

Amateur Radio Data Networking in Event/Incident Communications

SPECS Annual Meeting

Jan 31, 2015

Revised: 31-Jan-2015

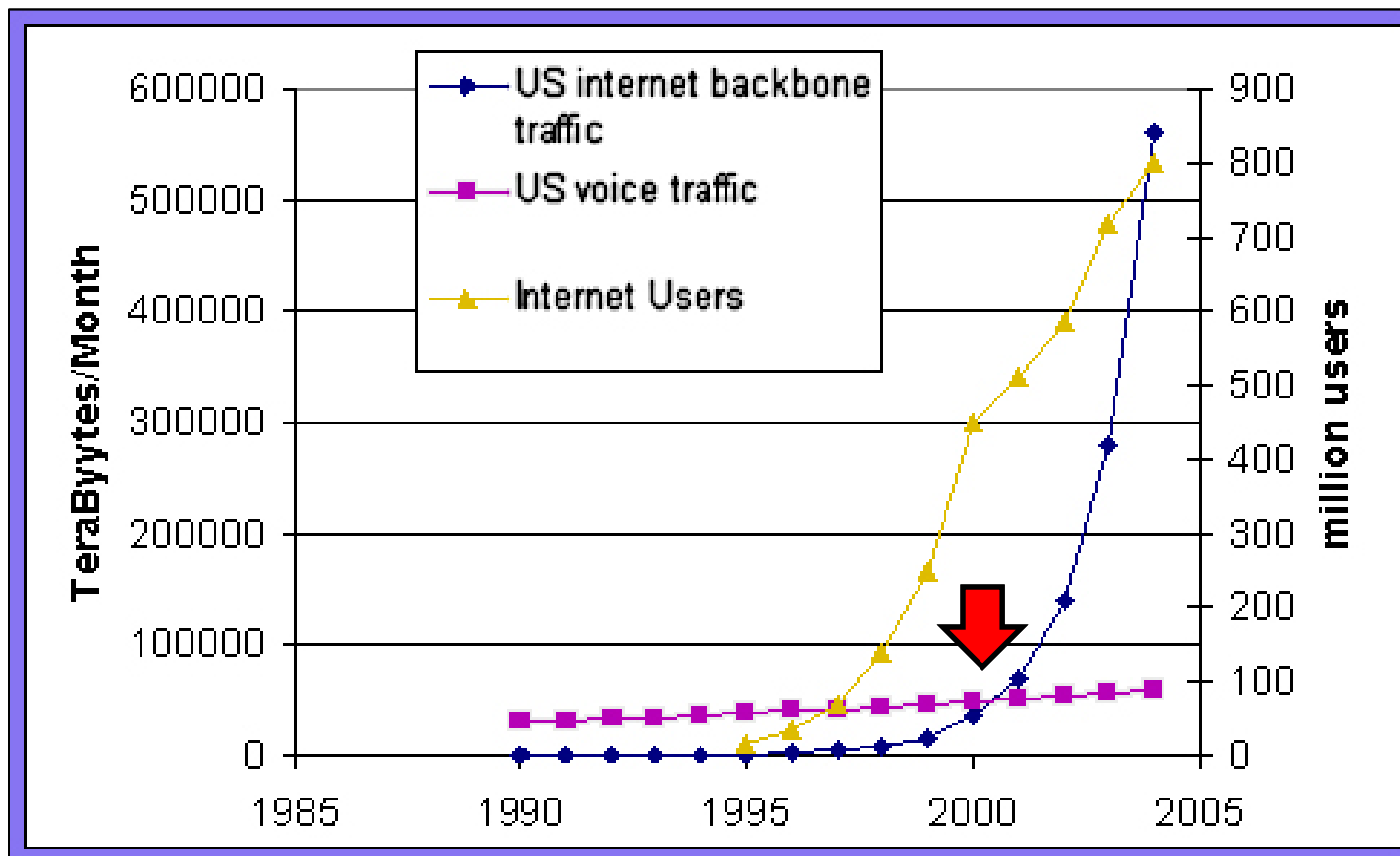
Why Do We Care About Data Networking?

- Whether it's audio from a microphone or data from a PC going in ...
- ... and whether it's analog modulation or digital modulation coming out ...
- ... and whether we track it manually on a pad of paper ...
- ... or automatically via a network of computers ...
- It's all amateur radio

Why Do We Care About Data Networking?

- In SPECS, we focus on providing communications services during a disaster or other communications emergency
- What services?
- The ones that people depend on
- So how important are data services?

Data Eclipsed Voice Traffic 15 Years Ago



U.S. Service Penetration

Year	Fixed Tel Line	Mobile Line	Internet User	Source
2005	59%	68%	68%	ITU
2006	56%	76%	69%	ITU
2007	52%	83%	75%	ITU
2008	53%	85%	74%	ITU
2009	49%	89%	71%	ITU
2010	48%	91%	72%	ITU
2011	46%	94%	70%	ITU
2012	43%	96%	79%	ITU
2013	42%	96%	84%	ITU
2014			87%	PEW

Mobile Lines Are Not Just For Voice ...

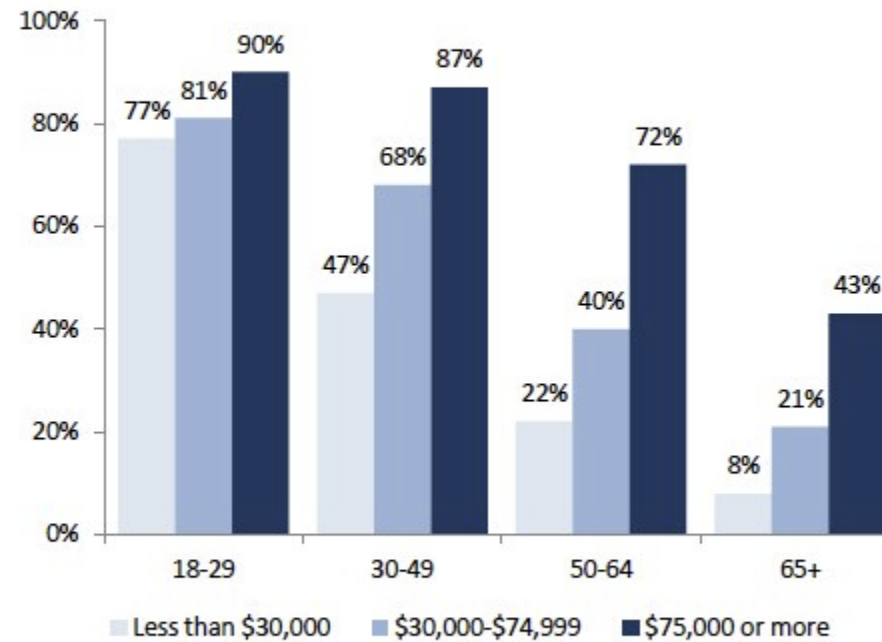


- 4G LTE mobile data communications
- Multi-Mbps up/download
- Personal WiFi hotspot

Now, > 60% of U.S. Adults Have Smart Phones

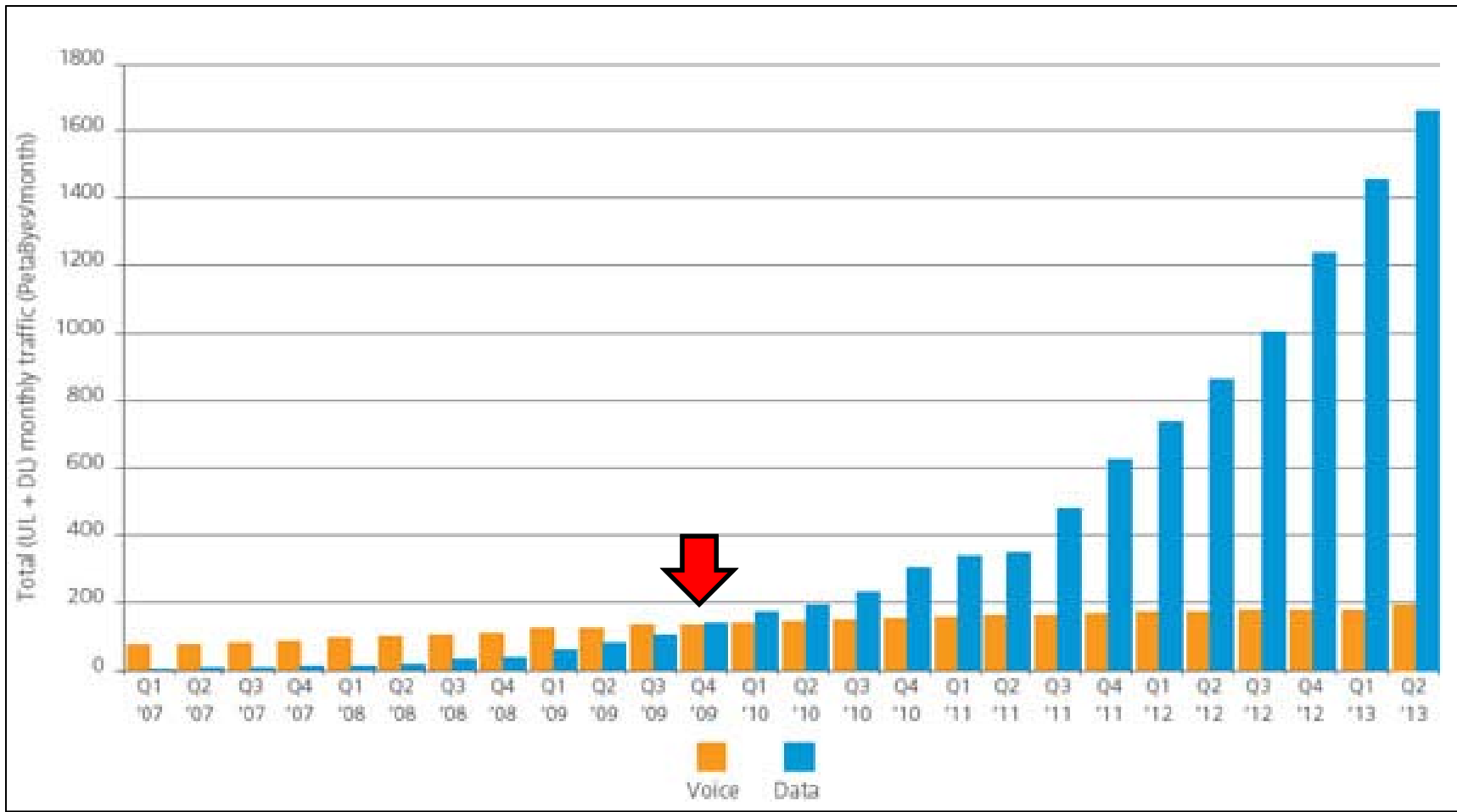
Smartphone ownership by income/age grouping

% within each age/income grouping who own a smartphone (example: 77% of 18-29 year olds with an annual household income of less than \$30,000 are smartphone owners)



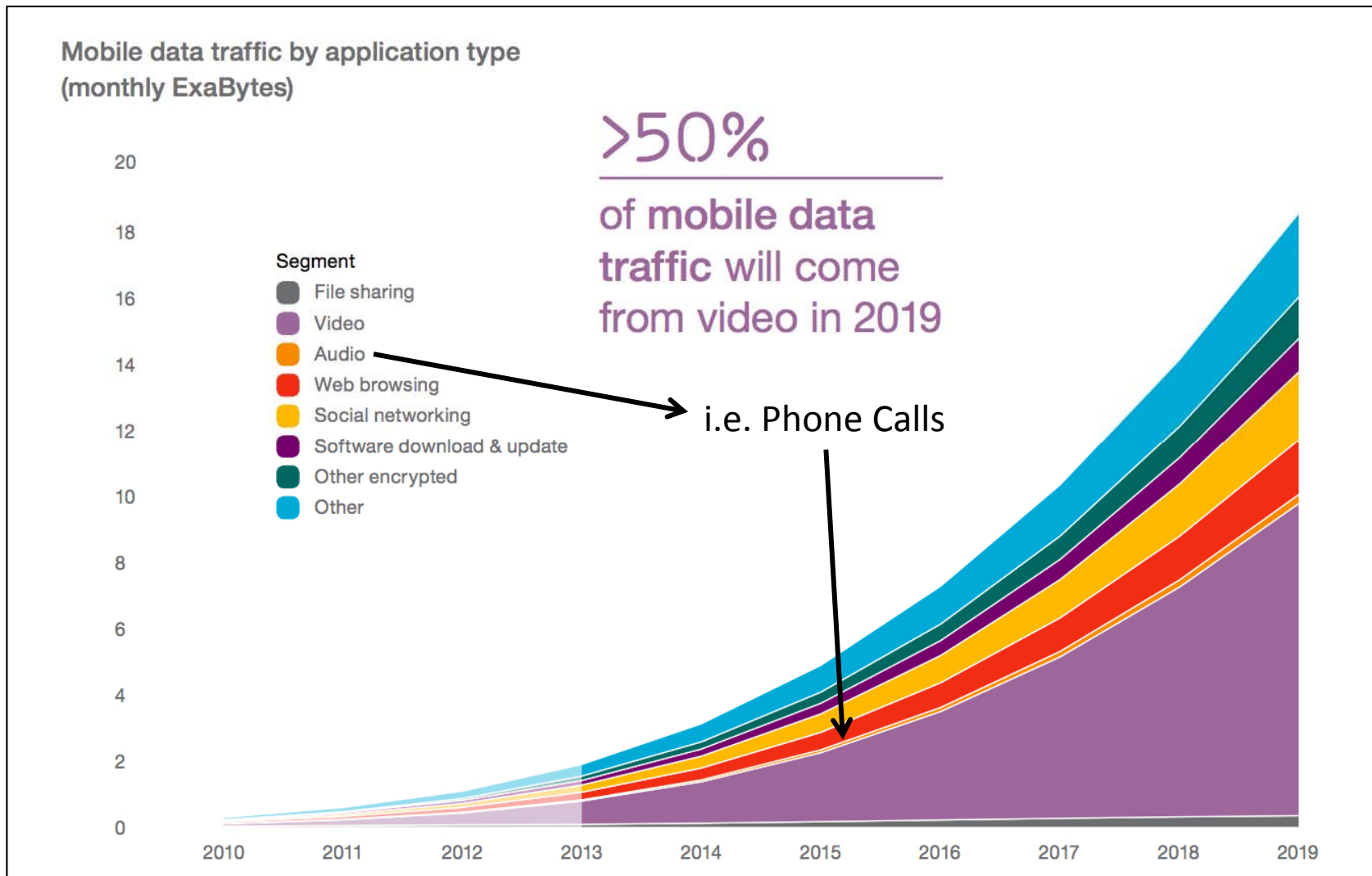
Source: Pew Research Center's Internet & American Life Project April 26-May 22, 2011, January 20-February 19, 2012, and April 17-May 19, 2013 tracking surveys. For 2013 data, n=2,252 adults and survey includes 1,127 cell phone interviews. All surveys include Spanish-language interviews.

Mobile Data Surpassed Voice in 2009



Source: Akamai & Ericsson

And Data Applications Continue to Grow



In Other Words, the General Public ...

- Is a heavy user of to Internet connectivity
- Is accustomed to WiFi at home, at coffee houses, on planes, trains, automobiles, ...
- Is accustomed to MOBILE Internet connectivity
- Uses MUCH more data than voice, even on their phones!
- So, overall, the demand for data services is very high

But, the General Public ...

- Are consumers of Internet services
- They are dependent on the public network infrastructure
 - The telephone, cable, or WiFi network service provider
- They are dependent on the application service provider
 - The PBX or repeater operator or the web site/app provider
- So, when data services break, there's not much they can do

So, What Can Amateur Radio Do?

- We build communications networks and applications
- We make them work “When All Else Fails”
- We’ve got voice covered pretty well
 - Lots of repeaters; ubiquitous HTs; message passing procedures
- But demand for data services today far exceeds the demand for voice services
 - And yet the number of hams prepared to provide data services is much lower than for voice services

So, What Can Amateur Radio Do?

1. We can make more hams data capable
 - Equipment, training, practice, ...
2. We can build new, more advanced data solutions
 - ... for use “When All Else Fails” (no dependence on public Internet)
 - ... but also for public service events (great for practice)
3. We can recruit new, younger hams
 - It’s hi-tech, it’s exciting, it’s aligned with their interests

So what data services can we offer?

Examples: Races/Marathons; Mountain View CERT Damage Assessment

NARROWBAND DATA STATISTICS COLLECTION / DISPLAY

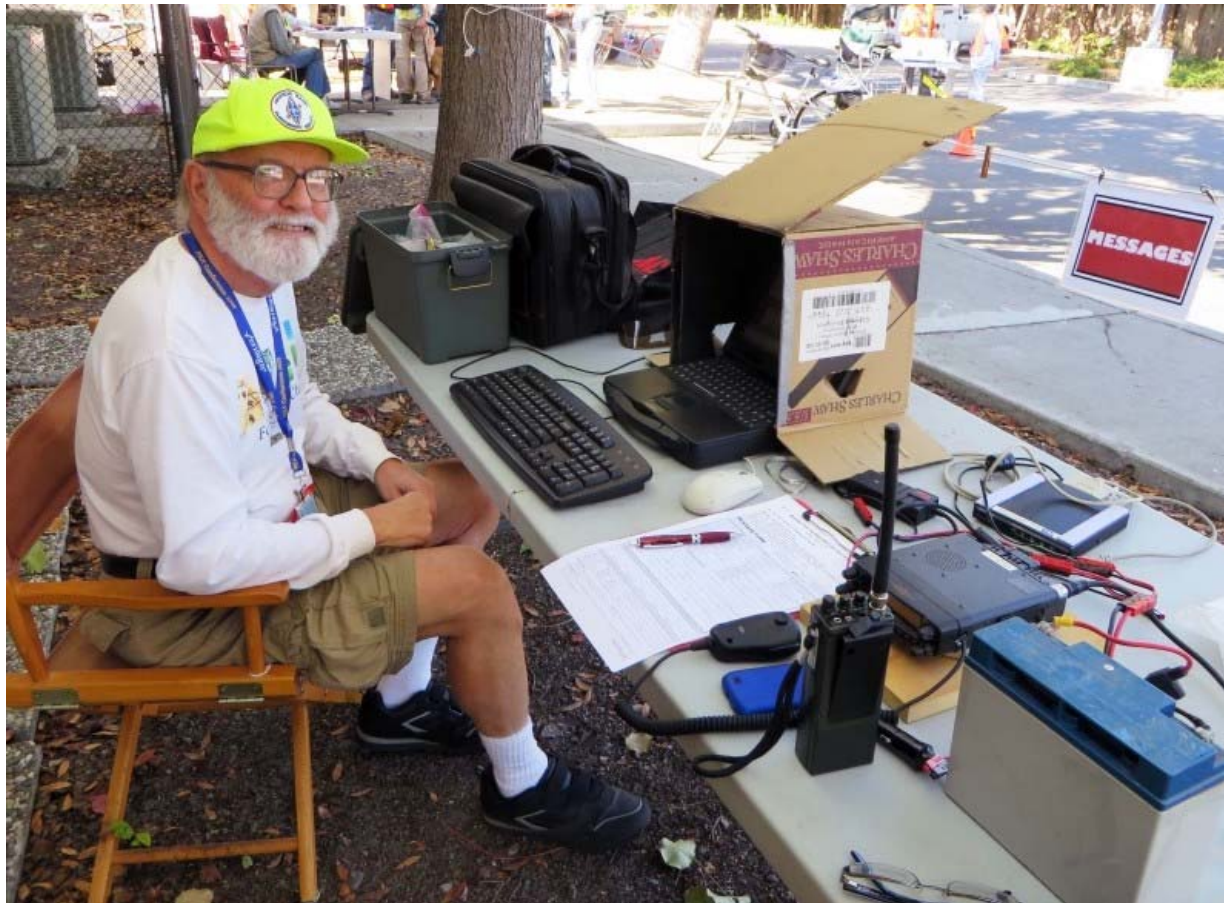
Neighborhood Information Gathering



CERT - DAMAGE ASSESSMENT FORM																						
DATE: 5/15/11		EVENT: CityWide Exercise					PERSON RECORDING / ID#:					PAGE #: 1 of 1										
Incident #	Reported	Priority	BURNING	OUT	GAS LEAK	H2O LEAK	ELECTRIC	CHEMICAL	LIGHT	MODERATE	HEAVY	IMMEDIATE **	DELATED	TRAPPED	DEAD	ACCESS	NO ACCESS	OTHER	ASSIGNED	COMPLETED	COMMENTS	
#	TIME	By	LOCATION	FIRE	HAZARD	BUILDING Damage	PEOPLE	ROAD	X													
1	1301	2	1	325 Paw	1	0	0	0	0	0	1	6	18	0	2							
2	1303	6	1	25W Dana		0	1	0	0	0	1	0	8	20	60	3	0	1				Apartment wing collapsed
3	1304	9	2	125 Church		0	1	0	0	0	1					0	1					Tree across Church
4	1305	4	1	135 Mercy	1	0	1	0	1	0	0	1	4	9	0	2	1	0				Powerline down
5	1307	8	1	152 Bush	1	0				0	0	1	2	3	10	0	1					Thick smoke
6	1309	6	1	272 Bush	1	0	1	0	0	0	0	1	1	4	9	1	0	1				
7	1310	4	1	372 Bryant		0	1	0	0	0	1	0	2	6	11	2	1	0				Chimney fell
8	1311	3	1	631 Oak	1	0	1	0	0	0	0	1	0	1	2	5	1	1	0			
9	1313	9	1	238 Villa						0	0	3	0	2	2	0						3 Townhouses down
10	1315	1		118 Eblora	1	0	1	0	0	0	1	0	2	3	6	0	1	0				
1320				Totals	6	0	5	3	1	0	0	4	8	26	67	103	11	5	3			20%

Radio Priority 1 - Life Threatening or growing, and Priority 2 - Property/Fire incidents immediately as you find them. ** Immediate Medical = life threatening; others are delayed/minor. Use "?" for Unknown. Put an "X" in the OTHER column for descriptions that don't fit elsewhere.

Field Data Station



Wes Freeman, KG6POV

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Amateur Radio Application: PacFORMS

ARES/RACES MESSAGE FORM - Mozilla Firefox

file:///C:/RVM/CERT - MTW/Drill 10-22-11/CERT-DA-Install/CERT-DA-MTWUniversal-message.html

(This form works with Outpost/OpDirect for Automatic ASCII text save)
 For Instructions using this form [Click Here.](#)

1a.) Date: (MM/DD/YY) 05/15/11	4.) Situation Severity (Select One) <input type="radio"/> EMERGENCY (e.g., Life Threat) <input type="radio"/> URGENT (e.g., Property Threat) <input checked="" type="radio"/> OTHER (All Others)	5.) Msg. Handling Order (Select One) <input type="radio"/> IMMEDIATE (As Soon as Possible) <input checked="" type="radio"/> PRIORITY (Less Than One Hour) <input type="radio"/> ROUTINE (More Than One Hour)	6.) Message Requests You to: TAKE ACTION (Check one) <input type="radio"/> Yes <input checked="" type="radio"/> No REPLY (Check one) <input type="radio"/> Yes, by <input type="text"/> <input checked="" type="radio"/> No <input checked="" type="checkbox"/> FOR YOUR INFO. (No action required)
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7.) ICS Position: (required) Display Dropdown List Planning	8.) ICS Position: (required) Display Dropdown List Planning
9a.) Location: (required) Mountain View EOC	9b.) Location: (required) Display CERT List Old Mtn. View CERT
Name: (optional)	Name: (optional)
Telephone #: (optional)	Telephone #: (optional)

10.) SUBJECT: Damage Summary for Old Mtn. View CERT

11.) REFERENCE (e.g., Number of earlier msg.):

Fill in the blanks with your current Damage Assessment column TOTALS.

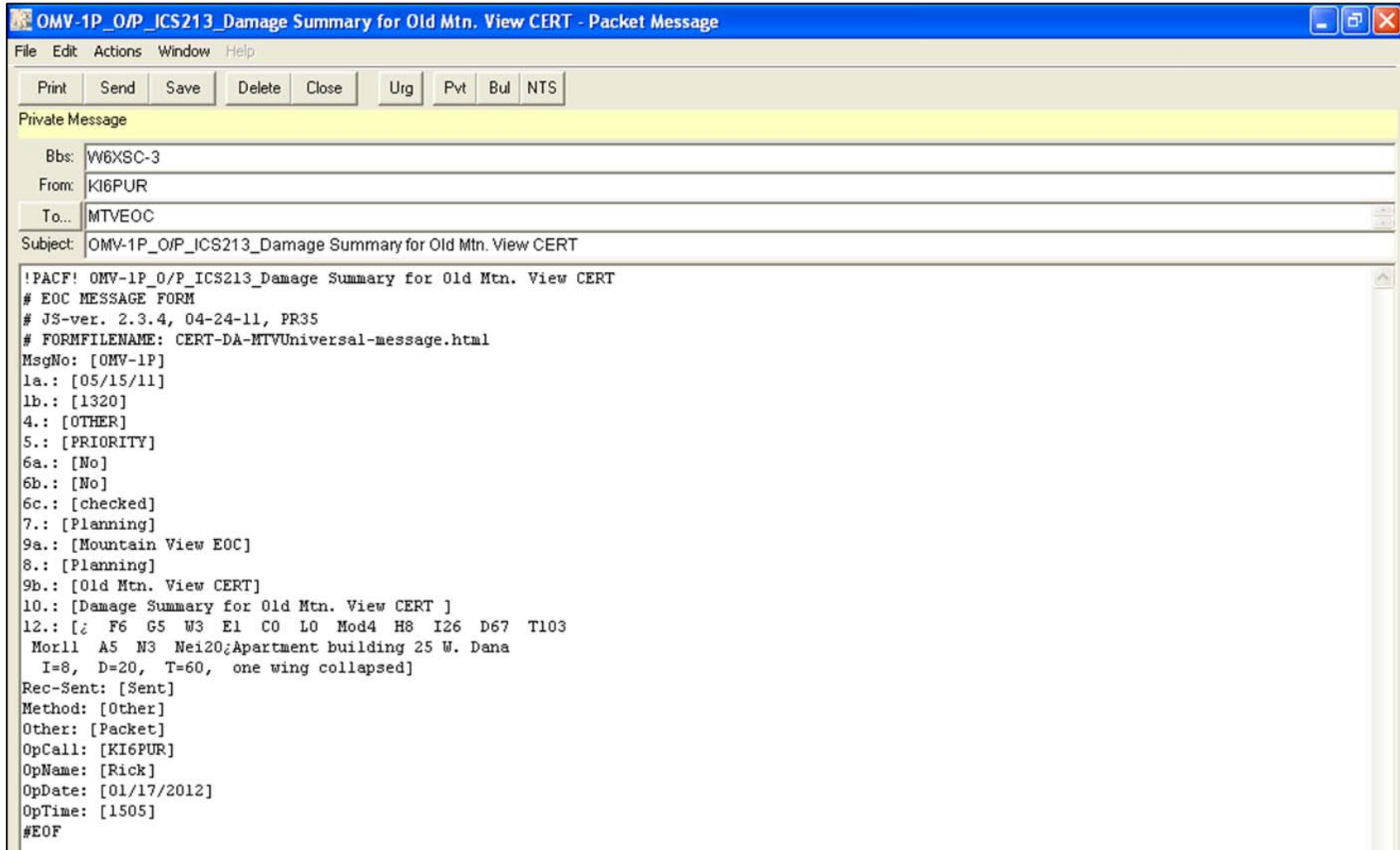
Fire & Hazzard					Building			People				Roads		Neighborhood
Fires	Gas Leak	Water Leak	Electrical	Chemical	Light	Mod	Heavy	Immediate	Delayed	Trapped	Morgue	Access	No access	% surveyed
6	5	3	1	0	0	4	8	26	67	103	11	5	3	20

12.) Message (what, when, where needed; how long; contact name and phone number) KEEP MSG BRIEF
 Optional: Enter top 1-3 incidents with locations and situation details.
 Apartment building 25 W. Dana I=8, D=20, T=60, one wing collapsed

Display/Hide DA Input

13.) Action Taken: (For use by Originator / Recipient) -> USE SEPARATE MESSAGE FORM IF SENDING REPLY!

Amateur Radio Application: Outpost




Amateur Radio Application: MTV DA Summary

DA Summary
_ □ ×


File Settings Help

	Fires Burning	Gas Leaks	Water Leaks	Electrical	Chemical	Light	Building Moderate	Heavy	Immediate	People Delayed	Trapped	Morgue	Roads Access	No Access	Neighborhood % Surveyed	Report Time
TOTALS:	8	7	6	2	0	11	7	10	27	68	105	11	5	3	2 %	1320
Ada Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Appletree Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
The Crossings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuesta Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dutch Haven	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monta Loma	-	2	3	1	-	7	1	-	-	1	-	-	-	-	10 %	1319
Mountain View Gardens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Whisman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Old Mtn. View	6	5	3	1	0	0	4	8	26	67	103	11	5	3	20 %	1320
Rex Manor	2	-	-	-	-	4	2	2	1	-	2	-	-	-	-	1312
Saint Francis Acres	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shady Ridge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sylvan Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wagon Wheel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Projected onto a screen in the Mountain View EOC



C:\...packetCommLog_101111_Recvd.csv 01-Jun-2011 01:



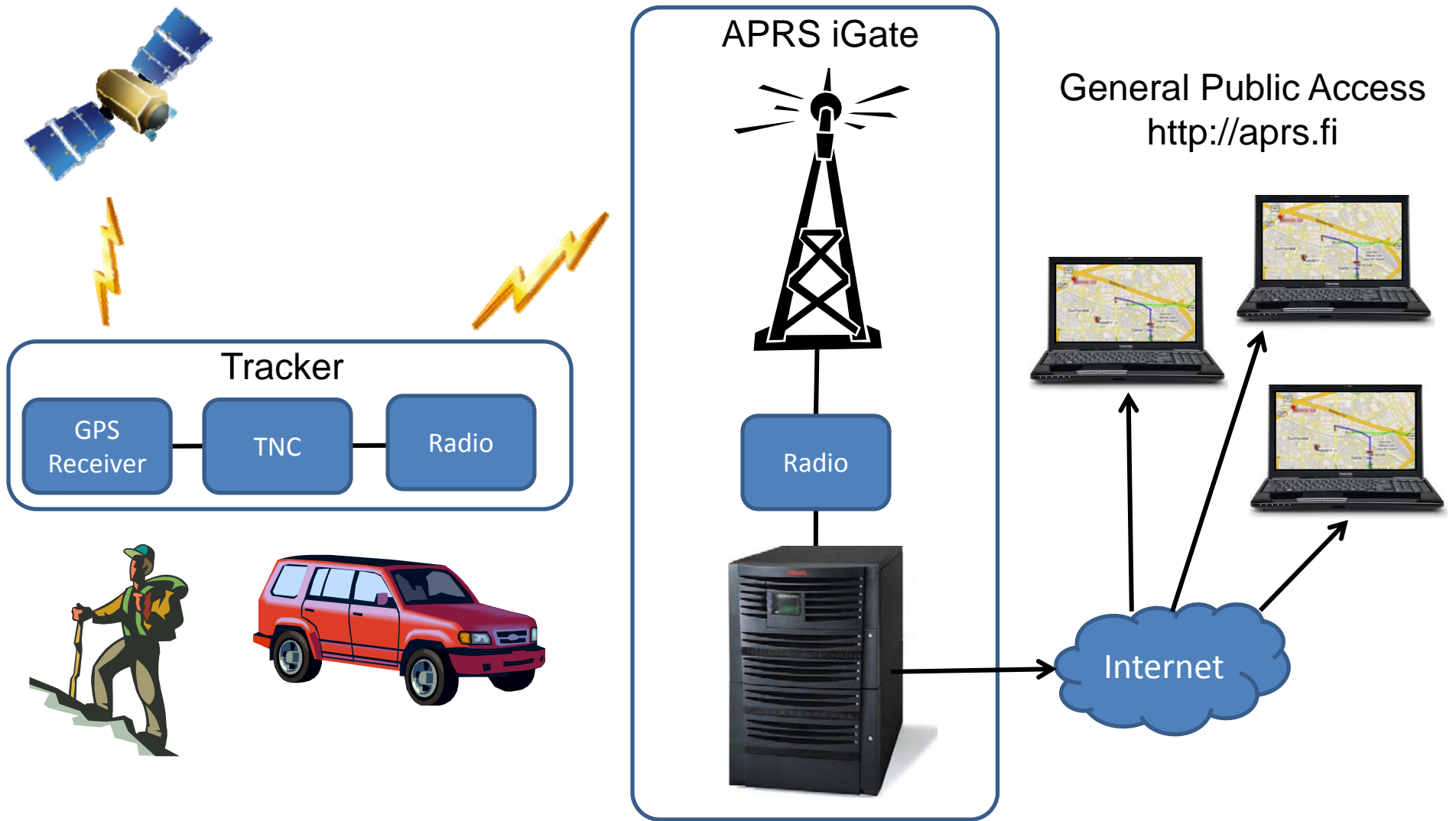
Monitor is On

New Information: Click to reset

Examples: Bike Race; Los Altos Festival of Lights Parade

NARROWBAND DATA MOBILE ASSET TRACKING

Typical APRS Connectivity to the Internet



Integrated APRS Trackers

- Integrated: Radio / GPS / APRS TNC
- Portable: for individuals
 - Yaesu VX-8DR
 - Byonics Micro-Track All-In-One
 - Others ...
- Mobile: for vehicles
 - Kenwood TM-D710G
 - Byonics Micro-Trak Ready-To-Go
 - Others ...



Kenwood
TH-D72



Yaesu
VX-8DR



Byonics
Micro-Track AIO



Kenwood
TM-D710G



Byonics
Micro-Track RTG

Portable APRS Tracking Solution for Events

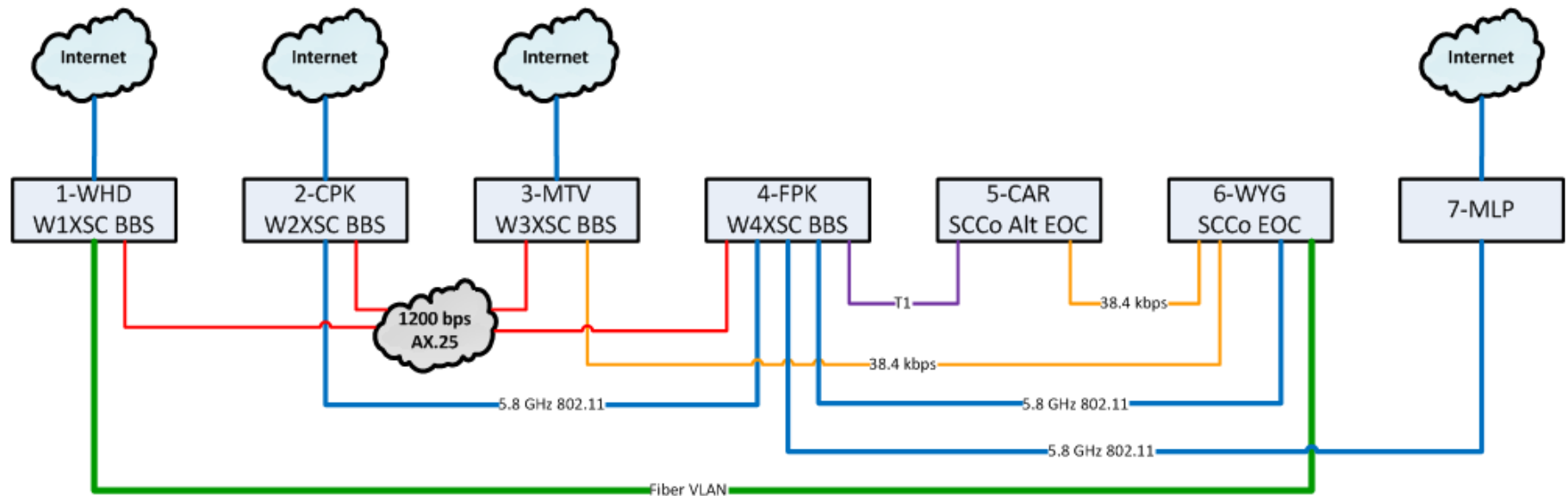


FASTER NARROWBAND DATA 56KBPS – 100KBPS RADIO

Wide Area Coverage Plus (not vs.) Speed

- County-wide coverage is critical for disasters
 - Need to operate from anywhere
 - Line of site issues in cities without tall buildings, trees
- 1200 baud packet provides coverage but limits functionality
 - 100 kB files not really practical to send (it would take too long)
- Broadband WiFi provides functionality but has coverage limits
 - Line of site issues, power limitations, ...
- New radio options are on the horizon (56kbps+ ... 100kbps+)
- Would allow
 - County-wide access; no line of site issues (440 MHz)
 - Simple antennas (role-up J-pole)
 - Standard applications (e-mail clients, web pages, ...)

2014 Backbone Connectivity



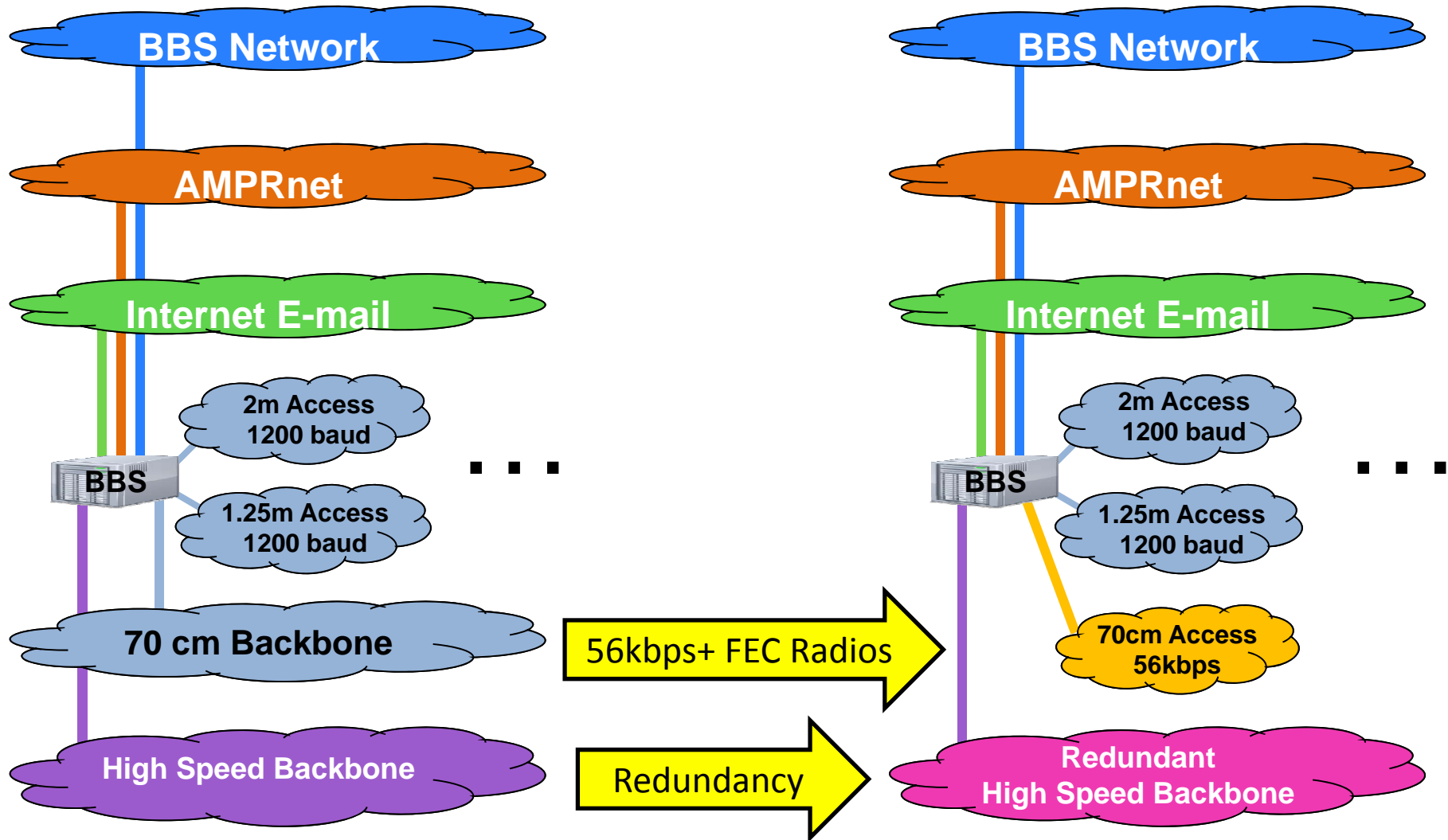
Legend:

- 100+ Mbps
- 10+ Mbps
- 1+ Mbps
- 10+ kbps
- 1+ kbps

Next steps:

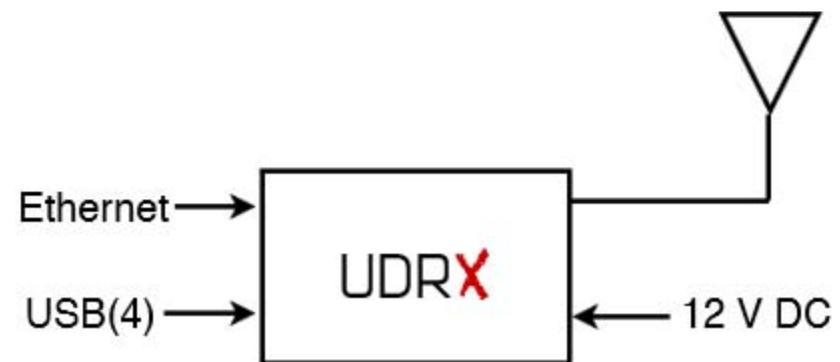
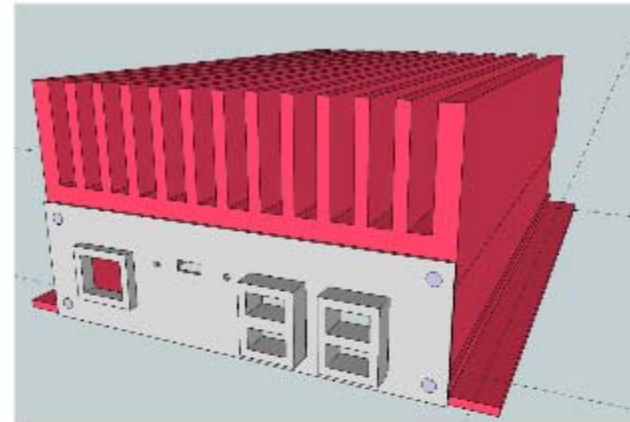
1. Move to high speed backbone as main BBS-to-BBS transport; 70cm network as backup
2. Add links to high-speed backbone to become fully redundant; 70cm can be repurposed

High Speed 440 Access in the Future?



Example: NW Digital Radio UDRX-440

- 25W, 70 cm Transceiver
- Linux platform
- Browser interface
- 1 Ethernet
- 4 USB

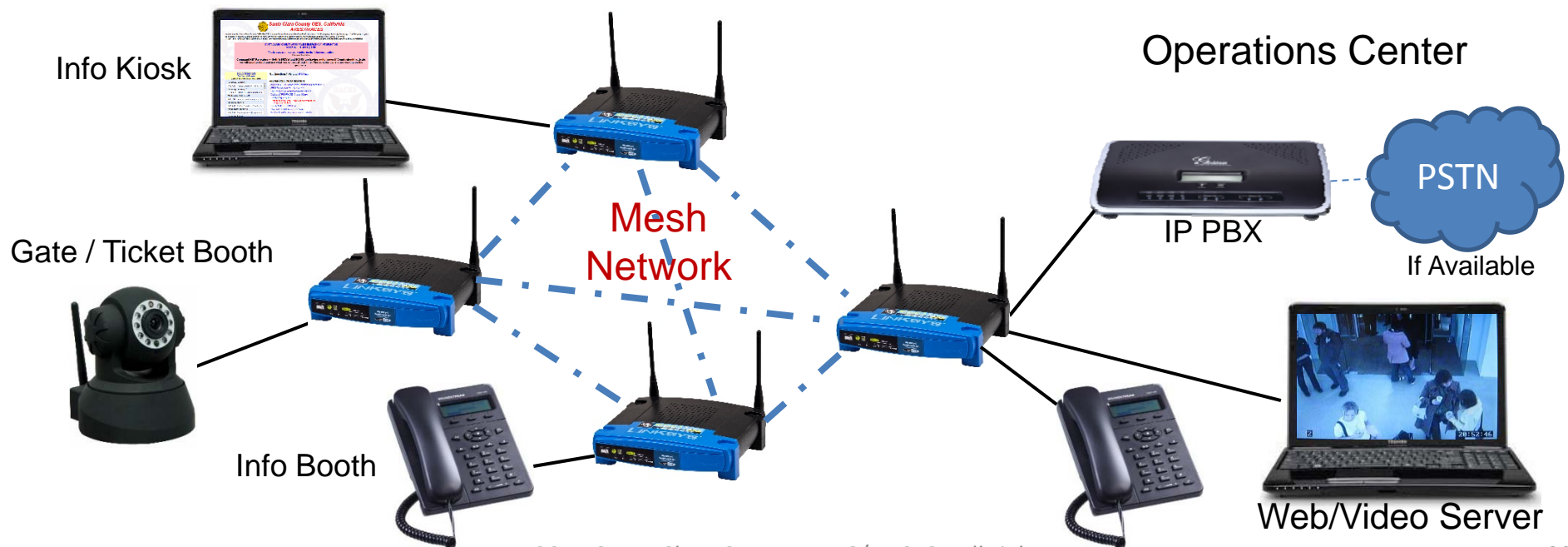


Example: Art & Wine Festival; SCCo County-wide Drill

BROADBAND MESH EVENT CONNECTIVITY

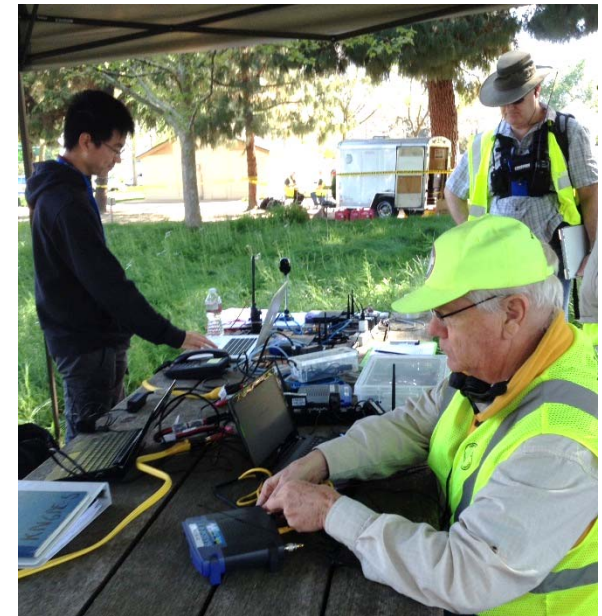
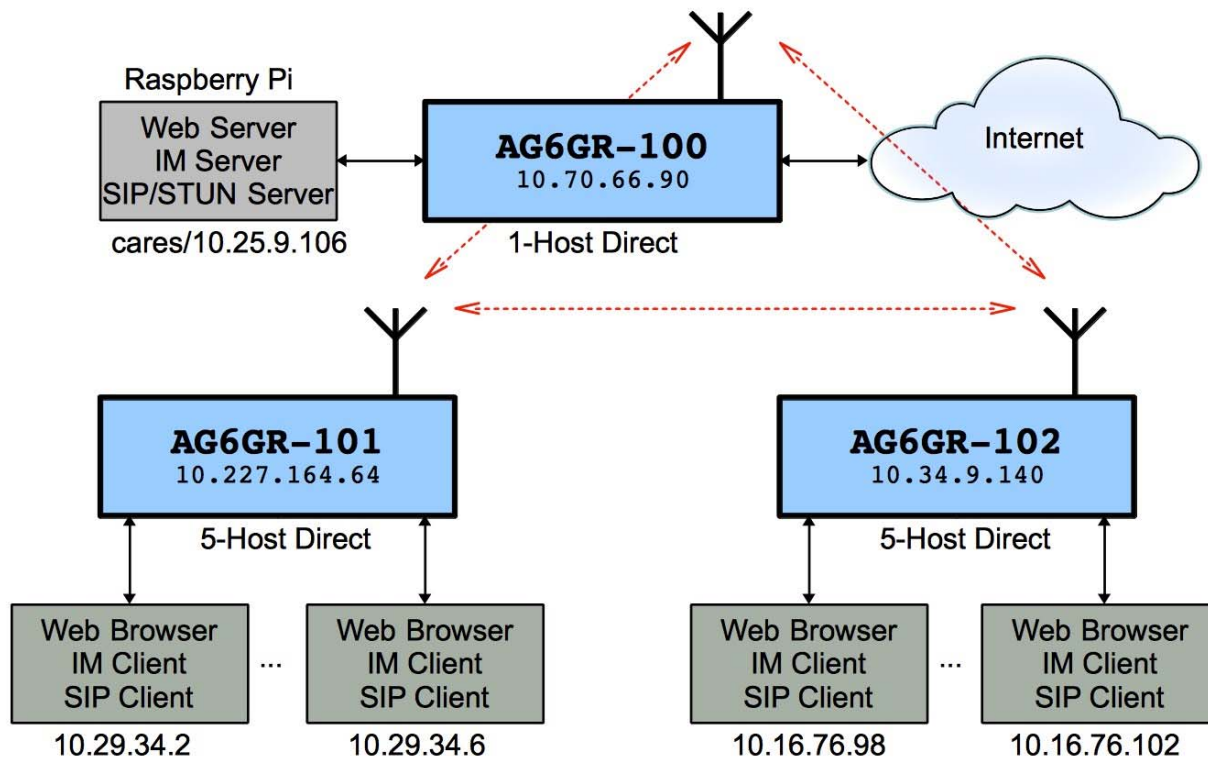
Voice/Video Solution for Public Service Event

- Provide easy-to-use services to public and event workers
 - Info booths, start/finish line, press office, first aid station, ...
- Monitor conditions at entrance, start/finish line, ...
- Independent of commercial power or network



Mesh Networking Experimentation

- 2014 SCCo ARES/RACES County-wide Exercise



Example: WB6ECE voted/simulcast system

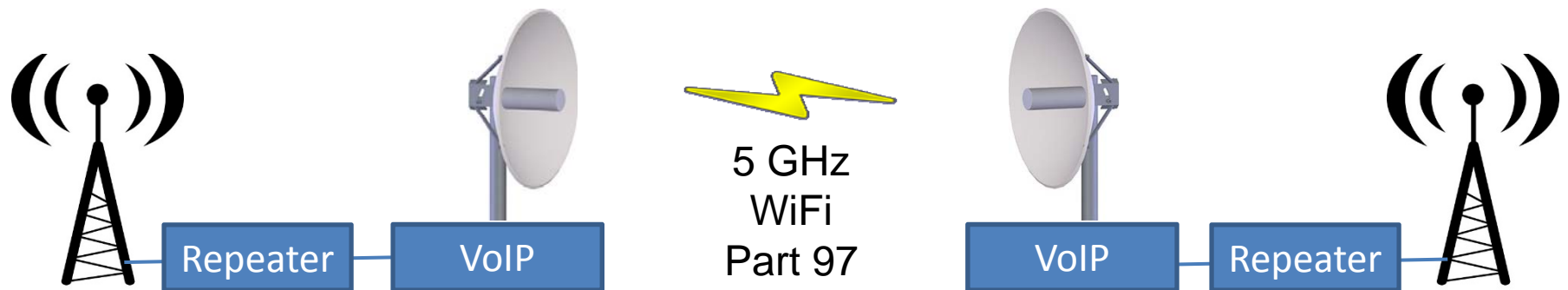
BROADBAND VOIP REPEATER LINKING

Analog Voice Repeater Linking Options

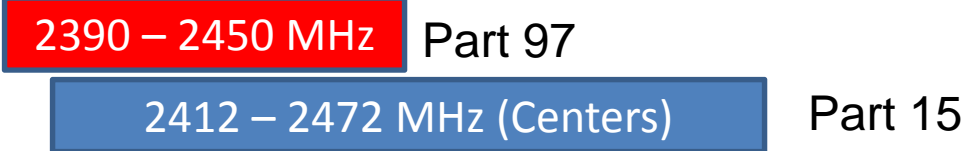
- Analog Link (example: W6ASH link to AA6BT)




- Digital Link (example: WB6ECE voted/simulcast system)



802.11 (WiFi): Part 15 vs. Part 97

- 2.4 GHz 

2390 – 2450 MHz Part 97
2412 – 2472 MHz (Centers) Part 15
- 5 GHz 

5650 – 5925 MHz Part 97
5180 – 5825 MHz (Centers) Part 15
- Off-the-shelf 802.11 gear is readily available and can be used under Part 97 (higher power, no encryption, no 3rd party)
- Or, the same gear can be used under Part 15 rules (encryption, 3rd party, but lower power)

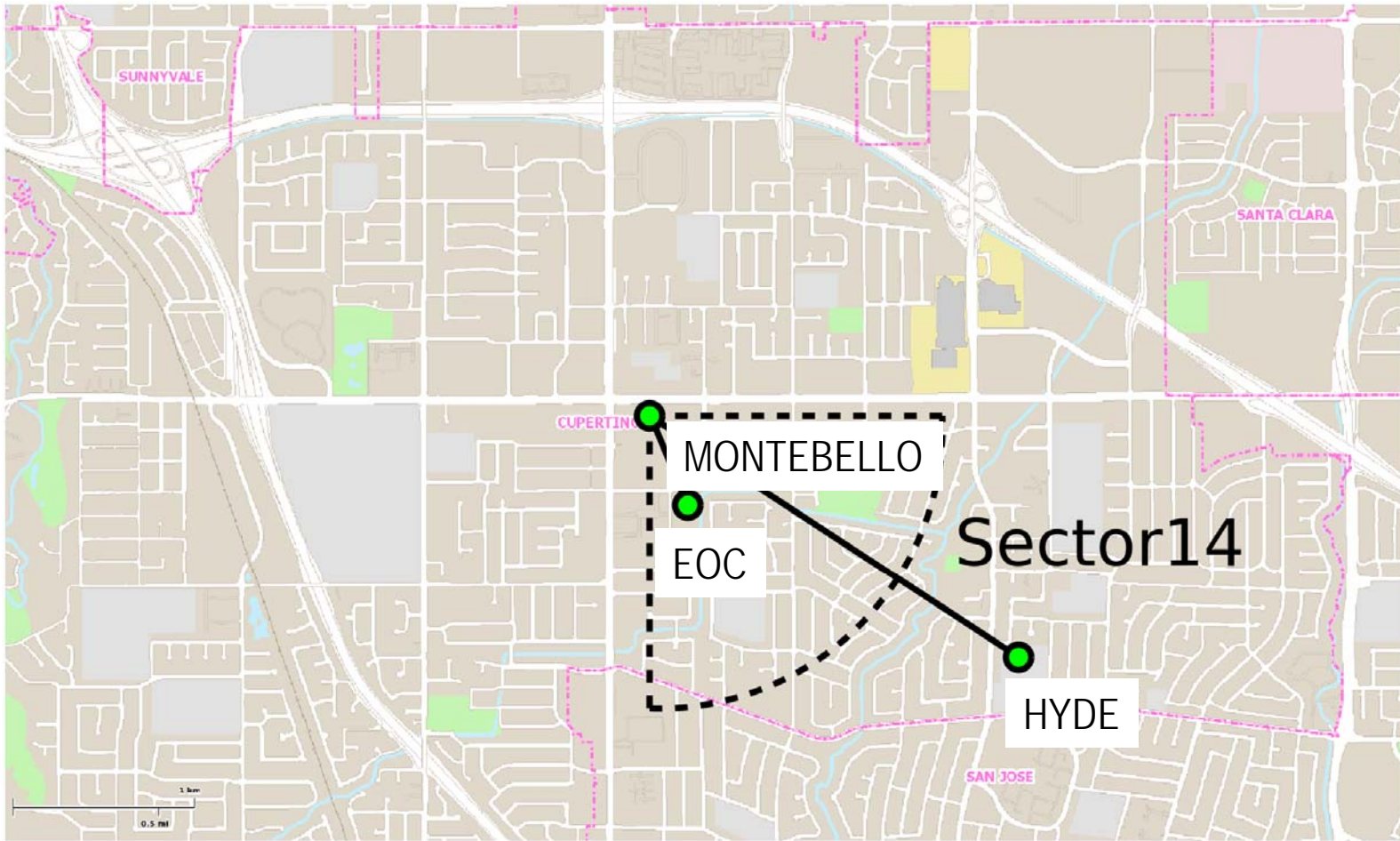
Example: Cupertino ARKnet

BROADBAND FIXED SITE CONNECTIVITY

Cupertino ARKnet Purpose

- Connect ARKs, key city locations and served agencies via a broadband data network
- Key applications:
 - Local hot spot for data exchange
 - Telephones (VoIP) at ARKs for ARK staff, possibly elsewhere for public
 - Status and information dissemination (web access)
 - Inventory management (shared file access)
 - Video surveillance
- Low cost vs. commercial service provider solutions
 - Off-the-shelf WiFi components
 - Volunteer labor

Pilot Coverage



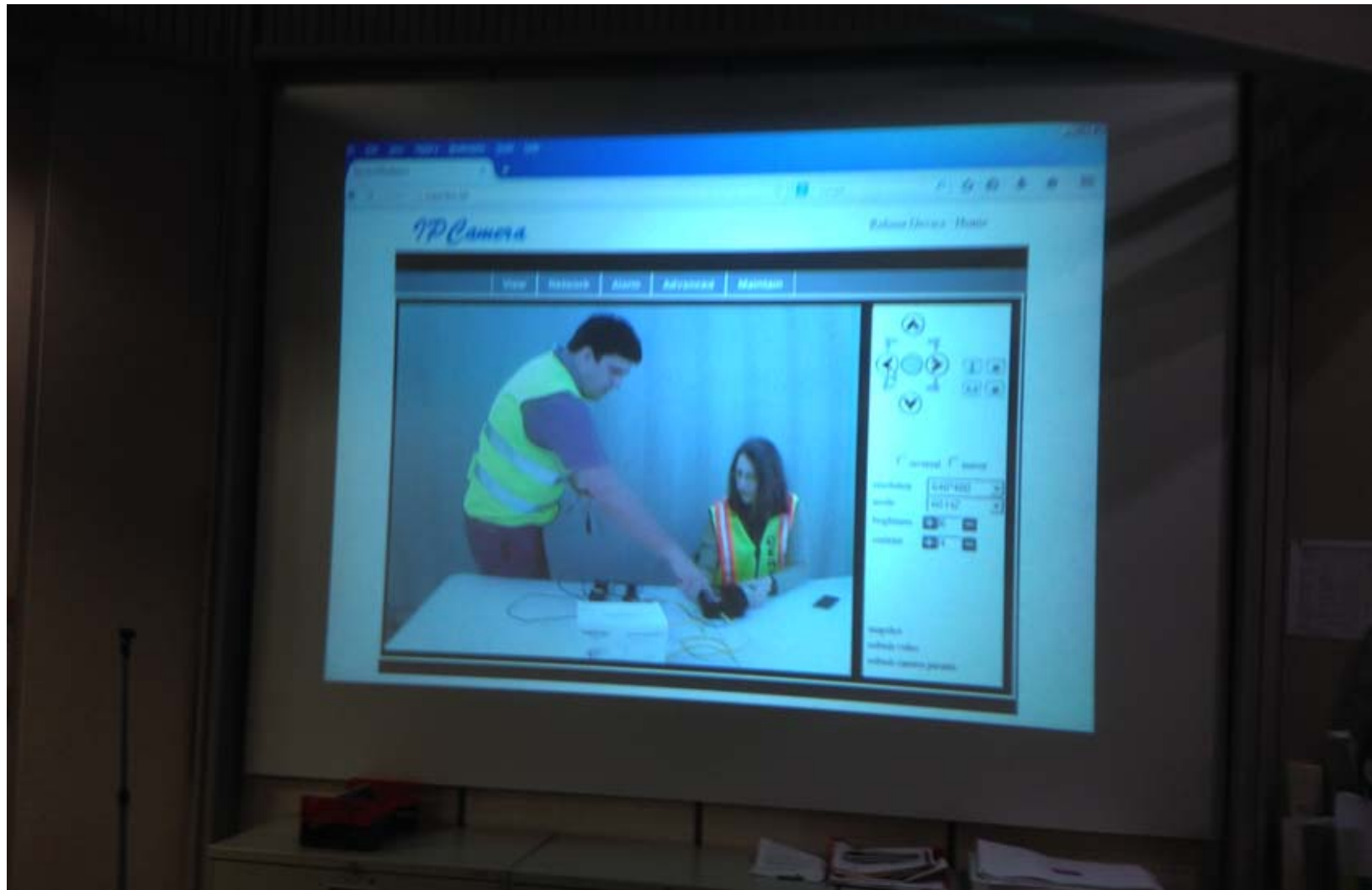
Montebello Site



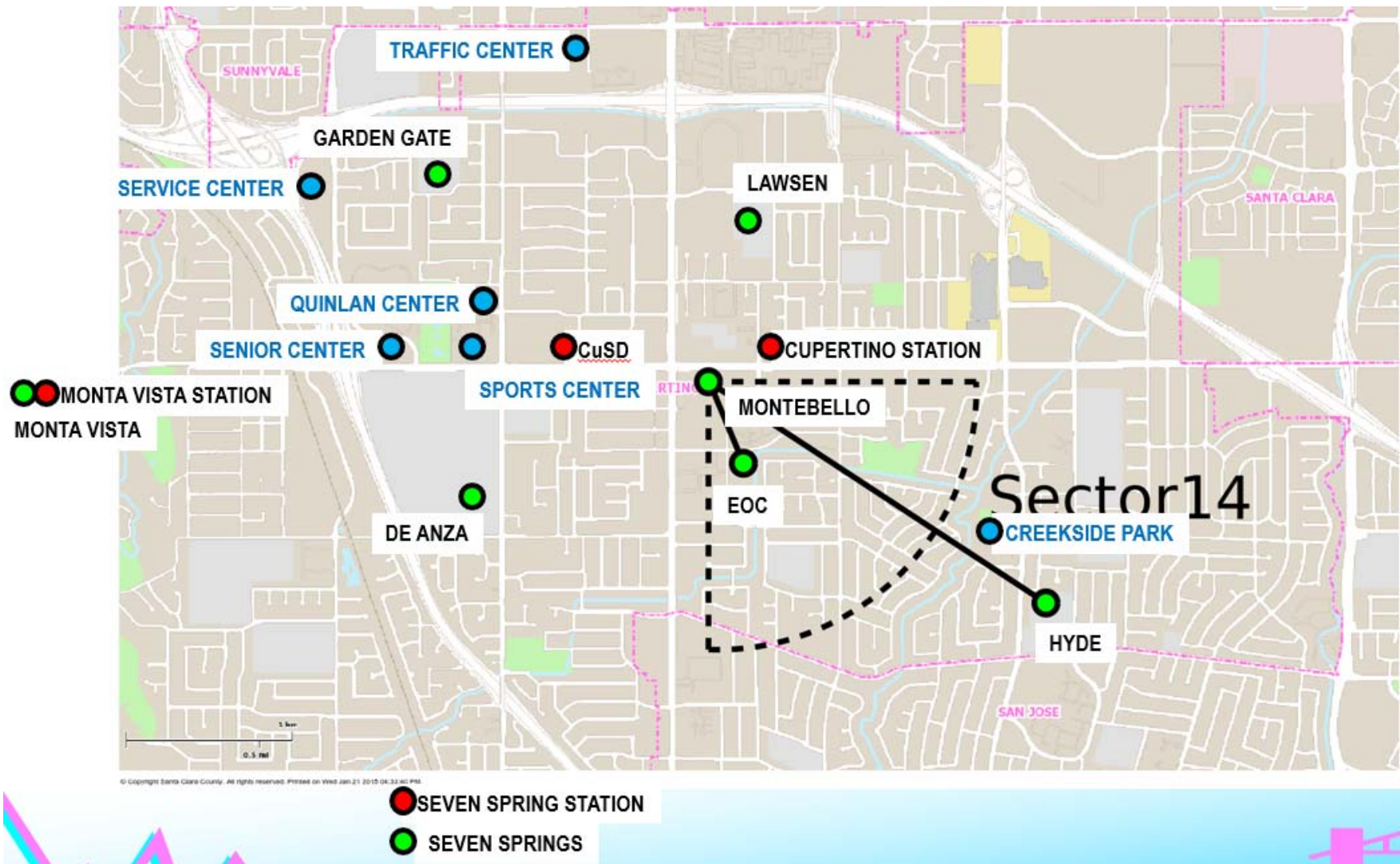
Hyde ARK site



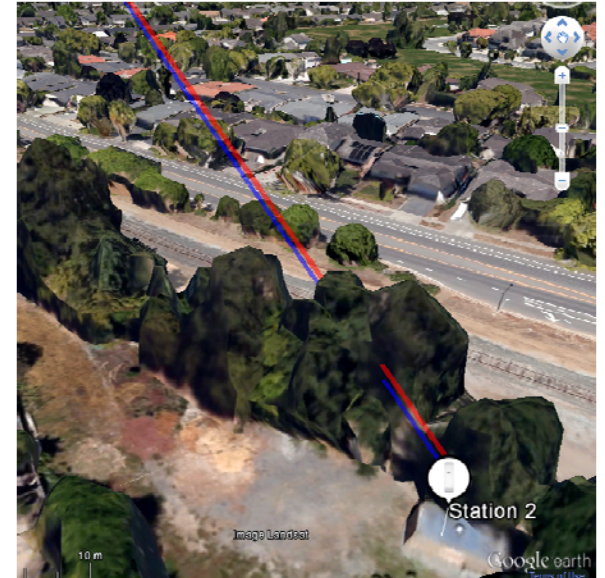
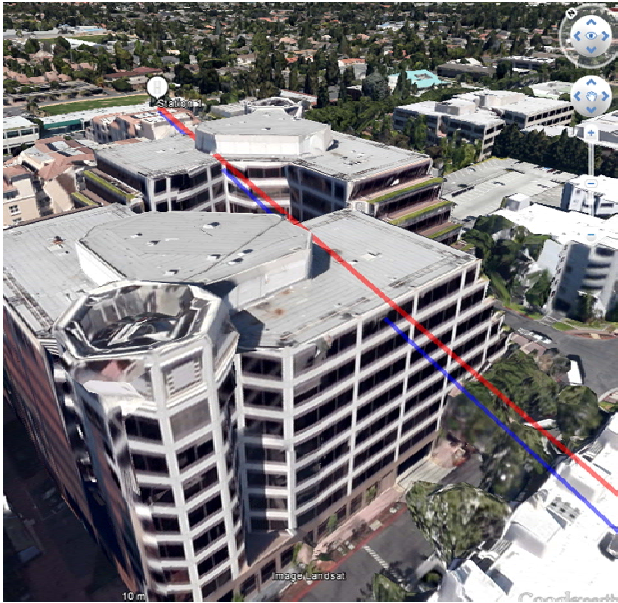
Demo... live, from Hyde Ark!



Future Sites... ARKs, City Sites, Served Agencies



Broadband Line of Sight Issues



- Line of sight can be a real problem for 802.11 networks
 - Example: Cupertino ARK Project
- Even more of a problem with ad hoc, temporary nets

Cupertino ARKnet Status

- Three site pilot was successful
 - Established connectivity
 - Showed examples of likely applications
- Approved for next phase (analysis)
 - Analyze and plan how they will cover the other sites
 - Some sites are much further away than the pilot locations
 - Some sites have line-of-site issues
 - Power/margin/coverage investigation

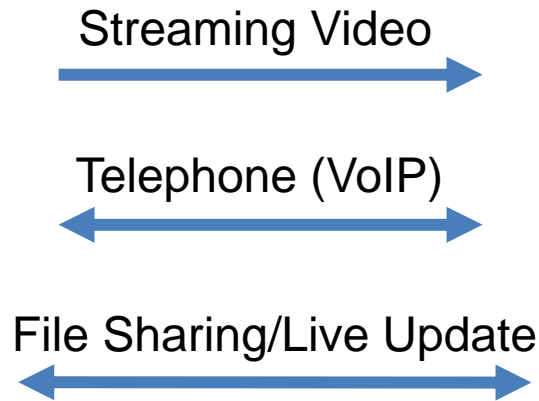
Demo Diagram and Explanation

ARKnet Demo

ARK Location



Demo Applications:



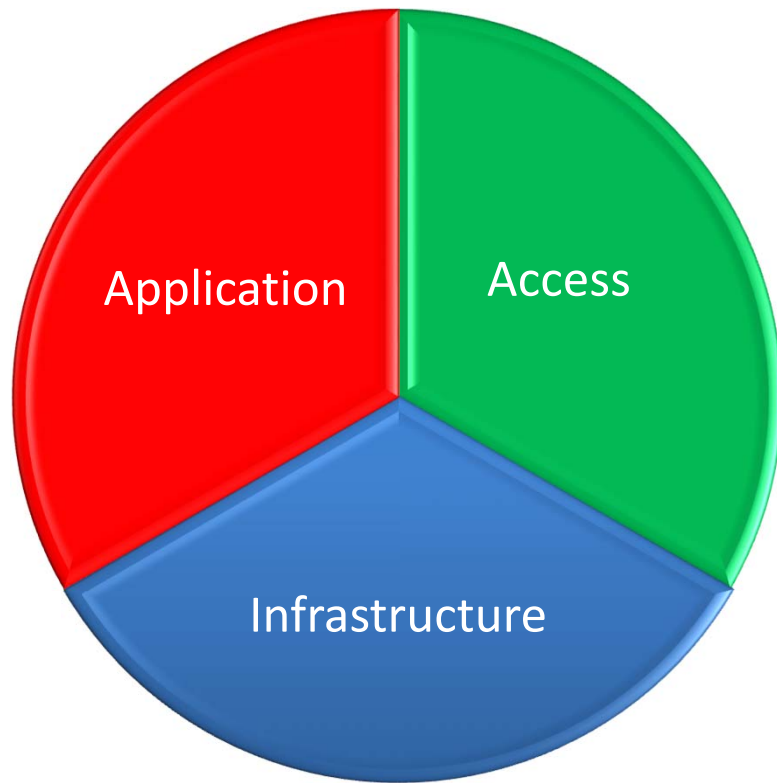
Central Location



Conclusions

- Public has a huge appetite for data
- Technology is affordable and available
- Lots of solutions ideal for amateur radio deployment
- Lots to learn / experiment / develop / spur interest
 - Applications: information collection, presentation, ...
 - New traffic types: VoIP, message traffic, telemetry, statistics, video, ...
 - IP Networking: addressing, switching, routing, security, ...
 - MHz and GHz radio: antennas, power, propagation, ...
- Recruiting tool for younger, hi-tech hams

Where Can You Contribute?



- What do you (want to) know?
- Applications
 - User software
 - Operating system, management
- Access
 - Client equipment
 - Training, demo, user mentor, docs
- Infrastructure
 - Site work (rack, tower, ...)
 - Design, implementation, monitoring of: RF TX/RX, antenna, IP network, power: design, implementation, monitoring

Thank You