By John Champa,* K8OCL

HSMM

Communicating Voice, Video, and Data with Amateur Radio

HSMM and Field Day – raison d'être

Field Day use of HSMM (high-speed multi-media) radio is increasing dramatically to the point where most major club Field Day sites have full intranet radio service among the various stations scattered across the countryside. Often they also have some Internet access to keep family and friends posted on their progress and to communicate vital needs to outside supporters. We will have more on these exciting events in the next issue, but of all the many uses radio amateurs have made of HSMM technology, Field Day is clearly its raison d'être (reason for being). When you must move a lot of data very quickly and accurately and there are no wires, HSMM radio techniques are tough to beat.

Although emergency communications applications of HSMM radio are frequently discussed and written about, the fact remains that too few radio amateurs know enough about IP-networked radios to set up such systems in the field and in a hurry. That is changing, but it will take time.

SSID Protocols

The ARRL HSMM Working Group never established an SSID standard for HSMM radio. However, the ARRL Michigan Section DRG (Digital Radio Group) has proposed such a standard. For example, the author's SSID is k8ocl-2. We encourage the further development and use of this DRG standard.

SSID	Purpose
-0	home stations
-1	home-station personal mailboxes
-2	gateways
-3	full-service BBS (those that forward mail and bulletins)
-4	network nodes (having two or more radio ports that perform TCP/IP routing)
-5	console, keyboard, printer, etc.
-6	conference bridges
-7	crossband digipeaters (802.11g and 802.11a, etc.)
-8	crossband digipeaters (other)
-9	mobile, modats, etc,
-10	WL2K
-11	HSMM airborne nodes (balloon, aircraft, etc.)
-12	HSMM satellite (OSCAR) nodes
-13	unassigned
-14	unasssigned
-15	downlink address when exiting the far end of a network

Note: There is now a page for listing your D-Star DD or 802.11 HSMM installations: <http://en.wikipedia.org/wiki/List_of_hsmm_nodes> (Thanks to KF4YFD for this information.)

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Coaxial Cable Feedlines

All present-day HSMM radio experimenting is done at 900 MHz and above, with the majority of it being on the 2.4-GHz band. Thus, please pardon me while I state the obvious: All 1/2-inch coaxial cable is not created equal. Even though the 1/2-inch black cable has quality N-series connectors at each end, this does *not* make it suitable for HSMM work; RG-213 and RG-214 are prime examples. Here is what I recommend in the way of "1/2-inch" coaxial cables, as they are far more suitable.

Cable Type	2.5 GHz Loss (dB/100 ft.)	5.8 GHz Loss (dB/100 ft.)
LMR400 (good)	6.8	10.8
1/2" Heliax (better)	5.7	10.5
LMR600 (best)	4.45	7.25

When installing coaxial cable for your antenna projects, exercise some care:

1. If you pull coaxial cable too hard, its loss properties may increase.

2. Bends in coaxial cable must not exceed the cable's spec for bend radius.

3. The longer the run the higher the loss, so keep runs as short as possible.

4. If the antenna is outside, you must provide for lightning protection.

5. Even weather-tight connections should be sealed outside.

The Biggest HSMM Events of the Year!

Every year a team from the HSMM Working Group of the Texas Microwave Society puts together huge HSMM radio networks to service the Wild Ride Against Cancer and the Plano (TX) Balloon Festival. We all can learn much from this team's experience. The notes and photos that comprise the remainder of this column were supplied by Kipton Moravec, KE5NGX (kip@kdream.com):

Standard terminology for a router setup:
The **host router** is the router that has the Internet connection and is going to share it with other routers. In our case, this is the church.

The **client router** is the router which does not have an internet connection. This is the officials area, ramp, and scissor lift units.

Setup:
Save the configuration on all routers: **Administration -> Backup**. Click the "Backup" button and follow prompts to save nvram backup files—i.e. nvram_host.bin, and nvram_client. bin. The configurations can be restored if the setup doesn't work
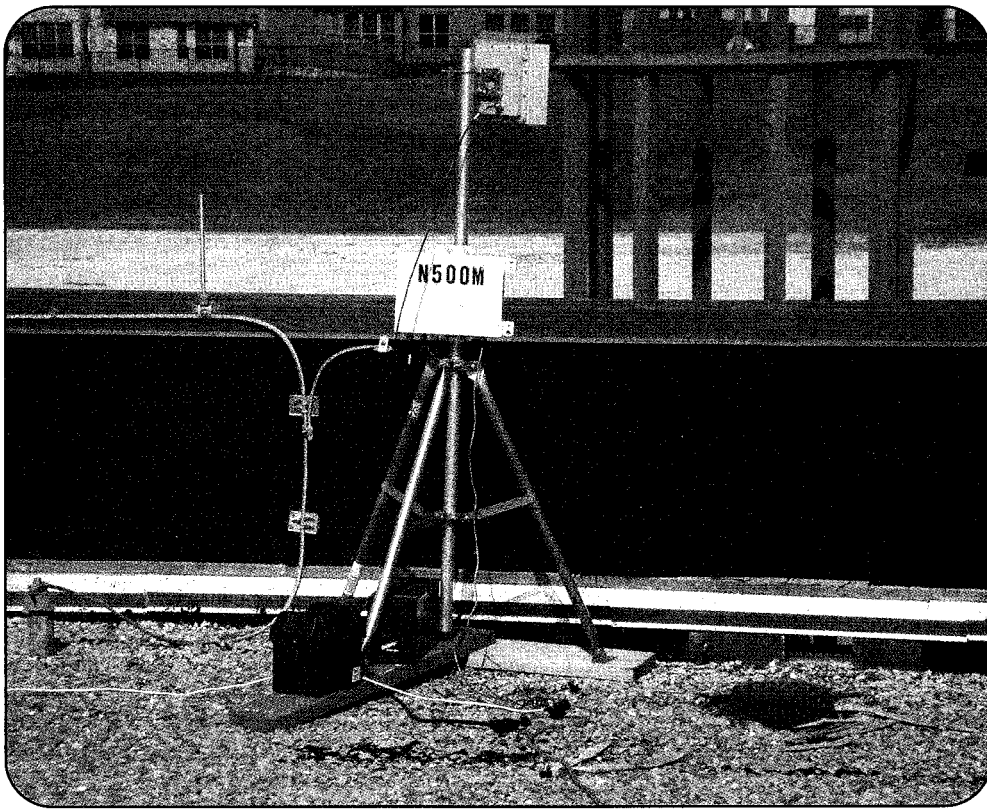
This is John Beadles, N5OOM's unit on the second-story roof of the First United Methodist Church of Plano, Texas. Since it is a flat roof, we attached the tripod to two 2'×6' pieces of wood so it would not damage the roof, and weighted them down with the uninterruptible power supply and extra battery so the wind would not blow over the tripod. The site on the roof had a clear view of the Balloon Festival field. The 15-dB gain flat-panel antenna had about a 30-degree beam width, which covered all of the antennas on the field. The farthest was about 2500 feet away. A Linksys router with DD-WRT software was mounted in the antenna case. (Photo by Kipton Moravec, AE5IB)
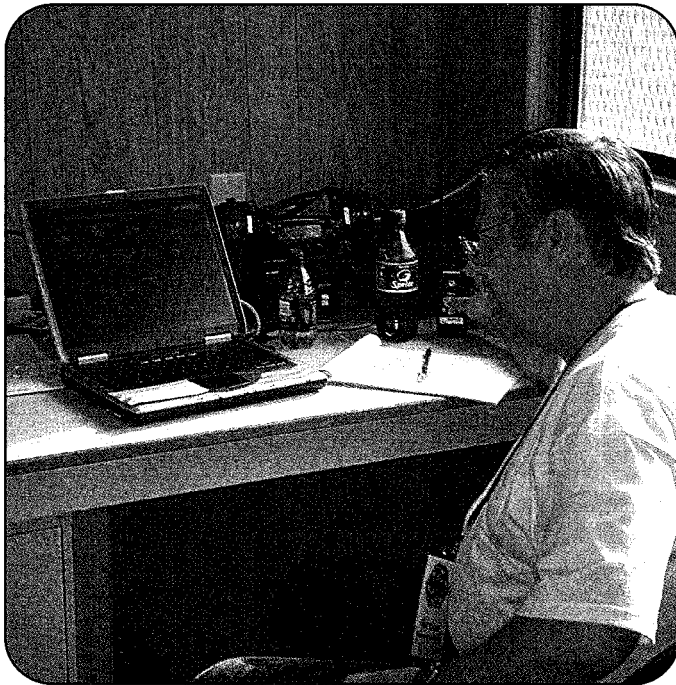
Bruce Dingman, N5BYL, was one of the amateurs in the communications trailer. Since the trailer was metal, we ran an Ethernet cable in from the antenna and router mounted on the outside of the trailer to provide them with Internet access to monitor weather and the balloons with APRS trackers. The people in the communications trailer monitored the commercial handheld radios from the Balloon Festival staff, and the Amateur Radio Balloon Festival Net acted as the interface between both groups. (Photo by AE5IB)

out and you need to quickly get back to a different (working) configuration.

DD-WRT default login is *root* and the password is *admin*. I am leaving mine to the default for now. Later we changed to login *root* and password *Sband*.

Reset the routers to factory default settings so other settings will not have a possible conflict: **Administration -> Factory Default, select yes, click "Save Settings" button**.

Screen by Screen Setup Procedure:
Setup -> Basic Setup

Wireless Setup
For the Host (on the church)

Connection Type:	**Automatic Configuration - DHCP**	This is for the WLAN port
STP:	**Enable**	Not sure what this does

For the Clients

Connection Type:	**Disable**	This is for the WLAN port
STP:	**Enable**	Not sure what this does

Optional Settings

Name:	Use router/SSID name (i.e., KE5NGX-AP1)
Host Name:	Leave Blank
Domain Name:	Leave Blank
MTU:	**Auto**

Network Setup
Local IP Address: This is for the Wireless and LAN ports. Give the routers a different IP address, i.e.:

192.168.157.1	N5OOM-2AP at the Church.
192.168.157.2	N5OOM-1AP at the Officials Area
192.168.157.3	N5OOM-4AP at the Ramp
192.168.157.4	N5OOM-3AP at the Scissor Lift
192.168.157.5	KE5NGX-AP1 Backup
192.168.157.6	KE5NGX-AP3 Church Backup

Subnet Mask:	**255.255.255.0**		
Gateway:	**192.168.157.1**	For clients only	
Local DNS:	**192.168.157.1**	We do not have one	

WAN Port

Assign WAN Port to Switch: **Unchecked**
This makes WAN port a 5th LAN port if checked. Let's not use it unless we need it.

Network Address Server Settings (DHCP)

DHCP Type: **DHCP Server**

Start IP Address:

192.168.157.200	N5OOM-2AP at the Church
192.168.157.20	N5OOM-1AP at the Officials Area
192.168.157.30	N5OOM-4AP at the Ramp
192.168.157.40	N5OOM-3AP at the Scissor Lift
192.168.157.50	KE5NGX-AP1 Backup/Field Ops if needed

Maximum DHCP Users: **10** Default to 10 per router (because it is easy)

Client Lease Time: **1440** Minutes Seems to be default

Static DNS 1: **192.168.1.1** I got it from the church/this is the router we connect to
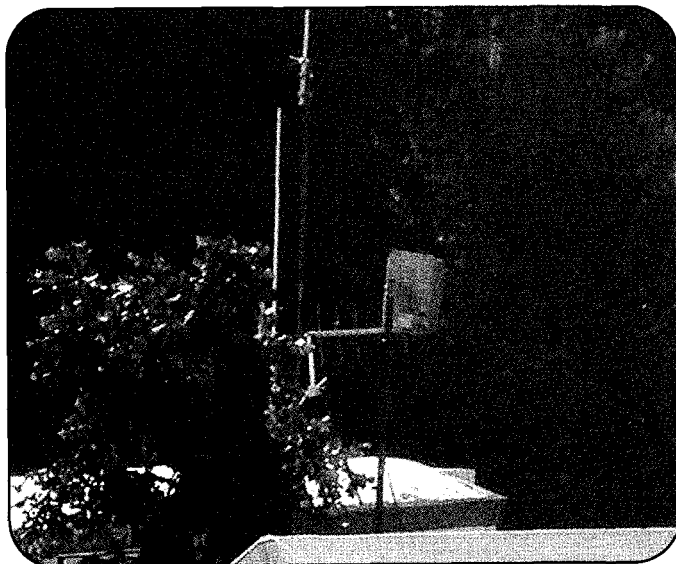
Static DNS 2: **208.67.222.222** (OpenDNS as backup)

Static DNS 3: **208.67.220.220** (OpenDNS as backup)

Other ones if these doesn't work:

68.238.96.12	Verizon FiOs Primary DNS at Kip's House
68.238.64.12	Verizon FiOs Alternate DNS at Kip's House

This is a view of the antenna on the communications trailer and the antennas from the Amateur Radio Field Operations Command Center. The HSMM antenna is pointed towards the church for Internet access, but the laptop computers in the Command Center were able to access the HSMM signal from the side lobe of this antenna. It was about 100 feet away. (Photo by AE5IB)

A late afternoon balloon launch from the launch field. Amateur radio operators on the field announced each balloon number as it took off so that the amateur radio recovery teams and the Balloon Festival staff knew which balloons had taken off. This information was also used to determine if all the balloons had been recovered. (Photo by AE5IB)

Use DNSMasq for DHCP:	**Checked**
Use DNSMasq for DNS:	**Checked**
DHCP Authoritative:	**Checked**

Time Settings

Time Zone/Summer Time (DST):

UTC—6:00/First Sun Apr – Last Sun Oct

Use Local Time: **Checked**

Save Settings

If the IP address changed or the Start IP Address changed, you will probably have to go to the command prompt (or DOS window) and type **IPCONFIG /RELEASE** then **IPCONFIG /RENEW** to get your computer to get a new IP address. The gateway is the IP address you want to go to.Use Internet Explorer to get back in the router.

Turn off security on both routers (this should already be done if you reset as above). Security can be re-enabled after all other steps are complete, but in order to minimize troubleshooting, it's best to get things set up with no security active: **Wireless -> Wireless Security -> Security Mode -> Disabled**

Put both routers into AP mode and on channel 1. **Wireless -> Basic Settings**

Under **Wireless -> Basic Settings**, set the SSID to the name of the router. The format I prefer is <Call Sign>-AP<number>—for example, KE5NGX-AP1 and KE5NGX-AP2. For WPA WDS, the SSID for the routers needs to be the same. For WEP, different SSIDs can make troubleshooting easier. We will use WEP.

If you plan to use WPA later, then select **G-only** in **Wireless -> Basic Settings**. You cannot use B-only with WDS.

Sensitivity Range (ACK Timing) for the Balloon Festival, the longest distance is 2505 feet, which is 763.5 meters. Since that is less than 2000 meters, we will stay with the default. If we ever have a link longer than 2000 meters, we will need to change this. Otherwise it times out before getting an ACK and then retries. This slows down the link a lot.

Open WDS configuration on both routers. **Wireless -> WDS**

On each router, you will see its wireless MAC address at the top of the **Wireless -> WDS** page. Put each router's MAC into the table of the other router, and select **LAN** for the type. Note that this MAC address is different from the one that may be printed on your case, because each router has three MAC addresses: WAN, LAN, and Wireless.

Here are known Wireless MAC Addresses for our routers:

Unit Name/SSID	Wireless MAC Address	Make
KE5NGX-AP1	**00:16:01:B9:87:A4**	Buffalo WHR-HP-G54
KE5NGX-AP2	**00:16:01:B9:92:16**	Buffalo WHR-HP-G54
KE5NGX-AP3	**00:13:10:94:92:09**	Linksys WRT54G v.3
N5OOM-1AP	**00:0F:66:A6:24:41**	Linksys WRT54G v.
N5OOM-2AP	**00:0F:66:A6:1E:C8**	Linksys WRT54G v.
N5OOM-3AP	**00:0F:66:A4:9D:B9**	Linksys WRT54G v.
N5OOM-4AP	**00:12:17:CE:F1:9F**	Linksys WRT54G v.
N5OOM-5AP	**00:12:17:D9:93:2A**	Linksys WRT54G v.

I am putting in all of the other routers in the table, and if not used, leaving it disabled, so in the future we can reconfigure more quickly. The interface is not very user friendly, and when you change type, anything not saved gets wiped out. Therefore, either save line by line, or change the type on all the lines first, then type in the MAC address. Then you should save. Then disable the ones that need to be disabled.

I am making a label for each of my units that has SSID, LAN MAC, WAN MAC, Wireless MAC, Login, and Password. It looks like this:

KE5NGX-AP1	
LAN MAC	**00:16:01:B9:87:A2**
WAN MAC	**00:16:01:B9:87:A3**
Wireless MAC	**00:16:01:B9:87:A4**
Login: root	**PW: admin**

If you send me the data, I will also print one for you. It helps with setup.

There is no need to enable **Lazy WDS** or **WDS subnet** on either router.

Test that you can ping the gateway from the client. Note that it may take a short amount of time for the WDS to be established, and you may need to reboot both the gateway and the client.

Enable encryption now, if you like (highly recommended). We must use WEP encryption. The encryption code we will use is: "HSSM_" or 95440EDCE0.

The other parameter we can play with is the power. The default is 28 mW, which is low. It says you can set it from 0 to 251 mW, but the help says 70 mW would be suitable for most applications. Higher power settings are not recommended for users due to the excessive heat generated by the radio chipset, which can affect the life of the router. We needed to play a little in the field to find out what is required. It turns out 28 mW is good enough.

Some Comments in the Setup

In some cases it may help to put the IP of the client router as a DMZ'd machine in the host router. Of course, this only works with a WDS between 2 routers. See: <http://www.dd-wrt.com/phpBB2/viewtopic.php?t=669&highlight=dmz>. *I did not see this in my experiments, but we will watch for it.*

If you have G-only enabled, you must use channel 1, 6, or 11. See: <http://www.dd-wrt.com/phpBB2/viewtopic.php?t=628&highlight=wds>. *We will use channel 1 only.*

The source material for this list comes primarily from the following DD-WRT forum posts:

Guide to Setting up WDS

<http://www.dd-wrt.com/phpBB2/viewtopic.php?t=124>

If you're using encryption, remember to configure it on all routers!

On the main **Status** page and the **Wireless Status** you can see the signal strength for any other routers in the WDS. If they are showing 0, then you're not connecting to them for some reason (wrong MAC address or, for WPA links, wrong SSID). *This is very helpful. You can see all wireless clients attached.*

It seems that when WPA2 is enabled, WDS does not work well with TKIP+AES: Client router reports no signal from the host router, while the host router reports a valid signal from the client routeur. Using TKIP only helps.

WPA2 works fine with TKIP+AES. Set both client and host to the same security settings, with the same password. Version in use is v24 Beta (07/12/07) – std on 2 Buffalo WHR-G125s. *We will use WEP so this is not a problem.*

We thank KE5NGX for his input for this column. Until next time . . .   73, John, K8OCL