

# San Francisco Community Broadband Network

How to tackle broadband access, costs,  
competition, local network neutrality  
and light up 6,000+ apartments or  
15,000 residents for less than \$300K.

# A little background...

Early in 2006, there was this “bright” idea that Mayor Gavin Newsom had about blanketing SF with wireless.

It was poorly politically executed.

Technically it was very naïve.

With the delays in addressing the two points above, it gave enough time for Earthlink/Google to figure out that they can't figure this wireless thing out, so they backed out causing Newsom to loose face.

Newsom had put a bunch of political cred into this so something had to happen....

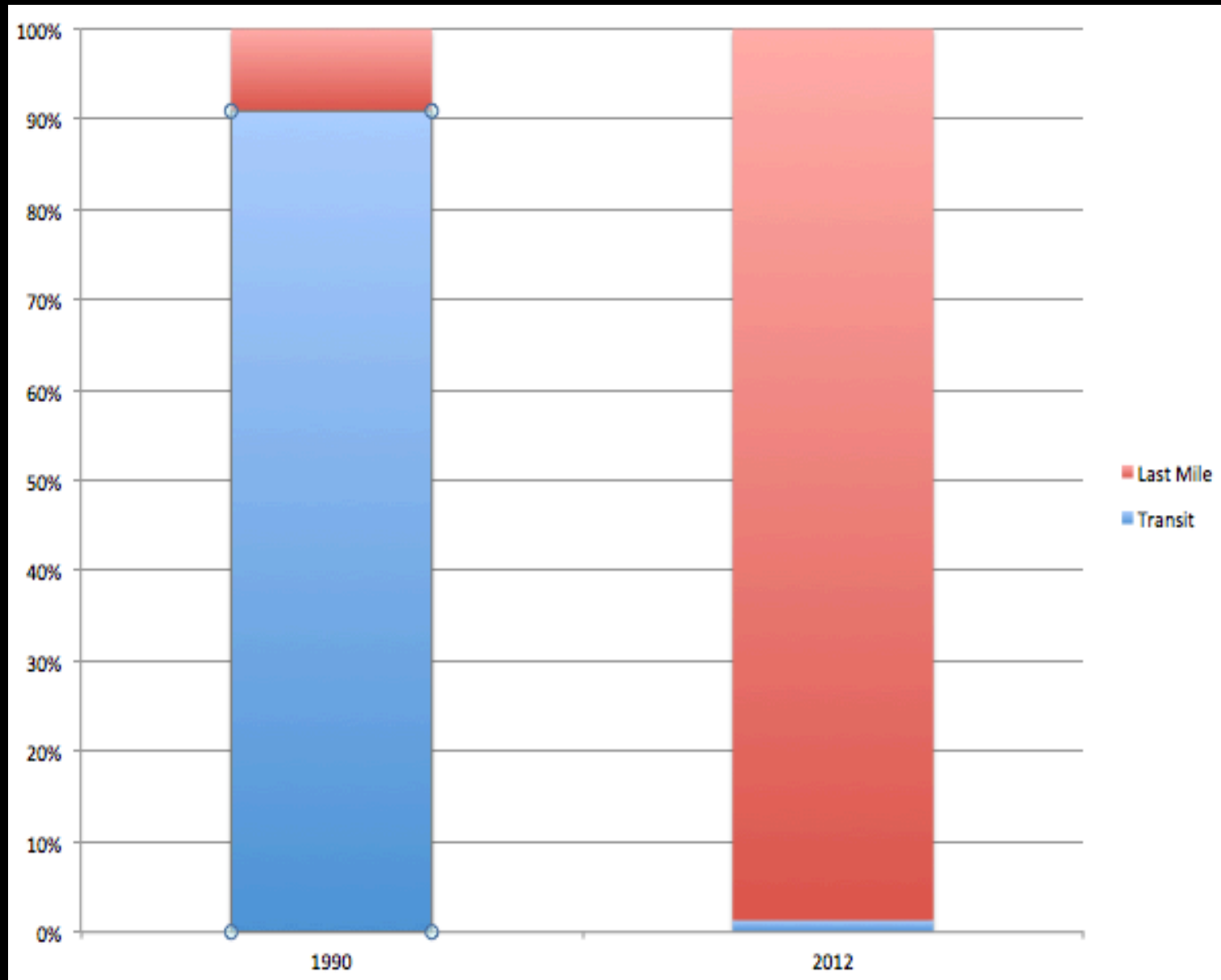
# In the mean time....

It was revealed that SF had considerable amount of dark fiber.

How about using fiber instead of this wireless protocol called 802.11 for the backbone and last mile?

How would things change if the municipality provides open access between street addresses and providers?

# Transit vs. Last Mile Costs





# This begat the proposal...

- The City should provide a sustainable (makes money) last mile-only solution. They can afford and ROI in the decades.
- It is based on the OSI network layer model.
  - Layer 1 (Physical): The City maintains. They are very good about digging up the streets and fusing fiber.
  - Layer 2 (Data Link): Is used to switch circuits between customers and L3 providers. To be run by some Not-For-Profit organization with City oversight.
  - Layer 3 (Network ): This layer contains providers like Internet, Voice and TV providers. SF does not compete at this level.

# Money Flows Down the Stack

- A resident or company of SF would call the L3 provider for service and pay them.
- The L3 provider would call the L2 provider to create the circuit. The L3 provider would pay the L2 provider.
- The L2 provider pays the L1 provider (The City of SF) for the use of the glass.
- This really isn't much different than just calling up your local fiber company, 'cept that this is scaled to support every street address in SF.



**Political**

**Financial**

**Application**

**Presentation**

**Session**

**Transport**

**Network**

**Link**

**Physical**

# Back to the drama...

Google/Earthlink pulls out and the City passes Prop “J”  
I get a call from the City saying something to the effect,  
“You screwed us on this project, Got any bright ideas  
Tim?”

“Why, Yes... Remember that proposal?”

Start to pull Fiber into Housing Projects

- Gain expertise in proving broadband to residents
- No SLA issues if you are giving it away
- Address digital divide.

Seems they took me seriously...

# Funding doesn't exist - Layer 8

Besides one City employee, Mike McCarthy who is leading the project, there was zero funding for the core network.

Base cost for the switch and optics is about \$3,000. Switches are being “bought” at heavy discount by organizations to be used as core and access switches for the network

Horse trading, begging, borrowing and stealing in order to get deployments done.

Some labor and materials for copper and wireless deployment in a development was borrowed from other departments.

“Surplus” fiber was supplied by the City.

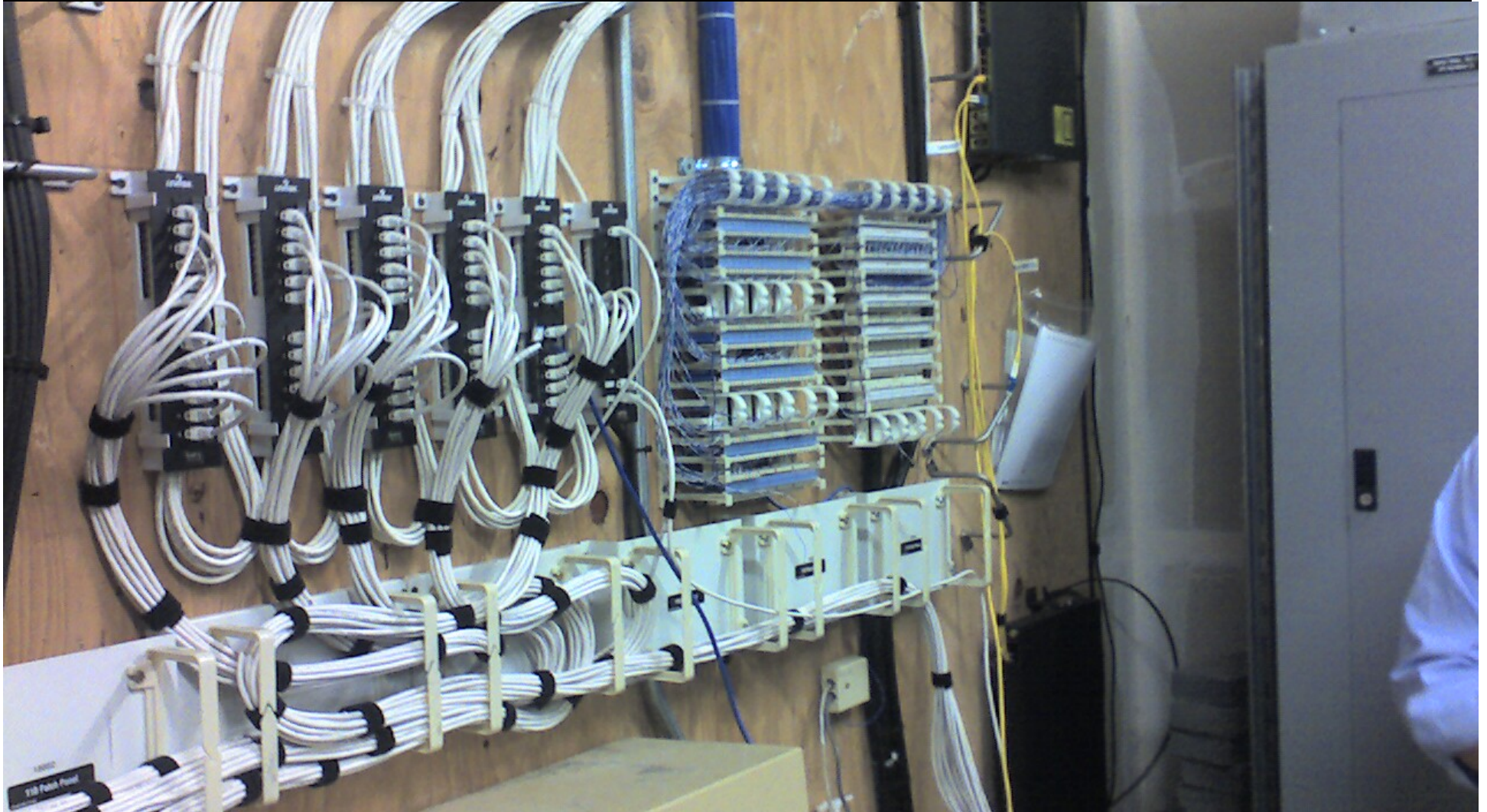
Monitoring, routing boxes have been donated.

Technical labor has been donated. We can use more help.

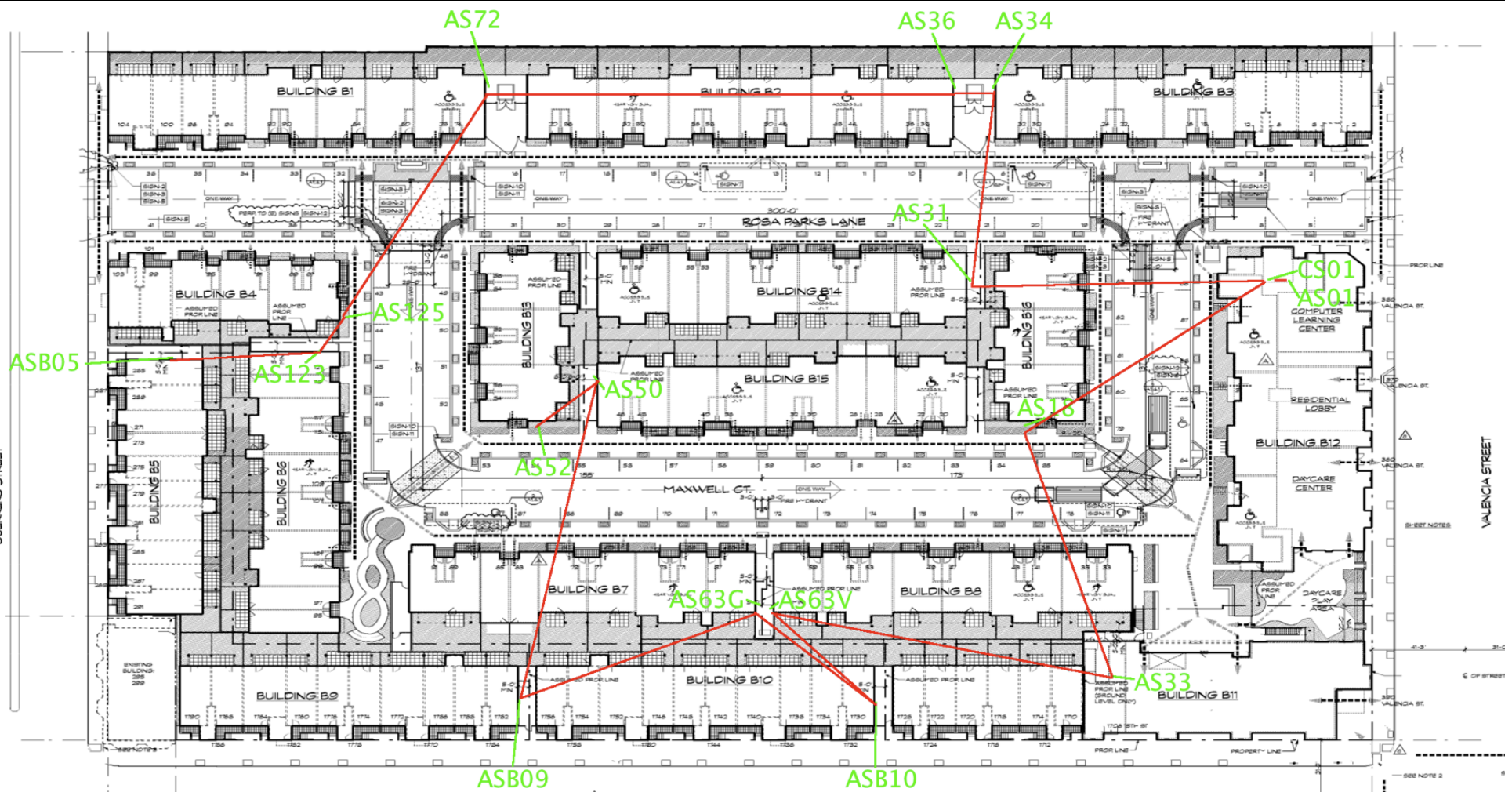
Internet transit is donated by the Internet Archive



# A “high end” install at Valencia Gardens

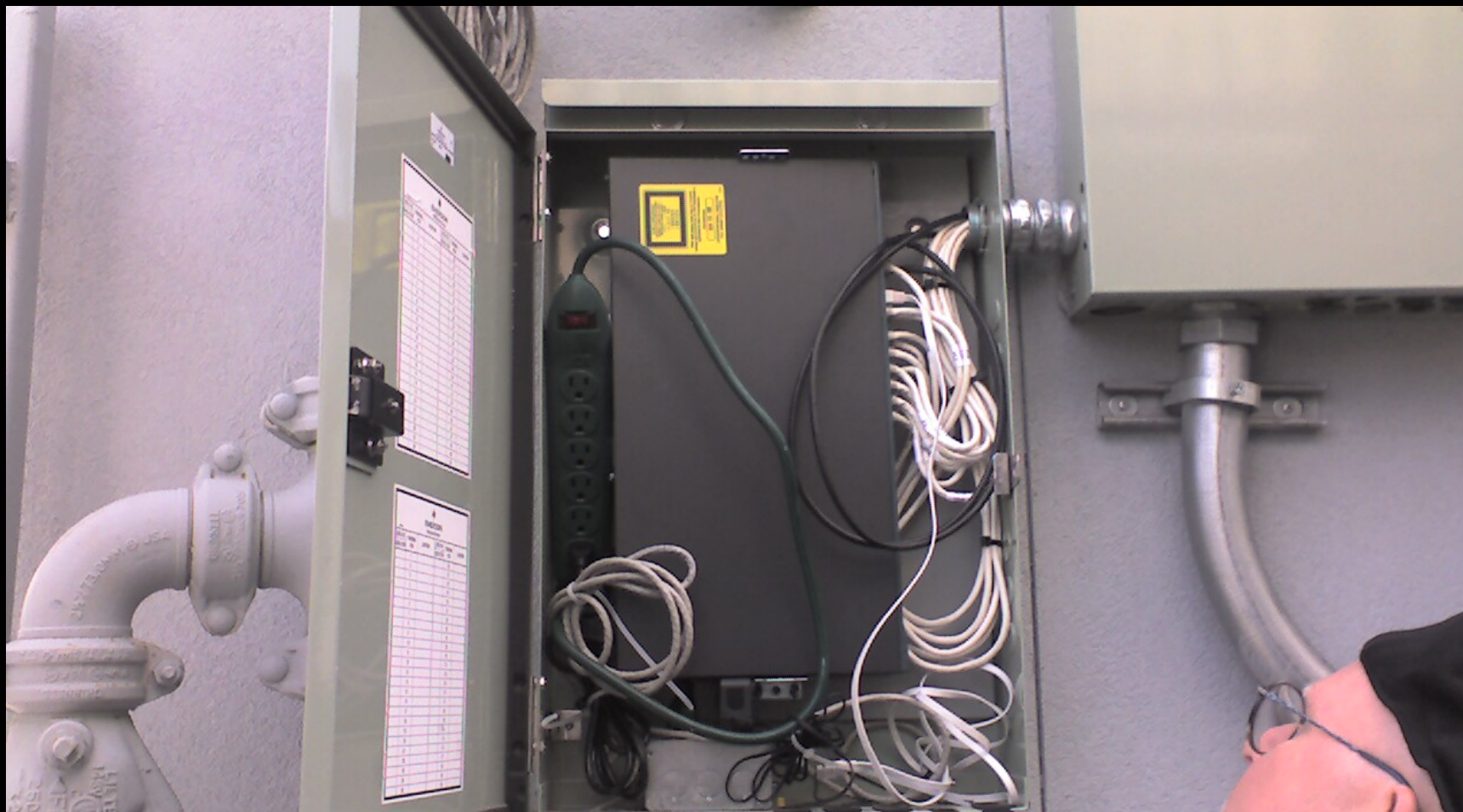


# Switch deployment at VG





# Outdoor installation at VG





Fiber was not an option in many cases





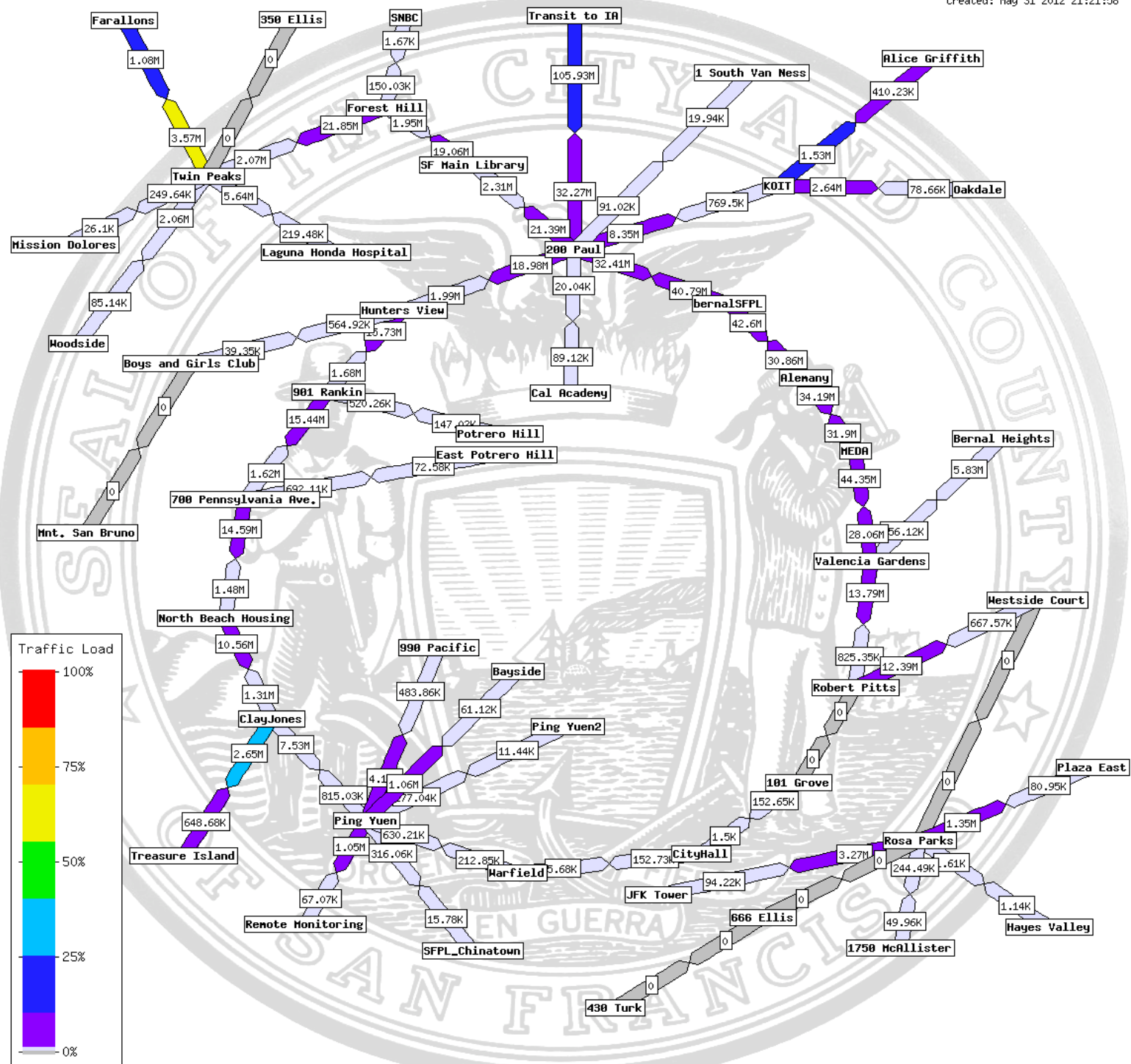
# Shooing back to Twin Peaks





# A cheaper switch





# In keeping with the OSI model - Layer 1 issues

- We have had some outages.
  - The City is just starting to get up to speed on organization and management of fiber.
    - Fiber databases are crude.
    - Operational procedures are not quite there yet.
  - Act of gods.
    - The occasional tree falling on some aerial fiber.
- Deployed a main ring that has saved our rear a number of times.
- Trying to get the rings is tough as we are not a high priority with the City.

# L2 issues

The City first started to deploy this as one large Ethernet segment to 6,000 units. What could go wrong?

- Customers with viruses.
- Customers plugging their Comcast network into the net and DHCP'ing it out to the rest of the net causing traffic to go out their Comcast connection.
- Customers assigning themselves the gateway IP address and all traffic going to them.

If only we could just get rid of the customers. 😊

# But it wasn't just the customers...

Another problem was turning up a wireless mesh network using WDS at a housing project as we couldn't get wire to the areas we needed to cover.

- Wireless Distribution Service (WDS) will proxy MAC addresses of other radios so packets tend to bounce around until they find an exit node.
- UBNT's version of WDS learns and rebroadcasts not only other radios, but other switches on the network.
- If a radio proxies, the MAC address of another switch or router, traffic destined for that device will get switched back to the radio.



# Spanning-Tree

The network is a ring with laterals coming off of it for sections that we haven't put back into the ring.

Spanning Tree uses a protocol called Bridge Protocol Data Units to discover loops and exchange information about the network.

Ports will go into "blocking" if it sees "bad" BPDU packets. This can happen on the wrong side of a non-ring link where we can't get to it. A site visit is required to clear this out.

Taming spanning-tree on a network this large is not for the faint of heart.



# IP to the rescue

Many of these problems were due to the layer 2 protocols.

Isolating Ethernet segments with a Layer 3 protocol like IP, to a customer, building or even a site gives a much better handle on the network.

Routers at each site was too costly.

Ended up deploying a pair of central routers that we distribute back to a site with VLANs. (Scaling an issue as we are limited to 255 by these switches.)

Using MPLS/VPLS would be great but edge devices are very expensive.

BTW ... These lessons are not new, but they take \$.

# One possible MPLS/VPLS solution - Mikrotik's RouterBoard



# L3 Issues...

The end goal is not to have the City do L3, but we need to test this so the City is supplying L3 from Internet Archive.

- We have had some uptime “issues”.
- Limited address space. Just have a /25 from them.
- A solution is to get our own ASN and ARIN v4 space. We are in the middle of doing this.

## Layer 4 through 7 problems...

- Falls mainly on customer support of their equipment.
- Currently there are very limited resources to do this.
- Would like to get a third party to supply this such as City College of San Francisco or various non-profit tech support groups.

# The End Result

- Work actually started with the fiber deployment in early '08.
- The San Francisco Housing Authority supplied about \$250K of funding for network and wireless infrastructure in the sites in '09.
- Finished lighting up 40+ housing projects in San Francisco
- This consists of more than 6,000 units or 15,000 tenants.
- User access of bandwidth ranges from 10s of Mb/s (wireless) to 1,000 Mb/s symmetrical.
- Neighbors of these developments can get free wireless access to the Internet.
- Starting to create a wireless “mesh” neighborhood deployments. Three neighborhood anchor links have been established. Want more! Anyone here live in SF?

# The End Result

In addition to Housing, the CBN is supporting a number of non-profits with access such as:

- California Academy of Science
- Point Reyes Bird Observatory / US Fish & Wildlife / Farallon Islands
- Bay Area Video Coalition
- Mission Economic Development Agency
- Boys and Girls Clubs
- Gray Area Foundation for the Arts

# Layer 8/9 – Financial/Political

Where does it go for the future for the commercial and non-commercial sides of the network?

- Lost some steam as SF lost some critical visionaries; The Mayor is now the Lt. Governor of CA. The CIO of SF, Chris Vein, to the White House. Need some rudder here
- Up through last year, the Department of Technology could not resell or lease its resources. Regulation was passed to allow this.
- The Board of Supervisor President Robert Chiu recently announced that DT will be selling dark fiber

## Layer 8/9 – Financial/Political

- A non-profit is currently being incorporated in California called the “Community Broadband Network” (CBN) to support the non-commercial side of the network.
- The City is starting to resell dark, waves and VPNs/VLANs/etc. to sustain the network. UCSF Hospital is one of our first customers.
- Besides the net profit that goes back into upgrading the network, some of the net profit will subsidize the CBN.



Ping us...

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