

Troposcatter in the Modern Military

By Mark Yamamoto

During the last decade of military conflict in vast areas of hostile terrain, widely dispersed military units had few choices to move large amounts of data across the battlefield. The choices were line of sight microwave systems (LOS), an aging fleet of large troposcatter systems or newer smaller satellite communication systems (VSAT). The introduction of a very large number of VSAT terminals soon led to a scarcity of available transponder space, which resulted in a very substantial rise in transponder costs. More importantly, because satellite bandwidth is a finite resource, systems and networks in the area of operation became critically bandwidth limited. Also, the relative insecurity of non-encrypted satellite transmissions which broadcast to all stations in the satellite area of coverage was driven home when it was discovered that the opposing force could monitor the video feeds from US UAVs using a program available through the internet. Lastly, satellites are vulnerable to attack from a hostile nation or simply a natural solar event, literally silencing a large area of operations solely dependent upon satellite communications.

In an attempt to free-up satellite bandwidth, ground forces increased the use of Line-Of-Sight microwave equipment. While useful, the problem in many instances was that LOS required multiple relays to maneuver around obstacles or to span distances greater than the limited range of tactical LOS links. This in turn resulted in relays being installed in unsecured areas that required force protection and had no supporting infrastructure, thus limiting the use of LOS as a complete battlefield bandwidth solution.

As an alternative to LOS and satellite, the military deployed its aging fleet of AN/TRC-170 troposcatter systems to provide intra theater communications. These vehicle mounted systems with trailer transported antennas were the main stays of tactical long haul communications from the 1970s through the early 1990s. One of the largest deployed troposcatter networks was established using the AN/TRC-170 during Operation Desert Storm, consisting of over 60 links. The success of mobile troposcatter systems in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) substantiated the value of troposcatter communications on the modern battlefield.

During operations in both Iraq and Afghanistan, the AN/TRC-170 troposcatter terminals was proven once again by extending critical command and control links across the theater area of operations, providing communications over medium to long range links, and over obstructed LOS links. While the tactical advantage of tropo was readily recognized, the limited four (4) Mbps bandwidth of the existing equipment presented a problem. It was apparent that the troposcatter technology in use by the U.S. needed an update. The first upgrade was to increase the data throughput of the AN/TRC-170 with the Comtech Systems CS6716 digital troposcatter modem; this increased the throughput of the AN/TRC-170



Typical AN/TRC 170 Deployment

from 4Mb/s to 16Mb/s, provided forward error correction, transmit power control and remote terminal operation. But, more importantly it was a low cost and quick to the field enhancement to rapidly increase bandwidth at a critical time. The second upgrade to the TRC 170 tropo terminals was a contract awarded to Comtech to provide a more mobile antenna system that would enable the deployment of the tropo terminal in 30-45 minutes by 2 men instead of the 6 hours and 6 to 8 men that was the norm with the AN/TRC-170s. The resulting Comtech TFLA (Transportable Fast Link Antenna) is a trailer mounted 3m antenna using an angle diversity feed horn, an automatic antenna pointing system, and offering dual or quad diversity modes.

In addition to a need to update the electronics and improve mobility and deployment times of the relatively large TRC-170 systems, the military requirements were moving to lighter weight, more maneuverable terminals of all kinds that could be used down to the company command post level without the use of highly trained personnel.



Transportable Fast Link Antenna (TFLA)

Also the relatively short towers used with tactical Line of sight microwave limited the distance that they could communicate. This left a large range of distances between LOS and tropo where the user, until this point, had to deploy multiple LOS links with the obvious disadvantages covered earlier in this paper or satellite, with the transponder limitations. This requirement resulted in a new breed of Terrestrial Beyond Line Of Sight (TBLOS) terminal that is just reaching the battlefield. Based upon decades of troposcatter modem technology experience Comtech Systems has introduced the first field proven Modular Transportable Troposcatter System (MTTS) as an alternative to the requirement for multi hop LOS or short satellite requirements.

MTTS is a fully modular, rapidly deployable, transit case based troposcatter system. Modularity means that only the cases needed to meet the mission requirements are deployed; saving valuable transport cargo space and reducing logistical support and man power.

The MTTS can be used as a full capability tropo terminal. Equipped with transit case mounted solid state high power amplifier(s) (SSPA), the MTTS can provide TBLOS operation from LOS ranges up to 80+ kilometers depending on terrain and antenna used.



MTTS with 2m Transit Case Antenna

By using the industry leading CS67200i digital troposcatter modem the user has the advantages of turbo code forward error correction (Comtech patent)

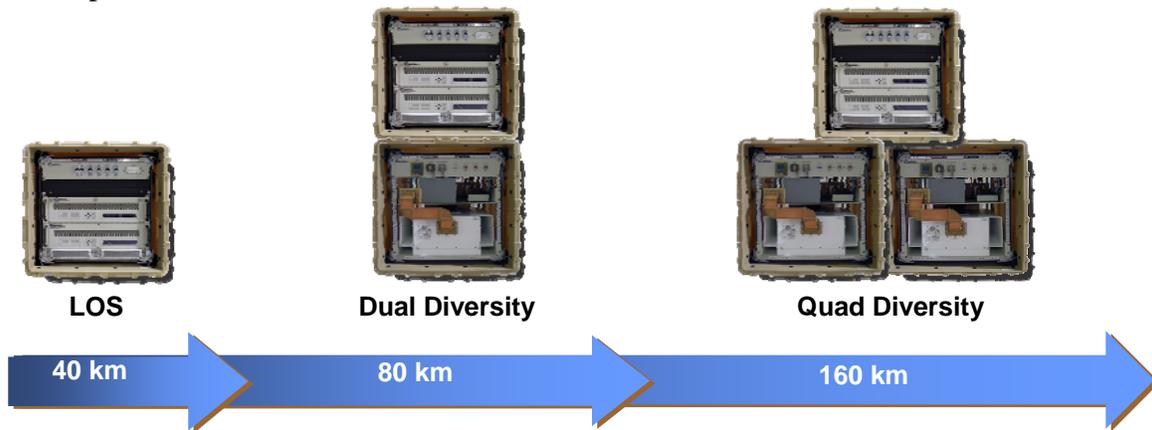
a selection of data rates from 2 Mb/s to 22 Mb/s, Automatic Power Control of the transmitted signal and a unique Auto Coding Rate (ACR) function which varies the data and/or FEC rate depending on the robustness of the link. In severe link conditions, ACR will automatically reduce the transmit rate to maintain the link performance and will then return to the nominal transmit rate when link conditions permit.



MTTS with 2m Transit Case Antenna

Just as important as the smaller size and modularity of the MTTS is the fact that it is simple to deploy, no longer requiring highly trained engineers to setup and operate the system. With auto antenna pointing, link establishment is completed in minutes, not hours, as with the older legacy systems.

This gives the military a terminal that can not only meet any of its communication requirements with up to a 22 MB/s for TBLOS applications, but also provides a highly mobile troposcatter capability to complement their long haul tropo terminals that use larger antennas and 2KW high power amplifiers.



With the military troposcatter terminal requirements and missions continuing to evolve and expand, Comtech has integrated the MTTS tropo terminal and the TFLA trailer mounted antenna system. This system has all of the capabilities of the MTTS terminals but with a greater operational range afforded by the 3 Meter angle diversity antenna. The TCT (Transportable Communications Terminal) is supplied in both a dual and quad diversity troposcatter configurations.

The army artillery and missile defense commands also recognized the advantages tropo communications offers as well as the versatility of the MTTS and TCT tropo systems. Tropo provides them a low transmission latency, short to longer range communications system that can be rapidly deployed in furtherance of accomplishing their mission. The low latency of troposcatter communications compared to the 500+ milli-second delay experienced with satellite is essential for commands task with anti-missile defense requirements.

The US is not the only country recognizing the benefits of the new generation of tropo. Several international militaries have installed or are planning large strategic tropo systems to be used for primary communications, initially as back up to new fiber systems. Other militaries are opting for transportable systems ranging from the MTTS to the TCT terminals. Comtech is supplying a complete tropo terminal including the routers and baseband equipment and generator mounted on a single trailer. This terminal is able to be fully employed by two operators in 30 minutes or less and requires only a prime mover to deploy the terminal.

Summary

Troposcatter equipment technology has evolved from large, heavy, low capacity terminals, to smaller, lighter, higher capacity network systems capable of transmitting digital voice, video and data over a secure link. The resurgence in the use of tactical tropo has been dictated by wider areas of operations, increased operational tempo and the growing importance of high bandwidth tactical networks. Improvements in data throughput, antenna technology and innovative configurations provide commanders at all levels with a low cost, easy to deploy high bandwidth system that is not dependent on scarce satellite resources to link units, headquarters, and forward operating locations.



Transportable Communications Terminal (TCT)



Transportable Communications Terminal (TCT)