

RICtest: RAN Intelligent Controller (RIC) Test Solutions

Emulation of O-RAN E2, A1 and O1 Nodes
for performance, conformance and interoperability testing

Overview

5G functionalities like radio access network (RAN) functional splits, control plane and user plane separation (CUPS) and network slicing require advanced monitoring and analytical capabilities to configure, optimize, and control the RAN infrastructure at the edge.

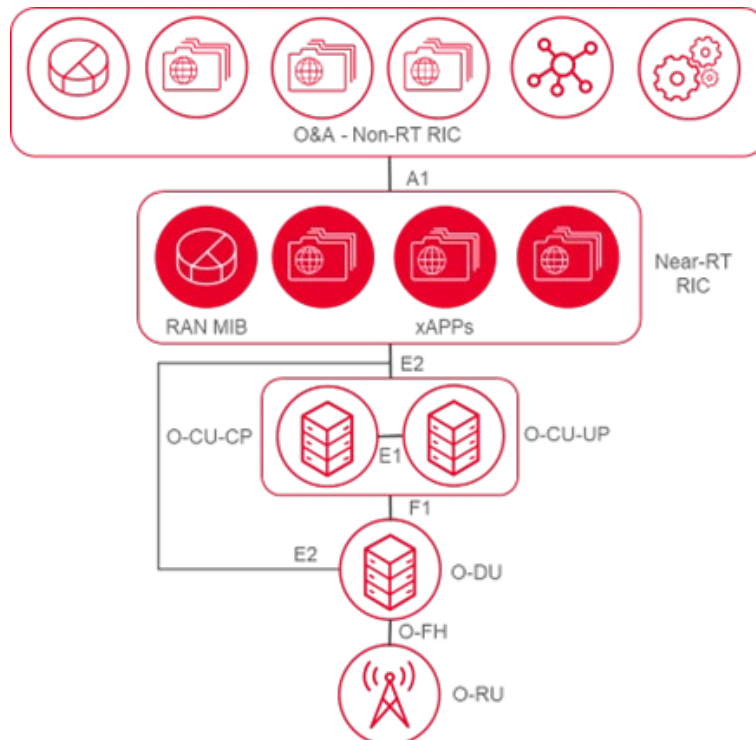
The RAN intelligent controller (RIC) functional entity provides advanced control capabilities, enabling increased efficiency and better radio resource management by leveraging analytics and data-driven operations to optimize access network utilization. The RIC consists of a near-real-time controller (Near-RT RIC) that implements functionalities requiring low latency and a non-real-time controller (Non-RT RIC) for operations without stringent latency needs. The Near-RT RIC software platform provides a cloud-based infrastructure to host various applications (xApps) for controlling a distributed set of RAN elements (O-eNB, O-gNB, O-CU-CP, O-CU-UP, O-DU) over the E2 interface from the O-RAN ALLIANCE. The Non-RT RIC is a component service of the Service Management Orchestration (SMO) that also hosts applications (rApps) capable of modifying operational parameters for these RAN elements.

For the RAN condition to be improved, the vertical integration - from the RAN Nodes to the SMO and Policy Management – must be successful. Bringing the relevant systems into the lab for performance, conformance, interoperability, and use case validation (including use of AI/ML in applications) is a first step to addressing these challenges. A test tool which can flexibly pivot at each challenge is required.

Keysight solutions for RIC testing can address every test challenge.

RICtest highlights

- **Performance.** RICtest's platform performance testing determines RIC readiness for production load levels.
- **Conformance.** RICtest has implemented O-RAN ALLIANCE-endorsed conformance test specifications for E2 and A1 interfaces to provide assessment of compliance.
- **Interoperability.** Simulation of O-RAN nodes generates telemetry to xApps and rApps using standards-based protocols and service models towards RIC and SMO providing assessment of the state of vertical integration.
- **Use Case Validation.** Many use cases from traditional Self Optimizing Networks (SONs) and from O-RAN ALLIANCE are supported today. The solution offers standards-based service models and performance metrics to test user-defined workflows for Use Cases, and to prove xApps and/or rApps in E2- and/or O1-driven closed loop validation.



Performance:

Validating RAN Optimization at Scale

To provide production level of service for its hosted applications, RICs must provide reliable and robust processing of messages from its RAN service area. This area can consist of O-eNodeBs and aggregated O-gNodeBs, as well as disaggregated nodes, servicing tens or hundreds of cells and hundreds or thousands of subscribers. The successful collection of telemetry to xApps on the Near Real-Time RIC, or rApps on the Non-Real-Time RIC, depends on component interoperability as well as system performance.

Determine RIC readiness for production load levels with Keysight RICtest. Software agents support O-RAN simulation with E2- and O1-based connections at scale, with sub-100ms Reporting Intervals, to drive transaction rate to test platform and protocol processing. With support for hundreds of E2 and/or O1 connections, the solution is ideal for network vendors who want to test the scalability of their RIC architectures.

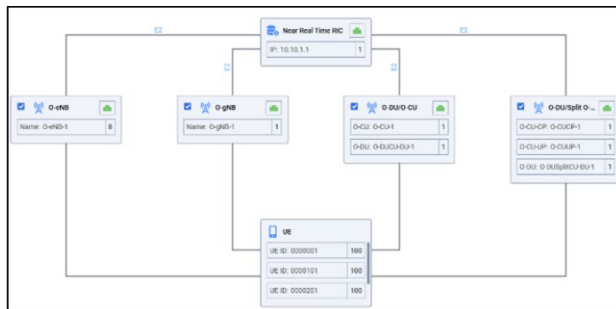


Figure 1. Performance Test Type Configuration



Figure 2. Performance Test Type Runtime

Performance - Key features

- Mix and match RAN performance metrics (PM) types with NR (TS 28.552) and E-UTRA (TS 32.425) support.
- Test performance with standards based E2 and O1 message loads.
- Vertical and Horizontal Resource Scaling allows users to resize software agents, as well as bring multiple software agents into the test, to enable and optimize performance testing.
- Scale of hundreds of nodes, hundreds of cells, and tens of thousands of packets per second, for test with Commercial and Open Source Near- and Non- Realtime RAN Intelligent Controllers under test.

Conformance: Assessing Standards Compliance

Keysight provides solution for O-RAN ALLIANCE endorsed conformance test specifications for E2 and A1 interfaces. Conformance tools not only provide assessment of compliance but are a step in problem area identification in pre-interoperability phase, as well as tool for baseline verification in a change management program. Automation via REST API is provided with each solution for headless operation.

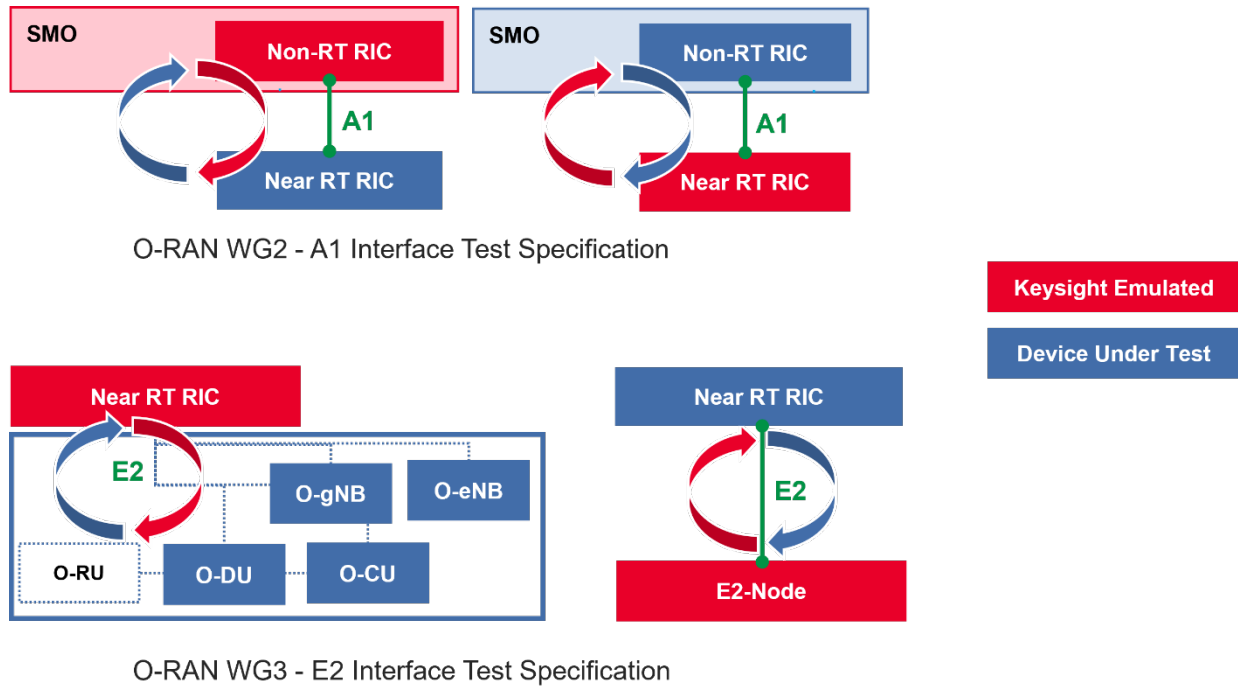


Figure 3. Conformance for E2 and A1.

Conformance - Key features

O-RAN Working Group 2 A1 Interface Test Specification (O-RAN.WG2.A1TS-R003-v03.00)

Keysight O-RAN Conformance Tool provides simulation of the Near Real-Time RIC for testing the Non-Real-Time RIC. A1TS Chapter 5.2 and 5.3 tests include these categories:

- Conformance test cases for A1-P Consumer
- Conformance test cases for A1-EI Producer

Keysight O-RAN Conformance Tool provides simulation of the Non-Real-Time RIC for testing the Near Real-Time RIC. A1TS Chapter 6.2 and 6.3 tests include these categories:

- Conformance Test Cases for A1-P Producer
- Conformance Test Cases for A1-EI Consumer

O-RAN Working Group 3 E2 Interface Test Specification (O-RAN.WG3.E2TS-R003-v02.00)

Keysight O-RAN Conformance Tool provides simulation of the O-RAN Node for testing the Near Realtime RIC. E2TS Chapter 5.2 tests include these categories:

- E2AP Global Procedures
- E2AP Functional Procedures including E2SM-KPM and -NI
- Support for defined Positive and Negative test cases

Keysight O-RAN Conformance Tool provides simulation of the Near Real-Time RIC for testing the E2-compliant O-RAN Node. E2TS Chapter 6.2 tests include these categories:

- E2AP Global Procedures
- E2AP Functional Procedures
- Support for defined Positive and Negative test cases

Interoperability

The diverse number of interoperating functions from O-RAN Node to rApp expands across many layers and potentially many vendors. While turnkey solutions are possible, the promise of O-RAN to promote innovation and avoid vendor lock-in requires interoperability to be a key strength of the architecture instead of a barrier-to-entry.

Simulation of O-RAN nodes generate telemetry to xApps and rApps using standard-based protocols and service models towards RIC and SMO, providing assessment of the state of vertical integration.

Performance, compliance, robustness, and reliability of the composite integration are valid areas of test – all required for successful execution of the xApps and rApps.

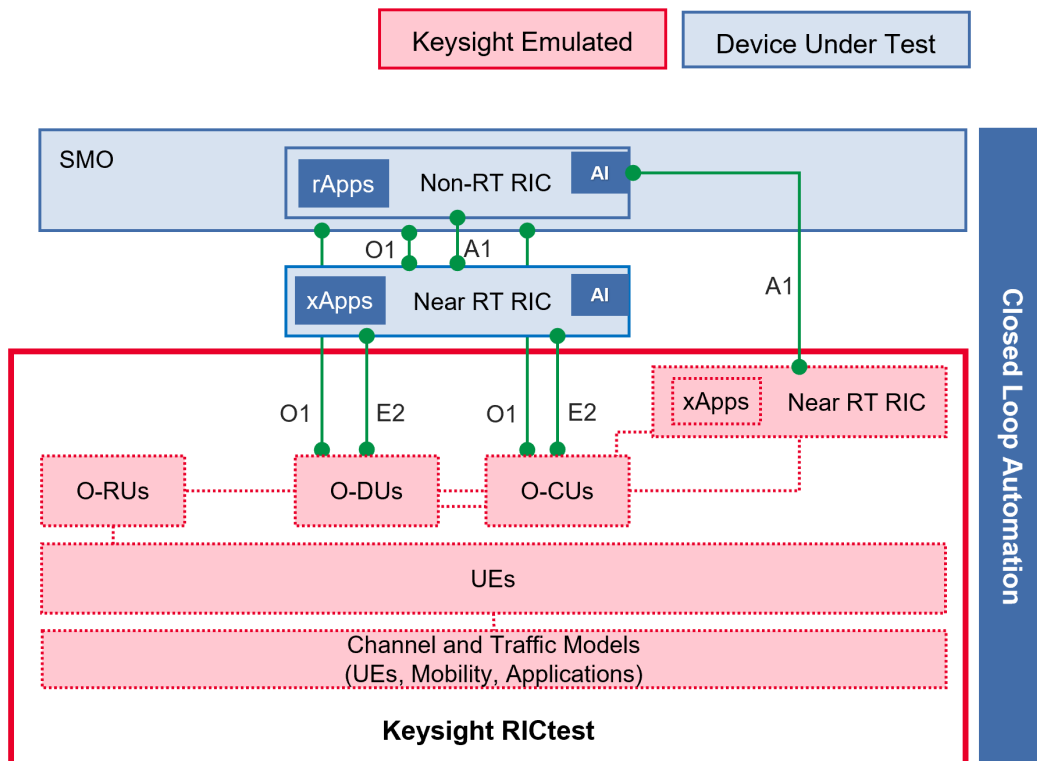


Figure 4. RAN emulation with Traffic and Channel Models for system validation top-to-bottom.

Use Case Validation

User-configured RAN scenario informs models which generate Performance Measurement (PM) data at volume. E2- or O1-based modifications to RAN scenario can be applied in real-time, with fresh outcomes observable in subsequent PM data. Many use cases from traditional Self Optimizing Networks (SONs) and from O-RAN ALLIANCE are supported today. The solution offers standards-based service models and performance metrics to test user-defined workflows for Use Cases.

RICtest offers a Traffic Model configurator that you can tune to provide the specific measurements of interest to an xApp or rApp application at volumes that are impractical to achieve in end-to-end lab settings.

Use case validation - Key features

- Prove xApps and/or rApps in E2- and/or O1-driven closed loop validation.
- Validate with support for E2SM Key Performance Metric (KPM), RAN Control (RC), and Cell Configuration and Control (CCC) service models for telemetry, network state, and network modification delivery.
- Validate with support for O1-based PM Job Controls, and Configuration Management (CM) through support of dynamically generated Yang model instances based on user-defined configurations and standards-based structures.
- Over 70+ Performance Measurements supported by RAN Simulation's telemetry generation.
- Browser-based user interface for scenario creation with runtime statistics generation.
- Emulates tens of thousands of active devices and sessions.
- Test control and results management integration with other systems using REST API.

Use Case Key Feature: Radio Access Network Designer

- Designer for user-defined layouts of cell types: Coverage (2 km), Capacity (300 m); Omnidirectional, Directional 3-sector site, or Directional 6 sector site. Option for Directional mMIMO beamforming.
- Designer offers topology import via CSV file for expedited RAN topology creation.
- Designer offers Large Topology Configuration wizard – design and allocate hundreds of cells in seconds.
- Plot mobility paths or stationary points for Subscribers.

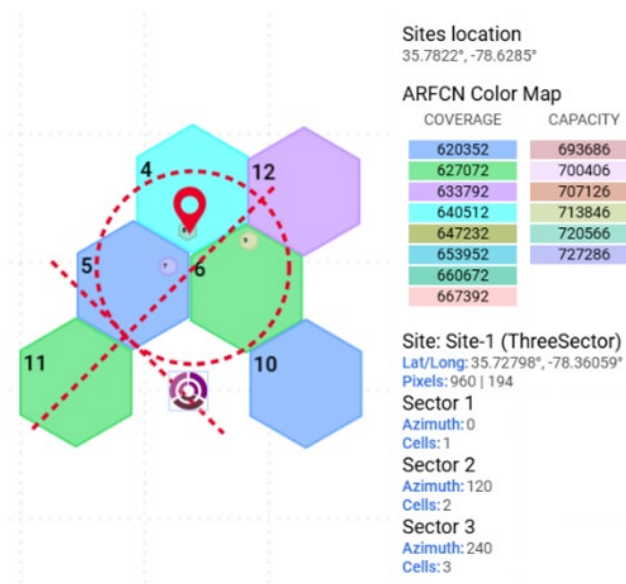


Figure 5. Designer for Cells and Mobility

Cell

Name: RDUXZMC1

Cell ID: 101

Cell Properties

☒ Beam Properties

Location

Restricted Slices: Select a value...

RRM Policies

- ☒ Name: PRB-UL-SNSSAI-1000
- ☒ Name: PRB-DL-SNSSAI-1000
- ☒ Name: PRB-UL-SNSSAI-1001
- ☒ Name: PRB-DL-SNSSAI-1001

Beam Properties

Horizontal Elements: 8

Vertical Elements: 4

Radiating Elements: 3

Azimuth (°): 15

Elevation (°): 0

Horizontal Beam Width (°): 25

Vertical Beam Width (°): 20

Figure 6. Cell Information

Use Case Key Feature: Online/Offline training of AI/ML models

- Online training of AI/ML models derived from RAN simulation and standards-based interfaces.
- Option for creation of data sets at accelerated timescale for Offline Training of AI/ML models, with user-defined granularity period and reporting interval. Create days of data sets in hours for pre-training.

Cloud Native Test Solutions

Keysight RICtest is a software-only test solution which supports standalone hypervisors VMware ESXi, and Linux Kernel-based Virtual Machine (KVM). RICtest runs on Commercial off-the-shelf (COTS) hardware.

Optional Hardware

Keysight-branded hardware is available.

Model	Description
ORAN Server 	ORAN RICtest Server, runs Ubuntu OS • 2x 56c Xeon 6238R processor • 128 GB RAM (3200MHz) • 2 x HDD: 4TB + 2TB • 2 x Power Supply
Network Interface Cards	Network Interface Cards • 4 x 10GbE X710 T4 • 2 x 10GBE-SFP Intel 520 • 2 x 10GBE-SFP Intel 520
Size and Weight	Size • 43.7 cm width (19" rack mounted) • 8.89 cm height (2U rack mounted) • 45 cm depth Weight • 14 Kg

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.