Flow Control | Stop and Wait Protocol

Computer Networks

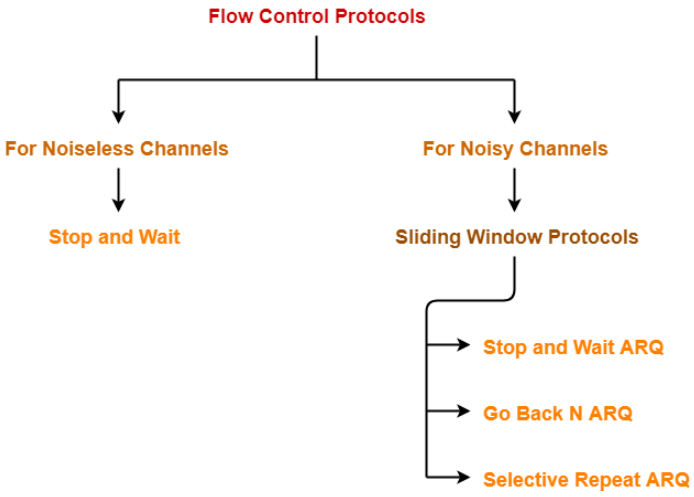
Flow Control in Computer Networks-

In computer networks, flow control is defined as-

> A set of procedures which are used for restricting the amount of data that a sender can send to the receiver.

Flow Control Protocols-

There are various flow control protocols which are classified as-



In this article, we will discuss about stop and wait protocol.

Stop and Wait Protocol-

> Stop and Wait Protocol is the simplest flow control protocol.

It works under the following assumptions-

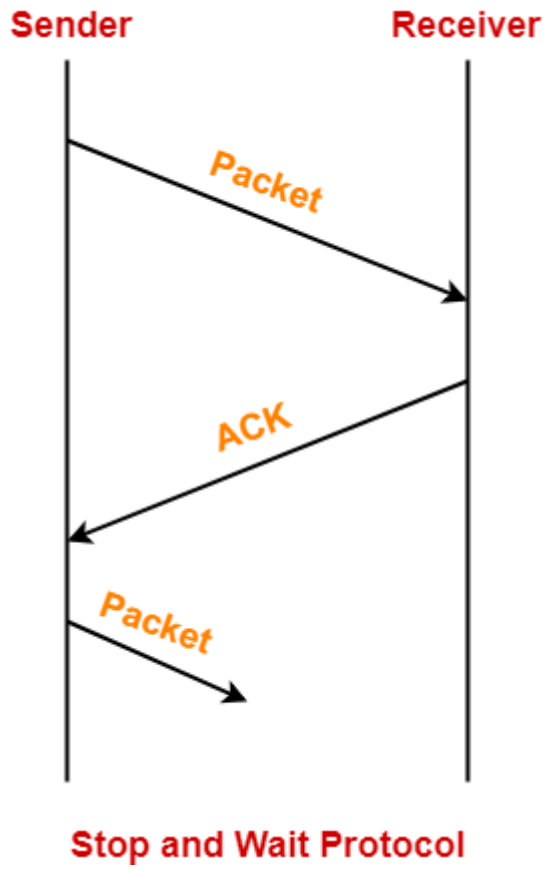
- Communication channel is perfect.
- No error occurs during transmission.

Working-

The working of a stop and wait protocol may be explained as-

- Sender sends a data packet to the receiver.
- Sender stops and waits for the acknowledgement for the sent packet from the receiver.
- Receiver receives and processes the data packet.
- Receiver sends an acknowledgement to the sender.
- After receiving the acknowledgement, sender sends the next data packet to the receiver.

These steps are illustrated below-



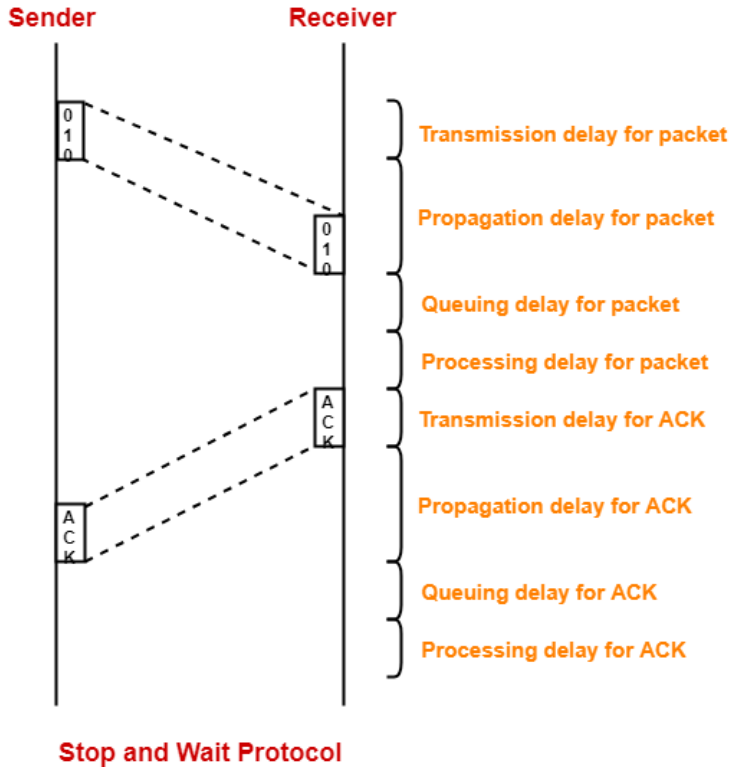
Stop and Wait Protocol

Analysis-

Now, let us analyze in depth how the transmission is actually carried out-

- Sender puts the data packet on the transmission link.
- Data packet propagates towards the receiver's end.
- Data packet reaches the receiver and waits in its buffer.
- Receiver processes the data packet.
- Receiver puts the acknowledgement on the transmission link.
- Acknowledgement propagates towards the sender's end.
- Acknowledgement reaches the sender and waits in its buffer.
- Sender processes the acknowledgement.

These steps are illustrated below-



Also Read- Delays in Computer Networks

Total Time-

Total time taken in sending one data packet

= (Transmission delay + Propagation delay + Queuing delay + Processing delay)$_{packet}$

+

(Transmission delay + Propagation delay + Queuing delay + Processing delay)$_{ACK}$

Assume-

- Queuing delay and processing delay to be zero at both sender and receiver side.
- Transmission time for the acknowledgement to be zero since it's size is very small.

Under the above assumptions.

Total time taken in sending one data packet

= $(\text{Transmission delay} + \text{Propagation delay})_{packet}$ + $(\text{Propagation delay})_{ACK}$

We know,

- Propagation delay depends on the distance and speed.
- So, it would be same for both data packet and acknowledgement.

So, we have-

Total time taken in sending one data packet

= $(\text{Transmission delay})_{packet}$ + 2 x Propagation delay

Efficiency-

Efficiency of any flow control control protocol is given by-

Efficiency (η) = Useful Time / Total Time

where-

- Useful time = Transmission delay of data packet = $(\text{Transmission delay})_{packet}$

- Useless time = Time for which sender is forced to wait and do nothing = 2 x Propagation delay
- Total time = Useful time + Useless time

Thus,

$$\text{Efficiency } (\eta) = \frac{(\text{Transmission delay})_{packet}}{(\text{Transmission delay})_{packet} + 2 \times \text{Propagation delay}}$$

OR

$$\text{Efficiency } (\eta) = \frac{T_t}{T_t + 2T_p}$$

OR

$$\text{Efficiency } (\eta) = \frac{1}{1 + 2\left(\frac{T_p}{T_t}\right)}$$

OR

$$\text{Efficiency } (\eta) = \frac{1}{1 + 2a}, \text{ where } a = \left(\frac{T_p}{T_t}\right)$$

Factors Affecting Efficiency-

We know,

Efficiency (η)

= $(\text{Transmission delay})_{packet}$ / { $(\text{Transmission delay})_{packet}$ + 2 x Propagation delay }

Dividing numerator and denominator by $(\text{Transmission delay})_{packet}$, we get-

$$\text{Efficiency } (\eta) = \frac{1}{1 + 2 \times \left(\frac{\text{Propagation delay}}{(\text{Transmission delay})_{\text{packet}}} \right)}$$

$$\text{Efficiency } (\eta) = \frac{1}{1 + 2 \times \left(\frac{\text{Distance}}{\text{speed}} \right) \times \left(\frac{\text{Bandwidth}}{\text{Packet length}} \right)}$$

From here, we can observe-

- Efficiency (η) ∝ 1 / Distance between sender and receiver
- Efficiency (η) ∝ 1 / Bandwidth
- Efficiency (η) ∝ Transmission speed
- Efficiency (η) ∝ Length of data packet

Throughput-

- Number of bits that can be sent through the channel per second is called as its throughput.

$$\text{Throughput} = \text{Efficiency } (\eta) \times \text{Bandwidth}$$

Round Trip Time-

Round Trip Time = 2 x Propagation delay

Advantages-

The advantages of stop and wait protocol are-

- It is very simple to implement.
- The incoming packet from receiver is always an acknowledgement.

Limitations-

The limitations of stop and wait protocol are-

Point-01:

It is extremely inefficient because-

- It makes the transmission process extremely slow.
- It does not use the bandwidth entirely as each single packet and acknowledgement uses the entire time to traverse the link.

Point-02:

If the data packet sent by the sender gets lost, then-

- Sender will keep waiting for the acknowledgement for infinite time.
- Receiver will keep waiting for the data packet for infinite time.

Point-03:

If acknowledgement sent by the receiver gets lost, then-

- Sender will keep waiting for the acknowledgement for infinite time.
- Receiver will keep waiting for another data packet for infinite time.

Important Notes-

Note-01:

Efficiency may also be referred by the following names-

- Line Utilization
- Link Utilization
- Sender Utilization
- Utilization of Sender

Note-02:

Throughput may also be referred by the following names-

- Bandwidth Utilization
- Effective Bandwidth
- Maximum data rate possible
- Maximum achievable throughput

Note-03:

Stop and Wait protocol performs better for LANs than WANs.

This is because-

- Efficiency of the protocol is inversely proportional to the distance between sender and receiver.
- So, the protocol performs better where the distance between sender and receiver is less.
- The distance is less in LANs as compared to WANs.

To gain better understanding about Stop and Wait Protocol,

Watch this Video Lecture

Next Article- Stop and Wait ARQ

Get more notes and other study material of **Computer Networks**.

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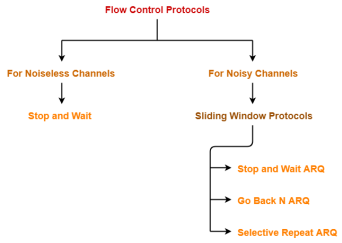
Summary



Article Name	Flow Control | Stop and Wait Protocol
Description	Flow Control in Computer Networks is a set of procedures to restrict the amount of data that sender can send. Stop and Wait Protocol is a flow control protocol where sender sends one data packet to the receiver and then stops and waits for its acknowledgement from the receiver.
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