TIME TO GET ACQUAINTED WITH IEEE 802.11n

The famous WLAN alphabet soup is getting yet another ingredient – the "n"!

We have over the years got used to all the letter extensions to the IEEE 802.11 WLAN standard. In many papers and already at the shops for home use and indeed in some enterprise installations, there are "pre-n products" that promise much higher data speed and longer range then existing products.

SO WHAT IS IEEE 802.11n?

First of all, it's important to understand that the standard is not ready yet and there are some critical issues regarding patent rights that are not yet solved. But nevertheless the proposals for the new "n" standards are dealing with improvement in basically two areas, Protocol overhead optimisation and Radio channel improvement. The overall goal is to improve the (always too low) net data throughput above 100Mbps.

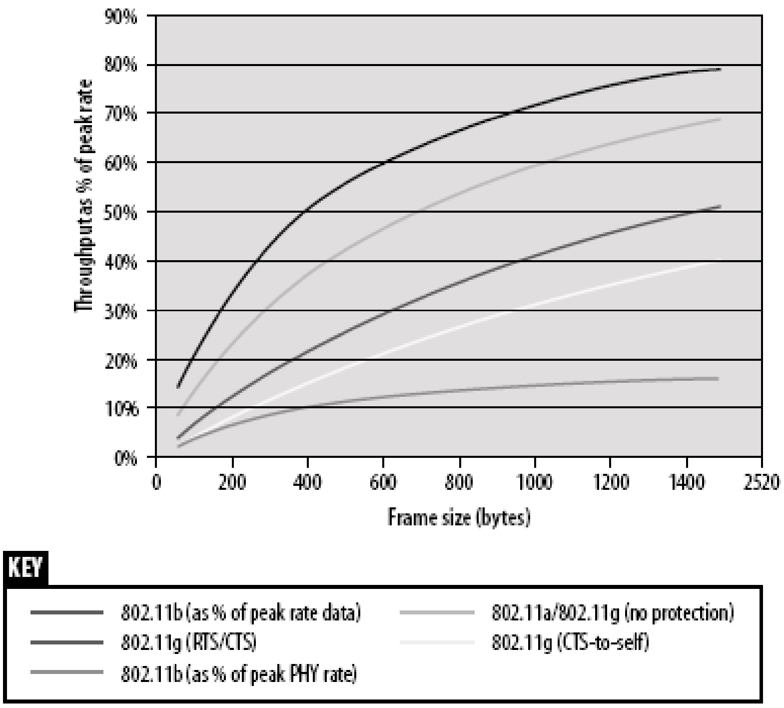
The slogan is "Bring WLAN to Ethernet speed".

PROTOCOL OVERHEAD

The efficiency of the IEEE 802.11 is often poor. In most usage scenarios, it is very difficult to exceed 50–60% of the nominal bit rate of the underlying physical layer.

Overhead is particular bad for small frames, when the overhead takes more time than the frame data itself. Figure below shows the efficiency, defined as the percentage of the nominal bit rate devoted to payload data, for a variety of frame sizes. Any network measurement would require additional data, and networks that are encrypted would have additional overhead bytes. Furthermore, most network protocols provide their own acknowledgment facilities, which further reduce real-world efficiency. The point of the figure below is that small frames have particularly poor efficiency.

A number of techniques will be used in IEEE802.11n to aggregate data and reduce overhead in order to maximize "real" data speed.



RADIO CHANNEL OPTIMIZATION

The next enhancement to the IEEE802.11n standard is derived from the radio interface.

A technique called MIMO (Multiple Input Multiple Output - pronounced "mymoe") will be used. MIMO antenna configurations are often described with the shorthand "YxZ," where Y and Z are integers, used to refer to the number of transmitter antennas and the number of receiver antennas. For example a base station with three antennas and a laptop with two antennas would be a 3x2 system.

MIMO technology is used for both the 2.45GHz and 5 GHz bands, but the full potential will only be available in the 5GHz band due to the limited available bandwidth at 2.45 GHz.

The theory behind MIMO is rather complex but the practical outcome is that the range can be extended with the same power and a combined higher data throughput can be achieved for a single user. For the technically interested audience I recommend a Web search on "MIMO" and you will find a lot of articles on spatial beam forming, Space-time block coding, interleaving and other cool techniques…

PRACTICAL CONSEQUENCES OF IEEE802.11n

As always with new standards there are backward compatibility requirements and that also holds true for the "n" standard. There is a Mixed mode and a Greenfield mode, where the Mixed mode must be able to handle old a/b/g clients and have to compromise the full capacity in order to be backward compatible. The Greenfield mode is using the full potential of the standard but is inoperable with legacy devices.

FOR QUITE SOME YEARS TO COME, THE MIXED MODE WILL BE THE DOMINANT DEPLOYMENT

When it comes to WiFi handsets MIMO is not a topic for higher data rates but indeed for longer range. Current chipsets are not optimised for low battery consumption and small handsets. The prediction is that we will se one more generation of a/b/g handsets being released before IEEE 802.11n becomes a common WiFi handset standard. However a standard a/b/g handset will experience some improvement in an "n" system and will be fully interoperable with the Mixed mode.

CURRENT IEEE802.11 MAJOR STANDARDS

Protocol	Release Date	Op. Frequency	Throughput (Typ)	Data Rate (Max)	Modulation Technique	Range (Radius Indoor) Depends, # and type of walls	Range (Radius Outdoor) Loss includes one wall
Legacy	1997	2.4 GHz	0.9 Mbit/s	2 Mbit/s		~20 Meters	~100 Meters
802.11a	1999	5 GHz	23 Mbit/s	54 Mbit/s	OFDM	~35 Meters	~120 Meters
802.11b	1999	2.4 GHz	4.3 Mbit/s	11 Mbit/s	DSSS	~38 Meters	~140 Meters
802.11g	2003	2.4 GHz	19 Mbit/s	54 Mbit/s	OFDM	~38 Meters	~140 Meters
802.11n	June 2009[2] (est.)	2.4 GHz 5 GHz	74 Mbit/s	248 Mbit/s		~70 Meters	~250 Meters