



COLORADO

Center of Excellence for Advanced Technology Aerial Firefighting

Department of Public Safety

2018 Overland Hand Crew TAK Deployment Report

CoE-18-005.1

Purpose

This report describes the Team Awareness Kit (TAK) support provided by the Center of Excellence for Advanced Technology Aerial Firefighting (CoE) to Colorado Division of Fire Prevention and Control firefighters on the Overland Hand Crew from July 25–August 7, 2018.

Overview

The CoE received a license from the U.S. Air Force Research Laboratory for the TAK app in the spring of 2018, allowing the CoE to commence operational deployments of the app. While the TAK app has applicability for a broad array of public safety missions, use of the app to improve coordination within wildland fire crews is of particular interest to the CoE.



Figure 1— goTenna Pro and phone running ATAK

A cache of Android smartphones, tablets, and charging accessories was purchased by the CoE to support TAK deployments with wildland firefighters. This cache also includes the goTenna Pro, which is a tactical mesh-



Figure 2—CoE TAK support cache

networking radio that integrates with the Android version of TAK—known as ATAK—and facilitates limited communication when firefighters are operating in cellular-denied environments. The deployment with the Overland Crew offered the second opportunity for the CoE to experimentally deploy this equipment with wildland firefighters.

The CoE's Wildland Fire Technology Specialist detailed with the Overland Hand Crew as a crew member. The crew had received a briefing on ATAK several months earlier, but they had not utilized the app or the goTenna Pro in an operational setting prior to this deployment.

Operations Summary

The Overland Hand Crew was initially dispatched to the Lake Christine Fire in Eagle County, Colorado, on July 24 and was given a mission in Division Sierra to contain numerous spot fires that had developed across a forest road and advanced into a bowl-shaped terrain feature. This area was steep and heavily forested and had no cell service. The crew boss, crew boss trainee, and squad bosses were issued goTenna Pros and smartphones running ATAK and were given basic instructions on how to track the locations of themselves and others, as well as how to create and share points of interest within the ATAK app.



Figure 3—Yeti 400 charging devices

Each morning, six smartphones and six goTenna Pros were issued to the firefighters, and each evening the devices were turned in. The smartphones and goTenna Pros were labeled with the names of the operators to ensure that the same devices would be issued each day and that the goTenna Pros would not have to be re-paired with new smartphones. A Goal Zero Yeti 400 battery was used to charge all twelve devices overnight. In turn, the Yeti 400 was charged using a vehicle inverter while driving and occasionally by deploying a solar panel if the battery was running low.

The CoE representative downloaded the official incident maps for all divisions on the fire and used ArcGIS to convert the maps from their native geospatial PDF format into GeoTIFFs that ATAK could ingest. The maps were loaded onto a USB drive and, using a USB On-The-Go cable, were copied onto the phones of each firefighter. This

process was repeated each morning on the Lake Christine Fire.

Initially, the app was used primarily for location tracking—with a handful of points dropped and to indicate the location of the trucks; a pump and hose-lay supplies that had been dropped off by another crew; and the crew lookout. The goTenna Pro was used for location tracking and point dropping and provided reliable connectivity in the roughly 0.5 mile × 0.5 mile area of operations for the crew. On the first day, VHF frequencies were utilized on the goTenna Pros and significant leakage into the VHF voice radios of the crew was detected. This leakage sounded like a radio squelch noise heard when pinging a repeater, but occurred every couple of seconds during conversations held on both repeated and unrepeated channels. On the second day, the goTenna Pros were reprogrammed to utilize UHF frequencies and this issue was alleviated. No difference in performance of the goTenna Pros was noted between the VHF and UHF frequency sets.

It is really big being able to see where people are at, because if you're trying to hike in to somebody, or say you're out scouting and somebody is trying to see where you are at, or maybe how much more line needs to be put in, that's extremely helpful.—Overland Crew Boss

The goTenna Pros are advertised on the company’s website as capable of battery life up to 40 hours, though it is unclear what the usage of the radios are in the advertised mode. The CoE representative experimented with increasing and decreasing the rate at which firefighter locations were automatically transmitted over the goTenna Pro, as this was by far the most frequent type of data exchanged using the radios. The shortest interval that the goTenna Pro can automatically transmit location information is 30 seconds, and it was found during this deployment that this mode would exhaust the battery of the radio by the end of a 12-hour field deployment. Initially, the tracking interval was lengthened to 2 minutes, which did ensure that the radios lasted through a work shift; however, firefighters began to notice that the accuracy of fellow crewmembers’ positions had deteriorated. Ultimately, a 90-second tracking interval was selected to ensure that the radios could both last through a shift and provide the most frequent possible updates on firefighter locations.



Figure 4—ATAK used on the Lake Christine Fire

As there were numerous spot fires in the bowl, the crew was instructed by supervisors to map the locations and dimensions of each spot fire to assist in their assessment and control. The crew boss performed this task using the Avenza mapping app. Avenza has a feature that ATAK lacks that allows a track segment collected by the GPS on the phone to be automatically converted into a polygon. The crew boss attempted to also collect the dimensions of the spot fires in ATAK and transmit the information in real-time to the crew. As ATAK does



Figure 5—Spot fires mapped for goTenna in ATAK (left) and in Avenza (right)

not have a conversion tool between tracks and polygons, the crew boss collected her tracklog and attempted to manually trace a polygon over it. This cumbersome process hampered the utilization of ATAK for this mission. Additionally, the goTenna Pro’s limitation that only allows the device to transmit eight or fewer vertices further hampered adoption of ATAK by the hand crew for fire mapping, as the fire perimeter presented a serpentine and complex shape with many more than eight vertices. Ultimately, the spot fires were mapped using the Avenza app and the data was provided back to the incident management team on the fire.

After 4 days on the Lake Christine Fire, the Overland Hand Crew was reassigned to the Cabin Lake Fire in Rio Blanco County, Colorado. A cell tower located on a ridge approximately 6 miles away from the fire provided network access to much of the fire. However, this tower was operated by a Verizon affiliate and thus



provided 3G roaming data service rather than the 4G LTE service available on the native Verizon network.

While traveling to the Cabin Lake Fire, the latest Multi-Mission Aircraft (MMA) perimeter for the fire was loaded into ATAK and sent to the devices of the crewmembers. Additionally, an official incident map for the fire containing an aerial photo of the area and the locations of structures was loaded on the devices. Thanks to the network access on this fire, the CoE representative was able to occasionally push updated fire mapping

Figure 6-Crewmembers utilizing ATAK

information to crewmembers during the workday as MMA or National Infrared Operations aircraft missions were flown. After a few days, the incident management team began producing high-quality daily maps of the fire and these were loaded into ATAK each morning using the same procedure honed on the Lake Christine Fire.

During the first day of operations on the Cabin Lake Fire, the crew relied solely on cellular data to share tracking information and other items. While cellular data provided much more frequent updates on the locations of firefighters than was possible with the goTenna Pros, it quickly became apparent that the 3G roaming cellular service had problems too. Firefighters were frequently disconnected from the TAK server, initially causing individuals' position dots to immediately go gray on the phones of others.

...the more recent fire perimeter updates helped to plan what the crew could honestly do in a single shift...it helped with time management for me to tell Division our progress (also showing my overhead on the fire the screen so they could see [the progress] real time was an added bonus)." - Overland Crew Boss Trainee

A setting was changed in ATAK to allow the position dot to stay current in ATAK until 10 minutes had elapsed without a report.

Even with the position dots persisting through disconnections from the server, problems continued on day one. Position dots were seen to rapidly jump around the map with no apparent relation to reality. Worse, position reports in ATAK were listed as being only a few seconds old when in reality they were much older. This led to inaccurate location reporting and situations in which firefighters were physically together when ATAK provided seemingly valid position information that they were instead hundreds of yards apart.

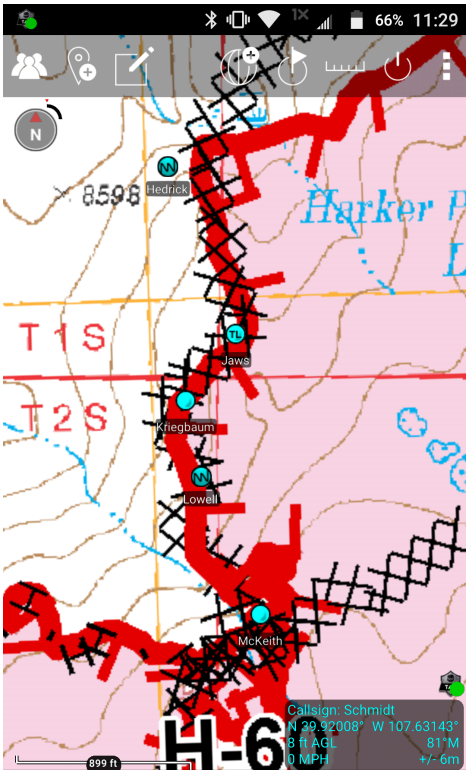


Figure 7—goTenna Pro and cellular position reports

To mitigate the unreliability of the cell coverage, the goTenna Pros were deployed in parallel with cellular service starting on day two of the Cabin Lake Fire. ATAK seamlessly integrated location reports passed by both cellular service and the goTenna Pros and position reports began smoothly moving around the map rather than jumping wildly. Utilizing cell service in addition to the goTenna Pros provided a number of benefits, including more frequent position reports when service was in place, the sending of nonstandard point icons (e.g., wildland fire-specific icons), the transmittal of more complex shapes, and the sending of large files (e.g., shapefiles and KML files containing aircraft-derived fire perimeters). The goTenna Pros were used with UHF frequencies on this fire and provided position reports across distances up to 1 mile, though exact range limits were impossible to determine due to the parallel transmission of information through cellular service.

The crew arrived on the day after the Cabin Lake Fire started and was initially assigned to secure the edge of the fire on the less-active western side. The fire had reached aspen tree groves in this area and had thrown embers into the groves—starting a multitude of spot fires that had not grown significantly, but nonetheless

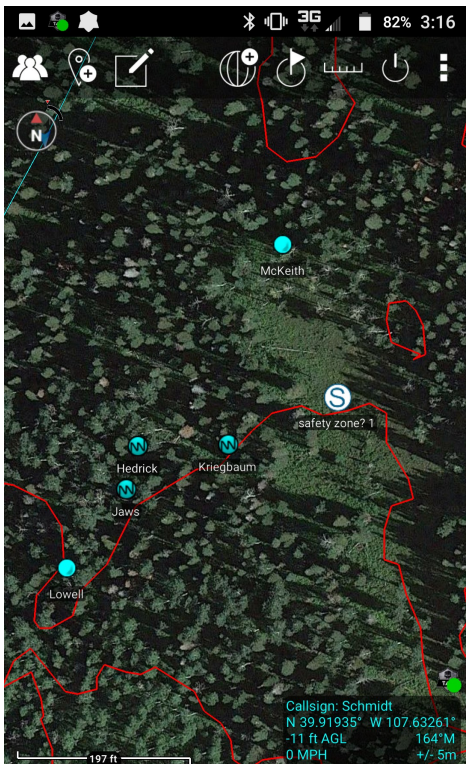


Figure 9—Crew working spot fires

posed a threat until extinguished. As visibility was limited in these aspen groves, ATAK proved to be a useful tool to coordinate the movement of firefighters as they tracked down and extinguished spot fires.



Figure 8—Terrain and vegetation typical on the Cabin Lake Fire

Firefighters and crew bosses would direct others over the voice radio to come to their location as shown in the ATAK app to meet or take other actions. The crew boss trainee also dropped and shared pins to depict locations, including medevac sites, safety zones, and areas targeted for line construction. Due to the confusing nature of the main fire disintegrating into multiple spot fires, ATAK was helpful in gaining situational awareness. However, in one case the crew boss and trainee were misled by an old fire perimeter that was in ATAK and planned a

strategy based on the old data, only to find once they were on the ground that the fire had grown and their strategy would need to change.

The CoE representative served as crew lookout during much of this time and benefited greatly from access to the crew's locations in ATAK. Due to heavy forest canopies, the firefighters themselves were rarely visible to the lookout, but by comparing position reports to a viewshed from the lookout's location (which illustrated what areas can and cannot be seen from a given location), he was able to determine where best to position himself to maintain oversight of the crew and watch for any dangerous fire behavior or weather.



Figure 10—Dense surface vegetation at the Cabin Lake Fire

The polar coordinate entry tool was also useful to the lookout, as it allowed him to enter into ATAK (1) a compass bearing obtained by pocket compass or by binoculars with integrated compass, and (2) an estimated distance; this allowed him to obtain a line along that bearing out to the estimated distance. This was useful when observing smoke columns, as it allowed the lookout to quickly determine where the fire behavior was occurring in relation to the crew. Also, ATAK provides live bearings to points and position reports of firefighters; the lookout used this feature to obtain a bearing and shoot the bearing using a pocket compass or the binoculars to see where the resource was in the real world.



Figure 11—Obtaining a bearing using binoculars with a built-in compass

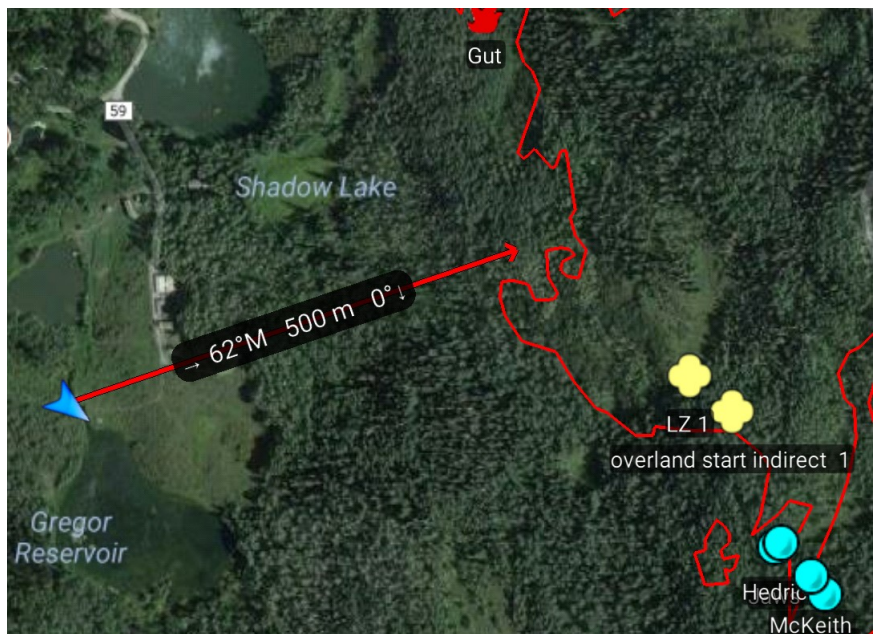


Figure 12—Polar coordinate entry for a smoke column

Conclusion

The ATAK app provided valuable situational awareness to the Overland Hand Crew during its deployment on two wildland fires. In particular, ATAK's ability to display the near real-time locations of the squads, crew boss and trainee, and lookout increased the efficiency and safety of the crew. Additionally, the ability in ATAK for the lookout to push mapping information collected by the MMA to the crewmembers proved very

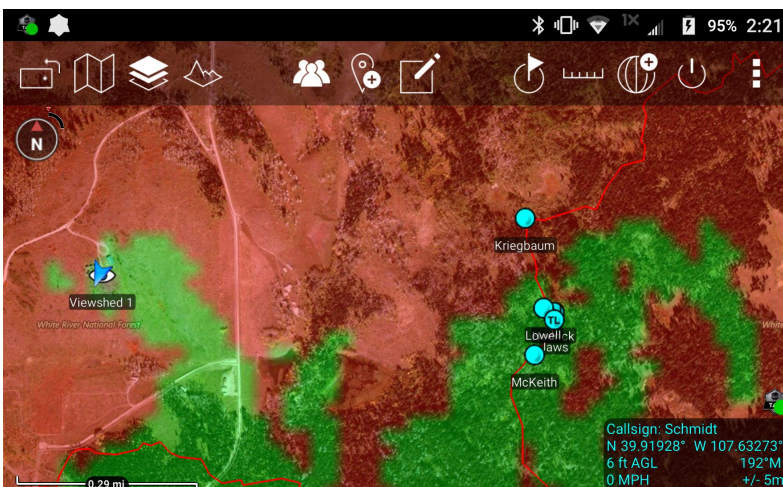


Figure 13—Viewshed from lookout's location

popular and allowed the crew leaders and their supervisors to increase the pace of their decision-making without overly distracting them from their core mission.

The goTenna Pro radios allowed firefighters to exchange basic types of data in ATAK even when no cell service was available, as was the case on the Lake Christine Fire. However, firefighters did express the desire to transmit more complex types of shapes using the radios, such as the serpentine fire perimeters that are commonly seen in the wildland. With some fine-tuning, the goTenna Pros were able to provide location tracking and other features throughout a day on the fireline and also provided an extremely useful adjunct to the unreliable cellular service found on the Cabin Lake Fire.

With additional development, ATAK could provide an end-to-end geospatial situational awareness platform for wildland firefighters. Specifically, the ability for ATAK to view geospatial PDF maps would mitigate the need to manually convert maps into a format the app can view. In the long-term this requirement may not be necessary, as ATAK is developing an ArcGIS plugin that could allow firefighters to directly receive geospatial data from incident GIS specialists via ArcGIS Online. Additionally, the ability to translate a track collected via GPS into a polygon, and ideally calculate the acreage of the polygon, would fulfill a basic workflow used in wildland fire and allow firefighters to quickly gain and exchange situational awareness on the fire.