ECE453 – Introduction to Computer Networks

Lecture 17 – Top – Down Approach (A Review)

From the moment you type in an http link in a web browser until you get the required webpage displayed in the browser, what has exactly happened?

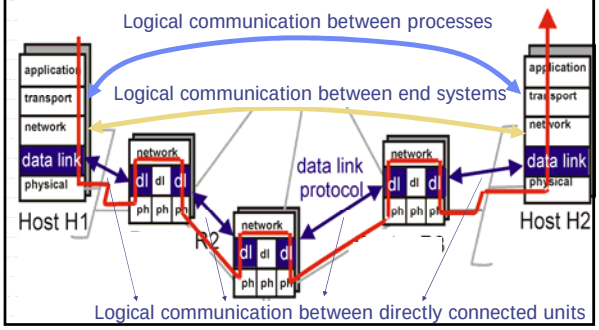
- Application
  - Client
  - Server
  - Protocol
- Transport layer
  - Set up a connection
    - Socket programming
  - Reliable data transfer
  - Congestion control
  - Flow control
- Network layer
  - Routing
  - Addressing
- Link layer
  - Error detection
  - Error correction
  - Multiple access (MAC)
  - Addressing
- Physical layer

```
GET /somedir/page.html HTTP/1.0
User-agent: Mozilla/4.0
Accept: text/html,image/gif,image/jpeg
Accept-language:fr

(extra carriage return, line feed)
```

message

Physical vs. Logical Communication



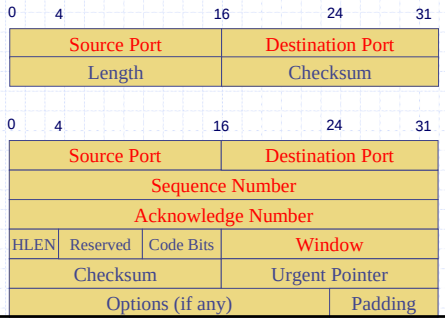
Application Layer

- Application
  - Client
  - Server
  - Protocol
  - DNS
    - Aliasing vs. load distribution
  - Email
    - SMTP vs. POP3 vs. IMAP vs. HTTP
  - Web
  - File transfer
    - Two connection flows
  - Application protocols
    - Push vs. pull
    - State vs. stateless
    - Persistent vs. non-persistent
    - Port number
    - Service model used
- Socket Programming
  - Difference in UDP and TCP socket programming
  - Byte order
  - What does “accept()” do?
  - What does “listen()” do?
  - What does “socket()” do?
  - What does “connect()” do?

Transport Layer Services

- Multiplexing/demultiplexing
- Error detection (checksum)
- Compose/decompose
- Reliable data transfer
  - Stop and wait
  - Sliding window
    - Go back N
    - Selective repeat
- Flow control
  - Receiver’s window vs. receiver’s buffer
- Congestion control
  - Slow start and AIMD
- Connection management
  - Three-way handshaking
    - Message exchange detail
  - Connection termination
    - Message exchange detail

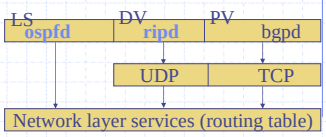
TCP Header



The Network Layer

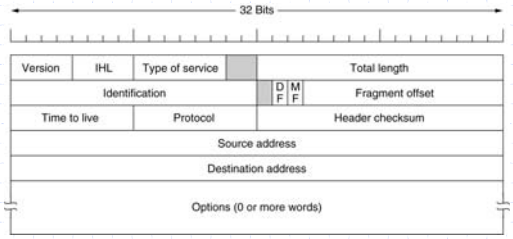
- Routing
- IP protocols
  - Addressing
    - Hierarchical addressing (5 classes)
    - Classless addressing (CIDR)
    - DHCP
    - NAT
    - IPv6
- Fragmentation
- Error monitoring
  - ICMP

Routing



- Static routing
- Dynamic routing
  - Centralized routing
    - Link state
    - The oscillation problem
  - Decentralized routing
    - Distance vector
    - Count to infinity problem
    - Good news vs. bad news
- Internet routing
  - Hierarchical routing (what is AS? Why hierarchical routing?)
  - Intra-domain routing
    - OSPF, RIP
  - Inter-domain routing
    - BGP

IP Header



Link Layer and MAC Layer Summary

- Link layer services
  - Flow control
  - RDT
  - Error detection
    - CRC
  - Error correction
    - Hamming distance and Hamming code
- Link layer addressing
  - ARP
- Specific link layer technologies:
  - PPP
  - Ethernet
    - Special features (CSMA/CD, encoding)
  - IEEE 802.11 LANs (CSMA/CA)
- Multiple access protocols (MAC)
  - ALOHA
  - Carrier sensing
    - 1-persistent
    - P-persistent
    - Non-persistent
    - CSMA/CD
  - Wireless LAN
- Link layer switching
  - Hubs
  - Bridges
  - Switches