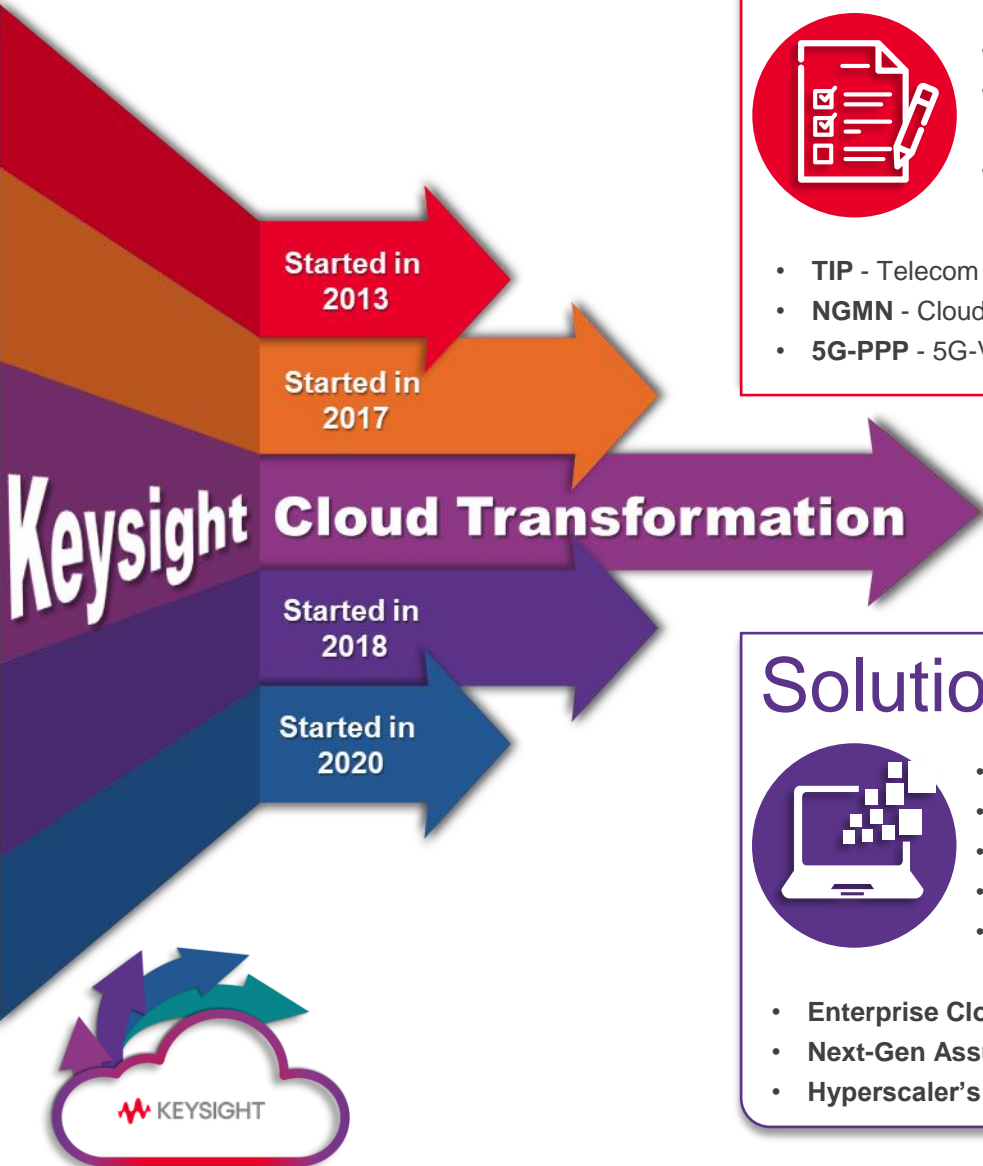KEYSIGHT

Network Disaggregation Evolutions
Impacts on B5G & 6G System Measurements

Renaud DUVERNE | Open RAN Sales Specialist

Keysight TelcoCloud & MEC Validation Context

Started in 2013

Started in 2017

Cloud Transformation

Started in 2018

Started in 2020

Keysight Cloud & Virtualization Transformation

Standards Bodies

- **ETSI-NFV** Testing Working Group - Chair leader
- **3GPP Rel.16** and beyond including major 6G research programs
- **O-RAN Alliance** active contribution & plugfest major achievements

- **TIP** - Telecom Infra Project, Test & Integration Co-Chair leader
- **NGMN** - Cloud Native working group D6 active contribution
- **5G-PPP** - 5G-VINNI Distributed Clouds Orchestration

Strategic Acquisitions

- Network visibility, 5GCore testing & emulation, xHaul, security & trust - **Ixia**
- UE emulation verify RAN & O-RAN from Edge to Core - **PRISMA**
- Digital automation intelligence, monitoring insights, RPA - **EggPlant AI**

- RAN analytics & visibility - **Sanjole Wireless Analyzers**
- Real-time network digital twin & simulation, network planning, modeling & cyber testing - **Scalable Network Technologies**

Solution Transformation

- **NFVi, ONAP, MANO**
- **KORA OpenRAN** solution architect
- **5G Core** testing & emulation
- **Visibility & security**
- **Automation-analytics-AI**

- **Enterprise Cloud** VM-Ware, Linux, IBM, OpenStack …
- **Next-Gen Assurance,** automation, AI & global analytics
- **Hyperscaler's** marketplace integration

TelcoCloud Projects

- **Global Coverage** - Japan, USA, India & EU
- **Network transformation** - USA, Japan & EU
- **Cloud Native** - USA, Japan & India
- **USA** commercial MEC SLA/Visibility deployment

- **3rd O-RAN Alliance Plugfest** Major Contributions
  - O-Cloud
  - O-RAN RIC
  - O-RAN Security

KEYSIGHT

Keysight TelcoCloud & MEC Validation Context

The promise of legacy assurance **LEGACY**   **NEXTGEN** Open, Disaggregated & distributed

LEGACY	NEXTGEN
Single Vendors & Monolithic Tightly integrated and closed Looked-in to vendor's roadmap	Modular and multivendor assurance Loose coupling Open innovation at any level
Predefined combinations Limited external APIs	Open composable assurance pipeline Component open API
"Cloud washed" Legacy architecture	Cloud Native Disaggregated distributed automated
Limited extension & future proof Automated Diagnosis & RCA ML / AI extension Fine grain automation	Easily integrated with assurance, orchestration frameworks & TaaS

Keysight O-RAN Solutions Coverage

O-RAN Architecture

O-RAN & 3GPP Protocol Sniffer ←

Visibility, Troubleshooting & Assurance ←

TaaS & Root Cause & CI/CD/CT ←

Site Installation Validation ←

EMF & RF Coverage Validation ←

Remote Field Monitoring ←

M-MIMO & Beam Forming Test ←

Cloud Infrastructure Validation ←

Device Sandbox & Validation at Scale ←

E2E Functional & Performance, Load & Capacity ←

O-RAN Sub-system

→ Measurement consistency from pre- to post-silicon

→ Early Development Cycle Validation

→ Multidomain RF, Digital, Protocol

→ O-RU, O-DU, O-CU, RIC

→ Transport Layer - xHaul

→ Multivendor Inter-Operability

→ O-Cloud Infrastructure

→ Security & Badging

→ Conformity of O-RAN equipment

→ IOT - Interoperability of O-RAN equipment

→ Functional & performance Validation

O-RAN Analytics & Test Automation

Pre-Silicon & Silicon validation

Field Performance & Benchmark

Keysight O-RAN Solutions

Vendors PoC & Pre-selection,

O-RAN Architecture Validation

Lab Network Integration & OTIC Certification

KEYSIGHT

Keysight O-RAN Solutions Coverage

O-RAN Architecture

O-RAN Sub-system
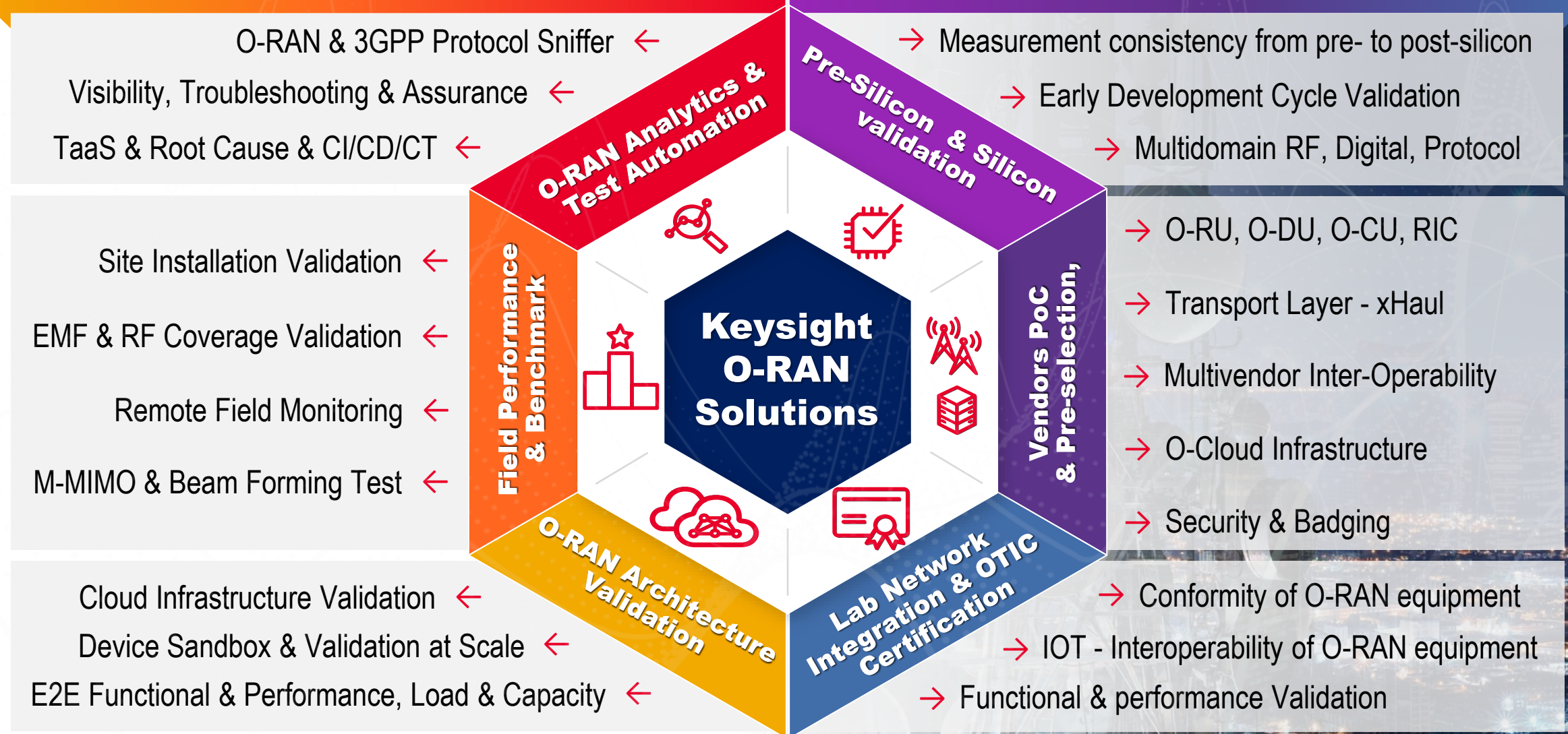
Visibility, Troubleshooting, Assurance TaaS & Root Cause CI/CD/CT

Measurement consistency from pre- to post-silicon.

O-RAN Analytics & Test Automation

Pre-Silicon & Silicon validation

Field Performance & Benchmark

Keysight O-RAN Solutions

Vendors PoC & Pre-selection,

O-RAN Architecture Validation

Lab Network Integration & OTIC Certification

Site Installation Validation
EMF & RF Coverage Validation

Remote Field Monitoring

UE, O-RU, O-DU, O-CU Emulators, RIC Testing
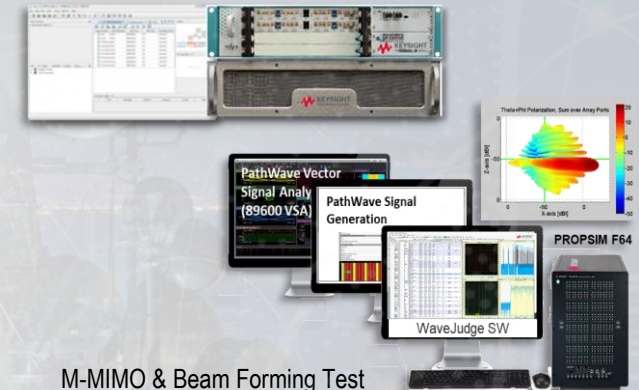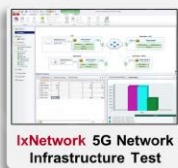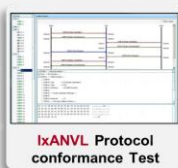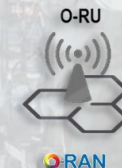
M-MIMO & Beam Forming Test

O-Cloud Infrastructure Validation
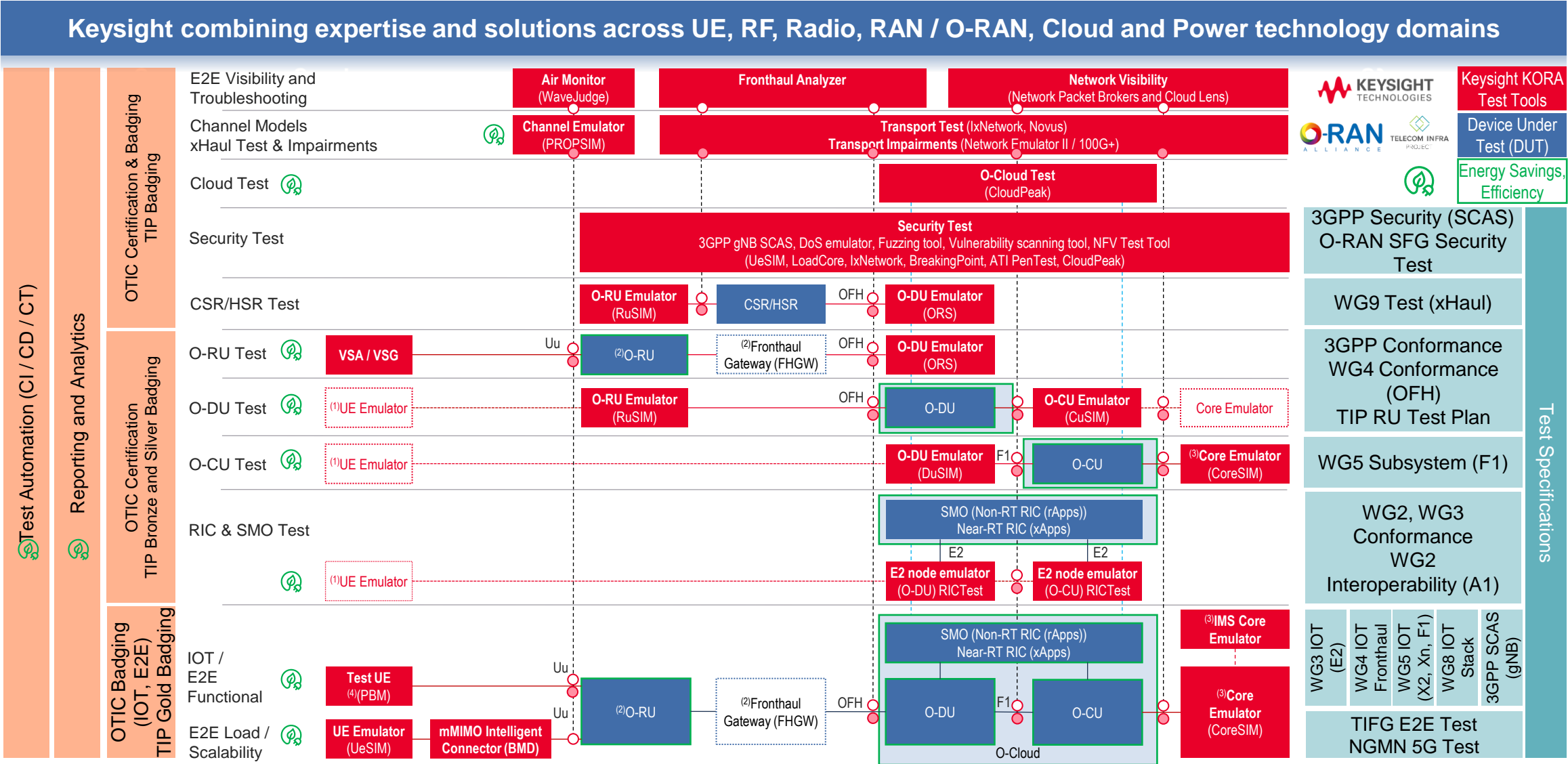
Transport Layer - xHaul

Security & Badging

Conformance, Interoperability, Functional and Performance O-RAN Alliance Validation

Keysight O-RAN Architect (KORA) for Lab Testing & Field Optimization

Challenges on Energy Efficiency (EE) and Savings (ES)

requires standardized approach for evaluating, testing, measuring and monitoring

- **Energy consumption (EC) has become a key part of the operators' OPEX**. *

- **Operators need Energy Efficiency (EE) KPIs** defined for various phases:

  - Buy: evaluate and compare vendors
  - Design / Build: design options
  - Operate: assess EE of the live network

- **Industry's emerging standardized approaches**
  - Energy savings optimization and orchestration
  - Evaluating, testing, measuring and monitoring energy consumption/efficiency and savings techniques for dis-aggregated multi-vendors O-RAN
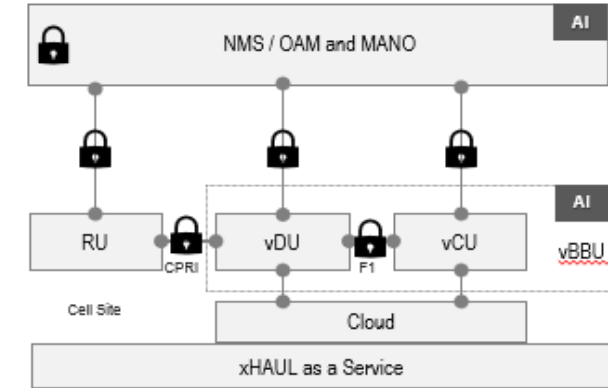
Single Vendor specific energy efficiency optimization and energy savings techniques are in use by operators today
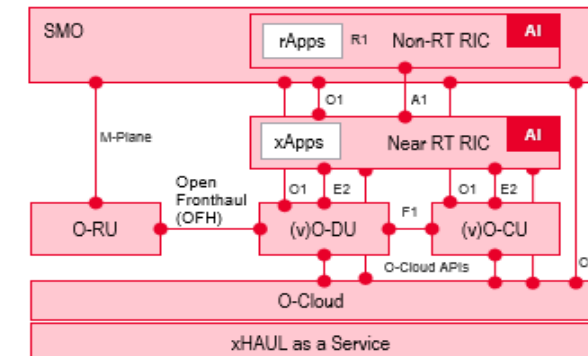
Multi-vendors energy efficiency optimization and energy savings techniques do not exist today

3GPP & O-RAN EC, EE and ES

EVALUATE, TRAIN, TEST, ASSESS, VALIDATE, CHARACTERIZE AND REPORT

Test Requirements and Functions

1. **Detailed Characterization and Reporting** of energy consumption, efficiency and savings for each of the subsystems, subsystems pairs and base station energy performance report

2. **Evaluate, Train, Test, Assess and Validate AI-based energy management** for near and non real time RICs and applications (xApps, rApps) and base station with real-world traffic and channel models in open and closed loop operation modes

3. **"Live-to-Lab" testing with real-world** realistic radio channel and network impairment emulation

4. **Enables Massive MIMO and Large-Scale MU-MIMO** energy consumption, efficiency and savings (such as selective elements switching on/off) test and optimization

5. **Test, Validate and Report 3GPP and O-RAN** energy efficiency counters / KPIs computation and reporting from each of the subsystems and base station

6. **Automated** test, correlation, analysis and reporting

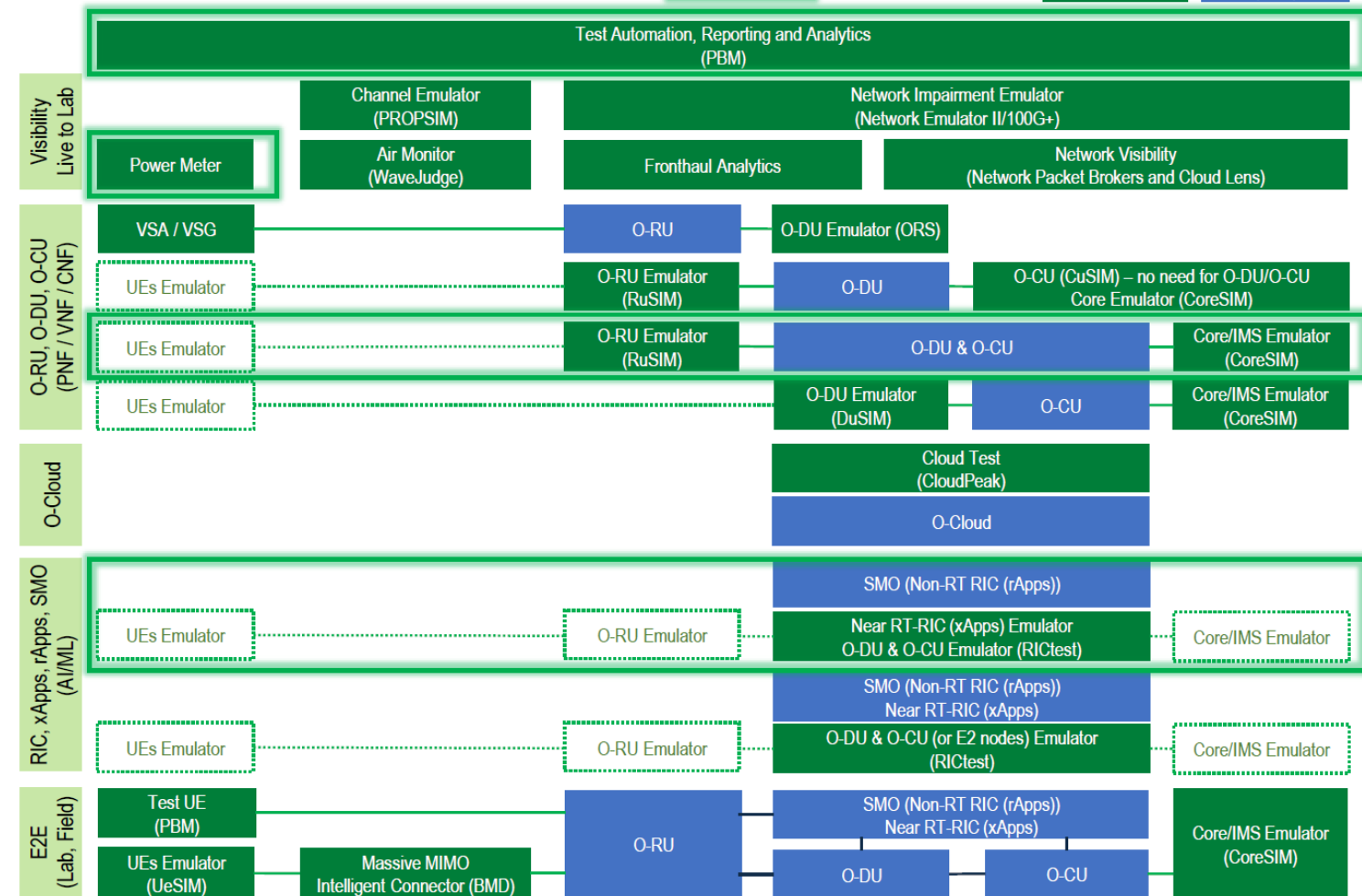7. **Troubleshooting** and root cause analysis

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2022 1H O-RAN Plugfest

KEYSIGHT

Keysight KORA Test Tools

Device Under Test (DUT)

Test Automation, Reporting and Analytics (PBM)

Visibility Live to Lab

Channel Emulator (PROPSIM)

Network Impairment Emulator (Network Emulator II/100G+)

Power Meter

Air Monitor (WaveJudge)

Fronthaul Analytics

Network Visibility (Network Packet Brokers and Cloud Lens)

O-RU, O-DU, O-CU (PNF / VNF / CNF)

VSA / VSG

O-RU

O-DU Emulator (ORS)

UEs Emulator

O-RU Emulator (RuSIM)

O-DU

O-CU (CuSIM) – no need for O-DU/O-CU Core Emulator (CoreSIM)

UEs Emulator

O-RU Emulator (RuSIM)

O-DU & O-CU

Core/IMS Emulator (CoreSIM)

UEs Emulator

O-DU Emulator (DuSIM)

O-CU

Core/IMS Emulator (CoreSIM)

O-Cloud

Cloud Test (CloudPeak)

O-Cloud

RIC, xApps, rApps, SMO (AI/ML)

SMO (Non-RT RIC (rApps))

UEs Emulator

O-RU Emulator

Near RT-RIC (xApps) Emulator O-DU & O-CU Emulator (RICtest)

Core/IMS Emulator

SMO (Non-RT RIC (rApps)) Near RT-RIC (xApps)

UEs Emulator

O-RU Emulator

O-DU & O-CU (or E2 nodes) Emulator (RICtest)

Core/IMS Emulator

E2E (Lab, Field)

Test UE (PBM)

SMO (Non-RT RIC (rApps)) Near RT-RIC (xApps)

Core/IMS Emulator (CoreSIM)

UEs Emulator (UeSIM)

Massive MIMO Intelligent Connector (BMD)

O-RU

O-DU

O-CU

KEYSIGHT

KEYSIGHT

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