PathWave Signal Generation (PWSG) for NR-V2X

Introduction

NR-V2X is a next-generation vehicle-to-everything (V2X) communication standard, based on 3GPP's 5G NR Sidelink standard with higher performance, flexibility, and reliability for advanced use cases beyond LTE-based Cellular V2X.

Developing and testing emerging standards like NR-V2X is especially challenging. PathWave Signal Generation (PWSG) for NR-V2X helps accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

The Keysight PathWave Signal Generation (PWSG) for NR-V2X is a 5G NR based V2X signal generation application.

Key features

- Create 3GPP standard compliant NR-V2X signals with channel coding for non-signaling transmitter and receiver testing
- Support Channels and Signals: PSSS, SSSS, PSBCH, PSCCH, PSSCH, PSFCH, CSI-RS, PTRS
- Provide Fixed Reference Channel (FRC) configuration wizard for standard-compliant receiver testing
- Provide Tx Config wizard for standard-compliant transmitter testing
- One-button generate and download to the supported Keysight Signal Generators
- Support SCPI programming

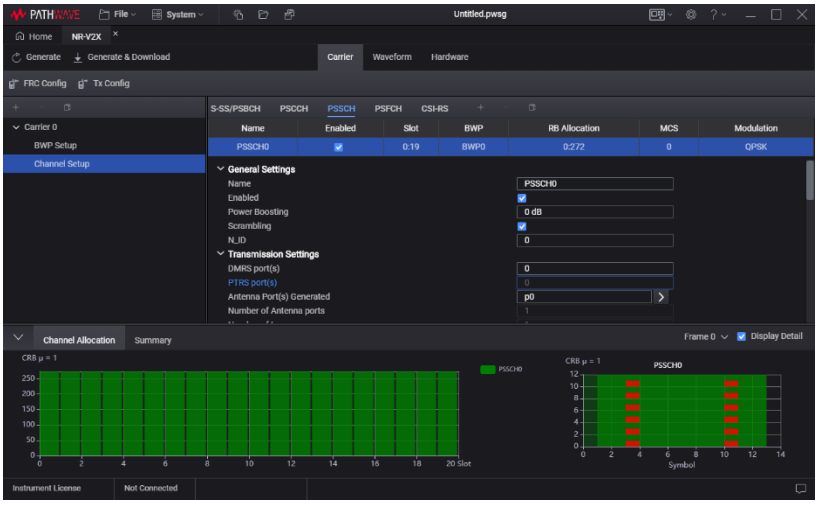

Figure 1. PWSG for NR-V2X channel setup user interface

Simplify Standard-Compliant Signal Creation

Keysight Technologies, Inc. PathWave Signal Generation (PWSG) for NR-V2X application is a flexible signal creation tool that will reduce the time you spend on signal simulation. Quickly and easily generate standard-based and custom NR-V2X signals for component, transmitter, and receiver tests.

Typical measurements

Component and transmitter test		Receiver test	
ACLR	CCDF	Sensitivity	Blocking
EVM	Channel power	Selectivity	Intermodulation
Occupied bandwidth			

Component and transmitter test

PWSG for NR-V2X application uses waveform playback mode to create and customize waveform files needed to test components and transmitters. Its user-friendly interface lets you configure signal parameters, calculate the resulting waveforms and download files for playback on a vector signal generator or for analysis using the vector signal analysis software. The applications for these test signals include:

- Parametric test of components, such as amplifiers and filters
- Performance characterization and verification of RF sub-systems and transmitters

Receiver test

PWSG for NR-V2X application enables you to create channel-coded signals for receiver bit-error-rate (BER), block-error-rate (BLER), packet-error-rate (PER), or frame error rate (FER) analysis. Applications include:

- Performance verification and functional test of receivers, during RF/baseband integration and system verification
- Coding verification of baseband subsystems, including FPGAs, ASICs, and DSPs

Apply Your Signals in Real-World Testing

Once you have set up your signals in PWSG for NR-V2X application, you can download them to a variety of Keysight instruments. The PWSG for NR-V2X application complements these platforms by providing a cost-effective way to tailor them to your test needs in design and development.

PathWave Signal Generation - Desktop
Live connectivity
• X-Series Signal Generator: N5182B MXG, N5172B EXG, and N5166B CXG • N5186A MXG Vector Signal Generator • M9410A/M9411A PXIe VXT Vector Transceiver • M9415A/M9416A PXIe VXT Vector Transceiver • M9384B/M9484C VXG Vector Signal Generator • M9484C VXG Signal Generator + VDI CCU (Beta) • M8190A AWG DUC • M8190A AWG

Component and transmitter test

Figure 2. Typical component test configuration using PWSG Desktop with an X-Series signal generator and analyzer.

PWSG for NR-V2X application generates RF performance optimized V2X waveform which enables you to characterize the power and modulation performance of your components and transmitters. Easy manipulation of a variety of signal parameters, including transmission bandwidth, cyclic prefix, and modulation type, simplifies signal creation.

- Create spectrally-correct signals for channel power, spectral mask, and spurious testing
- Set parameters such as signal bandwidth and channel modulation type (QPSK, 16QAM, 64 QAM, 256QAM) for modulation verification and analysis, such as EVM tests
- View CCDF, spectrum, time domain, and power envelope graphs to investigate the effects of power ramps, modulation formats, power changes, clipping, and other effects on device performance
- Adjust baseband filter to achieve a balance among ACPR, EVM, and narrow resource block spectrum performance

Receiver test

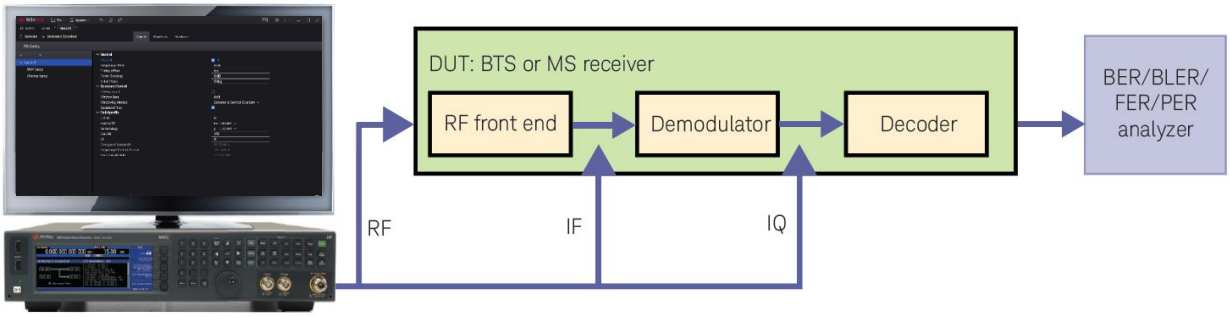

Figure 3. Generate receiver test signals for early testing of your receiver with Keysight X-Series signal generators and PathWave Signal Generation.

PWSG for NR-V2X application can be used to generate 5G NR based V2X signals for early testing of receiver system and component hardware. Pair with X-Series measurement application or VSA software on Keysight signal analyzers and oscilloscopes to evaluate receiver performance at various stages of the receiver chain (RF, IF, and IQ).

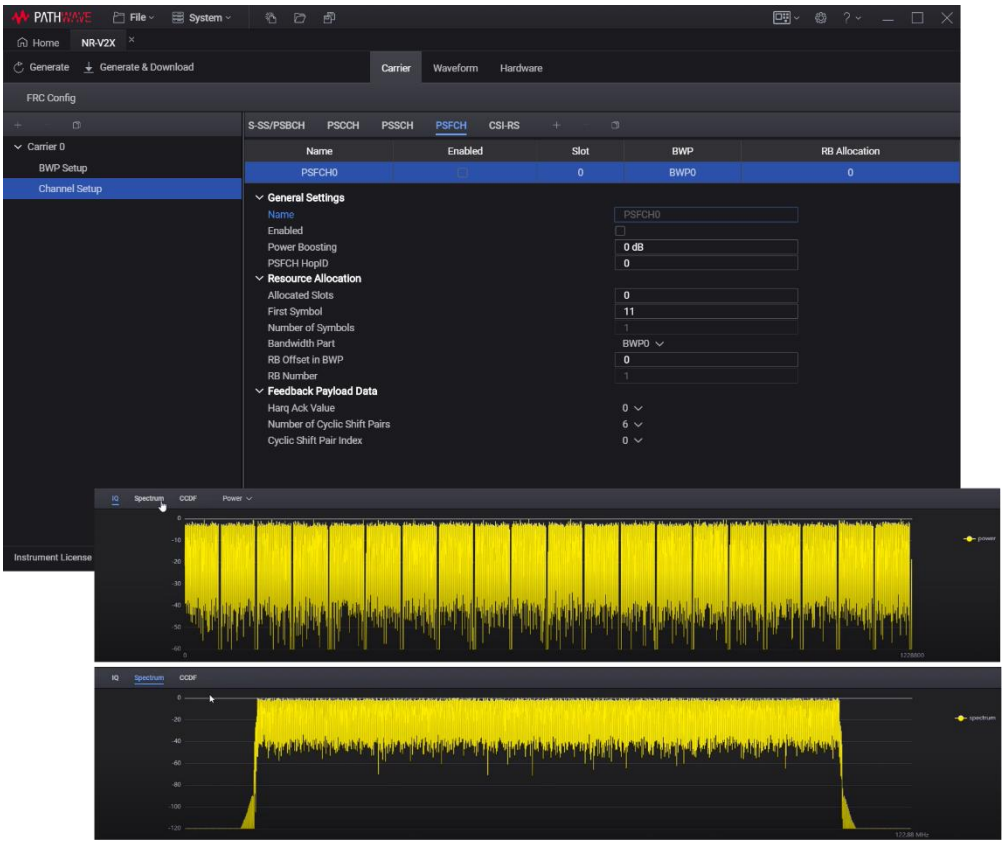

Figure 4. Generate channel-coded signals to evaluate the throughput of your receiver with Keysight signal generators and PWSG for NR-V2X application's advanced capabilities.

Testing of receiver hardware:

- Create 3GPP standard compliant NR-V2X signals for V2X direct communication using PC5 interface
- Quickly configure and generate Fixed Reference Channels (FRC)
- Create V2X signals with channel-coded PSSCH, PSCCH, and PSFCH for BLER and BER tests
- Support retransmission
- Support SCPI programming

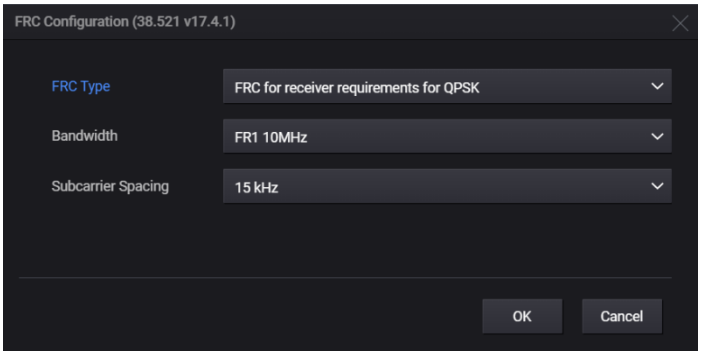

Figure 5. NR-V2X FRC configuration wizard

PWSG for NR-V2X Licensing

PWSG for NR-V2X application offers a waveform playback license N7632EMBC. The license should be installed on the supported signal generator instrument.

- N7632EMBC is an embedded license installed on a supported signal generator, such as X-Series Signal Generator, N5186A MXG, VXT or VXG, which enables you to generate, make a live connection to download and offline playback NR-V2X waveforms. N7632EMBC is recommended for design and verification or manufacturing teams.
- Instrument license mode: each instrument needs a valid license (N7632EMBC) to playback waveforms. Waveforms can be saved in signal generators for offline playback.

PWSG for NR-V2X feature summary

Capabilities
Sidelink channels and signals: PSCCH, PSSCH, PSFCH, CSI-RS, PSSCH-PTRS
Sidelink SSBlock: S-SS and PSBCH with MIB auto generation
Support both single carrier and multi-carrier
Subcarrier Spacing: FR1: 15 kHz, 30 kHz, 60 kHz; FR2: 60 kHz, 120 kHz
Carrier bandwidth (MHz): FR1: 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100; FR2: 50, 100, 200, 400
Support retransmission
Support FRC Config wizard
Support Tx Config wizard
PSSCH auto-detection based on SCI in PSCCH
Support PSSCH-Second stage SCI
Support Phase Tracking Reference Signal (PTRS)
Support auto phase compensation
Multiple BWPs in single carrier
Support Time Scale Factor
MCS Table 5.1.3.1-1/2/3 for PSSCH
DMRS Time Pattern List
Payload data (PN9/15/23/31, Custom Bit Pattern, or User File)
Export waveform files (encrypted Signal Studio waveform file)
Live Connection to X-Series Signal Generators, VXG, and PXIe VXT
Offline waveform file playback
IQ/Spectrum/CCDF Plots
Channel Allocation graph with Display Detail function for a selected channel

Supported standards

Specification	Name	Version	Date
3GPP TS38.211	Physical channels and modulation	16.8.0	2021.12
3GPP TS38.212	Multiplexing and channel coding	16.8.0	2021.12
3GPP TS38.213	Physical layer procedures for control	16.8.0	2021.12
3GPP TS38.214	Physical layer procedures for data	16.8.0	2021.12
3GPP TS38.101-1	NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone	17.4.1	2022.07
3GPP TS38.521-1	NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 standalone	17.4.1	2022.07

Ordering Information

Software licensing and configuration

PWSG Desktop application offers flexible licensing options, including:

- Node-locked: Allows you to use the license on one specified instrument/computer.
- Transportable: Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- Floating: Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased. Floating support single site, single region and worldwide three different types.
- USB portable: Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- Subscription (Time-based): License is time limited to a defined period, such as 6, 12, 24 or 36 months

PathWave signal generation for NR-V2X N7632EMBC license

Waveform Playback License (N7632EMBC)

Software license type	Software license	KeysightCare subscription
Node-locked perpetual	R-Y5B-001-A	R-Y6B-001-y[2]
Node-locked time-based	R-Y4B-001-z[1]	Included
Transportable perpetual	R-Y5B-004-D	R-Y6B-004-y[2]
Transportable time-based	R-Y4B-004-z[1]	Included

One-month KeysightCare Support and Subscription

Support subscription	Description
R-Y6B-001	1-month of support subscription for node-locked perpetual licenses
R-Y6B-504	1-month of support subscription for transportable perpetual license

1. z means different time-based license duration. F for 6 months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. y means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

Hardware configurations

To learn more about compatible hardware and required configurations, please visit:

www.keysight.com/find/SignalStudio_platforms

PC requirements

A PC is required to run PWSG Desktop. www.keysight.com/find/SignalStudio_pc

Websites

www.keysight.com/find/PWSG

PathWave Signal Generation for NR-V2X

- NR-V2X Waveform Creation and Offline Playback: www.keysight.com/find/N7632EMBC

Comprehensive Online Documentation: www.keysight.com/find/signalstudio_support

PathWave Signal Creation Desktop Software: www.keysight.com/find/PWSG_software

Literatures

PathWave Signal Generation, Brochure, 5989-6448EN

Signal Studio Pro for LTE V2X, Technical Overview, 5992-3826EN