EECS 489 - Winter 2024

Discussion 10

Assignment 4 is out!

- **Due: Tuesday, April 23rd @ 11:59 pm EDT**
  - Last Day of Classes
- You can use your remaining late days
- Autograder will be up soon

Today

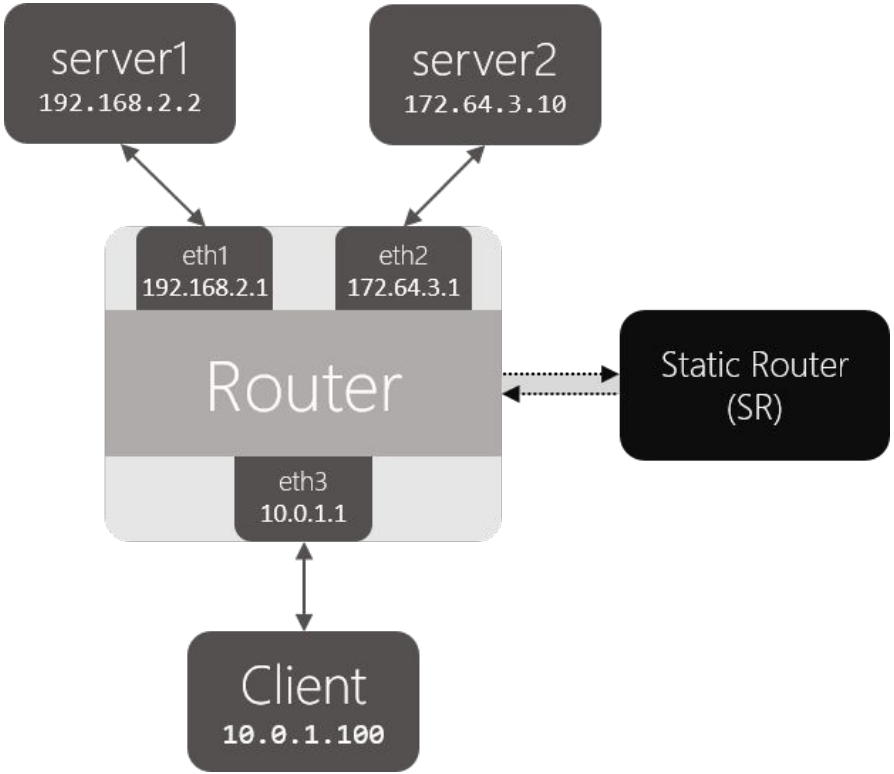
- Assignment 4
  - Environment
  - Static Router Flow Chart
- ICMP
- Traceroute

Assignment 4

- You will be building a static router! (Not simulating one, actually designing one)
- This will be able to handle raw Ethernet frames, as well as perform ARP when needed.
- Spec

Assignment 4: Environment

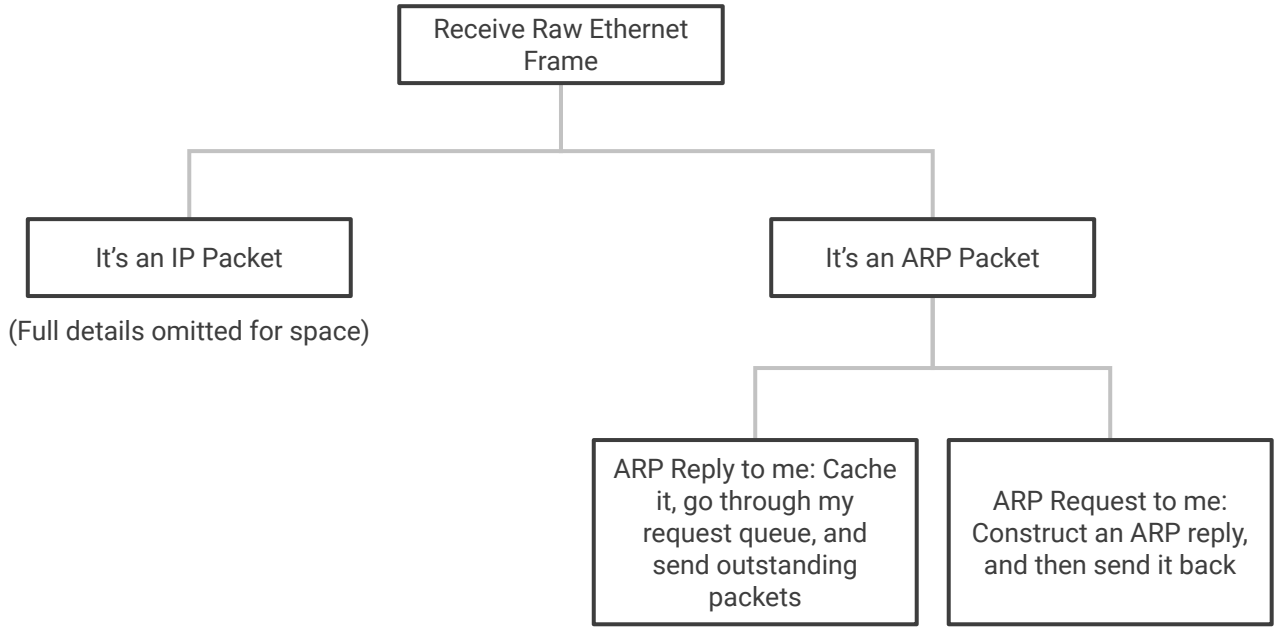
- The **Router** is a software-defined switch/router
  - It is controlled by an external controller (POX)
- The **Static Router (SR)** will talk to POX to control the **Router**



Assignment 4: Static Router Flow Chart (Handling ARP)

- When we receive a raw Ethernet Frame…
  - If it’s an ARP packet…
    - ARP reply to me:
      - Cache it
      - Go through request queue
      - Send outstanding packets
    - ARP request to me:
      - Construct an ARP reply and send it back

Assignment 4: Static Router Flow Chart (Handling ARP)



Assignment 4: Static Router Flow Chart (Handling IP)

- When we receive a raw Ethernet Frame…
  - If it’s an IP packet…
    - For me!
      - If it’s an ICMP echo request
        - Send the echo reply
      - If it’s TCP/UDP
        - Send ICMP unreachable

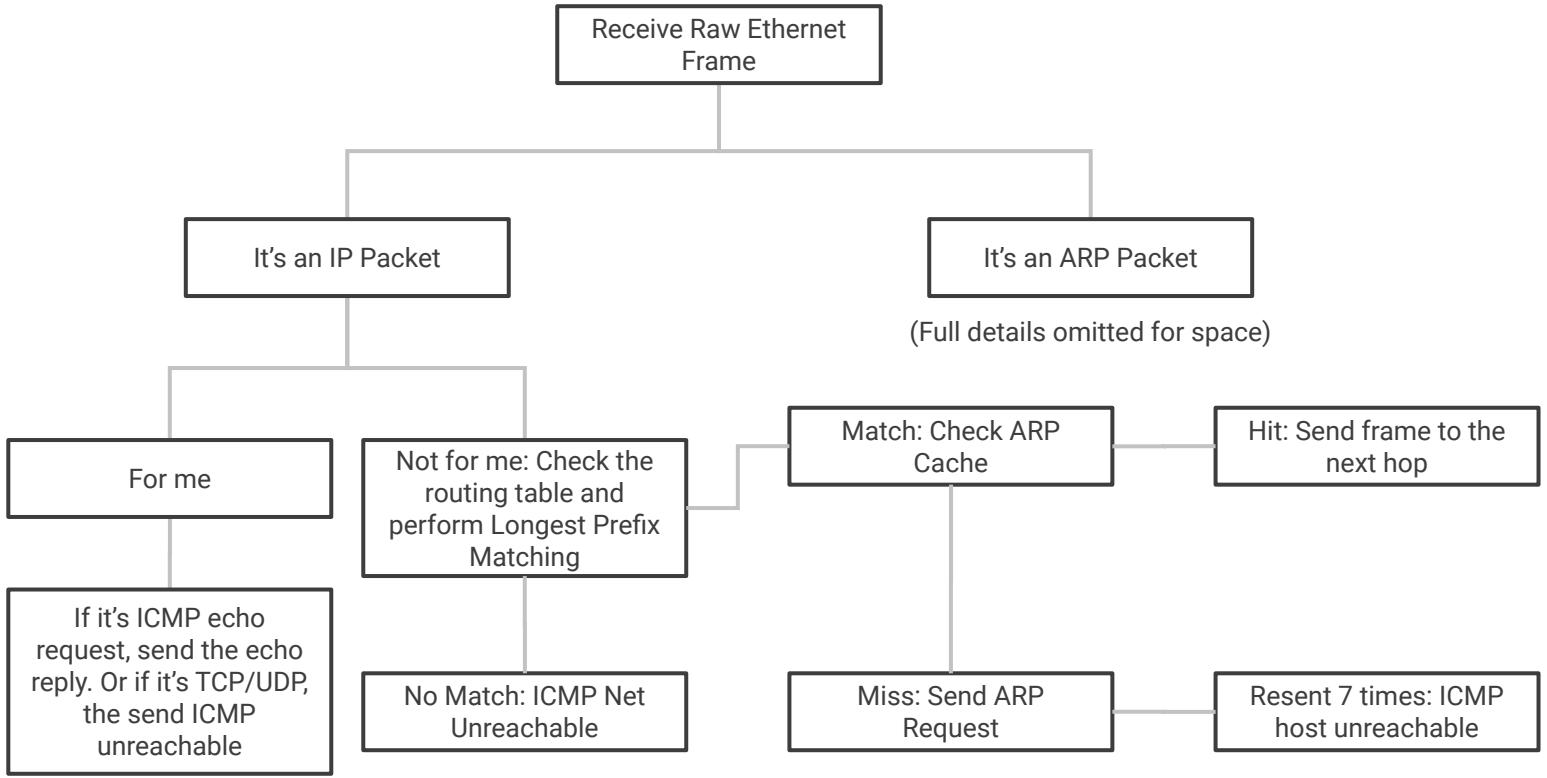
Assignment 4: Static Router Flow Chart (Handling IP)

- When we receive a raw Ethernet Frame…
  - If it’s an IP packet…
    - Not for me!
      - Check Routing Table, perform Least Prefix Matching
        - If no match: ICMP Net is unreachable!

Assignment 4: Static Router Flow Chart (Handling IP)

- When we receive a raw Ethernet Frame…
  - If it's an IP packet…
    - Not for me!
      - Check Routing Table, do Least Prefix Matching
        - If match:
          - Check the ARP Cache
            - If a miss: Send ARP Request
              - If resent **7** times, ICMP host unreachable
            - If a hit: Send the frame to the next hop!

Assignment 4: Static Router Flow Chart (Handling IP)



Assignment 4: Tips

- Make sure to use htonl, htons, ntohl, and ntohs when appropriate
- There are debug functions setup in sr_utils.c
  - `print_hdrs()`, `print_addr_ip_int()`, etc.
- Test your static router (sr) with ping, traceroute, wget, etc.
- Wireshark is your friend! Use it to analyze output

ICMP Messages

Type	Code	Description
0	0	echo reply (ping)
3	0	dest network unreachable
3	1	dest host unreachable
3	2	dest protocol unreachable
3	3	dest port unreachable
3	4	frag needed but DF set
3	6	dest network unknown
3	7	dest host unknown
8	0	echo request (ping)
9	0	route advertisement
10	0	router discovery
11	0	TTL expired
12	0	bad IP header

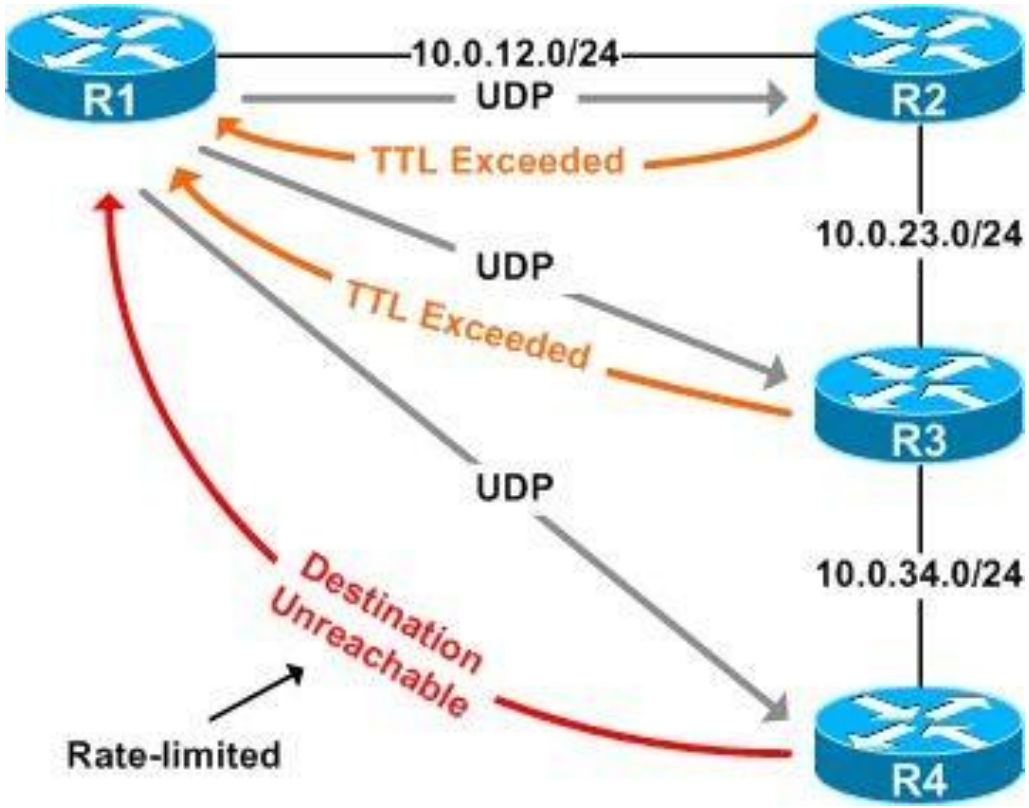
ICMP Common Usage

- Echo Reply (0) and Echo Request (8)
  - This is ping
- Destination Unreachable (3)
- Time Exceeded (11):
  - It is used to send an error to the sending system when the IP TTL has been exceeded.

traceroute

- Source sends a series of UDP packets:
  - First 3 packets have TTL set to 1
  - Next 3 packets have TTL set to 2, and so on.

traceroute


R1
10.0.12.0/24
UDP
R2
TTL Exceeded
10.0.23.0/24
UDP
TTL Exceeded
R3
UDP
10.0.34.0/24
Destination
Unreachable
Rate-limited
R4

Wrap-Up

- Thanks for coming!
- Take a look at the spec for Assignment 4 soon!
  - Announcement for Autograder will be out soon