SAMSUNG

5G Fixed Wireless Access

A powerful alternative to fiber to the home

The arrival of 5G has made it possible for wireless networks to compete against fiber, satellite, xDSL, and cable in delivering high-speed broadband service to residences and businesses at attractive prices. Wireless operators provide this service with Fixed Wireless Access (FWA).

FWA is a method of connecting subscribers to an electronic communications network (e.g., broadband Internet access or telephone services) using a wireless alternative to traditional copper cables and/or fiber. The 'last mile,' or transmission from the area node to the business or residence using it, is handled via wireless. Businesses with low mobility, such as utilities and oil & gas firms, are prime candidates for FWA service. The savings in deployment time and cost are significant. With no need to dig trenches to lay fiber, FWA is an attractive option for operators.

FWA is not new, but previous telecommunication generations have lacked the throughput and reliability necessary to make it a viable alternative to wired services. 5G FWA delivers up to ten times the capacity of a 4G FWA network, often with more reliability. It can provide a similar broaband experience as last-mile fiber networks but with the advantage and flexibilty of wireless technology.

The need for reliable broadband services has never been greater. The benefits of providing high-speed internet access to those currently without are significant. According to the World Bank[2] a 10% increase in broadband penetration results in a 1.21% increase in GDP. Broadband alows small businesses to compete on a wider scale and health professionals to interact with patients remotely. It enables remote work and learning, enhances in-home entertainment options, and enables distant friends and family to stay in touch with video calls and conferences easily.

Providing 5G FWA services[1]

Date	Oct 2021	Feb 2022
# of operators	65	83
Countries	36	45

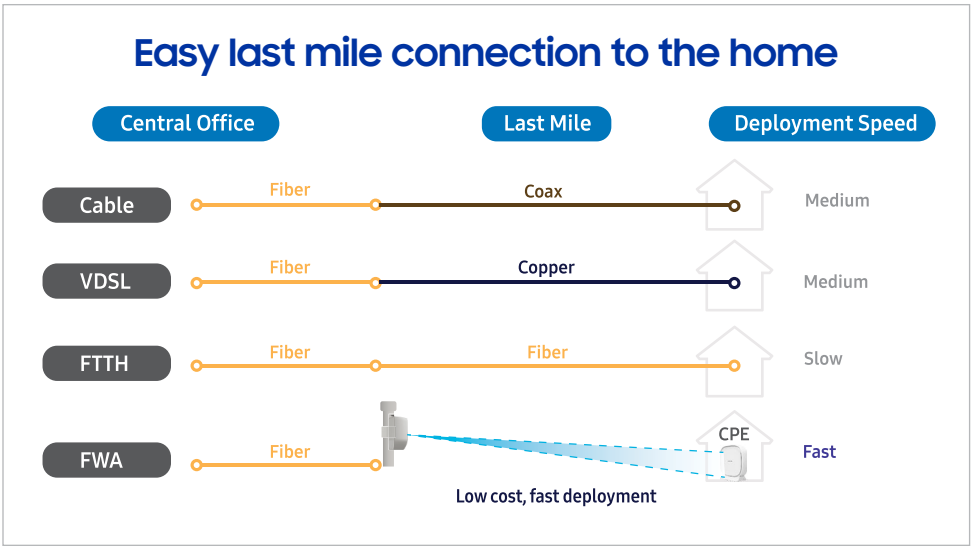
Another driver for more broadband services became evident as many people across the globe were required to stay home during the pandemic. The impact of this event on society drove the urgent need for governments to push harder to create incentive programs that focus on closing the digital divide - the gap between those who have access to high-speed Internet and those who don't. This divide is seen not only between countries but also within countries. The divide was brought to greater prominence during the pandemic, with the number of work-from-home employees skyrocketing, the number of students needing to attend school and do homework remotely affecting children around the globe, and the boom in home streaming entertainment options. Rural areas are often on the wrong side of the digital divide due to the low population density and the cost of bringing coverage to hard-to-reach areas. Per Forbes,[3] analysts suggest that FWA is poised to disrupt broadband pricing with low monthly fees.

5G FWA - A viable solution for high-speed broadband

How does FWA meet broadband needs?

Broadband access in the US is currently defined by the Federal Communications Commission (FCC) as a minimum throughput of 25 Mbps download and 3 Mbps upload.

FWA can achieve and exceed the FCC minimums by using 5G and operating with newer technologies such as beam-forming, massive MIMO antennas, and utilizing mid-band and high-band frequencies. FWA networks are expected to provide 100 Mbps download and 20 Mbps upload speeds.



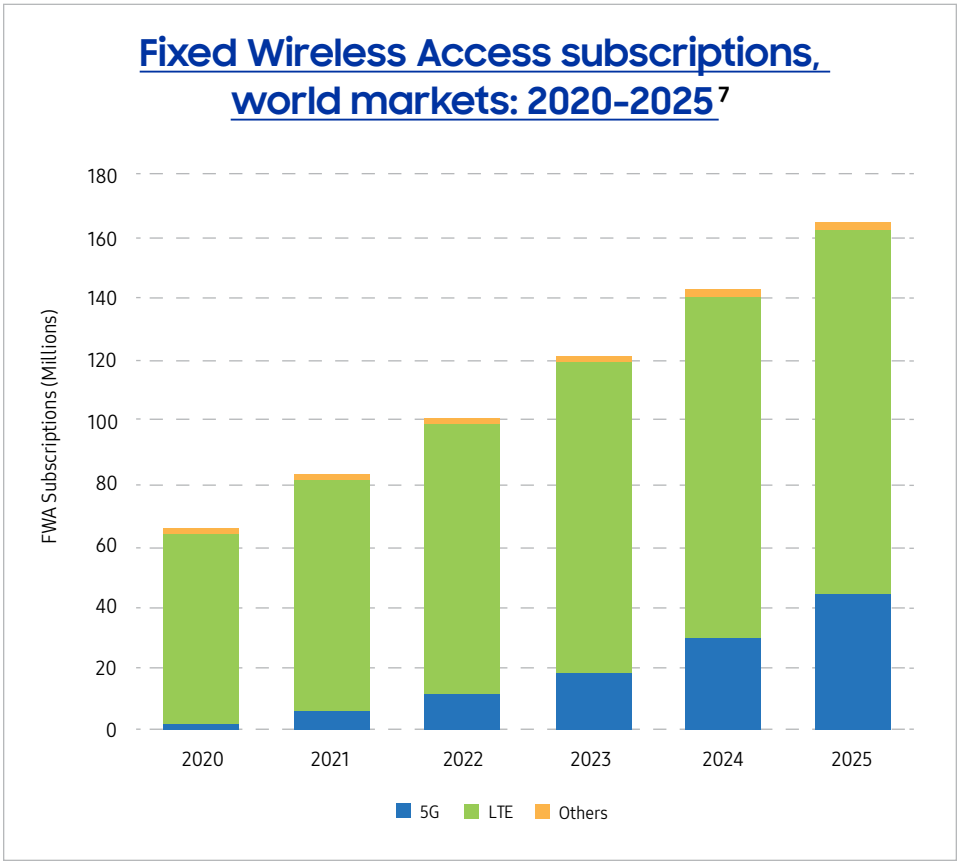
FWA makes financial sense for operators and consumers

A cost analysis comparing FWA to Fiber to the Home (FTTH) needs to consider many variables, including capacity requirements, population density, and which spectrum to use. Avoiding the cost of digging ditches to lay fiber and the ability to re-use existing base stations for FWA and mobile services result in significant cost savings. One estimate[4] finds that 5G FWA can reduce the 'last mile' connectivity by as much as 40% compared to fiber, while another[5] determines CapEx for FTTH per subscriber to be $2,000-$2,500 and for an FWA subscriber to be $1,000-$1,500, a savings of 50-60%.

> "5G mid-band plus mmWave is also cost-effective in urban areas lacking existing fibre infrastructure that can be shared or rented. In such cases, expected cost savings can reach 45% depending on the region." [6]

- The Global Mobile Suppliers Association (GMSA) has done extensive cost analyses comparing FWA to FTTH, using mmWave only or mmWave plus mid-band[6] frequencies, in urban, suburban, and rural areas, in multiple regions of the world, i.e., Europe, Latin America, and the US. They assumed that the operator had an existing 5G wireless network and found that:
- In **rural** communities, for those places that lack the underlying infrastructure necessary for operators to rent or share for FTTH, a 5G mmWave FWA solution could provide cost savings of up to 65%, and a mmWave + mid-band solution could save up to 80% over fiber. For the combined mmWave + mid-band solution in areas where operators can use existing poles or ducts for fiber, the cost savings would be up to 10% in Europe, 20% in the US, and 30% in Latin America for FWA as compared to FTTH.

- In **suburban** areas, where broadband usage is expected to be moderate orcivil infrastructure costs are high, 5G FWA using mmWave could supply savings up to 45% over FTTH. For the blended mmWave + mid-band offering, where an operator needs to build the necessary FTTH infrastructure, savings for FWA can be up to 70% compared to FTTH. If existing poles and ducts can be used for FTTH, cost savings to use FWA would be 30% in Latin America and 20% in Europe.



- In **urban** areas with challenging terrain or significant regulatory restrictions, a mmWave FWA solution would save up to 25% where fiber needs to be deployed and the operator expects a market share under 30%. With the mmWave + mid-band offer, FWA can offer 30-45% savings when the operator needs to deploy the fiber infrastructure. If there are existing poles or ducts for fiber, the cost savings would still be up to 10% in Europe and 20% in Latin America compared to FTTH.

FWA is a viable alternative to fiber in many circumstances worldwide based on cost savings, flexibility, more straightforward implementation, and faster time to market, allowing operators to begin service delivery much earlier than with FTTH.

FWA considerations

Operators should consider several factors when pursuing an FWA strategy – such as the physical constraints of the locations where broadband is needed.

Elements to review for FWA

Several attributes should be considered when looking at the area where FWA is to be deployed.

- Topography - Is there a direct line of sight? How will you adjust the network for non-line of sight service locations if not?
- Population density – Are there enough subscribers to earn a reasonable return on investment (ROI)?
- Site – Where will the transmit/receive nodes be placed? Are there existing towers or poles for equipment such as radios and antennas?

- Spectrum – What spectrum will be used is often the most critical consideration. Mid-band frequencies, such as CBRS or C-band, hold a significant data load. The spectrum rights must be purchased in the case of C-Band, while the CBRS rights can be bought or can be free in certain areas and circumstances. mmWave bands carry more data, but the signal doesn't travel as far as mid-band frequencies, and the spectrum rights must be purchased. It's often used as a capacity booster.
- Coverage – Over how big of an area does your subscriber base reside?
- Capacity – What throughput will you provide? Will you meet the FCC minimum or surpass it? Dimensioning needs to be done for peak traffic.

Equipment for the home, office, and field

How the end-user accesses the FWA network is an important consideration. Customer Premises Equipment (CPE) can be in-house/office, needing only to be plugged in or mounted on a roof, window, or the side of a house/building that offers a direct line of sight with the FWA antenna. In some cases, it would require a professional installation.

CPEs are specifically designed to support the different frequency bands used for FWA, such as mid-band CBRS and C-band, and high-band mmWave 28 GHz and 39 GHz. The service providers offer the CPE devices as a part of their broadband service to ensure the end-to-end service is provided at the highest level.

CPEs are available in two power classes: FR1 and FR2. FR1 covers frequencies under 6 GHz, such as CBRS and C-band. FR2 uses frequencies above 6 GHz, such as mmWave.

As of 2021, there are 56 5G CPEs available from 30 different vendors, covering bands such as CBRS, C-band, and mmWave, for indoor and outdoor scenarios.

Other considerations

Other factors should be considered when deploying FWA, including regulatory issues, environmental concerns, and government incentive programs.

Regulatory

The primary regulatory issue when dealing with FWA is the speeds that are defined as broadband. Initially set in the US by the FCC at 4 Mbps download and 1 Mbps upload (4/1), it was redefined in 2015 as the current 25/3. There are discussions underway to move those minimums to 100/20 Mbps.

Environmental

Higher frequencies are more easily affected by the environment, such as weather and topography.

Low-E glass in windows, valued for blocking solar radiation and keeping cooling costs down, can block RF signals and reduce throughput.

Care must be taken to ensure coverage and capacity limits are managed.

Government incentive programs

Many governments are finding ways to promote broadband competition and encourage its use, intending to spur development, create new services, and lower consumer prices. Several state and federal programs have been established to provide funding to bring broadband access to unserved, underserved, and tribal lands in the US. Operators can qualify for grants and loans by meeting specific criteria such as coverage, capacity, and throughput.

Examples of such programs include:

- Connect America Fund (CAF)
- Rural Development Opportunity Fund (RDOF)
- ReConnect Loan and Grant Program
- Growing Rural Economies with Access to Technology (GREAT)

5G FWA technology improvements over 4G FWA[6]

- Unified Standard
- Spectral Efficiency
- Advanced Features
- CPE innovation and model diversity
- New spectrum in mmWave bands

Congress acted last year with bipartisan support to improve the nation's infrastructure, including broadband. The approach included $42.5 billion in grants from the Department of Commerce to states for broadband projects with priority for unserved or underserved locations. It is called the Broadband Equity, Access, and Deployment Program, or BEAD. The technology-neutral minimum requirement for a broadband project to receive a share of that $42.5 billion is 100 Mbps downstream and 20 Mbps upstream.

Providing high-speed Internet to unserved and underserved areas is where FWA will shine - with the ability to cover a large area and jump over the "last mile" to people's houses at a lower cost. FWA will be essential to the solution, especially in rural areas.

Samsung's 5G solution for FWA

Samsung's 5G wireless solution is based on 3GPP standards, offering a wide selection of products to be used in an FWA solution for private networks and for the mid-band and high-frequency bands used for FWA solutions by service providers.

Private networks using FWA usually utilize the CBRS license spectrum known as band n48 (3.55–3.7 GHz) in the US, which is sometimes available free of charge depending on the county/region utilization of the spectrum. For this type of network, Samsung offers the Private Network (PN) Core, Private Network Management System (PNMS), baseband units, and/or a virtualized RAN (vRAN). Depending on the network architecture strategy of the enterprise, several CBRS outdoor radio options are available, from 2T2R radios up to 64T64R massive MIMO antennas. High band solutions with mmWave are also available for countries where the government allocated these frequencies for private network use.

Samsung's PN Core provides a pre-configured set to support various use cases of the private 5G network. The minimum configuration is a network-in-a-box system (compact core), offering a single server core and management solution for a small-scale enterprise site. PN Core can also be expanded and molded to fit a diverse case of private 5G networks for medium to large-scale multi-site enterprises.

For service providers, the FWA solution generally utilizes the mid-band, such as the C-band, known as band n77 or 3.7 GHz (3.7-3.98 GHz), and high-frequency bands such as band n258 or 24 GHz (24.25-27.5 GHz), n261 or 28 GHz (27.5-28.3 GHz), and band n260 or 39 GHz (37-40 GHz) in the US. Their use varies depending on the frequency band spectrum awarded to them by each government. Samsung offers a broad portfolio for these types of networks, including the cloud-native core and vRAN, which runs on Commercial-Off-The-Shelf (COTS) servers and can be expanded to a cloud platform. Also offered are baseband units, network automation solutions, deployment, and professional services, including the RAN Planning & Optimization services using the CognitiV tool to predict mmWave coverage. Samsung also provides a wide selection of radio products for mid-band, such as 4T4R and 8T8R radios, 16T16R, and 64T64R Massive MIMO antennas. For high-frequency bands, Samsung offers mmWave products such as the Compact Macro.

Samsung's mmWave Compact Macro can easily be deployed on streetlights or poles, placing them inconspicuously near homes and businesses. Deployment is fast and straightforward without any site access, keeping costs down. Massive MIMO antennas and radios are a critical part of 5G networks. MIMO allows the same spectrum to be re-used, significantly multiplying the number of data paths, and enhancing throughput considerably. Samsung's massive MIMO radios support both TDD and FDD and support CBRS, C-band, and other mid-band frequencies. Samsung's portfolio includes those with wide vertical coverage, suited for urban environments, and slim models, enabling efficient deployment and installation. Cutting-edge technologies such as beamforming and multi-user MIMO (MU-MIMO) allow Samsung's solutions to provide the capacity needed to ensure satisfied FWA customers.

Samsung's professional services offer RAN Planning and Optimization (RPO) services using the CognitiV tool, which uses AI and a unique 3D full ray-tracing model to simulate a realistic network deployment environment. It traces comprehensive propagation paths and estimates signal losses based on real-world information such as the buildings' window penetration and material surfaces. It provides operators with the information required to deploy their base stations accurately. The tool has a self-calibration function that continuously receives data from the installed CPEs to improve accuracy.

Customer Premises Equipment (CPE)

Samsung partners with companies that provide a variety of FWA 3GPP CPEs devices. All products have undergone thorough testing for performance and reliability.

Samsung's solutions feature some of the most significant 5G technical advantages applicable to FWA.

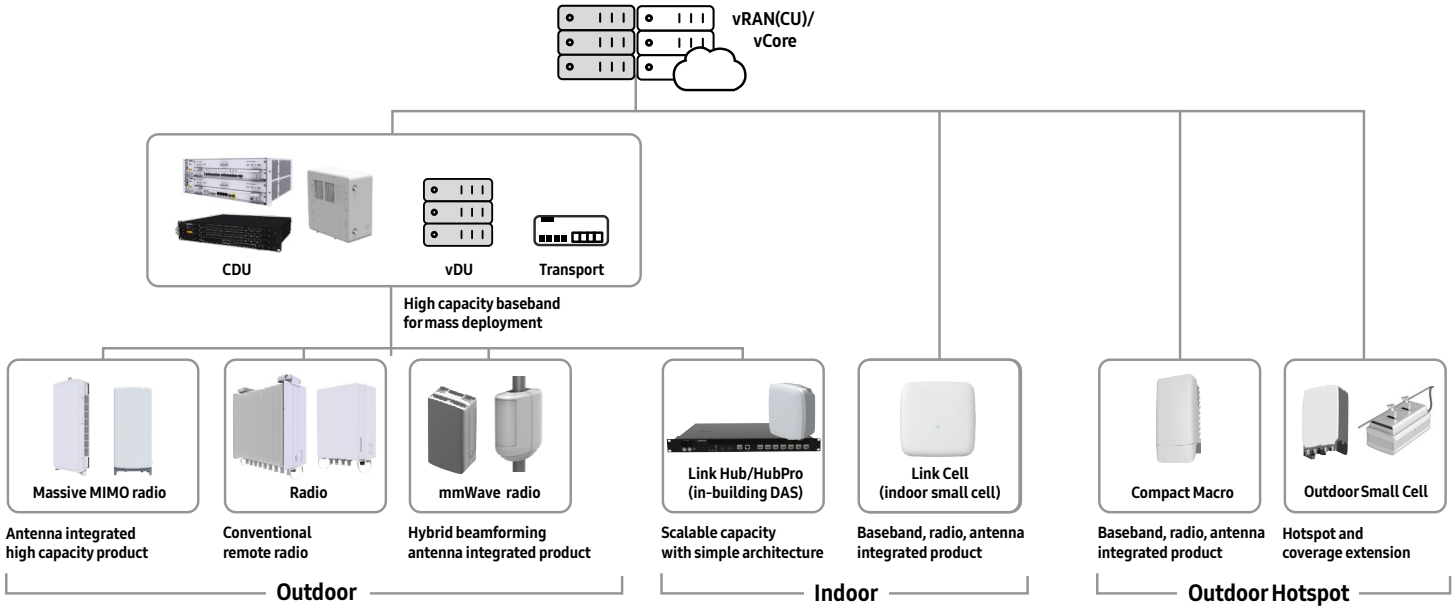
Extended coverage is feasible thanks to new technical developments in using mmWave for FWA applications. These developments extend coverage from 10 kilometers today up to 15 kilometers in the near future, thanks to improvements in FWA CPEs, with higher transmitting power than a mobile phone, combined with modifications of downlink allocation and downlink to uplink gap symbols, avoiding colliding with the Physical Random Access Channel (PRACH) signals used by mmWave signals.

Higher throughput for FWA is also achieved when combining Stand Alone (SA) and FR1 & FR2 with New Radio-Dual Connectivity (NR-DC), not only on the radio network side but also in the CPEs, increasing throughputs from 8 Gbps up to 10 Gbps soon.

Increased network efficiency and improved quality of service take advantage of beamforming, an advanced signal processing technology that physically shapes the radio signal into a tight, flashlight-like beam that accurately targets each individual CPE. Beamforming is used by mmWave and massive MIMO radio units, confining the radio output energy to a small area. This significantly extends the range and quality capability of the signals to simultaneously target several FWA CPE devices by focusing each radio beam of energy on them, with a stronger signal to increase service quality, range, and throughput.

Samsung RAN product portfolio

Full product lineup for capacity, coverage, indoor/outdoor



Select Samsung FWA success stories

- February 2017 – Samsung and Verizon deploy 5G in five US cities, delivering FWA to gauge user experiences, with full-scale deployments in 2018.
- July 2017 – Arqiva and Samsung launch first trials of 5G FWA in the UK and Europe on mmWave frequencies.
- February 2018 – Samsung offers the first 5G FWA commercial solution.
- September 2018 - Telefónica Deutschland and Samsung run FWA trials in Germany on 26 GHz mmWave.
- February 2019 – Samsung and Fastweb conduct Italy's first 5G FWA trials on commercial spectrum. Tests the previous year showed download speeds of 1 Gbps.
- June 2019 – Orange Romania and Samsung trial 5G FWA in Floreşti with overwhelmingly positive results.
- July 2020 – Samsung delivers 5G-ready CBRS massive MIMO solution to AT&T to support FWA solutions in rural markets.
- February 2022 – Amdocs collaborates with Samsung to offer end-to-end 4G and 5G private network solutions to US enterprises, including FWA in the CBRS band.
- March 2022 – Samsung and Avista Edge join forces to provide 5G CBRS FWA to public electric utilities and internet service providers in rural communities.
- March 2022 – Samsung and t3 Broadband partner to provide 5G-ready CBRS FWA to Mercury Broadband, with over 500 sites across the US Midwest.

Conclusion

FWA is a compelling alternative to FTTH, providing capabilities that rival wired connections but often at a lower price and usually quicker to install and activate. Mobile operators and private networks worldwide are looking to expand their offerings, compete in new markets, and take advantage of government incentive programs to help close the digital divide. FWA using 5G has become a very attractive substitute for fiber.

Samsung offered the world's first 5G FWA commercial solution in 2018 and continues researching, designing, testing, and delivering every facet of FWA solutions. Global deployments and trials continue to help us fine-tune our products, allowing us to offer an FWA solution for virtually all scenarios.

Samsung's 5G solutions are redefining how networks are built and managed to meet the exponential demand for broadband with FWA networks.

For more information about Samsung's Fixed Wireless Access solution

Samsung's Fixed Wireless Access page

https://www.samsung.com/global/business/networks/solutions/fixed-wireless-access/

Samsung's 5G RAN

https://www.samsung.com/global/business/networks/products/radio-access/5g-ran/

Sources

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