ETSF05
Internetprotokoll
SONET/SDH
ATM

Föreläsning 2

Jens Andersson

Figure 4.31 *Data transmission and modes*

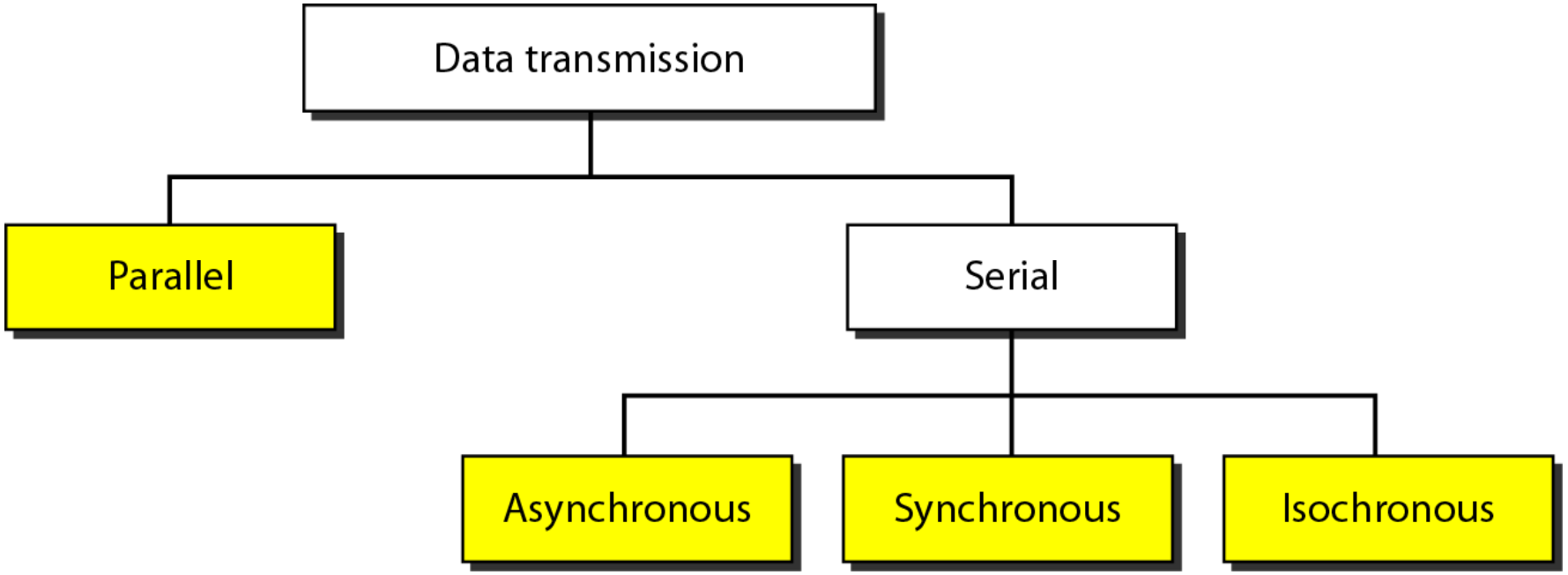


Figure 4.32 *Parallel transmission*

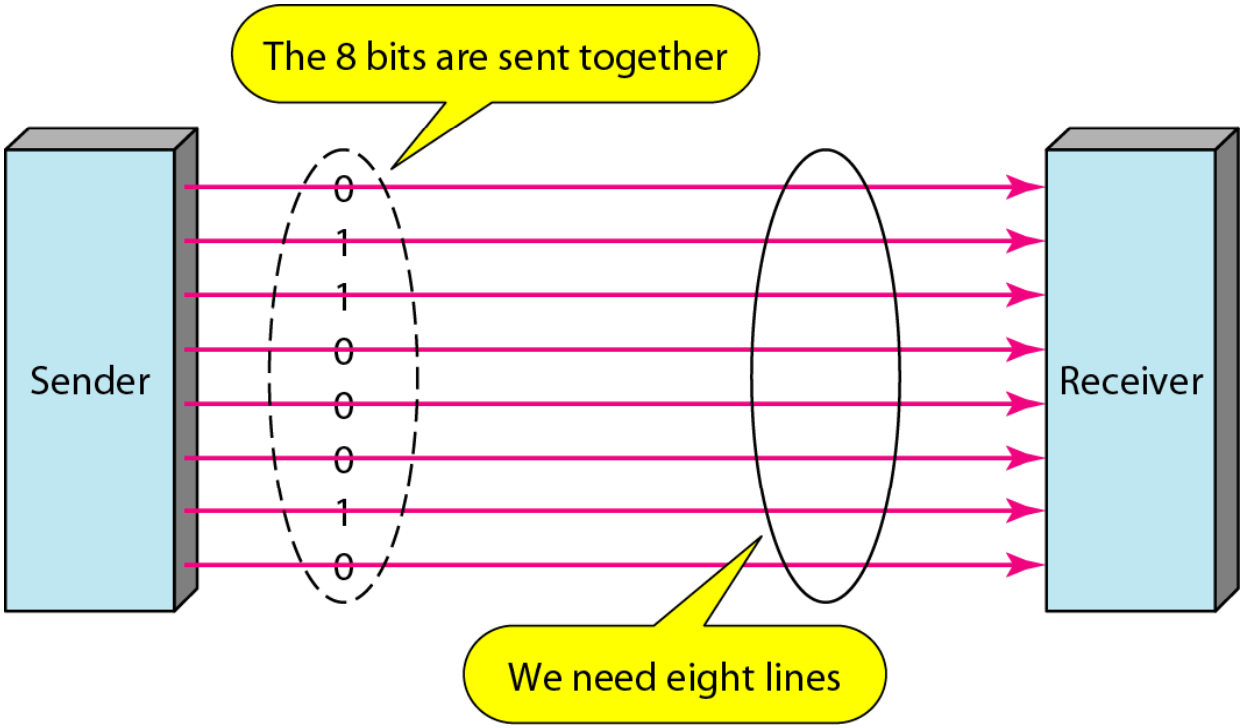


Figure 4.33 *Serial transmission*

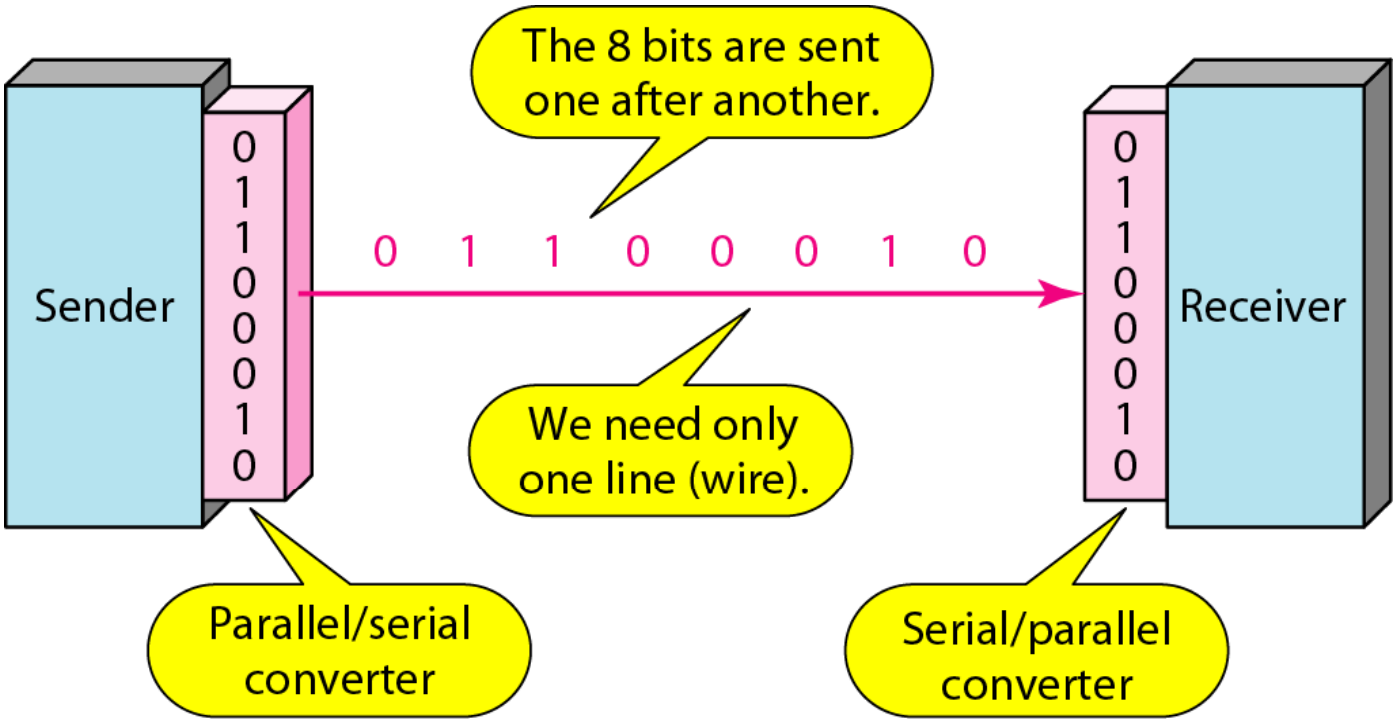


Figure 4.34 *Asynchronous transmission*

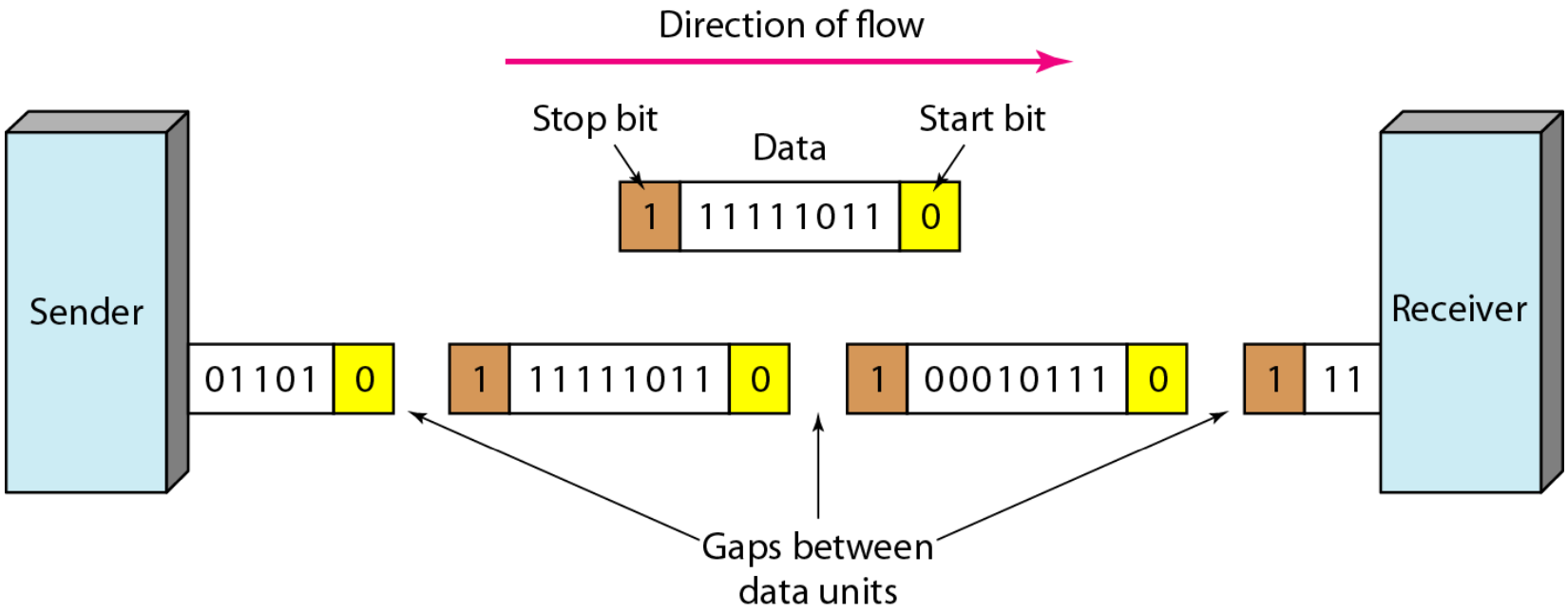
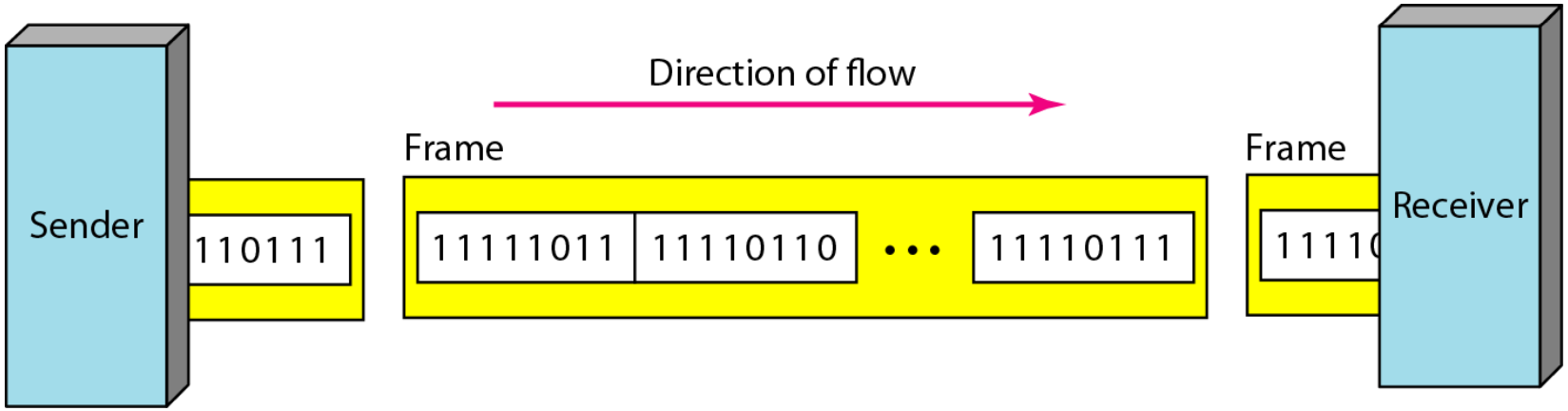


Figure 4.35 *Synchronous transmission*

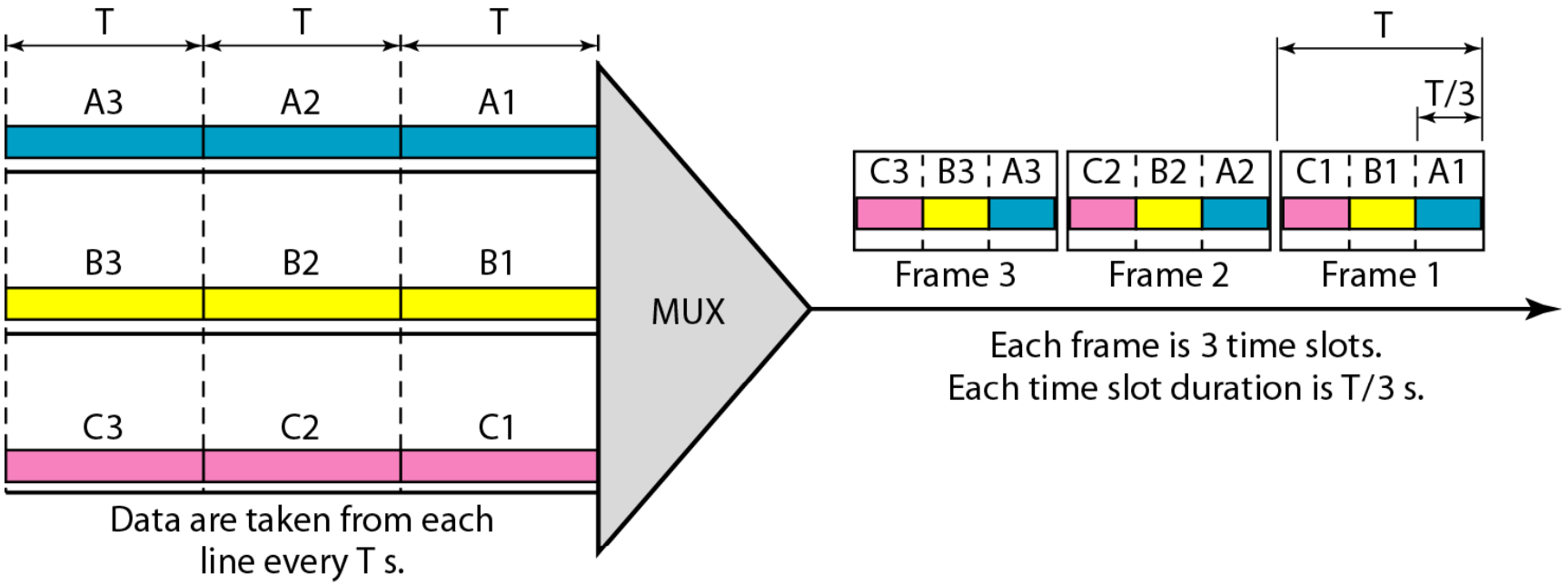


Isochronous transmission

- Exempelvis realtids audio/video
- Synkronisering av enstaka tecken/byte inte tillräckligt
- Hela bitströmmen måste synkroniseras

- Alternativet är buffring vilket medför fördröjning

Figure 6.13 *Synchronous time-division multiplexing*



Digital Hierarchy

- TDM i telefonnät
- Digital Signal (DS) Service
- Utgångspunkt = digitala telefonsignaler

Figure 6.24 *T-1 line for multiplexing telephone lines*

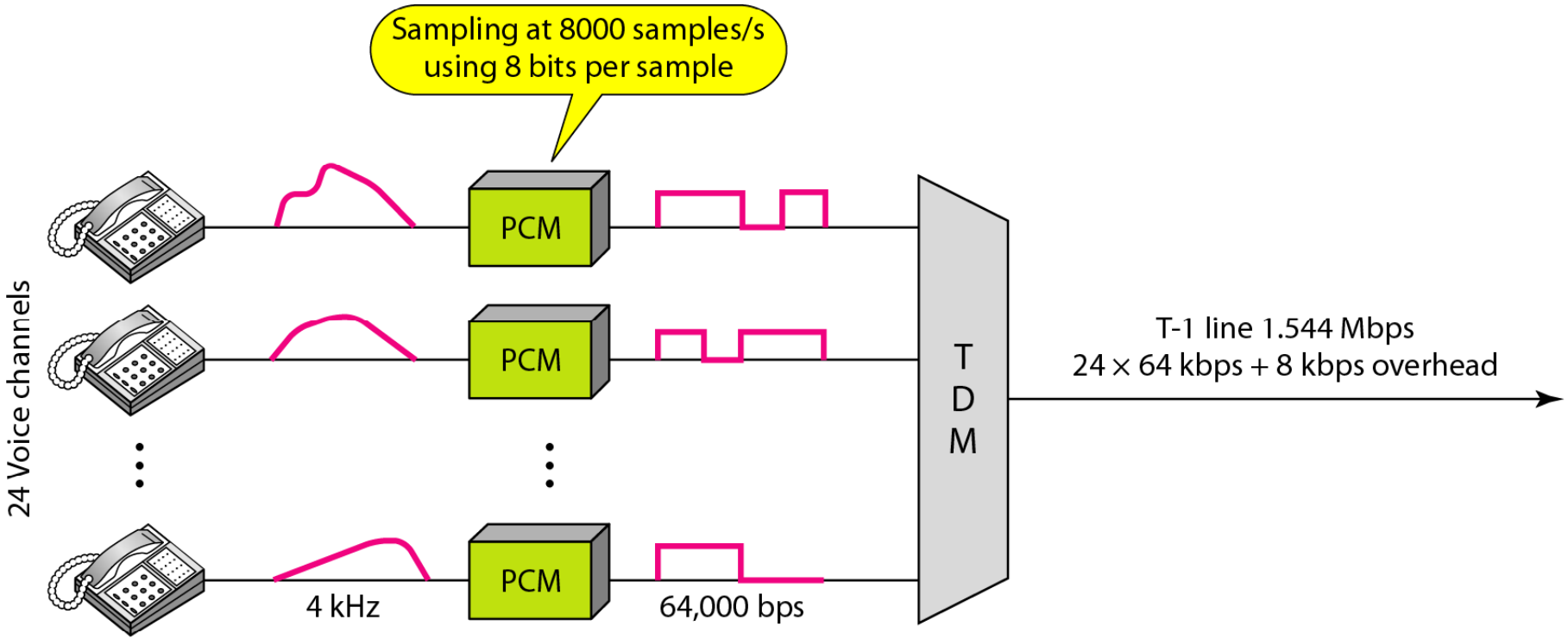


Figure 6.25 *T-1 frame structure*

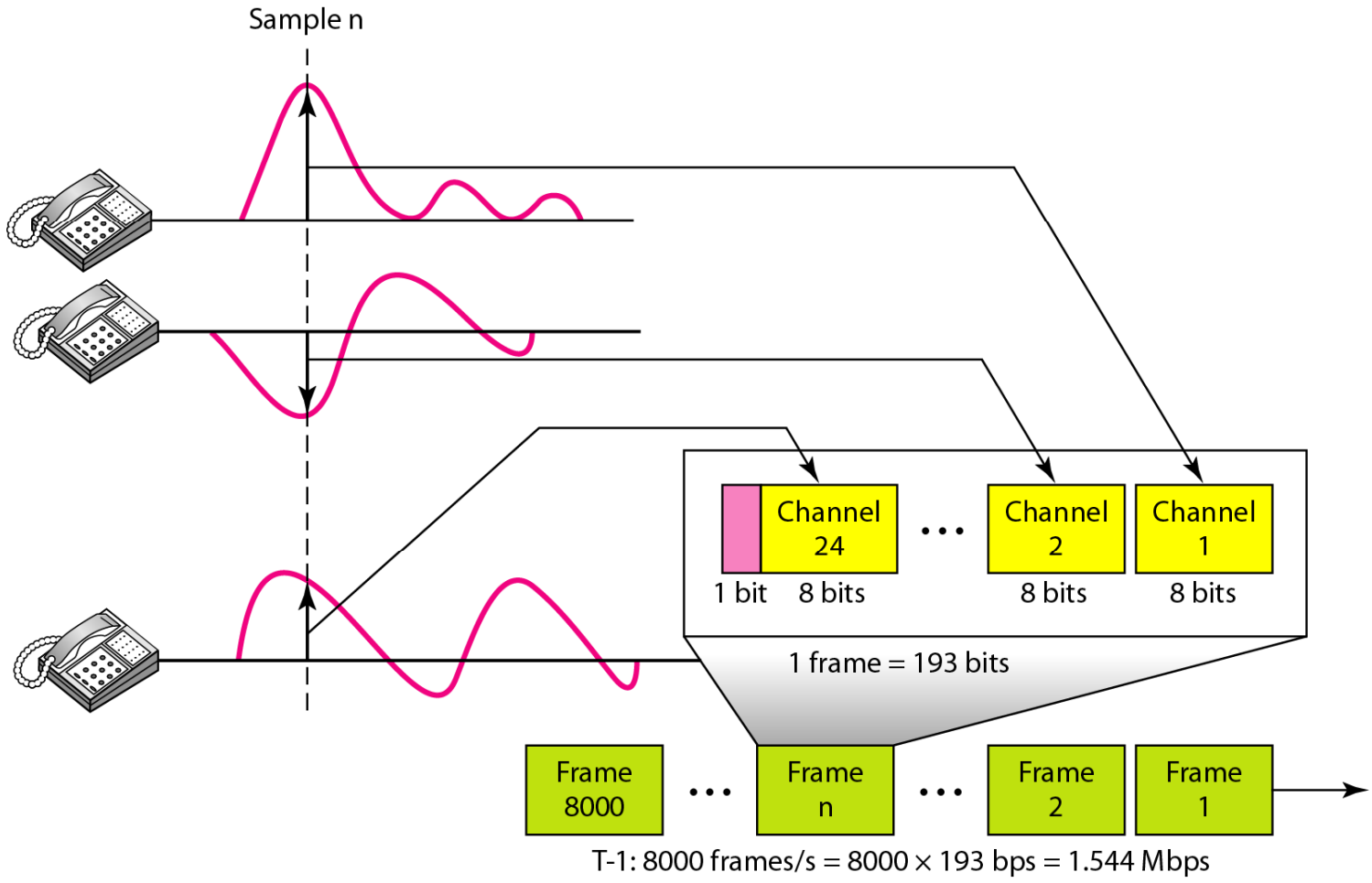


Figure 6.23 *Digital hierarchy*

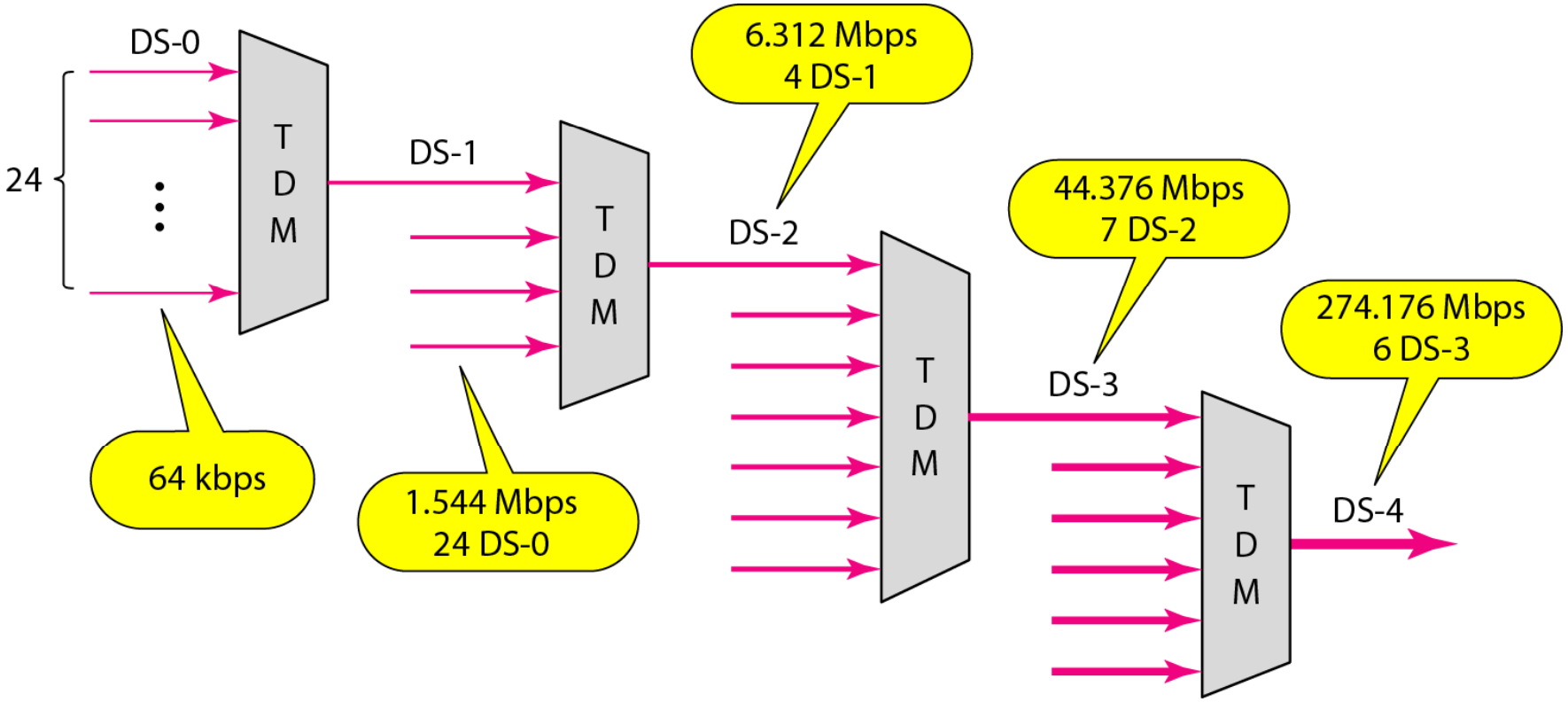


Table 6.1 *DS and T line rates*

Service	*Line*	*Rate (Mbps)*	*Voice Channels*
DS-1	T-1	1.544	24
DS-2	T-2	6.312	96
DS-3	T-3	44.736	672
DS-4	T-4	274.176	4032

Table 6.2 *E line rates*

Line	*Rate (Mbps)*	*Voice Channels*
E-1	2.048	30
E-2	8.448	120
E-3	34.368	480
E-4	139.264	1920

SONET/SDH

- SONET = Synchronous Optical Networks
- SDH = Synchronous Digital Hierarchy
- SONET was developed by ANSI;
  SDH was developed by ITU-T.
- (DS/TDM lägre hastigheter även på koppartrådar)

Table 17.1 *SONET/SDH rates*

STS	*OC*	*Rate (Mbps)*	*STM*
STS-1	OC-1	51.840	
STS-3	OC-3	155.520	**STM-1**
STS-9	OC-9	466.560	**STM-3**
STS-12	OC-12	622.080	**STM-4**
STS-18	OC-18	933.120	**STM-6**
STS-24	OC-24	1244.160	**STM-8**
STS-36	OC-36	1866.230	**STM-12**
STS-48	OC-48	2488.320	**STM-16**
STS-96	OC-96	4976.640	**STM-32**
STS-192	OC-192	9953.280	**STM-64**

Figure 17.1 *A simple network using SONET equipment*

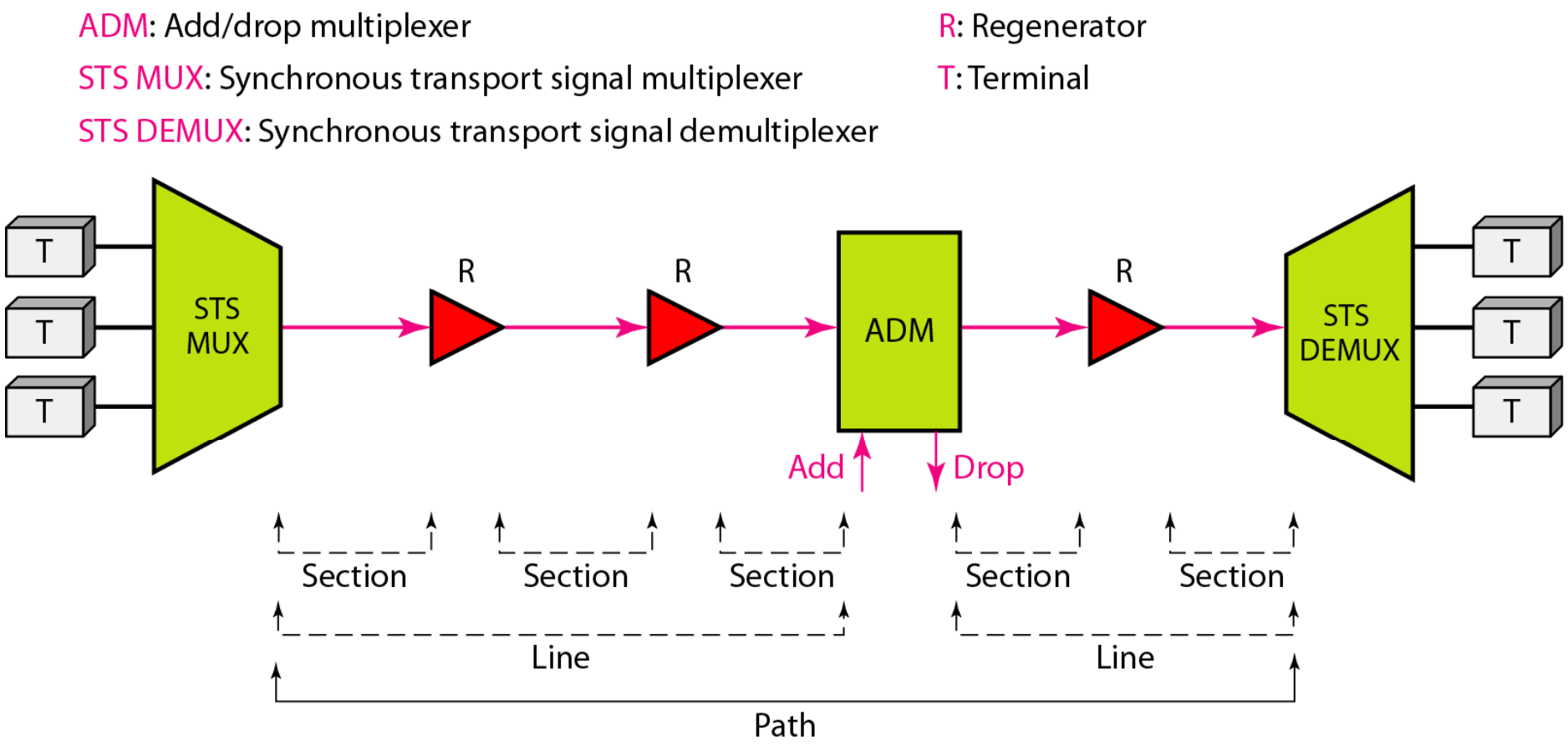


Figure 17.2 *SONET layers compared with OSI or the Internet layers*

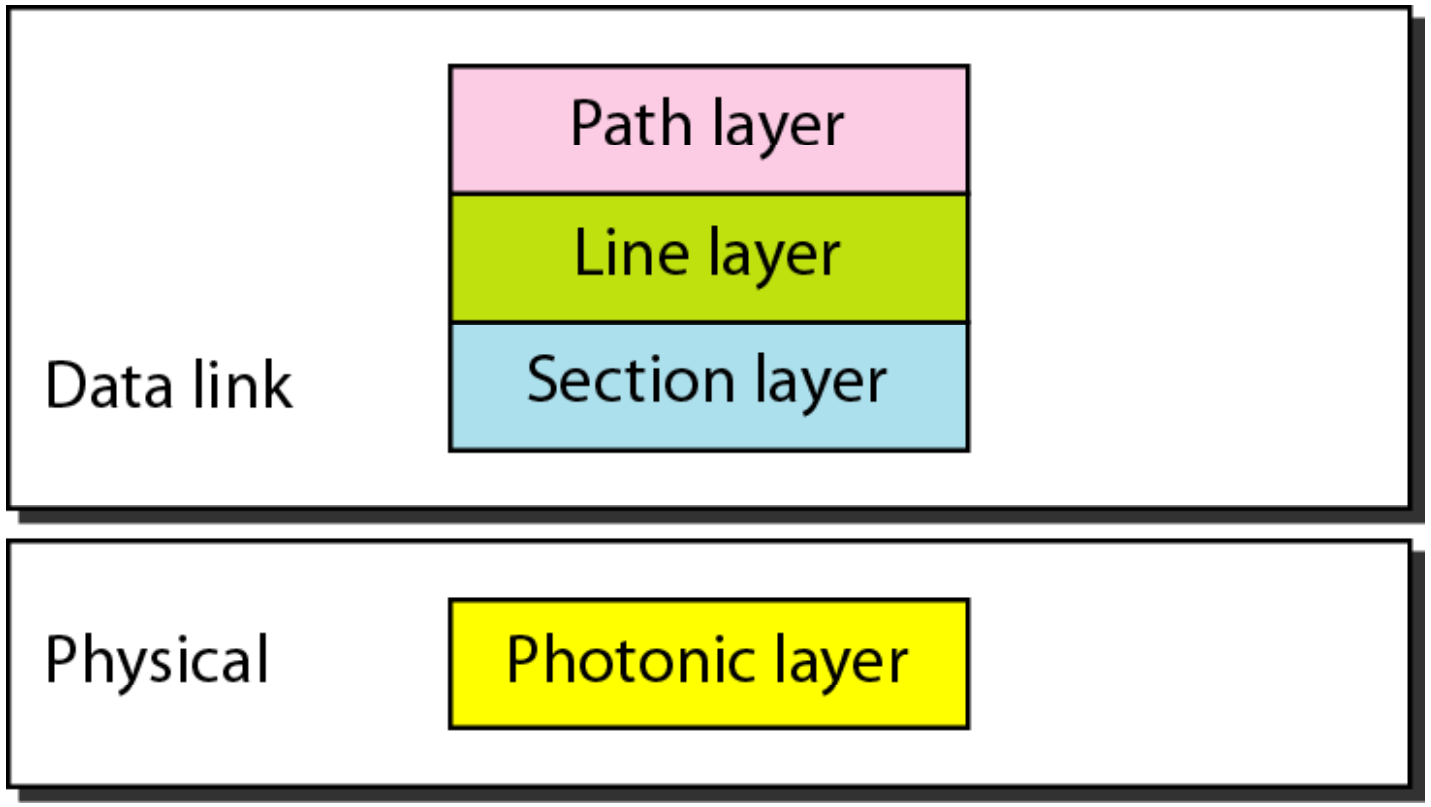


Figure 17.3 *Device–layer relationship in SONET*

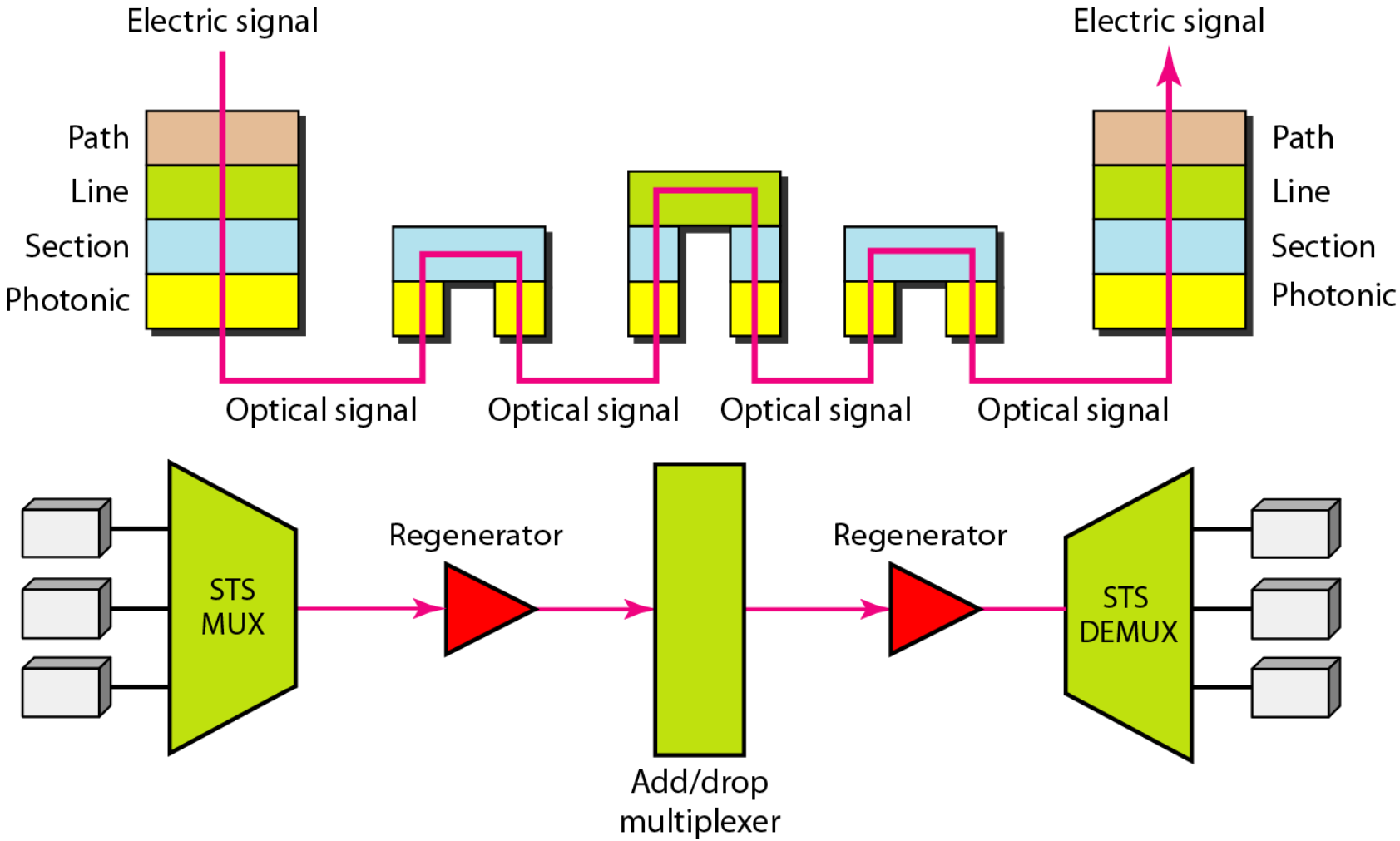
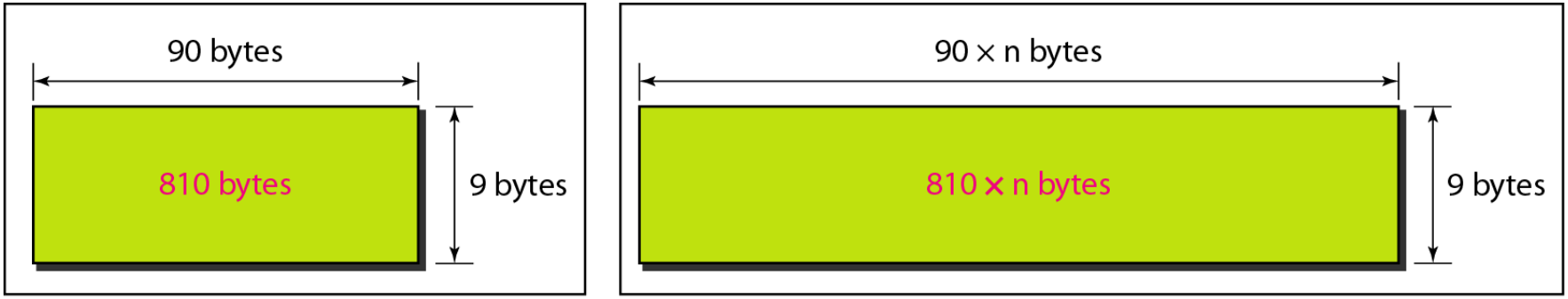


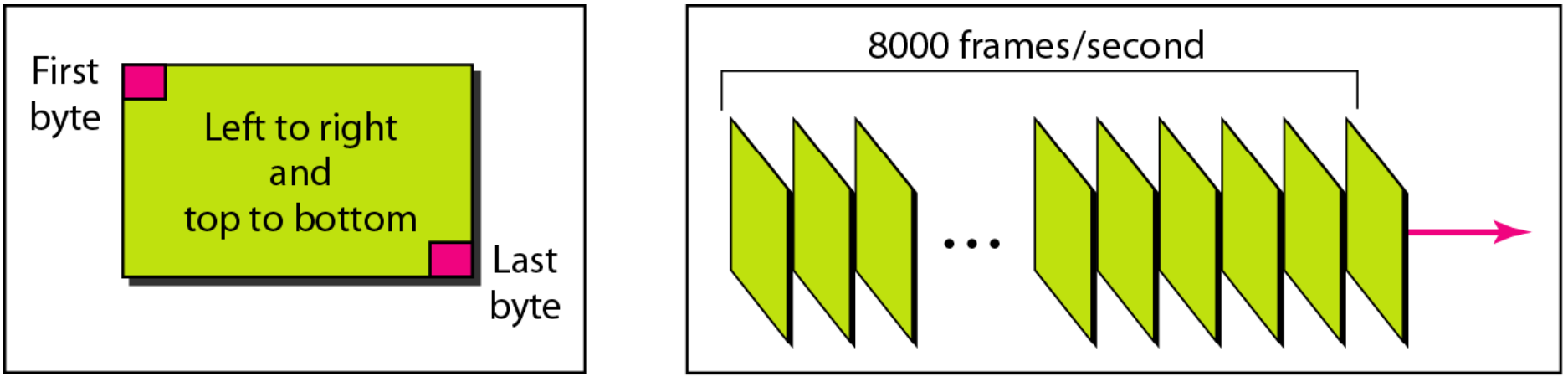
Figure 17.4 *An STS-1 and an STS-n frame*



a. STS-1 frame

b. STS-n frame

Figure 17.5 *STS-1 frames in transmission*



a. Byte transmission

b. Frame transmission

Figure 6.25 *T-1 frame structure*

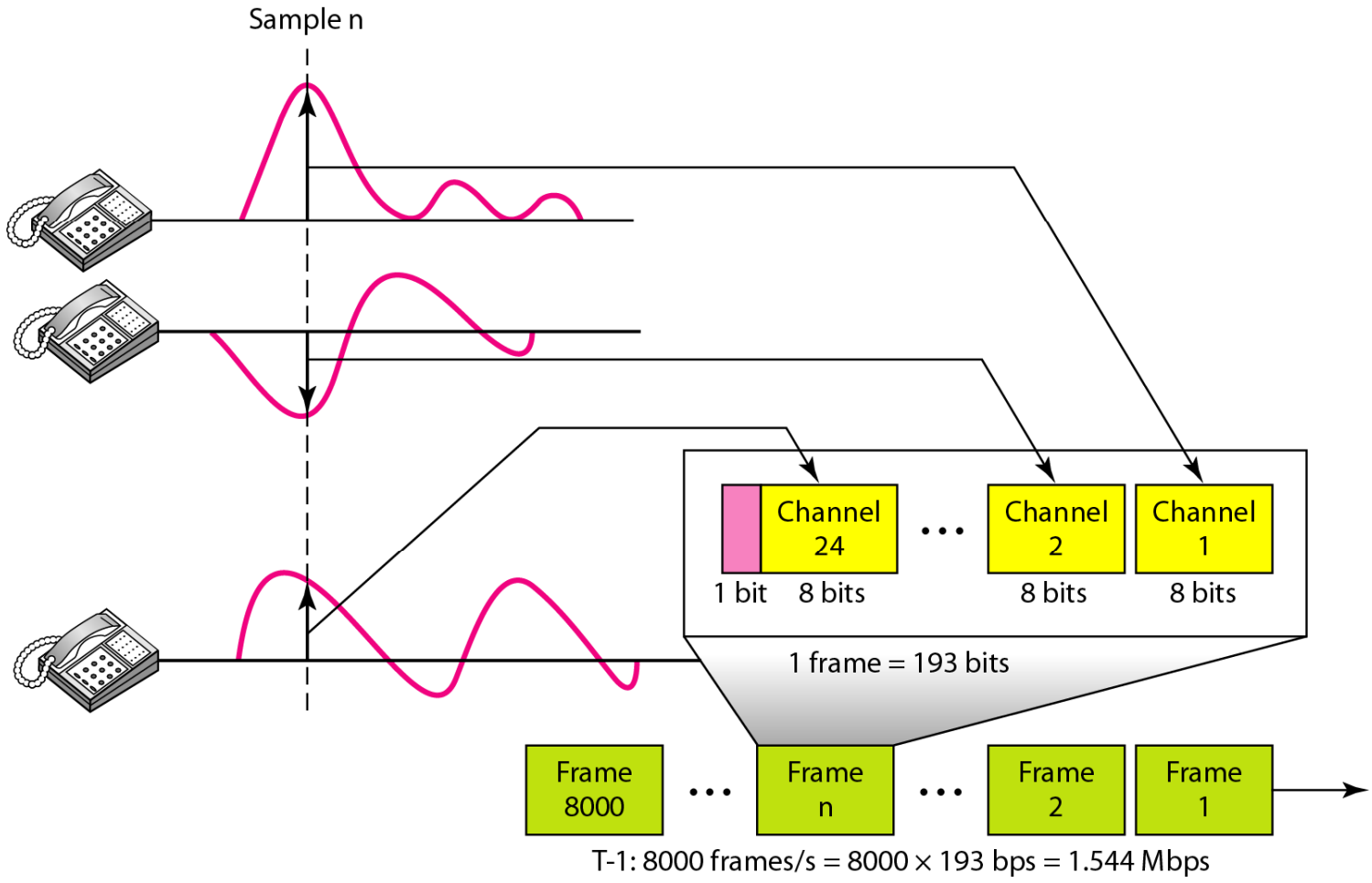


Figure 17.6 *STS-1 frame overheads*

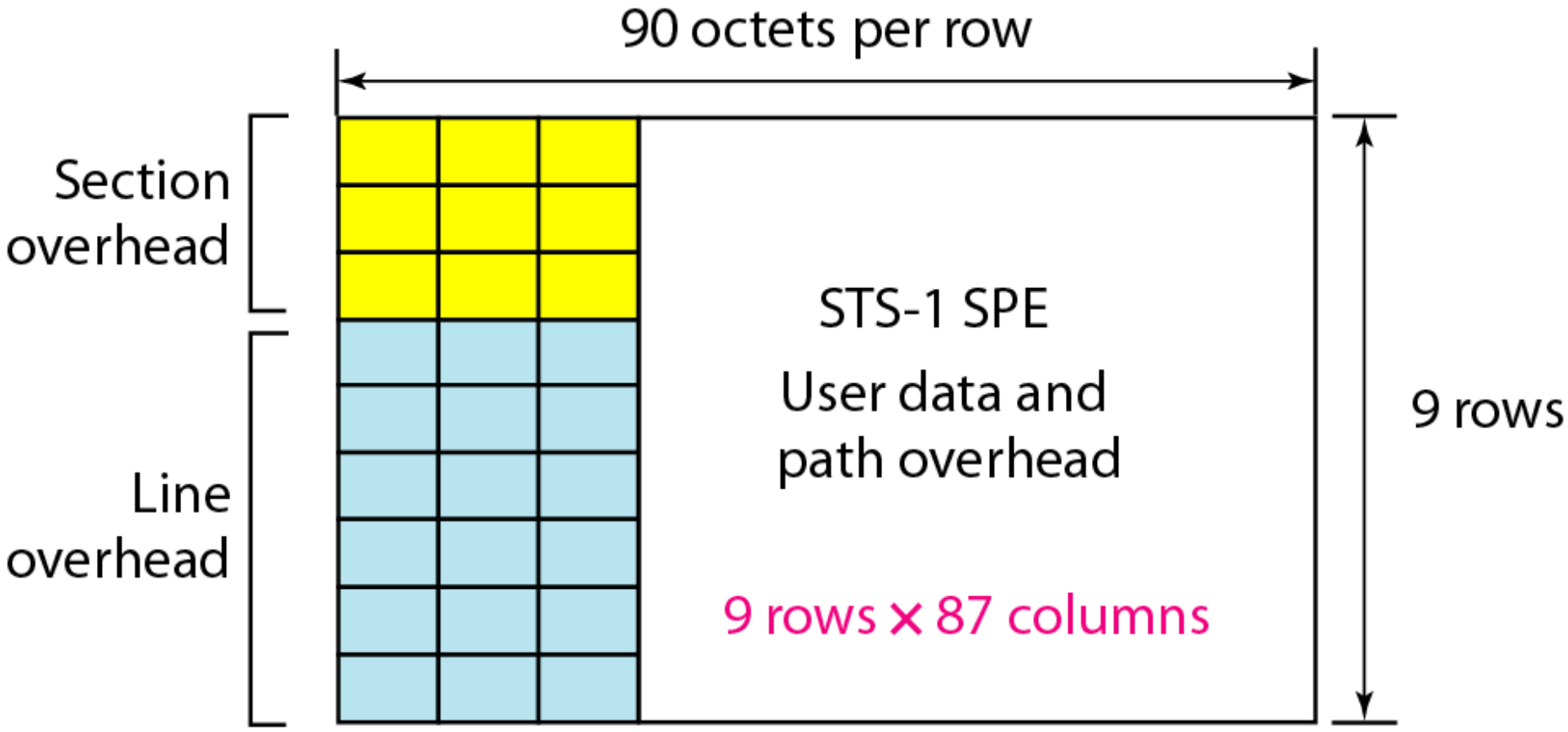


Figure 17.7 *STS-1 frame: section overhead*

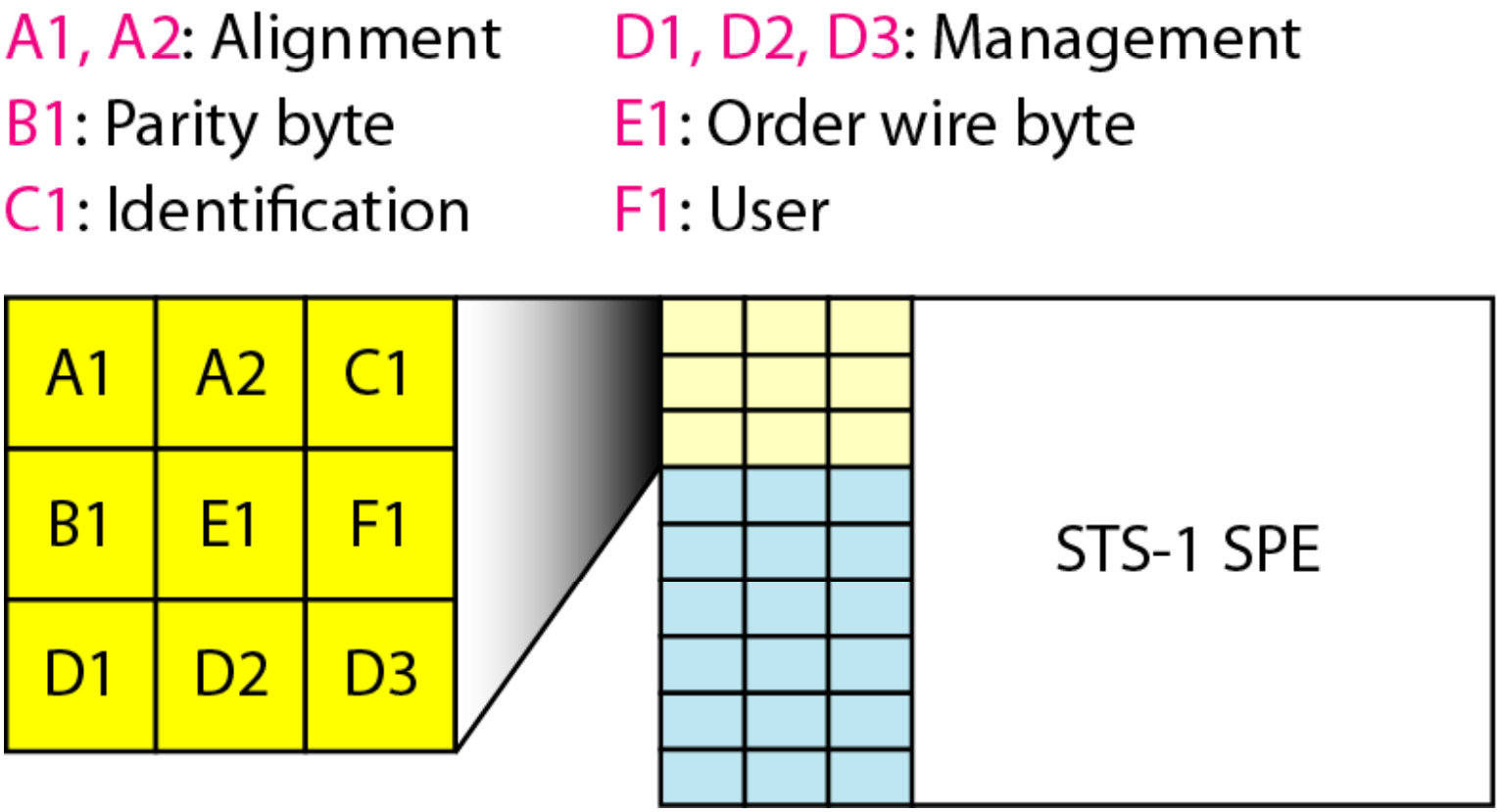


Figure 17.8 *STS-1 frame: line overhead*

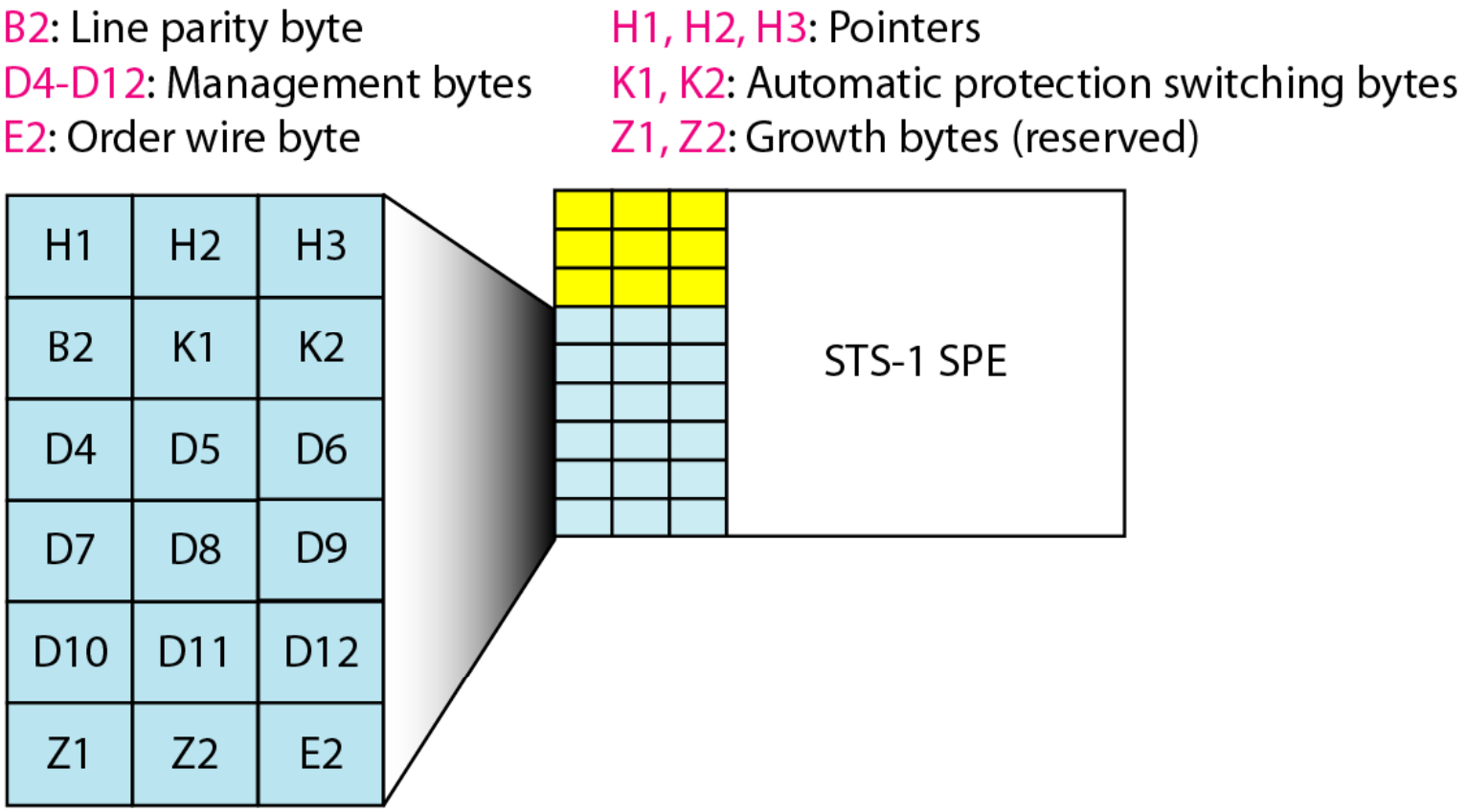


Figure 17.9 *STS-1 frame: path overhead*

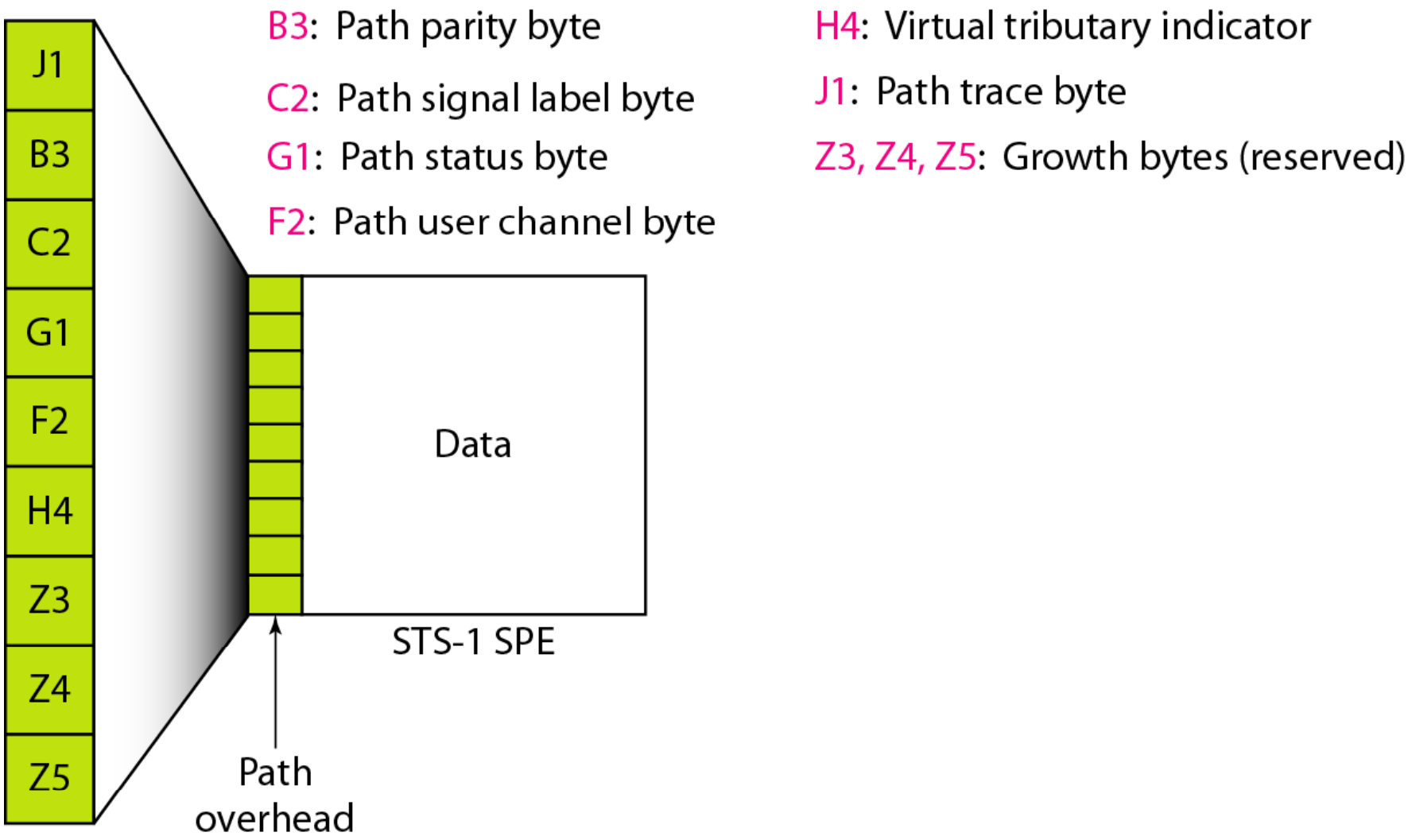


Table 17.2 *Overhead bytes*

Byte Function	*Section*	*Line*	*Path*
Alignment	A1, A2		
Parity	B1	B2	B3
Identifier	C1		C2
OA&M	D1–D3	D4–D12	
Order wire	E1		
User	F1		F2
Status			G1
Pointers		H1– H3	H4
Trace			J1
Failure tolerance		K1, K2	
Growth (reserved for future)		Z1, Z2	Z3–Z5

Figure 17.10 *Offsetting of SPE related to frame boundary*

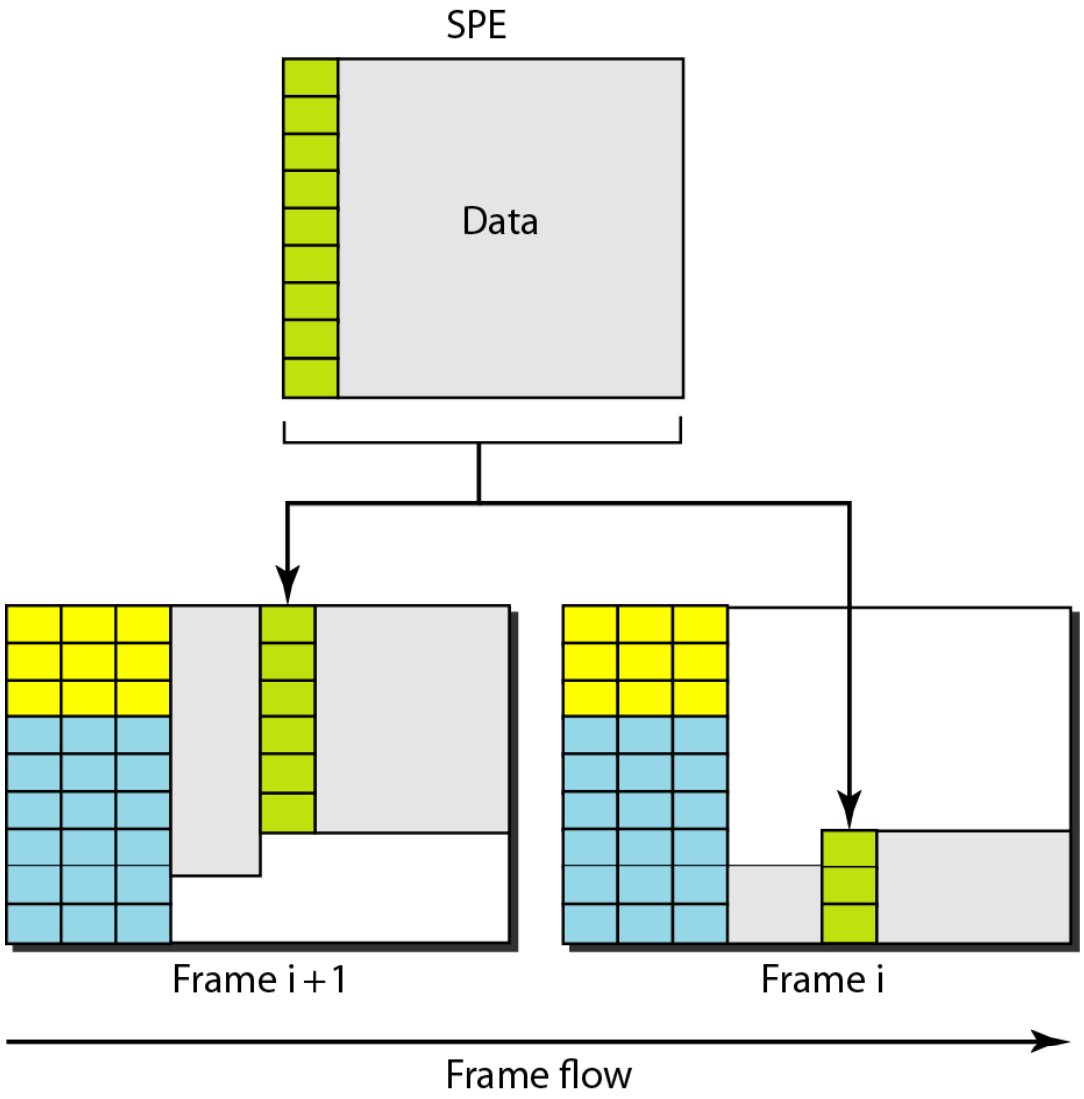


Figure 17.11 *The use of H1 and H2 pointers to show the start of an SPE in a frame*

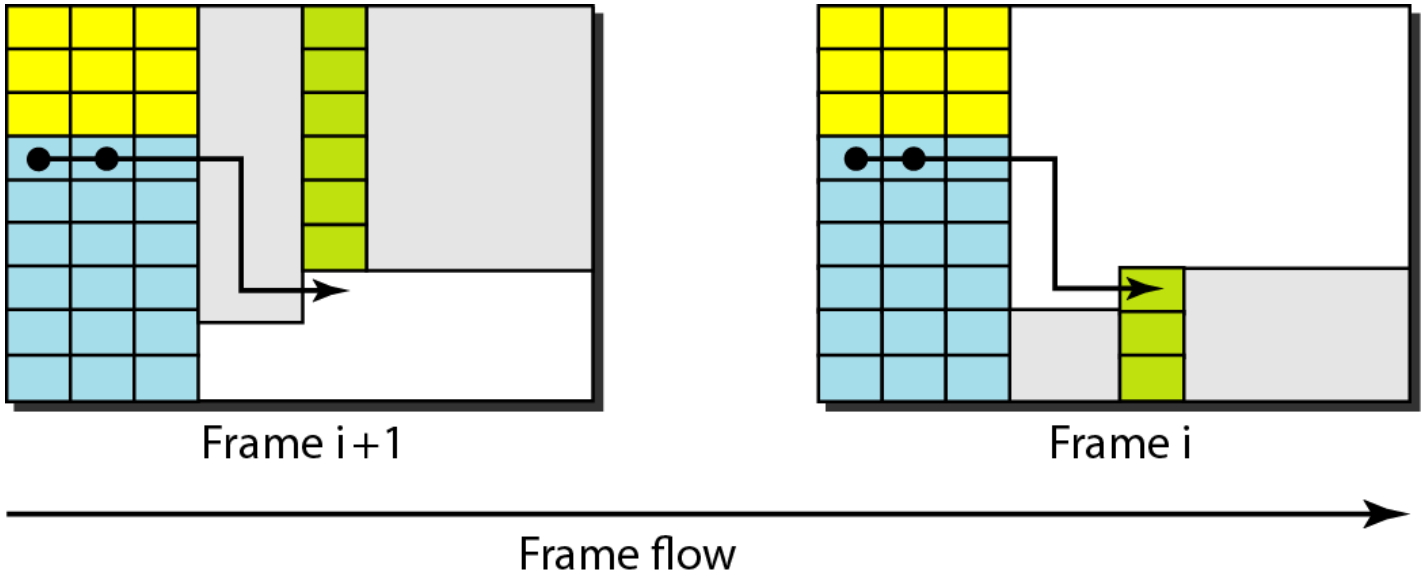


Figure 17.12 *STS multiplexing/demultiplexing*

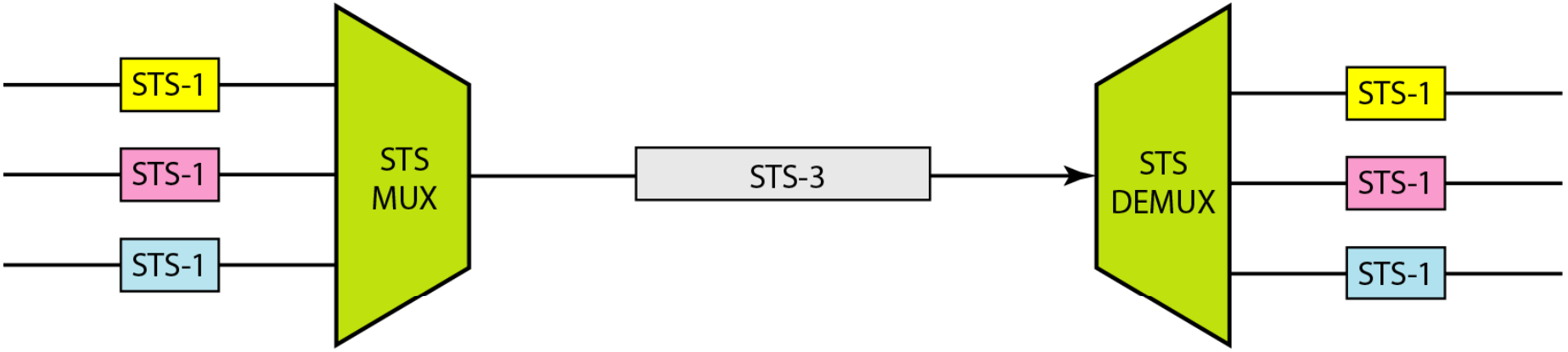


Figure 17.13 *Byte interleaving*

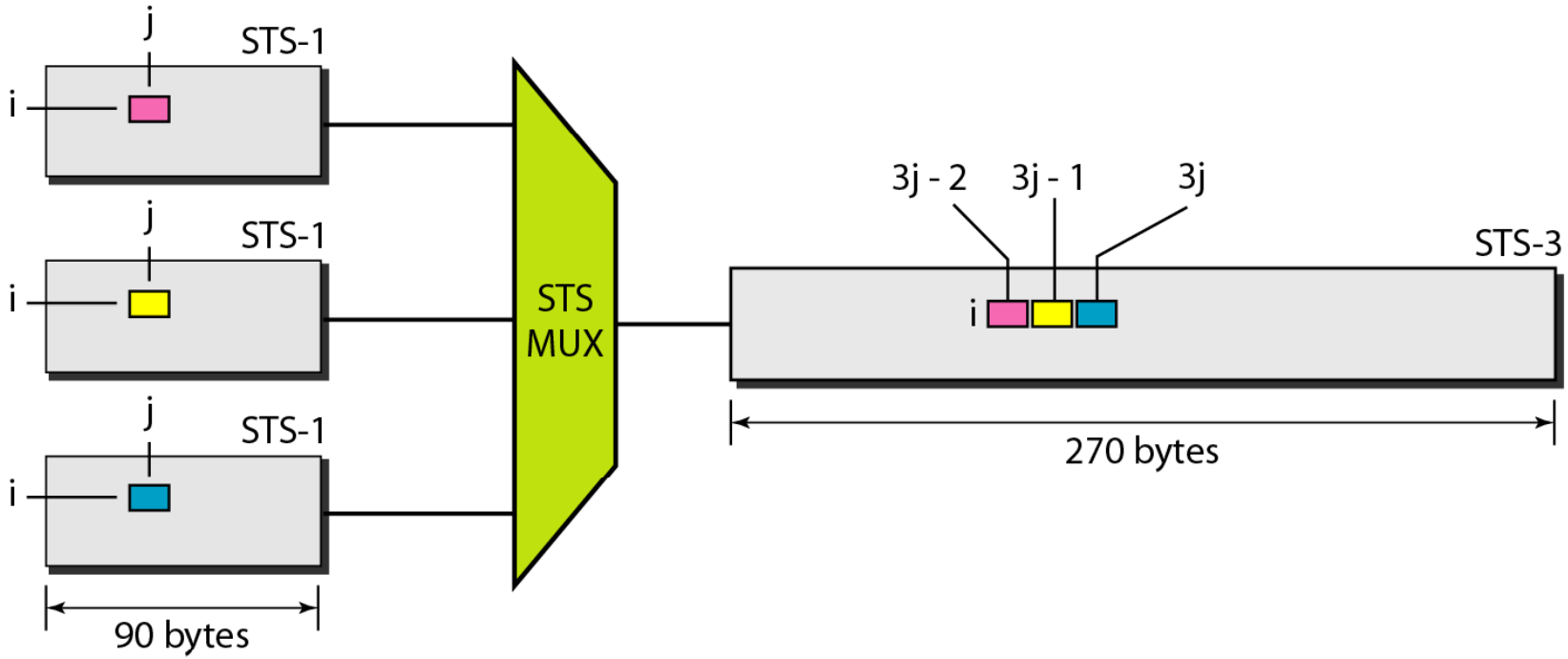


Figure 17.14 *An STS-3 frame*

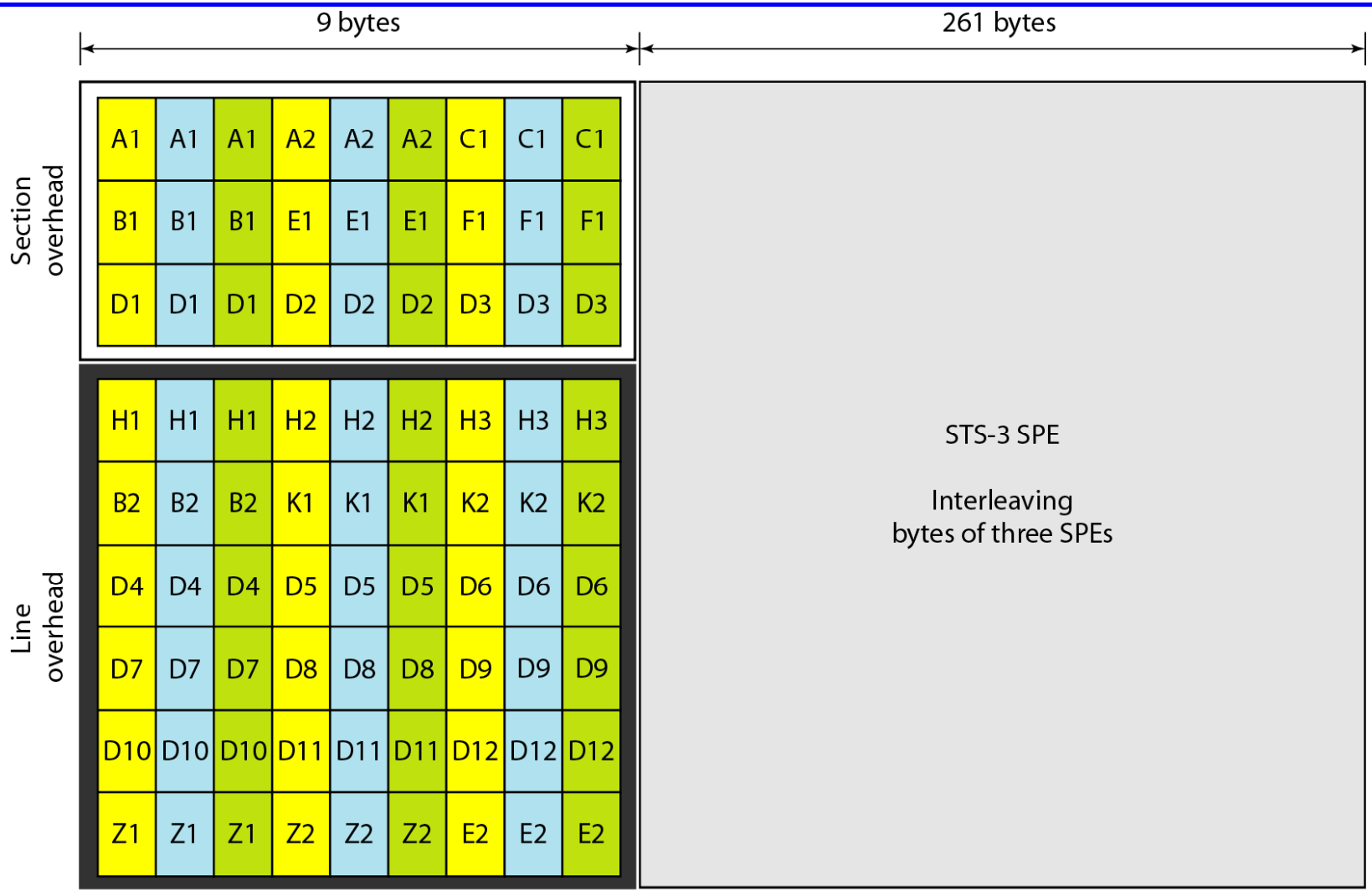


Figure 17.15 *A concatenated STS-3c signal*

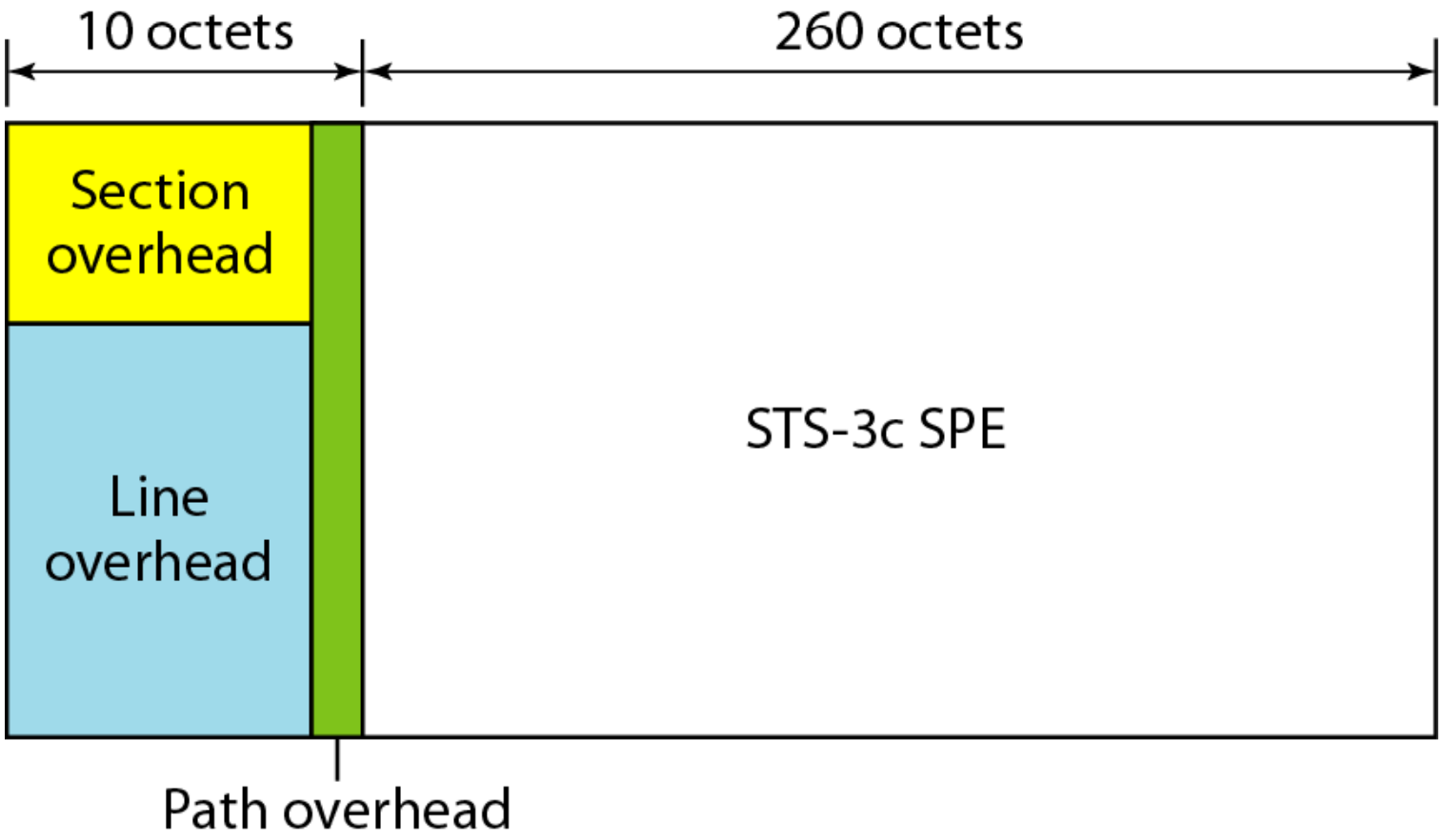


Figure 17.16 *Dropping and adding STS-1 frames in an add/drop multiplexer*

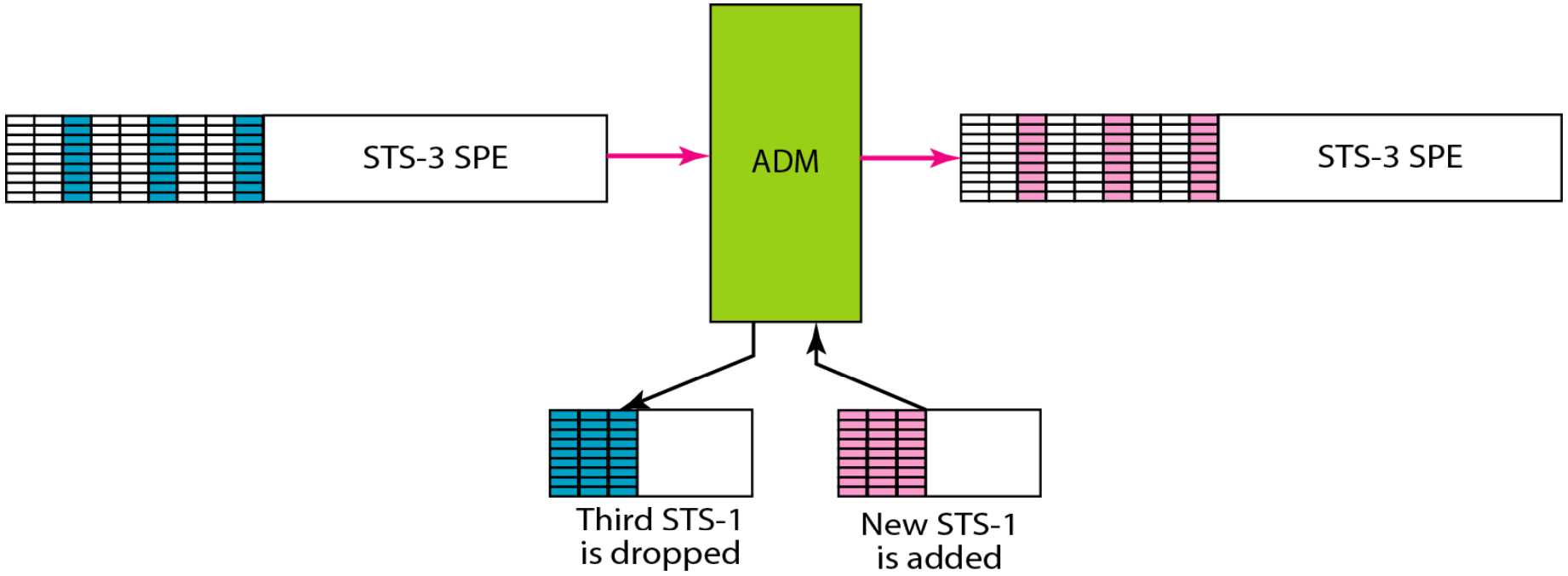


Figure 17.17 *Taxonomy of SONET networks*

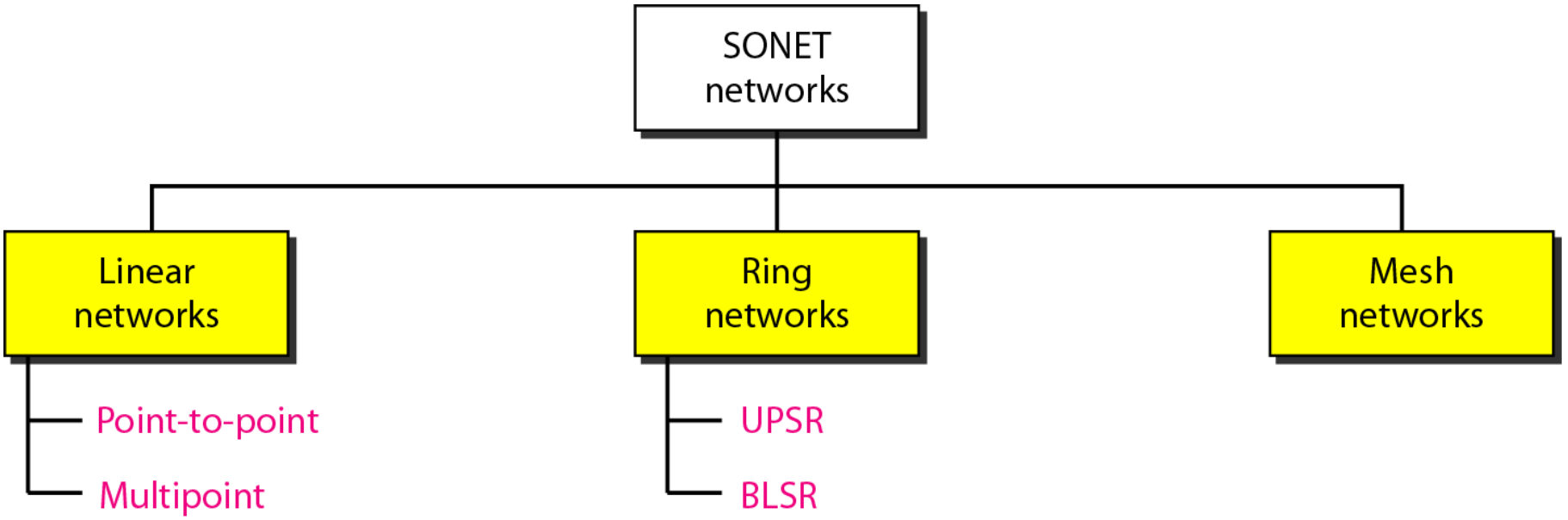


Figure 17.18 *A point-to-point SONET network*

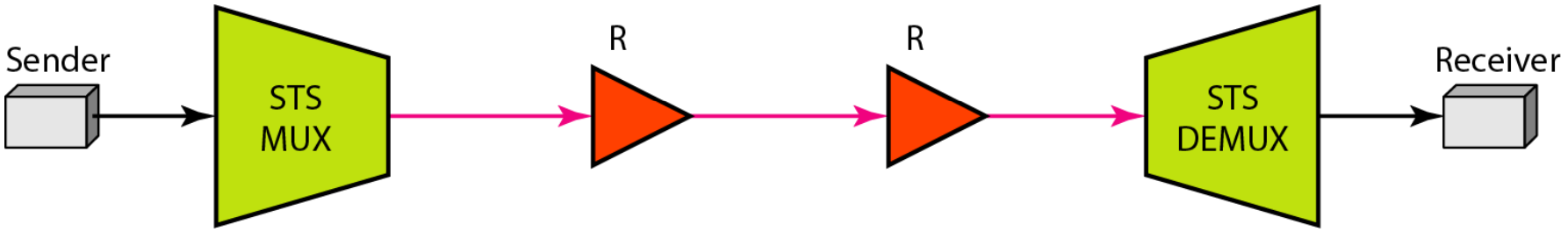


Figure 17.19 *A multipoint SONET network*

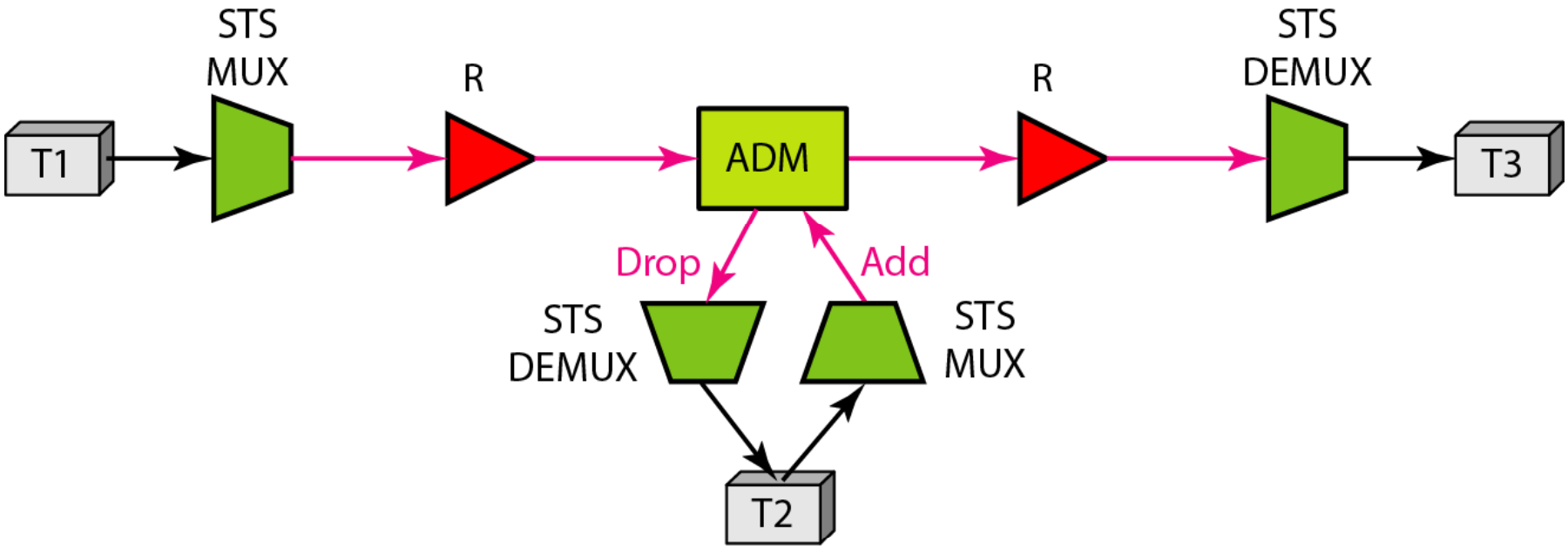


Figure 17.20 *Automatic protection switching in linear networks*

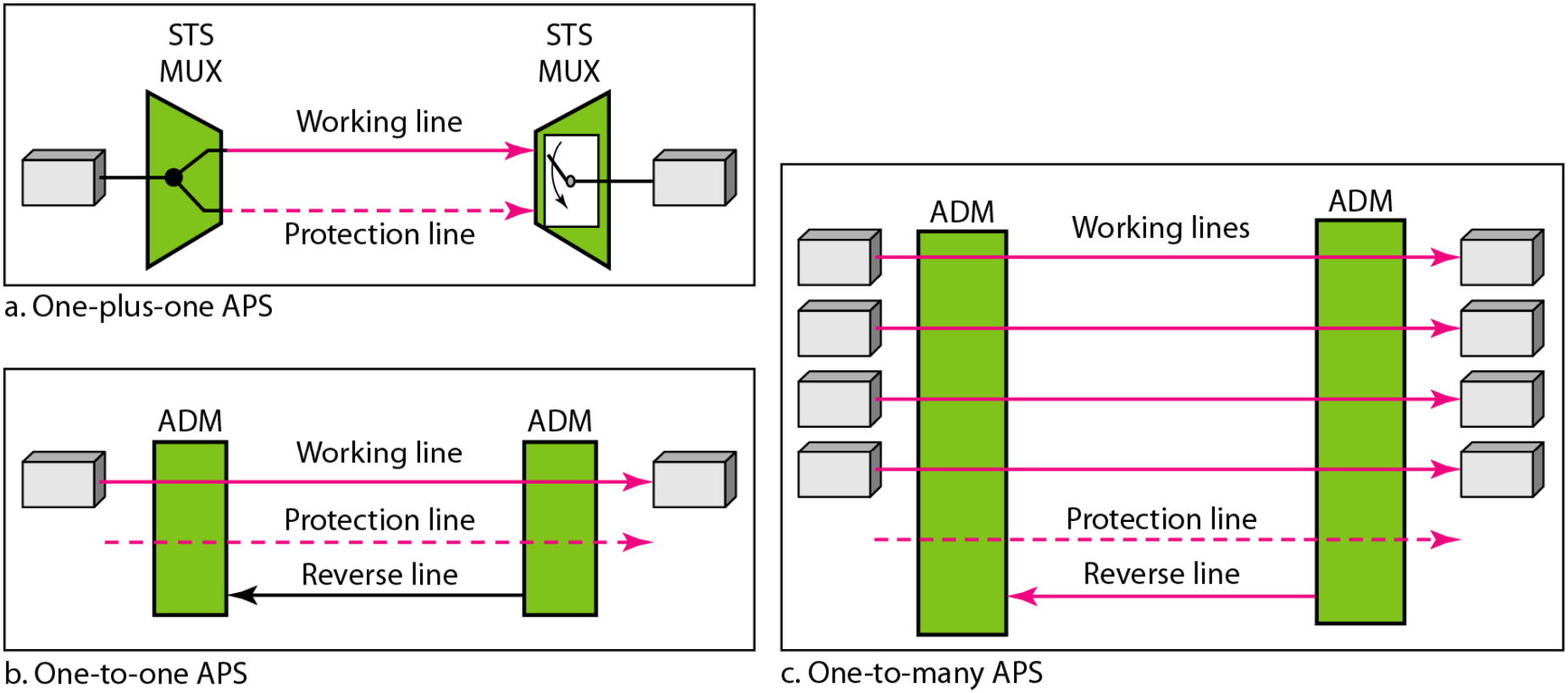


Figure 17.21 *A unidirectional path switching ring*

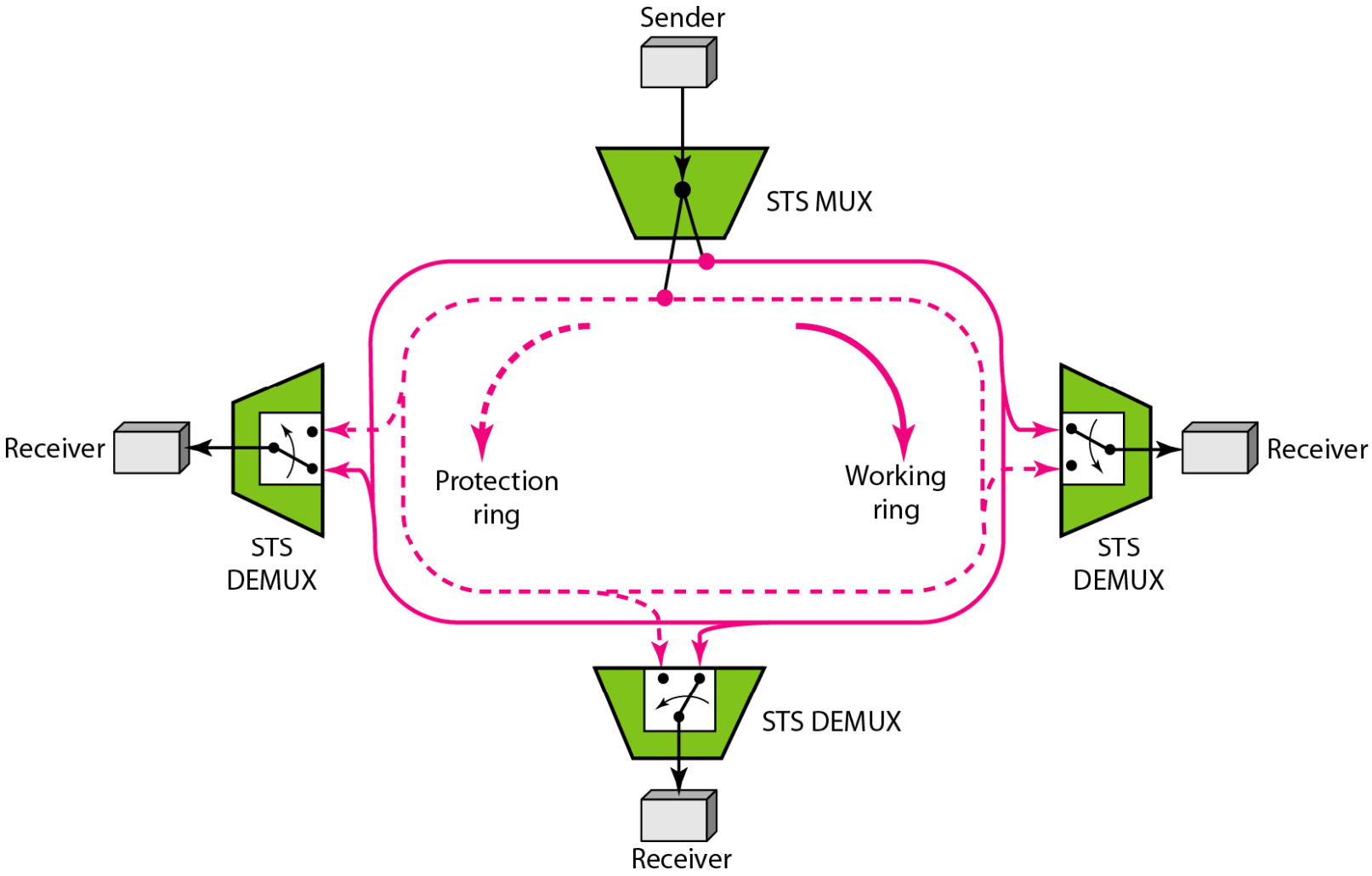


Figure 17.22 *A bidirectional line switching ring*

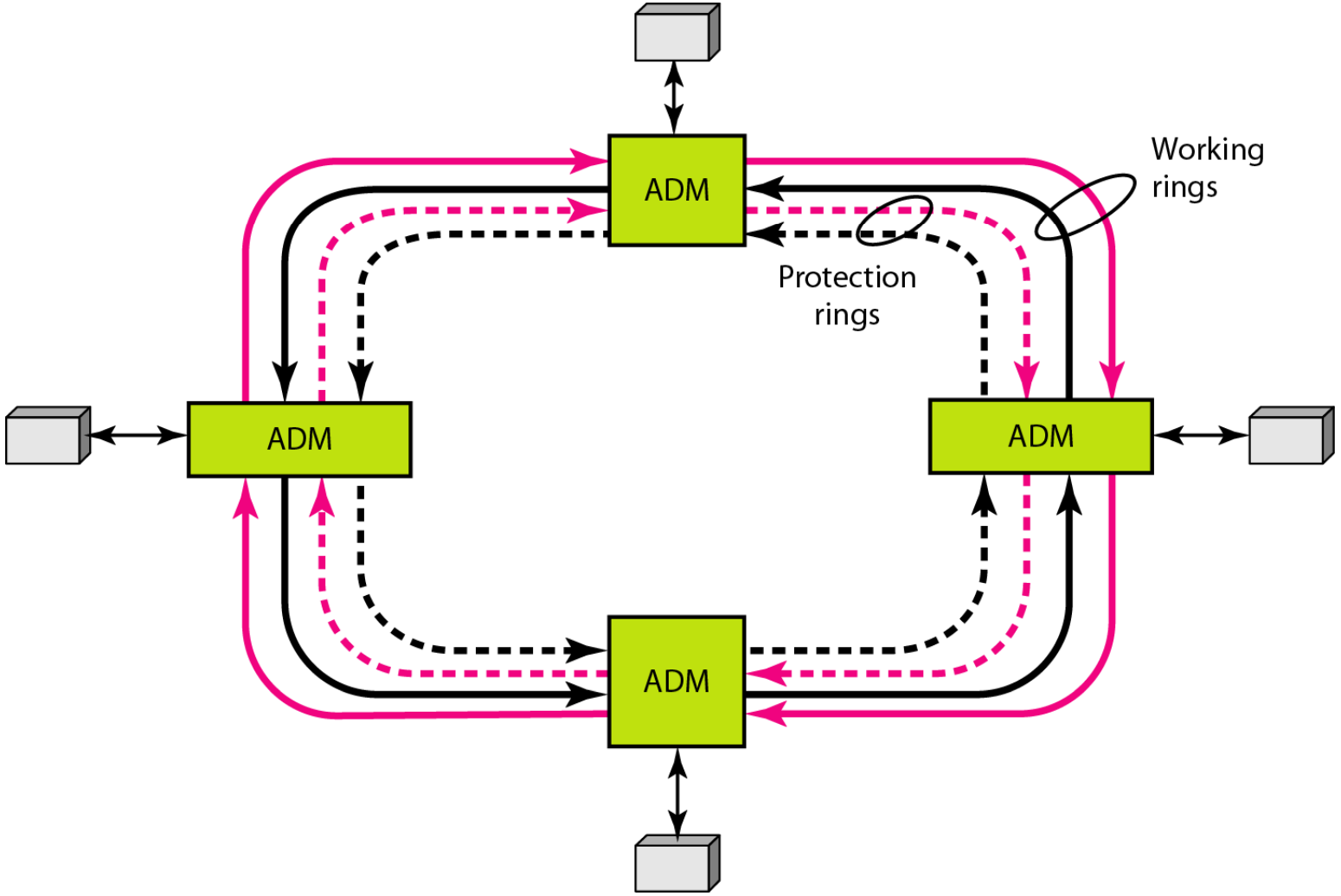


Figure 17.23 *A combination of rings in a SONET network*

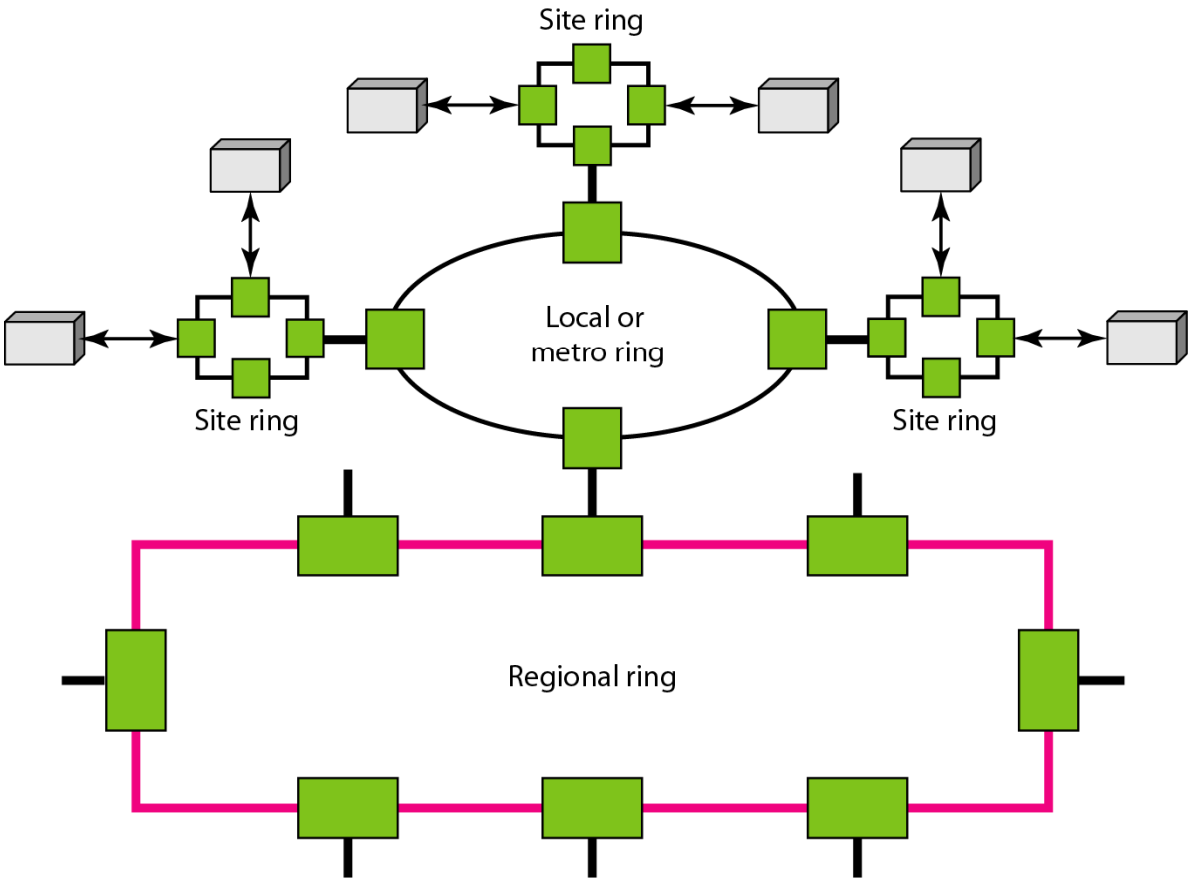
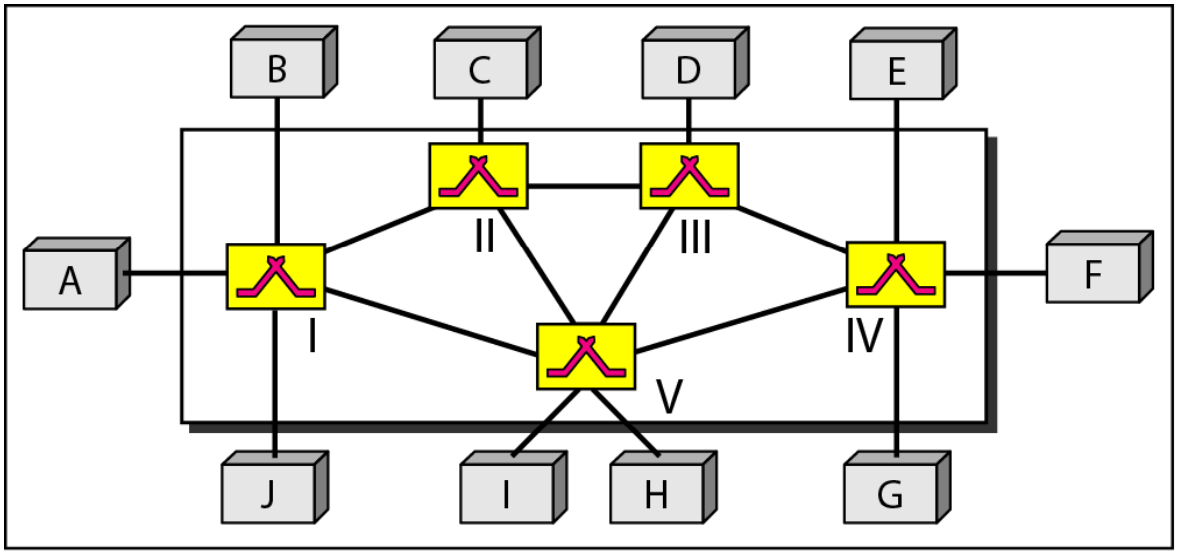
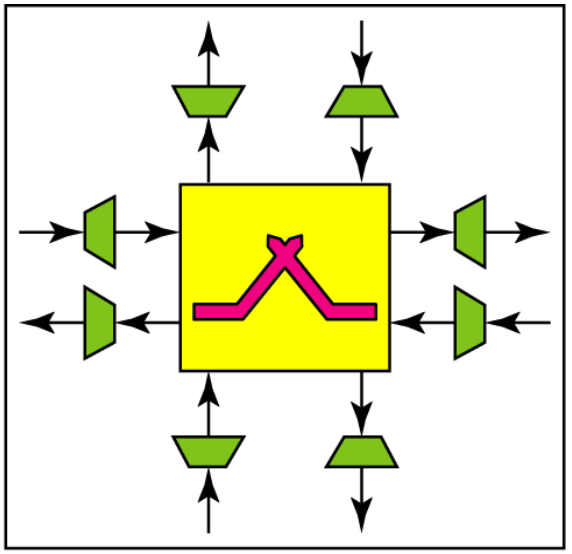


Figure 17.24 *A mesh SONET network*



a. SONET mesh network



b. Cross-connect switch

Figure 17.25 *Virtual tributaries*

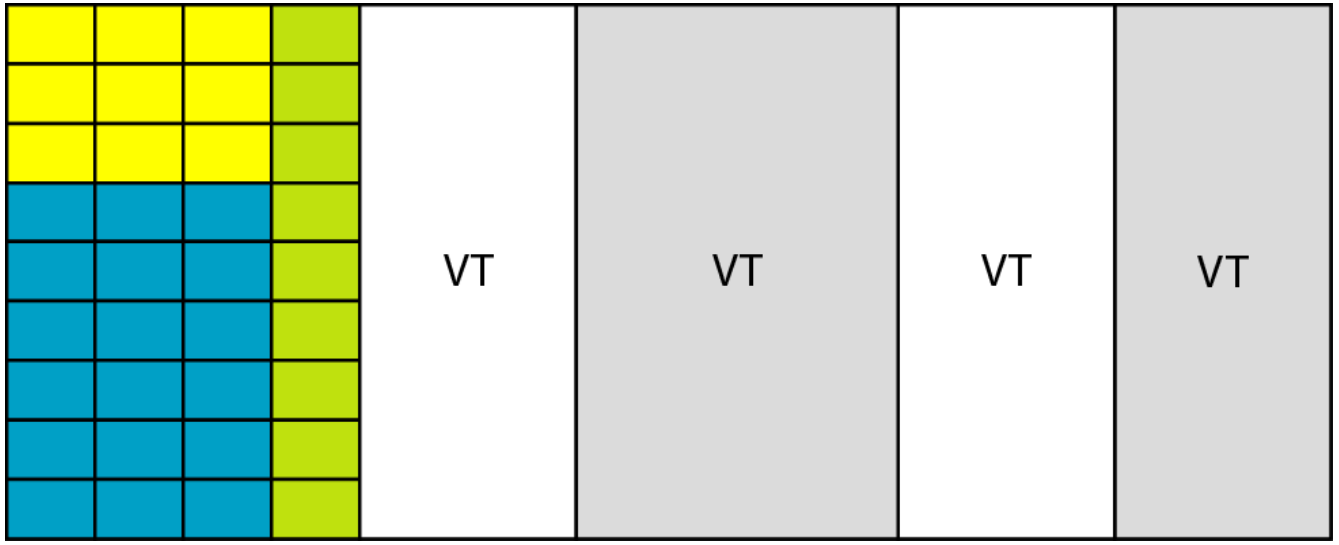
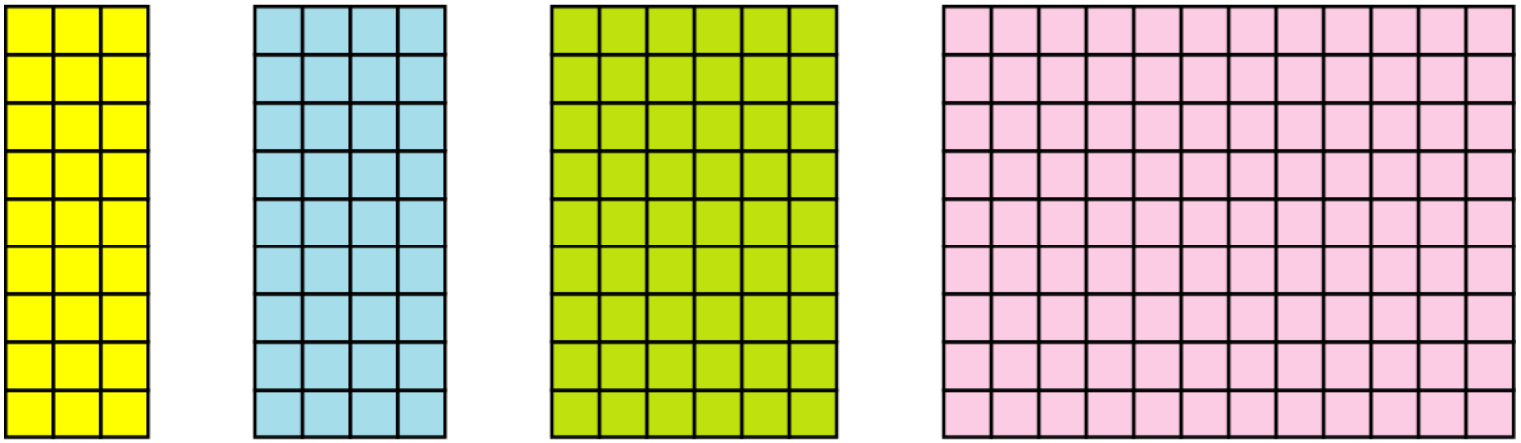


Figure 17.26 *Virtual tributary types*

VT1.5 = 8000 frames/s 3 columns 9 rows 8 bits = 1.728 Mbps
VT2 = 8000 frames/s 4 columns 9 rows 8 bits = 2.304 Mbps
VT3 = 8000 frames/s 6 columns 9 rows 8 bits = 3.456 Mbps
VT6 = 8000 frames/s 12 columns 9 rows 8 bits = 6.912 Mbps



ATM

- A cell network uses the cell as the basic unit of data exchange.
- A cell is defined as a small, fixed-size block of information
- Asynchronous Transfer Mode (ATM) is the cell relay protocol designed by the ATM Forum and adopted by the ITU-T.

Figure 18.6 *Multiplexing using different frame sizes*

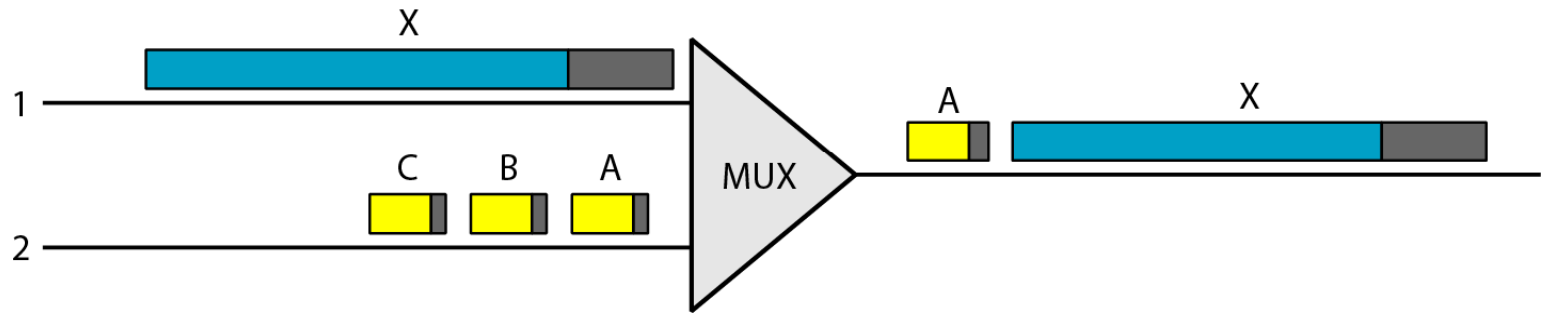


Figure 18.7 *Multiplexing using cells*

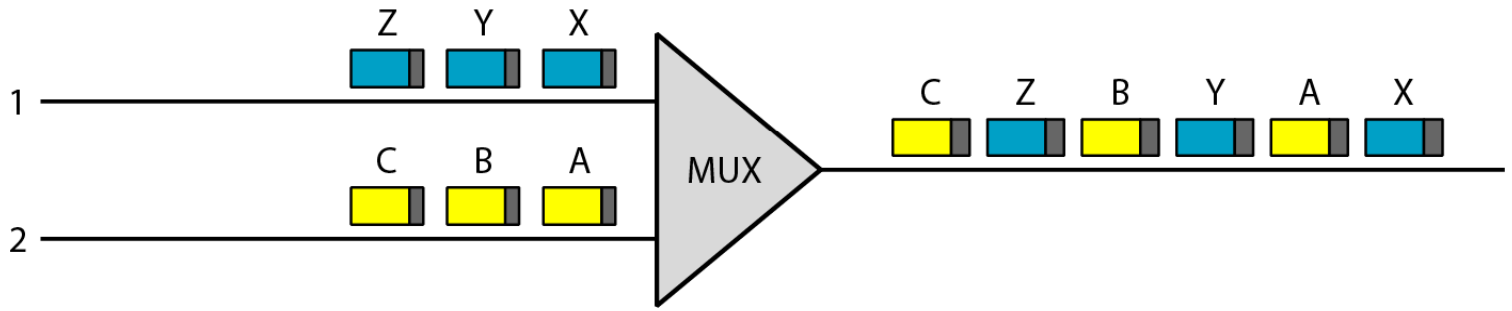


Figure 18.8 *ATM multiplexing*

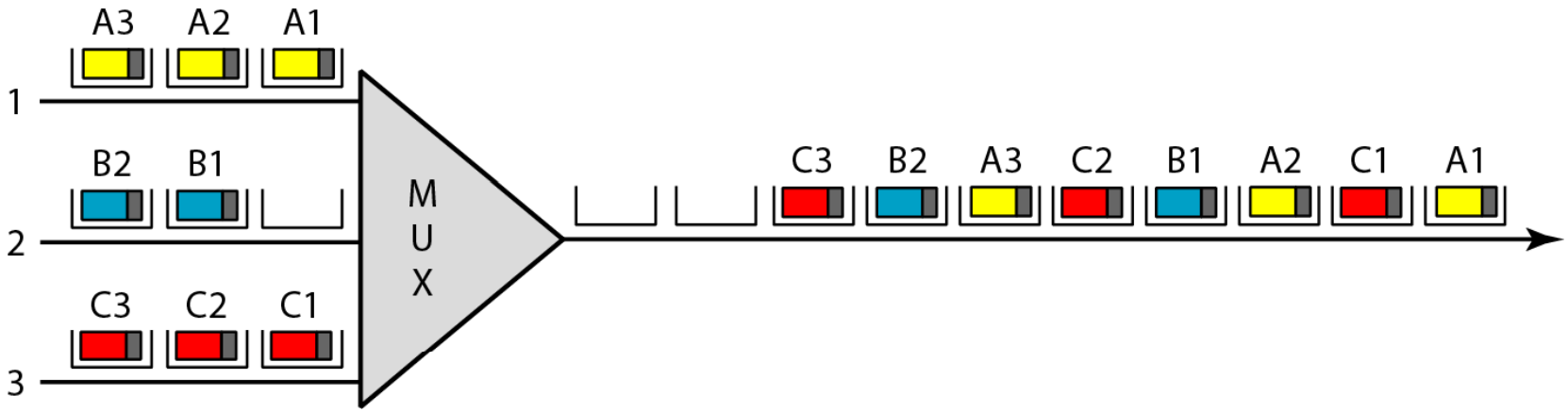


Figure 18.9 *Architecture of an ATM network*

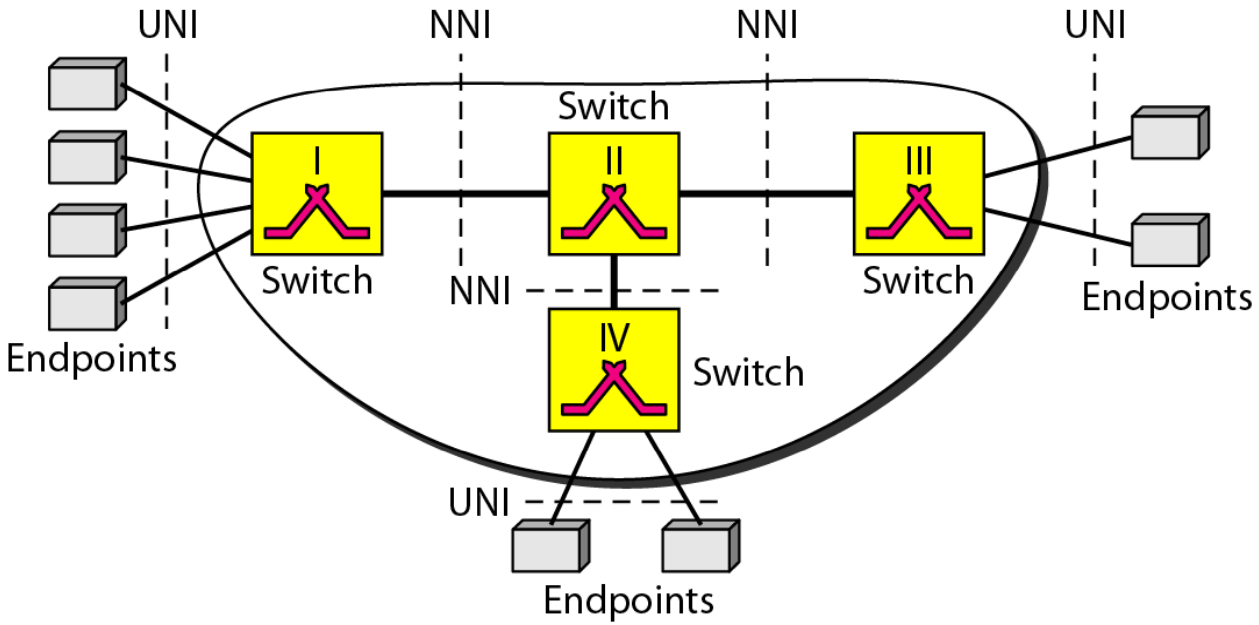


Figure 18.10 *TP, VPs, and VCs*

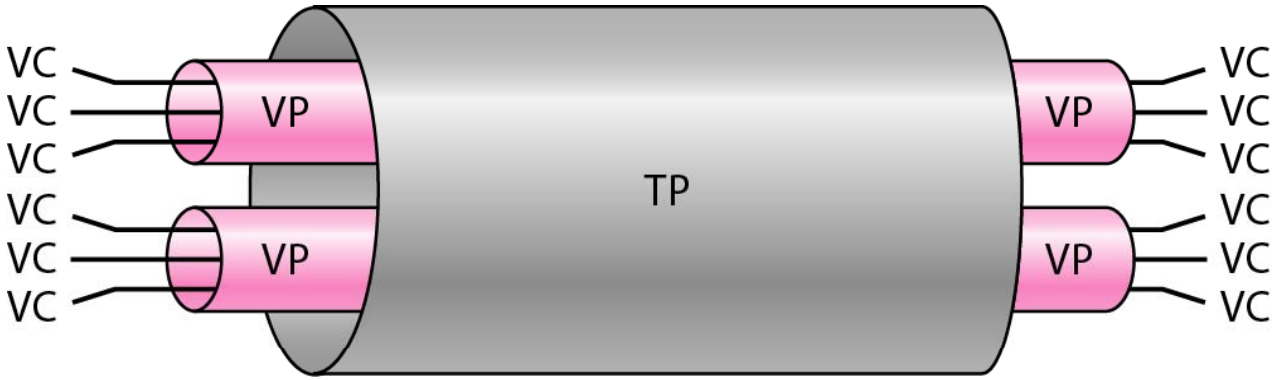


Figure 18.11 *Example of VPs and VCs*

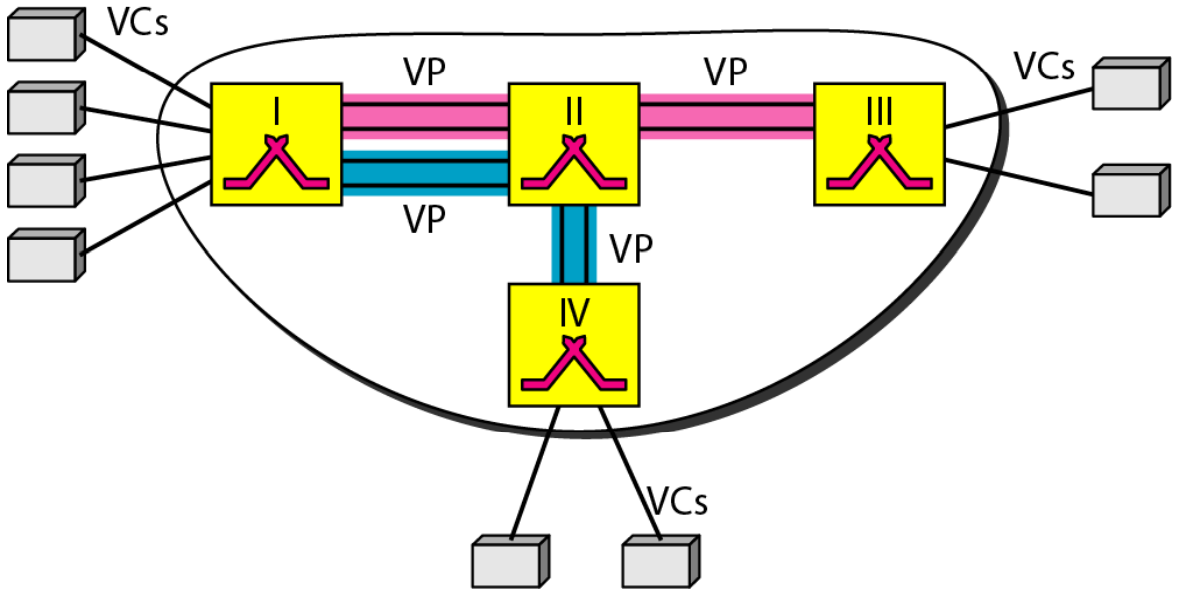


Figure 18.12 *Connection identifiers*

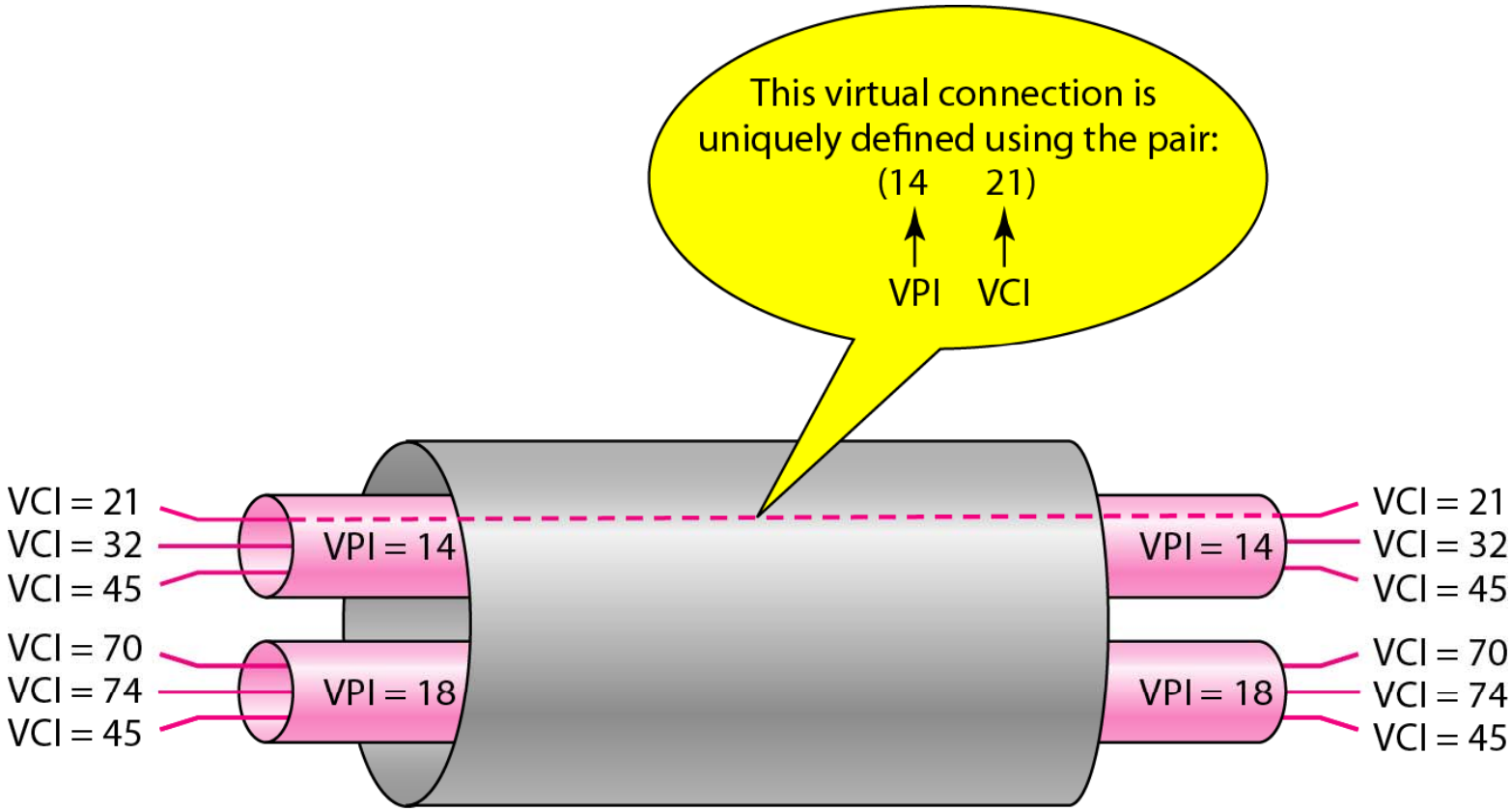


Figure 18.14 *An ATM cell*

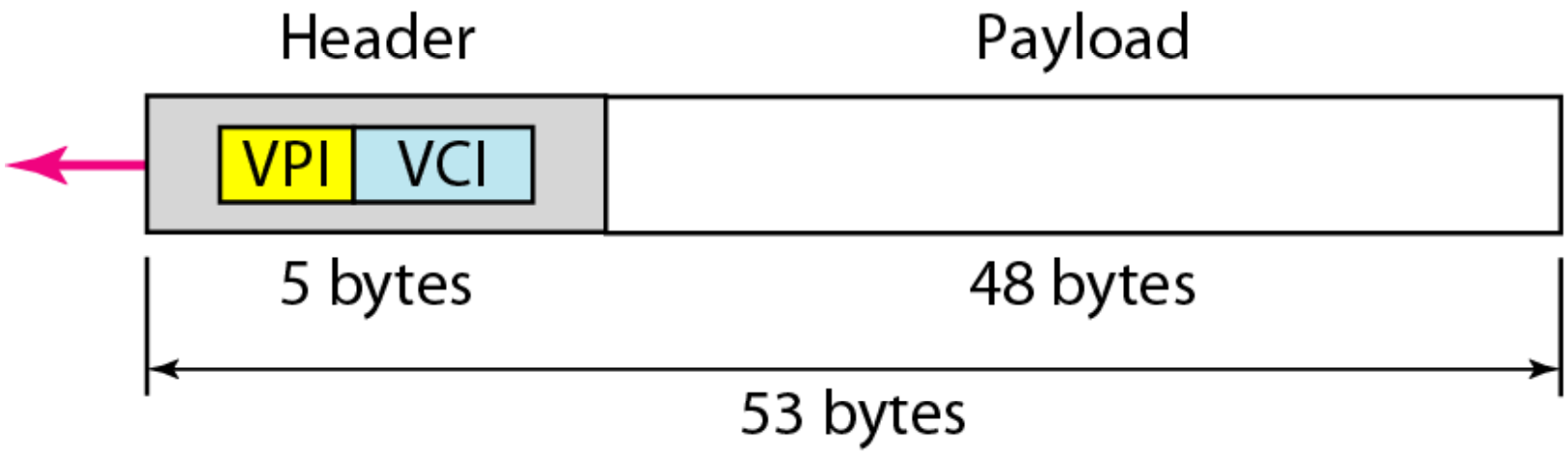
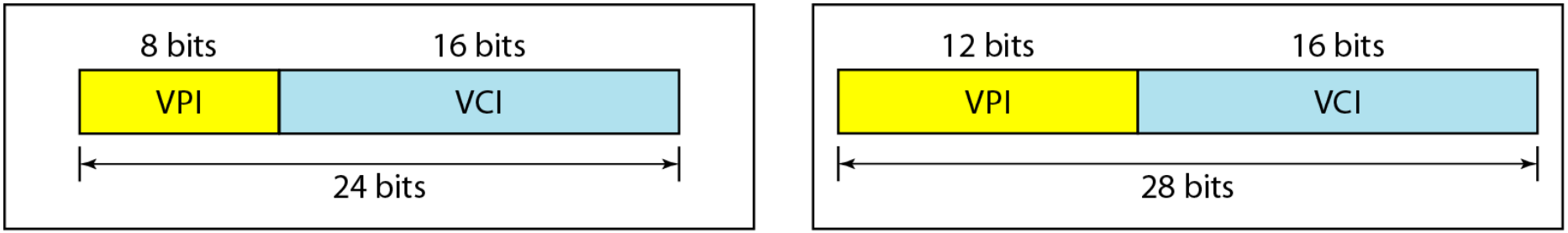


Figure 18.13 *Virtual connection identifiers in UNIs and NNIs*



a. VPI and VCI in a UNI

b. VPI and VCI in an NNI

Figure 18.15 *Routing with a switch*

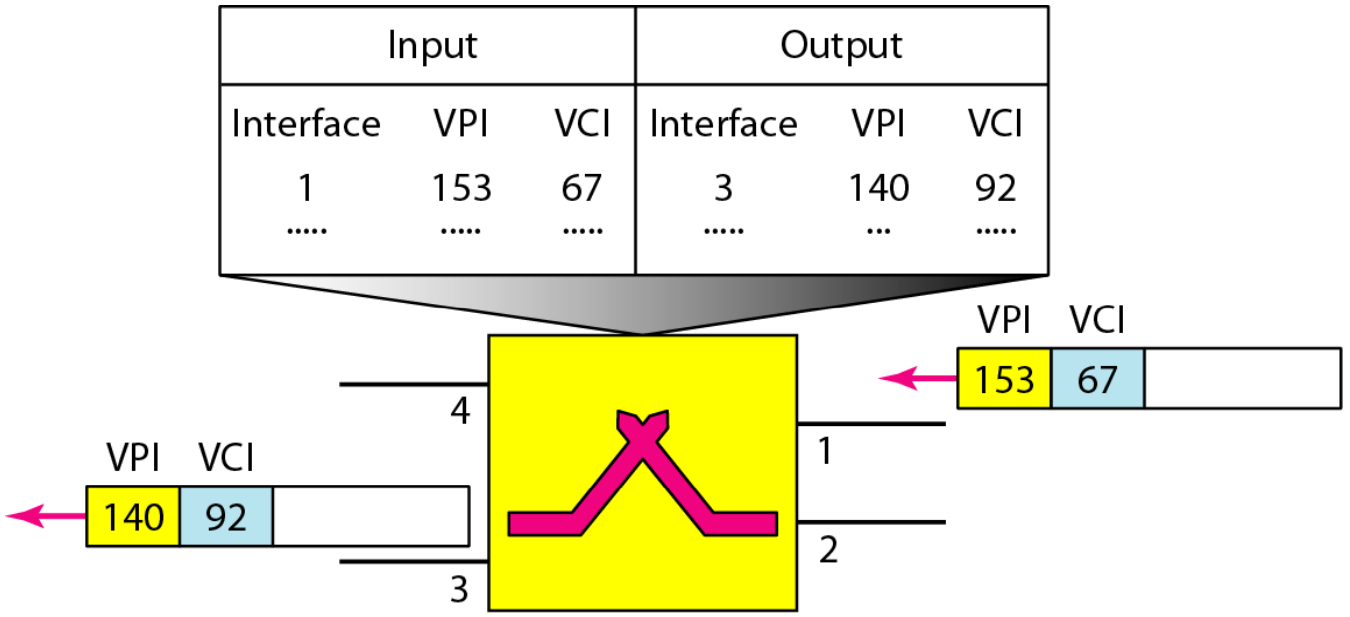


Figure 18.17 *ATM layers in endpoint devices and switches*

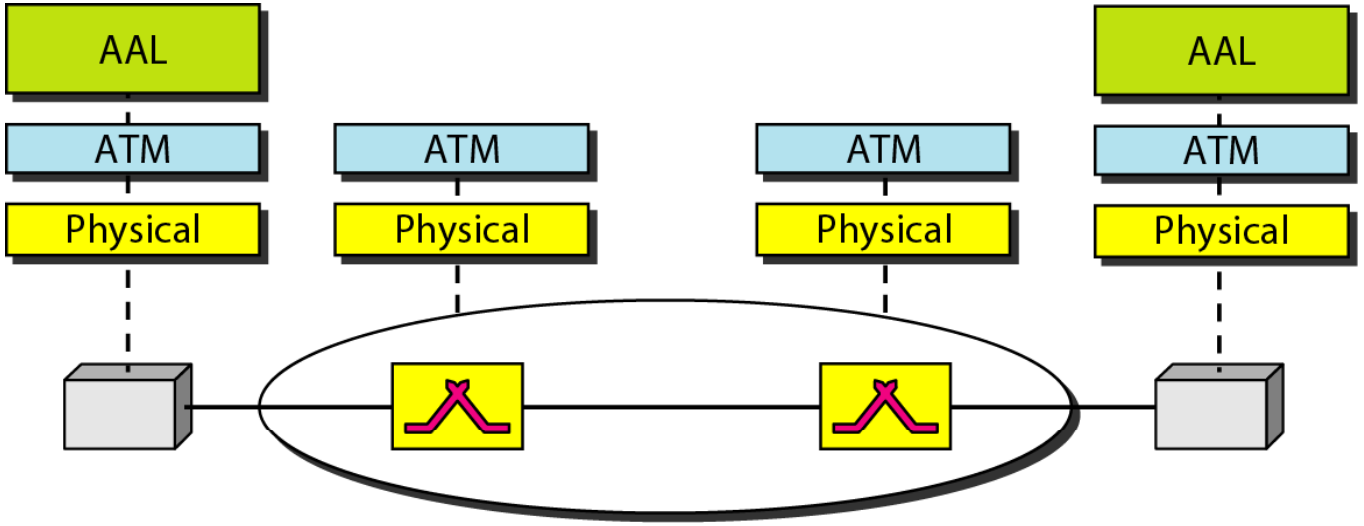


Figure 18.18 *ATM layer*

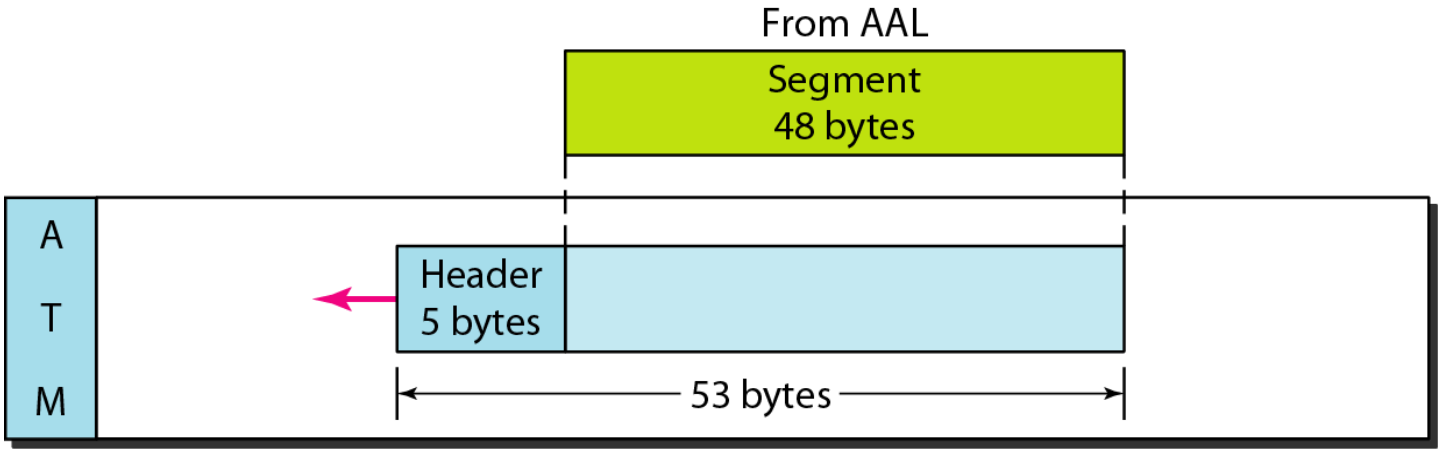


Figure 18.19 *ATM headers*

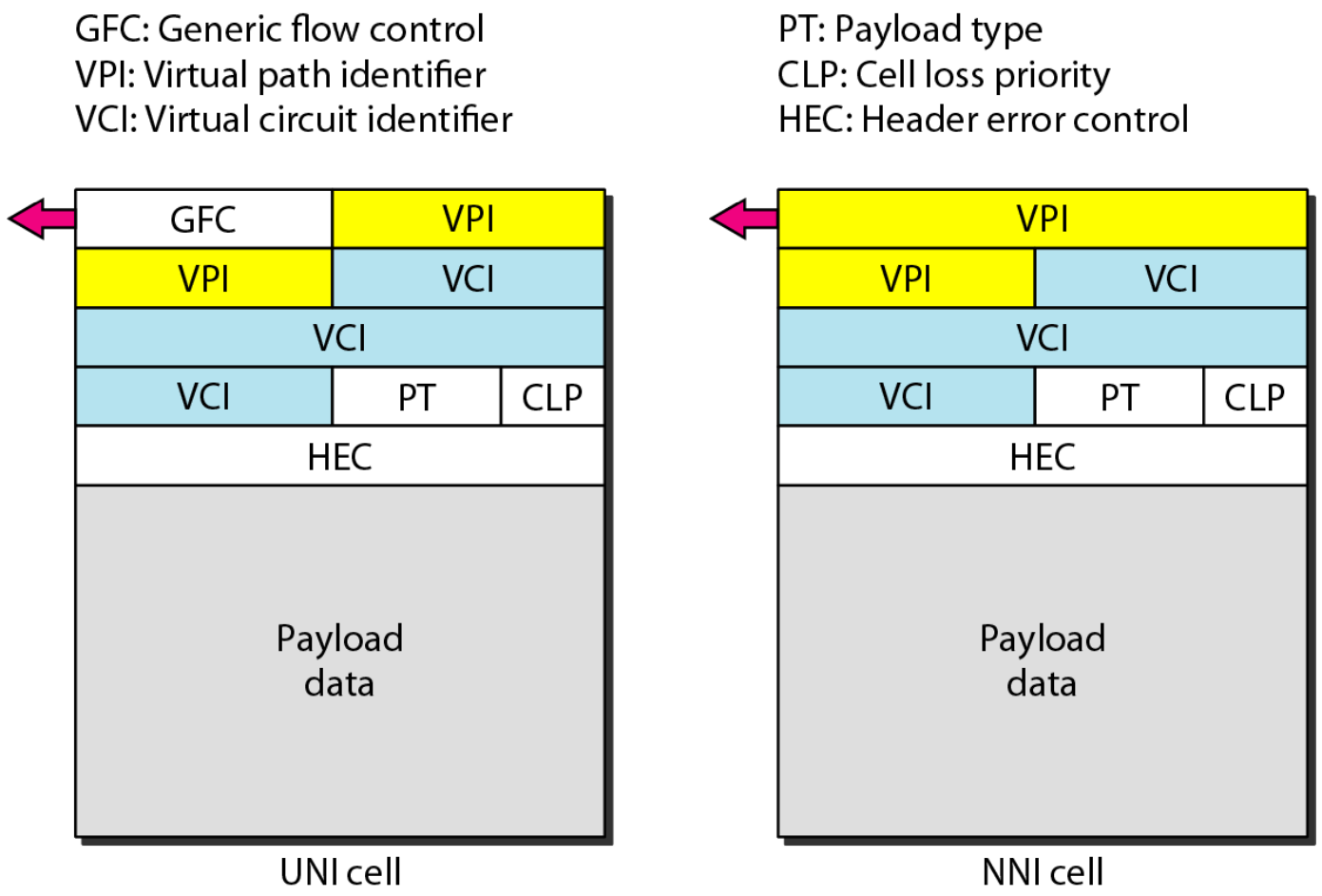


Figure 18.16 *ATM layers*

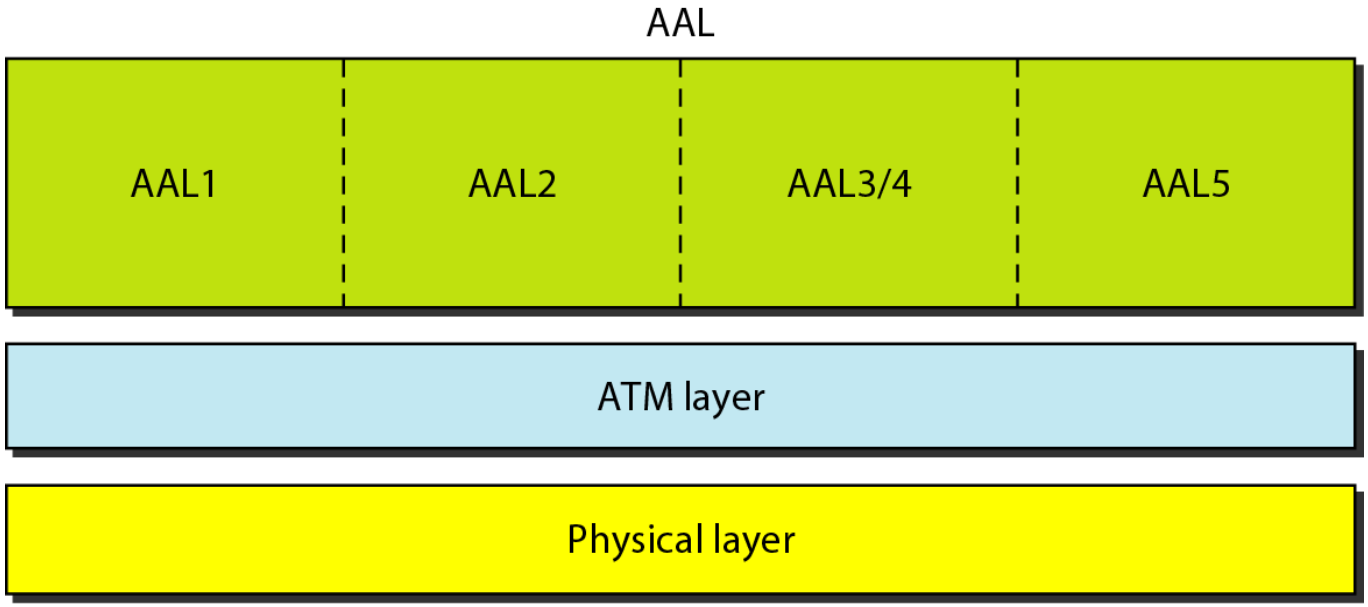


Figure 18.20 *AAL1*

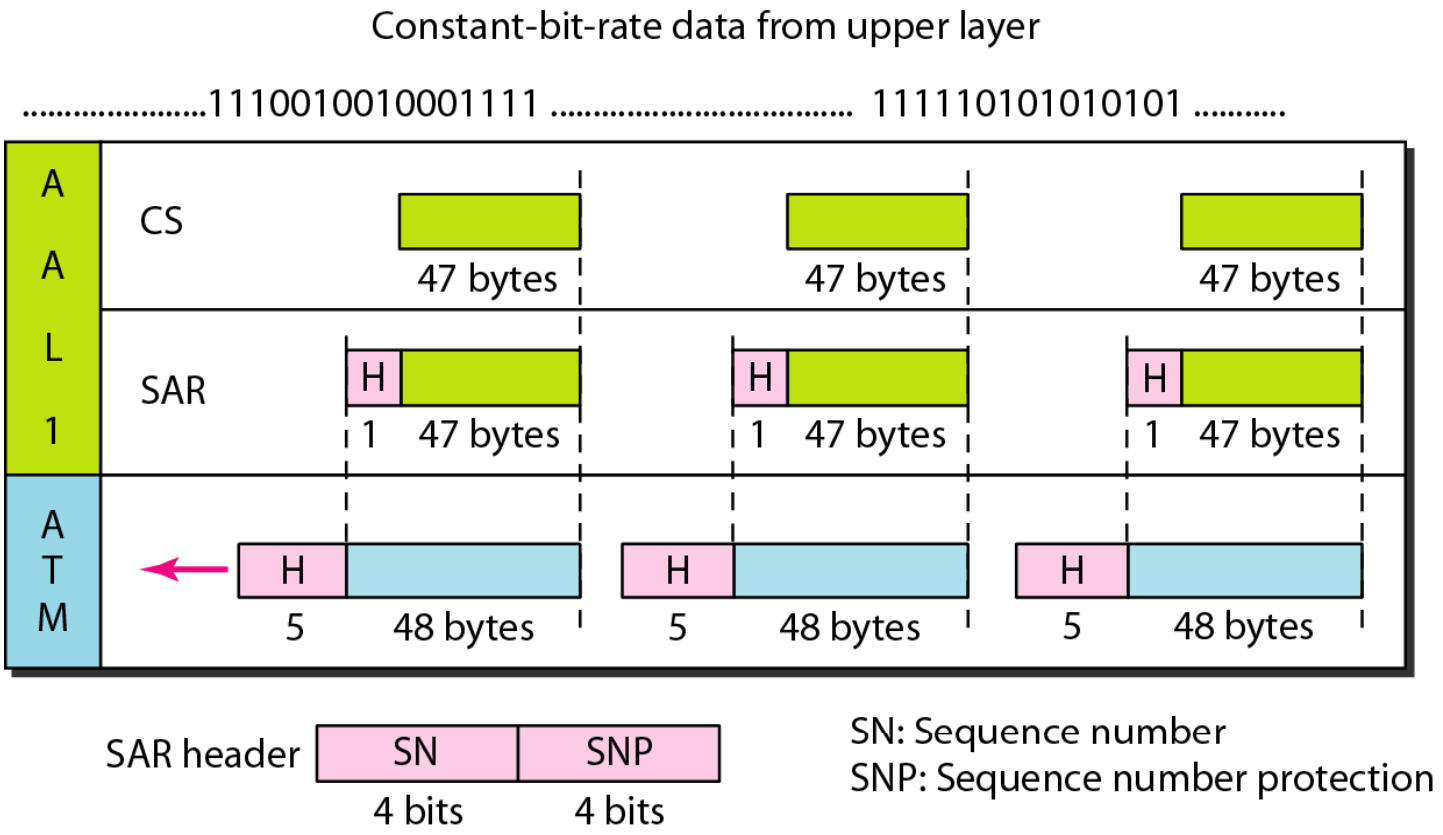


Figure 18.21 *AAL2*

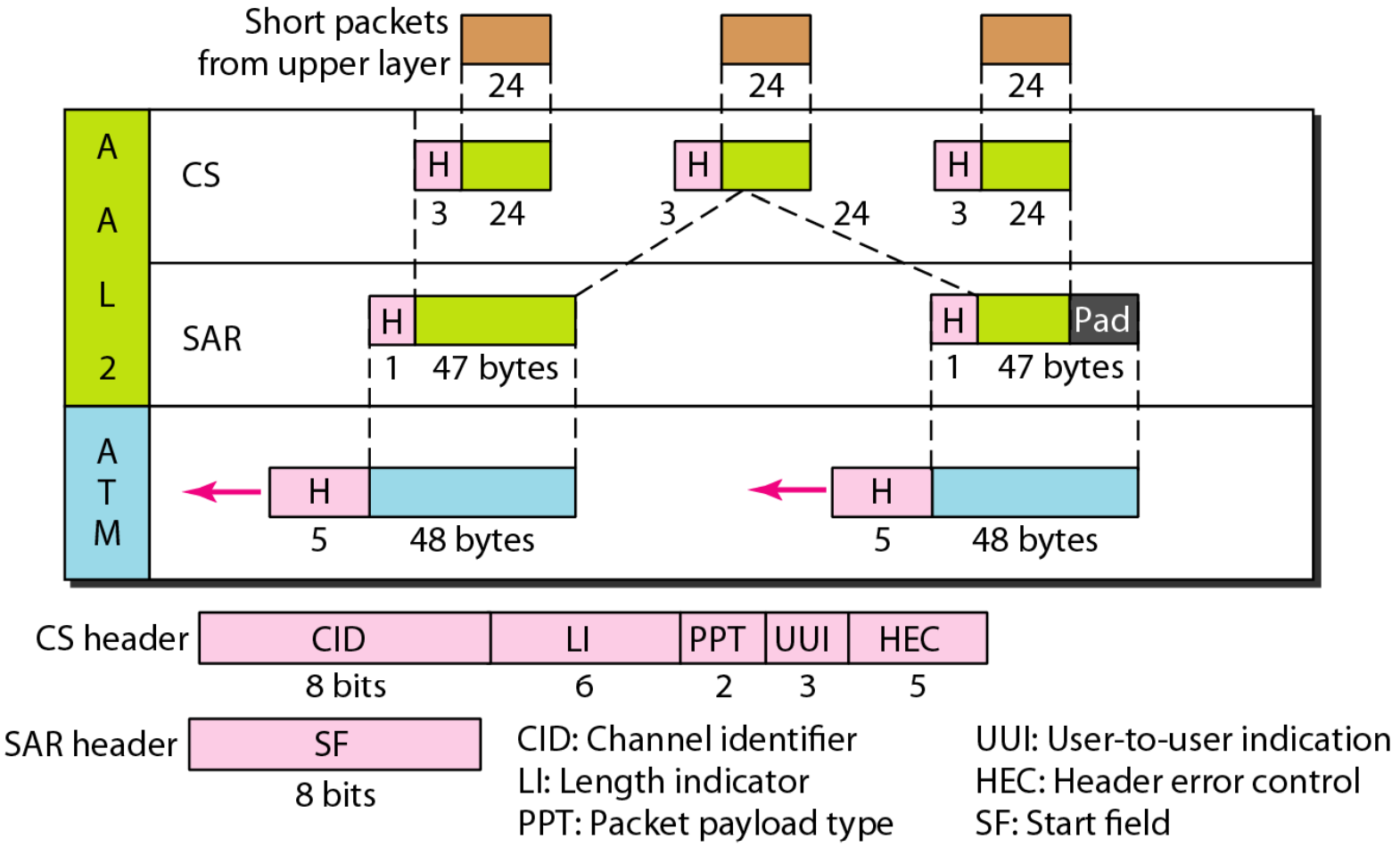


Figure 18.22 *AAL3/4*

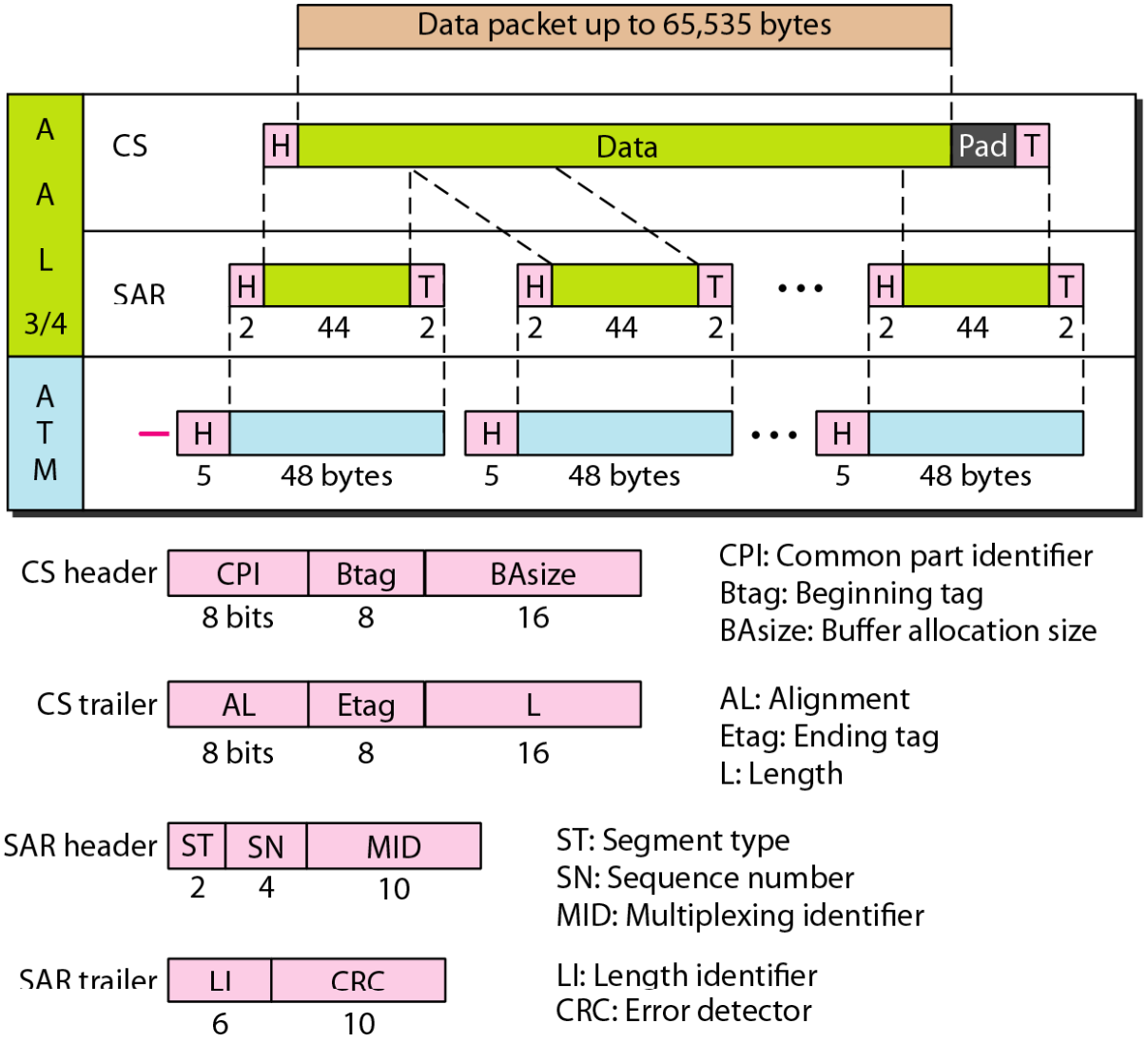
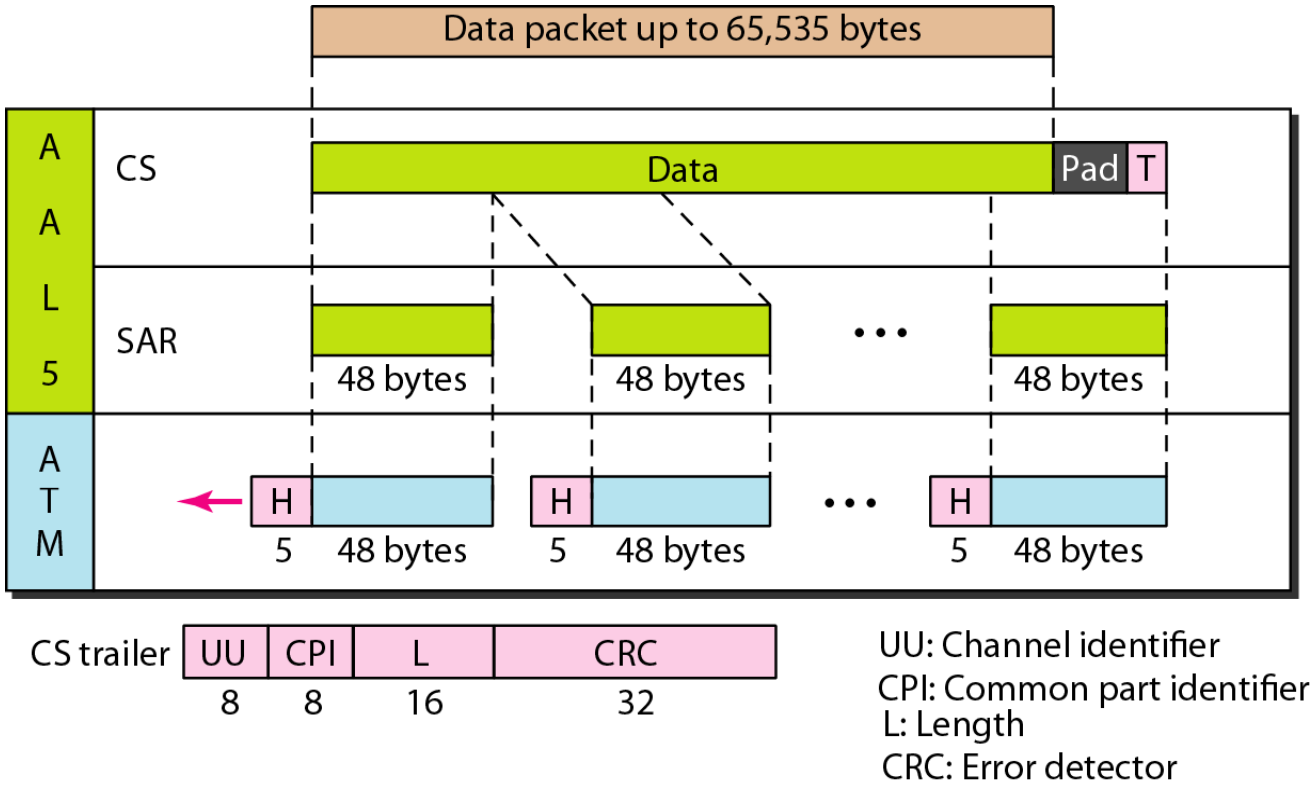


Figure 18.23 *AAL5*



ATM WAN & LAN

- ATM egentligen WAN-teknik
- ATM kan anpassas till att vara LAN-teknik
  - Olika typer av förbindelser mellan slutanvändare
  - Olika tjänster anpassade till multimedia
  - Skalar bra

Figure 18.24 *ATM LANs*

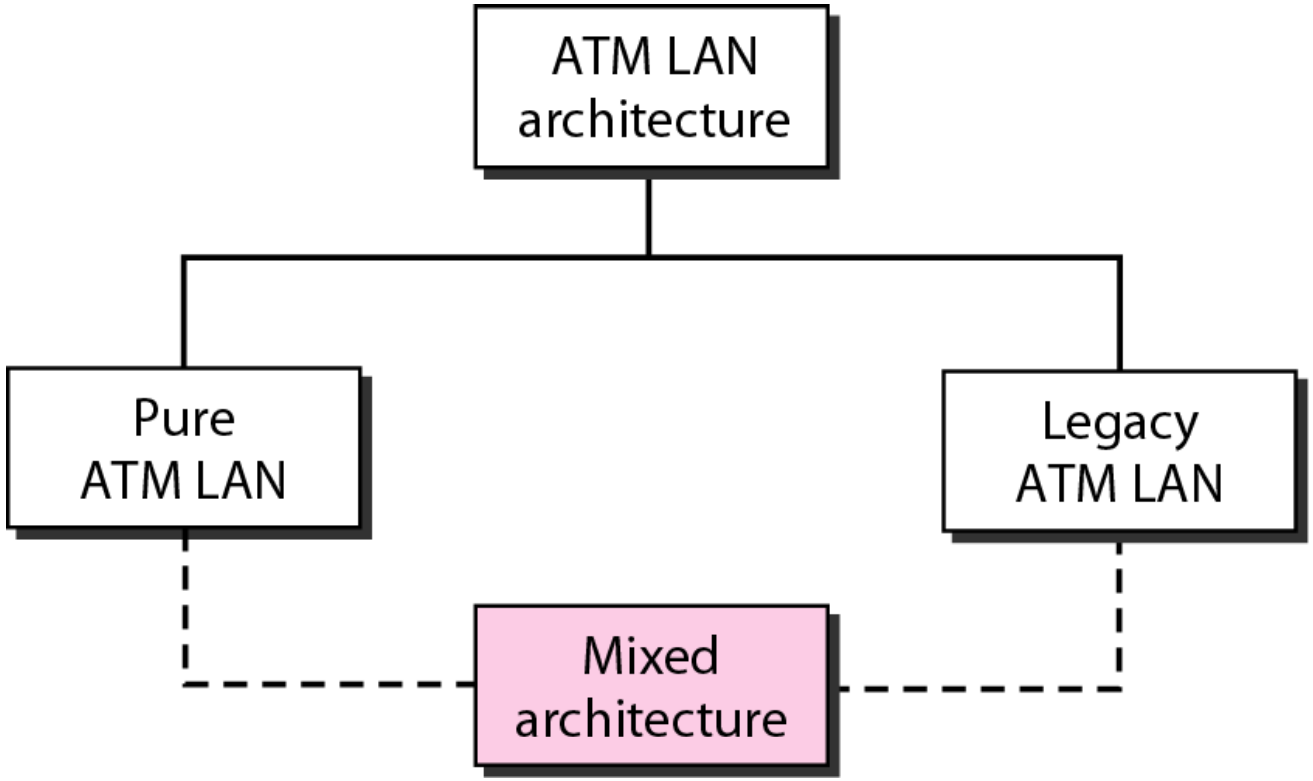


Figure 18.25 *Pure ATM LAN*

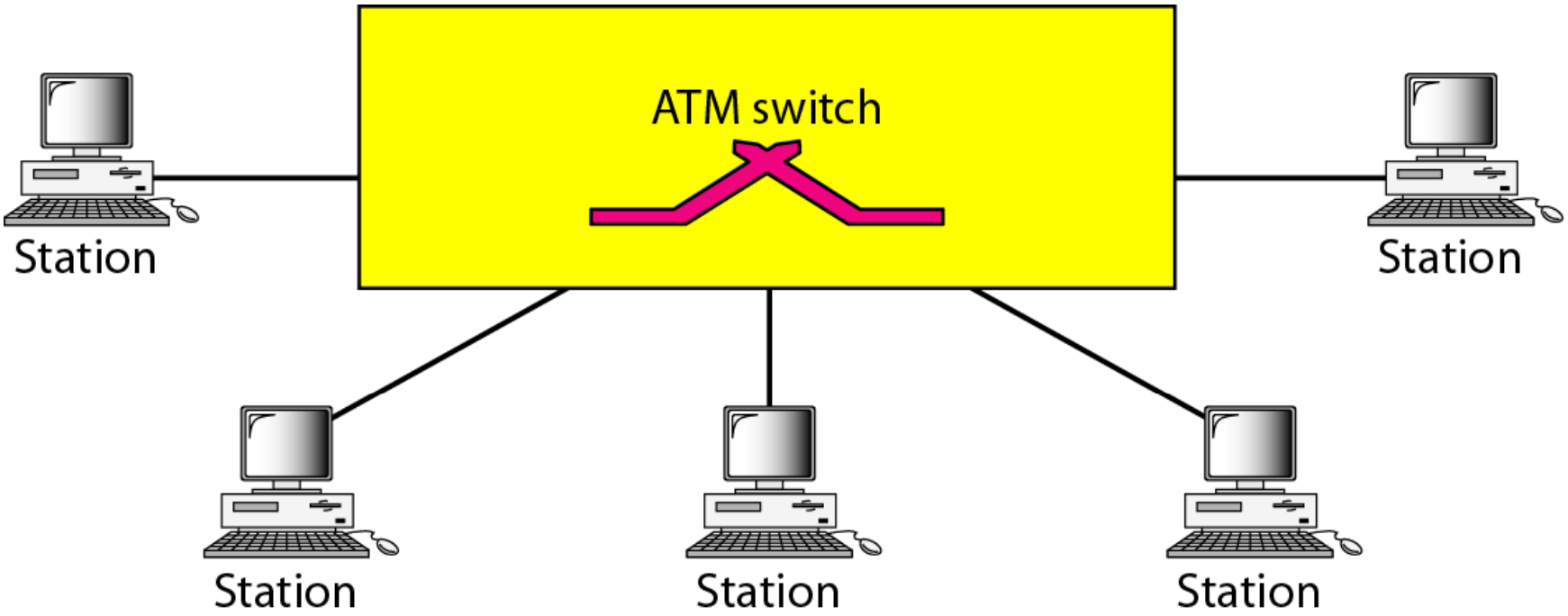


Figure 18.26 *Legacy ATM LAN*

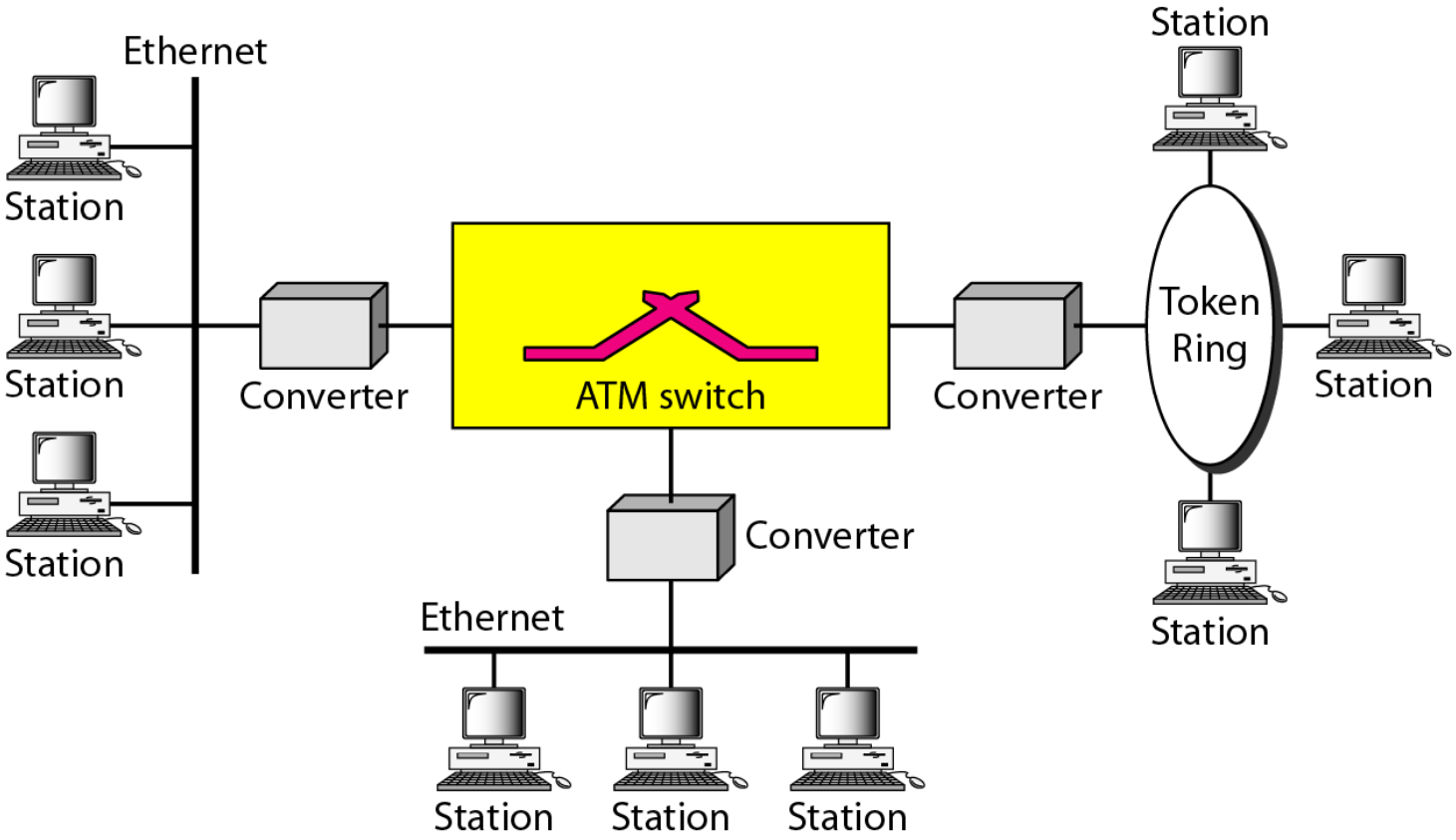
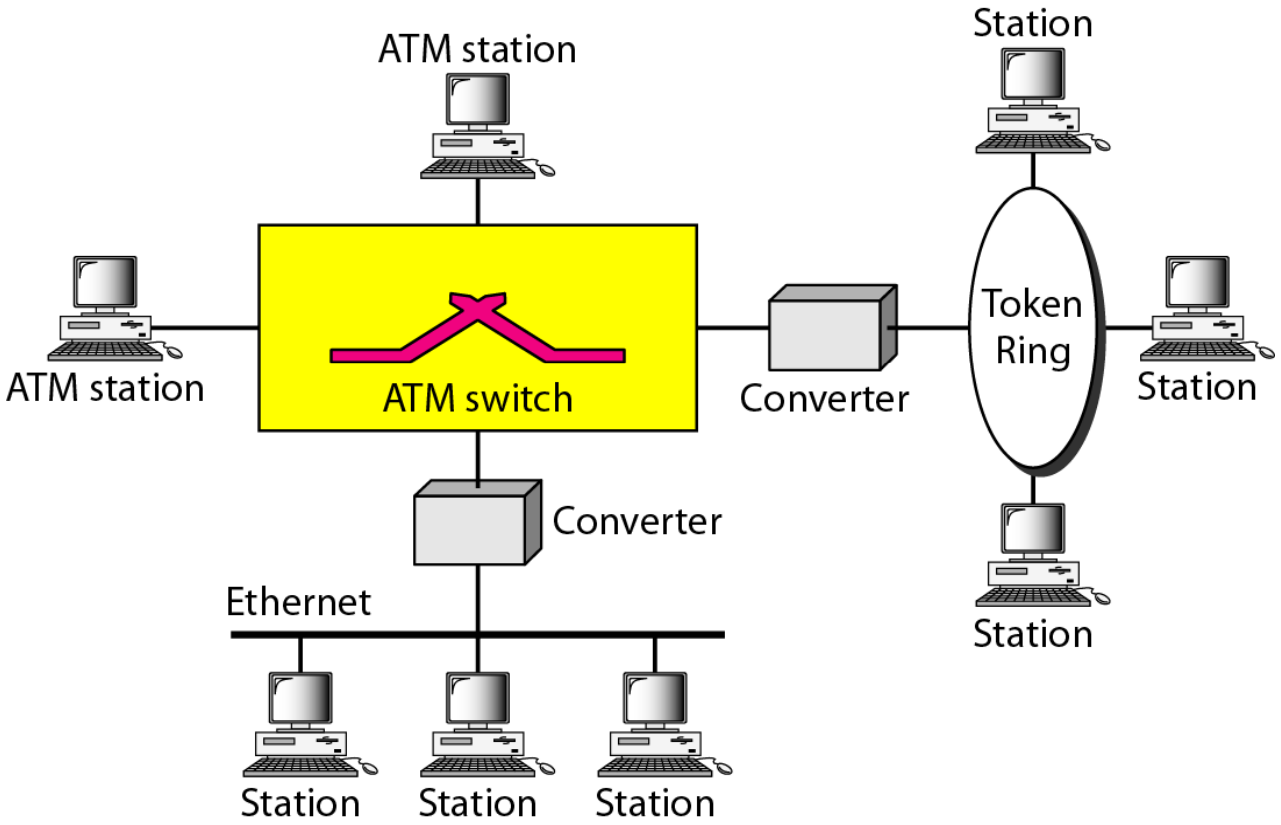


Figure 18.27 *Mixed architecture ATM LAN*



ATM som LAN inte helt enkelt

- ATM är förbindelseorienterat protokoll. Hur hantera överliggande förbindelselösa protokoll?
- ATM är en-till-en. LAN är en till många/alla.
- Fysiska adresser måste kopplas till Virtuella Circuit Identifier
- Multicast och broadcast?
- Interoperabilitet i mixed architecture?

Hjälpfunktioner behövs!

Figure 18.28 *Client and servers in a LANE*

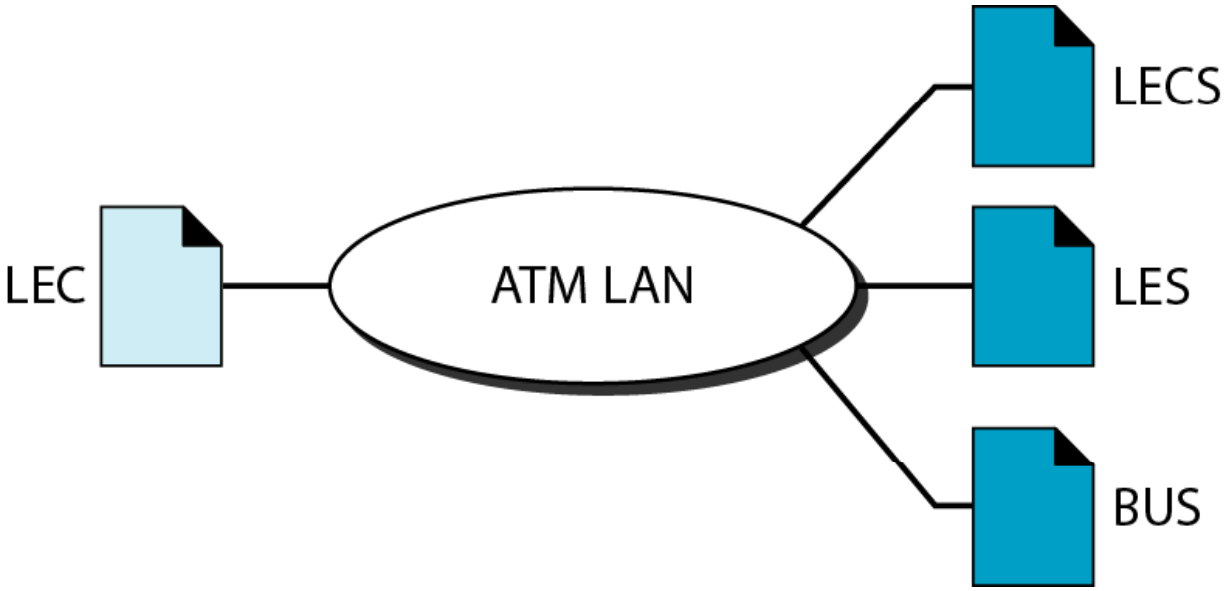


Figure 18.29 *Client and servers in a LANE*