Web Servers on the HSMM-Mesh

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Abstract

Here we demonstrate the practicality of providing web servers on the HSMM-Mesh. The first example shows a standalone server connected to its own Mesh node. In the second example, a Mesh node is added to an existing network that has web servers on its private and perimeter sub-networks.

Keywords : HSMM-Mesh, Amateur Radio, Wireless Networking, Wireless Mesh Network, High Speed Multimedia

Summary

Emergency communication is one of the main purposes of Amateur Radio. This has traditionally been provided by voice and low speed data such as Morse Code. High Speed Multimedia (HSMM) is a recent initiative to use Amateur Radio spectrum for high bandwidth data.

The HSMM-Mesh adapts consumer wireless networking equipment originally licensed under Part 15 of the Federal Communications Commission (FCC) Rules to Amateur Radio use regulated by part 97.

The Mesh is in its early stages of growth. It currently exists as groups of Mesh nodes (or even a single Mesh node) that cover small areas. Some of these Meshes are connected to each other through Internet tunnels. HSMM-Mesh.org is actively developing the Mesh.

While all nodes on the Mesh are part of the infrastructure, some exist primarily to provide client access or services to the Mesh. This paper describes one effort to provide web servers to the Mesh. It is hoped that the ideas presented here can be adapted to networks at sites served by Amateur Radio Operators.

Portable Web Server

A portable web server can be added to the Mesh using a portable computer and a mesh node. This was demonstrated by connecting a netbook to Mesh node `N7XSD-102`.

Node `N7XSD-102` is a Linksys WRT54GL with HSMM-Mesh firmware version 0.4.3 installed.

The portable computer, `Zoe`, is a simple Ubuntu Linux netbook with the addition of an Apache web server. The wired Ethernet interface, `eth0` was already configured to use DHCP and the wireless interface was disabled.

After `Zoe` was connected to a LAN port on `N7XSD-102`, a few configuration changes were required in “Port Forwarding, DHCP, and Services” of “Setup”. First, a DHCP address reservation for `Zoe` was added. Second, `Zoe` was chosen as the DMZ server. Third, `portable-web` was added as an

advertised service. A screen shot is shown in Illustration 1.

After the changes were saved, the web site `http://N7XSD-102/` was available on the Mesh.

Existing Office Network

The home office network used consisted of a perimeter sub-network connected to two firewalls. The first, `fw0`, connected the perimeter sub-network to a private sub-network with servers and workstations running both GNU/Linux and Mac OS X as well as wireless access points. The second, `fw1`, connected the perimeter sub-network to the Internet via WiMAX. All of these nodes used "stock" firmware and operating systems.

Firewall `fw1` provided DHCP and DNS for nodes connected to the perimeter network. `Wash`, a Debian GNU/Linux server, provided DHCP and DNS on the private network and also file services. `Jayne`, a Debian GNU/Linux server, hosted a public facing web server from the perimeter sub-network while `Mal`, an OS X desktop system, was used as a web server on the private sub-network. This network is shown in Illustration 2.

Both firewalls were capable of Network Address Translation (NAT). The perimeter sub-network used IP addresses in the `192.168.15.0/24` network and the private sub-network used `192.168.31.0/24` addresses. Both sub-networks had addresses outside the DHCP scope that can be used for static assignments. Internet connections from ports 811 through 827 were forwarded by `fw1` to `fw0`. The same ports were then forwarded by `fw0` to `Mal`. Ports 889 to 899 were forwarded by `fw1` to `Jayne`.

IP network `10.0.0.0/8` was not being used. This was an important consideration, since "ten" is always used by the Mesh for its wireless interface.

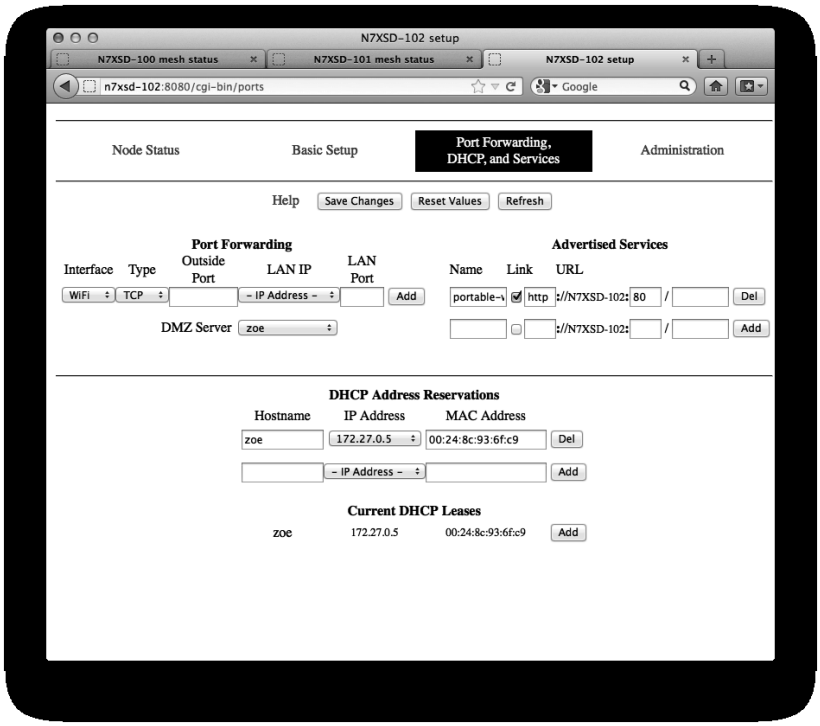

Illustration 1: N7XSD-102 Port Forwarding

New HSMM-Mesh Node

Mesh node `N7XSD-101` was established to give the web servers Mesh connectivity. No effort was made to give users of the home office network access to servers on the Mesh, nor was anything done to prevent users from accessing the Mesh.

Before being placed into the existing network, a Linksys WRT54GL was connected to a laptop computer with an Ethernet cable. All the laptop needed was an Ethernet connection, a web browser, and the current HSMM-Mesh firmware. It was already configured as a DHCP client (this is common for laptop computers).

Instructions from HSMM-Mesh.org were used for the original configuration. DHCP was then disabled from the LAN ports and the mesh node assigned an address of `192.158.15.2`. This address was outside the DHCP scope on the existing network. A screen shot of the basic setup is shown in Illustration 3.

Node `N7XSD-101` was then disconnected from the laptop and connected to the perimeter switch. The remaining LAN ports were then also available for nodes on the perimeter network. The WAN port was not needed.

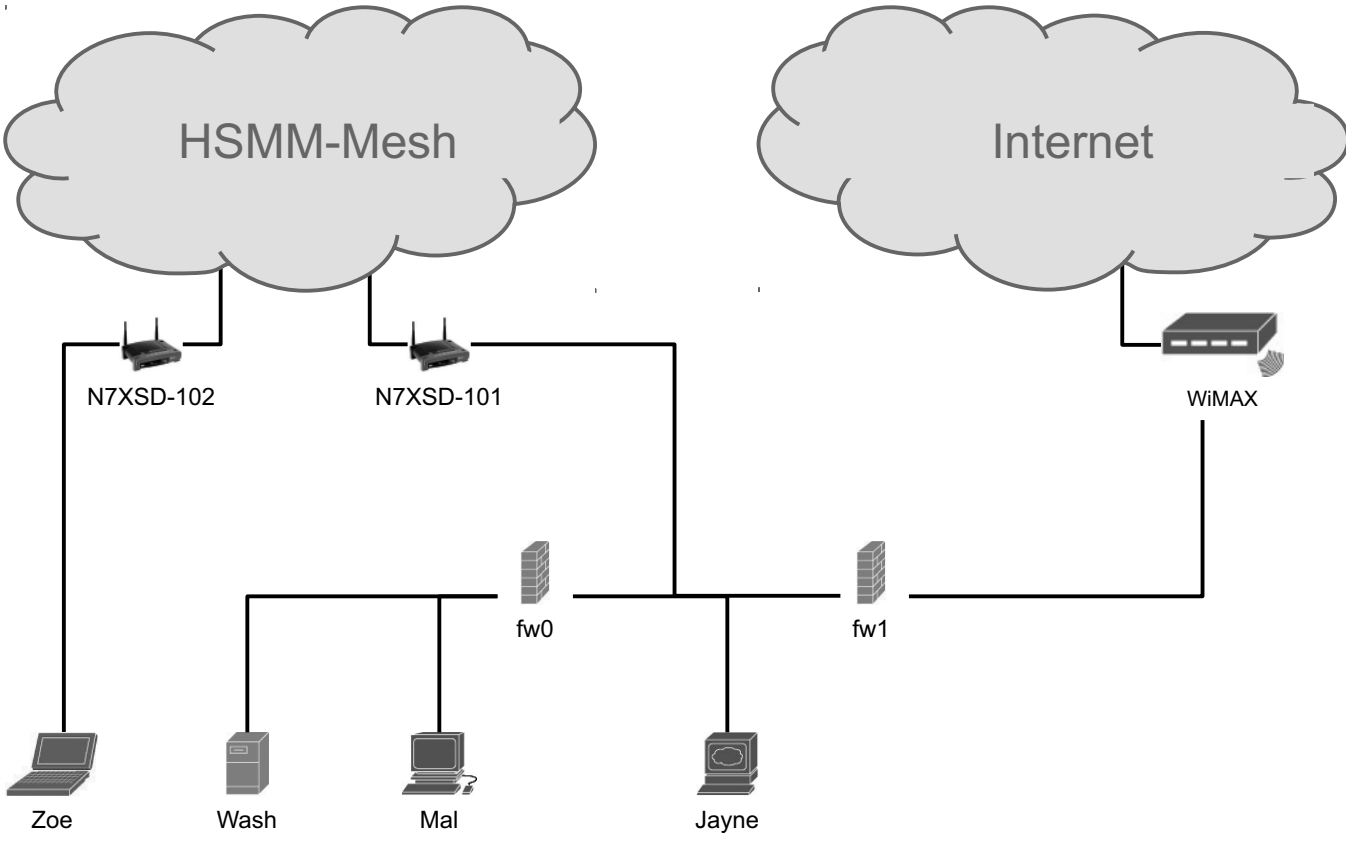

Illustration 2: Network

Network Routing

HSMM-Mesh uses IP addresses in the `10.0.0.0/8` network. A static route was added to `fw0`. Without this static route, packets intended for the `10.0.0.0/8` network were being routed to `fw1`, the default gateway on the perimeter sub-network.

DNS Name Server

Changes were made to the existing DNS servers.

DNS zones `mesh` and `10.in-addr.arpa` are used by HSMM-Mesh. The BIND configuration on `Wash` was changed to provide name resolution in these zones to the perimeter and private sub-networks. This was done with condition forwarding.

```
zone "mesh" {
    forward only;
    forwarders {
        192.168.15.2;
    };
    type forward;
};
zone "10.in-addr.arpa" {
    forward only;
    forwarders {
        192.168.15.2;
    };
    type forward;
};
```

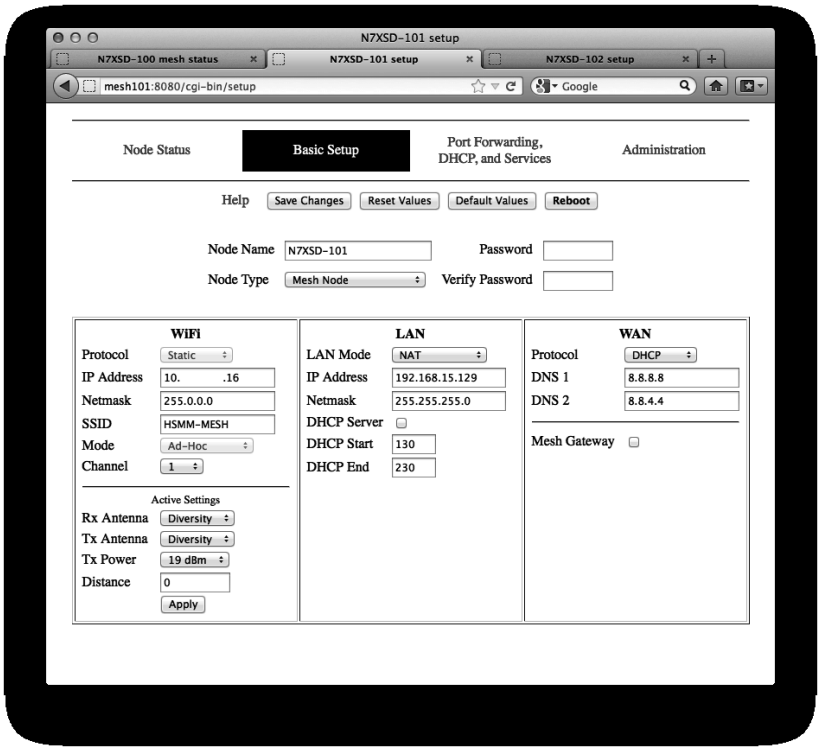

Illustration 3: N7XSD-101 Basic Setup

Node N7XSD-101 was also added to the zone file for n7xsd.us.

```
mesh101-lan    IN  A      192.168.15.2
mesh101-mesh   IN  A      10.X.Y.16
mesh101        IN  CNAME  mesh101-lan
N7XSD-101      IN  CNAME  mesh101-lan
```

The only record that was really important was the address record for 192.168.15.2. The additional records were added to fit in with local naming conventions. Also note that N7XSD-101.n7xsd.us and N7XSD-101.austin.tx.us.mesh resolve to two different addresses.

Mesh node N7XSD-101's web interface could then be reached at http://N7XSD-101:8080/ from the perimeter and private sub-networks.

Existing Web Servers

Jayne was an Ubuntu Linux server with an Apache 2 web server. This server was connected to the perimeter sub-network and had IP address 192.168.15.4. Apache listened on TCP ports 80 and 898 and did not have any virtual servers. All content on this server was appropriate for Amateur Radio. That is, none of the content was forbidden by Part 97 of the FCC rules.

Firewall fw1 did not provide a route to network 10.0.0.0/8. The command route add -net 10.0.0.0 netmask 255.0.0.0 gw 192.168.15.129 dev eth0 was added to Jayne's startup to provide routing to the Mesh.

Mesh node N7XSD-101 was changed to direct port 898 to 192.168.15.4 and port 818 to 192.168.15.2. Firewall fw0 would then forward port 818 to Mal. Port forwarding and advertised

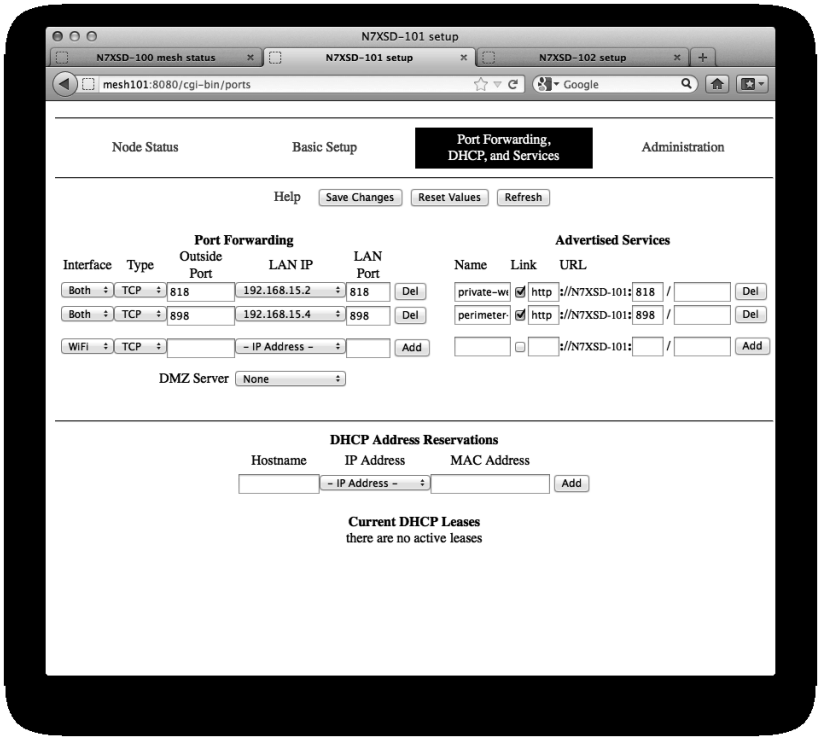

Illustration 4: N7XSD-101 Port Forwarding

services on the Mesh node are shown in Illustration 4.

`Mal` was a Mac OS X Lion desktop workstation on the private sub-network with IP address `192.168.31.115`. A new virtual server was created to serve specific content to the Mesh on port 818. The virtual host definition is given below.

```
<VirtualHost *:818>
    DocumentRoot "/Library/WebServer/Documents/hsmm-mesh"
    ServerAlias n7xsd-101 n7xsd-101.austin.tx.us.mesh
    ServerName hsmm-mesh.n7xsd.us
</VirtualHost>
```

File locations vary between installations. Apache virtual hosts are described on the Apache web site.

Web sites `http://N7XSD-101:898/` and `http://N7XSD-101:818/` were then both available from the Mesh.

Conclusion

The HSMM-Mesh can provide network connectivity to areas impacted by natural or man made disaster. Nodes on the Mesh can provide web and other services.

What services are most valuable to first responders using the Mesh remains an open question. One possibility is to extend existing tools (i. e. WebEOC) used by emergency management agencies to the field. Another option is to provide a complete package such as Sahana or Tickets CAD on the mesh. This questions and more should be investigated while the HSMM-Mesh grows into a robust infrastructure.

Links

Apache HTTP Server Project, `<http://httpd.apache.org/>`

Apple OS X, `<http://www.apple.com/lae/osx/>`

BIND DNS Server, `<http://www.isc.org/software/bind/>`

Debian GNU/Linux, `<http://www.debian.org/>`

FCC Rules and Regulations, `<http://www.fcc.gov/encyclopedia/rules-regulations-title-47>`

HSMM-Mesh “Firmware Installation Instructions” by David Rivenburg, AD5OO, `<http://www.hsmm-mesh.org/documentation/68-firmware-installation-instructions.html>`

Linksys WRT54GL, `<http://homesupport.cisco.com/en-us/support/routers/WRT54GL>`

Sahana `<http://sahanafoundation.org/>`

Tickets CAD `<http://www.ticketscad.org/>`

Ubuntu GNU/Linux, `<http://www.ubuntu.com/>`