ISDN

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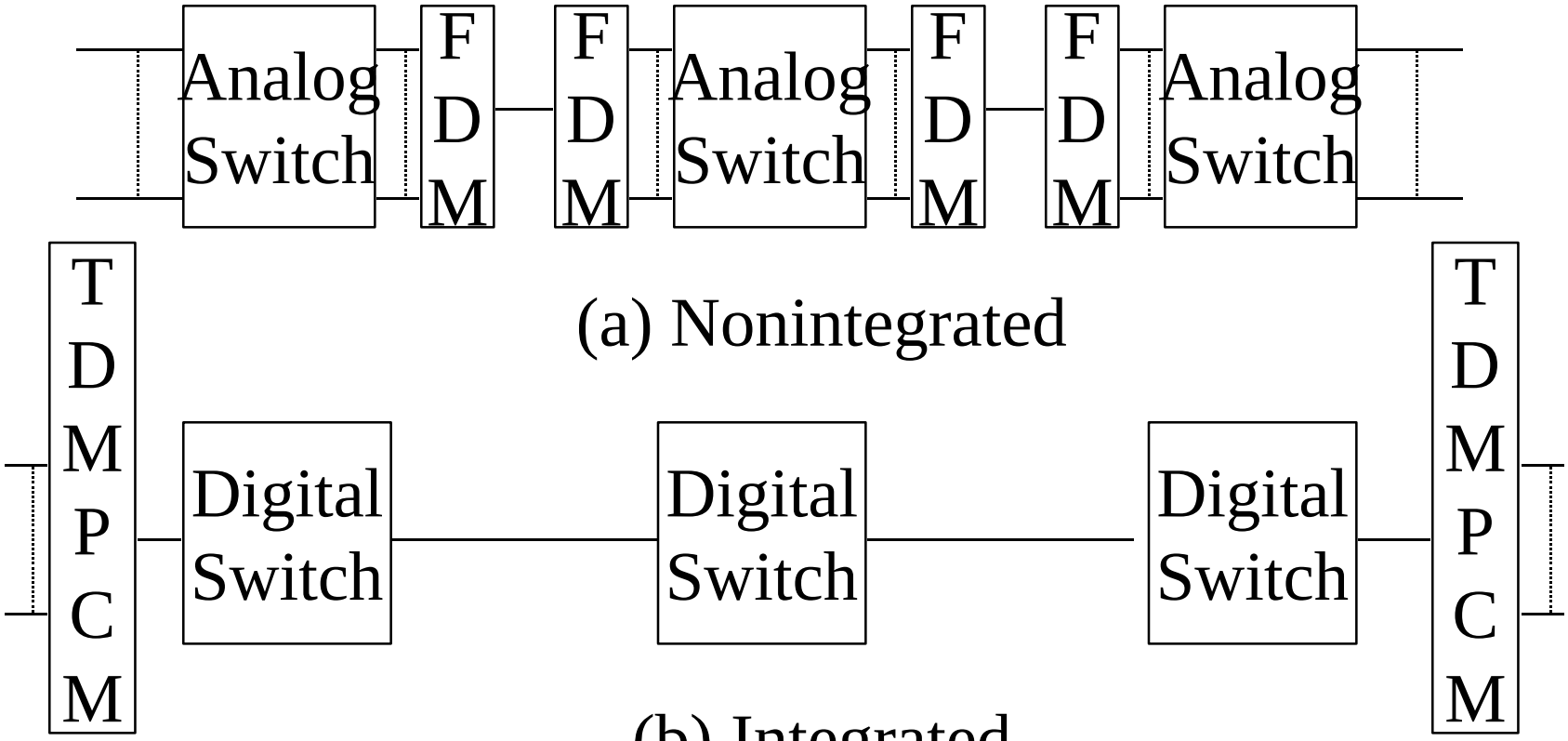
Overview

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

Integrated Digital Networks

- Integrated ⇒ Both transmission and Switching
- Access was still analog



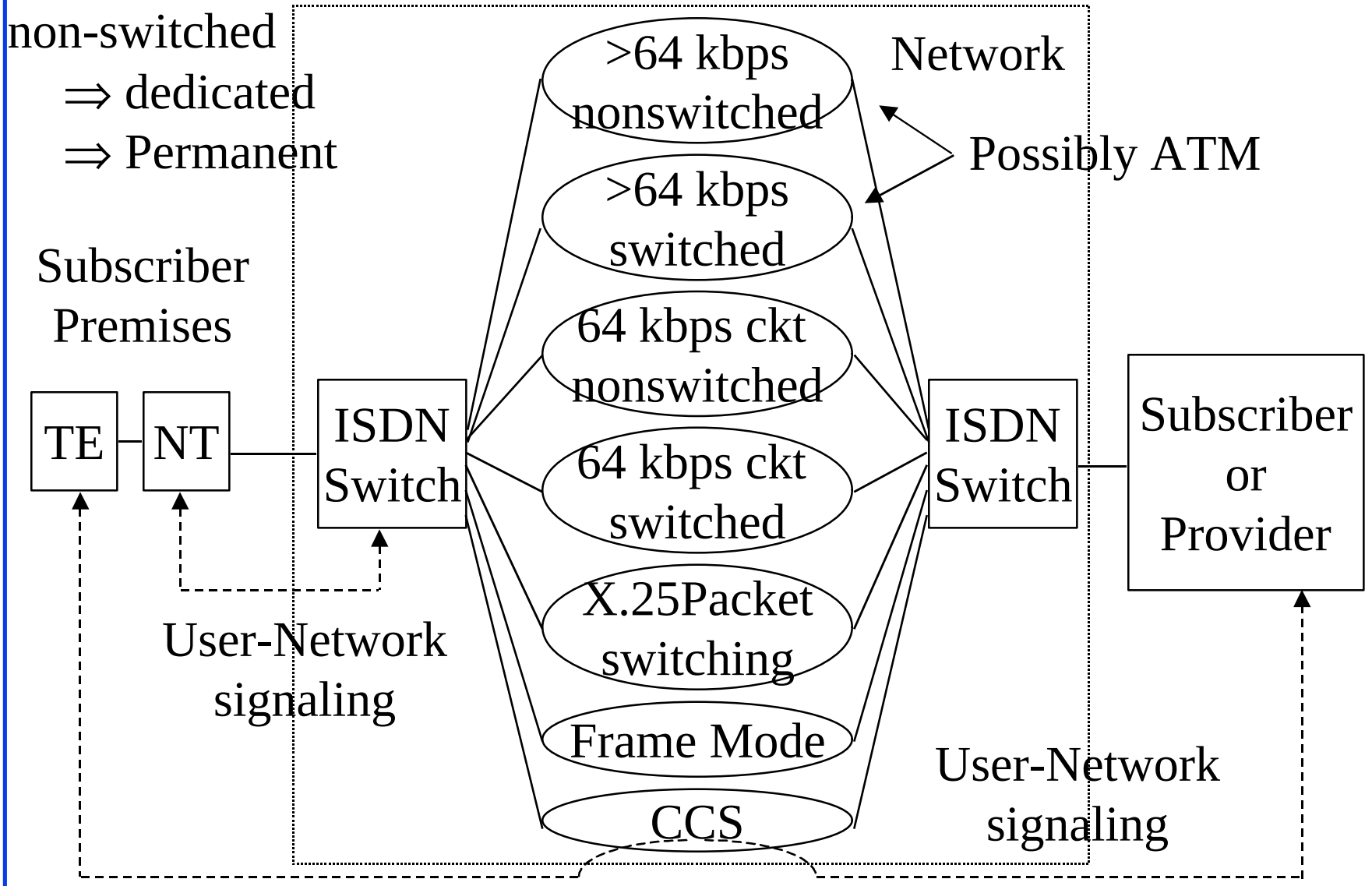
Int. Service Digital Network

- 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

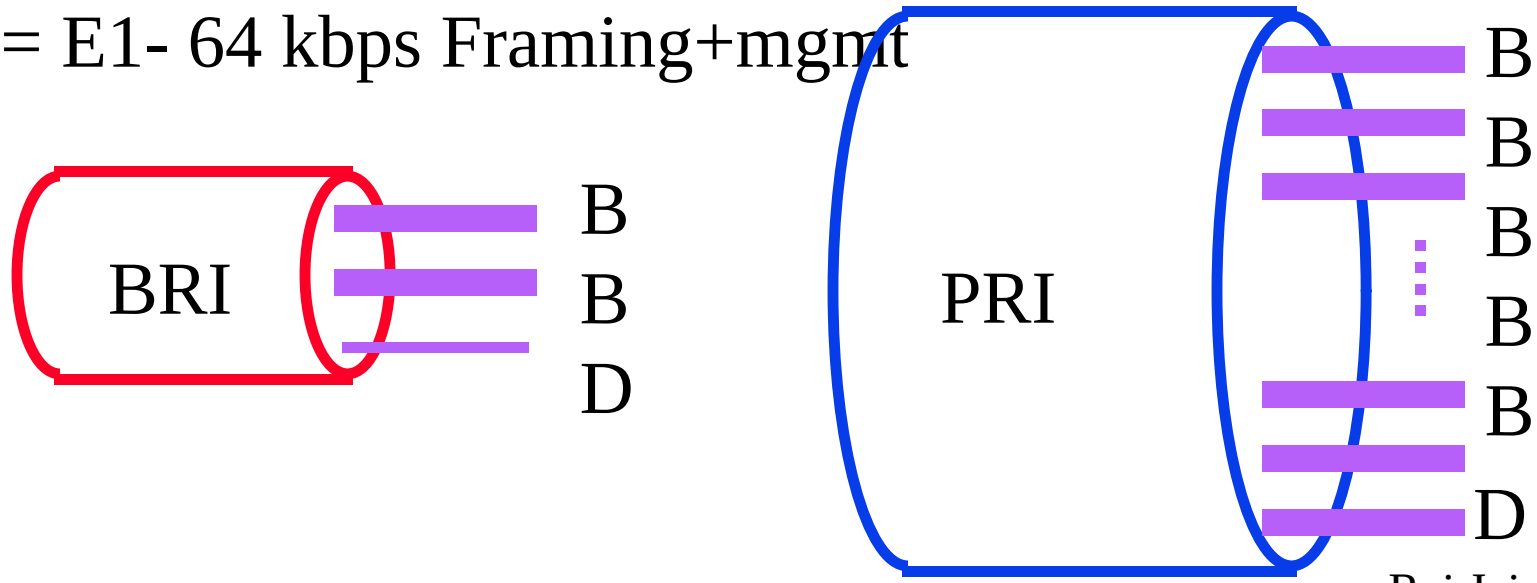


ISDN Channels

- 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 × 64 + 16 = 144 kbps (192 kbps total)
- Primary Rate Interface (PRI): For LANs or PBX
  - 23 B + D = 23 × 64 + 64 = 1.536 Mbps ≈ T1
  - 30 B+ D = 30 × 64 + 64 = 1.984 Mbps = 5H0+D = E1- 64 kbps Framing+mgmt



Other PRI Interfaces

- **PRI H0**:
  - 3H0+D or 4H0 = 1.544 Mbps
  - 5H0+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., 3H0+5B+D or 3H0+6B for 1.544 Mbps

Functional Groupings

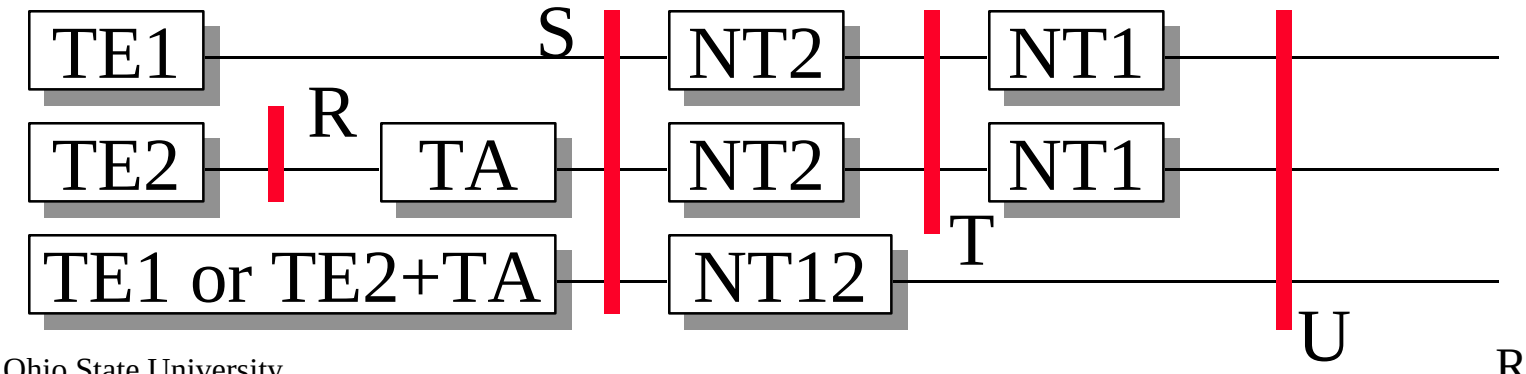
- Terminal Equipment 1 (TE1): ISDN terminal
- Terminal Equipment 2 (TE2): Non-ISDN terminal, e.g., POT
- Terminal Adapter (TA): Allows non-ISDN devices on ISDN
- Network Termination 1 (NT1): Physical layer device. Separates user premises from phone company. Owned by user in USA. Owned by PTT in many 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 ⇒ Telephone, personal computer, and alarm on one NT1
- NT2: Digital PBX, LAN, Terminal controller Switching and concentration

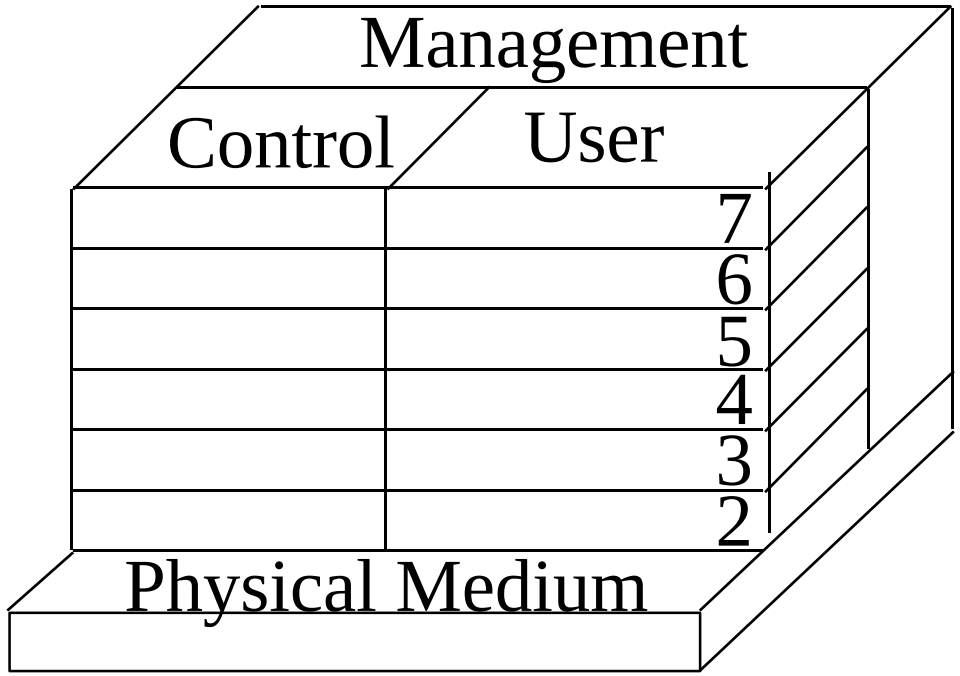
ISDN Reference Points

- 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.

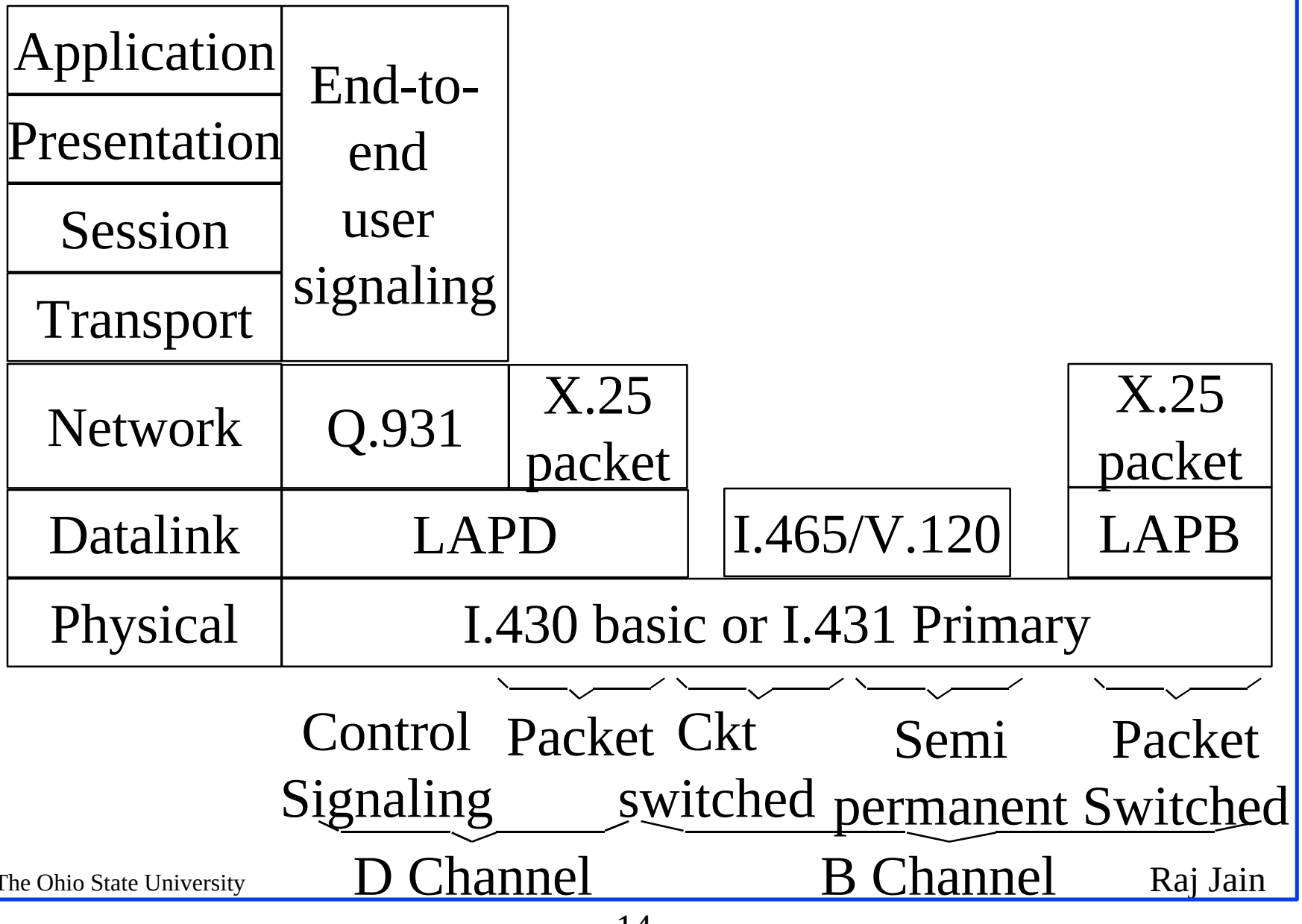


Protocol Reference Model

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



ISDN Protocols at UNI



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

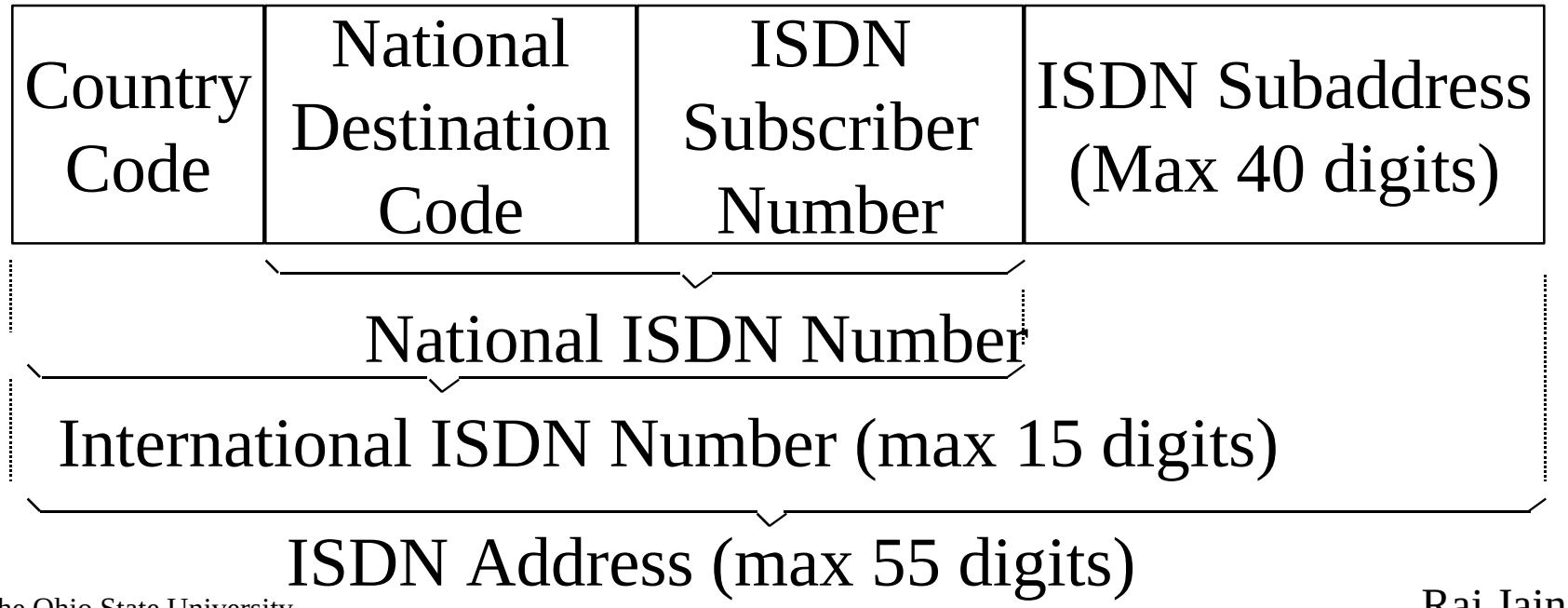
ISDN Services

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

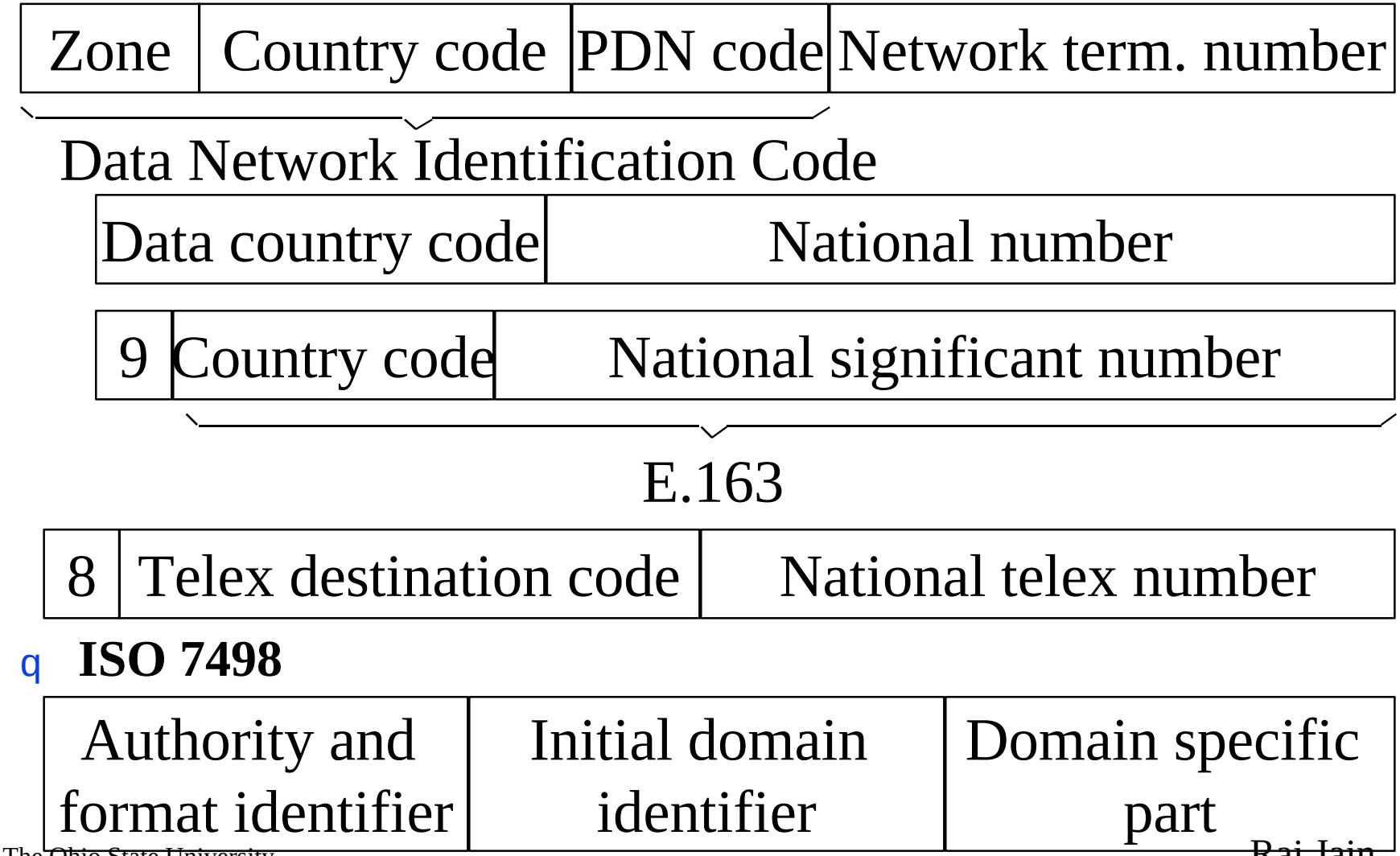
ISDN Addressing

- 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



Other Addressing Structures

- **X.121 Data Networks**

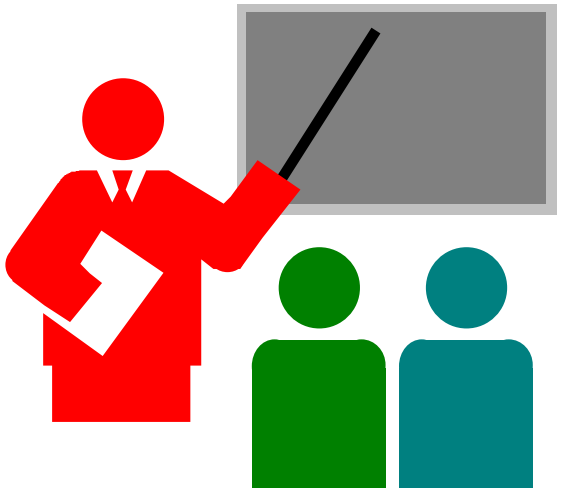


- **ISO 7498**

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 Section 6.4 of McDysan's book
  (or Read p 66-74 of Black's Emerging Technnologies 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 Week