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Fixed access network health check

Improve QoE by gaining a new understanding of broadband network performance and configuration

White paper

Fixed broadband network health plays a critical role in ensuring the quality of new ultra-broadband services. To meet customers' expectations regarding quality of experience (QoE), service providers need solutions that can enable them to understand and improve the performance and configuration of their broadband network.

This white paper describes how a network health check can help service providers make their fixed networks healthier, easier to control, and quicker to troubleshoot. By identifying issues that impact services, a health check can enable service providers to take the first step toward the highest levels of service quality assurance.

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Introduction

Technology evolution plays a central role in the lifecycle of every broadband network. Operators of fixed networks typically use evolution to bring higher bandwidth to business and residential subscribers. Today, these service providers are seeking to create a path to gigabit services by deploying new copper technologies or extending fiber to the home. As a result, most fixed service providers now use a heterogenous mix of access networks to deliver their services.

Subscribers have come to expect an improvement in quality of experience (QoE) with each major increase of available bandwidth. To meet these expectations, service providers must determine the most appropriate network evolution path from an economical point of view and ensure that their current operations and engineering processes do not hinder their service delivery capabilities. They can succeed only by ensuring that their fixed networks remain healthy throughout their lifecycle.

Service providers normally need an end-to-end analysis with a service-specific measurement strategy to evaluate QoE for services such as IPTV, VoIP, or high-speed internet (HSI). This approach can yield good insights about how end users perceive the service. However, it generally does not allow service providers to pinpoint the root causes of temporary or systemic service disruptions. Service providers need to perform a network domains analysis to determine whether each domain (e.g. fixed access, RAN, IP core) is operating or configured according to specifications.

This white paper addresses the challenges that service providers face in evaluating the QoE delivered by their fixed access networks.

Challenges in maintaining the network healthy

Many issues can impact service delivery. These issues vary for each network domain. Fixed access networks connect end users to the broader service provider network, so they will be the first suspected if a service fails. As a result, service providers must place a strong emphasis on maintaining healthy fixed access networks.

Three factors typically guarantee the quality of services delivered through broadband access networks:

- Appropriate engineering rules for all domains associated with these services, from broadband access networks to core IP/optical networks and service platforms
- An appropriate monitoring and operations strategy, which governs the monitoring of objects, key performance indicators (KPIs), and procedures
- Appropriate troubleshooting methodologies in case of service degradation or failure

New networks tend to be healthy. They deliver the services they have been designed for. However, two categories of service-affecting issues will occur during the lifecycle of a network. The first category includes service interruption issues caused by failure at different points in the networks, such as line cards, the outside plant, or customer premises equipment (CPE). These points are well monitored, and a service provider can typically resolve the problem and restore the services. If the service provider cannot immediately determine what caused the failure, it can perform a root-cause analysis to gain a better understanding of what happened. It can also create a plan to prevent the issue from occurring again.

The second category includes degradation issues or errors that do not necessarily lead to an immediate service interruption, but might eventually affect overall network performance. These issues are more complex to address or troubleshoot because they cannot always be detected in an operations center. The approaches for addressing these issues range from internal audits (proactive) to focusing on troubleshooting (reactive).

To provide a reasonable level of service quality assurance, service providers must understand, monitor, and identify issues from both categories. This means they must complement a reactive approach that focuses on troubleshooting with some level of regular auditing. Service providers tend to focus on failures that interrupt services through lifecycle management programs or reliability analysis, but degradation errors can have an equally great impact on services.

In analyzing configuration errors in fiber-to-the-home deployments, Nokia found a configuration accuracy level between 65 and 85 percent across more than 50 configuration check points. In contrast, a network with 100 percent configuration accuracy would fully comply with the initial configuration rules and achieve "pristine" status. The Nokia analysis shows that as networks age, their configuration degrades. This degradation reduces the degree to which service providers can control their networks.

These configuration issues are exacerbated by the fact that in several broadband evolution scenarios, the path towards gigabit services does not require a fresh network layer. Instead, the path often involves upgrading the current network with new hardware or software. In these scenarios, some systems will need to support legacy and new services. The upgrade-based strategy implies that errors introduced in earlier phases of the fixed access network lifecycle can impact the new services.

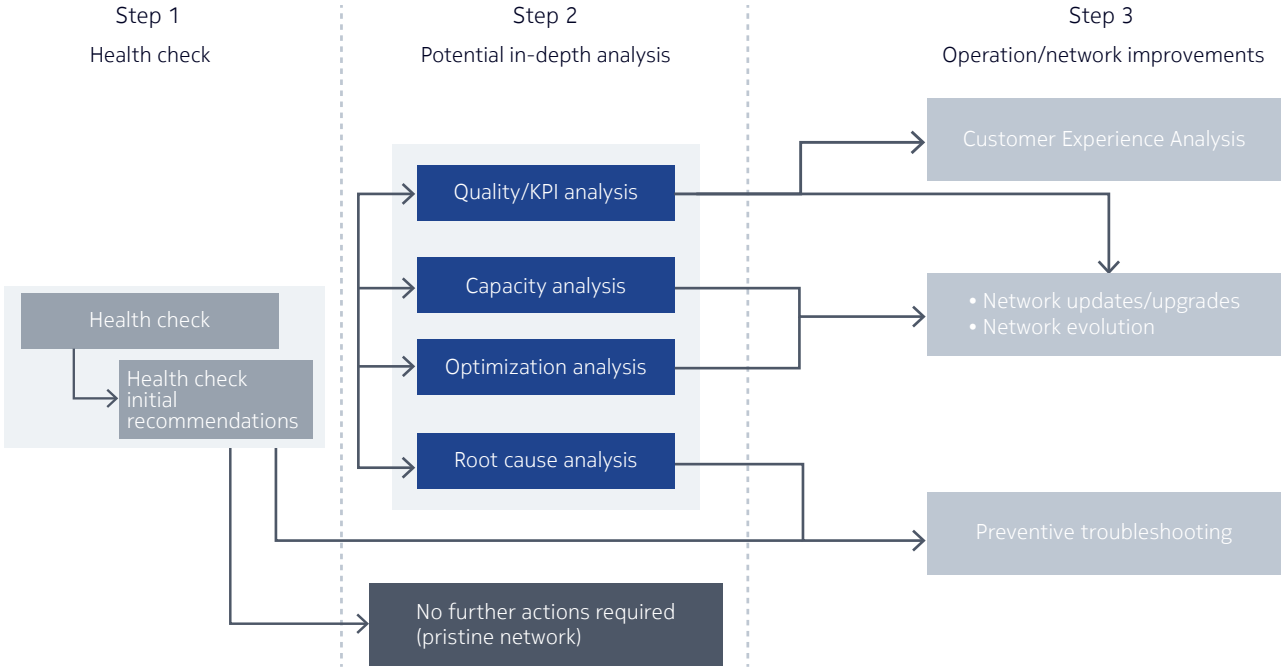
Increasing the network's competitive fitness

Nokia enables service providers to assess and improve the QoE delivered by their networks with a process that includes three main steps:

- Conduct a **health check** to gain a better understanding of the level of performance and quality (configuration) that the network delivers.
- Perform **in-depth analysis** that focuses on identifying areas that need optimization, uncovering the root causes of service interruptions, or expanding on complex assessment areas such as quality of service (QoS).
- Add **operations or network improvements** to support end-to-end customer experience assessments, upgrade the network, eliminate errors, or identify the root causes of failures.

The health check is a stepping stone that enables the service provider to capture a large set of relevant and manageable issues. It narrows the scope of the follow-up activities by identifying the key points to address with in-depth analysis and potential improvements. Figure 1 shows some types of analysis and improvement that can be addressed with this process.

Figure 1 Step-by-step approach towards service quality assurance



The health check enables the service provider to establish a baseline view of the health of its fixed access network. It provides a standardized way to capture performance and configuration data at a set of points within the network. At each point, the health check compares the status of each node in the network to a "golden" configuration or reference value. It then identifies performance or configuration issues that could have a negative impact on QoE.

Observed issues are further analyzed. This analysis creates benchmarks by using sources of information that are not available to third parties (which increase available information by 25-50 percent), and by providing initial recommendations based on Nokia's expertise and experience with other service providers.

The recommendations produced by the health check define the most appropriate next steps. They can include recommendations to analyze quality, capacity, optimization, or root causes in depth. The outcome of this in-depth analysis provides information that can be used to define required operational or network improvements.

Nokia health checks use predefined check points associated with:

- **Platforms**, which include specific types of equipment (e.g. DSLAM, OLT, ONT, CPE) that share common characteristics
- **Access technologies** such as xDSL, GPON, and EPON. Each of these technologies requires its own specific set of check points. It may share common check points with some or all other access technologies.

Once available, the information for each check point is clustered into categories (e.g. performance, quality, security) and subcategories (e.g. port status, CPU, uplink) to create a summary view of platform- or network-level health. Service providers can use this summary view to identify important issues, determine how far these issues have spread in the network, and understand the criticality level of each category. The health

check also provides a summary of recommendations that service providers can use for reporting or making quick comparisons with previous health checks to determine whether improvement measures are working.

Health check results are assigned scores (0-100 percent) that indicate performance and configuration levels. The scores are combined to create a Health Index. A score of 100 percent indicates optimal network performance and configuration. Lower scores indicate degradation or a lack of control over the network. Service providers can use the Health Index for peer comparison and to measure internal improvement following remedial actions.

Nokia Health Check benefits

The health check enables service providers to understand what is happening in their fixed access networks and identify issues that need to be addressed. Its direct benefits are improvements relating to network operations, cost, and quality thereby optimizing the return on investment (RoI) of their broadband evolution programs. The health check can also provide indirect benefits relating to operational improvements and the identification of growth potential.

Assurance of quality

By clearly representing issues and correlating seemingly disjointed information related to QoE and QoS, the health check helps service providers pinpoint relevant information and reduce systemic errors in the fixed access network domain.

The fixed network health check can also be part of a routine proactive maintenance check performed at regular intervals or prior to events that might drive increasing use of specific services. For example, a service provider may want to verify that IPTV-related resources are in good health before holidays or major sporting events. Proactive maintenance can enable service providers to identify and resolve issues that could cause customer complaints, including misconfiguration and abnormal node behavior.

Optimized cost of operations

Nokia has integrated lessons learned from past customer engagements into the health check to help service providers identify areas or check points that are most likely to cause service disruption. The health check also uses these lessons to identify potential issues with network nodes and anticipate on-site actions more accurately.

By offering the flexibility to evaluate and represent relevant check points for each specific need, the health check helps service providers optimize operating cost by avoiding unscheduled truck-rolls and spending less time on troubleshooting tasks. This translates directly to cost savings. It also improves end users' perceptions of QoE by reducing time to resolution. In addition, advanced methodologies from Nokia enable the health check to correlate large quantities of information and support more efficient management, troubleshooting, or maintenance.

Operational improvements

Service providers can use the Nokia health check approach to measure the impact of corrective operational actions. The initial health check helps identify areas for potential improvement. Subsequent health check results, summarized by the Health Index, can be used to track the service provider's progress in making these improvements. The Nokia health check methodology is standard and fully anonymized, so it allows service providers to benchmark themselves against peers or best-performing service providers.

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Identification of growth areas

Service providers can correlate data from the health check (e.g. utilization or capacity data) with additional sets of information (e.g. demographic or socio-economic data) to identify specific areas of low utilization. They can use their findings to attempt to stimulate take rate and growth.

Conclusion

The Nokia health check allows service providers to gather performance and configuration data from the fixed access network and analyze it to identify opportunities to achieve the highest levels of quality assurance. This analysis also produces a Health Index score that service providers can use to benchmark the quality of their networks against those of industry peers.

By following expert recommendations from Nokia on how to improve its network Health Index score, a service provider can inspire customer loyalty by ensuring that its fixed access network delivers the best possible QoE.

Acronyms

CPU	central processing unit
DSLAM	digital subscriber line access multiplexer
EPON	Ethernet passive optical network
GPON	gigabit-capable passive optical network
HSI	high-speed internet
IPTV	Internet Protocol television
KPI	key performance indicator
OLT	optical line terminal
ONT	optical network terminal
QoE	quality of experience
QoS	quality of service
RAN	radio access network
RoI	return on investment
TCO	total cost of ownership
VoIP	voice over IP
xDSL	digital subscriber line technologies (ADSL, VDSL)

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