Fixed Wireless

Broadband Over the Air

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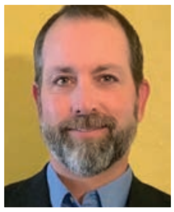
FW broadband is coming into its own as an internet access network. It provides a simple, quick and cost-effective solution to serving customers not easily accessed by traditional copper or fibre networks.



Bryan Blunt, Director of Product Management, Wireless Products, Amphenol Broadband Solutions

Bryan K. Blunt has been working in the telecommunications industry for more than a decade. He has spent the last three of those years specialising in wireless services. Bryan manages product lines for the wireless industry which include passives, antennas, cabling and connector solutions, as well as fixed wireless transport solutions. His education in business management, as well as years of operational and management experience, have given him a broad skillset which he draws upon daily in this rapidly changing marketplace. His wireless product portfolio forms part of the network solutions that can be viewed in detail at **amphenolbroadband.com**. Bryan also enjoys coaching baseball for his three boys and playing golf now and again.

Keith Mothersdale, Director of Technology, EMEA & APAC, Amphenol Broadband Solutions

Keith Mothersdale has worked in Broadband CATV engineering design and development for over 25 years. Currently with Amphenol Broadband Solutions, Broadband Product Division, he is in charge of technology engineering design and innovation within the last mile. In 2013, he was presented with an Honorary Fellowship by the SCTE in recognition of his long-term technical contribution to the CATV industry.

Before joining Amphenol, Keith worked at Teleste, heading engineering design and development within the passives and indoor division. Prior to Teleste, he worked at Technetix Group Ltd as CTO, focusing on product roadmaps, product innovation and all aspects of engineering. He has written several industry white papers and presented at major international broadband events. He has written and had published over six patents relating to product innovations. Keith holds a BEng (Hons) degree in Electrical and Electronic Engineering and an MBA from the University of Bradford.

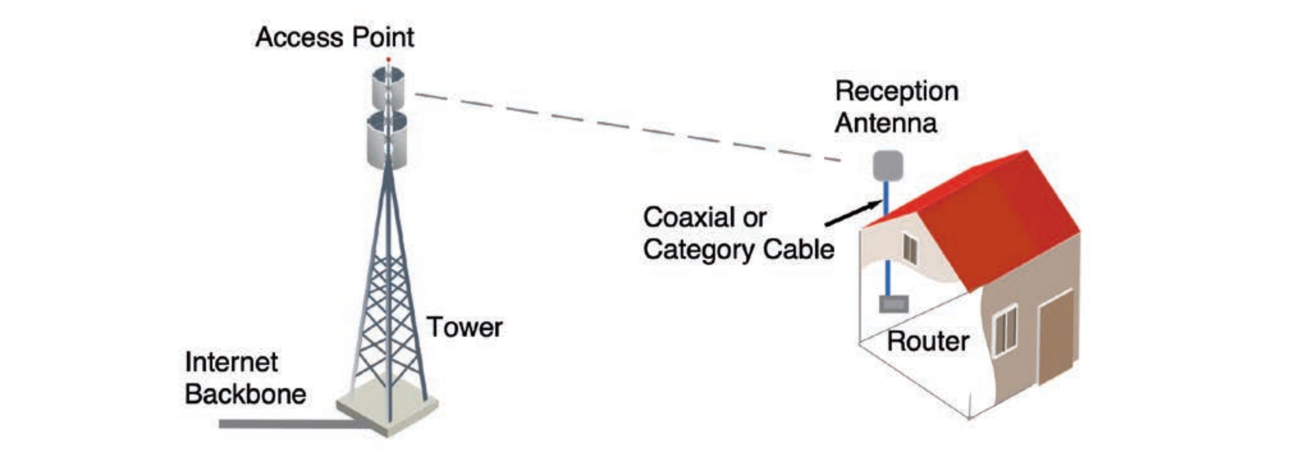


Figure A: Fixed wireless ecosystem

Everyone knows that the quickest path between two points is a straight line. As it turns out, when building an access network, a straight line may be the only path. While most current broadband subscribers worldwide may be served using physical copper or fibre connections, there are millions who have some form of barrier that precludes placement of such cables all the way to their premises. Fortunately for them, the time-proven technology of a fixed wireless (FW) network may allow them to enjoy broadband speeds without the expense of running a typical copper or fibre transport solution.

FW broadband is high-speed access in which the "last mile" connection to a service provider uses radio signals rather than a cable. It bridges the gap between the internet backbone and consumer by broadcasting radio waves from an access point, typically at the top of a tower, to reception dishes or antennas, at residence or business locations (Figure A above). Providers of the services over these networks are known as WISPs, or Wireless Internet Service Providers.

The use of FW to provide last mile connectivity continues to grow, with more and more service providers, large and small, deploying their own versions of the technology. And subscribers are responding. Preseem, a company that monitors FW networks, stated in a recent report that the average FW subscriber uses 6.7GB of data per day, or over 200GB per month. The average FW subscriber uses just over 3Mb/s when they are active.

While FW uses radio waves, it is not the same as some of the more commonly known radio technologies. First, it is not a satellite-based service. In fact, the technology provides better performance on consumer-sensitive factors, such as latency, when compared to satellite services. Online gamers, for instance, will certainly prefer the low "lag" of an FW access network when given a choice. Similarly, FW is not the same as a mobile system. Cellular systems can allow any device within range of tower-mounted antennas to connect to them and receive service. FW is point-to-point, broadcasting coverage in a straight line to a specific user. Finally, FW is not Wi-Fi. Unlike Wi-Fi, FW requires line-of-sight between antennas and cannot pass through or around minor barriers like Wi-Fi.

Before delving too deeply into FW broadband access systems, it should be noted that these networks have been in existence for quite some time. One can trace Wireless Local Loop back to the mid-90s, if not earlier. These early systems refer to the customer premises wireless equipment as the Subscriber Unit (SU), while the operator's transmitter delivering the last mile local loop services was known as the Access Point (AP). Similar terminology is used when describing FW today.

Benefits and limitations

An obvious question when contemplating FW is "why complicate the access network by adding a wireless approach to providing service?" As with most engineering choices, this question comes down to cost versus benefit. One of the greatest advantages offered by a FW system is the ability to greatly enlarge a broadband service area at a relatively low cost. The investment in placing fibre or coaxial cable to serve a single new customer, or even a whole group of them, is eliminated. Instead, an "access point", often called a "donor" antenna, may be placed at the nearest location served by the internet backbone, with a reception dish at the subscriber's location.

Another benefit of growing importance is the superiority of FW in handling latency when compared with other solutions. Typical rural technologies have very high latency, challenging the end-user's ability to effectively "stream" data. FW broadband offers much lower latency connections, making online gaming and streaming more feasible.

Another advantage offered with a FW solution can be the speed with which broadband services can be delivered to a new customer. Assuming that there is an already-deployed donor antenna on a local tower, the only additional equipment that must be deployed is that which resides at the customer's premises. After confirming line of sight between the premises and the tower, a reception antenna must be placed to complete the broadband connection. The actual placement is similar to that performed by a typical technician from a satellite television provider when installing satellite TV service at a residence.

While this technology can help service providers to address the need to supply high-speed internet in a variety of situations, it is not without its limitations. Perhaps the greatest of these is the fact that there must be a "line of sight" between the donor antenna and the reception dish. This means that intangibles, such as geography and even vegetation, can determine the possibility of using this solution.

Another challenge can, of course, be the cost of the system itself. While every FW deployment will be unique, the cost of a tower as well as radio equipment, power etc. can sometimes challenge even the best business case. On average, in most areas, FW is slightly more expensive per Mbs (the speed the subscriber actually receives) than wired solutions.

Unlike wired access solutions which use fibre or metallic media to carry broadband signals, FW systems use air as the medium. Wireless services; cellular, satellite, as well as FW, suffer a slight reduction in download and upload speeds during rainstorms. Known as "rain fade", this phenomenon is the absorption of microwave radio frequency (RF) signals by rain. More broadly, snow and ice can similarly affect wireless signals, as can changes in atmospheric conditions before, as well as during, a storm. It should be noted that rain fade can occur at either antenna location, or even at both of them, in an FW deployment.

As with any network deployment, security must be a major consideration. Vulnerability to intrusion, or "hacking", must be understood and addressed whenever a broadband deployment takes place. When designing an FW network, engineers must include how encryption and authentication will be accomplished. Generally speaking, FW systems are largely considered to be equally secure as other types of access networks when security protocols are part of the initial design. Like wired networks, continuous examination of how the FW network is kept secure is important.

Fixed wireless network topology

There are two types of FW networks; point-to-point and point-to-multipoint (Figure B below). A point-to-point connects two locations, such as a tower, on the internet backbone and a business or residential building. Such networks can also be used to connect, for example, adjacent buildings that may house the same company. Point-to-multipoint FW networks use a single internet backbone antenna tower to connect to multiple locations, each with their own reception dish. As can be imagined, campus environments and even larger areas may be efficiently served using a single, strategically-located antenna tower.

Elements of a fixed wireless access network

With an understanding of FW systems, their advantages and limitations, as well as their topology, we now turn our attention to the individual elements that make up these networks.

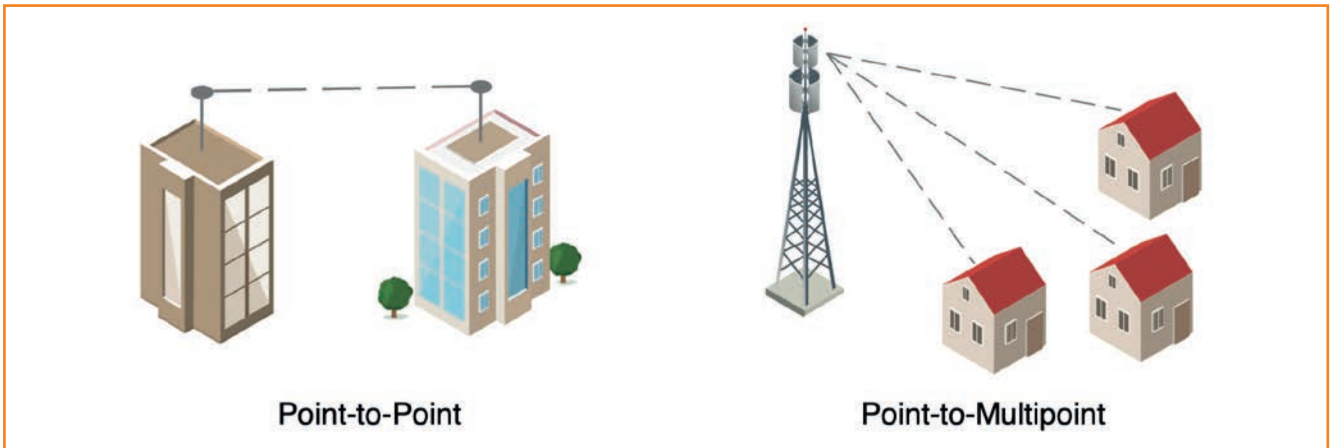


Figure B: Fixed wireless topologies

Access point

The access point is the location at which the broadband access network transitions from a hardwired internet connection to a wireless one. The donor antenna along with the equipment that places it in a convenient line of sight, such as a tower, as well as cabling that connects the antenna to the internet infrastructure must be at the location.

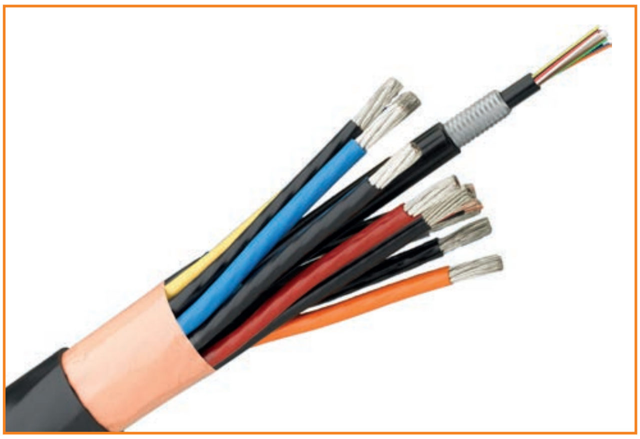


Figure C: Hybrid cable

FW uses a directional radio antenna on each end of the signal. The size of these antennas will vary between deployments but are generally larger than a WiFi antenna. The antenna will be used outdoors, so their design will have to take factors, such as humidity, wind load and sun damage, into consideration. Equally important is the anticipated distance that signals must travel as well as the bandwidth levels expected to be delivered.

Because subscriber locations are stationary, FW connections may be targeted, making the signal much stronger than a broadcast signal, such as FM radio. Best practices call for antenna set-ups which can focus the greatest transmit power at the target, usually by making the "beam" as narrow as possible. The focused beam has the added benefit of reducing the chance of intrusion. The narrow beam allows better signal speed and/or better reach for the same amount of transmit power.

The donor antenna site consists of much more than simply an antenna. For this reason, it is important to work with a supplier who can also provide the cabling and parts that complete the installation. As mentioned earlier, an advantage of FW is its ability to be deployed quickly. In such instances, time-saving innovations, such as the hybrid cable from Amphenol Broadband Solutions (Figure C), are designed to accelerate deployment while also reducing overall costs. Running a single cable that can provide both fibre backhaul connectivity as well as power is a proven alternative to using single-purpose cable.

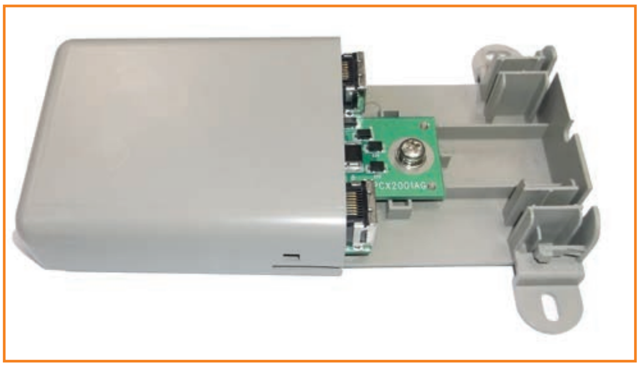


Figure D: Ethernet surge protection

Important across the entire network is protection against voltage surges. Voltage spikes can be harmful to delicate equipment and can be harmful to those working on, or even using, the network. Surge protection devices such as the example from Amphenol Broadband Solutions shown in Figure D, can work in series with coaxial or category cable to help ensure a safe network.

Subscriber's location

At the subscriber's end of the connection, a reception antenna with direct line of sight to the access point brings the wireless signal into the customer premises. At this location, the broadband signal is brought into the premises over a coaxial or category cable, which is connected to a router in exactly the same way as it would be if the premises were served by a copper or fibre connection.

One trend in customer premises deployments is the use of self-installation kits. Customer premises deployments may be the most daunting challenge of the entire FW network. In brownfield applications, each home or business can present its own set of unique requirements. This entails not only making the choice of where on a building to place an antenna but, just as importantly, how to bring the signal into a residence where the router must be placed.

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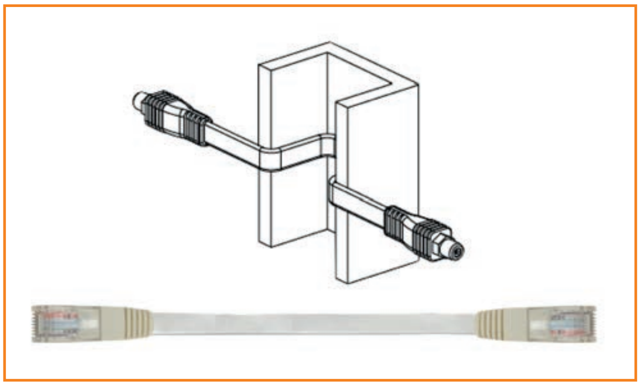

Figure E: Flat window jumpers - Coax (top) and Cat5e (bottom)

Category cables (Cat5, Cat5e, Cat6, etc.) are the most common methods of transport in an FW environment. These cables will normally bring the signal from the service antenna to a point of entry for the building.

A quick and clever entry into the premises can be made using a product such as a flat window/door jumper (such as the examples shown in Figure E from Amphenol Broadband Solutions). This cable utilises two embedded "rails" on either side of the cable to protect the category or coaxial component within. These cables can then be moulded by hand to enter the building through an existing door or window opening, eliminating the need to drill through a new wall, thus cutting down on installation time as well as minimising damage to the customer's home.

Fixed wireless radio spectrum

No discussion of wireless technology would be complete without an examination of how the solution fits into the radio spectrum scheme. FW is a solution that is suitable for rural areas where the cost of running cable to far-reaching homes, farms or businesses can be prohibitive. In these locations, wireless spectrum is not as "crowded" as it is in urban and suburban areas. Here, WISPs can utilise available unlicensed spectrum to deliver 30Mb/s or more of broadband service to subscribers.

Deploying FW in suburban and urban areas creates a greater challenge for service providers since the airwaves are shared with virtually every other type of wireless technology. In our modern lives, consider the many dozens, if not hundreds, of devices that operate without being wired. Police and public safety communications, cellular voice and data, satellite broadcasts and garage door openers to name but a few. With a constantly growing IoT, the list is always expanding. Providers of FW, then, are challenged with identifying available radio spectrum.

Fortunately, from a technical standpoint, FW may be broadcast across almost all of the radio spectrum, allowing a WISP to select the spectrum that may be available in the targeted area. Even connections at the lower end of the radio spectrum can provide internet speeds that are just as good as those over a hardwired path of twisted pair or coaxial cable. Data speeds increase even more at the higher end of the radio and microwave frequency bands, allowing WISPs to offer connectivity that rivals FTTX.

Summary

FW is a technology coming into its own as an internet access network. It provides a simple, quick and cost-effective solution to serving customers not easily accessed by traditional copper or fibre networks. The equipment required to deploy FW is readily available and, in a growing number of business models, may be installed by the subscriber himself.

Service providers would be wise to add this approach to their "toolkit" of solutions to reach end-users.

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