Three planes in networks

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User plane, control plane, and management plane

• Management plane: consists of all the protocols needed to “configure” data tables for the operation of the network
  – For example, protocols for routing data dissemination (distributed or centralized)
  – Other functions: performance, fault mgmt., accounting, security
• Control plane:
  – Connection control protocols
    • in CO networks, this includes connection setup at each switch (connections at the network layer)
    • in CL networks, this includes connection setup only at the endpoints (connections at the transport layer, if the TL protocol is reliable)
  – Call control protocols
• User plane: protocols for the actual flow of data
Routing protocol in all three types of networks - Phase 1

- Routing protocols exchange topology/loading/reachability information
- Routes to destinations are precomputed and stored in routing tables

Signaling protocol for NL connection setup in a PS CO network - Phase 2

- Connection setup consists of each switch on the path
  - Route lookup for next hop node to reach destination
  - CAC (Connection Admission Control) for buffer and BW
  - Writing the input/output label mapping tables and programming the scheduler
Signaling protocol for NL connection setup in a CS CO network - Phase 2

- Connection setup consists of each switch on the path
  - Route lookup for next hop node to reach destination
  - CAC (Connection Admission Control) for BW (note: no buffers)

User-plane packet forwarding in a PS CO network - Phase 3

- Labels are VPI/VCIs in ATM
- Labels are translated from link-to-link
User-plane actions in a circuit-switched network - Phase 3

- Bits arriving at switch I on time slot 1 on port a are switched to time slot 2 of port c

User-plane packet forwarding in a CL PS network - Phase 3

- Packet headers carry destination host address (unchanged as it passes hop by hop)
- Each CL packet switch does a route lookup to determine the outgoing port/next hop node
Addressing

• Where are endpoint addresses used:
  – In CL PS networks, endpoint addresses are carried in packet headers
  – In CO networks, be it PS or CS, endpoint addresses are carried in connection setup messages

Summarized addresses

• What are summarized addresses?
• Why summarize addresses?
Summarized addresses

- What are summarized addresses?
  - An address that represents a group of endpoint addresses
  - e.g., all 212 numbers, 128.238 IP addresses
- Why summarize addresses?
  - Reduces routing table sizes – hold one entry for a summarized address instead of a large number of individual addresses
  - Reduces routing message lengths that convey reachability information

Examples of signaling protocols

- SS7 (Signaling System No. 7) network (with its SS7 protocol stack) carries signaling messages to set up and release circuits in a telephone network
Examples of routing protocols

• In the Internet:
  – Link-state routing protocols, such as Open Path Shortest First (OSPF)
  – Distance-vector based routing protocols, such as Routing Information Protocol (RIP)

• In telephone networks:
  – Real-Time Network Routing (RTNR)

Examples of addressing schemes

• Internet
  – 4-byte IP addresses

• Telephone networks
  – 8-byte E.164 address (telephone number)

• ATM networks
  – 20-byte ATM End System Address (AESA)