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RF Engines Releases ChannelCore Flex™ - the World's Most Flexible Ultra-Wideband Channelizer Solution

High-performance, feature rich Channelizer addresses demands of next generation Electronic Surveillance, Satcoms and Wireless Base Station applications

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The ultimate radio receiver is capable of detecting and processing signals across all of the radio spectrum, all of the time. RF Engines Limited (RFEL) has taken a large step towards this goal with the introduction of an innovative and highly flexible, ultra-wideband, Channelizer IP core – the **ChannelCore Flex™**.

ChannelCore Flex is a major breakthrough as it provides the customer with the ability to extract from a very wide input signal any number of channels simultaneously in real time. These can be any combination of different bandwidths and sampling rates with any overlap and centre frequencies. Furthermore, each channel can be individually defined and changed as required so that the system designer can tailor a solution that precisely meets the needs of the application on a single FPGA.



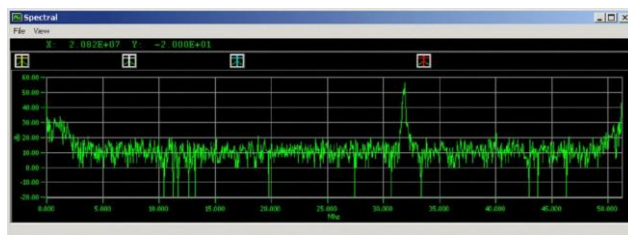
The Ultra-wideband ability of RFEL's ChannelCore Flex makes it ideal for Satellite communications

RFEL anticipates that the ChannelCore Flex will find widespread application in areas including Electronic Surveillance, satellite communications and future Base Station architectures, where simultaneous monitoring, detection and demodulation of a mixture of disparate communication channels, such as WiMax and GSM, using a single architecture are a definitive requirement.

“ChannelCore Flex delivers advanced features that are the culmination of over ten years of design and implementation experience and delivers the ability to do things that previously could not be done or required huge resources,” explained John Summers, RFEL’s CEO. “The pedigree of RFEL in the area of channelization means that there is a very low technical risk when embarking on a new design, so customers can be confident of being ‘up and running’ very quickly.”

Channelization is a relatively straight forward signal-processing task. For example, a Fast Fourier Transform (FFT) can efficiently process a wideband signal into over 1000 channels. However, this can only be done with limitations:

- The channels all have equal bandwidths, which is inflexible and problematic when processing different types of transmissions concurrently.
- The bandwidth of individual channels is inversely proportional to the number of channels supported.
- The centre frequencies of the channels are uniformly spaced and are not independently controllable.
- There is limited control of the frequency response of the individual channels, leading to compromised stop-band and pass-band performance.
- It cannot be readily interfaced to existing hardware due to differing sampling rates and data formats.



ChannelCore Flex can see simultaneously across 1GHz of input or more with thousands of channels

More advanced signal processing techniques, such as Weighted Over-Lap and Add (WOLA) pre-processing and hierarchical channelization using a Pipelined Frequency Transform (PFT), can overcome many of these limitations. RFEL has adopted these highly significant enhancements, along with other proprietary techniques, to create an ultra-wideband Channelizer that offers unrivalled performance and flexibility, enabling it to be tailored to bespoke applications while remaining very hardware efficient.



ChannelCore Flex is capable of being configured to support many thousands of channels, spanning an input bandwidth exceeding 1 GHz. Importantly, these channels can have individual bandwidths that can vary by several orders of magnitude, be overlapped to accommodate broadband transmissions, and have centre frequencies and sample rates that can be independently tuneable to sub-Hertz resolution ($\leq 1\text{Hz}$). The end result is a Channelizer architecture that can be configured to support concurrent monitoring of multiple channels, with bandwidths ranging from as large as hundreds of Megahertz, to as narrow as a few Hertz, delivering an overall aggregate channelized sample rate that can exceed 1Gs/s.

The ability to process 1000s of channels simultaneously in real time is ideal for base stations

Feature Comparison Table

Feature / Requirement	Old FFT-based architecture	RFEL ChannelCore FLEX
1000s Channels	✓	✓
Individual Channel Bandwidth control	✗	✓
Individual Channel Bandwidth unaffected by overall No. of channels supported	✗	✓
Flexibility in channel centre-frequency	✗	✓
Individually controllable frequency response per channel	Very Limited	✓
Easy to interface to system	✗	✓

Implementation

Unfortunately, there is no optimal, 'one size fits all,' Channelizer architecture, as each application places very different demands on the implementation. RFEL has resolved this problem by producing an IP core that is compile and run-time programmable from a simple set of parameters derived from the user's technical specification. The end result is a high-performance and optimized IP core that has precisely the required level of flexibility demanded by the application, while minimising hardware cost and delivering a fast time-to-market.

Price & Availability

ChannelCore Flex is available for licensing now for implementation in a wide range of Xilinx or Altera FPGA devices. Supplied as a netlist, the IP is very compact so that low cost, medium sized FPGAs could be used. For example, a solution for a 200MHz input with 500 channels ranging from 5kHz to 5MHz would fit on a \$100 device. Prices are dependent on each implementation's specific set of requirements, but typically fall in the range of \$10K - \$40K.

RF Engines Ltd

RF Engines Limited (RFEL) is a leading UK-based electronic systems design company, providing high specification signal processing solutions for FPGAs, as well as supplying digital receiver and complete product solutions for the homeland security, defence, communications and instrumentation markets. Applications include communications base stations, satellite communications systems, test and measurement instrumentation, and bespoke wideband receivers/transceivers.

Further Information and illustrations

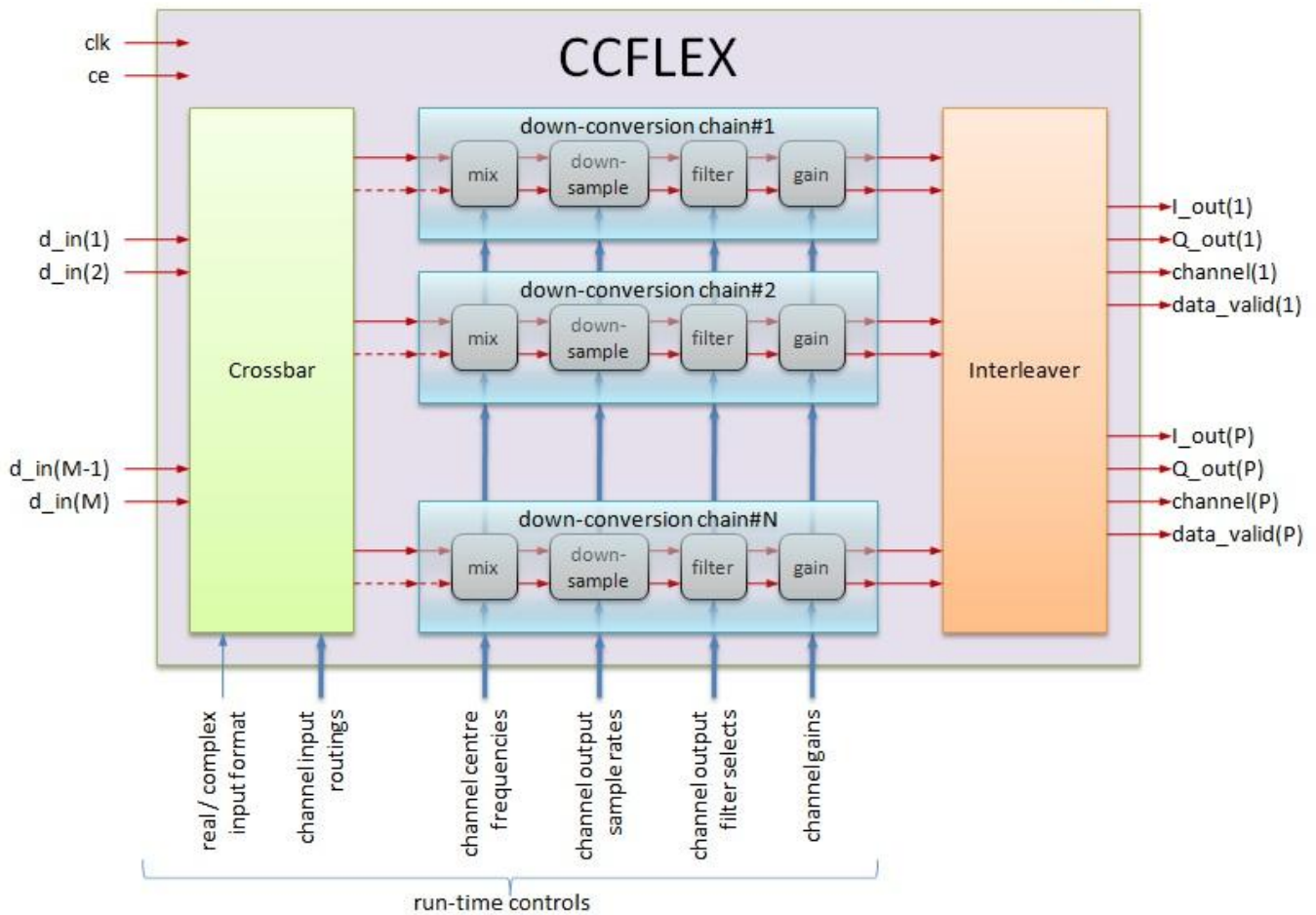
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ChannelCore Flex Functional Block Diagram



Build-time parameters

M	Number of independent inputs (ADCs) ¹	NF	Number of output filter coefficient sets ⁵
IP	Input parallelism ²	MXB	Maximum channel bandwidth ⁶
WI	Bit-width of each ADC input	MNB	Minimum channel bandwidth ⁷
N	Number of fully independent down-conversion channels	TR	Frequency tuning resolution ⁸
P	Number of parallel complex outputs ³	RR	Output sample rate resolution ⁹
FL	Output filter length ⁴	SFDR	Spurious-free dynamic range ¹⁰

Notes

- For two or more inputs, each pair can be runtime configured as independent real inputs or one complex input.
- Input parallelism applies to each input data port, and defines the degree of sample de-interleaving applied to the input. For example, a 1Gs/s ADC may have four de-multiplexed parallel data streams with a data clock rate of 250MHz.
- The number of complex parallel outputs determines the maximum aggregate sample rate obtainable from the core. For example, if the output parallelism is two, then the maximum aggregate output sample rate is 2x[clk frequency].
- Defined in number of output samples. Typically 32-taps provide a good degree of flexibility.
- Each output channel can choose from 1 of NF filter coefficient sets. Each set is runtime programmable (not shown).
- The maximum channel bandwidth determines various internal parameters within the core.
- The minimum channel bandwidth, together with SFDR and input bit-width determines word-widths within the core.
- Frequency tuning resolution is typically $\ll 1\text{Hz}$.
- Output sample rate resolution is typically $\ll 1\text{Hz}$, achieved by programmable rational rate change for each channel.
- Unlike other solutions, SFDR is defined for both NCO mixers AND rate resampling filters.