



Agenda

Introduction

ATM Fundamentals

Rudimentary ATM Concepts

ATM Reference Model

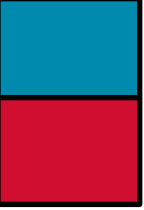
ATM Service Categories

Traffic Management

ATM Transport Standards

Campus ATM Internetworking

Wrap Up



Traffic Management

Why traffic management?

Traffic control techniques

ABR congestion feedback



Why Traffic Management?

Proactively combat congestion

Provision for priority control

Maintain well-behaved traffic

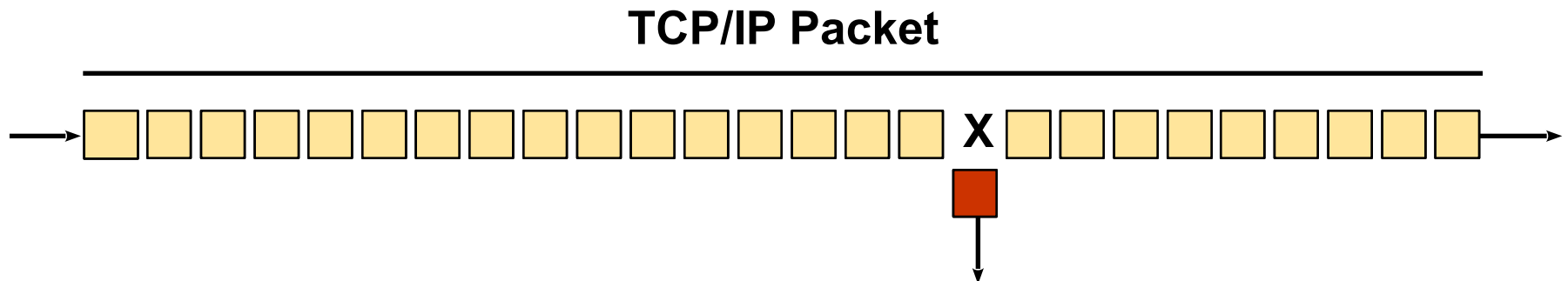
Why Traffic Management?

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

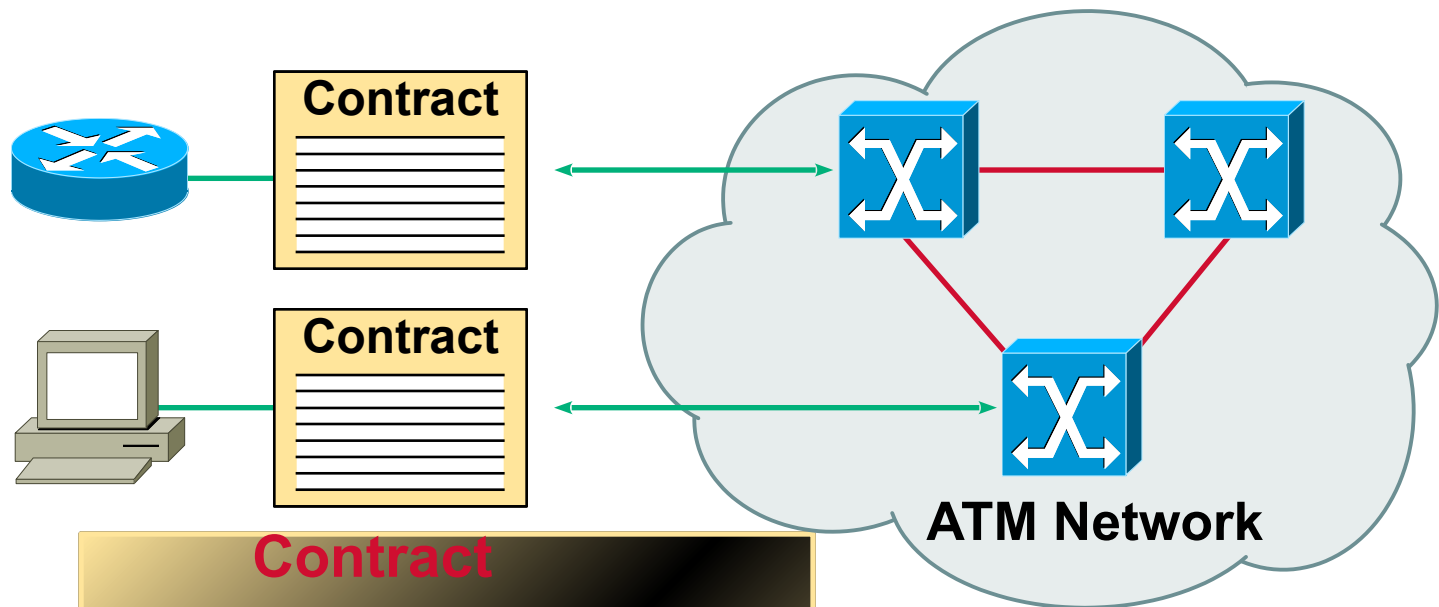


Traffic Control Techniques

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

Traffic Control Techniques

Connection Management



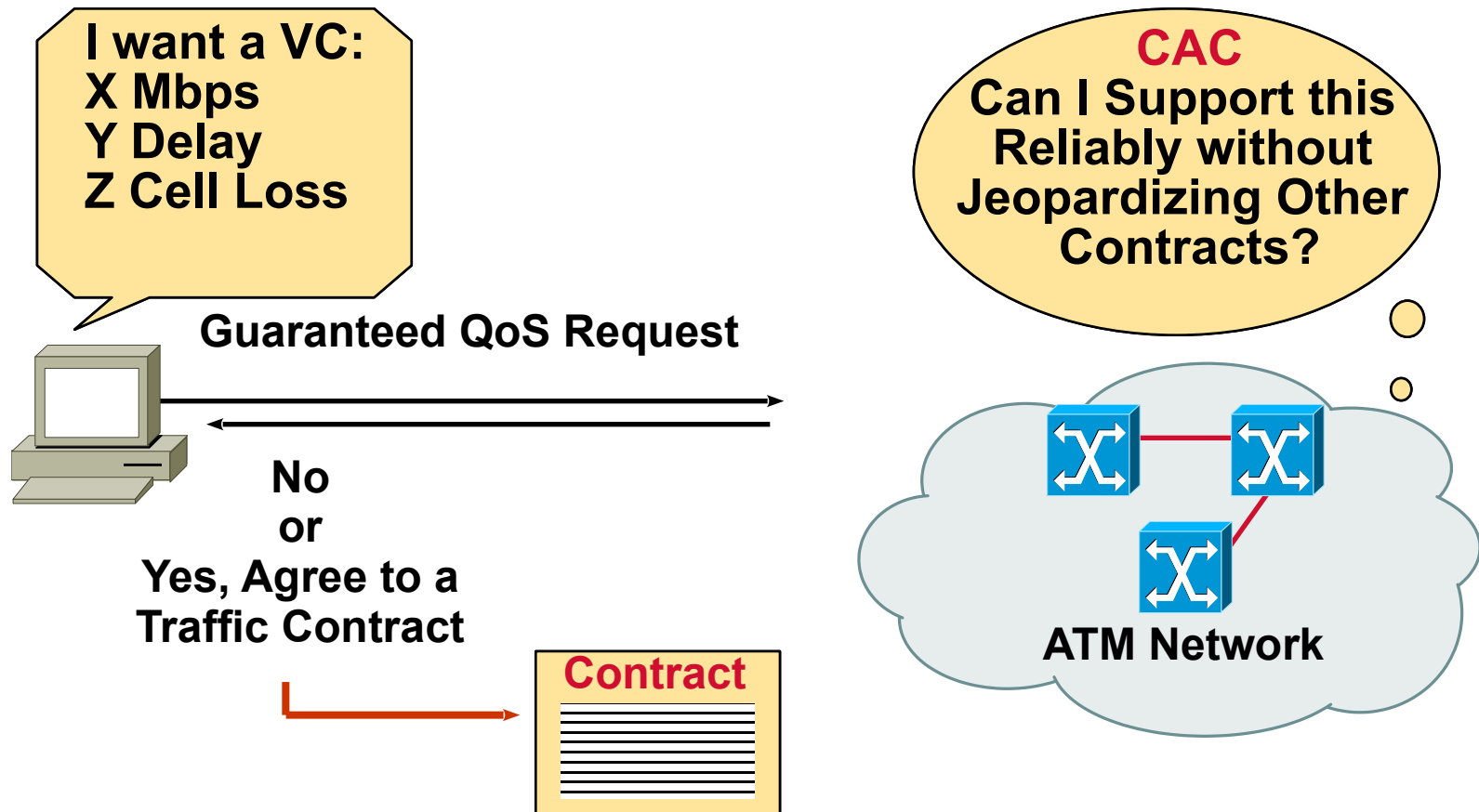
Contract

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

Traffic Control Techniques

Connection Management

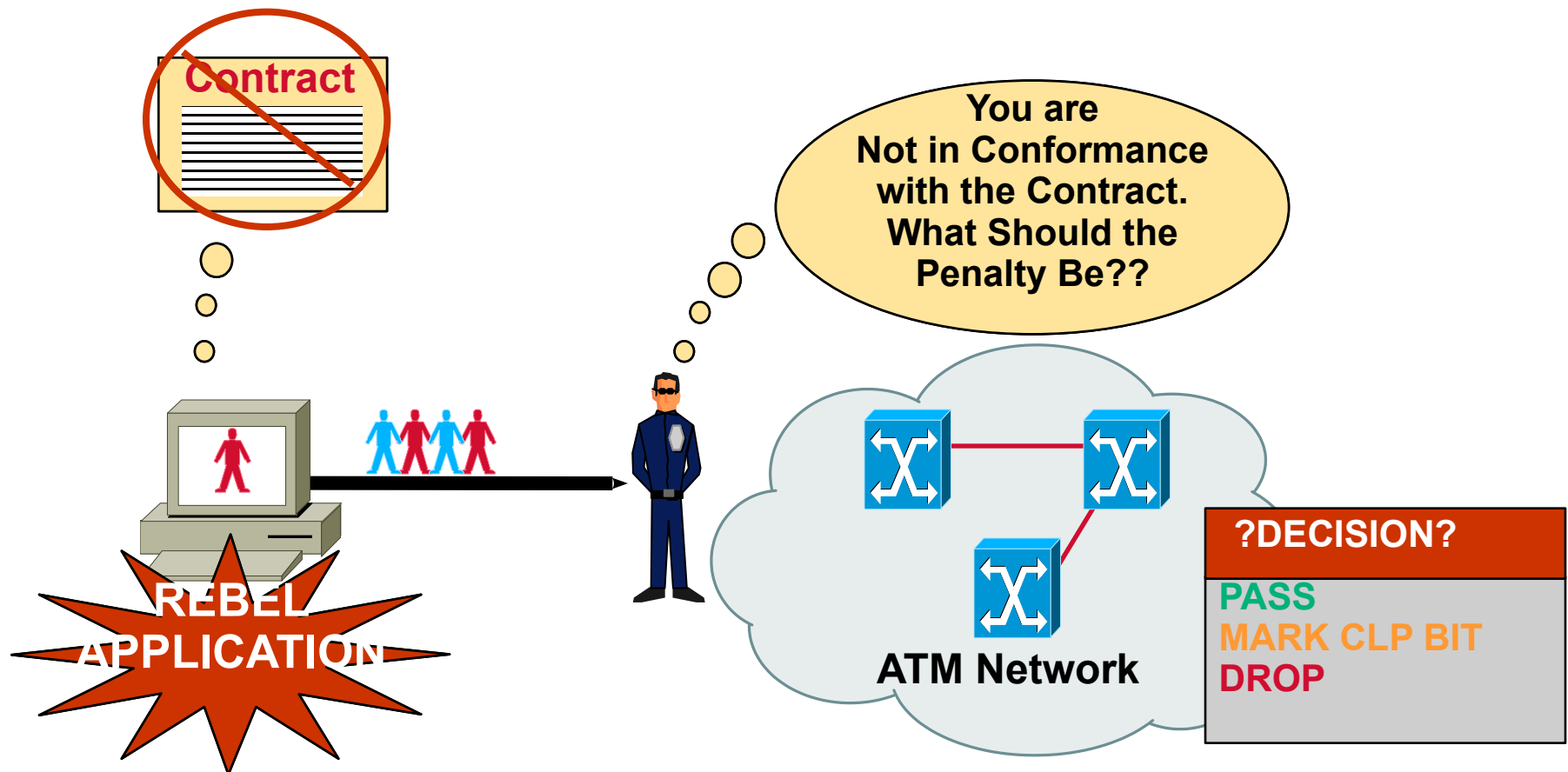
Connection Admission Control (CAC)



Traffic Control Techniques

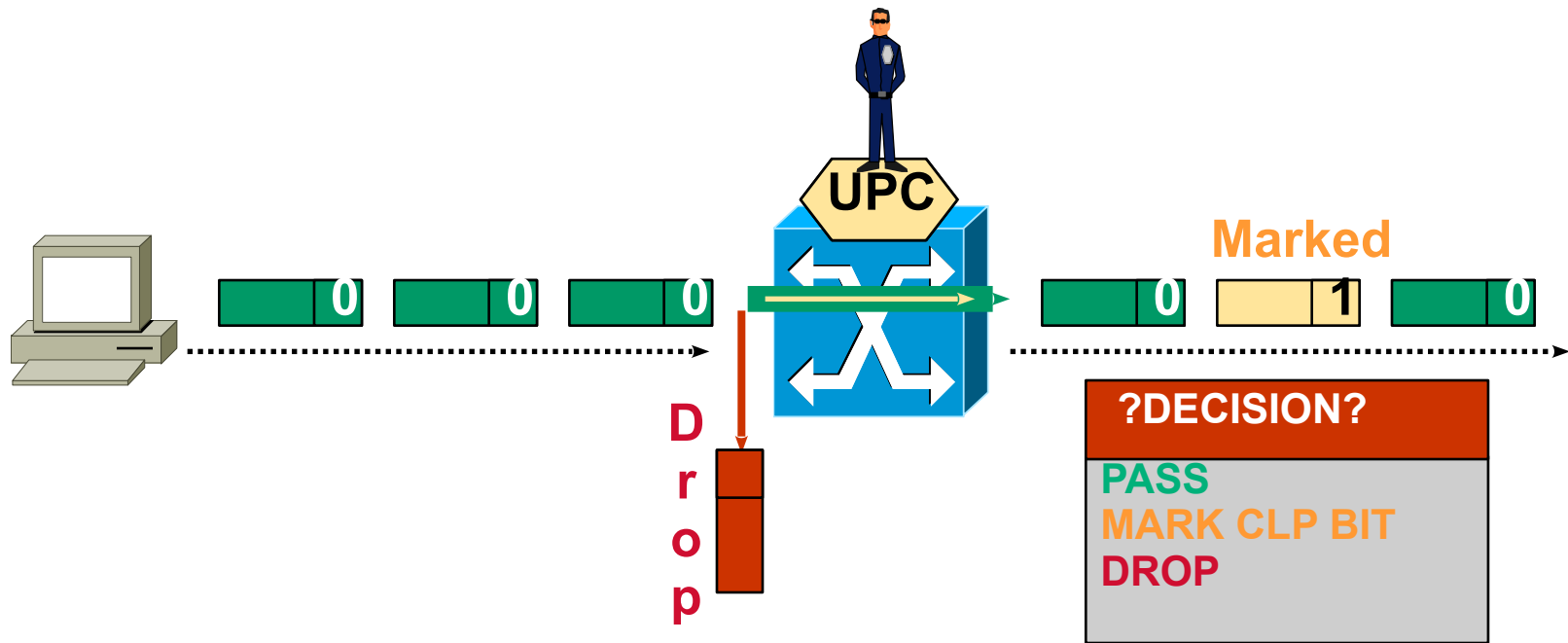
Traffic Management

Usage Parameter Control (UPC) aka **Policing**



Traffic Control Techniques

Traffic Management

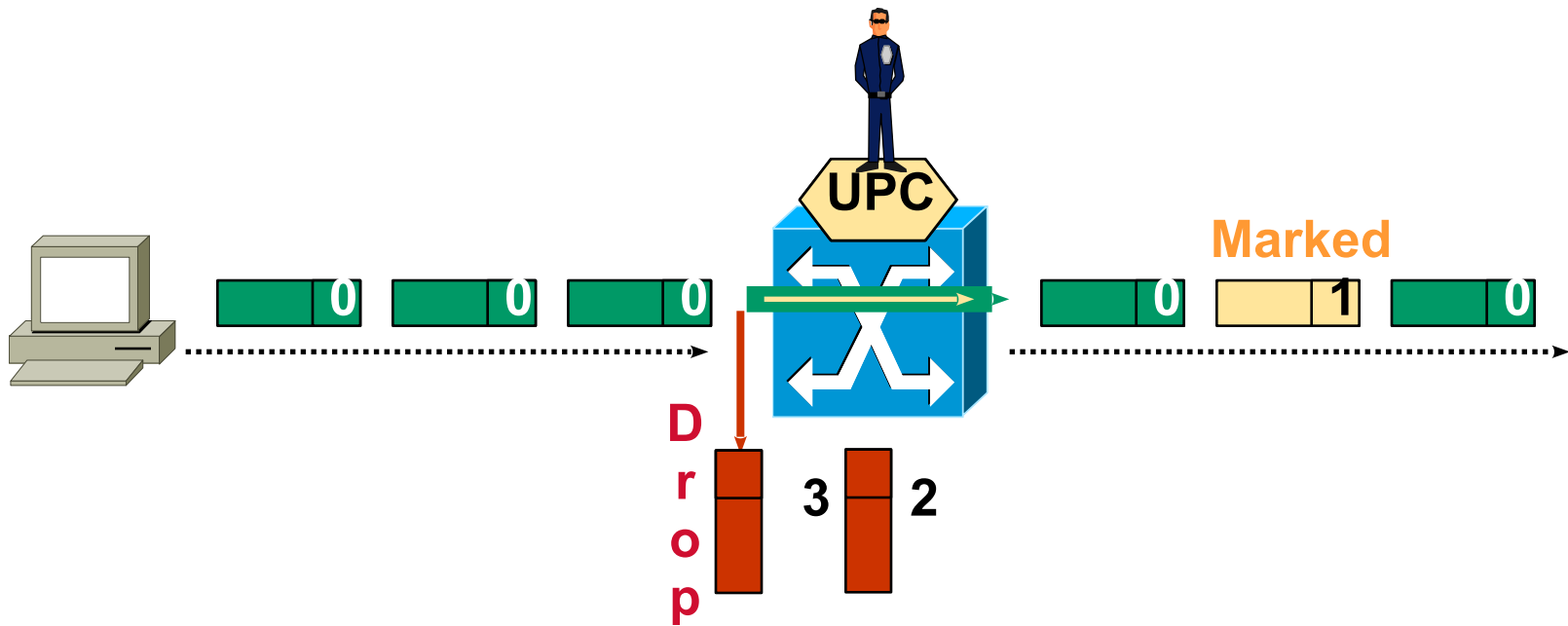


CLP Control—When congested, **drop marked** cells

Public UNI—Generic Cell Rate Algorithm (GCRA)

Traffic Control Techniques

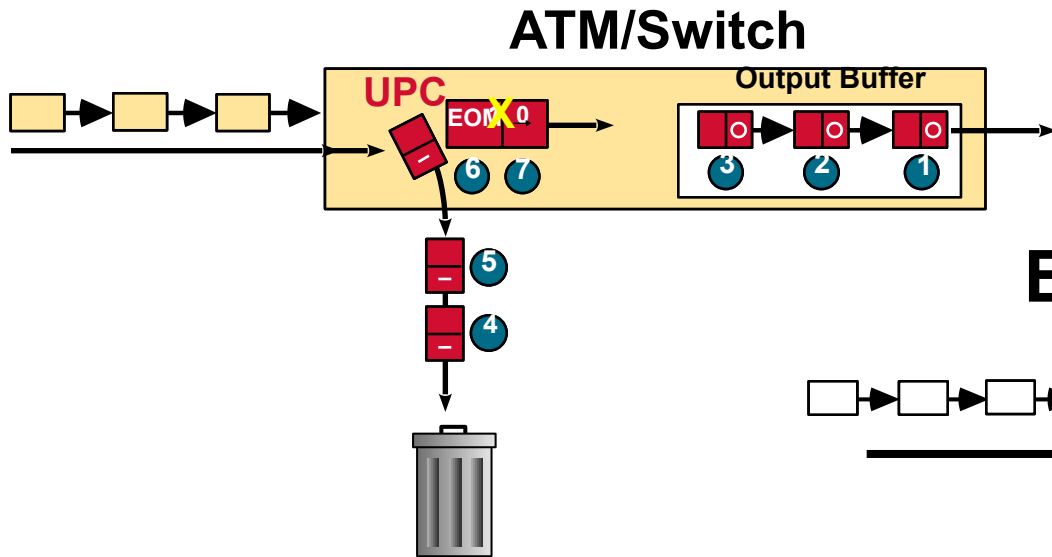
Traffic Management



Tail Packet Discard (TPD)

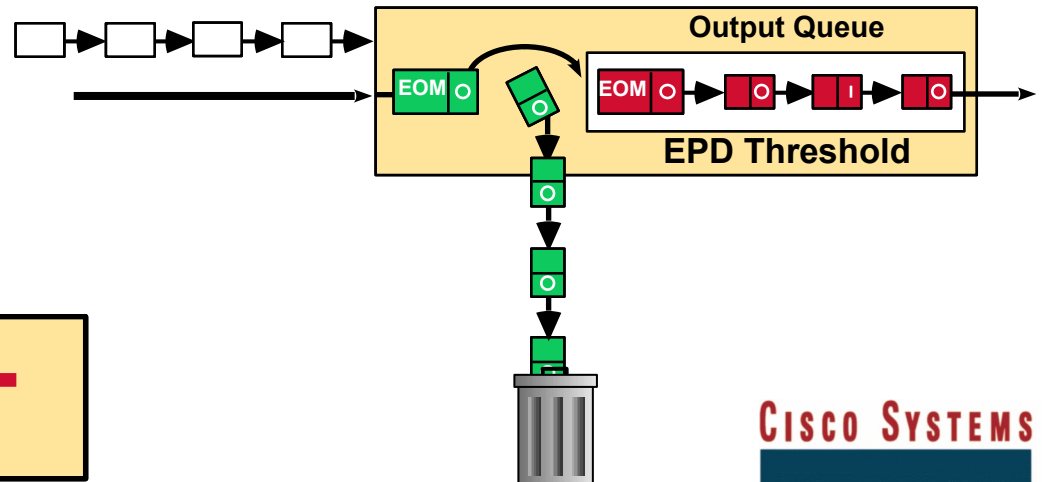
Discard cells from same 'bad' packet

Intelligent Tail Packet Discard



aka UBR+

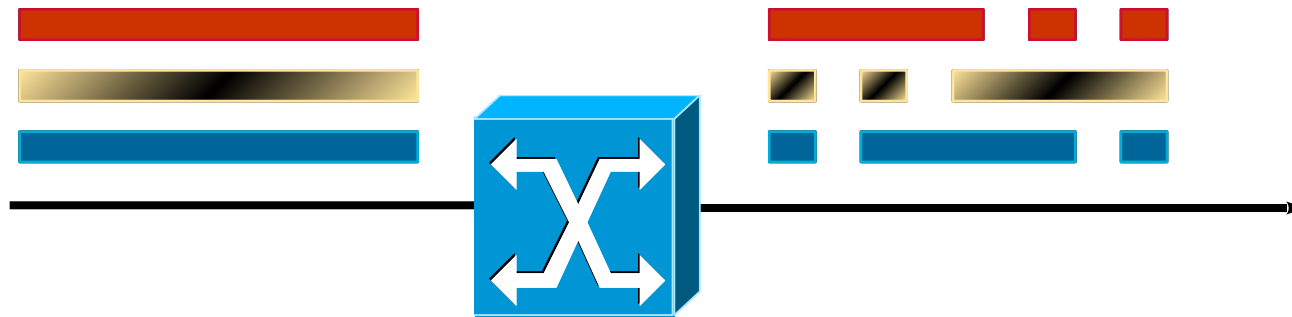
Early Packet Discard



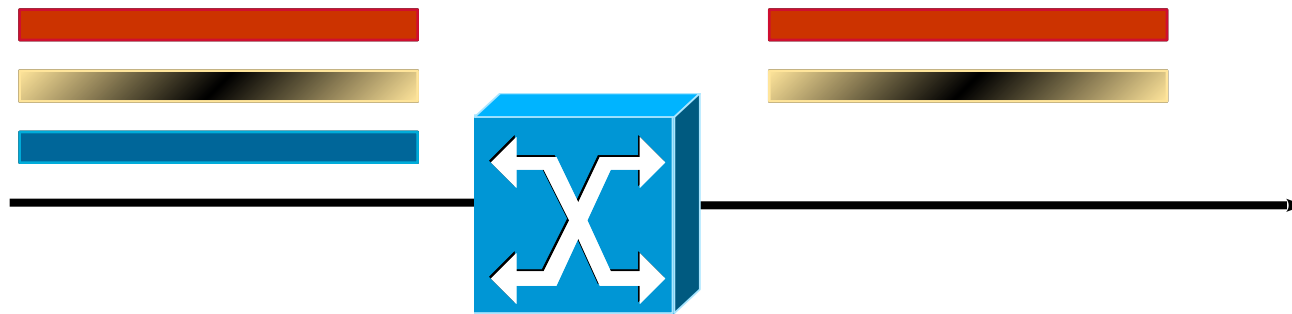
Traffic Control Techniques

Traffic Management

Switch without Packet Discard



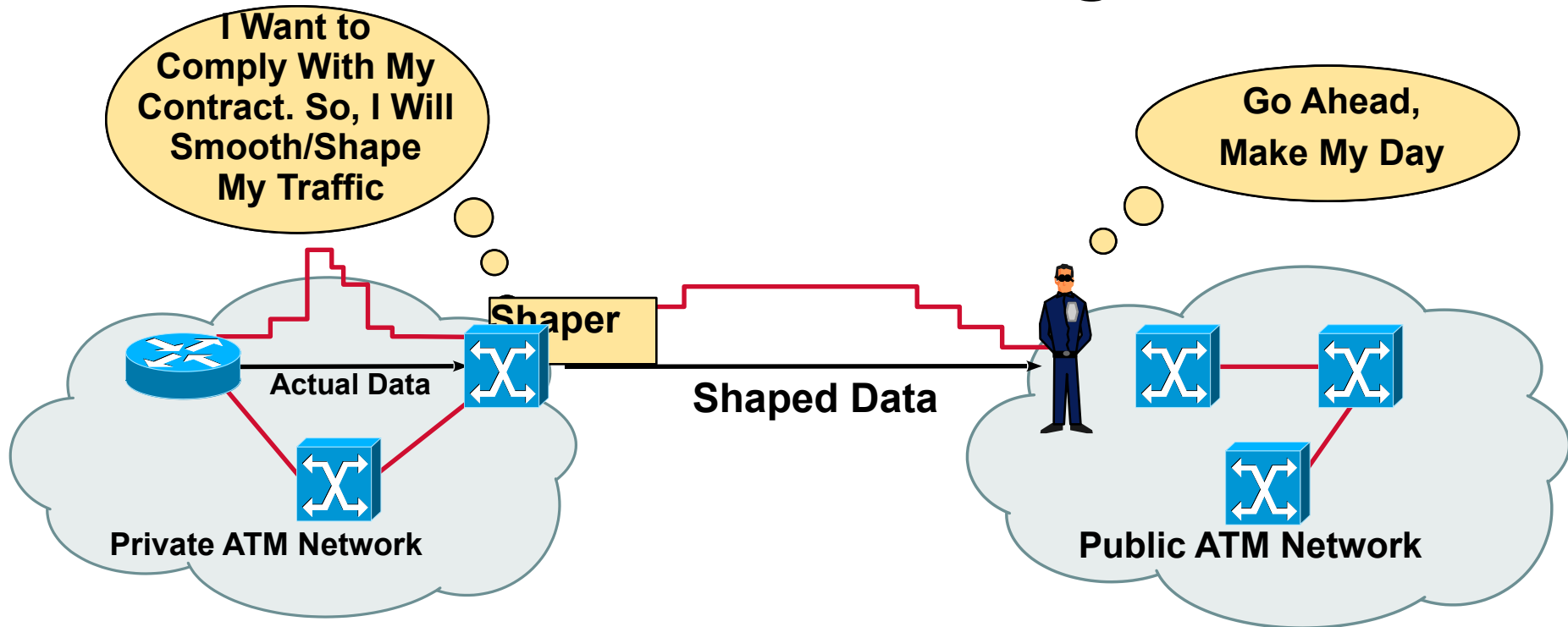
Switch with Intelligent Packet Discard



Maximize “Goodput”

Traffic Control Techniques

Traffic Smoothing



Traffic shaper at customer site
Changes traffic characteristics
Leaky bucket algorithm



Traffic Control Techniques

ABR Congestion Feedback

RM—Resource Management cells

Rate-based feedback mechanisms:

EFCT marking

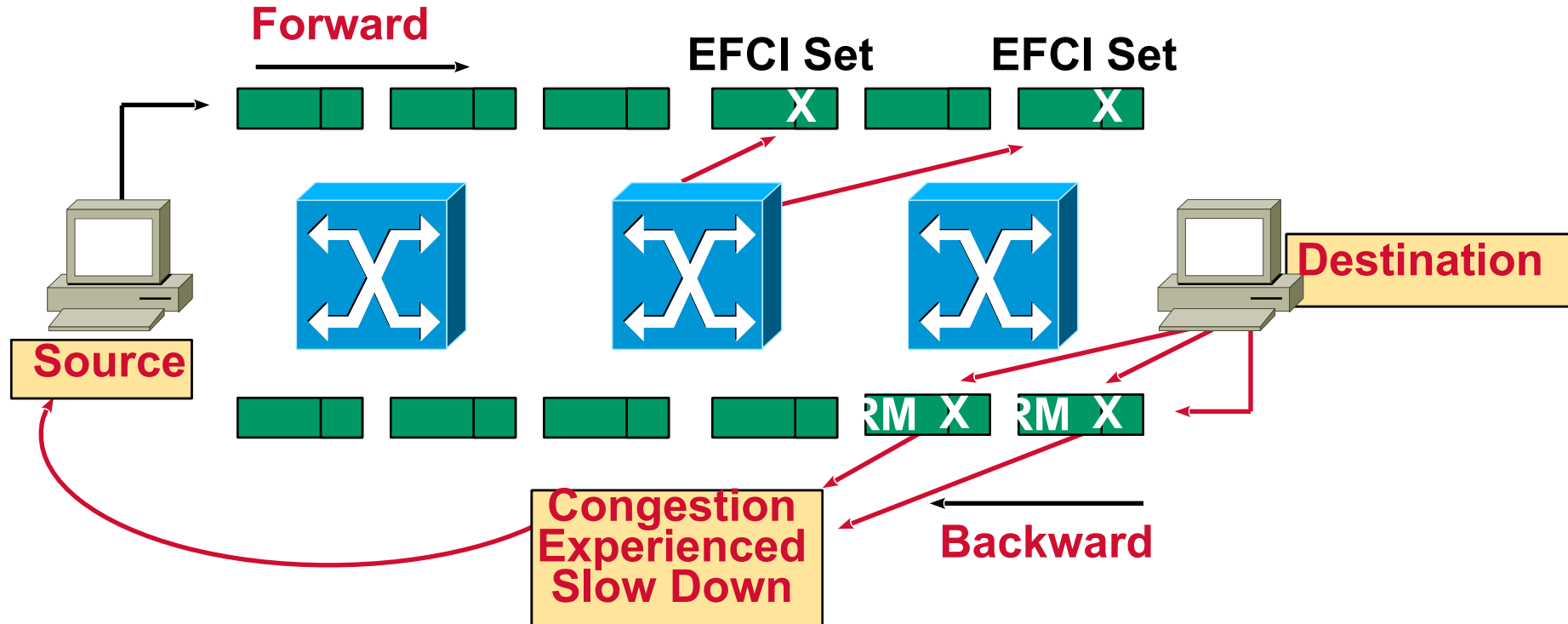
Relative rate marking

Explicit rate marking

VS/VD

Traffic Control Techniques

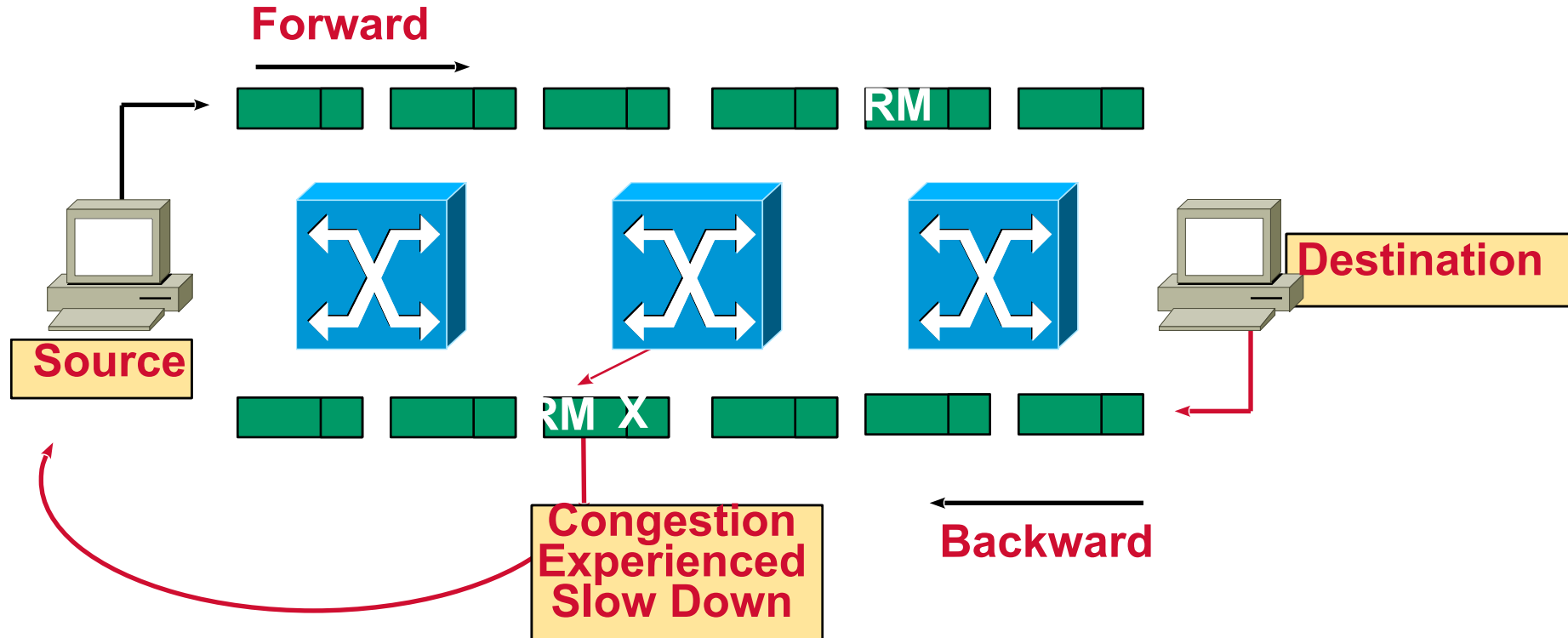
ABR Congestion Feedback



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

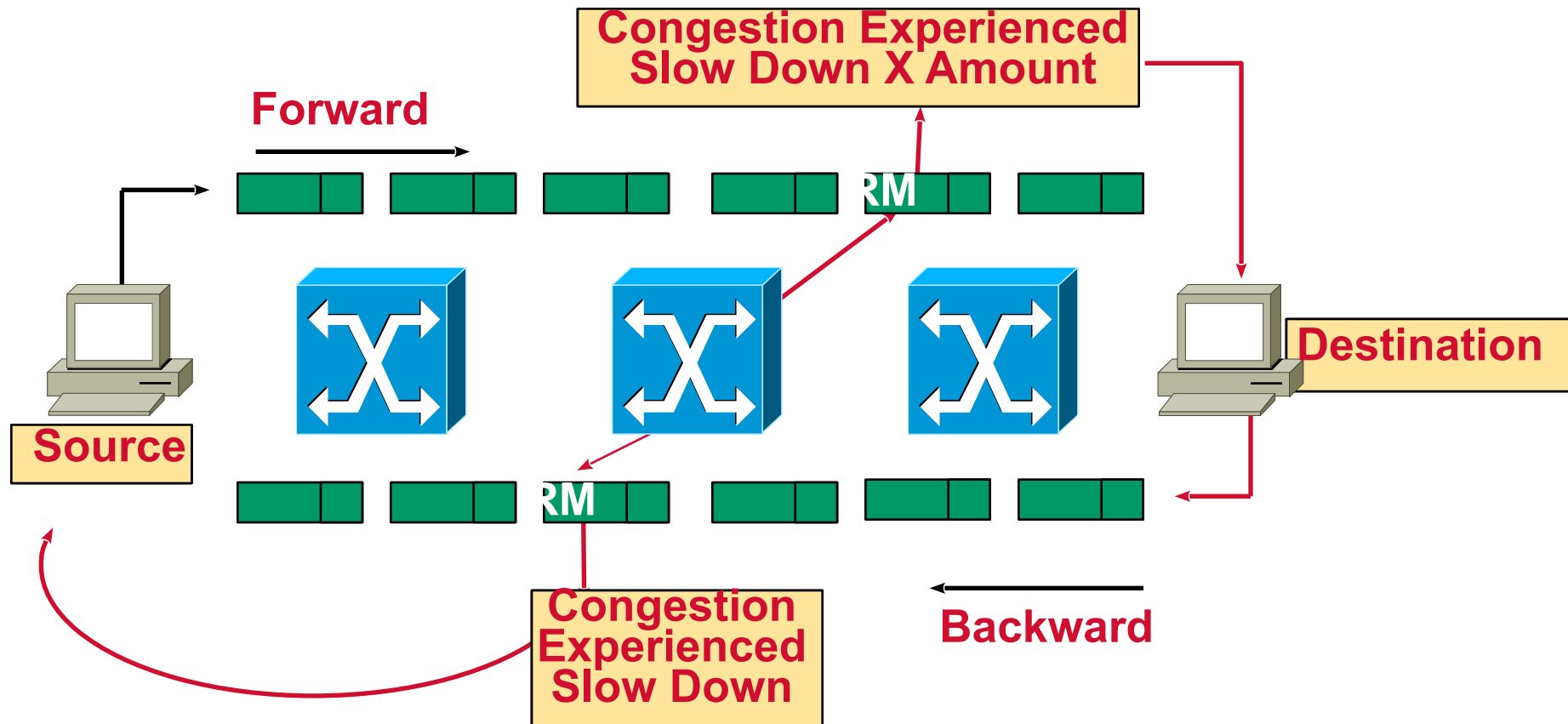


Relative rate marking

Switches can set congestion flag in backward RM cells

Traffic Control Techniques

ABR Congestion Feedback

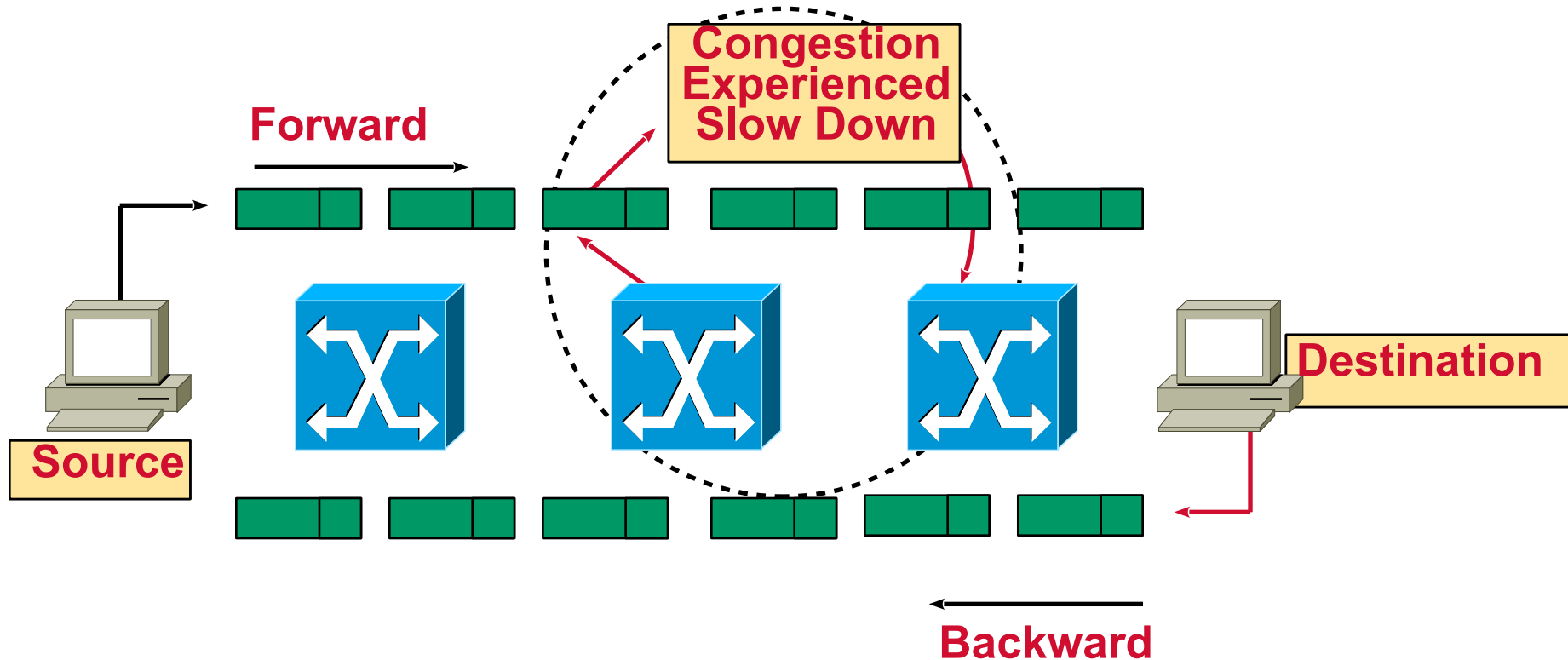


Explicit rate marking

Switches can tell source at exactly what rate to transmit

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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ATM Transport Standards

Campus ATM Internetworking

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ATM Transport Standards

The ATM forum

ATM UNI

UNI-3.0, 3.1, 4.0

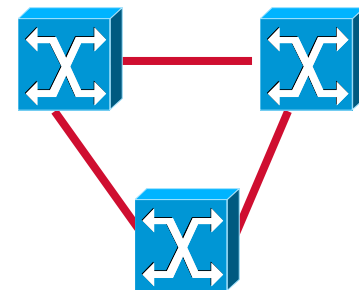
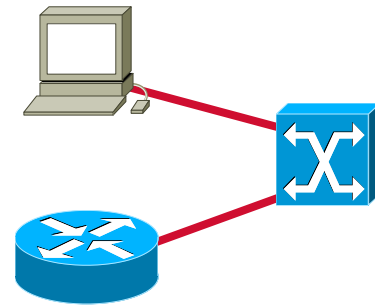
ILMI and address management

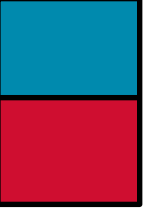
ATM NNI

Path determination

IISP

PNNI





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>

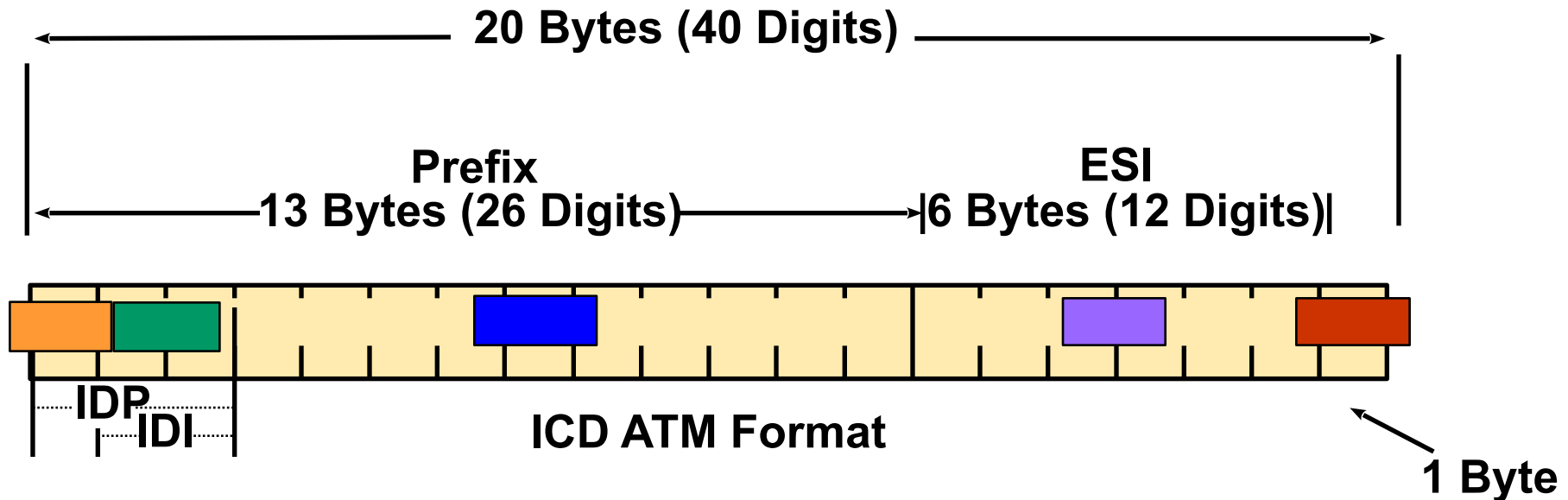


ATM Transport Standards

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

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:

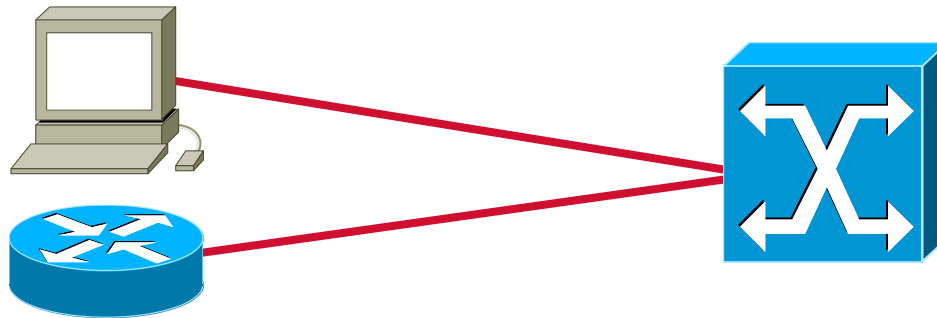
47.0091.0000.0000.0000.0000.1111.1111.1111.00

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

Also referred to as an NSAP address

ATM Transport Standards

Address Management ILMI Automatic Address Management



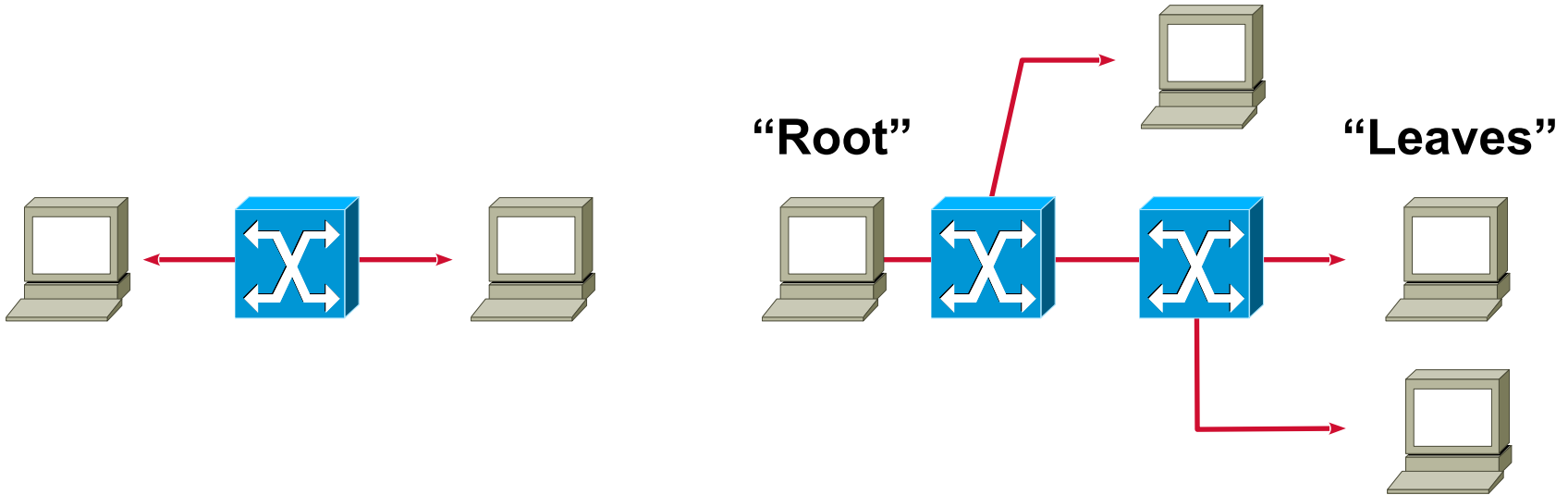
Here is My MAC Address (ESI)
(acdc.3124.efa8)
What is My ATM Prefix?

Here is Your ATM Prefix
47.0090.....

Goal: No manual configuration of end stations

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



ATM Transport Standards

Path Determination

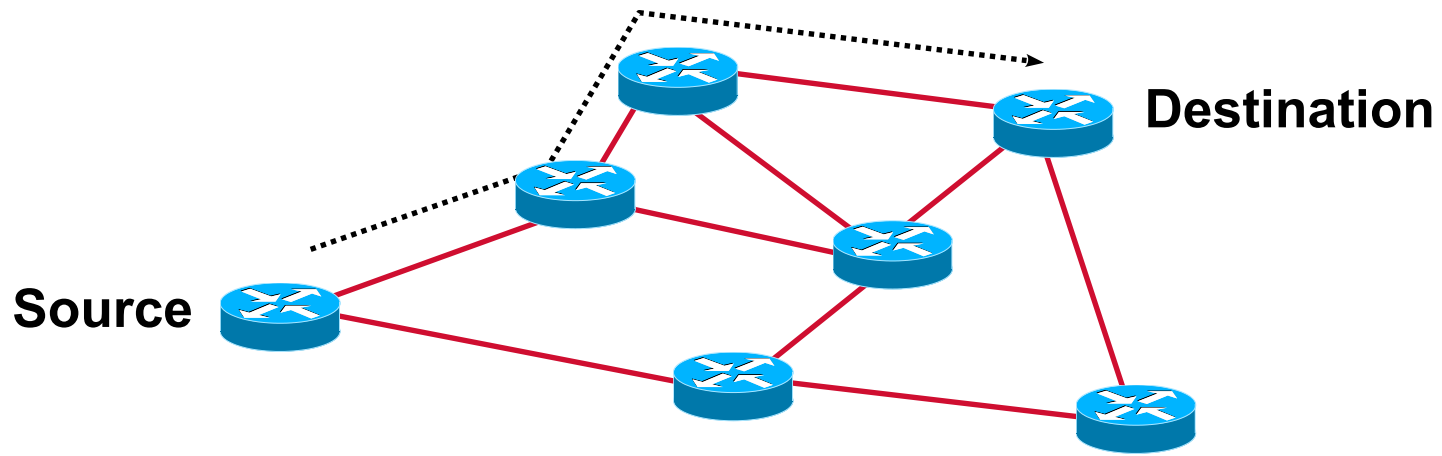
What is path determination?

**Static routing: IISp
(aka PNNI Phase0)**

**Dynamic routing: PNNI
(aka PNNI Phase1)**

ATM Transport Standards

What Is Path Determination?



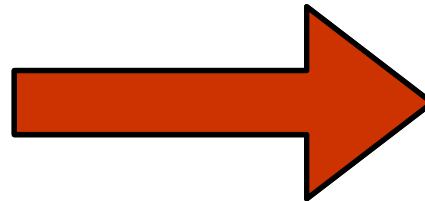
Traditionally router-based:

RIP

IGRP

OSPF

EIGRP

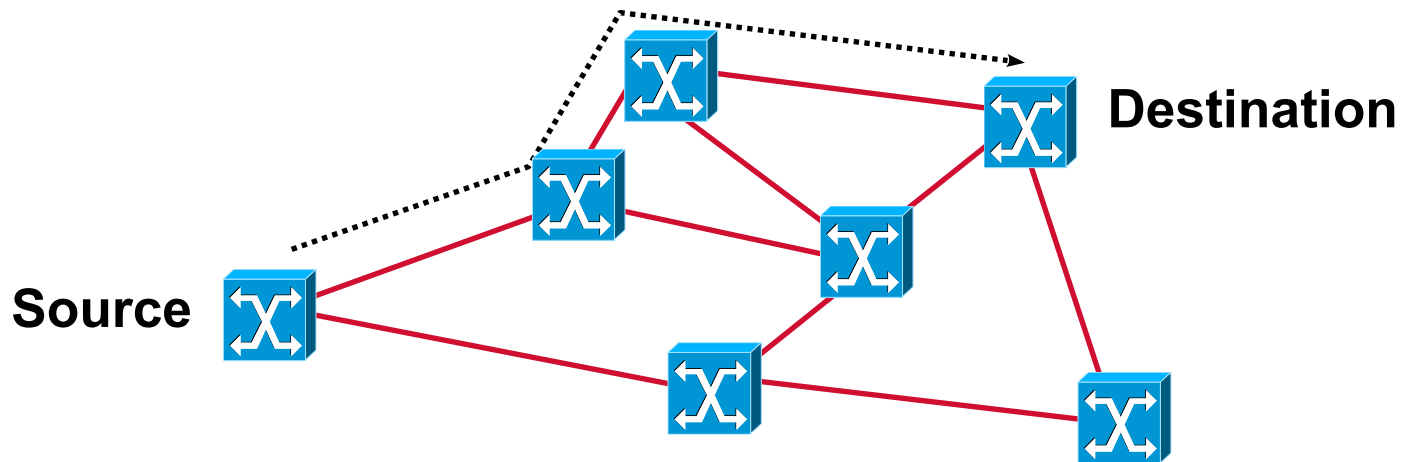


Cisco IOS™



ATM Transport Standards

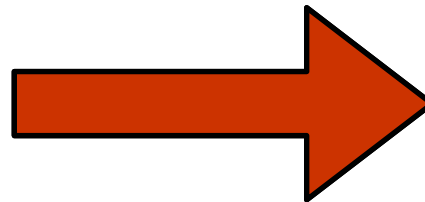
What Is Path Determination?



Now ATM switch-based:

IISP

PNNI

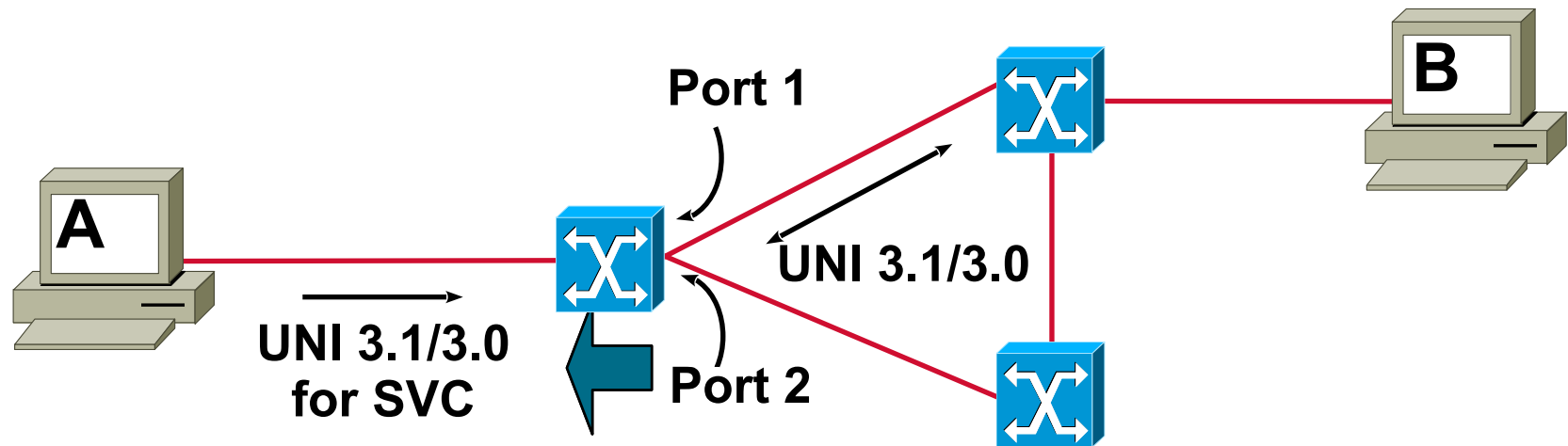


Cisco IOS™



ATM Transport Standards

IISP



Destination	Primary	Secondary
B	Port 1	Port 2

Interim Inter-switch Signaling Protocol (IISP)

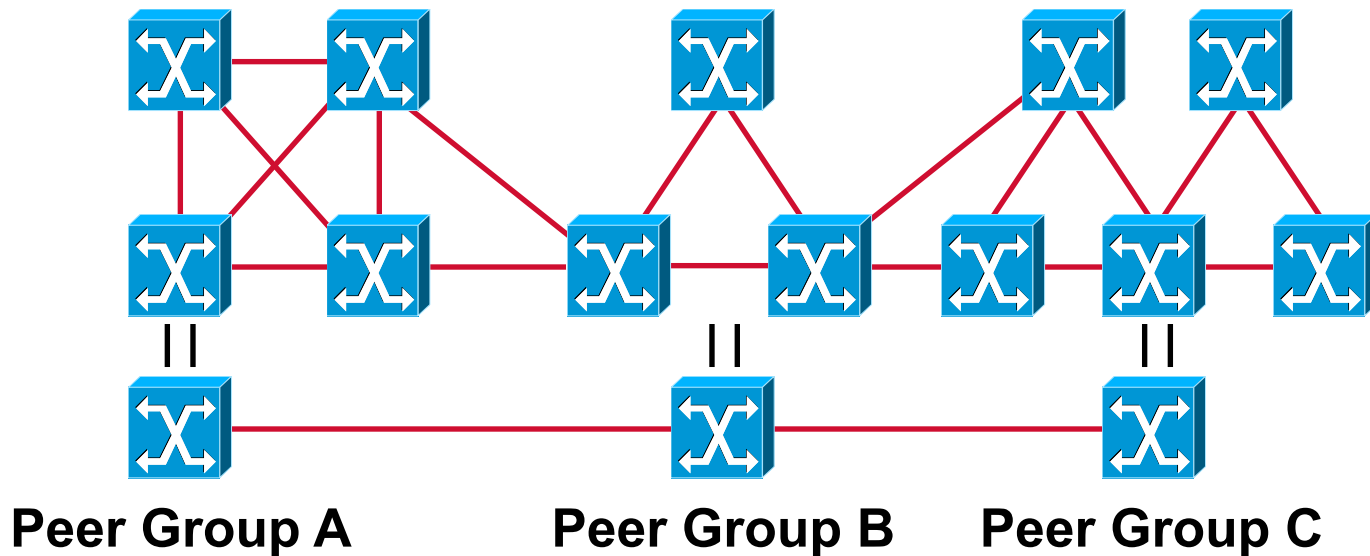
Static route defined in ATM switches

Dynamic call setup via UNI signaling

Suitable for small ATM networks

ATM Transport Standards

PNNI Phase 1

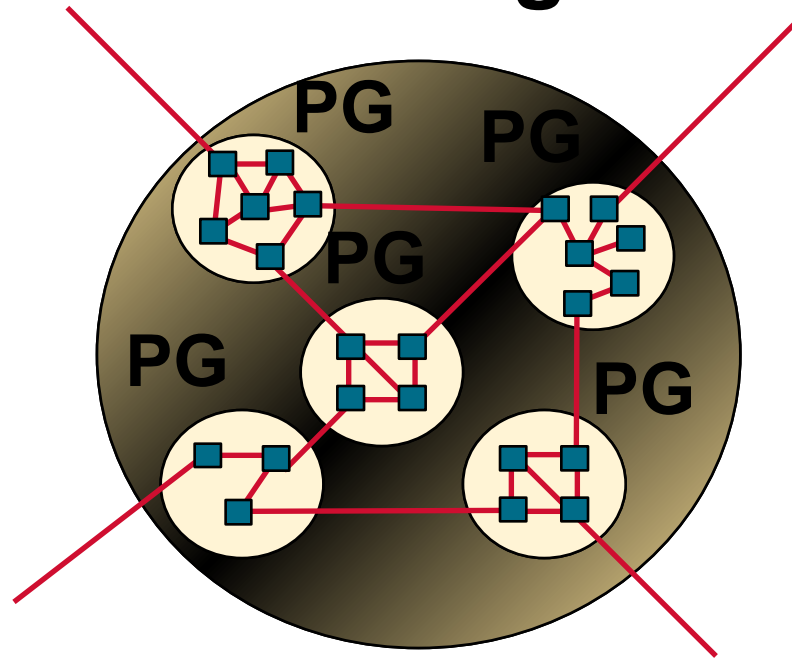


**Routing Protocol
+ Signaling Protocol**

PNNI

ATM Transport Standards

PNNI as Routing Protocol



Distributes reachability and topology information between switches

Dynamic re-routing around failures

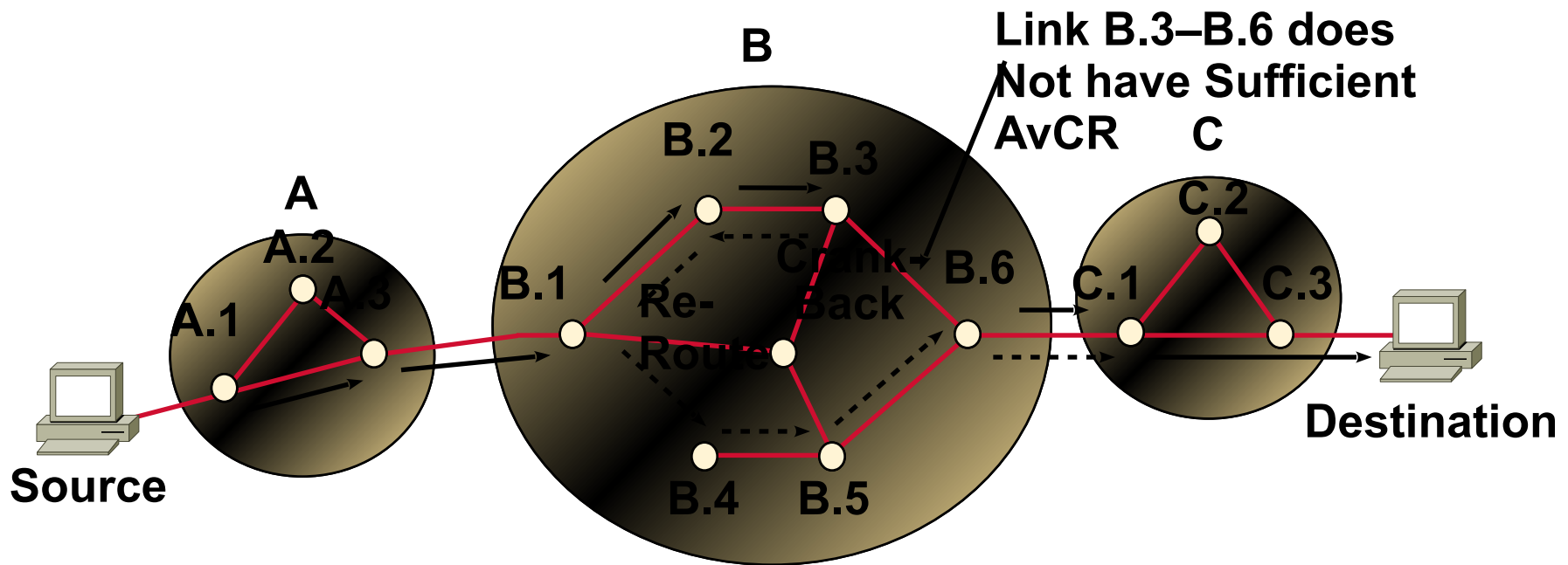
Routing for reachability based on OSPF

Peer groups are analogous to an OSPF area

PNNI allows hierarchical organization of network

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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ATM Internetworking

Challenges

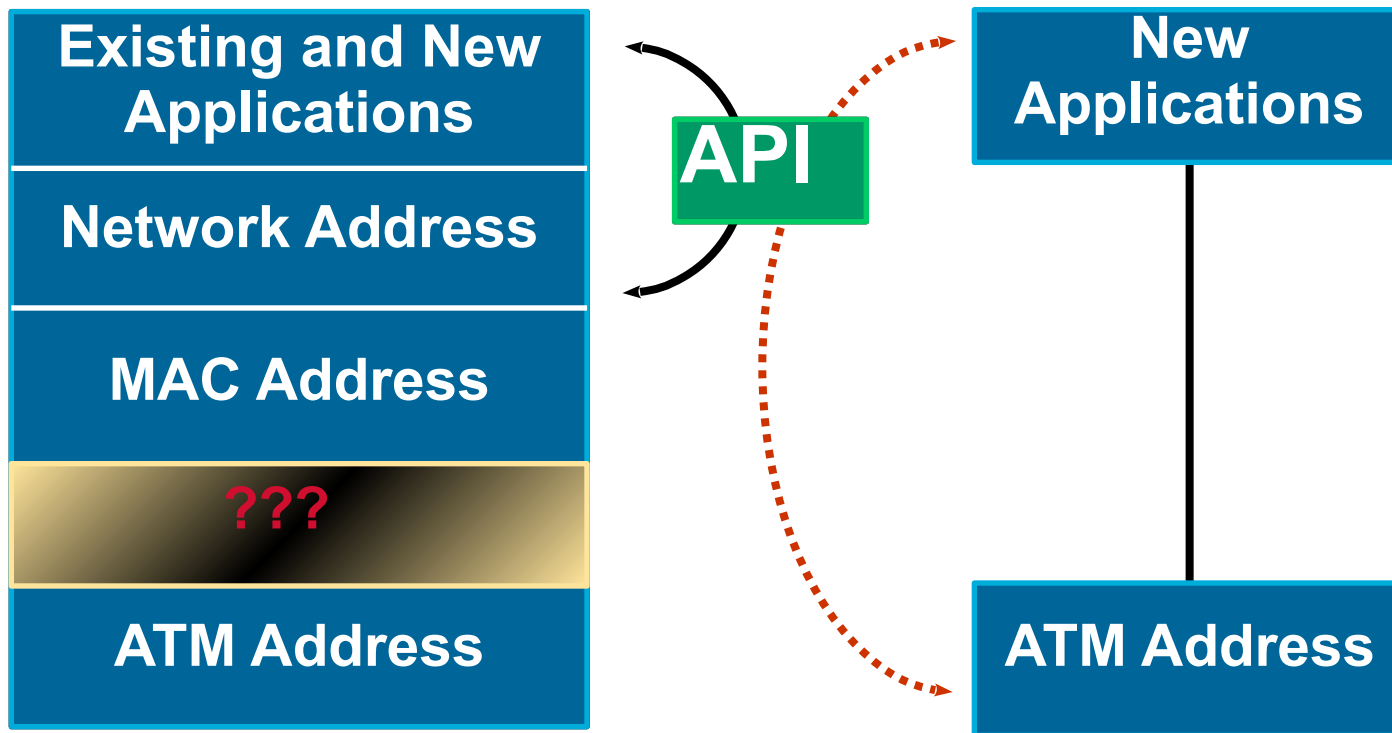
LANE 1.0

LANE 2.0

MPOA

ATM Internetworking

The Challenges



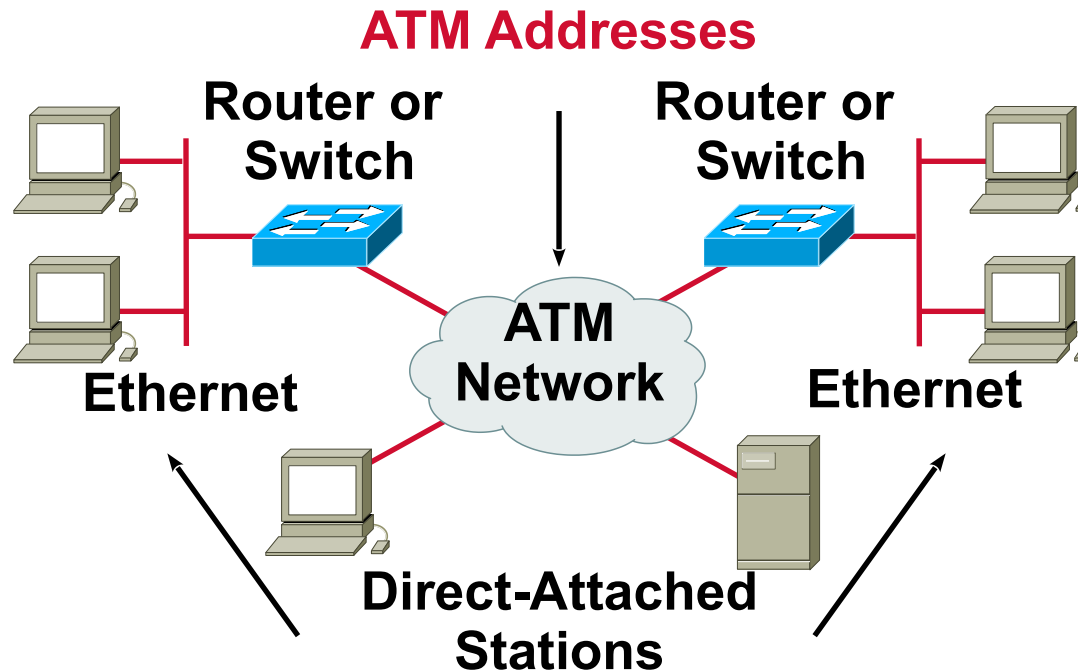
MAC address to ATM address resolution

No Standard ATM API

Broadcast handling

ATM Internetworking

Overlay Model

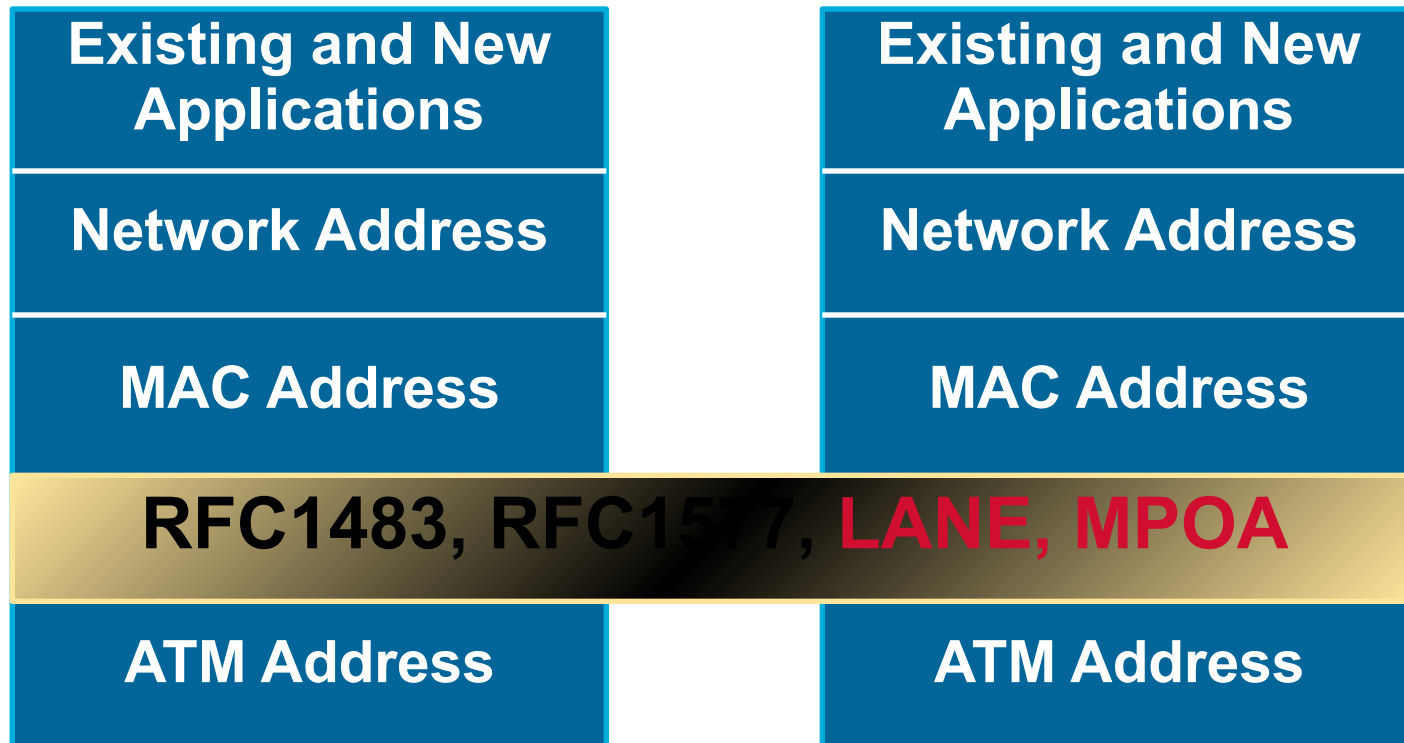


Multiple layers of addressing



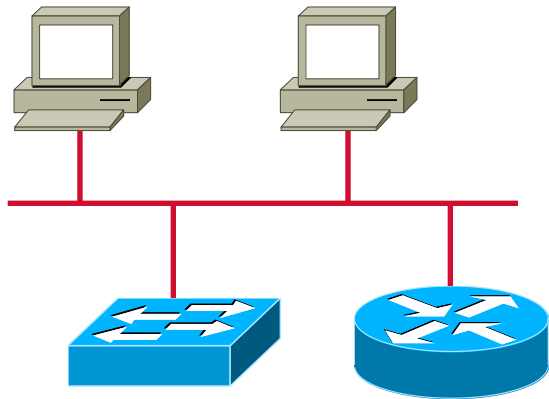
ATM Internetworking

Solutions

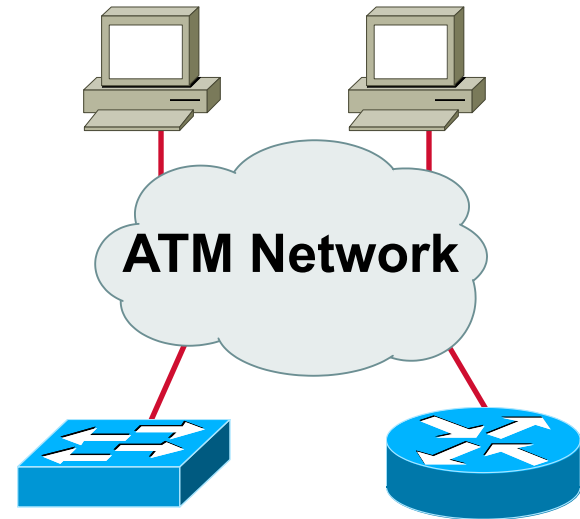


ATM Internetworking

LANE 1.0



Today's Physical LAN Segment



Emulated LAN (ELAN) Segment

Hides ATM to upper layers

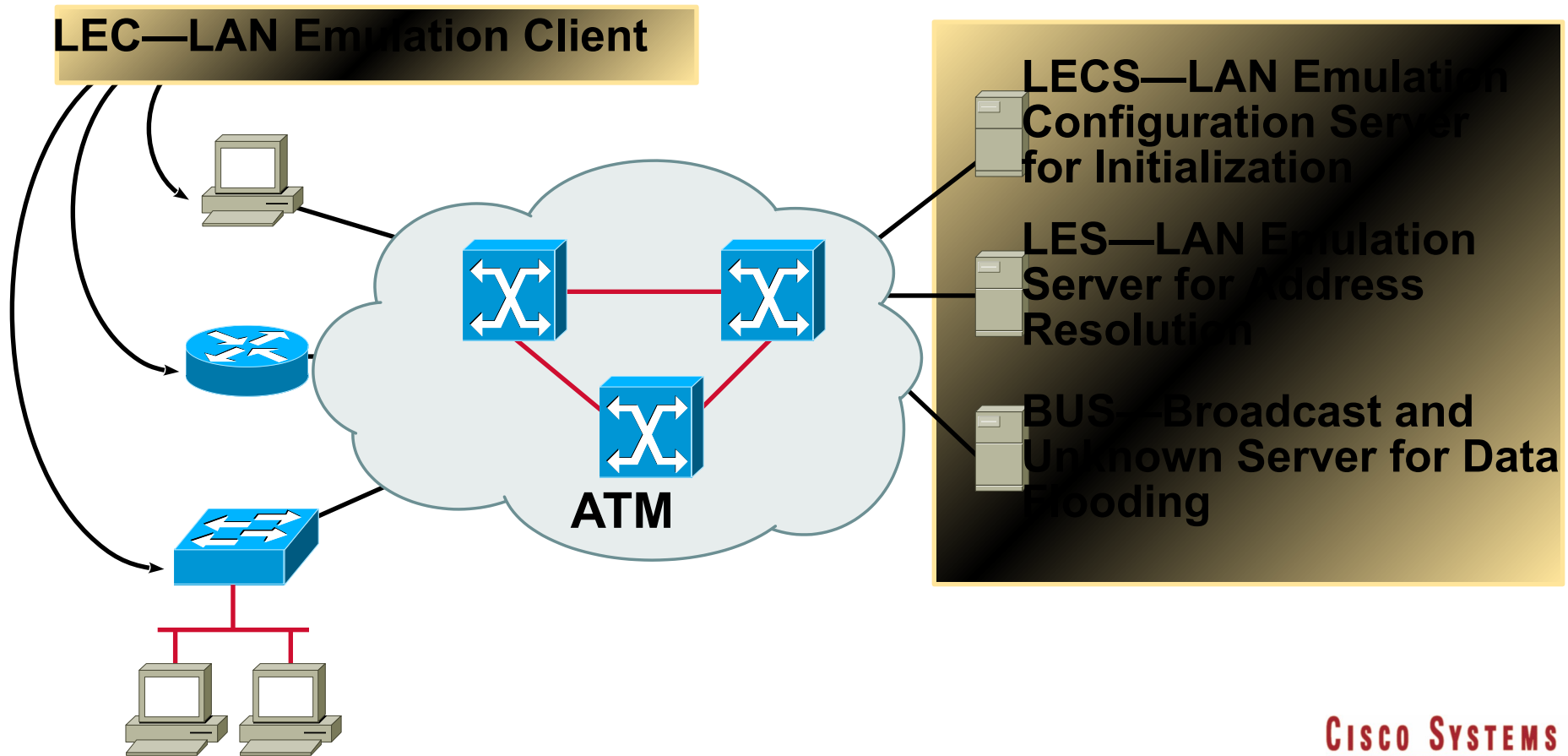
Makes ATM look like Ethernet/Token Ring

Supported in NICs, LAN switches, ATM routers

Allows ATM hosts connectivity with legacy LANs

ATM Internetworking

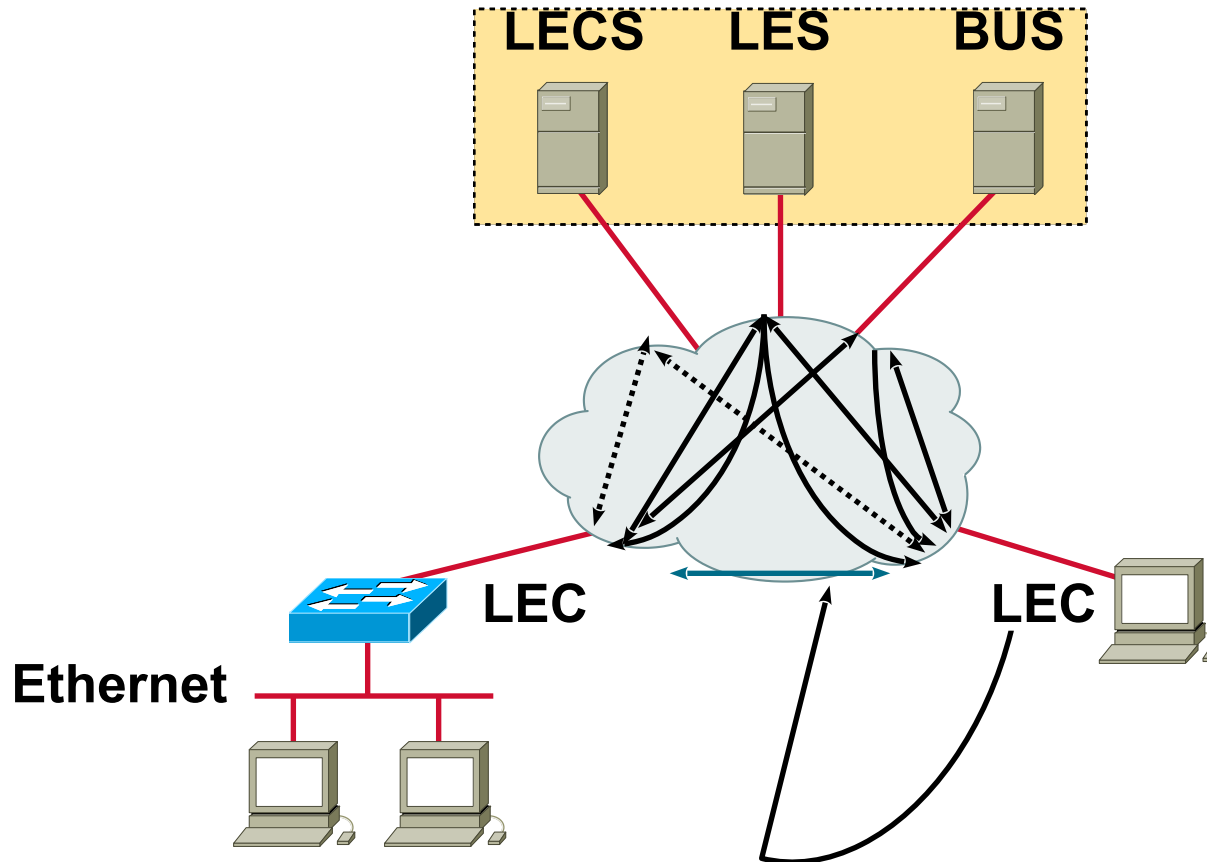
LANE Terminology





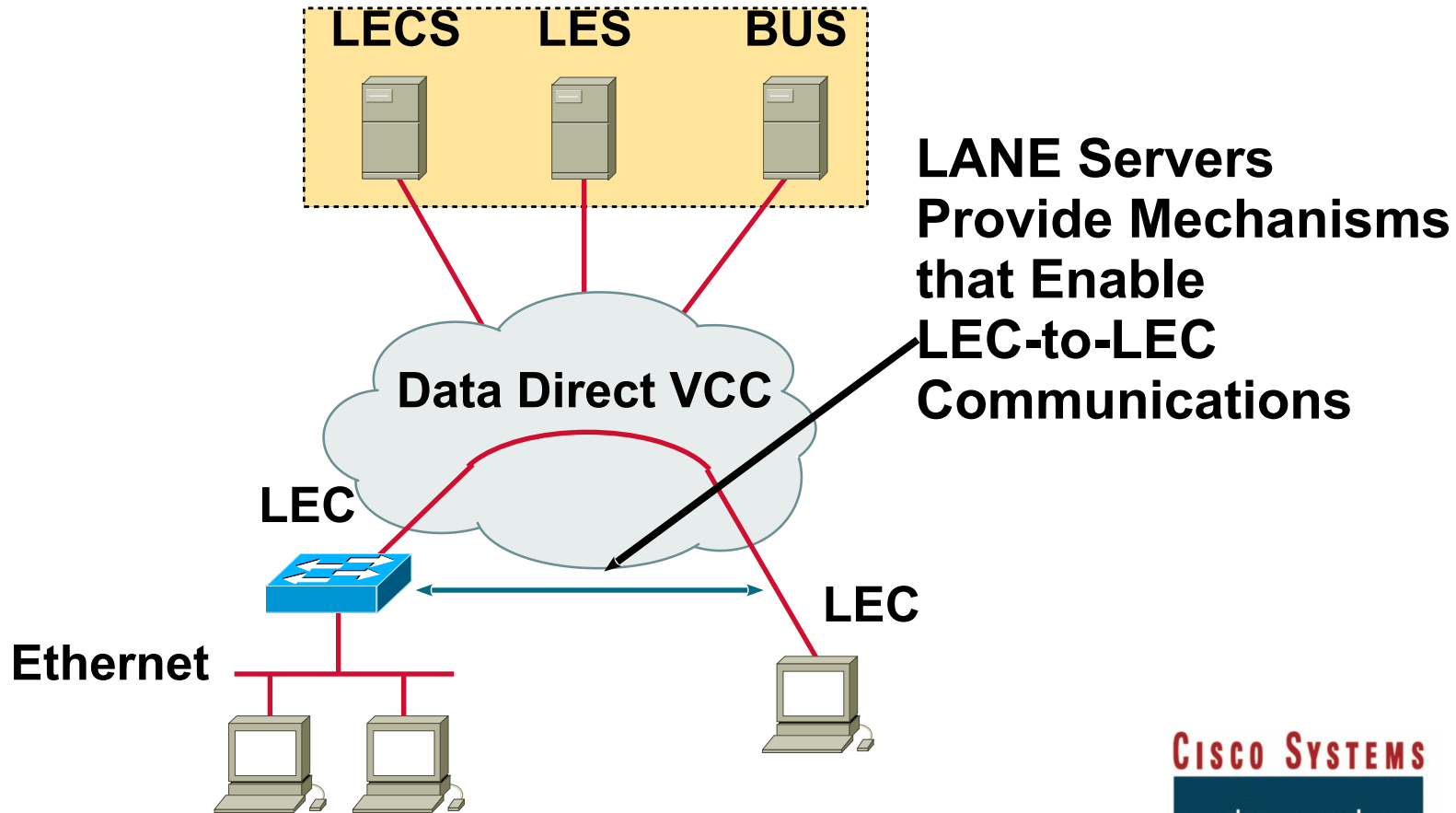
LANE in Operation

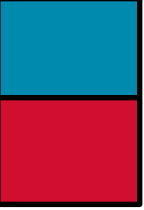
SVC are required to make this a viable technology
Setup of all VCC are **automatic**



LANE—End Goal (Logical view)

End goal—communication between LECs





ATM Internetworking

LANE 2.0

LUNI and LNNI

Better efficiency of VC's

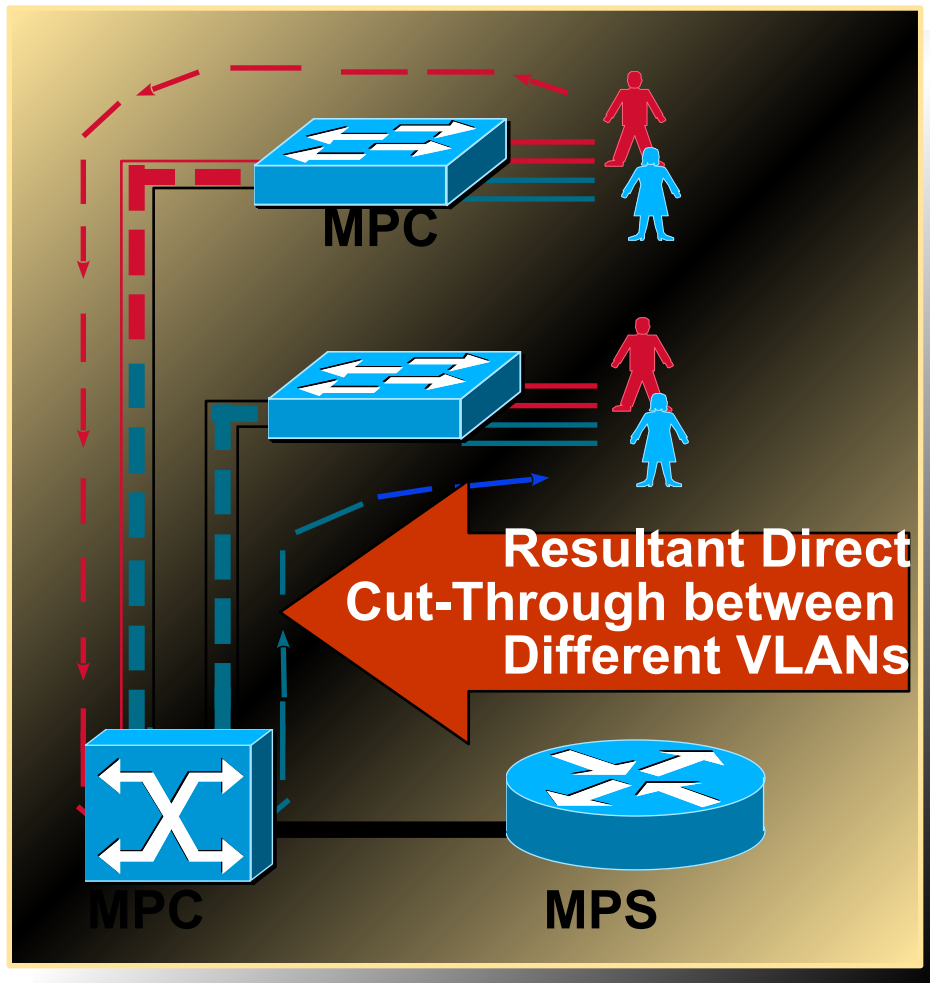
Use of ATM QoS

Special multicast servers

Server redundancy

ATM Internetworking

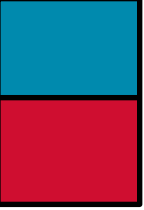
MPOA—Multi-Protocol over ATM



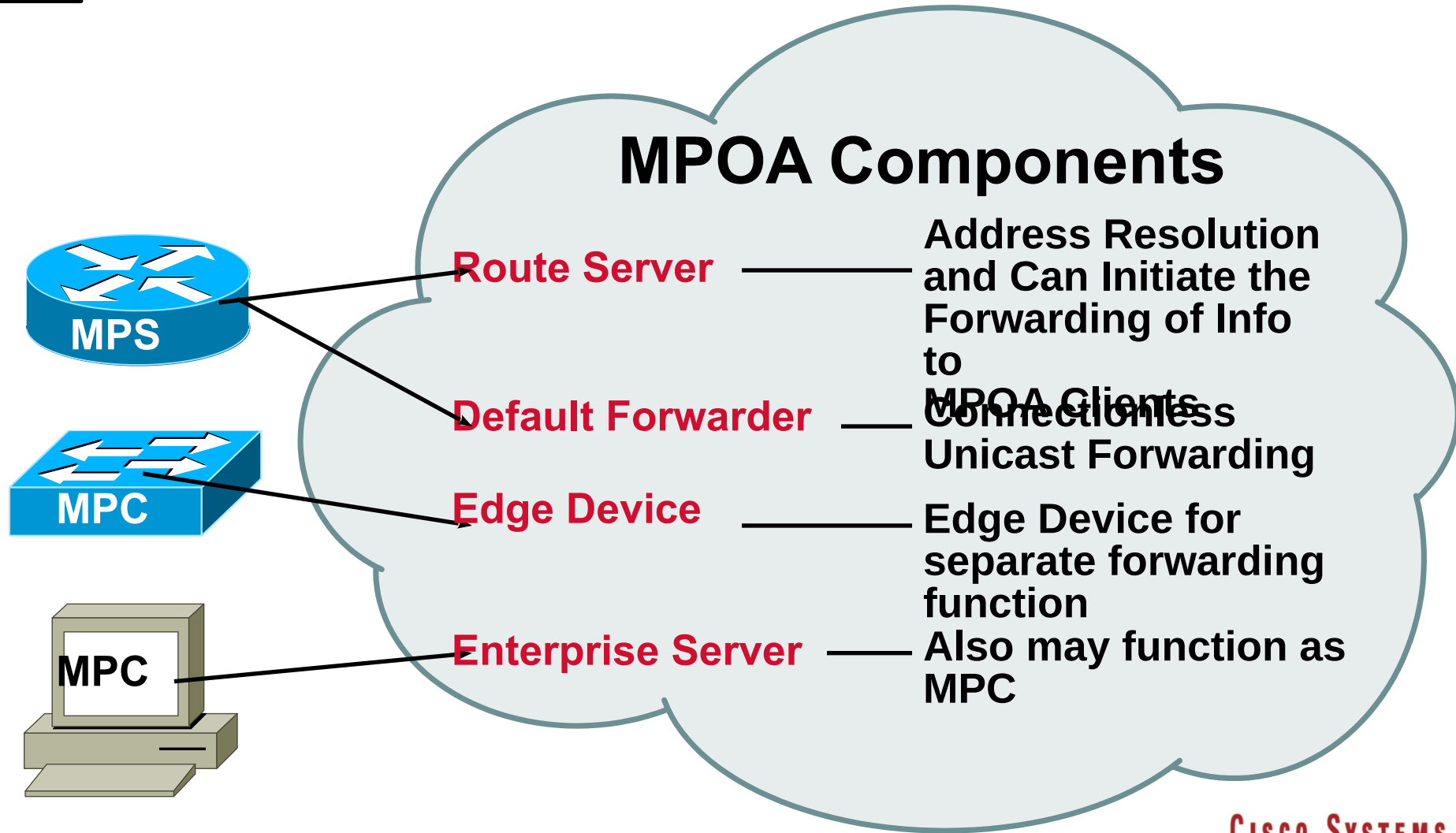
**For seamless transport
of layer 3 protocols across
ATM networks**

**Goes beyond LANE by
allowing direct ATM
connectivity between hosts
in different subnets**

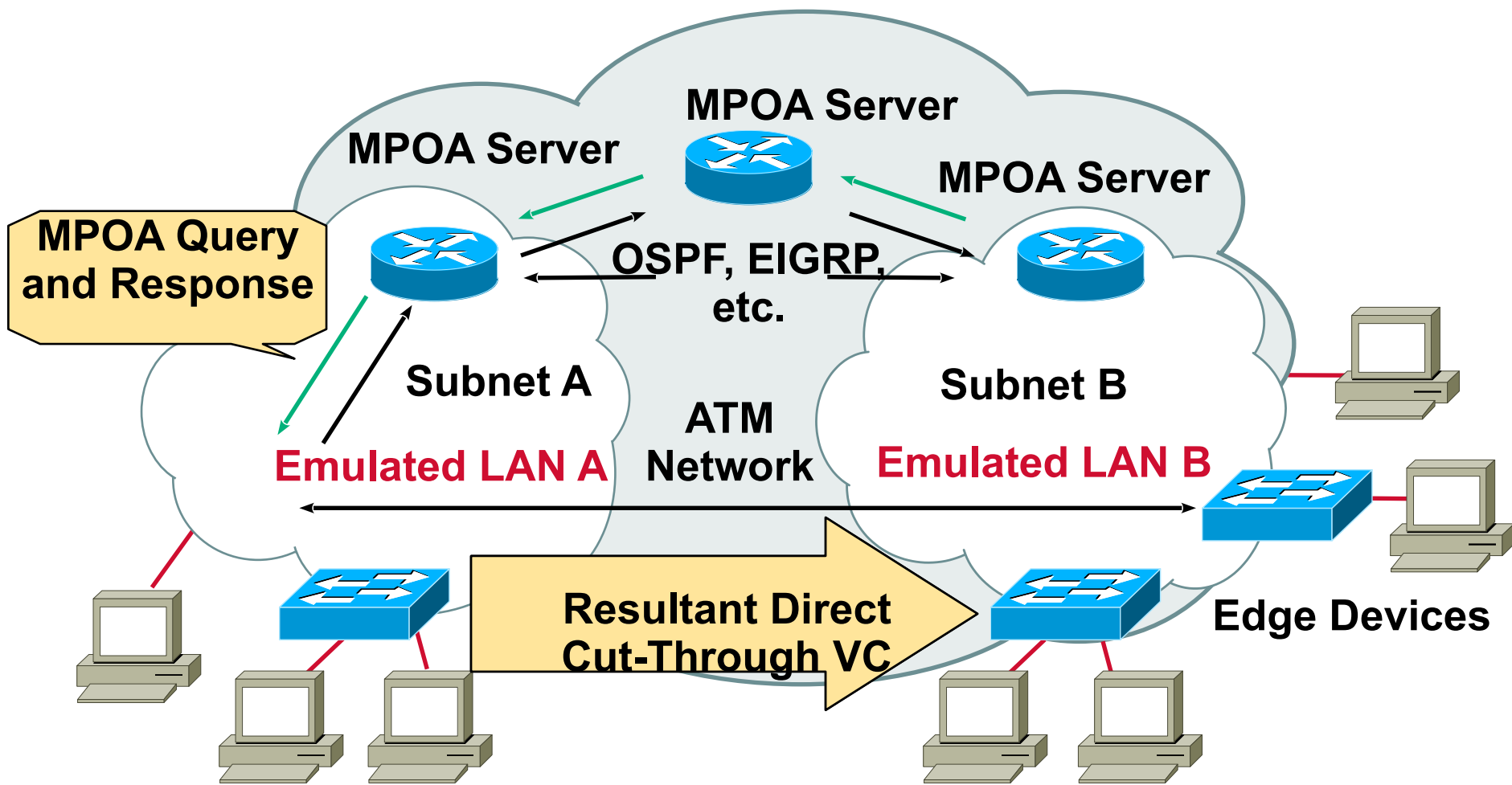
**Architecture consists of edge
devices and route servers**

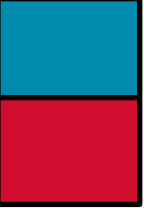


MPOA Service Basics



MPOA—Query and Response





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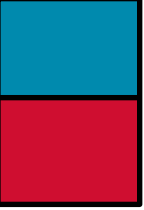
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Wrap Up

ATM References

<http://www.cisco.com>

<http://www.atmforum.com>

e-mail info@atmforum.com

<http://cell-relay.indiana.edu>

<http://www.atmreport.com>

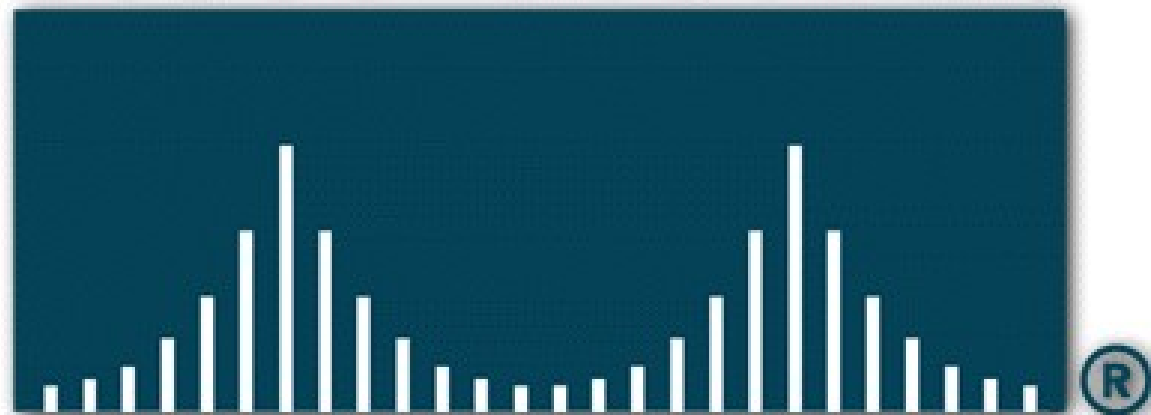
<http://www.atm-user.com>



Wrap Up

Thank You Q&A

CISCO SYSTEMS



EMPOWERING THE
INTERNET GENERATIONSM