Wireless Network Design

Joel Jaeggli

There's No magic bullet

- Design choices are dependant on:
  - Your goals
  - Budget
  - Environment in which you're working
  - Basic technology choices.

Goals

- What is the purpose of the the wireless network deployment?
  - Campus (university, hotel/resort, airport factory etc) deployment for end users
  - Wireless Backbone
  - Traditional Wireless ISP
    - Backbone
    - Last mile
    - Customer edge
  - Municipal wifi deployment, rural network coverage etc.

Budget

- Is the build-out a commercial endeaver?
- Are the customers paying for an SLA?
- Is it being done on a cost recovery or best effort basis?
- Is it supposed to be self sustaining.
- “As cheap as humanly possible”

Environment

- Topography
  - Outdoors
    - Hilly vs flat
    - Wooded or not
    - Built-up or not
    - interference
  - Indoors
    - Type of construction (resident vs industrial)
    - Sources of interference
    - Density required

Technology choices

- For indoor/campus type applications the edge is almost always going to be WIFI
- For other applications where the operator has control over both ends of the link the answer is less clear cut.
- Balance cost against current performance, and future expandability.

Campus

- Properties of campus networks
  - Large numbers of mobile users.
  - Customers generally manage their own equipment (laptop pda mobile phone etc)
  - Device on the network get used on other networks as well.
- Expectations
  - Roaming between two AP does not break security associations, TCP connections change your ip address etc.

Campus

- Implementation
- Campus networks are generally built with some form of layer-2 mobility in place.
- In practice that means most of them are flat subnets.
  - This can be implemented with overlays or tunnels however.
- Two models these days
  - Stand-alone APs using IAPP (inter-access point protocol) to exchange association information.
  - Centrally managed “thin” APs and a central controller or controllers

Campus - continued

- Proponents of “fat” ap approaches.
  - Cisco
  - Proxim
  - D-link
  - Etc

- Proponents of wireless controller approaches
  - Cisco
  - Aruba
  - Meru
  - Trapeze

Campus – wireless controller approach

- Wireless controllers have some advantages
- Able to build the overlay between the APs and the controllers (no need to distribute the same vlan everywhere)
- Central choke-point for the application of access control policy.
- Can do mobility including mobile-ip without the knowledge of the client.

Campus – Wireless controller approach

- Limitations
  - Can be costly
  - Can encourage the creation of seriously non-optimal topology.

Wireless Backbone

- Gaps in your network deployment that can't be filled with fiber.
- Remote campuses
- To provide infrastructure to hang an ISP or multiple isp's off of.
- High performance backhaul for cellular networks.

Wireless Backbone Implementation

- Formerly gear was specific to the telecommunications industry.
  - Would provide link capacity on the order of:
    - E1 (2Mb/s)
    - E3 (35Mb/s)
    - STM-1 (155Mb/s) etc
- Now it's mostly moved towards delivery of Ethernet frames, provides generic gigabit Ethernet interfaces regardless of link speed.

Wireless Backbone Implementation

- Interoperability, less of an issue as radio's are bought licensed and deployed in pairs.
  - Point-to-Multipoint is rare.
- Typically routed.
- Resembles a pop architecture for a typical backbone network. Critical pops are connected via multiple links service to smaller less critical pops provided by single links
- Alternative technologies use for access

Wireless backbone technology

- Point-to-point gear comes in several flavors depending on the application.
- Available in both lisensces and unliscensed spectrum uses.
- Generally proprietary if it offers FDX or TDD.
- Fixed WiMAX gear is making inroads here.

Wireless Backbone - Examples

- Trangolink gigaband
- 6 11 18 23 Ghz
- 4 x Gig-e
- 8 x T-1
- 310Mb/s full duplex
- 6-10Km at full speed
- $15-20K per pair

Proxim Gigalink

GigaLink 7451e MMW Transceiver

- 8 Km on 74Ghz liscensed
- 1Km on 60Ghz unliscensed
- ~600Mb/s FDX

Proxim teraoptic

- Freespace optical
- Up to about 1Km
- About $12,000 per pair.
- 100Mb/s ethernet

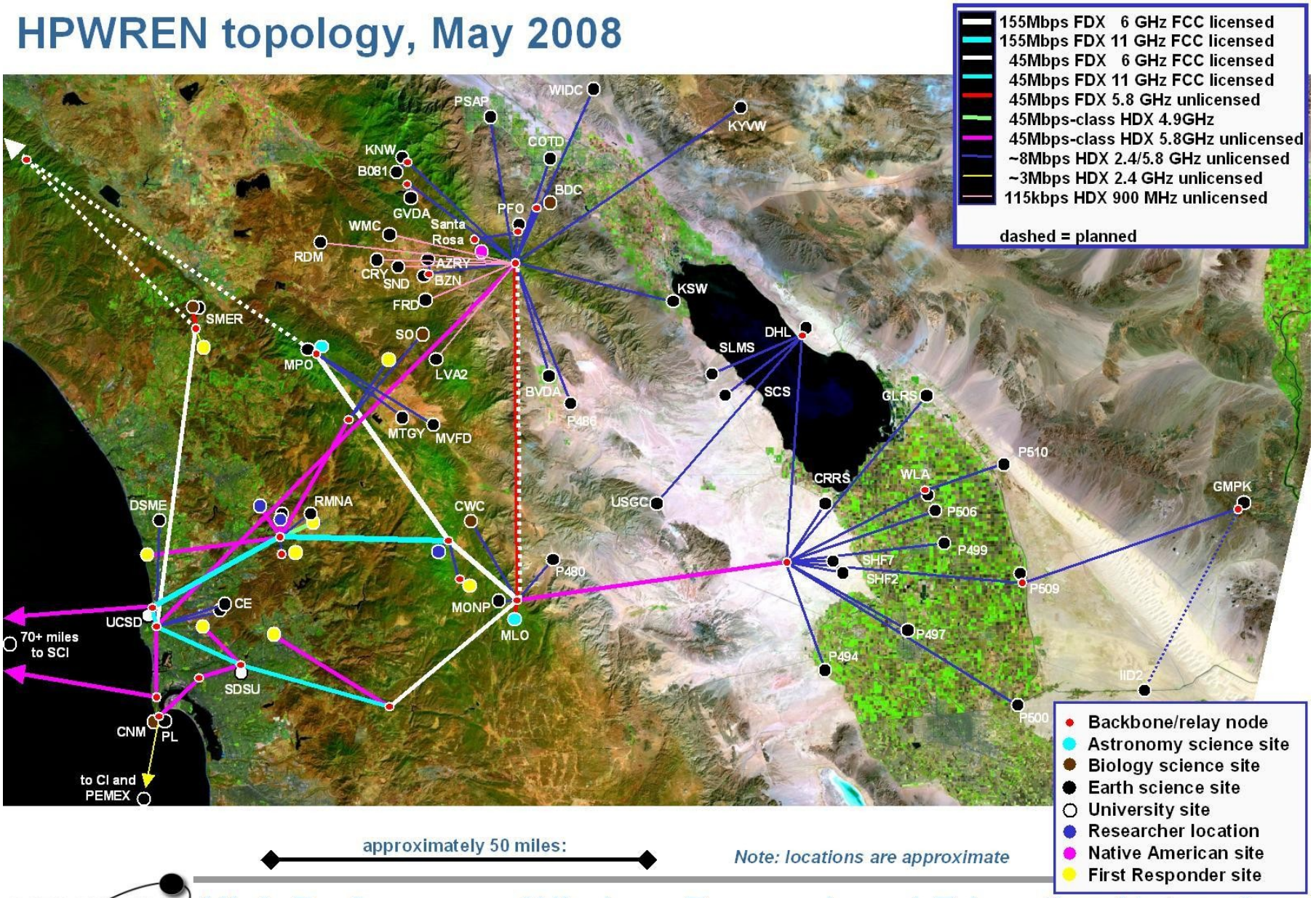
802.11 or derived backhaul

QuickBridge.11 (2454-R, 5054-R & 5054-R-LR)

* Shown with optional J-Bracket

- Examples include:
- Proxim tsunami quickbridge (proprietary)
- Power Station 2/5
- Tranzeo tr600/500
- Depending on throughput and antennas up to 50Km is feasible.

An example, HPWren



Obviously some antennas are larger than others...

Two 11Ghz Radio links

WISP

- WISPs Generally need both the wireless backbone and last mile technology.
- Effectively the can be provisioned independently of etc other.
- Fiber or other leased-line connectivity may substitute for wireless backbone
- Connectiy to an upstream

WISP – Last mile

- We discussed last mile technology yesterday
- Clearly there are a diversity of approaches.
- ISPs have needs
  - Access Control
    - Does the ISP control the CPE?
    - Does the End-user?
  - Billing and usage?
    - Is it flat rate?
    - Per customer bandwidth caps
    - Policy based qos

WISP – Last mile

- Is the cpe meant to go indoors or outdoors?
- Is there a mobility component?
  - Is it local or regional
  - PPPOE
  - mobile-ip

MESH network

- Wireless Mesh networks have been billed as a solution to the solution to building costly backbones.
- First wireless mesh network deployed would be aloha net in 1970, a 400km wide hf radio net.
  - Being the first of course it had it's own protocol

WDS Mesh

- Wireless Distribution system is L2 bridging
- Works with single radio AP meshes used by a number of low end commercial products, eg “range extenders”
- Supported by Open/DD WRT
- Issues
  - Maximum effective throughput is effectively halved for each station through which a packet must be relayed.
  - Dynamically rekeyed protocols (eg WPA) cannot be used in conjuction with a WDS mesh

Wireless Mesh Manet

- Work on mobile-adhoc-networks done in the IETF and IEEE
- Leveraged for some notable projects, including:
  - OLPC
  - DUMBO
  - OPENWRT – via freifunk firmware or 3rd party package
- Draft 802.11s
  - May be ratified july 2008
  - HWMP routing protocol based on a mix of distance vector (IE RIP) style and tree based routing protocols
  - Competing proposals involve OSLR which is a link state routing protocol like OSPF or ISIS

Proprietary mesh Approaches

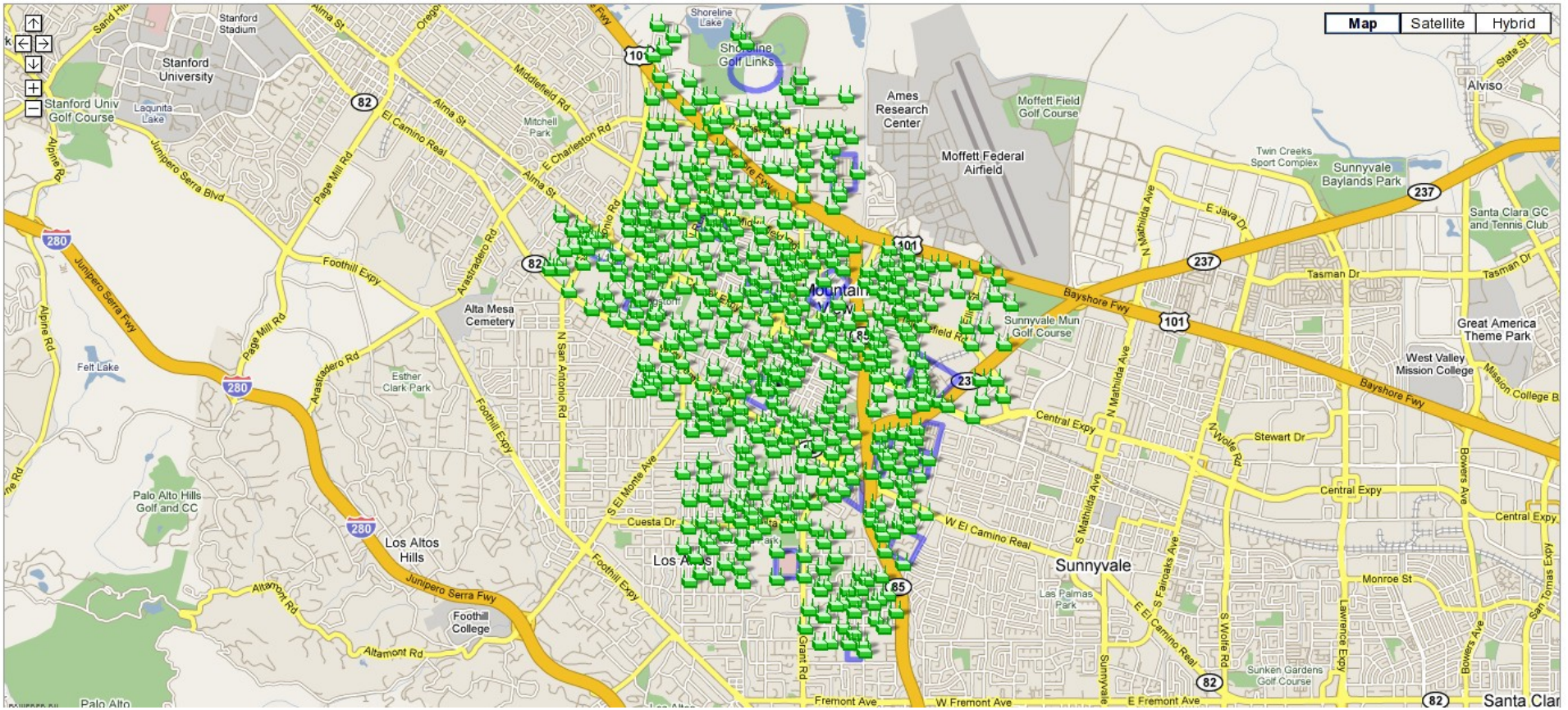
- Tropos metro mesh
  - Multi-radio customers and mesh are maintained on separate infrastructure
  - Predictive Wireless Routing Protocol (PWRP)
  - L2 mobility across the mesh cloud.
- Meraki Mesh

Google WIFI

Google WiFi Mountain View Coverage Map

This map shows the location of Google WiFi nodes in Mountain View, CA. The map also shows the areas of the city where we are not yet able to provide coverage. Often these locations do not have public light poles, on which we typically mount our network equipment. If you live in an area without coverage and you are interested in the possibility of hosting a Google WiFi node on your property, please email us at mvwifi-support@google.com.

Legend: Green icons indicate Google WiFi nodes. Purple shapes indicate areas of the city that are not currently covered by Google WiFi.



San Francisco

THE WALL STREET JOURNAL. Digital Network | WSJ.com | MarketWatch | BARRON'S | D | All Things Digital. | More

MarketWatch
Weekend Edition

Get to the next level of investment research

FRONT PAGE | MARKETS

Global Markets | Emerging Markets | Earnings Watch

LATEST NEWS Obama: Clinton should be honored for historic campaign

San Francisco formally ends citywide Wi-Fi effort

By Ben Charny
Last update: 9:38 p.m. EDT Sept. 12, 2007

SAN FRANCISCO (MarketWatch) -- EarthLink Inc.'s (ELNK: , ,) plans to build a wireless Internet network in San Francisco was formally scrapped by the city on Wednesday.

The initiative, which was also to include Google Inc. (GOOG: , ,) , ended when a committee of city supervisors refused to vote on a contract that San Francisco Mayor Gavin Newsom had negotiated with EarthLink.

According to Supervisor Aaron Peskin, who chaired the committee, it appears EarthLink isn't in a position to honor terms of the contract.

The bureaucratic move Wednesday makes the EarthLink effort "a moot point," San Francisco Supervisor Tom Ammiano said.

"It's done," he added. "Now we have to start all over again."

The events in San Francisco are illustrative of how cities across the United States are still struggling to build wireless Internet networks, ostensibly to provide their citizens with free Internet access.

In the case of San Francisco and 11 other cities in negotiations with EarthLink, business realities got in the way of cities' goals.

EarthLink's municipal wireless efforts began to dissolve in late August when the financially ailing broadband provider said it was no longer willing to solely fund construction of city-wide wireless networks in San Francisco and 11 other cities.

Rather, it wants the cities it was in negotiations with to help pay for the construction.

E-mail
Print
Disable Live Quotes
Subscribe to RSS
Yahoo! Buzz

Recommend this story
Save and tag this story
Be the first to comment

Bibliography

- Fleeman Anderson and Bird, antenna and cable resource - http://www.fab-corp.com/
- Wireless Networking the developing world - http://wndw.net/
- Hpwren - http://hpwren.ucsd.edu
- ALOHANET - http://hpwren.ucsd.edu
- Freifunk firmware - http://wiki.freifunk.net/Freifunk_Firmware_%28English%29