Connecting the Impossible™

The Avwatch Mobile Tracking System

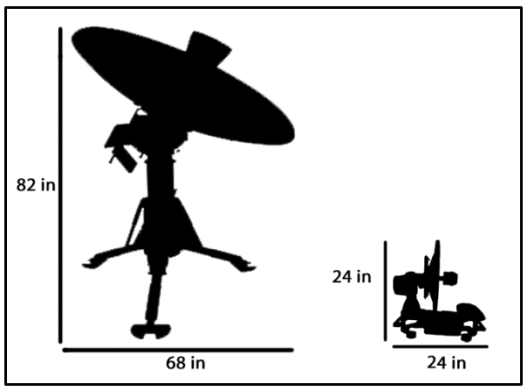
The Avwatch Mobile Tracking System (MTS) was developed through our own mission requirements after deploying Mobile Ad hoc Networks (MANETs) around the world for the last decade. We found traditional tracking systems to be overly bulky, time consuming to set up and susceptible to user error that could ruin a mission. The final MTS production model is the result of 5 years of engineering and operational testing, refined to a point where the previously mentioned obstacles are all minimized or nonexistent. We believe this smaller formfactor is ideally suited to meet most datalink requirements. We have tested range and performance out to 132 miles but believe the primary market for this product is operating in the 10-75 mile range. Less than 10 miles can be served more simply and cost effectively by omnidirectional antennas. Beyond 75 miles typically requires both the aircraft and tracking system to be elevated higher to address curvature of the earth; conditions that can be undesirable for most tactical operators.

MTS deployed in a disaster response

Background

The concept behind the Avwatch MTS came from years of frustration while setting up regular tracking systems. After some analysis there were three main issues that were the source of said frustration: setup location, complexity of components and overall assembly time.

First, a tracking system is rarely set up in proximity to where the received data needs to ultimately get to. Often, a tracking system goes on top of a nearby mountain or on the roof of the highest nearby building, and the data is routed down to a lower location where the end user ultimately receives the live data. These locations are usually difficult to get to, whether it be hiking up a hillside or climbing up an enclosed ladder. Tracking antennas will always perform better at these types of locations, but if the overall size of a system were to be smaller and more manageable, setup would be simpler and ultimately faster for the end user. When compared with a large tracking system, the MTS throughput numbers are only slightly lower at an operational distance. In flight testing to date, we have successfully carried 1 Mbps out to 132 miles. With proper radio settings and a clean RF environment, we have been able to achieve up to 30 Mbps at 30 miles and 15 Mbps at 60 miles.



Size comparison of the MTS to other tracking

Second, the number of components associated with older, larger tracking systems was a huge source of frustration. There are roughly 60 individual parts including nuts, bolts and critical items like RF cables, feedhorns and a parabolic dish that all break down into multiple pieces. Having a tracking system that is as few as 2 pieces out of the box provides unparalleled value to an end user.

Finally, overall assembly time was a huge limiting factor especially in an ever changing environment. By design, MANETs are rapidly deployed to support highly dynamic mission requirements. Current tracking systems

take 1 to 2 people roughly 30-45 minutes to set up. This was often unacceptable or unrealistic given mission requirements. By comparison, the MTS only requires 3 minutes to initialize.

The Current Market of Tracking Antennas

Current systems on the market that are branded as *Automatic Tracking Systems* are only partially automated when compared to the gimbal stabilized Avwatch MTS. Other tracking system can automatically calculate an initial heading of the tracking system, but this happens one time on initial boot. This does not correct for a tracking system that may not be perfectly level. It also does not allow for the heading to be changed for any reason during operation, without a reboot or user input. As long as the systems currently on the market are perfectly level, completely stationary and the end user has ample time for setup/breakdown, these tracking systems provide great performance. However, we've found that each of the aforementioned conditions is where an end user usually errs, and network performance suffers.

The Advantage of Directional Performance in Dynamic Scenarios

The concept of omnidirectional vs. directional antennas is easily understood; a water analogy is the best way to describe the scenario. In this analogy, water is data, a lawn-sprinkler that sprays a light mist 360° is the omnidirectional antenna, and a fire hose is a directional antenna. If a bucket were to be the 'receiver', which would fill up the bucket faster, the fire hose or the lawn sprinkler? The obvious answer is the fire hose with one huge caveat – it must be pointed into the bucket. If it's not pointed at the bucket, it will never fill up. If a directional antenna is not pointed perfectly at its target, it will not provide any data. If the omnidirectional sprinkler head is in range of the bucket, it will fill it up eventually; basically, it'll take longer to get the data to the receiver and you can't go as far but you can go anywhere within range to receive data.

The directional antenna requires additional calculations to know where to point. Not only does it require the exact location of the tracked node, but it needs to know its position and heading. Once those three things are known, the tracking system can follow the tracked node. But like the fire hose example, if the heading is off by a degree or two, the data may never make it to the receiver. The Avwatch MTS solves this problem and provides a huge technological step forward; the MTS updates its own position and heading 6 times per second. Not only does that remove the need for an end user to manually input a heading, it makes it capable of being mobile during operation. The MTS can operate while mounted to the roof of a moving vehicle, or on a maritime vessel while underway. This is the innovative addition that the MTS brings to the world of tactical networking. Not only does it make setup easier in static locations, but now an end user is able to get the benefits of a directional antenna while on the move.

MTS tracking a UAV from a ship underway

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Radio Agnostic: Cursor on Target

The MTS was built with the plan to enhance a variety of cutting edge technology already on the market. Cursor on Target (CoT), developed by MITRE, has become widely adopted as the universal language for sharing location data between machines. This data, in the form of multicast traffic, flows through a network and ultimately allows the MTS to point at a specific node allowing for the extension of that link, most commonly the air-to-ground link. The MTS can track anything that provides its position via CoT. Examples of equipment that utilize CoT are all major MANET radios as well as many of the gimbal and autopilot manufacturers. These different types of technology can be integrated into the MTS with nothing more than a wiring harness specific to whichever equipment is being used.

Use Cases and End Users

The MTS has been used in a variety of scenarios including:

MTS deployed post-Hurricane

- Operations on a 22' Boston Whaler in 3-5' seas while linking to a manned aircraft 30 miles away.
- Operations from a 96' off-shore supply boat while linking to a Class 2, long range, vertical takeoff and land unmanned aerial vehicle (UAV).
- Operated in desert heat conditions, in subzero winter conditions, high speed turning conditions from vehicles, static range tests establishing max link and throughput, and testing with multiple radio manufacturers to verify interoperability with any radio or system publishing CoT.
- Avwatch also deployed in response to several hurricanes in 2017, most notably to Hurricane Maria in Puerto Rico. We transported the MTS with us in a small Cessna and used it on a roof of a command center to establish a datalink to the plane that allowed us to survey the entire island while transmitting a 1.5Mb video feed. Rather than carrying a traditional tracking system in parts up a ladder to the roof, then trying to assemble it in high winds, powering it from inside the building, and finally trying to align it – we instead carried the 42 pound, fully assembled MTS up the ladder, strapped it to an AC unit, plugged it into a 2590 battery and were fully operational, tracking the aircraft within 3 minutes. It truly is a generational capability leap forward.

The market for the MTS starts with any entity that is currently using a regular tracking system as well as any unit that has previously been unable to use a tracking system because of a dynamic operating environment. This includes, but is not limited to: first responders, military units, the intelligence community, UAV operators and manned/unmanned ISR operations.

Moving Forward

We believe that this concept of a dynamic tracking system will replace the idea that tracking systems must be static and hard mounted. Avwatch is in the process of developing a larger version of the MTS which will utilize all the same technology but be able to hold heavier antennas. While the new unit will look like standard tracking systems already on the market, the primary differences will be the stabilized gimbal and the continuously updated heading. The new, larger version will be manufactured in the same ISO certified facility as the current MTS.