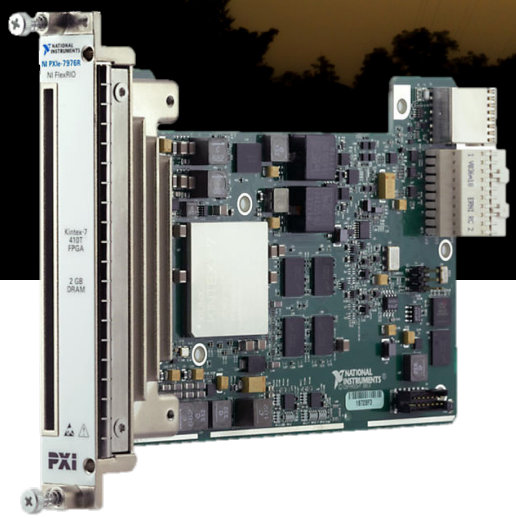
Flexible RF Channelization

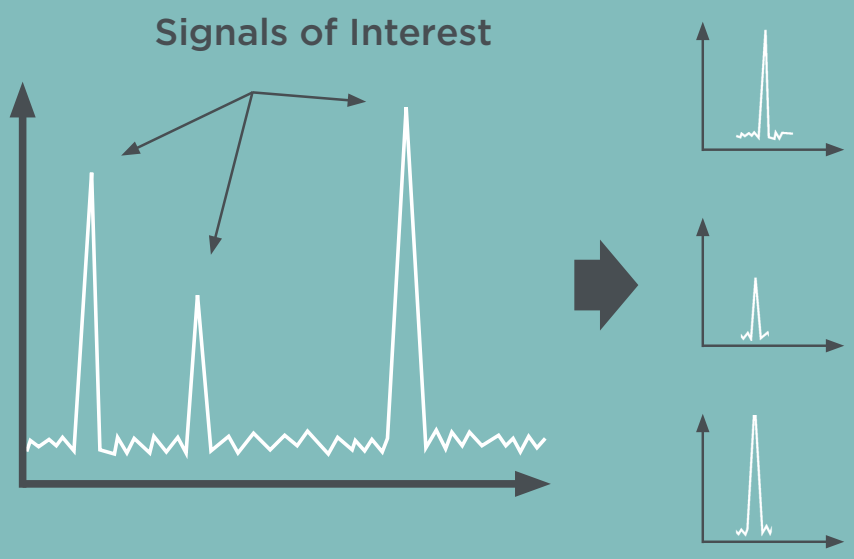
Extract up to 1024 RF signals of interest



NOVATOR SOLUTIONS

Why Channelize?

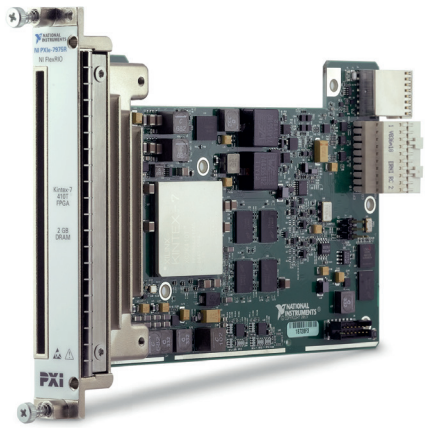
Spectrum monitoring and signal analysis have many application areas, both civilian and military. As wireless technologies are becoming more common, the RF spectrum is getting increasingly crowded and having the right tools to analyze these signals is important. By using channelization, it is possible to use a single wideband receiver and still analyze thousands of signals.



When monitoring a wideband source, many different signals of interest must be analyzed, demodulated, decoded, or processed in other ways. However, processing the entire wideband source for every interesting signal is too CPU intensive. Instead, the signals of interest should be extracted from the wideband source so that each signal is processed individually. This extraction can be achieved by filtering and decimating the wideband signal, resulting in a lower sample rate that contains only the signal of interest.

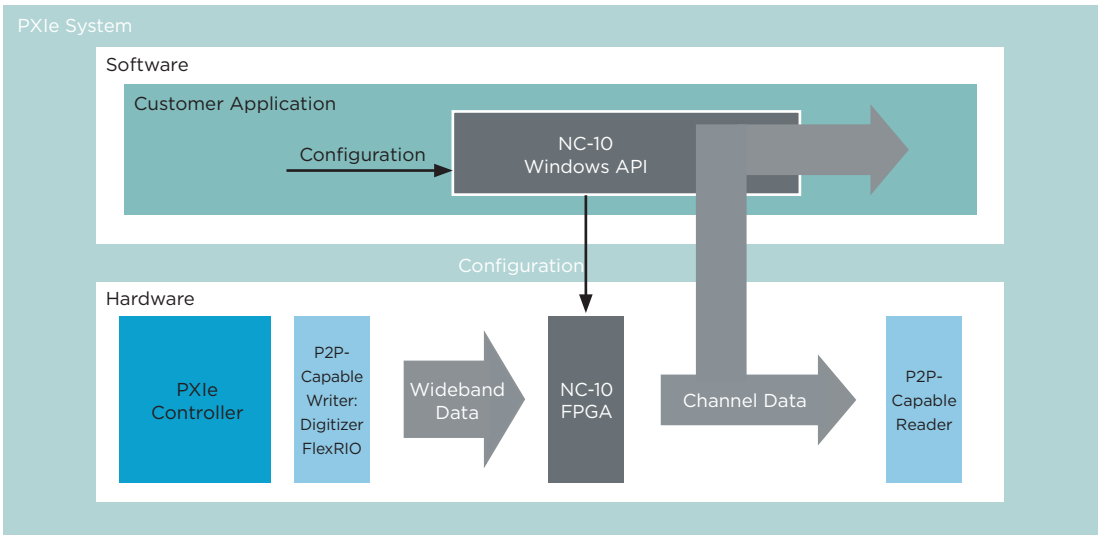
Processing Power

For online monitoring applications, channelization must be done continuously in real time and without disrupting the incoming wideband signal. The more extracted channels there are, the more processing power is needed. For high channel counts, software-based solutions cannot keep up with the incoming data if a single processing computer is used. By using an approach where hardware is tailored for the task, such as with a field-programmable gate array (FPGA), the channels can be extracted efficiently and without interruption.



NC-10 FPGA-Based Channelizer

The NC-10 Channelizer is an FPGA-based solution that enables you to extract up to 1024 channels in real time and stream the channels for further processing. The NC-10 is powered by ChannelCoreFlex Technology from RFEL.



The system is very flexible and unlike many other channelization approaches, each channel can individually be tuned in terms of:

- Center frequency
- Sample rate (fractional)
- Gain
- Filter selection
- On/off

You can combine narrowband and wideband channels and have overlapping channels. The channels can be reconfigured in runtime, and reconfiguring one channel does not affect the operation of the other channels.

PXIe-based

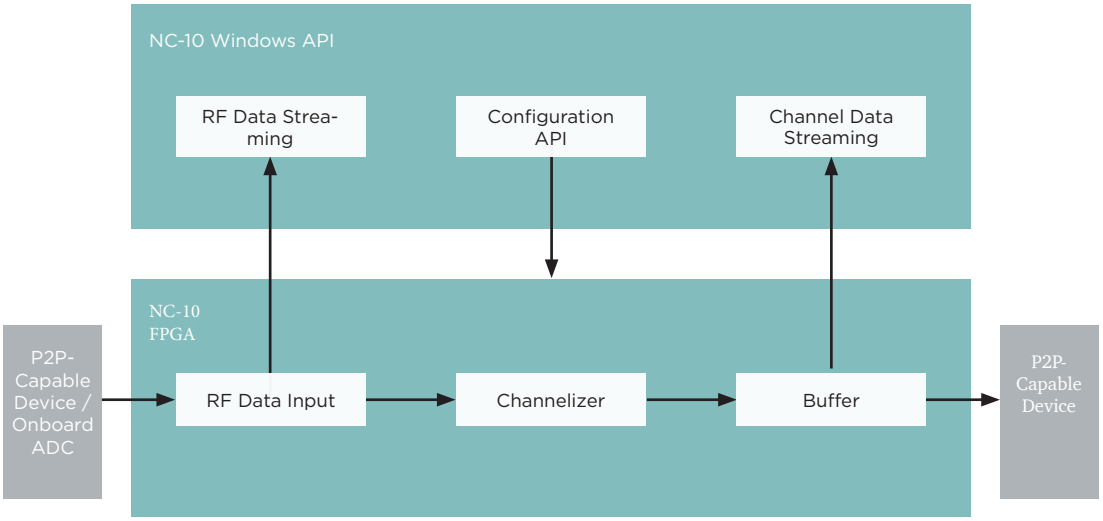
NC-10, the only ready-to-run channelizer solution for LabVIEW is available on multiple platforms and targets, all featuring a Xilinx Kintex-7 FPGA. The modular PXIe platform makes it easy to integrate NC-10 into your own system and transfer data to/from the device. Peer-to-peer communication is a technology used to stream data via the PXI backplane, and allows NC-10 to be combined with any peer-to-peer compatible NI digitizer or NI vector signal analyzer. You can stream the incoming data from, for example, a vector signal analyzer directly to the NC-10 FPGA without going through the CPU. PXI is a modular platform, so if an increased channel count is needed, multiple NC-10 products can be daisy-chained via multiple peer-to-peer streams.

Part of the NCR Series

NC-10 belongs to the Novator Channelized Receiver suite. These products provide you with a ready-to-run channelizing system, which includes one or multiple receivers (vector signal analyzers from National Instruments). The NC-10 is also available separately for customers who want to leverage its power in their own LabVIEW applications.

NC-10 Data Flow

The data input for NC-10 is wideband I/Q data (16-bit I and Q data, up to 250 MSps and higher available on request), and the output is time-interleaved channelized I/Q data.



Depending on the target device, the RF data will be provided either from a peer-to-peer capable digitizer or directly from an onboard ADC. The wideband RF data is routed both to the channelizer algorithm on the FPGA as well as up to the host system (Windows) where it can be processed or recorded.

Depending on the type of processing performed in downstream nodes, it can be difficult or impossible to handle one single sample at a time. In NC-10, data from the different channels are buffered to make processing in downstream nodes easier.

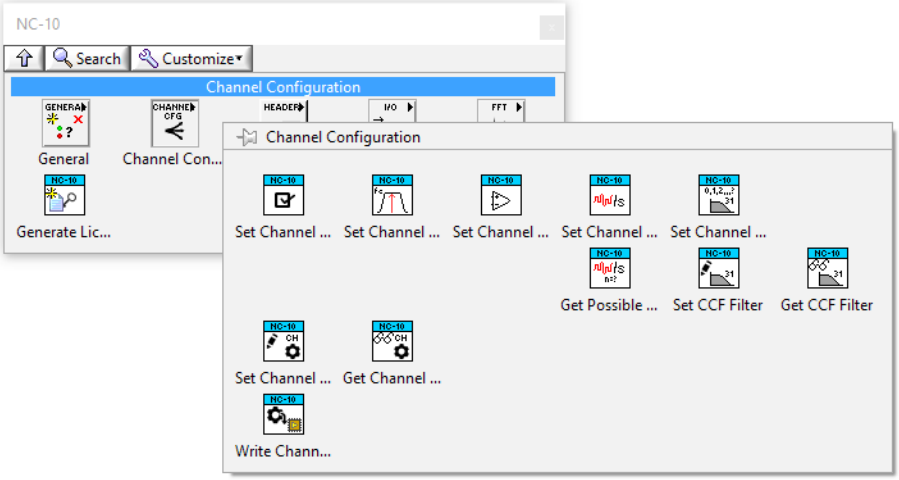
A simulation mode is available that lets you prototype your surrounding code without requiring the hardware to be present. The simulation mode gives you the same feedback regarding configuration settings as a hardware mode would. Measurement files can be used during simulations so that downstream nodes in your software application can operate on realistic output data.

LabVIEW Programming

The NC-10 LabVIEW API makes it easy for you to configure the channelizer settings. The API follows the same programming flow as National Instruments drivers, such as NI-DAQmx or NI-RFSA, to make you feel at home when programming. To help you get started, there are ready-to-run examples included as well as a user manual and documentation for the Virtual Instruments (VIs).

New users can be up and running quickly in the API, while the advanced functionalities of the API allow experienced users to tailor their application to their needs. With the API, you can create a channelizing application in which channel allocation is controlled by an operator or automatically or a combination of these two. NC-10 FPGA functionality is delivered as a bitfile and LabVIEW FPGA Module is not required to integrate NC-10 into your application; it is required only if you send data to/from other FPGA-based devices.

The API allows you to use the channelizer both as a single FPGA device communicating with the host PXI through direct memory access FIFOs or as an FPGA device communicating with other PXI instruments via the PXI backplane (peer-to-peer streaming).



API Features

The API consists of many different VIs and gives you programmatic access to NC-10. All host API VIs are native to LabVIEW and in the NC-10 palette you will find VIs to perform all tasks to configure and run NC-10. By obtaining peer-to-peer handles you can connect NC-10 to data sources and sinks.

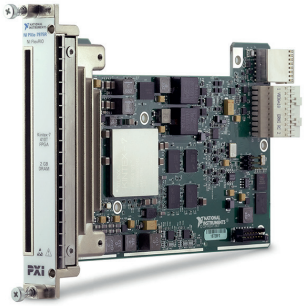
It is possible to stream the input data to host through streaming utilities that enables you to get deterministic timing of the data sent to host. Once a source stream is initiated the configuration VIs let you configure the channelization one parameter at a time or in bulk to configure multiple channels simultaneously. Even though multiple targets are available the API is the same, making it more easy to build modular code in your application.

Targets

NC-10 is available on multiple different targets, all programmable with LabVIEW.

FlexRIO 7975/7976

The FlexRIO targets are used as a co-processor. It receives data from a P2P-stream and streams channelized data to the host system in a DMA FIFO or to another FPGA in a P2P FIFO. Two different versions exist, 512 channels and 1024.



NI-6592*

The 6592 receives data in a P2P FIFO like the FlexRIO targets but can in addition to stream the data via DMA FIFO or P2P FIFO also stream the channelized data as UDP packets through the SFP+ ports. The NI-6592 features 512 channels.

NI-5668*

The vector signal analyzer NI-5668 features a digitizer module with an onboard FPGA which can be used for channelization. In this version of NC-10 the input data is fed directly to the FPGA (not P2P like other targets) and the 512 channels are output via DMA or P2P. The NI-5668 features 512 channels.

USRP-2955

The USRP-2955 features four RF-inputs which can share LO's to enable phase synchronized acquisition. This version of the channelizer can process the four inputs and channelize from either input phase coherently.

More information about this can be found in the NC-10 USRP specific broschure.

* Available on demand

NC-10 Specifications

Channelization Specifications

Input rate (I/Q), f_{in}	<=250 MSps (Higher rate available on request)
Number of output channels	512 or 1024 depending on target
Data width (in and out)	16-bit I, 16-bit Q
Output channel center frequency resolution	$f_{in} /2^{32}$
Output channel sample rate	Min: f_{in} /32768 Max: f_{in} /2
Output channel sample rate resolution	$<f_{in} /2^{30}$
Maximum guaranteed aggregate output sample rate	125 MSps
Maximum achievable aggregate output sample rate	250 MSps
Spurious-free dynamic range	>100 dBFS
Signal to noise and distortion ratio	>90 dB
Output channel alias-free bandwidth	80% of output sample rate
Output channel alias filter rejection	>100 dB
Output channel passband ripple	< +/-0.1 dB
Output channel programmable gain	0dB : 0.1 dB : 102.3 dB
Number of filters (Single Sample Mode)	32
Number of filter taps per filter	31

Specifications are subject to change without notice.

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.

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