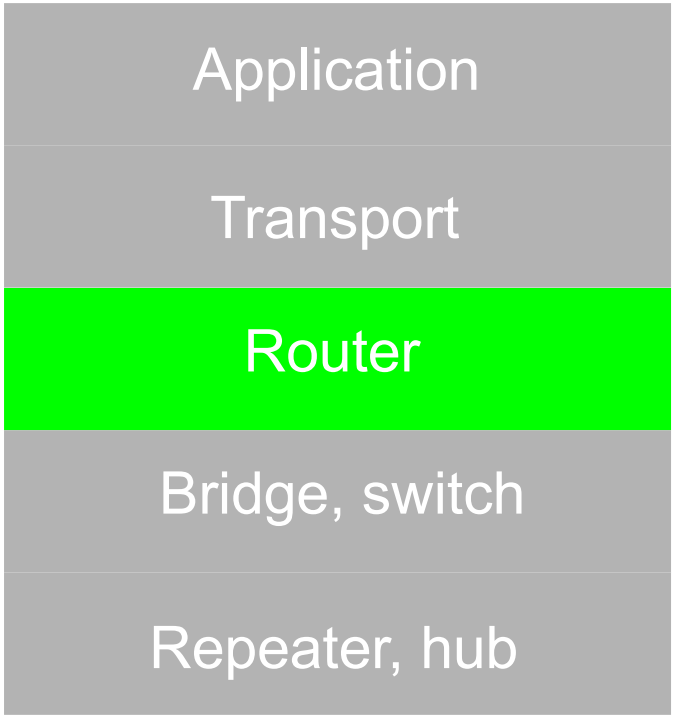
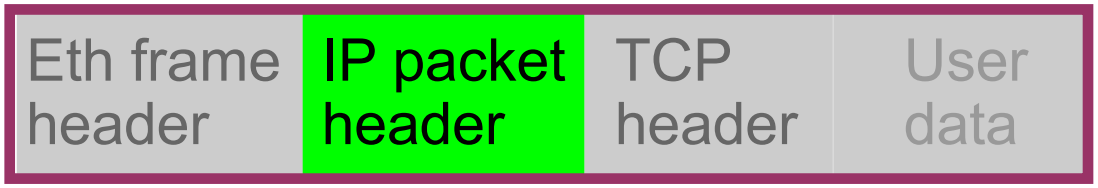
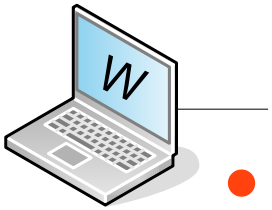
Unit 2: IP Layer

- Network layer: end-to-end multi-hop forwarding of IP packets across networks interconnected by routers

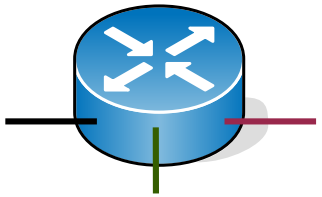




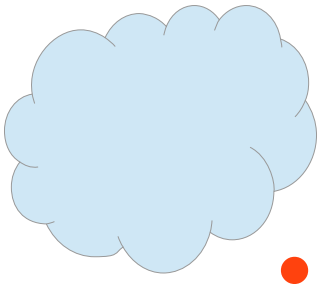
Devices



- Host: layers 1-7, operating system + apps
  - e.g. Wi-Fi, Linux OS, Firefox + DNS



- Router: L1-3, receive and send frames, forward IP packets, participate in routing
  - e.g. Fibre router: Wi-Fi, Ethernet, optical link
  - IP packets (data), ICMP packets (control)



- Network addressing: network, subnet, hosts
  - n..n s..s h..h /N+S: 2^H-2 IP addresses for r*+h*
  - 32=N+S+H, 2^S subnets 0..0 – 1..1
- Routing table:
  - Multiple entries, longest prefix match first
  - Direct * or indirect *gateway*

IP features

- TTL-- every hop
- Class: A: 0..127, B: 128..191, C: 192..223, D: 224..
- Private: 10/8, 172.16..172.31/16,
  192.168.1..192.168.255/24
- Control: ICMP, an IP packet
- Fragmentation (MTU)
- Mappings: IP to MAC: ARP, MAC to IP++: DHCP
- Routing:
  - Distance-vector/Bellman-Ford (RIP)
  - Link-state/Dijkstra (OSPF)
- Middleboxes: firewalls (filters), NAT (translation), VPN tunneling (IPinIP)

Exercises

- Problems: 1, 2, 4a, 5a,b,c
- 2017t-c1: office network with two locations, several hosts per network with different sizes + web server...
- 2018p-c1: schools: network allocation + ripv2 split horizon + link failures
- 2019t-c1 p1: IP classic + IPnIP + fragmentation
- 2020t-c1 p1: UPCLink VPN, routes, tunnel
- 2019p-c1: complex IP network
- 2018t-c1: IP net with DHCP + Ping with messages + routing + 2: ACL
- 2018t-f: Firewall