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NSF CNS 2434081 Jul 2025 – Jun 2028

Institute for the Wireless Internet of Things at Northeastern University

From Open RAN to Open Spectrum
Sharing Spectrum, Services, and Infrastructure in Spectrum Era 4

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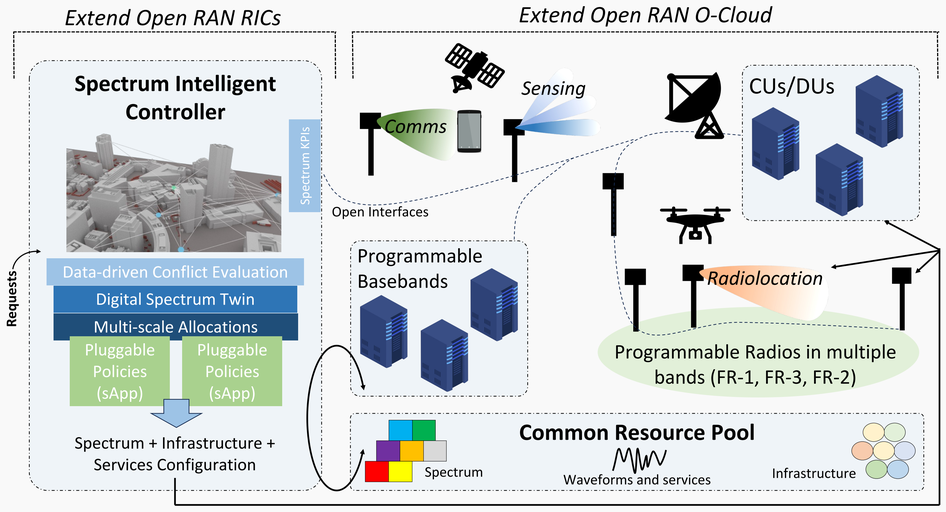
OPEN6G



Open Spectrum Vision

Observability + **Programmability**

Open-RAN Principles

*Spectrum and Infrastructure **Monitoring***

***Abstractions** to Dynamically Sense Spectrum*

Vision for Spectrum Era 4: Shared Spectrum and Infrastructure Pool

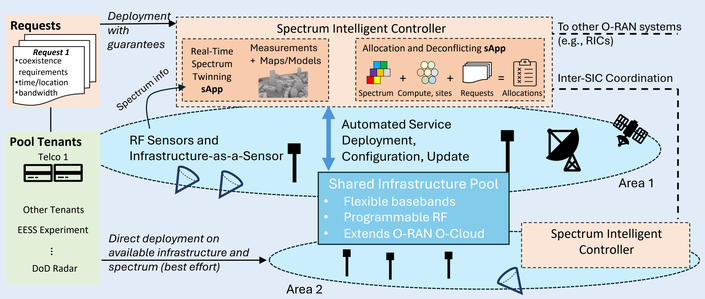
***Shared Infrastructure:** Highly Dynamic Closed-loop Spectrum Sharing*

*Policy-to-Allocation **Automation***

*Automated Closed-loop **Policy Generation** with SLAs*

***Sharing Services**: Multiplex Spectrum Services on Same Waveform/Infra/Spectrum*

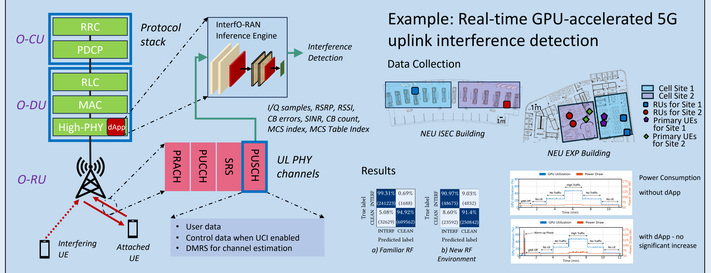
Open Spectrum Architecture



System design based on Open RAN and AI-RAN research

dApps: Real-time Spectrum Sensing and Programmability

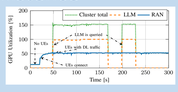
Flexible plug-and-play and real-time processing+control units for the next-generation O-RAN architecture - extending to different spectrum systems



A. Lacava, L. Bonati, N. Mohamadi, R. Gangula, F. Kaltenberger, P. Johari, S. D'Oro, F. Cuomo, M. Polese, and T. Melodia, *"dApps: Enabling Real-Time AI-Based Open RAN Control,"* ComNet, 2025
N. Neasamoni Santhi, D. Villa, M. Polese, T. Melodia, *"InterfO-RAN: Real-Time In-band Cellular Uplink Interference Detection with GPU-Accelerated dApps,"* ACM MobiHoc, 2025

Infrastructure Sharing: Neutral Host and AI-RAN Coexistence

Systems and abstractions to enable coexistence of multiple workloads on the same infrastructure

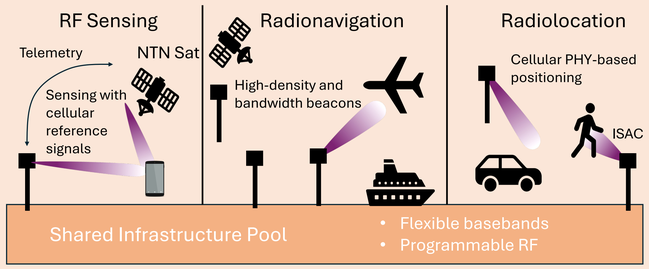


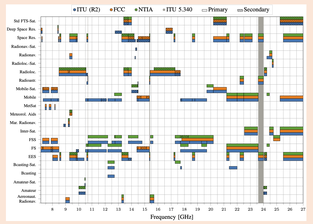
M. Polese, N. Mohamadi, S. D'Oro, T. Melodia, *"Beyond Connectivity: An Open Architecture for AI-RAN Convergence in 6G"*, arXiv:2507.06911 [cs.NI], 2025
S. Maxenti, R. Shirkhani, M. Elkael, L. Bonati, S. D'Oro, T. Melodia, M. Polese *"AutoRAN: Automated and Zero-Touch Open RAN Systems"*, arXiv:2504.11233 [cs.NI], 2025
L. Bonati, M. Polese, S. D'Oro, S. Basagni, T. Melodia, *"NeutRAN: An Open RAN Neutral Host Architecture for Zero-Touch RAN and Spectrum Sharing,"* IEEE Transactions on Mobile Computing, August 2023

Service Sharing

Programmable and white-box radios and software can enable multiplexing of different spectrum services on the same (i) protocol stack, (ii) waveform, (iii) radio using the same portion of spectrum

P. Testolina, M. Polese, T. Melodia, *"Sharing Spectrum and Services in the 7-24 GHz Upper Midband,"* IEEE Communications Magazine, 2024





Thrust 1: A New Network Architecture for the Next Era of Spectrum Management

***Design and Prototyping** of the Open Spectrum Architecture*

Thrust 2: Sharing Spectrum, Infrastructure, and Services

Sharing with RF Sensing, Radionavigation, Radiolocation

Thrust 3: Policies and Conflict Management For Spectrum and Infrastructure Sharing

Digital Twinning for Fast RFI Modeling and Data-Driven Conflict Mitigation

Thrust 4: A Dynamic and Automated Research Platform for Spectrum and Infrastructure Sharing Validation

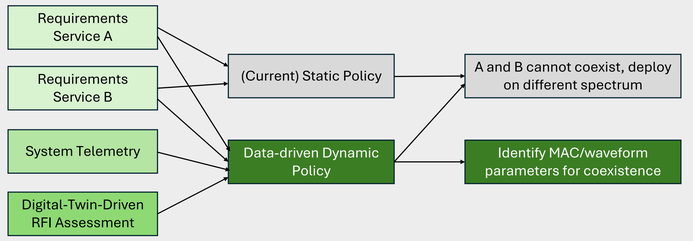
Experimental Platforms for Open Spectrum Prototyping and Evaluation

Colosseum – O-RAN Digital Twin

Arena + PAWR + X5G: Production and **Automated Private 5G**

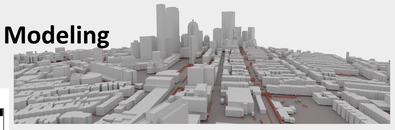
Policies and Conflict Management

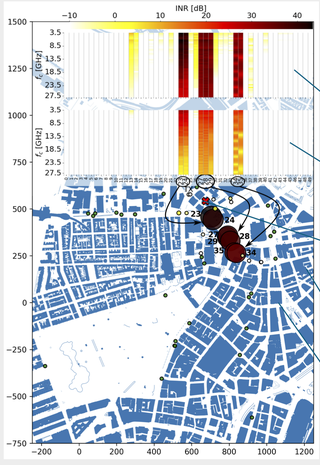
Different spectrum services have heterogeneous requirements (duty cycles, sensitivity to RFI, need for specific bands, etc). This thrust develops closed-loop modeling solutions that inform automated policy generation



Large-Scale Data-Driven RFI Modeling

Example: city-scale RFI between FR-3 cellular and satellite downlinks





RFI is predictable and generated by a specific subset of base station locations

Worst-case RFI (TX beam toward the FR-3 incumbent)

Average RFI over TX beam configurations

Incumbent

3D map with obstacles and buildings

Potential FR-3 base stations locations and associated RFI

P. Testolina, M. Polese, P. Johari, T. Melodia, "BostonTwin: the Boston Digital Twin for Ray-Tracing in 6G Networks", in Proceedings of the ACM Multimedia Systems Conference 2024 (MMSys '24), Bari, Italy, April 2024