CASE STUDY: IN-BUILDING WIRELESS TESTING

Most wireless traffic—especially data traffic—originates indoors. However, wireless macro networks often provide inadequate coverage and capacity for in-building venues. In-building wireless systems, such as Distributed Antenna Systems (DAS), can fill the gap by adding both coverage and capacity. In-building DAS systems need accurate testing before, during, and after deployment to ensure that the network meets performance requirements.

Challenge

Multiple network operators often share the same in-building network infrastructure, owned by a single operator or a neutral host. This means that, when hired to test an in-building network, PCTEL RF Solutions may need to test a large number of wireless network technologies, channels, and bands in a single project. Meanwhile, test engineers may have limited access to the facility. Any delay in attaining accurate test results can delay completion of the project and potentially increase costs.

With years of experience testing wireless networks, PCTEL's network engineering services team knows the value of high-quality test equipment. However, as the wireless industry has increasingly focused on in-building coverage and capacity, two new challenges with test equipment specifically related to multi-technology in-building networks have emerged:

1) **Limited Ability to Collect All Measurements in a Single Walk Test**

2) **Inaccurate In-Building Measurements of CDMA/EV-DO Network Technologies**

Solution

The SeeHawk® In-Building Test Suite (IBTS) is a complete solution for in-building baseline and optimization testing for planning, building, and maintaining in-building wireless systems. At its core is a PCTEL SeeGull® MX, EX*flex* or EX scanning receiver. The SeeHawk software with Indoor Mode Option makes it easy to collect and visualize data on a tablet or laptop. Finally, PCTEL's In-Building Walk Test Kit includes a backpack, battery and accessories designed to enable engineers to easily walk test in-building venues. Equipped with the IBTS, the PCTEL RF Solutions services team has been able to overcome the key challenges to multi-technology in-building testing and reduce costs while quickly delivering accurate in-building testing results.

Convention Center in Major U.S. City

Challenge: Collecting All Measurements in a Single Walk Test

PCTEL was hired to test a DAS deployment in a convention center in a major U.S. city. The convention center, with over two million square feet of floor space, was one of the most complex DAS networks PCTEL had yet encountered. It served five wireless operators using five different wireless technologies across multiple channels, for a total of 39 separate operator/technology/band combinations, each of which required a separate measurement. If the test equipment could not conduct all of these measurements at once, PCTEL would need to gain access to the building again and re-walk the building. This would have resulted in project delays and added costs for the customer.

Solution: SeeHawk IBTS with Multi-Technology SeeGull MX

The SeeGull MX scanning receiver is specifically designed for multi-technology networks like the convention center DAS. It has the power to process a high number of channels from an unlimited number of operators on up to 6 wireless technologies. Its measurement concurrency feature allows it to collect data on all of these channels quickly by processing multiple technologies in parallel.

Despite the unprecedented load on the scanning receiver, PCTEL had no trouble collecting the measurements in a single walk test using the SeeHawk IBTS with the SeeGull MX multi-technology scanning receiver. “The MX could handle all 39 measurements that the customer requested,” said Bob Joslin, PCTEL’s Vice President of Engineering Services. “Its efficiency was unprecedented in my 25 years of RF engineering experience”. As a result, PCTEL’s customer saved approximately 4x the labor costs that would have been required if a conventional user equipment-based testing system was utilized (see Table 1).

Table 1 - Estimated Walk Time and Typical Labor Costs for a 2 Million sq.ft. Convention Center.

Convention Center	SeeGull MX	Competitor UE-Based System
Measurement Sets Per Walk	27 or more	8 (maximum)
Wireless Network Operators Per Walk	5 or more	4 (maximum)
Walks Needed	1	4
Total Walk Test Time	1 day	4 days
Typical Labor Costs @ $3,000/day	$3,000	$12,000

Landmark North American Office Building

Challenge: Accurate CDMA/EV-DO Measurements

A new DAS installation was planned for a landmark North American office building. As the building is also a major tourist attraction, the DAS needed to serve both office employees and the large number of visitors who pass through every day. The DAS needed to be carefully designed and optimized to meet all of these users' needs across multiple operators' networks using a variety of wireless network technologies.

PCTEL was hired to conduct initial measurements of existing cellular propagation, known as baseline testing. These measurements would be used in the creation of the DAS network design. Optimal network design—and avoiding project delays—required accurate baseline measurements. Two of the five operators on the network used CDMA/EV-DO network technologies, which can pose particular challenges for in-building testing.

PCTEL knows that competitor in-building test equipment can sometimes produce CDMA/EV-DO data with incorrect PNs (pseudo-noise codes which are used to differentiate sectors in the network). This erroneous data could potentially result in project delays or require re-testing. In a worst-case scenario, a network designed and built based on inaccurate data might need to be completely re-designed.

The reason for the difficulty in obtaining accurate CDMA/EV-DO measurements is network timing. For traditional drive testing, network test equipment uses line-of-sight GPS signals to acquire accurate network timing synchronization in order to measure the correct CDMA/EV-DO signals. In indoor environments such as a large office building, the line of site is rarely available.

Solution: SeeHawk IBTS featuring SeeGull Scanning Receivers with GPS Timing Holdover for CDMA/EV-DO

SeeGull scanning receivers featured in the SeeHawk IBTS use GPS Timing Holdover to maintain accurate GPS timing for in-building testing. The SeeGull MX first acquires timing from a GPS satellite. Unlike some competitor scanning receivers, however, SeeGull scanning receivers are capable of accurately maintaining this timing for hours after line of sight is lost due to their GPS timing holdover capability.

PCTEL used the SeeGull MX scanning receiver in conjunction with the SeeHawk Wireless Drive and Walk Test Suite and a PCTEL in-building test kit to conduct complete baseline testing of the office building in a single day. The GPS Timing Holdover function allowed PCTEL to attain accurate CDMA/EV-DO measurements during the full day of testing, delivering the project on time and under budget.

"The SeeGull MX solved the CDMA/EV-DO measurement problems we had seen with competitor test equipment," said Greg Akin, Director, Network Performance Services, PCTEL RF Solutions. "The GPS Holdover feature has allowed us to save our customers time and money by delivering reliable measurements across all network technologies," added Akin.

Conclusion

PCTEL SeeGull scanning receivers have solved two of the biggest challenges PCTEL's services team has faced when testing in-building wireless networks. The SeeGull MX's multi-technology measurement concurrency and high performance has allowed PCTEL to reduce the total number of times required to walk a venue in order to acquire complete and accurate data. Meanwhile, the GPS Timing Holdover function available on multiple SeeGull scanning receiver models made it possible for PCTEL to acquire accurate indoor measurements of CDMA/EV-DO networks, where some other test equipment failed to do so.

Multi-technology measurement performance and GPS Timing Holdover are only some of the key features of PCTEL's scanning receivers and IBTS. The following features also help to make in-building testing more efficient, accurate, and effective.

Ability to identify low power signals in the presence of high power signals (deep dynamic range)

Benefits: Accurate interference and propagation identification helps in both design and optimization of in-building networks. Identification of these lower power signals helps to identify over propagating sectors (boomers) which reduce network quality due to interference.

LTE RF path measurements and support for MIMO when present

Benefits: Path measurements are critical for identifying antenna issues such as cross-connected antennas due to installation errors or improperly balanced antennas. These errors result in incorrect sector layouts and contribute to handover issues and poor service. When combined with MIMO parameters, path measurements also help to analyze the multi-path environment, making it easier to troubleshoot throughput problems.

Ability to find existing channels and bands without prior knowledge

Benefits: PCTEL's Blind Scan feature automatically identifies all channels propagating in the venue. Without this capability, users will need to have complete knowledge of all channels being broadcast in the region or request the information from various carriers beforehand. Missing channels will result in inaccurate baseline surveys leading to in-building network design errors.

SeeGull EX*flex* can support all technologies and all bands

Benefits: Ability to purchase field-upgradeable equipment for global usage.

SeeGull scanning receivers can be used either as part of the SeeHawk IBTS or as part of other walk test solutions. Please contact your sales representative for more information.

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