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High-Speed Networking: Time to Net Its Benefits

Amateurs are using the microwave region for public service broadband applications.

An example of adapting technology to support amateur public service communications appeared in the July 2013 *QST* article "A Broadband Ham Network Crosses the Finish Line."[1] It explained how amateurs established a microwave network to carry a video image.

With detailed planning, path plotting, and simple, inexpensive equipment, they solved a problem, and garnered excellent experience. The implications are profound for those of us interested in adding tools to our disaster response communications tool box, and providing enhanced capabilities for our served agencies.

At the heart of the solution is a high-speed multimedia network composed of nodes made from readily available, inexpensive consumer Wi-Fi routers. No internal hardware modifications are needed, only software from **www.broadband-hamnet.org**, which converts the router to a mesh node. Each node is self-configuring, automatically locates other nodes within its range, and routes data around faults. These household routers have a power output of 85 mW. With an Amateur Radio license, amplifiers and better antennas can be added to greatly increase the range.

Last year, ARRL® reported on the Broadband-Hamnet firmware developed by Amateur Radio operators to provide hams with a high-speed digital wireless communication mesh network. This development won both US and global awards from the International Association of Emergency Managers (**www.arrl.org/news/broadband-hamnet-wins-international-association-of-emergency-managers-awards**). The network uses Linksys WRT54G/GL/GS wireless routers operating in the 13 centimeter band.

Amateur's Mesh Embraced by Emergency Management

Last year, ARRL Virgin Islands Section Manager Fred Kleber, NP2X/K9VV, reported that mesh networking was brought to his section and it has spread like wildfire. At the time of Kleber's reporting, there were three dozen nodes in the USVI and more are coming online quickly. "We found a source for 'rootennas' (outdoor router-antenna combinations) and are in the process of building up those for permanent deployment in strategic locations, ie, attended locations with backup power, particularly at radio amateurs' home sites," Kleber said.

A demonstration of mesh network capability was given to the local EMA, VI National Guard, Transportation Security Administration (TSA), E-911, and VI police. "It was well received and we are moving toward designing systems to provide backup voice/data/video communications at key locations: the EOC, E-911, shelters, points of distribution, airports, and marine port," Kleber said (**www.arrl.org/ares-el?issue=2012-09-19**).

I asked Kleber for an update and he reported, "We're focused on renewing those efforts with the new year. It's still on the radar screen. The latest thing is trying to get a couple of VoIP phones working so we can have a 'hotline' between islands."

Amateur Mesh for Hospitals, EOC Proposed

In Volusia County, Florida, a sophisticated proposal to hospital administrators to network the major hospitals in the county for backup emergency communications was proffered by Volusia ARES®. It was dubbed *The Volusia Mesh* and, in a *PowerPoint* presentation, the proponents asked "Is it possible to use RF to send and receive data at Internet speeds on ham radio frequencies without expensive radios? Is there one piece of free software hams can access via RF and/or computer networks where multiple users can: send and receive Winlink 2000 (**www.winlink.org**) and Internet e-mail, engage in real-time chat in groups and private channels, and share files?" Yes and yes, were their answers.

Their proposal to link the hospitals in the county was enhanced by a link to the county EOC, all by line of sight radio using horizontally polarized 24 dB gain 2.4 GHz para-bolic dishes. A Winlink 2000 HF gateway, a VHF RMS (Radio Mail Server) gateway, a D-RATS *RatFlector* (**www.d-rats.com/documentation/4howtos/29-running-your-own-ratflector**) platform, Internet e-mail and Winlink 2000 (WL2K) Telnet capabilities rounded out the proposal.

At the EOC end, current EOC service offerings are limited to more traditional analog and digital VHF\UHF modes, HF voice nets, and a WL2K capability. Potential additional EOC service offerings under the proposal would include the D-RATS *RatFlector* providing live chat, messaging, and file transfer via Internet, Broadband-Hamnet and D-STAR, an Internet gateway to WL2K via D-RATS Telnet, SMTP Internet e-mail forwarding via D-RATS from RF and mesh-connected D-RATS stations, and mesh web server for form and information distribution. The ARES proposal also includes point to point server-less video chat. The principal architect of the proposal is retired Systems Engineer and IT Manager Mark Friedlander, KV4I.

Mexico and US High-Speed Networks Merge

Accordingto Mike Burton, XE2/N6KZB, the Radio Club of Baja (CREBC) Mexico and the Coronado (California) Emergency Radio Operators (CERO) have reached a

[1] L. Jelinski, AG4IU, "A Broadband Ham Network Crosses the Finish Line," *QST*, Jul 2013, pp 68 – 69.

milestone in their efforts for cross-border networking. The merger of their two networks will support high-speed emergency communications on both sides of the San Diego-Baja border.

The CERO network on the US side features a 2.4 GHz Ubiquiti (**www.ubnt.com**) system for emergency communications support using a satellite Internet tie-in. This network has more than 20 nodes connecting member-homes as well as access points at a local fire station and the Coronado Hospital.

On the Mexican side, CREBC uses a 5 GHz wide area Ubiquiti network to link the club radio sites for Internet and security camera use. This network has more than 40 nodes. It allows multiple Winlink gateways to access a common RMS relay point to the XE2BNC HF tri-mode station. Another gateway is also tied in via the 5 GHz backbone to support a VHF Winlink gateway and a local mail drop. The system allows e-mail to continue to flow when the Internet is down.

Burton said the two networks were connected at a common radio site that sees the CERO hub on 2.4 GHz about 15 kilometers away across the border (see Figure 1). A 5 GHz Ubiquiti links the Mexican side. Local routers handle the need for multiple Wi-Fi access and computer connectivity.

The CERO group is now able to re-direct their Winlink gateways to the XE2BNC RMS relay, and take advantage of HF Pactor auto-forwarding should area-wide Internet fail. The connection site and both groups' hub sites are battery backed up and secure. The total distance linked is more than 45 kilometers.

Any data source that is IP (Internet Protocol) addressed can be employed. For example, the CERO group on the US side has IP cameras with views now visible from Baja. Conventional *Skype*-style communications are also possible over the system.

A laptop computer LAN connected at any access point can use RMS Express to connect over the LAN to handle Winlink-based e-mail. A private LAN e-mail application allows large files and photos to be shared between emergency communications groups. Voice over Internet Protocol (VoIP) and video will be available once all is completed. As conventional mesh nodes and groups are established, they can be connected to the CREBC-CERO network.

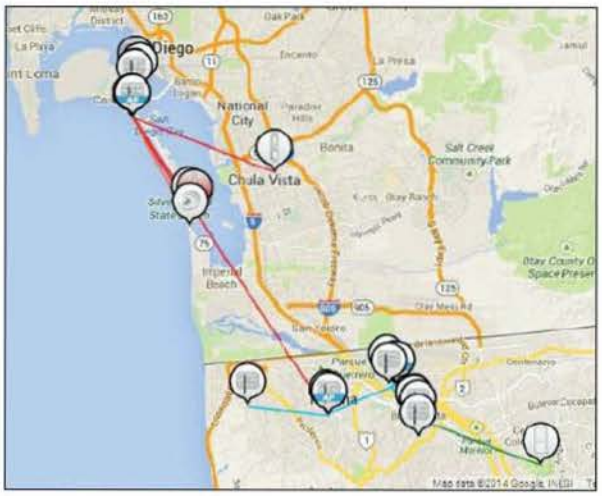

Figure 1 — Access Points on the CREBC-CERO High Data Rate EmComm Network [Edgar Sack, W3NRG, image]

The original concept was simply to improve regional communications for emergency/disaster response support. It has morphed into a reliable wide area system that can augment normal communications. While it is Winlink connectivity based, it has become much more applicable for today's high-speed data needs and environment.

Ed Sack, W3NRG, of the CERO Wi-Fi Committee, commented, "We are not mesh in the conventional sense of that word, but in a sense more like the 'long lines division' (to use an old AT&T term) and we install and manage the 'spokes' to the 'neighborhood nodes.' Our 'clients' set up a link from their location to one of these nodes." Burton summed it up by saying, "Anything you can do over the wired Internet, you can do over our emergency communications LAN and our LAN will be up when the wired Internet is down or overloaded."

Sack reports that their initial target clients are the San Diego County hospitals, which are served by ARES during the twice yearly health services emergency drills. "During those drills we practice using the network to send photos and video, which, of course, could not be handled by conventional 'packet' modes," he said. "We have now added VoIP so that eventually our network can handle the HF, VHF, and UHF voice communications used in those drills as well."

History and Evolution of a High Speed Network

The origins of the CERO system stemmed from the use of flashed Linksys routers to set up mesh style networks that provided high-speed backup communications for hospitals and other public facilities.

When a system was deployed in the Coronado community, it was found that the topography between members' locations would require amplifiers and high gain antennas. Accordingly, the group began to experiment with the Ubiquiti line of commercial antennas/radios for setting up a CERO experimental 2.4 GHz network. While the attractions of the mesh approach were appreciated, it was felt that the best initial architecture for the CERO footprint was a "spoke and node" structure, on which mesh cells could be superimposed at a later date.

The club radio room is located atop a 150 foot condominium tower. It was selected as the center of the CERO spoke and node system. Spokes reached out to nodes at distances up to 12 miles away. Some include nodes established at the Sharp Coronado Hospital, and a Coronado Fire Station. Cameras to demonstrate the network were mounted on the condo tower.

Another demonstration connected members together on the network and employed a commercially available video phone application to demonstrate the audio/video possibilities. The network has been used and will continue to be involved in local emergency communications drills.

Bandwidth being the major reason for installing a 2.4 GHz network, after some research, we found a software product that allows us to transfer very large files across the network at very high speed.

Much work remains to make the CERO 2.4 GHz emergency communications network fully operational. Spokes need to be established deeper into areas where there are many emergency communications stations. The software for VoIP and streaming video needs to be tailored to emergency/disaster requirements. The end objective is a greatly enhanced emergency network for the community.