Network Congestion Control

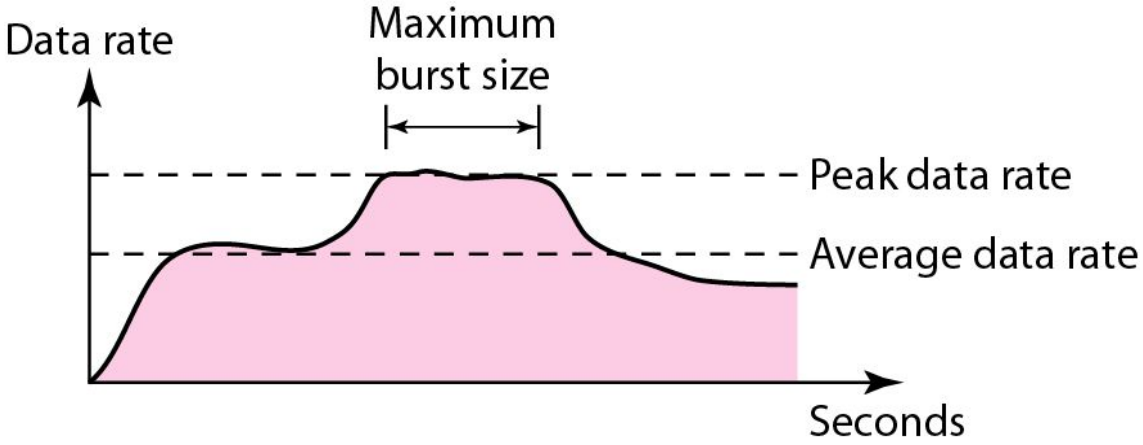
Session Objectives

After completion of the session you will be able to understand

- Concept of Network Traffic Congestion
- Congestion Control Policies
- Congestion Control Approaches

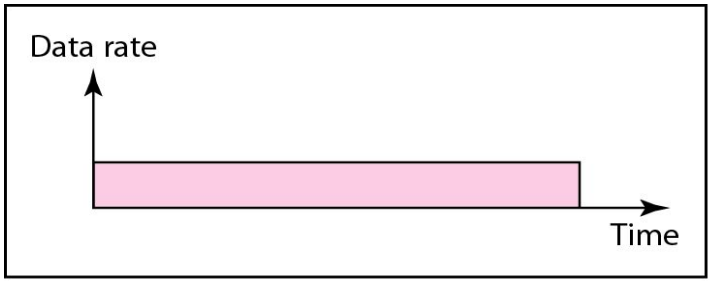
Introduction

- The main focus of congestion control and quality of service is **data traffic**.
- In congestion control we **try to avoid** traffic congestion.
- In quality of service, we try to create an appropriate environment for the traffic.

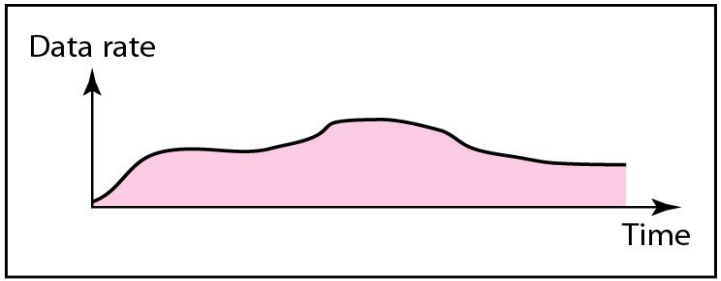


Traffic descriptors

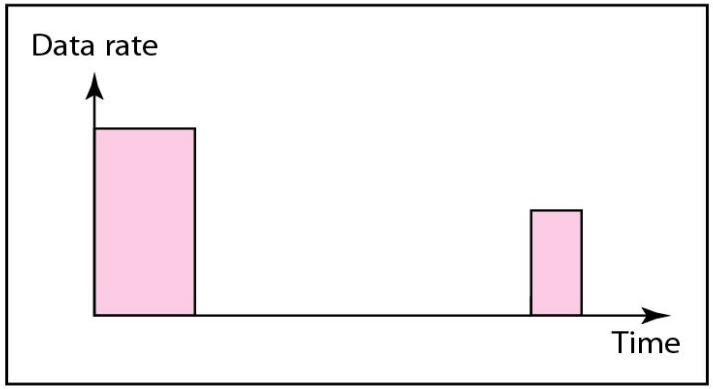
Network Traffic Pattern



a. Constant bit rate



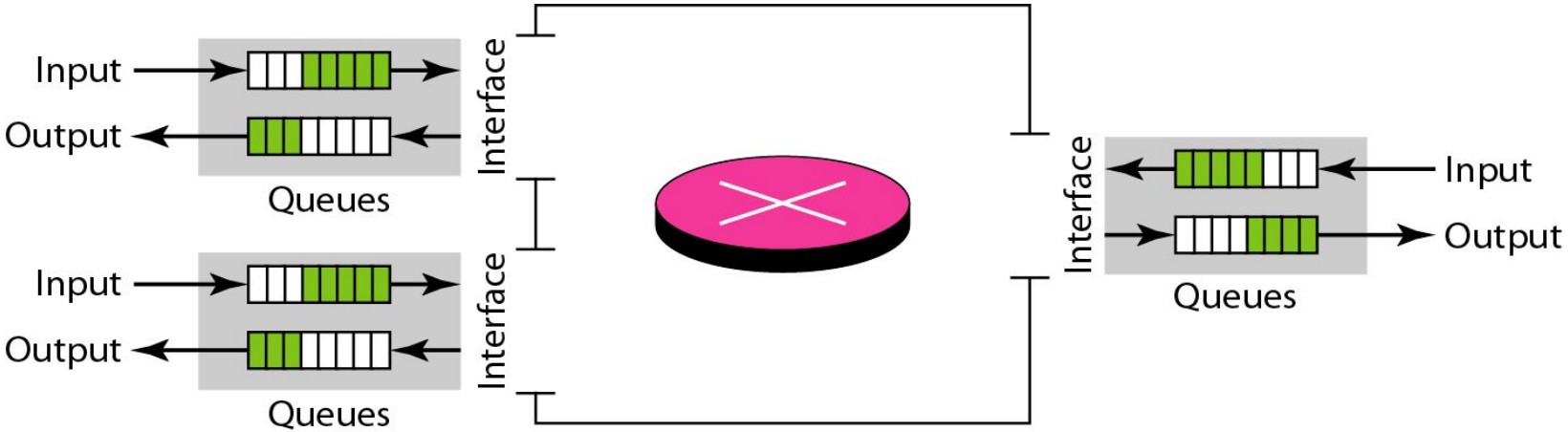
b. Variable bit rate



c. Bursty

Network Congestion

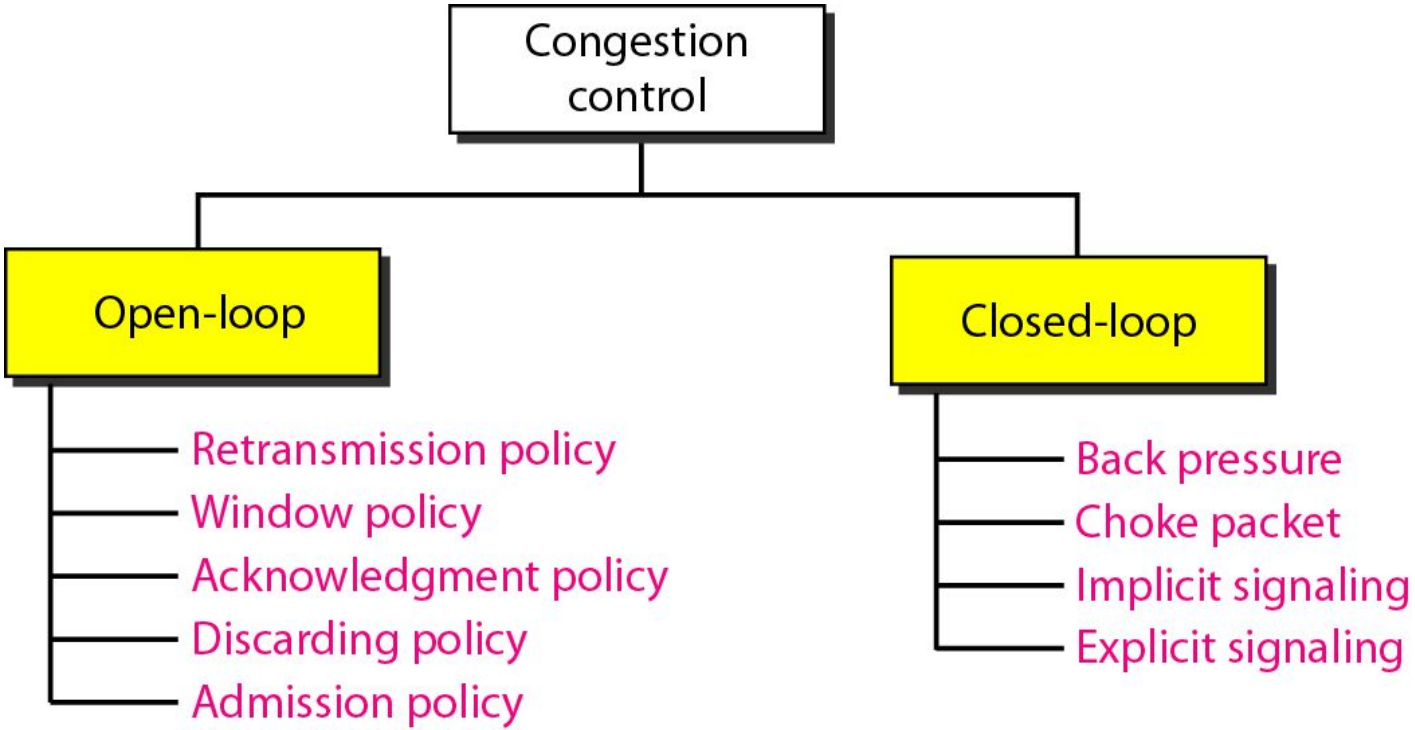
- Congestion in a network may occur if the load on the **network—the number of packets sent to the network**—is greater than the capacity of the network—the number of packets a network can handle.
- Congestion control refers to the mechanisms and techniques to **control the congestion** and keep the load below the capacity.



Congestion Control

- Congestion control refers to techniques and mechanisms that can either **prevent** congestion, before it happens, or **remove** congestion, after it has happened.
- In general, we can divide congestion control mechanisms into two broad categories: **open-loop** congestion control (prevention) and **closed-loop** congestion control (removal).
- The open-loop congestion control policies are used to prevent the congestion **before it happens**.
- In open-loop Congestion control is **handled** either by the source or by the destination.
- In closed loop congestion control mechanisms the congestion is **removed after it had happens**.

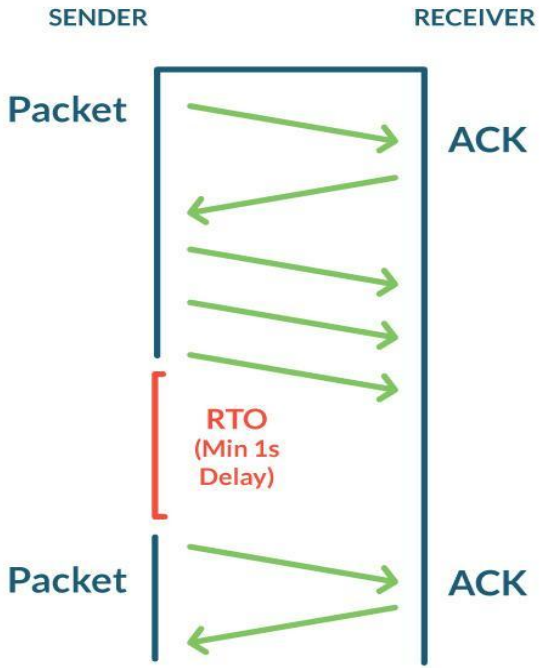
Congestion Control Approaches



Open-loop congestion control policies

Retransmission Policy

- The sender retransmits a packet, if it feels that the packet it has sent is lost or corrupted.
- However retransmission in **general may increase 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.



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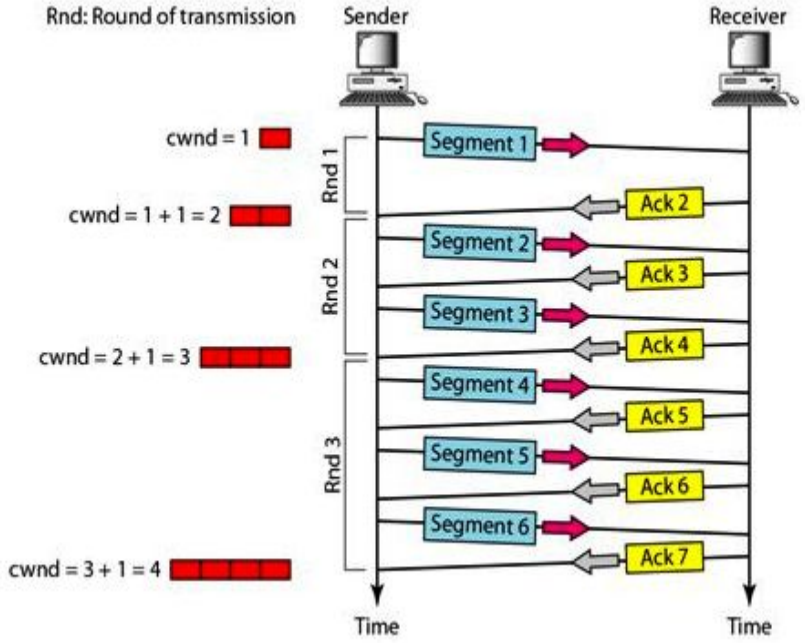
Window Policy

- To implement window policy, **selective reject/repeat 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/repeat method** sends only the specific lost or damaged packets.



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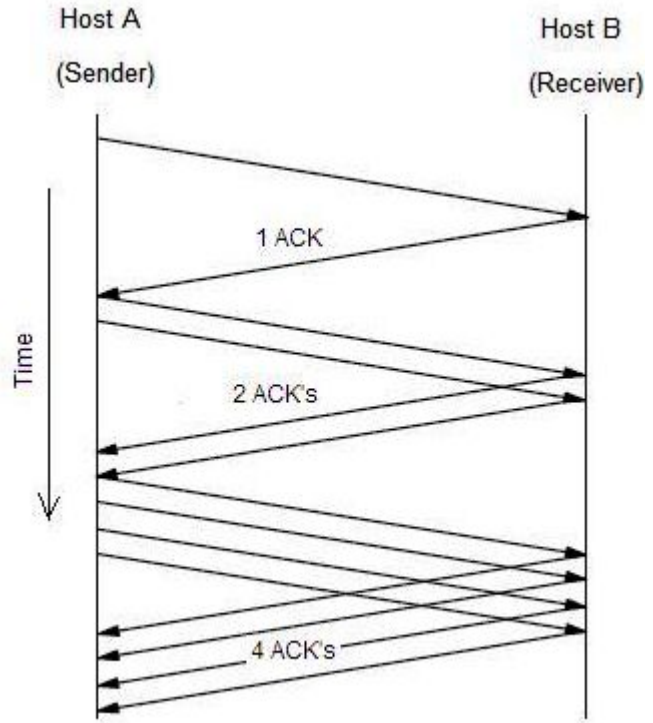
Acknowledgement Policy

- 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.
- To implement it, several **approaches** can be used by a receiver:

✔ Acknowledge only if it has a packet to be sent.
✔ May send an acknowledgement when a timer expires.
✔ Acknowledge only **N** packets at a time.



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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.

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.

Closed-loop congestion control policies

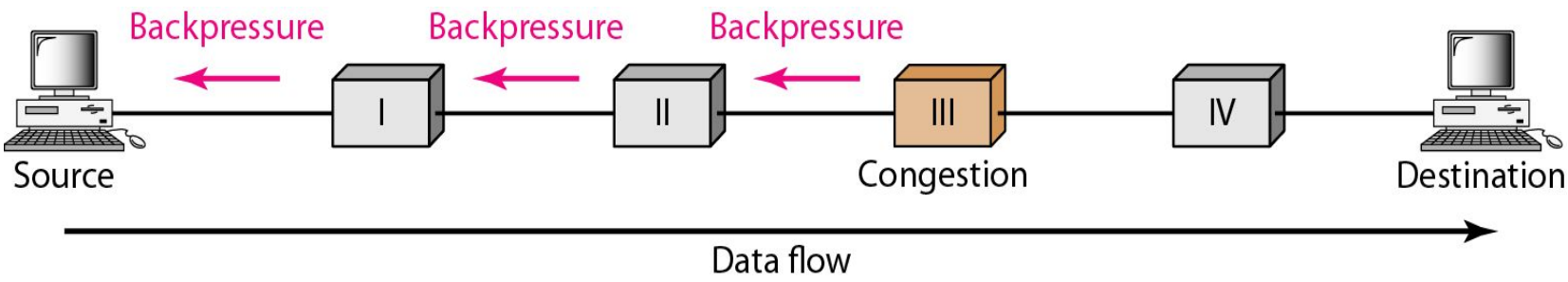
Backpressure

• Backpressure is a **node-to-node congestion** control that starts with a node and propagates, in the opposite direction of data flow.

• The backpressure technique can be applied **only to virtual circuit** networks. In such virtual circuit each node knows the upstream node from which a data flow is coming.

• Here, the **congested node stops receiving** data from the immediate upstream node or nodes. This may cause the upstream node on nodes to become congested, and they, in turn, reject data from their upstream node or nodes.

Backpressure Contd....



As shown in fig node III is congested and it stops receiving packets and informs its upstream node II to slow down. Node II in turns may be congested and informs node I to slow down. Now node I may create congestion and informs the source node to slow down. In this way the congestion is alleviated. Thus, the pressure on node III is moved backward to the source to remove the congestion.

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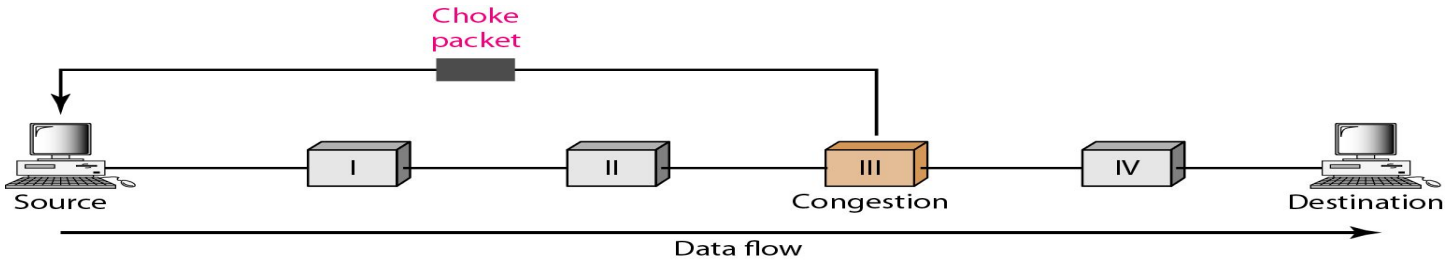
Choke Packet Method

• In this method of congestion control, congested router or node **sends a special type of packet called choke packet** to the source to inform it about the congestion.

• Here, congested node **does not inform** its upstream node about the congestion as in backpressure method.

• In choke packet method, **congested node sends a warning directly to the source station** i.e. the intermediate nodes through which the packet has travelled are not warned.



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Implicit Signaling

• In implicit signaling, there is **no communication** between the congested node or nodes and the source.

• The **source guesses** that there is congestion somewhere in the network when it does not receive any acknowledgment. Therefore the **delay in receiving an acknowledgment** is interpreted as congestion in the network.

• On sensing this congestion, the source **slows down**.

• This type of congestion control policy is **used by TCP**.

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Explicit Signalling

- In this method, the congested nodes **explicitly send** a signal to the source or destination to inform about the congestion.

- Explicit signalling is **different** from the choke packet method. In choke packed method, a separate packet is used for this purpose whereas in explicit signalling method, the signal is included in the packets that carry data .

- Explicit signalling can **occur in either** the forward direction or the backward direction

- In backward signalling, **a bit is set** in a packet moving in the direction opposite to the congestion. This bit warns the source about the congestion and informs the source to slow down.

Summary

In this session we have learned

- Network Congestion
- Open-loop congestion control policies
- Closed-loop congestion control policies


Thank
you!