Ranger and T/Rx Application Document – Training System

Train like you fight; fight like you train. VIAVI Solutions offers advanced Electronic Warfare training solutions for the modern warfighter.

Several key elements must come together successfully to deploy an effective training system. Accurate, high-resolution signal creation and generation hardware components need to be accessible through powerful, user-friendly software tools to build the foundation for an effective system. A comprehensive library of high-fidelity signal waveforms is essential to creating realistic signal environments needed for training. Advanced automation tools are necessary to precisely coordinate spectral emissions and monitor trainee responses throughout the training scenario and across the area of operation. Monitoring and analysis capabilities are needed to establish and maintain ground truth throughout the training exercise. VIAVI Solutions provides a comprehensive, fully-integrated tool set to create this highly-effective training environment, including Ranger, T/Rx, Signal WorkShop™, and EMS Sequencer products.

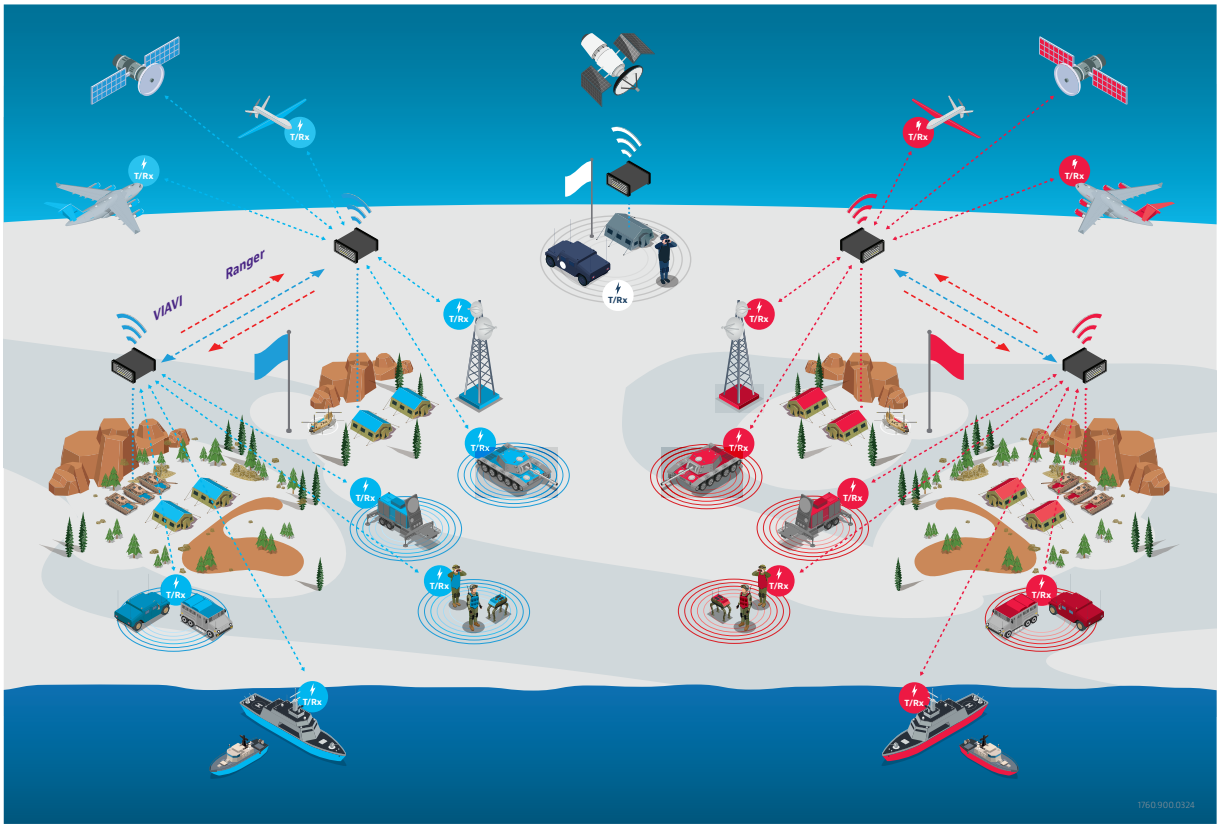

Figure 1: Operational View – VIAVI Ranger and T/Rx Training Environment

To create a successful, effective training scenario, the signals transmitted into the environment must be a high-quality representation of the original target signals, including RF parametric accuracy and realistic data payloads. The quality of transmitters and sensors/receivers must support the signal integrity needed to create realistic signals and signal environments. An effective training system must be able to create realistic and dynamic signal environments that operators and systems under test will properly recognize and adjudicate. VIAVI Ranger and T/Rx products include state-of-the-art baseband digital and RF hardware capabilities to create and replicate signals with unsurpassed fidelity, providing realistic environments that facilitate real-world training conditions.

A comprehensive library of high-fidelity signal waveforms is essential to an effective training platform. The VIAVI Solutions Ranger, using Signal WorkShop software, is the best tool on the market to create and/or record signals or signal environments necessary to create realistic, dynamic electromagnetic training environments. Ranger supports up to 1 GHz of Instantaneous Bandwidth to record entire signal environments for hours at a time. Using reduced bandwidth settings, Ranger can record continuously for days. Ranger can record complete environments, including multiple signals and discrete signals of interest such as specific radios or radars. Signal WorkShop includes advanced processing features to analyze, trim, filter, and optimize each signal for proper playback. Furthermore, Signal WorkShop can use parametric inputs to synthetically create ideal IQ waveforms when a pristine representation is needed or when signal sources are not available for recording. These synthetically generated and recorded signals can be stored in an I/Q waveform library for use in playback operations. This process creates the library of signals and signal environments that can be used to create training environments that accurately reproduce real-world conditions.

VIAVI Solutions EMS Sequencer software uses signals from the Signal WorkShop signal waveform library to build fully-automated training scenarios.

EMS Sequencer provides user-friendly tools to schedule and automate transmit and record operations on multiple Ranger and T/Rx units. This software presents an intuitive user interface to schedule transmit and record operations by placing tasks on a timeline associated with each Ranger or T/Rx unit. Each task can be associated with a waveform file, gain, power level, frequency, number of iterations, and other parameters needed to create a complex vignette. When executed, EMS Sequencer coordinates the transfer of all required files and parameters while coordinating each task with precision timing. For missions that do not have reliable network infrastructure, EMS Sequencer can transfer all required files and schedule each Ranger and T/Rx unit to perform scheduled tasks based on each unit's precision GPS-trained internal time clock, without the need for external command and control. VIAVI even offers resilient GPS technologies to ensure this operation in GPS-denied environments. Finally, Sequencer software may be installed and run on a Ranger unit or on a dedicated offline computer.

Both Ranger and T/Rx can be scheduled to perform complex, automated training missions using the EMS Sequencer software. Each product also provides intuitive user interface software for manual operation. Each product's local User Interface can be used to manually control the asset or to interrupt the automated sequence and retask the asset. This local interface can be accessed from the UI device (PC, smartphone, tablet, etc.) physically attached to the asset or from a remotely located UI device attached to the same network. These capabilities provide maximum capability and flexibility for automated, manual, and ad-hoc training scenarios.

Ranger and T/Rx can monitor and record the Electromagnetic Spectrum during the execution of a training scenario. This capability can be used to detect and evaluate the effectiveness of equipment, countermeasures, operators, and procedures in response to signals presented in the training environment. The same T/Rx systems deployed as emitters throughout the area of operation can also be tasked as sensors to perform this monitoring and recording function. Both Ranger and T/Rx provide RF event-based triggers that can be configured to perform recordings when specific signal conditions are detected in the Electromagnetic Spectrum. This powerful sensing capability can be used to establish and measure Key Performance Indicators needed to evaluate operator, equipment, and training effectiveness as well as to track progress and improvement.

VIAVI Solutions provides comprehensive solutions to monitor, record, analyze, and generate complex Electromagnetic Spectrum (EMS) environments. These products include the Ranger Record/Analyze/Playback system, the T/Rx Software Defined Transceiver (SDT) System, Signal WorkShop software, and EMS Sequencer software. Together, these products create a unique, comprehensive system that allows our customers to monitor, analyze, record, replicate, and exploit the EMS.

As a provider of advanced spectrum monitoring and EW equipment, VIAVI understands the challenges of Electromagnetic operations in pear or near-pear situations. EW operators and commanders need to be prepared to make rapid and well-informed decisions to disrupt and degrade an adversary's ability to use the spectrum and detect friendly locations while also ensuring unimpeded use of the spectrum by friendly forces and assets. VIAVI Ranger, T/Rx, and associated software products provide capabilities needed to understand and exploit the Electromagnetic Spectrum through monitoring, recording, analysis, obfuscation, and denial. These capabilities are well suited for both operational use and training, following the philosophy of "Train like you fight; fight like you train."

The **Ranger** provides signal creation, recording, analysis, and playback capabilities necessary to thoroughly understand and accurately replicate the Electromagnetic Spectrum. The Ranger provides capabilities to perform wide-bandwidth, deep-memory recordings of signals to create a signal library for signal identification, obfuscation, spectrum denial, and training missions. The Ranger uses Signal WorkShop as the User Interface, signal analysis, and signal creation software. Signal WorkShop is also available in a stand-alone version that can be used on a standard computer.

The list below shows some highlights of the Ranger capability:

- Transmitter and receiver frequency coverage from 1 MHz to 6 GHz, with options up to 44 GHz
- Standard 200 MHz instantaneous signal bandwidth, with options up to 1 GHz
- Modular platform provides flexibility to create custom configurations
- Signal WorkShop software provides powerful tools for EMS analysis, synthesis, recording, and playback
- Intuitive User Interface simplifies complex EMS analysis, generation, obfuscation, and training tasks
- Mass waveform storage memory provides hours of recording and playback at full signal bandwidth
- Connects to any standard Internet Protocol (IP) based network (wired Ethernet, Silvus radio, Trellisware radio, etc.)
- Interfaces with EMS Sequencer software to transfer waveforms and schedule transmissions and recordings on multiple T/Rx and Ranger units

Figure 2: VIAVI Ranger

T/Rx provides a compact, rugged, all-weather platform that can be operated from a fixed installation, backpack, vehicle, UAV, or unmanned remote location. The T/Rx also provides signal monitoring and identification as well as wide-bandwidth, deep-memory recordings. With its small size, modular power amplifier, and optional battery power, the T/Rx is suited for remote operation away from the main Command Post, Tactical Operation Center, Range Complex, or other fixed installation sites. Synthetic signals created on Ranger or Recordings that were made with a Ranger or T/Rx can be replayed into the Electromagnetic Spectrum, using T/Rx units, creating realistic and dynamic Electromagnetic Environments for use in obfuscation or training missions. The list below shows some highlights of the T/Rx capabilities:

- Two independent transmitters and two independent receivers per unit
- Transmitter and receiver frequency coverage from 1 MHz to 18 GHz
- Up to 400 MHz instantaneous signal bandwidth on each transmitter and receiver
- Compatible with Signal WorkShop signal waveform files used on the Ranger
- Intuitive and mobile-friendly User Interface can be operated from a PC, mobile phone, or tablet device directly connected to the T/Rx unit or remotely located
- Interfaces with EMS Sequencer software to schedule transmissions and recordings on multiple T/Rx and Ranger units
- Flexible software defined radio architecture can be used for many applications
- Software Communications Architecture (SCA) framework enables rapid deployment of new features and applications
- Modular hardware separates the SDT from the power amplifier unit, allowing for customizable configurations
- Flexible mounting solutions for fixed installation as well as vehicle and dismount configurations
- Connects to any standard Internet Protocol (IP) based network (wired Ethernet, Silvus radio, Trellisware radio, etc.)
- Operates on shore power, vehicle power, or standard BB-2590 batteries

Figure 3: VIAVI T/Rx Manpack

Figure 4: VIAVI T/Rx SDT and PA

T/Rx software is built on the Software Communications Architecture (SCA) JTNC SCA 4.1 core operating framework, providing an open software architecture and allowing for rapid development and deployment of new features and capabilities. The SCA framework significantly reduces the time, effort, and cost of developing and deploying new features or entirely new applications onto the platform as new capabilities are required. The SCA used in T/Rx is certified and fully-compliant with the SCA standard, and the core framework was used as the reference implementation in development of the US DoD's SCA Certification Lab.The SCA is part of the DoD's Sensor Open Systems Architecture (SOSA) making it ready for integration with other emerging DoD platforms. The SCA 4.1 standard is also called out in the DoD Information Technology Standards Registry (DISR) as required for all new tactical Software Defined Radios (SDR). VIAVI SCA tools and Raptor platform are listed as reference implementations as well. The combination of modular hardware design and open software architecture allows the T/Rx to be customized and upgraded throughout the lifespan of the system, providing long-term obsolescence protection.

EMS Sequencer software provides tools to schedule transmit and record operations on networked Ranger and T/Rx units. This software presents an intuitive user interface to schedule activities by placing tasks on a timeline associated with each Ranger or T/Rx unit. Each task can be associated with a waveform file, gain, power level, frequency, number of iterations, and other parameters needed to create a complex vignette. When executed, EMS Sequencer coordinates the transfer of all required files and parameters while coordinating each task with precision timing.

Figure 5: EMS Sequencer

The VIAVI products highlighted in this document provide a comprehensive tool set needed to create an effective training platform. The Ranger provides powerful tools to synthetically create signals based on parametric characteristics or record signals emitted from target devices or received over-the-air in live environments. Signal WorkShop software provides tools to analyze and process these signals to create a library of high-resolution I/Q waveform files needed to replicate both friendly and threat signals that can be replicated in the training environment. T/Rx units can be dispersed throughout the training area in a combination of fixed installations, vehicle installations, manned backpacks, and unmanned displaced units. The UI for each T/Rx can be operated locally on each T/Rx or remotely over a network connection. The EMS Sequencer software can be used to execute a pre-configured vignette, using many T/Rx units, designed to create a realistic and dynamic EMS that includes a rich variety of signals and changes over time and geographical location. Finally, the receive channels on the T/Rx units can be used to monitor the reactions of personnel and equipment throughout the training environment to assess the effectiveness of the training, operators, and equipment. These products provide the most advanced Electronic Warfare training capability available to the modern warfighter.

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