

## 802.11n: Know Its Limits

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Everyone's talking about the upcoming 802.11n standard and the excitement of its potential benefits of increased range and throughput. But before we can offer our customers wireless access points based on draft 802.11n technology, we need to understand what it can deliver today.

A quick look at the technology behind wireless networking and the proposed changes in 802.11n drafts reveals some benefits as well as concerns.

In brief, 802.11n must choose the best strategy for increased signal-to-noise ratio (SNR) without creating more interference on the 2.4 GHz spectrum. It must also solve the increased power demands resulting from the use of multiple radios and create a clear message regarding upgradeability and compatibility.

### Draft Means 'Not Finished'

Some manufacturers are already putting out products with this technology, having dropped the word "draft" from the name. However, many changes have already been made to the draft. So, older draft versions are not fully compatible with newer ones. A final approval of 802.11n is scheduled for March of 2009. Much can happen between now and then.

The problem with putting out products with 802.11n capabilities is that each manufacturer interprets the draft in its own way. This situation can produce devices that are incompatible with other devices and can, in turn, lead to





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consumer disappointment.

Optimistic estimates say 802.11n will increase throughput by 400 percent to 1,000 percent over G standard. However, Packedge's test of various 802.11n products in everyday environments revealed only modest actual range and throughput improvements. *PC World* tested 802.11n products for its October 2007 issue and reported throughput results between 5 and 28 Mbps. This is distinctly unreflective of predicted theoretical numbers of 300 (150 actual) Mbps all the way up to 600 (300 actual) Mbps. Our industry has a way to go in closing the gap between the potential and the real.

### 802.11n & MIMO

There are several significant benefits to the technology behind the new N standard: enhancing radio capability, enlarging the channel stream and the ability to add more radios. These alterations open the door for possibilities, but also contain their own set of functional challenges.

802.11n drafts currently employ multiple-in, multiple-out (MIMO) technology, which puts several antennas and several radio signals to work. There are two key parts of MIMO that are used in 802.11n: transmit beamforming and multipath/spatial diversity.

In transmit beamforming, the multiple radios "tune themselves" based on conditions in the air so that they send complementary information at the client. In order for that to work, the client must keep still and not move an inch. In a constantly changing environment, "fine tuning" a transmission could be impossible. Many of the potential clients of 802.11n technology are mobile devices, such as touch panels, handheld gaming devices and laptops. Keeping those clients immobile, therefore, is unrealistic.

Multipath, or spatial diversity, is a process in which the radios transmit separate signals. These signals take a variety of paths, arrive at different times and, then, are added up using a complex mathematical algorithm to increase SNR.

The benefit of a multiple-radio scenario is increased SNR. However, multiple radios will use up a tremendous amount of energy. Meanwhile, current client products that are outfitted with wireless cards already have limited battery life. Increased power usage and a shorter battery life might tie devices down to power cords and inadvertently defeat the purpose of "wireless" and mobile technology.

### Channel Bonding and Interference on the 2.4

The normal channel size for 802.11a and 802.11g is 20 MHz wide. Another strategy for N to increase SNR is to double the channel size to 40 MHz by simply adding another 20 MHz band. This is called "channel bonding" and essentially adds more lanes of traffic, making a single radio a super freeway.

The concern with channel bonding,

however, that any new "lanes" being put to use already have traffic on them. This might make for some traffic jams on the already-crowded 2.4 GHz spectrum. Interfering with other networks and lowering overall performance for everyone will convert the superhighway back to a crawling speed — just as before. With 2.4 GHz full of noise and interference, it's worth exploring the 5.0 GHz spectrum, which might offer some clearer pathways.

N standard promises some amazing advances, and many CE pros can't wait to take advantage of them. But with all the complexities of 802.11n drafts (which still need time to be addressed), it makes sense to proceed with caution. Be patient. Maximize the proven standards around 802.11a and 802.11b/g — and network responsibly.

*Victor Pak is president of Packedge Device & Software.*

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