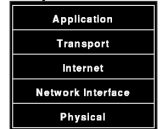


TCP

73

- IP- Internet Protocol
 - Addressing Scheme
 - Address Resolution
 - Datagram Forwarding
 - Encapsulation, Fragmentation & Reassembly

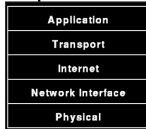
- TCP- Transmission Control Protocol
 - Connection startup & shutdown
 - Reliability: ordering, missing data handling



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Why TCP?

- Datagram service provided by IP is unreliable. For example, IP takes no responsibility if packets are lost, if there are duplicate packets, if a part of the router fails.
- But, many application programs want to assume that when a byte is sent it will be delivered correctly at the other end.
- TCP layer of TCP/IP protocol suits bridges this gap.



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TCP Services

- Connection Orientation
 - application sets up virtual connections.
- Point-to-point Communication
 - each connection has exactly two endpoints.
- Complete Reliability
 - TCP guarantees all bytes will be delivered.
- Full Duplex Communication
 - Data can flow in both direction over connections.
- Stream Interface
 - Byte order is maintained but no records.
- Reliable Connection Startup
 - No interference from earlier connections.
- Graceful Connection Shutdown
 - All sent data will be delivered before shutdown.



TCP provides a completely reliable (no data duplication or loss), connection oriented, full duplex stream transport to applications.

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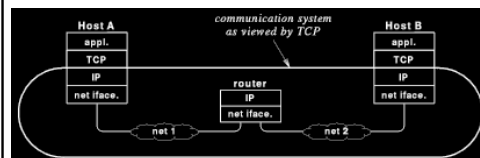
Virtual Connection

- TCP provides a feeling to the applications that a completely reliable connection exists between two applications.
- TCP use IP to carry packets. Each TCP packet is encapsulated into an IP datagram. IP layers do not read inside the TCP packets.
- However, the IP or underlying hardware do not know about the connection.



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Relationship Between TCP and IP



- TCP works at two endpoints.



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Reliability Problems

- Packet can be lost
- Packet can be duplicated
- Computers can reboot
- A packets from earlier connection can disrupt current connection.



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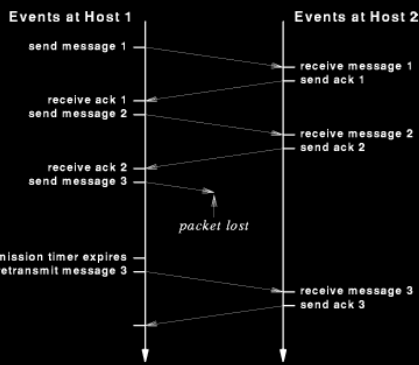
Packet loss and Retransmission

- TCP uses a variety to techniques.
- One of them is retransmission assisted by a timer.
- When a packet is send a timer is started.
- Each packet must be acknowledged by the receiver.
- If acknowledgement does not arrive within the specified time, retransmission occurs.



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Time

- What should be a good time out time?
 - Local computers can respond within ms.
 - A satellite connected computer needs about .25min.
 - Use long delay for satellite connections and short for local connections.

What if the time over the same connection varies?



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Adaptive Retransmission

- Previous Transport mechanisms used to use a fixed time delay. TCP uses an adaptive scheme.
- TCP monitors the round-trip-time for each communication.
- Measures average delay and variance.
- Sets the times as a weighted sum of average and variance.



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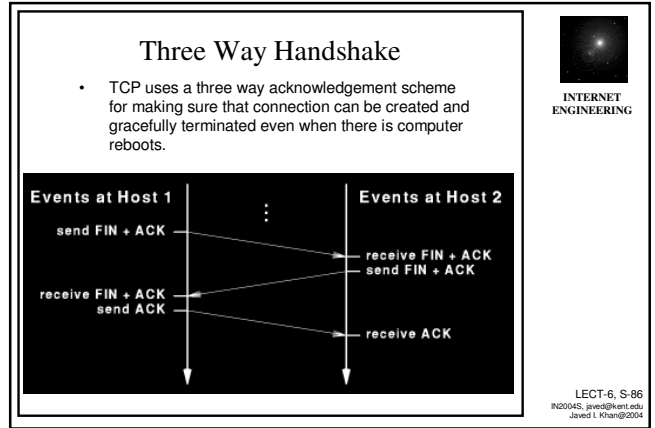
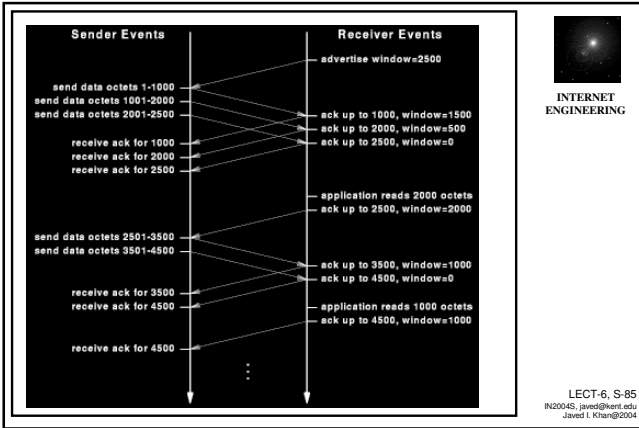
Buffer, Flow Control & Window

- TCP use windowing for flow control.
- Each site always advertises its remaining free buffer size.
- When receiver buffer is zero, sender stops.



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Congestion Control

- Congestion Collapse?
- When a message is lost, TCP assumes congestion!
- It sends one packet at a time even if the receiver advertised large buffer.
- If it receives acknowledgement, only then doubles the data per packet, and sends two additional packets.
- If these are acknowledged, then it sends four more packets..

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