X.25

Slow, Safe and Reliable

What is X.25 ?

- Connection-oriented Packet Switching
- WAN Technology
- Specifies User to Network Interface (UNI)
- Does not specify network itself (!)

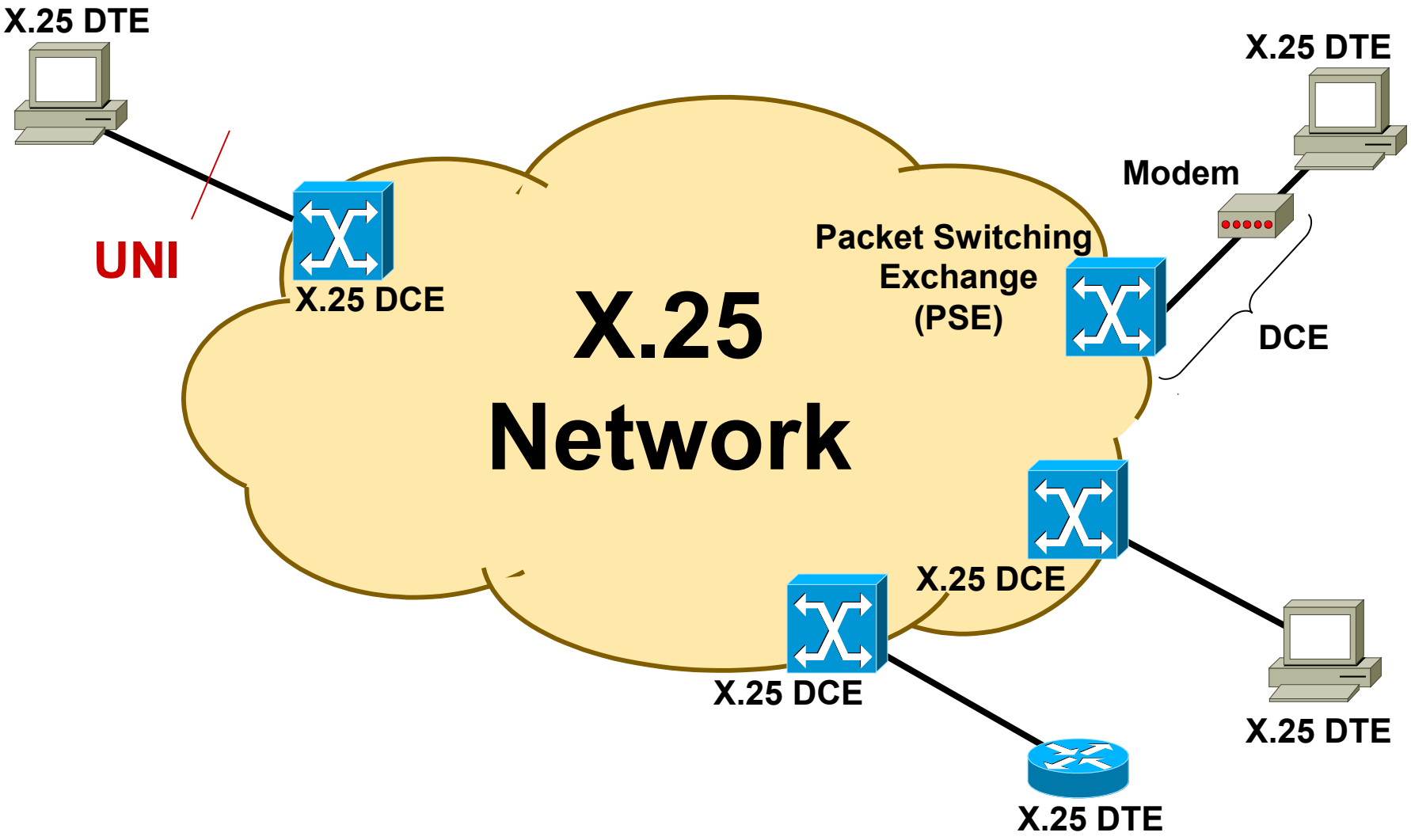
Roots of X.25

- Created by CCITT for Telco data networks in 1976
  - Example: Datex-P
- Adopted and extended by ISO
  - Defined as OSI-layer 3 protocol

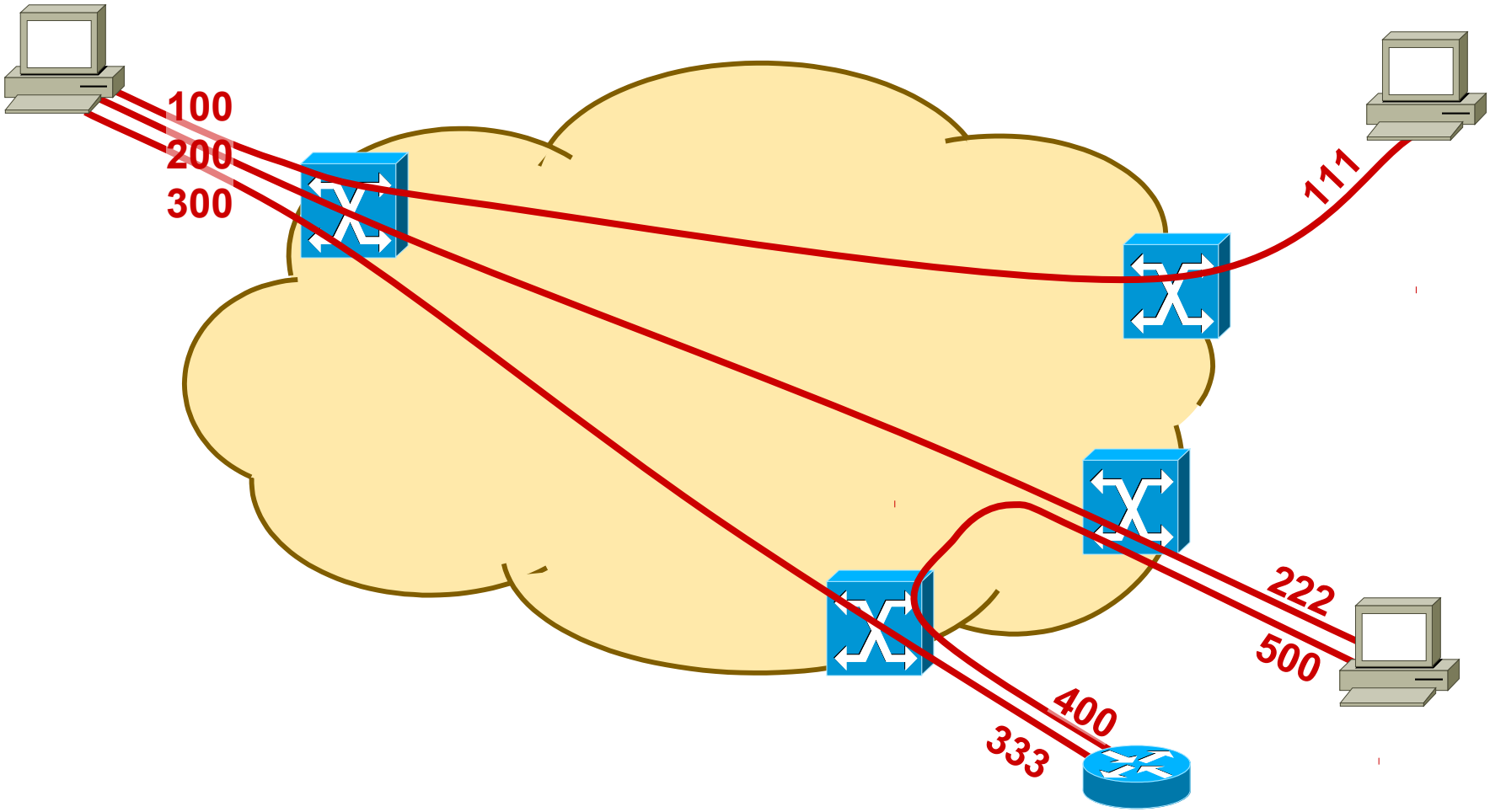
Features

- Reliable
  - Flow control and error recovery on layer two
  - Optionally on layer three
  - Can be used on bad links
- Secure
  - Often used with encryption
  - Network checks caller-ID
- High accountability

X.25 Network


X.25 DTE
UNI
X.25 DCE
X.25
Network
Packet Switching
Exchange
(PSE)
X.25 DTE
Modem
DCE
X.25 DCE
X.25 DCE
X.25 DTE
X.25 DTE

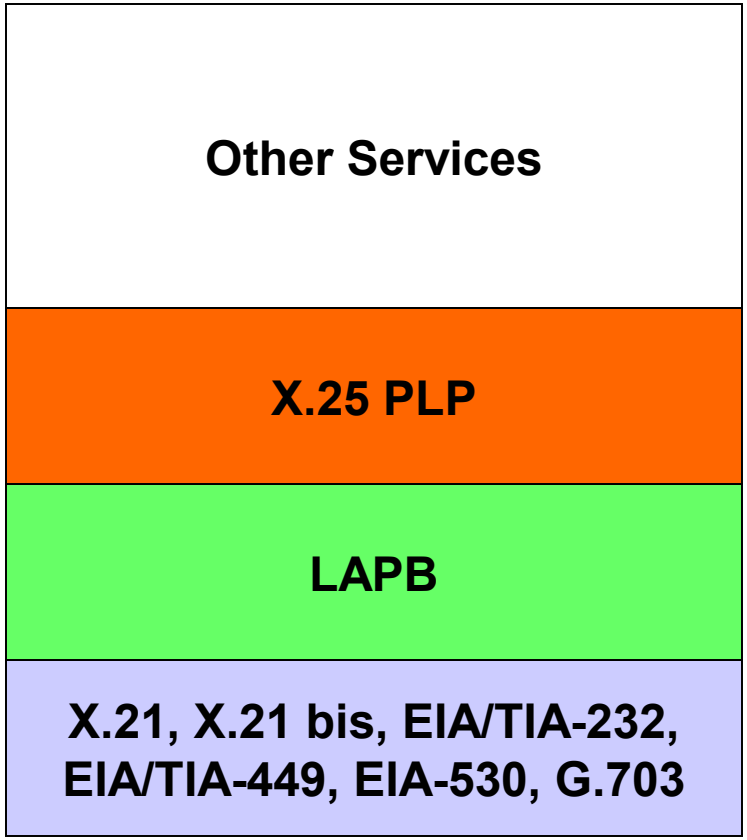
Logical Channels (1)

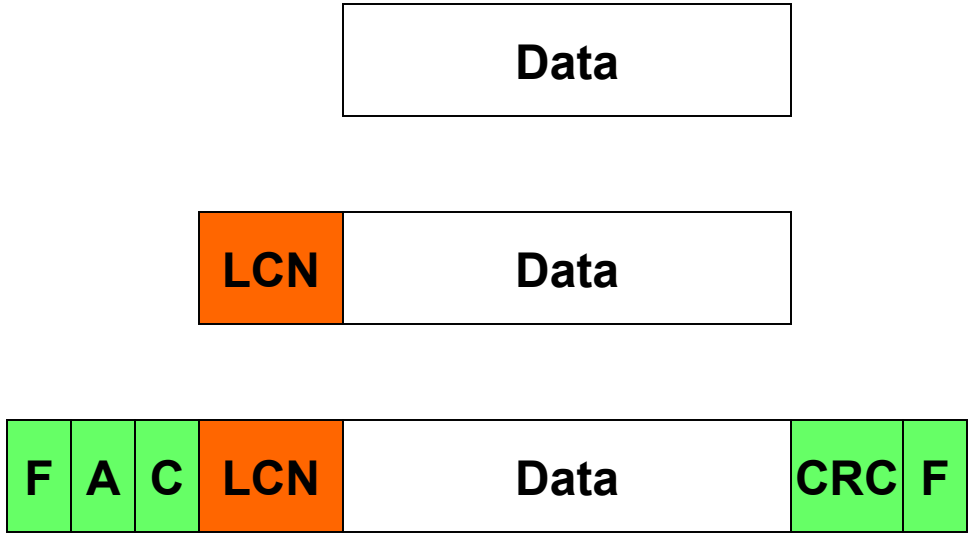


Logical Channels (2)

- Logical Channel Number (LCN)
  - Identifies connection
  - Local significance only (!)
- PVCs or SVCs
- Store and Forward Technology
  - Variable delays (!)

X.25 Layer Model

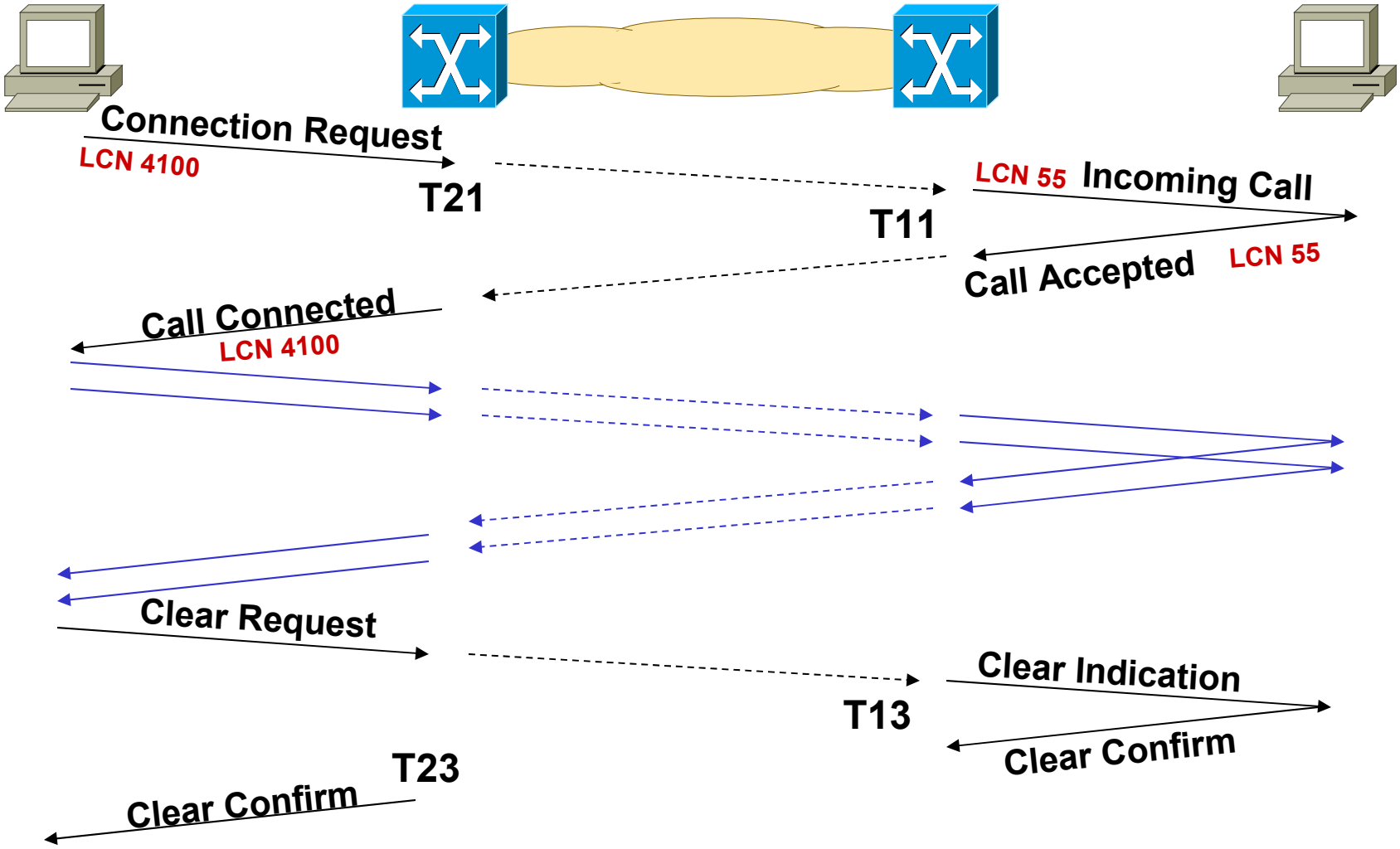




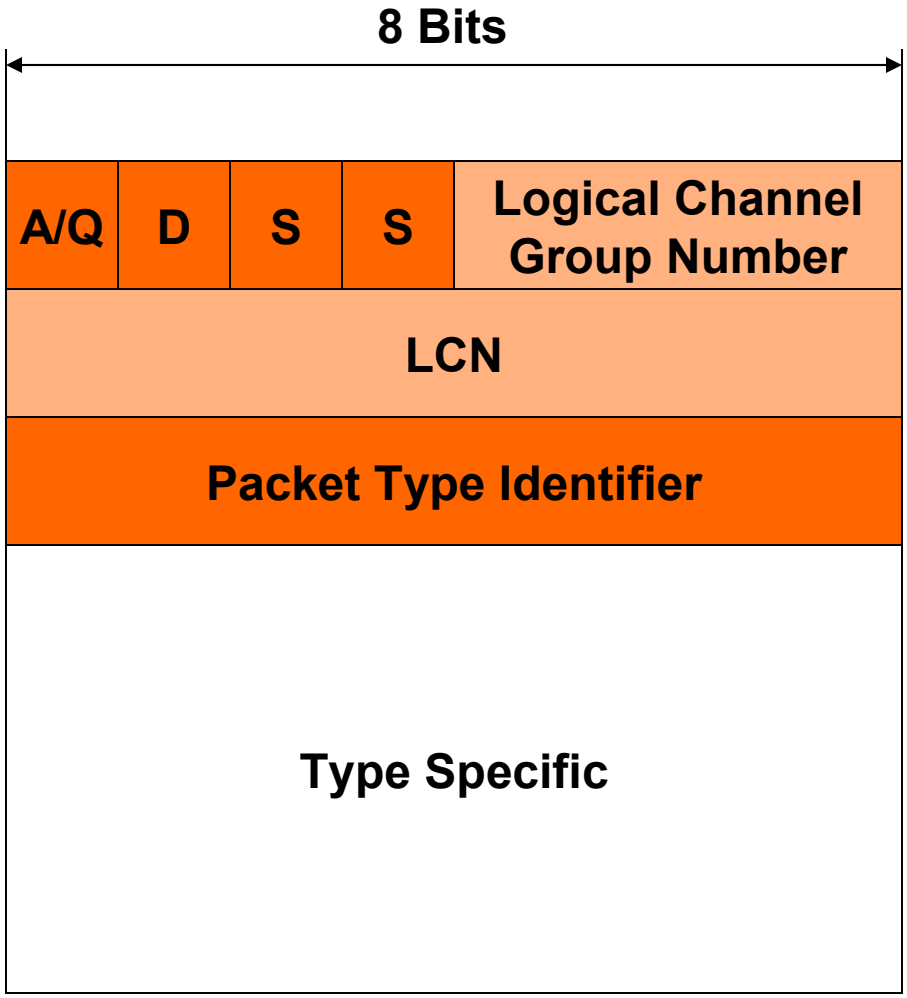
X.25 PLP (1)

- X.25 PLP
  - LCN (local significance) 0-4095
  - X.121 DTE-addresses (unique)
  - Virtual Circuit Services
  - Prioritizes precedence data
  - Flow control
  - Optional end-to-end error recovery (D-bit)

X.25 PLP (2)

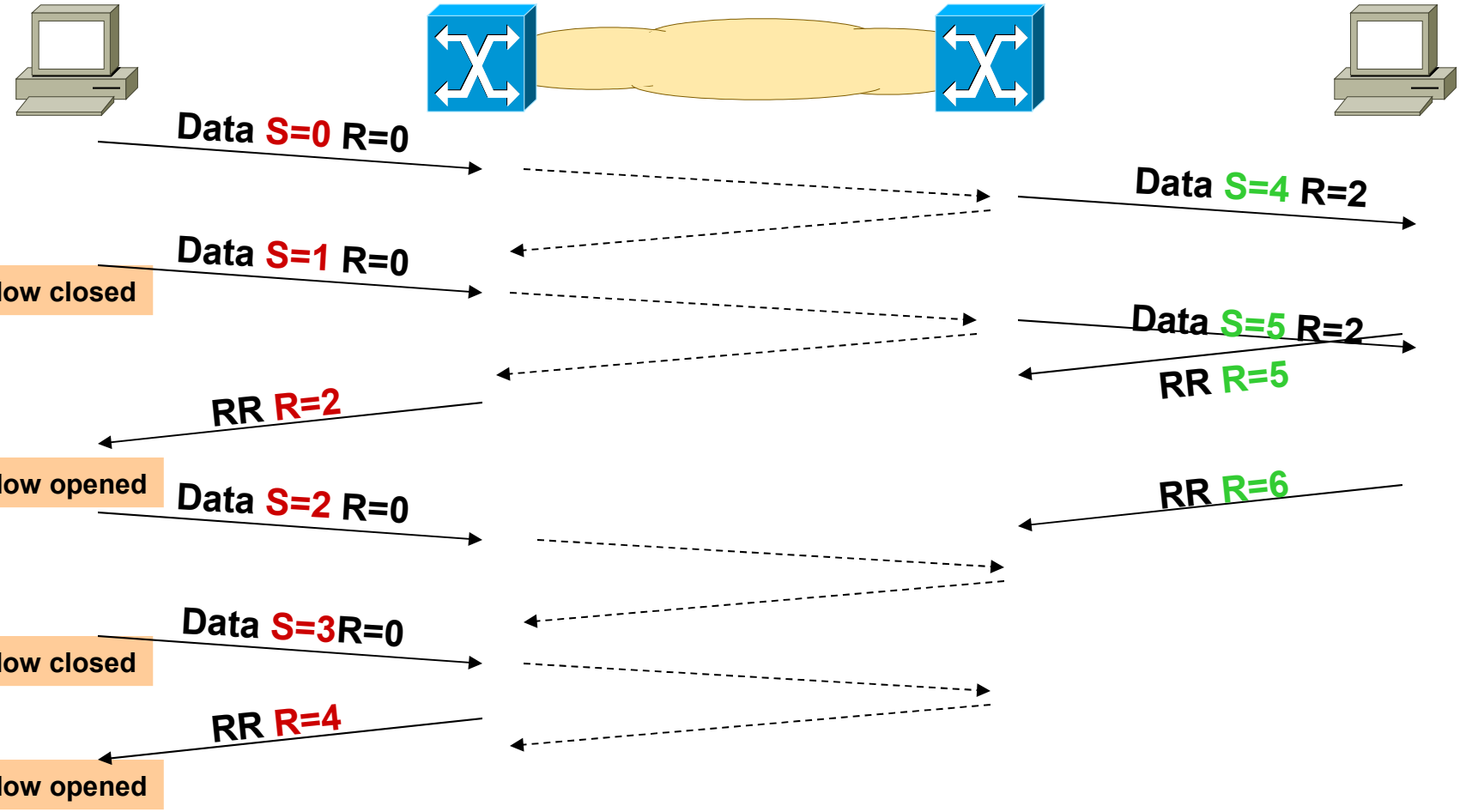

Connection Request
LCN 4100
T21
T11
LCN 55 Incoming Call
Call Accepted
LCN 55
Call Connected
LCN 4100
Clear Request
T13
Clear Indication
Clear Confirm
T23
Clear Confirm

X.25 PLP Format

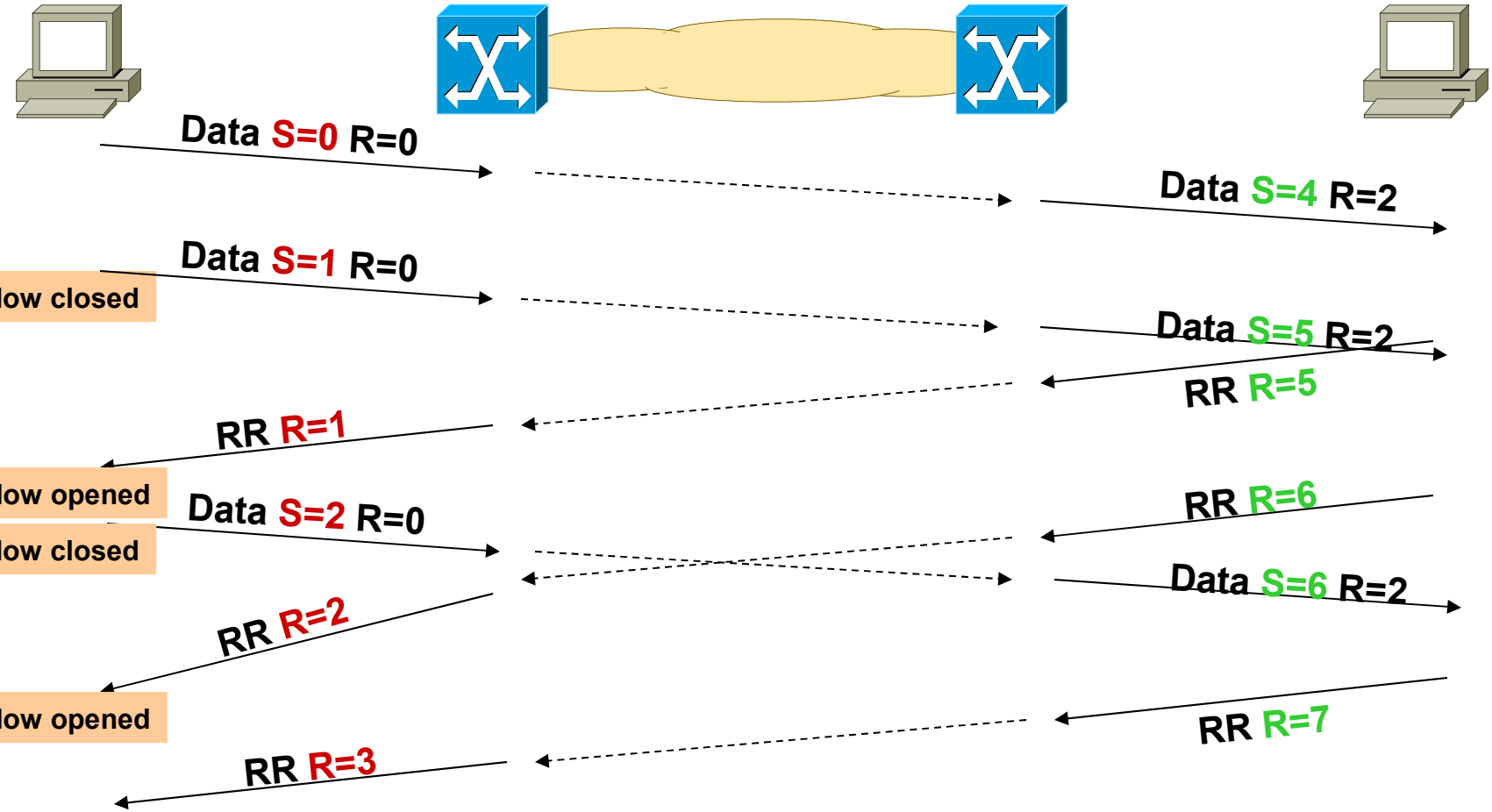


- A = 1 escape from conventional X.25 addresses (1988)
- Q...Qualifier bit, used for normal data packets to indicate user or control data (not really explained)
- Logical Channel Group Number + LCN = 4096 virtual channels
- SS specifies sequence number space (01=modulo 8, 10=modulo 128)

Window=2 and D=0

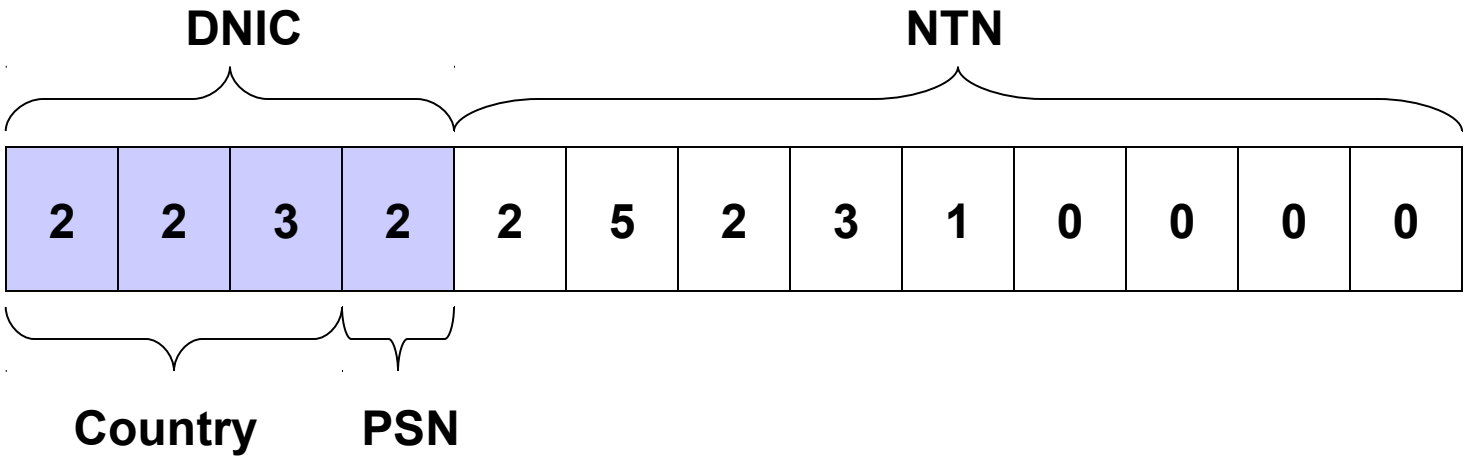


Window=2 and D=1



X.121 Addresses

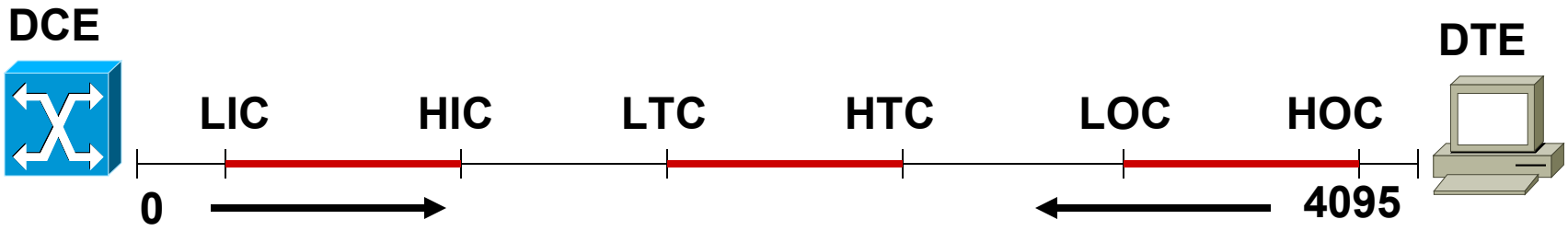
- Public data network numbering (ITU-T)
- Only used to establish SVCs
- Aka International Data Number (IDN)
- 4 + up to 10 digits



DNIC...Data Network Identification Code
NTN...National Terminal Number
PSN...Public Switched Network

LCN Ranges

- Outgoing requests succeed over coincident incoming calls with same LCN
- Predefined LCN ranges
  - Minimize propability of LCN collisions



X.25 Facilities (1)

- Essential Facilities
  - Provided by all X.25 devices
  - Have default values
- Examples
  - Maximum packet size (Default: 128 Bytes)
  - Window size
  - Throughput class (75, ..., 48000 bit/s)
  - Transit delay

X.25 Facilities (2)

- Optional Facilities
  - Don't need to be provides
  - Default values and negotiation possible
- Examples
  - Packet error recovery (REJ support)
  - Fast Select and Fast Select Acceptance
  - Closed user groups
  - Reverse charging
  - Hunt groups
  - Call redirection

Fragmentation (1)

- Switch may fragment packets
  - If one DTE requires smaller packet sizes
- Using M-bit ("More")
  - M=0 means unfragmented packet or last fragment
  - M=1 means first or middle fragment
- Switch may combine packets in the reverse direction

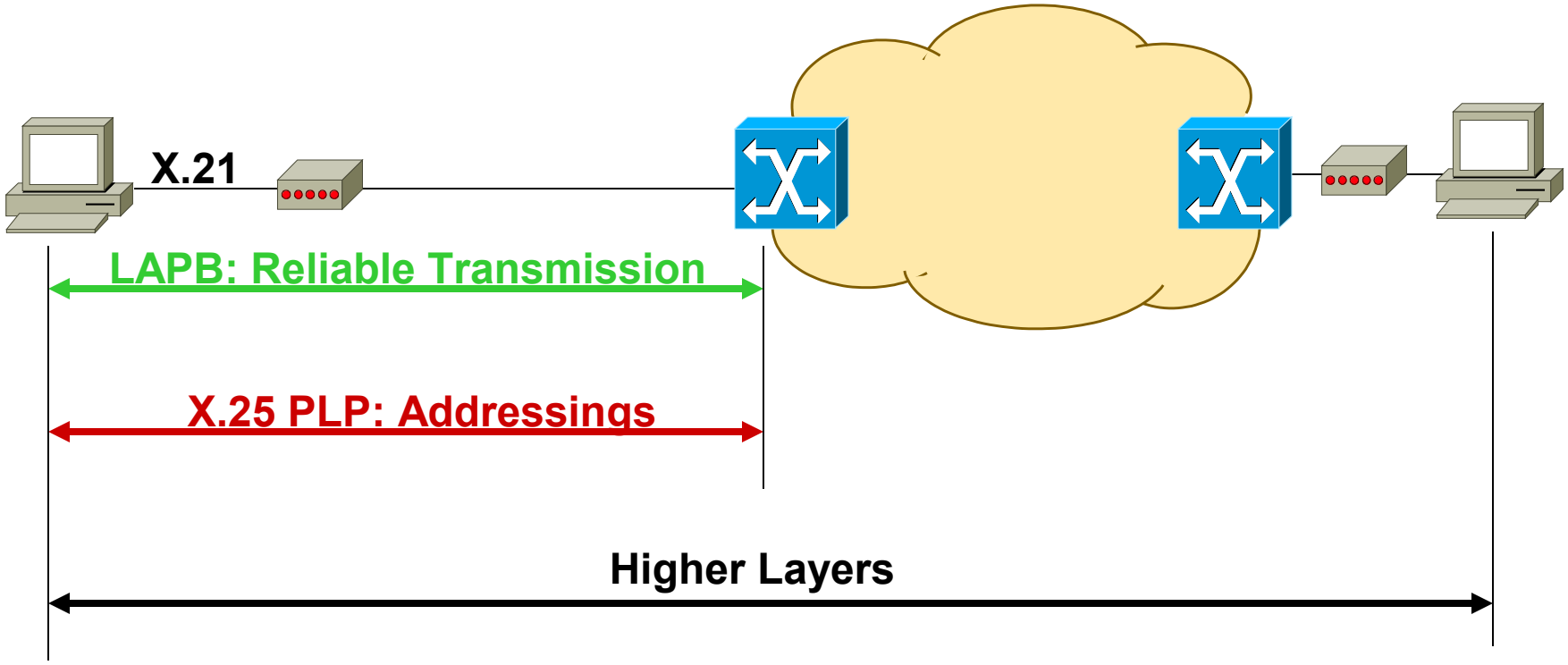
Fragmentation (2)

- In case of end-to-end acks (D=1)
  - We want an ACK for each sequence
  - Not for each fragment
- Two types of packets
  - In-sequence packets (M=1, D=0)
  - Single or end-sequence packets (M=0, D=1)

LAPB

- Link Access Procedures Balanced
  - HDLC variant (ABM)
  - Error recovery and flow control
  - Addresses are useless on point-to-point links ⇒ used to separate commands and respones

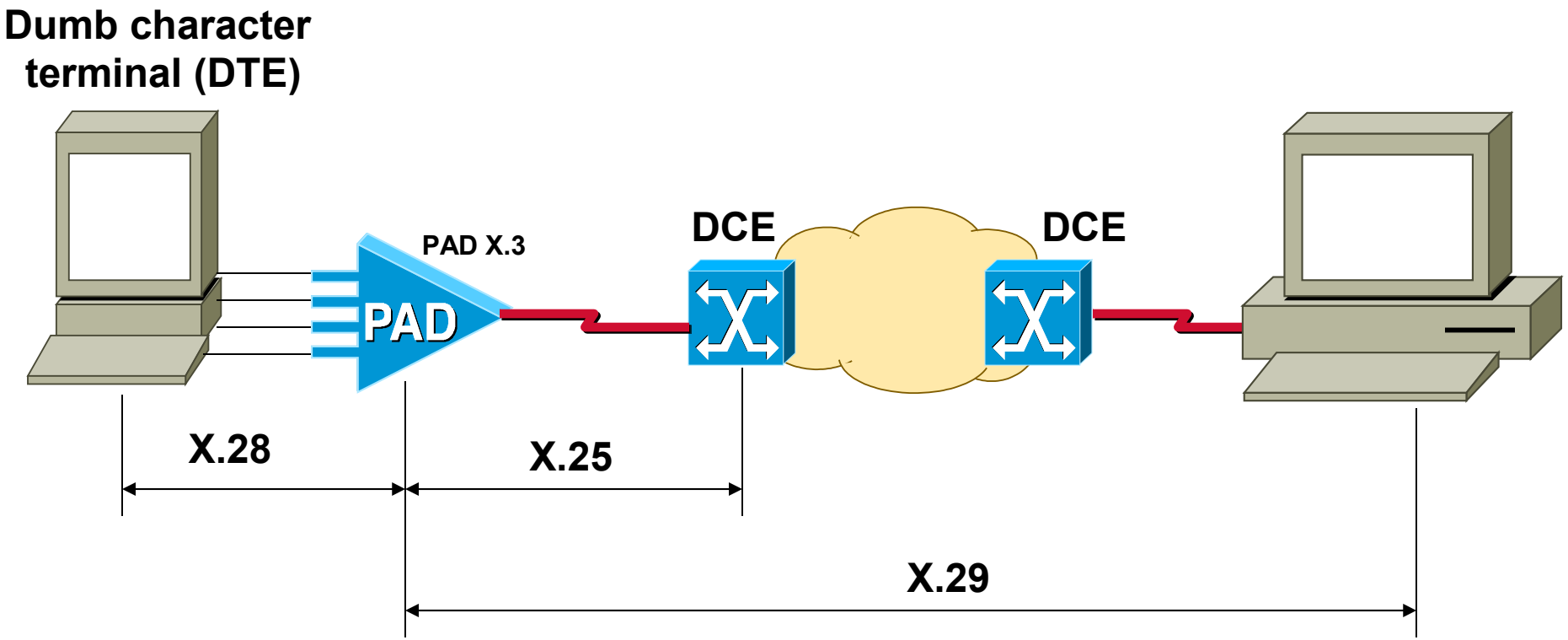
Scope of Each Layer



PAD (1)

- Packet Assembler/Dissassembler (PAD)
  - Commonly found in X.25 applications
  - Used when DTE is a character-oriented device
  - Too simple for full X.25 functionality
- Three functions
  - Buffering
  - Packet Assembly (chars to packets)
  - Packet Dissassembly (strips X.25 header)

PAD (2)



X.75

- Signalling system to connect two X.25 networks on international circuits
- Layer 2: LAPB
- Layer 3: X.75
  - X.75 is very similar to X.25 but includes a variable length field for network utilities

Summary

- CCITT and ISO standard for connection oriented packet switching UNI
- LAPB for reliable link transmission
- X.25 PLP for VC services
- Slow – mostly used for transactions today
- World-wide available

Quiz

- Who uses X.25 today?
- Do shops have both ISDN and X.25 separately installed?
- What is AX.25?
- How can we speed-up X.25?

Hints

- Q1: Chancelleries (ambassador's office), bank-terminals, airport-terminals, press agencies, Lotto,...
- Usually they put X.25 (VISA...) over D-channel. Also X.25 over B channels are in use.
- Q3: AX.25 is used for amateur packet radio. The difference is that the header must include the callsigns
- Q4: Reduce protocol overhead (double flow control and ARQ !) – which leads us to FR