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Physical Layer-Part-3

Network Performance Measures

NETWORK PERFORMANCE

One important issue in networking is the performance of the network—how good is it?.

Performance Measures

- **Bandwidth**
- **Channel Utilization**
- **Throughput**
- **Latency (Delay)**
- **Bandwidth Delay Product**
- **Jitter**

Bandwidth

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In networking, term bandwidth is used in two contexts.

- The first, bandwidth in hertz, refers to the range of frequencies in a composite signal or the range of frequencies that a channel can pass.

- The second, bandwidth in bits per second, refers to the speed of bit transmission in a channel or link.

Latency (Delay)

It defines the it takes for entire message to completely arrive at the destination from the time the first bit is sent out from the source

Latency= Propagation Time + Transmission Time + Queuing Time + Processing Delay

$$Propagation\ Time\ (T_p) = \frac{Distance}{Propagation\ Speed}$$

$$Transmission\ Time\ (T_t) = \frac{Message\ size}{Bandwidth}$$

Latency (Delay)

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Queuing Time:- It is the time needed for each intermediate or end device to hold the message before it can be processed

Processing Delay:- It is the time taken by routers to process the packet header.

Channel Utilisation

$$\text{Channel Utilisation (U)} = \frac{\text{Active time of sender}}{\text{Cycle Time}}$$

$$Cycle\ Time = (T_t + 2 \times T_p)$$

$$U = \frac{(T_t)}{(T_t + 2\ T_p)}$$

Throughput

It is a measure of how fast data can be sent through a network

$$\text{Throughput} = \frac{\text{Data send in 1 cycle time}}{\text{Cycle Time}}$$

$$T_h = \frac{(Frame\ size)}{(T_t + 2 \times T_p)}$$

Bandwidth Delay Product

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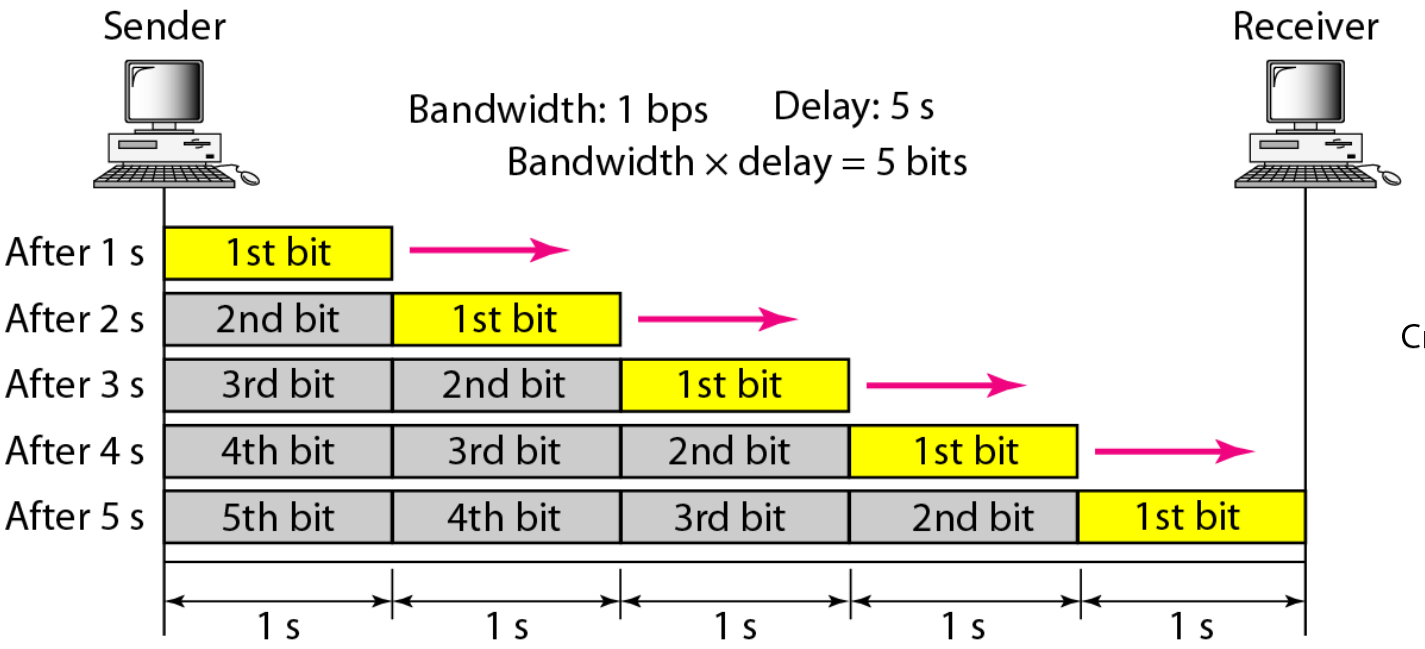
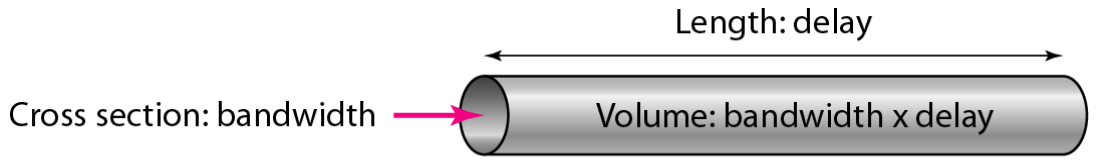
The bandwidth-delay product defines the number of bits that can fill the link





Jitter

- Jitter is defined as the variation in the packet delay.
- High jitter means the difference between delays is large; low jitter means the variation is small.

Question

What are the propagation time and the transmission time for a 5-Mbyte message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4×10^8 m/s.

Solution

$$\text{Propagation time} = \frac{12{,}000 \times 1000}{2.4 \times 10^8} = 50 \text{ ms}$$

Message size= 5 Mbyte= 5x10,00000x8 bits

Transmission time= (5x10,00000x8)/(1x10,00000) sec

= 40 sec

Question

A network with bandwidth of 10 Mbps can pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network?

Solution

Throughput of the network can be calculated as

$$\text{Throughput} = \frac{12{,}000 \times 10{,}000}{60} = 2 \text{ Mbps}$$