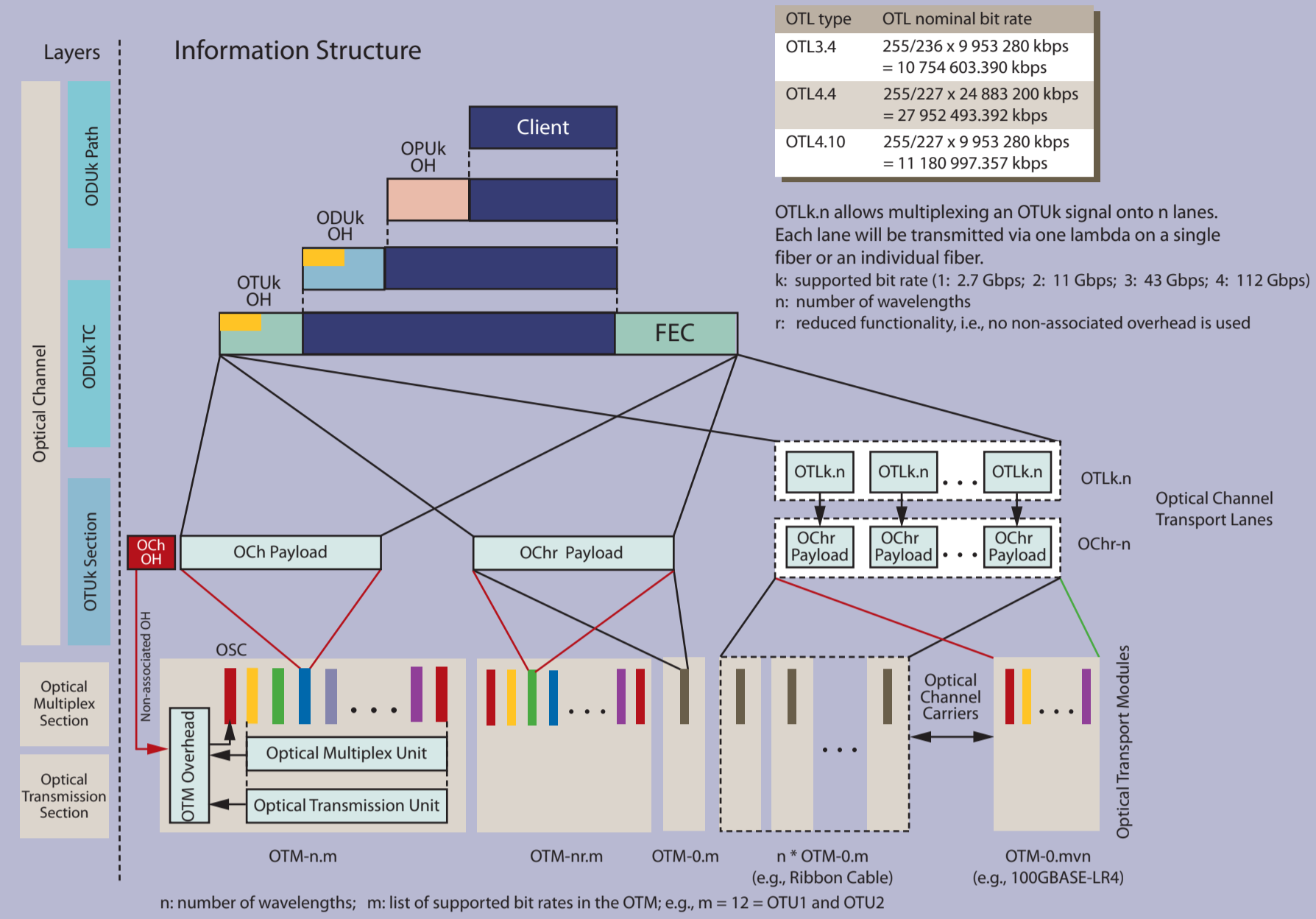


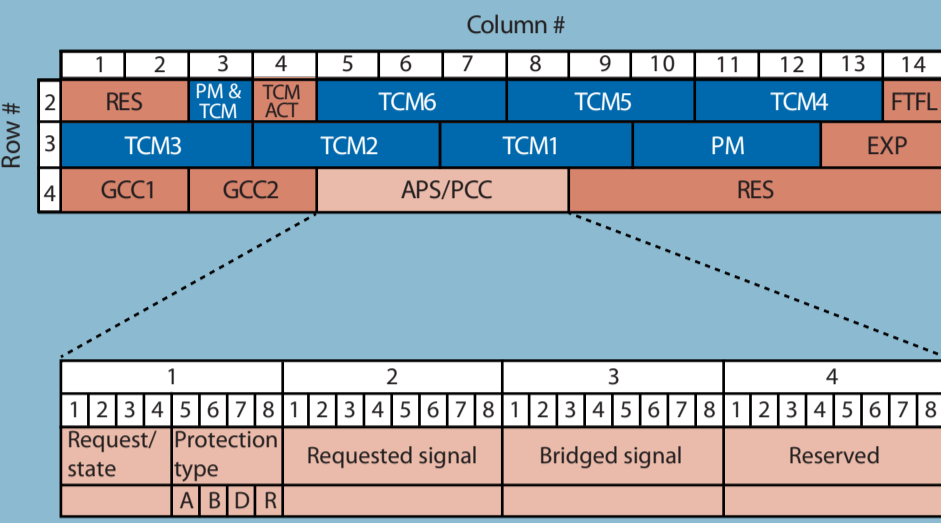
# OTN – Transporting Ethernet and SDH/SONET

## OTN Signal Structure



## ODU Overhead

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



### ODU PM status interpretation

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

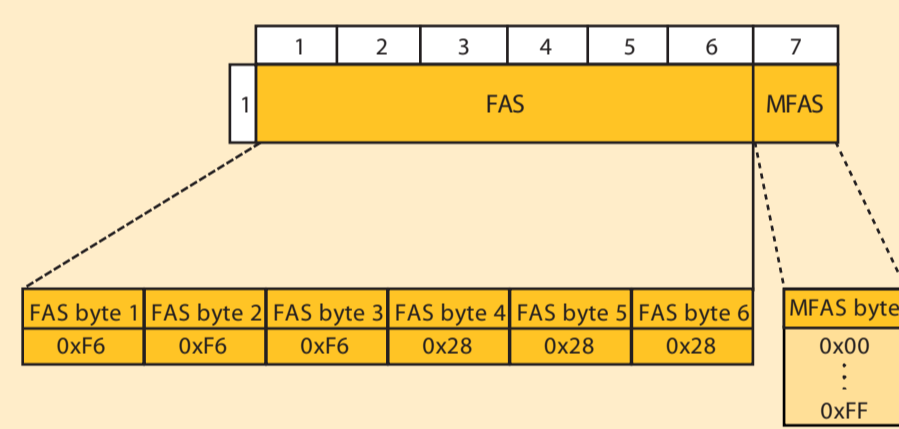


## Detection Criteria

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

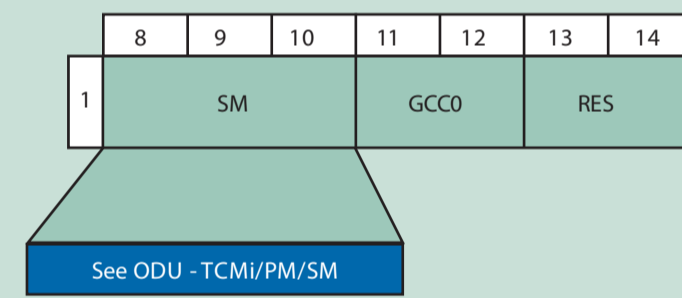
Abbreviation	Alarm/Error	Detection criteria
OOE	Out of Frame	FAS (bytes 3, 4 and 5) are errored for ≥ 5 frames
LOF	Loss of Frame	If OOF persists ≥ 3 ms
OOM	Out of Multiframe	MFAS numbers errored for ≥ 5 frames
LOM	Loss of Multiframe	If OOM persists ≥ 3 ms
<b>OTU-SM</b>		
SM-BIP-8	SM Bit Interleaved Parity	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 BIAE active
OTU-AIS	OTU Alarm Indication Signal	PM byte 3, bits 6 to 8 = '110' ≥ 3 frames and ODU filled with '0110 0110 ODU
SM-BDI	SM Backward Defect Indication	SM byte 3, bits 6 to 8 = '101' ≥ 3 frames and ODU filled with '0101 0101
SM-IAE	SM Incoming Alignment Error	SM byte 3, bits 1 to 4 = '1011' ≥ 3 frames
SM-BIAE	SM Backward Incoming Alignment Error	SM byte 3, bits 1 to 4 = '1011' ≥ 3 frames
<b>ODU-PM</b>		
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
ODU-AIS	ODU AIS	PM byte 3, bits 6 to 8 = '110' ≥ 3 frames and ODU filled with '0110 0110 ODU
ODU-OCI	ODU Open Connection Indication	PM byte 3, bits 6 to 8 = '101' ≥ 3 frames and ODU filled with '0101 0101
ODU-LCK	ODU Locked Defect	PM byte 3, bits 1 to 4 = '1011' ≥ 3 frames
PM-BDI	PM Backward Defect Indication	PM byte 3, bits 1 to 4 = '1011' ≥ 3 frames
<b>ODU-TCM</b>		
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, bits 1 to 4 = '1011' ≥ 3 frames
TCM-BIAE	TCM Backward Incoming Alignment Error	TCM byte 3, bits 1 to 4 = '1011' ≥ 3 frames

## 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).



## 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) information. Mapping and concatenation: PSI[1] to PSI[255] are mapping and concatenation-specific.

## Asynchronous Mapping Procedure (AMP)

Justification bytes Jc1/Jc2, NJO2/Jc(1), PJO1/PJO2/PJO3 are required for AMP. For BMP, all Jc(1)s are 0, NJO(1) is a justification byte and PJO(1) is a data byte.

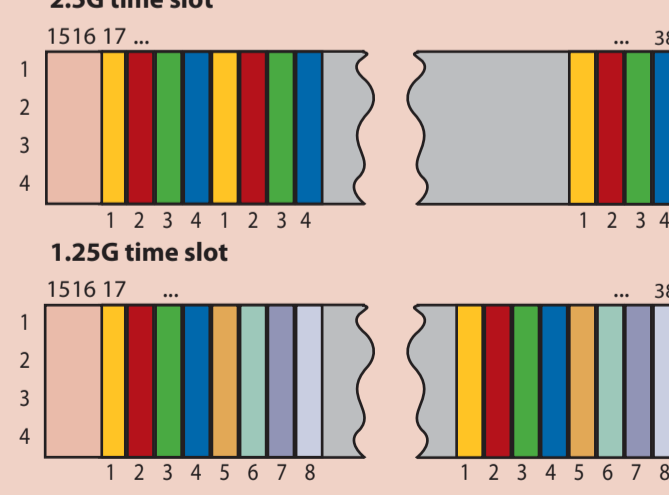
### Payload type code points (PT)

Hex code	Interpretation
01	Experimental mapping
02	Asynchronous CBR mapping
03	Bit synchronous CBR mapping
04	ATM mapping
05	GFP mapping
06	Virtual concatenated signal
07	100BASE-X into OPU0 mapping
08	40GBASE-R into OPU3
09	100GBASE-R into OPU4
0A	FC-1200 into ODU2e mapping
0B	GFP mapping into Extended OPU2 payload
0C	STM-1 mapping into ODU0
0D	STM-4 mapping into ODU0
0E	FC-100 mapping into ODU0
0F	FC-200 mapping into ODU1
10	FC-400 mapping into ODUflex
11	FC-800 mapping into ODUflex
12	Bit stream with octet timing mapping
13	Bit stream without octet timing mapping
14	IB SDR mapping into ODUflex
15	IB DDR mapping into ODUflex
16	ODU multiplex structure supporting ODTUk only (AMP only)
17	ODU multiplex structure supporting ODTUks or ODTUks and OTDUjk (GMP capable)
18	Not available
19	Not available
1A	Not available
1B	Not available
1C	Not available
1D	Not available
1E	Not available
1F	Not available
20	Not available
21	Not available
22	Not available
23	Not available
24	Not available
25	Not available
26	Not available
27	Not available
28	Not available
29	Not available
2A	Not available
2B	Not available
2C	Not available
2D	Not available
2E	Not available
2F	Not available
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31	Not available
32	Not available
33	Not available
34	Not available
35	Not available
36	Not available
37	Not available
38	Not available
39	Not available
3A	Not available
3B	Not available
3C	Not available
3D	Not available
3E	Not available
3F	Not available
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42	Not available
43	Not available
44	Not available
45	Not available
46	Not available
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48	Not available
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4C	Not available
4D	Not available
4E	Not available
4F	Not available
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57	Not available
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59	Not available
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5B	Not available
5C	Not available
5D	Not available
5E	Not available
5F	Not available
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63	Not available
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9E	Not available
9F	Not available
A0	Not available
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A3	Not available
A4	Not available
A5	Not available
A6	Not available
A7	Not available
A8	Not available
A9	Not available
AA	Not available
AB	Not available
AC	Not available
AD	Not available
AE	Not available
AF	Not available
B0	Not available
B1	Not available
B2	Not available
B3	Not available
B4	Not available
B5	Not available
B6	Not available
B7	Not available
B8	Not available
B9	Not available
BA	Not available
BB	Not available
BC	Not available
BD	Not available
BE	Not available
BF	Not available
C0	Not available
C1	Not available
C2	Not available
C3	Not available
C4	Not available
C5	Not available
C6	Not available
C7	Not available
C8	Not available
C9	Not available
CA	Not available
CB	Not available
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CD	Not available
CE	Not available
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D2	Not available
D3	Not available
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D6	Not available
D7	Not available
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D9	Not available
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EF	Not available
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F3	Not available
F4	Not available
F5	Not available
F6	Not available
F7	Not available
F8	Not available
F9	Not available
FA	Not available
FB	Not available
FC	Not available
FD	Not available
FE	Not available
FF	Not available

### Jc, NJO, and PJO generation by asynchronous mapping process

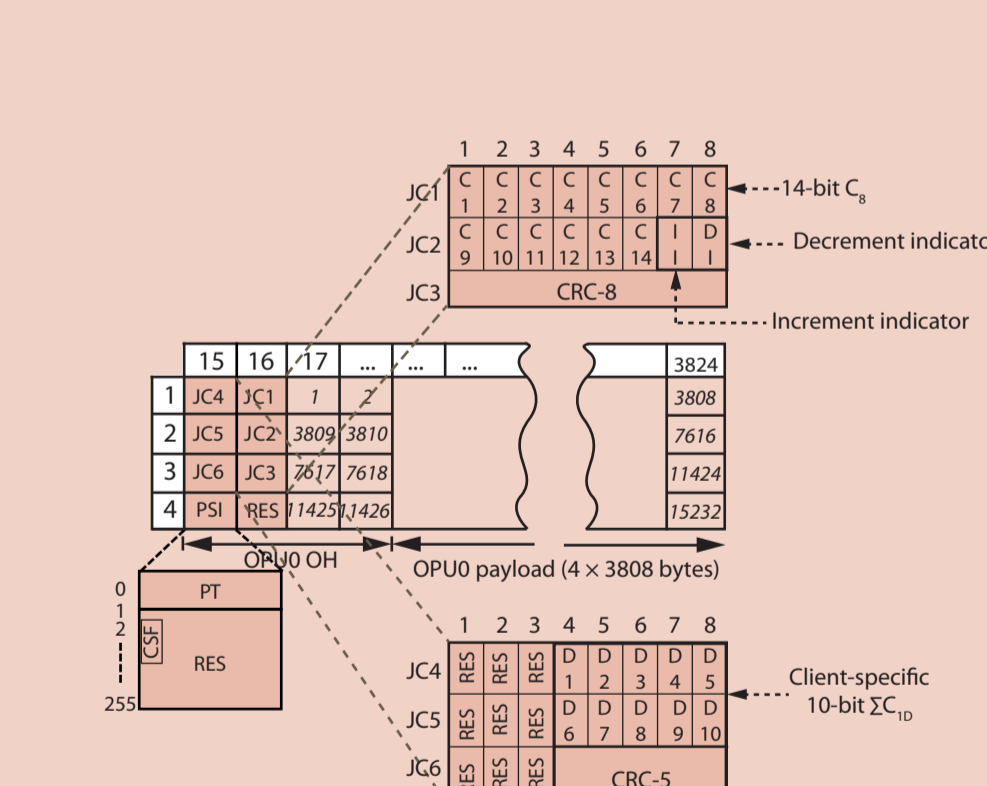
Jc2	Jc1	NJO1	NJO2	PJO1	PJO2	PJO3	Interpretation
00	00	Just. byte	Just. byte	Data byte	Data byte	Data byte	No justification (0)
00	01	Data byte	Just. byte	Data byte	Data byte	Data byte	Negative justification (-1)
00	10	Just. byte	Just. byte	Just. byte	Just. byte	Data byte	Double positive justification (+2)
00	11	Just. byte	Just. byte	Just. byte	Data byte	Data byte	Positive justification (+1)
01	*	Data byte	Data byte	Data byte	Data byte	Data byte	Double negative justification (-2)
11	*	Just. byte	Just. byte	Just. byte	Just. byte	Just. byte	Triple positive justification (+3)

### Time slot structure, e.g., OTU2



## Generic Mapping Procedure (GMP)

The 14-bit C<sub>2</sub> value indicates number of data bytes per frame. C<sub>2</sub> = 15232 means maximum transport capacity and zero stuffing bytes. Data bytes and stuffing bytes are evenly distributed over the frame. S<sub>C2</sub> value is used for one bit timing information when higher granularity is needed. Clients for which the 8-bit timing information in C<sub>m</sub> with m=8 is sufficient (e.g., 1000BASE-X client mapping) will not use S<sub>C2</sub> and Jc4/5/6 will be all 0s.



## OTU/ODU Types and Capacity

OTN Type	OTU Nominal Bit Rate	ODU Type	ODU Nominal Bit Rate	Example Client Signal
—	—	ODU0	1.244160 Gbps	1GE LAN
—	—	ODUflex	Client specific	MAC/IP
OTU1	255/238 x 2.488320 Gbps = 2.666057 Gbps	ODU1	239/238 x 2.488320 Gbps = 2.498775 Gbps	STS-48/STM-16
OTU1e	255/238 x 10.312500 Gbps = 11.049107 Gbps	ODU1e	239/238 x 10.312500 Gbps = 10.355830 Gbps	10GE LAN
OTU1f	255/238 x 10.518750 Gbps = 11.270089 Gbps	ODU1f	239/238 x 10.518750 Gbps = 10.562946 Gbps	10GFC
OTU2	255/237 x 9.953280 Gbps = 10.709255 Gbps	ODU2	239/237 x 9.953280 Gbps = 10.037274 Gbps	STS-192/STM-64 WAN
OTU2e	255/237 x 10.312500 Gbps = 11.095730 Gbps	ODU2e	239/237 x 10.312500 Gbps = 10.399525 Gbps	10GE LAN
OTU2f	255/237 x 10.518750 Gbps = 11.317642 Gbps	ODU2f	239/237 x 10.518750 Gbps = 10.607516 Gbps	10GFC
OTU3	255/236 x 39.813120 Gbps = 43.018414 Gbps	ODU3	239/236 x 39.813120 Gbps = 40.319219 Gbps	STS-768/STM-256
OTU3e1	255/236 x 4 x 10.312500 Gbps = 44.570974576 Gbps	ODU3e1	239/236 x 4 x 10.312500 Gbps = 41.774364407 Gbps	4 x ODU2e
OTU3e2	243/217 x 16 x 2.488320 Gbps = 44.583356 Gbps	ODU3e2	239/255 x 243/217 x 16 x 2.488320 Gbps = 41.785969 Gbps	4 x ODU2e
OTU4	255/227 x 99.532800 Gbps = 111.809973 Gbps	ODU4	239/227 x 99.532800 Gbps = 104.794446 Gbps	100GE

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