Smart Network Switch

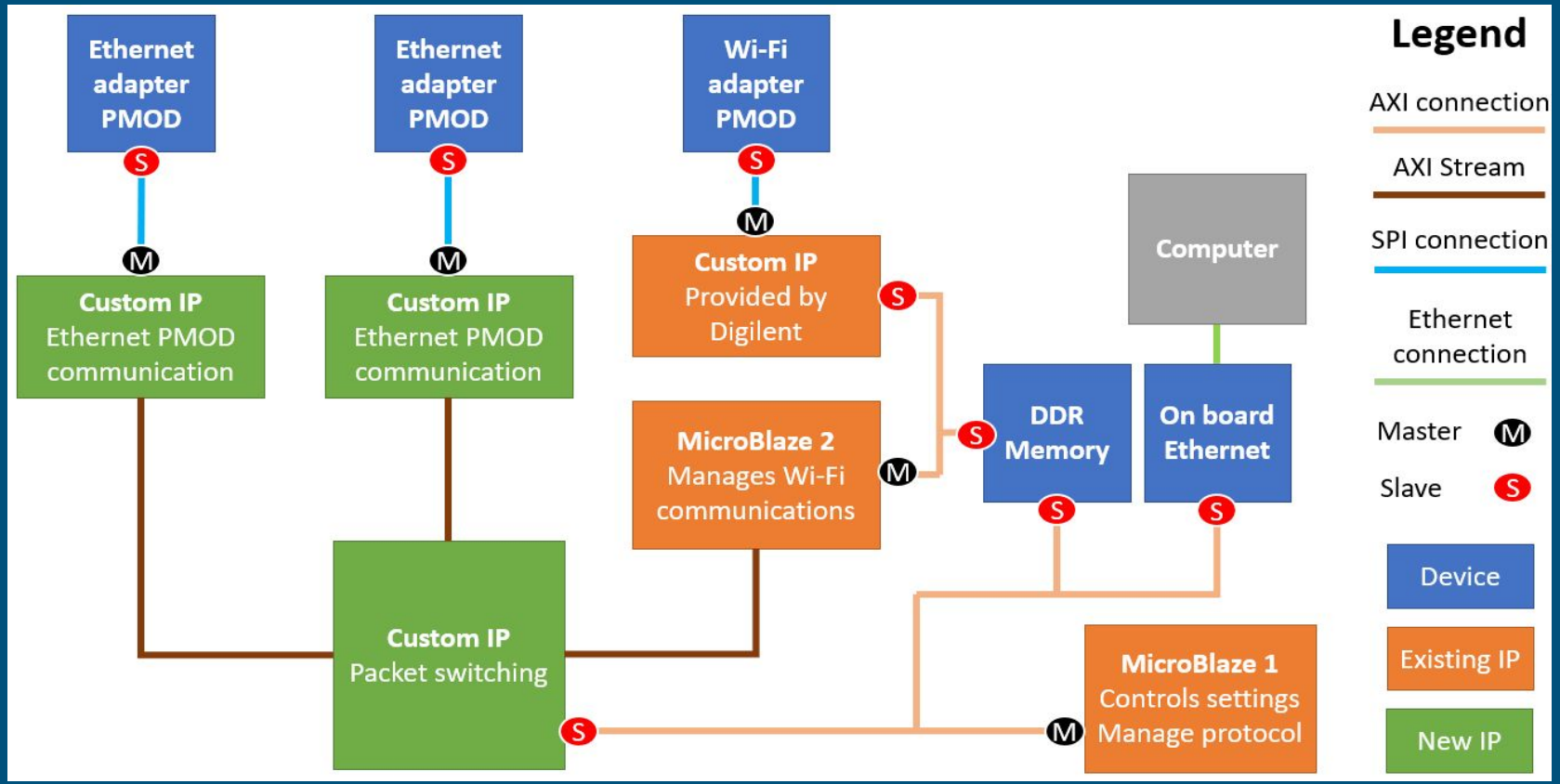
Group 9

Mahmoud Kharsa
Mark Bugaisen
David Nguyen

Project Overview

- Forward network traffic to the right target
- Done by building an address-port table

System Block Diagram



Requirements

• FPGA routes packets to the correct destination device (in hardware)	~
• Support two devices connected across Ethernet	✓
• Support one device connected across Wi-Fi	✗
• Support IPv4	✓
• Remotely configurable	✗
• Has monitoring capabilities from a PC connected across Ethernet	✗
• Minimum Throughput: 1Mb/s	✓
• Maximum Latency: 100 ms	✓

Initial Project Timeline (Mid-Project Demo)

Ethernet PMOD

- Look at Ethernet PMOD specs
- Implement the SPI interface
- Initialize the PMOD correctly

Showcase:
N/A (this will be done later on)

Status:
Completed ahead of Schedule

Wi-Fi PMOD

- Look at Wifi PMOD specs
- Initialize and set as access point correctly
- Establish communication through sending commands

Showcase:
Communication with a remote device

Status:
Not Completed / behind schedule

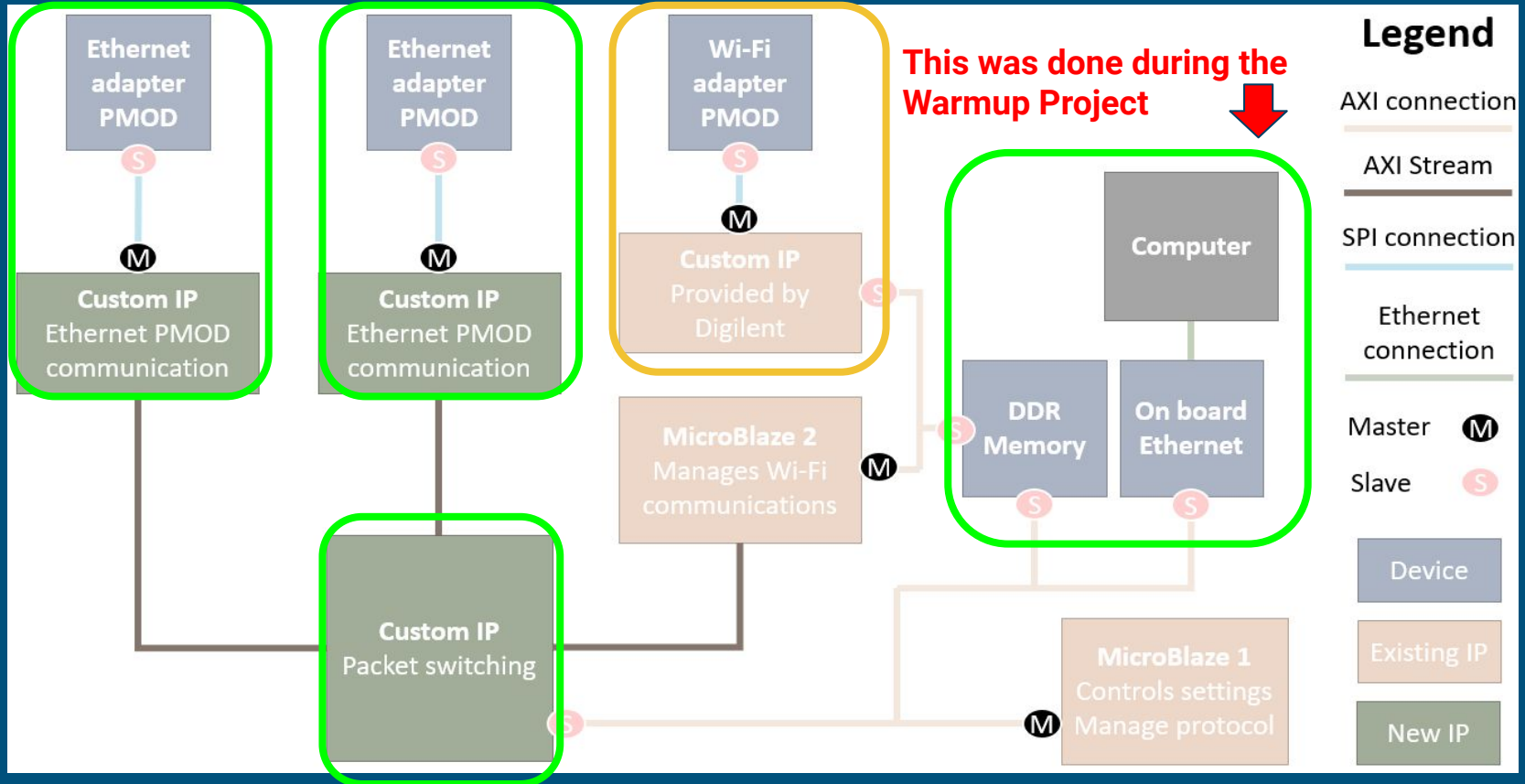
Packet Switching IP

- Create design plan
- Implement in Verilog
- Develop testbench
- Verify and debug functionality using simulation

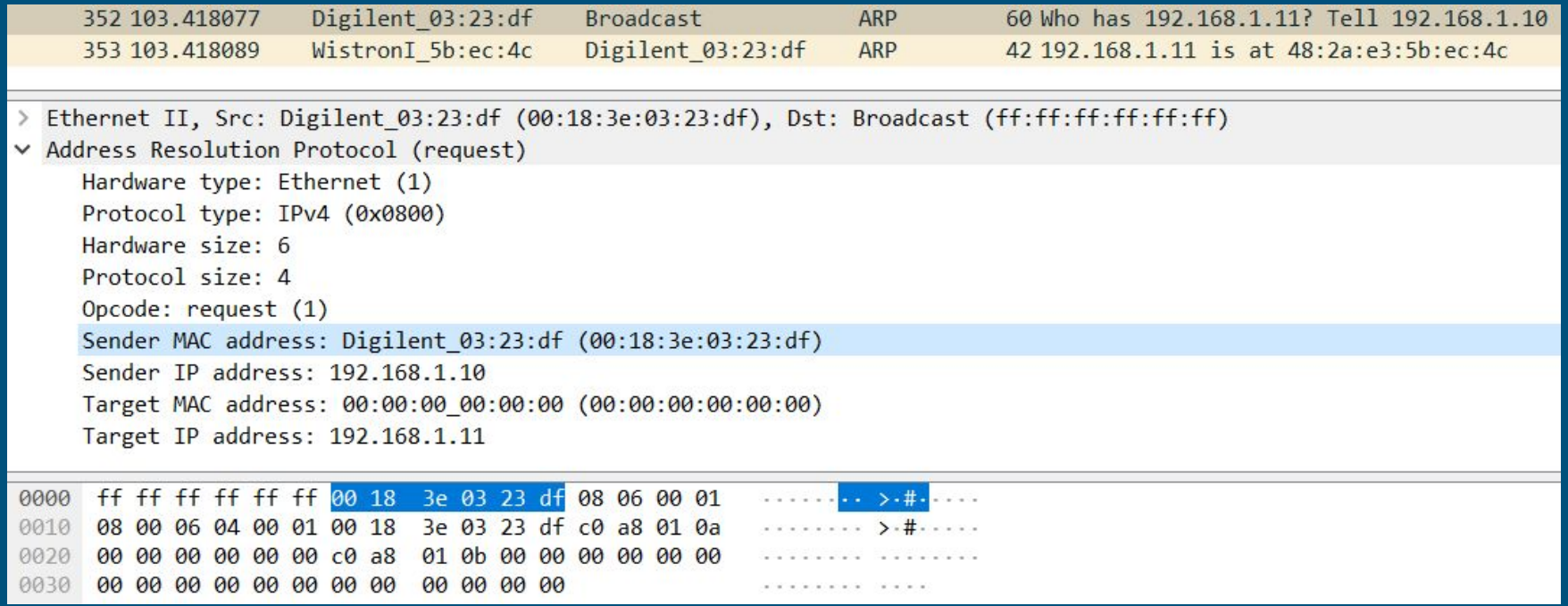
Showcase:
Switching of packets

Status:
Completed on schedule

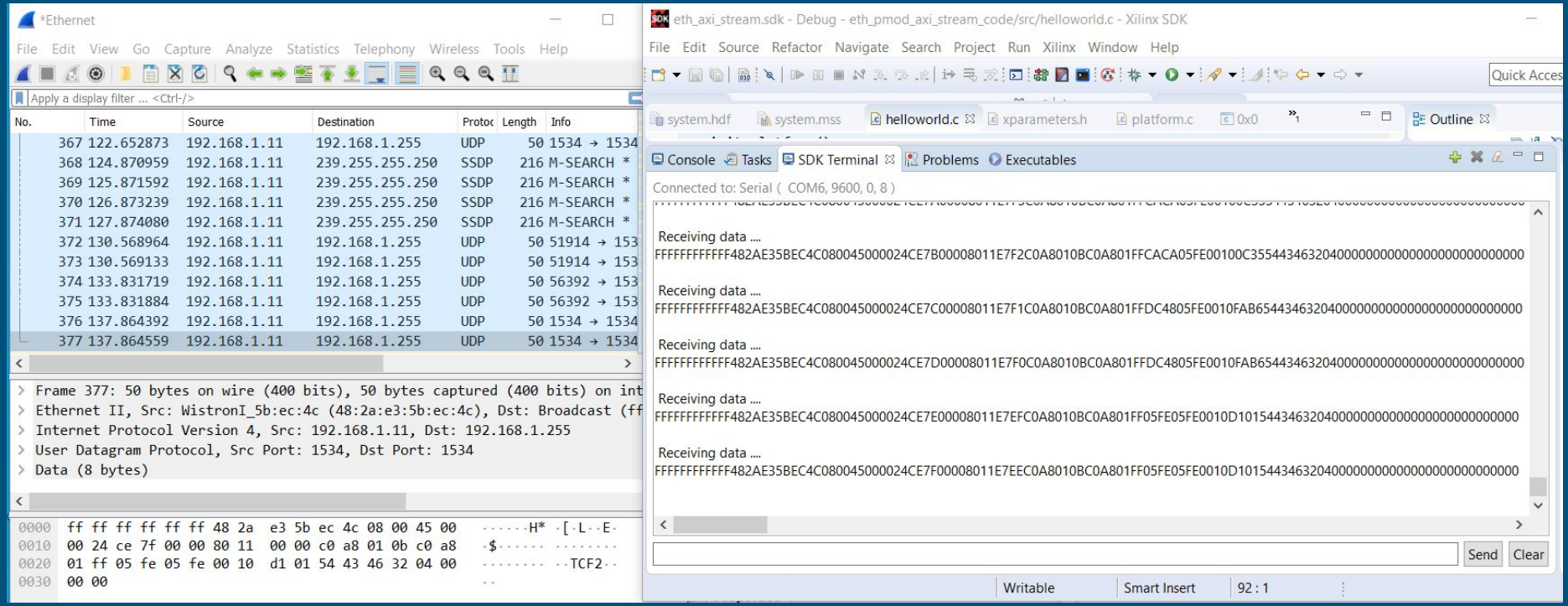
Implementation Progress



Demo: Ethernet PMOD Communication (Transmit)



Demo: Ethernet PMOD Communication (Receive)

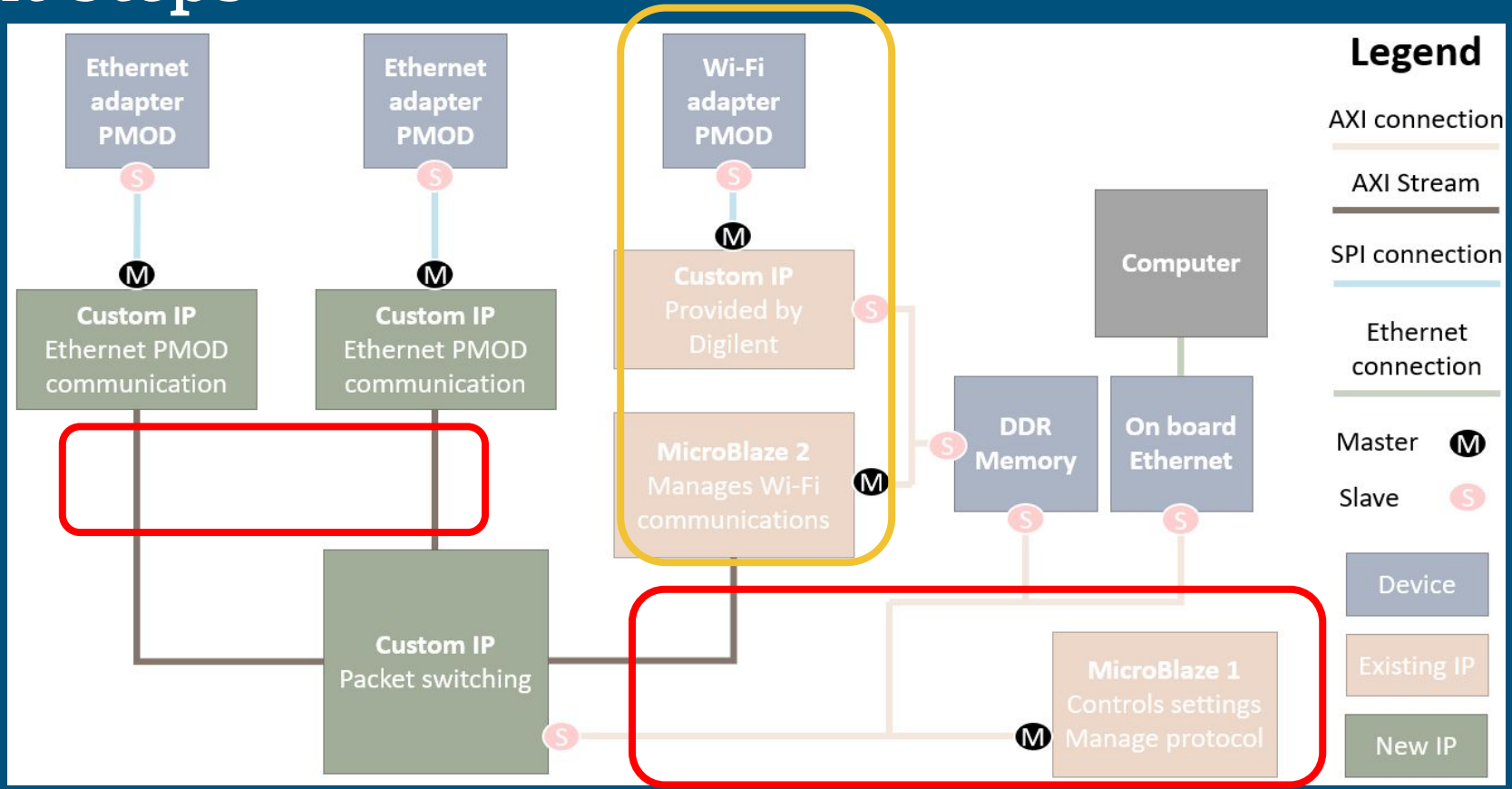


Challenges Encountered

- Wi-Fi PMOD communication
  - ESP32 PMOD was not readily available, had to wait a full week to order it
  - Debugging issues where the PMOD is not properly responding to sent commands

- AXI-Stream FIFO (for demo only)
  - If Transmit size is not the same as data pushed in, no response

Next Steps


Ethernet adapter PMOD
Ethernet adapter PMOD
Wi-Fi adapter PMOD
Custom IP Ethernet PMOD communication
Custom IP Ethernet PMOD communication
Custom IP Provided by Digilent
MicroBlaze 2 Manages Wi-Fi communications
Computer
DDR Memory
On board Ethernet
Custom IP Packet switching
MicroBlaze 1 Controls settings Manage protocol
Legend
AXI connection
AXI Stream
SPI connection
Ethernet connection
Master
Slave
Device
Existing IP
New IP

Updated Timeline

Milestone 5

- Integration of the Packet Switching IP and Ethernet PMOD modules
- Debug Wi-Fi PMOD communication

Milestone 6

- Add Microblaze configuration of the Packet Switching IP (turn off ports, track dropped packets, etc.)
- Integration of the Packet Switching IP and Wi-Fi PMOD module

Final Demo

- One week of ‘leeway’ time
- Resolve/Debug any issues or setbacks that occur in previous milestones

Potential Risks

- Might not get the ESP32 Wi-Fi PMOD working
  - Can’t receive much help, not many other groups use this PMOD
  - Likely not enough time to experiment with backup PMODs
  - **Last Resort:** Substitute with 3rd Ethernet PMOD

- Might not successfully integrate the Packet Switch IP + PMODs
  - Main portion of project, hence it’s much more severe
  - **Mitigation:** One week of ‘leeway’ time in the timeline
  - **Last Resort:** Do Packet Switching in software (if no convergence by Milestone 6)

ANY QUESTIONS?