Community Wireless Networks and Regulatory Impact on Deployment in the United States

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Community Wireless Networks

- Co-operative in nature
  - Supports the original “spirit” of the Internet.
  - Sharing work, resources and knowledge.
- Sometimes called a “Freenetwork”
  - Defined to be “free” within a network co-op.
- Stretching the limits of the technology.
  - Uses much of the same technology and layout.
  - Just more power and slightly more expense.
- Much of the character of a Community Wireless Network can be seen in the Bay Area Regional Wireless Network's (BARWN) objectives...

BAWRN Objectives

- Development and documentation of long range (>2 mile) wireless networking using very low cost, commodity unlicensed radio transceivers.
- Be a wireless network test bed for developing new protocols or "tuning up" current protocols such as dynamic routing protocols originally designed for "wired" networks.
- Research into the deployment of remote LANs for the support of public safety events and incidents.

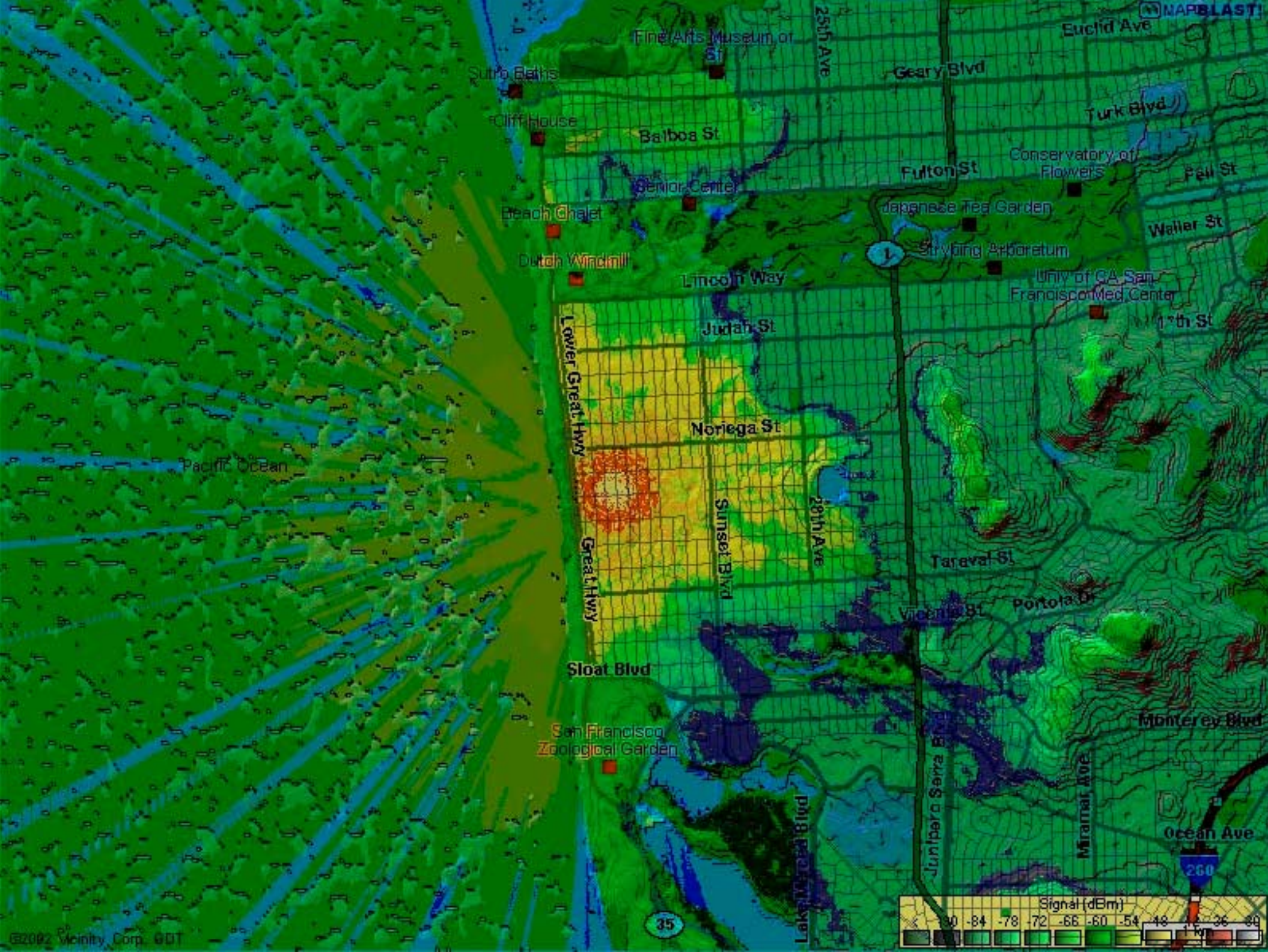
BAWRN Objectives (cont.)

- Provide a “back-bone” to tie together other communities and groups.
  - i.e.: offices, libraries, outreach centers.
- Respond to the loss of bi-directional expression on the Internet through experimentation with true broadband access to the home with features including:
  - Limited AUP restrictions.
  - Symmetrical bandwidth.
  - No port filtering.
  - Real static address space.

*Neighborhood Area Networks (NANs) and Hot Spots**

- Early example of a community network
- Typically short range - <1 Km diameter
- Commercially typically used to cover a store.
- Configurations will cover the size of a store (ie. A café), a park and up to several blocks.
- Examples:
  - NYC Wireless - Bryant Park in NYC
  - Coverage Map of PozarLAN...

Bryant Park in New York City


NAPBLAST!
Euclid Ave
Fine Arts Museum of
25th Ave
Geary Blvd
Sutro Baths
Cliff House
Balboa St
Turk Blvd
Conservatory of
Flowers
Fulton St
Senior Center
Japanese Tea Garden
Beach Chalet
Dutch Windmill
Lincoln Way
Univ of CA San
Francisco Med Center
Judah St
Lower Great Hwy
Noriega St
Pacific Ocean
Sunset Blvd
28th Ave
Great Hwy
Taraval St
Portola Dr
Sloat Blvd
San Francisco
Zoological Garden
Monterey Blvd
Junipero Serra Blvd
Miramar Ave
Ocean Ave
Signal (dBm)
-84
-78
-72
-66
-60
-54
35
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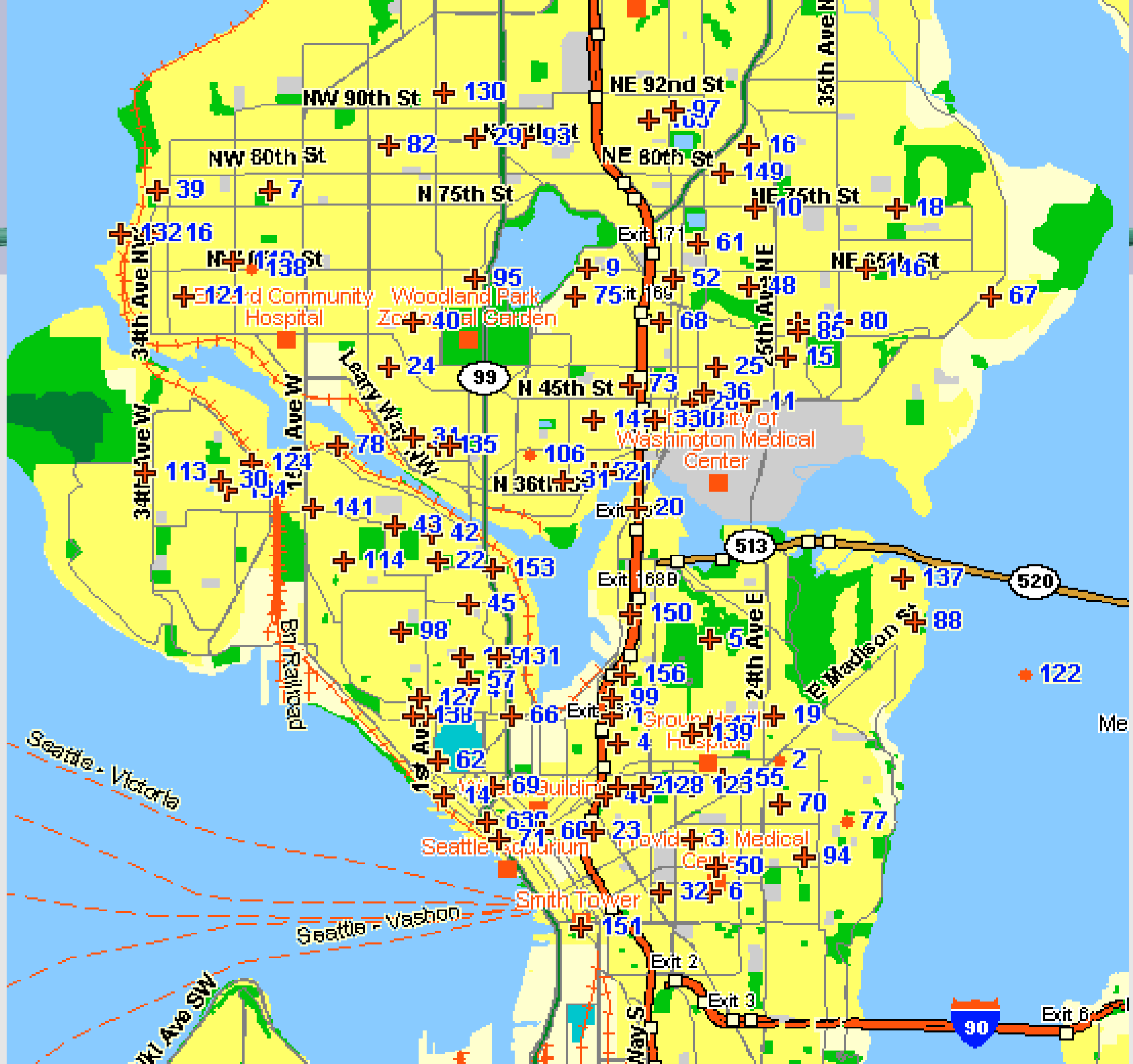
Metropolitan Sized Networks (MANs)

- MAN sized:
  - San Francisco Presidio – SFLAN
    - Point to multipoint
  - Seattle Wireless...
    - Mesh Network
    - Knowing friends in “high places”
- Multiple Counties:
  - BARWN – San Francisco Bay Area...


NW 90th St
NW 80th St
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NE 75th St
NE 65th St
35th Ave NE
25th Ave NE
24th Ave E
15th Ave W
34th Ave W
Leary Way NW
E Madison St
Exit 171
Exit 169
Exit 168B
Exit 167
Exit 2
Exit 3
Exit 6
99
513
520
90
Woodland Park Zoological Garden
Hospital
University of Washington Medical Center
Seattle Aquarium
Smith Tower
Seattle - Victoria
Seattle - Vashon
Ballard Bridge


Belvedere
Tiburon
Marin City
Waldo
Sausalito
Angel Island State Park
Ft McDowell
Frank Valley Military Reservation
KDFC - Wolfback Ridge
Bill's House
KPFA - Grizzly Peak
Orinda
Glorietta
Rheem Valley
Alamo
Alamo Oaks
Diablo
Danville
San Damiano Retreat
San Ramon
Rock C
Ft Cronkhite Military Reservation
Ft Baker Military Reservation
Marin Headlands State Park
U S Naval Station
Oakland Army Terminal
Emeryville
Piedmont
Oakland
Round Top Regional Park
Lake Temescal Regional Park
Eastport
Canyon
Moraga
Valle Vista
Redwood Regional Park
Crocker Park
Aquatic Park
Pioneer Park
Portsmouth Square
Golden Gate National Recreation Area
San Francisco
Mountain Lake Park
Union Square Park
San Francisco
Jack London Square
Peralta Park
San Antonio Park
Leona Heights Park
Sutro Heights Park
Lincoln Park
Alamo Square
Duboce Park
Coast Guard Alameda Base
McKinley Park
Brookdale Park
Alameda
Alameda Memorial State Beach
Arroyo Viejo Recreation Center
Lincoln Park
Sequoyah Country Club
Anthony Chabot Regional Park
Knowland State Arboretum And Park
San Leandro Hills
Lake Chabot Municipal Golf Course
Willow Park Golf Course
Tim's House
Sunset District
Sutro Tower
McKinley Square
Grand View Park
Sutro Forest
Sunset Heights Park
Holly Park
Buena Park
Pine Lake Park
Vicente Park
Bayview District
200 Paul
Harding Park
Ocean View Park
John Yehall Chin Park
Bayview Park
Martin Luther King Jr Shoreline
Godfrey Park
Siempre Verde Park
Elmhurst Park
Victoria Park
San Leandro
Estudillo Park
Lew Galbraith Golf Course
San Francisco Golf Club
Daly City
Bayshore
Thornton Beach State Park
Reservoir #5
KTSF - San Bruno
San Bruno Mountain State Park
Broadmoor
Colma
Brisbane
Sign Hill
Mulford Gardens
Washington Manor Park
Bonaire Park
Castro Valley
San Lorenzo
Dublin
Airport Park
Skywest Golf Course
Hayward
Hayward Memorial Park
South San Francisco
Pacific Manor
California Golf Course
Russell City
Milagra Ridge Military Reservation
Beach State Park
Pacifica
Sharp Park
San Bruno
SFO
Mt Eden
St Rose Hospital
Garin Regional Park
Runs Park
Hayward Golf Course
Baumberg
Carpenter
Sharp Park Golf Course
Junipero Serra County Park
Rockaway Beach
Green Hills Country Club
Millbrae
Shelter Cove
San Pedro Valley
Sanchez Adobe
Coyote Point Country Park
San Mateo Golf Course
Burlingame
Hillsborough
Eastside Park
San Pedro Valley County Park
San Mateo Park
San Mateo
Foster City
Union City
Alvarado
Pabrico
Niles
Niles Junction
Eberly
Shinn
Farwell
Dresser
Alameda Creek
San Francisco State Fish And Game Refuge
Hillsborough Park
Central Park
Hayward Park
Crystal Springs Golf Course
Coyote Hills Regional Park
Fremont Central Park
Centerville
Fremont
Montara
Moss Beach
Seal Cove
Beresford Park
Laurel
Belle Monte
Belmont
Newark
San Francisco Bay N W R
National Wildlife Refuge
Snoopy
Princeton
El Granada
San Carlos
Burton Park
Redwood City
ISC
Chestnut Park
Fleishman Park
Flood Park
Ravenswood
East Palo Alto
Atherton
Palo Alto Municipal Golf Course
Albrae
Drawbridge
Curtner
Half Moon Bay
Daryl's House
Stulsaft Park

Unlicensed doesn't mean unencumbered

Although community wireless networks have significant potential, there are a number of regulatory issues that can slow down growth.

FCC's Equipment Labeling Requirements...

Typically the only way a consumer is introduced to the FCC's rules about unlicensed devices...

"This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

- FCC Part 15.19

Biggest Issue

- This label touches on the biggest impediment to large investments in 802.11 deployment.
- FCC Part 15.5 defines the priority of part 15 devices to other users of the band and how part 15 devices need to correct interference with them and other users.

FCC Rules & Regulations - 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."

- FCC Part 15.5(b)

The Impact of Part 15.5:

- Owners of wireless networks covered by 15.5 have no legal standing under FCC's rules to require interfering devices to shut down. One could deploy hundreds of thousands of dollars of wireless equipment that can be rendered ineffective if an other user of the band starts to transmit.

- Owners and operators of part 15 networks must shut down (15.5(c)) once contacted by a representative of the FCC and must stay off the air until the problem is corrected.

Other users of 2.4 and 5 Ghz...

- Part 18 – Industrial, Scientific and Medical (2.4 & 5)
  - Also unlicensed devices.
- Part 25 – Satellite Communications (5)
- Part 74 – Broadcast Auxiliary (2.4)
  - Typically ENG video links.
- Part 80 – Maritime Services (2.4 & 5)
- Part 87 – Aviation Services (2.4 & 5)
  - Parts 80 and 87 are “radio navigation” aka RADAR
- Part 90 – Land Mobile Radio Service (2.4)
  - Public safety and commercial use
- Part 97 – Amateur Radio (2.4 & 5)
- Part 101 – Fixed Microwave Services (2.4)
- Federal Usage – NTIA/IRAC (2.5 & 5)

FCC/NTIA Warnings

In the case of 802.11b, a note in the Rules warns:

15.247(h) Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of Part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users.[...]

In the case of 802.11a, the FCC has a note in Part 15.407 stating that:

Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

...if they will even tell you.

Interference with other 802.11b Channels as they overlap...

- Internal frequency coordination is required.
- Some discussion if channels 1, 4, 7 & 11 would work as their energies slightly overlap.

Channel	Bottom (Ghz)	Center (Ghz)	Top (Ghz)
1	2.401	2.412	2.423
2	2.406	2.417	2.428
3	2.411	2.422	2.433
4	2.416	2.427	2.438
5	2.421	2.432	2.443
6	2.426	2.437	2.448
7	2.431	2.442	2.453
8	2.436	2.447	2.458
9	2.441	2.452	2.463
10	2.446	2.457	2.468
11	2.451	2.462	2.473

Equipment Certification

- The FCC wants some responsible party for emissions that can cause interference.
  - Typically this is the license holder. With unlicensed devices, the burden is on the manufacture.
- Part 15 equipment is designed to be used by the general public.
- Equipment is certified as a "system" can not be mixed and matched with other equipment
- It is possible to re-certify equipment for your configuration.

Human Exposure of Radio Frequency Radiation

- The standards that the FCC has accepted allows exposures to "staff" and "general public".
- With current regulations and worse case configuration, the public would be restricted from .6 meters from a high-gain antenna.
- Pseudo-scientific groups could be a factor.
  - As wireless operators become more "visible" they will be noticed by these groups. A backlash can happen much like what the cellular industry encounters in the US.

Other Regulations...

- Tower and antenna placement
  - In housing tracks
  - Height limits
  - FAA concerns

- Broadband Appropriate Use Policies (AUP)

The Future - "Good and Bad News"

- New standards & groups will help with interference.
  - 802.11h
    - transmission power control (TPC) and dynamic frequency selection (DFS) as required by the EU for 802.11a.
  - 802.15
    - Personal Operating Space (POS) devices (ie. Bluetooth)
  - 802.16
    - Wireless Metropolitan Area Networks
- Some devices may contribute to interference:
  - RF Lighting
    - Made by Fusion Lighting Inc. www.fusionlighting.com
- Regulation could cripple long distance networking
  - Sirius' FCC Application (Retracted)
    - Limit out-of-band signals (2320-2345MHz) to 8.6 µV/m @ 3 meters.

The Future (cont...)

- Who else may be trying to restrict unlicensed use of these bands?
  - American Radio Relay League (ARRL)
    - Doesn't believe the FCC has the legal right to allocate unlicensed spectrum and is challenging it.
  - NTIA/IRAC has expressed some concern.
    - Likely they have abandoned the channels except for high power applications.
  - Other adjacent channel users (ie Sirius's proposal)
  - Anyone can affect you through the FCC's Regulatory (NOI, NPRM) process.

Community wireless networks can work with the following caveats:

- Deploying wireless network infrastructure based on un-licensed spectrum can be risky as you have no rights or priorities.
- Coordination with other users is mandatory
  - New protocols will help in sharing spectrum in the bands.
- A properly engineered and designed network will survive longer.
- Other issues can affect deployment like FCC Rules changes or pressure to get the FCC to enforce. One needs to be active in watching and changing the FCC's Rules.
  - Watch for anything that affects Part 15
  - Help support and create new Regulation.

Resources

- Books:
  - “Building Wireless Community Networks” - Rob Flickenger – O'Reilly
  - “802.11 Wireless Networks” - Matthew Gast – O'Reilly

- Sites:
  - http://www.freenetworks.org
    - The “meta” site for the community groups such as:
    - Bay Area Wireless Users Group - http://www.bawug.org
      - Great informative mailing list.

Thank You

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www.bawug.org

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