

CS 725/825 & IT 725

Lecture 15

# Network Management

## Transport Layer

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October 25 2023

# Network Management

# Network Management

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

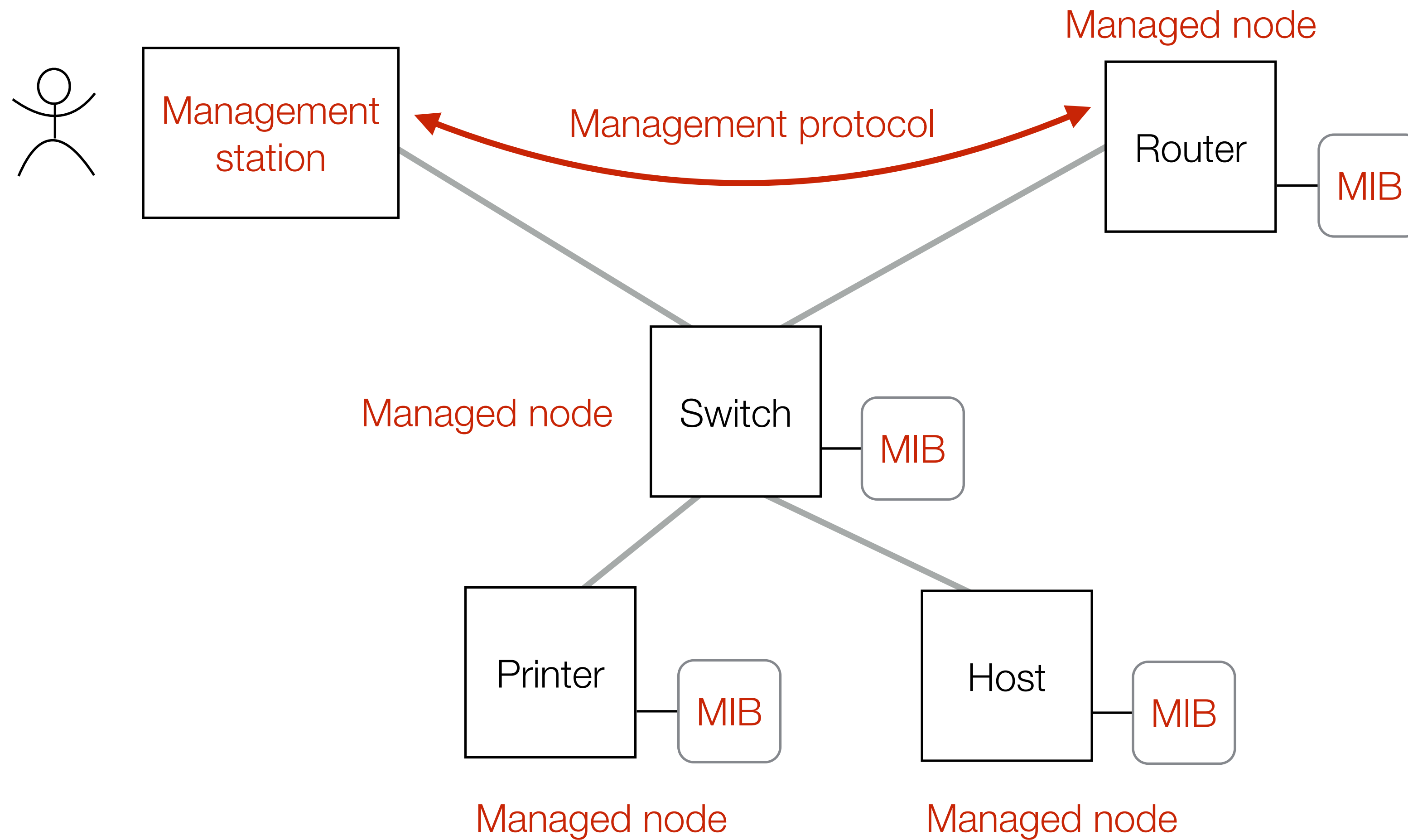
# Network Management

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

# Network Management

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# Management Protocols

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- ▶ 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

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## ► 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

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- ▶ 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

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

# Principles of Reliable Transport

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- ▶ **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

# Cumulative ACK numbers

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- ▶ 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)

