INTERCONTINENTAL MARK HOPKINS

Strong Wi-Fi Keeps Guests Coming Back

CASE STUDY

COMPANY OVERVIEW

Opened in 1926, the InterContinental Mark Hopkins hotel is a historic 19-story high-end luxury property with 380 guest rooms, 20 meeting rooms and over 215 staff. The Mark Hopkins hotel is constructed of thick metal lathe walls with concrete plaster, making the propagation of Wi-Fi signals extremely difficult.

REQUIREMENTS

- Eliminate dropped connections and unstable performance for Vocera voice over IP system
- High-density Wi-Fi support for meeting rooms
- Solve inter-cell Wi-Fi roaming problems
- Central management for Wi-Fi APs
- Deploy Wi-Fi system that could automatically mitigate Wi-Fi interference
- High-gain directional Wi-Fi system that eliminated co-channel interference and only generated signals where needed
- Remote management of WLAN controllers over a wide area network

SOLUTION

- 38 Ruckus ZoneFlex 2942 Smart Wi-Fi 802.11g APs
- One Ruckus ZoneDirector 3050 Smart WLAN controller

BENEFITS

- More consistent voice quality
- Eliminated clicks, pops and other audible voice impairments
- Reduced jitter/delay
- Dropped connections minimized
- Better Vocera system performance
- Stronger, more reliable Wi-Fi signals
- Centralized management of Wi-Fi system

THE MARK HOPKINS MAKES THE RIGHT CALL ON VOICE, SOLVING NAGGING CONNECTIVITY ISSUES WITH SMARTER WI-FI

The staff at the world-renowned InterContinental Mark Hopkins hotel in the Nob Hill district of San Francisco were less than thrilled with their new push-to-talk VoIP communicators that were supposed to make everything easier. But it wasn't the fault of the cool, Star Trek-looking communication badges, it was the Wi-Fi network.

While Wi-Fi was being used throughout the hotel for common high-speed Internet access (HSIA) services, Mark Hopkins' IT Director wanted to use the technology to make hotel services more productive and efficient for the 215 staff dedicated to making guests wildly happy.

The initial Wi-Fi network was originally designed to deal with the issue surrounding guest Internet access. The interior walls at the Mark Hopkins were constructed of thick metal lathe core with concrete plaster. This severely restricts the penetration of wireless signals. Faced with the choice of deploying more access points (APs) for better coverage or fewer APs with a stronger signal, the hotel added RF amplifiers and 5dBi cone antennas to its legacy 802.11g access points. And this did the trick, until voice came calling.

Robert Cantrell, IT Director at the Mark Hopkins, had acquired a Vocera voice communications system for security, engineering, housekeeping, food service and other customer-facing staff. The Vocera system provides instant one-to-many (push-to-talk multicast) as well as one-to-one (unicast) communications between staff members. It also interfaces with the hotel's work order system. Equipped with these communicators, front-desk staff, for instance, can quickly alert other staff to special guest needs, immediate tasks that needed attending and other communications essential to providing the superior service expected from a luxury hotel such as the Mark Hopkins. But when the system failed to deliver and staff started to defect.

"When the system started to consistently fail, some groups within the hotel refused to use it because they had heard about the problems," said Cantrell. "Our initial assessment was simply to add more APs with high-gain amps and antennas in areas without coverage. But that didn't fix the problem. In fact, we ultimately found that interference, not coverage, was the main culprit." Frustrated, Cantrell commissioned an RF analysis to see how to best fix the problem. The analysis concluded a number of issues causing poor VoIP over Wi-Fi:

WEAK SIGNAL LEVELS

There were numerous areas where wireless signal levels were falling below the recommended minimums for voice over wireless. However adding more high-gain access points wouldn't solve this problem. Increasing the effective

"We really needed an intelligent Wi-Fi system that could efficiently manage the RF environment and automatically cope with interference that was causing jitter and packet loss—a big problem for voice over wireless.

The Ruckus system has allowed us to kill two birds with one stone achieving greater client density within our meeting rooms while simultaneously giving us better performance and more reliable connectivity for our voice application."

ROBERT CANTRELL
IT Director, InterContinental Mark Hopkins

RF power beyond a certain level, while suitable for Internet guest data access services, introduced increased receiver noise and creating coverage cells that are were too large. With voice, coverage wasn't the issue, interference and roaming problems took center stage. VoIP handsets were not receiving sufficient signal to and from access point to which they're associated to maintain an acceptable voice quality or VoIP connection. Meanwhile the range of individual access points was excessively large causing a great deal of interference to neighboring APs which resulted in increased retries and packet loss.

TOO MUCH NOISE DEGRADING VOICE CALL QUALITY

The hotel's environment had a number of noise sources including cordless phones or other cordless communication devices (Bluetooth headsets, for example) as well as interference from microwave ovens. In turn, the signal-to-noise Ratio (SNR) in many parts of the hotel was well below the recommended specification for wireless Voice-over-IP (VoIP).

ROAMING PROBLEMS

At the point where a mobile VoIP user crosses from one coverage cell into the adjacent coverage cell the hotel's wireless VoIP communicators had to roam (reassociate) to the new cell's access point. This handoff process introduced degradation in the voice call. The existing wireless network was based on autonomous, stand-alone access points with no central management system to arbitrate or optimize inter-AP handoffs with "preemptive roaming."

Wireless VoIP systems, such as Vocera, specify an optimal signal strength of -65dBm to assure 54 Mbps 802.11g operation. Operating specifications consider -75 dBm with 11Mbps 802.11b connectivity to be the minimum acceptable level although call quality can be expected to degrade at lower connectivity rates.

In addition to signal strength specifications the Signal-to-Noise Ratio (SNR) and adjacent coverage cell overlap needed to be considered. SNR greater than 25 dB was recommended for best call quality.

Minimum recommended SNR for wireless VoIP is 19 dB with 1 Mbps 802.11b connectivity for lowest usable call quality. When SNR drops to less than 10 dB connections across an 802.11 wireless LAN begin to degrade and less than 5 dB is considered unacceptable.

It was also recommended to eliminate the high-gain amplifiers for this application that caused excessive overlap between Wi-Fi APs therefore creating co-channel interference. It was recommended that adjacent coverage cells overlap by no more than 15 to 20 percent.

"We really needed an intelligent Wi-Fi system that could more efficiently and automatically cope with interference that was causing jitter and packet loss—a big problem for voice over wireless," said Cantrell.

Cantrell noted Vocera badges transmit at much lower power levels than other wireless devices. So while the Wi-Fi signal from the APs to the badges might be acceptable, the Wi-Fi signal from the badges to the APs were consistently weak. This uplink communication is critical because the Vocera system depends on clear voice commands from the badges to the APs.

They needed the Wi-Fi signal from the APs to these devices to be strong while keeping receive sensitivity of the APs high—all without causing interference that might degrade voice quality.

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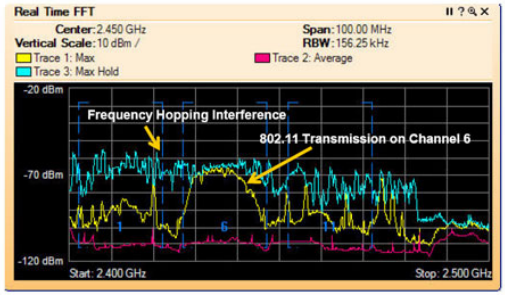

Figure 1. A spectrum sweep showed background noise energy peaked above the typical 802.11 signal envelope. During worst-case noise conditions the 802.11 connection experiences momentary dropouts causing "choppiness."

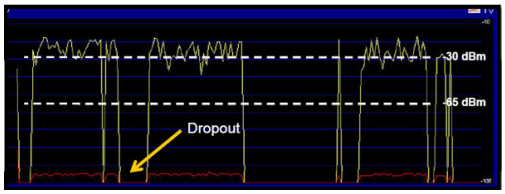

Figure 2. Signal strength over time measured near the edge of a coverage cell at the Mark Hopkins. The client device reporting the signal level was stationary. The "dropouts" were the result of the noise and interference in the environment causing a momentary disruption to the perceived signal level. As a result of environmental characteristics, even very strong received signals (-30 dBm) periodically experience complete dropouts.

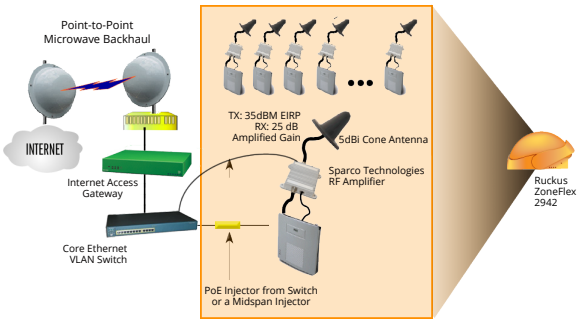

Figure 3. To support its Vocera VoIP over Wi-Fi application, the Mark Hopkins initially installed Cisco 1200s with RF amplifiers and 5dBi cone antennas. After RF noise was discovered to cause dropped connection, jitter and delays, the Mark Hopkins replaced them with Ruckus ZoneFlex 2942 Smart Wi-Fi APs that provide automatic interference mitigation and rejection.

"We definitely had some competing requirements with Wi-Fi, given this particular application," said Cantrell. "And finding an elegant solution was a big challenge."

"With other wireless LAN systems you can only increase or decrease the power on the APs, you can't shape the signal," said Cantrell, "The Ruckus APs were unique in their design with 12 different antenna elements that could be combined to provide thousands of different antenna patterns that direct the RF energy only where it's needed for any given wireless transmission at the proper power level. This is precisely what we'd hoped for. We were looking for consistency and continuity. And we found it.

Cantrell ultimately replaced the existing APs in the "back of the house" and within the meeting rooms with Ruckus ZoneFlex 2942 along with a centralized ZoneDirector controller.

The Ruckus Smart Wi-Fi system integrates a high-gain directional antenna array in every AP that forms and directs Wi-Fi signals only where needed. Meanwhile, automatic interference avoidance technology rejects unwanted RF noise by ignoring RF energy from other devices that would otherwise degrade performance. This same antenna technology is used to focus reception of faint signals from devices that would otherwise not be heard.

Since the Ruckus Smart WLAN system was installed, the erratic behavior of the voice system has been stabilized and groups in the hotel that previously refused to use the system have now adopted it.

"A unified communications system within the hotel with all groups is essential," said Cantrell. "Once we got all the issues resolved, we saw the system adopted by groups within the hotel that had previously stopped using it."

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