



Driving in-home experience in the digital age

Applying AI/ML insights for experience
centric fixed broadband

White paper

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Introduction

Broadband consumer networks have been expanding faster than forecasted. Remote work has accelerated across the world. The number of elderly people living alone has been rising in developed countries, raising the need for remote doctor visits. The need for online education from primary education to university degrees has also been increasing, with more online degrees available, higher acceptance of them in the workplace, and more virtual homeschool options available. And the broadband consumer networks also experienced the most rapid change in history, due to the COVID-19 worldwide pandemic.

At the same time, customer expectations over the past ten years have grown more sophisticated as network connectivity is now considered to be as vital as air, water, electricity, and even food.¹ The continuous increase in network traffic and higher customer expectations have created a set of challenges for broadband providers. First, it's about how to deliver broadband connectivity to every customer, i.e., how providers ensure that people can continue communicating and utilizing the applications they have come to depend on for everything from work to entertainment. Second is meeting the objective to increase the quality of service, i.e., connecting people with ease and low cost, providing extraordinary customer experiences that can be monitored, measured and amended to overcome problems.

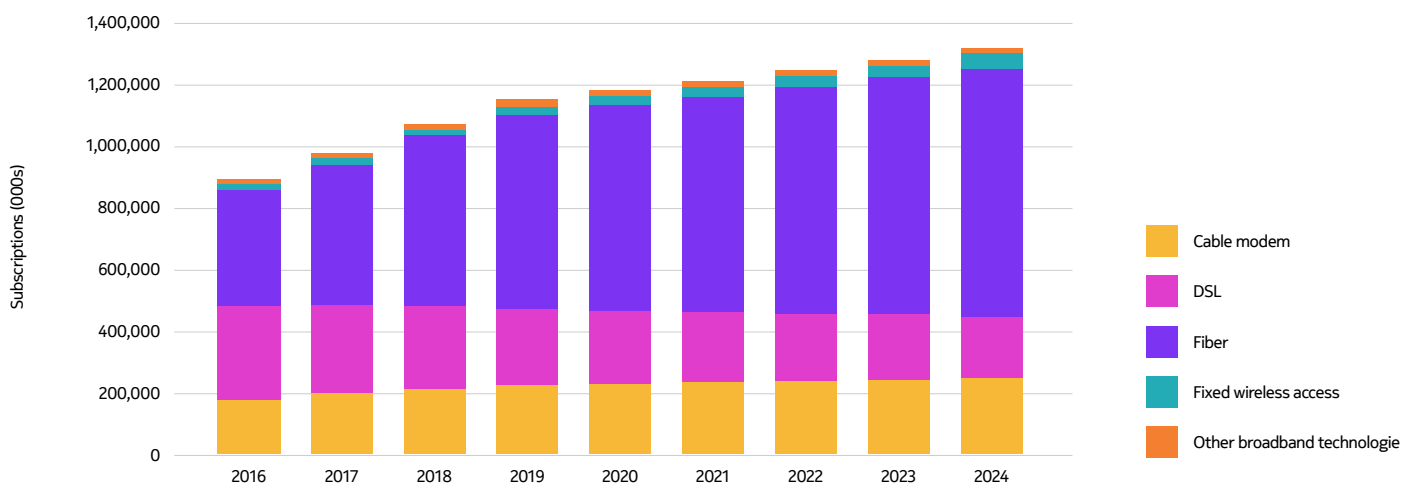
To increase efficiency and improve customer satisfaction, broadband providers need to shift their investments towards ensuring fixed network quality and optimizing customer experience. And to be successful, these objectives require current processes to be predictive, more data driven, more automated and capable of leveraging data across provider functions to react rapidly and dynamically to changes.

¹ Customer Experience Is More Than What You Think It Is, IDC whitepaper sponsored by Nokia, 2019

Fixed broadband: here to stay

Broadband connectivity has become a fundamental part of our daily lives, shaping entertainment, educational and business activities. While the United Nations in 2016 labeled access to the internet as a human right, many people today believe that it should be a public utility, very much like water, gas and electricity. Given its pervasive nature and growing importance, customers' expectations are at all time high – where always on and flawless connectivity is a new normal.

Figure 1 - Broadband access technology subscription forecast²



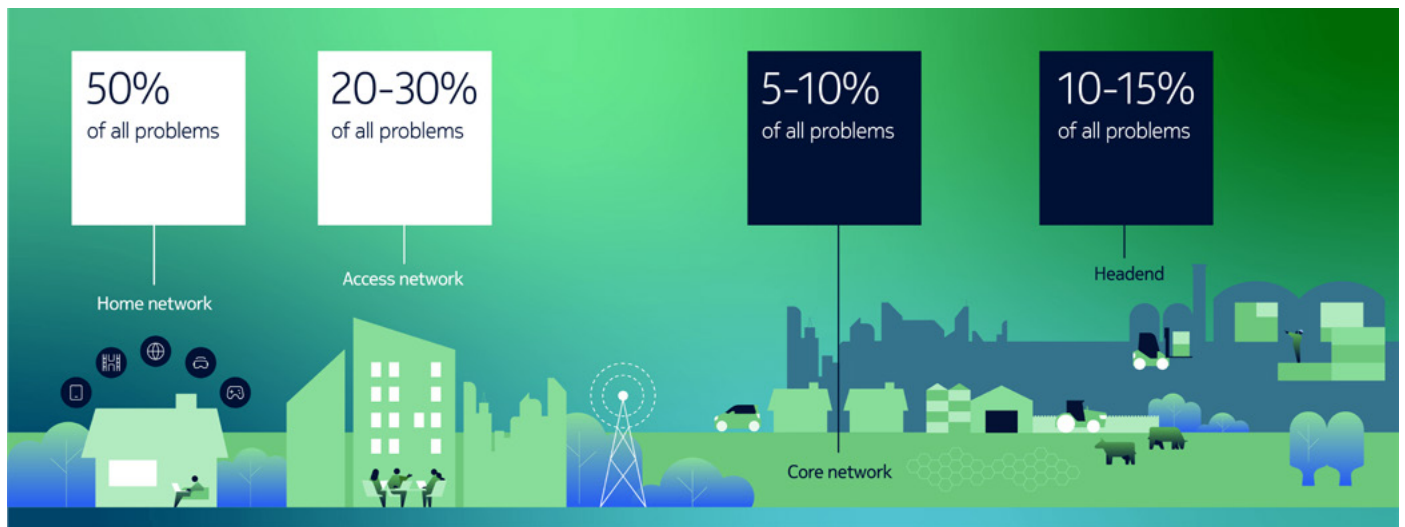
Broadband providers are facing a two-fold challenge: delivering broadband connectivity to every customer (i.e., network expansion) and increasing quality of service. Global deployments of copper (i.e., DSL) and cable are reaching a plateau, but there is strong momentum predicted in the coming years with fiber and fixed wireless access (FWA), as indicated in Fig. 1.² This means that providers will focus on expanding and strengthening the fiber to the home (FTTH) infrastructure and harvesting deployment velocity and network densification with FWA to offer service to as many customers as possible while increasing the throughput (with peak rates up to 1Gbps). The latter goes hand-in-hand with the rollout of 5G mobile networks where mobile providers will look to offer broadband connectivity via 5G FWA.

The challenge broadband providers must overcome has to do with service quality, and research has shown that most problems occur in the last mile – in home and access networks. Access network issues are characterized by cabling impairments, wireline interference and network element failures, while home network problems are predominantly driven by Wi-Fi issues (incl. contention, congestion, interference and coverage) and in-home wireline (ethernet, optical, powerline) connectivity.

With problems related to broadband internet delivery, it becomes of paramount importance for broadband providers to develop the means to monitor, diagnose and troubleshoot their networks in a proactive, accurate and effective manner in order to optimize customer experience.

² Total Fixed Broadband Subscription and Revenue Forecast: 2019–24, Ovum, Mar 2020.

Figure 2 - Problem distribution in broadband internet delivery³



Fixed broadband under unexpected pressure

Broadband consumer networks have been evolving the last few years, but recently experienced the most rapid change in history during the global COVID-19 lockdown, creating an enormous shift in network traffic. Network traffic that has normally been distributed among enterprise, education, and public Wi-Fi networks has now collapsed into a single network access type: fixed consumer broadband. This has caused significant changes in traffic composition and introduces new challenges for networks worldwide, and especially for broadband providers, to ensure the quality of service to the end users.

Nokia's customers are good examples of how network traffic increased. For a fixed provider, streaming traffic increased by 300% in the first week of the quarantine, mainly driven by YouTube and Netflix, causing an overall 200% increase in traffic. Video conferencing applications required to work remotely such as Webex or Skype for Business also experienced a huge increase of 1000% and 600% respectively. Gaming traffic grew by 600%, with the number of subscribers gradually increasing for family games and people playing all day with the same level of usage until late in the night. In fact, gaming, video streaming and social sharing experiences have driven consumer broadband usage in both mobile and fixed networks. These same activities are also the ones which have grown the most during the global pandemic and in our "new normal," and together add up to 80% of internet traffic worldwide.⁴

Bad experiences with these applications cause consumers to switch plans or even switch their broadband service provider altogether. In fact, 50% of end customers will be ready to switch their provider in 12 months if they cannot enjoy immersive experiences such as gaming, virtual travel, video capture and streaming (e.g. while mobile or at large events), or smart home video detection such as a package delivery or if someone is at the door, according to research conducted by Nokia.⁵ Those most likely to switch are also highly engaged users – remote workers, gamers, video streamers – representing a higher lifetime value to their providers than those who don't show interest.

All these applications and services are highly experience-sensitive. And it is vital for service providers to ensure their customers get the experience they are expecting based on their needs, at the right time and location, in the devices they use, and in the touch points they interact with. And this is where AVA Fixed Network Insights can help: to optimize customer experience for all home & access services.

³ Nokia internal research, 2019.

⁴ COVID-19 Global Internet Phenomena Report Highlights by Sandvine, 2020

⁵ 5G report: The value of 5G services and the opportunity for CSPs by Nokia, 2020

Expanding the view with AVA Fixed Network Insights

AVA Fixed Network Insights enable continuous data collection from multi-vendor access network elements (i.e., DSLAM, OLT) and home customer premise equipment (CPEs incl. Wi-Fi routers, Wi-Fi repeaters, powerline adapters, STBs etc.). This solution computes insights in a proactive manner to indicate issues on network segments and/or network elements.

Resolutions for these problems can be provided through proactive recommendations. In the process of turning raw data into insights and recommendations at scale as illustrated in Fig. 3, Fixed Network Insights blends domain knowledge, patented technology and dozens of productized use cases across a variety of networking domains.

Figure 3 - Fixed Network Insights



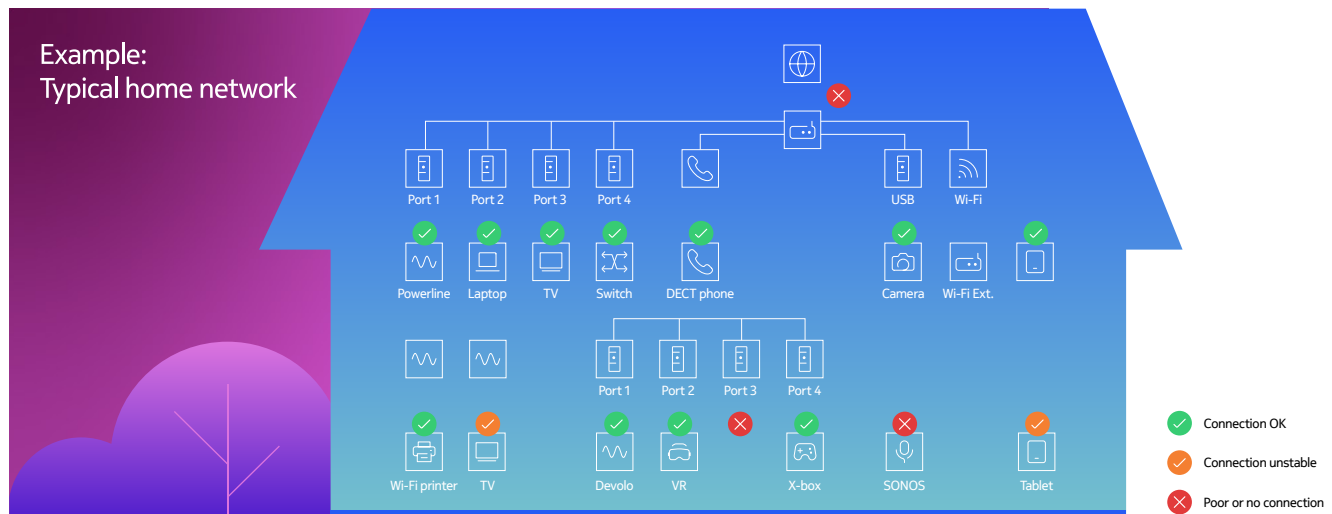
The number one broadband service issue reported by subscribers is the aggregate of a set of problem variants that are related to limited bandwidth, identifying the subscribers' satisfaction level regarding the service. There is also a higher probability that the access network is the cause of the issue, as well as the potential that subscribers used to a fixed service will perceive this as the origin of the problem. This makes it critical to isolate the domain that is the true source of the problem as soon as possible and recommend how to fix it. Hence, considering both the home and access network is vital.

AVA Fixed Network Insights provide visibility across both the home and access network segments irrespective of the access technology or device vendor. This unified model enables an expanded historical view from the access network element down to end user devices (e.g., smartphones) with insights (KPIs, KQIs, observations) and recommendations for each element and segment. This has proved to be a silver bullet for addressing customer issues, especially for customer support teams.

Addressing the home network

Today's broadband home networks and their connected devices require the analysis and combination of large network, device, and subscriber data sets to mine the customer experience across offered devices, manufacturers, models and firmware. And to improve the home experience requires further analysis to accurately determine actionable recommendations for problems affecting customer experience, either reactively (with the help desk) or proactively (with self-care or automatically triggered actions).

Figure 4 - Diagram of a home network



Service providers simply cannot ignore the home network. It is a risk for customer experience, even if the home network is not provided by the provider. Delays in activating or restoring service, double dispatches, replacements of functional devices and frequent calls to customer service centers can mean big trouble, by reducing customers' comfort with broadband services, reducing willingness to try new services, and inviting churn at a time when customers have lots of choices:

- 96% of customers expect their service providers to proactively notify them about actions being taken — or even better — the solution to an impending problem
- 50% of technical support calls are related to home network issues
- 70% of devices returned have nothing wrong with them
- 89% of churn is caused by poor customer experience

Many providers rely on customer complaints to learn about service disruptions because of the lack of visibility into the home and customer premises equipment (CPE). These difficulties diminish customer satisfaction and drive up the cost of supporting devices and services for the broadband home.

Get the visibility into home issues

With Fixed Network Insights (FNI), we extend the visibility into home issues, increasing the percentage of home issues that can be healed automatically without truck rolls or agent-assisted care support, and empower users to fix problems on their own through self-care. The end-to-end view enables an effective and accurate demarcation and resolution of issues, resolving many thousands of calls and increasing NPS.

For Nokia, prescriptive analytics is the foundation of comprehensive customer operations. It addresses customer issues before they arise and goes one step further by providing management systems with automated decision tools to prevent service disruptions.

The FNI recommendations module provides home experience repair and improvement recommendations. These can then be implemented through one of the care channels, including proactive care needed to optimize customer support, remediate problems, and fix home issues before they impact the customer experience.

FNI end-to-end recommendations are pre-integrated with our Service Management Platform (SMP) to implement a self-healing closed-loop automation process: Proactive Care. In this case, SMP acts as the orchestration engine, which is triggered by the FNI recommendations and consequently triggers corrective actions through the Home Device Manager or ACS (Auto configuration server).

Examples of automated decision tools include algorithms to predict CPE failure, analysis of home Wi-Fi data to predict Wi-Fi interference or poor coverage experience, and algorithms to detect line instability.

Examples of actions/proactive care that can be initiated by the automated decisions include:

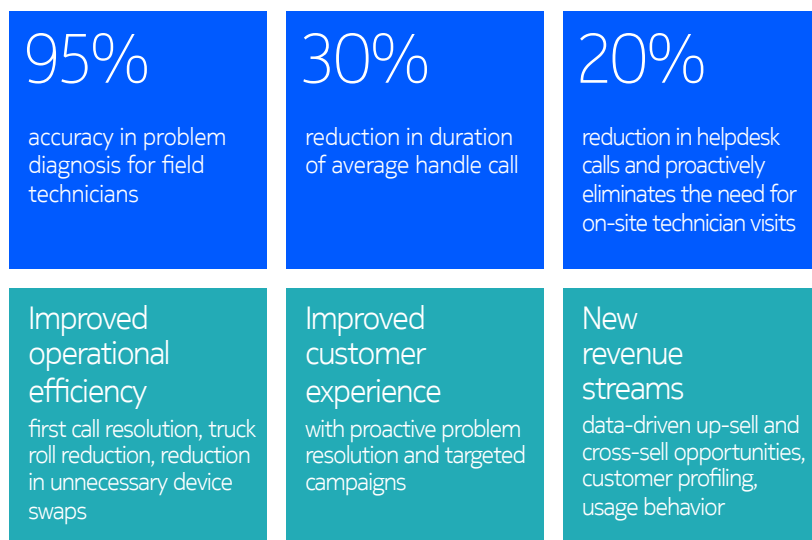
- automatically re-configuring or rebooting the CPE before the customer notices an issue and calls the help desk
- optimizing the Wi-Fi configuration of a group of access points
- notifying customers of the problem and providing instructions/information
- shipping replacement equipment or mobilizing field technicians to undertake proactive repair actions
- annotating the customer's account information, so that CSRs are aware of potential problems in case the customer calls the help desk

A key part of the solution for home networks is our Home Device Manager (HDM). It provides remote management of digital home devices, based on the Broadband Forum TR-069 standard. Home device manager accelerates the introduction - and automates the mass management - of new home devices and advanced home gateways. It can also provide crucial device information that call centers can use to quickly identify and resolve issues in the increasingly complex digital home.

Understanding your customers: Going proactive

Insights-driven proactive care is one of the pivotal drivers for care transformation programs at broadband providers. For these programs to succeed, it is vital to have a deep understanding of device, home and network-driven issues, and the ability to correlate the primary indicative datapoints across all these domains. And this is exactly what AVA Fixed Network Insights solution provides.

Figure 5 - Fundamental benefits of AVA Fixed Network Insights



Customer care teams are continuously monitoring customer experience to unveil short term (i.e., immediate) impact as well as long term trends. This is to identify impacted subscribers and trigger corresponding actions. There are also many opportunities to initiate proactive fixes that do not require the intervention of a subscriber or an agent. Fixing issues proactively, before the customer notices or calls customer care, is the best and lowest cost way to optimize customer experience.

For example, wireline impairments impact the successful delivery of streaming services, which in turn has a dramatic effect on customer experience, even if it lasts a short period of time. Nokia is uniquely positioned to solve this problem in real time and minimize the impact on subscribers and other services.

Nokia's deep understanding of networks enables the design and implementation of temporary or permanent proactive remediation operations within the network and inside the home in a way that creates a net positive outcome as opposed to surfacing new problems in other areas. It is also important to note that proactive fixes can have a negative impact if they are not handled properly. We bring the knowledge of those changes that can have an impact on network operations, so they can be highlighted and vetted as necessary before implementation.

The longer the service downtime persists, the more the customer's experience suffers, discouraging future customer adoption, and making it difficult to scale services to large numbers of subscribers. Therefore, providers need the fastest possible tools to quickly isolate and repair problems, while minimizing downtime.

There are often many different parties, from individual employees in the Network Operations Centers (NOC), support center and back office, to equipment and service partners, involved in delivering broadband service. Coordinating the exchange of information among all of these stakeholders is vital to the provider's success and addressing the challenges. Challenges will only get bigger in digital times, with next generation PON technology complexity and 5G network business models.

Empowering the customer support frontline

AVA Fixed Network Insights is complemented by Network Analyzer (NA), which is a cost-effective, remote management solution for access networks. It leverages the service provider's access equipment capabilities to speed up network activation, assess network performance, and localize and identify faults in the access infrastructure. NA can be effectively integrated into existing operations support systems (OSSs), customer portals, inventory systems, and third-party gigabit passive optical network (GPON & XG-PON) equipment.

NA supports multivendor environments and is pre-integrated with SMP to provide a library of FTTx use cases for Field Tech, Customer Care and Self-Service solutions. This includes the workflows and dedicated user interface for field technician activities that help them reduce call-backs for installation issues or other field activities. It also provides workflows for agent-assisted care and tools that can be leveraged for

self-service. It makes it easy to remotely troubleshoot access network issues and quickly and accurately escalate problems to proper channels for onsite resolution.

Personalizing in-home experiences

Customer satisfaction is defined through application touchpoints for entertainment, educational and business purposes. While network analytics is fundamental in understanding customer impact, for full customer centricity one must gain insight into customer experience. To that end, AVA Fixed Network Customer Insights delivers a customer experience index (CEI) that calculates customer satisfaction.

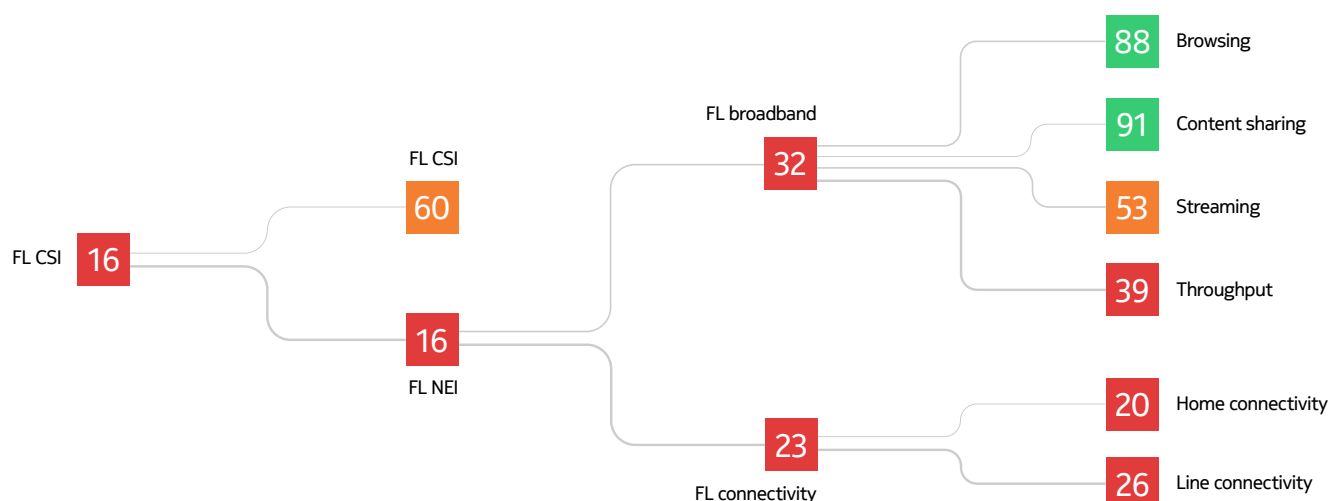
By leveraging the Nokia Customer Experience Index (CEI), broadband providers receive priceless insights into every moment with each and every customer, enabling them to better meet their needs before issues arise and ensuring positive experiences for all customers regardless of fluctuating demands caused by the global pandemic and new normal. Nokia CEI leverages machine learning to help providers understand their fixed customer's experiences.

With CEI, providers can identify the main driving factors and metrics for improvement and link them to actions across functions and processes. It leverages a customer centric cross-dimensional data model with 330+ metrics and dimensions for slicing & dicing.

Flawless streaming, gaming & video conferencing

The end customer's service experience plays a crucial role in the success of fixed broadband. By being able to recognize faults and provide transparency, instructions and detailed knowledge of the end-to-end service as well as the customer experience it helps the provider to provide fast, flawless and low latency broadband service.

Figure 6 - Customer Experience Index to understand fixed customers' experiences



Converged CEI, which combines both mobile and fixed customer satisfaction scoring, and the detailed fixed network customer experience indices speed up the detection, correction and proactive prevention of potential faults. They enhance the agents in frontline customer service desks and service operations centers (SOCs) and provide broadband executives a much richer and more accurate view of root causes and conversations about their customer's experiences. These indices can drive automation and improve first call resolution.

AVA Fixed Network Insights together with the CEI brings a truly multidimensional insight for each and every subscriber in the network, to know each customer as an individual. This allows broadband providers to provide in-the-moment, personalized experiences.

Optimizing the 5G experience

5G has the potential to change the rules of the game for fixed providers in an unprecedented way. The service consumption at home is more and more happening on wireless devices, with the home network being perceived as an extension of the mobile network eliminating worry about throughput and data volume. With 5G, the user experience will improve to such an extent that fixed lines will face

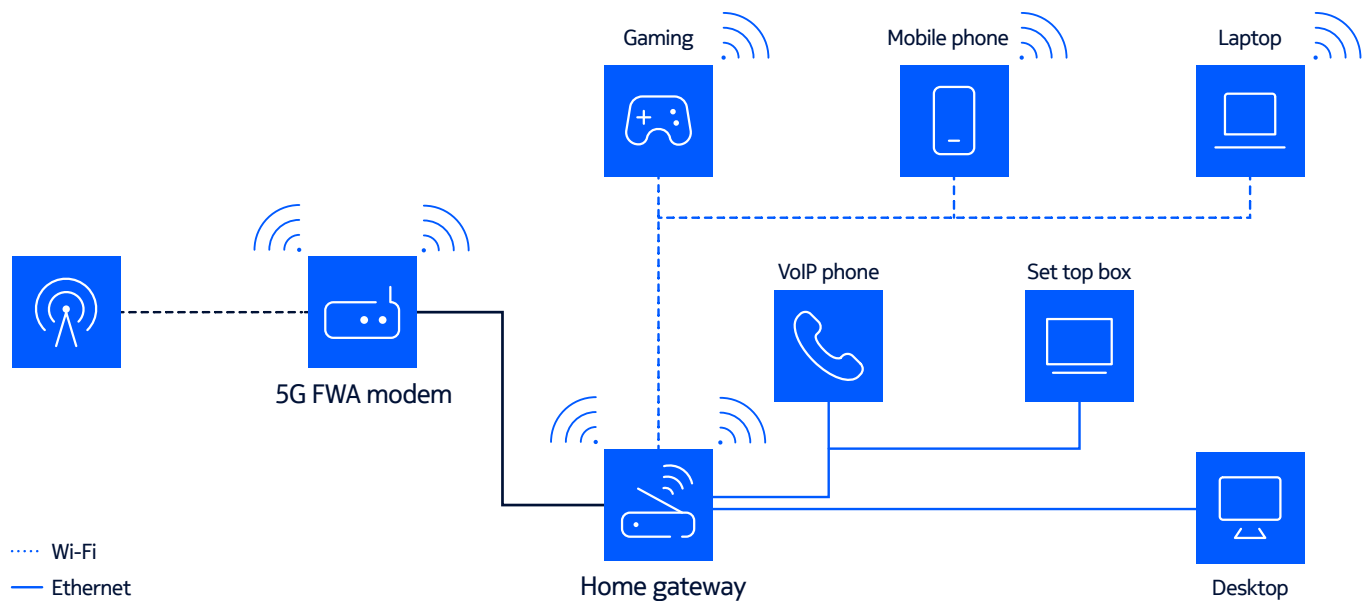
unprecedented infrastructure competition from multiple new players in the same geography. But to deliver great quality of service requires the current processes be more data driven, more automated, predictive and capable of leveraging data across an provider's functions.

To boost the last mile connectivity in both densely populated urban and remote rural areas, fixed wireless access (FWA) has recently emerged as the most suitable candidate. Nokia research found that 76% of mobile consumers in the U.S., U.K., and South Korea rated 5G FWA as appealing. Moreover, 66% of consumers would be willing to subscribe to 5G FWA if it cost the same as their current wired broadband service.⁶

With global rollouts of 5G networks and a simple self-installation process, subscribers can obtain internet access through an FWA outdoor receiver connected to the mobile network from one side, and an in-home Wi-Fi router on the other. Next to ease of deployment, part of the appeal for 5G FWA is the throughput of 1Gbps and 300Mbps for peak and average throughput, respectively.

6 Nokia Consumer Survey. The survey fielded 12/19 – 1/2020.

Figure 7 - 5G fixed wireless access connectivity to the home.



AVA Fixed Network Insights provides unique insights to optimize the 5G FWA experience. Home devices associated with a 5G FWA service include both outdoor (antenna unit) and indoor (home Wi-Fi and other gateway functions) components. It highlights the importance of isolating any issues to a specific device, and then to be able to distinguish between the access network, antenna, gateway, and Wi-Fi functions.

Also, with 5G FWA, two wireless networks are now in play as well as in-built automated control systems for each 5G access system and in-home Wi-Fi optimization. By collecting and analyzing data from both domains and monitoring behavior over time, AVA Fixed Network Insights can filter out changes driven by automated service optimization. It can also compare how these changes in each domain affect the other and recommend fixes that will isolate root causes and optimize overall service performance.

In addition, issues on the 5G network (core or access) can lead to reduced bandwidth or connectivity issues from the FWA side. AVA Fixed Network Insights can ingest this information to eliminate possible causes from the home side and alert customer support teams. It can also identify cases that are causing customer experience degradations, provide adequate recommendations to the end user and help in proper tuning of edge intelligence algorithms.

Accelerating digital transformation with SaaS

Embarking on a transformation journey for fixed broadband providers means shifting operations and decisions to be data driven and automated. The champions behind this transformation are CxO teams. Their objectives revolve around

(1) improving operational efficiency, (2) improving customer experience, and (3) finding new revenue streams.

AVA Fixed Network Insights provides actionable information (i.e., insights and recommendations) for network operations, customer support, IT, customer experience and marketing departments to advance toward these objectives. Network operations can optimize their processes with the aim of reducing truck rolls, unnecessary device swaps and resolving issues correctly in the first interaction, leading to

substantial savings in OPEX. Customer care departments can proactively identify the subscribers suffering deteriorated experience and uncover the most impacted subscribers in order to rectify their situations, preventing the possibility of churn. And the marketing department can harvest reporting capabilities to gain insights into how the home network is used (e.g., number and type of devices, consumption profile etc.). With the primary aim of improving customer satisfaction (increasing throughput or solving home networking issues), this enables data-backed upsell or cross-sell offers.

To accelerate the digital transformation journey, AVA Fixed Network Insights is also available in a Software as a Service (SaaS) model. Designed for carrier-grade networks, FNI SaaS is delivered with a fully digitalized business experience and a fully automated services lifecycle. With on-demand access through Nokia's SaaS framework, broadband providers can achieve faster time to value, cut IT infrastructure costs and improve operational agility. In addition, with FNI SaaS, broadband providers have always-on access to the latest AI insight and prescriptive recommendation packages for home and access domains to drive continuous improvements in broadband network performance and reliability, enhance customer experience and boost customer engagement and loyalty.

Key benefits of AVA Fixed Network Insights as SaaS



Faster time-to-value

SaaS accelerates time-to-value by speeding up software procurement, installation and configuration. We can typically provision software in hours or even minutes - for much faster customer adoption and use of service. SaaS also facilitates ecosystem development, making it quicker and easier to bring in partners and customers for service co-creation.



Greater business agility

Rapid provisioning and limited-time subscriptions make it possible to trial new services and evaluate new markets before committing to large-scale rollouts. You can then adjust SaaS usage as required - with automated scaling and on-demand resource availability according to customer need. Because all software patches and updates are handled automatically by Nokia, you no longer have to worry about installing new software or ensuring you're running the latest version - freeing internal IT teams to focus on more important priorities.



Improved cost control

SaaS eliminates large upfront capital expenditures as there's no need to buy software outright and no additional on premises hardware required to host the software. That can help you reduce spending on IT activities of negligible strategic value and little-to-no ROI justification, such as customizing OSS/BSS software or maintaining self-managed cloud environments. On-demand access to software and pay-as-you-go/grow subscription models provide improved cost management, lower TCO and compelling economies of scale.

Conclusion

The global lockdown and increased 5G rollouts have created a big challenge for broadband providers to ensure excellent quality of service and great experiences to subscribers. Delivering extraordinary customer experiences is still an area where telecom providers have room to differentiate and compete. According to Salesforce⁷, 84% of consumers say that experience is more important than the product or service. Adding to the trend, PriceWaterhouseCoopers states that “32% of all customers would stop doing business with a brand they loved after one bad experience.” This number approaches 50% after several bad experiences.⁸

The ability to manage and proactively resolve issues in the home network will be a key element to respond to the increased customer expectations around the in-home experience. Also, how well providers understand the home network and related devices to both proactively avoid service issues and offer quick remediation of those that require agent care is an important role to keep the end users happy.

In summary, success will depend on the ability to connect various insights, systems and processes across the journey that enable a consistent and positive experience. The ability to target the right subscribers and address any service issues before dissatisfaction and churn set in will be paramount to success.

Differentiating on customer experience offers an opportunity to be successful.

7 State of the Connected Consumer report, Salesforce 2019

8 Experience is everything: Here's how to get it right, PriceWaterhouseCoopers

About Nokia

We create the technology to connect the world. Only Nokia offers a comprehensive portfolio of network equipment, software, services and licensing opportunities across the globe. With our commitment to innovation, driven by the award-winning Nokia Bell Labs, we are a leader in the development and deployment of 5G networks.

Our communications service provider customers support more than 6.4 billion subscriptions with our radio networks, and our enterprise customers have deployed over 1,300 industrial networks worldwide. Adhering to the highest ethical standards, we transform how people live, work and communicate. For our latest updates, please visit us online www.nokia.com and follow us on Twitter [@nokia](https://twitter.com/nokia).

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