ENSURE 5G NETWORK SLICING QUALITY WITH RADCOM ACE

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INTRODUCTION

Smart 5G Networks: Enabled by Network Slicing

5G core network is designed to provide innovative capabilities such as Enhanced Mobile Broadband (eMBB), Massive IoT (MIoT), and Ultra-Reliable Low-Latency Communication (URLLC); Addressing all devices from smartphones to robots and advancing mobile technology for years to come.

While previous generations of mobile networks provided basic Quality of Service (QoS) levels for different services, 5G takes this to a whole new level. It is a more intelligent, adaptive network designed to serve diverse industries and enterprises, each with its different use cases and Service-Level Agreements (SLAs).

Such tailored services are enabled through network slicing, one of the key 5G service propositions that divide the network into virtual slices. Network slicing creates a set of logically independent networks that all run on shared physical infrastructure.

So, different enterprise customers can have their own private network for say broadband connectivity using the operator's infrastructure, but which the enterprise can completely control. Private networks are normally static deployments in a set location, but network slicing, can provide enterprise customers a dynamic solution that is flexible and customizable.

	Human to human	Human to machine	Machine to machine
eMBB Slice type Enable large volumes of data transfer and better coverage	Virtual reality / Augmented reality Video calling / Virtual meeting	Fixed wireless / UHD video	Video monitoring / Mobile cloud computing
mMTC Slice type Supports a very large number of devices in a small area, therefore, very large device density	Wearables / Social networking	Smart homes / Smart cities Health care monitoring / Vehicle to infrastructure	Industrial automation
URLLC Slice type Optimizing the network for processing large amounts of data	Public safety	Remote surgery / Vehicle to pedestrian / Vehicle to vehicle	

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NETWORK SLICING REVENUE OPPORTUNITY

As operators are investing heavily in their transition to 5G networks, they need to work out ways to generate revenues. According to GSMA, network slicing will be worth USD 300 billion to operators globally by 2025. Operators can tap into new customers and extend their business array by leasing multiple virtual network slices while still operating from a single physical infrastructure.

Furthermore, network slicing's flexibility is unprecedented. For example, multiple slices of different types may be packaged as a single product targeted towards customers with diverse business requirements. Hence, through network slicing, operators can create a win-win situation where the network is used more efficiently, and customers obtain the performance, functionality, and operational control they require to serve their use cases.

For example, the trial of a 4G/5G private network capable of network slicing, deployed at Schneider Electric's plant in France. Or the 5G trial proving the basic features of network slicing, namely slice isolation, flexible slice customization and multi-tenancy; In a real, large-scale industrial environment of the Hamburg Port Authority.

Network slicing will be worth USD 300 billion to operators globally by 2025*

*Network Slicing, Use Case Requirements. GSMA

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NETWORK SLICING BENEFITS

Tailor your network based on customers' needs

Network slicing can provide:

| Hight bandwidth/ capacity | Low latency/ mobility | Qulity of Service (QoS) | Service Level Agreements (SLAs) |

Network slicing enables operators to take the network and divide it into virtual slices 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.

Hence, while being built on a single physical infrastructure, 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 different slices, it can be treated differently. Thus, network slicing is the cornerstone of a more intelligent, more flexible network tailored to specific customers' needs.

RADCOM ACE:
SOLUTION OVERVIEW

The Challenge of Monitoring Slices E2E

A network slice can span end-to-end, crossing the RAN, edge, transport, and core. While the ability to visualize, monitor, and assure the quality of services across all these domains is indispensable, it presents a significant challenge to operators.

As an operator, when selling virtual slices to different customers for a specific purpose, you will be required to guarantee the quality of service and contracted SLAs of each network slice. To do so, you will need to monitor and analyze traffic performance KQIs and KPIs for each of these virtual slices crossing the network domains.

How can you smartly monitor, optimize and guarantee the performance of each virtual slice?

RADCOM Solution: Automated Assurance as the Core Step

Our automated assurance solution 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 QoE and 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.

Powered by AI and Machine Learning (ML), our solution offers quick and effective validation of network and service performance by providing:

- 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.

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Executive dashboard: QoE KPIs for a specific virtual slice

Integrating assurance with NWDAF for closed-loop automation

As an additional step towards full network automation, operators can move to a closed-loop approach to managing their network slices by deploying our automated assurance solution with enhanced Network Data Analytics Function (NWDAF) capabilities.

3GPP first introduced the Network Data Analytics Function (NWDAF) in 2017, and the specifications are included in 3GPP Releases 15,16 and 17. With NWDAF, operators can provide another level of network data granularity. NWDAF service consumer NFs, such as Network Slice Selection Function (NSSF) or Policy Control Function (PCF), can query NWDAF for real-time per-slice KPIs/KQIs load levels and slice QoE measurements or subscribe for network slice-specific notifications that provide periodic updates or anomaly alerts.

The output of NWDAF is then used as input to Policy Control Function (PCF) and Network Slice Selection Function (NSSF). PCF uses that data to optimize its policy decisions, while NSSF uses the data provided by NWDAF to add real-time intelligence to its slice selection algorithms.

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NWDAF advanced network analytics are delivered over standardized interfaces to other NFs, AFs, and OAM (Operations, Administration, and Management) functions to enable closed-loop automation.

NFs and OAM components such as Orchestrators and Cloud Infrastructure Managers (CIMs) use the analytics provided by NWDAF to mitigate current or predicted slice congestion by:

- Connecting new users to alternative slices

- Diverting traffic from congested slices to non-congested slices

- Scaling out or scaling up NF clusters by spinning up new NF instances or assigning additional resources to the overloaded network functions.

RADCOM ACE is our automated assurance coupled with enhanced NWDAF capabilities, enabling cross-domain monitoring of each virtual slice to guarantee pre-defined SLAs

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NWDAF constitutes a NF inside the 5G Core that is able to orchestrate closed-loop automation in conjunction with 3rd party NFs and OAM solutions. NWDAF provides continuous monitoring of each and every network dimension (slice, network function, cell site, group of UEs or individual UEs) and per each instance within the dimension, using multiple KPIs/KQIs that measure the customer experience and network performance as required by the use case.

These closed-loop use cases include:

Automated **resolving** of network issues occurring now based on real time KPIs from the NWDAF - pinpointing the root-cause a service degradation, by correlating KPI data coming from multiple sources, performing cluster analysis as well as using a rule engine to select the most probable cause.

Automated **prevention** of network issues predicted in the future using AI/ML predictive analytics from the NWDAF - provides a forecast of KPI/KQI values in the future per dimension/instance, including anomaly prediction. This technology can predict degradations in network performance and customer experience before it negatively affects users.

Automated **mitigation** of anomalies detected by NWDAF AI/ML anomaly detection - AI/ML is used to automatically build a baseline and an expected range of KPI values. Thus, providing an alert about significant anomalies for any monitored dimension/instance without the need to pre-define thresholds.

Corrective action is selected based on the detected anomaly and/or detected root cause and automatically pushed to OAM or 3rd party NFs for execution. Corrective action may be applied to resolve the issue and/or work around the issue.

Depending on the use case, typical actions to resolve may include:

- Restarting/rebooting a failed NF
- Assigning additional resources to an NF
- Spinning up additional instances of failed or congested NF
- Changing a parameter in failed NF assigning additional resources to an NF
- Changing QoS for a user or group of users
- Barring a user or group of users from certain services, etc.

Once the corrective action has been applied, the network can be fully monitored once again.

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Implementing a closed-loop automated issue detection and solution using RADCOM NWDAF

1

Monitoring
NWDAF monitors 1000's of network slices by calculating KPIs for performance, QoE etc.

NWDAF for Closed-Loop Automated Assurance

2

Analysis
NWDAF detects a degradation in a specific slice, performs root cause analysis and generates a prediction how subscribers will be affected

4

Issue Resolved
Normal slice performance levels are restored, and issue is resolved before subscribers are affected

3

Corrective Action
Analytics are transmitted to 3rd party NFs or OAM, which in turn change policy, rebalance traffic, or reassign resources to the network slice

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RADCOM ACE enhanced NWDAF

Coupled by enhanced NWDAF capabilities, RADCOM ACE continuously monitors a plethora of performance and quality indicators that measure subscribers' quality of experience, from download and upload speeds, latency and others.

It can then utilize each KPI and KQI to detect and predict anomalies and deviations from SLA and trigger automated closed-loop corrective action as described above. In addition, with built-in AI/ML capabilities, it can predict the future behavior of each network slice, therefore initiating an automated closed-loop corrective action that can resolve the issue before it affects subscribers—providing you with automatic, data-driven adjustments and insights not possible to reach through manual network monitoring.

Combined with automated assurance, it will generate a centralized analytics function that delivers cross-domain network troubleshooting and complete service and customer experience visibility. Thus, providing you with a comprehensive network assurance approach, monitoring and troubleshooting network slices at the service level, and improving customer experience end-to-end.

SUMMARY

In conclusion, network slicing is crucial in 5G networks, offering countless new revenue opportunities to operators while providing customers' guaranteed service quality for diversified use cases. Hence, each slice can serve as a virtual private network of its own, built for the exclusive use of a particular enterprise on the operators' infrastructure and is extremely flexible, delivering pre-defined requirements and SLAs.

Furthermore, assuring network slicing is part of our automated assurance solution, RADCOM ACE, enabling operators to monitor each slice performance in real-time and across all domains to ensure their complete lifecycle optimization.

As well as slice assurance and advanced troubleshooting, RADCOM ACE can also help operators move to a closed-loop approach to managing their network slices by deploying automated assurance coupled with NWDAF. This collects, correlates, and aggregates data per slice from multiple data sources, detecting slices with reduced QoE to optimize the orchestration of network capacity.

With integrated AI/ML capabilities, RADCOM ACE can automate this entire process, reducing operational costs while still assuring superior customer experience. Furthermore, it will enable you to launch and manage a more intelligent and adaptive 5G network when integrated into the network.

Assuring network slicing is part of our automated assurance solution, RADCOM ACE, enabling operators to monitor each slice performance in real-time and across all domains

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