By John Champa,* K8OCL

Communicating Voice, Video, and Data with Amateur Radio

New High-Speed Multi-Media Radio Mesh Networking

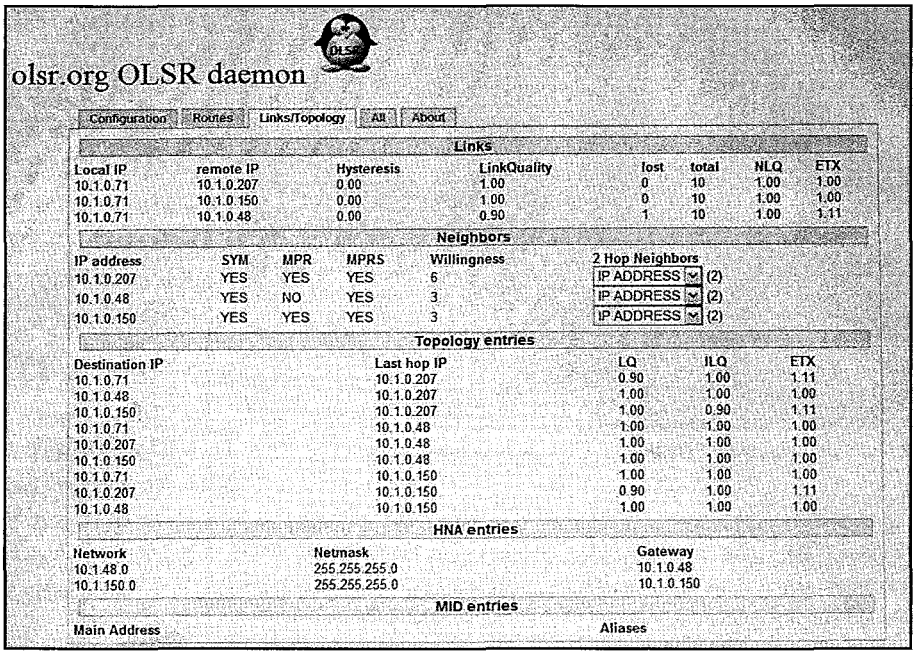
If you have not been tracking the events of the North Texas Microwave Society (ntms-hsmm@yahoogroups.com) on the HSMM web page, you are missing a lot of action! The NTMS is in the heart of wireless Telco development country in the Dallas/Plano area. New developments and innovative thinking are taking place all the time.

de KD5MFW

For example, recently I had an opportunity to interview Glenn Currie, KD5MFW, who is working with a team of HSMM radio experimenters in the Round Rock (Austin), Texas area. This team is called the Austin HSMM Special Interest Group (SIG). There are some key participants from the Roadrunners Microwave Group (RMG).

An interesting development Glenn reports is that by using Optimized Link State Routing Protocol (OLSR) their new mesh nodes auto link and are passing data within five seconds of coming into RF range. For more information on OLSR, go to <http://www.olsr.org>. With a large mesh, when two nodes are passing data and a node in the link goes down, OLSR automatically switches to another route through the mesh. The user usually notices nothing. This development puts HSMM on the cutting edge of mesh networking!

Figure 1 is a web page served up from inside the WRT54G router running the Austin HSMM SIG version of the OLSR mesh software. Under "Links" are shown all the current nodes within RF range. These nodes include node 71, which is serving up the web page (10.1.71.1:1978). Port 1978 is the OLSR status port address for each node.



olsr.org OLSR daemon

Configuration | Routes | Links/Topology | All | About

Links

Local IP	remote IP	Hysteresis	LinkQuality	lost	total	NLQ	ETX
10.1.0.71	10.1.0.207	0.00	1.00	0	10	1.00	1.00
10.1.0.71	10.1.0.150	0.00	1.00	0	10	1.00	1.00
10.1.0.71	10.1.0.48	0.00	0.90	1	10	1.00	1.11

Neighbors

IP address	SYM	MPR	MPRS	Willingness	2 Hop Neighbors
10.1.0.207	YES	YES	YES	6	IP ADDRESS (2)
10.1.0.48	YES	NO	YES	3	IP ADDRESS (2)
10.1.0.150	YES	YES	YES	3	IP ADDRESS (2)

Topology entries

Destination IP	Last hop IP	LQ	ILQ	ETX
10.1.0.71	10.1.0.207	0.90	1.00	1.11
10.1.0.48	10.1.0.207	1.00	1.00	1.00
10.1.0.150	10.1.0.207	1.00	0.90	1.11
10.1.0.71	10.1.0.48	1.00	1.00	1.00
10.1.0.207	10.1.0.48	1.00	1.00	1.00
10.1.0.150	10.1.0.48	1.00	1.00	1.00
10.1.0.71	10.1.0.150	1.00	1.00	1.00
10.1.0.207	10.1.0.150	0.90	1.00	1.11
10.1.0.48	10.1.0.150	1.00	1.00	1.00

HNA entries

Network	Netmask	Gateway
10.1.48.0	255.255.255.0	10.1.0.48
10.1.150.0	255.255.255.0	10.1.0.150

MID entries

Main Address	Aliases

Figure 1. ARES-MESH status screen as displayed by mesh node 71 by looking at address 10.1.71.1:1978 using a web browser. Three other nodes can be seen with good link quality.

Moving to the right on the top section, local node 71 can see remote nodes 207, 150, and 48. There is no delay (hysteresis) set. RF link quality between all nodes is "perfect = 1" except for node 71, which has a less than perfect, but usable, link to node 48, and thus the 0.90 rating. It looks as if that 0.90 link quality was because one packet was lost out of the last ten (but was resent and correctly received). Therefore, the net link quality to all nodes is perfect = 1.00, because no data was lost, although a resend was needed from node 48. The next group of data shows an IP address that node 71 can see. SYM, MPR, MPRS explanations will not fit in the caption.

Willingness shows the number of possible ways a node has to get to other nodes. Two Hop Neighbors show the IP address of the two different hops a node can make to other nodes. You have to click on the down arrow to see the addresses. In a big network the list would be huge.

The Topology entries show all combinations and permutations of links between nodes in the network: LQ, ILQ, and EXT all are measures of link quality.

Link quality is important for such things as Voice over Internet Protocol (VoIP). If the link quality is poor, you may be able to sputter files through without errors, but there will be dropouts for VoIP or video. No user intervention is needed to link with the mesh. This is why it is good for the field—no messing with addresses in the field. Exciting stuff! I will report more details on that in the next column. I also will try to strike a careful balance between giving recognition and at the same time protecting developers' time by preventing them from getting swamped with questions, which could interfere with their part-time work.

It appears that the Austin HSMM SIG is way ahead of what most other groups are doing in HSMM. John, N5OOM, and

*Former Chairman of the ARRL Technology Task Force on High Speed Multimedia (HSMM) Radio Networking
2304 Woodglen Drive, Richardson, TX 75082-4510
e-mail: <k8ocl@arrl.net>

the crew in the North Texas Microwave Society HSMM SIG have done a lot of good work, and John's presentations are well done and informative. Some of that material has been published here, and I highly recommend it to people interested in HSMM. However, nothing has been published yet about crystal modifications to the WRT-54G or making serious modifications to the firmware. We are looking for material on those subjects.

Glenn promotes HSMM for several reasons. Hams need to make use of the inexpensive WiFi gear that can easily be operated on the ham bands and get into broadband computer-based radios. Hams need to be active in this or the hobby will fade. It is related to what the younger tech folks are doing with the internet.

Glenn grew up with computers and radios. He has one foot in each camp, as do all the key developers he is working with. That puts them in a position to have just the right perspective to see the great value of HSMM and how it needs to come together. Glenn has a 16-GB USB thumb drive on a lanyard that he carries around with him. It is full of academic papers related to the U.S. Department of Defense's Defense Advanced Research Projects Agency (DARPA) and other robot and communications topics, and the material they have collected on their HSMM projects. I hope to convince him to publish some of that material in future columns.

Years ago Glenn worked for the McDonald Observatory associated with the University of Texas and had one of the early ARPANET e-mail addresses. That was 25 years ago, and he has worked with the early 4.1 BSD Unix on a VAX11780. After tinkering with Unix/Linux systems for 25 years, you can't help but pick up a few things.

Glenn is a founding member and on the board of directors of The Robot Group Inc., a non-profit technology corporation for building stuff they won't let them build at work. He was also a team member of the Austin Robot Technology autonomous SUV entered in the DARPA Grand Challenge, having a vehicle drive 130 miles through open country with absolutely no human intervention. They did not win, but their "Marvin" was competitive. He had access to and interest in DARPA information for a long time, and as the ARPANET morphed into the internet, it is much easier to follow trends in robotics and communications. Glenn blasts through many published papers each week—anywhere from 30 to over 100. Commercial and military folks have been using mesh technology for some time and are still refining significant details. Glenn tries to follow what they publish:

I have been pushing for integration of 802.11 wireless technology into our emergency ham radio stations at area hospitals since 2002. This is called the ARCHES project. I am lucky enough to have some very capable friends who are interested in HSMM and they have done a lot of the development work, so it is truly a group effort. I serve as the "spark plug" and evangelist for the project. The project stays interesting, as we are learning new things all the time.

We have a wealth of information we have collected for 5 years or more of development. I have given a handful of presentations to key groups in the Austin area. Austin is the state capital, and as such, there are some hams high up in a number of the big agencies and large high-tech companies in the area. This has provided offers of microwave sites that we need to make the project work. We don't have the funds to rent space like the cell phone companies can. The strategy has worked well.

Glenn recognizes the need to get hams up to speed on what they have done so far, and they have a specific planned deployment to demonstrate it to potential ARES served agencies so they can understand what they can and cannot do with the system. It can be of great use, but explaining it, even to most hams, is more of an education and not an explanation. The administrators of the served agencies need to understand the capabilities of the system *before* they are in the middle of managing a particular disaster response:

We started our HSMM efforts to link area hospitals that already had ham stations in them, with faster links and to free up the 2m/70cm 1200-baud packet traffic frequencies for hams coming in from Llano, Taylor, Luling, etc., where the propagation of 2m/70cm was well suited for the distance they were trying to cover.

We have a great mix of skills and experience! The Roadrunners Microwave Group historically has been oriented toward conventional high-power narrowband modes—e.g. CW. Therefore, the group is well versed in stretching the distance and is essentially used to/from a mesh stand point, doing long-distance, point-to-point fixed and mobile links. They include a bi-directional amplifier (BDA) in their systems as standard operating procedure. However, the Austin HSMM SIG, part of the Travis County ARES (TCARES), found little use for BDA amps around Austin.

Either you had good locations or not and unless your amp was powerful enough to burn a hole through obstructions in the path, it did little good. Our anchor station at the Chapter Red Cross building in Austin is on a tower that needs maintenance. We have a lot of stuff on the tower and the rotor for the main beam needs replacing, as well as feed lines and about a dozen smaller antennas. It has finally cooled off a bit, so the tower work can be done without frying the tower workers. (*Editor's note:* It gets extremely hot in Texas in the summer and that must be taken into consideration when planning to do any antenna work!)

The American Red Cross is working off loans to operate now and needs donations. They did all they could to help during Hurricanes Katrina and Rita and they went more than broke helping in these disasters. So we need to do what we can to help with the tower there, as they are living on credit at the moment.

Hurricane Ike was handled differently and ham radio involvement was limited. The participation of the Red Cross was different as well. All of the background-check stuff is causing hams who have worked maintaining Red Cross and Emergency Operations Center (EOC) ham shacks to tell the agencies to "shove it" when after decades of service, they are being treated like criminals. Therefore, more of the work is done by hired hands with minimal background checks.

When I worked for the McDonald Observatory, my office mate on the UT campus in Austin went to work for the NSA. They did a background check. This stuff of the Red Cross and other agencies is more a cynical attempt to put a sub-contractor between them and any liability of a worker having a criminal history.

Over 20 years ago, the NSA spent over $20,000 checking out my office mate. The Red Cross spends $7 on a "background check." Apples and oranges or whatever—it is fruitcake to compare the two, and terribly misleading. I "throw rocks" as much as anybody, but I feel it is important to try to then close the loop and figure out what can be done to help, after all the dirty cards are on the table.

Anyway, we are looking into setting up HSMM stations for shelter logging, on a somewhat expanded scale of how we have used HSMM to do Field Day logging for the past three years.

The idea is that we drop off the HSMM gear at a shelter, get it on line, and then clear our potentially criminal butts out of the shelter and just collect the data over the mesh network. This circumvents us being physically present at the shelters, except to set up the gear. We never have enough hams to man 60 shelters 24/7 for days on end anyway, but we could make a go of it with HSMM mesh links between shelters.

We hope to set up a few demos of the con-

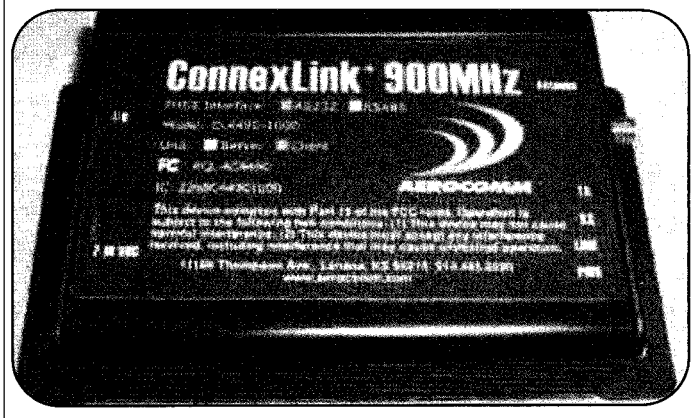


Photo A. The AeroComm 900-MHz, 1-watt modem.

cept with links between some of the most often used shelters in the area and invite potential served agencies to see what we can do, if allowed to deploy the gear. We have to demo the gear so we are part of the plan ahead of time. Once a disaster is under way, you cannot bug the administrators with new experiments; they have to go with what they have. Hopefully something will come of the demo effort, as ARES disaster support for served agencies has really changed as of Ike.

Thanks to Glenn, KD5MFW, and the RMG, I will report more on the Austin HSMM SIG next time and their cutting-edge mesh networking breakthrough! You will find their amateur digital video (ADV) and VoIP telephony experiments especially interesting.

de KB9MWR

Steve Lampereur, KB9MWR, of Green Bay, Wisconsin, reports that with the AeroComm 900-MHz, 1-watt units (photo A) his team has observed solid non-line-of-sight mobile coverage for 3 miles. This is with a base station at 35 feet into a 6-dBd omni antenna and a magnet-mounted antenna on the car. There is mobile coverage up to 6 miles, but it is not as solid.

The AeroComm CL4490-1000 ConnexLink is a 1-watt, 900-MHz Frequency Hopping Spread Spectrum (FHSS) RS-232 transceiver. The individual transceiver is available from Mouser Electronics (Part No.: 814-CL4490-232-C) for approximately $110 (http://mouser.com/>. Experimenters may wish to pick up the starter pack, which includes two transceivers, software, cables, and rubber-duck antennas (Part No.: 814-CL4490-232-SP) for approximately $225.

The actual RF module itself (AC4490) can be bought for $62 (Part No.: 814-AC4490-200M). The complete AeroComm CL4490 transceiver includes the AC4490 module housed in a nice aluminum case with an internal switching power supply and the necessary RS-232 to TTL conversion circuit. The antenna connection is via a Reverse Polarity SMA (RP-SMA). The CL4490 also includes four handy LEDs, which indicate DC power (PWR), link establishment (LINK), when it is receiving (RX), and when it is transmitting (TX).

Digi-Key (www.digikey.com) sells a handy "SMA Reverse Polarity Plug to SMA Jack" (Part No.: ACX1248-ND) adapter, which changes the CL4490's reverse polarity SMA connector into a normal SMA connector. To obtain specific details on network configuration go to: <http://www.qsl.net/n9zia/aerocomm>.

Until then, keep doing those radio experiments!

73, John, K8OCL