

RIS/O-RAN testing Framework

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RIS/O-RAN testing Framework

ITRI, ICL and ICL-M Div.

RIS end-to-end testbed

Bridge O-RAN ecosystem into RIS testbed





Founded in 1973

An independent non-for-profit innovation institution to create economic and societal values

- Develop advanced technologies for commercialization
- · Cultivate open innovation with academia, industry, and global partners
- · Incubates startups in emerging industries



International Recognitions

- Seven-time winner of Top 100 Global Innovator
- 10 CES Innovation Awards Honorees (2018-2023)
- Edison Awards for seventh consecutive year (2017-2023)
- 50 R&D 100 Awards in total since 2008









Industrial Technology Research Institute, ITRI

Taiwan's Largest and One of the World's Leading High-Tech Applied Research Institute



Total Staff: 6,042 (~04/2023)

PhD: 1,266

Master: 3,763

Bachelor: 1,013

Alumni: 27,508



Total Patents (~04/2023)

31,939

Startups & New Business Units (~Q1/2023)

157



Industry Services (2022)

Provided Services: 17,464

Transferred Technologies: 513

Incubatees (~Q1/2023)

213

ITRI Organization

Industrial Technology Investment Corporation

Technology Transfer and Law Center

Office of Strategy and R&D Planning

Business Development Center

Office of Marketing Communications

Administrative Service Center

Finance and Accounting Center

IT Service Center

Human Resources Office

ITRI Southern Region Campus

ITRI Central Region Campus

Biomedical Technology and Device Research Laboratories

Green Energy and Environment Research Laboratories

Material and Chemical Research Laboratories

Mechanical and Mechatronics Systems Research Laboratories

Information and Communications Research Laboratories

Electronic and Optoelectronic System Research Laboratories

Industry, Science and Technology International Strategy Center

Smart Sensing & Systems Technology Center

Intelligent Machinery Technology Center

Service Systems Technology Center

Center for Measurement Standards

Commercialization and Industry Service Center

ITRI College



Information and Communications Research Laboratories (ICL)

- Wireless network access technology
- Wireless communication signal processing platform, protocol · Baseband · RF and Antenna
- Privacy network management
- V2X communication technology
- Software-defined network technology
- Network function virtualization technology
- AR/VR/MR multimedia interactive technology
- Core technology for video coding
- OLEO satellite communication technology
- Remote communication and network relay



- Big Data Analysis and Artificial Intelligence
- Software-Defined Data Center
- Hardware as a Service (HaaS) Technologies
- Software-Defined Storage Service Technologies
- Deep Learning Model Technologies

Intelligent • Intelligent Edge Computing Platform Technologies



- Unmanned Aerial Vehicle Systems and
- Mobile Video Applications
- Audio Perception and Processing for **Unmanned Vehicles**
- Technologies for Financial and Regulatory Systems
- Connected Vehicles and Autonomous Driving Systems



Communication







Information

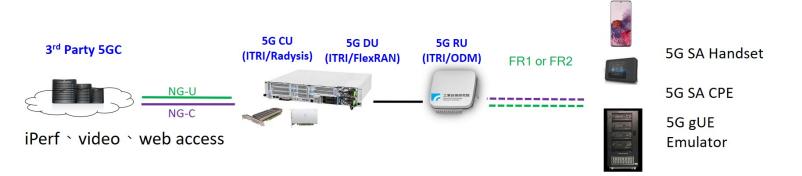
Green

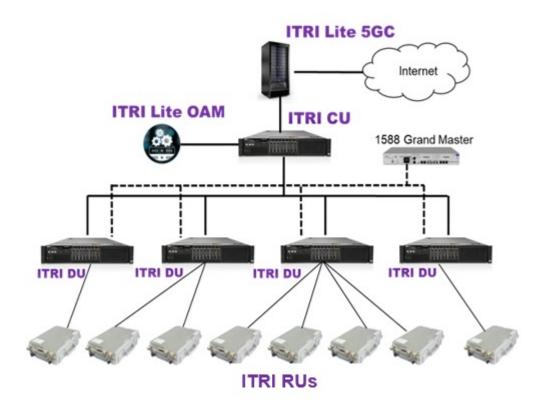
Information Communications **Research Laboratories**



Division for Emerging Wireless Applications Technology ITRI ICL-M Div

- Expertise
 - 3GPP standard
 - RF/Baseband/Protocol software
 - System integration
 - System simulation
- What we developed for 5G O-RAN systems
 - ORAN Compliant RU/DU/CU & Lite 5GC & OAM
 - Max Throughput 1.6 Gbps per RU
 - Support 128 Active UEs
 - Support Both FR1 and FR2
 - Pass OTIC and 7x24 long run testing
- Our achievement
 - provided technology to over 30 Taiwanese companies
 - semiconductor IC design \ components and systems





RIS use cases brings challenges

Commercial Challenges

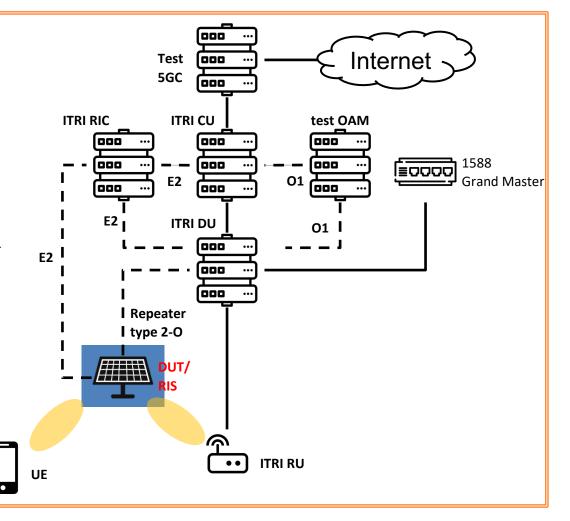
- Assured gains on key performance indicators while integrated with commercial O-RAN infrastructure
 - Explore best use case among combinations of exercise scenarios and spectrum bands options
- Need an OTA testbed to verify the performance via system-wide data collection
 & analysis
- Choice among RIS meta-surface options: Liquid Crystal (refraction/reflection),
 Electronic (PIN diode/CMOS Cap Array IC), and others
 - Trade off between phase control precision, beam switching speed & manufacturing cost

Deployment Challenges

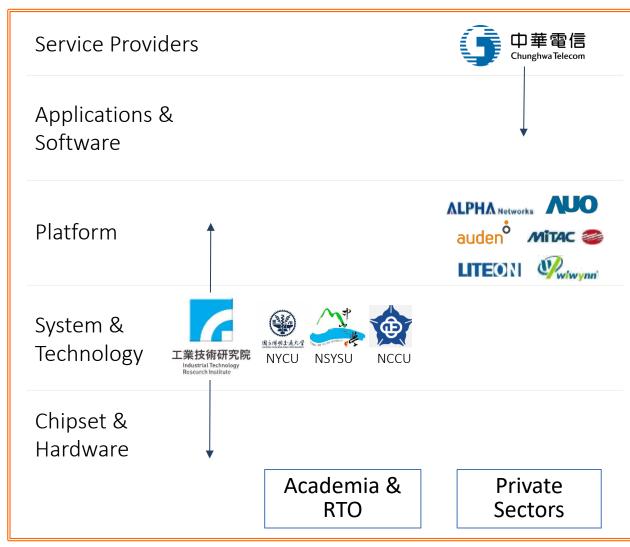
• The RIS deployment scenarios.

RIS end-to-end testbed

- RIS module and O-RAN network integrated system
- Testing framework, scenario, procedures, items & tools
 - Ongoing RIS testing
 - Frequency band: 4.5GHz and 28GHz
 - RIS Type: PIN diode/CMOS Cap Array IC RIS
 - Measurement items:
 - RIS module
 - Measurement of RIS signal gain, signal attenuation, 3D beampattern, etc.
 - Frequency band: 28GHz
 - E2E system
 - First level- SNR
 - Second level- App Throughput/ Error Rate



Bridge O-RAN ecosystem into RIS testbed



- Stream B: Research for Revolutionary Technology and systems
- What we are capable to contribute
 - Proxy with Taiwan O-RAN ecosystem
 - Chipset, commercial platform & well-known semicon
 - System validation for complicate RIS scenarios
- What we expect for the return
 - System proven towards commercial feasible
 O-RAN RIS integration network (spec. & solution with reasonable cost & ric/gNB)