Fixed Wireless Access: Changing the Face of Home Broadband Connectivity
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## About the author

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He authors reports, research notes, and white papers and has more than 30 years’ experience as a commentator and analyst in the telecoms arena.

Julian’s research has tracked the development of the mobile communications industry since its inception. In particular, he has provided analysis into associated wireless broadband technologies such as hetnets, next-generation IP core networks, and IMS. Julian has a particular interest in global spectrum availability.
Summary
In the two years since we reported a resurgence of interest in deploying fixed wireless broadband technology, the evolution of system capabilities, the improvement of network performance, and the commercialization of services have continued apace. The global surge in demand for high-speed broadband, along with the need to extend connectivity and improve the overall experience for broadband users, has opened new opportunities for fixed wireless access (FWA).

In emerging markets, FWA (also known as wireless broadband access or WTTx) is helping to drive social change and delivering a triple win for operators, end users, and local agencies such as the police and emergency services. As well as providing connectivity in underserved and remote rural areas, FWA is helping operators compete in the home broadband and small business markets, where acquiring high-ARPU subscribers in urban areas is one of the primary drivers of FWA growth.

Today, the expanding role of FWA across a broad set of commercial use cases is evidence that the technology is becoming well established in service providers’ networks alongside wireline alternatives such as copper and fiber, and even replacing slower and more outdated alternatives.

Key findings
- Fixed wireless broadband networks using mainstream LTE-Advanced (LTE-A) technology are proving capable of delivering fast, high-quality, highly managed, and profitable connectivity.
- These networks are helping governments and service providers to deliver on the promise of high-quality, universal broadband access, including helping some OECD countries to rapidly improve internet penetration and the broadband experience.
- As well as addressing rural populations, service providers are increasingly using FWA to acquire high-ARPU, broadband-connected customers through the rollout of networks in urban and suburban environments to both homes and enterprises.
- Higher speeds, efficiency gains, and improved economics are strengthening the case for FWA across a diverse set of use cases, ranging from legacy copper upgrades to providing high-capacity connectivity where fiber proves too costly.
- The equipment market for wireless massive MIMO technology and multi-antenna CPE is boosting fixed wireless access capacity by up to 10 times, with new CPE products helping to enhance overall system performance. Rapid progress is also being made in ease of deployment and self-install capabilities.
- 5G FWA will take fixed wireless to the next level, boosting speeds closer to 1Gbps and potentially increasing competition between FWA and fiber.

FWA status report
Operators are turning to fixed wireless
Wireline networks using copper or fiber have traditionally been the preferred choice for delivering fixed broadband services due to their high capacity and resilience, but the need for universal connectivity means that alternatives to the wired network are more in demand than ever.

According to Ovum, fixed wireless networks have now been deployed in 124 countries, and our calculations show that 350 million households could potentially afford FWA services by 2020. Global subscription estimates for FWA vary, partly because providers are often small scale or localized, but also because of how users are classified. According to one third-party vendor’s estimates, global CPE shipments exceeded 50 million as of end-2017. Data from the same vendor shows that 82 operators around the world launched fixed wireless services during 2017 alone.

Fixed wireless networks are increasingly contributing to home broadband connection in developing markets where levels of HBB penetration are particularly low. Today FWA represents more than 90% of total

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TMT intelligence | informa 3
broadband connections in Nigeria and DRC, and over 50% in a number of other countries including Ghana, Uganda, and Bangladesh. FWA is also helping to extend broadband penetration by complementing xDSL, fiber, and cable in markets where wireline is already more extensively deployed (see Figure 1).

In recent years, FWA has increasingly become a feature of national broadband programs designed to speed up home broadband connection and drive internet-connected penetration. In Australia, pressure to drive forward the government’s National Broadband Network (NBN) project to replace the country’s copper infrastructure with universal fiber-to-the-premises resulted in the decision to switch to a multitechnology approach that includes FWA.

**LTE is driving FWA growth and performance**

Broadly speaking, FWA provides a fixed wireless connection to a household or business, substituting for or complementing a wireline broadband access service such as copper or fiber (see Figure 2).
Most FWA systems today employ LTE technology in a simplified but highly managed and controllable network architecture, often using an operator’s existing mobile broadband infrastructure. The local connection to the home is made via an inside or outside antenna along with a broadband wireless router.

The ongoing evolution of LTE associated with LTE-A and LTE-A Pro is enabling typical download speeds for FWA of up to – or even in excess of – 50Mbps, and the use of technologies such as space division multiplexing means that today’s LTE-based FWA systems are many times more spectrally efficient than a comparable mobile broadband network.

The evolution of LTE and decreasing price per bit of the base station (put by one estimate to be 100 times in the past 10 years) are giving operators the confidence to expand the use of FWA in their networks (see Table 1).

Planning for FWA systems using 5G is already at an advanced stage, with the first services expected to launch in late 2018. 5G FWA will push performance limits toward 1Gbps and utilize the additional bandwidth provided by spectrum bands in the millimeter wave (mmWave) frequencies.

Ovum forecasts that LTE-based FWA will account for 40% of all fixed wireless broadband subscriptions by 2022, with 5G FWA accounting for a further 16% (see Figure 3).

<table>
<thead>
<tr>
<th>Downlink/uplink</th>
<th>Condition</th>
<th>Spectrum efficiency (bps/Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downlink</td>
<td>GSM (with HR + VAMOS)</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>UMTS (with 2x2 MIMO + 64QAM)</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>LTE (with 2x2 MIMO + 64QAM)</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>FWA LTE-evolution 64T64R (with 8x8 MIMO + 256QAM)</td>
<td>13.00</td>
</tr>
<tr>
<td>Uplink</td>
<td>GSM (with HR + VAMOS)</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>UMTS (with 1x2 MIMO + 16QAM)</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>LTE (with 1x2 MIMO + 16QAM)</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>FWA LTE-evolution 64T64R (with 8x8MIMO + 64QAM outdoor CPE)</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Source: Ovum

Figure 3: Fixed wireless access growth by technology, 2016–2022

Source: Ovum

Over the forecast period, the proportion of LTE-based FWA networks could be higher than anticipated due to the speed of development of LTE and 5G-based FWA networks and the likely acceleration of the migration of...
legacy WiMAX networks to LTE or 5G. Any such trends will continue to be tracked by Ovum and incorporated into future forecasts.

In addition, it should be noted that subscribers in emerging markets who have less purchasing power may choose instead to use Mi-Fi, so adding to the overall number of fixed wireless users.

The business case for FWA is expanding

FWA can be deployed in an increasing number of use cases depending on an operator’s business profile. The key competitive strength of FWA is that it allows operators to create new business opportunities and drive new revenues through fixed–mobile convergence (FMC). This can be by helping a mobile operator to expand its competitive offering with a fixed broadband play that complements an existing mobile service, or in another variation, enabling a converged operator to deploy fixed wireless broadband as a complement to fiber in dense urban areas where there is no timely and cost-effective access approval to deploy fiber. In the latter case, FWA can both enhance network performance and shorten the ROI compared to fiber alone.

Table 2: Selected fixed wireless deployment strategies

<table>
<thead>
<tr>
<th>Region</th>
<th>Operator/ country</th>
<th>Market</th>
<th>Target area</th>
<th>Operator</th>
<th>Fixed wireless strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia-Pacific</td>
<td>Dialog/Sri Lanka</td>
<td>Developing</td>
<td>Suburban/rural</td>
<td>Integrated</td>
<td>Dialog introduced its “Home Broadband” fixed TD-LTE service in 2017, and has since expanded coverage to the country’s major urban centers. Services provide between 4Mbps and 40Mbps (downlink) and between 1Mbps and 3Mbps (uplink), with packages ranging from $600 ($3.70) per month for 8GB, to $29,900 ($184) per month for 700GB.</td>
</tr>
<tr>
<td></td>
<td>Optus/Australia</td>
<td>Developed</td>
<td>Metro (all capital cities)</td>
<td>Integrated</td>
<td>Targeting users with short-term requirements (students, holiday homes, shared accommodation, renters, etc.).</td>
</tr>
<tr>
<td></td>
<td>Spark/New Zealand</td>
<td>Developed</td>
<td>Nationwide</td>
<td>Integrated</td>
<td>Targeting low–mid-usage-level customers and the short-term customer segment (e.g. renters).</td>
</tr>
<tr>
<td>Europe</td>
<td>Bouygues France</td>
<td>Developed</td>
<td>Nationwide</td>
<td>MNO and ISP</td>
<td>“4G Box” service starts at €32.99 per month, rising to €42.99 unlimited for consumers of over 200GB per month. Rental box included. Supports up to 220Mbps.</td>
</tr>
<tr>
<td></td>
<td>Relish/UK</td>
<td>Developed</td>
<td>Metro (London), regional (Swindon, Reading), rural</td>
<td>Operated by UK Broadband, a wholly owned subsidiary of Three UK</td>
<td>Targeting gaps and areas not served by FTTN. Consumer service offered at up to 50Mbps; business service includes 10/20/30/50/100Mbps services.</td>
</tr>
<tr>
<td></td>
<td>T-Mobile Austria/ Czech Republic/ Poland</td>
<td>Developed</td>
<td>Nationwide</td>
<td>Integrated operator</td>
<td>Services are using outdoor CPE and LTE-A Pro technology to boost speed. T-Mobile Austria’s MyHomeNet service offers between 30/6Mbps and 300/50Mbps at prices from €24.99 to €54.99 per month.</td>
</tr>
<tr>
<td></td>
<td>Vodafone Germany</td>
<td>Developed</td>
<td>Nationwide</td>
<td>Integrated</td>
<td>GigaCube fixed wireless broadband service launched in April 2017, offering up to 200Mbps. Targets areas with no high-speed fixed broadband, as well as tenants in multiple residences, holiday homes, SMEs, and business travelers.</td>
</tr>
<tr>
<td>Latin America</td>
<td>AT&amp;T Mexico</td>
<td>Developing</td>
<td>Nationwide</td>
<td>MNO</td>
<td>Basic Internet en Casa service offers 5Mbps for $200 per month or 10Mbps for $350 per month. Up to 15GB per month before speed drops to 2Mbps. CPE costs $35 per month or $2,100 single payment.</td>
</tr>
<tr>
<td></td>
<td>Sky Brasil</td>
<td>Emerging</td>
<td>Suburban/rural</td>
<td>Pay TV</td>
<td>FWA is being used to tap the unconnected outside the major cities where cable and fiber has been deployed.</td>
</tr>
<tr>
<td>North America</td>
<td>AT&amp;T/US</td>
<td>Developed</td>
<td>Rural</td>
<td>Integrated</td>
<td>AT&amp;T’s Fixed Wireless Internet service provides a home internet connection with download speeds of at least 10Mbps, for $60 per month. The carrier plans to provide access to more than 1.1 million locations by 2020.</td>
</tr>
</tbody>
</table>

Source: Ovum
Whatever the approach, FWA can create opportunities in the home broadband market, where there are two sources of potential revenue growth. One is revenue from connections, and the other is revenue from the monetization of home content (such as online entertainment and education) and services (such as network safety and online medical services). The speed, rapid deployment, fast provisioning, and quick navigation provided by FWA helps increase long-tail income and provides a hedge against competition in the future.

Examples of FWA use cases include:

- **As a high-capacity triple-play service:** A mobile operator can compete directly with fixed-line providers by using FWA to deliver a range of services including video, in-home entertainment, movies, and IPTV.

- **To complement an existing fixed broadband service:** A fixed–mobile convergent operator can use FWA to enhance speed and capacity on its wired network, providing guaranteed service levels and an improved home broadband user experience.

- **As an alternative to wireline broadband connection for multitenant apartments and nomadic users such as business travelers and students:** A mobile operator can reuse its existing cell towers and spare network capacity to tap into underserved areas of the fixed broadband market with FWA, creating new revenues.

- **As a copper (DSL) upgrade where service demand is uncertain:** A fixed-only provider can quickly and cheaply employ FWA prior to rolling out upgraded DSL or a full fiber service, or as a longer-term capacity boost where wired alternatives may be uneconomic.

- **For business users:** FWA can be sold as back-up to existing wireline services. It can provide network redundancy for businesses that cannot afford any outages and need service assurance in case of a fiber or copper line cut.

**Technology is driving the FWA experience**

Coupled with the cost advantages of deploying wireless networks compared with wireline equivalents, the performance gains delivered by recent developments in fixed wireless technology are making it a highly effective contributor to the global drive for broadband connection.

Modern fixed wireless networks can support peak speeds approaching those of fiber, provide a comparable video experience to wireline broadband technologies, and address a range of delivery scenarios where wireline alternatives such as VDSL or FTTx make less economic sense.

Broadband-to-the-home network monetization scenarios are highly dependent on factors such as population density, subscriber take-rates, ARPU, CPE device cost and availability, network contention or oversubscription rates, and labor costs. Weighed against the high cost of commissioning a fiber network (which can represent 80% or more of the total network costs) and time to build, these factors can render fiber deployment uneconomic.

**Figure 4: FWA network monetization: developed country, suburban area, at 20Mbps**

<table>
<thead>
<tr>
<th>Best-case scenario</th>
<th>2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard scenario</td>
<td>5.1</td>
</tr>
<tr>
<td>Worse-case scenario</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Source: Ovum
Although subject to the same broad conditions (along with spectrum costs), FWA network monetization can outperform wireline in a number of deployment scenarios.

A recent Ovum study found that in a range of urban and suburban scenarios, a newly built LTE-based FWA network capable of delivering speeds of up to 50Mbps can achieve ROI significantly faster than wireline options can.

Delivering broadband access to remote rural communities can present a more challenging business case, with the prospect of prolonged payback periods due to sparse populations and low subscriber ARPU. However, as previously stated, there is scope for regulators and governments to assist fixed wireless providers by easing barriers and providing financial stimulus to local service providers.

Such incentives do not necessarily have to fund ultrafast, ultra-high-capacity broadband services. For those areas where broadband connectivity is poor or non-existent, delivering a minimum level of performance for all subscribers can outweigh the need to provide gigabit access for the few, and a sustainable throughput of tens of Mbps can be adequate for most users’ needs and sufficient to support a range of services as well as being more economically viable.

Low-cost broadband connectivity on this basis is being provided to rural populations in countries including Nigeria, Myanmar, and the Philippines, where system vendors say it can reduce infrastructure and operational costs by 50% or more. The low-power system works on solar energy and transmits radio waves of up to 40km in distance. A non-QoS-based FWA service is offered to low-end users on a prepaid basis.

Where high-end users are seeking a premium service with guaranteed QoS, such as in Japan, Germany, and Finland, FWA can compensate for a poor fixed broadband user experience, while also serving multiple residences, holiday homes, business travelers, and the SME sector.

**FWA continues to evolve**

FWA networks are continuing to evolve, benefiting from peak rates achievable with LTE-A and LTE-A Pro by employing features such as 4×4 MIMO, 256QAM, large-scale carrier aggregation including combined FDD and TDD, and massive MIMO.

As a result, system performance is improving with services capable of supporting peak cell rates well in excess of those possible with ADSL. Combining higher bandwidths with massive MIMO on FWA systems can further increase cell capacity and support more users.

FWA systems support a wide range of frequency bands, both FDD and TDD, from coverage bands around and below 1GHz, to capacity bands above 3GHz. The higher bandwidths available with C-band frequencies around 3.5GHz are proving particularly attractive for FWA.

With the coming of 5G, the mmWave bands will increasingly come into play. Use of these higher bands presents new challenges in aspects such as signal propagation and in-building penetration. Nevertheless, trials of 5G FWA are well advanced and operators in a number of markets will be launching services in late 2018 or 2019.

**The FWA equipment market is expanding**

Greater spectrum efficiency and lower cost per bit is further strengthening the business case for FWA and helping to support the evolution toward 5G services. Among a number of network vendors bringing FWA technology to the market, Ericsson, Huawei, and Nokia are now offering fixed wireless as a last-mile broadband access solution. All vendor platforms incorporate LTE, LTE-A, and LTE-A Pro technologies to push peak network capacity toward the 10Gbps threshold, through the use of massive MIMO and 256QAM at the eNodeB.
Both indoor and outdoor commercial CPE for FWA is becoming more widely available, from entry-level units through to the high end. Along with TDD/FDD support, 4×4 MIMO, and support for a range of LTE bands up to 3.5GHz, units are becoming easy to self-install with features such as omni-directional antennas removing the need to align the antenna and the base station.

Outdoor CPE equipment with support for Cat 16 LTE is already helping to drive peak speeds of up to 1Gbps and will be introduced on the NBN network in Australia during 2018, provided by wireless company NetComm. Huawei plans to launch a Cat 19 TDD outdoor antenna device with 8×8 MIMO in early 2019.

Commercial 5G CPE is expected to be available this year, including for C-band and mmWave frequencies and incorporating dual-connected CPE combining LTE and 5G. The first products will be compliant with Release 15 of the 5G standards and support standalone 5G deployments of the kind envisaged for initial 5G FWA launches. However, 5G CPE is unlikely to be deployed on a large scale soon due to the very high price. The experience with 4G suggests it will be some time (possibly up to three years) before affordable 5G CPE becomes available in the market.

Network and business management are key

In the same way as for any commercial broadband service, fixed wireless deployments need to be preceded by an evaluation of the practical challenges and business case based on aspects such as existing fixed network penetration and network capacity; build-out cost; the opportunity for equipment reuse; spectrum assets; anticipated take-up rate; and the availability of local funding or incentives.

Close cooperation with vendor partners is essential to ensure adequate provisioning based on coverage and capacity requirements and CPE capability. Minimum service-level guarantees such as line speed must be adhered to, and services fully supported.

Forward planning for network expansion as user take-up increases will also be critical, as service providers can improve ROI through on-demand expansion and by exploring new business opportunities such as in the smart home and enterprise markets.

FWA delivers across the board

As fixed wireless systems evolve in line with advances in LTE technology, they can deliver the greater spectral efficiency and improved levels of performance also seen in mobile networks. They can also deliver the economic advantages associated with the mature LTE ecosystem, such as reduced price per bit and lower overall deployment costs. FWA systems additionally benefit from a relative lack of complexity, consistent and guaranteed quality of service, and rapid deployment.

In terms of the business case, FWA provides the ability to support a growing number of use cases and to expand the use of FMC to facilitate new business opportunities and monetize new services. As well as delivering social benefits by providing low-cost broadband connectivity to rural populations, fixed wireless is also helping to change the face of broadband connectivity by enhancing and expanding broadband services for homes and businesses.

The challenge of home broadband

Continuing the drive for universal broadband services

Ubiquitous and affordable access to broadband services is considered fundamental to building a modern digital economy. Connecting the 3-billion-plus people globally with no internet access is challenging for governments and service providers in developed and emerging markets alike. Just as critical is improving the overall experience for all broadband users and keeping pace with growing demand.

The International Telecommunication Union (ITU) has set a target for household broadband penetration in emerging markets of 56% in the next five years. According to the ITU, more than 150 governments, in both
the developed and developing worlds, have released national broadband plans in efforts to address these issues (see Figure 5).

Among the countries whose governments have set such targets are:

- **The Kingdom of Saudi Arabia**: The government plans to upgrade basic internet access to 10Mbps under the National Transformation Program 2020, as a stepping-stone to achieving its targets for e-services. Basic voice and internet services have already been provided to 5 million rural subscribers under the universal service fund, and fixed wireless broadband is slated to play a key role in achieving rural broadband coverage targets by 2030.

- **France**: President Emmanuel Macron has reaffirmed the government’s intention that the 10-year national broadband plan should be less dependent on FTTP to achieve its broadband access targets in the short to medium term, with greater use of wireless LTE technology being made for remote areas of the country. Between 40MHz and 50MHz of 3.5GHz spectrum has been reserved for FWA and is not to be used for mobile broadband services before 2026. The government’s target is to provide 30Mbps service at 100% coverage by 2020.

- **Indonesia**: The national broadband plan has set a target of delivering a 20Mbps service to 70% of households in urban areas and 10Mbps to 49% of households in rural parts of the country by 2019. Broadband prices for the country’s highly dispersed 263.5 million inhabitants should not exceed 5% per-capita monthly income, and the priority is to support services for e-government, e-education, e-health, e-logistics, and e-procurement.

- **South Africa**: The government has set a target of 90% population coverage with a minimum service of 5Mbps by 2020 and for 50% of inhabitants to have access to 100Mbps. By 2030, it hopes to achieve 100% coverage at a minimum of 10Mbps, with 80% of the population receiving 100Mbps speeds. Similar targets are being set for schools and health facilities, with 100% coverage at 1Gbps by 2030, and for government offices, with 100% coverage at 100Mbps by the same date. Universal service funding will fill the gap between private investment and full government funding of projects.

In many cases, national broadband plans have proved challenging, and overambitious time frames for large-scale fiber deployments have slipped, causing coverage targets to be missed.

Thailand’s national broadband plan, Smart Thailand, originally aimed to cover 80% of the population with fixed broadband services by 2015, extending to 95% of the population by 2020. It also planned to connect 70,000 villages to low-cost broadband services of at least 30Mbps.

As of mid-2016, however, fixed broadband penetration levels in Thailand were still below 10%, and the deadline for achieving the coverage target has now been revised to end-2018. Additional funding is being made available by the Thai regulator, the NBTC, but where operators fail to provide coverage in rural areas, they must contribute 4% of their revenues to the universal service fund.
National broadband and FWA’s positive impact

In view of advances in wireless technology and based on analysis of the business case, Ovum believes that fixed wireless access has the potential to play a more influential role in helping deliver on national broadband targets.

Furthermore, the cost advantages associated with mobile and wireless broadband technologies mean that they are becoming increasingly affordable when compared to wireline: according to the ITU, mobile broadband prices have dropped by 50% on average over the last three years. As a result, mobile broadband is more affordable than fixed broadband services in most developing countries, with the average entry-level fixed broadband subscription being 2.6 times more expensive than an entry-level mobile broadband subscription in the least-developed countries.

There are several ways in which regulators and governments can help encourage mobile operators to deliver a universal broadband service over fixed wireless networks. These include making technology neutrality part of national broadband plans, to ensure that wireless can be used. Creating easy access to sites for deployments of infrastructure such as base stations can also assist the process, as can reduced spectrum costs and free-of-charge spectrum utilization.

Although downlink speed can be an important factor in any national broadband plan, those developing such plans might well choose to prioritize coverage and milestone (delivery time) aspects over data speed. Since the main advantages of fixed wireless are that it provides both coverage and rapid rollout of services, this too can work in favor of FWA.

Finally, the part played by universal service obligation (USO) schemes for broadband can be key. In New Zealand, the government’s Rural Broadband Initiative is improving connectivity for the 25% of the market not covered by its ultrafast fiber broadband program by funding the rollout of wireless connectivity in schools and hospitals as well as households.

Even though USOs place legal requirements on service providers to meet targets such as timescales and minimum connection speeds, the cost and speed of deployment advantages of fixed wireless can prove attractive, and regulators can assist in the delivery of services by speeding up the availability of new spectrum.

FWA growth is accelerating

When countries with major fiber programs (China, Japan, South Korea, the US, Vietnam) are excluded, FWA is the second-fastest-growing fixed broadband technology in each of the four major world regions (Americas, Asia, Europe, MEA). Ovum forecasts that the CAGR for FWA outside China will be almost as high as for FTTH/B over the period to 2022, though from a lower base.

Fixed wireless complements wireline

Fiber and DSL together make up more than three-quarters of the global fixed broadband market, with fiber subscriptions accounting for 43% and DSL 33%.

However, as bandwidth demands grow and the number of simultaneous broadband users per household increases, legacy ADSL is struggling to support many TV, video, and entertainment-type services.

Copper upgrades such as VDSL, VDSL2 vectoring, and G.fast, when used for the last mile and coupled with fiber-to-the-distribution-point, can deliver average downlink speeds well over 100Mbps, and upgrading existing copper gear in conjunction with extended fiber to the curb or to the node has the advantage of significantly lower upfront costs than FTTH. However, not all aging copper networks can be cost-effectively upgraded, and performance gains can be eroded as loop length from the distribution point increases.

Alternatively, the use of optical technology such as passive optical networking (PON) to deliver fiber to the home or to the premises (FTTH/FTTP) can massively boost maximum speeds to 20Gbps and above. It can
also support multiple subscribers on the same network, using an optical network terminal device placed either on the outside of the premises or inside.

Despite a continuing decline in FTTH build costs, however, fiber remains substantially more expensive to deploy than FWA, and monetization periods tend to exceed 10 years. Building an FTTP PON is a major construction project requiring significant investment and time before it is usable for communications services. Commissioning costs are high due to the need to lay or bury the fiber cabling, and projects can be susceptible to local factors such as labor costs, which can vary significantly.

**Developing a positive business case**

Although FWA will not replace existing high-speed copper, fiber, and coaxial networks and upgrades, when cost, flexibility, and speed to market are important factors, the case for FWA can outweigh that for wireline alternatives (see Figure 6).

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**Figure 6: FWA vs. FTTP: Costs, time to build, and time to bring subscribers onto network**

<table>
<thead>
<tr>
<th>Costs (network building and equipment)</th>
<th>FTTP network:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ODN design and build</td>
</tr>
<tr>
<td></td>
<td>Central office preparation</td>
</tr>
<tr>
<td></td>
<td>Equipment installation</td>
</tr>
<tr>
<td></td>
<td>CPE installations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FWA network:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network design and site preparation</td>
</tr>
<tr>
<td>Base transceiver station installation</td>
</tr>
<tr>
<td>MBH network build</td>
</tr>
<tr>
<td>CPE installations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time (to build network and bring initial subscribers onto network)</th>
</tr>
</thead>
</table>

Source: Ovum

FWA networks are far less cost and labor-intensive than fiber. Landsite preparation along with construction and installation of the wireless base station may be necessary where a new network installation is required, but the final connection to the home is wireless. Every home will need an antenna, although even outdoor antennas may require very little installation work and may even be self-install. The time lag between initial construction and initial subscribers can be as little as several months.

Other positive factors for FWA include the opportunity to reuse site resources such as mobile BTSs and antennas as well as high-capacity mobile backhaul. Uneven smartphone traffic distribution also means that on many mobile networks, up to 70% of cell sites are likely to be heavily underutilized, potentially running at 30% capacity or below. With the migration of spectrum toward LTE and the drive for more frequencies through the licensing of bands such as 3.5GHz, network capacity suitable for FWA is increasingly being opened up.

Where network capacity is shared, operators will need to determine how much bandwidth is applied to each service, but as a general rule where existing network loads are light, FWA users can share the same carrier (the "common carrier") as mobile broadband subscribers without conflict. Where traffic loads are heavy, the FWA service can use a separate band (single carrier).

For heavy traffic loads, an FWA service will likely utilize a higher frequency than is used for mobile broadband to provide additional bandwidth. Where a TDD network is being deployed, the common duplex arrangement means that downlink traffic is favored.
Although coverage is important, operators do not have to spend on full geographic coverage with an FWA network. The network build spend can be more targeted.

Without the need to deliver connectivity in a constantly changing, dynamic mobile environment, fixed wireless networks can also be designed and provisioned around a consistent and sustainable level of service adapted to individual customer needs. This can be achieved within tighter cost and performance parameters than are possible in the mobile space, helping to improve the monetization curve.

FWA industry case studies
A variety of operators around the world are using fixed wireless technology to provide broadband connectivity, often under various market conditions and across a diverse range of business models.

Developed markets
Services in developed markets are generally characterized by guaranteed service levels and a better user experience, with precise provisioning and the use of outdoor CPE and LTE-A Pro technology at the eNodeB.

• In the Czech Republic, T-Mobile offers a fixed broadband replacement service using its cellular 4G LTE network. The network incorporates 4×4 MIMO and tri-band carrier aggregation to deliver capacity for a range of TV, FMC, and multiplay services. Outdoor-mounted CPE supports LTE connections of up to 600Mbps downlink and 150Mbps uplink. The operator is also currently rolling out massive MIMO on its network.

• The basic fixed wireless service in the Czech Republic, called “plug-in fixed-line internet,” uses a desktop router and promises to deliver a peak download speed of 20Mbps, and 5Mbps for uploads. The service costs CZK399 ($18) per month with no installation fees. Higher-speed fixed wireless service packages employing an external modem range from 50Mbps to 250Mbps, and cost up to CZK799 per month.

• In Ireland, Imagine offers its rural “LTE fibre speed broadband” fixed wireless access service using its LTE-A network coupled with fiber to the base station. The company says its service is community driven (the greater the demand, the higher the priority given to network rollout in a local area). LTE is a specified technology for delivering next-generation access under the Irish government’s national broadband plan which aims to deliver broadband speeds of 30Mbps download/6Mbps upload to all premises by 2020. Imagine provides connection speeds up to 70Mbps, with recent speed tests showing an average user data rate of almost 50Mbps. It charges €59.99 per month with a 20GB daily data allowance.

Emerging markets
In emerging markets, services generally offer a prepaid service using low-end CPE and no guaranteed experience, and a high-end postpaid service, including guaranteed service levels and outdoor, high-performance CPE.

• In the Philippines, Globe Telecom is using fixed wireless access to deliver broadband service throughout the country. According to the government’s department of ICT, the Philippines has continually fallen behind its ASEAN 5 counterparts for the affordability, availability, and speed of internet access. Under the country’s national broadband plan, a mix of wired and wireless broadband technologies including LTE are being employed to meet the needs of the last mile.

• Globe is using FWA to support an OTT ecosystem, offering 15Mbps with a 50GB allowance plus a 100GB supplement for YouTube, as well as a prepaid service option. It has already implemented large-scale massive MIMO in dense urban areas, and in a further extension of the service, a 50Mbps tariff is being introduced this year. Globe has scheduled its 5G launch for 2019 and says it will use the technology to deploy fixed wireless broadband.

• In the Kingdom of Saudi Arabia, Zain is using fixed wireless technology to address issues of poor indoor coverage and to provide a much-improved user experience. The deployment follows a successful trial of the technology which recorded speeds of 20Mbps. Zain is deploying the technology in the western and southern regions of the country and in the cities of Jeddah and Makkah. FWA will be deployed both in the typical rural environments, and in suburban areas where no fiber or copper network is available, using the 1800MHz band.
**Conclusion**

Starting from a smaller base relative to wireline, FWA is growing fast. In the drive for universal, high-quality broadband connectivity, fixed wireless is proving able to deliver highly effective levels of service coupled with a positive business case across a growing range of deployment scenarios. This is thanks to a number of factors in addition to the capacity and performance gains already discussed. These factors include favorable economics relative to wireline alternatives and the social and political drive to achieve national broadband targets where alternative technologies can prove too costly.

Through the expansion of services and where the economics are favorable, FWA provides an effective complement, or even substitute, for fixed wireline connectivity, even at speeds approaching those possible with fiber. Where subsidies and incentives are required to render broadband connectivity a viable proposition, FWA is often the most viable and cost-effective approach in meeting the universal demand for high-speed broadband services for homes, businesses, and governments.
ABOUT OVUM

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