AMATEUR RADIO EMERGENCY COMMUNICATIONS PROPOSAL FOR NORTH FLORIDA REGIONAL MEDICAL CENTER

Submitted by request, and completed by Gordon L. Gibby MD

DRAFT

Disclaimer: I have no financial interest in any of these products.

TABLE OF CONTENTS

Section 1: My Perception of North Florida Backup Communications Needs, Assets, and Limitations

COMM GOAL 1. Backup communications to reach approximately 6 outlying facilities, such as emergencies rooms, whose current connections via VOIP telephone have a vulnerability. This communication can be low speed, even voice.

COMM GOAL 2. Ability to reach the Alachua County EOC, other hospitals and other emergency-related entities should telephones quit working. This communication can be low speed, even voice.

COMM GOAL 3. Ability to reach other HCA hospitals in other cities. This communication is also low-intensity.

COMMUNICATION ASSETS:

1. 7/8 story roof on primary hospital. There is already at least one above-the-roof antenna / tower present, appears structurally supported by the "doghouse" on the top of the roof. Our experience with University of Florida Beatty Towers and University of Florida Dental Tower suggests that adding modest antennas to such towers is inexpensive.

2 200-foot cell tower. I looked at this and it is an imposing structure. Putting antennas on it would be a more expensive effort requiring professional tower climbers.

3. Incident CommandPost currentlly on 5th floor, but moving to a lower floor as emergency power gets installed.

4. Gainesville Amateur Radio voice repeaters (and others) – approximately 5 repeaters with backup power, varying coverage, but generally well beyond Alachua County.

5. SEDAN and Alachua County ARES digital (node) repeaters – Two high-placement digital repeaters and several residential (tree-mounted) digital low speed (1200-baud) repeaters. These have a 4000 sq. mi. coverage, generally well beyond Alachua County and the two high-mounted repeaters have significant backup emergency power (days). Because of their architecture, they allow "connecting" which allows reaching all the way to Tallahassee and to the East Coast.

6. Local WINLINK digital email RMS servers – provide digital email (with small attachments) even in the absence of Internet. Ham Radio station KX4Z has backup power , and DHS SHARES station NCS521 also have backup power, and provide nation- and world-wide email connections even in the absence of ALL normal telecommunications; normally used by mariners on the high seas and government agency practice. Tradeoff: email deliver is not fast.

7. North Florida Regional Medical Center has available facilities personnel who are handy and able to install systems.

LIMITATIONS:

1. Alachua County ARES is a growing, but fledgling group. We have fielded about 12 people for recent large-scale hurricane / full scale assets. We simply don't have enough people to staff six hospital-related assets with 24-hour coverage. Further, we are volunteer-funded and have out-of-pocket created a 4000 sq mile digital network to supplement the local amateur radio voice repeater assets owned by the Gainsville Amateur Radio Society and others.

2. North Florida Regional Medical Center has no previous LOCAL amateur expertise. There may be several on-staff amateur radio operators who might join a communications service such as the Hospital emergency communications group maintained in Marion County by Dave Welker, and we might find other interested persons who could gain the expertise and become licensed by the FCC to assist during emergencies. Normal business usage of amateur radio (other than drills or real emergencies) is prohibited. But a quite reasonable amount of practice drills (and all real emergencies) are no problem (http://www.arrl.org/news/fcc-modifies-amateur-rules-to-allow-participation-in-disaster-and-emergency-drills-on-behalf-of-an-e)

Section 2: Proposals to meet the Needs

1. Radio Hardware

<table>
<tr><td>COMM GOAL ADDRESSED</td><td>PROPOSED SOLUTION</td></tr>
<tr><td>1</td><td>2-meter/70 cm ham radio voice transceivers with external antennas
a) Install transceiver in a room near to the Incident Command Post, and run LMR400 cable to the outside, preferably at least 40 feet high, and possibly to the roof top, and install a Diamond X-50 gain antenna.
b) Install similar system at outlying facilities, with an antenna on the top of the roof.

Purchase Information (for each station):

<table>
<tr><td>ITEM</td><td>Cost</td></tr>
<tr><td>144-148 MHz FM transceiver
Kenwood TM-281A
https://www.dxengineering.com/search/department/transceivers-and-receivers/product-line/kenwood-tm-281a-2-meter-mobile-transceivers?autoview=SKU&N=4294949594&sortby=Default&sortorder=Ascending</td><td>$136 ea.</td></tr>
<tr><td>DC power supply
MFJ 4230mvp (multiple outputs)
https://www.gigaparts.com/mfj-4230mvp.html?gclid=Cj0KCQjwvOzOBRDGARIsAICjxodvWD7aaKGs51xOuBOlQlrl8b4p2xLxKGDZ2Ov6sLzD447fS1bZyJ8aApqUEALw_wcB</td><td>$90.00 ea.</td></tr>
<tr><td>X-50 144-148 / 440 MHz Vertical Antenna
https://www.gigaparts.com/diamond-antenna-x50a.html</td><td>$90.00 ea.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>VHF antenna SWR measurement
(The reason you want this, is that it allows people to verify the transmitter is working and the antenna is working in an emergency.)
https://www.gigaparts.com/mfj-812b.html?gclid=Cj0KCQjwvOzOBRDGARIsAICjxodC-hqTxoD0Y2OPzhFKxvdALQm29jKu2TJ_RMX_Oy91xV4zEqIw3LcaAipUEALw_wcB</td><td>$37.00</td></tr>
<tr><td>Low loss coax cable from radio to antenna
Custom length of DRF-400 coax cable
http://www.amateurradiosupplies.com/product-p/drf-400.htm

Add standard PL-259 connectors on each end of a custom length of coax cable: $13
http://www.amateurradiosupplies.com/product-p/standard.htm</td><td>$0.83/foot

$13 to put on connectors on both ends</td></tr>
<tr><td>Short jumper coax cable from radio to SWR meter</td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table>

Signal Levels:
These systems will almost certainly have strong signals on local analog repeaters, and with the addition of a laptop computer and a Signalink, can also access digital email. Even without the repeaters, direct communication will be possible between the ER facilities and the Hospital due to height advantage of the hospital and relatively short distance to the ER facilities.

Recommend 3 stations, one at the hospital, one at each of two Emergency Rooms.</td></tr>
<tr><td>2</td><td>Install 2.4 GHz commercially available Ubiquity microwave high power WIFI systems, operated on non-licensed frequencies.

a) 15 dBi omnidirectional antenna on top of roof of hospital, on the west side of any obstructing tower, in an attempt to reach the free standing Jonesville ER.
b) 24 dBi parabolic dish as high as reasonably practicable on the Jonesville ER (study done at 20 feet, but try to avoid tree obstruction).
c) 15 dBi omnidirectional antenna on top of Express ER

These high power WIFI systems will allow for encrypted voip private conversations using suitable telephones, or digital computer-based communications between facilities. Your own private microwave system using off-the-shelf components and not requiring any license. The Disadvantage is that although the Radio Mobile</td></tr>
</table>

propagation study suggests success in reaching the Jonesville ER, I am not able to guarantee it. You may need to install a modest height intermediary Ubiquity WIFI at, perhaps, one of the churches at 91st Street and Newberry Road or other high location. (I have already spoken to the "facilities director" at Westside Baptist Church and they would probably be amenable to working if you if you need; they already lease space to a solar power generator.)

If you install this system, I strongly suggest that you add one additional transceiver on amateur frequency 2.397 GHz as we expect to provide an amateur network that may reach you also from University of Florida.

Costs for these systems are quite modest: I would recommend 2 systems at the hospital (one unlicensed,and one on ham frequency 2.397 Ghz) and 1 system at each of your two emergency rooms. Total cost approximately There will be modest additional costs to wire the shielded Ethernet wiring from the roof mounted transceivers to a local network switch and network connections will need to be arranged. These systems do not use coaxial cable; instead they use shielded ethernet to your nearest ethernet switch. Your IT people will know how to route IP numbers etc. Each device is a small linux device that is capable of running DHCP for a small network if need be. I know enough to make them work, but your IT people will pick up on this much quicker than I do.

UNLICENSED SYSTEMS (recommend three total)

Transceiver ("router") Outdoor version; Bullet Titanium M2 (2.4 GHz) https://www.amazon.com/Ubiquiti-BulletM2-Titanium-802-11n-Outdoor/dp/B008FITTKQ/ref=sr_1_fkmr2_3?s=electronics&ie=UTF8&qid=1507569280&sr=1-3-fkmr2&keywords=ubiquiti+5.8+bullet	$114 each (you need one for each installation)
Omnidirectional vertical antenna for Hospital. 15dBi 2.4 Ghz vertical omnidirectional antenna https://www.amazon.com/TP-Link-Omni-directional-connector-resistant-TL-ANT2415D/dp/B004I5J2XY/ref=sr_1_5?s=electronics&ie=UTF8&qid=1507569173&sr=1-5&keywords=TP-link+antenna	$51 each. Use a bit of dielectric grease on the connection for water repellent.
High gain parabolic antenna for your farthest emergency room: https://www.amazon.com/TP-Link-Directional-Parabolic-Connector-TL-ANT2424B/dp/B003CFATOW	$51.00
Medium gain parabolic antenna for your Express Emergency room (significantly smaller than the 24 dbi antenna) 21 dbi https://www.amazon.com/Antenna-World-G2421-Directional-Parabolic/dp/B00NQGVLRG	$45.00

	Suggested VOIP telephone, one for each of your installations. https://www.amazon.com/Grandstream-GS-GXP1610-Small-Business-Device/dp/B00U0Z8DFE/ref=sr_1_3?s=electronics&ie=UTF8&qid=1507581114&sr=1-3&keywords=Grandstream+voip+phone Note: I don't yet know enough to create a PBX using Elastix, but we have already demonstrated how easy it is to simply dial by IP number to reach your other facilities.	$43 each
	Extra system for potential ham system connection Transceiver ("router") Outdoor version; Bullet Titanium M2 (2.4 GHz) https://www.amazon.com/Ubiquiti-BulletM2-Titanium-802-11n-Outdoor/dp/B008FITTKQ/ref=sr_1_fkmr2_3?s=electronics&ie=UTF8&qid=1507569280&sr=1-3-fkmr2&keywords=ubiquiti+5.8+bullet	$114.00
	Extra antenna for ham system connection Omnidirectional vertical antenna for Hospital. 15dBi 2.4 Ghz vertical omnidirectional antenna https://www.amazon.com/TP-Link-Omni-directional-connector-resistant-TL-ANT2415D/dp/B004I5J2XY/ref=sr_1_5?s=electronics&ie=UTF8&qid=1507569173&sr=1-5&keywords=TP-link+antenna	$51.00
3 – distant connections and digital email out of the area	HF Station to be able to reach outside the city to other HCA facilities, or to use digital email for emergency communications.	
	High Frequency (shortwave) transceiver (this is a moderately priced one which I have considerable experience with) ICOM 718 https://www.dxengineering.com/parts/ico-ic-718	roughly $600 depending on rebate

	Power Supply https://www.gigaparts.com/mfj-4230mvp.html?gclid=Cj0KCQjwvOzOBRDGARIsAICjxodvWD7aaKGs51xOuBOlQlrl8b4p2xLxKGDZ2Ov6sLzD447fS1bZyJ8aApqUEALw_wcB	$90.00
	Antenna We can literallly make an antenna, but this is a commercially available one that is likely to work well; it can be installed FROM your building and stretch out to a nearby tree, lamppost (non-metallic rope, please!) http://myantennas.com/wp/product/efhw-8010/#prettyPhoto	$140 (without coax)
	Automated tuner This tuner is essentially "insurance." I have two of them; they pretty much guarantee that your antenna WILL work with your transmitter and protect the transmitter from bad SWR. It is over-rated for this transceiver, but that means it is virtually indestructible. https://www.dxengineering.com/search/product-line/ldg-electronics-at-600proii-automatic-antenna-tuners?autoview=SKU&keyword=LDG&sortby=BestKeywordMatch&sortorder=Ascending	$369.00
	RG8X Coax with installed PL-259 connectors. This is available on amazon in many different lengths. Needs to reach from the transceiver to wherever you put the building end of the antenna. For example: 50 feet $31 https://www.amazon.com/50ft-Rg8x-Pl259-Antenna-Cable/dp/B00D66RDYQ 100 feet $54 https://www.amazon.com/dp/B00E2UZU9K?psc=1	Depends on length, $30-$100
	Purchase 2 short jumpers of coax $8 each https://www.amazon.com/Astatic-302-10268-Grey-Pl259-Connectors/dp/B000RG9SRI/ref=sr_1_4?s=electronics&ie=UTF8&qid=1507582656&sr=1-	$16 total

	4&keywords=RG8X+3+feet	
	MFJ soundcard interface with cable for ICOM 718 http://www.mfjenterprises.com/Product.php?productid=MFJ-1204D13I	$99.00
	Laptop computer I suggest the SSD drive computers because their battery life is so much longer --- useful in an emergency. (note: must be windows based) https://www.newegg.com/Product/Product.aspx?Item=N82E16834268397	$250.00

2. Operators

We suggest that NFRMC canvass its staff to find out which employees are already licensed amateur radio operators (and thus have some training already) and are interested in being involved in emergency communications. Additionally, canvas for which employees might be interested in getting training toward a license. Finally, some of your volunteers or others from the community may be interested in serving as communications volunteers for your facilities.

With no pecuniary interest, our ARES group and others periodically carry out license training courses; exams are given by volunteers at a generally fixed cost of $15 to cover materials.

Your volunteers will need extensive further training and our local ARES group does this in the form of monthly Wednesday night meetings, twice-yearly “full scale ICS exercises” and additional tabletop exercises.

3. Integration

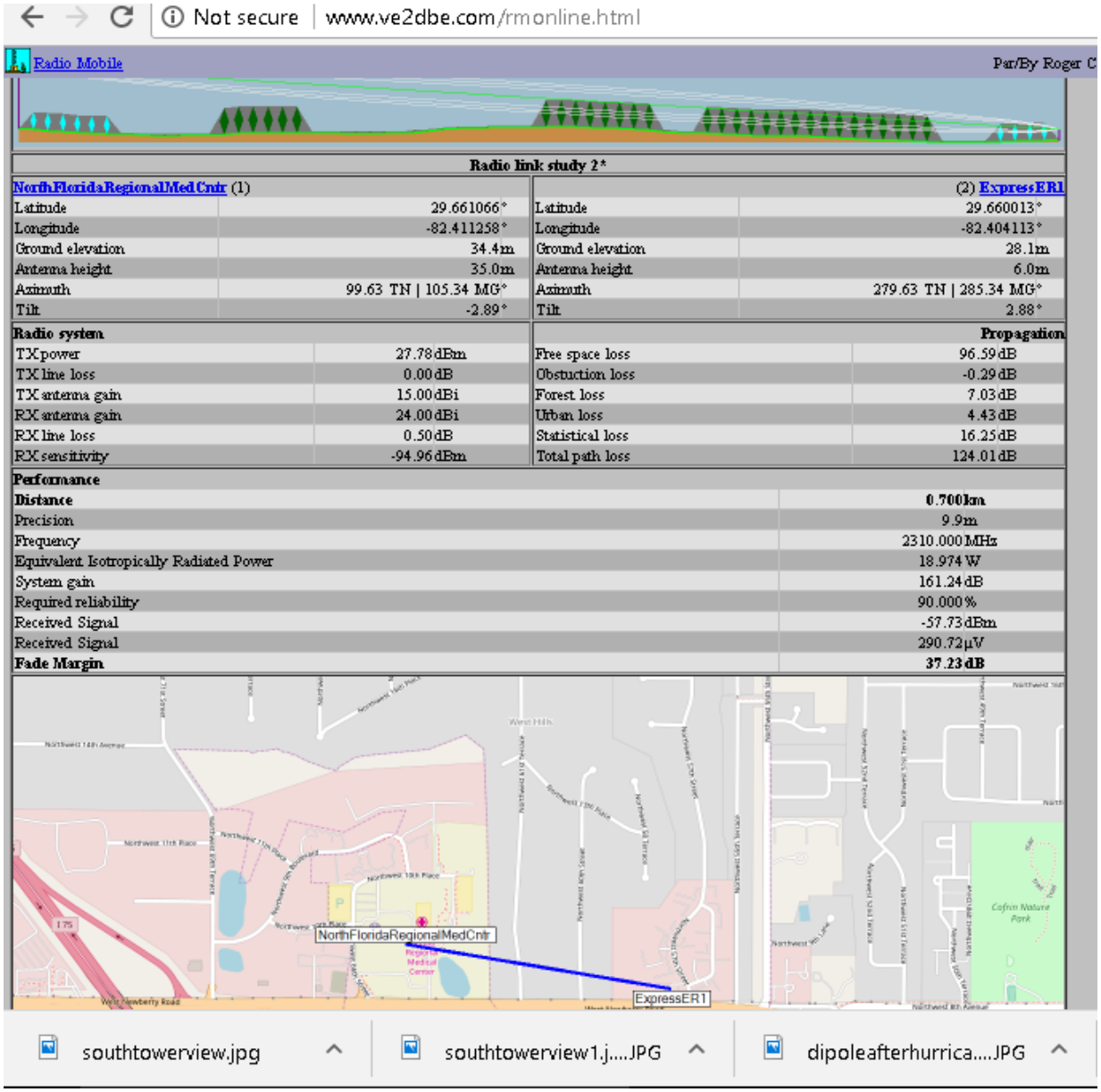
Based on the experiences of Dave Welker and others in the Marion county hospital systems, we recommend that volunteers who are not yet employees of your facility become trained in your normal volunteer system and badged appropriately.

Additionall, our group will keep track of their training and performance in exercises so as to maintain quality control.

Facilities: Communications emergencies such as hurricanes may run for 36 hours and you'll need "shifts" of communications workers. We recommend that you provide appropriate sleeping facilities for the off-shift workers

Section 3: Conclusion

APPENDIX 1: MICROWAVE PROPAGATION SIMULATION NORTH FLORIDA TO EXPRESS ER #1



Not secure | www.ve2dbe.com/rmonline.html

Radio Mobile — Par/By Roger C

Radio link study 2*

NorthFloridaRegionalMedCntr (1)		(2) ExpressER1	
Latitude	29.661066°	Latitude	29.660013°
Longitude	-82.411258°	Longitude	-82.404113°
Ground elevation	34.4m	Ground elevation	28.1m
Antenna height	35.0m	Antenna height	6.0m
Azimuth	99.63 TN | 105.34 MG°	Azimuth	279.63 TN | 285.34 MG°
Tilt	-2.89°	Tilt	2.88°

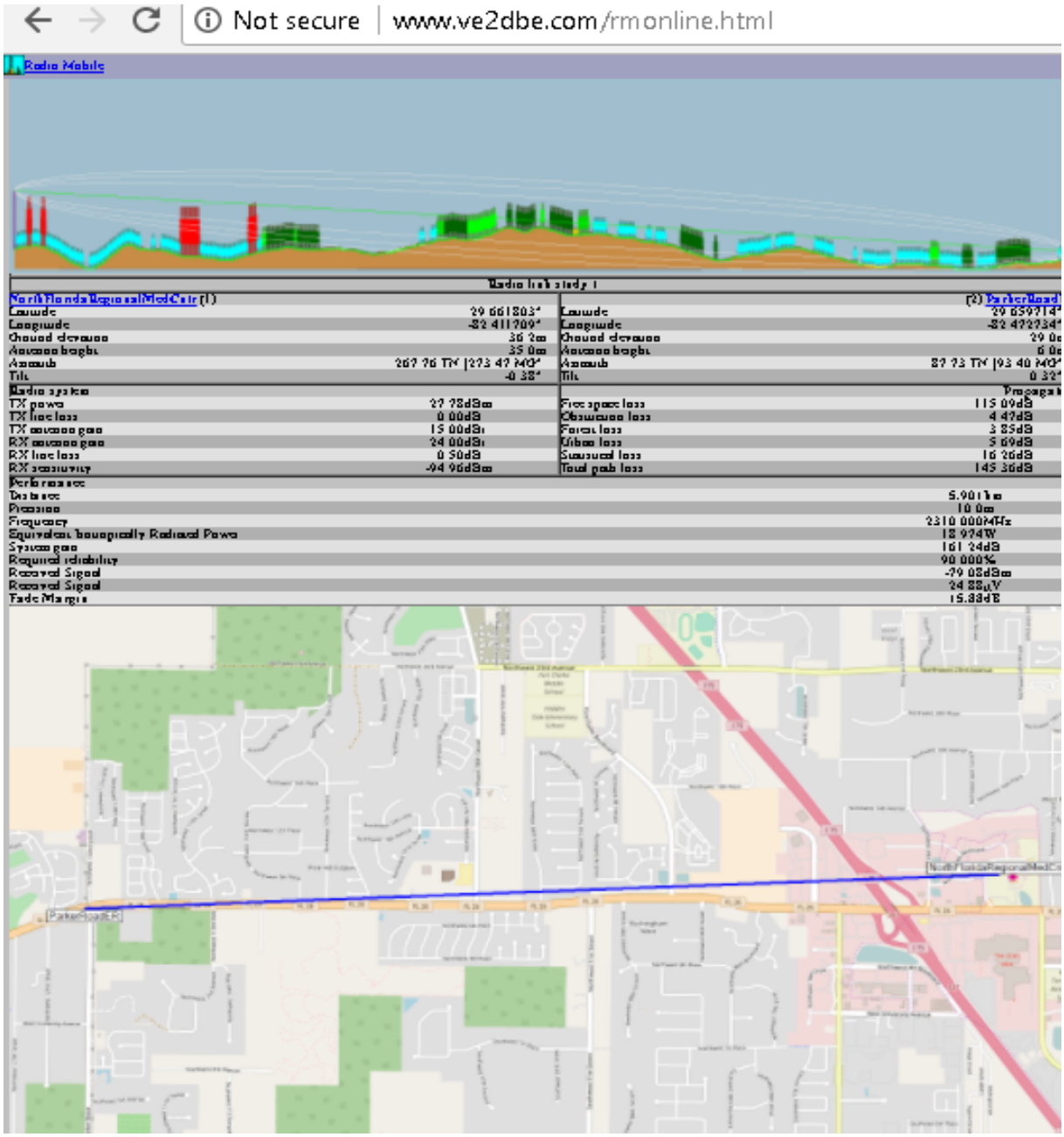
Radio system		**Propagation**	
TX power	27.78 dBm	Free space loss	96.59 dB
TX line loss	0.00 dB	Obstruction loss	-0.29 dB
TX antenna gain	15.00 dBi	Forest loss	7.03 dB
RX antenna gain	24.00 dBi	Urban loss	4.43 dB
RX line loss	0.50 dB	Statistical loss	16.25 dB
RX sensitivity	-94.96 dBm	Total path loss	124.01 dB

Performance	
Distance	**0.700 km**
Precision	9.9m
Frequency	2310.000 MHz
Equivalent Isotropically Radiated Power	18.974 W
System gain	161.24 dB
Required reliability	90.000 %
Received Signal	-57.73 dBm
Received Signal	290.72 µV
Fade Margin	**37.23 dB**

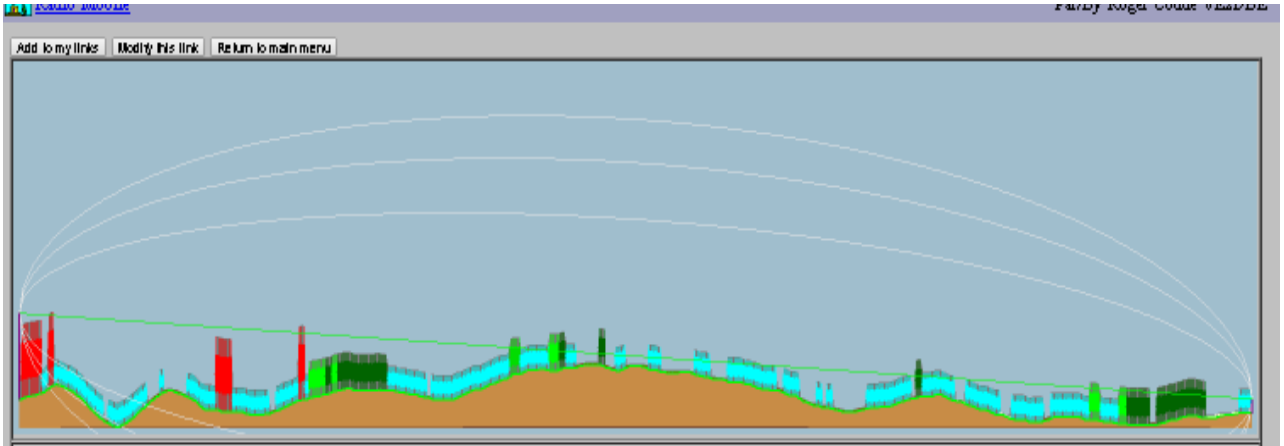
southtowerview.jpg | southtowerview1.j....JPG | dipoleafterhurrica....JPG

APPENDIX 2: MICROWAVE PROPAGATION SIMULATION NORTH FLORIDA HOSPITAL TO FREE STANDING EMERGENCY ROOM

http://www.gainesville.com/news/20160302/north-florida-regional-plans-free-standing-emergency-room-in-jonesville



Appendix 3 : 144-146 MHz Propagation Simulation to Free Standing ER



Radio link study 3

NorthFloridaRegionalMedCntr (1)		(2) ParkerRoadER	
Latitude	29.661066°	Latitude	29.659714°
Longitude	-82.411258°	Longitude	-82.472734°
Ground elevation	34.4m	Ground elevation	29.0m
Antenna height	35.0m	Antenna height	6.0m
Azimuth	268.57 TN | 274.27 MG°	Azimuth	88.54 TN | 94.20 MG°
Tilt	-0.36°	Tilt	0.30°

Radio system		Propagation	
TX power	43.01dBm	Free space loss	91.17dB
TX line loss	6.00dB	Obstruction loss	11.29dB
TX antenna gain	6.00dBi	Forest loss	1.12dB
RX antenna gain	6.00dBi	Urban loss	7.90dB
RX line loss	3.00dB	Statistical loss	14.61dB
RX sensitivity	-113.02dBm	Total path loss	126.08dB

Performance	
Distance	**5.942km**
Precision	10.0m
Frequency	146.000MHz
Equivalent Isotropically Radiated Power	20.000W
System gain	159.03dB
Required reliability	90.000%
Received Signal	-80.07dBm
Received Signal	22.21µV
Fade Margin	**32.95dB**

---------- NOTES MATERIAL BELOW IS NOT TO BE INCLUDED ----------

1. Tactical voice: At their hospital, install some kind of VHF/UHF outdoor antenna (Diamond X-50 $100) that can be cabled ($100) into some room "near" to their incident command post. This antenna might not be on the top of their roof --- but adequate to reach repeaters and generally provide service in most situations. It could be on a bracket on the side of their building for example.
Install a VHF/UHF voice transceiver. ($250) in the "comm station" near their incident command post. This gives them voice tactical connection to many many facilities, including the EOC.

2. Their own Microwave Network: On the top roof of their hospital, install probably TWO ubiquiti systems, omnidirectonal, one on ham frequencies (2.397) , and one on "public" frequencies (5.8 Ghz) [transceivers 2 x $80; antennas 2 x $60; wiring is extra] with Ethernet cabling so they can be accessed from our ham location. Also provide a voip telephone [$60] , and there we put in an Elastix pbx system evntually after we learn how. This gives them potentially encrypted voice connection to outlying facilities, as well as encrypted data communications. The non-encyrpted ham system gives us backup for our packet system and establishes another] high perch MESH system so they have connectivity to the EOC by multiple techniques.

3. DIGITAL low/high speed node: On the top roof doghouse of their hospital, install a dual-band VHF/UHF antenna (Diamond X-50 $100) that goes to a raspberry-pi bpq system packet node (with batery, about $100) , also connected to the ham MESH transceiver. Have the raspberry be accesible over PuTTY from the ham radio station nearby the Incident Command Post. We may have to add a 2nd ethernet on the raspberry to do this. (pocket change) This connection should NOT connect to the larger internet.

4. At each of their outlying facilities, install a dual band VHF/UHF antenna (Diamond X-50 $100) as high as reasonably possible, and while doing it, install a public 5.8 GHz ubiquity system ($80+ $60) . Provide a VOIP telephone ($60) to the 5.8 GHz system. The ham band transceiver might be optional; users might be able to bring their own? Or they might want to provide it; Doesn't have to be fancy (Yaesu or Kenwood $140-$250)

5. We work to identify potential volunteers and train them up, getting them licenses as needed, integrating their staff volunteers into at least a bit of our ARES training --- but probably not all the cutting-edge stuff we do...

6. We figure out which 5.8 GHz links are going to work and give them their own private digital net. Some of the systems may require parabolics, while others may do fine with omni antennas.

7. I already discused sleeping facilities and they said that would be covered.

8. We would need "volunteer training" for our local ARES people who might serve there as Dave has done.

9. HF to directly reach other HCA hospitals. : Two methods:

a) if they are able to run RG-8 level coax to any outside wall at about 50 feet or more above the ground, put an end-fed antenna (recent models are about $160) from the building to any supporting structure (tree, etc) nearby. Then position an ICOM 718 or similar modern transsceiver ($700) in the ham station near their ICP. An antenna tuner may still be needed ($300) Roof top access is not needed to give quite adequate performance. This option gives them voice or WINMOR digital email. Signalink $100. Laptop $300.

VERSUS

b) If they cannot put shortwave HF at the level of their near-incident command post station, then remote it over eithernet to the roof, and install an ICOM 718 or similar computer controllable HF rig ($700) in the roof doghouse, with a front-end laptop PC ($200) running WINMOR or FLDIGI, connected to their hospital ethernet. This might also be controlled by TeamViewer as an alternate option. Antenna is a center fed random length dipole on top of their building, connected to an auto-tuner ($300) . Then a computer in the ham station near the Incident command post ($300 laptop) can control that as well as the VHF station thru their network, and also access the ubiquiti microwave systems.