

# *HSMM-MESH Seminar Session 1*

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Lucas, Texas

# *Overview of HSMM and the HSMM-MESH software*

- What is HSMM?
- What is it used for?
- What is the Hardware?
- What is the Software?
- What is OLSR and why do we care?
- What else do you need to know?

# *What is HSMM?*

- HSMM = High Speed MultiMedia
  - General Term not a specific mode
  - Digital Radio - but not keyboard communication
- All Modes Supported
  - Digital Voice
  - Digital Video
  - Keyboard Communications (Chat)
  - File Transfers
  - Email and surf the Internet

# *HSMM is not a Mode or Frequency*

- Needs wide bandwidth – higher frequencies
- **HOWEVER**
  - For the purposes of this presentation we will be talking about using modified WiFi equipment and generally 2.4 GHz
  - And Software we call it HSMM-MESH <sup>(TM)</sup>

# *What is it used for?*

- Anything you can do on the Internet you can do with this.
  - Email
  - Surf Internet
  - Transfer/Stream Pictures, Video, files
  - Video Teleconferencing (Skype)
  - Telephone (Vonage)

# *Uses For High Speed Data*

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- Shelter Operations
  - Client Email or Telephone
  - Written Text to Hospitals and Pharmacies
- Disaster
  - Realtime Video
    - Video of Wall Cloud, Tornado, Fire
  - Photographs
    - Trees Down, Hail, Power Lines
  - Telephone Video Conferencing

# *Uses For High Speed Data (2)*

- Infrastructure Failure
  - Support Police / Fire
  - Support Hospitals
  - Support Responders in field
    - ARES (Amateur Radio Emergency Service)
    - CERT (Citizen Emergency Response Team)
    - MRC (Medical Reserve Corps)
- Public Service Events
- Field Day

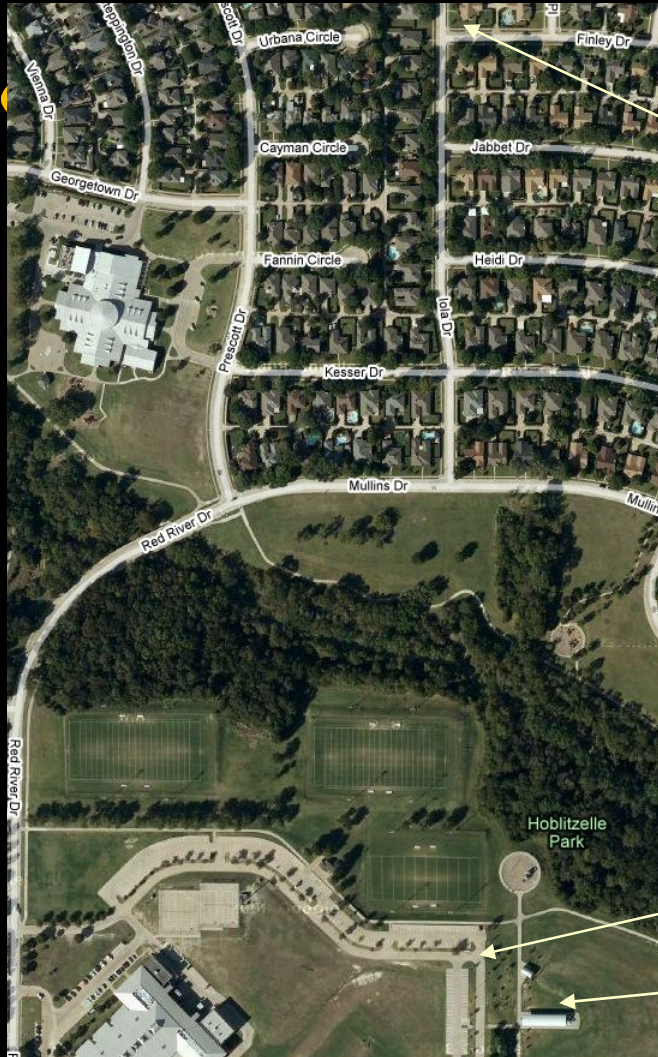
# *Planning 2007 PARK Field Day*

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- Found Ham that lived about a mile from Field Day.
- Break in trees provided CLOS to the hill we were on.



# *Field Day Site*



- Ham with home broadband internet access

- Relay
- Field Day site

## *Planning 2007 Plano Balloon Festival*

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- Surveyed site, asked Church if we could have access for the weekend
- Because of Wide angles we decided to go Vertical Polarity

# Balloon Festival Site



- Field Operations
- Communications Trailer
- Flight Director Scissor Lift
- Field Entry/Exit Point Camera
- First United Methodist Church (Internet Access)

# *PBF Church Routing*



- 15 db Rootenna Ch1 wire from access point
- Access Point for Church WiFi Ch 6
- Church Public WiFi Router Ch 6

# *Planning 2008 Wild Ride*

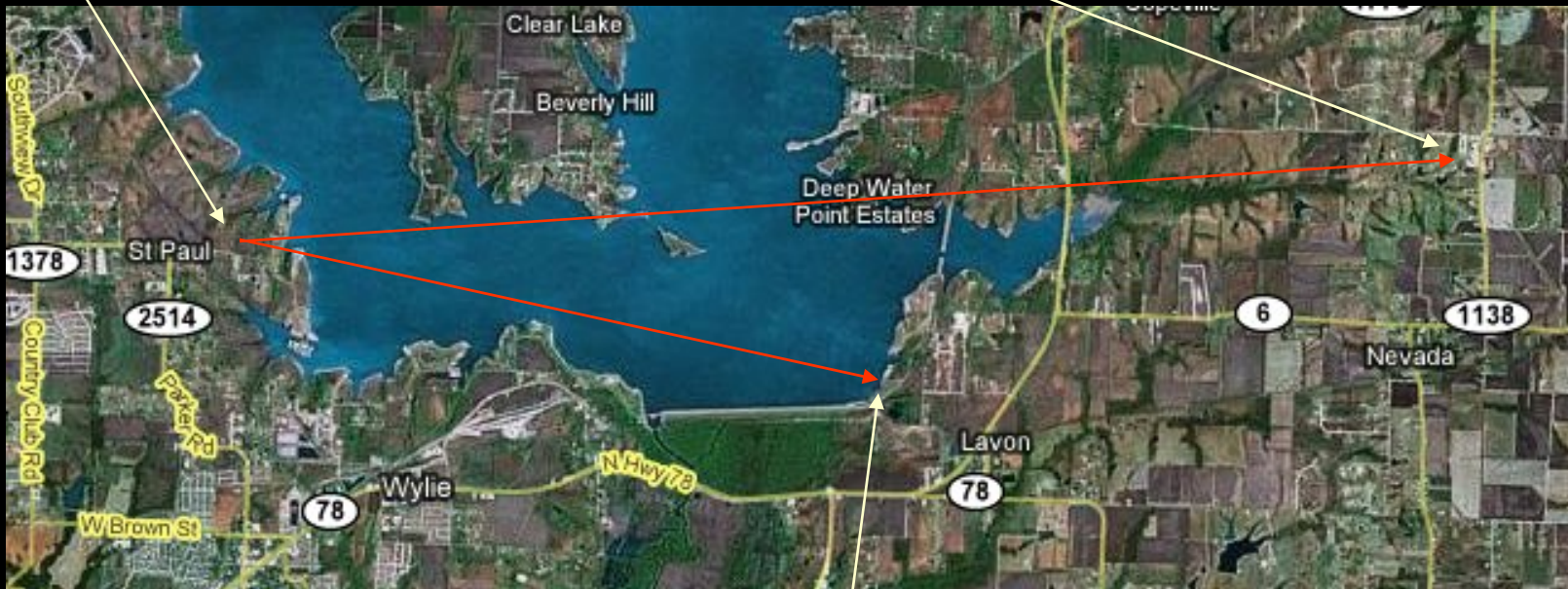
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- Goal: Provide pictures from Rest Stops to Start/Finish Line
- Have had lots of problems with 2.4 GHz
- 2007 used D-Star 1.2 GHz, worked well
- Found W5LT with a 70' tower that we guessed had CLOS to two of our sites. And he has high speed Internet access.
- Repeated in 2009 and 2010

# Wild Ride Rest Stop 2 and 3

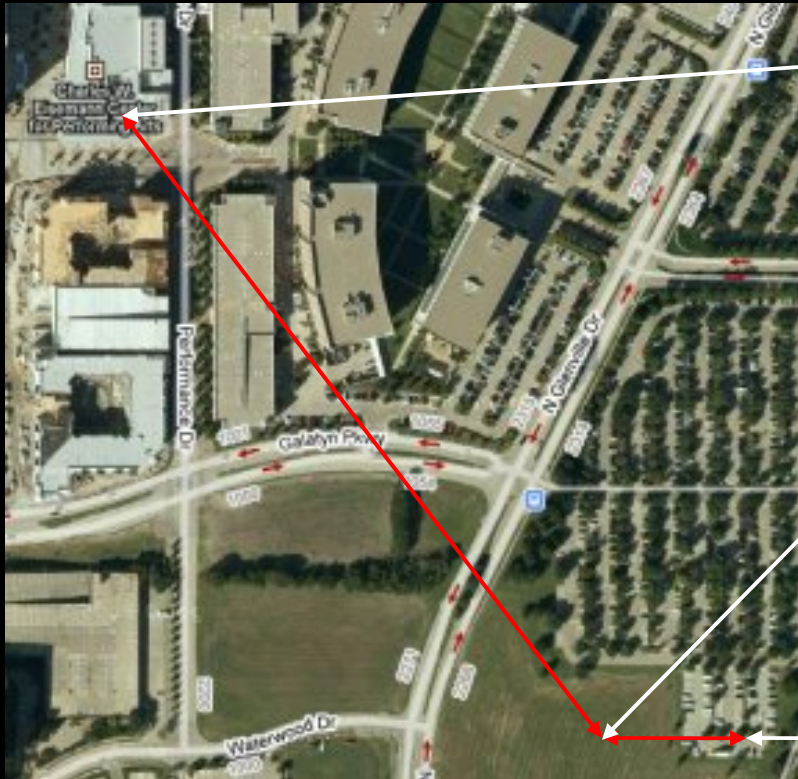
- W5LT

- Rest Stop #3 (9.7 mi)



- Rest Stop #2 (4.5 mi)

# 2007-2008 Wild Ride Start/Finish Line

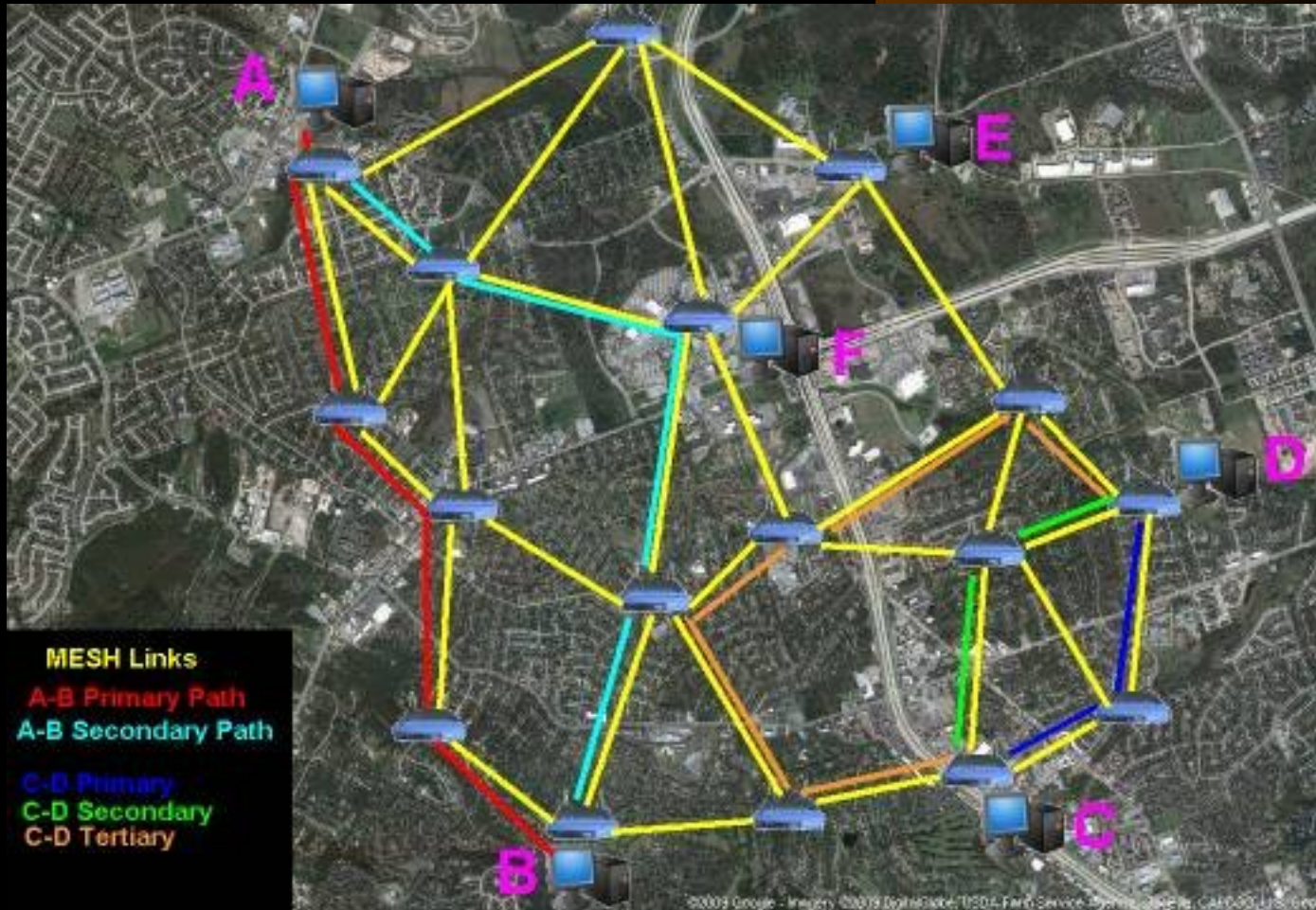


- Eismann Center Internet Access

- Relay point

- Start Finish Line

# Austin HSMM-MESH





# *HSMM-MESH for APRS*

- APRS I-Gate sends APRS data to Internet Servers
  - I-Gate can be connected to HSMM-MESH Node
- Local Digipeaters can connect to Wide Digipeater using HSMM-MESH
  - Digipeaters do not repeat on APRS Frequency
  - Reduces Bandwidth increases users
- AE5PL javAPRSServ SW supports this

# *HSMM-MESH for Weather*

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- Could have weather stations connect and report rain fall, and wind speed.
- Could have video cameras stream video during weather events.
  - Remote Locations
  - Elevated Locations
  - Control Pan-Tilt
- Storm Spotters in vehicles could send video or pictures.

## *“What HSMM-MESH is used for?” Summary*

- Whatever you can do on the Internet!
  - Talk
  - Stream Video
  - Transfer Data
  - Email
  - Maps
  - The list is endless

# 2.4 GHz HSMM-MESH is Fast

- The RF links are around **27- 54 Mbps**
  - Packet Radio/APRS 0.0012 Mbps
  - Pactor III .003 Mbps
  - D-Star DD 0.128 Mbps
- Home Service
  - FiOS (Fiberoptics) 2 -15Mbps up / 15-25 Mbps down
  - T1 1.5 Mbps
  - DSL up to 1.5 Mbps up / 6 Mbps down
    - often 0.768 Mbps, 0.512 Mbps, 0.368 Mbps
  - Dialup 0.014 – 0.056 Mbps

# *Strategy and Planning*

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- Know what the system can do and its limits
  - Channels 1, 6, and 11 are non-overlapping
  - Channel 1, 6 are in Ham band, 11 is not
  - Need Clear Line of Sight
    - Trees attenuate a lot
    - Hills, buildings block

# Security

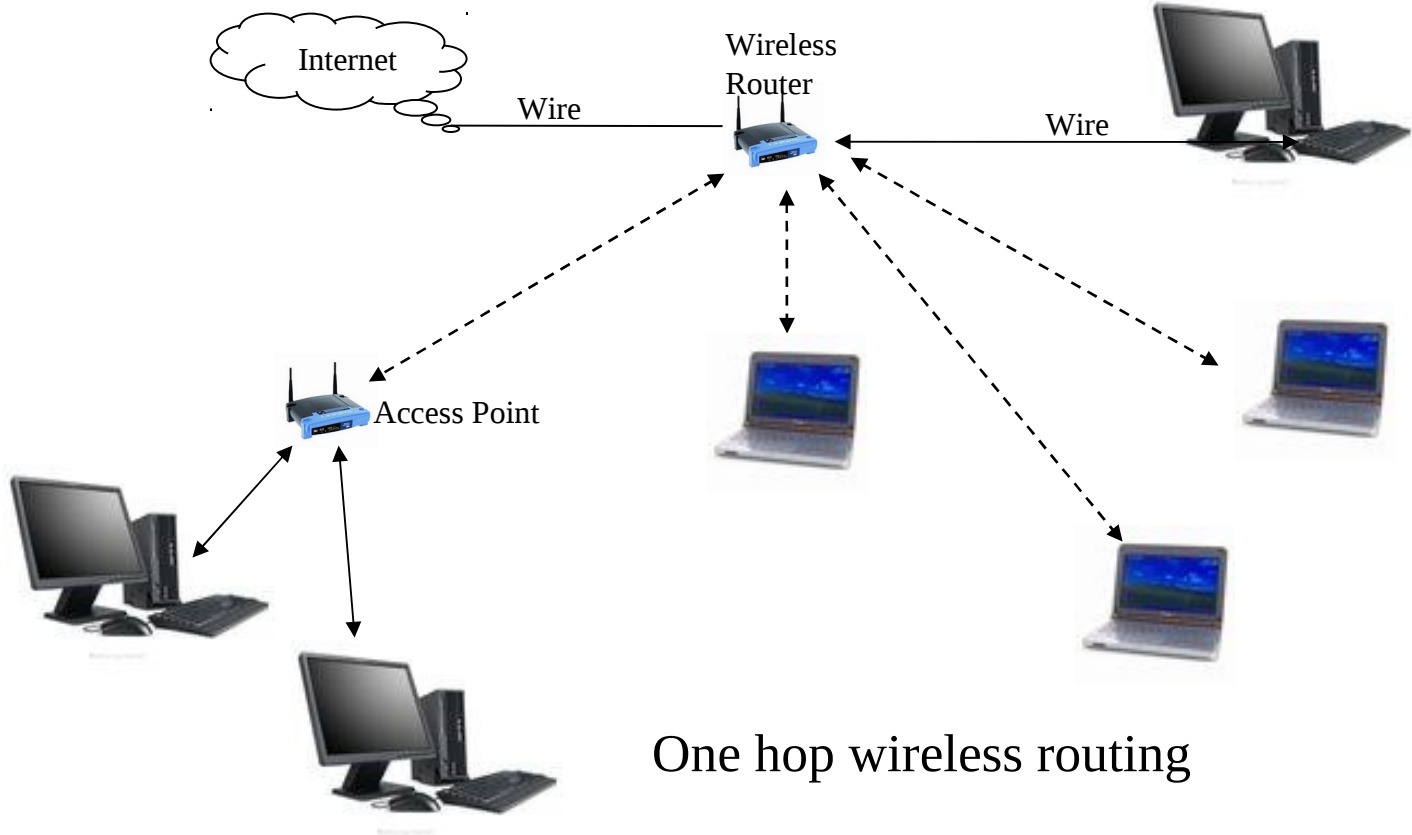
- Interpretation to ARRL HSMM WG from FCC Enforcement Branch via Chris Imlay
- Radio Amateurs using 802.11 type modulation under Part 97 could use WEP, WPA, etc as our intent or purpose is to provide authentication and thus protect our networks from part 15 intrusions... and not obscure the meaning of 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

# Software



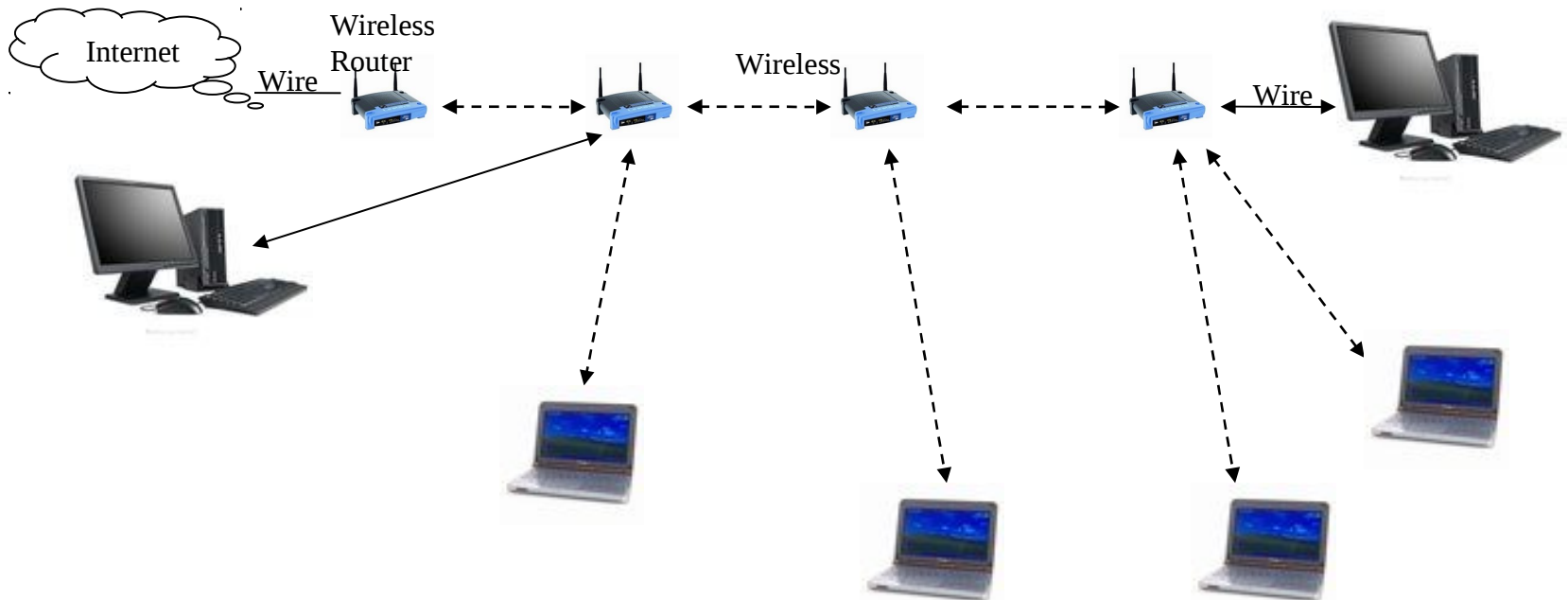
- Why change software?
  - More control
  - Add functions
  - **Wireless backbone**
  - **Mesh**

# Off the Shelf Software





# Alternate Software



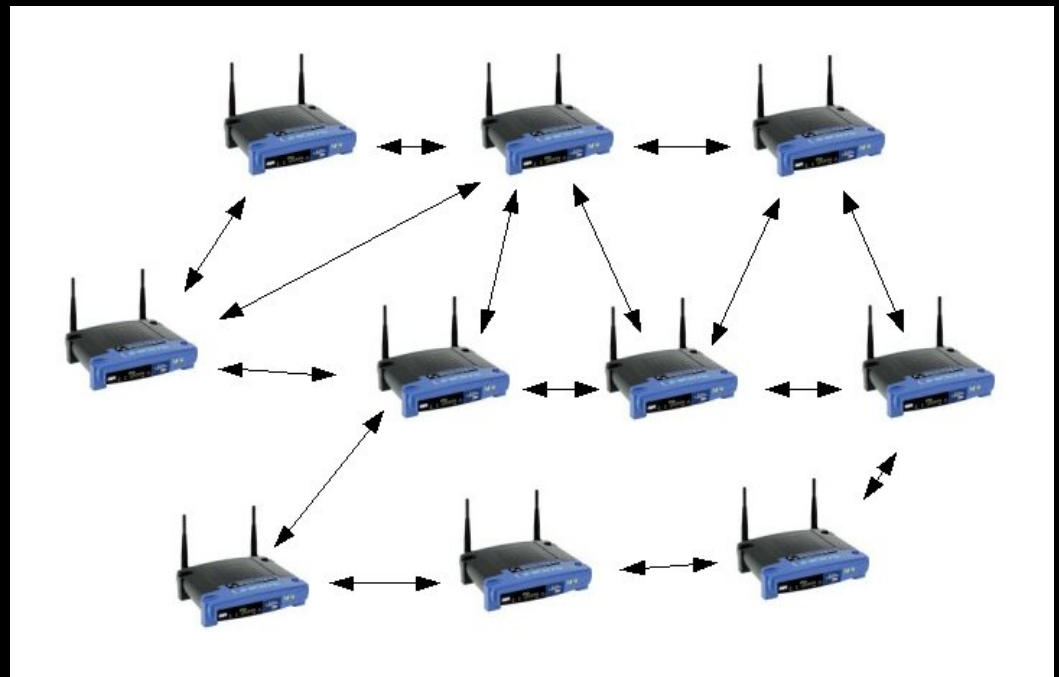
Multiple hop wireless routing

# *Advantages 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 automatically finds Routes*

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



# *MESH simplifies everything*

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- I have spent hours configuring routers to link together
- Operating HSMM-MESH joins net <10 seconds when in range.
- Cold start HSMM-MESH joins net < 60 sec.
- Cars with a HSMM-MESH router can drive around and automatically switch from one router to another, like a cell phone.

# *What's needed for HSMM-MESH*

- Custom SW - HSMM-MESH
- Off the shelf WiFi Routers
  - \$50 - \$100 (less than any new Ham radio)
  - Must support external antennas
  - Operate channels 1 – 6 Ham Bands
- High Gain Antennas
  - \$20 - \$100 (or More) Omni or Directional
- Accessories
  - Power, batteries, cables, masts, boxes, etc.

# SW History

- Linksys used Linux for the WRT54G
  - Modified the OS to work with the Broadcom Processor.
  - First version December 2002
- According to the GPL they had to share the code
  - Showed everyone how to program the processor
- On WRT54G v.5 they switched to VxWorks OS
  - Reduced Flash from 4MB to 2MB
  - Reduced RAM from 16 MB to 8 MB
  - v.8 changed to hardwired antennas, no antenna connector

# OpenWRT

- OpenWRT and Sveasoft first developed SW for the router once it was released under GPL
  - DD-WRT was a fork from this, and still incorporate updates from OpenWRT
- Originally supported only WRT54G
  - Now supports many different routers and chipsets
  - <http://oldwiki.openwrt.org/TableOfHardware.html>

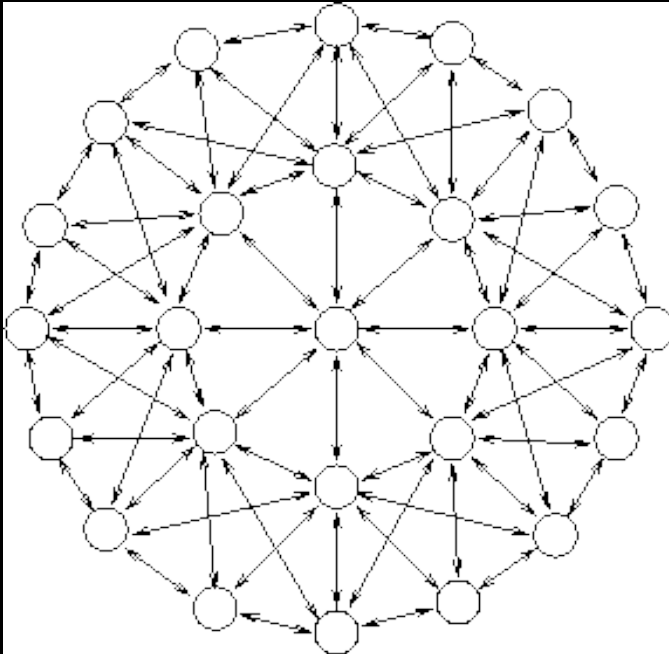
# *OpenWRT*

- Very little GUI, mostly a command line interface
  - Reason I started with DD-WRT
  - But more flexible

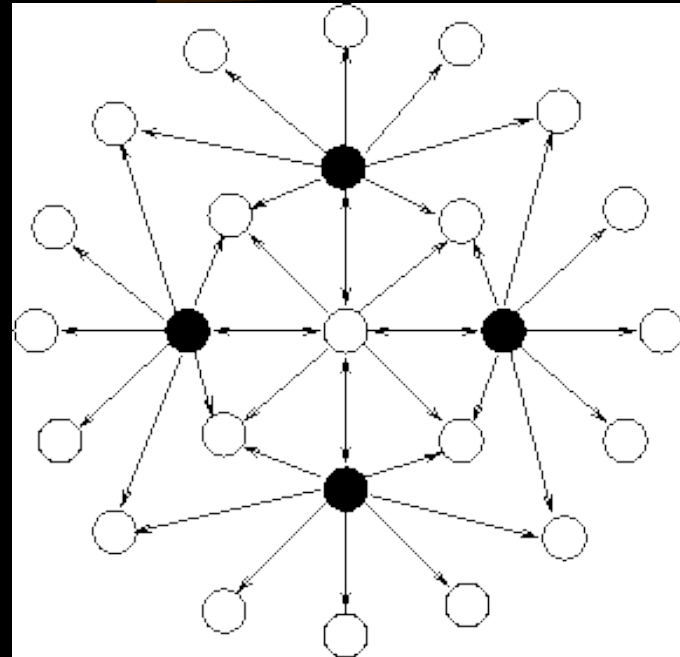


- Optimized Link State Routing Protocol is an IP routing protocol which is optimized for mobile ad-hoc networks.
  - Mesh Network
  - Fast insertion < 60 seconds after power-up
- Olsrd started out as part of the master thesis project for Andreas Tønnesen at UniK - University Graduate Center.
- RFC 3626

# How OLSR Works



Flooding a packet in a wireless multi-hop network. The arrows show all transmissions.



Flooding a packet in a wireless multi-hop network from the center node using MPRs(black). The arrows show all transmissions.

# Node Status

## AE5IB-AP4

[Help](#)

Refresh

Mesh Status

OLSR Status

WiFi Scan

Setup

Night Mode

<b>WiFi address</b>	10.122.107.89 / 8 fe80::21e:e5ff:fe7a:6b59 Link	<b>Signal/Noise/Ratio</b>	N/A <input type="button" value="Auto"/>
<b>LAN address</b>	172.27.0.1 / 24 fe80::21e:e5ff:fe7a:6b57 Link	<b>firmware version</b>	0.4.0
<b>WAN address</b>	none fe80::21e:e5ff:fe7a:6b57 Link	<b>configuration</b>	mesh
<b>default gateway</b>	none	<b>system time</b>	Sat Jan 1 2000 00:03:48 UTC
<b>your address</b>	172.27.0.5	<b>uptime</b>	3 min
		<b>load average</b>	0.09, 0.13, 0.05
		<b>free space</b>	flash = 688 KB /tmp = 7080 KB memory = 2332 KB

# Setup Page

[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="10.122.107.89"/>	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"/>	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"/>	
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"/>		

[Node Status](#)

**Basic Setup**

[Port Forwarding,  
DHCP, and Services](#)

[Administration](#)

Enter Name

[Help](#)

Save Changes

Reset Values

Default Values

Reboot

Node Name AE5IB-AP4

Password

Node Type Mesh Node

Verify Password

Change Password from default: hsmm

Automatic from MAC

**WiFi**

Protocol Static

IP Address 10.122.107.89

Netmask 255.0.0.0

SSID HSMM-MESH

Mode Ad-Hoc

Channel 1

Active Settings

Antenna 1 Diversity

Antenna 2 Diversity

Tx Power 19 dBm

Distance 0

Apply

Must not change

You can set

0 Automatic otherwise meters

**LAN**

LAN Mode NAT

IP Address 172.27.0.1

Netmask 255.255.255.0

DHCP Server

DHCP Start 5

DHCP End 25

**WAN**

Protocol DHCP

DNS 1 8.8.8.8

DNS 2 8.8.4.4

Mesh Gateway

This node Connected to Internet?

Save Changes and Reboot

# OLSR Status (Night Mode)

## AE5IB-AP4

[Help](#)

[Refresh](#)

[Mesh Status](#)

[OLSR Status](#)

[WiFi Scan](#)

[Setup](#)

[Night Mode](#)

<b>WiFi address</b>	10.122.107.89 / 8 fe80::21e:e5ff:fe7a:6b59 Link	<b>Signal/Noise/Ratio</b>	-40 / -85 / 45 dB	<a href="#">Auto</a>
<b>LAN address</b>	172.27.0.1 / 24 fe80::21e:e5ff:fe7a:6b57 Link	<b>firmware version</b>	0.4.0	
<b>WAN address</b>	none fe80::21e:e5ff:fe7a:6b57 Link	<b>configuration</b>	mesh	
<b>default gateway</b>	10.217.147.42 N5OOM-AP3	<b>system time</b>	Wed Dec 29 2010 01:45:54 UTC	
<b>your address</b>	172.27.0.5	<b>uptime</b>	2:07	
		<b>load average</b>	0.00, 0.00, 0.00	
		<b>free space</b>	flash = 688 KB /tmp = 7064 KB memory = 2464 KB	



# OLSR Routes Tab

[olsr.org](http://olsr.org) OLSR daemon on AE5IB-AP4



Configuration **Routes** Links/Topology All About Node Status

## OLSR Routes in Kernel

Destination		Gateway	Metric	ETX	Interface
0.0.0.0/0		<a href="#">10.217.147.42</a> ( <a href="#">N5OOM-AP3</a> )	1	1.209	wl0
<a href="#">10.1.96.15</a>	( <a href="#">k5prk-ap1</a> )	<a href="#">10.1.96.15</a> ( <a href="#">k5prk-ap1</a> )	1	1.000	wl0
<a href="#">10.148.146.9</a>	( <a href="#">AE5IB-AP2</a> )	<a href="#">10.148.146.9</a> ( <a href="#">AE5IB-AP2</a> )	1	1.063	wl0
<a href="#">10.164.157.185</a>	( <a href="#">N5OOM-AP6</a> )	<a href="#">10.164.157.185</a> ( <a href="#">N5OOM-AP6</a> )	1	1.000	wl0
<a href="#">10.217.147.42</a>	( <a href="#">N5OOM-AP3</a> )	<a href="#">10.217.147.42</a> ( <a href="#">N5OOM-AP3</a> )	1	1.209	wl0

(C)2005 Andreas Tønnesen  
<http://www.olsr.org>



# OLSR Links Tab

[olsr.org](http://olsr.org) OLSR daemon on AE5IB-AP4



Configuration Routes **Links/Topology** All About Node Status

### Links

Local IP	Remote IP	Hysteresis	LinkCost
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.217.147.42</a> (N5OOM-AP3)	0.00	(1.000/0.878) 1.138
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.164.157.185</a> (N5OOM-AP6)	0.00	(0.831/1.000) 1.202
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.148.146.9</a> (AE5IB-AP2)	0.00	(1.000/1.000) 1.000
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.1.96.15</a> (k5prk-ap1)	0.00	(1.000/1.000) 1.000

### Neighbors

IP Address	SYM	MPR	MPRS	Willingness	2 Hop Neighbors
<a href="#">10.164.157.185</a> (N5OOM-AP6)	YES	NO	NO	3	IP ADDRESS (3)
<a href="#">10.1.96.15</a> (k5prk-ap1)	YES	NO	NO	3	IP ADDRESS (3)
<a href="#">10.217.147.42</a> (N5OOM-AP3)	YES	NO	NO	3	IP ADDRESS (3)
<a href="#">10.148.146.9</a> (AE5IB-AP2)	YES	NO	NO	3	IP ADDRESS (3)

### Topology Entries

Destination IP	Last Hop IP	Linkcost
<a href="#">10.1.96.15</a> (k5prk-ap1)	<a href="#">10.148.146.9</a> (AE5IB-AP2)	(1.000/1.000) 1.000
<a href="#">10.217.147.42</a> (N5OOM-AP3)	<a href="#">10.148.146.9</a> (AE5IB-AP2)	(1.000/0.894) 1.118
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.148.146.9</a> (AE5IB-AP2)	(1.000/1.000) 1.000
<a href="#">10.164.157.185</a> (N5OOM-AP6)	<a href="#">10.148.146.9</a> (AE5IB-AP2)	(1.000/1.000) 1.000
<a href="#">10.148.146.9</a> (AE5IB-AP2)	<a href="#">10.1.96.15</a> (k5prk-ap1)	(1.000/1.000) 1.000
<a href="#">10.217.147.42</a> (N5OOM-AP3)	<a href="#">10.1.96.15</a> (k5prk-ap1)	(1.000/0.831) 1.202
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.1.96.15</a> (k5prk-ap1)	(1.000/1.000) 1.000
<a href="#">10.164.157.185</a> (N5OOM-AP6)	<a href="#">10.1.96.15</a> (k5prk-ap1)	(0.886/1.000) 1.128
<a href="#">10.148.146.9</a> (AE5IB-AP2)	<a href="#">10.217.147.42</a> (N5OOM-AP3)	(0.886/1.000) 1.128
<a href="#">10.1.96.15</a> (k5prk-ap1)	<a href="#">10.217.147.42</a> (N5OOM-AP3)	(0.819/1.000) 1.220
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.217.147.42</a> (N5OOM-AP3)	(0.878/1.000) 1.138
<a href="#">10.164.157.185</a> (N5OOM-AP6)	<a href="#">10.217.147.42</a> (N5OOM-AP3)	(0.497/1.000) 2.008
<a href="#">10.148.146.9</a> (AE5IB-AP2)	<a href="#">10.122.107.89</a> (AE5IB-AP4)	(1.000/1.000) 1.000
<a href="#">10.1.96.15</a> (k5prk-ap1)	<a href="#">10.122.107.89</a> (AE5IB-AP4)	(1.000/1.000) 1.000
<a href="#">10.217.147.42</a> (N5OOM-AP3)	<a href="#">10.122.107.89</a> (AE5IB-AP4)	(1.000/0.878) 1.138
<a href="#">10.164.157.185</a> (N5OOM-AP6)	<a href="#">10.122.107.89</a> (AE5IB-AP4)	(0.831/1.000) 1.202
<a href="#">10.148.146.9</a> (AE5IB-AP2)	<a href="#">10.164.157.185</a> (N5OOM-AP6)	(1.000/1.000) 1.000
<a href="#">10.1.96.15</a> (k5prk-ap1)	<a href="#">10.164.157.185</a> (N5OOM-AP6)	(1.000/0.886) 1.128
<a href="#">10.217.147.42</a> (N5OOM-AP3)	<a href="#">10.164.157.185</a> (N5OOM-AP6)	(1.000/0.497) 2.008
<a href="#">10.122.107.89</a> (AE5IB-AP4)	<a href="#">10.164.157.185</a> (N5OOM-AP6)	(1.000/0.886) 1.128

### MID Entries

Main Address	Aliases
--------------	---------

# OLSR About Tab

[olsr.org](http://olsr.org) OLSR daemon on AE5IB-AP4



Configuration Routes Links/Topology All **About** Node Status

## Httpinfo olsrd plugin version 0.1

by Andreas Tønnesen (C)2005.

Compiled 2010-08-14 23:45:40 at mini

This plugin implements a HTTP server that supplies the client with various dynamic web pages representing the current olsrd status.

The different pages include:

- **Configuration** - This page displays information about the current olsrd configuration. This includes various olsr settings such as IP version, MID/TC redundancy, hysteresis etc. Information about the current status of the interfaces on which olsrd is configured to run is also displayed. Loaded olsrd plugins are shown with their plugin parameters. Finally all local HNA entries are shown. These are the networks that the local host will announce itself as a gateway to.
- **Routes** - This page displays all routes currently set in the kernel *by olsrd*. The type of route is also displayed(host or HNA).
- **Links/Topology** - This page displays all information about links, neighbors, topology, MID and HNA entries.
- **All** - Here all the previous pages are displayed as one. This is to make all information available as easy as possible(for example for a script) and using as few resources as possible.
- **About** - this help page.

Send questions or comments to [olsr-users@olsr.org](mailto:olsr-users@olsr.org) or [andreto-at-olsr.org](mailto:andreto-at-olsr.org)

Official olsrd homepage: <http://www.olsr.org>

(C)2005 Andreas Tønnesen

<http://www.olsr.org>

# *HSMM-MESH Routers*

- WRT54G (v1-4)
- WRT54GL (all)
- USR5461
- WA840G
- WE800G
- WR850G (v1-3)
- WRT150N
- WRT300N (v1)
- WRT54G3G
- WRT54GS (v1-3)
- WRT54GS (v4)
- WRTSL54GS (all)

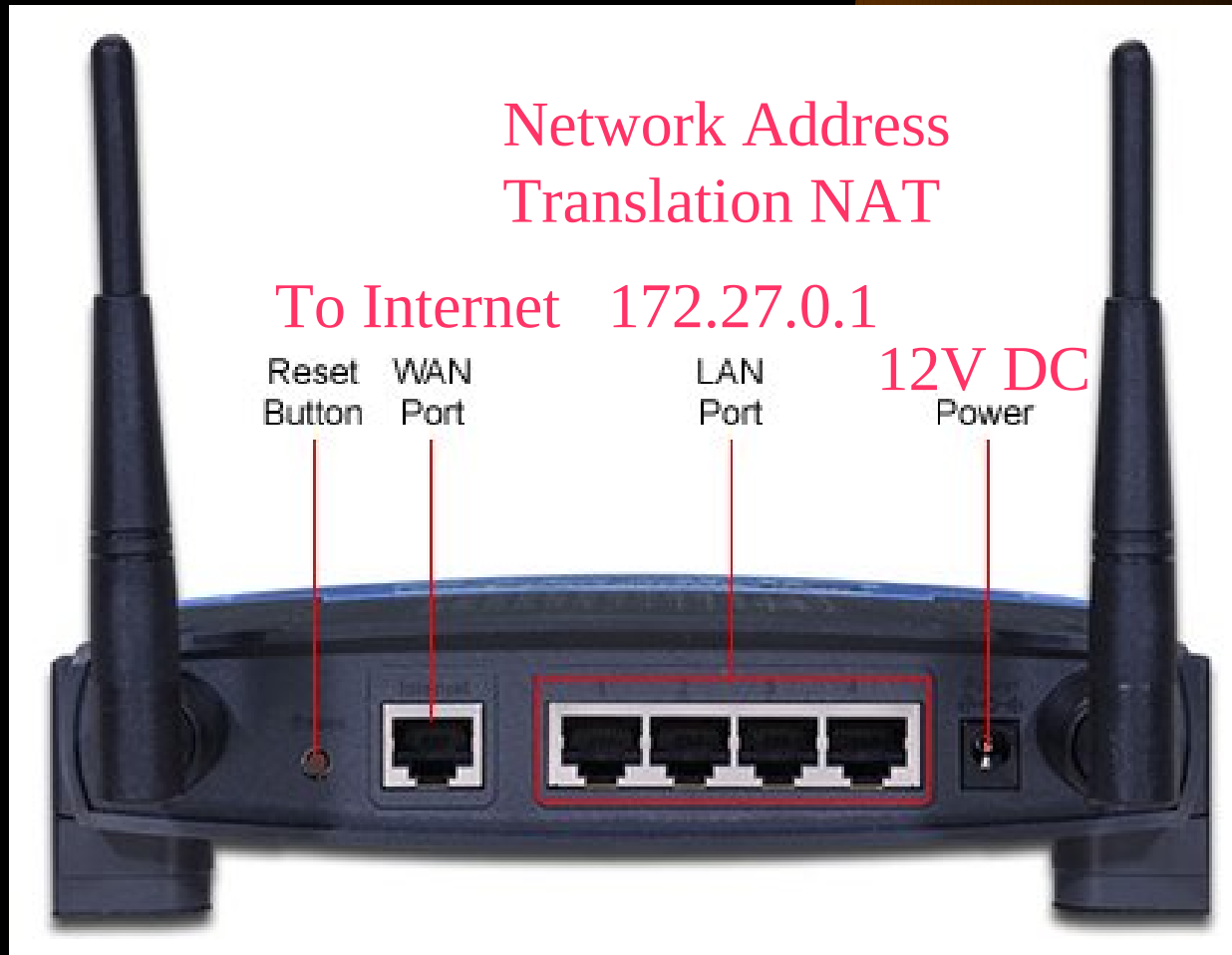
Stay with WRT54GL to be safest

# Router I Like

- Linksys WRT54G used
  - Versions lower than v.4
    - 4 Mb Flash
  - Current new is v.8
    - 2 Mb Flash
    - Soldered Antennas
- Linksys WRT54GL new
  - Linksys v.4
    - 4 Mb Flash
    - \$54.00 - \$79.99 New
- Built in regulator for 12VDC (7.5V to 18V DC)
- Two Serial Ports!



# *After Default HSMM-MESH Setup*



# Antennas

- All kinds available on internet
  - The ones in retail stores are very expensive!
- Vertical polarity
  - Omni-directional best for HSMM-MESH
  - Laptop Computers
- Horizontal polarity for point-to-point networking.
  - Less interference from other users

# Range



- Range is based on
  - Antenna
  - Noise
- Assume
  - Clear Line of Sight
  - Good Day
  - 19 db Transmitter
- Two 12 db - 5 mi
- Two 15 db - 10 mi
- Two 19 db - 24 mi

**Bigger is Better**

## *15 db Omni*

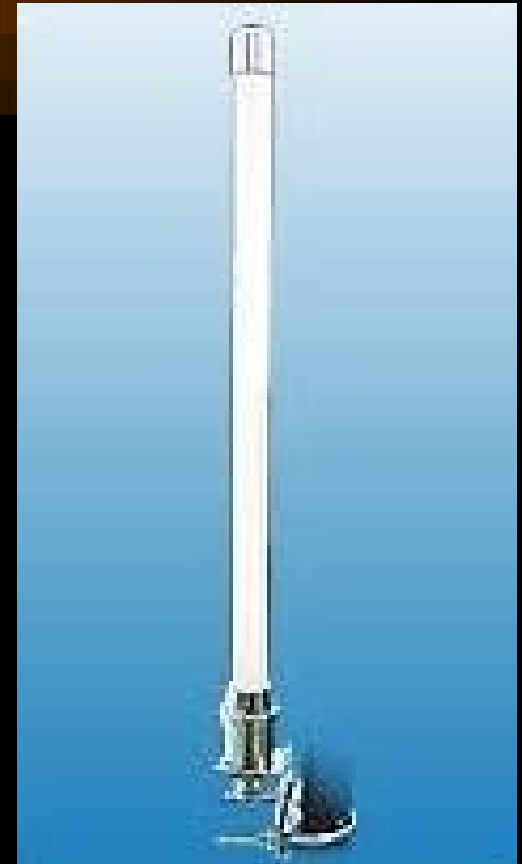
- Titan Wireless AT-15OM-24
- Lowest price 15 db Omni \$60
- N connector
- Probably base the Collin County HSMM-MESH on this
  - High Gain
  - Low Cost
  - Fast Delivery





## *8 db Omni*

- Titan Wireless AT-8OM-24
- 8 db omni \$29
- About 1 foot tall
- Good for special events and short distances



# RooTenna

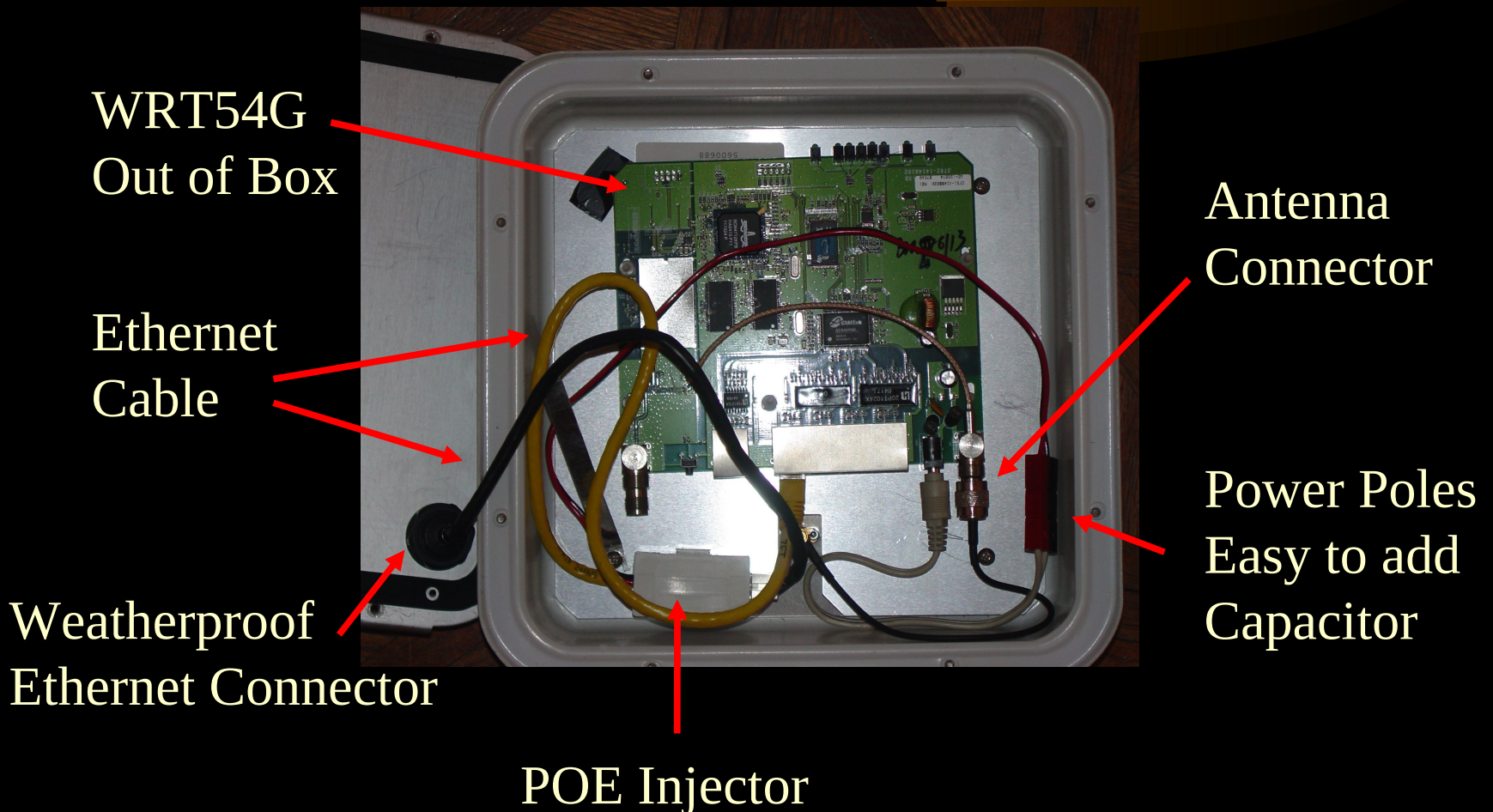
- RooTennas
  - Mounts on mast, easy switch from vertical to horizontal
  - Built-in housing for router
  - 19 db with housing
    - \$70.00 - \$74.00
  - 15 db with housing
    - \$36.00 - \$45.00

Pacific Wireless

<http://www.pacwireless.com>



# *Inside 15 db Rootenna*

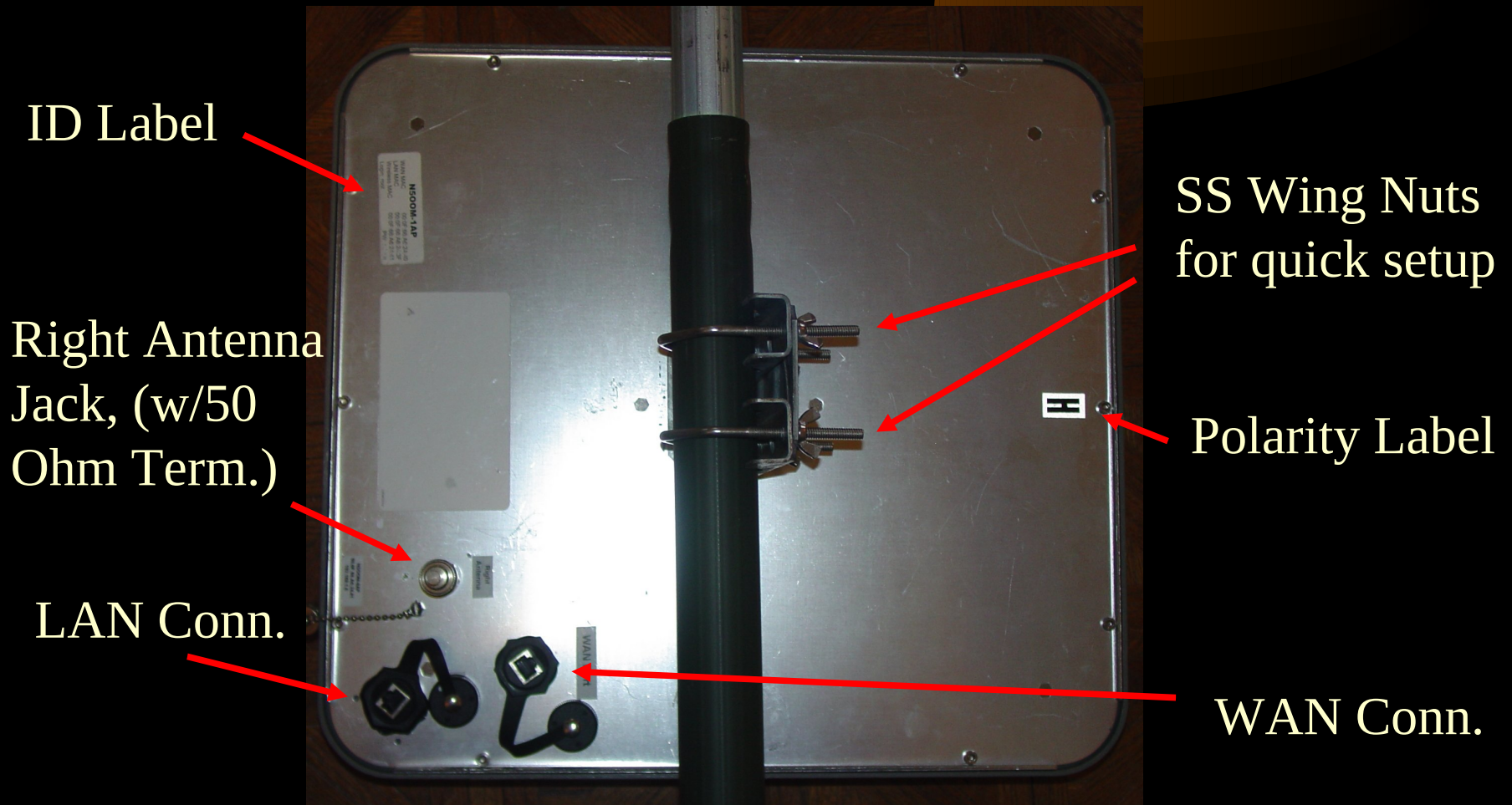


# *19 db Rootenna*

- Good Price \$70
- Large area for electronics
- Range Experience
  - 19 db to 15 db 5 mi
  - 19 db to 24 db 10 mi



# *N500M-AP1 19 db Rootenna*



ID Label

Right Antenna  
Jack, (w/50  
Ohm Term.)

LAN Conn.

SS Wing Nuts  
for quick setup

Polarity Label

WAN Conn.

# Antennas We Like

- HyperLink Die Cast Reflector Grid
  - Models
    - 30 db 5.3° beam \$479.99
    - 24 db 8° beam \$69.99
    - 19 db 12° beam \$59.99
    - 15 db 16° beam \$49.99
  - 24 db is recommended
    - Otherwise RooTenna is cheaper



L-Com Technologies

<http://www.l-com.com>

# *RFelements StationBox*

- Titan Wireless
- 14 db directional antenna \$25
- I have not tried this but it looks like a good deal.





## *KD5MFW 2 Ant.*

- 12 db omni
- 24 db directional Horz. Pol



# *AD500 Portable Node*

- 12 db Omni Antenna
- Weatherproof Box for Router
- Tripod
- Mast



# *Companies to know about*

- [fab-corp.com](http://fab-corp.com)
- [l-com.com](http://l-com.com)
- [wlanparts.com](http://wlanparts.com)
- [titanwirelessonline.com](http://titanwirelessonline.com)



# *Antenna Lightning Protection*

- If you are doing a permanent outdoor mount use a surge protector.
- Make sure it covers 2.4 GHz
- Have a good ground



# *Ethernet Lightning Protection*

- For Permanent Installation
- Add Surge Protection for Ethernet cables
  - Top and Bottom
- Good Ground



# *Passive Power Over Ethernet*

- I like 12V Passive P.O.E.
  - Simple adapters
  - Home made or purchased
  - Use Power Poles for 12V power
  - Compatible with rest of Ham Equipment
- Pins 4 & 5 +12V / Pins 7 & 8 0V or Gnd
- Simplifies wiring - 1 Ethernet wire



# *Home Made Passive POE Adapters*

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- It is easy to make you own Passive POE Adaptors.
- Parts easily bought
- Use Red for side with power.
- Use White for side with no power.
- Use 2.1 mm DC Power Connectors
- Or Power Poles

# *N500M Passive POE Injector*

- 4 Power Poles
- 6 POE Injectors
- Parts from Altex
- Great for the battery box



# *N500M Passive POE Injector*

- 2 POE Injector
- Power Pole Cable
- Mounted with Velcro on a 10/100 Mb Switch
  - Also 12V Power





# *Problems with Passive 12V POE*

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- Ethernet is small wire, and can run up to 100 meters or about 8 ohms and 29 mH at that distance.
- The router current changes continuously
- The router has a switching power supply so as the input voltage is lower it requires more current
- WRT54G v2 averages 5.25W
- Perfect Storm

# *12V POE Solution*

- Only noticed problem on POE Ethernet runs 200 feet and over
- To smooth out the current demand need a big capacitor.
- 10,000 MFD Works 1000 MFD Does not.
- The voltage stayed steady enough that I was able to reduce the supply to 7.5 volts at the router and it still worked.
- Adding 10,000 MFD, 50V 105°C Electrolytic capacitor to all routers because you do not know how long Ethernet runs will be.

# *48V Power Over Ethernet*

- The Standard for POE is 48V (Different Suppliers can vary from this.)
- Uses less current, so voltage drop is less
- More Expensive
  - Need 48V power supply at the bottom
  - Need 48V to 12V switcher at router
- May be needed in some situations
- Do not mix with 12V POE
- We use Yellow and Black Power Poles

# 48V to 12V POE

12V Power Pole 48V DC in

Six POE  
Injectors

Power  
Light



Four 12V  
Power  
Pole

48V DC in

# *K5PRK-AP1*

- HSMM-MESH node on water tower near Bethany and US75
- City installed narrow band 2.4 GHz data transmitters. Their power saturated our receivers and we could not communicate.



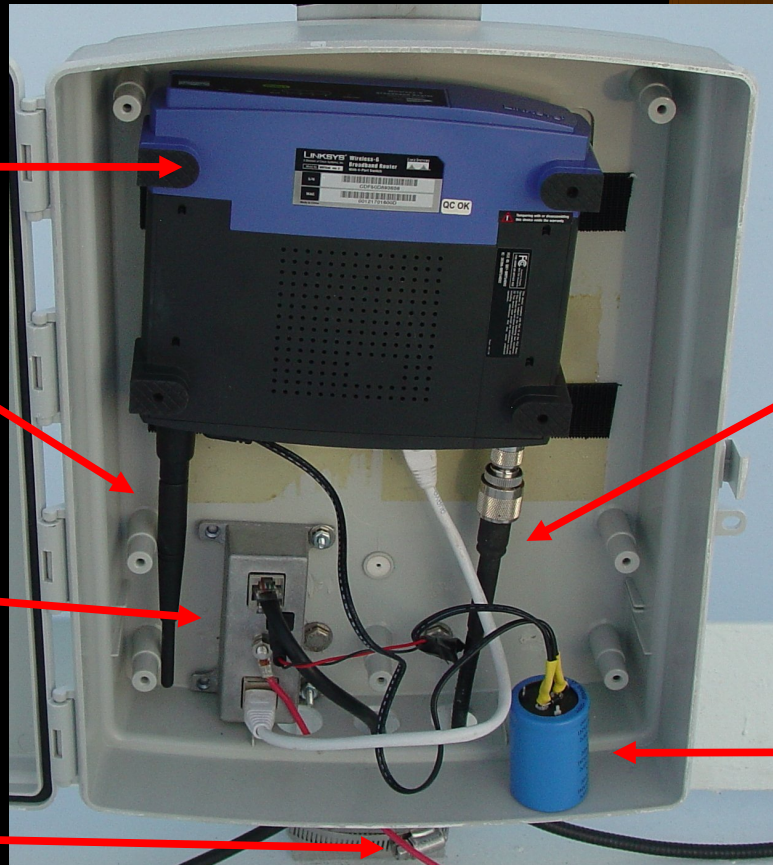
# *K5PRK-AP1 Router*

WRT54G v2

Stock Antenna

POE Injector  
and surge  
arrestor

Ground Wire



Cable to lightning  
arrester and 15 db  
omni Antenna

10,000 MFD  
Capacitor on  
power input

# *Interesting Web Links*

- HSMM-MESH Site
  - <http://www.hsmm-mesh.org>
- Building a Rural Wireless Mesh Network
  - [http://wirelessafrika.meraka.org.za/wiki/index.php/DIY\\_Mesh\\_Guide](http://wirelessafrika.meraka.org.za/wiki/index.php/DIY_Mesh_Guide)
- Wireless Networking for the Developing World
  - <http://wndw.net/>
- N500M HSMM Page
  - <http://www.n500m.org/hsmm/>

# Change Crystal to 19.6608 MHz

