What is HSMM?

• HSMM is High Speed Multi-Media.
• Name of an ARRL Working Group chartered to find out what it would take to do high speed data and other modes on frequencies above HF.
• The WG “donated” some ideas to the folks in Austin with projects they had already started.
• Originally tried to help out the ARES packet situation in and around Austin.
What is a Mesh?

- A mesh is a type of computer network.
- Wireless mesh networks were originally developed for military applications.
- A mesh is self discovering, self configuring, self advertising, and usually fault tolerant.
- The easiest to set up and most capable while running.
Structured Wireless Network

One hop wireless routing
Wireless Mesh Network

- Finds shortest route
- Fixes broken routes
- Adds routers as they show up
- No manual configuration
What is HSMM-MESH™?

• A high speed, data network for:
  – Images & Video
  – Data (files, email, chat)
  – Voice (VoIP & RoIP)

• The network of choice when the need arises to quickly create a network where none exists.

• Original intent was to provide computer networking for emergency situations.
What is HSMM-MESH™?

• While it is self-sufficient the mesh can be connected to “outside” network(s).
  – Internet for services (Data, Voice, Video).
  – Connect to distance meshes via the Internet.
  – Facilitate communications between served agencies/services.

• Suitable for permanent installation.
What is HSMM-MESH™?

- Based upon popular, license free 2.4-GHz ISM band that partially overlaps Part 97 allocations.
- Utilizes cheap 802.11b/g, Part 15 hardware which we operate under Part 97.
- Currently using consumer WiFi routers such as the Linksys WRT54GL.
- But consumer grade equipment has issues...
What can it be used for?

• Pretty much anything you can do on the Internet you can do with HSMM-MESH.

• Connect existing amateur digital services
  – Echolink, IRLP, APRS, D-Star, Winlink nodes.
  – Put equipment where RF coverage is best, not just where internet service is available.
  – Provide redundancy in the event of a land line Internet failure.
What can it be used for? (2)

- To an extent, provide internet connections to remote locations where land lines do not exist for:
  - Disaster recovery event
  - Special/Public Service events
  - 2-5 mi hops easy, 15-20 mi hops possible
  - Terrain dependent (clear line-of-sight, vegetation absorbs)
What can it be used for? (3)

- Shelter Operations
  - Client Email or Telephone
  - Written Text to Hospitals and Pharmacies
- Disaster
  - Real-time Video
- Video of Wall Cloud, Tornado, Fire
  - Photographs
  - Trees Down, Hail, Power Lines
  - Telephone & Video Conferencing
What can it be used for? (4)

- Infrastructure Failure
  - Support Police / Fire
  - Support Hospitals (images!)
  - Support Responders in field
    * ARES (Amateur Radio Emergency Service)
    * CERT (Citizen Emergency Response Team)
    * MRC (Medical Reserve Corps)
Wild Ride - Rest Stops 2 and 3

- W5LT
- Rest Stop #2 (4.5 mi)
- Rest Stop #3 (9.7 mi)
Plano Balloon Festival Site

- Field Operations
- Communications Trailer
- Flight Director Scissor Lift
- Field Entry/Exit Point Camera
- First United Methodist Church (Internet Access)
Big Bend Ultra Run
Haiti Relief (Inveneo/SET)

Red Mesh Nodes
Blue Possible Internet Access
Tacks Embassy and Airport

Epicenter
What's needed for HSMM-MESH

• Off the shelf WiFi Routers
  – $50 - $100 (less than any new Ham radio)
  – Must support external antennas
  – Operate channels 1 – 6: in the Ham Band

• Custom firmware - HSMM-MESH

• High Gain Antennas (optional)
  – $20 - $100 (or More) Omni and/or Directional

• Accessories
  – Power, batteries, cables, masts, boxes, etc.
Preferred Routers

- Linksys WRT54G
  - Versions 1.0 thru 4
    - 4 MB Flash/16 MB RAM
  - Last produced was v8
    - 2 MB Flash/8 MB RAM
    - Soldered Antennas

- Linksys WRT54GL
  - Linksys v4
    - 4 MB Flash/16 MB RAM
    - $58.99 - $79.99 New
Preferred Routers

• WRT54GS
  – Versions 1-3
    • 8 MB Flash/32 MB RAM
  – Version 4
    • 4 MB Flash/16 MB RAM
• WRT54G-TM
  – 8 MB Flash/32 MB RAM
  – Relabeled WRT54GS v3 by T-Mobile
• Some models by ASUS and Buffalo.
Software/Firmware

• HSMM-MESH™ is based upon Linux (OpenWRT, Kamikaze v7.09).
• OLSR (Optimized Link State Routing) protocol added for building/managing the Mesh.
• Drastically reduced configuration needs.
• So simple even a CW op caveman can handle it... well, usually. 😊
Software/Firmware

• Ability to load additional applications, Flash memory permitting. ('GS v1-3 and G-TM better)
• Mesh node status screen allows point-and-click interface to each known node and service.
• Deployment is pretty much “Set it, and forget it!” (apologies to Ron Popeil)
• Can re-load original Linksys firmware.
# Point-and-Click Interface

## ae5ae-base4 mesh status

<table>
<thead>
<tr>
<th>Local Hosts</th>
<th>Services</th>
<th>Current Neighbors</th>
<th>LQ</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>ae5ae-base4 / attic</td>
<td>FTP Server</td>
<td>ae5ae-base1 / kitchen</td>
<td>100%</td>
<td>IP Camera</td>
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<tr>
<td>• silverbullet</td>
<td></td>
<td></td>
<td></td>
<td>Rustys IRC Server</td>
</tr>
<tr>
<td>• arduino1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• arduino2</td>
<td></td>
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<td></td>
<td>Garage IRC Server</td>
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<table>
<thead>
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<th>Remote Nodes</th>
<th>ETX</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Previous Neighbors</th>
<th>When</th>
</tr>
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<tbody>
<tr>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>
Antennas

- More “oomph” per $ than amplifiers.
- All kinds available on Internet
  - The ones in retail stores are very expensive!
- Vertical polarity
  - Omnidirectional is best for HSMM-MESH
- Horizontal polarity for point-to-point networking.
  - Less interference from other users
Range

- Range is based on
  - Antenna
  - Noise
- Assuming
  - Clear Line of Sight
  - Good Day
  - 19 dBm Transmitter

- Two 12 dB - 5 mi
- Two 15 dB - 10 mi
- Two 19 dB - 24 mi

Bigger is Better
Interpretation to ARRL HSMM WG from FCC Enforcement Branch via Chris Imlay

Radio Amateurs using 802.11 type modulation under Part 97 could use WEP, WPA, etc as our intent or purpose is to provide authentication and thus protect our networks from part 15 intrusions… and not obscure the meaning of the signals.

Under the following 4 conditions:
1. Use only frequencies above 50 MHz
2. No foreign/international traffic is permitted
3. The type of encryption used must be standardized and published
4. The specific encryption key used must be recorded in the station logbook

More detail in ARRL VHF Digital Handbook, Chapter 7, HSMM Radio
Operations

• Setup is simple. Only three items to enter at firmware load time.
• Point and click access to other nodes and attached services (e.g. cameras, servers, etc).
• Mesh networks with SSID of HSMM-MESH are interoperable.
• Feel free to experiment! Change your SSID if non-standard (another channel, encryption, different OLSR configuration).
Operations

• General participation in the mesh does not require any centralized administration.
• Access to the mesh is available only from a mesh node, not directly from client devices.
• Simply attach any WiFi access point to a node's LAN port for wireless access.
HSMM-MESH™ is NOT

• It is NOT a replacement for your home internet connection.
  – Being an Amateur Radio network, it can only carry traffic that is allowed under FCC Part 97 rules.
  – Several types of internet traffic are a violation.
• And it most certainly CANNOT be used in any way with your business network.
Deployment Considerations

- Enclosure & Mounting
- Power supply (120vac, battery, solar, etc)
- Antenna (microwaves, Fresnel zone)
- Alternate entry to router
- Network Monitoring
- Know your Operating Environment
- PRACTICE!
- Things can go wrong - who ya going call?
Where to go next

• Website - www.hsmm-mesh.org

• Meetings
  – Lucas - Digital Tuesday – k5prk.net Calender
  – Austin – Digital Wednesday (4th Wed.)

• Yahoo Groups
  – Dallas Area Working Group HSMM
    DAWG-HSMM
  – Austin Development Group
    Austin_HSMM_Development
Books

  – http://www.wndw.net, hard copy/PoD @ lulu.com

• Building a Rural Wireless Mesh Network

• "TCP/IP for Dummies" is in its 6th edition.
• "Linux for Dummies" is in its 9th edition.
• "Networks for Dummies" is in its 10th edition.
  (good info for troubleshooting networks)
The End

Questions?

Answers?

Compliments?

😊