802.11 Wireless WAN's & BSD

Tim Pozar and Matt Peterson
BSDcon '03
09/10/03

Overview

- What is BARWN?
- The BARWN box
- BSD relationship
- Deployment issues
- Q&A

What is BARWN?

- **Bay Area Research Wireless Network**
  - Community wireless network based in San Francisco
- Affiliated with *Bay Area Wireless Users Group*
  - http://www.bawug.org/
- Currently has access points located on Mtn. San Bruno (south of San Francisco) serving south SF, Colma, and Daly City. Also located in SoMa/Portrero Hill.

Community Wireless Networks

- Difference genre's
  - BAWUG : education, spin-offs (SFlan, SFwireless, BARWN)
  - NYCwireless : public hotspots (ie: downtown parks)
  - SeattleWireless : citywide MAN (Metropolitan Area Network)
  - PersonalTelco, NoCat : hybrid of above

Community Wireless Networks

- Share common technical & political problems; regardless of “biz model”
- Different then FreeNet (P2P) or FreeNet (subsidized ISP); most build on concept of member owned infrastruture (wireless, fiber, string can, etc.); more of a **cheapnet**
- Free and Fee “feed” off each other : *NoCatAuth* used by NYCwireless (free) and Telerama (fee)
- Hotspots are borng; extending monolopy DSL isn't exciting

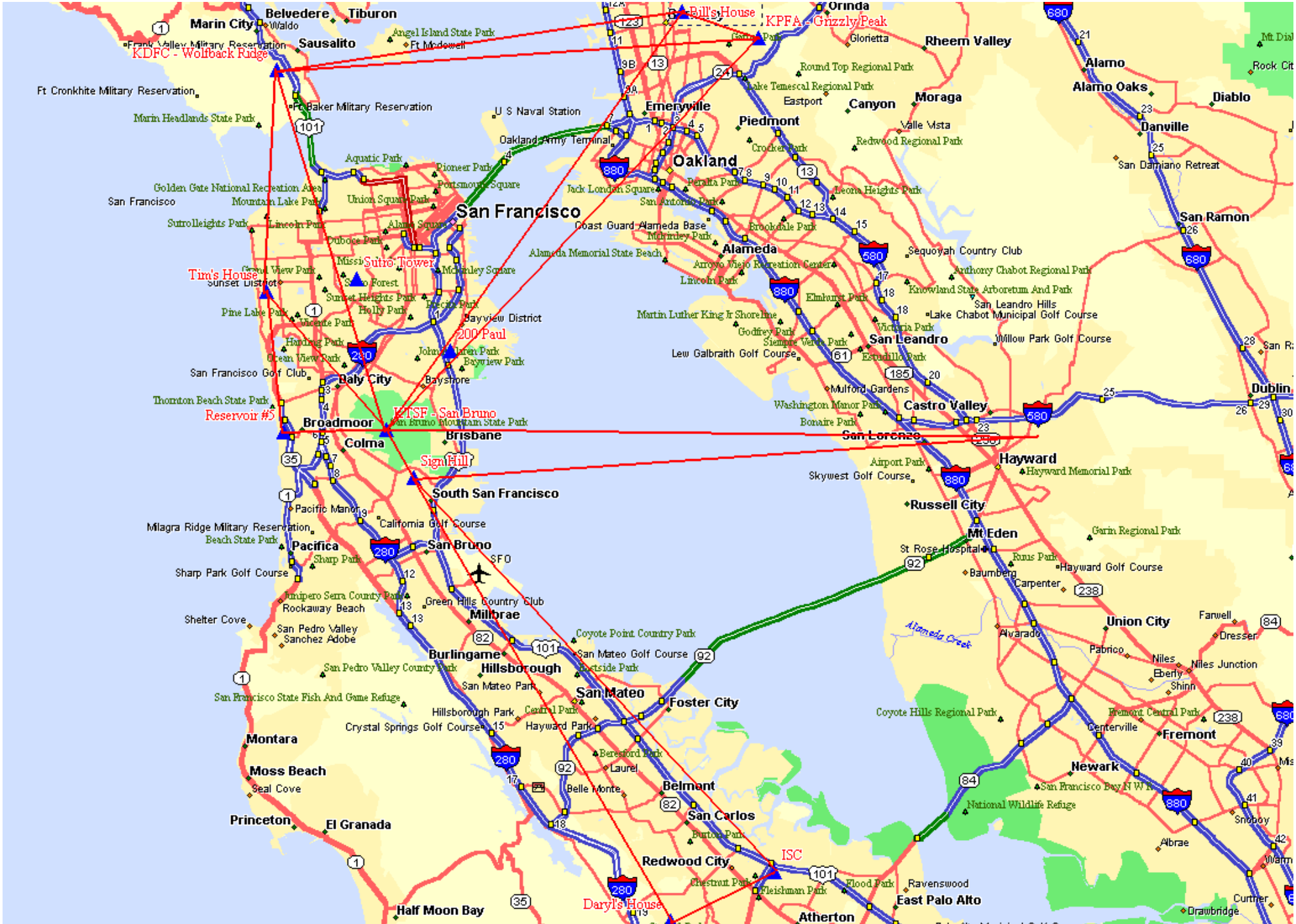
BARWN Objectives

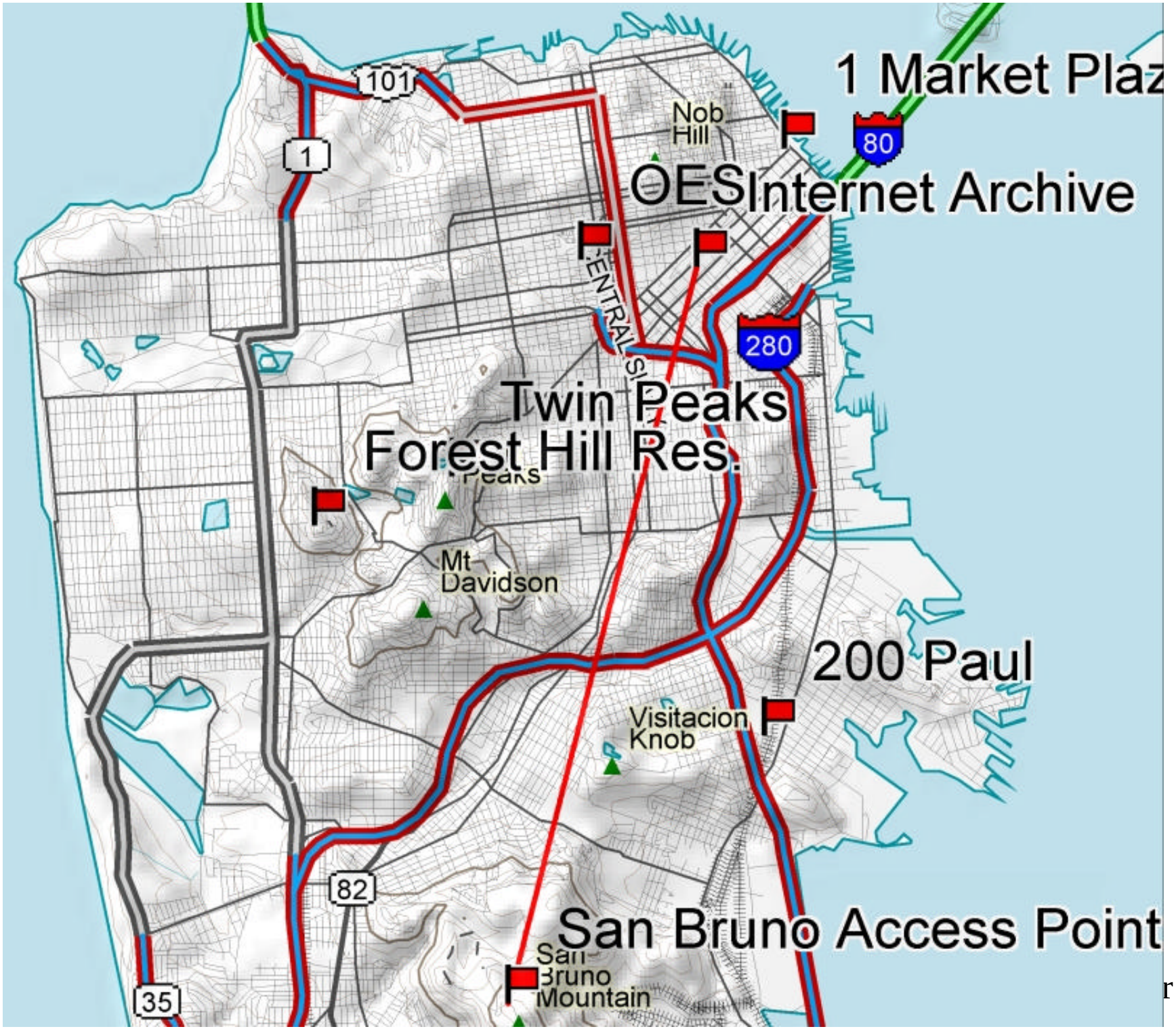
- Development and documentation of long range (>2 mile) wireless networking using very low cost, commodity unlicen
- Be a wireless network test bed for developing new protocols or “tuning up” current protocols; such as dynamic routing originally designed for wired networks
- Research into the deployment of remote LANs to support public safety events and incidents.
- Provide a “back-bone” to tie together other communities & groups
- Respond to the loss of bi-directional expression on the Internet though experimentation with tree broadband access:
  - Limited AUP restrictions
  - Symmetrical bandwidth
  - No port filtering
  - Real static address space

Network Design and Deployment Issues

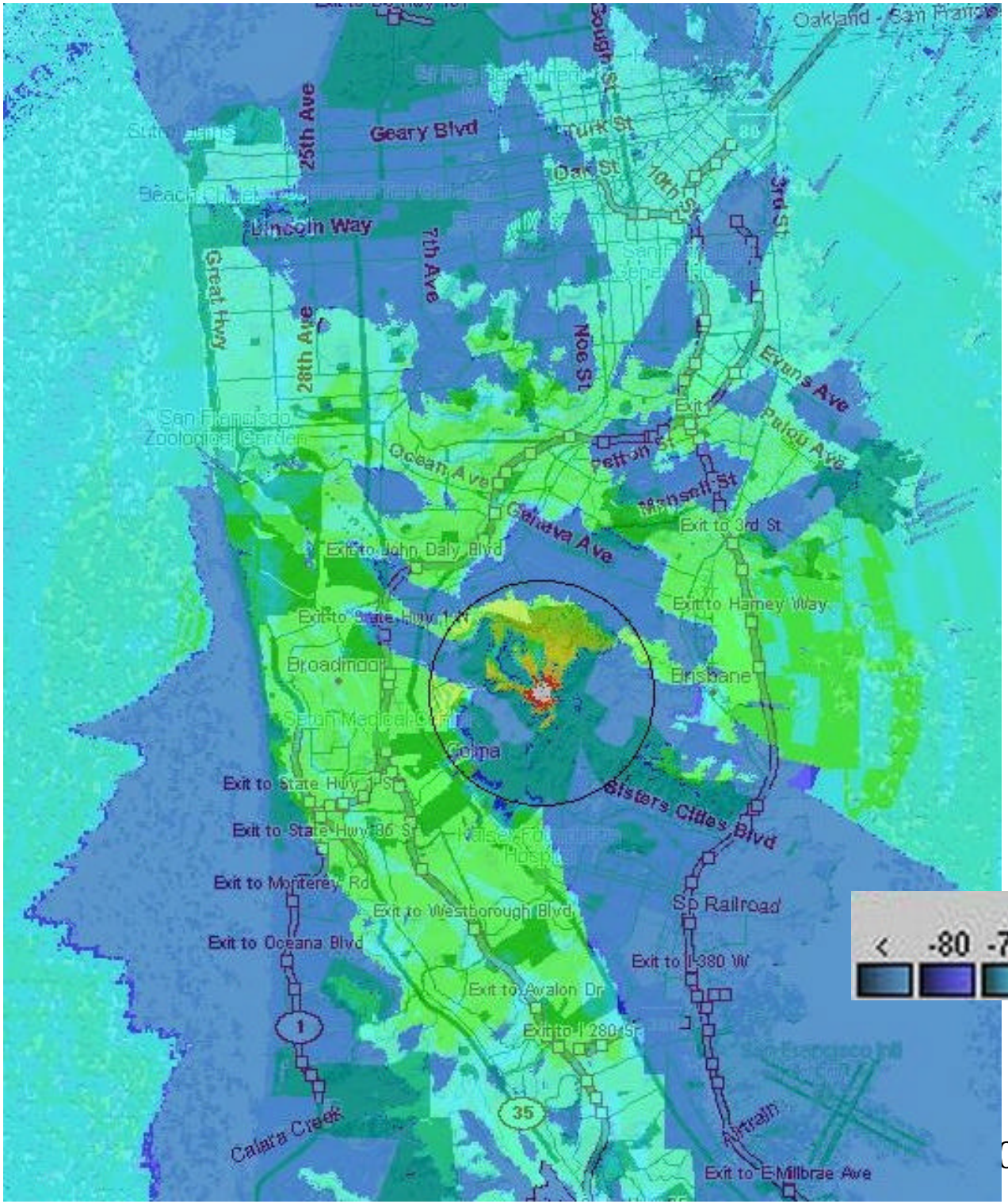
- Community Networks typically depend on a broadband connection for each AP.
- AUP issues with broadband try to limit sharing bandwidth
- Typical Broadband connections are asymmetrical
- Why have multiple broadband connections to the Internet when you want to communicate to someone across town.

Network for the Networks...




1 Market Plaz
101
1
Nob Hill
80
OES
Internet Archive
CENTRAL ST
280
Twin Peaks
Forest Hill Res.
Mt Davidson
200 Paul
Visitacion Knob
82
San Bruno Access Point
San Bruno Mountain
35

Coverage Map



Problems / Hurdles to Wireless Deployment

- Legal
- Political
- Technical

Problems – Legal

- Radio Frequency Radiation will dictate how the antennas are deployed.
- Limits of antenna height or aesthetics may be regulated by local government.
- Part 15 devices have no priority or rights over any other user of these bands.
  - Other users of the bands carry guns. :-)
  - See http://www.lns.com/papers/part15
  - Part 15.5...

Problems – Legal

CFR 47 – Part 15.5(b) Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator.

(c) The operator of a radio frequency device shall be required to cease operating the device upon notification by a Commission representative that the device is causing harmful interference. Operation shall not resume until the condition causing the harmful interference has been corrected.

Problems – Political

- We have been working with governments and commercial companies for access to sites.
  - Governments work at a glacial speed.
  - Finding the right person to talk to that has some clue and is in charge.
  - Getting everyone to sign off on the project.
  - Permitting and zoning issues.
  - Finding a person that will “take a risk”.
- Governments do like demos...

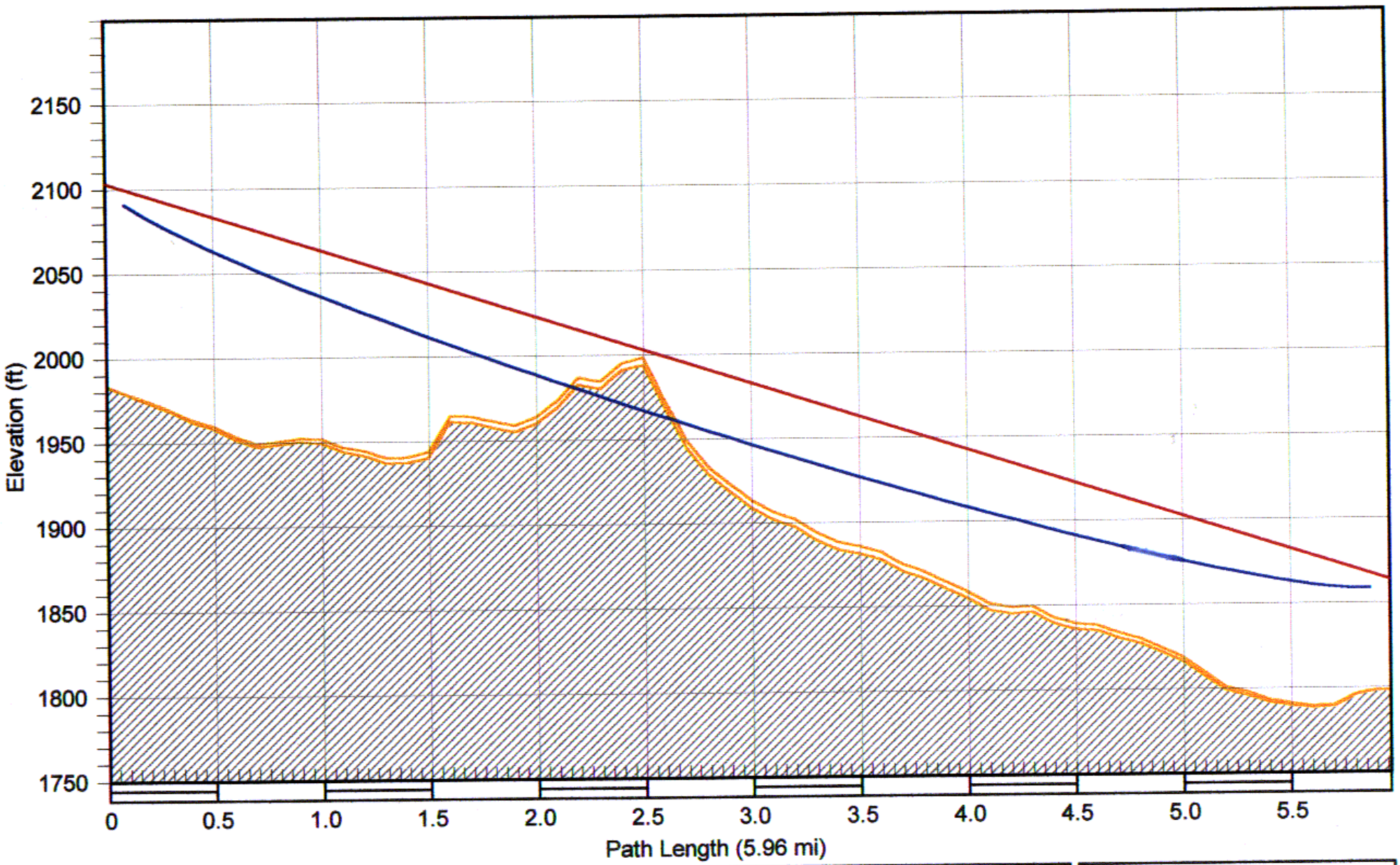

SAN FRANCISCO POLICE
S.F.P.D.
MOBILE COMMAND TWO

Problems – Technical

- Current 802.11 protocols do not scale beyond 15Km.
  - One needs to “modify” the protocol to go beyond this limit.
    - KarlNet, Lucent COR/ROR, other “polling” methods
- Unlicensed deployment still needs to be engineered to prevent interference to yourself and others.
  - Licensed Exempt means that the manufacture needs to take responsibility to minimize interference with devices.
  - Protocols such as 802.11h will go some ways to help.
    - Frequency “coordination” and automatic power control.

Problems – Technical (cont.)

- Path design / Survey – Can photons get where you want?
- Short distances (<30meters) can be determined by visual inspection.
- Longer distances will likely need to use a visual survey with microwave path engineering software.
  - Examples:
    - EDX - www.edx.com - 10s of thousands of $
    - PathLoss - www.pathloss - ~$4,000
    - Radio Mobile -www.cplus.org/rmw/ - Free (see: BARWN coverage map)
  - The more you pay the more accurate the uptime and coverage predictions.



KEYAFM	
Latitude	48 50 37.00 N
Longitude	099 45 02.00 W
Azimuth	241.42°
Elevation	1983 ft ASL
Antenna CL	120.0 ft AGL

Frequency (MHz) = 5800.0
K = 1.33
%F1 = 100.00

Shell Valley	
Latitude	48 48 08.22 N
Longitude	099 51 54.90 W
Azimuth	61.34°
Elevation	1798 ft ASL
Antenna CL	65.6 ft AGL

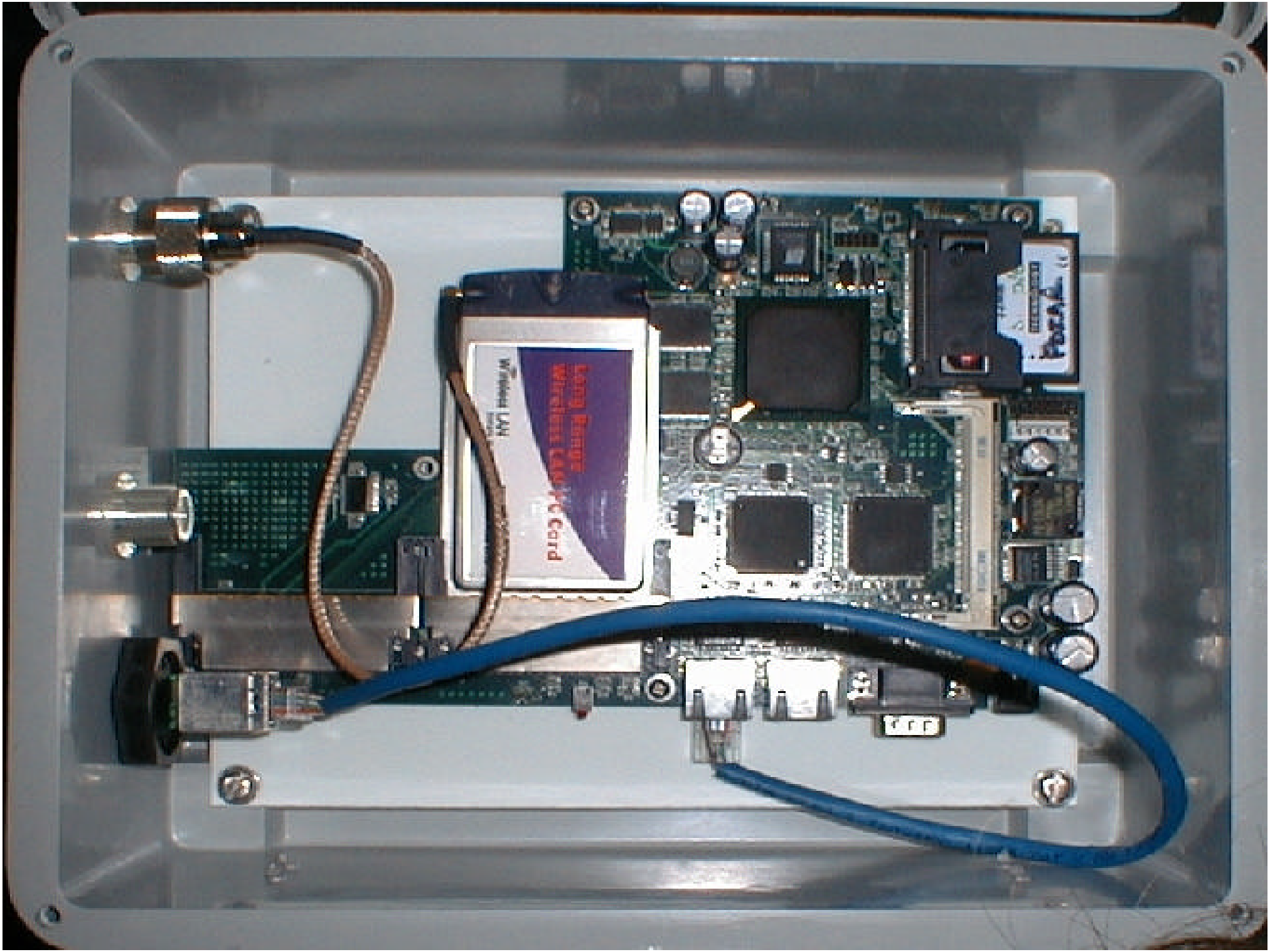
Problems – Technical (cont.)

- Protocol is half-duplex and as an extension of 802.x and as such will not handle traffic well as it reaches half the signaling speed.
  - Hacks for backbones could include using one radio-NIC for transmit on one frequency or band and another radio-NIC for receive on another frequency.
    - 802.11b – channel 1 and 802.11b channel 6
    - 802.11g for TX and 802.11a for RX
  - Or just abandoning 802.11 and going to another radio modulation scheme such as Motorola's Canopies (FM full-duplex) or Proxim's (was Western Multiplex) Tsuami radios.
    - HP-WREN is doing this.

“ Official” FreeNetworks WLAN router

- **Soekris net45x1**
  - 486/133Mhz, 64Mb, CompactFlash/PXE boot
  - Dual or single PCMCIA; MiniPCI (type III), etc.
  - Low power, small form, inexpensive
- **BSD (**OpenSoekris, m0n0wall) or **Linux** (Pebble, WISP-Dist)
- Senao/EnGenius ***200***mW Prism NIC w/ antenna connectors
- Outdoor case, pigtails, PoE injector, etc.

- **Future Direction**
  - 266Mhz - Soekris net4801 or Pcengines WRAP.1
  - 11g or 11a; Atheros


Long Range
Wireless LAN PC Card

BSD 802.11 Drivers

- **Stable (-RELEASE/-STABLE)**
  - wi(4) : Proxim/Agere/Orinoco/Avaya/WaveLAN/Lucent “Hermes” & Globespan/Intersil “Prism” 2/2.5/3
  - an(4) : Cisco/Aironet 34x/35x
- **Development (-CURRENT)**
  - ath(4) : Atheros 52xx 11a/b/g (FreeBSD & Linux)
  - atw(4) : ADMtek 8211b (NetBSD)
- **Dead?**
  - awi(4) : AMD “PCnetMobile”
  - ray(4) : Raytheon “Raylink”

BSD 802.11 Drivers (cont)

- **Pros**
  - Common *net80211* driver framework!
  - Mostly Stable (assuming stable firmware)
  - Check'd in to public CVS tree; Free/Open/Net sharing clue
- **Cons**
  - Limited HostAP features (no IAPP roaming daemon, disable broadcast SSID, etc)
  - 802.1x/EAP (Open1x.org patches exist for Free/OpenBSD)
  - Lack of Broadcom (Apple Extreme) & Ti drivers; typical NDA issues; un-official Linux drivers
  - Linux more f/w hacks; *if f/w is broke; do this; or else do that*

Who needs a beer ...

- **Atsushi Onoe -** net80211 framework, awi(4)
- **Sam Leffler –** ath(4); FreeBSD 5 convert to above framework
- **Thomas Skibo –** BSD HostAP
- **Warner Losh –** FreeBSD maint.
- **Bill Paul –** Initial wi(4) & an(4) drivers
- **David Young –** atw(4), NetBSD maint.
- **Kevin Lahey –** HostAP power saving support
- *And everyone we're forgetting!*