

## **IEEE 802.11s Mesh Progress**

Phil Belanger <phil@pbventures.net>

It's always a good thing when two separate factions in a standards working group come together and agree on a common approach for moving forward. That is certainly true of the recent progress made in the IEEE 802.11s working group that is developing a mesh networking extension for Wi-Fi networks. Now that there is only one proposal remaining, the group can focus on working out the details to make it into a standard rather than arguing about different approaches. We could see a finished standard in early 2007.

The IEEE's P802.11s™ Extended Service Set (ESS) Mesh Networking standard, will use mesh networking techniques to extend the range of wireless LANs securely and reliably. Mesh networking has received a lot of attention lately because of large outdoor wireless mesh networks that are being used to implement city-wide Wi-Fi clouds. Ironically, this standard will have little impact on that market. The biggest impact of 802.11s will be in your home.

### **Minimal Impact on Large Outdoor Wi-Fi Mesh**

The 802.11s proposal was developed as a single radio, shared mesh extension for indoor access points. That is a very different application than large outdoor wireless infrastructure used for municipal networks.

The big outdoor mesh vendors and some mobile mesh vendors participate in the 802.11s working group because they must. *It is marketing suicide for them to be absent from the only standard that is addressing mesh.* They all need to participate in the development of the standard even though it will not be core to their business. Some vendors would prefer that the 802.11s standard never happen. Those vendors who have a mesh routing algorithm as their big differentiator will see that differentiation evaporate as soon as the standard is published.

The outdoor mesh vendors can adapt their products to support the eventual 802.11s standard and they will. However, do not expect to see interoperability between a Tropos and a Strix box as a result of this. The main end user benefit in this market will be the creation of a mesh portal interface that will allow the big outdoor mesh to talk to your 802.11s enabled home AP/router in a standardized way. That will bring interoperability between different home routers and the big outdoor mesh infrastructure.

Look for an outdoor mesh infrastructure standard (that addresses single and multi-radio, point to point and point to multi-point links) to emerge from the IEEE 802.16 working group at some point in the future. It could be a few years because 802.16 still has lots of work to do on the core standard and there will be some technical challenges to

overlay a distributed mesh on top of a centrally controlled, hub and spoke architecture like WiMAX.

### **Biggest Benefit of 802.11s is in the Home**

Combined with other advances in the 802.11 standard, 802.11s will have its biggest impact on home users of Wi-Fi. A few years from now, most of the home entertainment and consumer electronics devices in your home will have embedded Wi-Fi. People may not even be aware that they are running a Wi-Fi network in their homes. Anything that is plugged into AC power will have access point (AP) functionality. All of the devices will support 802.11n and 802.11s. The network in your house might include 10 mesh enabled access points and will have several hundred megabits of wireless capacity. Your Wi-Fi network will be able to send multiple hi-def videos streams around the house, support wireless VOIP and handle the real time requirements of massively parallel multi-player on line games.

So what is the role of 802.11s in this type of network? The multi-hop wireless mesh of 802.11s will enable most of the embedded *APs to connect to the network wirelessly*. Mobile client devices will *connect to the closest available AP*, which promotes communication at the highest data rate (crucial for 802.11n). So your high def video stream gets there *as fast as possible*. Intel has shown that the benefit of communicating at the highest data rate to the closest AP outweighs the negative performance impact of packet forwarding in a multi-hop mesh. Intel is behind the current 802.11s draft.

“Turn that damn thing down!” Another benefit of always taking the shortest path is that smarter Wi-Fi adapters can keep their transmit power at the lowest possible level. This leads to *peaceful coexistence* with other wireless devices and better sharing of the limited spectrum available in the unlicensed bands. Lower power transmissions to the closest AP also means that *channel re-use within your house* is now much more likely. You should be able to use the same Wi-Fi channel in two different rooms, so you can exploit the capacity of all of those APs.

802.11s also helps deal with the complexity that this multiple AP configuration will bring to homes. The mesh standard includes auto-discovery and auto configuration features that will allow the mesh APs in your future home to find each other and organize themselves into the most efficient network. These mesh features are far more important to keep the network simple in a home application than for city-wide wireless infrastructure. The municipal Wi-Fi network will be professionally installed, and the big mesh AP on the light pole is not going to move around.

Look for consumer electronics gear with enhanced 802.11s and 802.11n under your 2007 Christmas tree.

Phil Belanger  
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