ATM

Asynchronous Transfer Mode

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"

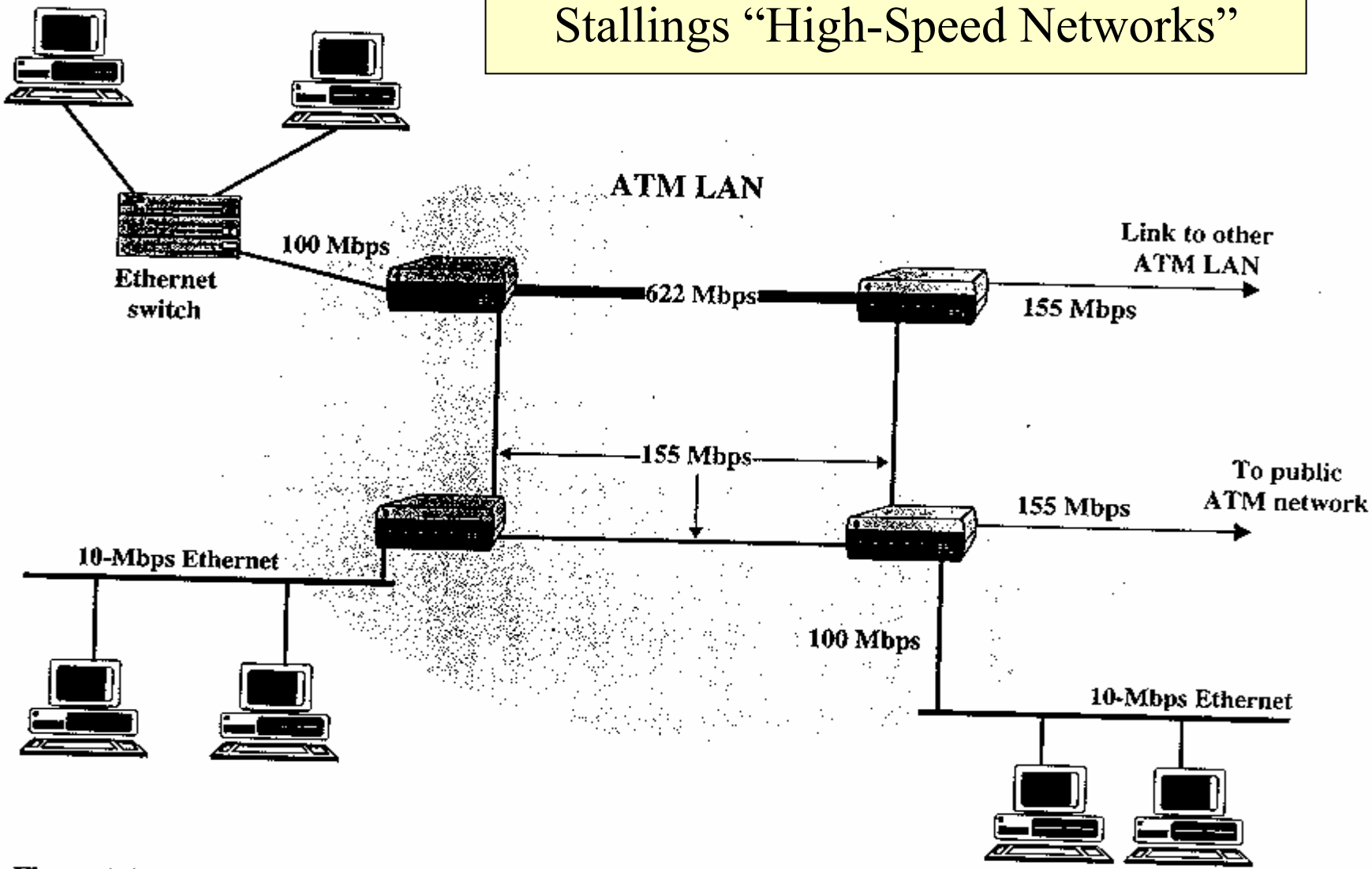


Figure 5.9 Example ATM LAN configuration.

Stallings "High-Speed Networks"

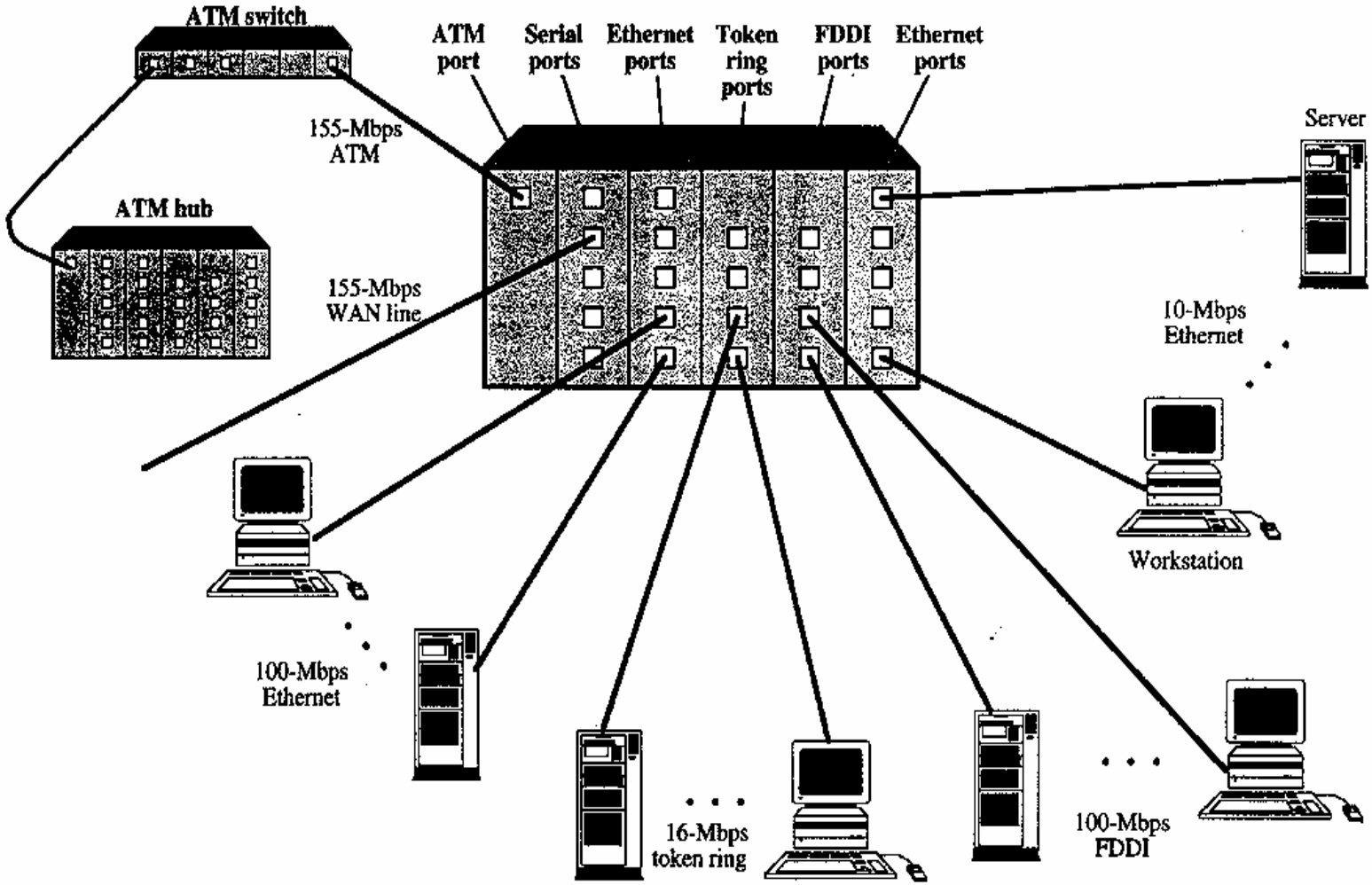
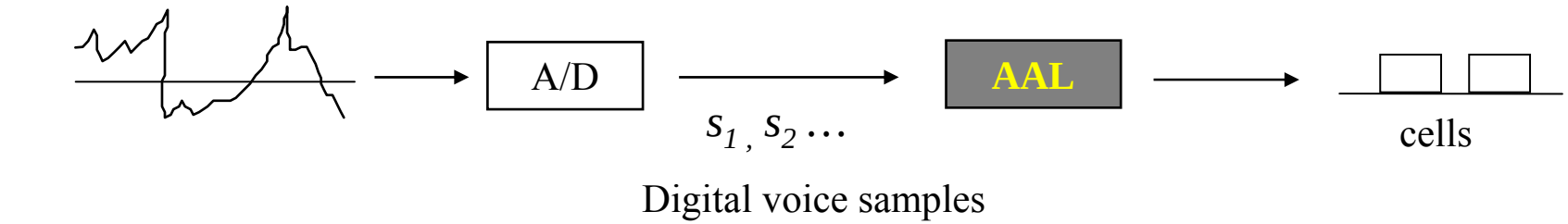
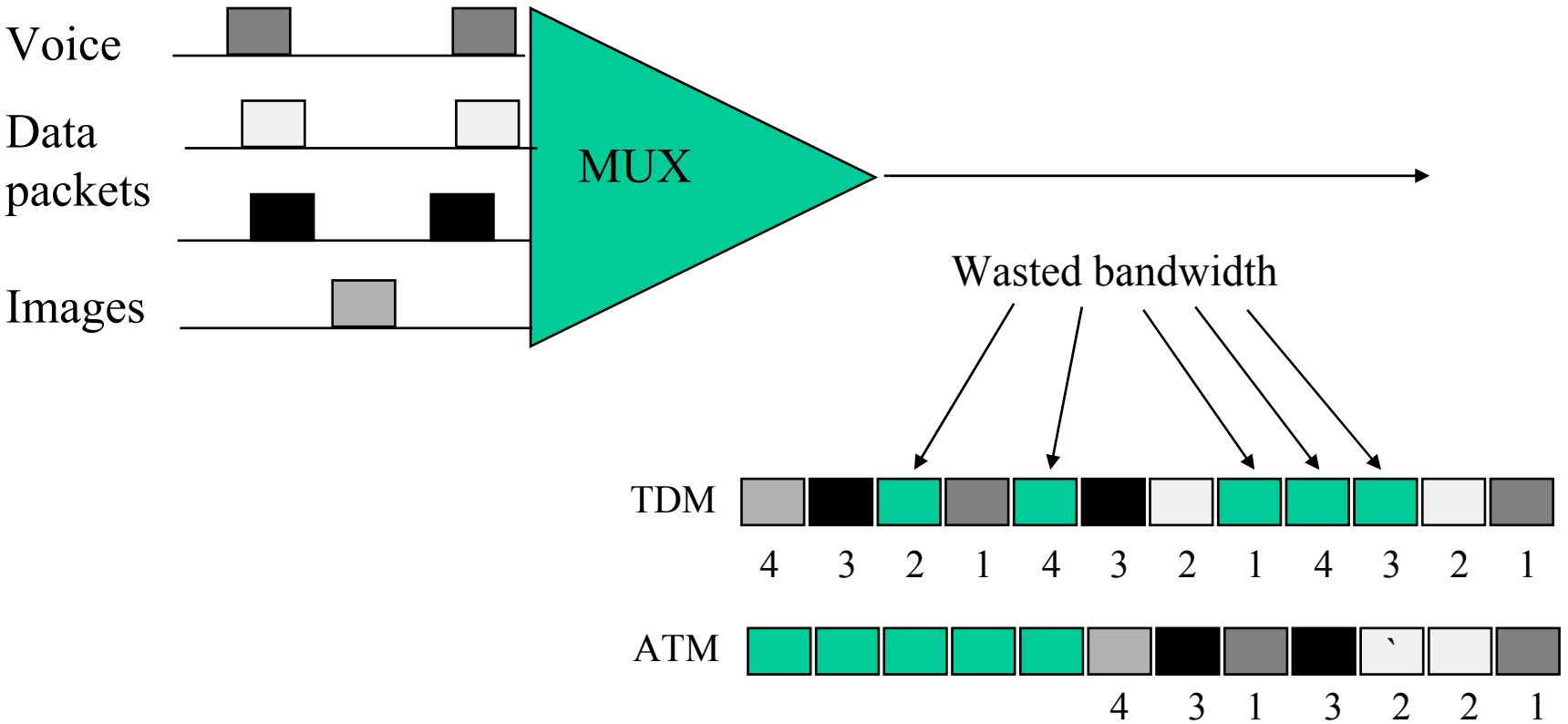


Figure 5.10 ATM LAN hub configuration.

ATM Adaptation Layers

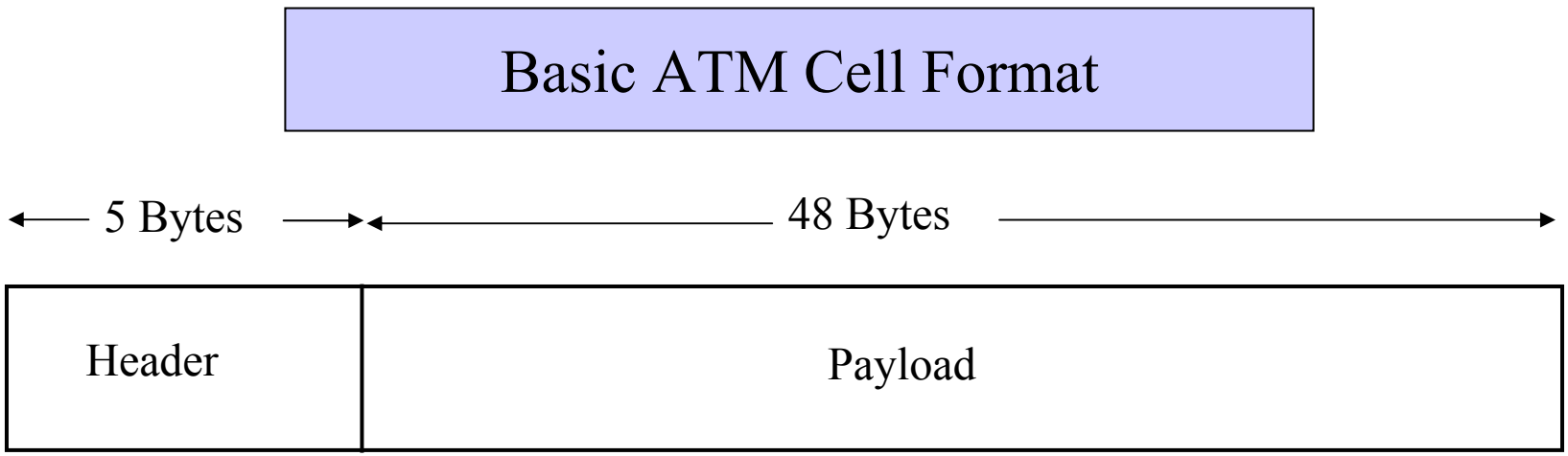


Asynchronous Transfer Mode (ATM)



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. [to facilitate hardware switches]



ATM Conceptual Model
Four Assumptions

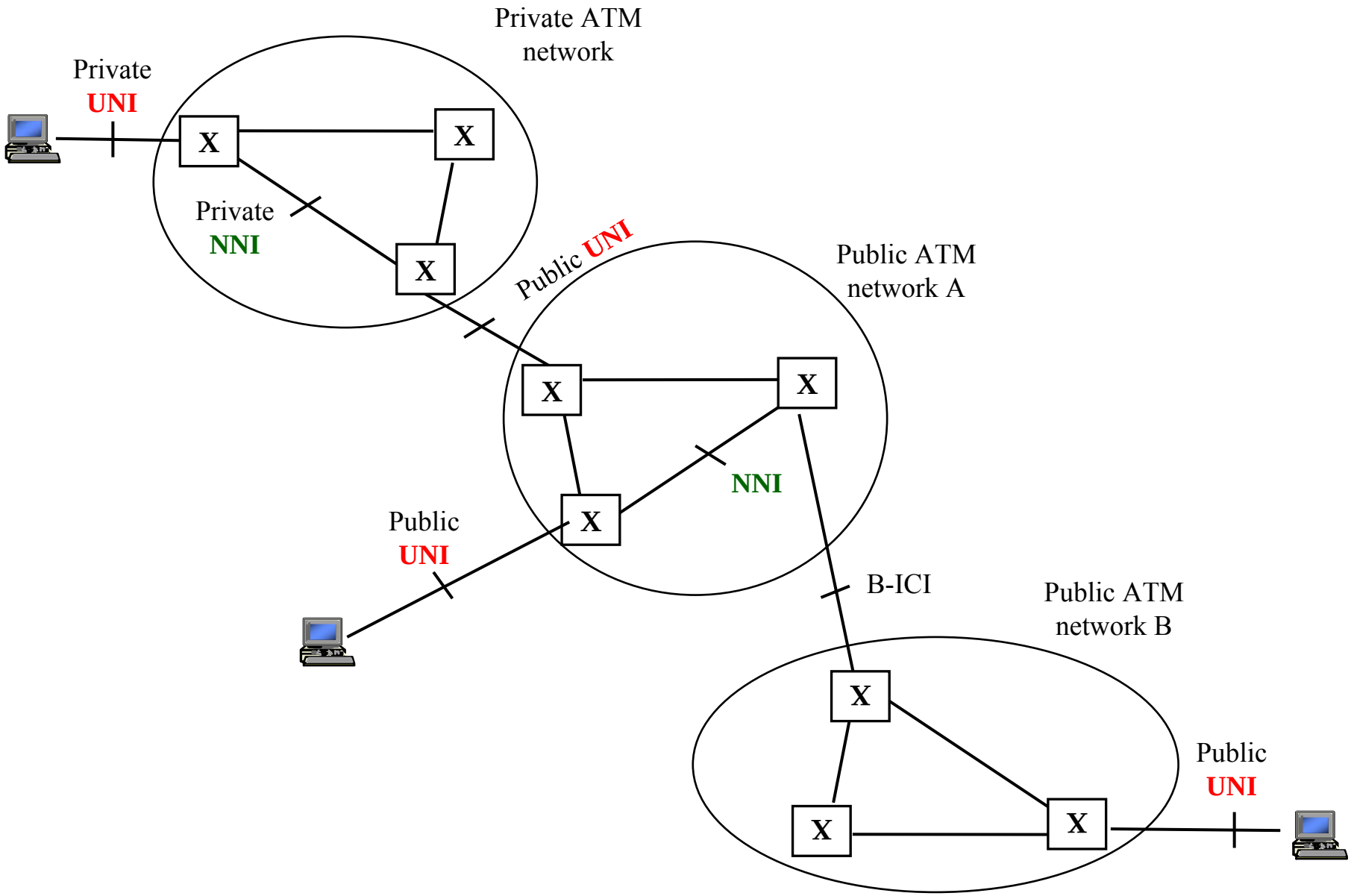
1. ATM network will be organized as a hierarchy.

   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. [The connection setup phase is called *signaling*.]



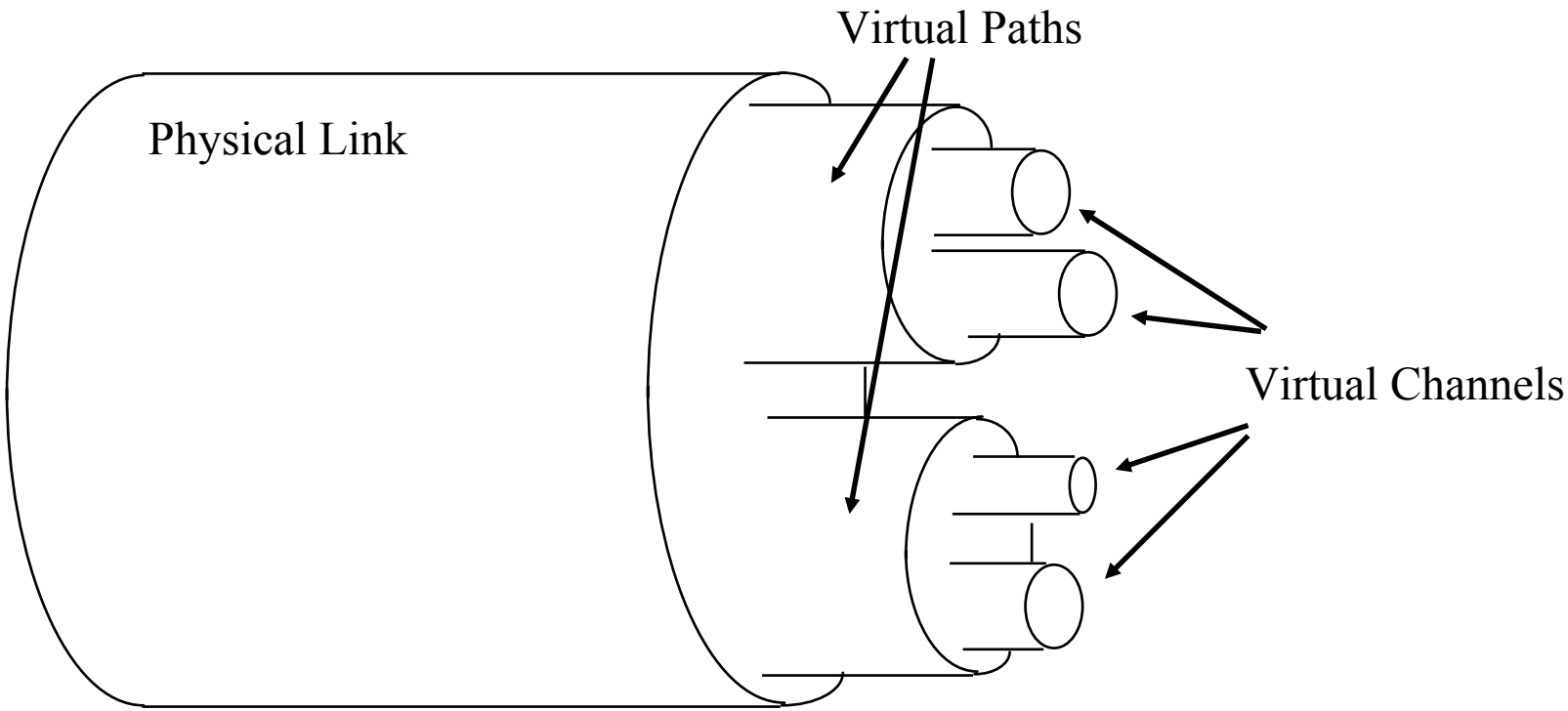
ATM Connections

- 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 supports low cost attachments
   - This decision lead to a significant decision – to prohibit cell reordering in ATM networks.

   ➔ ATM switch design is more difficult.

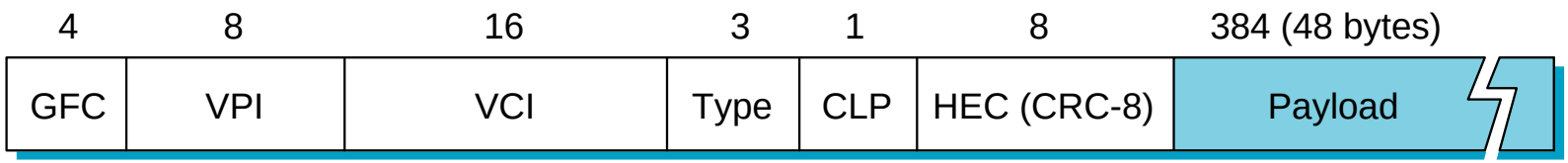


Figure 3.16 ATM Cell Format at the UNI

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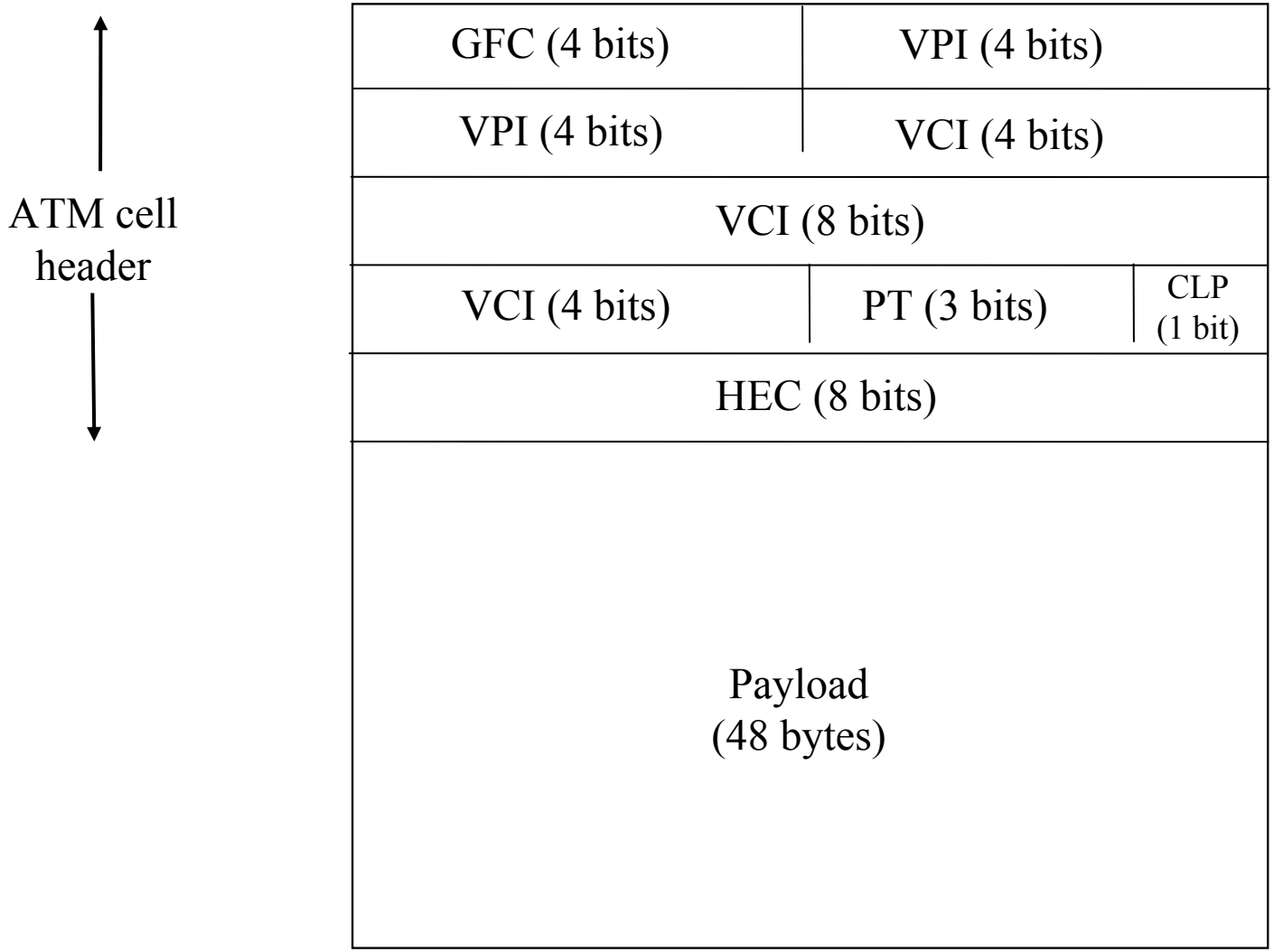
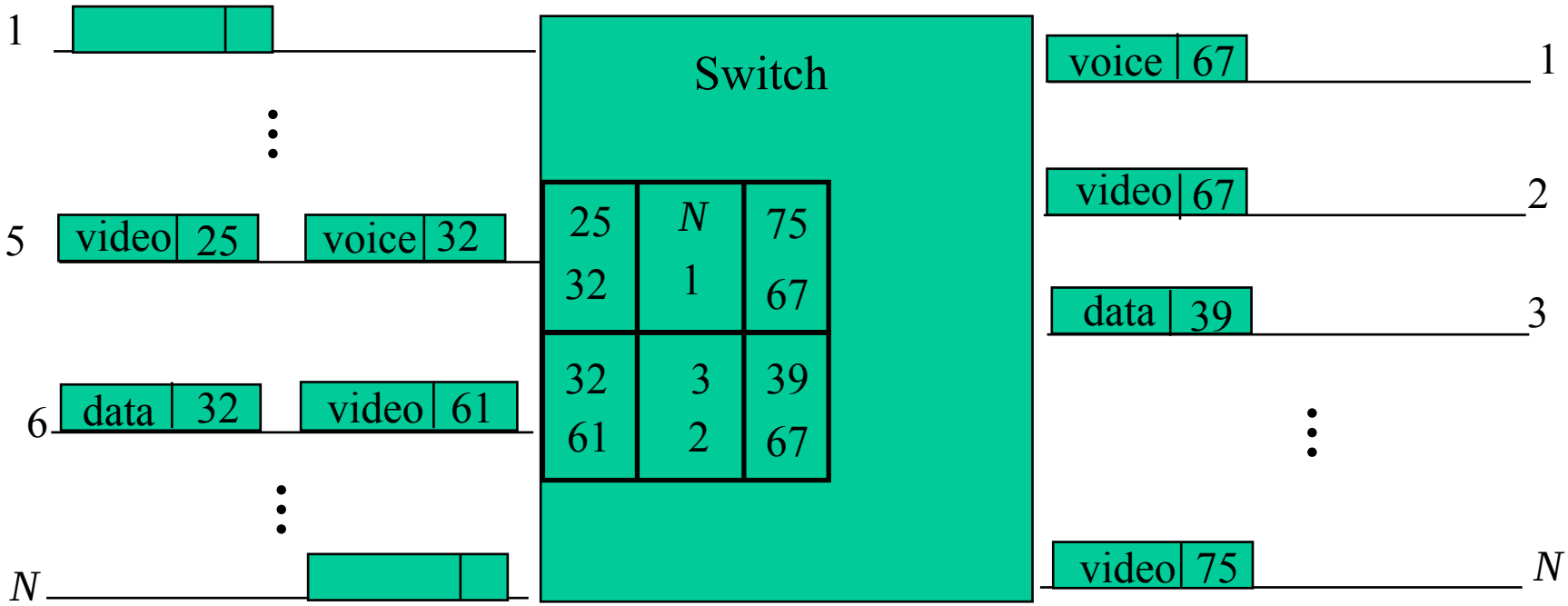
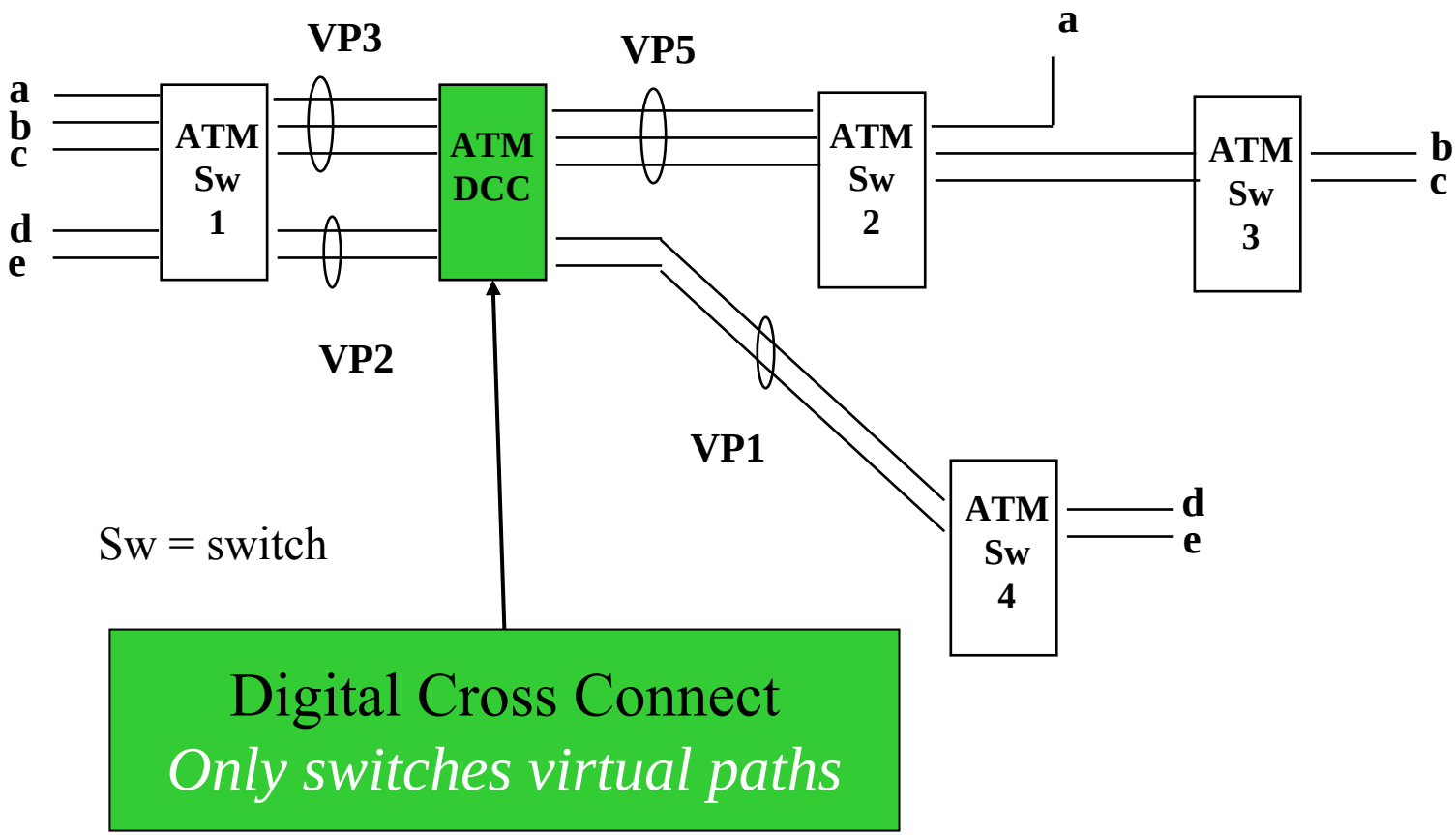
UNI Cell Format



ATM Cell Switching

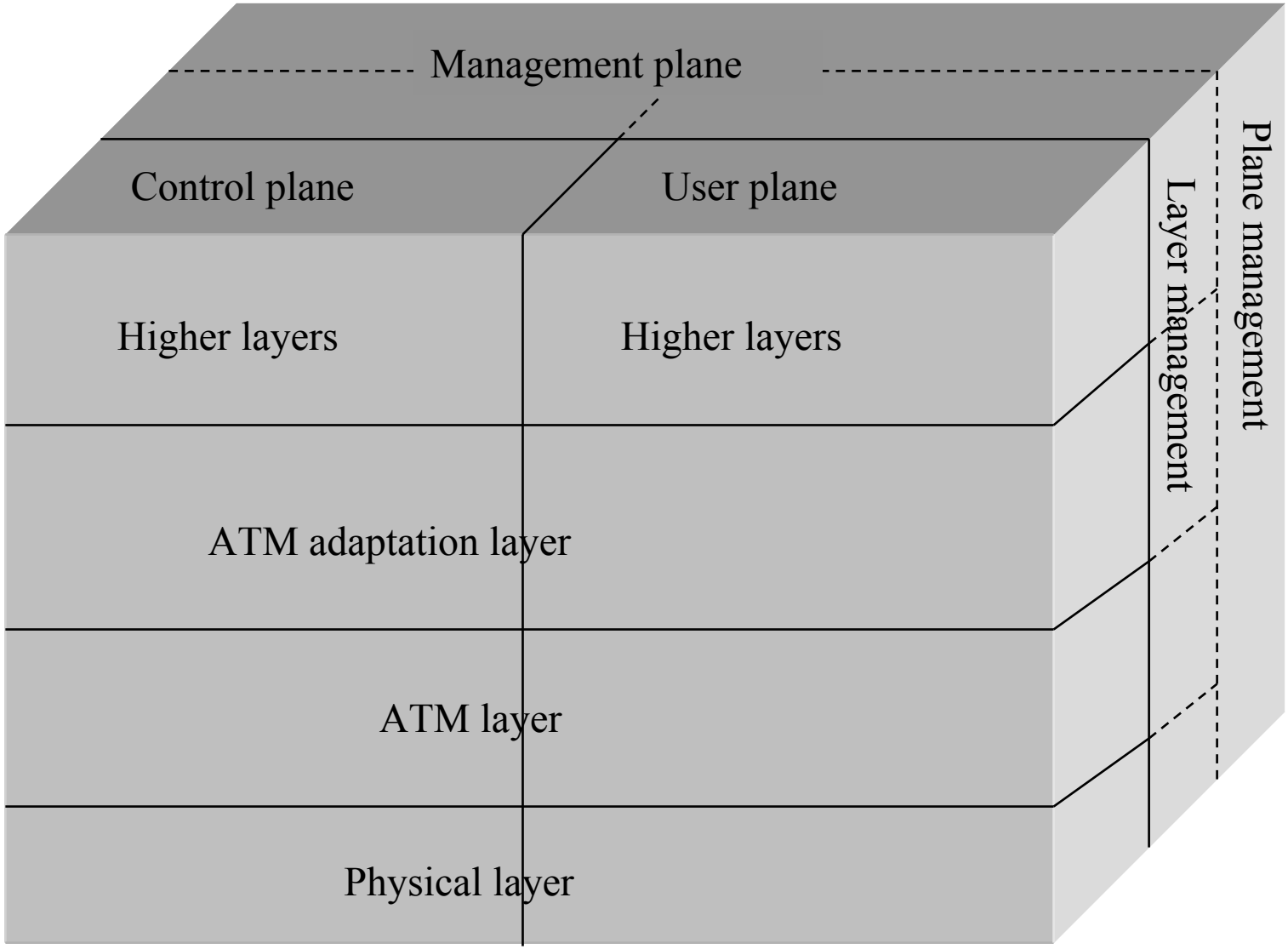


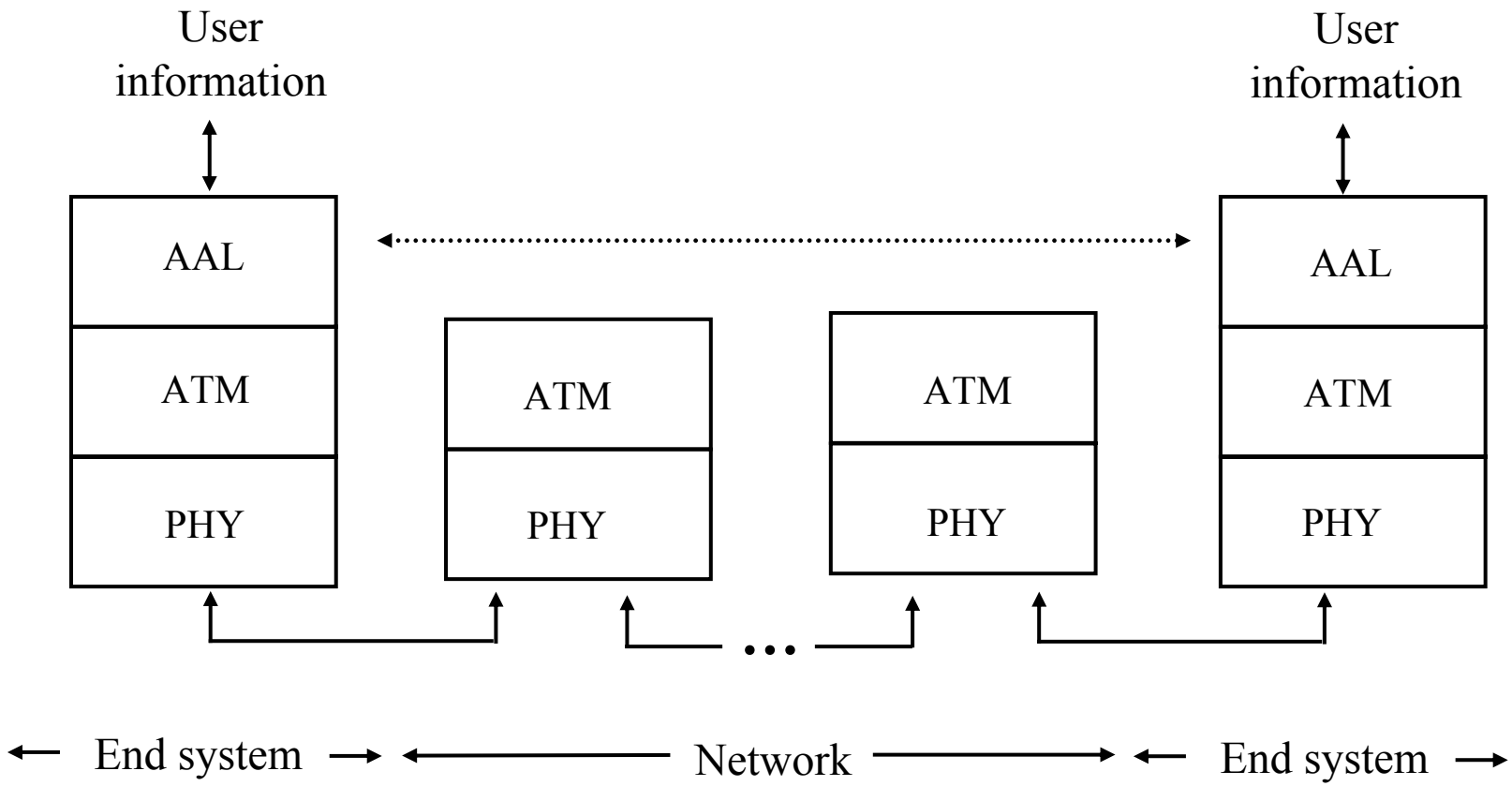


ATM Protocol Architecture

- 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:

Convergence Sublayer (CS)

manages the flow of data to and from SAR sublayer.

Segmentation and Reassembly Sublayer (SAR)

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

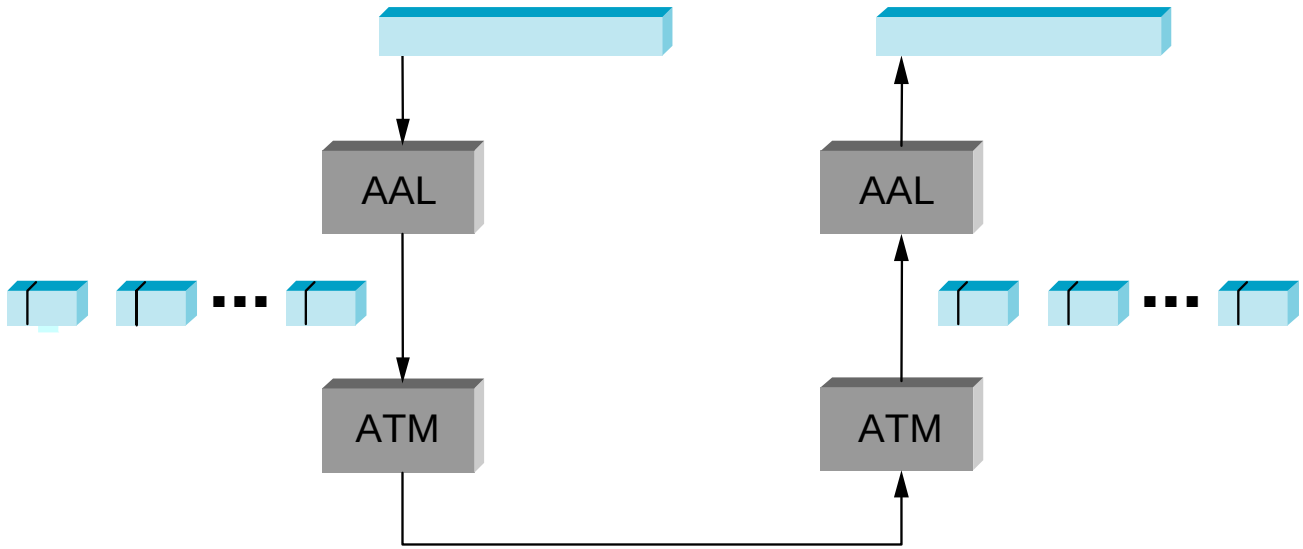
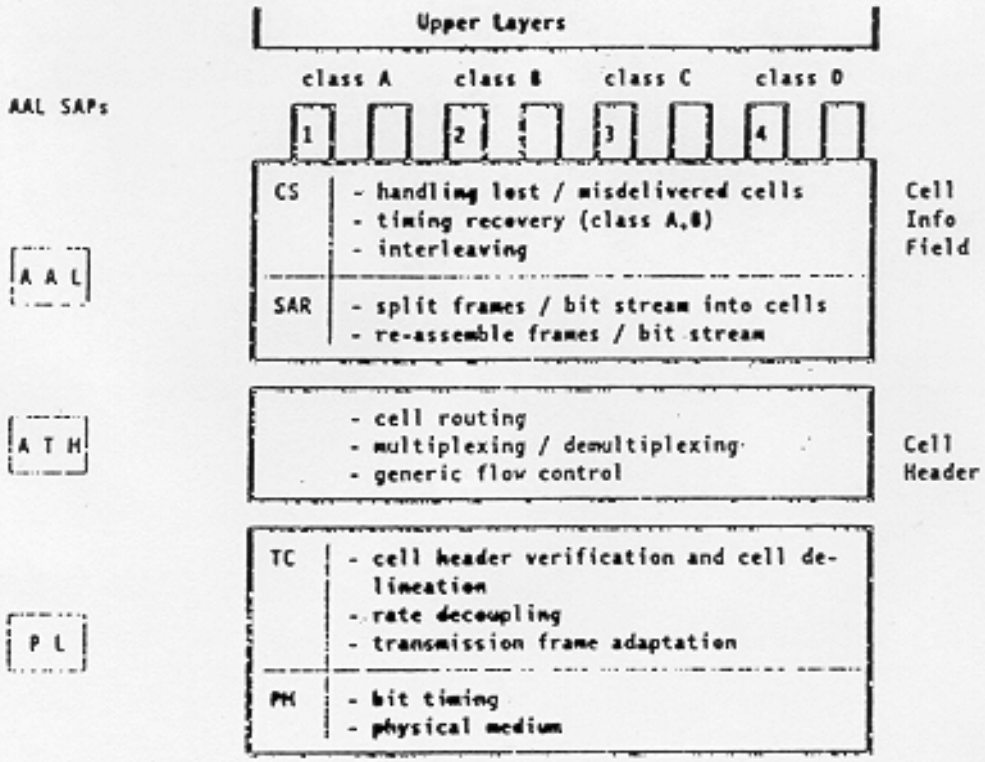


Figure 3.17 Segmentation and Reassembly in ATM

P&D slide

Original ATM Architecture



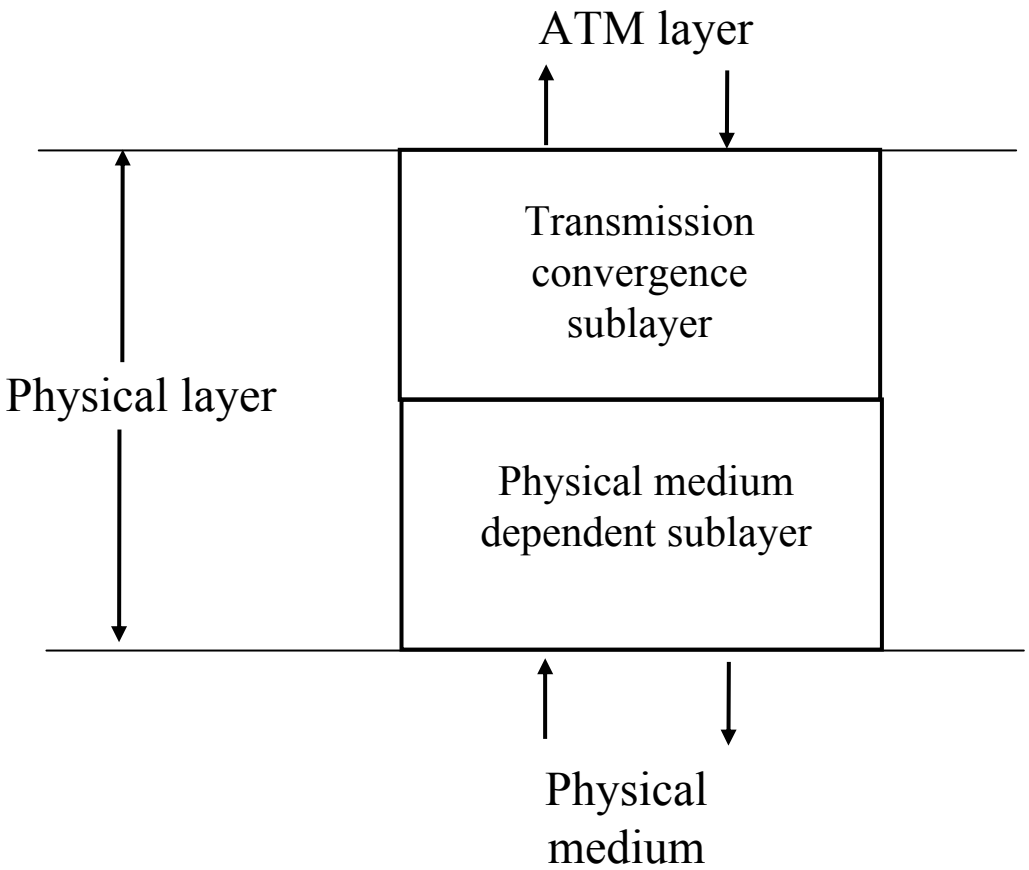
Abbreviations

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

SERVICE CLASSES for AAL

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

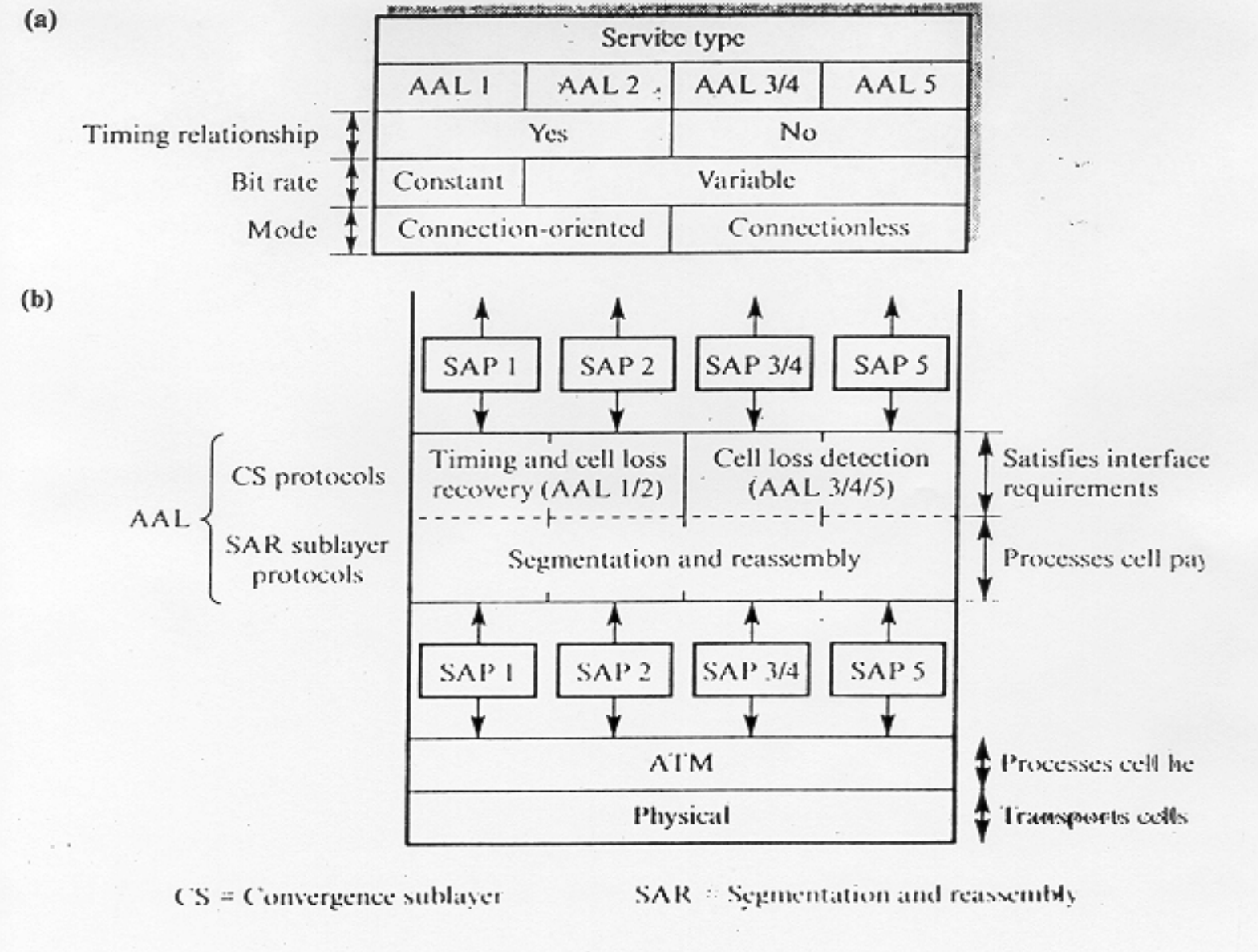
I. Protocol Reference Model in the User Plane. See Section 4.1 for AAI SAP classes (A to D) and values (1 to 4).



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



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

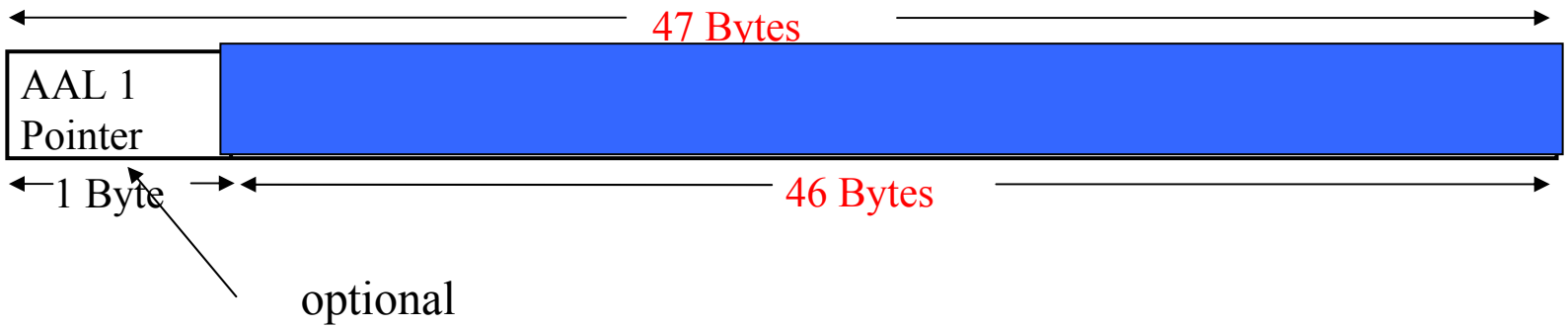
- Quality of Service (QoS) requirements are handled at connection time and viewed as part of *signaling*.
- ATM provides permanent virtual connections and switched virtual connections.
  - Permanent Virtual Connections (PVC)

    permanent connections set up *manually* by network manager.
  - Switched Virtual Connections (SVC)

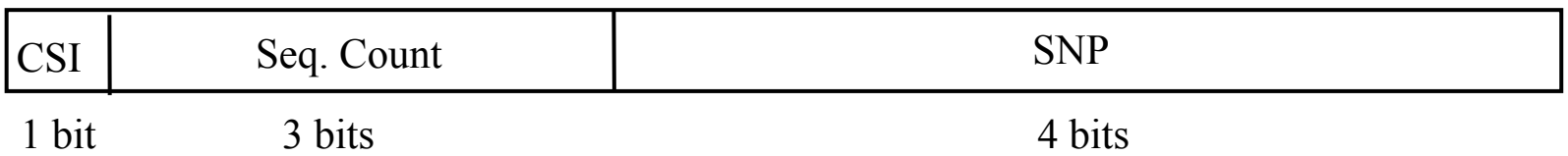
    set up and released *on demand* by the end user via signaling procedures.

AAL 1 Payload

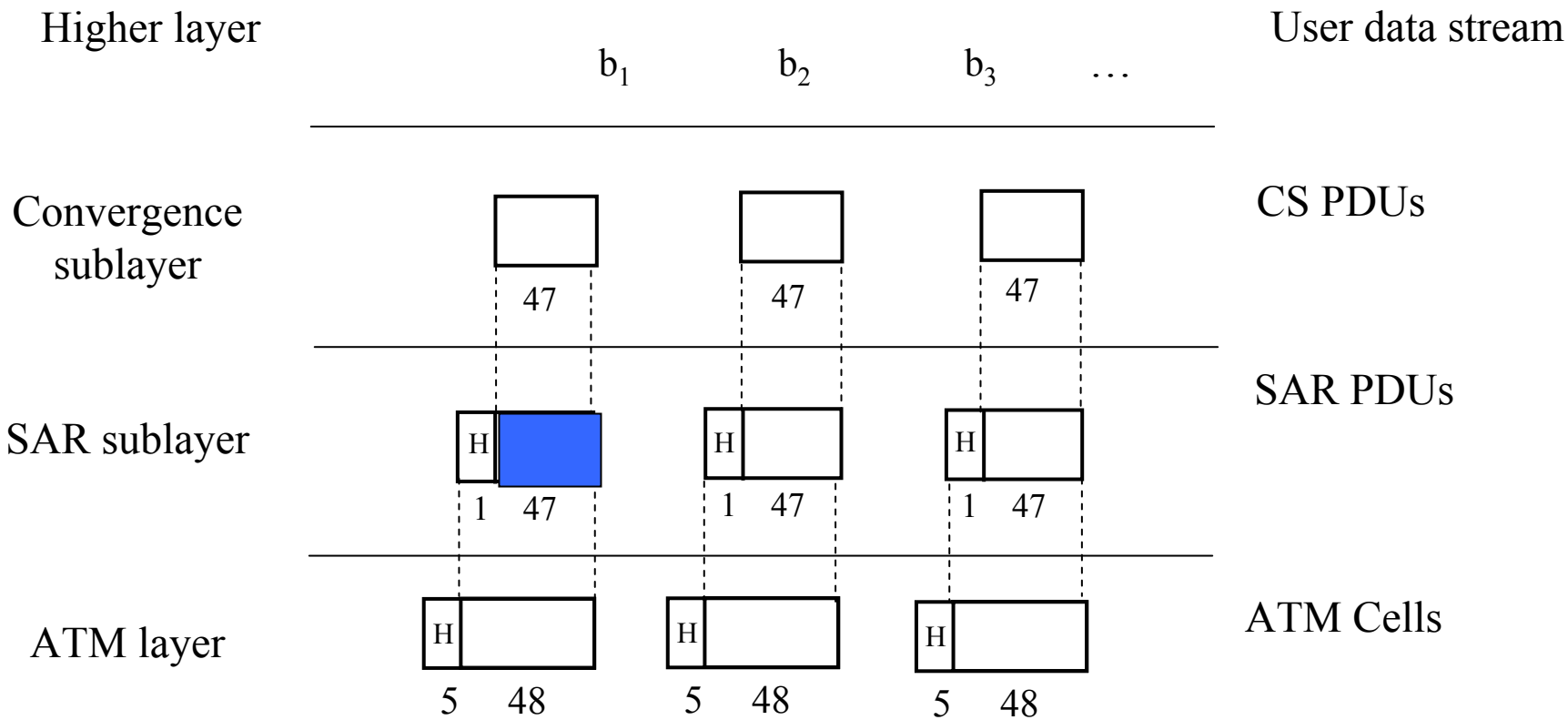
(b) CS PDU with pointer in structured data transfer



(a) SAR PDU header

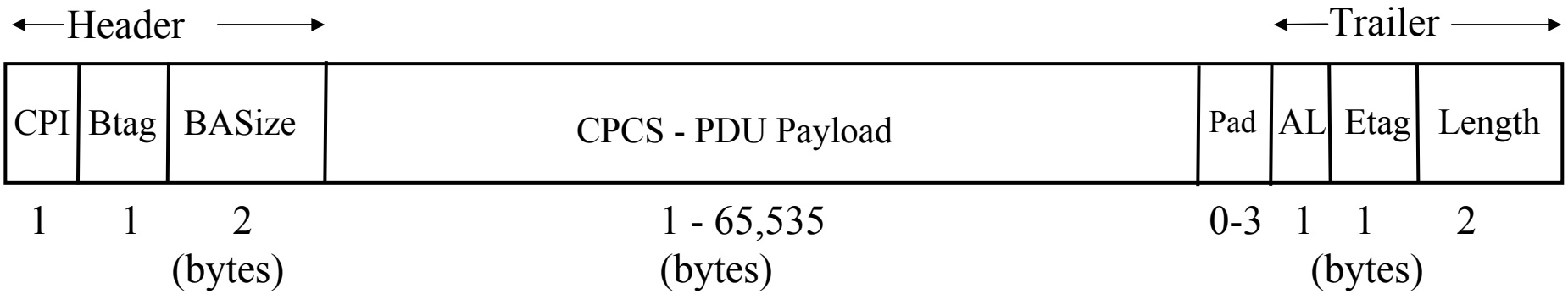


AAL 1



Convergent Sublayer PDUs

(a) CPCS-PDU format



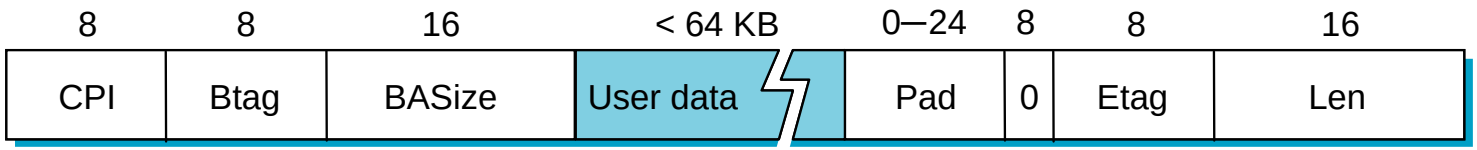
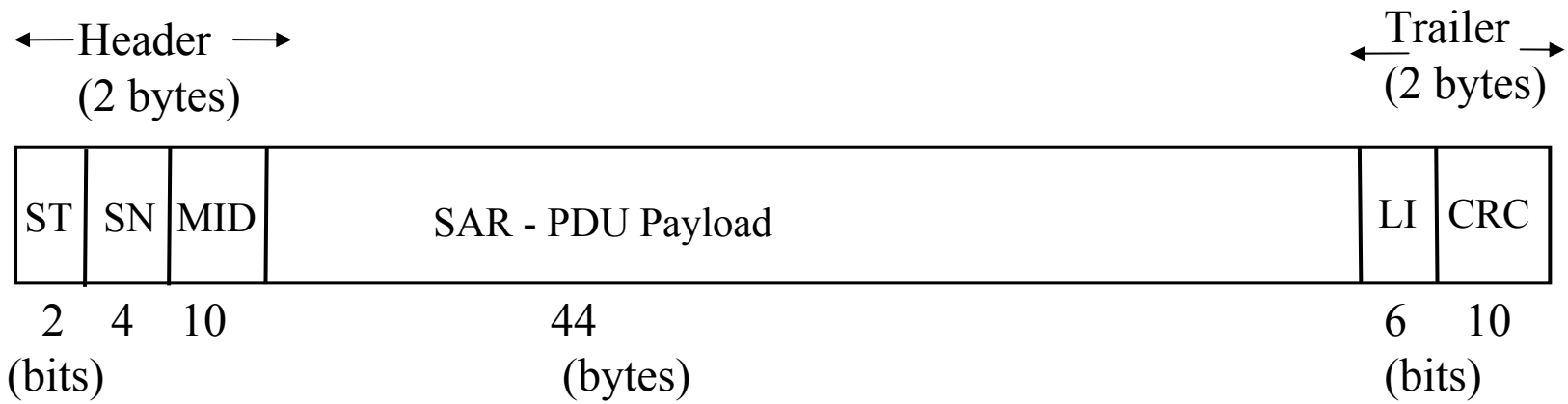


Figure 3.18 AAL 3/4

P&D slide

Segmentation and Assembly PDU

(b) SAR PDU format



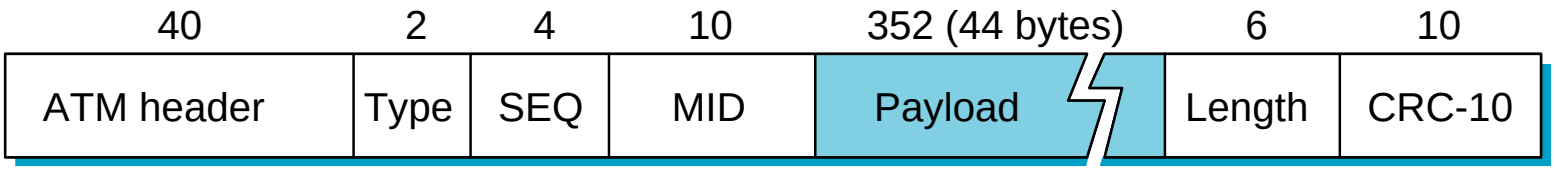


Figure 3.19 AAL 3/4

P&D slide

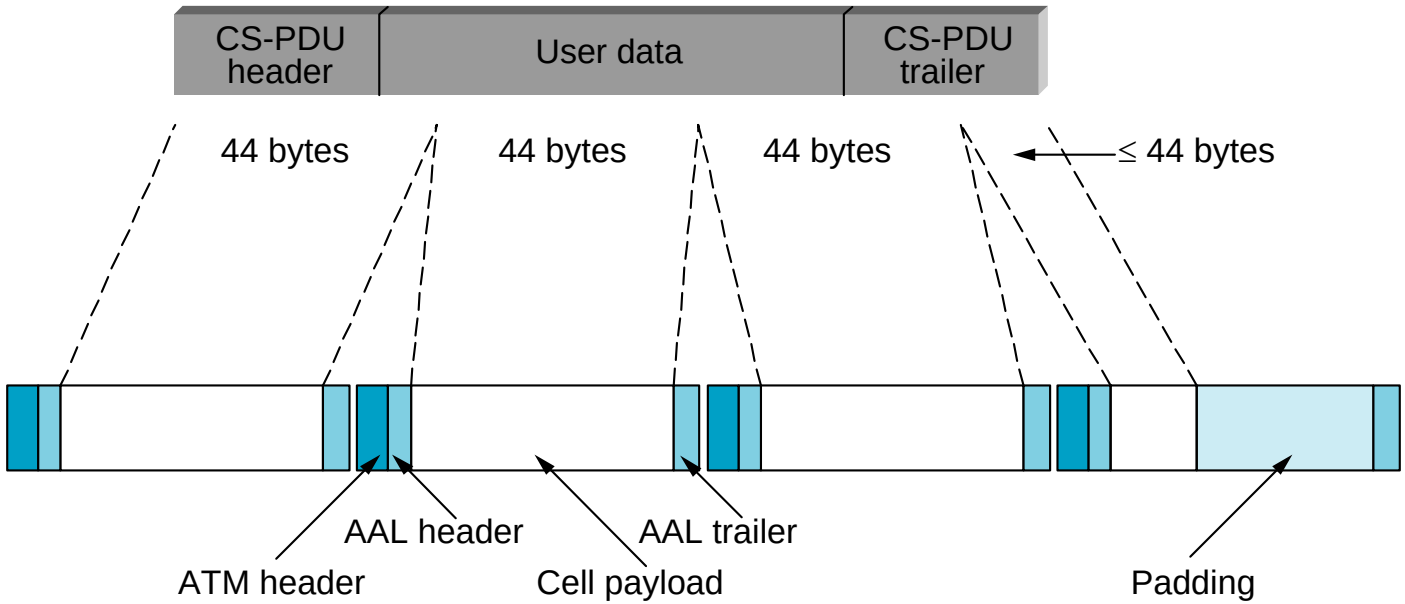


Figure 3.20 Encapsulation and Segmentation for AAL3/4

P&D slide

AAL 3/4

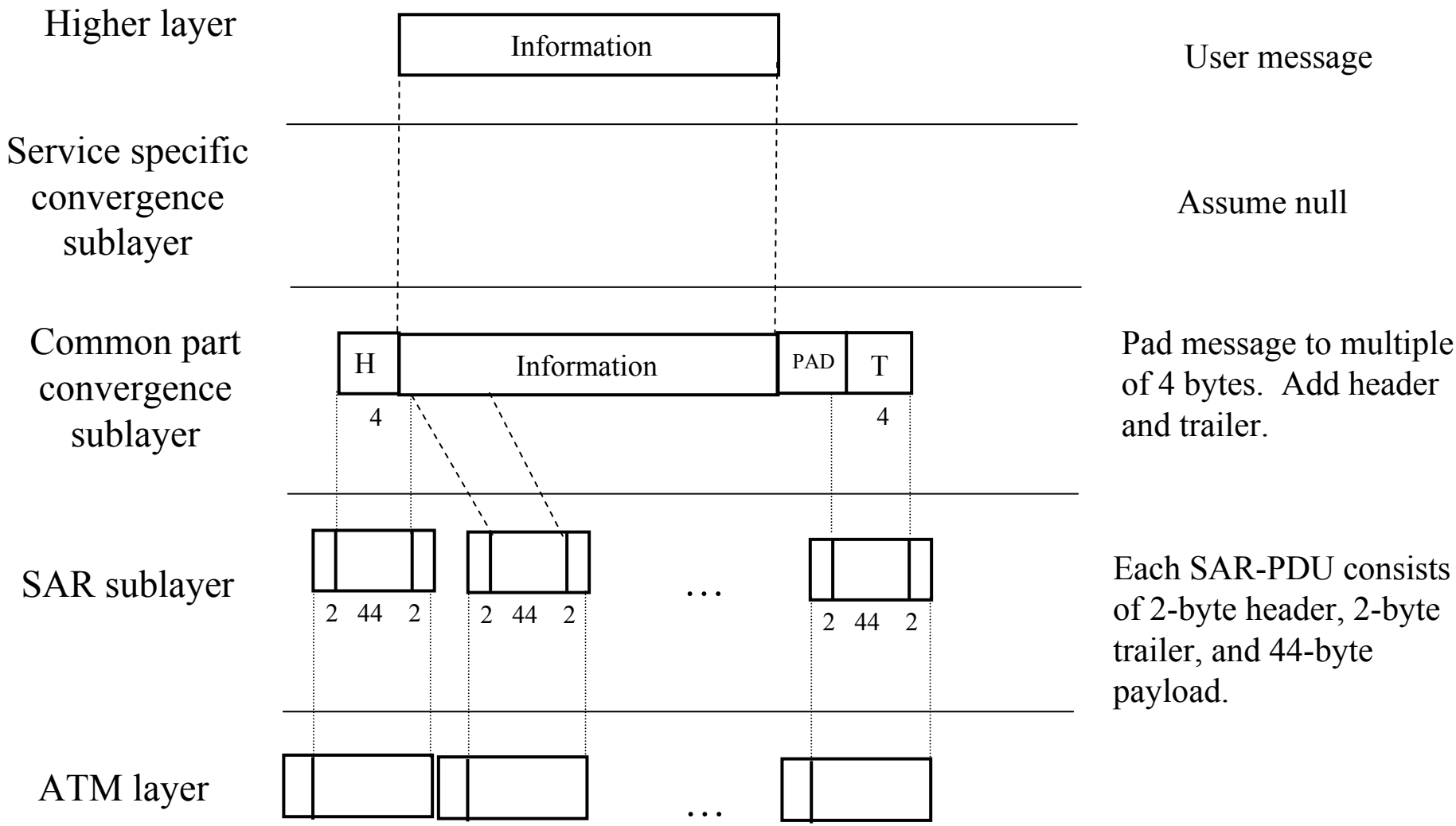
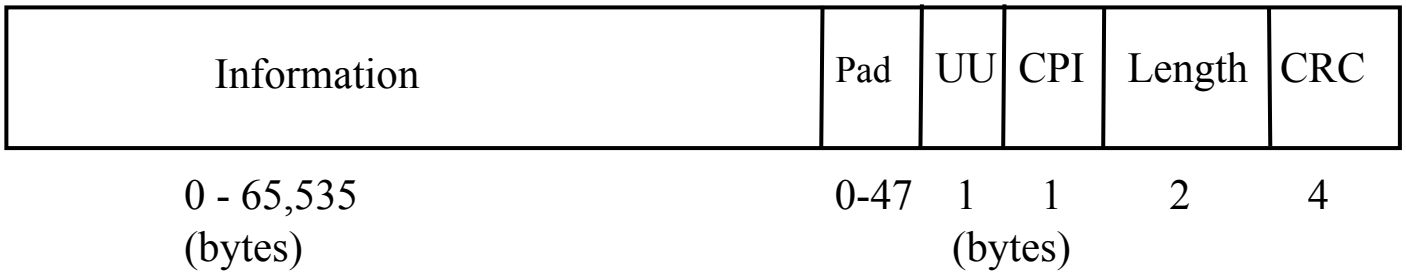


Figure 9.15

AAL 5 Convergent Sublayer Format



Leon-Garcia & Widjaja: *Communication Networks*
Figure 9.19

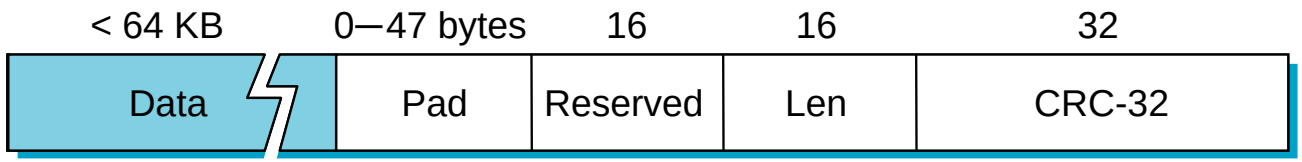
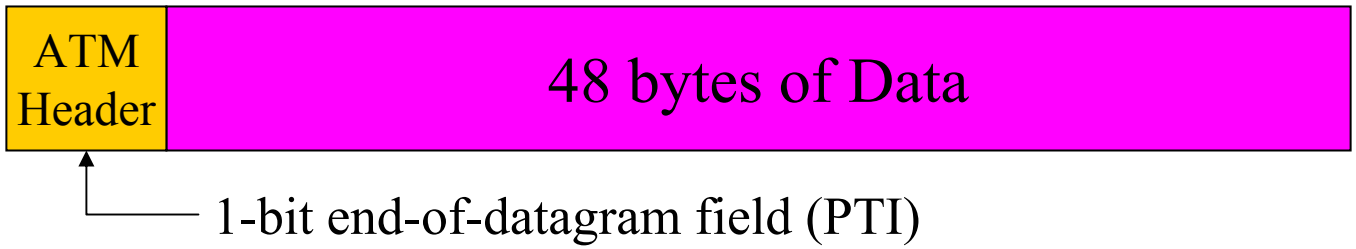


Figure 3.21 ATM Adaptation Layer 5

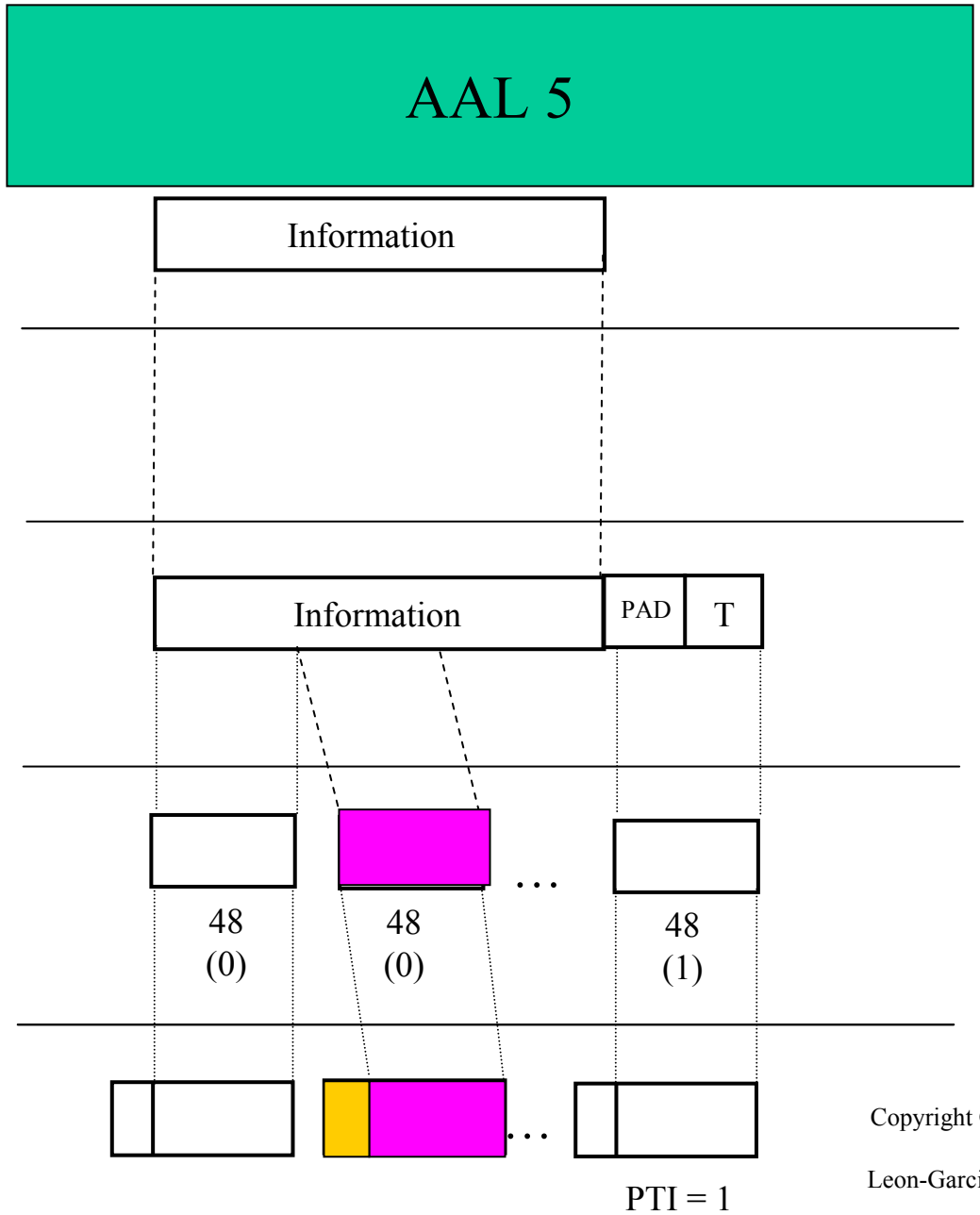
P&D slide

AAL 5 SAR Format



Leon-Garcia & Widjaja: *Communication Networks*

Figure 9.19



Assume null

Figure 9.18

Leon-Garcia & Widjaja: *Communication Networks*

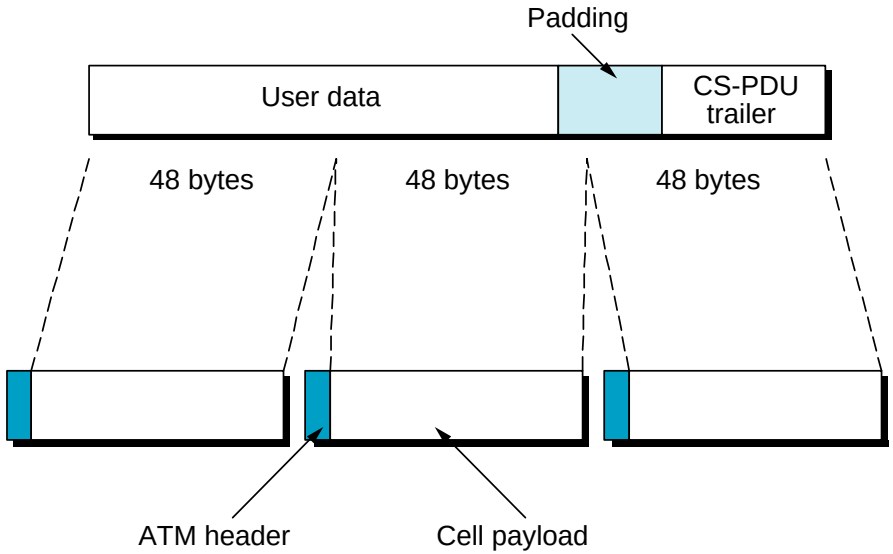


Figure 3.22 Encapsulation and Segmentation for AAL5

P&D slide

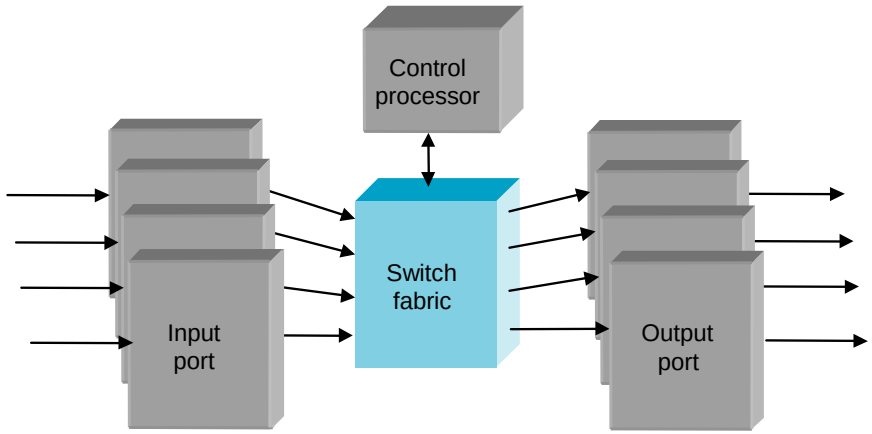


Figure 3.28 ATM Switch

P&D slide

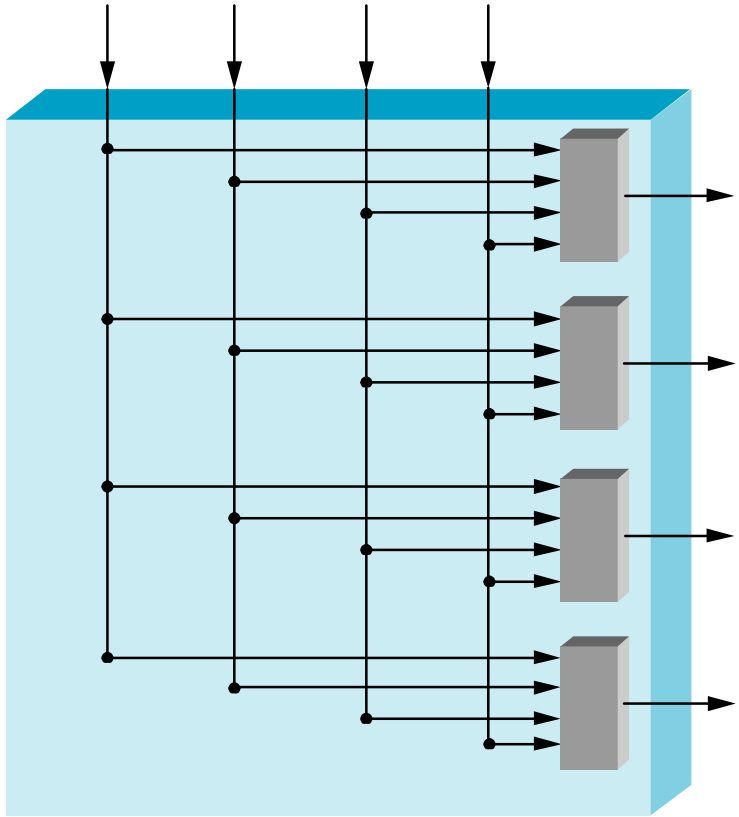
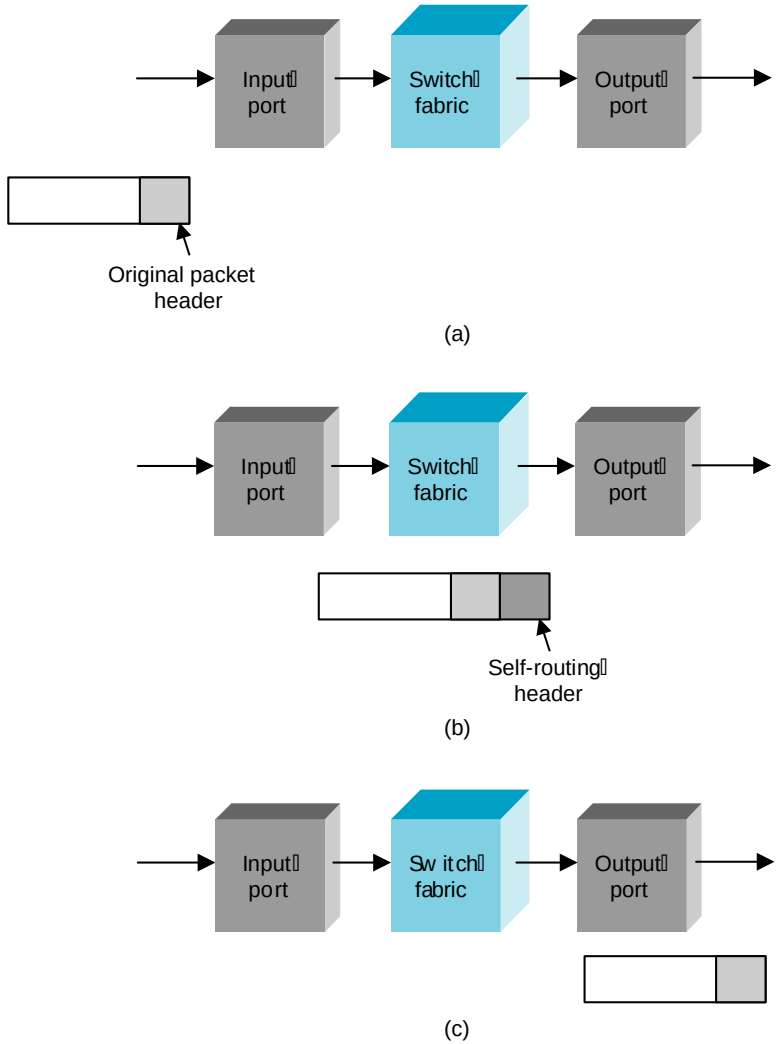


Figure 3.30 4 x 4 Crossbar Switch

P&D slide

Figure 3.31

Self-Routing Headers



P&D slide

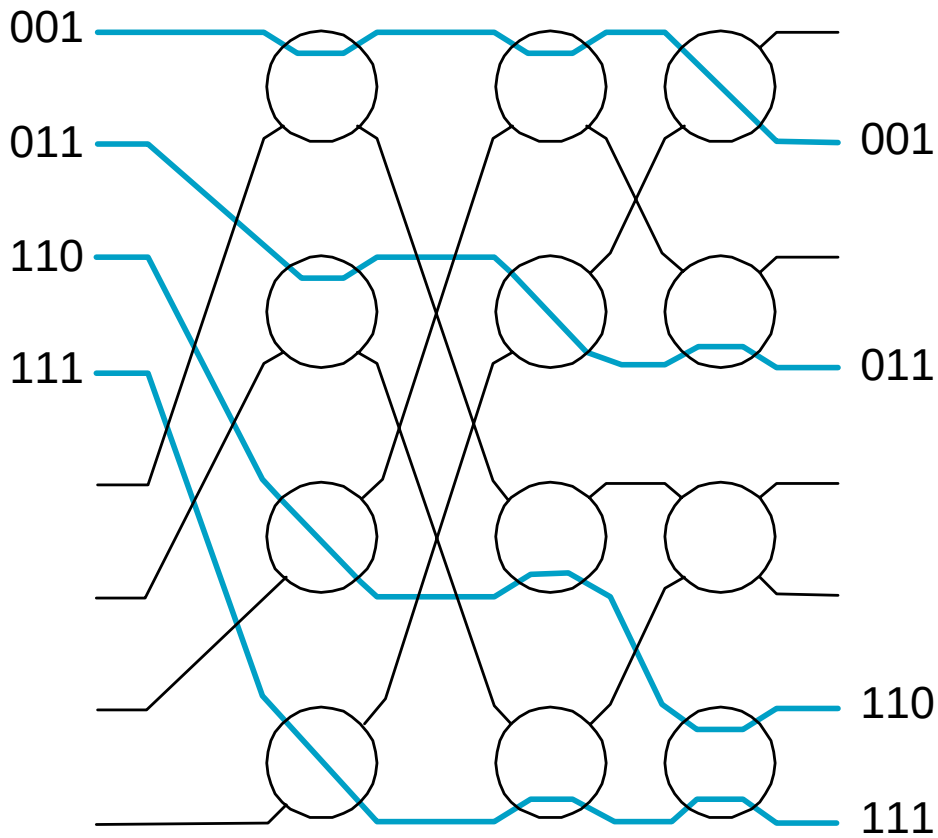


Figure 3.32 Banyan Switching

P&D slide