

Strategic Planning and Design for Application-Driven Wireless Local Area Networks

White Paper Series

Volume 3

Results-Driven Design for the Strategically Planned WLAN



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Introduction

The evolution of WLANs, from their initial status as a luxury or novelty to the current position as an essential element of a network architecture accommodating an ever-growing number of often very demanding applications were discussed in the first volume of this white paper.

This second volume of the series presented a process for determining an enterprise's WLAN requirements and the critical criteria that must be established in order to develop planning and design requirements necessary to implement a WLAN that will meet the enterprise's current and known future mobility requirements

The process of utilizing the criteria defined for the network's performance requirements and, delivering a plan and design for the wireless network, usually called a site survey will be examined in this volume of the white paper series. In this white paper we will examine the basic processes of a site survey, the methods and deliverables resulting from physical site surveys and the ability of predictive means to design and implement a WLAN capable of supporting the applications currently being wirelessly enabled in the enterprise.

The Site Survey

One of the purposes of a site survey is to determine a design for the physical placement of access points and antennas, selection and orientation of antennas, frequency reuse plans and access point output power levels optimal to providing a network that fulfills the requirements defined in the planning process discussed in the second volume of this white paper series. Capacity, coverage, density and the ability to roam and deliver QoS mechanisms, as defined in

About this White Paper Series

This educational series, Strategic Planning and Design for Application-Driven Wireless Local Area Networks, explores the evolution of wireless local area networks from their initial implementations to their current status as critical and necessary elements of IT networks and the planning and design process that is critical to developing a mobility platform that supports applications far beyond what were contemplated when the 802.11b specification was ratified in 1999.

The entire series is available at www.azuresol.com.

the planning process, are achieved through the creation and shaping of access point coverage areas by variations to power, antenna gain, antenna patterns and antenna orientation. Another equally important aspect of a site survey is the inspection and inventory of existing network electronics to which wireless network electronics interconnect and the collection of installation detail and requirements that are essential to a lowest cost, trouble-free and delay-free implementation. Information that drives bills of material and labor for cabling, jumpers and mounting hardware, installation details for mounting, power over Ethernet requirements, switch port and patch panel capacity and other details that are required for an efficient and effective implementation are collected at the site and ensure that engineers and technicians are able to deliver an interruption-free implementation.

Spectrum analysis is another essential component of a site survey. Physical obstacles are not the only kind of entities that can impact the strength and quality of an RF signal. Signals from other WLANs and wireless phones, microwave ovens and Bluetooth devices will have some impact on RF signal quality because they share the same RF spectrum as WLANs. Spectrum analysis will identify rogue and interference-causing equipment, after which decisions can be made to accommodate or eliminate the cause of such detrimental interference.

A kickoff meeting for a site survey is also a very beneficial element of a site survey. The goal of the meeting is to inform on-site personnel with the purpose of the survey team's purpose and presence, gain an understanding of rules for access, schedules, safety, security and identification of contacts for assistance, identify any planned or anticipated changes to the site with regards to the physical layout and expansion or applications which may not have been previously discussed and understand some of the building's characteristics that were not previously represented or understood, including such things as mezzanine coverage requirements, mounting height requirements, maintenance issues, danger areas, temperature variances, or the need for enclosures to protect the hardware.

Physical Site Surveys

After the kick-off meeting, the survey process begins with a spectrum analysis to determine the existence of interference and legacy wireless networks and the effect they may have on the

planned network. It must be known whether existing sources of RF signal must be accommodated or if they will be removed upon the implementation of the planned network.

Following the spectrum analysis, the onsite simulation of the planned network takes place. This process involves placing access points and antennas, selected and anticipated to be appropriate by a highly experienced engineer familiar with coverage patterns and gains, in locations identified as appropriate to achieving coverage, capacity and overlap sufficient to support fast roaming and accommodating implementation and end-user factors such as cabling, ease installation, access for maintenance, proximity to MDF/IDF locations and heights and locations necessary to avoid damage by personnel or moving assets.

Access points are tested with antennas appropriate to achieving access point cell coverage sizes suited for end-user capacity and reliability requirements, as well as cell shaping to minimize access point quantities and provide coverage for uniquely shaped spaces. After setting up the test access point and antennas, the access point's coverage contour (the point at which signal strength falls below that which will provide the desired capacity) will be mapped.

If the contour mapping proves that the access point and antenna placement will not provide suitable coverage, capacity or cell overlap, adjustments will be made to one or a combination of variables, including access point/antenna placement, antenna gain, antenna radiation pattern, antenna height and orientation, antenna polarization and access point power output level in order to achieve desired capacity and coverage.

Once it is determined that a proper placement and configuration has been achieved, the corresponding contour is mapped and the test equipment is relocated to the next adjacent location thought suitable, and the process is repeated and continued until the area for which coverage is desired has been tested in its entirety. Photographs of access point test locations may be taken for inclusion in the survey report and detail of channel setting, output power, antenna type, antenna height and orientation, RF jumper lengths and other relevant information required for configuration and implementation is recorded for inclusion in the survey report.

During the course of a physical site survey an inventory of existing and required switch, patch panel and power over Ethernet ports, AC power, cabling and patch cables is undertaken and the

requirement for additional components is identified and recorded for inclusion in the design deliverable.

Upon completion of the on-site survey and design, the information created and gathered as described above compiled into a final documentation package that is completed off-site and presented to the end-user upon completion. This documentation, both physical and electronic, typically includes:

- Spectrum analysis findings and recommendations
- Access point coverage contours, at appropriate signal strength threshold, overlaid on facility floor plans
- Photographs of access point and antenna test locations
- Configuration information such as access point channel setting, output power, switch/patch panel connection
- Equipment and material information such as antenna type, antenna height and orientation, RF jumper lengths and mounting hardware
- Other relevant information required for configuration and implementation such as installation location

A copy of one of Azure's actual WLAN site survey deliverables can be viewed at http://www.azureol.com/Azure_generic_sample_wlan_assessment.pdf.

Predictive Site Surveys

Predictive site surveys are software tools that utilize algorithms that predict WLAN performance, provide suggested access point locations and visualize WLAN performance.

With these modeling tools, the design engineer imports electronic floor plans, the desired performance of the WLAN, in terms of capacity and application, and assigns each wall, floor, ceiling, doorway, structure, piece of furniture and other building contents with an attenuation, or signal loss factor, after which the application populates the modeled environment with suggested access points locations presented in a visual format. Some of these tools then allow for the

adjustment of access point location, antenna selection and a number of other variables in order to address known issues with the suggested design and simulate alternative designs.

Summary

In more than ten years of designing, deploying and troubleshooting 802.11 wireless networks, Azure's engineers have utilized both physical and predictive site surveys in a wide variety of client environments, including healthcare, manufacturing, government, education and financial services.

In nearly all cases, a client's interest or preference for the use of a predictive survey method has been driven by the client's knowledge of the existence of predictive tools and the belief that this method will lead to a lower cost and shortened timetable for the survey and implementation, neither of which have proven to be true, except in the case of simple, coverage-driven WLANs using access points with integrated antennas in open, "carpeted" work areas where the concern for supporting specific applications does not exist.

While cost of a predictive study may be less than that of a physical survey due to the fact that the study can be performed anywhere, implementing a WLAN from the results of a predictive study is a much riskier proposition than implementing from a physical site survey and almost certainly results in a higher installation cost, with the total WLAN implementation cost being nearly the same. A predictive survey is performed by inputting data into a software tool while a physical survey takes place in the actual environment in which the WLAN will be deployed and a physical survey includes activities that are essential to a successful, lowest cost deployment that are not part of a predictive study, namely spectrum analysis and physical installation information. There being no question that spectrum analysis is critical to WLAN performance and success, the cost of an on-site spectrum analysis and physical installation requirements survey would need to be added to the cost of the predictive study in order to make an "apples to apples" comparison.

Predictive survey tools are, by their very name, predictive, and provide neither the certainty of a physical site survey nor the information which is available only through a physical site survey, including spectrum analysis, installation detail and requirements and bill of material for

installation and wired network electronics interface, all of which are essential to a lowest cost, trouble-free and delay-free implementation. No remote software tool can analyze the environment for interfering spectrum, and a physical site survey is the only way of determining requirements for bills of material for cabling, jumpers and mounting hardware, installation details for mounting, power over Ethernet requirements, switch port and patch panel capacity and other details that are required for an efficient and effective implementation. A predictive study conducted off-site simply can not provide this information, and installation technicians are likely to spend more in time acquiring installation information and materials than that which was saved as a result of choosing the predictive study.

The accuracy of the predictive method is also dependent on accurate input and knowledge of building materials, a subject at which most IT professionals are not proficient, knowledgeable or practiced. Also, this method assumes that the individual responsible for this data is fully aware of the composition of a wall or other surface that may be 20, 50 or 100 years old; only an actual simulation will provide 100% certainty as to the effect of any structure on a wireless signal. We have seen many hospitals where neither the IT staff nor the maintenance staff had any idea that the walls through which the RF signal was unable to penetrate were lined in lead. The cost of having IT and physical plant staff work to quantify and convey the composition of every wall, floor and ceiling is often more than the incremental cost of procuring a physical site survey.

The viability of predictive site survey tools is also often predicated upon the ultimate use of WLANs that utilize automatic fine tuning such as dynamic transmit output powers that would automatically adjust and compensate to overcome predictive design shortfalls. While these dynamic elements will allow the network to automatically compensate for predictive modeling shortcomings, dynamic transmit output power selection has proven to be extremely problematic in supporting advanced applications like voice, where a static and consistent RF environment is essential to network performance. A recent article in Network World magazine detailed the problems associated with voice and dynamic transmit output power. The article can be found at www.networkworld.com/newsletters/wireless/2006/1002wireless2.html

And, there are a number of areas in which even a sophisticated software tool is incapable of predicting what will happen. An example of this might be the effect on a client engaged in a wireless voice call and entering an elevator to go from the 4th to the 5th floor; a predictive model can not accurately foresee the effect of the closing elevator on the signal supporting the telephone call; only through an actual on-site simulation is it possible to gain knowledge of what is required to maintain this call as the user moves throughout his/her work day. No software tool is capable of predicting the effect of the closing elevator door and the movement of the elevator car throughout the elevator shaft.

Also, proponents of predictive methods, often WLAN OEMs, have also self-servingly advocated the concept of overpopulating the environment with access points under the pretense that this will provide a more robust network. However, such logic, while certainly flying in the face of basic economic tenets, fails to address the increases in interference resulting from such overengineering and overspending and resulting detrimental effects on roaming, which is critical for advanced services such as voice and session persistent-sensitive application delivery services like Citrix.

Most importantly, predictive methods do not provide guaranteed performance, as is customary with a physical site survey provided by a reputable, wireless-proficient service provider. Our engineers have worked with clients across the country that have spent hundreds of thousands of dollars implementing WLANs based on predictive study designs who have come to realize their design was nothing more than the prediction of their service provider without any guarantee for performance. In all fairness, the provider of the predictive study and the WLAN may not have been wireless-proficient nor known any better, but the bottom line is that significant investments were made on WLANs that are incapable of performing as desired and there is no avenue for recourse for those who made these investments.

While predictive studies are capable of providing an improved level of predictability for the quantity and placement of access points over the old and proven-to-be-deficient method of drawing circles on a floor plan that was, and in some cases, remains a practice for designing WLANs, they remain incapable of providing fundamental elements and information that is required for the implementation of an enterprise-class WLAN meeting current trends for WLANs capable of supporting business applications at the lowest total cost of ownership.

In the fourth and final volume of this white paper series, we will discuss a strategy for deploying a WLAN that meets current requirements and can be upgraded, without interruption, obsolescence and the cost of suffering the “rip and replace” scenario that has plagued the early adopters of WLAN, to meet the demands of future applications.

About Azure Solutions

Azure WirelessSolutions IT systems integrator that specializes in providing its clients and partners with wireless networking solutions that include wireless local area networks, point to point and point to multipoint wireless links and wireless wide area networks, as well as applications like telephony, video, real time location systems and manufacturing control systems that are enabled for mobility by wireless networks. Services include planning, site survey, design, spectrum analysis, project management, implementation, testing, support, maintenance and troubleshooting.

Providing solutions and services across the US, Canada and Mexico, Azure's clients include such enterprises and organizations as General Motors, Honda America Manufacturing, Kellogg Company, Whirlpool Corporation, Trinity Health, Ann Arbor Public Schools, Spectrum Health, Toyota Motor Corporation, SC Johnson, the University of Michigan, the American Cancer Society and the United States' Departments of Treasury, Defense and Energy.

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