

Basic Concepts (II)

Common Functions of a Layer

- **Encapsulation** and **decapsulation**
 - **Error Control**
 - error detection, error correction
 - encoding/decoding for data integrity (A), out of order detection (T), cyclic redundancy check (CRC) (L)
 - **Flow Control**
 - traffic management, congestion control
 - sliding window (T), conflict detection (L)
 - **Addressing**
 - Hostname (A), port (T), IP address (N), MAC (L)
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Basic Devices

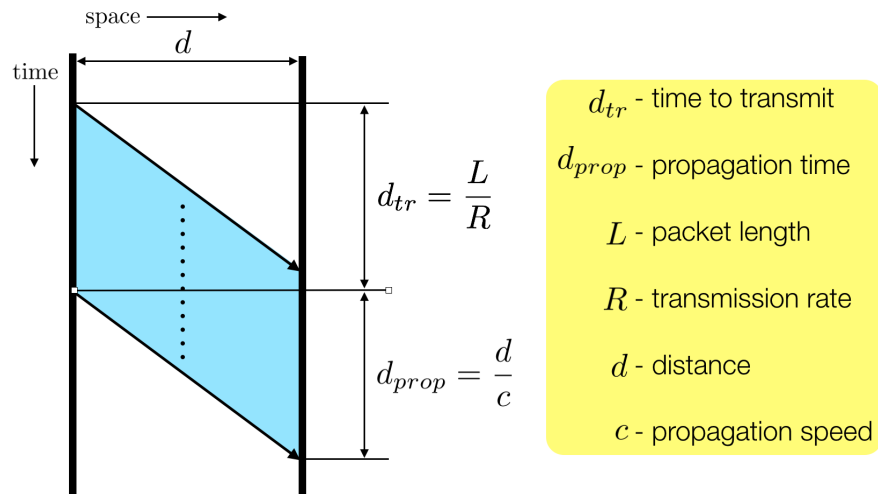
- **Router**
 - A network layer device (examines IP addresses)
 - route packets among LANs or WANs
 - **Switch**
 - A link layer device (examines MAC addresses)
 - forward packets between LAN segments
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Performance Measures

- **Throughput** — number of bits/bytes/packets delivered per second
 - **Latency** — time to deliver a packet
 - typically measured from the first bit transmission to the last bit reception
 - **RTT** (round-trip-time) — two-way latency
 - **Packet Loss Rate**
 - The percentage of unreceived packets during a period of time
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Time-Space Diagram

- End-to-end delay (latency) = $d_{tr} + d_{prop}$
- d_{tr} : transmission delay, time to send a packet out of the door
- d_{prop} : propagation delay, time between the moment the last bit out of the door and the moment it's received
- R : the width of the door
- d : the distance between the two ends
- c : the speed of bits (m/s)



- Example: How long does it take to deliver three packets back-to-back to the destination?
Assume that the packet length is L , the distance between the source and destination is d , the transmission rate is R , and the propagation speed is C .
 - $3 * d_{tr} + d_{prop} = 3L/R + d/c$

Disclaimer: Notes adapted from the textbook and online resources.