A Guide to an Error-Free Wi-Fi Network Lifecycle

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Abstract

Wi-Fi network planning and deployment can be a daunting task for most business operators. Network engineers need to carefully select network equipment, do site planning, deploy equipment, set optimal network parameters, and continuously tweak the network parameters to get the best possible performance. Any glitch in an industrial network can cause a shutdown of critical applications controlling industrial processes, with disastrous results. As more and more industrial operators switch to Wi-Fi technology, there is a need to build reliable Wi-Fi infrastructure that can outperform conventional networks. In this article, we discuss some key points to consider when planning and deploying a Wi-Fi network in an industrial environment.

Navigating Through the Wi-Fi Network Maze

Wi-Fi technology is gaining rapid acceptance in the industrial world. The technology is well on its way to becoming the default mode of communication for most organizations. However, many organizations are still trying to figure out the best way to deploy their Wi-Fi networks. The plethora of tools, network devices, and Wi-Fi solutions that are available can further add to their difficulty in choosing an optimal solution. We discuss some techniques that you can adopt to choose a Wi-Fi solution that best fits the operational environment and needs of your organization.

Undertake a Site Inspection before Planning Your Network

Before you purchase network equipment and hire experts to design your Wi-Fi network, it is important that you undertake a physical site inspection exercise to understand the area to be covered by the Wi-Fi network. Spend time to understand the site in detail. For example, take site measurements, identify obstacles and sources of Wi-Fi interference, and decide on installation points for network equipment. If you are unable to visit the site and have to rely on maps instead, make sure that the maps are accurate. This exercise will help you understand the network architecture and requirements more clearly.

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Create a Network Design and Deployment Plan

The next step is to design your network. Your network plan should be based on the information gathered during the site inspection. You can use site-planning tools, such as *Ekahau* and *AirMagnet*, to simulate a wireless coverage map (heat map) to visualize the AP distribution in your network. The network plan should also include details of network coverage and capacity as well as the number and type of APs that you require to achieve the same. A performance test using the type of equipment and the topology that you plan to use can help you further confirm the requirements. Developing a meticulous network plan in advance saves you time and cost when you start to deploy your Wi-Fi network.

Deploy and Configure Equipment as per the Network Plan

Use the network design and deployment plan that you create to deploy the network equipment and build your Wi-Fi network so that there is sufficient coverage overlap to avoid blind spots. Ensure that the AP signals are not obstructed by pillars, shelves, or industrial equipment. To ensure uninterrupted connectivity for clients deployed on mobile equipment or moving parts, make sure that they can switch between APs with minimum downtime. The access points should be configured to operate on non-overlapping channels to achieve maximum throughput. Do not configure adjacent APs such that they operate on the same channel. If your facility has multiple floors, make sure that you deploy the APs in a way that minimizes interference between the floors.

Monitor and Tweak Network Parameters

Even though you went through an in-depth planning exercise to come up with the optimal network settings for deploying your network, you will notice that over a period of time, these network parameter settings may not give you the best results. Wireless devices outside of your network can interfere with your network over a period of time and can cause your network performance to degrade. A Wi-Fi network requires constant monitoring and tweaking to get the performance that you need. In addition, new systems that operate in the same space and subsystems that are connected to your network can slow down your network. You can use frequency analyzer or spectrum analyzer tools to identify congested channels and help you decide if you should relocate the APs or just change the channel configuration to lower the interference. In most cases, the solution is to change the channel setting, provided the site layout has not changed. However, channel reassignment is not an easy task. Your site engineers need to have a good understanding of Wi-Fi radio channels and frequencies to be able to reassign channels for optimal results. For example, when channels overlap over the 2.4 GHz frequency, where channel 1 is fully occupied and channel 2 is rarely used, channel 2 is not a good candidate, even though it is available, because of the frequency overlap. The 5 GHz frequency should be your first choice when reassigning channels because it has a wider bandwidth as compared to the 2.4 GHz frequency. Most site engineers, who may be automation experts, lack sufficient knowledge and experience to solve Wi-Fi issues and hence they may take a long time to troubleshoot and fix such issues. The Wi-Fi interference in your network will dramatically increase over a period of time as you expand your industrial network to support additional production lines and new field locations. You will have to add Wi-Fi devices to the existing topology and configure them or deploy new subnetworks to provide seamless connectivity.

Utilize Solutions that Automate Wi-Fi Settings

You can utilize the following technologies to help you automate Wi-Fi configuration settings in your network:
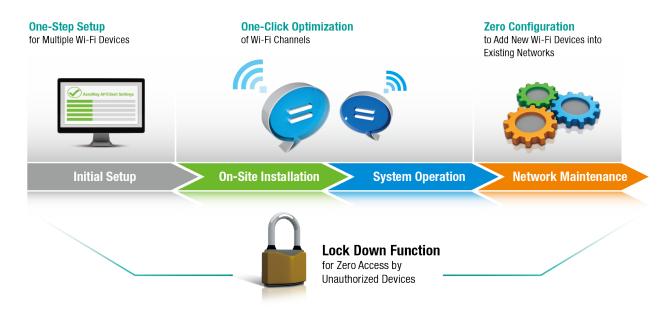
WPS (Wi-Fi Protected Setup)

WPS is a standard created by the Wi-Fi Alliance to provide an easy-to-use Wi-Fi solution for users with limited Wi-Fi security knowledge to enable them to effortlessly add new devices to an existing network. This setup can be implemented in three different ways—a push button, a PIN code, and using NFC (near-field communication). In the push-button method, WPS provides point-to-point quick connection without the need to specify the network name and password. Users need to set up the wireless devices one-by-one. The WPS PIN method can cause major vulnerability in wireless routers according to a CERT vulnerability note. In addition, you may not be able to turn off the WPS PIN feature in some router models.

Auto Channel

The auto-channel function dynamically adjusts the operating channels of your network devices to avoid RF interference in the Wi-Fi network. This function is enabled by default on some access points. Some APs have an additional radio that is dedicated to determining the scan-in order in real time for the auto-channel algorithm. In addition, a dedicated network controller is required to analyze airtime availability, channel utilization, and usage, which makes an auto channel based solution expensive.

AeroMag—A Wireless Technology for Effortless Wi-Fi Deployment

Moxa's AeroMag technology takes care of the basic Wi-Fi settings for you, saving you considerable effort when deploying your wireless networks. AeroMag is a useful tool throughout the Wi-Fi network lifecycle. When you are configuring network devices, AeroMag sets up your Wi-Fi connections correctly in a single step. During the installation phase, AeroMag streamlines network operation by analyzing the optimal channel for your current operating environment. From a maintenance perspective, new APs/clients can join the AeroMag topology without any additional configuration.

One-Step Setup
for Multiple Wi-Fi Devices

One-Click Optimization
of Wi-Fi Channels

Zero Configuration
to Add New Wi-Fi Devices into Existing Networks

AeroMag AP/Client Settings

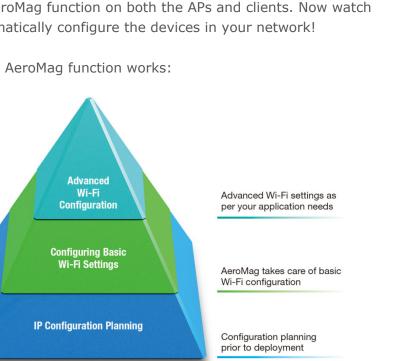| Initial Setup | On-Site Installation | System Operation | Network Maintenance |

Lock Down Function
for Zero Access by
Unauthorized Devices

Configuring Multiple Wi-Fi Devices

Once you have confirmed the quantity and location of the APs using a site survey tool and have configured their device names and IP addresses, connect all the APs to the same network using Layer-2 switches and then activate the AeroMag function on both the APs and clients. Now watch AeroMag automatically configure the devices in your network!

Here's how the AeroMag function works:

AeroMag AP/Client Setting
- ✔ SSID
- ✔ Password
- ✔ RF Type
- ✔ Channel

Advanced Wi-Fi Configuration — Advanced Wi-Fi settings as per your application needs

Configuring Basic Wi-Fi Settings — AeroMag takes care of basic Wi-Fi configuration

IP Configuration Planning — Configuration planning prior to deployment

1. AeroMag APs will designate one amongst them to act as the master AP.
2. The APs will automatically generate basic network settings such as SSID, WPA2 password, RF type, and channel.
3. All the APs will scan the channel spectrum for both 802.11 and non-802.11 signals.
4. Each AeroMag AP will send a spectrum status report to the Master AP (see Figure 1).
5. The Master AP will select the three best channels based on the information provided by the slave APs and sends this information to the slave APs (see Figure 2).
6. The slave APs complete the basic Wi-Fi configuration using one of the three "best channels" provided by the master AP.
7. AeroMag clients send connection requests to APs that are available and connect to an AP after a two-way authentication process (see Figure 3).
8. The APs will assign the optimal configuration generated to the client APs connected.
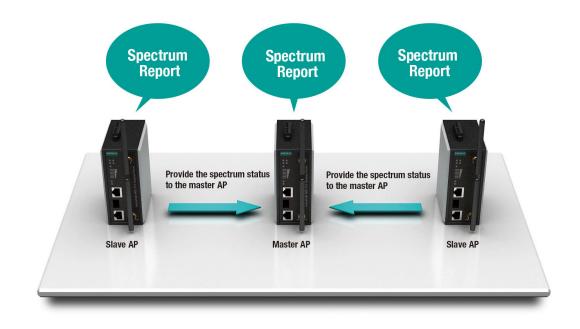
Figure 1: Slave APs send spectrum reports to the Master AP

Figure 2: Master AP provides a list of the optimum channels to the Slave APs

Figure 3: AeroMag clients connect to AeroMag APs

Once the AeroMag topology is established, you can lock it to prevent unauthorized devices from joining the network. Your Wi-Fi network is now ready for performance testing.

Optimizing Wi-Fi Channels On-Site

Once the testing phase is complete, install the network devices on-site. Because the network topology was already established in the test environment, you just need to turn on the network devices (AWKs) in the current topology and the devices will use AeroMag to establish a Wi-Fi network. However, channel usage in an on-site environment, such as in a factory or office, is considerably different from a test environment. AeroMag provides a refresh channel function, which checks the operating channels on the APs and adjusts them for the on-site environment. When you trigger the refresh channel function, AeroMag APs will scan the channel spectrum and will inform the AeroMag client if the operating channel needs to be changed. The refresh channel function remains available when the AeroMag topology is locked down.

Refreshing Wi-Fi Channels to Avoid Interference

When your wireless network is in operation, the AeroMag refresh channel function can be used to adjust the channels of field-side devices whenever their operating environment changes. A field-site environment changes when new wireless equipment or wireless networks for other purposes (e.g., Wi-Fi for personal devices) are deployed, making the optimal channel overcrowded and no longer the best operating channel. The refresh channel function reduces needed effort by finding the best channels for different operating environments automatically.

Adding New Wi-Fi Devices to Existing Networks

You can unlock the AeroMag topology to allow new units to join in. For example, when a production line is extended and more APs have to be installed to cover the additional Wi-Fi clients, all you need to do is connect a new AP in the existing AeroMag topology under the same subnet. The AP will automatically acquire the SSID, password, RF type, and operating channel settings to join the AeroMag topology. You do not need to manually import settings from a configuration file.

Figure 4: Fast deployment of new devices without additional configuration

Secure Wi-Fi Communication

AeroMag APs and clients communicate using WPA2 security protocol, which is the most secure communication protocol available today. During the AeroMag authentication process, RSA encryption is used throughout the wireless network for added security.

Moxa's Solution

Moxa's AWK-3131A/4131A wireless APs and AWK-1137C wireless client make your Wi-Fi network planning and deployment easy by supporting AeroMag technology. Aside from AeroMag technology, these devices also come with the following features that ensure a fast, reliable, and secure wireless network:

- ✓ Turbo Roaming for millisecond-level handover time for clients deployed on moving equipment and moving parts
- ✓ Protection against vibration for deployment in industrial applications
- ✓ -40 to 75°C wide temperature operating range for extreme environments
- ✓ MIMO technology that maximizes your Wi-Fi coverage
- ✓ Dual isolation to prevent power and RF interference

For additional details, click on the following links:

AWK-1137C	**AWK-3131A**	**AWK-4131A**
AeroMag Client	AeroMag AP	AeroMag AP