Communications Scenario Generator

Wideband radio-frequency scenario simulation software

Communications Scenario Generator builds a radio-frequency environment entirely in software. Each emitter has its own source, coding, scrambling, interleaving, modulation, spreading or hopping, timing, level and propagation channel; the generator combines all of them into one wideband I/Q stream and writes a file listing the known parameters of every emitter. The stream goes to a file, to the network or to a software-defined radio, so the same scenario can drive a receiver test, a signal analysis system or a training exercise. It is the signal generator of EW Training Suite, offered on its own.

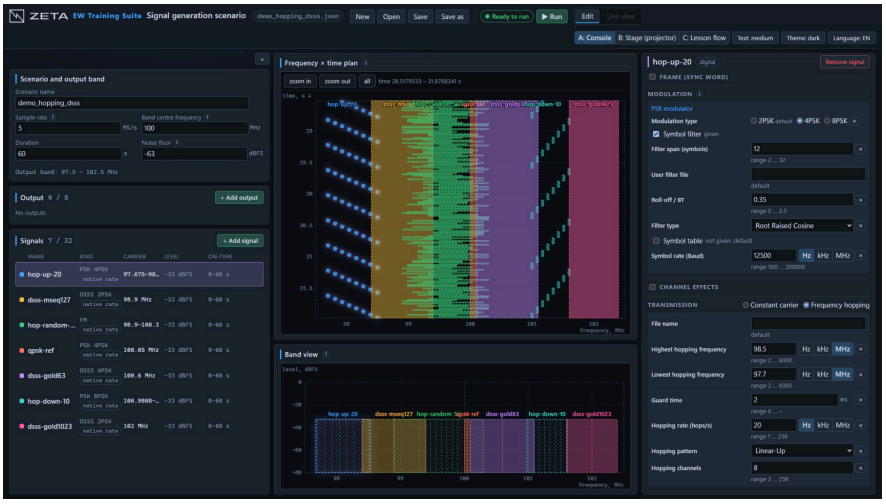


Figure 1. Scenario page: frequency–time plan, band view and the parameters of a frequency-hopping signal

Key Features

- Scenarios on a frequency–time plan
- Communication and radar waveforms
- Propagation channels
- File, network and radio outputs
- Known answers for every emitter
- Scales with the workstation

AT A GLANCE

SIGNALS PER SCENARIO
256 by default, configurable up to 1024

SIGNALS ON AIR AT ONCE
32 by default, configurable up to 128

OUTPUT SAMPLE RATE
Configurable, up to 125 MS/s

REAL-TIME CAPACITY
Scales with the workstation's processor cores; optional NVIDIA GPU output stage

SIGNAL SOURCES
Random bits, bit files, bit editor, sync words and frames, Morse text, tones, noise, audio files (WAV, MP3, FLAC, Ogg Opus), I/Q recordings

APPLICATIONS

- Test signals for receivers, direction finders and signal analysis systems
- Automatic scoring of detection, recognition and decoding against known answers
- Signal environments for EW operator training
- Repeatable acceptance and regression test scenarios

Capabilities

Scenarios on a frequency–time plan

The scenario page shows every emitter on a frequency–time plan and in a band view, with a parameter panel that lists ranges and defaults and validates the scenario before it runs. Each emitter has its own on-air windows and level; a total level cap scales all emitters together when their sum would clip. Scenarios are stored as files, and the same scenario runs from the command line.

Communication and radar waveforms

Sources range from random bits, bit files, frames and Morse text to tones, audio files and I/Q recordings. Each emitter is coded, scrambled, interleaved and modulated in its own chain, then sent as a constant carrier, in bursts or TDMA time slots, by frequency hopping or with direct-sequence spreading. Radar emitters are pulsed or CW, with agile pulse width, pulse repetition interval and carrier, and intra-pulse modulation.

Propagation channels

Each emitter can pass through an ITU-R F.1487 HF channel (latitude, condition, NVIS), an ETSI EN 300 392-2 VHF/UHF land-mobile channel (static, rural, typical urban, bad urban, hilly terrain, equaliser test, with vehicle speed) or a custom multipath channel with per-tap delay, gain, Doppler and Rice factor, plus frequency offset and phase noise.

File, network and radio outputs

The wideband stream is written as raw int16 I/Q or VITA-49 with SigMF metadata, sent over UDP as raw I/Q or VITA-49, or radiated through a software-defined radio. A scenario runs in real time or at a chosen speed ratio, so long scenarios can be rendered to file faster than real time.

Known answers for every emitter

Alongside the signal, the generator writes a machine-readable expected-result file with every emitter's carrier, level, timing, modulation, rates, codes and channel, and its ITU emission designation and necessary bandwidth under ITU-R SM.1138. The same scenario and seed give the same signal, so a receiver or analysis system can be scored automatically against the known answer.

Scales with the workstation

A scenario holds 256 emitters with 32 on air at once by default, configurable up to 1024 and 128, at output sample rates of up to 125 MS/s. Generation runs on the processor's cores and the wideband output stage can move to an NVIDIA GPU, so real-time capacity grows with the workstation. It runs on Windows 11 and Linux.



Figure 2. Live view: frequency-hopping and direct-sequence signals in a 5 MHz band, with the constellation and eye diagram of the selected QPSK signal

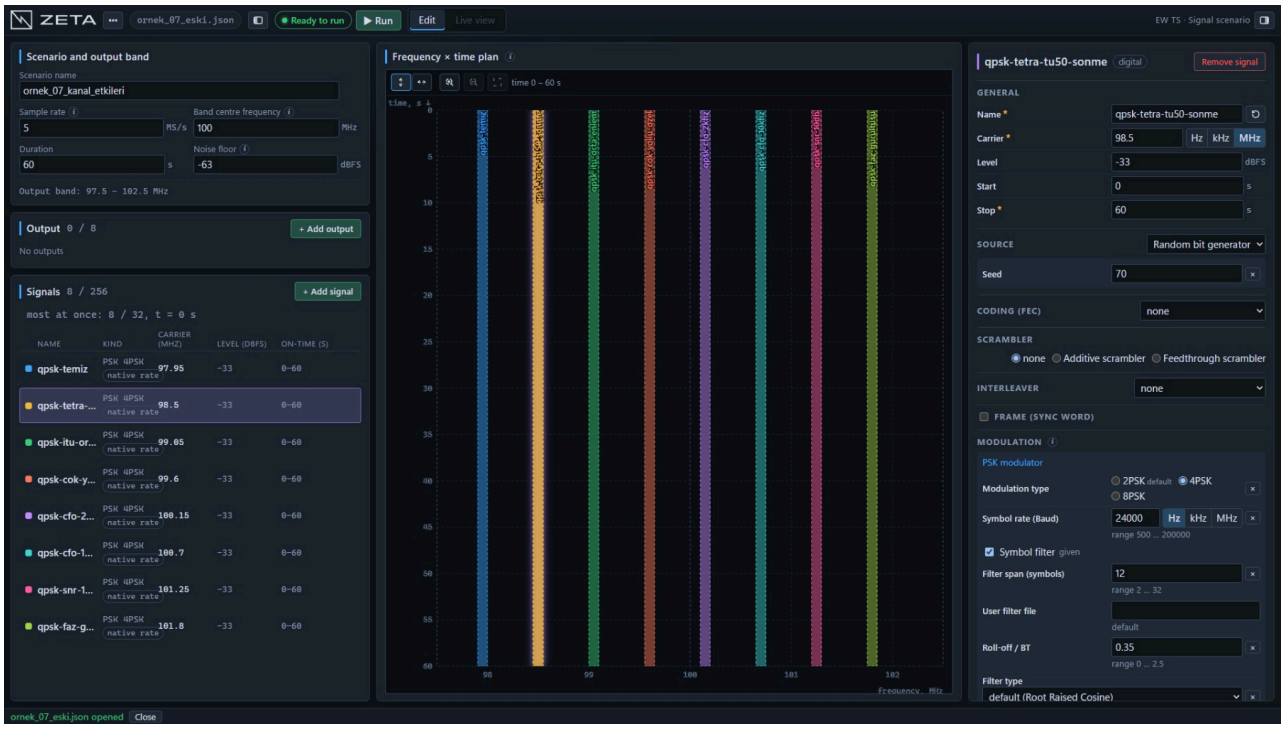


Figure 3. Scenario page: eight QPSK emitters, each through a different propagation channel

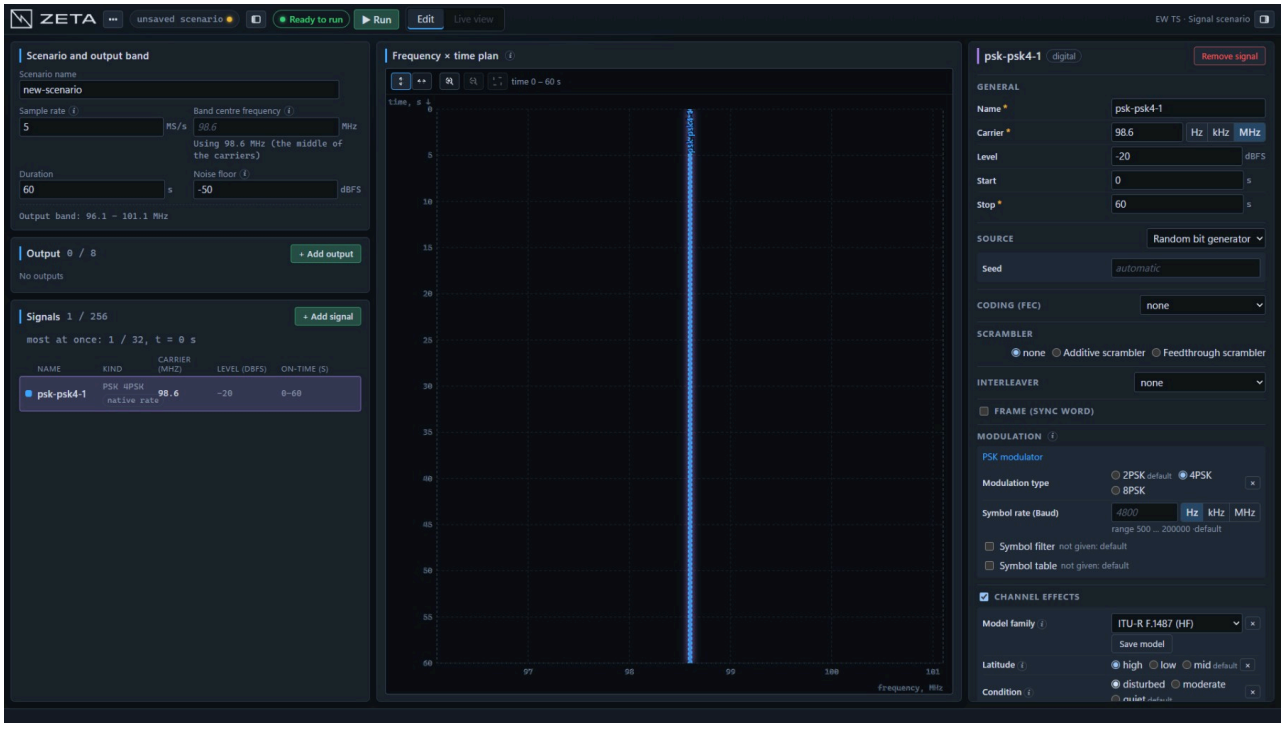


Figure 4. Scenario page: ITU-R F.1487 HF channel settings for a QPSK emitter

Specifications

General	
Signals per scenario	256 by default, configurable up to 1024
Signals on air at once	32 by default, configurable up to 128
Output sample rate	Configurable, up to 125 MS/s

General	
Real-time capacity	Scales with the workstation's processor cores; optional NVIDIA GPU output stage
Signal sources	Random bits, bit files, bit editor, sync words and frames, Morse text, tones, noise, audio files (WAV, MP3, FLAC, Ogg Opus), I/Q recordings
Analogue modulation	AM, FM, USB, LSB, CW (Morse)
Digital modulation	2/4/8-PSK; 16, 32, 64, 128 and 256-QAM; 2–64 FSK, MFSK, CPFSK, MSK, GMSK
Pulse shaping	Root raised cosine, raised cosine, Gaussian, rectangular, user-defined filter
Error-correction coding	Convolutional (including punctured), Reed-Solomon, BCH, turbo
Interleaving and scrambling	Block, convolutional and matrix interleavers; additive and self-synchronising scramblers
Spread spectrum	Direct sequence (m-sequence and Gold codes), frequency hopping with selectable patterns, rates and channel sets
Multiple access	FDMA, TDMA groups (time slots), burst transmission
Radar	Pulsed and CW; pulse width, PRI and carrier stable, wobbulated, jittered, staggered or dwell-switched; intra-pulse modulation
Channel models	ITU-R F.1487 HF (latitude, condition, NVIS); ETSI EN 300 392-2 VHF/UHF (static, RA, TU, BU, HT, EQ, vehicle speed); custom multipath with delay, gain, Doppler and Rice factor; frequency offset; phase noise
Level control	Per-signal level in dBFS, noise floor, total level cap with common scaling
Outputs	File (raw int16 I/Q or VITA-49, with SigMF metadata), UDP (raw or VITA-49), SDR
Run speed	Real time or a chosen speed ratio
Expected-result file	Known parameters of every emitter, with ITU emission designation and necessary bandwidth (ITU-R SM.1138)
Repeatability	The same scenario and seed give the same signal
Interfaces	Web-based scenario page served by a local station program; command-line tool
Operating system	Windows 11, Linux

Warranty

All hardware and software procured from Zeta is under warranty against manufacturing or design failures for 2 years. Customer-specific warranty terms may be arranged.

Disclaimer

Due to ongoing research and development, Zeta reserves the right to change product specifications without notice.

About Zeta

Zeta Defence develops electronic intelligence (ELINT) and communication intelligence (COMINT) equipment and radar / electronic warfare simulators. Its capabilities include RF transceiver system design, digital design and large-scale software development.

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