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6 Steps for Streamlining 5G O-RAN Radio Testing

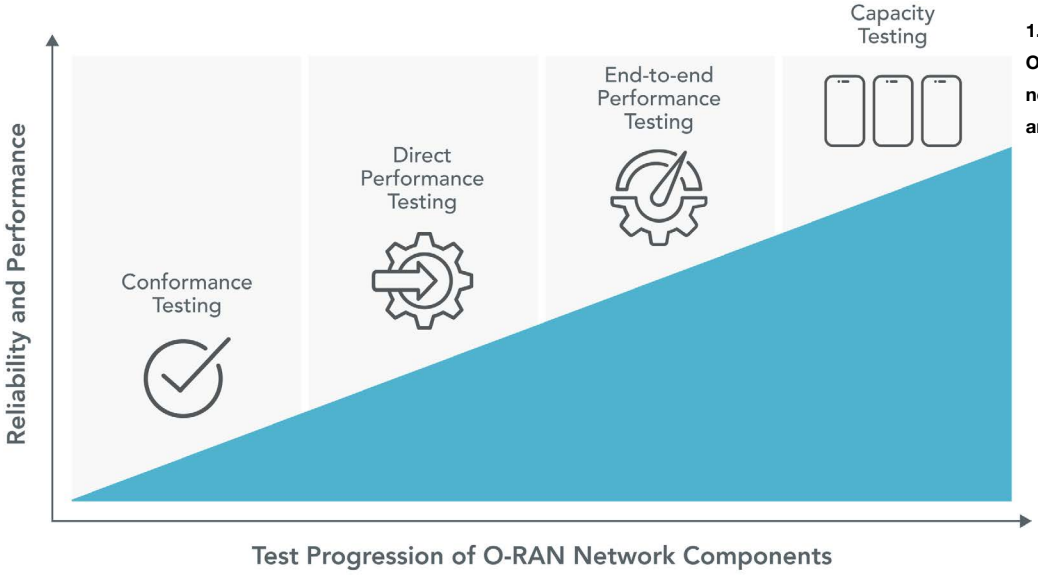
The O-RAN open-source model helps network designers avoid supplier lock-in, accelerating 5G deployment, reducing operational costs, and simplifying maintenance. But overcoming hurdles depends on comprehensive wireless network testing, and particularly the 5G O-RAN radio unit.

The telecommunications industry is pushing hard toward full-scale 5G deployment, with coverage projected to reach 85% of the world's population by the end of the decade. Open radio-access networks (O-RANs) are expected to account for a growing percentage of all 5G rollouts, with analyst firm Research Nester projecting a 53.6% O-RAN CAGR from 2025-2037, building off a 2024 revenue base of roughly $2.5 billion.

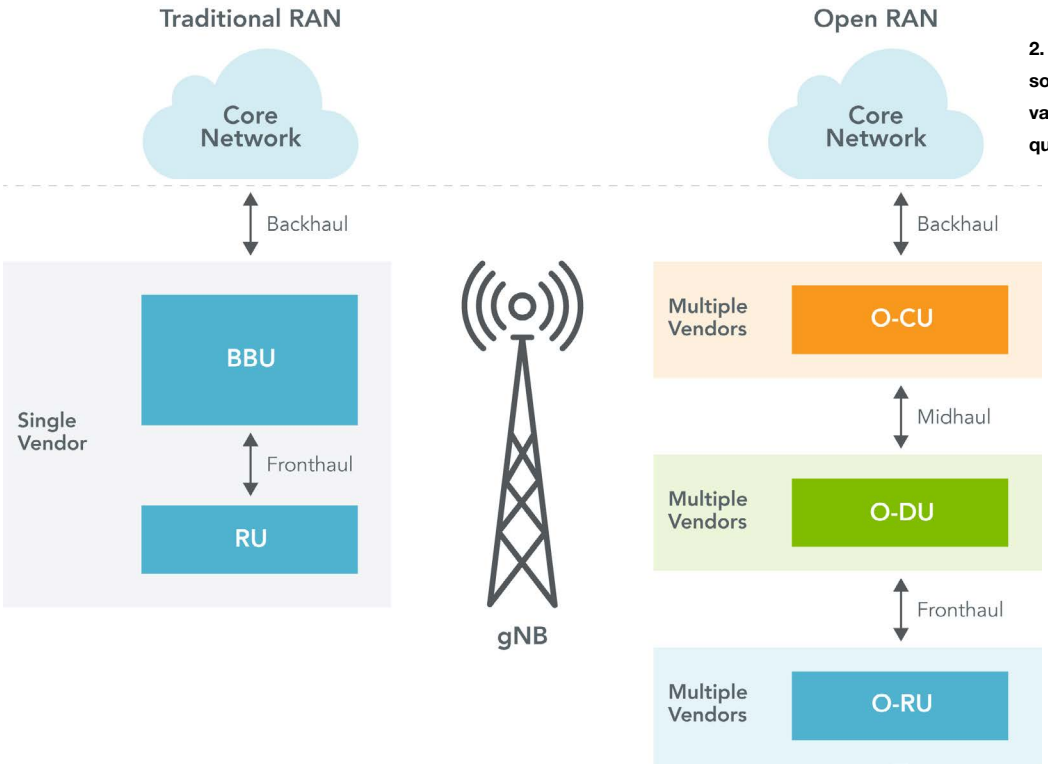
The promise of O-RAN lies in its ability to integrate disparate 5G network technologies by mixing and matching components from multiple vendors. Single-vendor 5G solutions limit a network's flexibility and robustness. Any non-compliance with O-RAN standards can lead to integration issues that require extensive troubleshooting. Deviation from these standards creates substantial network validation challenges that can delay deployment and increase development costs.

The O-RAN open-source model, on the other hand, helps network designers avoid supplier lock-in, which accelerates 5G deployment, reduces operational costs, and simplifies maintenance. But O-RAN isn't without challenges, particularly in the areas of network integration, security, performance, and scalability.

Overcoming these hurdles leans heavily on comprehensive wireless network testing, and particularly the 5G O-RAN radio unit (RU). The RU is responsible for transmitting and receiving 5G radio signals, and efficient and accurate RU testing is essential to ensure the radio meets the performance, compliance, and interoperability requirements of O-RAN standards.



1. The test path for O-RAN network components ensures reliability and performance.



2. Advanced O-RAN test solutions help operators validate networks more quickly and accurately.

Identifying O-RAN RU Test Pain Points

One of the biggest challenges encountered by operators in an open network environment is the complexity of integrating various vendor equipment into one secure, cohesive architecture. Traditional RU testing setups are often complex, expensive, and difficult to manage, requiring multiple testing devices and extensive manual configuration *(Fig. 1)*.

For example, operators might pass an O-RAN fronthaul conformance test using equipment from one vendor, only to encounter radio failures when attempting to integrate another solution for the same test.

One path for simplifying test and managing costs is a single-box solution designed for RF parametric and fronthaul conformance testing. It would integrate multiple vector signal analyzers (VSAs) and vector signal generators (VSGs) and eliminate dependency on external distributed-unit (DU) emulators. With that in mind, 5G O-RAN architects should pay heed to the following.

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1. **Downlink RF testing:** Downlink testing checks the RF parametric performance of the transmitter. The test protocol should support various 3GPP TS 38.141 test models to measure parameters including base-station output power, frequency error, modulation quality, and adjacent channel leakage ratio (ACLR).
2. **Uplink RF characterization:** Uplink testing tends to be more complex because of the need to simulate various interference scenarios. Make sure the tester generates both desired and interfering signals, which provides a comprehensive assessment of RU receiver performance under real-world conditions. This is crucial for validating the RU's sensitivity, dynamic range, and in-band blocking performance.
3. **MIMO testing for reduced cycle time:** MIMO testing is essential to ensure RUs can handle the simultaneous transmission and reception of multiple data streams. This requires MIMO testing to integrate all necessary signal generation and analysis capabilities into a single unit. And, multiple antennas can be tested simultaneously, significantly cutting testing time.
4. **MIMO testing to validate performance:** MIMO testing helps identify potential performance issues that might not be apparent in single-antenna testing. For instance, such testing has shown that while antenna-by-antenna measurements might indicate good performance, MIMO testing can reveal degradation in error-vector magnitude (EVM) under certain conditions, providing a more accurate assessment of real-world performance.
5. **Fronthaul conformance test:** Fronthaul conformance testing verifies that RUs within the O-RAN architecture comply with standards, ensuring proper network operation and seamless interoperability. This includes executing essential test cases for Management,

Synchronization, Control, and User planes.

6. **Automation:** Automation is a key aspect of modern testing solutions, enabling faster and more consistent test execution. Automated test tools provide a user-friendly interface for setting up test parameters and running test sequences, reducing time-to-market and ensuring consistent test results across different phases of development and production.

Expanding Test Support and Collaboration Yields Better Results

Thorough 5G O-RAN testing identifies and helps resolve issues early in the deployment process. Today's advanced test solutions are designed to help operators validate their networks more quickly and accurately *(Fig. 2)*. Critically, testing solutions minimize integration issues and reduce the need for design revisions, helping to keep deployment timelines on track.

Scalability in testing solutions further ensures processes can adapt to the size and complexity of each deployment, providing efficient and effective testing regardless of the network's scale.

As the industry evolves, customer support has become more critical. It's no longer as simple as providing testing solutions. To become a trusted partner in the 5G O-RAN deployment journey, test vendors are adopting a more consultative approach. They work closely with customers to understand their unique challenges and offer tailored advice to help them navigate the complexities of 5G and O-RAN. With a comprehensive understanding of a customer's specific challenges, testing organizations can provide more targeted and effective solutions.

Middle Wen graduated from National Chiao Tung University in Taiwan with a master's degree in Communications Engineering. Since joining LitePoint in 2015, he's been responsible for managing 5G/cellular signaling and non-signaling RF test solution products. With over 17 years of experience in the wireless communications field, Wen has in-depth knowledge and insights into the development and application of wireless communication technologies.