INF3190 - Data Communication

Summary (part 2)

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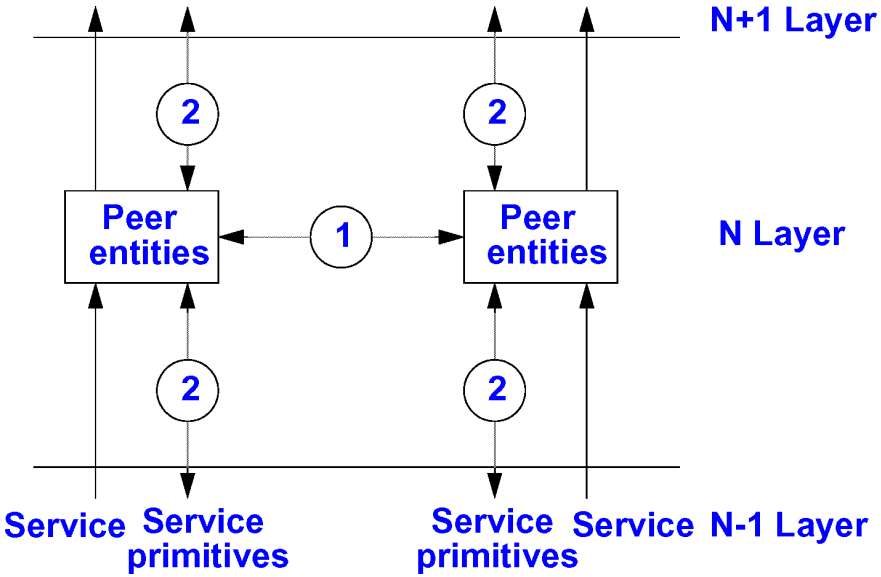
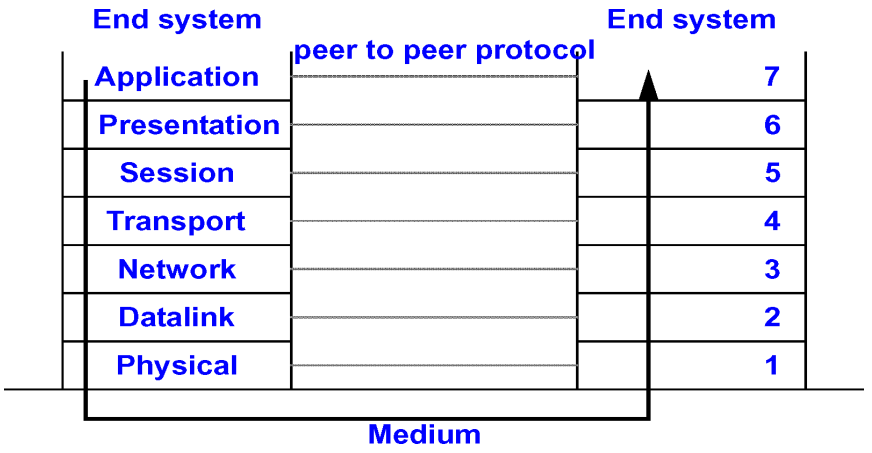
Basics

- Recap protocol terminology
  - several OSI terms are not introduced by Tanenbaum



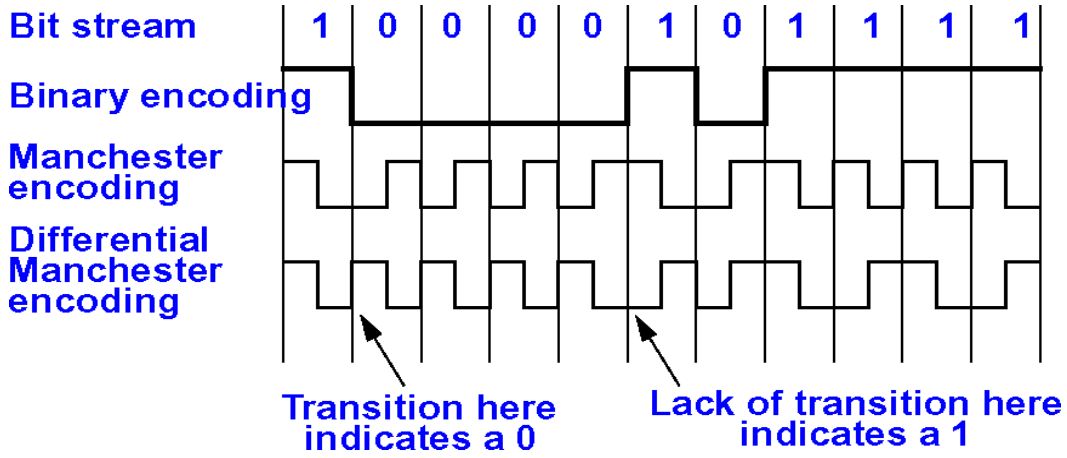
- Remember the functions of the OSI model
  - very brief in the book
  - but terminology persists and is used in unexpected contexts



Physical layer

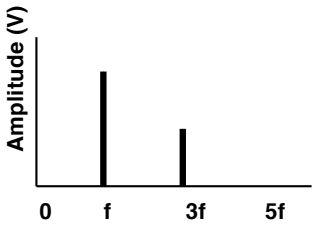
Baseband transmission schemes (very brief in Tanenbaum pp. 145)

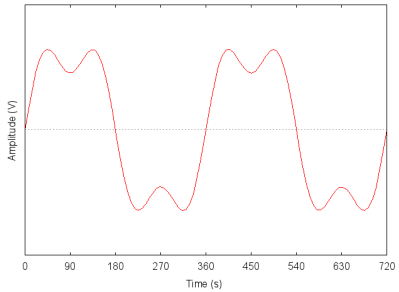
- presented
  - binary encoding / NRZ (non-return-to-zero)
  - NRZI
  - Manchester
  - Differential Manchester



Passband transmission (Tanenbaum pp. 110)

- definitions of bandwidth and wavelength
  - related, but only in a medium
- compositions of sinosoid signals can be described by Fourier series
- compositions can approximate digital signals
- bits vs. bauds
  - amplitude, frequency, phase





Physical layer

Capacity

- bitrate of a perfect channel (Nyquist's theorem)

$$C = 2 \times B \times \log_2 L \quad bit/second$$

- capacity of a noisy channel (Shannon's theorem)

$$C = B \; x \; log10(1 + SNR)$$

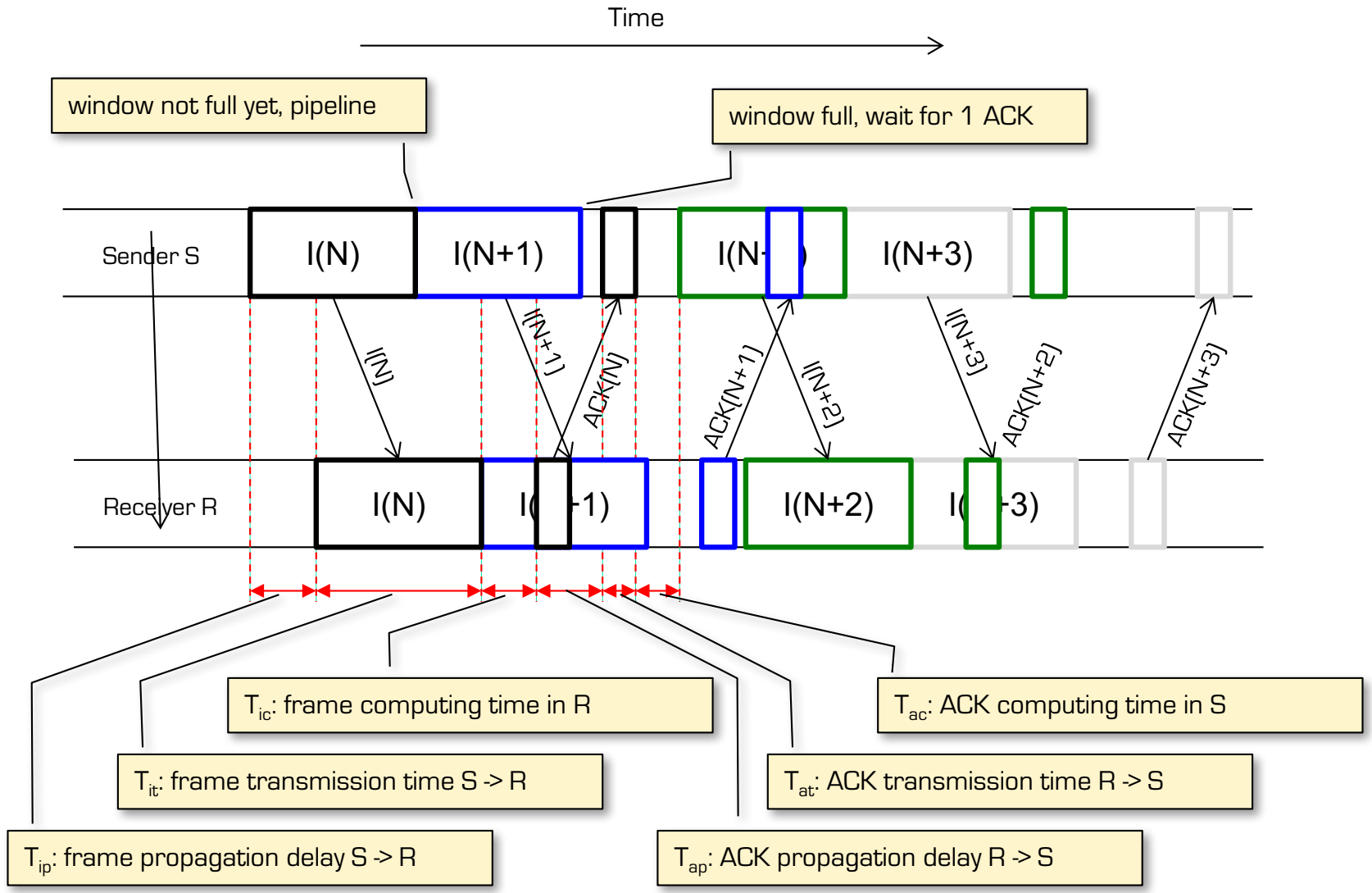
- reasons for noise
  - thermal noise, free electrons
  - impulse noise, e.g. from power lines, lightning
  - induced noise, e.g. from electric motors
  - crosstalk from other channels

In my opinion, physical layer is presented more clearly by *Behrouz Forouzan* in *Data Communications and Networking* (see course page)

Data Link Layer

Flow control (Tanenbaum pp. 235)

- Maximum link utilization is very brief in Tanenbaum



Data Link Layer

Flow control (Tanenbaum pp. 235)

- Maximum link utilization is very brief in Tanenbaum

Approximations:

$$T_{ip} = T_{ap}$$
$$T_{ic} = T_{ac} << T_{ip}$$
$$T_{at} << T_{it}$$

Windows size k leads to 2 cases:

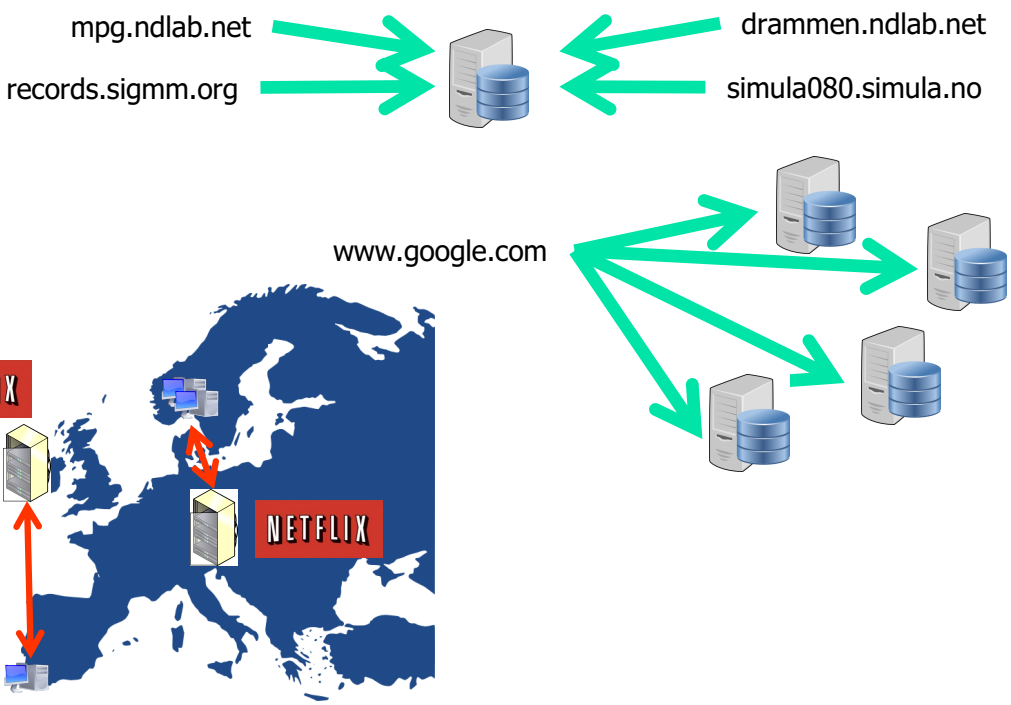
- if $kT_{it} < 2T_{ip}$: even in the best case, the sender must wait for an ACK the channel cannot be filled
- otherwise: the channel can be filled

$$U = \begin{cases} \dfrac{kT_{it}}{T_{it} + 2T_p} = \dfrac{k}{1 + 2\dfrac{T_{ip}}{T_{it}}} & \text{if } \left(k < 2\dfrac{T_{ip}}{T_{it}}\right) \\ 1 & \text{otherwise} \end{cases}$$

Application layer

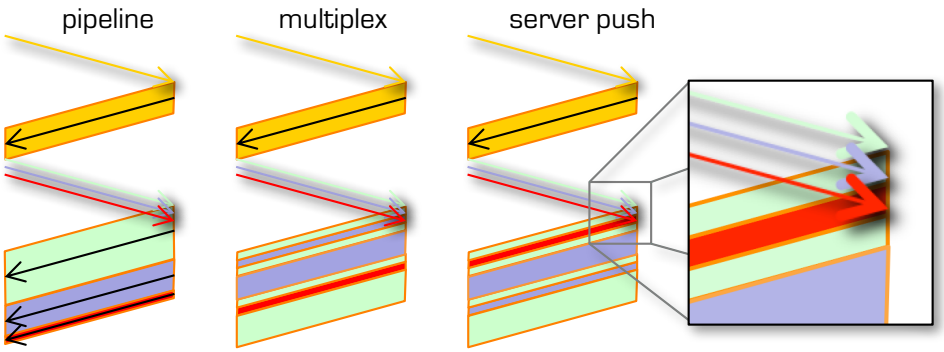
DNS (Tanenbaum pp. 629)

- recursive and iterative queries
- not in Tanenbaum
  - caching
  - aliasing
  - zoning and load balancing



HTTP (Tanenbaum pp. 664)

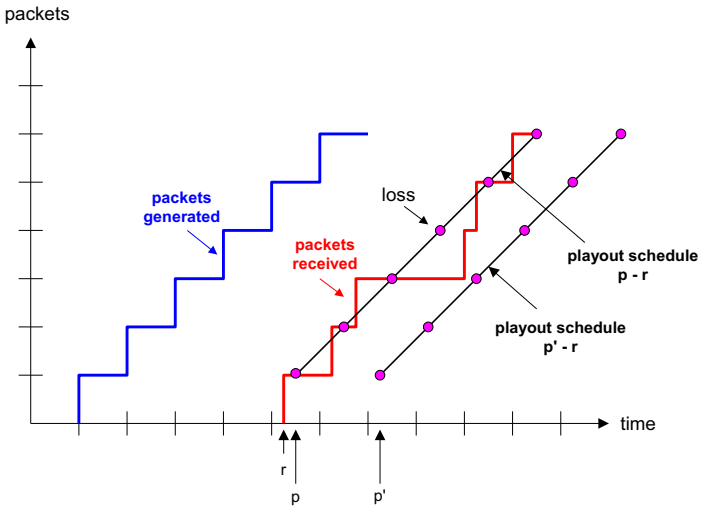
- not in Tanenbaum
  - HTTP/2.0



Application layer

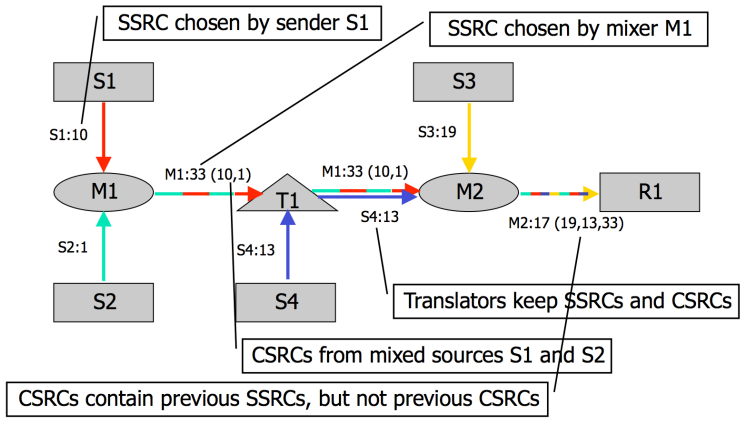
Multimedia (not in Tanenbaum)

- classes and characteristics of continuous media
- UDP or TCP?
- basic challenges
  - delay, loss, jitter
  - jitter compensation
  - loss compensation



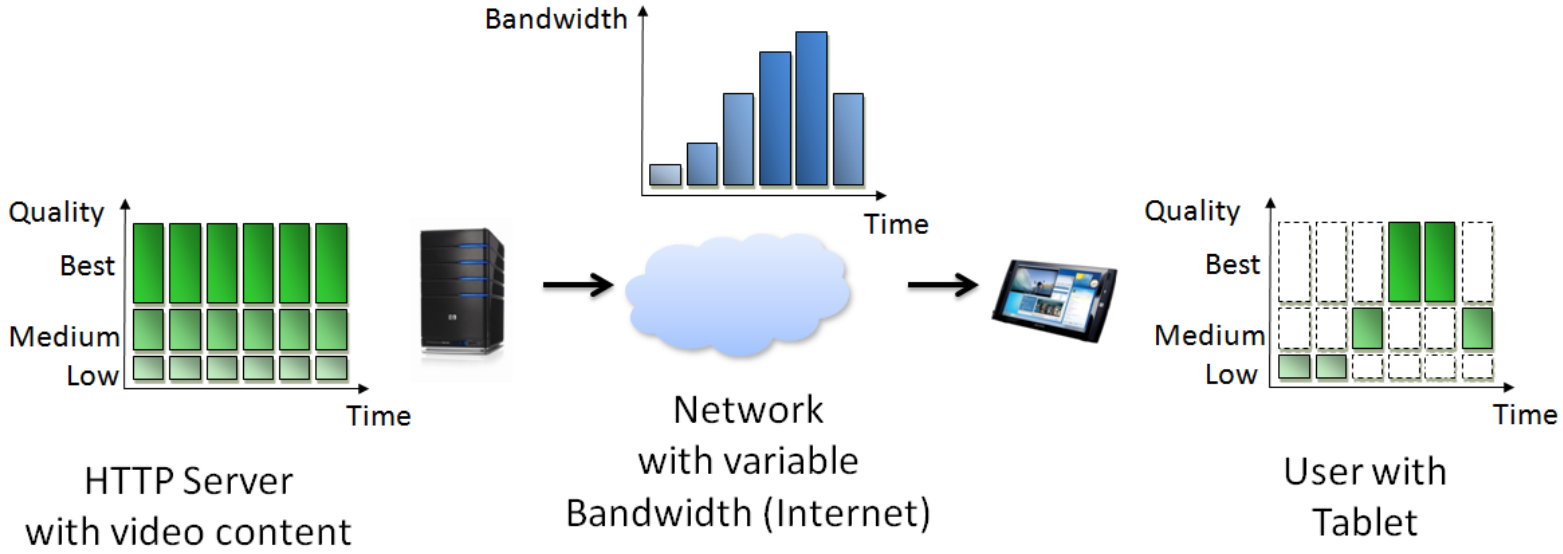
RTP (Tanenbaum pp. 564)

- *wrong section! not a transport protocol!*
- relation between RTP and Application layer framing / Integrated layer processing
- role of RTCP
- mixers and translators (not in Tanenbaum)

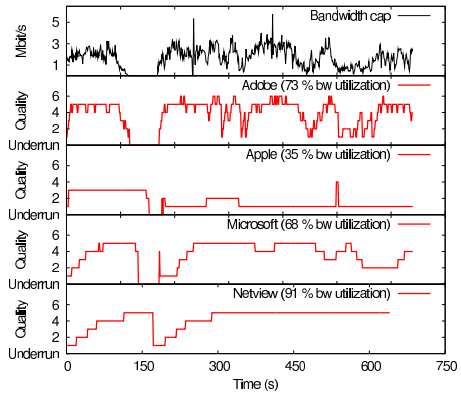


Application layer

Dynamic Adaptive Streaming over HTTP (not in Tanenbaum)



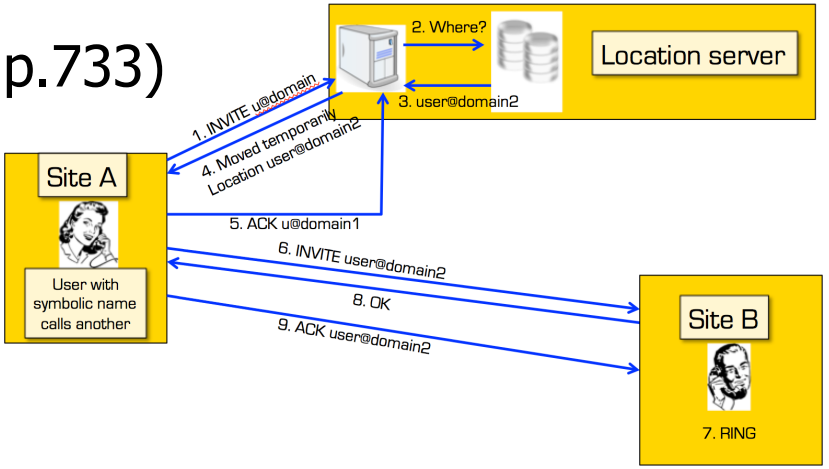
- Divide video into segments: completely independent little movies
- Choose the segment duration: 2-10 seconds usual
- Choose the number of quality layers
- Choose the adaptation strategy
  - the client chooses, not the server
  - these strategies make the difference between players



Application layer

Signaling protocols

- RTSP (briefly mentioned in Tanenbaum p.733)
- SIP (Tanenbaum pp.749)
  - proxy mode and redirect mode



Quality adaptation (not in Tanenbaum)

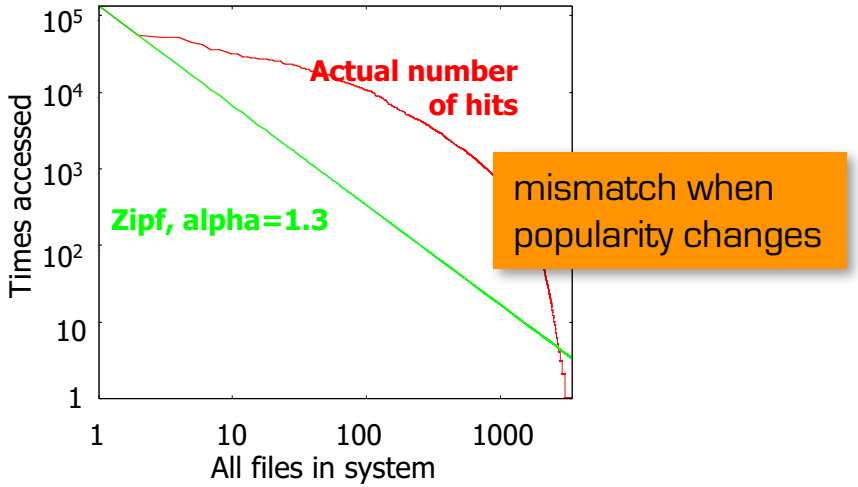
- Blurriness, noise and motion flicker

Popularity estimation (in Tanenbaum p.737f without the warnings)

- Zipf distribution
  - i'th most popular content ***while popularity remains unchanged***

$$z(i) = \frac{C}{i^{\varsigma}} \qquad C = 1/\sum_{n=1}^{N} \frac{1}{n^{\varsigma}}$$

  - is only an observed property
  - a subset of a Zipf-distributed dataset is no longer Zipf-distributed



Application layer

Content Delivery Networks (Tanenbaum pp. 743)

Peer-to-peer networks (briefly discussed in Tanenbaum pp. 748)

- BitTorrent (Tanenbaum pp. 750)
- Distributed Hash Tables (DHT, Tanenbaum pp. 753)
- this includes: Chord – where most things are O(log(n))