

This paper aims to introduce the user to the concept and need for WLAN design and deployment methods. It also educates the user on site surveys, the preferred method for accurate design for WLANs.

History of WLAN Design

WLAN design has come a long way in the last couple of years with fundamental changes and acceptance in terms of the setting of design requirements, goals and methodologies for successful WLAN deployments.

Before there were professional and purpose-built tools like AirMagnet Survey for WLAN design and deployment, the entire WLAN design and decision making process was very rough and rudimentary. Most users responsible for WLAN deployment employed a so-called “back-of-a-napkin” technique or did not design the network at all before deployment. This led to improper deployments of the network, which in turn led to wasted time, money, effort, and most importantly, a lack of positive results for the users in terms of connectivity or optimum performance.

“Back-of-a-napkin” technique

In the “napkin” technique, the user responsible for WLAN design drew the floor map on a piece of paper. In most cases, this map was simply a square or a rectangle-shaped box that represented the 4 walls of a building. Next, the designer would mark 4 locations at the corners of the building and 1 in the center representing locations where APs needed to be placed. This design method would then be repeated for every floor. This method has some major shortcomings that must be overcome in order to have a WLAN that provides optimum security, performance and compliance to the user. Shortcomings include:

1. No consideration into the actual capabilities of the AP (channels, media, transmit power, etc.);
2. No consideration into locations where APs could be placed dependent on availability of the power or Ethernet cable drop points;
3. No consideration into coverage bleed-over outside the corporate building, which is a major security risk;
4. No consideration into signal coverage at locations on the floor where users require WLAN coverage;
5. No consideration into user load on the WLAN;
6. No consideration into WLAN network’s readiness for specific applications;
7. No considerations into the performance of the WLAN including data rates, throughput, packet statistics;
8. No re-use of Access Points across multiple floors of the building;
9. Many more...

Examples that compare this technique with “professional WLAN site surveying” are covered later in this paper.

Professional WLAN Site Surveys

Site Surveys are needed to ensure the successful and efficient deployment of wireless networks. To understand the need for a survey, you should first understand the basic goal of a wireless network, which is to provide appropriate coverage and

performance to all end users while keeping interference to a minimum. RF signals are very unpredictable. If an access point is placed in an open environment with no obstacles, the signals usually maintain an omni-directional pattern. However, when obstacles and walls with different characteristics are introduced, the RF signals are disrupted and access point coverage will vary based on location.

Site Surveys determine the signal coverage, throughput requirements, interfering sources, dead spots, potential roaming behavior, etc. This helps determine:

- 1) What wireless equipment to purchase, i.e. how many access points to buy
- 2) Where to deploy access points
- 3) How to configure each access point for optimal coverage and best WLAN performance for all end user

It can easily be said that without site surveys, it would be difficult to determine the capital investment needed to deploy the wireless network in a timely and efficient manner. It is important not to generalize every wireless deployment in terms of requirements. For example, an office environment with only data clients using the wireless network for Internet access may tolerate a few dead spots, but this is unbearable in a hospital environment where the doctors/nurses require access to the network to get real-time patient information or use the voice network over the WLAN. Without site surveys it would be virtually impossible to determine if the requirements of each end user are being met.

Without site surveys, money and time may be wasted on implementing inappropriate hardware incorrectly. And finally after the deployment, the wireless LAN may never work properly resulting in frustrated users.

WLAN Design Goals

Even after the universal acceptance of site surveys for every WLAN deployment, there was a huge difference in the way design decisions were being made and networks being deployed. Below is a comparison of the fundamental changes in the thinking of the old and new WLAN design goals.

Old Way

- Networks would be deployed with minimum number of Access Points. WLAN devices were still considered to be very expensive and it was important to keep the equipment cost to a minimum, even at the cost of performance or availability of the network.
- Since a minimum number of APs were deployed, APs would need to operate at maximum transmit power levels to provide coverage in the required areas of the floor. Co-channel or adjacent channel interference between APs that could lead to lowered network performance was not considered at this time.
- Every AP would have more than 30 users associated to it. The fact that WLAN technology or APs are a shared medium and as the client load increases, the overall performance decreases was not considered.
- No consideration was given to bandwidth or performance of the network. As long as there was some signal coverage, it was considered to be a well-designed network. Usability and reliability of the network were not important design criteria

New Way

- WLAN network designs include many APs getting deployed.
- APs operate at minimum power. Users are open to the idea of deploying more APs than in the past. Minimized transmit power helps minimize any interference issues that may arise due to the overlapping of signals between the deployed APs.
- Networks are designed with less than 10 users associated per AP. This minimizes the load to maximize the performance of the shared WLAN.
- Bandwidth along with signal quality is important in defining any WLAN design decision. It is important to not only get good coverage at locations on the floor, but also to make sure that the network is actually usable. Network managers want to make sure users can connect to the WLAN successfully, stay connected and actually be able to run applications at optimum speeds over the WLAN.

When do you perform a site survey?

Site Surveys are required for:

New installations: Where there is no wireless network deployed and you need to obtain the number of access points required, locations where they need to be placed and how they must be configured.

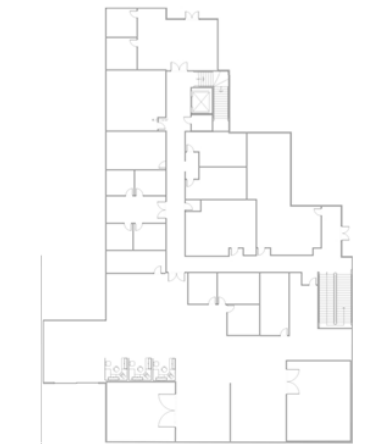


Figure: Building with no WLAN deployed

Existing installations: To verify the number of access points required versus the number actually deployed and validate their location and configuration to ensure optimal coverage and performance for all end users.

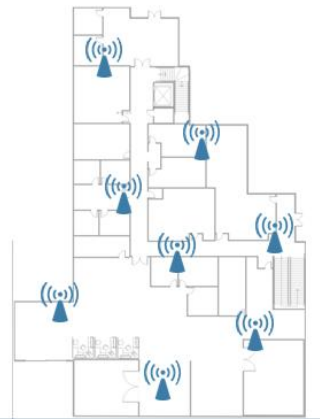


Figure: Building with existing WLAN

Ongoing Network Optimization: Site surveys are critical in ongoing network optimization scenarios such as:

1. Introduction of new users: As new users are introduced in the corporate environment, due to the shared nature of wireless, it becomes important to ensure that a sufficient number of APs are deployed to provide the best coverage and performance to the users. For example, a company with 20 users located in a certain location of the floor, now hires 30 more people who will need WLAN access and are expected to be placed in the same location. In this example, the IT staff must perform a site survey to ensure optimum coverage and performance for all the new as well as existing users. Maybe there is a requirement to add more APs or re-locate the existing ones to different locations on the floor.

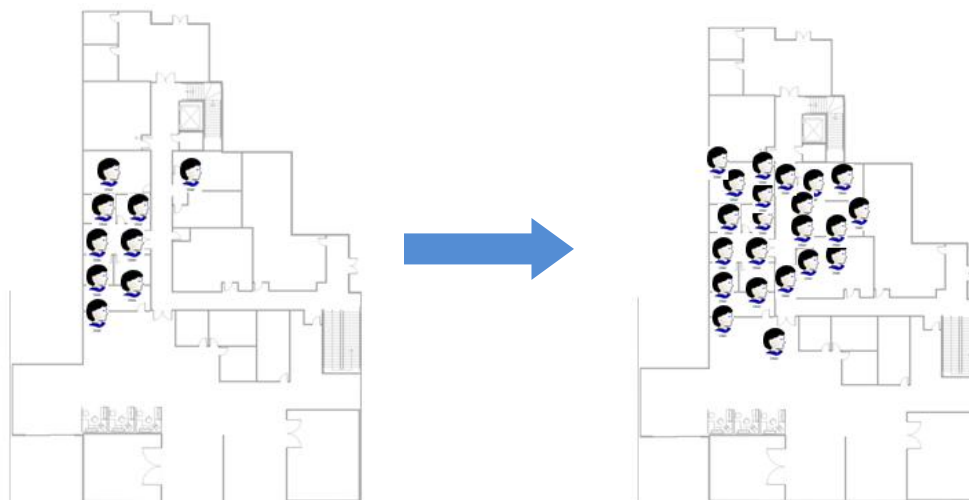


Figure: Network where number of users increases

2. Introduction of new applications over the WLAN: As new applications get introduced over the WLAN network, it becomes very important to perform a site survey to verify the network's readiness for the new application. For

example, if the current WLAN is only providing data services (browse the internet or to access some file servers), and now voice services need to be introduced over that network, it becomes very important to perform a site survey. Voice networks usually have more stringent requirements for signal values, coverage overlap, coverage from multiple APs, etc. to ensure the best performance and transparent roaming between APs for the phones. Any delay or a drop in the quality is more visible in a voice call as compared to a data-only transmission. Delays or performance-hits could lead to dropped calls, one-way audio issues, jittery conversations, etc. which is totally unacceptable. By performing a site survey, users can verify their network's readiness for voice.

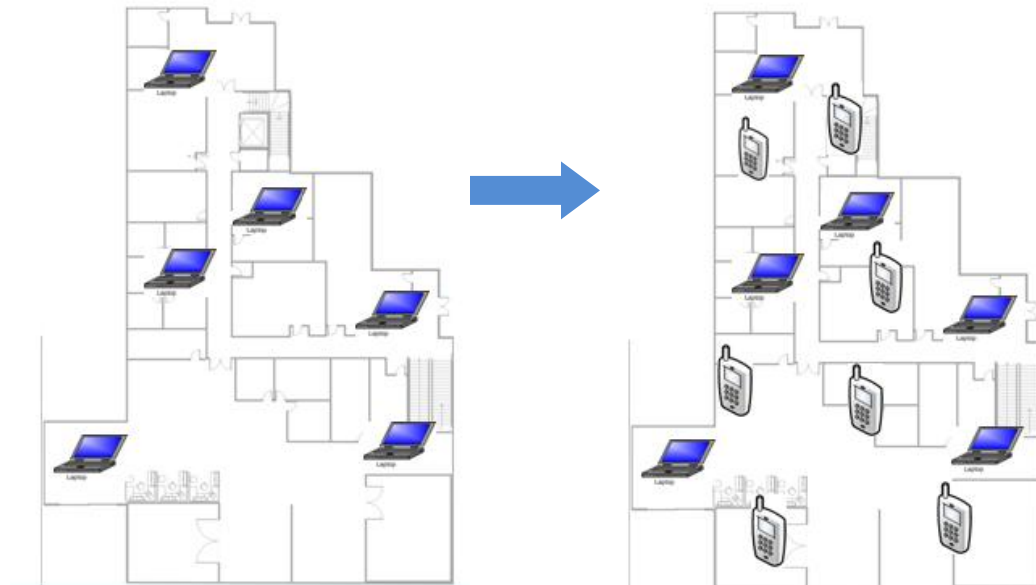


Figure: Network where voice services are introduced

3. Introduction of new technologies: A good example would be the introduction of the new 802.11n technology in a network with existing 802.11a/b/g devices. 802.11n has changed some of the RF fundamentals as compared to the legacy technologies. For example, multipath actually helps improve the performance of the network, while line-of-sight does not. Also you cannot just rely on signal strengths for 802.11n, as the signal values can be good at the location, but an optional configuration setting available on the 802.11n AP can be disabled, that can lower the performance of the network. It is important to perform a site survey to not only define your migration strategy to the new 802.11n technology, but also to verify true end-user performance metrics at every location on the floor.

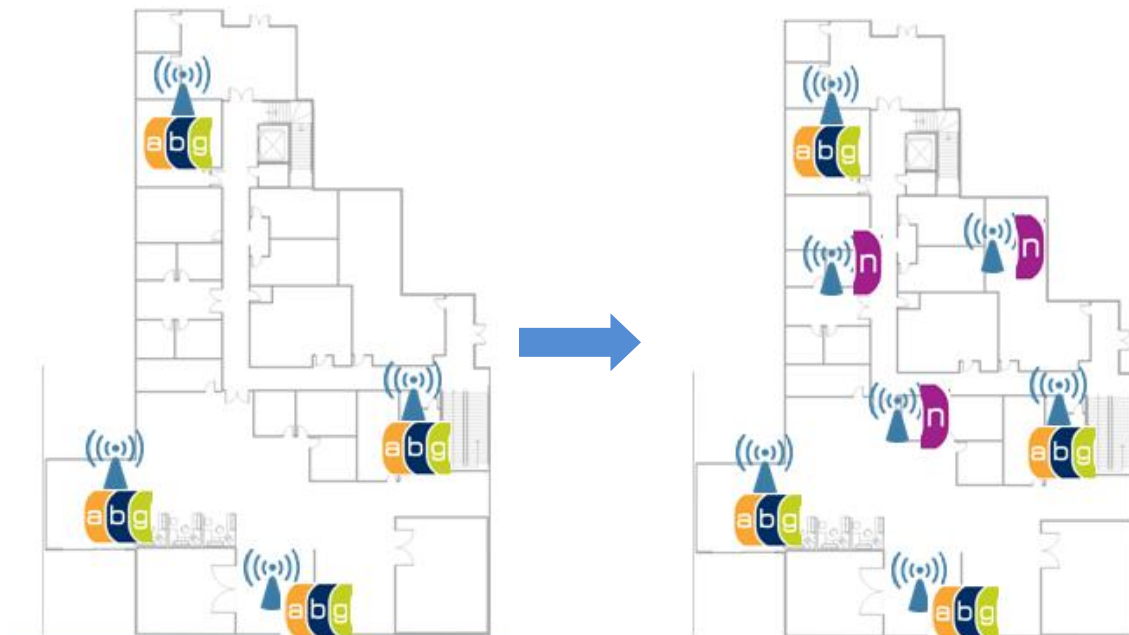


Figure: 802.11n APs introduced into an existing network

Questions to ask yourself or IT staff before performing any WLAN site survey

Here are some questions that must be answered before performing a WLAN site survey:

- 1. Have all the stakeholders in the project identified?** This may include a large group of people who maybe directly or indirectly involved with the site survey project or the enterprise LAN/WLAN.
 - Who will perform the survey?
 - Who will be making all the design decisions?
 - Who will approve the project or the budget for the project?
 - Who will install the APs once the design is finalized?
 - Who will assign me the IP addresses to be used on the AP
 - Who knows where/how to run Ethernet and power cables to the AP
 - Have the security personnel been identified? They will give you access to the building and the various offices inside to perform the site survey.
- 2. Is wireless access needed for indoors or outdoors or both?**
- 3. Are any building blueprints or floor maps available?** If not, how can they be obtained? Are there digital copies available?
- 4. Where do you require coverage?** Do users need WLAN access at every location on the floor or only in a certain areas?
- 5. What type of business is it?** This will influence the type of application that will run over the WLAN and finally influence your design decisions. For example, for a hospital deployment it is important to know that there are multiple sources of interference, voice and other bandwidth and time-sensitive applications could be used over the WLAN.
- 6. Is this a new deployment or an add-on to the existing one?**
 - If new APs are to be added to the existing ones, where are the existing ones located?
 - How are they configured?
 - Why are you deploying more APs?
 - Are you unhappy with it?
 - Are users complaining?
 - Is the business simply expanding and new users or applications being introduced?
- 7. Think about capacity.**
 - How many users require wireless service and what applications will they use?
 - What is the geographical distribution for the users?
 - Will they be using applications where they need to roam?
 - What are their throughput requirements?
- 8. Are there any known major non Wi-Fi interfering sources?** Do you know their locations? Are you worried about interference from your neighbor's facility? WLAN design decisions may have to be made to work-around certain interference sources. For example, it would be difficult to ask your neighbor to not use or move their microwave oven in their cafeteria if it interferes with your network.
- 9. Is this a multi-floor deployment?** AP resources can be reused across floors to save deployment time, money and effort.
- 10. What are the security requirements?** Can RF coverage bleed outside the corporate building?

11. **Where are the power and Ethernet drops throughout the facility?** Is the customer open to installing new drops?
12. **What is the anticipated growth for the future?** Will the corporation be hiring new users, implementing new applications or technologies? At times it is better to just plan the network deployment to absorb all these changes in the future to make best use of the investment.

Comparison of “back-of-napkin” technique and professional site surveys

Below is an example to compare “back-of-napkin” techniques and professional site surveys:

Project requirements: Deploy WLAN for a single floor building for optimum coverage, security and performance

“Back-of-napkin” technique

IT staff member has the plan or blueprint of the building floor, but does not have any tools or specialized professional tools, like AirMagnet Survey. The user employs the “napkin” technique as mentioned above, without any consideration to signal coverage, performance, security, etc.

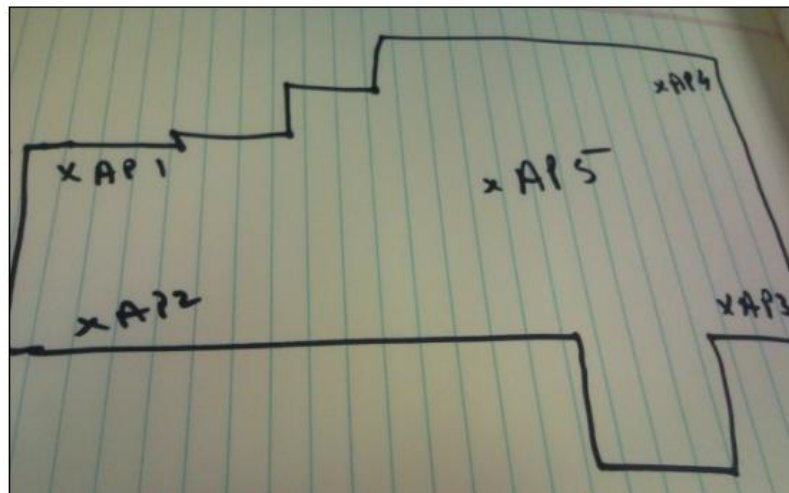


Figure: WLAN network design on a piece of paper

Shortcomings of the technique:

1. User assumes they will need 5 APs on the floor
2. APs are randomly placed at the 4 corners and the center of the building
3. There is no guarantee for coverage at every location
4. There is no guarantee of desired signal levels
5. Cannot calculate the performance of the network
6. Cannot decide how to configure the APs
7. Cannot ensure minimized interference in the network

Professional Site Survey

Below is a design of the same network using a professional survey product, AirMagnet Survey.

Advantages of site surveying:

1. Site Survey product recommends the deployment of only 3 APs. This saves the organization time, money and effort, by preventing unnecessary AP deployments. Image below shows AirMagnet survey recommending the number of APs and their appropriate locations on the floor.

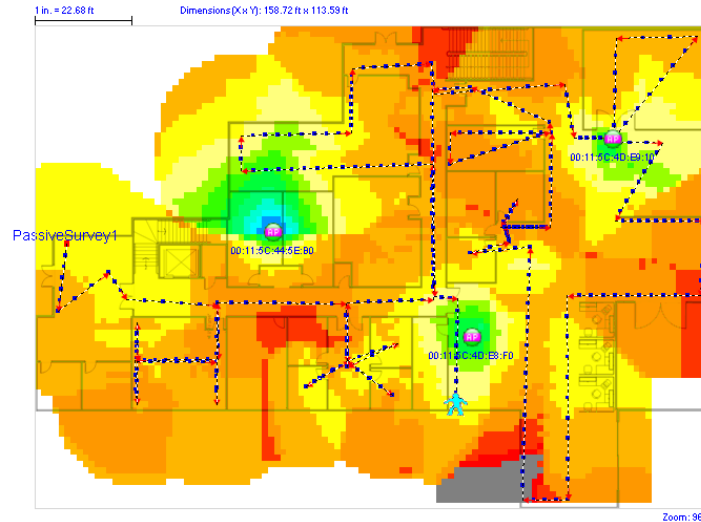


Figure: AirMagnet Survey's signal coverage map

2. With the site survey product, the user ensures that the signal strength meets their requirement to ensure good coverage. Image below, shows AirMagnet Survey's AirWISE screen showing the WLAN network's readiness for a certain signal coverage value (-67dbm). The "green" areas on the floor indicate areas that are meeting the user requirement for signal strength.

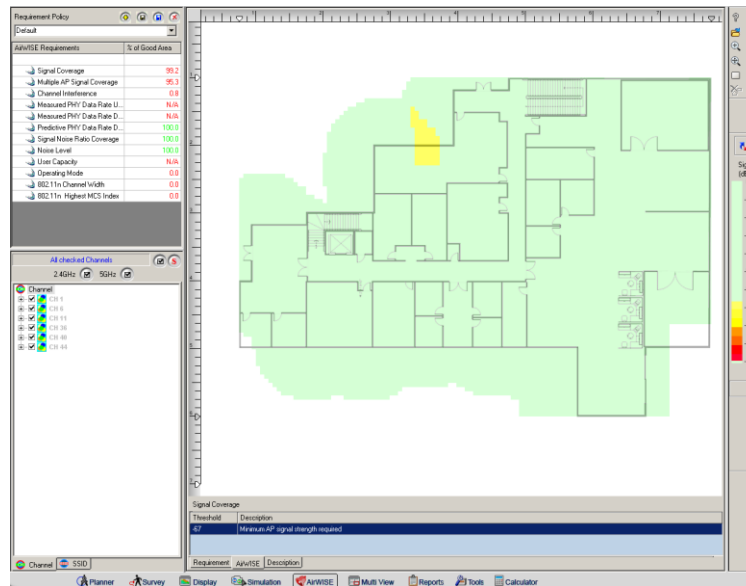


Figure: AirMagnet Survey’s AirWISE screen displaying WLAN’s readiness for the user requirement

- With the site survey product, the user can perform real-world active site surveys to measure real-world performance metrics for the WLAN. So network performance is guaranteed once the network is deployed. See image below that indicates high data rates at every location on the floor. Also users can visualize the packet losses and retries at every location of the floor. With active surveys, the user accounts for the real-world situation of the network, including, multipath issues, device configuration issues, interference issues, etc.

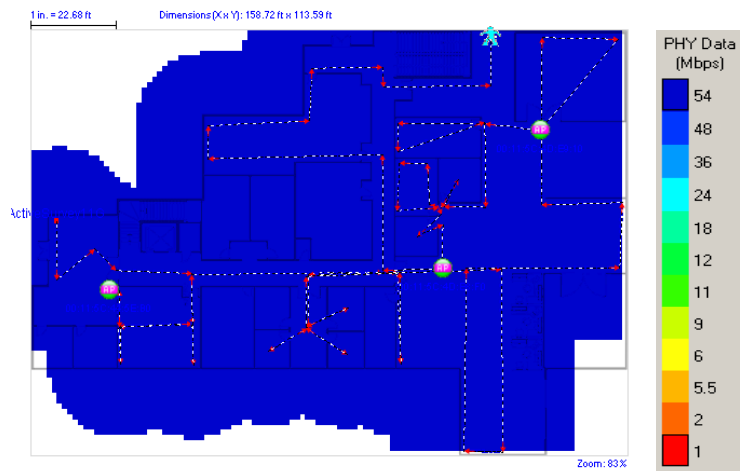


Figure: AirMagnet Survey’s data-rate (WLAN speed) coverage map

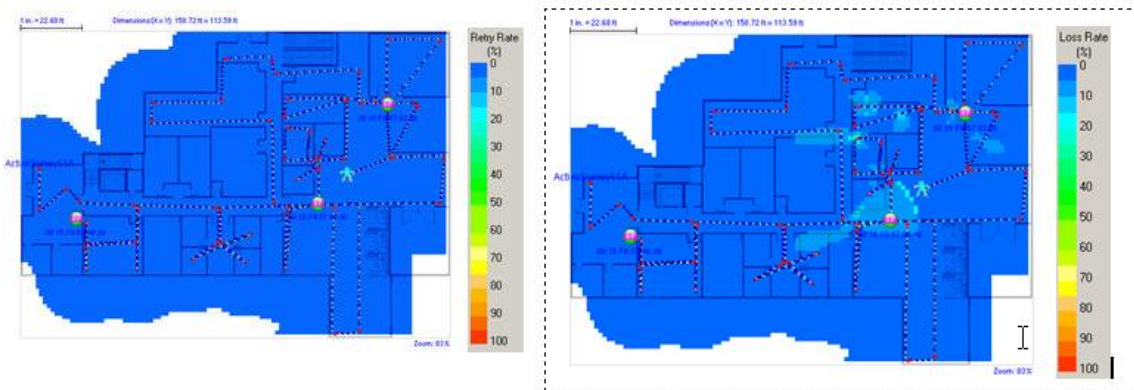


Figure: AirMagnet Survey’s packet retry and losses coverage map

- With professional site survey products, users can optimally design multi-floor environments and visualize the RF coverage bleed over across floors. As WLAN signals travel across floors, multi-floor deployments may not require APs on every floor, or the same number of APs on every floor or be deployed at the same location.

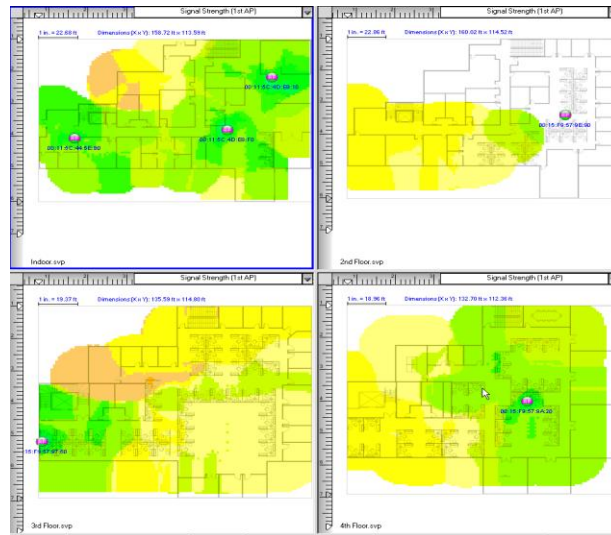


Figure: AirMagnet Survey’s Multi-view screen for multi-floor deployment

- Users can visualize changes in the environment over a period of time. Wireless is very dynamic and new users or applications or devices (including non Wi-Fi devices) introduced in the environment, could directly impact the coverage or performance of your WLAN. With AirMagnet Survey users can visualize the difference or changes using simple color codes in the industry’s only “Diff-view” screen. For example in the image below, the top window pane shows the differences between the 2 surveys that are being compared (coverage maps in the lower pane which could be at different points of time). It can be observed that on an overall basis, the signal levels in the network have become worse (indicated by the red color in the upper window pane) in this example. The green areas in the upper pane denote areas of signal strength improvement.

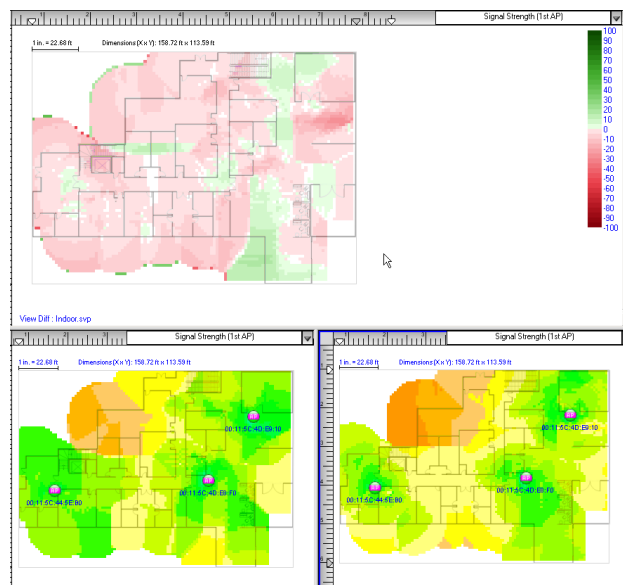


Figure: AirMagnet Survey’s Diff-view screen to compare 2 surveys

Conclusion

Today's user's including IT staff members at enterprise corporations, wireless service providers, managed-service providers, network infrastructure vendors all consider site surveys a mandatory and vital part of the wireless LAN deployment process for achieving the desired security, performance and compliance for the WLAN. With the AirMagnet Survey and Planner products, users can be assured of quickly deploying an efficient wireless network to satisfy their business requirements.

About AirMagnet

AirMagnet, now a part of Fluke Networks, is the leader in security, performance and compliance solutions for wireless LANs. The company's innovative products include AirMagnet Enterprise, the leading 24x7 WLAN security and performance management solution, and AirMagnet WiFi Analyzer — which is known as the "de facto tool for wireless LAN troubleshooting and analysis." Other products provide WLAN site survey and design, RF interference detection, remote diagnostics, and the world's first voice over Wi-Fi analysis solution. AirMagnet has more than 8,500 customers worldwide, including 75 of the Fortune 100. The company, based in Sunnyvale, California, USA, has offices worldwide. For more information, visit www.AirMagnet.com.