Ruckus
Simply Better Wireless.

white paper

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Carrier-Class Wi-Fi

ALL THE ELEMENTS ARE THERE FOR A ROBUST SERVICE OFFERING

Introduction

Service providers of all types are rapidly embracing Wi-Fi as an essential part of their wireless portfolio. Wi-Fi offers many compelling advantages including access to as much as 700 MHz of spectrum, availability on all data-centric devices, low cost, ease of installation, neutral host capable, and the list goes on. While this all sounds compelling, the technology must also be carrier-class.

The term 'carrier-class Wi-Fi' gets used a lot, but what does it actually mean?

What are the requirements of a carrier-class deployment and what do users and carriers expect from such an offering?

Wi-Fi didn't actually start out as a carrier-class technology. Its genesis was as a consumer and business class technology, but it has undergone a major transformation over the past few years that have allowed it to emerge as a cornerstone technology in the mobile Internet. Wi-Fi now carries the vast majority of all smartphone traffic worldwide. So what were the key elements of this transformation?

Network Architecture

To build carrier-class Wi-Fi networks the underlying technology must be self-organizing and self-optimizing. This means that even the largest networks can be quickly deployed without a lot of technical expertise. It also means that these easy-to-install networks can deliver a very compelling and consistent user experience, and the latter is at the cornerstone of what it means to be carrier-class. To deliver high-performance some of the time just isn't enough, it must be high-performance all of the time.

The key to a compelling and consistent user experience is to be able to deliver a strong signal to the user's device in almost any situation and regardless of any RF interference. To do this consistently requires very sophisticated antenna technology. Many techniques have been tried, but none have proven to be as effective as adaptive antennas.

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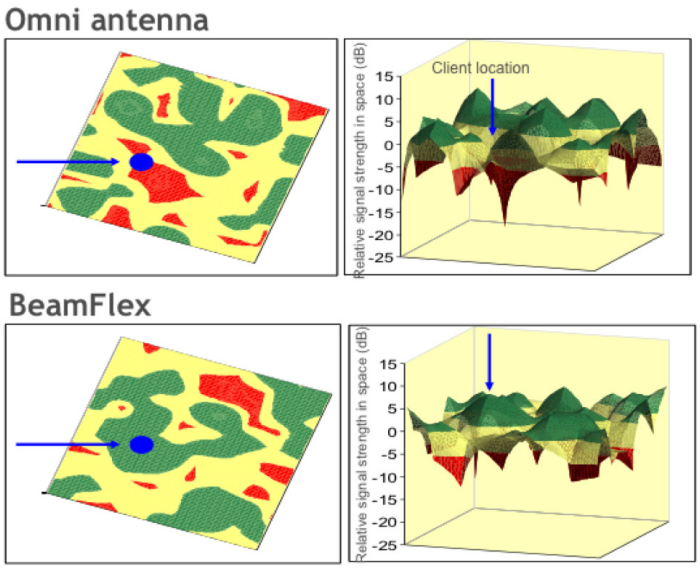
Adaptive antenna technology

Uses dynamically adjustable antenna patterns to guarantee that each user gets the strongest possible signal while also minimizing interference. This is all automatic and it optimizes the experience for each and every packet that is transmitted. Adaptive antennas are different from, but complementary to, chip-based Transmit Beamforming (TxB).

Automatic channel selection

Allows each AP in the network to select the optimum Wi-Fi channel for its situation and automatically change channels as circumstance dictate. This is accomplished by having Wi-Fi access points change channels on a regular basis to test airlink performance and then move to that channel if it will enhance the user experience. Automatic self-organizing channel selection is key to a carrier-class deployment as it ensures maximum throughput at the network level even in the face of RF interference.

Figure 1: BeamFlex Adaptive Antenna Technology uses Dynamically Adjustable Antenna Patterns to Control the Effects of Multipath so as to Create Signal Peaks at the User's Location.



Getting Easily and Securely Connected

The process of getting connected to Wi-Fi networks has always required a bit too much user intervention. The industry has been hard at work for close to a decade on a greatly improved approach that automates the entire process. This program is known as Hotspot 2.0 and is rapidly emerging as an essential part of any carrier-class deployment. It allows a user to get automatically connected to a Wi-Fi access point while on the move by looking for networks that the mobile device can roam with and then connecting using a variety of EAP based authentication methods (we are using the cellular definition of roaming). It also mandates the use of airlink encryption, which protects the user's data when accessing the Internet from a public hotspot. This combination ensures carrier-class security when accessing Wi-Fi networks. Hotspot 2.0 also makes it easy for service providers to use roaming relationships to weave together disparate 'islands' of connectivity into a single ubiquitous service offering that is transparent to the end user.

Staying Connected With Radio Resource Management

This refers to a host of capabilities that are required to help guarantee a compelling experience once the user gets connected to the network.

- **Airtime Fairness** is focused on making sure that all users are given equal time on the airlink regardless of the speed at which they are transmitting. Without this feature older and slower devices can dominate the airlink.
- **Network Load Balancing** allows users to be moved onto access points that have capacity instead of selecting the access point with the strongest signal (the default). This also addresses the 'sticky device problem' where a mobile device clings to an AP even though it no longer provides the best signal.
- **Fast Handoff** emulates a wonderful feature of cellular networks, which is the ability to rapidly handoff a user as they move from AP to AP in the coverage areas. There is no need to re-authenticate since their credentials follow them as they move. This is an especially useful feature when using Wi-Fi Calling while on the move.
- **Quality of Service** is a big part of any carrier class deployment and it will get a lot more important with the arrival of IR-92 based Wi-Fi Calling. This approach tunnels an LTE voice stack over Wi-Fi using an IPsec tunnel. A carrier-class deployment must be able to prioritize those flows using type-of-service (TOS) bits in the IP header or heuristics. In the latter case voice flows can be detected by looking at the size and frequency of packets (this works even if the packets are encrypted).
- **Capacity Based Admission Control** is designed to block new users from associating when there isn't enough network capacity to support them. This is especially important with voice applications that must have access to the airlink in a timely fashion in order to function properly.

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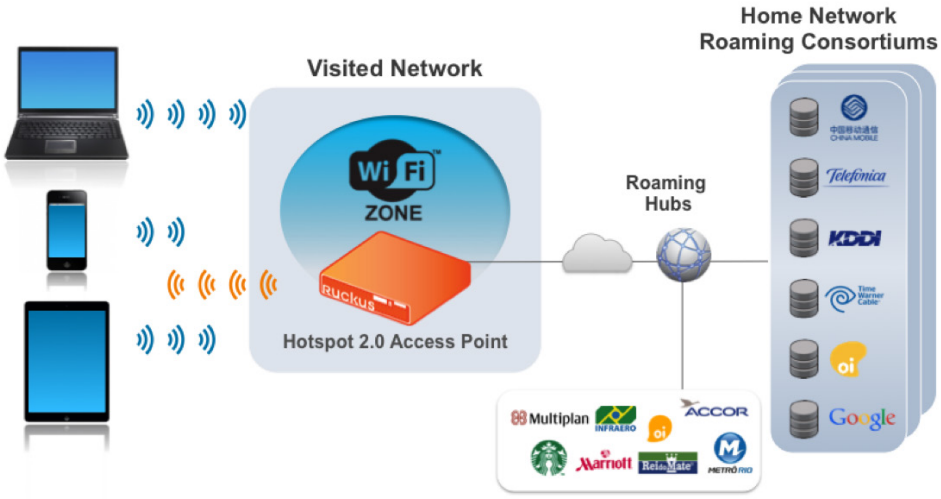
Figure 2: Hotspot 2.0 Enables Automatic and Secure Wi-Fi Roaming



Management, Operations, and Policy

The following are critically important from a network operations perspective:

Airlink performance testing

Is a very useful capability that comes with the deployment of adaptive antenna technology. As part of the process of picking the optimum antenna pattern, the AP measures effective throughput for each possible antenna pattern for each and every user.

Network statistics

Are generated on a massive scale in large networks. This information needs to be uploaded to a highly scalable analytics and reporting tool that can archive data for many years and generate a wide variety of reports.

Figure 3: Very Scalable Network Reporting and Analytics Tools Are Essential in Managing A Large Scale Deployment

Network selection policy

includes a set of rules given to the mobile device to help with the network selection process. This includes which Wi-Fi network to connect to when there is more than one option. This has been addressed in Hotspot 2.0 Release 2.

Moving Backend Systems into the Cloud

Carrier class Wi-Fi networks must be able to easily scale up into the hundreds of thousands of access points. The key element here is a WLAN management platform that has the needed scalability (at least 10,000 access points). Ideally these platforms should be virtualized so that it is easy to spin up new WLAN controller instances to support almost unlimited scaling. These systems must also be able to provide multi-tenant services to enable a profitable and scalable managed WLAN services offering.

Anytime a single element handles the management of a large number of access points, resiliency becomes an issue. These platforms must be able to quickly failover in any sort of a network fault scenario. **See figure 4 on next page.**

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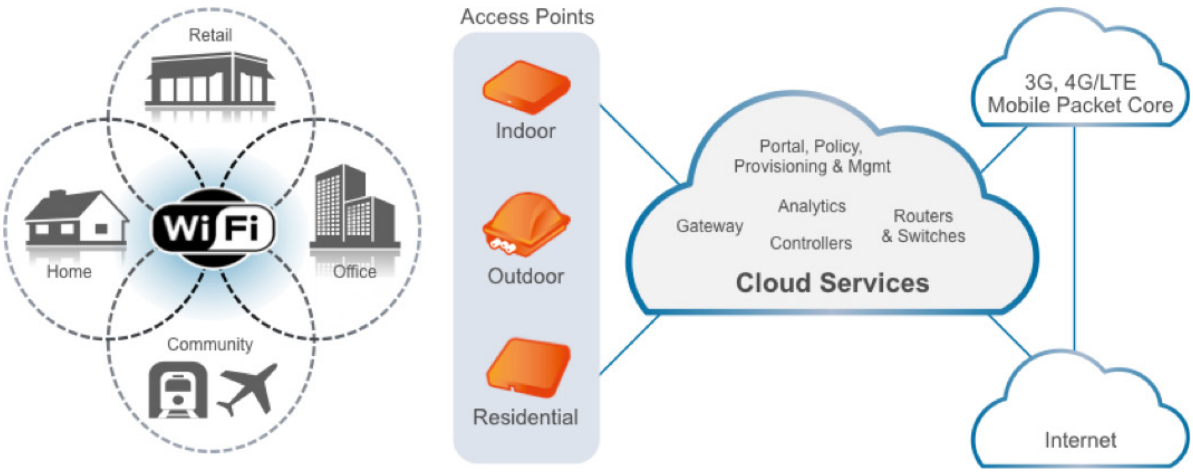
Figure 4: Cloud Architectures can be used to Support all Backend Systems Including WLAN Management, Location Services, and Analytics and Reporting.



Monetization

The more carrier-class a deployment is, the greater the opportunity to monetize because the user experience will be something that people would actually want to pay for. Monetization can occur in many different ways.

It can be used to strengthen the existing 3G/4G service by increasing the opportunity for users to get connected to the Internet at broadband speeds, and from more locations. A stronger service bundle provides greater competitive differentiation and this supports higher prices.

One Wi-Fi service that can be directly monetized is location. This is especially compelling for indoor applications, where GPS will not work. Wi-Fi access points triangulate in on the probe requests coming from any Wi-Fi device that is powered on in the coverage area. This information would then be sent to a cloud-based location application that can enable a host of services including location-based ad insertion, footfall analysis, navigation, etc.

Managed WLAN services are another great opportunity for service providers, and by building out a service with carrier-class equipment the service provider can offer a much more compelling option to the customer.

Conclusions

All Wi-Fi is not created equal, and when focusing on a carrier-class deployment it's important to start with carrier-class equipment. The key elements include making sure the user can pickup a strong signal from anywhere in the coverage area, get easily and securely connected to that signal, stay connected as circumstances change, and make sure it can all be managed at scale.

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