

SDH



Synchronous Digital Hierocracy



SDH Frame Structure



SDH Multiplexing Method

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Objectives

- Understand the basic of SDH standards
- Know the features, applications and advantages of SDH

Emergence of SDH



What is SDH?

- Synchronous Digital Hierarchy
- It defines frame structure, multiplexing method, digital rates hierarchy and interface code pattern.

Why did SDH emerge?

- Need for a system to process increasing amounts of information.
- New standard that allows mixing equipment from different suppliers.

Advantages of SDH (Interfaces)



- **PDH**

- Electrical interfaces**

- Only regional standards. 3 PDH rate hierarchies for PDH: European (2.048 Mb/s), Japanese, North American (1.544 Mb/s).

- Optical interfaces**

- No standards for optical line equipments, manufacturers develop at their will.

- **SDH**

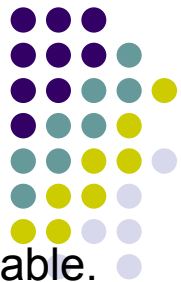
- Electrical interfaces**

- Can be connected with existing PDH signals.

- Optical interfaces**

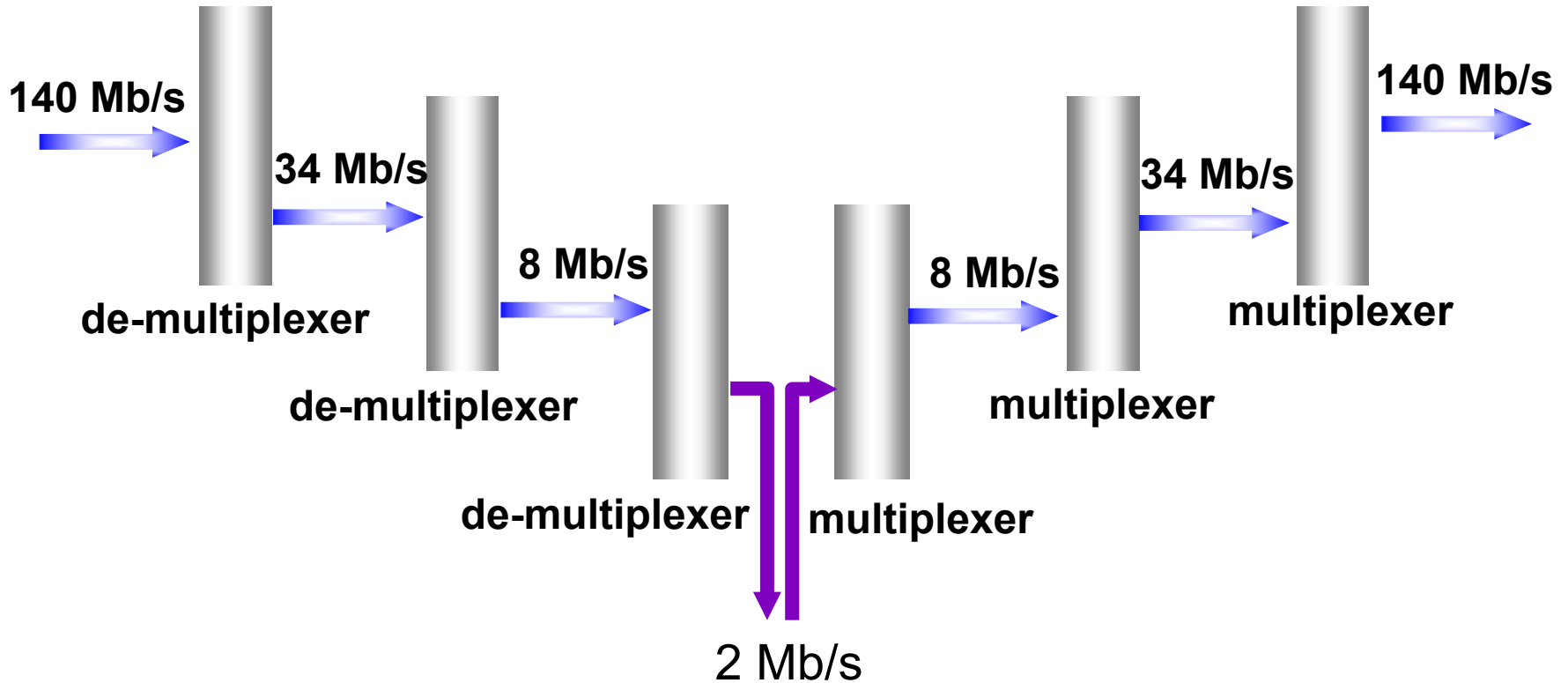
- Can be connected to multiple vendors' optical transmission equipments.

Disadvantages of PDH (Multiplexing methods)



- PDH : **Asynchronous Multiplexing**

The location of low-rate signals in high-rate signals is neither regular nor predictable.



level by level

Not suitable for huge-volume transmission

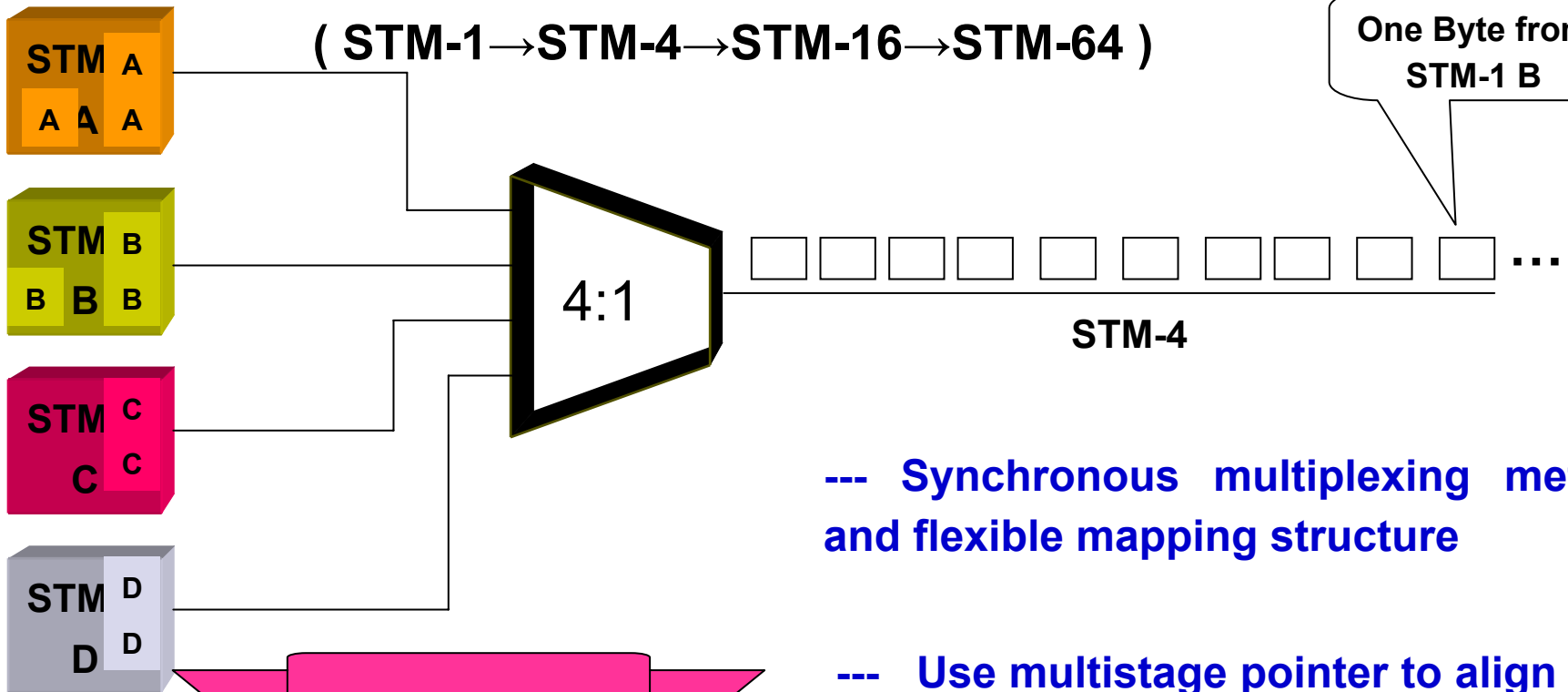
Advantages of SDH (Multiplexing methods)

byte interleaved multiplexing method



Low rate SDH to higher rate SDH

(STM-1 → STM-4 → STM-16 → STM-64)



What about PDH?

--- Synchronous multiplexing method and flexible mapping structure

--- Use multistage pointer to align PDH loads in SDH frame, thus, dynamic drop-and-insert capabilities

Advantages of SDH



● PDH

Weak Operation,
Administration &
Maintenance function.

● SDH

Abundant overheads
bytes for operation,
administration and
maintenance.

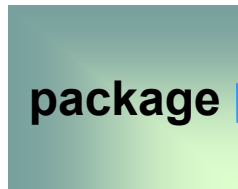
- About 5% of the
total bytes are being
used

Advantages of SDH (Compatibility)



PDH, SDH,
ATM, Ethernet

packing



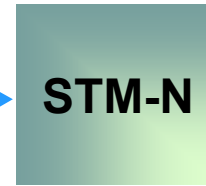
Processing



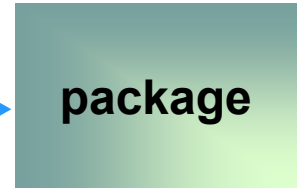
transmit



receive



Processing



unpacking

PDH, SDH,
ATM, Ethernet

Comparison between SDH and PDH



Low bandwidth utilization ratio.

Signal	Digital Bit Rate	Channels
E0	64 kbit/s	One 64 kbit/s
E1	2.048 Mbit/s	32 E0
E2	8.448 Mbit/s	128 E0
E3	34.368 Mbit/s	16 E1
E4	139.264 Mbit/s	64 E1

PDH Hierarchy

Bit Rate	Abbreviated	SDH	SDH Capacity
155.52 Mbit/s	155 Mbit/s	STM-1	63 E1, 3 E3 or 1 E4
622.08 Mbit/s	622 Mbit/s	STM-4	252 E1, 12 E3 or 4 E4
2488.32Mbit/s	2.5 Gbit/s	STM-16	1008 E1, 48 E3 or 16 E4
9953.28Mbit/s	10 Gbit/s	STM-64	4032 E1, 192 E3, 64 E4

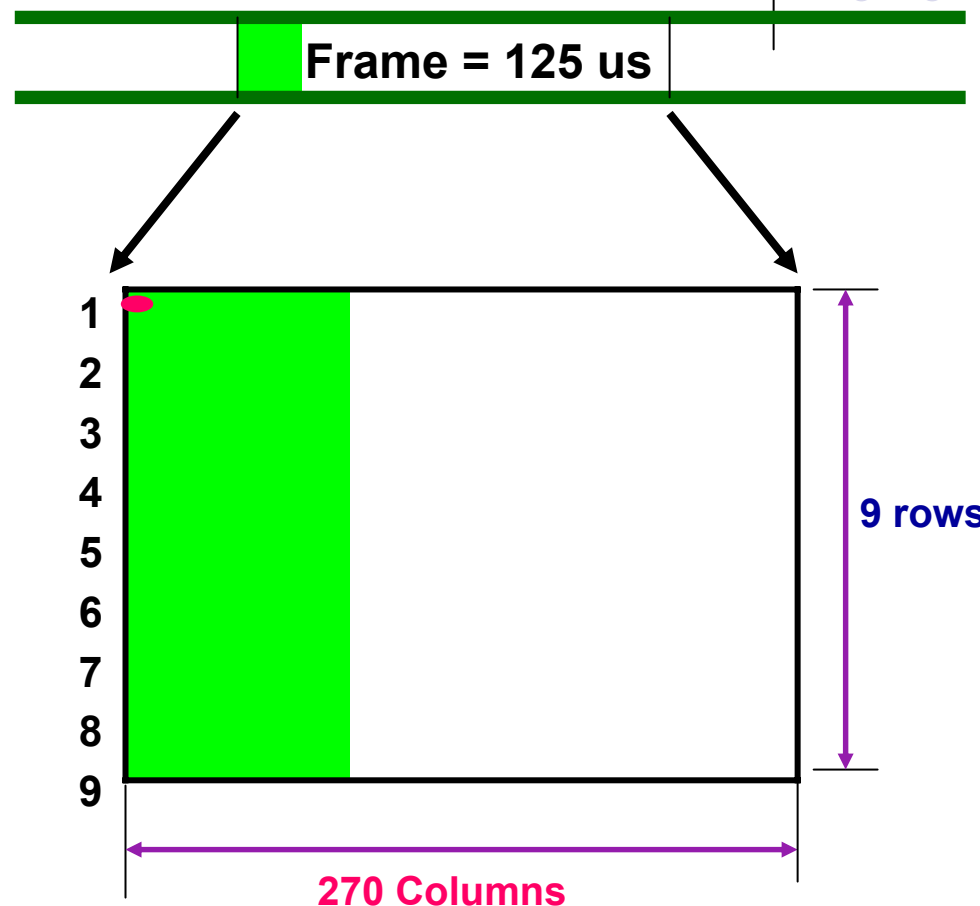
SDH Hierarchy

SDH Frame Structure



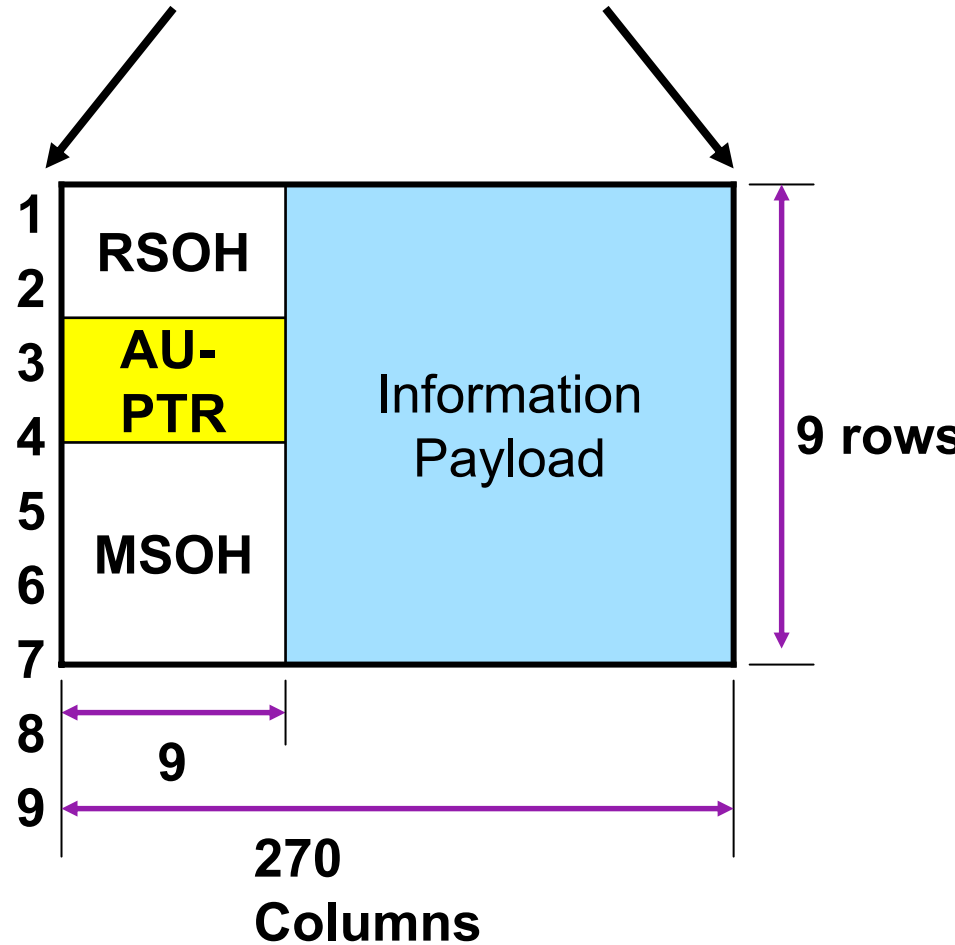
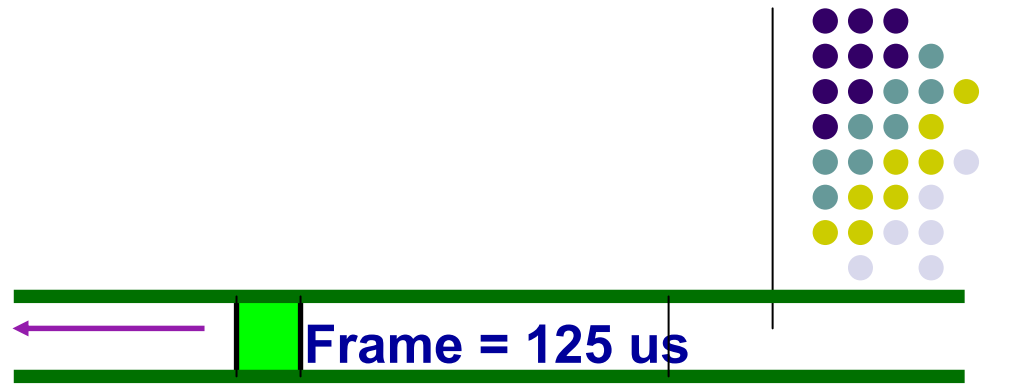
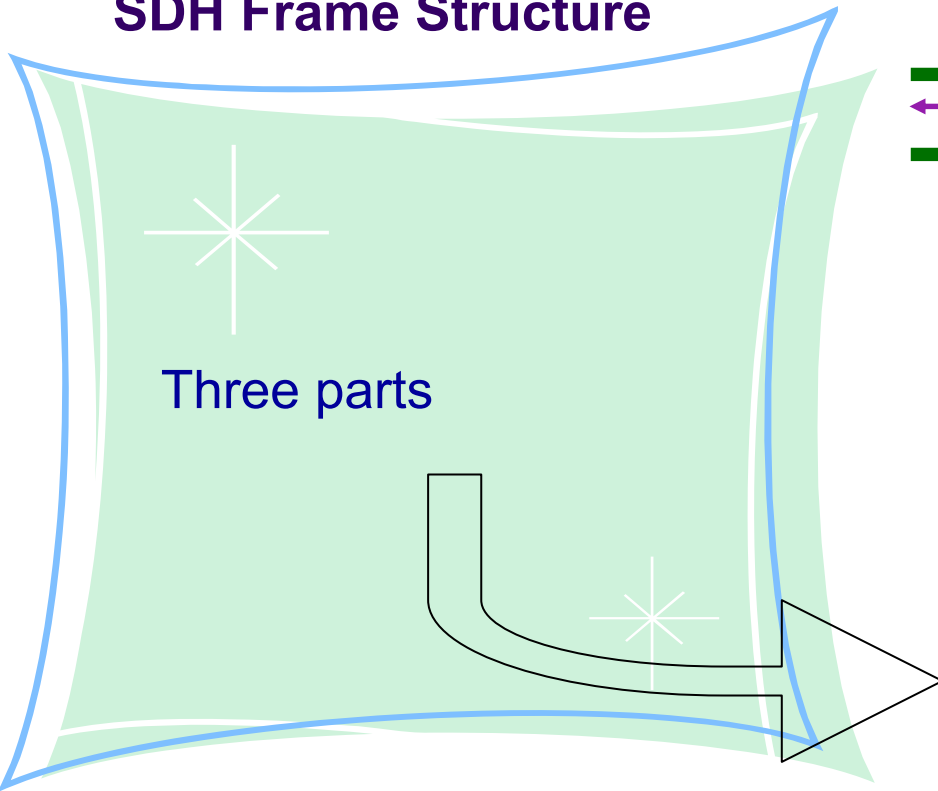
From ITU-T G.707:

1. One frame lasts for 125 microseconds (8000 frames/s)
2. Rectangular block structure 9 rows and 270 columns (STM-1)
3. Each unit is one byte (8 bits)
4. Transmission mode: Byte by byte, row by row, from left to right, from top to bottom



$$\text{Bit rate of STM-1} = 9 \times 270 \times 8 \times 8000$$

SDH Frame Structure

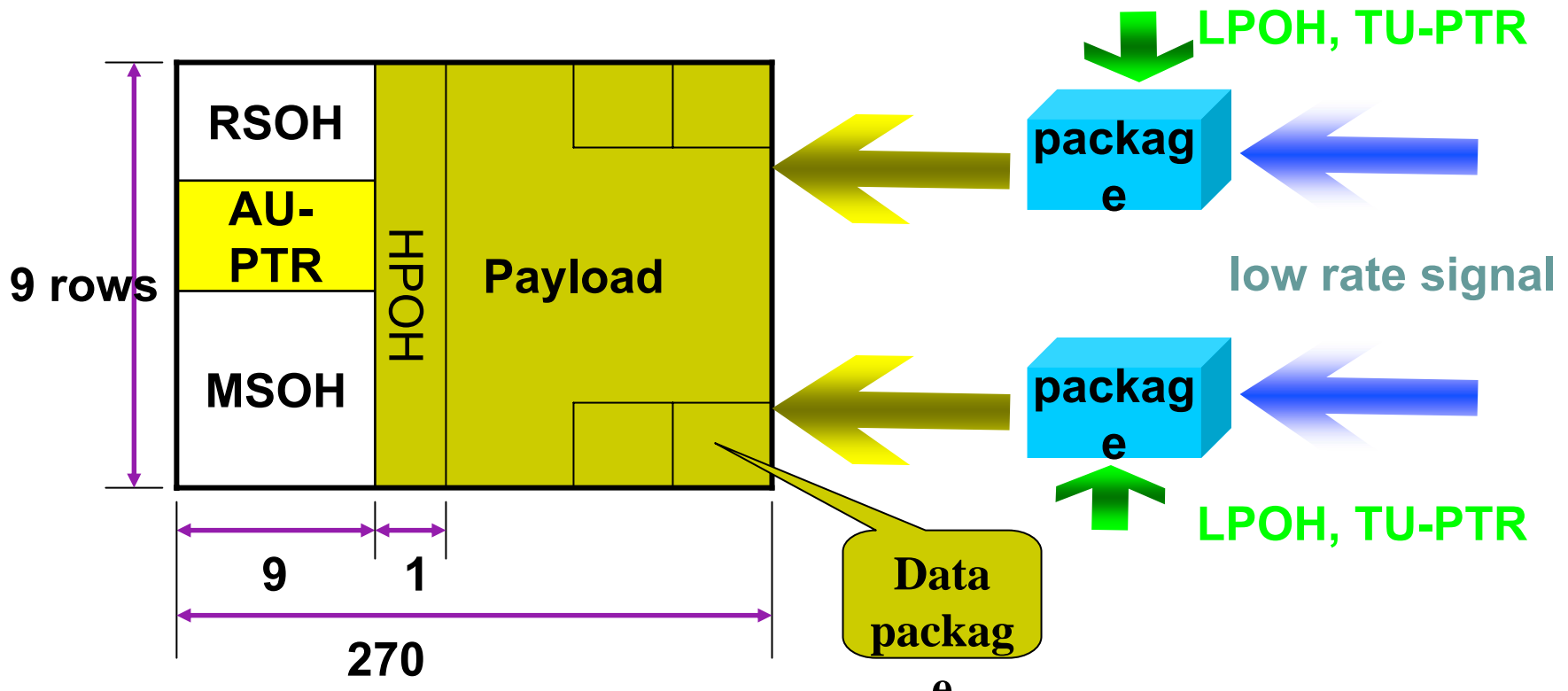


SDH Frame Structure



Information Payload

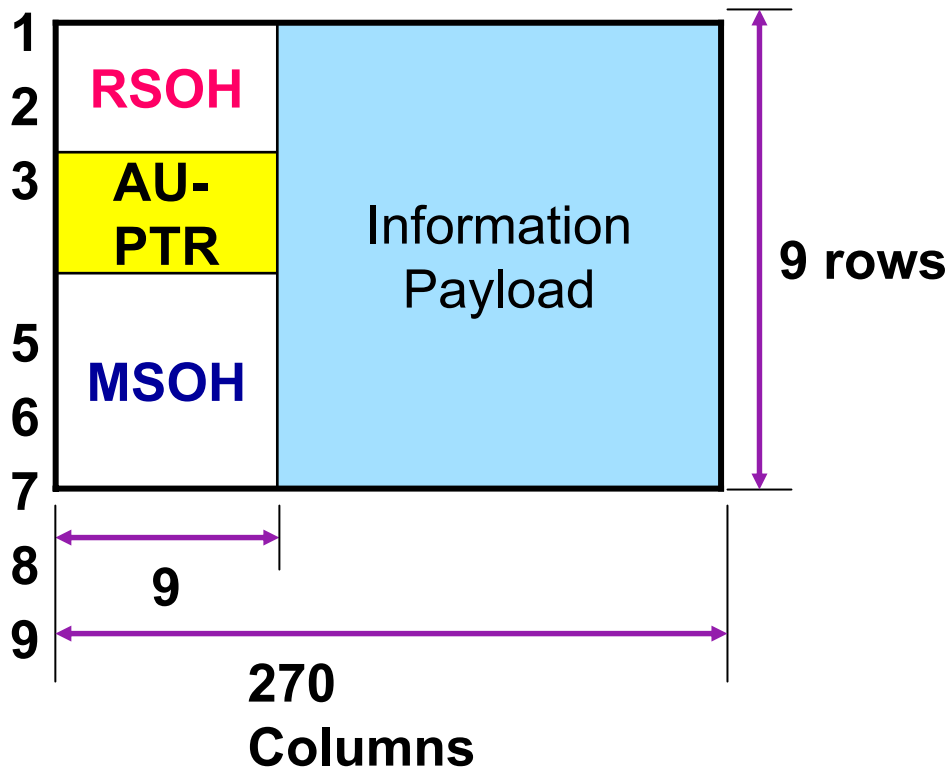
- ✓ Also known as Virtual Container level 4 (VC-4)
- ✓ Used to transport low speed tributary signals
- ✓ Contains low rate signals and Path Overhead (POH)
- ✓ Location: rows #1 ~ #9, columns #10 ~ #270



Section Overhead



SDH Frame Structure



Types of Section Overhead

1. **RSOH** monitors the regenerator section
2. **MSOH** monitors the multiplexing section

Location:

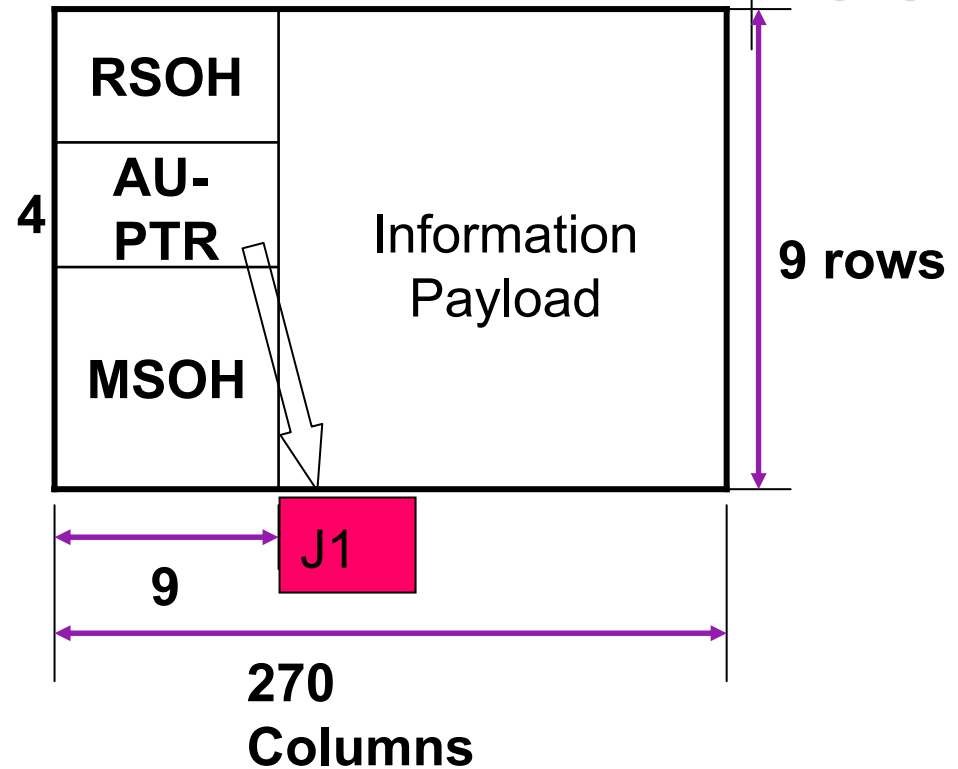
1. **RSOH**: rows #1 ~ #3, columns #1 ~ #9
2. **MSOH**: rows #5 ~ #9, columns #1 ~ #9

AU-PTR

SDH Frame Structure

Function:
Indicates the first byte of VC4

Location:
row #4, columns #1 ~ #9



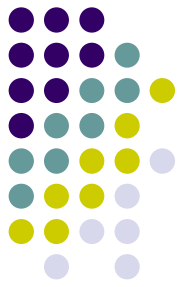
SDH Multiplexing Method

SDH Multiplexing includes:

- ✓ Low to high rate SDH signals (STM-1 → STM-N)
- ✓ PDH to SDH signals (2M, 34M & 140M → STM-N)
- ✓ Other hierarchy signals to SDH Signals (IP → STM-N)

Some terms and definitions:

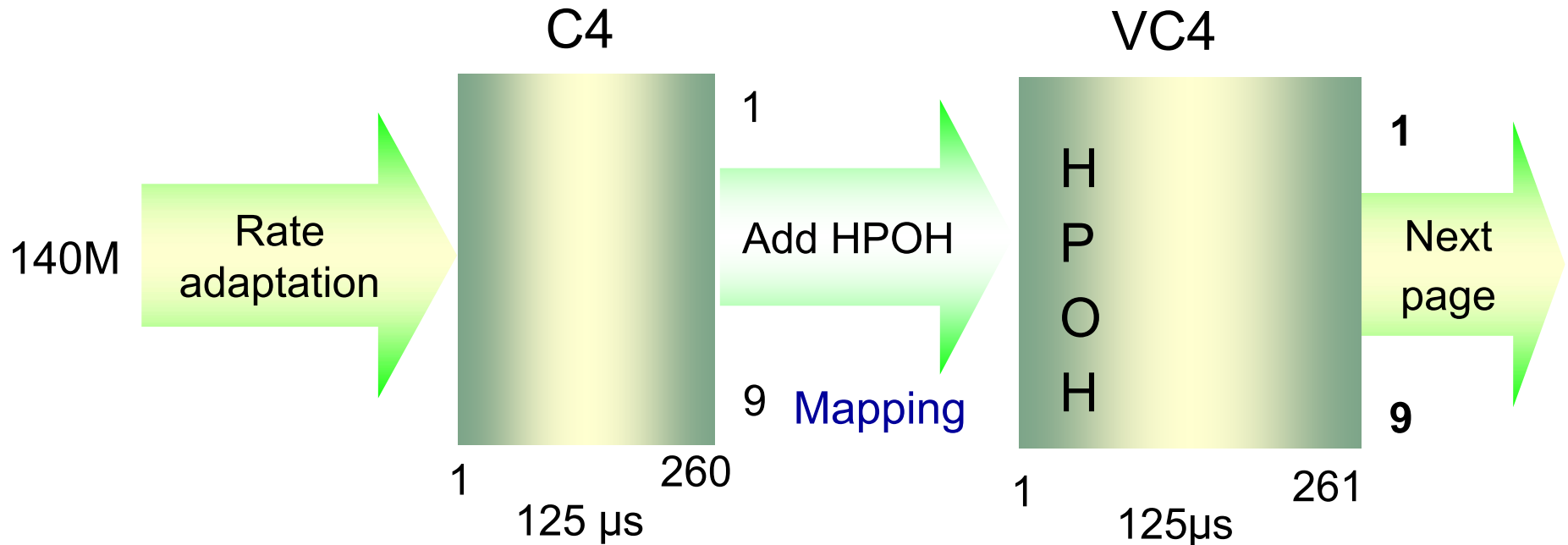
- ▶ Mapping
- ▶ Aligning
- ▶ Multiplexing



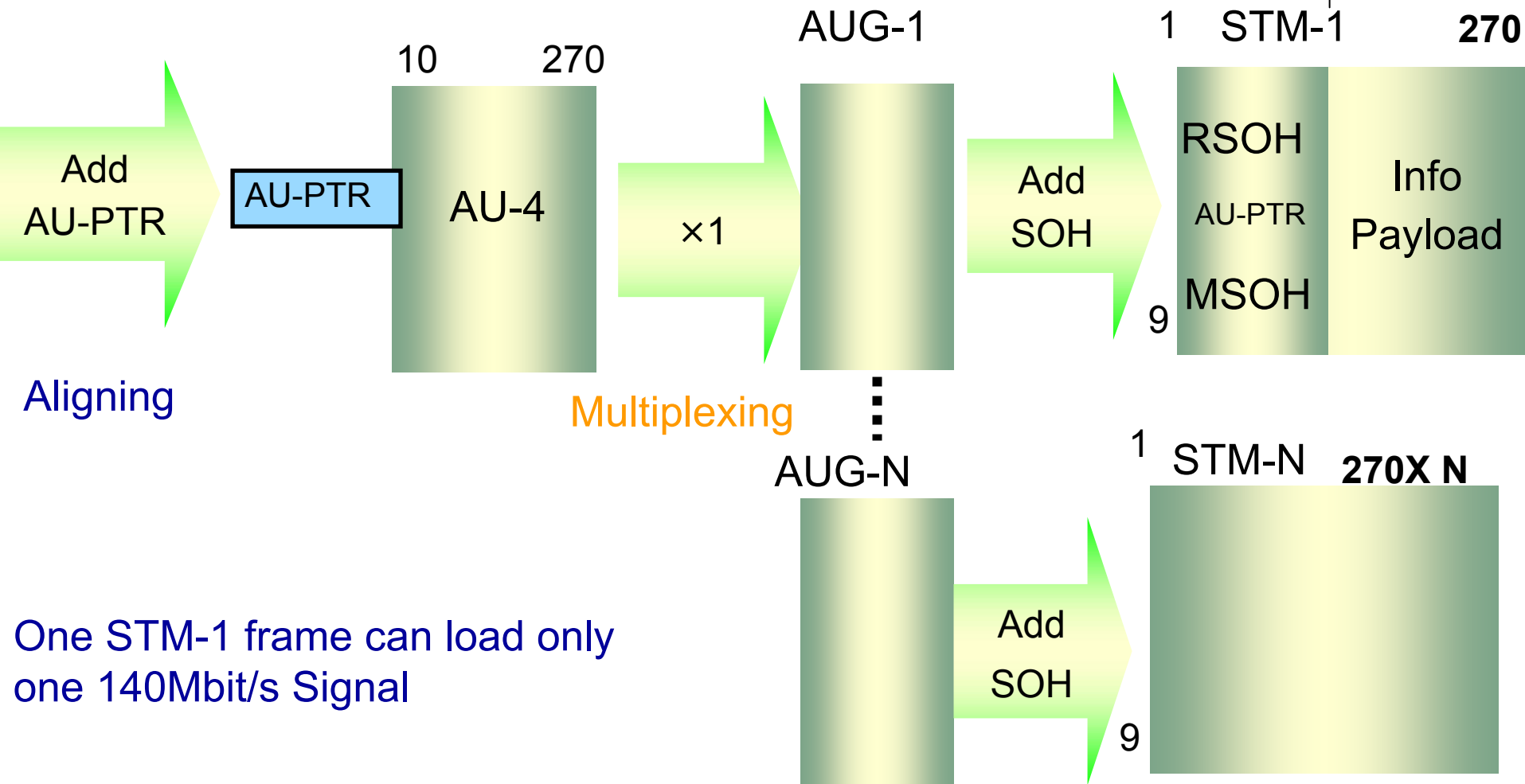
SDH Tributary Multiplexing (140M)



140 Mbit/s to STM-N



SDH Tributary Multiplexing (140M)



Aligning

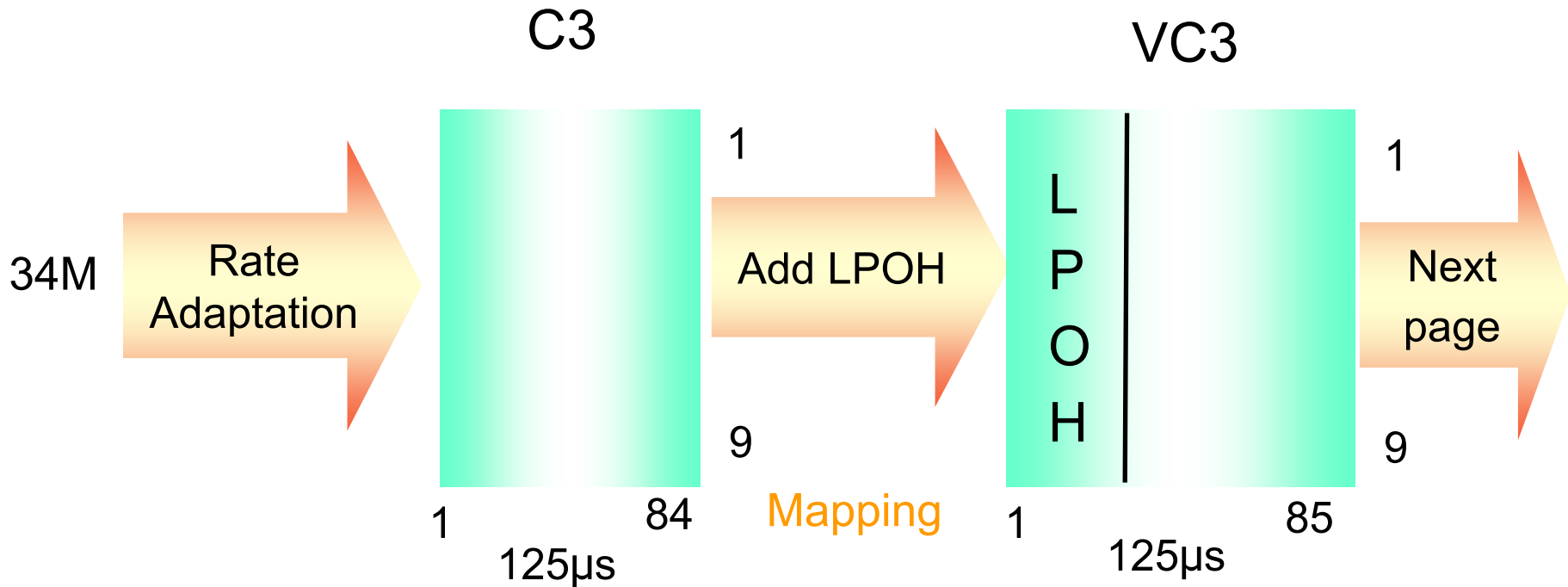
Multiplexing

One STM-1 frame can load only one 140Mbit/s Signal

SDH Tributary Multiplexing (34M)



34 Mbit/s to STM-N



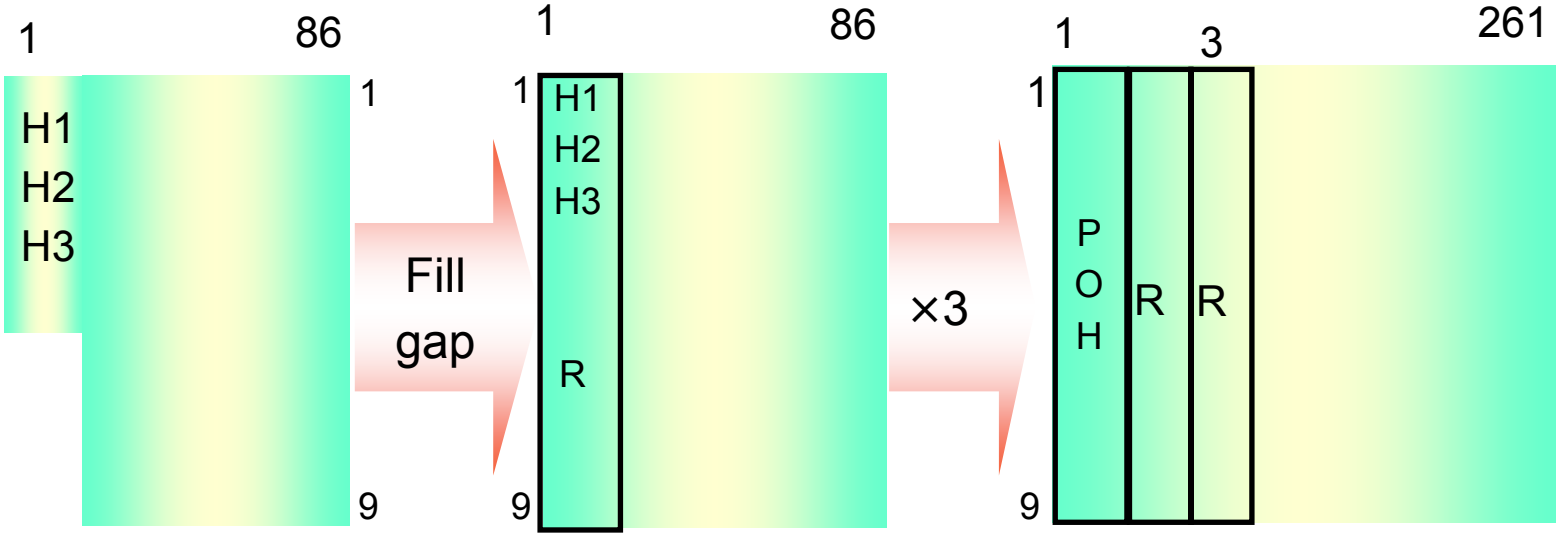
SDH Tributary Multiplexing (34M)



TU-3

TUG-3

VC-4



1st align

Fill gap

x3

Aligning

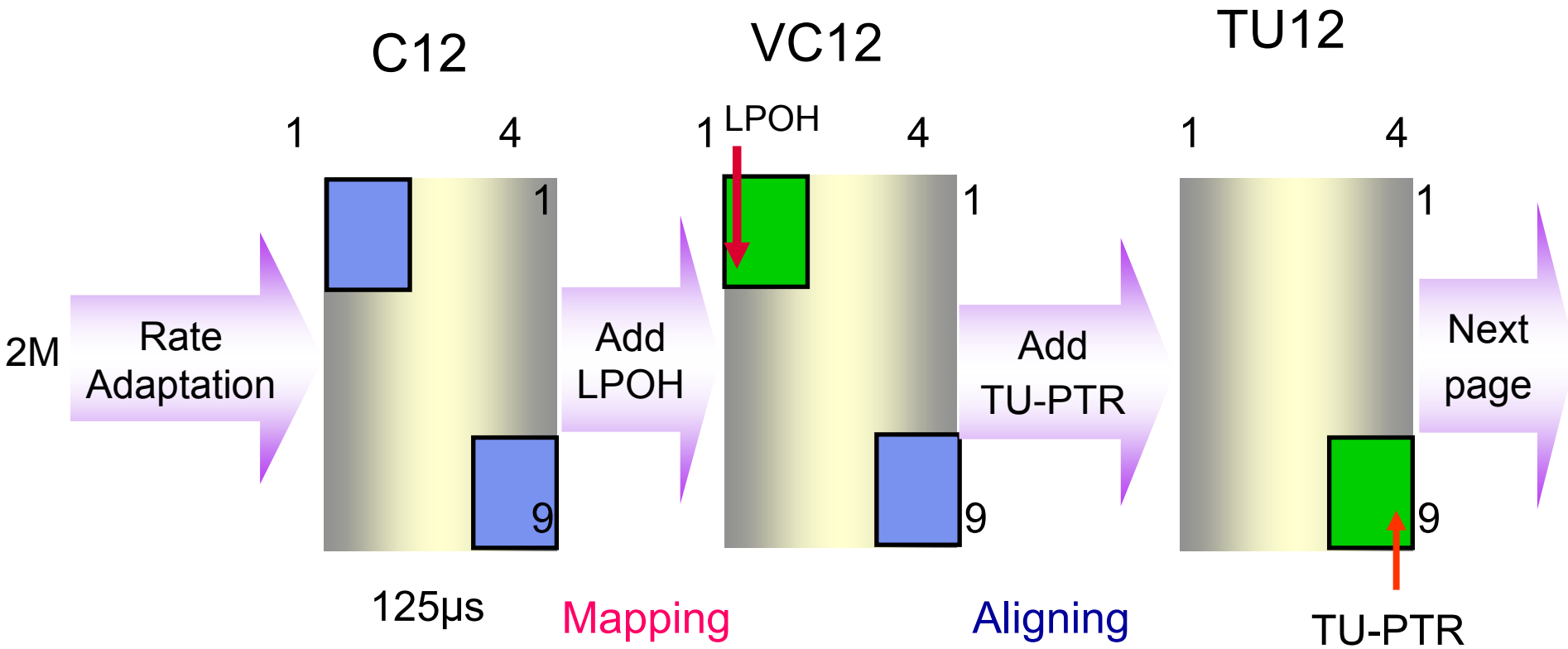
Multiplexing

Same procedure as 140M

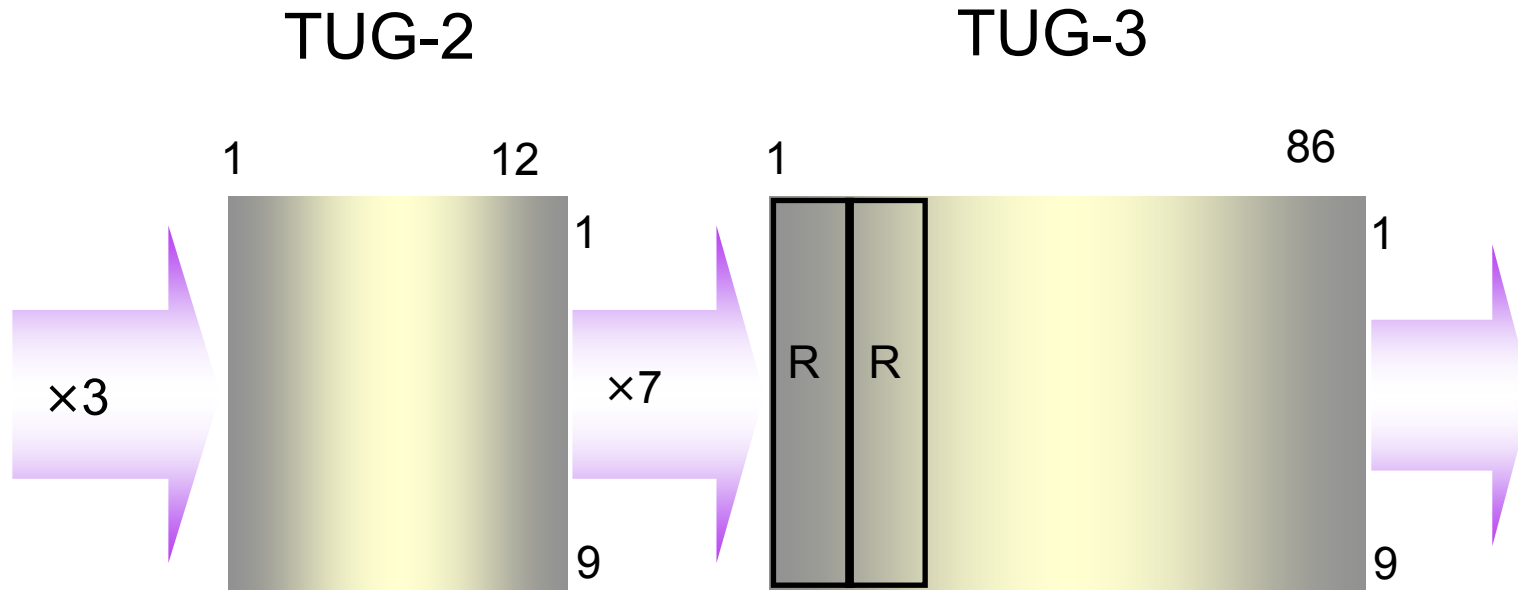
SDH Tributary Multiplexing (2M)



2 Mbit/s to STM-N



SDH Tributary Multiplexing (2M)



Multiplexing

Multiplexing

Same
procedure
as 34M

Glossary



- ▶ **Mapping** - A process used when tributaries are adapted into VCs by adding POH information
- ▶ **Aligning** - This process takes place when a pointer is included in a Tributary Unit (TU) or an Administrative Unit (AU), to allow the 1st byte of the VC to be located
- ▶ **Multiplexing** - This process is used when multiple low-order path signals are adapted into a higher-order path signal, or when high-order path signals are adapted into a Multiplexing Section

[Back](#)



Glossary

C = Container

VC = Virtual Container

TU = Tributary Unit

AU = Administrative Unit

TUG = Tributary Unit Group

AUG = Administrative Unit Group

STM = Synchronous Transfer Module

POH = Path Overhead

[Back](#)



CONTENT

1. SDH Overview

**2 . Frame Structure & Multiplexing
Methods**

3. Overhead & Pointers

Section Overheads



R S S H	A1	A1	A1	A2	A2	A2	J0		
	B1	Δ	Δ	E1	Δ		F1		
	D1	Δ	Δ	D2	Δ		D3		
AU-PTR									
M S S H	B2	B2	B2	K1			K2		
	D			D			D		
	D			D			D		
	D			D			D		
	S1						M	E2	

STM-1

$\Delta = 1$ Media dependent bytes

Questions

