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OTN Transport of CPRI signals

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Supplement 56 to ITU-T G-series Recommendations

OTN Transport of CPRI signals

Summary

The nature of common public radio interface (CPRI) signals is such that they require special consideration when carried as a client signal over the ITU-T G.709 optical transport network (OTN). One consideration is the stringent frequency accuracy requirements for CPRI. Another consideration is that the native line coding of the CPRI signals can be transcoded into a more bandwidth efficient coding, which allows the carriage of additional CPRI client signals in some important applications. Supplement 56 to ITU-T G-series Recommendations describes alternatives for mapping and multiplexing CPRI client signals into the OTN. This Supplement relates to Recommendations ITU-T G.872, ITU-T G.709/Y.1331, ITU-T G.798 and ITU-T G.959.1.

History

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Supplement 56 to ITU-T G-series Recommendations

OTN Transport of CPRI signals

1 Scope

This Supplement describes alternatives for mapping and multiplexing CPRI client signals into the OTN. These mappings include direct mappings for native CPRI client signals and mappings that apply transcoding in order to gain bandwidth efficiency. This Supplement relates to [ITU-T G.872], [ITU-T G.709], [ITU-T G.798] and [ITU-T G.959.1].

2 References

[ITU-T G.709] Recommendation ITU-T G.709/Y.1331 (2012), *Interfaces for the optical transport network*.

[ITU-T G.798] Recommendation ITU-T G.798 (2012), *Characteristics of optical transport network hierarchy equipment functional blocks.*

[ITU-T G.872] Recommendation ITU-T G.872 (2012), *Architecture of optical transport networks.*

[ITU-T G.959.1] Recommendation ITU-T G.959.1 (2012), *Optical transport network physical layer interfaces*.

[ITU-T G.806] Recommendation ITU-T G.806 (2012), *Characteristics of transport equipment – Description methodology and generic functionality*.

[CPRI V6.1] CPRI Specification V6.1 (2014-07-01), *Common public radio interface (CPRI), interface specification*. Available (viewed 2015-08-29) at: http://www.cpri.info/downloads/CPRI_v_6_1_2014-07-01.pdf

3 Definitions

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AIS Alarm Indication Signal

AMP Asynchronous Mapping Procedure

BaFN Basic Frame Number

BFP Basic Frame Pointer

CPRI Common Public Radio Interface

FEC Forward Error Correction

GMP Generic Mapping Procedure

HO High Order

LO Low Order

ODU Optical channel Data Unit

ODU2r overclocked ODU2 signal for carrying CPRI radio signals

OMFI OPU2r Multiframe Identifier

OPU	Optical channel Payload Unit
OTN	Optical Transport Network
PCS	Physical Coding Sublayer
PSI	Payload Structure Identifier
PT	Payload Type
RE	Remote Equipment
UIpp	Unit Intervals peak-to-peak

5 Conventions

Transmission order: The order of transmission of information in all the figures in this Supplement is first from left to right and then from top to bottom. Within each byte, the most significant bit is transmitted first. The most significant bit (bit 1) is illustrated at the left in all the figures.

6 Introduction

This Supplement first describes methods for mapping CPRI client signals into the OTN that make use of existing ITU-T Recommendations. CPRI signals are treated as a normal CBR client for the ITU-T G.709 OTN, but stringent frequency and clock tolerance requirements are specified for CPRI clients. Second, this Supplement describes a method that uses a combination of transcoding and multiplexing (interleaving) of multiple CPRI clients into an overclocked optical channel data unit-2 (ODU2), called the ODU2r, in order to optimize transport bandwidth efficiency in some important CPRI applications.

Note that OTN transport of CPRI is intended for use within an administrative domain. Users of this Supplement should not assume that the required performance for the CPRI client is met. It is the responsibility of the network operator to determine if the required performance can be met. For example, the OTN network should also be designed in order to meet the applicable symmetry requirements. Considerations for maintaining adequate frequency accuracy for CPRI clients are addressed in the respective clauses.

7 Mappings based on normative methods

This clause describes methods for mapping CPRI client signals into ITU-T G.709 payloads using techniques that are currently defined for use with other client signal mappings in [ITU-T G.709]. The descriptions also describe special considerations that may be needed.

NOTE – It is the responsibility of the network operator to determine if the required performance can be met. The noise generated by the OTN would have to be handled by the CPRI system in order to meet the application requirements. This is considered as a complex task according to the current OTN specification.

7.1 Single CPRI signal mapping into ODUk (k = 0, 1, flex(CBR))

CPRI constant bit rate signals ([CPRI V6.1] options 1 to 9) may be transported over an ODUk connection. These CBR signals are mapped into a low order (LO) optical channel payload unit-k (OPUk) via the generic mapping procedure as specified in clause 17.7 of [ITU-T G.709] for [CPRI V6.1] options 1 to 3 and via the bit-synchronous mapping procedure as specified in clause 17.9 of [ITU-T G.709] for [CPRI V6.1] options 4 to 9.

Two [CPRI V6.1] (options 1 and 2) signals are transported via OPU0, one [CPRI V6.1] (option 3) signal is transported via OPU1 and the remaining [CPRI V6.1] (options 4 to 9) signals are transported via OPUflex. The GMP C_m and C_n (n = 1) values associated with the [CPRI V6.1] options 1 to 3 signals are presented in Tables 7-1 and 7-2.

The use of the "Experimental mapping" payload type (code 0x01) is suggested.

Further details are provided below.

Simulation analyses were done for the transport of [CPRI V6.1] option 2, option 3, and option 4 clients over OTN for the following four cases:

a) Option 2 client signal → ODU0 → ODU2 → OTU2 → ODU2 → ODU0 → option 2 client signal

b) Option 3 client signal → ODU1 → ODU2 → OTU2 → ODU2 → ODU1 → option 3 client signal

c) Option 3 client signal → ODU1 → OTU1 → ODU1 → option 3

d) Option 4 client signal → ODU2 → OTU2 → ODU2 → option 4

In accordance with this Supplement, the mappings of the [CPRI V6.1] option 2 client to ODU0 and the [CPRI V6.1] option 3 client to ODU1 are via GMP. The [CPRI V6.1] option 4 client is mapped to ODUflex, and the ODUflex is mapped to ODU2 via GMP. Finally, in a) the ODU0 is mapped to ODU2 via GMP, and in b) the ODU1 is mapped to ODU2 via AMP. Cases a) and b) have a single mapping of the CPRI client to OTN and one level of OTN multiplexing. Cases c) and d) have a single mapping to OTN and no OTN multiplexing.

Simulations were run for no use of additional phase information for the CPRI client to LO ODU mapper (i.e., C_n with n = 8) and 1 UI of additional phase information for the CPRI client to LO ODU mapper (i.e., C_n with n = 1). The desynchronizer bandwidth for the HO ODU to LO ODU demappers was 300 Hz.

The simulation results indicated that, for CPRI client desynchronizer bandwidth in the range 100 to 300 Hz (current OTN client desynchronizers are 300 Hz or, in a few cases, 100 Hz or 200 Hz) RMS frequency offset ranges from approximately 113 ppb to 190 ppb for transport of [CPRI V6.1] option 2 for case a) and 156 ppb to 317 ppb for transport of [CPRI V6.1] option 3 for case b). In addition, for the same range of desynchronizer bandwidths, RMS frequency offset ranges from approximately 29 ppb to 116 ppb for [CPRI V6.1] option 3 for case c) and 32 ppb to 130 ppb for [CPRI V6.1] option 4 for case d).

The simulation results also indicated that, for CPRI client desynchronizer bandwidth in the range 100 to 300 Hz, peak-to-peak jitter ranges from approximately 6.9 to 14.2 UIpp (unit intervals peak-to-peak) for transport of [CPRI V6.1] option 2 for case a) and 6.7 to 14.1 UIpp for transport of [CPRI V6.1] option 3 for case b). In addition, for the same range of desynchronizer bandwidths, peak-to-peak jitter ranges from approximately 0.8 to 7.2 UIpp for [CPRI V6.1] option 3 for case c) and 0.76 to 7.2 UIpp for [CPRI V6.1] option 4 for case d).

In order to allow compatibility with OTN transport, CPRI remote equipment (RE) would need to be designed to tolerate and filter properly at least the noise added by the OTN transport, which is not currently budgeted by CPRI. Additional sources of noise may also exist. The OTN network should also be designed in order to meet the applicable CPRI stringent symmetry requirements; this is something that has not been studied. Interworking between OTN and the CPRI RE, in terms of jitter and wander, is still unknown and has to be considered.

The CPRI replacement signal is the link fault signal as defined in clause 17.7.1.1 of [ITU-T G.709].

Table 7-1A – C_m (m = 8) for su1.238G clients into OPU0

[CPRI V6.1] client signal	Nominal bit rate (kbit/s)	Bit rate tolerance (ppm)	Floor $C_{8,min}$	Minimum c_8	Nominal c_8	Maximum c_8	Ceiling $C_{8,max}$
Option 1	614 400	±0.002	7 553	7 553.429	7 553.580	7 553.731	7 554
Option 2	1 228 800	±0.002	15106	15106.858	15107.160	15107.463	15108

Table 7-1B – C_n (n = 8 or 1) for su1.238G clients into OPU0

[CPRI V6.1] client signal	Nominal bit rate (kbit/s)	Bit rate tolerance (ppm)	Floor $C_{8,min}$	Minimum c_8	Nominal c_8	Maximum c_8	Ceiling $C_{8,max}$
–	–	–	–	–	–	–	–
			Floor $C_{1,min}$	Minimum C_1	Nominal C_1	Maximum C_1	Ceiling $C_{1,max}$
Option 1	614 400	±0.002	60 427	60 427.433	60 428.642	60 429.851	60 430
Option 2	1 228 800	±0.002	120 854	120 854.867	120 857.284	120 859.701	120 860

Table 7-2A – C_m (m = 16) for supra-1.238 to su2.488G clients into OPU1

[CPRI V6.1] client signal	Nominal bit rate (kbit/s)	Bit rate tolerance (ppm)	Floor $C_{16,min}$	Minimum c_{16}	Nominal c_{16}	Maximum c_{16}	Ceiling $C_{16,max}$
Option 3	2 457 600	±0.002	7 521	7 521.825	7 521.975	7 522.126	7 523

Table 7-2B – C_n (n = 8 or 1) for supra-1.238 to su2.488G clients into OPU1

[CPRI V6.1] client signal	Nominal bit rate (kbit/s)	Bit rate tolerance (ppm)	Floor $C_{8,min}$	Minimum c_8	Nominal c_8	Maximum c_8	Ceiling $C_{8,max}$
–	–	–	–	–	–	–	–
			Floor $C_{1,min}$	Minimum c_1	Nominal c_1	Maximum c_1	Ceiling $C_{1,max}$
Option 3	2 457 600	±0.002	241 709	241 709.733	241 714.568	241 719.403	241 720

Table 7-3 – supra-2.488G CBR clients

[CPRI V6.1] client signal	Nominal bit rate (kbit/s)	Bit-rate tolerance (ppm)
Option 4	3 072 000	±0.002
Option 5	4 915 200	±0.002
Option 6	6 144 000	±0.002
Option 7	9 830 400	±0.002
Option 8	10 137 600	±0.002
Option 9	12 165 120	±0.002

Table 7-4 – Replacement signal for CPRI clients

[CPRI V6.1] client signal	Replacement signal	Bit-rate tolerance (ppm)
Option 1	Link Fault	±100
Option 2	Link Fault	±100
Option 3	Link Fault	±100
Option 4	Link Fault	±100
Option 5	Link Fault	±100
Option 6	Link Fault	±100
Option 7	Link Fault	±100
Option 8	TBD	±100
Option 9	TBD	±100

Table 7-5 – Number of tributary slots required for ODUj into HO OPUk

	# 2.5G tributary slots		**# 1.25G tributary slots**			
LO ODU – [CPRI V6.1]	**OPU2**	**OPU3**	**OPU1**	**OPU2**	**OPU3**	**OPU4**
ODUflex(CBR)						
– ODUflex(option 4)	–	–	–	3	3	3
– ODUflex(option 5)	–	–	–	4	4	4
– ODUflex(option 6)	–	–	–	5	5	5
– ODUflex(option 7)	–	–	–	8	8	8
– ODUflex(option 8)	–	–	–	–	9	8
– ODUflex(option 9)	–	–	–	–	10	10

Table 7-6 – C_m and C_n (n = 8) for ODUj into ODTU2.M

ODUj signal – [CPRI V6.1]	M	m = 8×M	Floor $C_{m,min}$	Minimum C_m	Nominal C_m	Maximum C_m	Ceiling $C_{m,max}$
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	12 534	12 534.900	12 536.404	12 537.909	12 538
– ODUflex(option 5)	4	32	15 041	15 041.880	15 043.685	15 045.490	15 046
– ODUflex(option 6)	5	40	15 041	15 041.880	15 043.685	15 045.490	15 046
– ODUflex(option 7)	8	64	15 041	15 041.880	15 043.685	15 045.490	15 046
			Floor $C_{8,min}$	**Minimum C_8**	**Nominal C_8**	**Maximum C_8**	**Ceiling $C_{8,max}$**
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	37 604	37 604.700	37 609.213	37 613.726	38 614
– ODUflex(option 5)	4	32	60 167	60 167.519	60 174.740	60 181.961	60 182
– ODUflex(option 6)	5	40	75 209	75 209.399	75 218.425	75 227.452	75 228
– ODUflex(option 7)	8	64	120 335	120 335.039	120 349.48	120 363.923	120 364

Table 7-7 – C_m and C_n (n = 8) for ODUj into ODTU3.M

ODUj signal – [CPRI V6.1]	M	m = 8×M	Floor $C_{m,min}$	Minimum C_m	Nominal C_m	Maximum C_m	Ceiling $C_{m,max}$
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	12 482	12 482.010	12 483.508	12 485.006	12 486
– ODUflex(option 5)	4	32	14 978	14 978.412	14 980.210	14 982.007	14 983
– ODUflex(option 6)	5	40	14 978	14 978.412	14 980.210	14 982.007	14 983
– ODUflex(option 7)	8	64	14 978	14 978.412	14 980.210	14 982.007	14 983
– ODUflex(option 8)	9	72	13 730	13 730.211	13 731.859	13 733.507	13 764
– ODUflex(option 9)	10	80	14 828	14 828.628	14 830.407	14 832.187	14 833
			Floor $C_{8,min}$	**Minimum C_8**	**Nominal C_8**	**Maximum C_8**	**Ceiling $C_{8,max}$**
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	37 446	37 446.030	37 450.524	37 455.018	37 456
– ODUflex(option 5)	4	32	59 913	59 913.648	59 920.838	59 928.029	59 929
– ODUflex(option 6)	5	40	74 892	74 892.060	74 901.048	74 910.036	74 911
– ODUflex(option 7)	8	64	119 827	119 827.296	119 841.677	119 856.058	119 857
– ODUflex(option 8)	9	72	123 571	123 571.899	123 586.729	123 601.560	123 602
– ODUflex(option 9)	10	80	148 286	148 286.279	148 304.075	148 321.872	148 322

Table 7-8 – C_m and C_n (n = 8) for ODUj into ODTU4.M

ODUj signal – [CPRI V6.1]	M	m = 8×M	Floor $C_{m,min}$	Minimum C_m	Nominal C_m	Maximum C_m	Ceiling $C_{m,max}$
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	12 006	12 006.001	12 007.442	12 008.883	12 009
– ODUflex(option 5)	4	32	14 407	14 407.201	14 408.930	14 410.659	14 411
– ODUflex(option 6)	5	40	14 407	14 407.201	14 408.930	14 410.659	14 411
– ODUflex(option 7)	8	64	14 407	14 407.201	14 408.930	14 410.659	14 411
– ODUflex(option 8)	8	64	14 857	14 857.426	14 859.209	14 860.993	14 861
– ODUflex(option 9)	10	80	14 263	14 263.129	14 264.841	14 266.553	14 267
			Floor $C_{8,min}$	**Minimum C_8**	**Nominal C_8**	**Maximum C_8**	**Ceiling $C_{8,max}$**
ODUflex(CBR)	ODUflex(CBR) dependent						
– ODUflex(option 4)	3	24	36 018	36 018.003	36 022.326	36 026.649	36 027
– ODUflex(option 5)	4	32	57 628	57 628.805	57 635.722	57 642.638	57 643
– ODUflex(option 6)	5	40	72 036	72 036.007	72 044.652	72 053.297	72 054
– ODUflex(option 7)	8	64	115 257	115 257.611	115 271.443	115 285.276	115 286
– ODUflex(option 8)	8	64	118 859	118 859.411	118 873.676	118 887.941	118 888
– ODUflex(option 9)	10	80	142 631	142 631.293	142 648.411	142 665.529	142 666

8 Multiple CPRI option 3, 4 or 5 signal mapping into ODU2r

Six [CPRI V6.1] option 3 signals, three [CPRI V6.1] option 4 signals or three [CPRI V6.1] option 5 signals into an OPUk (k = 2r), which has a somewhat higher rate than ODU2, can.be multiplexed and mapped using the following method. Transporting these signals over more than a single OTU2r link is for further study.

8.1 OPU2r overhead description

The OPU2r overhead includes the payload structure identifier (PSI) including the payload type (PT), the OPU2r multiframe identifier (OMFI) and client mapping specific overhead. The OPU2r PSI, PT and OMFI overhead locations are shown in Figure 7-1.

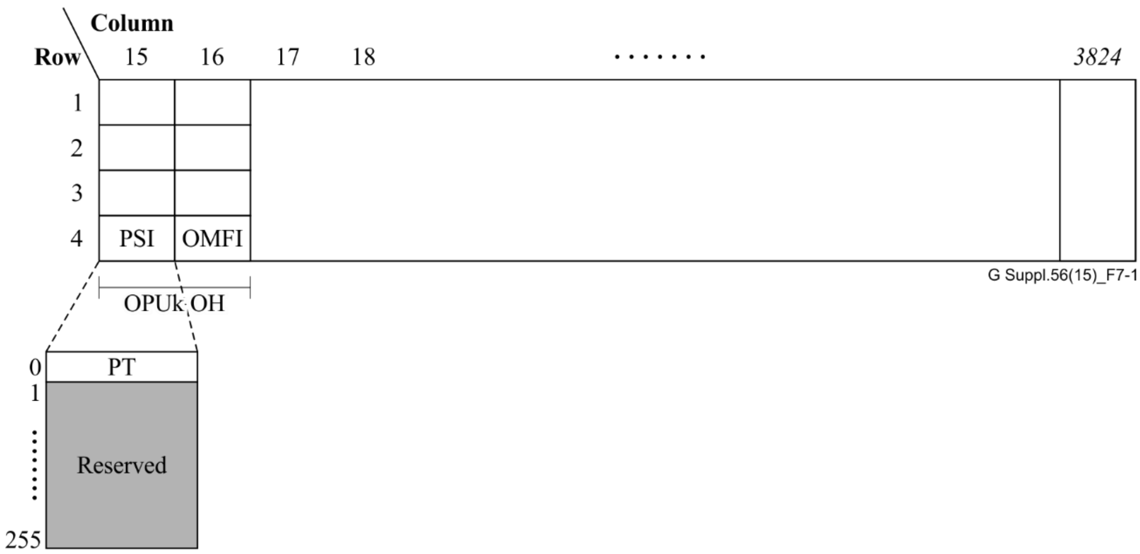

Figure 7-1 – OPU2r overhead

8.1.1 OPU2r overhead definition

8.1.1.1 OPU2r payload structure identifier (PSI)

A one-byte payload type signal is defined in the PSI[0] byte of the payload structure identifier to indicate the composition of the OPU2r signal. The code points are defined in Table 8-1. The remaining 255 PSI bytes are reserved.

Table 8-1 – Payload type code points for OPU2r

MSB 1234	LSB 5678	Hex code	Interpretation [CPRI V6.1]
1000	0000	80	Option 3 multiplexing structure
1000	0001	81	Option 4 multiplexing structure
1000	0010	82	Option 5 multiplexing structure
NOTE – These three code values are from the reserved codes for proprietary use. Refer to Annex A of [ITU-T G.806] for more information on the use of these codes.			

8.1.1.2 OPU2r mapping specific overhead

An OPU2r multiframe identifier (OMFI) byte is defined in row 4, column 16 of the OPU2r overhead (Figure 7-2). The value of bits 7 to 8 of the OMFI byte will be incremented each OPU2r frame to provide a 3-frame multiframe for the multiplexing of CPRI signals into the OPU2r.

NOTE – It is an option to align the OMFI = 0 position with MFAS = 0 position every 768 (the least common multiple of 3 and 256) frame periods.

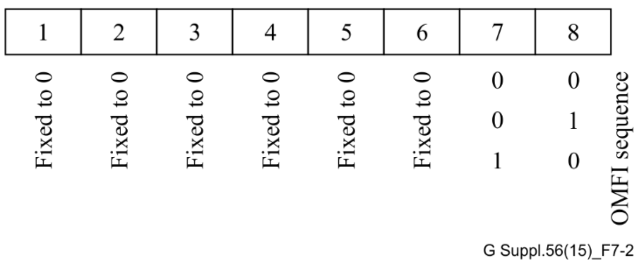

Figure 7-2 – OPU2r multiframe identifier (OMFI) overhead

8.1.1.3 BFP and BaFN overhead

The OPU2r overhead bytes in rows 1-3, column 16 are used to carry the CPRI basic frame pointer (BFP) of the first CPRI basic frame of each channel in the OPU2r payload. The BFP is the offset between the OPU2r payload start and the start of the CPRI basic frame for each signal.

The OPU2r overhead bytes in rows 1-3, column 15 are used to indicate the CPRI basic frame number (BaFN) of the first CPRI basic frame of each channel in the OPU2r payload.

The BFP and BaFN are shown in Figures 7-3 and 7-4.

For each CPRI signal, the corresponding BFP is set to the number of bytes mapped into the OPU2r frame for which OMFI = 0x00, prior to a CPRI basic frame start byte [CPRI V6.1]. The BFP range is shown in Table 8-2.

Table 8-2 – BFP range

[CPRI V6.1] signal type	BFP range
Option 3	0x00 to 0x3F
Option 4	0x00 to 0x7F
Option 5	0x00 to 0x7F
NOTE – The BFP range for option 4 is computed after augmenting as described in clause Y.2.2 of [CPRI V6.1].	

For each CPRI signal, the corresponding BaFN is set to the CPRI basic frame number, within the CPRI hyperframe (0x00 to 0xFF) [CPRI V6.1], of the first CPRI basic frame that starts in the OPU2r frame for which OMFI = 0x00.

NOTE – If the BaFN for a CPRI channel in OMFI cycle t was BaFN(t), then the BaFN in cycle t+1 is: BaFN(t+1) = Mod256[BaFN(t)+119].

8.2 OPU2r payload mappings

8.2.1 Mapping of six [CPRI V6.1] option 3 signals into OPU2r

Six [CPRI V6.1] option 3 signals are byte interleaved. In the OPU2r frame carrying OMFI = 0x00, the first OPU2r payload byte corresponds to a byte of the first CPRI signal, the second OPU2r payload byte corresponds to a byte of the second CPRI signal, and so on (see Figure 7-3).

The BFPi and BaFNi associated with CPRI signals 1 to 3 are located in row 15 and 16 of the OPU2r frame carrying OMFI = 0x00. The BFPi and BaFNi associated with CPRI signals 4 to 6 are located in row 15 and 16 of the OPU2r frame carrying OMFI = 0x01(see Figure 7-3).

	15	16	17	18	19	20	21	22	23	24	....	38	39	40	41	....	3823	3824
1	BaFN1	BFP1	CH1	CH2	CH3	CH4	CH5	CH6	CH1	CH2		CH4	CH5	CH6	CH1		CH3	CH4
2	BaFN2	BFP2	CH5	CH6	CH1	CH2	CH3	CH4	CH5	CH6								
3	BaFN3	BFP3																
4	PSI	0x00															CH3	CH4
1	BaFN4	BFP4	CH5	CH6	CH1	CH2	CH3	CH4	CH5	CH6								
2	BaFN5	BFP5																
3	BaFN6	BFP6																
4	PSI	0x01															CH1	CH2
1	RES	RES	CH3	CH4	CH5	CH6	CH1	CH2	CH3	CH4								
2	RES	RES																
3	RES	RES																
4	PSI	0x02															CH5	CH6

Figure 7-3 – Mapping of six [CPRI V6.1] option 3 signals into the OPU2r payload

8.2.2 Mapping of three [CPRI V6.1] option 4 signals into OPU2r

The [CPRI V6.1] option 4 signals are augmented by adding padding bytes to match the signal rate of [CPRI V6.1] option 5. Padding is implemented by inserting three pad bytes after every five data bytes. The value inserted in the padding bytes shall be 0x00. Padding bytes are ignored and discarded by the receiver.

Three [CPRI V6.1] option 4 signals are byte interleaved. In the OPU2r frame carrying OMFI = 0x00, the first OPU2r payload byte corresponds to a byte of the first CPRI signal, the second OPU2r payload byte corresponds to a byte of the second CPRI signal, and so on (see Figure 7-4).

The BFPi and BaFNi associated with CPRI signals 1 to 3 are located in row 15 and 16 of the OPU2r frame carrying OMFI = 0x00 (see Figure 7-4).

8.2.3 Mapping of three [CPRI V6.1] option 5 signals into OPU2r

Three [CPRI V6.1] option 5 signals are byte interleaved. In the OPU2r frame carrying OMFI = 0x00, the first OPU2r payload byte corresponds to a byte of the first CPRI signal, the second OPU2r payload byte corresponds to a byte of the second CPRI signal, and so on (see Figure 7-4).

The BFPi and BaFNi associated with CPRI signals 1 to 3 are located in row 15 and 16 of the OPU2r frame carrying OMFI = 0x00 (see Figure 7-4).

	15	16	17	18	19	20	21	22	23	24	....	38	39	40	41	....	3823	3824
1	BaFN1	BFP1	CH1	CH2	CH3	CH1	CH2	CH3	CH1	CH2		CH1	CH2	CH3	CH1		CH3	CH1
2	BaFN2	BFP2	CH2	CH3	CH1	CH2	CH3	CH1	CH2	CH3								
3	BaFN3	BFP3																
4	PSI	0x00															CH3	CH1
1	RES	RES	CH2	CH3	CH1	CH2	CH3	CH1	CH2	CH3								
2	RES	RES																
3	RES	RES																
4	PSI	0x01															CH1	CH2
1	RES	RES	CH3	CH1	CH2	CH3	CH1	CH2	CH3	CH1								
2	RES	RES																
3	RES	RES																
4	PSI	0x02															CH2	CH3

Figure 7-4 – Mapping of three [CPRI V6.1] option 4 (after padding) or 5 signals into the OPU2r payload

8.3 PCS receiver

The CPRI signal physical coding sublayer (PCS) is terminated and the 8-bit codes are recovered as specified by IEEE 802.3.

The K28.5 control character that indicates the beginning of the CPRI hyperframe is replaced by 0x00. The contents of this byte is ignored on reconstruction of the CPRI signal.

8.3.1 NE at RRH site remote management channel

The NE at the RRH site can be managed through the GCC0, GCC1 and/or GCC2 overhead. Protocols for these management channels are outside of the scope of this Supplement.

8.3.1.1 CPRI channel AIS signal

The CPRI channel alarm indication signal (AIS) is specified as all "1"s in the entire CPRI channel, including its BFP and BaFN overheads.

Under CPRI signal fail conditions as defined in [CPRI V6.1], the CPRI channel is filled with CPRI channel AIS.

8.3.1.2 Replacement signal

Under ODU2r signal fail conditions, or if the OMFI, BFP or BaFN are inconsistent, the egress CPRI signal should be replaced by the Link Fault signal.

8.4 OTU2r structure

The OTU2r frame structure is an OTUk (k = 2r) frame structure, which may or may not include the forward error correction (FEC) area.

8.5 Bit rates and tolerances

The bit rates and tolerances are defined in Table 8-3.

Table 8-3 – OTU2r/ODU2r/OPU2r rates and tolerances

Signal Type	Nominal bit rate	Tolerance
OTU2r	255/238 × 128 × 24 × 3 840 kbit/s	±100 ppm
OTU2r no FEC	239/238 × 128 × 24 × 3 840 kbit/s	±100 ppm
ODU2r	239/238 × 128 × 24 × 3 840 kbit/s	±100 ppm
OPU2r	128 × 24 × 3 840 kbit/s	±100 ppm
NOTE 1 – The nominal OTU2r rate is approximately 12 639 085.714 kbit/s. NOTE 2 – The nominal OTU2r without FEC and ODU2r rates are approximately 11 846 045.042 kbit/s. NOTE 3 – The nominal OPU2r rate is 11 796 480 kbit/s. NOTE 4 – Due to the BMP mapping, the OTU2r/ODU2r inherits the clock accuracy of the CPRI client signals at the ODU2r source.		

The OTU2r/ODU2r/OPU2r frame period is approximately 10.330 µs.

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