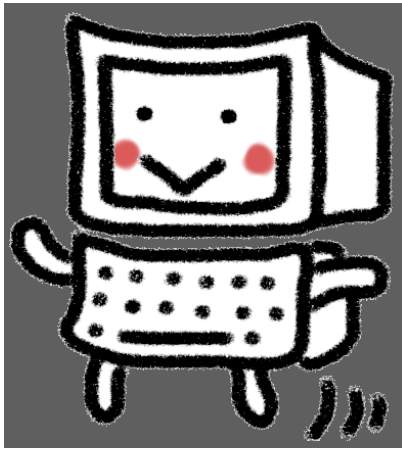

Project 7

Proxy ARP

Date: 2019/05/23 (Thu.)

Deadline: 2019/06/06 (Thu.)

Outline

- About ARP
- Proxy ARP
- Project 7 Requirements
- Hints

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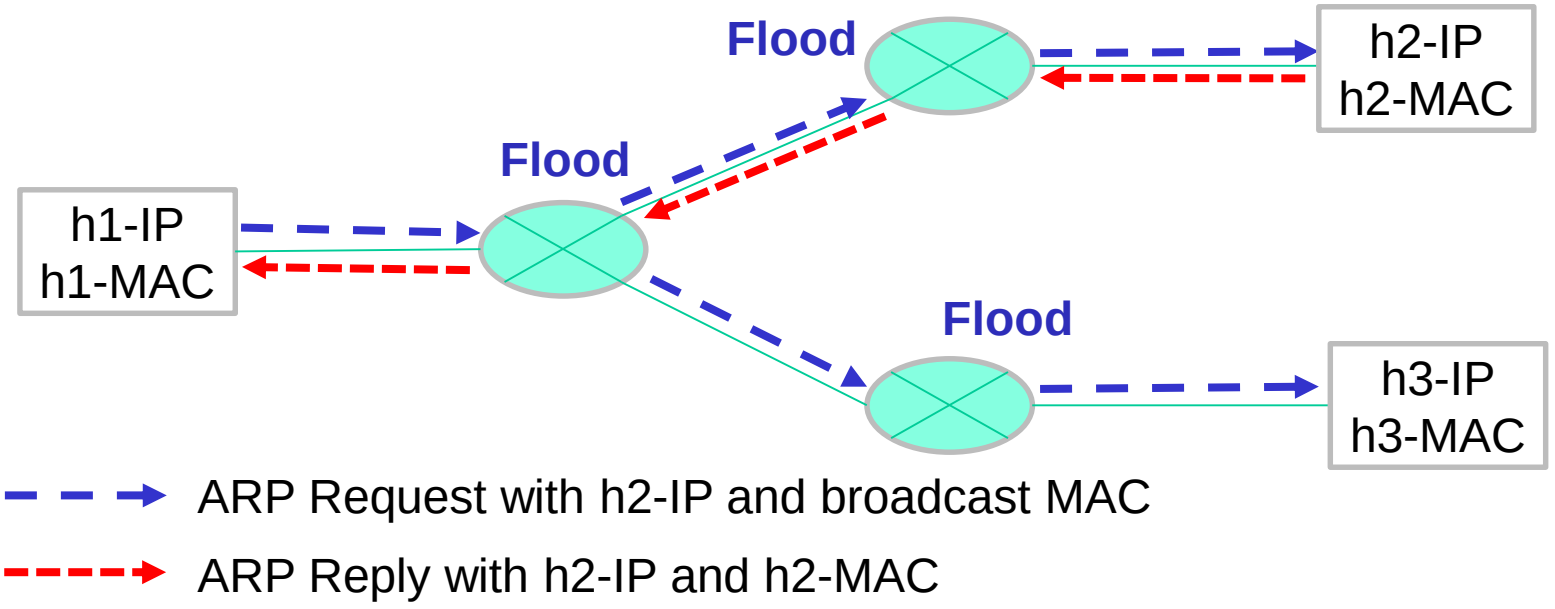
Address Resolution Protocol (ARP)

- To discover Link Layer address (e.g. MAC) with the given Network Layer address (e.g. IPv4)
- Flooding is used by ARP to discover devices
  - Destination Ethernet address of ARP Request is broadcast address
- Hosts maintain a ARP table for mapping of IPv4 to MAC address



ARP Request Packet Frame

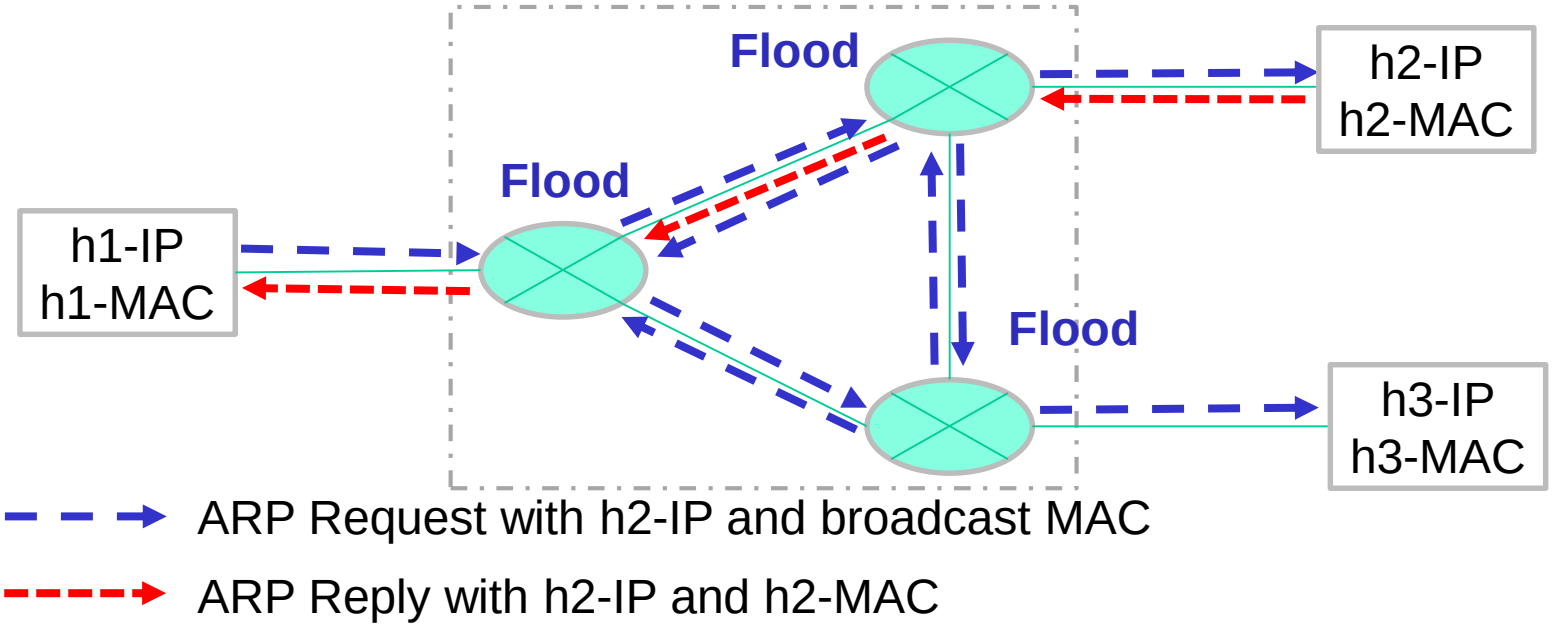
Hardware Type (Ethernet = 0x0001)		Protocol Type (IPv4 = 0x0800)
Hardware Length (for Ethernet = 6)	Protocol Length (for IPv4 = 4)	OP Code (ARP request = 1)
Sender Hardware Address		
Sender Protocol Address		
Target Hardware Address (FF:FF:FF:FF:FF:FF)		
Target Protocol Address		

ARP Reply Packet Frame

Hardware Type (Ethernet = 0x0001)		Protocol Type (IPv4 = 0x0800)
Hardware Length (for Ethernet = 6)	Protocol Length (for IPv4 = 4)	OP Code (ARP reply = 2)
Sender Hardware Address		
Sender Protocol Address		
Target Hardware Address		
Target Protocol Address		

Broadcast Storm Issue

- If a loop exists in the topology
  - ARP requests would be **repeatedly** broadcast!



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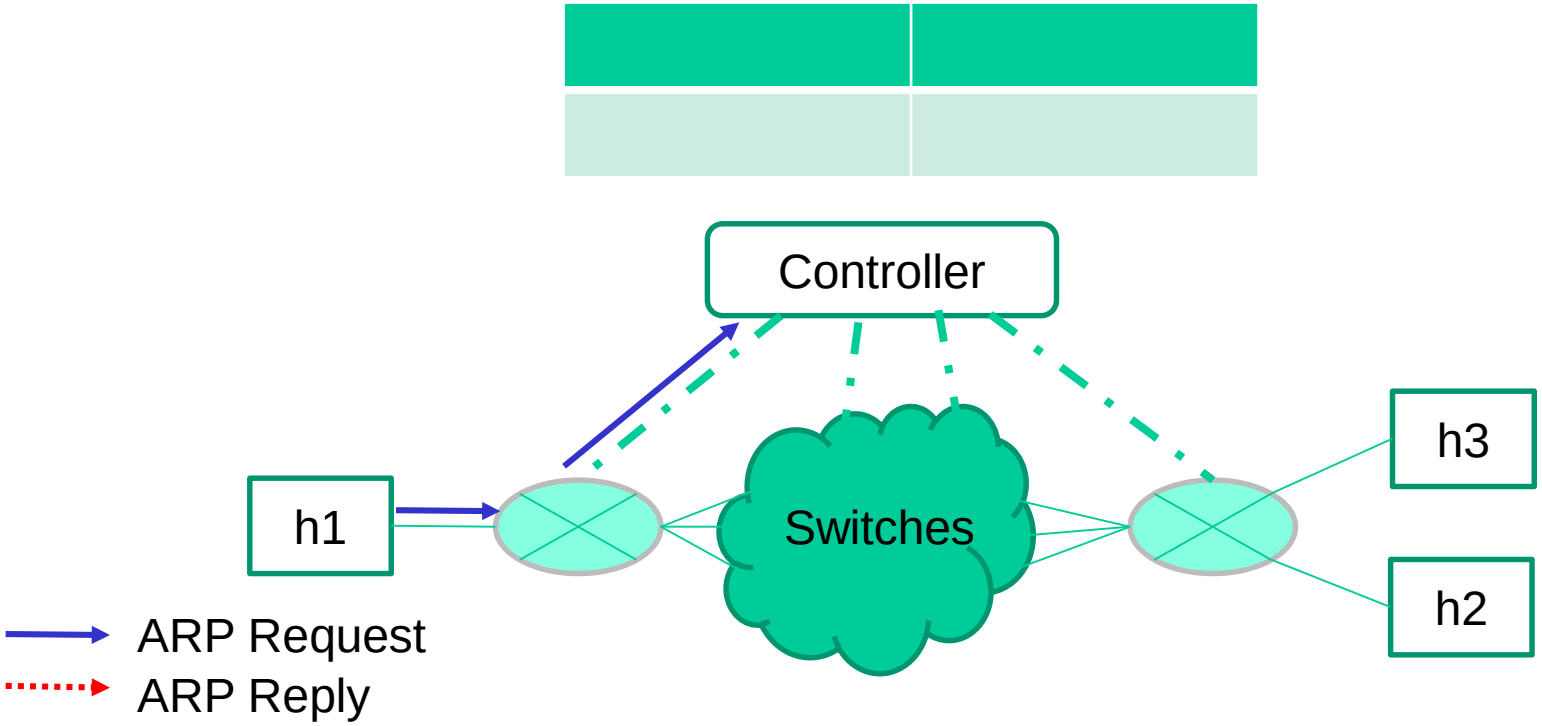
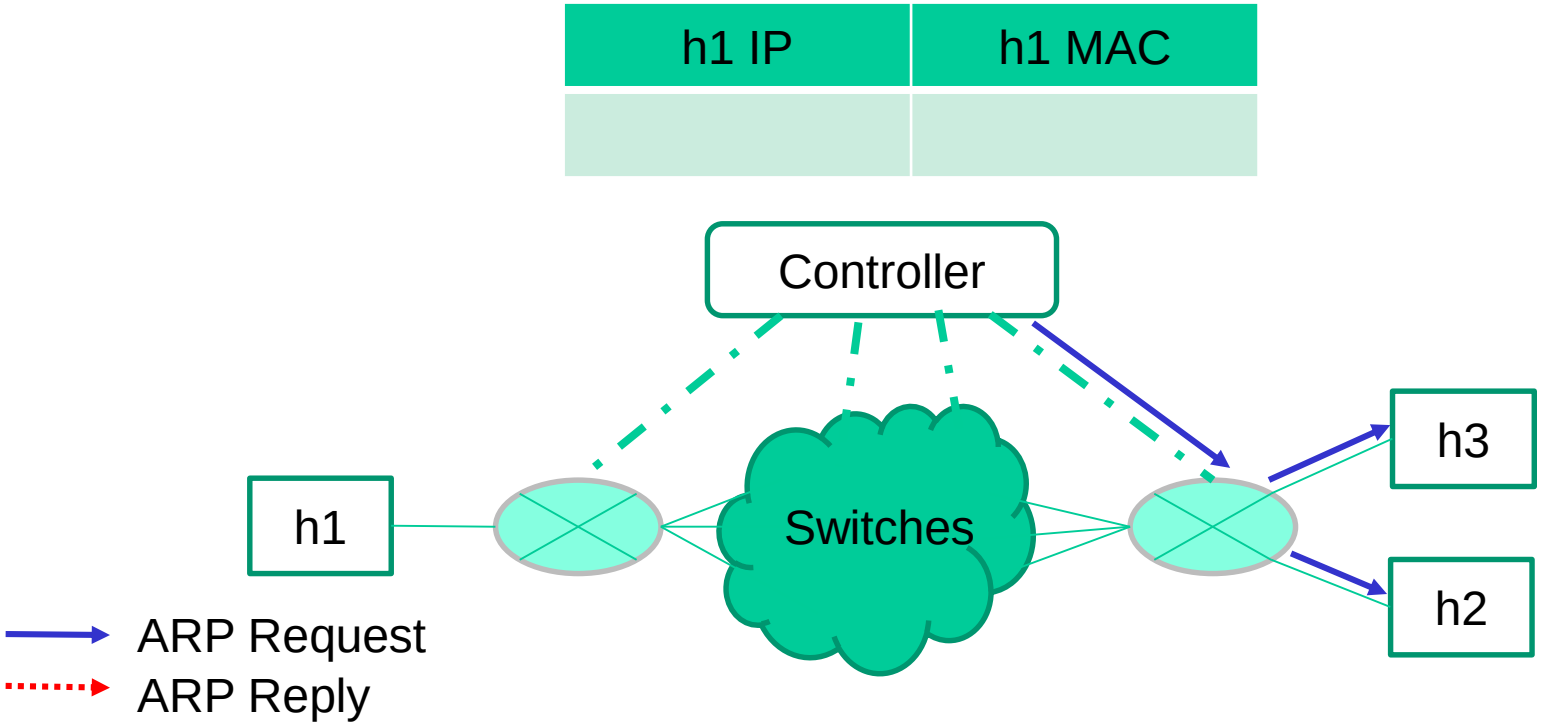
Proxy ARP (1)

- h1 sends ARP Request to get MAC address of h2 with h2's IP
  - The very first switch sends Packet-In to controller since no matching flow rule is installed



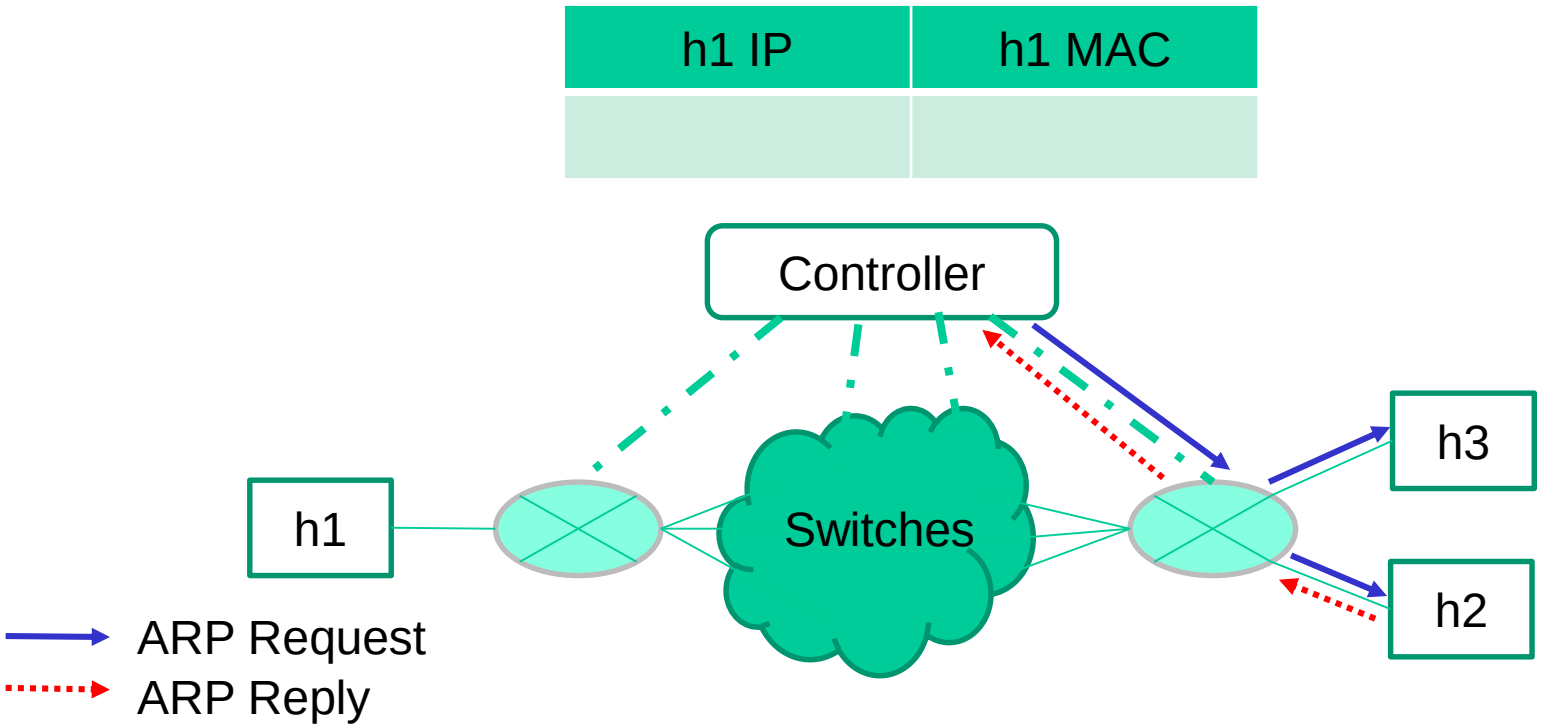
Proxy ARP (2)

- Controller may not know which host uses the IP
  - Controller sends Packet-Out to all edge ports
- Controller learns mapping of IP to MAC address of h1



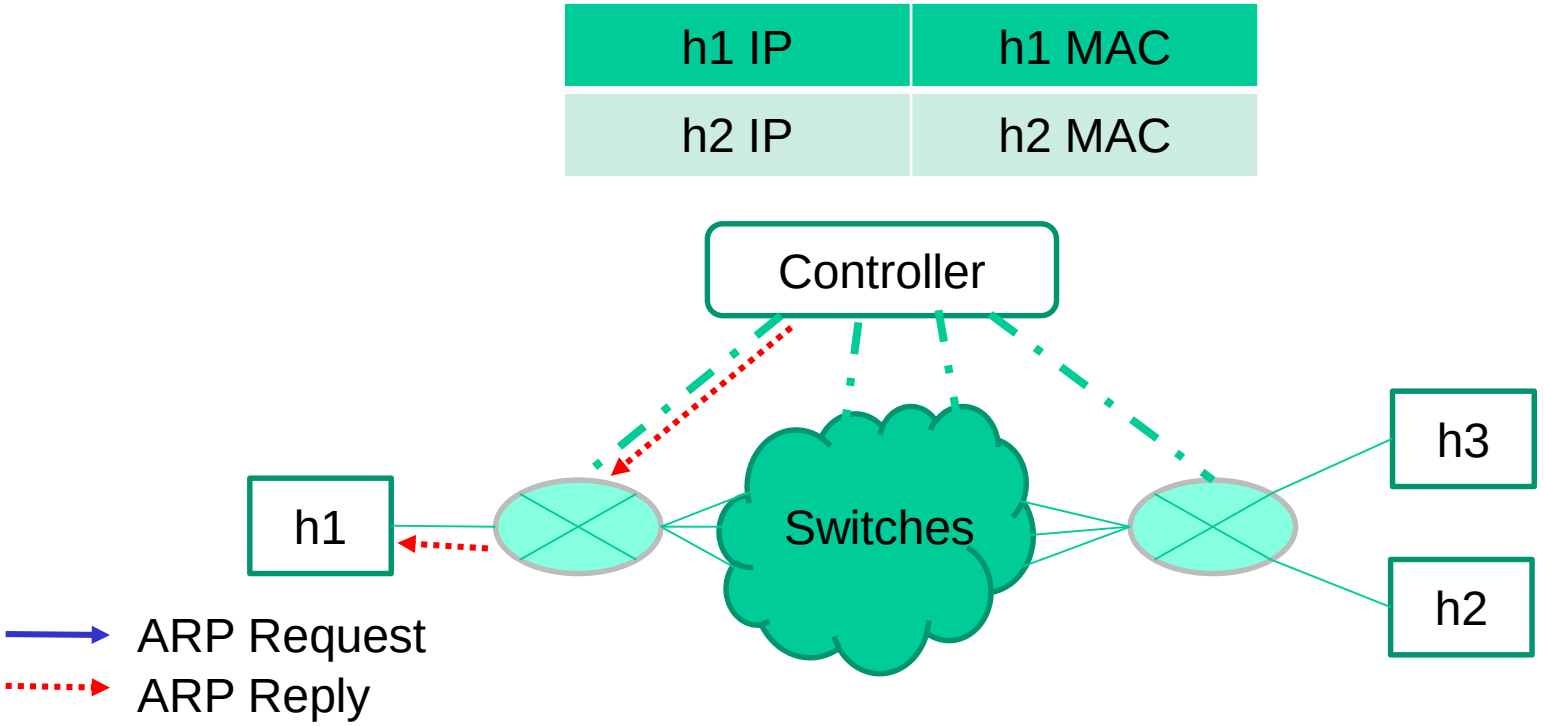
Proxy ARP (3)

- h2 and h3 receive ARP Requests
  - h2 will sends ARP Reply but h3 won't
- Again, the very first switch sends Packet-In because of no matching flow rule



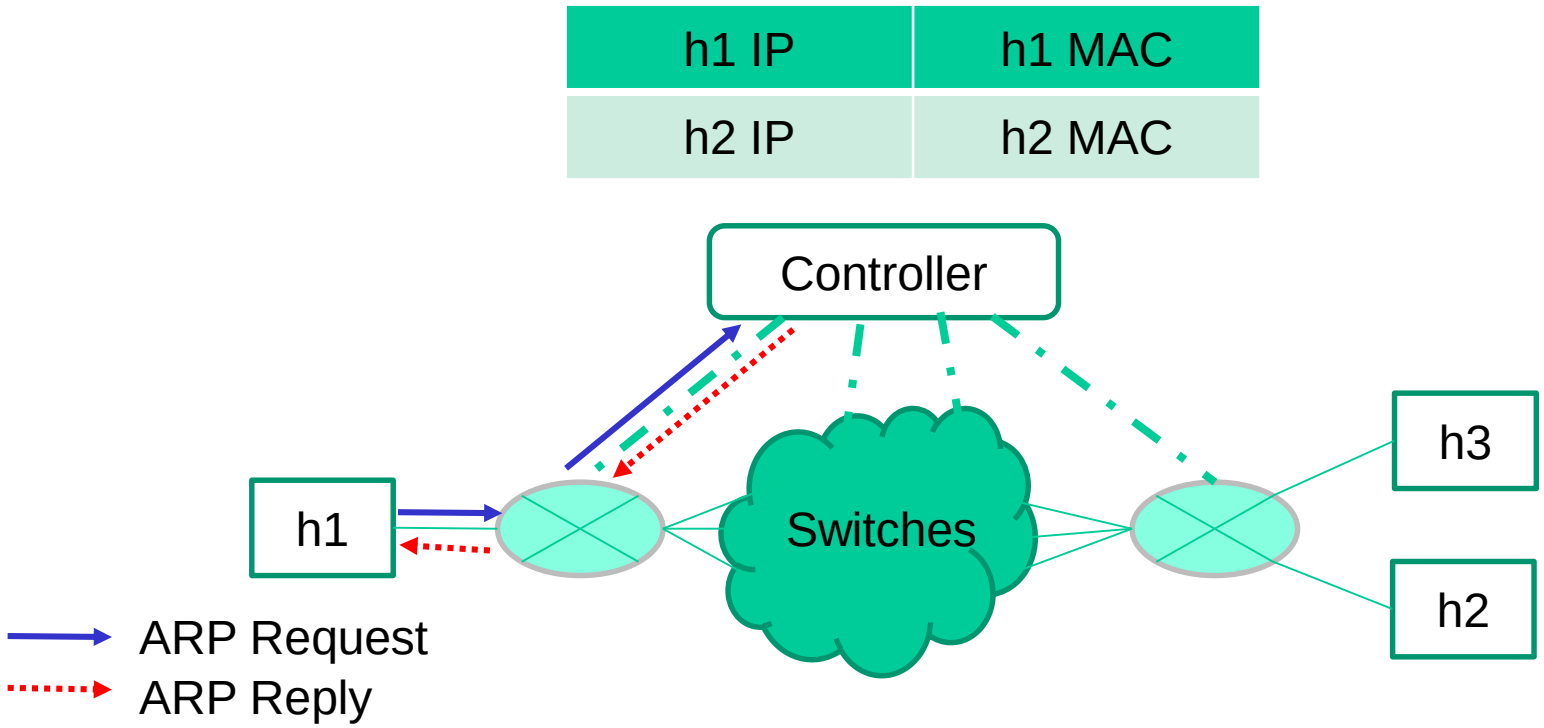
Proxy ARP (4)

- Controller learns mapping of requested IP to MAC address of h2
- Controller sends Packet-Out of ARP reply to the switch connected to h1



Proxy ARP (5)

- If h1 sends ARP request with the same IP again
  - Since controller has learned the mapping of the IP, it just sends Packet-Out to the switch with ARP Reply



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Project 7 Requirements

- In this project, you need to implement a Proxy ARP application
  - No flow rule should be installed
  - If mapping of requested IP to MAC address has already been learned
    - Send Packet-Out of ARP Reply directly
  - If no mapping is found
    - Flood ARP request to all edge ports
  - You should not activate other ARP or forwarding applications in the controller

Test Your Application

- Once your application and Mininet are activated, execute this command in Mininet to check ARP functionality
  - `mininet> h1 arping h2`

Submit to e3

- Files
  - All files of your application
- Submit
  - Upload “.zip” file to e3
    - Named: **project7_studentID.zip**
  - Wrong file name or format would not be scored

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Hints for Ryu

- To use the built-in functions of Ryu controller, run your application with extra argument
  - `ryu-manager myapp.py --observe-links`
- Some useful API can help you find edge ports or hosts easily
  - https://github.com/osrg/ryu/blob/master/ryu/topology/api.py
- You have to build packets with protocols such as ARP
  - https://github.com/osrg/ryu/tree/master/ryu/lib/packet
  - https://github.com/osrg/ryu/blob/master/ryu/lib/packet/packet.py

Hints for ONOS

- ONOS consists of bunch of powerful services
  - http://api.onosproject.org/1.15.0/apidocs/index.html?org/onosproject/net/host/HostService.html
  - http://api.onosproject.org/1.15.0/apidocs/index.html?org/onosproject/net/link/LinkService.html
- You have to build packets with protocols such as ARP
  - http://api.onosproject.org/1.15.0/apidocs/org/onlab/packet/Ethernet.html
  - http://api.onosproject.org/1.15.0/apidocs/org/onlab/packet/ARP.html