

Improving Command Centers By Antenna Remoting

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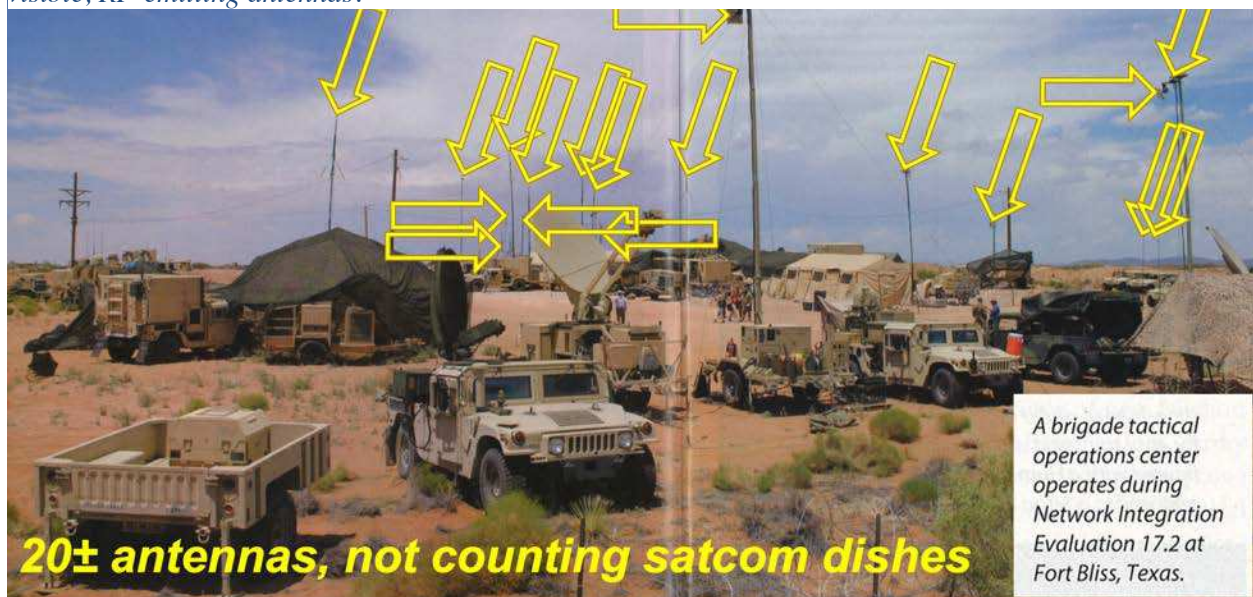
PROBLEM STATEMENT

When a hijacked airliner flew into the Pentagon in 2001, it directly struck the U.S. Navy's radio communications center, then located on the top floor of the building. That event cut off the Chief of Naval Operations and his staff from radio communications from their building and highlighted that identifiable command centers are vulnerable to hostile action.

Most command sites are not as well-known as the Pentagon, but they share a common issue: they are readily identified by their many antennas, which are tethered to radios inside by short coaxial cables. The antennas, which are necessarily near the command post, identify the site for what it is: a command-and-control node.

To a commander trying to control his forces, and to the radio operators, an antenna is part of a communications system that transmits and receives information. But to the enemy, an antenna is an **aiming stake** that identifies a command center and enables taking a shot at the commander, the command staff, and the radios, their main command and control assets. Any hostile actor with eyes or Direction-Finding equipment can confidently locate the commander's antennas and attack (Figure 1).

Figure 1. This mobile command post, pictured during an exercise in 2017, is festooned with highly visible, RF-emitting antennas.



SOLUTION

The security and covertness of command centers can be improved by moving their communication antennas far away using FORAX™ RF-over-Fiber technology. By using long optical fibers—up to 10-km and more—to connect the antennas, the commander’s radios now can be located conveniently and more securely far away, in a basement or a SCIF* or an unremarkable tent, because the short coaxial cables are eliminated.

RF-over-Fiber technology can relocate antennas many kilometers away from a command center without any compromise in receiver sensitivity or transmit power. Connected to their antenna by long optical fibers, radios can be placed in the command center where they are secure and convenient; distant antennas can be placed for good line of sight.

FORAX™ equipment has been operational for more than 15 years and has been successfully fielded around the world at numerous major command centers (Figure 2)†. FORAX™ RF-over-Fiber links in a command center include:

- A Radio Interface Module (RIM) for each radio, installed in a modular, rack-mounted Radio Interface Unit (RIU) in the radio room.
- An Antenna Interface Module (AIM) for each antenna, installed in a modular, rack-mounted Antenna Interface Unit near the antennas.
- One or two optical fibers per link.



Figure 2. Fiber Optic Remote Antenna eXtension (FORAX™) equipment uses electro-optic technology to remote communications antennas far away from their radios. The first FORAX™ RF-over-Fiber system was delivered in 2004 to a joint communications unit of the U.S. Special Operations Command.

Syntonics’ FORAX™ equipment connects radios to remote antennas up to 10-km away (and up to 100 km by special order). FORAX™ provides an all-analog optical link that can transport any RF signal with any modulation type over a single-mode optical fiber optic cable. FORAX™ links are available for most military waveforms and radios, both line-of-sight and UHF military satellite communications (“TACSAT”). The RF-over-Fiber technology can be easily adapted as new communications standards emerge, since the wideband RF signal is carried in its entirety as light over the fiber. Only electrical power needs to be provided at the antenna site, where the link’s AIM recreates the transmitter’s high-power signal and maintains the receiver’s sensitivity. Other advantages include the ease of locating an antenna on high terrain so that Line-of-Sight limitations can be overcome.

Features and benefits of this technology include:

* Sensitive Compartmented Information Facility

† FORAX™ equipment is used in command centers by eight of the nine U.S. DoD combatant commands, plus a wide range of civilian agencies and allied militaries.

Feature	Benefit
Long Connections	<ul style="list-style-type: none"> » Radio and its antenna can be located up to 10-km apart using single mode optical fiber — and up to 100-km by special order.
Easy Routing	<ul style="list-style-type: none"> » RF signals are carried on lightweight, flexible, rugged, optical cables. » Multiple radios can be carried on a single fiber optic cable. » Geographic diversity in RF signal routing becomes easy. » Separate TX and RX antennas can be implemented with conventional radios that have one half-duplex antenna port.
All Frequencies, All Modulations	<ul style="list-style-type: none"> » FORAX products cover 1 to 2000+ MHz including Combat Net Radios, Land Mobile Radios, GPS, and SATCOM frequencies from 3-18 GHz. » New Mobile <i>Ad Hoc</i> Networking (MANET) radios are also accommodated (e.g., TrellisWare Technologies, Persistent Systems, Silvus Technologies) » FORAX-RM modules handle military communications waveforms including HF, SINGARS, VHF and UHF LOS (“VULOS”), UHF MILSATCOM (“TACSAT”) including HPW and DAMA, HAVEQUICK, EPLRS, ANW2, SRW, and others.
EMP/EMI Immunity	<ul style="list-style-type: none"> » Lightning, electromagnetic pulses, or RF interference cannot propagate over, or influence the signals on optical fiber cables. » Radio equipment is opto-isolated from antenna.

The modular FORAX-RM rack-mount system can be customized to meet any military customer’s requirement for long, loss-free, secure RF connections from their antennas to their radios. A simplified diagram of a four-radio FORAX-RM system is shown in Figure 3.

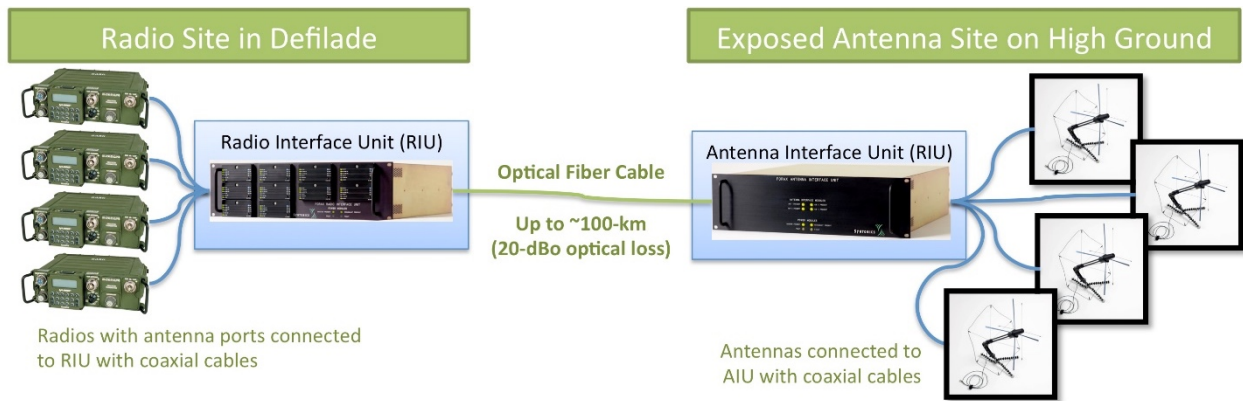


Figure 3. Any number of radios can be connected to distant antennas by a single fiber optic cable. To achieve geographic diversity, multiple separate antenna farms can be used by the same command center.

FORAX™ was initially developed during the 2003-2004 period for a USSOCOM sponsor. Syntonics has continued to develop this technology and expand the FORAX product line to meet the tactical and operational needs of a wide range of military communications needs. FORAX has been deployed since 2004 with most installations in 24x7 mission-critical operations.

Syntonics has delivered FORAX™ systems to U.S., and many allied nation’s SOF units; U.S. Air Force command centers; U.S. Army units around the world; a Missile Defense Agency project; many Joint command centers (including the Pentagon office of the Chairman of the Joint Chiefs); and many defense contractors, including all the major U.S. prime contractors.

U.S. government customers benefit because Syntonics’ FORAX™ products derive from development efforts funded by the U.S. Department of Defense’s SBIR/STTR program. U.S. government agencies have statutory authority to procure on a sole-source basis; the procuring agency cites either a “directed award,” or “an award directly to the firm without further competition.” The procuring agency cites 15 USC §638(r)(4) and uses the “authorized by statute” authority of FAR 6.302-5.

ABOUT THE COMPANY

Founded in 1999, Syntonics (www.SyntonicsCorp.com) is an engineering-driven manufacturer that conceives, develops, produces, and sells innovative RF systems for military and industrial markets. Our electro-optic and RF products enable otherwise impossible communications up, down, and sideways:



- Up—Our FORAX range extension systems extend comms using aerostats, balloons, towers, and tethered drones.
- Down—Our FORAX and special comms equipment extend tactical communications in tunnels, mines, and underwater from sensors and platforms.
- Sideways—Our FORAX antenna remoting systems are used around the world in command centers, including by eight of the nine DoD combatant commands.

Since 2003 we have developed highly customized RF equipment for the SOF community and DoD. In addition to our FORAX™ product lines, special communications equipment developed by ETC (merged with Syntonics in 2018) is used by the SOF community for tagging/tracking/locating and data exfiltration applications, both on land and underwater.

Headquartered in Columbia, MD Syntonics' facilities include a large Integration and Test Laboratory (ITL) equipped with an extensive suite of NIST-traceable electro-optical and RF test equipment operating up to 26 GHz; a production floor optimized for small lot, high-reliability electronics; and segregated Government material storage.

Syntonics is continually improving its ability to perform as a defense contractor and maintains these credentials: ISO 9001:2015 Quality Management System; DSS-approved clearances up to TS/SCI, plus storage; traditional COMSEC account; DCAA-approved cost accounting system; and computer infrastructure that conforms to NIST 800-171.



ISO 9001
FM 69168