

CS 725/825 & IT 725

Lecture 13

Network Management

Transport Layer

October 15, 2025

Network Management

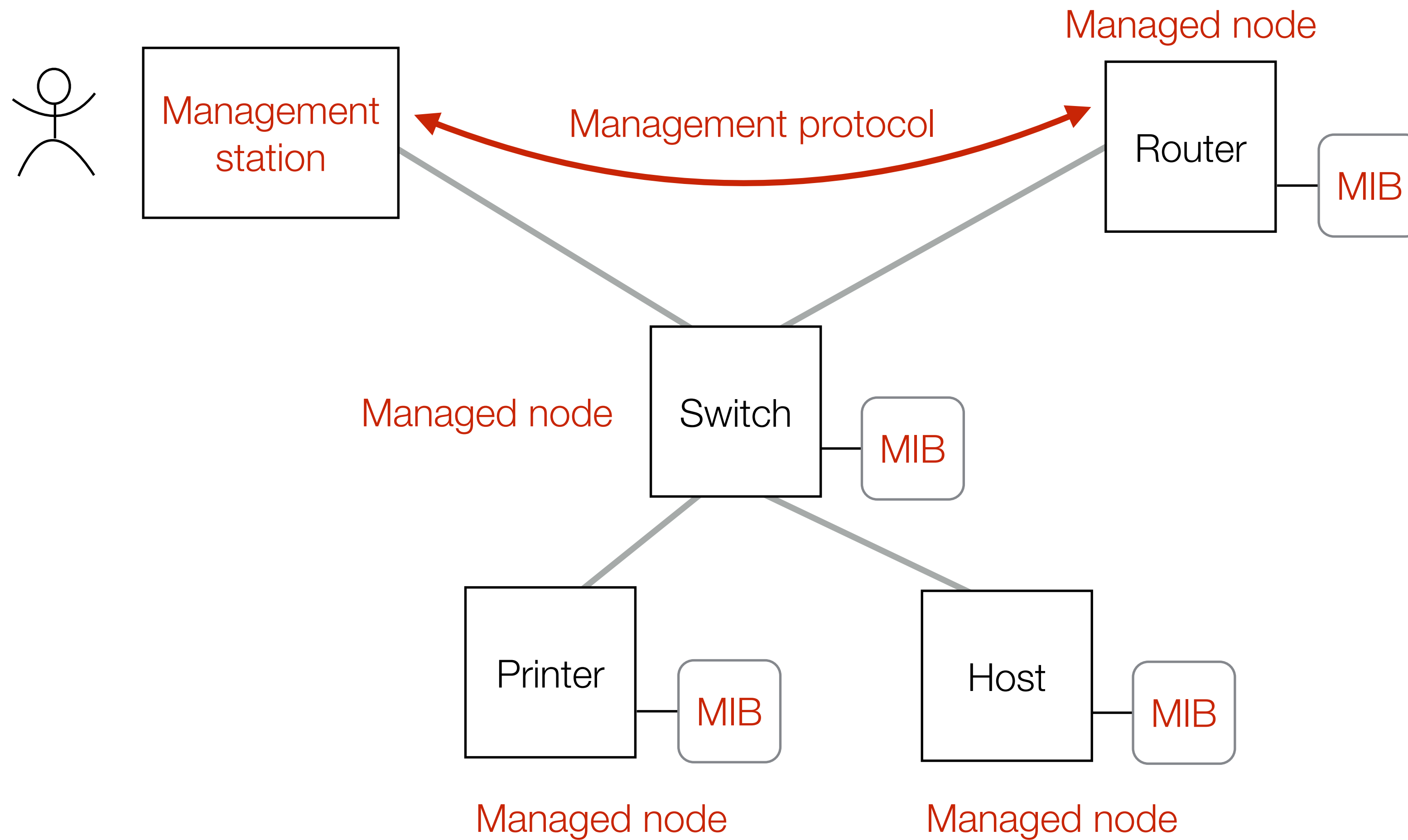
Network Management

- ▶ Networks are complicated...
- ▶ Targets of management:
 - configuration
 - faults
 - performance
 - security
 - accounting

Network Management

- ▶ Two aspects of management
 - information collection and dissemination
 - decision making
- ▶ Components:
 - managed node
 - management station
 - management protocol
 - management information base (MIB)

Network Management



Management Protocols

- ▶ Simple Network Management Protocol (SNMP)
 - another “simple” protocol...
 - polling and trapping
 - data representation (ASN.1)
 - object identifiers (OIDs)
- ▶ OID Example
 - iso(1) identified-organization(3) dod(6) internet(1) mgmt(2) mib-2(1) ip(4) ipInReceives(3)
 - 1.3.6.1.2.1.4.3

NETCONF

► Network Configuration Protocol (NETCONF)

- “provides mechanism to install, manipulate, and delete the configuration of network devices.” (RFC 6241)
- XML-based, realized as remote procedure calls (RPC)
- underlying transport must provide authentication and authorization
- a NETCONF implementation must support [ssh](#) transport

► YANG

- data modeling language
- describes data structures, data integrity constants, and data operations
- ... *Yet Another Next Generation*

Transport Layer

Transport Layer

- ▶ Big leap in the level of abstraction:
 - *Application Layer*: reliable, bidirectional, stream-oriented service
 - *Network Layer*: unreliable datagram service
- ▶ End-to-End Principle
 - as simple as possible network
 - all “smarts” at the end nodes

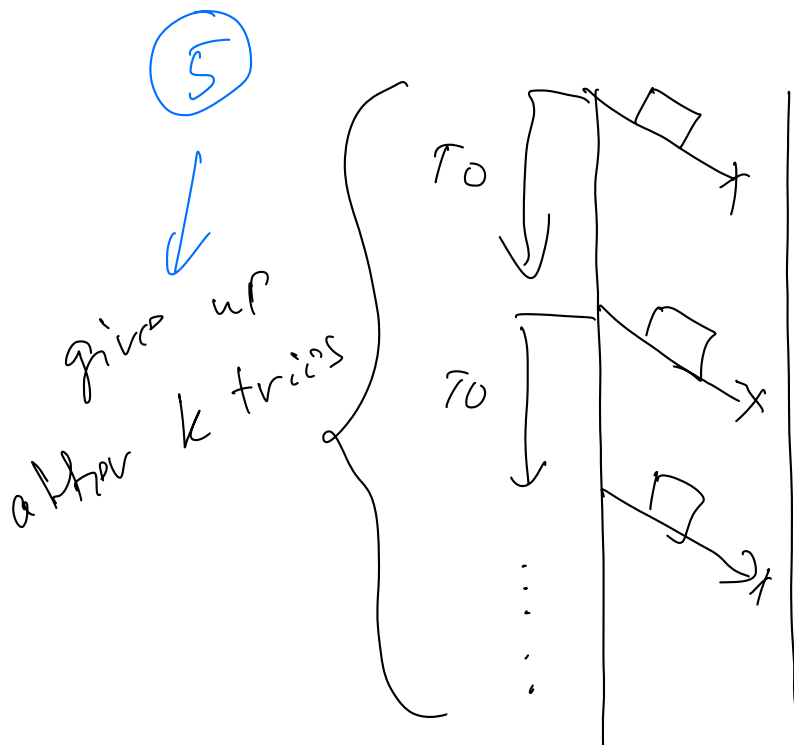
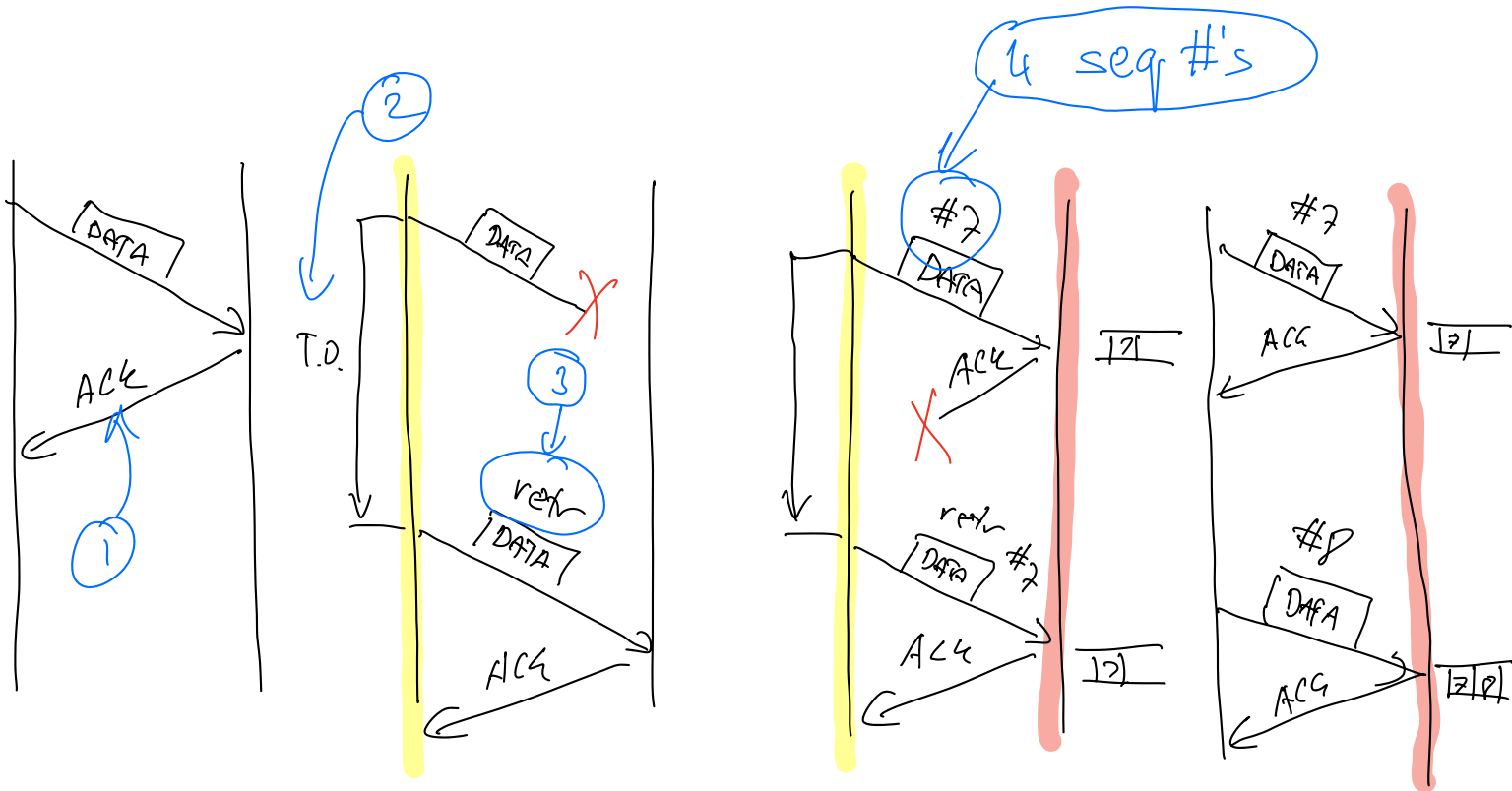
Functions of Transport Layer

- ▶ Addressing
 - port numbers (?)
- ▶ Error control
 - packet loss detection and retransmissions
- ▶ Flow and congestion control
 - controlling the transmission rate
- ▶ Session management

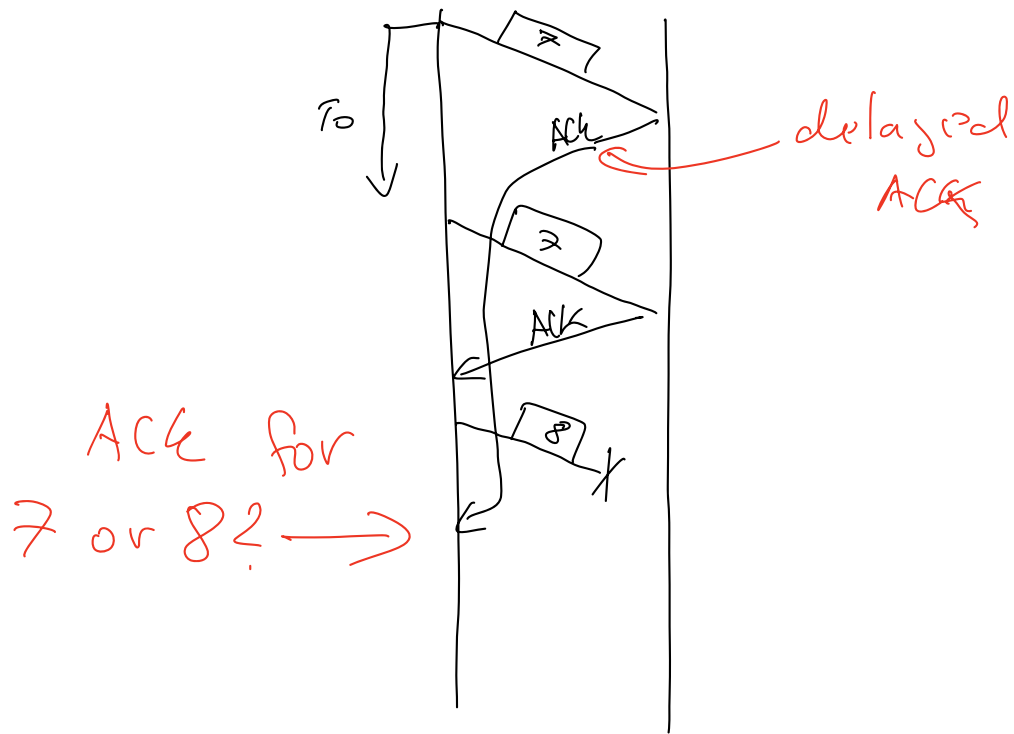
Principles of Reliable Transport

- ▶ **Goal:** deliver despite unreliability of the network layer or detect that delivery is not possible
- ▶ **Automatic Repeat reQuest (ARQ):**
 - acknowledgment
 - timeout
 - retransmission
 - give up after k retransmissions
 - sequence numbers on data packets
 - cumulative acknowledgment numbers

COMPONENTS OF ARQ



Ack #'s - MOTIVATION



Cumulative ACK numbers

- ▶ Method 1 (obvious but not used):
 - ACK carries the sequence number of the packet it acknowledges
- ▶ Method 2 (**Cumulative ACK**, used by TCP)
 - ACK carries the lowest sequence number of the packets that were not yet received (sequence number of the next expected packet)

