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Simplifying Deployment of 5G Open RAN Radio Units in Greenfield Sites

Learn about the opportunities and challenges related to O-RAN greenfield build-outs and testing requirements as 5G deployments expand across private and public networks.

A "greenfield deployment" is among the most important build-out scenarios in 5G Open RAN (O-RAN) mobile network architecture. Unburdened by installed and legacy hardware, greenfield deployments are completely new network installations that free designers and operators to achieve a more optimized integration of O-RAN open interfaces, intelligence, and virtualized network elements.

Such deployments come in two flavors: private and public networks. A private 5G network is tailored to meet the specific needs of an individual organization or a closed group of users, e.g., a university or a commercial enterprise. Public networks, on the other hand, are designed for access by the public. In both cases, several notable issues impede the successful deployment of O-RAN systems in greenfield sites.

To simplify O-RAN greenfield deployment, testing—both isolated and at the system level—is a prerequisite.

The Elements of 5G O-RAN Deployments

In general, an O-RAN system combines radio units (RUs), distributed units (DUs), and centralized units (CUs).

The RU, located at the cell site, is primarily responsible for handling RF signals. It converts frequency-domain digital signals from the DU into time-domain analog RF signals for transmission and reception. This process includes tasks such as modulation, demodulation, and amplification, which enable direct communication with end-user devices.

The DU, typically situated close to the cell site, acts as a mediator between the RU and the CU. It performs the baseband processing tasks, which include error correction, encoding, decoding, and the management of radio resources. The DU handles these computationally intensive tasks to ensure efficient data flow and optimize the use of radio spectrum.

The CU, usually deployed at a centralized location, oversees the control plane of the network. It handles functions related to session management, mobility management, and the orchestration of network resources. By managing these high-level operations, the CU ensures seamless connectivity and network consistency across multiple DUs and RUs.

Together, these components create a dynamic and scalable 5G network architecture. The separation of RU and DU processing, and CU network control, promotes greater flexibility in network deployment and management. This modular approach enables operators to optimize network performance, reduce latency, and efficiently scale resources to meet varying demands. The result is a more responsive and adaptive network infrastructure in O-RAN deployments.

Disaggregation's Pros and Cons in 5G O-RAN Deployments

In a technology such as O-RAN with its numerous disparate components, openness is a double-edged sword. While it allows for more competition and choice, it also leads to significant concerns over compatibility, management, and security.

The number of new players entering the O-RAN market further complicates this situation. Because there are far more radios than CU or DU subsystems in an O-RAN network, the market is attracting a growing number of fledgling radio architects who may or may not have experience developing O-RAN solutions.

This highly fragmented atmosphere creates major concerns over the compatibility and interoperability of O-RAN components, given that each device in an O-RAN deployment may be made by a different company. While the O-RAN Alliance provides specifications and interfaces to en-

LitePoint's IQFR1-RU is a pioneering simplified test solution for 5G FR1 O-RAN radio units.

sure greater levels of compatibility, vendors tend to interpret and implement specifications slightly differently, leading to small inconsistencies between disparate vendor solutions.

Issues of vendor management have also become a primary concern in greenfield deployments. When many different vendors are contributing to one system, each possibly implementing interfaces differently, troubleshooting becomes a problem. If a system fails, how do operators know which component is to blame? How will this be resolved?

Finally, a serious manifestation of this problem arises in the context of security. In such a scenario, each vendor focuses only on their portion of the system and hence operates in isolation from the other groups. However, because security is a full-system task, it raises the question of how best to ensure system-level security in the disaggregated O-RAN climate. If security issues arise, which entity is responsible for responding?

Testing 5G O-RAN Greenfield Deployments

Ensuring the successful deployment of O-RAN in greenfield sites requires early, thorough, and meticulous testing of deployments. Within this framework, testing happens on two levels: isolated testing and system-level testing.

Isolated testing assesses components individually to give designers and system integrators confidence that each system element meets specifications. Unfortunately, isolated testing is typically difficult, especially for new entrants in the marketplace.

For RUs, isolated testing systems generally require specialized equipment, such as a DU emulator, a vector signal generator (VSG), and a vector signal analyzer (VSA). Cohesively implementing these different systems in a testing setup creates overhead that makes isolated testing complex. It also leads to extremely long testing times, where RU testing can take anywhere from 30 minutes to one hour.

System-level testing, as the name implies, applies to the end-to-end testing of the entire O-RAN system. Because individual vendors don't have the knowledge to perform system-level testing, the system integrator or operator generally takes charge. Most system-level testing focuses on the RF performance of the base station (transmitter and receiver), including testing for signal quality, signal strength, and signal coverage.

Successful system-level testing has its own challenges. At the top of the list is that it requires proper vendor management to root out the causes of potential failures. It necessitates robust communication among vendors to identify and resolve issues encountered during testing. In such a disjointed marketplace, this is especially challenging.

Simplified Testing of 5G O-RAN Brings Benefits

The deployment of O-RAN in greenfield sites starts with simplifying the underlying testing procedures. Individual vendors must reduce overhead and turnaround time for their isolated testing, while the broader ecosystem must rally around more efficient system-level test options.

LitePoint tackles these challenges with products such as the IQFR1-RU tester, an industry-first, fully integrated 5G O-RAN Radio Unit (O-RU) tester that provides a simplified solution for isolated O-RU white box testing. One of the product's most important features is that it eliminates the dependency on external DU emulators and provides fully integrated MIMO signal generation and analysis *(see figure)*.

Delivering a fully integrated solution, the IQFR1-RU significantly simplifies testing procedures and reduces testing time. That means new market entrants can test with more confidence and get their solutions to market faster.

Simplifying Greenfield Deployments

Greenfield deployments are an important use case for O-RAN, despite their related challenges. Concerns over vendor interoperability, network management, and security all pose hurdles, particularly for emerging vendors.

Ultimately, the success of 5G O-RAN deployments hinges on streamlined testing and the creation of collaborative vendor ecosystems. If the industry can harmonize testing processes and foster an open dialog among vendors, individual companies can more easily handle O-RAN deployments, paving the way toward a more interconnected and flexible mobile network landscape.

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