

Asynchronous Transfer Mode (ATM)

Issues Driving LAN Changes

- Traffic Integration
 - Voice, video and data traffic
 - *Multimedia* became the ‘buzz word’
 - One-way batch Web traffic
 - Two-way batch voice messages
 - One-way interactive Mbone broadcasts
 - Two-way interactive video conferencing
- Quality of Service guarantees (e.g. limited jitter, non-blocking streams)
- LAN Interoperability
- Mobile and Wireless nodes

Stallings “High-Speed Networks”

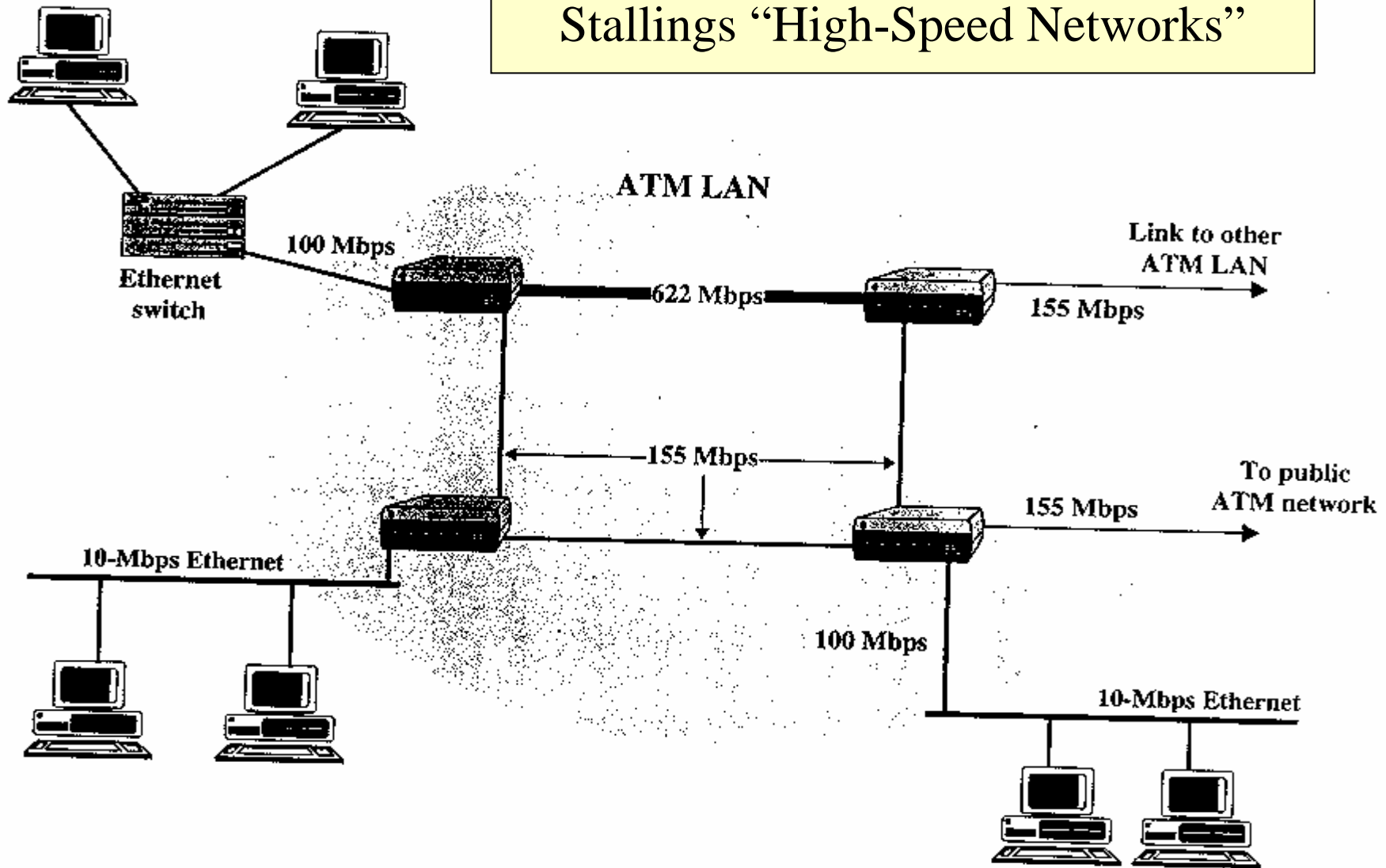


Figure 5.9 Example ATM LAN configuration.

Stallings “High-Speed Networks”

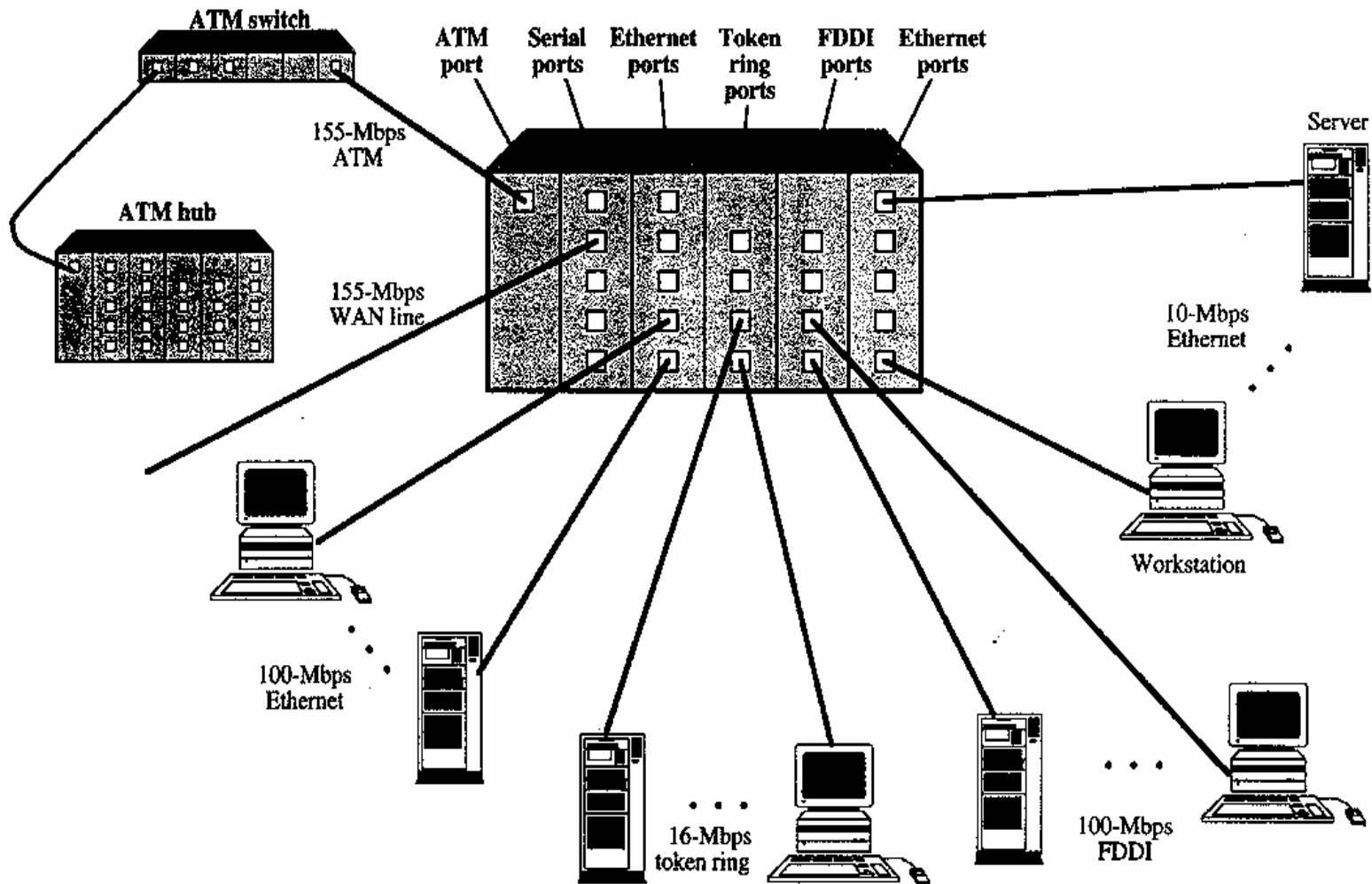
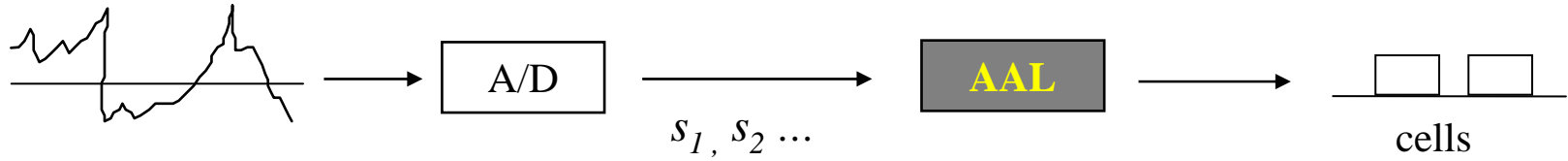


Figure 5.10 ATM LAN hub configuration.

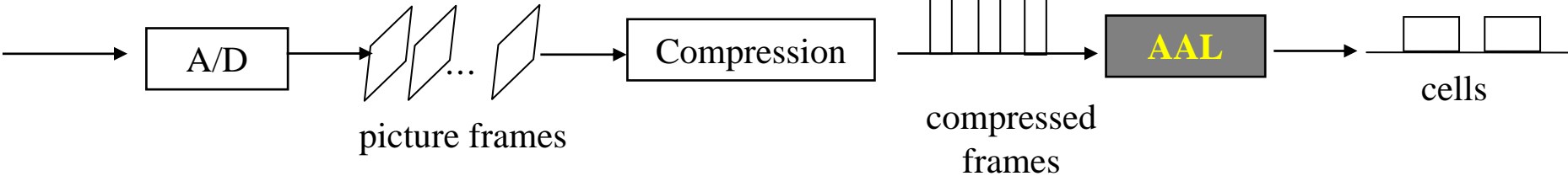
ATM Adaptation Layers

Voice

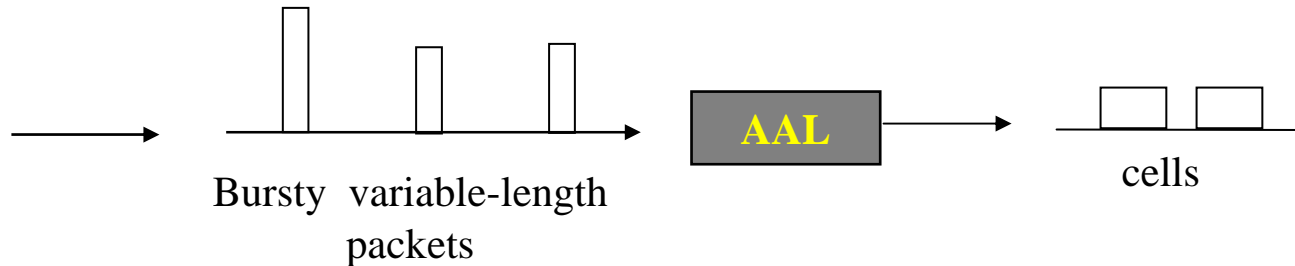


Digital voice samples

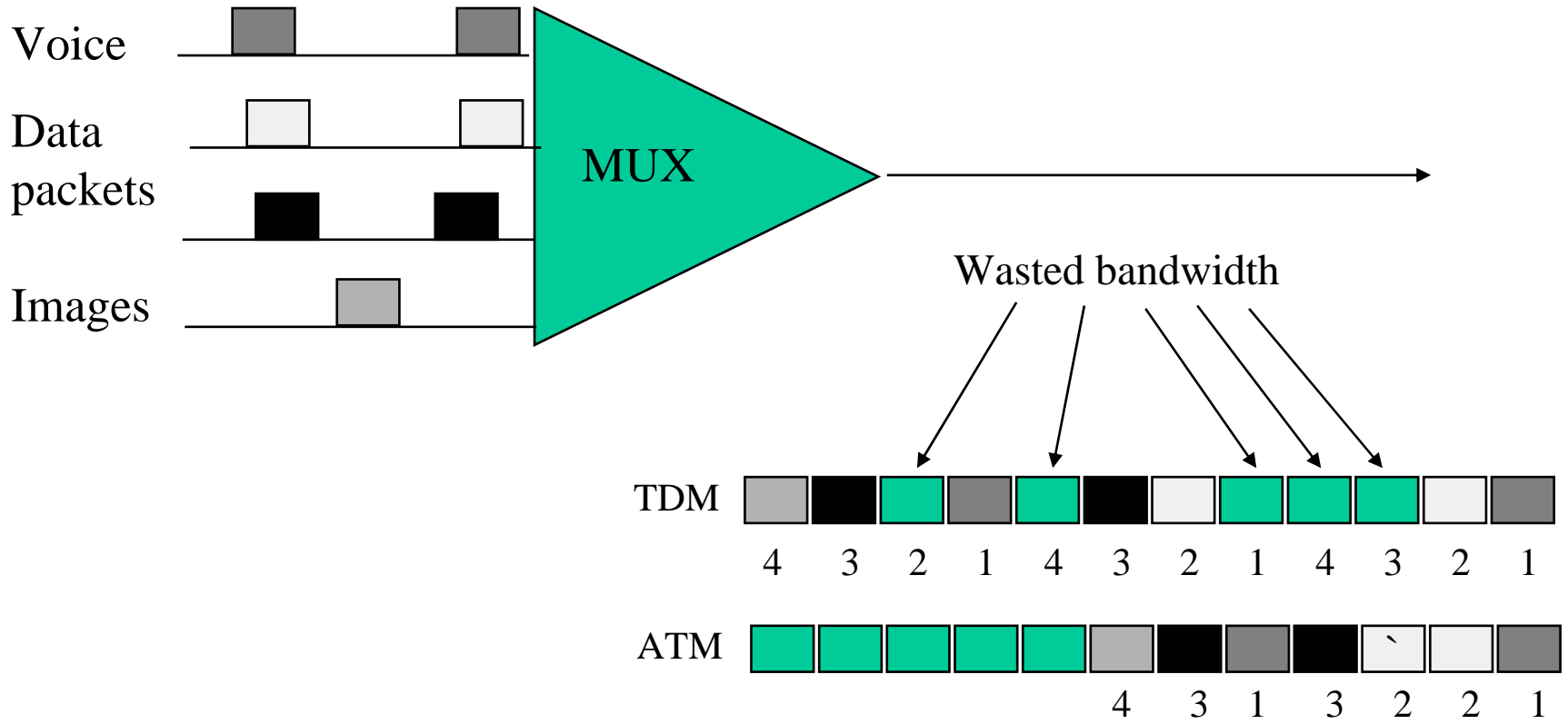
Video



Data

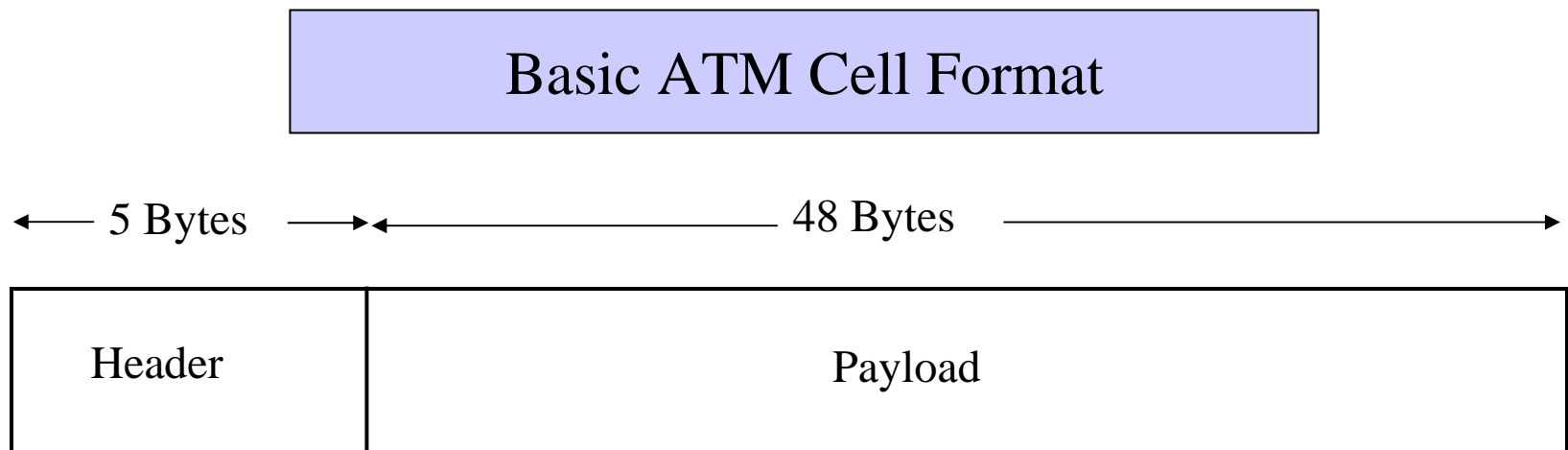


Asynchronous Transfer Mode (ATM)



ATM

- ATM standard (defined by CCITT) is widely accepted by common carriers as mode of operation for communication – particularly BISDN.
- ATM is a form of cell switching using small fixed-sized packets.



ATM Conceptual Model

Four Assumptions

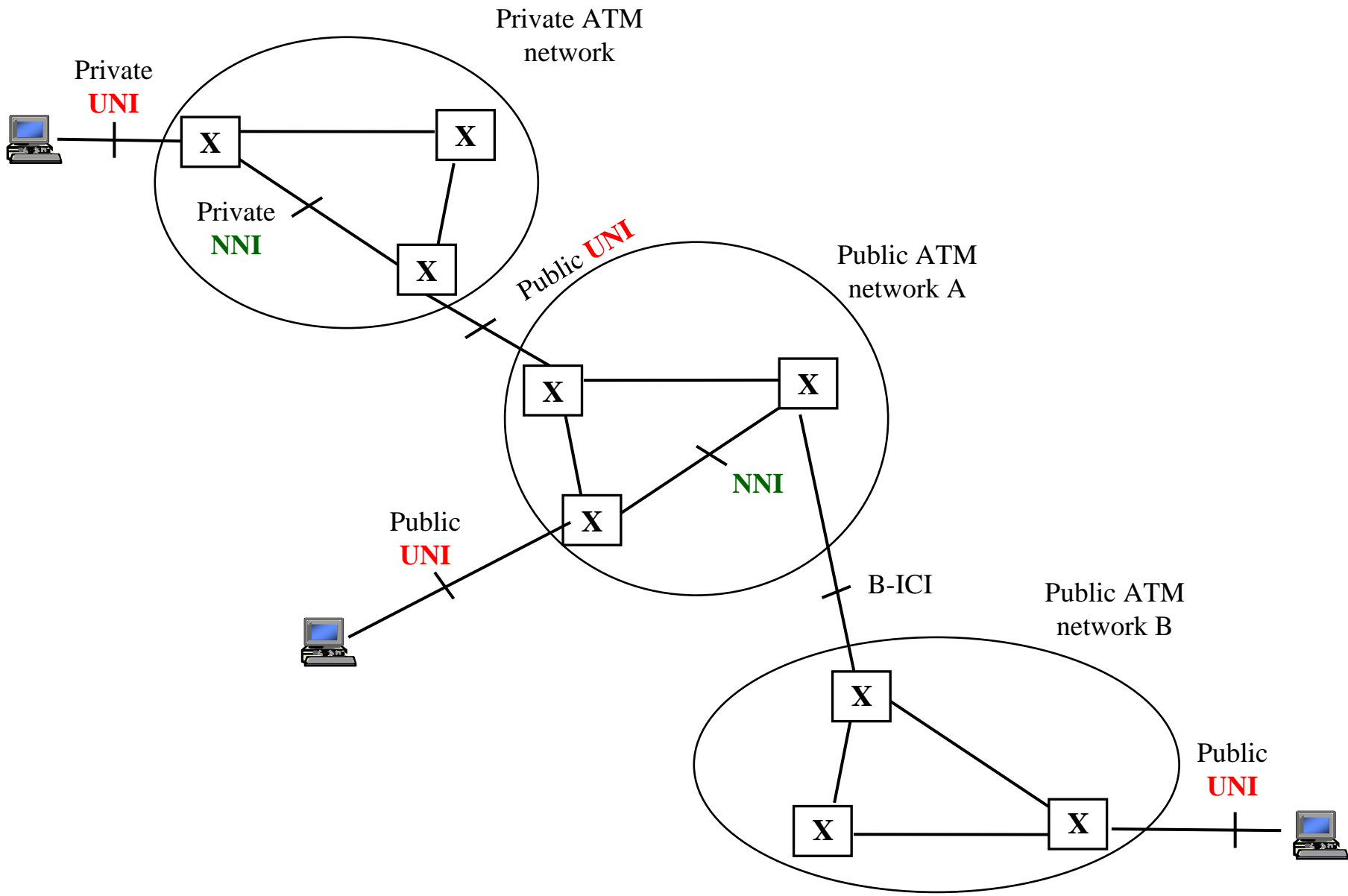
1. ATM network will be organized as a **hierarchy**.

User's equipment connects to networks via a **UNI** (User-Network Interface).

Connections between provided networks are made through **NNI** (Network-Network Interface).

2. ATM will be **connection-oriented**.

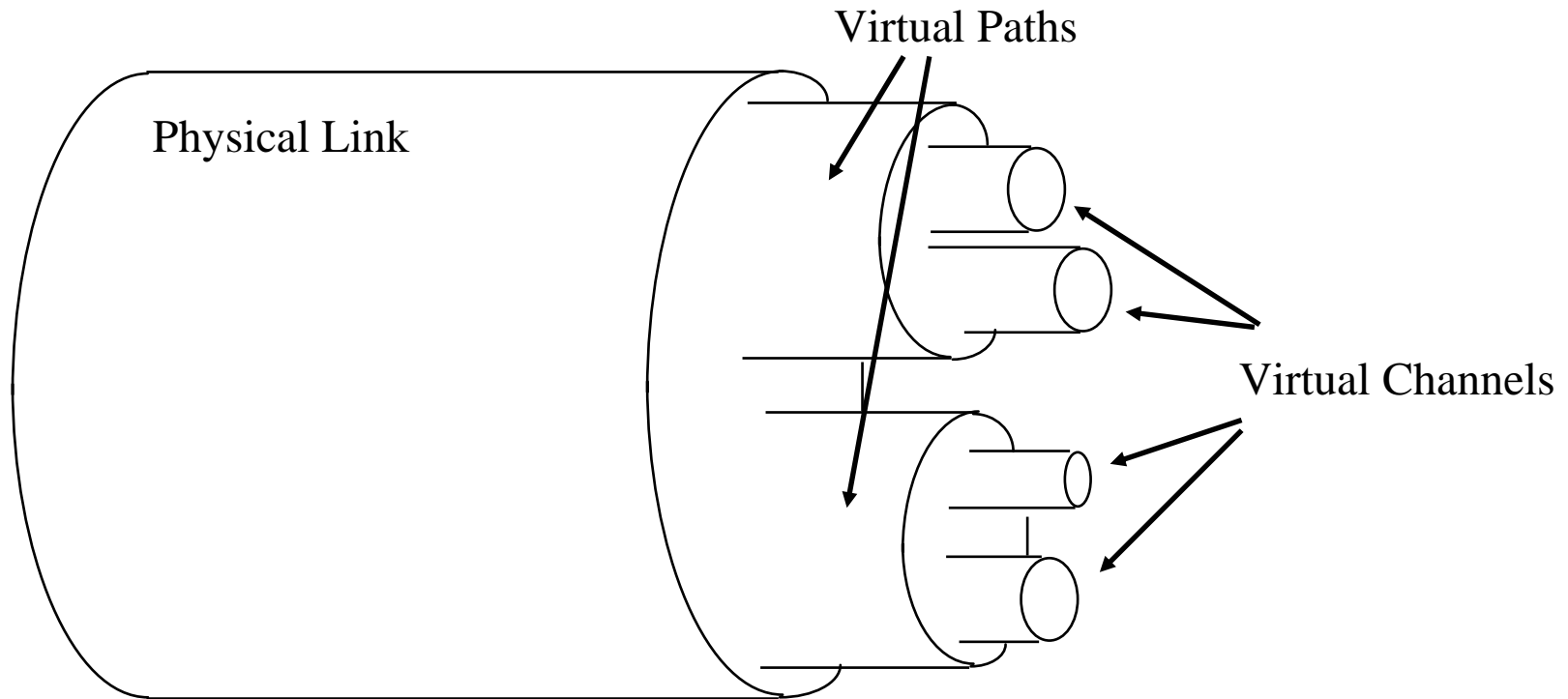
A connection (an ATM channel) must be established before any cells are sent.



ATM Connections

- two levels of ATM connections:
 - virtual path connections
 - virtual channel connections
- indicated by two fields in the cell header:
 - virtual path identifier* **VPI**
 - virtual channel identifier* **VCI**

ATM Virtual Connections



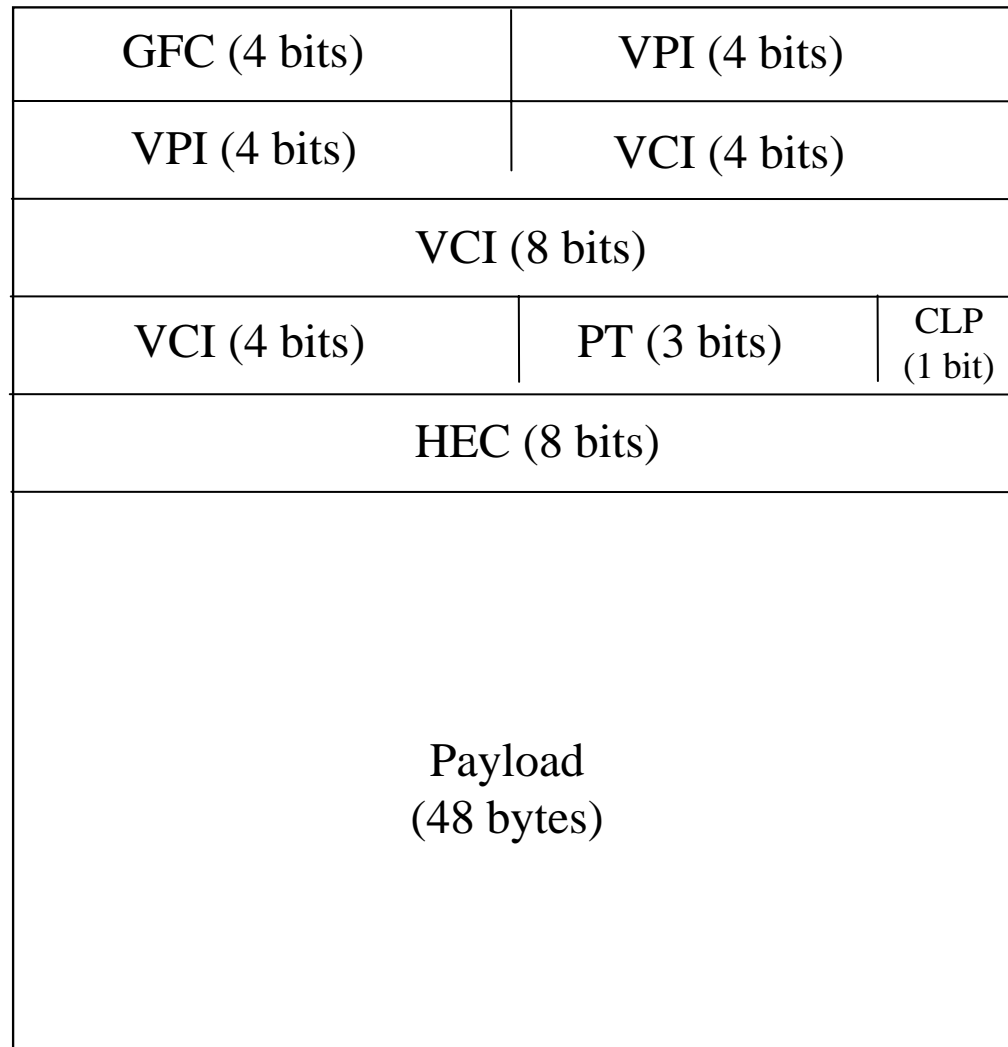
ATM Conceptual Model Assumptions (cont.)

3. Vast majority of ATM networks will run on optical fiber networks with **extremely low error rates**.
4. ATM must support **low cost attachments**.
 - This decision lead to a significant decision – to **prohibit cell reordering** in ATM networks.

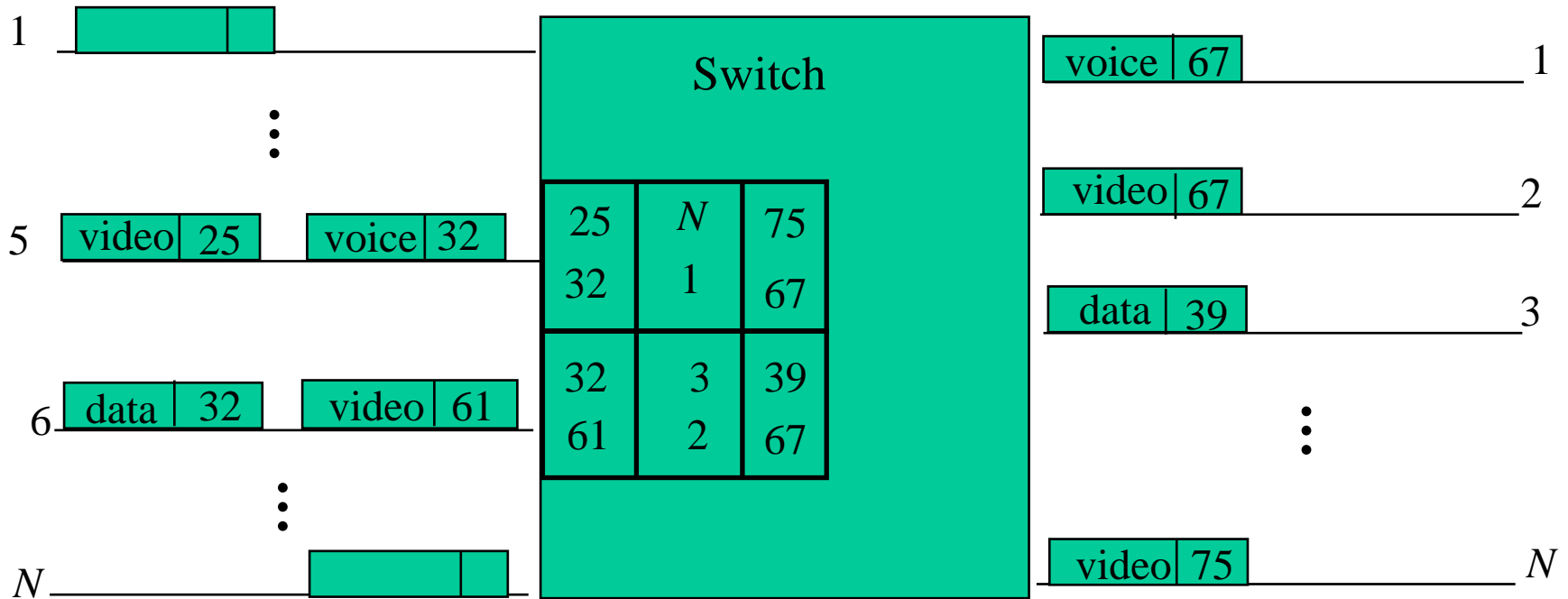
➔ ATM switch design is more difficult.

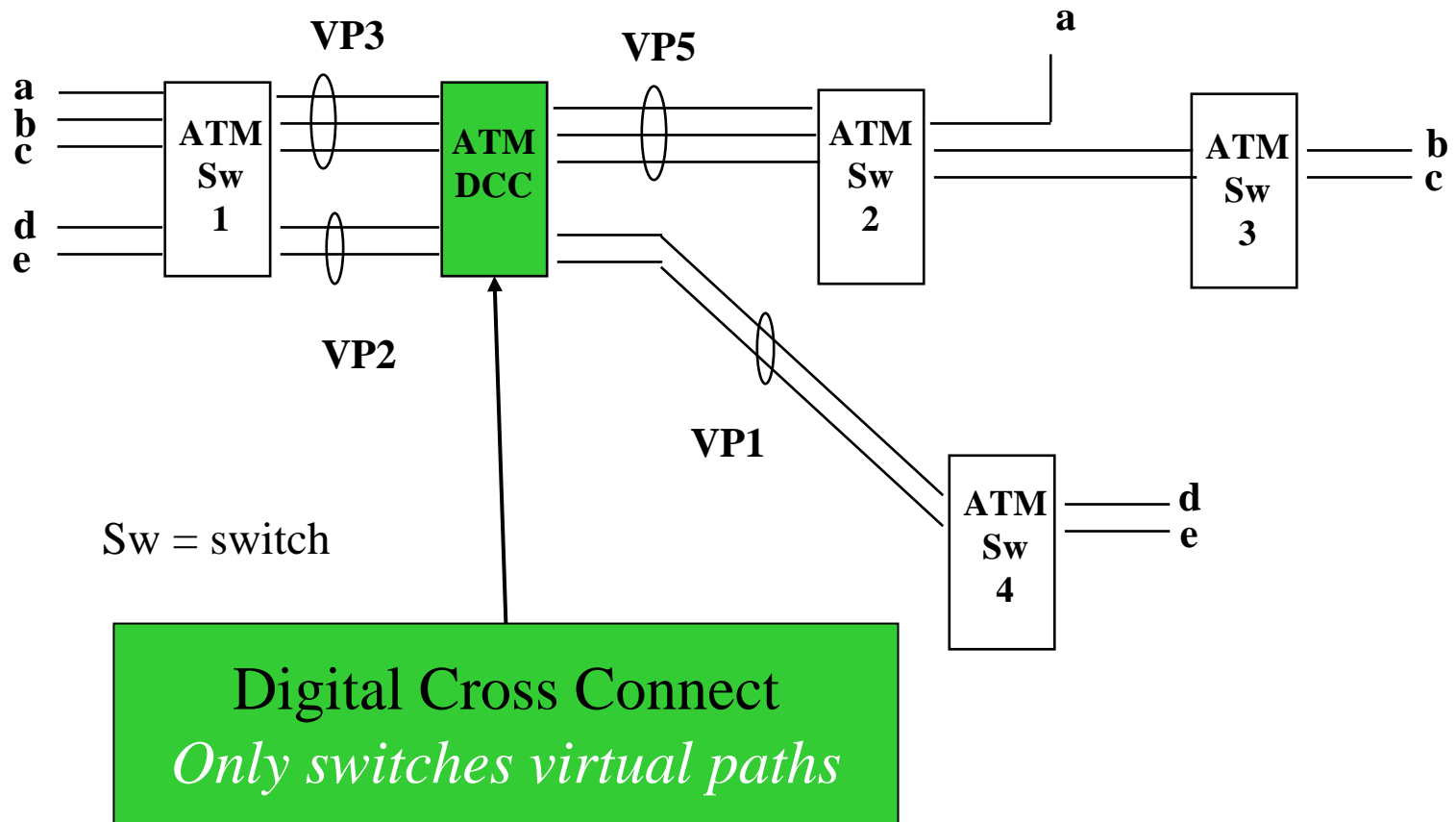
UNI Cell Format

↑
ATM cell
header
↓



ATM Cell Switching

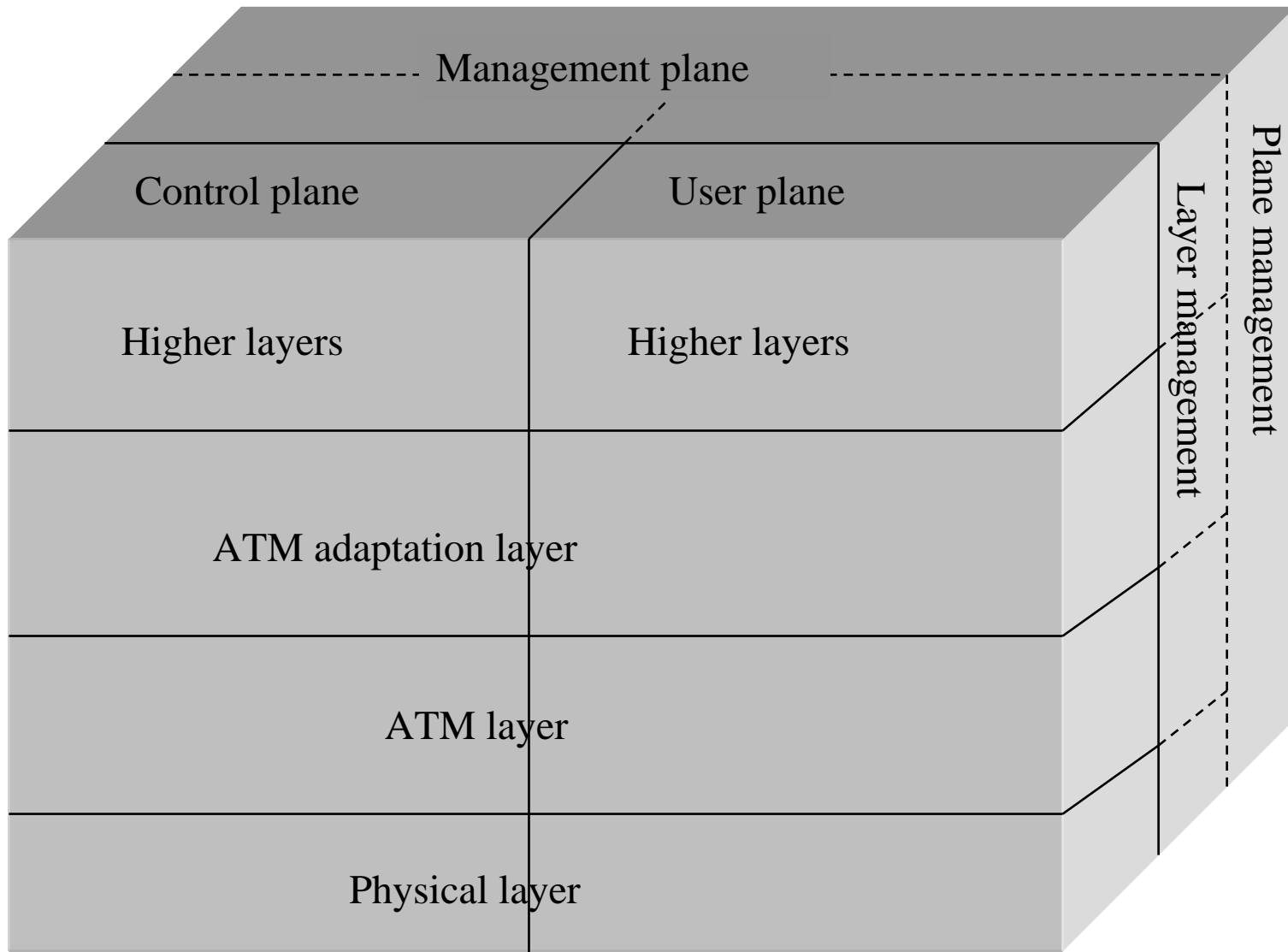


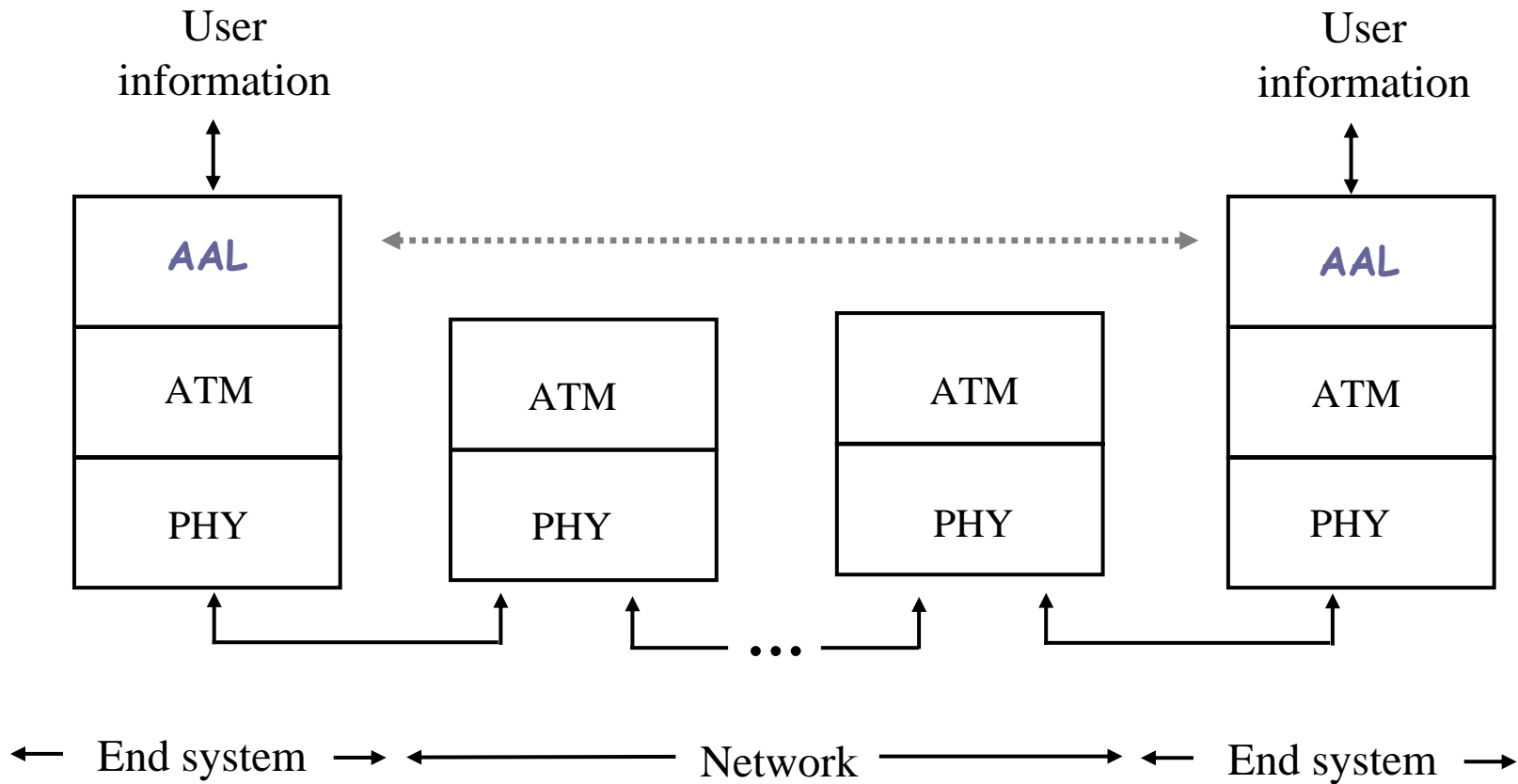


ATM Protocol Architecture

- ATM Adaptation Layer (AAL) – the protocol for packaging data into cells is collectively referred to as AAL.
- Must efficiently package higher level data such as voice samples, video frames and datagram packets into a series of cells.

Design Issue: How many adaptation layers should there be?





Original ATM Architecture

- CCITT envisioned four classes of applications (A-D) requiring four distinct adaptation layers (1-4) which would be *optimized* for an application class:
 - A. Constant bit-rate applications **CBR**
 - B. Variable bit-rate applications **VBR**
 - C. Connection-oriented data applications
 - D. Connectionless data application

ATM Architecture

An AAL is further divided into:

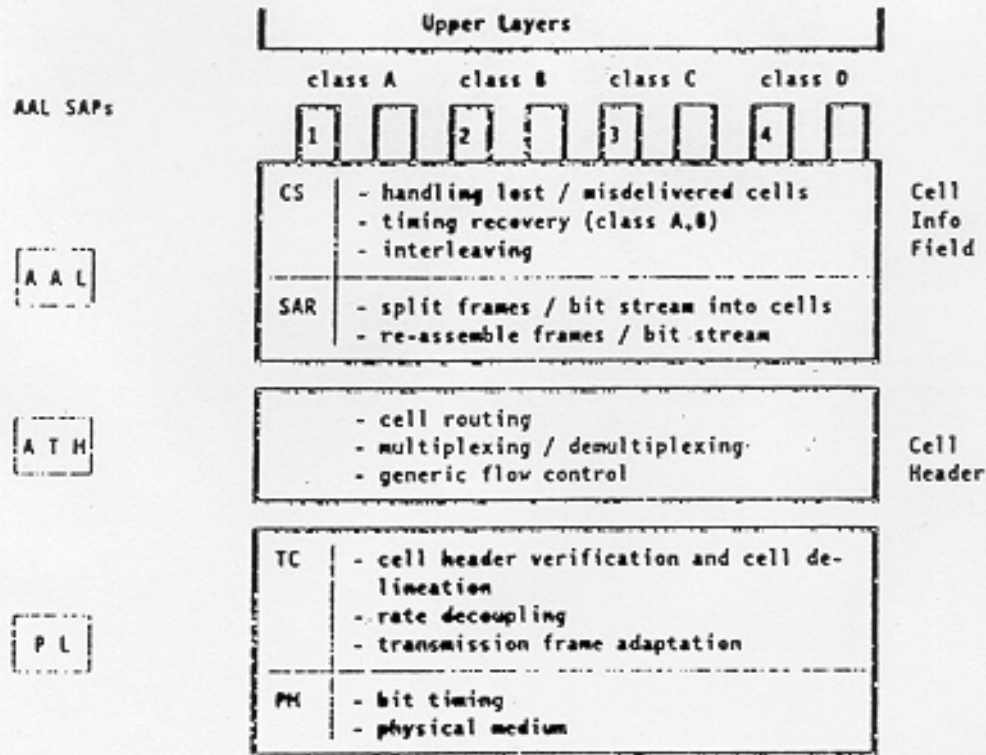
The **Convergence Sublayer (CS)**

manages the flow of data to and from SAR sublayer.

The **Segmentation and Reassembly Sublayer (SAR)**

breaks data into cells at the sender and reassembles cells into larger data units at the receiver.

Original ATM Architecture



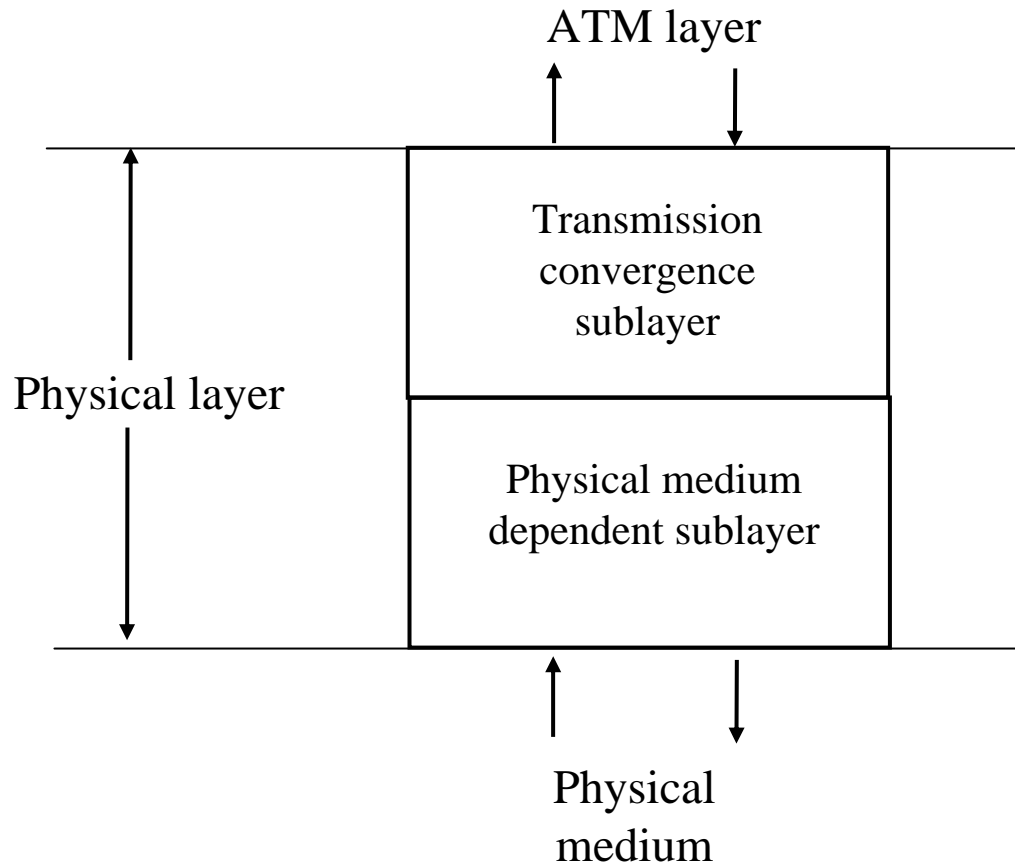
Abbreviations

AAL	- ATH Adaptation Layer
SAR	- Segmentation And Reassembly
CS	- Convergence Sub-layer
PL	- Physical Layer
TC	- Transmission Convergence
PM	- Physical Medium

SERVICE CLASSES for AAL

class	type
A	Constant Bit Rate
B	Variable Bit Rate
C	Connection Oriented Data
D	Connectionless Data

1. Protocol Reference Model in the User Plane. See Section 4.1 for AAL SAP classes (A to D) and values (1 to 4).

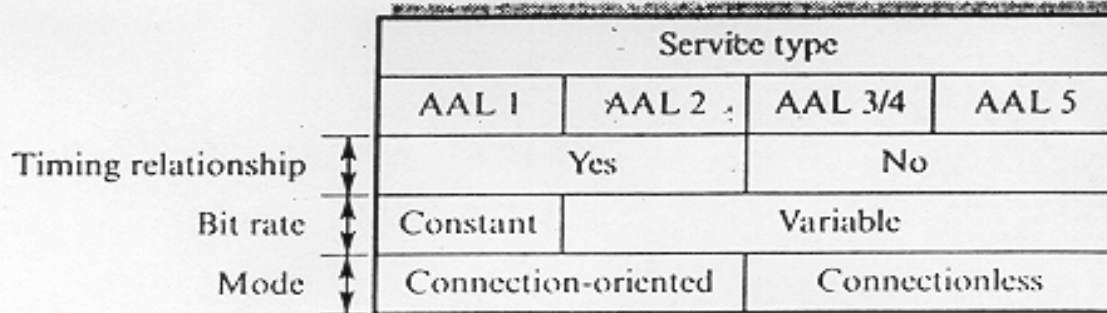


Original ATM Architecture

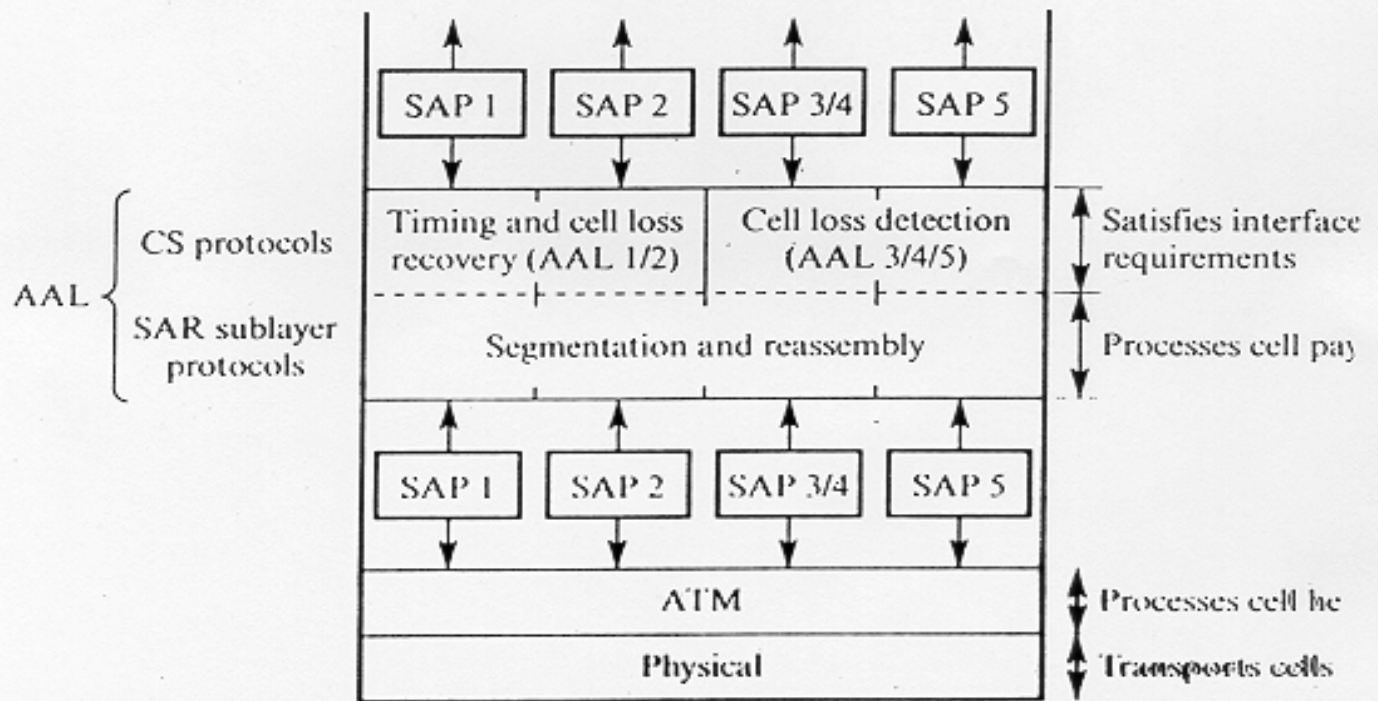
- The AAL interface was initially defined as classes **A-D** with SAP (service access points) for **AAL1-4**.
- **AAL3** and **AAL4** were so similar that they were merged into **AAL3/4**.
- The data communications community concluded that **AAL3/4** *was not suitable* for data communications applications. They pushed for standardization of **AAL5** (also referred to as **SEAL** – the **Simple and Efficient Adaptation Layer**).
- **AAL2** was not *initially* deployed.

Revised ATM Architecture

(a)



(b)



CS = Convergence sublayer

SAR = Segmentation and reassembly

Revised ATM Service Categories

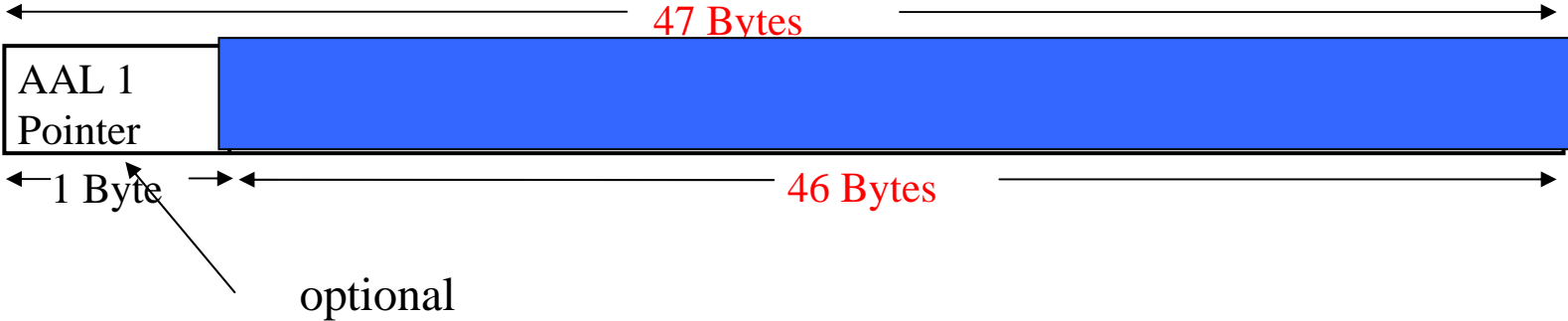
Class	Description	Example
CBR	Constant Bit Rate	T1 circuit
RT-VBR	Real Time Variable Bit Rate	Real-time videoconferencing
NRT-VBR	Non-real-time Variable Bit Rate	Multimedia email
ABR	Available Bit Rate	Browsing the Web
UBR	Unspecified Bit Rate	Background file transfer

QoS, PVC, and SVC

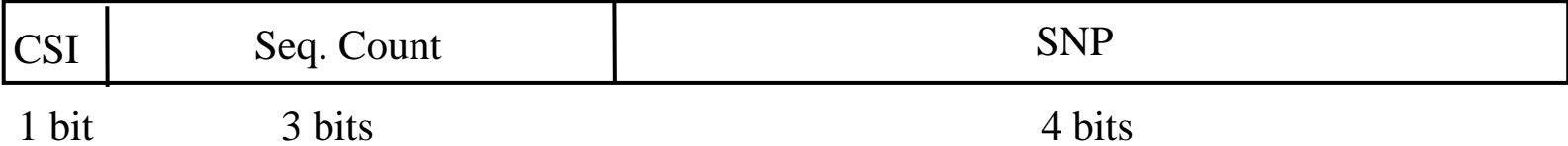
- Quality of Service (QoS) requirements are handled at connection time and viewed as part of *signaling*.
- ATM provides permanent virtual connections and switched virtual connections.
 - Permanent Virtual Connections (PVC)
permanent connections set up *manually* by network manager.
 - Switched Virtual Connections (SVC)
set up and released *on demand* by the end user via signaling procedures.



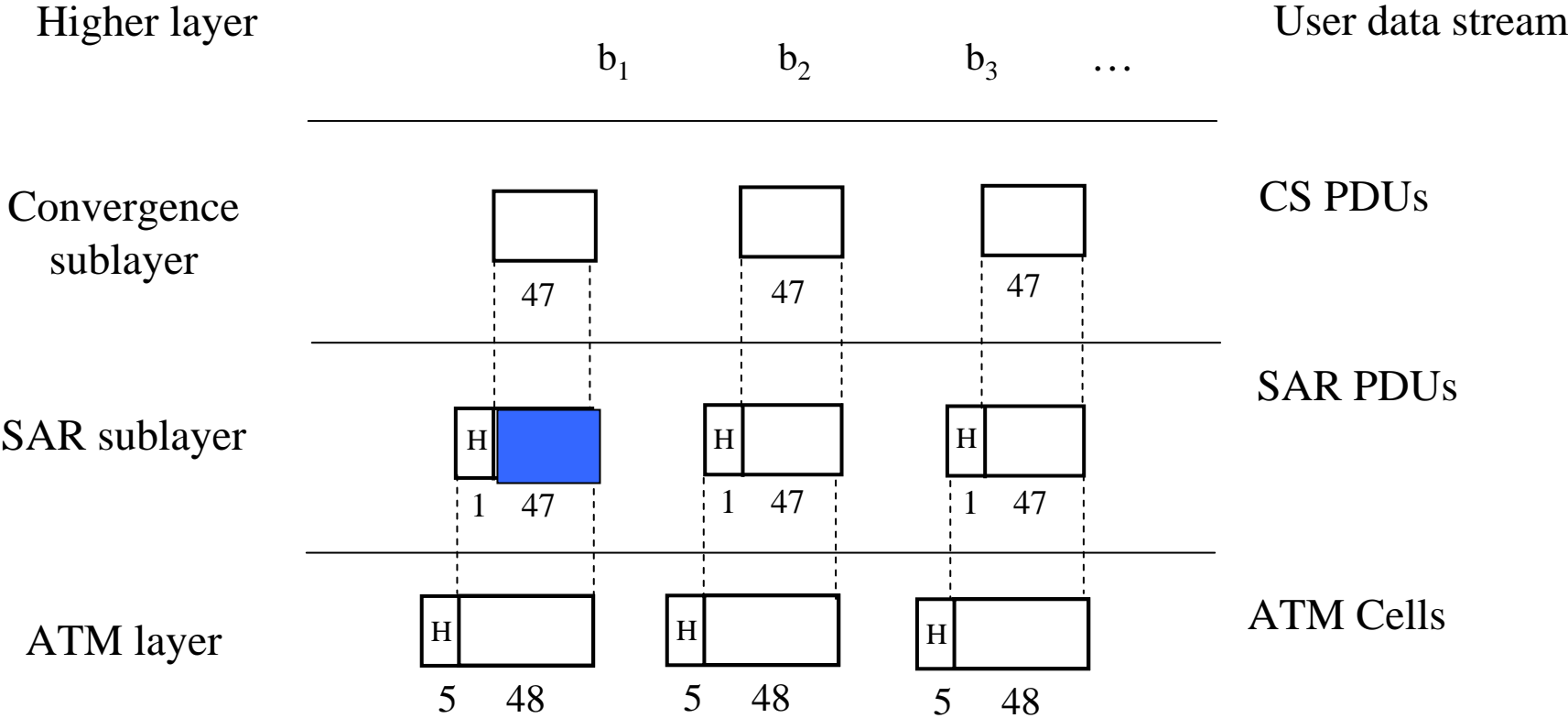
(b) CS PDU with pointer in structured data transfer



(a) SAR PDU header

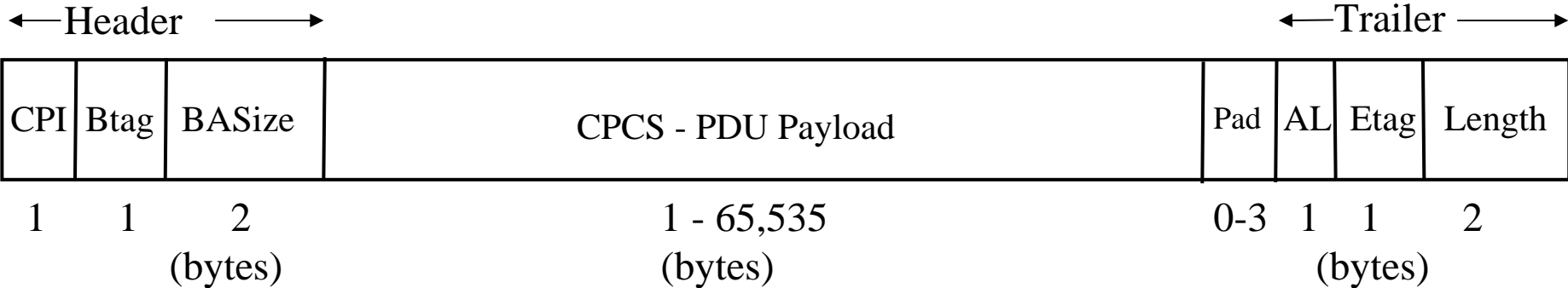


AAL 1

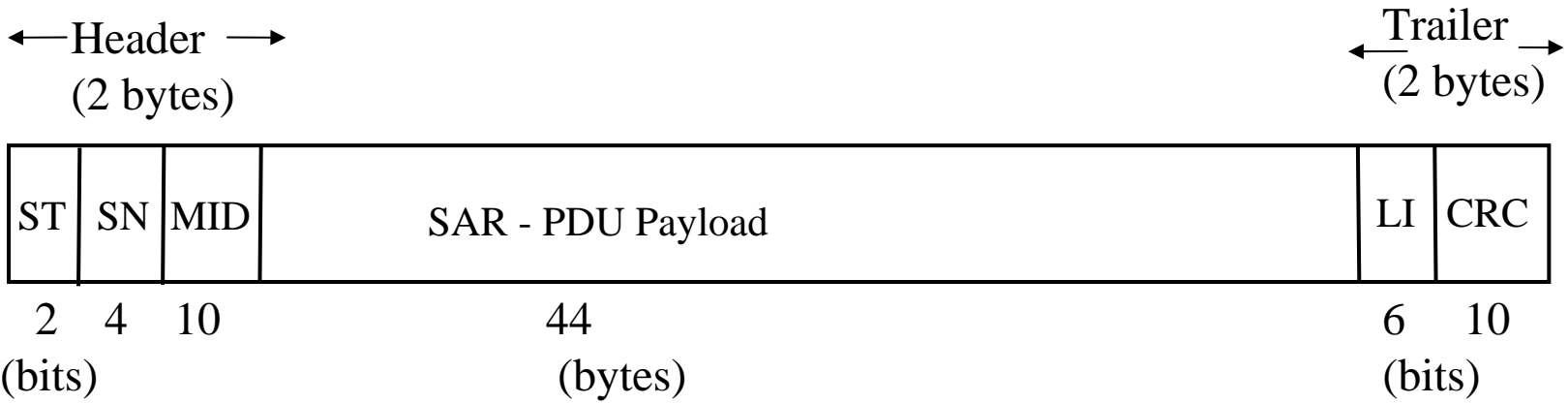


AAL 3/4 CS and SAR PDUs

(a) CPCS-PDU format



(b) SAR PDU format



AAL 3/4

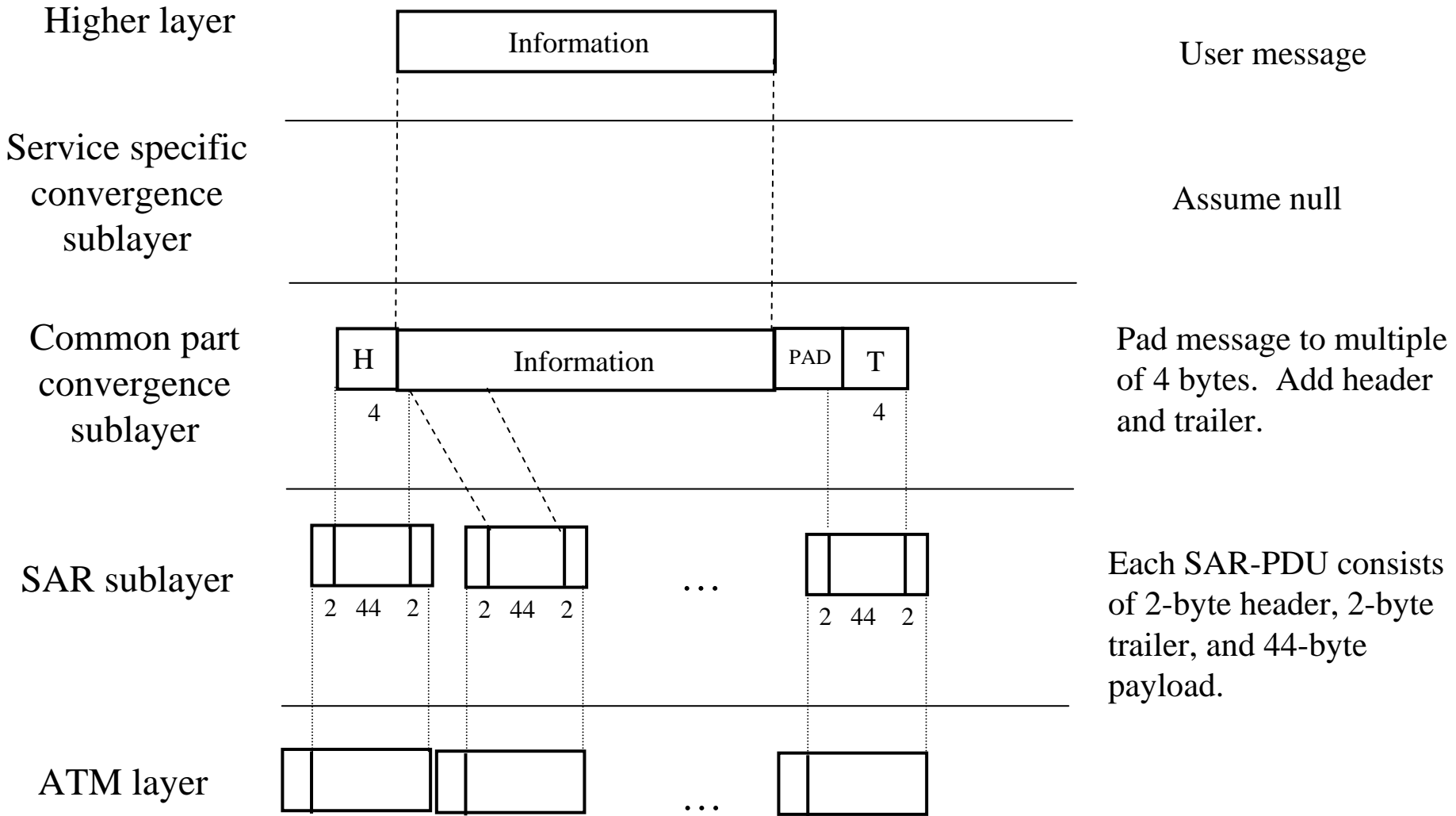
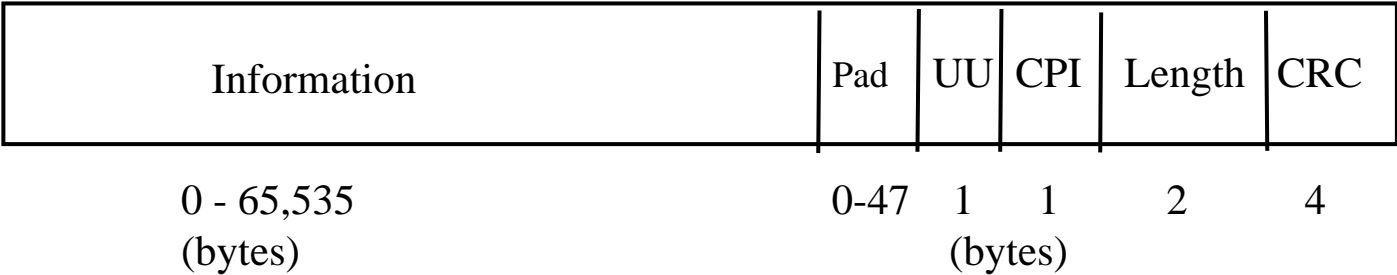


Figure 9.15



AAL 5

Convergent Sublayer Format



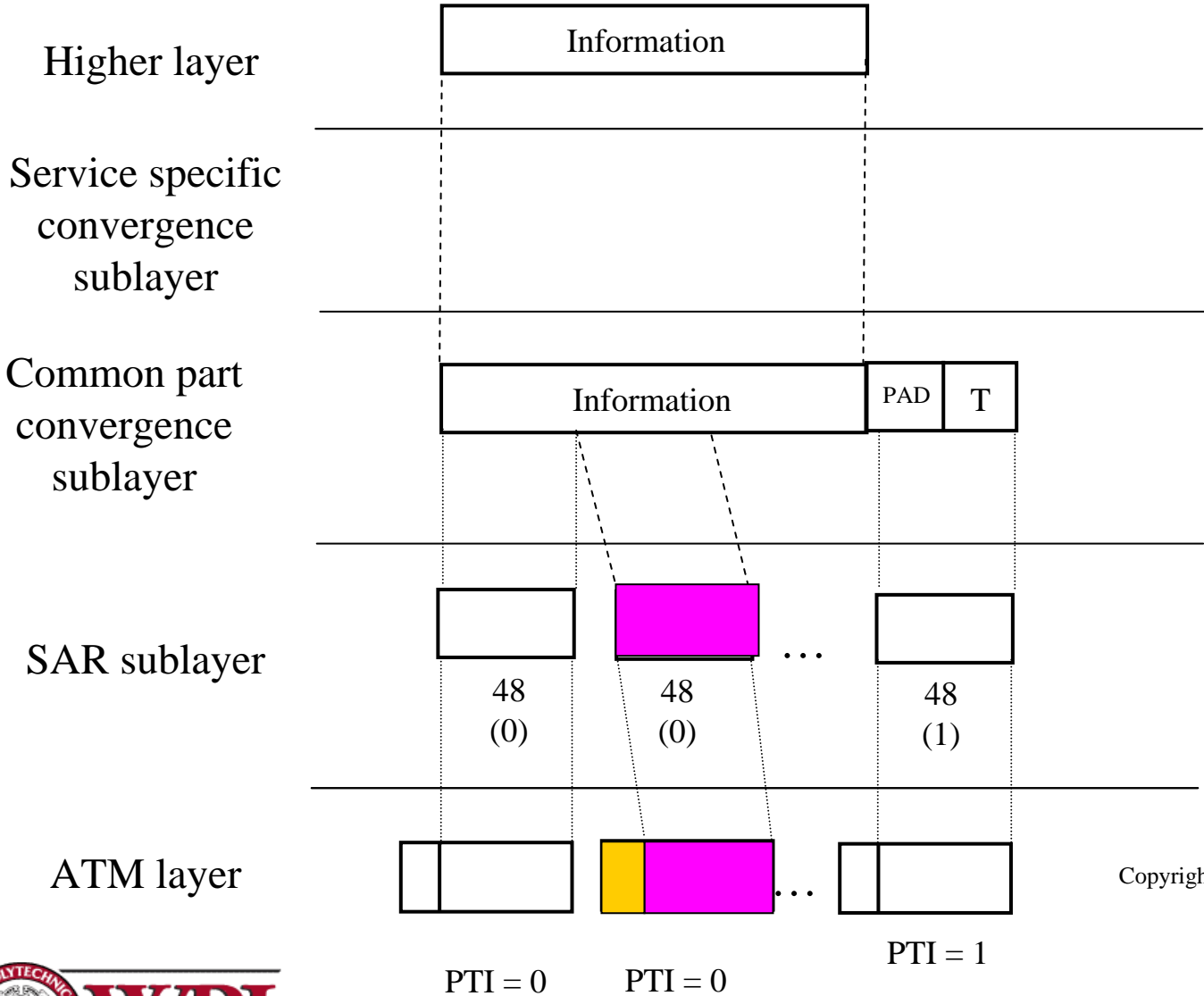
SAR Format



↑ 1-bit end-of-datagram field (PTI)



AAL 5



Assume null

Figure 9.18

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