40GE Interface

Trey Malpass
Zhong Qiwen

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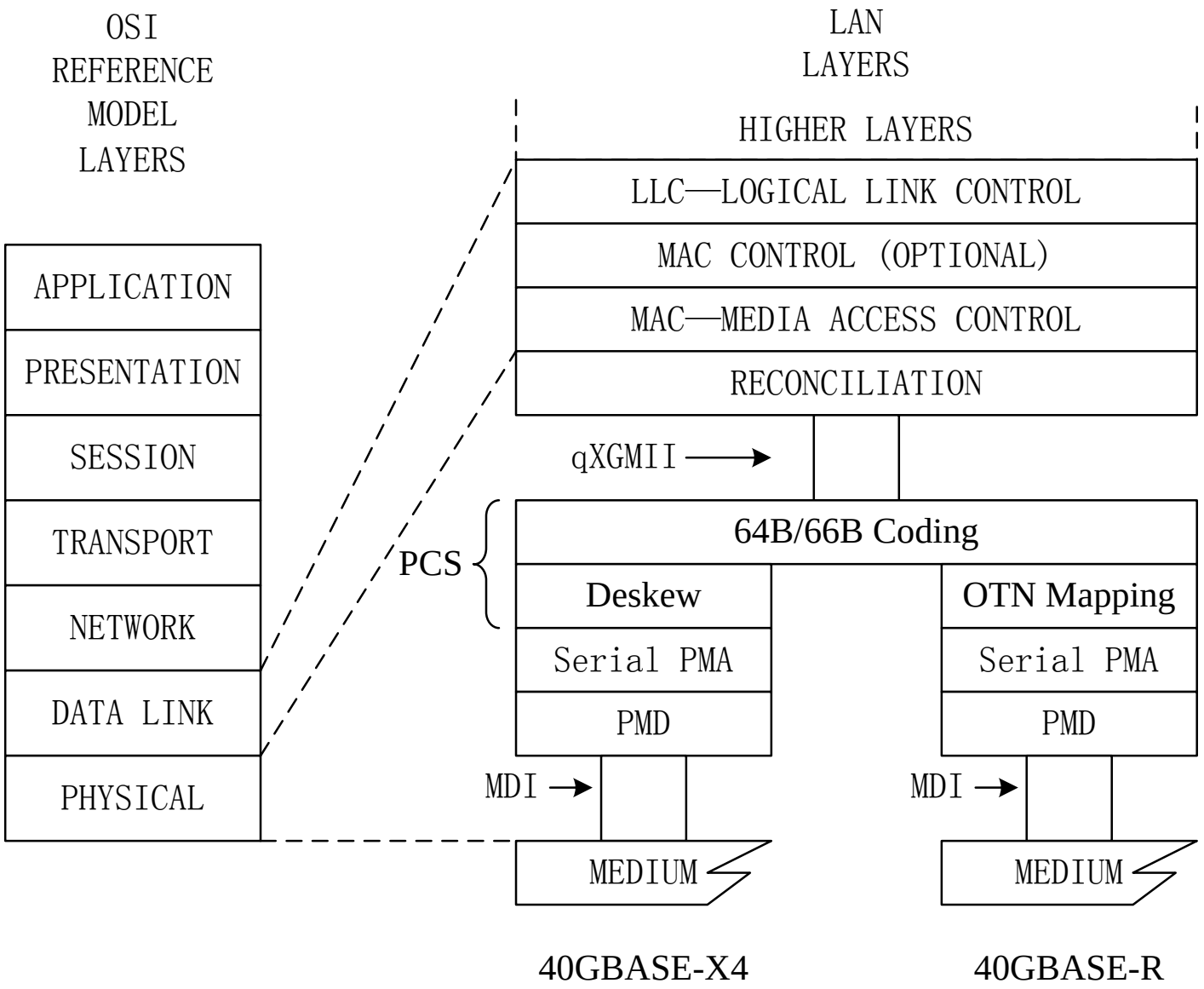
Seoul, Republic of Korea

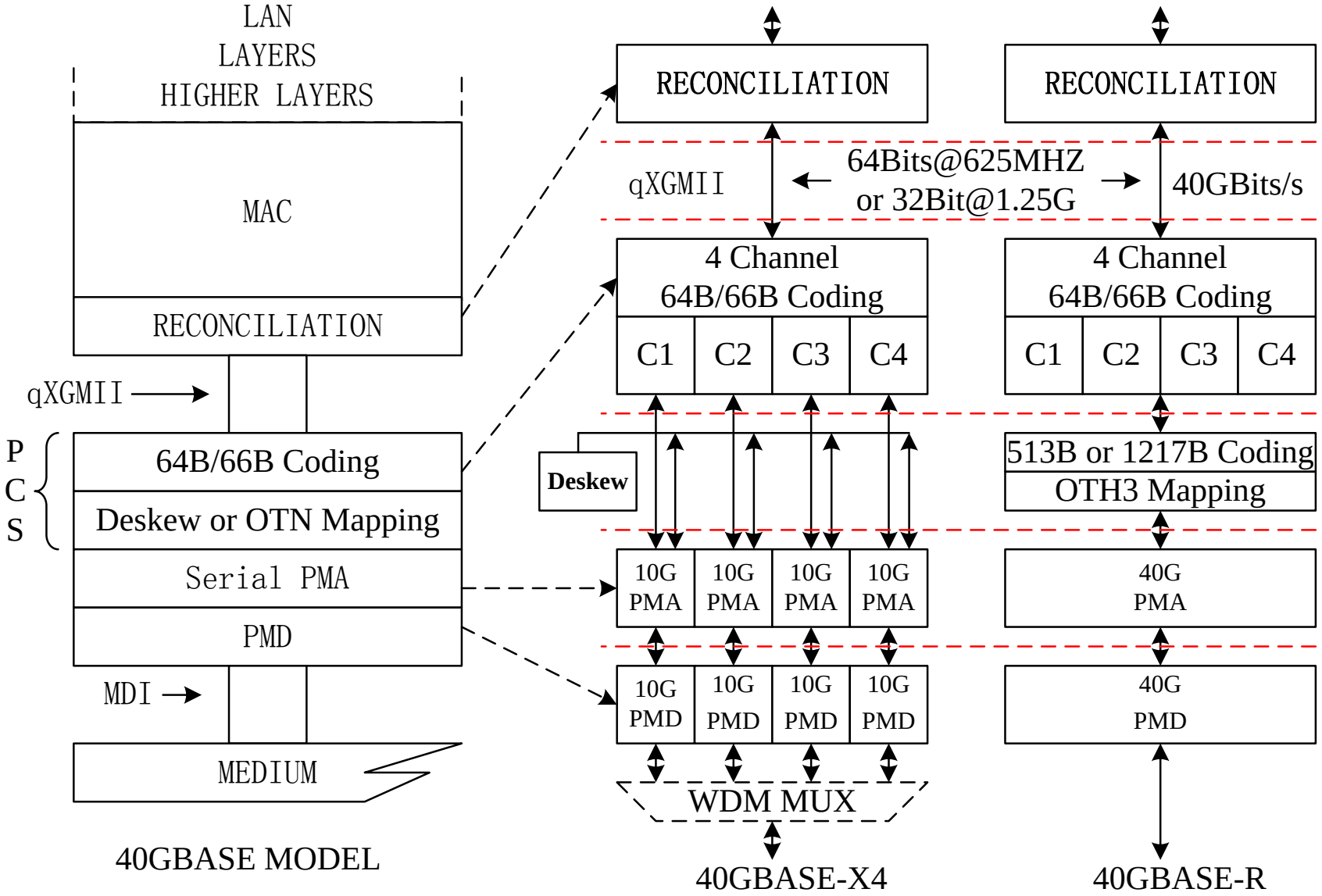
trey.malpass@yahoo.com
zhongqiwen52504@huawei.com

HUAWEI

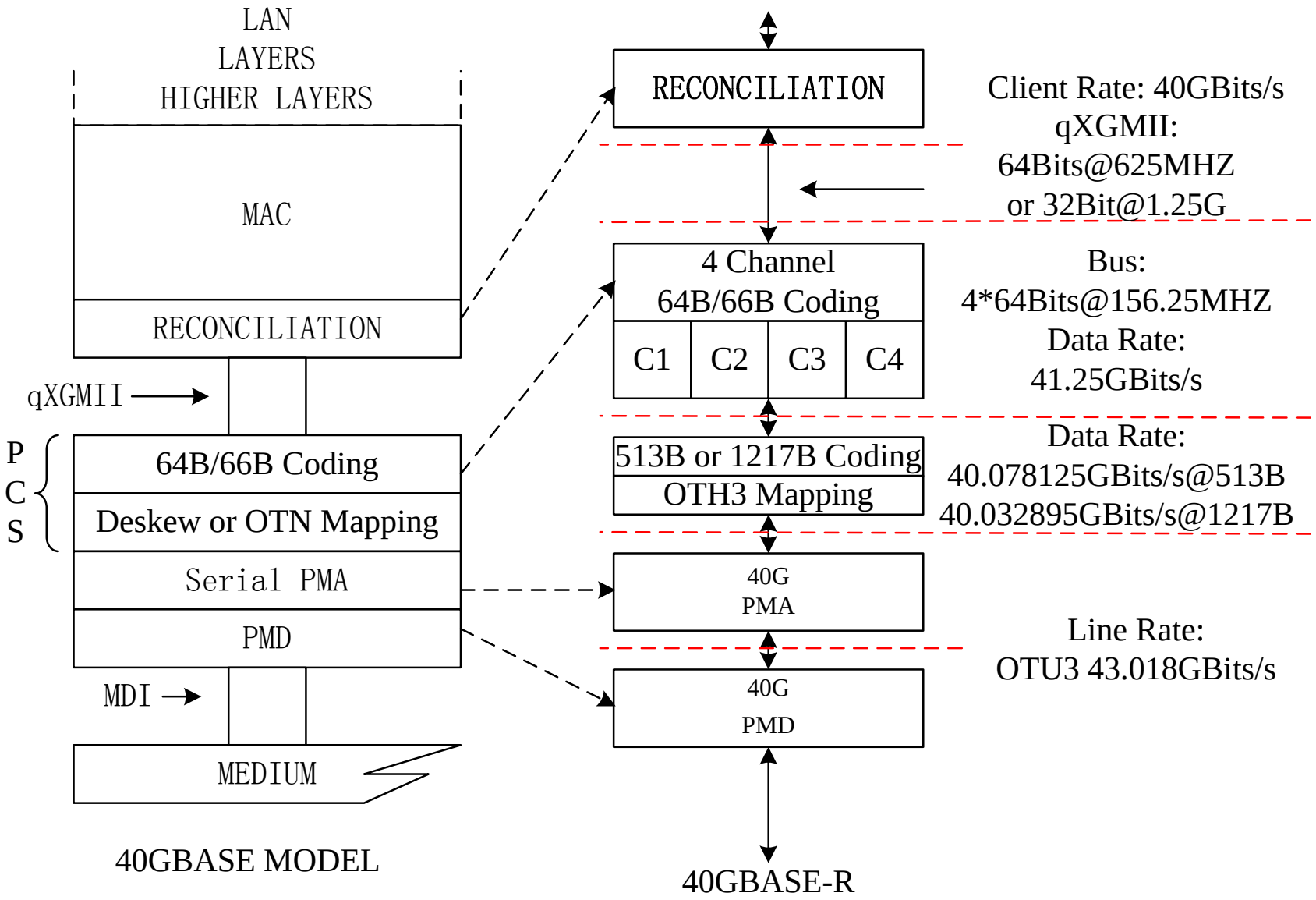
Proposed 40GE Reference Model



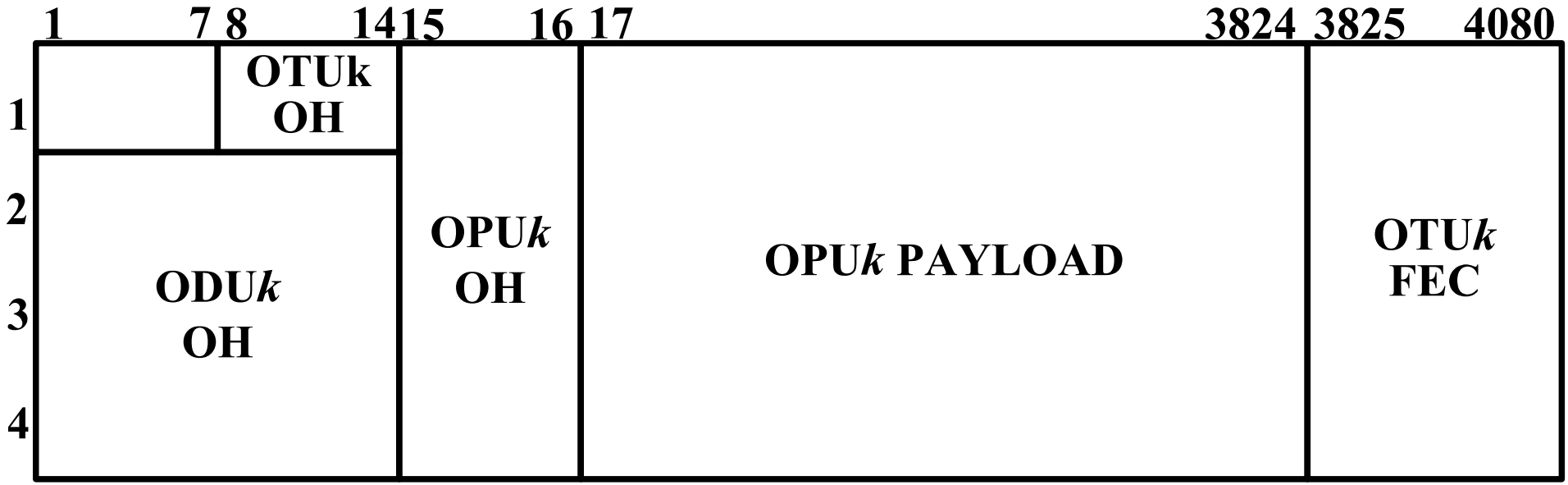
40GBASE Interface Model



40GBASE-R


LAN
LAYERS
HIGHER LAYERS
MAC
RECONCILIATION
qXGMII
P
C
S
64B/66B Coding
Deskew or OTN Mapping
Serial PMA
PMD
MDI
MEDIUM
40GBASE MODEL
RECONCILIATION
4 Channel
64B/66B Coding
C1
C2
C3
C4
513B or 1217B Coding
OTH3 Mapping
40G
PMA
40G
PMD
40GBASE-R
Client Rate: 40GBits/s
qXGMII:
64Bits@625MHZ
or 32Bit@1.25G
Bus:
4*64Bits@156.25MHZ
Data Rate:
41.25GBits/s
Data Rate:
40.078125GBits/s@513B
40.032895GBits/s@1217B
Line Rate:
OTU3 43.018GBits/s

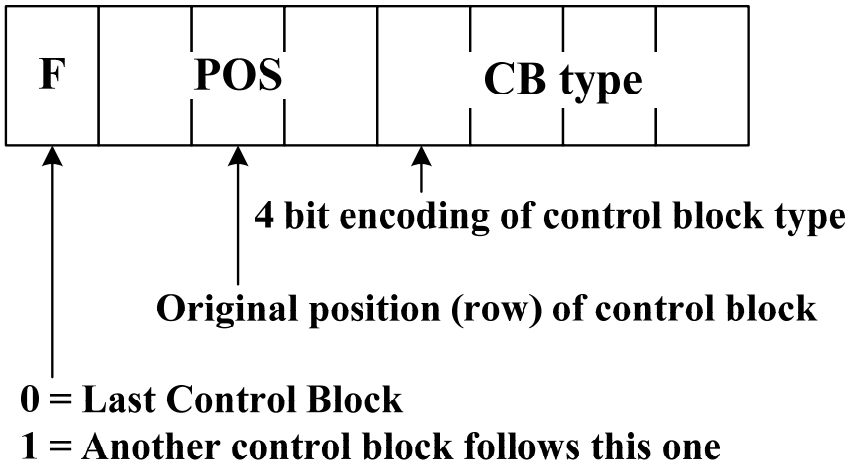
OTN



Type	Nominal bit rate		bit-rate tolerance
OPU3	238/236 × 39 813 120 kbit/s	40 150 519.322 kbit/s	±20 ppm
ODU3	239/236 × 39 813 120 kbit/s	40 319 218.983 kbit/s	
OTU3	255/236 × 39 813 120 kbit/s	43 018 413.559 kbit/s	

Transform 64B/66B to (64*N)B/ (64*N+1)B

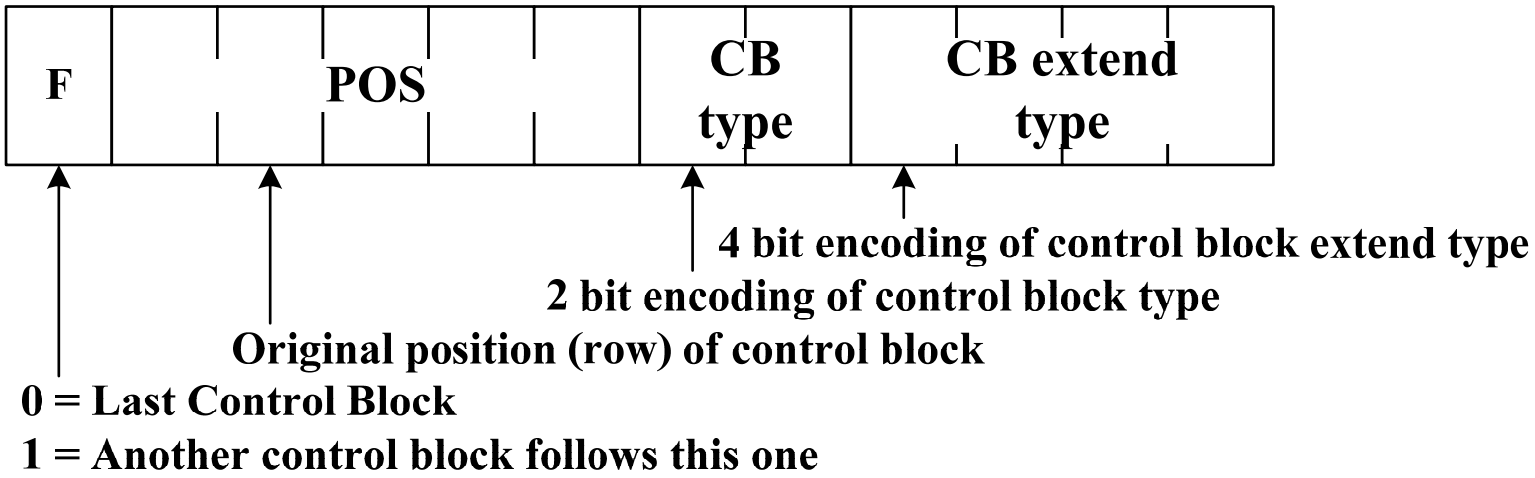
- **Why we have to transform 64B/66B to (64*N)B/ (64*N+1)B?**
  - The data rate of 40GE using 64B/66B code in PCS is 41.25GBits/s and this rate is faster than OPU3 payload rate.
  - (64*N)B/ (64*N+1)B code is more efficiency.



- **How to code (64*N)B/ (64*N+1)B?**
  - The solution is from Stephen J. Trowbridge, according to option 2 of the paper trowbridge_01_0707.pdf on HSSG web site, the value N (value of POS field) is from 2 to 8 and 512B/513B is recommended when N=8.
  - Basing on this solution, the POS field of control block header can be extended to 5 bits then the maximum N is 32.

Extending N to 5 bits

- **How to extend the POS field to 5 bits?**
  - C code in 64B/66B, 7 bits long, is transformed to 4 bits.
  - O code in 64B/66B, 2 bits long, is transformed to 2 bits.
  - CB Type filed occupancies 2 bits and 4 bits long CBTX field is used to indicate the difference control block.
  - POS field is extended to 5 bits long.



(64*N)B/ (64*N+1)B Code (N<= 32)

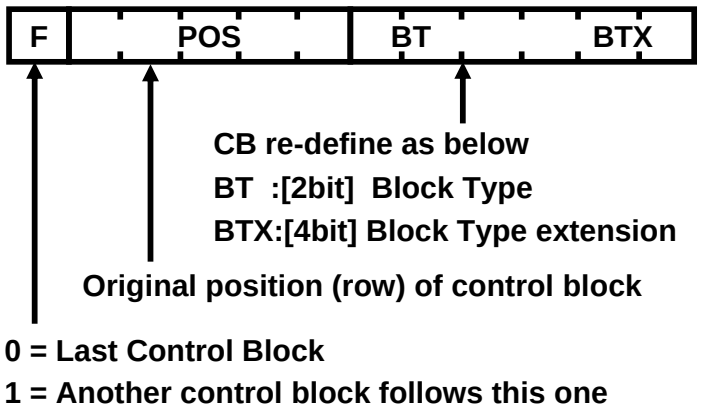
Input Data	Syn	Block Payload							
Data Block Format: / Bit Position:	01	2							65
D0 D1 D2 D3/D4 D5 D6 D7	01	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
Control Block Formats:		**Block Type Field**							
C0 C1 C2 C3/C4 C5 C6 C7	10	0x1e	C_0	C_1	C_2	C_3	C_4	C_5	C_6 C_7
C0 C1 C2 C3/O4 D5 D6 D7	10	0x2d	C_0	C_1	C_2	C_3	Q_4	D_5	D_6 D_7
C0 C1 C2 C3/S4 D5 D6 D7	10	0x33	C_0	C_1	C_2	C_3		D_5	D_6 D_7
O0 D1 D2 D3/S4 D5 D6 D7	10	0x66	D_1	D_2	D_3	Q_0		D_5	D_6 D_7
O0 D1 D2 D3/O4 D5 D6 D7	10	0x55	D_1	D_2	D_3	Q_0	Q_4	D_5	D_6 D_7
S0 D1 D2 D3/D4 D5 D6 D7	10	0x78	D_1	D_2	D_3	D_4		D_5	D_6 D_7
O0 D1 D2 D3/C4 C5 C6 C7	10	0x4b	D_1	D_2	D_3	Q_0	C_4	C_5	C_6 C_7
T0 C1 C2 C3/C4 C5 C6 C7	10	0x87		C_1	C_2	C_3	C_4	C_5	C_6 C_7
D0 T1 C2 C3/C4 C5 C6 C7	10	0x99	D_0		C_2	C_3	C_4	C_5	C_6 C_7
D0 D1 T2 C3/C4 C5 C6 C7	10	0xaa	D_0	D_1		C_3	C_4	C_5	C_6 C_7
D0 D1 D2 T3/C4 C5 C6 C7	10	0xb4	D_0	D_1	D_2		C_4	C_5	C_6 C_7
D0 D1 D2 D3/T4 C5 C6 C7	10	0xcc	D_0	D_1	D_2	D_3		C_5	C_6 C_7
D0 D1 D2 D3/D4 T5 C6 C7	10	0xd2	D_0	D_1	D_2	D_3	D_4		C_6 C_7
D0 D1 D2 D3/D4 D5 T6 C7	10	0xe1	D_0	D_1	D_2	D_3	D_4	D_5	C_7
D0 D1 D2 D3/D4 D5 D6 T7	10	0xff	D_0	D_1	D_2	D_3	D_4	D_5	D_6

Block Payload								
0								63
D_0			D_1	D_2	D_3	D_4	D_5	D_6 D_7
F	**POS**	**CB**	**CBX**					
F	**POS**	11	0001	_ C_0	C_1	C_2	C_3	_ C_4 C_5 C_6 C_7
F	**POS**	11	0010	_ C_0	C_1	C_2	C_3	_ Q_4 D5 D6 D7
F	**POS**	11	0011	_ C_0	C_1	C_2	C_3	_ D5 D6 D7
F	**POS**	11	0100	D1	D2	D3	Q0 _	D5 D6 D7
F	**POS**	11	0101	D1	D2	D3	Q0	Q4 D5 D6 D7
F	**POS**	10	D1	D2	D3	D4	D5	D6 D7
F	**POS**	11	0110	_ D1	D2	D3	_	Q0 C_4 C_5 C_6 C_7
F	**POS**	11	0111	_			C_1	C_2 C_3 C_4 C_5 C_6 C_7
F	**POS**	11	1000	_ D0	_			C_2 C_3 C_4 C_5 C_6 C_7
F	**POS**	11	1001	_ D0	D1	_		C_3 C_4 C_5 C_6 C_7
F	**POS**	11	1010	_ D0	D1	D2	_	C_4 C_5 C_6 C_7
F	**POS**	11	1011	_ D0	D1	D2	D3	_ C_5 C_6 C_7
F	**POS**	11	1100	_ D0	D1	D2	D3	D4 C_6 C_7
F	**POS**	11	1101	D0	D1	D2	D3	D4 D5 C_7
F	**POS**	01	D_0	D1	D2	D3	D4	D5 D6

Compress the 7bit C and O codeword into 4 bit codeword.

C code in 64B/66B, 7 bits long, is transformed to 4 bits.

O code in 64B/66B, 4 bits long, is transformed to 2 bits.

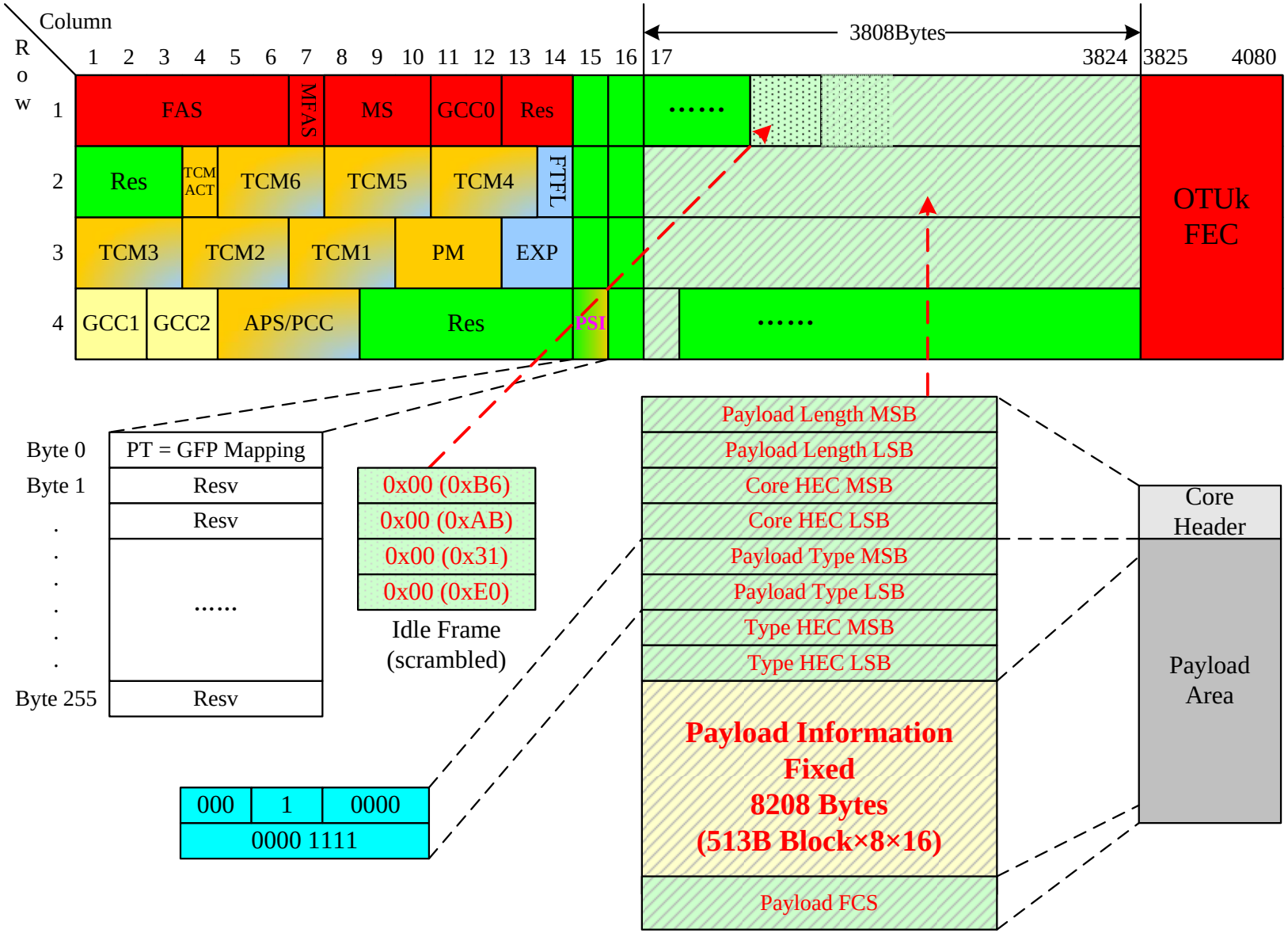


OTN Mapping

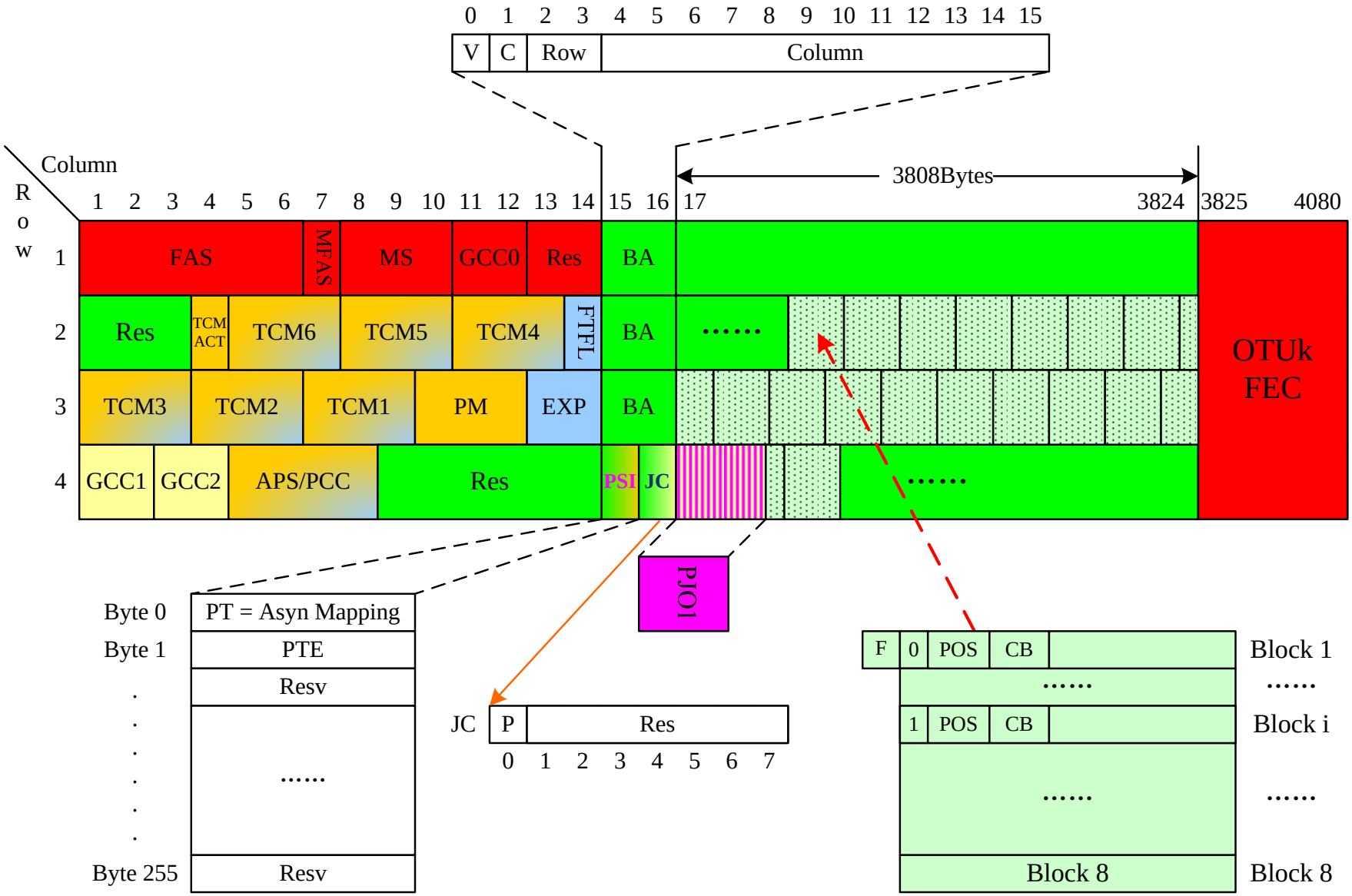
- **Alternatives to be considered:**
  - 512B/513B Block mapped to OPU3 payload using GFP.
  - 512B/513B Block mapped to OPU3 payload using block interleaved.
  - 1218B/1219B Block mapped to OPU3 payload using block interleaved.

	Nominal bit rate	Minimal Rate	Maximum Rate
OPU3	**40 150 519.322 kbit/s**	**40 149 716.311 kbit/s** **At -20ppm tolerance**	**40 151 322 .332 kbit/s** **At +20ppm tolerance**
512B/513B	**40 078 125.000 kbit/s**	**40 074 117.187 kbit/s** **At -100ppm tolerance**	**40 082 132.812 kbit/s** **At +100ppm tolerance**
1216B/1217B	**40 032 894.737 kbit/s**	**40 028 891.447 kbit/s** **At -100ppm tolerance**	**40 036 898.026 kbit/s** **At +100ppm tolerance**

Option 1: 513B Block mapped using GFP



Option 2: 513B Block mapped using interleaved

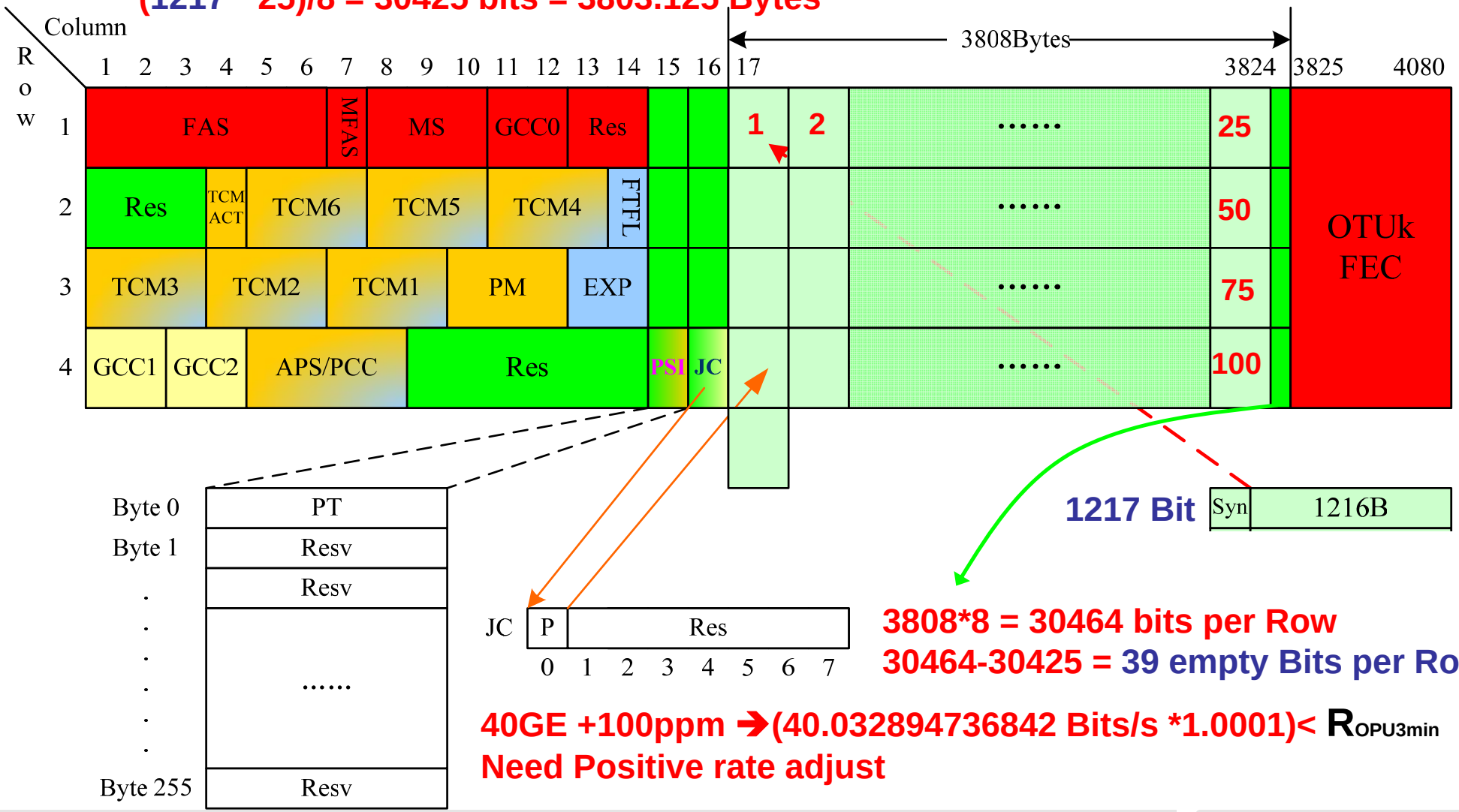


513B Block mapped using interleaved

- **map data flow (bit stream) directly into the OPU3 payload area:**
  - BA(OPU Payload Block Align):
    - V (valid) 1 bit:: “1” The OPU payload area block include data; “0” block do not include data
    - C (continue)1 bit: “1” The data in the local Block is continues of previous Blocks. “0” data started from the local block.
    - Row(2 bit) and Column(12 bit): to indicate the octet boundary of the start position of the bit stream.
    - Three BA area for verify due to the importance of Block Align.
  - Using all “1” or “0” for bit stream stuff in invalid area.
  - JC (Justification Control):
    - 1 bit P: P=1, Positive Justification indication, P=0 means not; ($N \times P = 0$)
  - One 513B Block PJO Positive Justification Area.

Option 3: 1217B Block interleaved

25 Blocks in one row; Total 100 blocks in one OPU payload area.
(1217 * 25)/8 = 30425 bits = 3803.125 Bytes



3808*8 = 30464 bits per Row
30464-30425 = 39 empty Bits per Row

40GE +100ppm ➔(40.032894736842 Bits/s *1.0001)< $R_{OPU3min}$
Need Positive rate adjust

Option 3: 1217B Block interleaved

- **Bypass the GFP process**
- **Map (64*19)B/(64*19+1)B Blocks directly into OPU3:**
  - JC (Justification Control):
    - Do not need Negative Justification
    - 1 bit P: P=1, Positive Justification indication, P=0 means not; (N × P = 0)
  - One (64*19)B/(64*19+1)B block PJO Positive Justification Area
  - need a new UPI to identify the above payload type;
  - 25 code blocks can map to one row, for a total of 100 blocks in the OPU3 payload area.
  - **There are 39 Bits empty per Row.**

Summery

- **40GE Mapping into OPU3**
  - Option No.1: Block interleaving:
    - **(64*19)b/(64*19+1)b is preferable**
    - **Simple than GFP encapsulation Mapping**
  - Option No.2: GFP frame encapsulation:
    - **The 512b/513b is also preferable**
  - Option No.3: Bit stream mapping
    - **General (64*n)b/(64*n+j) are OK (n > 5).**

- **Proposing:**
  - Consider 40GE OTN interface and select Option No.1 for mapping.
  - Collaborate with ITU-T SG15 closely to define 40GE.

Thank You