WIRELESS SETUP AND GENERAL ENVIRONMENTAL CONSIDERATIONS

GUIDELINES FOR ACHIEVING THE BEST Wi Fi® PERFORMANCE WITH YOUR ARRIS™ WIRELESS DEVICE

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The requirements being placed on wireless networks today differ significantly from what they were just a few years ago. Wireless networks have transformed from a network of convenience to a network of MUST HAVE and with performance to match. All of this demand has been exacerbated by primarily higher performance wireless clients in our laptops to becoming the primary connection technology for all sorts of devices; including tablets, smart phones, Smart TVs, Blu-ray players and more. The key to supporting the increased use of smart devices on your wireless network is to understand their requirements, your surrounding wireless environment, and laying out a network design to support your needs.

BACKGROUND

Many important design factors need to be considered when installing any Wireless Access Point (AP) in a home or small office in order to optimize the wireless coverage and wireless throughput capabilities. This document gives an overview of these factors and provides several guidelines and tips for achieving the best performance.

Environmental Considerations

The following factors in the physical environment where the gateway and the clients will be located need to be evaluated for each installation:

- Physical obstructions between the AP and the client.
  - These include walls, furniture, appliances, multiple storied home configurations, and more.
- A significant metallic object (including the AP's external power supply) close to the unit could potentially dampen the Transmit (TX) & Receive (RX) signals. It is recommended that the external power supply be at least 6 inches from the base of the unit when possible.
- Distance between the AP and the client. Speeds drop as distance increases.
- Interference from devices in the same RF spectrum such as microwave ovens, baby monitors, cordless phones, and other wireless devices.
- Variations of floor layouts and building materials used in homes.
- Micro-reflections that are seen in the environment.
  - Not a good line of sight but still has good coverage.
  - Good line of sight but sees some degradation due to the reflections.
- Mounting locations of the units will always have the possibility of having an impact on the overall performance of the AP.

- Relocate the product a couple of feet to see if there is any change in performance or not.

Wireless Technology Considerations

Current wireless devices utilize either the 2.4 GHz or the 5 GHz band while many can operate as dual-band concurrent devices. Dual-band concurrent wireless APs provide connectivity within both frequency bands at the same time.

The first thing to realize is the difference of available 'non-overlapping' channels between the two bands.

- The 2.4 GHz band only has 3 non-overlapping channels (Channels 1, 6, and 11) that can be used simultaneously without interfering with each other. 2.4 GHz wireless technology in the United States, Canada, and most of the 'America's operate on a channel between the ranges 1–11.
  - *Although there are 14 channels available in the 2.4 GHz band, not all 14 channels are available due to licensing restrictions in different countries. In some countries, the higher channels are unavailable due to other technologies (such as emergency services and other wireless systems).*
- Wireless Access Points in the area can and will "channel overlap". Even other "Auto Scan Enabled" AP's can put channels in an overlapping mode.
  - For example; if another device running with "Auto Scan Enabled" and selects channel 3, this channel will actually overlap with Channel 1 and 6. Refer to Figure 1 for details.
- The 5 GHz band offers up to 24 separate available channels in North America; however not all channels may be available due to Government Restrictions. 5 GHz wireless technology operates on channels 36 onwards. While these numbers correspond to specific frequencies, this isn't something we need to worry about.
  - Not all channels in the 5 GHz band are available due to licensing restrictions in different countries. In some countries, channels are unavailable due to other technologies (such as emergency services, defense protocols, and other wireless systems).

Wireless Channel Settings

The IEEE 802.11n standard allows bonding of two adjacent channels in 2.4 GHz (802.11n rates) or in 5 GHz (802.11a rates). By allowing this bonding, the channel bandwidth increases from 20 MHz to 40 MHz. This operational mode introduces some problems when operating where there are legacy wireless products in the environment. The legacy products operate within a 22 MHz channel bandwidth, which in the United States runs in the 2.4 GHz band and allows for only three channels out of 11 (in North America) to be non overlapping; refer to Figure 1.

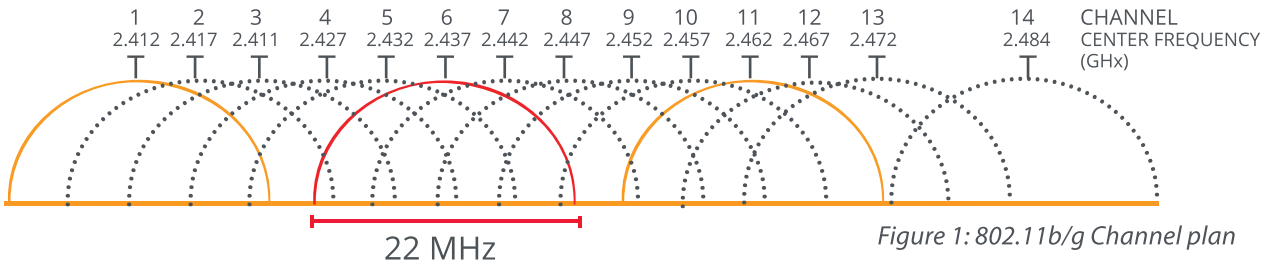

Figure 1: 802.11b/g Channel plan

The majority of installations may need to be a "mixed-mode" type where Clients running 802.11b/g will co-exist alongside clients running 802.11n in the 2.4 GHz range. The wireless experience of 802.11n clients in a "single-mode" or "11n only mode" will always be better than those in mixed-mode.

The following recommendations are for a "mixed-mode" type of environment.

- Eliminating legacy 802.11b client devices from the wireless network will enhance the overall wireless experience and eliminate network slow-downs.
- Run a wireless client application on a wireless device that will be used to conduct the site survey, to determine what existing 2.4 GHz wireless AP's are "leaking" into the customer's location. Refer to Figure 3 below.
    - In order to ensure the best wireless experience and coverage for an end-user, the customer location should be surveyed to ensure there is not another wireless access point using that channel.

You can see the advantages of the 5 GHz channel space as it provides 21-24 non-overlapping channels (available channels vary by regulatory domain), each already having the required separation defined. Refer to Figure 2 below. The bottom line here is that using 2.4 GHz technologies limits you to only 3 channels in one area whereas 5 GHz offers 7x more available channels.

- The additional channels are also extremely important when deploying 11n or 11ac that allow bonding of channels to get data rates of 300Mbps to gigabit speeds.
    - With 2.4 GHz you only have 3 channels so only 2 can be bonded for the higher data rates. As the 2.4 GHz band is the most used band, these channels (frequencies) are shared between you and your neighbors. Their activity on the same channel as yours detracts from your performance in the sharing of air time.
    - Note: If another access point overlaps one of the bonded channels then the bonded access point MUST drop back to a 20 MHz channel and 40 MHz Channel Bonding is not possible
- The 5 GHz technologies allow far more bonded channels.

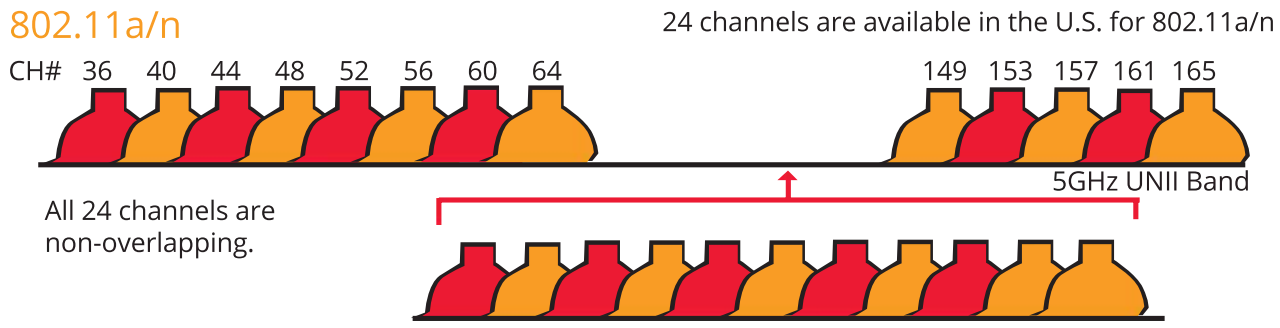

Figure 2 – 802.11 5 GHz Channel Map

Installation Steps

1. Placement

For installation, the ARRIS AP can be placed on a desk (or similar platform) either horizontally or vertically (depending on the design style of the AP), and may be mounted on a wall. For greatest coverage, it is recommended that the unit typically be placed in an upright position. In addition, if your ARRIS AP uses an external power supply, it is recommended that the power supply be placed at least 6 inches from the AP.

- It is required that only the power supply approved and certified for use with your AP be used in the installation of the ARRIS AP. While the output voltages of other power supplies may be equivalent to the ARRIS AP's certified power supply, there are other properties of those power supplies that may adversely impact the wireless performance of your ARRIS Access Point. In addition, for safety reasons, only the approved power supply should be used.
- For optimal coverage, the ARRIS AP should be placed as close to the center of a residence as possible in order to take advantage of the APs optimal antenna design. While this is not always possible, be aware that placement at an outer or corner room decreases the overall wireless coverage area.
- Ensure that there are no significant metal objects (such as a metal rack or metal file cabinet) next to ARRIS AP, which may dampen the TX and RX signals; this includes the external power supply. Any external power supply should be placed at least 6 inches from the unit. Be aware that stucco walls have wire mesh imbedded in them, as well as concrete barriers with metal rebar, which may affect wireless coverage. These same considerations should be kept in mind for the placement of wireless clients.
- Do not place your ARRIS AP in close proximity to a cordless phone base. This may cause interference with the 2.4 GHz wireless radio.
- Do not place your ARRIS AP in close proximity to a microwave oven. This may also cause interference with the 2.4 GHz wireless radio.

- If you are using an integrated ARRIS Cable Modem/Router, ensure that no matter where the device is placed, the RF characteristics of the cable modem are within the DOCSIS specifications. Poor RF signal quality directly corresponds to poor wireless/wired throughput.
- It may be difficult to provide an answer to these types of questions:
  - Will degradation be seen if the AP is placed in the basement of a brick building?
  - Will the client on the third floor be able to reach the AP?

2. Wireless Coverage Tools

Examples of wireless PC client analyzer tools that can be used to perform a site survey are (these are free tools available for download from the WEB):

- inSSIDer® (Refer to Figure 3 below)
  - This is an older version of inSSIDer which can still be found for free on the WEB. Metageek now charges for the latest releases of inSSIDer.
- NetStumbler®

In addition, Android mobile phones with Wi-Fi capability can be used for a site survey. "Wi-Fi Analyzer" would need to be downloaded and installed on the Android phone.

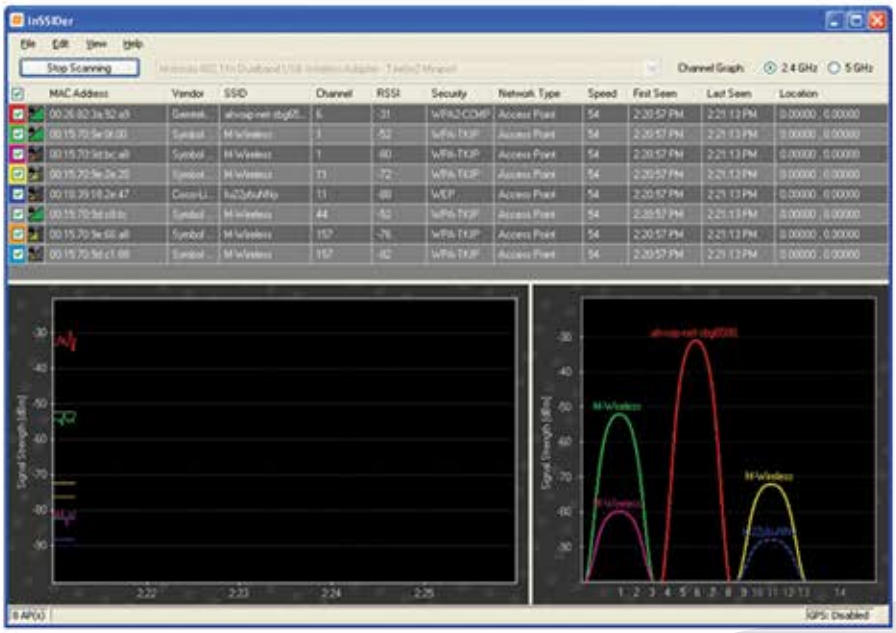

Figure 3: 2.4 GHz Wireless Survey

- In the above example, there are four additional wireless AP's visible in the customer location utilizing channels 1 and 11. Using the 2.4 GHz 802.11b/g channel plan from

Figure 1, this means channels 1-3 and 9-11 all will have some wireless usage. This allows the ARRIS AP to be set to use channel 6 without any outside interference. If you find that all channels have some sort of usage, find the channel with the lowest signal strength from an outside source, and set the ARRIS AP to utilize that one. The site survey should be done at the location of the ARRIS AP, as well as other areas in which wireless clients will be located that will be attempting to connect to the ARRIS AP.

- After setting the wireless channel on the ARRIS AP, again take a survey at all of the customer wireless client locations to verify the wireless signal strength and quality. A weak signal will mean lower wireless throughput for that wireless client device.

3. Wireless Encryption Settings

Several of the more common PC Operating Systems (as well as some wireless clients such as wireless printers) currently deployed do not support WPA2™ encryption, and manual reconfiguration of the unit may be required to establish a secure wireless connection with those systems.

The following Windows® Operating Systems will support the ARRIS APs pre configured WPA2-PSK wireless settings:

- Microsoft Windows® 8
- Microsoft Windows® 7
- Microsoft Windows® Vista
- Microsoft Windows® XP SP3
- Microsoft Windows® XP SP2 w/ KB893357 hotfix

Other Windows® Operating Systems (or devices that do not support WPA2) will require the user to manually set the default wireless encryption settings to enable BOTH WPA-PSK and WPA2-PSK. Both of these encryption methods can use the same “WPA Pre-Shared Key” concurrently.

- Selecting the right Security/Encryption methods will enhance your performance. Older technologies like WPA-PSK, WEP, and Open can limit a connection to 54Mbps; while utilizing the newer WPA2-PSK can allow for the full speed allowed within your environment.

4. Wireless Speeds

There are many variables that may affect wireless performance seen by a wireless client.

- Operating in a mixed mode - Clients running 802.11b/g alongside clients running 802.11n.

- In general, there is an overhead "tax" type penalty when running in a mixed environment. Mostly due to different timing sequences for 802.11b/g and 802.11n clients.
- An end-user's PC can contribute greatly to the performance of USB Wi-Fi adaptors.
- When pushing beyond 20 Mbps speeds, customer equipment is going to become a factor in performance.
- While the physical radio rate may show "130 Mbps" **<still the RAW data rate>**, it is still limited by the processing power of the small CPU in the wireless client and may only achieve about 15 to 25 Mbps throughput.
- Experiencing less than 50/5 speeds is largely going to be caused by operating systems, customer routers, or wireless connections.
- Windows XP may not achieve 50 Mbps downloads due to the manner in which the TCP stack is optimized; it is configured for high speed, low latency (LAN) connections -- not high speed, higher latency (Internet Broadband) connections. It may be possible to significantly improve Windows XP Client performance by optimizing the stack for broadband with tools such as SpeedGuide.net's "TCP Optimizer".

RELATED READINGS

- How to Increase the Performance of Your Wireless Network
  http://computers.tutsplus.com/tutorials/how-to-increase-the-performance-of-your-wireless-network--mac-32001
- 2.4 GHz Wi-Fi vs. 5 GHz Wi-Fi
  http://test.xirrus.com/blog/June-2012/2-4GHz-vs--5GHz
- Wi-Fi tweaks for speed freaks: 2013 edition
  http://www.computerworld.com/article/2497956/wireless-networking/wi-fi-tweaks-for-speed-freaks--2013-edition.html?page=2

REFERENCES

(1) **Computer Skills:** How to Increase the Performance of Your Wireless Network, November, 2012

(2) **XIRRUS Blog:** June 26, 2012: 2.4GHz vs 5GHz