# Fast, Affordable Gigabit for MDUs

A fiber-only approach to connect multiple-dwelling-unit properties isn't always fast or economical – but a combination of fiber and fiber-like wireless can provide gigabit speeds to residents quickly and at a remarkably reasonable cost.

By Boris Maysel / Siklu Communication

ultiple-dwelling-unit (MDU) residents want broadband! More than four of five residents rank the availability of high-speed Internet access as the most important MDU amenity, according to research conducted by market research firm RVA. Internet access is more important to residents than appliances such as washers and dryers. It's even more important than cable television.

Large MDUs that have tens or hundreds of residents require huge amounts of bandwidth. Residents of affordable housing struggle the most to get broadband, but student housing and other multifamily properties often lack appropriate infrastructure as well.

If broadband is so vital to MDUs, why are not there more success stories about connecting MDUs, and why are so many MDU buildings left in the dark?

The most complex problem involves providing fast broadband to existing, or brownfield, apartment buildings - which include much affordable housing and student housing. Upgrading the communications infrastructure in older buildings can cost an arm and a leg, and construction can take several years. Many MDU deployment issues identified a decade ago are still current today.

Fortunately, there is a way to deploy a sustainable gigabit network that can deliver real high-speed broadband to every MDU, and even to every residential customer, in a fast, cost-efficient way. This practical approach uses existing, scalable technology that may be

deployed in just a few days or weeks. It is an especially attractive solution for brownfield buildings.

#### LEVERAGING MIDDLE-MILE FIBER

The availability of fiber in the middle mile greatly simplifies the problem because the lastmile problem has already been solved many times. Today, middle-mile fiber is becoming much more readily available, and MDU owners can take advantage of this.

Fiber location tools and available operator fiber maps show that many MDUs are located within a mile of an existing commercial fiber network. In addition, many communities have fiber network assets that connect their municipal facilities and anchor institutions; in some cases these networks can be extended for other purposes. Almost every library is connected to a fiber network, and most schools are either connected or being connected through the FCC E-Rate program or as part of a community initiative. Such municipal or community broadband infrastructure is well-positioned to serve affordable housing, student complexes and senior housing. All that's needed is a fast, affordable way to leverage middle-mile fiber.

### FIBER-LIKE WIRELESS

Fiber is fundamental to any high-performance communications network. However, in a citywide deployment, a fiber-only approach faces time and cost challenges. The business case to lay additional fiber becomes less feasible at the edge of the network, especially in residential areas.

In the last few years, one major breakthrough in wireless technology has been the commoditizing of millimeter-wave equipment. Equipment that operates in these frequency bands can provide multigigabit capacity, is immune to interference and is suitable for deployment in dense areas. All in all, millimeter-wave wireless is a very cost-effective solution, particularly for the last mile. This approach is already widely used by wireless ISPs across the country to connect businesses in multitenant-unit buildings, and it is easily scalable to residential MDUs.

Adding fiber-like wireless connectivity to the toolkit introduces a new paradigm to swiftly provide fiber-grade services with a low investment. The middle mile remains fiber, and the last mile becomes wireless. This approach is called hybrid fiber-wireless, or HFW. It is a hybrid topology that takes advantage of an existing fiber network and utilizes state-of-the-art wireless technologies without compromising performance or reliability – and it has minimal risk.

Imagine connecting every MDU within 2 miles of the fiber point of presence (POP) to multigigabit speed in just a matter of days.

#### **MILLIMETER-WAVE Q&A**

How do millimeter-wave frequencies provide such very high capacity? There are actually two frequency bands called millimeter waves: the E-band and the V-band. In the United States, the E-band has 10 GHz of available spectrum (71-76 GHz paired with 81-86 GHz), and the V-band has "only" 7 GHz of free spectrum. In fact, the V-band has more free frequencies than all the unlicensed bands put together. This huge amount of bandwidth enables the use of wide channels - 250 MHz, 500 MHz or even wider. Using simple modulation schemes on these channels provides true, reliable gigabit capacity - and beyond.

Why are millimeter waves immune to interference?

Several things happen at very high frequencies. First, according to the Friis



Figure 1: Millimeter-wave signals are highly focused and thus have little interference.

transmission equation (which says that signal loss is proportional to the square of the frequency), signal attenuation increases. At the same time, the antenna (for a given size) becomes more directive – that is, a higher proportion of its signal is transmitted in the desired direction, and it provides more gain.

At high frequencies, as illustrated by the green band in Fig. 1, the electromagnetic signals transmitted are more focused. Interference signals that leak via antenna side lobes (unwanted radiation in directions other than the main direction) are highly attenuated both because the side lobes are small to begin with and because free space loss (overall signal attenuation) is high.

As a result, there is virtually no interference in these bands, which makes them extremely suitable for deployments in dense areas. In addition, there are nine 500 MHz channels in the E-band frequencies, and with

two available polarizations (different orientations within the same channel), network performance is rock solid.

Why do millimeter-wave links cost so little? Network costs include operating expenses (opex) and capital expenses (capex).

Let's start with opex. Because millimeter-wave bands are immune to interference, no radio planning is required, and therefore there is no work for the regulator. Spectrum license fees range from very low to none. Installation is easy as well. With a proper alignment mode and simple tools, installation of a radio link can take 15 minutes.

Now for the capex. Millimeterwave technology has advanced, and the old bulky, heavy, split-mount radios based on military technology have been replaced by compact, highly integrated, all-outdoor units based

Millimeter-wave radios were originally developed for military applications, and they were bulky, heavy and expensive. Now they've been commoditized.

## DU TECHNOLOG

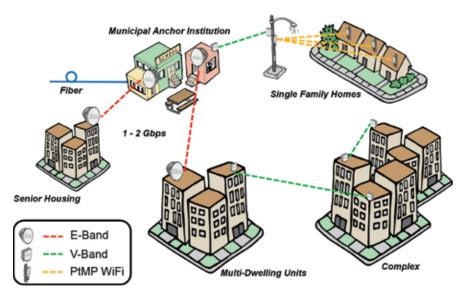


Figure 2: Fiber-connected municipal anchor institutions can serve MDUs wirelessly.

on commercial silicon technology. These outdoor units incorporate all the radio and networking components and an integrated antenna. The small number of components and the deep silicon integration make for affordable equipment pricing.

#### **IMPLEMENTATION ISSUES**

The practical approach to deploying HFW can be summarized in a single sentence: "Deploy HFW when needed; upgrade to fiber when desired."

In a municipal broadband network, as illustrated in Fig. 2, fiber must reach one of the municipal buildings - a school, library, hospital or fire station. From this location, the fiber may be extended wirelessly to virtually any other location within a radius of up to 2 miles and with available line of sight. In this case, all buildings that comply with the above requirements will receive multigigabit speeds.

Any community can use this approach to connect MDUs, provide

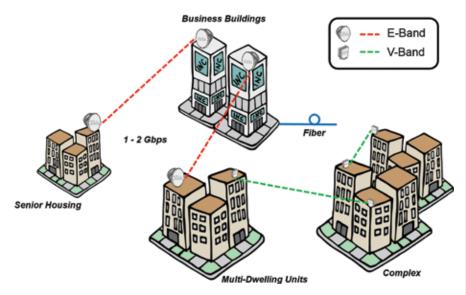


Figure 3: Similarly, fiber-connected commercial buildings can serve nearby MDUs wirelessly.

multigigabit bandwidth to its residents and decrease the digital divide by serving affordable housing. In a commercial network, the role of the community anchor institution can be filled by a commercial building connected to a fiber network. (See Fig. 3.)

The payback period of the fiber POP in the commercial building is dramatically reduced when it is used to light a number of nearby buildings and that makes this solution even more affordable. The scenario shown in Fig. 3 can be implemented by fiber operators or wireless ISPs, and it makes a lot of commercial sense.

The middle mile is fiber, and the last mile uses wireless millimeter-wave technology. But what about end users? Because all millimeter-wave radios implement standard Ethernet ports, they can easily be connected to other in-building wiring solutions, such as

- Copper, using xDSL or G.fast equipment to provide gigabit speeds
- Coax, using DOCSIS protocol
- Wi-Fi, which can provide indoor as well as outdoor coverage and may even be used to serve single-family homes.

The networking part of almost all the devices is standardized, which ensures interoperability and eliminates risks associated with combining different solutions.

Either municipalities or commercial carriers can implement HFW for areas of all sizes and can deploy it in as little as a few weeks. This topology is fieldproven, and network operators have already deployed it in many parts of the world.

Affordable and relatively simple and fast to implement, HFW (combining existing fiber with fiber-like wireless connectivity) makes gigabit connections to the home simple, fast and affordable. �

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