

FLOW CONTROL AND TRAFFIC MANAGEMENT

Closed-Loop Flow Control

- Congestion control
 - Feedback information is used to regulate the flow from sources into network based on buffer content, link utilization, etc.
 - Examples: TCP at transport layer; congestion control at ATM level
- Feedback information may be sent by End-to-end or Hop-by-hop.

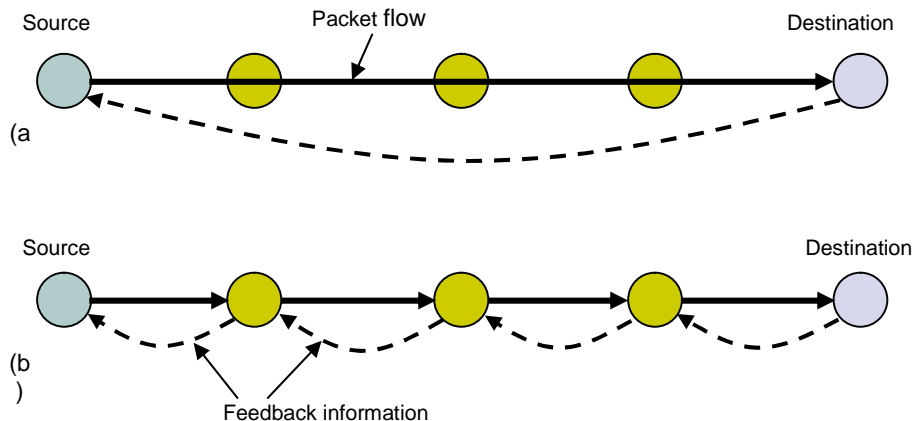
End-to-end closed loop control

- Feedback information about state of network is propagated back to source which regulate packet flow rate.
- Feedback information may be forwarded directly by a node that detects congestion, or it may be forwarded to destination first which then it relays information to source.
- The transmission of feedback information introduces propagation delay, so the information may not be accurate when the source receives the information.

Hop-by-hop control

- It reacts faster than end-to-end counterpart due to shorter propagation delay.
- State of the network is propagated to the upstream node as shown in below figure.
- When a node detects congestion it tells to its upstream neighbor to slow down its transmission rate.
- The Back Pressure created from one down stream node to another upstream node may continue all the way to the source.

End-to-End vs. Hop-by-Hop Congestion Control



Implicit vs. Explicit Feedback: - The information can be implicit or explicit.

Explicit Feedback

- The node detecting congestion initiates an explicit message to notify the source about the congestion in the network.
- The explicit message can be sent as separate packet often called as choke packets or piggybacked on a data packet.
- The explicit message may be bit information or it may contain rich amount of information.

Implicit Feedback

- In implicit Feedback, no such explicit messages are sent between the nodes.
- Here congestion is controlled by using time out based on missing acknowledgements from destination to decide whether congestion has been encountered in the network.
- TCP congestion control is one example that regulates the transmission rate by using the implicit feedback information derived from missing acknowledgement.

Traffic Management at the flow aggregated level / Traffic Engineering

- Routing of aggregate traffic flows across the network for efficient utilization of resources and meeting of service levels
- Traffic Management at the Flow-Aggregate Level is called "Traffic Engineering".
- Management exerted at flow aggregate level
- Distribution of flows in network to achieve efficient utilization of resources (bandwidth)
- Shortest path algorithm to route a given flow not enough
 - Does not take into account requirements of a flow, e.g. bandwidth requirement
 - Does not take account interplay between different flows
- Must take into account aggregate demand from all flows.
- Refer figure 7.63 and page number 560-561 for more information.

Why Internetworking?

- To build a "network of networks" or internet
 - operating over multiple, coexisting, different network technologies
 - providing ubiquitous(universal) connectivity through IP packet transfer
 - achieving huge economies of scale
- To provide universal communication services
 - independent of underlying network technologies
 - providing common interface to user applications
- To provide distributed applications
 - Rapid deployment of new applications
 - Email, WWW, Peer-to-peer
 - Application independent of network technologies
 - New networks can be introduced

Source : <http://elearningatria.files.wordpress.com/2013/10/unit2.pdf>