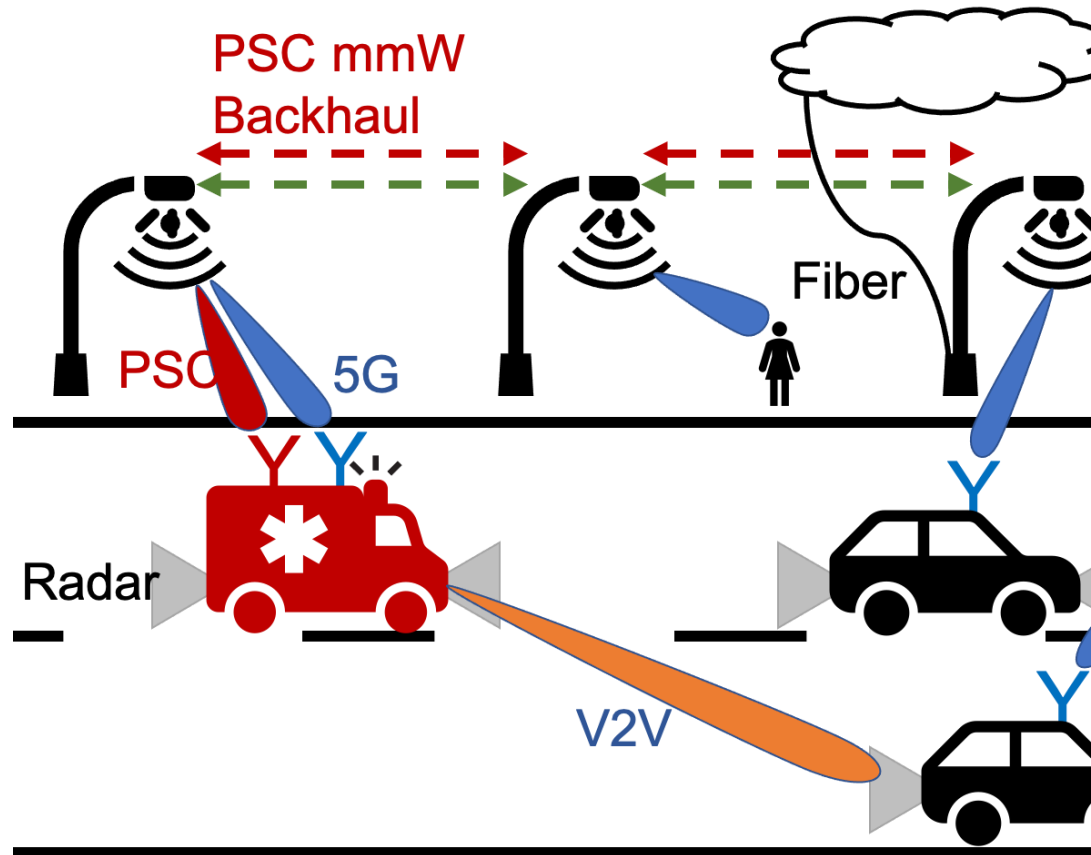




**Collaborative Research: SWIFT: LARGE:
DYNAmWIC: Dynamic mmWave
Spectrum Sharing Techniques for Public Safety
Communications
(ECCS 2030272/2030141)**

**PI (UNL): Mehmet C. Vuran
Co-PIs: Demet Batur (UNL), Jennifer K. Ryan (Lehigh)
PI (OSU): Eylem Ekici**

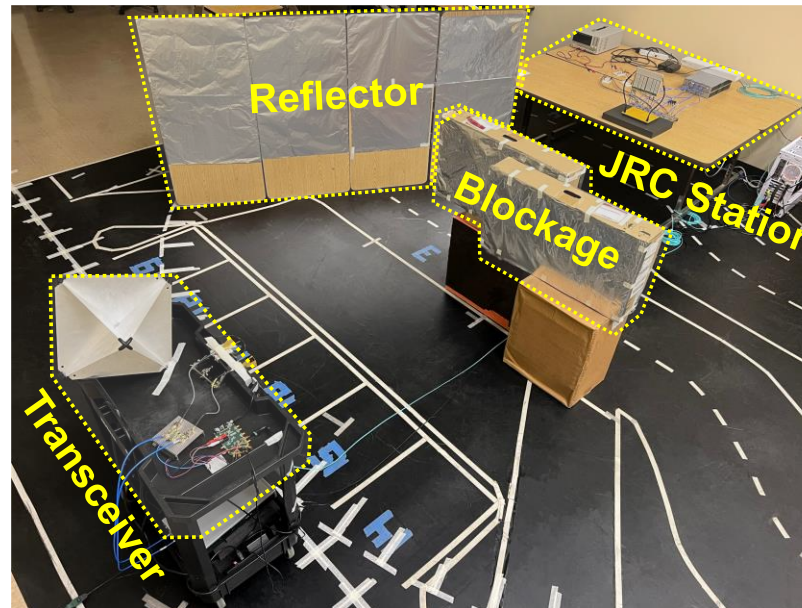
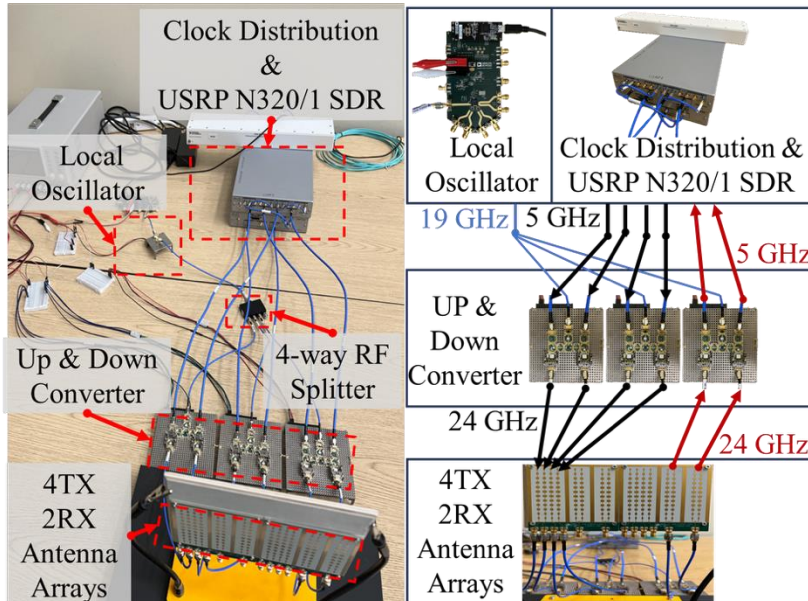
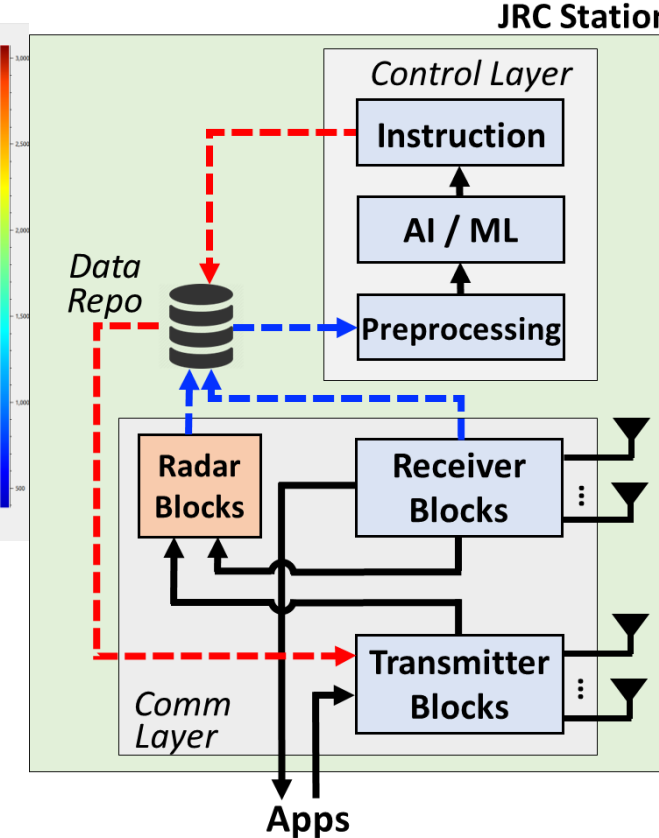
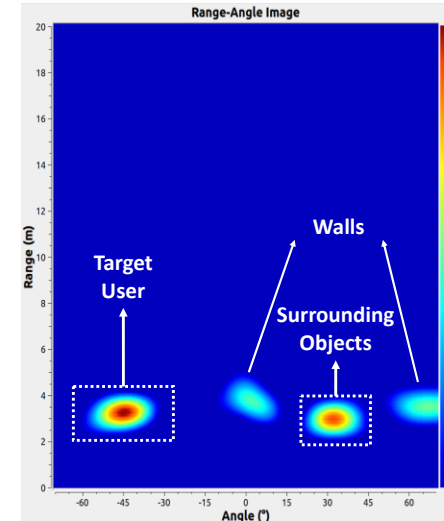
Objective and Significance



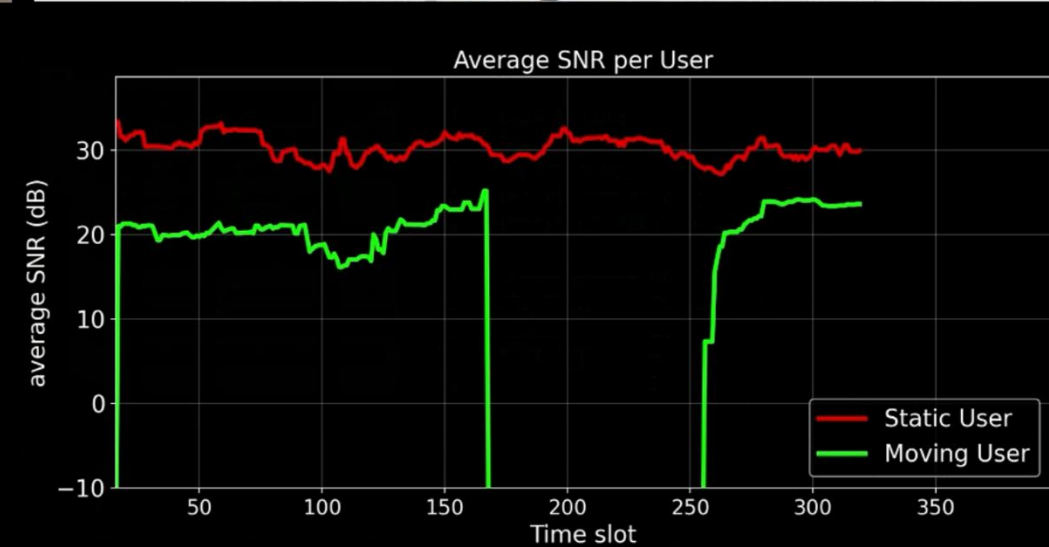
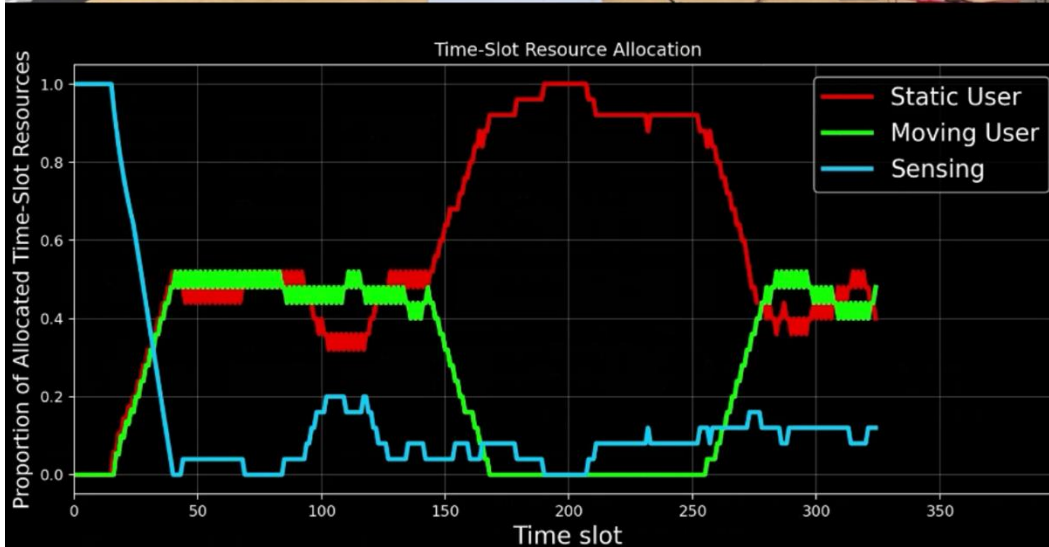
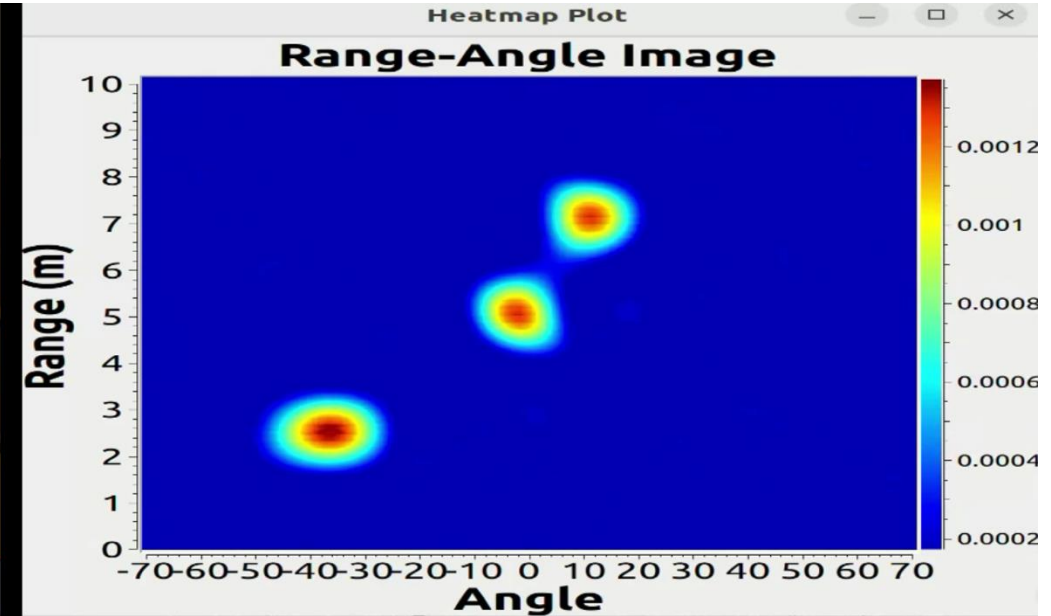
- Integration of PSC solutions into the mmWave spectrum
- Conventional spectrum management approaches not sustainable
- **GOAL: Fundamentally transform mmWave spectrum usage for PSC and accelerate readiness for 6G**
 - Dynamic mmWave spectrum sharing solutions
 - ISAC for in-band sensing and communication
 - mmWave NG-RAN
 - Comprehensive indoor and city-wide testbeds

JRC: Indoor ISAC Testbed

- 24GHz, 4x2 MIMO
- In-band sensing and communication
- AI/ML agnostic design
- Learning-based beam management
- LoS and NLoS communication

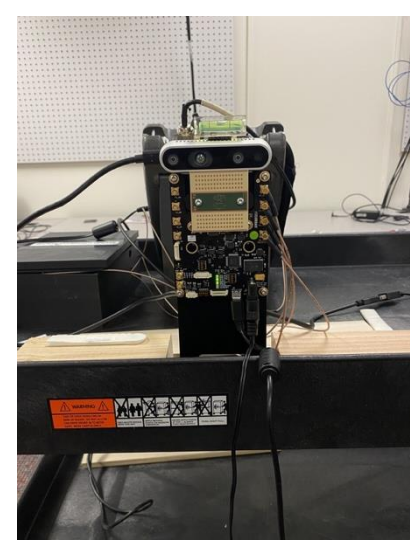


JRC: Indoor ISAC Testbed

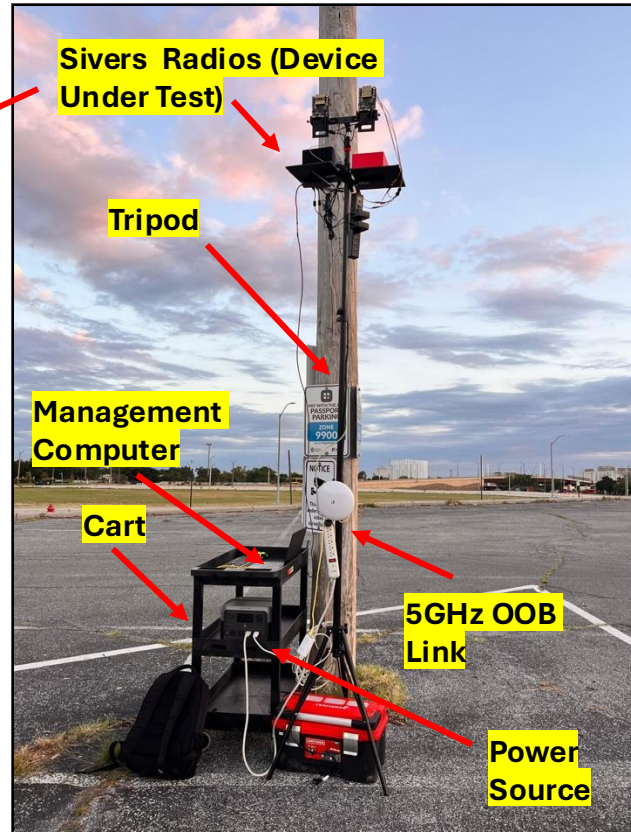
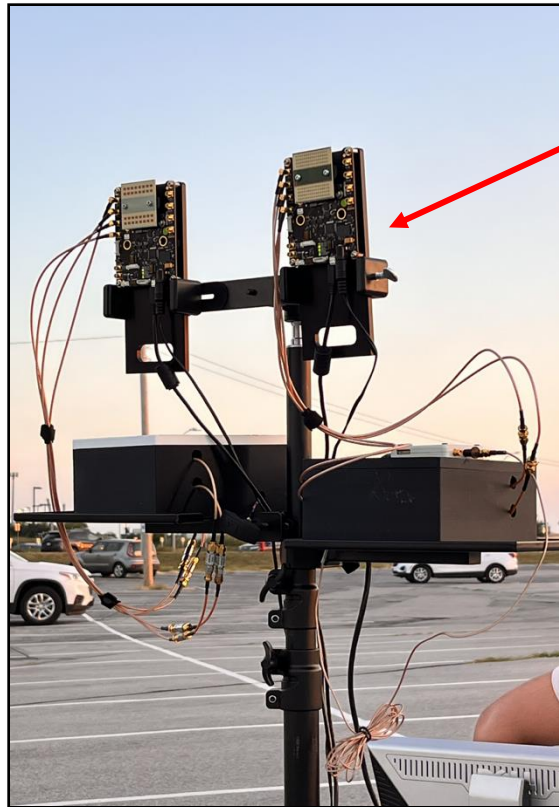




V2X Sensor Fusion for High-Mobility mmWave C-V2X Connectivity



C-V2X Experimental Prototype



24 – 60 GHz Multi-band mmWave Fusion



V2X Sensor Fusion for High-Mobility mmWave C-V2X Connectivity



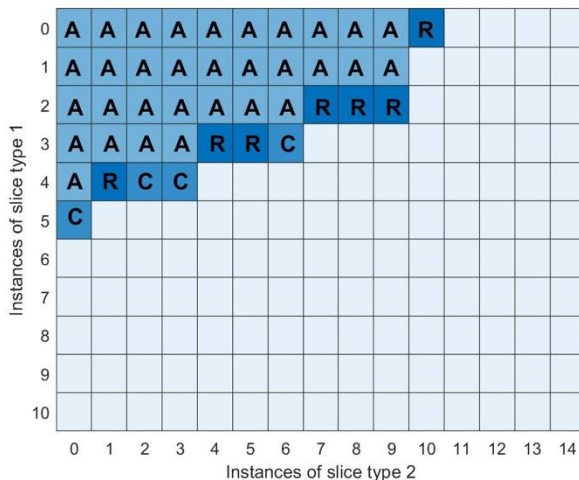
N Resource Leasing in 5G Private Cells



D. Batur, J. Ryan, and M. C. Vuran, "Dynamic Resource Sharing in Private 5G Networks with Slicing", submitted for publication, 2025.

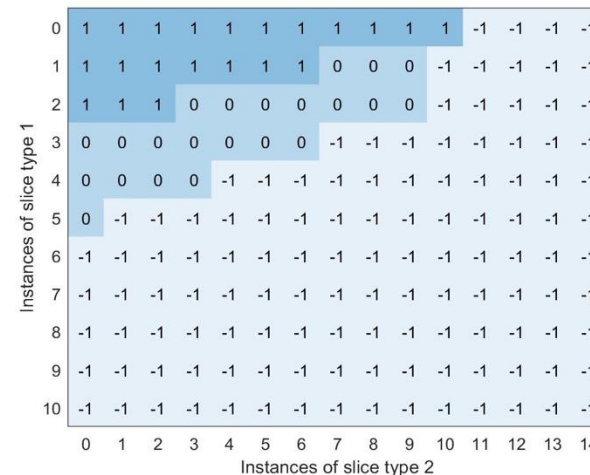
- Leasing brings additional revenue to private cell operators
- Objective: Find optimal dynamic admission and leasing policies
 - Markov-Decision Process (MDP)
 - Multiple slice types (e.g., eMBB, mMTC, URLLC)
 - Multiple resource types (spectrum, compute, storage)

**Optimal Admission Policy
for slice 1 instance**

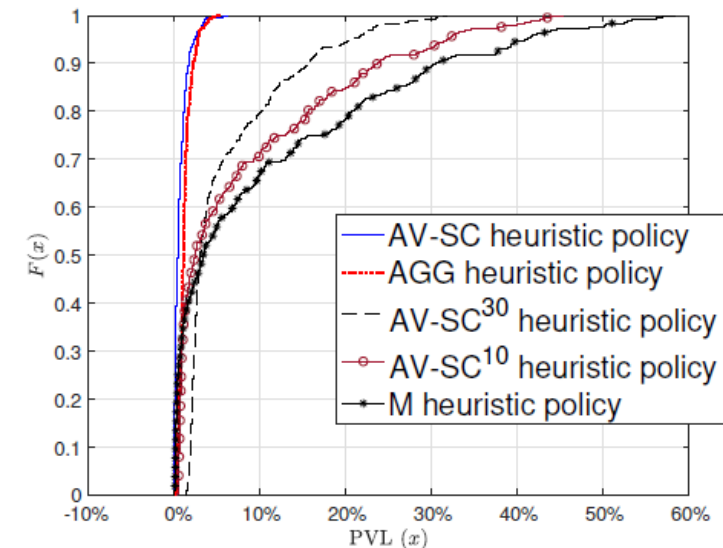


A: Admit
R: Reject
C: Admit canceling
the lease of
required resources

**Optimal leasing policy for
compute units**



Heuristic Policies



Broader Impacts

- Fundamentally **transform mmWave spectrum usage** as the industry goes through the first-license-then-share approach
- **Accelerate the readiness for 6G solutions** for mmWave
- Education on remotely accessible NEXTT testbed, lowering barrier to wireless education
 - NEXTT is utilized in UNL CSCE 865 Wireless Communications Networks, taught by another faculty member, for lab and project assignments
- Inform the local community through the well-established channels
 - Hour of Code event, attended by over 500 participants (elementary school students with families) in Lincoln
 - Beam-pairing game: Children use the real-time beam-switching capabilities of our testbed via an easy-to-learn interface
 - Raikes School Research Fair for UNL freshmen: Live demo of mmWave communication technology

