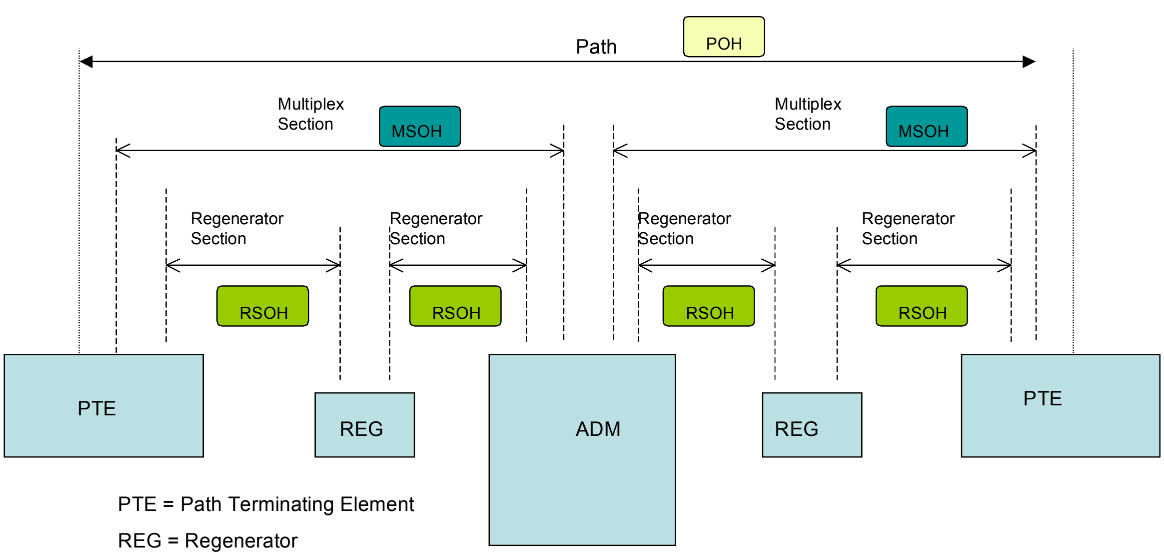
SDH Major Operational Components

- In SDH basic element is a Virtual Container. This container will follow a specified path from originating node to destination node. Hence a virtual container has to travel a path. When it is traveling its path, it will encounter 2 major operational components.
- These major operational components in the SDH are as follows;
  - Regenerator Unit
  - Add-Drop Multiplexer or Terminal Multiplexer Unit
- The above 2 major components are managed separately from one multiplex unit to the immediate next multiplex unit as a multiplexer section and from a regenerator to the immediate next / previous either multiplex unit or regenerator as a regenerator section.
- When a VC follow a path it will encounter many regenerator sections as well as many multiplexer sections.
- Therefore 3 types of overheads can be identified.
  - In the VC Path Overhead (already analyzed.)
  - Regenerator Section Overhead (RSOH)
  - Multiplexer Section Overhead (MSOH)
- In a multiplexer unit before the analysis of MSOH, RSOH will be checked treating this multiplexer unit as a repeater.

Summary of SDH Management Sections

SDH Network Layers



PTE = Path Terminating Element

REG = Regenerator

ADM = Add/Drop Multiplexer

- Regenerator Section Overhead
  - The Regenerator Section Overhead contains only the information required for the elements located at both ends of a section.
  - The Regenerator Section Overhead is found in the first three rows of Columns 1 through 9 x N of the STM-N, N ≥ 1 frame.

- Multiplex Section Overhead
  - The Multiplex Section Overhead contains the information required between the multiplexer section termination equipment at each end of the Multiplex section.
  - The Multiplex Section Overhead is found in Rows 5 to 9 of Columns 1 through 9 x N of the STM-N, N ≥ 1 frame.

- Path Overhead
  - Discussed earlier

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STM-1 Regenerator section overhead (RSOH) & Multiplex Section Overhead (MSOH)

9 bytes, 9 rows

A1	A1	A1	A2	A2	A2	J0	X *	X *	RSOH
B1	Δ	Δ	E1	Δ		F1	X	X	RSOH
D1	Δ	Δ	D2	Δ		D3			RSOH
Administrative Unit pointer(s)									
B2	B2	B2	K1			K2			MSOH
D4			D5			D6			MSOH
D7			D8			D9			MSOH
D10			D11			D12			MSOH
S1					M1	E2	X	X	MSOH

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(shaded) Unscrambled bytes

X Bytes reserved for national use

* The content of these reserved bytes has to be carefully selected as they are not scrambled.

Δ Media-dependent bytes

NOTE – All unmarked bytes are reserved for future international standardization (for media-dependent, additional national use and other purposes).

- A1 and A2 - Framing
- J0 - Regenerator Section (RS) Trace message
- B1 - RS bit interleaved parity code (BIP-8) byte
- E1 - RS orderwire byte
- F1- RS user channel byte
- D1, D2, D3 - RS Data Communications Channel (DCC) bytes

- B2 - Multiplex Section (MS) bit interleaved parity code (MS BIP-24) byte
- K1 & K2 - Automatic Protection Switching (APS channel) bytes
- D4 to D12 - MS Data Communications Channel (DCC) bytes S1- Synchronization status message byte (SSMB)
- M1- MS remote error indication
- E2 - MS orderwire byte

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Regenerator Section Overhead

- A1 and A2 - Framing bytes – These two bytes indicate the beginning of the STM-N frame. The A1, A2 bytes are unscrambled. A1 has the binary value 11110110, and A2 has the binary value 00101000. The frame alignment word of an STM-N frame is composed of (3 x N) A1 bytes followed by (3 x N) A2 bytes.
- J0 - Regenerator Section (RS) Trace message – It's used to transmit a Section Access Point Identifier so that a section receiver can verify its continued connection to the intended transmitter. The coding of the J0 byte is the same as for J1 and J2 bytes.
- Z0 - These bytes, which are located at positions in STM-N signal (N > 1), are reserved for future international standardization.
- B1 - RS bit interleaved parity code (BIP-8) byte – This is a parity code (even parity), used to check for transmission errors over a regenerator section. Its value is calculated over all bits of the previous STM-N frame after scrambling, then placed in the B1 byte of STM-1 before scrambling.
- E1 - RS orderwire byte – This byte is allocated to be used as a local order wire channel for voice communication between regenerators.
- F1- RS user channel byte – This byte is set aside for the user's purposes; it can be read and/or written to at each section terminating equipment in that line.
- D1, D2, D3 - RS Data Communications Channel (DCC) bytes – These three bytes form a 192 kbit/s message channel providing a message-based channel for Operations, Administration and Maintenance (OAM) between pieces of section terminating equipment. The channel can be used from a central location for control, monitoring, administration, and other communication needs.

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Multiplex Section Overhead

- B2 - Multiplex Section (MS) bit interleaved parity code (MS BIP-24) byte – This bit interleaved parity N x 24 code is used to determine if a transmission error has occurred over a multiplex section. It's even parity, and is calculated overall bits of the MS Overhead and the STM-N frame of the previous STM-N frame before scrambling.

- K1 and K2 - Automatic Protection Switching (APS channel) bytes – These two bytes are used for MSP (Multiplex Section Protection) signaling between multiplex level entities for bi-directional automatic protection switching and for communicating Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) conditions.

K1 Byte

Bits 1-4	Type of request	
	– 1111	Lock out of Protection
	– 1110	Forced Switch
	– 1101	Signal Fail – High Priority
	– 1100	Signal Fail – Low Priority
	– 1011	Signal Degrade – High Priority
	– 1010	Signal Degrade – Low Priority
	– 1001	(not used)
	– 1000	Manual Switch
	– 0111	(not used)
	– 0110	Wait-to-Restore
	– 0101	(not used)
	– 0100	Exercise
	– 0011	(not used)
	– 0010	Reverse Request
	– 0001	Do Not Revert
	– 0000	No Request
Bits 5-8	Indicate the number of the channel requested	

K2 Byte

Bits 1-4	Selects channel number
Bit 5	Indication of architecture
0	1+1
	1 1:n
Bits 6-8	Indicate mode of operation
111	MS-AIS
110	MS-RDI
101	Provisioned mode is bi-directional
100	Provisioned mode is unidirectional
011	Future use
010	Future use
001	Future use
000	Future use

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Multiplex Section Overhead (contd.)

- D4 to D12 - MS Data Communications Channel (DCC) bytes – These nine bytes form a 576 kbit/s message channel from a central location for OAM information.
- S1- Synchronization status message byte (SSMB) – Bits 5 to 8 of this S1 byte are used to carry the synchronization messages.

  Bits 5-8
  - 0000 Quality unknown (existing sync.network)
  - 0010 G.811 PRC
  - 0100 SSU-A (G.812 transit)
  - 1000 SSU-B (G.812 local)
  - 1011 G.813 Option 1 Synchronous Equipment Timing Clock (SEC)
  - 1111 Do not use for synchronization.This message may be emulated by equipment failures and will be emulated by a Multiplex Section AIS signal.
- M1- MS remote error indication – The M1 byte of an STM-1 or the first STM-1 of an STM-N is used for a MS layer remote error indication (MS-REI).
- E2 - MS orderwire byte – This orderwire byte provides a 64 kbit/s channel between multiplex entities for an express orderwire.

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Automatic Protection Switching (APS)

- Automatic Protection Switching (APS) is the capability of a transmission system to detect a failure on a working facility and to switch to a standby facility to recover the traffic.
- This capability has a positive effect on the overall system availability.
- Two modes of APS are provided:
  - 1+1 protection switching
  - 1:N protection switching.

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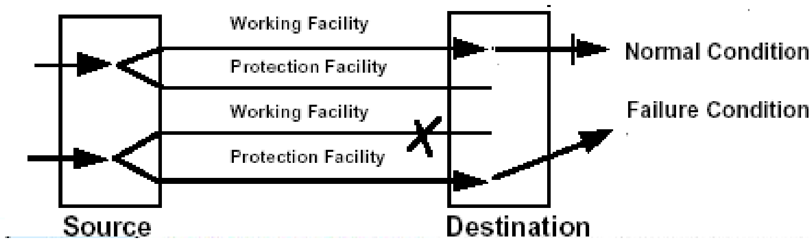
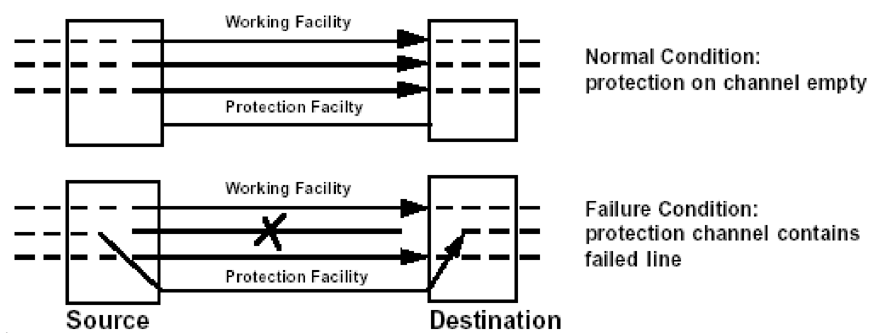
1+1 Protection Switching



1+ N Protection Switching



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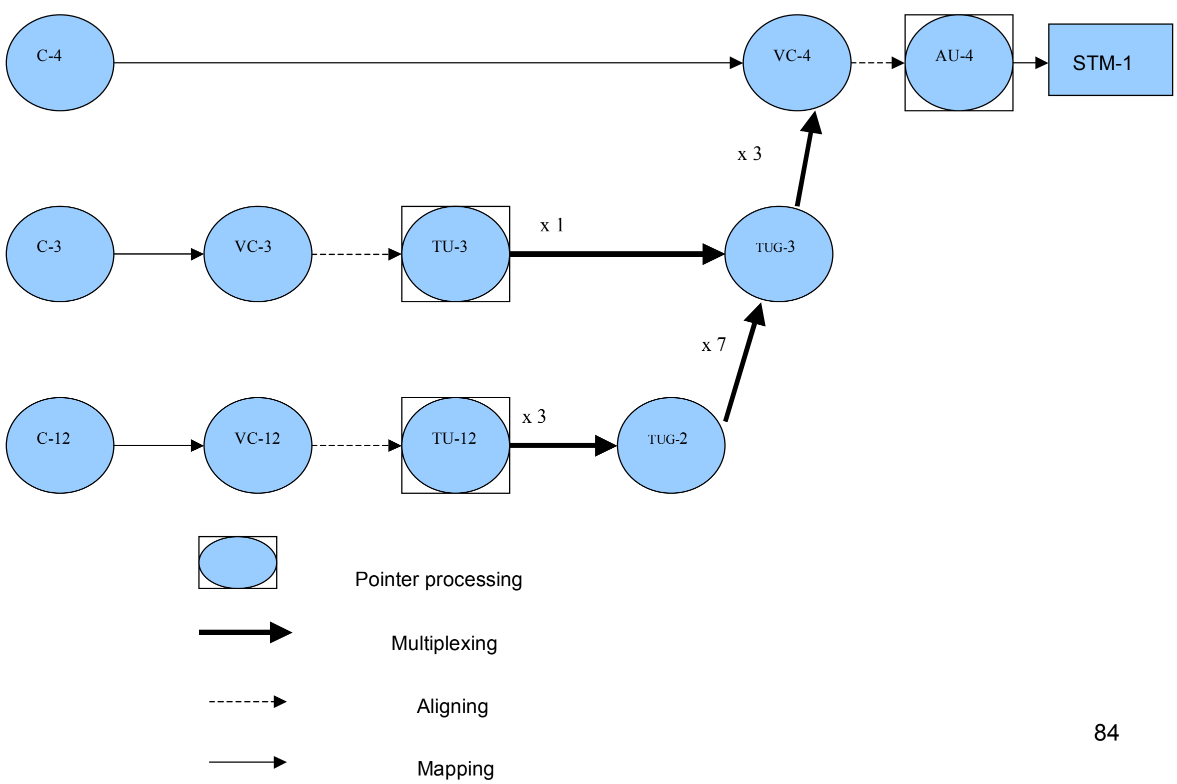
Summary of SDH Mapping, Aligning, Pointer processing & Multiplexing



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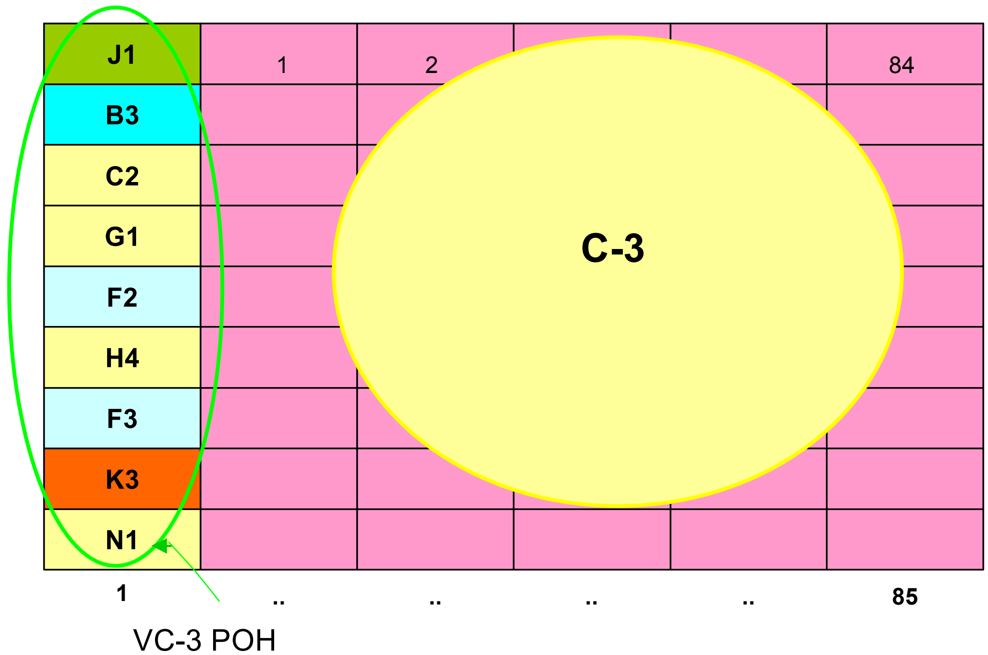
VC-3 Structure

When mapped by 34Mbps or 44Mbps



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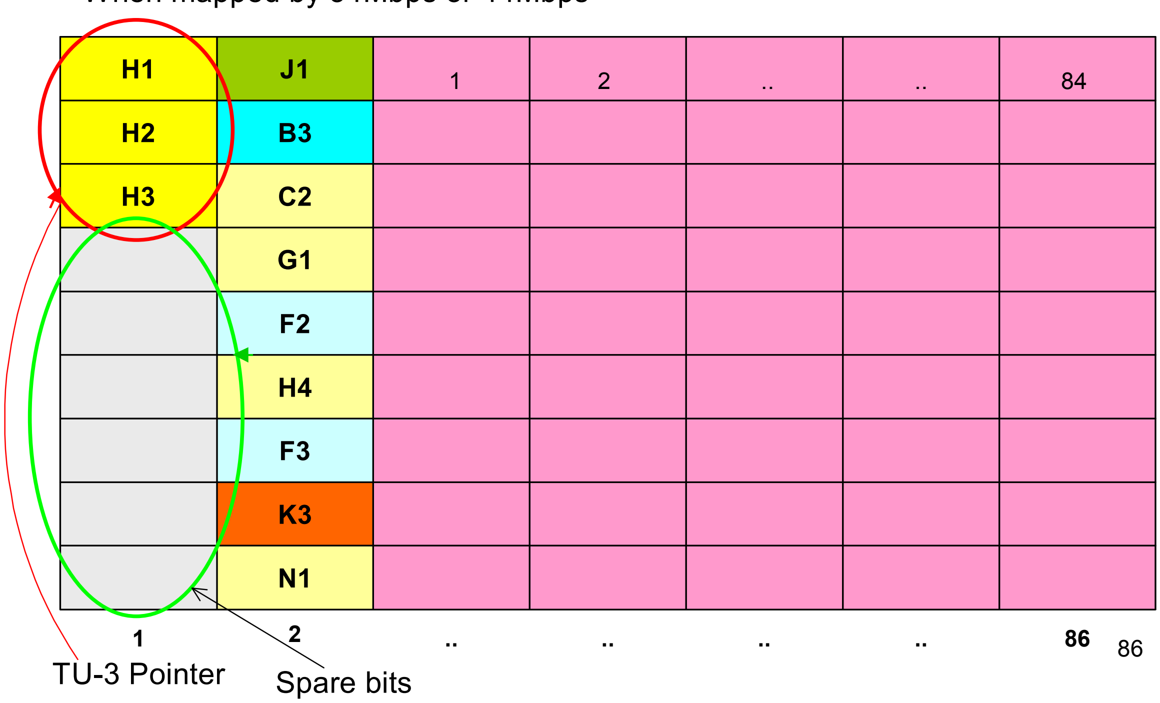
TUG-3 Structure

When mapped by 34Mbps or 44Mbps



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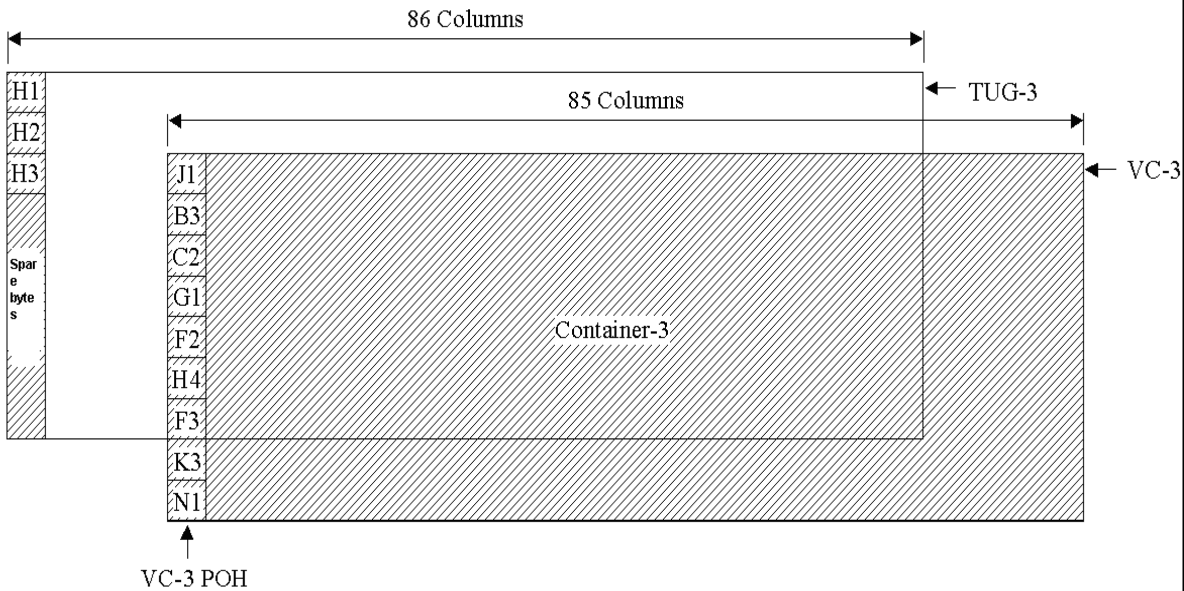
TUG-3 structure



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TUG-3 Structure

When mapped from lower order

Spare bits

* - no POH are added at VC3, but the individual POHs will be carried by each lower order container, i.e. VC12

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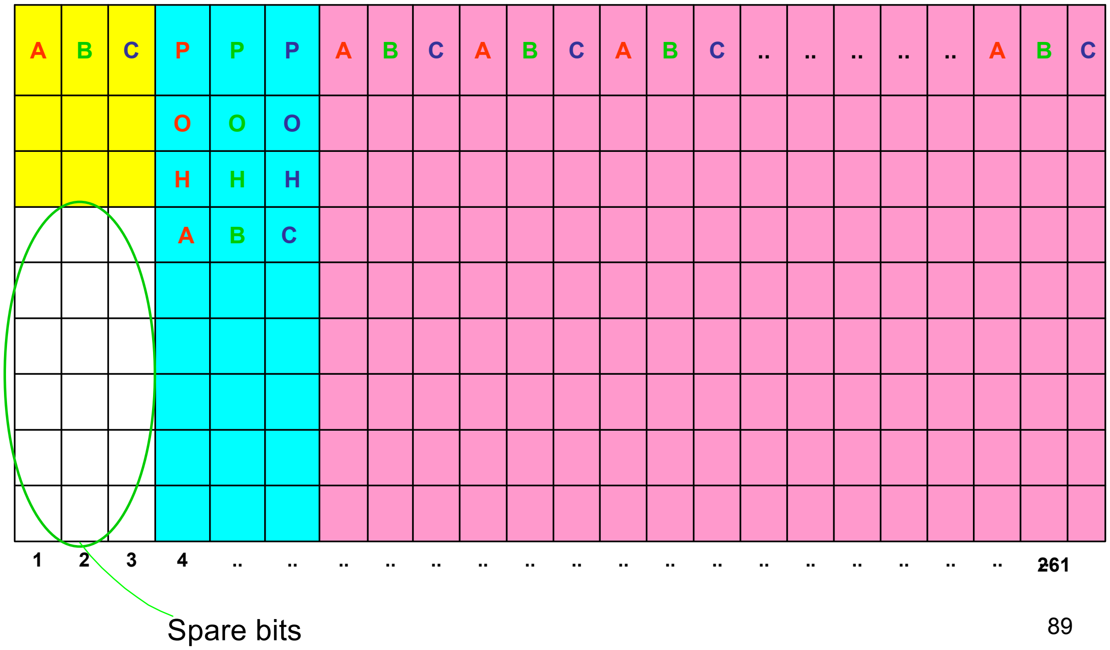
Structure of VC4

When mapped from TUG3: TUG x 3 (A,B,C)= AU4



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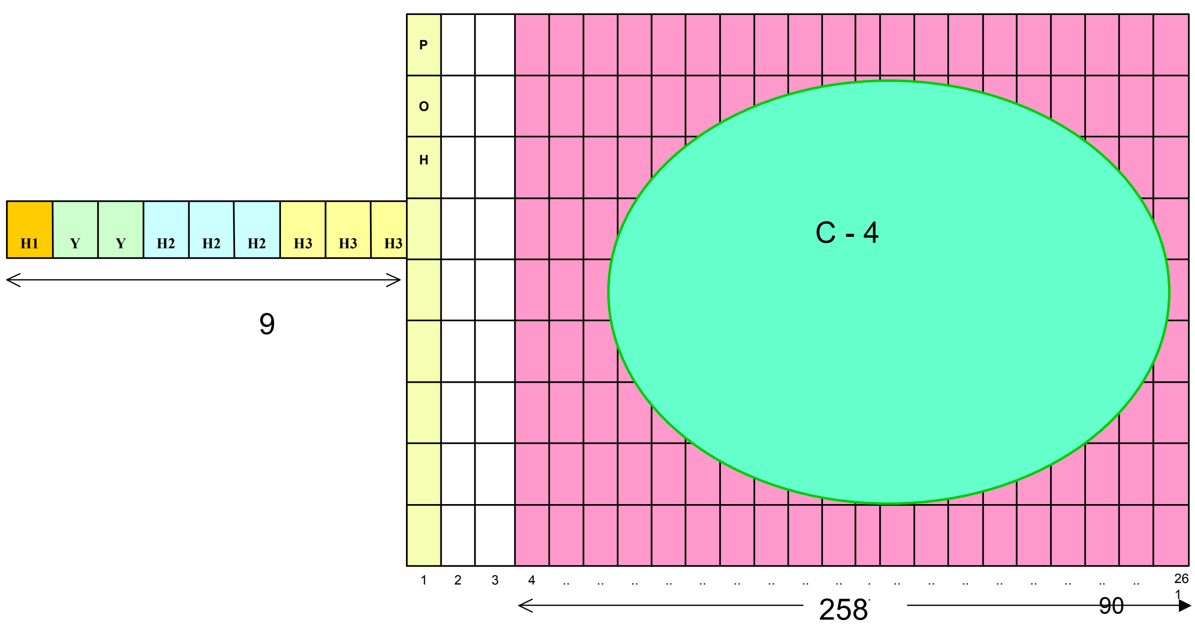
Structure of AU4

When mapped from VC4:



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