Congestion Control and its prevention policies

Congestion

- Congestion is an important issue that can arise in packet switched network.
- Congestion is a situation in Communication Networks in which too many packets are present in a part of the subnet.
- Congestion in a network may occur when the load on the network is greater than the capacity of the network.
- Due to Congestion the performance degrades.

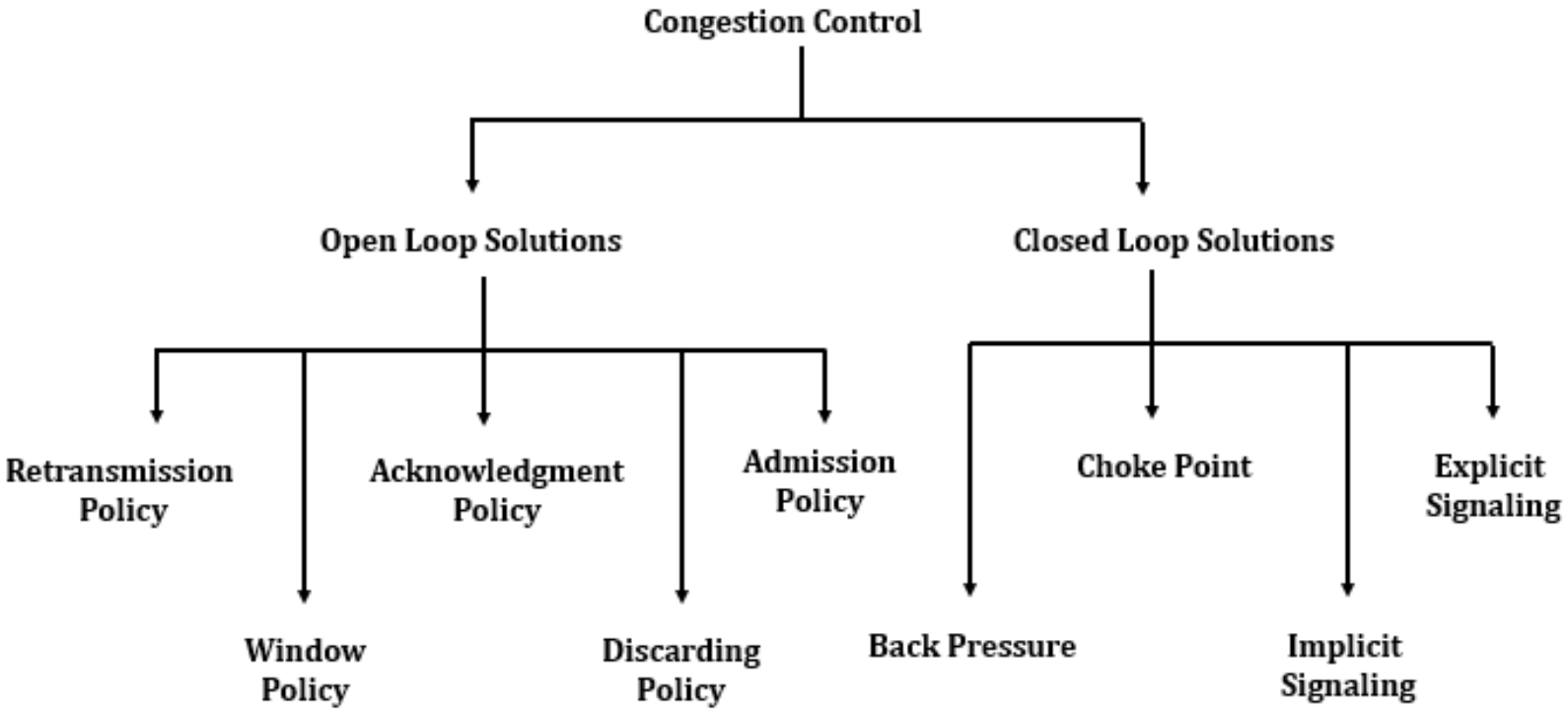
Factors that Causes the Congestion

- Packet arrival rate exceeds the outgoing link capacity.
- Insufficient memory to store arriving packets.
- Bursty traffic.
- Slow processor.

Congestion Control

- Congestion Control is the techniques and mechanisms which can either prevent congestion from happening or remove congestion after it has taken place.
- Congestion control mechanisms are divided into two categories, one category prevents the congestion from happening and the other category removes congestion after it has taken place.

Congestion Control (2)



Open Loop Congestion Control

- In Open Loop Congestion Control, policies are used to prevent the congestion before it happens.

- Congestion control is handled either by the source or by the destination.

Closed Loop Congestion Control

- Closed loop congestion control mechanisms try to remove the congestion after it happens.

- It uses some kind of feedback.

Need of Congestion Control

- It is not possible to completely avoid the congestion but it is necessary to control it.
- Congestions leads to a large Queue Length.
- It results in Buffer Overflow & Loss of Packets.
- So the congestion control is necessary to ensure that the user gets the negotiated Quality of Services.

Policies adopted by open loop congestion control

1. Retransmission Policy

- The sender retransmits a packet, if it feels that the packet it has sent is lost or corrupted.
- However retransmission increases the congestion in the network.
- But we need to implement good retransmission policy to prevent congestion.
- The retransmission policy and the retransmission timers need to be designed to optimize efficiency and at the same time prevent the congestion.

2. Window Policy

- To implement window policy, **selective reject window** method is used for congestion control.
- Selective Reject method is preferred over Go-back-n window as in Go-back-n method, when timer for a packet times out, several packets are resent, although some may have arrived safely at the receiver.
- Thus, this duplication may make congestion worse.
- Selective reject method sends only the specific lost or damaged packets.

3. Acknowledgement Policy

- The acknowledgement policy imposed by the receiver may also affect congestion.
- If the receiver does not acknowledge every packet it receives it may slow down the sender and help prevent congestion.
- Acknowledgments also add to the traffic load on the network.
- Thus, by sending fewer acknowledgements we can reduce load on the network.

3. Acknowledgement Policy

- To implement it, several approaches can be used:
  - A receiver may send an acknowledgement only if it has a packet to be sent.
  - A receiver may send an acknowledgement when a timer expires.
  - A receiver may also decide to acknowledge only N packets at a time.

4. Discarding Policy

- A router may discard less sensitive packets when congestion is likely to happen.

- Such a discarding policy may prevent congestion and at the same time may not harm the integrity of the transmission.

5. Admission Policy

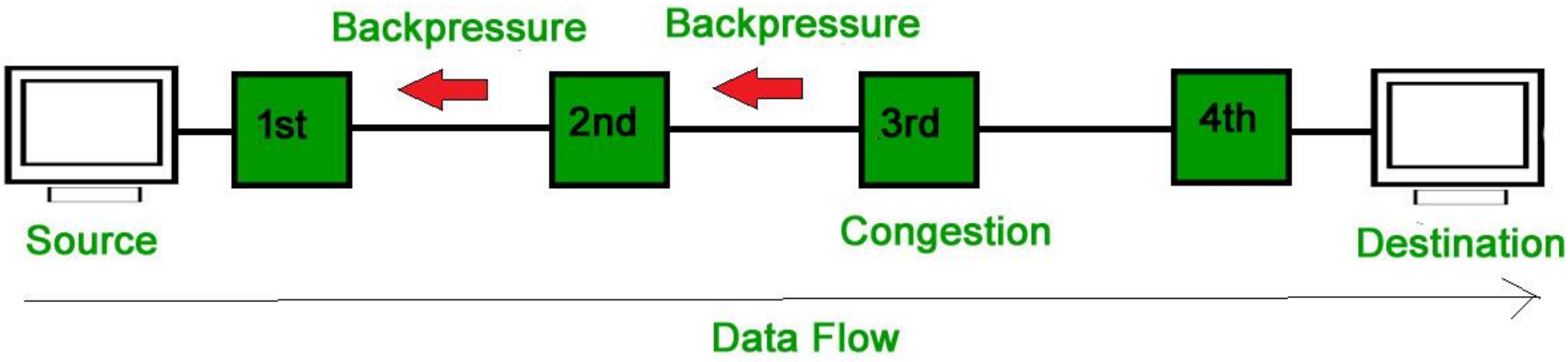
- An admission policy, which is a quality-of-service mechanism, can also prevent congestion in virtual circuit networks.
- Switches in a flow, first check the resource requirement of a flow before admitting it to the network.
- A router can deny establishing a virtual circuit connection if there is congestion in the network or if there is a possibility of future congestion.

Policies adopted by Closed loop congestion control

1. Backpressure

- Backpressure is a technique in which a congested node stop receiving packet from upstream node.
- This may cause the upstream node or nodes to become congested and rejects receiving data from above nodes.
- Backpressure is a **node-to-node** congestion control technique that propagate in the opposite direction of data flow.
- The backpressure technique can be applied only to **virtual circuit** where each node has information of its above upstream node.

1. Backpressure

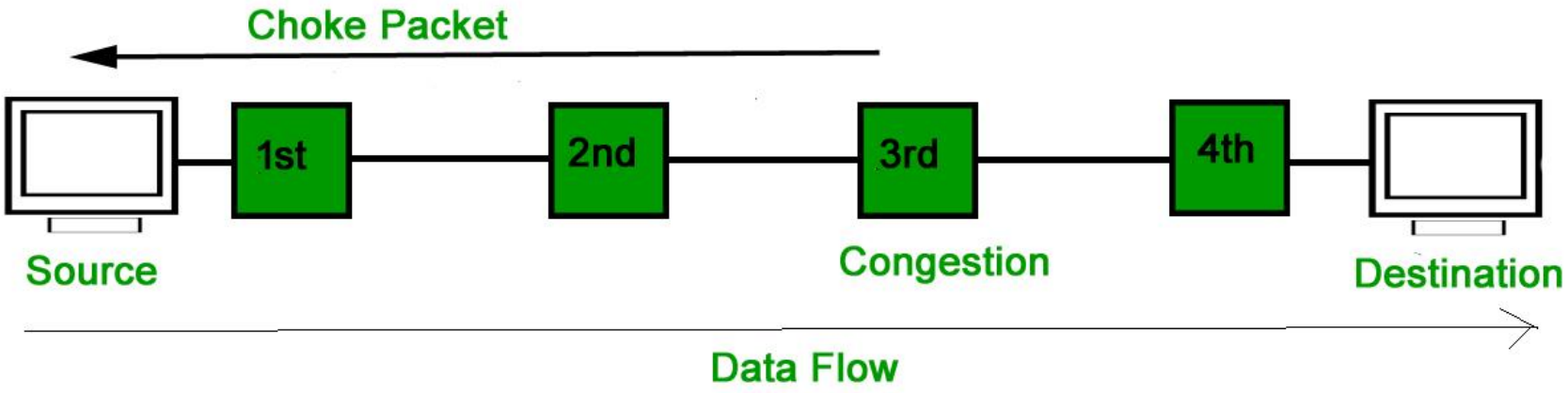


In above diagram the 3rd node is congested and stops receiving packets as a result 2nd node may be get congested due to slowing down of the output data flow. Similarly 1st node may get congested and informs the source to slow down.

2. Choke Packet Technique

- Choke packet technique is applicable to both **virtual networks as well as datagram subnets.**
- A choke packet is a packet sent by a node to the source to inform it of congestion.
- Each router monitor its resources and the utilization at each of its output lines. whenever the resource utilization exceeds the threshold value which is set by the administrator, the router directly sends a choke packet to the source giving it a feedback to reduce the traffic.
- The intermediate nodes through which the packets has traveled are not warned about congestion.

2. Choke Packet Technique



3. Implicit Signaling

- In implicit signaling, there is no communication between the congested nodes and the source.
- The source guesses that there is congestion in a network. For example when sender sends several packets and there is no acknowledgment for a while, one assumption is that there is a congestion.

4. Explicit Signaling

- In explicit signaling, if a node experiences congestion it can explicitly sends a packet to the source or destination to inform about congestion.
- The difference between choke packet and explicit signaling is that the signal is included in the packets that carry data rather than creating different packet as in case of choke packet technique.

4. Explicit Signaling

- Explicit signaling can occur in either forward or backward direction.
  - **Forward Signaling** : In forward signaling signal is sent in the direction of the congestion. The destination is warned about congestion. The receiver in this case adopt policies to prevent further congestion.
  - **Backward Signaling** : In backward signaling signal is sent in the opposite direction of the congestion. The source is warned about congestion and it needs to slow down.