White Paper

How to cable 802.11n Wireless Access Points

The 802.11n standard is an important advance in wireless Local Area Networks (LANs). In 2007, residential consumers began installing 802.11n products and in 2008 enterprises will begin adopting en masse. Since 802.11n provides bit rates many times faster than legacy 802.11 technology, the "wired side" of a wireless LAN will face new and stringent demands. This paper discusses the impact 802.11n will have on cabling as well as what installers and enterprises should do to address them.

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FLUKE networks

Background

802.11n wireless technology delivers throughput and coverage that will cause a seismic shift in enterprise use of wireless LANs. Where the "a," "b" and "g" versions of 802.11 supported casual PC connectivity or niche uses in a few industries, 802.11n will make wireless access to business-critical applications an everyday reality. 802.11n also cracks open use of Voice over Wireless LANs (VoWLAN) and wireless streaming media.

The 802.11n standard, as presently drafted, specifies data rates as high as 600 Mbps though WiFi certified data rates will be less. A "middling" data rate of 200 Mbps is still four times the maximum speed of an 802.11g Wireless LAN. Herein lies the rub: most of today's 802.11a/b/g Wireless Access Points (WAPs) are connected to Ethernet switches with Cat5 or Cat5e cable that was never tested for data rates beyond 100 Mbps. This means that the installed base of Cat 5/5e copper could obstruct 802.11n connections. As 802.11n approaches widespread adoption, anyone who installs, tests or troubleshoots a wireless LAN should be aware of its effect on the wired infrastructure.

The 802.11n Standard

A common perception of 802.11n is that it is simply a turbocharged version of 802.11g- more advanced modulation that pumps more data. While this is true, it is incomplete. 802.11n includes many features that make for a better wireless LAN.

- Greater Layer 2 efficiency
- Multiple Input- Multiple Output ("MIMO") antennas
- Support for two radios and two bands: 2.4 GHz and 5 GHz
- Shorter delays between transmissions

The 802.11n standard is at the "Draft 2.0" stage as of early 2008. Ratification of the final version is expected in the fourth quarter of 2008.

Despite its draft status, thousands of 802.11n Wireless Access Points and adaptors are being shipped. Many are Certified as "Draft n" Wi-Fi compliant and most vendors have, or will soon introduce enterprise-class Access Points. The 802.11n standard may change before it is finalized, but hardware vendors will resist modifications that make shipping products difficult to upgrade. Right or wrong, this is stabilizing 802.11n and diminishing the risk of deploying it.

The Value of 802.11n

Why will network owners adopt 802.11n? The first reason is clearly speed. At 200 Mbps, 802.11n is about four times the speed of 802.11g wireless. If higher data rates are achieved, so much the better.

Another reason to adopt 802.11n is better coverage. 802.11n Access Points offer greater range and promise to reduce the number and size of deadzones. This translates to fewer access points and simpler management.

Finally, 802.11n highlights two advantages inherent to all wireless LANs: flexibility and cost. If users roam or change work areas frequently then it is easiest to support them with a wireless LAN. Equally compelling is cost. The price of copper has doubled since early 2005 and tripled since early 2004. This is reflected in the cost of twisted-pair cable.

The Truth on Data Rates

802.11n hyperbole and rapid technology change created confusion about 802.11n data rates.
A clear understanding of the facts is needed.

As mentioned above, the IEEE 802.11n standard stipulates a top data rate of 600 Mbps. No one expects that speed, but some vendors are claim data rates up to 300 Mbps. More skeptical observers opine that 100 Mbps is a more reasonable expectation for the maximum data rate and that average rates will be less. The reason is that many 802.11n networks will use the 2.4 GHz band for 802.11b/g compatibility. When this is the case the 802.11n Access Point downshifts to slower data rates that are compatible with legacy wireless clients.

Access Point vendors will make 802.11n speed the topic of specmanship for months to come. The cabling installer can remain detached from this debate and assume 100 Mbps to 200 Mbps is the boundary. The pertinent question for the cabling installer is, "What is the maximum data rate between the Access Point and the Ethernet switch?"

Wireless LANs are shared media. As such, only one wireless device may transmit at a time. The Ethernet link to an Access Point is a full duplex media, though, making its maximum data rate two times the maximum wireless data rate. *Example:* if the Wi-Fi 80211.n maximum date rate is 100 Mbps, the aggregate data rate on the cable will be twice that or 200 Mbps. If an 802.11n network achieves a maximum data rate of 200 Mbps then the aggregate rate on the cable would be twice that or 400 Mbps.

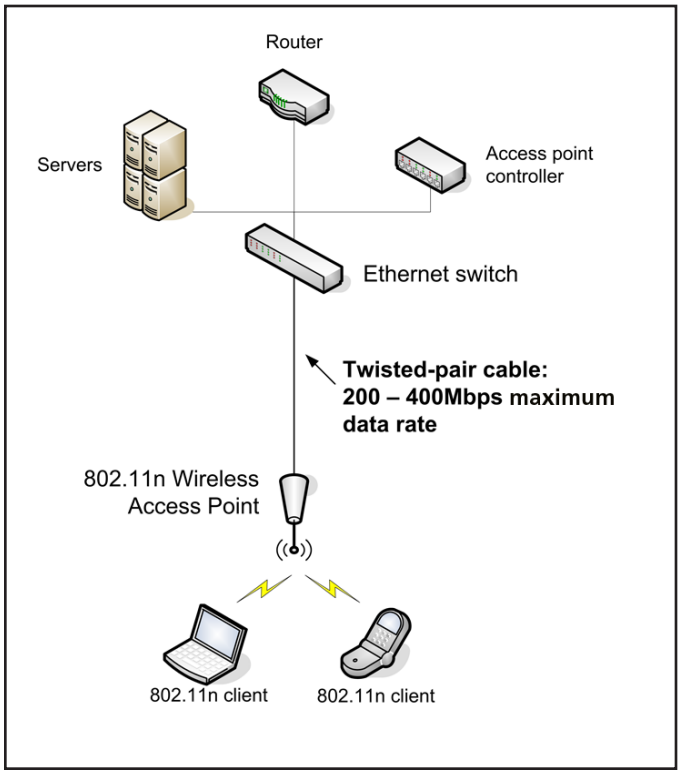

Figure 1

The most severe case for the cable involves a dual-radio 802.11n Access Point. These have a 2.4 GHz radio and a 5 GHz radio and their traffic loads one cable. If each radio reaches a data rate of 200 Mbps, the aggregate load on the twisted-pair could be 800 Mbps (two radios x 200Mbps x two for full duplex).

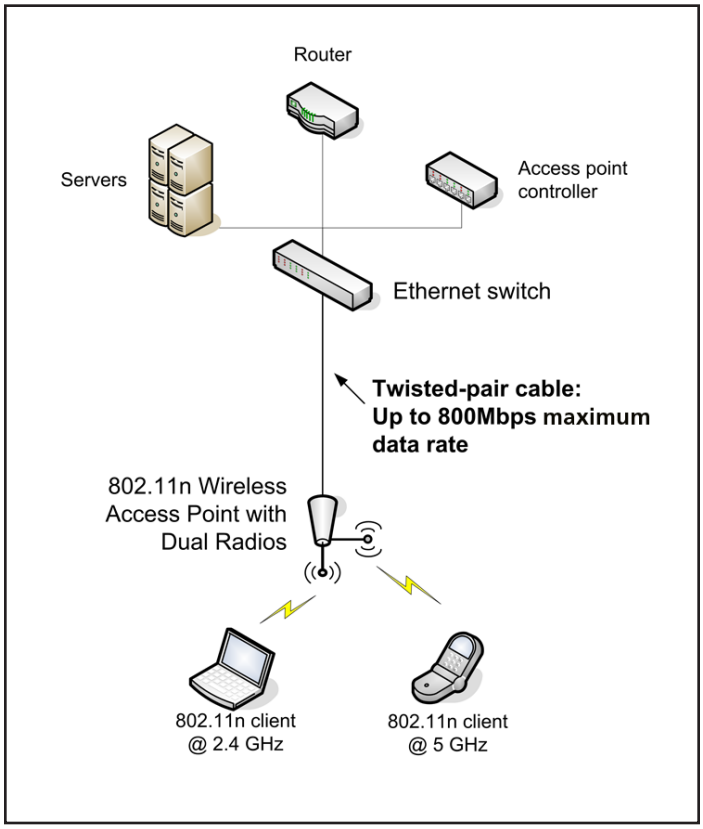

Figure 2

Key Takeaway – Twisted-pair copper Certified for 10/100Mbps may not be suitable for 802.11n Access Points, especially in the long run. The good news is that unless 802.11n approaches its theoretical maximum speed twisted-pair that is Certified for 1 Gigabit will do just fine.

Options for 802.11n Access Point Cabling

The brute force cabling strategy for 802.11n Access Points is to install new Category 6 (or better) twisted pair. Proper installation followed by Certification to TIA Cat 6 link performance will remove any doubt in support for 802.11n Access Points. For many, though, the cost of new wiring is prohibitive.

There is a less expensive alternative to consider. Proper testing may determine that a good deal of installed twisted-pair cabling links may be already suitable for 802.11n Access Points. A program to re-test installed twisted-pair can save a network owner significant money and raise the confidence in the deployment of 802.11n.

Recommended Test Steps

All 802.11n uplinks should be able to support 1 Gigabit Ethernet (1000BASE-T) traffic.

Cat 5

The Category 5 cabling standard predates the IEEE 1000BASE-T standard, so Cat 5 was not defined to support 1 Gigabit Ethernet. But before retiring it and investing in new cabling, a Certification test for compliance to the Category 5e standard will indicate if 1 Gigabit support is possible. Many high quality Cat 5 links will pass the Certification test to the TIA/EIA-568-B Cat 5e performance level. If they do, you have assurance it is a usable uplink for an 802.11n Access Point.

Cat 5e

The Category 5e cabling system was designed for 1 Gigabit Ethernet. Certifying an installed link to TIA/EIA-568-B Cat 5e performance is definitive proof that it is ready for 802.11n Access Points.

Cat 6

Category 6 cable is more than sufficient to support 1 Gbps traffic if it was Certified upon installation and no changes have been made. If there is any uncertainty about its status, re-Certification to TIA/EIA-568-B is wise.

Cable	Testing
Cat5	Certify to Cat 5e
Cat5e	Certify or Re-certify to Cat 5e
Cat6	Re-certify to Cat 6, if necessary

Upgrading to 802.11n may encompass upgrading Ethernet switch ports or replacing the entire switch. If the twisted-pair cable and patch cords are already in-place, the Certification should be done as a Channel test. That is to say, include the installed patch cords in the test configuration and use channel adaptors with the cable certification tool and select the Channel Test. If the patch cords are not in-place the test should be a Permanent Link test.

Summary

802.11n offers many advantages for the wireless portion of enterprise networks. Before those advantages can be realized, the wired infrastructure needs comprehensive evaluation. 802.11n Access Points might require new cabling, but some or all of the existing cable could suffice. There is only one way to know for sure: test it.

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