

R16

Processing delay

Depending on what kind of processing is done the delay can be both constant and variable. Most error correction and packet forwarding are done in constant time, but more advanced inspection of packets can depending on what kind, be variable

Queuing delay

Depending on how much other traffic the node is handling. If there are other packets that the node needs to process first in order to get to our packet.

Transmission delay

Delay for transmission is constant, in that every link has a specific constant transmission time. The slowest link will dictate the largest delay for the whole end-to-end transmission.

Propagation delay

The propagation delay is constant in that data propagates in a constant time thru a medium, for example light in fiber optic cables. Between nodes the propagation delay is constant but dependent on how busy the node is the propagation delay between source and destination can vary.

R18

The delay of sending the package depends on the size of the packet and the transmission rate.

$$delay_{transmission} = \frac{1000 \text{ byte}}{2 \text{ Mbps}} = 4 \text{ milliseconds}$$

$$delay_{propagation} = \frac{2500 \text{ km}}{2.5 \cdot 10^8 \text{ m/s}} = 10 \text{ milliseconds}$$

$$delay_{total} = delay_{transmission} + delay_{propagation} = 14 \text{ milliseconds}$$

R19

- A. Slowest link at 500 kbps dictates the fastest speed possible.
- B. $\frac{4 MB}{500 kbps} = 64 \text{ seconds}$
- C. Slowest link at 100 kbps dictates the fastest speed possible.
 $\frac{4 MB}{100 kbps} = 5.33 \text{ minutes}$

R24

Application-layer message

The application layer is the top of the OSI model, consisting of applications such as HTTP, HTTPS, SMTP, SSH, etc. This is the layer tasked with applications content.

Transport-layer segment

Is responsible for the full transmission of a message, TCP and UDP are two types. TCP guarantees that the data will arrive and be error-corrected, UDP does not either.

Network-layer datagram

Network-layer datagrams are used to transfer data from one host to another host using a receiver address. The datagram is routed and forwarded to its destination. Internet Protocol datagrams are Network-layer datagrams.

Link-layer frame

A frame is a basic container of data used to transfer to one node in a network to another one. It is the closest packet-type to the physical layer. Ethernet frames is a link-layer frame.

P28

A. $delay_{propagation} = \frac{36000 \text{ km}}{2.4 \cdot 10^8 \text{ m/s}} = 150 \text{ milliseconds}$

B. $10 \text{ Mbps} \cdot (150 \text{ milliseconds} \cdot 2) = 3000000 \text{ bits} = 375 \text{ kilobytes}$

C. $10 \text{ Mbps} \cdot 60 \text{ seconds} = 75 \text{ megabytes}$