802.11n Access Points and Power over Ethernet: Key Considerations

A Farpoint Group Technical Note

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As we have noted before, IEEE 802.1n is the only wireless-LAN (WLAN) technology that matters today. The outstanding improvements in rate, range, and price/performance now being seen in both residential/SOHO-class as well as enterprise-class products, as demonstrated by our own testing, have previously led us to conclude that the time to install .11n is now and that waiting will only result in an investment in last year's technology. Truly conservative technology adopters will of course take comfort in delaying action until the ink is dry on the still-under-development IEEE 802.11n standard, but the ever-growing demand for network throughput and capacity, as well as the need to support greater time-bounded traffic, indicates to us that .11n is today a far better investment than the venerable .11g and .11a. And the existence of a widely-implemented interim .11n specification from the Wi-Fi Alliance simply drops the last real barrier to adoption. We sincerely doubt that the official standard will differ in any meaningful way from this spec, and, if it does, backwards compatibility is all but assured.

A key consideration in the adoption of .11n, however, is the need for gigabit-Ethernet service to interconnect access points (APs) and to make sure that wire doesn't become a choke point for the capabilities of .11n. A further concern, and the subject of this Tech Note, is whether .11n APs can be powered via that Ethernet cable. It's one thing to upgrade Ethernet switches, but quite another if that switch or the IEEE 802.3af-compliant power injectors being used can't handle the power demands of a .11n AP.

PoE: A Brief Backgrounder

The addition of power to Ethernet was a major step forward for networking technology. While ideally suited, of course, to powering wireless LAN APs, the applications for Power over Ethernet (PoE) go far beyond wireless LANs. Many other devices, including VoIP phones, video cameras, security and telemetry equipment, and on and on, can be powered in this fashion. PoE simplifies installation in that there's no need to run a separate power feed to a given network device, and installation costs are similarly (and often dramatically) reduced.

The only problem with current PoE technology, which is based on the IEEE 802.3af standard, is that only a very limited amount of power is available in compliant implementations. The official standard specifies the availability of 12.95 watts (at 48 volts) at the end of a 100-meter Category-5 (Cat5) cable run. Of course, more power needs to be applied at the source in order to allow for the inevitable loss over the length of the cable, but no device can count on having more than 12.95 Watts available in any case.

Until the introduction of 802.11n, this limitation was of no real concern for wireless LANs. 802.11n, however, being based on MIMO and thus involving significantly higher processing requirements, clearly tests the limits of current PoE implementations. While it is possible in some cases to reduce the amount of processing involved (say, for example, by using a 2x3 rather than the higher-performance 3x3 MIMO configuration, or by powering only a single .11n radio rather than two), such is clearly undesirable. We see no point in installing .11n only to reap a less-than-optimal return on investment and the promised improved in Layer-7 performance.

The advantages of what is essentially a drop-in 802.11n replacement are many. We have for some time advocated a strategy based on *dense deployments*, in which the environment is overprovisioned by limiting the distance between clients and infrastructure nodes and using existing network wiring for AP interconnect and backhaul. While there is a tendency to think in terms of fewer .11n APs being required, we have in general advocated keeping the number the same (or even increased) so as to realize higher performance in terms of throughput, reliability, and overall capacity. The appeal, then, of simply unplugging old PoE .11g/.11a APs and replacing these with new .11n APs, and changing nothing else in the infrastructure configuration (save for firmware on WLAN controllers in some cases) is obvious. Note that "no changes" could include the use of existing 100 Mbps switch ports; this solution is likely to be suboptimal in most .11n applications, but we do have to admit that some performance gain will likely be realized in advance of the full-speed performance enabled by gig-E switches.

The idea of powering a .11n AP via .3af, however, has been met by a justifiable level of skepticism. Such is ferociously difficult from an engineering standpoint, and we recently jumped at the chance to actually test a product that claimed to be able to accomplish this feat.

Verifying Power Performance

And that product is the recently announced Siemens dual-radio AP3620 802.11n AP. We were intrigued during an introductory briefing by Siemens' claims that the device could indeed be powered - we're talking both radios operating here, both 3x3 MIMO, one at 2.4 GHz. and one at 5 GHz. - by current 802.3af PoE service, and designed a test to verify Siemens' claim.

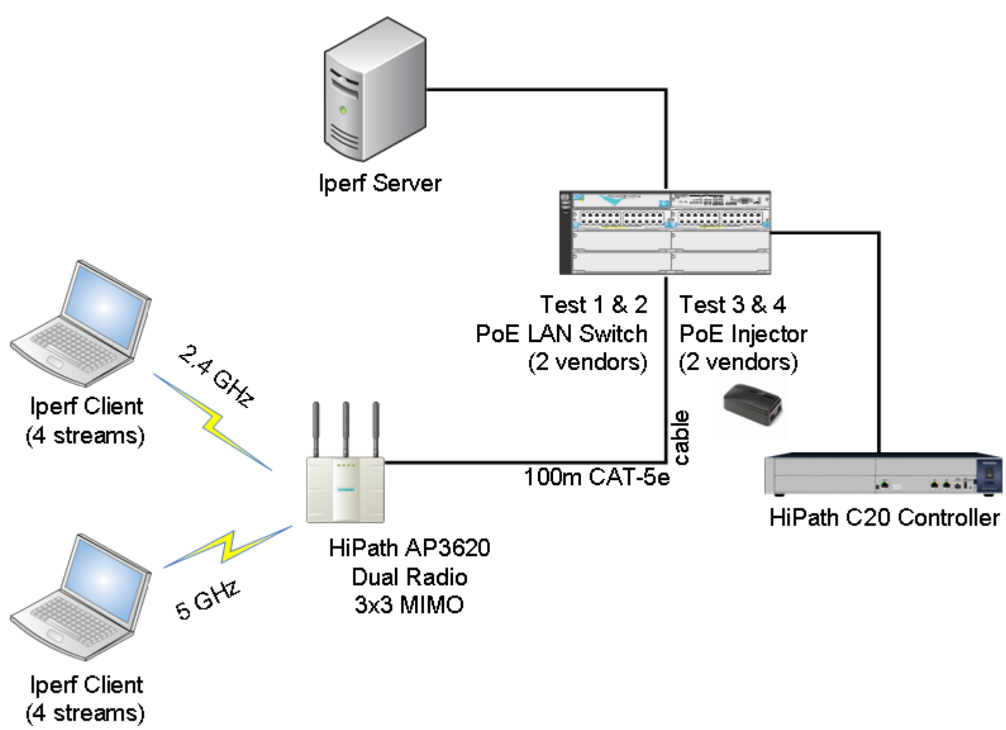

Figure 1 - Test configuration. *Source:* Farpoint Group

We set up a test configuration (see Figure 1) using the AP3620, a Siemens HiPath C20 controller, and two clients (one each on 2.4 GHz. and one at 5 GHz.), a Fujitsu 8410 notebook with an internal Intel 4965AGN radio, and a Fujitsu 8110 notebook with a D-Link DWA-652 Extreme N PC Card adapter. We powered the AP via two different intermediate switches, an HP ProCurve 3400XL and a Linksys SRW2008P, as well as via two different power injectors, a PowerDsine PD 3001G and a Phihong POE20U-560(G). The switch used with the power injectors was a Dell PowerConnect 2716. 100 meters of Category 5e cable connected the AP to the switches and power injectors as appropriate for each test run. The tests themselves involved two clients, one on each radio, being driven by the Iperf benchmarking tool generating four streams on each of the two notebooks for 30 seconds per run. Testing was done in a Faraday cage so as to eliminate the possibility that interference would affect connection quality, and thus the speed at which a client could connect, and thus effective throughput. Because the distance between clients and the AP was so short (just about one meter), we used +20 dB pads on all antenna leads. The results of the various test runs we made are detailed in Table 1. As can be seen, we saw outstanding performance with both radios running at expected (3x3 MIMO) levels of throughput.

PoE Source	2.4 GHz.	5 GHz.
PowerDsine PD 3001G Injector	131	119
Phihong POE20U-560(G) Injector	134	127
HP ProCurve 3400XL Switch	143	116
Linksys SWR2008P Switch	133	122

Table 1 - Iperf results in Mbps. *Source:* Farpoint Group.

Conclusions: Yes, It Works

While we were skeptical of Siemens' claim that .3af power would be sufficient for dual-radio, 3x3 MIMO operation, they have clearly achieved this feat. Inquiries to their engineering staff as to how they managed this were met with polite smiles; this accomplishment is clearly very difficult and we expect Siemens to gain some real market advantage from this for some time And the drop-in, no-new-power-equipment .11n upgrade strategy we noted above is clearly viable, removing one more obstacle to the floodgates opening for 802.11n. While a new PoE standard (802.3at) is currently under development, being able to use existing PoE gear is a huge plus for any IT shop.

Which leads us to a final note: saving power - any power, even from the AC mains - is always a good idea. In the world of mobility, of course, we tend to focus on optimizing power consumption because such is critical to longer battery life. But saving energy is now becoming a global theme, and anything that any of us - engineers, product designers, network planners, operations staff, and end-users alike - can do to save energy is very important, both for environmental as well as simple economic reasons. Money saved on energy goes a long way today toward helping the bottom line - or, perhaps even better, to enabling the more rapid deployment of new network technologies that boost productivity and assist the bottom line in an even more effective manner.

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