VIAVI Solutions

White Paper

Test Suite for O-RAN Specifications

Open Radio Access Network (O-RAN) is being adopted by operators and equipment manufacturers worldwide to reduce infrastructure deployment cost and lower the barrier to entry for new product innovation. As a leader in 5G test and measurement, VIAVI Solutions has developed a comprehensive test suite with modules for lab validation, field deployment and service assurance. This guide provides an overview of O-RAN, descriptions of use cases, and instrument and system recommendations to support a robust and efficient test environment.

O-RAN Overview

The expectations of 5G will place enormous demands on the network infrastructure to deliver massive volumes of data over swathes of spectrum to multitudes of users at challenging latencies. To meet this challenge necessitates the possibility for the different logical functions of the network to be flexibly placed at different physical locations and the network must be disaggregated into more components than has been seen before.

Traditionally, as shown in Figure 1, RAN components such as radio and digital base band have been built on proprietary hardware, and these components typically use vendor-specific protocols for communications. Software functions and interfaces between the different RAN components are designed for optimal performance for that proprietary hardware. For example, Common Public Radio Interface (CPRI) is commonly used for LTE fronthaul (link between radio unit and baseband unit), however, vendor specific implementation often restricts multi-vendor operability.

For the introduction of RAN functions disaggregation and open interfaces in 5G, 3GPP has in Release 15 specified a Higher Layer Split (HLS) option of the gNB which is known as well as the Option 2 NR-PDCP split option. In this option, the gNB may consist of a Central Unit (gNB-CU) and one or more gNB Distributed Unit (gNB-DU) connected through the F1 interface. 3GPP has delivered a set of specifications for the F1 interface, however realizing multi-vendors interoperability over the F1 interface can be very challenging as these specifications have been defined with options which can be used in different manners depending on vendors' implementation.

3GPP has started a study on Lower Layer Split (LLS) in Release 15 during which multiple lower layer split options were identified but it has proven to be difficult for the 3GPP community to converge on specifying a single split option in 3GPP. Many vendor specific implementations of lower layer splits exist in the market today which even though have been optimized to take advantage of the benefits of lower layer split such as improved radio performance due to coordination gains, these closed systems do not support multi-vendors interoperability.

O-RAN sets out to deliver well defined specifications to the industry aiming to enable deployments of O-RAN based programmable networks consisting of fully disaggregated modular O-RAN network functions which are designed to be multi-vendor interoperable over open interfaces running on cloud-based virtual systems. This allows operators to design and deploy mixed-vendor network and network slices which is key to delivering mixes of use cases in the same O-RAN infrastructure.

What is O-RAN?

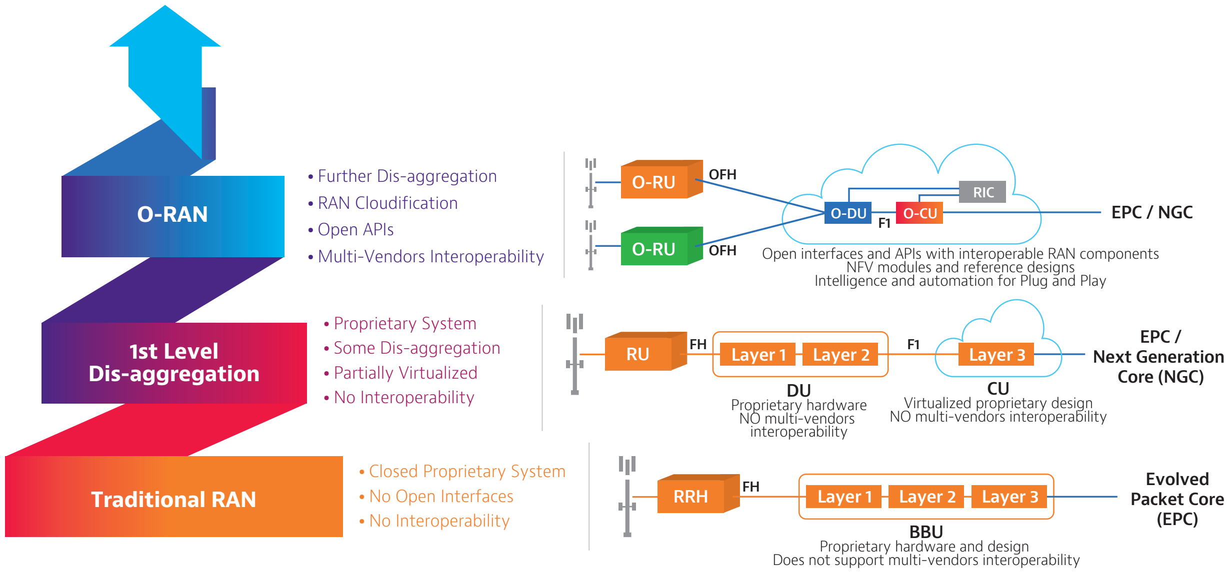

Figure 1. RAN evolution

A key challenge for the more complex and flexible 5G network that results from this is the scale and flexibility of deployment, optimization, management and orchestration of the network. Delivering new services and managing RAN capacity will no longer be practical if managed manually. Intelligence and automation must be integrated into all aspects of the network lifecycle to reduce both CAPEX and OPEX. As RAN disaggregation facilitates managing the complexity required to address the 5G challenge, intelligence in every layer of the RAN architecture is at the core of open RAN technology. This will allow operators to deploy a truly self-managed, zero-touch automated network. Consider the example where base band capacity can become a bottleneck during an unplanned network event. Using artificial intelligence and machine learning tools, this event can be detected and characterized in a short amount of time leading to automated optimization, such as small cell infill capacity. Such an innovative solution can be deployed quickly and efficiently on a white-box platform.

To achieve the above-mentioned goals of an open radio access network, operators founded the O-RAN Alliance to clearly define requirements and help build a supply chain eco-system that can foster an environment for existing and new vendors to drive innovation. As per the charter of O-RAN Alliance, *O-RAN Alliance members and contributors have committed to evolving radio access networks around the world. Future RANs will be built on a foundation of virtualized network elements, white-box hardware and standardized interfaces that fully embrace O-RAN's core principles of* ***intelligence and openness***.

The key principles of the O-RAN Alliance, as shown in Figure 2, include:

- Lead the industry towards open, interoperable interfaces, RAN virtualization, and big data enabled RAN intelligence
- Specify APIs and interfaces, driving standards to adopt them as appropriate
- Maximize the use of common off-the-shelf hardware and merchant silicon, thus minimizing proprietary hardware.

Although there are several operator-led industry initiatives that aim to generically create an open RAN ecosystem, the O-RAN Alliance has received the greatest amount of support. In this document we use "O-RAN" to refer to the open RAN ecosystem target of the O-RAN Alliance.

Benefits of O-RAN

5G's diverse use cases and scale have further challenged operators to:

- Evolve their infrastructure quickly to monetize the new business opportunities offered by 5G, and simultaneously.
- Manage their CAPEX while managing their OPEX.

As we know, deployment and management of RAN is the most expensive part of a wireless network, which means current ways of network evolution, growth and maintenance will not scale to meet the 5G challenges and opportunities. Therefore, operators are now seeing O-RAN as the most viable option to help them meet those goals:

1. Enable an open, multi-vendor interoperable ecosystem driving healthier competition, lowering costs for RAN equipment, and delivering a much larger pool of vendors.
2. Enable automation, which can reduce deployment and management cost.
3. Deliver scale and agility, where network components implemented as software functions can be scaled to meet network capability and capacity demands.

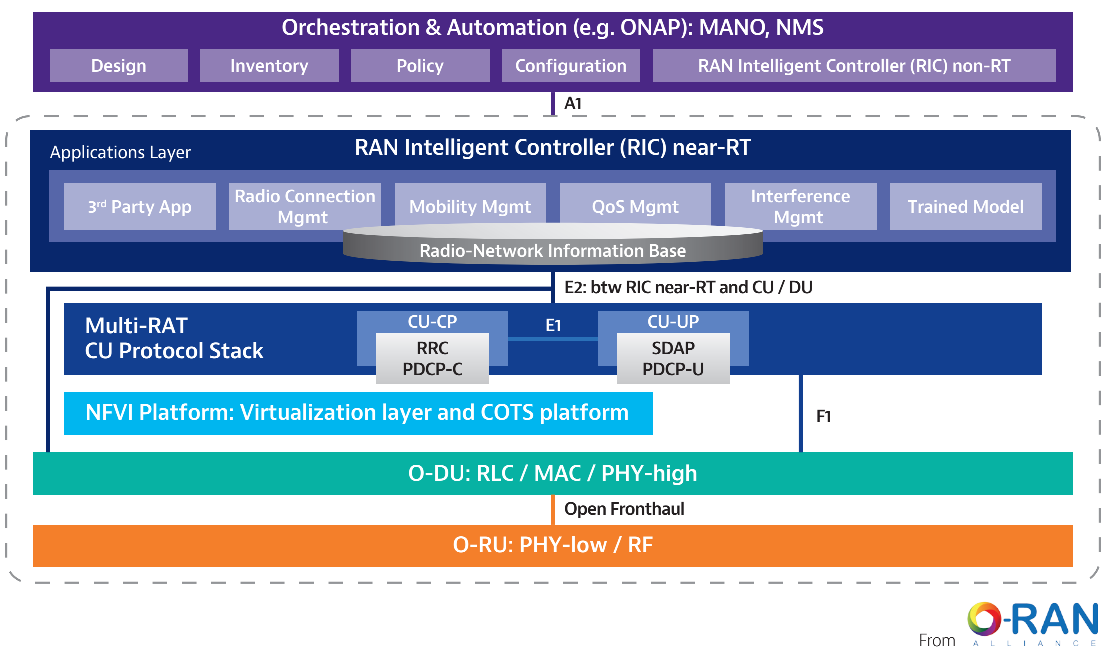

Figure 2. O-RAN Architecture

Challenges of Deploying and Managing O-RAN based networks

Interoperability and end-to-end performance will be by far the biggest concerns on the minds of vendors and operators in an O-RAN environment. Imagine all the advanced coordination features, power control algorithms and intra-technology interactions in a multi-vendor RAN. Today, having one vendor simplifies all that. And, when product related network performance issues arise, which is inevitable, service providers work with only one vendor to resolve them. Now imagine a network where RAN components such as central unit, distributed unit, and radio unit are supplied and supported by multiple vendors – operators and vendors will face greater challenges in both identifying and isolating issues as well as ensuring that performance/cost compares favorably to that of an optimized single vendor solution. Another key challenge of an O-RAN based multi-vendor network will be network management and resource management. Management of multi-vendor spares and training resources to maintain a multi-vendor network will be a learning curve for service providers' operations team. Not to forget, integrating new functions and orchestration of new services in an O-RAN based network will be another key challenge.

To overcome the above challenges, O-RAN Alliance has been working with its members and contributors, including VIAVI, to deliver a **Reference Architecture** designed to enable next generation RAN infrastructures. This reference architecture will be based on well-defined, standardized interfaces to enable an open, interoperable supply chain ecosystem in full support of and complimentary to standards promoted by 3GPP and other industry standards organizations. Further details of the structure and working groups are included in Appendix 1.

Key Test Areas for Vendors and Operators

Success of O-RAN will depend on the capability of operators to integrate and meet network KPIs in a true multi-vendor environment. To achieve this goal, operators need to have the confidence that all components in an O-RAN network have been tested in a trusted and controlled environment and all open interfaces and components are working correctly such that a multi-vendor O-RAN network cost to performance ratio is at least equivalent to that of a traditional a single-vendor network. Operators will only deploy a network with an O-RU from one vendor, fronthaul from another, and baseband from a third one only if the performance and cost meet their targets and network integration is robust.

VIAVI plays an active role in contributing to the development of O-RAN standards and how O-RAN compliant products can be tested to ensure interoperability, commercial robustness and high performance.

VIAVI was also part of the first global Plugfest, an event conducted to foster adoption of open and interoperable 5G and 4G Radio Access Networks. The O-RAN architecture references multiple standards bodies to deliver a robust open RAN ecosystem. VIAVI participates in those bodies and their workgroups including ITU-T, 3GPP, ONAP, IEEE (specifications for network transport, timing and sync workgroup) to name a few. VIAVI thus facilitates the delivery of test solutions so operators can be confident that their networks, once tested with VIAVI, are compliant with multiple required standards.

VIAVI has identified various use cases which can help identify, isolate and resolve network performance issues before an O-RAN multi-vendor network is launched.

The following are some key areas of our focus in lab validation, field deployment and network assurance.

- Multi-vendor interoperability test (MV-IOT) for functionality, performance, reliability, robustness, and resilience
- Subsystem (wrap-around) test
- System level test
- Vendors-pairing evaluation
- Protocol compliance for open interfaces and protocols
- Continuous Integration and Continuous Delivery test automation
- Continuous test process throughout the entire lifecycle
- Holistic evaluation of multiple RAN deployment options (RAN dis-aggregation, spectrum bands, delay management, features, vendors, etc.)
- Performance monitoring of open interfaces and protocols to ensure optimum operation

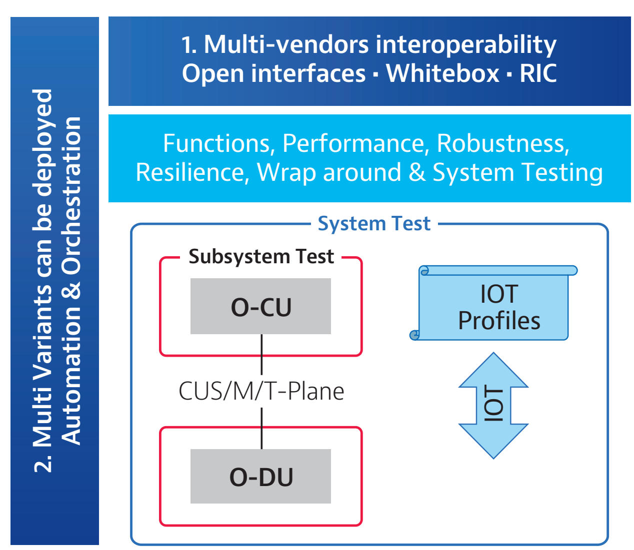

Figure 3. O-RAN Subsystem and System Testing using O-CU and O-DU

Figure 3 shows the scope of system and subsystem testing methodology using O-CU and O-DU. The remainder of this paper sets out several test challenges and associated use cases, resources and recommendations for how to overcome these challenges. The presented test cases are a subset of the potential use cases rather than an exhaustive list of every required test case and are intended to provide an insight into test requirements and act as a starting point for more detailed discussion. Emphasis is given to multi-vendor testing aspects.

There are many options for deploying multi-vendor networks and the choices made will drive test priorities. One potential scenario is that the operator sources the O-DU and O-CU from one vendor and uses them with O-RUs from different vendors. In this scenario, separating the testing of the single-vendor O-DU and O-CU will enable the single vendor part of the network to be tested and optimized separately from any variability introduced by different O-RUs. Once that is complete, end-to-end testing involving the complete O-RU, O-DU, O-CU chain should be performed as well.

In another scenario, the split is between the O-DU and the O-CU. In the same way, testing upwards from the F1 interface into the O-CU for the single-vendor part can be separated from the variability introduced by the different O-RU and O-DU suppliers.

Irrespective of decisions about the mix of different vendors and network architectures, certain critical performance aspects will remain. Included among these are:

- End-to-end network performance including during handover and with mobility and fading test scenarios
- Robustness of the X-haul transport and synchronization networks.
- Multi-vendor interoperability testing

To help operators manage testing, VIAVI has worked closely with the O-RAN Alliance in the development of interoperability and conformance test scenarios. Along those lines different operators are launching O-RAN Test and Integration Centers (OTIC) around the globe. The core charter for OTIC is to ensure O-RAN components from multiple vendors support standard and open interfaces and can interoperate in accordance with O-RAN test specifications. Some of the key goals are to:

1. Verify, integrate and test disaggregated RAN components.
2. Ensure O-RAN solutions functionally comply to the specifications of the O-RAN alliance.
3. Deliver the desired architecture that supports a plug-and-play model for O-RAN network components and solutions.

NITRO™ Platform for O-RAN

Delivering on Test, Measurement and Assurance for O-RAN through the lifecycle, VIAVI is leveraging the NITRO (Network Integrated Test, Real-time analytics and Optimization) Platform to enable an integrated and open T&M environment. Architected for Automated Workflows and lowering Total Cost of Ownership, NITRO enables full lifecycle analytics and reporting.

Use Cases for Enabling the O-RAN Ecosystem

As discussed earlier, in an open multi-vendor scenario, it is essential to ensure disaggregated RAN components (O-CU, O-DU, and O-RU) are not impacting network performance. As shown in figure 4, this can be achieved by validating them in the lab environment to make sure the nodes are designed and functioning per O-RAN specifications, and are interacting with each other without causing performance issues. Scaling the validation to a real network environment under heavy traffic with different traffic and application mix also needs to be performed to discover and address failures to meet KPI targets under real-world heavily loaded network conditions. Today, VIAVI TeraVM and TM500 are the de facto solutions used by almost all network vendors in the lab to make sure their products will meet the performance requirements of wireless service providers. Building on that experience, VIAVI solutions now support O-RAN specifications to ensure the same level of precision testing at the O-RAN interfaces can be performed in the lab. Once network components are deployed, our field solutions such as T-BERD®/MTS-5800 and CellAdvisor™ 5G 5G help service providers troubleshoot and isolate problems quickly and efficiently.

Now, let's discuss some of these lab and field challenges and how VIAVI can help both vendors and operators overcome them efficiently.

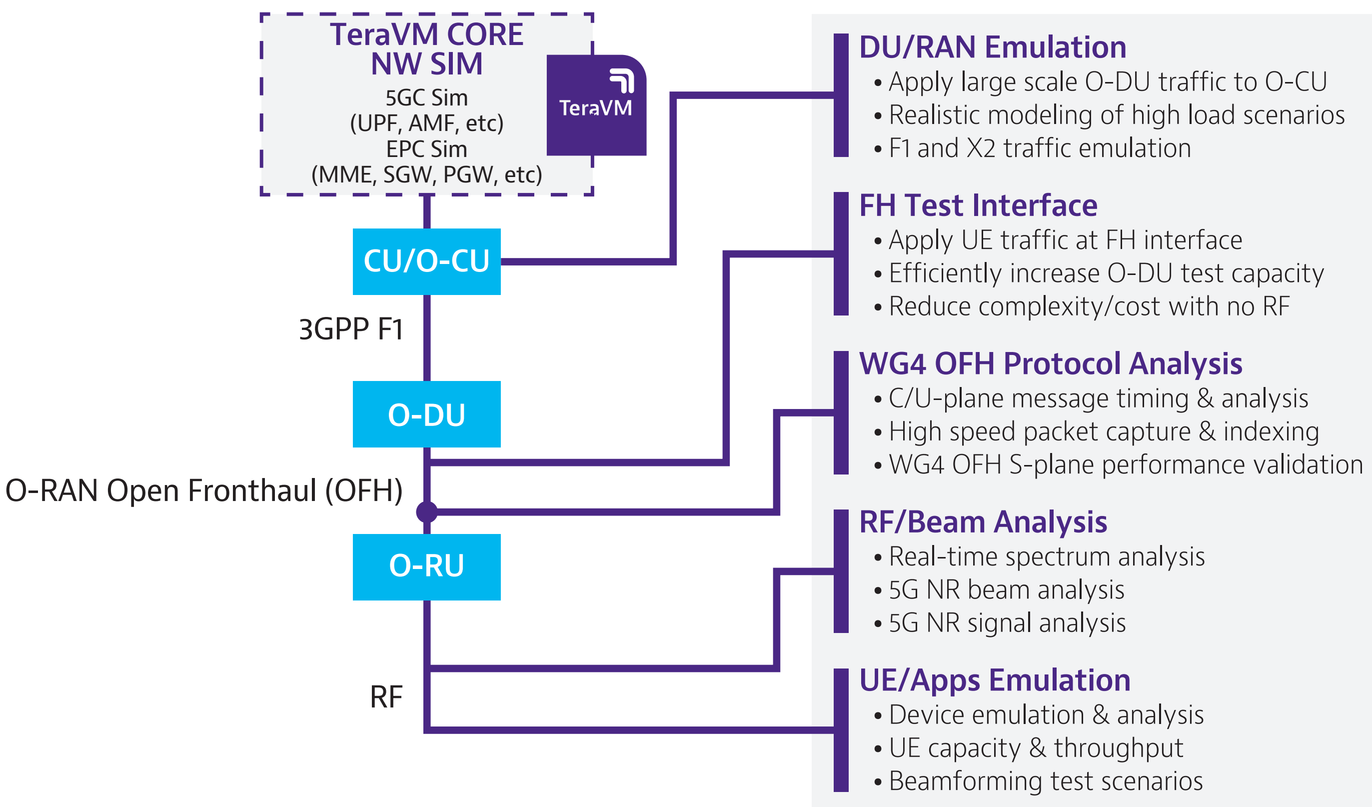

Figure 4. Example Test Points in an O-RAN environment

Use Case 1: Validating O-DU in a Multi-Vendor O-RU Environment

In a multi-vendor O-RAN environment, network vendors and service providers will face situations where they must support a varied set of O-RU configurations, potentially supporting O-RUs from multiple vendors simultaneously in the same network. Having different O-RU configurations can add complexity in terms of interoperability. This is compounded by the fact that compared to testing over RF of single vendor networks, the O-DU and standardized O-RAN Fronthaul interface are new elements, which introduces a new risk. O-DU focused testing is used to minimize this risk to the 3GPP features and interactions the network must support, which requires all disaggregated nodes to perform well. O-DU vendors therefore need to ensure that O-DUs can handle multi-vendor O-RUs without introducing performance compromises and avoid the addition of new risks from a 3GPP feature interaction point of view.

Extensive experience and VIAVI leadership in validation of 3GPP features and interactions over RF is leveraged (as shown in figure 5) in the VIAVI TM500 O-RU Emulator solution to validate the capability of an O-DU to handle multi-vendor O-RUs without unexpected performance compromises.

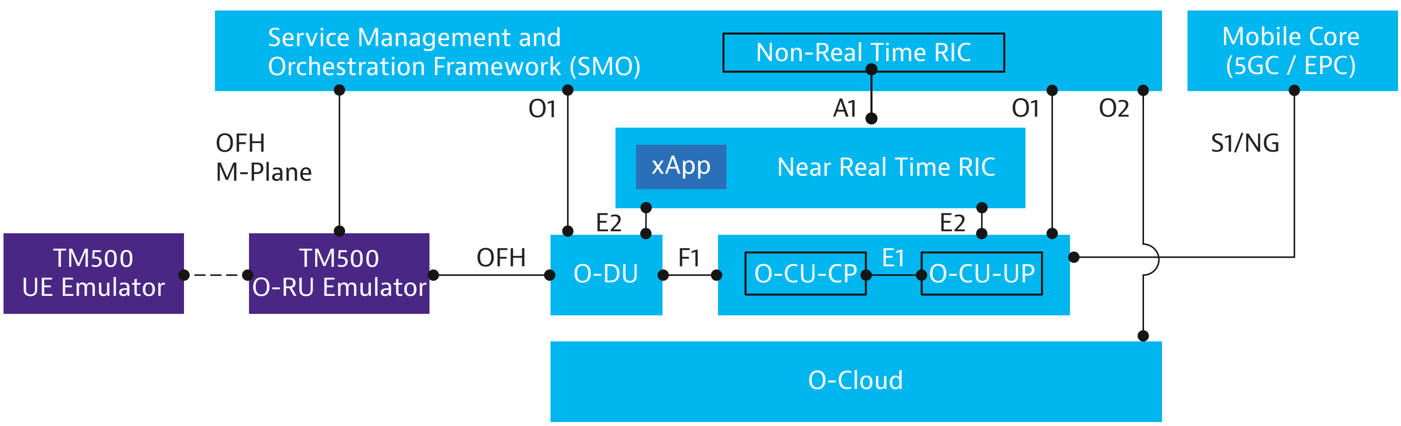

Figure 5. Validating O-DU in a Multi-Vendor O-RU Environment

Use Case 2: Validating F1 Interface Performance Using an O-DU Emulator

3GPP F1 interface connects multiple O-DU nodes back to the central unit (O-CU) for both the control plane (CU-CP) and user plane (CU-UP) . Ensuring the performance of the F1 interface and ability of the O-CU to handle many O-DU's while supporting different traffic profiles with large numbers of UEs is important to quantify overall network performance. With the VIAVI DU/RAN Emulation solution, network vendors and service providers can emulate many O-DU nodes with a realistic traffic mix generated by a large number of emulated UEs. The X2 interface used between eNBs in LTE is reused between the Master eNB and en-gNB for non-standalone (NSA) operation and is supported with VIAVI virtual RAN emulation functionality. The DU/RAN Emulation solution enables validation of the performance of the O-CU F1 interface , and how individual UEs are successfully managed in a multi-vendor environment. This solution efficiently adds hundreds of O-DUs worth of traffic applied to the O-CU under test without the cost or complexity associated with many real O-DUs (and even more O-RUs). UE stack integration allows realistic modeling of very high load traffic scenarios with dynamic F1 traffic emulation.

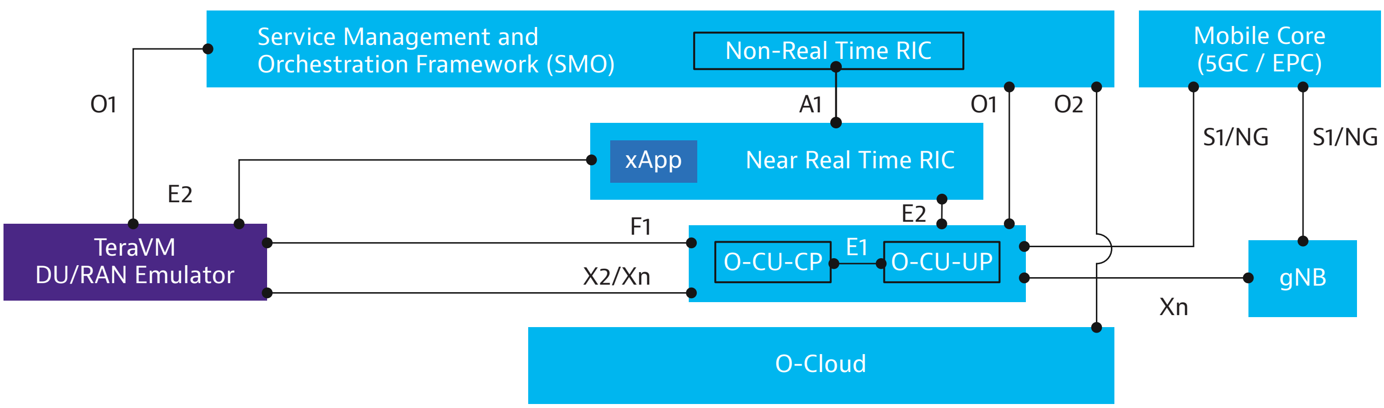

Figure 6. Validating F1 Interface Performance Using an O-DU Emulator

Use Case 3: End-to-End Network Performance, Mobility, and Capacity Test

With the TM500 Network Tester emulating multiple UEs, tests over RF can be done to assess the end-to-end performance of a real O-RU upwards to a real O-DU, O-CU and the core network. With the TM500 supporting Real Data Applications e.g. HTTP, FTP, streaming/UDP traffic, performance validation can be done to ensure that KPIs such as throughput, latency, and round trip times (RTT) meet customer requirements even though the O-DU and the O-CU may come from different vendors.

The introduction of 5G adds new fading profiles and handover scenarios which must be tested for low, medium, and high UE capacity test scenarios. In NSA mode for instance, multiple types of handovers can occur between 4G and 5G carrier depending upon the deployment scenario and UE distance from the base-stations. For example, a handover can occur from 5G to 4G, 4G to 4G or 5G to 5G. Additional fading and channel profiles introduced by new deployment scenarios and frequencies above 6 GHz defined in 3GPP TR 38.901 contribute to complexity in terms of the different test scenarios that must be validated.

The TM500 emulator, with the support of real data applications, can execute high capacity end-to-end performance tests in simulated real-world environments facilitating, validation of the different mobility, traffic and handover scenarios for 4G and 5G. Such end-to-end validations continue to be vitally important when testing disaggregated RAN networks leveraging O-RAN based components.

Use Case 4: Transport and Synchronization Verification of the Open Fronthaul

In O-RAN, open fronthaul is defined as the link between the O-DU and O-RU. Mobile broadband services that are expected to take advantage of advanced mobility applications will require coordination of multiple radios driving a lower layer functional split of the baseband function. The lower layer functional split was primarily implemented in 4G using CPRI as the interface between 4G BBU and RRH. While simple in design, it requires significant transport bandwidth proportional to the bandwidth of the baseband signal and the number of antennas. This disadvantage poses a significant challenge to the introduction of 5G services that rely on much larger bandwidths and antenna ports. The challenge has been addressed with the introduction of a new lower layer functional split. Known as eCPRI, this packet-based transport technology significantly reduces the fronthaul bandwidth, but it also presents some new challenges. It exposes some of the disadvantages of packet-based technology such a its inherent packet delay variation. Furthermore, eCPRI is not a synchronous technology and relies on synchronization technologies such as Precision Time Protocol (PTP) and optionally synchronous Ethernet (SyncE).

Open fronthaul facilitates the use of standardized multi-vendor interfaces which paves the path to successful interoperability between O-DU and O-RU, but performance validation of the open fronthaul and interoperability of the O-DU and O-RU over the open fronthaul will be necessary to ensure field deployments do not result in catastrophic failures.

The field-tested VIAVI T-BERD/MTS-5800 solution can be used to validate the performance of the open fronthaul in the lab and in the field. Network vendors can quickly validate the health of the transport and synchronization performance. T-BERD/MTS-5800 allows lab engineers and field technicians to perform this validation in the live mode giving them visibility into the protocol messages between the O-DU and O-RU. The following verification can be performed in the live mode:

Transport Health Verification

- Power Level
- Frequency Offset
- Packet count
- Bandwidth Utilization

Synchronization Verification

- PTP Connection
- Message count

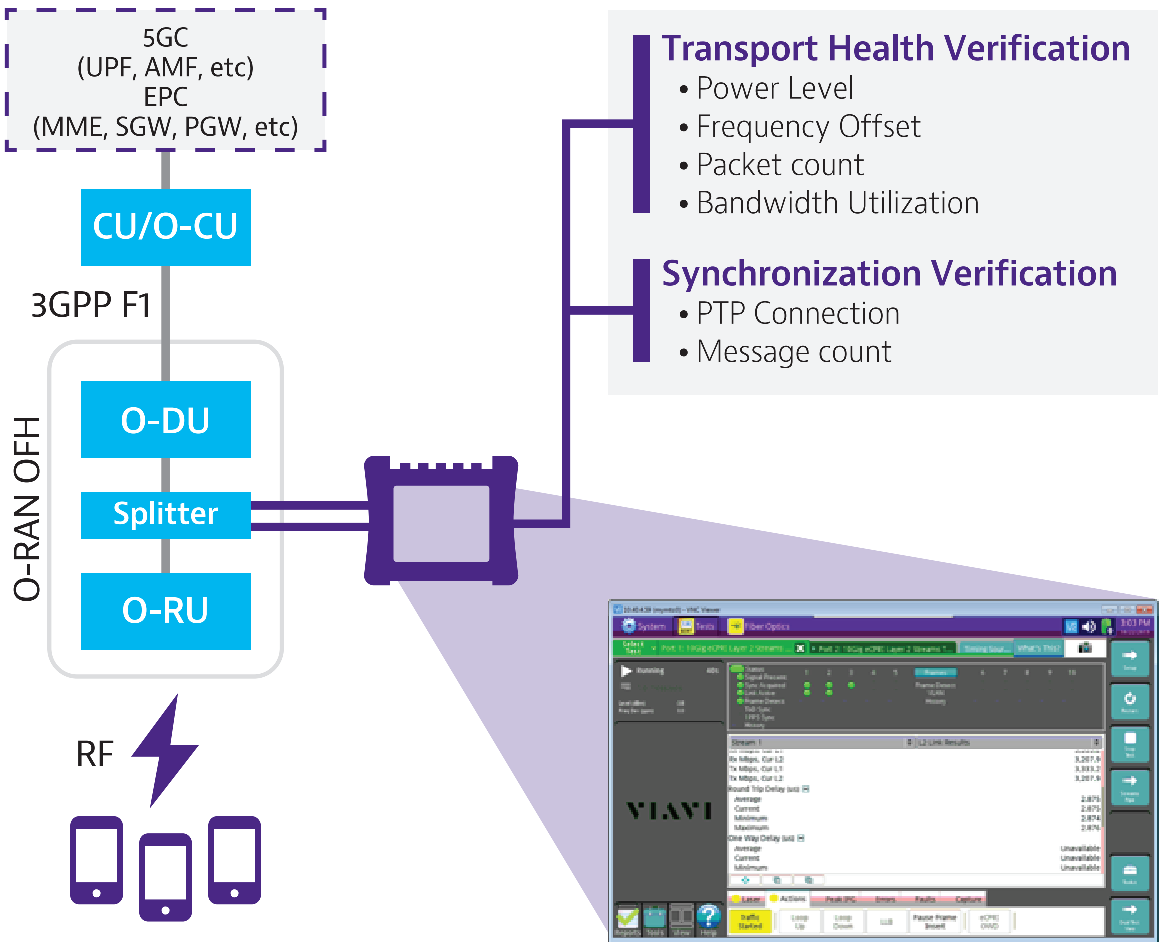

Figure 7. Fronthaul Analyzer – Transport and Synchronization Network Test

Use Case 5: Verification of 4G and 5G FH Transport and Synchronization Networks

Fronthaul transport nodes (FTN) aggregate and transport traffic between CPRI/eCPRI-based RRH/O-RU and BBU/O-DU's. While they simplify the fronthaul topology, they can introduce transport and synchronization issues. Validating FTN-based networks is essential to minimizing any issues caused by excessive packet loss, delays, jitter and poor QoS. In a multivendor O-DU/O-RU deployment, these FTN challenges can create more complexity in the validation, verification and troubleshooting of the open fronthaul, and other O-RAN components. Verifying FTN readiness for O-RAN is necessary for a smooth O-RAN deployment.

The VIAVI T-BERD/MTS-5800-100G performs eCPRI tests throughput, delay, and packet jitter. Engineers can configure eCPRI message types according to eCPRI specification, measure bandwidth for each message type, and measure Round Trip Delay (RTD) with sub 5ns accuracy. CPRI BERT verifies 4G BBU to RRU transport quality. By performing FTN tests, engineers can validate the transport requirements of the FTN and can ensure they are within the designed network specifications.

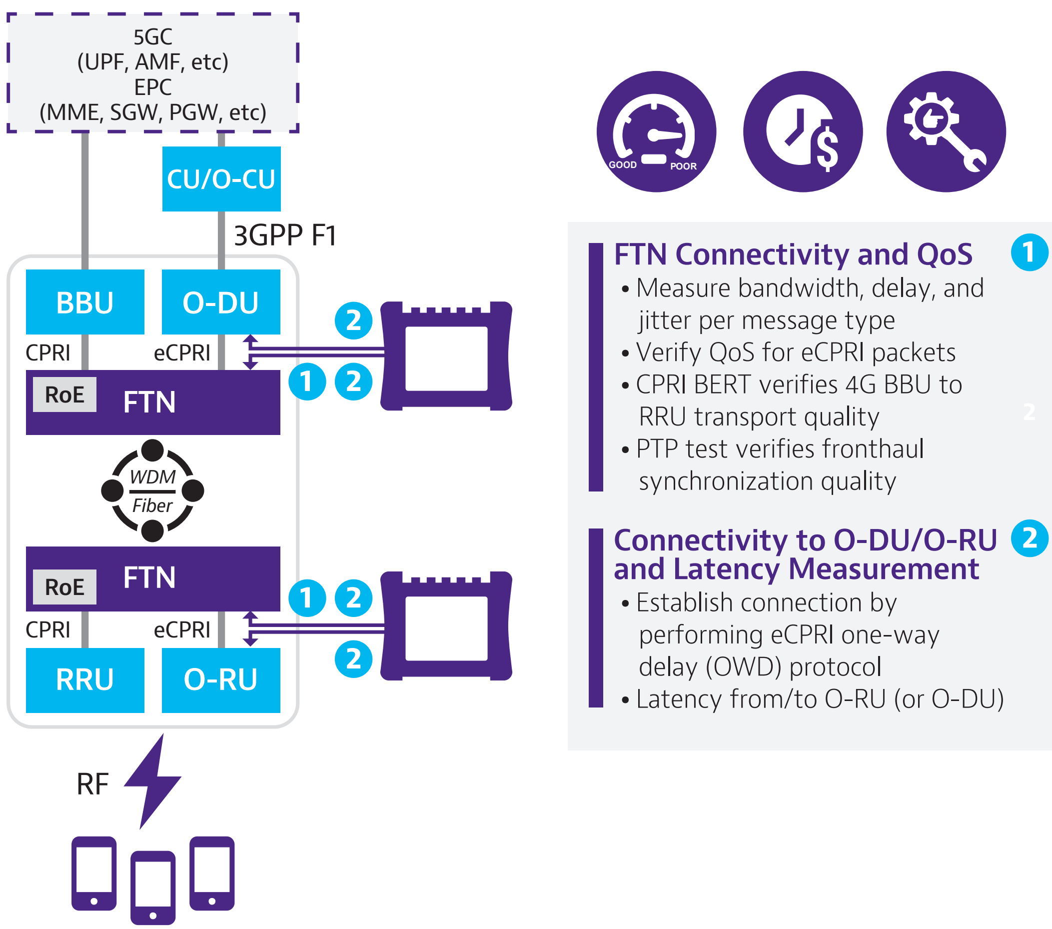

Figure 8. Fronthaul Analyzer – 4G /5G FTN test

O-RAN open fronthaul networks can be synchronized in several modes as depicted in figure 9 and as described in the O-RAN WG4 CUS specification. Where LLS-C1 through LLS-C3 modes rely on PTP/SyncE for O-RU synchronization, LLS-C4 works based on a local GNSS-based timing source. The LLS-C1 mode obtains its source from the O-DU, whereas LLS-C2 and LLS-C3 deploy one or several fronthaul transport nodes between the O-DU and O-RU. In LLS-C2, the Telecom Grandmaster (T-GM) resides in the O-DU; in LLS-C3, that function is assigned to the fronthaul network, and both O-DU and O-RU play the role of a telecom time slave clock (T-TSC).

The PTP networks can support an ITU-T G.8275.1 (Full Timing Support) profile, or ITU-T G.8275.2 (Partial/Assisted Partial Timing Support) profile. The former profile is expected to be the main one to be deployed in future fronthaul networks. It is characterized by one or several Telecom Boundary Clock (T-BC) functions resident in the fronthaul transport nodes. They ensure the proper function and performance of the synchronization plane in line with network limits provided in standards such as ITU-T G.8271.1. Timing error constitutes one of the most important parameters for the proper operation of the radio network. The T-BERD/MTS-5800 100G delivers the complete set of testing parameters, thresholds/masks and profiles for verification of synchronization standards. The measurements can be performed at the output of any T-BC as provided in the example of LLS-C3 mode below.

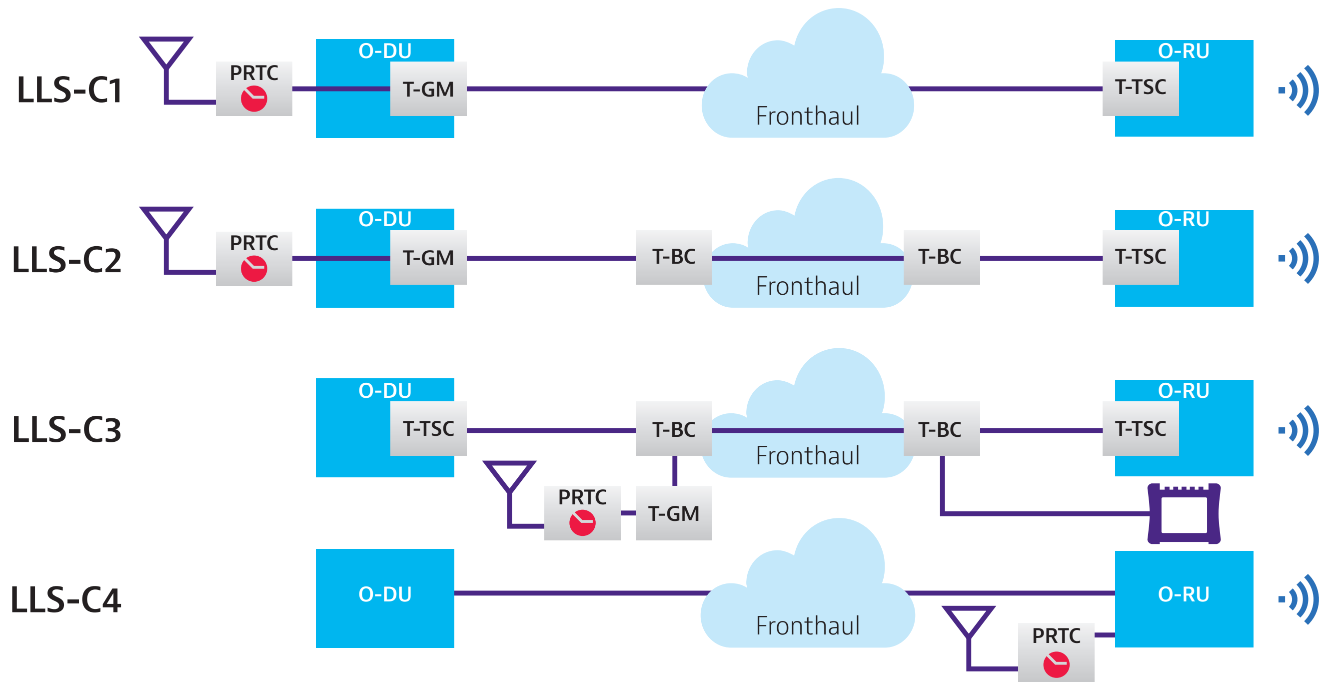

Figure 9. O-RAN WG4 S-Plane Topologies

Use Case 6: Control/User Plane Connectivity and Packet Capture

eCPRI based O-RAN technology relies on transmission of control plane (CP) and user plane (UP) packets between the O-DU and the O-RU. In an O-RAN environment with O-DU and O-RU from potentially different vendors, any anomaly in transmission of control and user plane packets can lead to problems in O-RU or O-DU. T-BERD/MTS-5800 with O-RAN support not only can check the health of the open fronthaul, but it also can capture O-RAN CP and UP packets and filter those packets to validate if the packet transmission is compliant with the O-RAN fronthaul protocol specification. Operators can view the captured and filtered packets in wireshark expediting the analysis and allowing faster troubleshooting and a successful on-time network launch.

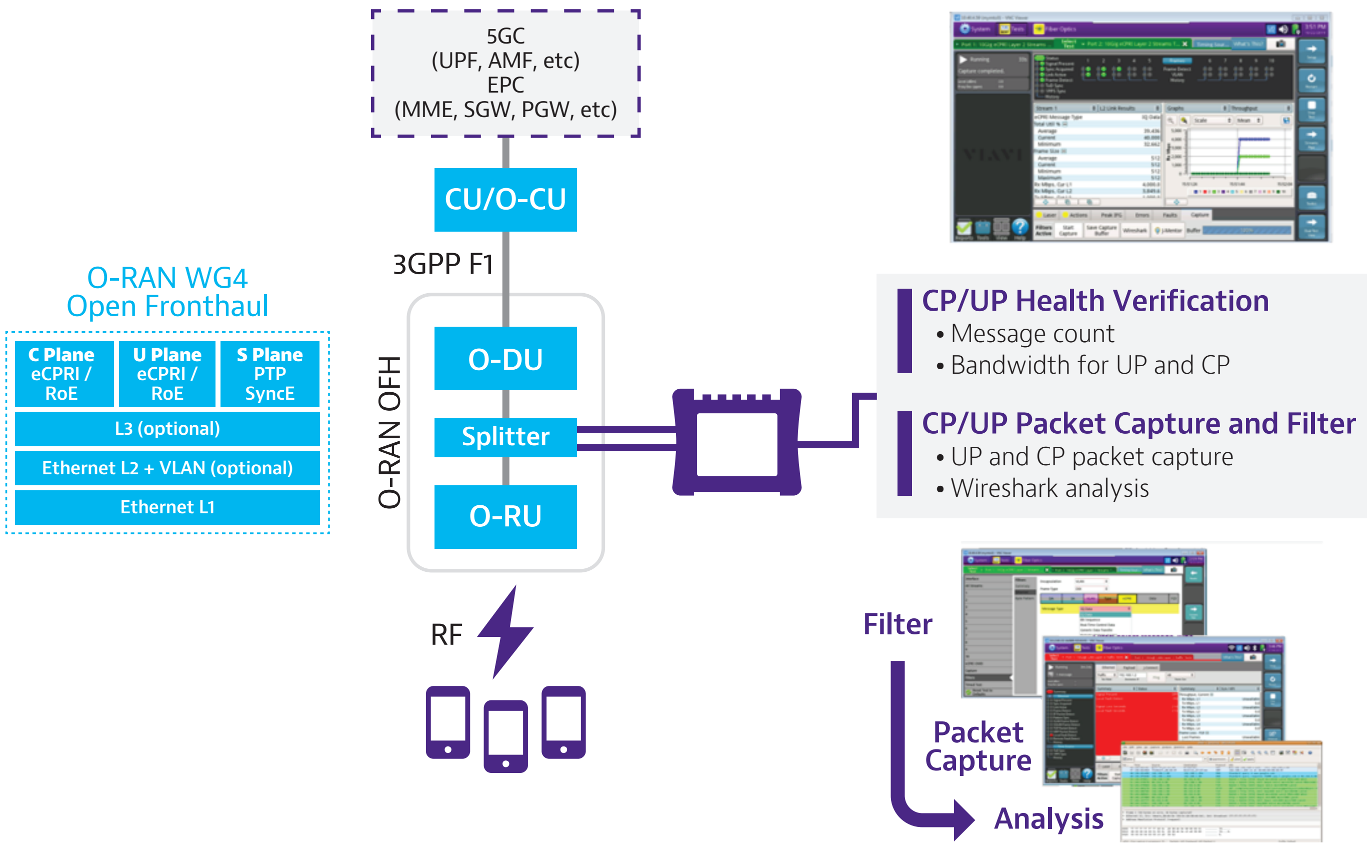

Figure 10. CP/UP Analysis using an T-BERD/MTS-5800

Use Case 7: RIC and xApp Mixed Vendor Ecosystem Assurance

The O-RAN Alliance is currently defining the RAN Intelligent Controller (RIC) which has two principle logical components. The non-real-time RIC (non-RT RIC) forms part of the vendor's service management and orchestration (SMO) framework and may implicitly use the SMO's O1/O2 interface (O2 connects to the RAN virtualization platform) for collecting data from the RAN and for making configuration changes. Additionally, the non-RT RIC may use the A1 interface, defined by O-RAN, for disseminating policy information to the near-RT RIC. The near-RT RIC is located with the O-CU network element of the vendor's gNB. It connects to the RAN via the O-RAN defined E2 interface which gives the near-RT RIC access to information exposed by the RAN and permits modification of RAN operation to execute policies passed down by the non-RT RIC.

The RIC and RAN together operate as a set of nested control loops. The O-DU operates in "real-time" with a sub 10 ms response time; the near-RT RIC operates in the 10 ms to 1 s range; and the non-RT RIC operates with response times of 1 second and greater. The response time associated with each element is indicative of where the decision functionality of use cases with that response time would be expected to be located.

The inputs and outputs of the near-RT RIC are defined by open interfaces. The O1/O2 interface is under review by standard bodies, and the A1 and E2 interfaces are standardized by O-RAN. The functionality of the near-RT RIC will be performed by a mix of xApps. These xApps will likely be from a variety of suppliers including the RIC vendor, in-house developments from the operator, and third parties. The xApps are expected to ingest RAN data from various sources including over E2, performance management (PM) data over O1, enriched data that may mash-up internal data and external data over O1, as well as data from other xApps. The xApps will process this data and ultimately implement A1 policies over the E2 interface.

The O-RAN ecosystem needs assurance across all stages of the product life cycle from sandbox development through to assurance of network operation. It is essential to ensure that once xApps from disparate sources are available, they operate in a coherent and compatible manner—either when operating in an independent manner or chained together—and produce the required objectives. This includes validation that the heterogeneous xApps in combination are able to implement the policies of the operator across a mix of subscribers consuming the range of services envisaged for the network across multiple network slices and in an appropriate set of mobility profiles. It must also be validated at scale, making it a use case well suited to VIAVI End-To-End Wireless Network Test.

Use Case 8: Operational Assurance, Troubleshooting and Optimization

As described above, there are profound benefits of disaggregation of the network into multiple discrete components with a decoupled control system in the form of the RIC. And with more components comes more complexity and an increased number of ways for the network to experience impairments. Impairments in a more complex network can be harder to detect, diagnose and resolve than they would be in a simpler network with fewer components.

Considering the many and varied potential ways that the operational network can experience degraded performance, the network may suffer from impairment or failure in the transport network (fronthaul, mid-haul, backhaul). This may range from congestion leading to latencies or packet loss out of acceptable ranges, to complete loss of a fiber link through breakage or physical disconnection. The disaggregated functions may become impaired, for example, through overload or software quality issues. The core network functions may suffer impairment for similar reasons. The SMO system may experience impairment or the physical infrastructure on which the logical functions are hosted may degrade. The 5G New Radio (5GNR) is a shared resource in a harsh environment and can sometimes be poorly tuned to the demands placed on it by the subscribers. Concentrations of increasing demand for 5G services can lead to congestion on the radio resources. Poor coverage or interference can impact on the accessibility of the network services. These phenomena will vary as the spatial dynamics of demand for services around the network changes. And as the demand for different mixes of services with novel mobility profiles pushing the resource management capability to the limit, new edge failure cases beyond what was tested at the pre-deployment stage can be exposed and manifest as degraded performance.

Each of these phenomena will manifest in the complex system in different ways, not necessarily associated with the network component directly suffering the impairment. For example, a loss of a radio unit through hardware failure will mean that nearby O-RUs, O-DUs, and O-CUs will pick up more traffic along with subjecting the X-haul links to more load and potentially congestion. This challenges the network monitoring and assurance system to provide a more complete view of the network, with richer analytics to detect problems, isolate the cause and provide the most appropriate mitigation.

The VIAVI NITRO™ platform provides the visibility of the network across the breadth of the radio, RAN, transport and core. This unprecedented visibility brings with it the ability to detect instances of issues such as congestion of spectrum or transport assets, or impairment of physical or logical infrastructure. The intimate view on the network means that the location of the problem can be quickly isolated and the root cause identified. Thus, with the richest information on the network performance, the autonomic network control systems will be most effective and where intervention by the operational network management engineers is required, resolutions can be implemented within the shortest timeframes.

Conclusion:

O-RAN brings many benefits for operators such as an open ecosystem that removes vendor lock, lays down the foundation for virtualized network elements, and introduces white-box hardware that can be quickly scaled up through software-based nodes. At the same time, it also creates significant challenges in terms of test and integration. Having the right test and network management strategy and the right partner during the development, deployment and operation of an O-RAN network can help operators overcome those challenges.

VIAVI has the expertise, legacy and vision to help operators validate open RAN components, both hardware and software in the lab. And with our NITRO™ Mobile integrated field and assurance solution, operators can be certain network performance issues will be isolated and rectified quickly to meet their KPI goals.

VIAVI End-to-End Solution Portfolio for O-RAN

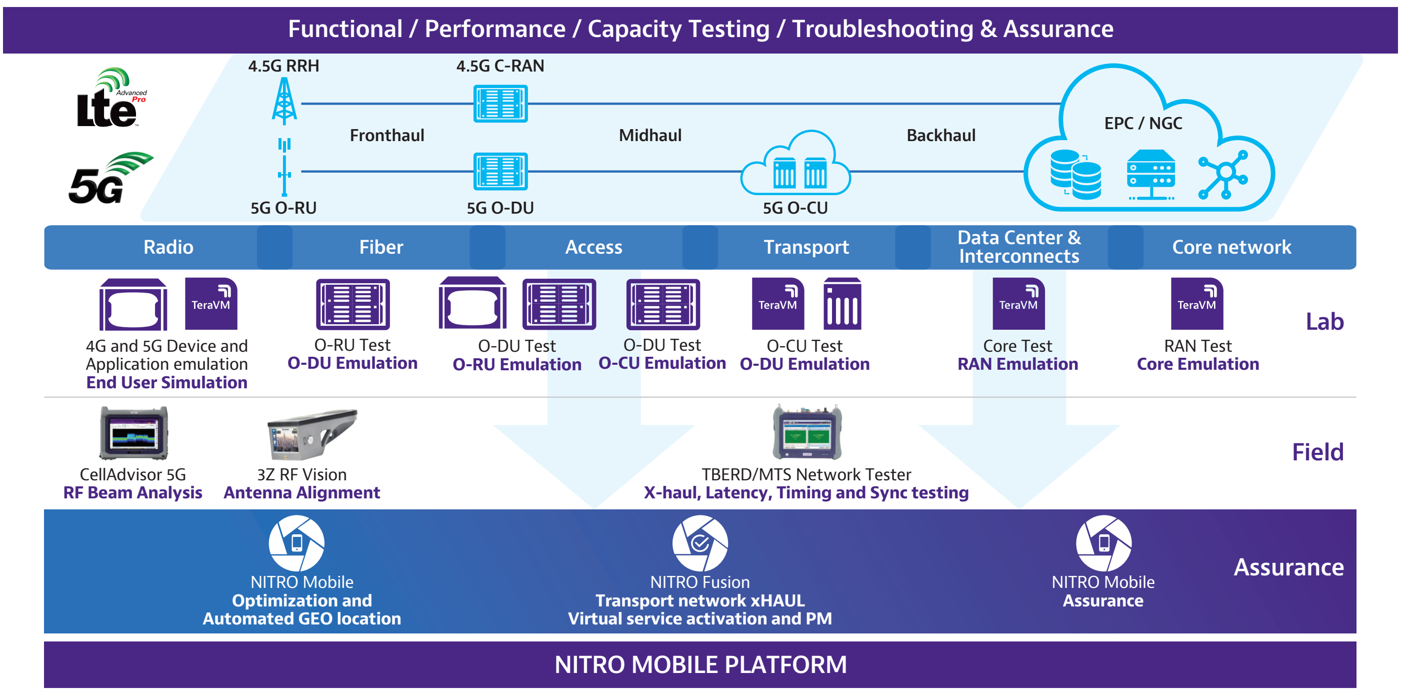

Figure 11. VIAVI Test Suite for O-RAN Specifications

Appendix 1:

The O-RAN Alliance management structure consists of a board made of operators and a Technical Steering Committee (TSC). Nine technical workgroups have been set up under the supervision of the TSC with specific focus areas as shown in Figure 12.

O-RAN Working Groups
WG1 – Use Cases and Overall Architecture
WG2 – The Non-real-time RAN Intelligent Controller and A1 Interface
WG3 – The Near-real-time RIC and E2 Interface Workgroup
WG4 – The Open Fronthaul Interfaces
WG5 – The Open F1/W1/E1/X2/Xn Interface
WG6 – The Cloudification and Orchestration
WG7 – The White-box Hardware
WG8 – Stack Reference Design
WG9 – Open X-haul Transport

Figure 12. O-RAN working groups

References

[1] O-RAN: Towards an Open and Smart RAN; October 2018

VIAVI Solutions

Contact Us **+1 844 GO VIAVI**
(+1 844 468 4284)

To reach the VIAVI office nearest you,
visit viavisolutions.com/contact

oran-testsuite-wp-wir-nse-ae
30191049 900 0320