Project 2 - IP Forwarding
Example: Sending to CNN
Basic Steps

1. Host A must learn the IP address of B via DNS
2. Host A uses gateway R to reach external hosts
3. Router R forwards IP packet to outgoing interface
4. Router R learns B’s MAC address and forwards frame
Host A Learns B’s IP Address

• Host A does a DNS query to learn B’s address
  • Suppose gethostbyname() returns 222.222.222.222

• Host A constructs an IP packet to send to B
  • Source 111.111.111.111, dest 222.222.222.222
Host A Learns B’s IP Address

- **IP packet**
  - From A: 111.111.111.111
  - To B: 222.222.222.222

- **Ethernet frame**
  - From A: 74-29-9C-E8-FF-55
  - To gateway: ????

![Diagram showing IP and Ethernet frames]
A Decides to Send Through R

- Host A has a gateway router R
  - Used to reach dests outside of 111.111.111.0/24
  - Address 111.111.111.110 for R learned via DHCP
- But, what is the MAC address of the gateway?
A Sends Packet Through R

- Host A learns the MAC address of R’s interface
  - ARP request: broadcast request for 111.111.111.110
  - ARP response: R responds with E6-E9-00-17-BB-4B
- Host A encapsulates the packet and sends to R
A Sends Packet Through R

- IP packet
  - From A: 111.111.111.111
  - To B: 222.222.222.222

- Ethernet frame
  - From A: 74-29-9C-E8-FF-55
  - To R: E6-E9-00-17-BB-4B
**R Looks up Next Hop**

- Router $R$’s adapter receives the packet
  - $R$ extracts the IP packet destined to 222.222.222.222
- Router $R$ consults its forwarding table
  - Packet matches 222.222.222.0/24 via other interface
R Wants to Forward Packet

- **IP packet**
  - From A: 111.111.111.111
  - To B: 222.222.222.222

- **Ethernet frame**
  - From R: 1A-23-F9-CD-06-9B
  - To B: ???
R Sends Packet to B

• Router R’s learns the MAC address of host B
  • ARP request: broadcast request for 222.222.222.222
  • ARP response: B responds with 49-BD-D2-C7-56-2A

• Router R encapsulates the packet and sends to B
R Wants to Forward Packet

- **IP packet**
  - From A: 111.111.111.111
  - To B: 222.222.222.222

- **Ethernet frame**
  - From R: 1A-23-F9-CD-06-9B
  - To B: 49-BD-D2-C7-56-2A