

N Institute for the Wireless
Internet of Things
at Northeastern University



Slices-RI Summer School 2022

*PAWR Testbeds for Building a B5G/6G Research
Roadmap
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- DoD Innovate Beyond 5G Program Senior Advisor
- US FCC Technology Advisory Council 6G WG Co-Chair
- Board Appointments
 - OpenAirInterface Software Alliance Board Member
 - O-RAN Alliance Academic Research Council
 - Open Networking Foundation (ONF) Member
 - ATIS NextG Alliance
 - Magma Foundation Founding Member
- Organizer of 6GSymposium

Why Open Testbeds



For many in the ecosystem, from academics, federal labs to mid-sized operators, end-to-end 5G is an expensive and difficult proposition

- Avoid Technology Lock-in, Impact Interoperability and Re-Aggregation

Academia

Works on existing radio/FPGA testbeds

Workforce Development

Innovation on lower layers: Scheduler, MAC, PHY

Access to a full 5G stack s/w implementation

Vendor Ecosystem

Shorten Design Cycles

Impact interoperability challenge: DU-RU, RAN-Core

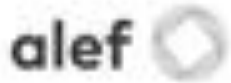
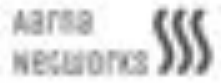
Work on multiple platforms: CPU/GPU/FPGA

PAWR program seeks to maintain U.S. leadership in advanced wireless networking innovation

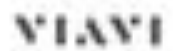
PAWR is funded by the National Science Foundation and a wireless Industry consortium of 35 wireless companies and associations. The PAWR Project Office (PPO) manages the program and is co-led by US Ignite and Northeastern University.



Founded 2017



FACEBOOK



PAWR platforms were chosen to be geographically diverse and research focus independent



POWDER

Salt Lake City, UT

Software defined networks and massive MIMO

AVAILABLE TODAY !!



COSMOS

West Harlem, NY

Millimeter wave and backhaul research

AVAILABLE TODAY !!



AERPAW

Raleigh, NC

Unmanned aerial vehicles and mobility

AVAILABLE TODAY !!



Rural Broadband Platform

Ames, IA

Colosseum – *World's largest RF emulator, located at Northeastern University in Boston*

AVAILABLE TODAY !!

Researchers use PAWR testbeds to prove out concepts in an array of disciplines



Cybersecurity Testing



AI-Enabled Network Functions



Internet of Things



Accelerated Virtualization of Network Architectures



Millimeter Wave Performance Optimization



Dynamic Spectrum Management

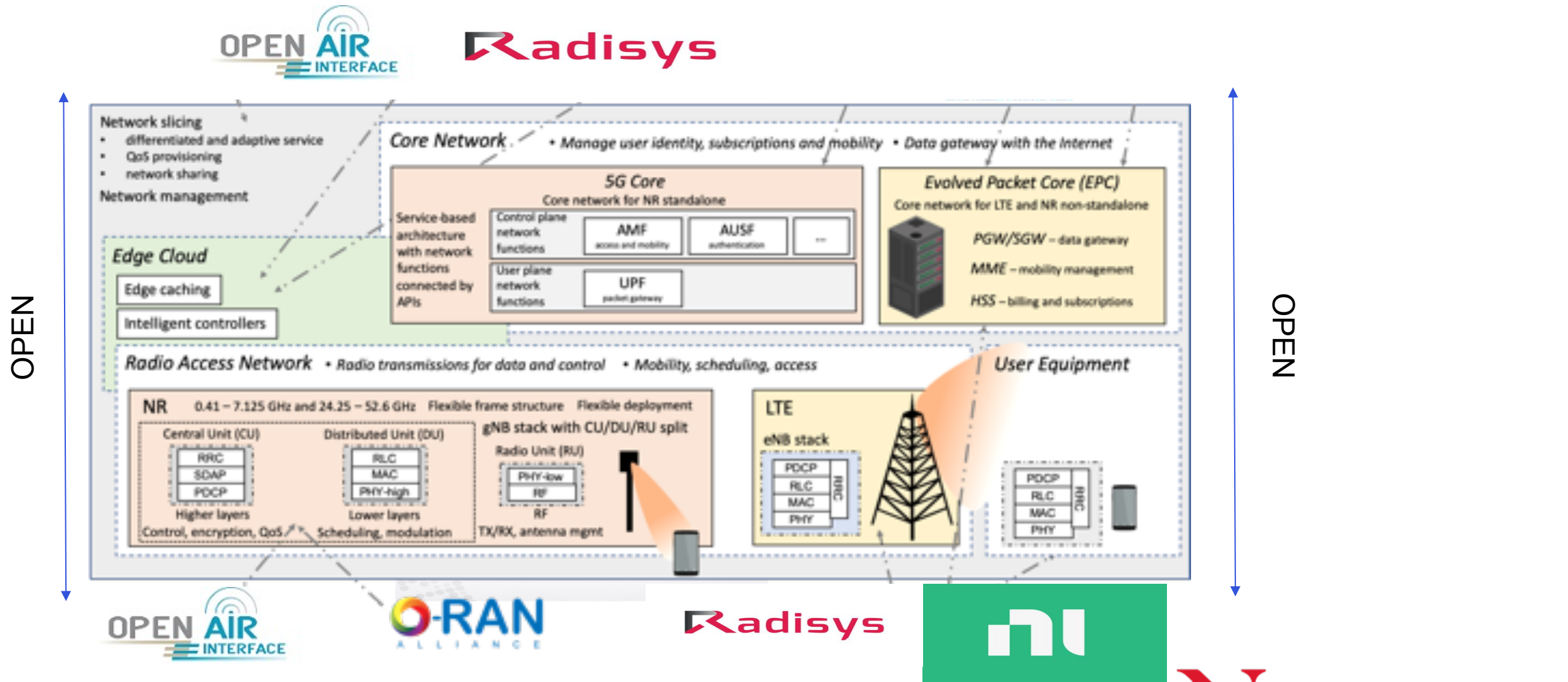


Open Source Hardware & Software Development



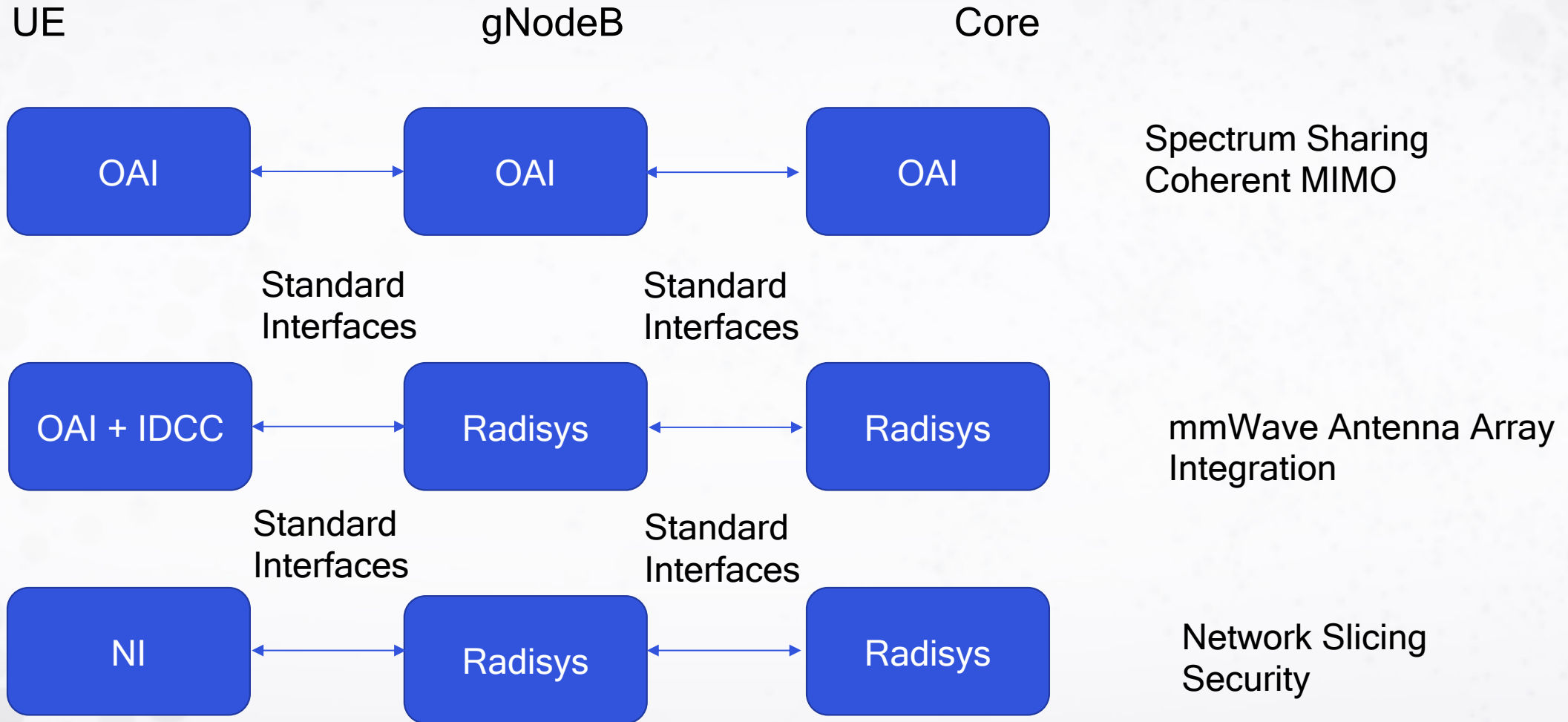
Highly Mobile Unmanned Aerial Vehicles

End-to-End Open Programmable, Virtualized 5G Stack

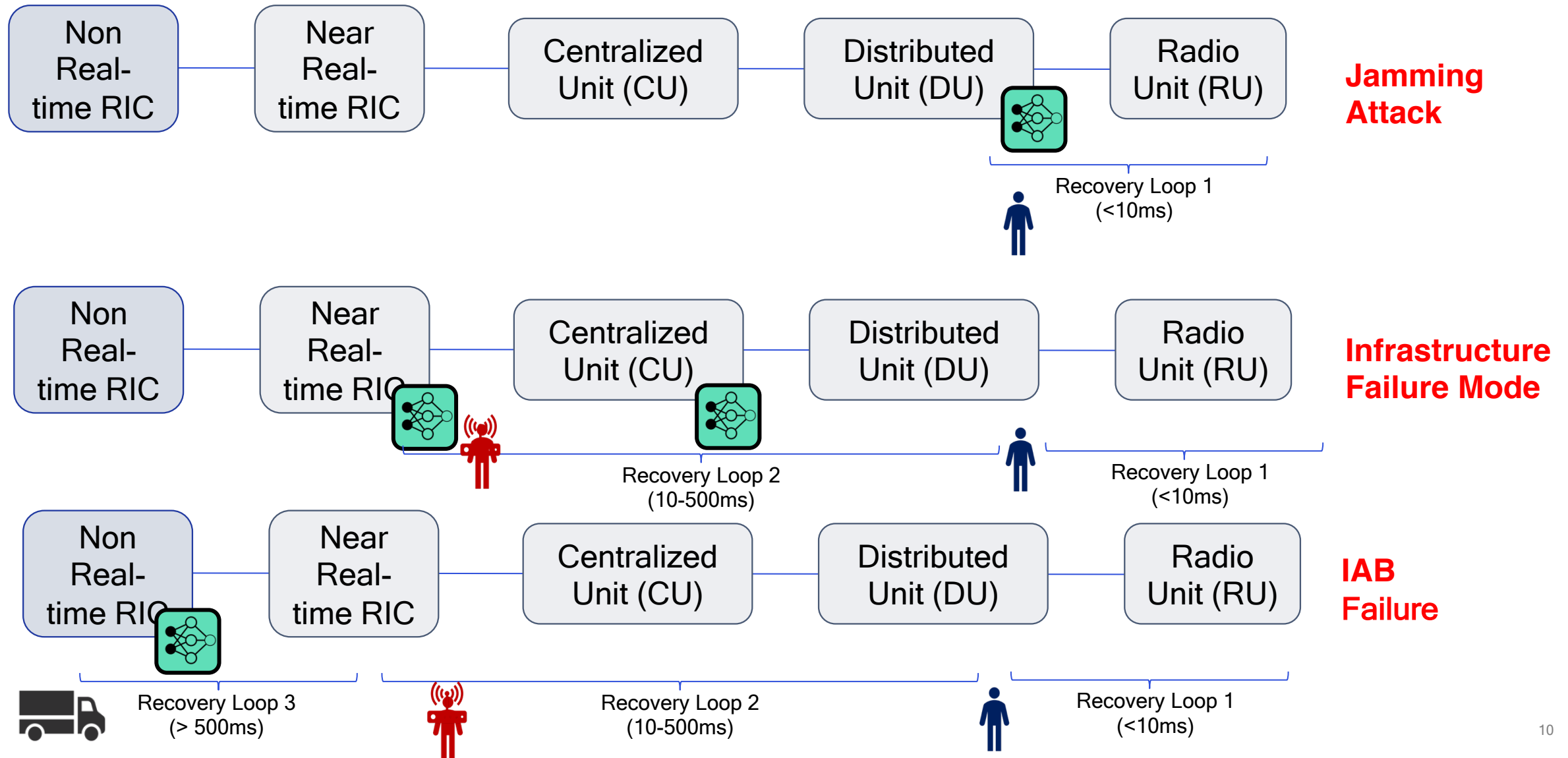


L. Bonati, M. Polese, S. D'Oro, S. Basagni, and T. Melodia, "Open, Programmable, and Virtualized 5G Networks: State-of-the-Art and the Road Ahead," *Computer Networks*, 2020

Interoperable/Interchangeable Modules Per Use Case



Network Intelligence in 5G + O-RAN



Experiment-as-a-Service Over Multiple Testbeds

One container to rule them all:

- Initial design and testing at-a-scale on Colosseum w/ different scenarios
- Validate on real-world indoor environment on Arena
- Experiment into the wild on PAWR city-scale platforms



6G Emerging Technology Trends and Enablers

Technology Enablers to Enhance the Radio Network

- RAN slicing
- Resilient and soft networks for guaranteed QoS
 - "Soft" = User-centric, service oriented, flexible, and powerful in capabilities, guaranteed in QoS, and consistent in user experience
- New RAN architecture
- Technologies to support a digital twin network
- Interconnection with NTN
- Ultra-dense radio network deployments
- RAN infrastructure sharing

Technologies to Enhance the Radio Interface

- Advanced modulation, coding, and multiple access schemes
- Advanced antenna technologies
- In-band full duplex communications
- Multiple physical dimension transmission
- Reconfigurable intelligent surfaces
- THz communications
- Ultra-high accuracy positioning

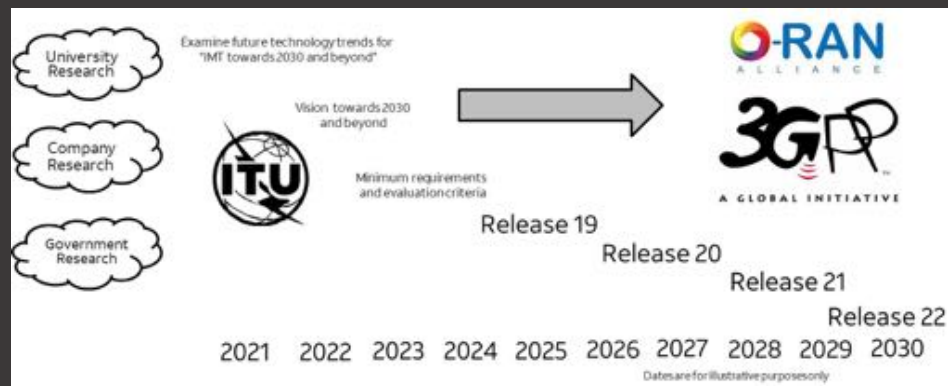
Looking Ahead

Invest in Next G Technologies developing 6G with timeline towards IMT-2030

Invest in B5G System Fundamentals (model & simulation, design for scale & resilience)

- Lead B5G System Integration with
 - 5G+ components
 - (distributed MIMO, DSA, terrestrial-NTN integration)
- Exploit Software-Defined Networking (autonomy, agility)

Time is Now during pre-competitive fundamental and applied research to develop joint roadmaps for digital infrastructure to support future wireless, networking and cloud research.



Anticipated IMT-2030/6G Timeline



Learn More...

<http://advancedwireless.org>

<http://colosseum.net>