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White Paper

Wireless Transport Modernization for 5G

Enhancing Fitness with Telemetry and Intelligence

Introduction

Since the advent of the Internet, the evolution of technology has fueled dramatic changes in how people communicate and do business. Now the completion of a major milestone is taking the mobile industry by storm. The standalone (SA) 5G specifications have been fixed by 3GPP in June 2018, following the release of the NSA (non-standalone) specific-ations just six months earlier. Operators and equipment vendors are rushing to capitalize on the new technology that will shape the mobile landscape for the next decade. Several pilot 5G networks have already been launched well before the general availability of compatible handsets and cellular devices from leading phone makers. The hype for 5G will culminate with the 2020 global sports event in Tokyo, capturing the spotlight as the platform to showcase full-scale deployment of the 5G ecosystem.

5G can generally be defined as a mobile technology that is different from the previous generations in throughput, latency, and number of connections, represented by the 3 service categories of eMBB (enhanced Mobile Broadband), URLLC (Ultra-Reliable Low Latency Communication), and mMTC (massive Machine-Type Communications) respectively. New and yet-to-be created services will inherit some or all the traits in these categories and evolve around them.

As end users take always-on connectivity for granted, mobile networks change at a fast rate. More diverse and critical services are provided over mobile and split-second decisions are crucial. The slightest outage will reduce the customer QoE (quality of experience) and revenue opportunity, the cumulative effect may be significant enough to affect churn in the long run.

Several use cases such as mobile broadband and finances are not exclusive to 5G; in fact equivalent services are already available on 4G/4G+ networks. However, many other cases that rely on tighter coordination of hardware and software can only be delivered on 5G architecture that has been designed from the ground up. At the end of the day, how these services are deployed efficiently, uninterrupted without operational overhead, and maintaining a high QoE, is key.

Connectivity

Mobile operators with existing 4G networks will continue to use them to maximize their investments even when 5G comes along, as it was the case for the 3G-4G migration. This composite network comprising several gene-rations of mobile technologies and other infrastructure like wireless, optical, and IP transports, results in a limitless combination of units, all for which connectivity has to be established. All can be changed on the fly depending on factors such as resource availability. Imagine the burden of operating and maintaining such a diverse network manually, with virtualization, cloudification, and other new schemes to take into account.

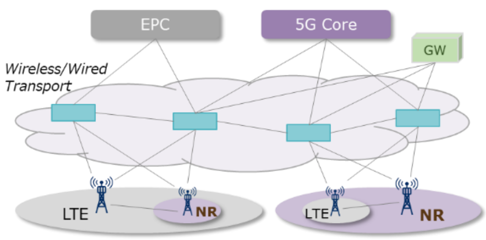

Figure1 Connectivity in 4G and 5G Domains

In addition to how connectivity is realised, their numbers will also grow exponentially with the proliferation of IoT (Internet of Things) and V2X (Vehicle-to-Everything) (URLLC) services. The associated set up and termination rates will rise as well. These will likely deplete available network resources quickly if not adequately monitored and controlled.

Because of this, real-time assessment and management of resources are becoming more and more imperative to make instantaneous decisions to choose the appropriate resources and reclaim them from terminated services. To make this happen, real-time data collection, as realized by telemetry, and ensuing processing and analytics through intelligence are required.

Services and Transport Slices

5G will bring about a variety of services, each having its own set of performance requirements, tied closely to the expectation of the end user, like faster download, smooth video delivery, etc. These expectations, when met, are resultant in fostering high QoE. Conversely, when they fall short, QoE is low.

A single flat network catering to all these requirements will be a vast undertaking, and one that is bound to fail. Prioritization among these services must be enforced so that certain services, for example, mission critical ones for public safety, social infrastructure, and finance, are handled promptly over less important services, such as broadband. More importantly, it is necessary to ensure isolation among these services to ensure that a failure or fault in one does not have a detrimental effect on another.

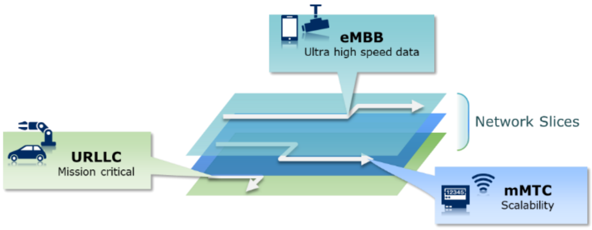

Figure 2 Network Slicing

Network slicing is a form of virtualization that creates multiple, isolated logical networks to run on a shared physical network infrastructure. Each of the slices can be configured separately and adapted to a specific performance requirement. Ideally, slicing should be performed in real-time as conditions in the network are bound to change rapidly. Take for instance weather. As the prevailing weather condition deteriorates, wireless transport capacity will diminish. To cope with this reduction, QoS and traffic reroute should be executed so that services in that slice are not affected. Other causes include vRAN/vEPC where they are spun up and taken down on demand at different locations, or HetNet (Heterogeneous Network) where a number of diverse cells serve overlapping areas and UEs connect to whichever cell providing the best connection, etc.

These conditions should be constantly monitored to finely tune individual slices and maintain service qualities. Per service slicing would offer the best performance, but a single slice can accommodate several services with similar requirements. This arrangement is much more resource-friendly and less operationally taxing.

This is a huge advantage for mobile operators. Not only they can manage traffic accordingly, but this creates an opportunity to market this as a service to content providers and OTT players who do not have this level of visibility into the network and its traffic.

Lifecycle and Automation

Services that run over the transport should be accounted end-to-end, spanning the mobile access, transport and the core. An entity that oversees the entire network should be able to visualize, collect data, configure devices, as well as coordinate and manage these elements across multiple network domains together intelligently to provide service, connectivity, and visibility. This, consequently, is the essence of LSO (Lifecycle Service Orchestration) and closed-loop automation.

Figure 3 Service Lifecycles
(Source: ONAP Architecture Overview)

Thus, having common interfaces and data models among all network elements and software components is of significance. A single set of scripts will be all that is required to manage the entire network. It would otherwise be a nightmare for engineers having to write unique codes for different devices and to analyze data collected in various formats.

Speaking of data, timely collection of data has become a major endeavor in the operational perspective. Traditionally, SNMP has been used extensively for the collection of network data and statistics, where an SNMP manager polls the target device for data of interest. It is still useful for basic fault management, but vastly outdated and ill-equipped for automated operations where continuous network monitoring and fine-grained information are essential.

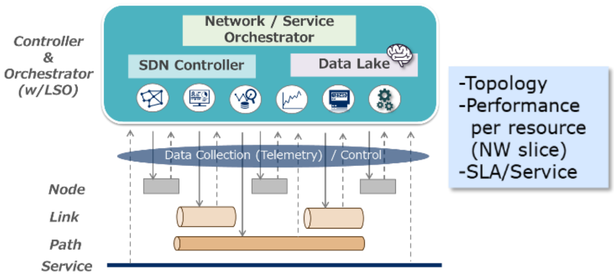

Figure 4 Telemetry Overview

Fortunately, there are technologies and protocols available for collecting high resolution network data, generally referred to as network telemetry, where the device streams granular data constantly to collector systems. One such example is OpenConfig. This is far more scalable and offers greater visibility of the network than SNMP. As the network gets even more complex with 5G, this visibility will be key for SDN and closed-loop automation to adapt and control the network without any delay.

As valuable as raw data can be, they do not add value unless analyzed and presented in meaningful and insightful ways. Humans are not capable of processing and analyzing the large volume of data that a network generates. Moreover, network dynamics will be fluid, therefore this task should be relegated to computing elements with sufficient power and intelligence. In the meantime, it is essential for the network administrators to understand and know what is going-on in the network in order to make critical decisions that cannot be done by the processing nodes. To realize this, masterful collection, analytics, and visualization of data should be integrated into the workflow.

Transport Modernization

What is already in the operators' networks can support a couple of services meant for 5G. However, 5G is a totally different concept, and keeping pace with maturing 5G specifications would require major reforms. In light of this, three aspects have been identified for transport modernization, namely high capacity, low latency, and intelligence. The impact that these metrics exert on 5G are profound, as they will serve as the touchstones to measure and judge how much advanced 5G has compared to previous generations.

High capacity is the most obvious requirement that can be perceived and experienced by the end user, thus it is important for any communication service provider to anticipate sufficient service bandwidth to satiate user demand. The wireless transport network can provide capacity in excess of 10Gbps via the use of wider channels, higher frequency bands, and wireless/optical convergence. However, it should be noted that recklessly adding capacity without consideration for other variables may impact cost and overall design of the network.

Latency is another metric that can easily affect the experience of the end user, especially when engaging in financial transactions, playing games, or immersed in VR/AR/MR (virtual/augmented/mixed reality). However, straight-forward reduction in end-to-end latency is bound by the propagation speed of photons and electrons in a particular medium such as air, fiber, or electrical wire. Lately, the concept of MEC (Multi-access Edge Computing) has been garnering attention to address the call for lower delays. As the name implies, MEC places compute and storage facilities closer to the edge, i.e., the consumers and where data is generated, for faster response times.

But there is more to MEC than just latency. Traffic can be analyzed at the edge to figure out various attributes of the network edge, like which cells or links have capacity to spare, etc. Ongoing trend analysis and refinement of data provide better insights into current bottlenecks. Backhaul requirements would also be reduced as traffic would not traverse all the way to the core. Other benefits of having a local computing infrastructure is that it provides more seamless service creation opportunities, decreases the vulnerability of network wide attacks, ensures data localization which may be required by local authorities.

5G takes network complexity to a whole new level, and requires coordinated efforts on both the hardware and software components. SDN delivers automation to some extent by enabling holistic control of the network and doing away with manual node-by-node configuration. However, 5G use cases require automation in broader domains like device provisioning, troubleshooting, data collection, etc., not just configuration.

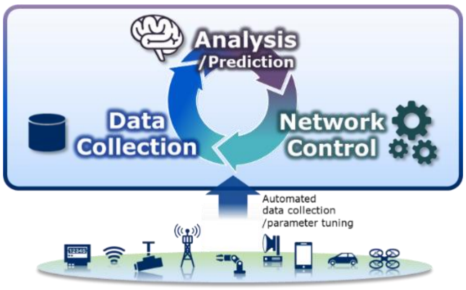

Figure 5 Closed-loop Automation

Automation can only be as good as the quality of data over time Overwhelming data volumes are likely to increase the chance of poisoning, which leads to lower efficiency and higher burden of the analytics engine.

For maximum efficiency and no active interaction from human operators, an autonomous operation with extensive use of AI is a must. But having said that, involvement of administrators or gatekeepers for critical decision making and governance with the help of visualization tools is still needed.

As important as high capacity, low latency, and intelligence are, they are without merit unless high resiliency is sustained. Resiliency, which is a measure of a system's ability to recover from problems that might otherwise cause it to fail. This is interlinked with availability which is a measure of operational time frequently represented in class of nines, and reliability which measures failure rate and usually quantified by MTBF (mean time between failures). Operatory surveys conducted by market research firms revealed that product reliability was one of the most valued and sought after criteria for their microwave vendor selection. Ensuring 5G services are not compromised by device failures or link downs is important, but equally imperative is implementing mechanisms to ensure that the network recovers from failures fast enough.

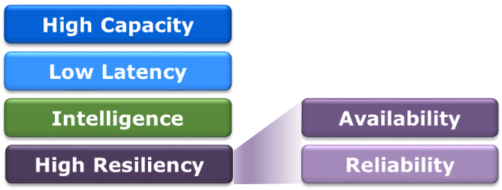

Figure 6 Modernization Objectives

There are already sophisticated management tools available, to ensure proper operations, maintaining health of the equipment and the network. But with AI in the equation, it will be possible to predict with accuracy when and where (equipment, link, etc.) it is likely to fail within the projected timeframe, and according to this information, take necessary precautions like unit replacements, design of backup links or traffic reroute. This is in addition to native resiliency features of the network.

NEC’s Core Strengths

NEC is a leading technology solution provider with over 100 years of history of innovations. In the telecommunications market, customers have recognized us as an established supplier with excellence in SDN, AI, and reliability. Particularly in the wireless transport industry, NEC provides the iPASOLINK series of wireless transmission equipment that are deployed in more than 150 countries and regions around the world, from the snow-covered mountains in the Andes to the scorching deserts in the Middle East.

The iPASOLINK series is a powerful wireless transmission system with rich wireless and Ethernet features that caters to operators worldwide to deliver reliable advanced communications services to the masses. Our top-notch support and engineering teams, through expertise and AI-derived insight, offer support to our customers, enabling efficient 5G transport while optimizing the existing systems and infrastructure.

“NEC the WISE” AI technology portfolio, having its origin in R&D begun over half a century ago, powers NEC’s unique “Smart Wireless Transport” (Smart WTN) Solution*1 and Advanced Performance Analytics for Transport Networks*2, where AI and analytics are used to deliver quick detection, diagnostics, and recovery with minimal human intervention

Over the years, we have made numerous contributions to various standards bodies promoting SDN. We also have our Netcracker subsidiary providing proven SDN solutions designed to combat the key challenges of commercialization, multivendor services and optimal efficiency, for an array of service providers around the globe. The synergy of the two companies helps drive the modernization of the transport network, enabling realization of 5G's full potential.

Conclusion

The importance of intelligence and automation is growing as operators now understand the complexities involved with operating 5G networks efficiently and cost-effectively. By continuing to refine actions with relevant and timely data from the network, automation and closed-loop control can be accomplished.

Lastly, none of the advanced features matter without the equipment performing non-stop and as promised. NEC's excellence in reliability and availability can be attributed to our vast experiences in satellite communications and submarine cable systems, both requiring meticulous effort to guarantee maximal uptime because of their unforgiving environment. Our highly resilient and reliable wireless portfolio has proven to be an important factor in operators' purchasing decisions. You can count on NEC to provide uninterrupted, high quality 5G services for the end users.

*1 NEC Introduces Wireless Transport Solution with AI Analytics for the 5G era
https://www.nec.com/en/press/201702/global_20170221_02.html

*2 NEC uses AI to optimize inventory and maintenance with highly precise predictions
https://www.nec.com/en/press/201802/global_20180222_01.html

About NEC Corporation

NEC Corporation is a leader in the integration of IT and network technologies that benefit businesses and people around the world. The NEC Group globally provides "Solutions for Society" that promote the safety, security efficiency and fairness of society. Under the company's corporate message of "Orchestrating a brighter world," NEC aims to help solve a wide range of challenging issues and to create new social value for the changing world of tomorrow. For more information, visit NEC at https://www.nec.com.

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