

Broadband Inter-Carrier Interface (B-ICI)

Raj Jain

Professor of Computer and Information Science

The Ohio State University

Columbus, OH 43210

Jain@CIS.Ohio-State.Edu

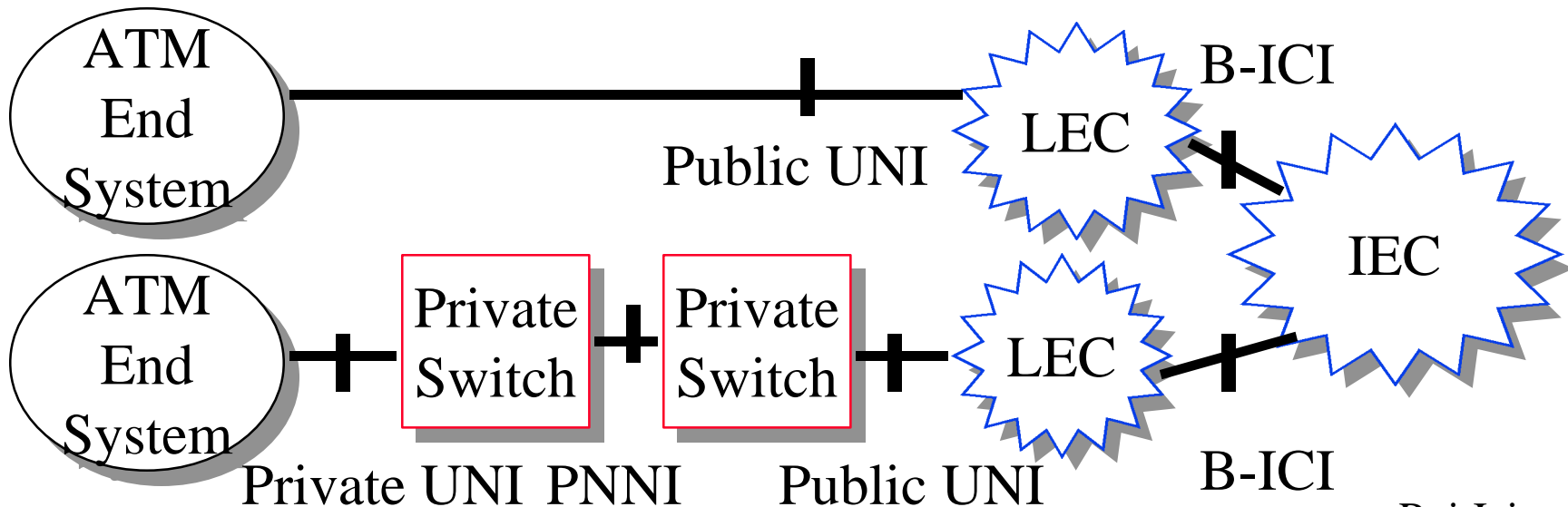
<http://www.cis.ohio-state.edu/~jain/>



- ❑ What is B-ICI?
- ❑ SS7 Signaling and BISUP
- ❑ NNI Signaling
- ❑ Interworking:
 - ❑ Circuit emulation services
 - ❑ Frame relay
 - ❑ SMDS

What is B-ICI?

- ❑ B-ICI = Public Network-to-Network Interface
- ❑ Public network= Local exchange carrier (LEC), Independent Local Exchange carrier (ILEC), Inter-exchange carrier (IEC)
- ❑ B-ICI \neq PNNI: Public carriers may not allow PNNI functions such as advertising, routing DTLs

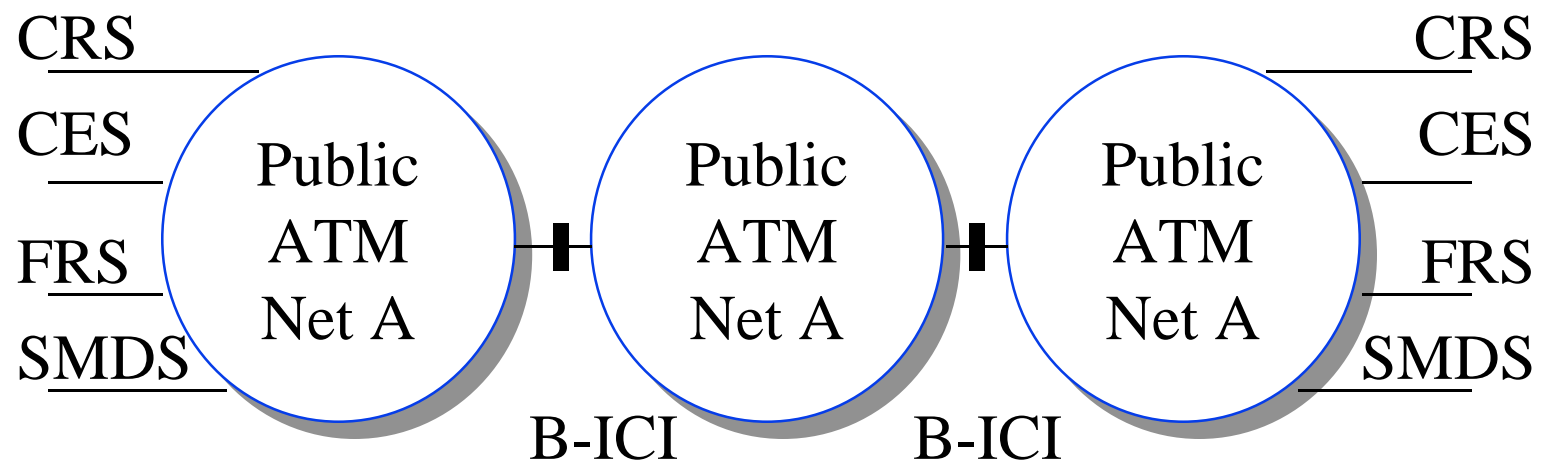


B-ICI: Key Features

- ❑ Based on Broadband ISDN User Part (B-ISUP) signaling messages and parameters
- ❑ Static routing based on E.164 addresses
- ❑ Point to point and multipoint connections (in V2.0)
- ❑ Supports UNI 3.1 QoS classes 0 through 4
- ❑ Allows end-to-end carriage of NSAP addresses
- ❑ Provides traffic data collection: ingress and egress cell counts
- ❑ Provides traffic management and network performance

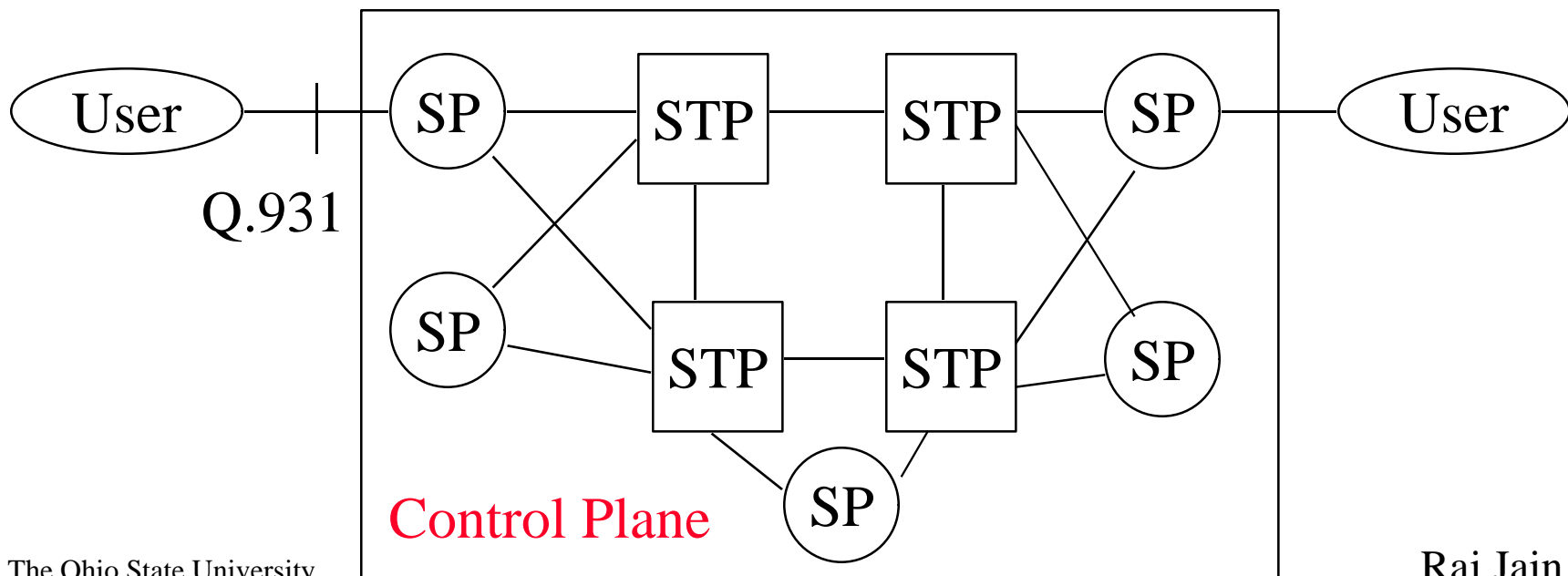
B-ICI: Key Features (Cont)

- Supports cell relay service (CRS), Circuit emulation services (CES), frame relay service (FRS), switched multi-megabit service (SMDS)

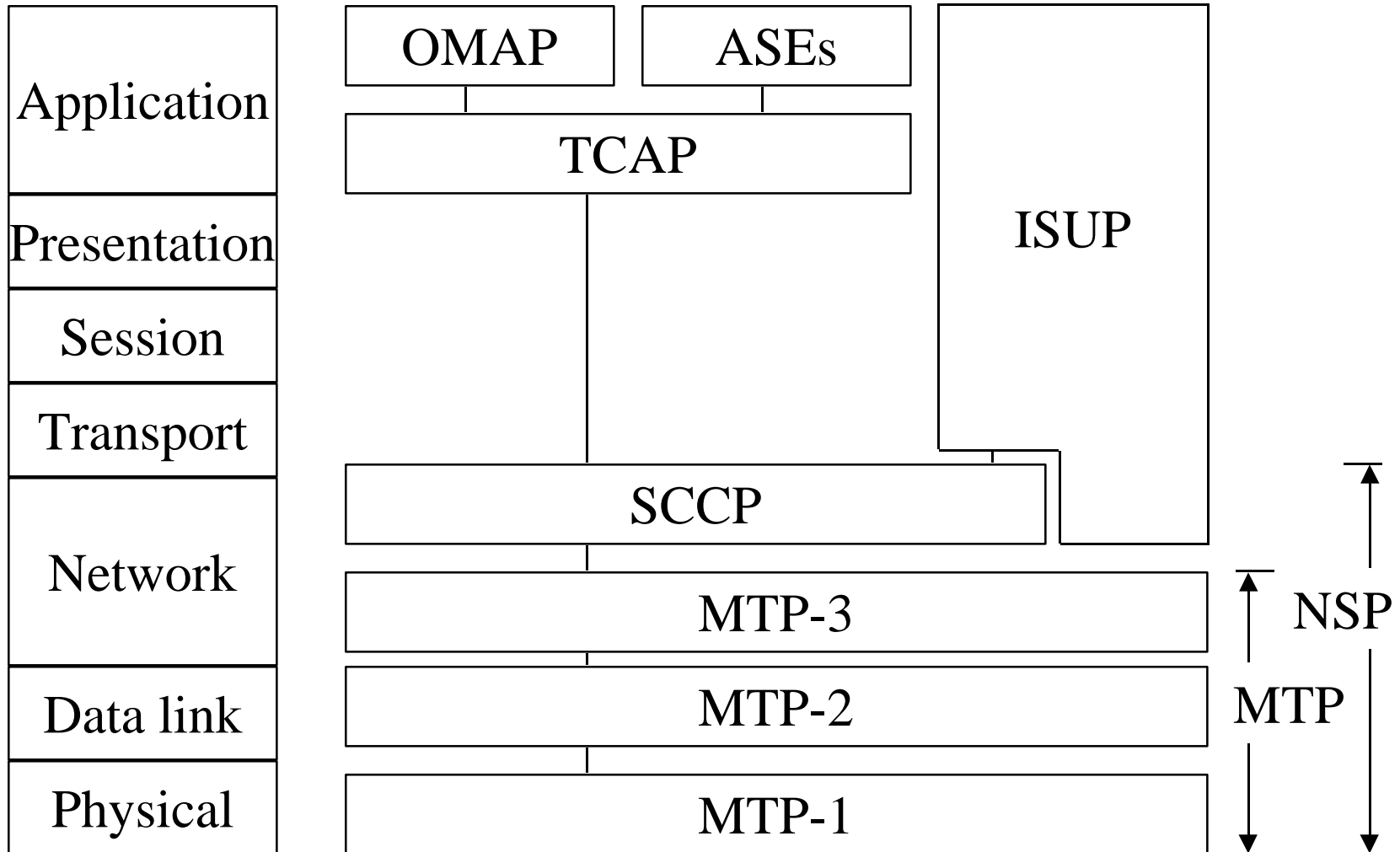


SS7

- ❑ Also known as Common Channel Signaling 7
- ❑ Separate signaling network of STPs
- ❑ STP = Signaling transfer points (can route sig messages)
- ❑ Signaling point (SP): Can handle SS7 control messages



SS7 Protocol Architecture



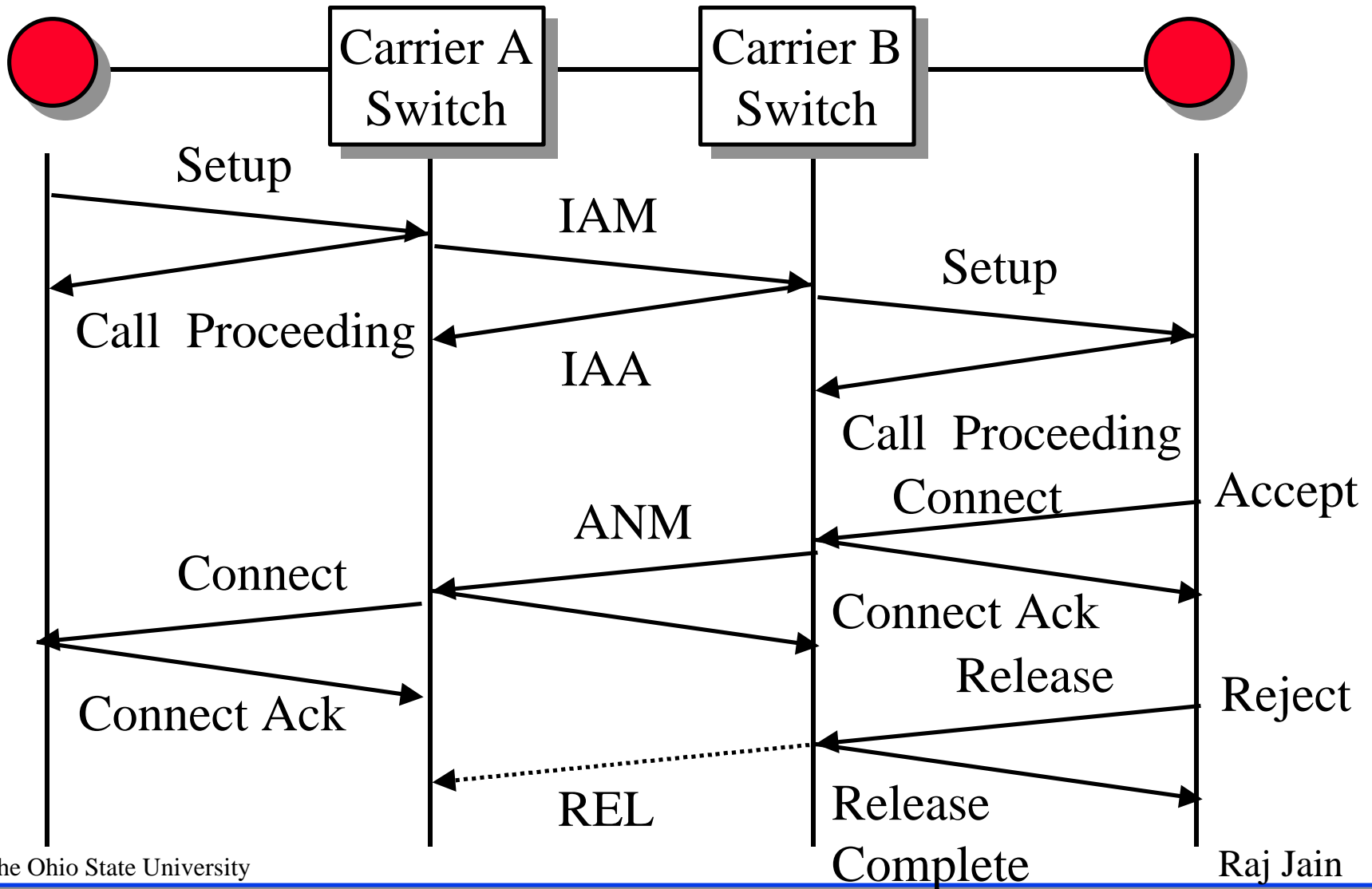
SS7 Protocol Architecture

- ❑ Q.931 specifies the control messages from user to network
- ❑ SS7 specifies the mechanisms (services and protocols) inside the network
- ❑ Reliable transport is provided by MTP (message transfer part)
- ❑ Signaling connection control part (SCCP): Routes messages using logical addresses. Also supports duplications of databases.
- ❑ SSCP+MTP=Network service part

SS7 User Parts

- ❑ Separate user parts for different services:
 - ❑ Telephone user part (TUP)
 - ❑ Data user part (DUP)
 - ❑ Transaction capability part (TCAP): Allows non-circuit related request-response communication between two nodes in a signaling network.
 - ❑ ISDN User part (ISUP): Defines functions, procedures, and signaling information flows to set up, supervise, and release connections.
- ❑ Broadband ISUP (and ISUP) define NNI signaling messages (similar to Q.931 and Q.2931)

BISUP Connection Setup



BISUP Messages: Examples

- ❑ Initial address message IAM
- ❑ IAM Ack IAA
- ❑ IAM Reject IAR
- ❑ Exit message EXM
- ❑ Answer ANM
- ❑ Release REL
- ❑ Release complete RLC
- ❑ Call progress message CPG

BISUP Message Format

Routing Label
Message Type Code
Message Compatibility
Message Length
Message Content

- ❑ Routing Label: Same label on all messages relating to a VC
- ❑ Message type: IAM, ...
- ❑ Message compatibility information:
What to do if message not understood?
Pass on, Discard message, Release call
- ❑ Message length: length of content

BISUP Parameter Format

Parameter name
Length Indicator
Parameter compatibility
Parameter Content

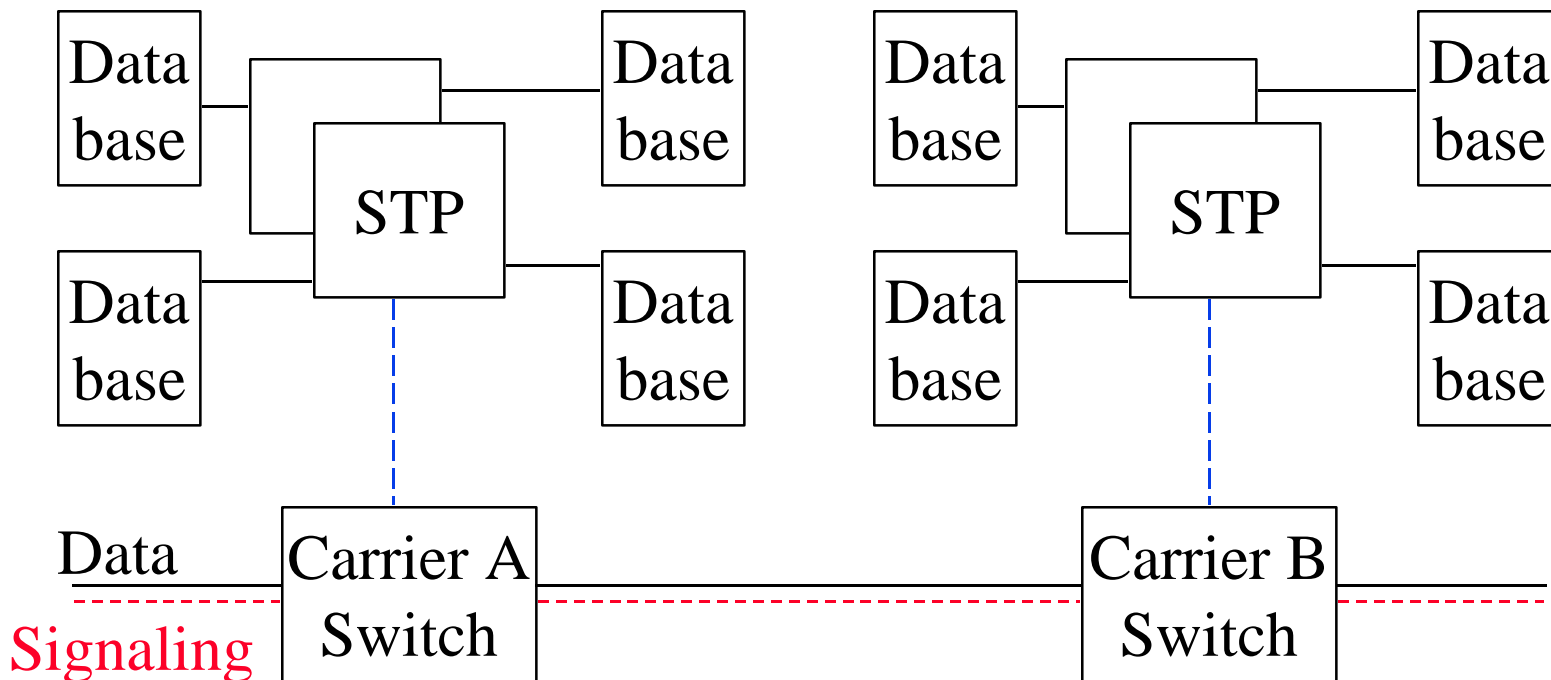
- ❑ Parameter compatibility information:
What to do if parameter not understood?
Pass on, discard parameter, discard message, release call

BISUP Parameters: Examples

- ❑ Called party number
- ❑ Called party subaddress
carries ATM End System Address (AESAs)
- ❑ Calling party number
- ❑ Calling party subaddress
- ❑ AAL parameters
- ❑ Additional calling party number
- ❑ ATM user traffic descriptor
- ❑ Broadband bearer capability
- ❑ Maximum end-to-end transit delay
- ❑ Transit network selection

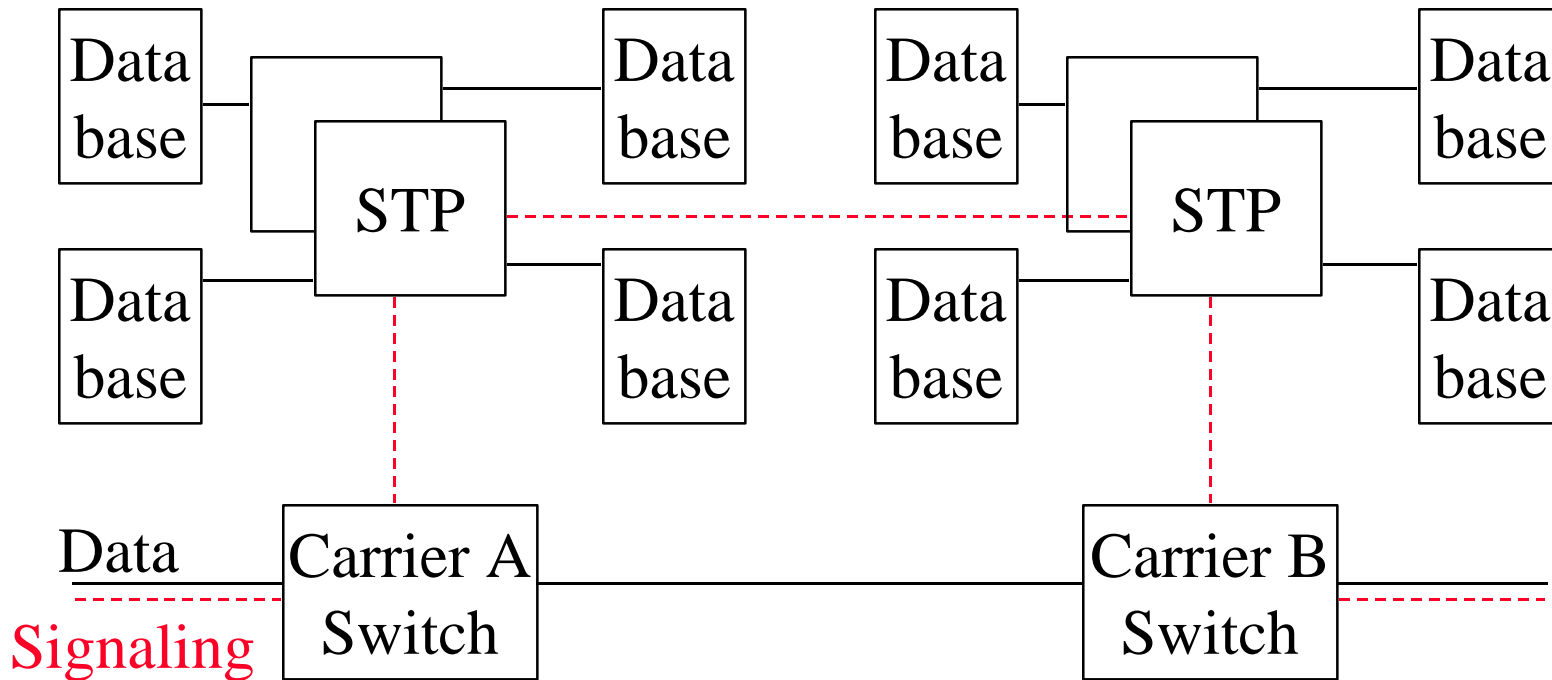
Associated Signaling

- ❑ B-ICI uses a subset of BISUP messages and information elements and uses them for inter-carrier NNI.
- ❑ B-ICI supports only associated signaling

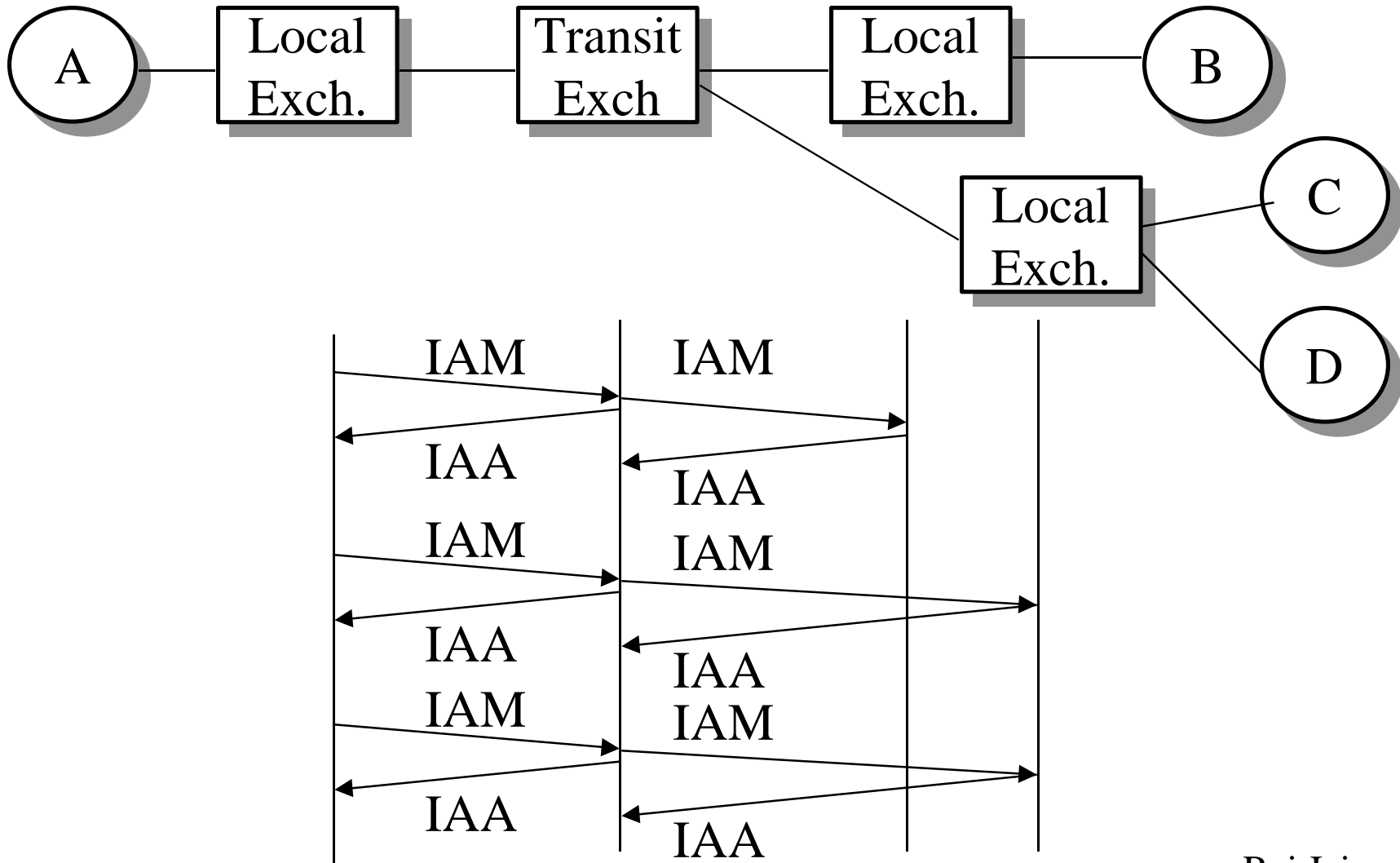


Quasi-Associated Signaling

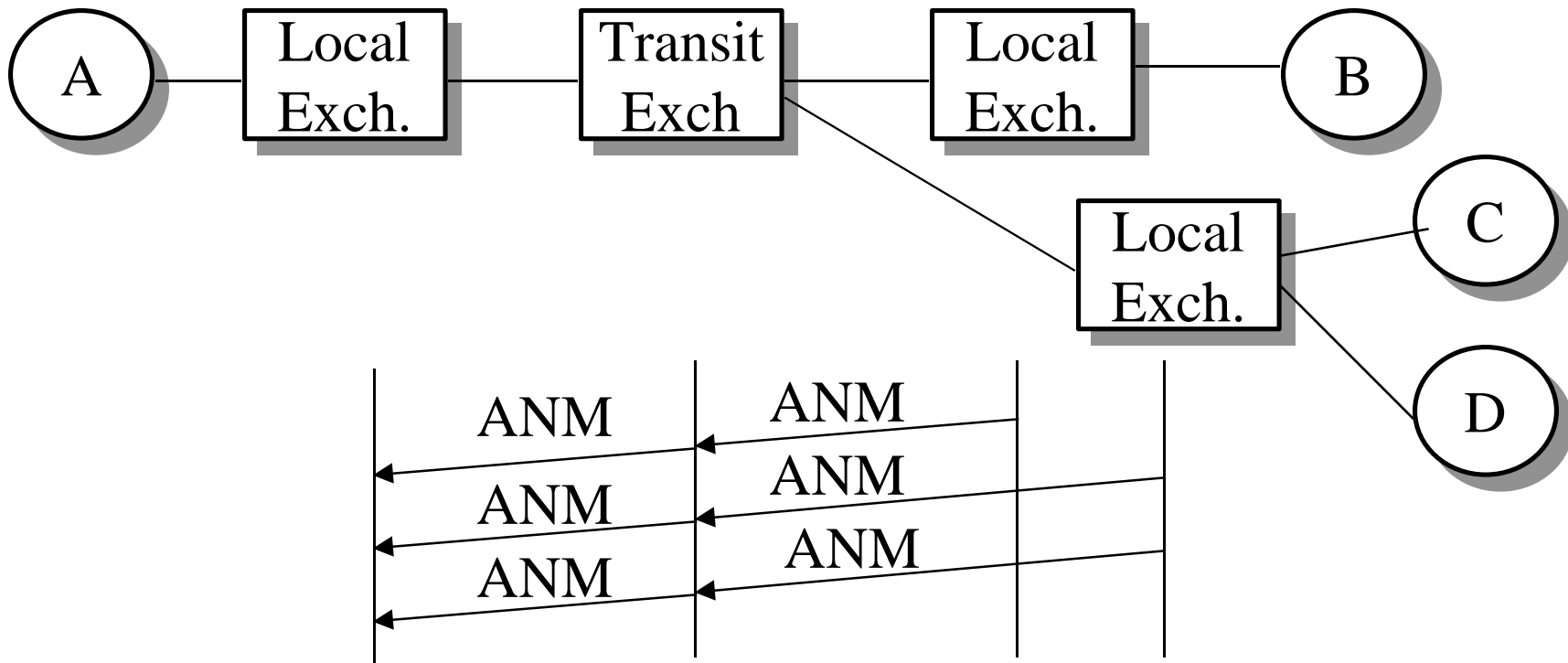
- ❑ BISUP supports quasi-associated signaling also. But B-ICI does not.



Multipoint Call



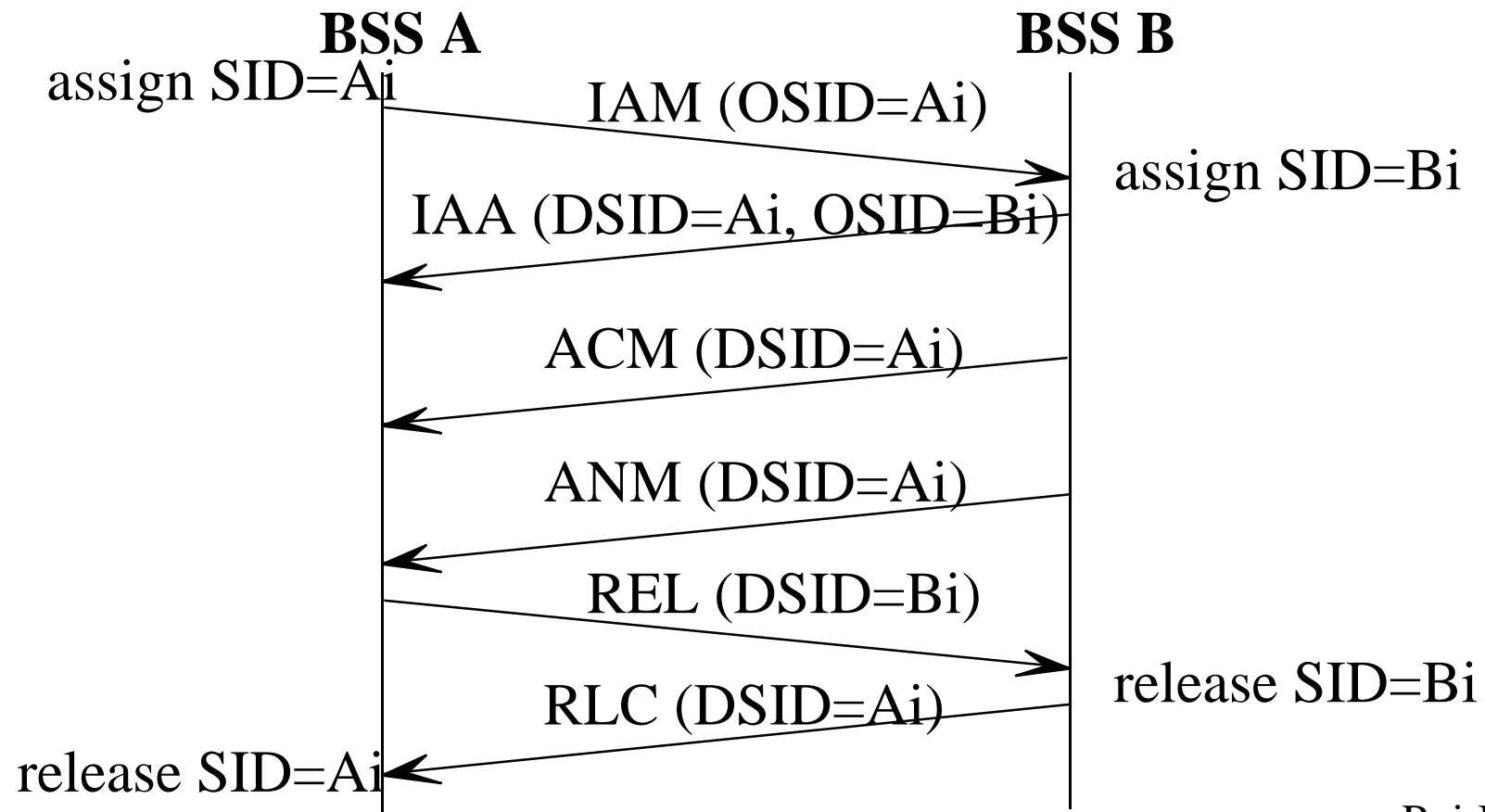
Multipoint Call (Cont)



- Leaf party type parameter
 - = 0 \Rightarrow First end point
 - = 1 \Rightarrow 2nd and subsequent end points

Signaling Identifiers (SIDs)

- Identify a signaling association between two switches
- Each switch gives its own ID



BISUP Maintenance Control Fns

- ❑ **Reset:** Caused by unexpected messages.
- ❑ **Blocking:** Enter diagnostic mode.
- ❑ **Remote User Part Availability:** Not supported by B-ICI.
- ❑ **Transmission Alarm:** fault indication.
- ❑ **Automatic Congestion Control:** Switch is overloaded. No new connections. or Release current connection"
- ❑ **Signaling Congestion Control:** Signaling network is overloaded. Discard lower priority messages. Four priority levels.
- ❑ **Destination Unavailability:** No new connections. Current connections released after a timeout.
- ❑ **VPCI/VPI consistency check:** Loopback test

Maintenance Control Messages

- ❑ Blocking BLO
- ❑ Blocking Ack BLA
- ❑ Unblocking UBL
- ❑ Unblocking Ack UBA
- ❑ Reset RSM
- ❑ Reset Ack RAM
- ❑ User Part Test UPT
- ❑ User Part Available UPA
- ❑ Consistency Check Request CCR
- ❑ Consistency Check Request Ack CCRA
- ❑ Consistency Check End CCE
- ❑ Consistency Check End Ack CCEA

Protocol Monitoring

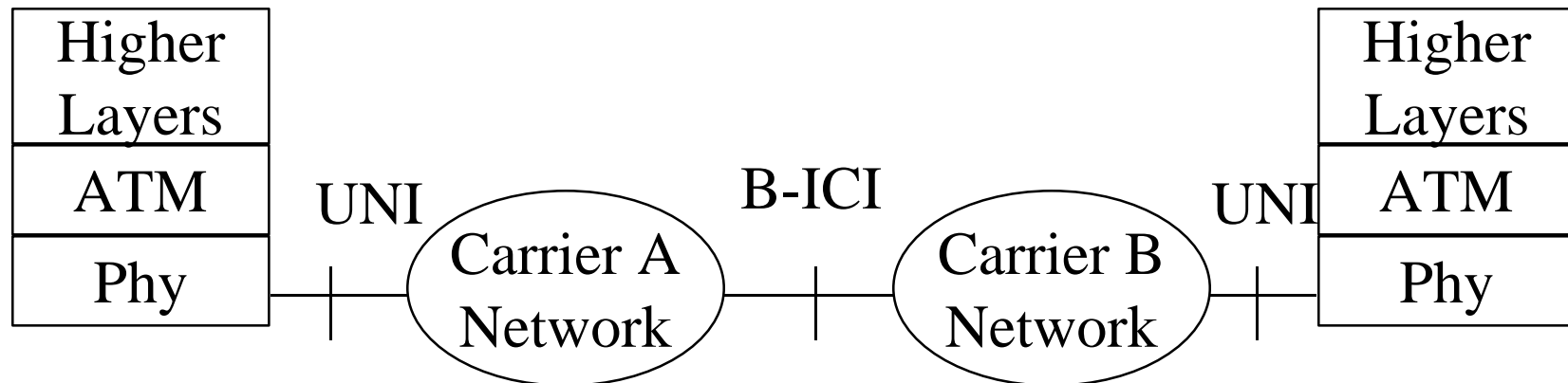
- ❑ Keep count of
 - ❑ Calls released due to:
 - + Unrecognized messages
 - + Unrecognized parameters
 - ❑ BISUP messages discarded
 - ❑ BISUP parameters discarded

Usage Measurement

- ❑ Ingress total cells
- ❑ Ingress high priority cells
- ❑ Egress total cells
- ❑ Egress high priority cells
- ❑ Interval start date
- ❑ Interval state time
- ❑ Interval elapsed time
- ❑ Recording interface: UNI or PVC
- ❑ Recording connection identifier
- ❑ Carrier identifier
- ❑ Type of service

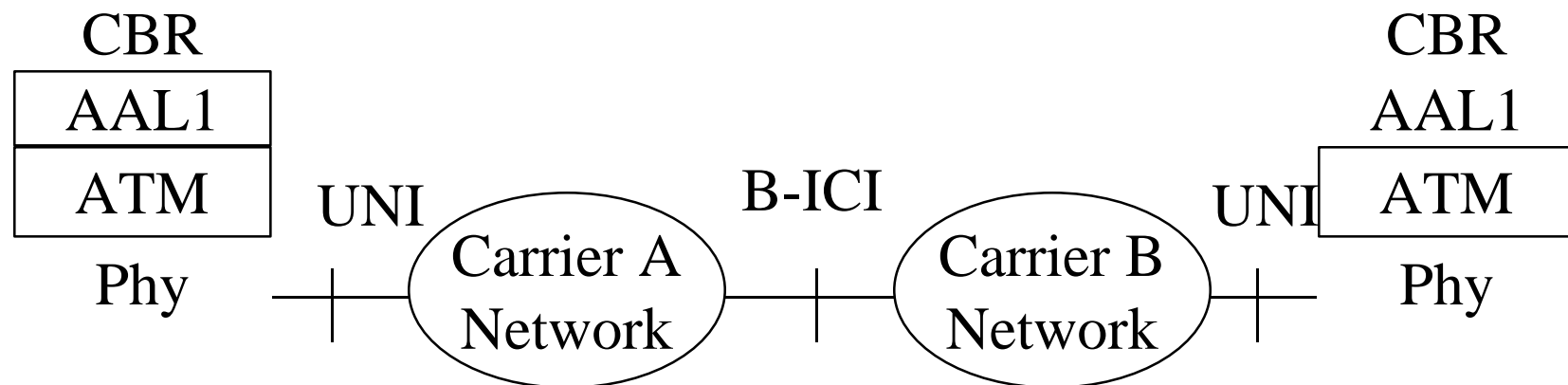
Cell Relay Service

- ❑ Provides multiple QoS: CTD, CDV, CLR, Cell error ratio, Cell misinsertion rate, Mean time between service outages, mean time to restore
- ❑ Static routing
- ❑ Operation and maintenance



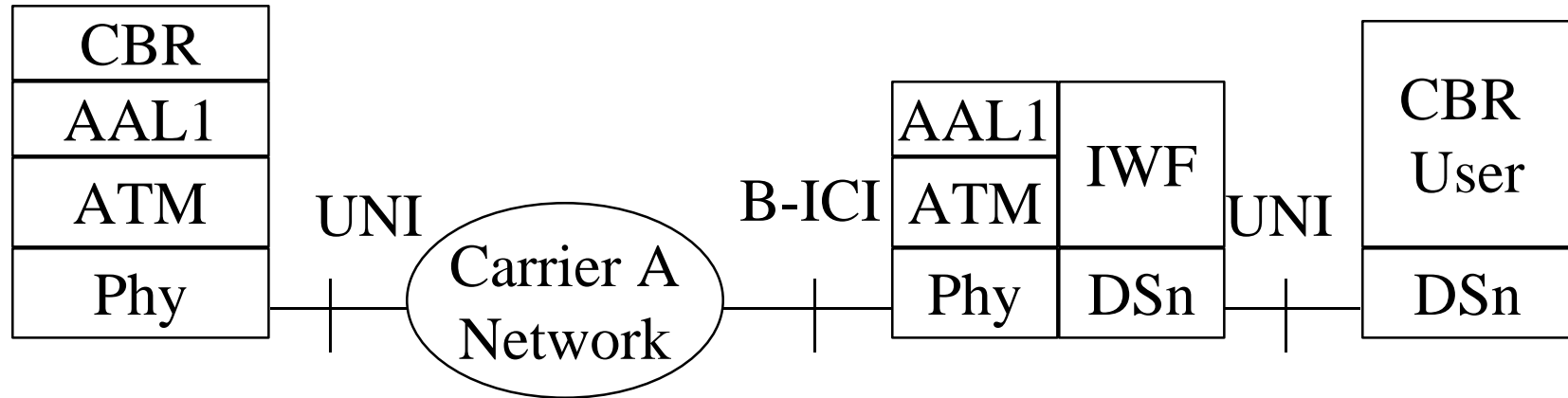
Circuit Emulation Service

- ❑ AAL1 for DS-1 and DS-3
- ❑ ATM to ATM

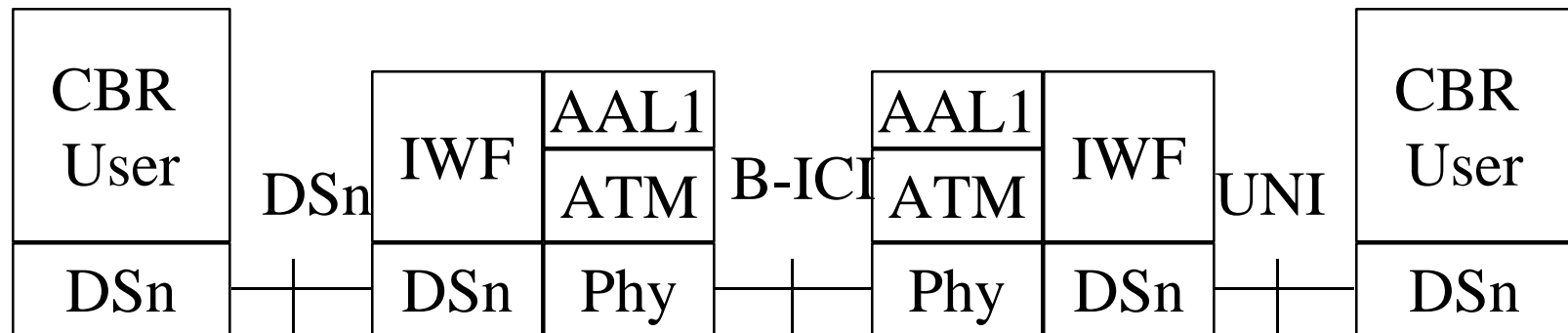


CES Interworking

ATM to DSn

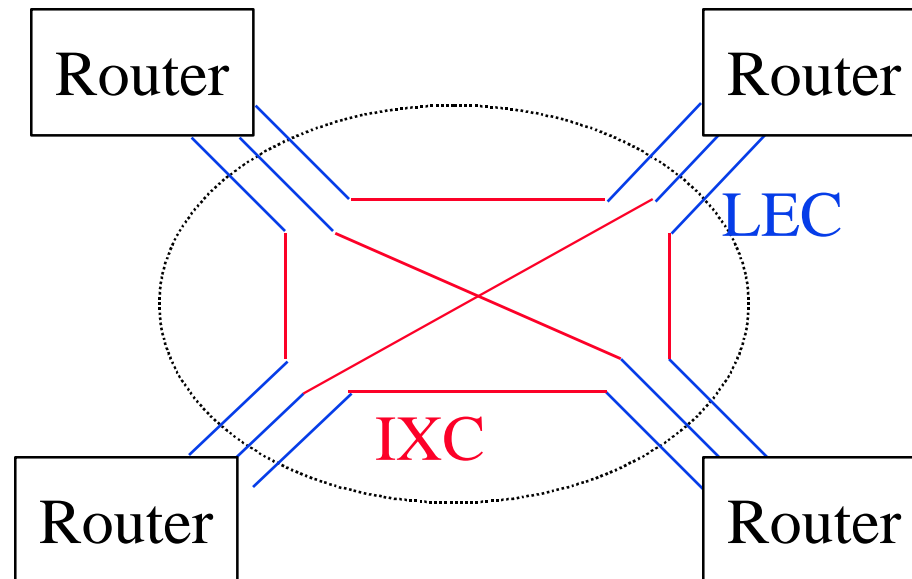


DSn to DSn



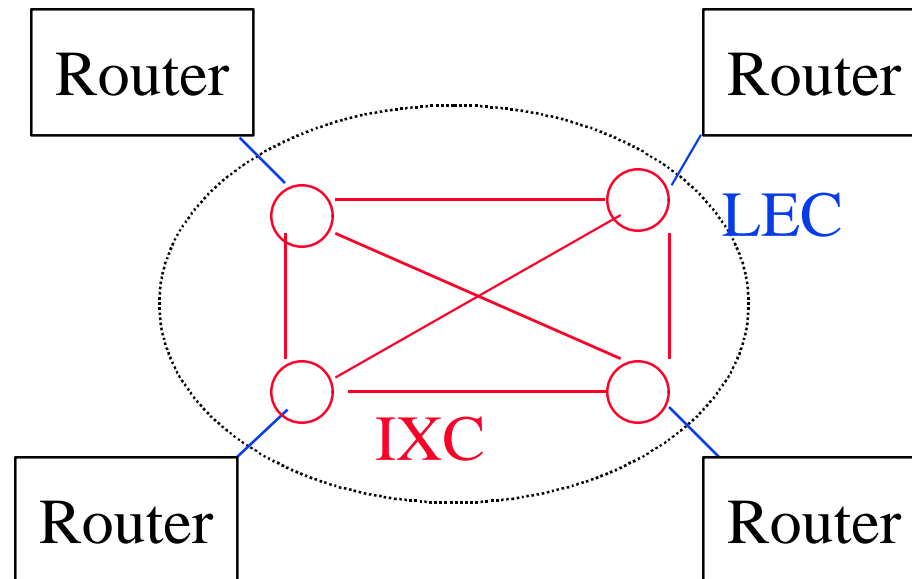
Problems with Leased Lines

- ❑ No user-to-user end-to-end signaling
- ❑ Multiple logical links \Rightarrow Multiple connections
- ❑ Four nodes \Rightarrow 12 ports, 12 local exchange carrier (LEC) access lines, 6 inter-exchange carrier (IXC) connections
- ❑ One more node \Rightarrow 8 more ports, 8 more LEC lines, 4 more IXC circuits



Solution: Frame Relay

- ❑ Four nodes: 4 ports, 4 LEC access lines, 6 IXC circuits
- ❑ One more node: 1 more port, 1 more access line, 4 more IXC circuits
- ❑ Share leased lines \Rightarrow Virtual Private Networks



Frame Relay: Key Features

- ❑ X.25 simplified
- ❑ No flow and error control
- ❑ Virtual circuit: Data Link Connection Identifiers (DLCI)
- ❑ Congestion control added

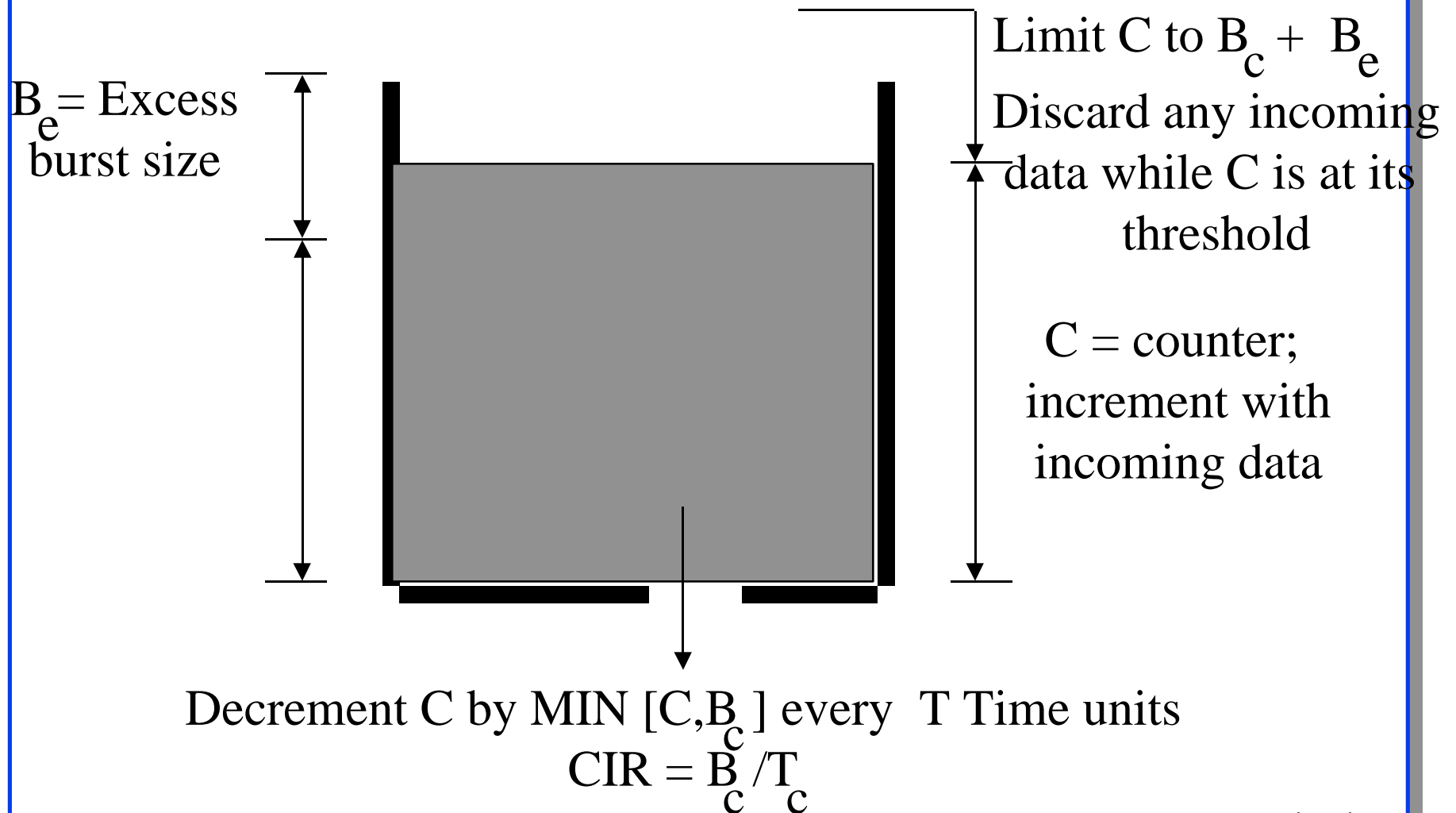
⇒ Higher speed possible.

X.25 suitable to 200 kbps. Frame relay to 2.048 Mbps.

Discard Control

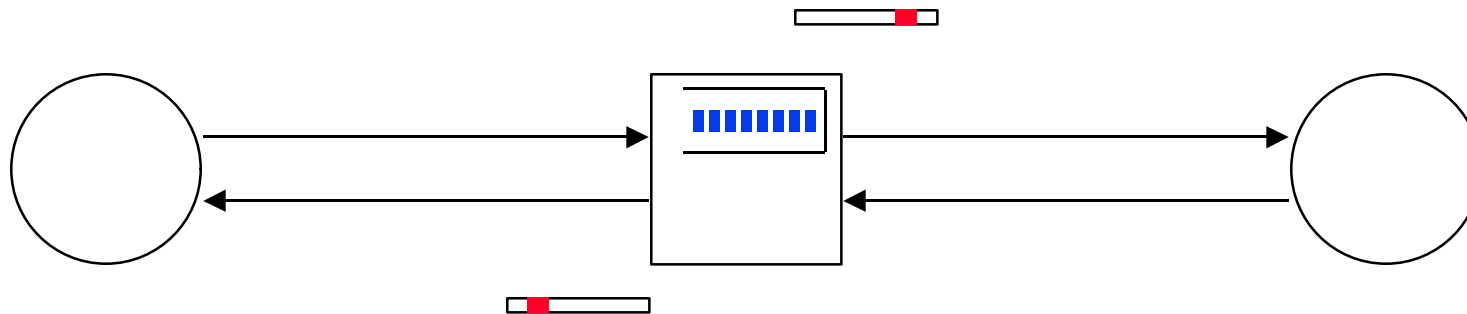
- ❑ Committed Information Rate (CIR)
- ❑ Committed Burst Size (B_c): Over measurement interval T
 $T = B_c / \text{CIR}$
- ❑ Excess Burst Size (B_e)
- ❑ Between B_c and $B_e \Rightarrow$ Mark DE bit
- ❑ Over $B_e \Rightarrow$ Discard

Leaky Bucket Algorithm

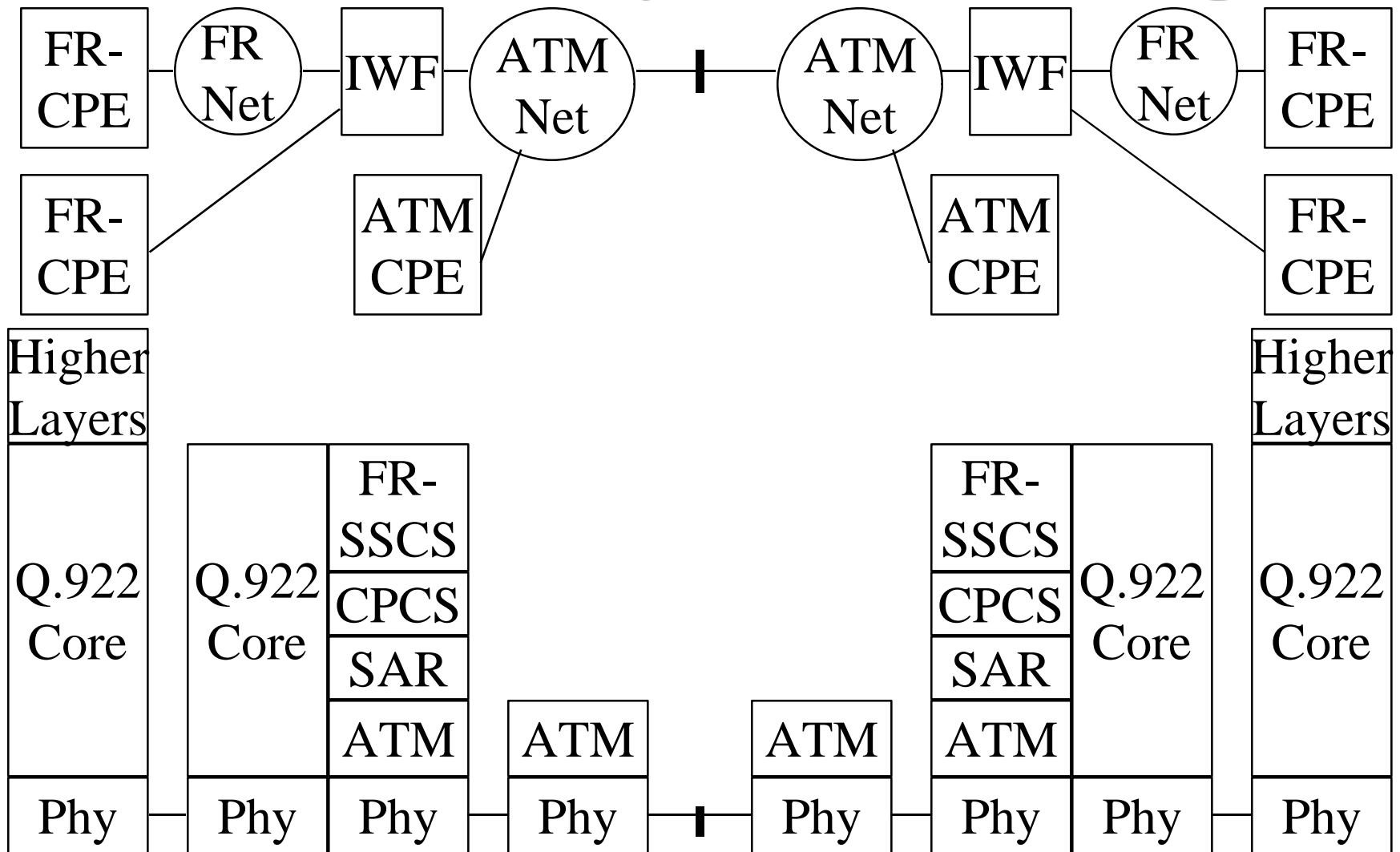


Congestion Control

- ❑ Each frame has two bits:
 - ❑ FECN: Forward explicit congestion notification
 - ❑ BECN: Backward explicit congestion notification
- ❑ Switches mark the bits when congested



Frame Relay Interworking



Frame Relay/ATM Interworking

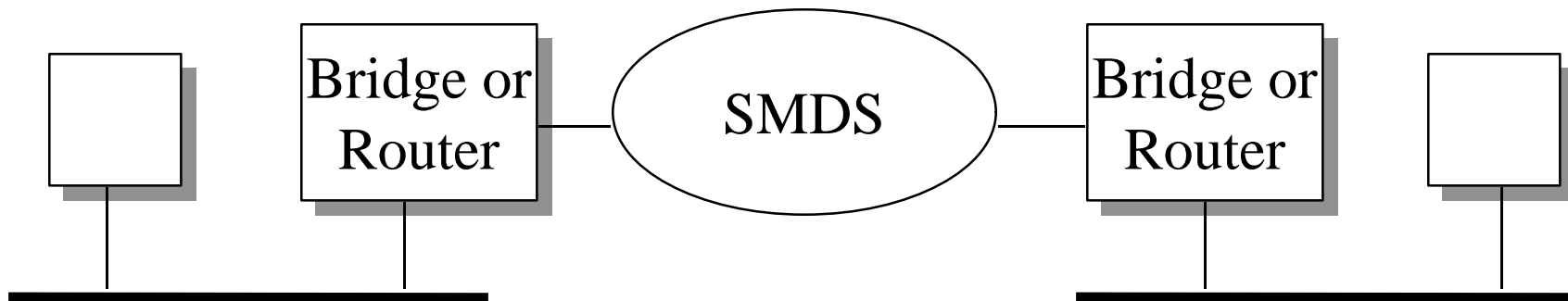
- ❑ Guidelines for connection parameter translation
 - ❑ Formula for converting access line rate, committed information rate, excess information rate, committed burst size, excess burst size, measurement interval to/from PCR, SCR, MBS, CDVT
- ❑ Guidelines for discard eligibility
 - ❑ FR to ATM: Two choices
 - + $DE = 1 \Rightarrow$ All cells have $CLP=1$
 - + CLP is not changed. Only header DE .
 - ❑ ATM to FR: Two choices
 - + Any CLP set $\Rightarrow DE = 1$
 - + CLP does not affect DE

FR Interworking (Cont)

- ❑ Guidelines for forward explicit congestion indication mapping
 - ❑ FR to ATM: Copy FECN into header. Set EFCI in cells to 0.
 - ❑ ATM to FR: SET FECN if FECN in header or if EFCI of last cell is 1.
- ❑ Guidelines for Backward congestion indication mapping
 - ❑ Pass BECN only in the header.
 - ❑ Set BECN in frames going in backward direction if EFCI in the last cell in the forward direction is 1.
- ❑ Support FR PVC status management
- ❑ Usage measurement

What is SMDS?

- ❑ Switched: More like dial up than leased lines.
Usage based billing.
- ❑ Multi-Megabit: 1.5 Mbps to 45 Mbps
- ❑ Data: For LAN interconnection
- ❑ Service: Underlying technology can change.
Service does not.
- ❑ Connectionless Broadband Data Service (CBDS) in Europe



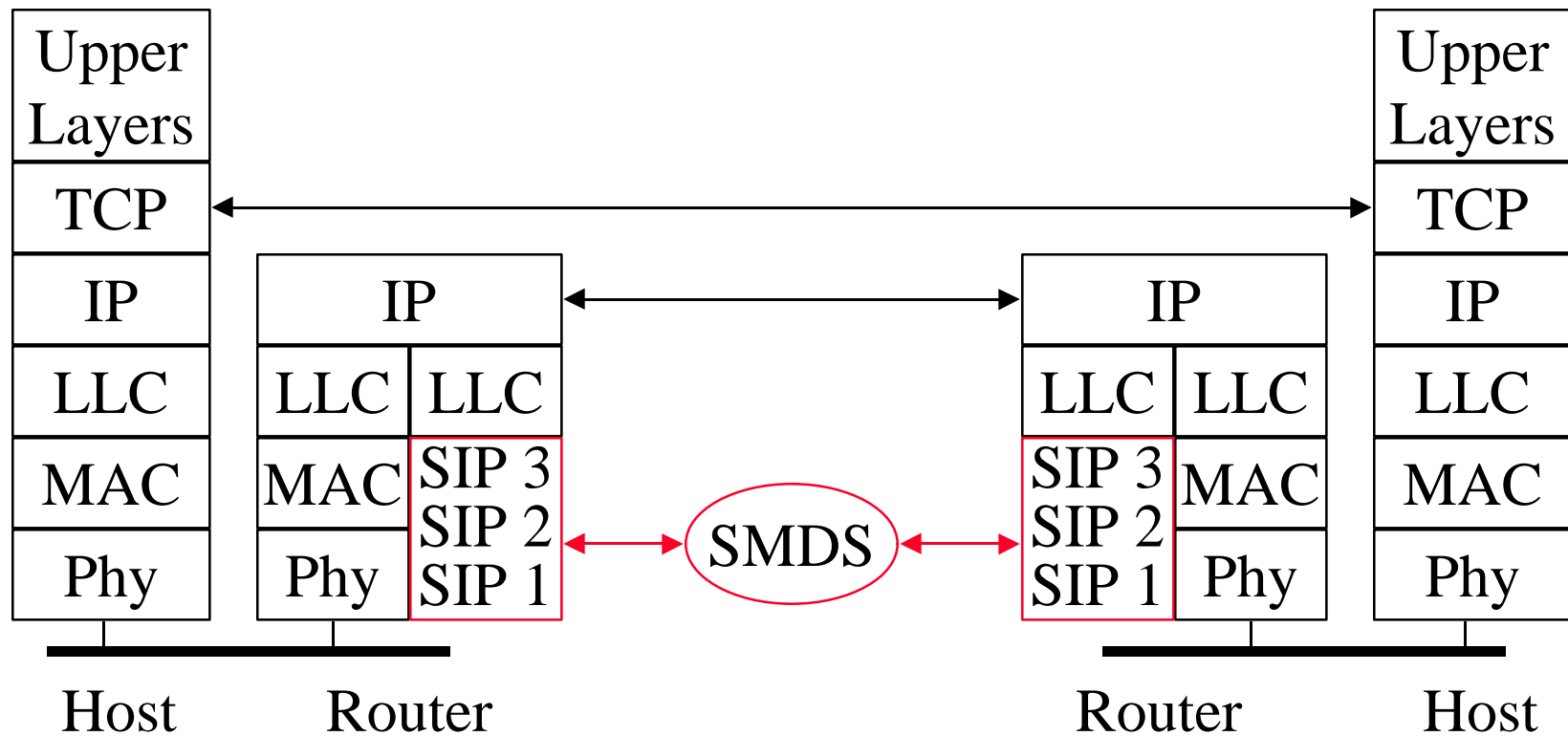
SMDS Objective

- ❑ Designed for LAN Interconnection
⇒ As many LAN features as possible
- ❑ Multicasting
- ❑ IEEE 802 compatible
- ❑ Connectionless: No connection setup through the network.
Each packet carries an address.

Destination address	Source address	
64 bits	64 bits	

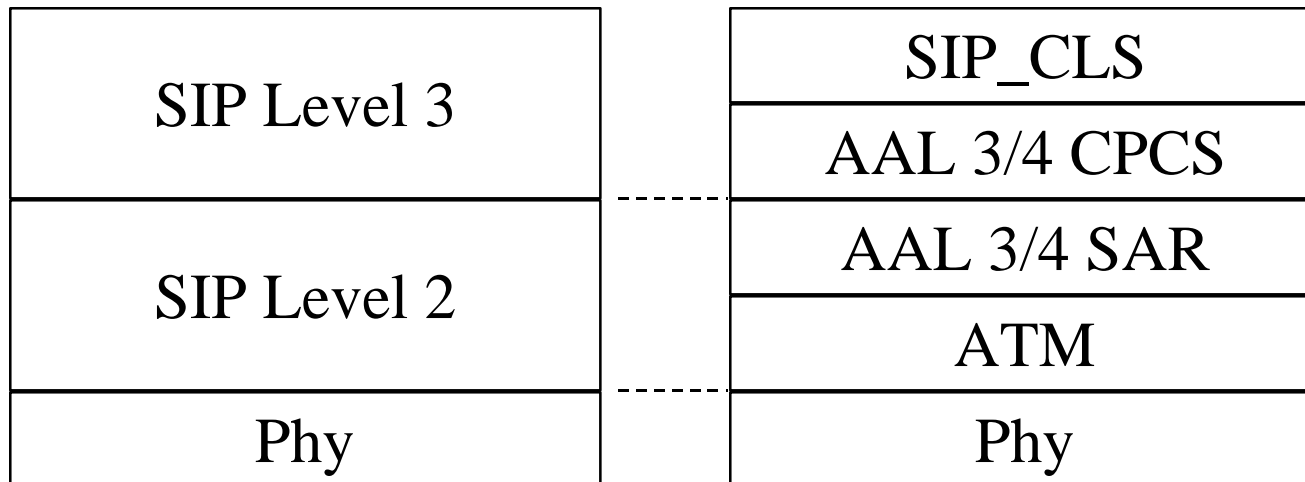
Routing with SMDS

- SMDS network looks like a LAN
- RFC 1209 describes IP address to SMDS address translation

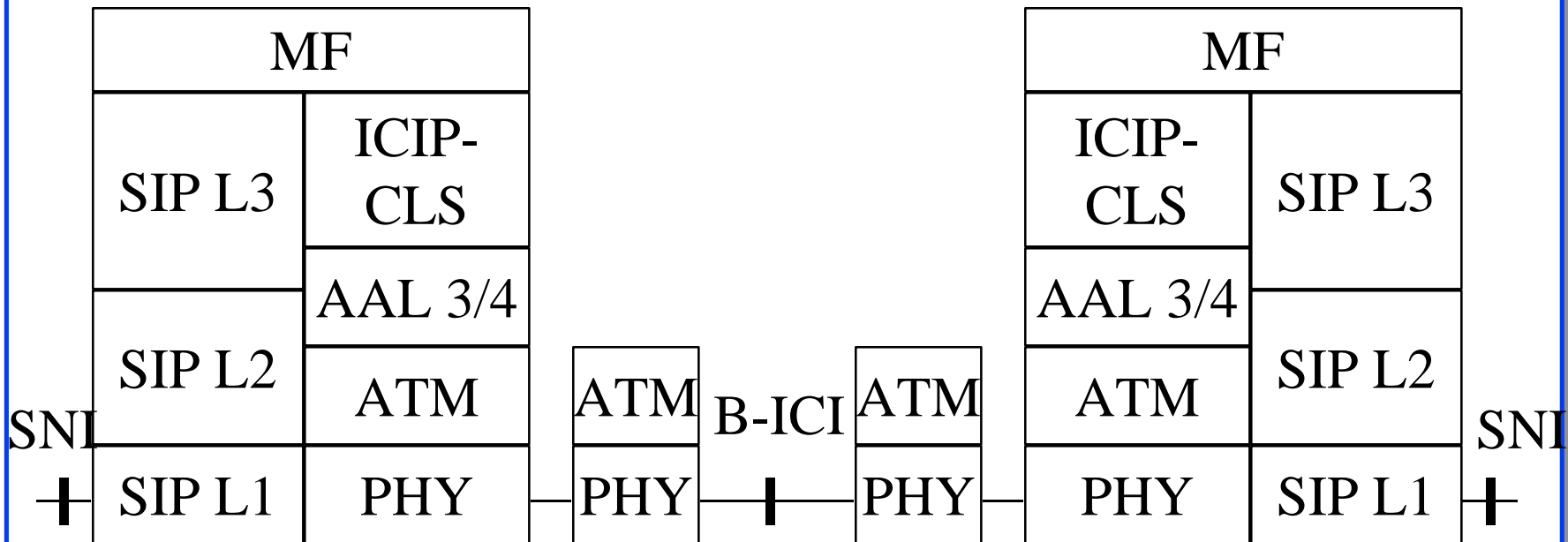
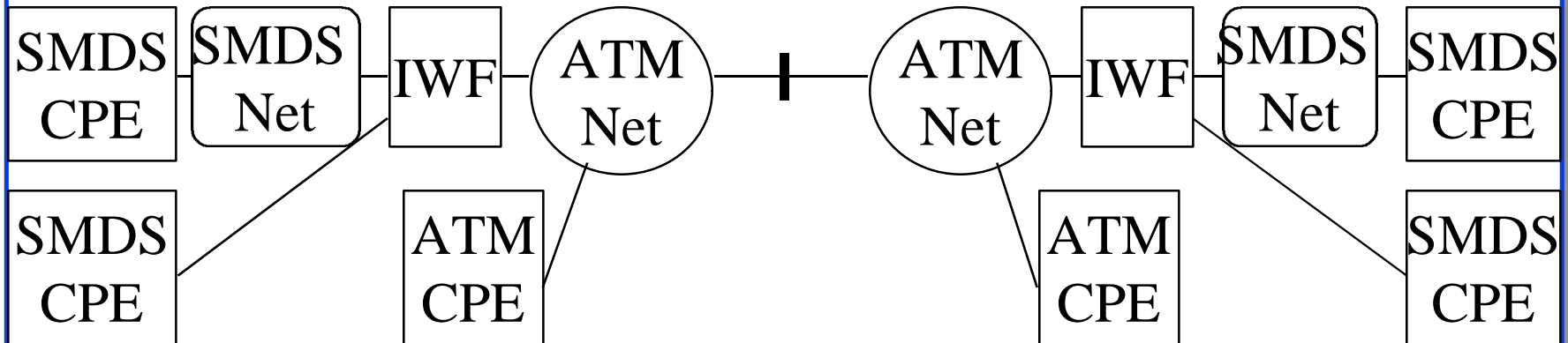


SMDS over ATM

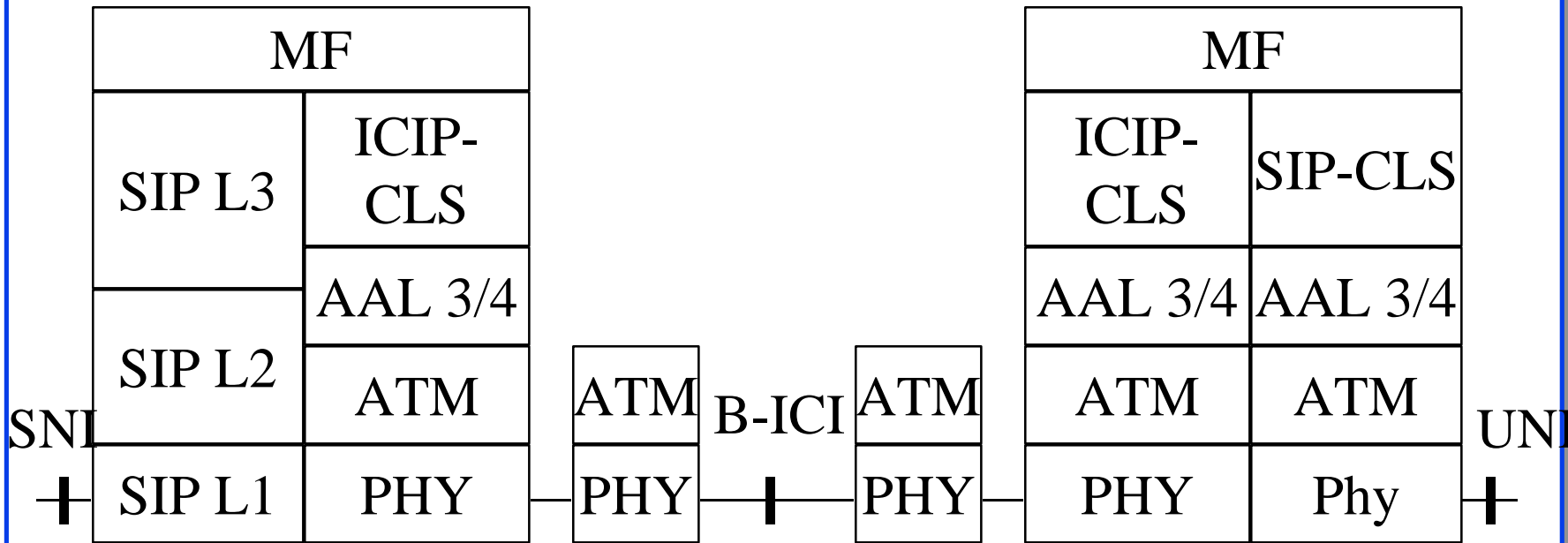
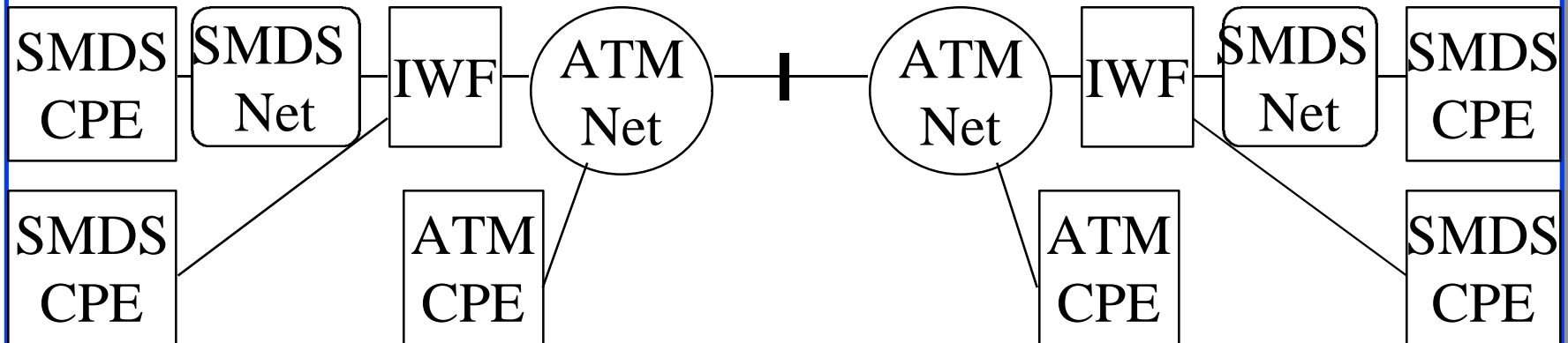
- ❑ SIP Level 2 uses 53 byte cells
- ❑ Service Specific Convergence Sublayer (SSCS) = SIP
Connectionless Service Layer (SIP_CLS) = Null
- ❑ AAL 3/4 Common Part Convergence Sublayer



SMDS/ATM Interworking



SMDS/ATM Interworking (Cont)



B-ICI 2.0 vs PNNI 1.0

- ❑ PNNI 1.0 parameters not specified in B-ICI 2.0:
 - ❑ ABR additional parameters
 - ❑ ABR setup parameters
 - ❑ Alternate ATM traffic descriptor (added for bandwidth negotiation)
 - ❑ Minimum acceptable ATM traffic descriptor (for negotiation)
 - ❑ Connected number
 - ❑ Connected subaddress
 - ❑ End-to-end transit delay
 - ❑ Extended QoS parameters

- ❑ Generic identifier support
- ❑ Narrowband bearer capability
- ❑ Narrowband high-layer compatibility
- ❑ Narrowband low-layer compatibility
- ❑ Progress indicator

B-ICI vs MTP Level 3

- ❑ Only a subset of MTP-3 is used in B-ICI
- ❑ B-ICI does not require any STP functions
- ❑ B-ICI does not use the following MTP-3 functionality:
 - ❑ Differences between national and international
 - ❑ N-ISDN interworking
 - ❑ Propagation delay determination
 - ❑ User part availability procedure
 - ❑ Segmentation of messages for use of narrowband signaling links
 - ❑ MTP level 3 quasi-associated signaling
 - ❑ MTP level 3 restart procedure

B-ICI vs BISUP

- ❑ B-ICI uses the following functions not in B-ISUP:
 - ❑ Messages:
 - + Exit message
 - ❑ Additional parameters:
 - + Carrier identification code
 - + Charge number
 - + Carrier selection information
 - + Outgoing facility identifier
 - + Originating link information
 - ❑ Additional procedures:
 - + Transit network selection

Summary



- ❑ B-ICI uses a subset of BISUP and MTP3
- ❑ Circuit emulation and ATM services interwork
- ❑ Frame relay and ATM services interwork
- ❑ SMDS and ATM services interwork

B-ICI: References

- ATM Forum, BISDN Inter Carrier Interface (B-ICI) Version 2.0, May 14, 1996.
<ftp://ftp.atmforum.com/pub/approved-specs/af-bici-0013.003.doc>

BISUP: ITU/ANSI Specs

- ❑ Q.2610, BISDN - Usage of Cause and Location in BISDN User Part and DSS2, October 1994.
- ❑ Q.2650, Interworking Between the BISDN DSS2 Layer 3 Protocol and the SS7 BISUP, December 1993.
- ❑ Q.2722.1, BISDN, BISDN User part - Network Node Interface Specification for Point-to-Multipoint call/Connection Control, July 1995.
- ❑ Q.2723, BISDN User Part - Support of Additional Traffic Parameters, July 1995.
- ❑ Q.2726.1, BISDN, BISDN User Part - ATM End System Address for Calling and Called Party, July 1995.
- ❑ Q.2761, BISDN User Part - Functional Description, October 1994.

- ❑ Q.2762, BISDN User Part - General Functions of Messages and Signals, October 1994.
- ❑ Q.2763, BISDN User Part - Formats and Codes, October 1994.
- ❑ Q.2764, BISDN User Part - Basic Call Procedures, October 1994.
- ❑ Q.2110, B-ISDN ATM Adaptation Layer Service Specific Connection Oriented Protocol (SSCOP),
- ❑ Q.2140, B-ISDN ATM Adaptation Layer - Service Specific Coordination Function for Signaling at the Network Node Interface (SSCF at NNI).
- ❑ Q.2144, B-ISDN ATM Adaptation Layer - Layer Management for the SAAL at the NNI

- ❑ Q.2210, Message Transfer Part Level 3 Functions and Messages Using the Services of ITU-T Q.2140, May 1995 (TD PL/11-97).
- ❑ T1.648-1995, American National Standard for Telecommunications — Signaling System No. 7 — Broadband ISDN User Part.

SS7 ITU-T Specs

- ❑ MTP: Q.701-704, Q.706, Q.707, Q.2210 (MTP level 3)
- ❑ TUP: Q.721-Q.725
- ❑ ISDN supplementary services: Q.730
- ❑ DUP: Q.741
- ❑ ISUP: Q.761-Q.764, Q.766
- ❑ SCCP: Q.711-Q.714, Q.716
- ❑ Transactions capability (TCAP): Q.771-Q.775
- ❑ Operation Maintenance and Administration part (OMAP): Q.795
- ❑ Singaling network structure: Q.705
- ❑ Numbering of International signaling point codes: Q.708

- ❑ Hypothetical signaling reference connection: Q.709
- ❑ PBX application: Q.710
- ❑ Test specifications: Q.780-Q.783
- ❑ Monitoring and Measurement: Q.791

SS7 References: Other

- ❑ ANSI T1.111-1996, American National Standard for Telecommunications — Signaling System No. 7 — Message Transfer Part, 1996.
- ❑ ANSI T1.113-1995, American National Standard for Telecommunications — Signaling System No. 7 — ISDN User Part.
- ❑ Bellcore TR-NPL-000246, "Signaling System No. 7" Issue 2, June 1991
- ❑ UNI for Point to multipoint connection control Q.2971

Signaling: ANSI Specs

- ❑ T1.637-1994, American National Standard for Telecommunications — B-ISDN ATM Adaptation Layer — Service Specific Connection Oriented Protocol (SSCOP).
- ❑ T1.645-1995, American National Standard for Telecommunications — B-ISDN ATM Adaptation Layer — Service Specific Coordination Function for Support of Signaling at the Network Node Interface (SSCF at NNI).
- ❑ T1.652-1996, American National Standard for Telecommunications — B-ISDN ATM Adaptation Layer — Layer Management for the SAAL at the NNI.

Frame Relay: Books

- ❑ W. Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM," Prentice Hall, 1995, 581 pp.
- ❑ U. Black, "Frame Relay Networks," McGraw-Hill, 1994, 234 pp.
- ❑ M. Miller, "Analyzing Broadband Networks," M&T Books, New York, 1994, 522 pp.
- ❑ B. Kumar, "Broadband Communications," McGraw-Hill, 1995, 512 pp.
- ❑ D. Minoli, "Enterprise Networking: Fractional T1 to SONET, Frame Relay to BISDN," Artech House, 1993, 736 pp.

Frame Relay: Papers

- ❑ B. Lisowski, “Frame Relay: What it is and How It Works,” A Guide to Frame Relay, Supplement to Business Communications Review, October 1991.
- ❑ S. Taylor, “Plain Talk About Frame Relay,” Networking Management, January 1992, pp. 72-78.
- ❑ I.M. Ali, “Frame Relay in Public Networks,” IEEE Communications Magazine, March 1992, pp. 72-78.
- ❑ E. Garciamendez-Budar, “The Emergence of Frame Relay in Public Data Networks,” Telecommunications, May 1992, pp. 24-32.
- ❑ C. Finn, “DataCom Buyer’s Guide - Frame Relay,” Network World, February 3, 1992, pp. 31-37.

- ❑ J.T. Johnson, “Special Report-Frame Relay Products,” Data Communications, May 1992, pp. 69-86.
- ❑ S. Hume and A. Seaman, “X.25 and Frame Relay: Packet Switched Technologies for Wide Area Connectivity.” 3TECH - the 3COM Technical Journal, Winter 1992, pp. 33-45.
- ❑ J.P. Cavanagh, “Applying Frame Relay Interface to Private Networks,” IEEE Communications Magazine, March 1992, pp. 48-64.
- ❑ J. Brown and S. Fry, “Designs Make or Break Frame Relay Switches,” Network World, September 14, 1992, pp. 39-60.
- ❑ J. Merritt, “The Future of Frame Relay,” TE&M, January 1, 1992, pp. 33-45.
- ❑ N. Lippis, “Frame Relay Redraws the Map for Wide Area Networks,” Data Communications, July 1990, pp. 80-94.

Frame Relay ITU standards

- ❑ I.122, Framework for Frame Mode Bearer Services, 1993.
- ❑ I.223 (I.233?), Frame Mode Bearer Services, 1992.
- ❑ I.365.1: Frame Relaying Service Specific Convergence Sublayer (FR-SSCS), July 1993.
- ❑ I.370, Congestion management for the ISDN Frame Relaying Bearer Service, 1991.
- ❑ I.372, Frame Relay Bearer Service Network-to-network Interface Requirements, 1993.
- ❑ I.555, Frame Mode Bearer Services Interworking, 1992.
- ❑ Q.922, ISDN Data Link Layer Specification for Frame Mode Bearer Services, 1992.

- ❑ Q.933, Signaling Specifications for Frame Mode Call Control, 1992.
- ❑ ETSI prETS-300478, CBDS Over ATM, Framework and Protocol Specification at the UNI, Version 10/94.
- ❑ ETSI prETS-300479, CBDS Over ATM, NNI Protocol Specification, Version 10/94.

Frame Relay: ANSI/Bellcore standards

- ❑ T1.606: Frame Relay Bearer Service - Architecture Framework and Service Description, and Addendum to ANSI T1.606, 1991.
- ❑ T1.617, Signaling Specification for Frame Relay Bearer Service for DSS1, 1991.
- ❑ T1.618, Core Aspects of Frame Protocol for Use with Frame Relay Bearer Service, 1991.
- ❑ T1.618: Data Transfer Protocol and Congestion Management, and ANSI T1.606 (Addendum), 1991.

- ❑ T1.5FR: Draft Frame Relay Data Communication Service - User Information Transfer Network Performance Parameters, T1A1.3/93-011, January 1993.
- ❑ TA-NWT-001327, Generic Requirements for Frame Relay Network Element Operations, Issue 1, Bellcore Technical Advisory, July 1993.
- ❑ TR-TSV-001370, Generic Requirements for Exchange Access Frame Relay PVC Service, Issue 1, Bellcore Technical Reference, May, 1993.

Frame Relay: FRF Documents

Available from Frame Relay Forum,
<http://frame-relay.indiana.edu/>

- ❑ FRF.1, The User-Network Interface (UNI)
- ❑ FRF.2, The network-to-network interface (NNI)
- ❑ FRF.3, Multiprotocol encapsulation
- ❑ FRF.4, Switched virtual circuit (SVC)
- ❑ FRF.5, Frame relay/ATM network interworking
- ❑ FRF.6, Frame relay service customer network management
- ❑ FRF.x Inter-Carrier Frame Relay Services:
Recommendations and Guidelines, Version 1.0, Draft,
October 26, 1992.

Frame Relay: RFCs

- ❑ RFC1604, "Definitions of Managed Objects for Frame Relay Service" by T. Brown, 03/25/1994, 46 pp.
- ❑ RFC1586 "Guidelines for Running OSPF Over Frame Relay Networks" by O. deSouza, M. Rodrigues, 03/24/1994, 6 pp.
- ❑ RFC1490, "Multiprotocol Interconnect over Frame Relay" by T. Bradley, C. Brown, A. Malis, 07/26/1993, 35 pp.
- ❑ RFC1315, "Management Information Base for Frame Relay DTEs" by C. Brown, F. Baker, C. Carvalho, 04/09/1992, 19 pp.

- ❑ Internet Draft, "PPP in Frame Relay," 04/23/1994, <draft-ietf-pppext-frame-relay-03.txt>
- ❑ Internet Draft, "Management Information Base for Frame Relay DTEs (IP Over Large Public Data Networks)," 03/20/1995, <draft-ietf-iplpdn-frmib-dte-04.txt>

SMDS Standard Organizations

- ❑ Bell Communications Research (Bellcore)
- ❑ SMDS Interest Group (SIG)
- ❑ European SMDS Interest Group (ESIG)
- ❑ European Telecommunications Standards Institute (ETSI)
- ❑ Pacific Rim Frame Relay/ATM/SMDS Interest Group (PR FASIG)
- ❑ Internet Engineering Task Force (IETF)
- ❑ IEEE 802: Remote bridging 802.1g and 802.6

SMDS: Books

- ❑ R.W. Klessig and K. Tesink, "Wide-Area Data Networking with Switched Multi-megabit Data Service," Prentice-Hall, 1995, 564 pp.
- ❑ M.A. Miller, "Analyzing Broadband Networks: Frame relay, SMDS, and ATM," M&T Books, New York, (ISBN 1-55851-389-2) 1994, Chapter 5-6, pp. 171-244.
- ❑ B. Kumar, "Broadband Communications: A professional's guide to ATM, Frame Relay, SMDS SONET, and B-ISDN," McGraw-Hill, 1994, Chapter 6-7, pp. 111-140.
- ❑ D. Minoli, "Enterprise Networking: Fractional T1 to SONET, Frame Relay to BISDN," Artech House, 1993, Chapter 12, pp. 687-713.

SMDS: Papers

- ❑ C.F. Hemrick, R. Klessig and J.M. McRoberts, "Switched Multi-megabit Data Service and Early Availability via MAN Technology," IEEE Communications Magazine, April 1988.
- ❑ A. Lindstrom, "Frame Relay and SMDS - Unlocking the Marketing Challenge", Telephony, November 21, 1994, pp. 28-32.
- ❑ F. Goldstein and J. Metzler, "Evaluating Network Services in the 1990s," Telecommunications, November 1994, pp. 47-62.
- ❑ G.H. Clapp, "LAN Interconnection Across SMDS," IEEE Network, September 1991, pp. 25-32.

- ❑ R. Sharer, "The SMDS Express," LAN Magazine, July 1993, pp. 51-58.
- ❑ P. Krishnaswamy and M. Ulema, "Developments in SMDS," ConneXions, October 1991, pp. 24-31
- ❑ D. Briere, "SMDS: The Silent Contender," Network World, November 29, 1993, pp. 39-49.
- ❑ A.J. Spiegleman, "SMDS has arrived," Networking Management, October 1992, pp. 40-45.
- ❑ T. Cox, F. Dix, C. Hemrick and J. McRoberts, "SMDS: The Beginning of WAN Superhighways," Data Communications, April 1991, pp. 105-110.

SMDS References: On-line

- Switched Multi-megabit Data Service,
<http://www.cerf.net/smds.html>
- q SMDS Interest group mailing list: sig@interop.com

SDMS: Bellcore Documents

- ❑ TR-TSV-000772, Issue 1, "Generic System Requirements in support of Switched Multi-Megabit Data Service," May 1991.
- ❑ TR-TSV-000773, Issue 1, "Local Access System Generic Requirements, Objectives, and Interfaces in Support of Switched Multi-megabit Data Service," June 1991.
- ❑ TR-TSV-000774, Issue 1, "SMDS Operations Technology Network Element Generic Requirements," March 1992.
- ❑ TR-TSV-000775, Issue 1, "Usage Measurement Generic Requirements in Support of SMDS," June 1991.
- ❑ TA-TSV-001059, "Inter-switching System Interface Generic Requirements in Support of SMDS Service," December 1990.

- ❑ TR-TSV-001060, Switched Multi-megabit Data Service Generic Requirements for Exchange Access and Intercompany Serving Arrangements, Issue 1, Bellcore, Technical Reference, December 1991; Plus Revision 1, August 1992; plus Revision 2, March 1993.
- ❑ TA-TSV-001061, "Operations-technology network-element requirements for interswitch and exchange access,"
- ❑ TA-TSV-001062, Issue 2, "Generic Requirements for SMDS Customer network Management Service," February 1992.
- ❑ TA-TSV-001063, "Operations-technology generic Criteria in Support of Exchange-access SMDS and Intercompany serving arrangements," Issue 1, December 1992, Plus Revision 1, March 1993

- ❑ TA-TSV-001064, "SMDS Generic Criteria on Operations Interfaces (information model and usage),"
- ❑ TA-TSV-001238, Generic Requirements for SMDS on the 155.520 Mbit/s Multi-services Broadband ISDN Inter-Carrier Interface (B-ICI), Issue 1, Bellcore Technical Advisory, December 1992.
- ❑ TR-TSV-001239, Issue 1, "Generic Requirements for Low Speed Access to SMDS", June 1993.
- ❑ TA-TSV-001240, Issue 1, "Generic Requirements for Frame Relay Access to SMDS," June 1993.
- ❑ SR-TSV-002395, Switched Multi-megabit Data Service First Phase for Exchange Access and Intercompany Serving Arrangements, Issue 1, Bellcore Special Report, July 1992.

SMDS: SIG Documents

SIG documents are available on-line

<http://www.cerf.net/smds.html>

- ❑ SIG-TS-001/1991, "SMDS Data Exchange Interface Protocol," Revision 3.2, October 1991.
- ❑ SIG-TS-002/1991, "SMDS DXI Local Management Interface," Revision 2.0, May 19, 1992.
- ❑ SIG-TS-003/1992, "Implementation of Phase IV DECnet over SMDS," Revision 1.1, May 3, 1994.
- ❑ SIG-TS-004/1992, "Specification for Implementation of Connectionless OSI over SMDS," Revision 1.1, May 3, 1994.

- ❑ SIG-TS-005/1993, "Frame-Based Interface Protocol for SMDS Networks - Data Exchange Interface/Subscriber Network Interface, Revision 1.0. February 2, 1993.
- ❑ SIG-TS-006/1993, "Frame-Based Interface Protocol for Networks Supporting SMDS - SIP Relay Interface, Revision 1.0, February 2, 1993.
- ❑ SIG-TS-008/1994, "Protocol Interface Specification for Implementation of SMDS over an ATM-based Public UNI," Revision 1.0, May 3, 1994.
- ❑ SIG-TWG-019/1992, "SMDSTalk: Apple Talk over SMDS," August 1992.
- ❑ SIG-TWG-042/1993, "Transmission of Novell IPX Datagrams over the SMDS Service," Version 1.0, July 1993.

- ❑ SIG TWG-1993/043, (or, ATM Forum/94-149, or ESIG-TS-008/94), Protocol Interface Specification for Implementation of SMDS over an ATM-Based Public UNI, Revision 0.10, March, 1994.
- ❑ SIG Inter-Carrier Working Group Draft Specification, Guiding Principles for Ordering and Provisioning of Exchange Access SMDS, Revision 0.03, February 1993.
- ❑ SIG Inter-Carrier Working Group Draft Specification, Guiding Principles for SMDS Inter-Carrier Operations Management, Revision 0.02, January 1993.

SMDS: ESIG Documents

- ❑ ESIG-TS-001/1992, "SMDS Subscriber Network Access Facility Service and Level 2 and 3 Subscriber Network Interface Specification," Edition 1.1, 22 June 1992.
- ❑ ESIG-TS-002, "SMDS Subscriber Network Interface Level 1 Specification," Edition 1.0, ESIG-TS-002, June 1993.
- ❑ ESIG-TS-003/1993, "SMDS Customer Network Management Service and Access," March 1993.
- ❑ ESIG-TS-006/1993: Interconnection of Public Telecommunication Operator (PTO) Networks Supporting European SMDS, June, 1993.
- ❑ ESIG-TI-001, "A Comparison of SMDS and CBDS Service", June 1993.

SMDS: ITU Documents+RFCs

- ❑ CCITT I.364: Support of Broadband Connectionless Data Service on B-ISDN, June 1992.
- ❑ RFC1209, "The Transmission of IP Datagrams over the SMDS Service" by J. Lawrence, D. Piscitello, 03/06/1991, 11 pp.
- ❑ RFC1694, "Definitions of Managed Objects for SMDS Interfaces using SMIv2" by T. Brown, K. Tesink, 08/23/1994, 35 pp.

Acronyms

AAL	ATM Adaptation Layer
ACM	Address Complete Message
AESA	ATM End System Address
Ai	Signaling ID Assigned by Switch A
AIS	Alarm Indication Signal
ANI	Automatic Number Identification
ANM	Answer Message
ANSI	American National Standards Institute
ATM	Asynchronous Transfer Mode
BBC	Broadband Bearer Capability
BCOB	Broadband Connection Oriented Bearer

- ❑ BECN Backward Explicit Congestion Notification
- ❑ BHLI Broadband High Layer Information
- ❑ Bi Signaling ID assigned by Switch B
- ❑ B-ICI BISDN Inter Carrier Interface
- ❑ BISDN Broadband Integrated Services Digital Network
- ❑ BLA Blocking Acknowledgment Message
- ❑ BLLI Broadband Low Layer Information
- ❑ BLO Blocking Message
- ❑ BSS Broadband Switching System
- ❑ CAC Connection Admission Control
- ❑ CBDS Connectionless Broadband Data Service
- ❑ CBR Constant Bit Rate
- ❑ CCE Consistency Check End Message

- ❑ CCEA Consistency Check End Acknowledge Message
- ❑ CCR Consistency Check Request Message
- ❑ CCRA Consistency Check Request Acknowledge
- ❑ CdPN Called Party Number
- ❑ CDV Cell Delay Variation
- ❑ CES Circuit Emulation Service
- ❑ CFN Confusion Message
- ❑ CgPN Calling Party Number
- ❑ CIP Carrier Identification Parameter
- ❑ CLNS Connection-Less Network Service

- ❑ CLSF Connection-Less Service Function
- ❑ CLP Cell Loss Priority
- ❑ CPCS Common Part Convergence Sublayer
- ❑ CPE Customer Premises Equipment
- ❑ CPG Call Progress Message
- ❑ CRC Cyclic Redundancy Check
- ❑ CRS Cell Relay Service
- ❑ CSI Carrier Selection Information
- ❑ CS-2 Capability Set 2
- ❑ CS-2.1 Capability Set 2, Step 1
- ❑ DCC Data Country Code
- ❑ DCLI Destination Connection Link Identifier
- ❑ DE Discard Eligibility

- ❑ DLCI Data Link Connection Identifier
- ❑ DSID Destination Signaling Identifier
- ❑ EA Address Extension
- ❑ EFCI Explicit Forward Congestion Indication
- ❑ ESIG European SMDS Interest Group
- ❑ ETSI European Telecommunications Standards Inst.
- ❑ EXM Exit Message
- ❑ FEBE Far End Block Error
- ❑ FECN Forward Explicit Congestion Notification
- ❑ FERF Far End Receive Failure
- ❑ FRS Frame Relay Service
- ❑ HEC Header Error Control

- ❑ IAA IAM Acknowledgment Message
- ❑ IAM Initial Address Message
- ❑ IAR IAM Reject Message
- ❑ ICD International Code Designator
- ❑ ICI Inter Carrier Interface
- ❑ ICIP Inter Carrier Interface Protocol
- ❑ ICIP_CLS ICIP Connectionless Service
- ❑ IE Information Element
- ❑ IEC Inter Exchange Carrier
- ❑ ILEC Independent Local Exchange Carrier
- ❑ INC International Carrier
- ❑ ITU International Telecommunication Union
- ❑ IWF Inter-Working Function

- ❑ LEC Local Exchange Carrier
- ❑ MF Mapping Function
- ❑ NNI Network Node Interface
- ❑ NPC Network Parameter Control
- ❑ PCR Peak Cell Rate
- ❑ PDH Pleisiochronous Digital Hierarchy
- ❑ PLCP Physical Layer Convergence Procedure
- ❑ OCLI Origination Connection Link Identifier
- ❑ OFI Outgoing Facility Identifier
- ❑ OLI Originating Line Information
- ❑ OSID Origination Signaling Identifier
- ❑ PMD Physical Medium Dependent
- ❑ PVC Permanent Virtual Connection

- ❑ QoS Quality of Service
- ❑ RAM Reset Acknowledgment Message
- ❑ RDI Remote Defect Indicator
- ❑ REL Release Message
- ❑ RLC Release Complete Message
- ❑ RSM Reset Message
- ❑ SAAL Signaling ATM Adaptation Layer
- ❑ SCR Sustained Cell Rate
- ❑ SDH Synchronous Digital Hierarchy
- ❑ SID Signaling Identifier
- ❑ SIG SMDS Interest Group
- ❑ SMDS Switched Multi-megabit Data Service
- ❑ SNI Subscriber Network Interface

- ❑ SONET Synchronous Optical NETWORK
- ❑ SPE Synchronous Payload Envelope
- ❑ SSCF Service Specific Coordination Function
- ❑ SSCOP Service Specific Connection Oriented Protocol
- ❑ SSCS Service Specific Convergence Sublayer
- ❑ STS Synchronous Transport Signal
- ❑ SVC Switched Virtual Connection
- ❑ TNS Transit Network Selection
- ❑ UBA Unblocking Acknowledgment Message
- ❑ UBL Unblocking Message
- ❑ UDT Unstructured Data Transfer
- ❑ UNI User Network Interface
- ❑ UPA User Part Available Message

- ❑ UPT User Part Test Message
- ❑ VBR Variable Bit Rate
- ❑ VCC Virtual Channel Connection
- ❑ VCI Virtual Channel Identifier
- ❑ VPC Virtual Path Connection
- ❑ VPCI Virtual Path Connection Identifier

B-ICI History

- ❑ V1.1: PVC based approved in Sept'94
- ❑ V2.0: SVC, multipoint, VBR, NSAP address carriage
- ❑ V2.1:
- ❑ V2.1+: ABR

Broadband ISUP (BISUP)

- ❑ Supports SVC and Switched VPs
- ❑ CBR and VBR (ABR in future)
- ❑ Forward and backward PCR (symmetric or asymmetric)
- ❑ AAL 1,2,3/4, 5
- ❑ Maximum transit delay
- ❑ Point-to-point and point-to-multipoint

SMDS Features

- ❑ Address translation
- ❑ Carrier selection
- ❑ Source address validation
- ❑ Individually addressed packets
- ❑ Group addressed packets
- ❑ Address screening
- ❑ Access classes
- ❑ End-user blocking

SMDS Service Types

- ❑ [Fig 11.1, page 245, BICI]
- ❑ Exchange SMDS: Local SMDS
- ❑ Exchange Access SMDS: IEC's customers use LEC's SMDS access service
- ❑ Inter-Exchange Access SMDS: Long distance SMDS

SMDS Specific Functions

- ❑ AAL 3/4
- ❑ [fig 11.3, page 251, BICI]
- ❑ [Fig 11.6, page 260, BICI]
- ❑ [FIg 11.7-10, BICI]

Current Issues in B-ICI

- ❑ Soft PVC or PVP: Use signaling to setup PVC/PVP
- ❑ Switched virtual paths: supported in UNI4.0 but not in B-ICI 2.0
- ❑ Interworking between PNNI and B-ICI: Crankback, DTL

Quiz

T F Please check True/False

1. Private and Public NNI's are same.
2. B-ICI provides automatic topological discovery
3. B-ICI is incompatible with SMDS and Frame relay
4. B-ICI uses Q.2931 signaling messages
5. B-ICI supports associated signaling only.
6. B-ICI provides only point-to-point calls
7. B-ICI does not provide congestion control
8. Frame relay allows connectionless communication.
9. SMDS allows connectionless communication
10. Frame relay's congestion control interopertes with B-ICI
11. SMDS is more compatible with AAL5 than other AALs