# Google Municipal Wireless Projects

For WCA March 21, 2006

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# Google's mission is to organize the world's information and make it *universally accessible* and useful

### Google Google Wifi Access Projects

- Objectives
  - Understand emerging access technologies
    - Capabilities
    - Needs of Operators, ISPs, Users
  - Deploy network to accelerate process
    - Provide a test bed for application development
  - Give back to communities we work in
- Projects
  - Mountain View
  - San Francisco (proposal)

## Google Mountain View Project Overview

- Cover city of Mountain View
  - Attempting to cover entire city (12 Square Miles, 70K Pop)
  - Not limiting to hotzone or high value areas
  - Laptop use outside
  - CPE to bring signal inside
- 802.11 b/g signal
- User supplies own access device
- Coverage in Mtn View Library and Book Mobile
- Attract lots of users

## Google Mountain View Service Description

- Service is Free
- Initial service will be up to 1 Mbps
- Requires Google Account to Login
  - Login page followed by landing page
  - Landing page will be simple customizable
  - No frame of advertising
- Single non-encrypted SSID to start
- 802.1x based SSID being considered for future
  - Public Safety SSID in the planning stage
- Exploring other non-web based methods of authentication



#### Sample Login Page



Sample Page Not Finalized

## Google Things We Hope to Learn

- Will Free service attract those to the Internet that were not users before?
- How many users will use system "out and about"?
  - Will usage be focused in hot zones?
- Can these systems maintain quality under load and vagaries of unlicensed spectrum?
- What are the capacity limits?
- How will the community use this network?
- What cool applications can be developed tailored for these networks?

### Google Mountain View Network Elements







- Mesh is Layer 3 routed.
- Capacity injection and backhaul are layer 2 switched

## Google Mountain View Architecture



# Google Mountain View Stats

- Nodes
  - 25-30 per square mile
  - Over 300 nodes in Mtn View
    - But still each must cover over 500 feet
- Gateways
  - 1 gateway per every 6 nodes
  - 4 per square mile
  - 50 to cover Mtn View
- Basestations
  - 1 per 4 sqr miles
  - 3 to cover mountain view

#### Google Map of Mountain View



Node placement not final or complete as shown



- P2P links
- Alvarion Breeze Access LB
- 5 GHz Bands



## Google Tropos Radios in Mountain View

- Radios are 13" x 10" X 5" and weigh 14 lbs
- 36 dBm EIRP
- Each unit uses 18 Watts of power







- Directional antenna (19 dBi)
- Mounted on extender
- 32 Mbps per sector in 20 Mhz
- 4 sectors per BS deployed





#### Google Other Node Architectures

- Multi-Radio Nodes
  - Decouple access and mesh links
    - Access link usually single 2.4 GHz radio
    - Mesh is 5 Ghz band
  - 3-port switch (cut through)
- Directional antenna mesh links
  - Static configured
  - Auto switched
  - TDMA scheduled
- Radio Controllers
  - Centralized node control performing channel and power selection.

# Google Current Status

- Most nodes and gateways installed
- Two BS is installed
- One BS remains to be installed along with P2P links
- About 25% (1BS worth) of network is operational for test
- Targeting to go live this summer

# Google San Francisco

- Google submitted joint bid with EarthLink to SF RFP
  - Approximately 40 square miles
- Earthlink to be network operator and offer premium paid services.
- Google provides free rate limited access on the network.
- Rate limits at approx 300kbps up/down
- Proposal is based on similar architecture as Mtn View network.
- San Francisco is considering bids



- Coverage
  - Especially Uplink
  - Laptop power is typically 50mWatt
- Roaming
  - PC's typically don't pick best AP
- Indoor access
- Interference
- Mounting assets

# Google My Wish List

- Multi-antenna Rx at AP for access link
  - MRC optimized for low SNR performance
  - Some Rx interference suppression would be nice too.
- Higher EIRP consumer devices (laptops)
- Better roaming algorithms for consumer devices
- Highly dynamic channel selection and link configuration for access and mesh links
- Node vendor interoperability
- More devices
- Capacity injection options

# Google Summary

- These networks are just emerging
  - Public service and safety networks becoming well established.
  - Public access models evolving.
- There is lots to learn
- There is lots of uncertainty
- Technology and service models are evolving quickly
- Mountain View and SF networks will hopefully add insight

