



SAMSUNG



Samsung's Fully Virtualized RAN

Ensures Flexibility, Scalability and Reliability for Telco-grade Performance

Cloud-Native and Fully Virtualized Radio Access Network

The continued demand for wireless capacity shows no sign of ending, and 5G networks are up to the challenge to handle this demand with reliability and safety, while offering flexible and scalable services. IT technologies such as virtualization and containerization have already been implemented in telecom networks. Initially introduced into the core network, they are now being inserted into the Radio Access Network (RAN) domain and called Virtualized RAN (vRAN).

Samsung's commercially available vRAN is a cloud-native, container-based solution that brings recognized value to mobile network operators today, helping usher in the 5G age with a flexible and scalable solution. Samsung's vRAN is an integral part of supporting 5G commercial services in leading markets. In addition, the virtualized solution offers a new option for mobile operators seeking maximized operational efficiency, network flexibility, and management benefits from deploying a software-based 5G network infrastructure.



1. Cloud-Native Virtualization Maximizes Operational Efficiency



2. Architectural Flexibility Enhances Network Responsiveness and Agility



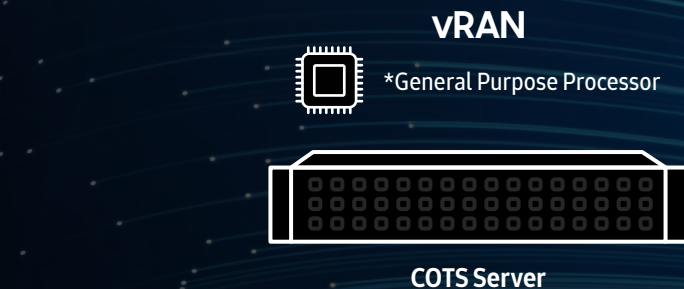
3. Software-Based Flexibility Simplifies Network Scalability and Monetization

Samsung's vRAN Solution

- Software enhancements can be done continuously
- Hardware server enhancements can be done independently
- Additional servers from cloud deployments can be added at any time
- On-demand performance and capacity
- Easy to find the right server and applications for specific use cases
- Flexibility in space, power, capacity, and features
- Easy to use in macro, in-building, and enterprise sites
- Eliminates vendor lock-in with a hardware-independent software solution

1. Cloud-Native Virtualization Maximizes Operational Efficiency

Samsung's vRAN is a software solution that runs on commercial-off-the-shelf (COTS) x86 servers, which are used as general purpose processors, allowing operators to pick vendor-agnostic servers and platforms. By using these generic COTS servers, when upgrading to higher capacity servers, the existing servers can be re-deployed for use in running other applications such as Core, Multi-access Edge Computing (MEC) and IT applications. Other operational advantages of vRAN come with the fact that hardware accelerators can easily plug in without replacing the hardware. Thus, there's no need to purchase or replace the existing server. By combining all of these benefits, vRAN reduces the total cost of ownership for the operator.



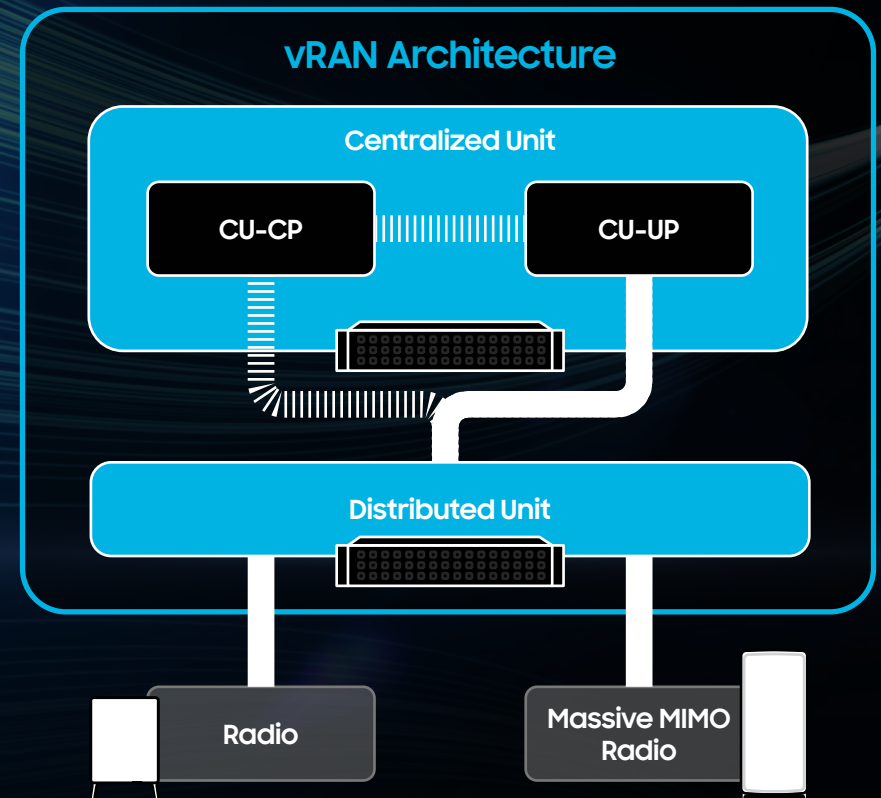
Rapid Deployment
Continuous integration
and continuous deployment



No Hardware Replacement
SW implementation on GPP*

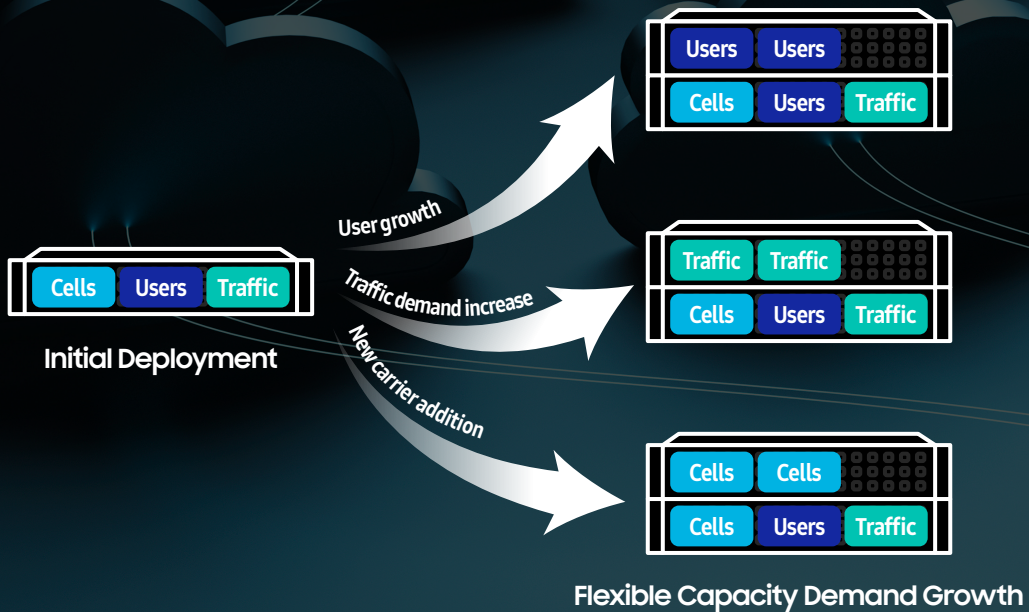


Unlimited Innovation
New Feature/
Technology/ Service

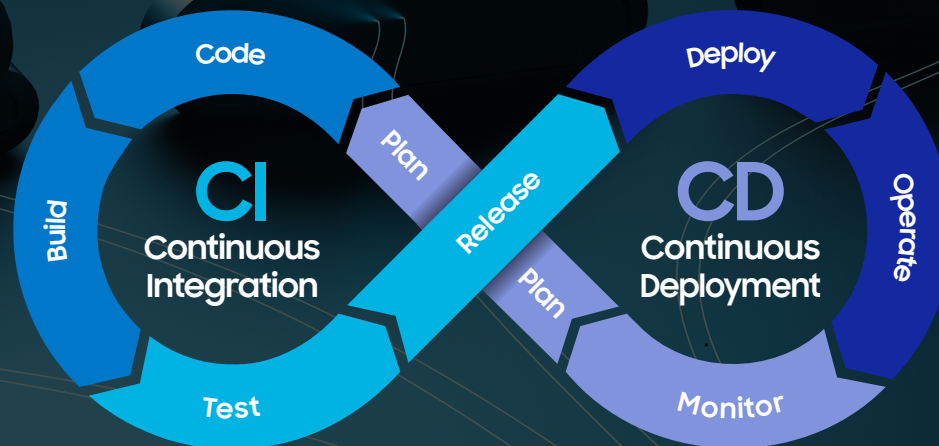


Samsung's vRAN allows for Continuous Integration (CI) and Continuous Deployment (CD), enabling remote management and near-zero-time upgrades, thereby running the vRAN without interruption, simplifying operations and maintenance, improving operational efficiencies, and driving costs down. Samsung's vRAN follows a standards-based approach, providing operators with the freedom to adopt new features, technologies, services, and to maximize future hardware upgrade choices. The use of both generic unified COTS hardware and the containerized software technology provides an homogeneous hardware and software infrastructure for RAN as well as other network functions, including Core and MEC. Operators can simplify their operation and maintenance practices to ease the tasks in capacity scaling, performance monitoring, and upgrading software. Through this simplified process, operational efficiency is greatly improved.

Flexible Network Configuration for Market Demands



Continuous Integration and Continuous Deployment

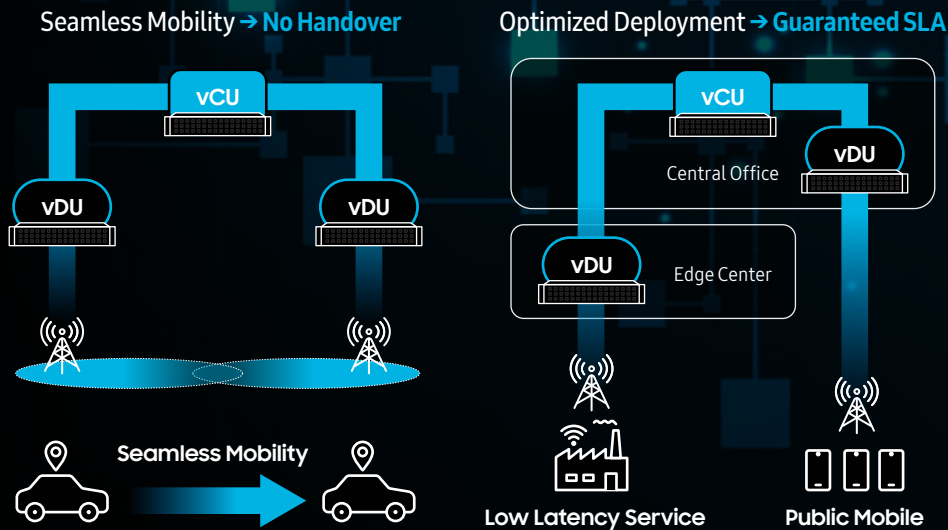


2. Architectural Flexibility Enhances Network Responsiveness and Agility

Disaggregated virtual functions offer deployment flexibility

Samsung's vRAN introduces the Virtualized Central Unit (vCU) and Virtualized Distributed Unit (vDU) to replace the baseband hardware found in legacy networks. The vRAN takes the radio network functions and converts them into the vDU, the vCU, and radios. The vDU sits near the remote radio head to support real-time baseband processing, including communication between the user and the cell site. The vCU can be placed at the same site or remotely at a central office or data center and can handle multiple vDUs, significantly reducing the number of anchor point handovers, improving quality, and enhancing the network's reliability. By placing the vCU and vDU in different locations, Samsung's vRAN offers optimal deployment and operational capabilities to meet the various speed, latency, throughput, and quality requirements in a network. For example, a vDU can be placed closer to the end-users for services that require low latency, such as connected vehicles and automated factories.

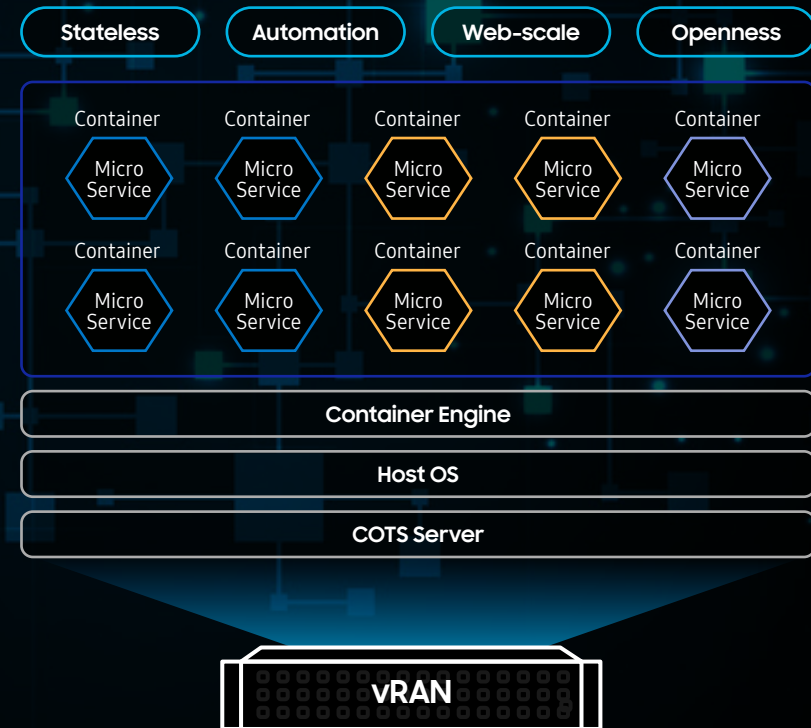
Deployment Flexibility for Network Optimization



Microservices enable seamless service deployment

With the 5G era, services are becoming more complicated and the technical requirements to meet each service's characteristics have grown in complexity. The cloud-native architecture of the Samsung's vRAN, based on microservices and containers, enables faster service launches. In addition, the micro-service approach allows for new services to be added without impacting existing ones, enabling scalability.

Cloud-Native Architecture of vRAN



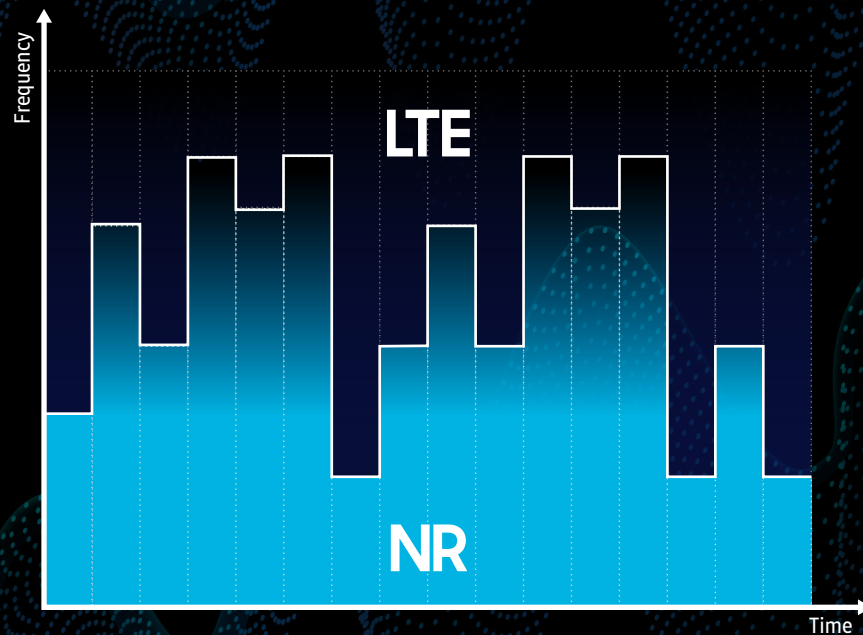
Dynamic Spectrum Sharing smooths the transition from 4G to 5G

Dynamic Spectrum Sharing (DSS) enables network operators to simultaneously use a single legacy LTE carrier for both LTE and NR services, without the need for spectrum re-farming. Samsung's vRAN supports DSS allowing both 4G and 5G to run on the same virtualization platform simultaneously, dynamically shifting frequency resources as needed, enabling a smooth transition from LTE to 5G services that require low latency, such as connected vehicles and automated factories.

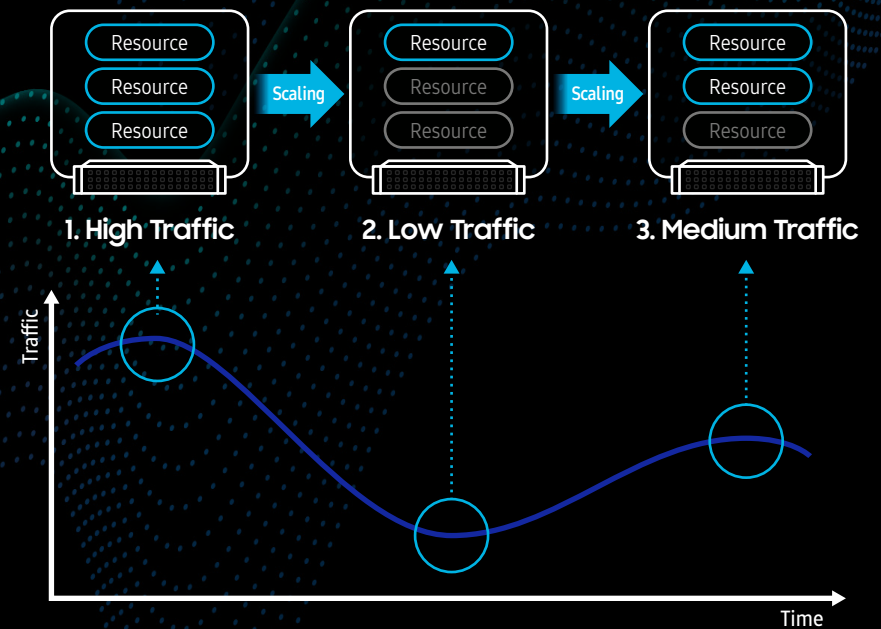
Resource pooling and dynamic scaling maximize efficiency

By optimizing resource pooling with the dynamic scaling of vRAN, the limits of proprietary RANs are surpassed. Resource efficiency can be maximized further as hardware boundary limitations are no longer an issue with virtualization. Dynamic scaling enables flexible management of vRAN resources and enables pooling to cope with network changes efficiently, dealing with unexpected traffic loads effortlessly.

Dynamic Spectrum Sharing in vRAN for a Smooth Transition



Dynamic Scaling for Operation Efficiency



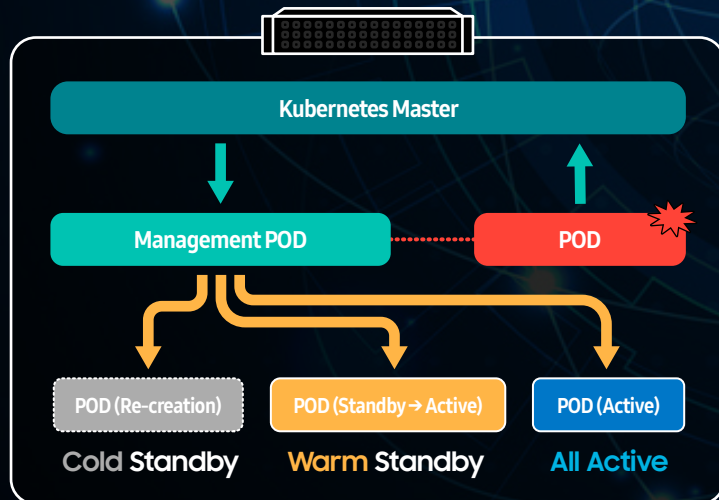
Containerization brings telco-grade reliability across the network

Reliability is a crucial part of the network. If mobile communications services become unavailable for a short time, severe damage can lead to social disruption and financial loss. To avoid such a situation, each network component maintains a high level of telco-grade service reliability. Container-based vRAN has an ideal architecture for high network reliability. It works in a self-healing manner, automatically recovering operations when a fault is discovered, thus maintaining high availability. Furthermore, by supporting local and geographic redundancy in vRAN, the network can minimize service outages even through disasters and emergencies.

Cloud security provides robust protection

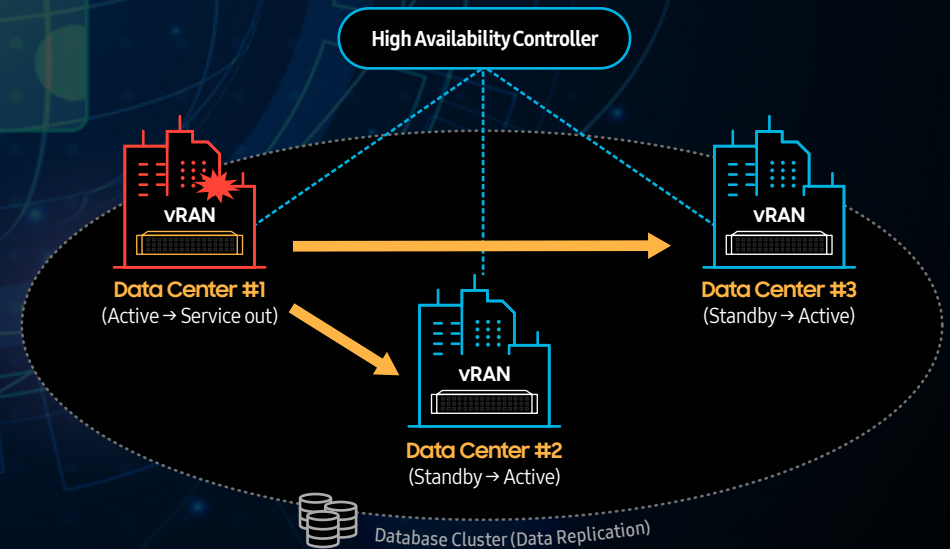
Samsung's vRAN uses a Cloud-native architecture to enable an elastic environment where network, compute, and storage services can expand and contract as needed in an automated way. This approach creates an environment where functions can be hosted as software services and dynamically instantiated on-demand in different network segments. Samsung's vRAN offers a cloud security measure to defend against potential cyber threats using an authentication process for all services and interfaces. These security features provide strong protection by preventing an unauthorized command request. This built-in security measures and utilizes many verification processes to ensure safe and reliable cloud-native services for mobile operators.

Supporting Various Redundancy Schemes



* These redundancy schemes are applied according to the appropriate application and service type.

Geo-redundancy for High Availability



3. Software-Based Flexibility Simplifies Network Scalability and Monetization

Backward compatibility ensures investment protection

Samsung's vRAN is an ideal architecture to support both new and legacy technologies. Thanks to virtualization and cloud-native architectures, it is easy to support legacy technologies by introducing new vRAN modules in a single platform. The software-based vRAN enables the adoption of new features and new technologies without hardware dependencies. vRAN can also interact with non-virtualized RAN functions, keeping existing equipment as needed.

Spectrum flexibility simplifies network scalability

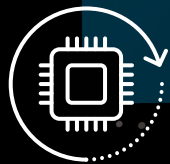
Samsung's vRAN provides complete scalability for the operator's spectrum. vRAN supports all spectrum usage techniques, including Time Division Duplex (TDD) and Frequency Division Duplex (FDD), from low-band to mid-band and narrow to wide band.

Radio diversity extends customer reach

For 5G networks, Samsung has a wide range of radio units based on the deployment environment, and diverse customer needs such as low or high power, multi-band, massive MIMO, and mmWave. By combining Samsung's vRAN and Massive MIMO radio for the first time in the industry, Samsung achieved a significant breakthrough, increasing the throughput, improving user experience and showing our leadership in virtualized technology.

E2E Network slicing creates monetization opportunities

Through End-to-End (E2E) network slicing from the RAN to the core, a wide variety of different service types are efficiently provided. Each network slice has its own service and performance requirement profile. vRAN can efficiently allocate network functions and radio resources for each separate service on a per-slice basis. It makes monetization to operators possible by providing differentiated user experiences.



Backward Compatibility



Spectrum Flexibility

Indoor Radio



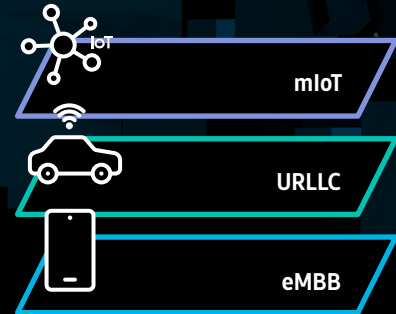
Outdoor Radio



Massive MIMO Radio



Radio Diversity



E2E Network Slicing

For more information about Samsung's fully virtualized RAN offering, please see the links below:

Press release:



- **Samsung Introduces Fully Virtualized 5G RAN for Commercial Availability ('20.7)**
<https://www.samsung.com/global/business/networks/insights/press-release/samsung-introduces-fully-virtualized-5g-ran-for-commercial-availability/>



- **Samsung Expands 5G Technology Leadership with Fully Virtualized Commercial 5G RAN ('21.1)**
https://www.samsung.com/global/business/networks/insights/press-release/0122_samsung-expands-5g-technology-leadership-with-fully-virtualized-commercial-5g-ran/



- **Samsung Achieved a Significant Breakthrough, Increasing the Throughput, Improving User Experience and Showing Our Leadership in Virtualized Technology ('21.6)**
https://www.samsung.com/global/business/networks/insights/press-release/0608_samsung-achieves-industry-first-expands-vran-capability-to-support-c-band-massive-mimo-radio/

Whitepaper:



- **vRAN Vol.1**
https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/virtualized-radio-access-network/white-paper_virtualized-radio-access-network.pdf



- **vRAN Vol.2**
https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-papers/0406_virtualized-ran-vol-2/Virtualized_RAN-Vol.2.pdf

Video:



- **Transition to Virtualized RAN Vol.1**
<https://www.youtube.com/watch?v=DOFcvil8prg>



- **Transition to Virtualized RAN Vol.2**
<https://www.youtube.com/watch?v=A7yGJCXOzeY>



- **Samsung is accelerating the next generation 5G with Virtualized RAN**
<https://www.youtube.com/watch?v=w0ZAw-sg-y8>

Webinar:



- **Radio Access Network Evolution: vRAN**
<https://www.youtube.com/watch?v=sOh3FLTCijQ>

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Samsung inspires the world and shapes the future with transformative ideas and technologies. The company is redefining the worlds of TVs, smartphones, wearable devices, tablets, digital appliances, network systems, and memory, system LSI, foundry and LED solutions.

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