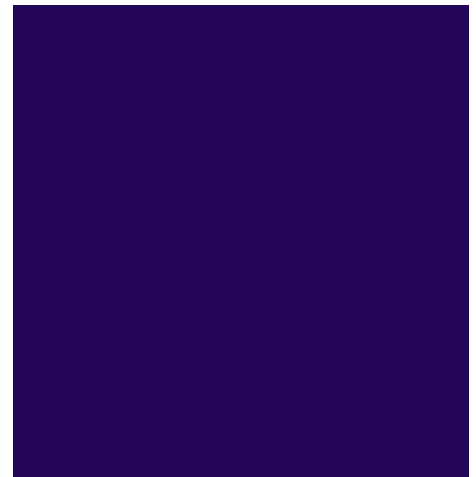


WHITE PAPER

Implementing Voice Over Wireless Networks: Realities and Challenges

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Implementing Voice Over Wireless Networks: Realities and Challenges

Voice over Wireless Fidelity (VoWi-Fi) presents wireless network designers with a difficult challenge because introducing high bandwidth wireless applications such as VoWi-Fi can cause wireless networks to suffer a loss of Quality of Service (QoS), and in many cases, fail.

This is important today because, according to a January 2006 report by Infonetics Research, “WiFi phone units grew 112 percent between 2004 and 2005 and will grow 158 percent in 2006.”

The cold reality is that ad-hoc design methods and site surveys are insufficient for wireless networks supporting high volume applications. Making matters worse, Radio Frequency (RF) interference, RF noise, and the physical environment dramatically affect wireless coverage and capacity. These challenges become exponentially more difficult to solve as the wireless network grows in size and complexity.

The approach used to plan the wireless network can be the difference between a successful project and one fraught with problems. Many companies are now finding that the optimal way to address VoWi-Fi coverage and capacity is through intelligent wireless network design. Following is a review of some of the challenges, and potential solutions, for implementing VoWi-Fi coverage.



The Physical Environment & VoWi-Fi

If you are experienced with wired networks and plan on implementing VoWi-Fi, you must consider several issues. In a wired network, you can simply plug into a LAN socket to achieve connectivity. In a wireless network, seeing the wireless access point (AP) does not necessarily mean that you can actually connect to it and achieve acceptable QoS.

Unlike a wired network, a wireless network depends on RF signal quality and network availability for communication. You must take into account the layout of your facility, such as the location and construction of walls, doors and windows. These factors have a significant impact on wireless signals, causing them to leak outside the building, weakening them, causing interference, or even blocking them entirely, which creates coverage holes.

Because wireless communications relies upon RF signals, there is a limited coverage area surrounding the AP. You cannot expect a uniform wireless coverage pattern due to the physical environment shaping the signal. Walls, tinted glass windows, metal shelving, ceilings, and other physical obstructions block or impede wireless signals—a critical variable that you must take into account to achieve optimal VoWi-Fi performance.

Capacity and VoWi-Fi

When compared to a typical wired network, a wireless network has a lower bit rate, generally 11Mbps to 54Mbps. This means that wireless networks provide less total capacity than a wired network.

What is capacity and why is it important for VoWi-Fi? 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 exceeds the network's capacity, roaming VoWi-Fi users will experience dropped or blocked calls.

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 bandwidth intensive applications such as VoWi-Fi.

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 channel interference, which brings us to the challenges of meeting VoWi-Fi signal-to-interference ratio (SIR) requirements.



Adding to the Challenge — How SIR Affects VoWi-Fi QoS

For VoWi-Fi applications to work properly, your wireless network must meet minimum RF quality levels. Specifically, VoWi-Fi phone manufacturers typically recommend that the wireless network maintain a 20-25dB SIR to ensure high QoS.

For those new to wireless, SIR is the ratio of RF signal strength on a given frequency to the signal strength of another transmitter, such as an AP, broadcasting on the same frequency. An AP receiving a VoWi-Fi signal must detect signal strength 20-25dB greater than the signal strength of the surrounding APs to guarantee QoS.

SIR becomes even more important when you have APs with overlapping channels. The most commonly used wireless network frequencies, 802.11b and 801.11g, have three unique channels on which APs can operate without any overlap of signal. Adding a fourth AP into a coverage area introduces channel interference because one of the frequencies must be re-used. Consequently, you must properly assign the channels and power levels so that the AP interference is minimized.

Another major variable affecting VoWi-Fi QoS is the signal-to-noise ratio (SNR). SNR is the ratio of RF signal strength to the background RF noise. This background noise, commonly called the environment's "noise floor" is generated by several sources including the AC grid, equipment in the building, and other unidentified sources. High RF noise levels are typically found in "RF unfriendly" environments like medical facilities, which contain large amounts of electronic equipment. You must take into account SNR and SIR during wireless network design to guarantee high VoWi-Fi QoS.



VoWi-Fi—Why Traditional Methods Fail

There are several commonly used methods for implementing a wireless network, but many of these techniques do not address all of the issues associated with VoWi-Fi.

Ad-Hoc Design

The ad-hoc wireless design method is to place APs into a dense grid. When QoS issues arise, you then add more APs. Unfortunately, this method is not cost effective and may actually cause more problems than it solves. Specifically, there is no way to determine how many APs will ultimately be required to achieve high VoWi-Fi QoS.

Because ad-hoc methods do not take into account the physical environment, you may be sending wireless services to areas where you may not want them, outside your building for instance. In addition, the SIR 20-25dB requirement still applies and is even more difficult to solve given the unpredictability and close proximity of ad-hoc AP placement.

Site Surveys

Wireless design methods, like site surveys, attempt to quantify the effect of the physical environment on wireless signal coverage through direct measurement. With this approach, APs are placed in a limited area, and then a site survey is performed by walking around and collecting wireless signal measurements. A site survey only indicates signal activity at that location and at that moment in time; it cannot identify the dynamics of capacity issues such as VoWi-Fi callers jumping on and off the network.

Connection Limiting

Many wireless network designers attempt to solve VoWi-Fi capacity issues by limiting the number of users per AP. The reality is that VoWi-Fi users will be roaming around the building, requiring a continuous connection. Without having visibility into the anticipated number of users, the impact of high-traffic regions, or the impact of coverage overlaps on SNR, this connection limiting approach makes QoS suffer from the dynamics of capacity fluctuations and RF quality issues.

Self-Healing Networks

A recent addition to the network designer's toolbox, self-healing wireless networks attempt to solve SIR, SNR, and coverage issues by dynamically configuring AP channel settings and power levels. If the self-healing process does not yield acceptable VoWi-Fi QoS, then more APs must be installed.

Because self-healing techniques are not aware of the impact of the physical environment, channel and power setting adjustments can form coverage holes or send wireless signals outside the building. This places the wireless network in a continuous state of QoS flux since the AP settings are constantly changing to meet requirements.

In summary, these wireless design methods are often insufficient for networks targeted for VoWi-Fi applications. In fact, the labor costs associated with these iterative approaches may actually be higher than the wireless network equipment costs.



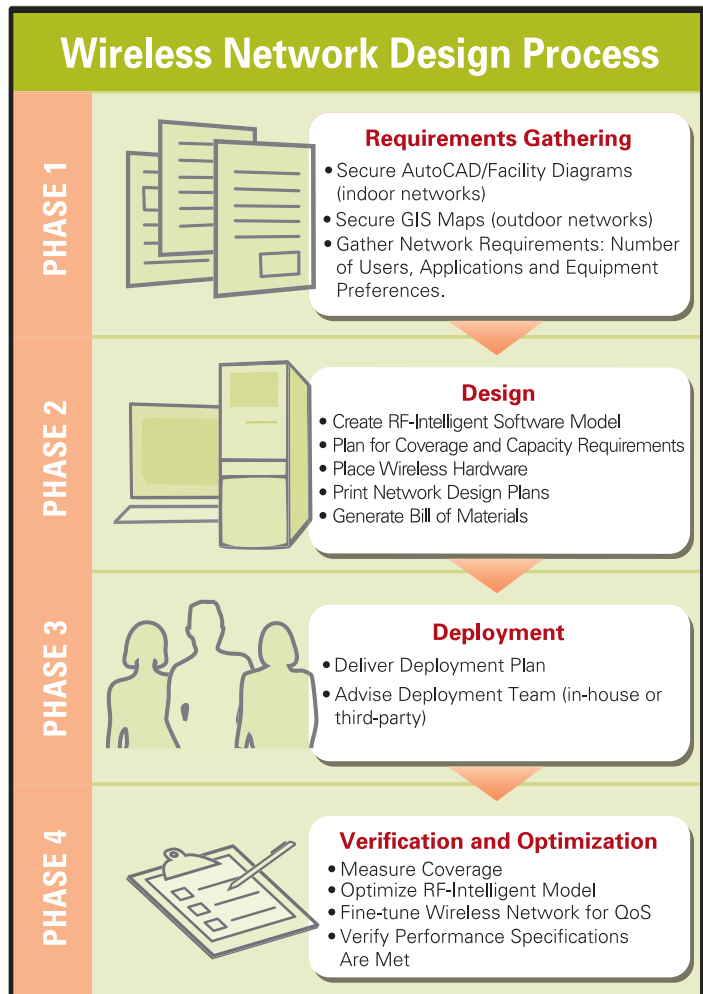
Meet Your VoWi-Fi Challenge with Predictive Simulation

For many companies, wireless network design using predictive simulation software has become the optimal way to solve the VoWi-Fi coverage and capacity challenges. This method approaches the problem by looking at all of the variables that go into the network: the physical environment, SIR/SNR, signal coverage, and VoWi-Fi capacity requirements. Then, the software uses highly accurate simulations to predict and visualize the wireless network's performance. Predictive simulation accommodates all of the RF variables and unknowns in advance, so that when the wireless network goes live, high VoWi-Fi QoS is assured.

With this innovative approach, the wireless network design process begins by importing data about a company's facility into the software. The designer then tags each wall in the facility map with a material type such as sheetrock or brick from a library of common building materials, places APs within the map and simulates the coverage areas.

The software predicts the effects of physical obstructions and visually displays a coverage strength map including SIR and SNR dB gradients. With this information, AP placement and channel settings can be adjusted to satisfy the 20-25dB SIR requirement.

Most importantly, the software makes designing for VoWi-Fi capacity efficient and predictable. The designer simply indicates expected client locations and bandwidth requirements within the environment. With this information, the simulation engine predicts whether the network capacity is sufficient given the current AP placement and configuration.



Predictive Simulation In Action

Whether designing a new wireless network for VoWi-Fi or planning the upgrade of an existing network, predictive simulation software is invaluable in ensuring the network will provide the QoS required.

Creating a New Network

Figure A shows the designation of the expected client locations and bandwidth requirements. The blue area, which covers the entire floor, requires web/email capabilities for 80 users; the yellow area will also serve 25 VoWi-Fi users.

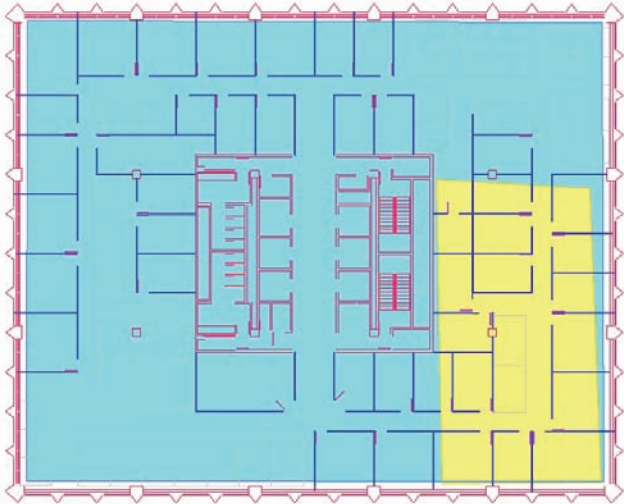


Figure A

In Figure B, the software evaluated the impact of both the building environment and the user requirements and recommended the best placement of APs in the facility. Note that multiple APs have been located in the VoWi-Fi area to provide the capacity and coverage necessary for those users. The color gradients represent different signal power levels and show that the signal will be sufficient to service the applications and users in the various regions. The center area, which contains stairwells, lavatories and elevator shafts, does not have coverage as it is not required in those areas.

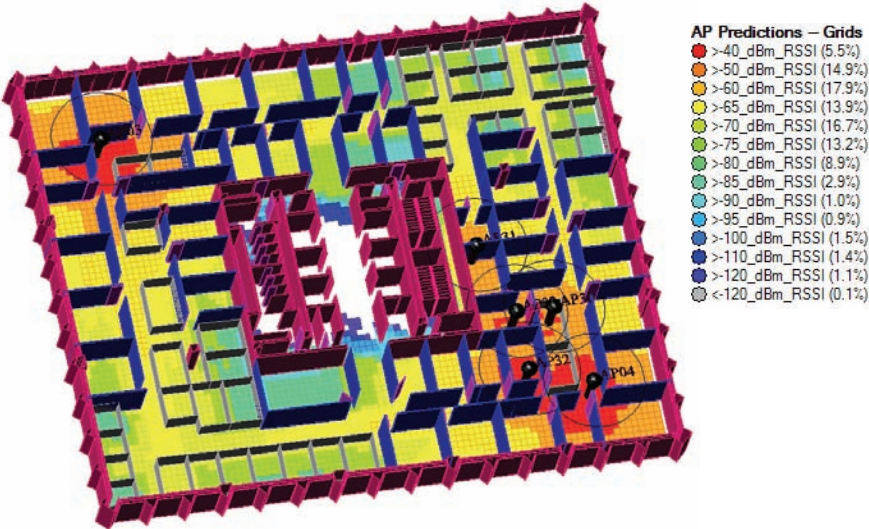


Figure B

Upgrading an Existing Network

Many companies have implemented wireless networks for data centric applications such as email and are now considering adding VoWi-Fi. **Figure C** shows a data based network containing two APs and the impact of adding 25 VoWi-Fi users in the lower right hand corner of the office. The red color indicates there is a high risk that the current network will not meet the VoWi-Fi bandwidth requirements.

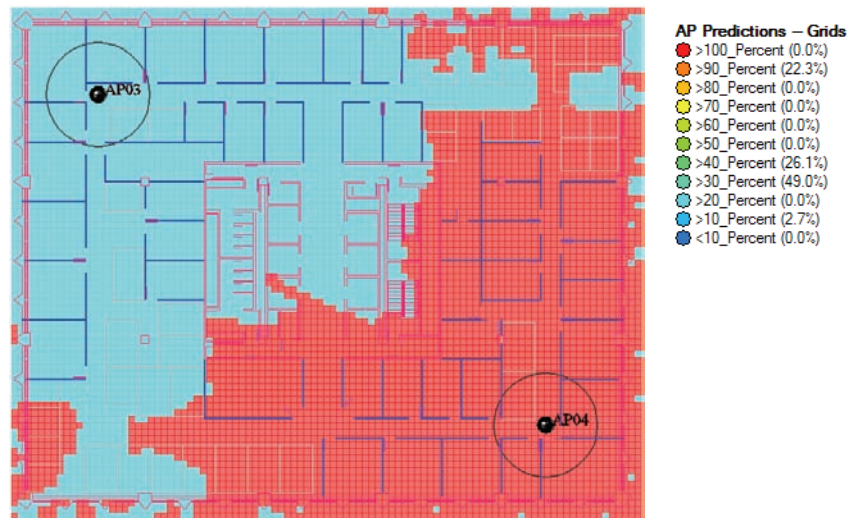


Figure C

Figure D shows the recommended AP placement along with the expected utilization. The software has not only added APs for additional capacity, but also has automatically assigned the channel and power settings to minimize interference. To complete the installation of the network, the software provides reports that can be supplied to the deployment team as well as the ability to collect measurements on site to confirm and fine tune the network performance.

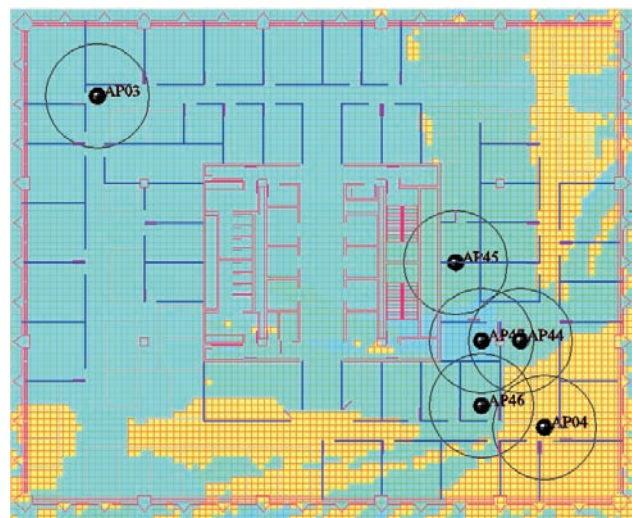


Figure D

Conclusion

The quality of service provided by a VoWi-Fi system is highly dependant on the underlying wireless network. The network must be planned with the proper amount of bandwidth and coverage and take into consideration the impact the environment has on wireless signals, or problems like signal choppiness, echo or call drop out will result. Organizations that use predictive simulation technology can quickly determine whether a network design can sustain high data rate applications and meet the needs of the most demanding VoWi-Fi users.



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