D-TA SYSTEMS

The Future Of EMSO

2026

OVER-THE-HORIZON RADAR

OTHR Products Brochure

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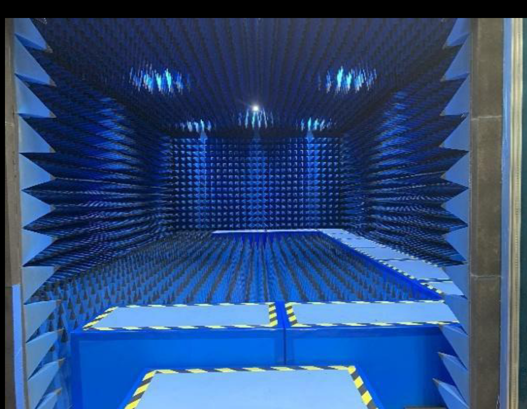

About D-TA Systems

D-TA SYSTEMS
The Future Of EMSO

Founded in 2007, D-TA designs, develops and manufactures spectrum processing solutions for demanding applications. D-TA's standard products cover virtually all aspect of Electromagnetic Spectrum Operations (EMSO): from spectrum sensing to spectrum creation. D-TA is the only SMB capable of offering complete turn-key solutions for all EMSO missions.

D-TA products are results of ‘out of the box' thinking, technical innovation, and no-compromise development that fulfills the company’s mandate to cut deployment risk, time, and cost by orders of magnitude. All D-TA products use antenna level digitization, high-speed optical networks as data backbone and software centric processing.

All D-TA products, including ESM/ELINT Radar, EW Emulation and Extreme-SWaP optimized products for disposable EMSO missions, are based on just two sub-systems (LRUs) connected by high-speed optical cables: a smart sensor-interface unit; and a (commercially available) processing server. The approach simplifies system design, installation, maintenance, and future upgradability.

Over the years D-TA has assembled a highly qualified technical team that has unparalleled expertise in RF, IF and Network system design and real-time multi-core software processing and EMSO application development. D-TA’s management staff has significant domain expertise and successful track record of managing and growing innovative businesses. D-TA has extensively equipped R&D and manufacturing facilities, including its own anechoic chamber. D-TA has over 50 active customers in FVEY, NATO and QUAD countries. Many of them are repeat customers.

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OVER THE HORIZON RADAR

D-TA has been involved in Skywave Over-The-Horizon Radar development since 2011. These radars use ionospheric reflections of HF signals to detect targets thousands of miles away. To combat the congested HF spectrum, these radars require receivers and transmitters with the highest possible performances and processing techniques that can detect low probability of intercept signals that exhibit both low and high doppler shifts.

Figure 1: 1024 receive channels are distributed across 4 identical racks with 256 channels in each rack. All 1024 channels operate synchronously across 4 racks with less than 1ns timing skew.

D-TA has been involved in many OTHR projects for channel characterization, R&D and risk mitigation and building two of the largest OTHR systems with 1024 receive and 256 transmit channels. One of the large OTHR systems has been deployed in the polar region and includes beamforming, range-doppler processing and long-duration recording of all channels at full bandwidth.

As OTHR activities skyrocket in recent years, D-TA is offering its highly advanced receiver and transmitter modules as COTS products to any System Integrator. These modules meet the stringent analog specifications and provide software-based narrowband channelization with floating-point arithmetic to provide over 140 dBc spur-free dynamic range. D-TA has recently introduced an innovative Shelter-Free rugged wide open front end (WOFE) receiver that can directly be placed outside near the antenna to enable direct digitization and simplifies site preparation, thereby saving millions of dollars.

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COTS-ifying OTHR

D-TA has been hard at work to de-risk deployment of large OTHR systems such as US HLD-OTHR and Canadian AOTHR for NORAD Modernization for on-time and on-budget delivery. With D-TA's decade-long experiences in deploying multiple OTHR systems in harsh environments, we can offer modular COTS Receiver and Transmitter (Arbitrary Waveform Generation) modules at competitive prices and timely delivery. These modules can be quickly integrated by a Lead System Integrator (LSI) for small and large OTHR applications.

Using WOFE receivers, the entire HF spectrum (3 to 35 MHz) is digitized and transmitted over fiber optics link to the OP shelter, where software based Digital Down Converters (DDC) channelize the data and send it to back-end software based processing modules over Data Distribution Service (DDS) for ease of integration. The software based DDCs use full floating-point arithmetic for each input using 64-bit double-precision arithmetic for NCOs. The result is an impressive 140 dBc SFDR performance after DDC channelization.

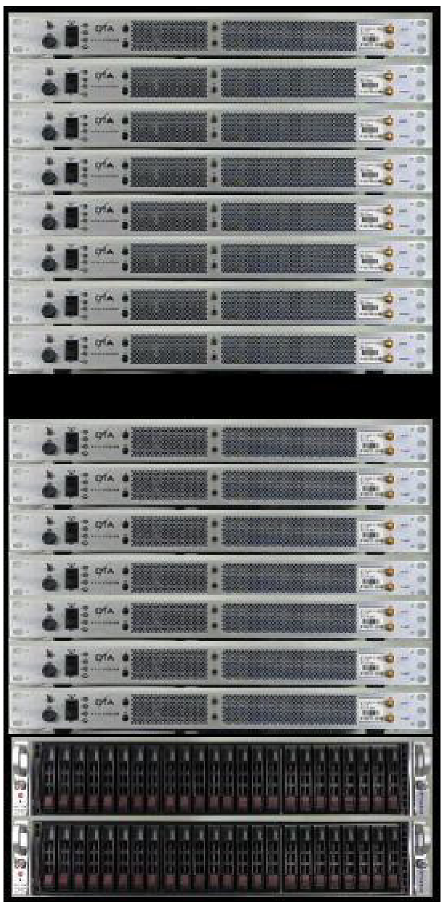

Figure 2: A 256-channel streaming I/Q based 256-channel AWG used for 2-D Transmit

The transmit system Sys-23H-T is based on the principle of I/Q data streaming from deep memories (RAID servers) to generate arbitrary waveform. It is, therefore, not limited to a particular signal type. Any waveform of any frequency within the entire HF band, and for virtually any duration, can be generated and transmitted. The building block of the Sys23H-T is an 8-channel unit with over 90 dB dynamic range. Internal digital signal processing uses 32-bit arithmetic (optionally 64-bit).

The 128-channel AWG shown here is built using the DTA-2300B – an 8-channel DAC output system. The output of the DTA-2300B can directly drive high power amplifiers. The AWG system based on I/Q data (complex baseband waveform data) streaming from deep memories (hard drives).

Power amplifies are integrated with the AWG system and allow for seamless operation. The integrated power amplifiers are able to handle full reverse power and enables implementation of a 2-D transmit array. For the POTHR-4 test bed, D-TA has delivered integrated PA each with 4kW forward power while handling 4kW reverse power without shutting down.

The COTS modules use commercially available RAID Servers for processing which are completely software based. Rapid reconfiguration is readily achieved. Further, fiber-optic networks provide the data backbone, which allows distributed processing with large separations between shelters housing various functional units.

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Next Generation OTHR

Since 2023, D-TA has upgraded its receiver and transmitter architectures for distributed processing and to meet stringent HLD requirements. The receiver system now includes a 4-channel WOFE receiver (DTA-2300H) that transfers ADC data to a signal processing server (DTA-1000H) via high-speed optical network. The WOFE features analog front-end linearization techniques to improve IP2/IP3 under strong interferers while minimizing Noise Figure.

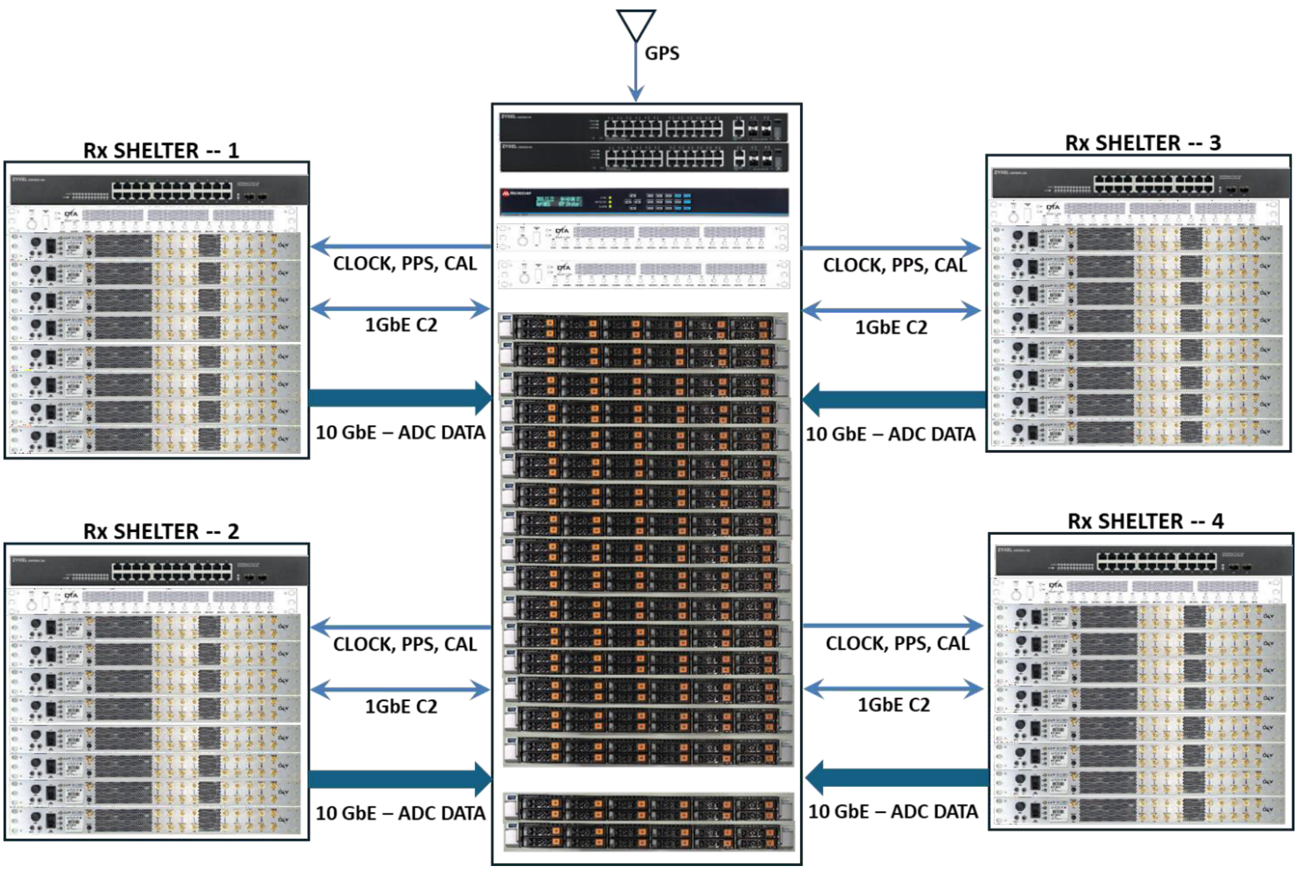

Figure 3: Layout of receivers in an OTHR deployment. Receivers are grouped in multiple groups with each group placed close to the subset of antennas it handles. Each group with N receivers is placed inside a protective shelter for outdoor operation . [N=32 in the above example]

The processing server (DTA-1000H) can be placed in the Master shelter in a secured setting. Narrowband channelization (DDC) is done in the DDC servers. This enables full floating-point operation and provides narrowband SFDR more than 140 dBc. The narrowband channelized DDC I/Q data is distributed over DDS interface to back-end radar processing servers. The architecture allows for use of government provided or other 3rd party processing algorithms to be used and allows for upgrade of algorithms without changing hardware.

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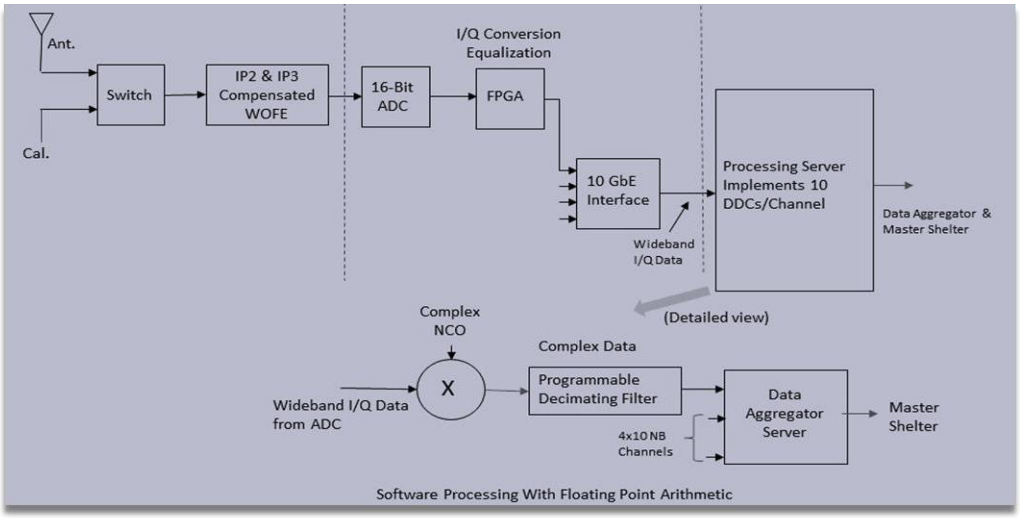

Figure 4: Single Channel Receiver Block Diagram

WOFE Analog Specification

The WOFE analog specification is presented in the table below.

Feature	Specification
Frequency	5 to 35 MHz (can be extended to 40 MHz)
Filter Bands	Bypass: 5 to 35 (or 40) MHz 5 to 8 MHz 7 to 12 MHz 1 to 20 MHz EQ Band: 19.5 to 35 (or 40) MHz, sloped to 5 MHz
Noise Figure	4 dB @ -40 dBm input 5 dB @ -30 dBm input 7 dB @ -20 dBm input 10 dB @ -16 dBm input 14 dB @ -10 dBm input
OIP3 (2-Tone)	+45.0 dBm @ -40 dBm input +45.0 dBm @ -30 dBm input +43.5 dBm @ -20 dBm input +44.5 dBm @ -16 dBm input +44.0 dBm @ -10 dBm input
OIP2 (2-Tone)	+95.0 dBm @ -40 dBm input +95.0 dBm @ -30 dBm input +92.0 dBm @ -20 dBm input +95.0 dBm @ -16 dBm input +95.0 dBm @ -10 dBm input

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Software Channelizer

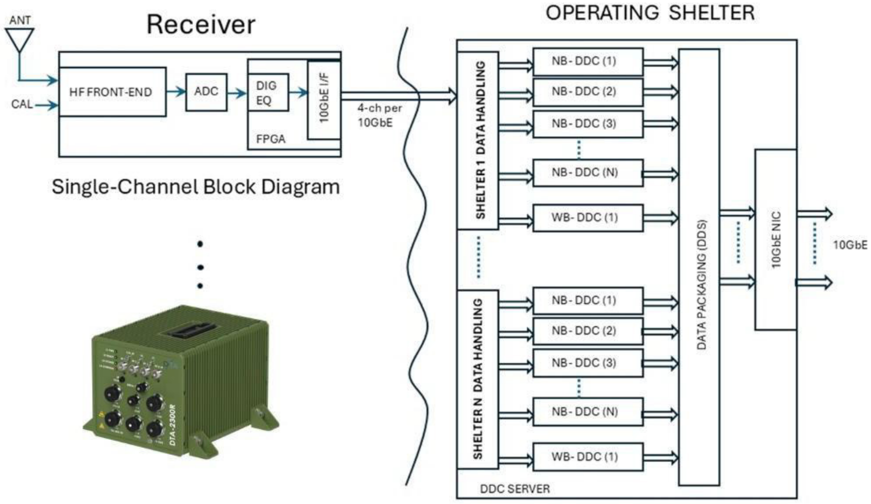

Figure 5: Network attached WOFE front-end streams full bandwidth HF data to operating shelter for channelization and processing. Channelization with SW DDC in the Op Shelter offers extreme performance and flexibility and simplification of the Rx shelter.

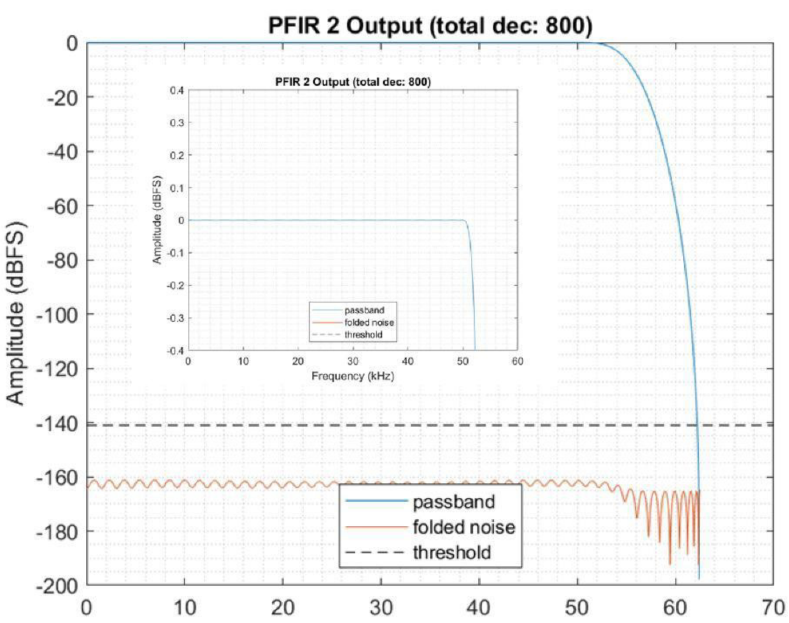

Figure 6: The SW DDC performance for a 100 kHz bandwidth – the zoomed in passband response shown as inset demonstrating negligible ripple and over 150 dB rejection.

Leveraging real time, multi-core, multi-threaded application development expertise, D-TA's extremely high dynamic range software based DDC solution is ideally suited for all HF applications. The software based DDCs allow floating point operation and provides unparalleled performance including better than 140 dBc spurious free dynamic range. High SFDR enables reliable detection of weak targets in the presence of strong HF interferers — a critical requirement for long-range early warning missions. This also allows the HF WOFE receivers to be installed near the antenna array and stream full bandwidth data to classified shelters having the DDC servers. This allows simplified red-black separation and simplifies system architecture.

OTHR receivers require narrowband channelization for high-precision processing for target detection and estimating target range and velocity. Multiple narrowband channels are used for simultaneous processing across multiple frequency bands.

Traditionally, FPGAs are used for DDC (comprising of NCOs and Decimating Filters) based channelization. FPGAs typically use fixed-point arithmetic with 16- or 32-bit arithmetic. To achieve ultimate phase noise and SFDR performances, D-TA has implemented DDCs, up to 10 per channel, with 32-bit floating point arithmetic for the decimating filters and 64-bit double precision arithmetic for the NCOs and other critical areas.

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DDC Implementation	Floating Point in Software
NCO Precision	64-Bit Double
NCO Spurs	Less than -143 dBc
DDC Decimation Range	160 to 80,000 (Extendable)
DDC Filter (CIC+FIR) BW	80% of Data Rate
DDC Filter Rejection at Nyquist & Beyond	>143 dBc
Cascaded Aliased Noise at all Decimation Stages	>143 dBc
Filter Taps	User Programmable
Self-generated Spurious	>143 dBFS
Output Precision	32-BIT I & 32-Bit Q, Floating Point, extendable to 64-Bit
No. of DDCs per Channel	10 (All can be full BW)
Output Data Link	10 GbE Optical
Output Data Format	Packetized Data with Meta Data Header

Test Data

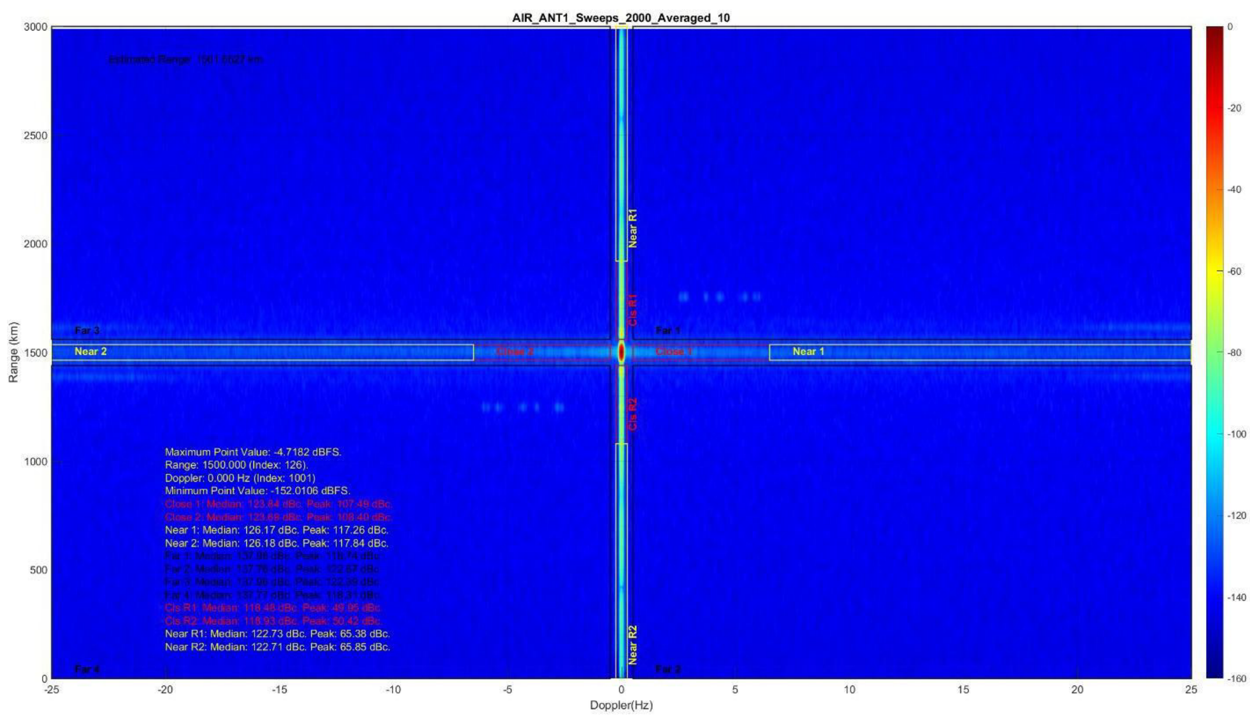

Figure 7: A range doppler plot for AIR waveform (WRF of 20 Hz with a BW of 10kHz) with close-in spectral purity of 123 dBc, Near spectral purity of 126 dBc and Far spectral purity of 137 dBc. The signal peak is at -4.7 dBFS

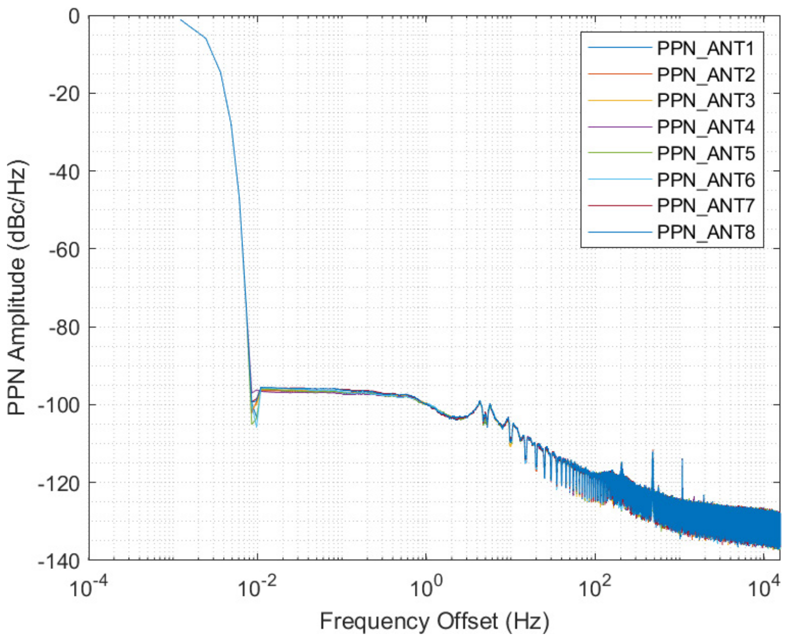

Figure 8: The unwrapped Pseudo Phase Noise (PPN) plot for multiple Rx channels using the PPN waveform (WRI of 200ms and BW of 25kHz)

Rx HMI

Figure 9: Receive Status monitoring. The dashboard can be easily customized by the user for monitoring specific parameters.

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A fully networked Rx status monitoring HMI delivers an integrated master shelter view for the radio. Examples of monitored parameters are the operating gain and filter states, internal temperature, input power, data flow status, etc. The HMI logs status over time for real-time views and historical perspective. Multiple operators can monitor and customize the dashboard simultaneously.

Dynamic OTHR Transmit

The legacy approach of integrating a small digital memory with a Power amplifier for HF transmit is highly inadequate for modern OTH radar implementation which requires the transmit system to be dynamic for detecting agile and high velocity targets. The digital memory used is limited in capacity and typically only holds an LFM transmit waveform for repeated use. A smart transmit system requires transmit waveform's frequency, modulation, PRI and PW to change every transmit cycle (CPI or illumination period) by operating in a scheduled mode.

D-TA's Power Amplifier (PA) integrated Arbitrary Waveform Generator (AWG) provides the ultimate flexibility for implementing a smart and dynamic transmit solution. The AWG is based on streaming I/Q data (waveform baseband time series data samples) from deep memories (computer hard drives). Since the storage capacity is very large (multiples of TBs), many different transmit waveforms can be pre-stored in the hard drives for use as required for each transmit cycle. Leveraging D-TA's multi-core based real-time processing expertise, it is also possible to compute a transmit waveform in real time based on the analysis of received signals.

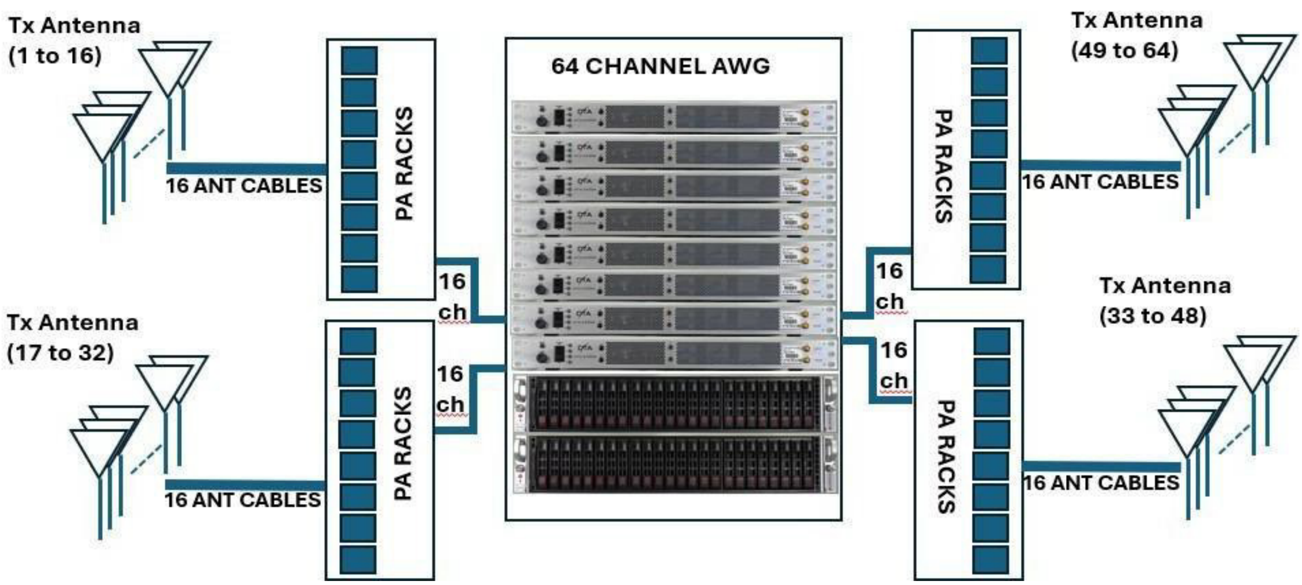

Figure 10: Example of a 256 kW transmit solution with 64 antennas each driven with a 4kW power amplifier with built in harmonic filter. The PAs can handle the full reverse power while maintaining the forward power and are ideally suited for a 2-D Tx array. By combining more PA modules, the EIRP can be doubled or quadrupled.

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Major Specifications of the DTA-2300B 8-channel AWG unit

Feature	Specification	
Number of Synchronous Outputs	8	
DAC Precision	16 Bits	
SFDR	90 dBc	Narrowband Channels
Channel BW	User Programmable from 5 kHz to 30 MHz	DUC Programmed Interpolation
Digital I/Q data	10 GbE Optical fiber	
Digital Equalization	Yes	Compensation for amplitude and group delay
Sampling Clock	100 MHz	
Phase Noise at 30 MHz o/p	-109 dBc/Hz at 1 Hz offset -125 dBc/Hz at 1 kHz offset -150 dBc/Hz at 100 kHz offset	Dependent on the 100 MHz sampling clock
Phase Noise at 10 MHz o/p	-115 dBc/Hz at 1 Hz offset -135 dBc/Hz at 1 kHz offset -155 dBc/Hz at 100 kHz offset	Dependent on the 100 MHz sampling clock
Built-In Test	Available	
System Health Monitoring	Available	
Power Consumption	100 W	
Size	19” x 1 U Rack	

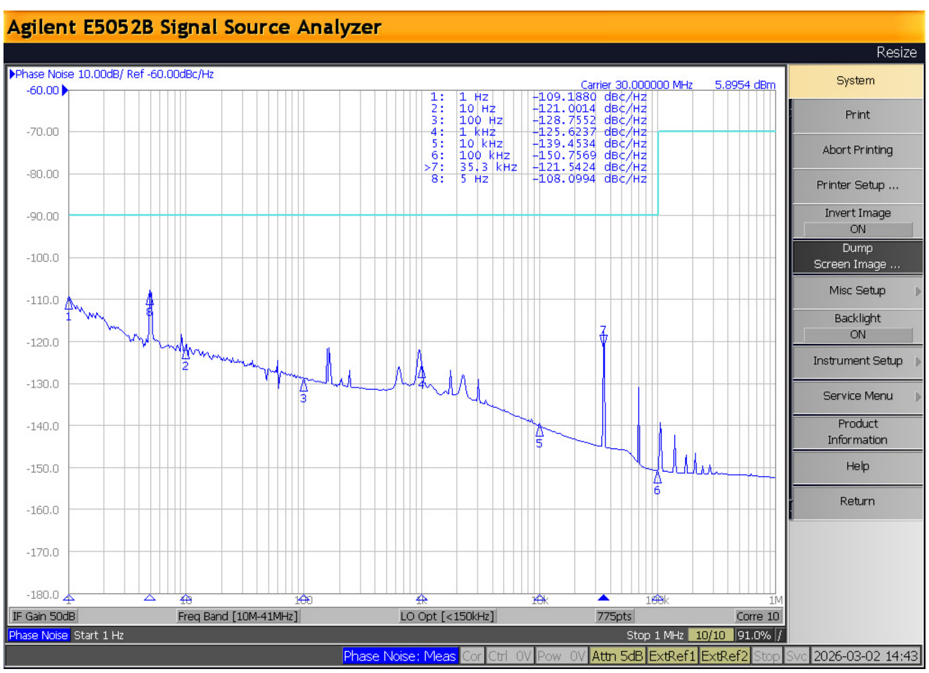

Figure 11: The phase noise plot for a 30 MHz output from the AWG.

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Tx HMI

The integrated HMI showing colour coded values for the PA operating state, forward and reverse power; AWG and GPS status. Additional details for debug and trouble shooting available by clicking individual items in the dashboard. The HMI logs status over time for real-time views and historical perspective. Multiple operators can monitor and customize the dashboard simultaneously for their use.

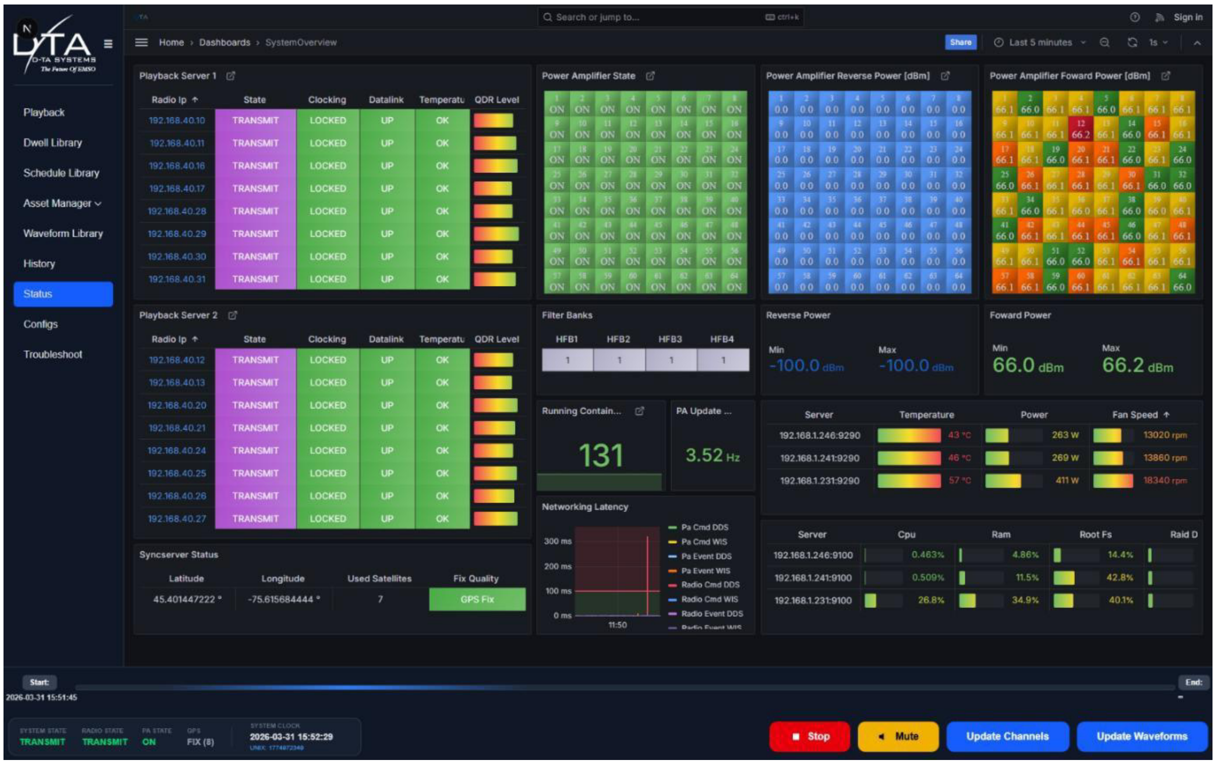

Figure 12: Status monitor of the PA integrated AWG showing PA forward and reverse power and AWG status.

The Tx HMI allows multiple operators to monitor and customize the dashboard simultaneously.

Shelter Free Rx Simplifies OTHR Installation

To simplify the logistics of building receive shelters and to place the receivers close to the antenna to reduce the antenna cable losses, D-TA has designed a shelter-free rugged WOFE receiver (DTA-2300R). The smallest block is a 4-channel unit that preserves all the functionality and analog performance of the DTA-2300H receiver that can be directly placed on the ground near the antenna for antenna level digitization and streaming the digitized version of the entire HF spectrum to the Op shelter for DDC and radar processing. The front-end provides the requisite gain and anti-aliasing filtering. Minimal site preparation is required thereby speeding up the system installation and commissioning and reducing the system deployment cost.

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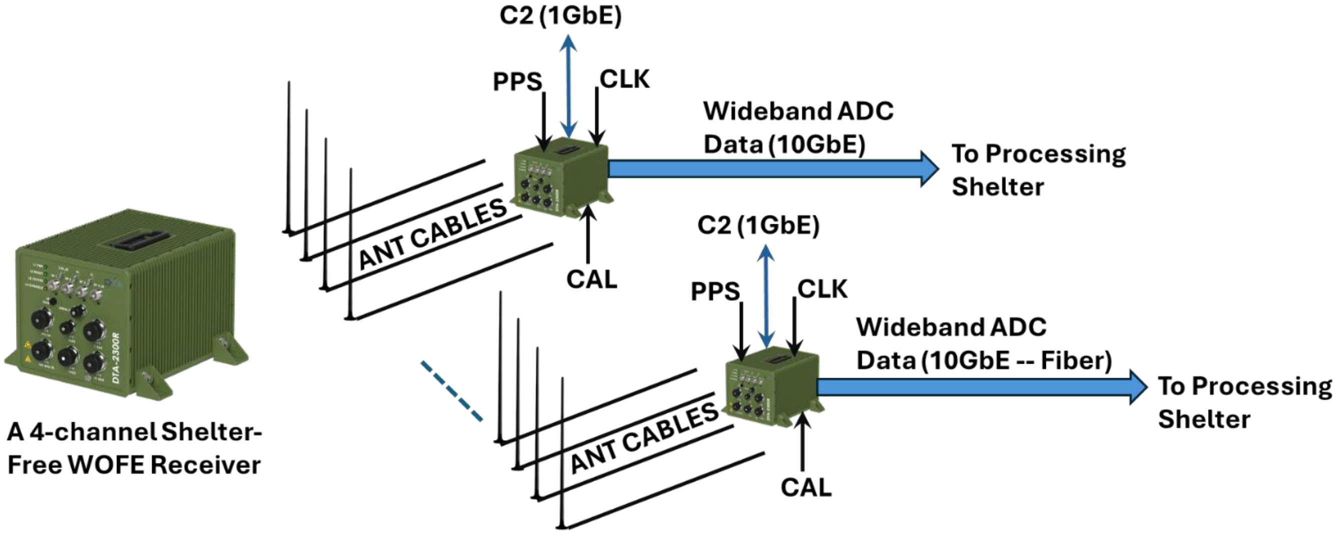

Figure 13: Site Installation made simple with D-TA's Shelter Free Receiver. The use of fiber-optic cables for clock, PPS, C2 and data simplifies installation and improves performance. Processing / Op Shelter includes commercial servers.

Shelter free receiver mechanical and environmental specifications

Feature	Specification
HF In Connectors	N-Female
Calibration In	SMA Female
Size	369.5 x 279.5 x 261.1 mm (in between ATR1 Short and ATR1 Long)
Operating Condition	-40C to +40C with natural convection
IP Rating	IP67
MIL-STD	MIL-STD-810H, MIL-STD-1472
Material	Aluminum 6061-T6
Finish	Chemical Conversion Coat Per MIL-DTL-5541 Type II, Class 3 + Green Matte Powder coat

The analog and functional features are same as the rackmount receiver.

OTHR Stimulator and Multi-Channel Rx Test

The AWG system is based on the concept of streaming baseband I/Q time-series data from computer hard drives to an HF signal generation circuit. The I/Q data is either mathematically computed based on a signal scenario or collected from an actual mission and stored in the hard drives. Upon playback, the digital I/Q samples are sent to an FPGA for digital up conversion (DUC), followed by a DAC and LPF to generate HF environment.

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Figure 14: A 64-channel streaming I/Q based OTHR stimulator in a portable carrying case for ease of Rx testing.

The I/Q data is prestored in the RAID server for playback during a test mission. Many I/Q data files can be stored, and a particular file is selected for playback in a loop or one-shot mode. Alternatively, several data files can be played back in a sequential manner using a soft or hard trigger to create a dynamic scenario. This is called a scheduled mode of operation. The same hardware used in the AWG transmit is used for the stimulator and Rx testing.

The stimulator software uses the ionospheric propagation modelling together with transmit and receive antenna array structure to simulate the I/Q data as received at the receive antenna array. It adds target characteristics (RCS, range, velocity) and ground and auroral clutter to the received waveform. The software offers unprecedented degrees of freedom in designing and evaluating the radar waveforms and allows the user to numerically simulate the Range-Doppler response for arbitrary Tx-Rx array geometry and target clutter models.

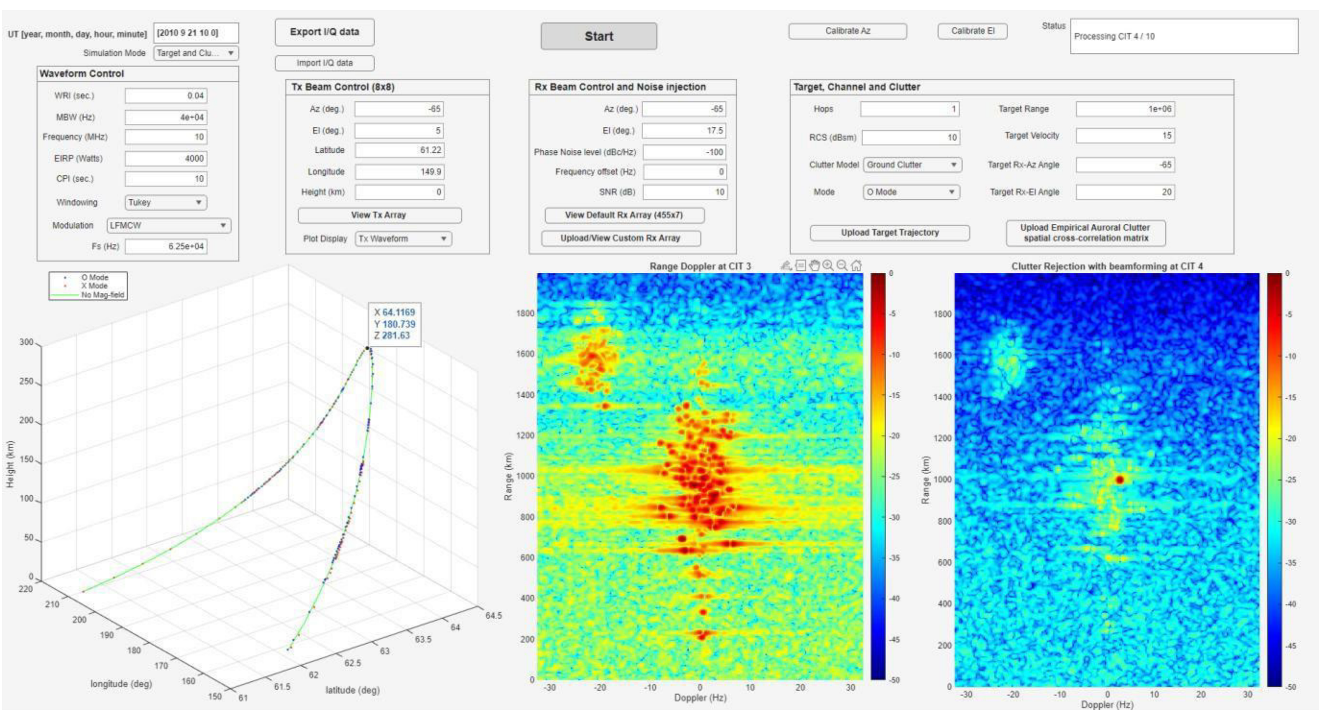

Figure 15: The HMI of the OTHR stimulator. The panel at the top allows users to define the waveform characteristics (WRI, modulation, bandwidth, etc.), Tx and Rx array geometry and target, channel and clutter parameters (target RCS, velocity, angle, range, clutter models, etc.). The 3 plots at the bottom (from left to right) show the reflected path of the radar, the range-doppler of any one of the receive signal (without any beamforming) and the range doppler after Rx beamforming. In the 2nd plot the target is hidden within the clutter and angular separation (using the Rx array) is needed to isolate the target. The Rx processing is not part of the Tx stimulation and is provided to verify simulator performance.

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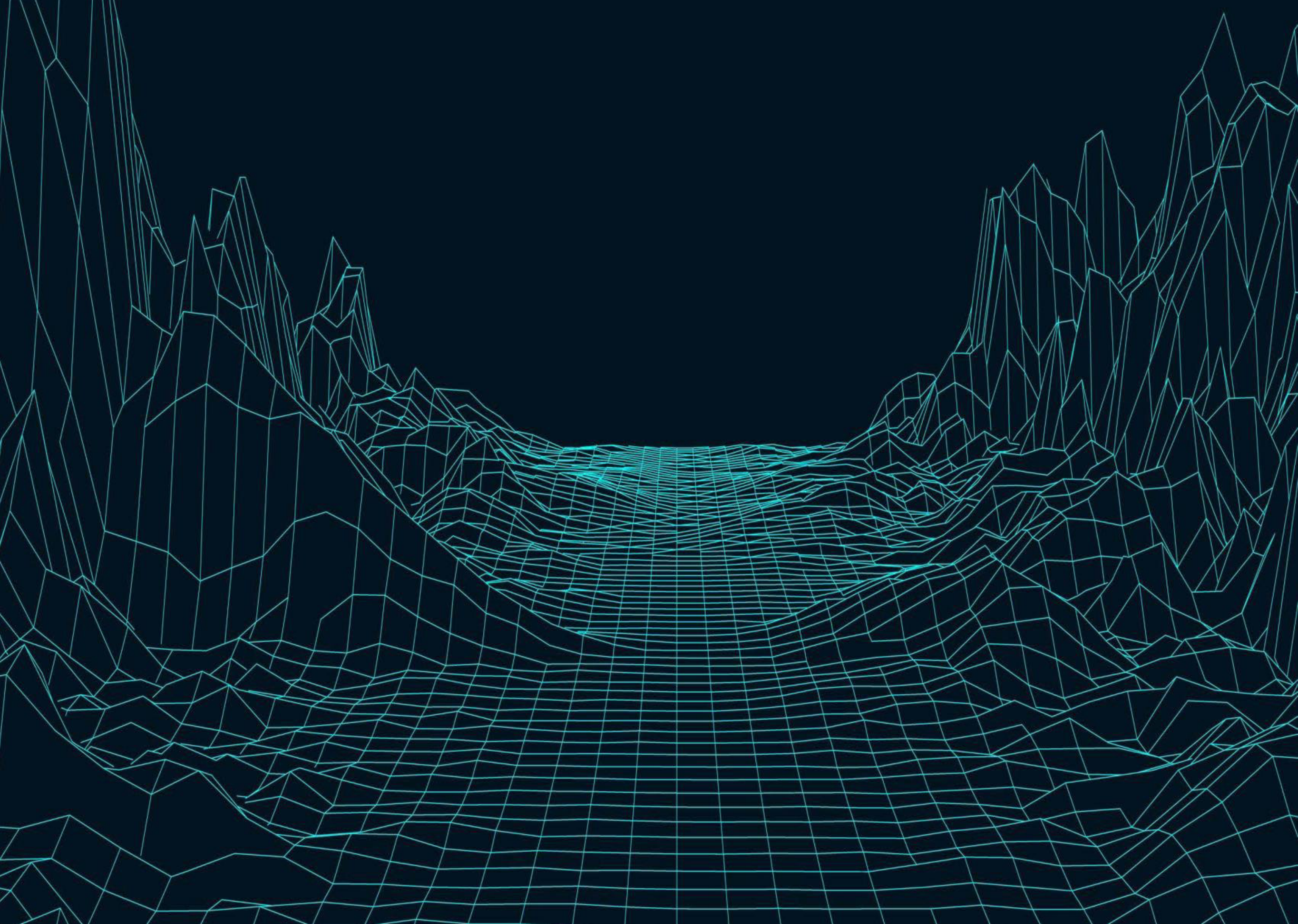
D-TA offers cutting-edge solutions for Electro-Magnetic Spectrum Operations (EMSO) to those who protect us.

From Antenna and RF Design to High-Speed Networks and Multi-core Real-Time Software Technologies, D-TA controls the technology stack to bring you end-to-end solutions for:

- SIGINT for spectral surveillance for threat detection
- EW Threat Emulation for device testing and operator training
- Over-The-Horizon Radar for long-range surveillance
- Wideband multi-channel RF & IF record/playback
- Extreme-SWaP and mission agnostic EMSO solutions



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