

HSMM-MESH Seminar Session 1



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February 6, 2010

Lucas, Texas

Seminar Sessions



- **Session 1: Overview of HSMM and the Austin software**
 - What is this stuff?
- **Session 2: Loading and Testing the Austin Code**
 - How can I play with it?
- **Session 3: Loading the Dev. System and Code**
 - How can I modify it?

Overview of HSMM and the Austin 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 is needed?

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

Background

- ARRL Technology Task Force Survey 2000
 - Highest interest in High Speed Digital Radio Networks
 - High-speed radio data links up to 20 mega bits per second (M bit/s)
 - Ethernet at 2 mbps on 10 GHz
 - Encourage development of a high-speed amateur digital radio network
 - High-speed digital audio/video radio

The HSMM Working Group



- January 2001 ARRL Board of Directors
 - ARRL should develop high-speed radio digital networks
 - ARRL President appointed a group of individuals to form the working group
- Working Group
 - Tested how would it be used in SET
 - Current Chairman is John Champa

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 ^(TM)

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



- 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)

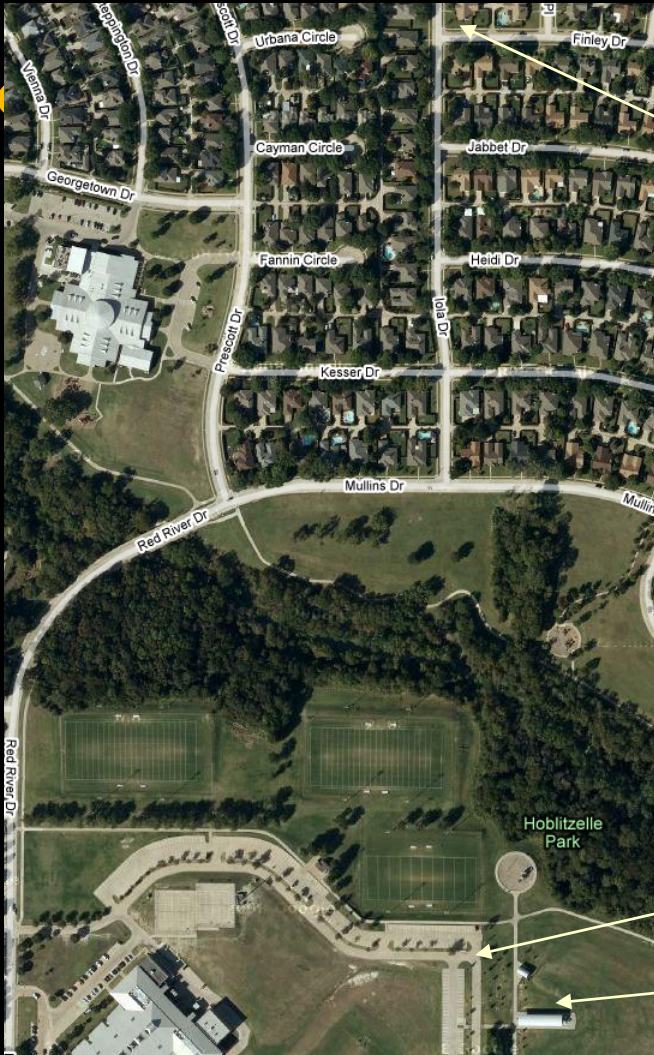


- Infrastructure Failure
 - Support Police / Fire
 - Support Hospitals
 - Support Responders in field
 - ARES (Amateur Radio Emergency Service)
 - CERT (Citizen Emergency Response Team)
 - MRC (Medical Reserve Corps)
- Public Service Events
- Field Day

Planning Field Day

- 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

- 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

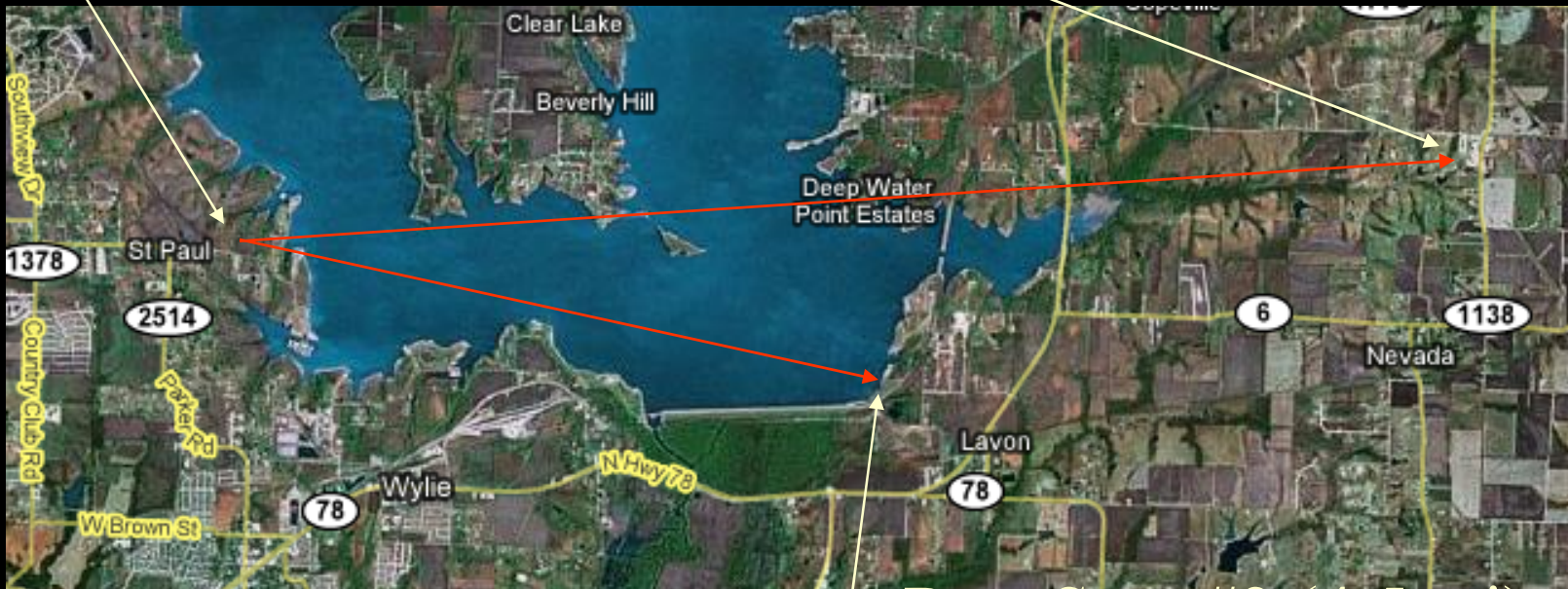
Planning 2008 Wild Ride

- Goal: Provide pictures from Rest Stops to Start/Finish Line
- Have had lots of problems with 2.4 GHz
- One year 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

Wild Ride Rest Stop 2 and 3

- W5LT

- Rest Stop #3 (9.7 mi)



- Rest Stop #2 (4.5 mi)

Wild Ride Start/Finish Line



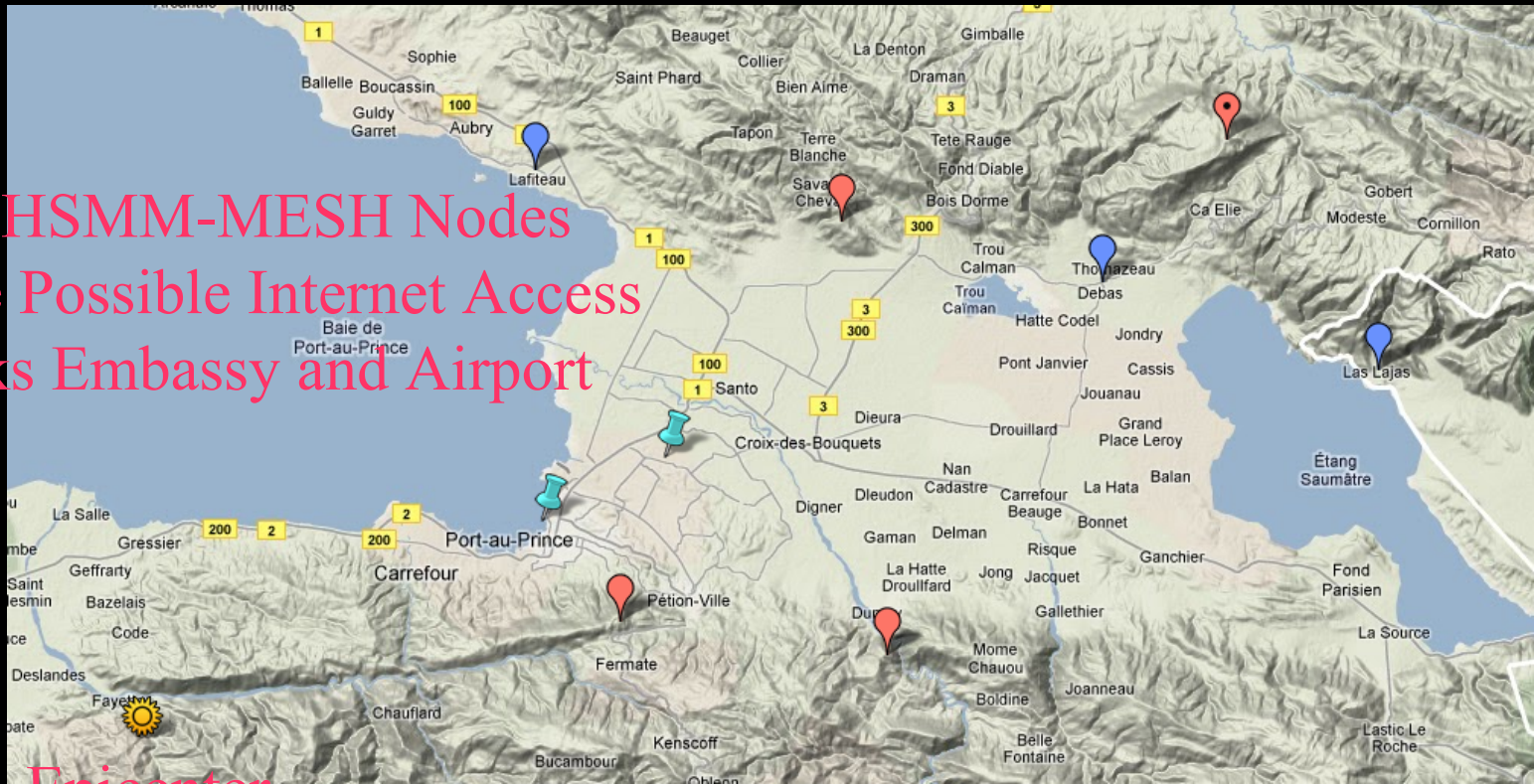
- Eismann Center Internet Access

- Relay point

- Start Finish Line

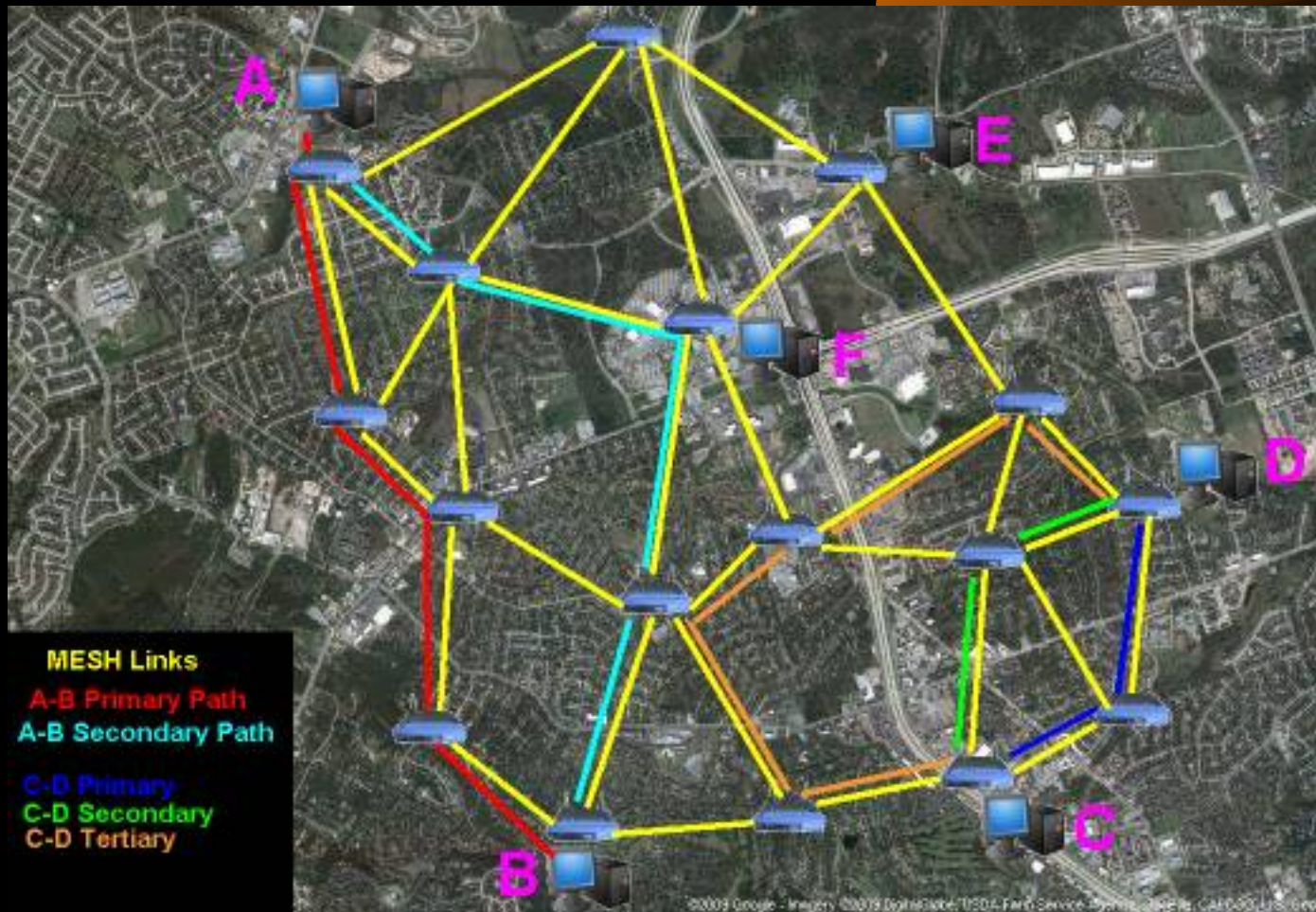
Haiti Relief

Red HSMM-MESH Nodes
Blue Possible Internet Access
Tacks Embassy and Airport

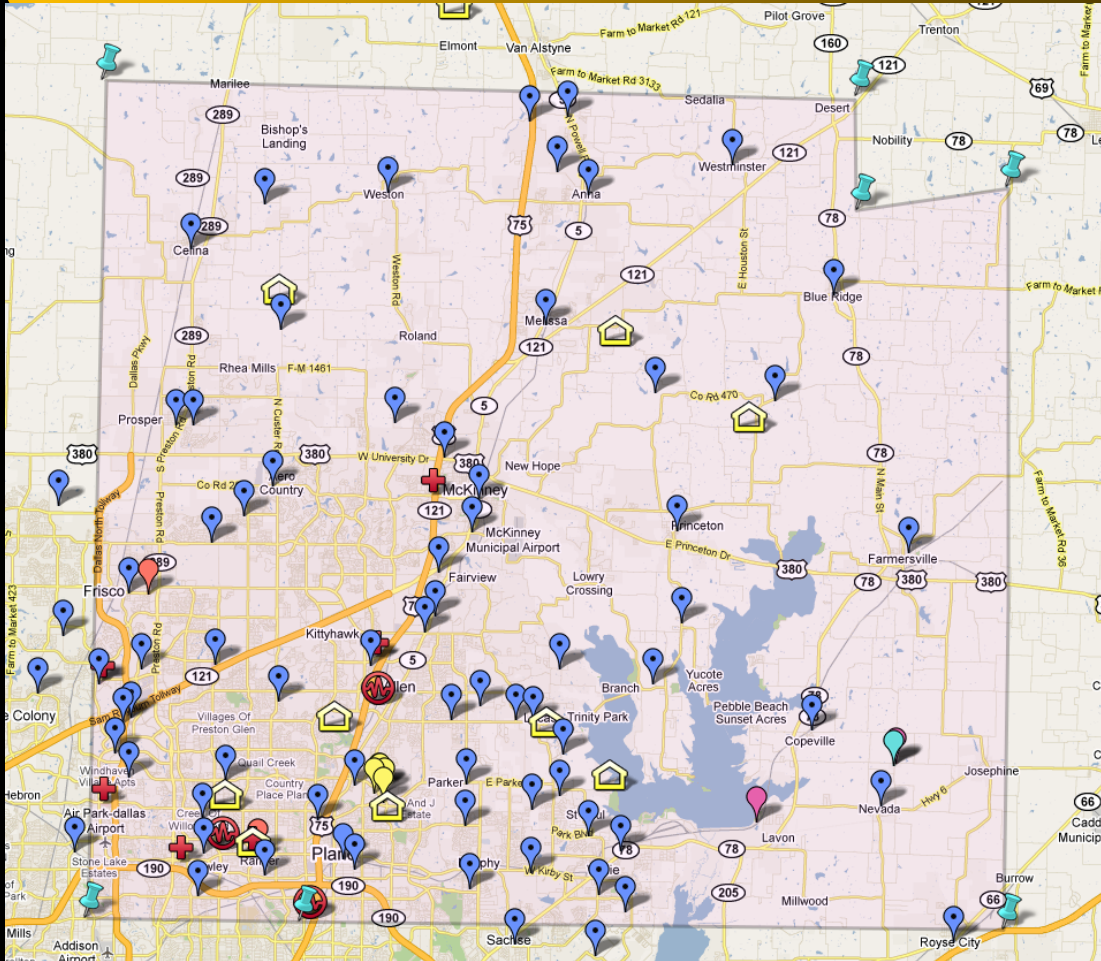


Epicenter

Austin HSMM-MESH



Potential Collin County Sites



- Blue w/dot
Water
Towers
- Red +
Hospitals
- Red Circle
Repeater
Site

HSMM-MESH for APRS

- In Collin County we have 1 Wide Digipeater in Melissa
- Weaker signals hit local digipeaters, and then Melissa Digi repeats.
 - Transmission, First Digi, Wide Digi
- Local Digi could send data to Wide Digi using HSMM and not tying up 1200 bps APRS packet.
 - AE5PL javAPRSServ SW supports this.

HSMM-MESH for Weather



- 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 **54 Mbps**
 - Packet Radio/APRS 0.0012 Mbps
 - Pactor III .003 Mbps
 - D-Star DD 0.128 Mbps
- Home Service
 - FiOS (Fiberoptics) 2 Mbps up / 15 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

- 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

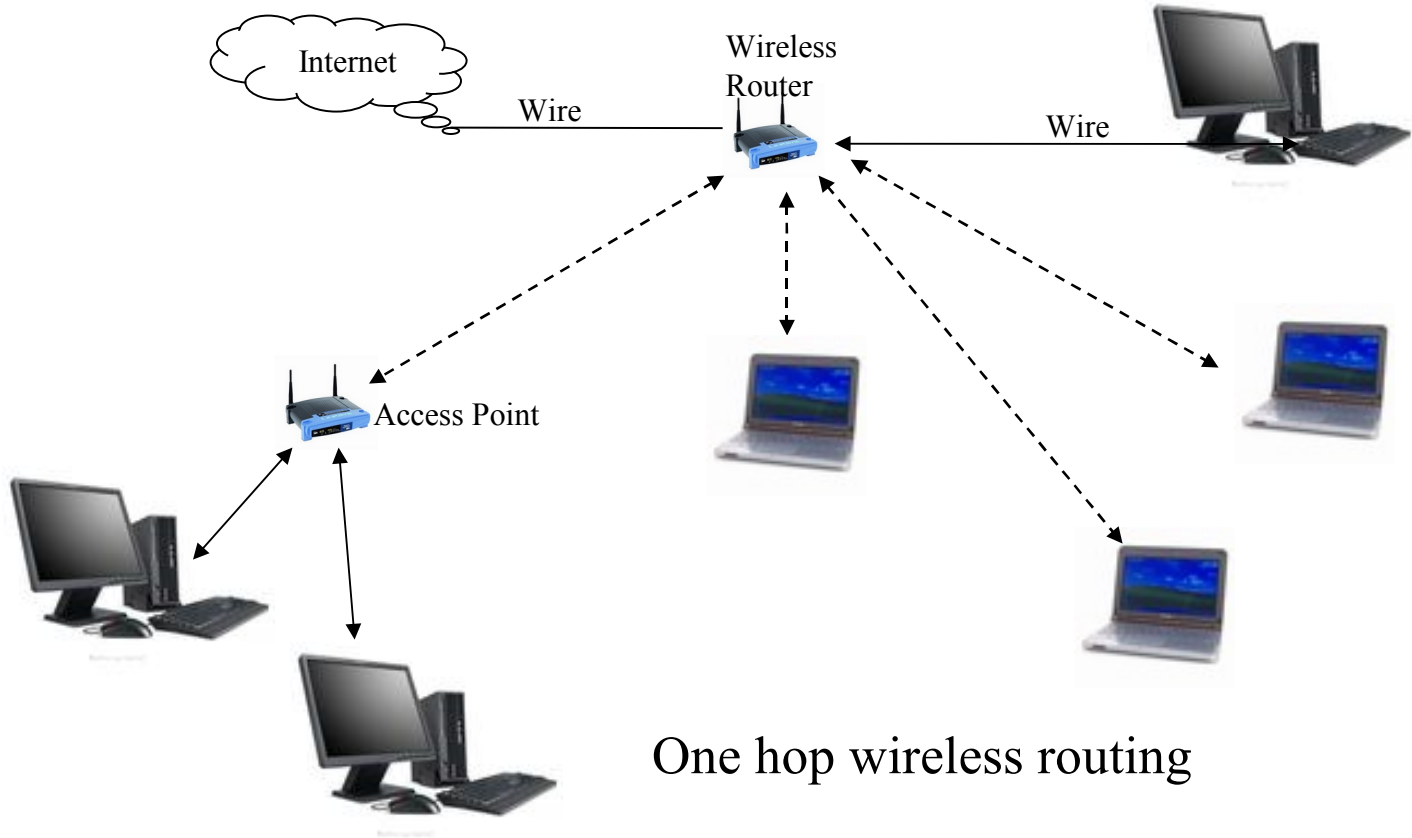
- Interpretation to ARRL HSMM WG from FCC Enforcement Branch via Chris Imlay
- Radio Amateurs using 802.11 type modulation under Part 97 could use WEP, WPA, etc as our intent or purpose is to provide authentication and thus protect our networks from part 15 intrusions... and not obscure the meaning of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

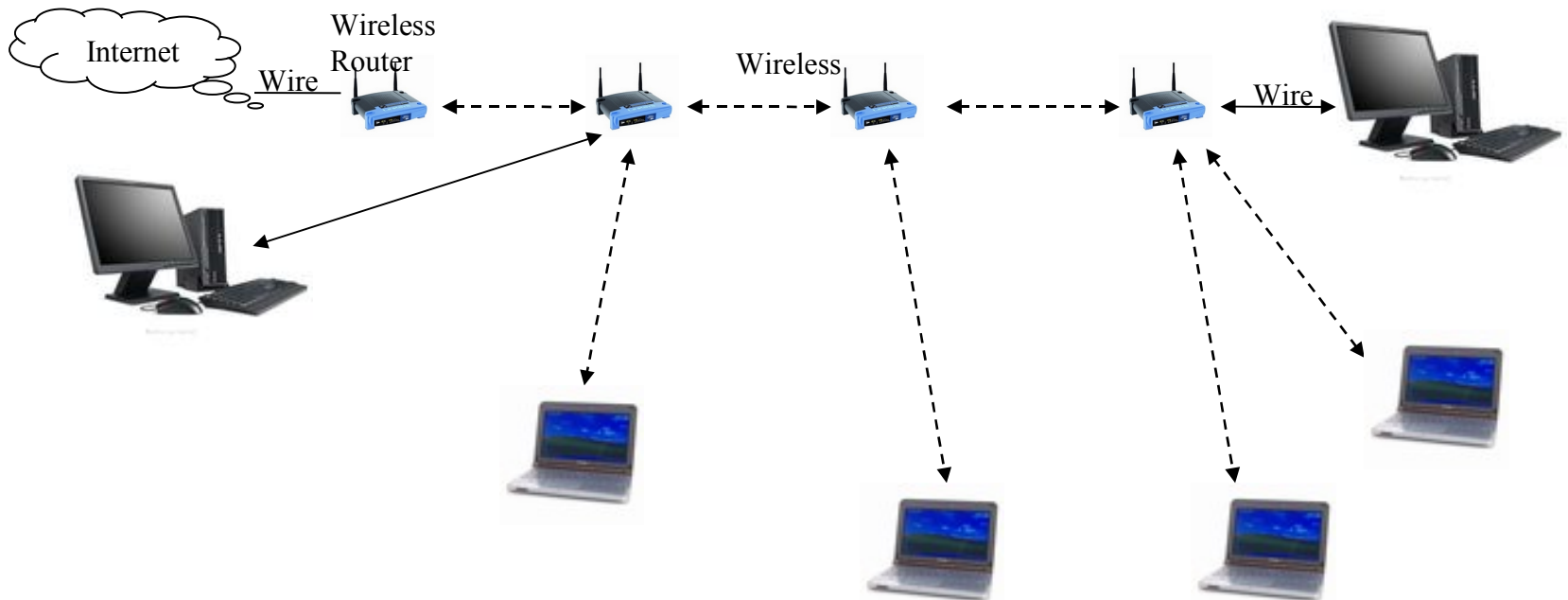


- Why change software?
 - More control
 - Add functions
 - **Wireless backbone**
 - **Mesh**

Off the Shelf Software



Alternate Software



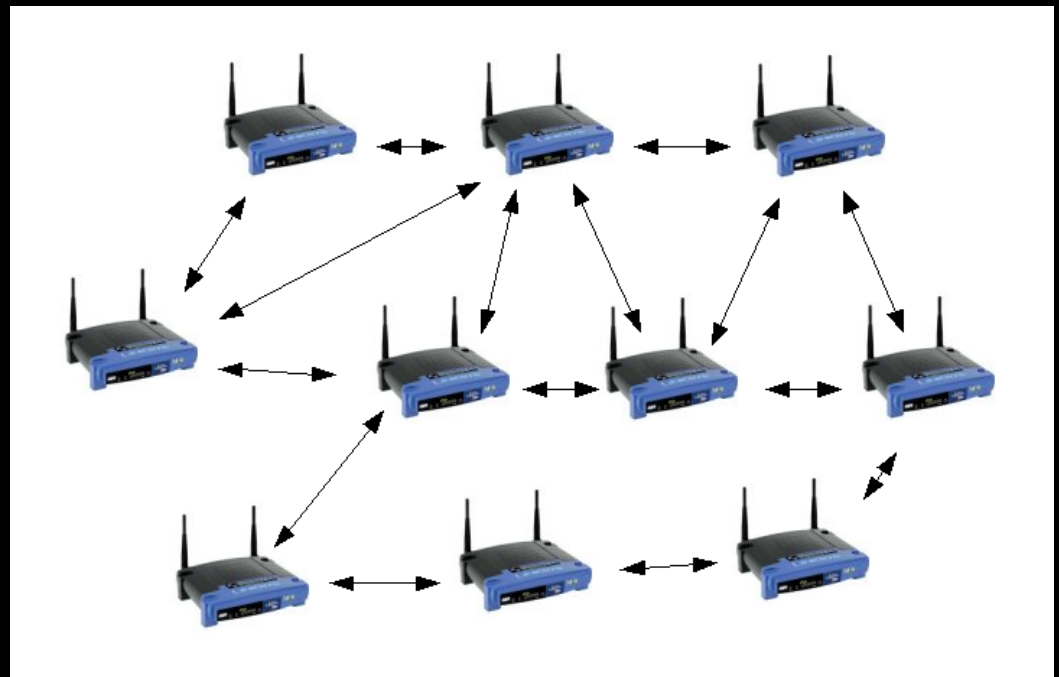
Multiple hop wireless routing

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

- I have spent hours configuring routers to link together
- Operating HSMM-MESH joins net <5 seconds when in range.
- Cold start HSMM-MESH joins net < 40 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

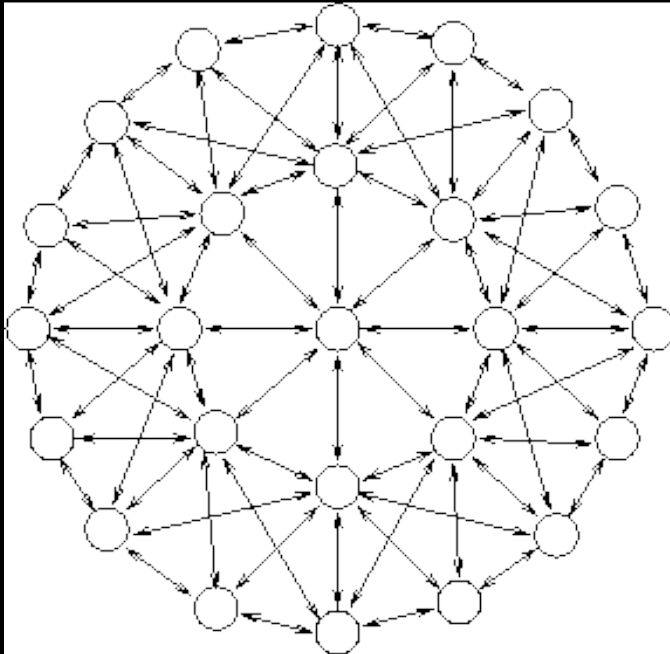


- Very little GUI, mostly a command line interface
 - Reason I started with DD-WRT
 - But more flexible

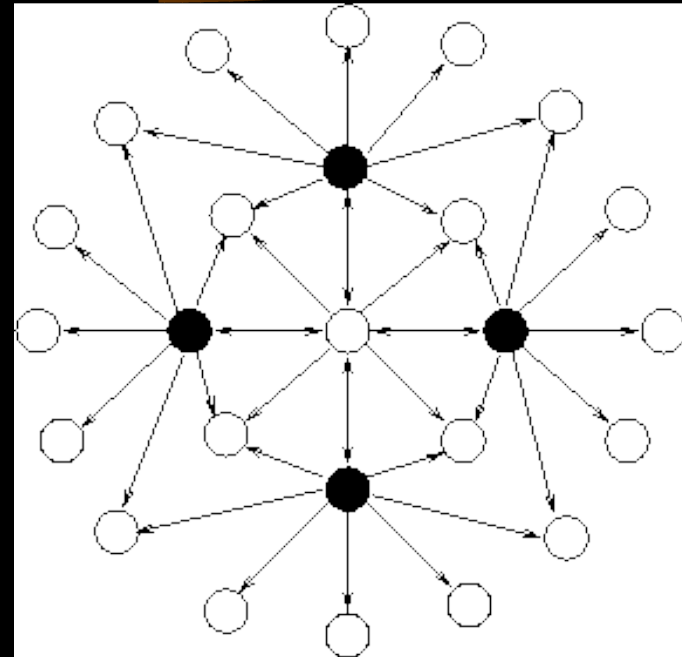
OLSR

- Optimized Link State Routing Protocol is an IP routing protocol which is optimized for mobile ad-hoc networks.
 - Mesh Network
 - Fast insertion < 5 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.

OLSR Status

Mesh Node AE5IB-AP4 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localnode/cgi-bin/status

Home Most Visited Smart Bookmarks Web Administration DPRglist Moderator ... Collin County ARES ... NWS - Fort Worth CC ARES Paging Sys...

AE5IB-AP4

Signal/Noise/Ratio **-49 / -94 / 45 dB**

firmware version 0.3.0

configuration mesh

WiFi address 10.122.107.89
fe80::21e:e5ff:fe7a:6b59 Link

LAN address 172.27.0.1
fe80::21e:e5ff:fe7a:6b57 Link

WAN address 192.168.1.7
fe80::21e:e5ff:fe7a:6b57 Link

system time Fri Aug 7 19:26:17 UTC 2009

uptime 9 min, load average: 0.02, 0.04, 0.01

free space flash=888.0k /tmp=6.9M memory=2572k

Night Mode

Downloads u... Vol... Vol... u... S... S... PAR... L... Cab... repl... inst... inst... Am... Clear

Done

Setup Page

n5oom-ap3 setup - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://n5oom-ap3/cgi-bin/setup

Most Visited Getting Started Latest Headlines

[Status](#) **Basic Setup** [Port Forwarding and Static DHCP](#) [Administration](#)

Node Name Password

Node Type Verify Password

WiFi	LAN	WAN
Protocol <input type="text" value="Static"/>	Protocol <input type="text" value="Static"/>	Protocol <input type="text" value="DHCP"/>
IP Address <input type="text" value="10.217.147.42"/>	IP Address <input type="text" value="172.27.0.1"/>	
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.0"/>	
SSID <input type="text" value="HSMM-MESH"/>	DHCP Server <input checked="" type="checkbox"/>	
Mode <input type="text" value="Ad-Hoc"/>		
Channel <input type="text" value="1"/>		
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"/>		

Done

[Status](#)

Basic Setup

[Port Forwarding
and Static DHCP](#)

[Administration](#)

Save Changes

Reset Values

Default Values

Reboot

Enter Name

Node Name

Password

Node Type

Verify Password

Automatic
from MAC

Must not
change

You can
set

0 Automatic
otherwise
meters

WiFi

Protocol

IP
Address

Netmask

SSID

Mode

Channel

Active Settings

Rx
Antenna

Tx
Antenna

Tx
Power

Distance

Apply

LAN

Protocol

IP
Address

Netmask

DHCP
Server



WAN

Protocol

Change Password
from default: hsmm

Save Changes
and Reboot

OLSR Status (Night Mode)

Applications Places System Fri Aug 7, 2:35 PM

Mesh Node AE5IB-AP4 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localnode/cgi-bin/status

Home Most Visited Smart Bookmarks Web Administration DPRglist Moderator ... Collin County ARES ... NWS - Fort Worth CC ARES Paging Sys...

AE5IB-AP4

Signal/Noise/Ratio **-47 / -81 / 34 dB**

firmware version 0.3.0

configuration mesh

WiFi address 10.122.107.89
fe80::21e:e5ff:fe7a:6b59 Link

LAN address 172.27.0.1
fe80::21e:e5ff:fe7a:6b57 Link

WAN address 192.168.1.7
fe80::21e:e5ff:fe7a:6b57 Link

system time Fri Aug 7 19:34:39 UTC 2009

uptime 17 min, load average: 0.00, 0.00, 0.00

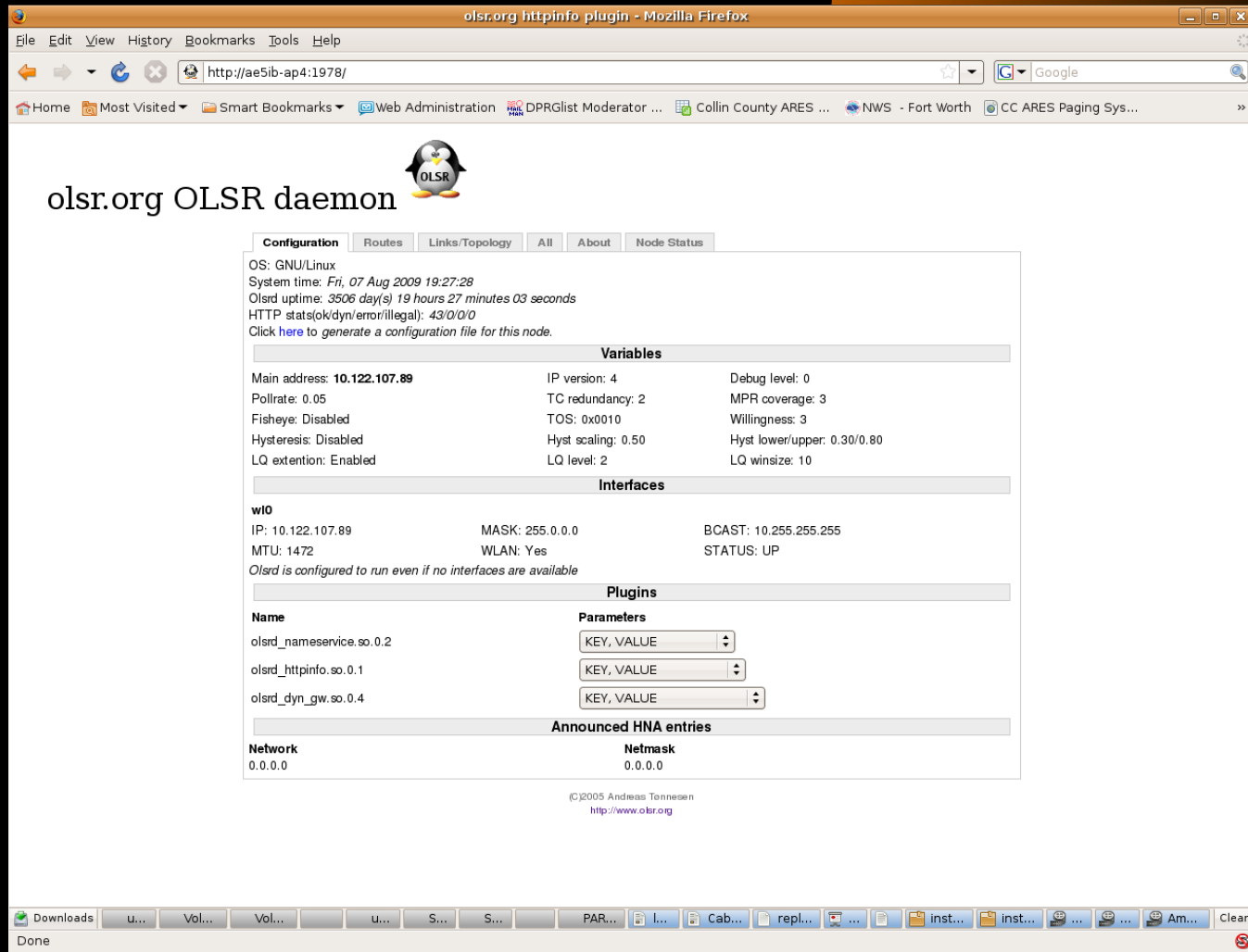
free space flash=888.0k /tmp=6.9M memory=2564k

Night Mode

Downloads u... Vol... Vol... u... S... S... PAR... l... Cab... repl... inst... inst... Am... Clear

Done

OLSR Configuration Tab



The screenshot shows a Mozilla Firefox browser window displaying the OLSR daemon configuration page. The browser's address bar shows the URL `http://ae5ib-ap4:1978/`. The page title is "olsr.org OLSR daemon" and features a penguin logo with "OLSR" written below it. The page has several tabs: "Configuration" (selected), "Routes", "Links/Topology", "All", "About", and "Node Status".

Configuration

OS: GNU/Linux
System time: Fri, 07 Aug 2009 19:27:28
Olsrd uptime: 3506 day(s) 19 hours 27 minutes 03 seconds
HTTP stats(ok/dyn/error/illegal): 43/0/0/0
Click [here](#) to generate a configuration file for this node.

Variables

Main address: 10.122.107.89	IP version: 4	Debug level: 0
Pollrate: 0.05	TC redundancy: 2	MPR coverage: 3
Fisheye: Disabled	TOS: 0x0010	Willingness: 3
Hysteresis: Disabled	Hyst scaling: 0.50	Hyst lower/upper: 0.30/0.80
LQ extention: Enabled	LQ level: 2	LQ winsize: 10

Interfaces

wi0

IP: 10.122.107.89	MASK: 255.0.0.0	BCAST: 10.255.255.255
MTU: 1472	WLAN: Yes	STATUS: UP

Olsrd is configured to run even if no interfaces are available

Plugins

Name	Parameters
olsrd_nameservice.so.0.2	KEY, VALUE
olsrd_httinfo.so.0.1	KEY, VALUE
olsrd_dyn_gw.so.0.4	KEY, VALUE

Announced HNA entries

Network	Netmask
0.0.0.0	0.0.0.0

©2005 Andreas Tennesen
<http://www.olsr.org>

The browser's taskbar at the bottom shows several open windows and the system tray with a "Done" status.

OLSR Routes Tab

olsr.org OLSR daemon

Configuration Routes Links/Topology All About Node Status

OLSR routes in kernel

Destination	Gateway	Metric	ETX	Interface	Type
10.190.20.41	10.190.20.41	1	1.11	wl0	HOST

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<http://www.olsr.org>

OLSR Links Tab

olsr.org OLSR daemon

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

Links							
Local IP	remote IP	Hysteresis	LinkQuality	lost	total	NLQ	ETX
10.122.107.89	10.190.20.41	0.00	1.00	0	10	1.00	1.00

Neighbors					
IP address	SYM	MPR	MPRS	Willingness	2 Hop Neighbors
10.190.20.41	YES	NO	NO	3	<input type="text" value="IP ADDRESS"/> (0)

Topology entries				
Destination IP	Last hop IP	LQ	ILQ	ETX
10.122.107.89	10.190.20.41	1.00	0.90	1.11

HNA entries		
Network	Netmask	Gateway

MID entries	
Main Address	Aliases

©2005 Andreas Tennesen
<http://www.olsr.org>


OLSR About Tab

olsr.org httpinfo plugin - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://ae5ib-ap4:1978/about

Home Most Visited Smart Bookmarks Web Administration DPRGlist Moderator ... Collin County ARES ... NWS - Fort Worth CC ARES Paging Sys...

 olsr.org OLSR daemon

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

Httpinfo olsrd plugin version 0.1
by Andreas Tonnesen (C)2005.
Compiled Dec 5 2008

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 or andreto-at-olsr.org
Official olsrd homepage: <http://www.olsr.org>

©2005 Andreas Tonnesen
<http://www.olsr.org>

Downloads u... Vol... Vol... u... S... S... PAR... l... Cab... repl... inst... inst... Am... Clear

Done

OLSR All Tab

olsr.org httpinfo plugin - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://ae5ib-ap4:1978/all

Home Most Visited Smart Bookmarks Web Administration DPRglist Moderator ... Collin County ARES ... NWS - Fort Worth CC ARES Paging Sys...

olsr.org OLSR daemon

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

OS: GNU/Linux
System time: Fri, 07 Aug 2009 19:30:50
Olsrd uptime: 3506 day(s) 19 hours 30 minutes 25 seconds
HTTP stats(ok/dyn/error/illegal): 55/0/0/0
Click [here](#) to generate a configuration file for this node.

Variables

Main address: 10.122.107.89	IP version: 4	Debug level: 0
Pollrate: 0.05	TC redundancy: 2	MPR coverage: 3
Fisheye: Disabled	TOS: 0x0010	Willingness: 3
Hysteresis: Disabled	Hyst scaling: 0.50	Hyst lower/upper: 0.30/0.80
LQ extention: Enabled	LQ level: 2	LQ winsize: 10

Interfaces

wi0

IP: 10.122.107.89	MASK: 255.0.0.0	BCAST: 10.255.255.255
MTU: 1472	WLAN: Yes	STATUS: UP

Olsrd is configured to run even if no interfaces are available

Plugins

Name	Parameters
olsrd_nameservice.so.0.2	KEY, VALUE
olsrd_httpinfo.so.0.1	KEY, VALUE
olsrd_dyn_gw.so.0.4	KEY, VALUE

Announced HNA entries

Network	Netmask
0.0.0.0	0.0.0.0

OLSR routes in kernel

Destination	Gateway	Metric	ETX	Interface	Type
10.190.20.41	10.190.20.41	1	1.00	wi0	HOST

Links

Local IP	remote IP	Hysteresis	LinkQuality	lost	total	NLQ	ETX
10.122.107.89	10.190.20.41	0.00	0.90	1	10	1.00	1.11

Done

OLSR All Tab (bottom)

The screenshot shows the 'olsr.org httpinfo plugin - Mozilla Firefox' window. The address bar contains 'http://ae5ib-ap4:1978/all'. The browser's bookmark bar includes 'Home', 'Most Visited', 'Smart Bookmarks', 'Web Administration', 'DPRGlist Moderator ...', 'Collin County ARES ...', 'NWS - Fort Worth', and 'CC ARES Paging Sys...'. The main content area displays the following information:

main address: 10.122.107.89 IP version: 4 Debug level: 0
Pollrate: 0.05 TC redundancy: 2 MPR coverage: 3
Fisheye: Disabled TOS: 0x0010 Willingness: 3
Hysteresis: Disabled Hyst scaling: 0.50 Hyst lower/upper: 0.30/0.80
LQ extension: Enabled LQ level: 2 LQ winsize: 10

Interfaces

wi0
IP: 10.122.107.89 MASK: 255.0.0.0 BCAST: 10.255.255.255
MTU: 1472 WLAN: Yes STATUS: UP
Olsrd is configured to run even if no interfaces are available

Plugins

Name	Parameters
olsrd_nameservice.so.0.2	KEY, VALUE
olsrd_httpinfo.so.0.1	KEY, VALUE
olsrd_dyn_gw.so.0.4	KEY, VALUE

Announced HNA entries

Network	Netmask
0.0.0.0	0.0.0.0

OLSR routes in kernel

Destination	Gateway	Metric	ETX	Interface	Type
10.190.20.41	10.190.20.41	1	1.00	wi0	HOST

Links

Local IP	remote IP	Hysteresis	LinkQuality	lost	total	NLQ	ETX
10.122.107.89	10.190.20.41	0.00	0.90	1	10	1.00	1.11

Neighbors

IP address	SYM	MPR	MPRS	Willingness	2 Hop Neighbors
10.190.20.41	YES	NO	NO	3	IP ADDRESS (0)

Topology entries

Destination IP	Last hop IP	LQ	ILQ	ETX
10.122.107.89	10.190.20.41	1.00	1.00	1.00

HNA entries

Network	Netmask	Gateway
---------	---------	---------

MID entries

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

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<http://www.olsr.org>

The taskbar at the bottom shows various icons for Downloads, U..., Vol..., S..., PAR..., Cab..., repl..., inst..., Am..., and Clear.

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)

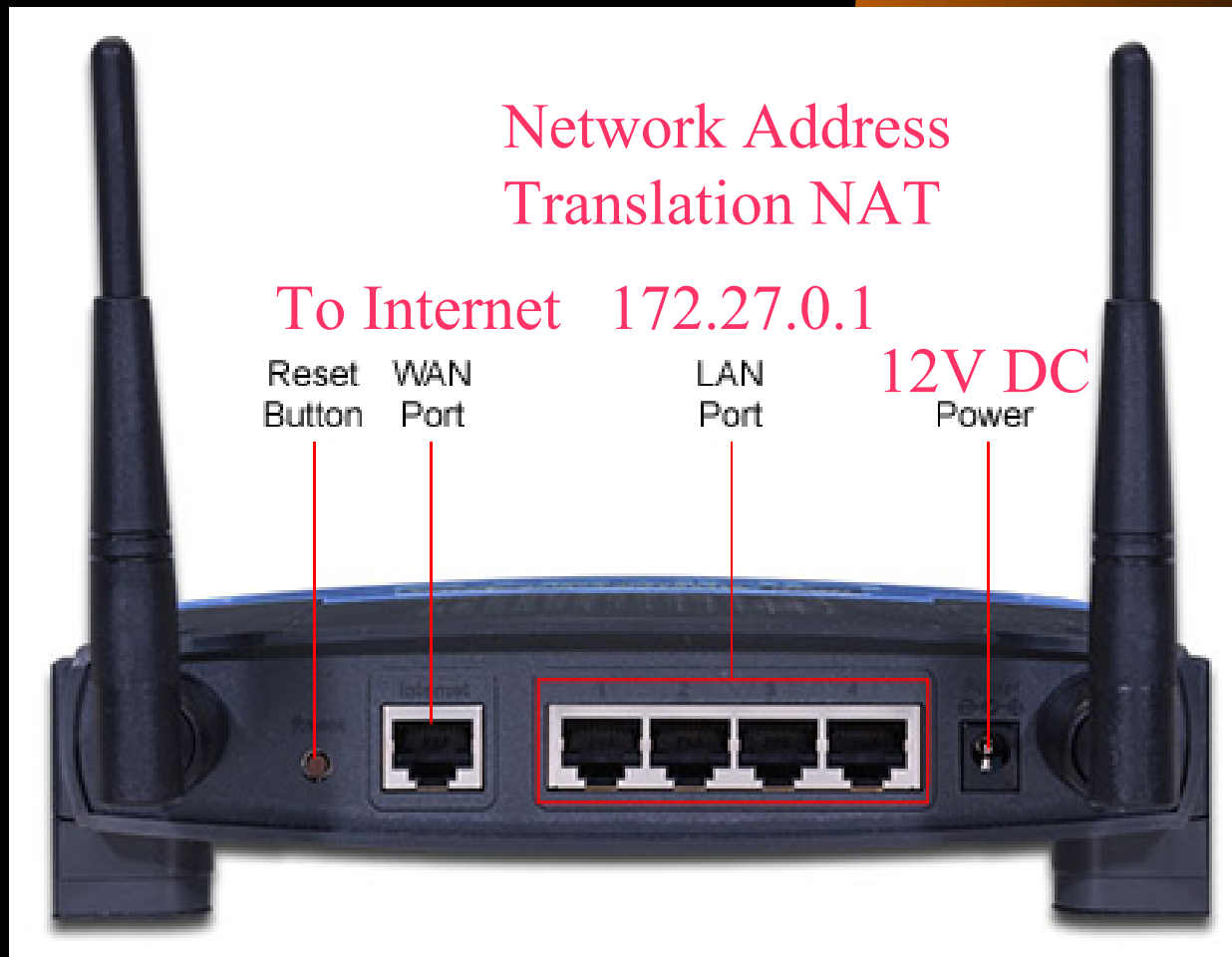
Stay with WRT54GL to be safest

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
 - \$58.99 - \$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

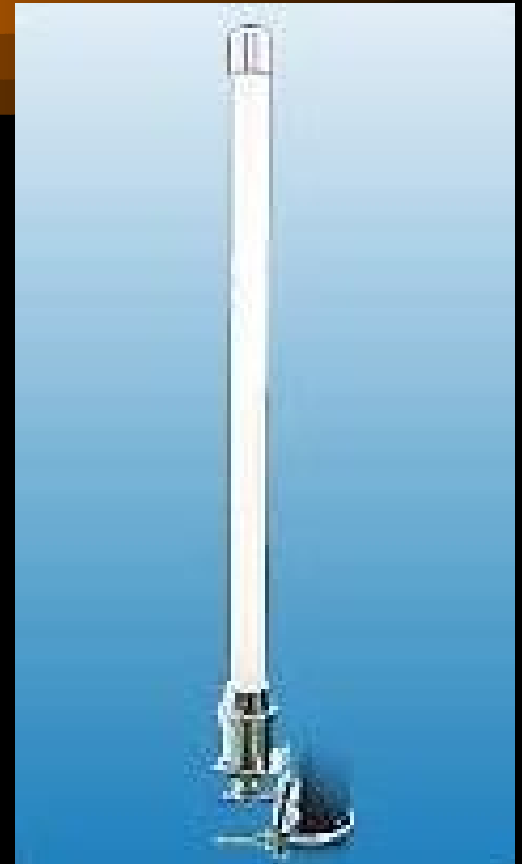
15 db Omni

- 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

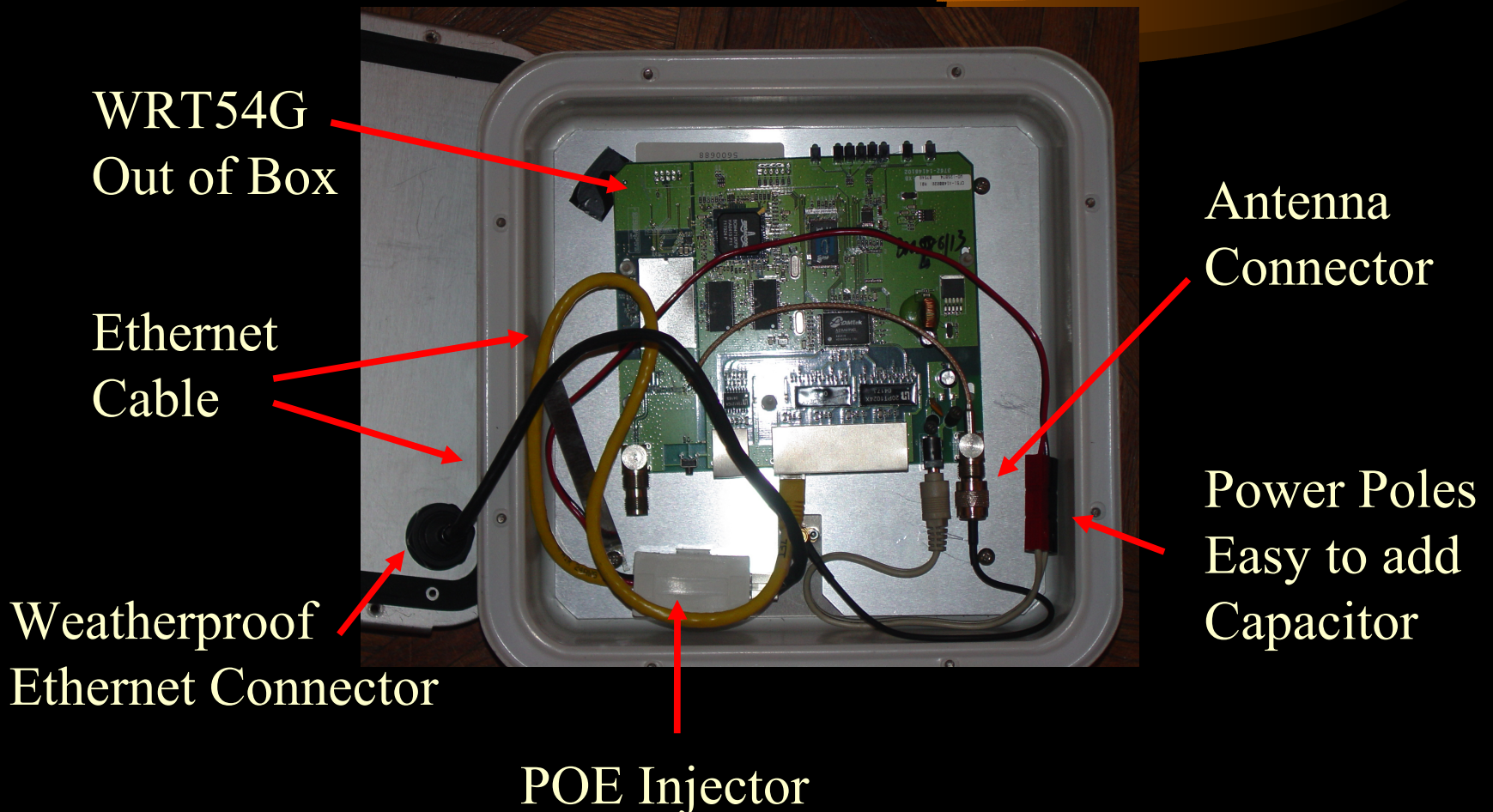
- RooTennas
 - Mounts on mast, easy switch from vertical to horizontal
 - Built-in housing for router
 - 19 db with housing
 - \$82.95
 - 15 db with housing
 - \$49.95

Pacific Wireless

<http://www.pacwireless.com>



Inside 15 db Rootenna

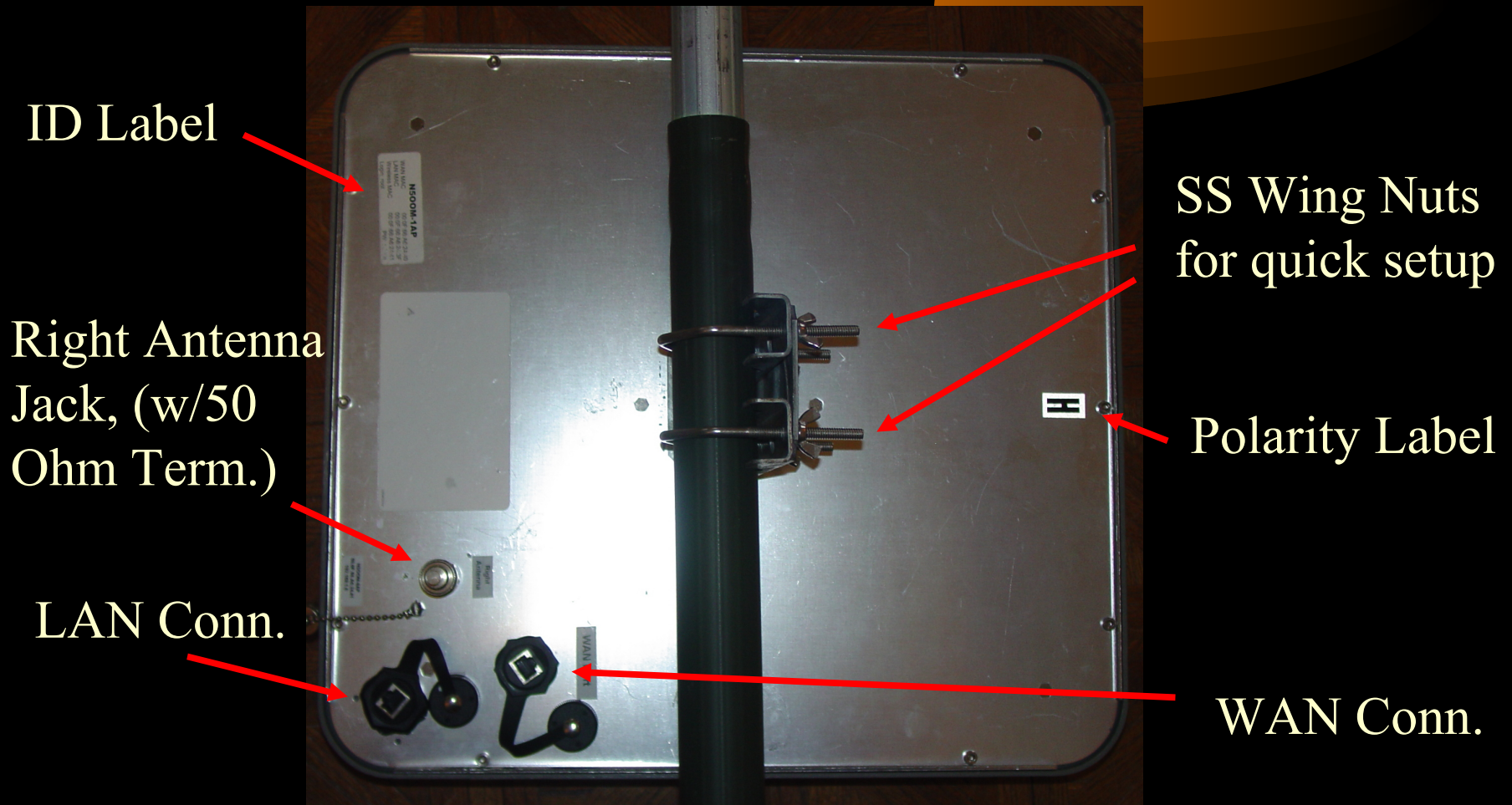


19 db Rootenna

- Good Price \$86
- 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.

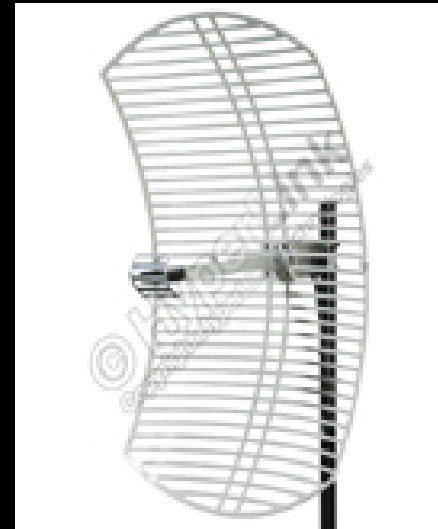
SS Wing Nuts
for quick setup

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
- l-com.com
- wlanparts.com
- 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

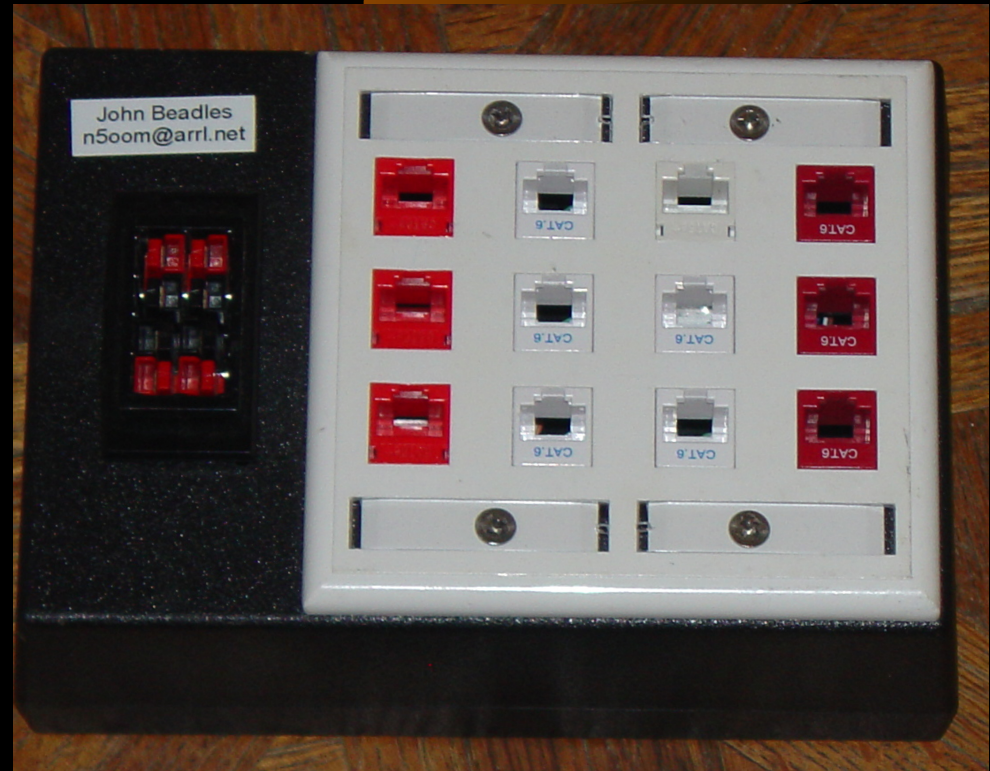


Home Made Passive POE Adapters

- 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 on a 10/100 Mb Switch
 - Also 12V Power



Problems with Passive 12V POE

- 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 Problems

- When the router needed more power the inductance and resistance of the long wire made the voltage sag, and the switching power supply started drawing more power, which caused the voltage to sag more. When the inductance caught up the current was less and the voltage went up, causing the switcher to draw less current, and maybe the demand was also less because the transmitter was now off.

12V POE Solution

- 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 with long Ethernet runs.
- Only noticed problem on POE Ethernet runs over 200 feet

48V Power Over Ethernet

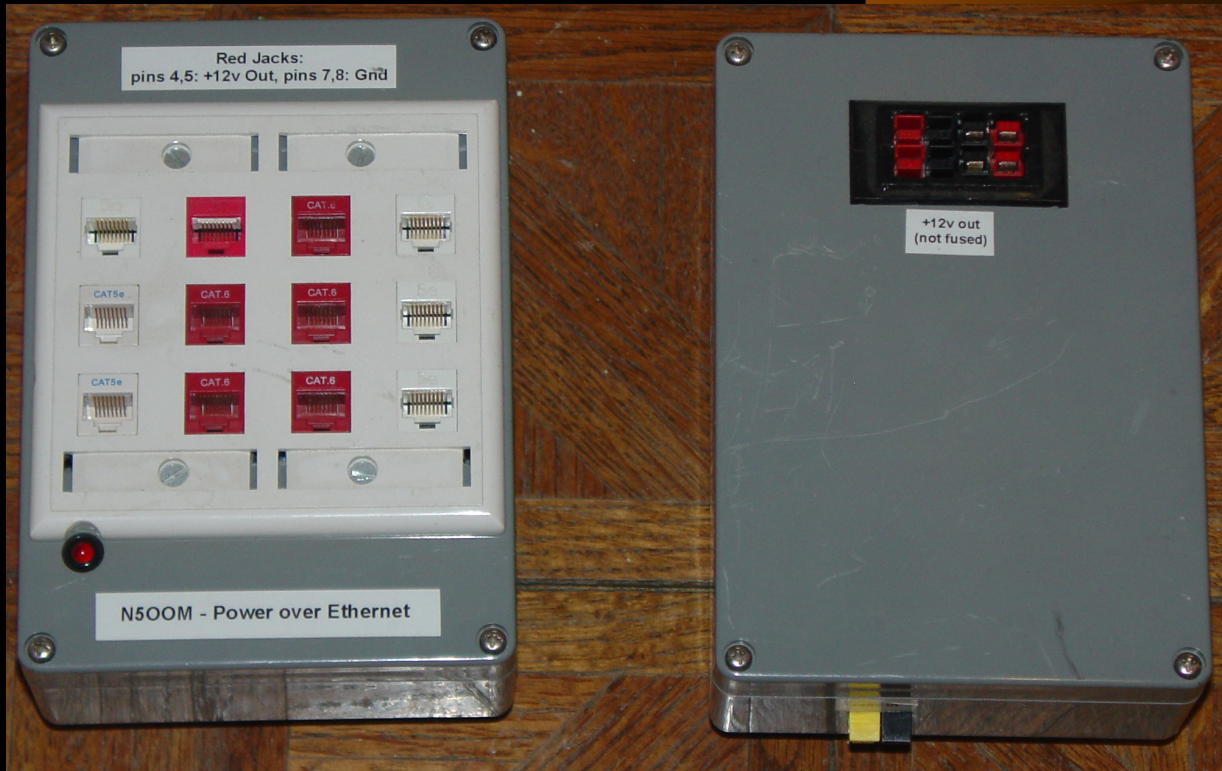
- The Standard for POE is 48V (Different Suppliers can vary from this.)
- Uses less current, so voltage drop is less
- More Expensive
 - Need 48V power supply at the bottom
 - Need 48V to 12V switcher at router
- May be needed in some situations
- Do not mix with 12V POE
- We use Yellow and Black Power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



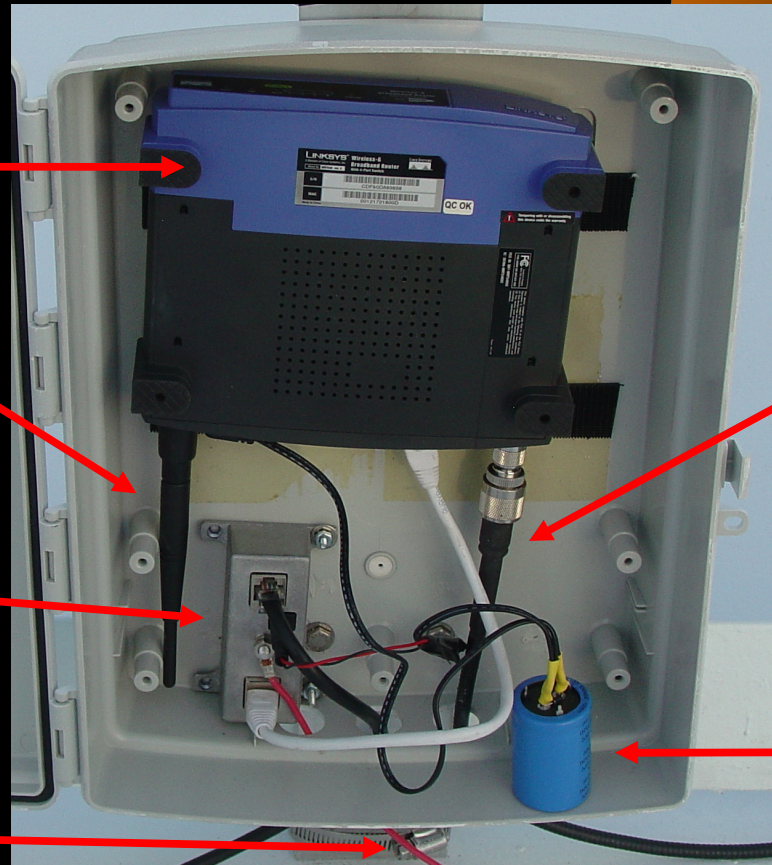
K5PRK-AP1 Router

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

Potential Collin County HSMM-MESH

- Blue marks are water towers
- Houses are Hams interested in hosting a node
- Latest Version:
- <http://tinyurl.com/oms2qn>

K5PRK-AP1



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
- Wireless Networking for the Developing World
 - <http://wndw.net/>
- N500M HSMM Page
 - <http://www.n500m.org/hsmm/>