Mobile IT Response Units (MITRU)

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Background

- Oregon had 43 active fires in 2020
- The Holiday Farm fire isolated the upper McKenzie river area
  - 20+ miles of power lines, fiber, cable and telephone lines burned
  - Hilltops hosting radio and cellular sites burned
  - Power upriver was restored by generator but NO communications
  - During COVID all school was virtual
  - No radio hampers first responders
  - No phone and Internet means no business and no recovery
  - Cellular COWs and COLTs have significant imitations
  - Volunteers from local WISPs brought Internet wirelessly over Cascades

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The building in the picture is the remains of the Blue River telephone switch that served the valley.

There was no communication at all. All cellular and land mobile radio was down. FirstNet, AT&T, Verizon and T-Mobile brought Cells on Light Trucks (COLTs) and Cells on Wheels (COWs). They had limited range, limited available LTE bandwidth, no support for other MVNO providers (no Tracphone, Cricket Wireless, Mint Mobile, Consumer Cellular, Xfinity Mobile, etc.) and no Wi-Fi. T-Mobile hung a Wi-Fi access point on their vehicle and was able to offer Wi-Fi calling and data for all users of any provider.

The volunteers from Oregon Internet Response are generally owners and employees of various Wireless Internet Service Providers (WISPs). They devised a plan to bring high-speed Internet wirelessly over the Cascades into the upper McKenzie valley. They built very visible orange boxes with wireless bridges and access points to create hotspots for public use. Each box had a QR code to allow simple connections. The bandwidth was sufficient to allow remote schooling. The local TV station had a nice report - https://1drv.ms/v/s!AgFdscwV4Kf5htMj0wH6gnncxJLDVQ?e=Nqb2oZ.

COOP Trailers

- Snohomish County had some available COOP funds
- A small trailer with batteries, solar panels, network gear and supplies could create Internet hotspots that could be expanded
  - Wi-Fi calling is supported on all modern phones regardless of provider
  - Radios provide additional communications capacity
  - Cameras can provide security and situational awareness
  - Large AC inverter can power external loads (lights, charging ability)
  - Generator only necessary intermittently for large loads
  - Internal storage allows tables, chairs, canopies, cables, chain saw, tools, etc.

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After seeing what worked and didn't in Oregon, a plan was developed to create systems to support Continuation of Operations (COOP) with some unused funds. These would offer self-contained power systems, all the capability of the Oregon Internet Response boxes but with multiple sources of Internet and large enough to provide secure equipment storage.

It was expected they would be valuable for more than COOP operations so they wouldn't just sit around. It was unclear how valuable they would become.

Internet Sources

- Cable from adjacent source
- Wireless bridge to nearby source
- Cradlepoint cellular LTE modem
- Starlink satellite Internet
- HamWAN (HamWAN.org)

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The Evergreen State fairgrounds in Monroe brought a cable for our mass vaccination site in Monroe, WA. There was also power so we used some network equipment from a trailer but didn't need the entire trailer (not shown).

The black trailer at the lower right has a wireless bridge (square panel) pulling Wi-Fi from Edmonds College and rebroadcasting (little white rabbit ears on top) in the parking lot with the vaccination site.

The white trailer at the lower left was located at the Arlington airport (AWO) for about 6 months. It is using a large Proxicast LTE antenna at the top of the mast to feed the Cradlepoint modem inside the trailer. The trailer also has a large Ubiquiti UAP AC Pro access point panel and there is a Ubiquiti 60GHz bridge attached to the conex box behind it (small white ball) pulling data from the fiber at the airport office 1km away. Once the bridge was installed, it became the primary Internet source at 280-850 Mb/s with LTE as a backup at about 50 Mb/s.

The black trailer on the top is at the Bolt Creek fire command at the Evergreen State Fairgrounds in Monroe, WA. It has the Starlink dish at the top of the mast with the Ubiquiti UAP AC Pro below to provide coverage outside the building. A cable ran inside the metal building to a second access point to cover the interior and offered 80-100 Mb/s.

COOP Trailers to MITRU Trailers

- **Remote EOC:** Can provide connectivity in a building or field
- **Remote Radio Repeater:** Park on hilltop with repeater inside
- **Wireless Link at Remote High Site:** Wireless bridges or HamWAN can extend Internet into remote area
- **Volunteer Registration Center:** Tables, chairs, canopy, lighting, ID printer, laptops and Internet allow working anywhere
- **Surveillance Station:** Internet-connected camera on the mast
- **Public Hotspot:** An obvious addition to a CPOD site
- **Emergency or Planned Response:** Internet and supplies for support

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Although the funding was for Continuation of Operations (COOP), there were clearly more applications so they could be deployed more often. These are the applications we initially envisioned. A typical COOP deployment would create a remote EOC with Internet across the site and some amount of power available to operate lights, charge phones and laptops. A few tables, chairs and canopies can be carried to setup operations anywhere.

We have several portable repeaters but they require power, a mast to support the antenna and a secure dry place to locate the equipment. The MITRU provides all of that easily. It's small and lightweight with reasonable ground clearance to tow it to a hilltop and install the equipment in minutes.

Although there may be no cellular coverage at a specific location, one unit can be located at a high site with coverage and push it to a second trailer in a desired location via wireless bridge. Large 30" dishes are available at DEM (not normally carried on board) that provide much better wireless performance for long wireless links.

With Internet, the table, chairs, canopy and a couple laptops, it can easily serve as a registration point for volunteers or create access passes for closed areas during an incident.

Each MITRU has a hard mounted camera internally and carries a panoramic and Pan/Tilt/Zoom (PTZ) camera. These can be used for local security coverage or broader overwatch, fire lookout, etc. The cameras are all Ubiquiti and are remotely accessible via web interface or Ubiquiti Protect app on a mobile device. The protect app is even available for a Google Chromecast device to create an inexpensive monitoring station.

When the public comes to a Community Point of Distribution (CPOD) site for food and water, being able to provide a hotspot allows them to contact family, friends, employers, insurance agents and conduct the personal business to facilitate recovery. They can send email, message via apps or place phone calls via Wi-Fi. There is power and a multi-port USB charger so they can charge their portable devices.

Ultimately, they are quite versatile and can be used during emergencies or for a planned event. The cache of equipment can be used independently from the trailer if power is available. There is gear on board to create a similar standalone wireless network with cameras. The Cradlepoint modems are installed on custom 3D printed brackets to allow removing them to use separately. A PTZ camera and Cradlepoint was used to assist the Monroe Public Works department during their parade to monitor road closures and parade progress.

Early Missions

- First application was supporting four mass vaccination sites
- Wi-Fi network in fairgrounds parking lots to support credit card billing
- Provided Wi-Fi to DEM during network cabling upgrade
- Bolt Creek Fire command and road closures
- Wi-Fi hotspot for remote community after storm took out power/Internet

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Although not envisioned as part of the original design, they were deployed to the mass vaccination sites as quickly as they could be completed. The first deployed was also the last one in operation at Arlington airport over 6 months later. It operated that entire time completely independently sitting on a closed runway, providing its own power and Internet.

The fairgrounds implemented a new credit card authorization system that required Wi-Fi access in the parking lots. All three units were deployed into multiple parking lots with some additional access points to increase the range.

A contractor came to upgrade the wiring at DEM which involved removing all the existing connections. Our IT department made no provision for an alternate Internet source during the week the work was happening. The volunteers moved a trailer in place, setup the Cradlepoint and placed mesh units throughout the building to restore connectivity for employees and a class that was occurring.

One of the units provided connectivity inside and around the building at Bolt Creek Command. It was also used at the WSDOT road closures on Hwy 2 to provide connectivity where they otherwise had none. They were able to make phone calls, email and upload photos and video.

During a winter storm, there were power outages all over the county. One remote neighborhood was particularly hard hit with no power, Internet or cellular service. We were able to roll a unit (shown above) to a private park with a large parking area and deploy a Starlink dish to provide connectivity in just a few hours after the request. We did have difficulty notifying folks it was in place. We now have some signage available to make it clear service is available.

In 2023/24 the MITRU trailers with Starlink supported a large SAR mission about 15 miles east of Darrington, well beyond any cellular coverage. The sandwich board with a QR code (lower right photo) allowed searchers (and deputies) to connect to the Wi-Fi, then scan a second QR code at the SAR command post to download the map, record their tracks and upload to the cloud-based mission map in SARTopo/CalTopo.

Some maintenance at Paine Field was going to cause an Internet outage at the Paine Field fire station. One of the MITRU units was positioned behind the station with a large LTE antenna and a second mesh unit inside the building to provide coverage throughout the station. The maintenance extended to a second day and the MITRU was able to simply continue without issue.

SCSO contacted DEM to provide connectivity on Mountain Loop Hwy about 20 miles past the nearest cellular site. The scene was so poorly located even the 800 MHz radio system was barely functional. A short site survey showed there would be marginal Starlink coverage through a hole in the trees. Once setup, it provided email and text messaging capability although Wi-Fi calling was less reliable.

The 10-year Oso landslide memorial was very crowded but there was a desire to stream the ceremony while maintaining a small footprint. The local cellular sites were crowded by attendee traffic and couldn't be relied on for streaming. A Goal

Zero solar generator (and spare) was used to power the Starlink and Ubiquiti equipment located in dry boxes. The portable light made it possible to setup the equipment before dawn.

Now How Much Would You Pay?

- These units cost between $25,000-$30,000 as configured
  - This is equipment price, not development or labor
  - Having skilled volunteers is an invaluable asset!
- Equipment can be built on most any platform (trailer or vehicle)

Description	Category		Subtotal
5'x8' trailer with lighting, ladder rack and other upgrades	Trailer	$	7,022.51
200AH lithium batteries, solar panels, solar charger, inverter/charger, breakers, outlets, etc.	Electrical	$	5,851.52
Fasteners, tape, glue, nylon webbing, plywood	Hardware	$	520.82
Hand tools, drill/driver, driver bits, paracord, straps, work gloves, gaffer tape, zip ties	Tools	$	429.54
Cradlepoint LTE modem, Ubiquiti networking equipment, wireless bridges, antennas, cabling	Network	$	5,369.11
Canopy, tables, chairs, power cords/strips, power stations, tarps, office supplies, mast kit	Support	$	3,810.78

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This is a breakdown of the 2020 equipment costs (before tax) in these units. Some equipment changes have been made and there has been some inflation, although lithium battery prices have dropped significantly. Because volunteers from the Snohomish County ACS team constructed the trailers there is no labor cost represented. A full bill of materials is available and some wiring and network diagrams have been included at the end of the presentation to demonstrate the features.

Photos

Loaded and ready for a mission

Network equipment mounted overhead with custom 3D printed brackets

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A typical mission load includes tables, chairs, canopy, generator, fuel, network equipment, power cords/strips, lights, electric chainsaw, tie down straps, mast, etc. The network gear was originally mounted on a stand so it could be portable. That took extra time to deploy and created the wiring mess visible on the box to the right. Ultimately, the basic gear was preconfigured and permanently mounted to the roof of the trailer. This allows it to be live all the time and keeps the wires up and out of the way of cargo being loaded and unloaded.

The trailers are equipped with a Ubiquiti Cloud Key Gen2 Plus with a hard drive to record video, Ubiquiti Security Gateway and Ubiquiti PoE switch mounted to the ceiling. They are live all the time to allow monitoring of the network and cameras remotely.

Typical Equipment

- Canopy, table, chairs, emergency food, water, office supplies
- Wheel chocks, mast mount, road cones, electric chain saw, ratchet straps, paracord, gaffer tape, first aid kit, fire extinguishers, tool kit
- Generator(s), fuel, solar generator(s), extension cords, power strips
- Additional network gear (access points, wireless bridges, switches),cameras, CAT6 cabling, connectors, tools, testers, wire ties, etc.
- Dual band radio with magnetic mount antenna, mast kit, high gain cellular LTE antenna

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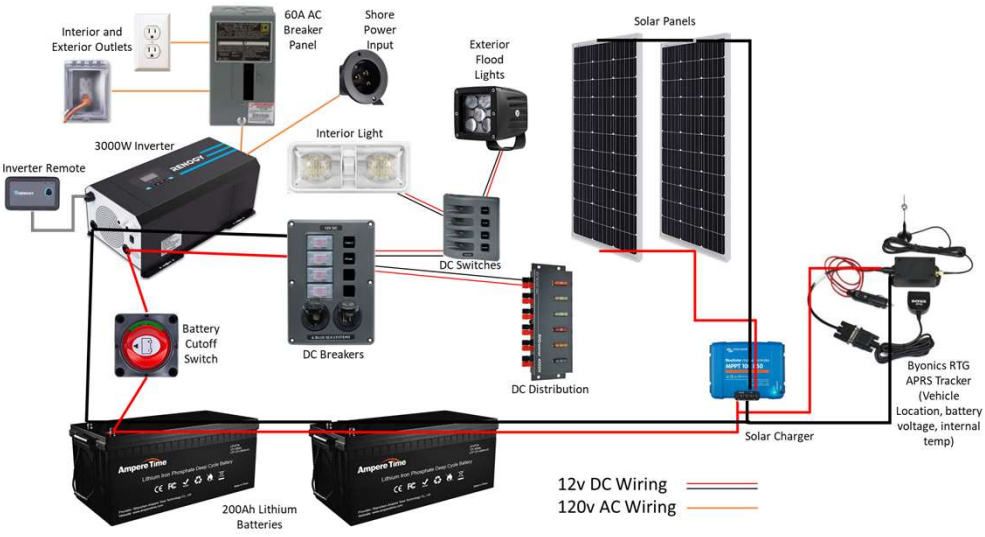
Power Wiring Diagram



This is the basic layout. There are multiple scene lights, more solar panels and batteries but this demonstrates how they're connected.

The Byonics RTG APRS tracker operates on amateur radio frequencies and provides the location, battery voltage and internal temperature of each trailer. The data is available at https://APRS.fi. The white trailer can be located at https://aprs.fi/#!mt=roadmap&z=11&call=a%2FWA7DEM-1&timerange=3600&tail=3600. The telemetry data can be seen at https://aprs.fi/telemetry/a/WA7DEM-1.

Ubiquiti Network Equipment

- Simple expansion – Simply adopting a new access point extends the network either wired or via mesh with no additional configuration required.
- All access points support meshing – no special hardware required to expand network.
- Automatic updates – Stays current with the latest security and feature updates.
- Remote management – Network admins don't need to be on-site.
- Insights feature monitors for security and performance issues to allow easier identification and correction.
- Modestly priced – Pricing tends to be on the high end of consumer devices but significantly less than enterprise devices and doesn't require any subscription.
- Compatible cameras products also available.
- Management of all devices through mobile app or web interface.

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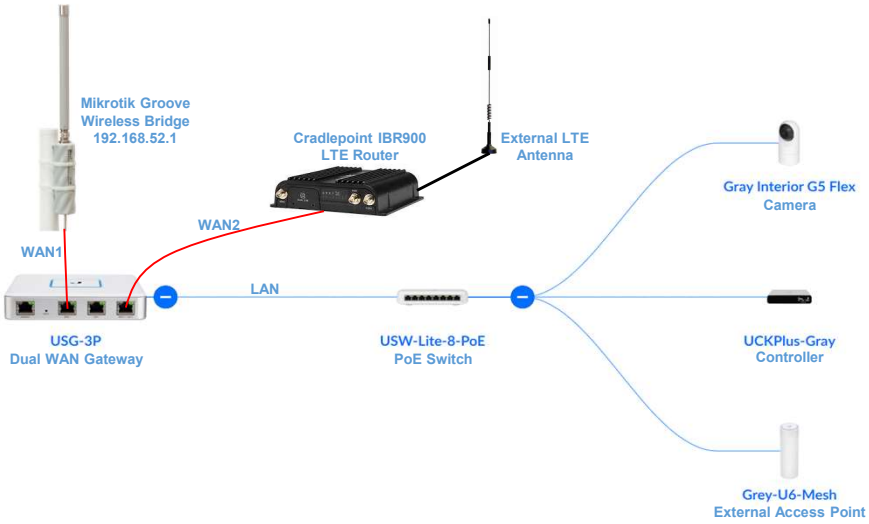
Ubiquiti gear offers a number of advantages for this application -

•Simple expansion - Simply adopting a new access point extends the network either wired or via mesh with no additional configuration required.
•All access points support meshing - no special hardware required to expand network.
•Automatic updates - If Internet is available, the system will keep current with the latest security and feature updates.
•Remote management - The network can be monitored and managed remotely in real-time so network admins don't need to be on-site.
•Insights feature monitors for security and performance issues to allow easier identification and correction.
•Modestly priced - Pricing tends to be on the high end of consumer devices but significantly less than enterprise devices and doesn't require any subscription.
•Cameras also available that work with the system (DEM has PTZ and panoramic models available).
•Management of all devices through mobile app or web interface.

Network Wiring Diagram



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This is the network configuration of the MITRU. The LAN can be expanded via cabling or wireless mesh from this point. The router has two WAN ports and by default the Mikrotik Groove is used to maintain Internet connectivity when parking at a staging location (Snohomish DEM). This connects to the building Wi-Fi. When it rolls away, this switches to the Cradlepoint. Other Internet sources (wire, bridge or Starlink) can be added by simply unplugging the Groove. These can be configured in parallel for more bandwidth or as a fail-over to limited charges on expensive bandwidth while retaining connectivity.

Wrap-up

- Do you have an additional application in mind?
- Any questions?

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References

More information at -
https://snohomishcountywa.gov/6417/MITRU-Program

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