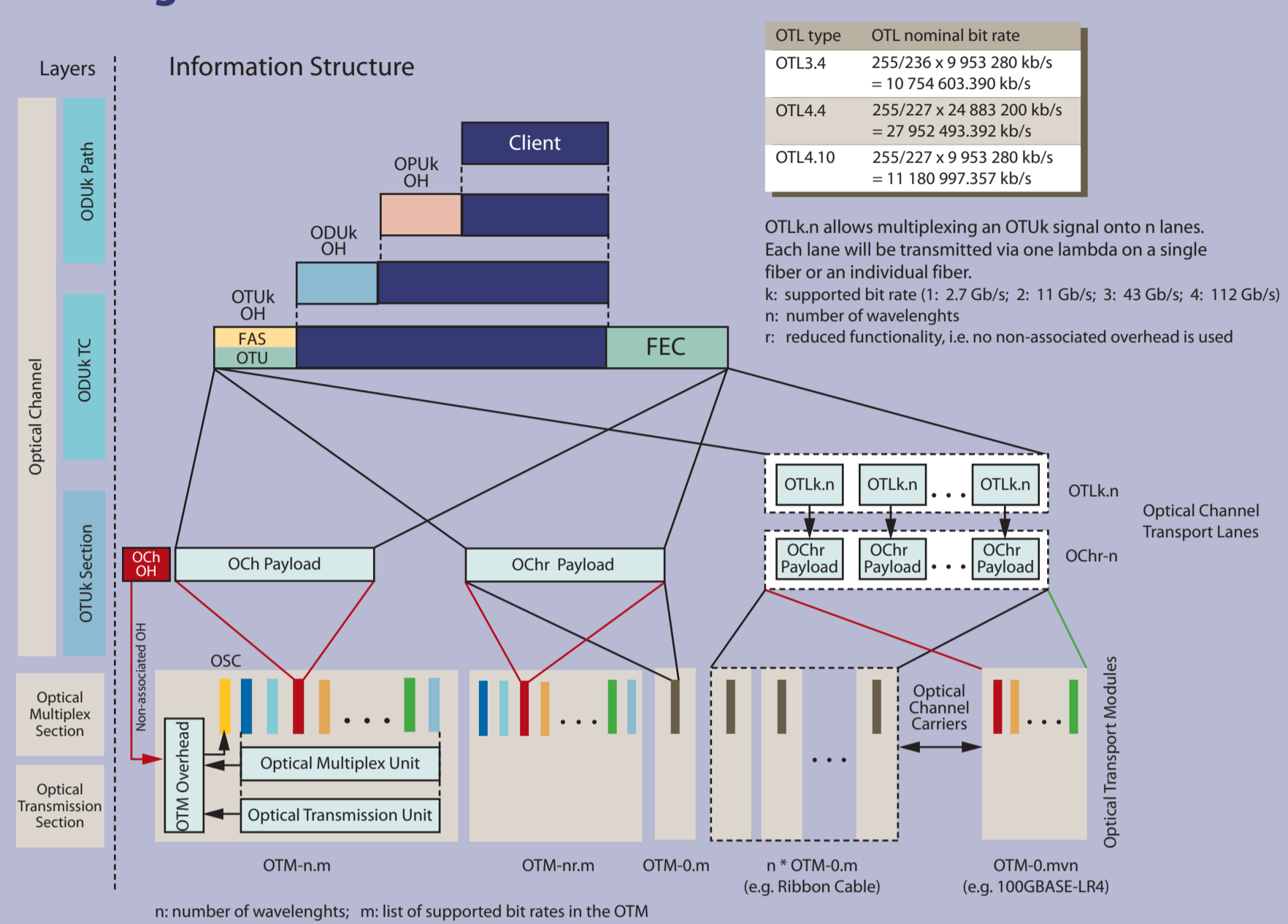


OTN – Transporting Ethernet and SDH/SONET

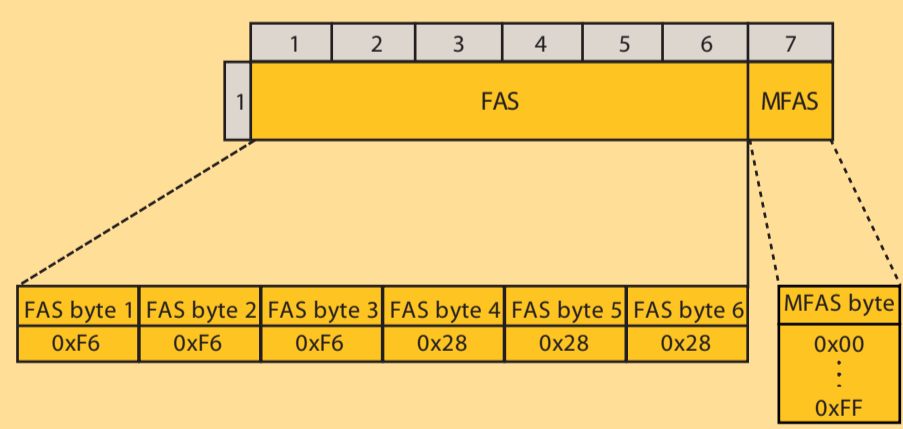
OTN Signal Structure



OTU Types and Capacity

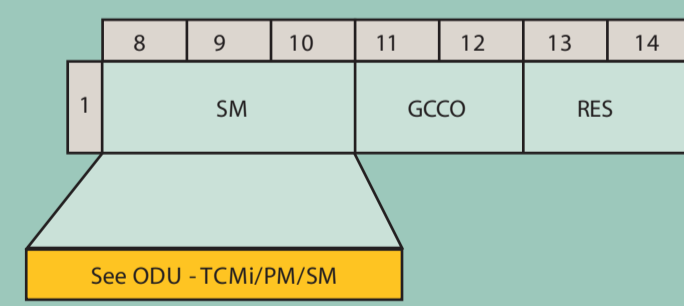
OTN type	OTU nominal bit rate	ODU type	ODU nominal bit rate	Client signal
-	-	ODU0	1,244,160 Gb/s	1GE LAN
OTU1	255/238 x 2.488320 Gb/s = 2.666057 Gb/s	ODU1	239/238 x 2.488320 Gb/s = 2.498775 Gb/s	STS-48/STM-16
OTU1e	255/238 x 10.312500 Gb/s = 11.049107 Gb/s	ODU1e	239/238 x 10.312500 Gb/s = 10.355830 Gb/s	10GE LAN
OTU1f	255/238 x 10.518750 Gb/s = 11.270089 Gb/s	ODU1f	239/238 x 10.518750 Gb/s = 10.562946 Gb/s	10GFC
OTU2	255/237 x 9.953280 Gb/s = 10.709255 Gb/s	ODU2	239/237 x 9.953280 Gb/s = 10.037274 Gb/s	STS-192/STM-64 WAN
OTU2e	255/237 x 10.312500 Gb/s = 11.095730 Gb/s	ODU2e	239/237 x 10.312500 Gb/s = 10.399525 Gb/s	10GE LAN
OTU2f	255/237 x 10.518750 Gb/s = 11.317642 Gb/s	ODU2f	239/237 x 10.518750 Gb/s = 10.607516 Gb/s	10GFC
OTU3	255/236 x 39.813120 Gb/s = 43.018414 Gb/s	ODU3	239/236 x 39.813120 Gb/s = 40.319219 Gb/s	STS-768/STM-256
OTU3e1	255/236 x 4 x 10.312500 Gb/s = 44.570974576 Gb/s	ODU3e1	239/236 x 4 x 10.312500 Gb/s = 41.774364407 Gb/s	4 x ODU2e
OTU3e2	243/217 x 16 x 2.488320 Gb/s = 44.583356 Gb/s	ODU3e2	239/252 x 243/217 x 16 x 2.488320 Gb/s = 41.785969 Gb/s	4 x ODU2e
OTU4	255/227 x 99.532800 Gb/s = 111.809973 Gb/s	ODU4	239/227 x 99.532800 Gb/s = 104.794446 Gb/s	100GE

Frame Alignment Signal (FAS)

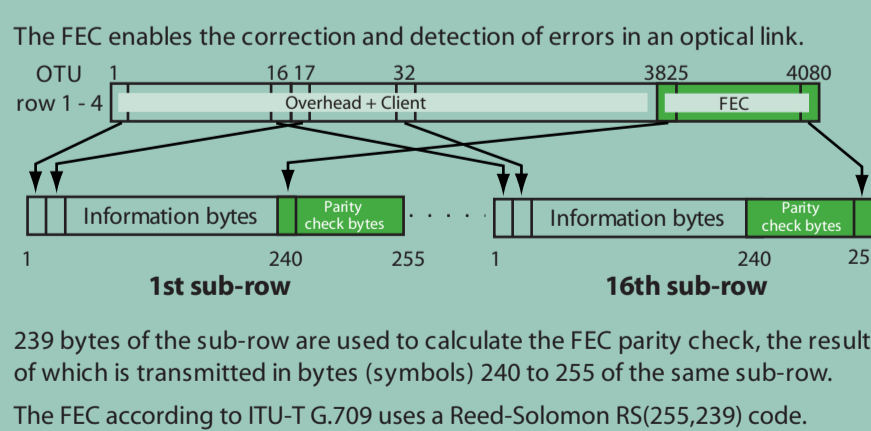


OTU Overhead

Allows the user to support Section Monitoring (SM).
For further description please refer to the optical channel data unit (ODU).



Forward Error Correction (FEC)

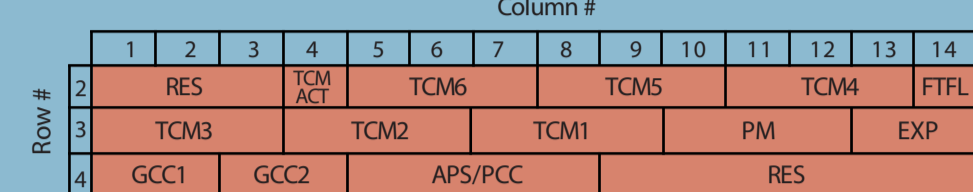


ITU-T G.975.1 defines additional FEC schemes, called Super-FEC:

Sub clause	Concatenated or non-concatenated	Used FEC code
1.2	Concatenated FEC	Outer code: RS(255, 239) Inner code: CSOC (n _k = 7/6, J = 8)
1.3	Concatenated FEC	Outer code: BCH(3860, 3824) Inner code: BCH(2040, 1930)
1.4	Concatenated FEC	Outer code: RS(1023, 1007) Inner code: BCH(2047, 1952)
1.5	Concatenated FEC (Soft decision capable)	Outer code: RS(1901, 1855) Inner code: Extended Hamming Product code (512, 502) x (510, 500)
1.6	Non-concatenated FEC	LDPC code
1.7	Non-concatenated FEC	Two orthogonally concatenated BCH codes
1.8	Non-concatenated FEC	RS(2720, 2550)
1.9	Concatenated FEC	Two interleaved extended BCH (1020, 988) codes

ODU Overhead

Allows the user to support Path Monitoring (PM), Tandem Connection Monitoring (TCM) and Automatic Protection Switching (APS).

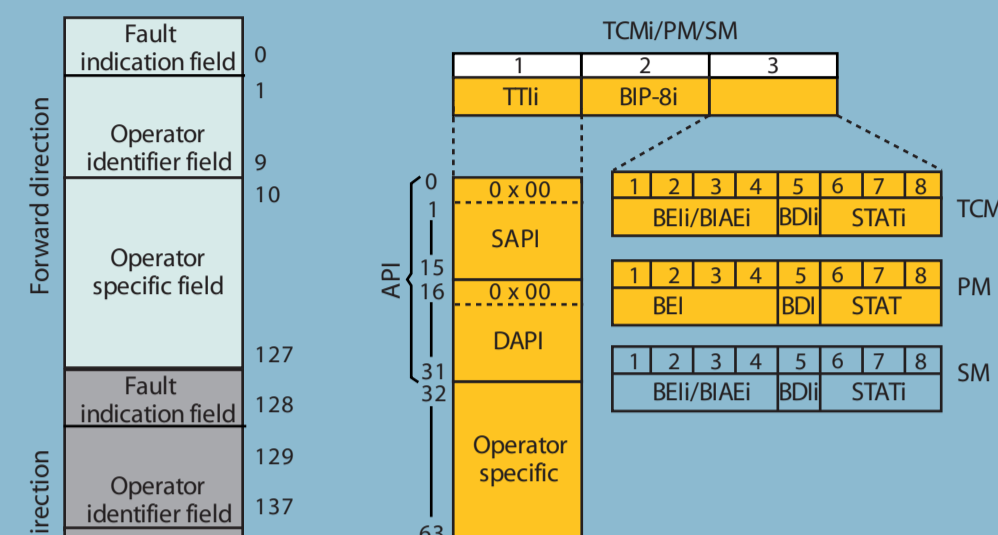


Fault indication codes

Fault indication code	Definition
0000 0000	No fault
0000 0001	Signal fail
0000 0010	Signal degraded
0000 0011	Reserved for future international standardization
0000 0100	Reserved for future international standardization
0000 0101	reserved for future international standardization
0000 0110	reserved for future international standardization
0000 0111	reserved for future international standardization

ODUK PM status interpretation

PM byte 3, bits 678	Status
000	reserved for future international standardization
001	normal path signal
010	reserved for future international standardization
011	reserved for future international standardization
100	reserved for future international standardization
101	maintenance signal: ODUK-LCK
110	maintenance signal: ODUK-OCI
111	maintenance signal: ODUK-AIS



OTUK SM BEI/BIAE bits 1, 2, 3, 4	Interpretation
0 ... 8	BIP error
9 ... 15	No BIP error
11	BIAE, no BIP error

ODUK TCM status interpretation

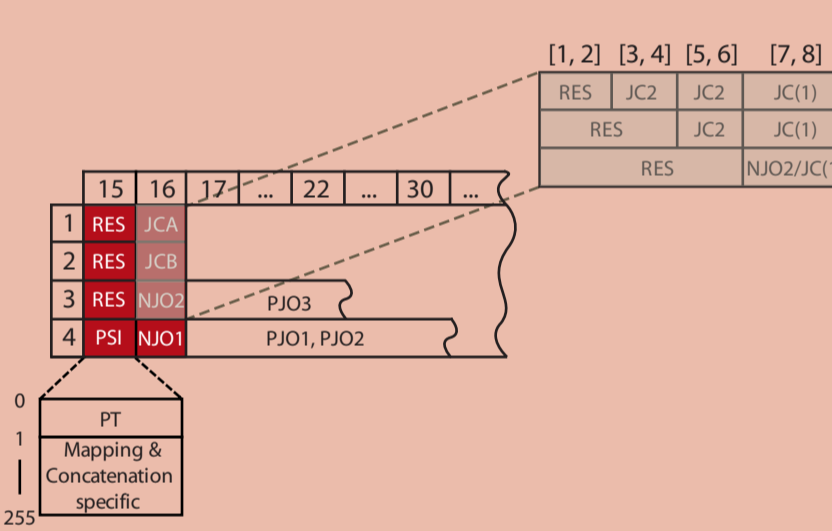
TCM byte 3, bits 6, 7, 8	Status
000	no source TC
001	in use without IAE
010	in use with IAE
011	reserved for future international standardization
100	reserved for future international standardization
101	maintenance signal: ODUK-LCK
110	maintenance signal: ODUK-OCI
111	maintenance signal: ODUK-AIS

OPU Overhead

The OPU OH regulates the mapping and concatenation of the client signals and provides information on the type of signal transported. Payload Structure Identifier (PSI) a 256 byte multi-frame signal. The PSI[0] contains the Payload Type (PT).

Justification bits JC1/JC2, BJO1/NJO2, PJO1/PJO2/PJO3 are required for asynchronous mappings. For synchronous mappings, all JC(1)s are 0, NJO(1) is a justification byte and PJO(1) is a data byte.

Mapping and concatenation PSI[1] to PSI[255] are mapping and concatenation specific.



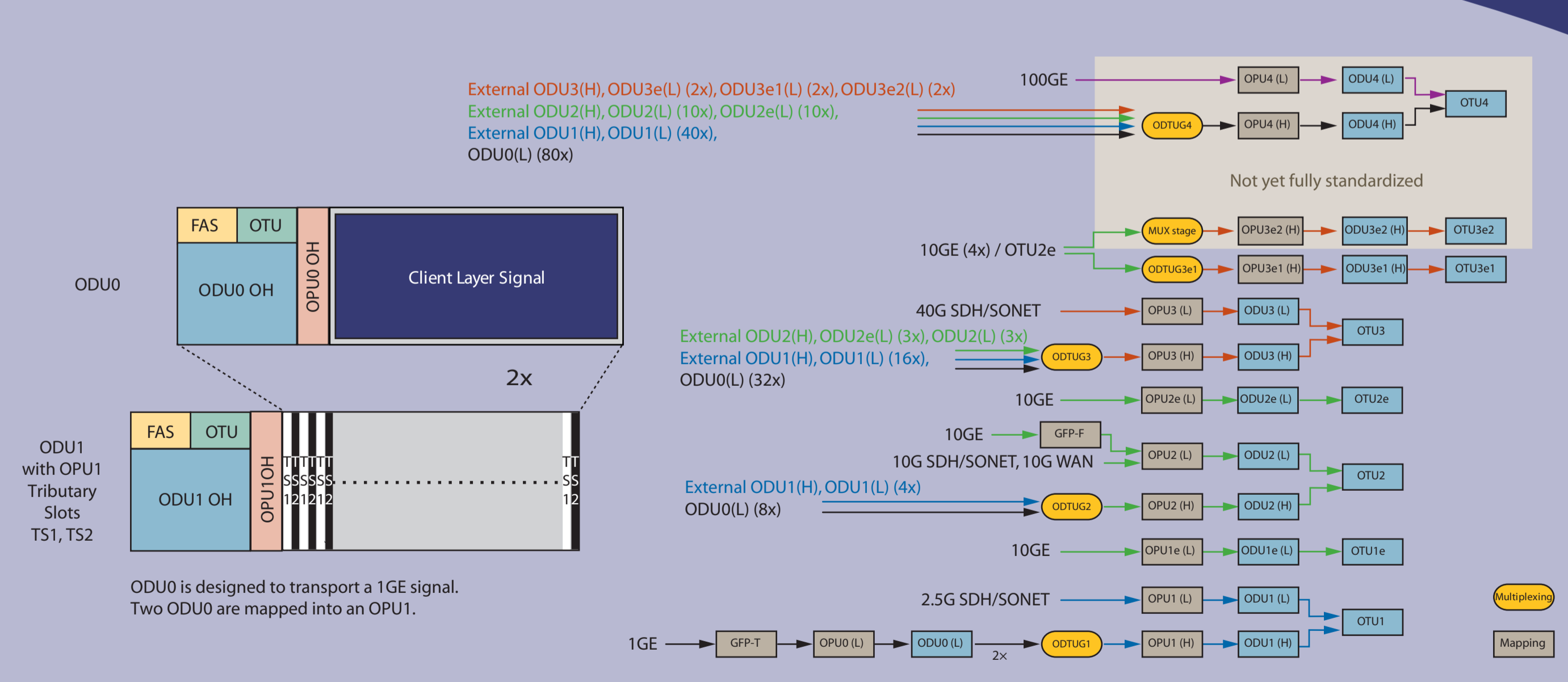
JC, NJO and PJO generation by asynchronous mapping process

JC2	JC1	NJO2	NJO1	PJO2	PJO1	PJO0	Interpretation
00	00	Justification byte	Justification byte	Data byte	Data byte	Data byte	No justification (0)
00	01	Justification byte	Data byte	Data byte	Data byte	Data byte	Negative justification (-1)
00	10	Justification byte	Justification byte	Justification byte	Data byte	Data byte	Double positive justification (+2)
00	11	Justification byte	Justification byte	Justification byte	Data byte	Data byte	Positive justification (+1)
01	*	Data byte	Data byte	Data byte	Data byte	Data byte	Double negative justification (-2)
11	*	Justification byte	Justification byte	Justification byte	Justification byte	Justification byte	Triple positive justification (+3)

Payload type code points

Hex code	Interpretation
01	Experimental mapping
02	Asynchronous STM-N mapping
03	Bit synchronous STM-N mapping
04	ATM mapping
05	GFP mapping
06	Virtual concatenated signal
07	100BASE-X into ODU0 mapping
08	FC-1200 into ODU2e mapping
09	GFP mapping into Extended OPU2 payload
10	Bit stream without octet timing mapping
11	Bit stream without octet timing mapping
20	ODU multiplex structure
55	Not available
66	Not available
80-8F	Reserved codes for proprietary use
FD	NULL test signal mapping
FE	PRBS test signal mapping
FF	Not available

OTN Multiplexing and Mapping



Detection Criteria

(according to ITU-T G.709/G.798)

Abbreviation	Alarm/Error	Detection criteria
OPF	Out of Frame	FAS (bytes 3, 4 and 5) are errored for ≥ 5 frames
LOF	Loss of Frame	If OOF persists ≥ 3 ms
OOM	Out of Multiframe	NFAS numbers errored for ≥ 5 frames
LOM	Loss of Multiframe	If OOM persists ≥ 3 ms
OTU-SM		
SM-BIP-8	SM Bit Interleaved Parity	Mismatch of the recovered and computed BIP-8 covers the OPU and Payload
SM-BEI	SM Backward Error Indication	SM byte 3, bits 1 to 4: value 0 to 8: BIP error count value 9 to 15: No BIP errors value 11: BIAE active
OTU-AIS	OTU Alarm Indication Signal	PN-11 sequence covers complete OCh
SM-BDI	SM Backward Defect Indication	SM byte 3, bit 5 = 1 ≥ 5 frames
SM-AE	SM Incoming Alignment Error	SM byte 3, bit 6 = 1 ≥ 5 frames
SM-BIAE	SM Backward Incoming Alignment Error	SM byte 3, bits 1 to 4 = '1011' ≥ 3 frames
ODU-PM		
PM-BIP-8	PM BIP Error	Mismatch of the recovered and computed BIP-8 covers the OPU and Payload
PM-BEI	PM Backward Error Indication	PM byte 3, bits 1 to 4: value 0 to 8: BIP error count value 9 to 15: No BIP errors value 11: BIAE active
ODU-AIS	ODU AIS	PM byte 3, bits 6 to 8 = '111' ≥ 3 frames and ODU except FTL filled with All-1s
ODU-OCI	ODU Open Connection Indication	PM byte 3, bits 6 to 8 = '110' ≥ 3 frames and ODU filled with '0101010100
ODU-LCK	ODU Locked Defect	PM byte 3, bits 6 to 8 = '101' ≥ 3 frames and ODU filled with '01010101'
PM-BDI	PM Backward Defect Indication	PM byte 3, bit 5 = 1 ≥ 5 frames
ODU-TCM		
TCM-BIP-8	TCM BIP	Mismatch of the recovered and computed BIP-8 covers the OPU and Payload
TCM-BEI	TCM Backward Error Indication	TCM byte 3, bits 1 to 4: value 0 to 8: BIP error count value 9 to 15: No BIP errors value 11: BIAE active
TCM-BDI	TCM Backward Defect Indication	TCM byte 3, bit 5 = 1 ≥ 5 frames
TCM-BIAE	TCM Backward Incoming Alignment Error	TCM byte 3, bits 1 to 4 = '1011' ≥ 3 frames

Glossary

- Access Point Identifiers (API)**
- Source Access Point Identifier (SAPI)**
- Destination Access Point Identifier (DAPI)**
- Justification Control (JC)**
- Low Density Parity Check (LDPC)**
- Negative Justification Opportunity (NJO)**
- Operator specific:** For operator specific use.
- Optical Channel Payload Unit k (OPUK)**
- Optical Channel Data Unit k (ODUK)**
- Optical Channel Transport Lane (OTL)**
- Optical Transport Module (OTM)**
- Optical Transmission Section (OTS)**
- Optical Channel Transport Unit k (OTUK)**
- Path Monitoring (PM)**
- Positive Justification Opportunity (PJO)**
- Bit Interleaved Parity (BIP-8)**
- Convolutional Self-Orthogonal Code (CSOC)**
- General communication channel (GCCO)**
- General communication channels (GCC1, GCC2)**
- Trail Trace Identifier (TTI)**

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