1. Strategy to provide backup ham communications
2. VHF antenna proposals
3. HF antenna proposals

If you don't have antenna height at VHF....
you better have megawatts....

1. STRATEGY
Levels of Comm. Failure

1 No systems fail, just very busy.

2 Scattered outages impair shelter comms / intrastate comms

3 Phones/cell/internet fail, ham repeaters still function

4 "Katrina" – phones/cell/internet/ham repeaters all damaged

Systems become busy

Hams at shelters assist with rapid voice/data communications to/from EOC

Little need for distant intrastate comms.

Scattered Outages

- Shelter hams use repeaters to reach EOC
- Shelter hams may use VHF WINLINK to pass guest email to KX4Z for HF forwarding to areas with remaining Internet
- EOC may use HF radio to reach EOC or WINLINK RMS's.

WINLINK, now used by the U.S. Government as well as untold mariners all over the world, is two decades mature, and approximately 64 times the throughput of a voice station.

Phones/Net Fail – Repeaters still working

All the previous, plus....

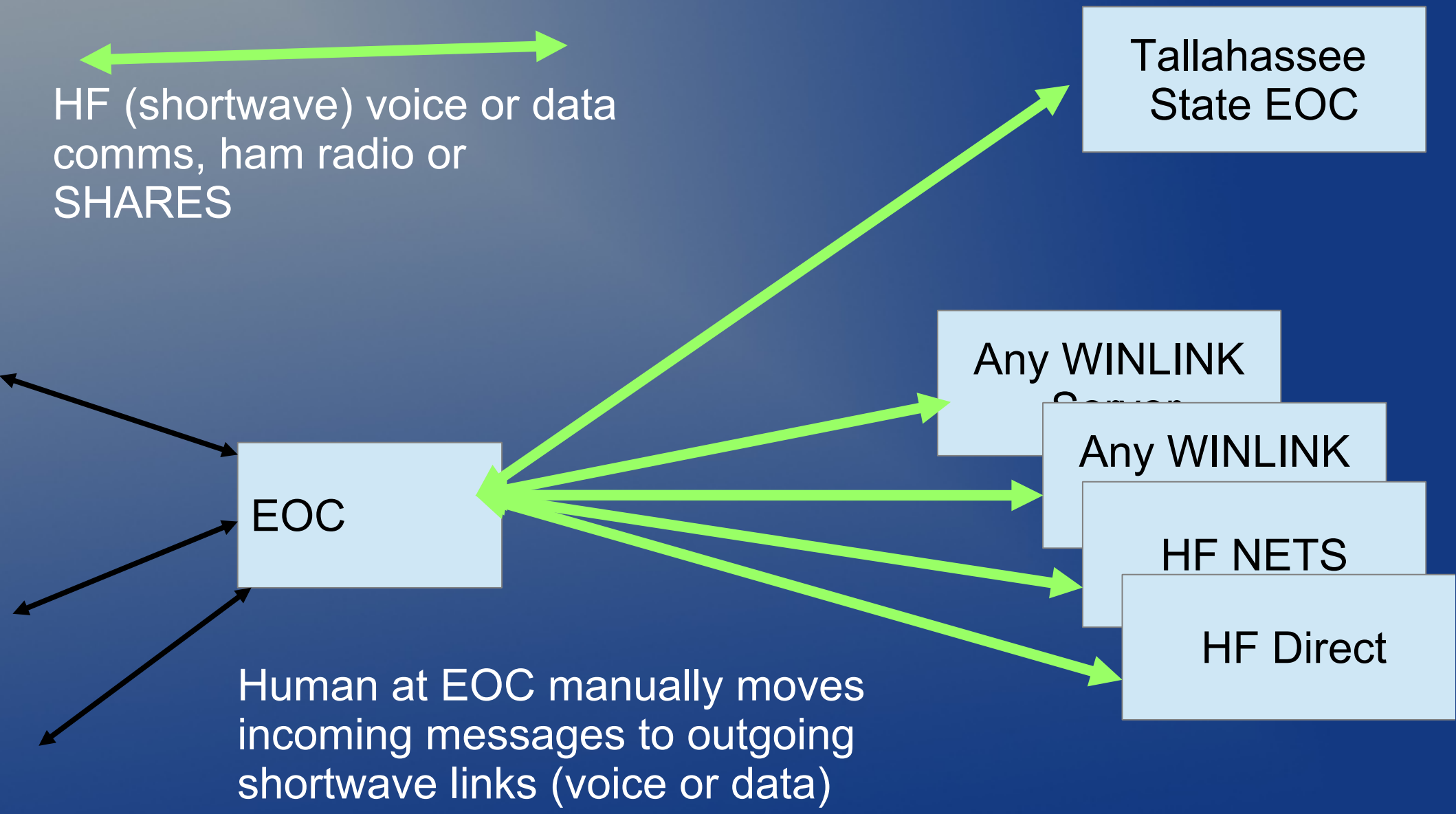
Hospitals get assistance with comms

Phones / Cell / Repeaters Out

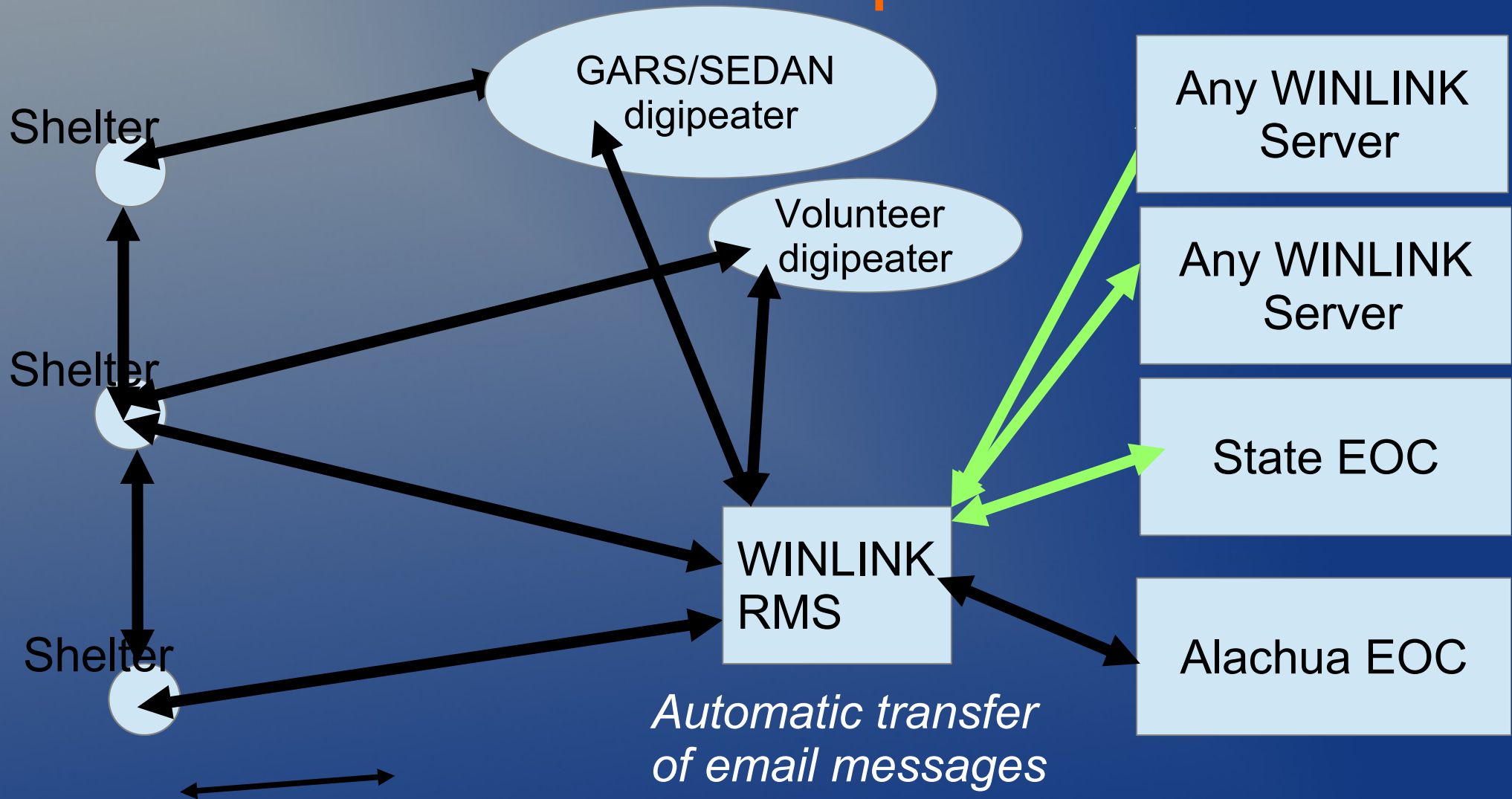
Planning a system that works without repeaters.

2-way direct voice or data VHF comms

Phones / Internet / Repeaters Out



Phones / Cell / Repeaters Out



Additional resiliency by existing digital system
Able to move > 10,000 words per hour.

Ham Radio To State EOC

Multiple, Redundant/Resilient Paths:

1. Voice Nets
2. SARNET
3. Ham winlink Email to NCS358@WINLINK.ORG
4. SHARES WINLINK (radio only!) to NCS358@WINLINK.ORG
5. PACKET to TLH

2. VHF Antenna Proposals

Two different resources: VHF vs. HF

- Different frequency bands have different advantages and disadvantages
  - HF can “skip”, even “near vertical” and thus reach the other side of the county despite trees, buildings & hills….but it is highly variable; a bit of expertise required.
  - VHF cannot normally “skip” [special situations beyond this scope]--- generally needs “line of sight” – but relatively RELIABLE once a working solutions is built. [“diffraction” adds helping hand]

Pro's and con's

	HF	VHF
“skip” available	SKIP –	NO SKIP
“bandwidth” available	Skimpy – slow data	HUGE – fast data
STATIC	LIGHTNING!	VERY LITTLE (esp FM)
Antenna size required	Long	Short

VHF Link Calculations

- A **baseline method** to evaluate communications link. (Does not take diffraction into account.) Conservative predictions.
- Start with transmitter output, subtract every loss (cable, antenna, path, etc....) – if the signal reaching the receiver is adequate, the link will be successful.
- Start with: 50 watts = 46 dBm (1 milliwatt considered “0” dBm)
- Must end up with AT LEAST -105 dBm (Modern receivers can receive this level)

“Free Space” Loss

- 46 dBm transmitter and -105 dBm receiver means even with a healthy S/N (signal to noise) ratio of 10 dB, you have 141 dB to “spend” on the comm link
- **Free Space Loss** quantifies the weakening of the signal resulting from spreading over distance, also incorporates the aperture effects of a 0 loss/0 gain antenna.
- Free Space Loss @ 144 MHz 23 miles = 107 dB loss …. 34 dB cushion remains

Hills, Trees, Buildings Are Not Free Space!

- If no trees, buildings, hills and no curvature of the earth....*you could literally reach 1000 miles!*
- CAUTION: 34 dB Cushion can easily be squandered
- Published residential neighborhood losses: 10-20 dB/mile PER MILE!!!
- My own experiments: 30 watts goes only 2-4 miles.....agrees with 10-20 dB losses!

Free Space Demonstration: Thursday evening High Springs Net

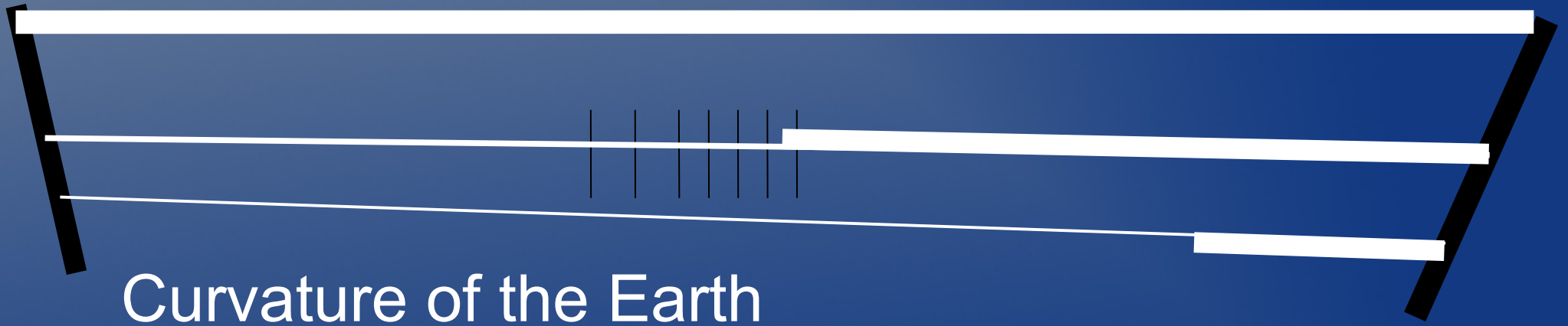
- Off the repeater (& through the trees)... I could hear people in High Springs who had 35-70 foot antennas. **Weak, readable**. Also heard windsor 90 ft . Beyond high springs...no go.
- **Above the trees:** SAME STATIONS were **booming** into the high springs repeater – simply because its antenna is far higher. Into the 200 ft repeater antenna they were “free space”

Extreme Example Proves The Point

- Windsor station (210 foot MSL antenna) using only FIVE WATTS booms “full quieting” into High Springs Repeater (275 MSL Antenna) FREE SPACE
- SAME Windsor station (210 foot MSL antenna) requires SEVENTY FIVE WATTS to be “weak but readable” into Jonesville KX4Z 45 foot AGL 145 foot MSL antenna. GOING THRU TREES
- If you can't get up to the top of the trees....you need LOTS OF POWER

Path loss versus antenna height

1) Both antennas high, path avoids all obstructions – free space easy comms w/ low power.
2) Mod. Antennas, signals through foliage – high loss.
3) Low antennas, signals impact terrain – extreme loss



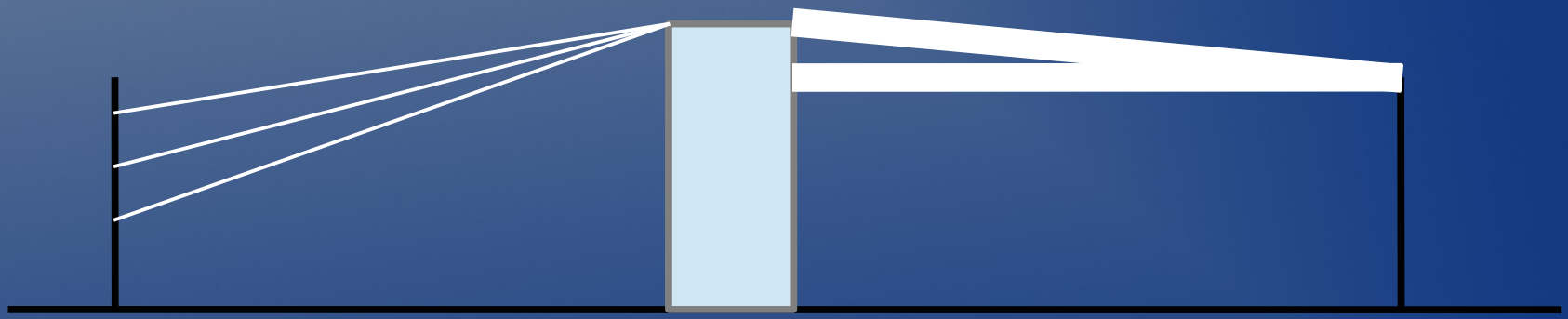
Curvature of the Earth

EOC in a valley

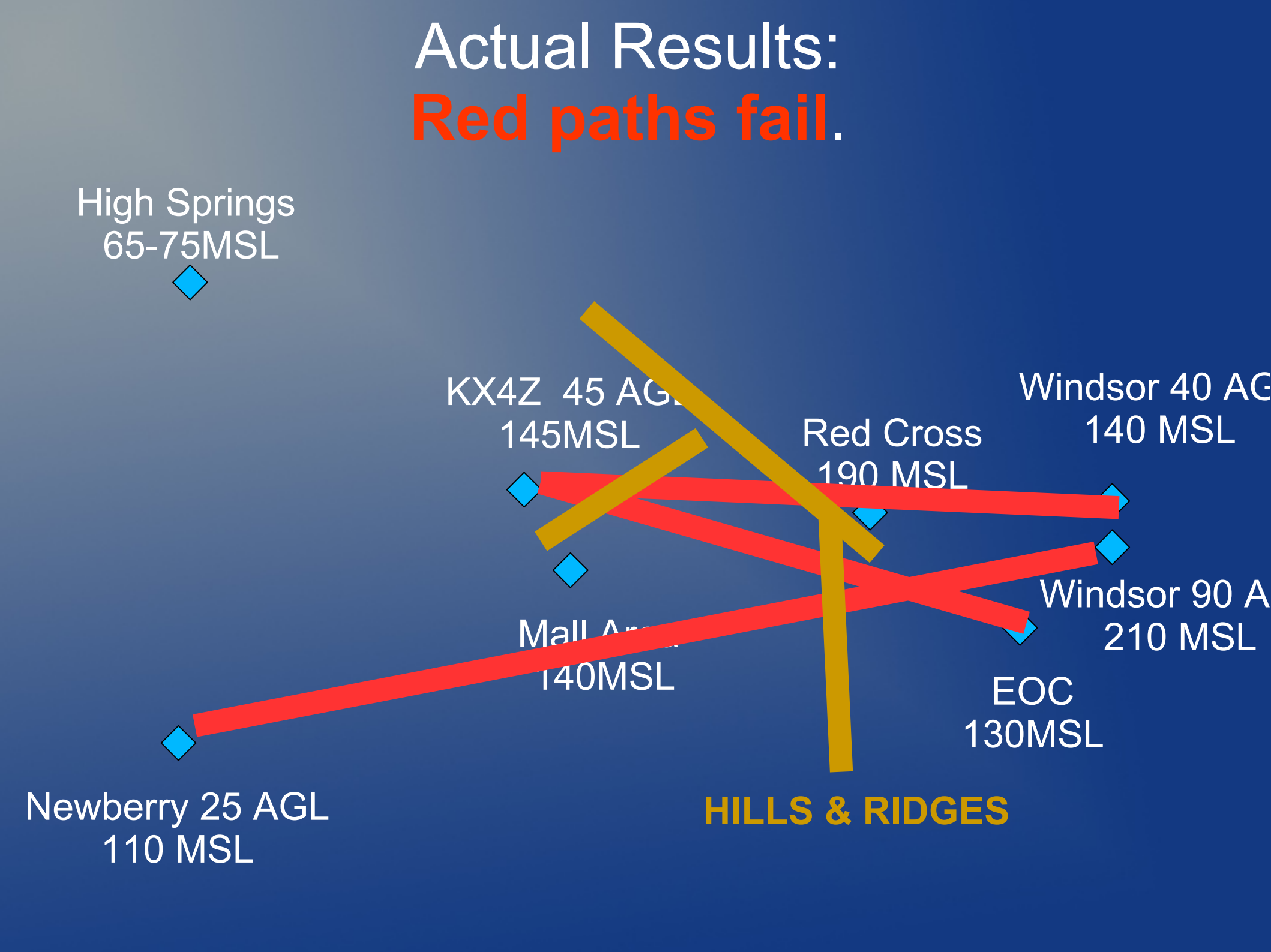
In (2) and (3) diffraction assists, raising signal levels somewhat.

Diffraction

Line-of-sight completey blocked. Edge diffraction sends *weak signals* around the edge, allows otherwise impossible communication.



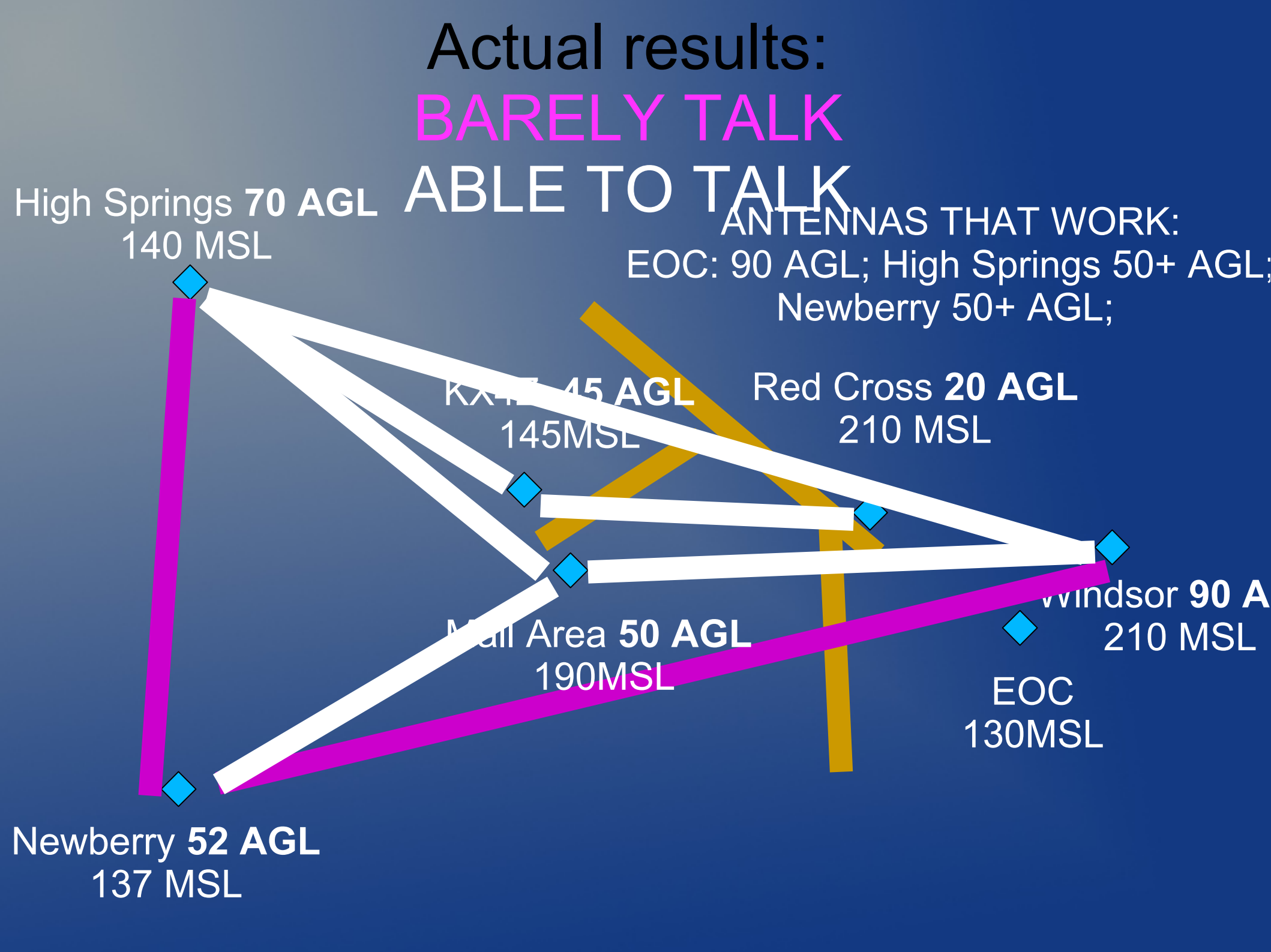
Actual Results:
Red paths fail.



Actual results:

BARELY TALK

ABLE TO TALK



The Conclusion for VHF

- The EOC is EAST of a ridge....and needs its antenna at 90 feet AGL.

- High Springs & Newberry are both FAR and LOW – need their antennas at 50 feet AGL minimum, low loss cable, good antennas.

3. EOC Backup Shortwave Amateur Antenna Proposals

Current HF Antenna Simply Doesn't Work

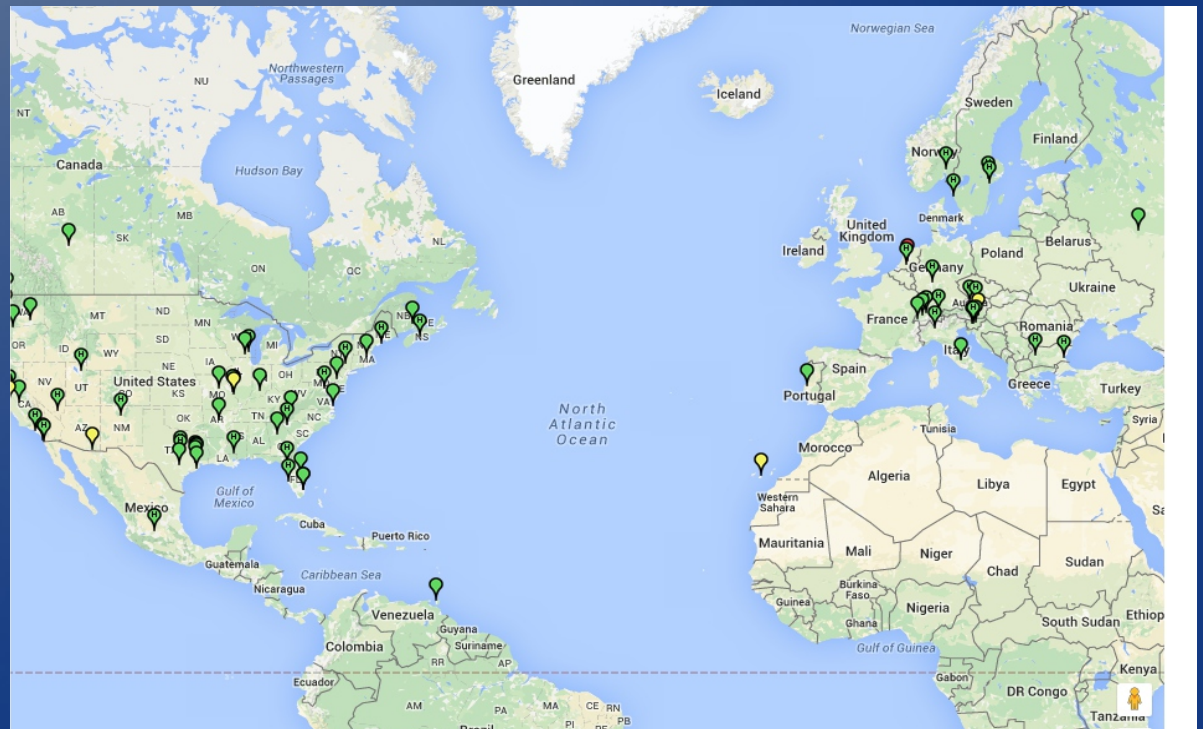
- Objective testing compared antena performance against my home's antennas – drove home quickly with exact same radio.

EOC Antenna	My home antenna
Heard approx 3 stns per band	**Too many stations to count**
Unable to contact ANY automated email (WINLINK) servers	**Successfully Contacted several of the ones unable to reach from the EOC**

Radio Comm Opportunities

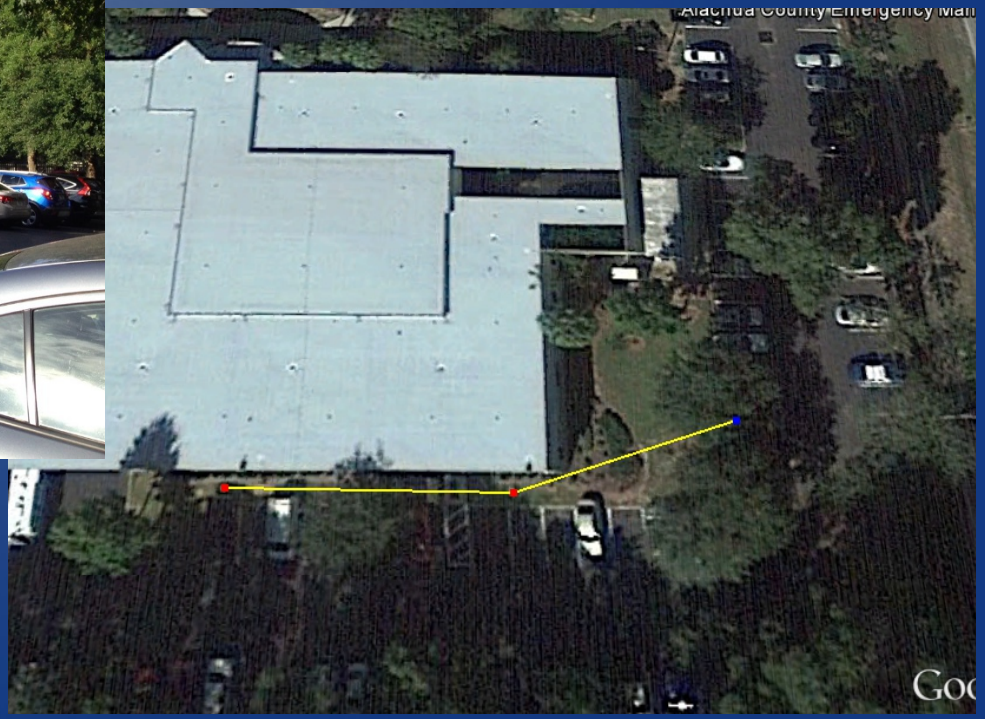
- EmComm nets 3.5 & 7 MHz
- Hurricane net 14 MHz
- Cyber Defense: WINLINK email system

1 winlink station can move as much data as 64 voice stations

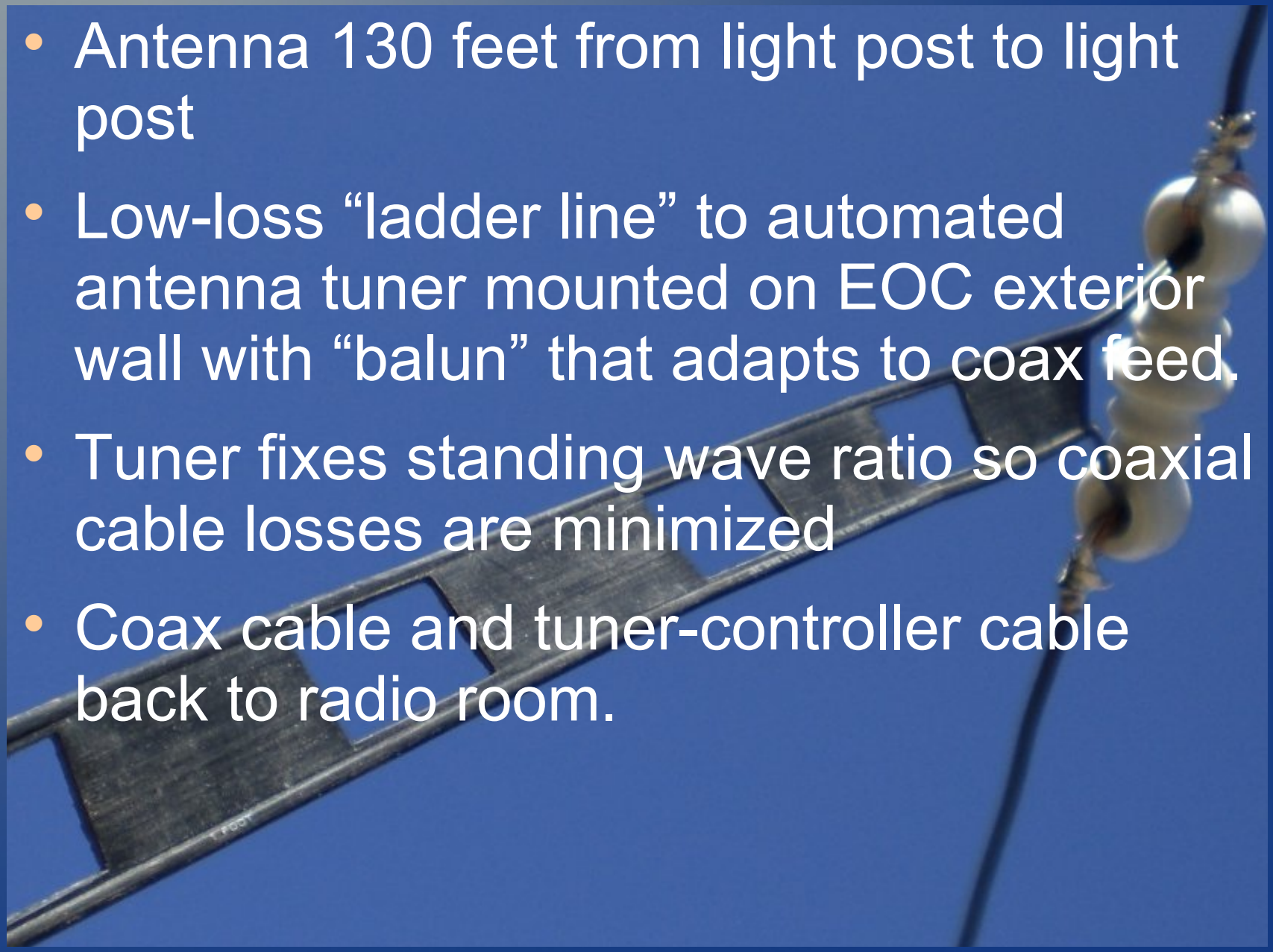


Horizontal Antenna Back of EOC

- Useful from 3.5MHz to 21MHz & beyond
- Good for Florida, SE, & OK for national



Construction



- Antenna 130 feet from light post to light post
- Low-loss “ladder line” to automated antenna tuner mounted on EOC exterior wall with “balun” that adapts to coax feed.
- Tuner fixes standing wave ratio so coaxial cable losses are minimized
- Coax cable and tuner-controller cable back to radio room.

Bolts On Lights Offer Connection Point

Just add nuts & washers to those bolts

Balun, Auto-Tuner

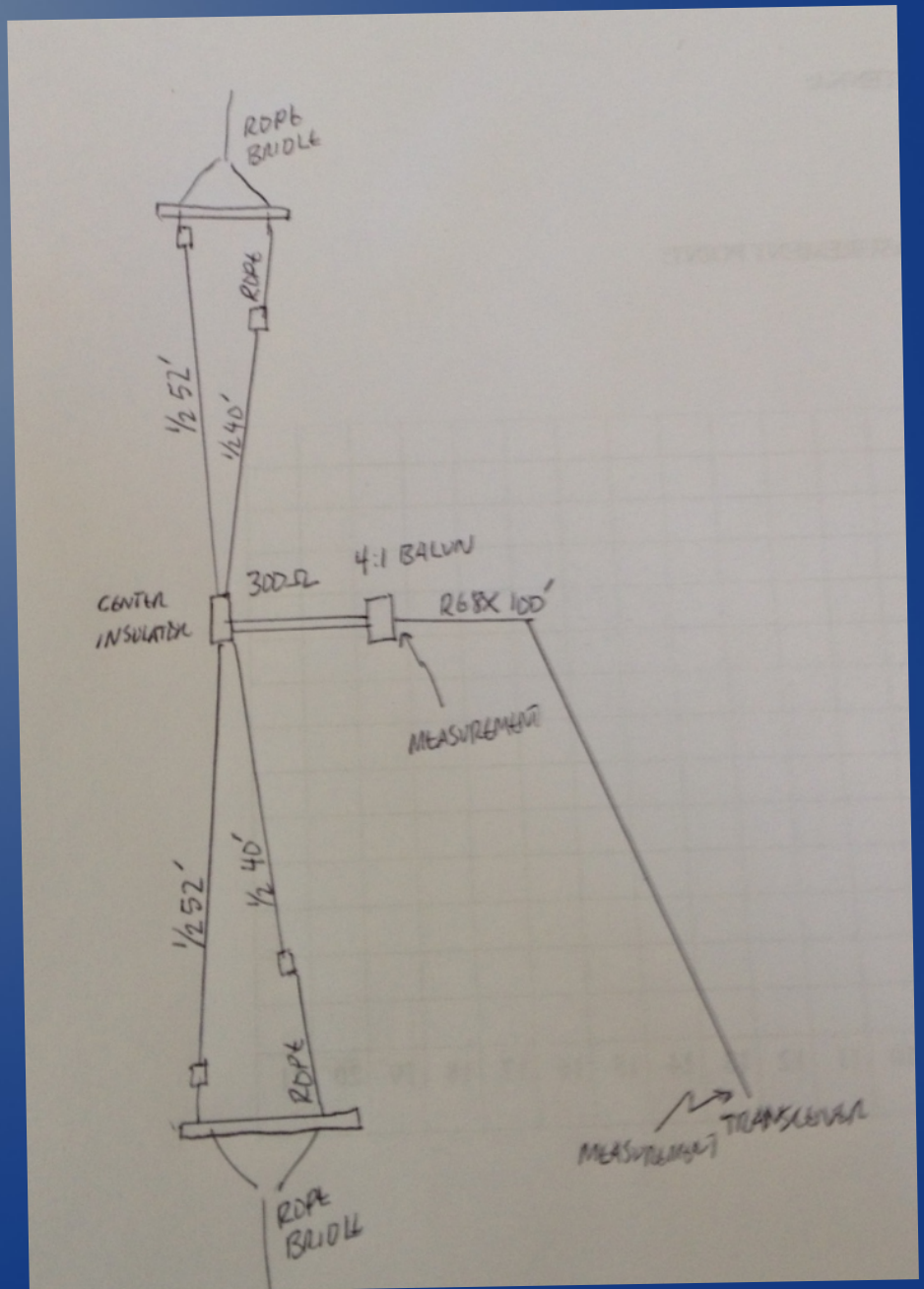
4:1 BALUN

Weatherproof automatic tuner goes under eave

Next Antenna: There is this TOWER.....

- Antennas must be confined to the fenced area, so vertical antenna is best option.
- Limited distance means unable to cover 3.7 MHz, suboptimal for 7 MHz
- Using “full dipole” means no losses in ground/radial system.
- “Fan” dipole increases bandwidth-- 2 different lengths connected

Vertical Antenna Construction



Cheap

Antenna wire	$48	
Antenna end insulators	$24	
Center strain relief insulators	$26	
300 ohm transmission line (vertical)	gift	vertical antenna only
450 ohm transmission line (horizontal)	$31	horizontal antenna only
50 ohm large dia. Coax ransmission line	$100	
	horizontal antenna only—200 feet	
6 conductor shielded wire to auto tuner	$158	
	horizontal antenna only—200 feet	
4:1 baluns	$54	
Miscellaneous	$10	

TOTAL ESTIMATED COST: $451 + shipping (both antennas)

SHARES

Both HF antennas could also be used by the EOC under the SHARES program, which gives free of charge licenses to the EOC to operate on the federal SHARES network frequencies with the same ham equipment – without ham radio licenses. Use your own employees!

Weekly nets offer training/familiarization opportunities.

Two SHARES RMS servers and mulltiple SHARES stations within the state. RMS server in Tallahassee (NCS358) and in Jonesville (NCS521)

1. Better antennas for both EOC and Shelters will dramatically reduce dependence onrepeaters and provide far more effective backup communications
2. Testing shows that the valley location of the EOC is best served by the highest possible VHF antenna on the tower.
3. Farther, lower shelters west of the “Gainesville Ridge” will need towers also, higher quality antennas, better feedline, than closer, higher shelters within the city.
4. Two fairly inexpensive HF (shortwave) wire-based antennas will give the EOC good ability to move traffic in and out of the area using shortwave.
5. As volunteers gain expertise, hope to add higher data throughput digital systems – but the starting point is antennas and voice communications.