SOLUTION BRIEF

Communications Service Providers
Virtual Radio Access Networks

Amdocs SmartRAN Analytics Offers Critical 5G vRAN Optimization

Amdocs SmartRAN near-real-time optimization solution delivers better quality of service on virtual radio access networks (vRAN); company is first to demonstrate massive multi-antenna use case from O-RAN Alliance

Virtual radio access networks (vRAN) for 5G networks provide mobile network operators (MNOs) with a cost-effective solution for network build-out with performance scalability to support both small cell and macro cell deployments. vRAN disaggregates the functionality of the RAN and connects these software elements using open interfaces. This is a new environment for RAN optimization software, which can now tap directly into these separate functions, providing access to more data, which leads to more fine-tuned adjustments to the vRAN configurations and ultimately better network quality of service. Intel® Network Builders ecosystem partner Amdocs is a leader in RAN optimization software and is working with Intel to develop its next-generation SmartRAN vRAN analytics solution.

5G Networks Need Optimization

Consumer demand is high for streaming video, cloud computing, and new virtual reality/augmented reality services, which are driving up the load on wireless data networks and are among the driving factors in moving to 5G mobile networks. At the same time, in many developed markets, the years of fast subscriber growth have receded due to market saturation, making customer retention increasingly important and making it even more essential to ensure cost-effective capital and operating expenses for all network investments.

These market dynamics are influencing MNO network evolution and service assurance strategies. To help to reduce network costs, MNOs are embracing network functions virtualization (NFV) and software defined networking (SDN), replacing fixed-function, proprietary systems with open network software running on Intel® architecture-based servers.

For MNOs, where this strategy has the most significant impact is in the radio access network (RAN) – which accounts for up to 70% of total network costs[1] according to the O-RAN Alliance, an open standards body.

5G virtual RAN (vRAN) can be served from cloud data centers, but often is located in edge cloud servers in base stations or other point-of-presence (PoP) locations. This puts a premium on automated and remote monitoring, management, and optimization of vRAN service as it is cost-prohibitive to send technicians to remote sites.

Network optimization solutions that can test virtual RAN systems to ensure a great customer experience are an important focus of this network evolution. vRANs are disaggregated and use open interfaces, giving network analytics software access to more vRAN elements generating much more data that can be analyzed for ways to reconfigure the RAN and remote radio heads (RRH) to maintain optimal performance. This allows MNOs to move their emphasis away from traditional network key performance indicators (KPIs) to new beam-based metrics that better emulate actual customer usage and experience.

The expanded data that comes from these solutions requires the use of machine learning (ML) tools to provide real-time data processing in order to make inferences and send new RAN configuration changes or policies back to the network.

Open vRANs Provide New Optimization Opportunities

The monolithic and proprietary nature of traditional RAN software has meant that network optimization software has only been able to collect non-real-time cell-based data from the network. As seen in Figure 1, the traditional RAN connects to other parts of the network using interfaces that are defined by the 3rd Generation Partnership Project (3GPP), but the interfaces between internal functional blocks are proprietary and not available to optimization software. Data collection is limited to non-real-time measurement from the 3GPP protocol stack, which presents difficulties to the MNO on any real-time issues that are occurring in layer 1 or layer 2. Network optimization software cannot collect data in real-time network operations and can only offer optimization on cell-based KPIs.

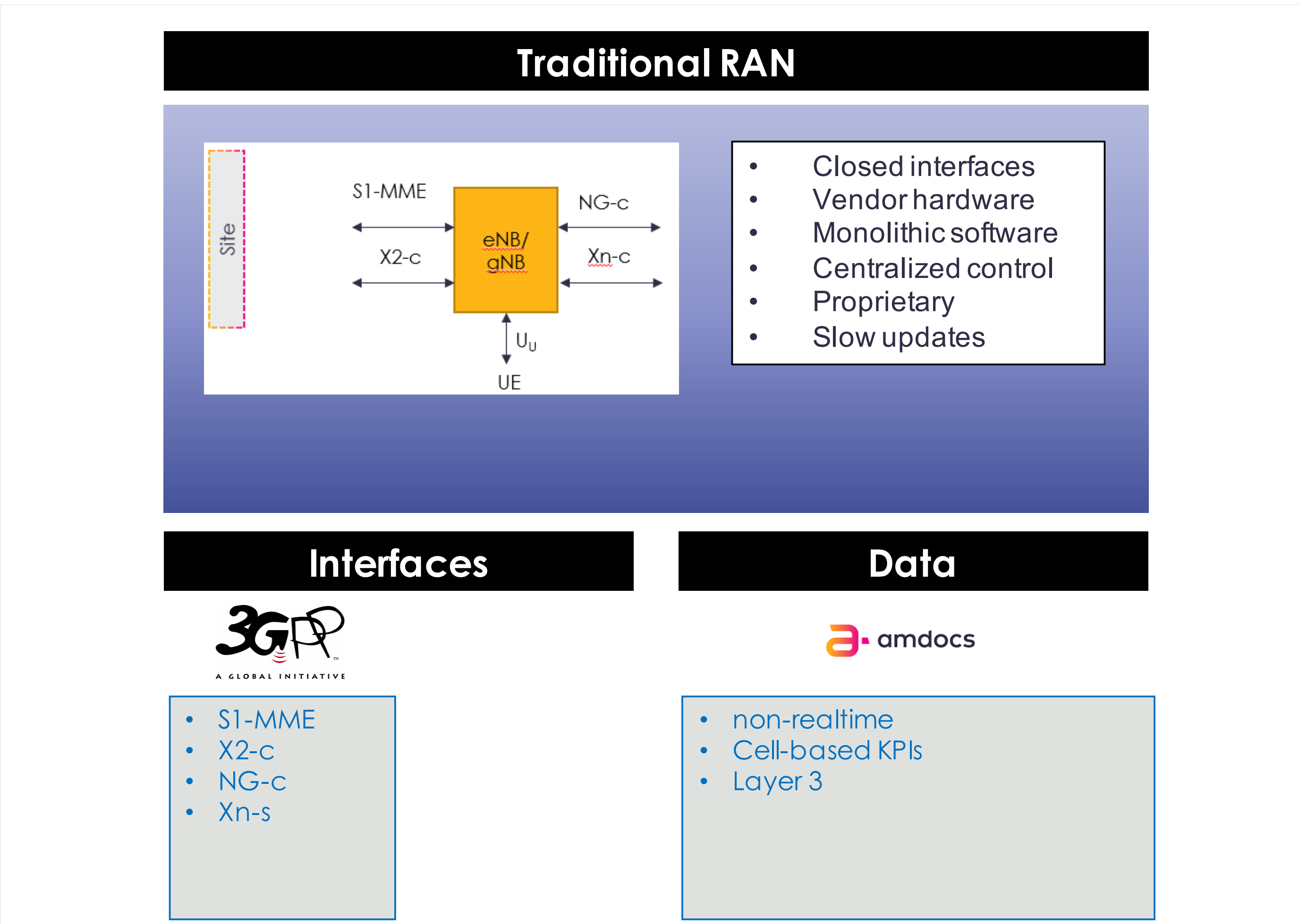

Figure 1. Challenges with network optimization of traditional RAN systems.

vRANs that are compliant with the O-RAN Alliance and that use 3GPP interfaces offer unique advantages for radio frequency (RF) monitoring and management. Both of these organizations have defined open interfaces to access the RAN elements to collect both the traditional cell-based and layer 3 data, and also layer 2 and layer 1 data, which provide both non-real-time and near-real-time operations (see Figure 2).

vRANs split the functionality of the baseband unit (BBU) into a centralized unit (CU) and a distributed unit (DU). The provides the freedom to deploy the real-time processing of the DU close to the remote radio head (RRH), while keeping the CU in a data center or central office. 3GPP and O-RAN has defined a number of CU/DU splits that provide increased deployment flexibility.

RAN optimization software now has direct access to all of the disaggregated component processes, including the non-real-time RAN intelligent controller (RIC) and the near-real-time RIC, both defined by the O-RAN Alliance, as well as the CU and DU processes that make up the baseband unit (BBU). Communications between these processes are done using open interfaces. In addition to the interfaces from the 3GPP, vRANs have access to O-RAN Alliance interfaces that include open fronthaul (O-FH), E2 (interface connecting near-real-time RIC and CU/DU), and A1 (interface between non-real-time RIC and near-real-time RIC). This openness allows the analytics solution to get near-real-time access to data in order to provide much more comprehensive and accurate beam-based analytics across the first three layers of the 3GPP protocol stack.

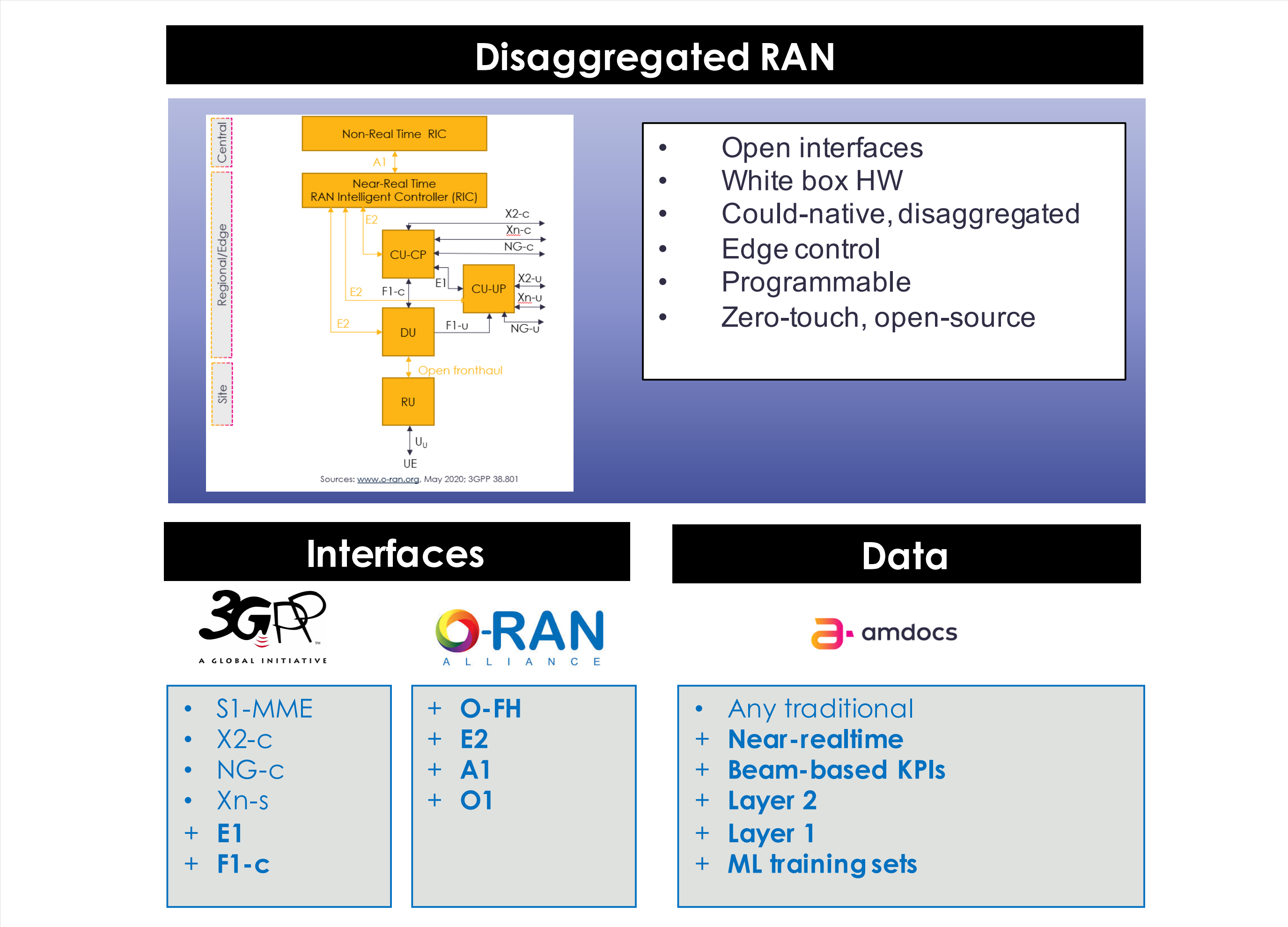

Figure 2. vRANs are more open, offering better access to data for network optimization.

SmartRAN Network Optimization for vRANs

Amdocs is creating its new SmartRAN analytics solution by utilizing its legacy ActixOne RAN analytics and developing new software capabilities to provide insights into the disaggregated vRAN elements. The company is partnering with Intel to integrate FlexRAN software reference architecture and Intel® machine learning libraries and optimizing the system to run on servers based on Intel® Xeon® Scalable processors.

The foundation of the new solution will leverage the vast amount of radio measurements collected by the non-real-time loop monitoring functionality of the ActixOne, including L3 measurements of customer calls and data sessions. This technology will gather cell-oriented service quality data as well as data from the cell's self-organizing network (SON) software.

As seen in Figure 3, the new SmartRAN analytics technology will soon monitor both the non-real-time control loop and a near-real-time control loop. The SmartRAN solution will be disaggregated to match the new vRAN environment and to allow deployments of near-real-time elements at the network edge or closer, or even running as a VNF on the same server as the vRAN itself. This disaggregation can be seen in Figure 3, where the SmartRAN will have separate processes to track the individual components of the remote radio head (RRH) and the virtual baseband unit (vBBU).

Figure 3 also shows how machine learning is a critical part of the solution, processing data from each vRAN layer to analyze the massive amounts of data now being collected in near-real-time. The SmartRAN solution takes analytics inputs and then uses that to train the ML engine and then to make inferences from the data that are used to tweak the RRH and vRAN configuration constantly for optimized service. Performance for this ML capability is provided by Intel Xeon Scalable processors that have improved instruction sets (Intel® Deep Learning Boost and vector neural network instructions (VNNI) on the 2nd generation Intel Xeon Scalable processors and 3rd generation Intel Xeon Scalable processors) for ML as well as Intel® ML libraries such as Intel® Math Kernel Library for Deep Neural Networks (Intel® MKL-DNN), Intel® Distribution of OpenVINO™ toolkit, and Intel® System Studio with C++ compiler that are enhanced for this application.

SmartRAN will be able to use this information to troubleshoot each problem experienced by an individual subscriber and aggregate the results to provide KPIs at the beam cluster, market, or country level.

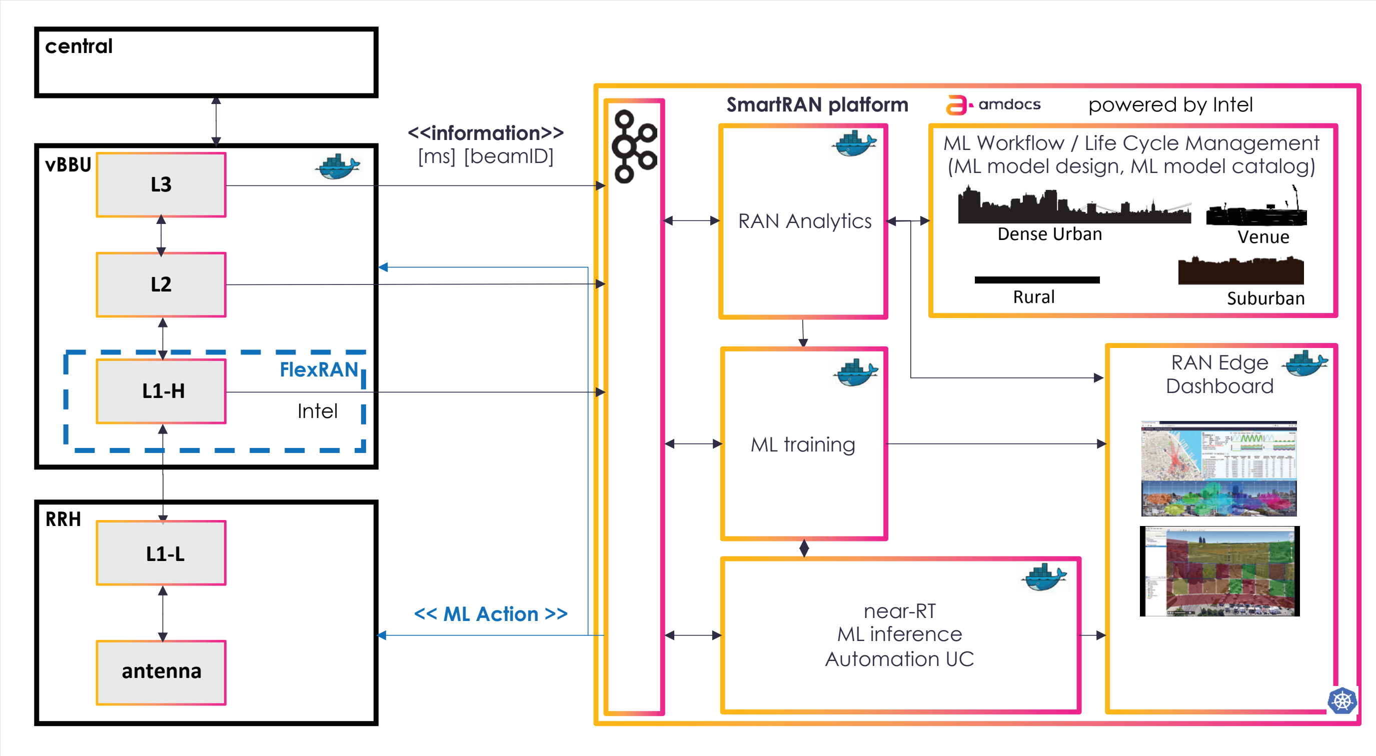

Figure 3. Amdocs SmartRAN solution architecture.

Amdocs Deployment of FlexRAN

The Amdocs SmartRAN system integrates FlexRAN to provide real-time L1 beam-based analytics. FlexRAN is a reference implementation for cloud-enabled wireless access VNFs. It is a flexible software architecture that efficiently implements wireless access workloads. FlexRAN uses Intel Xeon Scalable processors with the Intel® Advanced Vector Extensions 512 (Intel® AVX-512) instruction set, and optimized NFVI with DPDK deployed in a cloud native environment. As shown in the block diagram in Figure 4, the FlexRAN PHY application, which takes radio signals from the RF front-end and provides real-time signal and physical layer processing, is a critical ingredient for the SmartRAN solution.

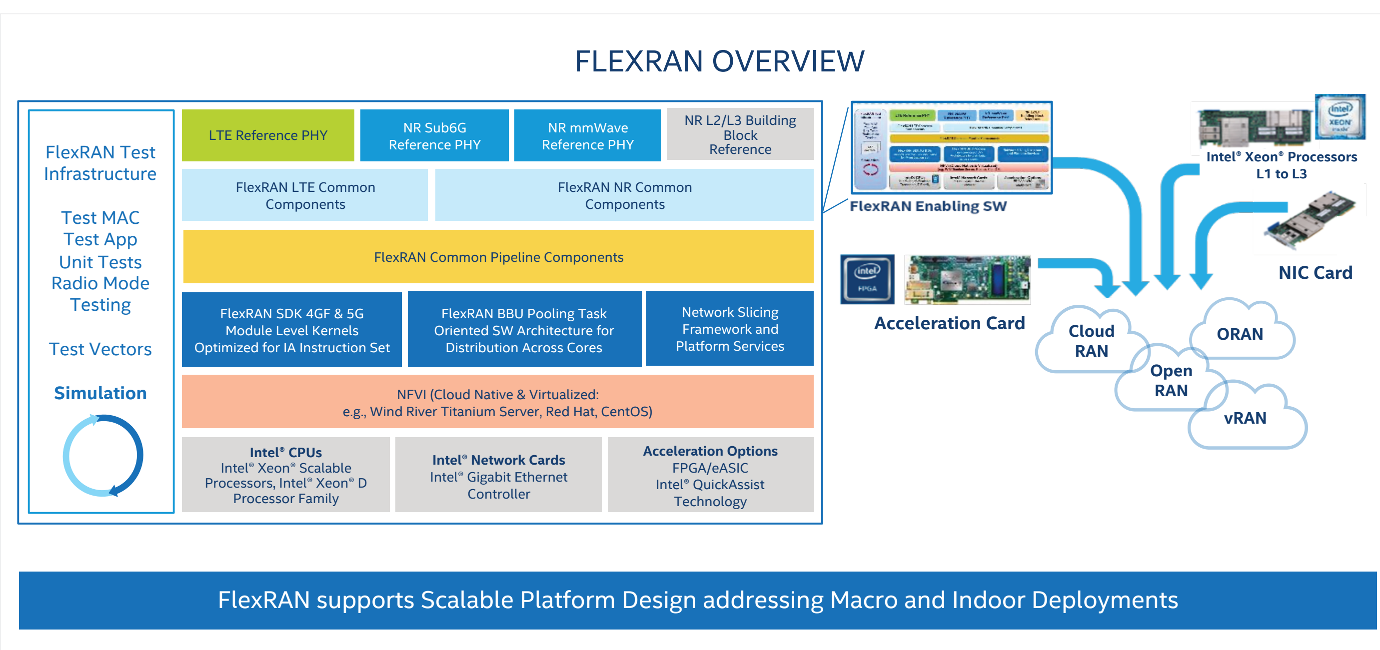

Figure 4. FlexRAN Architecture.

Massive MIMO Use Case

Amdocs is developing its SmartRAN solution to support the testing use cases that are established by the O-RAN Alliance. Amdocs will develop testing templates that match these use cases to simplify the testing of the network. Amdocs is first targeting the massive multiple-input, multiple-output (MIMO) use case that the O-RAN Alliance is developing to utilize the multi-antenna technology. With SmartRAN's ability to access beam data, Amdocs can create an analytics use case for proactively and continuously improving cell and/or user-centric coverage and capacity in a massive MIMO deployment by feeding back configuration changes for beam sets or individual beams into the RRH and vBBU (see Figure 3).

This use case lends itself to the Amdocs architecture because it features a high number of configuration parameters per array antenna, resulting in a massive amount of available measurement input data, the complexity, proactiveness as well as near-real-time requirement. Massive MIMO systems typically feature 64 different beams that are preconfigured as beams or beam sets for maximum coverage. Based on the analytics data, the Amdocs solution can switch or reconfigure the beamsets to have more or fewer beams per cell or sector, or simply optimize beam configuration for NR SSB control and coverage or NR traffic and capacity beams. It can also help define the number of traffic beams per sector.

This massive data set is processed using SmartRAN ML functionality. Early architectures and deployments, such as illustrated in Figure 3, will help Intel and Amdocs both to drive the O-RAN Alliance standardization and use case definition further, and to have O-RAN Alliance–compatible analytics and optimization solutions ready once O-RAN Alliance–compatible 5G deployments are available.

By following this use case, Amdocs can customize the SmartRAN to enable the MNO to develop the policies, configurations, or machine learning techniques to flexibly configure massive MIMO system parameters in a way that serves their service level objectives.

Conclusion

The disaggregation of the vRAN provides a wealth of data for network optimization that will help MNOs maintain service levels for 5G networks. SmartRAN, the vRAN optimization solution from Amdocs, leverages the company's RAN analytics expertise with new functionality for collecting this data from the vRAN and using ML techniques for data analysis and rapid configuration changes. By teaming with Intel, Amdocs SmartRAN will integrate industry leading FlexRAN platform and ML functionality all running on servers with the processing performance needed for high-speed 5G networks.

Learn More

Amdocs SmartRAN: www.actix.com/SmartRAN/Intel

2nd generation Intel® Xeon® Scalable processors and 3rd generation Intel® Xeon® Scalable processors: http://intel.com/xeonscalable

FlexRAN: https://software.intel.com/content/www/us/en/develop/videos/an-overview-of-flexran-sw-wireless-access-solutions.html

Amdocs is a member of the Intel® Network Builders ecosystem: http://networkbuilders.intel.com

Amdocs and Intel are members of the O-RAN Alliance and the Telecom Infra Project OpenRAN group

Notices & Disclaimers

[1] O-RAN Alliance, "O-RAN: Towards an Open and Smart RAN." October 2018. https://static1.squarespace.com/static/5ad774cce74940d7115044b0/t/5bc79b371905f4197055e8c6/1539808057078/O-RAN+WP+FInal+181017.pdf

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