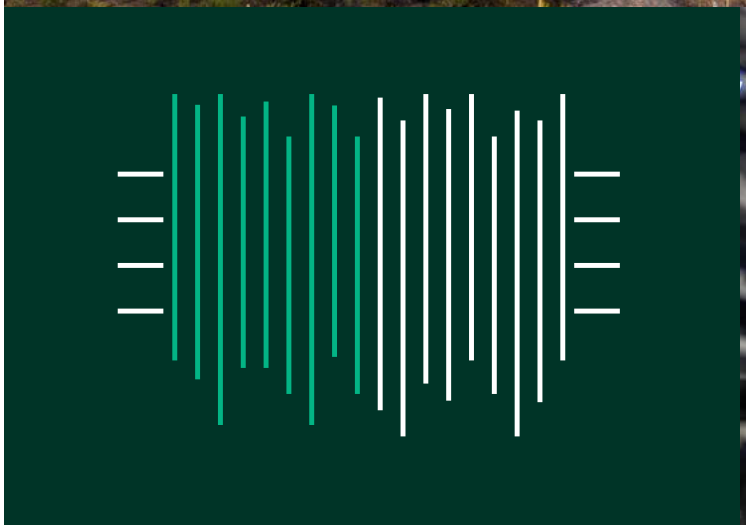
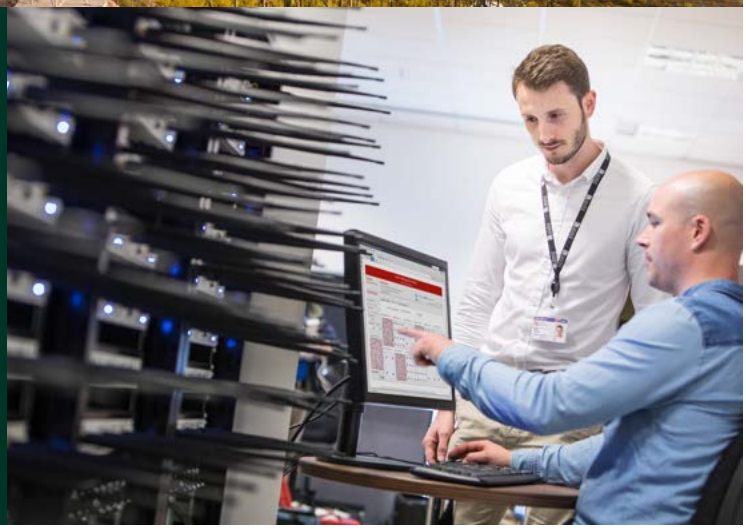
NI is now part of Emerson.

EMERSON





Solution Brochure

O-RAN RU Production Test

Enabling Integrated Test for a Disaggregated RAN Architecture

Automated O-RAN RU Production Test

The Open RAN (O-RAN) RU Production Test Solution allows you to quickly and efficiently ensure end-of-line quality and compliance in RU manufacturing. With a scalable and versatile platform, you can minimize overall cost of ownership and time-to-market while ensuring product quality.

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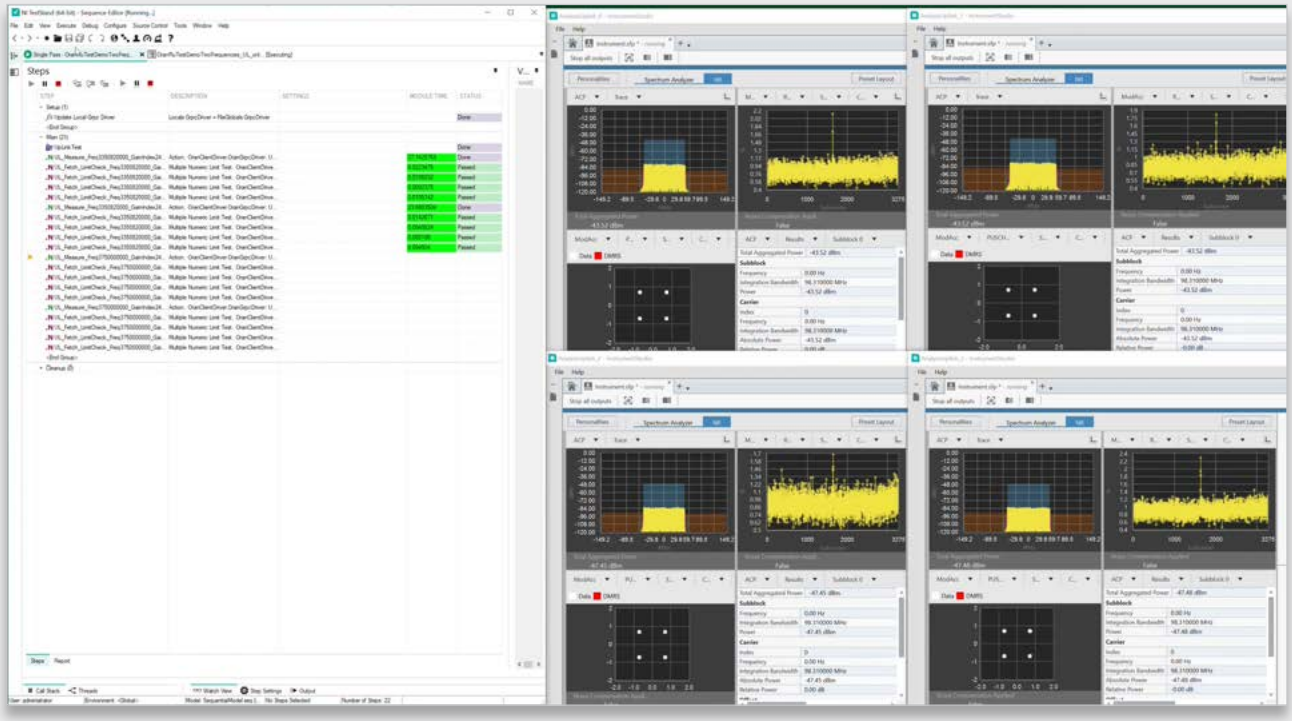
O-RAN RU Production Test

Fast and Efficient End-Of-Line Test in RU Manufacturing

ni.com/semiconductor

The NI O-RAN RU Production Test Solution provides fast and efficient test during RU manufacturing. With RF and digital DUT control under the same test and automation interface, superior timing and synchronization with NI instrumentation, real-time fronthaul link, and high-throughput DU emulation, this solution provides efficient, fast, and cost-effective RU production test. When combined with RU validation built on the same platform, users can leverage a streamlined workflow that can help lower overall test cost and shorten time to market.



KEY FEATURES:

01

High-throughput DU emulation record and playback

02

O-RAN and traditional RAN test cases for production test

03

Integrated DUT control

04

Adapt to evolving wireless standards with PXI Vector Signal Transceivers

05

Fast test times with four-layer RU with listed measurements

06

Cost-effective test platform with a small footprint

Why O-RAN?

The Future of Network Infrastructure

With the disaggregation of base station components, proprietary protocols have been replaced with standard interfaces. While this change has many positives for wireless network infrastructure, it also means these links need to be tested and require specialized in-the-loop tests and emulations. Also crucially important are the high-quality RF measurements that enable these test cases. By combining best-in-class RF performance with industry-leading expertise in wireless communications test, a collaboration with NI enables quality test solutions backed by decades of wireless industry experience.

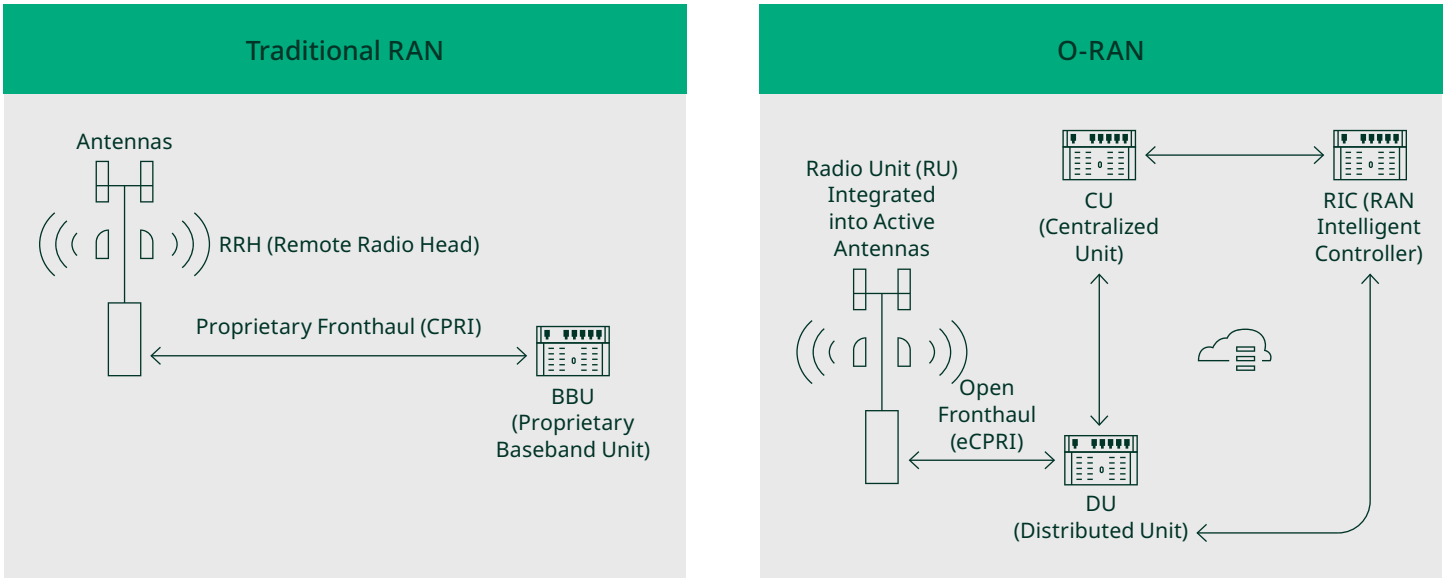


FIGURE 1
Changes from Traditional RAN to O-RAN

BENEFITS OF THE O-RAN ARCHITECTURE

- Standardized Interfaces
- Lower Deployment and Operational Cost
- Scalability and Versatility
- Open Protocols

CHALLENGES IN IMPLEMENTING O-RAN:

01
Lower cost requirements—will drive the need for fast deployment and efficient test system usage

02
DUT control—different protocols have introduced different requirements in DUT control, both inside the O-RAN FH interface and with custom protocols

03
DU emulation—proper DU emulation is crucial for operation and compatibility within the O-RAN architecture, especially as these will be standardized and developed by different vendors

04
Increased competition—the disaggregated RAN has opened the door for new vendors who traditionally have not been a part of network infrastructure development

The O-RAN Architecture

The O-RAN architecture includes changes in the way gNB components operate and communicate in order to simplify deployment, operation, maintenance, and even future-proof base station infrastructure. Instead of proprietary interfaces with closed systems, all protocols and the interface between base station components are standardized, allowing for interoperability of components from different vendors that will help enable lower deployment costs and easier maintenance, among other benefits.

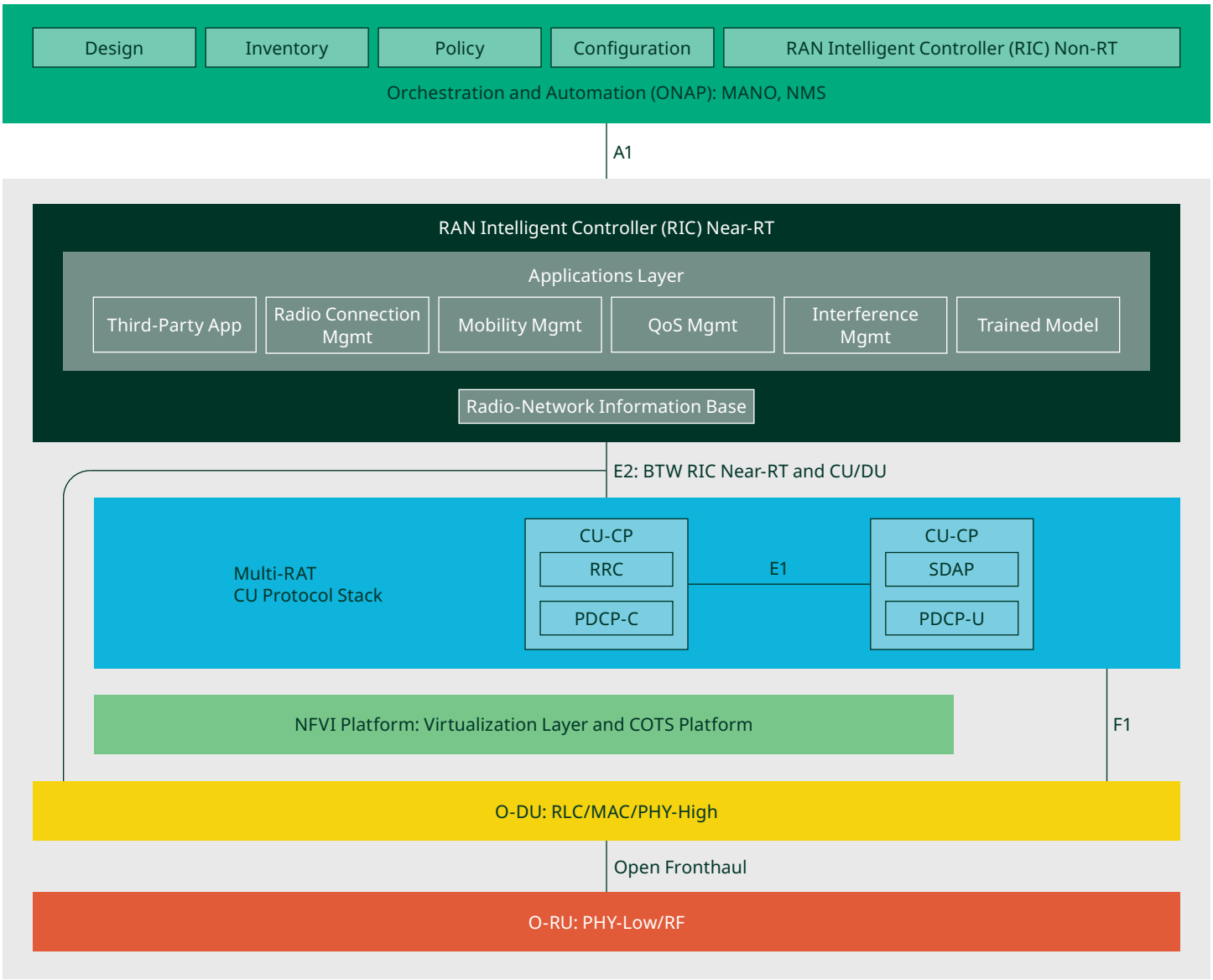


FIGURE 2
The O-RAN Architecture

While there are many different components in the O-RAN ecosystem, the RU presents many unique challenges in production, such as scalability and speed of test, as well as ensuring compliance within the O-RAN architecture. The RU handles communication with UEs and therefore needs to ensure interoperability with both new and legacy cellular standards. It is also the most numerous of O-RAN components, being replicated in the network many times over—even within just one gNB.

O-RAN RU Production Test Solution Overview

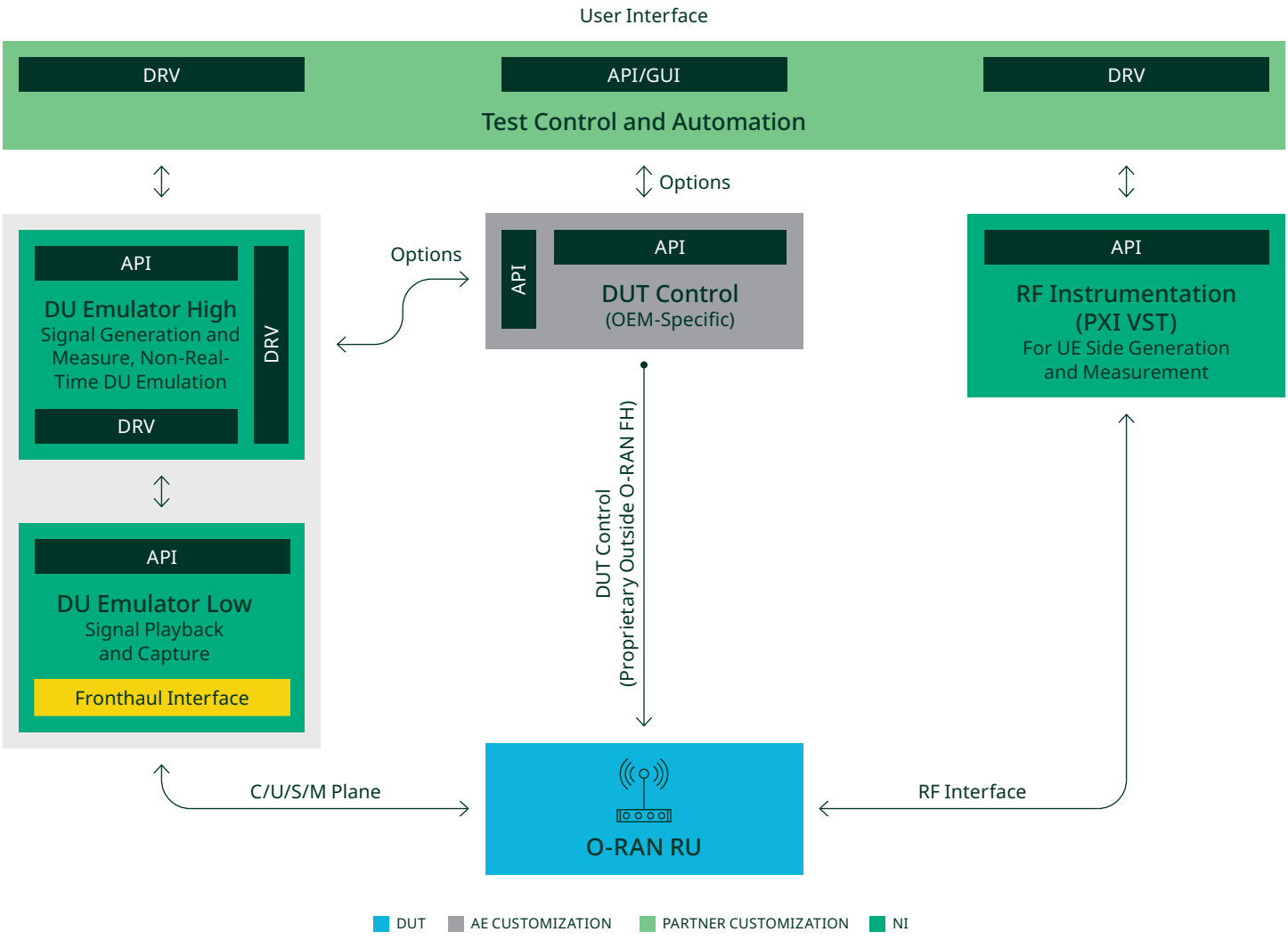


FIGURE 3

O-RAN RU Production Test System Diagram

NI's solution for RU production test incorporates many key features that will allow for easy implementation, thorough test coverage, and fast test times. At the top level, all APIs, test control, and automation interfaces are packaged within one user interface for easy and intuitive control of the entire system. The DU emulation is comprised of two components, each communicating with one another and with the DUT through the fronthaul interface that allows for a high-throughput link. UE signal generation and measurement is possible through PXI VSTs, allowing for fast and scalable test with multiple channels integrated into one system. Finally, DUT control is connected to the DU emulator, user interface, and DUT, allowing for easy connections and control implementation between all components. All these pieces together combine to provide a compact, cost-effective, scalable, and fast test system able to adapt to the needs of a given DUT.

O-RAN RU Production Test Solution Features

Scalable Test Configurations

With the ability to scale to multiple channels, the NI O-RAN RU production test solution is capable of scaling to different applications. Users can add switches for multiple channels connected to different ports on the same DUT. With a scalable and integrated PXI system, it's easy to synchronize all RF channels and connect them back to one integrated test executive.

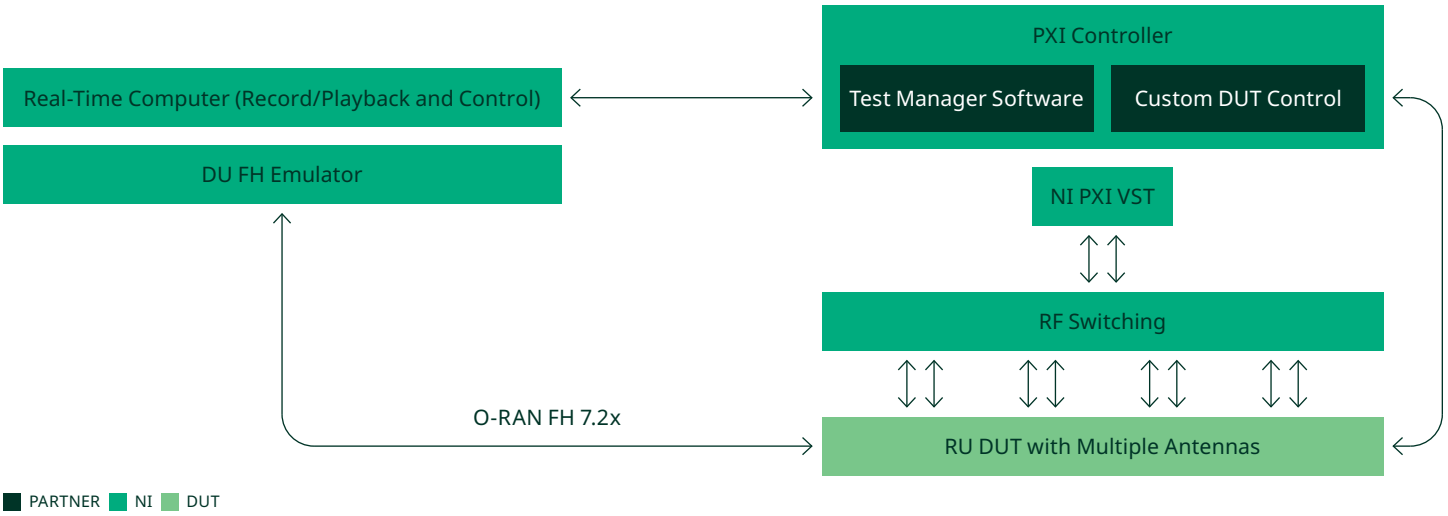


FIGURE 4
RU APT Configuration with Switching

All channels are also controlled through the same software interfaces, both interactively with the RFmx Soft Front Panels in NI InstrumentStudio™ software for debug and monitoring, or with fully automated test cases in NI TestStand. NI software makes it easy to control everything from one interface and transition easily from test development to fully automated production test.

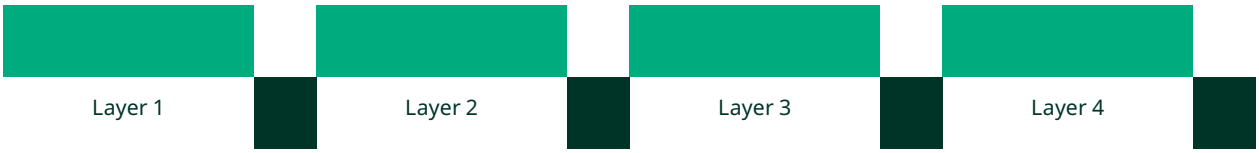
For integrated and ready-to-go test setups, leverage the expertise of an NI Systems Integrator for switching, signal conditioning, DUT handling, and other test fixtures for integration. As experts with NI hardware and software, NI Partners can tailor a custom instrument and test platform to meet the needs of a given application.

Fast Test Time

The PXI platform and NI software is designed with speed in mind. Leverage up to eight-layer listed RF measurements for drastic speed improvements over sequential measurements. By configuring the O-RU only once, then listing all measurements to be made, much of the time spent performing measurements is eliminated from the process entirely.

Typical Four-Layer RU DL Measurement

Four-Layer RU with Pipelined DL Measurement



Four-Layer RU with Listed (RF Switching and RFmx) Pipelined DL Measurement

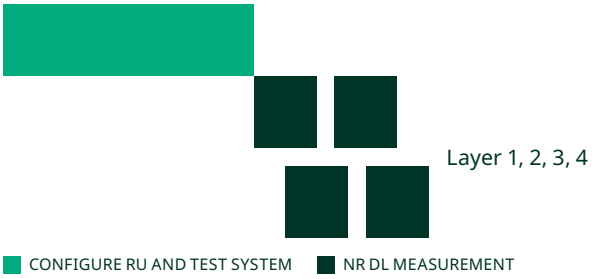


FIGURE 5

Speed Improvement with Four-Layer, Listed DL Measurements

Test times can improve by up to eight times using this method. While exact results depend on the requirements of a given application, this test methodology is built to enable fast and efficient test applications.

Implement custom DUT control with proprietary protocols as well as communication over the O-RAN fronthaul interface to test a variety of use cases.

Leverage an NI Partner for assistance in implementing DUT control, as well as integration support, DUT interfacing, and RF switching, all tailored to the requirements of your RU production test application.

Contact NI to learn more

Small Footprint

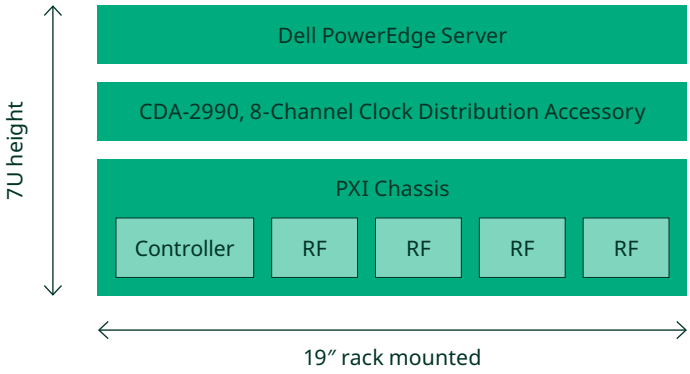


FIGURE 6
Spatial Dimensions of O-RAN RU APT Solution

Utilizing the compact PXI form factor, this solution is small, occupying just one 19″ rack width and comprised of just a few distinct components.

The PXI chassis, server, and reference clock module are all compact, with an integrated controller and multiple PXI VSTs within the PXI system.

This small footprint gives users the ability to consolidate multiple systems within just one rack, saving space and increasing efficiency on the production floor. The overall footprint will not grow with scale; simply add more RF switches to expand.

MEASUREMENTS AND SPECIFICATIONS

DL RF Measurements:

- Base station output power
- Occupied bandwidth
- Operational band unwanted emissions
- ACLR
- Spurious emissions
- Tx-Tx isolation
- EVM
- Frequency error

UL RF Measurements:

- EVM
- Rx power

System Characteristics:

- Support for up to 8 Tx and 8 Rx antennas
- DL test model:
  - 5G NR TM 1.1
  - 5G NR TM 2a
  - 5G NR TM 3.1a
- UL test model:
  - 5G NR custom QPSK
- DUT synch:
  - 10 MHz +PPS
  - S-Plane (PTP with VVDN RU)

5G NR and O-RAN FH Characteristics:

- TDD n78 NR band support
- RU numerology:
  - 100 MHz, 1CC, 30 kHz SCS, TDD
  - 20 MHz, 1CC, 15 kHz SCS , FDD
- FH vers/plane
  - CUS plane version 7
  - 7.2x fronthaul split
  - C-Plane section 1
- Fronthaul transport:
  - SFP28 connector
  - 1x (10, 25) GigE
  - eCPRI over Ethernet

O-RAN RU Production Test Hardware Components

PXIe-5841 VST

A VST combines an RF and baseband vector signal analyzer and generator with high-speed serial interfaces for real-time signal processing. The PXIe-5841 offers frequency coverage up to 6 GHz with 1 GHz bandwidth—all in just three PXI slots.

PXI Controller

PXI controllers provide a high-performance, compact embedded computer solution for PXI Express systems and come with features such as an integrated CPU, hard drive, RAM, Ethernet, video, keyboard/mouse, serial, USB, and other peripheral I/O.

VVDN O-RAN FH Interface

The VVDN ADYA PCIe card provides a real-time fronthaul interface with high throughput. Highly configurable IP interfacing on 10/25G Ethernet, this card also supports the 7.2x split, different IQ sample widths, and multiple bandwidths.

PXI Chassis

PXI chassis house PXI modules and connect them with a high-performance backplane that offers timing and synchronization capabilities.

PXIe-2543 Switch Module

The PXIe-2543 is a 4x1 RF multiplexer switch module featuring high-performance solid-state relays that offer unique benefits such as unlimited relay life and fast switching time.

Dell PowerEdge Server

Provide robust DU emulation with a Dell PowerEdge R750 server. With 10G and 25G Ethernet and integrated controller, this system can provide high-throughput DU emulation.

RU Production Test Partners

NI Partners enable efficient, scalable, and complete implementation for O-RAN RU production test. Contact NI for more information about which NI Partner can work with you to implement an RU production test solution.

Partner Capabilities

The NI Partner Network is a global community of domain, application, and test experts working with NI to meet your needs. NI Partners are trusted solution providers, systems integrators, consultants, product developers, and services- and sales-channel experts skilled in a range of industry and application areas.

For O-RAN RU production test, partners specializing in RF test and wireless communications can provide their skills and expertise in implementation, ensuring a comprehensive and tailored test system designed to meet the needs of your application.

Partners can provide:

- Integration and implementation support
- Test fixturing, harnesses, and DUT handling
- Signal conditioning and switching
- Test executive interfaces
- Support and services

Work with an NI Partner

Contact your NI product expert to get help solving your test challenges.

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System Integration on Your Terms

NI offers a variety of solution integration options customized to your application-specific requirements. You can use your own internal integration teams for full system control or leverage the expertise of our worldwide network of NI Partners to obtain a turnkey system.

Contact your account manager or call or email us to learn more about how NI can help you configure cutting-edge wireless test applications and accelerate test timelines at (888) 280-7645 or info@ni.com.

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