ELECTRONICS & DEFENSE

GSG 8 Gen2

EXPERT GNSS SIMULATOR

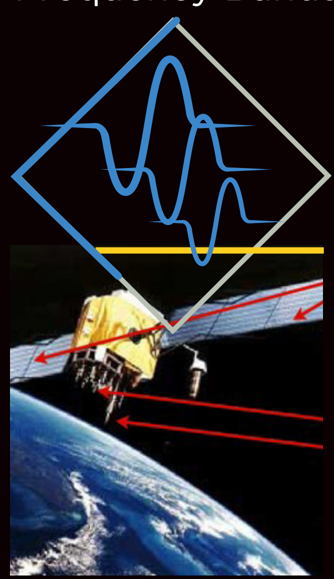
SAFRAN


SAFRAN
GSG 8 Gen2
POWER
20
RF OUT 1
RF OUT 2
RF OUT 3
RF OUT 4
RF OUT 5
RF OUT 6
RF STATUS
COMBINED OUTPUT

HIGH PERFORMANCE AND CAPABILITY MADE EASY.

2000+
Signals

Advanced Jamming & Spoofing on All Frequency Bands



Up to **6**
RF Outputs

1 Combined RF Output

Up to **6**
Simulated Antennas

THE IMPORTANCE OF GNSS SIMULATION

"To efficiently perform GNSS simulation, generated signals and environments must be realistic."

Simulating a comprehensive and realistic environment encompassing satellites, atmospheric conditions, geographic locations, velocities, and both natural and man-made errors is a complex endeavor.

Simulation then allows us to fully control that world, thereby permitting us to verify an application or device's full functionality.

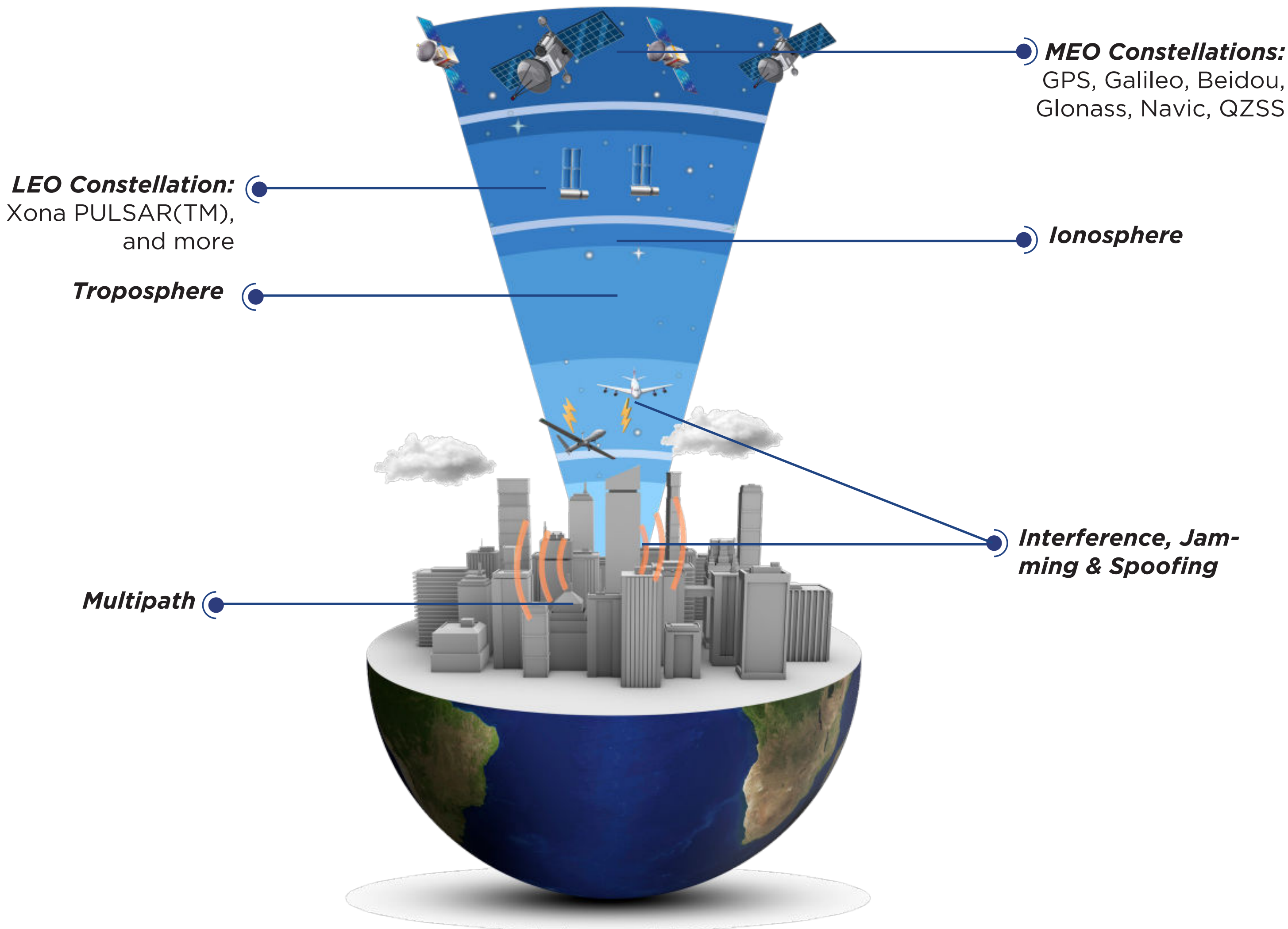
Taken a step further, we can then test for resiliency (RPNT/NavWar) by simulating interferences on GNSS signals – whether they are man-made or natural – under a wide range of environments and conditions.

GNSS simulators are essential in the scope of GNSS system development and production. **Live sky testing** is carried out using real signals, but, while being very realistic, it suffers from many drawbacks, including:

- **Can only simulate existing signals (not future, or in-development phase ones, for instance)**
- **No repeatability**
- **Not controllable (signal power, etc.)**
- **Difficult to obtain true reference**
- **Prohibitive costs**
- **Difficult access to authorized test range (including area where a dedicated regional constellation is available)**
- **Difficult to test degraded scenarios (atmospheric disturbances, jamming, spoofing, meaconing...)**

So, **GNSS simulation** is useful for:

- **Developing / tuning GNSS signals with simulation to accurately test theoretical models**
- **Develop and integrate GNSS receiver(s)**
- **Testing system resiliency against interference such as jamming, spoofing, and meaconing**
- **Develop systems using or related to GNSS technologies**
- **At production level, testing the GNSS reception on serial units, inside buildings, where GNSS signals are not often available and where repeatable and predictable tests are necessary.**



PERFECT FOR EXPERT TESTING

The GSG-8 Gen 2 is a perfect fit for expert civilian and defense users and organizations that need to simulate multi-antenna or very complex scenarios, or test their resilience to jamming or spoofing attacks.

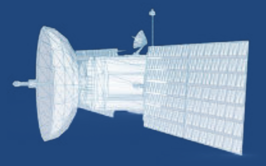
This evolution of the GSG-8 takes a step forward by adding power and flexibility that will benefit those conducting expert testing. Users will benefit from improved operability through front-facing N-Type connectors, a front-facing combined RF output, oscillator, and clock calibration. A small form factor and simple user interface also help improve the user experience.

The result is a GSG-8 Gen2 that is capable of delivering the performance and quality that is expected from expert civilian and defense customers, all the while keeping costs low and productivity high.

WHAT IS EXPERT SIMULATION?

A GNSS simulator for expert simulation requires the ability to generate on multi-constellation / multi frequency scenarios, perform jaming & spoofing simulations, and create multi antenna / multi vehicle scenarios. It is also capable of on-the-fly signal editing capabilities such as signal power, number of satellites in view, and signal parameters.

To efficiently perform GNSS simulation, generated signals must be realistic. This means that the simulation must take into account that – as much as possible -- errors that occur in real sky (satellite clock errors, orbit errors, ionospheric delays, tropospheric delays, multipaths...) are realistically replicated in the simulation.



LEO PNT

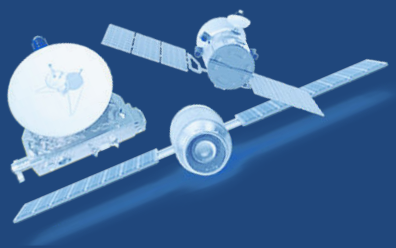
LEO PNT GNSS constellation are being launched into space with increased frequency, and with it comes a great deal of promise (security, accuracy, indoor GNSS). Like GNSS, LEO PNT relies on GNSS simulation to be developed and used – from the signal definition to receiver integration in systems.

The GSG-8 Gen2 is a state-of-the-art LEO PNT signal simulator. No other platform is able to generate the high number of signals needed for LEO PNT simulations in addition to legacy GNSS signals, threats, and multipaths. This high capacity also allows the GSG-8 Gen2 to generate S-Band signals in addition to the above.

MULTI ANTENNA / MULTI VEHICLE

When testing unmanned aerial vehicles (UAVs) such as drones, or aircraft (with one antenna per wing), or spacecrafts, GNSS simulators can generate a signal to represent multiple antennas and/or vehicles. But how those antennas/vehicles interact with others and perform in GPS and GNSS-denied environments can make all the difference in their performance. And many applications rely on multiple antennas for positioning and heading.

From a single GSG-8 Gen2, users can run and control multiple instances (running on the same hardware), each one representing an independent trajectory, vehicle, or antenna – each with its own output connector.



MULTI-SIGNAL MULTI-FREQUENCY

With multiple satellite constellations – both global, local, and LEO — providing signals for navigation and geospatial applications, the number of signals and frequencies being emitted, augmented, and echoed is staggering. Simulating all these aspects is a challenge for FPGA-based simulators which are not capable of generating an increased number of signals in view.

Skydel-based systems like the GSG-8 have successfully overcome this technological hurdle by leveraging the immense computational power of modern GPUs (Graphics Processing Units) to simulate well up to 2000 GNSS signals with maximum flexibility across multiple bands – simultaneously!

This capability allows GNSS engineers to create highly complex and realistic environments, with all satellites in view – even in space-based scenarios. Simulating hundreds of GNSS signals ensures comprehensive testing, optimizing receiver performance, and enhancing the resilience of navigation systems in the face of challenging conditions, ultimately resulting in more reliable and accurate positioning for a wide range of applications.

JAMMING & SPOOFING

The GSG-8 Gen2 provides the capability to replicate realistic jamming and spoofing scenarios encountered in military and non-combat environments – across all frequency bands. By digitally replicating jamming and/or spoofing signals, the simulator enables a thorough evaluation of a system's responses under various conditions, ranging from partial degradation to complete signal loss and/or deception.

This realistic simulation aids in identifying vulnerabilities and assessing a system's ability to adapt and withstand hostile jamming and spoofing tactics that can affect a vehicle or aircraft's navigation, timing, and positioning.

The GSG-8 Gen2 lets users manipulate signal strength, frequency, and timing. The ability to also simulate threat trajectories and emulate sophisticated jamming and spoofing methods employed by adversaries or bad actors is enhanced by the power to generate signals on three GNSS bands. Simulating this type of interference – with a device under test in a hardware-in-the-loop configuration, for example – allows engineers to gauge the system's resilience, refine countermeasures, and ensure uninterrupted operation even in the face of deliberate attacks.

AUTOMATION

Easy to use and comprising hundreds of commands, Skydel's API brings an unparalleled level of control over simulation, enabling you to build complex, elaborate and repeatable scenarios with open source client libraries. Benefits include:

- Can control Skydel remotely using the API
- Remote program can run on the same (or separate) PC as Skydel
- API Libraries and Examples in Python, C++, and C#
- Ideal for configuring tests, repeated tests, precise time setting, or repeating tests from the GUI

The GSG-8 allows users to configure, control and extend all aspects of the simulator in seconds. All interactions can be exported as Python scripts.

GSG-8 GEN2

Safran's **GSG-8 Gen2** is an evolution of the popular GSG-8. An expert-level positioning, navigation, and timing test solution offered through Safran's family of Skydel-based simulators.

The GPU-based GSG-8 Gen2 simulator delivers the highest standard of GNSS signal testing in an easy-to-use, turnkey form factor supporting the growing need for location-aware applications and systems that require navigation or timing. With 6 front-facing high-quality RF outputs and a combined one, the GSG-8 Gen2 GNSS simulator covers the entire GNSS bandwidth and features high-end performance with a 1000 Hz simulation iteration rate, high dynamics, real-time synchronization, and simulation of all-in-view satellite signals.

The GSG-8 Gen2 is ideal for development, NavWar testing, and integration projects that require very high performance and an increased number of constellations and satellites in view, and multi vehicle / multi antenna scenarios.

Key Features:

- **2000+ signals**
- **All MF/MC Signals via Individual or Composite Port**
- **Up to 6 vehicle or antennas in a simulation**
- **Simulate jamming, spoofing, meaconing, interference of all kind**
- **Unlimited number of jammers**
- **1000 Hz simulation iteration rate**
- **Available in three configurations with up to 6 SDRs**
- **Sub-nanosecond-level synchronization between RF bands**
- **High-end RF quality**

EMBEDDED HARDWARE

Dedicated High-End Software-Defined-Radio(s)
CDM-7 Timing Module
High-end Nvidia GPU
36-Core CPU
2 TB SSD Storage - Extractable
1 Combined RF output (N-type)
6 Separated RF outputs (N-type)

ADVANCED JAMMING & SPOOFING

Full jammer dynamics
GNSS signals + jamming on all GNSS bands (3x100MHz)
Power levels computed in real-time
No additional H/W required

2000+ SIGNAL CAPACITY

2000+ Signals
All Frequencies up to 3 GHz (including S band)
All GNSS Bands
All in view not limited by channels/card
All Constellations including: GPS, Galileo, BeiDou, GLONASS, NavIC, QZSS, SBAS, Xona's PULSAR™, and Custom Signals.

BEST-IN-CLASS PERFORMANCE

Skydel-Powered
Intuitive GUI
Control every aspect of simulation
Recreate real satellite signals in seconds
Live Sky Time Synchronization
IQ File Generation & Playback
Advanced Jamming & Spoofing

RF QUALITY

High-end RF Quality
Best spurious and harmonics quality on the market
Simultaneous RF Bands: 1-3
Nanosecond-level synchronization between RF bands
Jamming & Spoofing using up to 3 bands
S-Band compatible

HARDWARE-IN-THE-LOOP

Robust Hardware-in-the-loop (HIL) Integration
Test standalone or multiple DUTs
Perform closed and open loop HIL
10 ms HIL Latency
Zero effective latency

COMBINED OR SEPARATED OUTPUTS

1 Composite RF Port for simplified connection
6 Individual RF ports for flexible connections

Maximum bandwidth (per radio) 100 MHz
Pseudorange accuracy - ±0.001m
Pseudorange rate - ±0.001m/s

RF Signal Level (GNSS)
- Power accuracy: +/- 0.5dB
- Simulated GNSS signal: -175 to -100dBm
- RF output power amplification: +40 to +70dB

SCALABLE AUTOMATION

Integrated Automation
Extensive API
API Supports Python, C#, and C++
All interactions are recorded and can be saved and exported to Python script
Scripts are portable

SUPERIOR TIMING

Integrated CDM-7 Timing Module
Generates 10MHz and 1PPS signals
Multiple operating modes:
- Internal clock (OCXO)
- External clock (10MHz and 1PPS),
- Synchronous External, or Asynchronous External

FLEXIBLE, SCALABLE, AND POWERFUL

GSG-8 GEN2 SCENARIOS

LEO PNT

Like all GNSS technologies, LEO PNT relies a great deal on GNSS simulation to be developed and used – from signal definition to receiver integration in systems.

Accurately simulating LEO GNSS signals is different from MEO GNSS signals: multipath models and satellite propagation models are no longer accurate due to different atmospheric propagation models, SV trajectories, and more.

In addition to generating the first available LEO PNT signal (Xona's PULSAR™ XL signal), Safran permits users to create custom signals and provides tools to increase the realism of the simulated signal and pseudorange (as compared to a real sky signal).

Moreover, the GSG-8 Gen2 and its ability to generate over 2000 signals, allows GNSS engineers to simultaneously replicate both LEO *and* legacy MEO GNSS constellation trajectories, real-time atmospheric conditions, and custom signals/frequencies thus ensuring precise performance assessment of LEO satellite signals.

With this expanded ability, engineers gain a holistic view of their system's response to complex LEO constellations, identifying potential vulnerabilities and optimizing performance with increased accuracy.

Skydel Simulation Benefits

- **Dynamic Real-Time Simulation**: Skydel GNSS simulators offer dynamic, real-time simulation capabilities, allowing engineers to replicate the movement and behavior of LEO and MEO satellites precisely.
- **Multi-Constellation and Multi-Frequency Support**: Skydel simulators support multiple constellations (GPS, Galileo, GLONASS, BeiDou, etc.) and frequencies, providing a comprehensive testing environment for LEO constellations.
- **Scenario Reproduction and Customization**: With Skydel, users can recreate specific scenarios encountered by LEO satellites, such as orbital maneuvers, eclipses, and diverse signal obstructions.

Jamming & Spoofing Resiliency

In a common yet critical military operation, a fleet of autonomous drones is tasked with delivering supplies to a remote base deep in hostile territory. The mission depends on precise positning, navigation and timing (PNT), but there is a strong potential of interference from adversaries skilled in electronic warfare. To ensure the drones can withstand such threats, their resiliency can be tested with a GSG-8 Gen2.

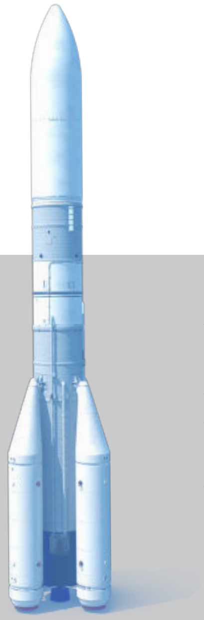
In the simulation lab, engineers set up a series of tests to evaluate the drones' navigation systems against various jamming and spoofing attacks. The GSG-8 Gen2 simulator is capable of generating realistic GNSS signals, including advanced multi-constellation and multi-frequency simulations.

The team begins by simulating simple jamming scenarios, where the GNSS signals are overwhelmed by noise. The GSG-8 Gen2 can generate an unlimited number of jamming and spoofing signals. In the test, the drones struggle to maintain their course, highlighting a potential vulnerability.

Next, engineers configure the simulator to test more sophisticated spoofing attacks. The GSG-8 Gen2 system creates false signals (across multiple bands) that closely mimic legitimate satellite signals, attempting to mislead the drones into deviating from their planned route.

By using all six RF output plus the additional combined output, the GSG-8 Gen 2 is able to create highly dynamic and challenging electronic warfare scenarios, including the ability to emulate a wide range of threats, including coordinated and multi-vector attacks.

Engineers can observe how the drones' systems respond in real-time. The insights gained allow the team to refine their technology, improving the drones' resilience to electronic warfare in the field, ultimately ensuring the success of their mission.



Space-Based Multi Antenna

A South American national space agency, faced significant challenges in testing and validating the GNSS (Global Navigation Satellite System) receivers for their Low Earth Orbit (LEO) satellites. The critical challenge was ensuring the accuracy and reliability of these systems under various simulated environmental conditions. CONAE needed to simulate complex scenarios including signal interference, multi-path effects, and the diverse atmospheric conditions encountered during satellite operations. Additionally, the agency required a portable solution that could be easily deployed across multiple facilities without compromising on performance.

To address these challenges, the agency implemented the GSG-8 GNSS simulation platform. The GSG-8 was chosen for its ability to deliver highly accurate and flexible GNSS signal simulations that could meet the stringent requirements of the agency's satellite navigation systems.

The GSG-8 simulator was configured to support multiple use cases, including the simulation of four LEO satellites with individual antennas, two LEO satellites with dual antennas, and even a single LEO satellite with four antennas. This flexibility allowed the agency to comprehensively test various satellite configurations under realistic conditions.

One of the standout features of the GSG-8 was its ability to maintain carrier phase coherence between RF outputs, with a phase jitter of less than 250 femtoseconds and nominal latency in Hardware-in-the-Loop (HIL) mode of less than 10 milliseconds. These capabilities were crucial in ensuring that the GNSS receivers could accurately process signals even in the most challenging scenarios. The platform's portability, fitting into a small cargo van, allowed the agency to transport the system between their testing facilities with ease, eliminating the need for complex reassembly at each location.

By leveraging the GSG-8, the agency significantly enhanced the reliability of their GNSS receiver testing process. The accurate simulation of real-world conditions allowed the agency to identify potential issues and optimize their satellite navigation systems before launch.

The result was a successful deployment of robust and reliable satellites, capable of operating effectively in the diverse and challenging environments encountered in space. The GSG-8's flexibility, precision, and portability were key to overcoming the complex challenges faced by the agency, contributing to the overall success of their space missions.

SKYDEL

Skydel is a GNSS software-defined, GPU-based simulator that features real-time signal generation for multiple constellations and multiple frequencies. Skydel generates high-quality and fidelity GNSS signals and interferences, provides innovative and powerful test automation, includes models of errors for signal propagation and multipath for legacy constellations, supports HIL with zero efficient latency, offers high dynamics for multiple vehicle types (6 degree of freedom) and multi-antenna configurations.

Skydel is compliant with all existing GNSS constellations as well as future ones, such as Xona's PULSAR™ LEO constellation.

Skydel uses a computer's GPU to perform the modulation of the signals in real-time. The GPU generates a wide band signal with 16-bit resolution for all visible satellites. All the signals, from all the satellites, are combined in the GPU to form a single baseband stream, which is transmitted to the SDR. The SDR then converts the baseband signal to RF.

Skydel provides GNSS testing solutions that enable engineers and scientists who design and test navigation systems to validate the performance of GNSS devices in real-world conditions from the comfort of their labs.

Skydel has also integrated a "custom signal" feature that enables users to create and tune PNT signals, to support the study of signal evolutions, more realistic channel propagation models and GNSS receiver and antenna advancements technology.

With these capabilities, Skydel helps the GNSS ecosystem from signal definition to system integration and production.

SKYDEL

Advanced Simulation with Modern, Software-based Flexibility
GNSS SIMULATION SOFTWARE

Multi-constellation / Multi-frequency
- GPS, GLONASS, GALILEO, BEIDOU, SBAS, NavIC, QZSS
- Support for restricted signals (GPS & Galileo)

Real-time GNSS simulator
- Simulation entirely GPU-generated.
- Most parameters can be modified at runtime

Powerful & simple automation
- Complete documentation API (Python, C#, C++)
- Innovative automatic Python Scripting generation

Scalable platform
- Software Only, Turn-Key system
- Multiple RF output
- Scenario Editor

Advanced interference simulation
- Full jammer dynamics
- GNSS signals + jamming on all GNSS bands
- No additional H/W required

User-defined waveforms
- Chirp, CW, BOC, AWGN, BPSK & Pulse modulation + custom IQ file
- Combine dozens of signals
- Real-time results on spectrum

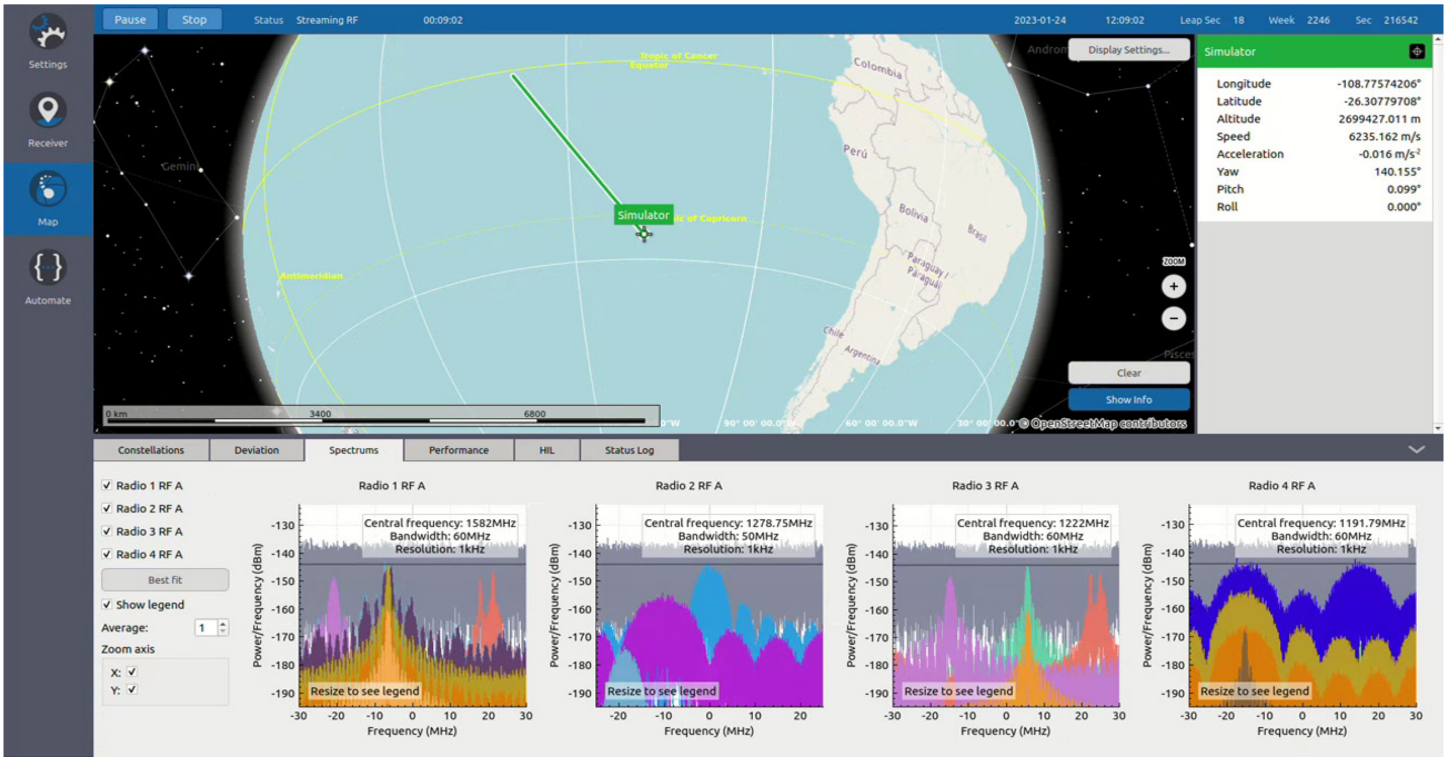
Test / Validation / Integration
- Multi-vehicles, multi-antennas
- HIL Low Latency
- 6 DoF and orbital trajectories

Skydel Key Features

- All-in-view satellites simulation
- 1000Hz simulation iteration rate
- Low-latency HIL
- Live sky time synchronization
- RTK
- On-the-fly scenario reconfiguration
- Flexible licensing
- In-field software upgradability
- High-end performance (precision, resolution, ultra-high dynamic motion)
- 6 degrees of freedom (DoF) receiver trajectories
- Simulate hundreds of satellites in real-time
- Comprehensive and intuitive API (Python, C# and C++ open-source client)
- IQ file generation
- Scalable and highly flexible architecture using software-defined radios
- Advanced Jamming and Spoofing capabilities

Signal Propagation and Errors Simulation

- Multipath and propagation models
- Additive pseudorange ramps
- Satellite clock error modification
- Navigation message errors
- Multiple ionospheric/tropospheric models
- Antenna pattern models
- Relativistic effects
- Pseudorange/ephemeris errors
- Advanced interference



POWERED BY skydel

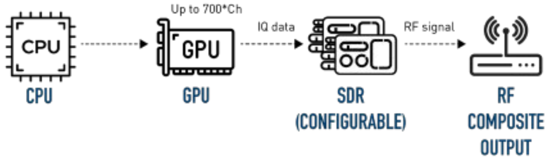
ADVANTAGES OF SDA

The Skydel simulation engine uses either a Windows of Linux-based PC's GPU to generate, in real-time, high-rate baseband signals that are converted to RF by the SDR.

This is achieved by having the GPUs parallel process simulated GNSS signals and directly stream their IQ data to the software-defined radio (SDR) in order to generate a real RF output.

The result is a simulation platform that is flexible, agile, and much more cost-effective. SDA provides the following benefits:

- **Maximum scalability and flexibility**
- **Agile/rapid software development process**
- **Innovation not limited by hardware design**
- **Based on market-proven, reliable COTS hardware**
- **Hundreds of signals generated in GPU with flexible allocation**
- **Supports user-created and open-source plug-ins**
- **On-site upgrades (software) throughout unit's lifecycle**



Better than FPGA

Another significant advantage of GPU-leveraged simulators over FPGA ones is that GPUs do not need to be pre-programmed with a firmware. Instead, signal modulation is done on-the-fly (in the software) depending on the scenario and evolution of the sky view. Unlike FPGA-based simulators, the number of simulated signals of each constellation is not static and purely dynamic.

Software Defined GNSS Simulation: The Difference

With software-defined GNSS Simulation, you gain maximum scalability and flexibility with agile, rapid development. Upgrading to the latest features requires only a simple software download and licensed software installation.

- **Lower TCO (Total Cost of Ownership)** – A lower cost of the initial system (hardware/software) and lower support costs mean you can use your budget for other projects, purchase multiple systems or add more software solutions.
- **Non-Proprietary Hardware** – Dedicated hardware is not flexible, and lacks the ability to create non-GNSS signals from same platform.
- **Software Defined Radios (SDR)** – Radios are easy to reconfigure based on test requirements. You can easily add/remove signals at click of a mouse or upgrade your systems. The result is an increase in efficiency with fast test setups, and no hardware configuration required.
- **All-Inclusive Modern Software** – All testing in a stable, responsive, easy-to-use, single package, so you can spend less time setting up, and more time simulating.
- **Automation & Integration** – Commands and info are already stored in the software. You can integrate with other systems more quickly and experience the exponential gains in productivity from automation.

GSG-8 GEN2 INTERFACE

Powered by Skydel, the GSG-8 Gen2's user interface is not only intuitive, but modern, and streamlined. The Settings, Receiver, Maps, and Automation menus are quickly accessed, and subtabs contain vital information and interactive tools.

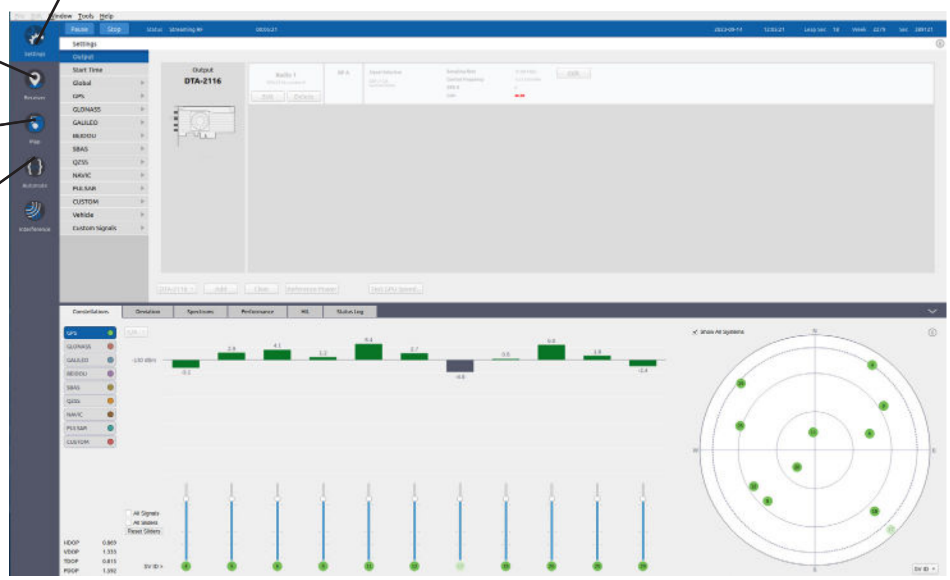
Settings:

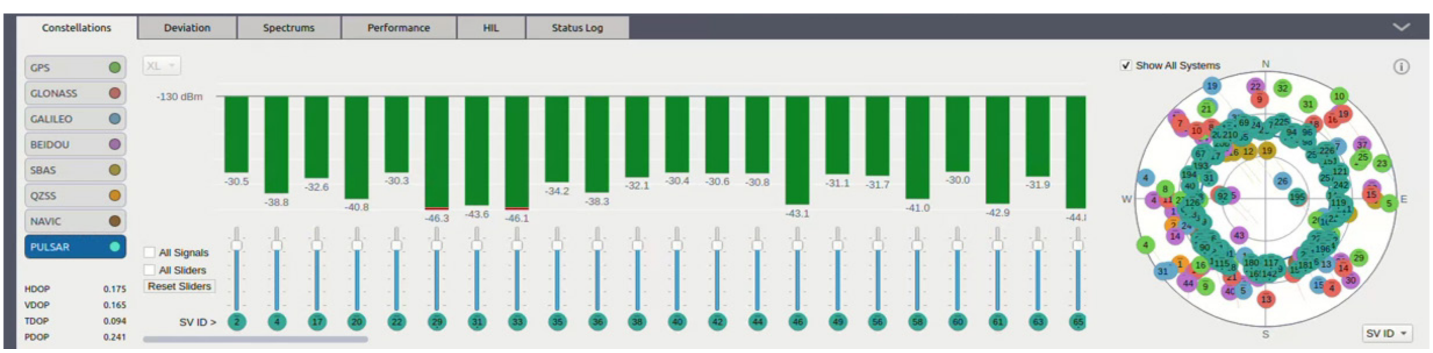
- Create a scenario
- Preset, or change settings on the fly
- Add errors, deviation, signals, echoes
- Add custom signals
- Change antenna patterns
- Control trajectory in real-time
- Log raw data

Receiver:
Connect a receiver under test to Skydel.

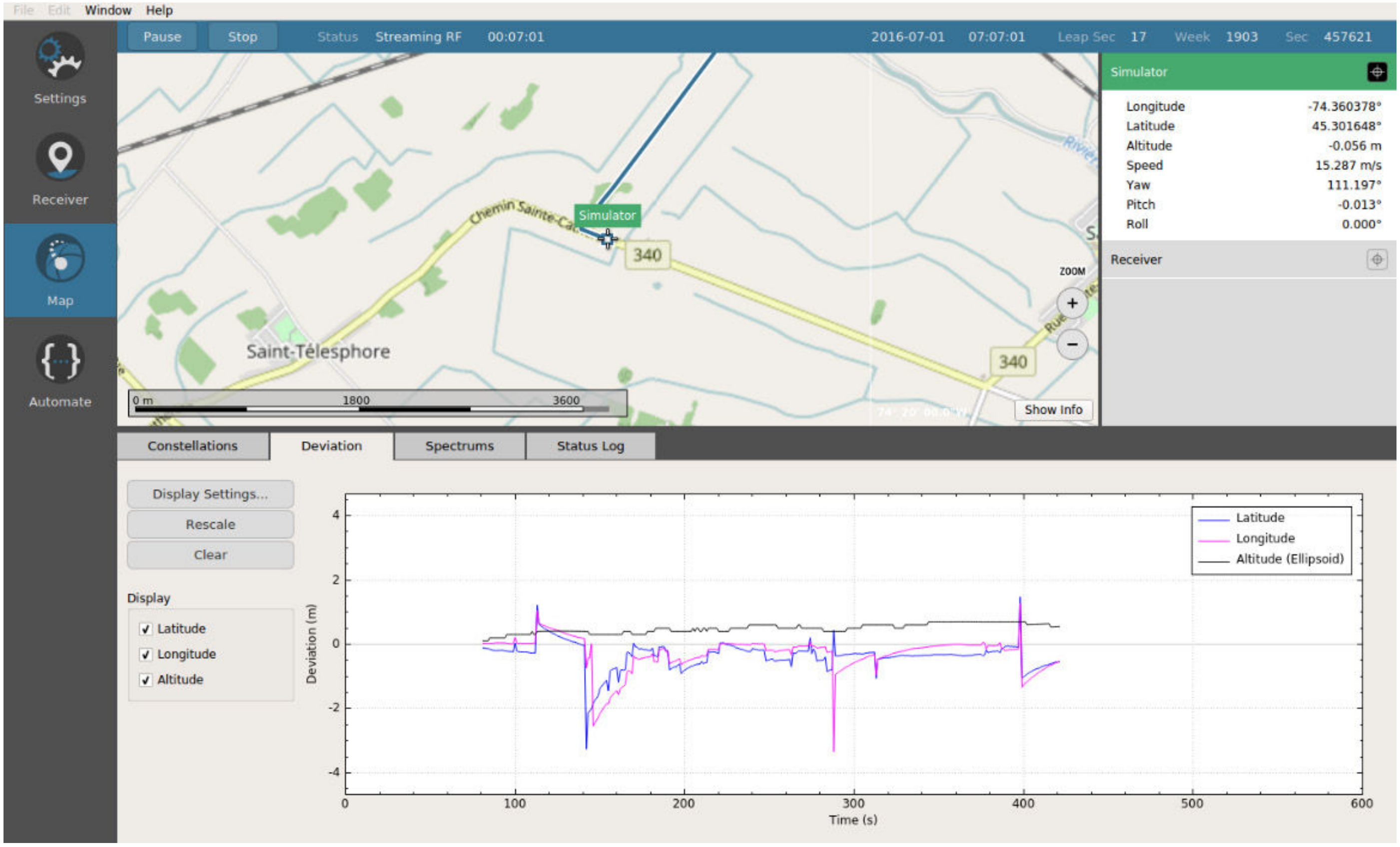
Map:
Contains the map and the information panel

Automate:
Helps you get started using the Skydel API
Save and write your own scripts to control Skydel





This **Constellations** subtab displays information about the GNSS satellites that are simulated and is divided by constellation and SV. Satellite power control as well as a Skyview allows you to define the strength if the satellite's signal and see its position.

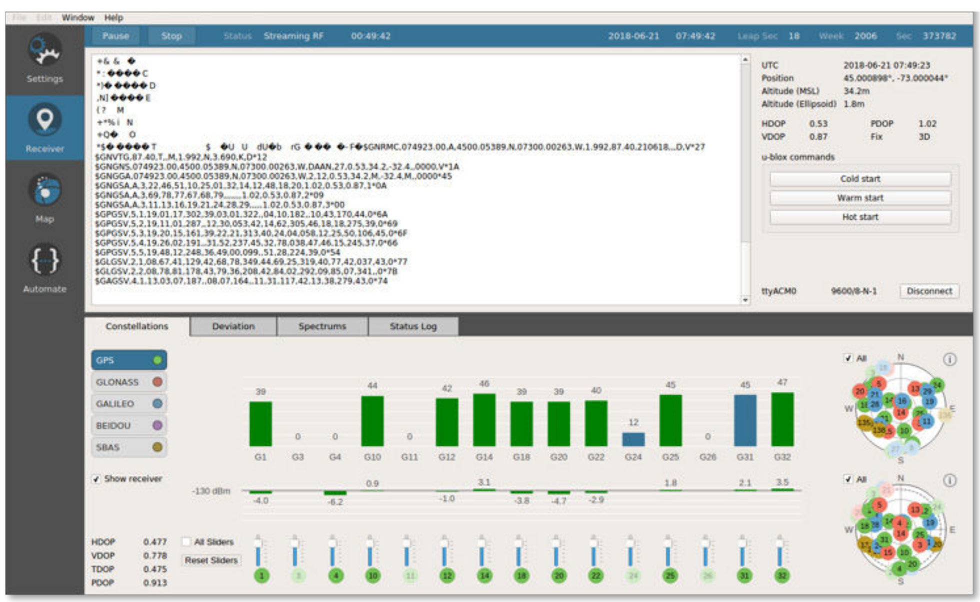


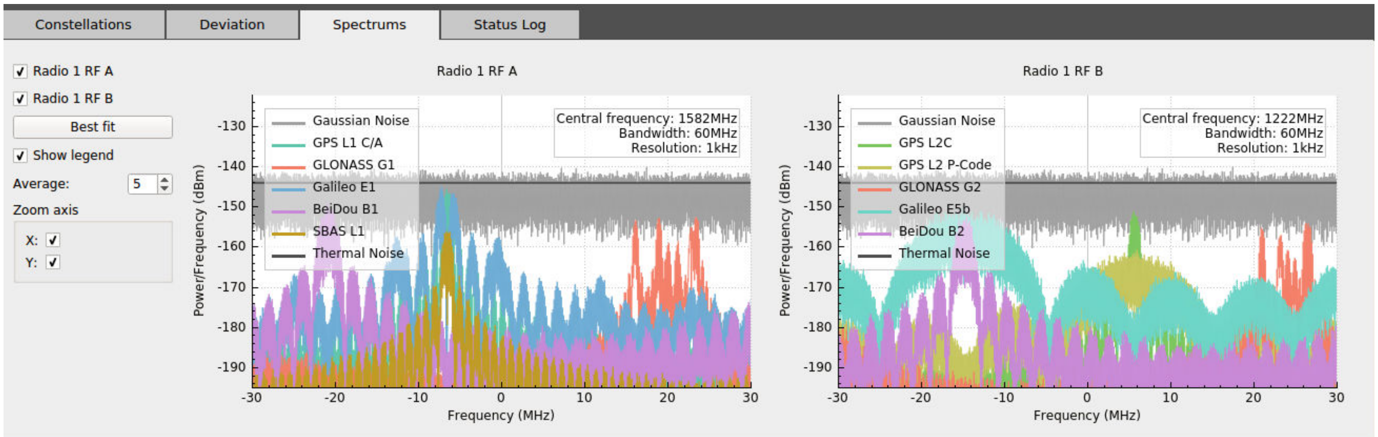
Map + Deviation:
Displays the simulated position and the receiver's position (using NMEA feed), as well as any interference and repeaters.

The **Deviation** subtab displays a graphic, in real-time, of the deviation between the position generated by the simulator and the position calculated by the receiver under test.

Receiver:
Displays DUT or reference receiver, in addition to receiver NMEA data, C/No and Skyview.

From this tab, you can modify the baud rate, data bits, parity, stop bits and flow control.

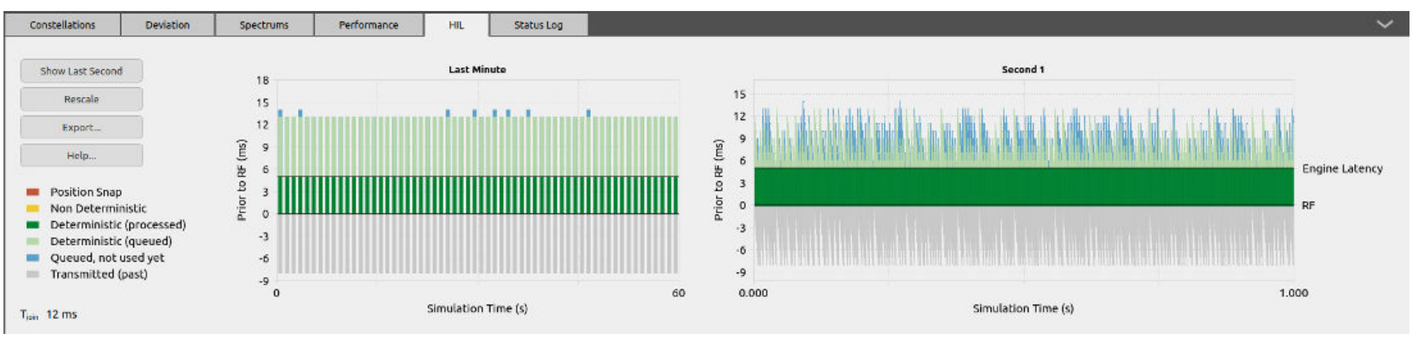




Spectrums:
Extremely useful for visualizing the content of each output, the Spectrums tab displays the spectrum based on the generated IQ data. Skydel depicts a baseband signal prior to conversion into RF.

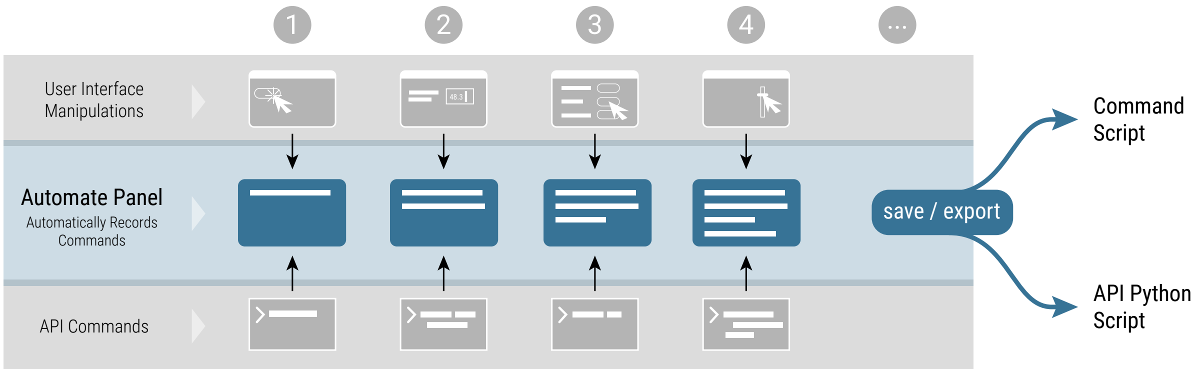
HARDWARE-IN-THE-LOOP

Safran's Skydel Simulation Engine is a high-end GNSS simulator that is also very flexible, scalable, and customizable. It uses software-defined radios and COTS components to outperform traditional FPGA-based simulators. Skydel features advanced HIL test solutions providing very low to zero-effective-latency.

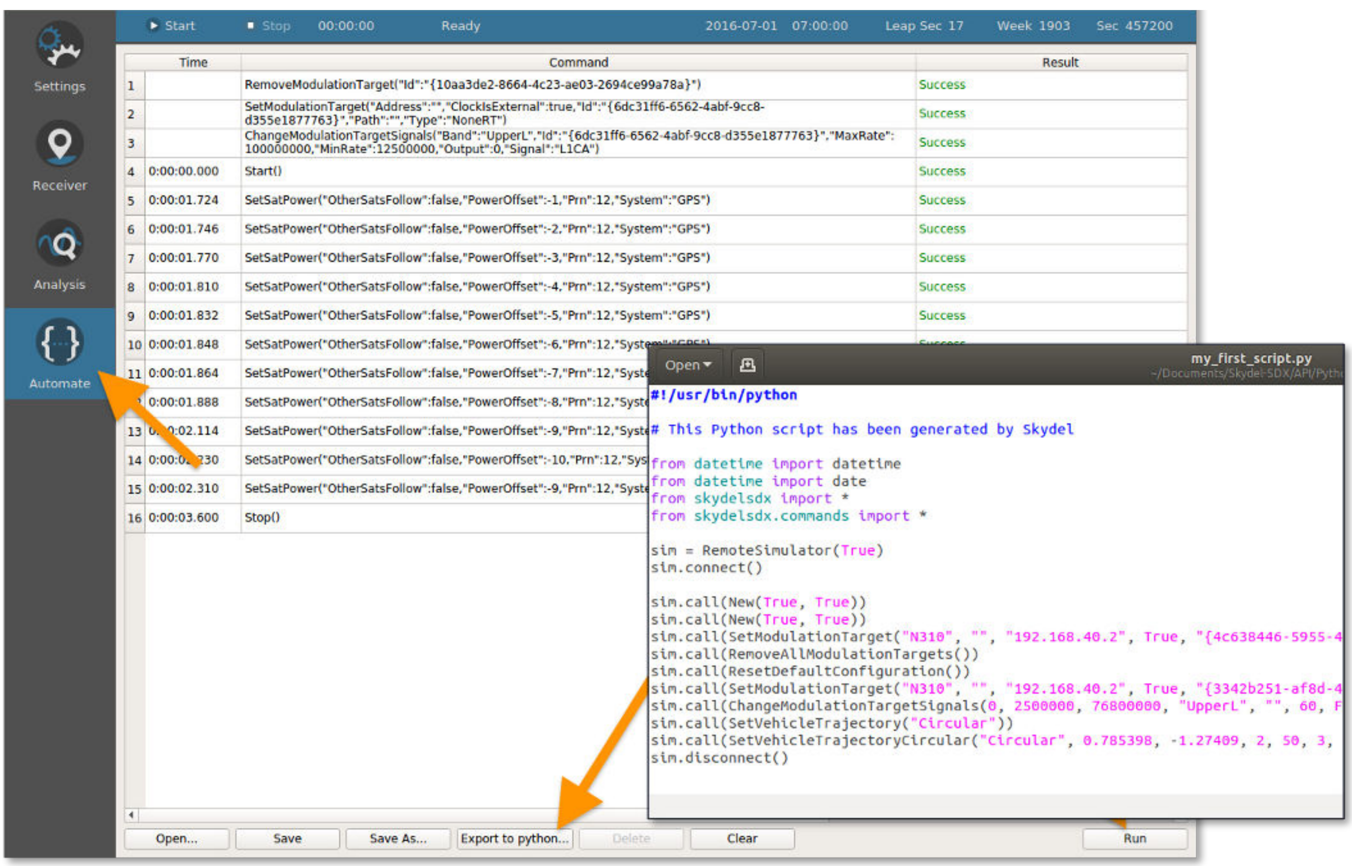


HIL:
The enhanced visualization tools of HIL testing can monitor internal latency through real-time curves showing when the data is generated and sent to the RF signal. Users can also review the transmission of HIL packets for optimizing the entire network's latency, checking its stability (jitter), and that data is available and used at the right time in Skydel.

AUTOMATION



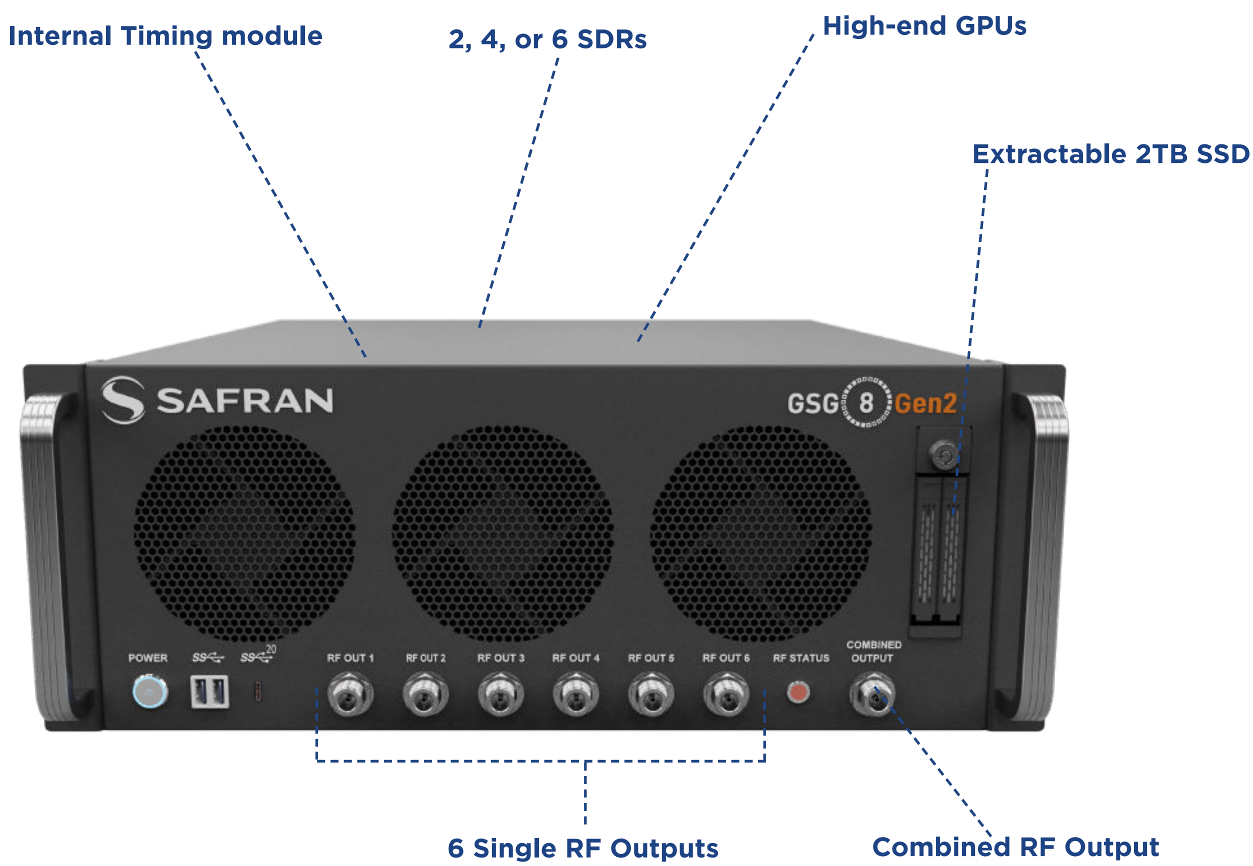
Automate: Skydel was built around the Command Design Pattern, which means that all actions (either from GUI or remote control) are sent to the engine using commands. The commands are processed by the engine exactly the same way whether they come from the GUI or remote program. If your simulation is working via GUI, it will work exactly the same via the API.



1. All Skydel actions are transformed into Commands and logged into the Automate tab.
2. Skydel users are able to export all recorded commands to a Python script.
3. The script can then be launched locally or remotely to replay all the recorded commands.
4. The script can also be modified as desired (add loops, functions, change timestamps of commands).

FLEXIBLE, SCALABLE, AND POWERFUL

INSIDE THE GSG-8 GEN2



The GSG-8 Gen2 has been purpose-built to provide exceptional signal quality and performance, all the while taking advantage of the latest commercial-off-the-shelf (COTS) hardware.
The leveraging of commercial (non-proprietary) SDRs and GPUs allows easy customization and maintenance throughout the unit's lifecycle while reducing costs. More affordable than other options on the market, the GSG-8 Gen2 delivers best-in-class precision and performance for your critical programs.

The GSG-8 Gen2 is available in three base configurations, and can be upgraded at any time.

-82 2 Software-defined radios

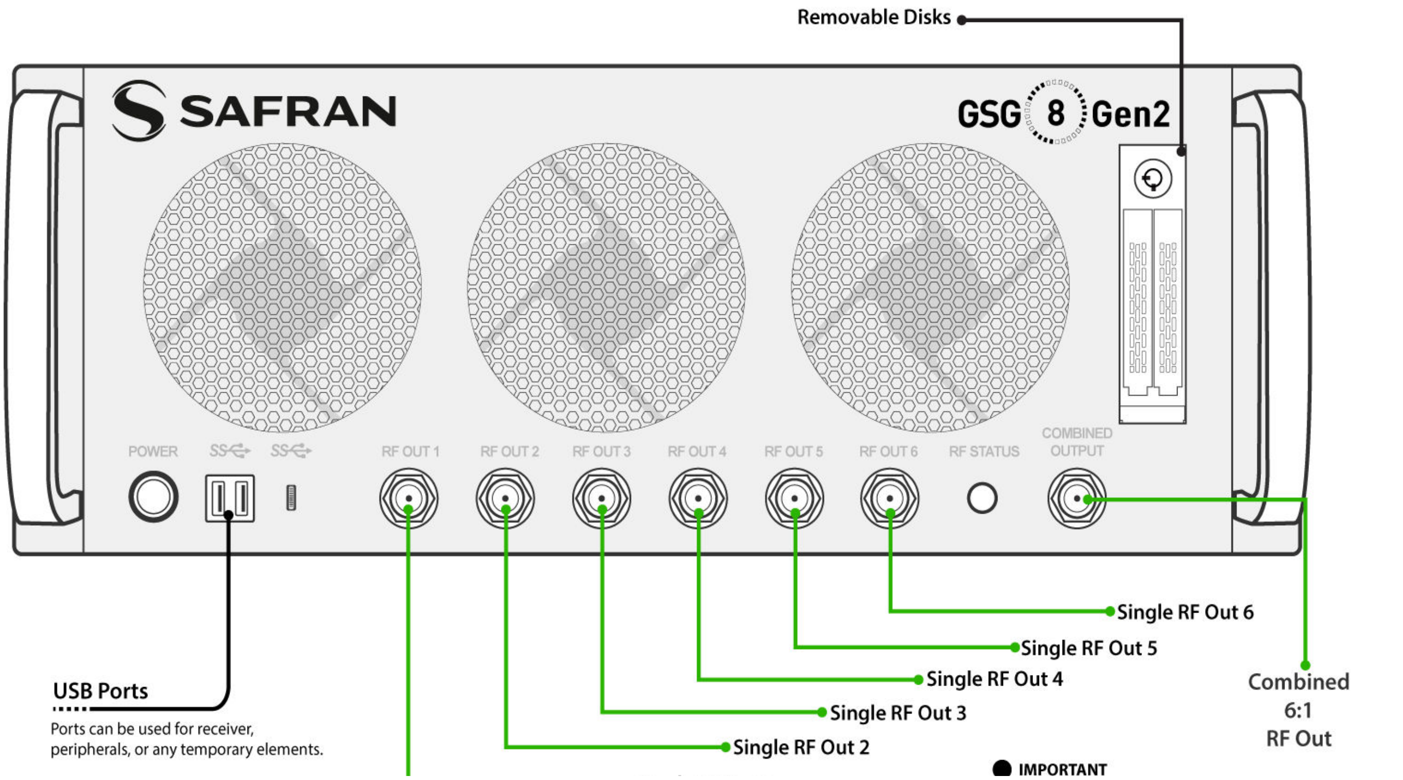
- One band 2 antennas
- One band + jamming/ spoofing

-84 4 Software-defined radios

- One band 4 antennas
- Two bands 2 antennas
- Two bands + jamming / spoofing

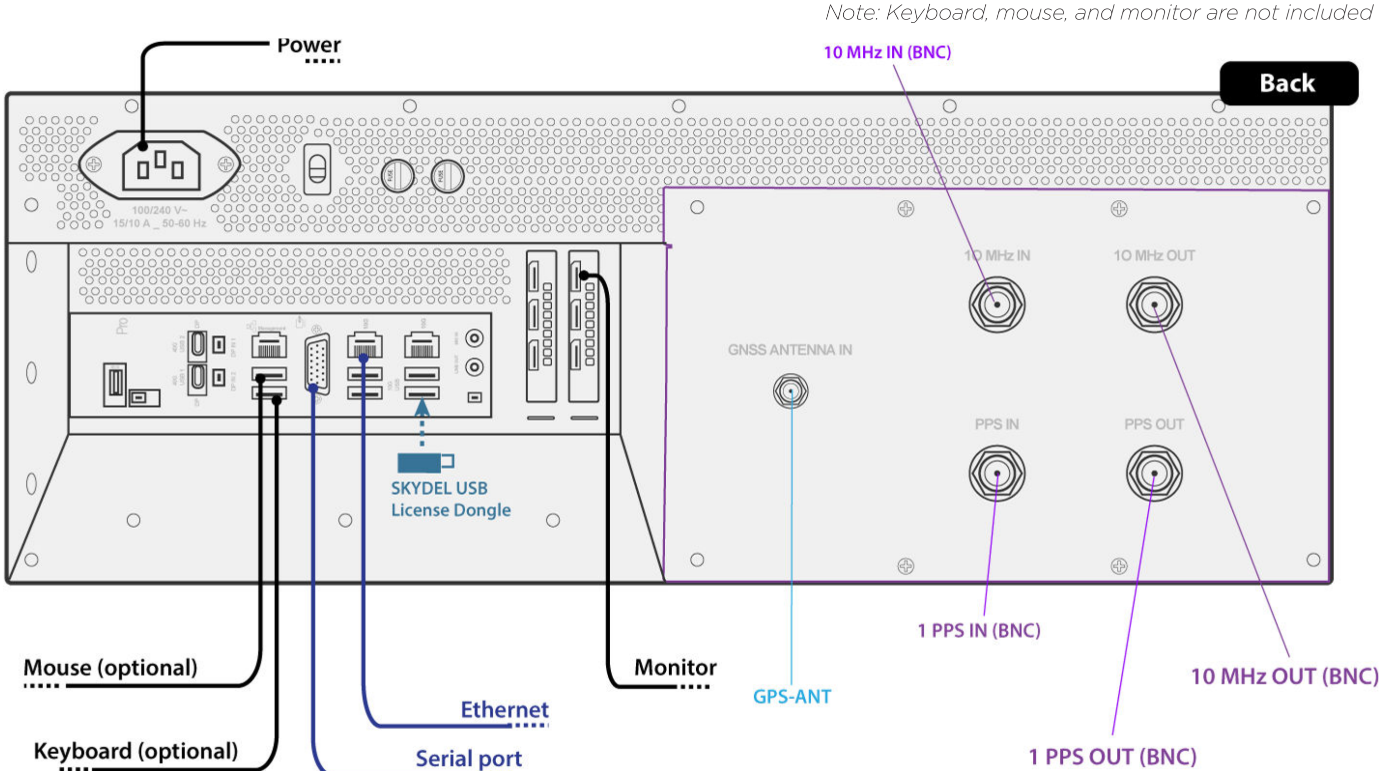
-86 6 Software-defined radios

- One band 6 antennas
- Three bands 2 antennas
- Three bands+ jamming / spoofing



IMPORTANT

Note: Keyboard, mouse, and monitor are not included



3 YEAR WARRANTY

At Safran, we stand behind our products with a comprehensive warranty designed to ensure your peace of mind. Our warranty covers the cost of in-factory repair or replacement of any defective product or component, giving you confidence in the quality and reliability of Safran solutions.

Rest assured that if any issue arises and it's determined to fall outside the warranty coverage, our dedicated team will swiftly address it at a fair and competitive price, with your approval.

Choose Safran with confidence, knowing that our commitment to excellence extends beyond our products to exceptional customer care and support.

Safran warrants each new standard product to be free from defects in material, and workmanship for the duration of the warranty period after shipment in most countries where these products are sold.

TECHNICAL SPECIFICATIONS

Constellations & Signals	GSG-8 Gen2 Interfaces

• GPS: L1 C/A, L1C, L1 P(Y), L2 P(Y), L2C, L5
• Galileo: E1, E5a, E5b, E5 AltBOC, E6 HAS, PRS (Restricted Signals), OSNMA
• GLONASS: G1, G2
• BeiDou:
  • BeiDou-2 (BDS-2): B1, B2
  • BeiDou-3 (BDS-3): B1C, B2a, B3I
• QZSS: L1 C/A, L1 C/B, L1S, L2C, L5, L5S, L6
• NavIC (IRNSS): L1, L5, S
• SBAS (Satellite-Based Augmentation Systems): L1, L5
• Xona: PULSAR XL, X1, X5
• Custom Signals: User-defined signals
• Custom Constellation
	• RF output: N-Type (Combined) x1
	• RF single outputs: N-Type
	GSG-82: 2
	GSG-84: 4
	GSG-86: 6
	• HDMI, USB, Ethernet and serial ports
	• 10 MHz clock input (BNC)
	• 10 MHz clock output (BNC)
	• 1 PPS input (BNC)
	• 1 PPS output (BNC)
	• GNSS antenna input (SMA)

RF/GNSS Signal	Specifications	
Power	Single Output • Maximum carrier level : -20 dBm * • Minimum carrier level : -125dBm ** • Carrier level resolution : 0.1dB • Linearity < 0.5dB (calibrated from -90dBm to -20dBm) • Absolute Accuracy : ±0.5 dB • Run to run repeatability: ±0.1dB	Combined Output • Maximum carrier level : -50 dBm * • Minimum carrier level : -170dBm ** • Carrier level resolution : 0.1dB • Run to run repeatability: ±0.1dB
GNSS Bands	Simultaneous bands 100MHz bands: • 2 (GSG-82) • 4 (GSG-84) • 6 (GSG-86)	
Compatible Bands	L1, L2, L5, E6, S band	
Signal Purity	• Spurious transmission < -65 dBc • Harmonics < -45 dBc • Phase noise: < 0.003 rad RMS***	
Signal Pseudorange Accuracy in RMS	±1mm RMS	
Pseudorange Bias	0mm RMS	

Time Alignment (internal operating mode)	• 1PPS output to RF output alignment bias <±1ns • Typical 1PPS output to RF output alignment deviation < 100ps • Inter Frequency signal Alignment (as inter-SDR alignment) < 1 ns • Inter-signal alignment bias in the same band : 0s
Sampling Rate	Configurable, up to 125 Msps

** The indicated power refers to the power measured at the output of the unit (via the output RF connector). You can increase or decrease this power level using attenuators (included in the ancillary kit) or an LNA (not included). Please note that active electronics, such as amplifiers, may affect signal purity, power linearity, and accuracy.*

*** As a result of the simulated signal from Skydel, which ranges from -175 to -100 dBm in IQ data, and RF output power amplification of +50 to +80 dB, and internal attenuation (30 dB loss in the combined path).*

**** Nominal Value, which can vary based on several factors such as temperature fluctuations and power supply stability. Based on single output.*

Scenarios	Type of Data
Number of Signals	2000+ signals
Iteration Rate	1000 Hz
Dynamics*	• Relative Velocity : 1 500 000 m/s • Relative acceleration : no limits • Relative jerk : no limits * This velocity requires the SKY-EXLI license in order to exceed 600 m/s • Angular rate (in rad/s) : • 15pi (at lever arm of 1.5m) • 60pi (at lever arm of 0.05m)
HIL Latency	• 10 ms • Zero effective latency
Scenario Duration	No limits

TIMING SPECIFICATIONS (CDM-7)

The GSG-8 Gen2's internal clock module is the CDM-7. It can be configured to address different timing use cases from within Skydel. The module has three modes:

Mode	Description
Internal	This mode uses the internal OCXO of the CDM-7. No additional input required. The CDM-7 will distribute the internal 10 MHz and PPS signals.
Synchronous External	This mode requires a 10 MHz and PPS input from an external device. The CDM-7 will distribute the external 10 MHz and PPS signals.

Timing Output Specifications

Output	1PPS
Connector Type	MMCX
Output range	5 V
Output waveform	Logic-level pulse
Duty cycle	1%
Time offset between any two 1PPS outputs	< 50 ps
Signal level	TTL compatible, 4.3 V minimum, base-to-peak into 50 (TTL compatible, 2.2 V minimum, base-to-peak into high impedance)
Pulse width	Configurable Pulse width (200 ms by default)
Rise time	< 10 ns
Timing Output	
Accuracy to UTC (locked to GPS @ 1 sigma)	±25 ns
Holdover (constant temp after 2 weeks GPS lock)	
After 4 hours	1 µs
After 24 hours	25 µs
Signal Waveform & Levels	TTL (5 $V_{P\text{-}P}$), into 50 ohm, BNC

Output	10 MHz
Connector Type	MMCX (CDM-7)
Output range	2.5 V
Output waveform	Square wave
Duty cycle	50%
Frequency Accuracy	< 100ppb
Recommended Warm-up time	30 min
Minimum operational warm-up time	5 min
Phase Noise	-113dBc@10Hz -120dBc@100Hz -140dBc@1kHz
Harmonics	< -40 dBc
Spurious	< -70 dBc

TECHNICAL SPECIFICATIONS

Included with GSG-8 Gen2

Item	Description
Documentation	Getting Started Guide Online User Manual
Ancillary Kit	• Attenuator 10dB N-Type • Attenuator 20dB N-Type • SMA Female to N-Type Male Adapter • U-blox GNSS Receiver (F9T-10B) • 50 Ohm termination N-Type connector

Available Plugins for the GSG-8 Gen2

- SKY-PLG-IMU – Inertial sensors emulation.
- SKY-ADVIMU – Advanced IMU simulation with a complete error model.
- SKY-PLG-RTK – RTCM message generation via virtual basestation.
- SKY-PLG-SDK – Plugin SDK allows the creation and integration of custom plugins for Skydel.

Optional Features for the GSG-8

- SKY-HIL – Hardware-in-the-loop mode allows input of vehicle trajectory information in real-time.
- SKY-IQFILE – IQ File, allows saving of generated IQ data to file
- SKY-IQPLAY – Allows the re-playing of an existing IQ file.
- SKY-CSI – Custom signal injections, allows real-time simulation of user-defined GNSS signals (custom modulation and navigation message).

Ext Warranty – Extends Hardware warranty over 3-years

TECHNICAL DATA

Timing Component

10 MHz Reference Clock	Safran CDM-7 with on-board OCXO. Accuracy < 100 ppb

GNSS Inputs + Outputs

10 MHz clock (BNC)	Input
10 MHz clock (BNC)	Output
1 PPS (BNC)	Input
1 PPS (BNC)	Output
GNSS Antenna (SMA)	Input
GNSS Signal Out N connector	Output (Front panel) x6
GNSS Signal Out N connector (Combined)	Output (Front panel)

Power

Line Voltage	100/240 VAC, 50-60 Hz +/- 10% from IEC60320 (option O) connector;
Power Consumption	Idle*: 150W Typical*: 500W Max: 1600W

Mechanical

Size	4U
Dimensions	Depth: 24 in (61.8 cm) Width: 19 in (48.4 cm) Weight: 57.3 lbs. (26kg) Height: 7 in (18 cm)

Environmental	
Temperature	+0° C to +40° C (operating), -15° C to +50° C non-condensing @ 12,000 m (storage)
Humidity	10% to 70% (non-condensing)
Altitude	max operating: 2000 m above sea level, max transport: 4,500 m above sea level
Certifications	
Safety	• IEC 61010-1:2010 + A1:2016
EMC	• EN62311: 2008 • Directive 2013/35/UE • EN IEC 61326-1 : 2021 • FCC 47 CFR PART 15: 2024 • ANSI C63.4 : 2014 • ICES-003 / NMB-003 edition 7: 2020 • NMB-Gen / ICES-Gen : 2018 / AMD1 : 2021 • KS C 9832: 2024 • KS C 9610-6-2: 2019 • KS C 9610-3-2: 2023 • KS C 9610-3-3: 2023
Substances	• - ROHS3, 2011/65/EU Emissions

Compliance:

CE *UKCA, KCC, FCC*

**: As measured on GSG86*

SUPPORTING YOU EVERY STEP OF THE WAY

SAFRAN SUPPORT

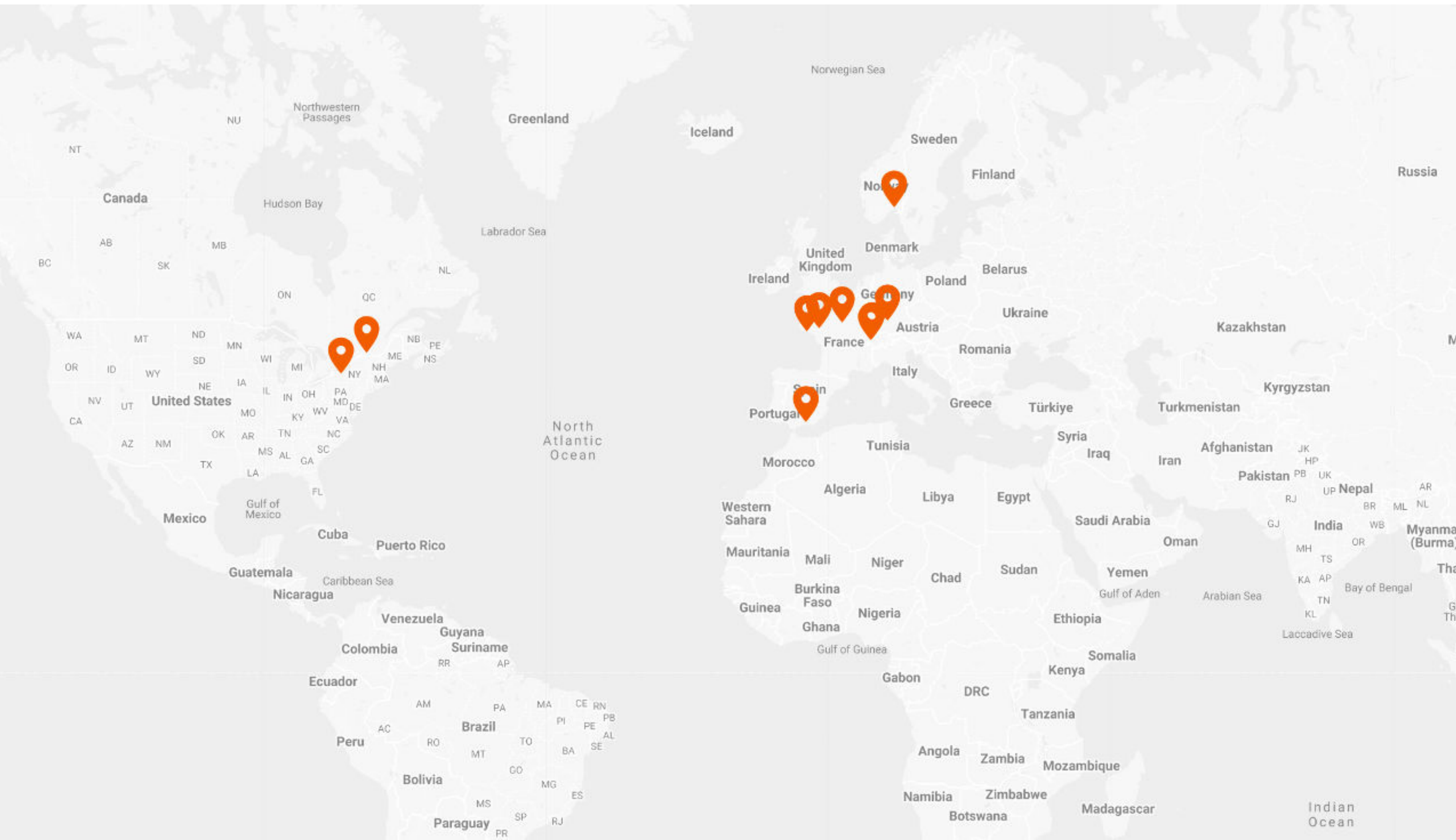
Safran's support packages, which complement our industry leading product warranties, are available to our customers to ensure maximum uptime and operational efficiency for covered equipment.

Skydel-based systems users can chose from a number of Simulation Service Plans which are designed for lab, factory, and test applications. It is recommended for all the GSG-8's due to the rapid evolution of the GNSS eco-system.

These service plans provide:

- Firmware and software updates with licenses for all new standard features
- Unlimited phone and email support
- Bi-Annual Calibrations
- Loaner Services
- Priority Service & Repair

The annual service plan may not be supported in all regions



Best in Class Support

All systems are provided with a three-year hardware warranty and one-year software support. Software support includes:

- Calibration
  Safran offers calibration services for your simulation products to ensure the accuracy of your profiles are not compromised.
- Extended Warranties
  In addition to our industry leading standard manufacturers warranty, our Service department also offers additional extended warranties to help customers bridge their budgets and keep their assets covered until the appropriate time to upgrade.
- Loaners
  If our quick turn option does not suit your needs, we also have an inventory of loaners to ensure your system stays active even during repairs.
- Online Forums
  We offer access to a wide network of users and contributors on our Online Forums for support and general inquiries. Saves time and allows users to collaborate on best practices and alternate use cases.

As with all Safran Trusted 4D products, phone and email support are always available, regardless of your support contract status.

REFERENCE, LEARN, COMMUNITY.

LINKS & RESOURCES

Certification Courses + Self-Paced Training

- Skydel Certification Courses
- Skydel Fundamentals
- Skydel Intermediate
- Skydel Advanced

Online User Forums

- Skydel User Forum
- Skydel Documentation and Release Notes

Application Notes + Articles

- Creating Custom Signals
- Convert a Motion-Based Trajectory Into a Waypoint Trajectory
- How To Test The ERA-GLONASS (GOST) Standard
- Testing a Receiver's Galileo OSNMA Capability Using Skydel
- Compliance: Radiating Real RF in GNSS Simulations
- Creating "Fixed" GNSS Satellites
- Real Time Correction Messages (RTCM) Plug-In
- Configure Satellite Positions Based on User-defined Elevation/Azimuth in Skydel

Github

- Skydel Repository

Support

- Safran Support Hub
- Warranty Information

Useful Links

- Simulation Nation Newsletter

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October 27, 2025