



Application & Transport Layers

CompSys Network Recapitulation

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Overblik

Application Layer

- Client-server vs. Peer-to-Peer models.
- HTTP & DNS.

Transport Layer

- Circuit switching vs. Packet switching
- UDP vs. TCP.
- TCP flow control.
- TCP handshake.
- TCP congestion control.

Network Communication Model

Client-server

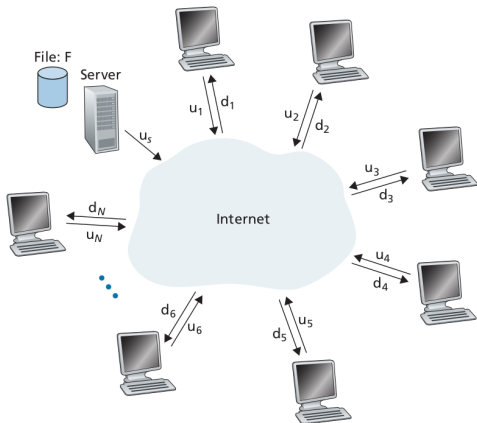
- Centraliseret netværk.
- Kommunikation er mellem en dedikeret server og en klient.
- Typisk få servere til mange klienter.
- Simpel implementation.

Peer-to-Peer

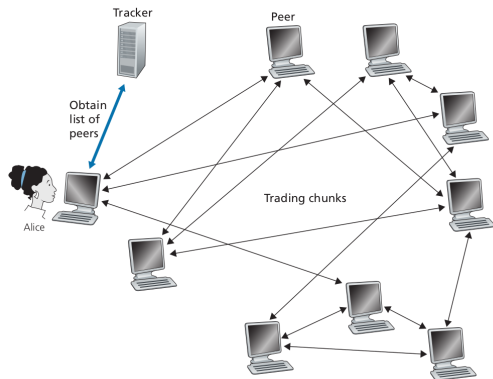
- Decentraliseret netværk.
- Alle på netværket kan agere server og klient samtidigt.
- Komplex implementation (tænk på de overvejelser I har gjort jer i A4).

Network Communication Models

Client-server



Peer-to-Peer



Application Layer Protocols

HTTP

- Stateless.
- Består af requests og responses.
- Typisk request:

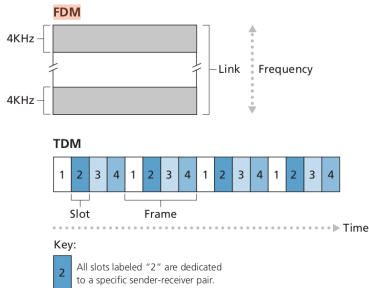
```
GET compSys/ HTTP/1.1
Host: absalon.ku.dk
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US; rv:1.9.1.5)
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Keep-Alive: 300
Connection: keep-alive
Pragma: no-cache
Cache-Control: no-cache
```

DNS

- Translation af ip-adresser, eg. `www.chat.openai.com` -> `13.107.246.54`.
- Foregår ved opslag i et DNS-server hierarki.
- Benyttes af andre application layer protokoller, eg. HTTP benytter sig af DNS.

Circuit switching vs. Packet switching

Circuit switching



Packet switching

- UDP, TCP.
- Et sendemedie er optaget den tid det tager at sende en pakke.

Figure 1.14 ♦ With **FDM**, each circuit continuously gets a fraction of the bandwidth. With TDM, each circuit gets all of the bandwidth periodically during brief intervals of time (that is, during slots)

TCP vs. UDP

UDP

- + Minimalistisk afsendelse.
- + Checksum til kontrol af data.
- Ingen garanti for om pakken når frem.
- Pakker modtages potentielt out-of-order.
- Hverken flow eller congestion control.

TCP

- Kræver 3-way handshake før data afsendes.
- + Sikrer modtagelse(*) af data i korrekt rækkefølge.
- + Flow control (overbelastning af modtager).
- + Congestion control (overbelastning af netværk).

UDP & TCP segments

UDP segment; 8 byte header

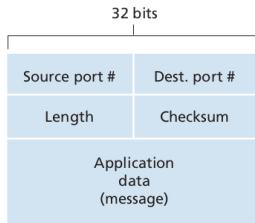


Figure 3.7 ♦ UDP segment structure

TCP segment; (mindst) 20 byte header

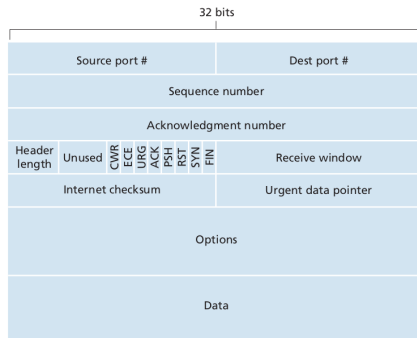


Figure 3.29 ♦ TCP segment structure

TCP-forbindelse

Initialisering (3-way handshake).

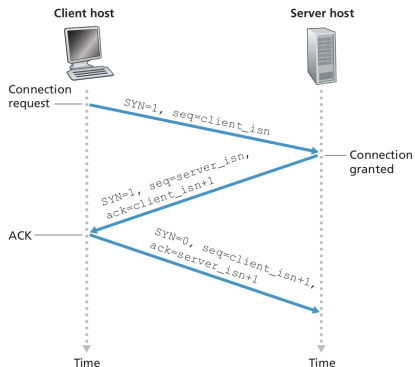


Figure 3.39 ♦ TCP three-way handshake: segment exchange

Terminering (4-way teardown).

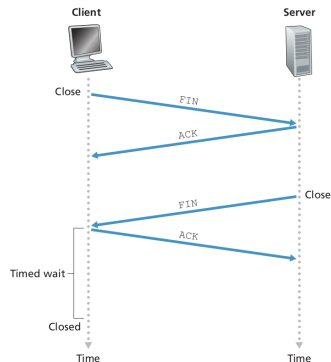


Figure 3.40 ♦ Closing a TCP connection

Flow control - Go-back-N vs. Selective Repeat

Fælles

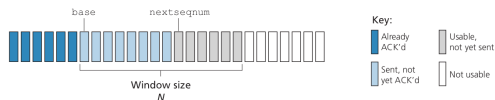
- Receive window/sending window

Go-back-N

- Pakker der ikke modtages i rækkefølge discards.
- Ved triple ACK starter afsender forfra ved angivne seq

Selective Repeat

- Buffer til out-of-order pakker.
- Ved triple ACK afsendes pakke angivet ved seq.
- Benyttes af TCP.



Congestion control

Congestion control stadier

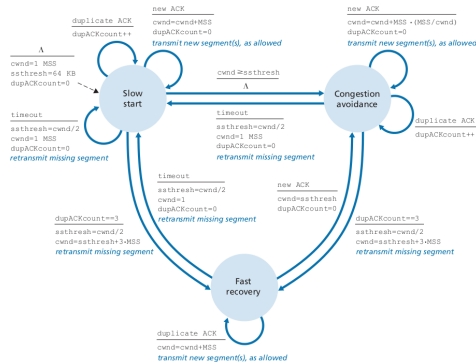


Figure 3.51 • FSM description of TCP congestion control

Udvikling af congestion window

