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10 Ways to Build a Better Wi-Fi Network

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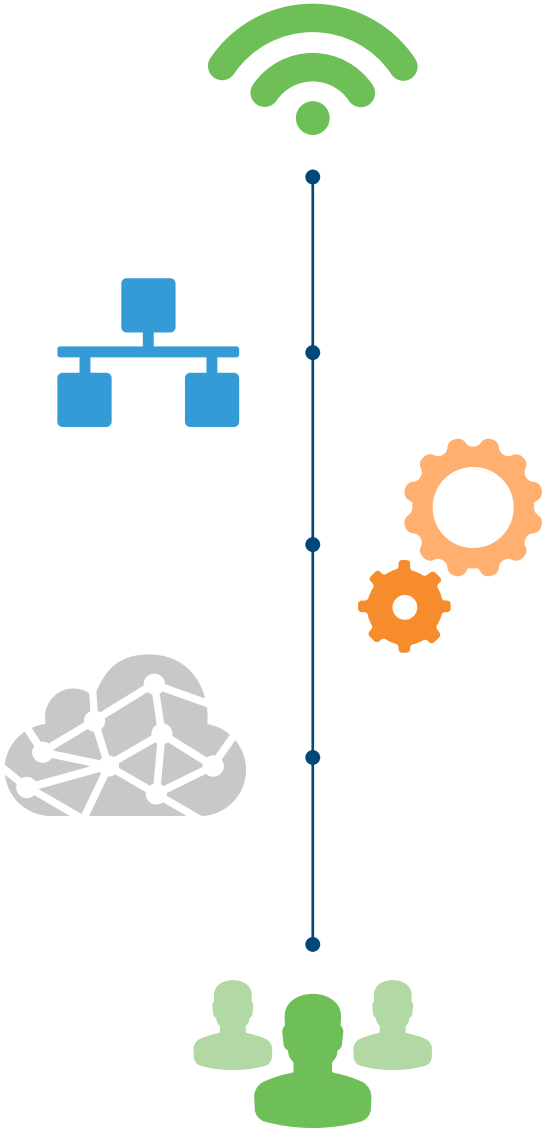
When it comes to designing a Wi-Fi solution, one size definitely doesn't fit all.

Offices, classrooms, meeting rooms, restaurants, public venues, and manufacturing buildings—they all have different user requirements. Bandwidth demands are continuing to accelerate because of the number of devices connecting and the volume of applications being used. The more you understand how Wi-Fi networks actually operate, the easier it is to make intelligent decisions about your next system. This guide, presented by Riverbed® Xirrus, will get you on your way.

1

Understand Wi-Fi Fundamentals

We've all heard about the alphabet soup 11a/b/g/n/ac, MIMO, MU-MIMO, 256 QAM, and so on. You don't need a Ph.D. to plan your next network, but there are a few concepts you should readily understand.



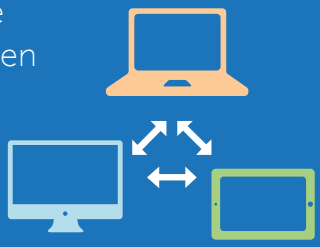
Understand Wi-Fi Fundamentals

RF SPECTRUM

Wi-Fi operates on two radio frequency bands: 2.4 GHz and 5 GHz. Until 2009, 2.4 GHz was the only band used. Today's devices also support the 5 GHz band, which offers up to 8x more channels (i.e. bandwidth) and is the primary band used in the latest 802.11ac standards.

WI-FI IS A SHARED MEDIUM

If you think of a Wi-Fi network as a room full of people where everyone wants to speak at once, you realize there's a big difference between the number of users who can connect to an access point (AP) vs. how many can actually communicate effectively when connected.



TECHNOLOGY EVOLVES

Since Wi-Fi was first standardized in 1997, we've seen five major "speed" upgrades (11a/b/g/n/ac). Upgrading the moment a new technology appears is unnecessary because client capability makes the biggest impact on overall network performance.

CLIENT CAPABILITIES VARY

Wi-Fi comprises multiple technologies operating at different data rates. Even within the same technology, different devices have varied capabilities. For example, one 11n device may only support 65 Mbps while other 11n devices support 300 Mbps or more.

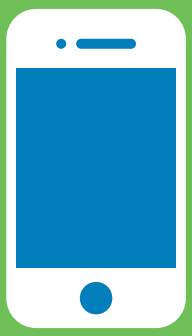
2

Understand the Clients

Not all clients are created equal—a laptop is significantly different from a smartwatch. Likewise, their Wi-Fi capabilities are not the same.

Laptops represent the ideal for a wireless product, boasting big antennas and strong radio frequency (RF) capabilities. Smaller, less expensive gadgets typically need a stronger signal to perform. If you want to support all users on all devices, including the Internet of Things (IoT), you have to design for the weakest clients.

Understand the Clients



Today's devices support either:

2.4 GHz only

OR

2.4 GHz + 5 GHz

This makes 2.4 GHz the "lowest common denominator"

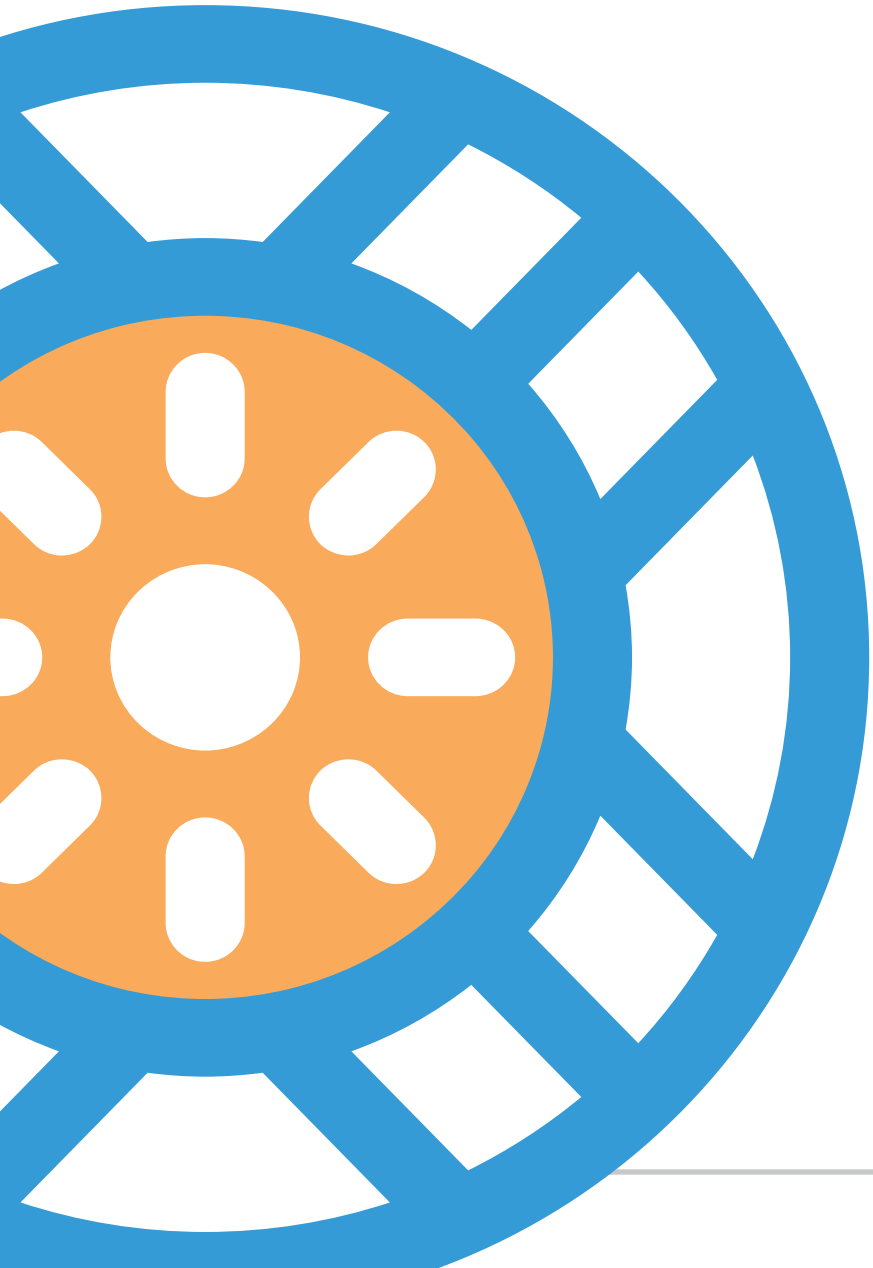
Network administrators still have to create a network that supports each spectrum to accommodate older phones, point-of-sale systems, gaming systems, and many other devices that remain tied to 2.4 GHz. However, designing for the 5 GHz spectrum should be the primary focus.

DON'T BE FOOLED!

Just because a product says 11n or 11ac on the package doesn't mean it supports the highest possible level of service. For example, 11ac Wave 1 data rates go up to 1.3 Gbps, but the majority of consumer and handheld devices such as tablets and smartphones can only provide data rates at a fraction of that speed.

3

Every Environment Has Density

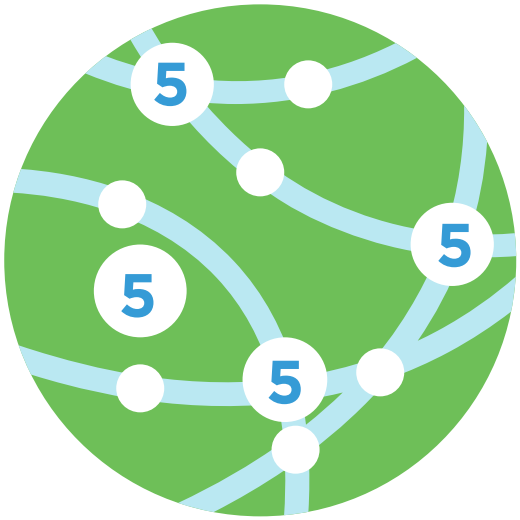


A decade ago, APs came in a standard two-radio design—one fixed on 2.4 GHz and one on 5 GHz. Regrettably, nearly all vendors still package their solutions this way even though more than 80% of Wi-Fi enabled clients support the 5 GHz band.

Every Environment Has Density

Today, networks need more 5 GHz radios, not just more APs. Yet **many vendors still force you to purchase a 50/50 mix of 2.4 GHz and 5 GHz radios, which is a waste of money** that prevents your network from evolving for 5 GHz capable devices.

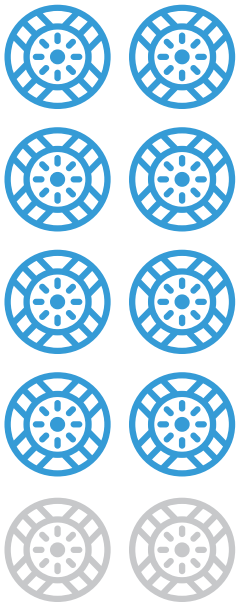
Riverbed Xirrus APs implement software defined radios whereby a single radio can switch between operating at 2.4 GHz or 5 GHz as needed, allowing more radios to operate at 5 GHz concurrently for high-density situations.



Every Environment Has Density

OPTIMAL CONFIGURATION OF APS

Today, **80% or more Wi-Fi clients are 5 GHz capable. That means at least 80% of the radios in the Wi-Fi infrastructure should operate on that band.** 100 dual radio APs provide 200 radios. For software defined radios, that means 160 radios should be configured to 5 GHz and only 40 radios (or less) on 2.4 GHz.



HDAP

Riverbed Xirrus High Density Access Points include:

Integrated controller + 2 to 4 software defined radios + Up to 13.6 Gbps of bandwidth per AP

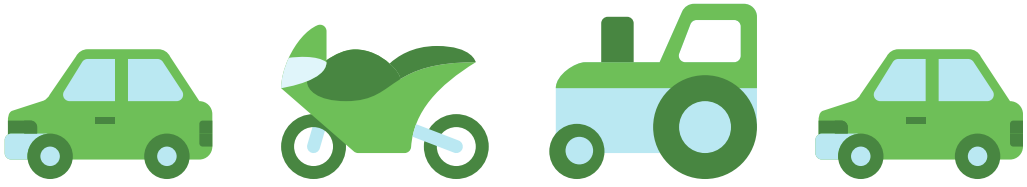
4

Utilize Traffic Management

A good Wi-Fi engineer should be able to design a network that can handle almost any number of devices. But even the most talented planner will find it impossible to create a network that supports all possible bandwidth demands. That's where traffic control comes in.

WHY TRAFFIC CONTROL MATTERS

Not all applications have the same value to an organization. A crystal-clear conference call is extremely important, whereas syncing desktop files with Dropbox is not as immediately critical. Traffic management lets network administrators apply policies that optimize overall performance by prioritizing, limiting, and even blocking specific programs or classes of applications.



Utilize Traffic Management

TRAFFIC MANAGEMENT ESSENTIALS

1

Find out which programs are eating up all your bandwidth; then determine what limits to put in place.

2

Unified communications, streaming video, file transfer/backup, social media, email, web browsing, etc. each place a different burden on your network. Assess the value of each application and decide how much bandwidth each deserves.

3

Prioritize real-time applications like VoIP and enforce bandwidth limits on non real-time data traffic to achieve a better experience.

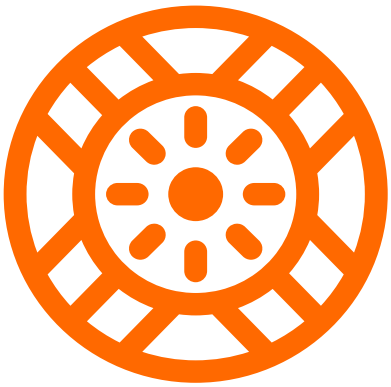
4

Restrict noncritical applications that can consume a huge amount of bandwidth, such as iOS updates or Dropbox. You can schedule OS updates and other system applications after peak business hours.

5

Don't be afraid to block traffic! It's one of the most valuable ways to control network usage and can be applied to security concerns, regional policies, or other criteria.

Utilize Traffic Management



Some vendors develop centralized appliances for traffic control, while others integrate the capability into the access point itself.

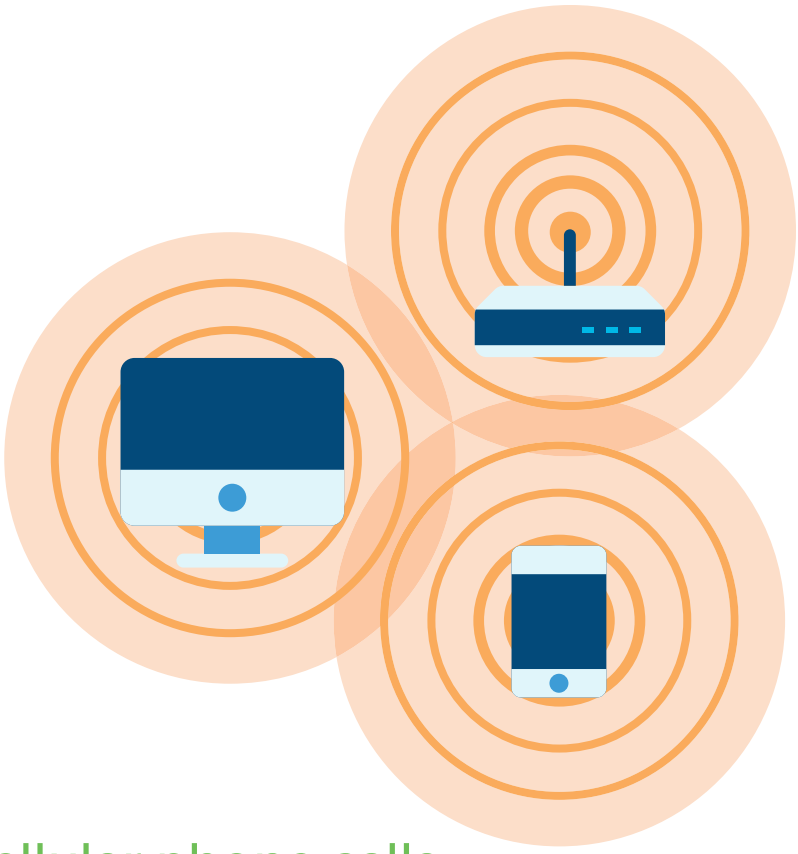
We think application management at the edge is the best approach. Placing the capacity in each AP delivers more processing power, enables control of P2P traffic, and eliminates the need to send all traffic across the network backbone.

Discover Riverbed Xirrus AP capabilities and see how our Management System delivers simple, fine-tuned control.

LEARN MORE

5

Avoid RF Interference



Just like car radios, cellular phone calls, and satellite transmissions, Wi-Fi is simply another form of radio frequency (RF) communication and therefore susceptible to RF interference from an array of sources.

IMPACT OF INTERFERENCE

There is always some interference present on a network. In a mostly "clean" RF environment, the interference may be minor and unnoticeable. In a "noisy" RF landscape, there will be mild to severe performance degradation.

Unfortunately, you can't control which users show up at your building with personal hotspots or other devices that generate disruptive RF noise. Additionally, nearby businesses and facilities can cause problems just by running their own network.

Avoid RF Interference

INTERFERENCE CONSIDERATIONS

Co-channel interference (CCI) occurs when multiple radios are operating on the same channel within range of each other—for instance, two radios on channel 6. When radios "hear" each other, they must take turns transmitting to avoid corrupting the other radio's signal. To the user, this appears as network slowness. CCI is most common in the 2.4 GHz band, as it offers far fewer channels for reuse.

Adjacent channel interference (ACI) happens when neighboring channels interfere with each other (i.e. channel 36 and 40). Avoid channel plans where possible that have adjacent channels collocated in a single area.

Sometimes Wi-Fi systems contend with interference from networks of neighboring businesses, schools, homes, and personal devices such as MiFi. Discuss the problem with those nearby to identify a channel plan that works for everyone.

Interference can also be caused by other wireless technologies that generate RF energy in the same frequency range as 802.11, including cordless phones, game controllers, microwaves, and Bluetooth gadgets.

Avoid RF Interference

Trying to eliminate all interference is impossible. But the 5 GHz spectrum provides many more channels than 2.4 GHz, making it less prone to disruption. That being said, you'll need to support 2.4 GHz for some time, as many devices still depend on that frequency.

6

Network Optimization

Due to the sheer number of devices using the airwaves and the different requirements and capabilities each brings to the mix, IT administrators are challenged with finding smart ways to deal with a larger and more diverse volume of wireless clients hitting their networks.

Gaming gadgets, smartwatches, and digital picture frames are prime examples of nonessential devices that suck up valuable bandwidth and might not be welcome on enterprise networks.

Network Optimization

INTERFERENCE CONSIDERATIONS

SOLUTIONS THROUGH SEGMENTATION

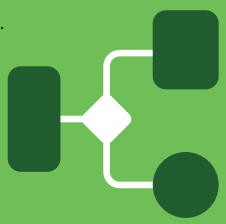
Network client segmentation allows administrators to formulate policies that classify and redirect devices, defining which clients are allowed onto a network and what resources they get.

BAND STEERING

Band steering works by directing dual-band clients to 5 GHz radios where they typically enjoy a better experience. A welcome result: 2.4 GHz clients see an improvement in service as well because there are now fewer devices competing on 2.4 GHz radios.

DEVICE TYPE AND CLASS

After you classify the types of devices on your network—phones, tablets, laptops, media players—you must implement policies: optimize roaming, group for multicast video, and outright block nonessentials (i.e. smartphone streaming video and eating up office bandwidth).



MODE STEERING

In addition to band steering, mode steering optimizes performance by separating high- and low-speed clients onto separate 5 GHz radios. This is the only way to prevent lower-speed clients—11a or 11n—from degrading the efficiency of the network.

6

Quality of Service vs. Quality of Experience

Quality of Service methodology relies on networking protocols that define how your equipment handles different types of traffic. Quality of Experience combines QoS methods with other best practices to perfect the user experience.

Quality of Service vs. Quality of Experience

KEYS TO QUALITY OF EXPERIENCE

Set the right number of clients per radio

This number should be determined by the performance demands of the location. For example, if you want to use Wi-Fi in the classroom for teaching, limit the number of clients on a radio to a level that provides users with a strong performance. In the cafeteria, where performance is less critical, the limit will likely be a lot higher.

Understand real-world limitations

We often hear that a new technology such as 11n or 11ac will support more clients per radio. For example, if 11n (300 Mbps) can handle 30 users per radio, an 11ac (1.3 Gbps) should support four times as many clients. This might sound good in a white paper, but it doesn't represent a real-world setting where client speeds and capabilities vary. Even a few low-speed clients on your 11ac network can substantially weaken overall performance.

8

Keep Your Signal Strong

Wireless communication strength isn't just impacted by RF interference or contrasting network technologies, physical barriers such as walls also play a role. Understanding the impact of physical obstacles will better help your wireless network achieve good signal strength.

DON'T SHORTCUT YOUR DESIGN

Under-designing your Wi-Fi network is never a good option, even though it may (initially) result in a lower cost for your project. If you don't deploy enough APs, or expect your APs to breezily pass through all obstructions, you'll find yourself grappling with signal problems and poor performance.

Keep Your Signal Strong

KEYS TO QUALITY OF EXPERIENCE

1 Determine just how far your Wi-Fi signal will reach.

The further the RF signal travels, the weaker it becomes, especially in a noisy environment. The weaker the signal and/or the higher the noise floor, the lower your actual data rate.

2

Overcome physical obstructions such as walls, windows, and types of furniture.

Spans of wood, sheetrock, or standard glass typically cut your signal in half. At the other extreme, concrete walls can sap your signal by as much as 15 dBm or more.

Predictive survey tools use common values to measure Wi-Fi attenuation. Since a piece of glass with UV shielding can be as tough to penetrate as solid concrete, the only way to determine how far a signal will go is to measure it throughout the site. Don't forget to factor in what's inside your walls—pipes, wiring, and other objects limit range as well.

3 Consider Range vs. Coverage vs. Performance.

Greater range sounds like a good thing, but when a single radio or AP covering a large area has to support more devices than it should, everyone experiences slower performance.

9

30 billion
DEVICES CONNECT BY 2020

40-100
APPLICATIONS USED PER DEVICE

Future Proof Today

Wireless technology will never stop evolving. As the use of tablets, smartphones, and other Wi-Fi capable devices continues to grow, the emerging Internet of Things has the potential to explode this number even further. At the same time, IT managers want their new Wi-Fi networks to last longer than ever.

How do you design a solution capable of handling increasing device numbers, shifting technology standards, and other transitions we can't even anticipate? The answer is future proofing.

Increasing capacity demands are inevitable. If you select a system with only static capabilities, you'll significantly limit your network's longevity. Instead, go with a solution that is adaptive to business requirements and the constant surge of new clients.

Future Proof Today

Protect Your Investment

KEEP YOUR RADIOS FLEXIBLE

80-90% of new Wi-Fi clients are 5 GHz capable. One way to future-proof your network is to choose only the latest generation of adaptive access points that allows both radios in an AP to operate on 5 GHz concurrently.

ENSURE SCALABILITY

As the Internet of Things becomes more pervasive, more and more everyday objects are becoming Wi-Fi capable. To keep up, your Wi-Fi solution should be able to add wireless capacity and radios without requiring an expensive wired infrastructure upgrade.

ENABLE TECHNOLOGY UPGRADABILITY

11n, 11ac, 3x3, 4x4 ... on average we see a technology jump every two or three years. Yet, IT departments typically want their Wi-Fi solution to last five to seven years or more. If that's the case, you must make sure your solution can be upgraded to a new technology standard.

MANAGE BASED ON YOUR NEEDS

Given all these requirements, how do you manage everything? This depends on your requirements—do you want a hosted solution in the cloud or maintain your own system on-premise? Xirrus Management System offers flexible options to meet your needs and handle the ever-changing demands of your Wi-Fi network.

10

Create a Wi-Fi Checklist

Here are the most essential points to consider when selecting a Wi-Fi solution:

1

PERFORMANCE

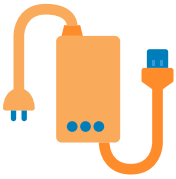
How many wireless clients do you have today?

What's your expected growth?

What are your business critical applications?

How much bandwidth will they consume?

2



WIRED INFRASTRUCTURE

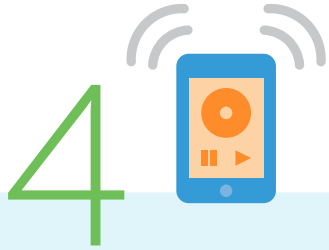
Don't make the mistake of viewing wired and wireless as separate systems. They are each part of a single network. Ensure that enhancements to your Wi-Fi are synced with wired adjustments as well.

3

BROADBAND UPLINK SPEED

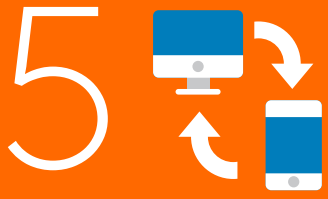
Growing Wi-Fi usage and proliferating cloud-based apps demand faster broadband service. To get the best results from your upgrade, you may also need increased broadband connection speed.

Create a Wi-Fi Checklist



4 APPLICATION MANAGEMENT

Streaming apps, multimedia players, and other data-heavy programs strain enterprise networks. Since you can't provide unlimited bandwidth, make sure your new solution is capable of monitoring and managing applications via traffic control policies.

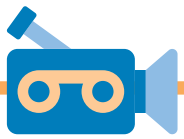


5 DEVICE CLASSIFICATION

Wi-Fi enabled devices grow every year, and technology standards change. As the Internet of Things expands, this mix will become even more complex. Opt for solutions that classify mobile devices and regulate their usage based on a defined corporate policy.

6 LONG-TERM PLANS

For your Wi-Fi solution to last as long as possible, you'll need a network with maximum flexibility, scalability, and upgradability. Constant monitoring of applications, clients, bandwidth consumption, and usage will help determine when you're ready for an overhaul.



WATCH OUR VIDEO and see why Riverbed Xirrus is the industry leader

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10 Years of Innovation

For over a decade, we have been designing and delivering Wi-Fi solutions to address the ever-growing, ever-changing demands of mobility. Today, those demands change daily with users bringing multiple devices and running almost any application imaginable on your network. As the technology landscape evolves, Riverbed Xirrus continues to pioneer powerful, versatile, forward-thinking solutions that lead the industry.

Try us out

Get a free trial High Performance AP and Cloud Management System

riverbed.com/xirrus

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