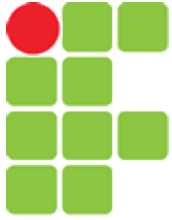


Federal Institute of Santa Catarina – Brazil
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Enhancing GNURadio Processing Block Migration from Software to Hardware

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WinnComm Europe 2014 – Rome, Italy



The History Beyond this Work...

Motivation



Motivation

- Size: 8.515.767,049 km²



Motivation

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- Costa Size: 7.491 km



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- However:
 - **60%** Freight transportation by truck



Motivation

- Size: 8.515.767,049 km²
- Costa Size: 7.491 km
- However:
 - **60%** Freight transportation by truck
- Rising Cargo Thefts:
 - **2013 - US\$ 380 Million**
 - **2014 - US\$ 400 Million**
 - **About 5% growth**



Motivation

Motivation

- Tracking System = Great Deal!!



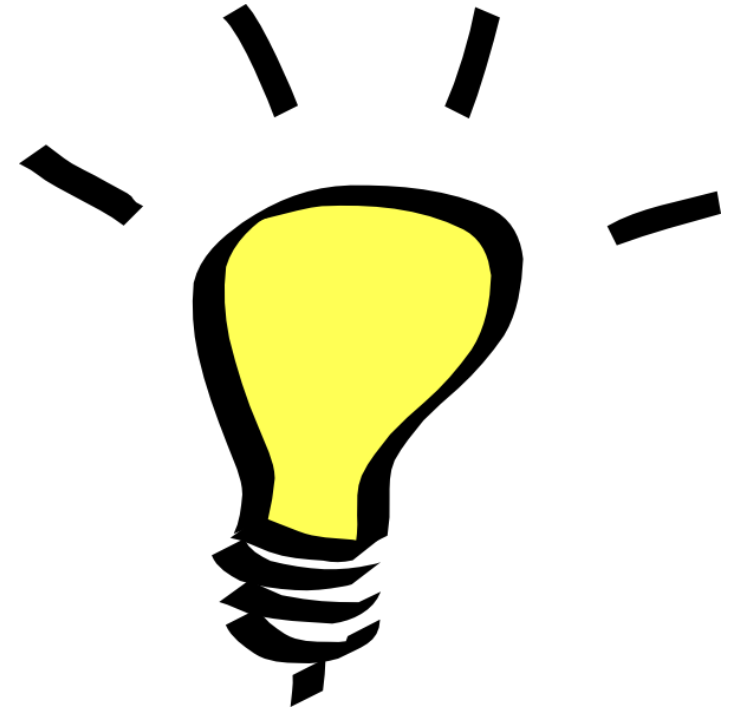
Motivation

- Tracking System = Great Deal!!
- Thieves are smart:
 - Jammers
 - Places without signal coverage



Motivation

- SDR Platform to implement:
 - Non-standard communication systems
 - Better Jamming detection algorithm
- Must be:
 - Cheap
 - Embedded



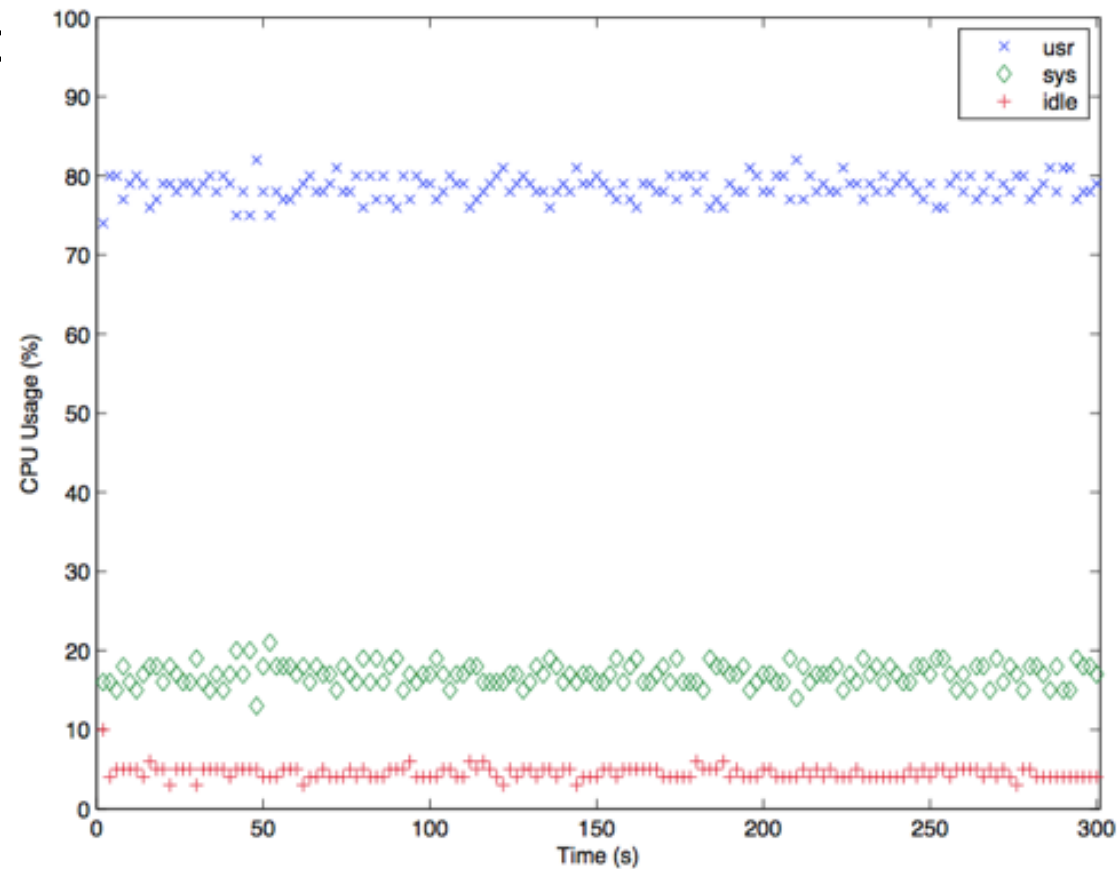
Two Main Problems Addressed

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- Performance limitations of embedded CPUs

Two Main Problems Addressed

- Performance



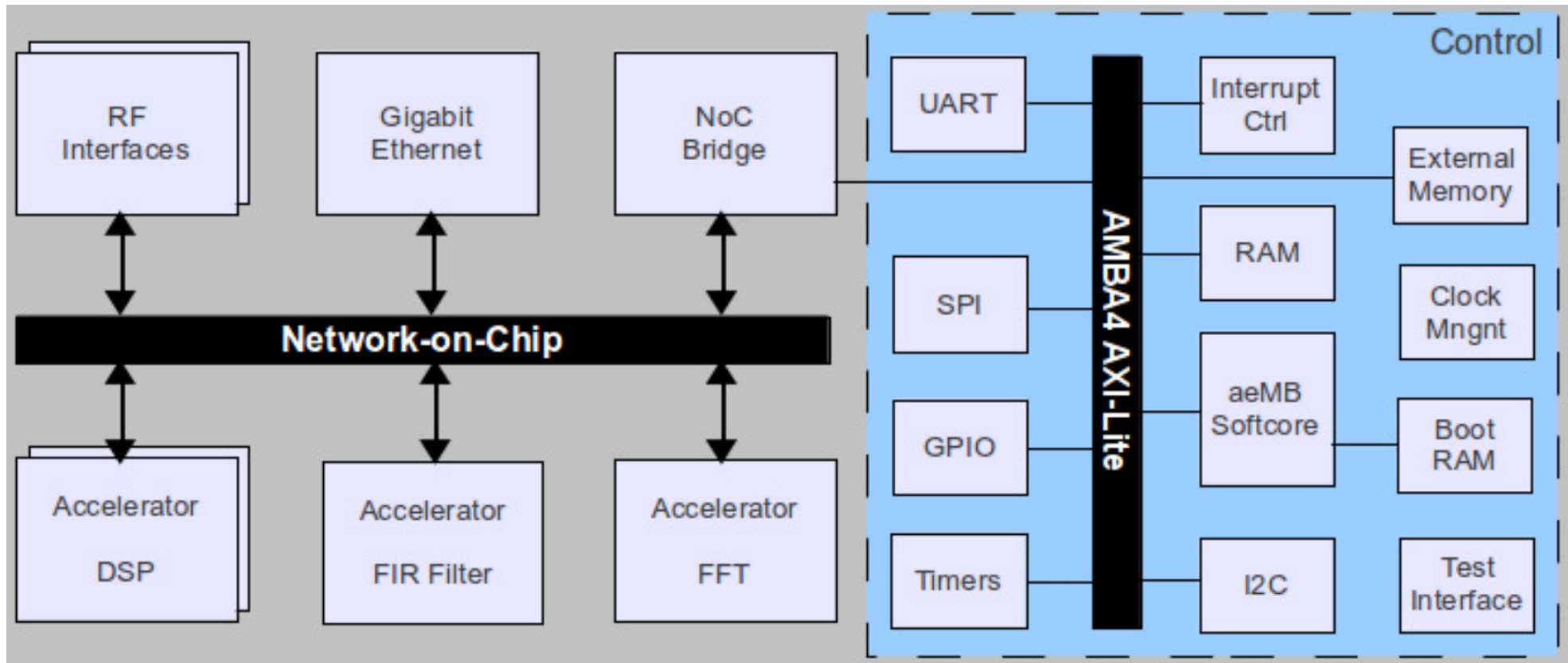
Two Main Problems Addressed

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Two Main Problems Addressed

- Performance limitations of embedded CPUs
- Lack of flexibility in SDR architectures in regarding hardware changes

Proposed Architecture



Implementation

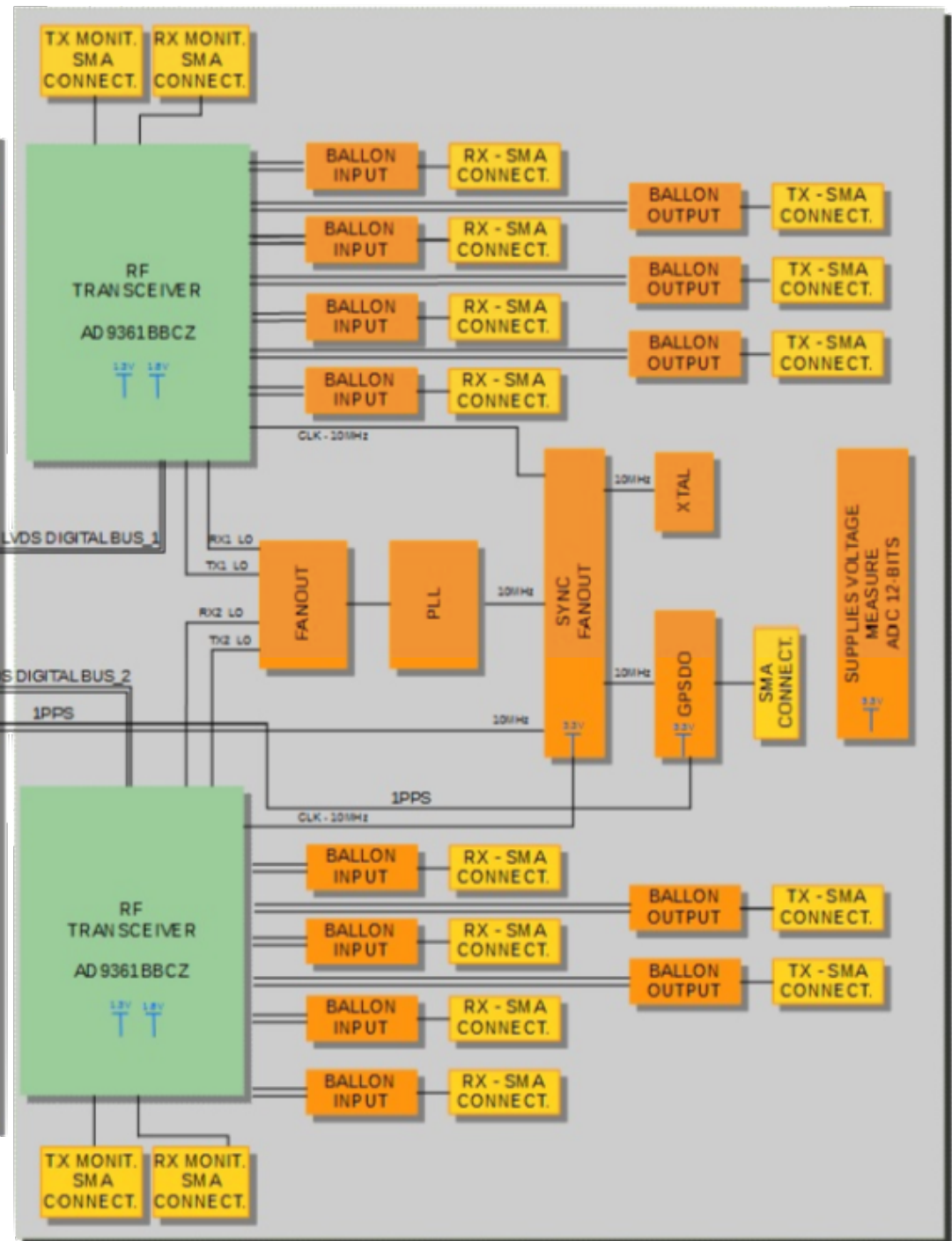
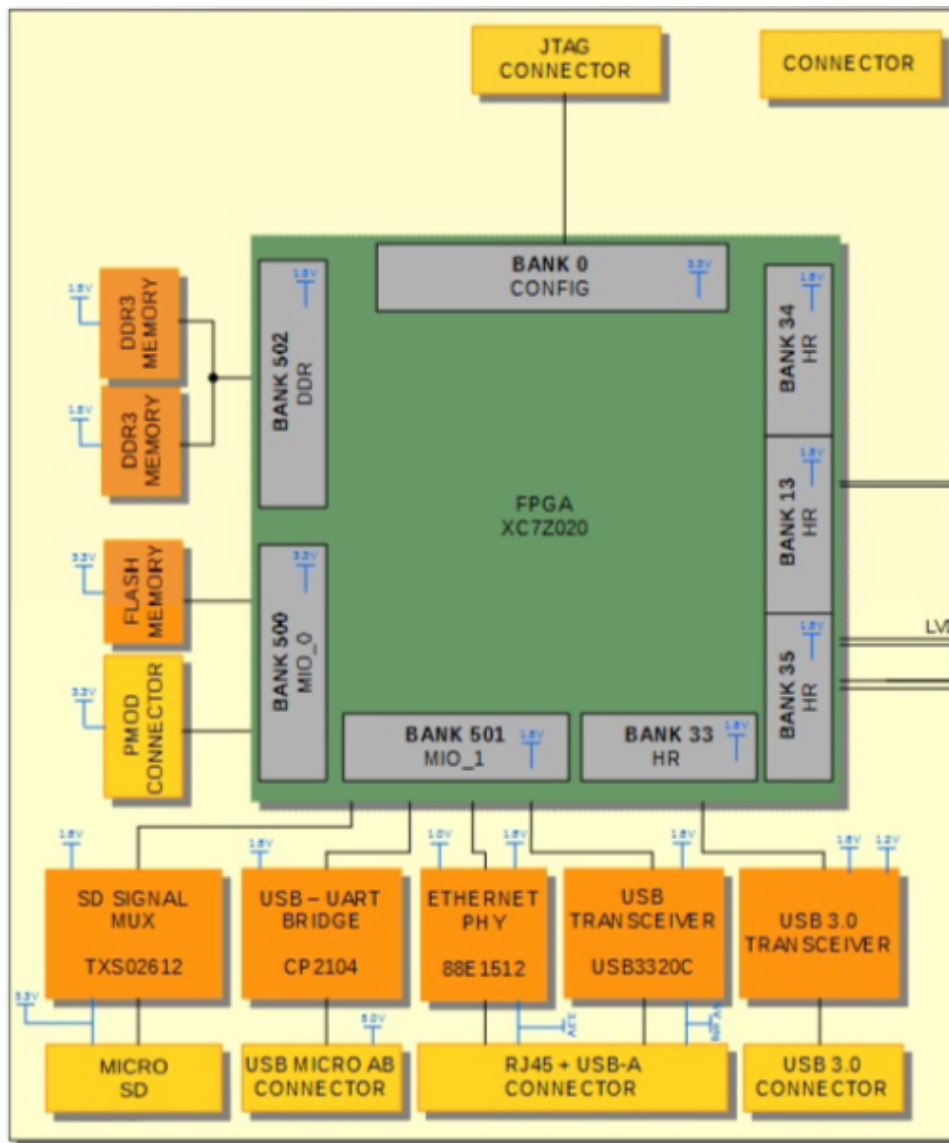
System Information

- Dual ARM Cortex-A9 MPCore
- Up to 667 MHz operation
- NEON Processing / FPU Engines
- Xilinx Zynq-7000
- 10/100/1000 Ethernet
- USB 3.0

RF Interface

- RF 2x2 Built-In (expansible to 4x4)
- Bandwidth: <200 kHz to 56 MHz
- Up to 56 MHz of real-time bandwidth 1x1
- Up to 32 MHz of real-time bandwidth 2x2
- Supports TDD and FDD operation

Hardware Implementation



Architecture Preliminary Results

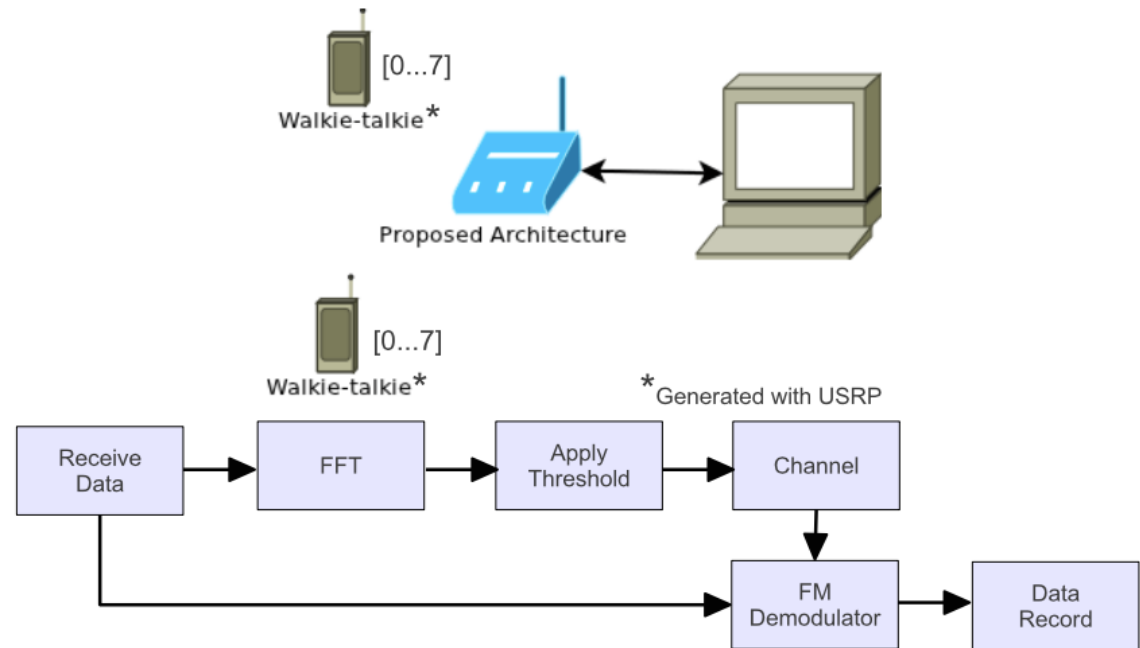
Architecture Preliminary Results

- Hardware:
 - ZedBoard
 - AD-FMCOMMS2-EBZ
 - Embedded GNU Radio
 - NOC on Zynq-7000



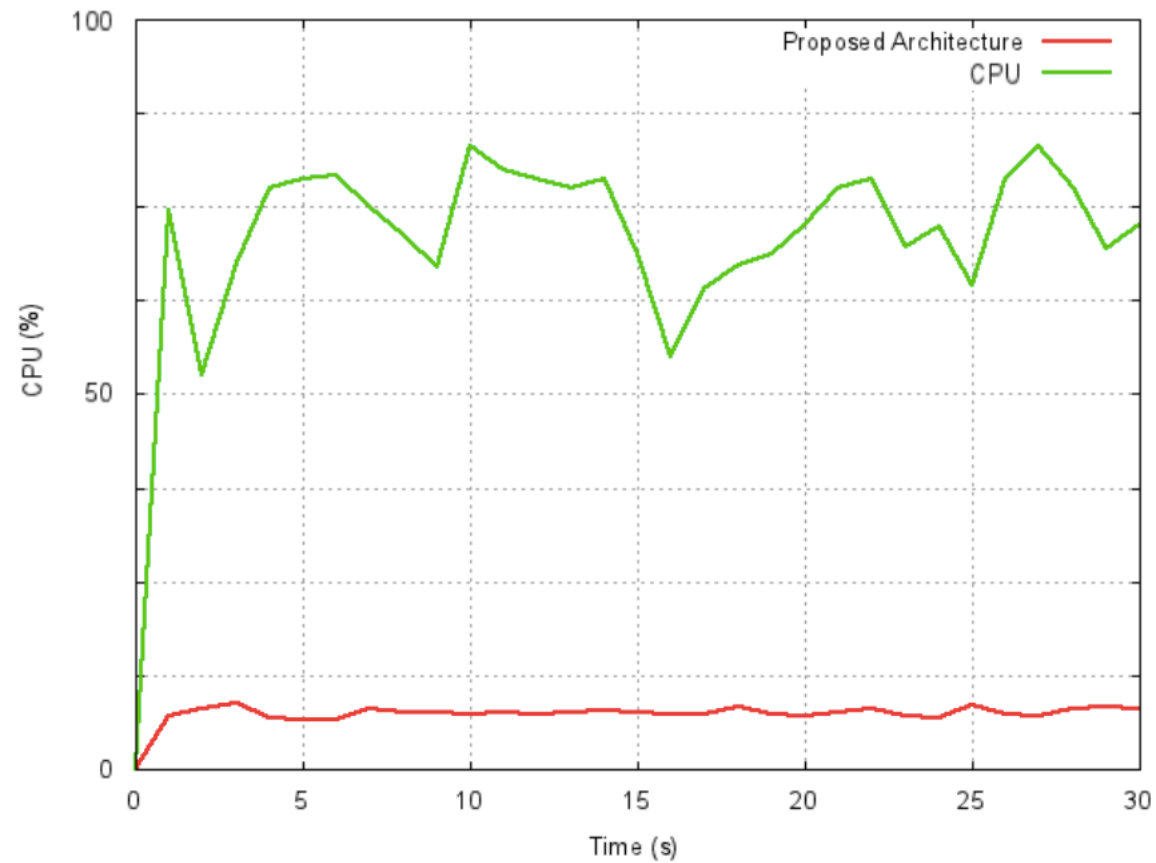
Architecture Preliminary Results

- Hardware:
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- Application
 - Intercepting communication of a PTP Walkie-talkie
 - Required a spectrum sensing algorithm and an FM demodulator
 - FFT implemented on hardware and software

Architecture Preliminary Results



Architecture Preliminary Results

FFT Size	FPGA Average (μ s)	Host Average (μ s)
64	4.21	937.89
128	6.12	912.25
256	10.98	1170.07
512	19.47	944.58
1024	34.61	995.26

Conclusion

- Hardware processing + NoC latency << Software Processing
- NoC allows a plug-and-play interface for Hardware blocks
- We encountered difficulties related with the scarce availability of DSP cores in HDL
- We still working ...

Contact

Questions??

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