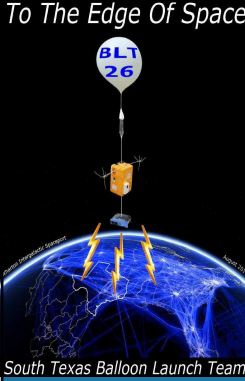



To The Edge Of Space

HSMM-MESH™

Sep 2010 BVARC Meeting
Andy W5ACM
Kirk KK2Z

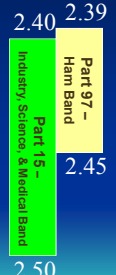
HSMM – What is it?

High Speed Multi Media = HSMM

- ARRL HSMM Working Group created in 2001 to develop high speed (faster than dial-up modem) digital networks for the Amateur Service
- HSMM champions the use of “commercial off the shelf” (COTS) equipment

HIinternet = Ham + Internet

IEEE 802.11b/g vs. 2.4 GHz Ham



Channel	Low	Center	High
1	2.401	2.412	2.423
2	2.406	2.417	2.428
3	2.411	2.422	2.433
4	2.416	2.427	2.438
5	2.421	2.432	2.443
6	2.426	2.437	2.448
7	2.431	2.442	2.453
8	2.436	2.447	2.458
9	2.441	2.452	2.463
10	2.446	2.457	2.468
11	2.451	2.462	2.473

“Ham” 802.11b/g


- Inexpensive (~\$60 for WRT54GL)
- “Stock” Power (**75mW-250mW**)
- Modified Firmware (OpenWRT, DD-WRT)
- Amplifiers (**500mW-1000mW** typical) → Part 97 allows up to **100 W!**
- Antennas, Antennas, Antennas (Yagi, Dish, Helical, GP, ...)

Routers / Client Cards



Linksys WRT54GL Router
HSMM-MESH Firmware
250mW Max Output
[\(Linksys\)](#)

BDA's / Antennas



2.4GHz BDA
1W Max Output (Part 15)
1.8W Max Output (Part 97)

Comet Omni
15.4 dBi
[\(FAB-Corp\)](#)

Antennas



ARC Wireless Patch
19 dBi Gain
(FAB-Com)



DieCast Parabolic Grid
24dBi Gain
(FAB-Com)

HSMM Uses

- Emergency communication (e-mail, file transfers including images)
- Two-way streaming video
- Full-duplex streaming audio,
- Voice over Internet Protocol (VoIP) such as eQSO, EchoLink, iLink and IRLP, and digital voice

HOW FAR DO WE OPERATE?

NEEDS LINE OF SITE FROM Antenna TO Antenna

Flat terrain → Limited by Distance to Horizon versus Antenna Height

Mountainous → 75 MILES between mountains

Austin → Water tower to Water tower clear path

Houston → Balloon to ground – Field Day vs BLT-26

Remember – NO Obstructions!

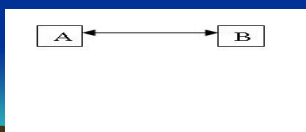
Range

- Range experiments are over
 - 134 MILES at sea in Italy,
 - 79 MILES in the California Coastal Mountains,
 - 34 MILES per leg in the Shenandoah valley,
 - 18 MILES to the edge of space!! BLT-26
 - 10 MILES across Austin, Tx.
- For reference, stock antenna and firmware only allows for about 300 FEET

What is a “network”

Ad Hoc or a Peer to Peer network

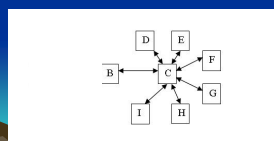
- Point to Point network.
- Node address can be manually assigned
- looks like this.



What is a network

Infrastructure network

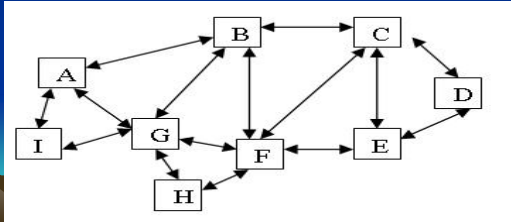
- Typically, star shaped network.
- Nodes join and drop off.
- Access Point controls many service functions like assigning addresses.



What is a **MESH** network

MESH Network:

- “Infrastructure-less” collection of “overlapping” radio access nodes in a mesh topology
- Think about a cell phone network

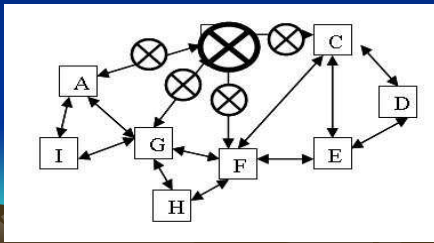


Advantage of a Mesh

- Self Forming
 - Mesh forms automatically
- Fault Tolerance
 - Data automatically rerouted if a node fails
- Self Healing
 - Once fixed, node rejoins the mesh seamlessly
- Community Ownership
 - Ownership is shared, node by node
- Low Cost Infrastructure
 - Built using low cost off the shelf consumer equipment
- Incremental Cost of Expansion is Low
 - Adding node expands area coverage for the cost of the node
- Ease of Deployment
 - Little or no training needed

MESH Network Diagram

- Broken net self heals
- Finds shortest route
- Fixes broken routes
- Adds routers as they show up
- No manual configuration



Nodes in a MESH Network

In a MESH, each node...

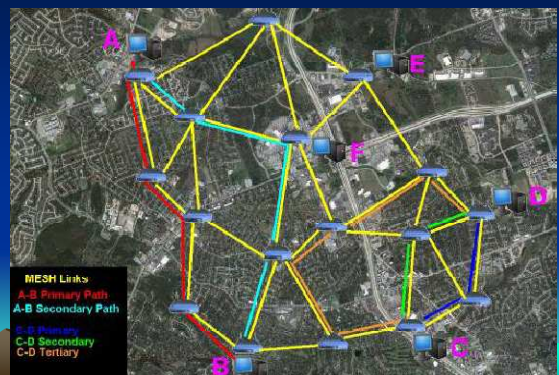
- Links to any node it can hear on the network
- Builds a routing table to track which nodes are currently connected to the MESH to enable routing messages through the MESH
- Can connect to a resource (internet, video camera, etc) allowing all nodes to have access to the asset

What is HSMM-MESH™?

- A HSMM-MESH™ System is a MESH node loaded with special Ham developed MESH software providing Optimized Link State Routing (OLSR)
- See... <http://hsmm-mesh.org>

AFTER THE BREAK...
We'll look at an HSMM-MESH network

Austin HSMM-MESH™ Net



Acknowledgements

Content was found in many sources, but primarily in presentations by:

- Bill Wallace KC0TGY
- John Champa K8OCL
- John Beadles N5OOM
- Kipton Moravec AE5IB

Questions?



Backup Slides

Power Limits

- Part 15 Unlicensed low power Maximum Transmitter Power Output (TPO) is **1.0 watt or 30dBm**
- Part 97 Amateur Radio regulations Maximum Transmitter Power Output (TPO) is **100 watt or 50dBm**

dBm to Watts

dB	Watts	dB	Watts	dB	Watts
0	1.0 mW	16	40 mW	32	1.6 W
1	1.3 mW	17	50 mW	33	2.0 W
2	1.6 mW	18	63 mW	34	2.5 W
3	2.0 mW	19	79 mW	35	3.2 W
4	2.5 mW	20	100 mW	36	4.0 W
5	3.2 mW	21	126 mW	37	5.0 W
6	4 mW	22	158 mW	38	6.3 W
7	5 mW	23	200 mW	39	8.0 W
8	6 mW	24	250 mW	40	10 W
9	8 mW	25	316 mW	41	13 W
10	10 mW	26	398 mW	42	16 W
11	13 mW	27	500 mW	43	20 W
12	16 mW	28	630 mW	44	25 W
13	20 mW	29	800 mW	45	32 W
14	25 mW	30	1.0 W	46	40 W
15	32 mW	31	1.3 W	47	50 W

SECURITY OF SIGNAL

- WEP and ENCRYPTION are acceptable to ARRL and FCC.
“Not obscuring but securing the message”
- Similar to control link to repeaters
- If we change the crystal “slightly”, we can move the Ham use to in-between standard 802.11 channels →
Hidden from NET-STUMBLER, ETC.