Using NFV to Enable a
Managed WLAN Service Offering

Network Functions Virtualization is a concept that is sweeping through the service provider industry and its central tenant involves the decoupling of the application from the underlying proprietary hardware. This decoupling is accomplished using hypervisor technology, which enables these applications to run on commodity x86 blade servers. The advantages of this approach include much faster time-to-market, lower hardware cost, greater service agility, simplified network operations, and the list goes on. This technology has already penetrated many mission critical parts of service provider networks and is now starting to make its way into WLANs.

Within the WLAN domain, the real need for NFV is in managed services. This is emerging as a major opportunity for service providers of all types and in all geographies. It takes advantage of a desire by SMBs, enterprises, and public venues to purchase a managed WLAN services. These businesses are all being overwhelmed with data traffic from smartphones, laptops and tablets. They are looking to SPs to provide a managed service to offload already overburdened IT organizations. They are also looking to SPs to enable these networks with value added services like location-based technology.

For the SP there are all sorts of advantages that come with getting into the managed services business and these are as follows:

- The customer will pay a monthly fee to have the managed service provider deploy and manage the network. This addresses the question of how to directly monetize Wi-Fi

- It enables the offload of already overloaded cellular networks

- It allows the SP to pull-through a variety of other related services, including broadband backhaul, LTE small cells, etc.

- Wi-Fi is mission critical to most businesses and venues, and this enables the SP to position itself as a strategic vendor

- There is sustainable competitive advantage that comes from deploying plant within a customer's facility

The latter is a hugely important issue as the great challenge for service providers over the remainder of the decade is how to cost effectively build-out indoor plant. Data is mainly an indoor phenomenon that is best addressed by putting radios really close to the users.

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A major industry trend in the coming years will be for service providers to concentrate on indoor network builds, and of course indoor site acquisition.

Indoor network build-outs bring with them a whole host of issues, many of which can be addressed with WLAN technology. Easily the greatest challenge with indoor footprint is site acquisition. Service providers will need permission from the venue owner to deploy infrastructure in their facility. This permission is more likely to be forthcoming if the operator focuses on mission critical services for the venue. Wi-Fi is just such a service, and many venues are looking to operators for a managed service.

One of the challenges with the managed WLAN services is that the SP must move quickly as venues only need one network. In fact most will not allow a second WLAN network. This has created a land grab at the most desirable venues, and when a venue is lost it is often difficult to recover. Another challenge with managed WLAN services is in deciding on which vertical markets to pursue. There are many options here with hospitality usually being at the top of the list. Hospitality has long been a favorite market because most people choose a hotel based largely on the quality of the Wi-Fi network. This causes the venue to put a premium on that part of the business, which means they will pay for a high-quality managed service. In some cases hotels offer Wi-Fi for "free" to guests and in other case they charge, but either way, they need a high quality offering. Other very compelling vertical markets include small and medium business, education, transportation, health care, and convention centers. The business models will vary depending on the venue type (or vertical market).

The Indoor Ecosystem

As service providers begin to look indoors, it is important to look at the indoor ecosystem, which consists of the venue, the user, and the operator. The needs of all three must be considered when plotting an indoor strategy.
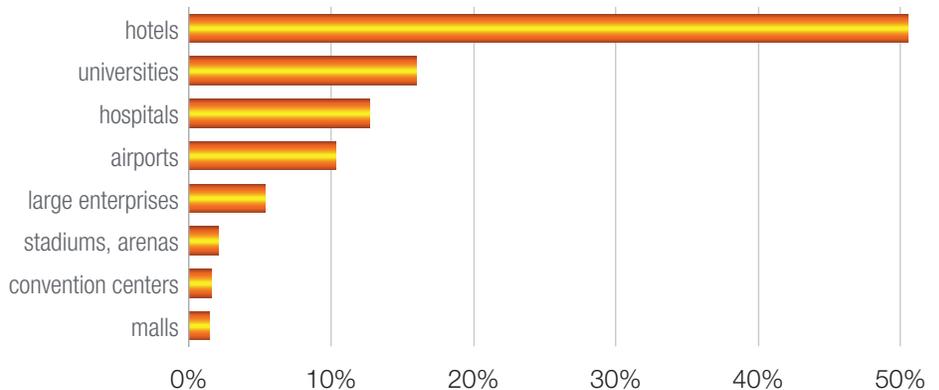
Needs of the Venue

Any indoor deployment will require the support of the venue (or enterprise). Venues view Wi-Fi as mission critical as it plays a major role in attracting people to their facility. They are also interested in managed WLAN services to offload overburdened IT organizations. Their requirements include:

FIGURE 1: Data Generated by Venue Type

Carrier Wi-Fi Deployment Illustration: 93 US Markets
% of total public-use capacity contracted by venue class

- A neutral host solution like Wi-Fi or DAS (distributed antenna system) that can support the needs of everyone who enters the venue and not just the subscribers of a specific operator

- Support for all device types (laptops, tablets, smartphones, digital cameras, etc.).

- High-capacity density for optimal user experience, along with public and private SSIDs.

Needs of the End User

- The Facebook Generation needs to be connected to the Internet at all times, and everyone else most of the time.

- Ideally connected by the least expensive (usually free) and highest speed Internet access possible.

- Business class users are less cost sensitive

- Most people expect Internet access to be an amenity at a major venue.

Needs of the Service Provider

- Must accelerate the build-out of indoor footprint, which may involve a very significant investment

- Challenges including site acquisition, equipment cost, deployment cost, network management, as well as dealing with a wide variety of business models for the different venue types (vertical markets).

- Provide a high quality user experience, which means controlling interference and this applies regardless of the RF technology used. With Wi-Fi, great success can be achieved by deploying carrier class equipment and by having the venue limit the deployment of equipment in their facility that uses the unlicensed bands.

- A Wi-Fi deployment within a venue will pave the way for the WAN backhaul business along with LTE small cell equipment at a later date, as it mitigates the neutral host problem.

Indoor Wi-Fi Deployments Must Still be Carrier Class

A managed WLAN service will still require carrier class equipment. The following are just some of the capabilities that make an offering carrier-class:

Advanced RF technologies: This includes support for adaptive antenna technologies, polarization diversity, automatic channel selection, airtime fairness, QoS, and much more. Of these different capabilities, adaptive antennas will have the greatest impact on the user experience in high-capacity density venues. It is important to note that **adaptive antenna technology is very different from transmit beamforming (TxB)**. For more see Ruckus Blog on adaptive antenna technology.

Faster wireless for gigabit speeds: This is now possible with 802.11ac, which enables connectivity at speeds above 1 Gbps by using channel bonding, advanced modulation techniques, and MIMO antennas. 802.11ac only operates in the unlicensed 5GHz band.

Seamless and secure roaming (Hotspot 2.0): This enables the user to roam automatically on "visited" Wi-Fi networks that could be across the street, across town, or on the other side of the world. The stage is now set for huge roaming consortiums to form with tens of thousands of partners (many of them venues) and millions of APs. This would enable near ubiquitous connectivity that is automatic and secure. HS2.0 also encrypts the airlink for maximum security.

Network selection policy (HS2.0 / ANDSF): This is a very popular topic with service providers as it involves the download of a policy to the device to help it select the right network when faced with multiple connectivity options. HS2.0 policy is appropriate when a non-SIM credential is being used, and ANDSF policy is appropriate when a SIM credential is being used. Policy is different from real-time load balancing, and is meant to be largely static and only changing when the users situation changes.

**Seamless Wi-Fi to Wi-Fi handoff**: This is being addressed with IEEE 802.11r and 802.11k. These protocols enable seamless handoff as the device moves about in a coverage area. Mobile devices must adopt these protocols to avoid the scenario where they stay attached to the AP that authenticated them, even as the user moves out of range.

Seamless Wi-Fi to Cellular handoff: This is being addressed in a number of ways including network-based approaches that involve 3GPP SaMOG technology or with client-based approaches like multi-link TCP. Most applications do not care if their point of attachment changes, but the ones that do are important (voice and video).

Making an Indoor Deployment Work Financially

Wi-Fi has the advantage of being the most cost effective way of adding network capacity regardless of who is doing the deployment. Wi-Fi excels when the objective is kbps per capex dollar spent. Macro cells will be the most cost effective option when looking at square meters covered per capex dollar spent. Small cell have the advantage of being reasonably cost effective for both coverage and capacity, and will be a key part of the equation.

FIGURE 2: Portfolio of RAN options
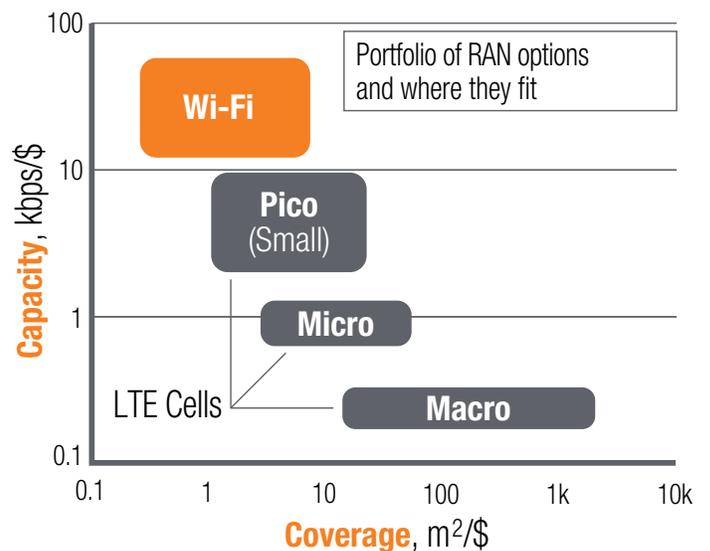
Source: Joint Ruckus and MNOs Analysis

One common misconception about Wi-Fi is that because it operates in the unlicensed band that the quality of the service will suffer and this is not true, especially when operating indoors. Many indoor public venues have come to regard the unlicensed bands as a critical business asset that must be protected at all costs, especially in an industry like hospitality where people pick

hotels based mainly on the quality of the Wi-Fi. In these and other venues the IT organization will watch over the unlicensed bands. They will take action to eliminate rogue access points and make sure that proper shielding is used with any other equipment that uses these bands.

These kinds of policies can greatly limit the effects of RF interference by limiting competing networks.

Bottom line: the venue often has a certain amount of control over the unlicensed bands by limiting what gets deployed in their building. Their control is not complete, as a user can turn their iPhone into a hotspot, but with the disappearance of unlimited data plans that is a very expensive option.

Wi-Fi As A Service

While anyone can deploy Wi-Fi, there is a strong desire on the part of many businesses and public venues to outsource this to a service provider. The key to enabling a profitable managed service offering is to bring all backend systems (WLAN control, management, authentication, and value added services) to a centralized data center and then moving it all into the cloud. Only Wi-Fi access points need to be deployed on the customer's premises, and that task can usually be turned over to a partners

The key enabling technology in cloud architectures is Network Functions Virtualization (NFV). The key tenant of which is to decouple applications from the underlying hardware so that they can run on commodity x86 blade servers. This approach offers a wide variety of advantages including:

- Very rapid time-to-market for new applications
- Ability to quickly turn-up service for new customers
- Utilization of commodity x86 blade servers instead of expensive proprietary hardware
- More efficient use of hardware through hypervisor technology
- Lower costs for power and cooling
- Greatly simplified network operations as new instance of a WLAN application can quickly be spun up on a virtual machine
- Ability to keep scaling by adding more x86 blade servers
- High application availability
- And much more

Network Functions Virtualization is key to a successful managed service offering as it plays a major role in driving down the cost of a deployment while at the same time accelerating the process of bringing up new customers. NFV and managed services are a perfect combination.

Figure 3 shows a framework for NFV where applications (with their OS) run on virtual machines created by a hypervisor that in-turn runs on the underlying x86 blade servers. This technology can be used to support a variety of processor intensive functions like WLAN control, location based service, and analytics and reporting.

FIGURE 3: Framework for NFV
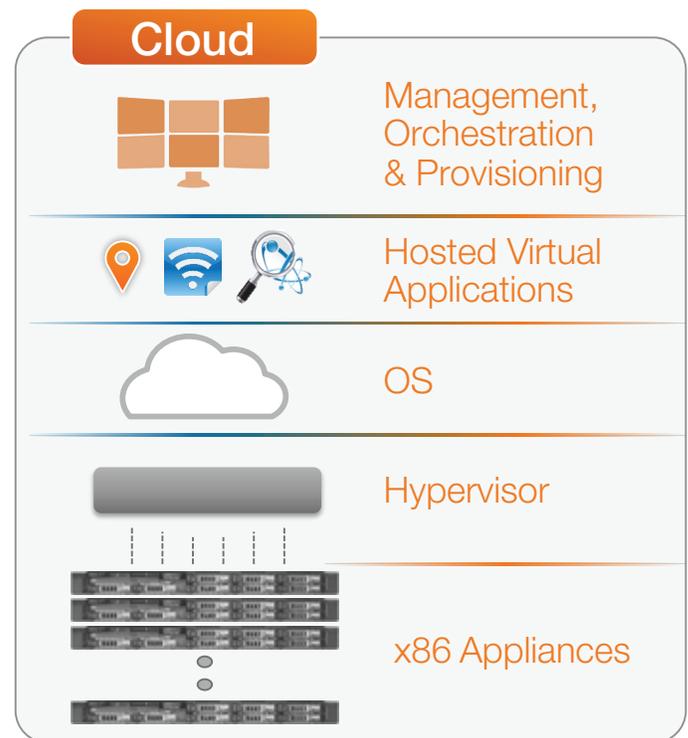
The key to a successful managed service offering is that all backend systems must run in the SP's cloud in their data center, under their control, and subject to their SLAs.

Value Added Services

Alt is recommended that operators initially focus on those venues that need high-capacity density. The business models that work for the different venue types will tend to vary, but they all have a strong need for more capacity. Operator will need to target their business proposition and service set for the different venue types.

One of the most compelling value added services that an operator can provide is indoor location technology. This is a really significant opportunity for the operator that is best done with Wi-Fi technology. It works by having Wi-Fi APs triangulate on the probe requests coming from ANY Wi-Fi device that is turned on in the coverage area. The devices don't need to associate with

FIGURE 4: The Enormous Potential of Indoor Location Services

- Analytics
- Time based footfall heat-map
- Targeted promotion
- Real-time based mapping & tracking
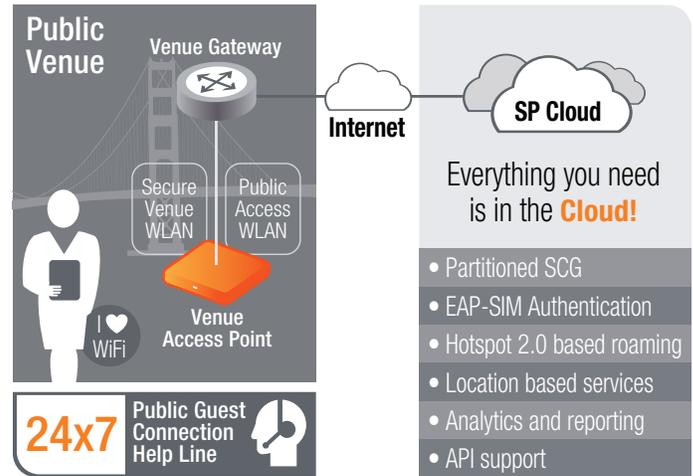- Compelling loyalty programs
- Outdoor GPS integration

the network they just need to send out probe requests. This technology works really well indoors, whereas GPS is very much an outdoor technology.

There is almost no end to the interesting services that can be enabled with indoor location technology. It can be used to:

- Generate time-based heat maps that show where the crowd is at any point in time.
- Show time-based footfall, in other words, how users move through a venue.
- Give the user a map of the surrounding area, and show where they are in relation to where they want to be.
- Create loyalty programs by automatically notifying the venue when a valued customer has entered the building.

There are also a wide variety of 3rd party companies that have developed specialized applications for different venue types that harness this location information. This is just one of many profitable services that an operator can add to a managed WLAN service offering.

FIGURE 5: The Miracle of Managed WLAN Services

Public Venue — Venue Gateway — Secure Venue WLAN — Public Access WLAN — Venue Access Point — WiFi — Internet — SP Cloud

Everything you need is in the **Cloud!**

- Partitioned SCG
- EAP-SIM Authentication
- Hotspot 2.0 based roaming
- Location based services
- Analytics and reporting
- API support

24x7 Public Guest Connection Help Line

Conclusions

A managed WLAN offering provides many opportunities for service providers to grow their business with enterprises and public venues of all types. In addition to managed WLAN connectivity, there is also a big opportunity in providing indoor location services. Wi-Fi also serves as a great entry point for service providers as they tackle the indoor site acquisition challenge in high-capacity density locations.

The opportunity is there for service providers to become strategic suppliers to the most desirable venues, while at the same time setting the stage for future deployments (e.g. LTE small cells).

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