Wireless Best Practices

by S. Bradley Noblet

A PRACTICAL GUIDE FOR SMALL/MEDIUM BUSINESSES DESIGNING AND IMPLEMENTING MISSION-CRITICAL WIRELESS LANS

ABOUT THE AUTHOR

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Introduction

Mobility, one of the most important social and technological movements in the past decade, has permeated all aspects of our lives. A key enabler of the movement, Wi-Fi is fast becoming the de-facto "on ramp" technology to our global communications networks. Many large enterprises have already begun architecting or building out enterprise-wide Wireless LAN (WLAN) infrastructures, but Wi-Fi adoption among small-medium businesses (SMBs) remains ad-hoc and isolated.

The cost and complexity of installing and maintaining a mission-critical WLAN can be daunting for the budget conscious, resource limited SMB. While setting up a standalone Wi-Fi access point (AP) is deceptively simple, building a mission-critical IT infrastructure out of these APs can be a whole different story. The Ruckus ZoneFlex multimedia WLAN system is designed to address the unique requirements of the SMBs.

This "Best Practices" guide contains insights and lessons learned from previous deployment experience to help maximize your success in designing and implementing a mission-critical WLAN. Also includes are guidelines for planning, designing, installing and operating a successful Ruckus ZoneFlex WLAN.

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Start with a Vision for Wireless

Before you start tacking up APs, it's a good idea to think about the purpose of the WLAN in your environment. Who are you serving? What will they do over the WLAN? Will it be just a convenience or will it become the primary service delivery system for network access? Understanding how the WLAN might be used today and tomorrow can affect how you plan, design and fund your deployment.

Funding Justification

Wireless has been, and still is, viewed as a luxury by many corporate financial planners. As such, the ROI for wireless is often ill defined. The fact is, for the new breed of mobile devices such as the Blackberry, Skype phones, dual-mode handsets, portable screen projectors and the ubiquitous laptop, the primary means of network connectivity is Wi-Fi. Additionally, as more people use Wi-Fi at home, they will become increasingly dissatisfied if wireless is not ubiquitous or even available in the workplace.

Consider also the following justifications as they may apply to your environment:

Moves, Adds and Changes — Reduce Cost; Minimize Disruption

In an office, hotel, airport or school campus where moves, adds and changes are disruptive to daily business operation, a WLAN can greatly mitigate the disturbance. With a ubiquitous WLAN on site, IT service need not be terminated and then restored. Pressure on the IT staff is alleviated while user inconvenience is minimized.

WLAN can also dramatically reduce the cost of relocating an IT infrastructure. The cost of rewiring a building can be as high as $3 per square foot or more. A WLAN infrastructure over the same space could be deployed at a fraction of the cost. Moreover, the time it takes to implement a WLAN, particularly with systems such as the Ruckus ZoneFlex, is but a mere fraction of the time it would take to rewire.

Serving a Mobile Society — Same Convenience; Lower Cost

The convenience of cellular is quickly reducing the desktop phone to a boat anchor at the expense of increased air-time and international roaming charges. With the availability of dual-mode phones and fixed-mobile convergence (FMC) services, SMBs can now realize substantial savings by implementing VoIP over Wi-Fi and still give employees the convenience of a single handset for mobile and fixed-line voice services. In specific verticals such as healthcare, hospitality and transportation hubs, Wi-Fi can also replace legacy two way radio systems with higher quality, full duplex communications while eliminating the cost of operating an additional infrastructure and associated devices.

Enabling New Media Services

The availability of video handsets, multimedia laptops and high-quality portable cameras is enabling organizations to easily implement TV-quality video applications. Deploying a video-capable WLAN day one will obviate future expenses associated with equipping a dedicated media facility or a separate video delivery infrastructure.

TABLE 1

VIDEO APPLICATIONS FOR VARIOUS VERTICAL BUSINESSES

Vertical business	Video applications
School/conference center	Smart classroom
Retail and transportation	Surveillance, ad insertion
Business office	Video conferencing, surveillance
Hotspots	Mobile IPTV, mobile gaming
Hotels, dormitories	IP-based TV and VoD, surveillance

Extending Hotspot Coverage and Improving Service Quality

Proliferation of mobile devices with built-in Wi-Fi is spurring an increase in hotspot usage. Hotspot operators need to expand coverage and increase capacity to support the growth in user density and bandwidth consumption. Offering tiered services based on wireless bandwidth can boost revenue and ensure the best experience for premium customers.

Planning considerations

With a vision and funding, you are ready to start planning the WLAN deployment. It is critical to understand and validate the WLAN requirements in detail. To insure you're delivering the highest quality WLAN experience, it's a good practice to map out the following:

Who and where is the potential wireless population to be served?

What is the size of your user population? Where are they located? How and when are they likely to use wireless? Knowing as much as possible about your wireless users will help you synthesize design requirements for access, performance and the scale of your WLAN infrastructure. What services will the WLAN support?

Will wireless be an overlay to the existing wired network or will it be the primary network?

If the WLAN is mission-critical, you will need to factor in the requirements for fault tolerance, load management, and a comfortable performance margin. Keep in mind that with a reliable wireless service, you may find your user population rapidly adopting it as their primary service vehicle. Will it be ready?

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To assess performance requirements, it is important to determine the applications and services that may be used over the WLAN. Will you support applications with real-time, latency sensitive traffic such as video and voice? Real-time services demand guaranteed delivery times; furthermore, video can consume a great deal of bandwidth. You must determine the extent to which your population will use these services, during what times and in what geographic locations.

Will you serve outdoor spaces as well as indoor?

Deploying outdoor Wi-Fi requires additional considerations including the WLAN's proximity to the wired network, topography and the potential AP locations/mounting options. Outdoor WLAN equipment is expensive and deployment requires personnel with RF expertise.

Experience has shown that many buildings enclose outdoor areas of interest, making it possible to serve an outdoor space from an indoor window. This can greatly reduce the cost and complexity of providing outside coverage.

What is your security policy?

Security can be a mixed bag. Everyone wants it but many are not willing to tolerate the overhead it imposes on access or IT administration. You must determine the trade off that your organization is willing to make. Most likely, some form of network access control will be required. Standards such as 802.1x enable per user access control of wireless users through external authentication servers such as RADIUS or Active Directory (AD). Guest access is a desirable service, giving temporary and limited authorization to select users whose access time is bounded. Typically a captive portal is used as a convenient, web based front end to provide guest credentials.

More often than not, access control is not enough. Some form of encryption "over the air" is desired to insure the integrity and privacy of the wireless content. Again, Wi-Fi link layer encryption can provide the answer through standards such as WPA and WPA2, depending on the desired strength. These encryption methods require a pre-shared key to be given out to each WLAN client. Key administration is an overhead that needs to be factored into the ongoing operational cost of the WLAN.

Have you really looked into the future?

Don't underestimate the user appetite for wireless. If your coverage is not ubiquitous on day one, at least spend time up front to verify that your WLAN design is scalable to provide ubiquitous access when the need arises.

Multimedia support may not be a current concern. However, applications and devices are converging. It is just a matter of time that the network will be tasked to support converged services — video, audio, graphics, interactivity, etc. Fortunately, 802.11ac, a new Wi-Fi standard for delivering several times the capacity of current 802.11n is available in business class 802.11ac products. Nevertheless, a solid QoS implementation is always a necessary insurance that the network can support diverse traffic types, applications, devices and users.

Personnel considerations

With every new technology comes the requirement for skilled resources to plan, design, install and maintain that technology. Wireless is no different in that regard. Choosing a WLAN offering whose features and support minimize the need for additional skilled personnel could be a top priority for SMBs.

WLAN design

With the detailed requirements in hand, you can now design a WLAN that meets your capacity, coverage and performance goals today with a path for expansion whenever the business demand arises.

Determining the required capacity

In general, a typical wireless user consumes no more than 250Kbps bandwidth on average. Here are some typical service rates:

TABLE 2

SAMPLE BANDWIDTH RATES

Network Need	Sustained Data Rate
Casual Data	1 Mbps
Mission Critical Data	10 Mbps
Voice/Video	20 Mbps

Voice doesn't take much bandwidth but it requires guaranteed bandwidth. Video on the other hand will create a major impact on bandwidth consumption. Surveillance video requires less bandwidth as frame rates and resolution are typically much lower. However, low cost surveillance cameras do not have the latest compression technology so the bandwidth required is not insignificant either.

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A good assumption to use in AP capacity planning is 1-2 Mbps per user for data and 5-10 if you think video will dominate. The average TCP throughput of 2.4GHz APs is approximately 20-30 Mbps, while an 5GHz AP can often deliver 75 Mbps or more in a typical open office environment. However, the average TCP throughput is much lower, depending on the number of clients on the AP. With the BeamFlex smart Wi-Fi antenna, Ruckus ZoneFlex APs create less interference (due to the targeted nature of the signal) and also reject interference (also because of the directional signal). Ruckus can conservatively support average TCP rates around 25 Mbps for 2.4GHz traffic and often 70+ for 5GHz.

Keep in mind that while most APs in the market are optimized for maximum performance at the close ranges in reasonably clean environments, the Ruckus APs are optimized to deliver consistent performance across distance, obstacles and interference.

For voice-intensive WLANs, the Ruckus ZoneFlex AP supports a maximum of 30 concurrent VoIP calls with some data traffic in the background. If the objective is to optimize user density, the Ruckus ZoneFlex AP can effectively support up to five hundred (500) typical users per AP. If you're planning for bursts you might want to bring this number lower.

Determining coverage area

Like a cellular base station, each AP defines coverage geography with a maximum radius determined by available signal power and signal attenuation from objects that block the communications path. A typical guidance for spacing between the Ruckus ZoneFlex APs is shown in **Table 3**. Use the online Ruckus AP

Performance Calculator.

As detailed in the "Determining Required Capacity" section, a Ruckus ZoneFlex AP can support 100 simultaneous data users or 20 concurrent voice calls in its coverage radius depending upon the required capacity for each user. If the user population exceeds that in a given geography, the only way to increase the capacity is to add more APs into that geography. This must be done in such a way that each AP does not interfere with its neighbor. Once installed, the ZoneDirector will automatically select the appropriate frequencies for each AP to allow increased capacity with minimal interference between the APs.

Security integration

If you already support a centralized AAA (authentication, authorization and accounting) service, you'll probably want to integrate it with your WLAN infrastructure. The Ruckus ZoneFlex supports 802.1x allowing for authentication handoff to standard centralized AAA services such as RADIUS or Active Directory. Examples of popular RADIUS servers include FreeRADIUS and Juniper's (previously Funk) SteelBelt RADIUS. If an existing AAA system does not exist, you can use the ZoneDirector's internal authentication database which supports a maximum of 1,250 authorized users.

For encryption, the ZoneFlex APs support WPA2 with AES/TKIP as well as PSK for robust encryption at virtually no performance degradation. If key administration is a concern, the ZoneFlex DynamicPSK™ technology provides the ability to automatically configure each client device with the requisite wireless settings including a unique, dynamically generated encryption key. This eliminates manual key administration while assuring the integrity of the encryption system.

Sighting for Optimization and Installation

When it comes to the reality of deployment, the BeamFlex smarts provide a great deal of margin to make up for moderate differences between the design and the real environment into which the APs are deployed.

Nevertheless, it's always a good practice to walk through the planned deployment sites before installation. There can be variations in construction not specified on floorplans, variations in building materials, obstructed access to proposed AP locations and certainly concern for esthetics.

Variation in building materials can affect the propagation of RF signals causing it to deviate from your planned coverage. For example, an AP designed to cover three or four rooms may work just fine through sheetrock walls.

TABLE 3

TYPICAL SPACING BETWEEN RUCKUS ZONEFLEX APS

Site characteristics	Optimized for casual data	Optimized for business-class data	Optimized for voice, video, data
Easy (line of sight, open space/cubes)	300-600 feet	200-300 feet	100-200 feet
Medium (dry wall, wood)	150-250 feet	100-200 feet	50-100 feet
Difficult concrete, cluttered)	50-100 feet	40-70 feet	25-50 feet

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However, if those walls are made of concrete, the AP signals may not propagate beyond the walls on which the AP is mounted. Table 4 details the typical RF attenuation while propagating through various materials.

By directing its signal toward each client, the Ruckus ZoneFlex AP will, in many cases, achieve sufficient gain to overcome signal degradation due to building material attenuation. Directional elements on the ZoneFlex antenna can also be

TABLE 4

WI-FI SIGNAL PENETRATION THROUGH BUILDING MATERIALS

Signal path obstacles	Number between Ruckus ZoneFlex AP and client	Number between typical AP and client
Interior drywall	3-4	1-2
Cubicle	5-6	2-3
Wooden door	3-4	1-2
Brick/concrete wall	1-2	0-1
Glass window (not tinted)	3-4	1-2
Double pane coasted glass	1-2	0-1
Bullet proof glass	1-2	0-1
Steel/fire exit door	1	0

used to reject interference from the opposing direction. In addition, the adaptive antenna is able to direct narrow beams through openings or gaps in non-penetrable material. However, if the attenuation is too great, additional APs may be required to "light up" the dead zones.

Lastly, building construction may prohibit AP placement where originally planned. Physically sighting AP placement will identify these issues before the installation to save time and money.

Optimizing indoor AP placement

While BeamFlex will self-optimize in all situations, there are some placement guidelines you should follow to maximize AP performance. All APs should be mounted as high and as visible as possible. Try to avoid any obstructions, especially those in close proximity to the AP. An obstacle two to three feet from the AP will have a much more detrimental effect on performance than one located 20 feet away.

The ideal orientation of the ZoneFlex APs is ceiling mount (especially if power or network cables are easily available there). The ZoneFlex AP can also be placed horizontal, i.e., flat-side down, on top of the highest office cubicles or mounted high on

the wall using the horizontal wall-mount plate supplied with each AP. Wall mounting the AP vertically, i.e., with the dome pointed sideways, should only be done on the "outside" walls as this orientation creates a shadow behind the flat-side of the AP. When Ethernet wiring to individual APs is not available, Smart Mesh technology extends Wi-Fi coverage by providing access and backhaul capacity for the ZoneFlex APs. Simply plug it in and walk away; Smart Mesh is self-organizing, self-optimizing and self-healing.

Outdoor coverage

If you need to provide Wi-Fi access outdoors, consider the possibility of extending the WLAN coverage from inside. With the directional BeamFlex antenna elements, placing an AP next to a window may be adequate for the desired coverage without the added expense of outdoor mounted APs. It also makes the AP much more accessible for servicing. Experience has shown that many buildings enclose or adjoin outdoor areas of interest making this a viable option. Make sure to verify the type of window glass through which your signals will travel. Older buildings may have glass that contains lead which can affect signal propagation.

For more extensive outdoor areas, SmartMesh can reduce the need to run Ethernet cable. If power is already available, but not network, Ruckus APs can establish a mesh network between themselves to serve as the network backhaul.

3rd party interference

Wi-Fi uses license-free RF spectrum. This means that any interference occurring within that spectrum must be tolerated. In other words, you can't control interference from other devices legally sharing your radio spectrum. Examples for such devices are cordless phones, microwaves, adjacent APs, and Wi-Fi clients. Fortunately, BeamFlex will automatically reject a great deal of interference simply by focusing the APs antenna narrowly away from the source of interference. In general, unless the source of interference is so close to a ZoneFlex AP that it drowns out all of its antenna elements, BeamFlex should automatically deliver Wi-Fi signals on the best path to maintain a reasonable level of performance in adverse environments.

During your walking tour, determine all potential sources of interference. By adjusting AP placement you'll likely eliminate much of the interference while BeamFlex takes care of the rest.

System Pilot and Installation

It's best to test your environment with one or two pilot APs before proceeding with the entire installation. As RF can be affected by many variables, your actual performance may vary from the

planned design. If you've done a thorough job gathering require-ments and sighting the installation, that variation should be minimal. In any case, it's much less costly to find and correct problems in the design before you roll out the entire installation. A pilot will also help to wring out any integration issues with the wired network that may have been overlooked during the design.

Select an area to pilot that best pushes the limits of the design. This will help you gain experience with installing and operating the equipment. It is also an excellent opportunity to test the support tools such as software upgrades and the management dashboard.

Once you've achieved a successful pilot, starting a systematic production rollout is prudent. You may still encounter site-specific problems. Not having to multiplex personnel between sites during production installation will speed the total installation time.

System Operation, Maintenance and Growth

During operation, you'll need tools to assist with monitoring your wireless network's performance. Ruckus provides some great tools for detecting rogue APs as well as identifying sources of interference. In addition, there are a variety of excellent third-party tools available for a fee or for free.

For example, there are two outstanding open source offerings known as AirSnort (based on the popular Snort package) and Kismet. AirMagnet offers tools for debugging RF problems in the field as well as tracking down offending rogue APs or wireless clients. WildPackets and Cognio offer a line of Wi-Fi analyzers that monitor RF spectrum plus capture and analyze individual wireless packets or protocol dialogs. Other excellent free tools are NetStumbler and Wi-Spy.

Experience has shown that checking the performance and availability of your WLAN from the clients' perspectives gives the ultimate indicator of your system's health. The Ruckus ZoneDirector allows you to track the signal strength of clients.

This helps you determine if there's a particular area where coverage can be improved with additional APs. SpeedFlex™ is a unique wireless performance tool that measures the Wi-Fi throughput of WLAN clients associated to ZoneFlex APs. SpeedFlex differs from iperf, IXIA Chariot, ttcp and others because it measures wireless link layer performance. Taking a proactive approach allows you to find problems before your users do and will help you maintain high availability in your wireless network.

When it comes to growth, a big advantage for a centralized WLAN like the ZoneFLex is that it scales very well. When set up correctly, the ZoneFlex APs will reject connections before they run out of capacity. Tools within the ZoneDirector will help you monitor, set thresholds then inform you when connections are being rejected indicating the need for more capacity. Adding that capacity is now a matter of placing additional APs in the geography then allowing BeamFlex to automatically set the optimal channel and power levels to maximize coverage while minimizing interference.

Summary

A robust, ubiquitous and high performance WLAN can deliver a quality experience to our mobile society that is much like their experience with a wired network. Following "Best Practices" will help you achieve that goal. Through its products and publica-tions such as this Best Practices Guide, Ruckus is committed to taking the complexity out of WLAN, allowing you to concentrate on what matters — delivering the best wireless experience at the lowest possible cost.

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Simply Better Wireless.

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