The Case for Managed Wi-Fi in Multi-Dwelling Units (MDUs)

Transformational opportunity for multifamily properties to change their service model from retail to managed, while also delving into smart community applications on the network.

Presented by

Wi-Fi NOW | MARAVEDIS Wireless Infrastructure Analysts

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Foreword

At Wi-Fi NOW, we're delighted to be contributing to and promoting this editorial report — the first in a series of collaborative research projects between probably the world's two most knowledgeable media and research organizations within the Wi-Fi industry. Wi-Fi NOW and Maravedis Research share the belief that accurate insights delivered at the right time are key to driving forward new business opportunities and thought leadership. We are proud to present this first editorial report "The Case for Managed Wi-Fi in Multi-Dwelling Units (MDUs)" sponsored by DISH Network and its technology partners, Commscope, RoamingiQ and Siklu. And of course, we would also like to extend a special thanks to our sponsors for making this report possible. As we discuss in this report, managed Wi-Fi in MDUs is a very hot market growing very fast.

Wi-Fi is no longer simply a technology. Wi-Fi is the invisible fabric that connects our lives to each other, our families, to our customers, even to machines that make our lives easier and more comfortable and secure. Wi-Fi is today also the most successful wireless technology of all time and one of the most all-pervading and useful tools created by man since our forefathers first learned to knock two rocks together.

And even after 20 years of continuous improvement, the Wi-Fi industry keeps expanding the envelope for Wi-Fi performance and usability. In fact, Wi-Fi is today on the brink of another revolution. New multi-gigabit Wi-Fi technology is on the cusp of expanding explosively and becoming available everywhere. This will happen over the next few years. The latest Wi-Fi revolution is driven by new and vastly improved Wi-Fi standards as well as a huge swath of new spectrum being made available for Wi-Fi operations (6 GHz). The benefits to consumers and businesses as well as the broader socio-economic impact will be vast and constitute a giant leap forward in innovation and use cases. This paradigm shift in Wi-Fi performance will usher in a new era of connectivity. However, all of this — massive improvements in core technology — is for naught without the contributions of companies developing technology and services to deliver the right Wi-Fi connectivity to end users. The Wi-Fi industry has over the past years evolved to the point that ad-hoc, home-grown, or simply poorly performing service provider Wi-Fi is no longer an option. Conversely: Efficient, user-friendly, managed Wi-Fi services are a big business opportunity. And it is growing.

This paper examines and documents the expanding opportunity to deliver managed Wi-Fi services to MDUs (Multi-Dwelling Units). Imagine residential (or campus) always-on Wi-Fi services that are as convenient as cellular. Now imagine Wi-Fi services that are faster and better than cellular. Imagine them connecting you seamlessly all over the property and connecting all your devices all the time — whether for work or entertainment or security and IoT.

At Wi-Fi NOW, we believe we are only a year or two away from this vision coming to fruition. This means that the Wi-Fi managed services opportunity for MDUs is here now. It is very much an opportunity also for property owners and managers to add significant financial value to their services. We hope this paper will aid in offering you the knowledge and the confidence to make MDU gigabit Wi-Fi happen everywhere.

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Executive Summary

According to the US Census Bureau, 20 million[1] U.S. households live in multi-apartment homes or multi-dwelling units, a.k.a "MDUs." (An MDU is a renter-occupied unit in a structure with five units or more.) The U.S. needs to build at least 328,000 new apartment homes each year through 2030 to accommodate household growth and losses to the existing MDU inventory.

Multi-family rental demand is also undergoing a multi-generational transformation. As the population continues to grow and younger generations enter the renter market, expectations and needs are changing. Millennials are aging and forming families, pushing them toward more spacious housing options. Meanwhile, baby boomers and seniors are increasingly willing to downsize and adopt an urban lifestyle. And then the youngest — Gen Z[2] — is entering the rental market with full force and distinct expectations.

Almost 61% of respondents to a recent survey by the National Multifamily Housing Council (NMHC) and Kingsley Associates cited amenities as the biggest benefit of renting, and Wi-Fi tops the list as the most wanted amenity — ahead of even a laundry room and garbage pickup! As a result, residents increasingly expect flawless Wi-Fi connectivity with easy onboarding and connectivity throughout the property including in main areas such as the lobby, gym or pool. With working-from-home requirements, COVID-19 has exacerbated the need for good quality and predictable Wi-Fi.

Despite the growing importance of Wi-Fi and expanded use cases for residents and owners, the only option for most MDU residents is to subscribe to high-speed internet the old-fashioned way: They contact their local service provider and order internet service. Each tenant then plugs his or her own Wi-Fi router used exclusively for that apartment. This decentralized and unorganized way of deploying Wi-Fi creates a series of problems that decrease the overall quality of experience.

The solution to that poor experience is managed Wi-Fi — a managed wireless network that allows residents, guests, staff or customers to connect to the internet via multiple access points throughout a building or venue, ensuring property-wide access.

As this paper demonstrates in detail, managed Wi-Fi provides many benefits to all stakeholders concerned with a property.

To residents, managed Wi-Fi means a better overall connectivity experience with predictable and superior performance, coverage and security. It also means that thanks to Wi-Fi calling, mobile coverage issues are resolved. Residents can also enjoy the much-desired benefits of a connected Smart Home without having to deal with the complexity of managing IoT devices themselves or being locked into a separate internet contract.

For property owners and managers, managed Wi-Fi translates into more revenues and better operational efficiencies, which then result in better net operating income (NOI). They can increase the value and retention rate of their properties and deploy facility IoT to automate select processes, reduce waste, and empower their staff with the appropriate tools to be more effective.

This paper is presented to you thanks to the generous sponsorships of DISH Fiber and its technology partners. DISH Fiber provides managed Wi-Fi to MDUs across the US using VAULT™ from RoamingiQ as the core software for Managed Wi-Fi with features to enable seamless, secure onboarding and roaming across properties anywhere, Commscope with its latest generation access points for optimal coverage and performance and Siklu radios for gigabit wireless connectivity between buildings.

[1] 2019 American Community Survey 1-Year Estimates, US Census Bureau, "Tenure by Units in Structure"
[2] Gen Z includes individuals born in or after 1997.

A Conversation with The National Multifamily Housing Council

We had the pleasure of chatting with Rick Haughey, Vice President of Industry Technology Initiatives at The National Multifamily Housing Council (NMHC), who was kind enough to share his views on overall MDU trends.

Please tell us about the NMHC mission?

Based in Washington, D.C., the National Multifamily Housing Council (NMHC) is the leader of the apartment industry. We bring together the prominent owners, managers and developers who help create thriving communities by providing apartment homes for 40 million Americans, contributing $3.4 trillion annually to the economy. NMHC also provides leadership on legislative and regulatory matters, advances research and the exchange of strategic business information, and promotes the desirability of apartment living.

As the leading trade association for the larger apartment companies in the U.S., NMHC seeks to ensure that the apartment industry is well-positioned to fully reap the benefits of advances in technology and innovation. With seemingly exponential growth in new technologies — such as artificial intelligence (AI), home automation, blockchain, and other revolutionary new tech that have the potential to create efficiencies and savings for the industry — NMHC hopes to ensure that an ecosystem exists which allows the industry to simply and seamlessly exploit the opportunities provided by existing and exciting new technologies and innovation.

For those who are not familiar with your organization, what is your role when it comes to connectivity for communities?

NMHC recognizes that one of its greatest assets is the expertise contained within its membership. To leverage that expertise, the Council is advised by several volunteer committees and subcommittees. These committees exist to engage members in public policy/advocacy discussions and to solicit input on potential research/best practices projects and educational content for NMHC meetings and conferences.

Connectivity is one of the important issues that our committees are addressing. The most relevant committees for connectivity include:

OPTECH (Operations & Technology) Conference Planning Committee

- Innovation & Emerging Technology Committee
- Enterprise Technology & Business Intelligence Committee
- Intelligent Buildings & Connectivity Committee
- Cyber Security Committee

We have both open and closed committees which are composed only of property owners, managers and/or developers. Telcos and vendors cannot join these committees; however, they can become regular members or sponsors for our various events (including the OPTECH Conference and Exposition in November 2021).

What are the hottest connectivity trends in MDUs?

Property owners, managers, and developers are having a hard time keeping up with technology innovation — including with 5G, small cells, CBRS and Wi-Fi. They very much want to provide a great living experience to their tenants, and that includes great connectivity. Property owners also want to utilize technology and connectivity to improve their own operational efficiency; this includes enabling automation of redundant tasks which can free up their staff time and increase overall productivity and job satisfaction.

Yet the pace of technology innovation is too fast for property stakeholders to handle effectively. So these property owners need to learn the best practices and receive guidance from us and the connectivity leaders.

In terms of connectivity trends, 91% of tenants surveyed indicated that having community amenities — including Wi-Fi — was at the top of their priorities. We are now seeing a whole new breed of amenities: mobile charging stations, smart lockers for packages, connected thermostats and door locks as part of the new way of living, amongst others.

What impact has COVID-19 had on the connectivity requirements for MDUs?

With COVID-19, the movement around self-servicing and the Smart Home have accelerated. The pace of adoption of new contactless technologies — such as self-guided and virtual tours and online payments — has increased thanks to connected smart locks. A person interested in visiting a property will make an online request and then receive an access code allowing them to unlock the door and enter the property at an agreed-upon time. This is also a great solution for short-term or corporate rentals. Self-service apartments are also on the rise, with 24/7 package lockers being an example. This is the tip of the iceberg in terms of the possibilities offered by the Smart Home. All these use cases need a reliable Wi-Fi connection throughout the property.

Of course, teleworking has generalized and will be here to stay—at least in a hybrid form—so high-speed and seamless connectivity throughout the property is essential to tenants. Another important aspect is dealing with spotty mobile coverage where Wi-Fi calling can be a handy solution. Thirty-two percent (32%) of tenants have indicated that their cell coverage is spotty and, in our research, 60% of tenants have said they use Wi-Fi calling. In our upcoming 2021 survey, we will be able to measure the impact of COVID-19 on all kinds of connectivity parameters within MDUs.

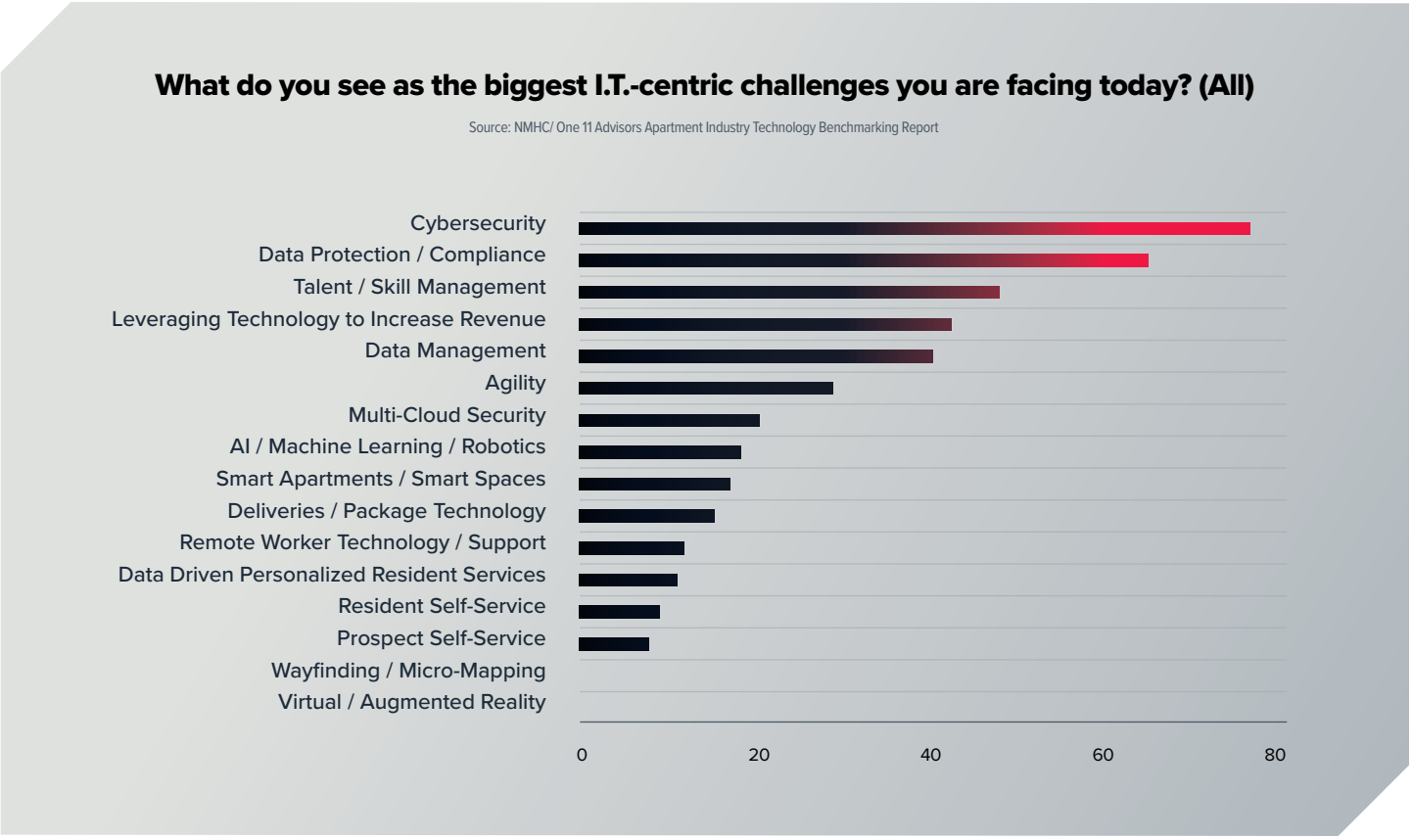
What are the top challenges for MDU property owners when it comes to technology?

Property owners and managers just want the technology to work throughout the property and are trying to streamline the operational process as much as possible and reach optimal efficiencies.

Another challenge for property owners is keeping up with technology changes and choosing the right path for future-proofing buildings in the context of many unknowns about the future of 5G, private LTE CBRS, and even future generations of Wi-Fi. Long-term contracts with ISPs will be less common given how fast technology evolves. There is also the issue of having to host 5G small cells as per regulatory requirements.

There are also specific challenges for owners or managers of older buildings where technology retrofit is more expensive and challenging, or at least that is the perception. In newer buildings, technology and connectivity was included in the concept and design phase, making changes much easier to implement.

Another reality is that half of smaller property unit owners don't even have full-time IT support. And those who do are confused by so many choices and aspects of IT and telecommunications which they need to integrate with their property management systems (PMS). As our survey showed, cybersecurity and data compliance rank at the top of IT centric challenges that property managers face today.



What are some of your priorities in the next eighteen months?

During COVID, we were busy handling government relief programs, legal issues around evictions, and such. Now that we are back to some normalcy, our priorities in terms of connectivity will be as follows:

- Assess how the industry is addressing the recent expansion of innovative new technology products and technology-enabled services, and highlight the challenges to adoption of new tech and innovation
- Improve energy efficiency and environmental aspects (referred to as “Climatech”)
- Determine how effectively the industry is addressing cybersecurity issues and highlight best practices for keeping companies safe
- Review how telecom and connectivity is addressed at apartment companies, as well as how this area is evolving with the deployment of new technology, including Smart Home devices
- Gather information on the leading challenges and opportunities that technology professionals are facing today

Where can readers learn more about some of the statistics and trends in the industry?

One goal of our surveys and other educational efforts is to assist our members and the industry in understanding important trends by providing data that highlights best practices. Further, this allows organizations to evolve their technology capabilities, regardless of their size or resources. I invite your readers to check the following websites for more information:

NMHC Quick Facts
Characteristics of Apartment Stock
Disruption, The Multifamily Design Revolution

In the next sections, we will look at the current trends in MDUs and the underlying drivers for managed Wi-Fi.

Latest Trends in Multi-Dwelling Units

The MDU market is generally comprised of multi-family units, student housing and senior living. In this paper we focus on the multi-family unit segment and will be looking at connectivity issues in high-rise, mid-rise and garden-style MDUs.

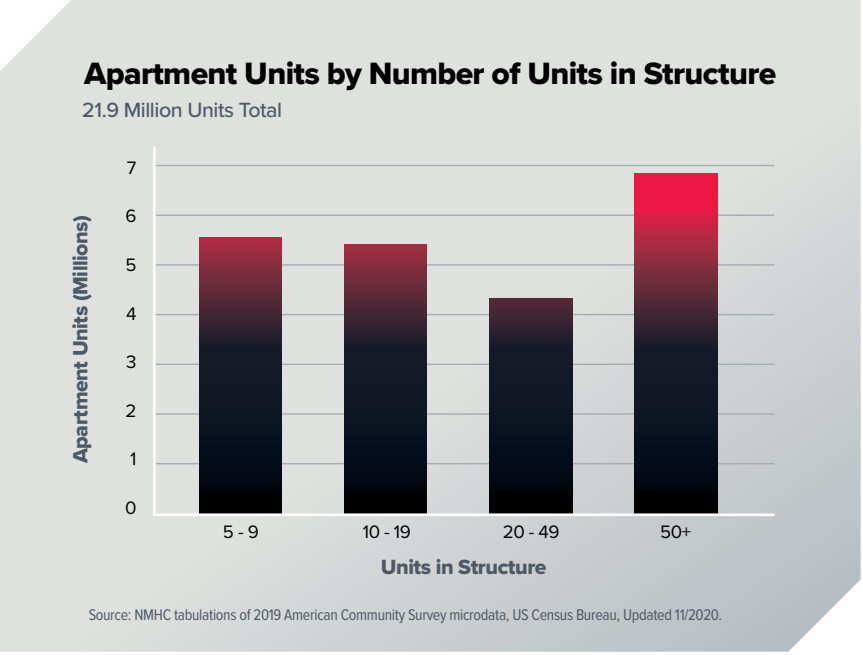
1.1 Latest Multi-Family Unit Trends

As mentioned above, according to the US Census Bureau, 20 million[3] U.S. households (which translates into over 40 million Americans) live in an apartment home, i.e., a renter-occupied unit in a structure with five units or more. That represents 45.4% of all renter-occupied households, and 16.3% of all households.

Those renters occupy almost 22 million units spread over a little more than 900,000 buildings. Moreover, approximately 19% of U.S. homes are considered MDUs; however, as many as 35%[4] could be counted as such because the basement and external facilities are a shared resource, supporting more than one family.

Some notable statistics[5] about MDU trends include:

- According to a study conducted by Hoyt Advisory Services (mentioned above), the U.S. needs to build at least 328,000 new apartment homes each year through 2030 (depending upon the rate of immigration) to accommodate household growth and losses to the existing stock.
- According to the National Apartment Association, the operation of the country's apartment homes contributes $175.2 billion to the local economy each year (including $58.0 billion in property taxes), creating 341,000 jobs.
- Apartment owners include individuals, partnerships, real estate investment trusts, corporations and nonprofit organizations.
- According to the NMHC, 18% of MDU companies do not have an in-house head of IT[6], and that number goes up to 48% for companies managing less than 10,000 units.



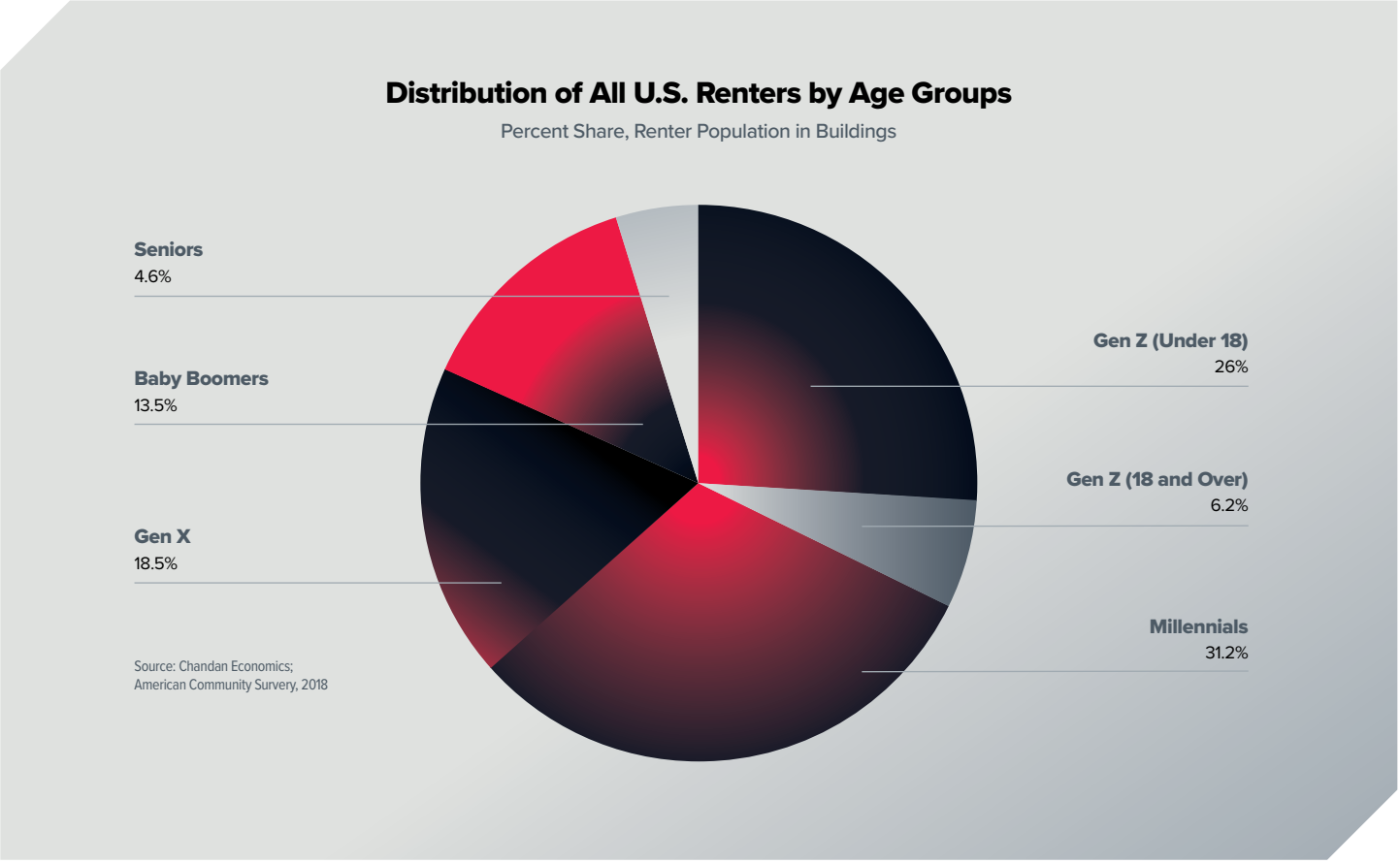
Source: NMHC tabulations of 2019 American Community Survey microdata, US Census Bureau, Updated 11/2020.

1.2 Evolving Expectations from Residents

Over half (right at 61%) of respondents to a recent survey by NMHC and Kingsley Associates cited amenities — or convenience and flexibility — as the biggest benefit(s) of renting. Renting is also increasingly popular because it is much cheaper than owning. The recent rebound in house prices has made the monthly cost of homeownership more expensive; in 2019, monthly expenses to rent an investment-grade apartment averaged $324 less than the housing payments needed to own a median-priced house.[7]

[3] 2019 American Community Survey 1-Year Estimates, US Census Bureau, "Tenure by Units in Structure"
[4] According to the National Multifamily Housing Council (NMHC).
[5] According to the NMHC and other sources..
[6] The NMHC/One11 Advisors Apartment Industry Technology Benchmarking Report, November 2020.
[7] NMHC tabulations of data from MPF Research, The National Association of Realtors, The Federal Reserve, and CoreLogic.

Multi-family rental demand is undergoing a multi-generational transformation. On one hand, millennials are moving to more spacious housing while on the other hand, baby boomers and seniors are moving back to cities and in smaller units. The next prominent trend, of course, is the emergence of Gen Z: both the youngest cohort and the most distinct.



These younger generations have higher expectations when it comes to digital amenities. Whether in their living rooms, down in the lobby, or out by the pool, apartment residents want seamless and secure connectivity. They want to be able to talk, surf, work and binge — wherever and whenever. According to the 2021 Renters' Report, one-person households' most wanted community amenity is Wi-Fi, ahead even of garbage pickup and laundry room!

A January 2021 report by Package Concierge found that during the COVID-19 pandemic, half of all renters have changed how they prioritize amenities, with 91% of those surveyed saying amenities will play a factor in their next apartment search. The top amenities that renters want are high-speed internet (91.7%), pre-installed Wi-Fi (74.8%), and community Wi-Fi (69.3%).[8] Mobile phone connectivity at home is also a must, with 91.2% indicating that cell reception is important when considering moving to a new place; half won't rent without proper cell coverage. Residents are also increasingly tech-savvy and want to enjoy the benefits of a connected Smart Home. According to a 2021 survey by Package Concierge, Smart Home devices — such as temperature control and digital locks — are the most important amenities to surveyed respondents.[9]

[8] 2020 NMHC/ Kingsley Apartment Resident Preferences Report.
[9] Multifamily Resident Survey: A Renter's View (Jan 2021) by Package Concierge.

However, according to a recent study by Wirescore[10], poor Wi-Fi is costing North American renters an additional $337 a year. The study among residents in the U.S. and Canada reveals that 86% of renter's face Wi-Fi connectivity issues, equating to around twenty service breakdowns per month. This is despite paying an average of $744 per year for their home internet service. These renters and homeowners are forced to use on average 3.5 GB of extra mobile data each month to compensate for their poor Wi-Fi: the additional cost totals $337 over the course of the year. The most significant issues experienced after general surfing were streaming TV / movies (43%) and social media (33%). It was also found that online shopping (22%) was causing frustrated surfers to purchase extra mobile data to compensate for the poor Wi-Fi.

Residents always expect a flawless Wi-Fi connectivity with easy onboarding and availability throughout the property, including in main areas, and COVID-19 has exacerbated the need for good quality and predictable Wi-Fi. However, service providers have yet to step into the new connectivity requirements, and it is estimated that 90% of MDUs are still connected in the old way where each unit subscribes to its own internet service.

1.3 Impact of COVID-19

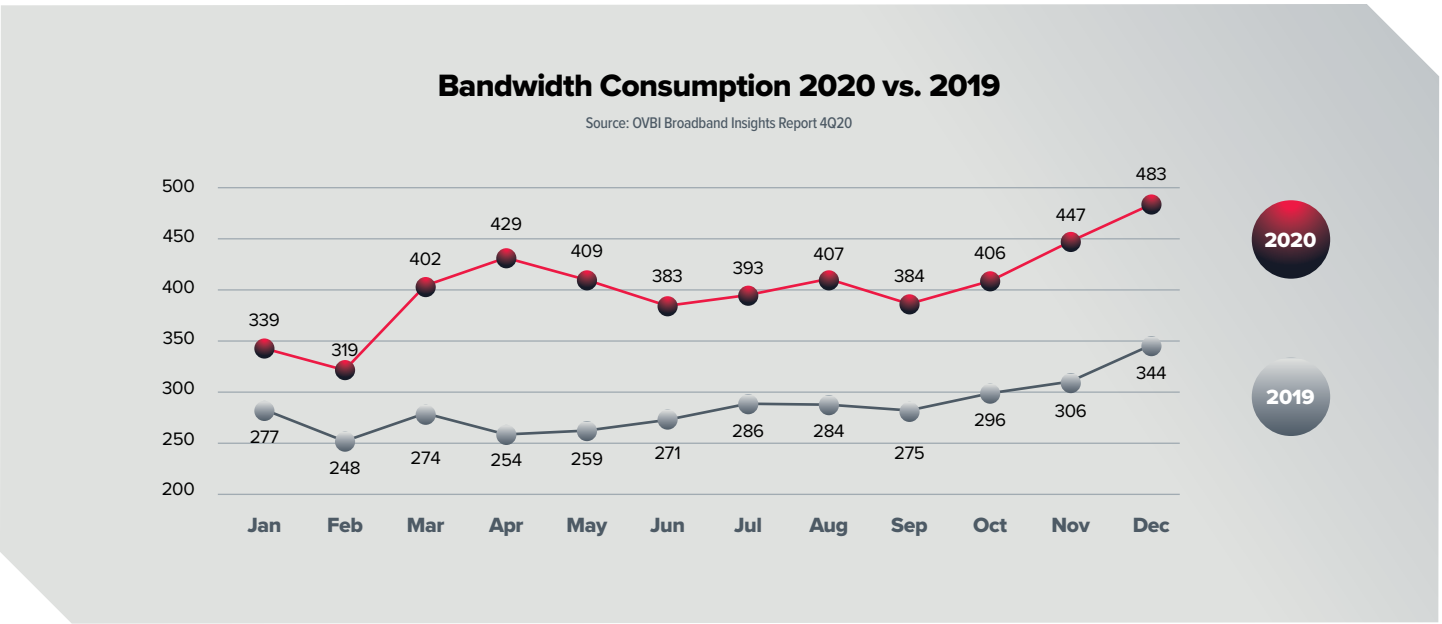
A large proportion of the global population is still facing great social restrictions, with some even still confined at home due to COVID-19. As businesses and consumers around the world adjust their routines amid this new reality, the internet is being used at a scale that the world has never experienced before. Fast and reliable broadband at home has become the lifeline to millions for work, education, socialization, and entertainment. Various sources (e.g., Cisco) have reported average growth of internet traffic at 40% and a decrease in download speeds of more than 13% in various countries because of school closures and shelter-at-home orders.

Some reported notable statistics include:

- Comcast reported a 32% surge in peak traffic; a 24% increase in mobile data use over Wi-Fi on Xfinity Mobile; VoIP and video conferencing up 212%; and VPN traffic up 40%.
- Network-monitoring company Sandvine reported that YouTube traffic is up by more than 10% worldwide.
- Fastly, a cloud computing services provider, reported a 45%+ increase in traffic in California and New York.

OpenVault, a provider of technology for management of broadband networks and information on broadband usage, released some interesting numbers about the monthly usage per household in the U.S. and the impact that COVID-19. The monthly weighted average data consumed by subscribers in 4Q20 was 482.6 GB, up 40% from 2019. For the first time, over half (53.6%) of all subscribers now routinely consume over 250 GB of data each month. This is an important benchmark, as just a few years ago, a 250 GB monthly user was considered a power user.

[10] https://www.businesswire.com/news/home/20210615005285/en/



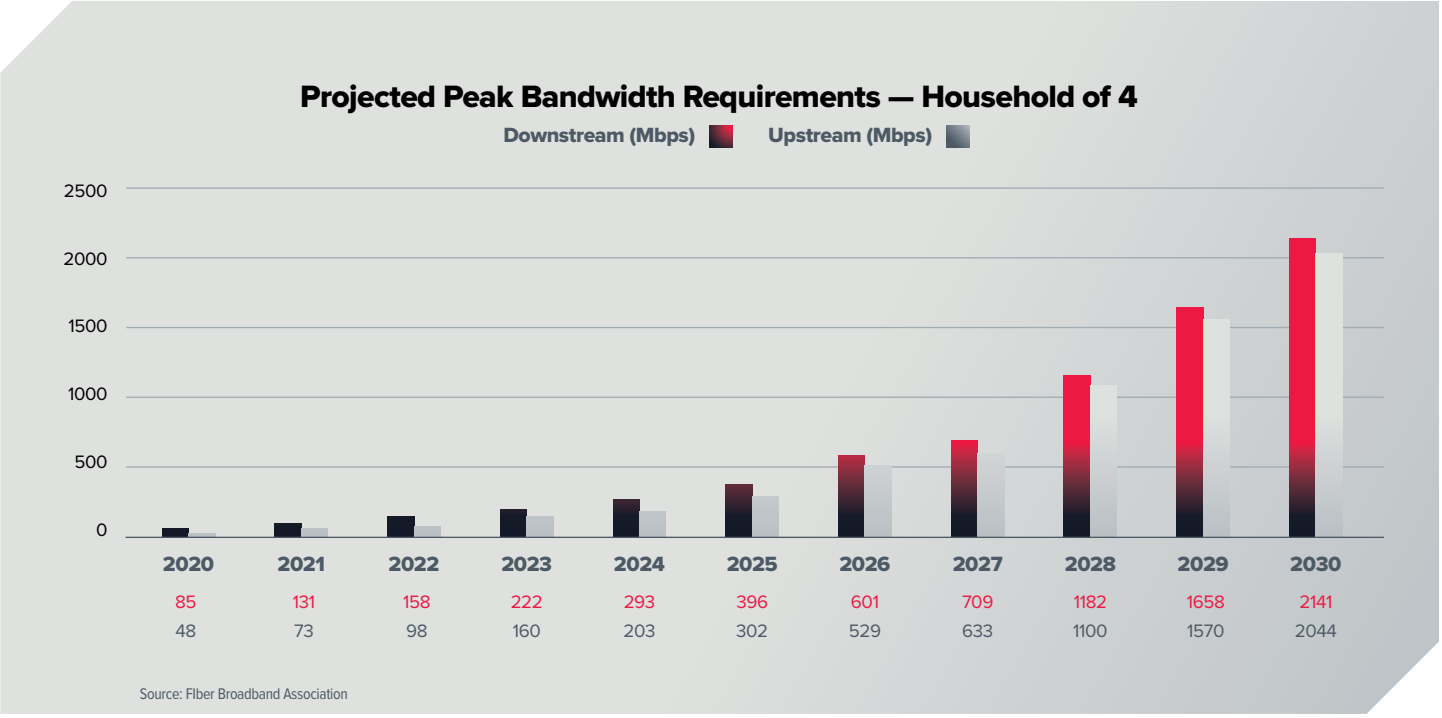
The impact from the pandemic began to take place in March/April 2020, as the above chart demonstrates through the growing year-over-year delta of usage patterns, beginning at that time.

1.4 Wi-Fi is the New Utility

Most people experience broadband through their Wi-Fi connection. Wi-Fi is simply king in the home. Well before COVID-19, the home was already becoming a highly Wi-Fi-dense environment with many connected devices. While the average number of connected devices in the home is estimated to range from five to nine, the trend is clearly towards many more connected devices in the next few years due to the proliferation of devices and the adoption of IoT. Not only is the number of connected devices in the home growing, but the proportion of high-capacity devices — such as virtual reality (VR) and 4K gaming — is also increasing, requiring high bandwidth and driving multi-AP growth. Those devices and related applications also require lower levels of latency, an increasingly important measure of quality of experience for home Wi-Fi.

With fiber gaining ground, Wi-Fi risks becoming the bottleneck for delivering the quality of experience required by residents. Video, gaming, and VR/AR applications now represent the lion's share of internet traffic, and they require both high speeds and low latencies. As shown in the exhibit of projected bandwidth requirements, the pressure on Wi-Fi networks will only continue to grow.

Exhibit: Projected Peak Bandwidth Requirements



1.5 Trends Among Property Owners

When considering any of the myriad challenges faced by the rental market in 2020, property managers have been on the front lines. In addition to working to prevent the spread of COVID-19 within their properties, managers and owners have also been tasked with somehow attempting to avert — or at least diminish as much as possible — the significant damage of missed rent payments on their entire properties/businesses. The tremendous uncertainty caused by the global crisis of this pandemic has been directly reflected in many of the rises in property management industry trends which have occurred this year.

One of the biggest takeaways of the Buildium 2021 Industry Report[11] is that property managers believe that COVID-19 has made the value of strategic, tech-embracing property managers clearer than ever before. They believe that un-tech-savvy property managers and DIY owners will ultimately get out of the business as regulations on the rental market increase and profitability becomes more difficult to achieve. But for property managers who figure out the right balance of aggressive growth goals and empathy for their customers, they see an enormous opportunity to gain market share in the years to come.

As discussed previously, there can be no doubt that connectivity plays a huge role both in attracting, as well as retaining, tenants. For both commercial and residential tenants, a must-have amenity is fast and uninterrupted connections; this includes Wi-Fi, internet, cell coverage, and security. It is unfortunate that often it is only because of complaints that technological deficiencies are addressed. When that is the case, an owner/manager generally encounters one, dissatisfied (i.e., looking elsewhere) tenants, and two, unnecessary costs. With a strategic approach to connectivity, both can be improved and/or alleviated.

[11] https://www.buildium.com/resource/2021-property-management-industry-report

Every sector of the rental market is highly competitive, and thus there is little room in rental rates. But even with tight operating margins, one area where owners/managers can still gain an edge is building technology. Utilizing a strategic approach in this arena —t hus providing the type of connectivity that both attracts and retains tenants—results in additional revenue. Nevertheless, for some reason (presumably lack of knowledge and/or manpower), owners/investors/developers often fail to even recognize, much less act upon, opportunities in building technology.

Challenges with the BYOI Model

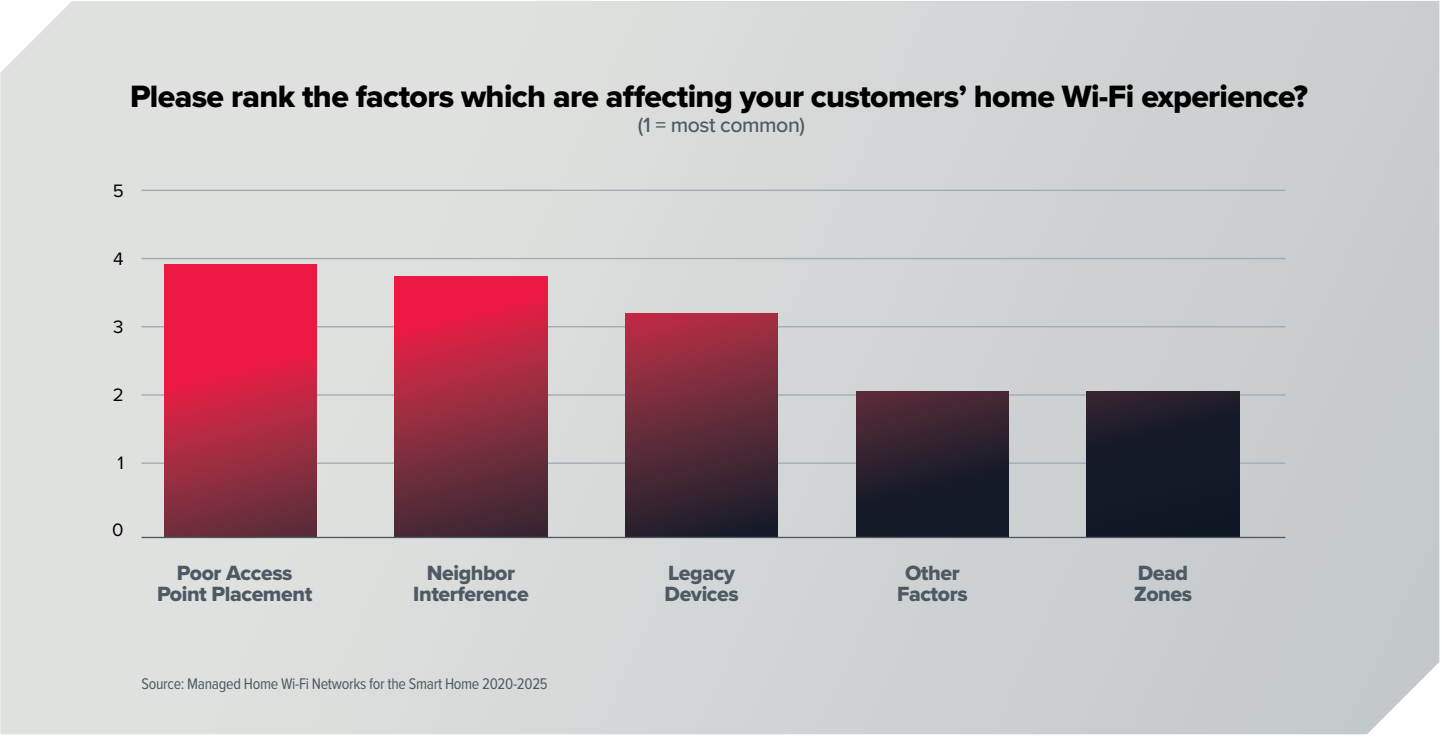
Despite the growing importance of Wi-Fi, however, most MDU residents still subscribe to high-speed internet the old-fashioned way — i.e., they contact their local service provider and order internet service. Each tenant plugs his or her own Wi-Fi access point (AP), used exclusively for his or her apartment. This decentralized and unorganized way of deploying Wi-Fi creates a series of problems that decreases the overall quality of experience as we will see in the following sections.

2.1 Poor Performance

When every apartment has its own AP, all deployed independently with no consideration for optimal coverage, that density creates interference that negatively impacts the Wi-Fi service. Wi-Fi networks interfere with each other. Older Wi-Fi standards are even worse in this respect, so old Wi-Fi hardware is not just hurting one's own network — it is also interfering with neighbors' Wi-Fi. When multiple Wi-Fi networks are close to each other, especially in the MDU environments, ideally, they should be on different channels to reduce interference.

Poor access point placement is the #1 cause of poor Wi-Fi performance, followed by dead zones and neighbor interference. While there are many factors that can affect home Wi-Fi operation, the placement of wireless access points (APs) can be one of the most significant factors in performance. Good AP placement must provide not only adequate coverage for all clients on a network, but also provide adequate throughput, good connectivity and minimal interference.

Exhibit: Factors Affecting Home Wi-Fi Experience



2.2 Spotty Coverage

The size of the unit, the reflective surfaces, and the poor location of the AP can cause major coverage gaps inside a unit. To achieve a good connection, Wi-Fi must overcome barriers and obstacles, some of which—such as dead zones—cannot be eliminated by simply purchasing a new wireless router. While a dead zone can be a result of poor access placement, it is generally due to the structure or the size of the home, specifically, the walls or materials that block signals requiring multi-access points, either in the form of extenders or repeaters which can be backhauled with a dedicated wireless link or with a wireline.

2.3 Tedious Onboarding

As soon as the resident leaves their premises, they need to connect to the building SSID (if there is one) or wait until they can connect to their mobile network service when they reach common areas (such as the parking lot, lobby, pool, etc.). In most cases, that means that connectivity is lost in the process and onboarding to a new SSID can be sub-par with a new password required as well as vulnerability to security breaches.

2.4 Expensive ISP Lock-In

When moving in, residents have no other choice but to sign up for annual contracts with ISPs and suffer penalties if they need to cancel their subscription. They must wait for the access point to be delivered and schedule a visit by a technician if rewiring is required, a long and inconvenient process. But younger generations expect to be able to connect to Wi-Fi the minute they walk into their new unit.

Benefits of Managed Service

Managing the quality of broadband experience in the home is a priority for service providers more than ever, and Wi-Fi is at center stage of that effort. As a result, service providers are now increasingly taking ownership of the Wi-Fi experience. Just as the diversity of wireless use cases and the demands they make on networks are exploding, so is the radical expansion of Wi-Fi capabilities underway to meet those demands. The centerpiece of this transformation is managed Wi-Fi which delivers a step change in Wi-Fi capabilities and performance.

3.1 Defining Managed Service

“Managed Wi-Fi” is an outsourced wireless network that provides property-wide internet access; put another way, managed Wi-Fi allows persons on-site (residents, staff, customers, or other visitors) to connect to the internet via multiple access points throughout a building/property/venue. Further, managed Wi-Fi is cloud-based, thus allowing internet providers to remotely manage and troubleshoot the Wi-Fi. The resulting tremendous benefit for owners/managers is the elimination of a need for on-site IT management of a building’s Wi-Fi network (or the need to call in IT people from the outside for the same).

The managed Wi-Fi providers have a considerable amount of responsibility as they are the gatekeepers of a property’s online connection. They are responsible for protecting a user’s data, defending them from attacks, and securing individual internet privacy for those connected to the managed network.

Managed Wi-Fi provides benefits to all stakeholders in the property as discussed in more detail below.

3.2 Benefits to Residents

Just recently, Millennials emerged as the largest segment of the population (overtaking Baby Boomers), and the trends of Millennials have been clearly seen in the multi-family market. According to a survey by ParcelPending[12], a whopping 90% of Millennials are renters, and their generation represents 40% of the entire housing market. Therefore, it is not surprising that the amenities which are most important to Millennials — remember, 90% of renters — have direct effects on today's rental market. This same survey indicates that given Millennials and Gen Z grew up in the digital age, they rely heavily on Wi-Fi for anything from work to play.

As a result, there are few things more frustrating to today's rental consumer than an inefficient Wi-Fi network — i.e., one which hinders them from working, utilizing social media, streaming videos/movies/shows, gaming, or just surfing the internet. It is not surprising that many younger renters have acknowledged that a reason for changing apartments was Wi-Fi speed (or lack thereof).

Even before COVID-19, working remotely was already on the rise for Millennials. But come 2020, the need for office and business amenities at home went straight through the roof. According to a Stanford report[13], and although the number is fluid, a large proportion of the workforce in the U.S. now works from home on a full-time basis. Obviously, this greatly increases the absolute necessity in multi-family housing for business amenities: silent areas, printing services, conference rooms, and last but certainly not least, stable and secure Wi-Fi. Indeed, as work from home continues in some form, the livelihood of many residents relies on access to a reliable Wi-Fi.

As one can see, managed Wi-Fi is a tremendous benefit for MDU residents. They can enjoy instant connectivity as they move in and not have to worry about another contract with an ISP.

3.2.1 Better Performance

Managed Wi-Fi enables an orderly deployment of access points that will not interfere with each other and/or generate all sorts of performance problems. As units become smaller due to the rising cost of real estate, more Wi-Fi access points means more chaos unless these are centrally managed.

With managed Wi-Fi, the service provider pre-plans the property's Wi-Fi network and deploys all access points to ensure optimal coverage everywhere in the apartment complex. This reduces interference and ensures that tenants receive Wi-Fi access no matter where they roam on the property. Property owners can use these Wi-Fi advantages — great performance, coverage everywhere in the complex, etc. — to attract and retain residents.

The equipment deployed in a managed network is connected and continuously monitored so if there is an issue the provider can compensate coverage from other access points and dispatch a service technician without the resident ever knowing there was an issue

While the average number of connected devices in the home today is estimated to range from seven to ten, the clear trend is toward an increase to many more personal and IoT devices in the next few years. Only a well-planned robust network can support such exponential growth.

[12] https://www.parcelpending.com/blog/apartment-features-list-to-attract-young-renters/
[13] https://news.stanford.edu/2020/06/29/snapshot-new-working-home-economy/

3.2.2 Better Coverage and Roaming

Managed Wi-Fi provides guaranteed coverage and performance throughout the property. Access points are deployed in units and common areas by professional installers with proper radio frequency (RF) design to minimize interference between units and to provide proper coverage inside the units.

Some Managed Wi-Fi networks such as DISH Fiber also ensure constant connectivity throughout the property with seamless roaming between access points using the same SSID and no need for reconnection at every turn. For example, residents can watch their favorite shows by the pool or remain connected to their video conference as they step out of their unit.

Further, residents do not have to create or share their passwords anymore. Each user has a pre-shared key (PSK) that belongs to them and only them. A resident at a Vault property can securely access Wi-Fi at other Vault properties, which is very valuable to owners of multiple properties because it makes a move to another property seamless. This also means that any devices they have configured on their profile don't have to be reconfigured, a benefit for residents. Users are constantly connected to their own secure and private connection. They enter their PSK on their devices once, and do not need captive portals or unsecure networks.

A Wi-Fi calling feature is another very important benefit of managed Wi-Fi, given how important mobile coverage is for residents (44% won't rent without it[14]). Managed Wi-Fi not only provides high speed internet, but it also resolves spotty cellular coverage issues.

3.2.3 More Secure Network

Security has always been important to wireless network users, but many of the applications which are driving the new generation of connectivity make them even more critical requirements. The rising use of augmented reality, many critical IoT services (such as smart locks), and the trend to use wireless as the default connection even for sensitive data (especially important for residents working from home), are all throwing a strong spotlight on these three critical capabilities of modern wireless networks. A managed Wi-Fi network provides end-to-end security for all stakeholders in the building.

Residents like to personalize their Wi-Fi network name, but no Wi-Fi system can support hundreds of individual SSIDs. In fact, residents are frustrated when they must search their own SSID among dozens listed on their devices.
Therefore, managed Wi-Fi creates personalized area networks through virtual LANs under the same single SSID throughout the property. By using virtual LANs, each resident data is isolated, encrypted and invisible to others.

Each resident can share access to local devices and control which devices have access to their network. Friends can quickly jump on their guest network, while neighbors or strangers are still held out or they can use the shared guest network. Being able to control access is a significant security benefit for shared internet service.

The pre-shared key (PSK) is never transmitted from the cloud to the edge device, even when the connection occurs, which means it cannot be intercepted. Consequently, wireless traffic from DISH managed Wi-Fi is always encrypted and secure; thus, malicious actors cannot gain access. Events such as man-in-the-middle attacks are de facto prevented. (A man-in-the-middle (MitM) attack is when an attacker intercepts communications between two parties either to secretly eavesdrop or modify traffic traveling between the two.) Attackers might use MitM attacks to steal login credentials or personal information, spy on the victim, or sabotage communications or corrupt data.

[14] NMHC and Kingsley Associates.

3.2.4 Enabling the Smart Home and Smart Community

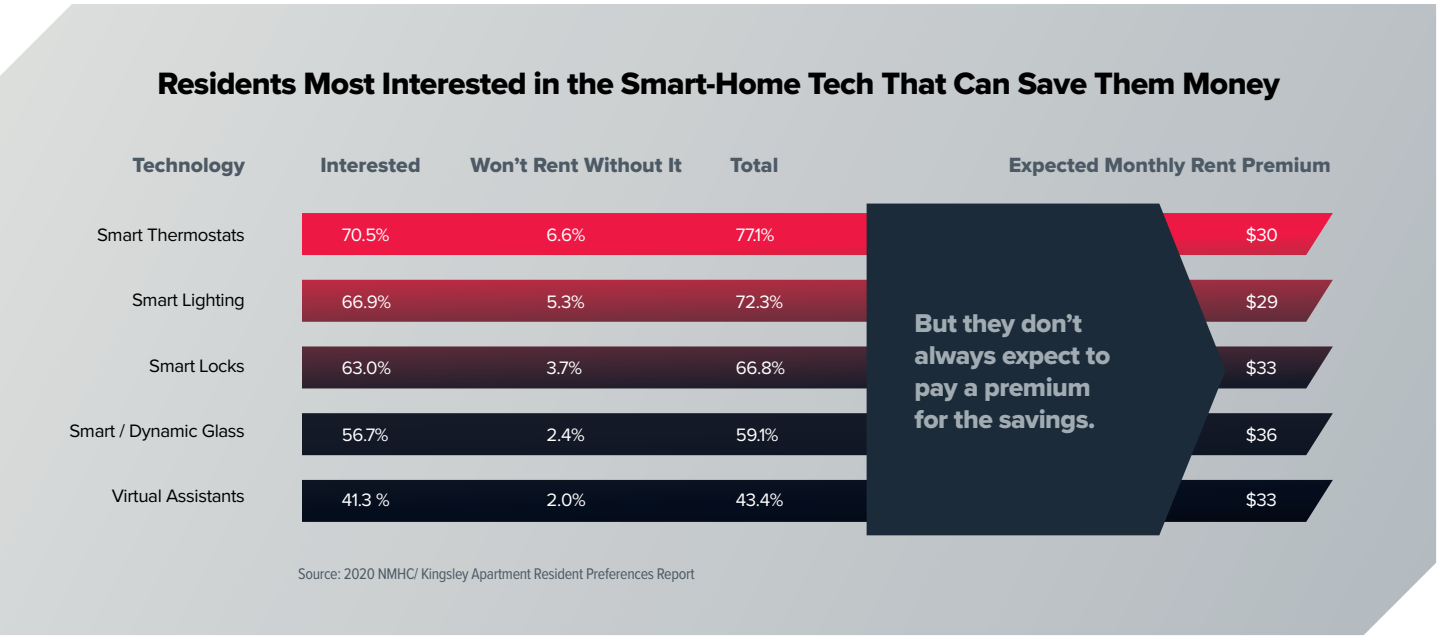
Wi-Fi is the digital fabric enabling Smart Home devices to be connected and even integrated to other forms of communication, such as ZigBee and BLE. Smart home applications are now becoming part of the expected amenities, and 87.2%[15] of multifamily residents say amenities significantly impact their renting decision.

Residents want more power and flexibility to manage their indoor environment through IoT devices — such as smart locks, lights, or thermostats. While high-speed internet connectivity is not centrally important for all devices within the home, the availability of a permanently accessible broadband connection ensures the full functionality of a Smart Home. In the last few years, the most important advance in the Smart Home has been the emergence of voice assistants. Voice assistants have become the dominant modality for many users' control of their Smart Homes.

Until recently, Z-Wave or ZigBee were dominating the Smart Home ecosystem as connectivity platforms. However, every Smart Home manufacturer is now focusing on Wi-Fi integration with Alexa and Google increasingly used as the hubs synchronizing all the Smart Home devices. The new versions of Wi-Fi 6 and 6E are also more IoT-friendly and better suited to support a large density and mix of devices.

Some issues ZigBee and Z-Wave have (compared to Wi-Fi) is that the hub used to control them represents a single point of failure. If that fails — either because the company quits, or it just breaks — the whole Smart Home gets disconnected which is not the case with managed Wi-Fi which is redundant and self-healing. Further, Wi-Fi devices often cost less than their Z-Wave and ZigBee counterparts

Exhibit: Smart Home Features Most in Demand



[15] 2021 Multifamily Amenity Guide by 2ndKitchen.

3.3 Benefits to Property Managers and Owners

Contracting a managed Wi-Fi service is great not only for residents, but also for property owners and managers. Managed Wi-Fi allows them to both improve their bottom line and build a future-proof connectivity system to support all the upcoming new use cases expected by their residents, as well as the tools to improve operational efficiency referred to as "facility IoT" (discussed in more detail below).

3.3.1 Increase Net Operating Income (NOI)

According to Property Management Minutes[16], resident turnover costs multifamily properties anywhere from $1,000 to $5,000 per single turnover. Reducing tenant turnover by only 5% improves operating income by thousands of dollars depending on rentals. As we plainly have seen how important Wi-Fi is to residents, it makes sense for property owners to offer such a valued amenity to increase the value and retention rate of their property. Less resident turnover means more revenues and an increase in net operating income.

Savvy MDU owners will use the amenity of Smart Home technology as a marketing tool to: improve overall resident satisfaction (and thus tenant-retention), to increase conversions, and even to demand a rental premium. It has been estimated that rental tenants are willing to pay as much as $30 more per month for some Smart Home devices.[17] (However, note that within the next five years, these amenities will most likely be expected, and at no additional line-item cost.)

With carrier grade Wi-Fi coverage throughout the property, owners can enable mobile traffic offload to their residents, enabling seamless roaming to all the venues they own or manage and improving the overall satisfaction of their customers.

Another long-term benefit of a well-managed Wi-Fi infrastructure is that it enables the building to be future proof for upcoming technology upgrades, removing the need to rewire cables with multiple wiring supported (fiber, coax, category, etc.) or to engage in messy repairs.

3.3.2 Facility IoT

"Facility IoT" refers to the connected devices which improve the overall business efficiency of the building's systems. Facility IoT requires a robust and secure connectivity layer throughout the property to function. If well-integrated into the operations of the building, these IoT devices will bring efficiencies and reduction in expenses which will in turn improve the bottom line. Facility IoT enables automation of repetitive tasks and a more granular control of the building environment.

Further, real-time monitoring of assets is another tremendous benefit of facility IoT. This enables management to address issues immediately since they are instantly notified when problems occur.

[16] https://propertymanagementminutes.com
[17] 2020 NMHC/Kingsley Apartment Resident Preferences Report.

Following are other use cases of facility IoT:

- Monitor building access (security cameras, smart locks, key card readers, elevators, etc.)
- Automate functions to optimize energy consumption and reduce energy and maintenance bills
- Monitor conditions in the building and prioritize maintenance work orders
- Detect and stop water leaks
- Reduce and manage temperature of unoccupied units
- Reset locks when residents move out
- Monitor moisture sensors, smoke detectors, and light or motion sensors
- Improve staff productivity (package alerts, mail, orders, interaction with residents, etc.)
- Reduce utility bills
- Use analytics for future business decisions (staffing, maintenance, etc.)
- Reduce overall carbon footprint

In other words, if implemented properly, facility IoT can bring many operational efficiencies and improve the productivity and safety of staff. Firms must of course assess how these technologies fit into their own needs and assess costs, potential savings, rent premiums, operational efficiencies, cybersecurity data and privacy risks before moving ahead.

Case Studies from Interviews with Property Owners/Managers

4.1 Continental Properties

Background Information

Continental Properties (CP) is a multi-family property developer which operates sixty properties across nineteen states with an average of ten to fifteen buildings per property, for a total of approximately 25,000 rental units.

CP has two rental product lines. The first is The Springs Apartments (B+/A-)[18] with townhome-style private entrance homes. The second property line is the newest Authentix apartments with the same feel and look as The Springs (50+ properties) but comes at more affordable prices. All properties provide a wide range of physical amenities, from a clubhouse, outdoor grill area, gym, pet playground, and pet spa. These properties are garden style with their own private entrance and resemble townhouses.

Problem to Be Solved

Residents value their physical amenities as part of their quality of life, but often they value instant Wi-Fi even more. Wi-Fi is the fourth utility and CP cannot conceive of building a property without great internet service. Residents certainly place tremendous priority on the ability to have fast, reliable Wi-Fi throughout their property with a simple onboarding process and the hassle-free experience of not signing a separate contract with an ISP (Internet Service Provider). They also value the fact they are getting a superior internet service at a lower cost than they would be able to find on their own.

Because internet is so important to residents, it is imperative that internet problems be handled right away. Unfortunately, CP found many local ISPs' customer service was too slow to respond or otherwise not acceptable. CP had been struggling to find the right ISP partner for years. The ideal ISP would be one that provides a consistent high quality service and onsite support nationwide. CP has a well-established process to build new properties and was looking for an ISP who can provide the same level of predictable network deployment and management throughout its properties with the same network type and equipment. CP was looking for an ISP who would adapt to its needs rather than one who followed the traditional ISP model of bundling the same services to all clients. Also having one common ISP nationwide makes it easier to resolve issues.

[18] Class A properties represent the highest quality buildings in their market and area. They are generally newer properties built within the last fifteen years with top amenities,high-income-earning tenants, and low vacancy rates. Class A buildings are typically professionally managed. Class B properties are one step down from Class A and are generally older, tend to have lower income tenants, and may or may not be professionally managed. Further, rental income is typically lower than Class A, and there may be some deferred maintenance issues. Mostly, these buildings are well maintained and can be upgraded to Class B+ or Class A- through renovations and improvements to common areas.

The Solution

After much due diligence and test projects, CP selected DISH® Network because of its ability to provide a “white glove” service and adapt to CP’s mandate to provide excellent customer service to residents. DISH also has a national presence and strong brand recognition. CP was also able to receive a national pricing which it passed on to its residents, adding to the value of its rental properties. Residents are able to pay less for a superior internet service. Managed Wi-Fi is now already offered in 25% of CP properties, with a clear goal to extend it to all properties (including older ones which require technology retrofit). DISH takes care of all the infrastructure design and maintenance, and provides “white glove” service.

The biggest obstacle to quicker deployment to all properties remains the legal aspects of existing contracts which are in place with other ISPs and do not have coterminous expiration. Typical contracts are ten years long.

Technology Aspects

Most sites have some fiber termination. But for some, a gigabit wireless solution makes more economic sense. The “pipe” is then distributed with Wi-Fi. Typically, one strategically located access point is deployed per apartment. Units range in size from 600 to 1,400 square feet. Field testing is performed to ensure good coverage inside the individual units and throughout the property, and access points are replaced every four years to ensure the technology is optimal.

Wi-Fi calling is a very popular feature given that many properties do not have satisfactory cellular coverage. Each resident gets access to a segmented and protected portion of the network. Upon request, internet guest access is also provided.

Results

CP is in the process of surveying its residents to measure their satisfaction score evolution. However, it is already seeing signs of success with fewer residents turning to the office staff for internet support, but instead calling DISH support (with quick resolution times reported).

Thus far, customer benefits of managed Wi-Fi include:

- Faster go-to-market speed with launch of new services in two months or less
- Not just standard cable, but completely customizable entertainment packages
- Better quality customer service than Tier 1 operators

And regarding operational benefits of managed Wi-Fi thus far, the following are reported:

- Improved pro forma returns
- Single point of contact (decreased bureaucracy)
- One entity for engineering/construction/install
- Contract and plan templates; not negotiating with different providers in various markets — one single master agreement for all properties
- Decreased manhours (saving construction, IT and Legal teams over 100+ manhours per project)
- Better data backbone for future Smart Home tech

Smart Home

Thermostat and keyless door locks are the top two amenities valued by residents, followed by voice command abilities. In fact, CP measured that 25% of residents are willing to pay an additional $45-$65 per month for these top amenities. It is unclear whether residents will expect these amenities at no additional charge in the next few years, which makes investment in select Smart Home features risky. Thermostat and keyless door locks do, however, make business sense for the property owners from an operational perspective as they increase the property(ies)’s overall efficiency and provide a clear return on investment. CP is evaluating the long-term benefit and business value of investment in Smart Home, including buy-back programs for older devices which may no longer be relevant.

Lessons Learned

Consistency and efficient processes matter when tasks are repeated over many projects and are a key factor in selecting a long-term ISP partner. Mistakes need to be fixed quickly by onsite representatives so that property staff can remain hands off. A learning curve cannot be avoided for staff and ISP alike, but once resolved, install and service run smoothly.

4.2 Lynd, North Dakota

Background Information

Lynd Opportunity Partners is a property organization which owns and manages fifty-three properties in thirteen states in the US. The Lynd property in North Dakota is named Fairways at Hunter's Run and consists of 108 furnished units spread over eight buildings in a garden-style environment. This property was built in 2015 and acquired by Lynd Partners in 2019. The property is located in Watford City, a small community where many people are employed in the oil field. Renters generally work short-term assignments and thus on average rent for three months before moving out. Quality internet is very important to residents given that they need to communicate with and send their work reports to headquarters or use the internet for training. Further, residents have limited access to local services and entertainment.

Problem to Be Solved

Since the building opened in 2015, some form of managed Wi-Fi has been provided. Prior to DISH®, this property used the services of another ISP which provided sub-par customer service. The network itself just couldn't support the users. In one of the buildings, a single access point was shared among thirty-six apartments. In another building, there was no coverage at all, and Lynd had to put in its own equipment. One of the challenges of this property is that given its remote location, it takes much time and effort to get technicians on site for support. Wi-Fi calling is also a needed feature as cell coverage can be problematic in the property.

The Solution

DISH Fiber was first approached in February 2021, and installation was completed two months later (April 2021). DISH wired each apartment unit with category 5 cable and deployed an access point in each unit, regardless of the apartment size. Each of the eight buildings are now connected to a fiber termination.[19] Units range from small studios to large three-bedroom apartments. Now each resident enjoys gigabit Wi-Fi and can easily upgrade their TV service directly with DISH with one phone call. Onboarding is quick and easy. New tenants receive a unique pre-shared key (PSK) upon profile creation by the property manager. Profiles can be set up in advance of move-in for immediate connection.

Results

Residents now enjoy great internet speed and robust connectivity that supports multiple devices streaming and gaming. As stated above, the onboarding process is quick and easy, and the property managers add the information of each new tenant. And technical support is one phone call away for all stakeholders.

Next Steps

Cameras are to be deployed in the office and around the building and will be connected to the Wi-Fi network. Corporate is evaluating deploying energy efficiency lighting and water leak detection to further improve operational efficiency.

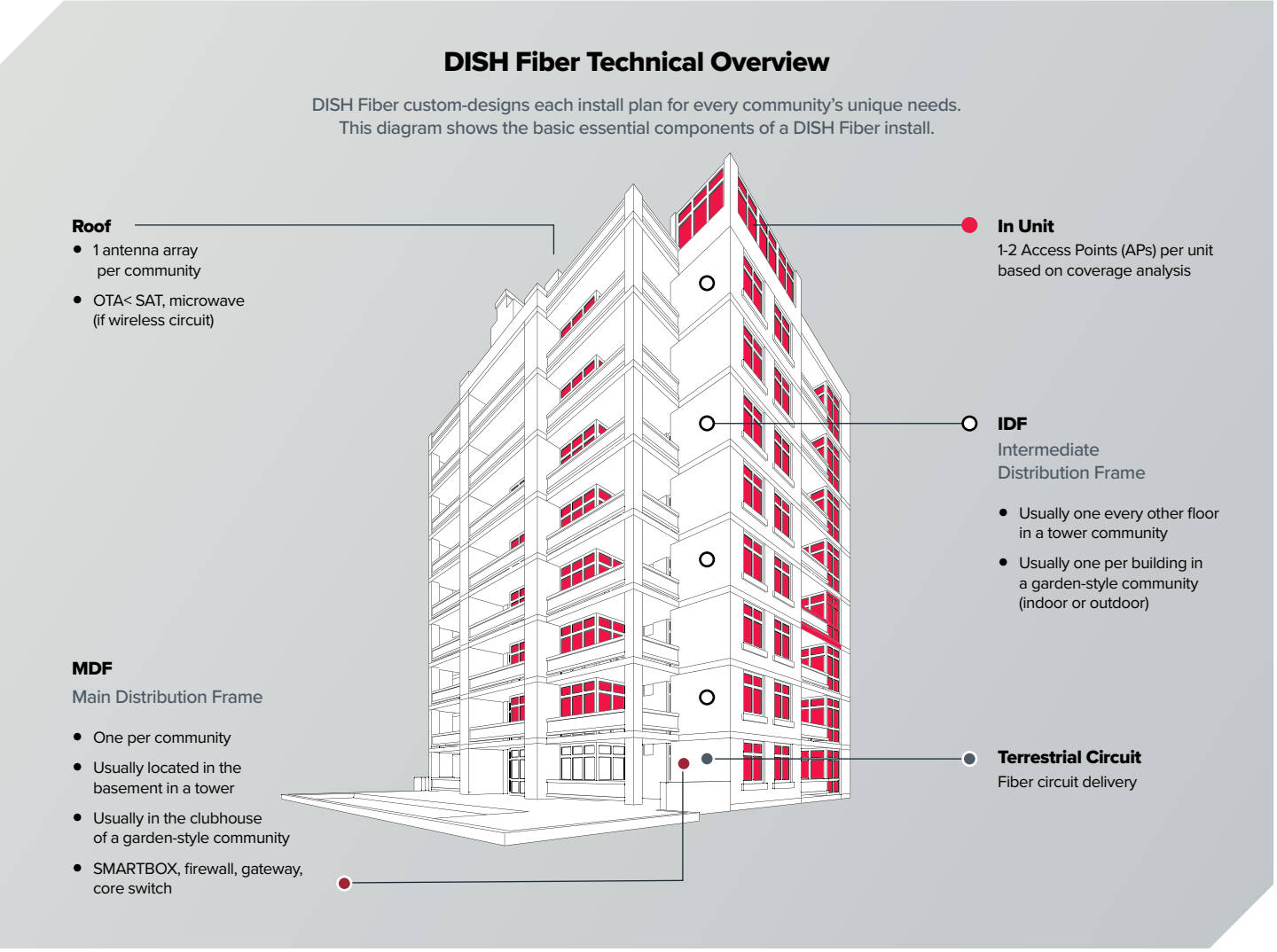
[19] A coterminous lease or contract is when multiple contractual agreements are structured to terminate simultaneously.

Technology Overview

In a multi-story building, a managed Wi-Fi is usually composed of the following network elements:

- Radio access (access points, switches)
- Controllers, gateways
- Fiber termination

Exhibit: DISH Fiber Technical Overview 1



5.1 Radio Access with Commscope

Most people are familiar with their wireless router (or access point/"AP") which is the radio placed inside a home. In a managed Wi-Fi deployment, each unit will have their own AP to provide coverage in that unit, and additional APs will be deployed in common areas in an organized fashion to avoid "signal bleeding" and interference.

With a single SSID for an entire building/complex, a separate SSID is not deployed for each unit. Rather, in all instances devices will simply and seamlessly connect to the best possible AP. This single SSID even covers common areas.

For each dwelling unit, managed service providers (MSPs) also separate traffic into unique VLANs (virtual local area networks). Therefore, all the devices owned by/located at a single residence—cell phones, PCs, smart watches, smart TVs, etc. — are placed on the same VLAN. Consequently, tenants can do their own thing (i.e., watch Netflix, use their PCs and printers, etc.) under their own personal area network (PAN), but would not be able to see their neighbors' devices and traffic, and vice versa.

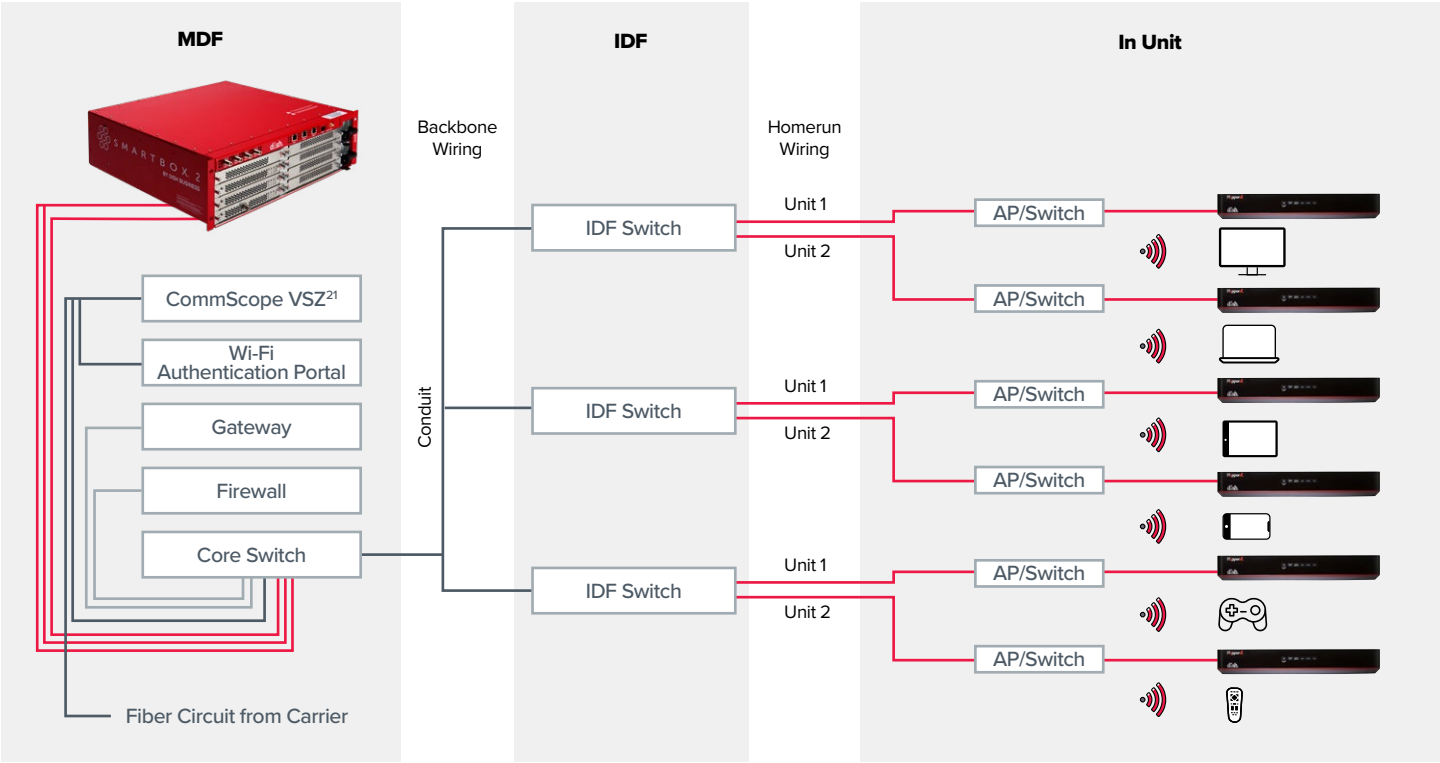
In a high- or mid-rise building, typically one or two access points will be deployed in each unit based on coverage analysis: or, in a garden-style community, one or two per building. As shown in the exhibit below, this is in what is called the Intermediate Distribution Frame (IDF). This is also where the switch is located. Examples of access points include the Ruckus H510 WiFi5 Indoor Wall Plate Access Point and the new WiFi6 Certified H550. For indoor common area coverage, the Ruckus R550 WiFi6 Certified wall/ceiling mounted access point is utilized.
To cover common indoor areas, the R550 (a wall/ceiling mounted radio, is installed in hallways, corridors, or the lobby area.

In outdoor areas such as the pool or parking lots that require weatherproof access points, the IP67[20] rated Ruckus T310 outdoor product is typically used. To connect buildings or IDFs in a garden style environment, the MultiHaul TG Terragraph certified radio from Siklu enables gigabit wireless backhaul of outdoor access points mounted on top of buildings using the 60GHz mmwave band (see section 4.3 for more details).

Management of wired and wireless network elements is provided by the Ruckus SmartZone High-Scale Network Controller which scales to 10s of thousands of network elements . The SmartZone virtual network controller can be deployed in a private cloud solution such as AWS, Azure, & Google, or an on-premise appliance or virtual instance.

In buildings where legacy digital DOCSIS infrastructure exists, support for Personal Area Networks (PAN) and unique VLAN per resident requires WLAN tunneling. In this case, the Ruckus SmartZone Data Plane is deployed to enable WLAN tunneling throughout the property thereby enabling PAN. The SmartZone Data Plane is available as both a software-only virtual instance or the SmartZone 144 appliance.

Exhibit: DISH Fiber Technical Overview 2

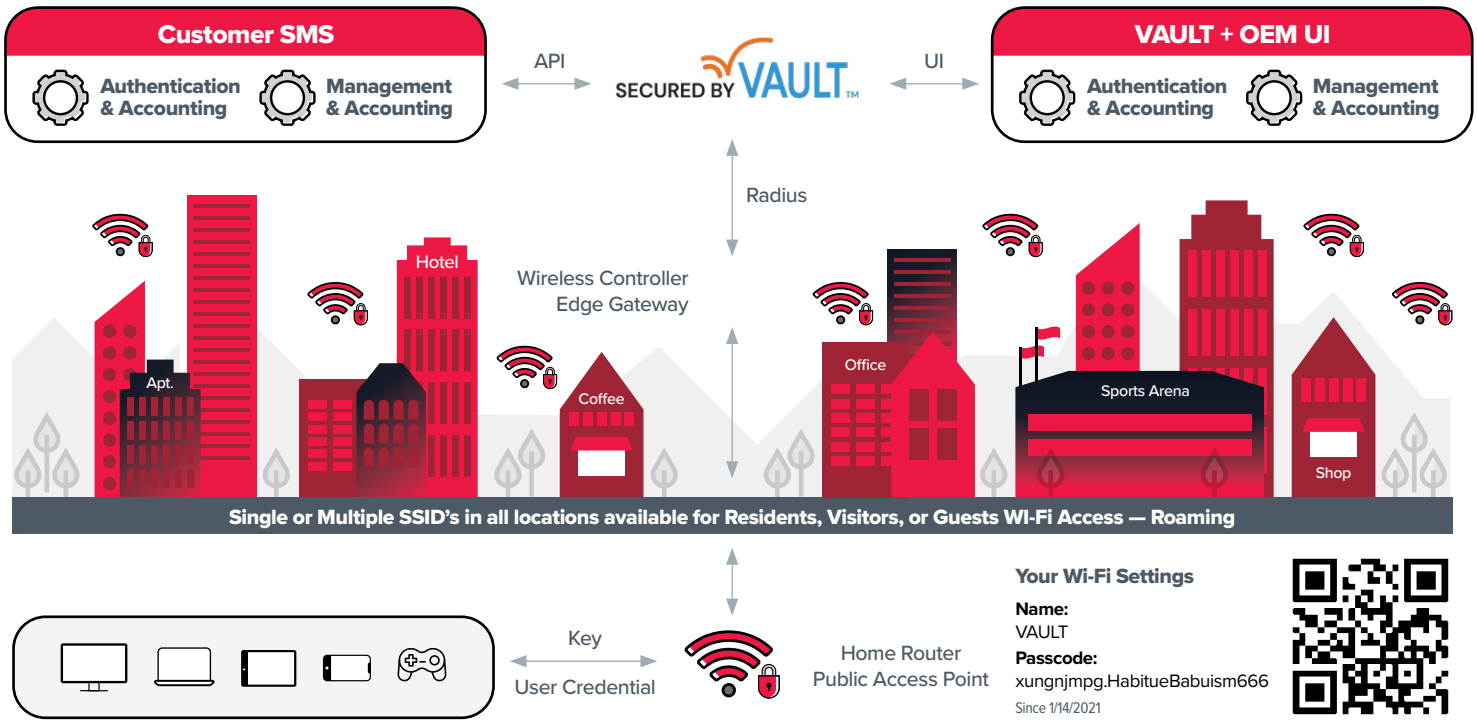


[20] IP67 equipment is the most common weatherproof denomination in the connectivity market. It is 100% protected against solid objects (like dust and sand), and it has been tested to work for at least 30 minutes while under 15cm to 1m of water.
[21] The CommScope Virtual SmartZone (VSZ)

5.2 RoamingiQ Identity

DISH Network has partnered with RoamingiQ to leverage the VAULT technology platform into its offering. VAULT is the core solution that carries all the features for managed Wi-Fi in a MDU property. For example, VAULT provides truly unique global pre-shared keys (PSK) or credentials to be used by any device joining secure and encrypted Wi-Fi networks without any user intervention anywhere in the managed properties independent of physical location. VAULT enables property owners to offer a seamless and unlimited onboarding of users and devices into the managed Wi-Fi network independently of what Wi-Fi hardware is being used. VAULT generates a unique PSK to a particular household, and then every device in that household will enjoy secure and seamless connectivity throughout the property — and beyond if local businesses (such as a restaurant, mall, coffee shop, nail salon, etc.) are also using VAULT. In other words, as a resident moves from their MDU to the local business, they will automatically connect to the Wi-Fi as seamlessly as they do within their own apartment unit, thus providing a home type experience while roaming with a one-time login process. An access key is generated and stored in the cloud as a service as shown below:

Exhibit: VAULT™ Network Diagram



Source: RoamingiQ

It's important to note that VAULT-generated PSKs are truly unique and work globally. If desired, property managers can establish a limit to the number of devices that use the same PSK. VAULT enables an unlimited number of PSKs per SSID and triggers the virtual LAN for each resident/guest/staff device as their personal area network (PAN). VAULT removes the limitations by all hardware vendors of the numbers of PSK's handled per SSID.

Moreover, VAULT addresses the need for a new identity mechanism to identify devices that are independent of their MAC address. This is critical as vendors manufacturers continue to introduce and deploy MAC randomization for every period or time a device is disassociated from the Wi-Fi network. Some examples of services that will be impacted by MAC randomization include:

- Home network with multiple SSIDs
- Parental control offered in 802.11 routers is usually based on the MAC address of the device
- Customer support and troubleshooting that is based on MAC address
- Home automation requiring MAC address
- Detection of rogue devices in the network

VAULT also integrates with any subscriber management platform (CRM, PMS, etc.) to manage subscriber Wi-Fi-based keys or credentials, and report back data usage for further billing and integration.

For property owners, this means the ability to onboard, remove, and/or manage any connection anytime throughout their properties and issue different policies per location. Property owners can even use this tool to provide support and communicate with residents when needed while respecting security and privacy issues.

VAULT also opens the possibility for property owners to negotiate a deal with mobile carriers who are interested in offloading their subscribers' roaming traffic and gaining visibility on indoor usage, including Wi-Fi calling. VAULT will send mobile subscribers' consumption information to all parties involved and be used as a traffic broker.

These VAULT capabilities extend to IoT devices and become tools to enable the connected property as well.
VAULT is designed from the ground up to be Smart Home friendly for residential MDUs and can be easily deployed in networks with thousands of devices, such as: Apple TV, Alexa, Ecobee thermostats or Nest cameras, and other devices that cannot use certificate-based authentication.

Finally, VAULT not only integrates with the local wireless network, but it also communicates with the edge devices (gateway and/or routers) providing the ability to upgrade their internet bandwidth at any given time.

5.3 Backhauling Access Points

Often MDUs come in garden-style settings with multiple buildings scattered around and several outdoor amenities (e.g., a pool, basketball court, gardens, and other common areas). These buildings need a way to connect back to the main distribution frame (MDF)—usually one per community. Using unlicensed or lightly licensed mmWave[21] frequencies, such as the 60 GHz, is a cost-effective choice for backhauling Wi-Fi access points scattered in a large outdoor area. Commercial mmWave radios are capable of operating in a point-to-point (PtP) or point-to-multipoint (PtMP) topology to deliver gigabit broadband to MDUs. In addition to the cost, time, and scalability, wireless backhaul has been demonstrated and offers several advantages, including gigabit throughput, low latency, and inexpensive infrastructure. Gigabit wireless solutions present an appealing option for MSPs looking to provide ubiquitous coverage within their large properties.

Siklu offers the widest selection of mmWave[22] radios in the industry. This portfolio of 60GHz (V-Band) and 70/80GHz (E-Band) solutions in both PtP, PtMP, and Mesh configurations allows Siklu to offer complete end-to-end multi-Gigabit wireless networks.

[22] Millimeter wave (mmWave), also known as millimeter band, is the band of spectrum with wavelengths between10 millimeters (30 GHz) and 1 millimeter (300 GHz). It is also known as the extremely high frequency (EHF) band by the International Telecommunication Union (ITU).

Initiated by Facebook, Terragraph is the Gigabit wireless technology designed to meet the growing demand for reliable, high-speed internet access in urban and suburban environments. The Facebook initiative is important because it provides a way for a cluster of base stations broadcasting at 60 GHz to autonomously manage and distribute traffic among themselves. If one base station goes down, another can take over in an instant—and they can work together to find the most efficient path for information en route. Siklu has made significant contributions to this initiative, and this effort has resulted in innovative products such as the MultiHaul™ TG N366 and companion MultiHaul™ TG[23] TU series.

The Siklu MultiHaul radio has the following advantages for an MDU deployment:

- The radio can be deployed as a mesh node, with the built-in self-backhaul connecting to additional radios, terminal units, or to a network POP. The POP connection can be via ether fiber or our EtherHaul™ PtP links with up to 10Gbps full duplex capacity. The ability to create multiple self-backhaul links enables diverse traffic routing to support differentiated SLA levels, as well as carrier-grade, make-before-break redundancy with sub-50ms traffic switchover.
- Siklu's self-organizing protocols tightly integrated with its SmartHaul™ Runner software ensure smooth deployments of L2 SDN mesh networks across a neighborhood or multiple buildings, with no service disruptions from link or radio node failures. The mesh network will automatically establish connectivity between all nodes, and reroute traffic based on performance in terms of capacity, oversubscription, and even latency to determine the best paths. In addition, the software provides on-going, dynamic optimization in response to changing traffic patterns and RF link quality.
- Combining the advanced self-organizing centralized controls and provisioning with superior automatic beam steering means installations can be done quickly and with minimal skillsets. If the units can "see" each other, they automatically connect; installation is a matter of physical mounting and providing power.

MSPs do not have to choose between mmWave and fiber — they need both since these technologies complement each other to provide the most cost-effective solution under the Hybrid Fiber-Wireless (HFW) model.

About Maravedis

Maravedis is a boutique wireless infrastructure analyst firm founded in 2002. Maravedis focuses on broadband wireless technologies with a particular focus on Wi-Fi and IoT as well as industry spectrum regulations and operator trends. Our mission is to research, analyze and provide guidance on the role of unlicensed technologies in the overall connectivity space.

About Wi-Fi NOW

Wi-Fi NOW is the world's only media, event, and advisory organization dedicated to the Wi-Fi industry. Since 2016, Wi-Fi NOW has served hundreds of Wi-Fi industry organizations from every corner of the diverse industry including vendors, manufacturers, service providers, resellers, and more. Wi-Fi NOW is the undisputed leader in dissemination of Wi-Fi industry news and information and today serves a readership of close to 20,000 subscribers and followers. Wi-Fi NOW was founded by current Wi-Fi NOW CEO & Chairman, Claus Hetting.

[23] Terragraph certified.

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