



HSMM-MESH

High Speed Multimedia MESH Network

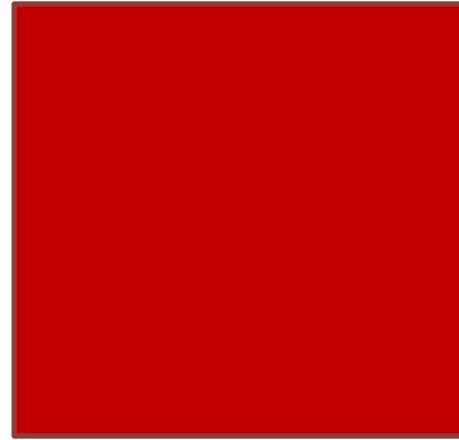
Typical Infrastructure Network

MESH Network

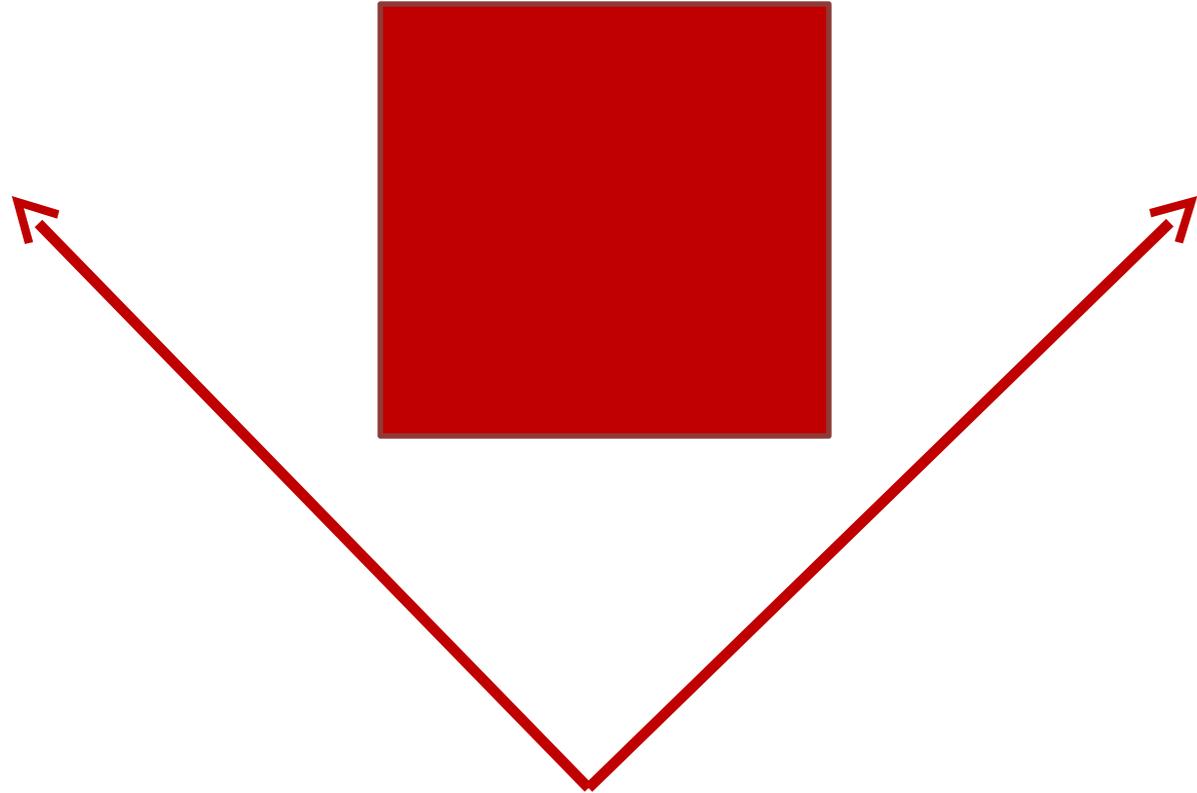
MESH Network



MESH Network



MESH Network



Hardware - Linksys WRT54G Series



WRT54G			
S/N Prefix	Version	CPU	Flash Memory
CDF0	v1.0	125 MHz	4MB
CDF1	v1.0	125 MHz	4MB
CDF2	v1.1	125 MHz	4MB
CDF3	v1.1	125 MHz	4MB
CDF5	v2.0	200 MHz	4MB
CDF6	v2.1	216 MHz	4MB
CDF7	v2.2	216 MHz	4MB
CDF8	v3.0	216 MHz	4MB
CDF9	v3.1	216 MHz	4MB
CDFA	v4.0	200 MHz	4MB

WRT54GS			
S/N Prefix	Version	CPU	Flash Memory
CGN0	v1.0	200 MHz	8MB
CGN1	v1.0	200 MHz	8MB
CGN2	v1.1	200 MHz	8MB
CGN3	v2.0	216 MHz	8MB
CGN4	v2.1	216 MHz	8MB
CGN5	v3.0	200 MHz	8MB
CGN6	v4.0	200 MHz	4MB

WRT54GL			
S/N Prefix	Version	CPU	Flash Memory
CL7A	v1.0	200 MHz	4MB
CL7B	v1.1	200 MHz	4MB
CL7C	v1.1	200 MHz	4MB
CF7C	v1.1	200 MHz	4MB

NOTE: CDF0 uses a 5V, 2A power supply. All others use 12V, 1A power supply.

Firmware

- HSMM-MESH firmware is available via download from the HSMM-MESH website
<http://hsmm-mesh.org/software-download.html>
- The firmware is comprised of two parts
 1. OpenWRT – Router functions
 - DHCP
 - Port Forwarding
 - Services
 2. OLSR (Optimized Link State Routing) – MESH network
 - Tracks nodes that are “seen” directly
 - Tracks nodes and networks the other nodes can “see”

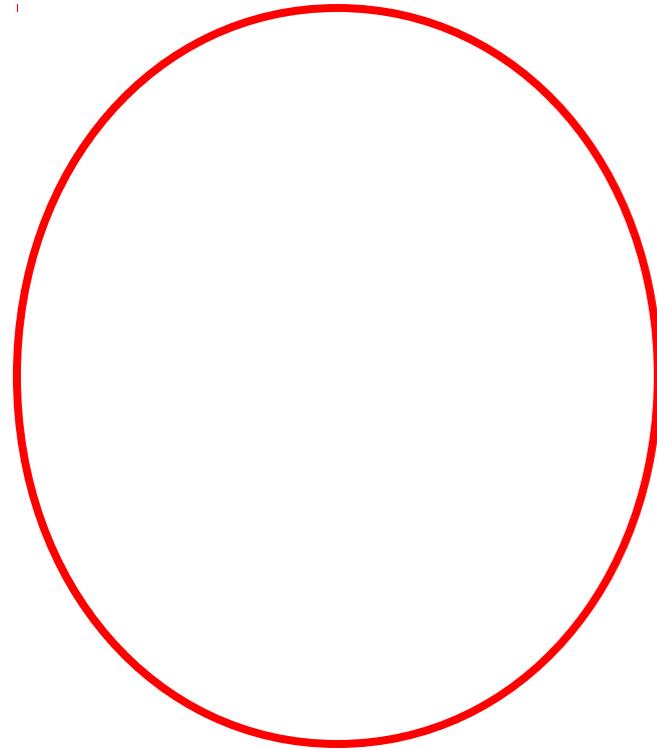
Three Networks



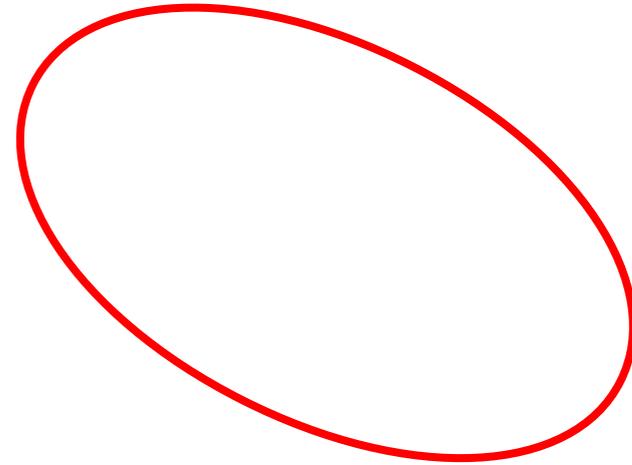
Three Networks



Three Networks



Three Networks



[Node Status](#)**Basic Setup**[Port Forwarding,
DHCP, and Services](#)[Administration](#)[Help](#)

Save Changes

Reset Values

Default Values

Reboot

Node Name Password Node Type Verify Password

WiFi		LAN		WAN	
Protocol	<input type="text" value="Static"/>	LAN Mode	<input type="text" value="NAT"/>	Protocol	<input type="text" value="DHCP"/>
IP Address	<input type="text" value="10.0.227.108"/>	IP Address	<input type="text" value="172.27.0.1"/>	DNS 1	<input type="text" value="8.8.8.8"/>
Netmask	<input type="text" value="255.0.0.0"/>	Netmask	<input type="text" value="255.255.255.0"/>	DNS 2	<input type="text" value="8.8.4.4"/>
SSID	<input type="text" value="HSMM-MESH"/>	DHCP Server	<input checked="" type="checkbox"/>	<hr/>	
Mode	<input type="text" value="Ad-Hoc"/>	DHCP Start	<input type="text" value="5"/>	Mesh Gateway	<input type="checkbox"/>
Channel	<input type="text" value="1"/>	DHCP End	<input type="text" value="25"/>		
<hr/>					
Active Settings					
Rx Antenna	<input type="text" value="Diversity"/>				
Tx Antenna	<input type="text" value="Diversity"/>				
Tx Power	<input type="text" value="19 dBm"/>				
Distance	<input type="text" value="0"/>				
<input type="button" value="Apply"/>					

**HSMM-
MESH**

[Node Status](#)**Basic Setup**[Port Forwarding,
DHCP, and Services](#)[Administration](#)[Help](#)

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SSID <input type="text" value="HSMM-MESH"/>	DHCP Server <input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="5"/>	
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="25"/>	
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Tx Antenna <input type="text" value="Diversity"/>		
Tx Power <input type="text" value="19 dBm"/>		
Distance <input type="text" value="0"/>		
<input type="button" value="Apply"/>		

**HSMM-
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[Help](#)

Save Changes

Reset Values

Refresh

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
Both <input type="button" value="v"/>	Both <input type="button" value="v"/>	<input type="text" value="9000"/>	W3KDW-ASUS <input type="button" value="v"/>	<input type="text" value="9000"/>	<input type="button" value="Del"/>
Both <input type="button" value="v"/>	Both <input type="button" value="v"/>	<input type="text" value="48080"/>	172.27.0.26 <input type="button" value="v"/>	<input type="text" value="48080"/>	<input type="button" value="Del"/>
Both <input type="button" value="v"/>	Both <input type="button" value="v"/>	<input type="text" value="81"/>	W3KDW-ASUS <input type="button" value="v"/>	<input type="text" value="81"/>	<input type="button" value="Del"/>
WiFi <input type="button" value="v"/>	TCP <input type="button" value="v"/>	<input type="text"/>	- IP Address - <input type="button" value="v"/>	<input type="text"/>	<input type="button" value="Add"/>

DMZ Server None **Advertised Services**

Name	Link	URL	
<input type="text"/>	<input type="checkbox"/>	<input type="text" value="://W3KDW-2: /"/>	<input type="button" value="Add"/>

DHCP Address Reservations

Hostname	IP Address	MAC Address	
W3KDW-ASUS	172.27.0.5 <input type="button" value="v"/>	e0:cb:4e:a2:73:a7	<input type="button" value="Del"/>
<input type="text"/>	- IP Address - <input type="button" value="v"/>	<input type="text"/>	<input type="button" value="Add"/>

Current DHCP Leases

*	172.27.0.6	00:15:c5:cc:84:5a	<input type="button" value="Add"/>
---	------------	-------------------	------------------------------------

W3KDW-2

[Help](#) Night Mode

WiFi address	10.0.227.108 / 8 fe80::214:bfff:fe00:e36c Link	Signal/Noise/Ratio	-72 / -98 / 26 dB	<input type="button" value="Auto"/>
LAN address	172.27.0.1 / 24 fe80::214:bfff:fe00:e36a Link	firmware version	0.4.2	
WAN address	none fe80::214:bfff:fe00:e36a Link	configuration	mesh	
default gateway	10.117.179.38 W3KDW-1	system time	Thu Mar 29 2012 16:24:48 UTC	
your address	172.27.0.6	uptime	16:34	
		load average	0.23, 0.10, 0.02	
			flash = 4336 KB	
		free space	/tmp = 15156 KB	
			memory = 15332 KB	

W3KDW-2 mesh status

Refresh

Auto

Quit

Local Hosts	Services	Current Neighbors	LQ	Services
-------------	----------	-------------------	----	----------

W3KDW-2		W3KDW-1	100%	
---------	--	-------------------------	------	--

Remote Nodes	ETX	Services	Previous Neighbors	When
--------------	-----	----------	--------------------	------

none			none	
------	--	--	------	--

W3KDW-2 WiFi scan

Refresh

Auto

Quit

Sig	Chan	Enc	SSID	MAC	Vendor
-61	6		WhippNet-G	0016B6:E42589	Cisco-Linksys
-69	1		HSMM-MESH	A60E82:6B14E4	Ad-Hoc

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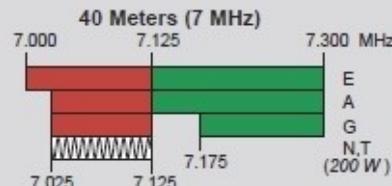
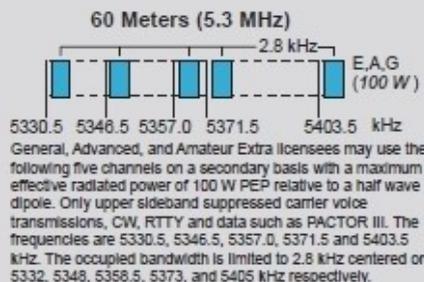
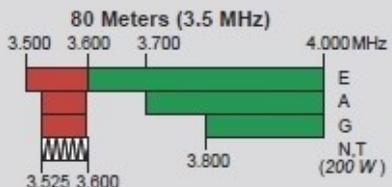
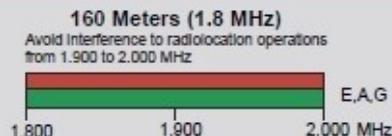
US Amateur Radio Bands

US AMATEUR POWER LIMITS

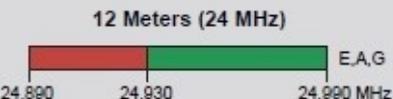
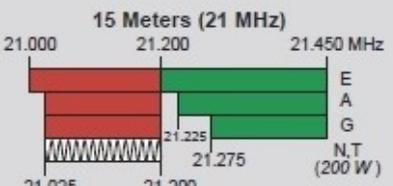
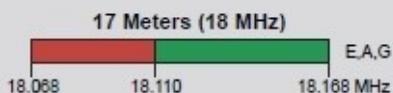
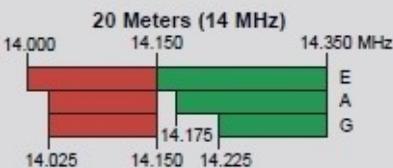
FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Effective Date
March 5, 2012

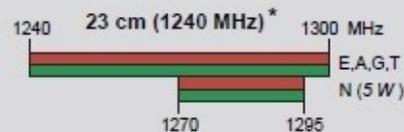
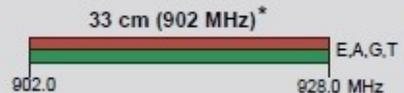
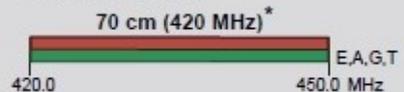
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*Geographical and power restrictions may apply to all bands above 420 MHz. See The ARRL Operating Manual for information about your area.



All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

KEY

Note:
CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz.

- = RTTY and data
- = phone and image
- = CW only
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems only

- E = Amateur Extra
- A = Advanced
- G = General
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- N = Novice

See ARRL Web at www.arrl.org for detailed band plans.

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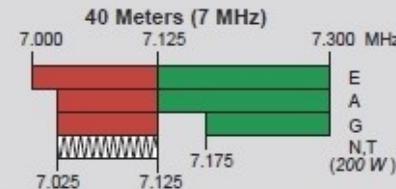
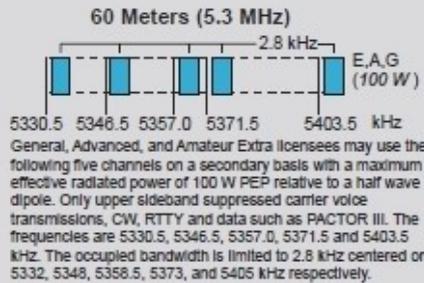
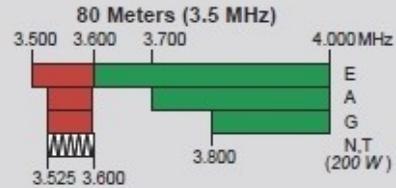
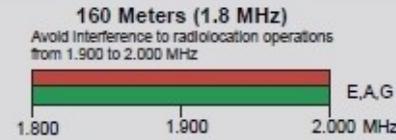
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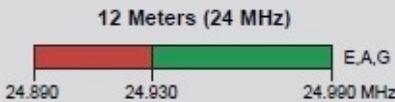
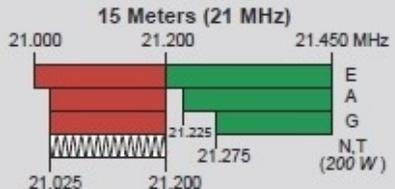
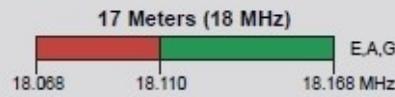
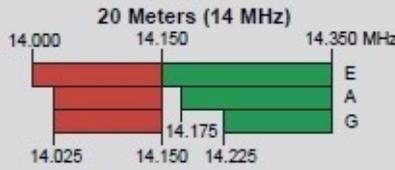
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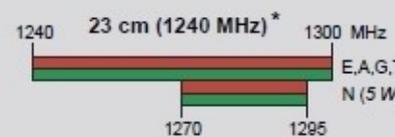
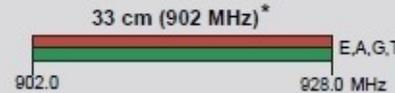
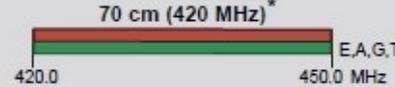
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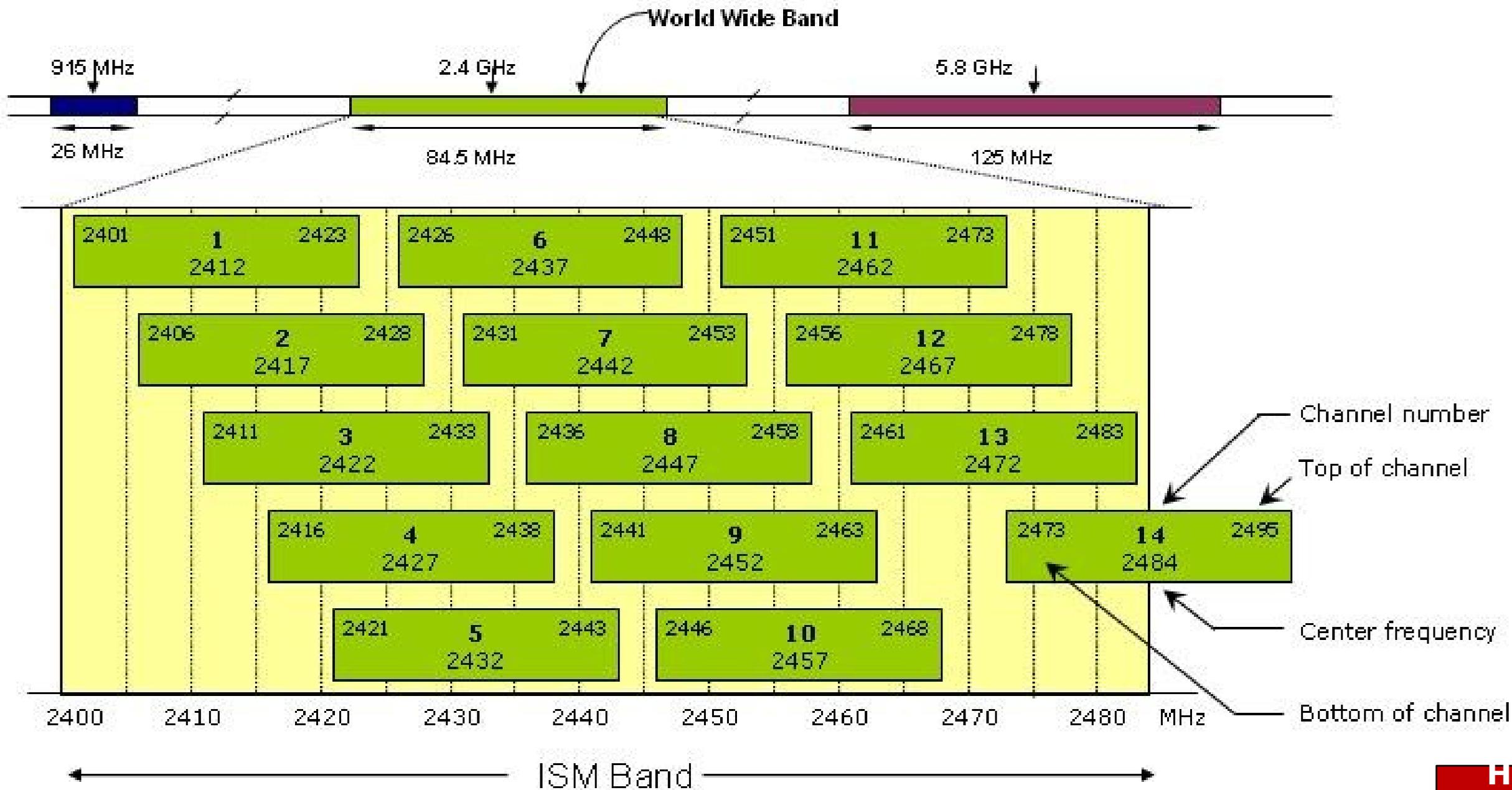
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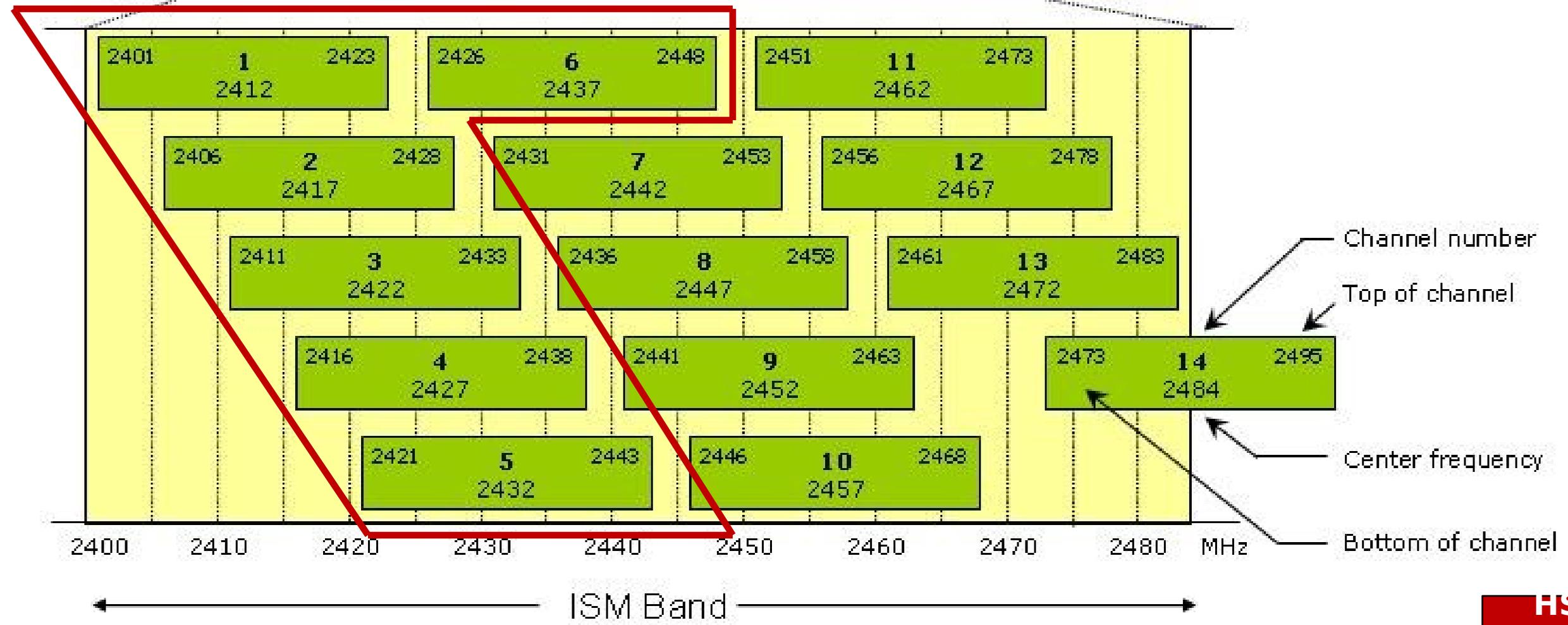
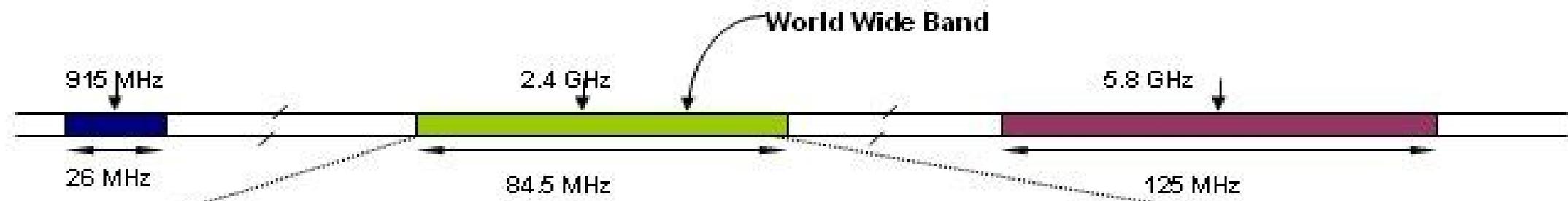
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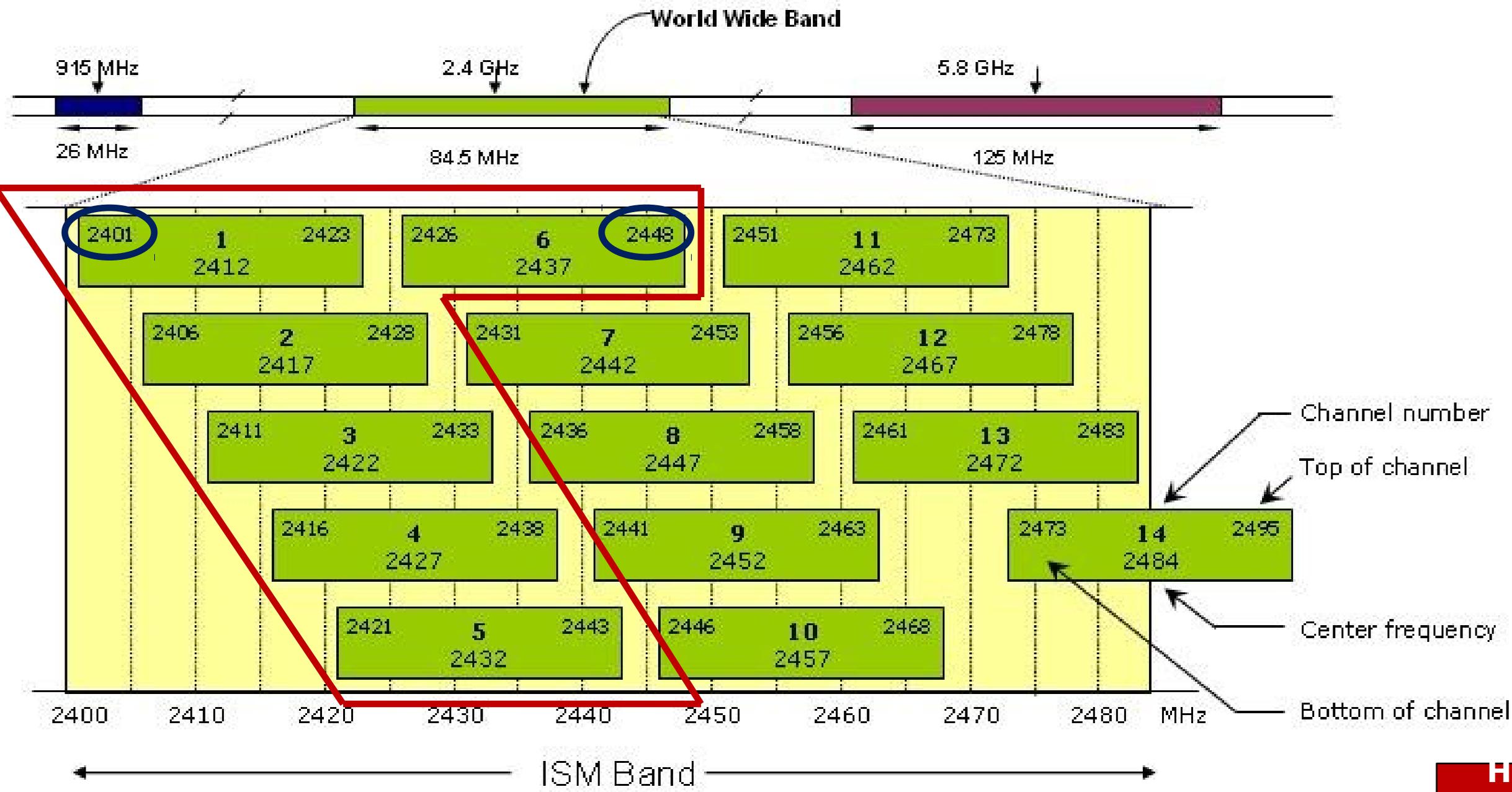
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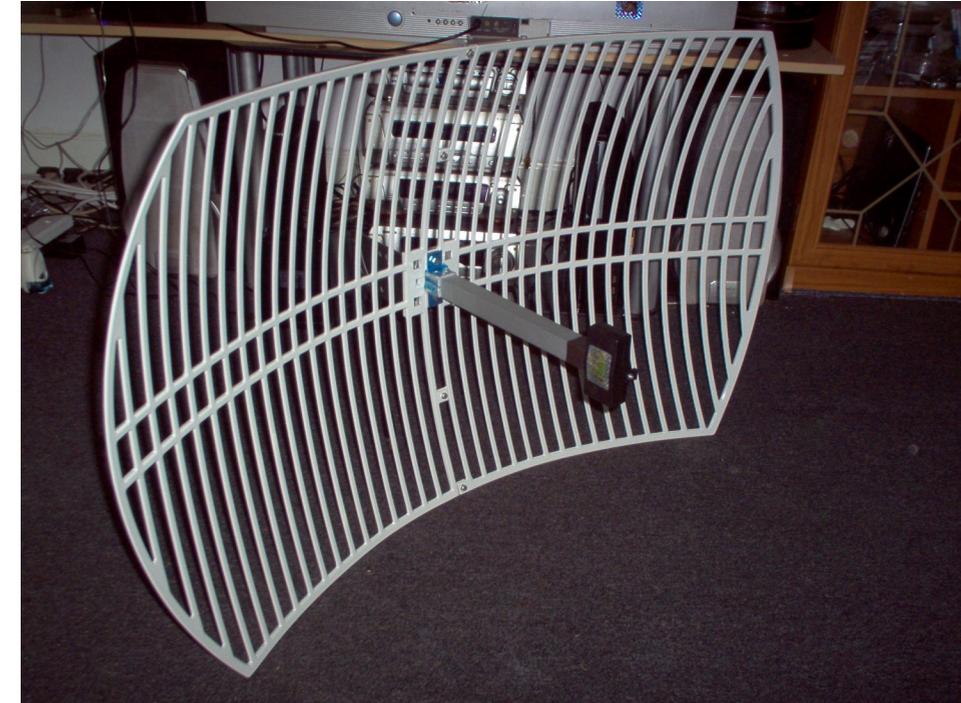
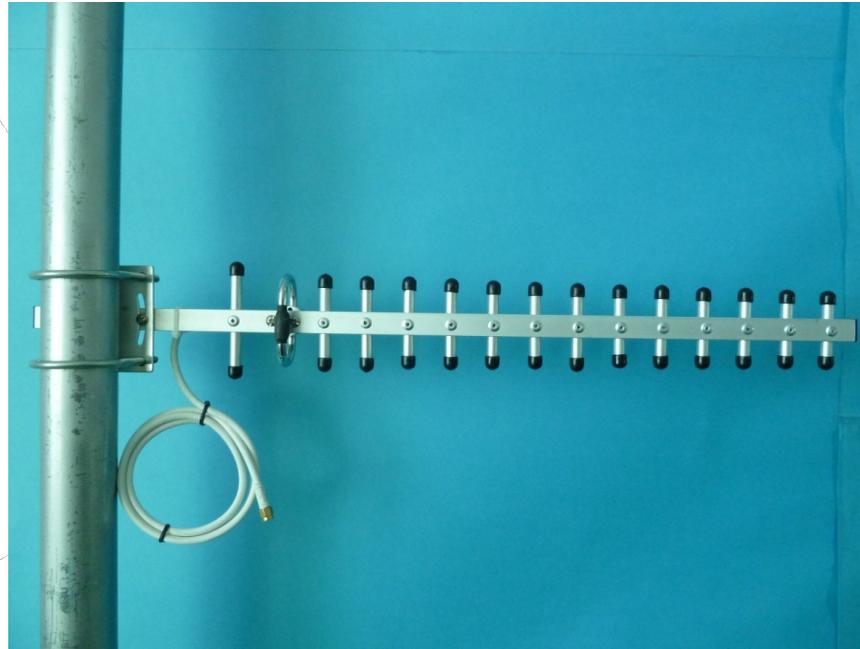


Other than identifying the WiFi channels that fall within the amateur radio bands, these are still just off-the-shelf, Part 15 devices.

What can a ham do that a member of the Geek Squad can't?

Apply Part 97

High Gain Antennas



"No matter how many watts you're pushing, having a better antenna ALWAYS helps out more than the amp, especially when you factor in the cost." - Jim Kinter, K5KTF

Montgomery College

Rockville Campus

Fixed MESH node with 9db rubber
duck antennas atop a 15' painter's
pole.

Portable MESH node with a yagi
antenna.

Distance: about 300 meters
Lost line of sight due to elevation drop
in the landscape.





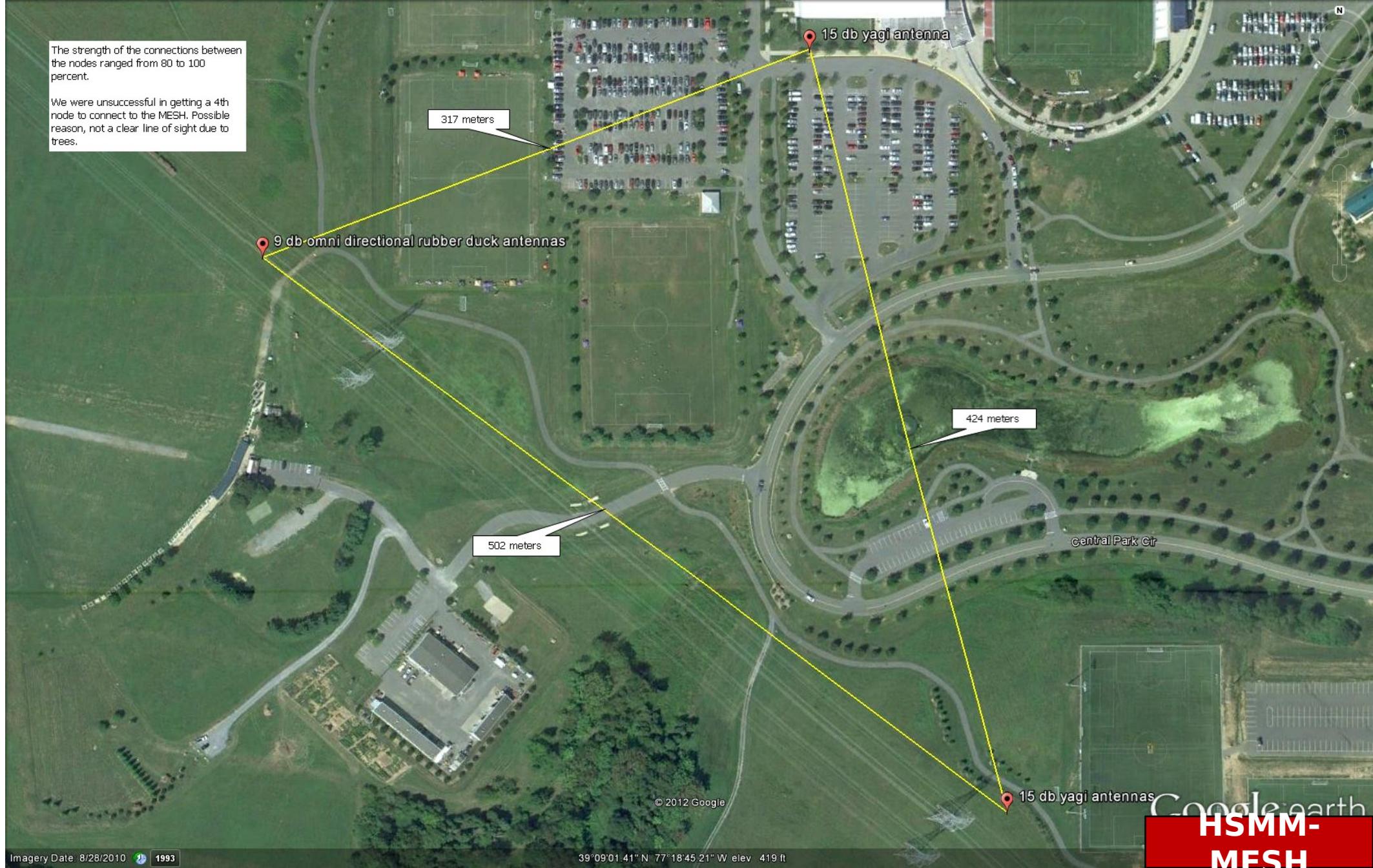
HSMM-MESH

Maryland SoccerPlex

Germantown, MD

Successfully connected three nodes. The fourth unsuccessful node demonstrated how critical line of sight really is.

Maintained a very good link strength between the three nodes.



Black Hill Regional Park

Boyd's, MD

Successfully ran D-RATS chat, email
and file transfer.

Connections were consistently
between 80% to 100% LQ.

Biggest surprise, 80% LQ from a
node across the lake using the
standard stock antennas.





**HSMM-
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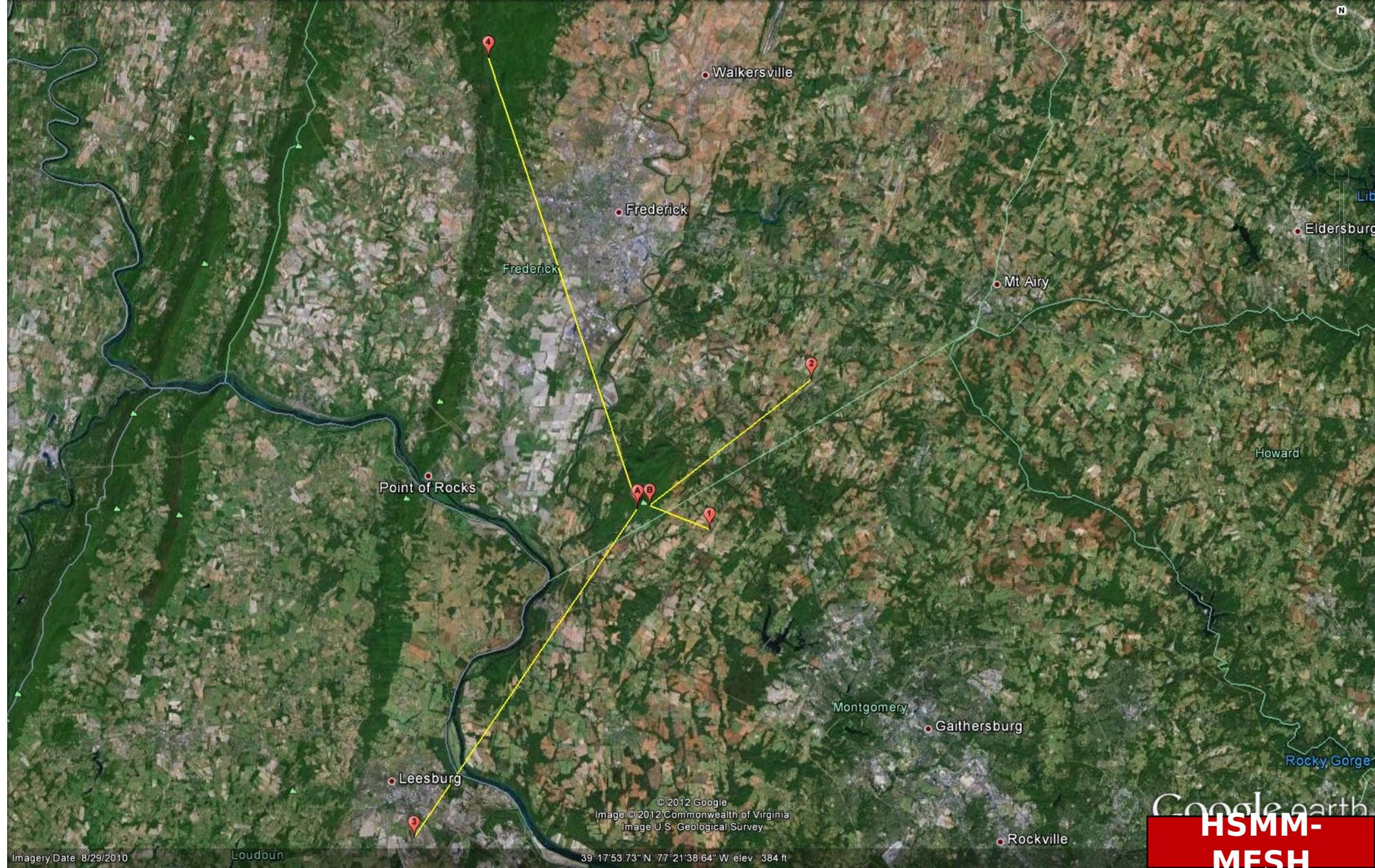
Applications Running Over The MESH

- IP Camera and WebCam (visual monitoring)
- Web Server (distribute information, files and software)
- D-RATS (chat, email and file sharing)

Future Field Trips

Sugarloaf
Mountain

Dickerson, MD



Sugarloaf Mountain

Comus, MD

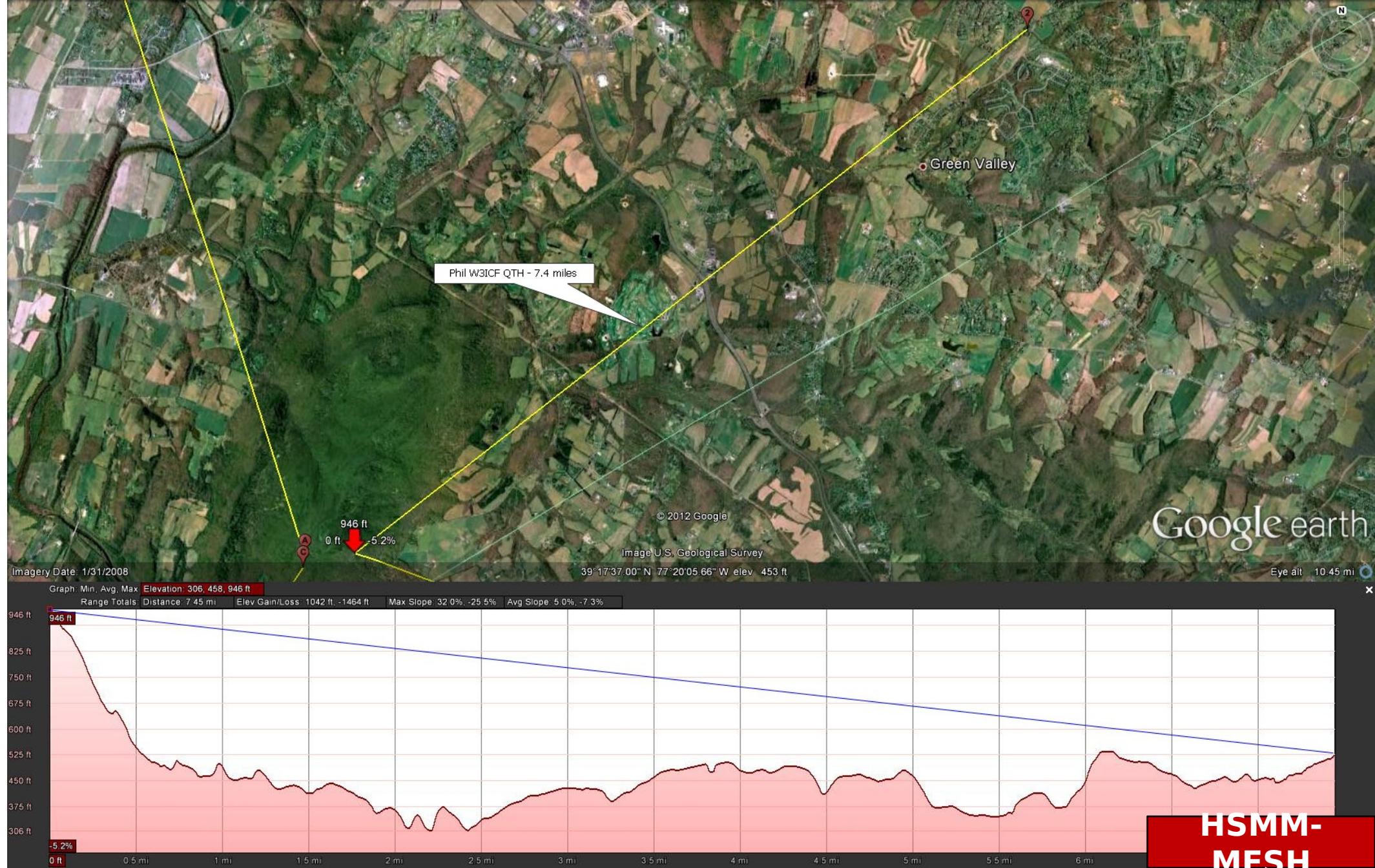
2.3 miles



Sugarloaf Mountain

Green Valley, MD

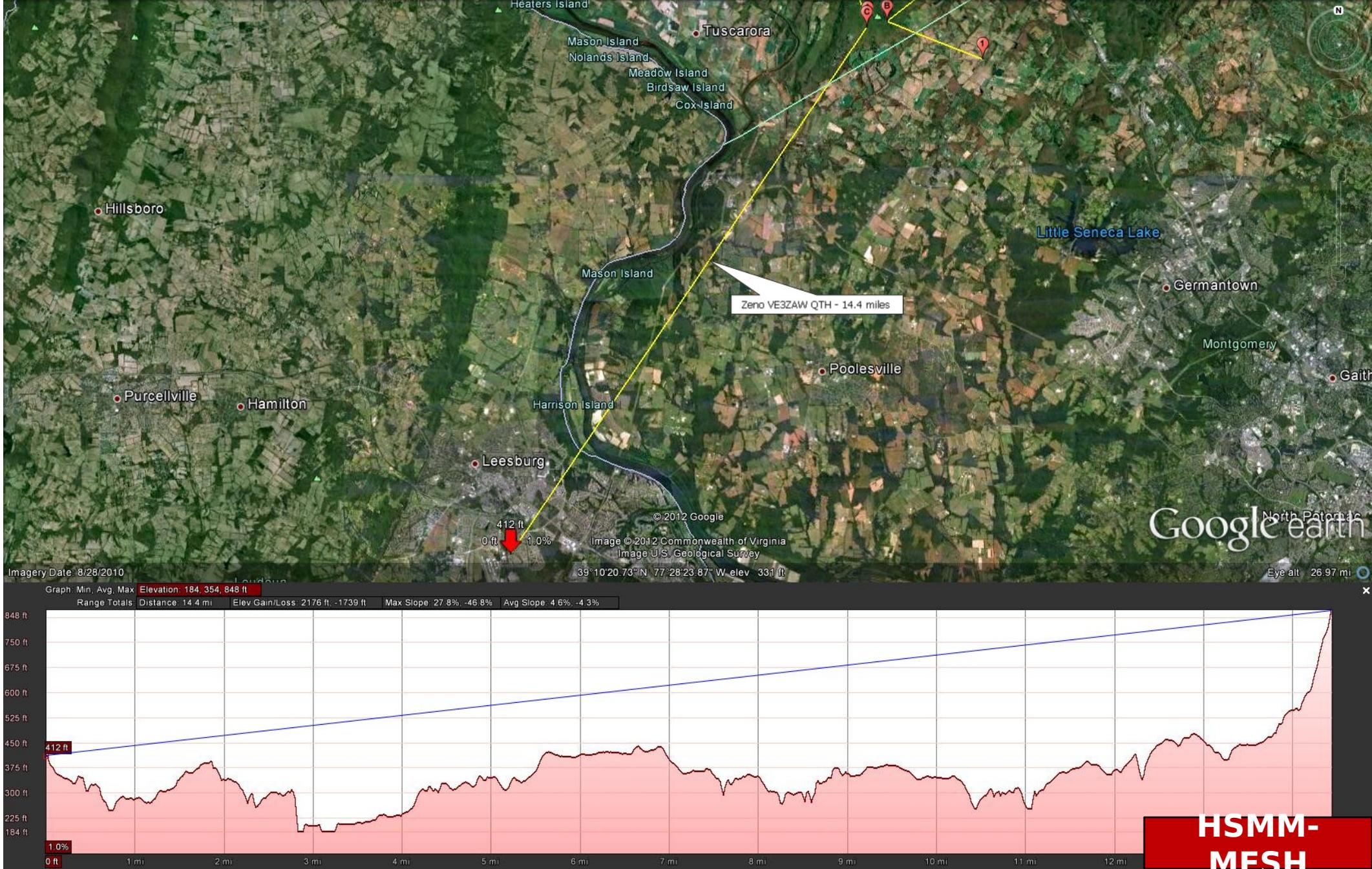
7.4 miles



Sugarloaf Mountain

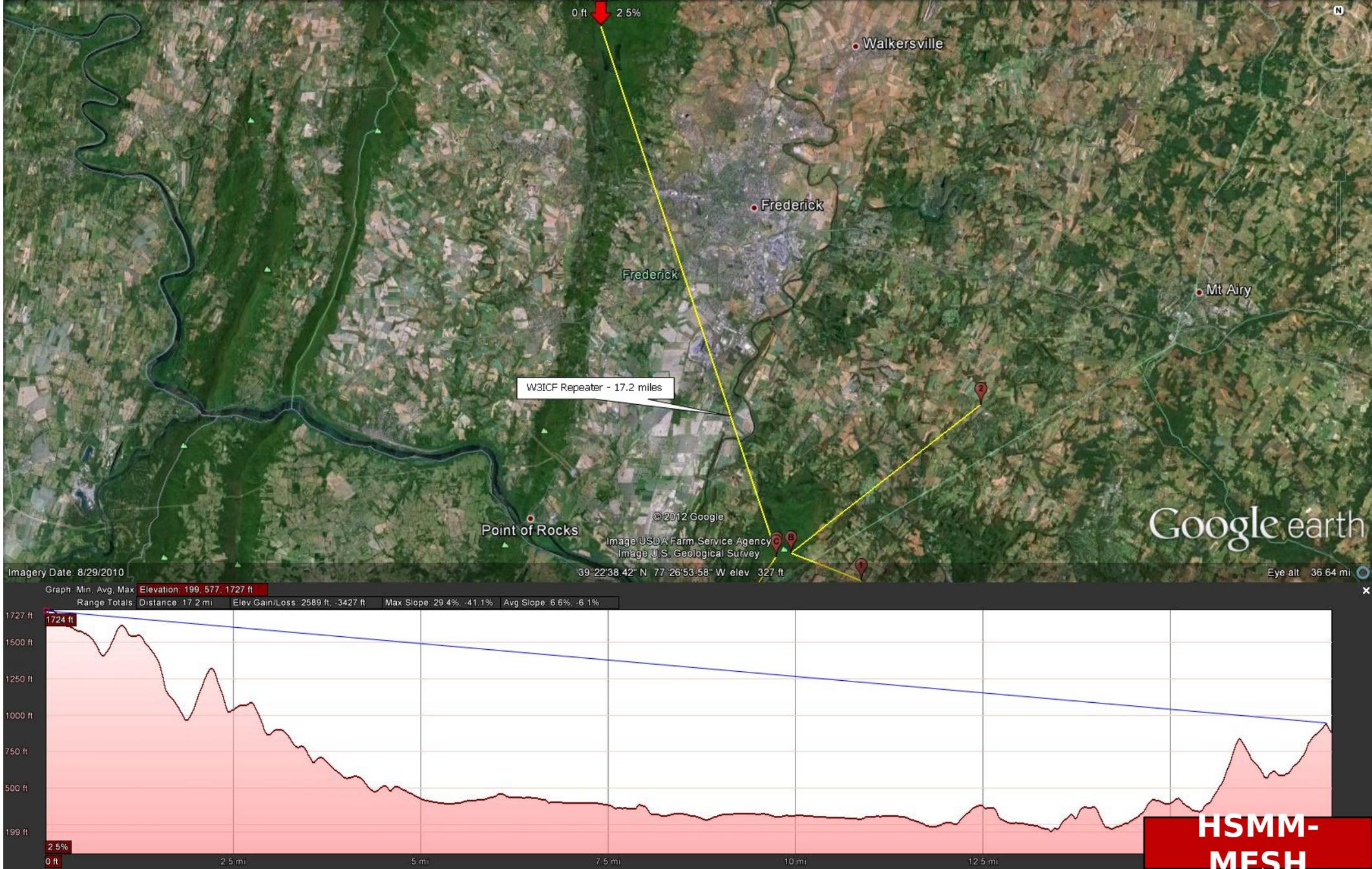
Leesburg, VA

14.4 miles



Sugarloaf Mountain Gambrill State Park

17.2 miles



Future Endeavors

- Use analog radios with D-RATS to bridge the line of sight limitation.
(Resource paper by Kirk - KB3ONM)
- Use 420 MHz PC cards to bridge the line of sight limitation.
- Voice over IP for real-time voice communications