Two Decades of SDR: USRP Past, Present, and Future

Martin Braun

Chief Engineer

EMERSON

Looking back…

Memory Lane Road Trip Ahead

Introduction of USRP1

Quiz Question: When was the USRP 1 announced?

[Date Prev][Date Next][Thread Prev][Thread Next][Date Index][Thread Index]

[Discuss-gnuradio] The USRP is available for sale!!!!

From: Matt Ettus
Subject: [Discuss-gnuradio] The USRP is available for sale!!!!
Date: Fri, 24 Dec 2004 18:25:09 -0800
User-agent: Internet Messaging Program (IMP) 4.0-cvs

Ettus Research LLC is pleased to announce that the USRP in now available for purchase! Shipment will begin in the first half of January.

The USRP motherboard is US$450, and includes a USB cable and power supply. The supply is a universal switching type which works on 90-260 VAC, 50/60 Hz, so it will work internationally with a US-type plug converter.

The BasicRX and BasicTX daughterboards are also available, for US$50 each. These boards are perfect for operation with an external RF frontend, or for prototyping your own. Each board provides a pair of SMA connectors for IF signals (either two independent signals or one IQ signal), and headers for access to 16 general purpose digital IOs per board, as well as the I2C and SPI buses, and 4 low-speed DAC outputs and 2 low-speed ADC inputs.

Each USRP can accommodate 2 Basic RX boards AND 2 BasicTX boards. A simple receive only system would require one BasicRX board. A basic transceiver would require one BasicRX and one BasicTX. A complete system (2 of each) is recommended if you plan to do any multi-antenna systems or custom development of code for the FPGA.

Additional daughterboards will be available in the next few months.

What came next? (Small selection)

2004

2008
USRP2

LabView
Support

2011
E1x0
UHD

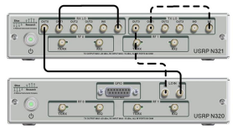
2015
UBX

2014
E310
X3x0
RFNoC

2013
B2x0

Matlab
Support

2016
TwinRX



2018
N310

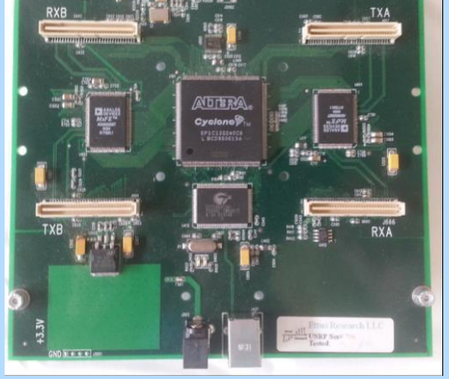
2019
N320
E320

2020
UHD4

2021
X410

2021
X440

2025



USRP1
Launching the SDR revolution!

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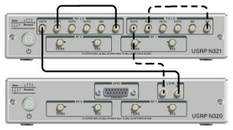

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USRP2
Ethernet! MIMO! Timed Commands!

EMERSON

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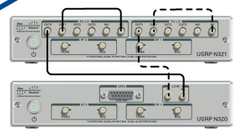

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Embedded
OpenEmbedded, Standard Architecture, MPM

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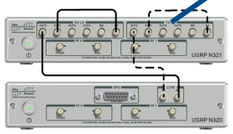

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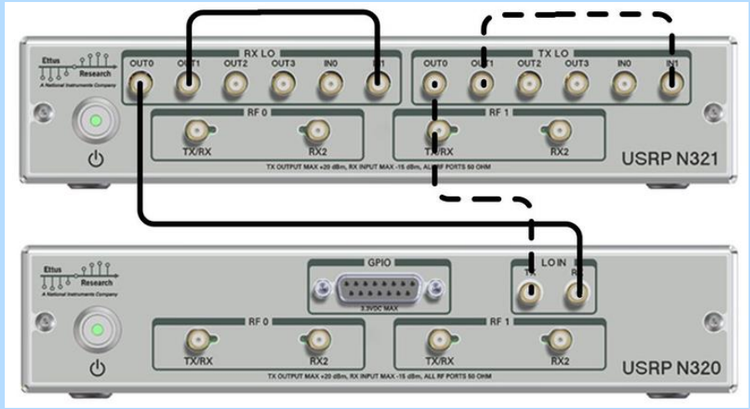

LO Sharing
High-quality phase alignment

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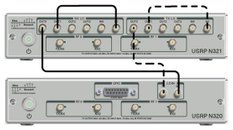

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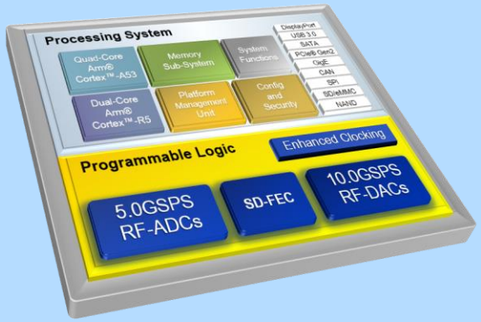

Next Gen Fabric
100 GbE, 64-Bit ARM, RFSoC

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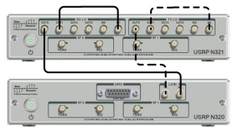

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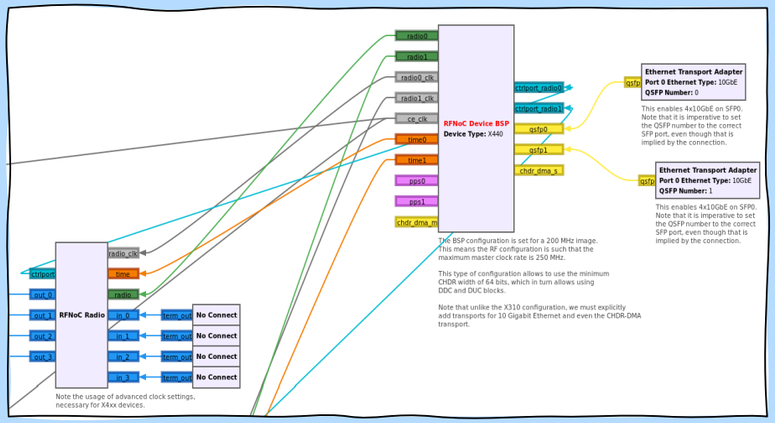

RFNoC
FPGA Customization, properly organized

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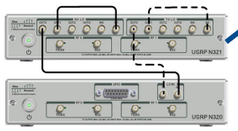

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Higher Bandwidth
DPDK, Multi-GHz
Streaming

EMERSON

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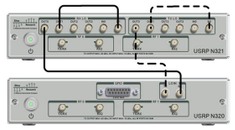

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Open Source
Great Software Integration

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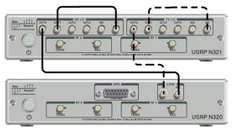

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There's More!
Partner Enablement,
SWaP, …

...and ahead!

What's coming up?

Introducing the NI Ettus USRP B206mini-i

Pocket-sized Powerhouse

70 MHz to 6 GHz Frequency Range

Up to 56 MHz IBW

Fast data streaming and connectivity with USB-C 3.0

1 transmit/receive and 1 receiver RF channel

85 x 55.7 x 18 mm, 108 g Ultra-compact form factor

See the demo in the Emerson / NI Booth

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NI Ettus USRP B206mini-i

Features:

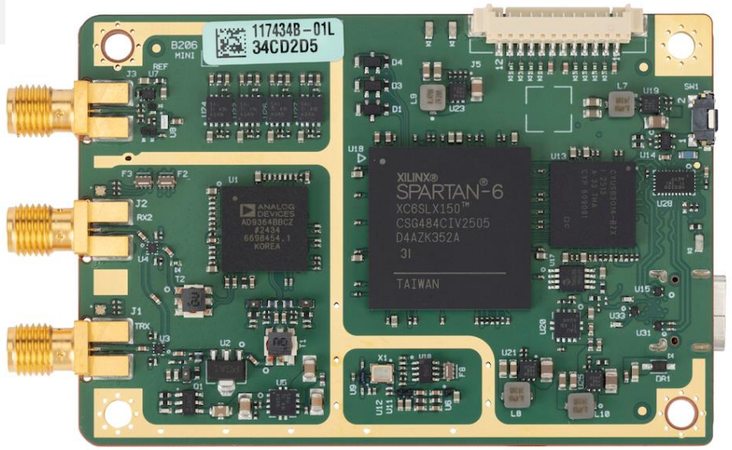
- 70 MHz to 6 GHz frequency range
- Up to 56 MHz Bandwidth
- 1 TX, 1 RX channel
- Spartan-6 LX150 FPGA
- USB 3 Type C connector, bus powered
- 10 MHz or PPS reference input
- GPIO, JTAG control
- -40 to +75 °C temperature range (w/enclosure)
- 84.3 x 51.6 x 8.4 mm, 25 g (board only); 85 x 55.7 x 18 mm, 108 g (board in enclosure)

Benefits:

- Type C USB connector
- Available with or without an enclosure
- Industrial temperature support
- Low cost

Applications

- FM, TV Broadcast
- Signals Intelligence
- Communications Research
- Teaching & Education



LabVIEW	Coming soon!
GNURadio	✓

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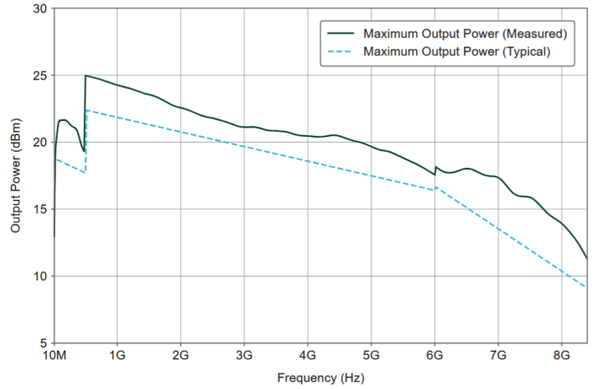
OBX Daughterboard

Features:

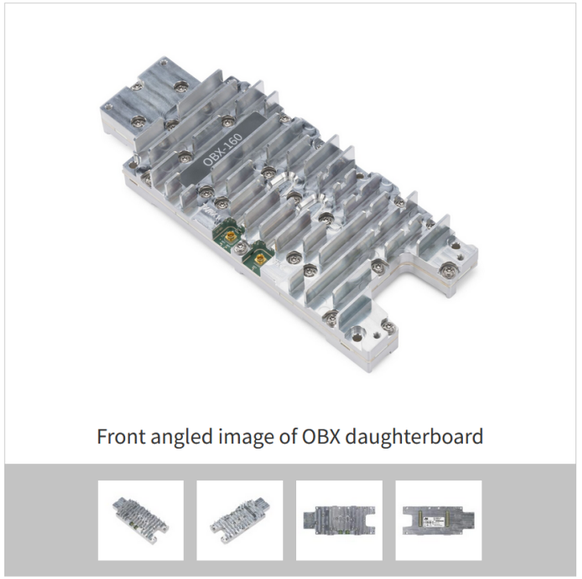
- Wide frequency range: 10 MHz **– 8.4 GHz**
- Wide bandwidth: up to 160 MHz
- USRP compatibility: X300 Series
- RF shielding
- Full duplex operation with independent TX and RX frequencies
- Synthesizer synchronization for applications requiring coherent or phase-aligned operation
  - => See Jan Schirok's talk on Thursday on beamsteering!

Figure 3. TX Maximum Output Power



Applications

- Advanced Wireless Prototyping
- Massive MIMO Applications
- Passive RADAR
- Signals Intelligence
- FR3 Research



Front angled image of OBX daughterboard

OBX 10-8400 MHz Rx/Tx (160 MHz, X Series only)

$2,490.00 USD

789162-01 QTY: 1 Add to Part List

OBX 160 USRP Daughterboard (10 MHz - 8.4 GHz, 160 MHz BW)

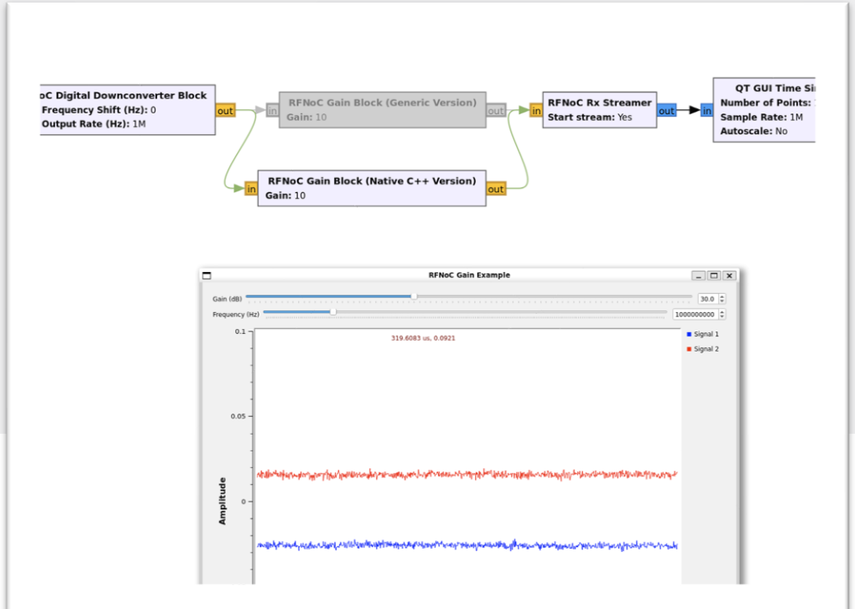
The OBX 160 daughterboard is a full-duplex wideband transceiver that covers frequencies from 10 MHz to 8.4 GHz with up to 160 MHz* of instantaneous bandwidth. Coherent and phase-aligned operation across multiple OBX daughterboards enables users to explore MIMO and direction finding applications. The OBX 160 daughterboard works interchangeably with other USRP daughterboards and is compatible with the USRP X300 Series devices.

* The OBX 160 transmitter path has 160 MHz of bandwidth throughout the full frequency range of the device; the receiver path has 84 MHz of bandwidth for center frequencies from 10 MHz to 500 MHz.

UHD: Keeps evolving

UHD 4.8

- rfnoc_modtool is back!
- Many RFNoC tooling improvements
- Improved FFT RFNoC block (cyclic prefix support!)
- Windows binary installer improvements



UHD 4.9

- Support for B206mini, OBX
- Even more RFNoC tooling improvements
- Check out the release notes and the release video!

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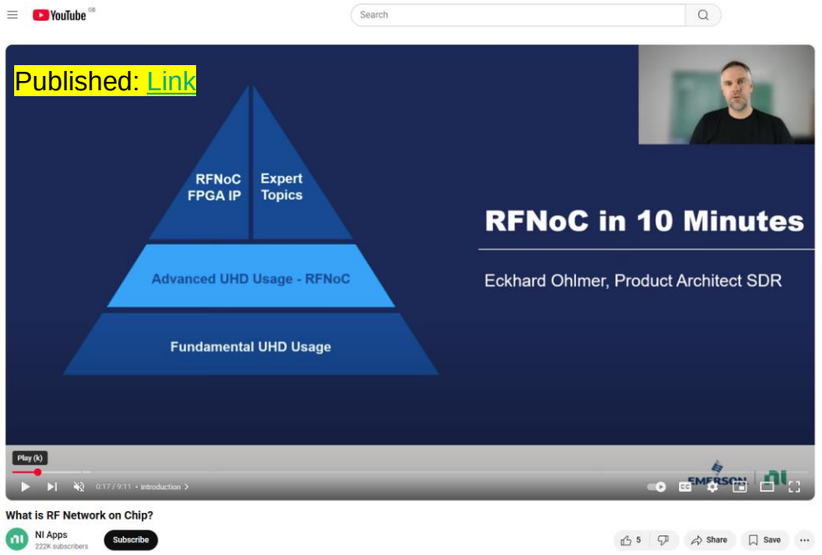
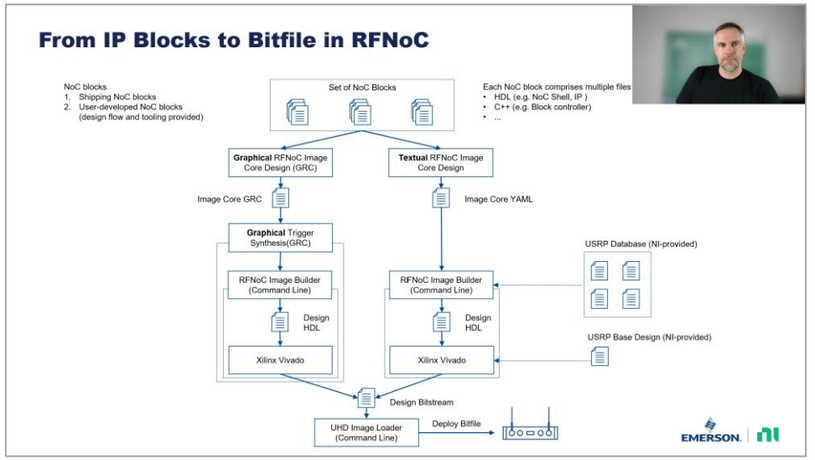
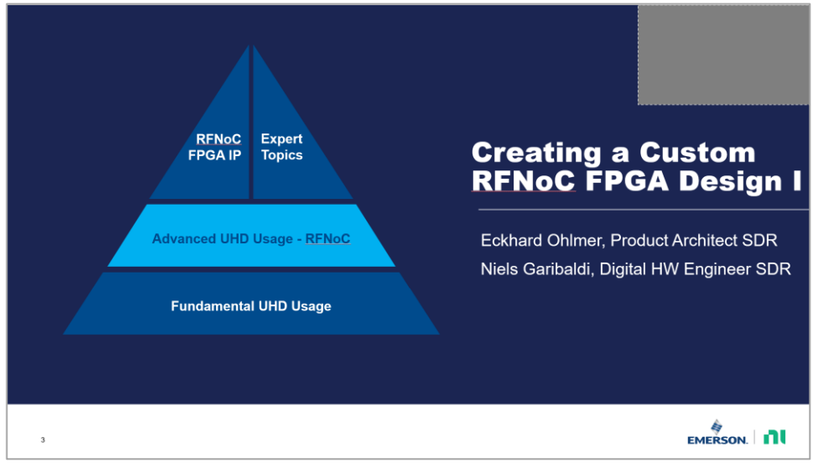
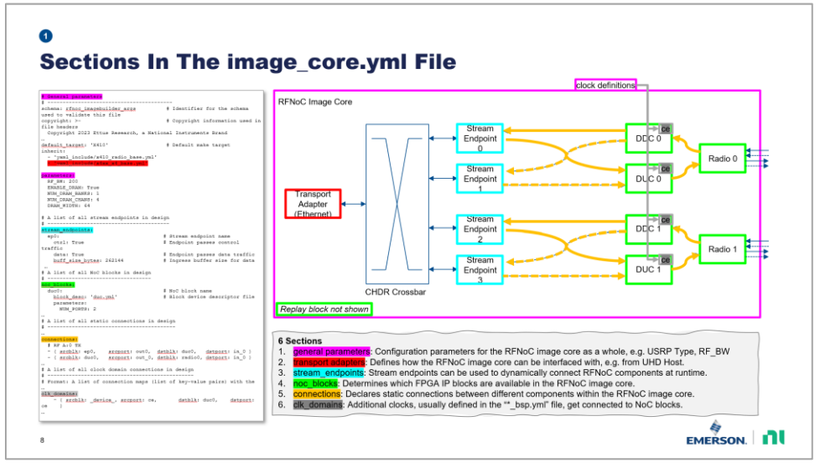
User Enablement: Workflow Videos

- Check them out on YouTube!
- More videos in the pipe
- Other activities also ongoing or planned:
  - New tutorials for getting started with Windows, Linux, Python, and GNU Radio
  - Restructuring of user manual









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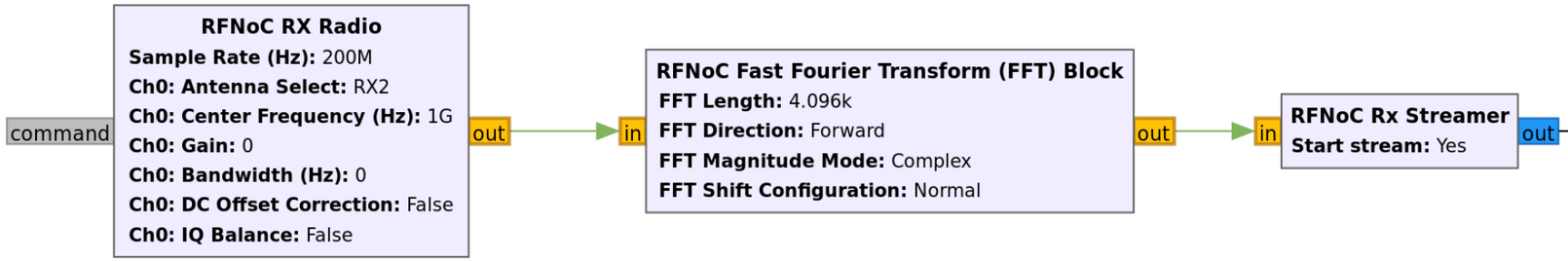
RFNoC FFT Block Updates

New size limit: 65536 (64k)

Default size limit: 4096

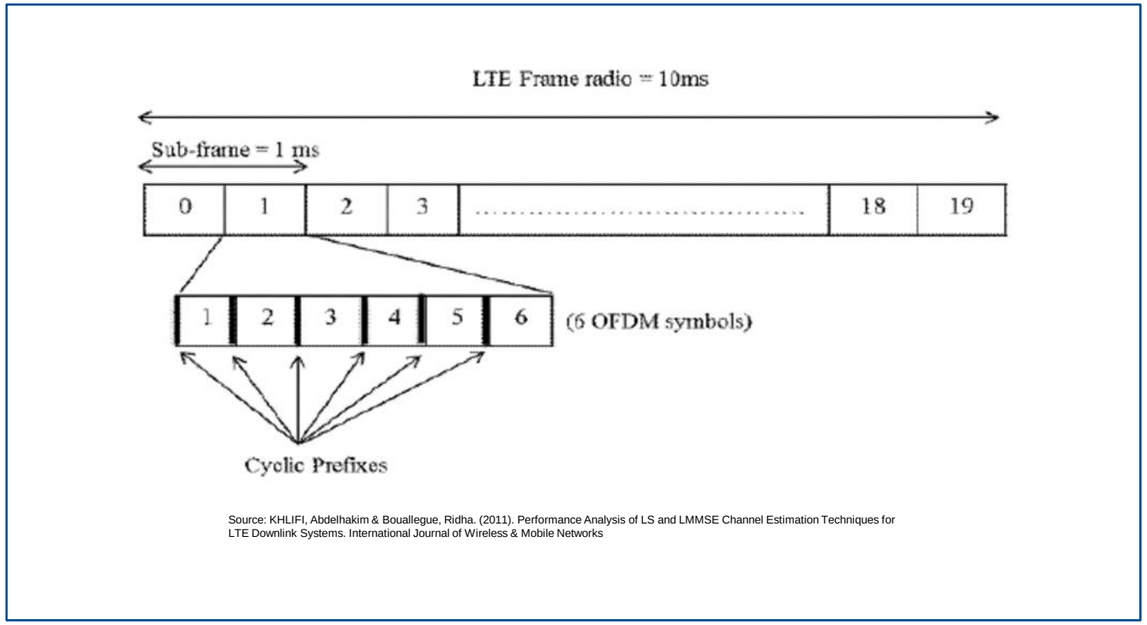
MTU size no longer limits FFT size

Multi sample-per-clock processing!



OFDM Processing: Cyclic Prefix Insertion/Removal

- Variable CP length possible



Source: KHLIFI, Abdelhakim & Bouallegue, Ridha. (2011). Performance Analysis of LS and LMMSE Channel Estimation Techniques for LTE Downlink Systems. International Journal of Wireless & Mobile Networks

RFNoC: Block authoring now much easier

RFNoC Out-Of-Tree Modules have improved, too

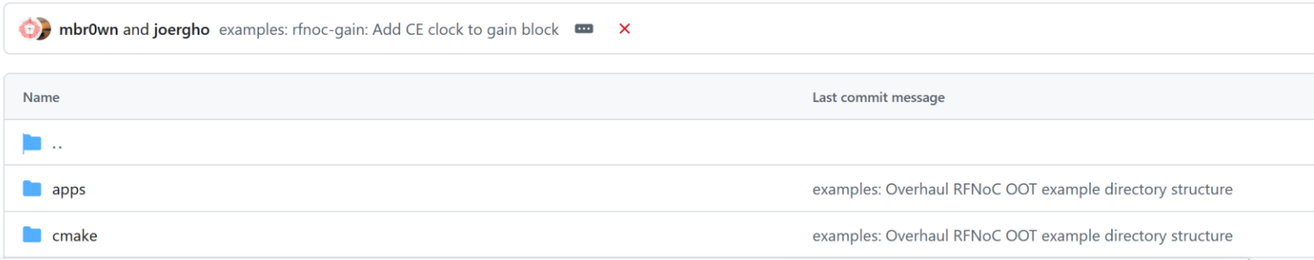
`rfnoc-example` is now known as `rfnoc-gain`

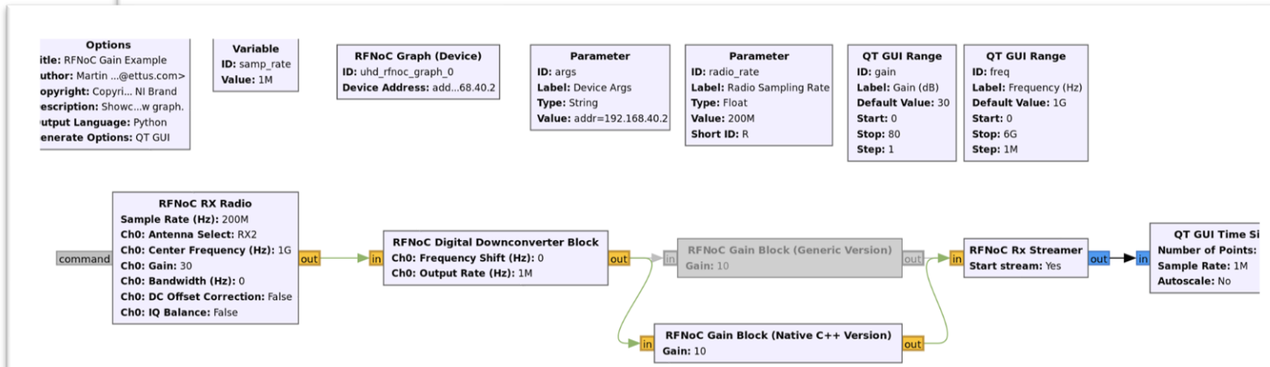
Better CMake, better directory structure, better examples

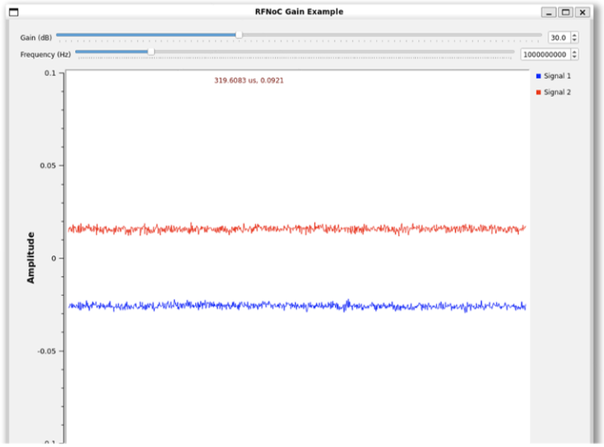
DLL preloading now easier

Includes GNU Radio examples, too!

Behold, the return of `rfnoc_modtool`!








```
…/tmp/rfnoc  rfnoc_modtool create foo
…/tmp/rfnoc  cd rfnoc-foo
…/rfnoc/rfnoc-foo  ls
apps  cmake  CMakeLists.txt  examples  fpga  icores  include  lib  python  README.md  rfnoc
…/rfnoc/rfnoc-foo  cp ../myblock.yml rfnoc/blocks
…/rfnoc/rfnoc-foo  rfnoc_modtool add myblock
…/rfnoc/rfnoc-foo  ls fpga/foo/rfnoc_block_myblock
Makefile  Makefile.srcs  noc_shell_myblock.sv  rfnoc_block_myblock.sv  rfnoc_block_myblock_tb.sv
…/rfnoc/rfnoc-foo
```

lock

th UHD 4.7 and

talled into `share/`

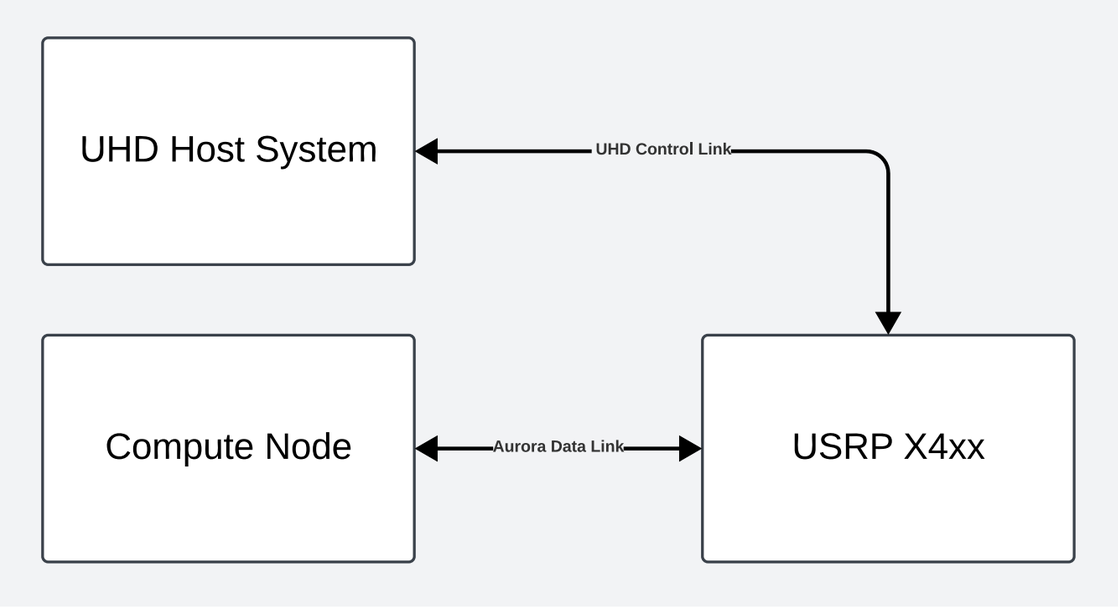
testbenches, and
apter). This is also
ory" for gateware,
to the installation
en compiling bitfiles

es GNU Radio and

gets. For example,
block included. You
`make`. These files

rfnoc-oot-blocks: A new home for our RFNoC IP

- New RFNoC blocks developed by NI will be published here
- Ships with new 100 GbE Aurora block



README

RFNoC OOT Blocks: Official Ettus Research Out Of Tree (OOT) RFNoC blocks

This is an out-of-tree (OOT) module for RFNoC blocks. Out-of-tree means that these RFNoC blocks are maintained outside of the uhd repository. The uhd repository contains the core RFNoC blocks which are required for the default FPGA bitfiles which are published as part of the UHD releases.

In this repository we maintain RFNoC blocks which further extend the functionality of RFNoC-capable USRPs.

This repository is maintained by Ettus Research, a National Instruments (NI) Brand. NI is now part of Emerson.

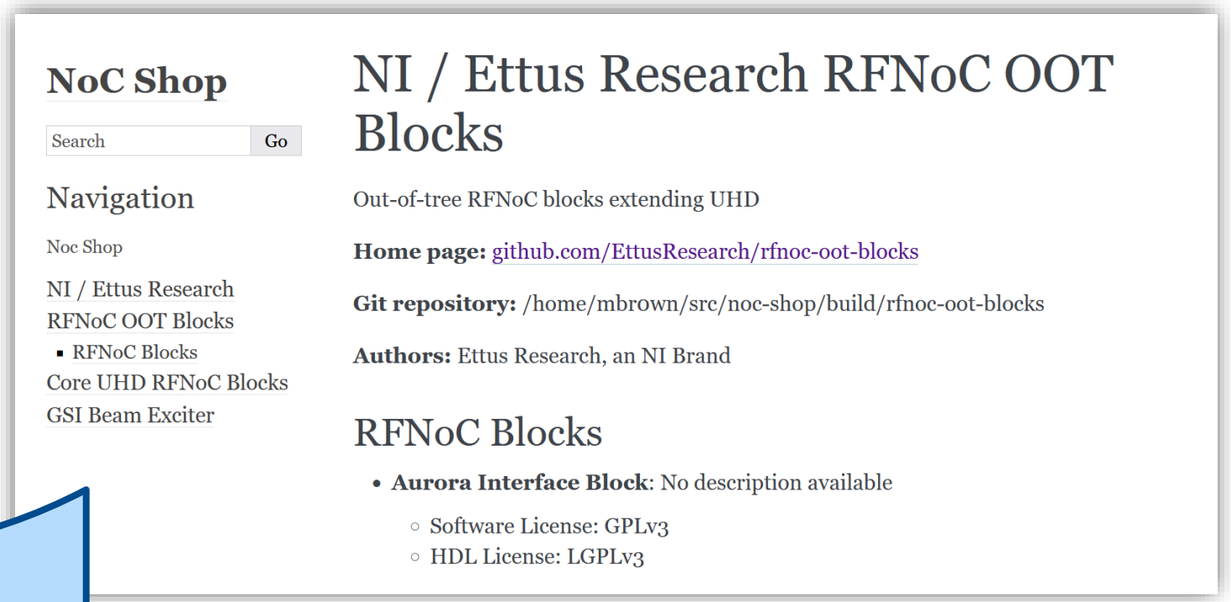
RFNoC Blocks

The following RFNoC blocks are contained in this repository:

- Aurora
  - Block definition file: aurora.yml
  - FPGA implementation: rfnoc/fpga/oot-blocks/rfnoc_block_aurora
  - Getting Started: RFNoC Block Aurora
  - User manual: Aurora RFNoC Block User Manual

What about *your* RFNoC blocks?

- Why not add them to our Noc-Shop?
- May become for RFNoC what CGRAN is for GNU Radio
- Currently, we're at version 0.00-alpha1-unstable-experimental-ugly, **this is far from the final version!**
- Why should you care?



[https://ettusresearch.github.io/noc-shop]

There will be free USRPs!
Prizes for the best RFNoC blocks!
Keep your eyes & ears open for details!

Come and talk to us!

We have a booth!

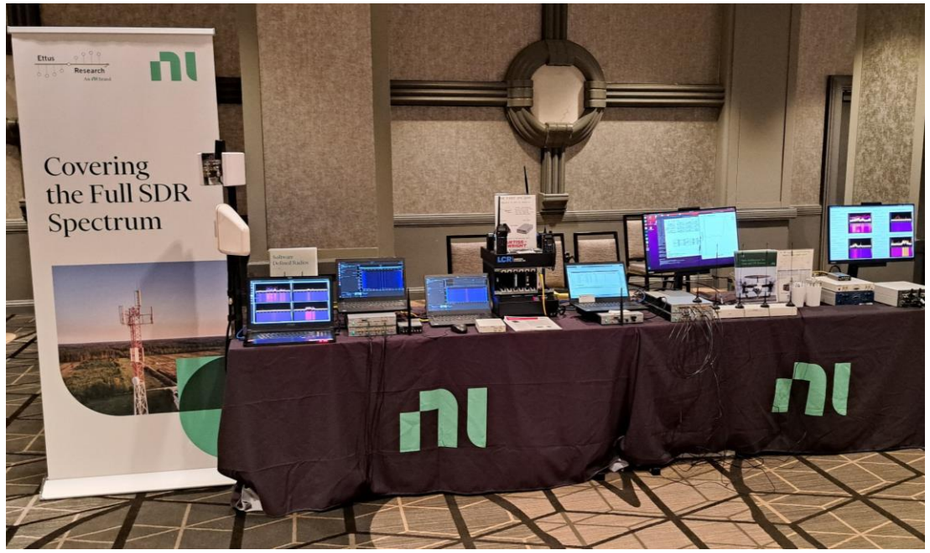
And there's our workshops!

- Wednesday: How to use our MultiUSRP API
- Thursday: RFNoC Development

Oh, and be there for the Wednesday night social! (Sponsored by NI)!

Celebrate the 20th anniversary with us!

Find us and talk to us!



[This is not actually this year's booth, but I liked the picture]