Embedded Systems

1. Describe the architecture and main components for asymmetrical computation platform, with CPU and FPGA! Explain the connection of computer network components and schematic of analogue/digital Input/Outputs!

Ref:

R1. National Instruments, CompactRIO Developers Guide, ed. May 2009

Chapter 1: Machine Control Architecture Overview, Introduction to CompactRIO

Chapter 2: Basic Architecture for Control

R2: National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

Overview and Background

LabView 2014 Examples:

Queue Message Handler Fundamentals.vi

CompactRIO Project Template: LabVIEW FPGA Control on Compact RIO

2. Describe the architecture and main components of a DAQ system: analogue parts, ADC, and digital processing with CPU. Please explain analog-to-digital conversion theory in time and frequency domain!

Ref: University of Oslo, FYS3240, PC based instrumentation and data acquisition, Spring, 2011, Lecture #6

LabView 2014 Project Template: Continuous Measurement and Logging

3. Describe an asymmetrical architecture (components, data paths, important states of each software component) of a control device with remote user interface. Please explain the state machine running on remote host, CPU and FPGA.

Ref: R2: National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

Chapter 1: Designing a CompactRIO Software Architecture

LabView 2014 Project Templates: LabVIEW Real-Time Waveform Acquisition and Logging (NI-DAQmx)

4. What is a Real Time OS? Please explain soft and hard real-time features on CPU and FPGA. Please explain the main components and features of a Real-Time Operating System.

Ref: R2: National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

Chapter 3 Designing a LabView Real-Time Application

LabView 2014 Project Templates: LabVIEW Real-Time Control (NI-DAQmx)

5. Data sharing and communication among embedded systems. Communication types: shared data, streams, queues, tags, shared variables. Low level (TCP/IP) based data communication. definitions of URL-s for data communication.

Ref: R2: : National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

Chapter 4, Best Practices for Network Communication

LabView 2014 Examples:

- Butterworth Filter.lvproj (LPF on FPGA, no RT VI, UI on Host, FPGA access by URL!)

- Shared Variable.lvproj (different access techniques of shared variables)

- RT FIFO Variables – networked.lvproj (RT – Host FIFO communication)

6. Web services for embedded system. What is a web service, and web server? How to control user access? How to create web service in LabView for embedded systems.

Ref: R2: : National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

Chapter 4, Best Practices for Network Communication, Web Services only.

LabView 2014 Example: Web Services – Weather Monitor RT.lvproj

7. FPGA in embedded system. What is an FPGA and what the purpose of application? How to create FPGA resource in LabView? What is a scan engine, how does it work? Draw a simple state machine template in LabView for FPGA execution.

Chapter 2, Choosing a CompactRIO Programming Mode

LabView 2014 Example:

- Edge Counter.lvproj (FPGA only, no RT and no Host Vis)

- DC and RMS Measurement.lvproj (FPGA only, no RT and no Host Vis)

- PWM Generation.lvproj (FPGA only, no RT and no Host Vis)

- Butterworth Filter.lvproj (LPF on FPGA, no RT VI, UI on Host, FPGA access by URL!)

General resources for each question in Embedded Systems:

National Instruments, CompactRIO Developers Guide, ed. May 2009

National Instruments, NI LabVIEW for CompactRIO Developer’s Guide

NI-RIO 14.0.1 NI-RIO Device Driver August 2014 f1 – for RIO based examples and project templates

http://www.ni.com/download/ni-rio-14.0.1/4862/en/