

# 5G Network Slicing Requires Packet Analysis for E2E QoS Verification

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White Paper

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### Introduction

Dynamic End-to-End 5G Network Slicing holds promise as the key to unlocking revenue growth in 5G networks. 5G is not only the next generation platform for future innovation but also a service enablement platform for engaging verticals and enhancing mobile broadband for consumers. 5G is about business transformation and new business models for Communications Service Providers (CSPs). Network slicing is a mechanism that will allow CSPs to dynamically allocate network resources in ways that will maximize customer value and enhance differentiated services, so that 5G can serve new purposes, adapt to specific needs and drive revenue opportunities.

GSMA defines a network slice as an independent end-to-end logical network that runs on a shared physical infrastructure, capable of providing a negotiated service quality. The technology enabling network slicing is transparent to business customers.

A network slice could span across multiple parts of the network (e.g. terminal, access network, core network and transport network) and could also be deployed across multiple operators. A network slice (Fig. 1) comprises dedicated and/or shared resources, e.g. in terms of processing power, storage, and bandwidth and has isolation from the other network slices.

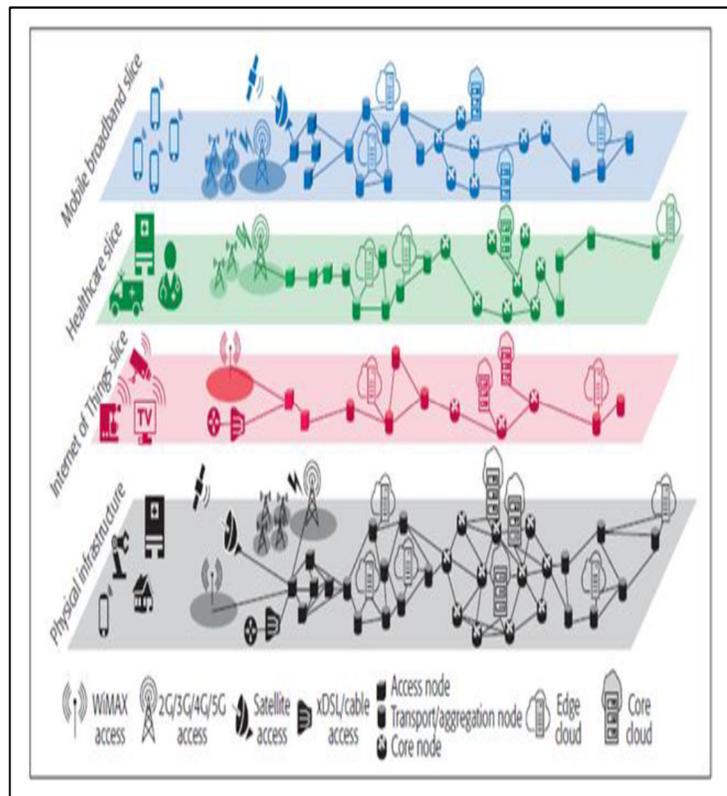


Fig. 1 Source: IEEE Communications 0517 'Network Slicing for 5G

The number of slices will depend on the diversity of customer service requirements and the CSPs' ability to guarantee E2E Quality of Service (QoS) with available physical resources and a good business case.

## Opportunity

5G is the next generation platform for future innovation and a service enablement platform for engaging verticals and enhancing mobile broadband evolution for consumers. 5G is about business transformation and creating new business models. Who offers services, who uses services, what services are offered and how they are packaged will shift, as 5G enables new business models, and potentially new types of CSPs. Network slicing is a mechanism for assigning network resources in different ways so that 5G can serve new purposes and adapt to specific needs that will in turn drive revenue opportunities.

In a recent study with BT, Ericsson attempted to estimate some of the financial benefits that 5G network slicing could provide for operators highlighted in Fig. 2.

The study shows that network slicing enables new revenue generation, and lower OPEX and greater CAPEX efficiency, resulting in significantly increased incremental contribution to the bottom line through new service launches. Network slicing, with cost-effective deployment of operational automation, will become the most economical way to manage service scalability. Ericsson notes that “the economic benefits are seen even with a small number of service launches. Benefits then increase with the scale of services added thereafter.”

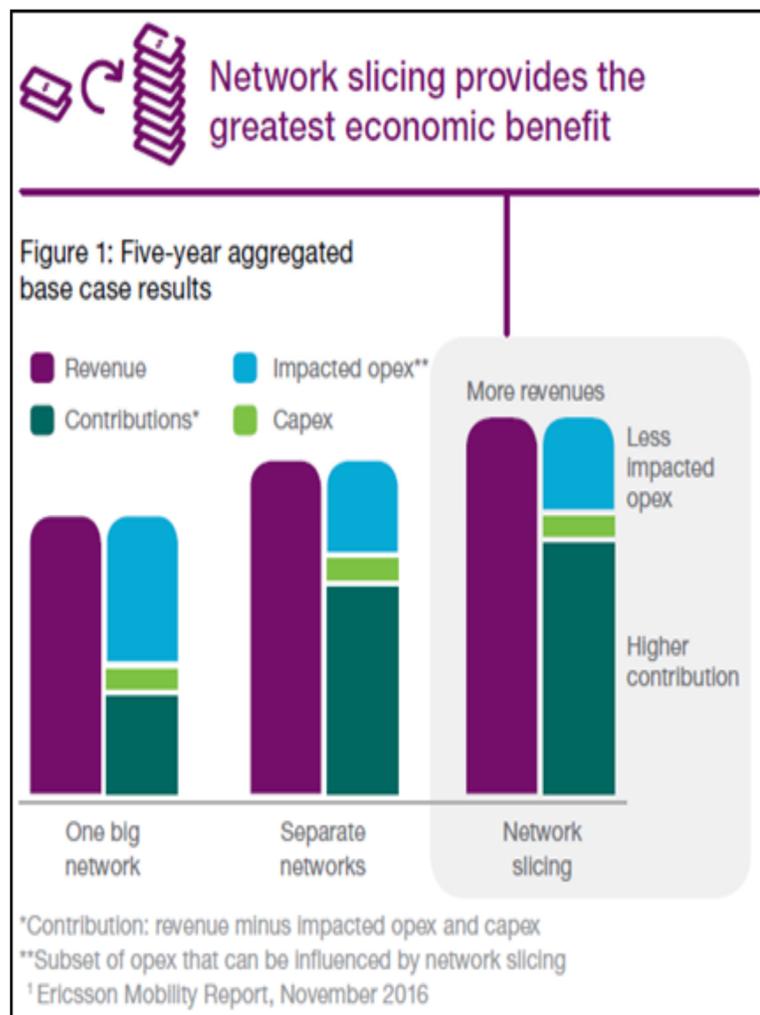


Fig. 2 Source: Ericsson Study: How Network Slicing Pays Off Sept 20, 2017

## Technical and Operational Challenges

While some practical implementations of network slicing—such as fixed and mobile enterprise VPNs with E2E SLAs—can be offered in the near future, there are some significant barriers to the full deployment of dynamic network slices for many demanding classes of low latency or high volume service. Some serious technical problems for network slicing remain that will require additional research. Many others have no simple traditional solutions.

Strategy Analytics in their report *Network Slicing the Key that Unlocks 5G Revenue Potential – Where 5G meets SDN/NFV in cooperation with RCR Wireless* dated December 2017, highlights fundamental challenges for network slicing that include:

- How to guarantee Quality of Service (QoS) with a high degree of certainty
  - Network slicing is all about matching the right Class and Quality of Service or QoS to every application—for example, real time two-way video and scheduled file downloads would be assigned to different slices that meet different parameters i.e. different latency, bit loss, throughput, etc. If network slices and E2E QoS guarantees can only be delivered over fixed VPNs or MPLS tunnels with dedicated physical resources they just become silos of ‘nailed up’ assets that cannot be allocated dynamically—undermining the value of the dynamically shared NFV network.
- Performance issues in a shared infrastructure
  - Problems of resource overprovisioning are likely to occur if there is ‘hard partitioning’ of network slices, but if slices share resources then new mechanisms and policies are needed to avoid contention and ensure QoS for each slice.
- Inherent contradiction between ‘nailing up’ VPN resources to guarantee SLAs for network slicing vs. true NFV virtualization
  - If ‘hard partitioning’ means that network resources can only be virtualized within a slice a major NFV benefit of maximizing capacity utilization with the dynamic allocation of all network resources from a ‘virtualized network pool’ could be severely reduced.
- Management and orchestration issues
  - Given the dynamism and scalability that slicing brings, management and orchestration in multiservice flow scenarios are not straightforward. Slices need resources to be assigned ‘on the fly’ and resource demands may vary dramatically in very short time intervals, both within and across slices.
- End-to-End services vary in ‘scope’ of a slice
  - Many descriptions of network slicing assume that the scope of a slice must always go across the entire network from a user application to a server in the heart of a fixed network or another user on the other end. But in fact we are now in a world where some services may stay within the Radio Access Network (RAN) while others may go directly between data centers in the core. Still

others may move dynamically around the Telco Cloud as required. So E2E requirements will vary widely in scope and complexity.

- Business models must become diverse and flexible to match the services
  - The allocation of network resources per flow/slice can become highly dynamic and the business models for pricing etc. may sometimes need to match the dynamic traffic variations and even SDN controlled bandwidth allocations. Other prices may, however, not even be based on traditional throughput or usage metrics. Instead CSPs may be able to charge for QoS delivered or the value of low latency of high performance results.

The above technical and operational challenges require packet analysis for; real-time, per flow/slice, E2E, QoS guarantee verification.

### **Solution**

It can be appreciated that methods of measuring QoS for mobile networks have been in use for years. Typically, mobile operator network teams drive test the mobile network to identify areas that need improvement. In addition, periodic network element KPIs provide visibility of the service level of individual components of the network.

The main problem with conventional methods of measuring QoS is existing mobile network element based KPIs are not real-time or granular enough and do not provide E2E visibility. Solve these problems by providing packet analysis that non-intrusively detects and analyzes E2E QoS in real-time per flow/slice. Unique algorithms provide E2E QoS indicators for encrypted and non-encrypted data flows/slices without utilizing personal subscriber data.

### **Conclusion**

This white paper discusses 5G network slicing opportunities, challenges and solutions. Challenges include the difficulty of providing E2E QoS visibility in real-time per flow/slice. Solve these challenges by providing packet analysis that non-intrusively detects and analyzes E2E QoS. Unique algorithms provide E2E QoS indicators per flow/slice (including encrypted data) to verify and ensure service guarantees that are required for network slicing, without utilizing personal subscriber data.