RADCOM

ENSURING PRIVATE 5G NETWORKS' QUALITY WITH AUTOMATED ASSURANCE

INTRODUCTION

At the Center of the Fourth Industrial Revolution

Private mobile networks, designed for a specific company or organization's use cases, represent a potential growth market for telecom operators. According, to the GSA, there are already 626 private networks worldwide[1], with some based on 4G and more and more networks being deployed on 5G. Either they are deploying their first private network or replacing a legacy network with the latest 5G technology.

With the power of 5G, operators can provide enterprise customers with Private Mobile Networks (PMNs) that deliver ultra-low latency, enhanced mobile broadband, and massive device density. Ushering in the next industrial revolution for many vertical industries such as smart factories, airports, hospitals, transport services, logistics, and many more. Bringing rapid change to technology, industries, and processes due to increased interconnectivity and intelligent automation.

A PMN is a network designed to serve the specific needs of a private company or organization, including enterprise customers and local municipalities or government organizations. Companies receive a network that provides a guaranteed level of service that is not possible with a public mobile network.

When deploying a private network, each company will obtain pre-defined, customized capabilities that will enable the development of its use cases and communication needs. Different customers can have their private network using the operator's infrastructure or a completely isolated network that the company can completely control.

The demand for private networks based on 5G technologies is expanding, with the forecast to reach 14,000 in 2025[2]. Furthermore, private mobile networks are forecast to generate over US$64 billion in equipment revenues by 2030[3].

Private mobile networks are forecast to generate over US$64 billion in equipment revenues by 2030

[1] Private Mobile Networks: Executive Summary – September 2021
[2] What are LTE/5G private networks and why are they important? Feb. 2021, Analysys Mason.
[3] ABI Research on Private Cellular Networks, October 2020

PRIVATE NETWORKS - DEPLOYMENT OPTIONS

Private networks can be deployed in the following ways:

A network that shares resources with the public network	The network deployed is a blend of public and private infrastructure and is implemented by the telecom operator. For example, a slice of the public RAN may be combined with a dedicated on-premises core network. Here are the main options: a) A private network deployed with network slicing b) A private network deployed with Multi-Access Edge Computing (MEC) and Control and User Plane Separation (CUPS) c) A combination of a and b
A physically-isolated network deployed by a private entity (enterprise, government agency etc.)	For example, an enterprise deploys a RAN and core dedicated network in a set location, built to deliver a pre-defined purpose for its sole use. In this model, the network is totally private being completely detached from any public mobile network.

Table 1 – Deployment options for private networks

A physically-isolated network

In this case, the enterprise deploys (its own network, with a telecom operator or a system integrator) a full 5G network, including the radio (gNB), core (UPF, 5GC CP, UDM), and edge (MEC) within its own premise or site. The 5G spectrum can be licensed frequency or unlicensed frequency.

A network that shares resources with the public network

In all the options in which the company's private network shares resources with the public network, deployment costs are significantly reduced compared to deploying their own independent, stand-alone network. In addition, especially with emerging technology such as 5G and Open RAN, the enterprise typically has limited know-how building and operating a 5G network. So, cooperating with the telecom operator means that the enterprise can focus on its business. In contrast, the operator handles the networking side.

PRIVATE NETWORKS AS NETWORK SLICES:

According to the GSMA, network slicing will be worth USD 300 billion to operators globally by 2025[4]. Network slicing enables operators to take their public network and divide it into virtual slices that are essentially private networks that all run on shared physical infrastructure. The logical partitioning of a physical network into independent virtual slices enables the multi-tenancy paradigm. Multitenancy allows multiple customers to use the same physical resources without being aware of each other and keeping each one's data wholly isolated and secure.

Each slice is a single, end-to-end network of its own that delivers pre-defined network capabilities designed to serve a specific customer's business purpose. As a result, the service quality and SLAs are guaranteed at a per-slice level.

Within each network slice, all the components that make up a communication proposition, such as latency, bandwidth, processing power, storage, security model, and others; Can be pre-defined by a customer use case, apportioning every feature and level of functionality of the service offered to meet contracted SLAs. This powers the network to prioritize its resources more efficiently and tailor them based on each customer's performance, functionality, and operational needs.

Furthermore, while QoS Class Identifiers (QCIs) can differentially treat diverse types of traffic, such as web browsing and VoLTE, they cannot prioritize the same kind of traffic coming from different sources. With 5G network slicing, if the same type of traffic (e.g., live video streaming) is assigned to other slices, it can be treated differently. Thus, network slicing is the cornerstone of a more intelligent, flexible network tailored to specific customers' needs.

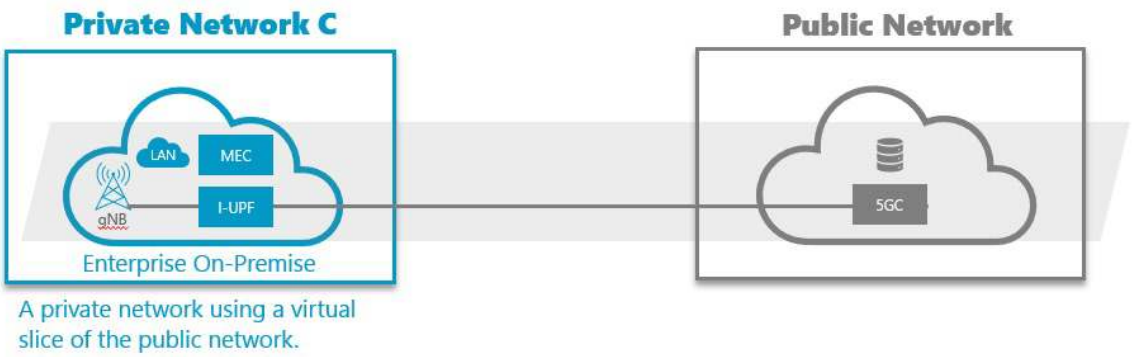

Figure 3 – Network slicing offers a private network as a virtual slice running on the public network

[4] Network Slicing, Use Case Requirements. GSMA.

AUTOMATED ASSURANCE FOR PRIVATE NETWORKS

When managing the performance of public networks, operators have continuously provided standard functionality, including coverage, connectivity, capacity, and quality of experience. However, they were not required to address mission-critical applications and services, such as the critical monitoring and control applications in primary production industries such as oil extraction, quarrying, refining industries, or telehealth long-distance medical care.

Private networks open a new market where the customer is a company with mission-focused applications and services that need to guarantee a certain performance level. As a result, operators will sign a stringent SLA (Service Level Agreement) contract with each enterprise or SME to assure a certain quality of experience.

This shift requires real-time detection and even prediction of service degradations, solving detected issues extremely fast. For it to become a profitable shift, operators are expected to support it by applying high levels of automation in their network provisioning and operations.

How can operators smartly monitor each private network deployment to guarantee SLAs?

Private networks can deliver mission-critical applications and services that require operators to guarantee stringent SLAs

MONITORING NETWORK SLICES WITH RADCOM ACE

RADCOM ACE enables operators to monitor each virtual slice end-to-end, mapping every XDR/KPI/KQI to the relevant service slice to understand the overall Quality of Experience (QoE) and Quality of Service (QoS) and confirm compliance to SLAs. Its multi-tenancy capabilities, enable operators to provide their enterprise customers with self-monitoring capabilities of each virtual slice so that hundreds or even thousands of enterprises can self-manage their own slices while ensuring their isolation and complete data privacy.

Figure 4 – RADCOM ACE monitors each slice and alerts when SLA thresholds are breached

RADCOM ACE identifies each network slice by the Single Network Slice Selection Identifier (S-NSSAI), which includes the following components: Slice/Service Type (SST) and an optional Slice Differentiator (SD).

The PCF takes the input from RADCOM's solution to assign more resources or steer traffic policies, which helps the operator run their network slices more dynamically. In contrast, the NSSF takes the load level information provided by RADCOM's solution for slice selection. The user plane and control plane transactions are associated with the SST, and SD and KPIs are aggregated by the SST and SD (exposed via the 3GPP standard interfaces).

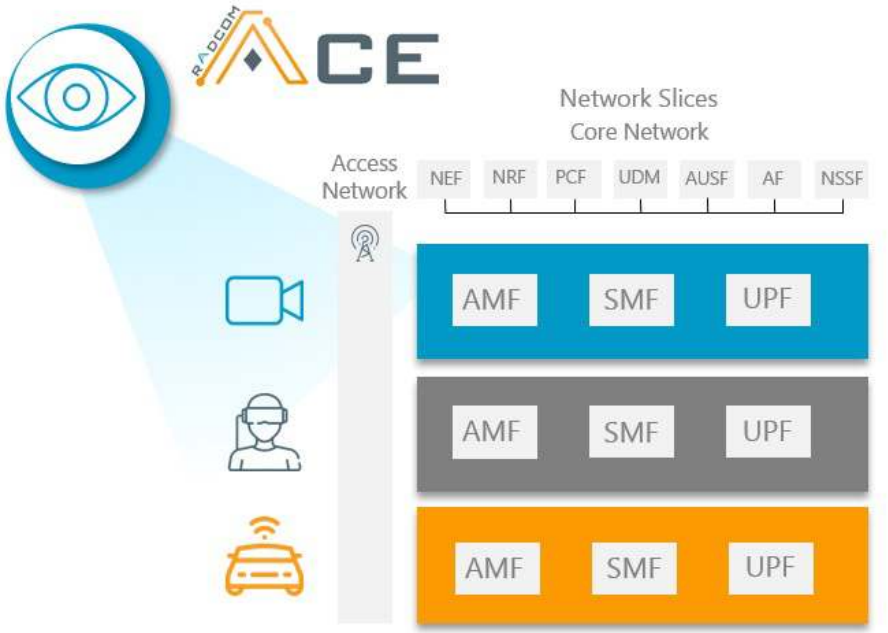

Figure 5 – RADCOM ACE monitors each network slice

Gain network performance insights per-slice and type

RADCOM's correlation algorithms map KPIs/KQIs to each network slice

Understand subscribers' perception of QoE

RADCOM ACE provides an overall CEI and CEI for each service per slice

Know the severity of different KPI and service degradations

RADCOM Network Insights grades the severity, so you know what to prioritize

Define your own KPI weights and service thresholds

RADCOM enables operators to set thresholds for your premium services

MONITORING NETWORK SLICES WITH RADCOM ACE

End-to-end slice monitoring

For both the user plane and control plane, KPIs are mapped for Network Slice Identifiers using RADCOM's correlation algorithms and the Network Slice Identifiers are populated per XDR. The S-NSSAI (Single – Network Slice Selection Assistance Information) is used to identify a Network Slice. The S-NSSAI contains two components:

- SST - the Slice/Service Type
- SD - Slice Differentiator

KPIs/KQIs are aggregated per Slice Identifiers to provide per-slice and per-slice-type KPIs and KQIs. RADCOM ACE provides:

- A single Customer Experience Index (CEI) which portrays the subscriber's perception of quality of experience per network slice
- Overall CEI and CEI for each service
- Flexible CEI model enabling many KPIs for each service
- Classification of severity for KPIs and for services
- User-defined KPI weights and service thresholds
- Provide CEI for each subscriber and for multiple dimensions such as devices/locations
- Scalable for millions of subscribers

MONITORING NETWORK SLICES WITH RADCOM ACE

Automated Slice Assurance with Built-AI/ML Capabilities

RADCOM ACE utilizes each KPI and KQI to detect and predict anomalies and deviations from SLA and trigger automated closed-loop corrective action as described above. With built-in AI/ML capabilities, it can predict the future behavior of each network slice, therefore initiating a closed-loop action that can resolve the issue before it affects subscribers. Thus, providing operators with automatic, data-driven adjustments and insights not possible to reach through manual network monitoring.

Benefits of RADCOM ACE for deploying network slicing.

- Visibility into your network slices and their QoS/QoE
- Advanced troubleshooting and root cause analysis to find and resolve issues quickly
- Rapid self-healing and adjustments to a network's optimal configuration
- Proactive and continuous monitoring of QoE and QoS to confirm SLAs
- Automated anomaly detection
- Predictive analytics that can forecast issues before they occur

Drill down to Packet and Session Level

While most issues can be automatically resolved using the closed-loop approach, some of the most complex problems will require more traditional tools such as KPI/KQI dashboards with the ability to drill down to session and packet views for manual deep-dive troubleshooting. Therefore, a comprehensive assurance solution must have both automated and manual options.

MONITORING MEC/CUPS WITH RADCOM ACE

Use of Control and User Plane Separation (CUPS)

Private networks will depend heavily on Multi-access Edge Computing (MEC) site deployments and Control and User Plane Separation (CUPS), an integral part of the 5G network architecture. It allows operators to distribute resources throughout the network and move the data closer to the end-users, which is key to having an efficient 5G core network.

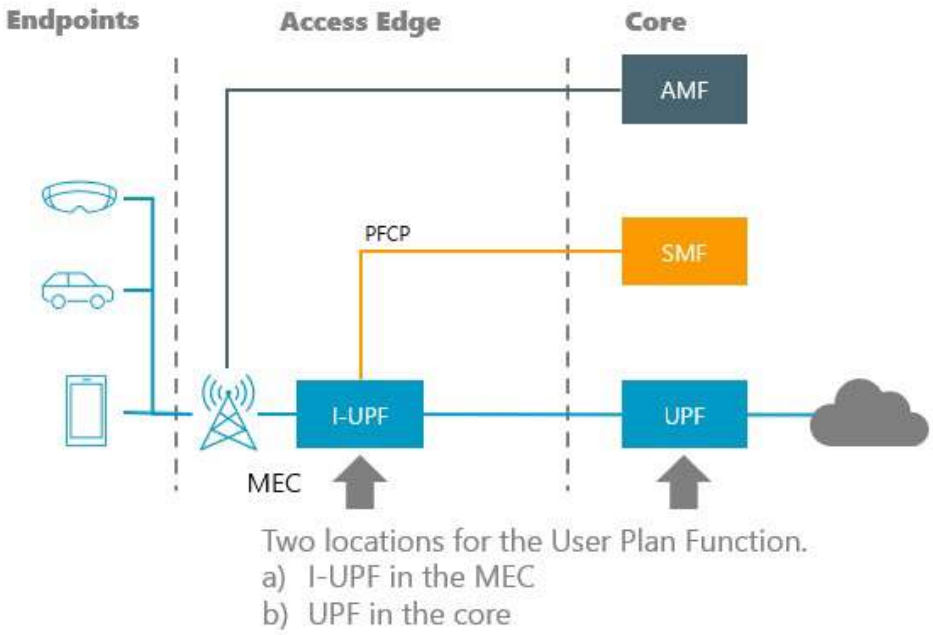

Figure 6 – The UPF function is in the edge (I-UPF) and core network

Separating the user plane traffic from the control plane (signaling) and distributing the "heavy" user plane traffic to the far edge may make the network more efficient and enable low latency applications. However, it also creates a significant challenge. An operator needs to understand the service quality from a subscriber's point of view and troubleshoot network issues, but this is not possible when the operator can't correlate the control and user plane traffic into subscriber-based analytics.

RADCOM ACE monitors the end-to-end network (from RAN to the core) and fully supports CUPS. A solution that can assure the entire network lifecycle, from launch to operation, with zero-touch automation. A solution capable of monitoring, analyzing, and predicting network issues and prioritizing network actions and changes according to the customer's impact. Thereby ensuring end-users receive a high quality of experience and that service delivery meets promised SLAs.

MONITORING MEC/CUPS WITH RADCOM ACE

The fact that the user plane traffic does not include any subscriber identification fields means you lose the essential visibility into the subscriber's activity. It also prevents the ability to troubleshoot specific subscriber issues. In private networks deployed with shared public network resources there can be even more challenges in correlating traffic and gaining visibility into the network performance and quality.

For example, in a private network with RAN and control plane sharing with the public network the UPF, and MEC are deployed at the company's site. 5G base stations (gNBs) are in the private network and the public network. And the 5GC CPs and UDMs are in the edge cloud being shared between the private and public networks. The gNB, 5GC CP, and UDM are logically separated between the private network and the public network, and the UPF and MEC are physically separated.

Complete visibility into private edge networks

By deploying RADCOM ACE, operators gain edge assurance capabilities that provide complete visibility across these distributed networks for private cloud deployments and provide the following benefits to telecom operators.

- Gain real-time subscriber analytics to know where network degradations are occurring and diagnose the root cause
- Correlate RAN/edge data into subscriber-based insights to understand and resolve RAN-based issues quicker
- Ensure revenue generators such as network slicing and Ultra-Reliable Low Latency Communications (URLLC) SLAs for reliability, latency, and visibility
- Improve the customer experience for premium subscribers
- Monitor edge networks to ensure cloud providers deliver the expected service quality and meet SLAs
- Utilize built-in AI/ML-based insights for automated anomaly detection

RADCOM ACE offers a patented solution that efficiently captures and distributes the relevant encryption keys from the signaling sites to the MEC sites. This key distribution gives the operator complete visibility and troubleshooting capabilities for edge site deployments used in private networks.

MONITORING STAND-ALONE PRIVATE NETWORKS

Multiple vertical markets will adopt a private cellular network as the perfect solution for industry use cases that requires operational optimization through automation, control, and the power of 5G. Decoupling their reliance on public mobile networks ensures the network delivers performance that incorporates high device density and predictable latency. The main benefits of isolated private networks are:

- Guaranteed coverage, both indoors and outdoors, through a dedicated spectrum
- Cast-iron security provides companies with a solution that ensures that all data stays on-premises
- Ensured capacity makes it possible to guarantee network performance and low latency
- Critical reliability enables new services like mission-critical communication services and ultra-high-definition video services to be deployed

These private networks require real-time detection and prediction of service degradations, solving detected issues extremely fast. For it to become a profitable shift, operators are expected to support it by applying high levels of automation in their network provisioning and operations.

RADCOM ACE enables companies to monitor their end-to-end private networks (from RAN to the core) from launch to operation, with zero-touch automation. Allowing a company to monitor, analyze, and predict network issues and prioritize network actions and changes according to the end-user impact. Thereby ensuring end-users receive a high quality of experience and that service delivery meets promised SLAs.

RADCOM ACE enables companies to monitor their private networks (from access, edge and core)

SUMMARY

In conclusion, private networks are a new and promising revenue stream for operators, offering companies guaranteed service quality for mission-critical applications and low-latency services.

RADCOM ACE enables both enterprises (or other private entities) and telecom operators to monitor, analyze, and detect degradations in private networks in real-time and across all domains (access, edge, and core). Thus, ensuring that SLAs are met, and users have seamless communications and access to services.

With integrated AI/ML capabilities, RADCOM ACE can automate this entire process and predict network issues while assuring a superior customer experience. You can efficiently launch and optimize private 5G networks while ensuring that end-users receive the required service quality.

RADCOM ACE

Assure. Launch. Connect.

ABOUT RADCOM

RADCOM is the leading expert in cloud-native, automated service assurance solutions for telecom operators running 5G and 4G networks.

RADCOM (Nasdaq: RDCM) delivers real-time network analysis, troubleshooting, and AI-driven insights to ensure a superior customer experience. Utilizing cutting-edge technologies for over 30 years, we are the operators' eyes into their network supporting them as they transition to new network technologies such as the cloud and 5G. Delivering dynamic service assurance for an accelerated digital transformation.

We offer the most advanced 5G portfolio for large-scale networks, providing operators with a smart, efficient, and on-demand approach to network monitoring that meets the challenges of assuring the customer experience in the 5G era. Our leading solution, RADCOM ACE, is explicitly designed for telecom operators, delivering Automated, Containerized, and End-to-end network visibility.

Using our innovative technology, we enable operators to seamlessly manage and optimize their network operation.

Global Footprint

Leading Cloud-Native Technology

Proven Solutions

"Deploying RADCOM ACE on our network helps us identify service issues in real-time and troubleshoot them, tasks which are essential for smoothly migrating our customers to the new 5G network and onboarding new customers while maintaining the highest quality of service."

Tareq Amin, Chief Technology Officer, Rakuten Mobile

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