Mesa County ARES Communication Support for
The UTMB/Ironman Desert Rats Running Festival
Bill Tillery KØDZ

At the recent UTMB/Ironman Desert Rats Running Event from Mack, CO to Western Rim in UT, Mesa County ARES deployed to provide communications support to UTMB/Ironman race officials. Every year we use the Desert Rats race as a test bed for new technologies and to practice field deployments. This was our most comprehensive communication systems deployment to date. Read along for the story.

The Plan

UTMB/Ironman hosts running events all over the world, and for most other races their cellular-based POC radios are sufficient to provide comms to Race Aid Station locations. But in our area, there is spotty cellular coverage at best. So, FM Voice communication over the WestCO Repeater System has always been the primary method to provide communications support to the UTMB Race officials between Aid Stations scattered from Mack to Western Rim along race routes from 10k to 100k (62 miles). Even then, this year, Keri N2KNK had to deploy two portable repeaters as fill-in to provide rock-solid FM Voice to all Aid Station locations.

The WestCO Repeater System

The core capability for ARES communications during the races was the WestCO Repeater System, owned, built, and maintained by Keri N2KNK. This repeater system covers much of the Western Slope and can be accessed via AllStar as well. Keri deployed two portable repeaters during the UTMB races to provide fill-in coverage to aid stations in low-ground positions.

Keri N2KNK setting up the portable comm trailer, containing portable repeater, APRS digipeter and Meshtastic node, with a full solar and battery system.

Keri's second portable repeater site, including Meshtastic node.

AREDN

As a way to test new capabilities, I suggested that this year we deploy AREDN in the field to practice with and to evaluate our AREDN services. I built 4 AREDN stations consisting of Mikrotik HAP AC Lites (with GPS) and IP telephones to place at Start/Finish, Rustlers, Rabbit Valley, and the Western Rim Aid Stations. The Start/Finish and Western Rim stations would be equipped with IP-based video (More on that later).

AREDN excels at ad-hoc deployments using dish-dish microwave links, but distances are vast on the racecourse, so we decided to "cheat" by using Starlink to link the Aid station locations back to the AREDN

Mesh in Grand Junction, and also as way to test Starlink suitability for use with AREDN. This would serve to simulate a widespread internet outage where Starlink was still working.

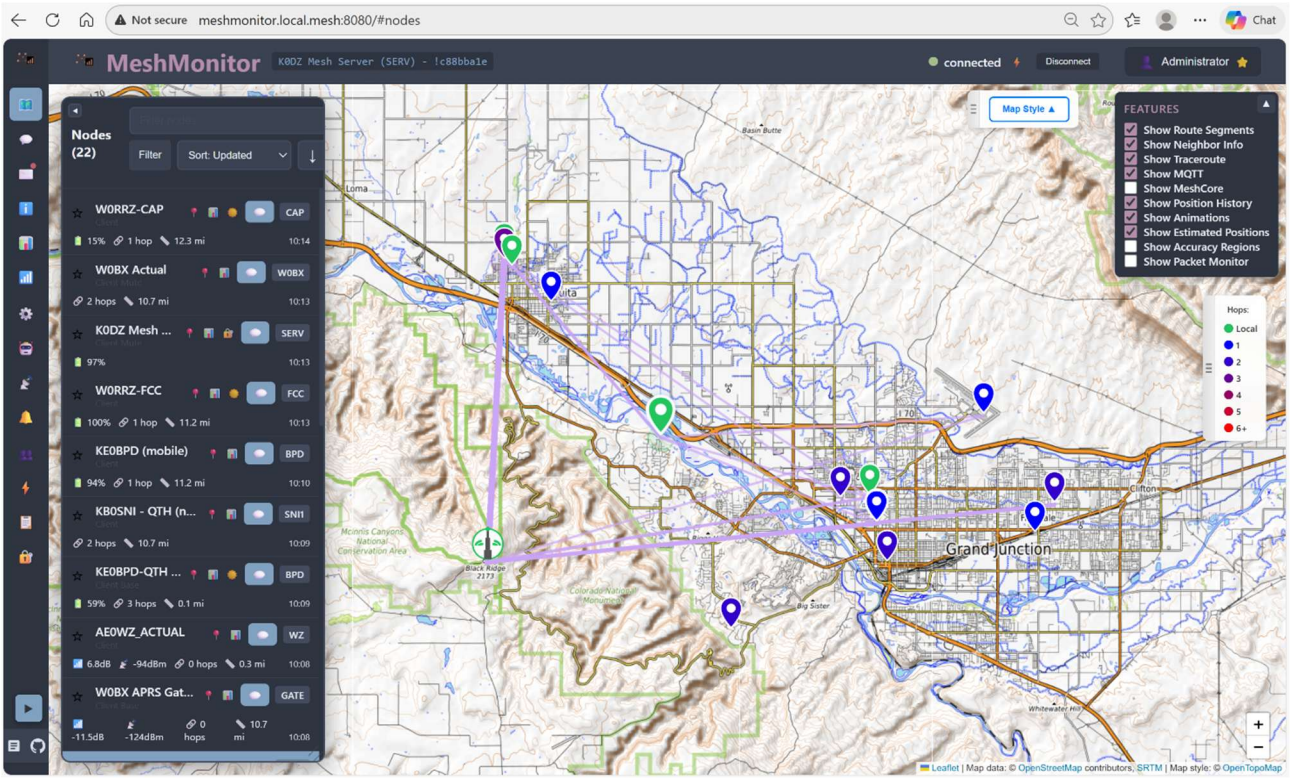
AREDN can use Wireguard Tunnels to connect distant nodes, but Wireguard requires correct time at each end of the path in order to form tunnels. To be absolutely sure of correct time, I installed GPS dongles and the appropriate software packages on each AREDN node used in the field, and the four AREDN stations were tested over Starlink a few days prior to the races to ensure success. Special thanks to Andrew AEØWZ, Mark KFØNYB, Henry KBØSNI, and Steve KEØBPD for getting that done!

During the weekend when AREDN-equipped Aid Stations were active, those stations could make IP phone calls to Start/Finish and to each other, as well as monitor RaceCommand, the Computer-Aided Dispatch, video streams and Meshmonitor.

Meshtastic

Meshtastic is great for off-grid texting, but it also can be used for positioning. Meshtastic nodes with built-in GPS can provide real-time positioning data, while nodes without GPS can still be set to static positioning.

Chip NØWKR, Steve KEØBPD, and I gathered and configured 14 Meshtastic nodes to use for tracking during the races, and many Hams brought their own Meshtastic devices during their Aid Station shifts. Keri ran Meshtastic nodes at the two portable repeater sites to improve coverage, and several Aid Stations ran nodes to also improve coverage. Meshtastic data was monitored in Fruita with my Meshmonitor Server (shown below).



Meshmonitor send traceroute commands to all nodes on the Meshtastic Mesh (distinct from the AREDN Mesh) and maps the routes that Meshtastic nodes use to communicate. Meshmonitor also serves position information over the AREDN Mesh, which allowed Ryan to pull Meshtastic positioning information into RaceCommand (see below).

APRS

The Automatic Packet Reporting System (APRS) on 144.390 is great for sending position reports and we used APRS during the races. To improve coverage, Keri installed a two-way iGate in her communications trailer. The iGate acted as a digipeater for APRS, as well as bridged APRS to and from the internet. Keri then towed the trailer to the race location to provide both a fill-in voice repeater as well as APRS coverage.

I run an APRStastic server in Fruita. APRStastic provides a way to register a Meshtastic node (based on its MAC address) to a corresponding callsign and then sends that information to APRS-IS on the internet. Sites like APRS.fi can then display Meshtastic nodes as though they were coming from 2-meter APRS radios. APRS messages can flow in both directions as well. You can send an APRS message from your Kenwood/Icom/Yaesu radio straight to a Meshtastic node, and the user can respond back to you!

I assigned each Meshtastic node used for UTMB tracking a WØRRZ-SSID callsign. And with a little fiddling with the APRS iGating rules, WØRRZ callsigns from Meshtastic began appearing on 2-meter APRS!

Ryan was able to pull any relevant APRS callsigns and specifically the WØRRZ callsigns directly from the APRS-IS backbone and feed them into RaceCommand. His software automatically filtered any duplicates.

Position reports could flow on the:

- Meshtastic --> Meshmonitor --> RaceCommand path,
- Meshtastic --> APRStastic --> APRS-IS --> RaceCommand path,
- 2-meter APRS --> APRS-IS --> RaceCommand path.

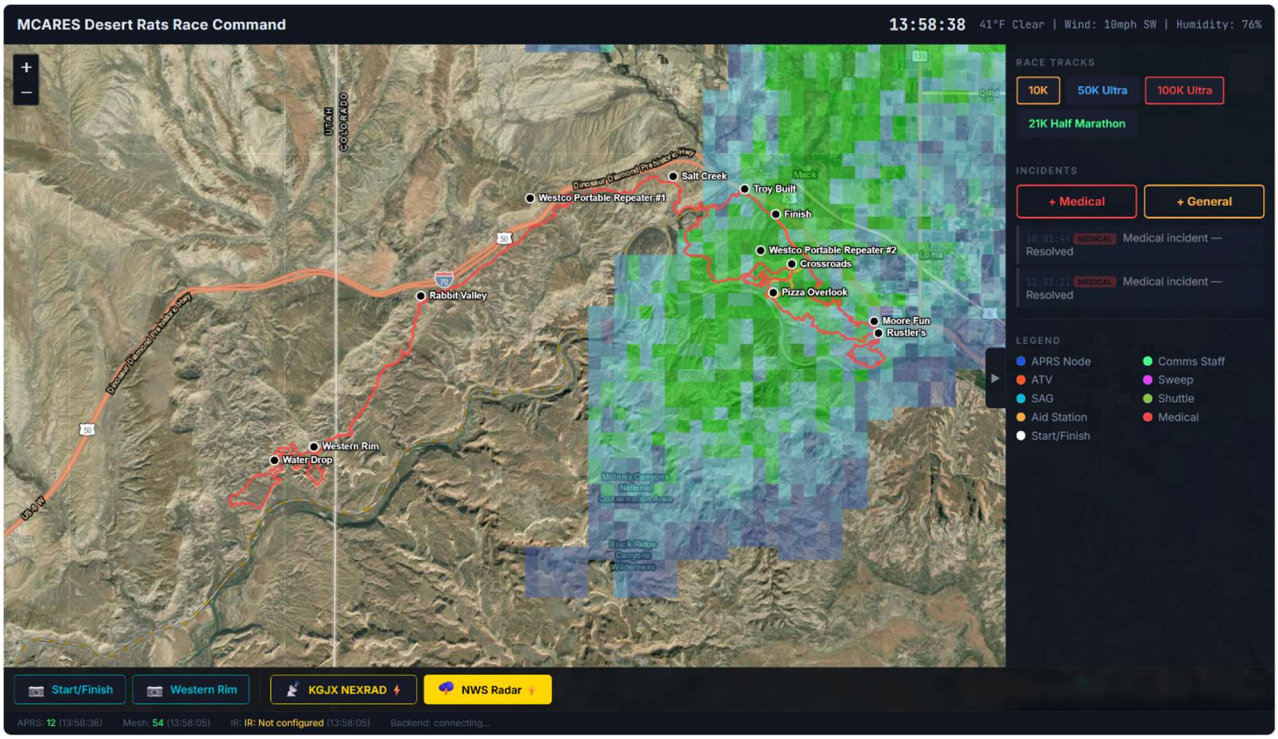
AI - Artificial Intelligence

Just three weeks prior to the races, Ryan KFØVMF approached Chip NØWKR and I to suggest he build out some custom apps to use during the races. Not being aware of his capabilities, we thought it would be better to build those apps for next year's races but encouraged him to do what he could and that we would run his apps in parallel with our existing software. We were stunned when he showed us a working prototype of his RaceCommand software just three days later!

Next, Ryan built a video server that would handle bandwidth limitations of the AREDN Mesh (AREDN is fast, but not nearly as fast as the internet!) and A Computer-Aided Dispatch console!!

Here is a screenshot of Ryan's RaceCommand App as used during the races. RaceCommand was running in the Comms Trailer and was available over the AREDN mesh to all AREDN-equipped Aid Stations as well as any AREDN node on the entire Mesh! Capabilities included:

- Full pinch & zoom mapping, with on and offline maps available.
- GPX race courses switched on and off manually, or automatically (by AI, based on race start/stop times).
- Video from IP cameras could be pulled up with a button click.
- Aid station locations were plotted, along with real-time positioning of Hams and Tracked assets via Meshtastic and APRS
- Medical or general incidents could be plotted on the map
- NEXRAD and local weather radar overlays could be switched on and off as-needed (and they were needed!)

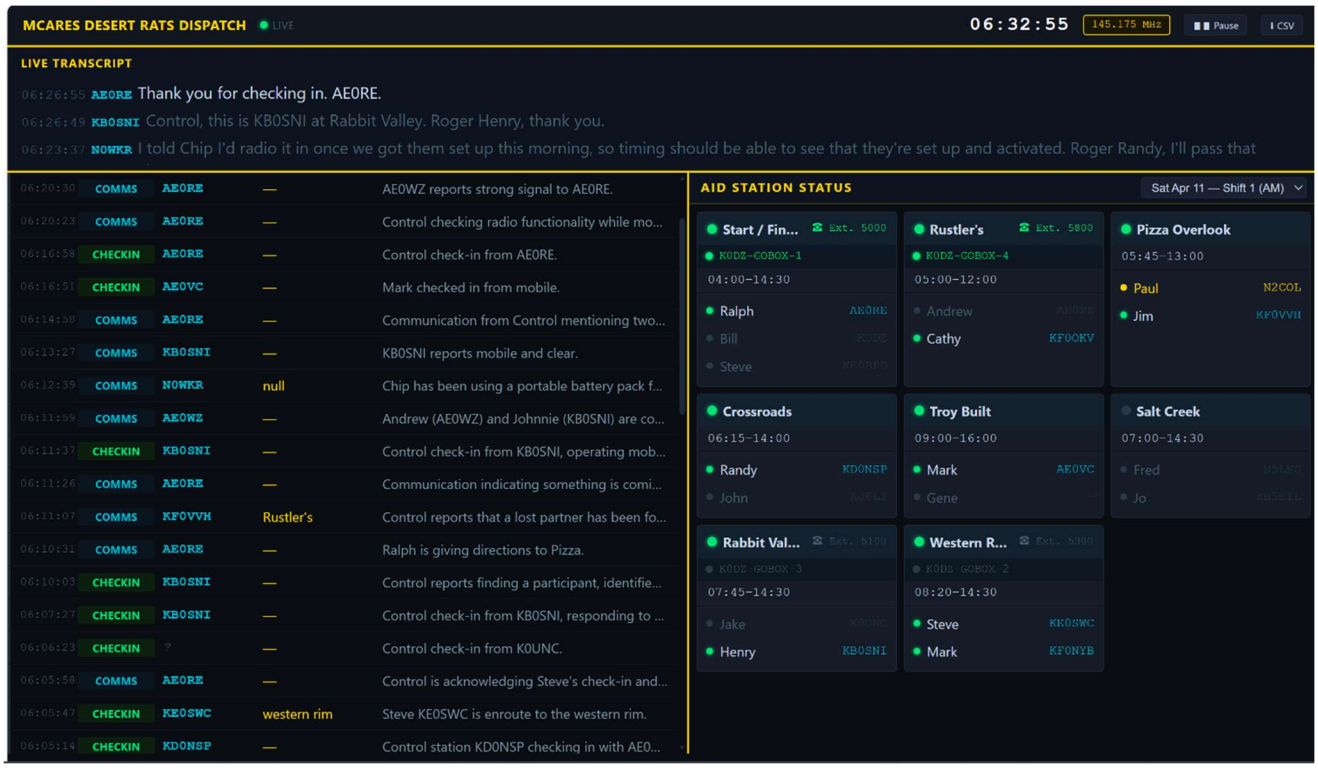


RaceCommand was an amazing capability! And the true magic is that when Ryan used AI to help code the app he built AI into the app itself so that he could make changes and improvements on-the-fly, even while the app was running!

During the races, we learned that UTMB had just acquired some Garmin InReach Satellite tracking devices with which to equip some of their personnel. Ryan was able to code the backend software necessary to import the Garmin tracking into RaceCommand in real time. Absolutely incredible!

Computer-Aided Dispatch with AI

Any time ARES is activated, an ICS-309 is started. The ICS 309 is a hand-written record of the communications Net Control makes with all stations. Ryan felt he could contribute to that effort and so he built another app, a Computer-Aided dispatch console enabled by AI-voice to text transcription as well as automated Aid Station status!



The dispatch console listened to radio traffic on WestCO and provided the following:

- Word-for-word transcription of each radio transmission
- AI-generated summary of each conversation
- A .WAV file recording of each transmission so we could verify any traffic of which we were unsure.
- Automatic tagging of audio-of-interest, including Check-Ins, Medical or Logistical incidents, and Did-Not-Finish (DNF) of any runners, including bib-numbers.
- Ability to print a PDF for all DNF runners to be handed to UTMB Race Officials
- AI-assisted status of all Aid Stations

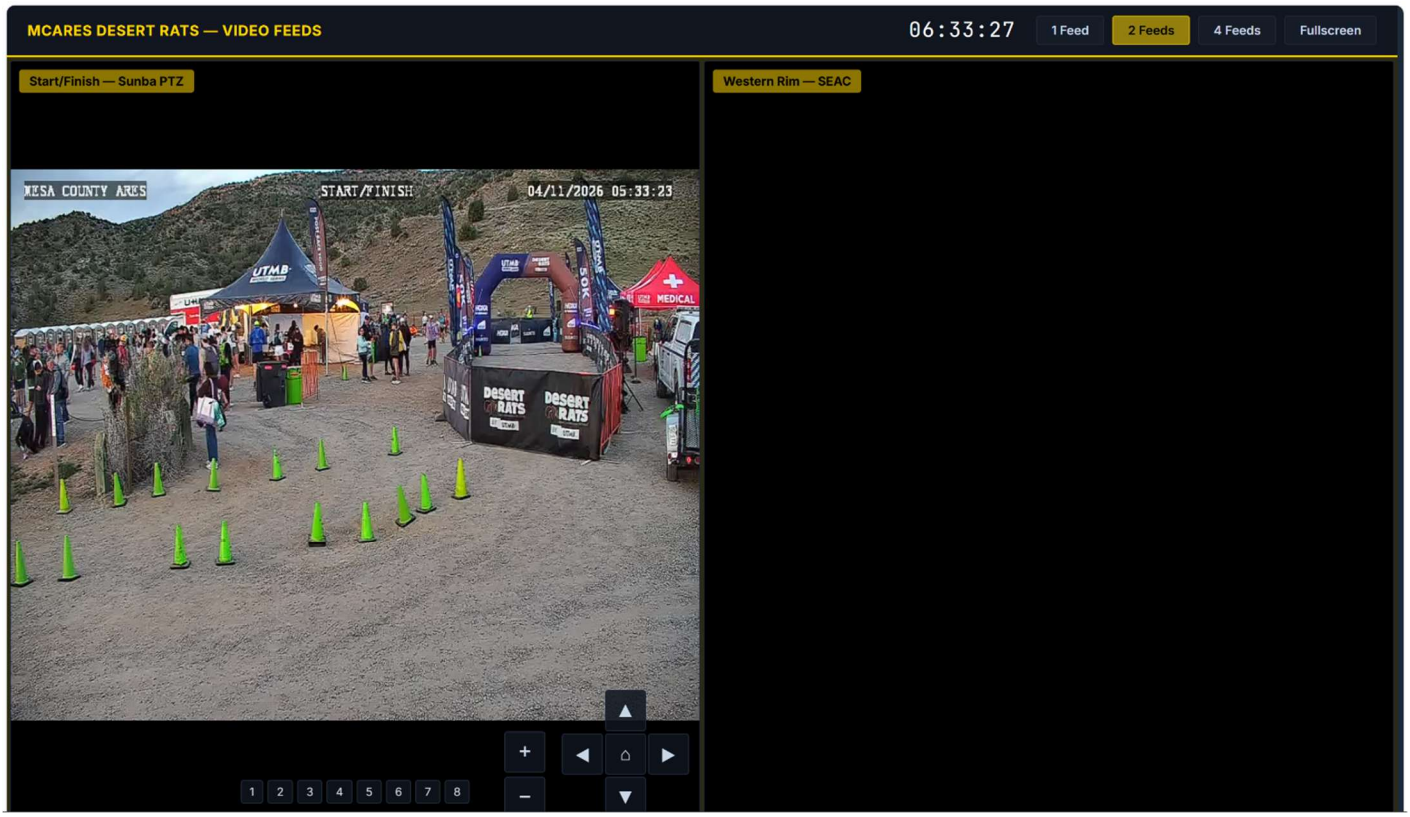
The AI CAD was aware of the race schedules and the approximate times each Aid Station was to be occupied. As various hams reported to the race, the Aid Stations changed from black to green and each Ham's status changed as well. Any time an AREDN node became active at any Aid Station, its status appeared in green along with the IP-telephone extension of that station.

All of this information appeared automagically (you read that right!) with no input from Net Control. If we needed to review any previous transmission, we could immediately scroll back through the dispatch console to verify.

As this was a very new capability for us, the paper ICS-309 was used throughout the weekend with the CAD system as backup.

VIDEO Streaming

AREDN is extremely fast compared to all other Amateur radio data systems but is not as fast as raw internet. To allow seamless transmission of high data rate services such as video, Ryan built a multi-stream video server for use during the UTMB event.



The server could distribute video from four sources, including drones.

Video quality from all sources was superb, including this view from the far end of the 100k (62 mile) race course at Western Rim in Utah.

An Interesting Incident

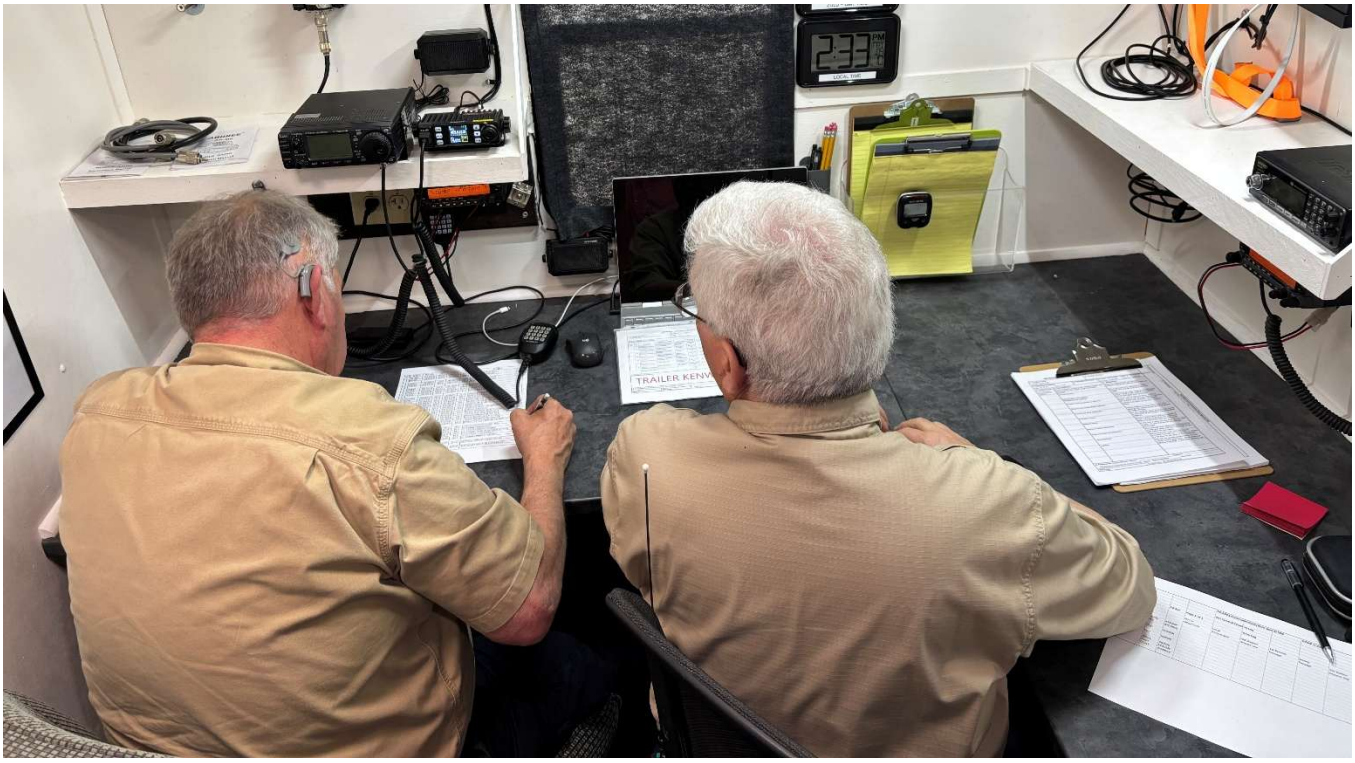
Western Rim is the most remote Aid Station on the UTMB Race Course, and three UTMB vehicles were making their way to Western Rim when one of the vehicles sustained minor damage while attempting to cross a washed-out area of the "road". Because of that, UTMB began discussing moving the Aid Station. Then they realized that our ARES folks were already at Western Rim. I asked if they would like to speak with our people about how they reached the site. They agreed and I simply called Western Rim with an IP phone and handed the phone to UTMB.

While UTMB staffers were talking with our team I pulled up live video of the Western Rim Aid Station. UTMB folks who had reached Western Rim with a UTV then began talking to the UTMB folks at Start/Finish. And then saw them on the live feed! They were excited at that capability! In fact, staffers were able to assist the UTMB folks at Western Rim with configuring their Race timers by holding up the timers to the camera while getting instructions.

The Comm Trailer

New for this year, ARES was able to borrow a communications trailer Randy KD0NSP and the trailer's owner Goggi spent hundreds of hours building cabinetry, pulling wires, and otherwise outfitting the trailer. And we were the first users!

We had multiple radios for WestCo, GMRS for civilian emergencies, Starlink, AREDN, Meshtastic, etc. inside.



The Radio room housed the Control operator and scribe.

The rear of the trailer housed the AREDN operator and UTMB personnel.

Closing Thoughts

I'm struck by the incredible heart, talent and knowledge displayed by the many, many Amateur Radio operators involved in the planning and execution of this event. By my estimate, the volunteer hours are in the thousands over the last year. Just for the race weekend, Mesa County ARES members logged more than 425 hours in addition to planning and setup that has been taking place for the last year. All equipment used was privately owned, purchased at the expense of the hams involved. We learned so much!

I hope that you will read this article and decide to join us in ARES and come play radio with us!

Best,

Bill KØDZ