Ettus Research: Future Directions

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What's in a Title?

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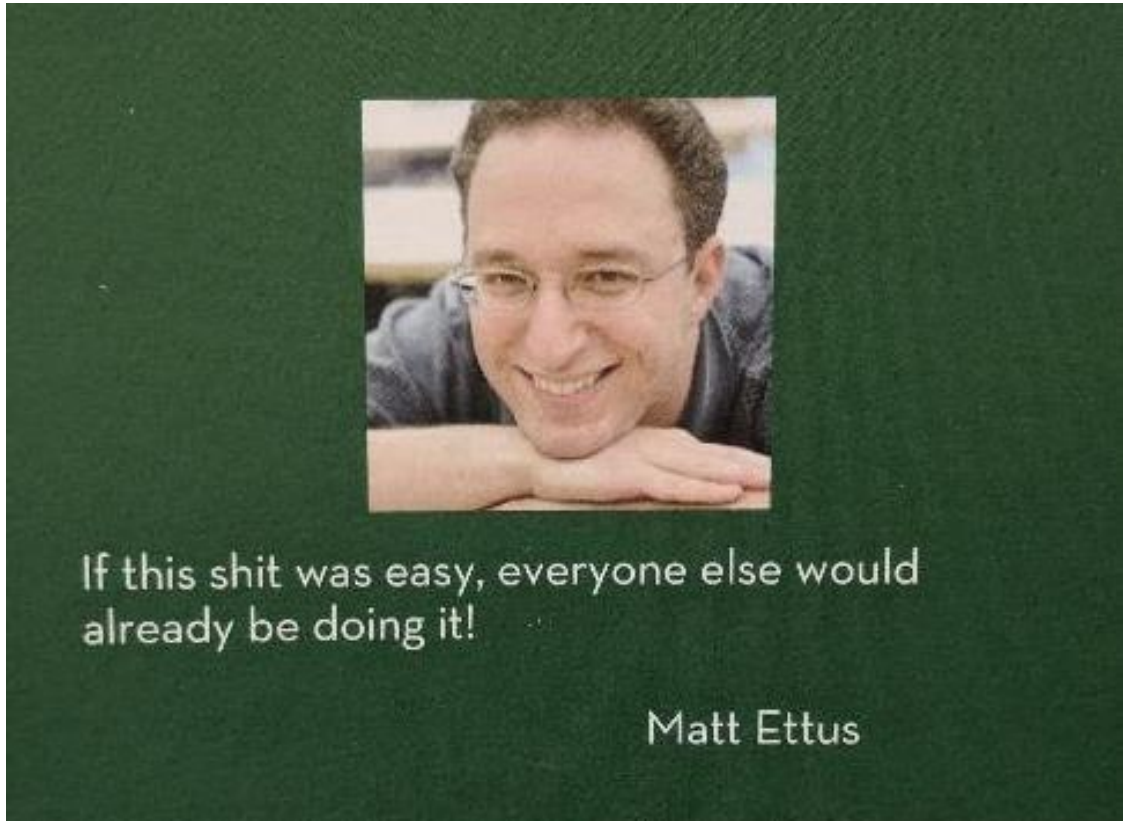

RFNoC/Vivado HLS Challenge

+

= USRP FPGA algorithms in C/C++

- RFNoC (RF Network On Chip) = enabling technology for FPGA developers to integrate their IP into their USRP signal processing chain using GNU Radio
- Xilinx Vivado HLS (High Level Synthesis) = IP creation acceleration by enabling C, C++ and System C specifications to be directly targeted to Xilinx FPGAs
- The winners:
  3) 3rd Prize: Team WINLAB for its real-time wide band channel sounder
  2) 2nd Prize: Team Rabbit Ears for its ATSC signal-processing library
  1) Grand Prize: Team E-to-the-J Omega for its Neural Network library

  See EJ's presentation on Tuesday @ 3:45pm

What Does the Future Hold for COTS SDRs?

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- More frequency coverage?
- More channels?
- More scalability?
- More bandwidth?
- More compute resources?
- Lower SWaP?
- Lower latency?
- More accurate synchronization?
- More applications?
- More tools?
- More regulation?
- More policy?
- More security?
- More reliability?

What does the Future Hold for USRP?

Introducing the Ettus USRP N310/300 SDRs

It’s called SDR: Why do we always talk about hardware first?

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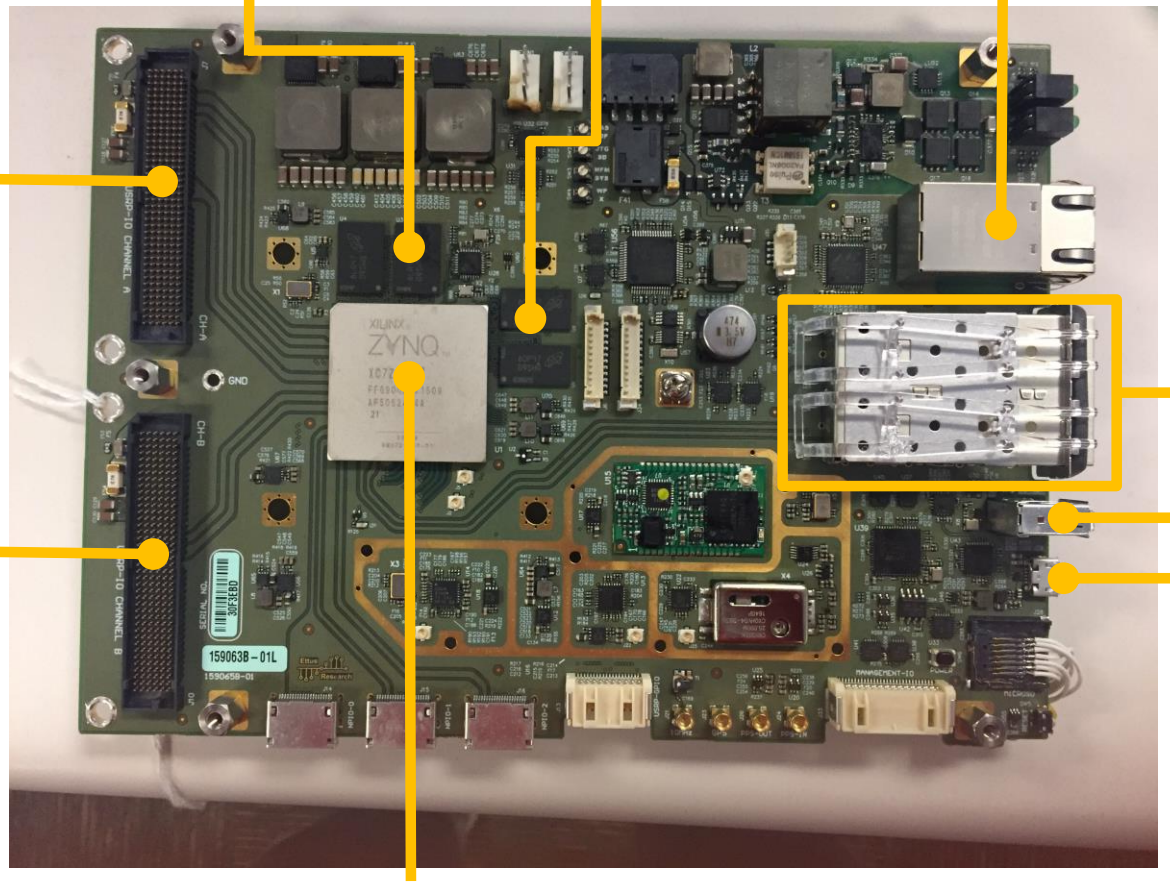
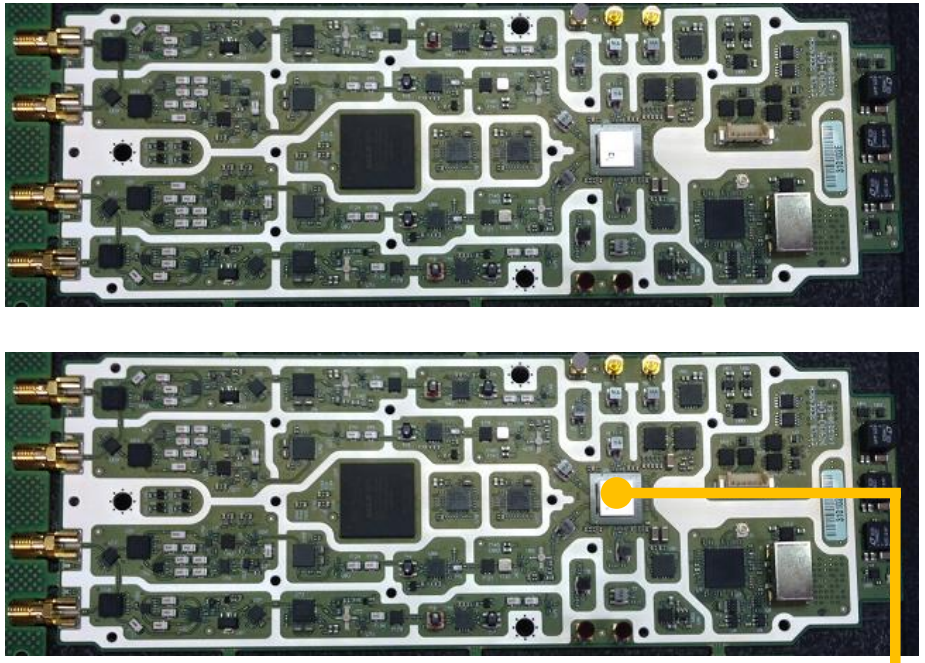
N300 Family Motherboard



Yup, more hardware…

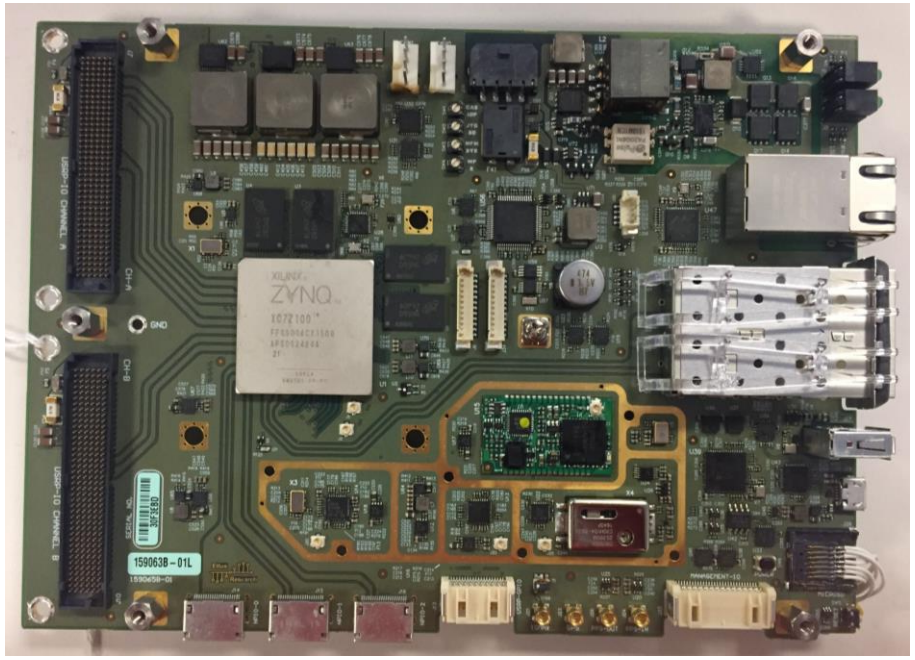
N300 Family Architecture

ADI 9371 (“Mykonos”)
based daughtercard



Front

ADI 9371 (“Mykonos”)
based daughtercard



N3x0 Motherboard

Rear

ADI 9371 “Mykonos”

Can you believe we're still talking about hardware?

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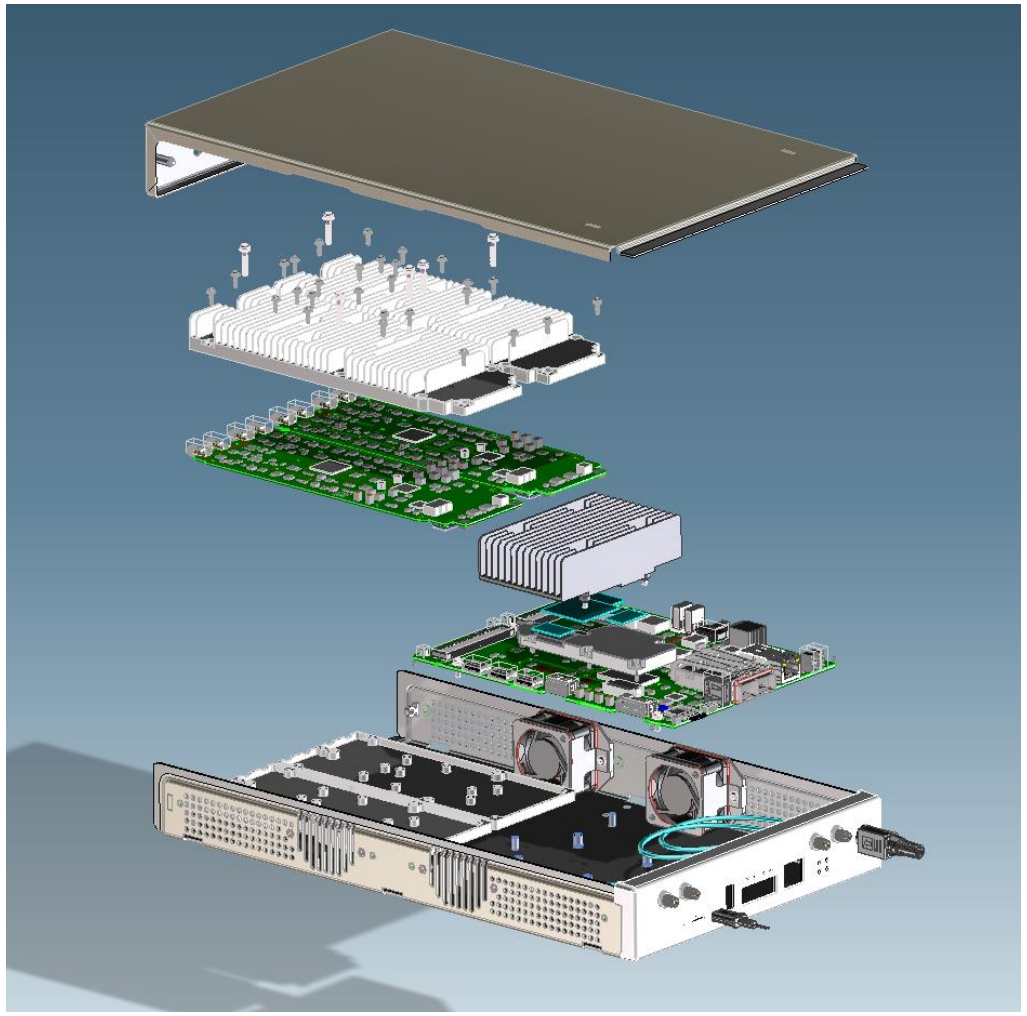

Enough with the hardware already!

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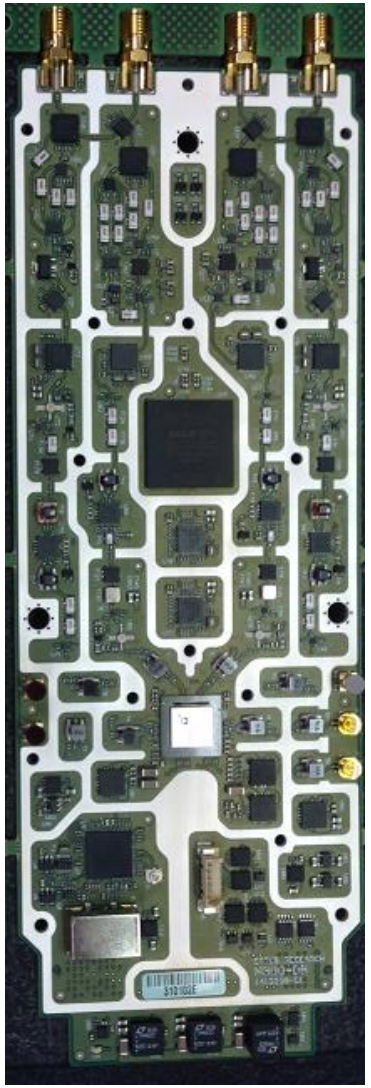
Key RF Performance Specifications:

- Up to 4 Tx channels, 4 Rx channels
- RF daughtercard based on the new Analog Devices 9371 RFIC
- 16-bit resolution, 100MHz Instantaneous Rx RF bandwidth/channel
- 14-bit resolution, 100 MHz Instantaneous Tx RF bandwidth/channel
- Phase Coherent
- 10 MHz – 6 GHz Frequency Coverage
- IQ impairment corrections: IQ Sampling with IQ imbalance, DC offset calibration
- Programmable 128 tap Tx FIR filter
- Programmable 96 tap Rx FIR filter



It’s about time we talked about software!

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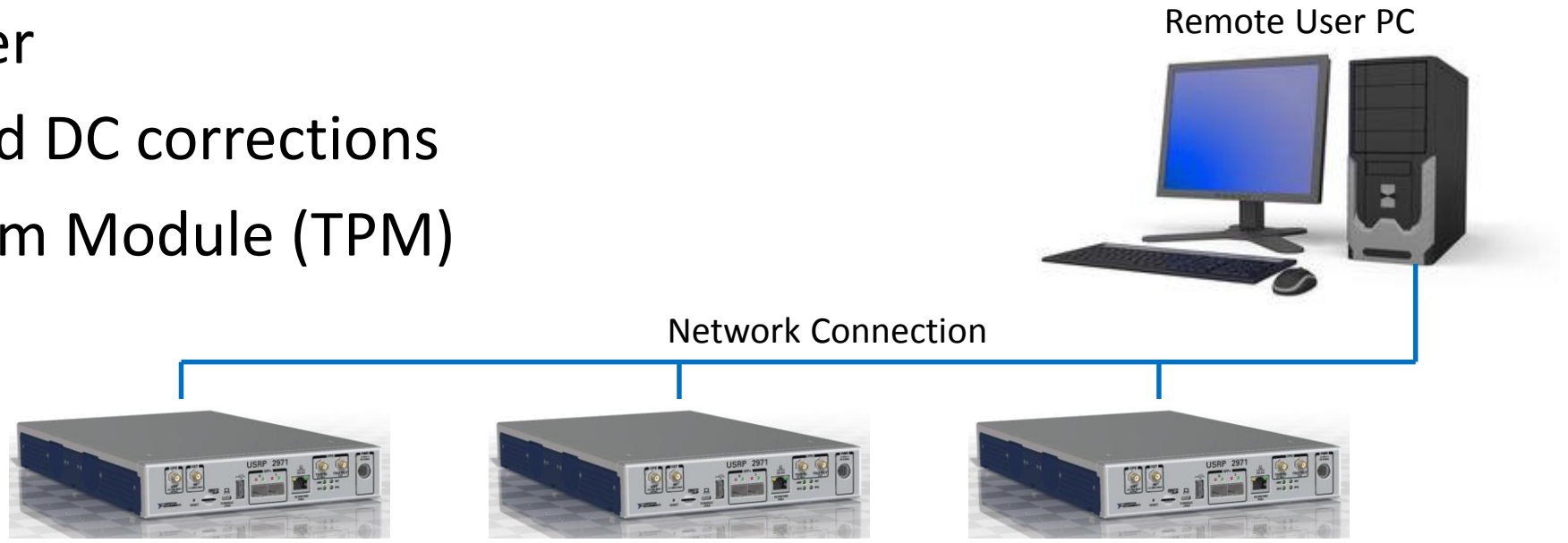
- Remote firmware & OS updates
- Remote reboot
- Remote factory reset
- Remote diagnostics including system health
- Watchdog timer
- Quadrature and DC corrections
- Trusted Platform Module (TPM)



Yay, more software!

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Embedded Mode:

- Application runs on ARM
- Embedded Linux OS
- Use the Zynq FPGA for compute intensive processing
- Network access (internet, ssh, etc) via SFP+ and RJ45
- Host USB

Network Mode:

- Application runs on host computer
- High speed data streaming

USRP N300 Family Overview

- Channels: up to 4x4 per device
- 100 MHz bandwidth/channel
- 10 MHz – 6 GHz
- Embedded ARM processor for stand-alone operation
- Large user-programmable FPGA
  - Zynq 7100 or Zynq 7035
- 2 x 10 GbE streaming support
- Remote management support
- Rack mountable, half wide, 1U
- Support for UHD/RFNoC, GNU Radio, LabVIEW Communications (post release) & MATLAB (post release)

Available: Q1 2018

Applications:

- Communications System Design/Prototyping
  - 5G NR, LTE, 802.11
  - UE emulation
  - massive MIMO
- SIGINT/EW
- Spectrum Monitoring
- Navigation
- Record & Playback

Ethernet Based Synchronization

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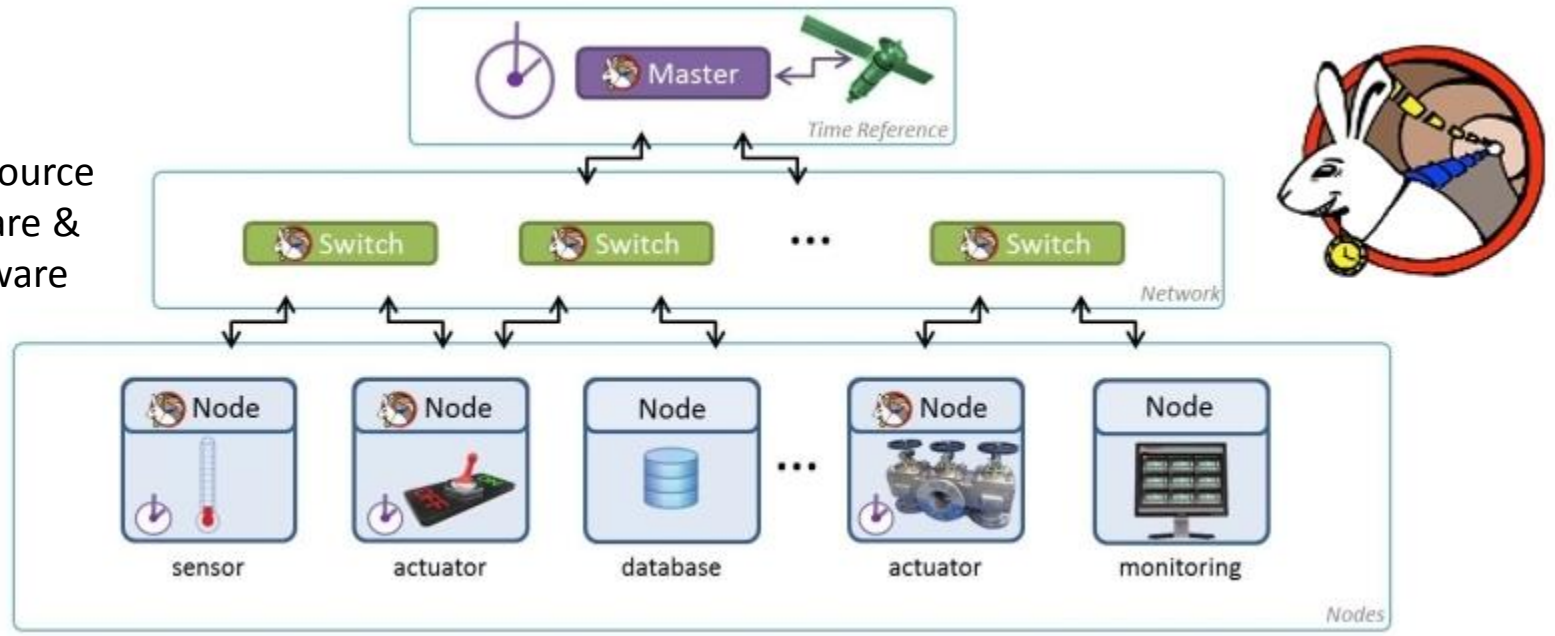
White Rabbit: sub-ns ethernet-based synchronization based on IEEE 1588 and SyncE

- Accuracy: < 1 ns skew, < 100 ps jitter
- Distance: > 10 km
- > 2,000 nodes

Open Source Software & Hardware



What's wrong with this picture?

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More hardware? I can't even read this! WTF??!!

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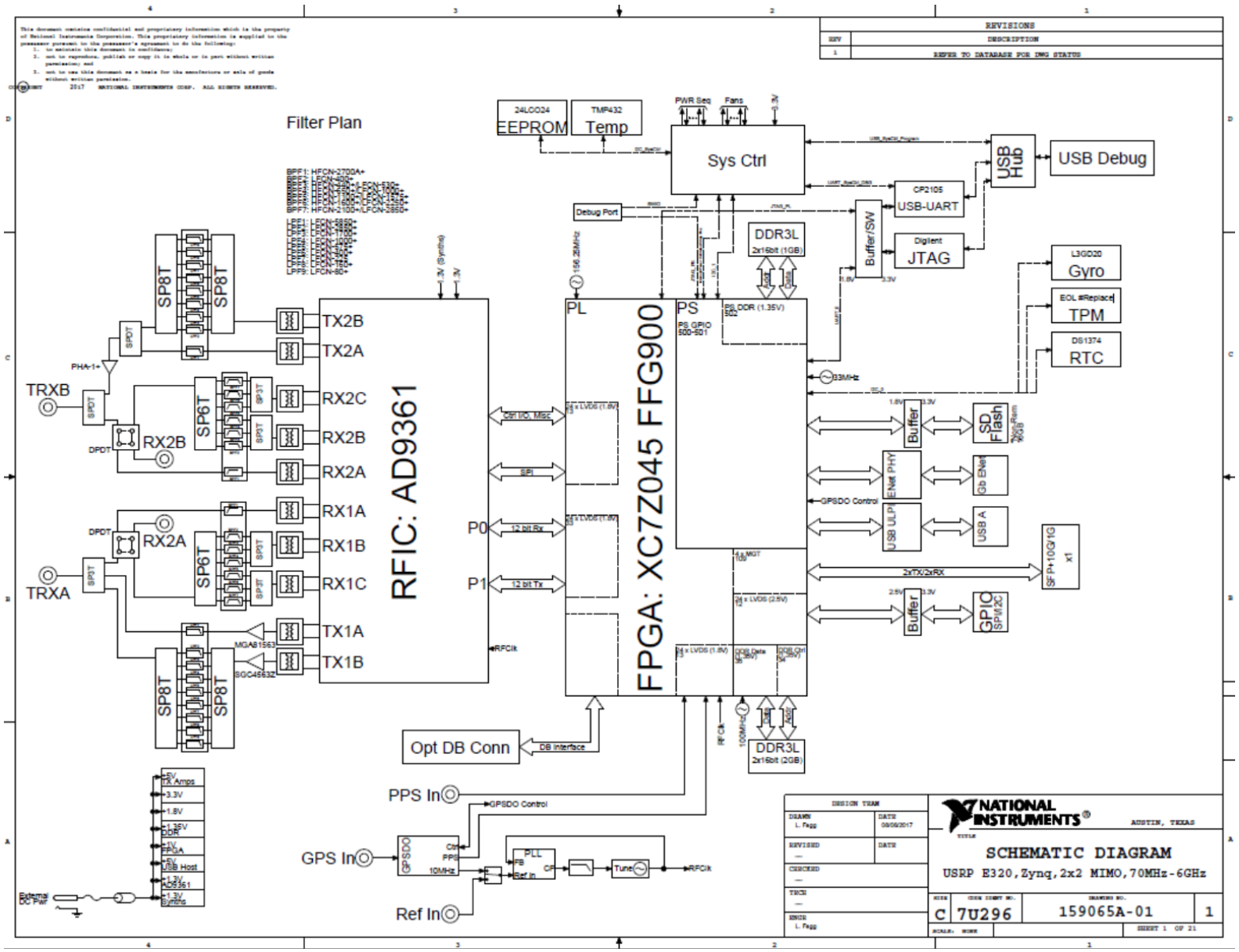

USRP E320 SDR Block Diagram

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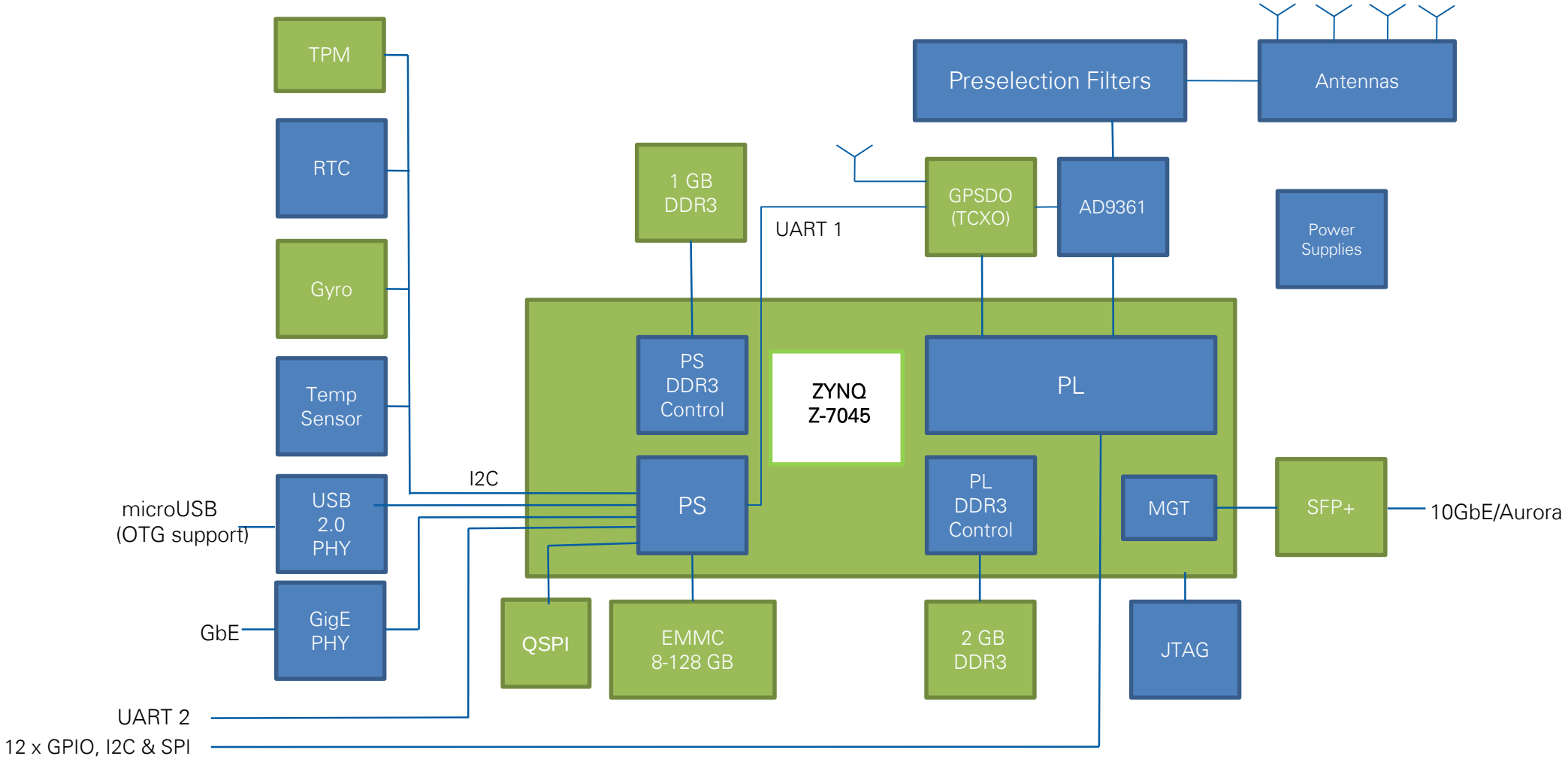

FPGA Resources Comparison

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	E310	N300	E320	X310	N310
	Zynq 7020	Zynq 7035	Zynq 7045	Kintex 7 410T	Zynq 7100
Logic Cells	85K	275K	350K	406K	444K
BRAM (MB)	4.9	17.6	19.1	28.6	26.5
DSP Slides	220	900	900	1540	2020
Flip-flops	106K	343K	437K	508K	554K
LUT's	53K	171K	218K	254K	277K
GMACS	276	1334	1334	2289	2622

E320 Notable Features

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- Bandwidth: SFP+ to MGTs on FPGA to support a single 10GbE or 12.5Gb Aurora streaming interface
- Security: Trusted Platform Module
- Ruggedness: Enclosure which also acts as a passive heatsink, fan header and attach points for Zynq (for convection cooled apps), single PCB to make OEM integration easier
- Reliability: Temperature sensors on AD9361 and Zynq
- Portability: Battery connector
- SWaP: 3U Eurocard size
- Jackson Labs LTE-Lite GPSDO
- MEMS gyroscope

Other Ettus Events This Week!

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- "You have turned on the future!", Thursday @ 11:15am
  - Featuring Martin Braun
- RFNoC Tutorial, Wednesday @ 2:15pm and Friday @ 1:00pm
  - Featuring Neel Pandeya, Nate Temple
- 3 Lightning Talks, Friday @ 8:45am
  - Featuring Tom Tsou, Brent Stapleton, Neel Pandeya
- Techniques for Debugging your GNU Radio Application, Wednesday @ 4:45pm
  - Featuring Marcus Müller
- Ettus booth with live demos galore starting Tuesday
  - Featuring the whole Ettus gang in green!