# Packet Updates in Santa Clara County

**SPECS – Southern Peninsula Emergency Communications System**

30 January 2010

Jim Oberhofer  KN6PE

# Agenda

1. Why do we still talk about packet?  Why use it?
2. Where are we today?
3. The Enhanced County Packet System

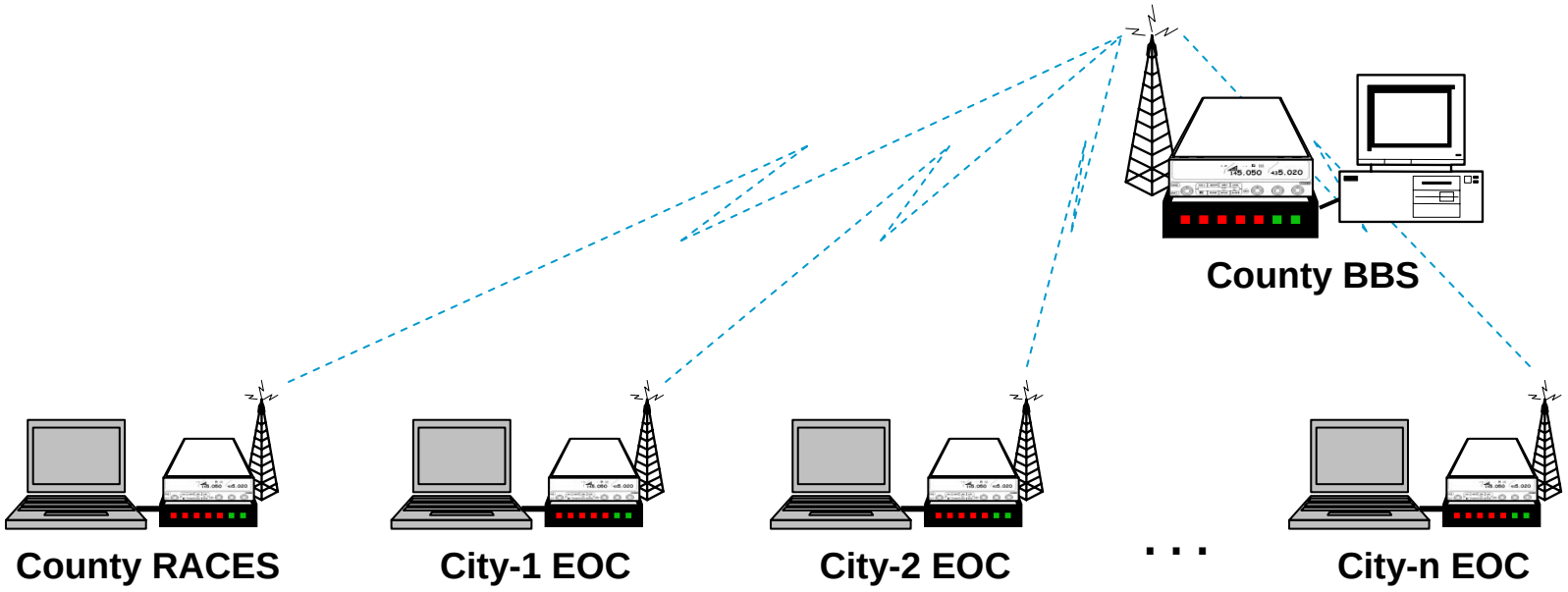
# Why use Packet Radio?

# Why use Packet Radio?

*The case for packet radio*

## 1. Message Store and Forward

- BBSs allow messages to be stored, retrieved, or forwarded throughout the connected BBS network.
- The recipient does not need to be on line to get the message, meaning that messages can be retrieved at the recipient's convenience.

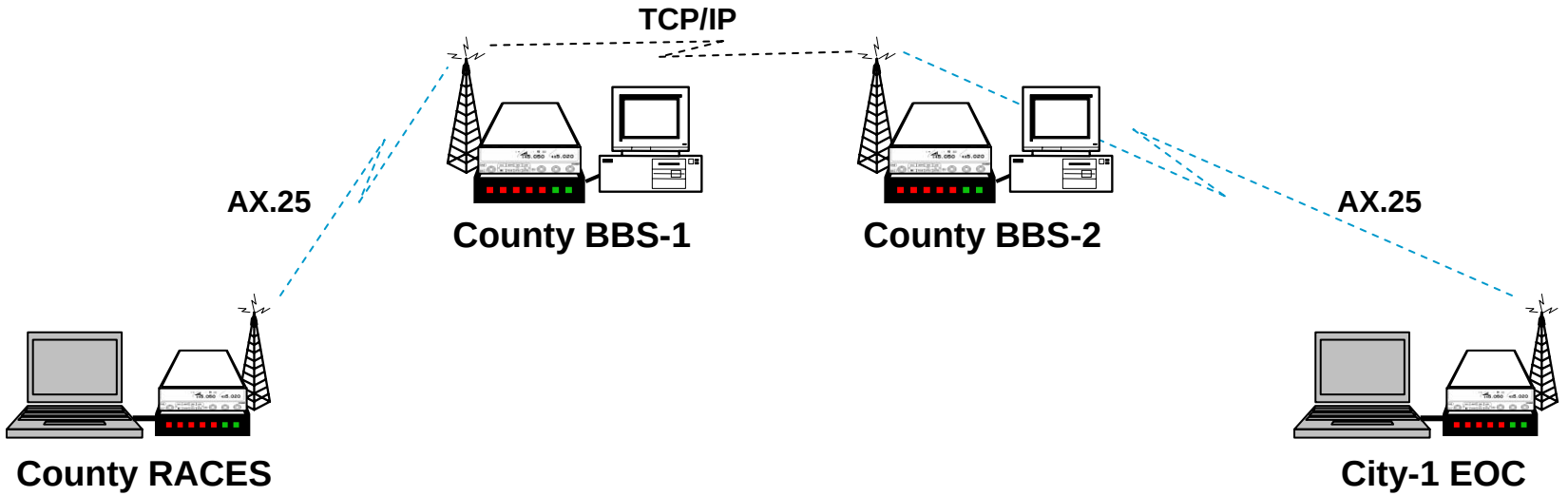


# Why use Packet Radio?

*The case for packet radio*

## 2. Communications Protocol

- Packet uses a protocol called AX.25. This is based on the ITU X.25 protocol for networked packet communications.
- AX.25 supports error correction and control that guarantees that all packets (and subsequently messages) are delivered correctly.
- TCP/IP is also used to support interlinking BBSs together



# Why use Packet Radio?

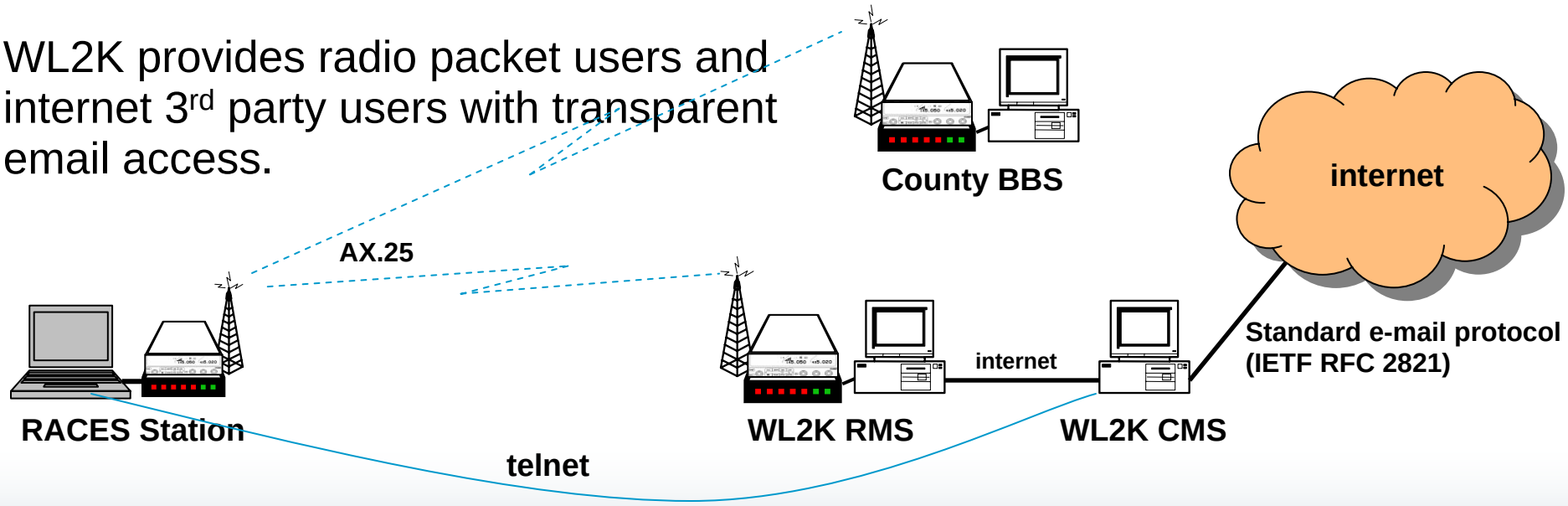
*The case for packet radio*

## 3. Interoperability

- DHS suggested to the ARRL that the Amateur community should design and maintain a national digital network for emergency communication purposes**.**
- Winlink 2000 (WL2K) was adopted as that solution.
- WL2K provides radio packet users and internet 3rd party users with transparent email access.

*Definition:* **RMS – Radio Message Servers**, provides an RF gateway from packet users to the WL2K system.

*Definition:* **CMS – Common Message Servers**, coordinates message traffic between RMS stations and the internet.

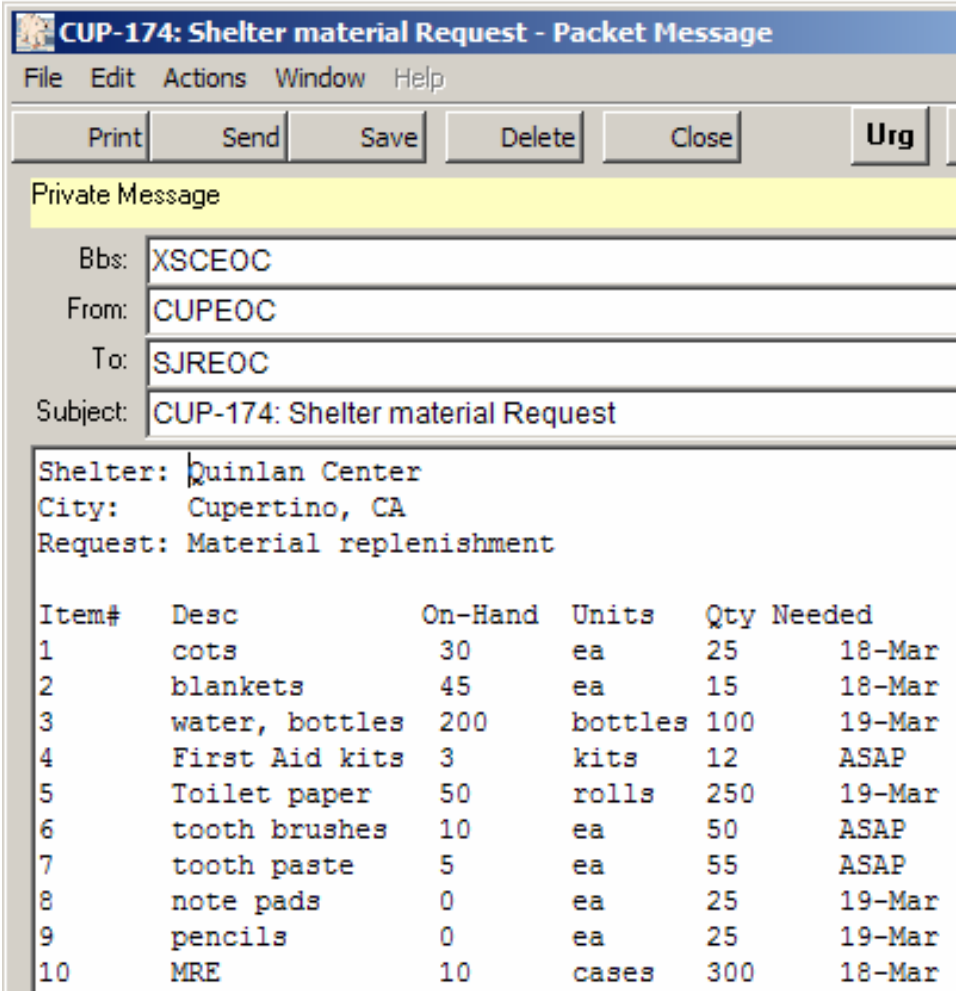


# Why use Packet Radio?

*The case for packet radio*

## 4. Complex messaging

- Packet is ideal for passing lists of material, addresses, instructions, or complex words (i.e. pharmaceuticals or chemicals)
  - you do not want to mistake ***Hydrogen Sulphide*** (a gas) with ***Hydrogen Sulfate*** (an acid)
- Packet-based messaging ensures...
  1. the originator can verify the content before it is sent (more than likely typed it him/herself),
  2. reduces transcription errors between the sender and receiver, and
  3. keeps the voice channel clear for more critical traffic.



# Why use Packet Radio?

*The case for packet radio*

**5. Reduces message handling**

- Packet messaging can originate from the source using standard office applications (or other methods) and sent directly to the packet app or by *sneaker-net* to the radio room for loading and sending.
- Because packet is digital and relies on a computer, messages can also be printed directly to a printer (assuming the terminal program supports it, such as Outpost).

# Why use Packet Radio?

*The case for packet radio*

## 6. Supported by the Amateur Community

- Packet is supported by hams with the interest and intent of supporting a disaster response when commercial communications is overwhelmed or lost.
- During last year's Chino Hills Earthquake…
  - Magnitude 5.4 Earthquake
  - telephone companies reported no physical damage to telecommunications facilities.
  - phones in the San Bernardino County Sheriff's station worked only intermittently
  - Sprint: "… reported an 800% increase over normal call volume in the half hour after the earthquake struck… the volume soared past predictions for emergencies."
  - Verizon: "… about 40% more than the peak we expect during disasters."


*Source: Los Angeles Times* article, "Post-quake callers overload phone systems", 30-July-08

# Why use Packet Radio?

*The case for packet radio*

## 7. Packet aligns with how we work today

- Message complexity and timeliness of delivery drives how we use…
  - The telephone and email (during non-emergencies)
  - The radio and packet (during an emergency)
- We would use packet radio for the same reasons we would use internet email: message accuracy, delivery, privacy*, and the ability to handle message complexity.

| | Simple Messages | Complex Messages |
|---|---|---|
| **Mode** | **Voice** | **Packet** |
| **Messages** | **Short messages** | **Lists, instructions, details** |
| **Delivery** | **Immediate** | **Store & forward; mail drop** |
| **Equipment** | **Radio** | **Radio + TNC + PC + SW + BBS** |
| **Complexity** | **Short learning curve** | **Easier with Outpost vs. native packet commands** |

# Why use Packet Radio?

*The case for packet radio*

**8. Expectations**

- Our connected society has come to rely on our inherent ability to contact anyone, at anytime (thanks to cell phones and WiFi)
  - ***Wireless connectivity has evolved beyond a novelty to an EXPECTATION***

- The Santa Clara County Emergency Management Association (EMA) knows that our local communications infrastructure ***WILL FAIL*** during an earthquake and ***expects*** Ham Radio to enable the response and speed the recovery.

- Packet is well suited to support the response mission. *Are we ready?*

# *Where are we today with packet?*

# Our current operating environment

Where are we today?

1. New focus and enthusiastic support for packet by the County's Emergency Management Association and local RACES organizations
   - Packet messaging is a part of every county exercise
   - Packet is built into the new County RACES MAC qualification program
   - County is making loaner packet PCs available
   - Cities are promoting packet within their jurisdictions

2. County RACES established a Packet Committee
   - Jim Clark N6JRC
   - Bob Fishman K6FSH
   - Michael Fox N6MEF
   - Jerry Haag KF6GAC
   - Phil Henderson KF6ZSQ
   - Doug Kalish KA3L
   - Jim Oberhofer KN6PE
   - David Ranch KI6ZHD
   - Tom Smith KD6SOJ
   - Al Whaley KV6U

# Our current operating environment

Where are we today?

3. County RACES operates a 3 channel BBS system with Tactical Call and digipeater support…
4. … that hosts 25 organizations, 16 of which are active on packet

**Who is ACTIVE* on Packet**

- Campbell
- Cupertino
- Gilroy
- Los Altos
- Los Altos Hills
- Los Gatos
- Milpitas
- Morgan Hill
- Mountain View
- NASA – Ames
- Palo Alto
- San Jose
- Santa Clara
- Santa Clara County
- Saratoga
- Sunnyvale

**Who else has a Tactical Call**

- County Comm
- Loma Prieta
- Los Gatos Red Cross
- Monte Sereno
- Palo Alto Red Cross
- San Jose Red Cross
- San Jose Water Company
- Santa Clara Valley Water District
- Santa Cruz County
- Stanford

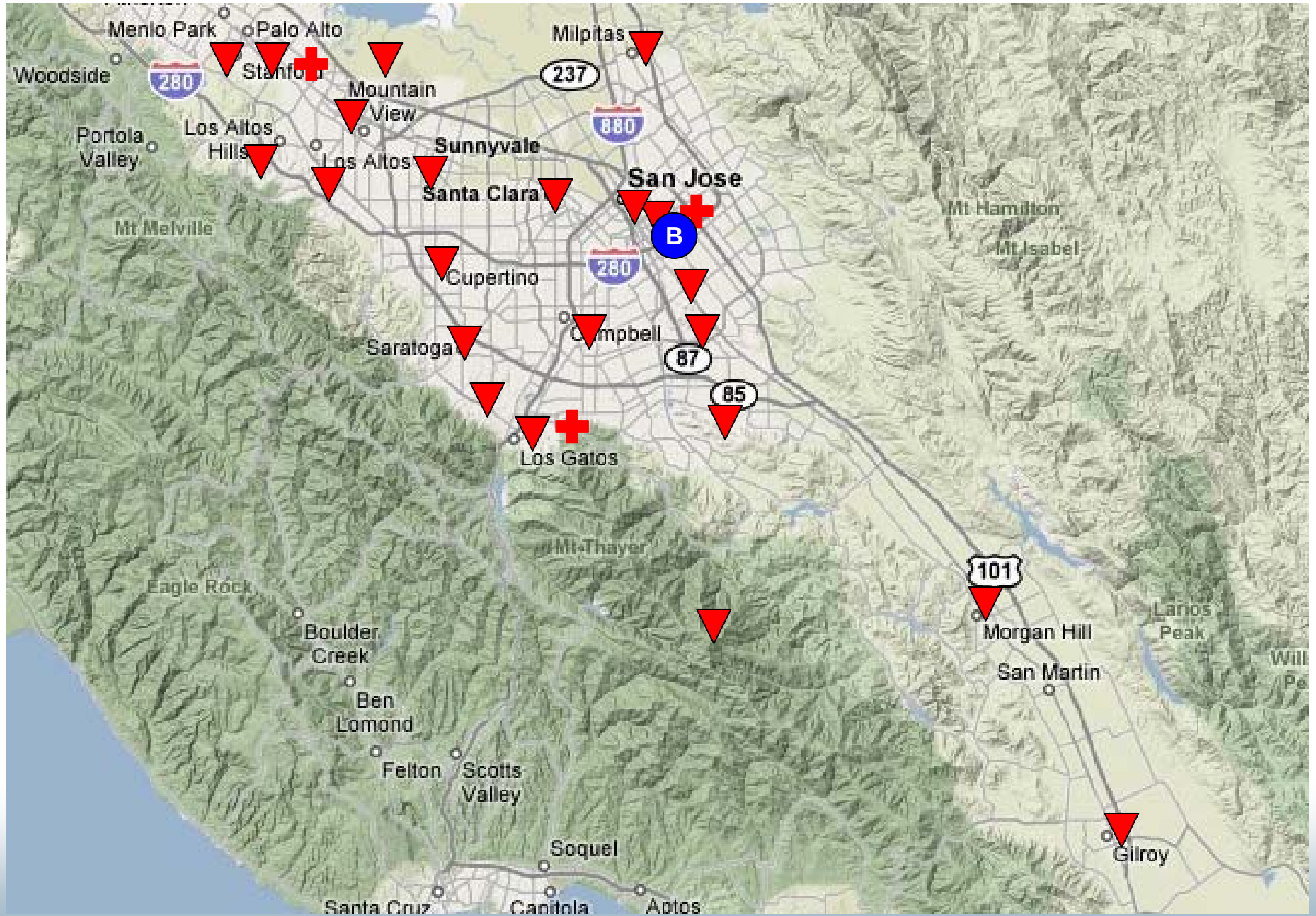
**Who else wants to use Packet**

- Various cities in the county
- 14 County hospitals

*__Active__ means: the city/agency…
(i) is confirmed as an active packet user,
(ii) has participated in County RACES Drills, and
(iii) has equipment and resources to support packet operations

# Our current operating environment

Where are we today?



# The Enhanced County Packet System

# So, what's the problem?

Where are we today?

1. **Out of date packet infrastructure**
   - Obsolete BBS software – the AA4RE BBS author has no plans for future development or enhancements.
   - Old hardware – BBS operates on an 80386-based PC, other old hardware.
   - DOS operating system.
   - The last system failure took several weeks to resolve.
   - No formal back-up BBS system in place in the event of a county BBS system failure.
2. **Message throughput with a single BBS instance**
   - With more packet use, we are seeing packet message bottlenecks and access problems.
   - To address message delivery, packet policies and procedures have been defined that inherently reduce the effectiveness and efficiencies of packet messaging.
   - County RACES is concerned with the current system's ability to handle an activation-level message volume.

# What do we need?

Enhanced County Packet System

**The new packet system needs to address the following:**

1. Common hardware platform… intel-based, current X86 architectures
2. Contemporary O/S… Linux or Windows
3. Contemporary BBS app… still supported, widely used
4. Message volume… handle the current and anticipated growth
5. TNCs and radios… support 1200 and 9600 baud speed
6. Leverage of the installed base hardware
7. Number of users… support the current users and ad-hoc (MACs)
8. Tactical Call support
9. Expandable… cover what we have today, add to it as necessary
10. Interoperability… with our PacFORMS and Outpost toolset
11. Short learning curve… looks and behaves like what we have today

# JNOS – the new BBS environment

Enhanced County Packet System

1. Adopt JNOS as the BBS of choice.
   - Based on Phil KA9Q's *Network Operating System* (NOS) for packet radio, originally written in the late 80's.
   - BBS application environment with a strong emphasis on networking.
   - Operates as a BBS Mailbox, File Server, Telnet Gateway, etc.
   - Supports both the AX25 and TCP/IP protocols.
   - Open-source and still under active development.

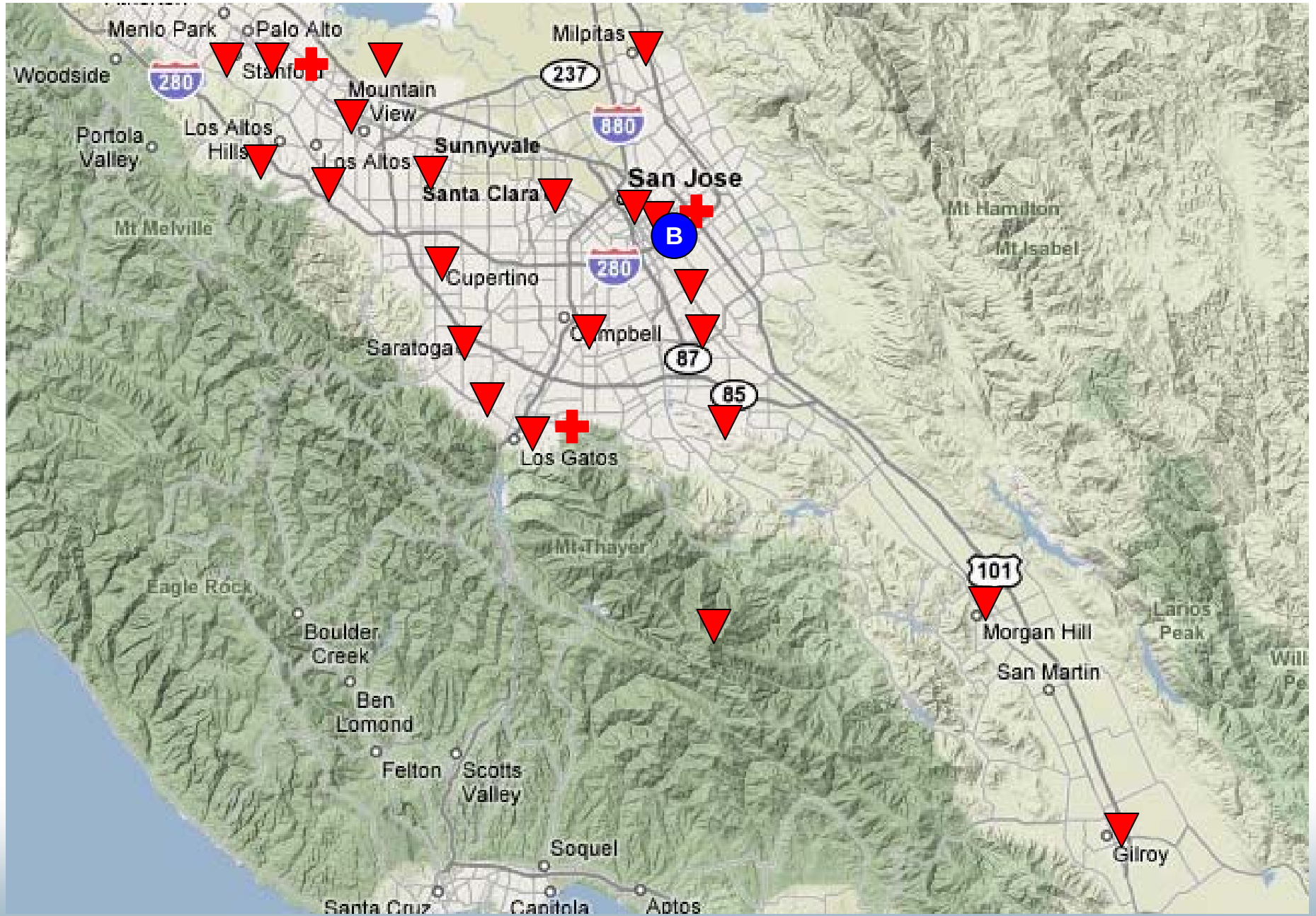
# City / agency alignment

Enhanced County Packet System

2. SCC is divided into 4 packet ***node areas***, each with a dedicated JNOS BBS (Message Server) serving the cities within that region.

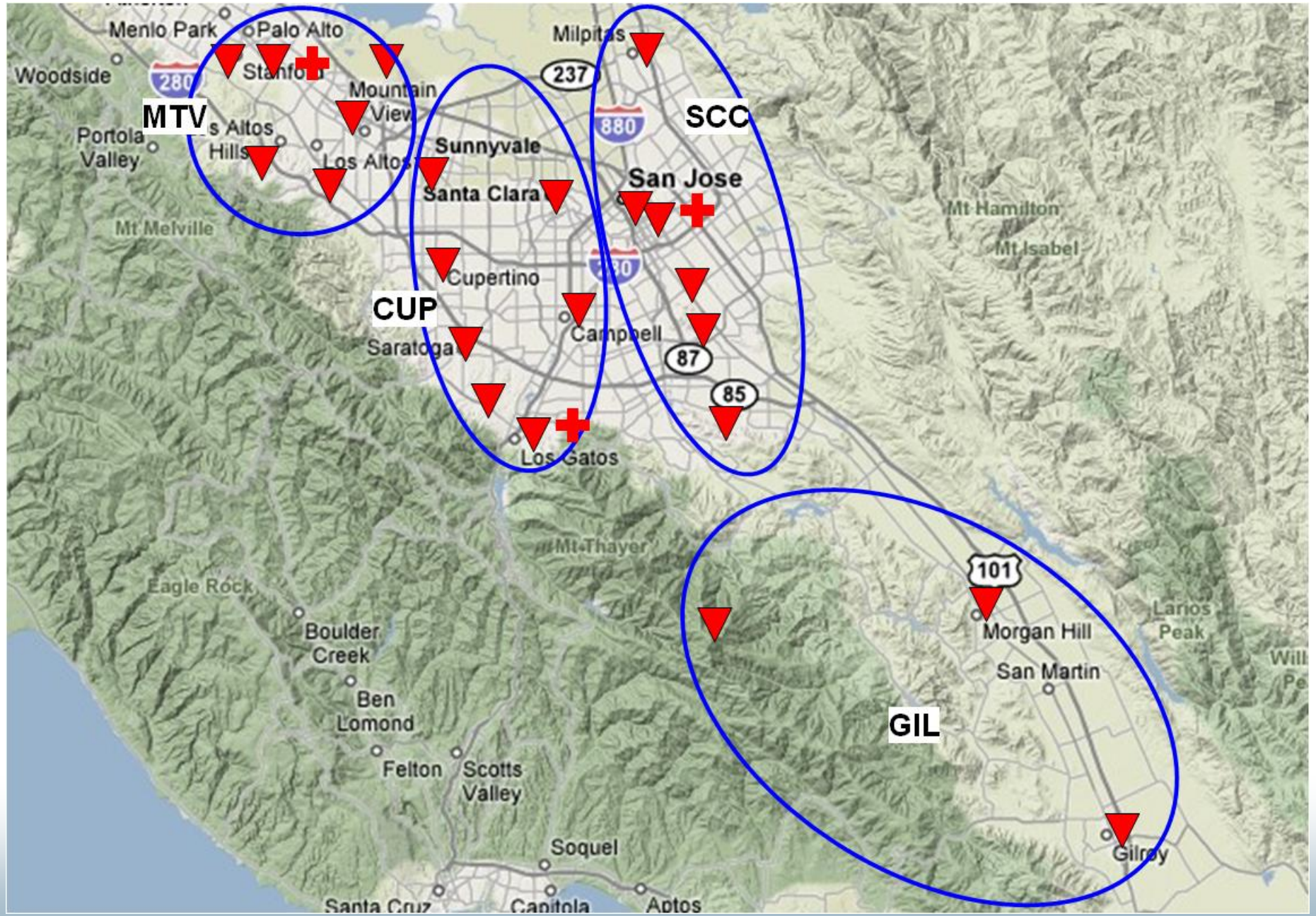
# Where is everybody?

Enhanced County Packet System



# Proposed grouping into packet areas

Enhanced County Packet System



# City / agency alignment

Enhanced County Packet System

3. Each JNOS BBS is hosted by a city and supported by either County RACES or the host City's local ARES/RACES organization.

4. Assign participating cities and served agencies a primary JNOS BBS for their main packet access.

| Node Name | MTV | GIL | SSC | CUP |
|---|---|---|---|---|
| Host City | Mountain View | Gilroy | San Jose | Cupertino |
| Assigned Cities | 1.Palo Alto<br>2.Los Altos<br>3.Los Altos Hills<br>4.Mountain View<br>5.NASA AMES. | 1.Gilroy<br>2.Morgan Hill | 1.Milpitas<br>2.San Jose<br>3.San Jose Red Cross<br>4.County EOC | 1.Sunnyvale<br>2.Santa Clara<br>3.Cupertino<br>4.Campbell<br>5.Saratoga<br>6.Los Gatos |
| Others Pending | 1.Palo Alto Red Cross<br>2.Stanford University | 1.Loma Prieta | 1.County Comm<br>2.San Jose Water<br>3.SCVWD | 1.Monte Sereno<br>2.Los Gatos Red Cross |

# BBS Names and Routes

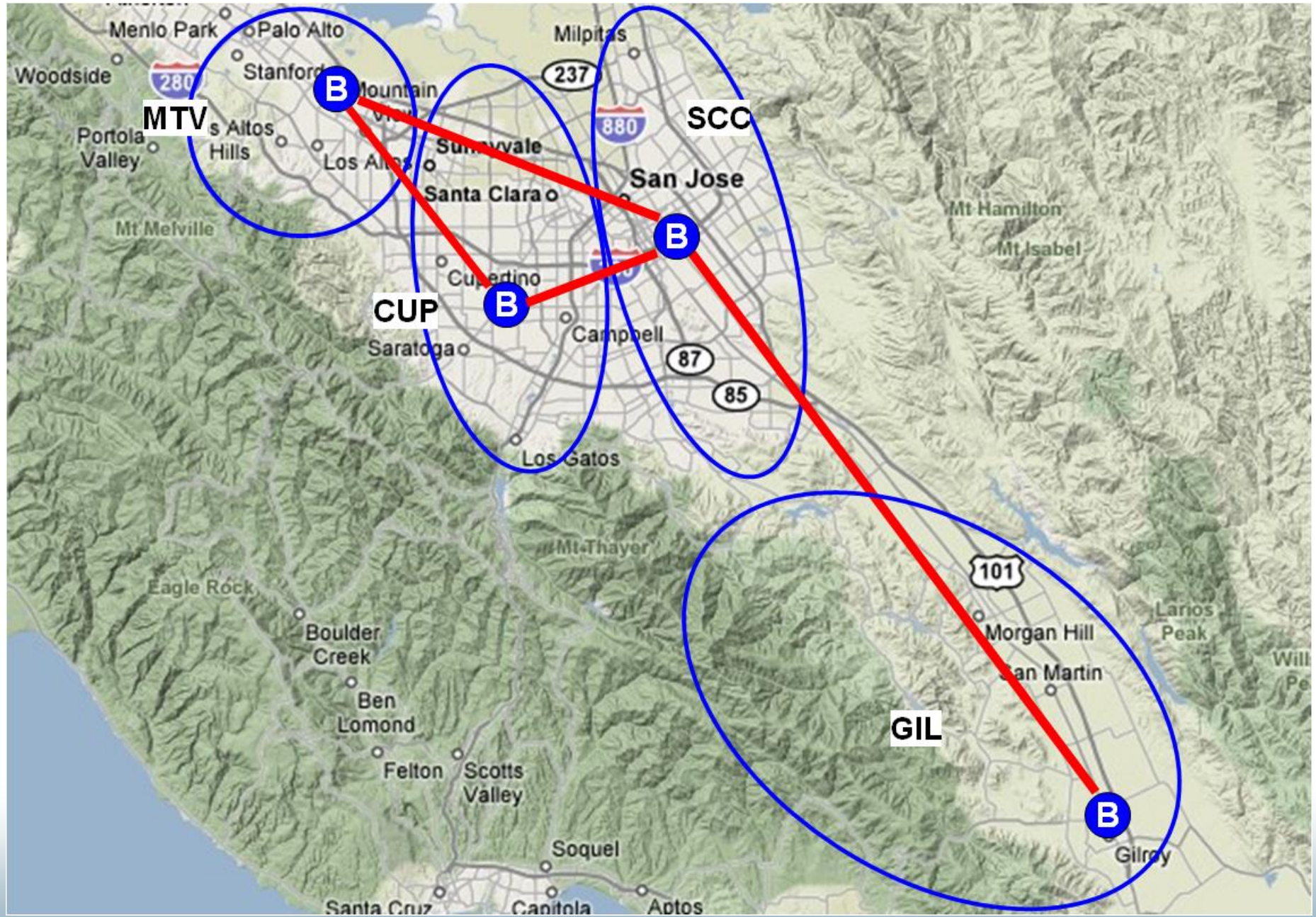
Enhanced County Packet System

5. City and Served Agencies will connect to their assigned BBS

| Node Name | MTV | GIL | SSC | CUP |
|---|---|---|---|---|
| **Host City** | **Mountain View** | **Gilroy** | **San Jose** | **Cupertino** |
| **BBS Connect Name** | **K6MTV-1** | **--TBD--** | **W6XSC-1** | **K6KP-1** |
| Direct routes to: | SSC<br>CUP | SSC | MTV<br>GIL<br>CUP | MTV<br>SSC |
| Indirect Routes to: | GIL | MTV<br>CUP | | GIL |

# Overlaying our 4 BBSs

Enhanced County Packet System



# Frequency Assignments

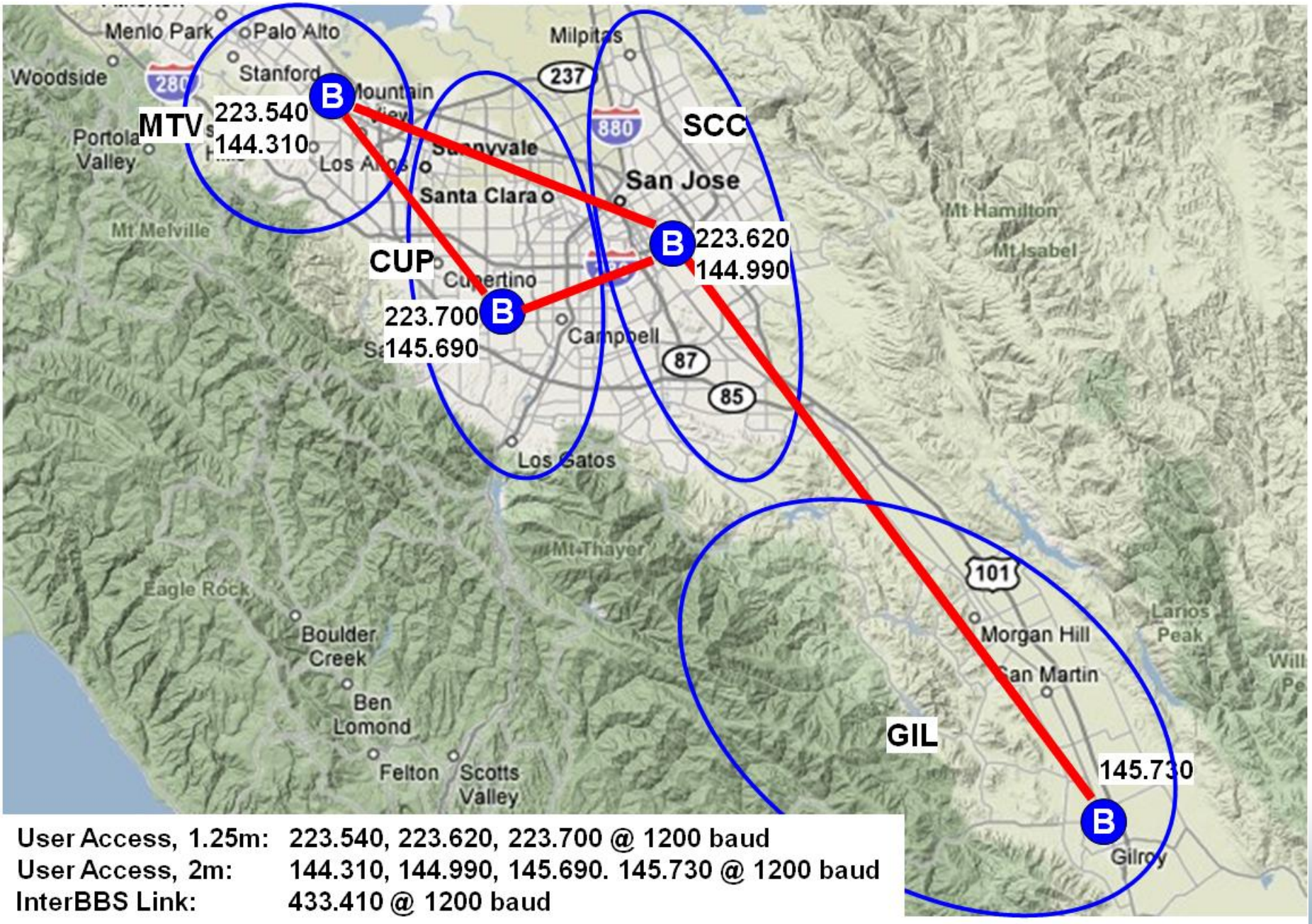
Enhanced County Packet System

6. Users access the BBS on different 2 meter and 220 MHz frequencies using standard AX.25 packet with existing equipment at 1200 baud.
7. Messages are transferred between JNOS BBSs using a common TCP/IP 1200 baud 440 link.

| Node Name | MTV | GIL | SSC | CUP |
|---|---|---|---|---|
| **Host City** | **Mountain View** | **Gilroy** | **San Jose** | **Cupertino** |
| **2 meter user frequencies** | 144.310 MHz | 145.730 MHz | 144.990 MHz | 145.690 MHz |
| **220 user frequencies** | 223.540 MHz | | 223.620 MHz | 223.700 MHz |
| **440 Link frequency** | 433.410 MHz | 433.410 MHz | 433.410 MHz | 433.410 MHz |

# Frequency Assignments

Enhanced County Packet System

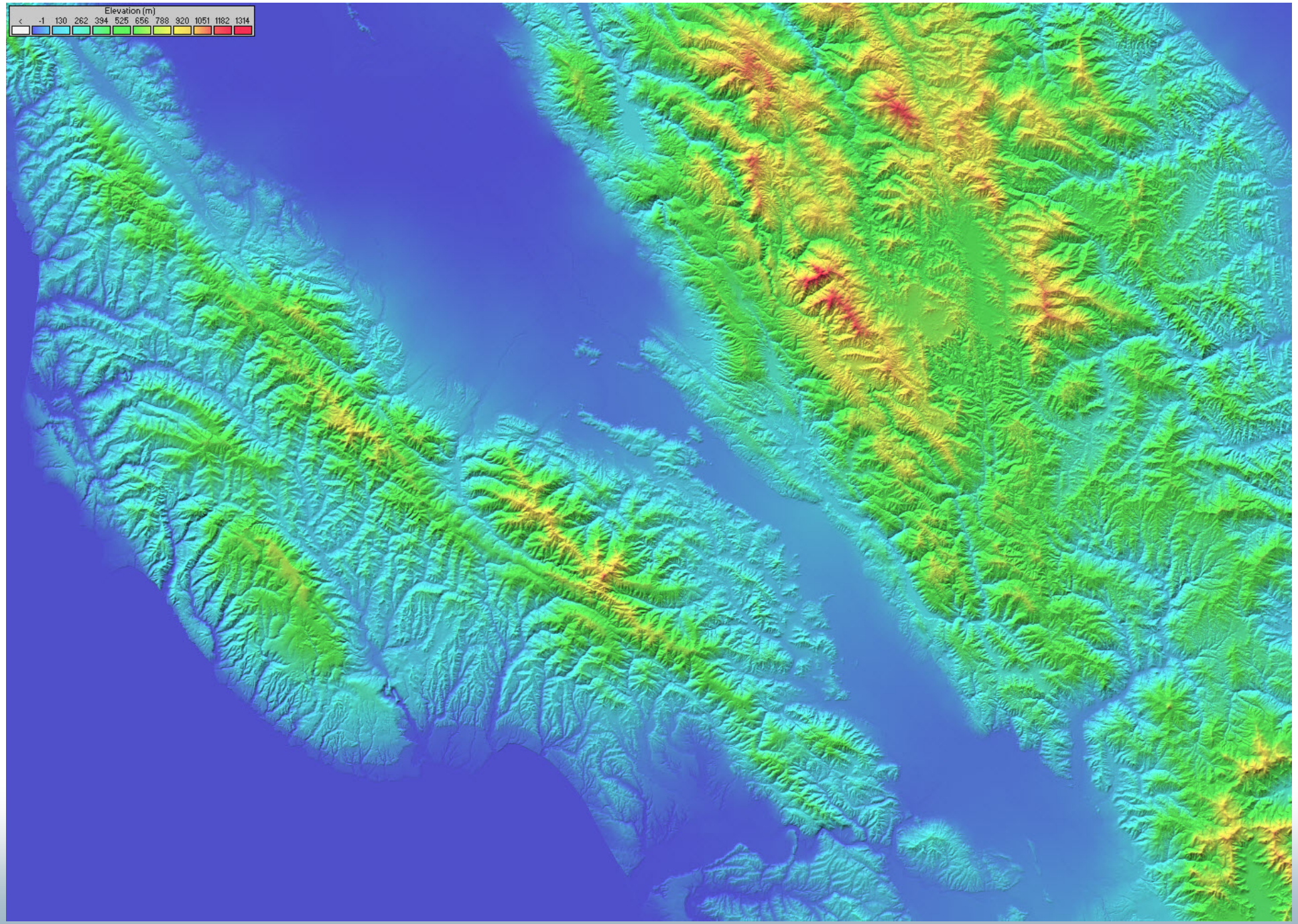


# Design Principles

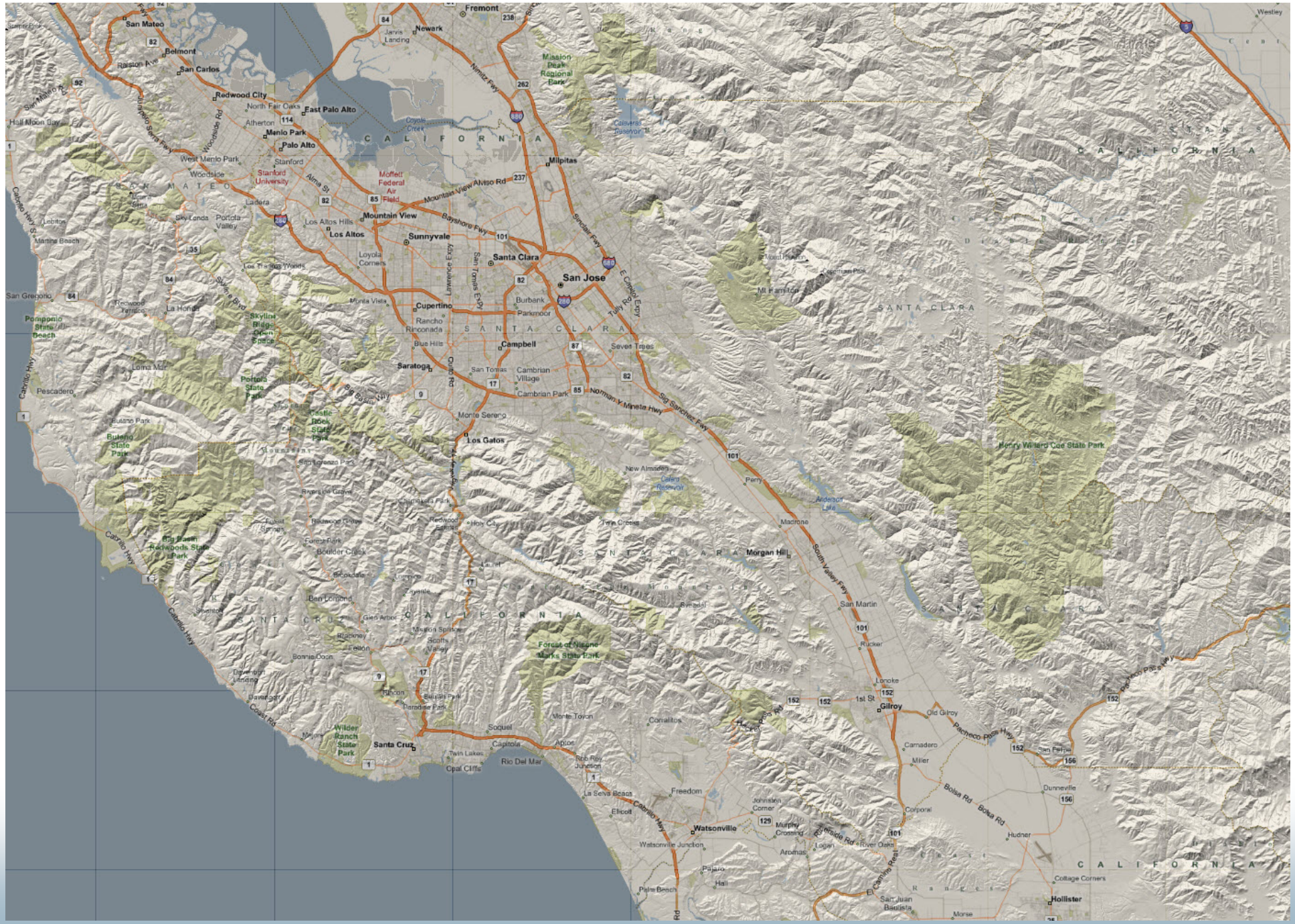
Enhanced County Packet System

- **Survivability Goals:**
  - All cities/agencies can reach at least two nodes
  - Each node can reach at least two other nodes
  - "When all else fails …"
- **Reliability goals** (Mean Time Between Failures, Mean Time To Recovery, …)
  - Availability:  7 x 24 x 365 – power, environmental, security
  - Coverage:  fade margin, signal level at cities, agencies, area
  - Serviceability:  easily sourced components; backup
- **Performance**
  - 26 cities / agencies
  - 12 hospital locations (including DEOC)
  - Field sites
- **Radio Propagation study used to verify ideas**
  - Radio Mobile; a software tool to predict the performance of a radio system

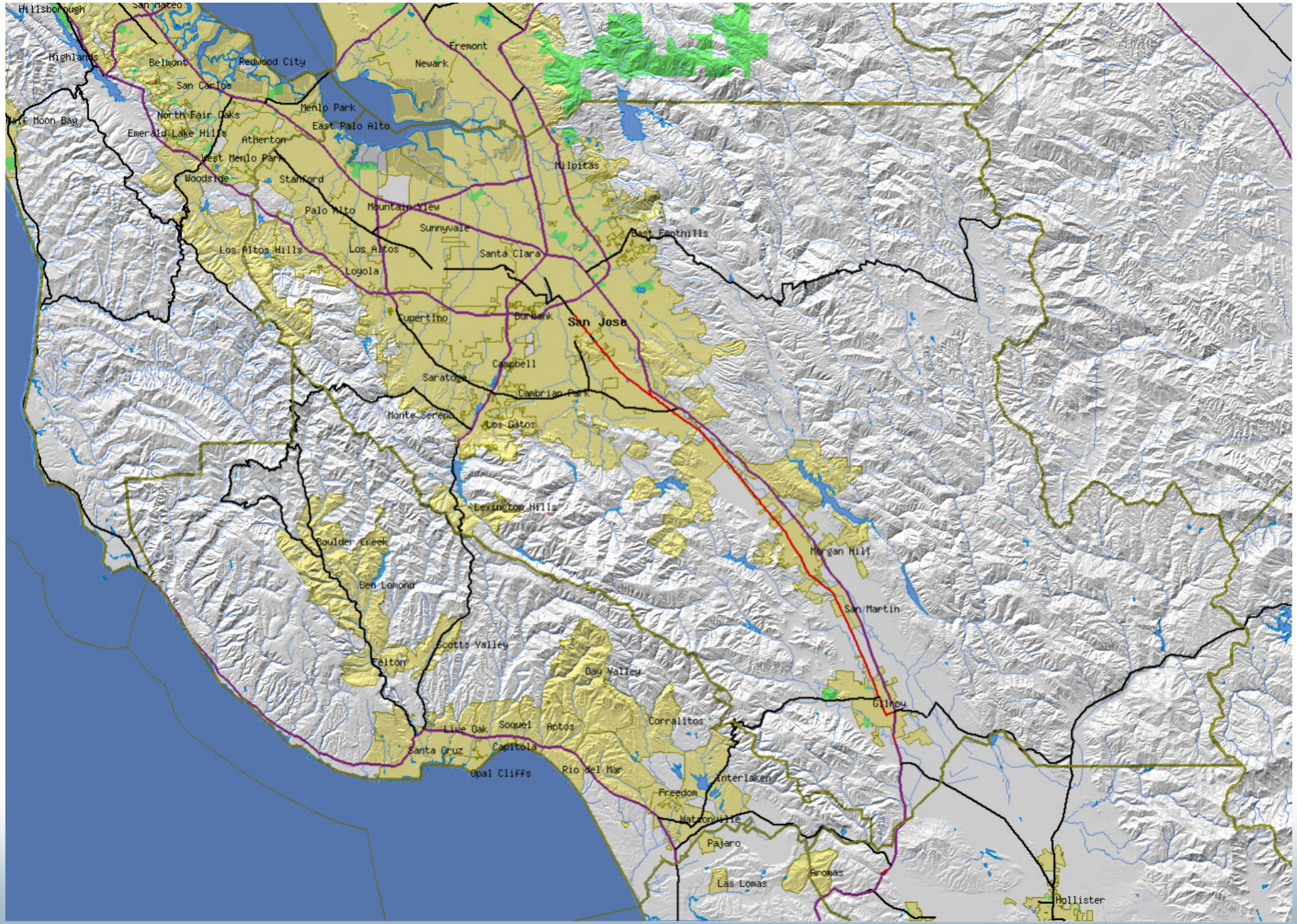
# Propagation Study – the terrain



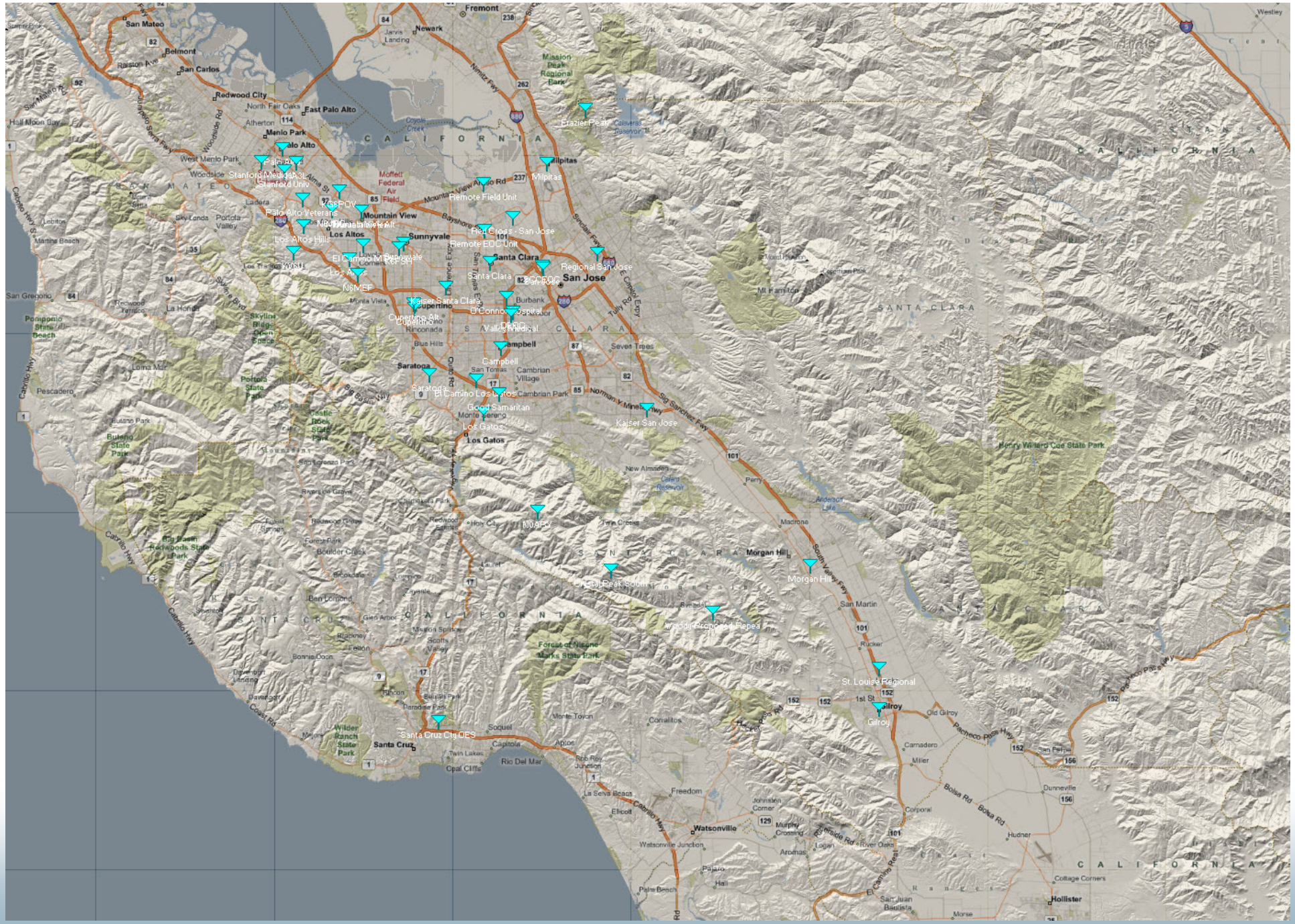
# Propagation Study – … with roads



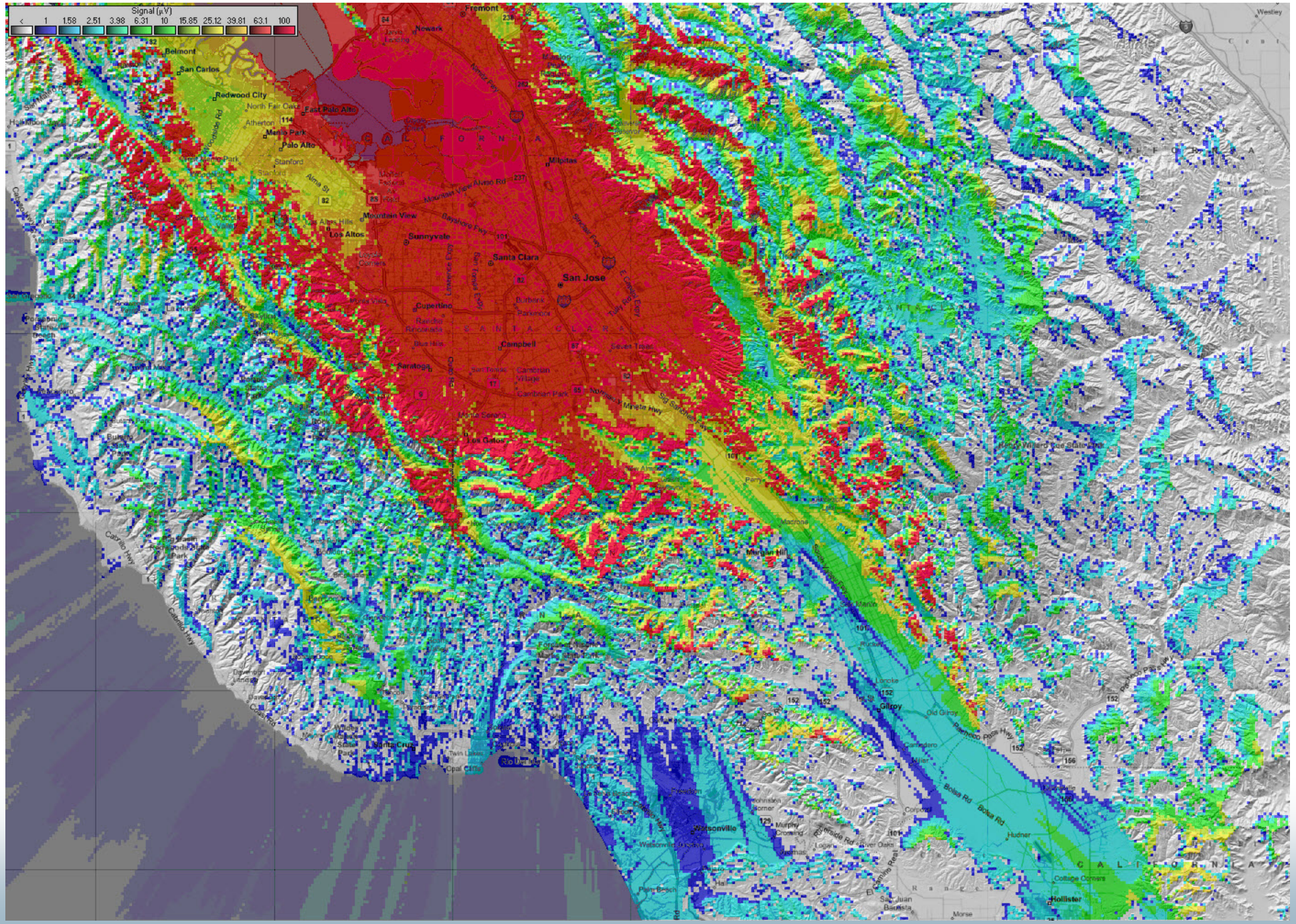
# Propagation Study – … and boundaries



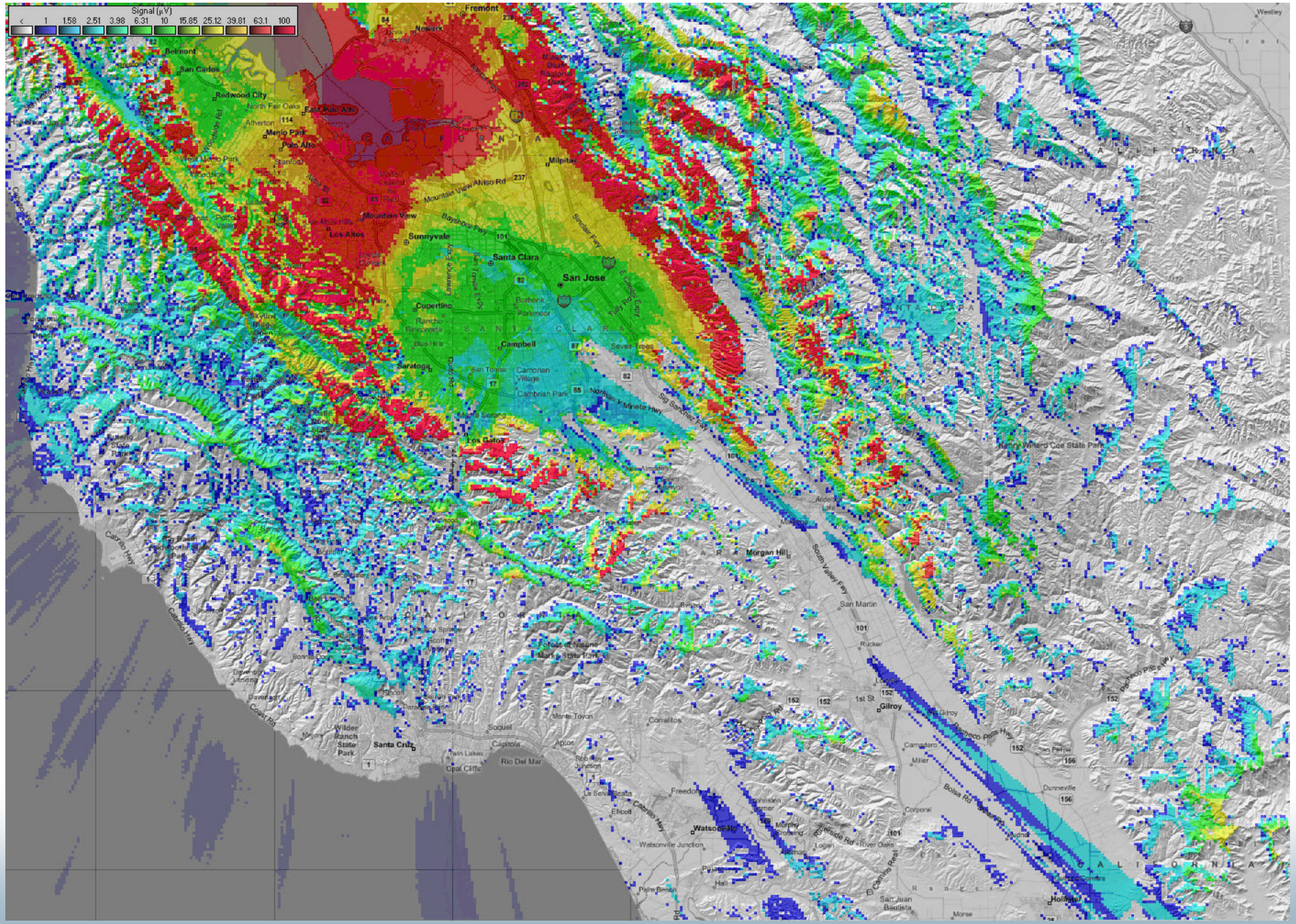
# Propagation Study – … and EOCs



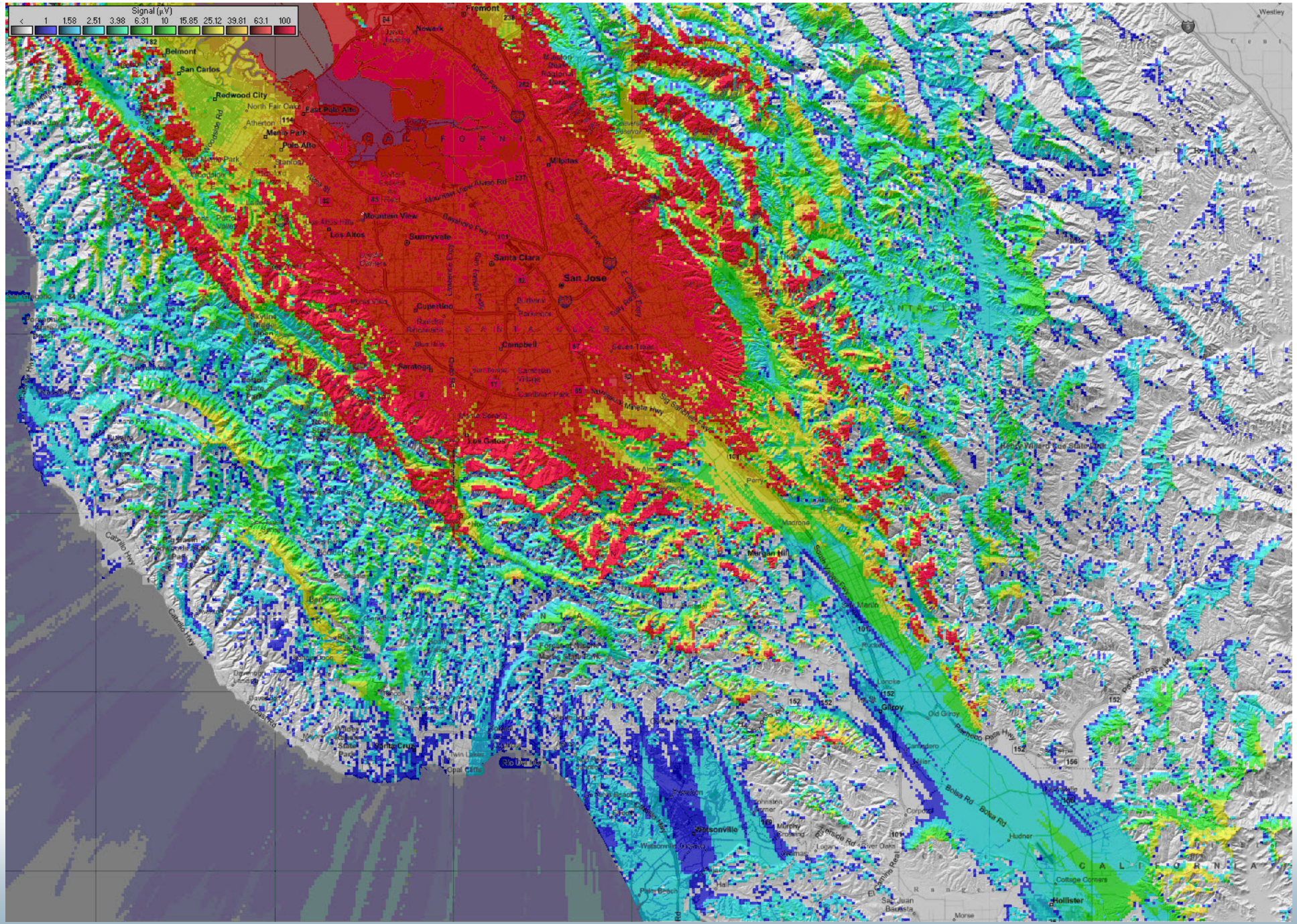
# Propagation Study – SCC coverage



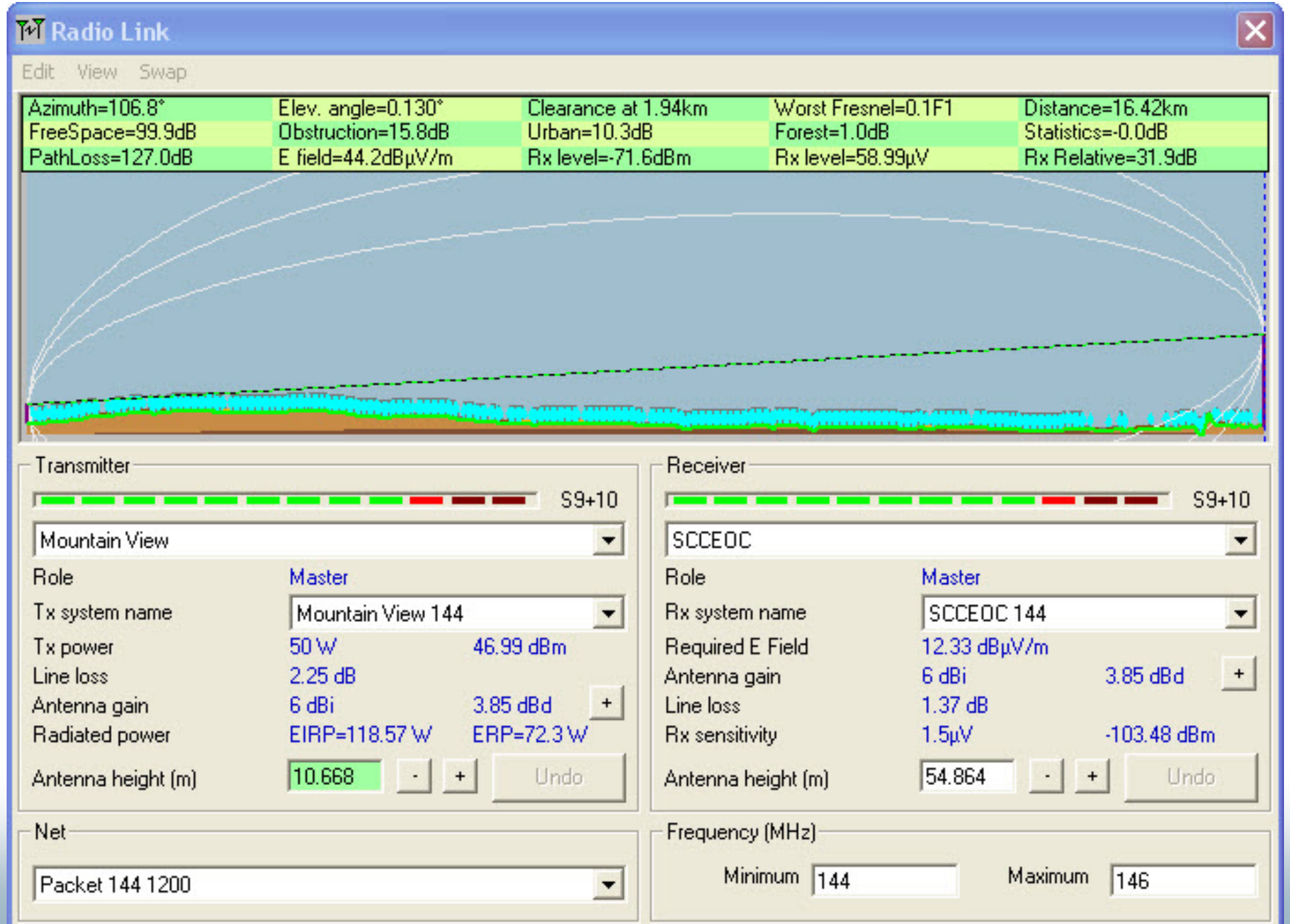
# Propagation Study – MTV coverage



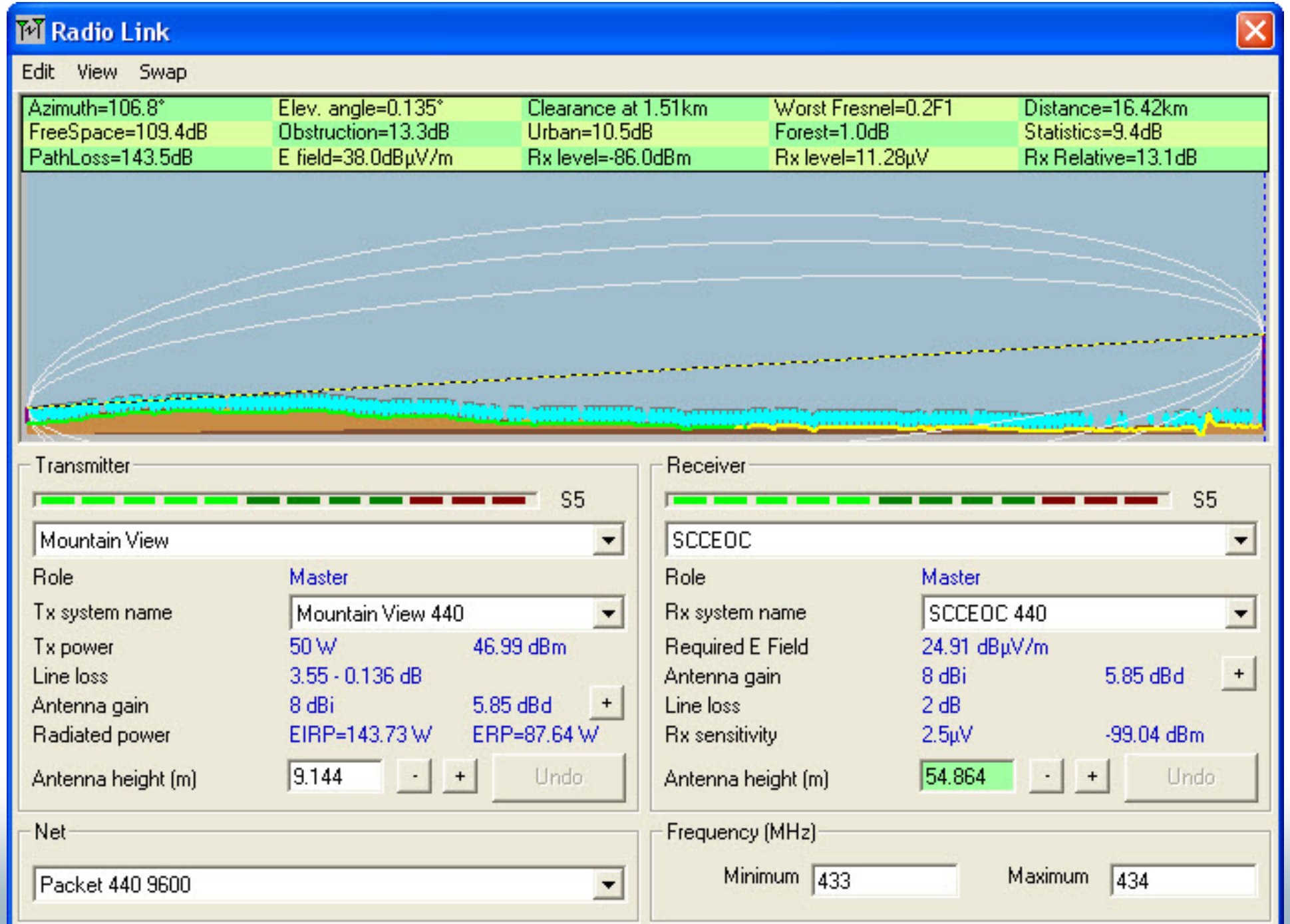
# Propagation Study – SCC+MTV overlap



# Propagation Study – MTV to SCC on 2m



# Propagation Study – MTV to SCC on 440



# Propagation Study – MTV to SCC challenge

# Testing (lots and lots of testing) …

Enhanced County Packet System

**Goal:** Build confidence in our design and system

## Design and Planning tests

- Traffic patterns, access vs. forwarding, radio coverage
- The results informed and guided overall planning effort, freq. selection

### Current deployment phase (multi-hours/day, past several weeks)

- Message routing – alias and rewrite rules
- Multi-access – multiple simultaneous connect, disconnect, messages
- Multi-frequency – multiple simultaneous sessions, multiple frequencies
- Backbone utilization – fill w/ large msgs, add interactive sessions, small msgs
- Backbone queueing – queue up large # msgs to be forwarded
- Security – protect from malicious access via radio
- Operations – start-up, shutdown, logging, troubleshooting, …
- Radio propagation to, between, within cities – predicted vs. actual

### Current testing focus: future deployment phases

- Multi-node backbone @ 9600 - TCP/IP parameter tuning
- Alternate routing
- Hospital net (11 hospitals plus DEOC)

# … Results

Enhanced County Packet System

| Area | Problem | Approach to address |
|---|---|---|
| 9600 Baud on 440 backbone | Signal is about 8db short for sustainable and reliable message passing | **Short-term:** Operate the backbone on 1200 baud for the drill.<br>**Long Term:** Raise the MTV antenna or switch to a Yagi |
| Node to Node access | CUP (Cupertino) is in behind a “hill” and cannot hit MTV | Move CUP; in progress |
| Throughput performance | Long message transmission time and BBS handshake is excessive. | Proposed TNC setting changes that reduces transmission time by 80% |
| | | |

# Conclusions

Enhanced County Packet System

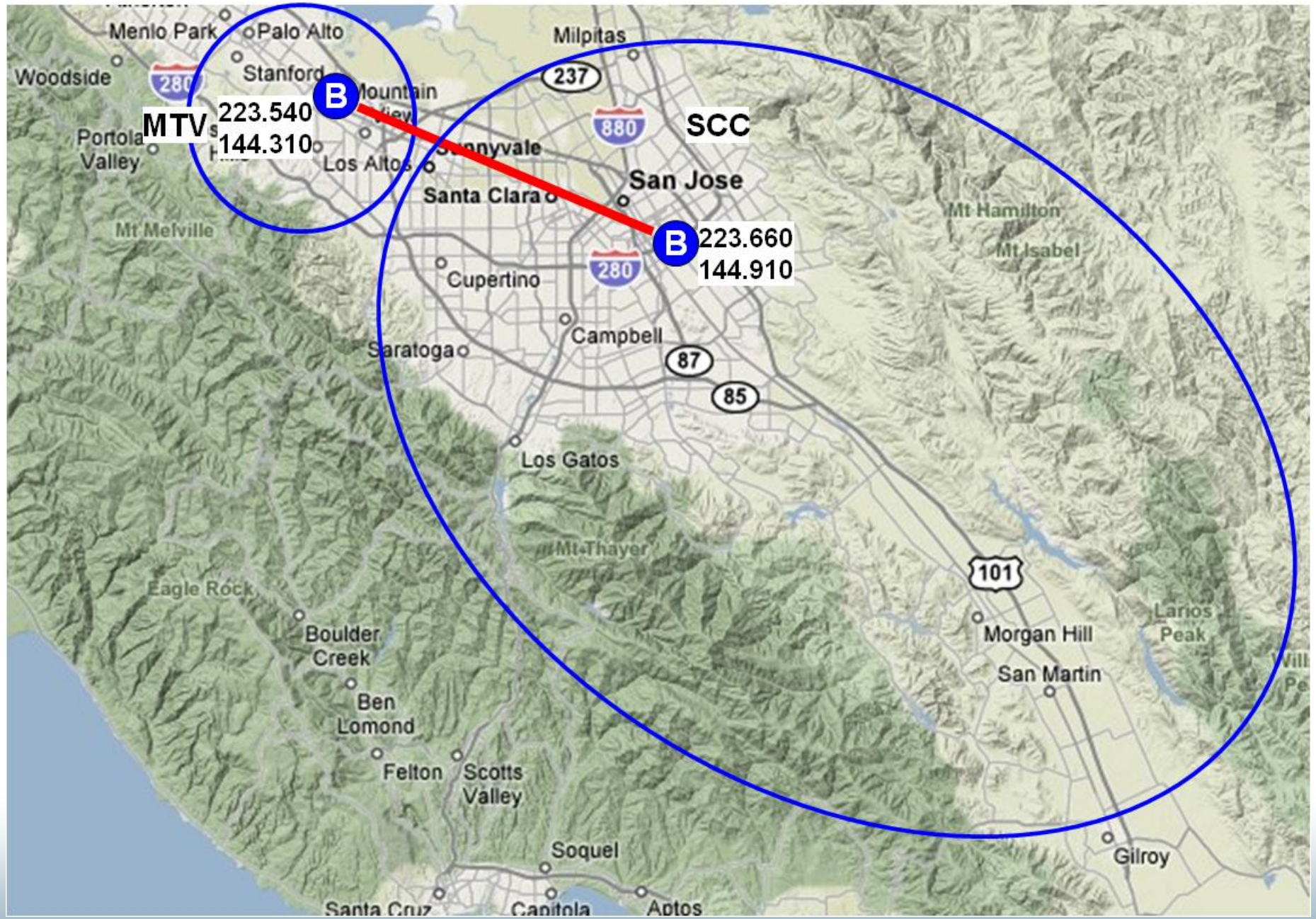
- **Overall plan is sound**
- **4 to 5 nodes is reasonable**
  - Meets performances, survivability goals
  - More will likely impact reliability
- **Santa Clara County site (70 W. Hedding) is good**
- **Mountain View site is good**
- **CUP and GIL sites will likely need to move**
  - Work already underway on both sites

# Current Deployment Phase

- Move new county node into position (70 W. Hedding)… **Done!**
- Mountain View node status change: test > production… **Done!**
- Cities in North end of county move to MTV node… **Done!**
  - Los Altos
  - Los Altos Hills
  - Mountain View
  - Palo Alto
  - Palo Alto Red Cross
  - Stanford University
- Everyone updates their Outpost configuration… **Done!**
  - “Let Outpost determine the BBS and setup the prompts”

# Node Assignment – 18 Jan 2010

## Enhanced County Packet System



# Are we alone?

**NYC ARES**

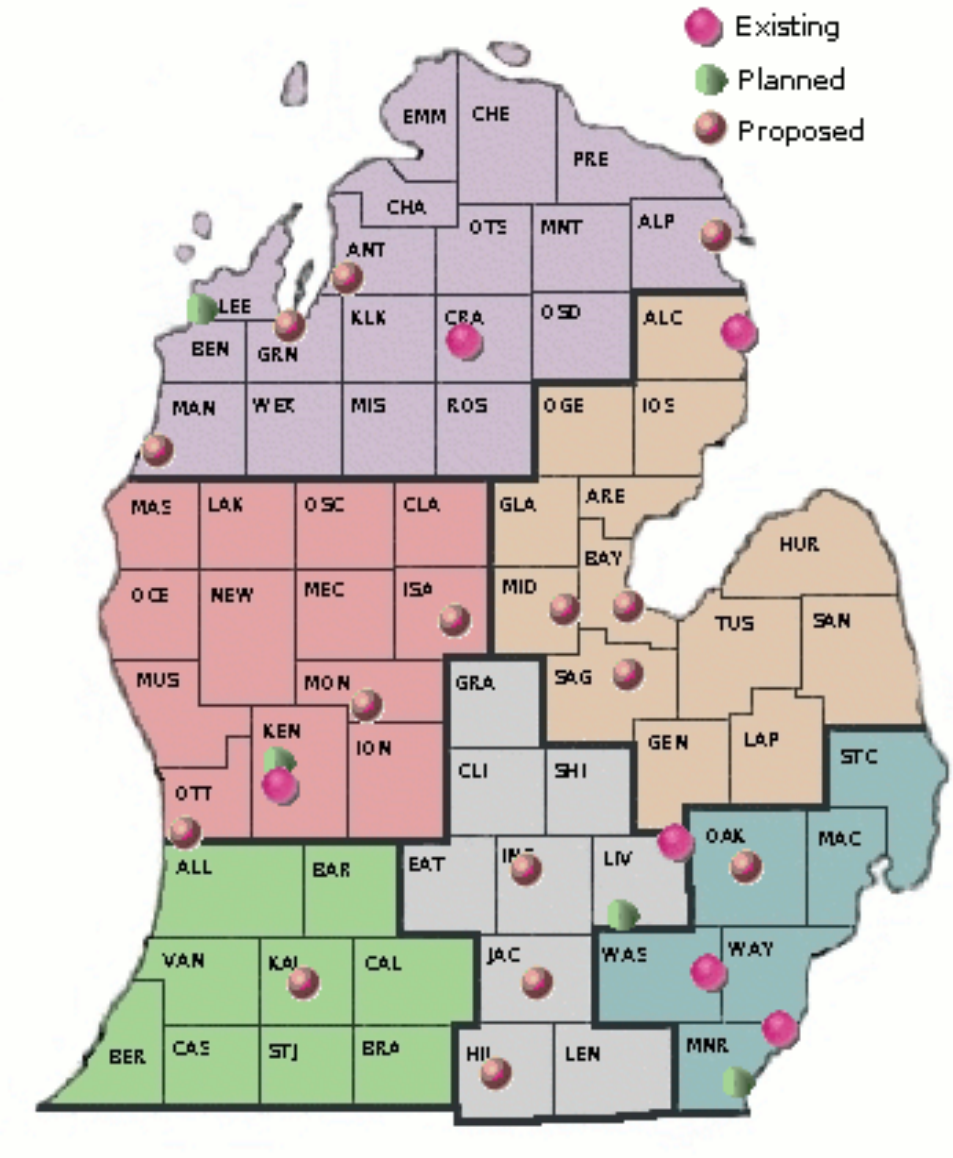
- 8 nodes

**Michigan Section Digital Radio Group**

- 50+ JNOS nodes, 23 are HamGates

# 2006 JNOS and HamGate deployment

Michigan Section Digital Radio Group




- HamGates allow disperse portions of the state network to be interlinked via the Internet using the TCP/IP protocols.
- NetROM/X1J4 can be natively run across these links making them transparent to the End Users.
- The HamGates provide a mechanism for SMTP mail to both be sent and received between the RF network and the Internet.
- ***2009 UPDATE:*** 50+ JNOS nodes, 23 are HamGates

# Summary

## Next Steps

1. Resolve CUP node (Cupertino) location
2. Get GIL node (Crystal Peak) on the air
3. When all nodes are up, move SSC to its final frequency

***Other ideas:*** look at converting the digi on Crystal Peak to a traffic-forwarding node (Howard is looking at this proposal) to ensure coverage.

# Thank you

*Any Questions?*