAB

## ORAN and 6G

**WINLAB is an O-RAN Test and Integration Centers (OTIC):**

- ACCoRD (Acceleration of Compatibility and Commercialization for Open RAN Deployments)
- SMaRT-5G ( Sustainable Mobile and RAN Transformation 5G)

**Recent award to support COSMOS expansion for 6G:**

- Hardware upgrade including mobile nodes supporting multi-band (FR1/FR2/FR3) operations, JCAS, and multi-modal (camera/lidar/radar) sensing
- Open-source software and example experiments smart-city, spectrum sharing, and beyond

# NSF AI-Ready Testbeds Program

## Partnership between CISE and TIP directorates

**The Goal:** “new approaches to develop and evaluate novel artificial intelligence (AI) methods in real-world settings.”

- Build on existing (not necessarily NSF-funded) testbed infrastructure.
- Support design/evaulation of AI-based methods time-varying data *in situ*.
- Support work on resilience, reliability, safety, privacy, fairness…
- “Reduce the communication barriers that researchers currently encounter upon entering an application domain”

**This is a planning grant to priories and develop scope…**

# What does “AI-Ready” mean?

# ~~Buying~~Building a STAIRWAI to COSMOS

## Making COSMOS accessible to more researchers


**Our goal:** support evaluation and experimentation of AI methods for and with wireless communications.

**The challenge:** The testbed has a steep learning curve and requires expertise in wireless systems.

**The approach:** Work with the research community to understand

1. Enable easy use of existing testbed measurements for AI research.
2. Create cyberinfrastructure to make AI solutions easier to test and evaluate.
3. Living lab model for evaluating AI system prototypes
4. Support research on accelerating AI for real-time wireless systems
5. Help to develop an interdisciplinary research community like we have here in this room!

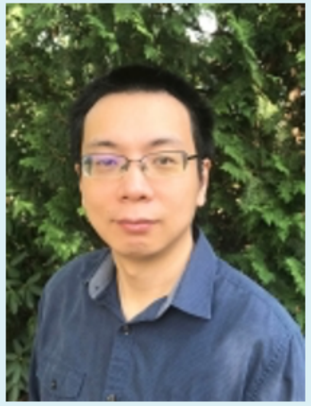
# Our team

Anand Sarwate

Jorge Ortiz

Ivan Seskar

Yingying Chen



Bo Yuan

Narayan Mandayam

Waheed Bajwa

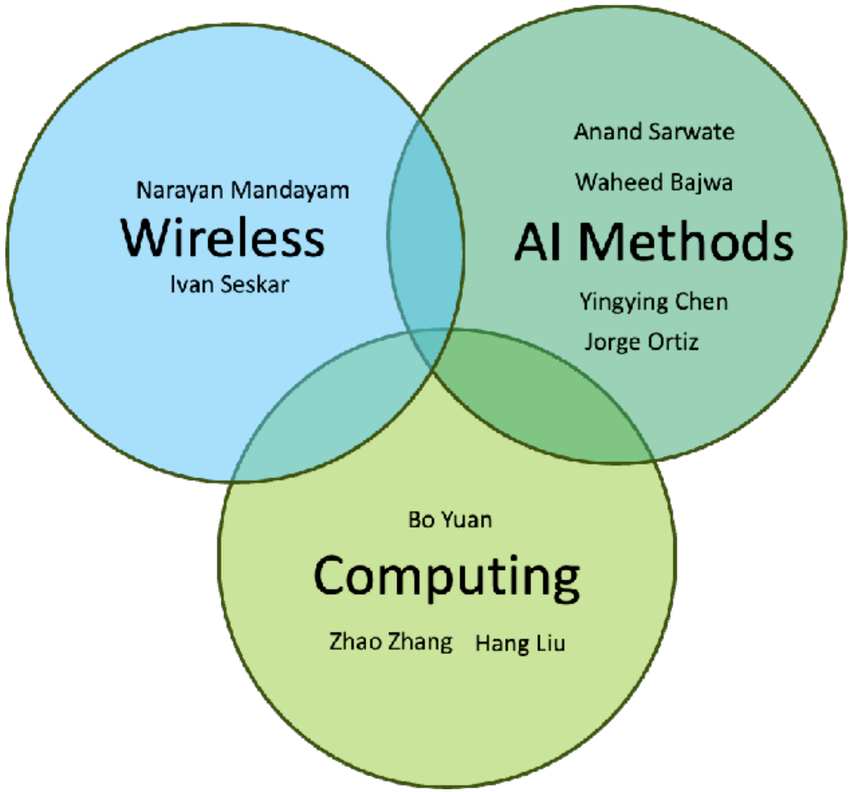
Zhao Zhang

Hang Liu

Taqiya Ehsan

# Three main components for the testbed

## Why we need such a big team




To succeed in bring COSMOS into the AI-era more fully, we need leverage:

- Expertise in **management and design of wireless communication systems** and networks: Ivan Seksar, Narayan Mandayam.
- Expertise in **AI algorithms and applications that use wireless networks:** myself, Jorge Ortiz, Yingying Chen, Waheed Bajwa
- Expertise in **optimizing large-scale computing** using both high performance computing and hard-ware based acceleration: Bo Yuan, Hang Liu

# What we will do

## This is a 2 year planning grant process

1. **Understand the bottlenecks** facing researchers who could benefit from the testbed: : wireless people who could benefit wanting to use AI methods AI researcher

2. **Determine what we should prioritize** in developing the AI infrastructure for COSMOS: get input from industry and academic researchers via workshops.

3. **Promote the Wireless + AI research area** and engage researchers: create a blog with features like interviews, explanations of challenges for specific verticals, and research that could use the testbed.

4. **Start lowering the barrier to entry**: develop onboarding and tutorial materials aimed at non-wireless experts.

# Planning for the future

# AI for Wireless (AI4W)

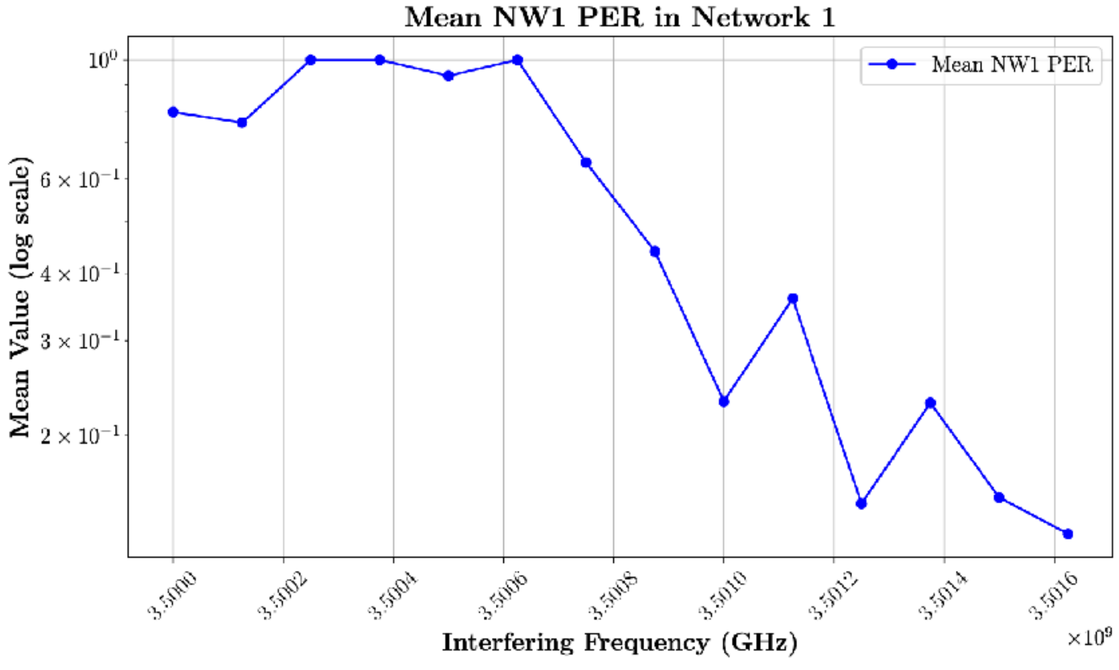
## How can AI help in core wireless tasks?

We think of AI4W as developing AI methods for tasks in various layers of the communications stack.

**Example from WINLAB** (Barbardekar et al. 2024):

Tried different ML approaches for interference prediction and dynamic frequency/channel assignment for colocated 5G networks (3.5 GHz).

**How can we make it easier for to train and deploy models for AI4W tasks?**



# AI4W Workshop: January 30, 2026

**Registration/schedule will be posted soon!**

**Goal:** bring together industry and academic researchers to understand what will be needed to bring AI into NextG:

- How should we enable dataset generation using COSMOS? What benchmarks do we need? How should they be managed?
- What are the core wireless problems that AI could address and where the testbed is critical validation?
- What are key obstructions to using AI methods for wireless?

**This testbed will not be built out immediately:** think on a 5-10 year horizon.

# Wireless for AI (W4AI)

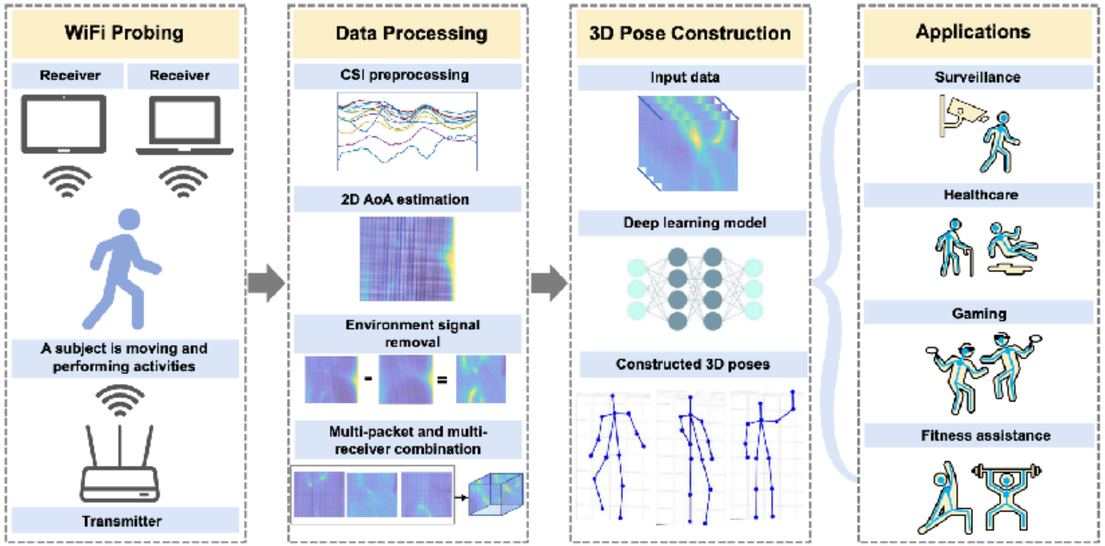
## Making AI applications wireless “native”

We think of W4AI as making wireless testbeds easier to use for AI researchers. Lots of applications want to use AI and operate over wireless? Can we evaluate performance in more realistic network conditions?

[Example from WINLAB](#) (Ren et al. 2021):

Real-time pose estimation using mmWave with applications in safety

**How can we research that uses AI on data from wireless measurement or operates in realtime over a wireless network?**



# W4AI Workshop: May/June 2026

## Still in early planning stages

**Goal:** get input from systems researchers and industry developers on what capabilities are needed in COSMOS?

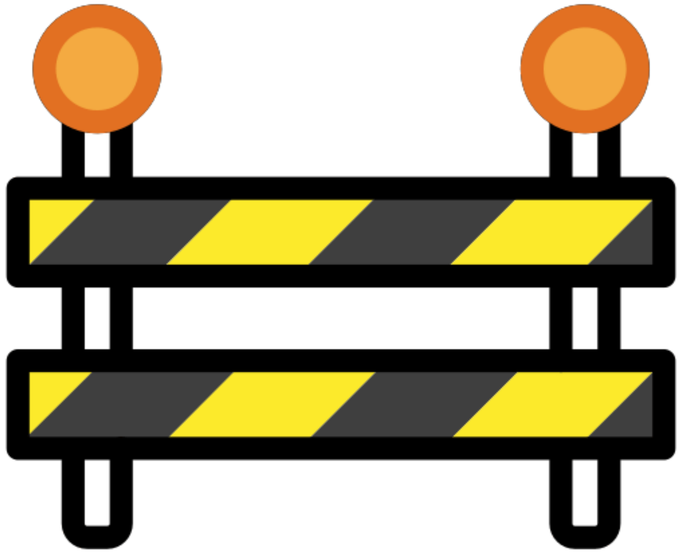
- What kind of realtime measurements can we make easier to access (e.g. via an API).
- What sorts presets/preloaded environments would make it easier for researchers with less wireless experience (e.g. grad students working on AI) to get going and make impacts?
- What verticals should we focus on first as we develop?

**Capabilities will have to grow over time:** what's needed sooner?

# Demo workshop: planned for 2027

## How we can show the potential

We want to show proof(s) of concept(s) (a few steps on the stairway)
involving both AI4W and W4AI.



**Do you have a project you want to try out! Let us know!**

# Outreach and community building

## Understanding the landscape

Starting a blog to help build more connections for people working in wireless, AI, or application domains which want to use wireless + AI:

- Profiles/short interviews with researchers working in the field.
- Challenges posed by researchers in different verticals: urban planning, healthcare, agriculture, you name it.
- Public-facing write-ups about research using the testbed (not just from us!)

# We need your help and input!

# Wireless + AI is not easy

## … especially for academic research

Image: Wikipedia

We want the testbed to be usable and useful for as many people as possible.

- The learning curve presents a real challenge for graduate student researchers, people who are not deep in the weeds of wireless, and so on.
- Wireless moves after long deliberation (hello 3GPP!) whereas AI models and paradigms can change relatively quickly.

**We need to ensure that what we build isn't obsolete by the time we finish it!**

Partner with initiatives like AI-RAN and… all of you!

# We need your help!

## Get announcements!

Join our mailing list!

Follow our blog!

# Do you want to be more involved?

## Join in our planning!

Come to our workshops!

Contribute a post!

# Work with COSMOS!

## Register for an account and explore

https://www.cosmos-lab.org/

# Thank you!