

802.11n Wireless and Enterprise Networks

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- » With the rapid adoption of Draft-N wireless networks in the home, network administrators are starting to consider deployment in the enterprise environment.
- » This presentation will cover the technology behind 802.11n, progress towards standardization, real-world experience in home and SOHO environments and discuss the issues that need to be considered prior to building 11n networks for the enterprise.

NETGEAR ??



- » **NASDAQ listed US company.**
 - US\$1B market Cap (Jan '07)
- » **Australia-wide sales & support**
- » **#1 Supplier of WLAN Equipment to Australian market**
(IDC WLAN Tracker Q3, 2006 – Revenue Market Share by Brand)
- » **#2 Supplier of Switch Ports to Australian market**
(IDC LAN Tracker Q3, 2006)
- » **> US\$750m sales worldwide**



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NETGEAR ??



- » **Business splits evenly between home, business & service provider product group**
- » **Home >> Business**
 - Commodity volume manufacturing
 - Chipset vendor relationships
 - Home as a proving ground for new technology



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How much bandwidth?



How much bandwidth?

- » **Gigabit to desktop**
 - Because we can....
 - New multimedia applications
- » **Wireless**
 - 11g >> 54 Mbps per AP
 - Say 22 Mbps effective bandwidth
 - » Send & Receive
 - » Shared between clients
 - Say 5-10 Mbps at home
 - 0.5 – 2 Mbps at the office (overlay only?)
- » **Please Sir, Can I have some more....**

802.11n Goals

- » 100+ Mbps net throughput (5x)
- » >250 Mbps Link Speed
- » Improved Range (2x distance)
- » Maintain backward compatibility with 802.11a/b/g



802.11n Timeline

- » July 2004, Call for Proposals
- » November 2004, 4 Proposals Submitted
- » September 2006, Draft 1.04 to progress with 1000 outstanding comments
- » Jan 2007, Draft 1.10 incorporating last 400 comments
- » Mar 2007, Draft 1.10 >> Draft 2.0 (unanimous)
- » Only significant change re channel bonding auto-disable
- » Oct 2008, Tentative date for final ratification

802.11n Timeline



» 2H 2006, Draft-N chipsets & SOHO products

- Broadcom, Intel, Atheros, Marvell chipsets
- Airgo to proceed
- NETGEAR and others shipping products
- Interoperability success
- Substantial takeup in SOHO

» 1H 2007

- Notebook vendors starting to ship in volume

» 2H 2007

- Draft 2.0 (final?) products
- WiFi Certification now....



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How it works...

» **Spatial Multiplexing (multiple radios on same channel)**

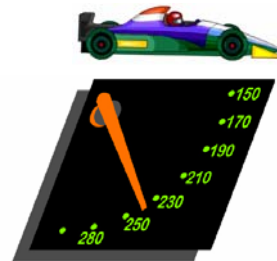
- 2 or 3 radios in most current implementations
- Improves range as well as speed
- >> 135 Mbps

» **Channel Bonding (2 x 20MHz channel groups)**

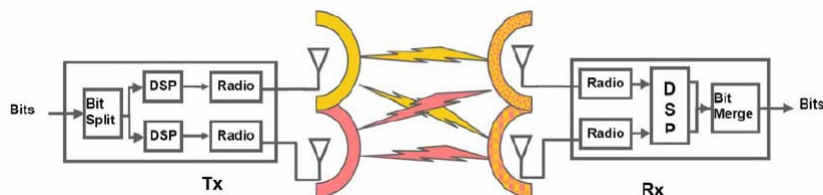
- 2 out of 3+ available in 2.4GHz
- 2 out of 12+ available in 5GHz
- >> 270 Mbps

» **Other Optimisations**

- e.g. short Guard Interval, 2 vs 2/3 radios
- Burst mode transmission
- >> 300 Mbps



- » **2-4 transmit radios**
- » **2-5 receive radios**
- » **Radios operate on same channel**
- » **Multi-path becomes benefit, not hindrance**
- » **More than doubles throughput w/o channel impact**



Spatial Multiplexing



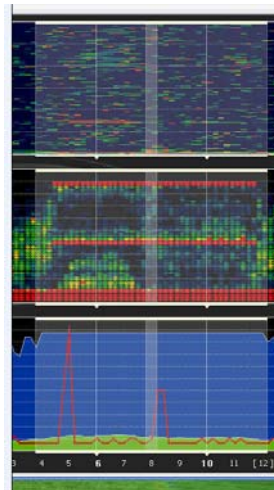
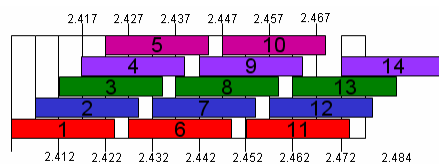
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Channel Bonding

- » Use 40 MHz vs 20 MHz channel
- » 2 Channel groups
- » 3+ available in 2.4GHz
- » 12+ available in 5 GHz



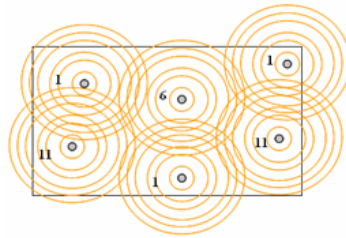
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Channel Bonding

- » No issue for single AP solution
- » Draft 2.0 change (bluetooth etc)
- » Better than earlier channel bonding approaches, eg Super-G
- » Can be OK for small AP count, with careful placement
- » For high AP counts, probably need to disable in 2.4GHz
- » No issue in 5 GHz



Actual Performance

- » 65-100 Mbps actual net throughput in typical home environment
- » Single AP success in typical homes
- » Little real-world impact on existing nearby networks
- » Early products 2.4GHz only, though dual-band appearing on embedded clients



What about larger networks ??

Larger Network Characteristics

- » Different to SOHO in several dimensions, similar in others
- » 11g dominates
- » 15-20 Mbps per AP working bandwidth
- » 0.5-2 Mbps per client working bandwidth
- » 5-20 clients per AP
- » Multi-AP
 - Coverage
 - Client count
 - Resilience
 - AP not combo router



- » May have very large AP count
- » Overlay or all-client
- » RF management and/or WLS
- » Embedded client preference
- » Scale limits early adoption
- » Requirement for IDS and other NMS tools



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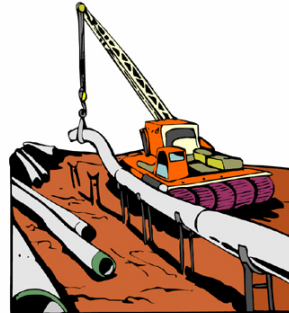
- » From a pure technical perspective, channel bonding is the key issue (for 2.4GHz)
- » Without it, can still get 135 Mbps bit rate.
- » Fine for SMB to (say) 100 clients
- » Fine for enterprise for small-scale & pilot rollouts to support new clients
- » Fine for localised coverage for high bandwidth needs
- » Eventual solutions will comprise power management, directional antennas, and 5GHz.

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- » Gigabit with PoE network connections for APs
- » Generous PoE allowance
- » Coverage footprint similar to today's 11g networks
- » Expect extra capacity to be shared between increased client count and increased usage
- » Look for dual-band embedded clients

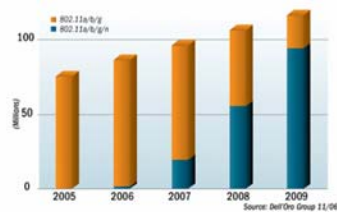


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- » Client takeup expected to be ready for widescale deployment in 2008



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- » **SOHO and SMB OK Now**
- » **Enterprise with larger AP count will require some of:**
 - 5 GHz AP support
 - Directional antenna support
 - Active power management
 - IDS and monitoring tools
 - WLS support
- » **Standards risk (declining..)**
- » **Client population**
- » **Probably won't see large scale adoption for Enterprise till 2008/2009**



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