Implementing a Multiprocessor System on an FPGA using Altera Nios II Processors & SOPC

ECE6170: High-Performance Embedded System Design Using FPGAs
Need for a Multiprocessor System

- Common application of an embedded system is processing of video and audio streams.
- This especially demands computational performance of a few Giga operations per second.
- Can’t be obtained using a single processor.
- Multiprocessor systems possess the benefit of increased performance.
- Increase complexity.
Goal of this presentation

- Give an overview of the components that are required for building a multiprocessor system using tools such as Quartus II (SOPC) and NiosII.
- Ref:
  
  http://www.altera.com/support/examples/nios2/exm-multi-nios2-hardware.html
Components required for SOPC

- Nios Development Board, Cyclone® II edition
- Nios 2 cores/processors
- System timer for each system
- On chip memory
- Off chip SRAM
- SDRAM controller
- JTAG UART
- Button & LED peripherals
- Mutex peripheral
- System ID peripheral
- Phase Locked loop
Snapshot of SOPC system
Implementing it using NIOS II

- Key component in the whole implementation (SOPC and NIOS II) is mutex.

- Mutex: Short for *mutual exclusion object*.

- Mutex is a program object that allows multiple program threads to share the same resource, but not simultaneously.
Zero: Mutex successfully locked else non zero

Mutex not locked

If all conditions met, Processor acquires Mutex then processor sends data.

Returns non zero if the Mutex is owned by a certain processor.
At any given time only one processor can send data packets.
A processor locks the Mutex by writing the value of its cpu id control register to the OWNER field of the Mutex register.

Value field is 0x0000: Mutex available/unlocked. else locked
Conclusion

- The mutex core provides a protocol which ensures mutually exclusive ownership of a shared resource.
- Understanding how to implement a multiprocessor is important.
- Another aspect to look into is providing security to these multiprocessor systems.
Backup Slides (Extra time)

Pointers

- Nios II is doesn’t support multiple debug/run sessions by default.
- This is a requirement for multiprocessor systems.
- How to do this on Nios: On the Window menu, click Preferences and turn on Allow multiple active run/debug sessions.
New project should be created for each processor. 5 processors = 5 sub projects. Complexity increases rapidly for these systems.
Questions?