Introduction to Broadband Hamnet

ARRL Western Pennsylvania Section
Juan Manfredi NA0B
University of Pittsburgh

Harry Bloomberg W3YJ
SEC WPA ARRL Section
w3yj@arrl.net

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

The Need for Speed

- NBEMS is a great suite for sending data but...
- It is slow...MT63-2000 is only 1 kb per sec
- 3 min to send a modest 3000 byte file
- Can send only text
- Even low res photos are impractical to send
- Forget about sending video
- Would like to send rich multimedia data
- Live streaming video
- Large spreadsheets and documents

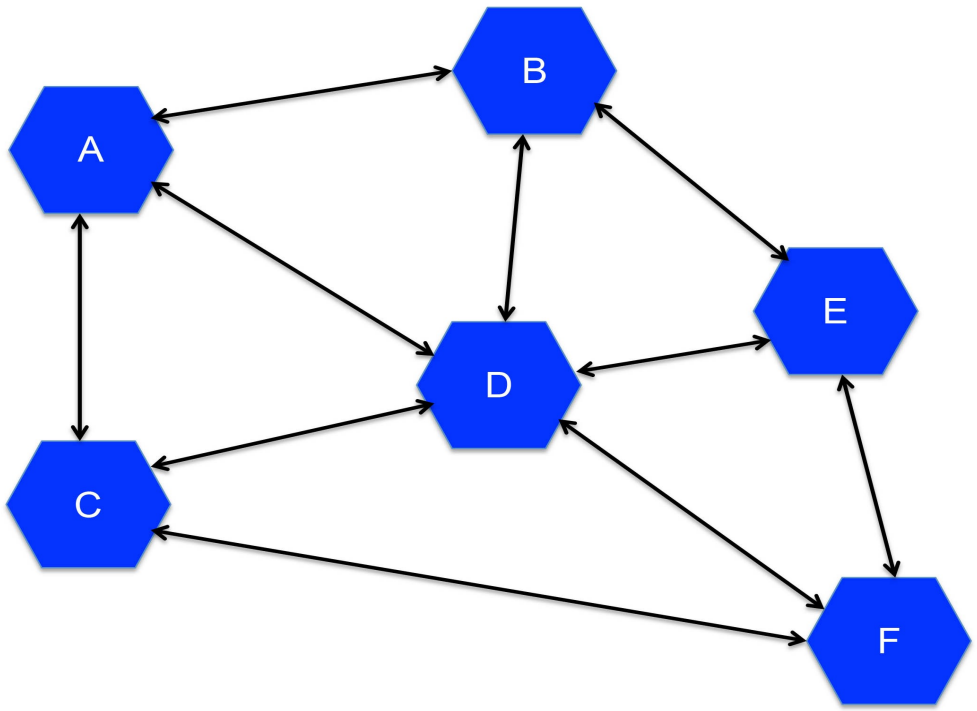
The Solution: Broadband Hamnet

- One solution is Broadband Hamnet (BBHN)
- Was known as High Speed Multimedia (HSMM)
- Take an inexpensive off-the-shelf wi-fi device...
- Install ham-developed firmware and...
- We can easily create high-speed networks
- Networks are self-discovering and self-configuring
- Hams don't need to be IT personnel to create networks
- Limitation...line of sight range
- But, in the clear and with high-gain antennas, range of miles

Mesh Network Concepts

- Each BBHN router is known as a “node”
- Nodes listen for other nodes
- When another node is found, it is added to the network.
- We have multiple redundant paths through the network.
- Looks like a fish net, or a mesh
- No ham intervention is required for nodes to form a mesh.
- Ham shows up, plugs in router, it's added to mesh
- It's all automagical!

Mesh Network Diagram



Mesh Network Diagram

Note multiple paths between Nodes A and F

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Wi-fi concepts

- Commercial wi-fi networking devices use the 2.4 GHz amateur radio band
- NEW! 5.8 GHz devices now available
- Wi-fi channels 1-6 fall in the 2.4 GHz ham band
- We can operate wi-fi devices under FCC Part 97 meaning...
- No limits on antenna gain
- Higher power than allowed under Part 15
- Drawback to Part 97...no encryption

Wi-fi channels in 2.4 GHz ham band

Channel	Center Frequency
1	2.412 GHz
2	2.417 GHz
3	2.422 GHz
4	2.427 GHz
5	2.432 GHz
6	2.437 GHz

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Supported Hardware

- Two families of wi-fi devices supported by BBHN
- Linksys
- Ubiquiti
- Linksys suitable for short range indoor use
- Ubiquiti appropriate for outdoor use
- Including antenna, can easily put together a BBHN system with new hardware for under $100
- Hardware available via Amazon, NewEgg, etc.

Linksys WRT54G...a classic!

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Linksys Hardware Selection

- Be careful before buying...
- Lots of versions of WRT54G produced
- Not all of them will run the BBHN firmware
- Check http://broadband-hamnet.org for list of supported Linksys devices
- WRT54GL available new for around $50
- Often see older versions of WRT54G at hamfests for as little as $10

Ubiquiti Hardware

- Ubiquiti hardware recently supported by BBHN
- Two favorites...
- Ubiquiti Bullet M2...600 mW radio
- N connector on top
- Attaches directly to antenna...no feedline loss!
- Ubiquiti AirGrid...200 mW radio integrated into 16 dBi – 23 dBi dish antennas
- Both use Power Over Ethernet (PoE)
- Bullet available for about $80 from Amazon
- 16 dBi AirGrid available around $60

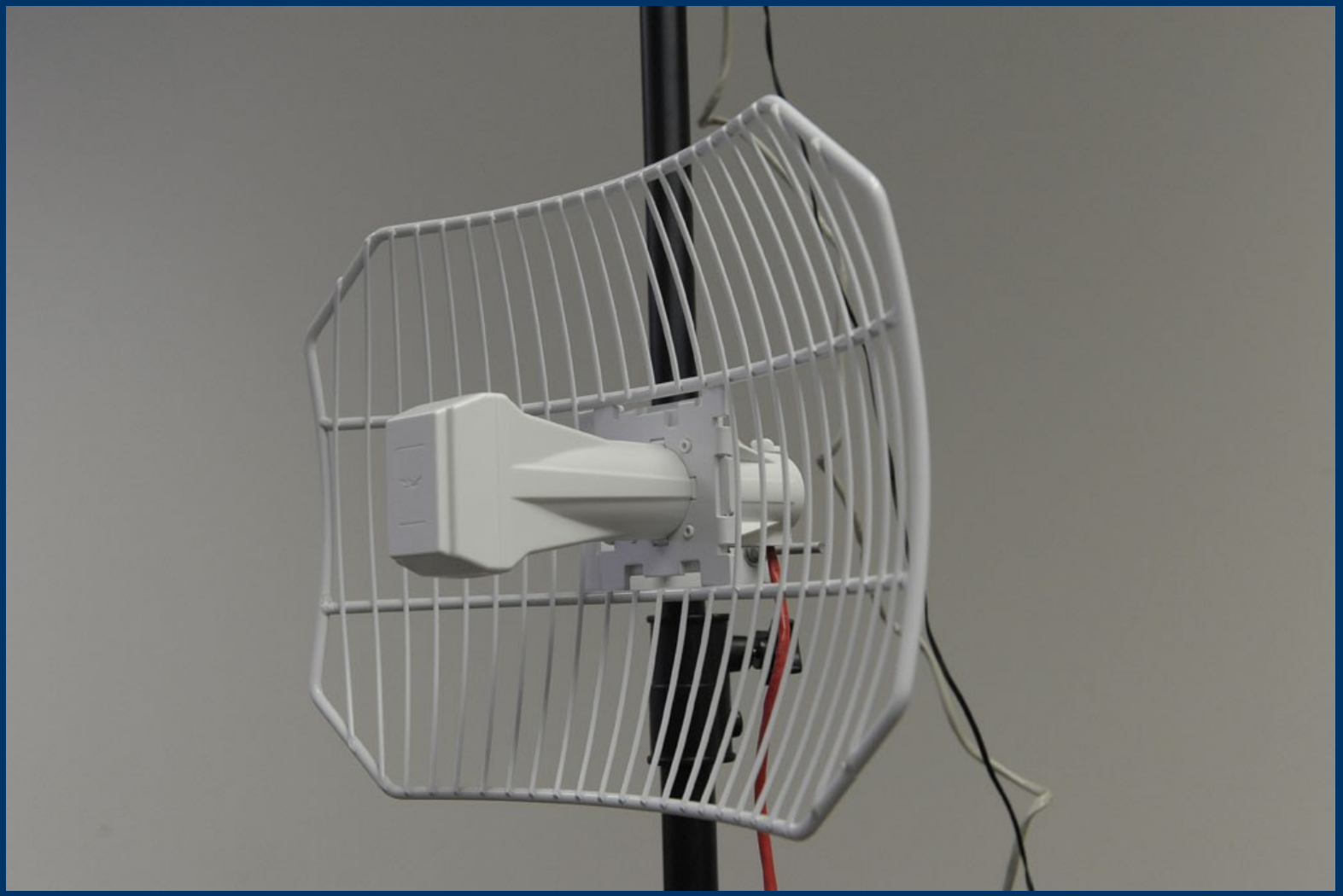
Ubiquiti Bullet M2

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Ubiquiti Bullet on 24 dBi antenna

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Ubiquiti AirGrid 16 dBi



© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

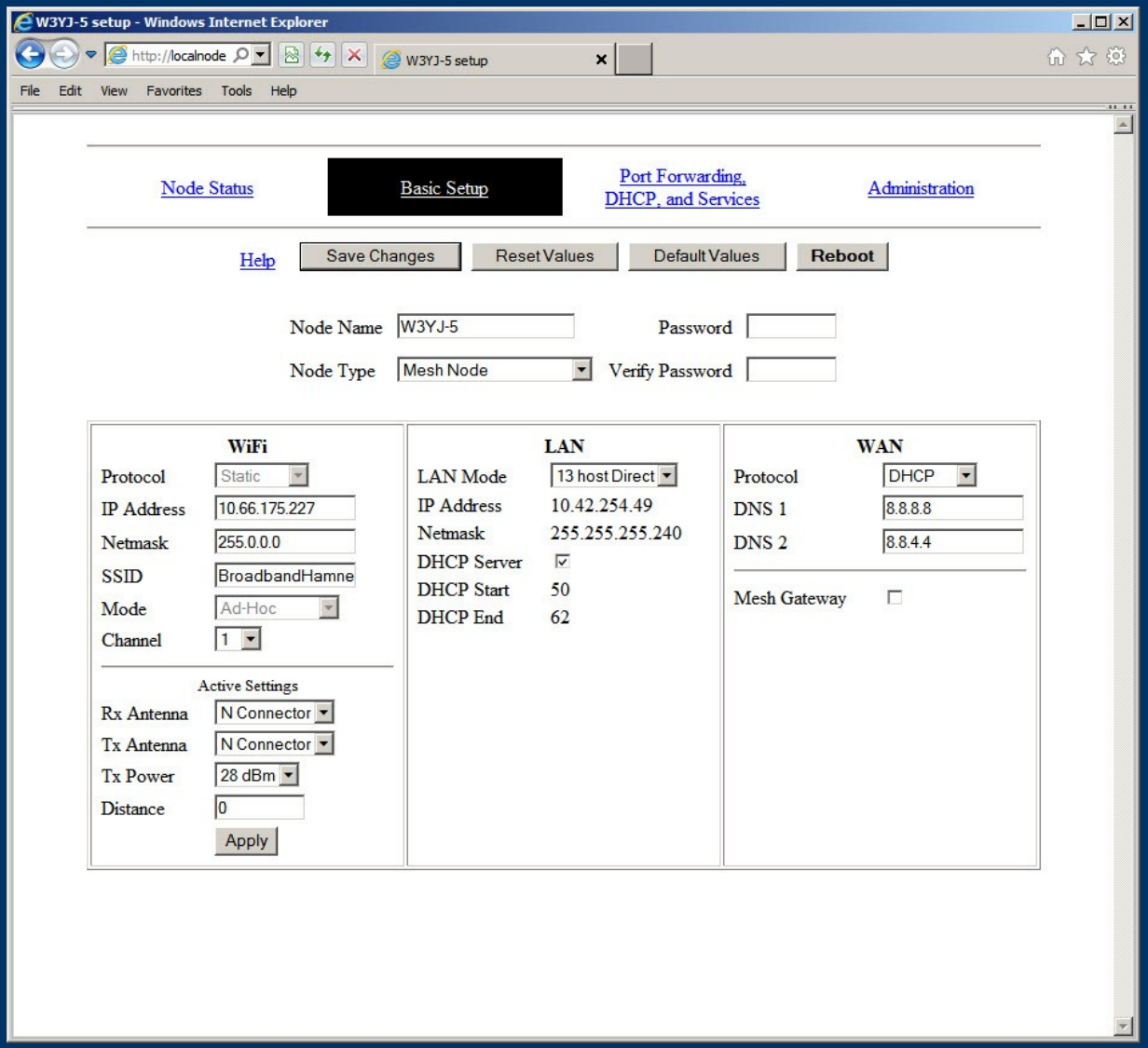
Installing the BBHN Firmware

- Detailed instructions available on BBHN website
- Slightly different between Linksys and Ubiquiti
- DON'T TURN OFF POWER WHILE INSTALLING!
- Not as intimidating as it sounds
- Pretty easy, takes about 15 minutes

Connecting to new BBHN router

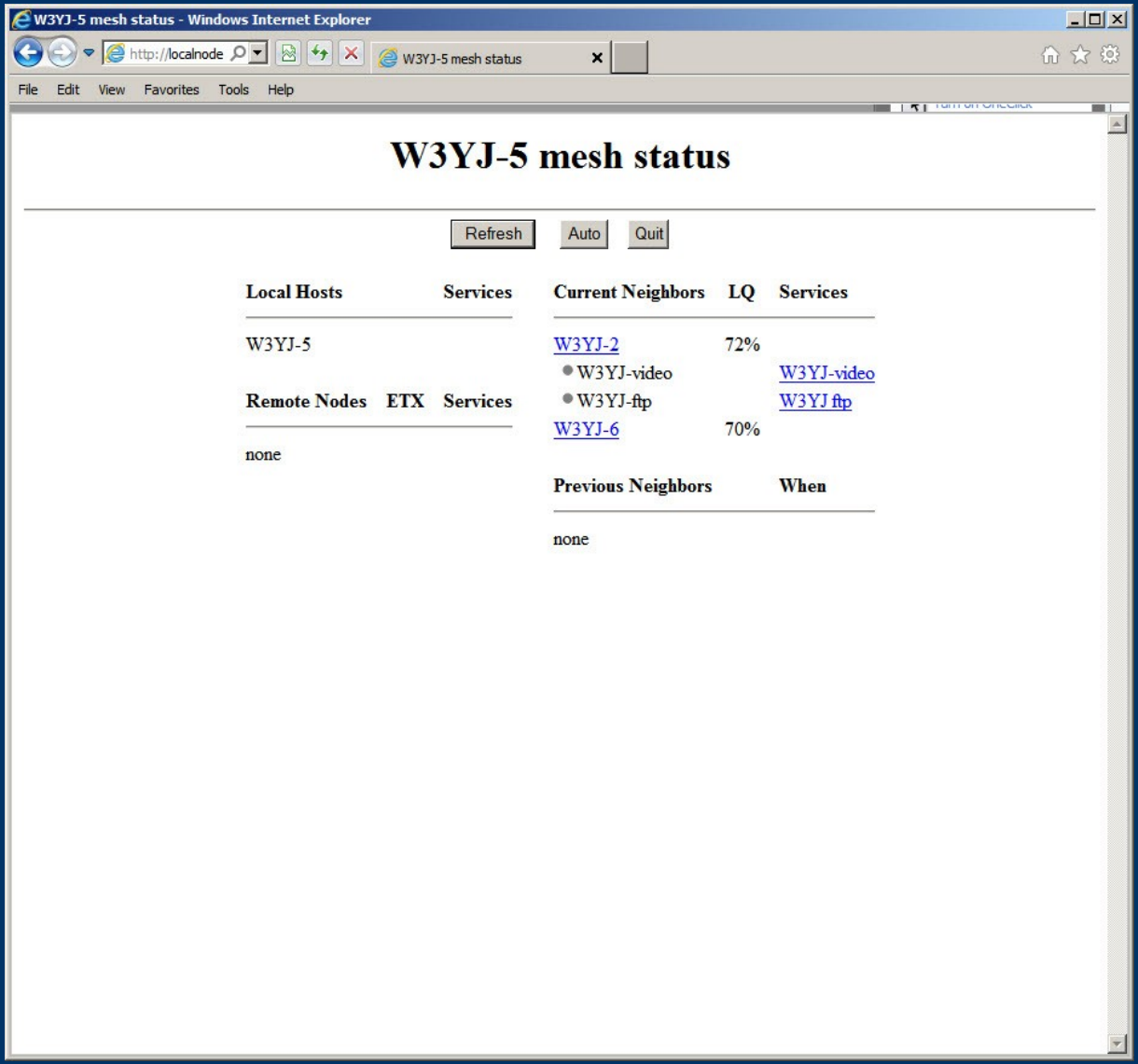
- Configure your computer to use DHCP to obtain IP address
- In Windows, configure to “obtain IP address automatically”
- Also select “obtain DNS server automatically”
- Plug in Ethernet cable, power up router
- On Windows, run ipconfig command to verify you have IP address starting with 10.x.x.x
- Go to http://localnode:8080 in browser
- Initial login credentials root, hsmm

Initial Node Configuration



© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

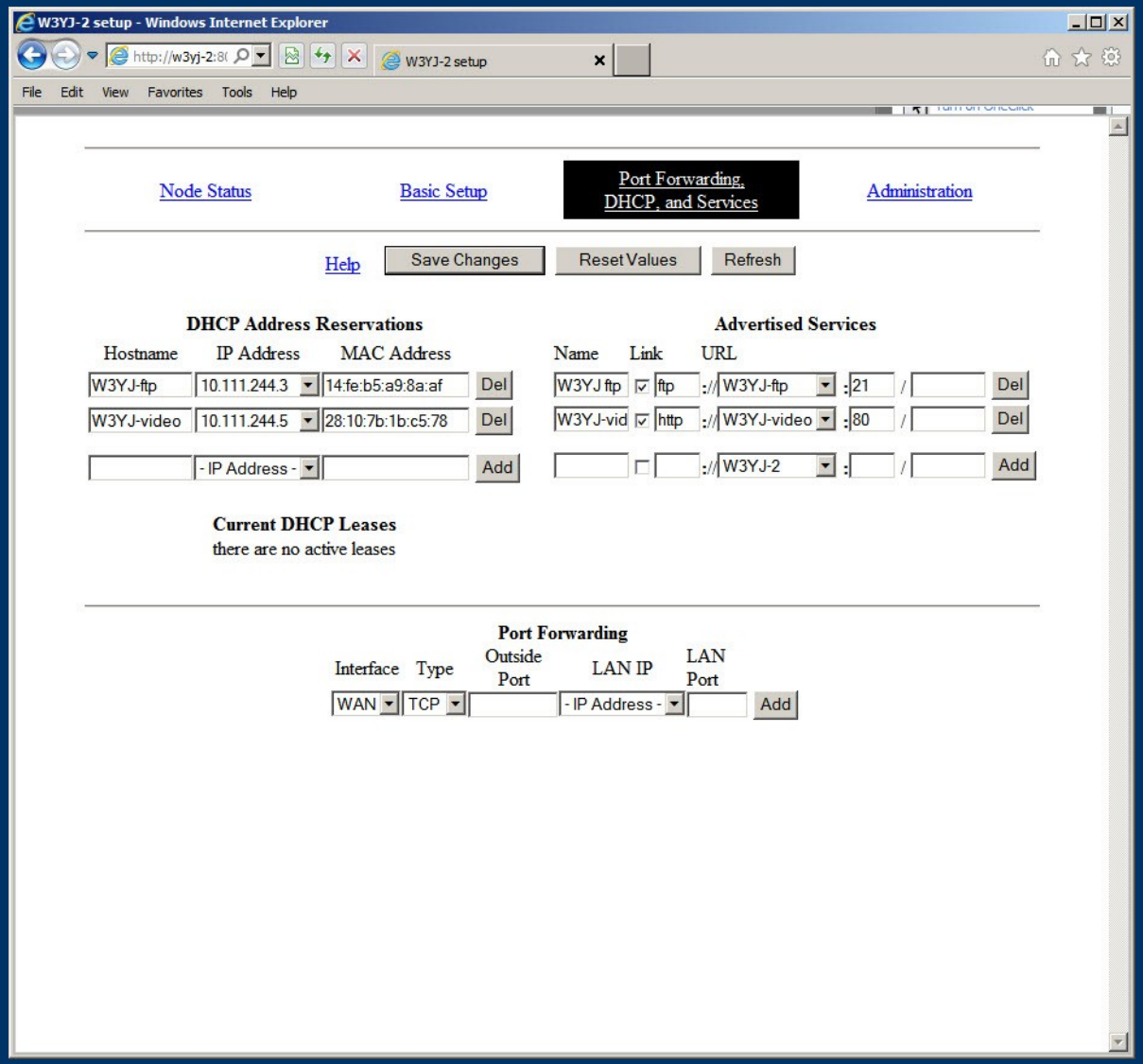
Exploring the Mesh



Configuring Services

- When you plug a device into a router, it will be assigned an IP address
- IP addresses are great for computers, lousy for humans!
- Set up your router to advertise a service
- Tell your operators the name of the mesh node
- They can then point and click on the desired service

Advertising a Service



What can we do with a mesh?

- Use your imagination!
- Any Internet application can be run
- We will show how to do the following...
- Live streaming video
- File transfer with FTP for integration with NBEMS
- Will show how to use with point-and-click and drag-and-drop
- Need to keep applications easy to use
- Remember, we're hams, not IT professionals

Live Streaming Video

- Lots of cheap IP webcams available starting at $50
- Configure webcam for DHCP and...
- Plug into node
- Advertise the service on a node
- Go to the service, click on the link and...
- You'll see live streaming video!
- Video can be displayed on smartphone or tablet device
- Useful for public events
- Crowd control, traffic jams, disaster scenes
- Provide remote eyes for our Served Agencies

IP Webcam for Streaming Video

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Westmoreland County

- Mesh networking used at events in Westmoreland County
- Drill at Arnold Palmer Regional Airport
- Westmoreland County Airshow
- Streamed video of drill to mobile command post
- Relayed live video of traffic jam at airshow
- High-res photos delivered using ftp at airshow
- Hardware a mix of Linksys and Ubiquiti

Airport Drill Video

- Dramatic video of burning FAA fuselage attracted lots of attention!

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Video in Mobile Command Post

- Live video was streamed to Westmoreland County's mobile command post

© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

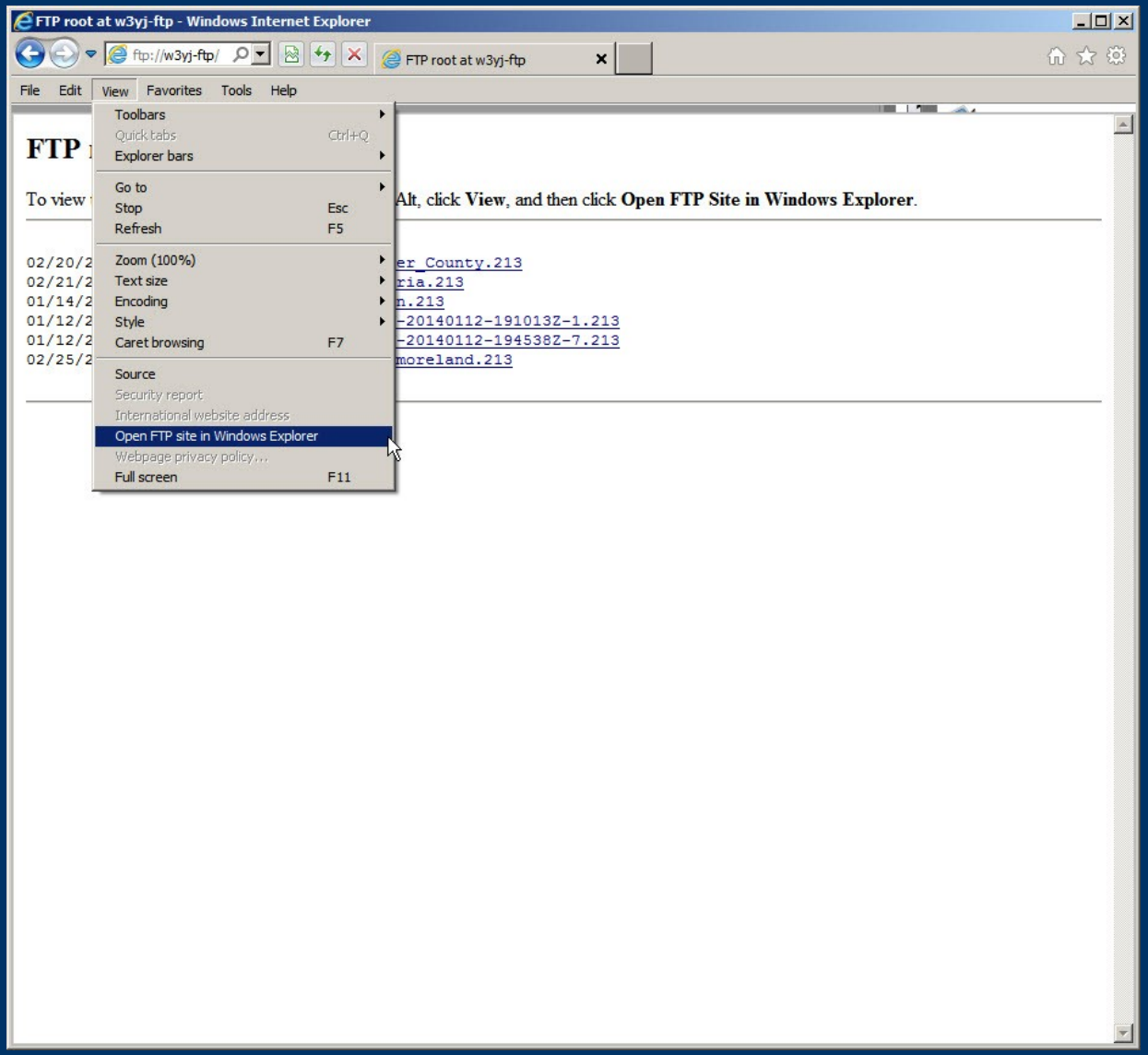
FTP Integration with NBEMS

- Goal: Send data from an aid station to an NBEMS station for long-haul relay
- Set up an anon FTP server and attach to the mesh
- Use Flmsg to write and read forms
- Will send Flmsg messages to our NBEMS station using the mesh and the FTP server
- Frees up NBEMS station for communication with outside the scene
- Can setup Windows or Linux FTP server
- Good Windows FTP server is FileZilla: https://filezilla-project.org/

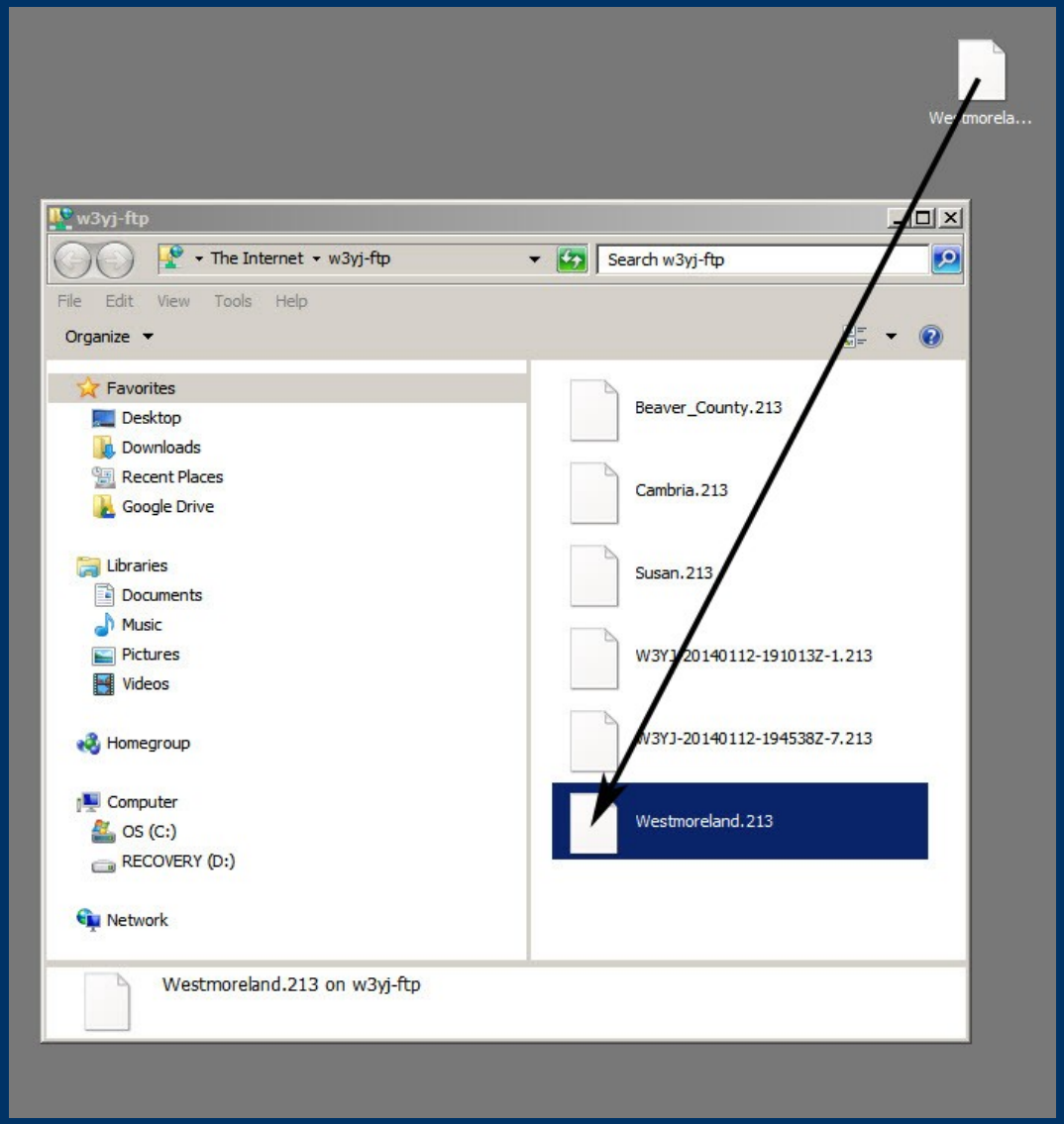
FTP to NBEMS Workflow

- Entire workflow uses point-and-click, drag-and-drop from end-to-end
- For the ham at an aid station...
- Create message with Flmsg
- Save file to desktop
- Open IE
- Go to advertised FTP service on mesh
- Click on link
- In IE, View-> Open FTP Site in IE
- Drag file from desktop into FTP window

FTP to NBEMS Workflow



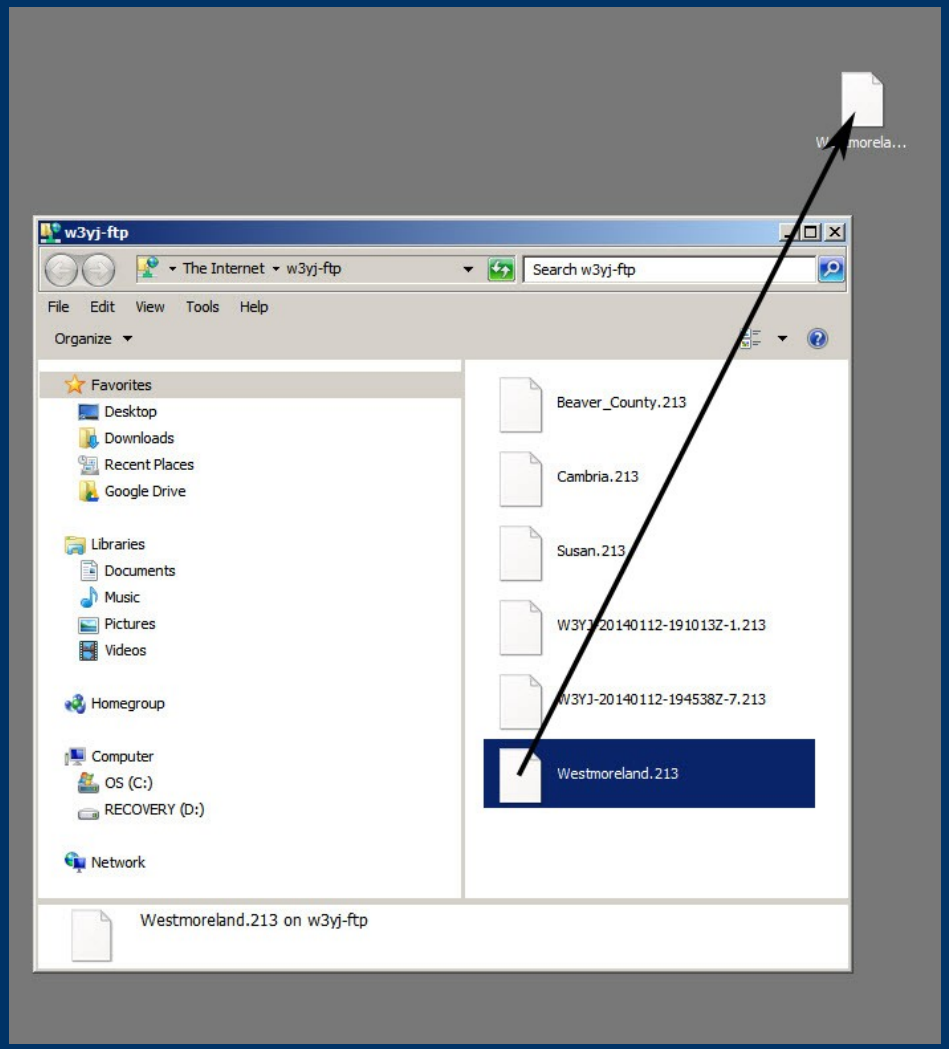
Drop Flmsg file into FTP window



FTP to NBEMS Workflow Cont...

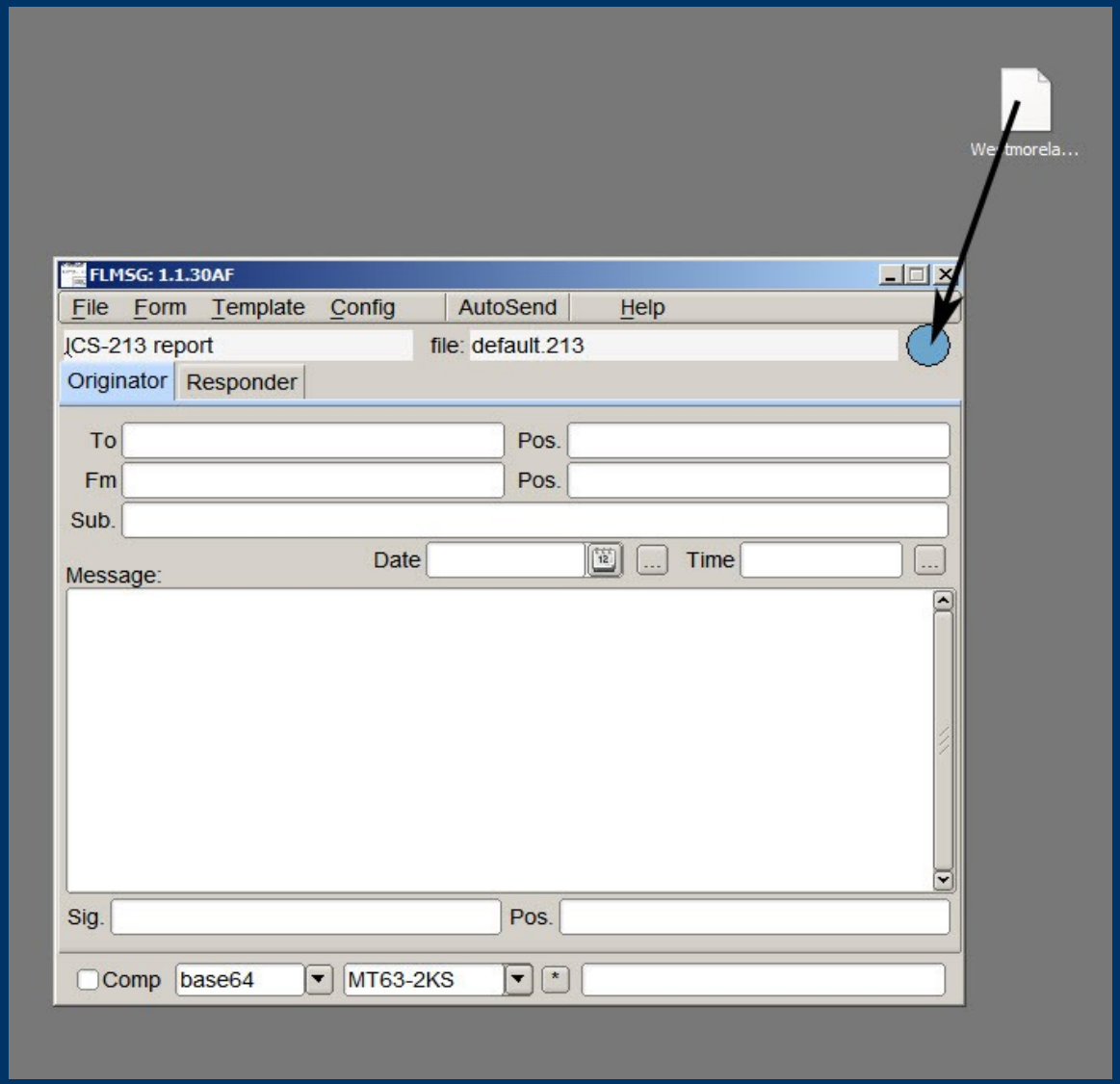
- To retrieve Flmsg file from FTP server for NBEMS transmission...
- Go to advertised FTP server, open FTP window as before
- Drag file from FTP window onto Desktop
- Open Flmsg
- Drag file into little blue circle at top right of Flmsg
- Save file, hit AutoSend
- The file is on the way!

Obtain Flmsg file from FTP Server



© 2014 Harry Bloomberg W3YJ 6 Aug 2014 http://wpaares.org

Drop file into Flmsg



Where do we go from here?

- New technology for us
- Must get out in the field and experiment!
- We will be holding additional workshops
- Let's think of additional uses for technology

References

- BBHN website
  http://broadband-hamnet.org
- Wireless Networking in the Developing World
  http://wndw.net
  Free book!

Acknowledgements

- Juan Manfredi NA0B
  University of Pittsburgh
  Assist SM Education, Western PA ARRL
- Bill Edgar N3LLR
  Atlantic Division ARRL Director
- John Rodgers N3MSE
  Section Manager, Western PA ARRL

CPIN

Central PA IP Network

Purpose

- A network providing high speed multi-media fixed and portable communications during times of disaster
- Capabilities include voice, data and HD video

Founders

- Several amateur radio operators built this network in central Pennsylvania using their own funds and resources.
- Multiple contributors were solicited to provide the necessary high profile microwave sites.

Needed Communications

- Ask your emergency management coordinators what gaps exist in their emergency communications systems and plans.
- In Central Pennsylvania we asked that question and received these answers:

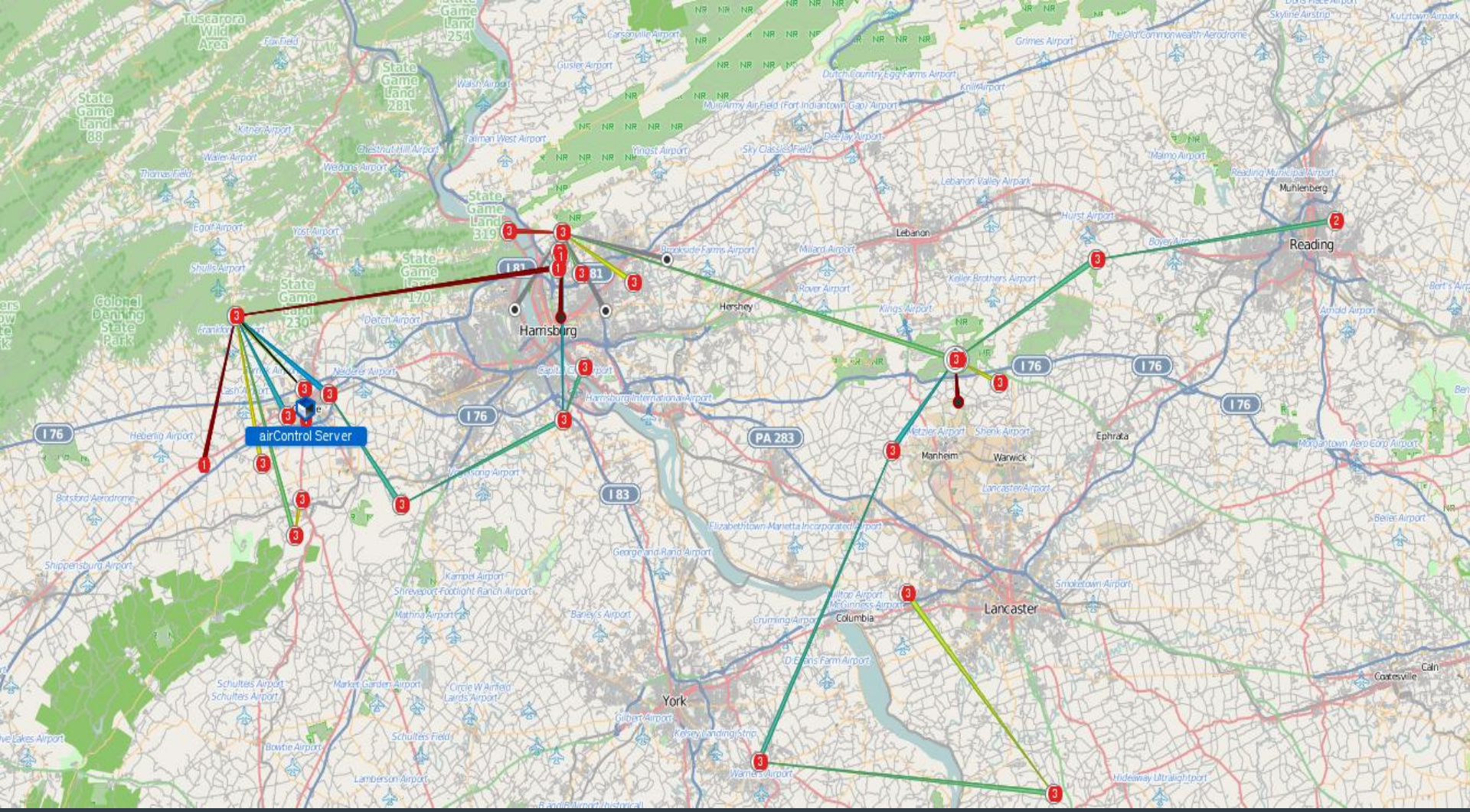
1. POTS telephone service separate from the PSTN
2. FAX machine communications separate from the PSTN
3. Backup communication between the County EOC and local townships

Telephone & FAX

- Under Part 15 anyone may use
- Under Part 97 anyone may use in a disaster
- 24/7 amateur manpower is finite
- Easily operated by all
- Real telephone service, not simplex
- Private system with public gateways
- Easy to add where needed
- Email adds an extra step of complexity

Network Backbone

- 13 High-profile relay sites
- 157 Miles of network backbone w/ 65 transmitters
- 25 Subscribers connected
- Majority is privately owned
- 93 Mbps maximum throughput
- 150 Mbps maximum aggregate throughput
- Cisco Routers and Switches throughout the network
- VLAN topology deployed
- Ubiquity Networks equipment used throughout



CPIN Network Map

Device Name	IP	Firmware Version	Wireless Mode	SSID	Signal Strength	airMAX Quality	airMAX Capacit
KB3HJCHP	192.168.30.4	5.5.8	Access Point	KB3HJCQTHAP01	-60 dBm		
K2RBT	172.17.1.18	5.5.6	Access Point	K2RBT	-96 dBm		
Training Room RACES	172.17.1.17	5.5.6	Access Point	Training Room RA(	-96 dBm		
RACES Room CC EOC	172.17.1.16	5.5.6	Access Point	RACES Room	-96 dBm		
BLDG #3 Wireless Router	172.17.1.15	5.5.6	Access Point	BLDG #3 Wireless I	-96 dBm		
WA3CPO Upstairs Wireless	172.17.1.14	5.5.6	Access Point	WA3CPO Upstairs	-72 dBm		
WA3CPO Basement Router	172.17.1.13	5.5.6	Access Point	WA3CPO Basemer	-96 dBm		
AirRouter HP	172.17.1.12	5.5.6	Access Point	cpin	-96 dBm		
PEMA AirRouter	172.17.1.11	5.5.6	Access Point	RACES	-96 dBm		
K4ITO AirRouter	172.17.1.10	5.5.6	Access Point	CPIN	-56 dBm		
WA3CPOPACCQ01	172.16.5.252	5.5.6	Access Point	WA3CPOPACCQ01	-54 dBm	84 %	67 %
WAGPPACCQ02	172.16.5.251	5.5.6	Station	WA3CPOPACCQ01	-55 dBm	85 %	60 %
WAGGAPPACCQ03	172.16.5.250	5.5.6	Access Point	WAGPPACCQ03	-70 dBm	63 %	42 %
KB3HJCQTH01	172.16.5.249	5.5.6	Station	WAGPPACCQ03	-71 dBm	67 %	43 %
WAGGAPPACCQ00	172.16.5.246	5.5.6	Access Point	WAGPPACCQ00	-72 dBm	64 %	57 %
MTHOLLY01	172.16.5.245	5.5.6	Station	WAGPPACCQ00	-66 dBm	60 %	54 %
MTHYPACCQ00	172.16.5.244	5.5.6	Access Point	MTHYPACCQ00	-70 dBm		
KB3ZTTPACCQ01	172.16.5.243	5.5.6	Station	MTHYPACCQ00	-69 dBm		

ics | Charts | Events

Device Summary

Device Name	**KB3HJCHP**
SSID	**KB3HJCQTHAP01**
IP	192.168.30.4
Network Mode	Bridge
Wireless Mode	Access Point
Membership Type	Regular member
Product	AirRouter HP
MAC	DC:9F:DB:04:5F:11
Firmware Version	5.5.8

Status: online

Unchecked Alerts	1
Uptime	3 days 05:59:50
Connection Time	
Connected Clients	7
Frequency	2412 MHz
Last Contact	00:00:06 ago
TX Total	10.7 GB
RX Total	5.34 GB

Current Statistics

Signal Strength	-60 dBm
Noise Floor	-84 dBm
CCQ	96 %
TX Throughput	0.43 Kbps
RX Throughput	0.13 Kbps
TX Rate	48 Mbps
RX Rate	60 Mbps
Memory Usage	61 %
CPU Load Average	0

Average Statistics for the Las

Signal Strength	-60 dB
Noise Floor	-84 dBm
CCQ	98.14 %
TX Throughput	9.82 Kbps
RX Throughput	1.16 Kbps
RX Rate	54.6 Mbps
TX Rate	62.36 Mbps
Memory Usage	61 %
CPU Load Average	0

Primarily 5 GHz Band

- 5.150-5.250 Part 15 low power indoor
- 5.250-5.350 Part 15 low power
- 5.475-5.600 Part 15 low power
- 5.600-5.650 No Operation: Airport Radar
- 5.650-5.725 Part 15 low power
- 5.725-5.875 Part 15 high power
- 5.650-5.925 Part 97 full power
- 5.250-5.600 Proposed Part 15 low power
- 5.725-5.925 Proposed Part 15 high power

Network Utilization

- Asterisk IP Telephony w/gateways to public network & remote repeater access
- Asterisk IP Fax
- 20 IP Cameras
- File server/shared drive access
- Multiple Emergency Internet Gateways
- Amateur Repeater Interconnections
- Railfan Signal and Audio

Users

- PEMA HQ
- Cumberland County RACES (ACS) at EOC
- Lancaster County RACES (ACS) at EOC: Under Construction (Completion by 8-31)
- More RACES (ACS) at EOCs to be added
- Ethernet connection to each county EOC via Task Force Microwave: under construction
- Individual Radio Amateurs

Potential Users

- Red Cross
- Salvation Army
- Emergency Relocation Shelters
- Other Volunteer Organizations Active in Disasters (VOAD)

RF ACCESS POINTS

- Cumberland County: Waggoner's Gap
  White Rock
  Lam's Gap: Under construction
  Three Square Hollow: Future
- Dauphin County: Reeser's Summit
  Blue Mountain
- Lebanon County: Cornwall Mountain
- Lancaster County: Cornwall Mountain
  Lancaster City: Future

FUTURE RF ACCESS POINTS

- York County
- Adams County
- Franklin County
- Perry County

RF ACCESS POINT RANGE

- Nanostation M5 15 dBi gain antenna: 3 miles
- Nanobridge M5 25 dBi gain antenna: 7 miles
- Rocket Dish 24” 30 dBi gain antenna: 13 miles

All devices use Horizontal & Vertical polarities simultaneously

300 Mbps on a simplex frequency

Current transmitter ethernet port limits throughput to 100 Mbps

Maximum throughput 150 Mbps aggregate (both directions)

Planned upgrade has 1000 Mbps ethernet ports

Annual Field Day Testing

- Simulates disaster communication in a portable environment
- Provides POTS telephone circuits to emergency centers
- Provides POTS access to PSTN
- Provides FAX service to emergency centers & public network
- Provides multiple internet gateways
- Provides on-site IP camera & viewing of other IP cameras on network

All of these services provided on a single RF frequency

Daily Testing of Circuits

- Network online for over four years
- Established links have very high reliability
- Management software alerts any circuit or element failure
- Ubiquity equipment is inexpensive & reliable
- Multiple hams participate in system maintenance

Searching for Other Users

- Every transmitter has built-in tools to search for other users
- Site Survey: Searches all used frequencies based on SSID
- Spectrum Analyzer: Finds all signals
  Reports signal strength and bandwidth

Bridge Mode

- All transmitters operate in Bridge Mode, not repeat or router mode
- Typical throughput loss in the repeater mode is 50%
- Bridge Mode allows higher throughput
- For instance inputting 93 Mbps into the first transmitter in series will yield 93 Mbps out of the third transmitter if all are in the Bridge Mode.

Commercial Switches

- Cisco 2950 24 port commercial switches are deployed
- All network elements are remotely manageable
- VLANs may be used to segregate traffic
- Some consumer grade routers limit speed to 25 Mbps and have a high failure rate
- EBay has switches for about $20 each
- PA State Surplus has had them for less
- A high quality switch between transmitters is essential for reliable network throughput and stability

Microwave Path Analysis

- Use Google Earth or similar to obtain site coordinates
- http://n9zia.ampr.org/path.main.cgi
- http://community.ubnt.com/t5/airMAX-Getting-Started/airMAX-Plan-a-outdoor-wireless-link/ta-p/487689
- http://airlink.ubnt.com/

Speedtests

- http://www.speedtest.net/
- Find a test in your area that produces the same test result every day.
- A reliable test is needed to tweek your throughput:

Throughput Tweeks

- Adjust the following for maximum throughput:

1. Frequency
2. Bandwidth
3. ACK
4. Long Range PTP Link Mode (on or off)
5. AirMax (on or off)
6. Power level
7. Firmware

Ubiquity Networks, Inc

- www.ubnt.com
- http://www.streakwave.com/product-ubiquiti.asp
- http://www.microcom.us/browse-by-brand--ubiquiti-networks.html

CPIN Contact Information

- Gary L. Blacksmith Jr., WA3CPO
- 1215 Georgetown Circle
- Carlisle, Pa 17013
- 717-574-0425
- WA3CPO@ARRL.NET

pennsylvania
EMERGENCY MANAGEMENT AGENCY

pennsylvania PA

Welcome to the 2014 PEMA State Conference

ACS/RACES Specialty Session

pennsylvania
EMERGENCY MANAGEMENT AGENCY

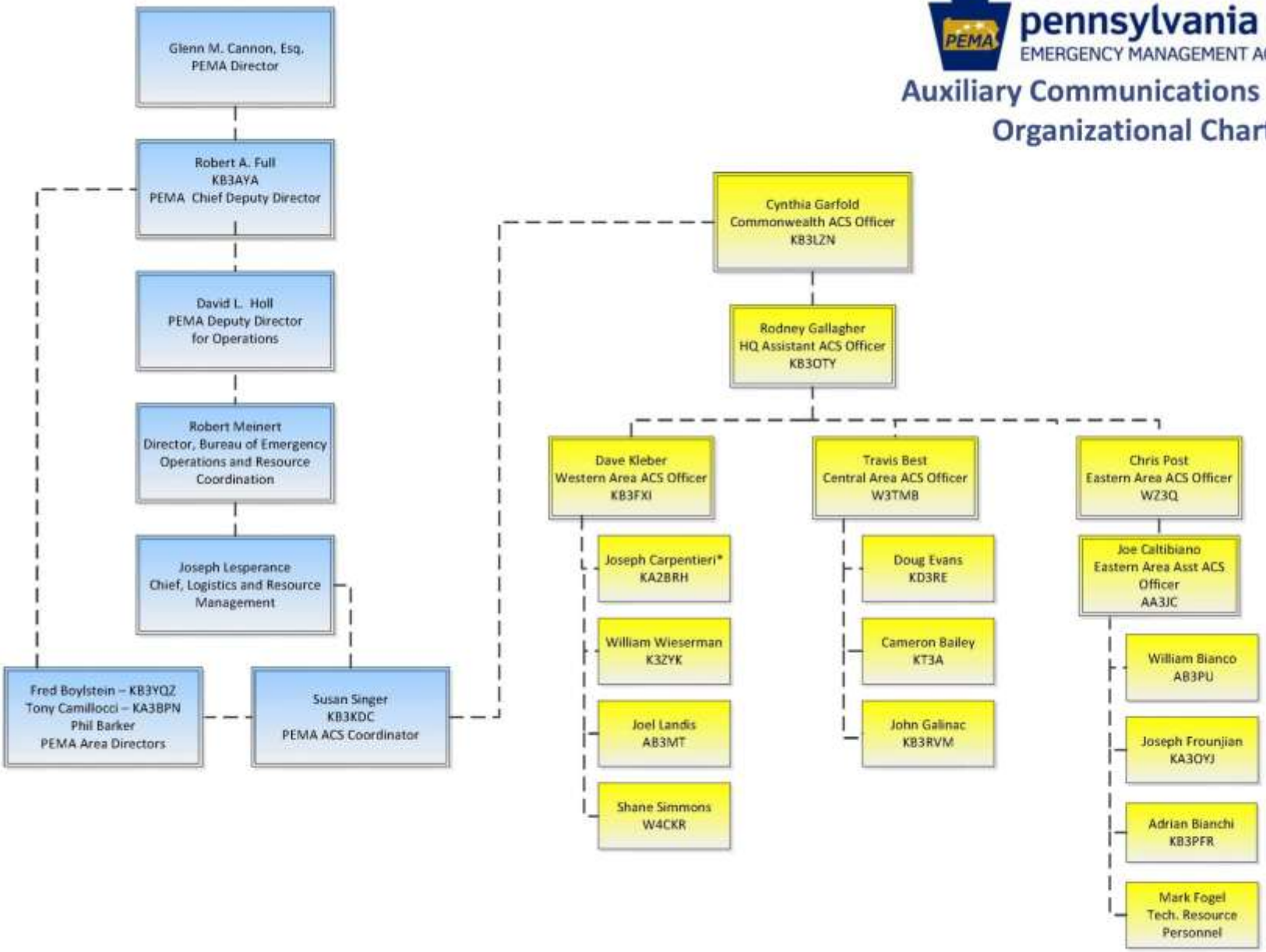
PEMA ACS Update

Background

- As of July 14th there were 23,946 amateur radio operators in PA with active licenses.
- PEMA ACS currently rosters 17 amateur radio operators. A few more will be coming onboard shortly.
- Several PEMA employees are amateur radio operators including our Chief Deputy, one Bureau Director and two Area Directors.

pennsylvania
EMERGENCY MANAGEMENT AGENCY

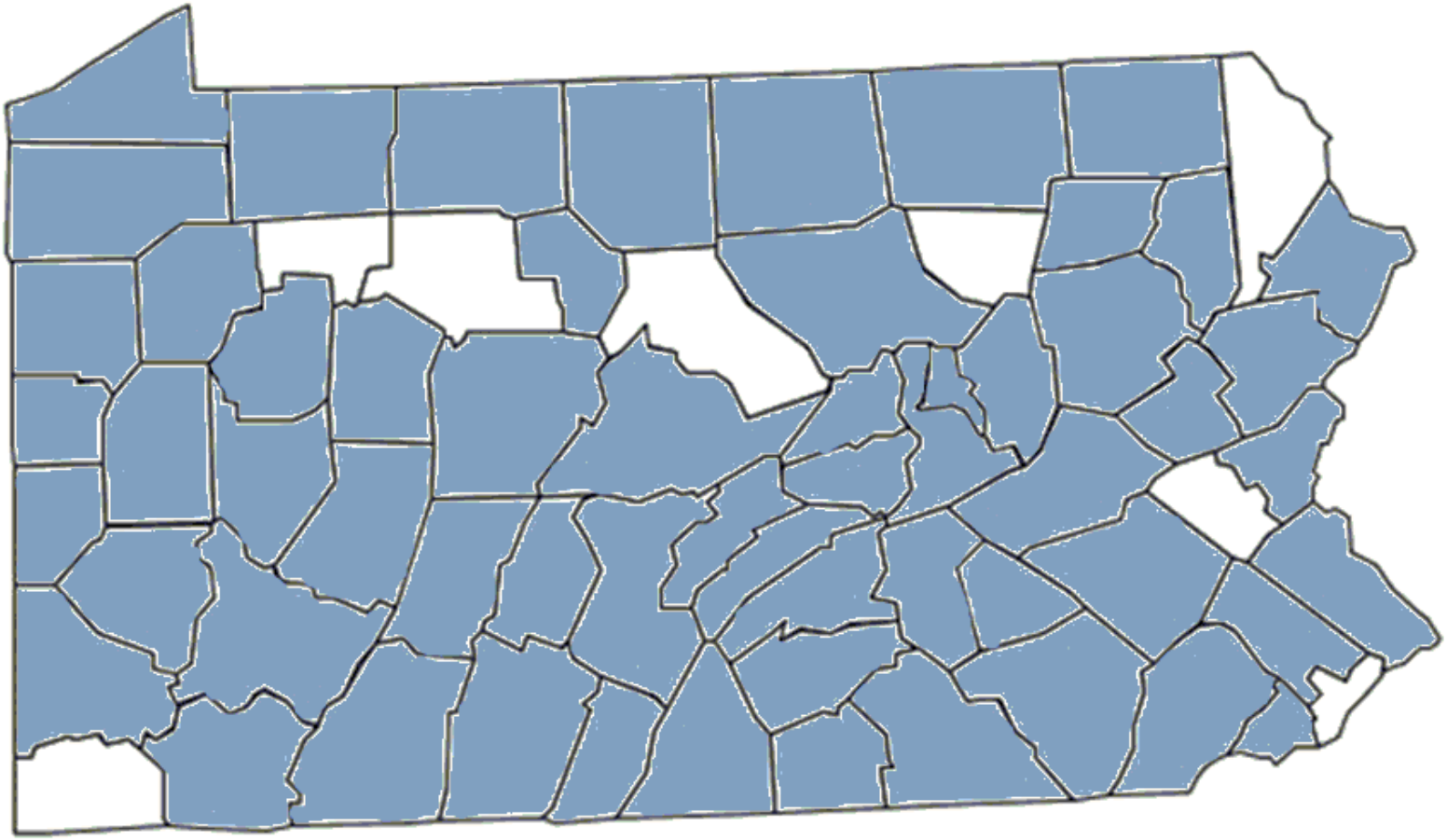
Auxiliary Communications Service Organizational Chart



* Leave of Absense

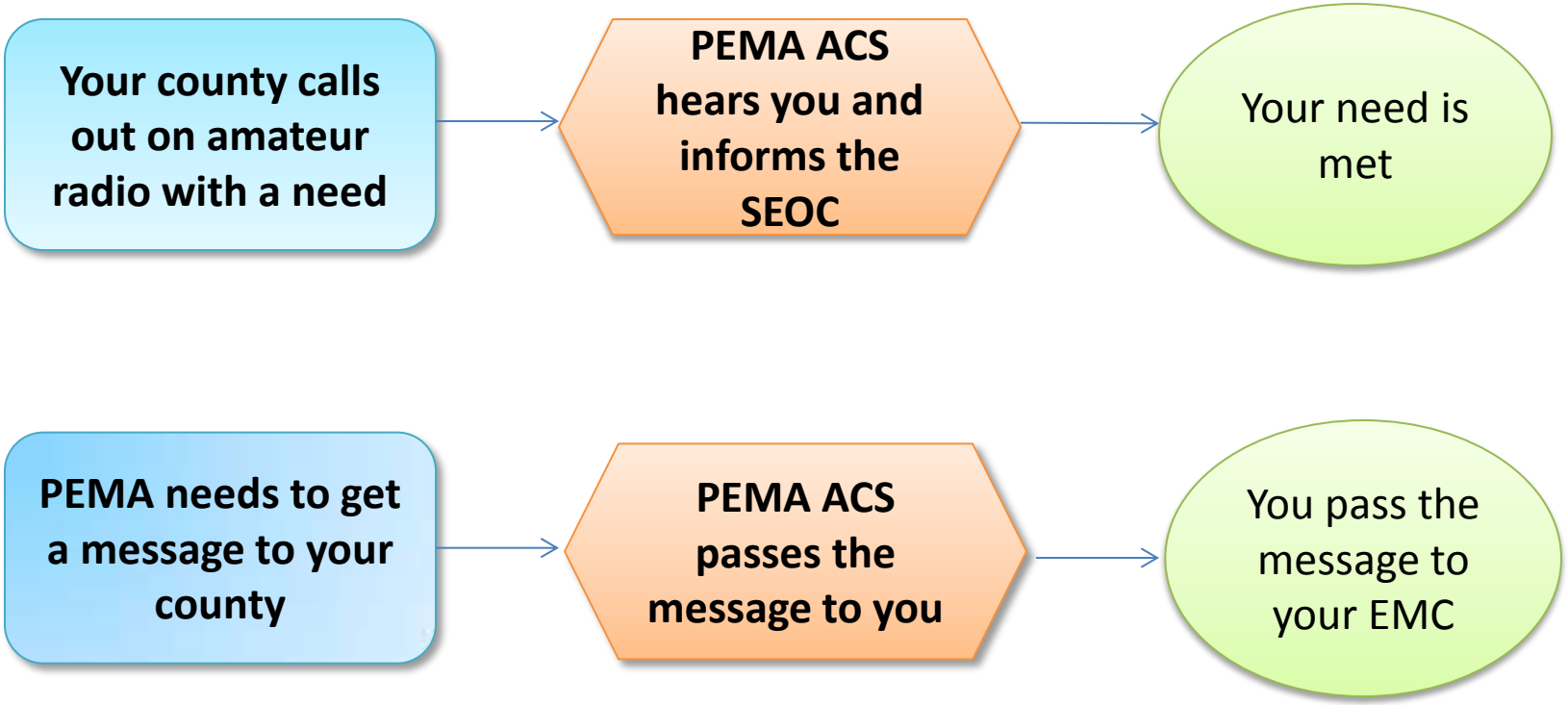
8/1/2014

Counties with ACS/RACES Programs



pennsylvania
EMERGENCY MANAGEMENT AGENCY

How PEMA supports your county



pennsylvania
EMERGENCY MANAGEMENT AGENCY

Activations

- Disasters
- Drills/Exercises
- Field Days
- Training Days or Weekends
- Large Scale Events with Potential Risk

PEMA's ICS Form 205

INCIDENT RADIO COMMUNICATIONS PLAN	Winter Weather Incident January 5-8, 2014 Incident Name	January 5, 2014 Date/Time Prepared	January 5, 2014 2000 January 8, 2014 0800 Operational Period Date/Time

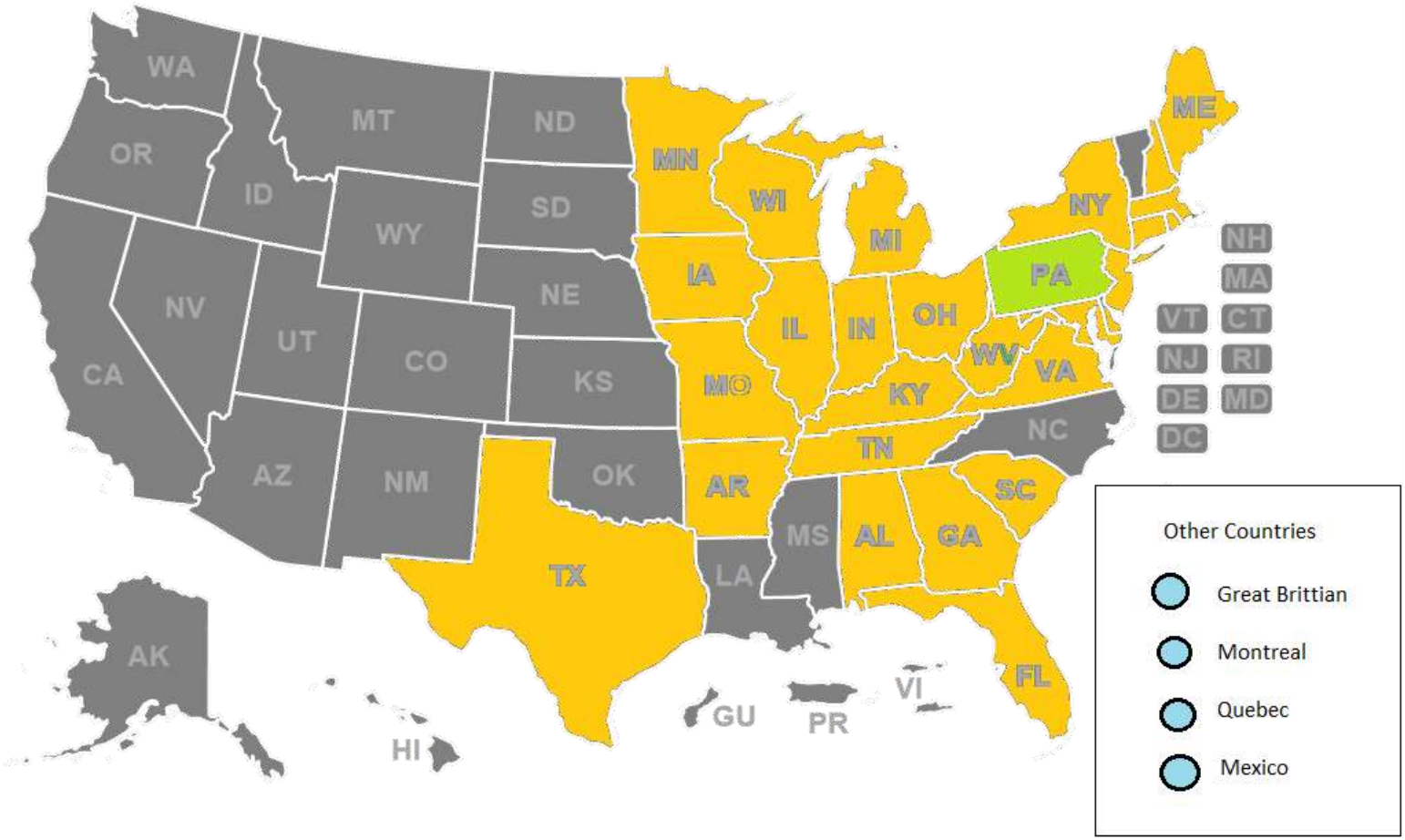
Ch #	Function	Channel Name/Trunked Radio System Talkgroup	Assignment	RX Freq N or W	RX Tone/NAC	TX Freq N or W	Tx Tone/NAC	Mode A, D or M	Remarks
1	HF Voice	**Central Area**	Daytime	7.2505				A	LSB
2	HF Voice	**Central Area**	Night	3.9935				A	LSB
3	HF Voice	**Eastern Area**	Daytime	7.2275				A	LSB
4	HF Voice	**Eastern Area**	Night	3.9875				A	LSB
5	HF Voice	**Western Area**	Daytime	7.2720				A	LSB
6	HF Voice	**Western Area**	Night	3.9905				A	LSB
7	USB Data	**PaNBEMS**		3.583				D	Olivia 1500 Hz 8/500
8	USB Data	**PaNBEMS**		7.0730				D	Olivia 1500 Hz 8/500
9	VHF Voice		PEMA-1P	147.075 W		147.675 W	123.0	A	SCTF primary shared w/ PEMA
10	VHF Voice	**Nationwide**		146.52 W		146.52 W		A	Nationwide Calling Freq
11	UHF Voice	**Public Safety 1**		453.2125		458.2125	151.4	A	
12	UHF Voice	**Public Safety 2**		453.4625		458.4625	151.4	A	
13									
14									
15									
16									
7									
18									
19									
20									

Prepared By (Communications Unit)	Incident Location Statewide
Susan Singer, KB3KDC PEMA ACS Coordinator	County State Latitude Longitude

ICS 205 Excel 3/2007

pennsylvania
EMERGENCY MANAGEMENT AGENCY

Interstate & International PEMA RACES/ACS Contacts



pennsylvania
EMERGENCY MANAGEMENT AGENCY

Today's Schedule

9:30 am break into two tracks:

Administrative –	Network Check-ins MARS Amateur Radio Contests PANG ARRL Update Lawrence County Reorganization
Technical -	FlDigi Go Kits HSMM Networks Satellite Networks ICS Forms

1:00 pm Back to one track for Keynote Speaker, REACT Presentation and Panel Discussions.

pennsylvania
EMERGENCY MANAGEMENT AGENCY

Take a Break

We will reconvene
at
9:15 am

The Johnstown Flood of 1977:

and the communications specialists who volunteered there.

REACT

EMERGENCY RACES COMMUNICATIONS

- Jim Crowley – NJ3T - currently the Somerset County RACES Radio Officer – was R.E.A.C.T. in 1977
- Nate Firestone – W3SVJ was a ham radio operator from Pittsburgh
- Bill Heffern – K3DYR – was a ham operator from Somerset County
- Dean Hillegas – was a television news reporter from the Johnstown Area.
- Stew Saylor – AK3J was a ham radio operator from Pittsburgh

“Needed: The Right Information at the Right Time”

“Ninety-nine years ago, a young engineer inspecting the Connenmaugh River Dam upriver from Johnstown, Pennsylvania, realized that the dam was about to collapse. He jumped onto his horse and raced to the nearest railroad station to telegraph a warning to communities in the valley below. His message never got through. The Johnstown Flood of 1899 is part of the lore of American disasters. Even though the engineer was using state-of-the-art communications, he could not deliver the right message at the right time. More than 2,200 people drowned.”

- Excerpt from an article by Robert Vessey and Jose Aponte

The Johnstown Flood of 1977

- The flood occurred on July 20th
- 12 inches of rain fell
- 6 earthen dams broke, the most catastrophic was the Laurel Run Dam, above Tanneryville

The Johnstown Flood of 1977

- The flood affected
  - 8 counties:
    - Cambria
    - Somerset
    - Indiana
    - Crawford
    - Westmoreland
    - Jefferson
    - Bedford
    - Clearfield
  - 136 communities

The Johnstown Flood of 1977

- 85 persons killed (76 drowned)
- 2700 persons either injured or became sick

The Johnstown Flood of 1977

- Presidential declaration July 21st
- 330 Million Dollars in damage –
  - $117 million in Johnstown
  - $213 million outside the city

RAIL
CROS
SING

Soon all sorts of volunteers began giving assistance. Exactly how efficiently these well-meaning efforts panned out cannot be told exactly because the results were varied. To help improve communications, the Central Pennsylvania Repeaters' Association sent a team of about twenty amateur operators with radio equipment. They set up base stations at the hospitals, with the police chief, the mayor and at other locations. In a review session ten days after the flood, the group concluded that there had been so many other radio operators and so much disarray, their resources were underutilized. Nevertheless, ham radio assistance proved invaluable.[567]

- Excerpt from "All the Kings Horses and All the Kings Men"

PENNY
PACKING
PUMP
756

CUERS

REFRACTORIES

ohnstown Flood Probers: Warning Sys

(Continued from Page 1)

r service personnel in recognis-
dar and satellite patterns. "Radar
ers and satellite meteorologists
be instructed to pay more atten-
small details and to relay this
ation to forecast offices more
ntly, particularly during events
nay cause major local forecast
ms," says the report.

specialist on the staff at Pittsburgh," says the report. "And staff shortages due to illness and training assignments curtailed this year's county visitation efforts."

▸ More effort by government to organize local ham radio and CB operators into an effective natural disaster emergency communications system. The report also recommends that the weather service encourage more radio

like Johnstown.

At the time of the flood, there were two 24-hour rain gauges in Johnstown. "However," notes the report, "they were established for hydrological records and local service use and were not available for operational rainfall reporting."

The investigation also states that while volunteer observers are trained to report severe weather like thunder-

"I have written to
committees and ind
asking them to revie
the survivors who
friends in this terribl
to make certain no
with government offic

Murtha came up
tion plan in respon
report.

He called for Co
research a
to provid
o local
raining
warni
nended
nity al
rt area

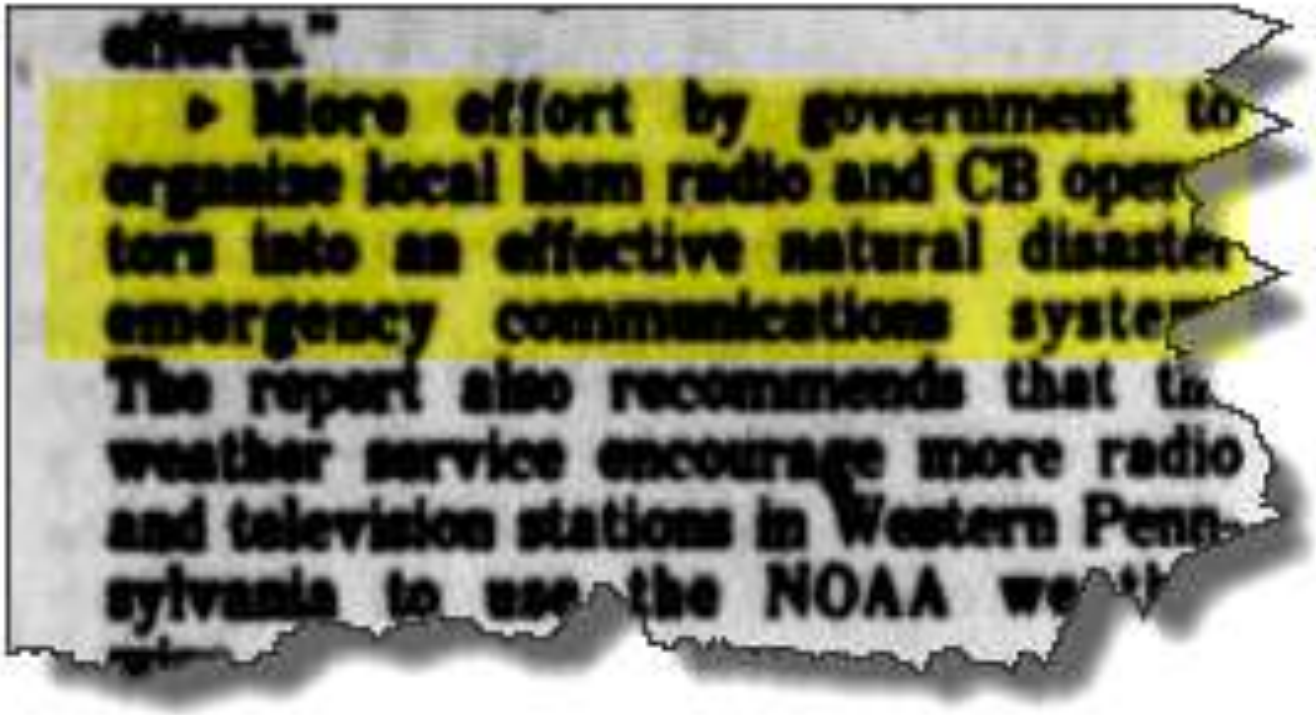
dged t
o arra
local
isaster
ash floo
told o
of Joh
ash flo
n the
ny in
time."
answe
port its

An article from the Pittsburgh Post Gazette referring to findings from a report on the 1977 Johnstown flood by the Comptroller General of the United States.

This report was entitled:

The Johnstown Area Flood of 1977:
"A Case Study for the Future"

uick-Fix Steel Package Unveiled by C


efforts."

▸ More effort by government to organize local ham radio and CB operators into an effective natural disaster emergency communications system.

The report also recommends that the weather service encourage more radio and television stations in Western Pennsylvania to use the NOAA weather

"More effort by government to organize local ham radio and CB operators into an effective natural disaster emergency communications system…"

-Findings from a July 1977 report on the Johnstown Flood by the Federal Comptroller

31 Feet 1889

17 Feet 1936

8.5 Feet 1977

Johnstown Flood of 1977

IN

Recognition

OF

OUTSTANDING SERVICE

TO: W A 3 W E E

For vital emergency communications assistance rendered, which was invaluable in the saving of lives and suffering, following the Flooding of The Conemaugh Valley that occured on the night of July 19, 1977

Laurel Mountain V.H.F. Society *Conemaugh Valley Amateur Radio Club*

AMERICAN RADIO RELAY LEAGUE, INC.

PUBLIC SERVICE AWARD

THIS IS TO CERTIFY THAT RONALD F. FIELDS, WA3WEE

Has been issued this award in recognition of outstanding emergency communications

in connection with THE JOHNSTOWN, PA, FLOOD, JULY 1977

as reported in JAN. 1978 QST, page(s) 50-52.

George Hart WINJM

George Hart, WINJM
Communications Manager, ARRL

Administrative Headquarters - Newington, CT U.S.A.