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Report for Viavi Solutions Inc

Improving mobile customer retention through multi-dimensional analysis of QoE

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1. Executive summary

Mobile communication service providers (CSPs) are facing the twin challenges of increasing cost and revenue pressures, and rapidly changing consumer characteristics. Revenue growth is expected to slow or even contract in some key markets, while the data usage is forecast to grow exponentially for many years to come. Fueled by massive proliferation of smart devices and a significant increase in the use of OTT apps (especially video), CSPs are facing unprecedented network demands on the one hand and poor customer loyalty on the other hand.

The launch of LTE and related services such as VoLTE, together with the increased use of OTT apps, are introducing further complexities into the network. Consumers are spending more time than ever on smart devices, downloading and accessing a plethora of OTT apps, and creating signaling and data deluges in the network. Assuring the network performance to sustain the level of service quality is more important than ever. However, the availability of LTE and superior network performance are increasingly accepted as table stakes in the mobile CSP market in most countries, and cannot be long-term differentiators, especially when consumers are showing greater loyalty towards smartphone brands and OTT apps, and relegating CSPs to being low-value bit-pipe carriers.

In an increasingly commodified mobile services landscape, CSPs are realizing the need for a new strategy to achieve sustainable growth. In most markets, mobile penetration is more than 100% and there are limited avenues for new customer acquisition; CSPs now accept that customer retention is the most important strategic pillar for long-term sustainability. To support this strategy, CSPs must better understand their customers' quality of experience (QoE) so that necessary steps can be taken to enhance it and improve loyalty. Superior end-to-end QoE is the new competitive differentiator which CSPs must deliver through their customer retention strategies.

Traditional assurance approaches addressing quality of *service* (QoS) are effective for legacy voice and data services, but are narrow in scope and not entirely fit for purpose in the era of complex mobile networks, services, smart devices and OTT apps. CSPs now need a multi-dimensional QoE measurement and assurance strategy that encompasses the entire end-to-end service delivery chain, including the network and access (device, RAN, backhaul, mobile core and the application servers), and context-enriched with the location, device type, service/application accessed, and the customer identity.

This whitepaper discusses the multi-dimensional QoE approach and presents example use cases that demonstrate the value of this approach for CSPs. The use cases discussed in this paper are (a) assuring QoE for voice over LTE, (b) targeted RAN optimization based on geo-location, application and financial metrics, (c) device-aware heterogeneous network optimization, and (d) assuring QoE for video.

2. Mobile CSPs face a future of declining revenue and increasing customer expectations

After years of growth, revenues from telecom services are expected to decline in key developed markets, requiring CSPs to take measures to nurture and retain existing customers, while at the same time trying to increase ARPU. However, these challenges are further aggravated by rapidly changing consumer behavior driven by the success of alternative application service providers.

2.1 Mobile service revenue is forecast to decline in key markets

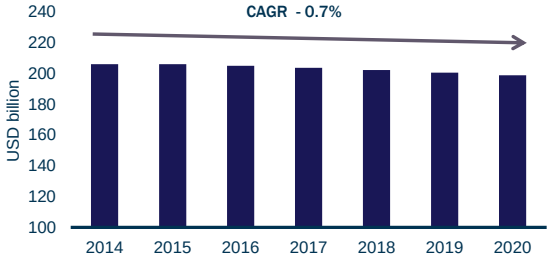

Figure 2.1: Mobile service revenue, NA, 2014–2019 [Source: Analysys Mason, 2016]

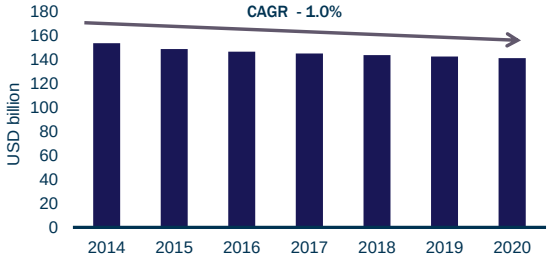

Figure 2.2: Mobile service revenue, WE, 2014 – 2019 [Source: Analysys Mason, 2016]

The year 2014 marked a significant turning point in the North American market, as CSPs recorded a decline in service ARPU after a long period of growth. Intensifying competition contributed to the decline, as well as operators eliminating device subsidies, stripping out the device payment portion that they previously attributed to service revenue. A similar revenue decline occurred in Western Europe as a result of intense price competition. CSP sub-brands and MVNOs will continue to compete in low-cost segments, but converged players will increasingly erode the value of mobile services as they bid to increase market share.

2.2 Increasing network and service complexity present operational challenges

Evolution from the legacy circuit-switched to all-IP packet-switched networks is well underway (e.g. with the shift to LTE). Although this evolution has improved the economics of operators' business both in terms of spectral efficiency and the cost of service delivery, it has also introduced significant levels of network and service complexity: because of the inherent nature of IP services, there are now many more network elements in the service path, and therefore more potential points of failure.

Voice over LTE (VoLTE) is a prime example of how new IP-based services are introducing significant network complexities. While VoLTE promises significant business benefits such as increased spectral efficiency, increased efficiency in the voice domain and higher voice quality, the service itself is not straightforward to implement. The all-IP nature of the voice service, the use of IMS for call control, and the need to hand over calls from LTE to

2G/3G, in addition to the established QoS expectations of a voice service, will make it challenging for CSPs to ensure that customers receive a superior QoE.

Furthermore, in addition to the native services such as VoLTE, there has been a dramatic increase in the availability and use of OTT apps – there are now about 1.6 million Android apps and about 1.5 million apps on the Apple app store. Smartphones with large screens and a high number of apps – especially video streaming apps – are resulting in higher data usage. According to research carried out by Analysys Mason, on average, mobile users have about 35 apps installed on devices with 3.5 inch screens, and as many as 81 on devices with screens larger than 5 inches.[1]

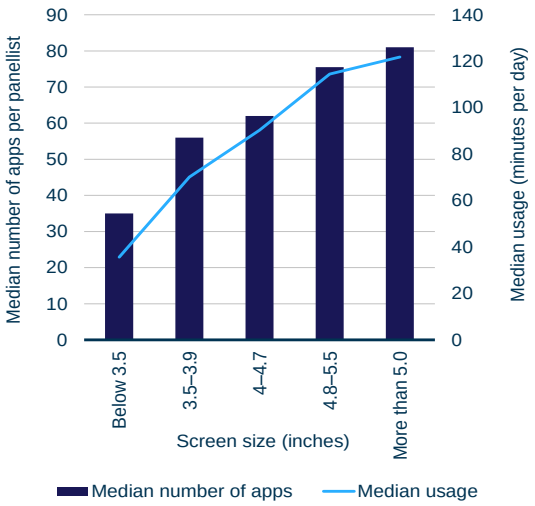

Figure 2.3: Median app usage (n = 1596) [Source: Analysys Mason and Nielsen, 2014]

Exacerbating the problem for CSPs are the advanced capabilities of LTE devices, which can support 24 simultaneous sessions. In addition, LTE mobile networks generate up to ten times more signaling traffic than 3G. With customers increasing their data usage and spending more time on average per session, CSPs today face issues both in the control plane and the user plane, resulting in unprecedented network complexity and demands on performance and operations.

2.3 Rapidly evolving consumer behavior and expectations

Rapidly changing customer expectations are creating new challenges for CSPs. The improving mobile broadband coverage and the availability of advanced smartphones have immensely altered the behavior of consumers, who are increasingly demanding personalized services and expecting everything to be available in real time. Smartphone sales have already reached 1 billion units worldwide, and the take-up will accelerate significantly with the emergence of cheaper smartphones in emerging markets.

Figure 2.4: Changing customer expectations [Source: Analysys Mason, 2016]

For many smartphone users, the device is synonymous with OTT apps such as Facebook, WhatsApp, Skype, Viber and YouTube – that is, they buy smartphones primarily in order to use these applications. Customers primarily identify themselves with their smartphone brand (Apple iOS or Android) and the apps they use – they lack loyalty towards their CSP, resulting in increased churn.

[1] 35, 81, 35.6 and 121.8 are median numbers. Refer to Consumer smartphone usage 2014: headline results

3. Need for a new basis for competitive differentiation

3.1 Customer retention should be the long-term strategy

The commodification of mobile networks has clearly raised the bar for competitive differentiation for CSPs. Their data service offerings look increasingly similar, and CSPs are trying to differentiate themselves based on content partnerships with players such as Spotify or Netflix – with limited success. Many leading CSPs in developed markets have already deployed LTE, and CSPs in emerging markets are following suite. LTE will be a differentiator in the short term, but many CSPs are pursuing network-sharing agreements to save capex, so network technology alone cannot be a sustainable, long-term differentiator.

Furthermore, acquiring new customers is an expensive task compared to retaining existing customers. In mature markets where mobile penetration is in excess of 100%, there are no 'new' customers – customer acquisition is mostly achieved through aggressive sales strategies and price wars. However, the products on offer look increasingly similar, with identical device options. CSPs are therefore quickly realizing that customer retention is a more viable long-term strategy for revenue protection and sustainable revenue growth.

So how can CSPs differentiate themselves against the competition in order to retain customers in the present-day, commodified mobile services landscape?

3.2 Superior end-to-end and multi-dimensional QoE – the new competitive differentiator

Traditionally, QoS has been the metric of choice for CSPs to measure the quality of their networks. With legacy circuit-switched networks, the QoS of voice and SMS services was directly dependent on the network performance, since these services were provided to customers over dedicated channels. But in modern, all-IP networks, data services are delivered over connectionless packet-data technology on a best-efforts basis. Further, the increasing disaggregation of the telecom value chain means that many of the services delivered over CSP networks (especially OTT services) are actually provided by third-party content providers. For all these reasons, technical QoS measures alone cannot provide a true picture of the customer QoE.

As the world has shifted to smartphones and third-party content services, CSPs' networks have become part of a larger ecosystem, providing the crucial mobile network infrastructure required to deliver video, VoLTE and data services. In this scenario, the end-to-end service quality not only relies on the performance of the network, but also other factors such as device and application performance that could affect the customer's service experience. A more holistic measure of service QoE is therefore necessary to enable CSPs to effectively assure services.

CSPs should consider a multi-dimensional approach to measuring QoE, including all legs of the infrastructure (i.e., access, backhaul, core, and the backend servers), all layers of the OSI protocol stack, combined with the contextual customer information such as who (eg: IMSI), when (time of the day), where (geo-location) and what (which device and application). (Figure 3.1)

A multi-dimensional QoE aproach can benefit CSPs on three broad fronts, as shown in Figure 3.2 below.

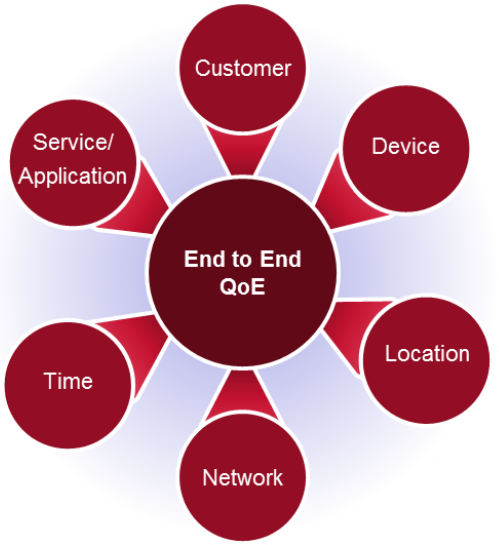

Figure 3.1: Multi-dimensional approach to assuring QoE [Source: Analysys Mason, 2016]

Benefit	Description
Improve customer experience and reduce churn	By making end-to-end QoE the key enabling pillar of their customer retention strategies, CSPs can provide a consistent and superior QoE on a per-service, per-user basis, thereby providing a better platform to enhance customer experience and improve customer retention.
Improve operational efficiency	CSPs can streamline processes and prioritize actions in customer care, network operations, service operations, network planning and engineering.
Targeted network optimization and next best network investment	Analysis of end-to-end QoE provides CSPs with an experience-centric insight to supplement the traditional network performance KPIs, enabling them to make better decisions on network optimization (e.g. indoor vs outdoor) and network investment strategy (e.g. Wi-Fi build-out vs RAN expansion).

Figure 3.2: Benefits of holistic QoE assurance [Source: Analysys Mason, 2016]

4. CSPs need a new approach to assuring QoE

4.1 The traditional assurance approach is inefficient for assuring end-to-end QoE

Service assurance software has evolved from being a set of disparate tools predominantly used to gather alarms and events from the network for display on a dashboard with some reporting capability, through to a full OSS capable of collecting large volumes of diverse network data and performing root-cause analysis. With the introduction of new network technologies such as Ethernet, IP and 3G/4G, new domain-specific assurance systems were deployed, resulting in a fragmented and siloed OSS estate. Such solutions lead to long call-resolution times, high costs, and ultimately poor customer experience, because operations must deal with multiple screens to perform accurate diagnoses, and are often forced to delegate the issue deeper into the organization where staff costs are higher.

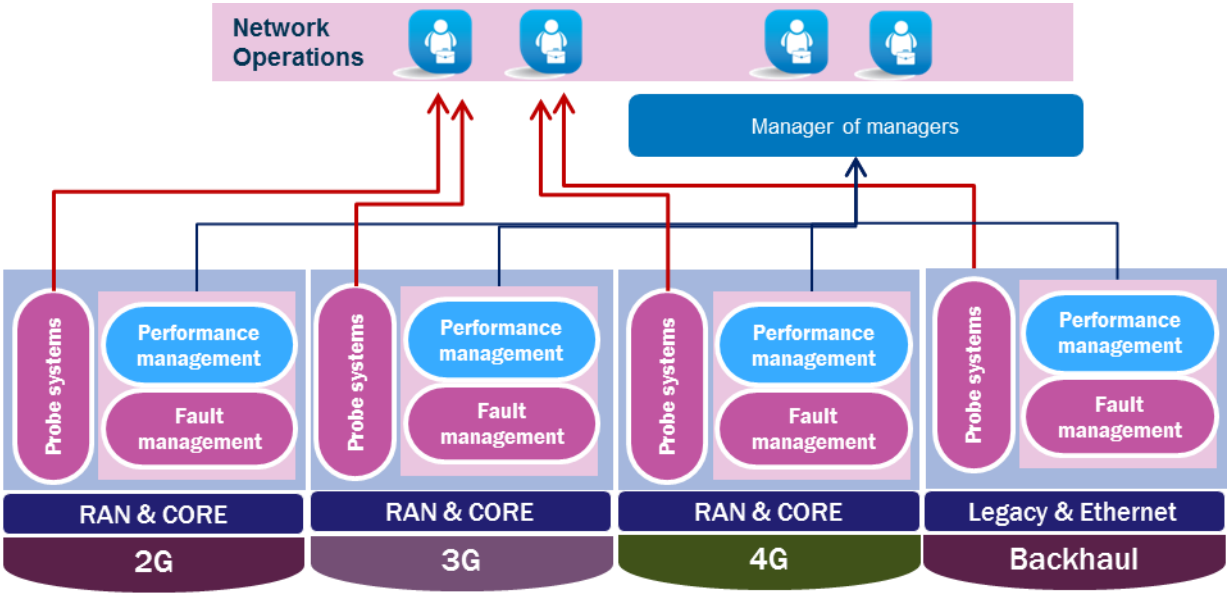

Figure 4.1: Legacy service assurance architecture [Source: Analysys Mason, 2016]

CSPs have sought to address this problem by deploying 'managers of managers' and replacing some of these systems with unified fault and network-performance monitoring solutions, combined with the ability to carry out cross-domain correlation and advanced troubleshooting. While this approach has significantly improved operational efficiency metrics such as mean time to resolution and first-call resolution, it continues to take a traditional, narrow view on assurance – still focusing pretty much on network assurance and network QoS. It also does not allow real-time analysis of QoE or performance in terms of appropriate dimensions, which prevents many critical issues from being quickly discovered and resolved.

Many CSPs are realizing the drawbacks of this approach, and are implementing service quality management (SQM) software that can correlate *network* KPIs such as latency, jitter, etc. to derive *service* KQIs pertaining to the accessibility, retainability, integrity and mobility of services. By using service models for different services such as

voice and video, SQM systems raise alarms when a service KQI breaches a certain threshold (e.g. page-loading delays during browsing, video stall rates, etc.), and automatically trigger troubleshooting workflows.

Although SQM systems provide an important leap forward for CSPs wishing to manage customer QoE, in their purest implementation – as discussed here – such systems still lack the broader contextual factors that influence QoE as summarized in Figure 3.1 above.

4.2 Assurance systems underpinned by network analytics enable QoE-based use cases

Next-generation assurance solutions must look beyond the network, and evolve towards management of both 'service quality' and 'customer experience' (refer to Figure 4.2). SQM is a step in the right direction, but embracing the multi-dimensional QoE-based approach and harnessing data from a diverse set of data sources will be important next steps. Network analytics can play a pivotal role in this evolution, as illustrated in Figure 4.3.

CSPs have always gathered diverse network data, but selectively stored and used them in isolation and in a non-holistic manner. However, the rapidly declining cost of storage and computing, and the development of new technologies such as machine learning and real-time streaming analytics, is enabling CSPs to aggregate, correlate, contextualize and analyze the varying data from diverse sources.

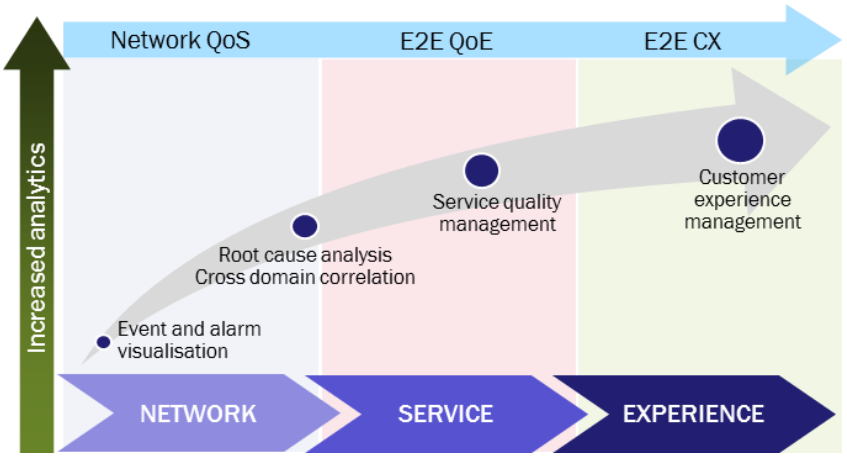

Figure 4.2: The evolution of service assurance enabled by network analytics [Source: Analysys Mason, 2016]

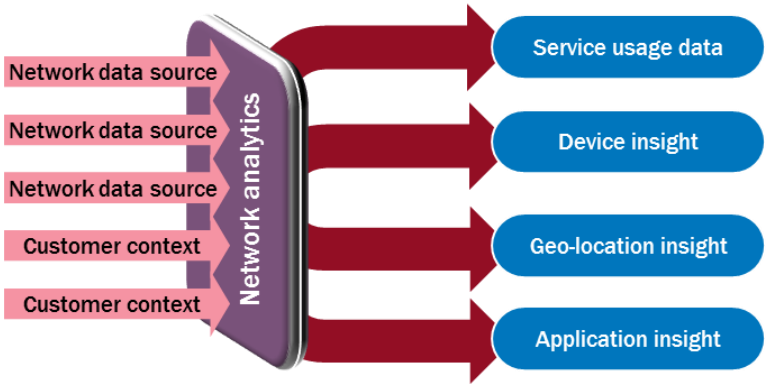

Figure 4.3: Customer-level insight generated from network and customer data [Source: Analysys Mason]

Solutions based on network analytics have the ability to aggregate data from a plethora of network sources, enrich it with relevant supplementary data, and then apply analytics models. This produces insights that can be visualized in different forms, and to drive a diverse range of use cases and automation at various levels. For example, using network analytics, CSPs can measure and assure customer QoE, improve the agility of processes in the NOC, and automate network optimization.

Customer micro-segmentation is another important area where CSPs can benefit from network (usage and QoE) analytics. For many years, CSPs have used factors such as age, economic indicators, etc. to segment the customer base. But with rapidly changing customer behavior, and increasing demand for personalization, CSPs need a better way to segment the market. Micro-segments gather considerably smaller numbers of people into groups based on, for example, application usage, device usage or location, so they can be better served on various fronts such as handling complaints, troubleshooting QoE issues, or providing micro-services tailored to their exact needs.

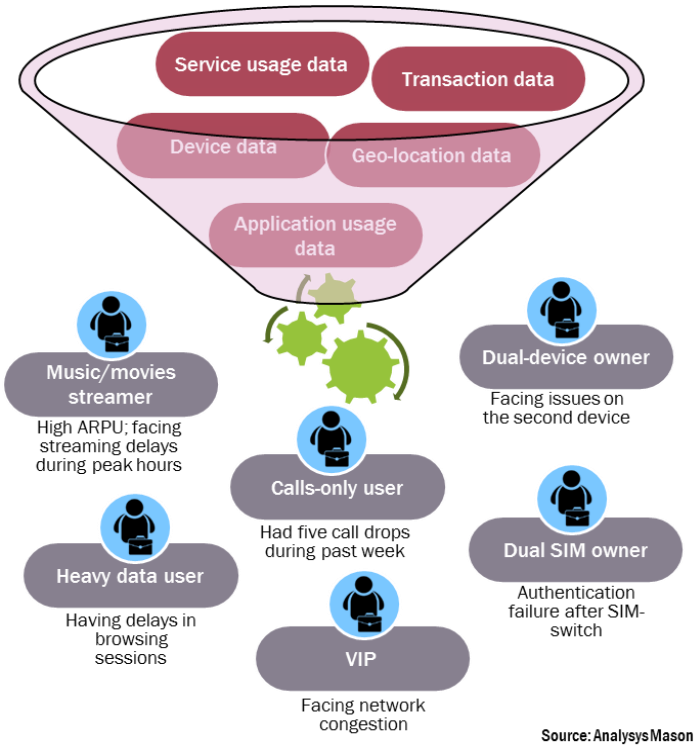

Figure 4.4: Network analytics-enabled customer micro-segmentation [Source: Analysys Mason, 2016]

5. Example use cases that demonstrate the value of holistic QoE approach

This section discusses four example use cases illustrating how CSPs can adopt a unified QoE assurance approach, to achieve benefits such as increased customer experience and improved operational efficiency.

5.1 Assuring QoE for VoLTE

VoLTE is the new incarnation of the native mobile voice service, delivered over all-IP LTE networks. By Q2 2015, 58 CSPs worldwide had either launched, or were in the process of deploying, VoLTE.[2] In many countries, VoLTE is being marketed as 'HD voice', with a promise of superior voice quality, adding impetus to the marketing position of CSPs, especially for those aiming to position the service against established OTTs such as Skype, Viber, etc. However, it also places significant pressure on CSPs to not only match but also exceed the quality expectations established by circuit-switched voice.

On the other hand, the inherent technological complexities of VoLTE bring new challenges such as call handover between LTE and 2G/3G using SRVCC,[3] potential signaling overload in the core, and increased network performance requirements. The voice service being real-time in nature, any degradation in network performance can have a noticeable impact on call quality, so the network has to be optimally tuned (e.g. QoS class identifier) to ensure that voice packets get the highest priority, with a guaranteed bit rate. Some of the network KPIs such as bit rate, latency, jitter and packet loss – which are the inputs for the measurement of voice quality – must be monitored and actioned in real time.

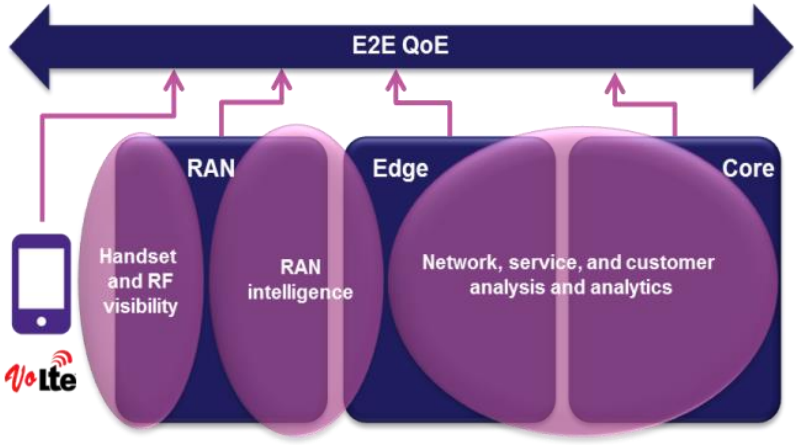

Figure 5.1: Illustration of end-to-end QoE [Source: Viavi Solutions Inc, 2016]

[2] Refer to Next-generation communication services tracker 2Q 2015

[3] Single Radio Voice Call Continuity

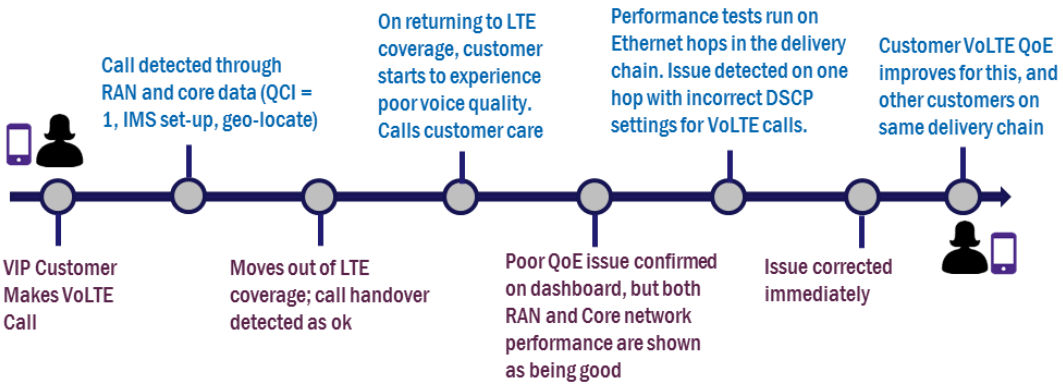

Figure 5.2: Troubleshooting VoLTE example [Source: Analysys Mason, Viavi Solutions Inc 2016]

By enriching data on network performance and voice quality with contextual information such as the location of the call, CSPs can identify the location of RAN issues such as interference with pinpoint accuracy. Additionally, further data enrichment such as customer identity (e.g. the customer's IMSI, whether they are a low-value customer or a high-value VIP) allows for the prioritization of actions; for example, CSPs can focus on high-value customers as a priority. Such a multi-dimensional and proactive approach to end-to-end QoE assurance enables CSPs to trigger troubleshooting workflows and resolve problems before they impact customers' experience, and prevent calls to customer care.

5.2 Targeted RAN optimization based on geo-location, application and financial metrics

Mobile CSPs are under significant pressure to increase network capacity and better allocate and optimize network resources to support the rising rate of mobile data consumption. CSPs have traditionally used network planning and optimization software to add the appropriate capacity in the right place at the right time without expensive overbuilds. However, this is largely an offline process that does not take into consideration other factors such as financial KPIs and app performance metrics. How can CSPs extract the biggest 'bang for their buck' by optimizing the use of existing network resources, while providing the latest services at the highest possible quality levels?

By correlating the app performance data with the location intelligence, CSPs can determine what throughput the top data apps are receiving by location. By further linking subscriber-level commercial data such as ARPUs, CSPs can accurately visualize where subscribers are spending their time and what types of apps they are accessing. CSPs can then prioritize immediate follow-up actions to optimize the RAN to ensure that high-value subscribers get the best QoE.

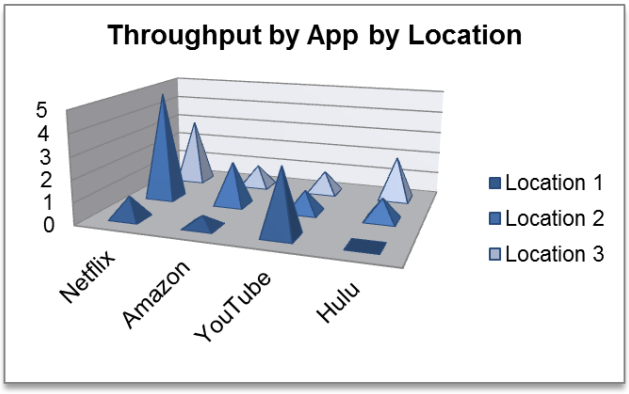

Figure 5.3: Customer level insight generated from network and customer data [Viavi Solutions Inc, 2016]

To further illustrate this use case, consider a scenario where four sites have been identified as having a congestion problem, all requiring remedial action such as traffic offload. How can the CSP decide which site should be given priority? The app-aware capability can provide deeper insight into the characteristics of the apps being used at each site. In this example, three sites may be shown to be dominated by low-value traffic and customers, while the fourth may be carrying high-value traffic; the CSP can then prioritize the fourth site over the other three for traffic offload.

Examples of other variants of this use case are:

- Identifying cell sites for technology upgrades, or 'next best investment' of network capex, based on revenue per site and customer location access points.
- Initiating targeted marketing campaigns based on customer context and location.
- Enabling proactive customer care by preempting calls to the contact center.

5.3 Device-aware heterogeneous network optimization

In the past, mobile businesses were based on the idea that mobile would gradually replace fixed. According to recent trends, however, this is not happening: in particular, the rise of connected TV in many markets makes it almost impossible. Mobile alone cannot make further great inroads into the consumer data market, because mobile network networks alone cannot carry the ever-increasing volumes of data.

To counter this challenge, a heterogeneous network strategy based on Wi-Fi and small cells is emerging. In many countries in Europe, about 80% of smartphone traffic is carried by Wi-Fi, mainly on home Wi-Fi networks. Fixed-plus-Wi-Fi is slowly emerging as the default indoor network for nearly all consumer wireless traffic. As a consequence, mobile networks are expected to become more clearly delineated as out-of-home networks, and may become predominantly outdoor networks in the long term.

In this context, CSPs must have a robust strategy for assuring QoE over HetNet access technologies such as Wi-Fi or small cells. One approach is to supplement the passive probing technology in the network with device-based active probing software for in-building service quality analysis, providing multi-device and multi-app support and reporting in near-real-time. In addition to Wi-Fi and small cells, the solution must also support other technologies such as femtocells, distributed antenna system and emerging technologies such as cloud-RAN.

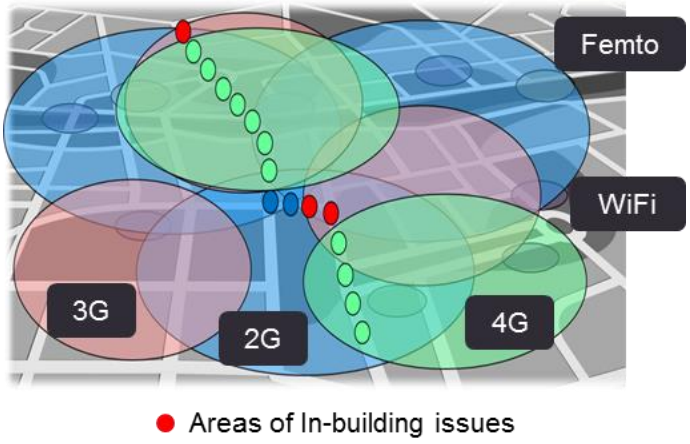

Figure 5.4: The evolution of service assurance [Source: Viavi Solutions Inc, 2016]

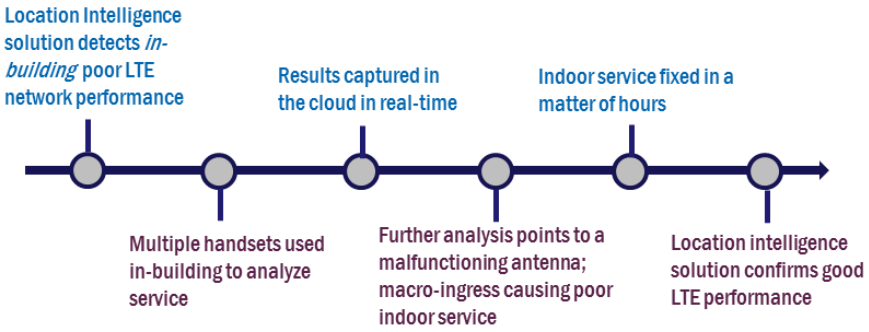

Figure 5.5: Customer-level insight generated from network and customer data [Source: Analysys Mason, Viavi Solutions Inc, 2016]

5.4 Assuring QoE for video

It is now widely accepted in the telecom industry that video is the new killer app. Video accounts for the majority of data traffic that traverses communications networks, and most forecasts predict that video will account for about two-thirds of mobile data traffic by 2020. Furthermore, with the increasing adoption of multi-screen video services, a diverse set of consumer devices will drive different consumption patterns, with varying QoE expectations. It is therefore essential for CSPs to implement a robust QoE assurance strategy that takes into consideration the multiple facets of video service delivery, such as the nature of video application (e.g. YouTube or Netflix) and the type of device used for service consumption (e.g. tablet, PC, IPTV or smartphone).

Figure 5.7 illustrates an example scenario where a customer suffers poor QoE because of a low-quality Wi-Fi service. Using location intelligence and app awareness, together with data from instrumentation on the consumer's device, the CSP can isolate the issue and identify a resolution which improves the QoE of the video service and enhances the customer's experience.

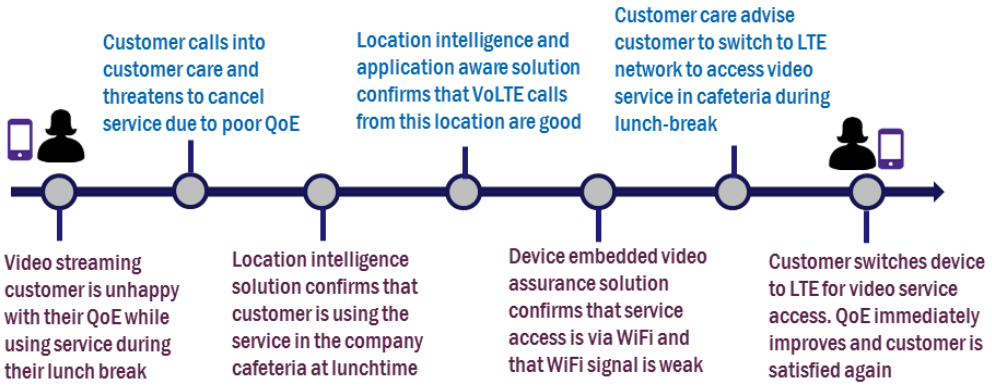

Figure 5.6: Assuring QoE for video: example scenario [Source: Analysys Mason, Viavi Solutions Inc 2016]

6. Conclusion and recommendations

In the rapidly changing mobile services landscape, CSPs must make customer retention the basis for their long-term sustainable growth, and use a strong competitive differentiator to support this strategy. A multi-dimensional QoE approach to monitoring and assuring the customer's service quality can be the differentiator. Only a holistic QoE approach provides a true end-to-end view of the service, enabling CSPs to prioritize follow-up actions to improve service quality and overall customer experience. A unified QoE approach should consider the following six aspects:

- End-to-end network performance, including the end device, access (RAN, Wi-Fi, small cells), core network, and the application servers.
- Customer's geo-location (where and when?).
- The app or service accessed by the customer (what?).
- The customer's identity (who?).
- The device being used.
- The time period of usage.

For highest impact, CSPs must consider implementing use cases that takes into account all six aspects. Assuring VoLTE, targeted RAN and HetNet optimization, as well as video QoE, are some examples that the CSPs can consider.

About the author

Anil Rao (Senior Analyst) is a member of Analysys Mason's Telecoms Software research team, and is the lead analyst for the Service Assurance programme, focusing on producing market share, forecast and research collateral for the programme. He has published research on IP probes, real-time network analytics and the importance of service assurance in reducing churn and improving customer experience. Anil holds a BEng in Computer Science from the University of Mysore and an MBA from Lancaster University Management School, UK.

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