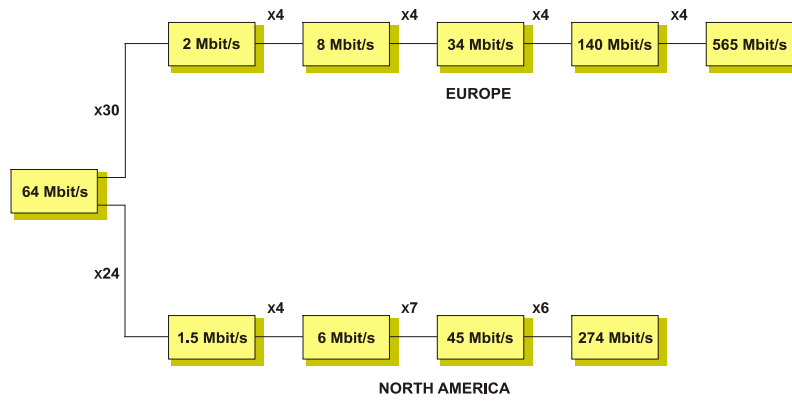


Chapter Objectives

After completing this chapter you will be able to:

- Describe the various PDH standards
- Describe the operation and the frame format, of PDH systems
- Describe the SONET standard under the following headings: frame structure, overheads, pointers, multiplexing and the network
- Describe the SDH standard under the following headings: frame structure, payload capacity, multiplexing and equipment

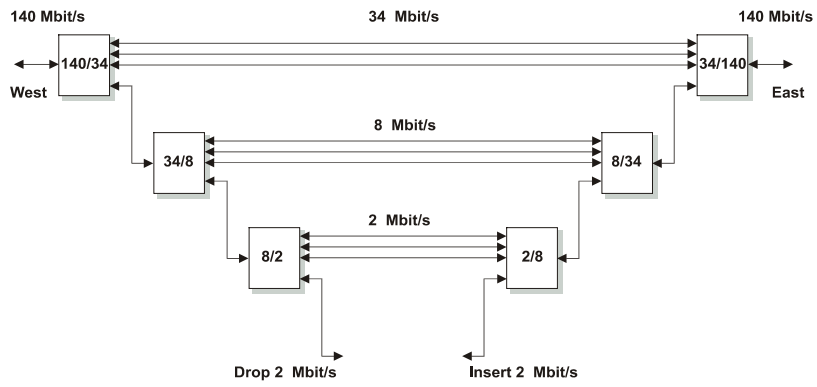
Europe and North American PDH Systems



Digital Hierarchy Levels

Digital Hierarchy Level	1544 kbit/s		2048 kbit/s
	(Japan)	(USA)	(Europe)
	64	64	64
1	1,544	1,544	2,048
2	6,312	6,312	8,448
3	32,064	44,736	34,368
4	97,728		139,264

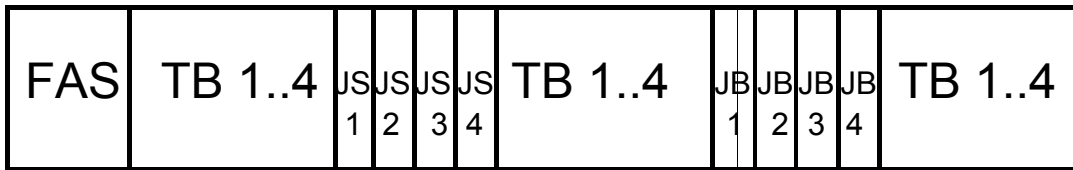
PDH Multiplexing



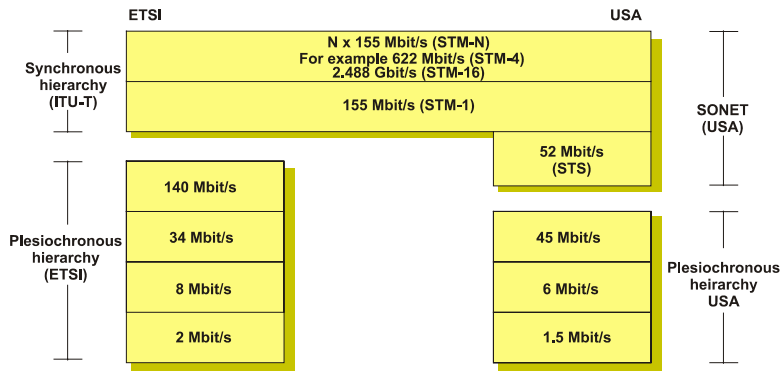
Disadvantages of PDH

- Inflexible and expensive**
- Limited management and maintenance capabilities**
- Costly AO&M**
- Low capacity**
- Network status verification problems**
- Network failure**
- High capacity growth**
- Access network problems**
- Vendor incompatibility**

Basic Frame Structure of Plesiochronous Digital Signals



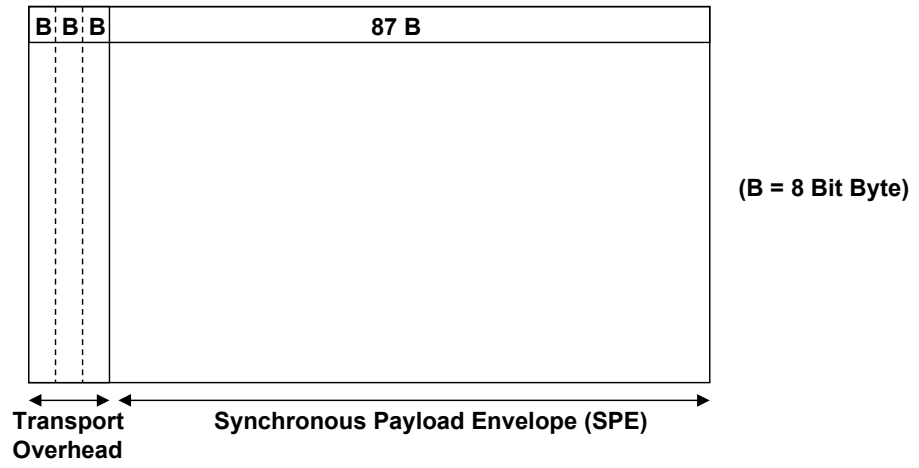
PDH/SDH and SONET



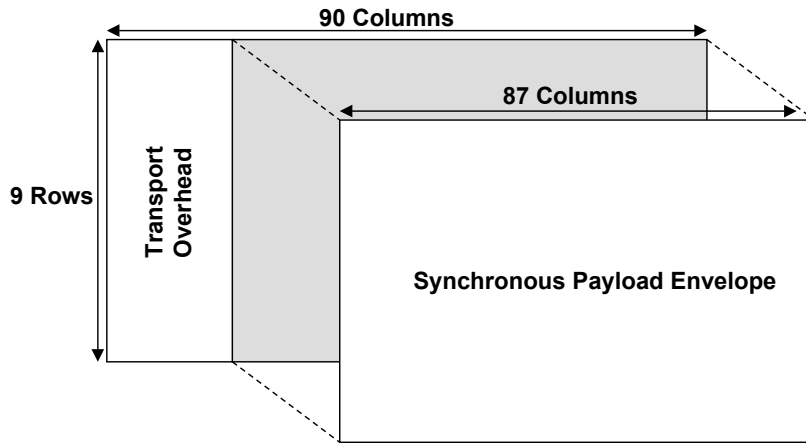
SONET Hierarchy

Signal	Bit Rate (Mbit/s)	Capacity
STS-1 (OC-1)	51.840	28 DS-1s or 1 DS-3
STS-3 (OC-3)	155.520	84 DS-1s or 3 DS-3s
STS-12 (OC-12)	622.080	336 DS-1s or 12 DS-3s
STS-48 (OC-48)	2.488.320	1344 DS-1s or 48 DS-3s
STS-192 (OC-192)	9.953.280	5376 DS-1s or 192 DS-3s

STS-1 Frame Format

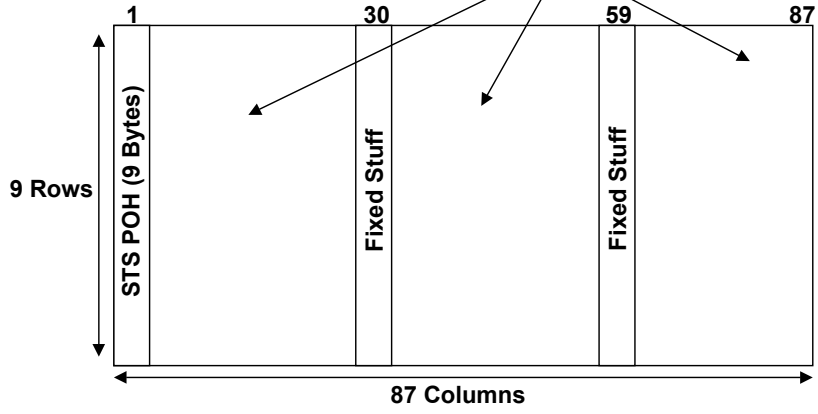


STS-1 Frame Elements

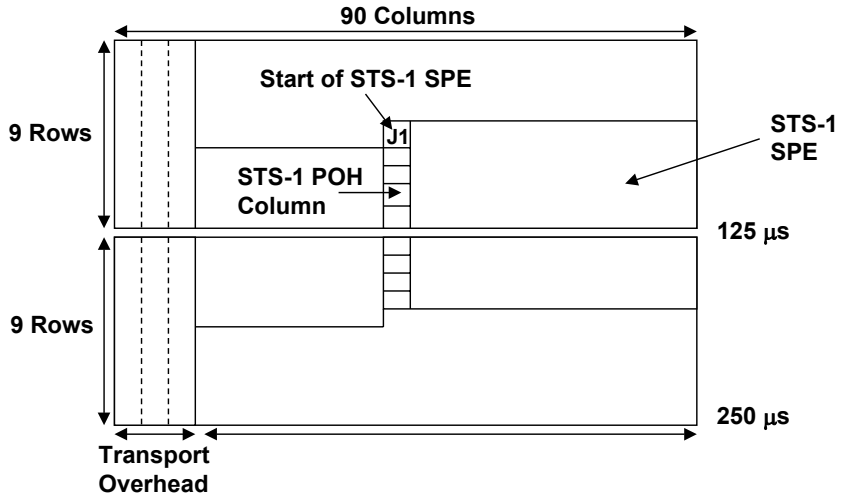


STS-1

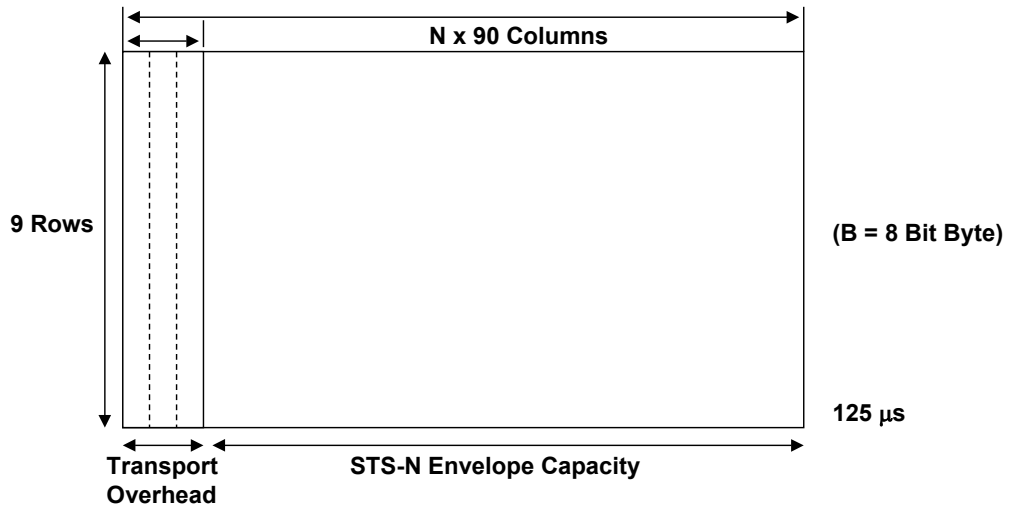
STS-1 Payload Capacity



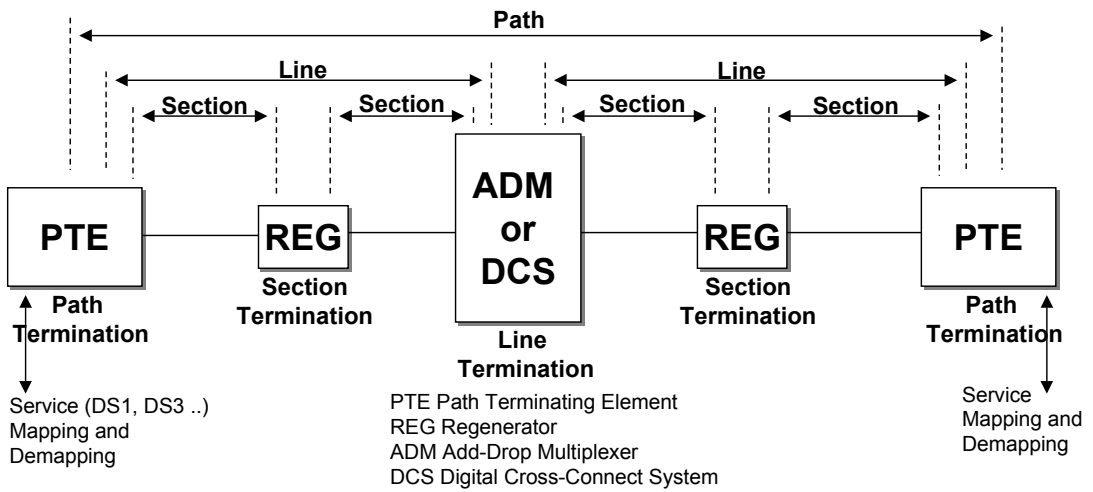
STS-1 SPE



STS-N



Overhead Layers



Section Overhead

		1	2	3		
Section Overhead	↑	1	A1	A2	JO/ZO	J1
		2	B1	E1	F1	B3
	↓	3	D1	D2	D3	C2
Line Overhead	↑	4	H1	H2	H3	H4
		5	B2	K1	K2	G1
		6	D4	D5	D6	F2
		7	D7	D8	D9	Z3
		8	D10	D11	D12	Z4
	↓	9	S1Z1	M0 or M1/Z2	E2	Z5
			Transport Overhead			Path Overhead

Line Overhead

		1	2	3		
Section Overhead	↑	1	A1	A2	JO/ZO	J1
		2	B1	E1	F1	B3
	↓	3	D1	D2	D3	C2
Line Overhead	↑	4	H1	H2	H3	H4
		5	B2	K1	K2	G1
		6	D4	D5	D6	F2
		7	D7	D8	D9	Z3
		8	D10	D11	D12	Z4
	↓	9	S1Z1	M0 or M1/Z2	E2	Z5
			Transport Overhead			Path Overhead

Path Overhead

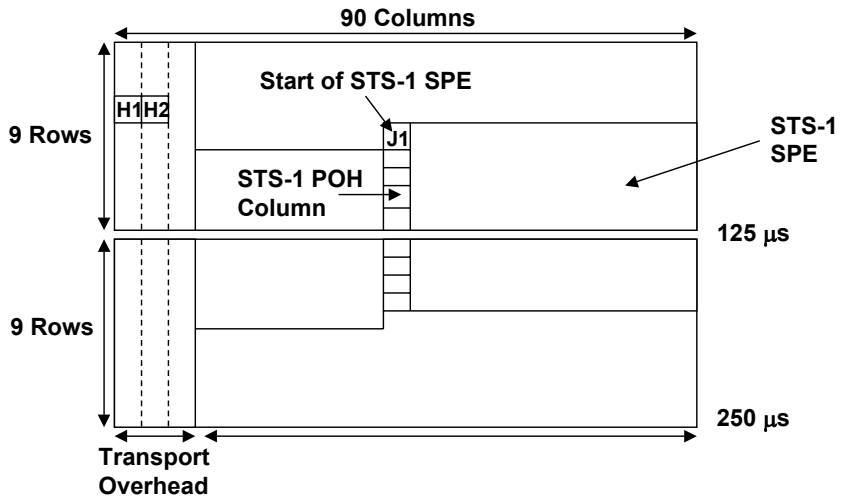
		1	2	3		
Section Overhead	↑	1	A1	A2	JO/ZO	J1
		2	B1	E1	F1	B3
	↓	3	D1	D2	D3	C2
Line Overhead	↑	4	H1	H2	H3	H4
		5	B2	K1	K2	G1
		6	D4	D5	D6	F2
		7	D7	D8	D9	Z3
		8	D10	D11	D12	Z4
	↓	9	S1Z1	M0 or M1/Z2	E2	Z5
			Transport Overhead			Path Overhead

VT POH

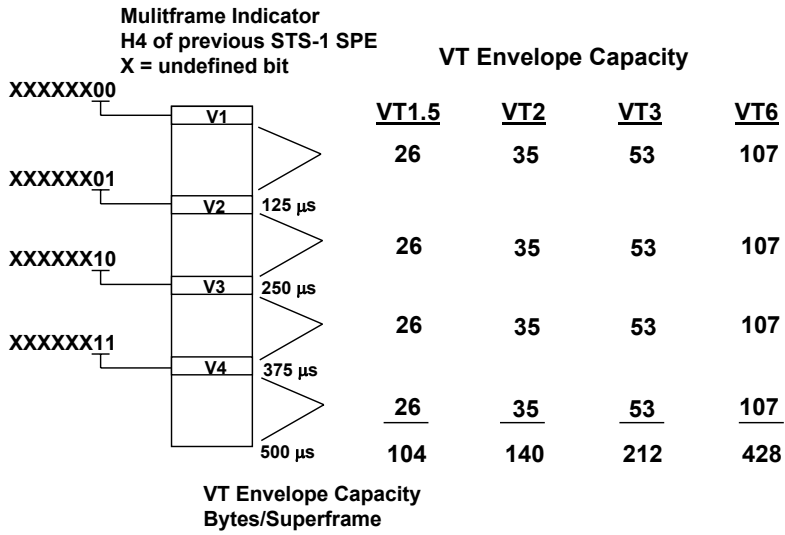
BIP-2		REI-V	RFI-V	Signal Label			RDI-V
1	2	3	4	5	6	7	8

RFI-V VT Path Remote Failure Indication
REI-V VT Path Remote Error Indication
RDI-V VT Path Remote Defect Indication

Pointer

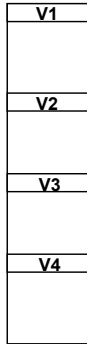


VT Superframe and Envelope Capacity

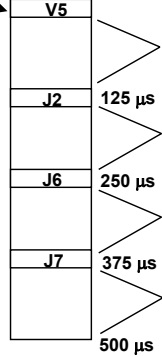


VT SPE and Payload Capacity

VT Superframe



VT SPE

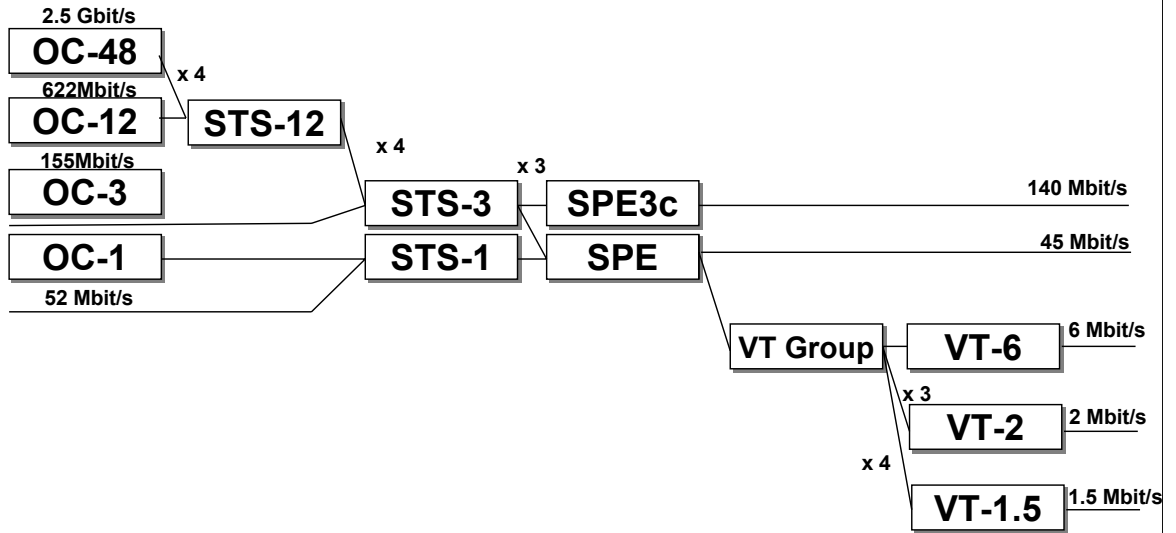


VT Payload Capacity

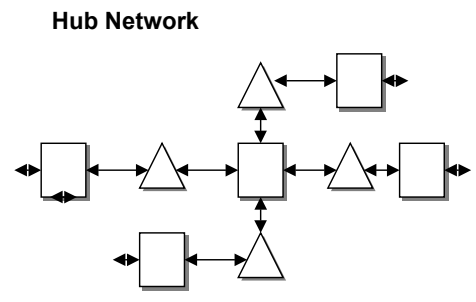
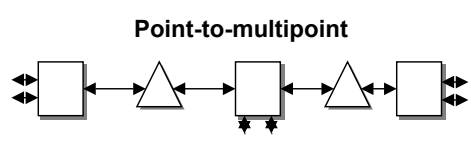
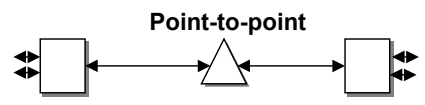
<u>VT1.5</u>	<u>VT2</u>	<u>VT3</u>	<u>VT6</u>
25	34	52	106
25	34	52	106
25	34	52	106
<u>25</u>	<u>34</u>	<u>52</u>	<u>106</u>
100	136	208	424

VT Payload Capacity
Bytes/VT SPE

Multiplexing Hierarchy



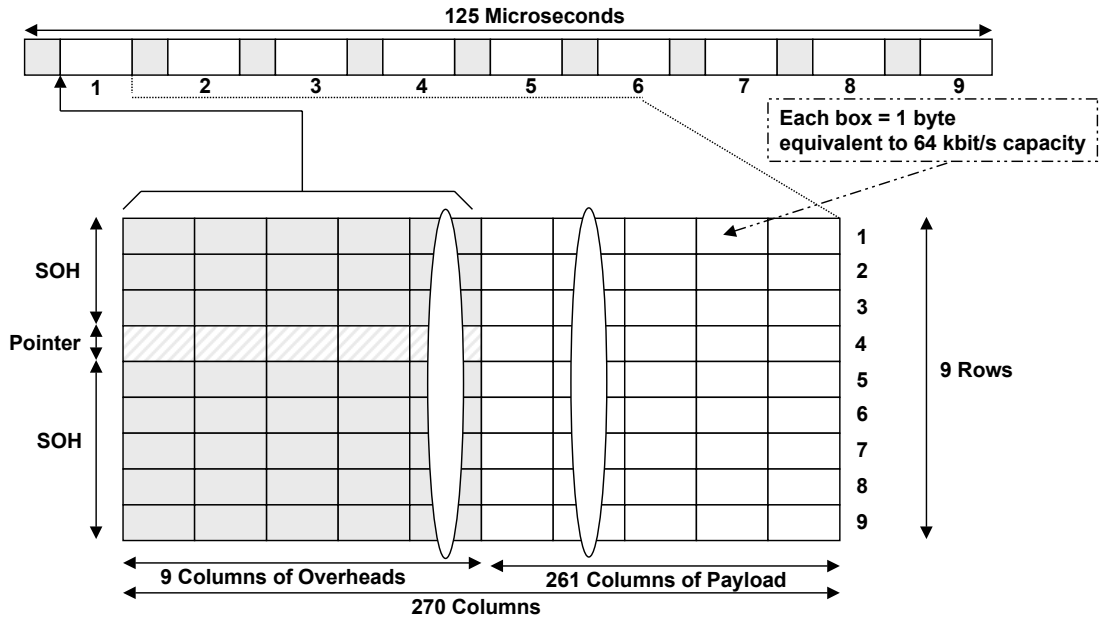
Network Configurations



SONET/SDH Hierarchies

SONET Signal	Bit Rate (Mbit/s)	SDH Signal	SONET Capacity	SDH Capacity
STS-1 (OC-1)	51.840	STM-0	28 DS-1s or 1 DS-3	21 E1s
STS-3 (OC-3)	155.520	STM-1	84 DS-1s or 3 DS-3s	63 E1s or 1 E4
STS-12 (OC-12)	622.080	STM-4	366 DS-1s or 12 DS-3s	252 E1s or 4 E4s
STS-48 (OC-48)	2.488.320	STM-16	1344 DS-1s or 48 DS-3s	1008 E1s or 16 E4s

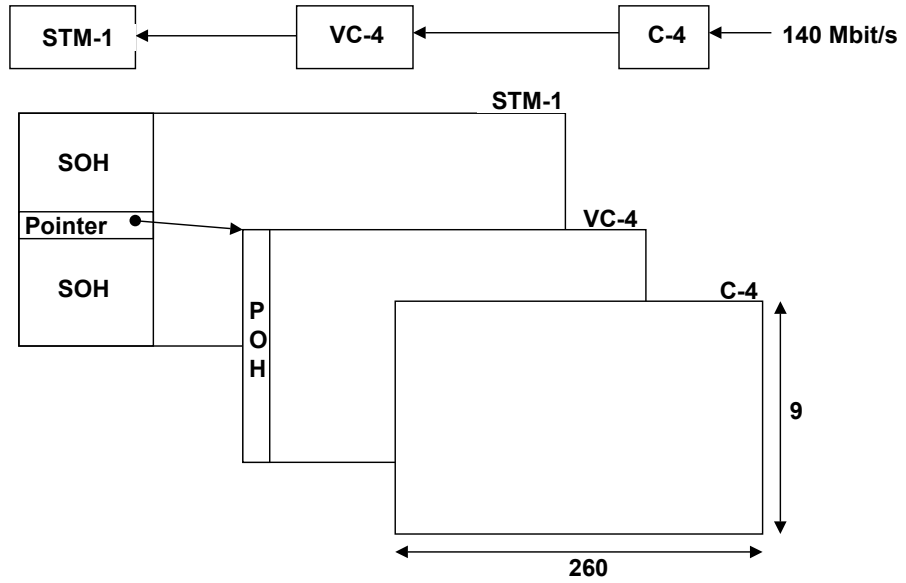
SDH Frame Structure



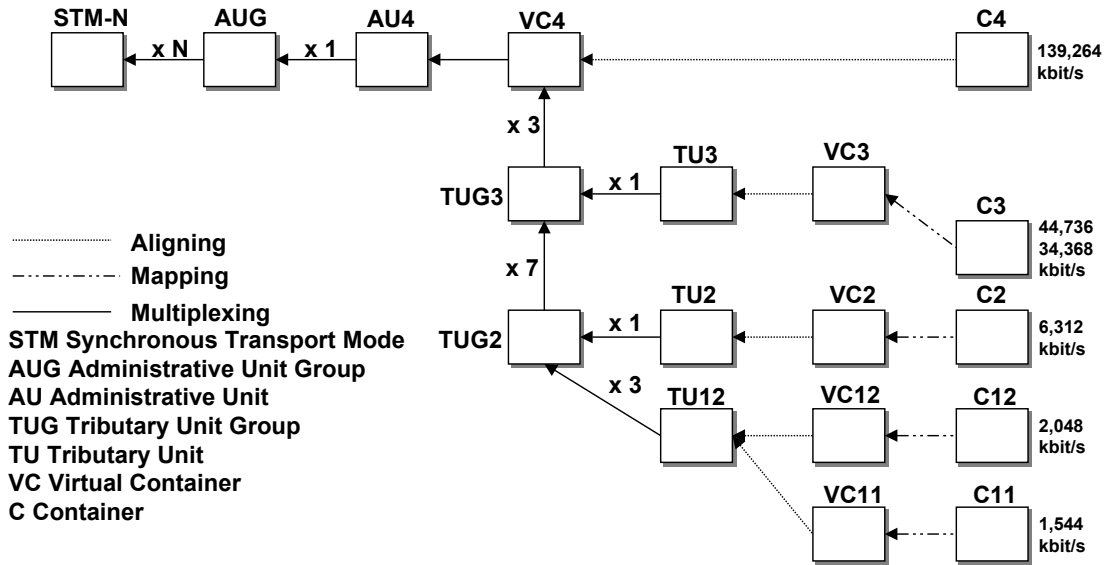
SDH Bit Rates

STM-N	Bit Rate (Mbit/s)	Electrical Interface	Optical Interface
STM-1	155.520	G.703	G.957
STM-4	622.080		G.957
STM-16	2.488.320		G.957

SDH Multiplexing Structure



SDH Multiplexing Structure



Add-Drop Multiplexer

