Experience Deploying High Density 802.11 Networks

Joel Jaeggli
-
University of Oregon
Computing Center

Problem

- How to deploy wireless infrastructure that will support conference sized groups of 802.11 users?
- How to keep 500-2000 active users in one room happy?
- Institutional knowledge on the subject appears to be extremely limited.

Some Observations

- When we started working on the 2002 fall NANOG and IETF we knew a few things from previous events:
  - Various enterprise access points get into trouble with more than 200 users(specific models).
  - Performance on a given access-point starts to degrade dramatically around 70-100 users.
  - Radio interference causes dropped frames which results in queueing on access-points.

Observations Continued

- Cascading failures can cripple the whole network of access points.
- The largest source of Radio interference is the other access points not the users.
- Site surveys and testing can't entirely alleviate problems that will occur when people actually use the network.

What people Want?

- Roaming between access-points?
  - Requires them all to be on the same subnet.
  - Vendors are moving into this space (reefedge, vernier, Nokia etc).
  - IP-Mobility?
- Low latency/loss.
- It to work just like home...

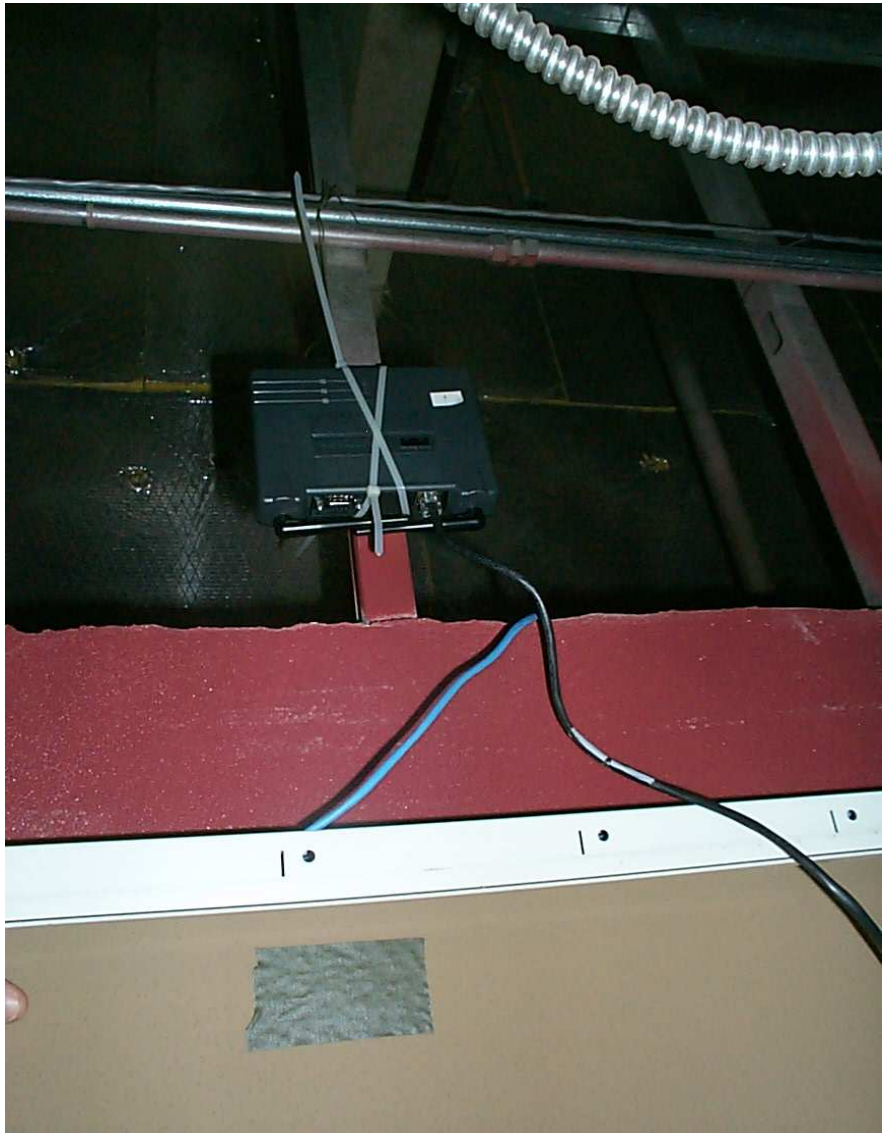
Givens

- In the US 11 available channels, 3 non-overlapping, 1, 6, 11, in 83mhz of assigned spectrum in 2.4ghz ism band.
- Wireless cards with 30mw tx have a free space range of about 100 meters with typical antennas.
- Wireless cards typically perform only incrementally more poorly horizontally vs vertically.

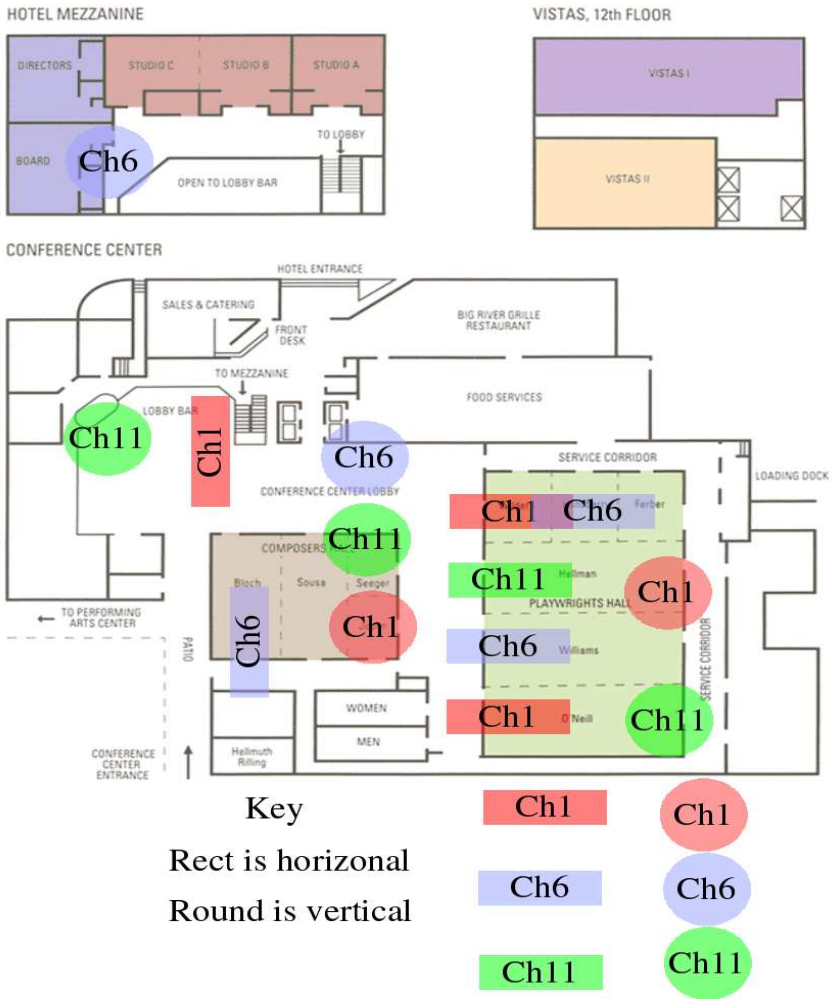
NANOG 26 Design

- 13 access-points.
  - 7 for main room alone.
- Address space for wireless network was a /21.
- Used a mix of horizontally polarized antennas in the ceiling and vertically polarized dipoles on the back-wall.
- TX power reduced to 15mw and antenna diversity disabled (Cisco) except for Lobby access -point

Horizontal AP



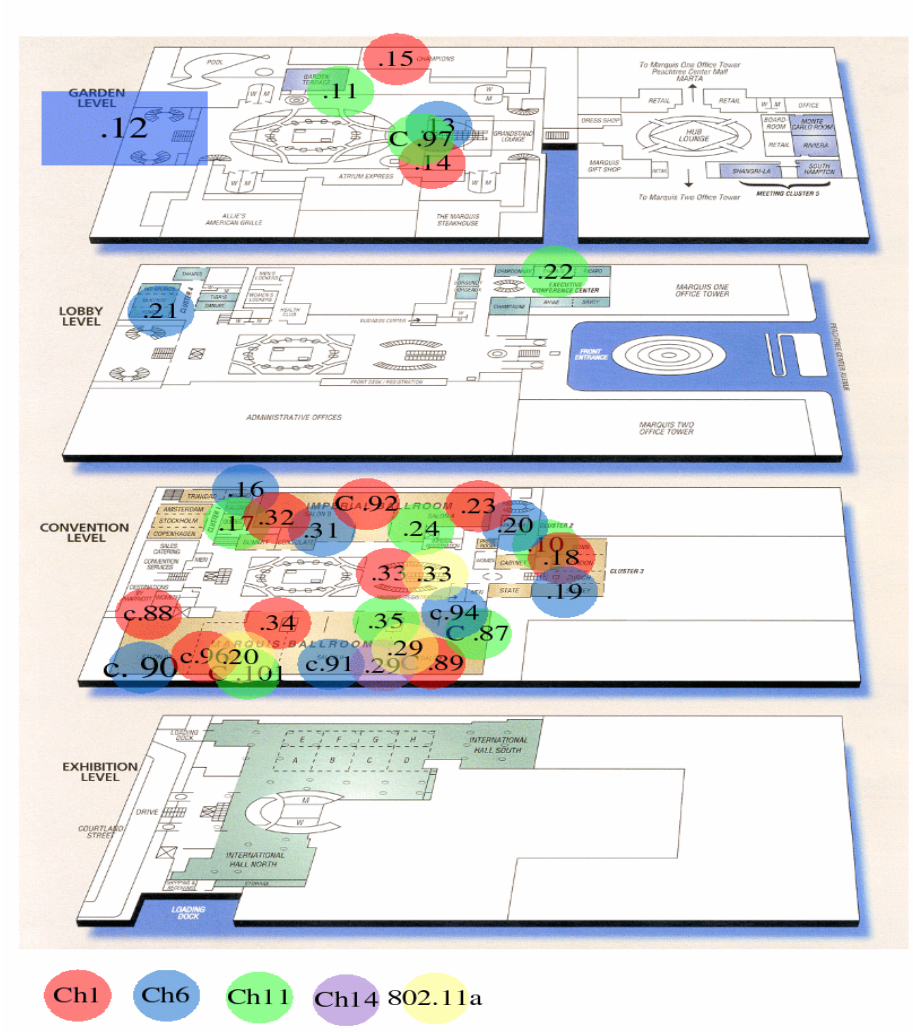
NANOG Layout



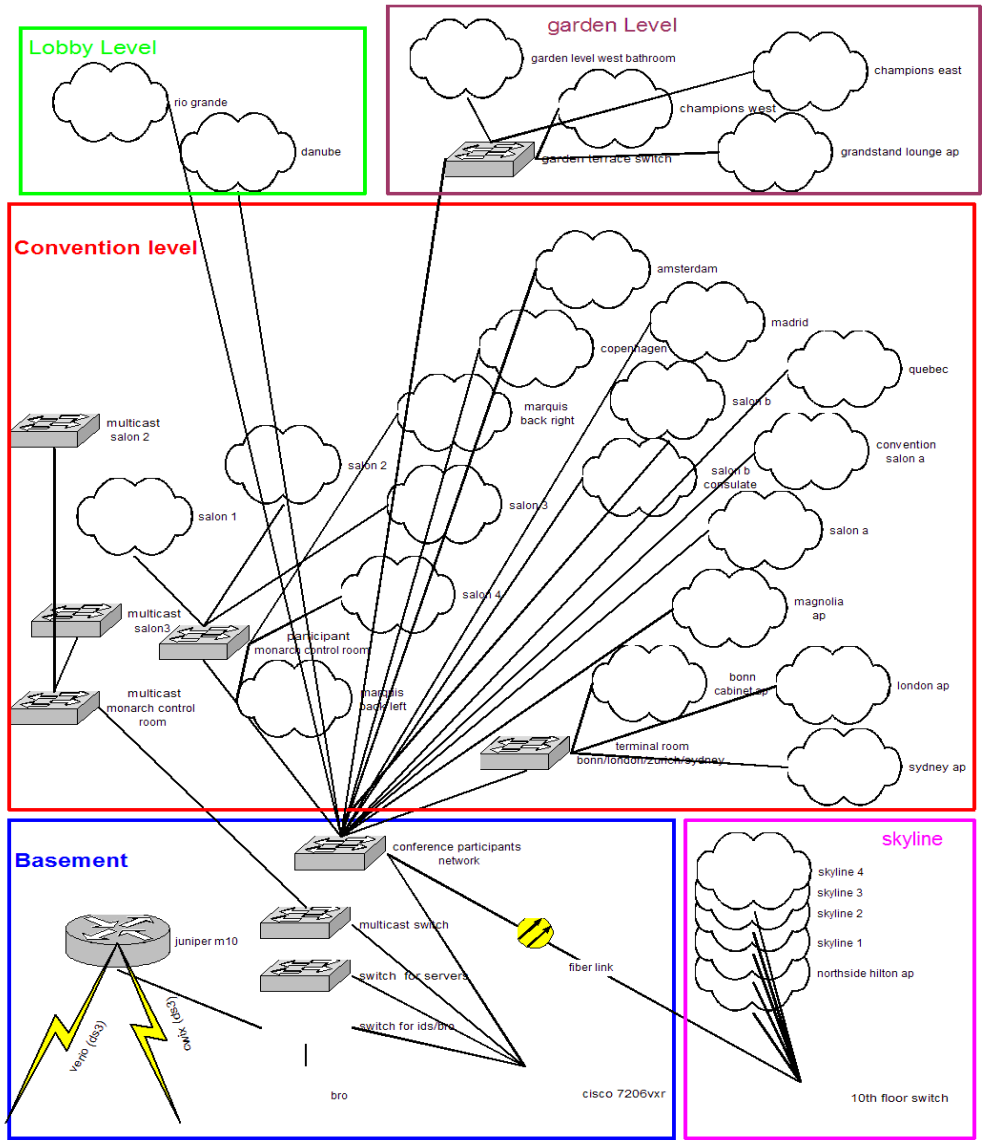
IETF55 Design

- 34 access points
  - 13 for plenary space
- Address space for wireless subnet was a /20
- Reduced output power to 15mw (Cisco) or set density to high (Agere/Proxim/Orinoco) where possible.

IETF 55 layout



IETF Logical layout



Some Complaints about “enterprise” access-points

- Some access-points allow you set output power, some use density/sensitivity settings, they don't do the same thing.
- One vendor provided us with access-points on which it was impossible to determine how many or which stations were associated.
  - Ethernet bridge MIB did not age, and no enterprise MIB with associated stations was available.
- IAPP doesn't appear to be standardized between vendor platforms.

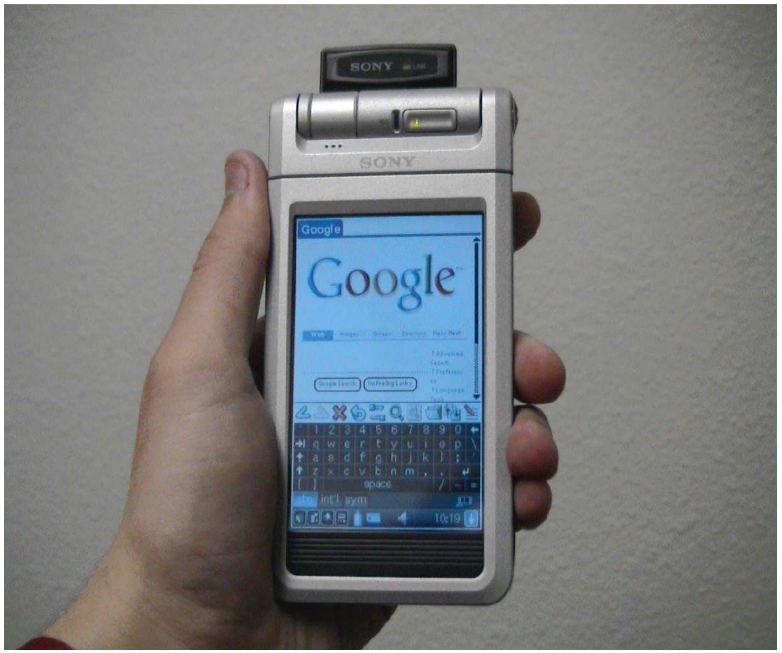
Complaints Continued

- Crashes lead to cascading failures.
- One vendor's access-points would give up after attempting to dhcp and lose random bits of their configuration making stability an even bigger issue.
- Interoperability issues with some older cards.
- Need secure (ssh or ssl wrappered) management interfaces.
- One access-point model would provide the management password to anyone who asked.

Clients

- Not all wireless card/in-built antennas are created equal (Toshiba portege/Apple g4-ti laptops)...
  - Sensitivity settings on access-points may cause clients to flip-flop between access-points in marginal situations.
- Misconfigured clients (ad hoc mode) can cause all sorts of chaos.
- Host implementations lacking or hiding critical control functionality.

What does the future hold?



- 802.11A
  - 8 non-overlapping channels
  - 54Mb/s
  - OFDM
  - Power requirements and the size of decently performing antennas probably keep it out of devices smaller than laptops.
  - A/B access-points are a no-brainer.

Future Continued

- 802.11G
  - 54Mb/s
  - OFDM
  - The same 3 channels we have now... (with power issues on 1 & 11)
  - Backward compatible with B
- On laptops, 802.11/a/b/g chipsets.
- PDA's cell phones and other devices, will probably stick with B/G until/unless the power/size requirements for A go down

Acknowledgments

- Merit, the University of Oregon, Nokia and IETF Secretariat for allowing me to mess with their networks.
- Bill Fenner (AT&T), Carlos Vicente (U of O) tools development and monitoring.
- David Kessens (Nokia)
- Jennifer Adams (Cisco)
- Everyone who worked on the NANOG26 and IETF55 Networks.