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Groups Hope to Avoid Mesh Standard Mess

Greg Goth

Backers of interoperable mesh networking gear hope to narrow one portion of the Wi-Fi alphabet soup—IEEE 802.11s—to a single proposal by next year.

"By May 2006, I expect we'll have a single document, and from there we move to crossing t's and dotting i's," says Bilel Jamoussi, director of strategic standards at Nortel Networks. "By the first half of 2008, we'll probably have a ratified standard. But I think the point where we get to a single document would be the point where people start feeling comfortable . . . implementing . . . it."

Wi-Mesh, SeeMesh, and more

Because each unique IP-address node is connected to several other nodes, mesh topologies establish a robust wireless networking environment. An IEEE 802.11s standard would make the networks interoperable as well. Nortel is part of a group of influential vendors, called the Wi-Mesh Alliance (http://www.wi-mesh.org), proposing one set of specifications. Nortel's Wi-Mesh partners include Accton Technology Corporation, ComNets RWTH Aachen University, InterDigital Communications, NextHop Technologies, Thomson, and Philips Electronics.

The strongest competing proposal, called SeeMesh, is backed by Intel, Nokia, Motorola, Texas Instruments, and NTT DoCoMo.

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Those two proposals emerged atop a pile of 15 that the IEEE 802.11 Task Group considered at the July plenary meeting (http://grouper.ieee.org/groups/802/11/Reports/tgs_update.htm). However, Jamoussi says that, unlike many of the knock-down, drag-out debates that have delayed other Wi-Fi standards (such as 802.11n), the two proposals are actually geared toward different-sized network conceptions. The proposals should therefore be easier to reconcile before moving a unified proposal forward to ratification.

Jamoussi sees three major segments of the current mesh network market: small office, home office (SOHO); security and military applications; and campus and metropolitan area network deployments. "Wi-Mesh is looking at the whole range of deployments," he says, "and SeeMesh may have had its focus on the smaller consumer-electronic and SOHO area. That's why I don't expect a big friction between the alliances. I believe they will see our input is complementary and actually addresses a larger market segment than originally intended, which will make the convergence a lot easier."

SeeMesh executives did not reply to a request for comment.

Applications space

In the long term, proponents of standardized mesh networks envision technology that complements WiMax (http://www.wimaxforum.org) in delivering long-range, high-speed data to nomadic end users, as well as protocols such as the IEEE 802.15 personal area network standard.

"Very shortly there should be accepted standards for mesh networks on a variety of media layers—802.15.4 and 802.11, for starters," writes Bruce Boyes, founder and coleader of the Java.net Robotics Community, in his blog (http://weblogs.java.net/blog/bboyes/archive/2005/07/real_soon_now_m.html). "This makes it possible to think about practical distributed control and communication applications utilizing standardized wireless communications." Boyes claims that mesh-based systems fit many applications better than current star or tree topologies. "Mesh networks can be more easily self-adapting and healing," he says, "especially when typical nodes are ephemeral. These are exactly some of the issues which would be faced by large robot swarms."

However, in the short term, the most ballyhooed use of wireless mesh networks is in extending high-speed Internet access via either a campus or metro configuration. As such, mesh networks are a highly disruptive technology, requiring comparatively little hard wiring to the Internet. Consequently, they're becoming an increasingly popular network topology

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for small ISPs, community groups, and academic researchers building low-cost, high-speed networks. In many cases, these networks are under the radar of market research firms and major vendors, and one of their pioneers says vendors in the vanguard aren't getting their due in the standards process.

"The trouble is, without the context of real-life activities, standards debates can be a little closed," says Richard Lander, director of LocustWorld (http://www.locustworld.com), a UK-based vendor of open source mesh boxes. He estimates about 15,000 registered LocustWorld nodes deployed worldwide on wireless mesh networks, yet he says the standards writers have ignored the company's effort to offer technical advice.

"The real-life experience of very many real-life projects must be of value if you're trying to build a standardized process," Lander says. "There's very great danger you could suffer from the 'not invented here' syndrome, discard all the real-world results, and attempt to produce a standard in theory. That's a recipe for an unsuccessful project."

Lander says LocustWorld could remotely update its open source mesh boxes fairly easily when the 802.11s standard is ratified. However, the phenomenon of grassroots wireless mesh itself might hide many networks that would need virtually total replacement. Whether that will prove too costly for some grassroots operators is an open question.

"You can't look our statistics up according to the metrics that have been used to cover the market because it's actually a different market," Lander says. He cites a UK government report on broadband that found only three wireless broadband networks in the country. "Luckily for us, one of the guys who was listening to this report had better intelligence, and he was able to commission his own report on wireless broadband, which came up with over 500 networks. The official guardians and regulators of the business, because they were working in the context of their own limited horizons of what they were doing, didn't think those networks existed."

In fact, the second report, "Springing Up All Over (http://www.broadband-uk.coop/papers/Springing%20Up%20All%20Over%20Report.pdf)," counted more than 550 community networks, run by 260 organizations; 92 percent of these networks used 802.11x technology to deliver data to their customers.

IEEE standards process

Donald Eastlake, the 802.11s Task Group chairman, says the deadline to offer from-the-

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ground-up proposals for the standard has indeed passed. However, people can still submit information they think will help advance the technology via comments or amendments to an accepted draft. Additionally, he says backers of any of the existing proposals could ask a new approach to merge into their document. In addition to the SeeMesh and Wi-Mesh proposals, the group is considering 10 others. Eastlake thinks several of those will merge by September's group meeting.

The basic requirements of the mesh standard entail amendments to the 802.11 media access control layer. Nortel's Jamoussi says the standard's concept as embodied in the Wi-Mesh proposal includes "essentially a topology database, and you also need a lightweight routing protocol that tells you more information about the capabilities of the access point—how many radios it has, what kind of quality of service it can support, et cetera."

The routing protocol transports this information to other network nodes to support intelligent decisions about how to route traffic. A measurement layer lets you optimize power levels and radio resources, Jamoussi says. For configuration control and QoS management, "we are proposing extensions to 802.11e that would enable multimedia applications in a mesh environment, so you could do not only data but VoIP and video and so on over your mesh infrastructure."

A sample network

One example of using wireless mesh to bring low-cost 802.11 access to both residential and commercial customers is a project undertaken in Houston, Texas, by a local community group, Technology For All (http://www.techforall.org/press_feb_17_05.html). Any resident of Houston's Pecan Park neighborhood who holds a Houston Public Library Power Card and attends an orientation class might be eligible to receive free or reduced-rate Internet services from TFA-Wireless. TFA says it has established a sustainable wireless business model that lets it provide free 128-Kbps service to qualified residents. The organization also says higher-bandwidth services up to 1 Mbps are available for a monthly charge that is significantly less than alternative solutions.

Researchers at Rice University designed and built the TFA network, led by Ed Knightly, associate professor of electrical and computer engineering and computer science.

In a short paper (http://www.techforall.org/TFA-TAPS-bkgd.pdf) describing the network, Knightly and his colleagues explain the reasoning behind installing a wireless mesh network. They calculated that installing a fiber network in the area could cost up to US$200,000 per

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linear mile, whereas constructing a mesh network covering about two square miles cost US$26,000. The network topology consists of one wired entry point, 12 mesh boxes, 12 omnidirectional antennas, two directional antennas, and one Ethernet bridge per home. The Rice group selected mesh boxes that run a Linux kernel with LocustWorld mesh software, which uses AODV (Ad-hoc On-demand Distance Vector) routing to wirelessly multihop back to the wired gateway.

In planning for installation, Knightly discovered that the mesh boxes lose an average of 15 percent efficiency per hop from the wired entry point, thus limiting the maximum number of hops from the gateway meshbox to four. Any additional hops would degrade service levels below what higher-speed commercial services require.

Mesh standards and the market

As the demand for wireless networks grows, especially in areas where wireline broadband is too expensive to deploy, so too will the quandary over purchasing and installing equipment based on an 802.11s standard. In some cases, notably in underserved areas in the US where incumbent broadband providers have fought vigorously to block publicly funded wireless networks, a ratified standard and its resultant economies of scale might entice the incumbents to deploy their own mesh networks that could cover areas wider than one municipality.

"I think most customers we talk to would like to see a standard in place," Jamoussi says. "Although on a sector or geographic coverage basis, you may have just one vendor, in the region next to it, they may have another. If you have the same standard, you'll have pretty much the same look and feel. As a service provider, if you're going to be offering a hosted service or managed services, you want to have a consistent set of protocols and standards you're dealing with."

As for the wide range of existing grassroots networks, Eastlake says he believes that as existing hardware becomes obsolete, network operators will decide on a case-by-case basis whether migrating to the standard would pay sufficient dividends.

As to the possibilities that an adopted standard could reduce mesh equipment prices enough to pressure incumbents to coexist with community- and municipally-run networks, Eastlake and 802.11 Working Group chair Stuart Kerry say the higher-level policy implications are best left to policy committees at the IEEE.

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Conclusion

LocustWorld's Lander says any factors encouraging greater visibility for lower-cost broadband, including opposition from incumbents, have to benefit those in the vanguard of new data delivery moves.

"We think it's fantastic news they're fighting it," he says. "In the land of the free, David beats Goliath as soon as people hear about it. We see that as something that plays into our hands. A lot of people hear about this community model and misinterpret it as a 1960s love-in, and it's not. It's about people building a business that is much more grassroots and much less Wall Street. Ultimately, the capital requirements for these networks are so low they don't need the Wall Street approach—and because you haven't borrowed a billion dollars, you don't have a billion dollars you have to pay back."

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