Wireless | Access | Switching | Mobile

WHITE PAPER

Is Wireless LAN the next Cloud Service?

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As Wireless LAN equipment vendors move WLAN management to the cloud, the smartphone revolution is driving Service Providers into full-scale deployment of Wireless as a Service.

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As everything moves to the cloud, a new class of cloud services has emerged – managed network services or Network as a Service (NaaS). Alongside successful Infrastructure as a Service (IaaS) models, Service Providers are now delivering on-demand WAN connectivity as a cloud service, too. We believe small Enterprise and Consumer **wireless access** is next in line for a similar transformation.

Fueled by the smartphone revolution, the data load on 3G and 4G networks is skyrocketing, putting enormous strain on mobile networks, and eroding profitability for Mobile Network Operators (MNOs). Operators are reluctant to license more expensive spectrum, but they simply cannot keep investing in network build-out, to match the insatiable demand. The CAPEX cost is crippling, and as load increases, month after month, they are seeing diminishing ROI.

That's why many Service Providers believe that wireless deployment in subscriber homes and SMBs is ripe for the evolution to a Wireless as a Service (WaaS) model, with which they can simultaneously alleviate the mobile network with seamless Wi-Fi offload, reduce customer churn and monetize value added service offerings over cloud-managed Wi-Fi infrastructure at the customer premises.

This white paper explores the motivations and operational details of such developments, and answers the questions of how will Service Providers go about deploying WaaS, and what WLAN equipment vendors and ODMs must do, to be a part of those networks.

Why Wireless as a Service appeals to SMBs

Before diving deep into how and why MNOs are getting into Wireless as a Service, let's examine the recent trend of Enterprise WLAN vendors to move management and control to the cloud, and the receptiveness of SMBs to this type of managed service offering.

For most SMBs, deploying a secure, Enterprise-grade, high-performance wireless network comprising more than a few Access Points (APs) is more than they are capable of. By "Enterprise-grade", we mean coordinated APs, sharing common user security information and capable of providing multiple SSIDs, with tiered access for employees and guests, and seamless roaming throughout the facility - All the standard Enterprise features that are assumed in typical Enterprise deployments.

For SMBs, installing and managing a network is nothing more than a distraction from running their business. Wireless as a Service simplifies deployment, reduces CAPEX and eliminates most of the support and maintenance burden.

If SMBs have more than one location, it is doubly difficult, as they don't have the know-how in remote offices. Another issue is the lack of knowledge to choose suitable equipment in the first place, and to stay current with the times, as Wi-Fi features and performance continue to advance. Installing and managing a network, however simple, is nothing more than a distraction from running their business.

Recognizing these issues, WLAN equipment vendors such as Meraki, PowerCloud, AeroHive, Xirrus and several others, have developed cloud-based network management solutions which allow Enterprises to configure and monitor Access Points, from the cloud, without needing a local management server or management appliance.

Taking it a step further, Meraki and Powercloud also moved the controller function into the cloud, so the customer only has to buy and install APs. Since Xirrus and AeroHive have "controller-less" architectures, they don't need controllers in the cloud, to achieve similar results.

Although none of these players are the Enterprise market leaders, they have all been successful at addressing the growing SMB market, and have found profitable niches, in hospitality, warehousing managed care and other verticals, where IT expertise is often shallow. This model is attractive to such SMB customers, because it simplifies deployment, reduces CAPEX and eliminates most of the support and maintenance burden.

WaaS proved to be more profitable for WLAN vendors

Meraki's acquisition by Cisco for $1.2 Billion in 2012, suggests that this cloud-based approach has legs. In just over 8 years, having raised only $80M in funding, Meraki had grown sales to $100 million run rate, and was cash flow positive – something that most Enterprise WLAN equipment companies failed to achieve, even with much larger VC investment.

This is a clear indication that this business model is more profitable than those dependent on selling controller hardware and management software. In fact, most Enterprise WLAN equipment vendors, often found themselves giving away the entry-level WLAN management software as a sales incentive, and had low success in upgrading all but the largest customers to the full management suite. In contrast, with cloud-based management every customer pays for management, a little each month. From the vendor's perspective, after making a high initial investment in cloud controllers and management software, they reap monthly recurring revenue that within 3 years far exceeds the ROI from selling controller hardware and management software or appliances. Thereafter, incremental scaling is a cinch. When you take into account the economies of scale, the service revenue is almost pure profit.

But there are other efficiencies too. Let's examine cost of sales: Large Enterprise sales of wireless LANs can be a lengthy process. A 3-6 month sales cycle is typical, and it commonly involves demonstration equipment and competitive bake-offs, if not RFP responses. This sales model does not scale for small business, and this was the reason why the SMB market was largely ignored by WLAN vendors. But the cloud-managed wireless approach changes the dynamics. It cuts cost of sales and accelerates the sales process, because it is only necessary to ship Access Point gear. Potential customers can be up and running fast, with a minimal learning curve.

This is a slam-dunk for small to medium sized businesses. First to work is usually what gets bought. Furthermore, with this simplified model, it becomes possible to cut out the distribution and VAR channel altogether and deal with customers directly - a major profitability factor. PowerCloud is one poster child for this business model. With funding of only 6M, they have taken the cloud

Meraki and PowerCloud have proved that SMBs see the value of cloud-managed WLANs and that it is possible for WLAN equipment vendors to generate recurring revenues from cloud-managed WLAN infrastructure.

approach one step further through partnering. In addition to supporting their own 2x2 MIMO APs, they partner with WLAN equipment vendors Dlink, Amer Networks and Zytel who have their own APs and wireless routers, as well as channels which are focused on SMB and emerging markets.

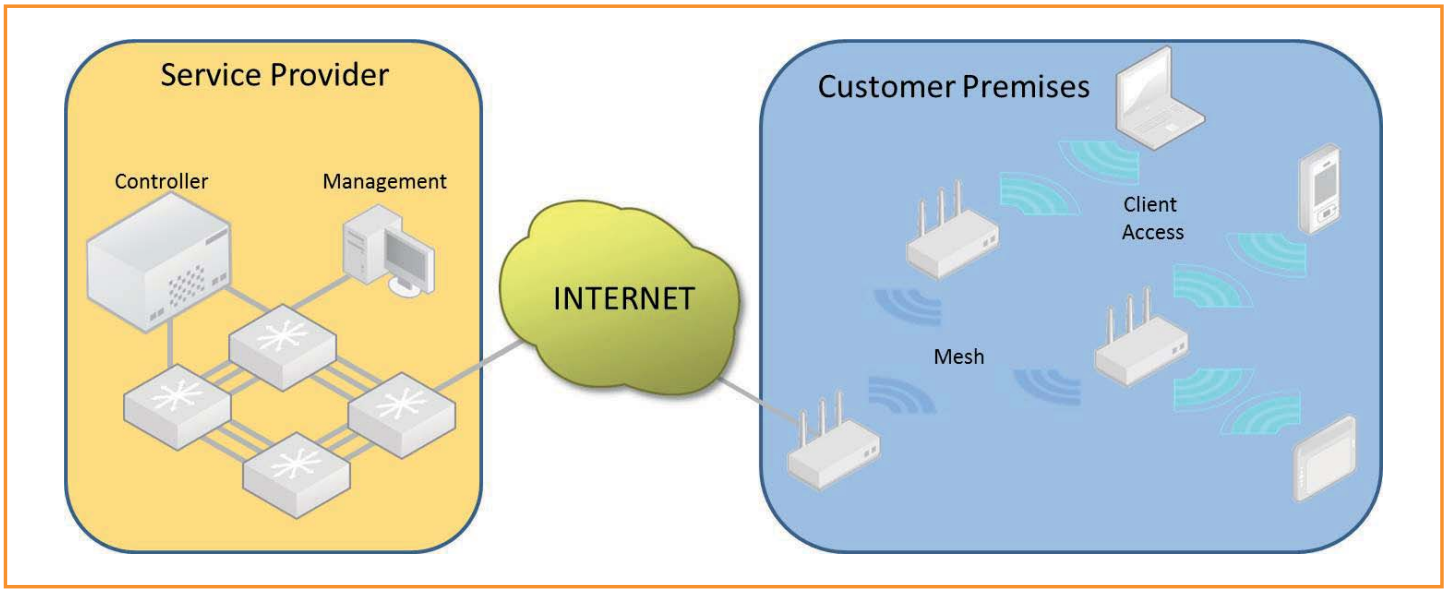
PowerCloud provides each partner a branded portal through which the end-customer manages its wireless network. Plus they are also partnered with Qualcomm/Atheros to offer PowerCloud's technology to OEM customers as part of its XSPAN reference design kit. The company is also applying the same approach to the Consumer market, selling users a consumer-grade Wi-Fi router, and giving them value added features such as parental controls and visibility into their home wireless usage, through their cloud-based portal, as a low cost subscription service.

How far they go with this approach remains to be seen, but Meraki and PowerCloud have both proved two things: First, SMBs see the value of cloud-managed WLANs and secondly, it is possible for WLAN equipment vendors to cross the line and become a form of "Service Provider" generating recurring revenues from cloud-managed WLAN infrastructure.

WLAN commoditization plays into Service Provider hands

In recent years, Enterprise WLAN vendors have all seen price erosion in APs, as many ODMs and low-cost competitors have entered the market. Yet they are heavily burdened by the advanced Enterprise features they have developed. So they are all keen to capture recurring revenue from services rather than only selling hardware. That said, it is likely most of them have missed the window, because it is Service Providers who will capture the lion's share of SMB business, and reap the recurring revenues from them.

Wireless LAN hardware is fast becoming commoditized to the point that SMBs and consumers won't think twice about choosing a few APs online, plugging them in, when they arrive in the mail, and going online to register users and client devices. Consumers already do this today for broadband access to the home, VoIP services like Vonage, and cell phone purchases. So the commoditization and pervasiveness of Wi-Fi plays right into the hands of Service Providers, who have gotten very good at dumbing it down for the consumer.



If the only CPE hardware involved is a few wireless APs, it is a small step for MNOs and wireline Service Providers to take the now proven cloud-managed wireless deployment model and apply it to SMBs.

Hence, if the only CPE hardware involved is a few wireless APs, it is a small step for Service Providers to take the now proven cloud-managed wireless deployment model and apply it to SMBs. Plus they have the financial clout to give the hardware away, and recoup the cost over the contract term in the form of services revenue – thus removing another adoption barrier for the customer.

With the increased speeds now available with 11n and 11ac, it gets even easier. Mesh backhaul has come of age, making for a really practical solution which completely eliminates the biggest barrier to rapid deployment – the need for an underlying Ethernet infrastructure when you need more than one AP at a location.

Smartphone explosion drives chronic need for data offload

These developments would seem quite trivial, were it not for another important catalyst - the global smartphone revolution. The massive demand for mobile data in Europe and the US, is congesting 3G/4G networks and MNOs can't keep up. Global mobile data requirements are growing at a CAGR of 92%, outstripping Mobile network capacity which is only growing at a CAGR of 60%.

With Asian smartphone penetration in the low 20%, due to historically high phone prices, their 3G networks have not reached saturation point, yet. However, this is about to change, as new low-cost smartphones from Samsung, LG, Huawei (now 3rd in global market share) and ZTE flood Asian markets. Plus emerging Indian smartphone vendors Karbonn, Micromaxx and Lava are ramping fast in their home market with full-featured smartphones under $200, and preparing for aggressive exports across Asia and Latin America. According to IDC, Q1 2013 saw the first quarter in which worldwide sales of smartphones outstripped feature phone, with smartphones taking 51.6% of the global mobile phone market.

The widely accepted answer to the smartphone data-load problem is proving to be Wi-Fi offload to carrier-grade Wi-Fi at public hotspots, businesses and mobile subscriber's homes. Early deployments have shown it can reduce 3G data load 50%-75%. While there are a number of alternatives to the problem, Wi-Fi is a clear winner.

The least attractive of all options is of course, licensing more spectrum, first it is extremely expensive, and second since the spectrum is a finite resource, this is a dead-end path. And gains in spectrum efficiency resulting from upgrades from 3G to 4G are only expected to yield 15-20% more capacity year-on-year, at considerable cost. What is needed is a quantum leap in data capacity.

Another alternative is to increase the radio density by deploying 3GPP small cell technology such as Femtocells and Picocells. But these are comparatively expensive, and cannot provide data capacity on the scale available with Wi-Fi. In fact to achieve the same data capacity as 802.11n using LTE Femtocells, would likely cost at least 10 times more. Plus, Wi-Fi performs better in indoor environments, and enables non-SIM devices to reach the Internet. Of course that's not the full picture, because Femtocells would also handle voice services, and Service Providers also need the increased cellular capacity afforded by small cell deployment. But clearly if scaling data capacity is the primary goal, Wi-Fi is the better choice in most cases.

A third option, which may be a good fit especially in use cases where both cellular and Wi-Fi coverage is either lacking or in need of capacity upgrades, is a combination of Femtocell or Picocell and Wi-Fi in the same Access Point device. Such a device could fulfill multiple objectives: relieving the macro cell network; providing high capacity Wi-Fi offload for smartphones and other non-SIM devices, and reducing overall CAPEX/OPEX compared with having

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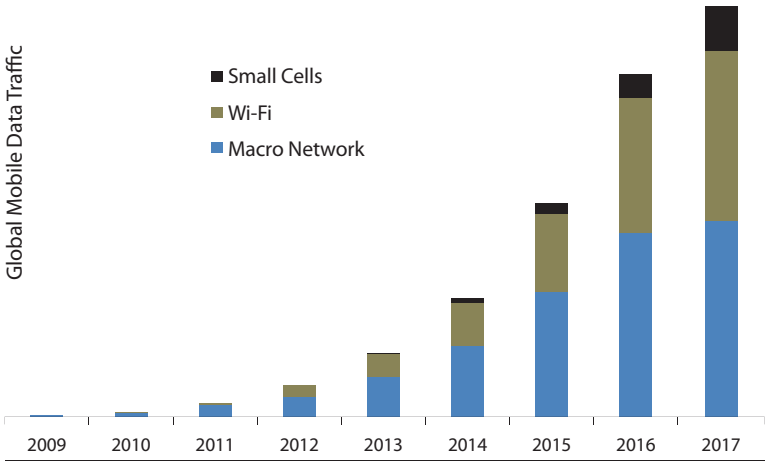

Source: Mobile Experts Carrier Wi-Fi Report 2013

two separate devices. Among others, Ruckus Wireless and SpiderCloud are two notable companies with such a product. Research firm Mobile Experts predicts by 2017, over 70% of new Enterprise and carrier-grade small cells will include Wi-Fi.

Meanwhile the industry as a whole, thanks to various standardization efforts, is on an evolutionary path to full interworking between Wi-Fi, 3G and LTE which will result in seamless Wi-Fi/3G/LTE services and full Wi-Fi network integration. These factors combined make the expansion of carrier-grade Wi-Fi networks both a safe bet, and a financially attractive option for Service Providers.

As these three trends come together (Cloud management of WLANs, commoditization of Wi-Fi hardware, and rising data offload requirements) the moons are aligned for Services Providers to begin rolling out Wireless as a Service more rapidly and on a larger scale, than ever before.

Service Provider requirements for WaaS roll-outs

Service Provider deployment of Wi-Fi hotspots in public venues is not new. There are already 2-3 million Service Provider operated Wi-Fi hotspots around the world which means the build out has been going on for quite some time. In the US and Europe many MNOs and wireline Service Providers have a Wi-Fi hotspot business unit, focused specifically on marketing Wi-Fi hotspot offerings to Hospitality, Retail and other verticals. AT&T for example, has been quite aggressive in capturing the Wi-Fi hotspot business for marquee accounts such as McDonalds, Starbucks and Hilton Hotels. It now boasts over 100K Wi-Fi hotspots in its network. BT in the UK recently built out a 1000 AP Wi-Fi network in Olympic Park to support the 2012 London Olympic Games, in addition to the 475,000 "hotspots" (better named home spots) it already had throughout Greater London mostly enabled through businesses and homes sharing their broadband connection wirelessly. Every major US service provider has some hotspots: Time Warner ~100K, Comcast ~100K, Verizon ... the list goes on. And in Europe it is the same picture: BT, Sky, Orange, Vodafone and many others all have small hotspot networks.

But now the rate and scale of deployment is accelerating. China Mobile is rumored to be planning

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1 million hotspots, KDDI in Japan plans to grow from 10K to 100K hotspots by the end of 2013. According to the Dell'Oro Group, global Wi-Fi sales to Service Providers have grown more than 100% per year since 2010, versus only 25%-35% annual growth for Enterprise sales, and this is set to continue. Asian markets accounted for over 70% of those Service Provider Wi-Fi Access Point unit shipments. Dell'Oro also predicts that by 2016, over nine million Service Provider Wi-Fi Access Points will be in operation. That would represent a ten-fold increase over 2011 levels. Based on interviews conducted with hundreds of Service Providers and wireless industry experts worldwide, the Wireless Broadband Alliance also claims global public Wi-Fi hotspot numbers are set to grow to 5.8 million by 2015.

We believe a tipping point has been reached, that will result in widespread roll outs of Wireless as a Service to SMB and Consumer markets in addition to continued public hotspot deployments. Service Providers that recognize these trends, and start to roll out Wireless LANs as a managed service stand to gain new customers, reduce subscriber churn, and recover capacity in their 3G network. But there are several questions Service Providers must address, before they are ready to roll out profitable WaaS. And those questions have a bearing on what the WLAN equipment vendors need to do if they want a piece of the action. These include the following:

1) **Simplified deployment:** How to simplify ordering, deployment and provisioning so the entire deployment is completely self-service and no truck-roll is required.

2) **Multi-vendor interoperability:** How to provision the minimum set of services to wireless APs, while maintaining maximum flexibility to change Controller and/or AP providers or mix and match equipment from different vendors as hardware prices continue to fall.

3) **Provisioning and Management:** Service Providers need scalable service provisioning tools as well as traditional FCAPS management interfaces. And subscribers need the functionality to add users and devices, and gain visibility and control of the applications and services available to them. Where will this come from and what features are required?

4) **Value-added /OTT services:** What premium services can be layered on top of the WLAN infrastructure once it is in place? For example, adding seamless Wi-Fi offload, Fixed Mobile Convergence, VoIP support, QoS and more.

Let's consider the issues in each of these areas in turn:

Simplified deployment:

Consumer and SMB WLAN deployment logistics is where the rubber meets the road. At the SMB and consumer level, one truck roll can erase half a year of profits. Although optimal coverage and capacity less of a concern than it used to be, one cannot ignore the fact that RF coverage is greatly affected by where APs are placed, and by the position and channel usage of the APs from neighboring homes and businesses.

In large Enterprise locations, successful deployment begins with a site survey and network planning. The same is somewhat true in small to medium sized locations as well. Site surveys and network planning may be practical and necessary for business-grade hotspots in hotels, malls, airports, train terminals, and stadiums but for SMBs and individual consumers, it won't pay. You can't be doing any of that, if you want a low-cost, zero-touch deployment model. It has to be much simpler and idiot-proof.

Dumbing down the configuration and provisioning of APs with online wizards, is sure to have penalties. Not least of which is sub-optimal placement of APs, resulting in sub-optimal performance. However with the higher performance now available with 11n and 11ac, what

For Service Providers to configure, manage and provision the heterogeneous access network they desire, they must use standardized protocols such as Control and Provisioning of Wireless Access Points (CAPWAP).

does it matter if the network performs at 25% or even 50% short of maximum, if it is "good enough"? Maybe it is no longer necessary to sweat over squeezing out every last Mbps of throughput, like it was with 11abg.

In very small premises under 2000 Sq Ft one 11n or 11ac AP may be sufficient, and two APs are easily deployed using simple rules of thumb for AP mounting points. But in larger premises where the need is three or more APs, optimal AP placement and channel assignment are more important considerations.

Even with automatic channel selection that takes account of channel usage detected in adjacent floors of multi-tenant buildings, or neighbors in nearby buildings, for optimal coverage within the confines of the customer's premises, there is no substitute for mapping predicted or actual RF coverage on a floor plan.

If this is the case, it begs the question: Can the process still be automated and simplified to a self-service or semi self-service solution? Or do you now need a truck roll, or at least highly skilled customer support? If sub-optimal deployment is considered "good enough", then self-service or semi self-service seems viable.

Many businesses already have a to-scale floor plan of the premises which could be uploaded, digitized and calibrated. If not, there are already in existence, several intuitive online floor plan drawing tools that customers could use to quickly draw a floor plan of their building to scale.

With a digital calibrated floor plan, a Service Provider could easily carry out automated RF simulations to evaluate and recommend the most suitable mounting points for the APs. This done, the Service Provider can give its customer a recommended installation plan, and allow them to drag and move APs to the exact position on the floor plan where they are actually mounted, which would in turn result in automatically adjusted radio profiles.

Alternatively, in the absence of a calibrated floor plan, auto RF-tuning and Spectrum analysis can do a pretty good job of reaching a stable happy medium, provided the Service Provider is willing to supply more APs than actually necessary, and apply simple rules of thumb for where to tell customers to place them. True, they will likely need to shrink the cell-size, to avoid co-channel and cross-channel interference, but small cells with more APs ultimately results in higher aggregate access capacity, so it is not all bad.

Multivendor interoperability:

For this model to work, just as WLAN management becomes a cloud service, so too the WLAN controller must move to the cloud, so that the only device at the customer premises is a low-cost thin AP. In Service Provider deployments, WLAN controllers will most likely be implemented, not as hardware, but as scalable virtualized server software.

Until now most Service Provider deployments have been single-sourced from Cisco, HP, Alcatel-Lucent, Ruckus and a few others. But as Service Providers scale up their investment in Wi-Fi, they don't want to get locked in to either the controller vendor or the AP vendor. Especially not the AP vendor, since there are now so many ODMs they can choose from.

They want a brand agnostic AP provisioning solution. But in order to perform the necessary configuration, management and provisioning functions across a heterogeneous access network, comprising controllers and APs from different vendors, Service Providers will need to use standardized protocols such as Control and Provisioning of Wireless Access Points (CAPWAP). At the very least, they will need a minimum subset of the CAPWAP RFCs implemented in both controller and APs from the chosen vendors, to enable interoperability.

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Therefore, to become the suppliers for these networks, WLAN equipment vendors and ODMs will need to strip away proprietary features, implement the minimum CAPWAP RFCs dictated by the Service Provider, and then undergo hundreds of multi-vendor interoperability and performance tests. It could be a long haul for vendors whose CAPWAP stack has morphed beyond recognition, as many have, in order to support advanced proprietary features as well as 11n features not defined in the RFCs.

ODMs may be better positioned to meet Service Provider's needs, as they are starting with a clean slate so to speak, and don't have a vested interest in proprietary protocols and years of software investment. They can simply license a CAPWAP stack from embedUR, or port their own CAPWAP from open source, and begin interoperability trials.

For Service Providers, the use of CAPWAP or a standardized subset of CAPWAP is the linchpin they need to have buying leverage to capitalize on the commoditization of WLAN Access Points, and choose APs from whomever they want, including the growing number of low-cost AP vendors and ODMs, who use reference designs from the chip vendors. Without CAPWAP, Service Providers would be limited to buying APs at inflated prices, from the vendor that sources the WLAN Controller software, and they don't want that.

Properly implemented, CAPWAP should enable any WLAN controller to perform the following functions with APs from any number of different vendors:

- AP Discovery
- Authentication
- Association
- Firmware Distribution
- Management Traffic
- Configuration

But since almost no-one has a fully RFC-compliant stack, proving it, is a matter of extensive testing.

Controller scalability will also be a major test criterion. For wireless networks on the scale they are planning, Service Providers are unlikely to want to deploy controller hardware. Rather they would much prefer virtualized controller software running on standards server equipment. This means that Access Point client software must be designed in such a way that it can seamlessly connect to the virtualized controller and still behave well in scenarios where for some reason, the connectivity comes into question. Fault tolerance and the ability to recover gracefully from communication failures is paramount when the controller function is in the cloud.

Provisioning and Management

In addition to establishing and validating a common protocol between controllers and APs, another key requirement is an automated provisioning and control platform that integrates the entire provisioning process, and device level configuration. Each step in the process should be carried out automatically, in a dynamic fashion, as new services are deployed and new devices come online. The goal is to maximize network administrator productivity and enable Service Providers to keep pace with the adds, changes, and deletes.

The service provisioning and device management interfaces must be easily integrated with the Service Provider's existing operational support systems (OSS), including integration with order ticketing, subscriber databases and CRM systems via RESTful APIs to provide true end-to-end provisioning. This is necessary, to allow an operational team to provision customers efficiently, or enable customers to order and self-provision new services, and reduce Service Provider overhead in the process. Service Providers will usually expect this management platform to come from the WLAN Controller vendor, or in some cases from a third party, adding even more variables to the interoperability challenges. Having the right management integration capabilities off-the-bat can be a big differentiator for WLAN equipment vendors.

Scalability will be a major requirement for vendors. They are used to "large network" meaning 10,000 APs not 100-500K nodes. This has huge implications for the architecture of cloud controllers and management software.

The management system likely needs to be more of a middleware platform than a management GUI which is the norm in Enterprise deployments. Service Providers have their own management front ends, and the Wi-Fi network OAM needs to fit seamlessly into the Service Providers' existing provisioning and management framework. This requires highly flexible APIs to facilitate new service provisioning, monitoring SLA assurance and assisting with capacity planning as well providing appropriate alarms, and state information to the Service Providers NOC.

Management scalability is another factor that WLAN equipment vendors must consider. They are used to "large network" meaning 10,000 APs not 100-500K nodes. This scale renders most management appliances useless, and requires that the management platform can run on a cluster of virtualized servers. All this has significant implications for the architecture of the management software.

Meanwhile, subscribers will need the basic tools to remotely view, and securely control, manage and configure only their portion of the Wi-Fi infrastructure and assets. While a lot of the complexity of WLAN configuration can be masked from subscribers - they don't need to see or even understand the inner workings of how radio profiles are controlled, or how service provisioning, security and QoS is administered - they do however, need information on what SSIDs and passwords to use, and need to be able to register users and devices, and add or move APs on demand. Plus, over time they will expect to have more control and visibility of performance and utilization. In order to support the multi-client environment of carrier Wi-Fi networks, Enterprise equipment vendors, may need to make a lot of enhancements to their management software in order to provide the isolated views and reporting for just one subscriber's portion of the network.

With real-time WLAN management being done in the Service Providers' NOC, the network management views for users can also be simplified. When everything is in order, they only need simple performance charts, user counts and application usage statistics to feel assured that they are getting what they paid for. And when something goes wrong, they just need clear instructions on what to do about it. "*Move AP#3 nearer the doorway for better performance*", or "*move the microwave near AP#5, further away from the wireless Access Point*".

More sophisticated spectrum analysis and signal fingerprinting features now available in the latest chipsets, can detect threats to the RF integrity, and give the Service Provider the necessary data with which they can rapidly provide customers with actionable instructions on how to avert downtime or improve performance.

Value-added services on top of WaaS

Unlike managed WAN services, where the Service Provider / Enterprise demarcation line is clearly defined at the network edge, where the LAN connects to the WAN CPE. With WaaS the Service Provider potentially has reach to the devices themselves. With this extended reach into the small and medium Enterprise, there are a number of lucrative value-added software services that can easily be sold into the account, without requiring any additional CPE. Since the Cisco acquisition, Meraki has already branched out in this direction, putting considerable emphasis on mobile device management.

3G/4G data offload: While data-offload may be the hidden agenda for offering WaaS to the home or small business, there is no reason why it should not be monetized as well. This is especially feasible if the Service Provider also has a large network of public hotspots that subscribers can access while away from their office or home.

WaaS gives Service Providers reach beyond the CPE, into the client devices. This makes it possible to monetize a range of value-added services, while simultaneously relieving the Mobile network with 3G/4G data offload to carrier-grade Wi-Fi infrastructure.

BT for example, lets its broadband customers share a portion of their Wi-Fi capacity to the BT subscriber community, in return for the ability to do the same, while on the road. In this way, BT has built a massive network of so called "hot-spots" that it can monetize as a service to its mobile clients, who may not be broadband clients. This frees up BT's mobile network capacity, at the cost of a bit of capacity from home and business users' broadband connections, which they probably don't even notice.

Similarly, through partnerships with WISPs and other network providers, Service Providers can offer their WaaS customers a larger roaming footprint, either for free or for a fee. And at the same time, encourage Wi-Fi offloading more of the time, which relieves the Mobile network even more.

Fixed mobile convergence: This is an easy sell to the end-customer: "save your cell minutes and get better phone coverage indoors". All this needs is an agent / client software on the client smartphone device to provide session continuity between fixed broadband and the cellular network, and SIP software on the gateway CPE to tunnel VoWi-Fi traffic back to the mobile core.

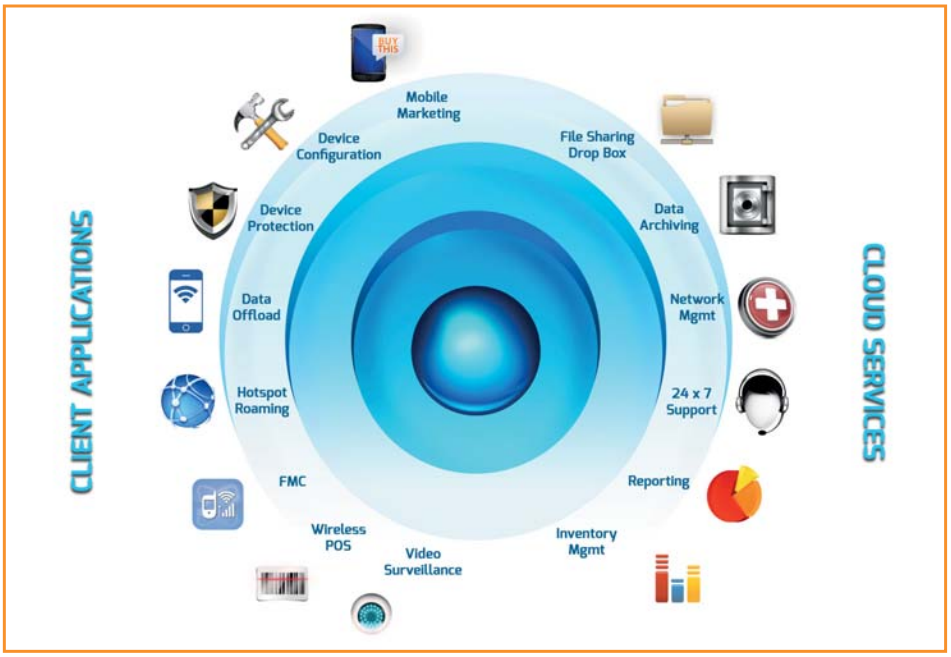
Roaming Fees: Since Wi-Fi works the same way in nearly every country, operators can host other operators' customers on their network and generate roaming fees. While traditional wire-line providers can enter the mobile market by offering Wi-Fi to its own customers, as well as those of mobile operators for generation of roaming fees. Boingo, iPass and a few other global roaming providers have developed healthy subscription businesses offering just such Wi-Fi roaming services for worldwide travelers, by forming revenue-sharing partnerships with Service Providers who own the hotspots. However, these solutions depend on a mobile Wi-Fi client from the providers on each device. The result is far different from seamless roaming that one experiences on cellular networks.

To improve the hotspot roaming experience, more than 50 companies are involved in the Next Generation Hotspot (NGH) Program, an initiative to develop new certifications and standards for public hotspot discovery, authentication, roaming and 3G/4G data offload. A new Wi-Fi Alliance certification called Wi-Fi CERTIFIED Passpoint covers the areas of automatic hotspot discovery and selection, new account provisioning and automatic device authentication, using SIM-based and non-SIM methods to cater for different types of devices. The authentication methods being tested include EAP-TLS, EAP-TTLS, EAP-SIM and EAP-AKA.

Mobile device management (MDM): With Wi-Fi access for all clients in the network, Service Provider could offer highly valued device security, backup and disaster recovery all managed through a unified cloud service, and leveraging the end-to-end infrastructure. This could be extremely profitable, since enterprises willing to pay for MDM today, are paying in the order of $5.00-7.50 per month per client, over and above server licenses and setup fees. A recent poll on enterprisemobilehub.com indicates enterprises are 60-70% in favor of MDM as a cloud service, rather than doing it themselves.

Much, much more: From enabling remote loading of applications to all devices, to providing cloud-based "drop box" and file sharing resources. Cloud-based management of wireless networks and the devices using those networks opens up Pandora's box in terms of add-on services.

By partnering with embedUR you can augment your software teams with unique wireless and mobile embedded software skills, to help you design, develop, test and certify your products, so you can get to market faster.



How can embedUR help Service Providers and equipment vendors?

Whether you are a Service Provider, a WLAN equipment vendor or an access equipment vendor, the race is on to pull together the complete framework of components to deliver Wireless as a Service and enable follow-on value added cloud services to be sold into small and medium sized businesses around the globe. embedUR has the resources and unique expertise in Wireless LANs, access CPE, mobile device integration and Wi-Fi Alliance certification to help you accelerate time to market and join the early leaders in this market in generating high-profit subscription revenues from offering Wireless as a Service to SMB and consumers.

Over the last decade, embedUR has undertaken more than 75 major wireless projects for many of the leading companies in the Enterprise WLAN market, developing everything from WLAN Controllers, wireless enabled routers and cable modems, Access Points and CAPWAP stacks, to providing sustaining engineering on existing Wireless LAN product lines and carrying out pre-certification testing on a variety of Wi-Fi enabled devices.

We have also undertaken a wide range of mobile application projects, including mobile cloud storage, mobile device management and mobile multimedia integration within the Internet Multimedia Subsystem (IMS) framework. We also have extensive unified communications expertise, having developed numerous access and communications products from Fixed Mobile Convergence gateways to SIP-enabled cable modems.
As embedded software experts with a networking and telecom focus, we are a non-competing resource you can rely on to augment your software teams with unique wireless and mobile embedded software skills, to help you design, develop, test and certify your products, so you can get to market faster.