# CprE 489
## Lecture 22

Fall Semester 1997



## Transport Layer

- Services provided to the transport layer from the network layer
  - virtual circuit service (potentially with quality of service options)
  - datagram service
    - connectionless
    - lossy
    - non-fifo
  - network service given and cannot control it



## Services Provided by the Transport Layer

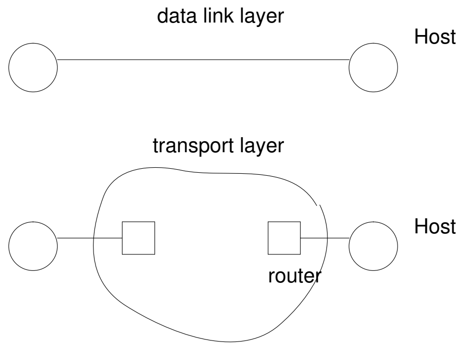
- Level of service - Byte stream
  - reliable (TCP is reliable, UDP is not)
  - timely (Satisfy delay constraints or not)
- Transport Layer Addressing - TSAP
  - Addresses typically found withing the operating system of a host. Thus, a TSAP address would be hierarchical
    - <country><network><host><port>
  - Example is Unix "sockets".
- In internetworking the transport layer does not have to be universal. There may be several options depending on services desired.



## Transport Layer Protocols

- Connection management
  - multiplexing many connections
  - making sure a packet from an old connection does not get in the stream of a new connection.
- Dividing long messages into into network packets
- Error control
  - reassemble messages correctly upon arrival - packets can arrive out of order.
  - Setting the timeout period properly
- Flow control
  - both sender and receiver have limited buffer space for packets
- Deal with network failure

## Data Link vs. Transport






## Socket Primitives for TCP

- Create a Socket
- Bind a Socket
- Listen to  Socket
- Accept a call
- Connect a call
- Send and Receive data
- Close a connection



## Connection Control

- Similar to opening and closing a file, but complications arise.
- The attempt to open does not elicit a response
  - is the open packet lost or is the receiver down?
  - Early timeouts should not cause two openings to happen.
- Can closing be mutually agreed upon?  Theoretically no, but for practical purposes sort of.
- How do you reopen when when party has crashed and the other has not.
- How do you choose sequence numbers for reliable transmission.
  - some sequence numbers might not be safe to use because they were recently used in a previous connection.



## Releasing a Connection

- Three phase protocol
- DR/DR/ACK
- Second Dr may get lost
- Ack may get lost
- Second DR and ACK may get lost