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The Role of Wi-Fi in the Premium Home Broadband Market

Why high-quality Wi-Fi has become an essential investment for broadband service providers

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Summary

In brief

The consumer broadband service market is now worth $250bn worldwide and is expected to increase to $290bn by 2023. This represents the largest, and fastest-growing, residential telco market by some margin. However, many countries are now reaching market saturation, and fierce competition has driven service providers to offer higher and higher access speeds while ARPU has remained relatively flat. Pressures in other parts of the telcos' business, especially around traditional communication services, means that globally the telco market will only see 2% CAGR over the next five years. In developed regions such as Western Europe, it will be less than 1%. Increasing network scale and service complexity, however, continue to drive operational costs, which with the advent of 5G, consumer Internet of Things (IoT), and next-generation service bundles, will significantly reduce profit margins if not brought under control.

Home Wi-Fi has become an essential part of an operator's broadband business but remains an unmanaged part of the overall network. Poor customer experience has led to up to 60% of customer service calls now being linked to the home Wi-Fi network. With technical support staff unable to remotely access the home network, such calls can be lengthy and costly, increasing the total cost of ownership. Investing in a more advanced home Wi-Fi platform has been proven to significantly reduce such costs as well as to improve customer satisfaction through a better-quality experience.

As broadband consumers become more insensitive to pure bandwidth improvements, service providers must also shift their attention to overall quality of experience to both drive brand differentiation and increase ARPU. Investments are now being made, therefore, in intelligent networks and AI data analytics capabilities to better monitor and manage network quality of service (QoS) and application quality of experience (QoE), as well as to create new service opportunities and better-targeted marketing capabilities. However, to be effective this capability must stretch right to the end device. It is essential, therefore, that home Wi-Fi networks are now equipped to be able to deliver future digital applications such as multiple streams of 4K TV, 8K video, AR, and VR to every room in the home with the right level of quality.

The business case for such investment has been proven by early movers as more advanced home Wi-Fi technology not only enhances brand net-promotor scores (NPS), but also increases operational efficiency, reduces customer premises equipment (CPE) total cost of ownership, and either directly drives or indirectly enables new revenue opportunities such as multiroom video and consumer IoT.

Ovum view

- **A new focus on QoE.** To differentiate their brand and grow revenue, operators have shifted from marketing broadband purely on speed to a new focus on consumer experience. Maximizing the broadband experience is vital to continued broadband growth but also strengthens the service provider's brand, enabling it to successfully expand its digital service portfolio into new areas such as UHD video, consumer IoT, and – in the future – VR and AR.
- **Home Wi-Fi is an essential element of a broadband service.** Broadband service providers around the world have invested in their core and access networks to bring faster and faster speeds down to their residential customers. However, such investment is wasted if the user

does not have an adequate home network to connect their expanding range of devices. To maximize the customer experience, this home network must be based on Wi-Fi technology and all broadband service providers now need to base their future CPE roadmap around this standard.

- **Home Wi-Fi investment is key to service differentiation.** Broadband marketing is rapidly shifting to QoE, but to be effective this must be provided right down to the end device, not just across the operator's core and access network. An important link in the end-to-end network is the home Wi-Fi network, and operators have proved that by investing in this area they can improve their NPS results.
- **Investment is also essential to manage operational costs.** Up to 60% of customer service calls are now related to home Wi-Fi and this is a significant driver of telcos' operational costs. Numerous pilots and early network deployments have proven that by investing in more advanced home Wi-Fi hardware and data analytics software, operators can dramatically lower such costs through reduced customer service calls and call times. This reduction in operational costs alone is typically enough to warrant the investment, without any of the additional benefits produced around brand differentiation and increased ARPU.
- **Telcos are the consumer's favored go-to supplier for home Wi-Fi.** Approximately 80% of home Wi-Fi CPE is now supplied through telco channels. By 2022 this will have increased to 84% and amount to 174 million devices per year worldwide. In some countries, service providers can be responsible for more than 90% of devices shipped, making them by far the consumer's favored go-to supplier for home Wi-Fi products. Operators should use this fact to strengthen their brand in the home and cement their position in the future digital home.
- **Investing in software in addition to hardware brings the biggest benefits.** Wi-Fi standards are constantly evolving, and certainly there are clear advantages to building these new technology developments into a service provider's CPE roadmap. However, as well as new hardware, service providers need to invest in AI data analytics software in order to improve their customer service and technical support capabilities in the home. This will reduce the total cost of ownership and enable service providers to better understand the issues their customers face in the home and, therefore, better plan ongoing investment roadmaps.
- **High-quality Wi-Fi can drive new ARPU opportunities.** Home Wi-Fi is now firmly on the consumer's radar. Extreme QoE is essential to every device and every room in the home. High-quality Wi-Fi technology is essential for that QoE and can, therefore, be used to increase the attractiveness of premium broadband services or can be offered directly as an additional value-added option. On top of broadband QoE, new solutions around AI, big data, and IoT are starting to be built into home Wi-Fi capability, enabling future opportunities for those service providers that control these devices in the home. In addition to direct Wi-Fi CPE opportunities, high-quality Wi-Fi is also critical for the development of future advanced video and other media services around the home. Being in a strong position in the home is therefore key to future success.

Recommendations

- **Service providers must look at the broadband router as a strategic asset.** Focusing on just driving down the cost of Wi-Fi hardware to reduce capex costs is counterproductive, as it only increases customer dissatisfaction, which in turn drives operational costs. This will be

particularly the case for service providers moving to next-generation broadband access and high-speed broadband offerings. Instead, operators must invest in home Wi-Fi, which has been proven to have significant commercial advantages.

- **Operators should develop a separate software and hardware strategy to the home.** Investing in more advanced hardware has its advantages, but without an effective data analytics platform that covers the service provider's entire broadband footprint, operational efficiencies cannot be maximized. It is imperative, therefore, that service providers have a hardware and cloud management software investment strategy. Ideally, the cloud management layer should be separated from the hardware to ensure devices from multiple vendors can be managed through a single system. Conversely, service providers should avoid – where possible – working with hardware vendors whose devices cannot be supported via their cloud management software.
- **Telcos must strengthen their position in the home.** The number of connected devices in the home is set to explode. New opportunities around AI and big data are expected to be significant, and all players are looking to cement their position in the home so that they are well placed to take advantage. As the supplier of not only the main IP connection to the home but also the central gateway, the telco has an opportunity to play a central role in this new connected, digital home – but only if it invests now. If it does not, then OTT players will continue to spread their influence, securing all future revenue opportunities in the process.

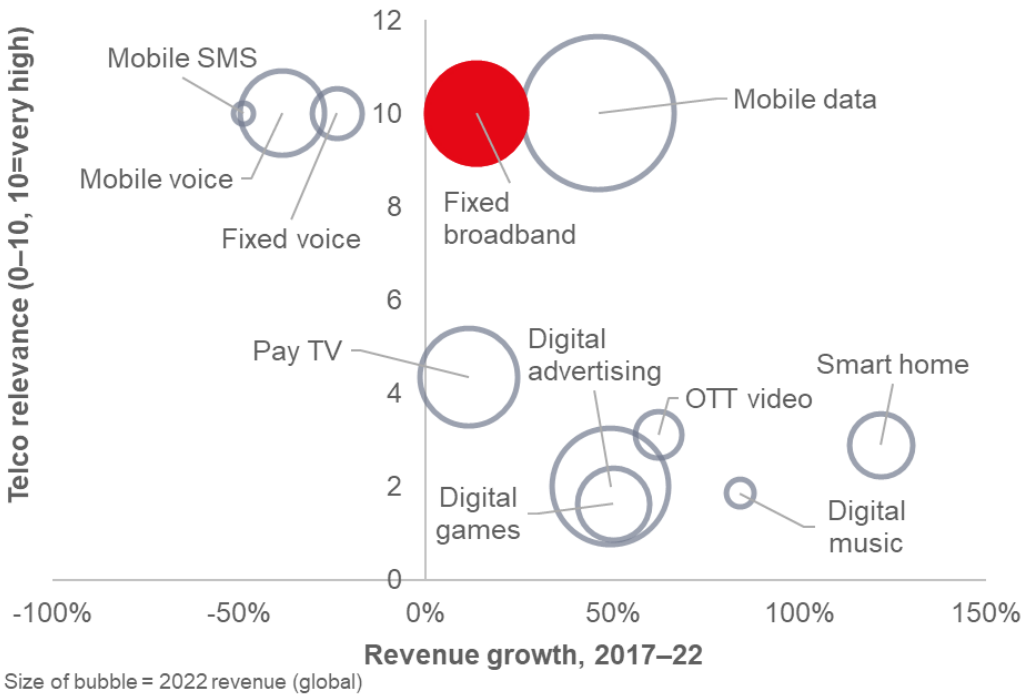
Market overview

Broadband remains a key market for telecommunications service providers

The residential TMT market continues to offer telecommunications providers good growth potential over the next five years. The combined traditional residential segments of fixed voice, broadband, and pay TV will be worth $560bn globally by 2022, which is a growth of $33.6bn over five years. Fixed broadband will account for 45% of this revenue, and broadband represents the biggest overall opportunity in the fixed TMT sector globally in terms of overall growth and telco relevance (Figure 1).

As well as direct subscription revenue, broadband access enables service providers to move into other areas such as TV and smart home. Just over 60% of telcos' pay-TV services (worth a total of $104bn by 2022) are reliant on broadband access for service delivery. New opportunities such as smart home will be worth a further $106bn by 2022, which is a five-year revenue growth of 122%. Additionally, there is another $221bn worth of revenue opportunity from applications such as OTT video, digital music, and digital gaming.

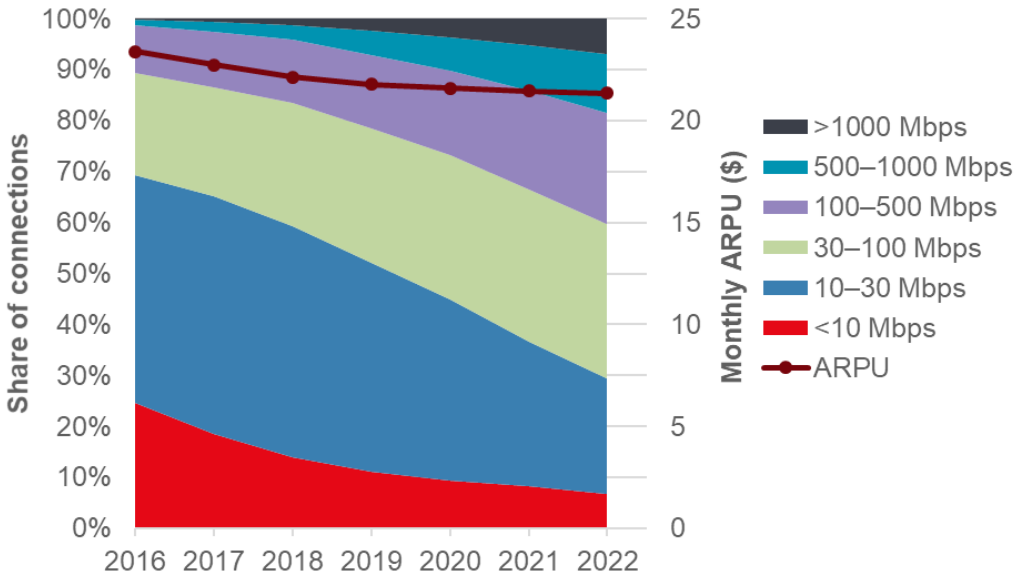
Figure 1: Global revenue growth versus telco relevance in the consumer TMT sector



Source: Consumer TMT Revenue Context Model, 2017–22, May 2018, Ovum

Although broadband still offers good growth, it is also a very competitive market. Unlimited usage plans became popular early in the market's development, leaving differentiation strategies largely focused around speed and price. Fierce competition has therefore created a situation where average download speeds have risen dramatically with ARPU under constant pressure. Figure 2 shows that this trend will continue over the next five years, with worldwide broadband subscriptions offering speeds of 100Mbps or more increasing by 250%, while the overall average ARPU declines by 6% over the same period.

Figure 2: Broadband subscriptions by speed versus average ARPU, worldwide



Source: Consumer Broadband Subscription and Revenue Forecast: 2017–22, March 2018, Ovum

A greater focus on the customer experience

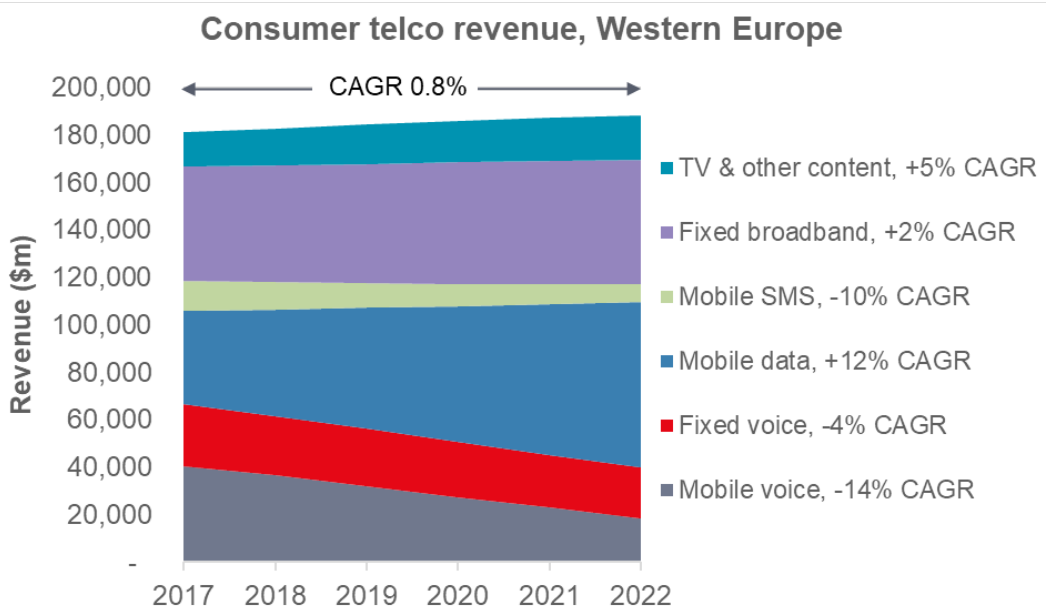
With the increase in broadband speeds across all service tiers, consumers have become gradually insensitive to pure bandwidth improvement. To differentiate service offerings, therefore, service providers have shifted their service and marketing focus onto the overall customer experience. This includes standard QoS indicators such as installation times and customer support efficiency as well as key performance indicators (KPIs) around digital application performance.

Many of today's consumer digital applications come from third-party sources, but if the applications do not perform to the required level of quality, then it is usually the network delivering the application that is blamed – whether this is justified or not. Consistent poor digital application performance is a major driver of broadband service churn. To differentiate their services, therefore, broadband service providers are investing heavily in intelligent networks and AI data analytics capabilities to monitor and manage network QoS and application QoE.

Operational efficiency is key to both business success and consumer experience

Although broadband service revenue continues to grow on a global basis, because of declines in other areas such as voice and mobile messaging, the consumer telecoms industry as a whole will only grow globally at a CAGR of 2% over the next five years. In developed markets such as Western Europe, this rate will be less than 1% (see Figure 3).

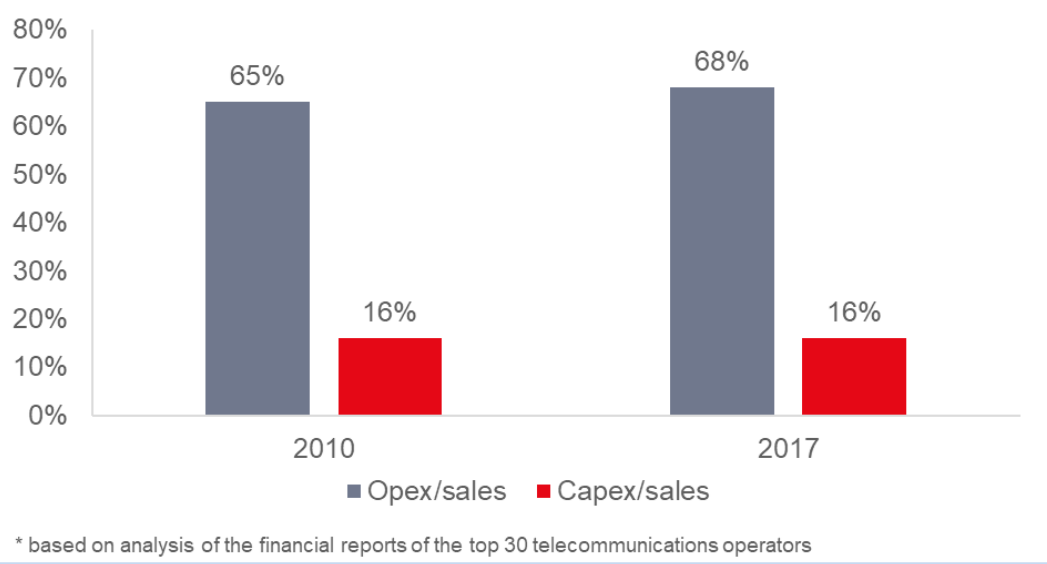
Figure 3: Developed consumer telco markets will grow at a CAGR of less than 1% over the next five years



Source: Ovum

As overall growth slows, it becomes increasingly important to drive operational efficiencies in order to maintain a profit. Although telcos have been relatively successful in controlling capex cost growth (although this is expected to grow once more with the rollout of 5G), operational costs continue to gradually increase as a proportion of revenue (see Figure 4), with network operations in particular increasing, reaching on average 26.5% of the total operational costs in 2018.

Figure 4: Telco operation and capital expenditure cost trends*



Source: Ovum

With the advent of 5G and IoT, the number of connections and the amount of traffic will explode. Next-generation service bundles will also become more personalized and flexible in nature, inviting consumers to swap out services on a more regular basis. If innovative methods are not used to

optimize operational costs, the total cost of ownership for telcos will only continue to increase in the future, significantly impacting overall profitability.

The importance of QoE right down to the device

Home Wi-Fi has become synonymous with home broadband

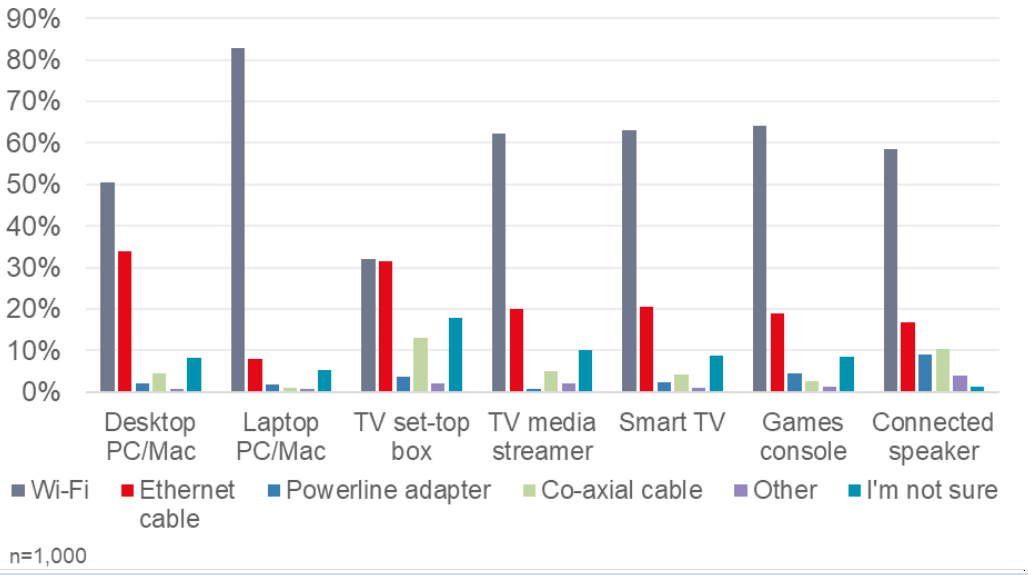
Technically, the broadband service provider's network responsibility has traditionally ended either at the outer wall of the home or at the network termination point (NTP), which is installed just inside the building (Figure 5). Historically, service provider investment has therefore been focused on the core and access network, with investment inside the home minimized to reduce capital expenditure. However, consumers can only experience broadband services and applications via connected devices, which today could be anything including a PC, a smartphone, or a 60-inch UHD TV. To connect all these devices to the broadband network, the user requires a home network, which is increasingly viewed by the consumer as the responsibility of their broadband service provider.

Figure 5: Change of perceived telecommunications operators' responsibility

Source: Ovum

Although there are a number of home networking technology choices available, Wi-Fi is by far the most popular choice in the consumer space. It is supplied almost as standard in today's broadband routers and an increasing number of connected devices, including tablets, TVs, and smart speakers, now rely on Wi-Fi. Figure 6 illustrates how Wi-Fi has become the technology of choice, even for non-mobile devices such as smart TVs.

Figure 6: How devices are connected in the home



Source: Ovum

Required quality for a good customer experience

Broadband-enabled applications are now an essential part of the consumer's daily life, and consumers expect such applications to be delivered in high quality. To measure this quality, key quality indicators (KQIs) and KPIs must be defined that quantify the user experience by indicators such as video-streaming delay, web-page loading time, and application response time.

Experience KQIs are objective service quality parameters that are determined based on service-feature analysis and are used to determine the service quality. A summary of the KQIs (based on network measurement research carried out by equipment vendor Huawei) that are required to provide a very good quality of experience for different digital applications is shown in Table 1.

Table 1: Key experience indicators for core digital applications

Application	KQI 1	KQI 2	KQI 3
Web browsing	Page response time of <0.6s	Above the fold time of <1.5s	Full loading time of <8s
Video streaming	Initial buffering time of ≤100ms	Zero frame freezing	Frame-freezing ration of 0%
Online gaming	Operation response time of <0.4ms	Operational freezing rate of 0%	
File download	Transmission request response of 0.1–0.14s	Transmission-rate stability of 65–70%	Average transmission rate of 4–5Mbps

Source: White Paper of Home Wi-Fi Networks with Optimal User Experience, June 2017, Huawei

Network KPIs then determine the actual end-to-end throughput between the user device and content servers, affecting the time taken to transmit the digital content to the user device and further affecting

the user experience KQIs. Home Wi-Fi network KPIs include service experience in the way of delay and packet loss, connection capability, coverage, throughput, and anti-interference.

The demands on the home network have become significant and will only increase as demand for advanced video-streaming services continues to evolve. Table 2 illustrates the bandwidth, delay, and packet-loss ratio (PLR) requirements required of Wi-Fi mesh networks for a single-stream 4K and ultra-4K video service. Today though, it is common for homes to already have multiple 4K screens, and thus to carry multiple streams, Wi-Fi networks will need to be capable of n×100Mbps.

Table 2: Home Wi-Fi bandwidth, delay, and PLR requirements of 4K TV services

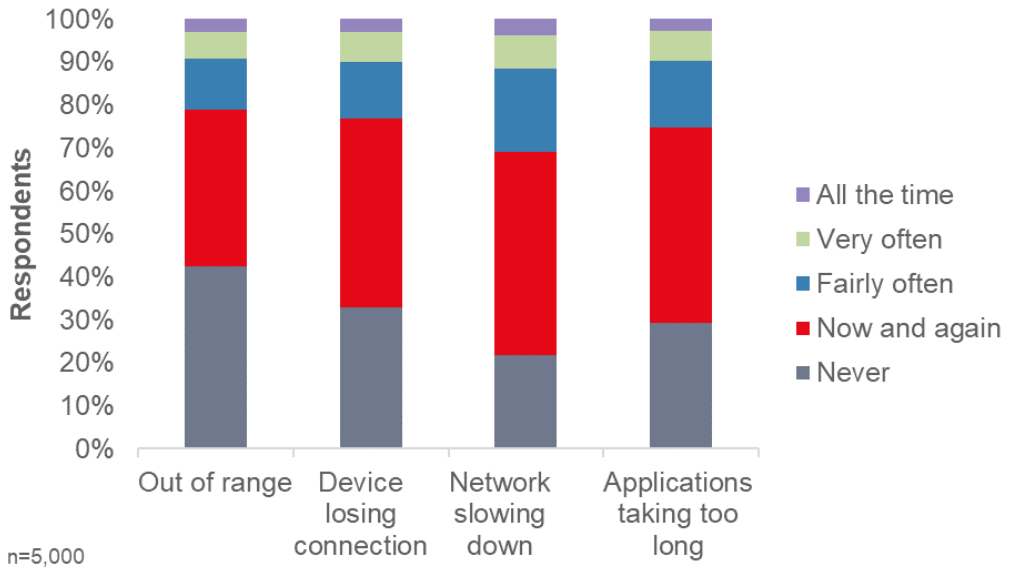
	Basic 4K	Real 4K	Ultra-4K
Resolution	3840×2160	3840×2160	3840×2160
Frame rate	30P	50/60P	100/120P
Sample bits	8	10	12
Bandwidth	20–30Mbps	30–50Mbps	50–100Mbps
Delay	6–11ms	6–11ms	6–11ms
PLR	1×10–4	5×10–5	5×10–5

Source: Huawei

Wi-Fi now accounts for 30–60% of broadband customer service calls

Wi-Fi technology was not originally developed for the distribution of high-bandwidth media applications to multiple devices around the home, and although it has seen significant developments over the years, it is still not a perfect medium for such applications. This is not helped by the fact that, to save on network capex, operators have not traditionally invested heavily in making sure their own-brand routers are equipped with the latest optimized technology – instead leaving consumers to purchase a superior retail box if they wish. As shown in Figure 7, this has resulted in a significant proportion of broadband customers suffering from some type of Wi-Fi issue at least occasionally, while ~20% witness such issues on a regular basis.

Figure 7: Consumer home Wi-Fi experience



Source: Digital Consumer Insights 2018: Smart Living, July 2018, Ovum

The picture, however, is improving. Operators are starting to invest in more advanced Wi-Fi hardware and software, and this is slowly being deployed throughout broadband footprints, with some evidence of success, especially around Wi-Fi range issues. In Ovum's 2017 survey, only 30% of respondents stated that they never suffered range issues, whereas in the 2018 survey the average was up to 42%. However, experience of the network slowing down and applications taking too long to respond is still as big an issue as it was 12 months ago.

According to Ovum's discussions with broadband service providers, the Wi-Fi element of the network is increasingly becoming the source of customer service calls. Ovum's research finds that Wi-Fi issues now account for 30–60% of all telco service center calls.

Unhappy customers cost service providers money

Customer service calls cost money, typically $5–$30 per call according to broadband service providers. There are several issues with the increased number of calls about Wi-Fi problems:

- Calls typically take a long time (approaching 30 minutes) to resolve, as the customer support staff have little visibility of what the issue may be and have to rely on the consumer to run certain tests and make necessary changes.
- It may take multiple calls to solve a single issue, as the repair process can often be one of trial and error. This increases both inefficiency and cost, as well as customer frustration.
- Calls may result in the shipping of more hardware, thus increasing capex costs, due to remote support staff not being able to resolve the issue over the phone and therefore resorting to replacing the customer's hardware, in the hope that this will finally resolve the issue. This has resulted in Wi-Fi CPE no-fault-found rates of up to 50%; in half of cases there was nothing actually wrong with the Wi-Fi router, and the fault must have been elsewhere.
- The number of technical support home visits in order to get a technical expert actually in the home to see if they are able to resolve the customer's problem increases. Such visits can cost between $60 and $80 each.

All these opex and capex costs, on top of other costs such as software maintenance and licensing, can actually double the broadband-CPE total cost of ownership (TCO). Simply focusing on reducing the cost of Wi-Fi hardware to increase overall service return on investment (ROI) can therefore be a false economy, as the strategy only increases the cost of the operational elements. Broadband service providers therefore need to take the full TCO into account when developing their CPE strategy.

Creating the business case for high-quality Wi-Fi

Smarter quality of service

As discussed, Wi-Fi issues cause customer dissatisfaction and drive service provider opex costs. At the very minimum therefore, operators should invest in greater data analytics capabilities that can both help reduce the number of Wi-Fi–related calls and dramatically reduce the time the customer service agent spends on each call.

Depending on the CPE hardware the broadband service provider has deployed across its footprint, data analytics software can often be deployed as a simple software upgrade – allowing such capabilities to be deployed across the entire network quickly in a cost-effective manner. Vendors quote a typical ROI of around 10 to 1 on such an investment.

The core objective of Wi-Fi data analytics software is to help reduce customer service calls by adding a level of intelligence that enables the network to resolve potential issues before they occur or to provide an in-depth customer support tool to enable support staff to quickly identify and resolve issues that do occur. As a minimum such tools should provide

- a detailed view of the status of the router and an understanding of what is going on deeper within the home network
- a current as well as a historical view of activity on the home network
- diagnostics of all possible issues with corrective suggestions.

In addition to reducing customer service support opex, Wi-Fi data diagnostics software can help operators make more intelligent hardware investment decisions, based on detailed customer data.

New standards enable Wi-Fi for a connected world

Wi-Fi technology was not created for today's digital media world. However, significant development effort has gone into the technology, and future standards have been released to increase not only the speed and throughput of the medium but also the QoS. A summary of some of the more important technologies and standards is provided in Table 3.

Table 3: Wi-Fi standards for a digital media world

Technology development or standard	Brief summary
802.11ac Wave 1	Uses the 20MHz, 40MHz, and 80MHz channels all in the 5GHz band. Offers a technical throughput of 845Mbps, but only supports single-user multi-input, multi-output (SU-MIMO).
802.11ac Wave 2	Wave 2 adds a 160MHz channel for the high-speed delivery of large files and additional 5GHz channels for greater flexibility to avoid interference. Technical throughput is increased to 1.52–2.2Gbps. Wave 2 also adds multi-user MIMO capability.
802.11ad	Millimeter-wave Wi-Fi technology using the 60GHz frequency range. Very high speeds (up to 7Gbps) but at a very short range.
802.11ax	Builds on 802.11ac Wave 2 by introducing OFDMA (orthogonal frequency division multiple access). Increases spectral efficiency of each separate stream. Vendors claim between 4× and 10× increase in speed over 802.11ac. Full standardization not expected until 2019.
Mesh	A communications network made up of radio nodes (normally three in a single home), organized in a mesh topology enabling greater resilience and efficiency.
EasyMesh	Brings a standards-based approach to Wi-Fi mesh networks.
802.11v	An amendment to the IEEE 802.11 standard to allow configuration of client devices while they are connected to wireless networks.
802.11r	An amendment to the IEEE 802.11 standard to permit continuous connectivity aboard wireless devices in motion – also known as fast roaming.
WT-398	When approved, WT-398 will specify tests for Wi-Fi router performance. In addition to delivery fairness and QoS, test plans will cover interference from other devices that use the same unlicensed channels as Wi-Fi.
WMM	Wireless multimedia extensions (WME), also known as Wi-Fi multimedia (WMM), is a Wi-Fi Alliance interoperability certification based on the IEEE 802.11e standard. It provides basic QoS features to IEEE 802.11 networks.
DFS	Dynamic frequency selection (DFS) enables Wi-Fi CPE to identify and take action to avoid other radio transmissions – thus reducing interference.

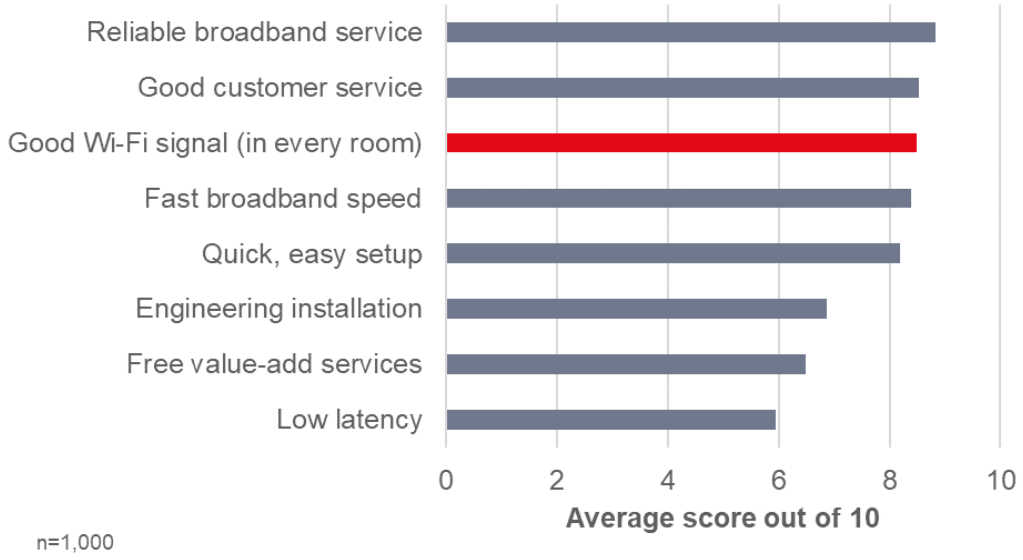
Source: Ovum

High-quality Wi-Fi technology drives new differentiation

Digital applications are now an essential part of daily life, and service providers that are seen to offer those applications in the best quality way can increase their brand differentiation. The flip side of this is that if consumers perceive that the quality of the experience is being hampered by the broadband

network, then they will turn to another provider in the hope of improving it. In Ovum's consumer survey, 60% of people looking to change their broadband service provider over the next 12 months are doing so to get a more reliable, faster broadband service. Delivering a high end-to-end broadband QoE is therefore essential for broadband service providers, and as shown in Figure 8, the home network is an essential part of that.

Figure 8: Characteristics of a high-quality broadband service



Source: Ovum

Wi-Fi investment can also drive consumer ARPU

Both consumer survey data and operator case studies suggest that more advanced Wi-Fi technology is something consumers are willing to pay extra for. With home Wi-Fi seen as an important ingredient of being able to receive an enhanced experience, broadband service providers can market more advanced Wi-Fi solutions to drive greater ARPU – either by enticing more consumers to take a higher level of broadband service or by charging directly for the more advanced equipment (see Figure 9).

Figure 9: Dropping Wi-Fi technology into the broadband tier system

Broadband tier	Wi-Fi CPE
Value tiers	Current market standard Wi-Fi CPE (e.g., 802.11ac Wave 1 technology)
Premium tier	Advanced Wi-Fi CPE (e.g., tri-band 802.11ac Wave 2)
Additional premium broadband VASs	Mesh extenders

Upgrade option

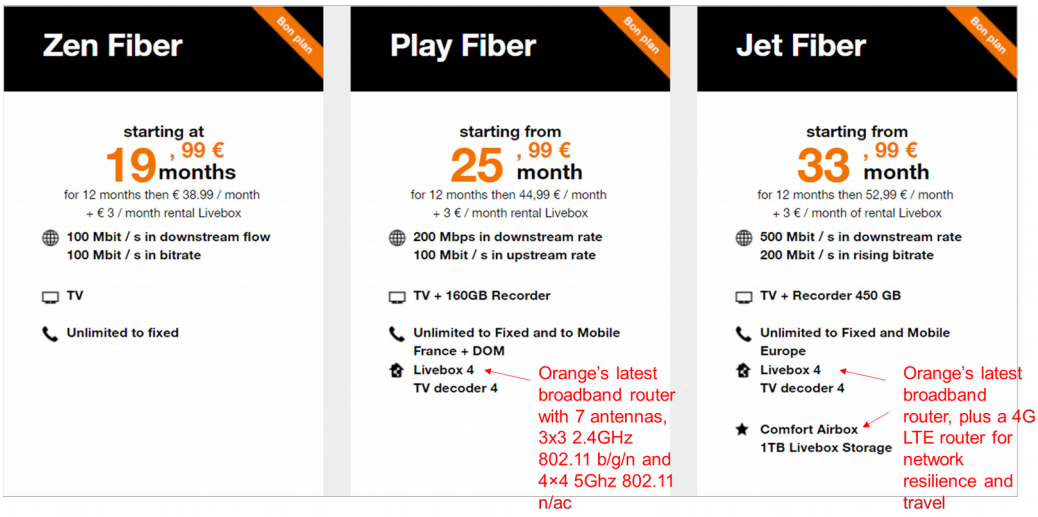
Upgrade option

Source: Ovum

One example of a company offering more advanced home broadband CPE equipment as part of its broadband tiers is Orange in France (see Figure 10). Orange offers its Livebox 4 gateway to its mid- and top-tier broadband customers, providing not only more advanced home Wi-Fi capabilities but also network-attached storage. Top-tier customers can also receive the Comfort Airbox, which provides

broadband connectivity via Orange's 4G mobile network. Additional access points and network extenders are also available for a one-off fee through the Orange store.

Figure 10: Example of using advanced Wi-Fi technology as a service differentiator



Source: Orange (France), Ovum

UHD video over Wi-Fi enables new advanced media services

TV and video are now important revenue sources for many broadband service providers. Worldwide, 30% of all pay-TV subscriptions are provided by telecommunications operators. Just as for broadband, the trend in TV and video is to offer more advanced video services to improve the consumer experience. This helps reduce pay-TV subscriber churn and drives incremental ARPU. In addition to enhancements in the set-top box (STB) user interface and content choice, this means optimizing picture and sound quality, as well as increasing flexibility through on-demand and multidevice/room applications.

Wi-Fi is an essential ingredient in the delivery of these new features and services. Rather than being reliant on a fixed wall socket, TVs can be placed in any position in the home, and content can also be played through additional wireless devices such as a tablet or smartphone. Without Wi-Fi, service providers' ambitions for multiroom and multidevice services would therefore be limited.

A good example of this strategy is the Sky Q Experience service provided by Sky in the UK. Sky Q Experience costs an additional £12 ($16) per month and provides UHD content as well as multiroom/device viewing. In addition to the main set-top box, consumers can order up to an additional four Sky Q Mini boxes at an upfront cost of between £20 and £317 ($26–$414). All boxes have integrated mesh Wi-Fi technology, enabling each box to act as a meshed-Wi-Fi access point, extending the reach of the Wi-Fi network around the home for all connected devices. As of June 2018, Sky had 3.6 million Sky Q homes, with an additional 1.1 million customers added in the last quarter alone. Figures on Sky Q Experience are not available, but Sky confirms that its overall Sky Q strategy has successfully lowered customer churn and created incremental ARPU.

The future potential of consumer IoT

Additional future value can be driven from the Wi-Fi gateway by integrating it into a wider smart home/IoT strategy. This can be anything from enabling voice-enabled home assistants (e.g., Amazon Alexa) to allow easier control of broadband applications such as advanced parental control settings to

enabling the broadband gateway to interact directly with and control smart home devices. Such initiatives can bring value to service providers whether they have a dedicated smart home strategy or not.

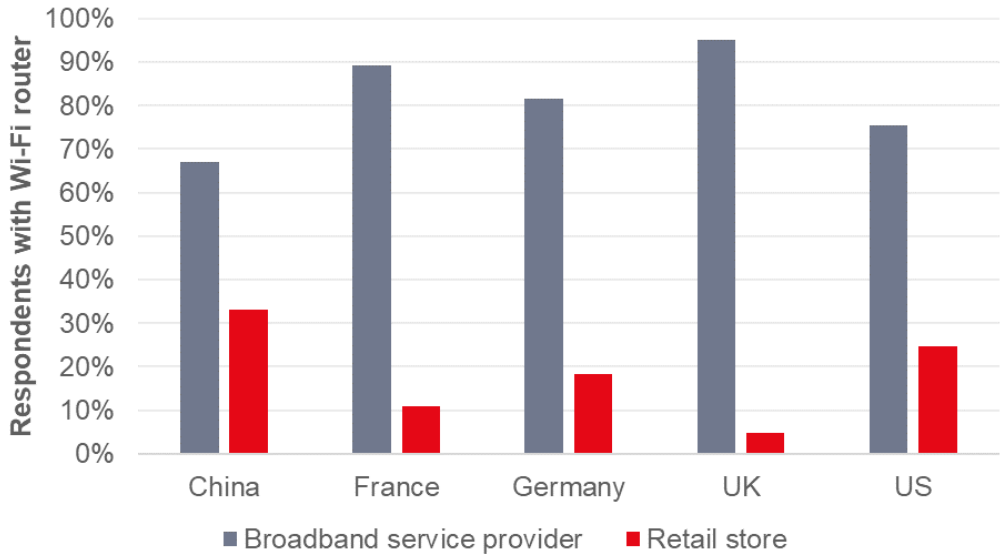
Deutsche Telekom is one service provider that already offers smart home services and is utilizing the broadband router to lower the setup costs of such services for its customers, thus driving greater take-up. However, many other broadband service providers are still cautious about entering this new smart home market while it is still not clear what and how big the opportunity will be or how fast it will grow. Doing nothing, however, will simply hand any future opportunity, including opportunities around consumer data, over to OTT players such as Amazon and Google that are investing and have already sold millions of devices.

The status of the home Wi-Fi market

Telcos have become the main channel for Wi-Fi CPE

In the vast majority of cases, the main home Wi-Fi CPE (usually a combined broadband modem and Wi-Fi router) has been supplied by the consumer's broadband service provider. As shown in Figure 11, the ratio between broadband service-provided CPE and CPE bought through retail channels differs from country to country, but based on Ovum's survey data, on average the CPE was supplied by the broadband service provider in approximately 80% of cases.

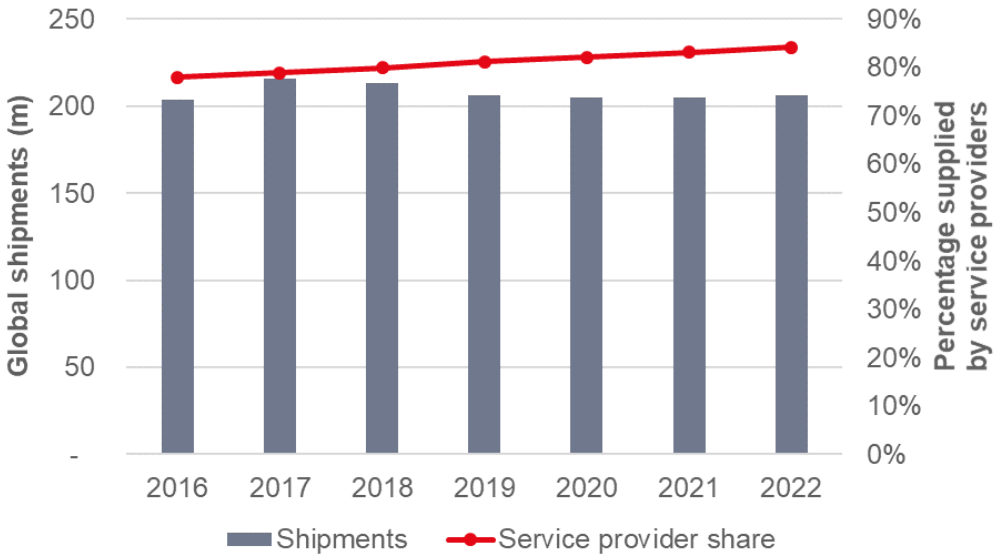
Figure 11: Wi-Fi CPE channel by country



Source: Ovum

Ovum forecasts that there will be 213 million devices shipped globally in 2018, and broadband service providers will be responsible for 170 million (80%) of these (see Figure 12). This figure will rise to 174 million – out of a total of 206 million – by 2022, as the percentage of devices provided through operator channels increases to 84%, pushed in part by operators providing more advanced Wi-Fi CPE equipment.

Figure 12: Telcos will be responsible for 174 million device shipments by 2022



Source: Ovum

Advanced service providers are now moving to high-quality Wi-Fi

Table 4 provides a summary of the core CPE strategy of some of the biggest broadband service providers in the world. In more "emerging" markets, it is still the norm to offer fairly standard, no-frills CPE at a low cost. The CPE does normally have Wi-Fi access capability but is based on cost-effective and low-grade Wi-Fi technology. For such operators, it is still all about providing a basic CPE box to give customers basic access to broadband services. In some countries, such as India and Turkey, there is still a monthly fee for such devices.

In more developed markets, however, where the shift is to providing a differentiated experience in the home, operators are moving toward more advanced Wi-Fi CPE, normally as part of a more advanced broadband service but sometimes at an additional charge. In both cases, the service providers are using the Wi-Fi device to drive greater ARPU through offering more advanced technology.

Table 4: Examples of leading broadband operators' Wi-Fi CPE strategy

Country of operation	Broadband operator	Wi-Fi CPE brand (if listed)	Feature summary	Wi-Fi CPE pricing strategy (fees in $)
US	Comcast	xFi	802.11ac Wave 2, 8×8 antenna, IoT capability including Bluetooth LE, Zigbee, and Thread.	$11 per month
US	Charter Communications	Spectrum Wi-Fi router	Current router is based on 802.11ac. Charter has announced the launch of a new 802.11ax router in 2019.	$5 per month
Germany	Deutsche Telekom	Speedport Smart 3	Speeds up to 2.5Gbps, 802.11ac Wave 2 with 4×4 antenna. Includes Magenta SmartHome functionality.	$5.80 per month
Russia	Rostelecom	None	Standard routers are 2×2 802.11n-based hardware. Premium options include dual-band 802.11ac capability.	Standard Wi-Fi router is free for first 18 months then $0.01 per month. Premium Wi-Fi equipment can be purchased with installments of $2.20 for 24 months or rented for $1.30 per month.
France	Orange France	Livebox	Livebox Play: dual-band 802.11n. Livebox 4: 4×4 802.11ac with a total of seven antennas and a total capacity of 2.1Gbps.	Zen fiber (100Mbps) customers receive the Livebox Play.Play fiber (200Mbps) and Jet fiber (500Mbps) customers receive the Livebox 4.
Turkey	Türk Telekom	None	Basic router with features not marketed.	$0.80 per month
India	BSNL	None	Basic router with features not marketed.	$0.80 per month
United Kingdom	BT	Home Hub/Smart Hub	Home Hub 4: dual-band 802.11n router with four antennas. Smart Hub: 802.11ac Wave 2 router with seven antennas.	Standard broadband (10Mbps) customers receive the Home Hub 4. Superfast fiber (36–67Mbps) customers receive the Smart Hub.
Mexico	Telmex	None	Basic router with features not marketed.	Free

South Korea	KT Corp	Wi-Fi Home/Giga Wi-Fi	Wi-Fi Home: 802.11n with speeds up to 300Mbps. Giga Wi-Fi: 802.11ac Wave 2 with speeds up to 1.7Gbps.	Standard broadband customers receive an option to rent three different versions of Wi-Fi router, ranging from $1 per month to $5 per month based on a three-year contract. Customers of Giga Internet (500Mbps) receive a discount on the Giga Wi-Fi option."Internet up to 1G" customers receive a Giga Wi-Fi device free.

Source: Ovum

Operator case studies

Orange France

Overview

The French market continues to be highly competitive, with all the major operators competing on converged offerings with an emphasis on 4G and fiber coverage and media content. To remain competitive, Orange has accelerated its own fiber-to-the-home (FTTH) rollout, and as of 1Q18, Orange had 2.1m FTTH customers (an increase of 35% on the previous year).

Providing an unrivaled customer experience is at the heart of Orange's business strategy. Launched in 2015, Orange's five-year strategic plan is based around five business drivers, designed to maintain strong customer relationships as well as drive new revenue growth:

- Offer richer connectivity.
- Reinvent the customer relationship.
- Build a people-orientated and digital employer model.
- Support the transformation of enterprise customers.
- Diversify by capitalizing on its assets.

Home hub strategy

Orange accepts that it has a responsibility to its broadband customers when it comes to developing a high-quality home network. However, Orange also sees the home as one of the new battlefields, where it competes not only with traditional broadband competitors but also increasingly with the consumer electronics and internet players. To maintain a strong customer relationship in the home environment, Orange believes it must offer a best-in-class experience. To achieve this, it has focused on three key areas to improve the home network experience:

- Enhanced Wi-Fi coverage of remote areas of the home – providing a high quality of service 100% of the time in all locations.
- Increased network performance – traditionally the bottleneck was always the last mile, but with FTTH deployed, the bottleneck has shifted to the local area network (LAN), and

technology investment must be made so that customers can enjoy the full benefits of an FTTH network.

- Providing more value to the customer through better use of data – enabling a more tailored, personalized service to the customer using data analytics on data gathered by the home router.

Providing the right level of experience, however, is only part of Orange's home hub business model. Quality of service and customer care are also key elements. By having and providing greater access to analytical data via the My Livebox application, Orange can provide greater, and more efficient, support to its customers as well as providing them with the tools they need to better manage their own home network. This also includes convenience features such as easy-to-control guest access and parental controls, which in turn increase the value of the overall service.

Moving forward, new personalized applications can also be created on the back of more advanced cloud computing techniques, and of course there is the additional promise of consumer IoT. Orange's belief is that the home hub sits at the heart of such new business models. Over time, an increasing portion of the intelligence will be moved into the cloud, but the physical box will remain in the home to provide connectivity and act as a gateway for data analytics.

Outcome

Orange sees NPS as a key measure for the ROI on its Wi-Fi hub devices. This drives not only customer stickiness but also future new revenue opportunities such as smart home services, as Orange believes that only when customers are very satisfied with existing products are they likely to then be upsold new services and applications. If Orange's services and hub technology do not provide the right level of QoE, then they are in danger of losing this direct customer relationship and all future opportunities could be lost. To understand what drives customer satisfaction, however, is not simple, as it is not always easy to correlate technical metrics with customer satisfaction KPIs. To manage this, therefore, Orange always focuses first on what will best drive customer satisfaction, based on extensive consumer survey data, and then works backward to develop the technical KPIs that will best improve that experience.

Orange's latest Wi-Fi hub, Livebox 4, is freely available to all customers taking its mid-tier (Play) and top-tier (Jet) fiber broadband services. Jet customers can also receive a Comfort Airbox device, which provides 4G connectivity in case of a fixed-network incident. It is not possible for Orange to isolate and quantify the impact of Livebox 4 in terms of the uptake of these services, but Orange looks to provide the best possible experience to its premium broadband customers, and overall the offers have been successful, with 42% of customers now taking Play or Jet services, an increase of three percentage points year on year. QoS software is available on its entire range of Wi-Fi–enabled devices to maintain a consistent level of QoS for all its customers, regardless of what tier of service they are on.

Swisscom

Overview

Swisscom has the benefit of operating in a high-priced market. Approximately 90% of its broadband customers take a service bundle, and consumer ARPUs range from $90 for a fixed customer to $131 for a fully converged customer. This compares to a typical European consumer fixed ARPU of between $40and$55. Because of such high prices, Swiss customers can be demanding. To both

retain its market position and grow revenue, Swisscom has developed a strategy centered around superior network performance and customer service, together with investing in innovation to deliver high customer experiences to realize new business opportunities.

This has led to a nationwide deployment of a mix of the latest fiber optic technologies such as FTTH, FTTB (fiber-to-the-building) and FTTS (fiber-to-the-street). FTTB/S use copper-based technologies such as vectoring or G.fast for the last 220 meters. As of 1Q18, 57% of broadband customers could access speeds of 80Mbps or more at their location, and 29% could access speeds of more than 200Mbps. By the end of 2021, around 90% of all homes and offices will enjoy a minimum bandwidth of 80Mbps, with around 75% achieving 200Mbps or faster.

Home hub strategy

Swisscom has invested heavily in its core and access networks to push higher-speed broadband services into the home. However, this was putting an increasing strain on the home network, and Swisscom found that home Wi-Fi–related calls were increasing, which was impacting on overall customer satisfaction. In 2012, therefore, the company decided to also invest in better home gateway technology. Currently, Swisscom offers the Internet-Box 2 as standard to all new broadband customers. The Internet-Box 2 device is a dual-band router with 802.11ac Wave 2 capability, offering a theoretical speed of 2.2Gbps over the 5GHz channel and 450Mbps over 2.4GHz.

Swisscom has also decided to divide the home gateway hardware and software so that it could create a single software platform for all its devices. This enables Swisscom to have a greater level of control over the whole home network, ultimately providing its customers with a better QoS. It also gives Swisscom the opportunity to offer its customers supplemental home networking options as part of a wider home ecosystem. For example, Swisscom offers its WLAN-Box (~$79), which acts as a repeater and access point connecting directly to Swisscom's main gateway device, the Internet-Box 2. It can also be used as a video bridge by connecting the Swisscom TV STB by LAN cable to the WLAN-Box. This provides value to the consumer because of increased flexibility around where they can position the TV STB, while reducing the number of boxes Swisscom must provide to maintain a quality connection between the TV STB and main router.

Swisscom does not offer smart home services directly, but does not wish to step out of the market completely. It therefore looks to add value to its customers by providing a smart home application that enables control of third-party devices and applications via the Wi-Fi gateway. Swisscom also supports its partners by selling these smart home devices through its online and retail stores. Device partners include myStrom, Philips, Sonos, and QBee, with others to follow. With little financial risk, this strategy enables the company to generate some revenue via device sales, and increases the stickiness of its Wi-Fi router, which is now central to smart home device interworking. Maintaining a footprint in the smart home sector will enable the company to explore new opportunities as they emerge in the future.

Outcome

Swisscom's home gateway strategy has been a big success. Based on its investment around QoE on an end-to-end basis (not just within the core and access networks), customer satisfaction scores have improved. Investment in the gateway in particular has reduced overall customer service calls for internet-related items by 30%, thus reducing operational costs. It has also managed to successfully push its more advanced solutions, with a significant segment of its broadband customers now taking its WLAN-Box. In some cases, this is provided free for customer retention purposes, but Swisscom claims that 95% are purchased.

NextGenTel

Overview

NextGenTel is a competitive operator in Norway offering fixed broadband, TV, and landline services. Operating in a mature market, and up against stiff competition from the incumbent telco Telenor, FTTx player Altibox (owned by Lyse Energi), and cable operator GET, the company has found it challenging to scale its broadband business. It has therefore turned to providing a best-in-class customer experience to protect its market position and grow ARPU. In Norway's mature market, it has also become imperative to drive operational efficiency to maintain a healthy margin.

Like many operators, NextGenTel has invested in FTTx networks to boost broadband speeds and is already seeing some ARPU success from this initiative. However, customer feedback also showed that a good experience was reliant on high speeds not just to the home but also around it. In the eyes of its customers, it is NextGenTel's responsibility to ensure the broadband experience right down to the device. Additionally, with the aim of increasing operational efficiency, the company wished to reduce the time spent answering home Wi-Fi–related customer support calls, which in recent times have started to escalate. The answer to both problems was to deploy a more advanced home networking solution that would enhance the customer experience in the home, while also providing greater insights into home networking issues to enable a more efficient customer service proposition.

Home hub strategy

To be successful in its strategy, NextGenTel needed to find a solution that could be quickly deployed to all its broadband customers. NextGenTel already offered customers advanced Wi-Fi hardware from companies such as Technicolor and AirTies, but rolling out new hardware is expensive and takes time. Like all operators therefore, the company constantly manages a wide range of existing CPE devices with varying capabilities. In order to maximize the operational and customer benefits, the company needed a cost-effective solution that could quickly be deployed to all households.

The company turned to Domos, a cloud software company specializing in AI data analytics. Domos does not develop any hardware itself but carries out analytics on data supplied by other vendors' hardware via open APIs and was therefore able to be quickly, and cost-effectively, distributed across NextGenTel's entire broadband footprint.

NextGenTel's primary focus was to use data analytics technology in its customer and technical support tools to help increase the efficiency of its customer service operation, which was experiencing a steady increase in the number of Wi-Fi–related queries. It therefore installed the Domos Diagnostics customer service tool, which provides support staff with two levels of detail: a high-level view for first-line customer support and a more detailed view for second-line support.

Through the diagnostics tool, customer support can quickly see not only a detailed view of the status of the router but also what is going on deeper within the home network. Troubleshooting takes into account current as well as historical data to identify changes in the network and therefore help identify potential issues. To help the less technical first-line support staff, the tool highlights the likely issues and suggests solutions for customers to try to help resolve their problems.

As well as back-end software, NextGenTel has also deployed a self-care app, which is free for its customers to download. In addition to self-care troubleshooting capabilities, the app provides other value-add services such as control of devices connected to the home network, access to parental controls on a per device basis, and a speed-test feature.

The app also allows NextGenTel to push messages down to customers who may be facing Wi-Fi issues that they are yet unaware of, enhancing the customer experience before it becomes a potential customer care problem. With its deeper knowledge of the home network, NextGenTel can also push support messages for other connected devices, for example, a device software update message, to enhance the overall customer experience beyond just networking issues.

Technically, the app can also help customers understand issues such as Wi-Fi range by identifying "dark spots" in the home. However, NextGenTel is yet to turn this feature on, as the company is preparing to introduce a new extender device in the near future and wishes to time the launch of this feature to go hand in hand with the new device.

Outcome

By providing support staff with a more detailed understanding of what is happening within the home, the deployment of Domos' software has successfully driven down average customer service call times. Before the rollout of data analytics software, staff were often "flying blind," having to simply make educated guesses as to how to best resolve issues, whereas now they have all the information they need to quickly provide the right support. According to Ovum's data, support calls can cost between $5 and $30 each, so reducing the time spent on such calls will significantly reduce operational costs. Fixing customer issues quickly and efficiently also increases customer satisfaction with the overall service.

In such a competitive market, QoE is essential for NextGenTel, and Domos' software is helping it provide differentiation with new customers as well as stickiness with existing ones. For many of its customers, the Wi-Fi router is the only visible element of NextGenTel's brand in the home, and the company is largely judged by the performance of the service delivered via that box. Offering the best home broadband performance, together with easy-to-use tools and quick, efficient customer services, is therefore key to NextGenTel's future success. It is a bit early in the deployment yet to measure the overall impact of Domos on the company's performance. However, before the mass rollout the company carried out a field test of approximately 1,000 customers, and the result of that test was an increase in NPS of 10 points across those customers.

There are other noted advantages:

- **New customers have been gained, and not just through improvements in customer satisfaction ratings.** Although not the primary motivation for its deployment, Domos' software also has some advanced techniques to monitor and control Wi-Fi channels and power output. Working in a building such as an apartment block that is covered by multiple Domos-enabled routers, the software can optimize each access point to provide the maximum coverage but minimum interference in each individual apartment. NextGenTel has successfully used this feature when targeting apartment-block landlords with its FTTB services, guaranteeing a great broadband experience to each of the landlord's tenants.
- **More intelligent investment decisions can be made.** In the past, NextGenTel has always been operating somewhat in the dark, going on gut instinct and general market trends. Having a detailed view of real customer data and trends not only indicates which technologies it needs to invest in but also which customers would benefit the most from them.
- **Future revenue opportunities will open up.** The company is currently exploring several ways of further monetizing this new capability, the first of which is to target customers with new premium Wi-Fi hardware solutions by combining its knowledge of customers' Wi-Fi usage

with use of the self-service app as a sales channel. There is a customer privacy angle to such initiatives, of which the company is well aware. It wishes to provide customer value without being intrusive, and this is a hard balance to maintain. However, in trials of this type of feature, customer feedback has been largely positive, with 20% of trialists stating they would have made the purchase.

Guangdong Telecom

Overview

Guangdong Telecom is part of China Telecom Group, which as a group provides broadband services to 134 million customers as of December 2017, 126 million of which are FTTH. Just under 50% of China Telecom's broadband customers receive speeds of over 100Mbps, and the average bandwidth is 73Mbps.

Home hub strategy

In March 2018, Guangdong Telecom was the first operator in China to launch a Wi-Fi home-management platform based on Huawei's SmartWiFi solution, which consists of Wi-Fi gateways, access points, and management software. The operator's objective for this initiative was threefold:

- Offer its customers an advanced home Wi-Fi solution offering speeds of 100–300Mbps in every room of the house. Wi-Fi devices must be plug and play for ease of use and offer Wi-Fi roaming to ensure QoE.
- Develop a more advanced management capability to enable the operator to easily visualize the network quality in real time, quickly detect issues and identify fault locations, and offer remote parameter settings and Wi-Fi channel optimization.
- Roll out a customer installation and maintenance app to allow its broadband subscribers to assess the quality of their Wi-Fi network, better design their home network, and gain quick technical support.

To meet these objectives, Guangdong Telecom deployed a new Wi-Fi router and dual-band access points, a Wi-Fi cloud management platform, and a new consumer Wi-Fi service application. The management platform provides customer service staff with a visualized home network topology with remote query of more than 60 entities, including the access mode, traffic rate, and connection status. The system also enables remote configuration of the network, which includes in-line configuration, software upgrades, and the ability to restart Wi-Fi hardware. As well as providing single-click diagnostics of a single user, the platform provides a network view of the service status and a Wi-Fi quality ranking to identify households with poor QoS.

Outcome

After the deployment of both hardware and software solutions, Guangdong Telecom witnessed a reduction in engineering support visits of 30% and an increase in operational and maintenance efficiency of 40%.

Wi-Fi vendor positioning

A fragmented market

The home network equipment market remains fragmented. Most vendors sell their hardware through both retail and broadband service provider channels, but some, such as AirTies, are 100% focused on

the service provider market. In addition to home network hardware, OEMs often provide management software to enable remote management and operational support. There are also independent management software specialists such as SoftAtHome, Domos, and Assia whose software runs over the top of third-party hardware but that typically do not provide CPE hardware of their own. To provide an overview of the market, Ovum has analyzed eight of the top Wi-Fi vendors across the consumer and service provider markets: AirTies, Plume, Netgear, Linksys, Huawei, TP-Link, eero, and Google.

Vendor portfolios can differ significantly

Vendors can range from very specialist providers to large global organizations such as Huawei that support extensive hardware portfolios, with multimedium access-point support and their own cloud management platform. Other companies such as Plume and eero are largely focused on Wi-Fi mesh access points (that typically must connect to an existing home broadband modem/router).

Look beyond the standards for differentiation

Based on the high-level technical specifications, it is often difficult to separate Wi-Fi vendor solutions. All the vendors Ovum analyzed for this report, for example, support the core elements you might expect in quality Wi-Fi devices such as 802.11ac Wave 2, Wi-Fi mesh, video QoS, Wi-Fi channel optimization, beamforming, dual-band concurrency, and Wi-Fi security. Newer Wi-Fi standards, such as 802.11ax (otherwise known as Wi-Fi 6), are rarer but are starting to appear in some high-end (especially retail-focused) models such as NetGear's Nighthawk series.

There is a bigger difference, however, when it comes to service provider cloud management support capabilities. Most vendors provide consumer software/mobile applications to enable basic consumer troubleshooting and Wi-Fi control/setup, and all but those vendors that are purely focused on the retail sector support some level of remote management standards to enable service providers to utilize management software and remotely monitor devices. Companies with a heavy focus on the service provider market, however, such as Plume, Huawei, and AirTies, supply full cloud management software alongside their hardware to enable service providers to provide deep QoS capabilities within the home. AirTies also licenses this software so that it can additionally be used to support third-party vendor devices.

Vendors quickly introduce new Wi-Fi standards

In order to differentiate their products, vendors are typically quick to support new Wi-Fi standards, starting with their high-end products and then gradually filtering new technology down throughout their product range. Vendors selling direct to consumers are often the quickest new adopters, often adopting pre-standardized technology in order to appeal to heavy home users. For example, Netgear's new NightHawk AX series routers are the only routers among those analyzed for this report that support 802.11ax (Wi-Fi 6), giving them a throughput of 6Gbps.

However, such routers are normally aimed at the high-end gaming sector. All the routers in this analysis that were aimed at the service provider market supported 802.11ac Wave 2, with the fastest – produced by Huawei – offering speeds of 3.8Gbps. TP-Link, Plume, and AirTies also all offered devices with throughputs of 2.5Gbps or higher. Google, a vendor focused on the more mass-market retail sectors, offered one of the lowest throughput speeds at only 1.3Gbps and additionally had the lowest number of radio antennas supported (four compared to Netgear's eight).

Coverage between vendors can differ significantly, with those more focused on access point mesh systems (such as Google, AirTies, Plume, and eero) offering relatively low coverage per device.

However, those with more of a core router strategy, such as Netgear, Linksys, and TP-Link, offer single devices that can cover large spaces of 4,000 square feet or more.

All vendors will include Wi-Fi security, with some companies such as AirTies and Huawei supporting advanced protocols such as WPA2-802.1x. Additionally, all players reviewed supported plug-and-play capabilities, Wi-Fi roaming, beamforming, guest support, and DFS support. However, AirTies was the only player Ovum could identify that supported zero-wait DFS support.

Finally, all players reviewed except Google now offer some sort of smart home capability, with TP-Link having the greatest capability, supporting Thread, Alexa, Google Home, and IFTTT.

Service provider cloud management capabilities

As far as Ovum could ascertain from public material, most of the vendors included in this report except Google provide some level of operational support capability for broadband service providers. However, as is to be expected, there is a significant difference between the vendors that are more retail focused and those that either have large service provider operations or are 100% dedicated to selling their products through service provider channels. Huawei, Plume, and AirTies have extensive cloud management capabilities that can provide service providers with detailed data analytics capabilities in the home. Of these three, AirTies was the only vendor supplying its software on a licensed basis.

Appendix

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Ovum Consulting

We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Ovum's consulting team may be able to help you. For more information about Ovum's consulting capabilities, please contact us directly at consulting@ovum.com.

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