

University of Cape Town



An open source implementation of a data acquisition system for a current pulse ERT system using an industry standard interface

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ERT data acquisition using NI/LabVIEW

Details of the electronic circuits for the UCT current pulse ERT system were published at WCIPT6. This paper deals with the replacement of the USB DAQ and two micro-controllers with an industry standard IO system available from National Instruments and the LabVIEW software developed for data acquisition. **The system enables the transmission of data at 1000 fps* over an TCP/IP network.** This open source code complements the published electronics and now provides a complete solution for ERT measurements.

* For frames of 208 data points (Adjacent pairs using 16 electrodes)

WCIPT7 / September 2013



Current Project

Objective

- **Replace current USB interface with modern device supporting ethernet communications**

Benefits

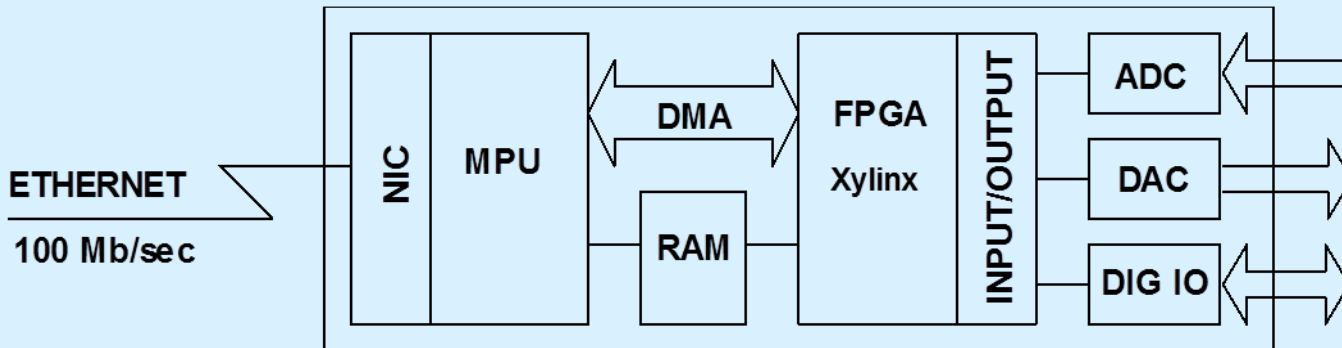
- **LabVIEW support – simplified coding**
- **Local processing (microcontroller + FPGA)**
- **Cost reduction – replaces DAQ, 2 x MCUs, and PC**
- **1000 fps data transmission over IP network**
- **Open source code**

Complete ERT system implemented on 2 PCBs and sbRIO

Data streamed to PC via TCP/IP at 1000 fps



What is a National Instruments RIO ?



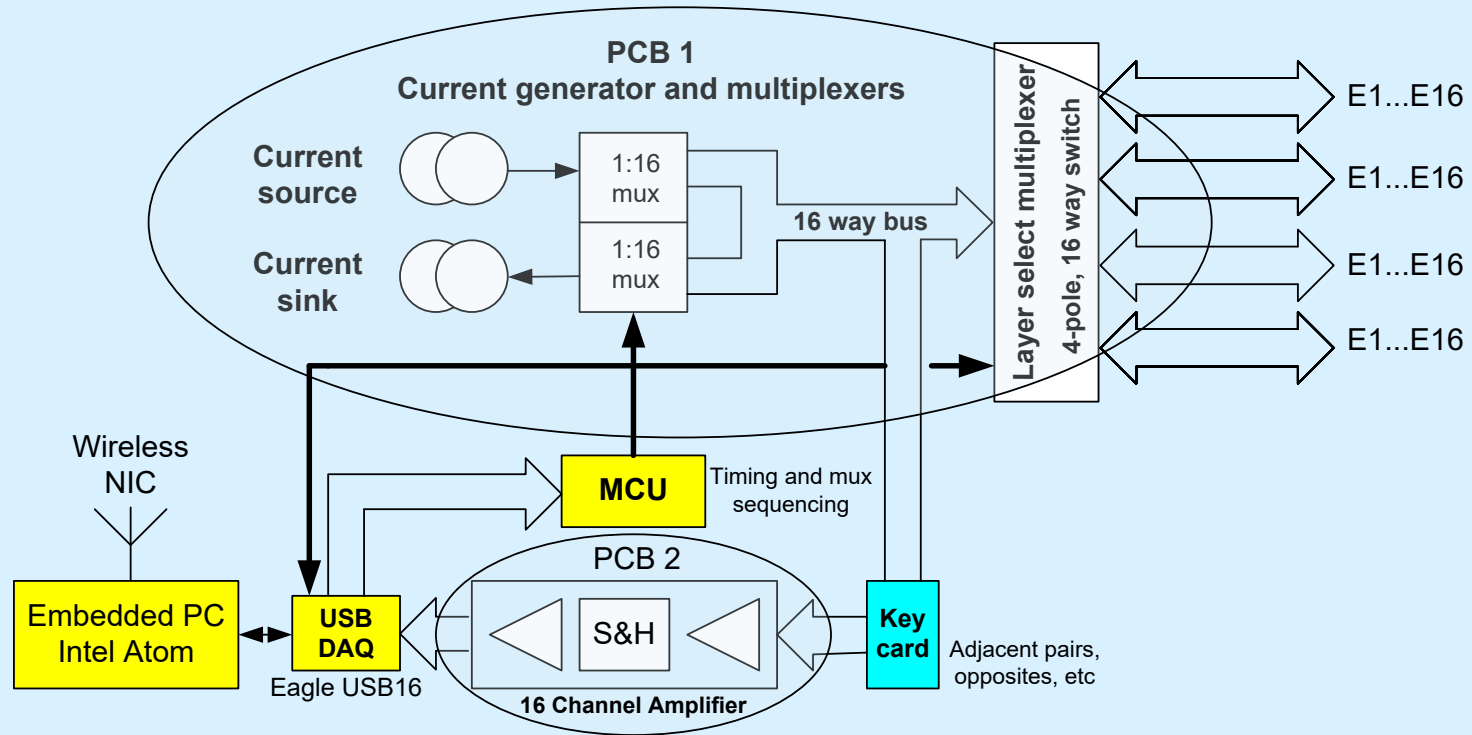
Programmed
using
LabVIEW

Local data
processing on
MPU (and
FPGA)



FPGA
controls
IO

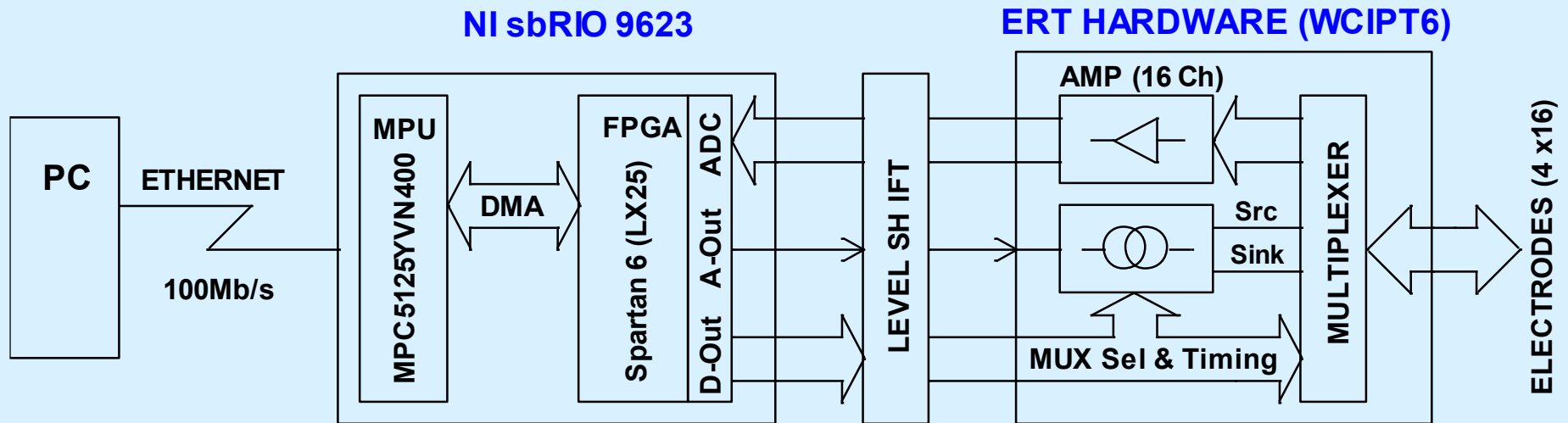
GB60 Microcontroller version



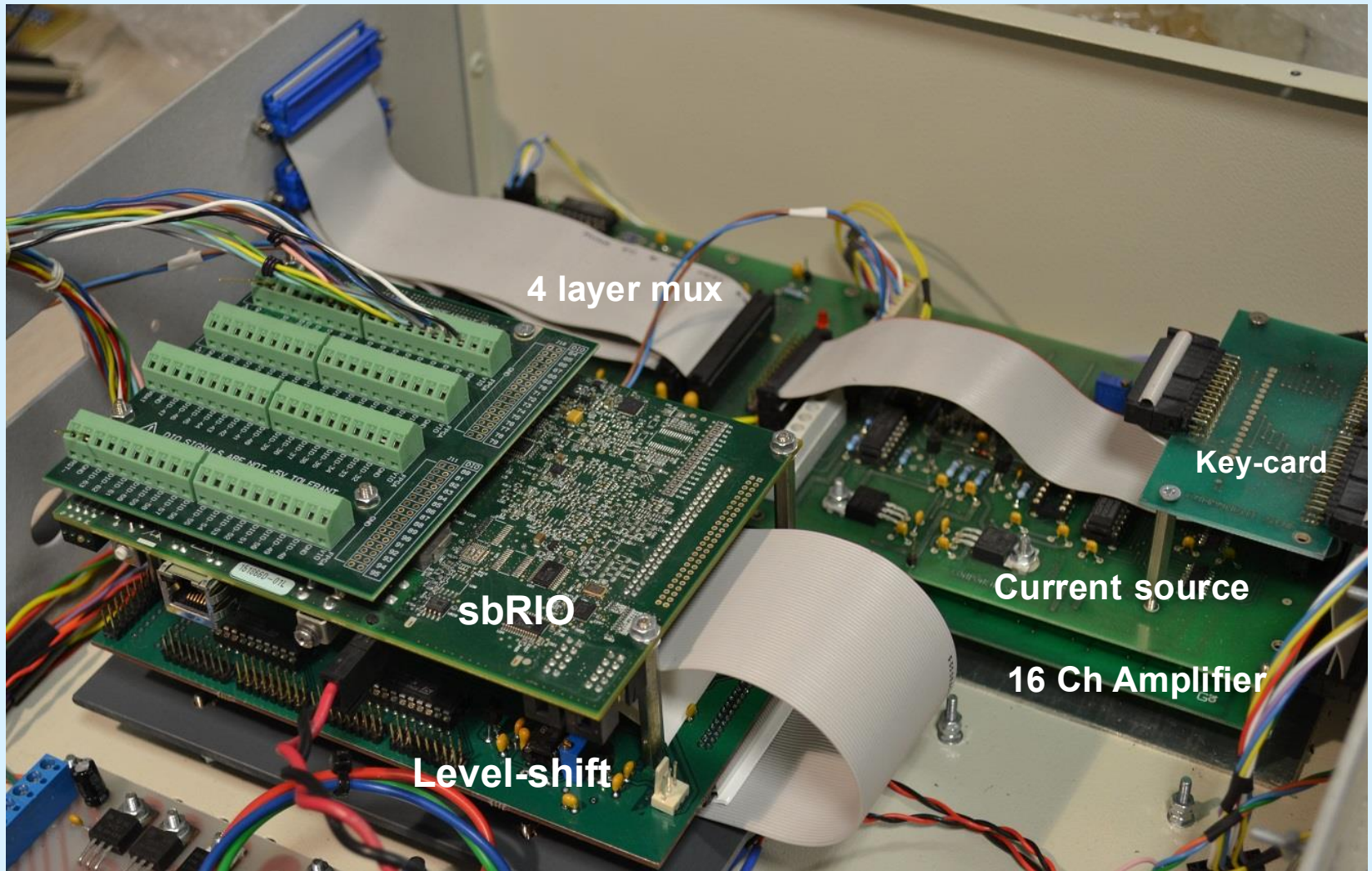
**DAQ, MCU and embedded PC replaced with
NI sbRIO**



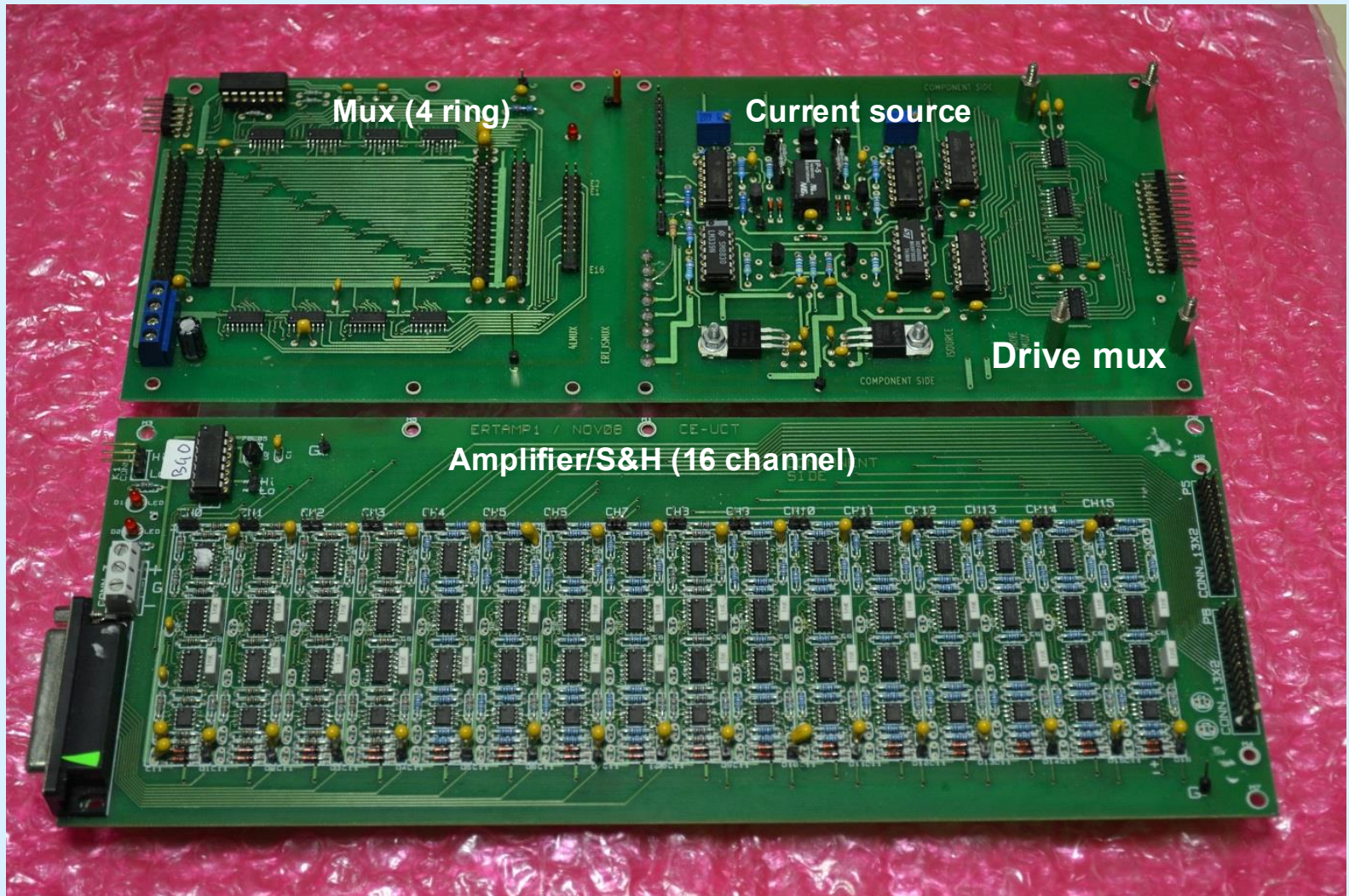
ERT / sbRIO configuration



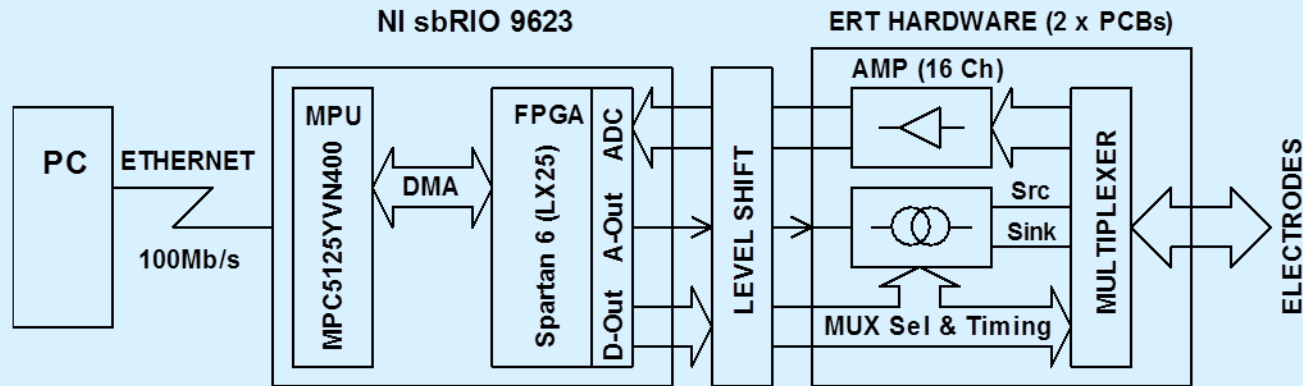
Internal view of ERT system (sbRIO version)



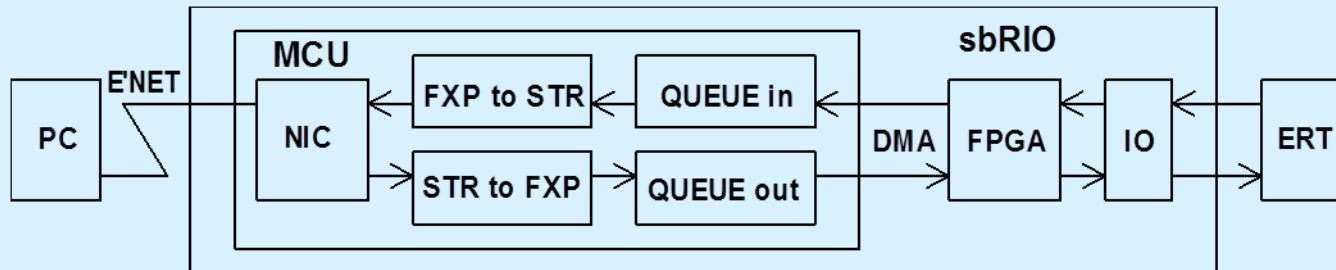
2 PCB implementation of ERT hardware



sbRIO in ERT Application

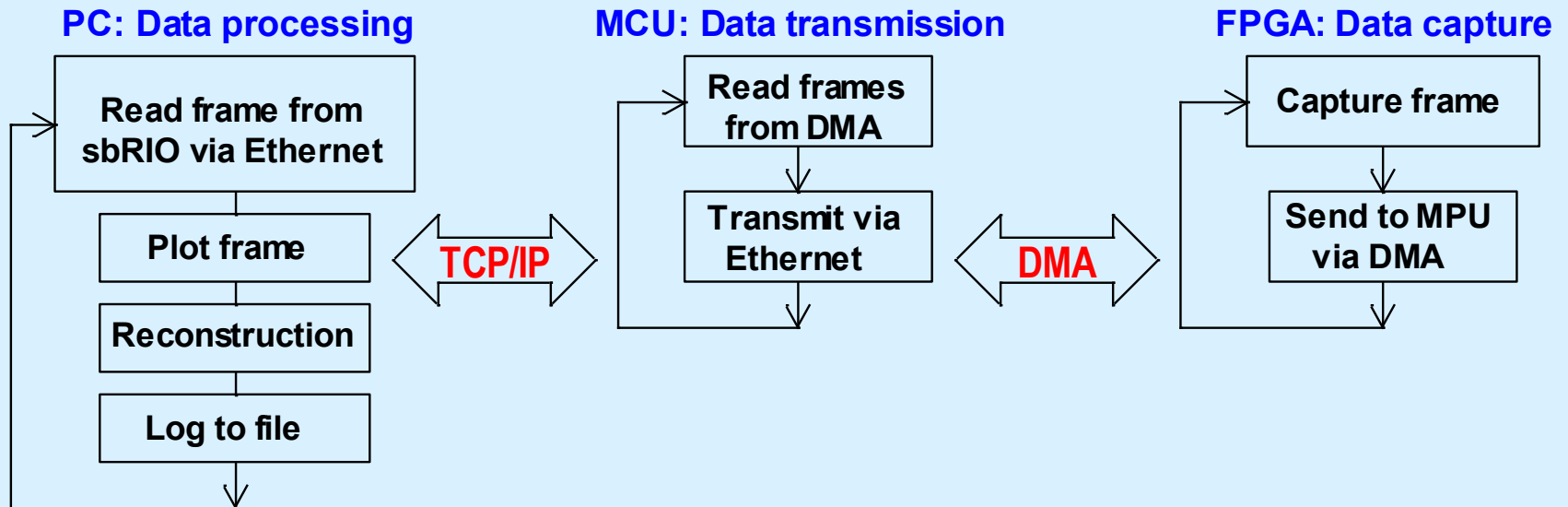


sbRIO / ERT hardware interface



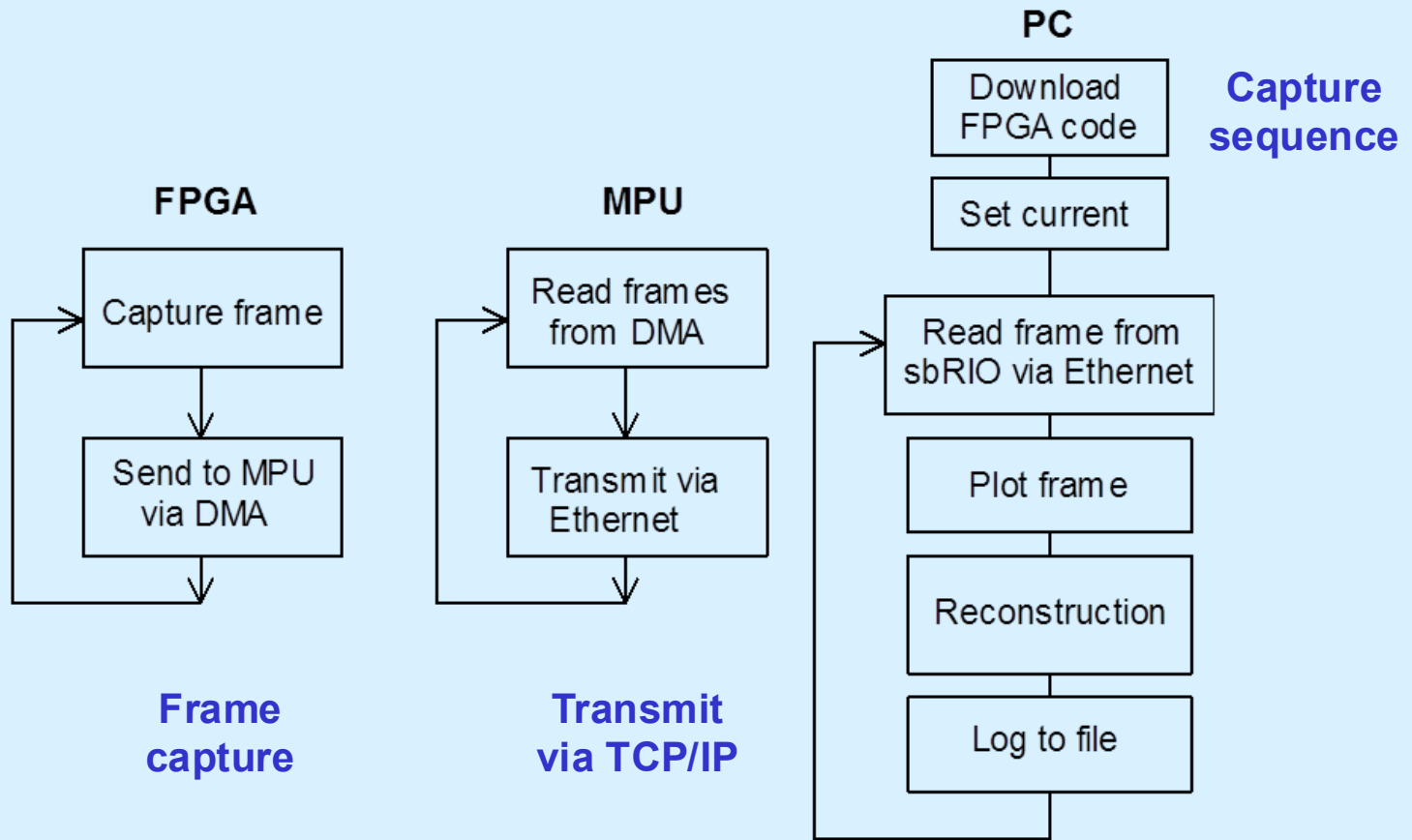
ERT to PC data flow

LabVIEW code modules for ERT / sbRIO implementation



Data transfer between modules by TCP/IP and DMA

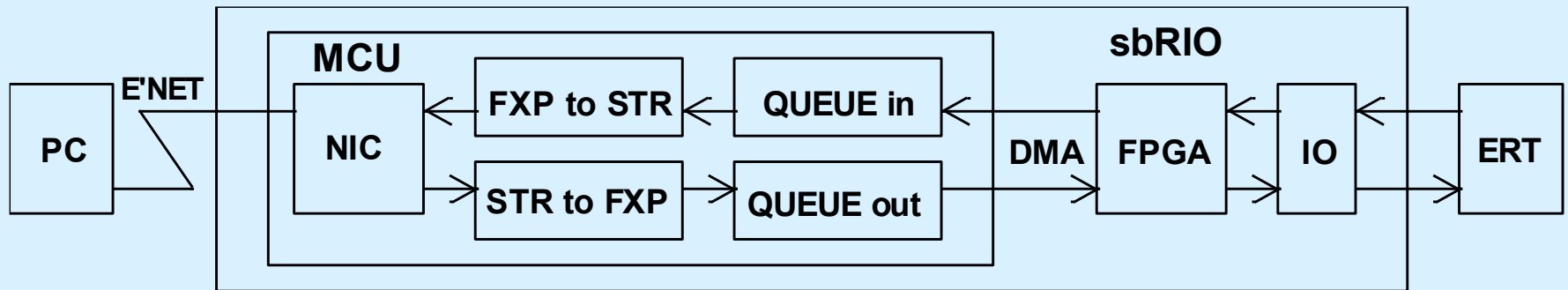
Labview code structure



System transfers 1000 fps to PC via TCP/IP (16 electrodes, adjacent pairs)



sbRIO/ERT Data Flow

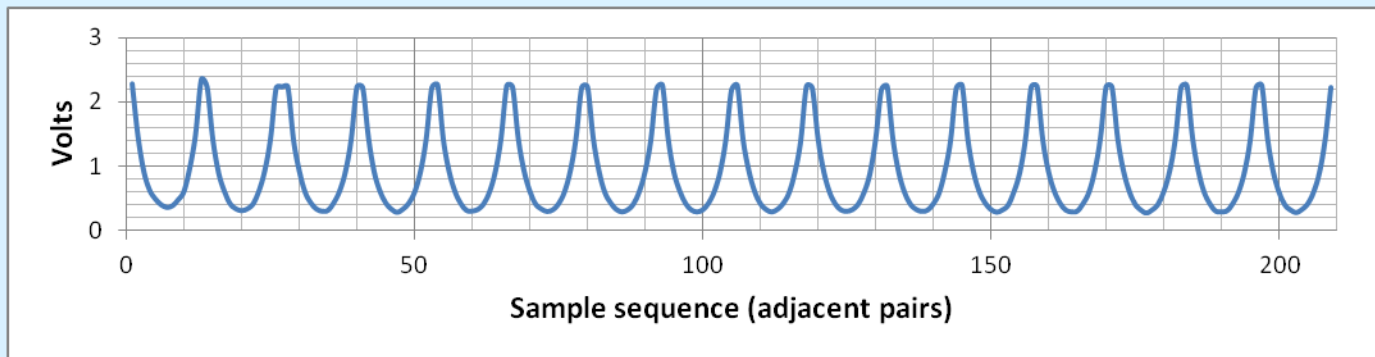


Coding structure critical to achieving maximum data transfer rates

1000 ERT fps achieved on 100 Mb/s IP network for 16 electrode system using adjacent pairs strategy

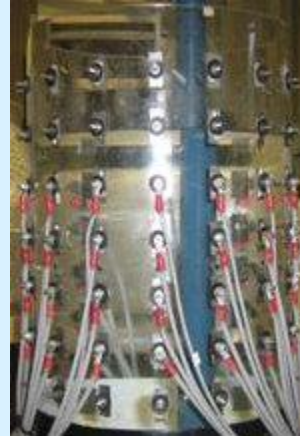
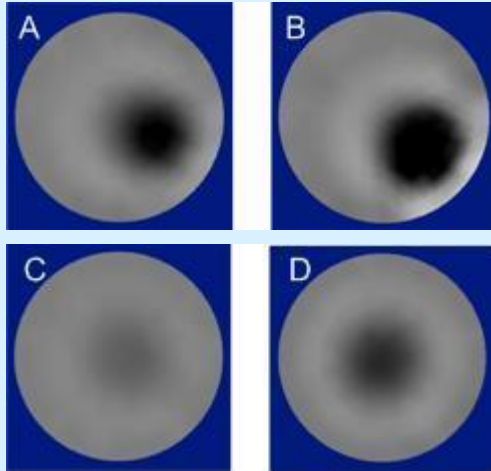


sbRIO frame capture



Single frame “U” curve for 16 electrodes using adjacent pairs

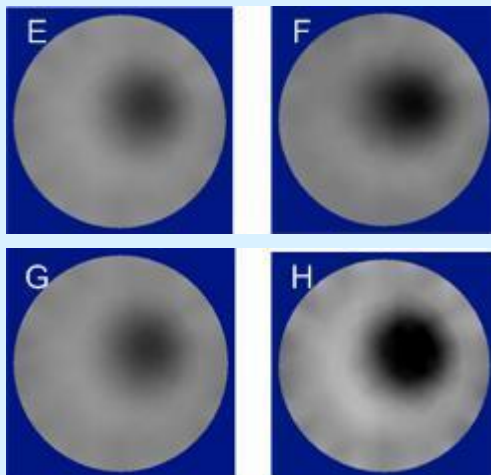
Reconstructed data frames



Insulating phantoms

25mm rod B/W range (A) 40%, (B) 20%

12mm rod B/W range (C) 30%, (D) 10%



Bubble streams

**B/W range 10%
(E) Low flow, (F) High flow**

**Low flow
(G) B/W Range 10%, (H) B/W Range 4%**

Conclusions

- **Open source Hardware (2010)**
- **Open source LabVIEW software (2013)**
- **Industry standard IO system (NI sbRIO)**
- **sbRIO incorporates MCU and FPGA**
- **Ethernet connectivity**
- **1000 fps transmitted over IP network**
- **Local processing of data on RIO**



Acknowledgements

UCT

- Prof Andrew Wilkinson (UCT EE) – conceptual design
- Tim Long – UCT “On-line Tomography” software
- Kyle Hauslaib – sbRIO / LabVIEW implementation
- Contributions from many students

CPUT

- Andrew Sutherland (Pipe-line flow facility)

International

- University of Manchester (UK)
- University of Queensland – JKMRC (Australia)
- CSIRO (Australia)
- Carlton University (Canada)
- Teltek (Norway)



Table Mountain from Franchoek

Questions ?

