AREDN Mesh Tunnel via Satellite at Baker 2 Vegas 2018

Setting up the communications system at this large annual event.

Oliver Dully, K6OLI

From March 17 to 19, 2018, Dave Gross, W6JDG; Brian Kanegawa, KM6IGY; Tran Huynh, K6NHI, and Oliver Dully, K6OLI, helped support the Baker 2 Vegas Relay Race (**bakervegas.net**). The relay race takes place every spring, starting in Baker, California, and ending in Las Vegas, Nevada. Covering 120 miles, and with 8,000 runners, there needs to be a lot of communications support. Our ARES LAX Northeast District Mesh group was stationed at Stage 8 of the race (located 6 miles east of Shoshone, California), which happens to be a great location for emergency communications testing, because there are no cell phone towers, water, or electricity nearby. Radio operators have to be completely self-sufficient.

Amateur Radio Emergency Data Network (AREDN) mesh connections are mainly used with MeshChat, Voice over Internet Protocol (VoIP), Winlink, shared data storage, and cameras. These mesh connections are line-of-sight, thus presenting a geographical challenge because Stage 8 is obscured from Mile Out by steep hills (see Figure 1).

We successfully created and tested a local area mesh network (see Figure 2), using four full mesh go-kits, which included AirRouters HP with 9 dBi TP Link antennas, 2.4 GHz and 5.8 GHz

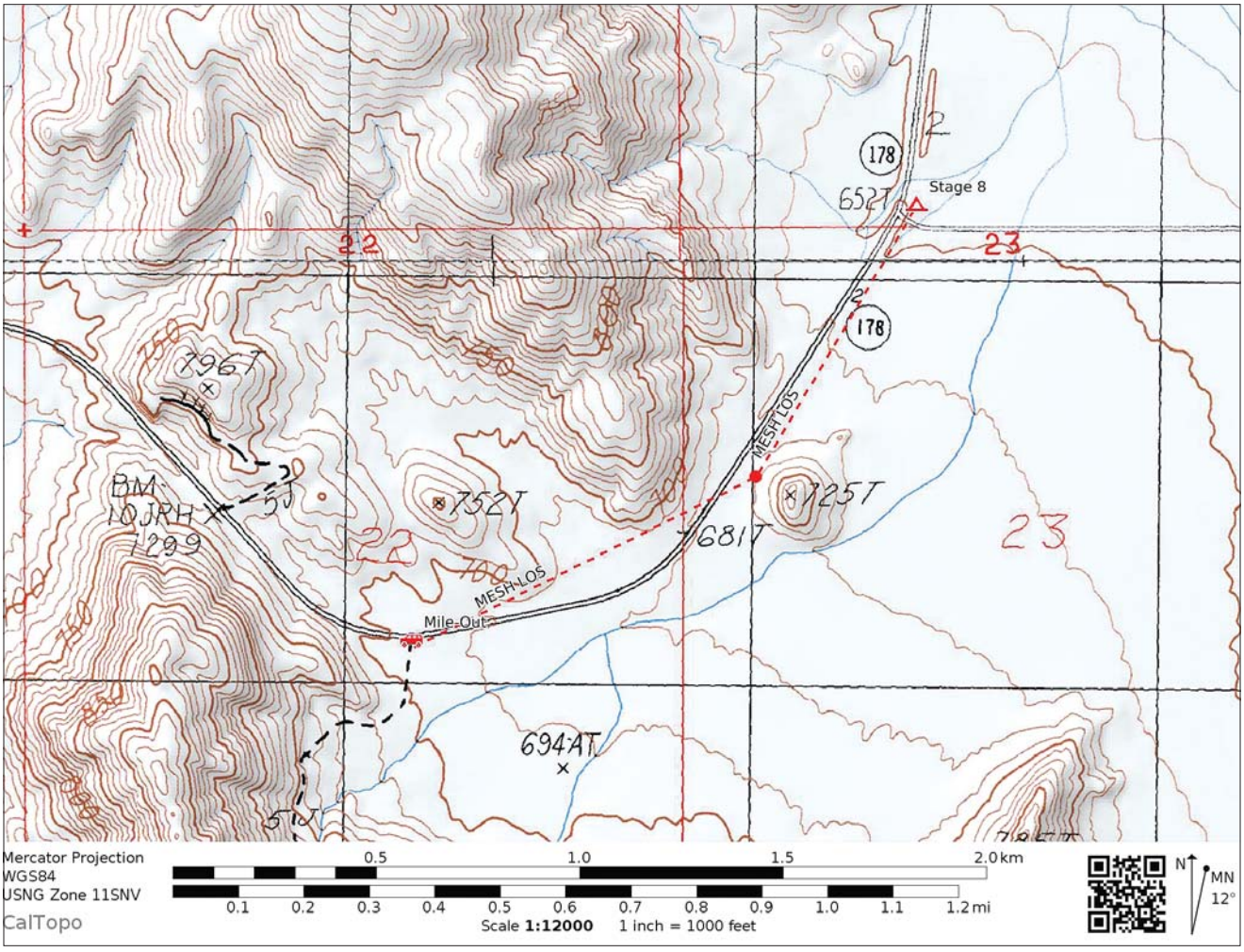

Figure 1 — A map to show the topography around Stage 8 and Mile Out.

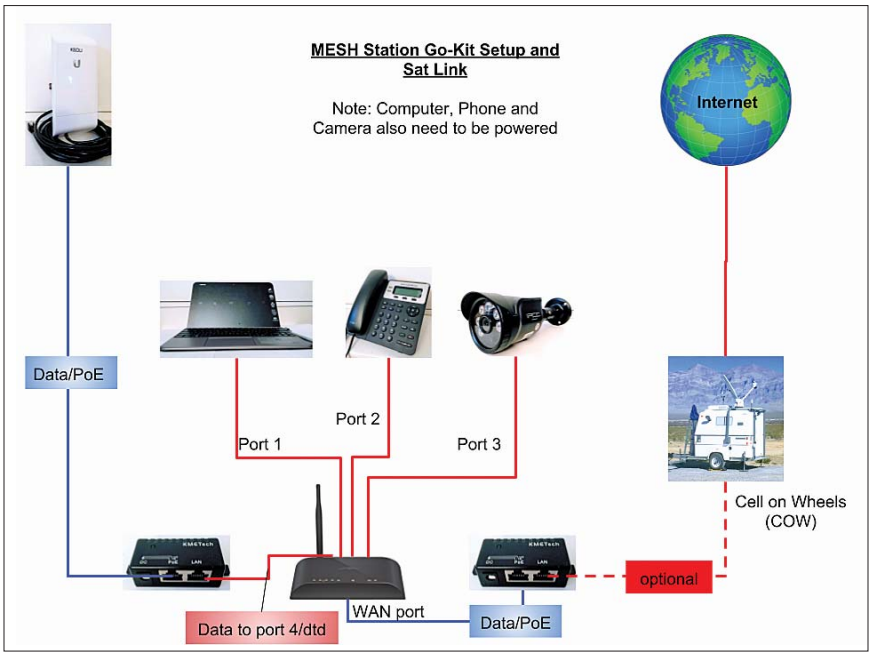

Figure 2 — An example of an AREDN mesh go-kit, which was employed at Stage 8.

NanoStations Loco and NanoBeams, a GL.iNet travel router (to bridge between the AREDN mesh and a Mac computer), VoIP phones, IP cameras, and laptops. The kits were powered by Bioenno LiFePO4 batteries, solar controllers, and solar panels.

A Stellar Opportunity

This year, Curtis Mentz and his Verizon Crisis Response Team deployed Cell On Wheels (COW) trailers at Stages 8 and 9. COWs are mobile communications units that provide localized cell phone coverage, as well as wireless and wired network access, all via a satellite connection to a commercial geosynchronous satellite. Connection speed can reach up to 20 Mbps.

We used the internet connection through the COW to test a wireless bridge connection. We configured Tran's, K6NHI, travel router as a bridge, meaning it received the Wi-Fi signal from Verizon and passed it on through the LAN port of the travel router to the WAN port of an AirRouter HP (see Figure 2 for a more detailed view of the connections). From there, all the connected local AREDN mesh nodes could connect and share the internet connection.

Around noon, we turned off our local mesh and just kept the AirRouter HP and its attached computers running. We then switched from Wi-Fi to a wired ethernet connection, which linked one of the Verizon router LAN ports to the WAN port of the AirRouter HP.

Ease of Use

Amazingly, the setup was not difficult. For the wireless connection, we only had to connect to the SSID and enter the password in the appropriate settings of the travel router, then connect the AREDN node to the LAN port.

For the wired connection, Curtis simply identified an unused LAN port on the router, located in the COW, and we connected that with an ethernet cable to the WAN port of the AREDN node, in this case the AirRouter HP.

In both cases, the external router DHCP assigned an IP address to the connected AREDN mesh node.

Tunnel

AREDN is cleverly designed as a local area network, which allows Amateur Radio operators to create an ad-hoc Emergency Data Network with a myriad of resources. At our isolated location, a direct connection to the Southern California AREDN mesh had been beyond reach, but the COW allowed for the opportunity to set up a tunnel for the AREDN mesh nodes to connect to one another via the internet, as if they were connected via RF.

With our AirRouter HP as the tunnel client, we connected our local Stage 8 AREDN mesh to a tunnel host node in Pasadena. From there, we connected to the entire Southern California Amateur Radio Emergency Data Network mesh with all its resources: Winlink Gateways, VoIP phones, file servers, and more. We then had Dave, W6JDG, and Gary Wong, W6GSW, who is the ARES LAX Northeast District Coordinator, test the connection, and they both confirmed the high quality of the link (see Figure 3).

Game Changer

The combination of AREDN mesh and COW set a positive precedent for the future of disaster communications and the Amateur Radio Emergency Data Network. Within the ARES LAX Northeast District group, we have expanded our AREDN mesh capabilities over the last year. Our goal is for all interested operators in our District to provide AREDN mesh capability in addition to VHF/UHF and HF voice and data services when deployed, especially to hospitals, which could instantly share a connection to the outside world via satellite with just one COW at any mesh-connected hospital. Moreover, the hospitals would have instant high-speed access to many Amateur Radio services, such as Winlink, VoIP, or file sharing.

Training Implications

After seeing the results from our AREDN mesh experiments in the desert, we have begun further development of AREDN mesh nodes by training Amateur Radio operators on the effective use of nodes and standard operating procedures for

Figure 3 — Dave Gross, W6JDG, demonstrating the tunnel connection. On the left side of the computer screen, the SoCal AREDN mesh nodes are clearly visible.

AREDN mesh use, and we continue to develop our capabilities.

Winlink has also grown exponentially in importance, providing Amateur Radio operators the ability to send and receive emails across bands using multiple modes, both via gateway and peer-to-peer connections. Moreover, when Winlink is paired with *Linphone* (an open-source VoIP software) on a laptop on mesh, it becomes an all-in-one solution for high-speed voice and data on the Amateur Radio Emergency Data Network.

Force Multiplier

A public/private cooperation between Amateur Radio and COW operators extends capabilities and increases Amateur Radio operators' crucial role as force multipliers in any disaster. Mesh nodes are quick and easy to deploy, offer higher data rates, use very little power, and offer more room for interoperability. With only a few COWs, AREDN mesh clusters can connect via satellite and potentially overcome topographical challenges like mountain ranges, valleys, flood zones, and more.

Amateur Radio operators could also work more productively with any similar satellite connection provided by any company, governmental organization (e.g. FEMA), non-governmental agency (e.g. SATERN), or even the military. It also demonstrates that Amateur Radio is a modern service that can focus on the needs of served agencies and its served communities.

The Amateur Radio Emergency Data Network is an important part of our already impressive capabilities in VHF/UHF and HF, and it will provide valuable and meaningful service to our communities when their need for Amateur Radio operators is greatest.

Oliver Dully, K6OLI, is an ARRL member and the Training and Education Coordinator for the ARES LAX Northeast District. An Amateur Extra, licensed since 2016, he is especially interested in digital modes. With his ham friends, Oliver regularly conducts workshops on Ham Basics, NBEMS, Winlink, AREDN mesh, and emergency communications in the Los Angeles area. Oliver enjoys interacting with hams from around the world and helping new hams find their way. Oliver can be reached at **k6oli@arrl.net**.

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