

WHITE PAPER

# How to Make Your Wireless LAN Work:

Design for Context, Coverage & Capacity

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## WLAN Design Challenges

“I’m just starting to develop a wireless network infrastructure, and my executives have high expectations for a quick return on investment and excellent quality of service.” – *RF Engineer*

“I implemented a WLAN on a trial basis, and now I need to expand the network to the entire company including introducing business critical applications.” – *Wireless Network Manager*

“My WLAN is nothing but a headache with users constantly complaining about having no service or dropped calls on our voice over Wi-Fi system.” – *IT Manager*

“We have been implementing wireless networks, but the time and cost involved in conducting a site survey makes our bids uncompetitive, and the resulting networks often do not provide the performance expected by our customers.” – *Systems Integrator*

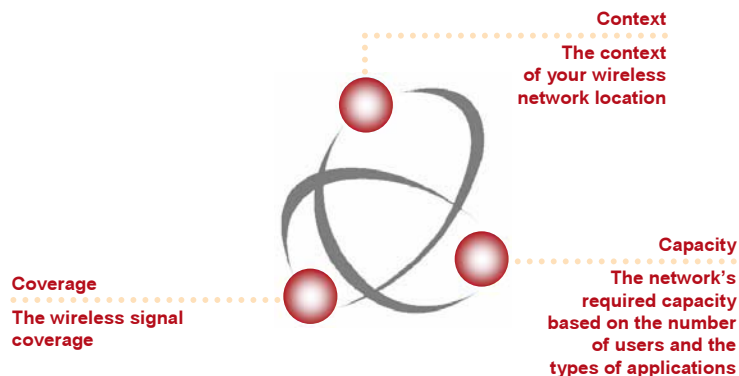
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## Consider the Three “C’s” When Creating a Network Design

While the above real-world situations may not appear to have any common aspects, they indeed do. Many people believe you can install wireless networks without spending much time on planning and designing the installation. While these hastily installed wireless networks might perform well enough for basic e-mail and web access, they are not sufficient for large numbers of users, challenging environments like healthcare and retail facilities or more demanding wireless applications such as voice-over Wi-Fi (VoWi-Fi) or high volume financial transactions.

How can you create a wireless network that will meet your capacity and quality of service (QoS) expectations? Some organizations recommend that you just place access points (APs) in a grid, turn them on and add more APs as you discover problems. Others recommend a site survey method where you place APs in a small portion of the environment and then collect measurements of the wireless signal provided. Neither of these methods will create a WLAN with the performance required.

The three “C’s” of creating a network design



## Context—How Will Your Environment Affect Your Wireless Signal?

The first issue to consider is the context of your wireless network design. You must take into account the composition and contents of your facility, such as the location of walls, doors, stairwells, windows and partitions, the construction of those materials and electronic interferers. These factors can have significant impact on wireless signals, allowing them to spill outside the building, weakening them, causing interference or even blocking them entirely creating dead zones.

## Designing for Coverage—Issues and Limitations

Now that you understand the importance environmental context plays in your wireless network design, you must consider this context in relation to the coverage provided by your WLAN.

Wireless coverage is the area around an AP within which a client can connect to the network. The importance of coverage really depends on the type of applications you are running. For example, if you move from your cubicle to the conference room, your email connection may drop due to a coverage hole—a minor annoyance. Dropping a voice call, however, would be unacceptable, especially if the call was to a key customer. Do you want coverage in the parking lot, or just the office cubicles? Is it important to cover the stockroom as well as the produce aisle? Do you want coverage in the hospital lobby as well as the nurses' station?

Because APs use radio waves, there is a limited coverage area surrounding the AP. You may discover that most AP manuals show circular coverage areas of a specific radius. Unfortunately, this is misleading because AP coverage is typically not circular or uniform. Why? As we discussed earlier, walls, tinted glass windows, metal shelving, ceilings, and other physical obstructions can block or impede the wireless signals—a critical factor often overlooked during the WLAN design process.

## Traditional Design for Coverage is Costly and Unpredictable

Many wireless networks are deployed using trial-and-error AP placement. As coverage holes are detected, network designers add new APs—a costly and unpredictable process. Some designers place APs in a regular pattern or grid to eliminate coverage holes. Unfortunately, this approach does not take into account the building context and may provide WLAN services to areas where you may not want them, like outside your building.

Another commonly used WLAN design method uses site survey devices to measure wireless signal strength. Network designers install test APs, then walk around measuring the coverage area. In reality, this technique is both exhausting and nearly impossible to predict precise AP requirements.

*Even though you may have 100% wireless coverage in your target area, your WLAN may not have enough capacity to keep users connected and productive.*

Keep in mind that site surveys are only as good as the collected data. If you require coverage in a given area, you will have to collect readings in that area. Otherwise, the obstructions in the physical environment may block wireless signals. Since the environmental context plays such a major role in determining coverage, the site survey approach falls short.



## Designing for Capacity— A Must for Today's WLANs

What is capacity and why is it important? Wireless network capacity is the maximum amount of data or number of users that can simultaneously be on the network. The more users on the network, the more data you can expect the network to carry. Like cellular telephone networks, if the amount of data the network must carry exceeds its capacity, problems such as packet loss, timeouts, or loss of connectivity will occur.

Because each AP has a maximum bandwidth, the total bandwidth divides across the number of users currently using that AP. Each new wireless device connecting to the AP causes the total bandwidth available for each user to shrink. This is especially critical when users add high-bandwidth applications such as VoWi-Fi or streaming media.

## Designing for Capacity is Not an Easy Task

Designing for capacity is far more complex than designing for coverage. Of course, all of the same challenges posed by the context of the physical environment still apply.

Then you need to consider three things: the number of people the network will service, the user locations, and what applications they will use. For example, let's say that you expect 20 engineers in the cubicle area will need e-mail and web access, while five users in the sales office will need VoWi-Fi service. Since all applications require a certain bandwidth, the number of application users in a given area defines the total bandwidth requirement. To satisfy high-bandwidth requirements, you can place APs with overlapping coverage, thus increasing the available bandwidth within the overlap area. However, this also introduces the chance for intra-network interference, as APs whose coverage overlaps can interfere with one another if you do not take the proper care in assigning channels to the APs.

In summary, iterative trial-and-error AP placement and exhaustive site surveys make the traditional WLAN design process unrealistic for networks targeted for high-bandwidth or real-time applications. In fact, you may find that the labor costs associated with these iterative approaches may be higher than the actual WLAN equipment costs.

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*Fortunately, there is a wireless network design solution that allows you to consider the context of the environment and predict coverage and capacity before deploying hardware resources.*

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## Take Control of Wireless Network Design

The only way to solve the WLAN design challenge is to use a predictive design approach that leverages knowledge of the context of the environment, the area to be covered and the intended use of the network.

Decades of research have led to the development of predictive design software for simulating the coverage area and capacity of wireless devices when physical environmental context is available. These techniques are some of the most effective ways of planning AP placement that guarantees WLAN coverage, signal quality, capacity and overall QoS.



## Designing A Wireless Network

The WLAN design process begins by importing data about your facility into Motorola's LANPlanner® software. Import formats include CAD files, scanned images, and digital pictures. Next, you take into account the environmental context by tagging each wall in the facility map with material types such as sheetrock or brick from a library of common building materials. Then, you place APs within the site map and simulate the coverage areas. The software is designed to predict the effects of physical obstructions and visually displays a coverage strength map.

The network designer can adjust the design to address identified coverage holes. Most importantly, this software makes designing for capacity efficient and predictable. To do this, you simply indicate expected client locations and application requirements within your environment. With this information, the LANPlanner simulation engine predicts if the network capacity is sufficient given the current equipment placement and configuration. This allows you to quickly determine whether your existing network design can sustain high data rate applications and meet the needs of your subscribers.

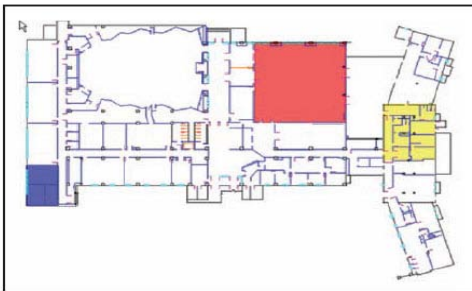


Figure A

**Figure A** shows the designation of the unique user requirements. The red area will serve 200 Internet users in a conference hall. The yellow area will need to handle four users with streaming video and six employees using email, and the Internet will be in the blue area.



Figure B

In **Figure B**, the software has evaluated the impact of both the building environment and the user requirements to recommend the best placement of APs in the facility. The color contours represent different signal power levels, with green indicating the signal will be sufficient to service the applications and users in the various regions.

With LANPlanner, you can solve your WLAN context, coverage and capacity challenges by generating design guidance based upon location, number of users, bandwidth requirements, and physical obstructions. Now you can design and deploy your wireless network with confidence and ease.

For more information about the Motorola's LANPlanner solution, go to [www.motorola.com/enterprise](http://www.motorola.com/enterprise).



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