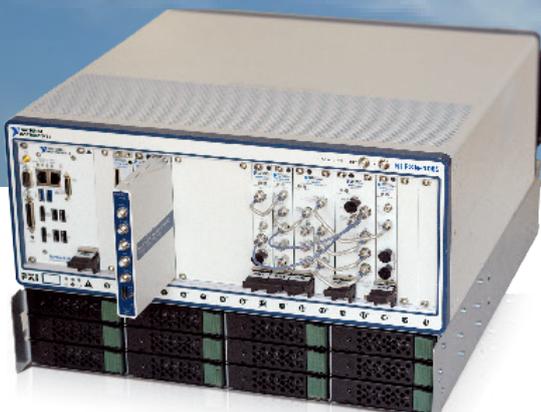
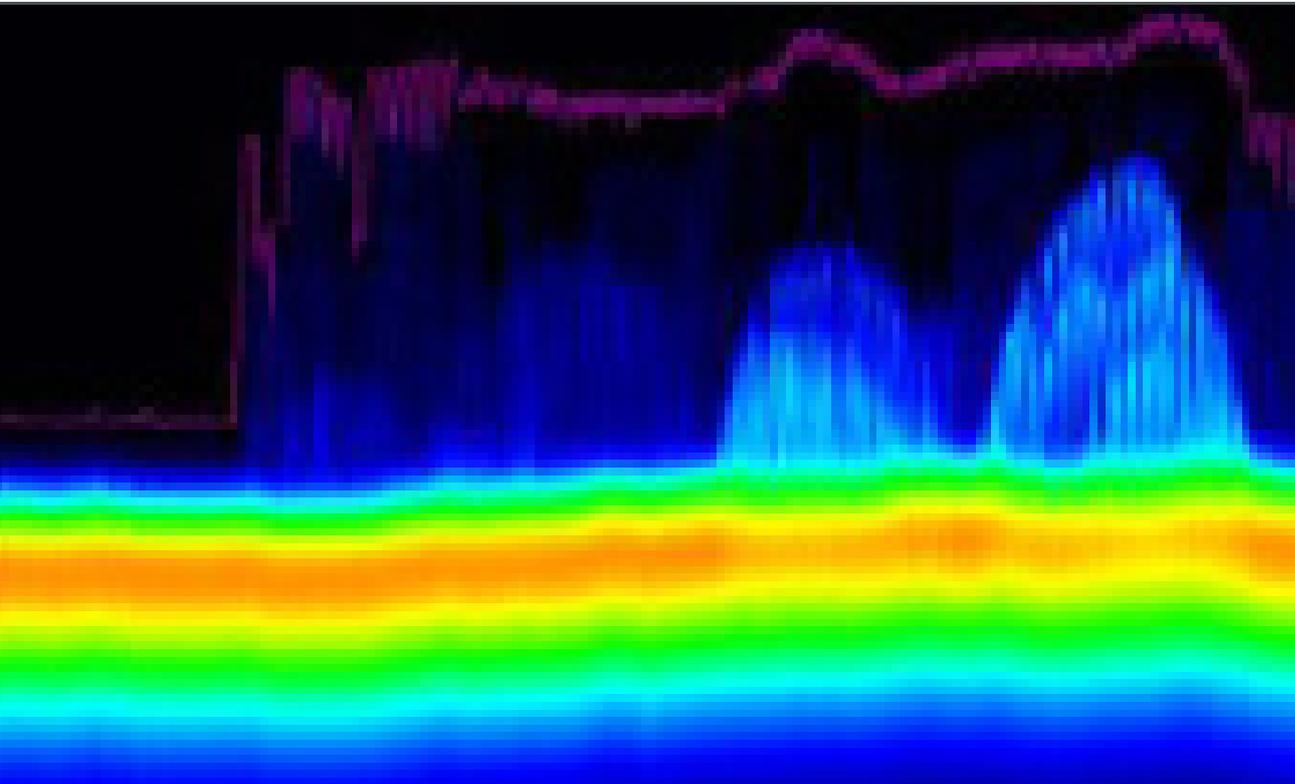


# Flexible **High Speed** Recording

Wideband recording of IF & RF signals



# Recording Wideband Signals



**Recording signals is important** in many application areas, both in the lab and in the field. By recording data during tests or experiments, you can review the data later on. Recorded signals can help to prove misuse of the spectrum or gather other valuable information.

As the real-time bandwidth of RF front-end units becomes wider, the requirements for recording systems are also expanding. Recording wideband I/Q signals can require writing speeds in excess of 3 GB per second. To avoid missing important data, the recording system is designed to continuously handle a data rate in excess of 3 GB per second.

## **NWBR: High speed and highly flexible**

Novator Wideband Recorder (or NWBR, for short) is a high-speed recording system built on the NI PXIe platform, which is capable of recording signals of up to 765 MHz of bandwidth. NWBR is compatible with most RF hardware and digitizers from National Instruments. External RAID units are used to store substantial amounts of data. With the NWBR, you can quickly get operational, recording RF- and other high-speed signals.

A highly flexible recorder, NWBR can record narrowband and wideband signals of different center frequencies and bandwidths. With NWBR, it is also easy to include multiple signals in one recording system. The system can be used for both civilian and defense applications and be customized for airborne systems.

# Features

**Gapless recording.** The NWBR records all data continuously without gaps.

**Triggered recording.** Recordings can be initiated and stopped manually from the client interface or through TCP/IP commands. They can also be hardware triggered or scheduled in advance.

**Pre-trigger buffering.** NWBR features a pre-trigger buffer that always temporarily stores data. With the buffer enabled, data before the trigger is also recorded – this gives a more complete recording of the event. The maximum length of the pre-trigger buffer depends on the signal being recorded, with wider signals giving shorter pre-trigger buffers. A 500 MHz signal can have a pre-trigger buffer of seven seconds while a narrower band can last for several minutes.

**Remote control.** For various reasons, the operator is not always located close to the RF signal source. NWBR can be remotely controlled via TCP/IP commands, either by using the included client application or by integrating NWBR into other systems.

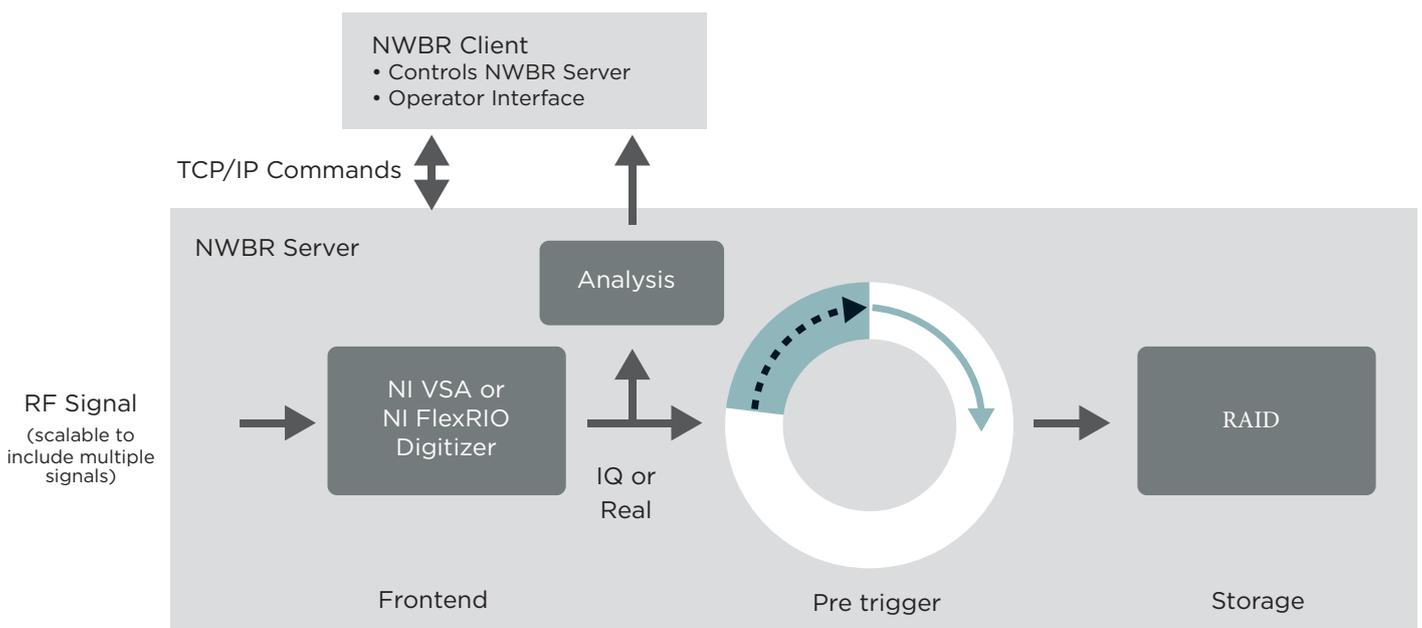
**Open file format.** The generated files are saved as binary files in an open file format that can be opened by third-party software for analysis. Metadata can be customized, and custom formats are available upon request.

**Time-stamping.** The possibility of importing 10 MHz and 1 PPS signals in combination with NTP time values ensures the accurate time-stamping of the recordings. You can use IRIG-B time codes or connect the NWBR directly to a GPS antenna to receive accurate time.

**Long recording time.** With the NWBR, you can record hours and up to days of data depending on bandwidth and the selected storage option.

**Scalable.** You can add multiple input sources to the same recorder to record different center frequencies, bandwidths, etc.

**Playback.** By adding a signal generator, recorded data can be played back. Contact us for more information about playback functionality.



# Front End

NWBR is built on the PXIe platform, which makes it both flexible and scalable. It can be used together with a wide variety of RF instruments from National Instruments. The RF front end can be based on a vector signal analyzer, an NI FlexRIO with adapter module, other NI digitizers, or a combination of these products. If you would like to know more about any of these options, contact us.

## Vector Signal Analyzer Options



Vector signal analyzers, such as the NI PXIe-5667 or NI PXIe-5668R, are RF instruments with a high frequency range (up to 26.5 GHz) and industry-leading real-time bandwidths (up to 765 MHz).

With a vector signal analyzer, it is possible to create a flexible RF recording system containing all the necessary hardware to acquire and record signals of various center frequencies and bandwidths.

## FlexRIO Digitizer Options

By combining a FlexRIO FPGA board and different adapter modules with different analog-to-digital conversion possibilities, you can build a digitizer customized to your needs.

FlexRIO digitizers are often used together with already existing RF hardware to record intermediate-frequency signals, but they can be used to record other signals, too.



# Signal Processing

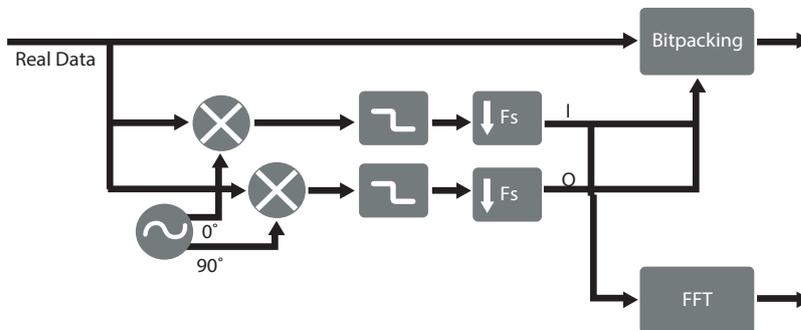
## IF Digitizer

With FlexRIO-based options, you can use NWBR as a pure digitizer sampling real data or you can leverage the onboard signal processing functionality added to the field-programmable gate array (FPGA) to get a powerful intermediate-frequency (IF) digitizer.

By using band-pass sampling, you can acquire IF signals of relatively high center frequencies with moderate sample rates. The FlexRIO options include signal processing on the FPGA to downconvert the signal to baseband (using

digital downconversion). This frequency translation and decimation help to reduce the data rate, thus decrease the storage and write speed requirements.

In addition to downconversion, a 1024-point FFT is calculated on the signal and can be sent to the client via UDP from the controller. If it is necessary to save additional storage space, 12-bit samples are bit-packed into 16-bit samples (four 12-bit samples are saved as three 16-bit samples).



# RTSA

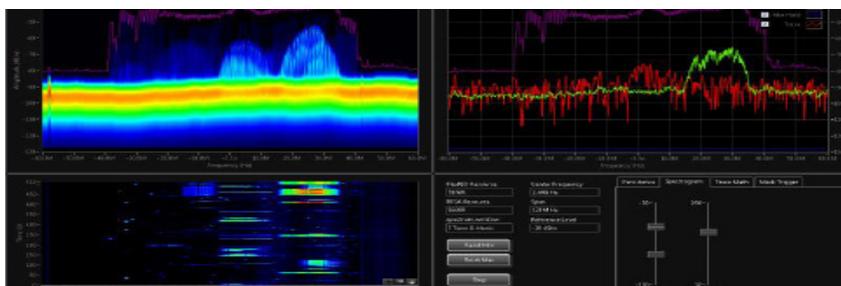
## Real-Time Spectrum Analysis

This add-on empowers NWBR with real-time spectrum analysis (RTSA) capabilities, making it easier for operators to discover hidden signals or signals with short duration.

By using an FPGA to compute 62,5 million overlapping FFTs per second, it is possible to process input bandwidths up to 765 MHz with a 100% probability of intercept of 1.5  $\mu$ s.

RTSA includes both a persistence display and spectrogram, so you can easily inspect the spectrum both in frequency and time. Frequent signals with longer duration appear in warmer colors while shorter signals are in cooler colors that slowly fade away (see picture).

With RTSA option, you can also trigger recordings on spectrum masks, thereby automating the recording system.



# Specifications

The NWBR is based on the NI PXI platform. Full specifications of included hardware can be found at [www.ni.com](http://www.ni.com).

Rack mount	19 inch
Controller	NI PXIe-8880
Chassis	NI PXIe-1085

# Options

The NWBR software and hardware can be customized. Below are the main differences between the different systems.

## Controller (RAM)

The memory is directly related to the size of the pre-trigger buffer.

	8 GB	16 GB	24 GB
80 MHz buffer length [s]	16	32	48
500 MHz buffer length [s]	2.5	5.12	7.68

## RF Frontend

NI Vector Signal Analyzers

	NI PXIe-5667	NI PXIe-5668R
Frequency range	7 GHz	26.5 GHz
Real-time bandwidth [MHz]	50	320/765 above 3.6 GHz
Channels	1	1

## FlexRIO

	NI-5762	NI-5772
ADC resolution [bits]	16	12
1 Ch sample rate [MSps]	150–250	800–1600
Analog bandwidth [MHz]	600	2000
Channels	2	2

## RAID

RAID drives can be internal (PXI module in the chassis) or external (connection via PCIe cable). Different sizes and write speeds are available. A rough estimation of the required data rate (MB/s) is to multiply the bandwidth in MHz times five. Options below are a subset of possible RAID solutions.

	NI 8260	NI HDD-8261	NI HDD-8266
Form factor	Internal	Internal	External
Type	SSD/HDD	SSD/HDD	SAS
Write speed [GB/s]	0.4/0.2	2/0.25	3.1
Capacity [TB]	1/3	2.9/4	24

## RTSA

This option adds signal processing to make signal detection easier and enables frequency-mask trigger functionality.

# Example Configuration

This example configuration uses a recording system to digitize and record two narrowband IF signals and one wideband IF signal. Custom sample rates are used to under-sample the IF signals. On the FPGA, the signals are processed to baseband signals, which are stored to disk.

System configuration and options:

Signal	2 x narrowband	1 x wideband
IF center frequency	160 MHz	1 GHz
Bandwidth	Up to 80 MHz	700 MHz
ADC resolution	16	12
Front-end option	NI-5762	NI-5772
RAM option	24 GB	
Pre-trigger memory [s]	48	7.7 (10.2*)
RAID option	24 TB (96 TB as option)	
Data rate [MB/s]	400	2 800
Data rate [GB/min]	24	164*
Recording time [min]	850	75*
RTSA	NO	YES

In this configuration, two narrowband channels can be recorded simultaneously. All three signals can be monitored at the same time by displaying the FFT in the client.

# About Novator Solutions

**Based in Stockholm, Sweden,** Novator Solutions is specialized in developing FPGA-based software defined radio instruments on National Instruments platforms such as PXIe and USRP. We offer turn-key solutions for channelization, analysis, wideband recording and playback of RF signals in various scenarios.

Novator Solutions is a National Instruments Gold Alliance Partner, as well as winner of numerous awards including Alliance Partner of the Year 2015 in northern Europe and Alliance Partner of the Year 2016 in Europe, Middle East, India and Africa Region (EMEIA).

## Our Partners

**National Instruments (NI)** is an American company based in Austin, Texas, with over 7000 employees worldwide. NI provides an integrated hardware and software platform that helps engineers and scientists in nearly every industry. NI RF products and solutions span from design to test. Its high-performance PXI platform and RF instrumentation deliver unprecedented flexibility, accuracy, and measurement speed.

**RFEL** is a UK based Technology Company providing high specification signal, image and video processing solutions to government, defence, security and industrial customers.

As world leaders in high performance software defined digital receiver designs for Electronic Warfare systems, RFEL offers rapid and flexible design services based on an extensive library of multi-award winning, patented FPGA IP-Cores.

