



A year in Wi-Fi

Research and Analysis
from 2018



About this Resource

Welcome to the Maravedis Wi-Fi Annual Resource. Here you will find analyses and commentaries from Maravedis experts on Wi-Fi, how it has transformed in 2018 and where it could be going.

Wi-Fi has become king in the indoor world. Businesses and homes are relying on Wi-Fi more than ever to glue the array of technologies they are using in their digital transformation. Businesses are also realizing that Wi-Fi is the central platform to engage with customers and empower employees.

In the past few years, carrier Wi-Fi has become a natural part of both network and business strategies both for mobile network operators (MNOs) and wireline or converged operators such as cable providers. For cable operators, especially in the US and western Europe, Wi-Fi has taken center stage in wireless/mobility strategies with the proliferation of managed home-spots and public hotspots

There are those that claim that with the emergence of 5G, Wi-Fi days are numbered. We strongly disagree and make the case that Wi-Fi will continue to dominate the indoor technology environment and leverage its formidable footprint and ecosystem. We believe it is use cases that dictate technology use not the way around.

Wi-Fi is also not resting on its laurels as showcased by the introduction of the latest Wi-Fi 6 which promises to deliver greater spectrum efficiency and is optimized to serve high density environment and IoT. Wi-Fi is evolving quickly and will be part of the 5G vision.

We hope you find this unique resource both useful and enlightening.

The Maravedis Team



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Lines Blur Between Cellular and Wi-Fi

by Adlane Fellah

This increasingly variegated platform drives the requirement for coexistence between 5G NR, LTE and unlicensed technologies – close integration at core and even radio level now, and a harmonized migration path both to 5G and future IEEE 802 standards. The two tracks may not converge entirely but operators are clear that they want the closest possible coexistence so they can mix and match current and future 3GPP and IEEE technologies as their business case requires.

Most work on 5G radio standards is driven by 3GPP, and in the past the IEEE and the Wi-Fi community have been on largely separate, and even competing, paths. However, most stakeholders would welcome convergence between the two, through common interconnectivity frameworks and APIs, if not an actual unified physical layer.

According to the latest WBA annual survey and [industry report](#), 43% of respondents believe that convergence is either crucial or very important to their current network strategy, while 33% say it is important. And looking ahead, 55% say convergence will be crucial or very important, and 29% that it will be important in future network strategies.

This is because a key objective for wireless operators is to increase the flexibility of their networks so they can harness a wide variety of spectrum and equipment resources, to support demanding usage patterns as affordably as possible. Unlicensed spectrum will be an important element of that effort to reduce



the cost of wireless capacity. As more unlicensed spectrum is opened up around the world, including in mmWave bands, there will also be a growing number of technologies and use cases which rely on it.

Such developments show how the Wi-Fi platform is evolving, often in parallel with cellular, and sometimes taking the lead in key technology areas like mmWave spectrum. In its [latest industry report](#), the Wireless Broadband Alliance (WBA) says that Wi-Fi will be a key component in three critical 5G use cases – smart cities, IoT sensor networks and safety/surveillance.

The WBA's CEO Shrikant Shenwai said: "While plans to roll out 5G networks are well on their way, the industry still needs to agree upon the standards for the technology before 2020. The WBA has put together this report to highlight the significant impact that Wi-Fi is having on the definition of 5G." He added that the WBA was studying what "we as an organization can do to bridge the gap between licensed and unlicensed technologies within this timeframe [to 2020]. The WBA will continue to develop its 5G strategy to work towards ensuring WBA and Wi-Fi networks are ready and enabled to meet the needs of a 5G-based world."

The IEEE, the standards body for the 802.11 specs which underpin Wi-Fi, has its own 5G Initiative, which falls within its Standards Association (IEEE-SA). This, in turn, is part of the Global Standards Collaboration (GSC), which also includes the ITU plus bodies like ETSI. The IEEE has the advantage of standards activities in many areas of the value chain, in contrast with 3GPP's narrower focus on the radio and systems architecture/core. The Initiative's co-chair, Ashutosh Dutta, said: "IEEE 5G is able to build upon IEEE work in several key emerging technology initiatives such as IoT, Smart Cities, Smart Materials, and Brain and Digital Senses. Accessing the technical breadth and depth of IEEE, we will help unlock the potential of the broader 5G ecosystem."

In the age of blurring lines between licensed, shared and unlicensed spectrum – and the overall race for airwaves – 802.11 may be able to access IMT-2020 identified frequency bands, including exclusive as well as shared spectrum access. Cisco's Andrew Myles, manager of wireless and security standards, has suggested that the IEEE might take advantage of a 3GPP technology, LTE-LWA (LTE-WLAN Aggregation), part of 3GPP Release 13. This supports aggregation between LTE and Wi-Fi at or just above the PDCCP (packet data convergence protocol) layer and so could help 802.11 address any ITU requirements for 'macro-type' operations, since these could be satisfied by the cellular partner network (some countries may insist on IMT-2000 compliance for certain use cases).





How will LTE Unlicensed affect Wi-Fi performance?

by Veli-Pekka Ketonen

Wi-Fi has enjoyed a quasi-monopolistic usage of the 5GHz in the last few years but that is changing as Multefire and LTE unlicensed in general are making inroads in once considered "Wi-Fi" bands. We thus feel it is about time we ask how these new technologies will impact Wi-Fi performance. It is hard to find a neutral opinion in this highly debated topic but I sat down with Veli-Pekka Ketonen, founder and Chief Innovation Officer at 7signal to pick his brain and help us understand where we are today.

There are conflicting views about how various flavors of LTE unlicensed may impact the performance of Wi-Fi networks. Depending on who you ask you will get a different answer. Can you provide some clarity into this debate?

Any additional traffic and RF energy thrown at current Wi-Fi channels will reduce the airtime and spectrum available for existing Wi-Fi networks. All unlicensed LTE variants add traffic to 5 GHz Wi-Fi channels. Variants using LTE modulation at 5 GHz channels will add further inefficiencies to Wi-Fi radio operation.

However, unlicensed LTE variants which aggregate a normal Wi-Fi carrier at 5 GHz band to LTE anchor do guarantee fair co-existence. These variants include LWIP (LTE-Wi-Fi aggregation using IPsec tunnel) and LWA (LTE-WLAN aggregation) with the latter being more efficient and capable. eLWA is an evolution version of LWA which also supports WiGig (60 GHz). However the market does not seem to favor LWIP and LWA at this time.



There are of course, Unlicensed LTE variants which use LTE carrier at the 5 GHz band. These include LTE-U, LTE-LAA (Licensed Assisted Access) and Multefire. LTE uses only central scheduling. It has been reliably shown that high duty cycle LTE transmissions completely override Wi-Fi traffic. Wi-Fi will stay out of occupied channels by design. LTE-U and LAA (used also by Multefire) technologies add features which help to share airtime more fairly. Reaching a true fair spectrum sharing is still a big challenge.

What are the differences between LTE and Wi-Fi LBT mechanisms?

Just talking about using LBT (Listen Before Talk) can be misleading. There are significant differences between LTE-U, 3GPP and Wi-Fi LBTs. Devil is in the details here. The exact implementation and parametrization of LBT defines completely how fairly LTE co-exists with Wi-Fi. Using one of the 3GPP LBT variants does not yet mean fair co-existence. This is a common misconception.

It's mandatory for Wi-Fi to use two different thresholds for channel occupancy detection. Wi-Fi's threshold for ED (Energy Detection) is -62 dBm, this applies to any energy, Bluetooth, ZigBee, LTE, etc.. Wi-Fi also needs to detect Wi-Fi pre-ambles, typically at 5 GHz down to -78 dBm. This threshold varies between vendors and can go down to -90 dBm range. If either of these indicate channel is busy, Wi-Fi transmitter will hold back from transmitting to prevent frame corruption.

3GPP LBT only specifies use of ED threshold. LTE-LAA will hold back from transmitting only if transmitter detects energy above ED threshold. With 3GPP specifications ED is defined -72 dBm. However, this is high compared to -78 - -90 dBm range used Wi-Fi pre-ambles detection. Note that 6 dB difference doubles the cell radius in open space. It's very important to remember that USA, China and Korea do not require LBT at all. If LBT is used, it's mechanism and any related parameters are not defined. If LTE ED is higher than Wi-Fi pre-ambles detection threshold, this means LTE will end up transmitting during Wi-Fi frames and there will be corrupted frames. These lead to retransmissions, reduces channel efficiency and Wi-Fi quality. The opposite is also true, as LTE frames may get corrupted as well. Since Wi-Fi RF power levels are generally lower, Wi-Fi is at disadvantage.

LTE-U does not use LBT but uses CSAT which relies on controlling duty cycle of LTE scheduling based on average Wi-Fi energy in the channel. CSAT is also based only on ED. It does help, but it's not very effective. Overall, it seems LTE-U was a stepping stone to LAA and may have shorter life than LAA.

It's worth mentioning that the standard does not prevent LTE-U and LAA products using Wi-Fi pre-ambles detection to ensure co-existence. It may also be a competitive advantage in environments where owner of the space wants to minimize risk on Wi-Fi operation.

What studies do you see as most complete or reliable?

3GPP has defined fairness as follows. "The capability of an LAA network not to impact Wi-Fi networks active on a carrier more than an additional Wi-Fi network operating on the same carrier, in terms of throughput and latency."

In practice, results of co-existence fairness testing are heavily impacted by the way the tests are done.

The Co-existence Test Plan developed with Wi-Fi Alliance's leadership is an important benchmark. The first version was completed in September 2016. This work was done in collaboration with a number of



industry players, like Qualcomm, Broadcom, Ericsson, Verizon, T-Mobile, Huawei, HP Enterprise, Google and CableLabs.

Unfortunately, to my knowledge, there are no public test reports against this test plan. Neither are there any companies claiming to be compliant with the test plan. The test plan is not a standard either, so compliance is not mandatory. Furthermore, compliant once does not mean product needs to be compliant after the testing has passed. It's not like FCC or ETSI RF emissions requirements with strict requirements.

Which vendors have committed to ensure coexistence between these 2 technologies?

Committing to ensure co-existence means to me that implementation is compliant with the Wi-Fi Alliance co-existence test plan. I have not seen anyone stating that yet. I'd be happy to be mistaken here.

In which environments do you expect LTE to impact Wi-Fi performance? How can it be prevented?

It does not seem to me that Unlicensed LTE suppliers are actively promoting fairness. The mobile industry seems to consider LTE more efficient, thus preferable. In any case, additional traffic in shared channels will limit Wi-Fi capacity and quality.

Environments requiring the highest mobile network capacity will continue be first ones in focus. These include for example stadiums, arenas and dense city centers. There are already a number of areas and some common devices supporting different flavors of unlicensed LTE. Impact on Wi-Fi increases as more terminals start to support unlicensed LTE. Press releases on unlicensed LTE are published regularly. Often a key theme is record speed.

Unless an organization controls what carriers and technologies are used in their physical space, appearance of LTE carrier in unlicensed spectrum happens without any upfront notice. Unlike in mobile networks, performance management has not been common practice in Wi-Fi, while recently it has started to gain more attention. Having proper visibility to network performance and user experience is important. There is no guaranteed way to just prevent the impact completely. One way is to reduce impact on Wi-Fi is to use different 5 GHz channels than unlicensed LTE. For DAS customers with indoor Wi-Fi and LTE network coverage, it's important to be aware of what kind of carriers are transmitted inside the buildings.

What are the conclusions you have drawn from your research?

Unlicensed LTE is already happening. There will be no big announcements to Wi-Fi users that LTE is now sharing the spectrum. When you hear about Gigabit LTE network roll out, unlicensed LTE is most likely used.

After all the effort put into co-existence test plan, it's disappointing that it seems not to be in active use.

There will be impact on Wi-Fi. The impact will grow as more unlicensed LAA and Multefire are deployed and more terminals start to support it. Companies providing Wi-Fi products and organisations operating Wi-Fi networks seem unprepared for this. It's important to make sure Wi-Fi continues to operate reliably in hospitals, warehouses, universities, enterprises and other locations which rely on its good performance.





The Battle for Wi-Fi Monetization

by Adlane Fellah

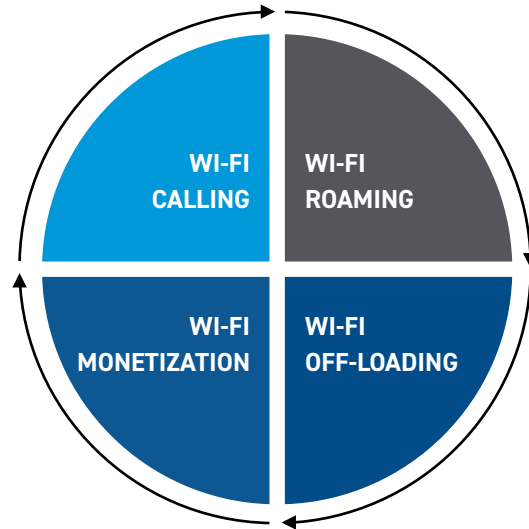
Wi-Fi has become a household necessity even for kids as young as 4 years of age. It is No. 1 method of connecting in the home, at work, and, increasingly, in public spaces. Although Wi-Fi is expected to be free, enterprises, venues, and service providers are working hard to find **ways to monetize this amenity**. Verticals such as retail and hospitality who depend increasingly on Wi-Fi to run their businesses and satisfy their customer needs, are now fully embracing innovative ways to leverage their Wi-Fi infrastructure

The last several years have also witnessed the change of the telcos attitude towards Wi-Fi. On one hand, the mobile network operators (MNOs) have realized that, by offloading a portion of the mobile data traffic and thus embracing high-quality Wi-Fi, they could both reduce their OPEX and improve customer experience with or without unlimited mobile data plans. On the other hand, the cable operators, particularly in the US, are finally in a position to offer viable wireless services and leverage their extensive Wi-Fi and homespot footprint.

In this context, numerous innovations have been implemented in the last few years to improve the end-user experience and to ensure that onboarding is both seamless and secure. In particular, Wi-Fi SaaS vendors have developed different solutions for offloading to roaming and monetization. This report discusses the overall market and technology trends encompassing service providers, enterprises, and venues; however, **the primary focus is on the guest Wi-Fi solutions and market size projections.**



Indeed, the Wi-Fi software as a service is a rather broad topic in itself. Functions like offloading and roaming have a loose relation to location-based marketing and guest Wi-Fi. Those are different propositions for distinct uses cases and markets. While some players may be participating in both, the dynamics are different and, therefore, projecting their respective markets within a single report is an arduous exercise. Wi-Fi offloading and roaming are sufficiently broad and distinct for their own dedicated report and set of projections. Consequently, **the present report provides market projections ONLY for the guest Wi-Fi portion of the business for both telcos and enterprises.** While discussing roaming and offloading trends from a qualitative perspective, the report does not include market forecasts for roaming and offloading.



The guest Wi-Fi SaaS vendors have barely scratched the surface of its market potential. According to our estimates, only about 1 million access points are “powered” today with managed guest Wi-Fi SaaS worldwide. Yet, the potential is for more than 69 million managed access points by 2023 from 34 million today which could use a SaaS platform but do not

Currently, the guest Wi-Fi SaaS landscape features small vendors with fewer than 300 employees and guest Wi-Fi revenues of less than \$10 million each. There is no clear one leader today among the SaaS vendors but the top 3 account for 80% of deployments measured in access points. These vendors are catering to both telcos and enterprises but with limited scale deployments of less than 200,000 access points each. However the market potential is real with annual revenues from license fees sold to distributors and service providers of \$9 billion by 2023.

Yet, what is obvious is that this is a volume business above all: the more access points and users using the software, the more licensing revenue. Consequently, the major concern of solution vendors is how to scale—and do it fast before depleting their financial resources.

This report is based on years closely tracking the Wi-Fi industry, speaking to both service providers and solution vendors. Some of the information shared by the providers and vendors interviewed remains under non-disclosure agreement; however, the data and insights shared by these industry insiders were useful to provide a detailed account of the state of the market as well as understand key trends.





Wi-Fi Roaming Case Study: AT&T

by Adlane Fellah

AT&T has been a highly enthusiast adopter of Wi-Fi roaming and has garnered great results from its initiative. As a market leader in all things roaming, A&T has developed a Business Model simulator which allows operators members of the WBA to run business model simulations based on a number of roaming variables. Mored details on WiFi roaming can be found in the annual [WBA industry report](#) now available.

Drivers

AT&T wanted to address the silent roamers among its customer base while delivering them a seamless experience. At the same time, AT&T needed to optimize cost and revenues associated with Wi-Fi roaming.

Building the Service

AT&T created integrated offers by adding Wi-Fi to its international data offers while building an international Wi-Fi roaming footprint through bilateral, unilateral and aggregator agreements. Now, customers with International Packages, in addition to an allowance of cellular minutes, messages and megabytes, also enjoy seamless access to over 18 million hotspots in 100+ countries. These hotspots include close to a million venue-based hotspots (airports, hotels, cafés, etc) and over 16 million “homespots”. The company also includes, in the Wi-Fi Finder portion of the AT&T Global Wi-Fi app, the location of 1.5 million public hotspots; and it has 60+ roaming agreements. Most of the roaming



agreements are international although some are domestic too. AT&T found a technology partner to build a Wi-Fi client to provide seamless connections using cellular credentials.

AT&T's International Data Plans

A T&T International Day Pass	AT&T Passport
Talk and Text all you want and use your data plan for \$10 a day	Use Passport to stay in touch with talk text and data, starting at \$40 one-time charge
Available in over 100 countries	Available in over 200 countries
Includes Unlimited Wi-Fi Access at participating hotspots	Includes Unlimited Wi-Fi Access at participating hotspots

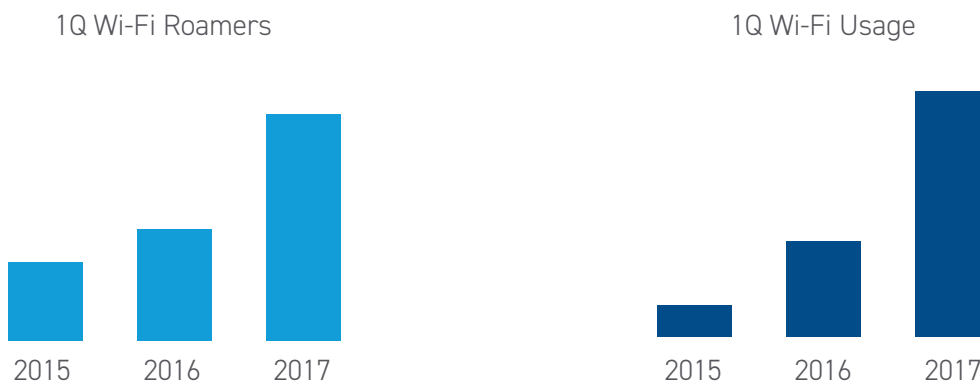
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Results

The results have been very positive according to AT&T, which claims soaring usage in terms of the number of roamers, roaming data consumption (including cellular) and retention rate. As long as the cost of Wi-Fi wholesale remains lower than cellular data (25-50% lower), the model works and AT&T plans to expand its footprint, as well as the adoption of Passpoint profiles into client devices, especially on iOS. AT&T has its own application to discover and authenticate into partner Wi-Fi networks.

AT&T Wi-Fi Roaming Growth



MNOs are no longer interested in paying voice service per minute or data per Mb because:

- VoLTE will soon replace traditional voice and will be included in data packages
- MNOs require better support to offer more attractive roaming packages including unlimited data offers with more flexible retail offers

Establishing a roaming agreement is still a long process resulting in Wi-Fi roaming revenue not yet achieving its full potential. The reasons are many: identifying a potential partner who is not an active member of the WBA can be tricky in the first place; ensuring the potential partner abides by the requirements needed to establish a successful bilateral agreement requires also a great of work and time. There are the technical, business, financial and legal steps that must be overcome, and in turn a clear view of the potential return on investment of all the total investment in time.

The WBA has made it easier to negotiate and implement those roaming deals between WBA members by setting the specific guidelines detailed in the WRIX standard which also handles the technical aspects of roaming. As a reminder, WRIX includes WRIX-i (Interconnect), WRIX-l (Location) WRIX-d (Data Clearing) and WRIX-f (Financial Settlement). Each of these can be deployed by Visited Network Providers (VNPs) and Home Service Providers (HSPs) either in-house or through an intermediary WRIX service provider. However, for roaming agreements between WBA members and non-members, challenges remain.

Syniverse (with the help of Bandwidth X) are working on facilitating that marketplace exchange. BandwidthX is the company which has pioneered a cloud-based B2B marketplace to match service providers with available Wi-Fi capacity on an on-demand, pay-per-use basis while Syniverse is involved in international Wi-Fi roaming deployments.

The initiative is designed to encourage cities, government bodies, fixed and mobile operators, vendors, web platforms and service providers, as well as retailers, to support a universal connectivity model. Service providers are increasingly combining Wi-Fi and cellular in roaming packages, and by joining the BandwidthX trading platform with Syniverse's IP roaming hub, this presents a genuinely viable alternative to carriers' own offerings. Among its offerings, Syniverse has Wi-Fi Roaming eXchange, which aims to make "mobile Wi-Fi roaming as seamless as 3G/4G data roaming."

However those models may be replaced by more distributed methods enabled by blockchain to enable smart contracts. [Read my blog bringing blockchain to telecom.](#)



GDPR

The impact of GDPR on Guest Wi-Fi

by Adlane Fellah

The EU General Data Protection Regulation (GDPR) is a law that was adopted by the European parliament in April 2016 and will become enforceable on May 25, 2018. The regulation applies to the collection, processing, and movement of personal data for individual residing in 32 European states (28 EU states + 4 other European states). Now, individuals must understand exactly what they have consented to which means that an end-user must give specific consent for each personal data and agree on how it will be used.

How will GDPR impact guest Wi-Fi practices and deployments?

Vendors will need to provide tools to get end-users' consent to use their personal data for marketing. Venue managers and brands will also want to give end-users transparent access to that personal information

Johan Terve from Aptilo believes the transparency will mean that venue owners will think twice about how aggressive they will be or they will risk to lose some customers. But, when they find the right balance I agree that people will feel more comfortable. The vast majority of users will probably not care/read the simplified text anyway as they just want to get online?



"As for sharing data. Everything is ok as long as there is a legitimate reason for storing the data and the user agrees. In the cases you mention the provider need to be crystal clear who is going to get access to the data and how they are going to use it" he added.

Ucopia's CEO Didier Plateau indicated "Databases must be classified according to the purpose they serve: legal or marketing. The collection of personal data must be performed in compliance with applicable laws, including antiterrorist laws that require the retention of logs and their disclosure to official authorities in case of an investigation".

Clients will want to use a central consent and personal data management system for all their different services including Wi-Fi. Different deployment scenarios are possible:

- Privacy self-management
- Handled by customer care
- Automatic

GDPR, requires vendors to erase all personal data upon request from the end-user within 30 days (GDPR).

SaaS vendors will need to provide system administrators the ability to create and configure as many terms and conditions/privacy policies as required. All end users must be able to exercise their access rights through the network administrator.

GDPR requires companies to implement privacy-by-design, VP Marketing at Cloud4wi, so that information is always protected regardless of the application in use as well as development projects. Privacy must also be protected by default, ensuring that the least amount of personal data is in play at any time. Reducing the amount of accessible data is key to improving data protection.

"If there is a data breach, it must be reported to authorities and customers within 72 hours from when a company first becomes aware of the incident. This will require a high-speed response that many companies today are unable or unwilling to provide." she added

Fon's GDPR highlights some important end-user rights:

- All end users may exercise their right to **rectify** their personal data by contacting the network administrator who has access to user profile pages and can edit and update all modifiable personal information based on the requests of end users.
- All end users have the right to request that they be permanently deleted from the service. Their associated user data will not be deleted until period of proscription but none of the information related to this end user will be displayed in any API, and thus will not appear in the management platform.
- All end users have the right to oppose acceptance of any previously optional Terms and Conditions/ Privacy Policy. By accessing the specific end user's profile, the network administrator can view all of the Terms and Conditions/Privacy Policy that the end user has accepted.

In summary, the impact of GDPR among the public is hard to predict, one thing is sure, GDPR will force the adoption of better marketing practices.





14 Benefits of Managed Wi-Fi

By Adlane Fellaah - sponsored by Datavalet

There are many benefits to outsourcing the management of your Wi-Fi network to experts, just as there are many advantages of outsourcing services for data storage, security services, software tools, and other services. Let's explore these benefits in more detail.

FIRST GROUP OF BENEFITS: COSTS REDUCTION AND PRODUCTIVITY GAINS

Considerable cost savings are realized by having a Managed Service Provider (MSP) handle multiple Wi-Fi connected locations for multiple clients. This fixed cost sharing translates into true efficiency gains, reduced network downtime and frees up IT staff so then can focus on other essential functions.

1 - Reduced capital expenditure

Since Wi-Fi-related hardware and software are hosted by the MSP, businesses no longer need to invest upfront capital when setting up their own networks. Instead, companies simply pay a monthly or annual subscription fee on a pay-per-use model.

2 - Reduced Operational Expenditure

Since MSP take care of all hardware and software updates, as well as upgrades, security patches, problem-solving tasks and support to users through a helpdesk, businesses do not have the added



expense of having to hire dedicated IT staff to manage and maintain wireless networks and provide support to guests and other Wi-Fi users.

3 – Better Productivity

With the elimination of network management responsibilities, IT staff is available and can be redirected towards other more strategic initiatives for their business, and employee productivity may be less impacted by network downtime. The need to purchase, install and configure a network infrastructure is thus eliminated, saving IT staff considerable billable hours.

4 – Gains in Efficiency

As an added bonus, outsourcing to a specialist with expertise in managing Wi-Fi systems across a broad range of different businesses means that your organization benefits from their proficiency and efficiency. This is especially valuable when problems arise that require Wi-Fi technology expertise and the involvement of hardware manufacturers, ISPs, telecom carriers and all other types of partners in the larger Wi-Fi ecosystem. In such instances, the dedicated Wi-Fi MSP will always be far more efficient thanks to its in-depth knowledge of Wi-Fi technology and its ecosystem.

SECOND GROUP: RISK REDUCTION

The MSP ensures the infrastructure is always secure, up-to-date and optimized while specifically meeting the business requirements. The workload and risks previously assumed by an internal IT teams diminish significantly since they are now outsourced to a dedicated specialized service provider.

5 – Less Downtime

Organizations will experience less network downtime resulting from updates, upgrades and ongoing monitoring of [network infrastructure](#) as these tasks will now be handled by the MSP. In the event of downtime, the organization can also rely on a 24/7 support from the MSP.

6 – Improved Quality of Service

Some MSPs provide the complete range of Wi-Fi services from architecture to design, development, deployment, user support, equipment lifecycle management, upgrades and replacement, as well as daily management of the network. This ensures that the Wi-Fi network will perform optimally on an ongoing basis for both staff and guests.

7 – Greater Scalability

Because managed Wi-Fi networks are cloud-based, it is relatively easy to increase the number of [Access Points](#) to follow business growth. Organizations can extend their coverage and/or easily add new connected sites with reduced hardware investments since most of the Wi-Fi intelligence resides in the cloud. Managed Wi-Fi thus enables extremely agile and scalable wireless networks.

8 – Greater Security

Moving to [managed Wi-Fi](#) shifts the burden of network security from your organization to the MSP, and as such, cloud providers are incentivized to offer the best possible security features. These include



encryption, authentication, malware protection, data loss protection, firewalls, and more. In fact, many companies today are moving to cloud services specifically because the security capabilities of large cloud providers vastly exceed those of their own organizations.

9 – Bring Your Own Device (BYOD)

Since cloud services can be accessed by any device with a Wi-Fi connection, managed Wi-Fi enables the possibility for employees, clients or guests to securely utilize their own mobile devices (BYOD) with relevant and appropriate network access rights and permissions.

THIRD GROUP: REVENUE INCREASE

A managed Wi-Fi network will provide increased flexibility to introduce new applications that can positively impact both the top and bottom lines, such as real-time client-engagement solutions, which some MSPs may deploy when they have a development team at the ready to innovate on customer requirements.

10 – Fast and Simple Guest Access Wi-Fi

Managed Wi-Fi provides [guests](#) and shoppers a seamless onboarding experience, getting them online in seconds. Businesses must be able to customize all aspects of their network from the [Welcome Portal](#) to the Privacy Policy. They should also be able to define Internet plans, such as recurring vs. one-time, free vs. paid, and time-based services. Retailers should also be given the option to choose how customers log in. Options include using a username and password, social media accounts, email, and click-through among other options.

11 – Advanced Analytics

Nowadays, best-in-class Wi-Fi systems come with advanced analytics. Such functionalities permit businesses to learn more about visitors and shoppers, even if they don't connect to the Wi-Fi network. A device can also be tracked over time and its owner's behavioral profile detected – in turn engagement activities can then be deployed based on these precious analytics. In addition, analytics are used to monitor and evaluate the performance of Wi-Fi services and the health of the Wi-Fi infrastructure. These “back-end analytics” substantially improve the level of service MSP may provide.

12 – Engagement Marketing Tools

These tools enable businesses to [directly engage customers](#), during and after their visits, by delivering relevant and personalized content. Businesses can further extend their brand's presence on social media networks through social Wi-Fi. They should be able to set up features such as automated Likes, Posts, Check-in's and Follows in just a few clicks. Encouraging customers to “Like” their Facebook page and timeline posts should also be an easy task to complete.

13 – Central Management

This type of management offers control of every aspect of your guests' Wi-Fi access across all store locations, all from a single, cloud-based dashboard. This includes Wi-Fi onboarding, analytics, visitor traffic



and marketing, among others. These centralized capabilities give an in-depth view of what is going on in each location which permit for better decisions and revenue optimization.

14 – Richer Tailored Experience

This approach allows for the delegation of control over policies and permissions. Organizations can create a consistent look for their Welcome Portal across all locations, while allowing local managers to promote location-specific offers. In addition, IT can control guest Wi-Fi services and marketing can manage engagement tools simultaneously.

CONCLUSION

With the expectations that Wi-Fi should always be available, cost-effective, secure and simple to use, the adoption of the “utility model” managed Wi-Fi solution represents the simplest path for organizations to grow and leverage their wireless networks without needing to spend time worrying about (and ultimately handling) the myriad details. Businesses can then focus on their core activities, improve their bottom line and reduce their risks.





Assessing the MDU opportunity

by Adlane Fellah

According to the US Census Bureau, out of 127 million households, were close to 35 million households living in MDUs (multi dwelling unit) of more than 2 units in 2016. Those numbers translate into over 17 million units spread over a little more than 800,000 buildings. Estimates vary but let's say 20% of these units are connected to fibre while the rest get broadband through either coax cable or variations of xDSL and a little percentage with wireless.

However, as we wrote in a [previous blog](#), broadband internet service in the U.S. has been plagued by uncompetitive practices. Large, nationwide internet service providers (ISPs) have built monopolies that prohibit innovation, drive down levels of service, and block competitors from entering the market. In their 2016 Broadband Progress Report, the Federal Communications Commission (FCC) found that only 38% of Americans have more than one choice of broadband provider, and only 10% of Americans have access to broadband speeds of up to 25 Mbps downlink/3 Mbps uplink. Many Americans lack access to broadband internet entirely, especially in rural areas: 39% of rural Americans, 4% of urban Americans, and 41% of Americans living on Tribal lands do not have access to broadband services. In light of these factors, the FCC concluded that “advanced telecommunications capability is not being deployed to all Americans in a reasonable and timely fashion.”

Some organizations have attempted to provide a better broadband option to consumers, through the deployment of fiber-optic networks. For example, Google Fiber, announced in 2010, offers fiber-to-the-home



(FTTH) high-speed broadband internet with downlink speeds of up to 1 Gbps. Verizon Fios is another FTTH fiber solution that offers high speed broadband, up to a "Fios Gigabit Connection" of 940 Mbps down/880 Mbps up. Such networks serve to raise consumer expectations of broadband internet, pressuring ISPs to improve service. The US Fiber Broadband Association reports that:

- 2016 saw 4.2 million homes passed with fibre;
- During 2004–2013, large telco's (Verizon, AT&T, CenturyLink and Frontier) accounted for about 83% of the FTTH build, while other providers added just 17% of the annual additions. But in the last three years, the large telcos only accounted for about 52% of the build while the "other 1000" FTTH providers added 48% in aggregate.

However, deploying fiber networks is a slow and expensive process, with an installation cost estimated to be approximately \$1000 per home. Accordingly, despite the high speeds available with fibre, time and cost expenses prohibit fibre as a practical broadband remedy.

The MDU market is not only large but provides better economics than access to single family units, especially for wireline providers who already provide broadband access to the building. Large MDUs that have tens or hundreds of residents require very large pipes. Those residents of affordable housing struggle the most to get broadband while student housing and other multifamily properties often lack appropriate infrastructure as well.

In the case of semi-public MDUs such as student housing, and other similar venues, residents need more than a fast pipe. They can benefit with properly managed Wi-Fi networks that are well with guest Wi-Fi easy to sell and implement.

In some emerging economies worldwide, the proportion of the population living in MDUs is extremely high, for example it is estimated that approximately 90 percent (90%) of Chinese urban households are in MDUs.

As a result, the MDU market is very important for both communication service providers as well as both wireline and wireless technology vendors including mmwave for last "portion" access and Wi-Fi for in-building distribution and managed services.

Maravedis will be looking more in-depth into the MDU market opportunity and is seeking comments, contributions and further engagement.





The Benefits of Managed Wi-Fi Solutions for the Healthcare Sector

By Adlane Fella - Sponsored by Datavalet

Imagine a hospital in which wireless technology enables visitors, healthcare professionals and patients to roam anywhere throughout the facility, while providing continuous, accurate, and real-time monitoring. This vision can only become reality through the integration of Wi-Fi technology as an integral part of a hospital's IT systems. Already quite impressive you will say, and yet, this vision is in reality, only the tip of the iceberg. "Connected hospitals" have so much more to offer patients and hospital administrators.

THE BENEFITS OF WI-FI ACCESS MANAGEMENT IN HEALTHCARE

The healthcare industry does an excellent job of making use of technology to support new and advanced medical care. However, hospitals can also use Wi-Fi to improve health outcomes for patients as well as their overall experience while in the facility.

With the right platform, hospitals can create a customized Wi-Fi experience for each type of user: medical staff, non-medical staff, patients and visitors, each with their own level of access rights, security, bandwidth consumption and relevant features. Such tiered access can help hospitals increase staff productivity, generate new revenue streams and improve their overall patient and visitor experience.



WI-FI AND CONNECTED DEVICES CAN IMPROVE PATIENT CARE

The first obvious area to exploit the power and functionality of Wi-Fi is with connected medical and non-medical devices. This includes smart beds, monitoring devices, and testing devices like MRI and X-ray equipment. When equipped with Wi-Fi, these devices can connect with a central database or system that automatically update patients' electronic medical records.

Doctors and nurses carrying tablets or other types of smart devices can then directly access a patient's medical records anywhere throughout the hospital. This feature saves them precious time not having to search through copious paper files or locating a computer terminal to retrieve and enter medical information. It further enables medical staff to provide more efficient services, enhances patient care and improves productivity.

As artificial intelligence becomes more prevalent in assisting doctors with diagnosis and treatment, the benefits of Wi-Fi access management are compounded.

"Wi-Fi offers the opportunity for remote monitoring of patients through portable devices, bringing clinical information directly to the relevant people. Where used, it dramatically reduces errors, saves time and increases efficiency." (Adlane Fellah, Maravedis)

Moreover, Wi-Fi systems may be used to push surveys to patients regarding their experience during their stay. The actionable data provided by these surveys become insights that establishments may act upon to continually improve services. The data and results obtained can also be used to improve the healthcare organization's visibility within the community and governmental bodies (think HCAHPS scores).

GENERATING NEW REVENUE STREAMS WITH TIERED ACCESS SERVICES

Patients, and their families, are willing to pay for reliable Wi-Fi, so they can stay connected to the outside world. They can connect with friends and family through social media and access entertainment just as they would at home. Even though a hospital room may have a television and telephone, the average patient has become accustomed to seamless Internet access on their portable devices. When hospitals provide this level of access, they can potentially generate new revenue streams by charging for high-speed access and, at the same time, improving the overall patient experience. Hospitals can offer different tiers of speed and charge accordingly or provide the opportunity to make contributions to charitable foundations in exchange for internet access.

WI-FI HELPS TRACK & MONITOR MEDICAL EQUIPMENT

Hospital administrators can also use Wi-Fi to monitor and track key assets such as medical equipment. For example, tagging a wheelchair or other piece of mobile asset can provide administrators with a real-time view of where that equipment is located anywhere throughout the facility. This detailed knowledge helps reduce equipment theft and misplacement. Also, knowing where equipment is being used provides administrators with useful analytics about how the hospital functions.



WI-FI SUPPORTS INDOOR POSITIONING SYSTEMS

Wayfinding technology uses Wi-Fi signals to help patients and visitors navigate hospital campuses. Many hospitals have buildings spread out across vast campuses. Once patients and visitors have found parking, they must then locate the correct building. Then, they must find the right floor, office number, room number, or desk to make their appointment or visit a loved one. Guiding patients and visitors can also represent a considerable unproductive use of staff time.

One of the major benefits of using a Wi-Fi Indoor positioning system is that it provides the hospital's administration with a treasure trove of data about the movement of people throughout the hospital. They can collect data about where people are in each facility, where they tend to gather, how long it takes to move from one location to another, the average dwell time in specific locations, and other data that can help hospital administrators understand how their hospital functions.

FREEING RESOURCES AND FOCUSING ON CORE ACTIVITIES

Many healthcare IT teams are significantly challenged by the pace of change and increased complexity of new technologies, not to mention the various demands of other departments. The diversity and proliferation of devices, range of operating systems, security threats, new business requirements, technology lifecycle, and upcoming IoT all represent a challenge for understaffed and budget-stretched IT departments. Moreover, health institutions are not equipped with support resources to deal with the large number of Wi-Fi users' requests, neither processing transaction through Wi-Fi, for example. Thus, hospitals, clinics and other healthcare facilities are increasingly resorting to outsourcing the complete management of their Wi-Fi access and infrastructure to service specialists in order to refocus their attention on managing their core business as previously discussed [in this article](#).

TOWARDS A HEALTHY NETWORK

If healthcare institutions are to fully leverage the many benefits of deploying Wi-Fi throughout their facilities, they must first focus on improving the capacity and stability of their Wi-Fi infrastructure through trusted third-party managed service providers. Many of the more forward-thinking hospitals have already begun the process of improving the integration of their equipment and services with Wi-Fi. As Wi-Fi technology continues to improve, the healthcare industry will find new and more creative ways to harness technology to revolutionize patient care and streamline healthcare management.





Reporting from the 2018 Wi-Fi Trek

By Adlane Fellah

Last week I attended my second CWNP conference called "Wi-Fi Trek" in San Diego as a member of the CWNP family myself, I felt a great sense of community with the other delegates who also have at least one vendor-neutral certification. The CWNP under new leadership is making some great initiatives to reach out to a broader audience while retaining its member spirit. Maravedis is proud to be participating to that outreach. For those not familiar, the Certified Wireless Network Professional (CWNP) is the IT industry standard for vendor neutral enterprise Wi-Fi certification and training.

This is a conference for and by networking and security experts who live and breathe Wi-Fi very with solid representation from various verticals ranging from healthcare to airlines. The new 802.11 ax amendment was the at the center stage of discussions for this WLAN community at the event. The following are some of the highlights of the event.



CWNP

The Certified Wireless Network Professionals (CWNP) launched the Certified Wireless Specialist (CWS) and Certified Wireless Technician (CWT) certifications in 2017. CWS and CWT are entry-level certifications designed to teach and validate wireless LAN basics to those wishing to enter the wireless LAN industry.

Given the proliferation of wireless technologies in the enterprise such as BLE and LPWAN, the CWNP is also expanding its certification offering, and will introduce a new certification on integration next year. Details are coming soon and I will be happy to take that one!

AN UPDATE ON 802.11 AX

Some vendors have already released 802.11 ax compliant radios, but the standard is not finalized yet. A [list of List of 802.11ax Hardware is constantly being updated](#). Devices supporting 802.11 ax will be available before the end of the year with volumes ramping up in 2019.

The IEEE is currently scheduled to ratify the 802.11ax amendment in Q3 of 2019. The Wi-Fi Alliance has a similar timeline for an 802.11ax certification with testing planned for August 2019.

As a reminder the 802.11 ax is the name of the IEEE amendment while Wi-Fi 6 is the new Wi-Fi Alliance label referring to vendor certification program for 802.11 ax.

Even though the amendment is not ratified yet, silicon and AP vendors have already agreed and committed to supporting some key aspects of the upcoming amendment such as OFDMA, Target Wake Time or BSS coloring on their chipset and hardware designs.

OFDMA OR MU-MIMO?

802.11 ax will provide a much-improved experience in dense environments characterised by the simultaneous connection of many devices. With the improved uplink capabilities and increased throughput, there will be much less competition among home users for airtime to send emails, post pictures to social media, and otherwise upload data. The first improvement of 802.11 ax is to provide additional spectral efficiency, that is using Wi-Fi bandwidth more effectively. This is accomplished with the introduction of "Orthogonal Frequency Division Multiple Access (OFDMA)" a technique developed in the cellular world which enables to divide a channel into subcarriers called Resource Units and dedicated to specific end-users at the same time as shown in the picture below



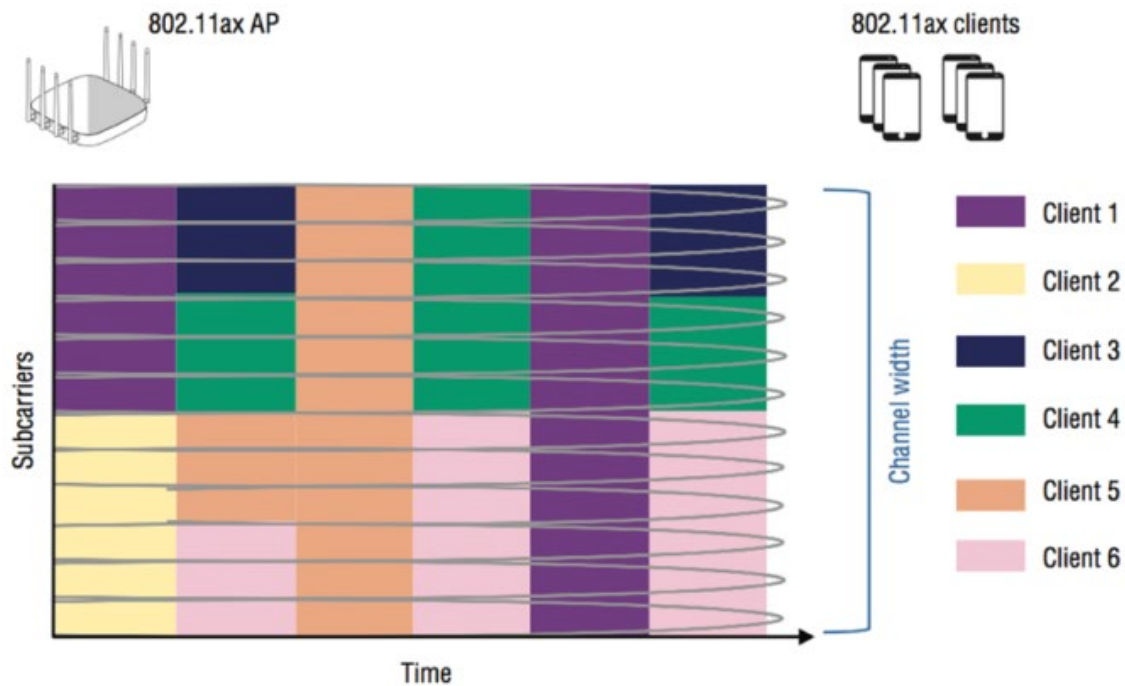


Figure: OFDMA transmissions over time

Source: Aerohive

There was a great deal of skepticism in the audience about the opportunity for MU-MIMO to be widely implemented at least in the short term because of its indoor limitations and the fact that uplink MU-MIMO for 802.11 ac is not expected until wave 2 which is still years away.

MU-MIMO allows for multiple-user access by using different spatial streams. Access points will send unique streams of data to multiple clients simultaneously. "The 802.11ax standard also allows for the combined use of MU-MIMO and OFDMA but MU-MIMO is not expected to be widely implemented" says Perry Correll, Director, Product Management at Aerohive.

"OFDMA is designed to deal with high density clients, is a proven technology coming from the cellular side and was also part of the 802.16 WiMAX standard." he added.

Indoors, MU-MIMO would be hard to work, "if have 30-40 people in the same room because of the physical separation needed to stream those beams" Perry added.

MU-MIMO requires transmit beamforming (TXBF) which requires sounding frames. The sounding frames add excessive overhead, especially when the bulk of data frames are small. MU-MIMO would only be a favorable option in very low density, high bandwidth environments, with a small number of users requiring extremely high throughput.

Alexandra Gates (also from Aerohive) wrote in her blog "Multi-user OFDMA will be the most relevant technology that 802.11ax offers. Regardless of stream count, all APs will support the same number of 802.11ax OFDMA clients. OFDMA technology makes better use of the available frequency space by subdividing the channels into resource units for simultaneous multi-user transmissions both downlink and uplink. Even with a 20 MHz channel, we can talk simultaneously to up to 9 client devices and theoretically up to 37 with an 80 MHz channel (although enterprise customers should rarely use anything above 20 MHz).

However, MU – MIMO is great for outdoor PMP to connect AP that are well physically separated with dedicated spatial streams.

6GHZ SPECTRUM

With the proliferation of Wi-Fi devices and usage, as well as 802.11 ax allowing wider channels, the Wi-Fi community is pressured to look for additional spectrum to maintain high-quality experience. Overall, the main sources before 2020 will be as follows:

- Additional 5 GHz frequencies for conventional Wi-Fi/802.11ac

Most of these will be enabled by new spectrum-sharing techniques, which make it more practical to have Wi-Fi (and other license-exempt technologies) coexist with licensed incumbents such as radar.

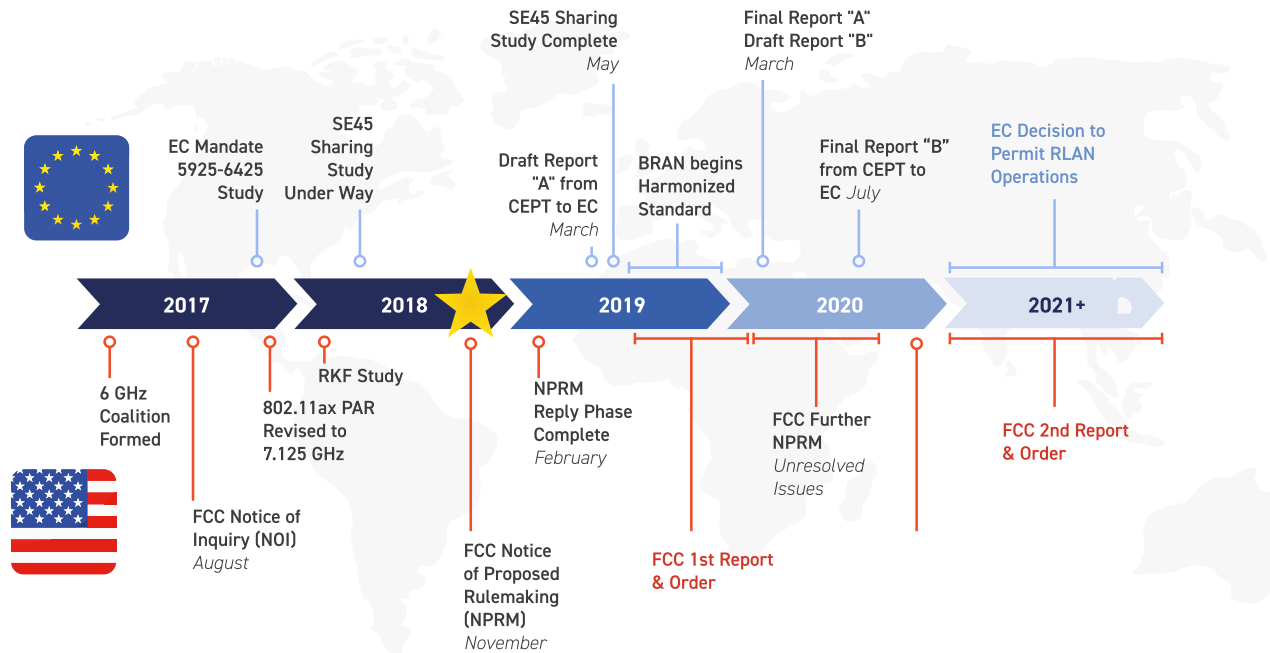
- Shared spectrum options, such as TVWS and 3.5 GHz (especially in North America).
- Expansion into the bands currently used by short-range devices and others, notably 863-868 MHz, with the 802.11ah extension.
- Expansion into 60 GHz spectrum courtesy of the WiGig standard (802.11ad).

Chuck Lukaszewski, Vice President, Wireless Strategy & Standards at Aruba provided a very comprehensive overview of the new spectrum opening for unlicensed usage at 6GHz and beyond which could be the basis of a report study by itself!

Unlicensed access to the 5.925 – 7.125 GHz band – referred to as the 6 GHz band – is particularly important to the future of Wi-Fi innovation. According to the Wi-Fi alliance, this spectrum is suitable for deployment of the next generation of Wi-Fi, as it offers sufficient bandwidth to alleviate data traffic congestion and provides for commonality of equipment with existing Wi-Fi networks already using adjacent frequency band.

The 'Notice of Proposed Rule Making' is not the final step in the FCC's regulatory process. The NPRM is the FCC's proposal for the rules in 6 GHz for which the Commission will seek public comment. Subsequently, based on input received, FCC will issue a Report and Order. "The Wi-Fi alliance is hopeful that the FCC's regulatory process to allow unlicensed use of 6 GHz will be completed by end of 2019 – if all goes well".





Source: Aruba

However, other groups are against opening up that band to unlicensed use. According to AT&T, the band contains about 100,000 microwave links, many of which are carrying critical voice and data traffic, including for the nation's first responders. Furthermore, as AT&T reports, ca. 25% of the links in the 6 GHz band support public safety and critical infrastructure industry licensees, and ca. 27% of the links in the band support utilities, making the upper and lower 6 GHz bands essential in terms of supporting the nation's critical infrastructure. It also said that maintaining long-haul and high-reliability microwave links will be critical for 5G and other advanced services. In this context Automated Frequency Coordination (AFC) will be an important tool to avoid interference issues.

Overall a very productive conference with down-to-earth presentations and discussions from people who deploy and manage enterprise Wi-Fi networks and a great CWNP family reunion!

A special thanks to the CWNP, Aerohive and Aruba teams for their great insights!

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CBRS impatience rises, but LTE will be main neutral host system for years

by Caroline Gabriel

The promise of the USA's multi-tiered CBRS spectrum band has been discussed for so long that it is easy to forget that there are still no commercial services in the 3.5 GHz band, either in its licensed or shared tiers; and still barriers to full deployment, though most of them are political rather than technical. And with the timing of 5G in shared spectrum uncertain, there is likely to be plenty of time for CBRS to make its mark on the mobile services landscape, even if impatience is rising for it to kick off its activities.

So much is riding on the success of the FCC's bold experiment with opening up a formerly federal band for mobile broadband, with three different levels of priority access – guaranteed top priority for federal incumbents; followed by holders of licences (Priority Access Licensing or PAL); and then by General Authorized Access or GAA – unlicensed, subject to being assigned vacant channels by a spectrum allocation system (SAS), which will manage all the priority levels. Round the world, supporters of a more open ecosystem of mobile service providers, including industrial specialists, are hoping that CBRS will be sufficiently successful to encourage similar schemes elsewhere.

Most focus on the potential opportunity for new mobile entrants has focused on the general access tier, but PAL could also encourage new players, because the licences are likely to be shorter term, and more



localized, than most mainstream mobile franchises, and so more affordable for non-traditional MNOs. Wireline or industrial providers have shown interest, since they might want more assured performance and capacity than the shared system would support, but of course, the mobile operators are also keen to snap up the airwaves, to add affordable capacity to their networks, and to fend off those new players.

CBRS ALLIANCE CONDUCTS INTEROPERABILITY TESTS:

As a relatively high frequency band with power limitations, the shared access portion of CBRS will be best suited to small cells and to 'hotzones' of urban or rural coverage and capacity, especially indoors. To support scalability, and eventually the potential for nationwide services, interoperability between these networks, and between the SAS systems, will be important.

That is a central remit of the CBRS Alliance, which recently held an interoperability event at CableLabs' facility in Louisville, Colorado, where over 55 different CBRS combinations were tested. The Alliance said there was a 98% completion rate across all these test scenarios, and no failures – an optimistic sign of a maturing ecosystem. GAA services are expected to start late this year, even while the FCC continues to mull over the final terms and conditions for the auctions in the PAL portion.

The stabilizing of a commercially ready ecosystem in GAA is highlighted by a rising number of FCC certifications for CBRS equipment. Ruckus Networks, now part of Arris, received the FCC's first CBRS Device (CBSD) authorization earlier this month, for its Q710 and Q910 small cell products.

And last week, Ericsson said it had received this green light for its CBRS portfolio, which include indoor and outdoor small cells under its Ericsson Radio System banner. In CBRS, it offers the Radio 2208 for outdoor and a version of its Radio Dot indoor distributed radio system. The latter is significant, for those supporting new entrants and neutral host models in shared spectrum, because it is built for multi-operator deployment.

Of course, MNOs will use CBRS too, as they are looking to use 5 GHz spectrum for LTE-Unlicensed or LTE Licensed Assisted Access (LAA) in many parts of the world – adding affordable open spectrum to boost their overall airwaves. AT&T recently said it would use Samsung equipment for its initial CBRS fixed wireless deployment, harnessing CommScope's SAS, and putting in place a migration plan to 5G when shared spectrum standards emerge. AT&T will test CBRS equipment in its labs early next year and plans commercial roll-out in certain US cities from late 2019.

This is an example of using current spectrum and technology for a particular application – fixed wireless – to complement 5G FWA plans in mmWave, and the wireline business.

But some believe the use of shared spectrum will become less necessary in 5G, because there will be higher capacity bands available to MNOs, and early auction results, especially in millimeter wave, indicate their plentiful capacity will make them affordable. This is one factor that reduces the risk, to new open models, that 5G-Unlicensed will not appear for several years, although that also suggests that most of the innovation in flexible and neutral host platforms will take place, for a considerable time, in LTE enhancements.



That is particularly likely, because there has been development of many specialized, vertically-focused offshoots of LTE standards recently, such as LTE-V for vehicles and NB-IoT for low power WANs, and it is unlikely that providers which invest in those now will want to change their technology for at least five years.

Of course, outside North America, those high frequency 5G bands include 3.5 GHz – which in most regions has been mainly used for fixed wireless but will now be a 5G band. Opponents of the flexible LTE framework of CBRS, notably T-Mobile USA, have argued that the FCC has put the USA out of step with the world, and restricted its 5G options, by not also making 3.5 GHz a 5G allocation).





New Horizons for the Wireless Industry (Part 1)

by Robert Syputa

Among the lessons we can learn about where the wireless industry will head come from an understanding of the past success. At its roots, the wireless industry has grown due to technological progress in the design and manufacture of semiconductor-based equipment and mobile devices. That opened up waiting markets for people to make phone calls into the existing landline phone network. Almost every 'blockbuster' application since has been an extension of what occurred first on wired Internet communications. These required up-front agreement on standards, access to spectrum and capital that are highly organized and lengthy endeavors. In many cases, particularly in the early stage of each new generation of wireless, the use cases beyond voice and simple text messaging have been a process of trial and error. Of concern to mobile operators is whether they would become 'fat pipe' access providers detached from the revenue-generating services, content, and applications that ran OTT, Over the Top.

In recent years, more applications have developed in which the use of mobile devices have become essential to the functionality and user experience: mobile money, social chat, and some gaming apps are centered on use while people are in social settings rather than in front of a computer screen.

The 5G environment will also occur mostly as an extension of what has come before. During the early stages, harnessing 5G's lower latency and higher speeds will be isolated. The new 5G environment must first proliferate to reach a substantial percentage of consumers before it becomes the platform for new applications to gain market traction. As with 4G, there is no date certain for this to occur, however, from



that experience it may be around 2021-22 for this to occur. Our forecasts for 5G development in the USA takes two different tracks: under the scenario in which T-Mobile and Sprint do no merger, the deployment of mobile 5G will take longer to reach a large strata of the US population. If the merger is allowed by the US government, by 2023 we project that over 50% of US subscribers will have 5G enabled SmartPhones that can deliver a marked improvement in applications performance, i.e. '5G apps'.

MOBILE OPERATORS MOST DIFFICULT TASK? MASTERING THE INNOVATIONS THAT WIRELESS UNLEASHES

The task of building networks and devices that adhere to the standards and the building of managed networks is a highly disciplined and lengthy process. The task of developing new applications is "capturing light in a bottle"; part methodical process and part the serendipity of being in the right place at the right time with an inspired and highly motivated team of developers and entrepreneurs.

It has been estimated that over 70% of operator sponsored applications either failed and were abandoned or were merged with others or gained limited adoption. Many remaining operator-developed applications are retained to become more a nuisance than a benefit to ongoing operations. Each of the major US operators and many in other countries have applications with low user ratings, some of which have not been upgraded for several months and have questionable compatibility with the current OS. This issue is certainly not unique to mobile operators. In fact, it is indicative of the application development environment: large numbers of applications appear, some gain leadership that tends to soak up marketshare quickly. However, some categories, such as security applications, continue to draw new participants even while the feature sets and user interface are almost identical. What defines applications that have staying power and where mobile operators have an advantage? And why do some applications where operators have an edge, such as customer service applications, garner low user ratings and are not extended to leverage the connection to the user and account tie-in to gain traction in other categories?





The Importance of Managed Home Wi-Fi

by Adlane Fellah - sponsored by Calix

The home is rapidly becoming an environment that is dense with technology. With the proliferation of devices, a new level of Wi-Fi performance and coverage is required. Because the wireless footprint of these devices varies considerably, if some order isn't established, an inconsistent Wi-Fi experience seems inevitable.

Wi-Fi performance, and by extension the user experience, can suffer due to many environmental factors, such as congestion, noise, and interference. Many residential subscribers are tackling the problems in their own way (and at their own risk) by purchasing third-party hardware in retail stores. However, if these devices fail to fix their Wi-Fi issues, they will blame their service providers for it, resulting in more service calls, churn, and OpEx (operational expenses) for the carriers.

SERVICE PROVIDERS' STRATEGIES

As a result, service providers are now increasingly taking ownership of the Wi-Fi experience and are on a mission to educate their customers and manage their Wi-Fi experience. To this end, while some carriers sell **home Wi-Fi as a service**, others include it as part of their normal broadband service at no additional cost.

Managing home Wi-Fi transfers the responsibility of having a proper Wi-Fi experience from the end user to the service provider. This transfer requires the service provider to take over control and gain visibility into the home Wi-Fi network through a variety of ways; all of which are detailed in our new report, "From Managed Home Wi-Fi to Enabling the Secure Smart Home 2018-2023".



FACTORS AFFECTING HOME WI-FI PERFORMANCE

Throughout the course of our new research report, we asked 5 leading global service providers to identify the top 3 factors that are affecting Wi-Fi performance for their subscribers. Responses included:

- **Poor Access Point Placement:** Poor access point (AP) placement is the primary cause of Wi-Fi-related service calls. Poor placement of access points can result in low data rates, signal bleeding, bad roaming coverage, and even overspending on additional APs. Better informed customers, along with more beautiful designs for APs, can definitely contribute to curbing the customer tendency to hide APs in the closet or behind the TV set.
- **Dead Zones:** To achieve a good connection, Wi-Fi has to overcome barriers and obstacles—some of which cannot be eliminated by simply purchasing a new wireless router. A dead zone is typically caused by either the structure or size of the home or the walls or materials that block signals.
- **Neighbor Interference:** Wi-Fi networks interfere with each other. Older Wi-Fi standards are the worst culprits in this respect, so old Wi-Fi hardware is not just hurting one network—it may also be interfering with neighboring networks. Modern routers often try to automatically choose the best Wi-Fi channel for the least interference.

TOWARDS MULTI-ACCESS POINTS

There are different approaches and elements to solving home Wi-Fi performance and coverage issues. Each vendor we spoke to for our report had its own approach and “secret sauce”, typically comprised of algorithms sold in modules to perform the essential functions needed to solve emerging problems.

Some functions are essential for resolving performance within a single access point (intra-AP), while others are core to enabling improved coverage and roaming (inter-AP). Each software module is designed to perform a particular function or set of functions.

Multi-access point (with or without mesh) networks seek to solve problems with coverage within the home. Wireless mesh network devices (Mesh STAs) form links with one another, over which mesh paths can be established using an ad hoc mobile routing protocol. A key aspect of this architecture is the presence of multi-hop wireless links and routing of packets through other nodes towards the destination nodes.

CONCLUSION

Overall, providing proper coverage and performance in the home is more complicated than it appears to be. In upcoming blogs, we will look at various examples of operators who have decided to provide a reliable and managed Wi-Fi experience to their residential customers in the context of the proliferation of IoT, the emergence of next generation Wi-Fi, and rising customer care costs.

When it comes to Managed Wi-Fi, Calix has worked with dozens of service providers, offering them a Carrier Class Wi-Fi solution that includes the [Calix GigaCenter](#), [Calix Support Cloud](#), and [Calix 804Mesh](#) satellite units.

For more information on the Calix approach to Managed Wi-Fi, you can read the blog [“What IS “Managed Wi-Fi” Anyway?”](#)





Home Managed Wi-Fi: A Growing Opportunity for Service Providers

by Adlane Fellah - sponsored by Calix

With the proliferation of devices, the home is rapidly becoming a dense environment requiring a new level of Wi-Fi performance and coverage. The wireless footprint of these devices varies considerably and, unless some order is established, is a sure way towards an inconsistent Wi-Fi experience. Wi-Fi performance, and by extension the user experience, will suffer due to many environmental factors, such as congestion, noise, and interference.

As discussed in our report “From Managed Home Wi-Fi to Enabling the Secure Smart Home 2018-2023”, typically, users are unable to differentiate between problems caused by Wi-Fi, and other problems in the access network, or in the underlying applications. As a result, service providers are now increasingly taking ownership of the Wi-Fi experience and are on a mission to educate their customers and manage their Wi-Fi experience for them. To this end, while some carriers sell home Wi-Fi as a service, others include it as part of their normal broadband service at no additional cost.

For each of the operators included in our forecasts, we built forecasts for the following two categories:

- home broadband lines with home managed Wi-Fi with penetration rates; and
- average number of devices providing connectivity (e.g., gateways, extenders, STBs, and repeaters).

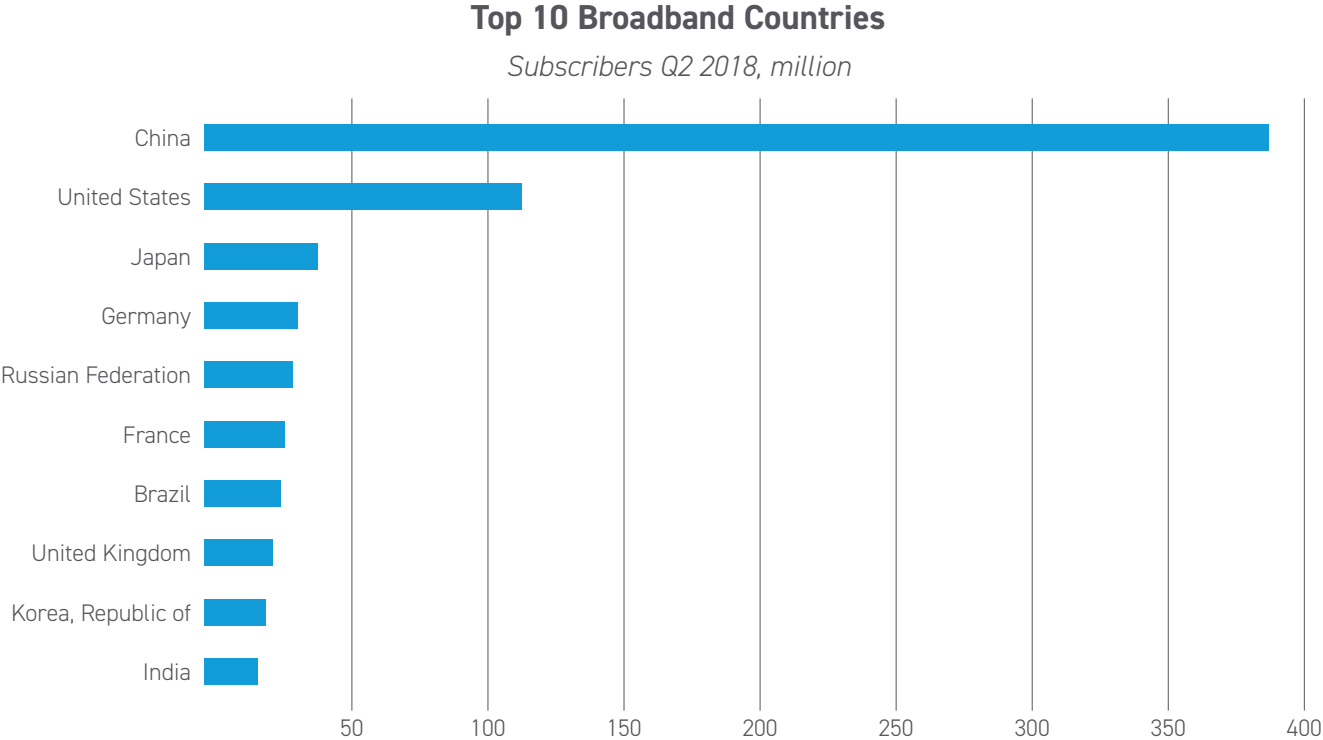


The licensing models and the average licensing fees vary considerably per deployment scenario between the agents deployed on third party gateways, fully integrated solutions (hardware and software), solutions with mesh, solutions with Power Line Communication or wireline backhaul, hosted solutions on AWS (OpEx), or purchased with a perpetual license (CAPEX). Consequently, we limited our forecasts to the number of licenses and units rather than dollars. Few vendors were willing to disclose how much they charge their customers for those licenses, which rendered any revenue forecast more than an educated guess. Most vendors are still private companies with no obligation to report revenues. Said differently, we asked and got few detailed responses. However as shown in the methodology flow below, our internal model provided an elegant and robust basis to derive the number of managed access points starting with the number of fixed broadband lines per operator for the top 34 countries modelled.

Broadband Lines

According to the latest research from Point Topic, as of the end of September 2018, there were more than one billion fixed broadband subscribers worldwide.

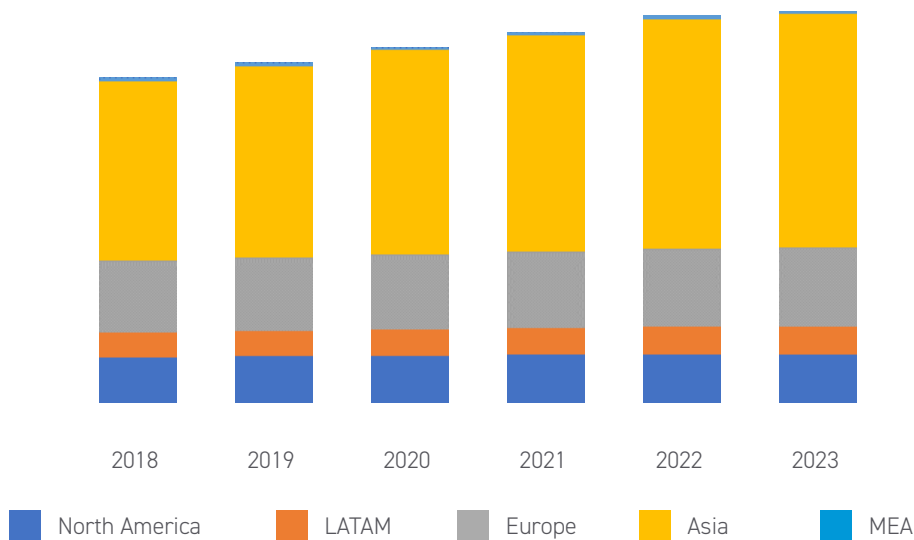
The growth is mostly due to the trends in East Asia, which provided 70% of all net additions in fixed broadband subscribers. Almost 50% of all subscribers were also in East Asia, which includes China. The graph below shows that Asia represents more than one third of worldwide broadband subscriptions.



Source: Point Topic, Q2 2018

“Fixed internet access continues to exceed expectations with growth tracking ahead of most models. Driven by China and other Asian markets the second age of internet expansion is nevertheless showing the effects of market saturation. The next phase will seek to provide adequate access to those in the places hardest to reach” according to Oliver Johnson, CEO at Point Topic.

Number of home broadband lines



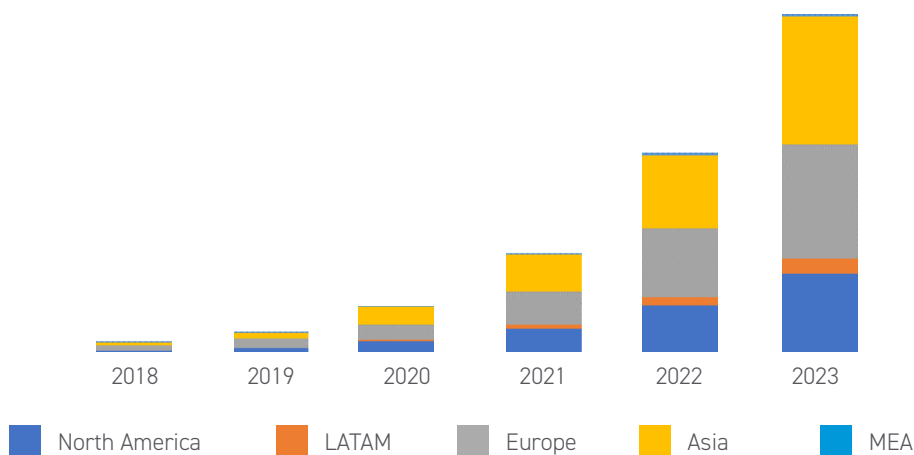
Source: From Managed Home Wi-Fi to Enabling the Secure Smart Home 2018-2023 Report, Maravedis LLC

Those broadband trends have of course direct implications on home Wi-Fi. The faster the pipe to the home, the greater customer expectations who expect those speeds to be delivered right to their devices in the home.

As a result, Managed Wi-Fi is a fast-growing market. We forecast that, by 2023, over 140 million broadband lines in the top 34 countries worldwide will have service provider-managed Wi-Fi. This represents 14% penetration of the total broadband lines in service in 2023. Below are some charts taken from the report, values have been removed but the trends are clear. To take advantage of the detailed value, please refer to the full report.

Not surprisingly, Asia represents the largest market for both fixed broadband and managed Wi-Fi followed closely by Europe and North America as shown in the following exhibit.

Number of home broadband lines with managed WiFi



Source: From Managed Home Wi-Fi to Enabling the Secure Smart Home 2018-2023 Report, Maravedis LLC

CONCLUSION

We believe that the adoption of guest Managed Wi-Fi is led initially by a few large fixed operators such as Comcast, Liberty, Orange, or DT who have embraced the notion that Managed Wi-Fi makes sense both strategically and financially. Managed Wi-Fi is poised to help operators reduce their Opex, Capex, and increase revenues with the sale of additional bandwidth or repeaters. Other operators are watching and evaluating their best technology choices in light of the proliferation of IoT, the emergence of Wi-Fi 6, and the overall role of Wi-Fi in the 5G era.





About Maravedis

Maravedis is a premier **wireless infrastructure analyst firm** since 2002. Maravedis focuses on broadband wireless technologies (including 5G, LTE, Wi-Fi, Small Cells) as well as industry spectrum regulations and operator trends. More information at www.maravedis-bwa.com

