



*Exploring the nature of nature.*

# Recent Experiences

## Wireless 802.11n

*(draft standard 2.0)*

Andrew Rader

July 2008



*Exploring the nature of nature.*

**Q: How many wireless professionals does it take to unscrew a lightbulb?**



*Exploring the nature of nature.*

**Q: How many wireless professionals does it take to unscrew a lightbulb?**

**A: *None, they all knew it was best to keep the copper connection.***



# Overview of “N”

- Not a ratified standard yet.
- Draft v3.0; 2.0 has been out a while.
- Theoretically up to 600 Mbps radio throughput
- Backward compatibility with a/b/g
- Improvement of range/speed even for legacy b/g clients.



# Back to Back AP Tests

- 802.11g
  - ~42 Mbps client to server
  - ~44 Mbps server to client



# Back to Back AP Tests

- 802.11g
  - ~42 Mbps client to server
  - ~44 Mbps server to client
- 100 Mbps Copper
  - ~96 Mbps client to server
  - ~94 Mbps server to client



# Back to Back AP Tests

- 802.11g
  - ~42 Mbps client to server
  - ~44 Mbps server to client
- 100 Mbps Copper
  - ~96 Mbps client to server
  - ~94 Mbps server to client
- 802.11n (greenfield)
  - ~43 Mbps client to server
  - ~108 Mbps server to client



*Exploring the nature of nature.*



## Cisco Aironet 1250 Access Point

- 2.4 GHz Radio Module
- 5 GHz Radio Module
- 5.1 pounds
- Six antennas
- MIMO with diversity





## Cisco Aironet 1250 Access Point

- Great mountings
- Easy install
  - One for one
- Zero config
- Color coded antennas
- Cards seat well
- Drop tested
- Console port protected



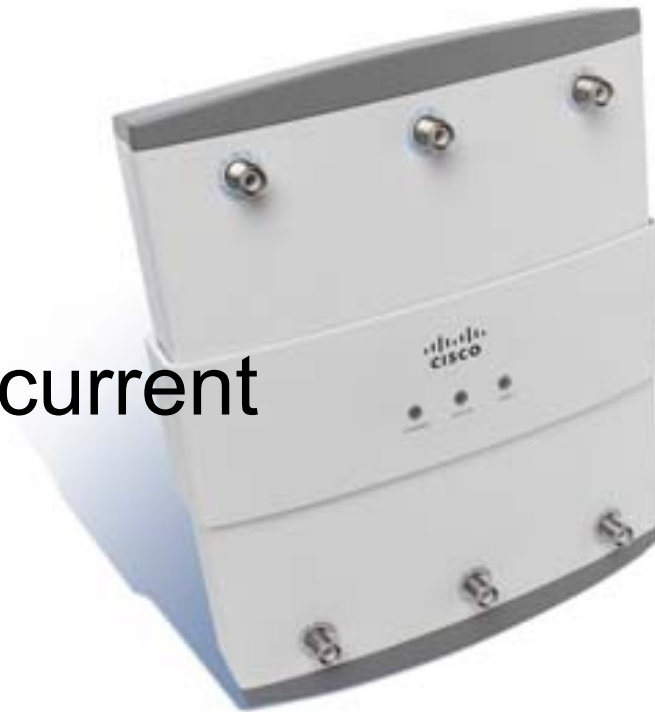
 **Fermilab**

*Exploring the nature of nature.*



# Power Issues

- Runs hot (dual radios)
- Power Injector hot
- Power not included
- Power Injector leaks current back to network port
  - Fluke “One-Touch” tester
  - Micro switch problems





# Power Issues

- Not 802.11e POE (dual radios)
  - Some Cisco switch support
- 24 gauge wire problems
  - CAT6 is not necessarily 23 gauge, and CAT5 can be.
  - Limited distance
- Difficult to support POE





## “Off Label” Use

- Need for high speed mesh-like network.
- Wireless repeaters typically cut the bandwidth in half.
- Current mesh solutions don't support “n” speeds.
- All dual radio examples show one of each. No mention found of dual radios of the same type.



*Exploring the nature of nature.*



# Mesh-ish Testing

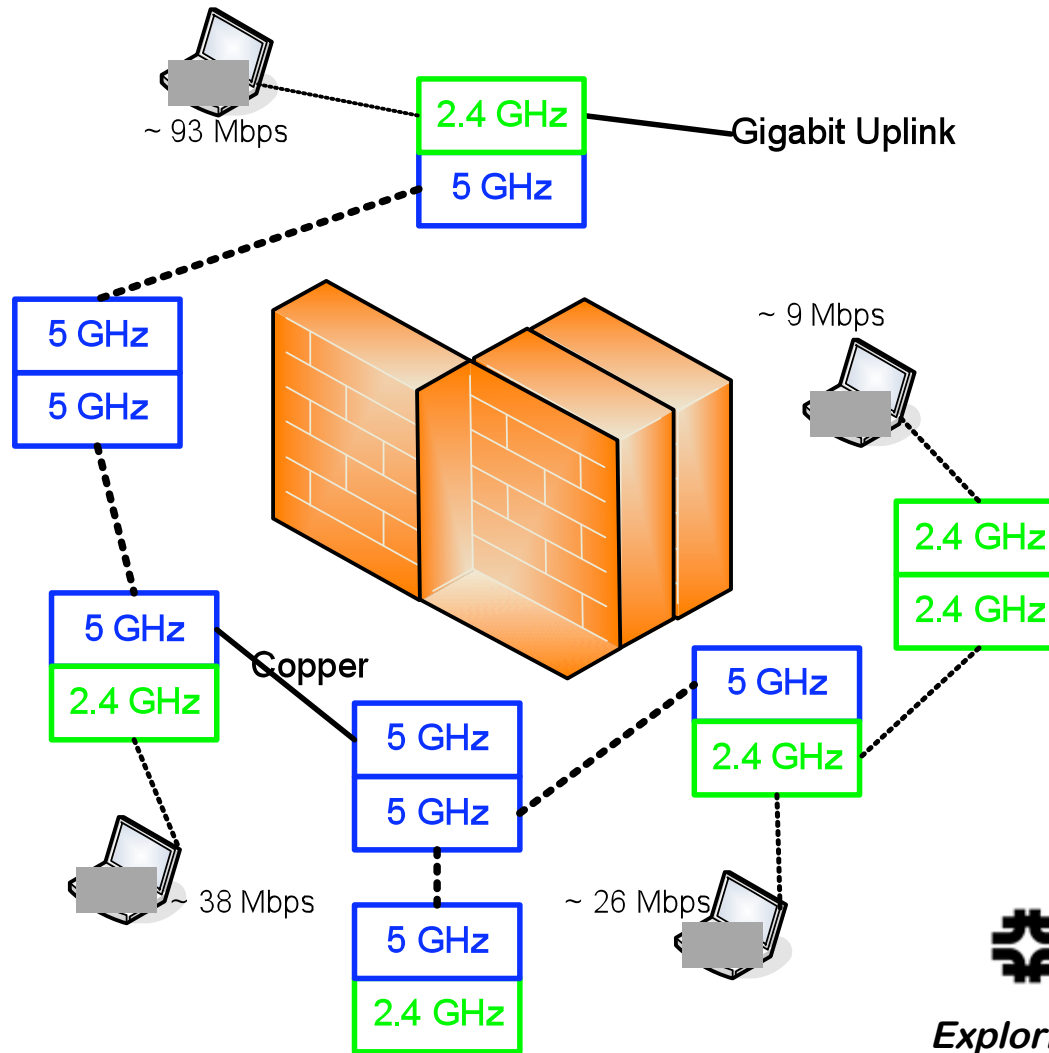
- Dual 5GHz radios
- Separate channels
- Greenfield config for backhaul
  - 40MHz channel overloading
  - 400ns guard interval
- Various topologies tested
- Dual 5GHz/2.4GHz for customer premises
- Repeater hit on last leg



*Exploring the nature of nature.*



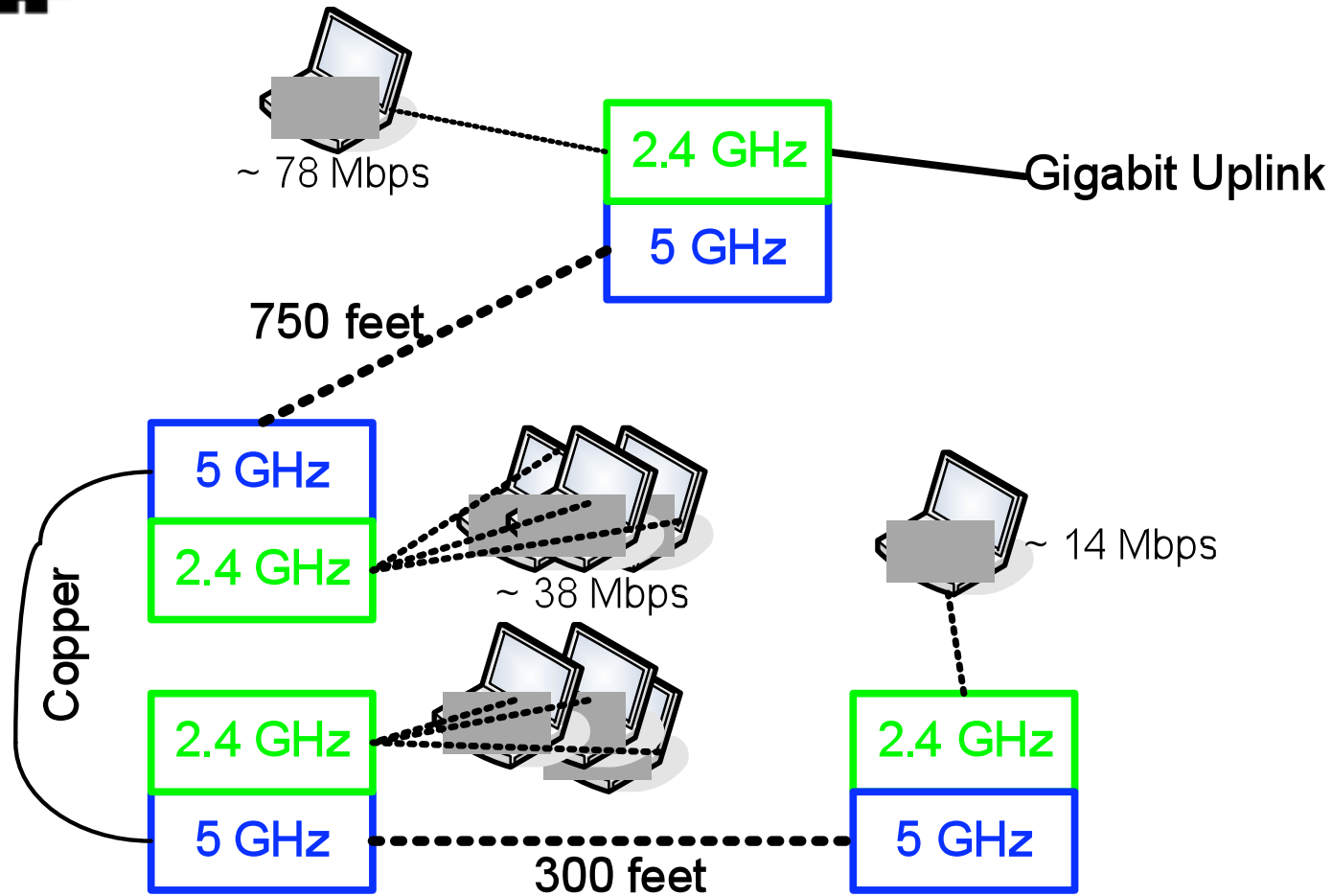
# Mesh-ish Lab Test



*Exploring the nature of nature.*



# Field / Production Test





# Next Steps

- Expand out to other locations that currently have no connection or only have 2 Mbps DSL.
- Test in lab with two APs at each end (four radios) and 2 Gig etherchannel uplink.
  - Not enough adjacent spectrum for channel overloading.
  - Can overcome by using directional antennas.
  - Doesn't scale, but it's fun!



*Exploring the nature of nature.*



*Exploring the nature of nature.*

Questions & Comments?