Introduction to the Mesh  The Montgomery Amateur Radio Club, March 5, 2014
If you want a presentation on the MESH at your local group, send me an email and I or someone else will get back to you. mesh@KB3TCB.com
If you have worked with a Mesh and a presentation you would like to give, please let me know, I have requests for presentation in a wide area!

Mother of all sites

Broadband-Hamnet

Broadband-Hamnet™ is a high speed, self discovering, self configuring, fault tolerant, wireless computer network. Its primary focus is on emergency communications.

Getting Started

Wireless Networking in the Developing World
HSMM HSMM-MESH - Seminar Session 1 [Kipton Moravec AE5IB] (PDF) - February 6, 2010
HSMM-MESH - High Speed Multimedia MESH Network [Montgomery ARC] - 2012/04/11
HSMM-MESH™ - BVARC Meeting [Andy W5ACM] - Sep 2010

Use Cases

● A Broadband Ham Network Crosses the Finish Line

Disasters and Emergencies

● Minneapolis network aids rescuers-bridge collapse
● Comm Center Deployment - Amazon S3
● The Mesh
● Wireless To Enhance Mass Casualty Treatment
● Wildfire Exercise in Maine

● 2013 After Action Report - City of Berkeley
● Wind - Greece (click UK flag for English)
● CalMesh: Mesh Supports Emergency-Response

Slide Presentations

Public Networks for Public Safety Briefing Document
COTS Wireless.pdf - Oahuraces.org
Broadband-Hamnet™ Update 2010 Glenn Currie, KD5MFW, (Summerfest 2010)
Broadband-Hamnet™ Update 2013 Glenn Currie, KD5MFW, (August 2013)
High Speed Multi Media – Mesh Networking Using Commercial Off
Introduction to Mesh Networking Doug Kingston, KG2IQ (2013-01-17)
MSMM-Mesh Presentation - HLARC Rik Chapman, K5RIK (March 29, 2013)
High Speed Data for HAM Operators Larry Pesc
WELCOME To HSMM-MESH K4VRC
A strong dependence on point-to-point communication links and a limited degree of redundancy give these systems an insufficient level of resilience and robustness in disaster scenarios.
Broadband Hamnet™ Router Shopping Guide

This list is from the Broadband Hamnet™ site, please contact them for possible changes. I have tested WRT54G and WRT54GS units and they work as indicated. I have tested some Ubiquiti units.

Existing Systems

Maryland

- **5 GHz and Directional Antennas** Baltimore Radio Amateur Television Society B.R.A.T.S.
- **Emergency Cloud system** Jesse Alexander, (January 24, 2014)
- **Raspberry wifi HSMM-MESH node Emergency Cloud Server** Jesse Alexander, WB2IFS
- **Raspberry Emergency Cloud Server** Jesse Alexander

Clubs

- **York Region ARC (YRARC)**
- **Integrating HSMM-MESH into an existing net** Ohio Packet
- **WSU Amateur Radio Club WAN (W7YH)**
- **W8QQQ – SARA Field Day HSMM Setup** Shiawassee Amateur Radio Association
- **Presentation from LETARC Meeting** 01/2014
- **grapevinehamradio**
- **Clearfield County ARC**
- **Orange County Radio Amateur Civil Emergency Service** August 2013
- **Introduction to Broadband-Hamnet (HSMM-MESH)** Brown County ARES/RACES
- **Sunset Empire ARC** Aug
- **Hurst ARC – W5HRC** February 2013
- **Gadsden ARC, LLC** April 22, 2013
- **Garland ARC, The Arclite** August 09
- **Temple ARC** Dec 2011
- **Rockwell Collins Amateur Radio** May 2011
- **Newsletter - Manatee-arc.org**
- **Austin ARC** February 2013
- **Rockwell Collins ARC** May 2011
- **Orange County Radio Amateurs** August 2010
- **Carrier - Mount Diablo ARC** May 2012
- **Newsletter, Tri-County ARC Inc.**
- **AARO Newsletter Alamo Area Radio Organization** February 2013
- **Cedar Valley ARC** August 2012
- **Mike And Key ARC** October
- **San Angelo ARC, Inc.** June
- **OARC e-Magazine - Ogden ARC**
- **Mid-Atlantic ARC** March 2013
- **Grayson County ARC News**
• Palomar ARC - Feb
• Newsletter - Manatee-arc.org
• BLT-26 and HSMM MESH -- Flight Results - BVARC
• The Exciter - Denton County Amateur Radio Association
• Editorial Sum09-Cq-Vhf.com
• MARC Newsletter - The Mississauga Amateur 2012 November
• Membership Meeting Minutes - Grand Rapids Amateur March 2012
• Newsletter - W2JSN.com February 2013
• meeting (Approved)-Enid ARC Minutes of July 2010
• Minutes of PREVIOUS MEETING 2013 (DRAFT)-Enid ARC
• W9UVI September 2013
• Hammet (Mesh) at HOTARC
• Highland Lakes Amateur Radio Club HLARC
• 2013 October Meeting Slides - Amateur Radio Association of
• W5ES Sep. 12
• Aug - Seaside Tsunami Amateur Radio Society
• 4x4 Ham Forum - HSMM Mesh Node - 2.4GHz & Part 97 (Part 4 - Calculating Mesh Link Performance)
• Digital Communications - Cascade Amateur Radio Society
• eaars August
• eaars September
• newsletter - N4brf.org december 2012
• Newsletter - Wa6bgs.us August 17, 2013
• Zero Bias
• Lake County Ham Radio Journal April/May 2010
• Palacios TX rally review - RV Radio Network
California
• Santa Clara County OES
Florida
• Martin County Amateur Radio Association • Martin County ARES
• Operation RADAR II Exercise Putnam County
New Jersey
• Fair Lawn Radio Emergency Service • Bergen Amateur Radio Association's
Pennsylvania
• Western PA ARES begins Tech Initiative
Texas
• Montgomery County ARES
Montgomery County Amateur Radio Emergency Service
• Montgomery County Ham Radio
Information about the clubs, hams, activities, and repeaters relating to ham radio in Montgomery County, TX. Plus ...
How To

How to Enable a Guest Access Point on Your Wireless Network

Common RF Coax Connectors

hsmmmesh-step-by-step

W5MAE Rootenna HSMM-MESH Node

drop-boxes

Sector Antenna for 2.4 and 5.8 GHz YU1AW

Here's the how-to for WRT54RG Steve, VA3SRV

Configuring D-RATS to run over the HSMM MESH

Build a Patch Antenna for 2.4 GHz (~8 dbi)

Build a Bi-Quad Antenna or To feed a dish

FlashUbiquiti

Pidgin is a chat program.

Enabling ham radio channels in wireless

Raspberry

● Setting up Asterisk on a Raspberry Pi

● HSMM Pi Tabletop Demo (YouTube)

● HSMM Mesh - Raspberry Pi

● Raspberry wifi Emergency Cloud Server

● Setting up Asterisk on a Raspberry Pi

HSMM-Pi Blog

The HSMM-Pi project provides an easy way to transform a Raspberry Pi equipped with a USB wifi adapter into a wireless mesh node. HSMM-mesh nodes are different from other mesh nodes in that they can be operated at much higher power and with larger antenna structures.

Watts to dBm Converter ● Perl Scripts / Interactive Design / Software

Microwave Radio Path Analysis ● Wireless Network Link Analysis

Downtilt Coverage Radius ● Calculating your 802.11 power output.

RF Link Budget Calculator ● Proxim Link Budget Calculators

Broadband sites

HamWAN

Italian Cisar Radio Amateur WiFi Network Overview: CisarNet

What is the DRG and What is the AMPRnet

Managing the AMPRNet™ — TCP/IP Networking for Amateur Radio

Internet network 44 (44.0.0.0/8), known as the AMPRNet™, has been used by amateur radio operators to conduct scientific research and to experiment with digital communications.
Puget Sound Data Ring Bart Kus, AE7SJ
Northwest MESH Amateur Radio Networking Bart Kus, AE7SJ
HamWAN: Modern IP Networking on Ham Bands Ryan Turner, K0RET
British Columbia Wireless Amateur Radio Network
DB0KV HAMNET-Userzugang aktiviert
AMPRNet IP Koordination

Misc.

KF7BWS Amateur Radio
Mesh Amateur Radio
Visionary of the Valley WU2S
FCC report and order WT Docket No. 97-12 (regulatory aspects of 802.11 use)
Wireless Security Products
Netstumbler
Putting High Speed Multimedia to Work in Italy
San Diego wireless net installs 72-mile, 2.4-GHz link November 12, 2002
AirSnare
yahoo HSMM-MESH SIG
EL PASO, TX Doug AE5HE, (Apr 8, 2012)
Mesh Network Field Test – NP2X (Great Pond, St. Croix), Jun 27, 2012
Welcome to the Stateline Repeater System
MMARS and GAIA Dot Org - FinalDraft - marspapers.org
Roadmap Doc Version 3 - Cupertino Amateur Radio Emergency
Starting to use HSMM-MESH™
New High-Speed Multi-Media Radio Mesh Networking - Transistori.net
HSMM Radio Equipment - QSL.net
Design and implementation of a Wireless Link in a HSMM - MESH
Ham-Com
Point-to-Point vs. MESH
Mesh vs. point-to-multipoint topology
Point to Multipoint (PtMP) vs. MESH
To Mesh or Not To Mesh for Wireless Security and Surveillance
An Infrastructure for Long-Term
What wireless microwave to use and when July 7, 2013
Wireless Battle Mesh
Wireless Mesh Routing and Wireless Bridging Architecture
MobiMESH vs Others

Government

- 2011 DCC - Digital Modes for EmComm - FCC
- ARES-RACES WebEOC Input - Michigan Section ARES
- Stark County Amateur Radio Emergency Service Website
YouTube

Point to Point Microwave Paths for HSMM
Introduction to HSMM-MESH or Broadband-Hamnet
Overview: Mesh Networks
Phoenix HSMM-Mesh Node Antenna Height Calculator
HSMM flexibility with the D-Star ID-1
HSMM-MESH Node for Amateur Radio

Ham Radio HSMM Using Ubiquiti Equipment (Part 1)

HSMM-MESH Test approximately 5mi point to point near Otisville, NY. Part 1
HSMM-MESH
Big Bend 50 Ultra Marathon HSMM-Mesh(TM) networking
Setting up a MESH Node for Amateur Radio - WRT54G firmware install. HSMM-MESH
WIFI Internet tower. UBNT
High Speed Multimedia in Albuquerque
Mesh Experimentation for Emergency Communications

HSMM-MESH V 1.0
420 MHz Broadband Mesh Network for Emergency Communications Part Two
Mesh Upgrade
HSMM MESH
Ham Radio HSMM Using Ubiquiti Equipment (Part 3)
Test 5mi point-to-point Otisville, NY. Part 2
Update Firmware on a Remote Node - Testing Using Mesh Nodes to set up Pharmacy Digital Signs
The Mesh Network: Powering Tomorrow

3 PirateBoxes in a B.A.T.M.A.N. Mesh network
Get to know Open-Mesh

Introduction to HSMM-Mesh
HSMM-Pi - Location and Service Forwarding Demo
iCruze display on a Broadband-Hamnet (HSMM-Mesh) node

Linksyst Router to HSMM-MESH node AE5IB Dayton 2012.mp4
Setting up a MESH Node for Amateur Radio - WRT54G firmware install. HSMM-MESH

How To Configure Your HSMM-Mesh Nodes for N3FJP and N1MM Contest Loggers

2-6-2010 HSMM-MESH Webinar
DCARC December 2012 Homebrew - Gerald Hasty
York Region Amateur Radio Club - Emergency Preparedness Fair
WISPER for first responders on KITV4 News

HSMM MESH in Big bend 2013
Recording with HD Camera on Mesh Networking
Enabling ham radio channels in wireless 802.11 devices (updated)
Test a Cisco CP7971G-GE SIP K5KTF and WA5VBP

HSMM MESH in Big bend 2013
WiFi Stand Prototype for HSMM

Test 5mi point-to-point Otisville, NY. Part 3
KD5MFW 2012 HamComm HSMM-Mesh Project Update
How To Flash a Cloudtrax Enabled WiFi Router with Open Mesh NG Firmware for WiFi Network Tutorial
Open-Mesh- WiFi Install Using Open-Mesh and CloudTrax
Getting started with the Mesh Network project
Open-Mesh Indoor Wall Plug Enclosure
Mesh Network Radio is Plug and Play Right Away!
Mesh Networks / New Antenna Technologies - Wireless LAN Weekly EP 25

High speed mobility test @ 802.11n based MESH Mobility system

SAT: A Security Architecture Achieving Anonymity and Traceability in Wireless Mesh Networks

Mesh Node Ron Ziernicki, VA3RRZ

Hamradio Pacificon event at the ARRL Forum Chris Imlay, October 16th 2011

WISPER Demo - Outdoor. Disposable wireless mesh communication nodes

Adding an Analog Telephone

HSMM Range Test

Net 44 - Amprnet update John, K7VE, Jan 30, 2013

HAMNET

hamnet radio amateurisme DB0KWE HAMNET DiaShow

Hamnet Migration DB0KWE Modifikation des HamNet DB0KWE

Hamnet

Non-Amateur Networks

- Village Telco, Mesh Potato
- Byzantium - wireless mesh networking for the Zombie apocalypse
- Mesh Projects
- Hyperboria Sites - see the list of available services.
- Meshnet - using CJDNS - Seattle or Santa Cruz
- Seattle Wireless - previous community wireless project. Still lots of good data in the wiki.
- Manly Warringah Radio Society March - Mesh Potato's and Wifi Networking (YouTube) 2013
- Introduction to Mesh Networking 2011

Community Networks

- Community Wireless Approach in Mount Pleasant, DC
- Commotion Wireless - an open-source communication tool that uses mobile phones, computers, and other wireless devices to create decentralized mesh networks.
- Serval Mesh - Emergency Preparedness MESH project
- SPAN - Smart Phone Ad-hoc Network
- Serval Mesh Extender - http://igg.me/at/speakfreely
- Serval Mesh 0.90 Demo

Companies - Products

(These are not endorsements, just items that have come to our attention.)

- 900 MHz wireless Ethernet bridge
- l-com
- Radiolabs
- Communications Technology Group W2TTT
- TP-LINK TL-ANT2424B 2.4GHz 24dBi Grid Parabolic Antenna
- Instant Mesh Radio
- Parabolic dish antenna (24 dbi) (Hint: consider "used")
- Fleeman, Anderson, & Bird (cables, antennas, POE, etc.)
- ISP Supplies (wi-fi antennas, etc. in College Station, TX)
- NanoStation M900 Loco (900MHz)

Unclassified

1. Constrained Channel Assignment...Mesh Networks
2. W1GHZ Microwave Antenna Book (LOTS of technical info!)
3. HeyWhatsThat Signal Profiler (terrain calculator)
4. Adding a secure shell login (SSH) (by AE5CA)
5. HSMM-Mesh for public safety?

Articles to Read

1. QST July 2013 pg 68-69 (HSMM in a special event)
2. Redolving HSMM interference, CQ VHF KB0CL , (2003)
4. WiFi RF Spectrum by W5VWP
5. Using Part 15 Wireless Ethernet Devices For Amateur Radio
6. Multipath and Diversity Mode (Cisco article)
7. Antenna Basics (easy and informative read)
8. Parabolic Dish Antenna Theory (by Paul Wade N1BWT)
9. Offset Dish Antenna Theory
10. Patch Antenna Design (how-to)
11. Rootenna Design (how to)
12. Horizontally Polarized Omni Antenna (how to)
13. Linking HSMM-Mesh into Your Home Network (how to by Ohio Packet; use local.mesh now.)
14. Peek into a Ubiquiti Nanostation (photos under the hood)

dBm to Watt Conversion Table

<table>
<thead>
<tr>
<th>dBm</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0 mW</td>
</tr>
<tr>
<td>1</td>
<td>1.3 mW</td>
</tr>
<tr>
<td>2</td>
<td>1.6 mW</td>
</tr>
<tr>
<td>3</td>
<td>2.0 mW</td>
</tr>
<tr>
<td>4</td>
<td>2.5 mW</td>
</tr>
<tr>
<td>5</td>
<td>3.2 mW</td>
</tr>
<tr>
<td>6</td>
<td>4.0 mW</td>
</tr>
<tr>
<td>7</td>
<td>5.0 mW</td>
</tr>
<tr>
<td>8</td>
<td>6.0 mW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>dBm</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>40 mW</td>
</tr>
<tr>
<td>17</td>
<td>50 mW</td>
</tr>
<tr>
<td>18</td>
<td>63 mW</td>
</tr>
<tr>
<td>19</td>
<td>79 mW</td>
</tr>
<tr>
<td>20</td>
<td>100 mW</td>
</tr>
<tr>
<td>21</td>
<td>126 mW</td>
</tr>
<tr>
<td>22</td>
<td>158 mW</td>
</tr>
<tr>
<td>23</td>
<td>200 mW</td>
</tr>
<tr>
<td>24</td>
<td>250 mW</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>9</td>
<td>8 mW</td>
</tr>
<tr>
<td>10</td>
<td>10 mW</td>
</tr>
<tr>
<td>11</td>
<td>13 mW</td>
</tr>
<tr>
<td>12</td>
<td>16 mW</td>
</tr>
<tr>
<td>13</td>
<td>20 mW</td>
</tr>
<tr>
<td>14</td>
<td>25 mW</td>
</tr>
<tr>
<td>15</td>
<td>32 mW</td>
</tr>
</tbody>
</table>

**Tools**

**Wireless Network Link Analysis**
Calculates approximate received power levels and fade margins for wireless links

**Wireless Network Link Analysis - Super Edition**
Same as above, but generates a PDF file containing Fresnel zone and radio path graphs

**latlong.net**
Latlong.net is a geographic tool that lookup lat and long of a place and get coordinates on map.

**Microwave Radio Path Analysis**
Generates a terrain profile graph and obstruction reports for a microwave radio link between two points

**Line-of-Sight Path Analysis**
Generates a JPEG image showing the line-of-sight path for a given transmitter location

**Longley-Rice Path Loss Analysis**
Generates a JPEG image showing the estimated Longley-Rice path loss for a given transmitter location.

**Tower Coverage**
Allows you to create Tower Coverage Maps for any geographical area in the entire world. Our maps are based on region and topography, taking into account for hills, mountains and trees.

**Parabolic Reflector Gain & Focal Point Calculator**
Calculates the gain, focal point, and radiation distances for parabolic dishes

**Fresnel Zone Calculator**
Calculates the required Fresnel zone clearances for a point-to-point link.

**Urban Area Path Loss**
Calculates the approximate path loss through an urban area

**Antenna Up/Down Tilt Calculator**
Calculates the required antenna tilt to compensate for Earth curvature

**Alphimax PtP Estimator**
The Point-To-Point Estimator is a free web based tool that will enable you to compare manufacturers, simply and accurately, while taking into account the terrain of your area, products’ performance and more.

**Distance & Bearing Calculator**
Calculates the distance and bearing between two geographic points

**Omnidirectional Antenna Beamwidth Analysis**
Estimates the coverage of a vertical antenna pattern

**Knife Edge Diffraction Loss Calculator**
Calculates knife edge obstruction attenuation

Decibel Conversion Calculator
Converts various values referenced to/from decibels

Scattering Parameters Are Fun!
Calculates gamma in/out from S-parameters, experimental

United States Ground Elevation Retriever
Get the ground elevation to any point in the continental United States, experimental (dynamic IP)

TCS Online Conversion Page!  Everyone likes to steal their Javascript

Wireless tools for Linux

Radio Mobile Deluxe  A free RF path plotting tool from VE2DBE.

Terraform

Wireless Network Link Analysis
Interactive Wireless / RF Design Utilities < dd>

Times Microwave attenuation calculator

Distance and azimuth calculations at the FCC

Antenna Height Above Average Terrain (HAAT) Calculator

Google Earth
Explore the elevations of a particular path through the Elevation Profile. To start, either draw a path or open an existing one. Once you've chosen a path from the Places panel, there are two ways to see its Elevation profile. Either go to Edit > Show Elevation Profile, or right-click on your path from the Places panel and select Show Elevation Profile. An Elevation Profile will appear in the the lower half of the 3D Viewer

Earth tools
Find Elevation/Height Above Sea Level, Find Local Times and Time Zone. Contour Maps...

HeyWhatsThat Path Profiler
You hike to the top of a mountain or pull off at a scenic overlook. You see mountains in the distance. Which mountains are they? HeyWhatsThat will tell you, providing a 360° panoramic sketch labeled with the names of the peaks you're looking at. From almost anywhere in the world. dd>

Radio Mobile
It uses digital terrain elevation data for automatic extraction of path profile between an emitter and a receiver.

Online Performance Calculator
There are several online websites which contain tools necessary to do path analysis. The Radiolabs site has one of the better implementations.

Fresnel Zone Calculator
While you may find several Fresnel calculators online (including at the RadioWorks site above), this link will take you to a calculator which allows for differing RX/TX antenna heights, which allows you to calculate Fresnel zone obstacle clearance during your path analysis.

UbiquiTi online tool to help you calculate the probable performance due to the environment, height, terrain and other factors.

Wireless LAN Calculator
The TP-LINK wireless calculator will provide you with answers to questions like maximum separation, transmission power, and link quality.

D-Link Wireless LAN Calculator

The D-Link has several sections, Calculate Distance & Fresnel Zone, Calculate Fade Margin and Select Antenna.

Low Cost Wireless Network How-To

Collected by Keith KB3TCB
If you have a link that you feel should be added, email the title and URL to mesh@KB3TCB.com