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Boeing turns to wireless LAN when a key part goes missing

BY PHIL HOCHMUTH

It's easy to lose track of something in the world's biggest building — even a jumbo jet engine.

InSite: **Lessons from Leading Users**

Not that this happens often at aerospace giant Boeing, but the company recently deployed a wireless LAN (WLAN)-based location tracking system to keep tabs on all its high-value components and manufacturing equipment.

"In the factory, the ability to locate major parts and tooling on a timely basis is critical," says Jim Farricker, chief network engineer and technical fellow at Boeing. (Vaho Rebassoo, CTO, computing and network operations, at Boeing, will participate in an Interop panel on the future of wireless technology on May 4 at 11:30 a.m.)

Quickly locating parts is difficult at times in Boeing's Everett, Wash., facility, where 737s, 747s, 767s and 777s are built. The plant covers almost 100 acres, encloses 472 million cubic feet and is the largest building in the world (by volume) according to *The Guinness Book of World Records*. The site is also where Boeing is readying its 787 Dreamliner super-jumbo jets, scheduled to roll out this summer.

In advance of the 787 project, and to speed up production of its other aircraft lines, Boeing's IT group last year began installing wireless location tracking. The technology will let engineers find and assemble the collection of airplane parts and tools — known as kits — more quickly and allow for better inventory tracking.

"It will streamline our production environment and make it more efficient timewise and dollar-wise by not having to replicate tooling and pieces of gear," Farricker adds.

> "Even with fairly big parts, you'd be surprised how easy it is to lose track of stuff."
>
> *Richard Paine, network technologist, PhantomWorks' Math and Computing Division*

Tagging technology

The idea to track the location of factory assets physically using an 802.11 network originated in the company's PhantomWorks R&D group. At the time the idea was to use the existing Cisco Aironet WLAN installed in the factories to do the physical tag tracking.

"Even with fairly big parts, you'd be surprised how easy it is to lose track of stuff," says Richard Paine, a network technologist with the PhantomWorks Math and Computing Technologies division.

The location tracking for assets in the factory is more selective than slapping an RFID chip on every wrench and bolt. The 802.11 active tags, which are about the size of a book of matches and contain batteries and circuitry, cost $45 to $60 apiece. The tags are put on only components and tools that are "valuable enough so that we don't mind putting an active tag on them," Paine says. Boeing uses tag products, WLAN tracking servers and software from Aeroscout.

Everything from lifts, cranes, jet engines and planes' fuselage parts are tagged. The units constantly relay the position of whatever they are attached to, using one of two types of technology: Received Strength Signal Indicator (RSSI) and Time Difference of Arrival (TDOA).

RSSI lets an 802.11 network track an object physically by measuring the strength of the signal against three points, then using that triangulation to get the exact position. TDOA similarly triangulates a WLAN tag, but a time-stamp technique is used to pinpoint location. A location tracking server provides a real-time view of where everything is and where it has been.

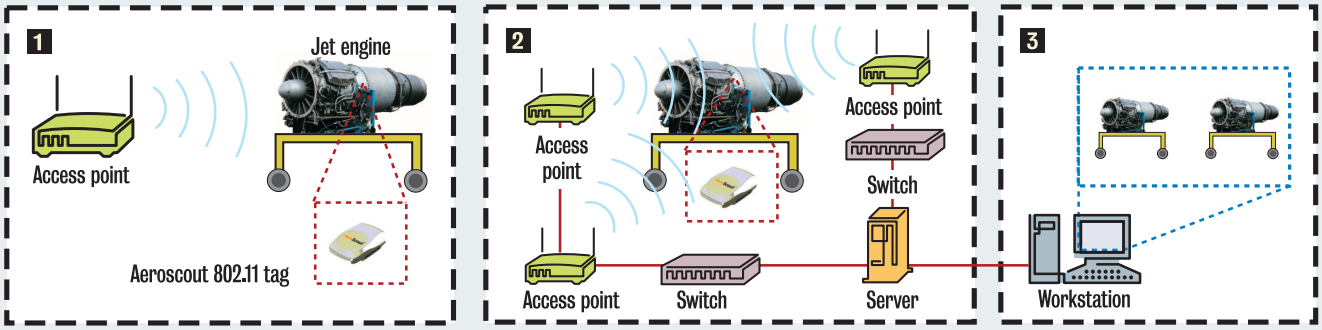
Boeing's tracking system keep tabs on key parts at its aircraft facility.

"The issue is that a lot of [802.11 equipment] is designed for an office environment," Farricker says. "So we're working with our vendors to ensure we have the capabilities required in these cavernous locations, which really look more like the outdoors."

The physical positioning of the access points in the factory is simple: "You have a north wall and a south wall," Farricker says. "They both have [access points] on them, and they all point to the middle of the factory." Before

Where it's at

Boeing deployed wireless LAN (WLAN) location tracking in its Everett, Wash., aircraft plant using Cisco Airespace infrastructure equipment and location-tracking tags and server software from Aeroscout.



1 Key aircraft components, tool kits and assembly equipment are fitted with 802.11 active tags, which relay the position of the equipment over the WLAN.

2 As tagged equipment moves from aircraft to aircraft around the 4.3 million-square-foot facility, Cisco Airespace WLAN access points track its movement in real time using triangulation. Location data is relayed to a tracking server over the LAN.

3 Engineers can view where all key manufacturing assets are in real time, which allows for faster setup of aircraft assembly stagings.

location tracking was added to the network, engineers with laptops and tablet PCs used the WLAN for data access on the plant floor. Coverage of the large space was spotty, however.

The trick to better coverage was the ability to make dynamic changes in power settings and antennae directions on the access points. This also was essential for real-time location tracking, which must adapt to major shifts in the physical environment on the plant floor.

"Previously, you would have to go and design the channel and power levels based on the environment" with first-generation 802.11 equipment, Farricker says. "In the airplane business, the fact that you have large, metallic airplanes moving around in the middle of everything makes things more complex." This made radio frequency configurations a moving target: One day there would be open space, and another a 20-foot aluminum fuselage creating a WLAN dead spot. The statically configured Cisco Aironet WLAN gear used previously for plant floor data access required manual tweaking of signal power and antennae direction to accommodate the constantly shifting dead spots. Boeing is a predominantly Cisco network, but it had started to look elsewhere for a more flexible WLAN vendor.

Airespace WLAN gear using Lightweight Access Point Protocol (LWAPP) technology was tested in the factory in 2004, before Cisco acquired Airespace. This was a key development in Boeing's plans for factory-floor WLAN, because the technology allowed for a more simplified setup. "LWAPP is allowing a dynamic design and taking a lot of the site-survey pieces out of the equation," Farricker says.

"What allowed us to continue to go the Cisco path was the Airespace acquisition," he says. "We had spoken to Cisco on many occasions, and told them that [the older-version access points] were really limited; we told them that they had to step up as far as what we need to provide for our customers in terms of availability."

The most impressive thing Farricker says he's seen during the WLAN rollout is "how the technology has matured, just within the last year." Dynamic RF power configuration, centralized security and management, and improved QoS and reliability are some of the gains.

"We've gotten to the point of where we can actually do things" with WLAN technology, he says. "Then all of a sudden you get into the discussion of RSSI vs. TDOA. What are the accuracy constraints of both? How about tags in the 802.11g environment?" Location tags are mostly 802.11b-based today, he says.

Overall, the wireless industry is responding well to the company's needs, Farricker says. That's good, because demand for advanced WLAN technology is booming inside the company.

"Because of the benefits such as productivity gains for our customers in the factories, [WLAN and location tracking] are at a point where they're really being pushed to be deployed," he says.

Data deluge

The next challenge for Boeing's PhantomWorks, IT and network groups is how to deal with the massive amounts of data generated by location tracking.

"How do you manage all of this real-time data that's coming from RFID systems and sensors and the rest of it?" the PhantomWorks group's Paine asks. "Data mining can become a real issue when you've got all of this information flowing all over the place."

Farricker agrees.

"I see that as being just a huge area," he says. "Right now [location data tracking] is really project-oriented or program-oriented technology." As it becomes more widespread, how Boeing as a whole uses the aggregated data from its manufacturing processes could lead to more valuable and productivity-enhancing applications.

"We could go out and utilize that data for something else," he says. "Even for things like parts inventories. Parts history. Having a database that can trend it all. I can see us doing many more things with all this tag data." ■