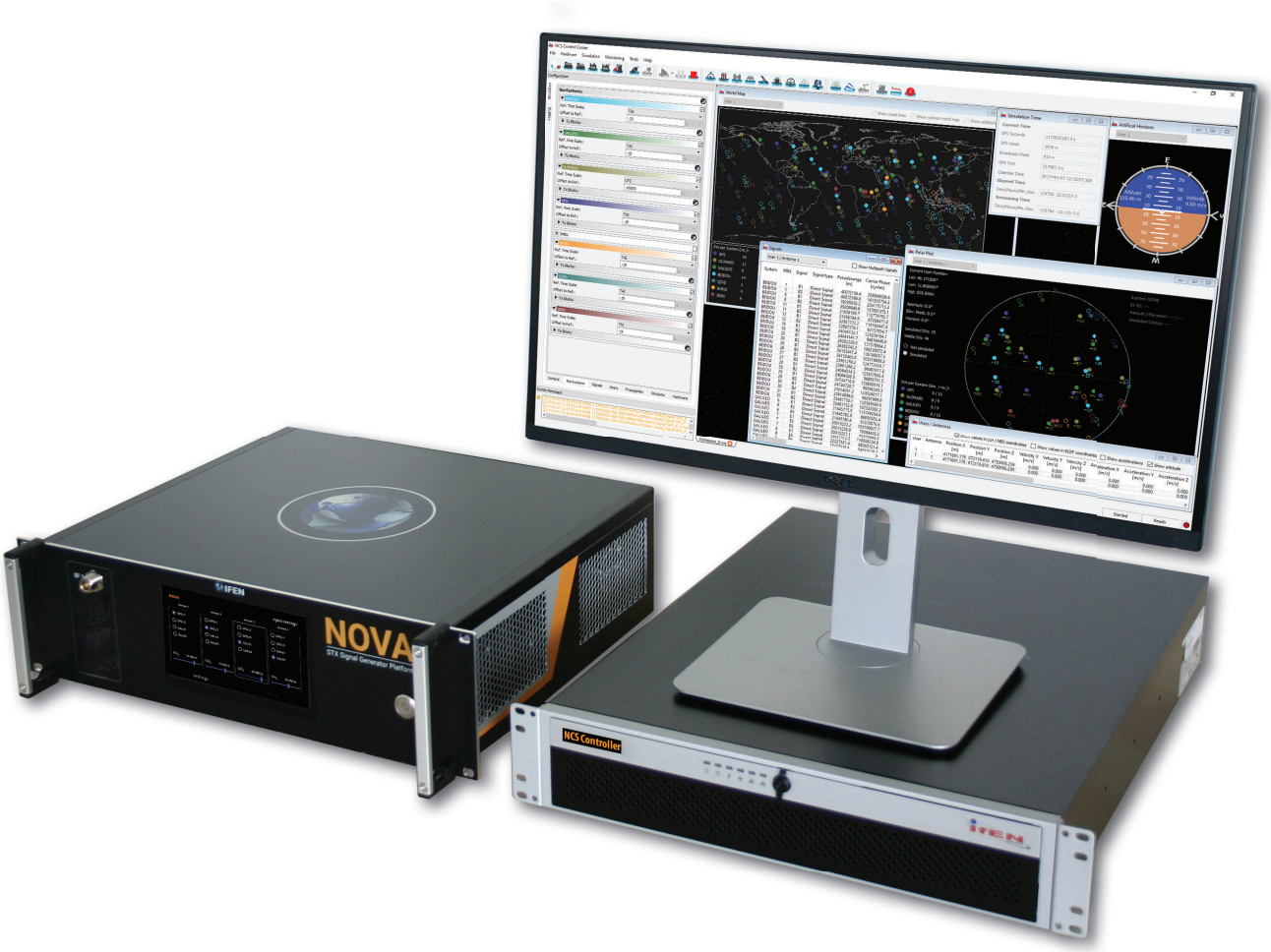
NCS NOVA

GNSS SDR RF Signal Simulator



NOVA

GNSS RF Signal Generation Platform

GNSS Multi-System and Multi-Frequency SW Defined RF Signal Generator with Maximum Flexibility and Extendability

NCS NOVA GNSS Simulator

Features

Signal Capabilities

- Support of all global (GNSS) and regional satellite navigation systems (RNSS) as well as satellite based augmentation systems (SBAS)
- 160 signal channels available per NCS NOVA chassis (with number of used channels to be licensed)
- Each signal channel has additional multipath channels (not limited, as simulated in SW)
- In-field extension of signal capability and GNSS functionality by software license
- The user may select which signals are simulated and the allocation of channels to each signal, for each test scenario
- All GNSS constellation types and almost all frequencies combined in one chassis

Connectivity

- Remote control capability via Ethernet interface
- 1 PPS out
- 10 MHz reference in & out
- External trigger input

System Setup

The NCS NOVA GNSS Simulator is a high-end, powerful but easy to use satellite navigation testing and R&D device. It is fully capable of multi-constellation, multi-frequency simulations for a wide range of GNSS applications including Space, Aviation, Automotive (including autonomous driving testing) and many others. With the NCS NOVA GNSS Simulator you will get a complete, flexible and easy to use laboratory test equipment, which provides a reliable, stable and repeatable platform for a range of test applications.

NCS NOVA RF Signal Generation Unit

NCS Control Unit with Simulation Software

The NCS NOVA GNSS simulator consists of the NCS NOVA RF Signal Generation Unit and a dedicated NCS Control Unit (host computer with MS Windows® 10) running the NCS simulation software called 'Control Center' software.

Support for all GNSS Systems and Signals

The NCS NOVA GNSS Simulator is the next generation solution, providing almost all signals for GPS, GLONASS, Galileo, BeiDou, IRNSS, QZSS, SBAS and beyond in one box. The following signals can be licensed using a flexible licensing scheme.

System	Frequency Band	Signal(s)
GPS	L1 L2 L5	C/A Code L2C I, Q
Galileo	E1 E5	OS CBOC Data/Pilot E5a Data/Pilot + E5b Data/Pilot, AltBOC
GLONASS	L1 L2	Standard accuracy Standard accuracy
BeiDou-2	B1 B2	B1-I B2-I
NavIC-IRNSS	L5 S-Band	SPS, RS-Noise SPS, RS-Noise
QZSS	L1 L2 L5	C/A Code L2C I, Q
SBAS (WAAS, EGNOS, MSAS, GAGAN)	L1 L5	C/A Code I , Q

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NCS Control Center Simulation Software

The comprehensive and user friendly NCS Control Center simulation software provides full test scenario generation capability in terms of flexible scenario definition, simulation configuration and interactive control. The rich and easy to use Control Center software is the result of IFEN's listening and implementing changes, requested by multiple customers from a wide variety of applications. This is an ongoing process and IFEN continues to enhance the software as customer needs evolve.

A very comprehensive set of simulation parameters can be modified by the user to build up the desired scenario. Various graphical widgets are used to visualize the simulated data in a very clear way. The NCS Control Center allows the user to log a variability of simulated parameters in real-time to corresponding files.

For Hardware-In-The-Loop (HIL) testing with integrated vehicle motion simulators, user trajectories (user position and attitude plus their derivations) can be streamed via Ethernet in real-time at any rate up to 250 Hz into the simulator using UDP datagrams.

The Remote Control capability allows the user to load, modify, start and control scenarios from a remote PC via a simple TCP/IP client (e.g. Telnet, Hyperterm) or by using a scripting language with TCP/IP module (e.g. Perl, Python). The Remote Control capability allows for full featured batch processing of several scenarios and an enhanced interactive control of the generated signals.

The design of the NCS GNSS simulator allows the user to easily enhance system capabilities by SW licensing to cover changing user needs. This enables the customer a cost-efficient selection of the needed signals.

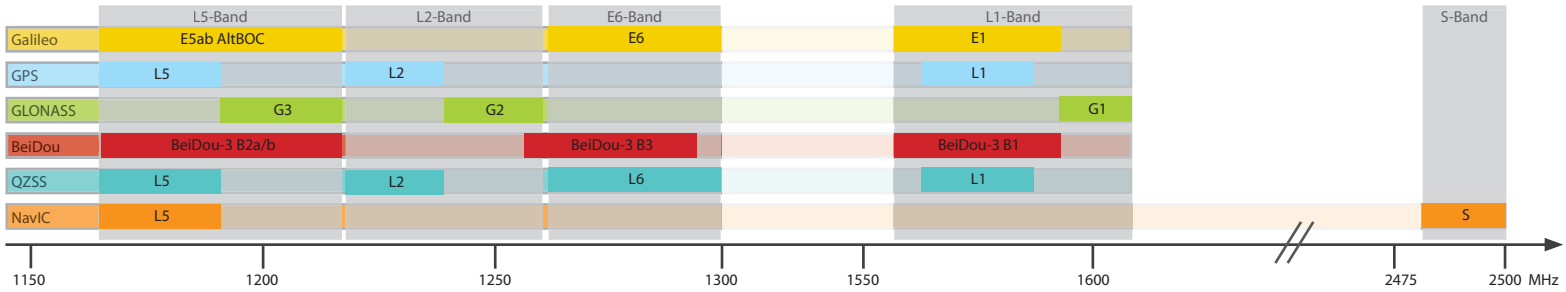
Two types of licenses are available:

- Purchase of additional GNSS signals licenses at any time
- Purchase of additional number of channels at any time

NOVA RF Signal Generation Unit

The NOVA RF signal generation unit hardware is already able to cover all current GNSS signals on the L-band and additionally the NavIC-IRNSS signal on the S-band, subdivided into five RF bands.

The RF module of NOVA RF signal generation unit is equipped with four RF signal chains, with an RF bandwidth of 50 MHz each. The user has the choice to select for each test scenario up to 4 RF signal bands (out of the total 5 RF signal bands). This selection can be adjusted from one test scenario to another.



Mapping of NCS NOVA supported RF frequency bands (signal chains) to GNSS signals

NCS NOVA HW

Front View

- 1 RF output
- Monitoring display
- Up to 160 channels in a 3HU 19" chassis

Rear View

- 4 RF monitoring outputs with higher RF signal power level
- 10 MHz input
- 10 MHz output
- Trigger input
- PPS output
- 2 Ethernet
- USB 2/USB3

Features

Simulation Capabilities

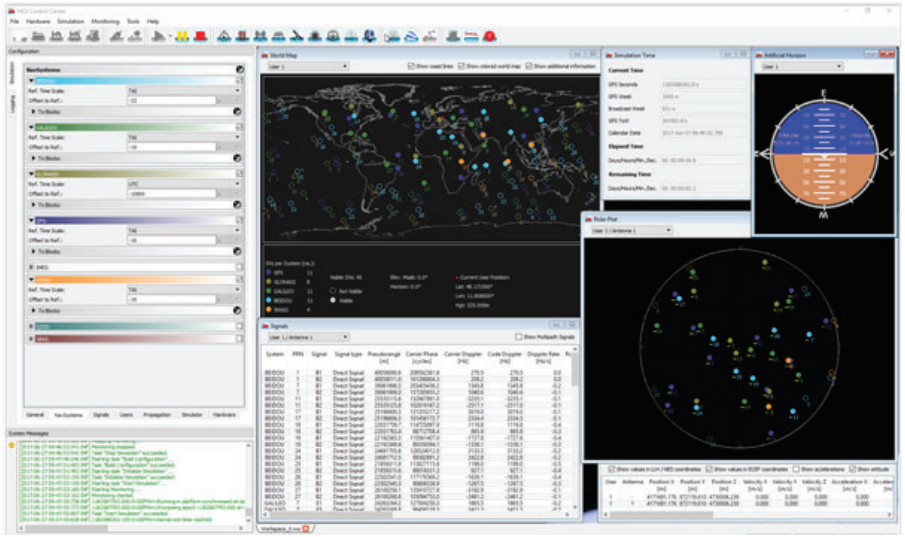
- Satellite orbits and clock simulation for all existing and coming GNSS systems
- Different signals per GNSS constellation batch (e.g. IIR-M, IIF...)
- Ionosphere and troposphere effects
- Different user types supported (vehicle, aircraft, space vehicle, ...)
- 6D-trajectories from static ground to dynamic space user (pre-defined, from file, via editor or remote motion data)
- Simulation of multi-user configurations
- Simulation of transmit and receive antenna characteristics
- Simulation of LNA effect (in active antenna) on C/N0 using optional noise generator for realistic C/N0 generation
- Full control of signal power level (automatic or manual)
- Different satellite simulation selection strategies available
- Selectable logging of all simulated outputs (true values and broadcasted values) for later performance comparison analysis with the receiver

NCS Control Center

▶ Full GNSS Simulation Configuration & Control Flexibility

The powerful and easy to use NCS Control Center GNSS simulation software offers the user full control over all aspects of the test scenario configuration, interactive control, monitoring and data logging. This capability allows a wide range of GNSS testing to be conducted for any customer application, with the same hardware ensuring maximum utility for the investment.

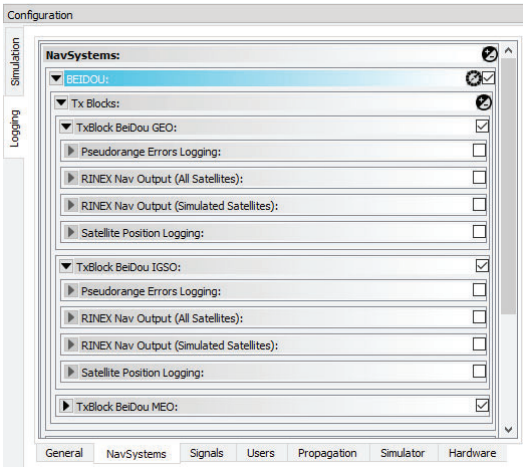
Within the 'Simulation' configuration view, all aspects of the simulated GNSS systems and signals, the propagation path effects, the local user enviroments and the user dynamics can be configured. The assignment of the simulated GNSS signals to available hardware resources (up to 160 channels distributed on up to 4 RF bands within one RF-module) is an important topic in the configuration, offering full flexibility to the customer in assigning the number of channels to one signal.



Screenshot of the NCS Control Center software

▶ Comprehensive GNSS Simulation Data logging

Within the 'Logging' configuration view, all output data can be individually selected by the user to log to files for later analysis comparison. These logged files can also be edited to introduce artificial errors for later simulation input in the next simulation run. Core output data are satellite position and clock, signal broadcast data, propagation data, multipath data, observations and user PVT.



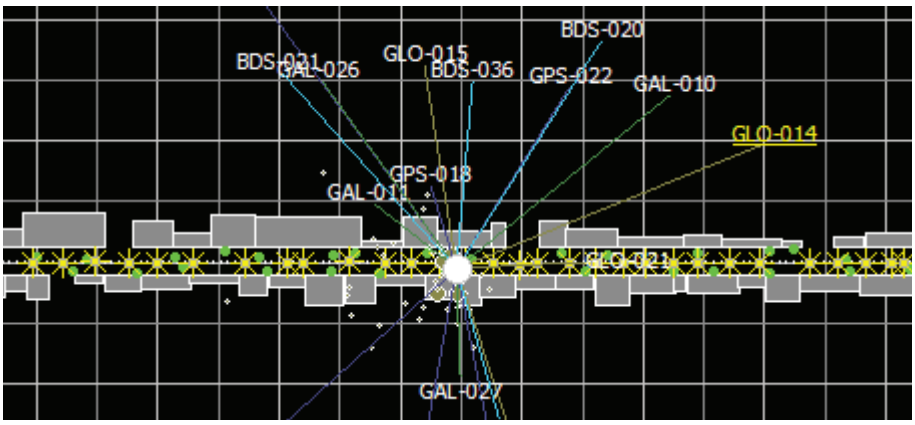
Logging of GNSS simulation data using 'Logging' tab

Simulation of Environmental Effects

▶ Simulation of Multipath Effects

One of the most important local environment driven receiver error is caused by multipath effects. The NCS Control Center software provides a wide range of multipath models. From simple single reflection models to advanced statistical and combined statistical/deterministic models, including the ITU based Aeronautical Mobile Propagation data multipath model and the Land Mobile Propagation data multipath model (Narrow-Band and Wide-Band LMS model). This enables to test the impact of multipath (C/N degradation and LoS path delay) on the receiver performance.

Multipath effects are simulated by using the dedicated multipath channels, supported by each primary channel, in order to guarantee a very high level of fidelity and smooth changes to the relevant parameters like Doppler shift, path delay and power loss between the different epochs.

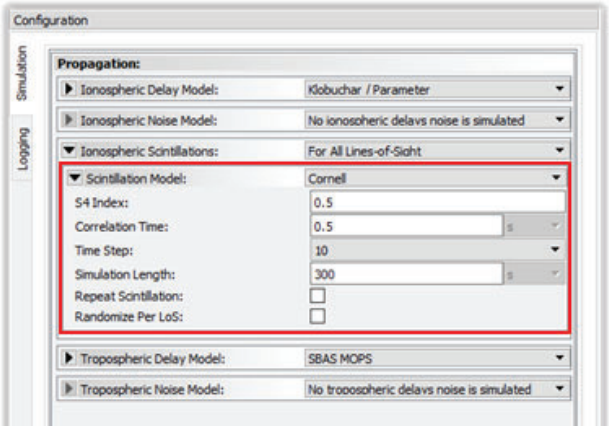


Screenshot of LMS wide-band model simulation visualization (urban environment)

▶ Simulation of Ionospheric and Tropospheric Effects

Propagation effects through the ionosphere are either simulated according to the Klobuchar model, the 3D TEC model NeQuick, the IONEX model, the SBAS and NavIC-IRNSS iono grid model, the spacecraft ionosphere model or by data imported from RINEX files.

Additionally scintillation scenarios are simulated by using the Cornell model or the GISM. The NCS Control Center software supports also the modeling of ionospheric and tropospheric delay noise, which is added to the modeled ionospheric or tropospheric delays.



Configuration of Cornell scintillation model

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GNSS Signal Generation Platform

Features

Usability

- Advanced graphical user interface (GUI) for scenario definition, simulation configuration and control
- Easy modification of variables
- Full constellation, user and vehicle motion control

Signal Licensing

- Licensing of additional signals on-the-fly within a day
- One signal license can be applied to as many signal channels as selected by the user
- New signal licenses will be added as new ICDs are introduced

Extended Simulation

- Support of Differential GNSS (DGNSS) test scenarios, including generation of DGNSS correction data in RTCM format
- Real-time external user trajectory streaming for Hardware-In-The-Loop (HIL) applications
- Enhanced simulation capabilities for space applications and very high signal dynamics to support aerospace and defense applications
- Optional IMU/Sensor Emulation Package (SEP)
- Optional Automotive Test Platform (ATP)

Applications

Discover the perfect test solution for all types of GNSS applications. The innovative multi-constellation and multi-frequency simulation capability sets new standards in the field of GNSS simulation in terms of fidelity, performance, accuracy and reliability. Designed to deliver maximum flexibility, users are no longer faced with configuration limitations.

Extensions

If your application requires an advanced test setup, select the available extensions or ask for your specific customization.

Applications and Extensions

The Solution for all GNSS Applications


Agriculture


Maritime


Surveying


Aviation


Rail


Timing & Synchronization


LBS


Road


Space

IMU/Sensor Emulation Package (SEP) Extension

The real-time IMU/Sensor Emulation Package enhances the NCS NOVA with emulation capability of Inertial Measurement Units (IMU) and inertial sensors, such as Micro Electro-Mechanical System (MEMS) sensors and of other common aiding sensors, enabling full testing of sensor fusion algorithms of the receiver under test.

Noise Generation

Optionally (selectable at every time by SW license) is the capability to generate noise, being important to emulate LNA characteristics typical for an active anntena used in high-end applications. Having a controlled C/N0 is important for proper GNSS receiver testing, as C/N0 is a primary parameter determing the achievable receiver performance.

Automotive Test Platform (ATP) Extension

The Automotive Test Platform (ATP) provides a complete solution to test integrated vehicle navigation systems, which combines GNSS with emulated vehicle sensor data (e.g. wheel ticks) and CAN-bus data. Future Emergency Call (eCall) systems and Advanced Driver Assistance Systems (ADAS) for the automotive sector can be tested based on this platform in a simple way.

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GNSS Signal Generation Platform

NCS NOVA Key Specifications

Parameter / Notes	Detail / Value
Channels, RF Bands and Frequencies	
Signal channels per signal generation unit	Up to 160 per NCS NOVA (number defined per SW license)
RF modules per NCS NOVA chassis	1 RF module
RF bands (signal chains) per RF module	4 (center frequency selectable per SW) with 50 MHz RF bandwidth each
Frequencies generated	Center frequency ranging from 1 GHz to 2.6 GHz
RF band 1 signal coverage (1,559 - 1,610 MHz)	GPS L1 / Galileo E1 / GLONASS G1 / BeiDou-3 B1 / QZSS L1
RF band 2 signal coverage (1,164 - 1,214 MHz)	GPS L5/ Galileo E5ab / GLONASS L3 / BeiDou-3 B2ab / NavIC(IRNSS) L5 / QZSS L5
RF band 3 signal coverage (1,217 - 1,260 MHz)	GPS L2 / GLONASS G2 / QZSS L2
RF band 4 signal coverage (1,261- 1,300 MHz)	Galileo E6 / BeiDou-3 B3 / QZSS L6 (all available in coming updates)
RF band 5 signal coverage (2,483 - 2,500 MHz)	NavIC (IRNSS) S-Band
Multipath channels per signal channel	Not limited (as generated in SW)
Multipath capability	From simple ground reflection to complex LMS Narrow- / Wide-Band Models
Power Levels	
RF Signal Power	-90 dBm to -177 dBm
Dynamic Range	87 dB
Resolution	0.1 dB
Linearity (over total Dynamic Range)	< 0.1 dB
Absolute Accuracy	± 0.3 dB
Run-to-Run Repeatability	± 0.1 dB
Signal Accuracy	
Simulation (Iteration) Rate	100 Hz (up to 250 Hz optional)
Pseudorange Accuracy	< 0.1 mm RMS
Pseudorange Rate Accuracy	< 0.1 mm/s RMS
Pseudorange Uncertainty (due to Interchannel Bias)	0 mm RMS
Deltarange Accuracy	< ±0.5 mm RMS
Optional Signal Generation	
Noise Generation	-170 dBm/Hz to -110 dBm/Hz
Signal Dynamics	
Max. Velocity (LoS)	± 1,460,000 m/s
Max. Acceleration (LOS)	± 667,000 m/s^2
Max. Jerk (LoS)	± 6,600,000 m/s^3
Angular Rates (indicative) (at 1.5 m lever arm) (at 0.5 m lever arm)	 > 15π rad/s > 60π rad/s
Spectral Purity	
Harmonics	< -40 dBc
In-band Spurious	< -70 dBc
Phase Noise	< 0.005 rad RMS
Frequency stability	< ± 5 * 10^{-10}
Inter-Carrier Phase Coherence	
Inter-Carrier Bias	< ± 1.0 ns
Carrier Phase Coherence (@ Rf Output)	< 0.5°

IfEN

Contact your local IFEN sales representative for expert advice regarding the optimum simulator configuration to meet your current and future needs

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