

# ISDN

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These slides are available at

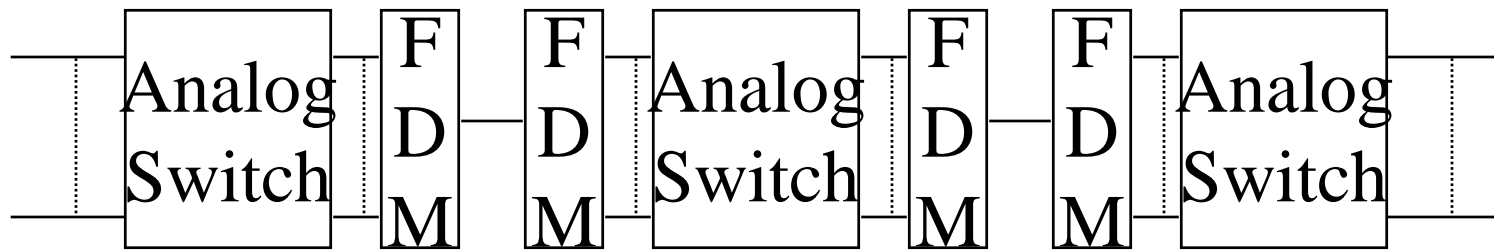
<http://www.cse.ohio-state.edu/~jain/cis777-99/>



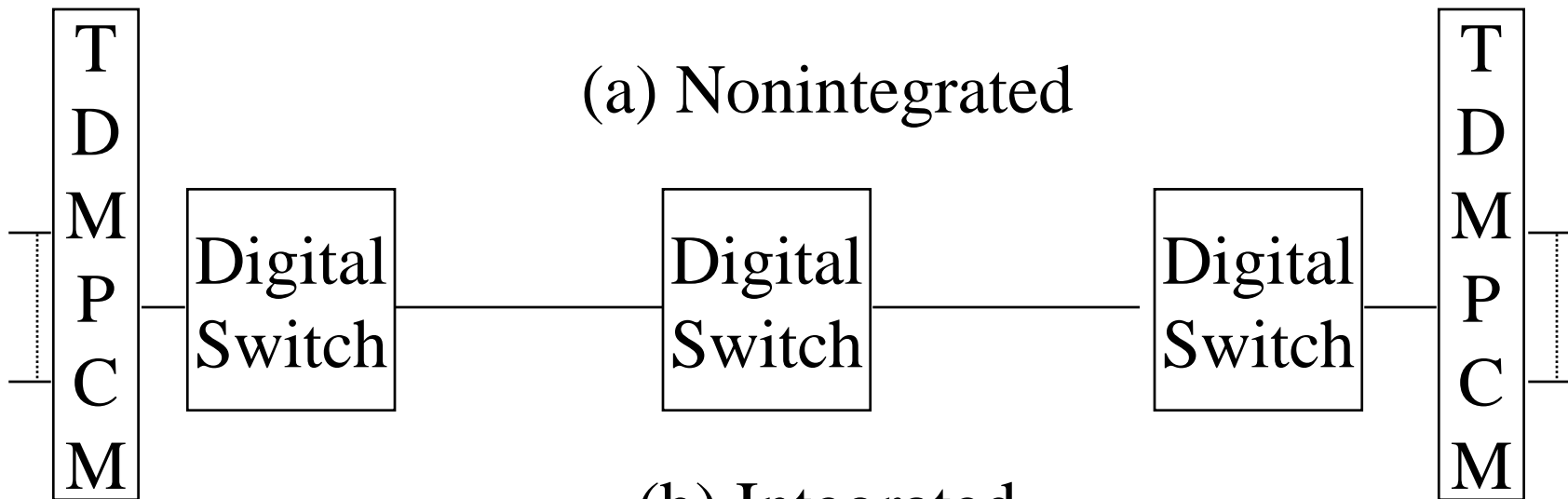
- ❑ History
- ❑ Interfaces and protocol layers
- ❑ Reference points
- ❑ Addressing

# Integrated Digital Networks

- Integrated  $\Rightarrow$  Both transmission and Switching
- Access was still analog



(a) Nonintegrated



(b) Integrated

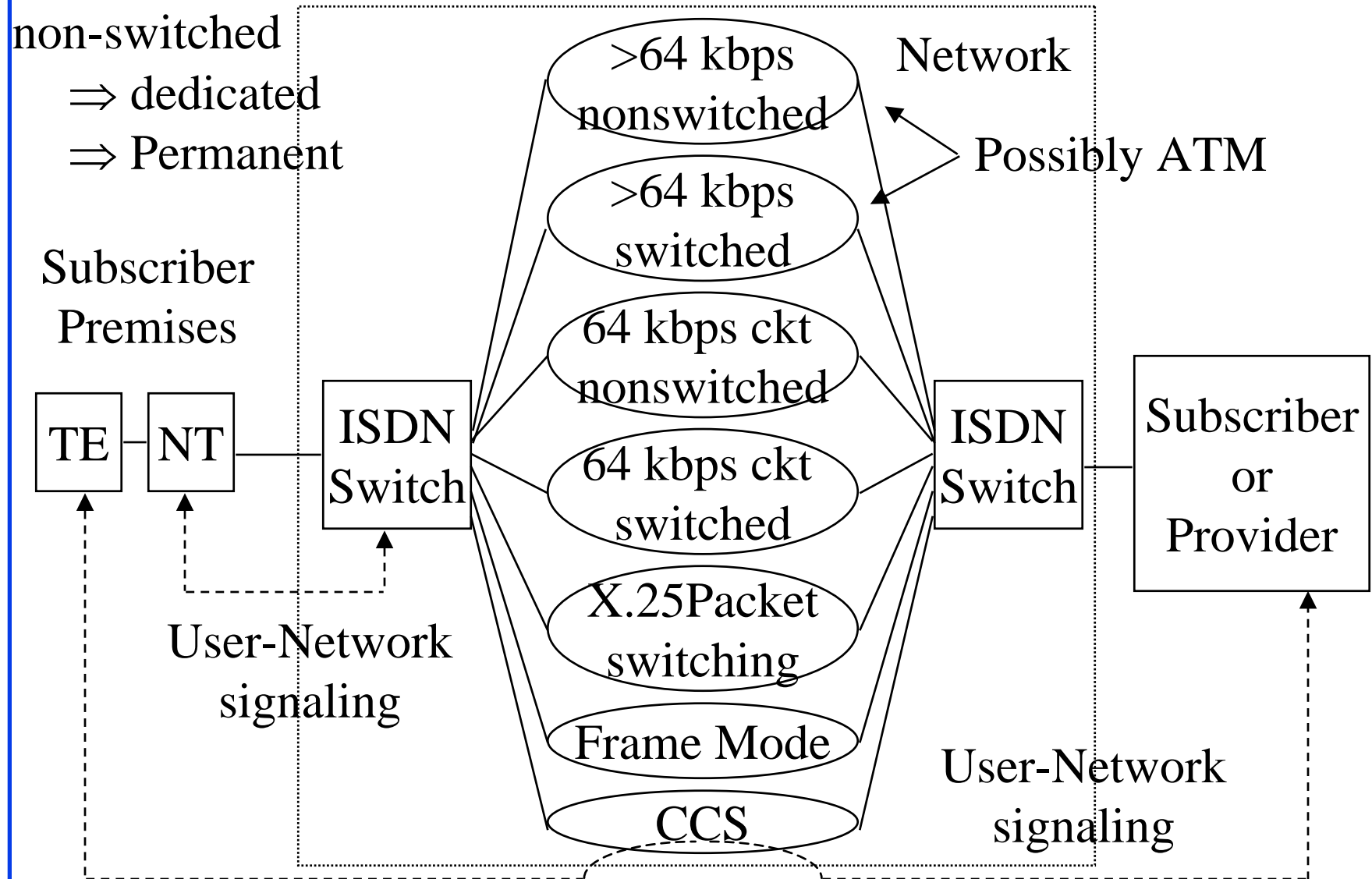
# Int. Service Digital Network

- ❑ Past: IDN = Integrated Digital Network  
⇒ Standardized digital techniques for switching and transmission (T1 etc)
- ❑ 1980: ISDN ⇒ Integrated access to all services  
⇒ Digital end-to-end (Digital subscriber loop)
- ❑ One set of interfaces for all services at multiple speeds
- ❑ Supports both circuit switching and packet switching
- ❑ Out-of-band signaling. Sophisticated network management and maintenance using Signaling System 7 (SS7)
- ❑ Layered protocol architecture

# History

- ❑ 1968: Study Group D set by CCITT to study digital voice
- ❑ 1972: G.702 Integrated digital switching and transmission (IDN) concept
- ❑ 1976: Digital switching and signaling (SS7) spec
- ❑ 1980: G.705 - One page recommendation on ISDN
- ❑ 1984: First set of standards in 1984.  
Inconsistent and incomplete.
- ❑ 1988: Revised set of standards.  
Implementation feasible.
- ❑ 1992: Additional revisions

# ISDN Architecture

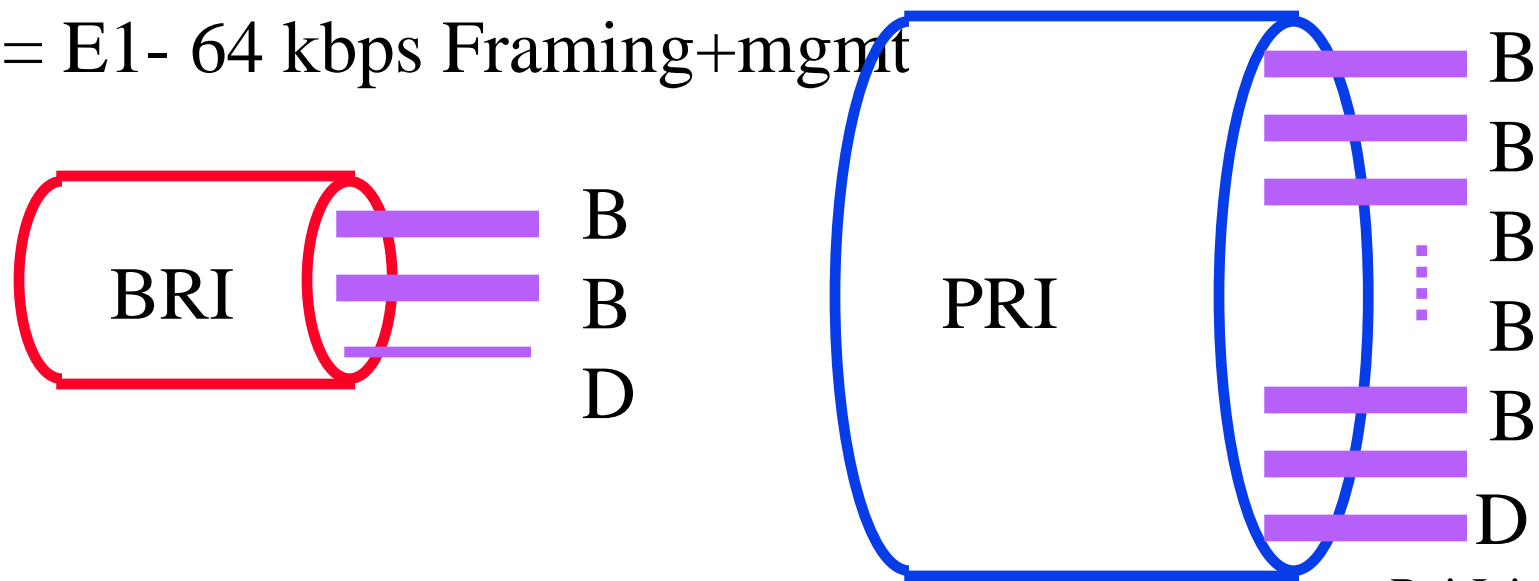


# ISDN Channels

- ❑ B: 64 kbps for data or voice
- ❑ D: 16 or 64 kbps for signaling or packet switched data
- ❑ H: 384 kbps (H0), 1536 kbps (H11), 1920 kbps (H12)

# ISDN Access Interfaces

- Basic Rate Interface (BRI):  $2B + D = 2 \times 64 + 16 = 144 \text{ kbps}$  (192 kbps total)
- Primary Rate Interface (PRI): For LANs or PBX
  - $23 B + D = 23 \times 64 + 64 = 1.536 \text{ Mbps} \approx \text{T1}$
  - $30 B + D = 30 \times 64 + 64 = 1.984 \text{ Mbps} = \text{E1} - 64 \text{ kbps Framing+mgmt}$



# Other PRI Interfaces

## □ PRI H0:

- $3H_0 + D$  or  $4H_0 = 1.544$  Mbps
- $5H_0 + D = 2.048$  Mbps

## □ PRI H1:

- One H11 in 1.544 Mbps
- One H12 in 2.048 Mbps

## □ PRI for Mixture of B and H0:

- 0 or 1 D and any combination of B and H0, e.g.,  
 $3H_0 + 5B + D$  or  $3H_0 + 6B$  for 1.544 Mbps

# Functional Groupings

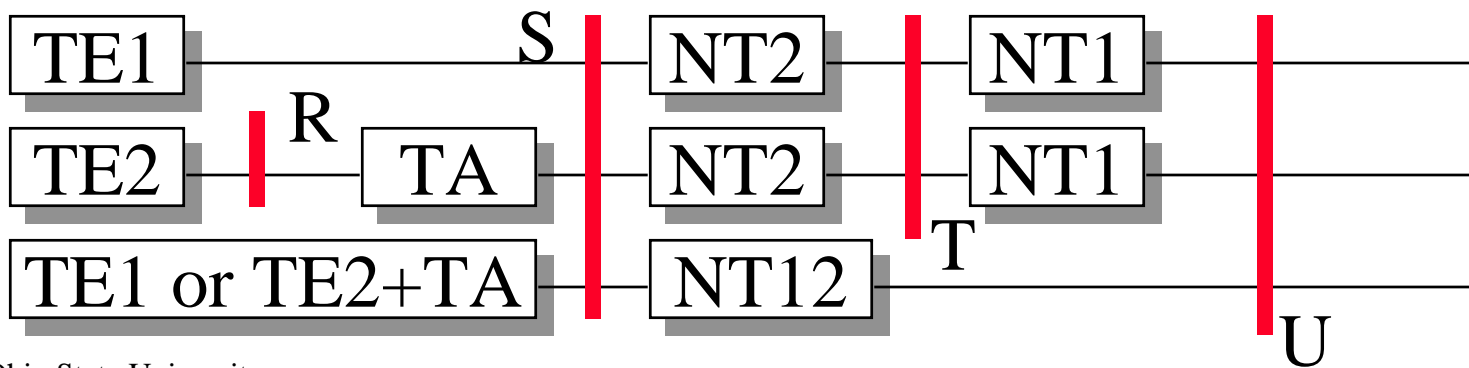
- ❑ Terminal Equipment 1 (TE1): ISDN terminal
- ❑ Terminal Equipment 2 (TE2): Non-ISDN terminal, e.g., POT
- ❑ Terminal Adapter (TA): Allows non-ISDN devices on ISDN
- ❑ Network Termination 1 (NT1): Physical layer device. Separates user premises from phone company. Owned by user in USA. Owned by PTT in many countries.
- ❑ Network Termination 2 (NT2): OSI layers 2-3, e.g., PBX, LAN
- ❑ Network Termination 1,2 (NT12): NT1 + NT2

# Functional Groupings

- NT1:
  - Physical and electrical terminal of ISDN at user
  - Isolates the user from the transmission technology of the subscriber loop
  - Line maintenance functions such as loop back testing and monitoring
  - Bit multiplexes various B and D channels
  - Supports multi-drop lines  $\Rightarrow$  Telephone, personal computer, and alarm on one NT1
- NT2: Digital PBX, LAN, Terminal controller  
Switching and concentration

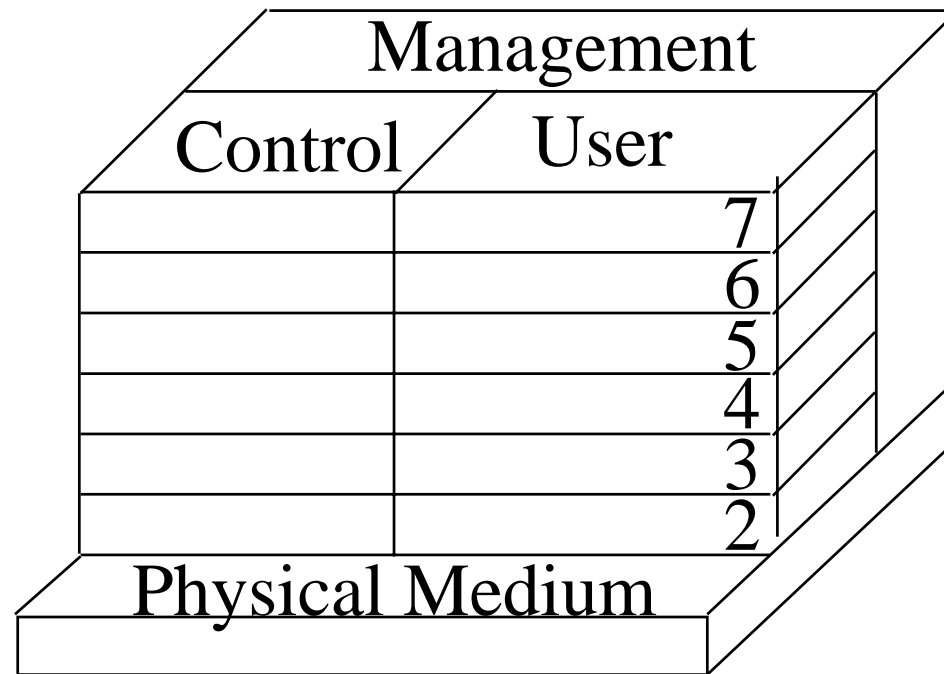
# ISDN Reference Points

- ❑ Rate (R): Between Non-ISDN and Terminal Adapter. Uses X or V series recommendations.
- ❑ System (S): Between ISDN equipment and NT2. Separates user equipment from switching equipment.
- ❑ Terminal (T): Between NT2 and NT1. Separates network from user.
- ❑ User (U): U interface not defined by ITU. Defined in North America since NT owned by user.



# Protocol Reference Model

- ❑ Similar to OSI 7-layer model
- ❑ Separate user, control, and management planes
- ❑ Control = signaling
- ❑ Management = network diagnosis, maintenance, and operation



# ISDN Protocols at UNI

Application	End-to-end user signaling		
Presentation			
Session			
Transport			
Network	Q.931	X.25 packet	X.25 packet
Datalink	LAPD	I.465/V.120	LAPB
Physical	I.430 basic or I.431 Primary		

Control Packet Ckt      Semi Packet  
 Signaling      switched permanent Switched

D Channel

B Channel

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# LAPD

- ❑ Link Access Protocol for D Channel
- ❑ Similar to HDLC and LAPB
- ❑ X.25 packets are transmitted in LAPD frames
- ❑ LAPD used for signaling messages

# ISDN Services

Six types of services

- ❑ Circuit switched calls over a B or H channel
- ❑ Semi-permanent connections over a B or H channel
- ❑ Packet switched calls over a B or H channel
- ❑ Packet switched calls over a D channel
- ❑ Frame relay calls over a B or H channel
- ❑ Frame relay calls over a D channel

# ISDN Addressing

- ❑ E.164 designed for ISDN allows up to 15 digits  
= Superset of E.163 for telephony (12 digits)
- ❑ Country code: 1 to 3 digits
- ❑ National Destination Code: Provider ID or Area code
- ❑ ISDN Address = ISDN number + ISDN subaddress

Country Code	National Destination Code	ISDN Subscriber Number	ISDN Subaddress (Max 40 digits)
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National ISDN Number

International ISDN Number (max 15 digits)

ISDN Address (max 55 digits)

# Other Addressing Structures

## ❑ X.121 Data Networks

Zone	Country code	PDN code	Network term. number
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Data Network Identification Code

Data country code	National number
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9	Country code	National significant number
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E.163

8	Telex destination code	National telex number
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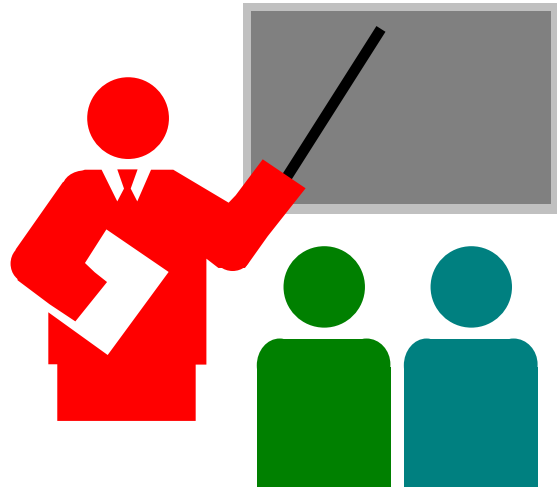
## ❑ ISO 7498

Authority and format identifier	Initial domain identifier	Domain specific part
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# Other Addressing (Cont.)

- ❑ IDI = Initial domain identifier
- ❑ DSP = Domain specific part
- ❑ AFI = Authority and format identifier (Six authorities):
  - Four ITU controlled: Packet-switched Data Networks (PSDN), Telex, Packet-switched Telephone Networks (PSTN), ISDN.
  - Two ISO Controlled:
    - ❑ ISO geographic domain: Assigned by countries
    - ❑ International organization domain, e.g., NATO.
- ❑ AFI = 44  $\Rightarrow$  ISDN in decimal, 45  $\Rightarrow$  ISDN in binary

# Summary



- ❑ B, D, and H channels
- ❑ BRI and PRI
- ❑ NT1, NT2, TE1, TE2, TA
- ❑ R, S, T, and U reference points
- ❑ Addressing, E.164, ISO

# Homework

- ❑ Read p 66-74 of Black's Emerging Technologies 2nd Ed.

*Or*

Read Chapters 4, 5.1-5.5 of Stallings' ISDN and Broadband ISDN book

- ❑ Submit answers to the following exercise:  
List all of the approved interface structures for the primary rate interface. Don't forget combinations that include H channels.

Due: Next Class