Internet & Multimedia

Exercises: timing and delays

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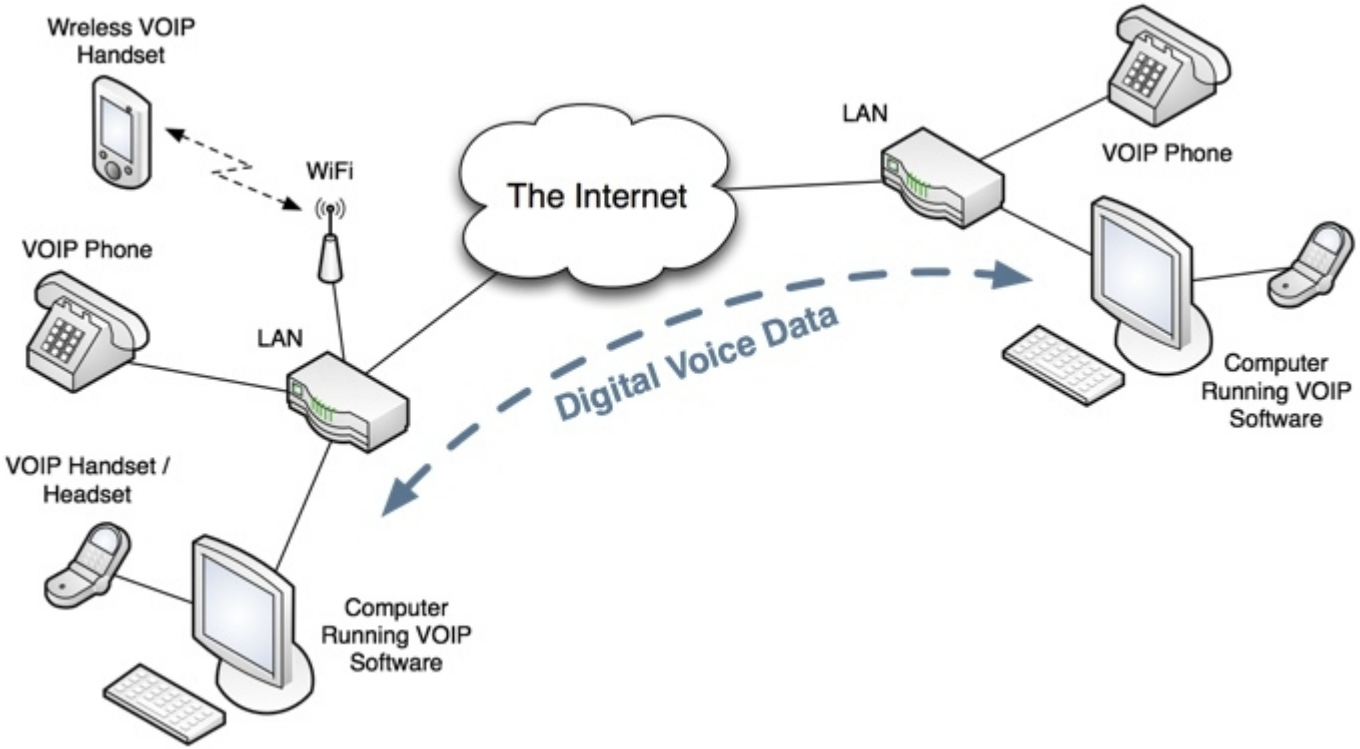
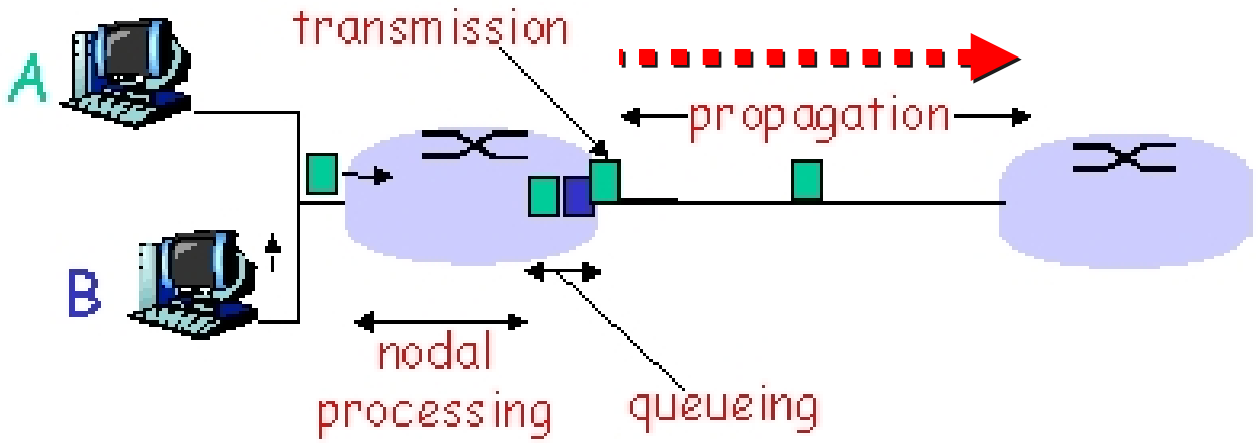
Internet data transfer - delays



- Find and discuss the system level delays

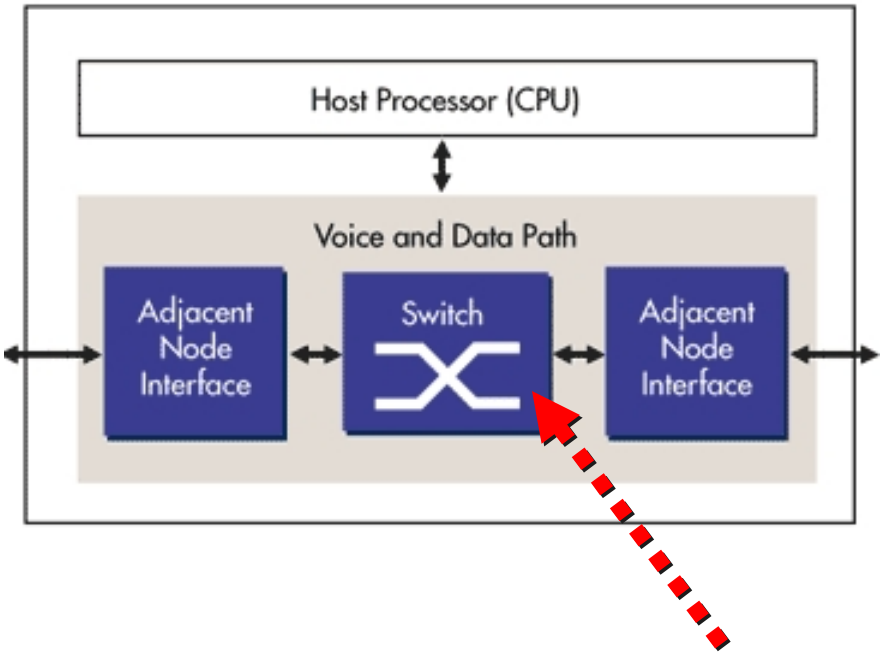
Packet switching delays

types of delays



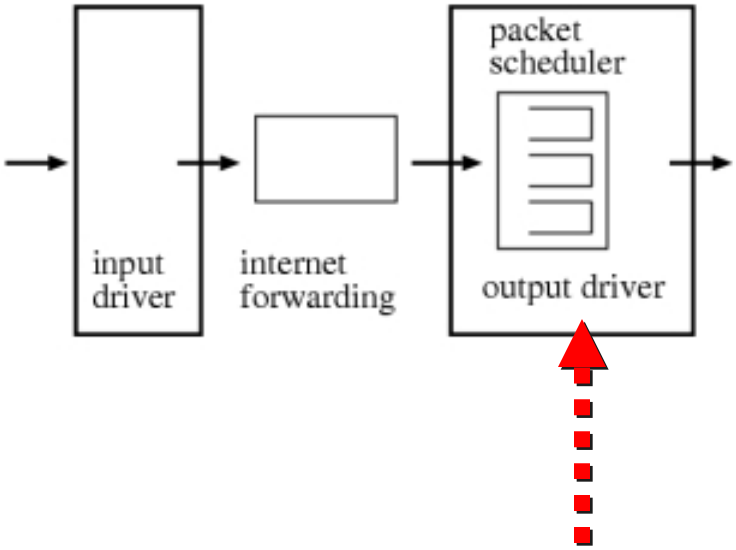
- Nodal processing
- Queuing
- Transmission
- Propagation

Processing delays



- nodal processing - several μ sec

Queuing delay



- queuing delay - several μ sec to several milli-secondes

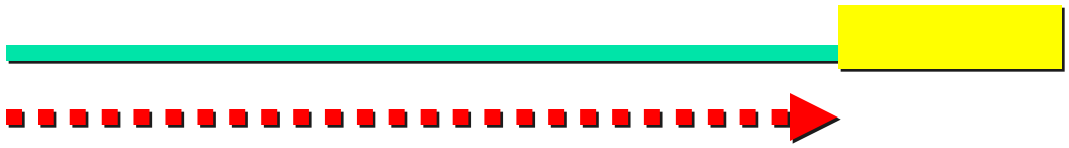
Transmission delay

- Transmission delay: time necessairy to output or transmit (by host or router) all the bits of the packet

- R_{ate}=100 Mb/s , L_{ength} = 1000 bits

Propagation delay

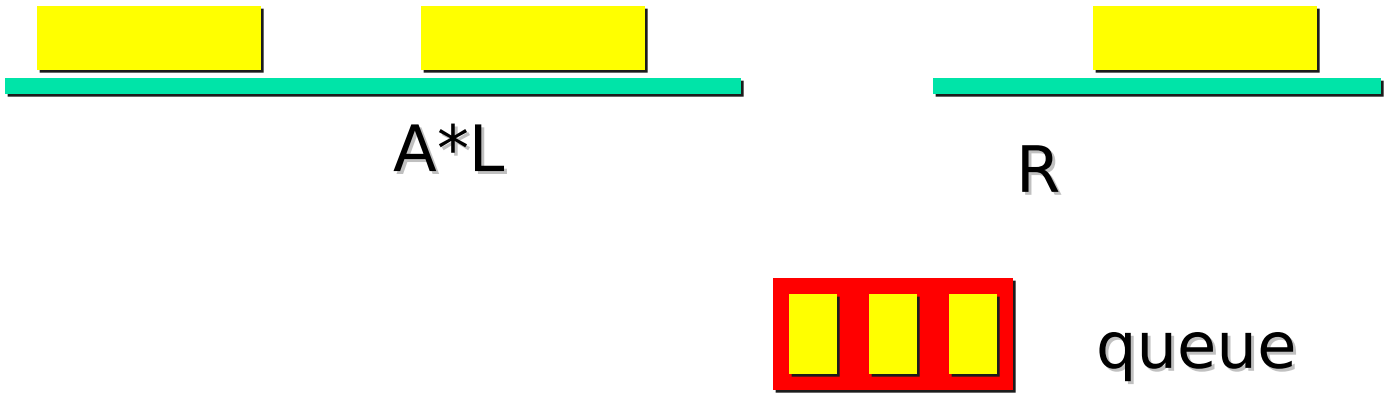
- Propagation delay: time delay between the last bit of the packet sent and its reception at the receiver end



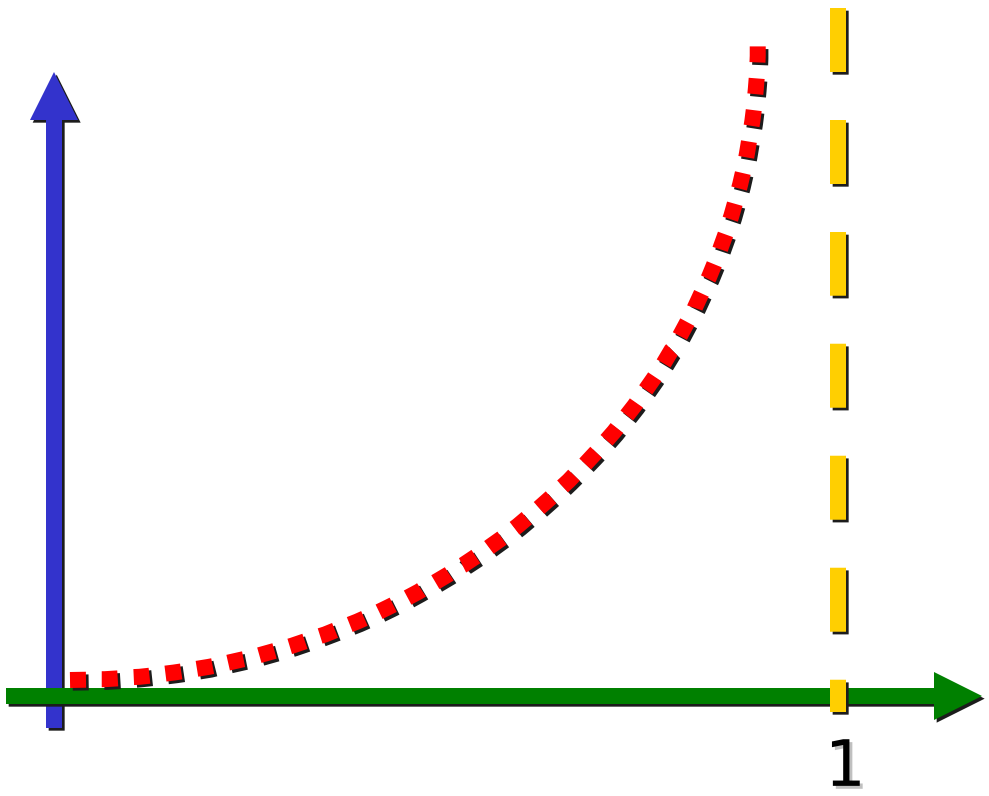
- V_{itesse} = 200 000 Km/s , $D_{istance}$ = 1 Km

Average queuing delay

- Queuing delay
  - Arrival – average arrival data-rate of the packets
  - L – size of the packets
  - A*L – average data rate
  - R – transmission data-rate (at the output)
  - A*L/R – traffic density (needs to be <1)



Average queuing delay



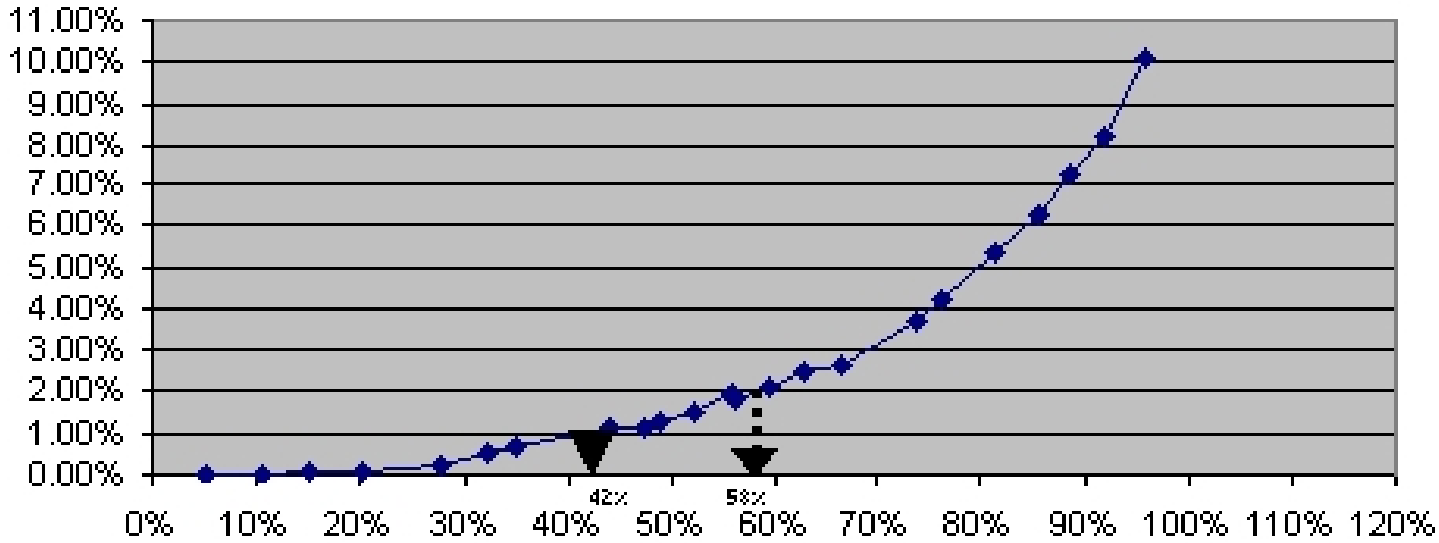
$D_{elay} = 1/(R - A*L)$

R = 1 Mb/s
A = 100 packet/s
L = 1 KB

Exercise :
Calculate the average queuing delay for the bits and for the packets

Packet loss

- Packet loss:% of the load



- A*L/R – density (%)

Interpret the results shown on the graph

End-to-end routing delay

N routers-switches

$$D_{end\text{-}to\text{-}end} = N * (D_{processing} + D_{transmission} + D_{propagation})$$

Routing – file transfert time

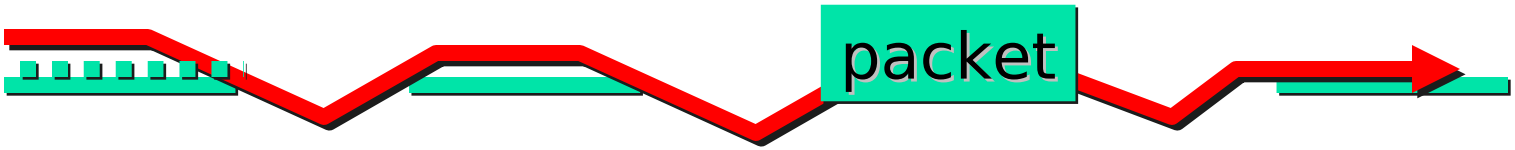
- The file to send F = M*L bits on the route with N routers
- Link data-rate is given by : R_{ate} b/s
- Light load – no queuing delays
- Propagation delay is close to zero
- Processing delay per node (high) is given by $P_{rocessing}$
- The number of routers is given by Q

Routing – file transfert time

- F = 10 KB
- Q=3
- M=80
- R= 10 Mb
- H = 200 bits (25 Bytes)
- P = 1 ms

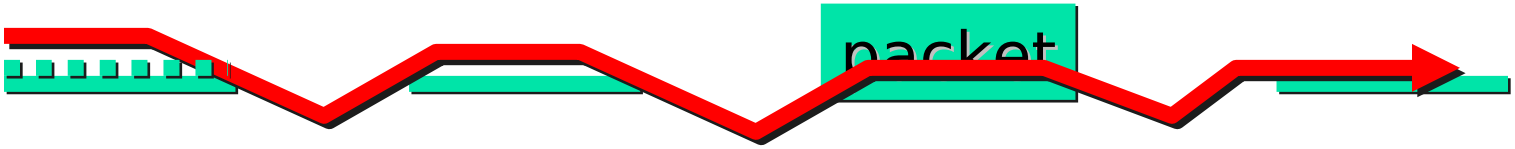
Question: what is the time necessary to send this file ?

Switching – file transfert time



- Now let us take a switching system with virtual circut established before transmission of the file, this operation takes $C_{onnection}$ seconds
- The packet header (H) is much shorter and the processing time (P) also lower.

Switching – file transfert time



New and modified parameters:

- VC *setup* C =10 ms
- header H => 100 bits

Question: what is the time necessary to send this file ?

Packet – optimal size (L)

- Let us take a system with N routers
- The data rate of the links is given by R (b/s)
- The data packet size is represented by L (bits)
- H is the number of bits added to the packet.
- Question : for the given file size F, what is the optimal lenght of L giving the minimal transport time over this route (find the symbolic expression)?

Packet – optimal size (L)

file

- Given the following values :

N = 10

R = 1Mb/s

L = ?

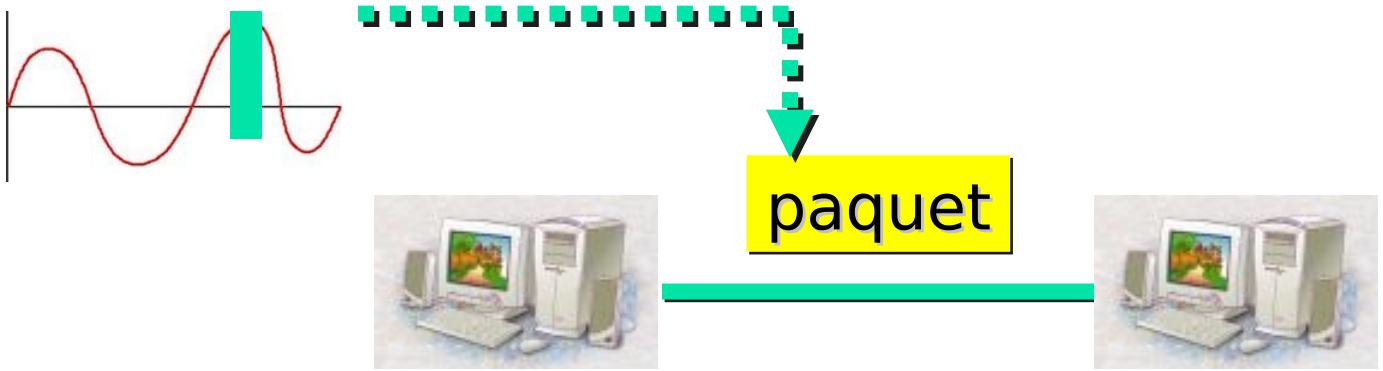
H = 10 bytes

F = 1 Mo

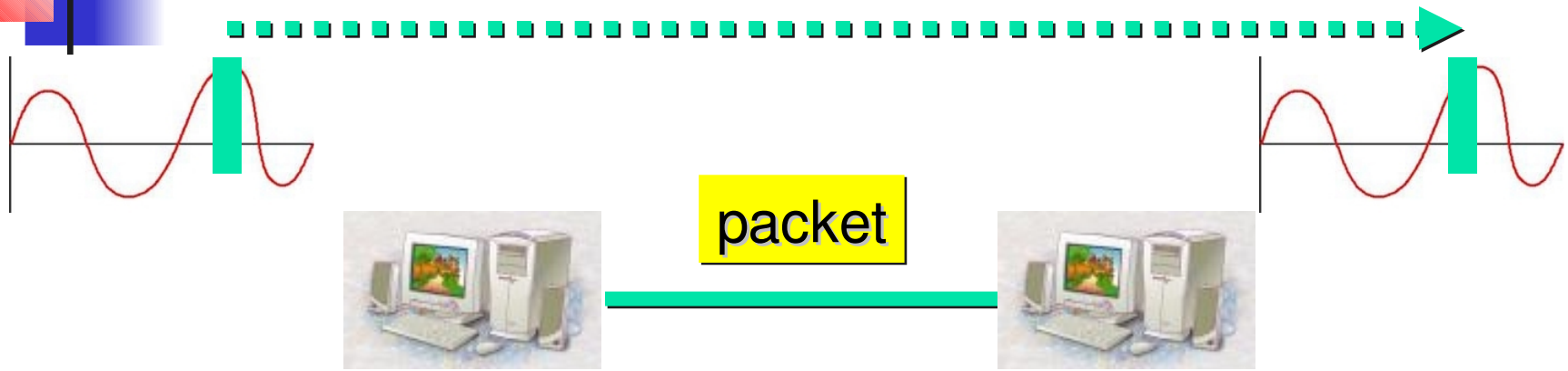
- Question : what is the minimal transport time ?

Packetization delay

- In this exercise we are trying to send the packetized voice samples (media flow) from host A to host B.
- Host A converts the analog signals into 64kb/s digital flow, this flowis packetized into 48 byte packets.
- The communication link has 1 Mb/s data-rate and its propagation delay is 2 ms.



Packetization and transmission

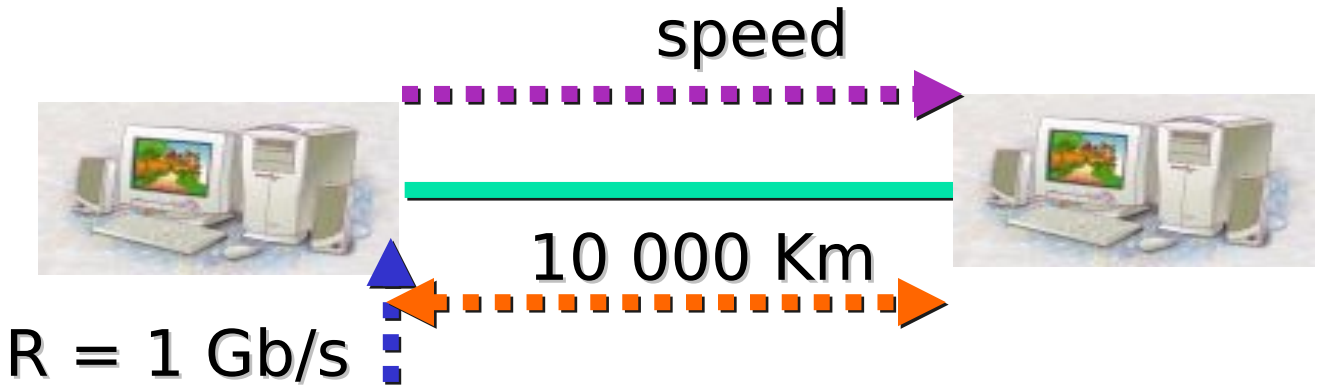


- Question: What is the total delay between the sampling of the input signal at host A and the regeneration of the analog signal at the receiving host B ?

Propagation delay

- Let us take two hosts, A and B, connected by a direct (optic) link of 10 000 Km with the data rate of R=1Gb/s.
- Calculate the product of :

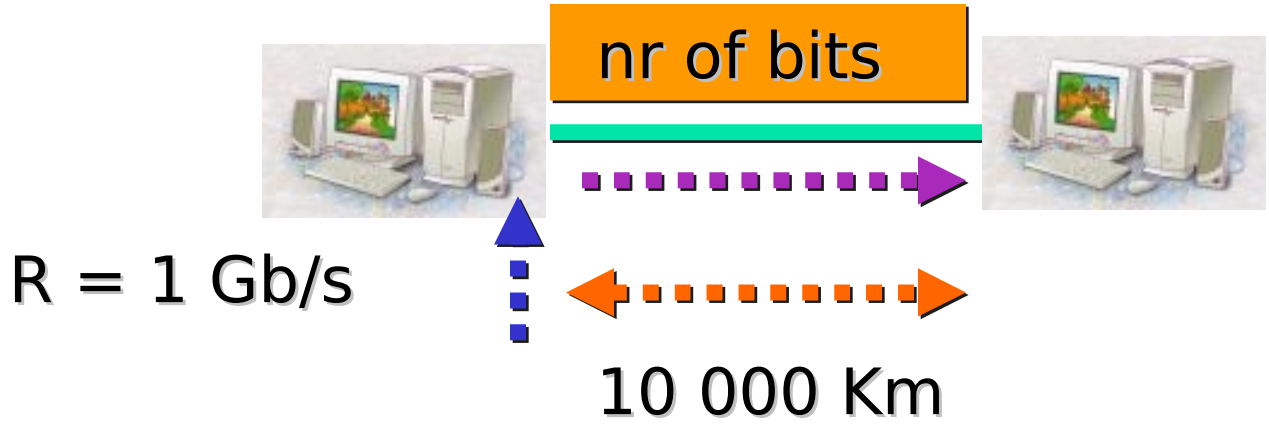
rate*propagation_delay - $R*D_{propagation}$



Propagation delay

- On this link you send a 800000-byte file

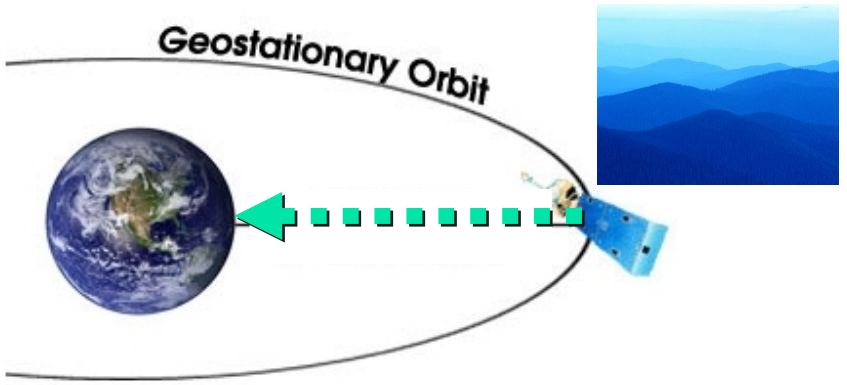
Questions : 1. What is the max number of bits in propagation on this link ? 2. What part of this file is in « propagation » state ? 3. What is the place taken by 1 bit in propagation ?



Satellite link – propagation and rate

- Let us take a satellitary link with 10 Mb/s between a geostationnary satellite and the base station.
- Every minute the satellite takes one photo.

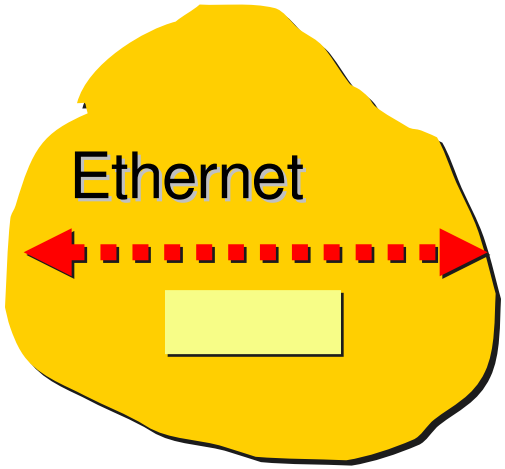
Question : What is the minimum size of the photo in pixels (uncompressed bitmap) necessary to feed continuously this link ?



Ethernet transfer time

Let us take a client/server configuration where client and server are connected via an Ethernet link wit data rate 100 Mb/s. Client request is sent in one Ethernet frame (1518 bytes).

The server response is carried by 7 Ethernet frames.



Question:

What is the minimum time for this transaction - T_{trans}?