

Mesh Networks

Willem A. Schreüder ACØKQ

Denver Radio League
May 27, 2015

With many slides stolen from the BBHN website

What is It?

- High speed
 - 10 megabit or faster
- Self-configuring
 - Automatic routing of packets
 - Multi-hop
- Fault-tolerant
 - Routes around failed nodes
- Data network
 - Standard Internet Protocol

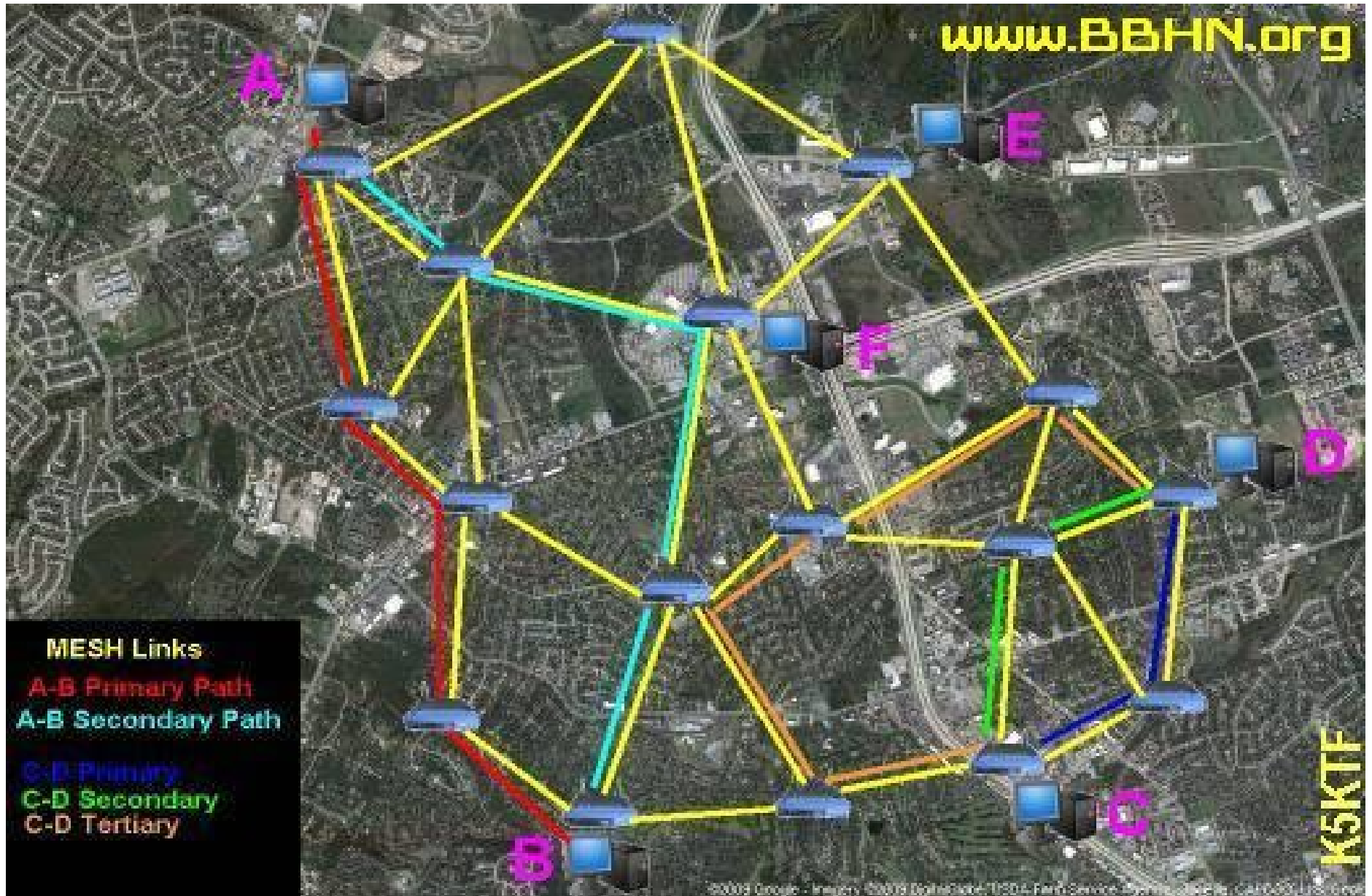
What do you do with it?

- Transport packets from one location to another
- Applications
 - Anything that works on a LAN
- Use cases
 - Ham fest
 - Field day
 - Public service events
 - Emergencies
 - Private network

What is new here?

- Operating at higher power in the ham bands
 - 2.4 GHz, 5GHz
- Mesh
 - Nodes are peers
 - Multi-hop (packet forwarded by neighbors)
 - Self-configuring (automatic neighbor discovery)
 - Redundant (automatically discover new paths)
 - No configuration (new nodes added automatically)

Example Network

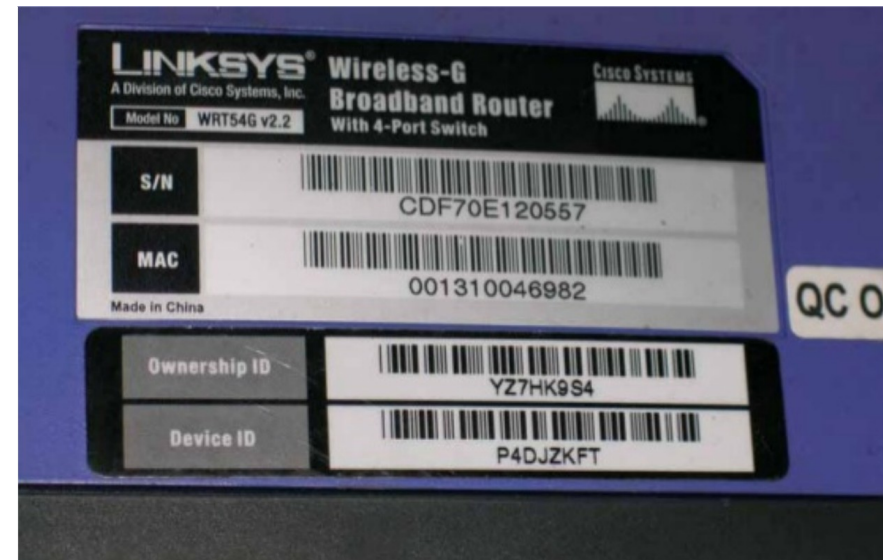


How did this happen?

- Hams that put this together
 - Started as ARES-MESH in Travis County, TX
 - Became High Speed Multi-Media (HSMM)
 - Evolved into Broadband Hamnet (BBHN)
 - Fork to Amateur Radio Emergency Data Network (AREDN) – not sure where that is headed
- FCC declared it legal
 - Encryption is legal for protecting data networks
 - Traffic should be Part 97 appropriate

Hardware - Linksys

- WRT54G v. 1.0 – 4.0
- WRT54GS v. 1.0 – 4.0
- WRT54GL v. 1.0 – 1.1
- A few others
 - Check the web site
- ***Other versions do not work because of inadequate memory or changes to the chipsets***



Hardware - Ubiquiti

- Airgrid
- Bullet
- Rocket
- Nanostation



How do you get started

- Web site with software and instructions
 - <http://www.broadband-hamnet.com/>
- Find suitable hardware
- Install the firmware
- Configure the node with your callsign
- Join the revolution...

Download Firmware - 1

The screenshot shows a web browser window with the address bar displaying www.broadband-hamnet.org. The search bar contains the text "gimp draw ellipse". The browser's toolbar includes icons for back, forward, search, star, home, and a menu icon. Below the toolbar, there are several website shortcuts: Dilbert, APOD, GN, XKCD, NTP, WL2K, CTN, DOQ, Temps, moodle, ADSB, and W0VG-7.

The main content area is titled "Broadband-Hamnet" and features a "Release 3.1.0" announcement. The release was written by Administrator on Thursday, 19 March 2015 at 22:41. The announcement states: "Broadband-Hamnet has a new release of Ham-oriented data networking firmware for the Linksys and Ubiquiti products!"

The announcement text continues: "Broadband-Hamnet (BBHN) has released version 3.1.0 firmware for the Linksys WRT54G and Ubiquiti families of products. This firmware returns to the use of patch updates, while also supporting add-on tools such as HamChat created by Nikolai, VE3NKL and a tunneling solution optimized by Darryl, K5DLQ."

It further explains: "This firmware release continues support for EMCOM data networking in the 2.4 GHz, 5 GHz and 900 MHz bands using Ubiquiti equipment and in the 2.4 GHz band using Linksys equipment. Many Hams were concerned about future Broadband-Hamnet support of the Linksys units; the core team has listened to these concerns and has decided to continue support of Linksys devices. Additionally, with the recent frequency of updates, the lack of available patches became very apparent. There are two items here:

1. In order to focus on Broadband-Hamnet as an EMCOM tool we have resolved to limit our major (non-compatible) updates to no more frequently than every 6 months.
2. By returning to our patch capability we expect to make all of the minor updates much more friendly to existing networks, especially those with hard-to-reach installed locations.

By creating solutions with Commercial Off The Shelf (COTS) hardware and Broadband-Hamnet firmware, a high-speed IP network can be deployed in the time required to set it in place and power it on.

There have been many requests for tunneling capability to allow interaction between remote Broadband-Hamnet networks. While this has been done before, the resources and complexity were quite high. With the new VTUN capability this feature becomes feasible for all Broadband-Hamnet users.

The HamChat server is a real innovation that allows keyboard-to-keyboard chats between any connected users on the same mesh. By using your web browser instead of chat client software, the complexity is reduced and the speed to deploy is increased. The HamChat server is not installed but is a downloadable package option for the Broadband-Hamnet 3.1.0 firmware.

We hope that Hams interested in high-speed data networks look at the new Broadband-Hamnet 3.1.0 firmware!

For more information, please take a look at www.Broadband-Hamnet.org.

The footer of the page indicates "Last Updated on Thursday, 19 March 2015 22:47".

The left sidebar contains three sections: "Main Menu" with links to Home, Just starting? Read this, Web Links, HSMM-MESH™ Forums, and Awards; "Resources" with links to Contact the Webmaster, which hardware to use, Software Download (circled in red), Applications for the mesh, Voice over IP, and Regional Mesh Elmers; and "HSMM-MESH Info" with links to Under Development, User Documentation, Developer Documentation, FAQ, FD Logging With Mesh, HSMM files, Videos, Usage Articles, Learn about OLSR, Learn about Open WRT, Learn about WRT54G, Learn about WRT54GL, Learn about WRT54GS, and Visual of a Mesh Network.

Download Firmware - 2

Software Download


www.broadband-hamnet.org/software-download.html

gimp draw ellipse

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

Broadband-Hamnet™
HSMM-MESH™

NEWS for the la



News

Search

Who's Online

We have 265 guests and 6 members online

- kg7dgh
- kh2fl
- m6jgj
- KC0TXV
- N7XUC
- AC0KQ

Software Download

Broadband Hamnet Software Download

[Linksys](#)

[Ubiquiti](#)

Main Menu

- Home
- Just starting? Read this
- Web Links
- HSMM-MESH™ Forums
- Awards

Resources

- Contact the Webmaster

Download Firmware - 3

Software Download

www.broadband-hamnet.org/software-download.html

gimp draw ellipse

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

We have 200 guests and 0 members online

- kg7dgh
- kh2fl
- m6jgj
- KC0TXV
- N7XUC
- AC0KQ

Main Menu

- Home
- Just starting? Read this
- Web Links
- HSMM-MESH™ Forum
- Awards

Resources

- Contact the Webmaster
- Which hardware to use
- Software Download
- Applications for the mesh
- Voice over IP
- Regional Mesh Elmers

HSMM-MESH Info

- Under Development
- User Documentation
- Developer Documentation
- FAQ
- FD Logging With Mesh

bbhn-3.1.0-we800g-squashfs.bin	2.9M	firmware for a non-mesh we800g md5sum: ed537c278b6305aa4d2a2699f0ce0f50
bbhn-3.1.0-wr850g-squashfs.bin	2.9M	firmware for a non-mesh wr850g md5sum: 0cd816091408a191947f6625de70c795
bbhn-3.1.0-wrt150n-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt150n md5sum: b5587f6e90fcae0e6b01fa9b26f1fccf
bbhn-3.1.0-wrt300n_v1-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt300n_v1 md5sum: bf2ff3a9072e0864ac9dad25cbbf30f4
bbhn-3.1.0-wrt54g-2.4-squashfs.bin	2.9M	firmware for a non-mesh WRT54G and GL md5sum: 451b1b6156e27540cd4f561dadabd146
bbhn-3.1.0-wrt54g3g-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt54g3g md5sum: 2ca80836ee2b53a8148a3662f11d374d
bbhn-3.1.0-wrt54gs-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt54gs md5sum: 36890182c43fb47fe8ff939b4c57c28a
bbhn-3.1.0-wrt54gs_v4-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt54gs_v4 md5sum: bbce7618509d72bd378c8e64d145fa3b
bbhn-3.1.0-wrtsl54gs-2.4-squashfs.bin	2.9M	firmware for a non-mesh wrt54gs md5sum: ab3c684ea1edaac7306b32b9c09069a9

SPONSORED AD:

Arduino's Wireless Mesh

All-in-one hardware, a free API, no-fuss mesh, entirely open source.

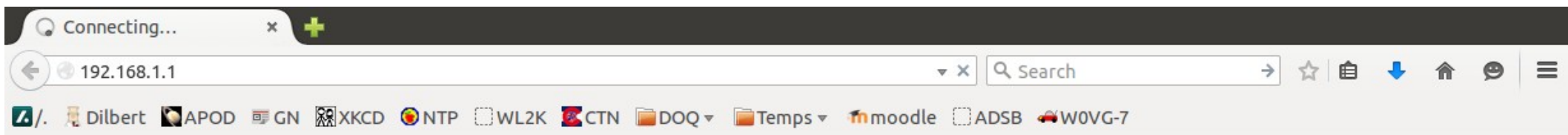
Connect via Ethernet to the LAN




If necessary, reset the device to factory defaults by holding the reset button for about 10 seconds



Point browser to <http://192.168.1.1/>
User name **admin** Password **admin**



Authentication Required

 A username and password are being requested by [http://192.168.1.1.](http://192.168.1.1/) The site says: "WRT54G"

User Name:

Password:

Select Administration

The screenshot shows a web browser window with the address bar displaying '192.168.1.1'. The browser's address bar and tabs are visible at the top. The main content area is the Linksys WRT54G router's configuration page. The page has a blue header with the Linksys logo and 'A Division of Cisco Systems, Inc.' on the left, and 'Wireless-G Broadband Router WRT54G' and 'Firmware Version: v1.00.4' on the right. Below the header is a navigation menu with tabs for 'Setup', 'Wireless', 'Security', 'Access Restrictions', 'Applications & Gaming', 'Administration', and 'Status'. The 'Administration' tab is highlighted with a red circle. Under the 'Administration' tab, there are sub-tabs for 'Basic Setup', 'DDNS', 'MAC Address Clone', and 'Advanced Routing'. The main content area is divided into three sections: 'Internet Setup', 'Network Setup', and 'DHCP Server Settings (DHCP)'. The 'Internet Setup' section has a dropdown menu set to 'Automatic Configuration - DHCP'. Below this are fields for 'Router Name' (WRT54G), 'Host Name', 'Domain Name', 'MTU' (Auto), and 'Size' (1500). The 'Network Setup' section has fields for 'Local IP Address' (192.168.1.1) and 'Subnet Mask' (255.255.255.0). The 'DHCP Server Settings (DHCP)' section has a 'DHCP Server' checkbox checked (Enable), 'Starting IP Address' (192.168.1.100), 'Maximum Number of DHCP Users' (50), and 'Client Lease Time' (0 minutes). On the right side of the page, there is a blue sidebar with information about 'Automatic Configuration - DHCP', 'Host Name', 'Domain Name', 'Local IP Address', 'Subnet Mask', 'DHCP Server', and 'Starting IP Address'.

Basic Setup

192.168.1.1

LINKSYS®
A Division of Cisco Systems, Inc.

Wireless-G Broadband Router WRT54G
Firmware Version: v1.00.4

Setup

Setup | Wireless | Security | Access Restrictions | Applications & Gaming | **Administration** | Status

Basic Setup | DDNS | MAC Address Clone | Advanced Routing

Internet Setup

Internet Connection Type

Optional Settings (required by some ISPs)

Automatic Configuration - DHCP

Router Name: WRT54G

Host Name:

Domain Name:

MTU: Auto

Size: 1500

Network Setup

Router IP

Local IP Address: 192 . 168 . 1 . 1

Subnet Mask: 255.255.255.0

DHCP Server: Enable Disable

Starting IP Address: 192.168.1.100

Maximum Number of DHCP Users: 50

Client Lease Time: 0 minutes (0 means one day)

Automatic Configuration - DHCP: This setting is most commonly used by Cable operators.

Host Name: Enter the host name provided by your ISP.

Domain Name: Enter the domain name provided by your ISP. More...

Local IP Address: This is the address of the router.

Subnet Mask: This is the subnet mask of the router.

DHCP Server: Allows the router to manage your IP addresses.

Starting IP Address: The address you would like to start with.

Select Firmware Upgrade

The screenshot shows a web browser window with the address bar displaying "192.168.1.1/Manage.htm". The browser's address bar also contains a search field and navigation icons. Below the browser window, the Linksys administration interface is visible. The top navigation bar includes the Linksys logo, "A Division of Cisco Systems, Inc.", and the firmware version "v1.00.4". The main navigation menu is divided into sections: "Administration" (with sub-items: Setup, Wireless, Security, Access Restrictions, Applications & Config, Administration, Status) and "Router Password" (with sub-items: Local Router Access, Web Access, Remote Router Access, UPnP). The "Firmware Upgrade" link under the "Applications & Config" section is circled in red. The right sidebar contains informational text for "Local Router Access", "Web Access", "Remote Router Access", and "UPnP".

LINKSYS®
A Division of Cisco Systems, Inc. Firmware Version: v1.00.4

Wireless-G Broadband Router WRT54G

Administration

Setup Wireless Security Access Restrictions Applications & Config Administration Status

Management | Log | Diagnostics | Factory Defaults | **Firmware Upgrade** | Config Management

Router Password

Local Router Access

Password:

Re-enter to confirm:

Web Access

Access Server: HTTP HTTPS

Wireless Access Web: Enable Disable

Remote Router Access

Remote Management: Enable Disable

Management Port:

Use https:

UPnP

UPnP: Enable Disable

Local Router Access: You can change the Router's password from here. Enter a new Router password and then type it again in the Re-enter to confirm field to confirm.

Web Access: Allows you to configure access options to the router's web utility. [More...](#)

Remote Router Access: Allows you to access your router remotely. Choose the port you would like to use. You must change the password to the router if it is still using its default password.

UPnP: Used by certain programs to automatically open ports for communication. [More...](#)

Browse to select firmware

Select *Upgrade*

The screenshot shows a web browser window with the address bar displaying "192.168.1.1/Upgrade.htm". The browser's address bar includes a search field and navigation icons. The browser's toolbar shows various icons, including Dilbert, APOD, GN, XKCD, NTP, WL2K, CTN, DOQ, Temps, moodle, ADSB, and W0VG-7.

The main content area is the Linksys administration interface. The top header is blue and contains the Linksys logo, "A Division of Cisco Systems, Inc.", and the firmware version "v1.00.4". Below the header is a navigation menu with "Administration" selected. The "Administration" menu includes "Setup", "Wireless", "Security", "Access Restrictions", "Applications & Gaming", "Administration", and "Status". The "Administration" menu is further divided into "Management", "Log", "Diagnostics", "Factory Defaults", "Firmware Upgrade", and "Config Management".

The "Upgrade Firmware" section is highlighted. It contains the following text:

Upgrade Firmware

Please select a file to upgrade: **Browse...** No file selected.

Warning: Upgrading firmware may take a few minutes, please don't turn off the power or press the reset button.

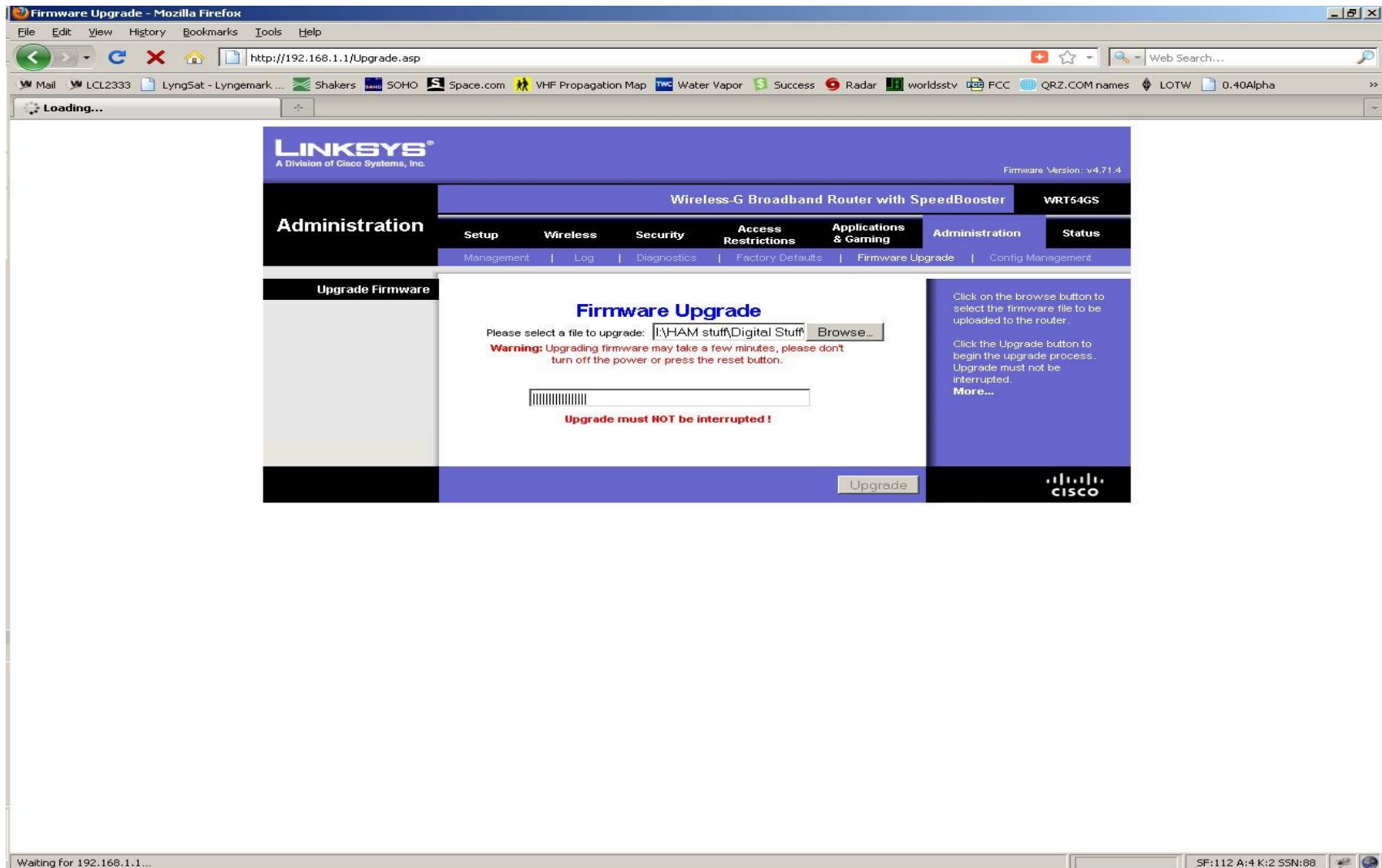
Upgrade must NOT be interrupted !

Click on the browse button to select the firmware file to be uploaded to the router.

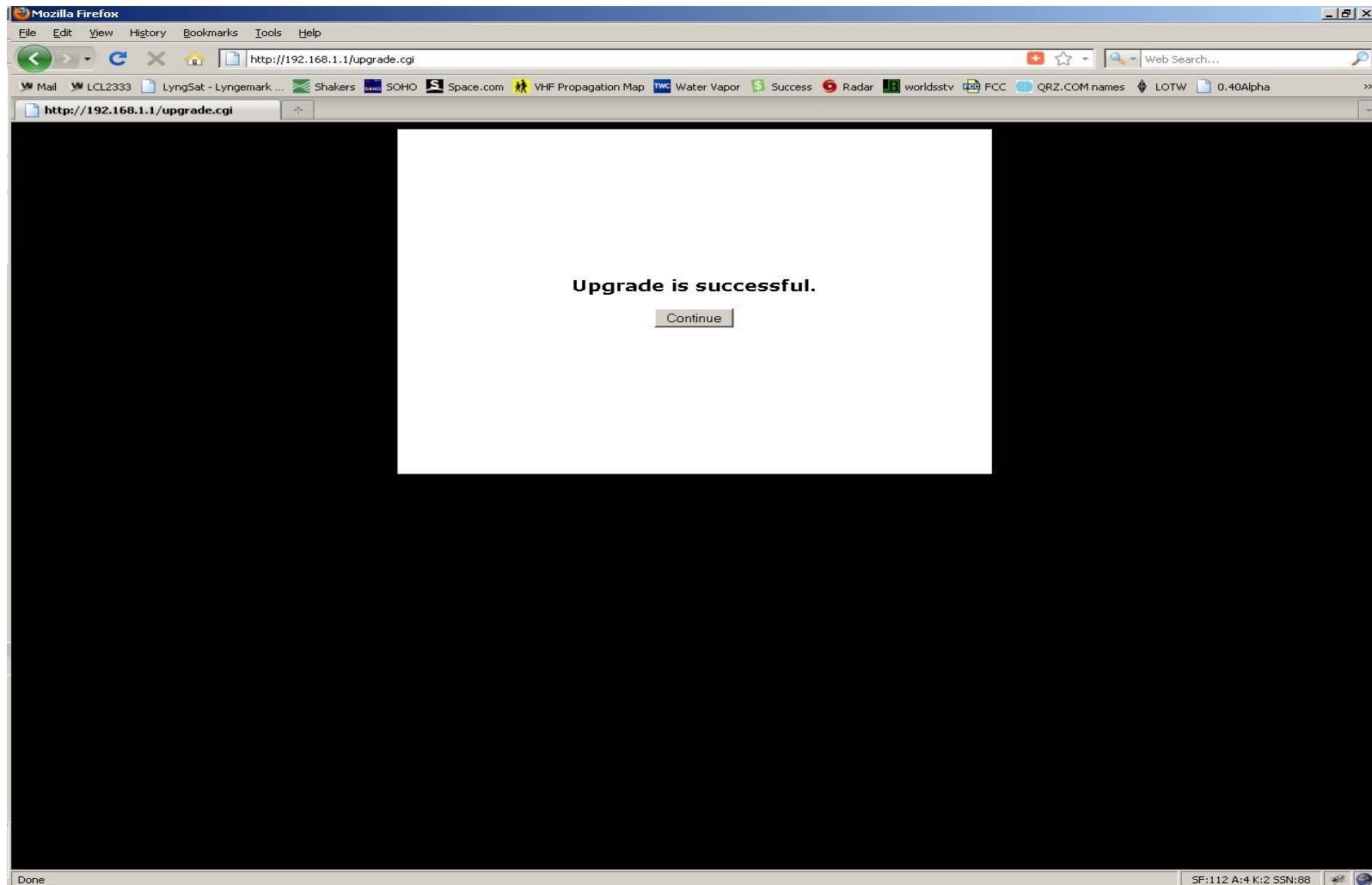
Click the Upgrade button to begin the upgrade process. Upgrade must not be interrupted. [More...](#)

The "Browse..." button is circled in red, and the "Upgrade" button is circled in yellow.

DO NOT remove power while it is updating



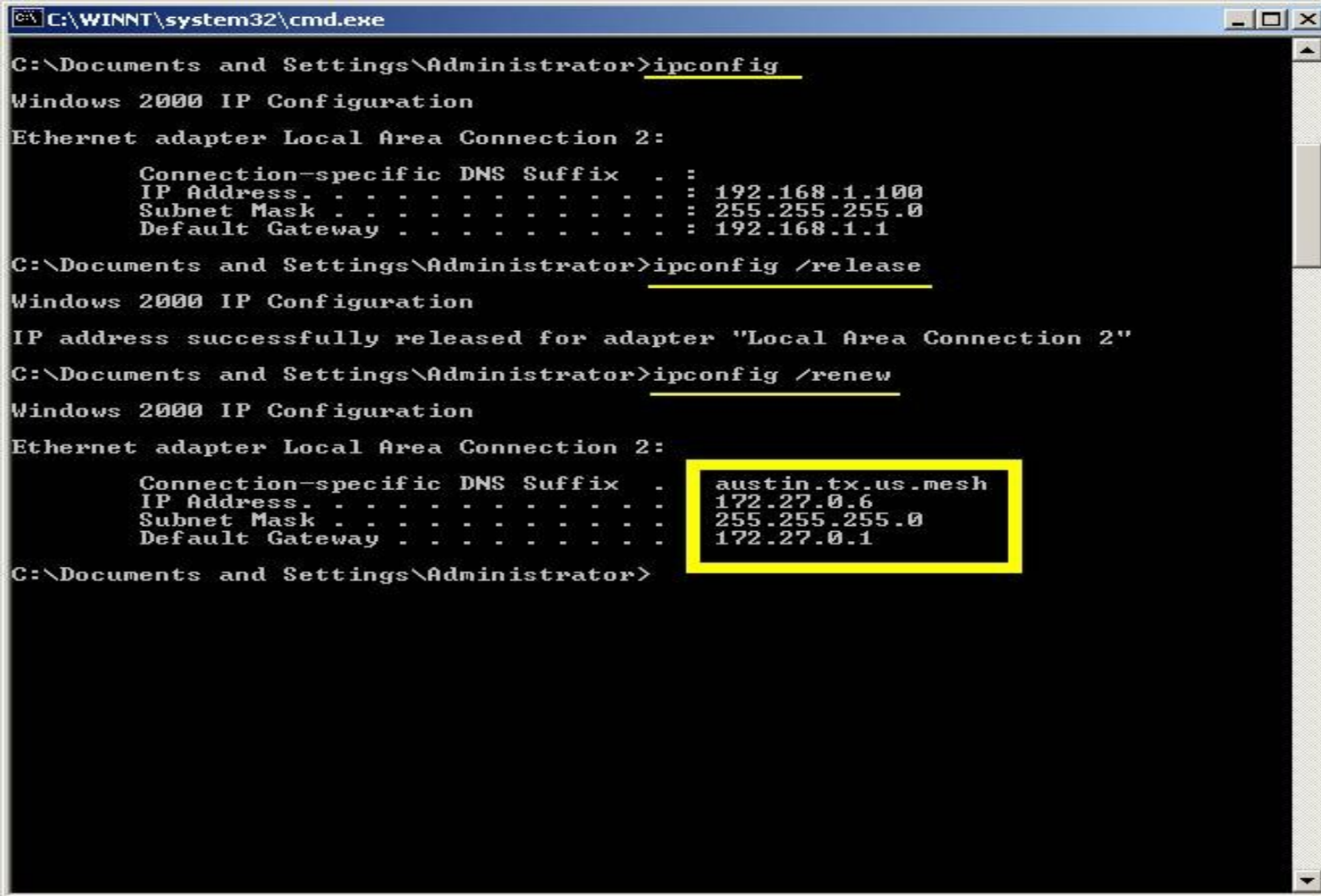
Router will reboot and become a MESH node when you click Continue



Your computer now needs to get a new IP address from the router

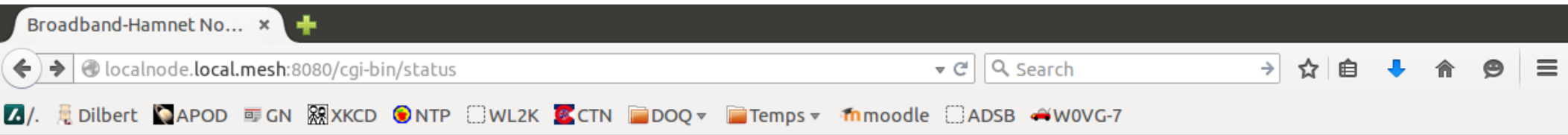
- Unplug the ethernet cable
- Close your browser
 - It may cache information
- Wait for the router lights to stop flashing
- Plug the cable back in
- Start your browser again

Type `IPCONFIG /release` <enter> and then `IPCONFIG /renew` <enter>. It should then show like the text in the yellow box below.



```
C:\WINNT\system32\cmd.exe
C:\Documents and Settings\Administrator>ipconfig
Windows 2000 IP Configuration
Ethernet adapter Local Area Connection 2:
    Connection-specific DNS Suffix . : 
    IP Address . . . . . : 192.168.1.100
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1
C:\Documents and Settings\Administrator>ipconfig /release
Windows 2000 IP Configuration
IP address successfully released for adapter "Local Area Connection 2"
C:\Documents and Settings\Administrator>ipconfig /renew
Windows 2000 IP Configuration
Ethernet adapter Local Area Connection 2:
    Connection-specific DNS Suffix . : austin.tx.us.mesh
    IP Address . . . . . : 172.27.0.6
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 172.27.0.1
C:\Documents and Settings\Administrator>
```

Start Setup <http://localnode:8080/>



NOCALL

[Help](#)

Refresh

Setup

Night Mode

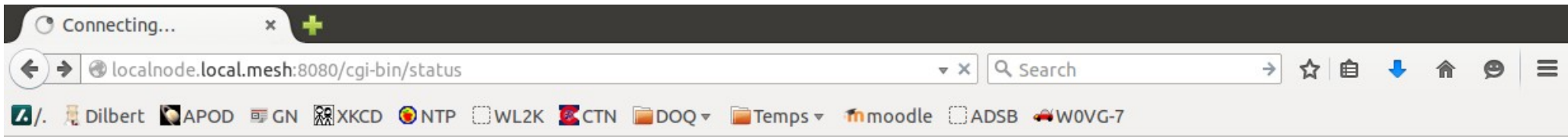
This node is not yet configured.

Go to the setup page and set your node name and password.

Click Save Changes, even if you didn't make any changes, then the node will reboot.

WiFi/LAN address	172.27.0.1 / 24 fe80::218:39ff:feec:e165 Link	firmware version	3.1.0
WAN address	none fe80::218:39ff:feec:e165 Link	configuration	not set
default gateway	none	system time	Sat Jan 1 2000 00:06:47 UTC
your address	172.27.0.5	uptime	6 min
		load average	0.00, 0.06, 0.04
		free space	flash = 508 KB /tmp = 7104 KB memory = 2456 KB

User name *root* Password *hsmm*




NOCALL

[Help](#) Night Mode

This node is not yet configured.

Authentication Required

 A username and password are being requested by http://localnode.local.mesh:8080. The site says: "OpenWrt"

User Name:

Password:

free space flash = 508 KB
/tmp = 7104 KB
memory = 2456 KB

Initial Setup Screen

setup x +

localnode.local.mesh:8080/cgi-bin/setup

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

[Node Status](#) **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#)

Node Name Password

Node Type Verify Password

WiFi	LAN	WAN	
Protocol <input type="text" value="Static"/>	LAN Mode <input type="text" value="5 host Direct"/>	Protocol <input type="text" value="DHCP"/>	
IP Address <input type="text" value="10.236.225.103"/>	IP Address <input type="text" value="10.103.11.57"/>	DNS 1 <input type="text" value="8.8.8.8"/>	
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.248"/>	DNS 2 <input type="text" value="8.8.4.4"/>	
SSID <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server <input checked="" type="checkbox"/>	<hr/>	
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="58"/>	Mesh Gateway <input type="checkbox"/>	
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="62"/>		
<hr/>			
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"/>			

Selecting a node name

- Your call sign should be in the node name in order to properly identify ham operations
- The node name must be unique
 - Callsign followed by -XXX is customary
 - Maximum node name length is 64 characters

Enter Node Name and Password

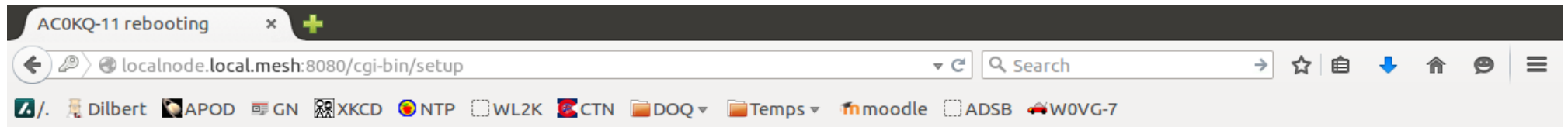
The screenshot shows a web browser window with the URL `localnode.local.mesh:8080/cgi-bin/setup`. The page has a navigation bar with tabs: [Node Status](#), **Basic Setup**, [Port Forwarding, DHCP, and Services](#), and [Administration](#). Below the navigation bar are buttons: [Help](#), **Save Changes** (circled in red), [Reset Values](#), [Default Values](#), and [Reboot](#). The main form contains the following fields:

- Node Name:** (circled in green)
- Password:** (circled in green)
- Node Type:**
- Verify Password:** (circled in green)

Below the form are three columns of settings:

WiFi	LAN	WAN
Protocol: <input type="text" value="Static"/>	LAN Mode: <input type="text" value="5 host Direct"/>	Protocol: <input type="text" value="DHCP"/>
IP Address: <input type="text" value="10.236.225.103"/>	IP Address: <input type="text" value="10.103.11.57"/>	DNS 1: <input type="text" value="8.8.8.8"/>
Netmask: <input type="text" value="255.0.0.0"/>	Netmask: <input type="text" value="255.255.255.248"/>	DNS 2: <input type="text" value="8.8.4.4"/>
SSID: <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server: <input checked="" type="checkbox"/>	Mesh Gateway: <input type="checkbox"/>
Mode: <input type="text" value="Ad-Hoc"/>	DHCP Start: <input type="text" value="58"/>	
Channel: <input type="text" value="1"/>	DHCP End: <input type="text" value="62"/>	
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 will reboot



AC0KQ-11 is rebooting

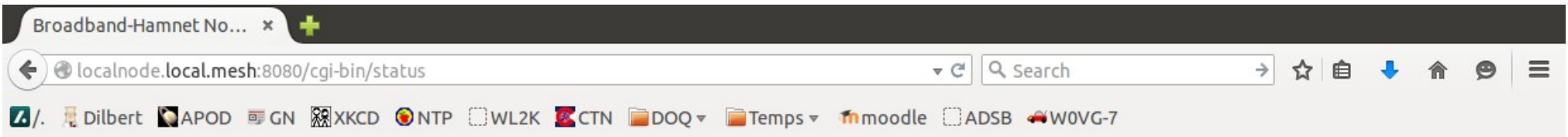
The LAN subnet has changed. You will need to acquire a new DHCP lease and reset any name service caches you may be using.

**Wait for the Power LED to start blinking, then stop blinking.
When the DMZ LED turns off you can get your new DHCP lease and reconnect with
<http://localnode.local.mesh:8080/>
or
<http://AC0KQ-11.local.mesh:8080/>**

Get a new IP address for the PC

- Unplug the ethernet cable
- Wait for the router lights to stop flashing
- Plug the ethernet cable back in
- On windows additional fooling around may be required to allow connection to the new network

Connect to http://localnode:8080/

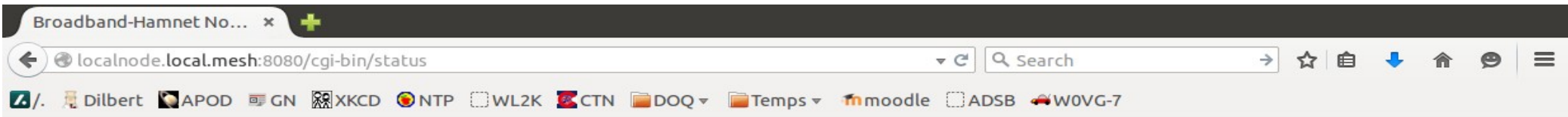


AC0KQ-11

[Help](#) Night Mode

WiFi address	10.236.225.103 / 8 fe80::218:39ff:feec:e167 Link	Signal/Noise/Ratio	-34 / -93 / 59 dB <input type="button" value="Auto"/>
LAN address	10.103.11.57 / 29 fe80::218:39ff:feec:e165 Link	firmware version	3.1.0
WAN address	none fe80::218:39ff:feec:e165 Link	configuration	mesh
default gateway	10.122.166.20 AC0KQ-9	system time	Mon May 25 2015 01:12:59 UTC
your address	10.103.11.60	uptime	3 min
		load average	0.03, 0.10, 0.05
		free space	flash = 496 KB /tmp = 7064 KB memory = 2568 KB

If there is a gateway mesh node, OLSR will discover it and put you online



AC0KQ-11

[Help](#) Night Mode

WiFi address 10.236.225.103 / 8
fe80::218:39ff:feec:e167 Link

LAN address 10.103.11.57 / 29
fe80::218:39ff:feec:e165 Link

WAN address none
fe80::218:39ff:feec:e165 Link

default gateway 10.122.166.20
AC0KQ-9

your address 10.103.11.60

Signal/Noise/Ratio -34 / -93 / 59 dB

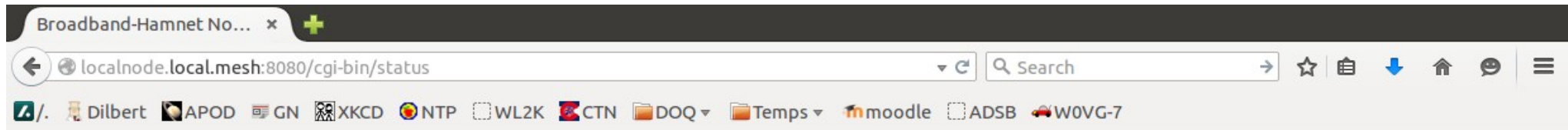
firmware version 3.1.0
configuration mesh

system time Mon May 25 2015
01:12:59 UTC

uptime 3 min
load average 0.03, 0.10, 0.05

free space flash = 496 KB
/tmp = 7064 KB
memory = 2568 KB

When online, NTP sets the time



AC0KQ-11

[Help](#)

Refresh

Mesh Status

OLSR Status

WiFi Scan

Setup

Night Mode

WiFi address 10.236.225.103 / 8
fe80::218:39ff:feec:e167 Link

LAN address 10.103.11.57 / 29
fe80::218:39ff:feec:e165 Link

WAN address none
fe80::218:39ff:feec:e165 Link

default gateway 10.122.166.20
AC0KQ-9

your address 10.103.11.60

Signal/Noise/Ratio -34 / -93 / 59 dB

firmware version 3.1.0

configuration mesh

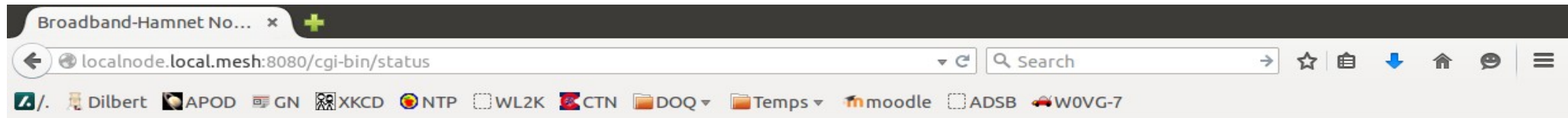
system time Mon May 25 2015
01:12:59 UTC

uptime 3 min

load average 0.03, 0.10, 0.05

free space flash = 496 KB
/tmp = 7064 KB
memory = 2568 KB

View the Mesh



AC0KQ-11

[Help](#) Night Mode

WiFi address	10.236.225.103 / 8 fe80::218:39ff:feec:e167 Link	Signal/Noise/Ratio	-34 / -93 / 59 dB <input type="button" value="Auto"/>
LAN address	10.103.11.57 / 29 fe80::218:39ff:feec:e165 Link	firmware version	3.1.0
WAN address	none fe80::218:39ff:feec:e165 Link	configuration	mesh
default gateway	10.122.166.20 AC0KQ-9	system time	Mon May 25 2015 01:12:59 UTC
your address	10.103.11.60	uptime	3 min
		load average	0.03, 0.10, 0.05
		free space	flash = 496 KB /tmp = 7064 KB memory = 2568 KB

Mesh Status

AC0KQ-11 mesh status

Refresh Auto Quit

Local Hosts	Services	Current Neighbors	LQ	Services
AC0KQ-11		AC0KQ-1	100%	
		AC0KQ-10	100%	
Remote Nodes	ETX	Services		
none		<ul style="list-style-type: none">• KD0ZYF• race2		KD0ZYF
		AC0KQ-12	100%	
		AC0KQ-13	100%	
		<ul style="list-style-type: none">• N0SZ		N0SZ
		AC0KQ-14	100%	
		AC0KQ-3	100%	
		AC0KQ-5	100%	
		<ul style="list-style-type: none">• race14• KD0DPX		KD0DPX
		AC0KQ-7	100%	
		AC0KQ-9	100%	
		<ul style="list-style-type: none">• K8ZTT		K8ZTT

Previous Neighbors When

Neighboring Mesh Node

AC0KQ-11 mesh status - Mozilla Firefox

AC0KQ-11 mesh status

localnode:8080/cgi-bin/mesh

Refresh Auto Quit

Local Hosts	Services	Current Neighbors	LQ	Services
AC0KQ-11		AC0KQ-1	100%	
		AC0KQ-10	100%	
Remote Nodes	ETX	Services		
none		• KD0ZYF		KD0ZYF
		• race2		
		AC0KQ-12	100%	
		AC0KQ-13	100%	
		• N0SZ		N0SZ
		AC0KQ-14	100%	
		AC0KQ-3	100%	
		AC0KQ-5	100%	
		• race14		
		• KD0DPX		KD0DPX
		AC0KQ-7	100%	
		AC0KQ-9	100%	
		• K8ZTT		K8ZTT
		Previous Neighbors		When

Clicking on the neighbor takes you to its status screen



Broadband-Hamnet Node AC0KQ-5 - Mozilla Firefox

Broadband-Hamnet No... x

ac0kq-5:8080/cgi-bin/status

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

AC0KQ-5

[Help](#) Refresh Mesh Status OLSR Status WiFi Scan Setup Night Mode

WiFi address	10.236.227.68 / 8 fe80::218:39ff:feec:e344 Link	Signal/Noise/Ratio	-29 / -95 / 66 dB <input type="button" value="Auto"/>
LAN address	10.206.52.65 / 28 fe80::218:39ff:feec:e342 Link	firmware version	3.1.0
default gateway	10.122.166.20 AC0KQ-9	configuration	mesh
your address	10.103.11.60	system time	Mon May 25 2015 17:03:08 UTC
		uptime	3 min
		load average	0.19, 0.14, 0.07
		free space	flash = 368 KB /tmp = 7064 KB memory = 2552 KB

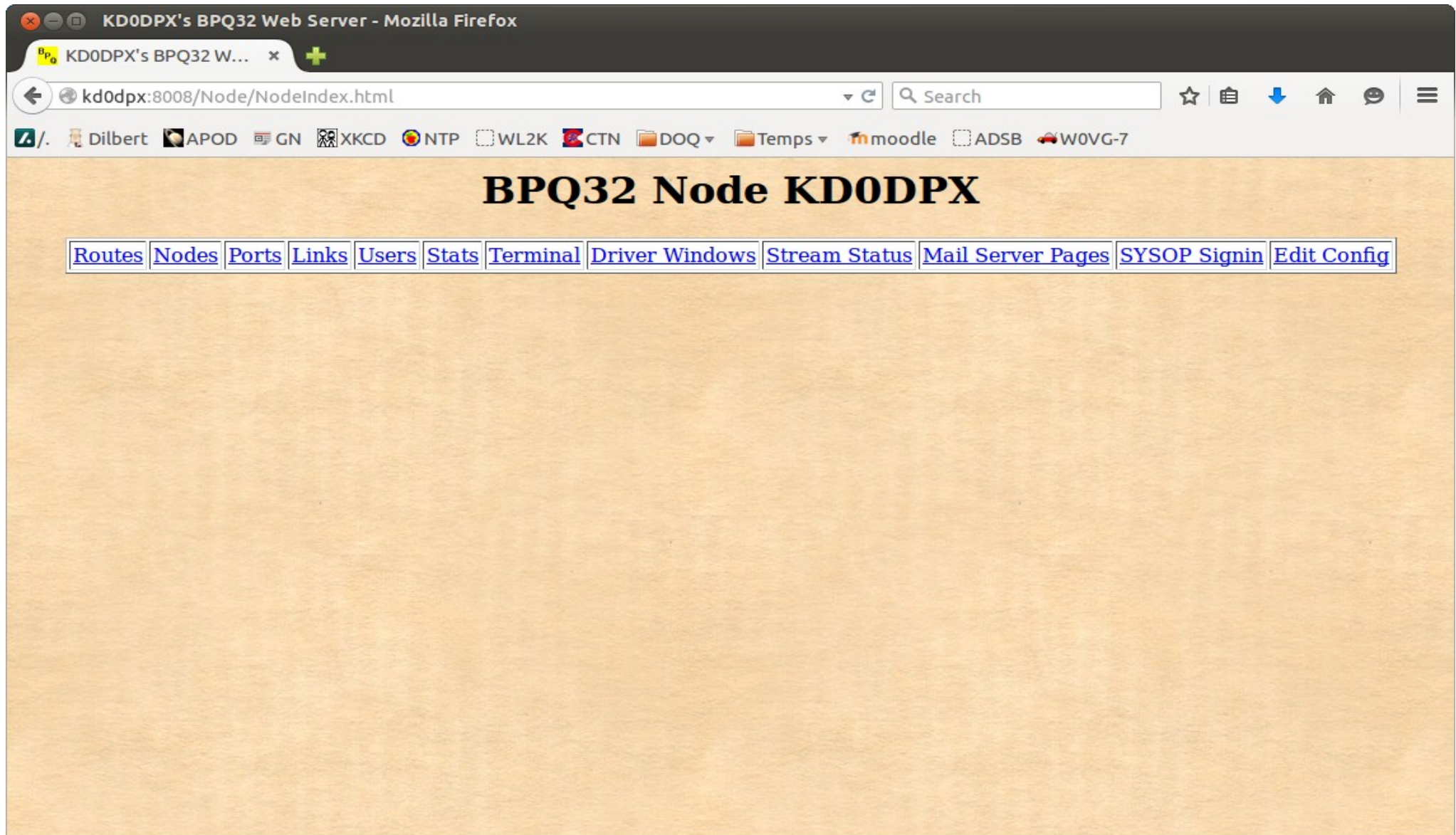
Attached Clickable Link

AC0KQ-11 mesh status

Refresh Auto Quit

Local Hosts	Services	Current Neighbors	LQ	Services
AC0KQ-11		AC0KQ-1	100%	
		AC0KQ-10	100%	
Remote Nodes	ETX	Services		
none		• KD0ZYF		KD0ZYF
		• race2		
		AC0KQ-12	100%	
		AC0KQ-13	100%	
		• NOSZ		NOSZ
		AC0KQ-14	100%	
		AC0KQ-3	100%	
		AC0KQ-5	100%	
		• race14		
		• KD0DPX		KD0DPX
		AC0KQ-7	100%	
		AC0KQ-9	100%	
		• K8ZTT		K8ZTT
		Previous Neighbors		When

Attached Web Service (BPQ)



Select Setup on Neighbor Node

The screenshot shows a Mozilla Firefox browser window with the address bar displaying 'ac0kq-5:8080/cgi-bin/status'. The page title is 'AC0KQ-5'. Below the title, there is a navigation bar with buttons for 'Help', 'Refresh', 'Mesh Status', 'OLSR Status', 'WiFi Scan', 'Setup', and 'Night Mode'. The 'Setup' button is circled in red. Below the navigation bar, the page displays system information in two columns. The left column lists network-related information: WiFi address (10.236.227.68 / 8), LAN address (10.206.52.65 / 28), default gateway (10.122.166.20), and your address (10.103.11.60). The right column lists system and signal information: Signal/Noise/Ratio (-29 / -95 / 66 dB), firmware version (3.1.0), configuration (mesh), system time (Mon May 25 2015 17:03:08 UTC), uptime (3 min), load average (0.19, 0.14, 0.07), and free space (flash = 368 KB, /tmp = 7064 KB, memory = 2552 KB).

AC0KQ-5

[Help](#) Refresh Mesh Status OLSR Status WiFi Scan **Setup** Night Mode

WiFi address	10.236.227.68 / 8 fe80::218:39ff:feec:e344 Link	Signal/Noise/Ratio	-29 / -95 / 66 dB <input type="button" value="Auto"/>
LAN address	10.206.52.65 / 28 fe80::218:39ff:feec:e342 Link	firmware version	3.1.0
default gateway	10.122.166.20 AC0KQ-9	configuration	mesh
your address	10.103.11.60	system time	Mon May 25 2015 17:03:08 UTC
		uptime	3 min
		load average	0.19, 0.14, 0.07
		free space	flash = 368 KB /tmp = 7064 KB memory = 2552 KB

Select Services on Neighbor Node

The screenshot shows the AC0KQ-5 setup web interface. The browser address bar displays 'ac0kq-5:8080/cgi-bin/setup'. The navigation menu includes 'Node Status', 'Basic Setup', 'Port Forwarding, DHCP, and Services' (circled in red), and 'Administration'. Below the menu are buttons for 'Help', 'Save Changes', 'Reset Values', 'Default Values', and 'Reboot'. The main form contains fields for 'Node Name' (AC0KQ-5), 'Password', 'Node Type' (Mesh Node), and 'Verify Password'. The settings are organized into three columns: WiFi, LAN, and WAN.

WiFi		LAN		WAN	
Protocol	Static	LAN Mode	13 host Direct	Protocol	DHCP
IP Address	10.236.227.68	IP Address	10.206.52.65	DNS 1	8.8.8.8
Netmask	255.0.0.0	Netmask	255.255.255.240	DNS 2	8.8.4.4
SSID	BroadbandHamnet	DHCP Server	<input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>	
Mode	Ad-Hoc	DHCP Start	66		
Channel	1	DHCP End	78		
Active Settings					
Rx Antenna	Diversity				
Tx Antenna	Diversity				

Reserving a DHCP address makes it visible to the rest of the mesh

The screenshot shows the AC0KQ-5 setup web interface in Mozilla Firefox. The browser address bar shows 'ac0kq-5:8080/cgi-bin/ports'. The page has a navigation menu with 'Node Status', 'Basic Setup', 'Port Forwarding, DHCP, and Services' (highlighted), and 'Administration'. Below the navigation are buttons for 'Help', 'Save Changes', 'Reset Values', and 'Refresh'. The main content area is divided into two sections: 'DHCP Address Reservations' and 'Advertised Services'. The 'DHCP Address Reservations' section has a table with columns 'Hostname', 'IP Address', and 'MAC Address'. The first row, 'KD0DPX', is circled in red. The 'Advertised Services' section has a table with columns 'Name', 'Link', and 'URL'. The first row, 'KD0DPX', has a checked checkbox in the 'Link' column. Below these sections are 'Current DHCP Leases' and 'Port Forwarding' sections.

DHCP Address Reservations

Hostname	IP Address	MAC Address	
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Del
race14	10.206.52.75	68:27:eb:02:02:83	Del
	- IP Address -		Add

Advertised Services

Name	Link	URL	
KD0DPX	<input checked="" type="checkbox"/> http	::/ KD0DPX : 8008 /	Del
	<input type="checkbox"/>	::/ AC0KQ-5 : /	Add

Current DHCP Leases

KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Add
--------	--------------	-------------------	-----

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP		- IP Address -		Add

A service your browser understands can be made into a clickable link

The screenshot shows a web browser window titled "AC0KQ-5 setup - Mozilla Firefox" with the address bar at "ac0kq-5:8080/cgi-bin/ports". The page has a navigation menu with "Node Status", "Basic Setup", "Port Forwarding, DHCP, and Services" (highlighted in black), and "Administration". Below the menu are buttons for "Help", "Save Changes", "Reset Values", and "Refresh".

The main content area is divided into two sections: "DHCP Address Reservations" and "Advertised Services".

DHCP Address Reservations

Hostname	IP Address	MAC Address	
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Del
race14	10.206.52.75	b8:27:eb:d2:d2:83	Del
	-IP Address -		Add

Advertised Services

Name	Link	URL	
KD0DPX	<input checked="" type="checkbox"/> http	::/ KD0DPX : 8008 /	Del
	<input type="checkbox"/>	::/ AC0KQ-5 : /	Add

Current DHCP Leases

KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Add
--------	--------------	-------------------	-----

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP		-IP Address -		Add

Plug in a new device, refresh and when it gets its address click **Add**

AC0KQ-5 setup - Mozilla Firefox

ac0kq-5:8080/cgi-bin/ports

Node Status Basic Setup **Port Forwarding, DHCP, and Services** Administration

Help Save Changes Reset Values Refresh

DHCP Address Reservations

Hostname	IP Address	MAC Address	
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Del
race14	10.206.52.75	b8:27:eb:d2:d2:83	Del
	-IP Address -		Add

Advertised Services

Name	Link	URL	
KD0DPX	<input checked="" type="checkbox"/> http	:// KD0DPX :8008	Del
	<input type="checkbox"/>	:// AC0KQ-5 :	Add

Current DHCP Leases

*	10.206.52.66	00:26:b0:ef:1d:be	Add
KD0DPX	10.206.52.72	54:4a:16:be:d7:21	Add

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP		-IP Address -		Add

Initially it shows up as nonameX

AC0KQ-5 setup - Mozilla Firefox

AC0KQ-5 setup

ac0kq-5:8080/cgi-bin/ports

Node Status Basic Setup **Port Forwarding, DHCP, and Services** Administration

Help Save Changes Reset Values Refresh

DHCP Address Reservations

Hostname	IP Address	MAC Address	
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Del
face14	10.206.52.75	50:27:b4:d3:d2:82	Del
noname1	10.206.52.66	00:26:b0:ef:1d:be	Del
	- IP Address -		Add

Advertised Services

Name	Link	URL	
KD0DPX	<input checked="" type="checkbox"/> http	::// KD0DPX : 8008 /	De
	<input type="checkbox"/>	::// AC0KQ-5 : /	Ad

Current DHCP Leases

*	10.206.52.66	00:26:b0:ef:1d:be	Add
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Add

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP		- IP Address -		Add

Pick a hostname and *Save Changes*

Hostname *must* be unique on mesh

AC0KQ-5 setup - Mozilla Firefox

ac0kq-5:8080/cgi-bin/ports

Node Status Basic Setup **Port Forwarding, DHCP, and Services** Administration

Help Save Changes Reset Values Refresh

DHCP Address Reservations

Hostname	IP Address	MAC Address	
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Del
race14	10.206.52.75	b8:27:eb:d2:d2:83	Del
dopey	10.206.52.66	00:26:b0:ef:1d:be	Del
	- IP Address -		Add

Advertised Services

Name	Link	URL	
KD0DPX	<input checked="" type="checkbox"/> http	::// KD0DPX : 8008 /	De
	<input type="checkbox"/>	::// AC0KQ-5 : /	Ad

Current DHCP Leases

*	10.206.52.66	00:26:b0:ef:1d:be	Add
KD0DPX	10.206.52.72	54:4a:16:be:b7:21	Add

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP		- IP Address -		Add

The new host shows up mesh wide

AC0KQ-11 mesh status

Refresh Auto Quit

Local Hosts	Services	Current Neighbors	LQ	Services
AC0KQ-11		AC0KQ-1	100%	
		AC0KQ-10	100%	
Remote Nodes	ETX	Services		
none		<ul style="list-style-type: none">• KD0ZYF• race2• AC0KQ-12• AC0KQ-13• N0SZ• AC0KQ-14• AC0KQ-3• AC0KQ-5• dopey• race14• KD0DPX• AC0KQ-7• AC0KQ-9• K8ZTT		KD0ZYF N0SZ KD0DPX K8ZTT

You can also access an device on the mesh by name

```
willem@KD0DPX: ~  
File Edit View Search Terminal Help  
willem@bashful:~$ ssh kd0dpx  
Debian GNU/Linux 7  
  
BeagleBoard.org BeagleBone Debian Image 2014-05-14  
  
Support/FAQ: http://elinux.org/Beagleboard:BeagleBoneBlack\_Debian  
Last login: Fri May 22 20:50:50 2015 from argon.schreuder.us  
willem@KD0DPX:~$
```

You can also log directly into each node from the command line

User *root* Port *2222*

```
willem@bashful: ~  
File Edit View Search Terminal Help  
willem@bashful:~ ssh -p 2222 root@AC0KQ-5  
root@ac0kq-5's password:  
  
BusyBox v1.4.2 (2008-08-04 21:28:11 CDT) Built-in shell (ash)  
Enter 'help' for a list of built-in commands.  
  
|_| W I R E L E S S F R E E D O M  
KAMIKAZE 7.09 -----  
* 10 oz Vodka      Shake well with ice and strain  
* 10 oz Triple sec mixture into 10 shot glasses.  
* 10 oz lime juice Salute!  
  
Broadband-Hamnet(TM) build 2 version 3.1.0  
-----  
root@AC0KQ-5:~#
```


Each mesh node is a regular Linux Box

```
willem@bashful: ~  
File Edit View Search Terminal Help  
root@AC0KQ-5:/# ls  
bin  etc  lib  proc  sbin  tmp  var  
dev  jffs  mnt  rom  sys  usr  www  
root@AC0KQ-5:/# cd etc  
root@AC0KQ-5:/etc# ls  
banner          hosts           ppp  
config          hosts.user     preinit  
config.ap       hotplug.d      preinit.arch  
config.client   hotplug2-init.rules  profile  
config.mesh     httpd.conf     protocols  
config.mesh_ap  init.d         rc.common  
config.router   inittab        rc.d  
crontabs        ipkg.conf      resolv.conf  
diag.sh         mesh-release   services  
dnsmasq.conf    modules.d      shells  
dropbear        mrd6.conf      sysctl.conf  
ethers          ntab           uci-defaults  
firewall.dtdlink  nvram          vlan  
firewall.natmode  olsrd.key     xinetd.conf  
firewall.user    passwd        xinetd.d  
functions.sh     passwd-  
group           permpkg  
root@AC0KQ-5:/etc#
```

The Kernel and CPU

```
willem@bashful: ~  
File Edit View Search Terminal Help  
root@AC0KQ-5:~# uname -a  
Linux AC0KQ-5 2.4.34 #6 Thu Sep 25 22:15:08 CDT 2008 mips unknown  
root@AC0KQ-5:~# cat /proc/version  
Linux version 2.4.34 (driven@trogdor) (gcc version 3.4.6 (OpenWrt-2.0)) #6 Thu S  
ep 25 22:15:08 CDT 2008  
root@AC0KQ-5:~# cat /proc/cpuinfo  
system type          : Broadcom BCM5352 chip rev 0  
processor            : 0  
cpu model            : BCM3302 V0.8  
BogoMIPS             : 199.47  
wait instruction     : no  
microsecond timers   : yes  
tlb_entries          : 32  
extra interrupt vector : no  
hardware watchpoint  : no  
VCED exceptions      : not available  
VCEI exceptions      : not available  
root@AC0KQ-5:~#
```

Installing Packages - 1

The screenshot shows a web browser window with the title "AC0KQ-11 administration - Mozilla Firefox". The address bar displays "localnode:8080/cgi-bin/admin". The browser's tab bar shows "AC0KQ-11 administration" and "Software Download". The browser's toolbar includes a search bar and various navigation icons. The page content features a navigation menu with links for "Node Status", "Basic Setup", "Port Forwarding, DHCP, and Services", and "Administration" (which is highlighted in a black box). Below the navigation menu is a "Help" link. The main content area is divided into sections: "Firmware Update" (current version: 3.1.0) with "Upload Firmware" and "Download Firmware" options, and "Package Management" with "Upload Package", "Download Package", and "Remove Package" options. The "Refresh" button in the "Download Package" row is circled in red. At the bottom, the "Authorized SSH Keys" section is partially visible.

AC0KQ-11 administration - Mozilla Firefox

AC0KQ-11 administration x Software Download x +

localnode:8080/cgi-bin/admin

Search

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

[Node Status](#) [Basic Setup](#) [Port Forwarding, DHCP, and Services](#) **Administration**

[Help](#)

Firmware Update
current version: 3.1.0

Upload Firmware No file selected.

Download Firmware

Package Management

Upload Package No file selected.

Download Package

Remove Package

Authorized SSH Keys

Upload Key No file selected.

Installing Packages - 2

AC0KQ-11 administration - Mozilla Firefox

AC0KQ-11 administration x +

localnode:8080/cgi-bin/admin

Search

Dilbert APOD GN XKCD NTP WL2K CTN DOQ Temps moodle ADSB W0VG-7

[Node Status](#) [Basic Setup](#) [Port Forwarding, DHCP, and Services](#) **[Administration](#)**

[Help](#)

Firmware Update
current version: 3.1.0

Upload Firmware No file selected.

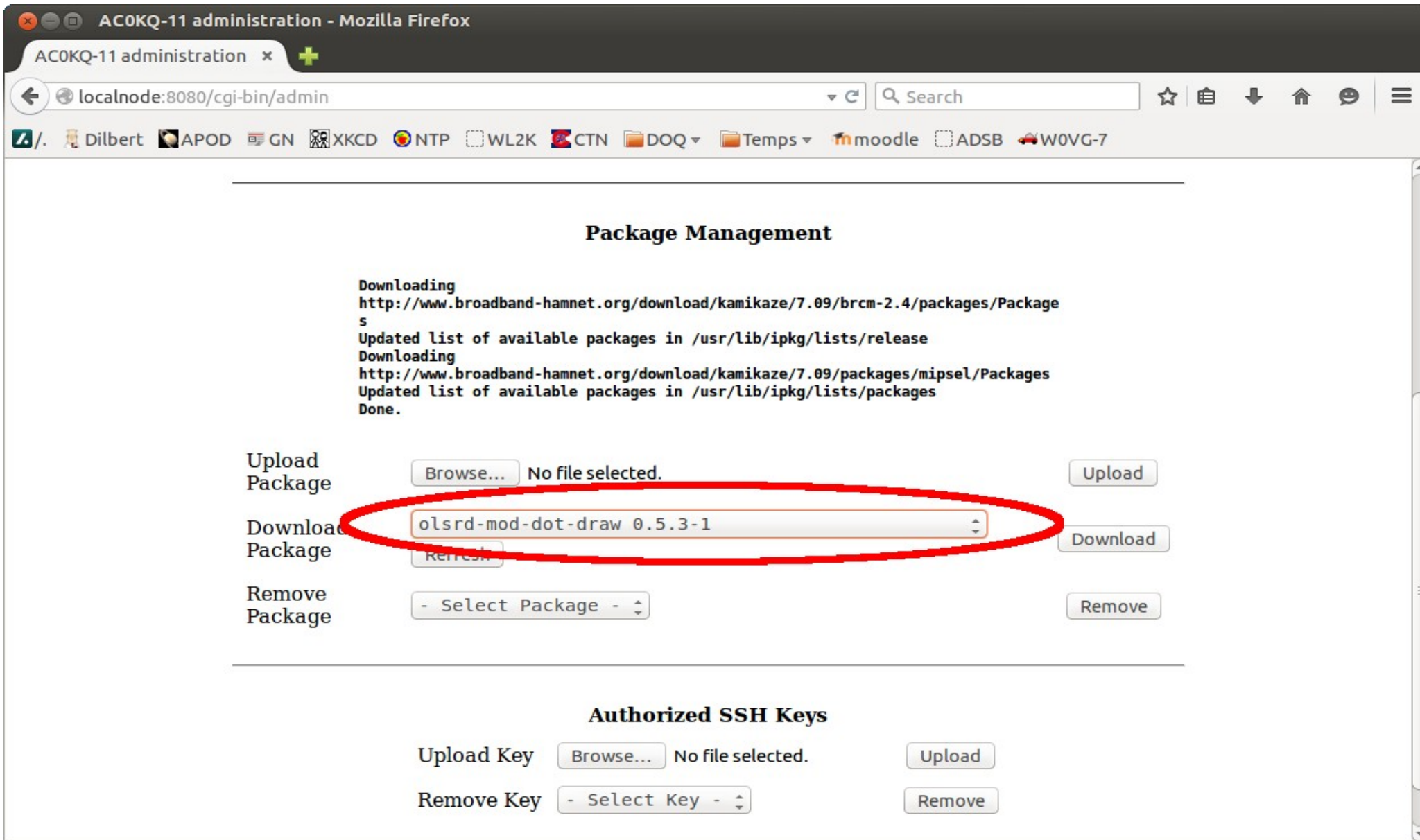
Download Firmware

Package Management

```
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/brcm-2.4/packages/Packages
Updated list of available packages in /usr/lib/ipkg/lists/release
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/packages/mipsel/Packages
Updated list of available packages in /usr/lib/ipkg/lists/packages
Done.
```

Upload Package No file selected.

Installing Packages -3



The screenshot shows a web browser window titled "AC0KQ-11 administration - Mozilla Firefox". The address bar shows "localnode:8080/cgi-bin/admin". The page content is titled "Package Management" and displays the following text:

```
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/brcm-2.4/packages/Packages
Updated list of available packages in /usr/lib/ipkg/lists/release
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/packages/mipsel/Packages
Updated list of available packages in /usr/lib/ipkg/lists/packages
Done.
```

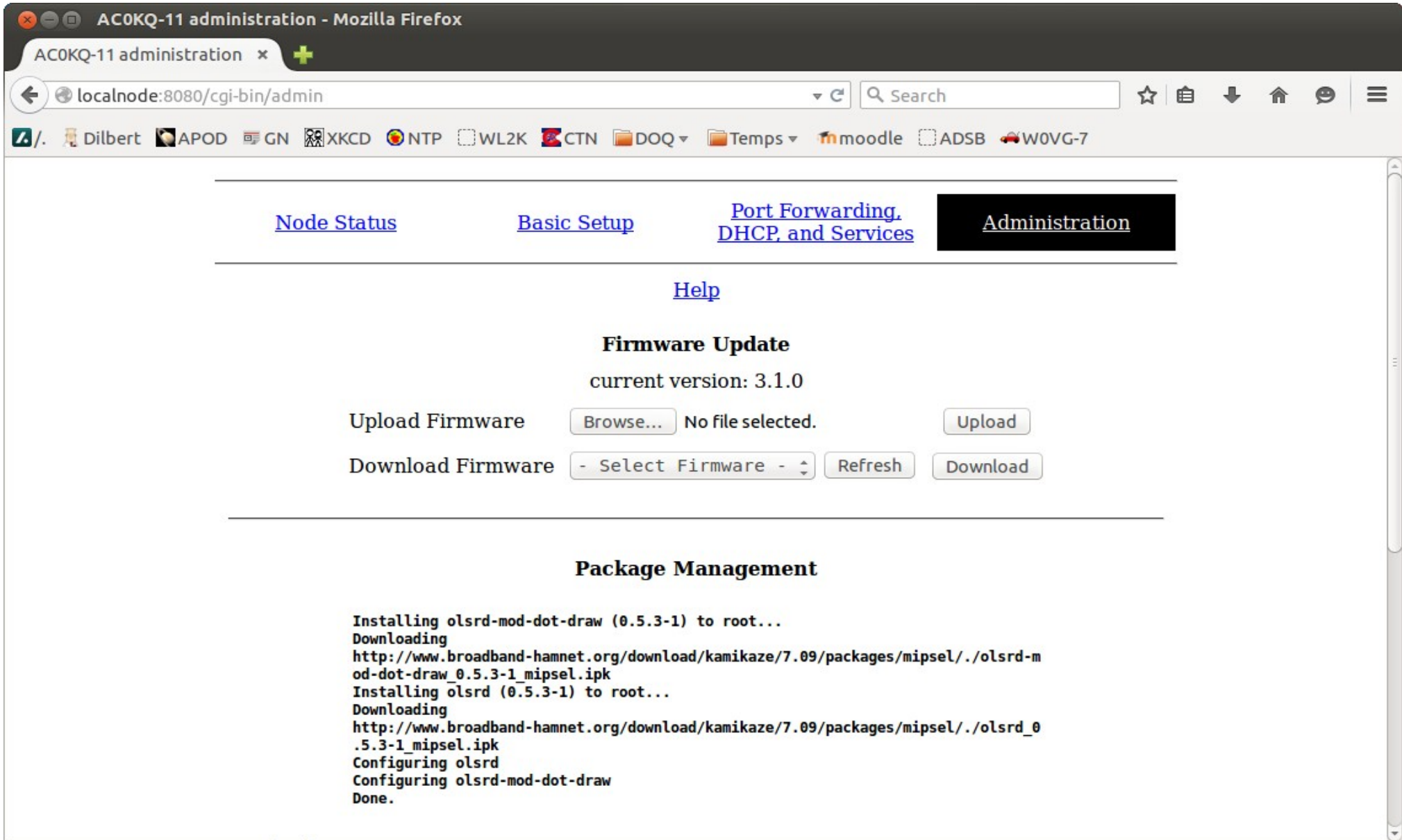
Below the text, there are three rows of controls:

- Upload Package:** Includes a "Browse..." button, the text "No file selected.", and an "Upload" button.
- Download Package:** Includes a dropdown menu with the selected package "olsrd-mod-dot-draw 0.5.3-1" (highlighted with a red oval), a "Refresh" button, and a "Download" button.
- Remove Package:** Includes a dropdown menu with the text "- Select Package -" and a "Remove" button.

At the bottom of the page, there is a section titled "Authorized SSH Keys" with two rows of controls:

- Upload Key:** Includes a "Browse..." button, the text "No file selected.", and an "Upload" button.
- Remove Key:** Includes a dropdown menu with the text "- Select Key -" and a "Remove" button.

Installing Packages - 4

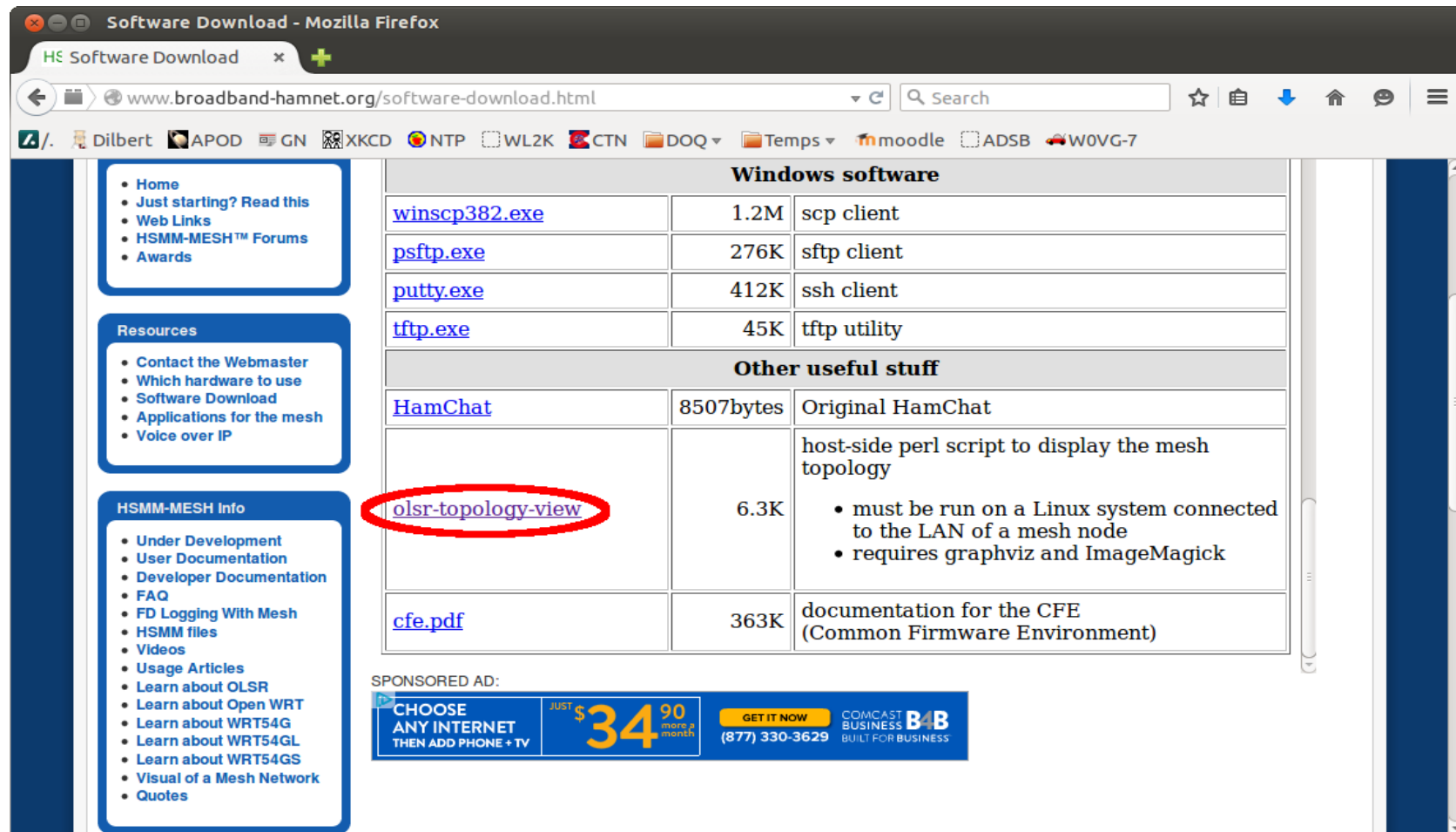


The screenshot shows a web browser window titled "AC0KQ-11 administration - Mozilla Firefox". The address bar shows "localnode:8080/cgi-bin/admin". The page has a navigation menu with links for "Node Status", "Basic Setup", "Port Forwarding, DHCP, and Services", and "Administration" (which is highlighted). Below the navigation is a "Help" link. The main content area is titled "Firmware Update" and shows the current version as 3.1.0. There are two rows of controls: "Upload Firmware" with a "Browse..." button, "No file selected.", and an "Upload" button; and "Download Firmware" with a "- Select Firmware -" dropdown, a "Refresh" button, and a "Download" button. Below this is a section titled "Package Management" which displays a terminal-style log of package installation:

```
Installing olsrd-mod-dot-draw (0.5.3-1) to root...
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/packages/mipsel/./olsrd-m
od-dot-draw_0.5.3-1_mipsel.ipk
Installing olsrd (0.5.3-1) to root...
Downloading
http://www.broadband-hamnet.org/download/kamikaze/7.09/packages/mipsel/./olsrd_0
.5.3-1_mipsel.ipk
Configuring olsrd
Configuring olsrd-mod-dot-draw
Done.
```

Download oslr-topology view (needs a Linux machine)

- Install prerequisites if necessary
 - apt-get install graphviz imagemagick



The screenshot shows a Mozilla Firefox browser window with the address bar displaying www.broadband-hamnet.org/software-download.html. The page content is organized into several sections:

- Home**: Home, Just starting? Read this, Web Links, HSMM-MESH™ Forums, Awards.
- Resources**: Contact the Webmaster, Which hardware to use, Software Download, Applications for the mesh, Voice over IP.
- HSMM-MESH Info**: Under Development, User Documentation, Developer Documentation, FAQ, FD Logging With Mesh, HSMM files, Videos, Usage Articles, Learn about OLSR, Learn about Open WRT, Learn about WRT54G, Learn about WRT54GL, Learn about WRT54GS, Visual of a Mesh Network, Quotes.
- Windows software**:

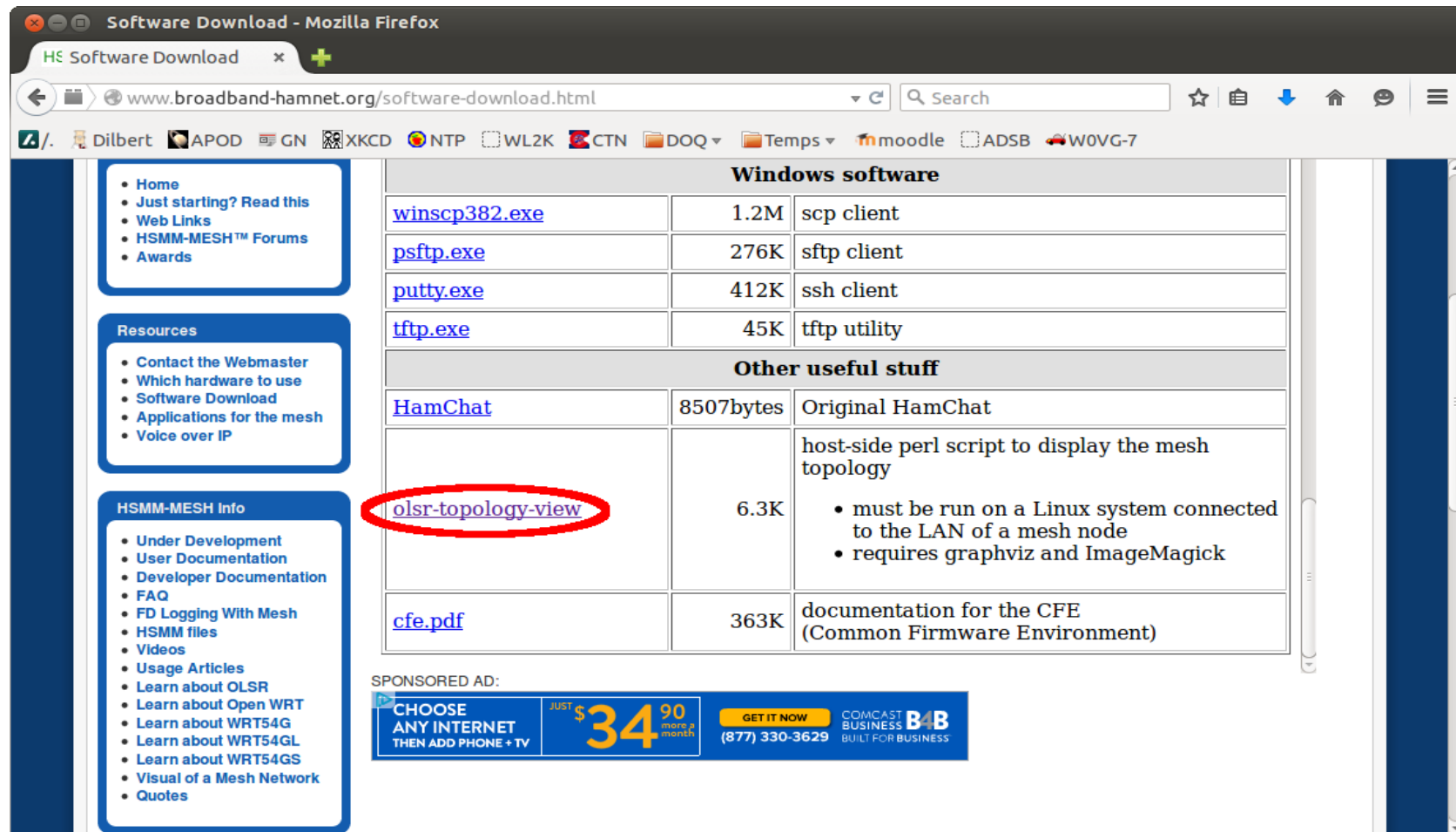
winscp382.exe	1.2M	scp client
psftp.exe	276K	sftp client
putty.exe	412K	ssh client
tftp.exe	45K	tftp utility
- Other useful stuff**:

HamChat	8507bytes	Original HamChat
oslr-topology-view	6.3K	host-side perl script to display the mesh topology <ul style="list-style-type: none">• must be run on a Linux system connected to the LAN of a mesh node• requires graphviz and ImageMagick
cfe.pdf	363K	documentation for the CFE (Common Firmware Environment)

A sponsored advertisement for Comcast Business B4B is visible at the bottom, offering internet service for \$34.90 per month.

Download oslr-topology view (needs a Linux machine)

- Install prerequisites if necessary
 - apt-get install graphviz imagemagick



The screenshot shows a Mozilla Firefox browser window with the address bar displaying www.broadband-hamnet.org/software-download.html. The page content is organized into several sections:

- Windows software**: A table listing various executables for Windows.
- Other useful stuff**: A table listing additional tools and scripts.

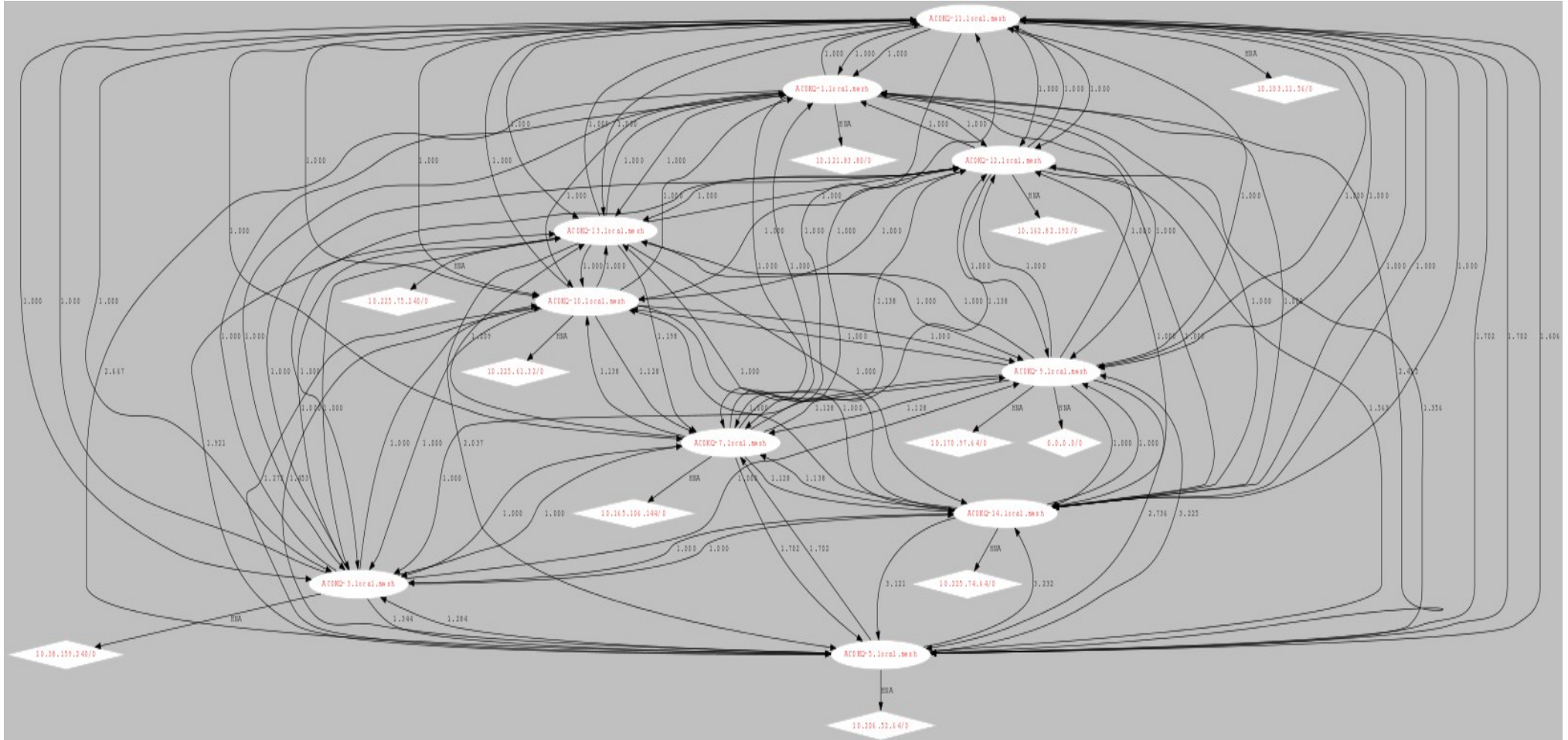
Windows software		
winscp382.exe	1.2M	scp client
psftp.exe	276K	sftp client
putty.exe	412K	ssh client
tftp.exe	45K	tftp utility

Other useful stuff		
HamChat	8507bytes	Original HamChat
oslr-topology-view	6.3K	host-side perl script to display the mesh topology <ul style="list-style-type: none">• must be run on a Linux system connected to the LAN of a mesh node• requires graphviz and ImageMagick
cfe.pdf	363K	documentation for the CFE (Common Firmware Environment)

A red circle highlights the [oslr-topology-view](#) link in the 'Other useful stuff' table.

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Show the OLSR network with olsr-topology-view



More Setup

AC0KQ-11 setup - Mozilla Firefox

AC0KQ-11 setup × Broadband-Hamnet No... × +

ac0kq-11:8080/cgi-bin/setup

Node Status **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#) Save Changes Reset Values Default Values Reboot

Node Name AC0KQ-11 Password

Node Type Mesh Node Verify Password

WiFi	LAN	WAN
Protocol: Static	LAN Mode : 5 host Direct	Protocol: Static
IP Address: 10.236.225.103	IP Address: 10.103.11.57	IP Address: 73.225.18.18
Netmask: 255.0.0.0	Netmask: 255.255.255.248	Netmask: 255.255.255.248
SSID: BroadbandHamnet-20-v3	DHCP Server: <input checked="" type="checkbox"/>	Gateway: 73.225.18.17
Mode: Ad-Hoc	DHCP Start: 58	DNS 1: 8.8.8.8
Channel: 1	DHCP End: 62	DNS 2: 8.8.4.4
Mesh Gateway: <input type="checkbox"/>		

Active Settings

Rx Antenna: Diversity

Tx Antenna: Diversity

Tx Power: 19 dBm

Distance: 0

Apply

Node Type

- Mesh Node (default)
 - WiFi used for mesh, wired ports for LAN and WAN
 - WiFi can only be used to talk to MESH nodes
- Mesh Access Point
 - Wired connection to Mesh Node via LAN port, WiFi and LAN ports used for LAN access
- Non-mesh modes
 - Standard Access Point (acts like a non-mesh router)
 - Wireless Client (WiFi to wired access)
 - Wired Router (WiFi disabled)

LAN mode

- Direct mode (default) is best for a flat network
 - 5 hosts (default) good for 4 port device
 - 15 hosts for larger LAN (e.g. with switch)
 - 1 host when attached to a smart device such a another router
- NAT mode translates LAN addresses
 - This is what your regular internet router does
 - Requires port forwarding to go MESH to LAN

WiFi IP is selected automatically

setup

localnode.local.mesh:8080/cgi-bin/setup

Node Status **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#) Save Changes Reset Values Default Values Reboot

Node Name Password

Node Type Mesh Node Verify Password

WiFi	LAN	WAN
Protocol <input type="text" value="Static"/>	LAN Mode <input type="text" value="5 host Direct"/>	Protocol <input type="text" value="DHCP"/>
IP Address <input type="text" value="10.236.225.103"/>	IP Address <input type="text" value="10.103.11.57"/>	DNS 1 <input type="text" value="8.8.8.8"/>
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.248"/>	DNS 2 <input type="text" value="8.8.4.4"/>
SSID <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server <input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="58"/>	
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="62"/>	
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"/>		

DO NOT change the SSID

setup

localnode.local.mesh:8080/cgi-bin/setup

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="5 host Direct"/>	Protocol <input type="text" value="DHCP"/>
IP Address <input type="text" value="10.236.225.103"/>	IP Address <input type="text" value="10.103.11.57"/>	DNS 1 <input type="text" value="8.8.8.8"/>
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.248"/>	DNS 2 <input type="text" value="8.8.4.4"/>
SSID <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server <input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="58"/>	
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="62"/>	
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"/>		

Default max power and diversity

AC0KQ-11 setup - Mozilla Firefox

AC0KQ-11 setup

ac0kq-11:8080/cgi-bin/setup

Node Status **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#) Save Changes Reset Values Default Values Reboot

Node Name AC0KQ-11 Password

Node Type Mesh Node Verify Password

WiFi		LAN		WAN	
Protocol	Static	LAN Mode	5 host Direct	Protocol	DHCP
IP Address	10.236.225.103	IP Address	10.103.11.57	DNS 1	8.8.8.8
Netmask	255.0.0.0	Netmask	255.255.255.248	DNS 2	8.8.4.4
SSID	BroadbandHamnet-20-v3	DHCP Server	<input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>	
Mode	Ad-Hoc	DHCP Start	58		
Channel	1	DHCP End	62		

Antenna Settings

Rx Antenna Diversity

Tx Antenna Diversity

Tx Power 19 dBm

Distance 0

Apply

For long range, experiment with this

Note that values are in *meters*

AC0KQ-11 setup - Mozilla Firefox

ac0kq-11:8080/cgi-bin/setup

[Node Status](#) **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#) Save Changes Reset Values Default Values Reboot

Node Name AC0KQ-11 Password

Node Type Mesh Node Verify Password

WiFi	LAN	WAN
Protocol: Static	LAN Mode: 5 host Direct	Protocol: DHCP
IP Address: 10.236.225.103	IP Address: 10.103.11.57	DNS 1: 8.8.8.8
Netmask: 255.0.0.0	Netmask: 255.255.255.248	DNS 2: 8.8.4.4
SSID: BroadbandHamnet-20-v3	DHCP Server: <input checked="" type="checkbox"/>	Mesh Gateway: <input type="checkbox"/>
Mode: Ad-Hoc	DHCP Start: 58	
Channel: 1	DHCP End: 62	
Active Settings		
Rx Antenna: Diversity		
Tx Antenna: Diversity		
Tx Power: 19 dBm		
Distance: 0		
Apply		

Enable *Mesh Gateway* if this node can provide external access

The screenshot shows the AC0KQ-11 setup web interface. The browser title is "AC0KQ-11 setup - Mozilla Firefox" and the address bar shows "ac0kq-11:8080/cgi-bin/setup". The interface has a navigation menu with "Node Status", "Basic Setup" (highlighted), "Port Forwarding, DHCP, and Services", and "Administration". Below the menu are buttons for "Help", "Save Changes", "Reset Values", "Default Values", and "Reboot".

The main configuration area is divided into three columns: WiFi, LAN, and WAN.

- WiFi:** Protocol: Static; IP Address: 10.236.225.103; Netmask: 255.0.0.0; SSID: BroadbandHamnet-20-v3; Mode: Ad-Hoc; Channel: 1. Active Settings: Rx Antenna: Diversity; Tx Antenna: Diversity; Tx Power: 19 dBm; Distance: 0. An "Apply" button is at the bottom.
- LAN:** LAN Mode: 5 host Direct; IP Address: 10.103.11.57; Netmask: 255.255.255.248; DHCP Server: ; DHCP Start: 58; DHCP End: 62.
- WAN:** Protocol: DHCP; DNS 1: 8.8.8.8; DNS 2: 8.8.4.4; Mesh Gateway: (circled in red).

DNS by Google

AC0KQ-11 setup - Mozilla Firefox

AC0KQ-11 setup

ac0kq-11:8080/cgi-bin/setup

Node Status **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#) Save Changes Reset Values Default Values Reboot

Node Name AC0KQ-11 Password

Node Type Mesh Node Verify Password

WiFi	LAN	WAN
Protocol: Static	LAN Mode: 5 host Direct	Protocol: DHCP
IP Address: 10.236.225.103	IP Address: 10.103.11.57	DNS 1: 8.8.8.8
Netmask: 255.0.0.0	Netmask: 255.255.255.255	DNS 2: 8.8.4.4
SSID: BroadbandHamnet-20-v3	DHCP Server: <input checked="" type="checkbox"/>	Mesh Gateway: <input type="checkbox"/>
Mode: Ad-Hoc	DHCP Start: 58	
Channel: 1	DHCP End: 62	
Active Settings		
Rx Antenna: Diversity		
Tx Antenna: Diversity		
Tx Power: 19 dBm		
Distance: 0		
Apply		

WAN IP by DHCP

The screenshot shows the AC0KQ-11 setup web interface in Mozilla Firefox. The browser address bar shows 'ac0kq-11:8080/cgi-bin/setup'. The page has a navigation menu with 'Basic Setup' highlighted. Below the menu are buttons for 'Help', 'Save Changes', 'Reset Values', 'Default Values', and 'Reboot'. The main form includes fields for 'Node Name' (AC0KQ-11), 'Node Type' (Mesh Node), 'Password', and 'Verify Password'. The configuration is divided into three sections: WiFi, LAN, and WAN. The WAN section is circled in red, showing 'Protocol' set to 'DHCP', 'DNS 1' as '8.8.8.8', and 'DNS 2' as '8.8.4.4'. The LAN section shows 'LAN Mode' as '5 host Direct', 'IP Address' as '10.103.11.57', 'Netmask' as '255.255.255.248', and 'DHCP Server' checked. The WiFi section shows 'Protocol' as 'Static', 'IP Address' as '10.236.225.103', 'Netmask' as '255.0.0.0', 'SSID' as 'BroadbandHamnet-20-v3', and 'Mode' as 'Ad-Hoc'. An 'Active Settings' section at the bottom of the WiFi panel includes 'Rx Antenna' (Diversity), 'Tx Antenna' (Diversity), 'Tx Power' (19 dBm), and 'Distance' (0).

AC0KQ-11 setup - Mozilla Firefox

ac0kq-11:8080/cgi-bin/setup

Node Status **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#)

Node Name Password

Node Type Verify Password

WiFi	LAN	WAN
Protocol <input type="text" value="Static"/>	LAN Mode <input type="text" value="5 host Direct"/>	Protocol <input type="text" value="DHCP"/>
IP Address <input type="text" value="10.236.225.103"/>	IP Address <input type="text" value="10.103.11.57"/>	DNS 1 <input type="text" value="8.8.8.8"/>
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.248"/>	DNS 2 <input type="text" value="8.8.4.4"/>
SSID <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server <input checked="" type="checkbox"/>	Mesh Gateway <input type="checkbox"/>
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="58"/>	
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="62"/>	
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"/>		

Static WAN IP

AC0KQ-11 setup - Mozilla Firefox

ac0kq-11:8080/cgi-bin/setup

[Node Status](#) **Basic Setup** [Port Forwarding, DHCP, and Services](#) [Administration](#)

[Help](#)

Node Name Password

Node Type Verify Password

WiFi	LAN	WAN
Protocol <input type="text" value="Static"/>	LAN Mode <input type="text" value="5 host Direct"/>	Protocol <input type="text" value="Static"/>
IP Address <input type="text" value="10.236.225.103"/>	IP Address <input type="text" value="10.103.11.57"/>	IP Address <input type="text" value="73.225.18.18"/>
Netmask <input type="text" value="255.0.0.0"/>	Netmask <input type="text" value="255.255.255.248"/>	Netmask <input type="text" value="255.255.255.248"/>
SSID <input type="text" value="BroadbandHamnet-20-v3"/>	DHCP Server <input checked="" type="checkbox"/>	Gateway <input type="text" value="73.225.18.17"/>
Mode <input type="text" value="Ad-Hoc"/>	DHCP Start <input type="text" value="58"/>	DNS 1 <input type="text" value="8.8.8.8"/>
Channel <input type="text" value="1"/>	DHCP End <input type="text" value="62"/>	DNS 2 <input type="text" value="8.8.4.4"/>
Active Settings		Mesh Gateway <input type="checkbox"/>
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"/>		

WAN access to the mesh must be explicitly enabled

The screenshot shows the AC0KQ-11 setup web interface in Mozilla Firefox. The browser address bar shows the URL `ac0kq-11:8080/cgi-bin/ports`. The interface has a navigation menu with links for [Node Status](#), [Basic Setup](#), [Port Forwarding, DHCP, and Services](#) (highlighted in a black box), and [Adminstr](#). Below the navigation menu are buttons for [Help](#), [Save Changes](#), [Reset Values](#), and [Refresh](#).

The main content area is divided into three sections:

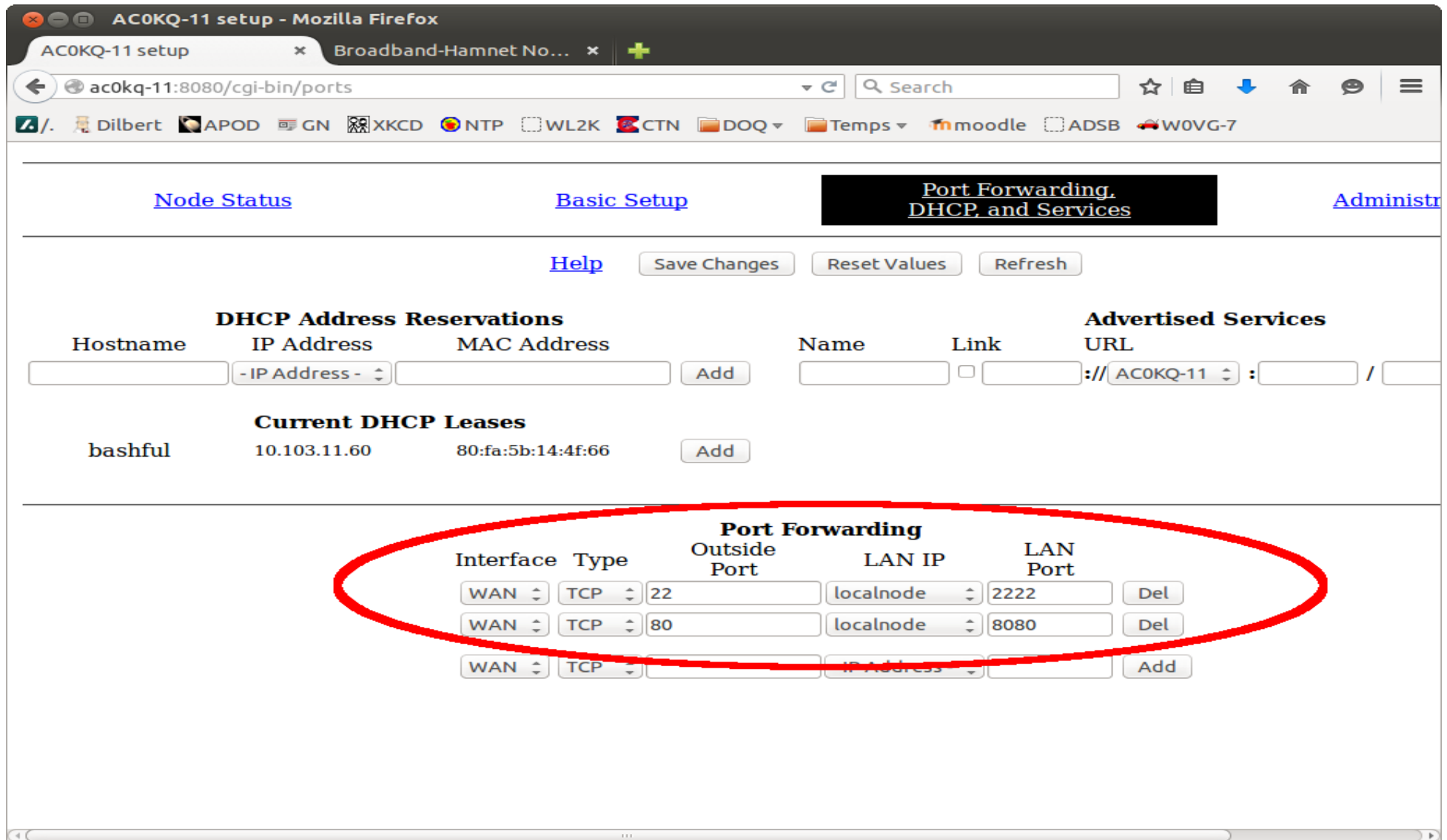
- DHCP Address Reservations**: A table with columns for Hostname, IP Address, and MAC Address. It includes an "Add" button.
- Advertised Services**: A table with columns for Name, Link, and URL. It includes an "Add" button.
- Current DHCP Leases**: A table with columns for Hostname, IP Address, and MAC Address. It includes an "Add" button.

The bottom section is titled **Port Forwarding** and is circled in red. It contains a table with columns for Interface, Type, Outside Port, LAN IP, and LAN Port. The "Interface" dropdown is set to "WAN", and the "Type" dropdown is set to "TCP". There is an "Add" button next to the form.

Interface	Type	Outside Port	LAN IP	LAN Port
WAN	TCP		-IP Address -	

WAN 22 maps to localnode ssh

WAN 80 maps to localnode http



AC0KQ-11 setup - Mozilla Firefox

ac0kq-11:8080/cgi-bin/ports

[Node Status](#) [Basic Setup](#) **Port Forwarding, DHCP, and Services** [Administr](#)

[Help](#)

DHCP Address Reservations

Hostname	IP Address	MAC Address	
<input type="text"/>	<input type="text" value="-IP Address -"/>	<input type="text"/>	<input type="button" value="Add"/>

Advertised Services

Name	Link	URL
<input type="text"/>	<input type="checkbox"/>	://AC0KQ-11 : /

Current DHCP Leases

bashful	10.103.11.60	80:fa:5b:14:4f:66	<input type="button" value="Add"/>
---------	--------------	-------------------	------------------------------------

Port Forwarding

Interface	Type	Outside Port	LAN IP	LAN Port	
WAN	TCP	22	localnode	2222	<input type="button" value="Del"/>
WAN	TCP	80	localnode	8080	<input type="button" value="Del"/>
WAN	TCP	<input type="text"/>	<input type="text" value="IP Address"/>	<input type="text"/>	<input type="button" value="Add"/>

Versions and Updates

- Versions with same major numbers interoperate
 - 3.X.Y will talk to each other
 - 1.X.Y will only talk to other 1.X.Y
- When you update the software, you will need to re-configure the node
- If you patch the software, the configuration is retained

Upgrades can be done from the GUI

The screenshot shows the AC0KQ-11 administration interface in Mozilla Firefox. The browser address bar displays 'ac0kq-11:8080/cgi-bin/admin'. The navigation menu includes 'Node Status', 'Basic Setup', 'Port Forwarding, DHCP, and Services', and 'Administration' (which is highlighted in black). Below the navigation menu is a 'Help' link.

The main content area is titled 'Firmware Update' and shows the current version as '3.1.0'. There are two main sections for firmware management:

- Upload Firmware:** Includes a 'Browse...' button, the text 'No file selected', and an 'Upload' button.
- Download Firmware:** This section is circled in red. It features a dropdown menu with 'patch-3.1.0.tgz' selected, a 'Refresh' button, and a 'Download' button.

Below the firmware update section is the 'Package Management' section, which includes options for 'Upload Package', 'Download Package', and 'Remove Package', each with a corresponding button and a dropdown menu.

At the bottom of the visible area is the 'Authorized SSH Keys' section.

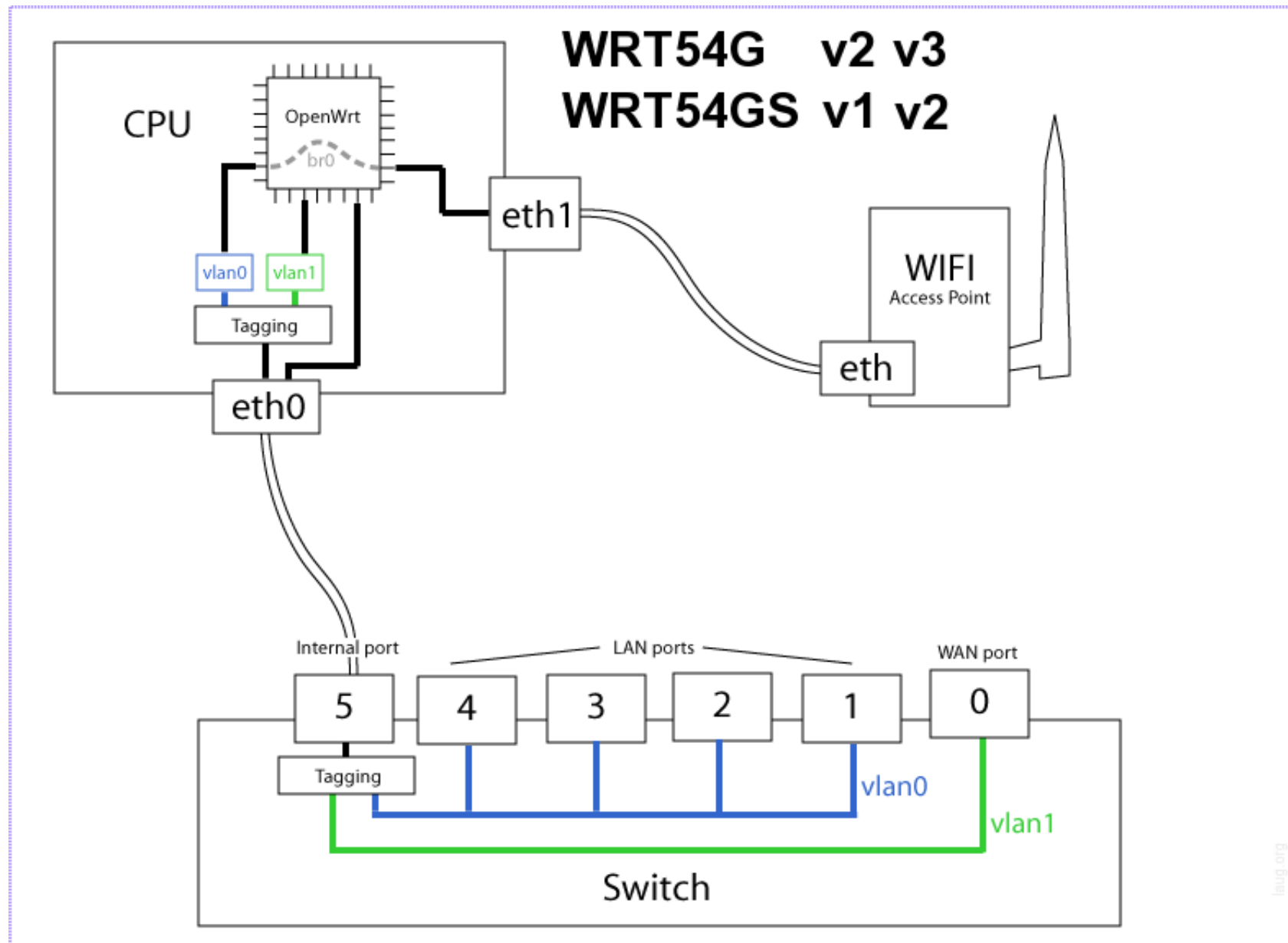
Hints and Kinks

- Only unobstructed line of sight works
- Take good care of Linksys devices
 - They run at max power, so make sure it is well ventilated
 - Keep them dry, they don't like getting wet
- Nodes can only talk when they can hear each other, so an amplifier is a bad idea
- High gain antennas are a very good idea
- For longer range use Ubiquity radios
 - Higher power
 - Can be mounted outdoors
 - Powered over Ethernet

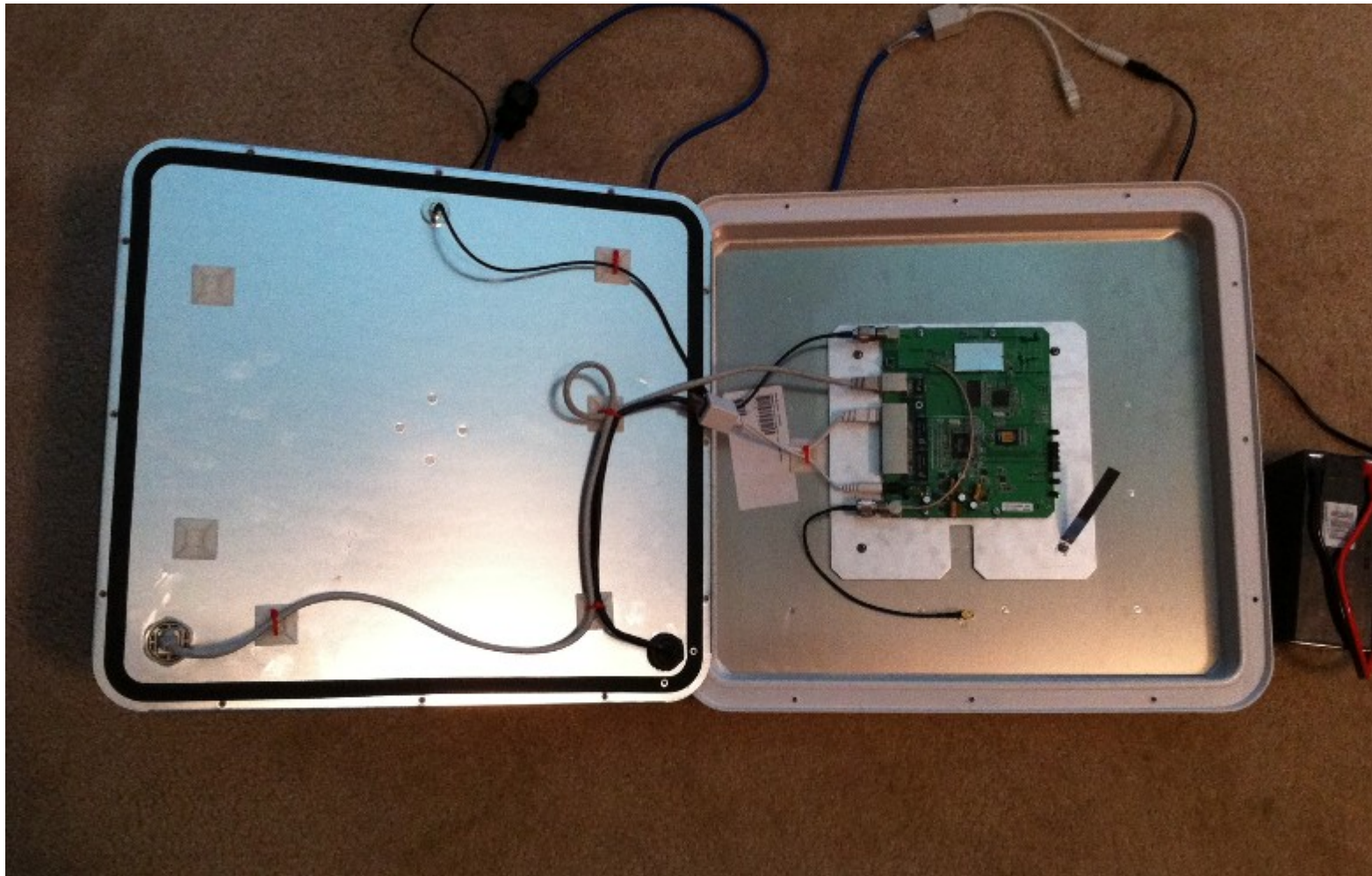
Refused Installs

- Check that you have the right type of router
- Upgrade the firmware to the latest from Linksys and then try to upgrade to MESH
- Upgrade the firmware using tftp
 - tftp 192.168.1.1 << END
bin
put bbhn-3.1.0-wrt54gs-2.4-squashfs.bin
END
 - Google WRT tftp install for more details
- If you are desperate, try the JTAG method

Internal Architecture of the WRT54G



A better mount: W5MAE Rootenna



Conclusions

- The MESH approach is great for moving IP
- Setup is easy
 - Defaults works for most situations
 - Mesh configuration is automatic
- Hardware is readily available
 - Linksys hardware great for short distances
 - Ubiquity hardware great for long distances
- Open source software is powerful and flexible
 - Nodes run a Linux kernel