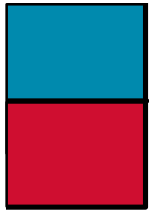

Agenda

- Introduction
- ATM Fundamentals
  - Rudimentary ATM Concepts
  - ATM Reference Model
  - ATM Service Categories
  - Traffic Management
- ATM Transport Standards
- Campus ATM Internetworking
- Wrap Up

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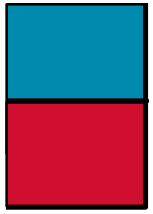

Traffic Management

- Why traffic management?
- Traffic control techniques
- ABR congestion feedback

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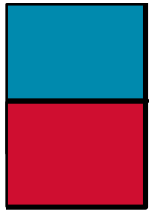

Why Traffic Management?

- Proactively combat congestion
- Provision for priority control
- Maintain well-behaved traffic

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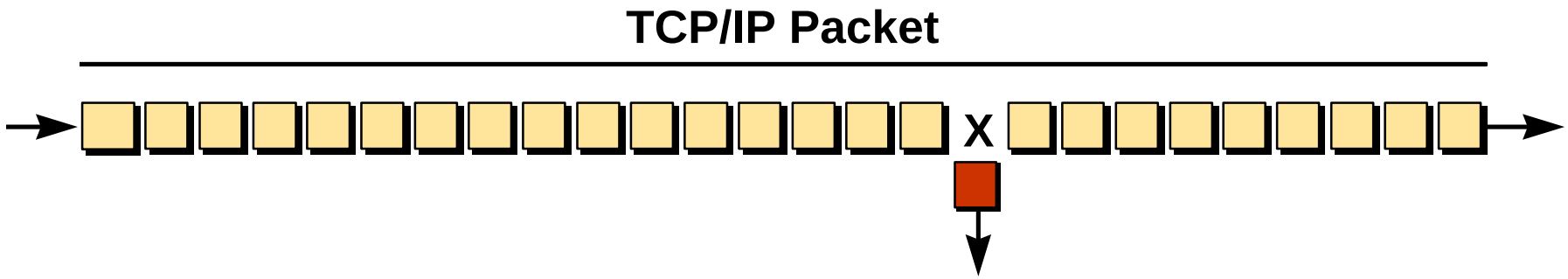
Why Traffic Management?

Cell Loss—Data's Critical Enemy

Ethernet (1500 Bytes) = 32 Cells

FDDI (4470 Bytes) = 96 Cells

IP over ATM–1577 (9180 Bytes) = 192 Cells



- Lose one cell and the rest are useless
- Need to re-transmit 32+ cells for one cell lost
- Congestion collapse is the result

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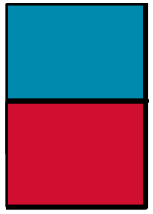

Traffic Control Techniques

- Connection management—Acceptance
- Traffic management—Policing
- Traffic smoothing—Shaping

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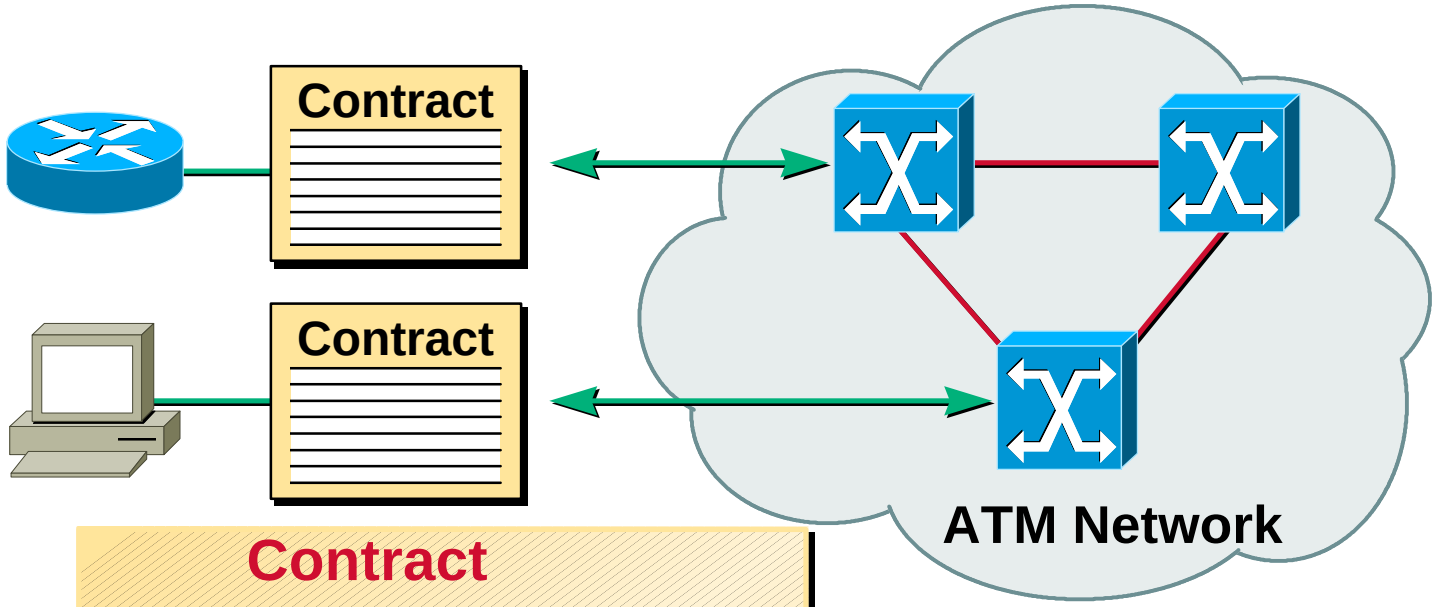
Traffic Control Techniques

Connection Management



Contract

- Traffic Parameters
  - Peak cell rate
  - Sustainable cell rate
  - Burst tolerance
  - Etc.
- Quality of Service
  - Delay
  - Cell loss

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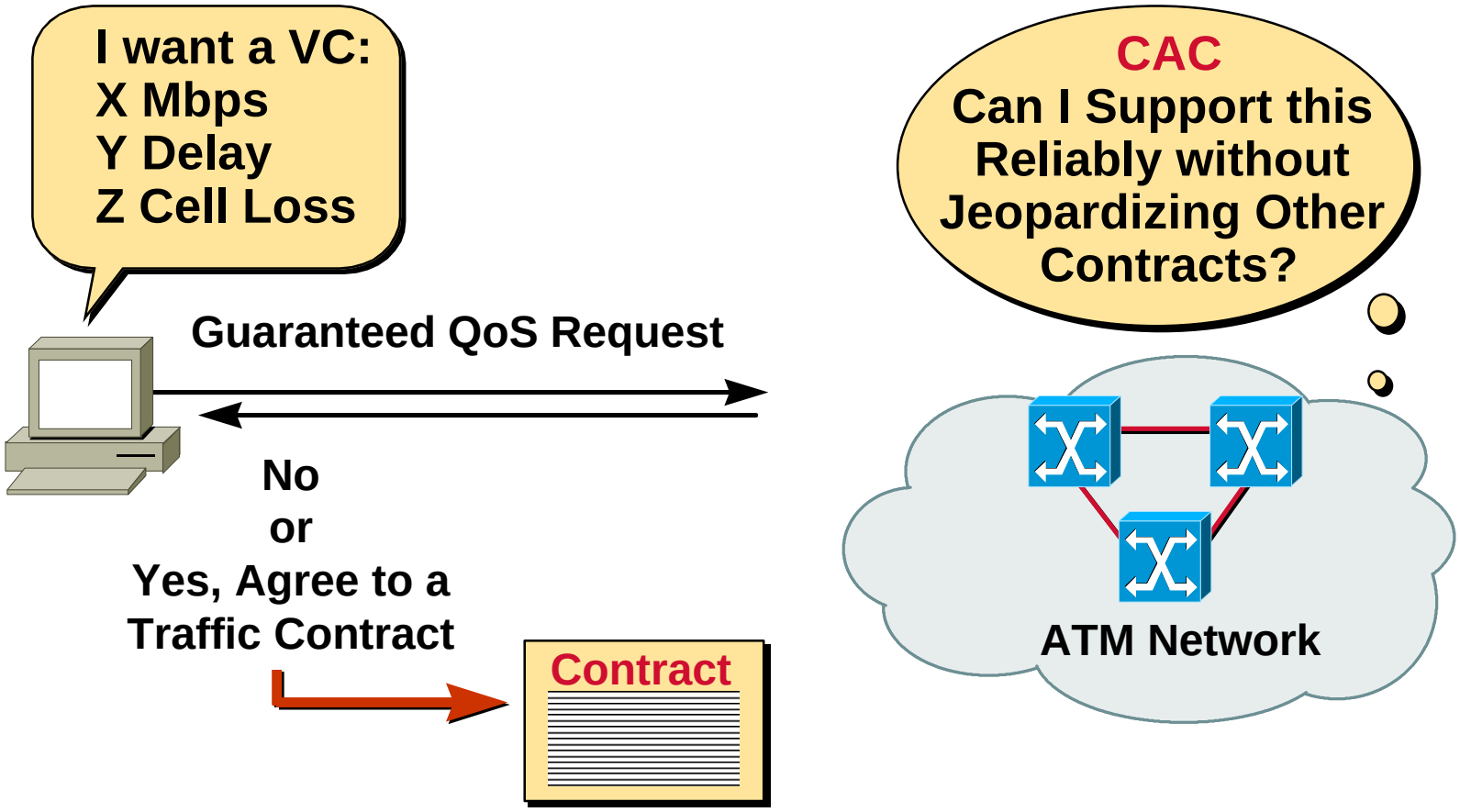
Traffic Control Techniques

Connection Management

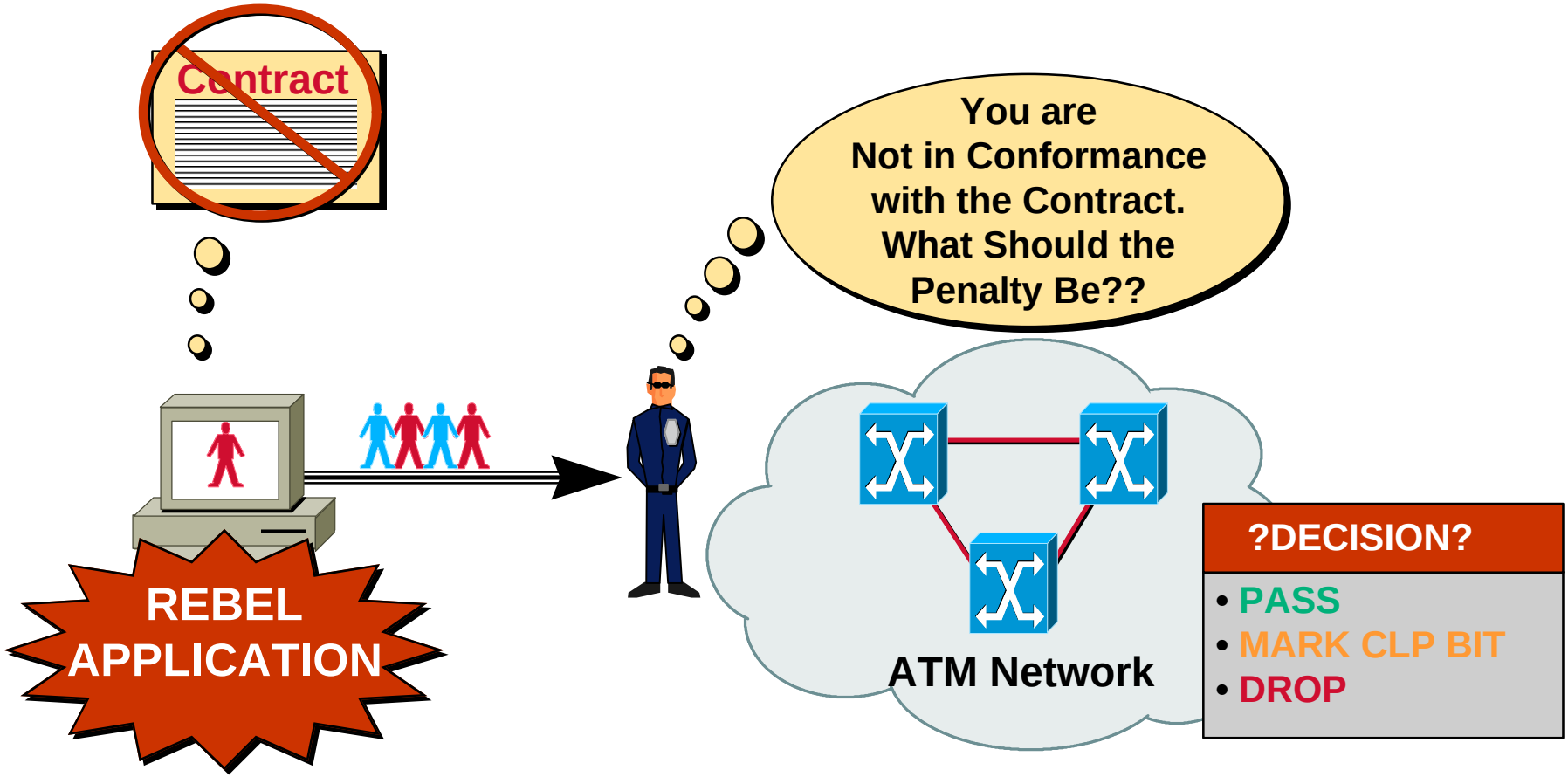
Connection Admission Control (CAC)



Traffic Control Techniques

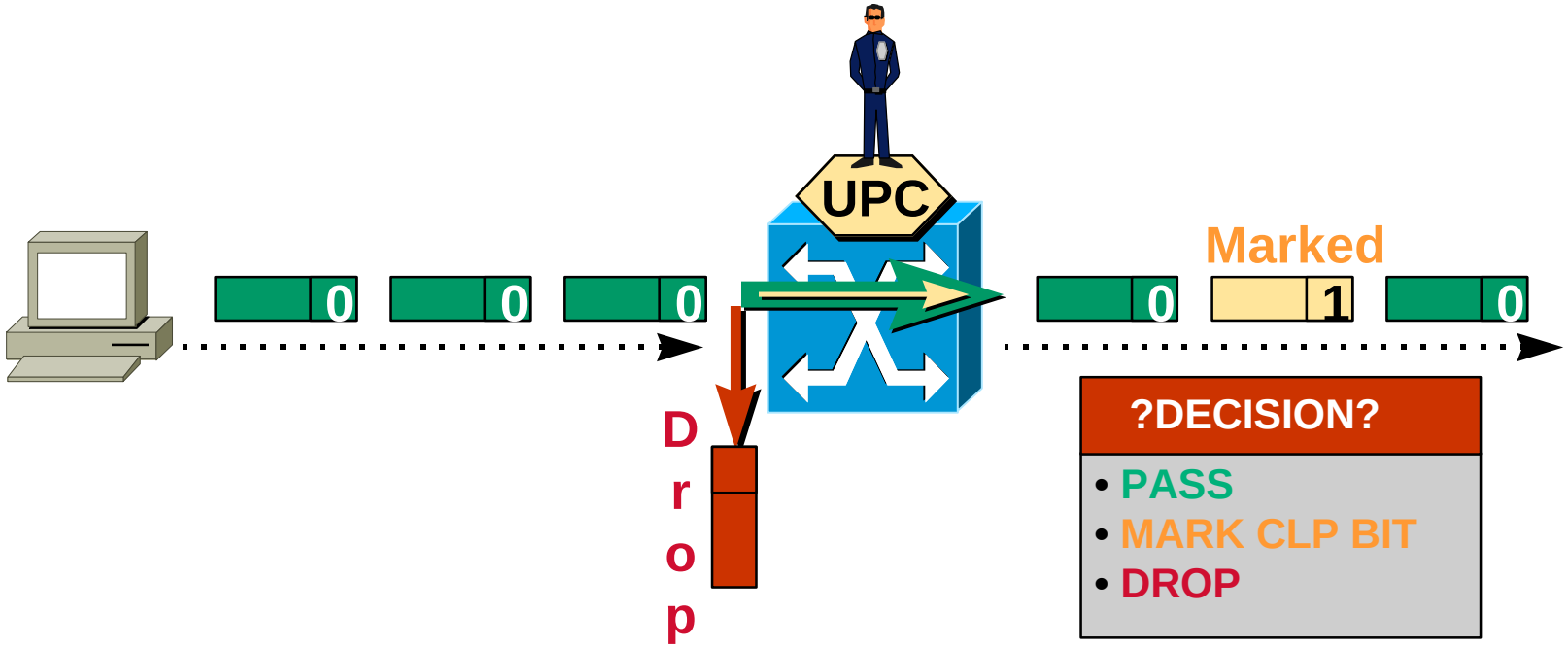
Traffic Management

Usage Parameter Control (UPC) aka Policing



Traffic Control Techniques

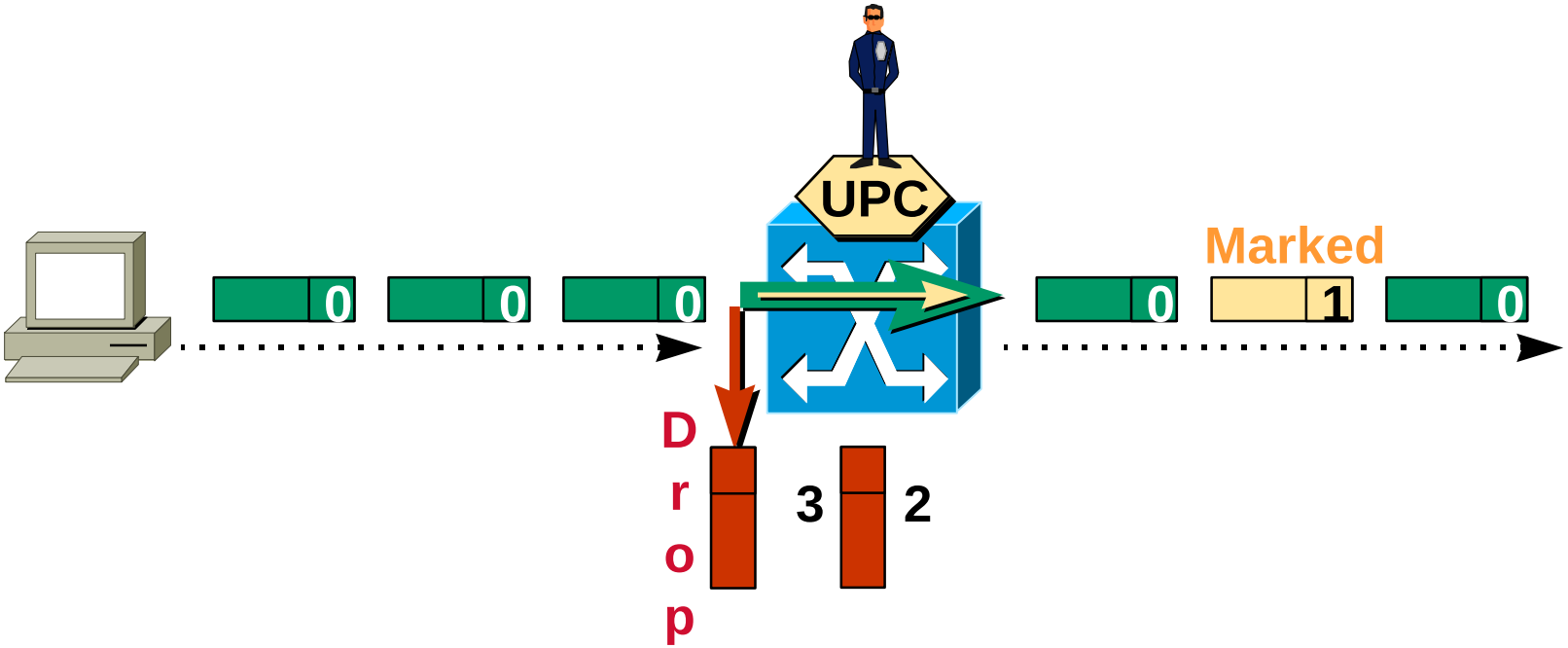
Traffic Management



- CLP Control—When congested, drop marked cells
- Public UNI—Generic Cell Rate Algorithm (GCRA)

Traffic Control Techniques

Traffic Management

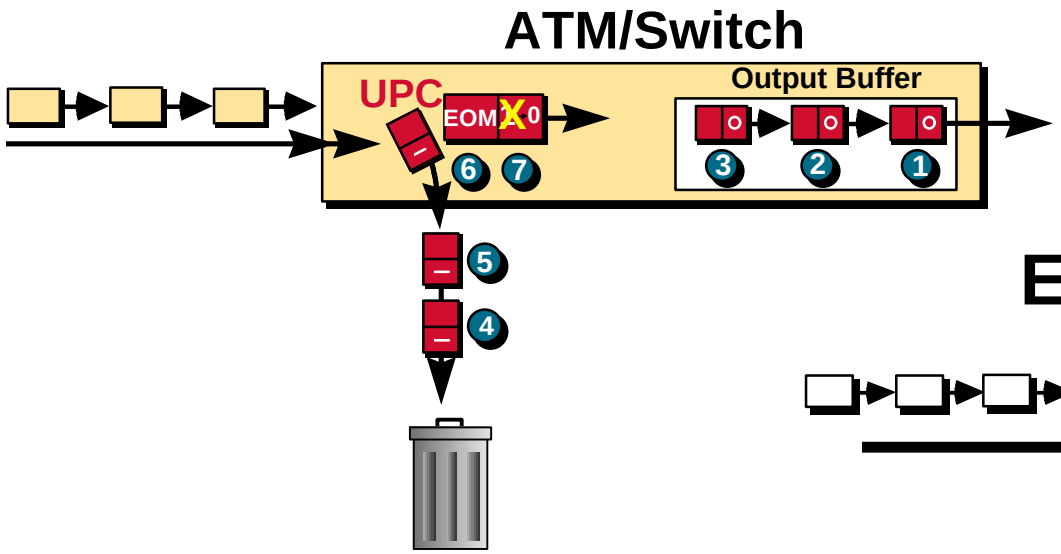


- Tail Packet Discard (TPD)
- Discard cells from same ‘bad’ packet

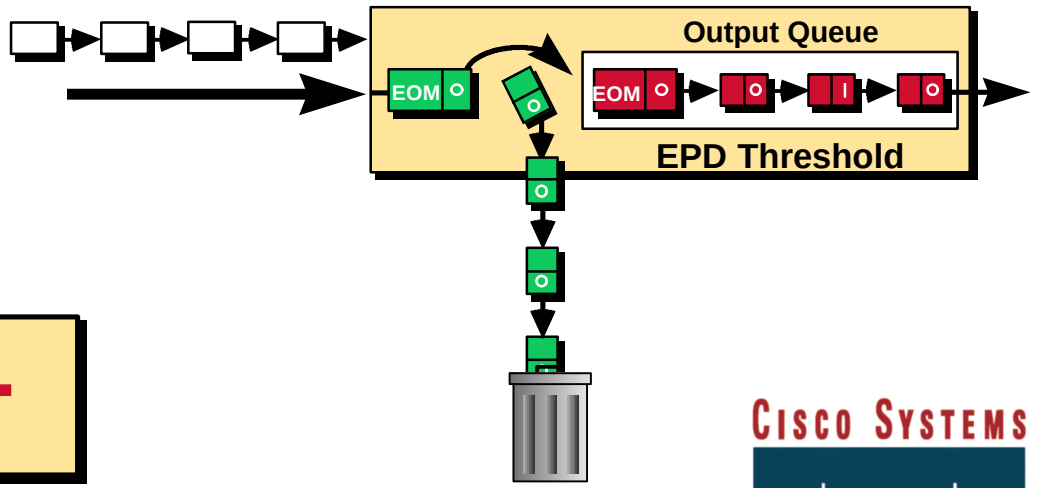
Traffic Control Techniques

Traffic Management

Intelligent Tail Packet Discard



Early Packet Discard



aka UBR+

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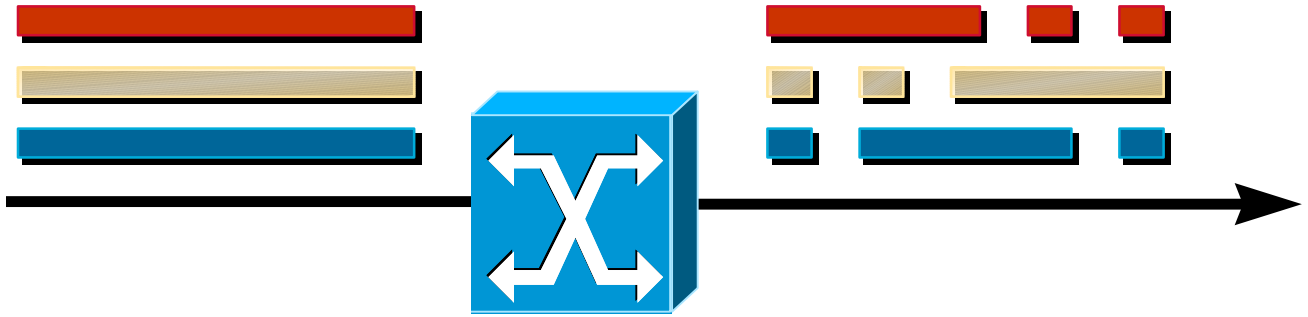
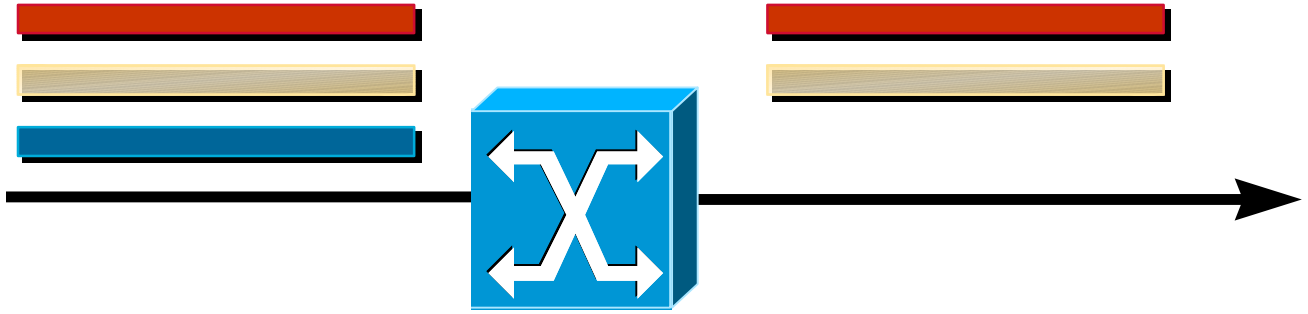
Traffic Control Techniques

Traffic Management

Switch without Packet Discard



Switch with Intelligent Packet Discard



Maximize “Goodput”

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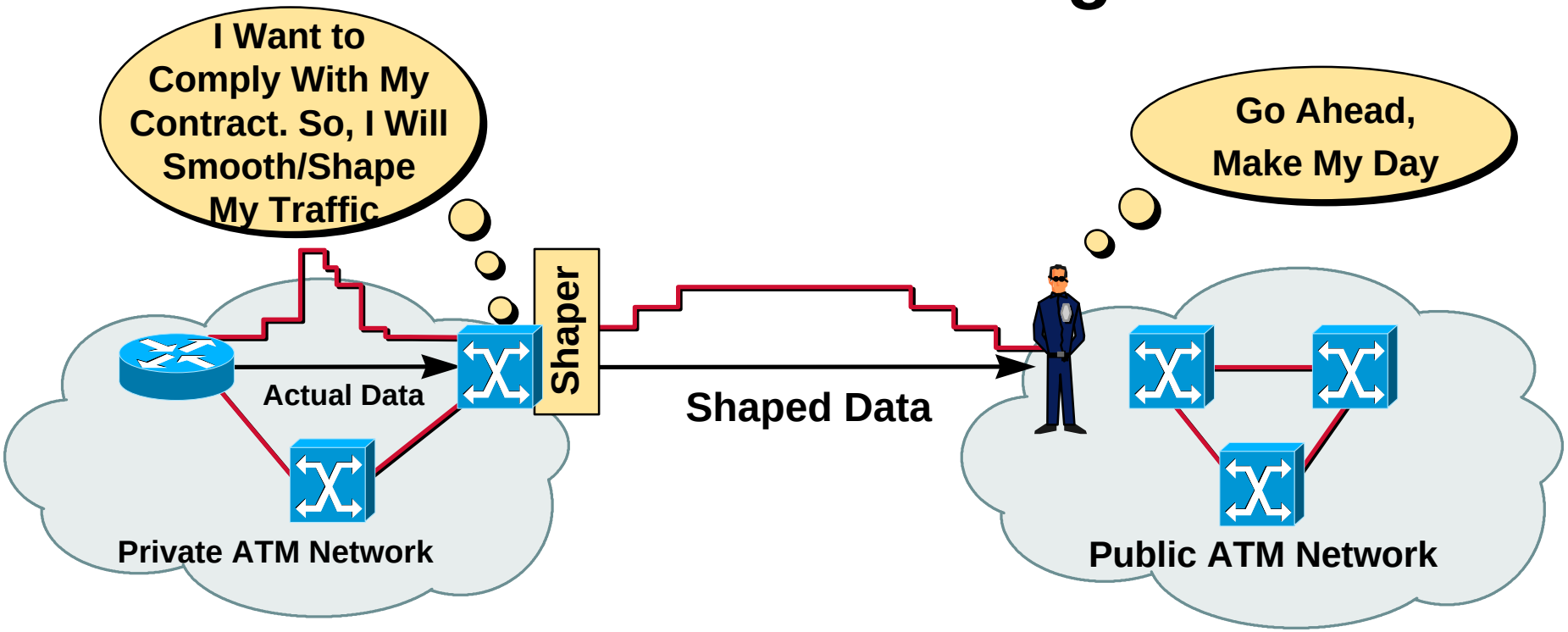
Traffic Control Techniques

Traffic Smoothing



- Traffic shaper at customer site
- Changes traffic characteristics
- Leaky bucket algorithm

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Traffic Control Techniques

ABR Congestion Feedback

- **RM—Resource Management cells**
- **Rate-based feedback mechanisms:**
  - **EFCI marking**
  - **Relative rate marking**
  - **Explicit rate marking**
  - **VS/VD**

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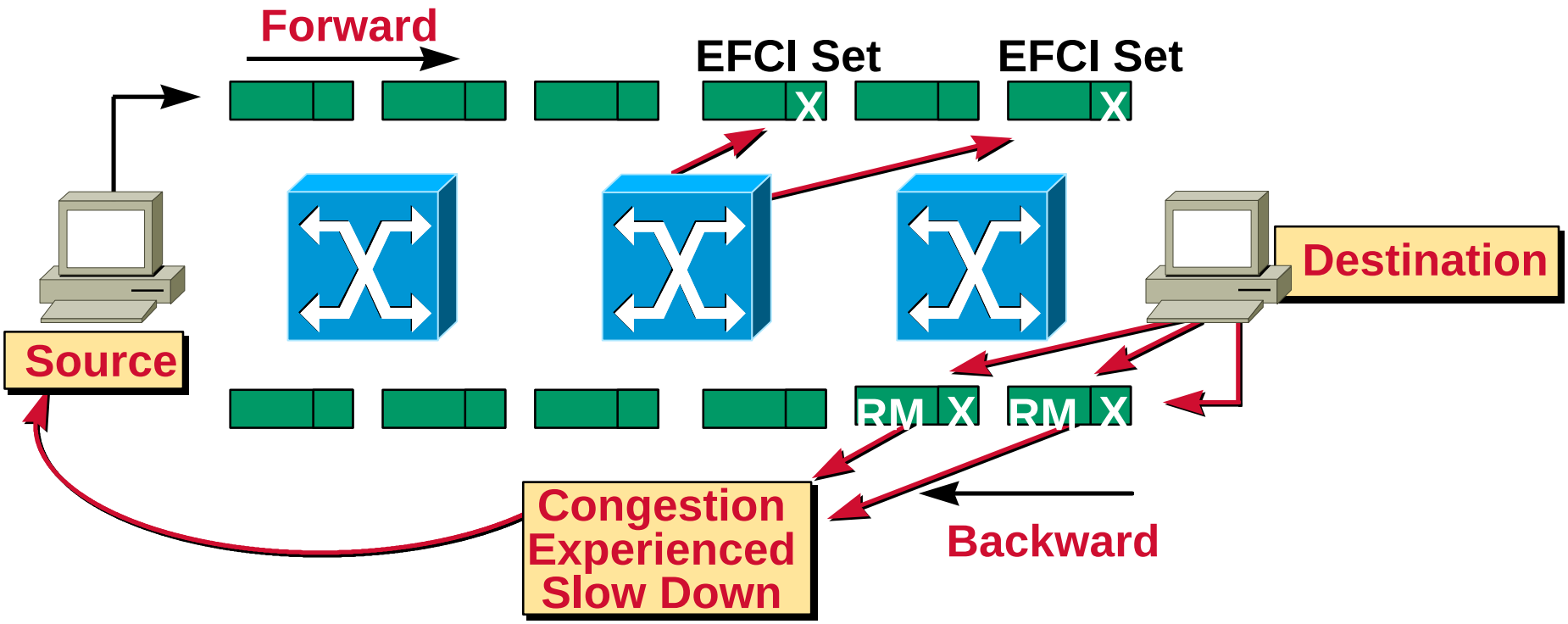
Traffic Control Techniques

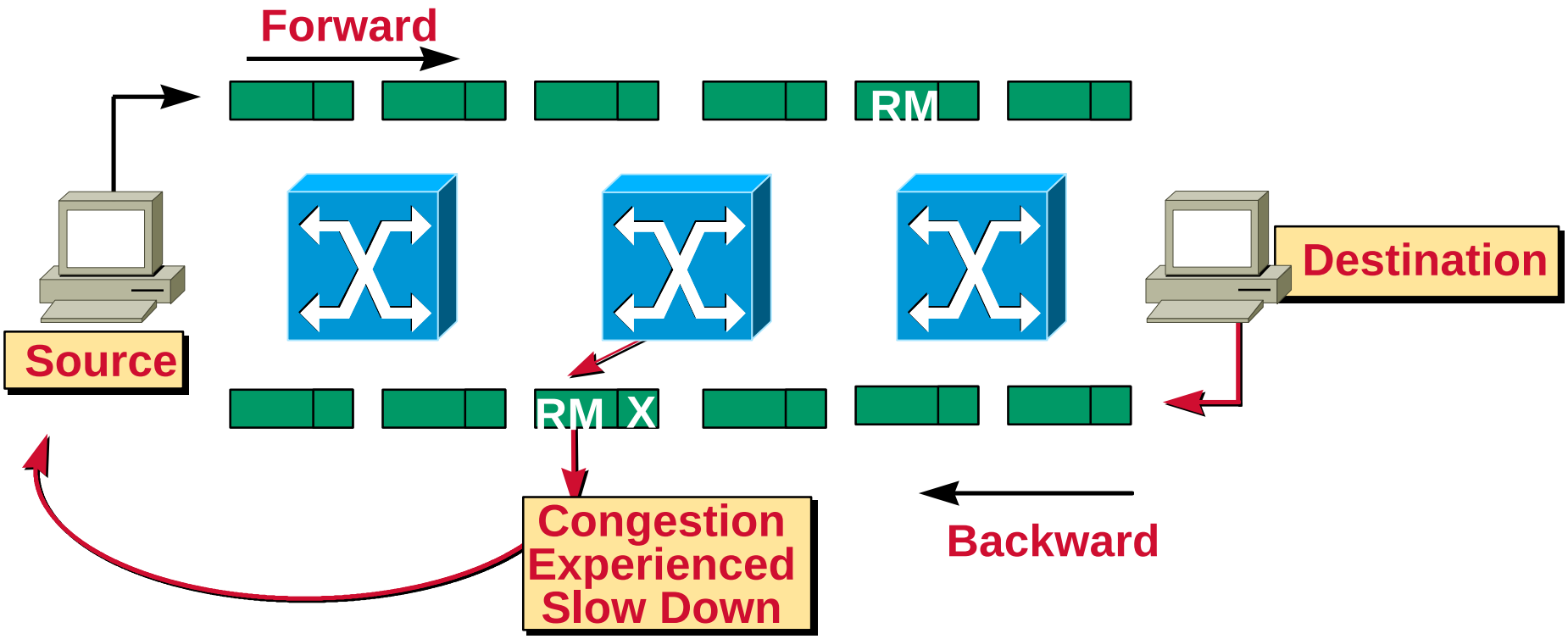
ABR Congestion Feedback



- **EFCI Marking—Explicit Forward Congestion Indicator**
  - **Congestion flag set on forward cells only**
  - **Destination end-system sends RM cells back to source**

Traffic Control Techniques

ABR Congestion Feedback



- **Relative rate marking**

  Switches can set congestion flag in backward RM cells

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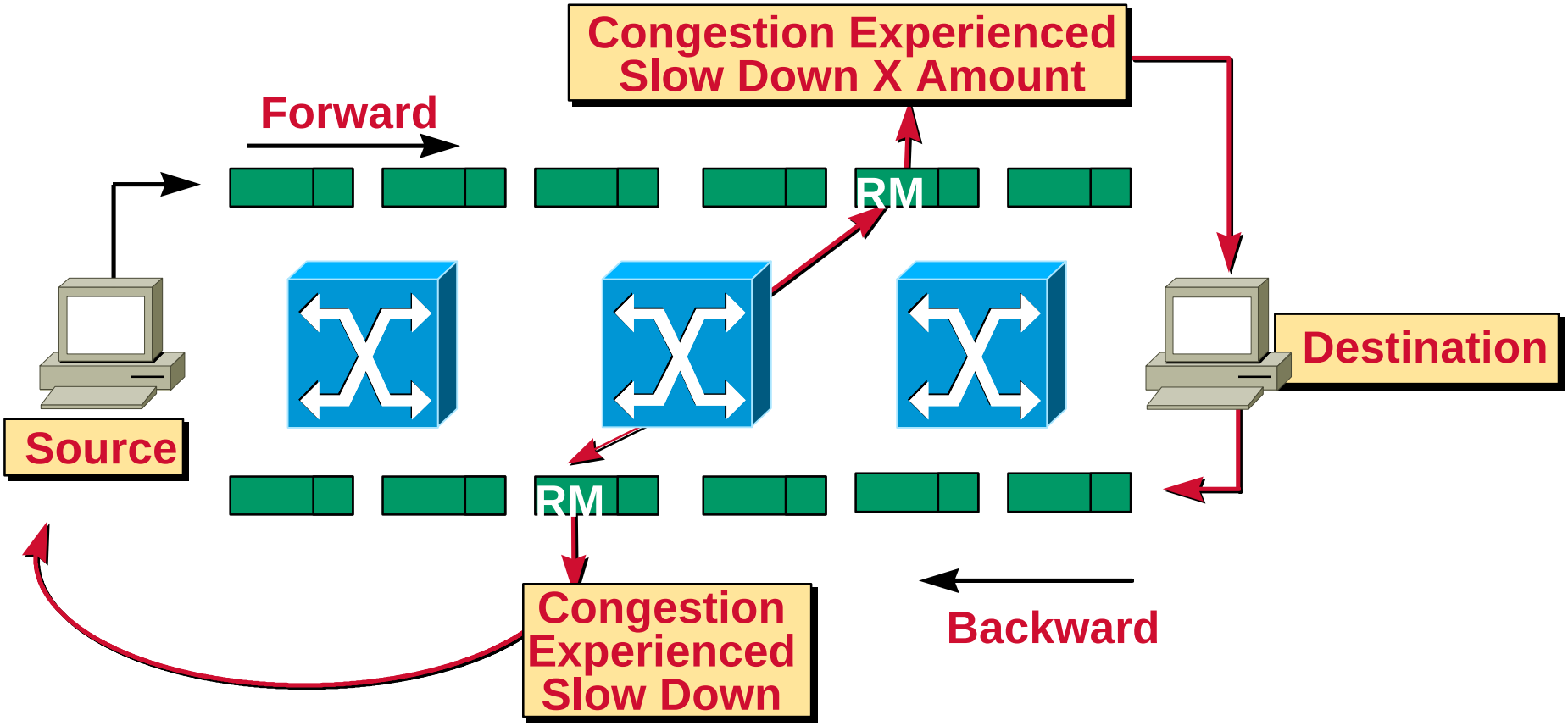
Traffic Control Techniques

ABR Congestion Feedback



- **Explicit rate marking**

  Switches can tell source at exactly what rate to transmit

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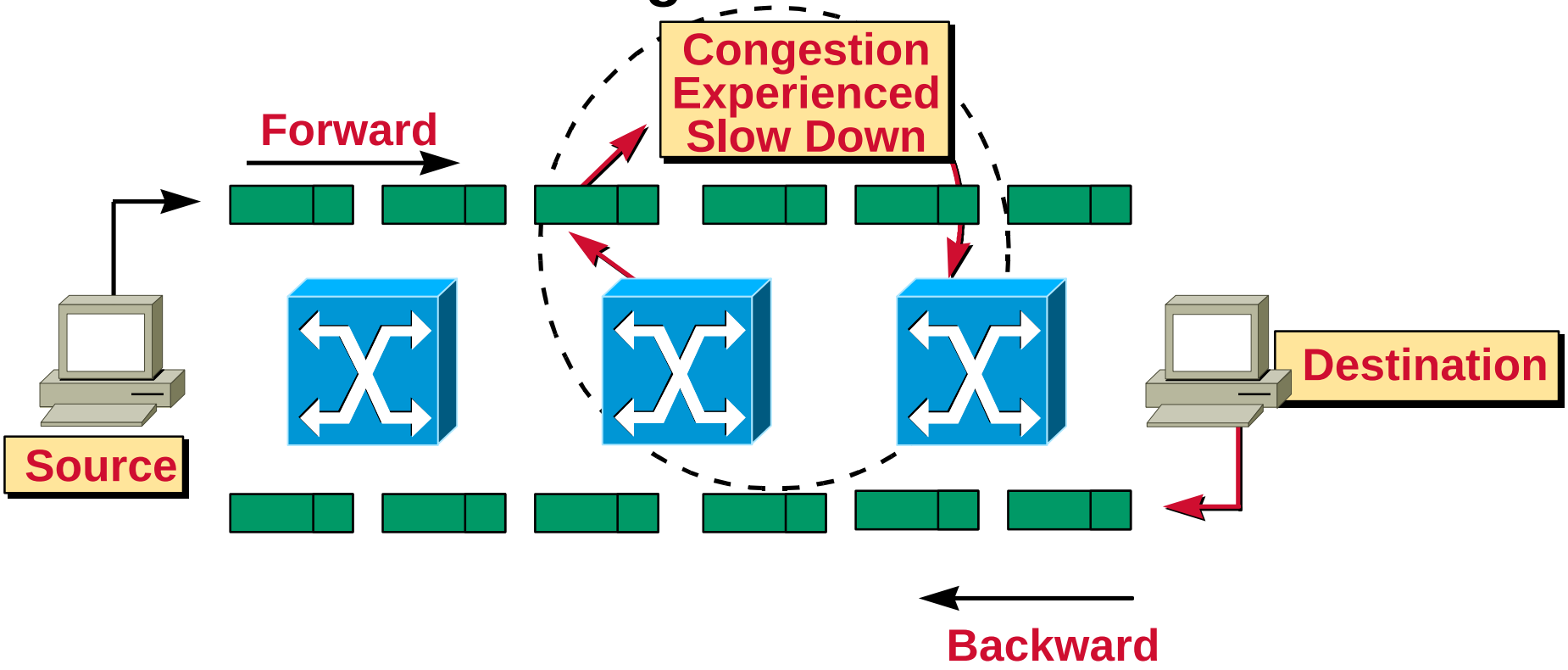
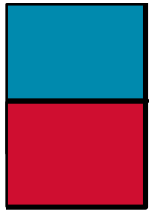
Traffic Control Techniques

ABR Congestion Feedback



- **VS/VD—Virtual source/virtual destination**
  - **Breaks the feedback loop into separate segments**
  - **Shortens length of feedback loop**



Traffic Control Techniques

Buffers Are Your Friend

- Absorb traffic bursts from simultaneous connections
- Switches schedule traffic based on priority of traffic according to QoS
- Switch must reallocate buffers as the traffic mix changes
- Effective buffering maximizes throughput of usable cells as opposed to raw cells (aka goodput)

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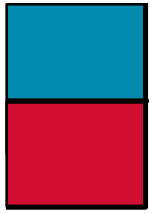

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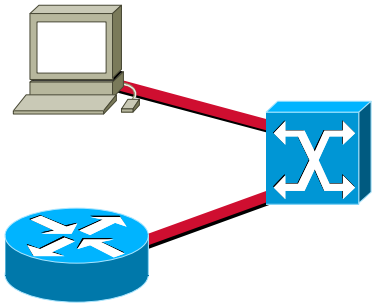
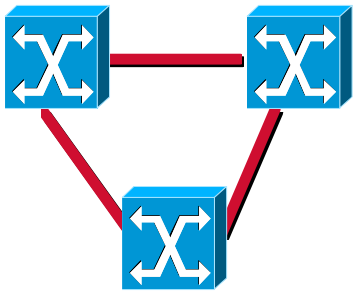
ATM Transport Standards

- The ATM forum
- ATM UNI
  - UNI-3.0, 3.1, 4.0
  - ILMI and address management
- ATM NNI
  - Path determination
  - IISP
  - PNNI





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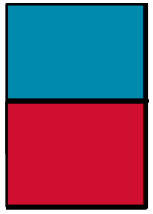

The ATM Forum

- Founded in fall of 1991
- Founding members: Cisco Systems, NET, Nortel, Sprint
- Now over 700 members
- Working Groups: Signaling, UNI, PNNI, LANE, MPOA
- http://www.atmforum.com

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ATM Transport Standards

- **UNI 3.0 and 3.1 not interoperable because they use different data link signaling protocols: Q.SAAL vs. SSCOP**

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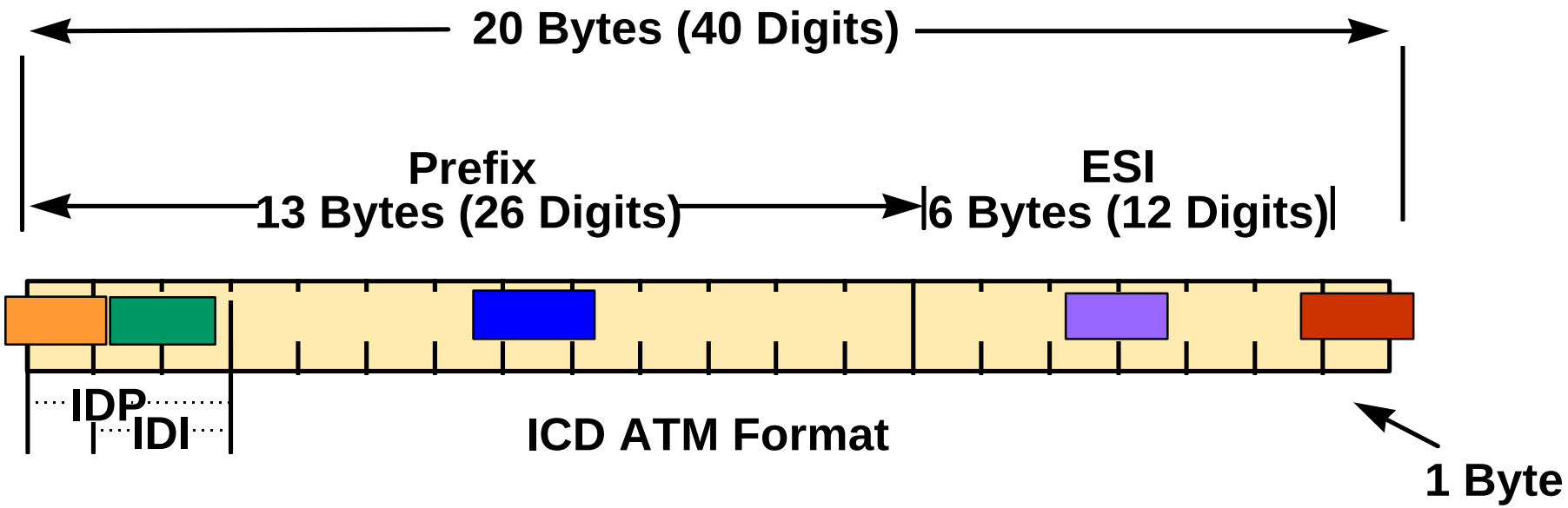
ATM Transport Standards

Address Management



AFI = Authority and Format Identifier
ICD = International Code Designator
IDP = Initial Domain Part
IDI = Initial Domain Identifier

DSP = Domain Specific Part
ESI = End System Identifier (MAC Address)
SEL = Selector

ATM Transport Standards

Address Management

- **Real life ATM address example:**

47.0091.0000.0000.0000.0000.0000.1111.1111.1111.00

----------ATM Prefix----------MAC--------SEL

- **Also referred to as an NSAP address**

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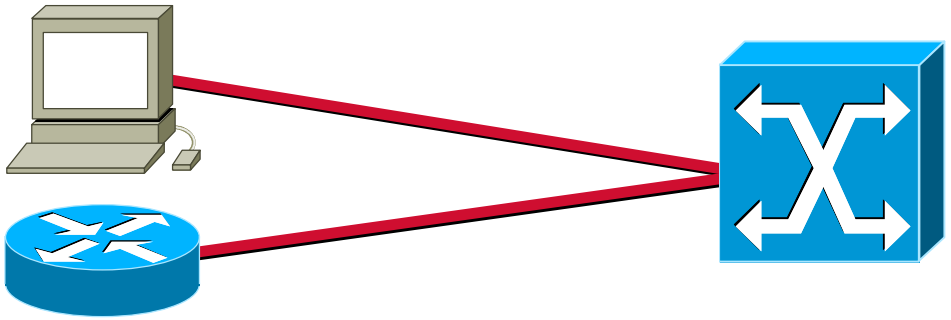
ATM Transport Standards

Address Management

ILMI Automatic Address Management



Here is My MAC Address (ESI)
(acdc.3124.efa8)
What is My ATM Prefix?

Here is Your ATM Prefix
47.0090……

Goal: No manual configuration of end stations

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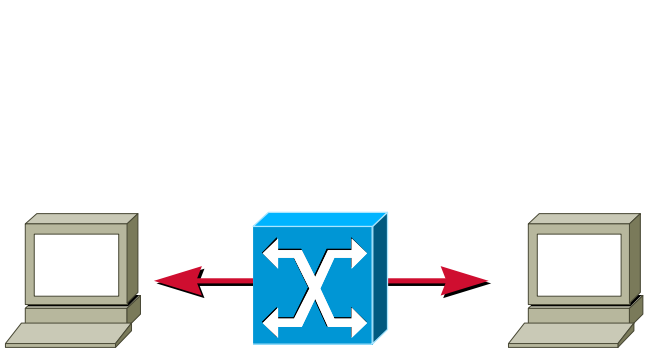
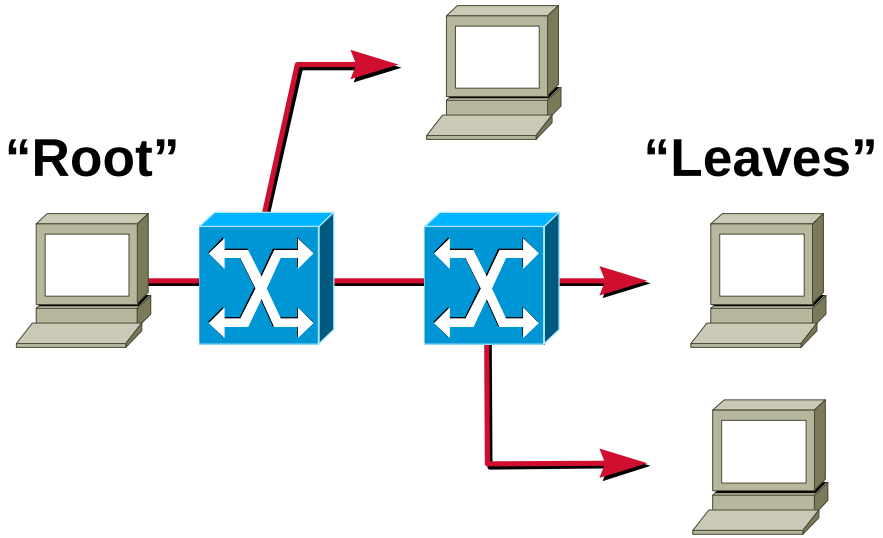
ATM Transport Standards

UNI 3.X Connection Types





- **Point-to-point**
  - **Uni-directional or bi-directional traffic**
- **Point-to-multipoint**
  - **Uni-directional (root-to-leaves) only**
  - **Only Root can add leaves**

ATM Transport Standards

UNI 4.0

- **Multicast support**

  Leaf initiated joins

  Group addressing

- **Better QoS definitions**

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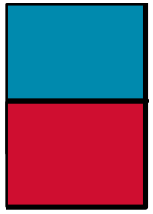

ATM Transport Standards

Path Determination

- What is path determination?
- Static routing: IISP
  (aka PNNI Phase0)
- Dynamic routing: PNNI
  (aka PNNI Phase1)

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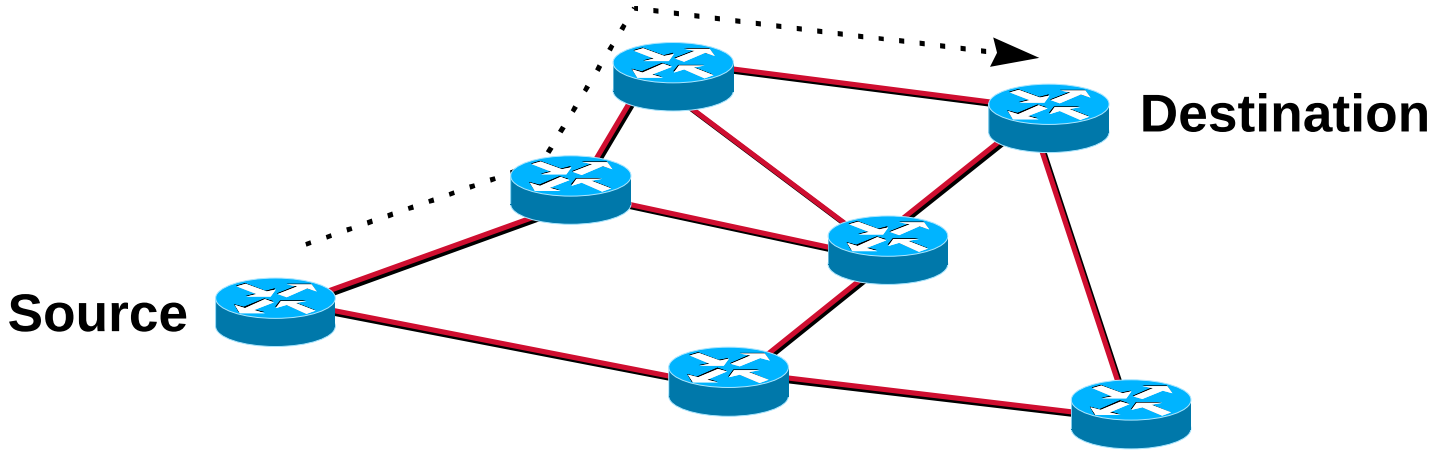
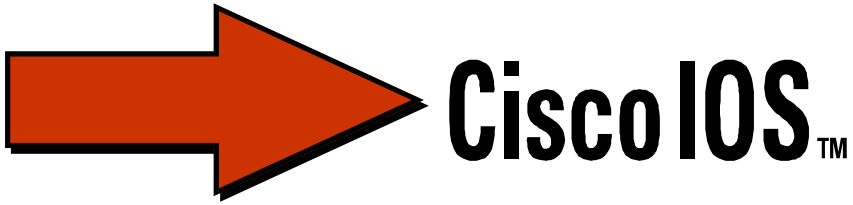
ATM Transport Standards

What Is Path Determination?



- **Traditionally router-based:**
  - **RIP**
  - **IGRP**
  - **OSPF**
  - **EIGRP**



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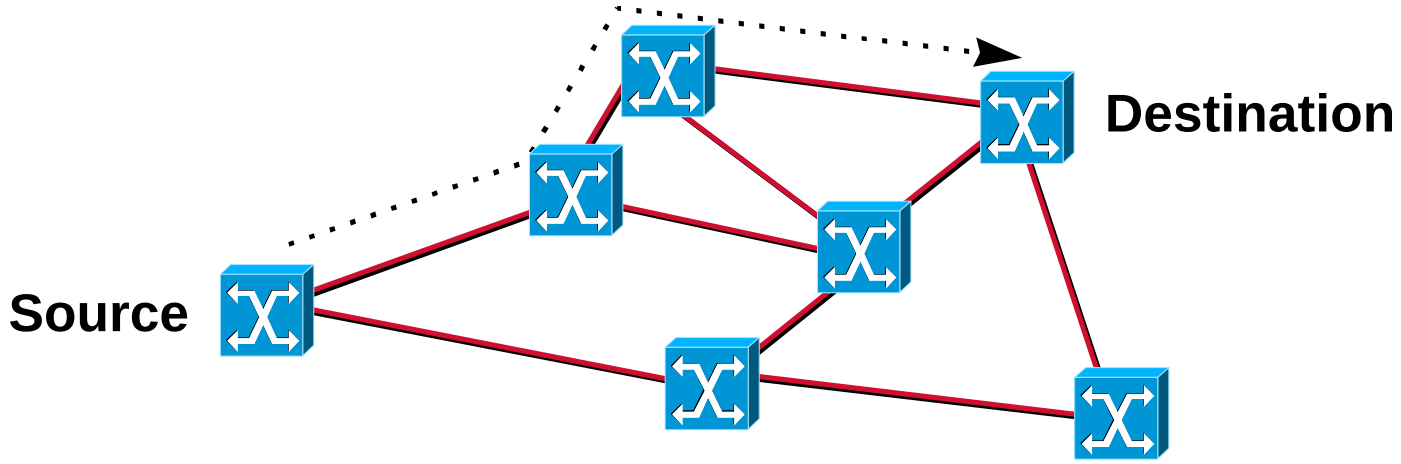
ATM Transport Standards

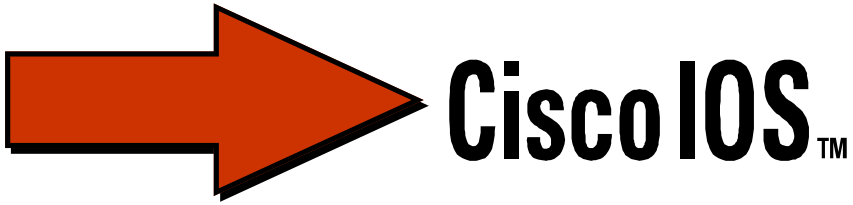
What Is Path Determination?



- **Now ATM switch-based:**

  IISP

  PNNI



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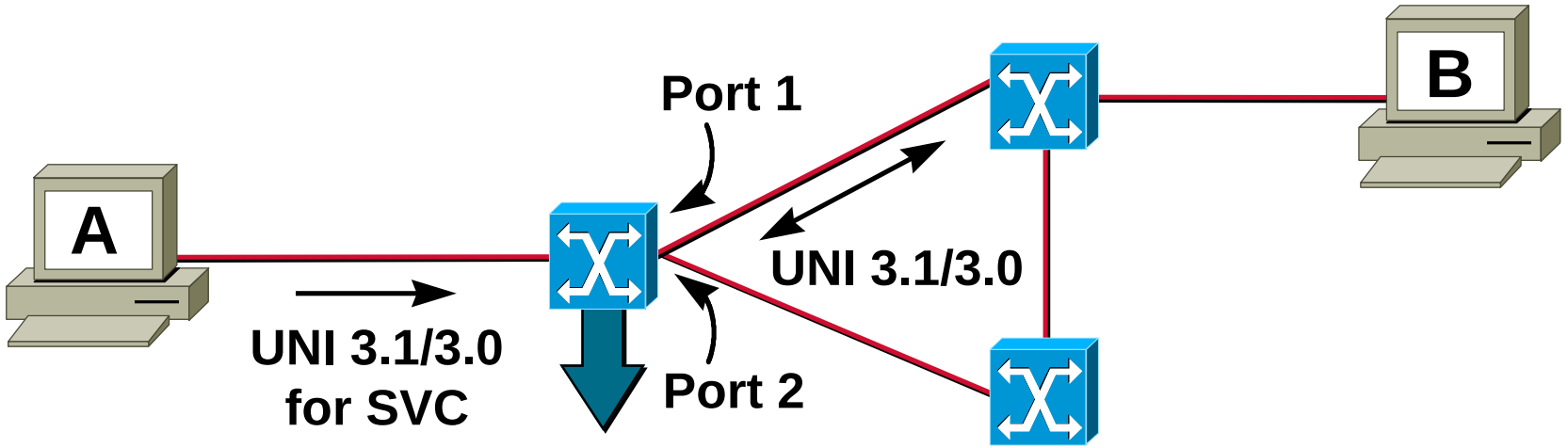
ATM Transport Standards

IISP



Destination	Primary	Secondary
B	Port 1	Port 2

- Interim Inter-switch Signaling Protocol (IISP)
  - Static route defined in ATM switches
  - Dynamic call setup via UNI signaling
  - Suitable for small ATM networks

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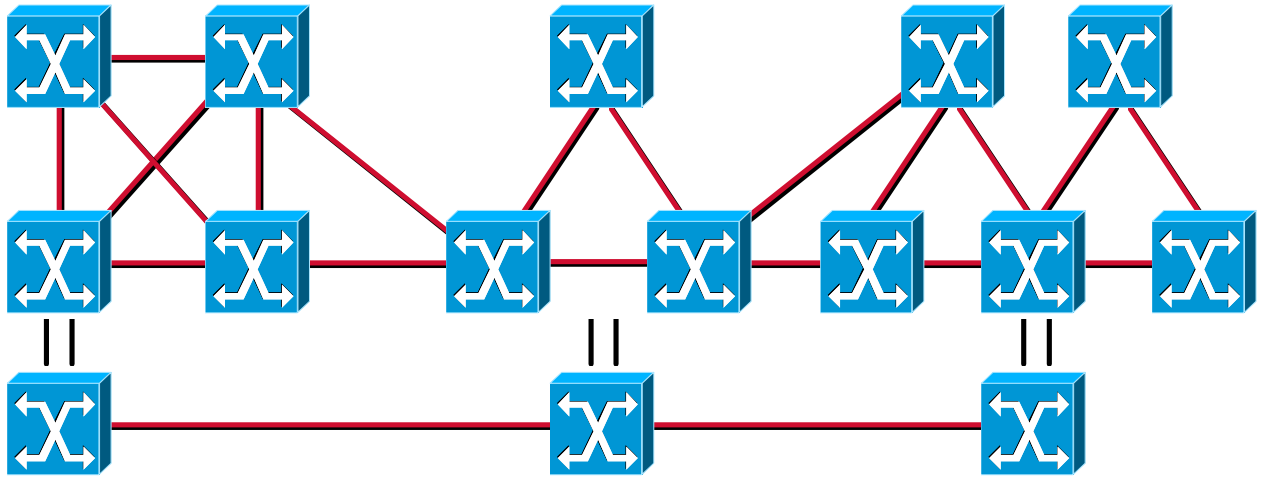
ATM Transport Standards

PNNI Phase 1



Routing Protocol

+ Signaling Protocol

PNNI

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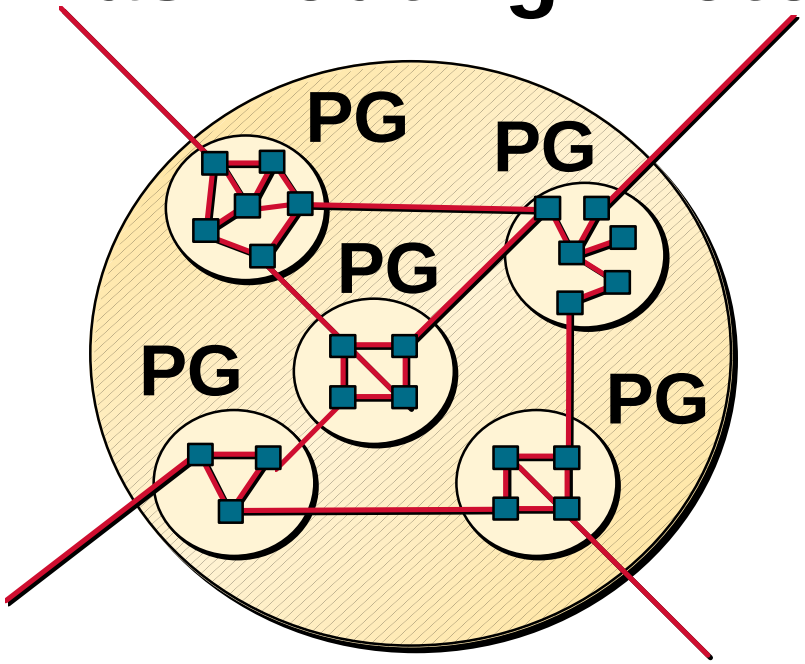
ATM Transport Standards

PNNI as Routing Protocol



- Distributes reachability and topology information between switches
- Dynamic re-routing around failures
- Routing for reachability based on OSPF
- Peer groups are analogous to an OSPF area
- PNNI allows hierarchical organization of network

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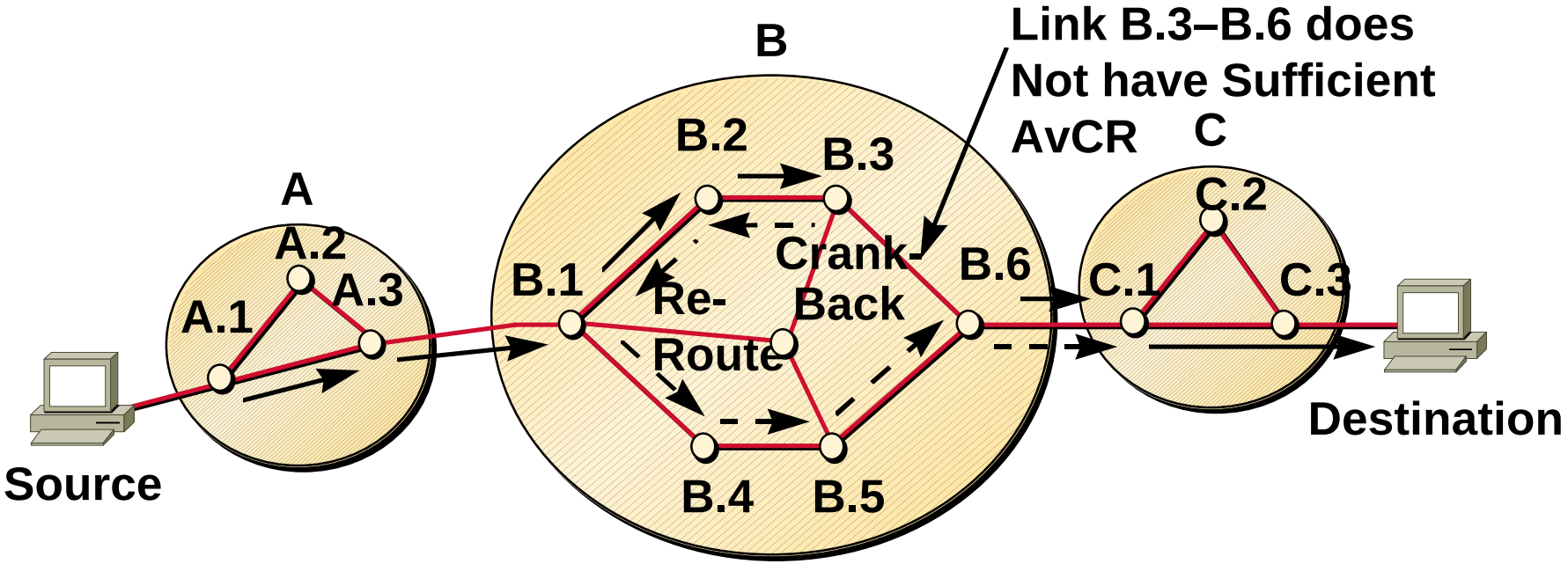
ATM Transport Standards

PNNI as Signaling Protocol



- PNNI—provides a path that satisfies the request QoS
- Negotiates metrics such as AvCR, MCTD, MCLR
- Uses Connection Admission Control (CAC)
- Uses Crankback for re-routing to alternate path

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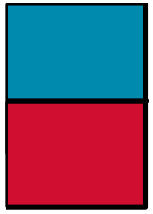

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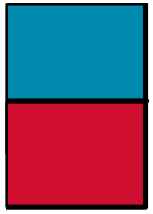

ATM Internetworking

- Challenges
- LANE 1.0
- LANE 2.0
- MPOA

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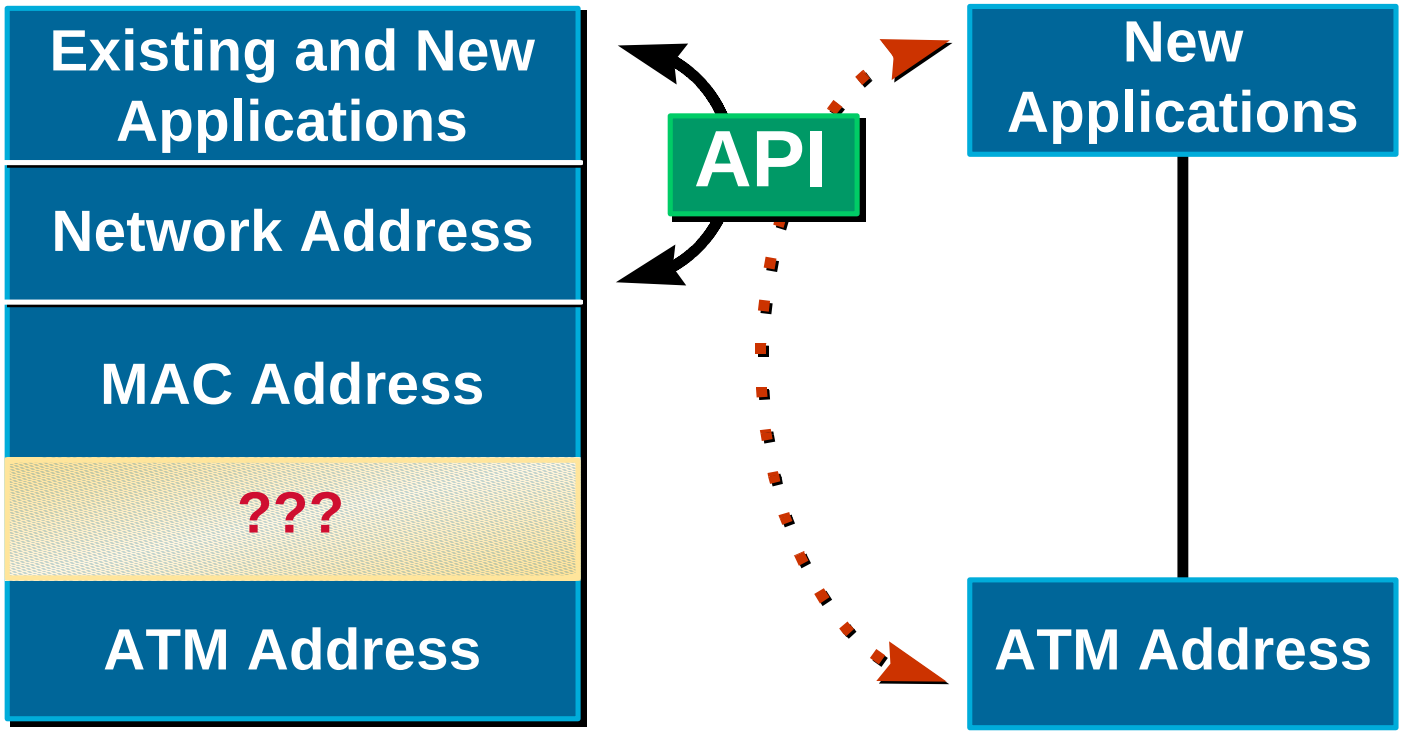
ATM Internetworking

The Challenges



- MAC address to ATM address resolution
- No Standard ATM API
- Broadcast handling

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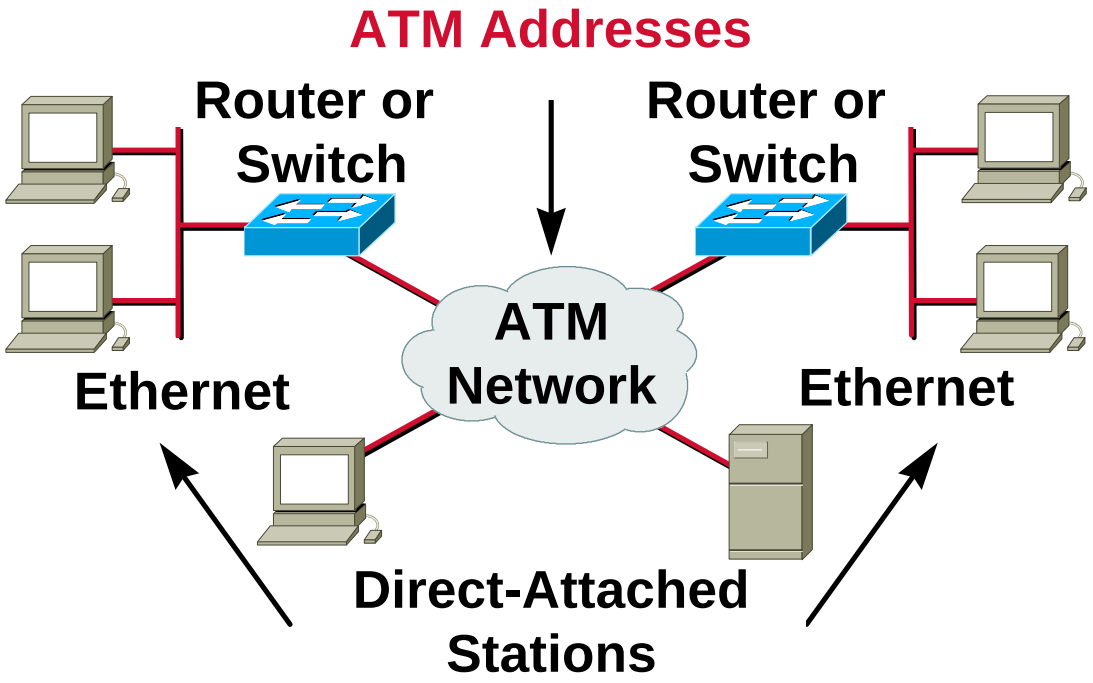
ATM Internetworking

Overlay Model



- Multiple layers of addressing

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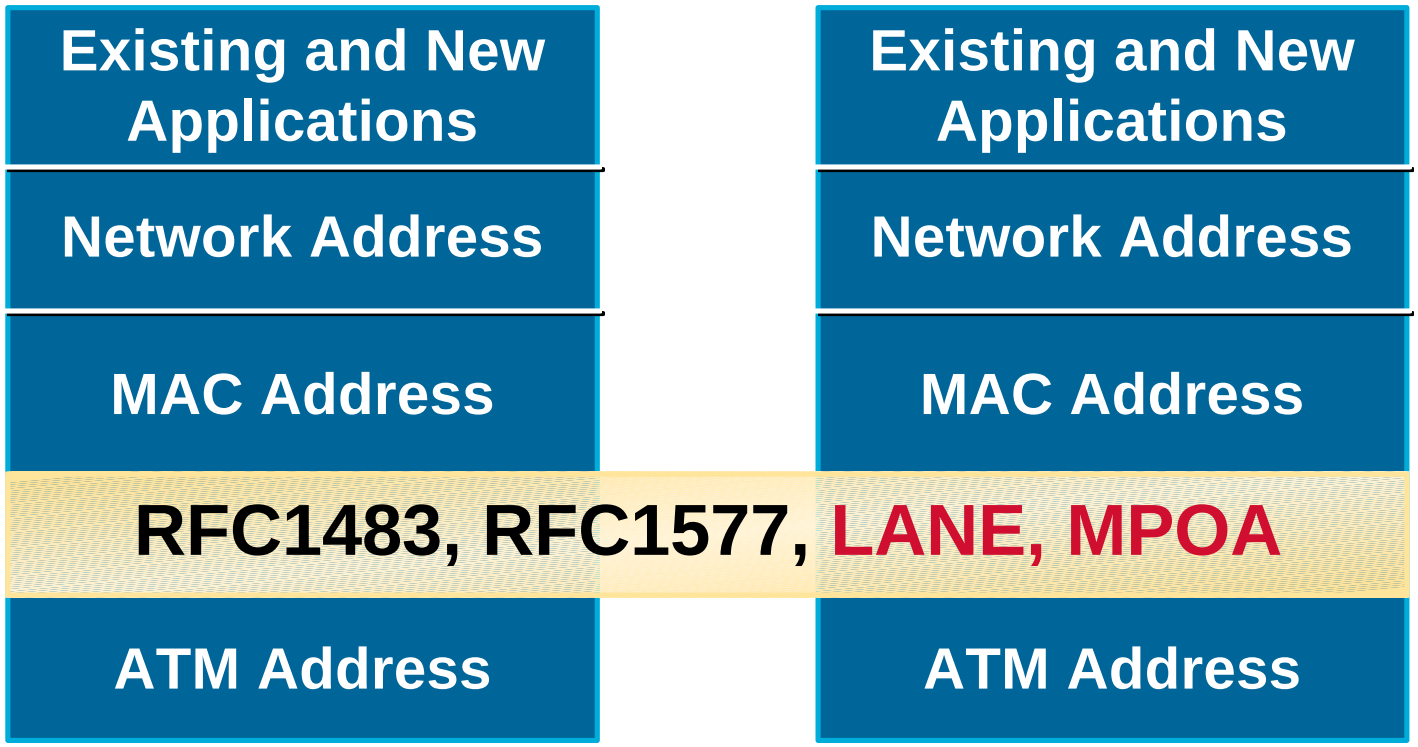
ATM Internetworking

Solutions



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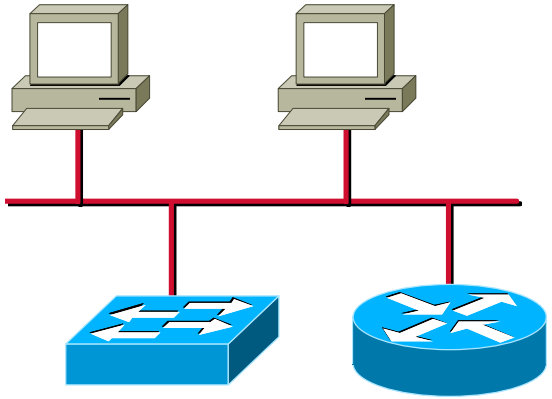
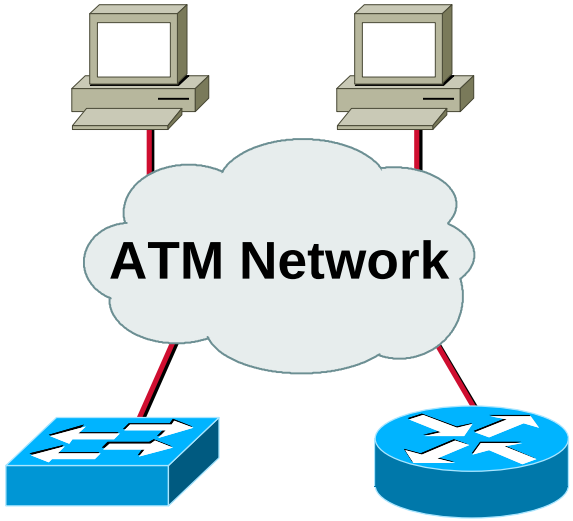
ATM Internetworking

LANE 1.0



Today's Physical LAN Segment

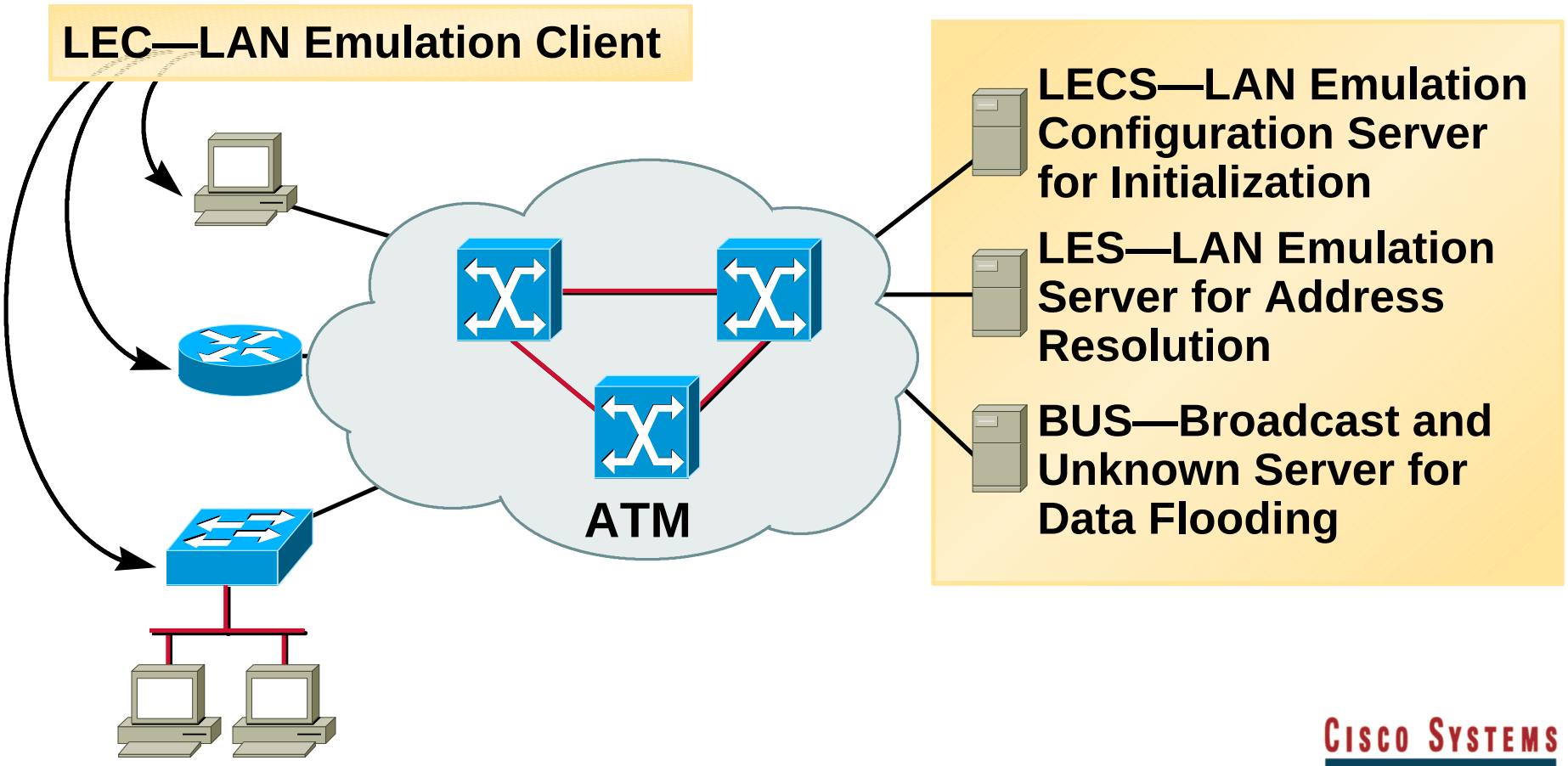


Emulated LAN (ELAN) Segment

- Hides ATM to upper layers
- Makes ATM look like Ethernet/Token Ring
- Supported in NICs, LAN switches, ATM routers
- Allows ATM hosts connectivity with legacy LANs

ATM Internetworking

LANE Terminology



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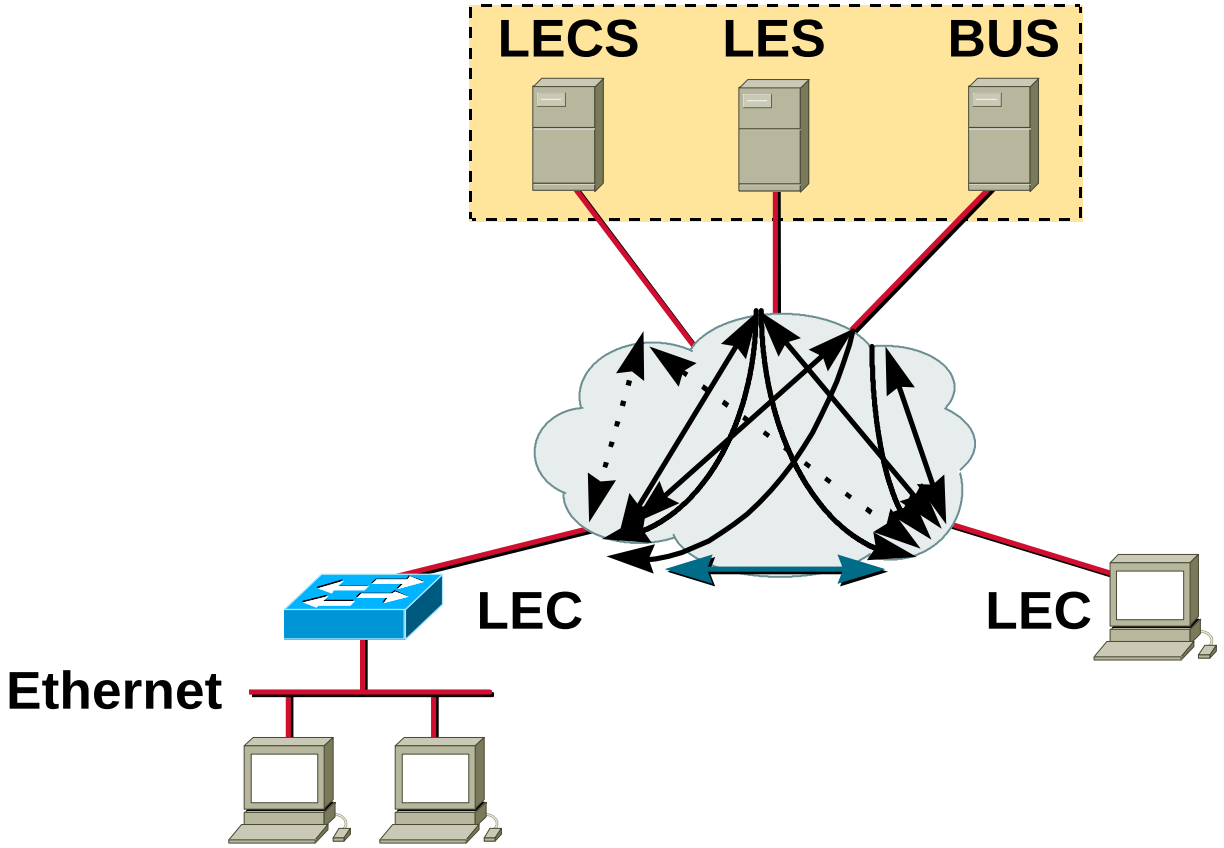
LANE in Operation

- SVC are required to make this a viable technology
- Setup of all VCC are automatic



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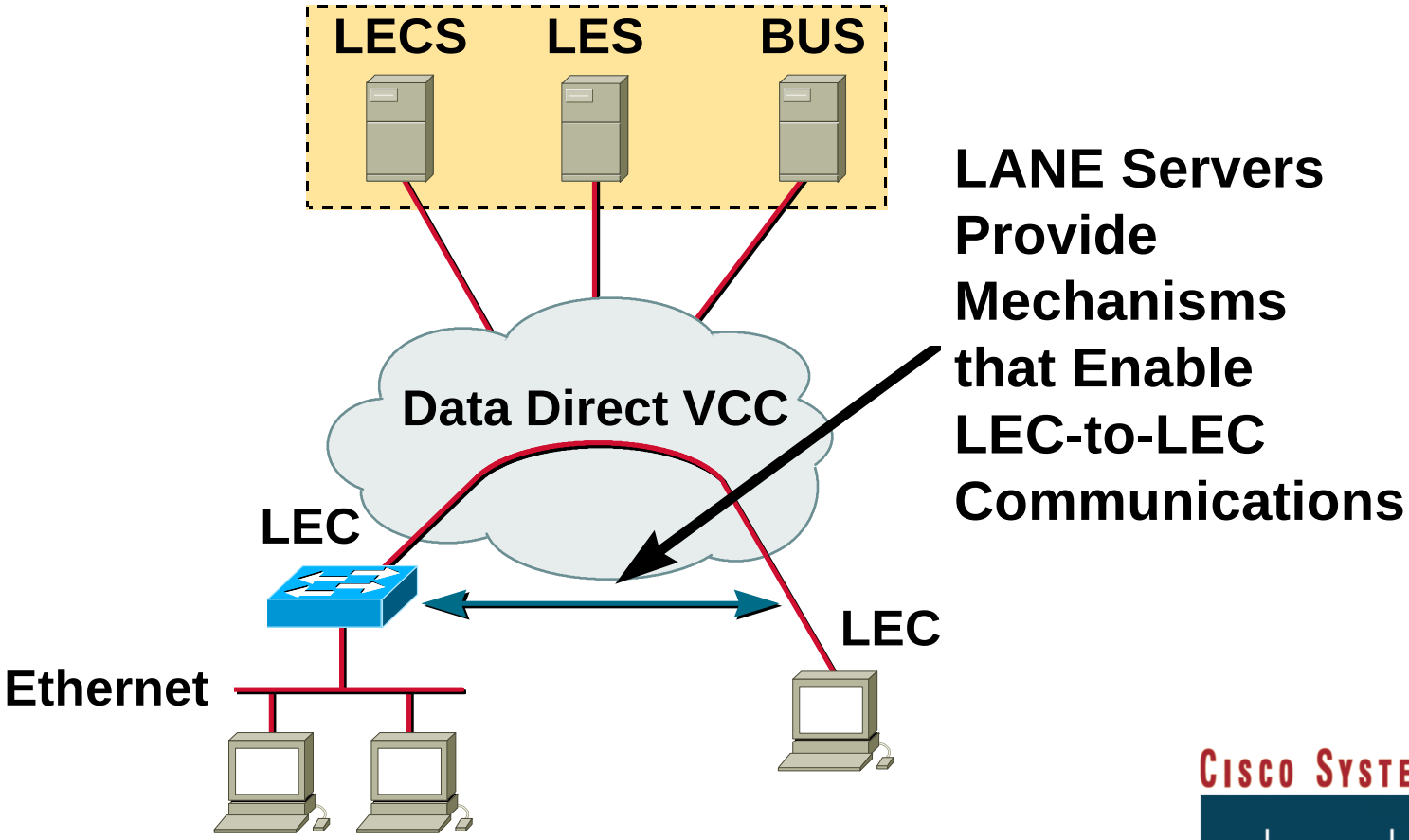
LANE—End Goal (Logical View)

- End goal—communication between LECs



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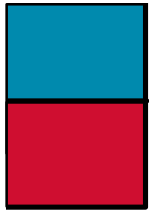

ATM Internetworking

LANE 2.0

- LUNI and LNNI
- Better efficiency of VC's
- Use of ATM QoS
- Special multicast servers
- Server redundancy

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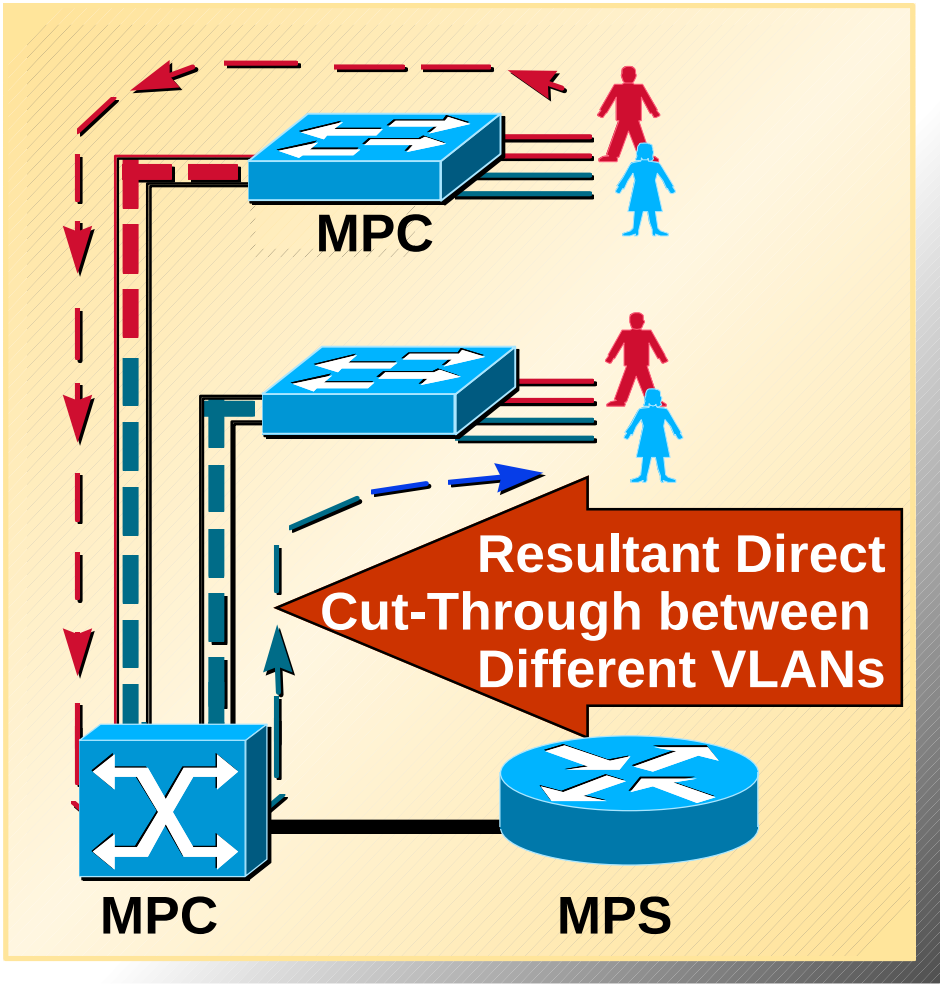
ATM Internetworking

MPOA—Multi-Protocol over ATM



- For seamless transport of layer 3 protocols across ATM networks
- Goes beyond LANE by allowing direct ATM connectivity between hosts in different subnets
- Architecture consists of edge devices and route servers

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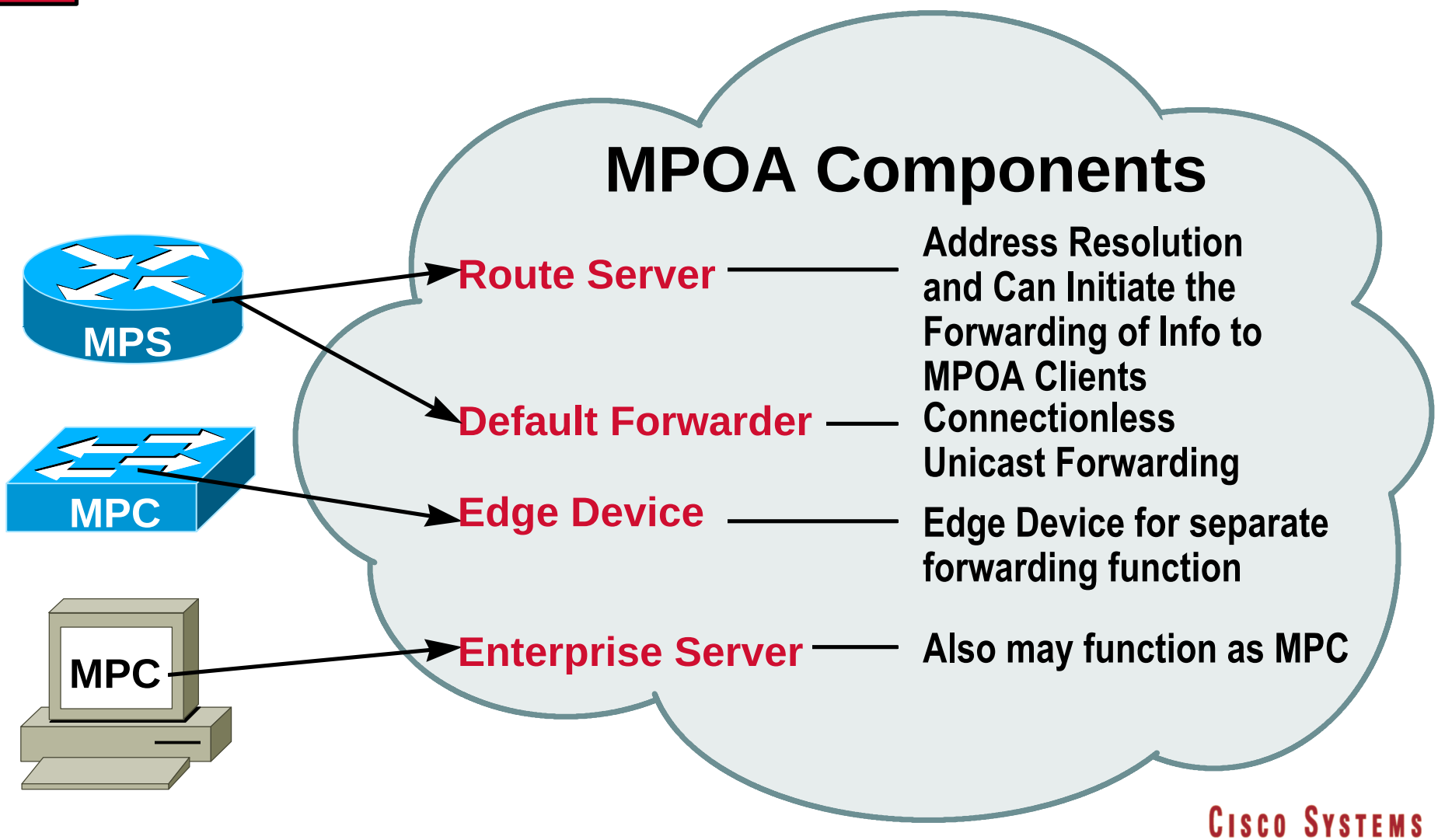
MPOA Service Basics



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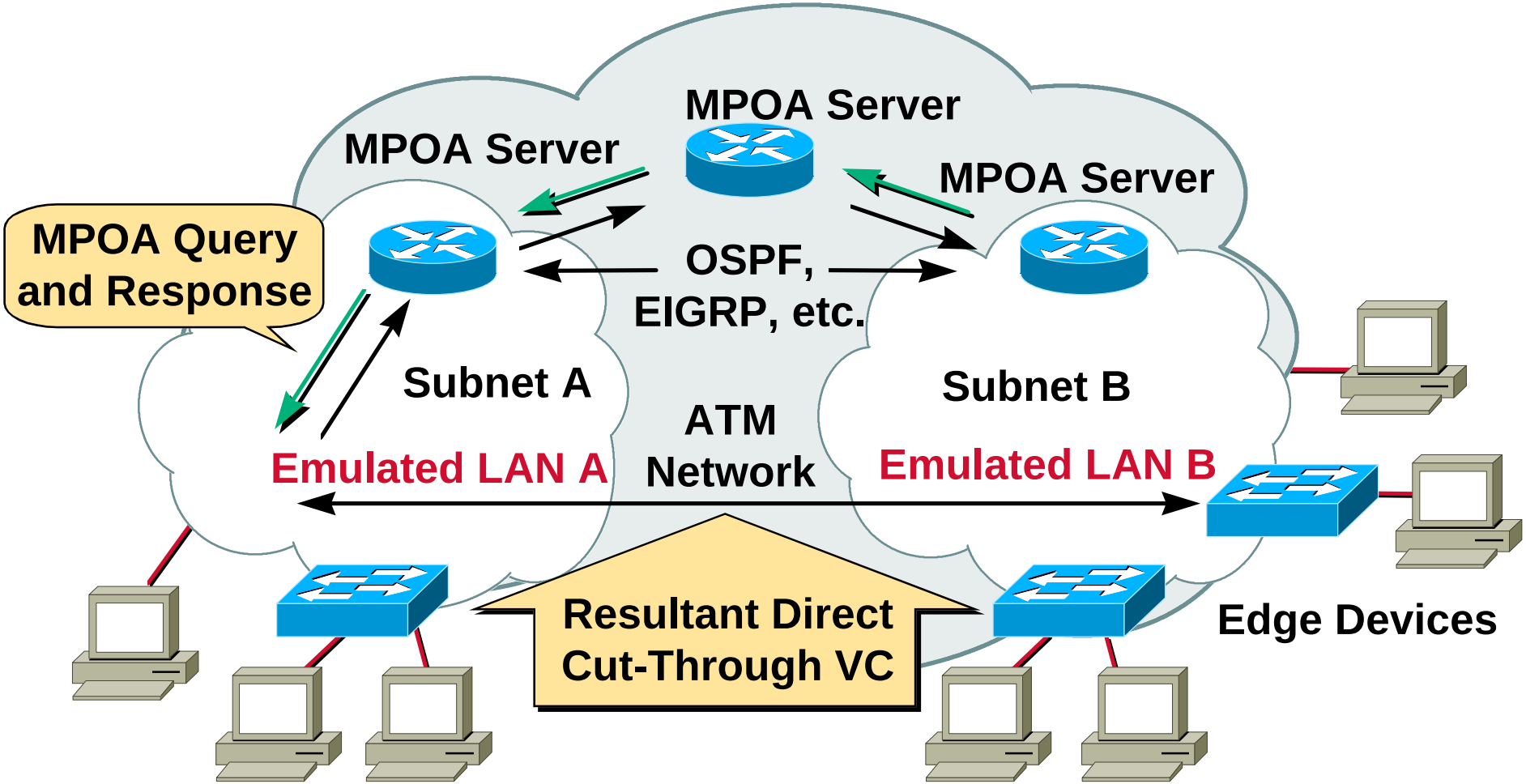
MPOA—Query and Response



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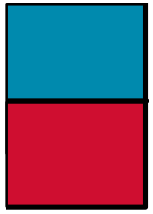

Agenda

- Introduction
- ATM Fundamentals
  - Rudimentary ATM Concepts
  - ATM Reference Model
  - ATM Service Categories
  - Traffic Management
- ATM Transport Standards
- Campus ATM Internetworking
- Wrap Up

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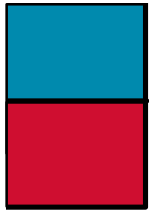

Wrap Up

ATM References

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- e-mail info@atmforum.com
- http://cell-relay.indiana.edu
- http://www.atmreport.com
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Wrap Up

Thank You
Q&A

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