5G Sustainability Initiatives of LF-Aether (Previously ONF)

Sarat Puthenpura, Chief Architect – Open RAN

- SMaRT – 5G (https://aetherproject.org/smart-5g/)
  - Sustainable Mobile and RAN Transformation 5G (SMaRT-5G) is a collaborative effort to develop and enable ML-driven energy savings solutions for mobile networks
    - Series of PoCs that demonstrate progressively advanced energy savings techniques on both Open-RAN and traditional RAN architectures
      - Completed two PoCs (Fyuz -23; NTIA RIC Forum – 24), more on the way

- 5G Energy Efficiency – Metrics, Models, and System Tests
  - R&D effort funded by NTIA grant under the Public Wireless Supply Chain Innovation Fund*
  - Joint effort with Rutgers WINLAB
  - Research, develop, and validate accurate and effective test methods:
    - To measure the energy efficiency of 5G network components
    - Effectiveness of end-to-end Open RAN energy optimization strategies
  - Key enabler of SMaRT-5G

Join our efforts for creating the next generation sustainable networks!

*Note: The NTIA grant is yet to be transferred to Aether from ONF

First Commercial Open RAN Public Network in the world

- **Over 90K** Open RAN 4G/5G Radios Deployed

Deployed 250K Small Cells

- 170M VoLTE calls per day; 4,000T of traffic per day

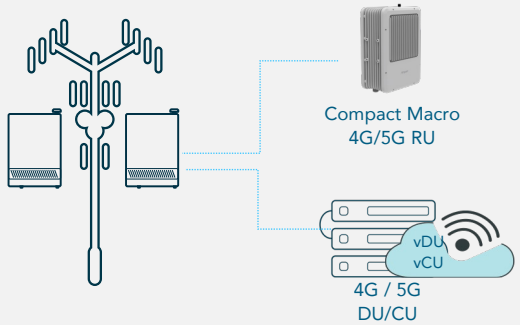
Largest geographical Open RAN network in the world

- **Over 5k** Open RAN Units Deployed (Base Stations and AirCards)

> 500 Private Networks deployed worldwide

- Smart Energy (Oil & Gas, Utilities), Transportation, Factories / Warehouses

Airspan ORAN Solution



Stats: 2022 to 2023:15k participants from 33 countries; 4k+ trained electronics engineers

ASIA OPEN RAN ACADEMY

- Started in April 2019, formed the interim Board, Ph-SEC registered on March 31, 2023; supported by USAID-IDG by providing the Secretariat;
- Started with developing ORAN courses, delivered through webinars, partnered with several institutions, advocated for the ORAN Lab that will be located in UP-EEE, an AORA partner
- Now with 14 University partners, 3 Government agencies, 7 international partners +++ potential partners
- AORA-Philippines is preparing for the Operations Phase, the outgoing and incoming BOD are faced with ensuring sustainability
- The Academy just concluded its annual Strategic Planning session and is committed to the following goals:
    - Produce world class ORAN engineers
    - Contribute in the building of the ORAN ecosystem in Ph
    - Continuously advocate Open RAN by providing webinars (micro-credentials, digital badges) and technical assistance
- For details: https://www.asiaopenranacademy.org/ https://www.facebook.com/asiaopenranacademy https://www.youtube.com/@asiaopenranacademy

BOOZ ALLEN

NTIA & VIRGINIA TECH

NTIA PWSCIF: O-RAN SECURITY

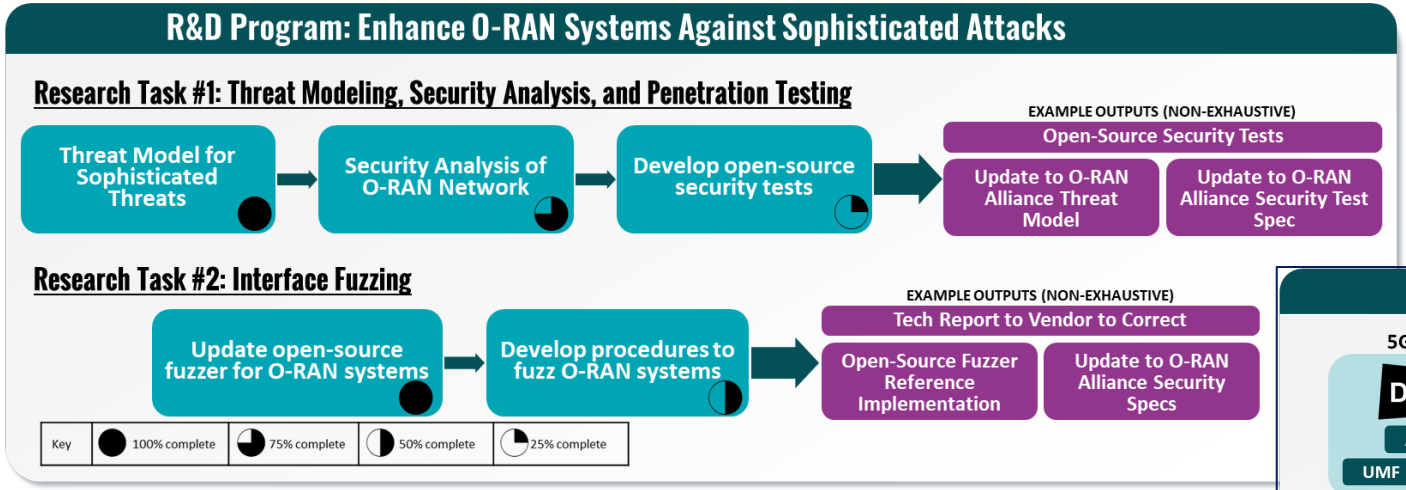
IORS, SEPT 2024

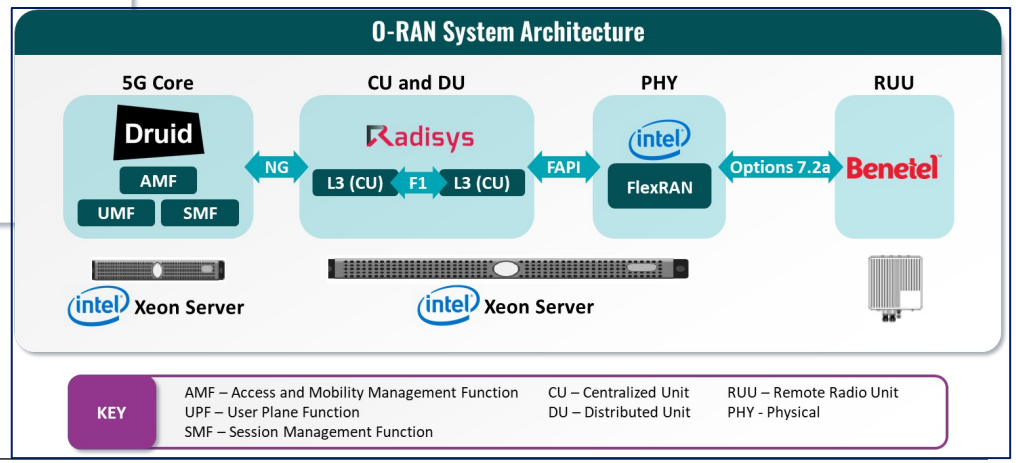
Samuel Appiah-Mensah

NTIA PWSCIF GRANT: ENHANCING O-RAN SYSTEMS AGAINST SOPHISTICATED ATTACKS

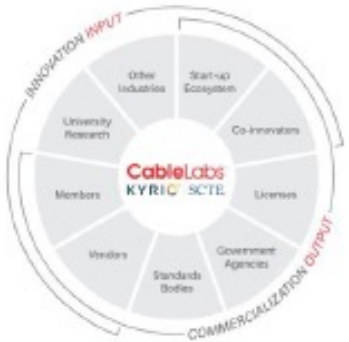
Booz Allen in collaboration with Virginia Tech will look to achieve the following objectives by the end of calendar year 2025:

- Drive **advanced security tests for sophisticated attackers** into specifications.
- **Increase industry and community adoption** of advanced security tests for sophisticated attackers, through open-source reference implementations and building relationships with commercial test vendors .
- **Procure and deploy O-RAN lab** for security analysis, penetration testing, and interface fuzzing.





CableLabs®



TOMORROW STARTS HERE

We energize the ecosystem for scale and speed.

We build platforms-technologies and specifications--that help support a wide variety of services and applications, enabling one cohesive and seamless ecosystem that continually fuels the imaginations of millions.

SUBSIDIARY

KYRIO®

TESTING/CERTIFICATION SPECIALISTS

Offers testing for development, interoperability, comparative analysis and certification for a variety of wireless and wired products

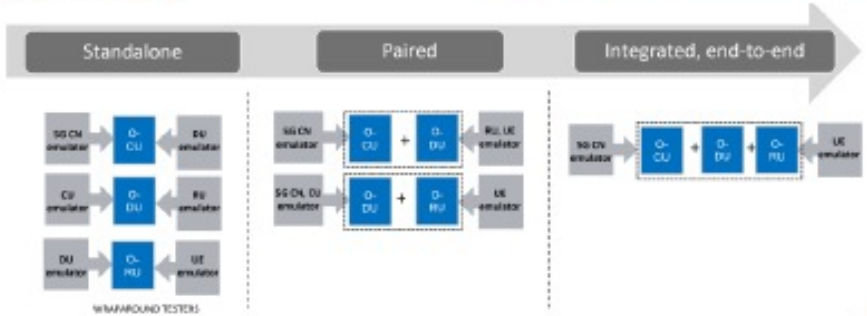
CableLabs is the leading innovation and R&D lab for the cable industry

CableLabs has a long history of hosting interoperability events for the telecom industry

5G OPEN RAN LAB

5G CHALLENGE

O-RAN Global PlugFest Fall 2022 — Plugged in PlugFest Host



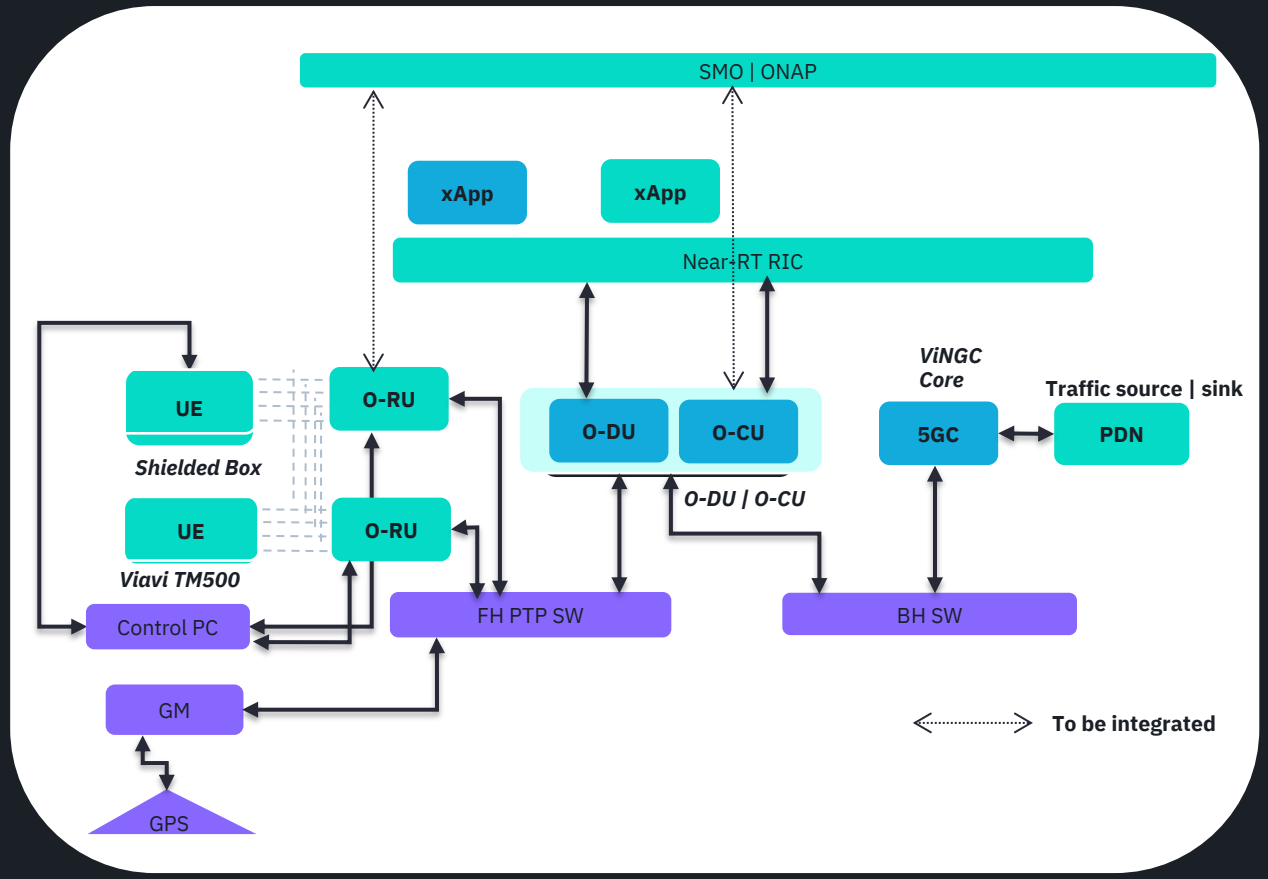
CAPGEMINI IN OPEN RAN

System Engineering
Work with customer to come-up with System architecture based on solution requirements & Identify the key components and infra options to realize the solution

System Integration
E2E system Integration in multi-vendor environment.

Testing & Support
Testing and Validation of deployed Setups. Dedicated support team to handle specific requirements.

O-RAN 5G Framework
Compliant to O-RAN architecture
- 5G CU/DU SW Framework supporting 3GPP & O-RAN interfaces (E2, O1, FH)
- 5G RIC framework (Near-RT RIC, Non-RT RIC with SDK and reference xApps/rApps)



- ✓ Design and integration of end-to-end (E2E) reference test setups in the lab.
- ✓ E2E advanced test coverage setup: Functional, security, Performance.
- ✓ Plugfests participation with (O-CU/O-DU framework, xApps, RIC, 5GC…).
- ✓ Certification & Badging: based on the O-RAN Alliance for Capgemini O-DU/O-CU Framework.
- ✓ Valuable contributions towards automation, LaaS and TaaS.
- ✓ Support on the lab research topics around RIC uses cases and conflict resolution.

https://go.capgeminigroup.com/OpenRAN

i14y LAB

Commonwealth Cyber Initiative

CCI xG Testbed

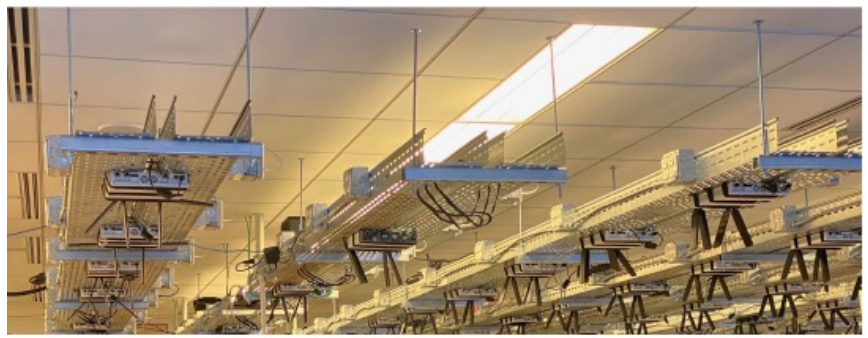
An O-RAN Based Platform for Testing and Experimentation

Dr. Aloizio Da Silva
Wireless Testbed Director, CCI
aloiziops@vt.edu

International Open RAN Symposium
September 17 – 19, 2024, in Golden, Colorado, USA

An O-RAN Testbed at Washington DC Metro Area

www.ccixgtestbed.org



In-Lab
Washington DC Metro Area/ Arlington

- FCC Experimental License
- End-to-End O-RAN : Non and Near-RT RICs; AIMLFW
- Open Source Cloud Environment OpenStack-based
- SDR-based Radio-Grid

Commonwealth Cyber Initiative TESTBED

WorkForce Development

OPEN TESTING AND INTEGRATION CENTRE

Washington DC Metro Area

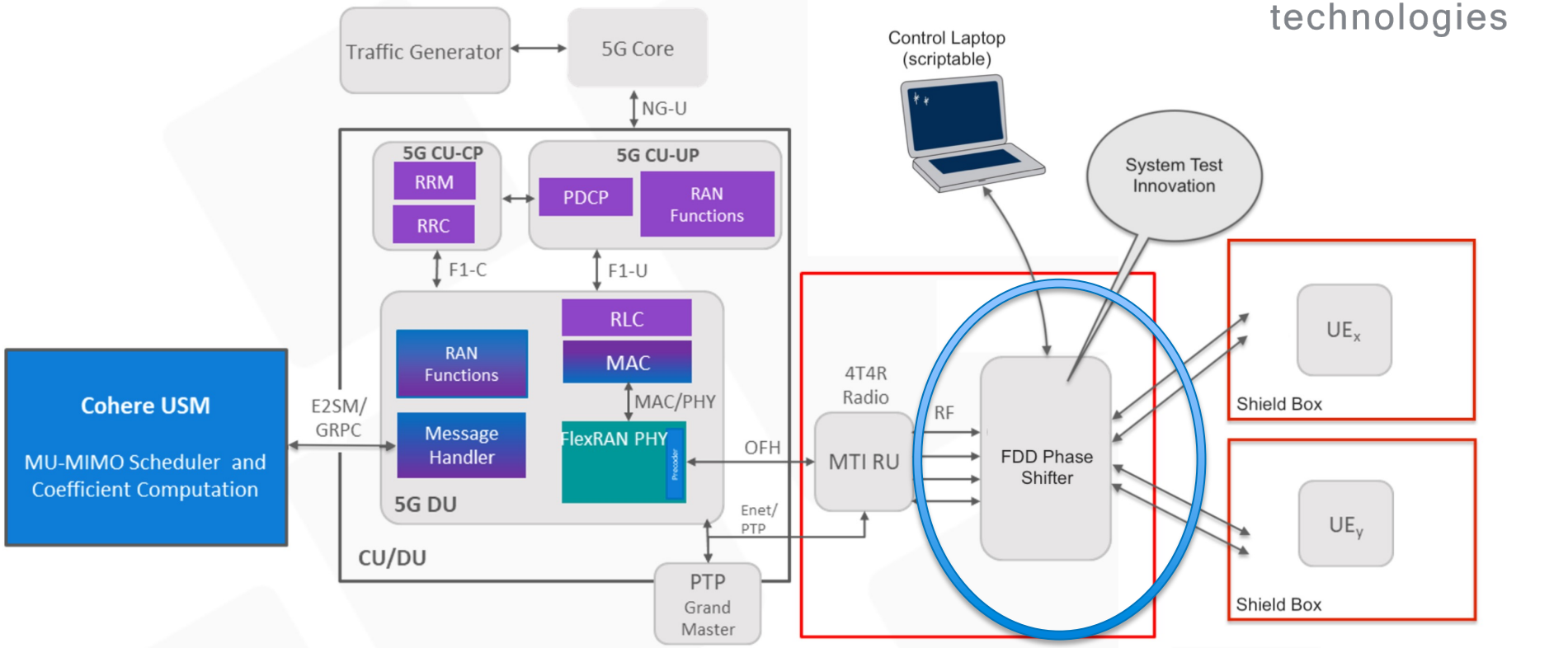
In-The-Field
Blacksburg - Virginia

- CBRS Priority Access License 3.5-3.7GHz
- FCC Experimental License
- Authorized SAS : Federated Wireless
- Open Source SAS : OpenSAS

Hardware and Software Testing

KEYSIGHT ROHDE&SCHWARZ

Test Innovation – FDD MU-MIMO



Band 71 FDD MU-MIMO under test

Links

Video demo of the USM xApp at Vodafone CREATE 5G Trial Site:
https://youtu.be/PefFScgSDVM

Universal Spectrum Multiplier Open RAN xApp page:
https://www.cohere-tech.com/universal-spectrum-multiplier-open-ran-4g-5g

DEEPSIG

Accelerating OpenRAN Performance with AI/ML in the Air Interface

Dr. Tim O'Shea, CTO, Arlington, VA

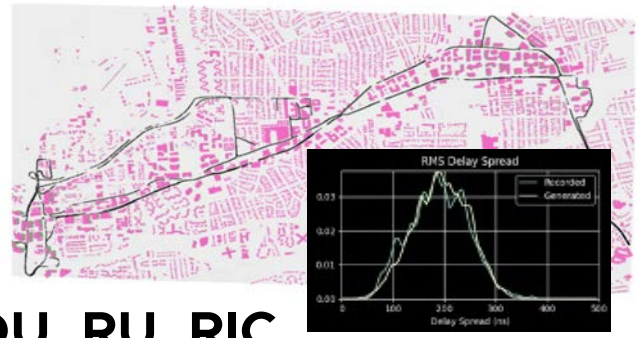
17 Sep 2024

AI/ML Accelerating OpenRAN Air-Interface Performance

DEEPSIG

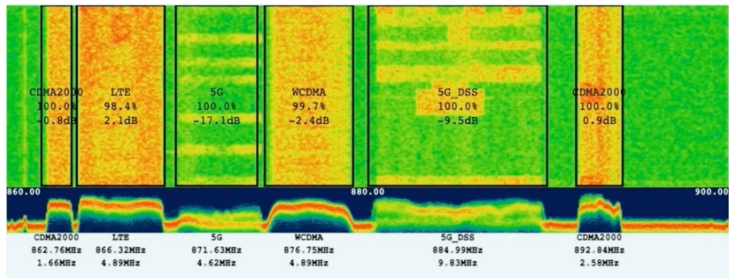
NOFO1: Air Interface T&E /w RAN Digital Twin

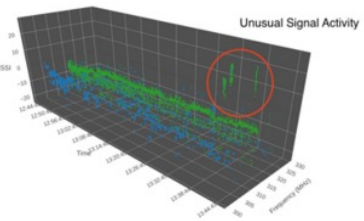
- Generative AI Models for Air Interface T&E
- RAN-DT empowers RAN Function Optimization



OmniSIG Sensing & Situational Awareness

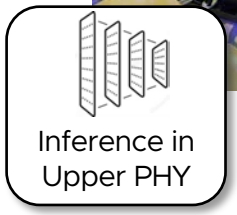
- Spectrum Awareness, Monitoring, Sharing
- Wireless Security and Fault Automation





OmniPHY Optimization in DU, RU, RIC

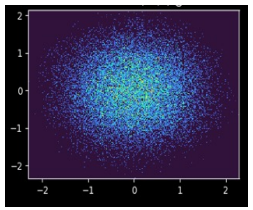
- Spectral Efficiency Enhancement
- Private/Public & FlexRAN Networks

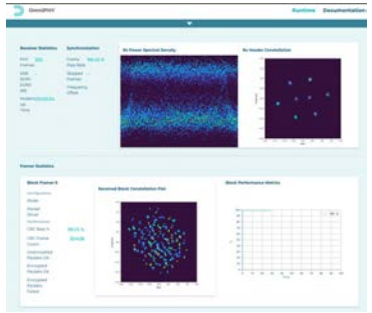


OmniPHY 5G Neural Receiver

Next-G RAN Technology & Standards

- End-to-end MIMO Air Interface Learning
- Secure, Resilient, Adaptive Physical Layer





About Digital Catapult

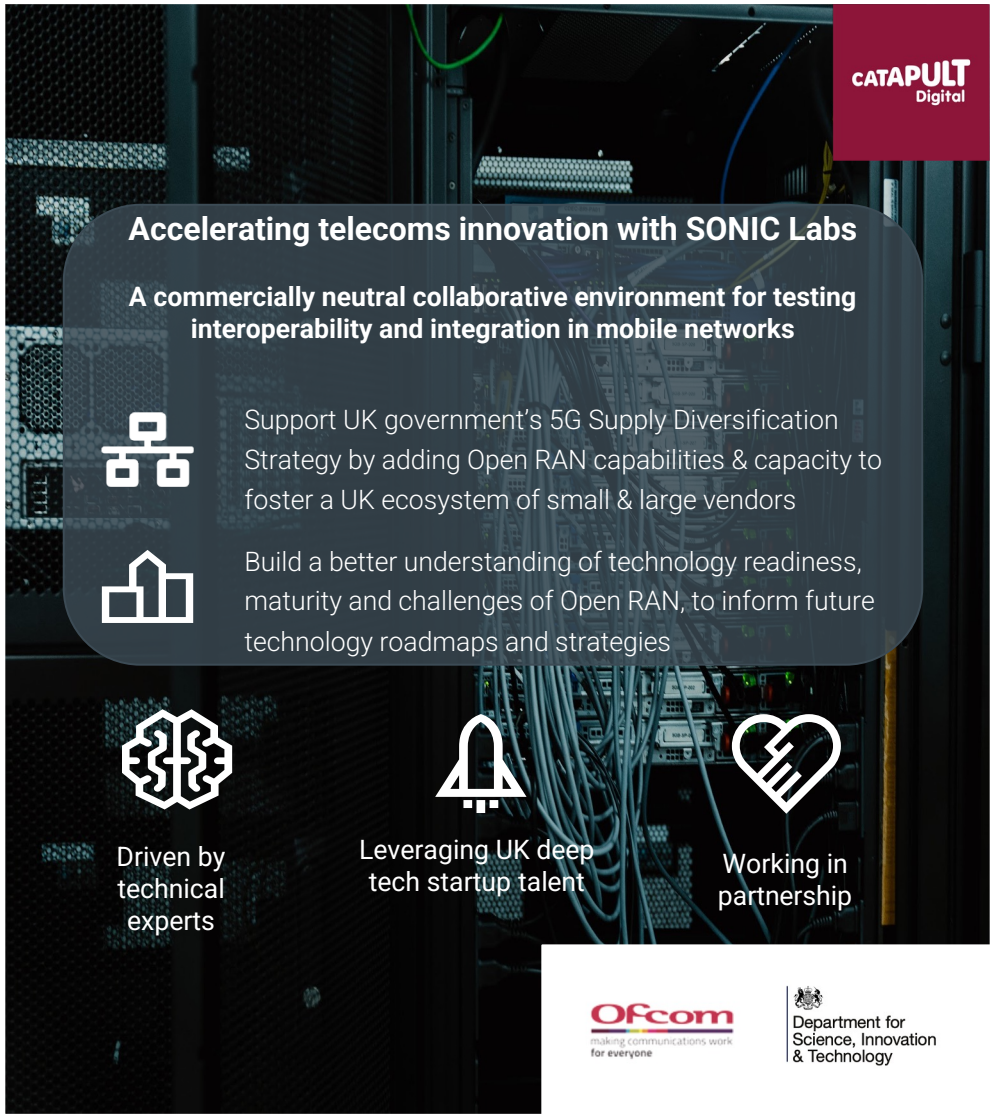
Digital Catapult is a deep tech innovation organisation. We help businesses grow by applying deep tech. We show what is possible, positive and productive with advanced digital technology.

WHAT WE DO

Deliver specialised **acceleration** and **innovation programmes** aligned to industry challenges and themes

Build **testbed facilities**, run **pilots** and **proof of concepts** and test new **business models**

Facilitate **R&D projects**, inform **policy recommendations** and **lead research** on emerging tech trends

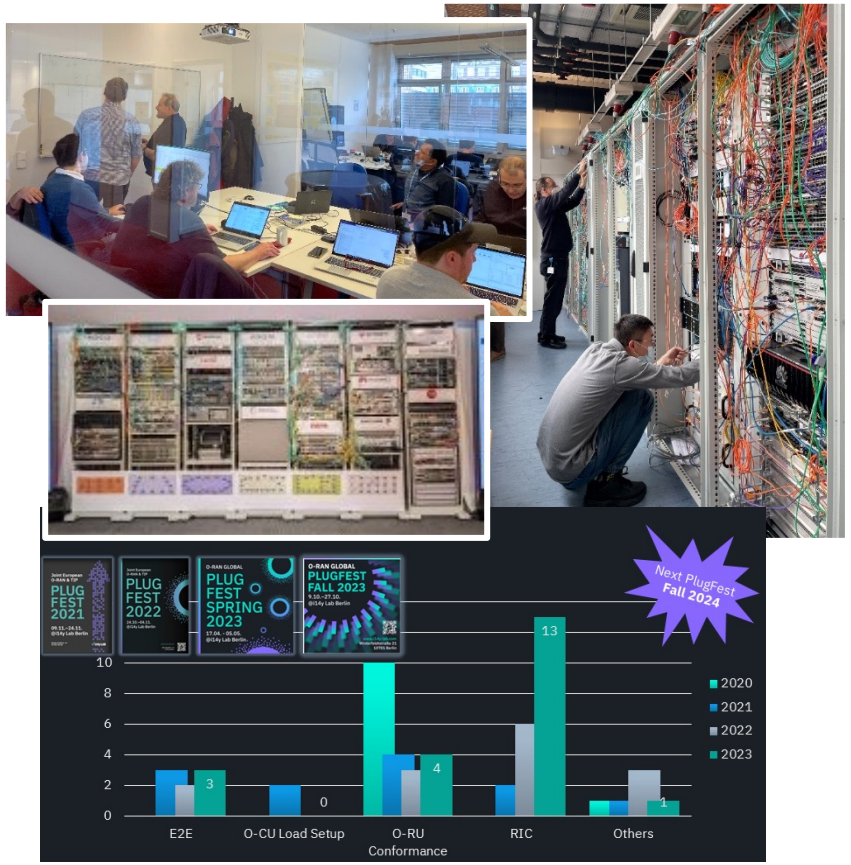


EANTC (European Advanced Networking Test Center)

Independent Test Lab Founded in 1991, based in Berlin, Germany

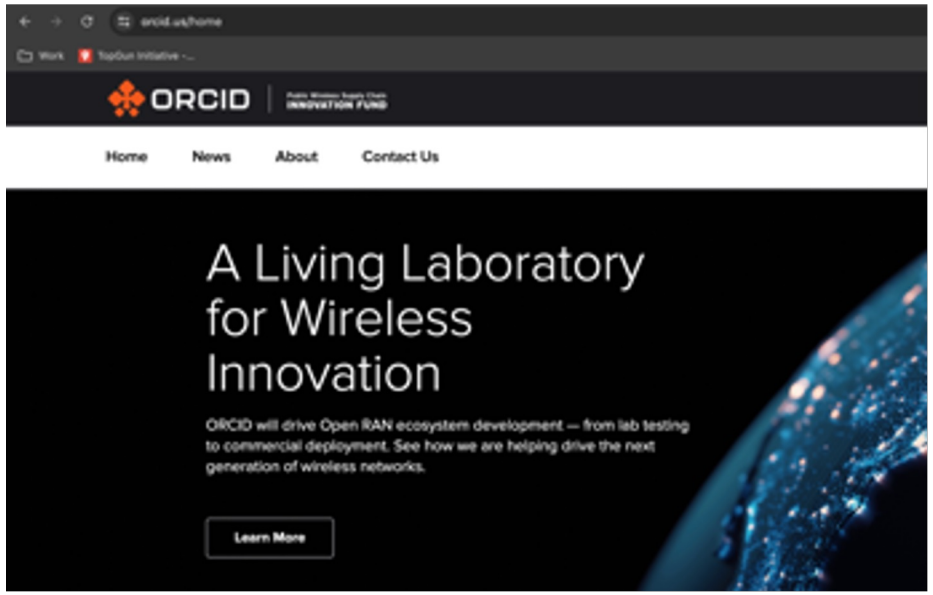
Planned workshop contributions in areas marked in bold

- Quality assurance for innovative mobile and fixed networks, hybrid cloud, and network security
- Emulating **realistic, complex use case scenarios at scale**
- 100% vendor-neutral; proud to create **reproducible and verifiable results**
- Specializing in **well-coordinated multi-vendor interoperability** tests
- Actively participating in **standardization of test methods**, including O-RAN Alliance, TIP, IETF, ETSI, and others
- Member of the i14y Lab consortium, leading work packages for **plugfests**, **certification**, and **efficient, automated testing** of O-RAN solutions
- Member of German “CampusOS” project creating and validating disaggregated 5G Campus network solutions
- Extensive mobile core and **5G application** testing experience related to Open Gateway initiative (5GASP and 5G-VINNI public projects)



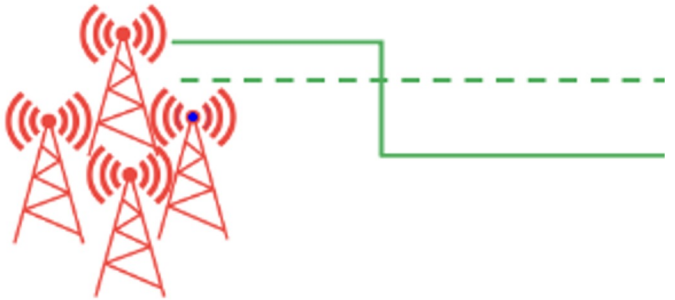
ORCID - Open RAN Center for Integration & Deployment

- **$50 Million grant from NTIA to promote O-RAN**
- **Launched July 15th**
- **Portal (https://www.orcid.us)**



4 Lab Test Lines

4 Field Test Sites



Consortium Partners:

ECHOSTAR MAVENIR FUJITSU vmware

International Open RAN Symposium

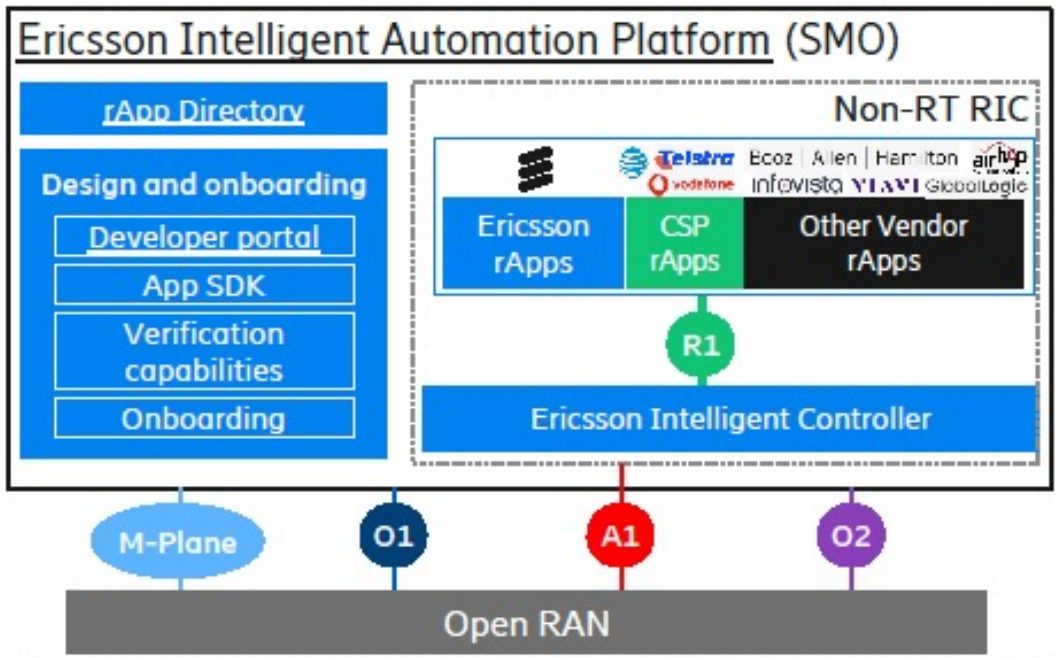
Lightning Talk, Ericsson

Golden, Colorado

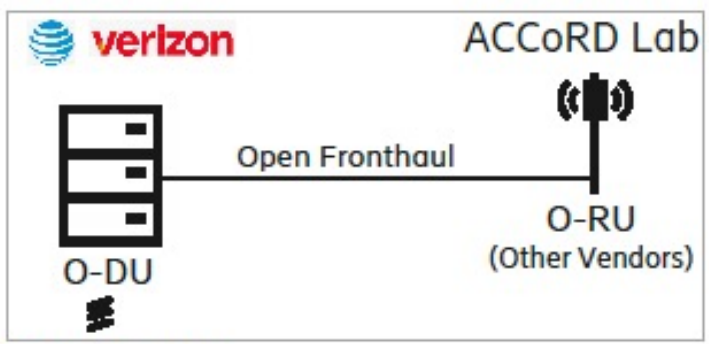
September 17-19, 2024

Ericsson Open RAN testing

- Open RAN products, Open RAN industrialization
- State-of-the-art 5G factory in Texas



(August 2024)



- rApps:
  - Multi-vendor interoperability over R1
  - SDK for integration with external supplementary data
  - Mediation for open interface (A1, O1, M-Plane, O2) towards RAN
  - Global rApp certification service for 3rd party rApps
- Open fronthaul:
  - Multi-vendor interoperability testing in NTIA NOFO-1 ACCoRD lab
  - Validation with automated O-RAN test cases (TIFG), gaps fed back into standards

ACCoRD: Acceleration of Compatibility and Commercialization for Open RAN Deployments, NOFO: Notice of Funding Opportunity, NITA: National Telecommunications and Information Administration, TIFG: Testing and Integration Focus Group

Fujitsu Network Communications - IORS

System Integration & Apps Testing
Challenges and opportunities

Ladan Pickering

System integration & Apps testing

FUJITSU

- Global leader and pioneer in Open RAN
- ORAN deployments in Japan, Germany and U.S.
- Full open RAN stack (RUs, CU/DU, SMO, …)
- ORAN System Integration Services

2022 5G CHALLENGE

2023 5G CHALLENGE

NOFO-1
Providing RUs to DISH, Viavi, AT&T/Verizon

APPs Challenges and opportunities:

Standards and Software

- R1 API detail missing in standards
- Lack of standards definition for SDKs to onboard APPs
- Lack of visibility/access to KPIs on E2, O1, and O2 interfaces
- RU/DU/CU/SMO must support read/write access to KPIs that APPs require to function properly
- Limited RIC vendors

Labs

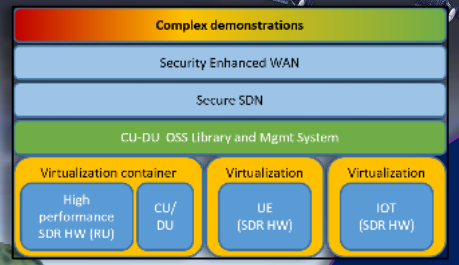
- Lack of access to Labs w/ full stack and multiple vendors
- Lab infrastructure access complexity (should be as simple as Cloud)
- Lack of multi disciplinary skills
- Expensive/complicated Test equipment to simulate large networks that APPs may require

- DISH ORCID Lab Funded by NTIA can alleviate some of the challenges

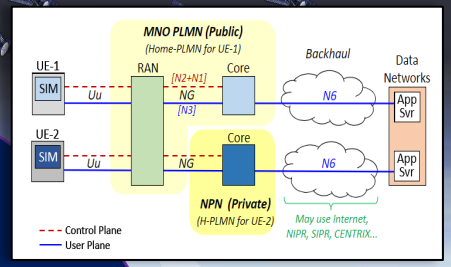
Contact: Ladan.pickering@fujitsu.com

FutureG Priority Efforts for 2024

Open Centralized Unit Distributed Unit (OCUDU)



DoD Multi-Operator Core Network (MOCN) RAN Sharing Project



Microelectronics Commons

MICROELECTRONICS COMMONS

Resilient and Open Commercial Solutions

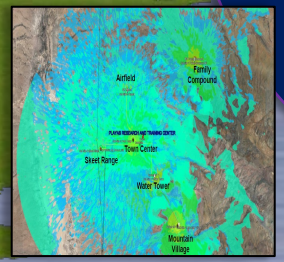
Ubiquitous, Secure and Instant Access

Workforce Development

Integrated Sensing and Communications

Expeditionary and Tactical Use

Smart Resilient Logistics INDOPACOM Integration



Playas Research and Training Center (PRTC) FutureG Build-out

NATO ACT / Latvian Range

XCOM RAN

Globalstar

XCOM RAN

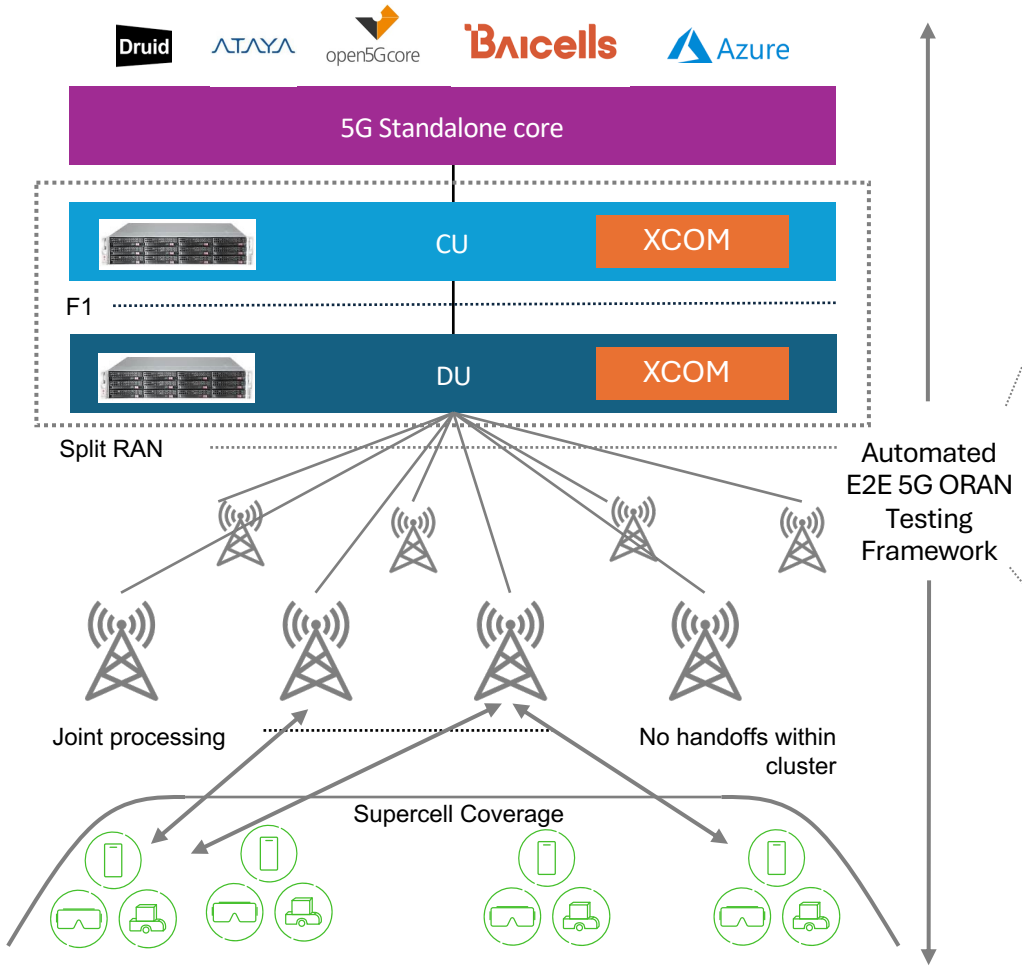
- Commercial Distributed Massive MIMO
- ORAN system (32 antennas / 16 MIMO Layers

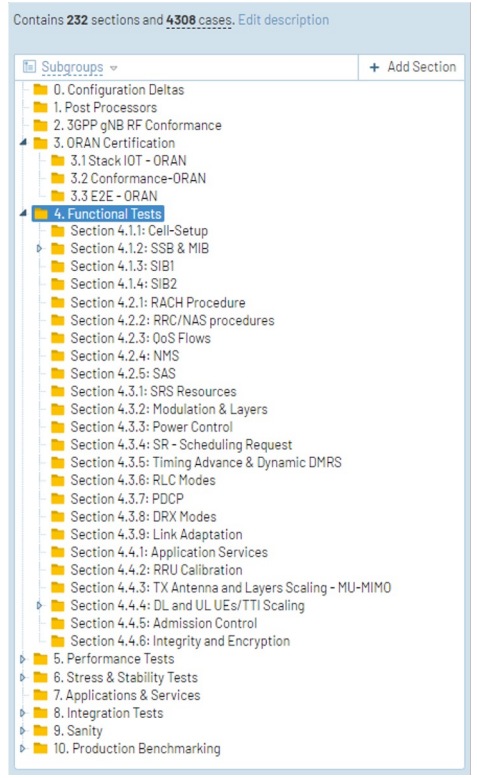
Automated E2E 5G ORAN testing framework

- Continuous test over 5 production platforms over 60 days with over 4,000 test per testing cycle

- Opening an Innovation Lab to test band53 n53 solutions and high performing workloads

  - 2024: n48 (up to 100MHz)
  - 2025: n48 + b 53 / n53 (2.4GHz) – Global spectrum





- System being deployed for warehouse automation workload
  - Network resiliency
  - Low latency
  - High reliability

Telit QUECTEL Qualcomm ZEBRA edge 50 PRO Pixel ONEPLUS

- Capacity gains >4x baseline of 5G NR
- Simplified network planning

Luis.Mirabal@globalstar.com

Hewlett Packard Enterprise

Geetha Ram
WW Compute CTO

✓ Procurement Flexibility
✓ Accelerated Innovation
✓ No Vendor or Technology lock-in

x Financial (TCO, cashflow) risks
x System integration complexities
x Operational challenges

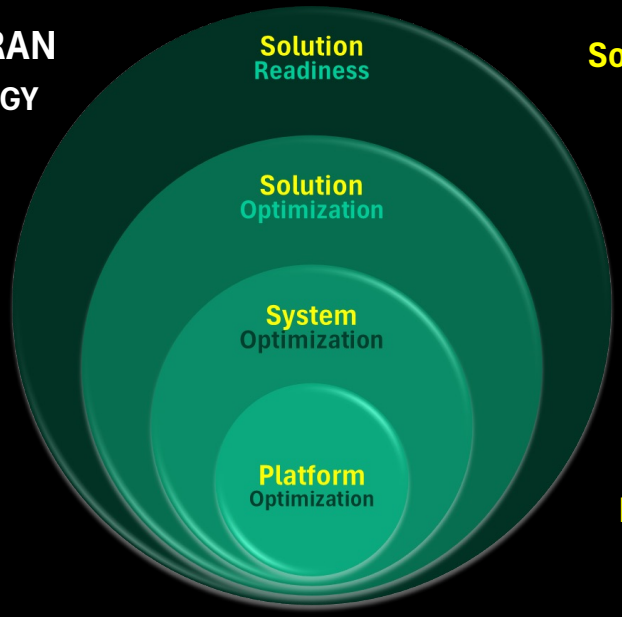
?

Open Infrastructure Benefits − Risk Premium = OPERATOR Net Business Benefits

Hewlett Packard Enterprise + Partners

LOW RISK ORAN TRANSFORMATION CATALYST FOR OPERATORS

HPE ORAN STRATEGY



Solution Deployment Readiness
- Automated and Zero Touch Provisioning

Solution Optimization
- HW + SW optimized for power and performance

System Optimization
- HW Infra Performance and Power optimized (Carrier Grade)

Platform Optimization
- Server Power, Performance optimized (Carrier Grade)

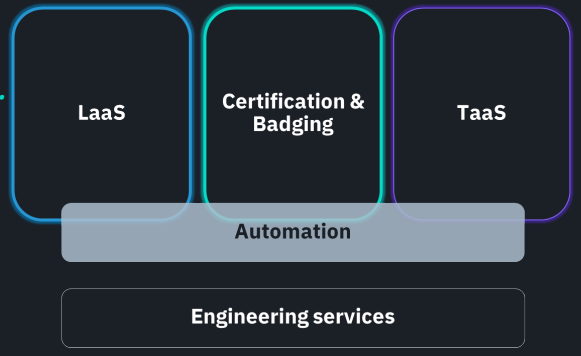
i14y LAB Achievements

- O-RAN Alliance certificates & badges *First in Europe / Germany, Berlin!*
- TIP Silver Badge
- i14y Lab Summits *2022 · 2023 · 2024*
- 6 Plugfests and more to come

We are open for a collaboration with you!

Offers

- Certification & Badging *Easy & reliable certification.*
- Test as a Service *Helping you along towards certification and badging.*
- Lab as a Service *Our setups for your development*



What's next?

- More certificates & badges
- More global lab collaboration *Collaboration with ITRI UC9*
- More development *MoU and CoW blueprints Energy Efficiency study with Rimedo*
- More Plugfests

i14y LAB

Dr. Arupjyoti (Arup) Bhuyan

Directorate Fellow, Idaho National Laboratory (INL)

Director, INL Wireless Security Institute (WSI)

Wireless Security Research at INL WSI

Idaho National Laboratory

INL Wireless Security Institute (WSI)

VISION: National Leadership on Wireless Security for Secure Adoption of Advanced Technologies including 5G/ORAN, 6G, Wi-Fi 6E/7 and related Spectrum

MISSION: Provide best in class security research, assessments, evaluations, engineering support, and technology development to enable government and industry harvest the benefits of advanced wireless technologies

Innovative Research

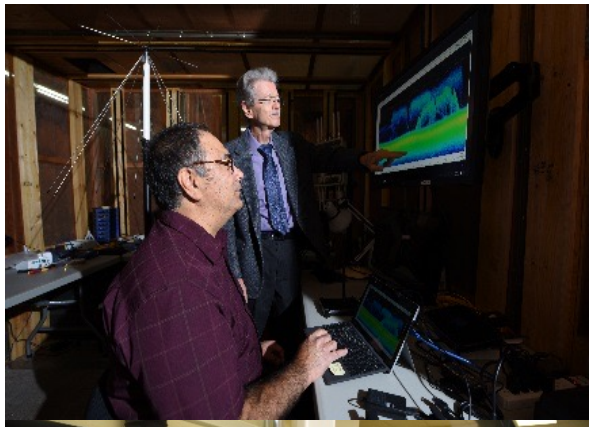
- Lab directed research on security of advanced technologies and secure spectrum use and sharing
- Externally funded research, analysis, and engineering studies to address national security gaps in secure use of 5G & Future G/6G technologies and spectrum
- Proof of Concept for development and deployment of secure real-world use cases with transformational technologies

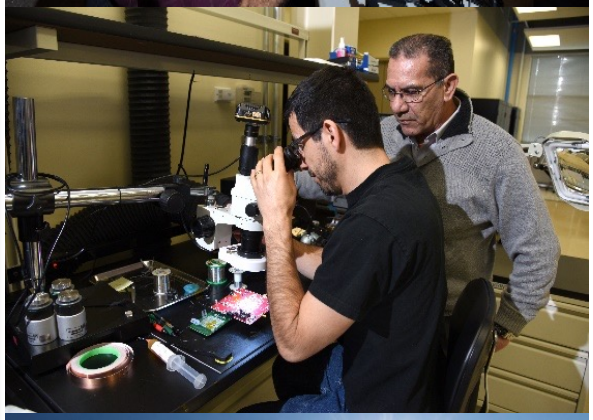
Evaluation & Validation

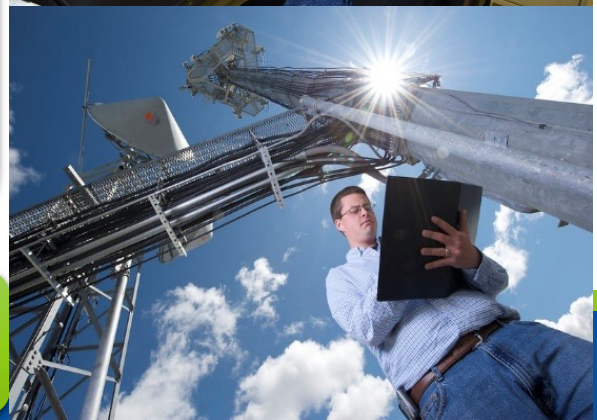
- Effective, accurate, responsive testing and verification
- Advanced Lab based systems for highly efficient and intrusive testing
- Unique Wireless Test Bed (WTB) in outdoor environment providing capability to test real world scenarios at scale
- WTB Spectrum flexibility with NTIA experimental station status

External Collaborations

- Academic and Industry Researchers in US
- Hosting of National Security workshops and Conference Tracks addressing key security topics with participation from US Government, Industry, and Academia
- International collaboration with wireless leaders in US Government partner countries







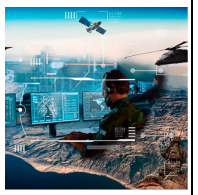
NOTABLE OUTCOMES: Diversely Funded RDD&D Portfolio supported by WSI as a National Authority on Wireless Security and utilizing resources across INL to exceed customer expectation

IOWA STATE UNIVERSITY
Center for Wireless, Communities and Innovation (WiCI)

Hongwei Zhang
Richardson Professor (ECE), Director (WiCI)
hongwei@iastate.edu, (515)294-2143

ARA PAWR & OTIC for Real-Time, High-Capacity Edge Wireless

Remote Connectivity Challenge



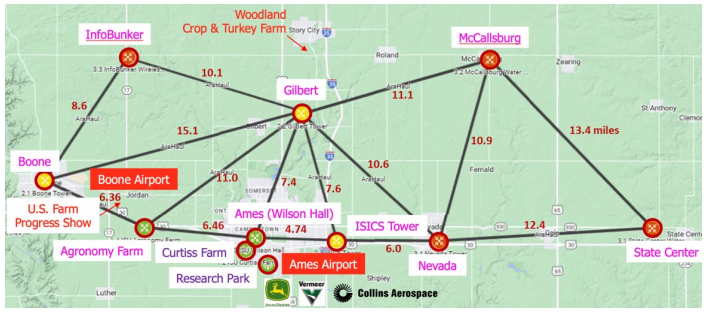
- Lack of connectivity as key barrier to real-time AI in remote areas (e.g., agriculture farms, tactical fields)
- Challenge of providing affordable, high-throughput connectivity to remote areas
- Challenge of wireless spectrum access

ARA OTIC Focus

- nG research, development, testing and integration
  - far-edge, real-time, high-capacity
- Open-source prototyping & ecosystem building
- Production systems testing & integration
  - performance, inter-operability, conformance

ARA PAWR Wireless Living Lab in Central Iowa

arawireless.org



- High-capacity 5G-and-beyond wireless access, x-haul & LEO satcom platforms covering 290+ sq. miles: up to *100Gbps+ x-haul, 3Gbps+ access*
- Support for bring-your-own-device (e.g., O-RU, O-DU, O-CU, RICs etc)
- Collaboration across sectors (wireless & applications), TRLs, communities

O-RAN & Advanced Wireless Research & Innovation

- Robust, high-capacity *wireless x-haul* via heterogeneous x-haul wireless platforms operating from free-space optical (194THz) down to mmWave and microwave bands, as well as *spatial, temporal, and spectral diversity*
- Affordable, high-capacity *wireless access* via low-frequency operation, massive MIMO, spectrum & RAN sharing, predictable interference control
- *Integrated* wireless access, x-haul, and LEO satellite comm.
- RaptorQ coding based *liquid wireless network architecture* for robust, real-time communications across heterogeneous wireless access and x-haul systems

Ongoing Projects at ISU WiCI

wici.iastate.edu

- *NTIA Innovation Fund:* ACCoRD
- *National Radio Dynamic Zone* for spectrum innovation: ARA-NRDZ
- MISO free-space optical communications: AraOptical 2.0
- *Real-time liquid wireless networking at far edge*: RT-LWN
- *AI Institute* on AI cyberinfrastructure: ICICLE
- *Open-source* ecosystem for broadband prairie: OPERA

Key Participants

- ISU Center for Wireless, Communities and Innovation (WiCI)
- 65+ public-private partners (e.g., Skylark Wireless, Ericsson, Collins Aerospace, John Deere, Vermeer, AT&T, City of Ames)

More on ARA Rural Wireless Living Lab

- ARA Overview and Call for Participation [video]
- Robotics-related demos in the ARA Public Launch event:
  - ARA-Enabled Teleoperation of Automated PhenoBots [video]
  - Livestock Monitoring via Telepresence and Video Streaming
  - Data Throughput and Connectivity for AI Infused Ag Machinery Systems [video]

ITRI 5G Open Network Lab

Maggie Chao
Deputy Division Director

ITRI
Industrial Technology
Research Institute

ITRI 5G Open Network Lab

- **ITRI** is a research institute to drive industrial development, create economic value through technology R&D
- **Taiwan** is one of the major hometown of Open RAN suppliers, especially for the RU solutions
- Supported by Taiwan government, ITRI established a carrier-grade, end to end integration testing lab in 2020.

Globally Recognized

TELECOM INFRA PROJECT

- OpenRAN
- RIC
- OpenWiFi
- DCSG

Local Requirements

中華電信 Chunghwa Telecom　台灣大哥大 Taiwan Mobile

- Pre-test for private network
- Core network integration test
- Field test
- Technical collaboration

Labs Collaboration

NTIA　CATAPULT Digital SONIC LABS　i14y LAB

- Vendors recommendation
- Test plans development
- Joint testing activities

Next Steps

- Advanced testing development
- Emerging markets support
- Sustainable business model

5G Summit 2024

October 23 – 25

@ Taipei, Taiwan

Lions　QCT　WNC Wistron NeWeb Corp.　LITEON　NYCU National Yang Ming Chiao Tung University　ATAYA　Groundhog　COMPAL　FOXCONN 鴻海科技集團　PEGATRON　TAILYN Built Rugged.　REIGNS　ALPHA Networks

Communications Research and Innovation Network (CRAIN)

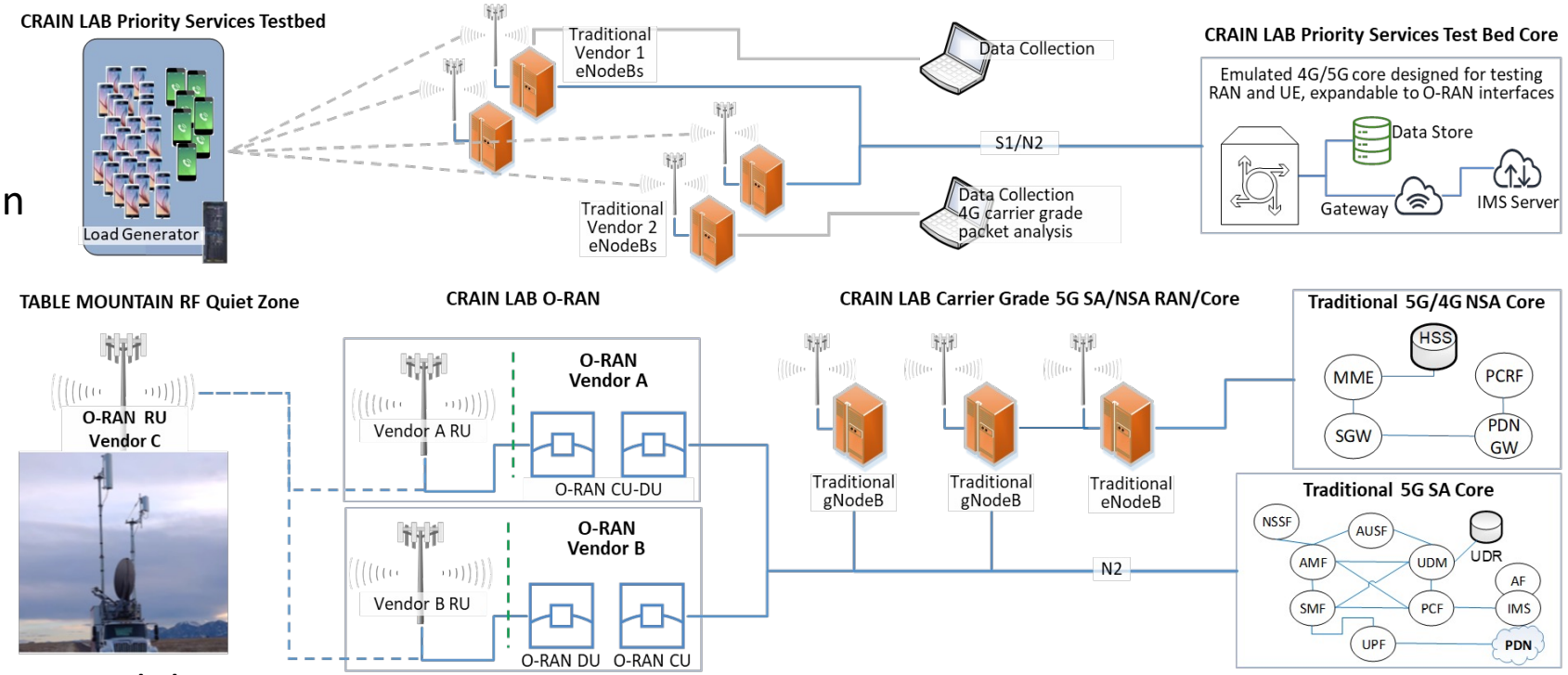
17 September 2024

Shariq Ashfaq | sashfaq@ntia.gov
Angela McCrory | amccrory@ntia.gov
Tim Thompson | sthompson@ntia.gov

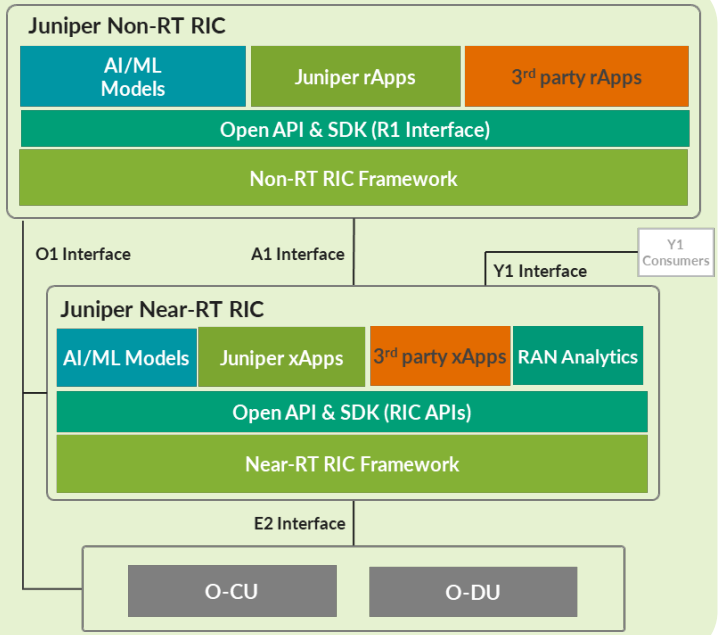
Boulder, Colorado • its.ntia.gov

CRAIN Laboratory – Traditional 5G RAN + Open RAN

- Major NTIA/ITS resource for research into next-generation communications technology
  - Initial focus on Open RAN integration with Tier 1 5G Network Core
- Open RAN Test Plan based on O-RAN ALLIANCE specifications
  - Consistent with 5G Challenge/CableLabs
  - Close alignment with UK SONIC Lab
- Collaborating with UK SONIC Lab
  - Shared Test Plans and Test Equipment Capabilities
  - Monthly Meetings
- Plan to Collaborate with Other Labs in the Future



Juniper Non-RT and Near-RT RIC – Commercially Available & Carrier Grade



Juniper RICs

- Fully compliant to O-RAN specifications and interfaces
- Open APIs and support for 3rd party rApps/xApps
- Support for O-RAN compliant 4G/5G O-CUs, O-Dus
- Integration with Juniper and/or 3rd party SMOs
- AI/ML support
- Meets carrier-grade expectations
  - High scalability, availability, redundancy, security micro-services based containerized architecture
  - Flexible deployment options (AWS, Google Cloud, RedHat OpenShift, WindRiver CP, etc.)

O-RAN Global PlugFest Spring 2022 · O-RAN Global PlugFest Fall 2022 · O-RAN Global PlugFest Fall 2023

HiPer-RAN EFFICIENCY THROUGH INTELLIGENCE

6G SUNRISE

2024 RIC FORUM

6G XCEL

NTIA IORS goal: Consistent and repeatable Open RAN testing

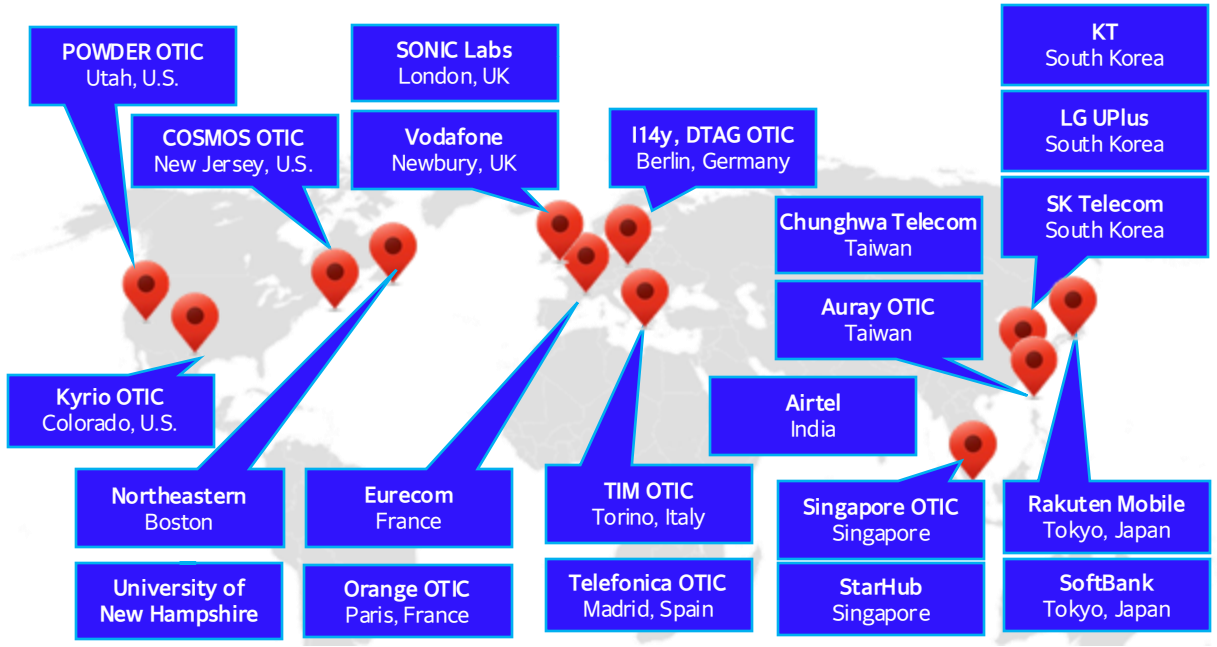
- Juniper RICs are commercially available - many advanced trials, field deployments
- Juniper RIC application partner program for 3rd party rApp/xApp developers
- Leadership and active contributions to O-RAN Alliance, including test specifications
- Regular participation in O-RAN plugfests in several regions
- Demonstration of interoperability through many industry and research projects (UK DSIT, NTIA RIC Forum, EU research projects)
- Working with test vendors, test labs and interop labs to validate the open and standards compliant interfaces and verification of end-to-end use cases

Keysight Technologies

DESIGN, EMULATE, AND TEST TO ACCELERATE INNOVATION AND DEPLOYMENT OF OPEN RAN

Open RAN Test & Enablement Solutions and Industry Collaborations

- **Comprehensive Automated Test Solution Portfolio** – Conformance, Subsystem (O-RU, O-DU, O-CU, RIC/SMO, xApps/rApps, Transport, Cloud), Interoperability (OFH, F1/X2/Xn, A1, E2, O1), E2E, Security, Energy Efficiency and Savings (RU, DU/CU/Cloud, gNB), Performance, 3GPP features inc. Massive MIMO, AI/ML Models Training & Testing
- **Extensive Global Collaborations in O-RAN PlugFests** - enabled more than 140 demos and collaborated with more than 60 vendors in 18 labs globally since the 1st O-RAN PlugFest



Open RAN Consortia and Standards Participation

- **NTIA Open RAN NOFO1** ACCoRD and ORCID – test partner
- **NTIA 5G Challenge** – test partner
- **O-RAN ALLIANCE** co-chairs Test and Integration Focus Group (TIFG), Minimum Viable Plan Committee (MVP-C); co-rapporteurs and contributors for WG2 (non real time RIC, A1), WG3 (near real time RIC, E2), WG4 (fronthaul), WG11 (security) test specifications; co-leads nGRG RS-08 (nG Research Platforms)
- **Telecom Infra Project (TIP)** Test & Validation Committee Member

Involvements in Open RAN Consistent, Repeatable Testing Worldwide

Keynote Presentation in the 1st IORS 2024 with Keysight enabling 4 global OTICs in the O-RAN Spring 2024 Plugfest testing

- **O-RU Fronthaul Conformance** – Rakuten Mobile/Japan OTIC and SUTD/Singapore OTIC
- **O-DU Fronthaul Conformance** – SUTD/Singapore OTIC and Northeastern Open6G U.S. OTIC
- **O-RU Energy Consumption/Efficiency (3 O-RUs)** – Auray OTIC
- More upcoming in the Fall 2024 Plugfest

Contact - Eng Wei Koo
EngWei.Koo@keysight.com

Korea's Open RAN Policy

"A comprehensive approach: From R&D to Commercialization, along with Public-private and International collaboration/governance"

1 Strategic R&D Effort

Securing O-RAN technology and international joint research

- **Development of core parts/equipment/software**
  - ※ 20 R&D projects(approx 200mil$) in progress
- **Joint R&D and training program with global partners**
  - ※ O-RAN joint research partners: U.S., U.K., Singapore
  - ※ Training program('24~): Korea-U.S. universities

2 Interoperability & Testing

Operation of Korea OTIC and field test project

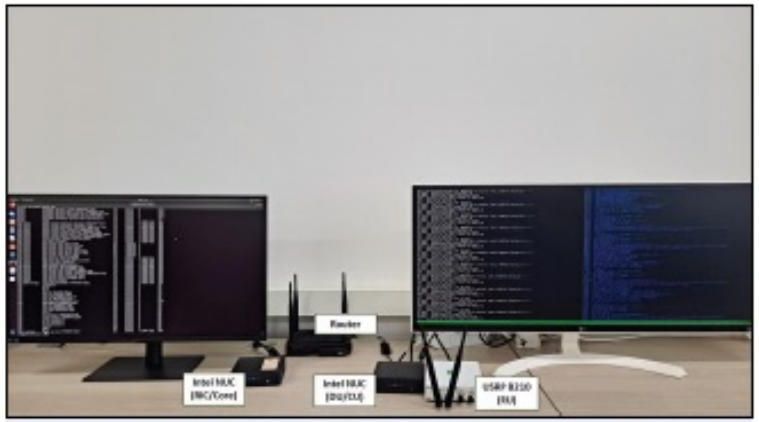
- **Korea OTIC as a center of badging, certification, and domestic/global Plugfest**
  - ※ K-OTIC: Accredited by O-RAN ALLIANCE('23.10)
- **Embark on commercial network Open-RAN deployment and establish O-RAN Testbed**

3 Governance

Public-private collaboration and international outreach

- **O-RAN Industry Alliance**(ORIA, '23.4~): **30+ member companies incl. Samsung**
- **Joint effort with partner countries** (U.S., U.K., Japan) **for global O-RAN Deployment**
  - ※ Participated in ICT Roadshow('23.12)

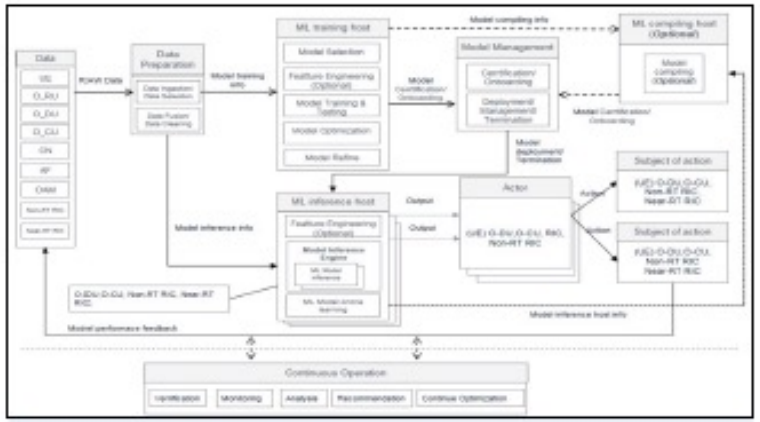
KyungHee University MCL: Open RAN Leader in the South Korean Academia



SD-RAN Engineering Team

Linux Foundation Aether Project

- 6 members are actively driving the SD-RAN project forward
- Development of RRM/RIC Testbed & Simulator
- Industry-Academia Collaboration with SD-RAN developer

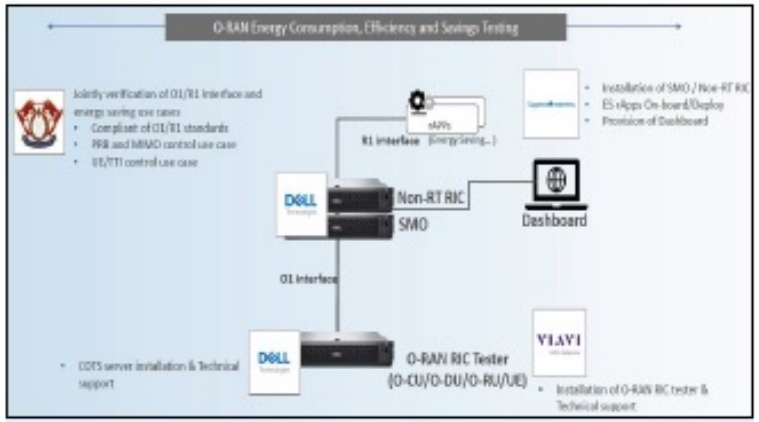


O-RAN SC AI/ML Workflow

O-RAN Software Community: AIMLFW

*** KHU with Samsung**

- O-RAN SC AI/ML Workflow Main Contributors
- Standards Researches for AI/ML in Open RAN
- Work with AIMLFW, NONRTRIC, RIC workgroups



O-RAN Plugfest 2024

KHU with LGU+

- Energy Saving Use Case Verification
- Co-work with LG U+ / Capgemini / Dell / Viavi
- Participating in Plugfest 2024 Fall and KRS2024

Lekha Wireless

- **Bangalore, India based OEM** of 5G and 4G RAN, industrial wireless connectivity solutions and Software Defined Radio (SDR) for defense networks. **Started in 2010, 300+ staff focused on R&D.** Member of India's Bharat 6G Alliance and the TSDSI standards organization

O-RAN Solution

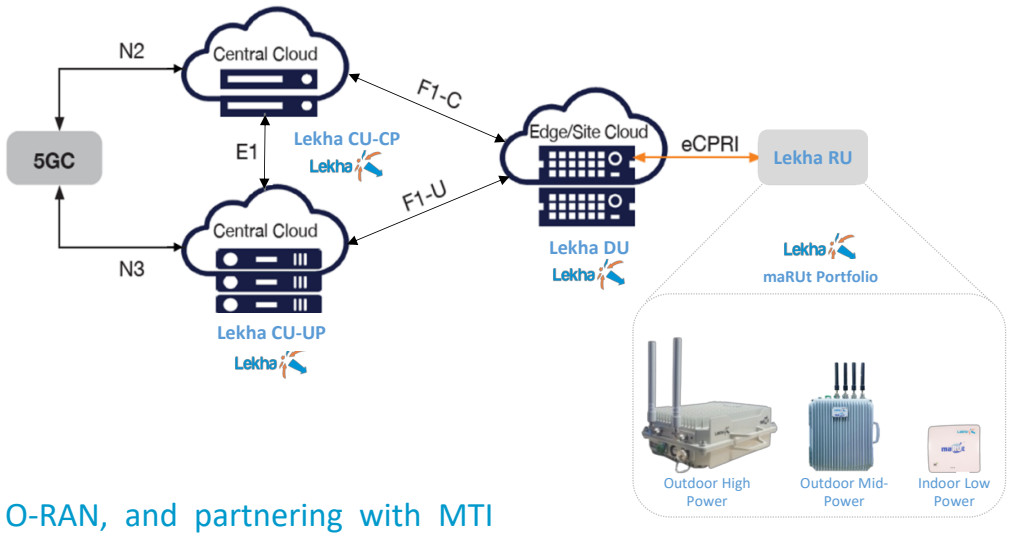
- **Built on O-RAN 7-2x split architecture:** maRUt™ portfolio for multiple FR1 bands; disaggregated CU & DU with open F1 & E1; and O1 & OF M-Plane to SMO/EMS & DU

Interoperability

MTI Group, Taiwan: MTI O-RU with Lekha's O-DU

IOS-MCN, India: Lekha O-RU with a leading open-source vendor's O-DU

C-DOT, India: Lekha O-CU with a 3rd party O-DU - upcoming



Next Steps

- **Commercial Deployment:** Full rollout of E2E Lekha O-RAN, and partnering with MTI Group and IOS-MCN for multivendor RAN
- **Open to providing our O-RAN solution** to a standards organization and others, as part of their interoperability validation testbed

Lekha

LIONS Technology

Who We Are

- LIONS team have decades of experience in mobile network from 3G era.
- Dedicate in 5G O-RAN RU and FHGW, as well as CBRS DP and lightweight CUDU.
- Comprehensive TEM HW, SW, system IOT integration, and E2E testing capabilities.
- Participating SONIC and AACoRD activities.
- Innovation in the US, Design in Japan, and Made in Taiwan

Certificates & Awards

O-RAN ALLIANCE

O-RAN Global PlugFest Spring 2025 — Plugged in PlugFest

O-RAN Global PlugFest Spring 2022 — Plugged in PlugFest

O-RAN Global PlugFest 2021 — Plugged in PlugFest

TELECOM INFRA PROJECT

Outdoor RU

Macro RU

E2E RAN

5G CHALLENGE $3,000,000 MOBILITY PRIZE

Most Valuable for E2E Integration 2nd Prize RU Lions $250,000

Wraparound Emulation Testing 5G CHALLENGE $100,000 WINNERS

$20,000 Lions Best Collaborator

5G CHALLENGE

O-RAN Interoperability

5G Core

casa systems

Druid

JRC

QCT

CISCO

NOKIA

ERICSSON

free5GC

Open5GS

5G O-DU

Capgemini

Radisys

QCT

PEGATRON

JRC

COMPAL

Taiwan • USA • Japan

https://lions.technology/

tony.huang@lions.technology

Concord Lions

MAVENIR:
Open RAN Disaggregation – RU, DU, CU & RIC using AI/ML

Radios

Integrate Mavenir O-RAN Radios with other vendors O-RAN BBU/vDU

Reduces the overall TCO, TTM, and no-vendor lock-in and stimulates innovation

Same path as other large US operators – common baseband in a region

Baseband

Integrate Mavenir DUs and CUs with other vendors O-RAN radios

Reduces the overall TCO, TTM, and no-vendor lock-in

RIC & AI/ML

Path to Dynamic Programmable RAN, Operational efficiency and Autonomous Network Operations

Improve Radio System Performance, Improve network operations productivity

Enforce SLAs, and Utilize Network Resources Efficiently

Mavenir Open RAN Provides Options to Minimize TCO and Maximize Value

総務省
MIC Ministry of Internal Affairs and Communications

Leading Japan's Open RAN overseas deployment strategy

GCOT/QUAD members

- Support Asia Open RAN Academy
- Work for conducting Open RAN field trials

Private Sectors

- Closely communicate with NTT docomo, Rakuten Symphony, NEC, Fujitsu, etc.

Partner countries in Asia

- Conducted Open RAN related activities
- Concluded the Memorandum of Cooperation

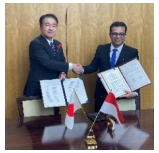
Relevant Ministries

- Cooperation with MOFA, METI, etc. under the leadership of the Cabinet Secretariat








Feel free to contact us !

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MINISTERIO DE CIENCIA, INNOVACIÓN, TECNOLOGÍA Y TELECOMUNICACIONES

GOBIERNO DE COSTA RICA

Opportunities for Open RAN Worldwide

Francisco Troyo
Director of Radioelectric Spectrum and Telecommunications Networks

5G Process in Costa Rica

Transformation opportunity

- Yes, we are late.
- Enabling 5G deployments.
- Current 5G networks:
  SA FWA and NSA DSS
- Leveling the playing field:
  Spectrum availability and ongoing auction.
  Working to lead regional spectrum assignment.
- Experimentation licenses:
  Open RAN testing
- Technological neutrality.

5G era challenges

- 2023 Regulation on cybersecurity for 5G and above wireless networks.
- High Risk scenarios:
  - Single HW/SW vendor, integrator, support
  - CSIRT-CR incidents
  - Subject to direction from external governments.
  - Budapest Convention.
  - Standards (ISO 27000 family, SCS-9001)

Commitment to secure 5G networks

- Mandates established by law, enforced by regulation and public policy.
- 2023 Regulation dispute.
  2 major favorable rulings in Const. Court.
- We see Open RAN as an opportunity to provide efficient, recure and reliable 5G.

MINISTERIO DE CIENCIA, INNOVACIÓN, TECNOLOGÍA Y TELECOMUNICACIONES

GOBIERNO DE COSTA RICA

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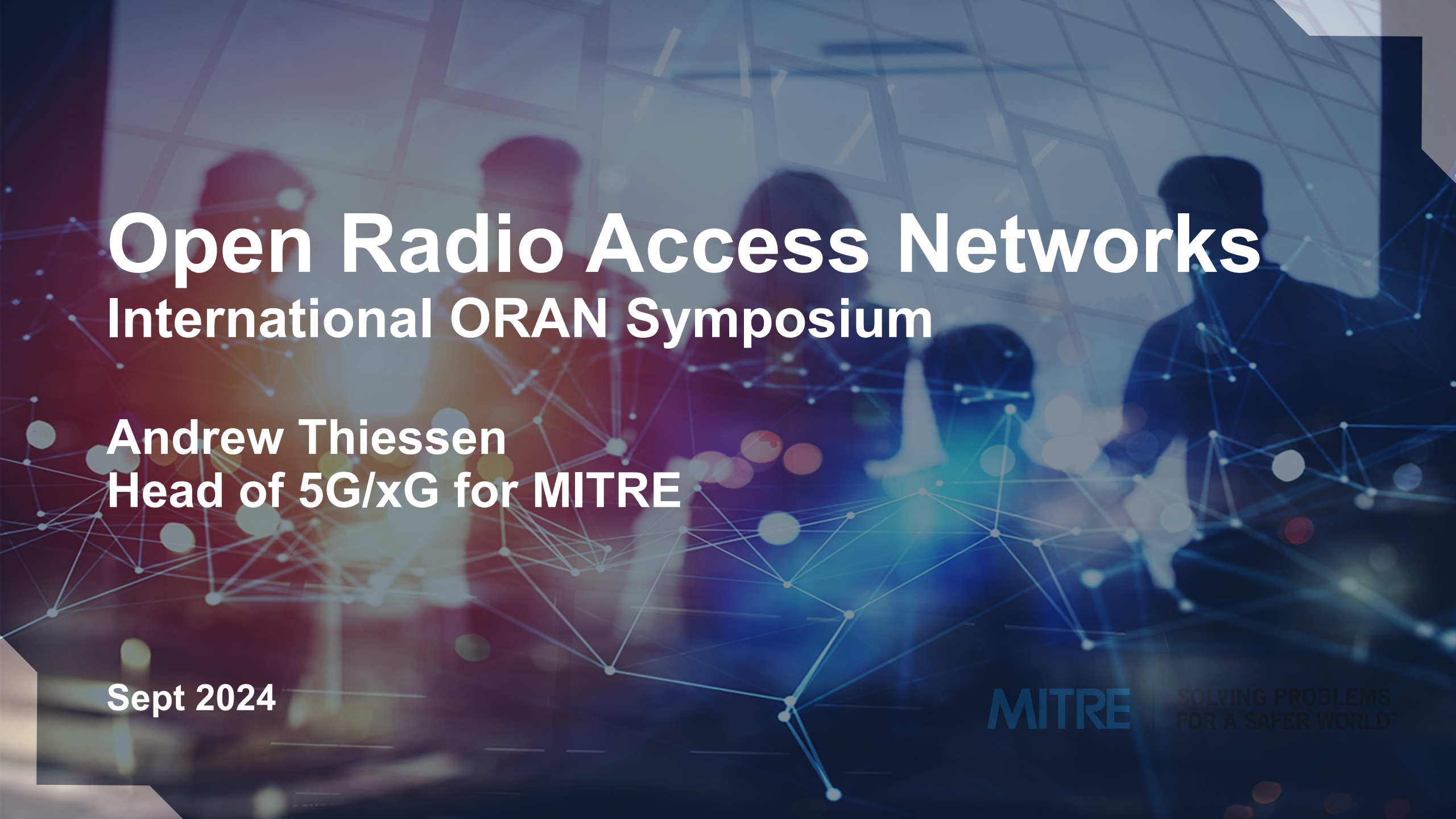


Open Radio Access Networks
International ORAN Symposium

Andrew Thiessen
Head of 5G/xG for MITRE

Sept 2024

MITRE | SOLVING PROBLEMS FOR A SAFER WORLD®

NIST COMMUNICATIONS TECHNOLOGY LABORATORY

NIST's Activity & Interests in Testing

- **Contribute NIST experience** from other technology testing programs.

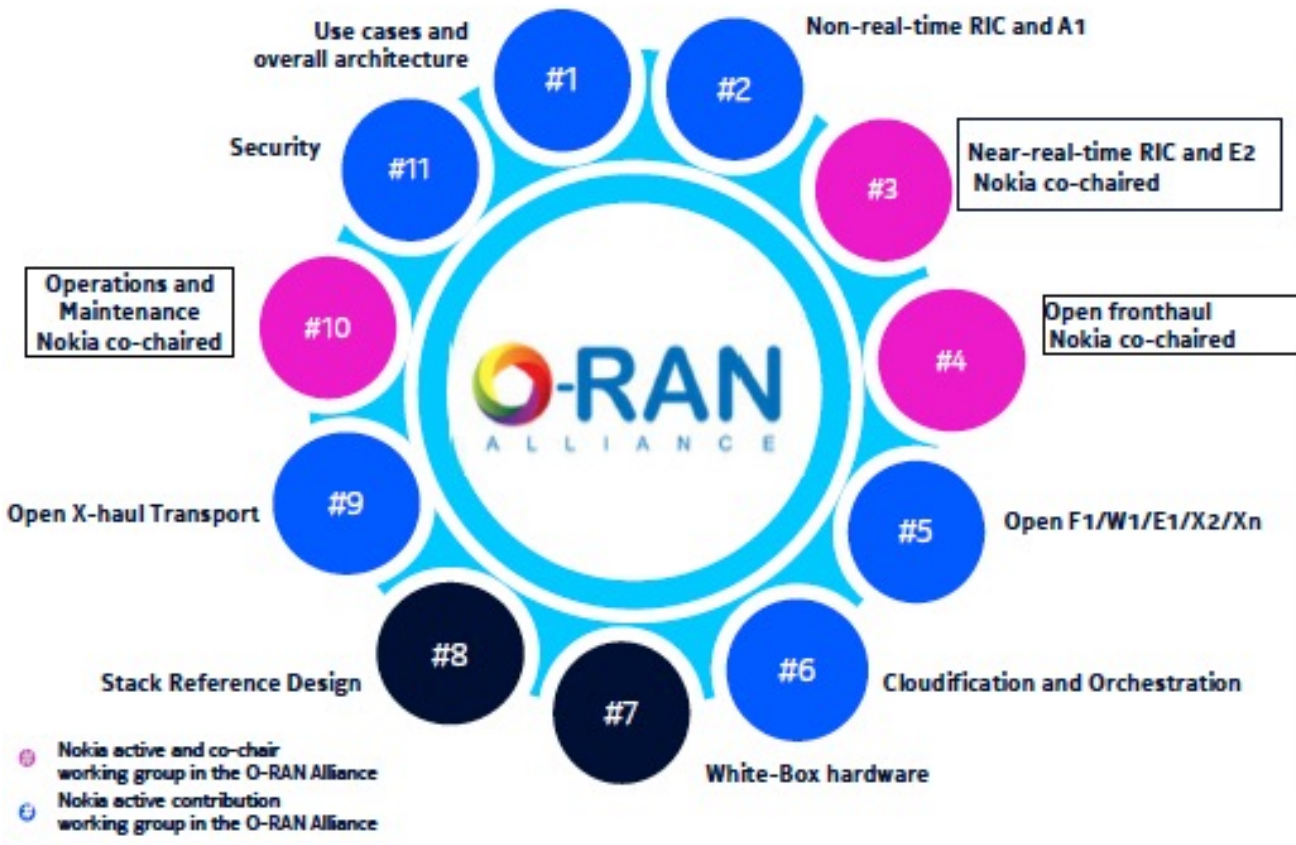
- **Analysis of the O-RAN testing ecosystem**.
  - From a USG acquisition/policy perspective.
  - Security requirements & test accreditation.

- **Help refine O-RAN Alliance test programs** to:
  - Recognize that different labs might have different objectives/incentives:
    - Innovation labs, Interoperability labs, systems integration, and product certification labs.
  - Increase the rigor, traceability, and consistency of product certification labs.

- **NIST Communication Technology Lab**
  - https://www.nist.gov/ctl
- **Wireless Networks Division**
  - https://www.nist.gov/ctl/wireless-networks-division
- **ORAN Research**
  - https://www.nist.gov/programs-projects/open-ran-research-nist
- **Current Projects**
  - Advanced Security Architectures for Next Generation Wireless
  - RAN Intelligent Control
  - ORAN Interoperability & Coexistence
  - Machine Learning in Network Modeling and Simulation
- **Collaborations**
  - DHS S&T (Shridhar Kowdley)
  - O-RAN & NextG Alliances, 3GPP, TIP, IETF
  - NITRD LSN & WSRD
- **Doug Montgomery** (dougm@nist.gov)
  - https://www.nist.gov/people/doug-montgomery

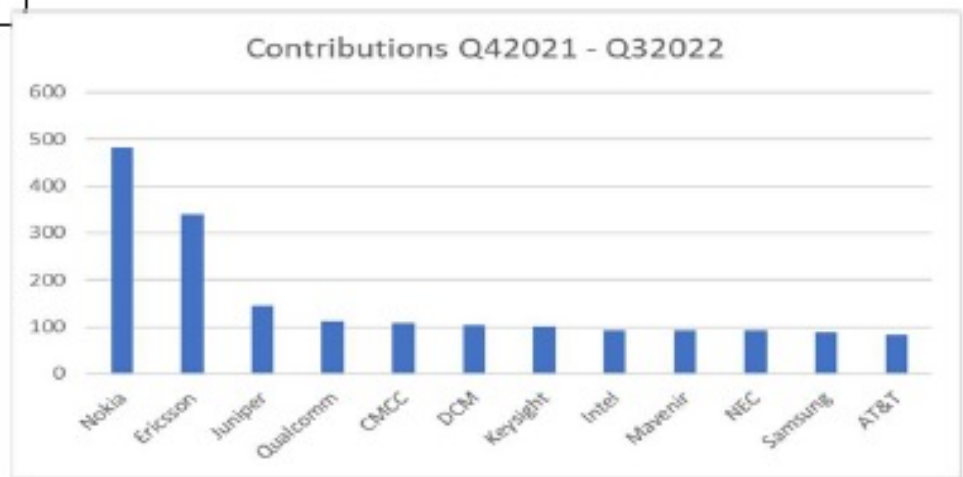
Nokia O-RAN focus is in near-Real Time RIC and Open Fronthaul (OFH)

Nokia #1 in contributions. We are active in nearly all O-RAN working groups



Nokia priorities

- **Adoption** of O-RAN without negative impacts on performance or TCO
- **Ensure alignment** with 3GPP specifications
- Continued progress and consolidation of **Fronthaul specification**
- **RAN Intelligent Controller**



NC State hosts an NSF PAWR testbed - **AERPAW**, and two ERC centers – **ASSIST** (wearable and implantable systems) and **FREEDM** (smart grid).

Current Efforts and Collaborations

AERPAW OTIC Lab

- Contains **Keysight test equipment** and required software packages and test automation packages.
- **Current** - it has the capability to run O-RU conformance tests, gNB E2E gNB test, and IOT test and issue **certificates and badges**.
- **Future Plan** - Integrate RIC testing, and other testing capabilities.
- **Current collaborations:** AORA (new OTIC), ITRI (joint testing)

Digital Twin

- Radio (USRP), propagation, and drones software emulation
- Up to tens of nodes and channels
- Capabilities: MIMO, 3GPP, doppler channel models

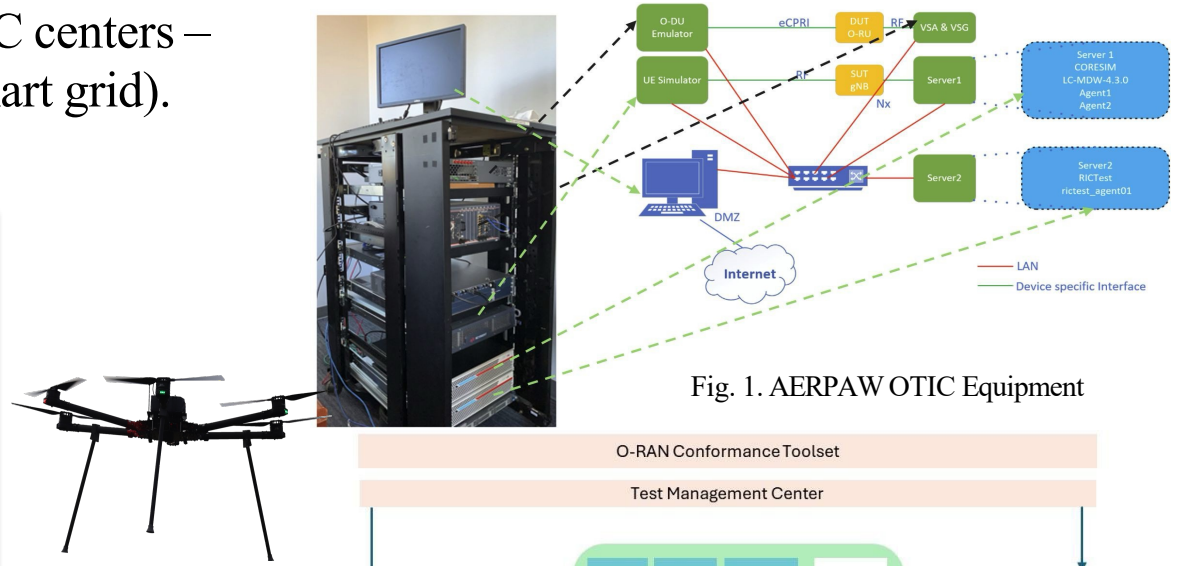


Fig. 1. AERPAW OTIC Equipment

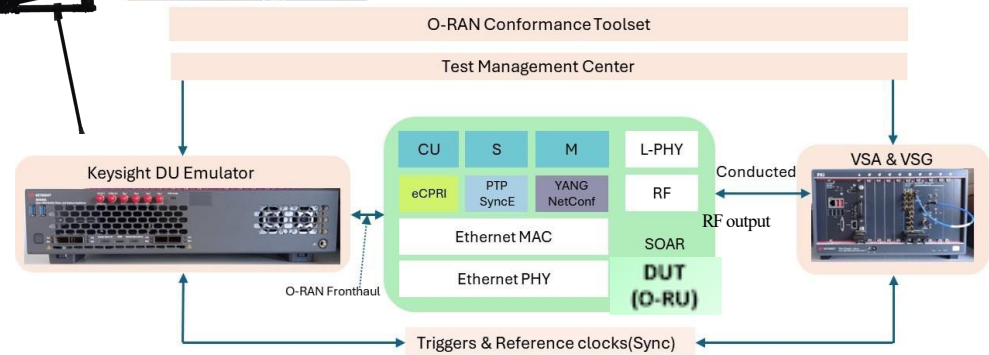


Fig. 2 AERPAW OTIC O-RU Conformance Test setup

NextG Wireless Lab@NC State

- **Open AI Cellular (OAIC)** – a 5G O-RAN OTA platform, based on SDRs and open cellular software - with MSU/VT
- **Multi-time-scale RIC** = Non-RT RIC (rApp) + Near-RT RIC (xApp) + EdgeRIC (uApp) - with UCSD/TAMU
- **ORAN-Bench-13K** - (https://github.com/prnshv/ORAN-Bench-13K)
- **ORAN-Test-Bench** - will be available soon!

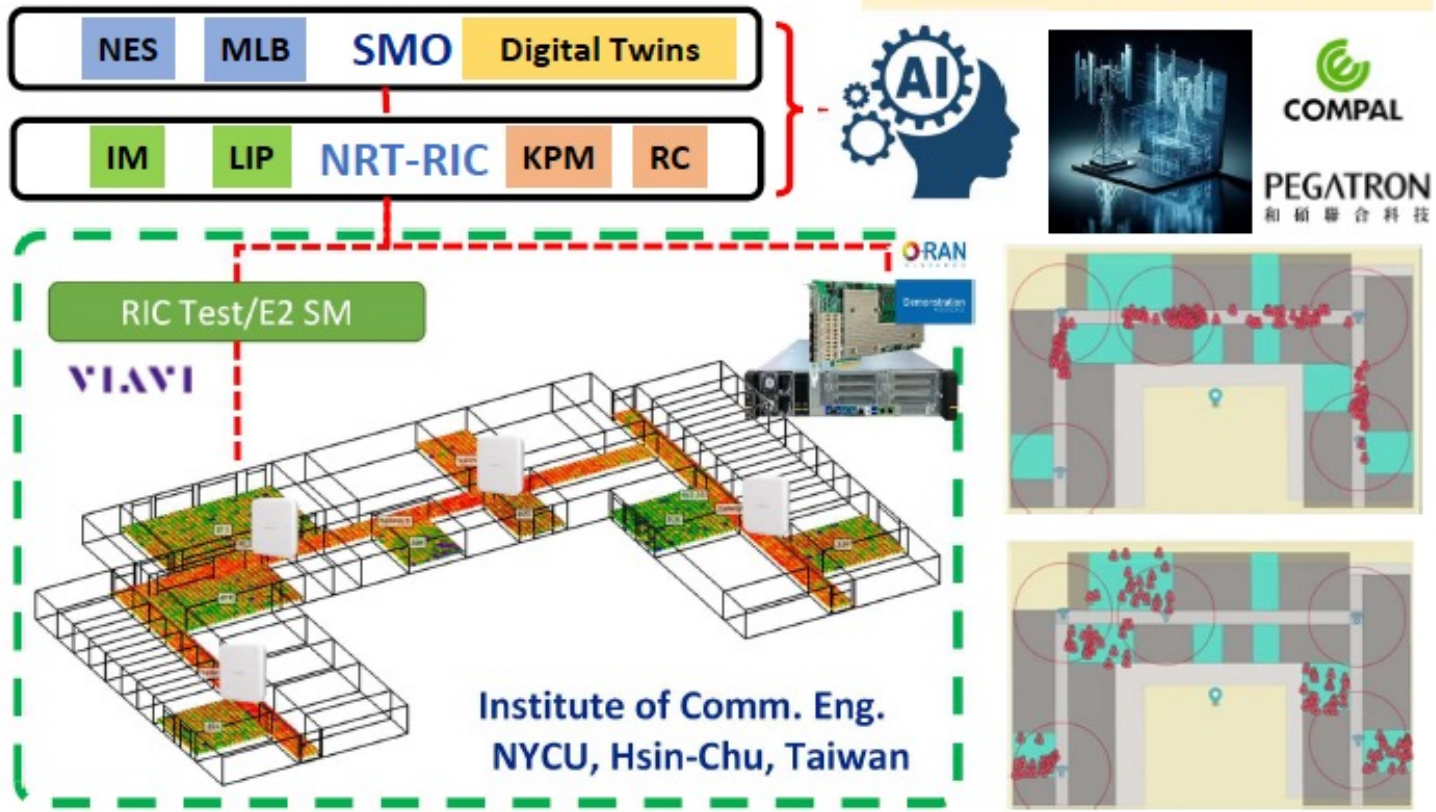
Ongoing/Future Efforts and Collaborations

- Two NTIA projects on O-RAN testing R&D
- R&D efforts – 5G/NextG, O-RAN testing, spectrum sharing, O-RAN use cases – UAV, wearables, smart grid
- **PlugFests** - Starting Fall, 2024 - Do join us, if interested!

Contact: Ismail Guvenc (Lead), Mihail Sichitiu (Co-lead), Rudra Dutta (Co-lead)
Magreth Mushi (Platform Director), Md. Rabeek Sarbudeen (TPoC)

WiSDON A DIGITAL-TWIN ASSISTED RIC

- WiSDON RIC for
  - Network optimization
  - Quick deployment
  - Automated testing
- WiSDON Digital Twin
  - Device digital twin
  - Network digital twin
- WiSDON AI:
  - rAPPs: Network energy saving (NES)…
  - xAPPs: Interference management (IM)…
- WiSDON Lab
  - Testing procedures for RIC rAPPs/xAPPs
  - Asso. with ITRI TIP Lab



WiSDON AI and Digital Twin

COMPAL

PEGATRON 和碩聯合科技

NATIONAL YANG MING CHIAO TUNG UNIVERSITY

ITRI Industrial Technology Research Institute

htc

NVIDIA OMNIVERSE

Northeastern Open6G – One-stop Shop for Open RAN Innovation

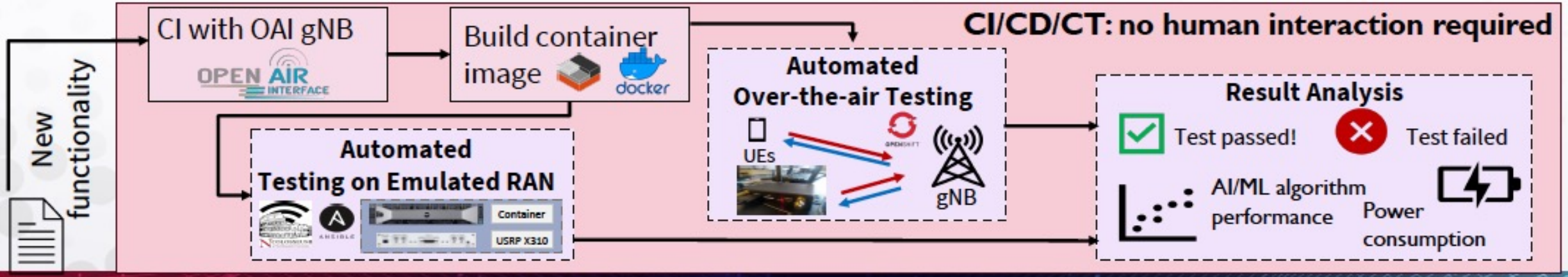
Open RAN Platforms

Conformance, IOT
End-to-End
RIC
Digital Twins
OTIC

End-to-end automation for RAN and OTIC

Interoperable AI-powered networks

Energy efficient networks



OPENAIRINTERFACE FOUNDATION

Mission n°1

Foster and support the US-based OAI community in their Open RAN devs

Mission n°2

Work with US public programs for Open RAN technology and workforce development

1 OAI US COMMUNITY

2 US NATIONAL PROGRAMS

IRFAN GHAURI, BOARD MEMBER

Public-Private Open RAN Industry Alliance(ORIA), supported by MSIT

Mission

Ramping up domestic Open RAN ecosystem toward 2030

Goal

"Promote Open RAN Demands from Public/Private Sector" — "Supporting Open RAN R&D" — "Strengthening Ecosystem"

Strategy

Promoting Market

- Engaging in domestic trial's demand survey
- Help Korea-OTIC with global certification system
- Influence to the Open RAN strategy, national and international cooperation

Promoting R&D

- Developing R&D strategy and roadmap
- Public-private joint R&D planning
- Proposing inbound standards

Collaboration with Test Infra & Global Org

- Supporting dedicated Open RAN test bed
- Coordinate global PlugFest with members
- Fostering international cooperation

MoU between ORIA and O-RAN Alliance, O-RAN F2F meeting in Korea(June, 2024)

ORIA members

Board Member : 11

Representative chair: SK telecom

LG U+, kt, SAMSUNG, LG전자, HFR, Inc. for Mobile Internet, NOKIA, ETRI 한국전자통신연구원, NIA 한국지능정보사회진흥원 National Information Society Agency, IITP 정보통신기획평가원, TTA 한국정보통신기술협회

General Member : 22

SAMJI, Innowireless, SOLID, RFTek Fiber Radio Technologies, ELUON, COWEAVER, KMW TELECOM, KTNF, CS corporation, EUCAST, TJ innovation, PANTECH C&I ENGINEERING, TmaxCloud, ktl 한국산업기술시험원 Korea Testing Laboratory, HYPERX, ERICSSON, LG, Hewlett Packard Enterprise, Qualcomm, DELL Technologies, Red Hat, KEYSIGHT TECHNOLOGIES, intel

Organization

- General Assembly
- Steering Committee
  - Virtualization & Intellectualization
  - Open Solution
  - Ecosystem
  - Strategy

Prof. DongKu Kim, Chair of SC, ORIA, dkkim@yonsei.ac.kr
Dr. Takki Yu, Chairman of ORIA, SKTelecom, takki.yu@sk.com
ORIA office, HyunSoo Kim, manager, hyunsoo.kim@kani.or.kr
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PennState

SyNSec

ORANalyst: Consistent, Repeatable, Open RAN Security Testing Worldwide

Syed Rafiul Hussain

Assistant Professor

Systems and Network Security (SyNSec) Research Group

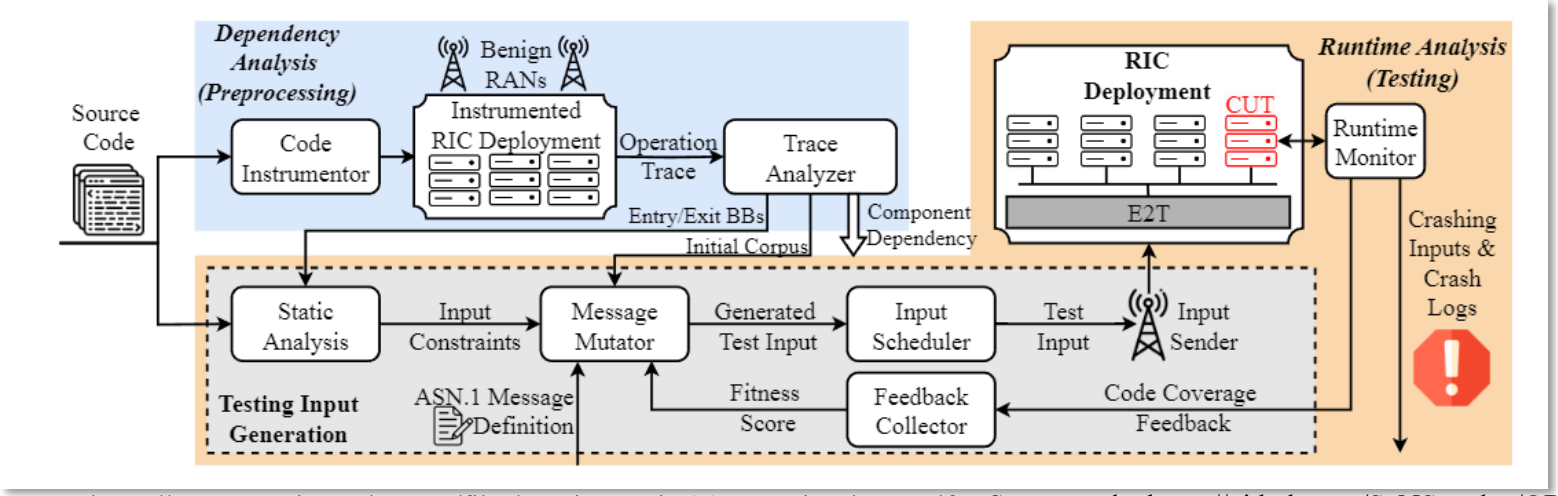
Department of Computer Science and Engineering

The Pennsylvania State University

ORANalyst: End-to-End Testing of O-RAN

Secure-by-Construction of Open RAN

Automatically generate test cases by combining dynamic tracing and static program analysis to rigorously test O-RAN implementations (i.e., software) before deployment (NTIA and DARPA)



White paper: https://www.usenix.org/system/files/usenixsecurity24-yang-tianchang.pdf Source code: https://github.com/SyNSec-den/ORANalyst

Test memory safety: e.g., buffer overflow causing RCE or crashes

Grammar-guided and dependency-aware testing

Test multiple microservices

Support multiple programming languages (Go, C/C++)

Tested ORAN-SC and SD-RAN and uncovered 19 new bugs (0-days)

White-box testing, and can be adapted to grey-box and black-box testing

Logical vulnerability testing (e.g., auth bypass and access control violations)

Testing O-RU, O-DU, O-CU, third-party libraries, and SBOM

Comprehensive Security Conformance Testing

Operational threat monitoring

Anand Bhaskarwar
EVP Professional Services

Parallel Wireless develops GreenRAN™ solutions that enable MNOs to leverage open platforms, enjoy reduced TCO and improved energy efficiency, and eliminate vendor lock-in

Challenge: RU-DU Integration

- RU IOT specifications are **permissive,** and documentation required for alignment is limited, causing RU-DU integrations to be a huge challenge
  - Time to market: Efforts can last up to 1 year
  - Cost: can reach up to $1M per party (man-years, equipment, etc.)
- Most challenging: iterative interoperability testing of the C/U planes

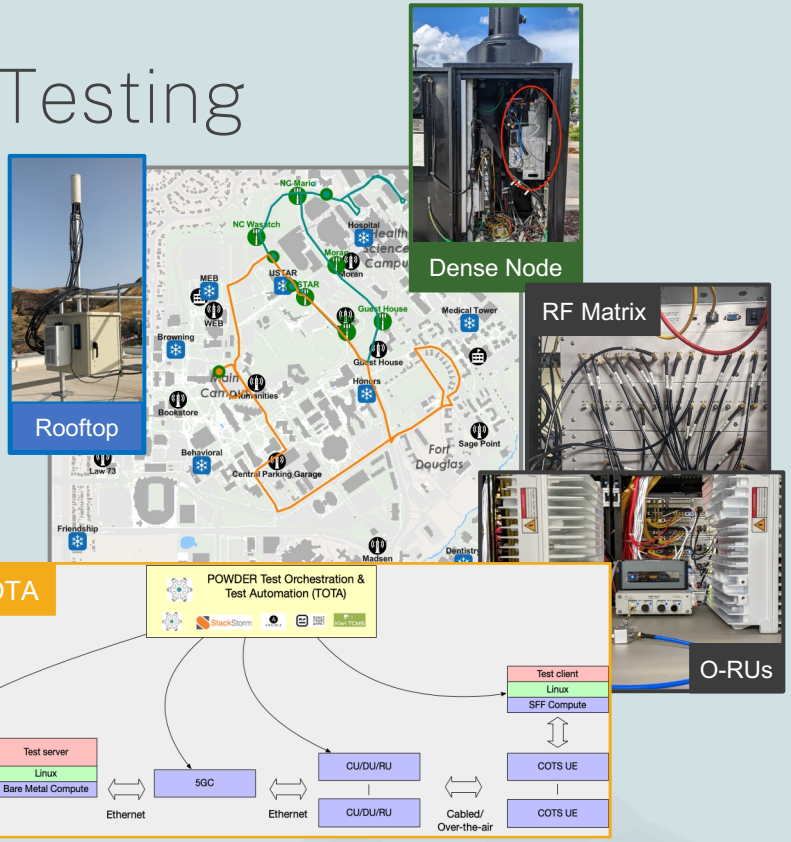
Proposed Solution: *Standardized* Interoperability Testing Platform (ITP)

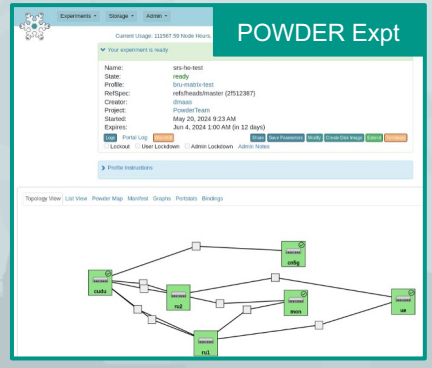
- Standardized, automated test setup (equipment, SW, Automated Test Flow) for **pre-integration testing**
- Reduce **cost** and **time to market** by aligning expectations
- Reduce number of iterations and allow independent work
- **RU Manufacturer benefits**:
  - Detect compatibility issues in advance
  - Generate extensive relevant standardized IOT Profiles automatically
  - Understand integration gaps and requirements in advance
- **DU Manufacturer benefits**:
  - Understand full, relevant RU IOT Profile and potential integration issues
  - Select best RU for task
  - Plan and prepare for integration process and evaluate cost and TTM

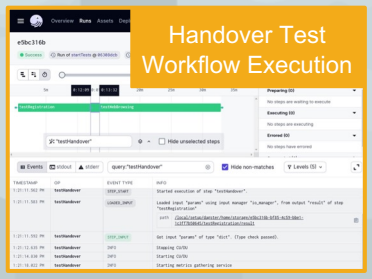
Parallel WIRELESS

POWDER OTIC: Automated, E2E Testing

- Indoor/outdoor automated lab-as-a-service
  - 25 fixed sites, 25 mobile, FCC IZ, O-RUs, UEs, SDRs, BYOD, RF matrix
  - 1000+ compute (Flexran, GPU, accel); programmable interconnect
- Customizable software and hardware “building blocks”
  - Private, on-demand 5G, O-RAN RIC/SMO, k8s, Openstack
- TOTA: advanced test automation, lab-to-field workflows
  - Mavenir: outdoor fixed O-RAN testing with TOTA
  - Celona: outdoor 5G mobility testing with TOTA
- Many Plugfest engagements, most E2E indoor:
  - Energy savings (Keysight/Wind River/Radisys/Intel/Vodafone)
  - O-RU/O-DU (Radisys/Actiontec) integration, performance testing
  - Automated near-RT RIC testing (Keysight RICtest, TOTA)
  - *Indoor/outdoor O-DU mobility, E2E TIFG tests (srsRAN/Benetel, TOTA)*



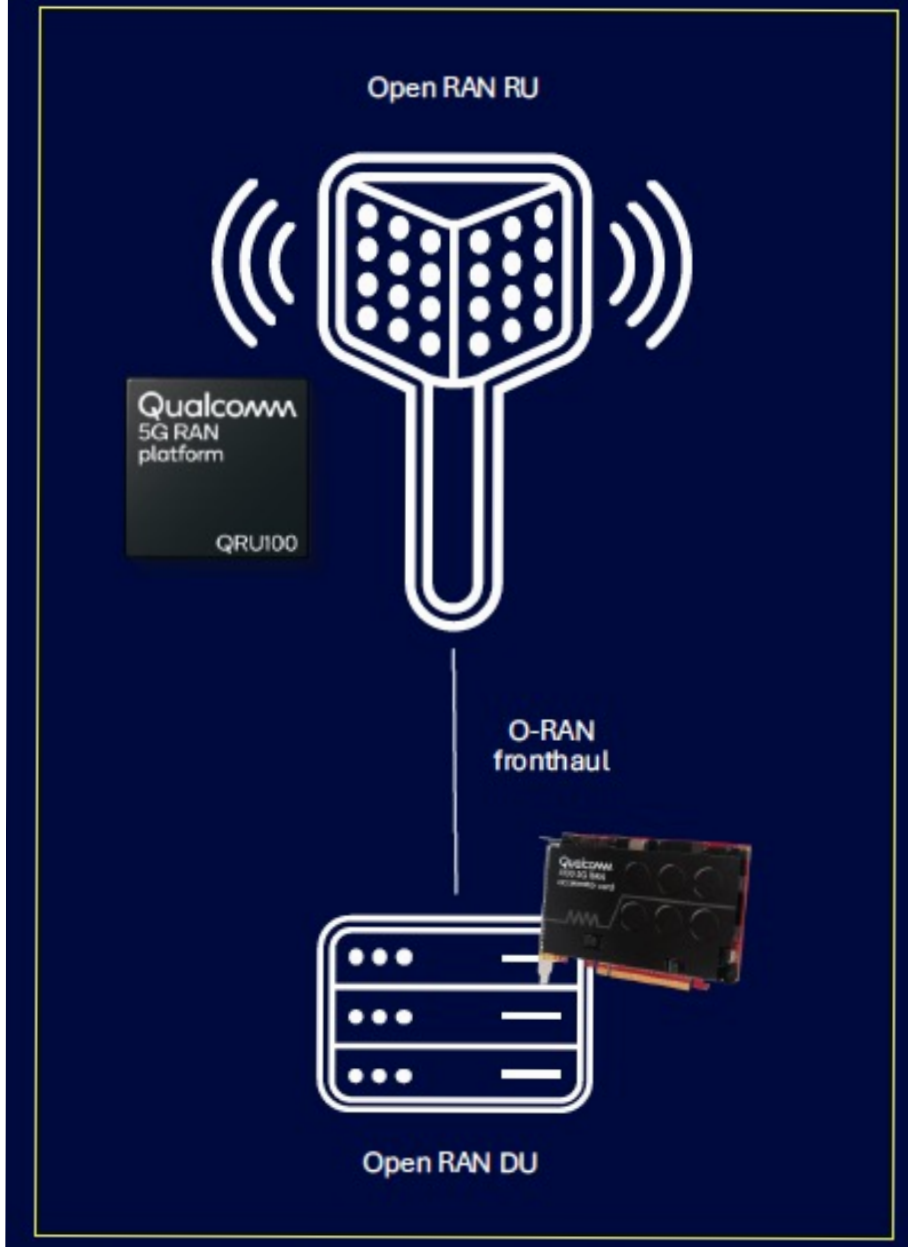




ID	Summary	Test plan	Produ
174	Benetel 5G SA registration and deregistration of single UE (TIFG E2E 4.3) Test 2024-05-21T19:21:06.032Z	TP-8: Benetel Matrix Test	Benet
175	Benetel Inter-O-DU mobility (TIFG E2E 4.5) Test 2024-05-21T19:22:14.673Z	TP-8: Benetel Matrix Test	Benet
176	Benetel Web Browsing (TIFG E2E 6.1.1) Test 2024-05-21T19:41:54.846Z	TP-8: Benetel	Benet

O-RAN TIFG E2E Tests

Open RAN Momentum



Radisys Open RAN Solution

September 2024

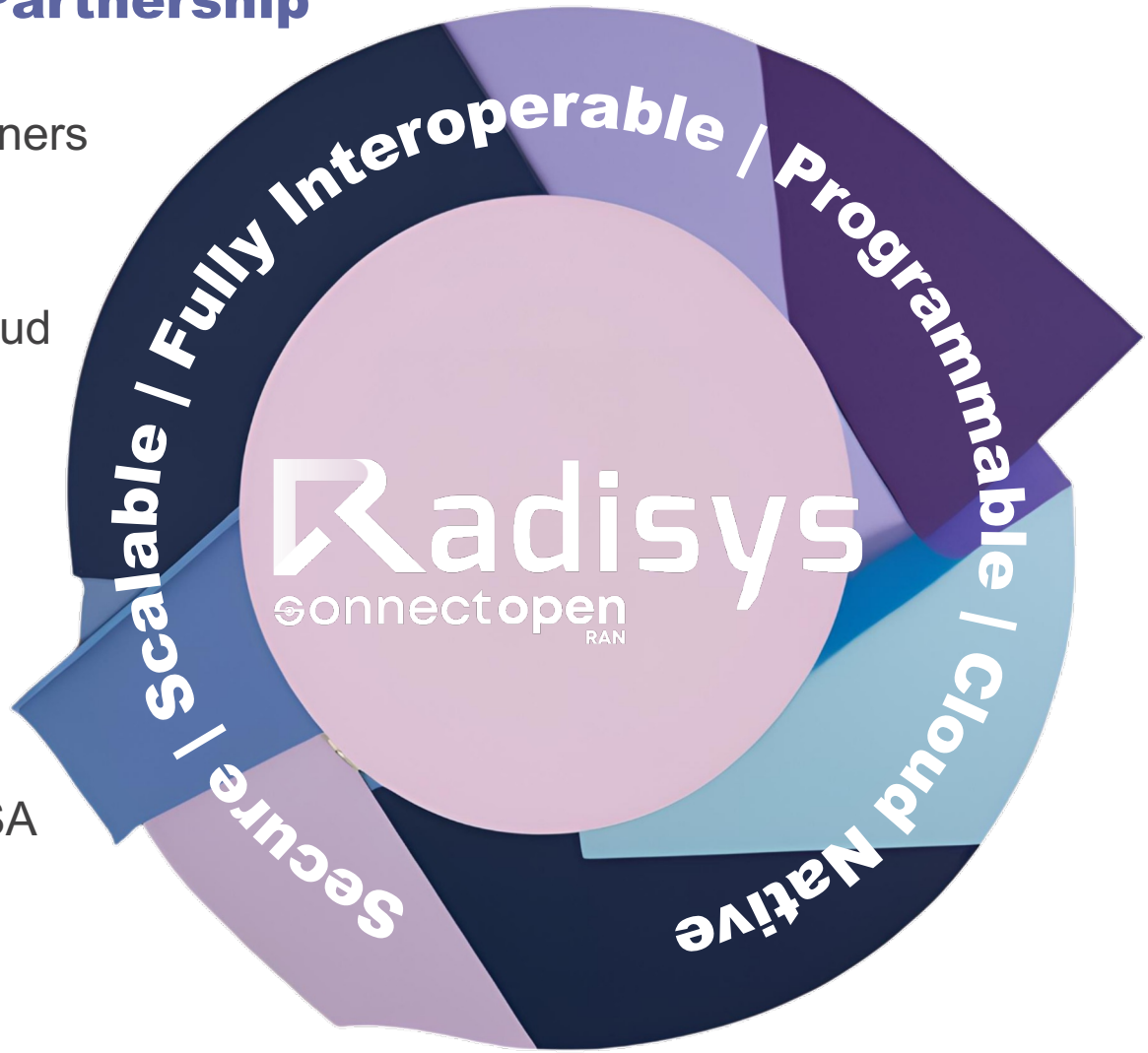
Radisys

Broadest Ecosystem Partnership

- Multiple RU partners
- Small cells SoC/Chipset partners
- Hardware accelerators
- COTS servers
- Private Cloud and Public Cloud
- RIC, xApp, rApp partners

Feature Rich

- COMP
- Energy Efficiency
- MOCN/MORAN
- TDD/FDD bands
- Multi-CC CA
- CBRS Domain Proxy



Trusted Globally for Many Use Cases

- 5G FWA
- Macro Mobility – SA and NSA
- Neutral Host Solutions
- Outdoor Small Cells
- Defense

Elastic and Programmable

- Optimized for small cells
- Scaling for macro PNF/CNF
- Containerized CU and DU
- Network slicing
- RIC/xApp Control

Winner: NTIA 5G Challenge (2022, 2023)
DCMS Projects in UK.

Open RAN at Rutgers University WINLAB (http://winlab.rutgers.edu)

- Long history of wireless R&D - hosting Open RAN PoCs and plug fests since 2019
- Extensive COSMOS city-scale indoor/outdoor testbed as part of NSF Platforms for Advanced Wireless Research program (with Columbia University and NYU) – SDR, mmWave, optical networking, cloud networking, federation of testbeds, FCC innovation zone
- One of the early North-American O-RAN OTIC sites – advocate for consistent and repeatable Open RAN testing and open-source solutions
- Co-PI (with ONF) for NTIA PWSCIF project on O-RAN Energy Efficiency Testing:
  - Develop testing methods and models for the energy consumption and efficiency of individual 5G network components and end-to-end O-RAN architectures
  - Seeking collaboration to repeat tests in different scenarios to refine energy models
- Part of NTIA PWSCIF ACCoRD project led by AT&T and Verizon:
  - Leverage OTIC role to ensure future O-RAN products meet the highest standards of efficiency and reliability

contacts: N. K. Shankar, Ivan Seskar {shankar, seskar}@winlab.rutgers.edu

SAMSUNG

Who we are:

- Samsung is a leader in 5G and next-gen infrastructure
- Secure and trusted supplier to the most technology-forward operators around the world
- #1 market share in O-RAN and vRAN globally per 3rd-party market research firms like Dell'Oro and Omdia, with customers including **Verizon, Boost, Telus, Vodafone, KDDI, NTT Docomo.**

What we're working on:

- We have done more interoperability work across every layer of the stack than any other vendor.

Our O-RAN work with NTIA:

- Member of two **NOFO 1** consortia – **ACCoRD** and **ORCID**
- O-RAN/vRAN system now installed at ACCoRD DORADO lab at UT Dallas
- Planning Commscope O-RU IOT as next step in Q4

SOLiD Introduction

Home page: https://solid.com/us/about/
https://solid.com/us/open-ran/
Contact: Dr. Yong Hoon KANG, yhkang@solid.com

- Telecommunications OEM > 25 Years
  - Open Radio Access Networks (O-RAN)
    - Delivered more than 13K commercial in-building low-power O-RU products globally since 2021 (U.S., Germany, Japan, and Korea)
    - Actively participating in O-RAN Alliance standardization activities since 2019
  - Distributed Antenna Systems (DAS)
  - Fiber Transport

- Open RAN Testing
  - O-RAN Alliance Plug-fest, hosted by France Orange in 2022
  - SONIC Labs Cohort 2, funded by U.K. Government in 2022~2023
  - Korea OTIC, funded by Korean Government in 2024
  - VIAVI VALOR Lab, funded by U.S. Government NTIA NOFO1 in progress
  - ACCoRD program, funded by U.S. Government NTIA NOFO1 in progress
  - Interoperability test with several major O-RAN DU vendors

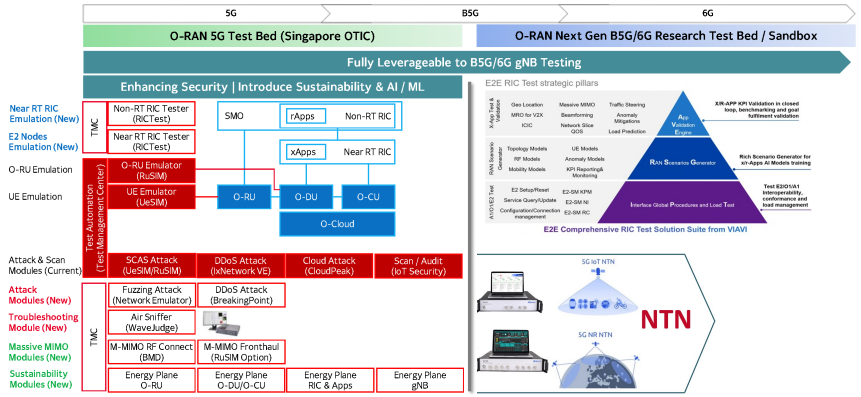
- Proposal for Future Collaboration
  - Multi-operator O-RU test for RAN sharing and Neutral Host applications
    - Shared O-RU feature defined by O-RAN Alliance

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

A research-intensive university with the vision of
"Trailblazing a Better World by Design"

SUTD hosts **Asia & Pacific OTIC in Singapore** with strong support from Singapore's national **Future Communications R&D Programme (FCP)**

FCP FUTURE COMMUNICATIONS R&D PROGRAMME



Our OTIC in Singapore provides comprehensive O-RAN integration, testing, and certification services, covering areas from open fronthaul, AI/ML, security, to sustainability and NTN.

SUTD hosted the **1st Global OTIC Summit** in 2023 and the Global PlugFest, Spring 2024

O-RAN Global PlugFest Spring 2024 — Plugged in PlugFest Host

Achievements in Global PlugFest, Spring 2024 towards repeatable & consistent testing

Institute for the Wireless Internet of Things at Northeastern University

Rakuten Mobile

YRP R&D Promotion Committee

SUTD collaborated with Northeastern University to conduct the 1st **cross-continent** conformance and performance tests on the same O-DU

SUTD collaborated with Japan OTIC to complete comprehensive O-RU conformance tests in Singapore **in less than 4 days***

* In our previous experience, O-RU conformance test can take 4+ months to complete

Towards an open, secure and resilient wireless network!

Bill Huang
Director General
Taipei Economic and Cultural Office in Denver

Empowering Open RAN Innovation

Varun Kapoor, Tejas Networks

Tejas Networks, a Tata Group company is fully committed to Open RAN innovation

- Actively engaged in Open RAN standardization efforts, and development of O-RAN compliant radios

Contributions to O-RAN Alliance: WG6/AAL on Cloudification and Orchestration

- Work item for microservices based Hi-PHY
- Proposal for chaining of AAL-profiles
- Introduction to management of Hardware Accelerator Manager

Participation at Global OTICs

- TIM, European OTIC, Torino (2022)
- i14y lab, European OTIC, Berlin (2023)
- SUTD, South-East Asia OTIC, Singapore (2024)
- Active partnership with leading T&M instrument vendors

Future Collaborations

- *n*GRG RS02 contribution to propose Service Based Architecture for O-DU
- nGRG RS02 contribution for SW-HW disaggregation in O-RAN
- WG6/AAL: AAL Profile Bypass mode (with Intel)

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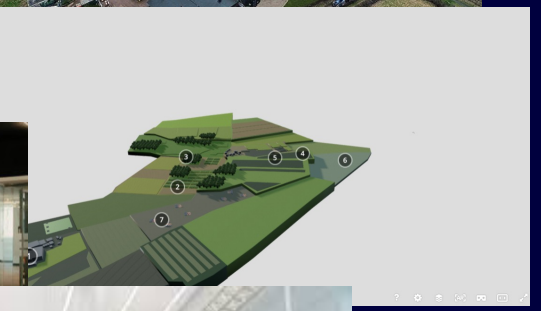


CHEDDAR

Data

Software

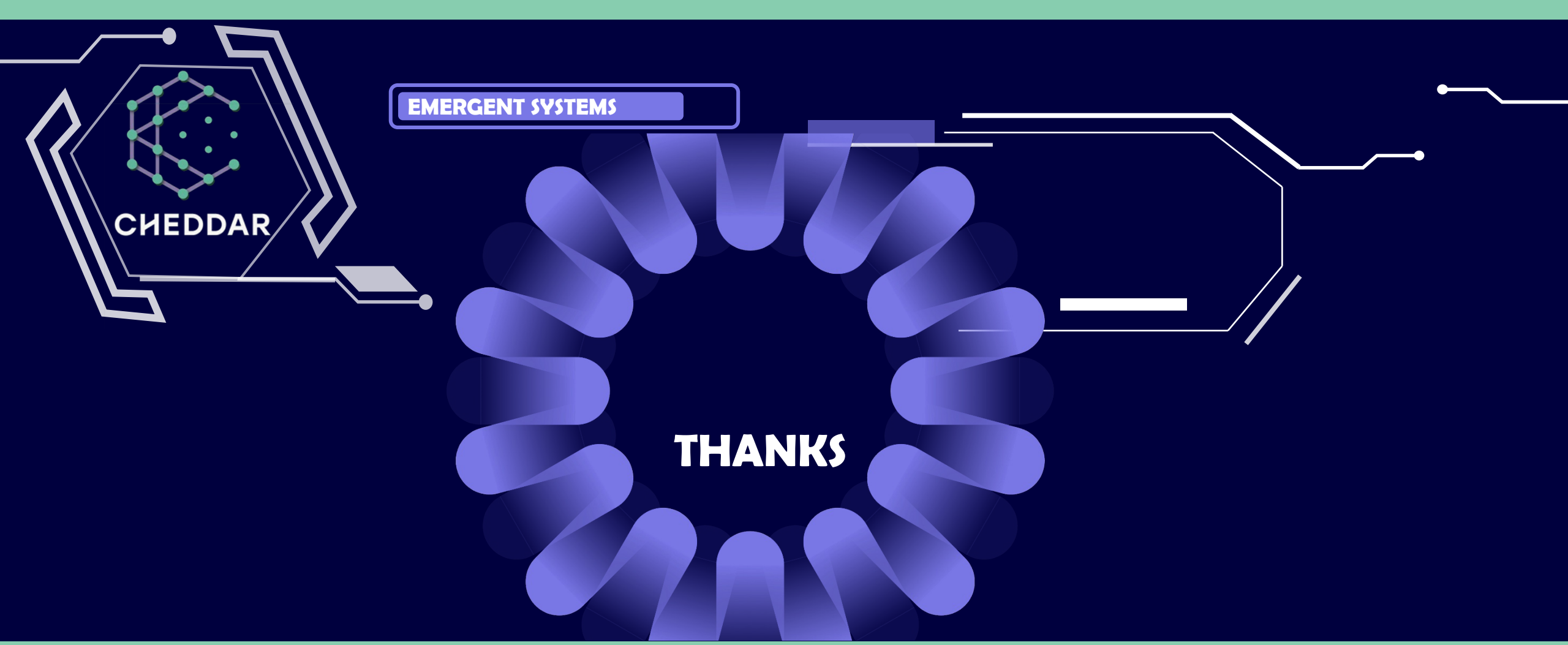
Hardware

UNIVERSITY OF LEEDS

DR SYED A. R. ZAIDI

Repeatability and Consistent Testing

6G


CHEDDAR
EMERGENT SYSTEMS
THANKS

University of New Hampshire Interoperability Laboratory

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Lincoln Lavoie
Principal Engineer
lylavoie@iol.unh.edu

UNH-IOL is the foremost independent, neutral testing facility and a strategic resource for successful data networking companies worldwide.

- **Renowned** for **expertise in end-to-end testing** for interoperability, conformance, certifications
- Comprehensive services, **customized testing solutions**, 265 active test plans
- 36 years of **trusted testing and certification** for companies and organizations worldwide
- Access **cutting-edge technologies**, latest advancements, and testing to industry standards

While IOL is part of the UNH ecosystem, we are a commercial enterprise self-sustained by revenue from the sales of testing services, test tools, hardware components, and membership services.

Why IOL?

- Approved O-RAN ALLIANCE OTIC
- State-of-the-art testing facility; event space
- Cost-effective and unique expertise
- Reduce time-to-market
- Ensure confidence in product launch

Fall Plugfest 2024

- Hosting the Joint North American Plugfest for the O-RAN ALLIANCE
- Fall 2024 Plugfest focuses on end-to-end integration testing between multiple open-source projects: OAI, O-RAN OSC RIC, Open 5GS.

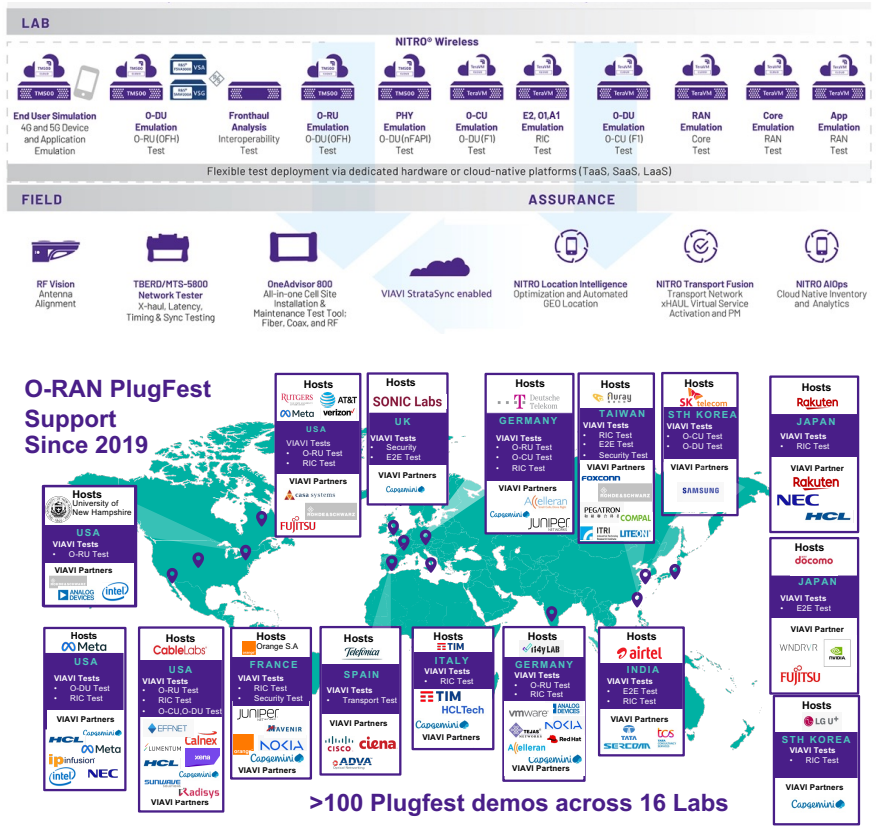
Open-Source O-RAN Testbed

- Building reference testbed for open-source O-RAN
- Testbed project aims to publish a set of Ansible reference playbooks for deploying open-source projects to construct an O-RAN-based network.

VIAVI - Leading Provider of O-RAN Test Solutions

Collaborating across the entire O-RAN ecosystem since 2018

Complete O-RAN Test Suite from Lab-to-Field-to-Assurance



O-RAN PlugFest Support Since 2019

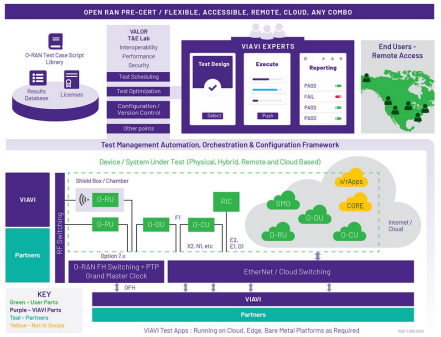
>100 Plugfest demos across 16 Labs

VALOR (VIAVI Automated Lab-as-a-Service for Open RAN)

The project is funded by the NTIA [Public Wireless Supply Chain Innovation Fund]

1 of 3 NOFO1 T&E Awardees

- Hybrid (Physical and Cloud-based)
- Cost Effective / Pay-As-You-Go
- Accessible and Affordable
- Industry Neutral – Partner Friendly
- Realistic, Scalable, Carrier-Grade Testing
- Complementary to Existing Initiatives
- O-RAN Pre-Certification and Pre-Badging



Keys to Consistent Repeatable Testing

- ❑ Rigorous test specifications and certification and badging procedures
- ❑ Availability of a lab accreditation program e.g. ISO 17025 for O-RAN
- ❑ Global network of labs that have gone through such a program
- ❑ Test equipment that can provide true “carrier-grade” test solutions including capacity, scale, load-and-stress, negative testing

VIETTEL HIGH TECH Corp. (VHT):

Open RAN achievements from Vietnam

viettel high tech

- **VIETTEL**: Biggest network operator in Vietnam + Operating top mobile networks and digital services in 10 other countries
- **VHT**: VIETTEL R&D subsidiary on telecommunications, with 10+ years, developed commercial 4G/5G RAN/Core, IMS, OCS, Site Router, ONT, ...,

- **VHT Open RAN**: 5G R&D from 2020 (commercial 4G from 2018), ORAN Alliance member

Keys: HW + SW | fast development | customizability | optimization on real NW | various product options

Currently:

- ✓ Complete 4G/5G CU/DU + RU ORAN, from 4T4R/8T8R to 32T32R radio, compact Micro to high-capacity Macro cell
- ✓ field trials of NSA/SA in 3 years, commercial deployments with hundreds of sites for Viettel public network; Private network solutions including VHT radio router to core system
- ✓ Continuous performance improvement on live networks for data/voice services and O&M
- ✓ ORAN integrations, PlugFest; powered by FPGA, Intel, Qualcomm, Capgemini, Deepsig, ...

Looking forward:

- ➢ Expanding tech cooperations on cloud, RIC, vertical industries, advanced 5G processing
  Expanding integration opportunities & trials for public and private networks.

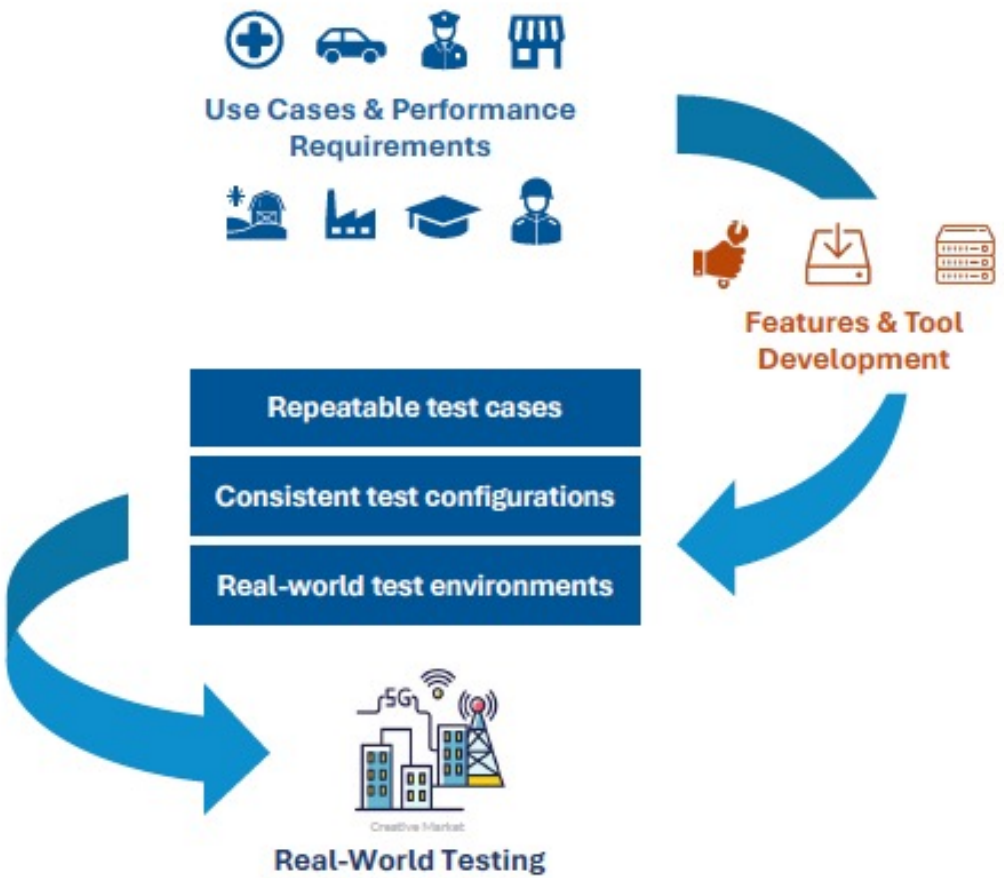
O-RAN ALLIANCE

https://viettelhightech.vn/en/telecom

VT-ARC
Virginia Tech
Applied Research Corporation

Michael Miller
Engineering, Test & Evaluation Division
VT-ARC.ORG/ETED

Interoperability challenges & costs barriers associated with Open RAN adoption can be mitigated through a shared understanding of use cases and performance requirements

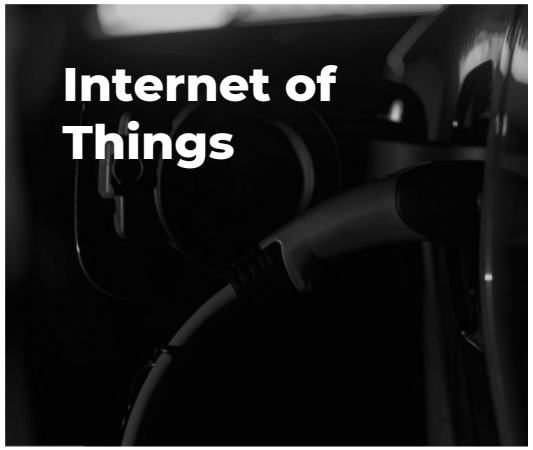


Independent, "honest broker" E2E testing facilities can create a new, affordable way of multi-vendor testing, while protecting competition sensitive data

VVDN

Voice. Video. Data. Network

Global Providers of
SOFTWARE, PRODUCT ENGINEERING, AND MANUFACTURING SERVICES



COLLABORATION WITH OpenRAN ALLIANCE COMPANIES

Collaborations on Testing

- Energy Efficiency and Sustainability
- Sustainable Materials and Processes
- Scalability Across Diverse Environments
- AI-Driven Testing Automation
- Security Validation and Continuous Monitoring

What we Bring?

- Reference Platform Development
- Supporting end customers
  - Evaluation
  - End to End product design and development
  - Mass Manufacturing
- Help promote partner chipsets/solutions to VVDN existing customers