



# Smart Network Switch



Group 9



# Team

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## Mahmoud

- Hardware design
- Microprocessor programming
- Graphic drivers
- Computer networking

## Mark

- Hardware design
- Microprocessor programming
- Inferring RAM
- Writing testbenches

## David

- Hardware design
- Microprocessor programming
- Design verification
- Debugging with simulations

# Background

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- Internet infrastructure: routers and switches
- Forward network traffic to right target
- Done by building an address-port table



# Requirements

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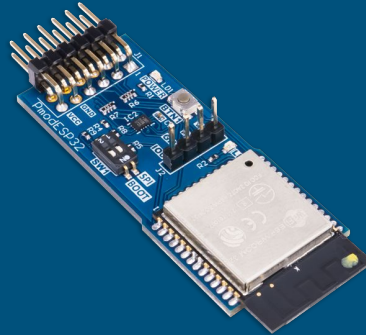
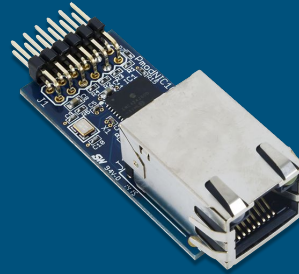
- FPGA routes packets to the correct destination device (in hardware)
- Support two devices connected across Ethernet
- Support one device connected across Wi-Fi
- Support IPv4
- Remotely configurable
- Has monitoring capabilities from a PC connected across Ethernet
- Minimum Throughput: 1Mb/s

# PMOD Peripheral Modules

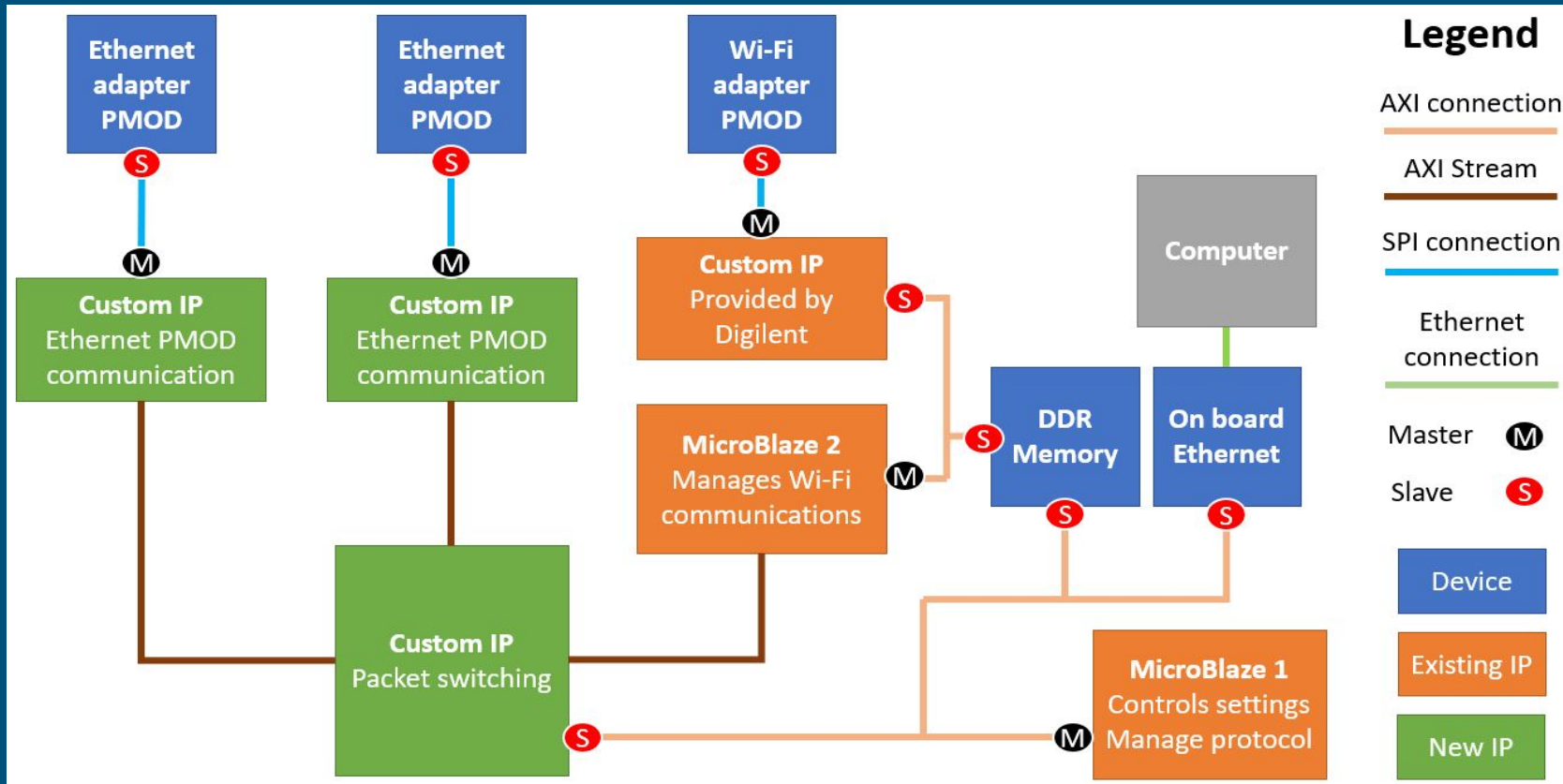
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Peripheral Modules Used:

- 2x NIC100: Network Interface Controller  
Supports ARP
- 1x ESP32: Wireless Communication Module  
Supports wireless access point mode



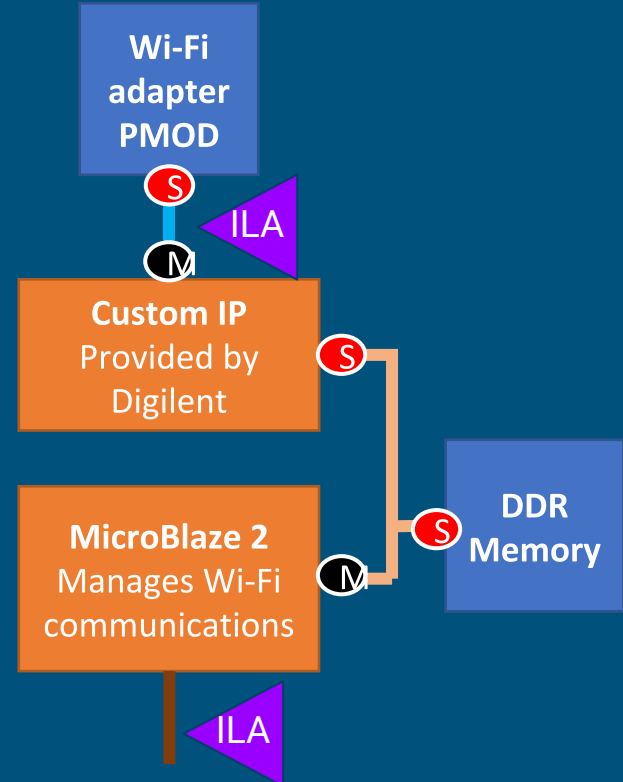
# System Block Diagram



# Testing

## Wi-Fi PMOD + Microblaze 2 wireless access point

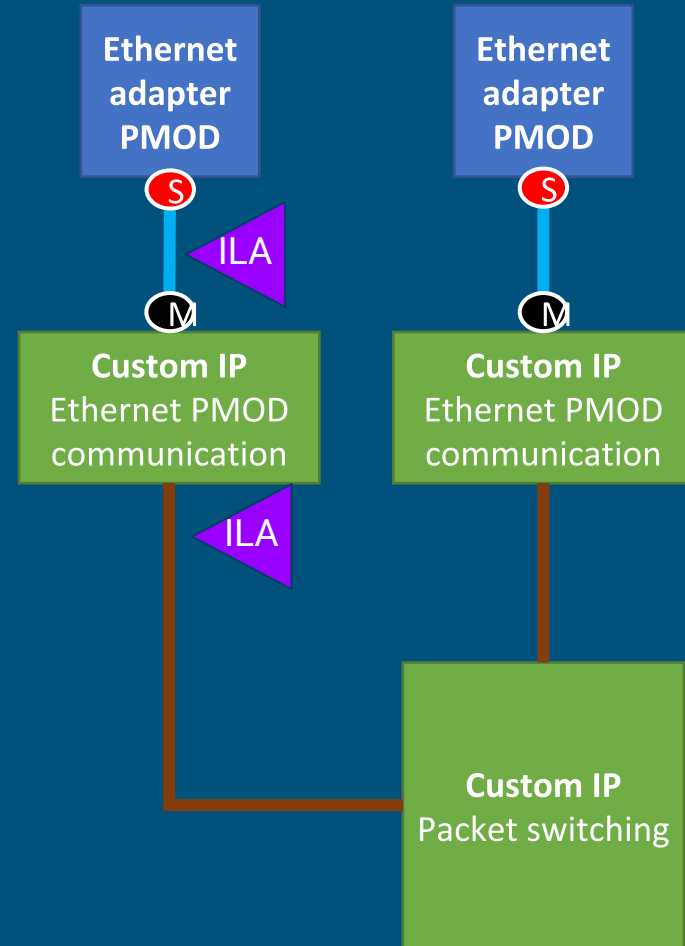
- ILAs at pins of Wi-Fi PMOD and SPI interface from Microblaze to the Packet Switching IP
- Wireshark on PC connected to the wireless access point
- Can test the communication from Wi-Fi PMOD to the Microblaze using the demo project



# Testing

## 2x Ethernet PMODs + Ethernet PMOD Communication IP + Packet Switching IP

- Simulate packets and track the data as it transitions from source input buffer to destination output buffer for Packet Switching IP
- Information about packet loss and traffic related information stored in AXI slave registers for Microblaze 1
- ILAs added for both interfaces of Ethernet PMOD Communication IP + Wireshark for connected devices

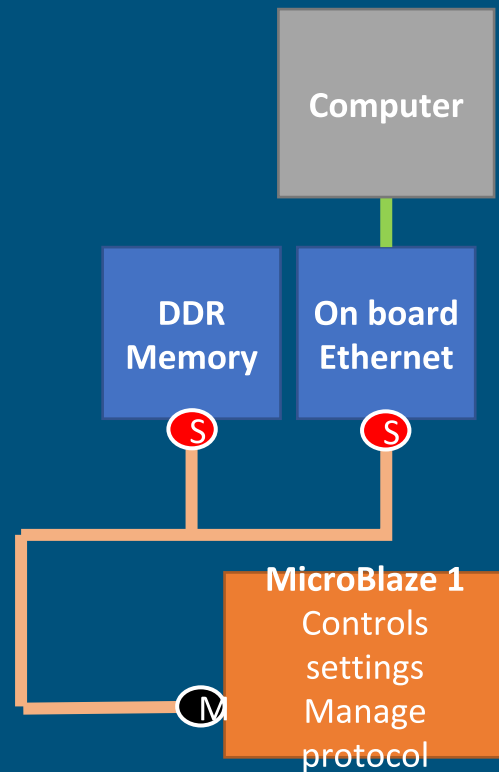




# Testing

## Ethernet + Microblaze 1 for configuration

- The project demo already incorporates most of this functionality (minimal testing needed)



# Milestones (up to 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)**

## 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**

## Packet Switching IP

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

**Showcase:**  
**Switching of packets**

# Milestones (up to Final Demo)

## Ethernet PMOD (cont.)

- Establish communication through sending commands

## Remote Access

- Program Microblaze to receive and interpret messages
- Add capability of enabling/disabling ports in the Packet Switching IP

## System Integration

- Integrate Wi-fi PMODs with Packet Switching IP
- Integrate Ethernet PMODs with Packet Switching IP
- Final integration and system-level debugging

**Final Demo: Everything working! (ideally...)**

# Risks

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- Unable to establish Ethernet PMOD communications
  - **Mitigation:** Work with the PMODs early on to identify issues quicker
  - **Backup Plan:** Use Bluetooth PMODs
- All components/IPs may not fit on the Nexys DDR Board
  - **Mitigation:** Can customize Microblaze to remove features, saving space
  - **Backup Plan:** Limit the number of PMODs used in the network switch

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**ANY QUESTIONS?**