Enterprise Strategies for 802.11n

Introduction and Summary

This report, the third in a series, discusses enterprise attitudes and plans for deploying next-generation, high-speed 802.11n wireless LANs (WLANs). The trends reflect partial results of the fifth annual WLAN survey conducted by the Webtorials Editorial/Analyst Division. Responses were gathered in August 2008 from several hundred members of the Webtorials subscriber base who said they currently played a role in their organizations' WLAN implementations.

Among the key findings:

- Acceptance of 802.11n networks in pre-standard form took a big jump from last year. However, there is relatively little 802.11n commercially deployed in enterprises today.
- More than a third of respondents are thinking ahead to all-wireless enterprise access networks as a reason to deploy 802.11n.
- Respondents cited infrastructure and client upgrade costs as the greatest barrier to 11n deployment. They also still consider standards ratification delays to be a significant challenge.

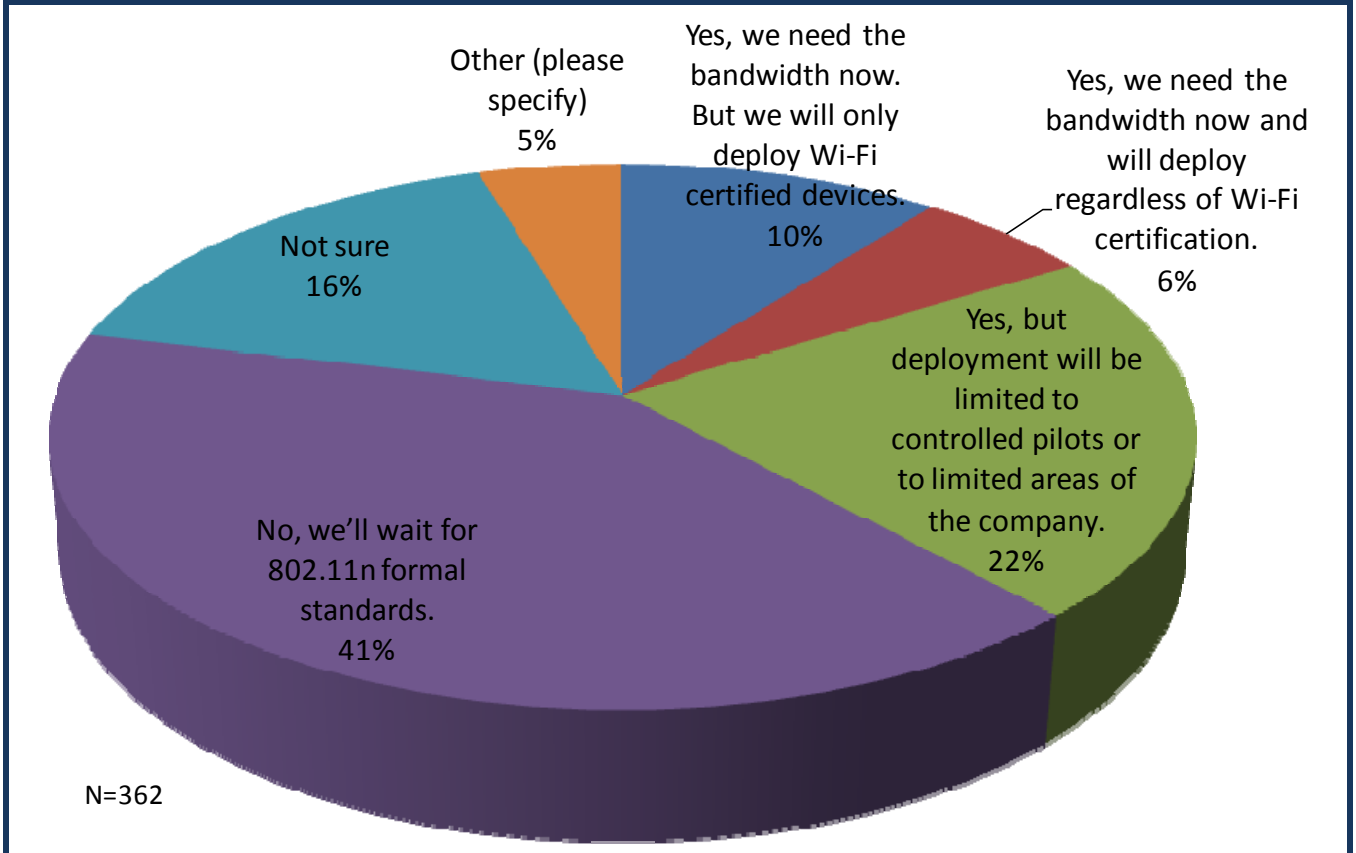
The remainder of this document analyzes each of these findings and related issues in more detail. For more information on the demographics of this year's respondents and other background information, visit **http://webtorials.com/abstracts/2008-WLAN.htm**.

Enterprises Warm to Draft N

802.11n networks have been long in coming. The IEEE 802.11 Task Group N was formed in 2003 with a tentative ratification date for the standard initially expected in late 2005. From there, it has seen a number of delays, first caused by the emergence of dueling technology factions that have since made their peace. Subsequent holdups have been caused by the vast number of optional features to be defined and debates over whether 11n 40MHz (channel-bonded) operation should be allowed at all in the 2.4GHz band. One reason for the 40MHz debate is that representatives from other 2.4GHz technologies, such as Bluetooth, worry about legacy devices getting squeezed out of the spectrum entirely. They believe that 40MHz operation should not be allowed or that the 11n standard should be amended for better coexistence.

Until this year, enterprises have remained fairly resolute about waiting for final IEEE standards ratification and the availability of standards-compliant products before starting to deploy the next-generation, high-speed WLAN, which often offers throughput of 150Mbps to 170Mbps in enterprise-class products. In 2008, however, respondents more eagerly embraced pre-standard, or "Draft N," products and networks, which use multiple sending and receiving antennas to boost throughput and coverage range. More than a third of respondents (38%) now say they intend to deploy 802.11n ahead of standards ratification in some form (**Figure 1**). By contrast, in 2007, just 17% said they would deploy ahead of standards.

Figure 1. 802.11n Attitudes and Plans

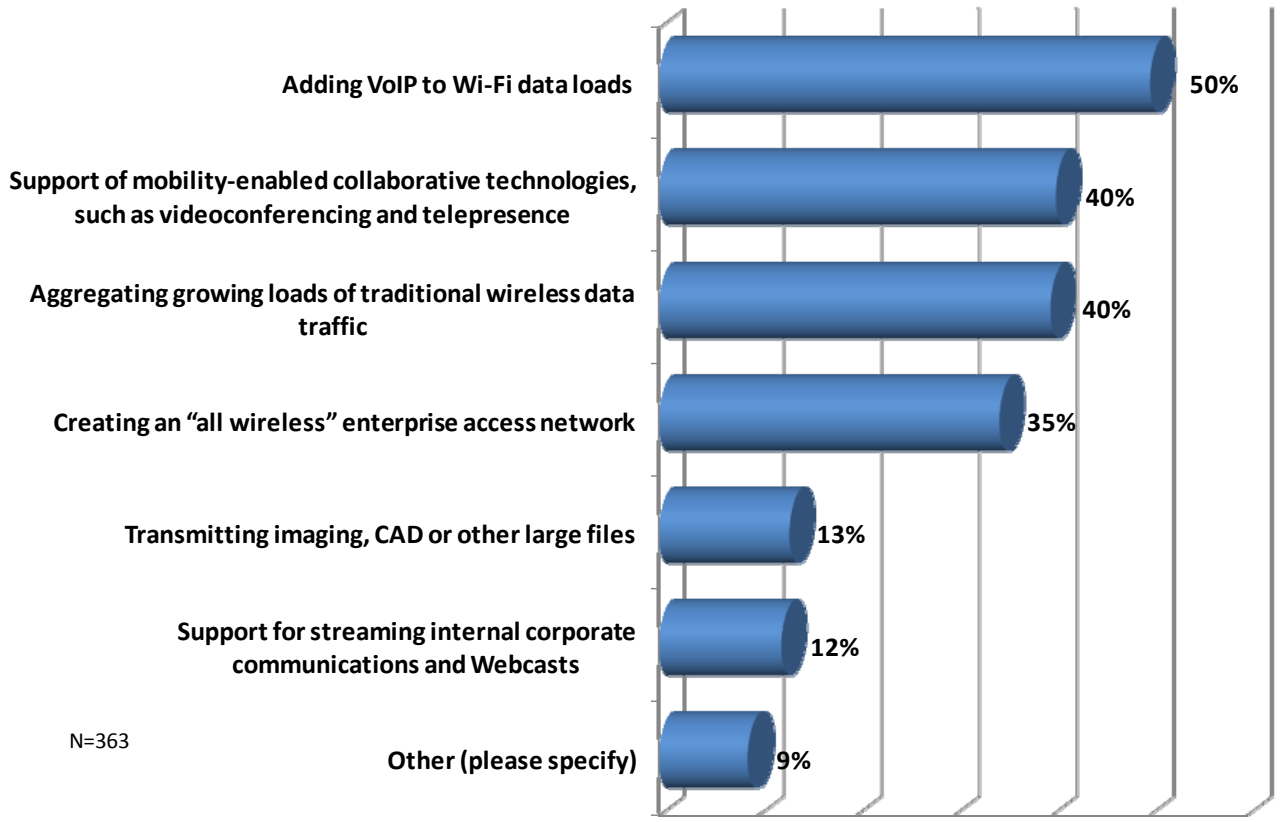


Does your organization plan to deploy "Draft N" or "Pre-N" 802.11n products ahead of final IEEE 802.11n standards ratification?

Why the Shift?

The reasons for the attitude shift lie, in part, with the reality of the commercial landscape compared with progress (or lack thereof) of the formal standards process. Increasingly, vendors are bringing products to market that have been built to the Draft 2.0 specifications of the 802.11n standard and certified for interoperability by the Wi-Fi Alliance industry consortium. Enterprises are taking some amount of investment-protection comfort in the alliance's certifications, particularly as they eye greater WLAN bandwidth requirements, driven by growing volumes of traditional data and VoIP traffic, new collaborative applications and plans to eventually create an all-wireless access network (**Figure 2**).

Figure 2. 802.11n Drivers



There are a number of wireless applications fueling enterprise interest in 100Mbps+ networking.

As was the case with previous generations of Wi-Fi, users are also getting introduced to the N technology in their homes, then expecting similar capabilities in the office. Early 802.11n products are being sold into residences in large part to extend the coverage of a single access point (AP) residence-wide. The greater bandwidth also accommodates the consumer trend for multiple individuals in a household to conduct separate but simultaneous high-bandwidth multimedia sessions.

Some organizations can make a business case for 802.11n's higher throughput or coverage range now - particularly those in the highly competitive university environment, which is known to refresh much of its information technology every three years. Higher education and other verticals, such as the hospitality industry, can't control what wireless radio resides in the client devices brought into the organization by students, guests and attendees. Some are turning to Draft N networks to accommodate the highest performing technology of their transient user bases.

Consumer and enterprise-class companies alike are selling Draft 2.0 N-enabled client products. For example, Asus, HP, Lenovo, Panasonic and RealTek have 802.11n-draft radios embedded inside their laptops. A number of other suppliers offer Draft N internal network interface cards (NICs) or external Draft N NICs and USB adapters for laptops.

The VoIP Factor

VoIP is playing a role in the movement to 802.11n networking. Significantly, 50% of respondents cited "adding VoIP to data traffic loads" as one of their two most important business applications for 11n. Another 35% cited "creating an 'all-wireless' enterprise access network" as one of their top two 11n drivers. Still, "VoIP" and "all wireless" weren't linked as strongly in respondents' minds as one might presume: only about 1% of respondents cited the availability of Wi-Fi Alliance Voice-Enterprise or Voice-Personal certified products as being a likely driver for moving to all-wireless networking.

Getting consistently high-performing voice installations over Wi-Fi has been a challenge, given that 802.11 networks were originally designed with a shared access medium for data, which can tolerate some packet loss. They also didn't account for multiple APs at all, let alone roaming among them, in their first iteration. Much work has taken place architecturally and from a standards perspective in the past 10 years to adapt WLANs to yield enterprise-grade, high-quality transmission of all types. Among these advances have been packet prioritization and call admission control standards added to the 802.11 standards set to enhance voice support.

The Wi-Fi Alliance has already begun certifying products for Voice-Personal interoperability, which constitutes a subset of the alliance's Voice-Enterprise certification capabilities. Voice-Enterprise requirements will add components of 802.11r for Fast Handoff and 802.11k for Radio Resource Measurement, standards that were ratified in May 2008. Along with both standard and vendor-enhanced quality-of-service capabilities, these improvements will help ease the delay problems associated with user roaming and data interference. Because these technologies are new and the alliance must sort out which pieces of them to use, Voice-Enterprise certification will not begin until June 2009.

Deployment Challenges

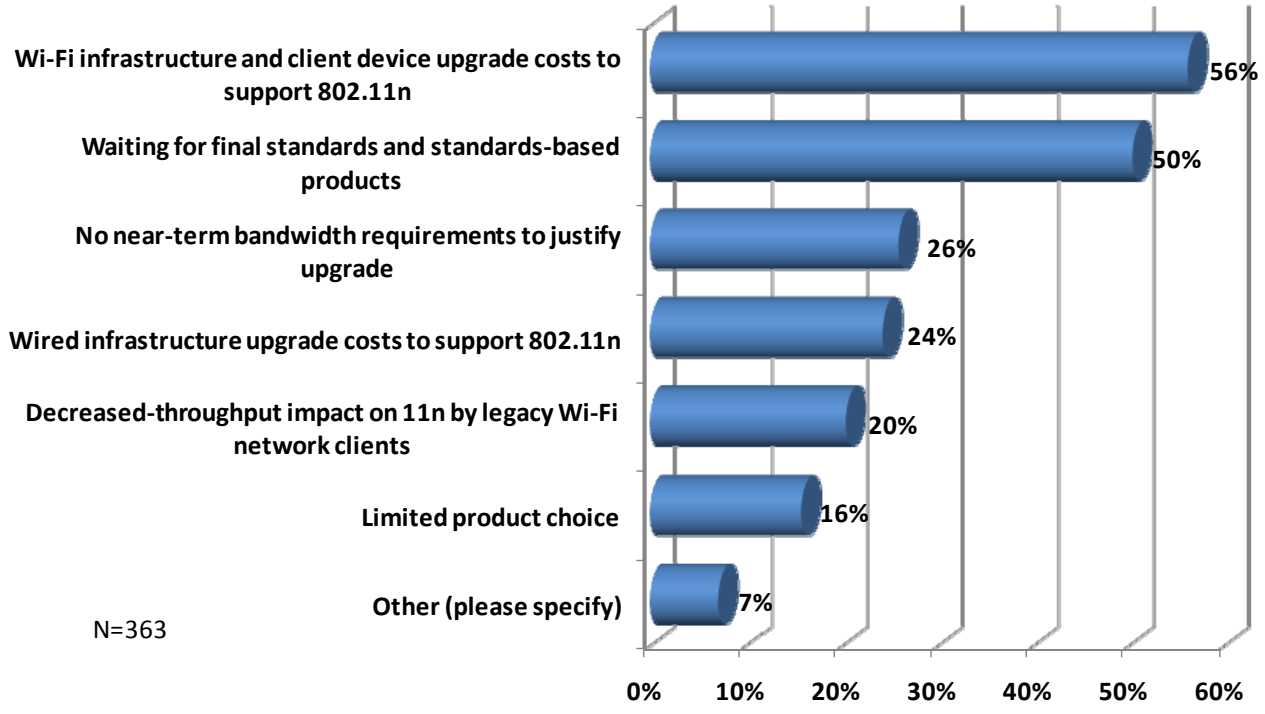
Despite the 11n excitement, a limited volume of 802.11n has actually been deployed. Nearly two thirds of respondents (62%) said none of their users currently use 11n and 22% said that a small number of their users - between 1% and 10% - were 11n-enabled.

Most enterprises surveyed (91%) were using 802.11g, the 2.4GHz, 54Mbps standard WLAN that is backward compatible with 11Mbps 802.11b networks. 802.11b was in use by 86% of respondents. This year, 64% of respondents reported having 802.11a networks in use, up from 48% last year. 802.11n, which is backward compatible with all these networks and can be deployed in the 2.4GHz or 5GHz bands (or both), is the next technical step forward. The greatest difficulty in getting there, said respondents, involves footing the bill and gambling on whether standards will resolve themselves with minimum impact.

Migration Costs and Options

As shown in **Figure 3**, the majority of respondents (56%) cited WLAN equipment upgrade costs as the primary inhibitor to deploying 802.11n in their organizations. These costs can be challenging to calculate. Generally speaking, the cost to purchase and install enterprise-grade 802.11n APs today is about twice that of earlier technology versions - roughly a $2,000-per-AP proposition versus a $1,000-per-AP proposition. However, the upgrade strategy will affect the cost, too. So will an organization's decision whether or not to run voice over Wi-Fi and whether the organization is conducting the upgrade primarily to gain extra bandwidth or longer transmission ranges.

Figure 3. Deployment Challenges



Enterprises are most worried about upgrade costs as they consider 802.11n deployments, though the lack of final standards is a challenge not far behind.

For example, organizations might elect to begin their 11n deployments for backhaul transport only, running 802.11n mesh networks as an aggregation backbone to lower-speed 802.11b/g/a networks. Most enterprise-class 11n APs support mesh, and the newer devices can be eased into the organization that way.

Similarly, enterprises might opt to run dual-radio APs in high-traffic areas of the organization, whereby one radio is 11n and serves 11n-only clients, while the other radio is an earlier generation of Wi-Fi serving legacy clients. In this transitional mode, newer 11n clients get all the advantages of 11n, while existing traffic is not disrupted. Here, too, 11n would not be needed on a one-for-one replacement basis.

Because 802.11n can transmit at twice the coverage range of earlier 802.11 versions, some users might approach the project as needing APs that cost twice as much but only needing half as many. This calculation can be misleading: Connectivity between 802.11n clients and APs will reach longer distances, but at reduced throughput. So an organization should choose whether it wants higher throughput at traditional distances or similar “legacy” throughput but at longer distances (the latter being an impetus behind 802.11n in the home market).

How many APs are needed if voice is in the traffic mix will have to be calculated, too. Generally, voice requires an overall denser deployment than data networks to avoid coverage gaps and dropped calls. On the other hand, APs too close to each other can cause a client device (in this case, wireless handset) to see multiple AP signals, causing the client to ping-pong back and forth among them and the session to become unstable.

Some vendor implementations have addressed this problem by adjusting their architectures such that the network (not the client) decides which AP the client device associates with and under what conditions it should roam to another AP. Traditionally, the client device has made these decisions, which has proven a strain on the battery-limited devices, as well.

In addition, increasingly sophisticated WLAN site survey, planning and management tools are being made available by WLAN system vendors and third parties alike to help organizations figure out this complex equation of how many APs to use and where to place them depending on a given enterprise's environmental conditions, needs and wants. Such systems account for building materials, desired minimum throughput at given distances, the effect of multi-path on coverage, power adjustments needed for desired signal strength and other variables to help enterprises arrive at the appropriate number of APs to install. Most often, the organization will use the tools after installation, as well, to tune the environment and account for changes.

Standards and Technical Matters

While mobility gains traction, the ratification date of the 802.11n standard continues to be pushed out, quarter by quarter. At the time of this writing, ratification was expected in late 2009 or early 2010, and the draft release number was up to Draft 7.0[1]. Meanwhile, in September 2008, an IEEE 802.11 Very High Throughput study group was formed to investigate gigabit-speed 802.11 networks, which would represent the next generation of Wi-Fi after 802.11n.

The industry mantra remains, as of this writing, that "there will only be a software upgrade required" to bridge users from today's Draft 2.0 standard to the Draft 7.0-or-up specification that is ratified as final. Still, that can't be known until the final standard is actually here. And, depending on the nature of the changes that are required, a given vendor may or may not be able to achieve the update in software. In the U.S., for example, unless the Federal Communications Commission has already certified a vendor's Draft N product as a software-defined radio (SDR), changes related to frequency support will require the product to be rebuilt and recertified by the FCC. Similar regulations regarding frequency changes apply around the world on a country-by-country basis.

Conclusion

Enterprises have warmed to pre-standard 802.11n, which typically offers 150Mbps to 170Mbps throughput today in enterprise-class products. Forward-thinking enterprises are now looking more closely at pre-standard 802.11n networks, in part because their bandwidth and coverage needs are rising while ratification dates for the standard keep getting delayed. Still, few organizations have yet to commercially take the 11n plunge enterprise-wide.

Enterprises consider upgrade costs to be their biggest obstacle to deploying 11n networks, though there are a number of migration strategies they can adopt to ease the new technology into their organizations without having to pay for an enterprise-wide forklift upgrade. Whether they want to get started with 11n to serve certain high-traffic areas, as a backhaul network, to accommodate new 11n client devices entering the environment or to accommodate voice alongside data will all factor into how they get started and over how long a time period they can spread their capital investments.

[1] http://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm

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