Orbex Voice and data system specialists

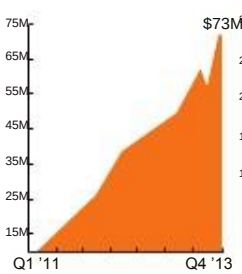
Ruckus Simply Better Wireless.

BIG DOG AUTHORIZED PARTNER

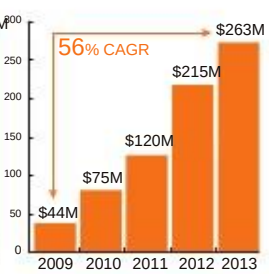
Ruckus - Simply Better Wireless

Formed	June, 2004
Headquarters	Sunnyvale, California
Status	Publicly held (NYSE: RKUS)
Market	Mobile Internet infrastructure
Founders	William Kish and Victor Shtrom
President /CEO	Ms. Selina Lo
2013 revenue	$263 million
Q4 2013 revenue	$73 million
Customers	33,000 mobile carriers, broadband service providers and medium/large enterprises
Product(s)	Smart Wi-Fi access points, controllers, and WLAN management systems
Employees	800+
Notable customers	KDDI, Time Warner Cable, Mandarin Oriental Hotel Group, Marriott, Global Reach, City/County of San Francisco & City of San José, CA, Kawasaki Motors, Katoen Natie, Accor SA, Towerstream, O2 Teléfonica, Axtel, Bright House Networks, PCCW, Oi, Marston's, Orange, MWEB, Waterstones Book Stores, Sprint, China Telecom, Le Pain Quotidien

Quarterly Revenue Growth



Annual Revenue Growth



Source: Ruckus Wireless

THE BUSINESS

Ruckus Wireless, Inc. (NYSE: RKUS) is a global supplier of carrier-class, Smart Wi-Fi products and technologies. Ruckus competes in the global market for mobile Internet infrastructure and enterprise wireless LAN systems. The company is credited with developing the industry's first adaptive Wi-Fi technology for carriers.

Formed in June 2004, Ruckus is one of the fastest growing wireless technology companies in the world, experiencing rapid revenue growth. From 2009 to 2013, Ruckus realized a compound annual growth rate of 56% with revenues reaching $263 million in 2013 and Q4 2013 revenue of approximately $73 million.

Patented technologies integrated into Ruckus Smart Wi-Fi products enable unprecedented reliability, range, speed and scale of Wi-Fi services. These technologies uniquely focus and steer Wi-Fi signals by choosing the best performing paths and channels — adapting to environmental changes and mitigating interference, obstacles and obstructions that degrade Wi-Fi performance.

Ruckus markets and manufactures a complete line of advanced indoor and outdoor wireless systems – ZoneFlex™ and SmartCell™ – for service provider and enterprise customers to support applications such as WLAN access, mobile data offload, public access, and managed wireless LAN services.

The company sells its products worldwide through both direct and indirect channels. Ruckus Smart Wi-Fi systems are sold through a vast global network of accredited channel partners, systems integrators and distributors to enterprises of all sizes. To date, the company has shipped millions of units to approximately 33,000 customers worldwide.

Carriers and corporations use Ruckus products to solve capacity, reliability and coverage challenges caused by increasing volumes of traffic, devices and of users accessing wireless networks.

Ruckus Fact Sheet

THE MILESTONES

04
- June — Company founded, begins operations

05
- Dec — Selected Technology Pioneer by World Economic Forum

06
- Jan — Hits 1M unit shipment mark
- May — Unveils rst line of Smart WLAN systems for the enterprise
- Nov — Selected by Deutsche Telekom for national IPTV service

07
- Sept — Delivers rst product, announces rst customer, PCCW
- Feb — Introduces rst Smart 802.11n system, voted "Best New Product Idea" by Cablelabs
- Mar — Named best 802.11n product by CRN
- Apr — Unveils industry's rst 802.11n SmartMesh WLAN system

08
- July — Unveils industry's rst dual-band 802.11n outdoor system with adaptive antennas
- Nov — Enters the Wi-Fi Broadband Access market with rst end-end 802.11n system

09
- June, May — Awarded 41st patent for dynamic pre-shared keys; Ruckus introduces 1st 802.11n Wi-Fi wall switch
- Dec — Dell'Oro ranks Ruckus as 2010 market leader in Wi-Fi mesh node shipments to operators

10
- Jan — Sundance Film Festival selects Ruckus, China Telecom deploys Ruckus for massive public access network
- Feb — Ruckus unveils services gateway, awarded "Best Mobile Broadband Technology" at 2011 Mobile World Congress
- July — KDDI selects Ruckus for world's largest mobile data of oad network

11
- Nov — Announces record 2012 revenues with 79% y/y growth
- Dec — IEEE Spectrum Ranking of the Most Valuable Patent Portfolios Places Ruckus in Top 10 of the Communications Equipment Category

12
- Feb — First LBS App launched (SPoT)
- May — Initial public offering on NYSE under the symbol RKUS
- July — Unveils City of San José, CA "Wickedly Fast Wi-Fi" network
- Mar — Announces partnership with Sprint CNS
- Oct — Ruckus acquires LBS pioneer YFind

13
- Ruckus Named a Leader in IDC MarketScape: Worldwide Enterprise WLAN 2013-2014 Vendor Analysis

14
- Dec — San Francisco Market Street public Wi-Fi launch

A highly diversified and global business, Ruckus is critically acclaimed for its excellence in engineering, garnering more than 50 industry awards for industry-leading product performance and company success.

The company is also credited with having the world's largest Wi-Fi deployment in India through Tikona Digital Systems, which has installed more than 40,000 mesh nodes across 25 cities to provide last-mile wireless access to hundreds of thousands of subscribers. And in Japan, KDDI, is using Ruckus to build a mobile data offload network with over 120,000 Wi-Fi locations.

Ruckus has a large and diverse base of world-class service provider and enterprise customers including KDDI (Japan), The Cloud, a BSKYB company (UK), O2 Teléfonica (UK), Time Warner Cable (US), Oi (Brazil), PCCW (Hong Kong), Cincinnati Bell (US), Airtel Africa, China Telecom, Katoen Natie (Belgium), Vodafone (UK), SingTel (Singapore), Telstra, CenturyLink, Bright House Networks, Marriott, Fairmont Hotels, Marston's PLC, City of San José, CA, Waterstones Book Stores, Le Pain Quotidien, and many more.

SERVICE PROVIDERS

ENTERPRISES

Ruckus Fact Sheet

THE MARKETS

The increased adoption and use of mobile devices, such as smart phones, tablets and laptops, is causing significant growth in wireless traffic. As a result, service providers and enterprises are struggling to address both the increased demands on their networks and the significant investment required to upgrade network capacity and provide ubiquitous wireless connectivity.

Service providers and enterprises need solutions that meet these capacity and coverage demands while providing them the ability to address three basic issues: interference, integration and scalability.

According to Signals Research Group, mobile data traffic in the United States is expected to grow anywhere from fifty-three times to one hundred fifty-three times between 2010 and 2020. To meet this demand, mobile service providers are adding macro network capacity by increasing cell site density, investing in new cellular technology, such as long term evolution, or LTE and LTE Advanced,and acquiring additional spectrum.

Meanwhile, Signals Research Group also projects that the U.S. cellular network capacity will grow by only approximately twenty-five times, or 25x, over the same time period. While this capacity gap is significant in itself, it actually doesn't factor in the peak usage demands that must be considered when designing and upgrading networks or capacity deficits outside the U.S.

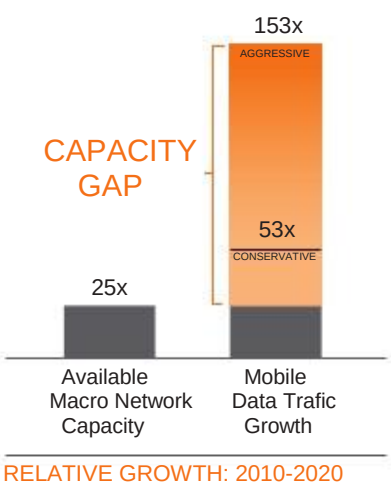
As a result of this capacity gap, mobile service providers must find new ways to inject capacity into their wireless networks. The capacity gap is also opening up new business opportunities for other providers, such as cable companies, wholesale operators and fixed-line carriers, to add reliable Wi-Fi access services to their service portfolio.

Capacity challenges are also experienced by enterprises in a variety of industries such as hospitality, education, healthcare, warehousing and logistics, corporate enterprise, retail, state and local government and public venues, such as stadiums, convention centers, airports and outdoor public areas.

With increased data traffic growth, enterprises experience widely fluctuating network load, both in number of users and amount of traffic and are faced with a range of operating conditions.

Wi-Fi is a conceptually attractive solution to increase capacity, improve wireless network performance, expand coverage footprint, deliver new services and better accommodate traffic growth. Mobile devices are increasingly equipped with Wi-Fi, and many devices now rely on Wi-Fi as their primary Internet connection. Wi-Fi also operates over unlicensed, widely available spectrum and functions well both indoors and outdoors.

However, the ability of service providers and enterprises to deliver robust and pervasive connectivity over Wi-Fi has been constrained by the limitations of basic, or conventional, Wi-Fi technology.



The carrier Wi-Fi market is forecasted to grow from $296 million in 2011 to $2.8 billion by 2016 while the enterprise WLAN market is expected to grow from $3.4 billion in 2011 to $6.9 billion by 2016.

Mobile data traffic in the US is expected to grow anywhere from 53x to 153x over the next decade while US cellular capacity (best case) is expected to only grow by 25x over the same period.

Corporate Fact Sheet

THE TECHNOLOGY

Ruckus has developed leading carrier-class Wi-Fi products and technology, which we refer to as Smart Wi-Fi, that enable service providers and enterprises to benefit from advanced levels of performance and integration capabilities that are not possible with basic Wi-Fi.

Wi-Fi standards and network equipment were originally designed to allow simple, easy-to-use and low cost connectivity in the lower interference environments, such as the home. As a result, basic Wi-Fi products suffer from a number of inadequacies for addressing today's wireless challenges such as interference, scalability and support for a large number of concurrent users.

At the heart of all Ruckus products is Smart Wi-Fi technology developed to solve these problems. Smart Wi-Fi is a collection of patented technology breakthroughs such as: adaptive RF control (BeamFlex), predictive channel selection (ChannelFly), resilient and self optimized meshing (SmartMesh), automatic user device configuration (Zero IT config) and dynamic Wi-Fi security (Dynamic pre-shared keys).

Integrated within Ruckus Smart Wi-Fi systems, these technologies deliver reliable and predictable performance for supporting the most challenging applications.

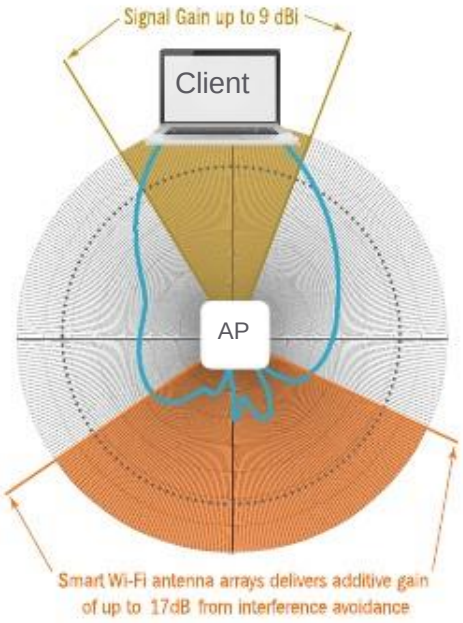
BeamFlex is the industry's most advanced Wi-Fi smart antenna implementation. Combining a compact internal antenna array with expert control software, BeamFlex continuously ranks the antenna configurations for each receiving device and reconfigures itself in real-time to choose the best performing antenna configuration to address interference and obstructions.

BeamFlex adapts Wi-Fi signals to interference conditions to deliver predictable performance at greater ranges. It also reduces dead spots, increasing the range and performance of the Wi-Fi network up to 300 percent. High-gain directional antennas provide up to 9dBi of antenna gain and 17dB of interference rejection.

Patented BeamFlex

Miniaturized Adaptive Antenna Arrays

High gain, directional antenna elements are automatically controlled by an expert software system. This provides the ability to constantly adapt to a changing Wi-Fi environment by picking the best signal path on a per packet basis for any type of traffic at any given time to any given client.

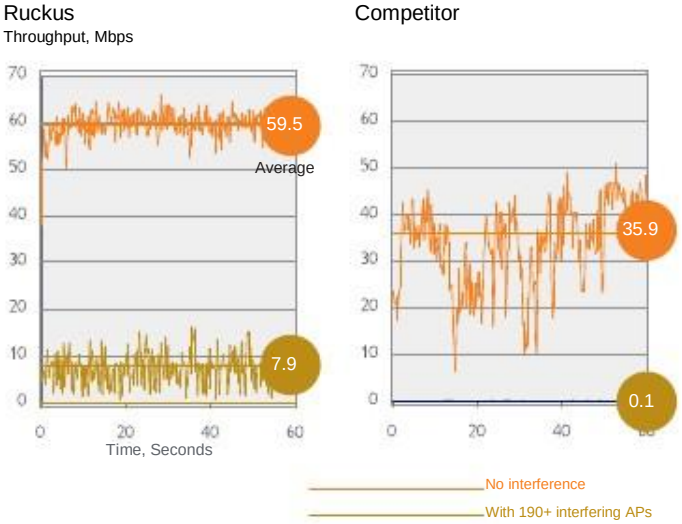


Highly sensitive antenna elements also deliver the industry's most sensitive Wi-Fi receiving capabilities. BeamFlex allows long-range reception of Wi-Fi signals down to -100 dBm. This results in some of the most reliable Wi-Fi systems available today.

SmartMesh Networking changes the fundamental economics of WLAN deployment. SmartMesh Networking uses Ruckus Smart Wi-Fi and expert RF routing technologies to create long-range, reliable and adaptive Wi-Fi trunk connections between mesh APs, eliminating having to cable Ethernet to all APs.

802.11n Laptop Comparison With and Without Interference

Source: Ruckus Wireless



Wireless Best Practices

Ruckus Wireless | White Paper

A practical guide for small/medium businesses designing and implementing mission-critical wireless LANs

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.

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?

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 tradeoff 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, 802.11n, a new Wi-Fi standard for delivering several times the capacity of current 802.11g is available in business class 802.11n 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.

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 11g APs is approximately 20-30 Mbps, while an 11n 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 11g traffic and often 70+ for 11n.

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 20 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 one hundred (100) 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.

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

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.

A good way to accomplish this is to set a different operating frequency for each AP within an area. For 802.11b/g there are three non-overlapping frequencies, channels 1, 6 and 11. For 802.11n there are 23 non-overlapping frequencies (the actual number varies by country). 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 sheet rock walls.

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.

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

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 used to reject interface 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 steer 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 requirements 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 dash board.

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 publications 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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