International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.798

Amendment 2

(01/2015)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital terminal equipments – Other terminal equipment

Characteristics of optical transport network hierarchy equipment functional blocks

Amendment 2

Recommendation ITU-T G.798 (2012) – Amendment 2

International Telecommunication Union

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Recommendation ITU-T G.798

Characteristics of optical transport network hierarchy equipment functional blocks

Amendment 2

Summary

Amendment 2 to Recommendation ITU-T G.798 (2012) contains material related to the:

− addition of adaptation functions for 64B/66B encoded client signals with forward error correction (FEC);

− addition of FC-1600 client signals with optional FEC.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Recommendation ITU-T G.798

Characteristics of optical transport network hierarchy equipment functional blocks

Amendment 2

1) Scope

This amendment contains text modifications and additions extending the set of constant bit rate signal of bit rate [range] x (CBRx) atomic functions in ITU-T G.798 to support 64B/66B encoded clients with optional or mandatory forward error correction (FEC).

2) Modifications to ITU-T G.798

2.1) Clause 4

In clause 4, add the following abbreviations in alphabetical order:

dLFA Loss of FEC word Alignment defect

dLOCA Loss Of Client Alignment defect

FCWS FEC code word start

2.2) Annex A, Introduction

Modify Table A.1B as follows:

Table A.1B – Jitter standard and replacement signals (fibre channel)

x	Jitter standard	Replacement signal	FEC
FC-100	[b-ANSI INCITS 352]	17.7.1.2 of [ITU-T 709]	None
FC-200	[b-ANSI INCITS 352]	17.7.2.1 of [ITU-T 709]	None
FC-400	[b-ANSI INCITS 352]	17.9.1 of [ITU-T 709]	None
FC-800	[b-ANSI INCITS 352]	17.9.1 of [ITU-T 709]	None
FC-1200	[b-ANSI INCITS 364]	17.8.2 of [ITU-T 709]	None
FC-1600	[b-ANSI INCITS 352]	17.9.2 of [ITU-T 709]	Optional [b-ANSI INCITS 470]

NOTE – FC-y is used throughout this clause as shorthand for the defined values for x for fibre channel type interfaces.

2.3) Clause A.3.1.1

Modify clause A.3.1.1 header as follows:

A.3.1.1 OSx to CBRx adaptation source function without FEC (OSx/CBRx_A_So) (x = 2G5, 10G, 40G, FC-y)

Modify clause A.3.1.1 as follows:

For SDH OSn type interfaces and fibre channel type interfaces, the information flow and processing of the OSx/CBRx_A_So function is defined with reference to Figures A.7 and A.8.

NOTE – For SDH OSM256.4 type interfaces, please see ~~A.3.1.1.3~~A.3.1.3.

Symbol

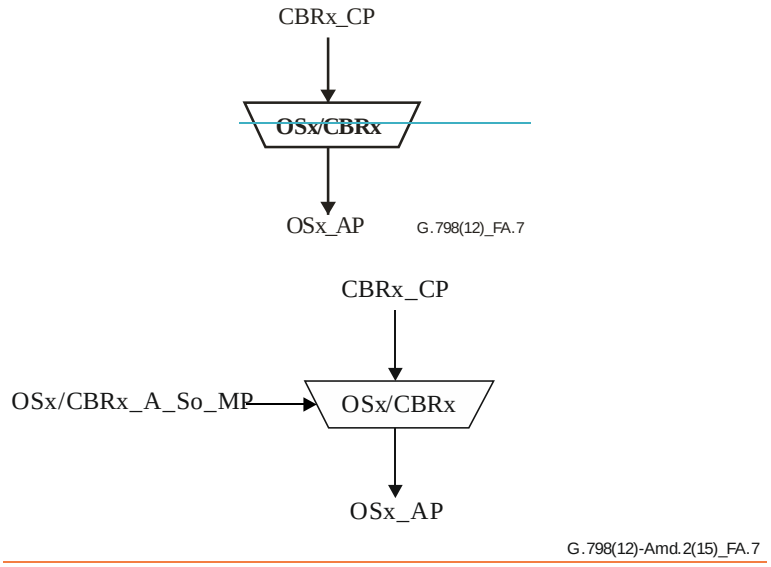

Figure A.7 – OSx/CBRx_A_So function

Interfaces

Table A.4 – OSx/CBRx_A_So inputs and outputs

Input(s)	Output(s)
CBRx_CP: CBRx_CI_D CBRx_CI_CK **OSx/CBRx_A_So_MP:** OSx/CBRx_A_So_MI_Active	**OSx_AP:** OSx_AI_D

Processes

The processes associated with the OSx/CBRx_A_So function are depicted in Figure A.8.

Activation

– The OSx/CBRx_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Mod (optical carrier modulation): See clause 8.11.1. For parameters of SDH type interfaces, [ITU-T G.957] and [ITU-T G.691] apply.

Optical signal pre-conditioning: Pre-conditioning of the single wavelength optical signal might be required. The specific conditioning processes depend on the OSx interface type (see [ITU-T G.957] and [ITU-T G.691] for SDH type interfaces). For optical pre-conditioning processes, see clause 8.11.2.

For SDH type interfaces, the jitter and wander requirements, as defined in clause 9.3.1.1 of [ITU-T G.783], apply. For fibre channel type interfaces, the input clock ranges are defined in Table A.1A and the jitter and wander requirements, as defined in the specifications referenced in Table A.1B, apply.

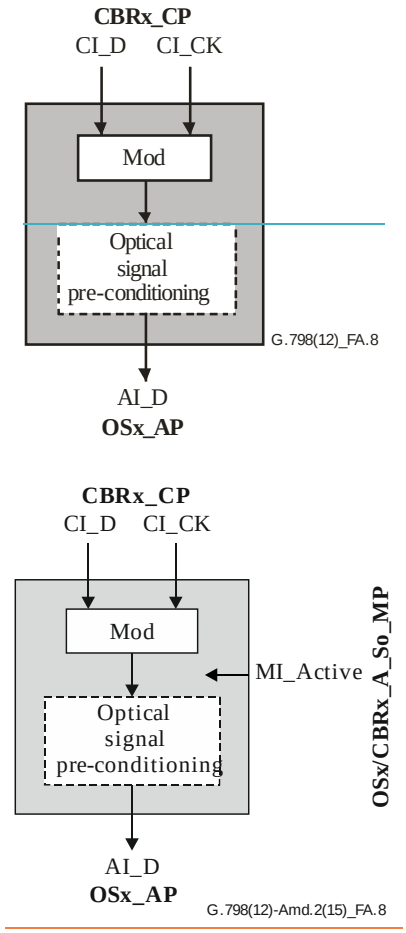

Figure A.8 – OSx/CBRx_A_So processes

2.4) Clause A.3.1.2

Modify clause A.3.1.2 header as follows:

A.3.1.2 OSx to CBRx adaptation sink function without FEC (OSx/CBRx_A_Sk) (x = 2G5, 10G, 40G, FC-y)

Modify clause A.3.1.2 as follows:

For SDH OSn type interfaces and fibre channel type interfaces, the information flow and processing of the OSx/CBRx_A_Sk function is defined with reference to Figures A.9 and A.10.

NOTE – For SDH OSM256.4 type interfaces, please see clause ~~A.3.1.1.4~~A.3.1.4.

Symbol

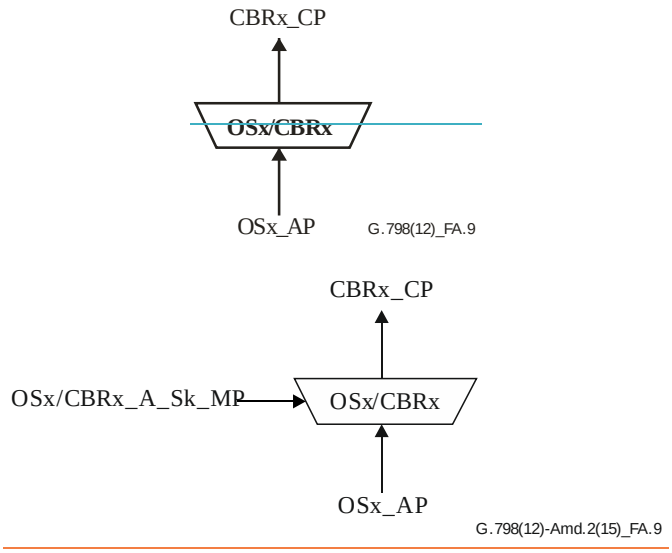

Figure A.9 – OSx/CBRx_A_Sk function

Interfaces

Table A.5 – OSx/CBRx_A_Sk inputs and outputs

Input(s)	Output(s)
OSx_AP: OSx_AI_D OSx_AI_TSF **OSx/CBRx_A_Sk_MP:** OSx/CBRx_A_Sk_MI_Active	**CBRx_CP:** CBRx_CI_D CBRx_CI_CK CBRx_CI_SSF

Processes

The processes associated with the OSx/CBRx_A_Sk function are depicted in Figure A.10.

Activation

– The OSx/CBRx_A_Sk function shall access the access point and perform the common and specific processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CP) and not report its status via the management point.

Optical signal post-conditioning: Post-conditioning of the single wavelength signal might be required. The specific conditioning processes depend on the OSx interface type (see [ITU-T G.957] and [ITU-T G.691] for SDH type interfaces). For optical post-conditioning processes, see clause 8.11.2.

DMod (optical carrier demodulation): See clause 8.11.1. For parameters of SDH type interfaces, [ITU-T G.957] and [ITU-T G.691] apply.

Clock recovery: The function shall recover the clock signal from the incoming data. For SDH type interfaces, the input clock ranges are defined in Table A.1 and the jitter and wander requirements, as defined in clause 9.3.1.2 of [ITU-T G.783], apply. For fFibre cChannel type interfaces, the input clock ranges are defined in Table A.1A and the jitter and wander requirements, as defined in the specifications referenced in Table A.1B, apply.

To ensure adequate immunity against the presence of consecutive identical digits (CID) in the signal, the function shall comply with the specification in clause 15.1.4 of [ITU-T G.783] for SDH type interfaces.

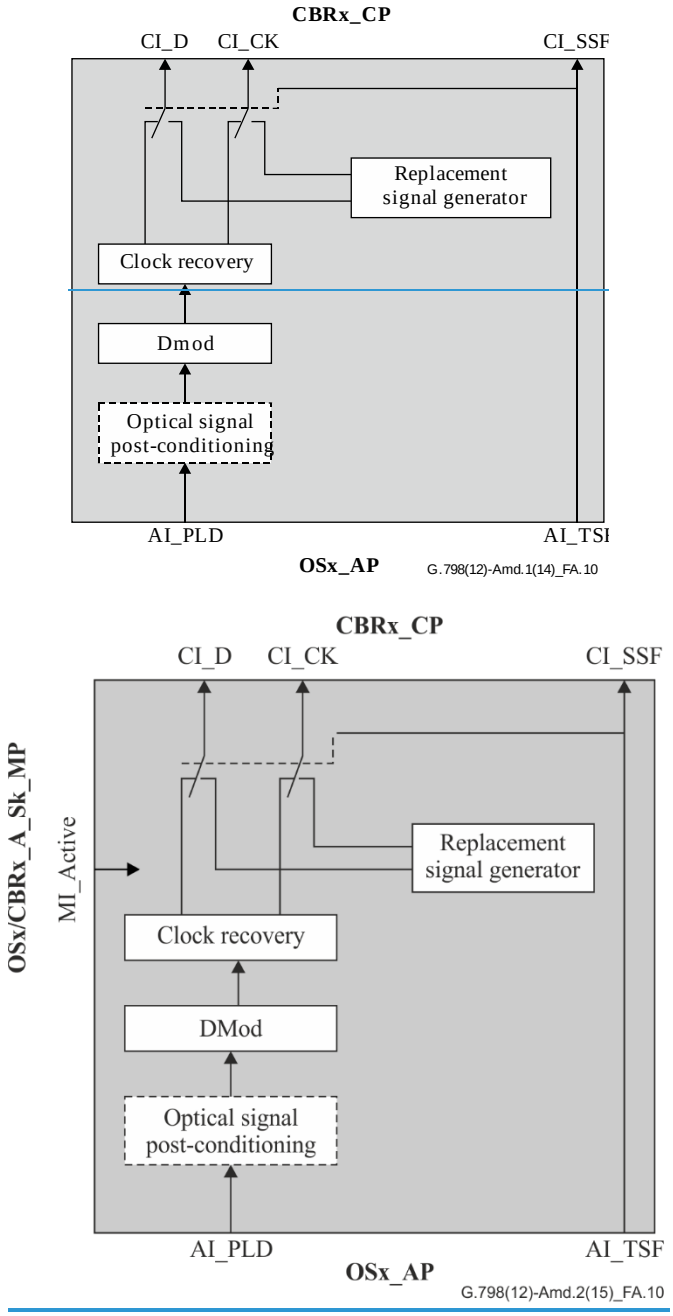

Figure A.10 – OSx/CBRx_A_Sk processes

Defects: None.

Consequent actions

The OSx/CBRx_A_Sk function performs the following consequent actions.

aSSF ← AI_TSF

aAIS ← AI_TSF

On declaration of aAIS, the function shall output a replacement signal as defined in clause 16.6 of [ITU-T G.709] for SDH type interfaces and in Table A.1B for fibre channel type interfaces within X

ms. On clearing of aAIS, the replacement signal shall be removed within Y ms, with normal data being output. The values for X and Y are for further study.

The replacement signal clock start shall be independent from the incoming clock. For the defined values of x, the replacement signal clock has to be within the range defined in Table A.1 for SDH type interfaces and Table A.1A for fibre channel type interfaces.

Defect correlations: None.

Performance monitoring: None.

2.5) Clause A.3.1.3

Modify Figure A.11 and Table A.6 in clause A.3.1.3 as follows:

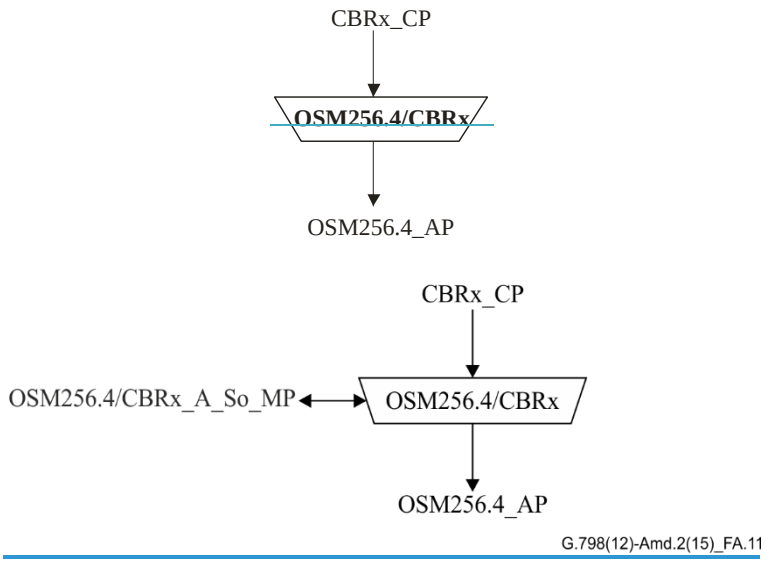

Figure A.11 – OSM256.4/CBRx_So function

Table A.6 – OSM256.4/CBRx_So inputs and outputs

Input(s)	Output(s)
CBRx_CP: CBRx_CI_D CBRx_CI_CK **OSM256.4/CBRx_A_So_MP:** OSM256.4/CBRx_So_MI_Active	**OSM256.4_AP:** OSM256.4_AI_D OSM256.4_AI_CK OSM256.4_AI_FS **OSM256.4/CBRx_A_So_MP:** OSM256.4/CBRx_A_So_MI_cLOF

2.6) Clause A.3

Add new clauses A.3.1.5, A.3.1.6 and A.3.1.7 describing OSx/CBRx adaptation functions:

A.3.1.5 OSx to CBRx adaptation source function for 64B/66B encoded clients with FEC (OSx/CBRx-b_A_So) (x = FC-y)

The information flow and processing of the OSx/CBRx-b_A_So function is defined with reference to Figures A.15 and A.16.

Symbol

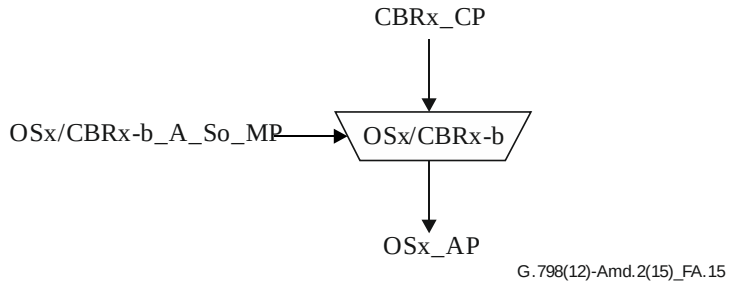

Figure A.15 – OSx/CBRx-b_A_So function

Interfaces

Table A.8 – OSx/CBRx-b_A_So inputs and outputs

Input(s)	Output(s)
CBRx_CP: CBRx_CI_D CBRx_CI_CK CBRx_CI_SSF **OSx/CBRx-b_A_So_MP:** OSx/CBRx-b_A_So_MI_Active	**OSx_AP:** OSx_AI_D

Processes

The processes associated with the OSx/CBRx-b_A_So function are depicted in Figure A.16.

Activation

– The OSx/CBRx-b_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

Block alignment: Block alignment consists of the recovering 64B/66B block lock per the state diagram in Figure 49-12 of [IEEE 802.3].

Transcoder: Transcoding of the 64B/66B blocks might be required. The specific transcoding processes depend on the CBRx client type, as defined in the specifications referenced in Table A.1B. The transcoder shall convert invalid 66B blocks to an error control block before transcoding. An invalid 66B block is one which does not have a sync header of "01" or "10", or one which has a sync header of "10" and an invalid control block type field.

FEC encoder: The function shall generate and insert the FEC code words. The specific processes and FEC coding scheme depend on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Scrambler: Scrambling of the FEC code words might be required. The specific scrambling process depends on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Mod (optical carrier modulation): See clause 8.11.1.

Optical signal pre-conditioning: Pre-conditioning of the single wavelength optical signal might be required. The specific conditioning processes depend on the OSx interface type. For optical pre-conditioning processes, see clause 8.11.2.

For fibre channel type interfaces, the input clock ranges are defined in Table A.1A and the jitter and wander requirements, as defined in the specifications referenced in Table A.1B, apply.

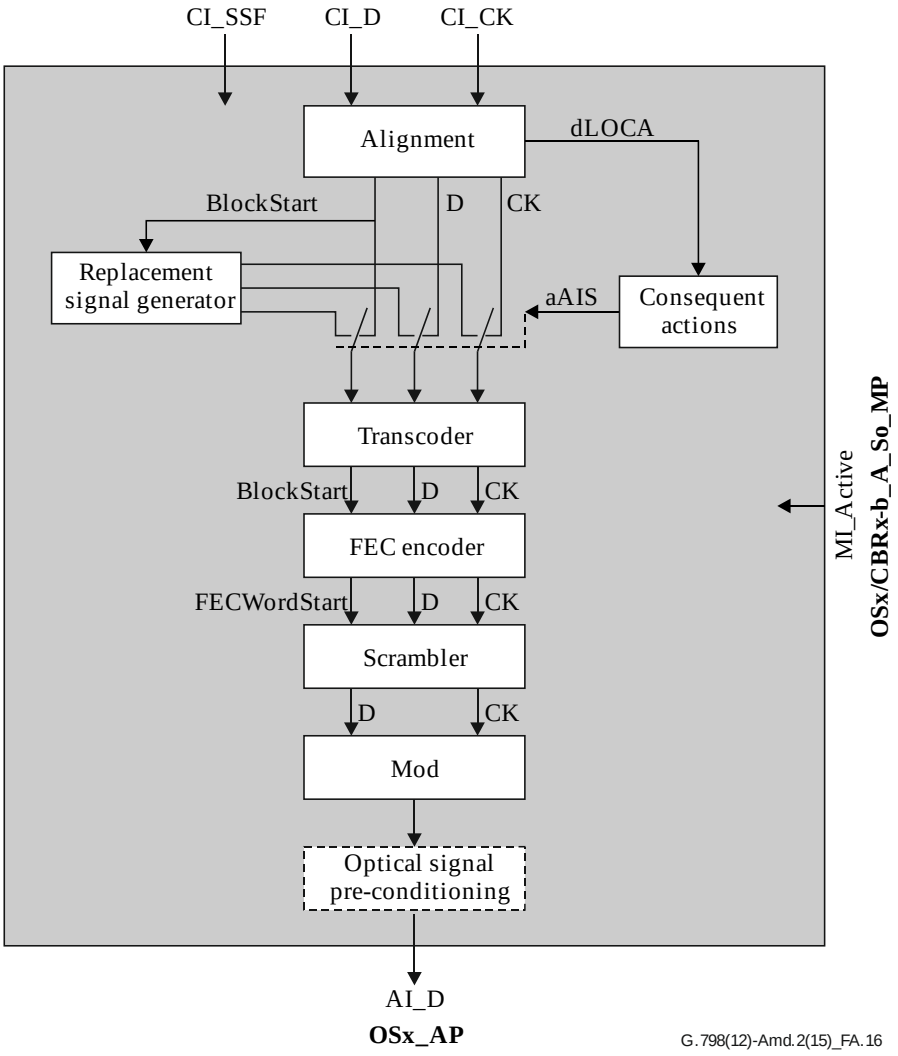

Figure A.16 – OSx/CBRx-b_A_So processes

Defects

The OSx/CBRx-b_A_So function shall detect the loss of client alignment defect (dLOCA).

dLOCA: If 66B block alignment is persistently lost for 3 ms, dLOCA shall be declared. dLOCA shall be cleared immediately when 66B block alignment is recovered.

Consequent actions

The OSx/CBRx-b_A_So function shall perform the following consequent action:

aAIS ← dLOCA and (not MI_Active)

On declaration of aAIS, the function shall output a replacement signal as defined in Table A.1B for fibre channel type interfaces within X ms. On clearing of aAIS, the replacement signal shall be removed within Y ms, with normal data being output. The values for X and Y are for further study.

The replacement signal clock start shall be independent from the incoming clock. 66B Block alignment shall be maintained. For the defined values of x, the replacement signal clock has to be within the range defined in Table A.1A for fibre channel type interfaces.

Defect correlations: None.

Performance monitoring: None.

A.3.1.6 OSx to CBRx adaptation sink function for 64B/66B encoded clients with optional FEC (OSx/CBRx-b_A_Sk) (x = FC-y)

The information flow and processing of the OSx/CBRx-b_A_Sk function is defined with reference to Figures A.17 and A.18.

Symbol

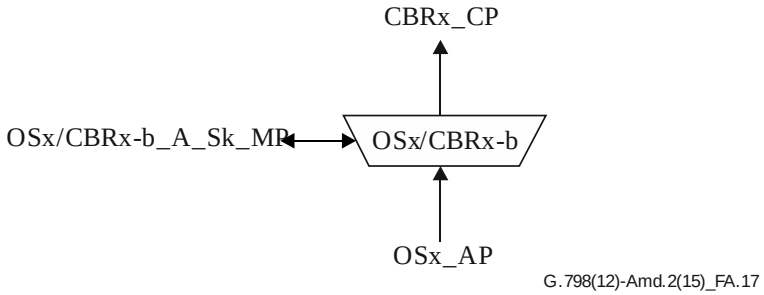

Figure A.17 – OSx/CBRx-b_A_Sk function

Interfaces

Table A.9 – OSx/CBRx-b_A_Sk inputs and outputs

Input(s)	Output(s)
OSx_AP: OSx_AI_D OSx_AI_TSF **OSx/CBRx-b_A_Sk_MP:** OSx/CBRx-b_A_Sk_MI_FECEn OSx/CBRx-b_A_Sk_MI_Active OSx/CBRx-b_A_Sk_MI_1second	**CBRx_CP:** CBRx_CI_D CBRx_CI_CK CBRx_CI_SSF **OSx/CBRx-b_A_Sk_MP:** OSx/CBRx-b_A_Sk_MI_cLFA OSx/CBRx-b_A_Sk_MI_pFECcorrErr OSx/CBRx-b_A_Sk_MI_pFECuncorrErr

Processes

The processes associated with the OSx/CBRx-b_A_Sk function are depicted in Figure A.10.

Activation

– The OSx/CBRx-b_A_Sk function shall access the access point and perform the common and specific processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CP) and not report its status via the management point.

If FEC processing is enabled (MI_FECEn is true), the function shall perform the FEC code word alignment, descrambler, FEC decoder and transcoder processes. Otherwise, the FEC data is ignored and no error correction is performed.

FEC code word alignment: The function shall recover the FEC code word start (FCWS). This process is specific for the CBRx client type, as defined in the specifications referenced in Table A.1B.

Descrambler: Descrambling of the FEC code words might be required. The specific descrambling process depends on the CBRx client type, as defined in the specifications referenced in Table A.1B.

FEC decoder: The function shall extract the FEC data and perform error correction. The specific processes and FEC coding scheme depend on the CBRx client type, as defined in the specifications referenced in Table A.1B. Uncorrectable FEC words shall be replaced with the corresponding number

of 66B error control blocks. The number of corrected and uncorrectable errors shall be reported (nFECcorrErr, nFECuncorrErr).

Transdecoder: Transdecoding to 64B/66B blocks might be required. The specific transdecoding processes depend on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Optical signal post-conditioning: Post-conditioning of the single wavelength signal might be required. The specific conditioning processes depend on the OSx interface type. For optical post-conditioning processes, see clause 8.11.2.

DMod (optical carrier demodulation): See clause 8.11.1.

Clock recovery: The function shall recover the clock signal from the incoming data. For fibre channel type interfaces, the input clock ranges are defined in Table A.1A and the jitter and wander requirements, as defined in the specifications referenced in Table A.1B, apply.

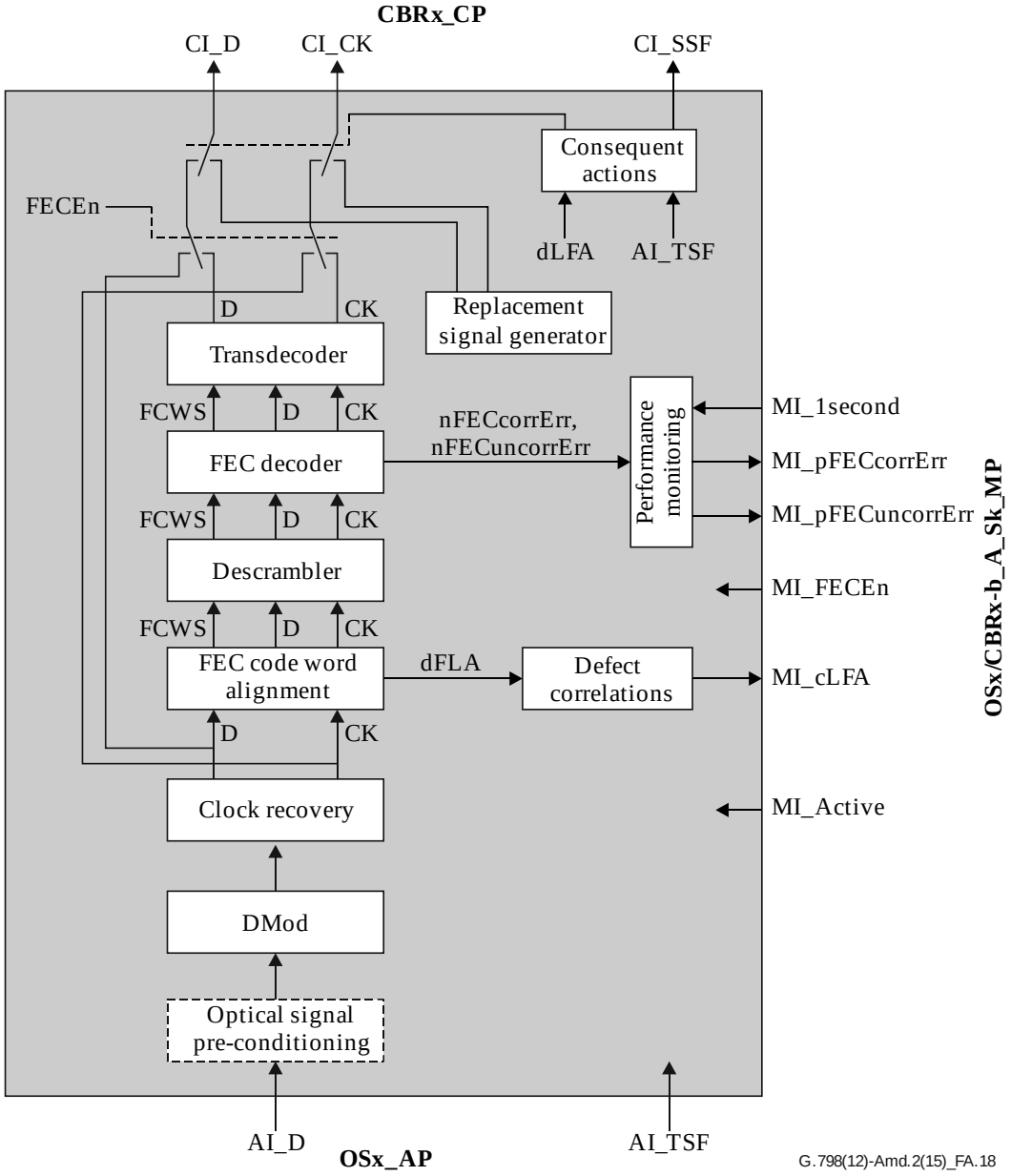

Figure A.18 – OSx/CBRx-b_A_Sk processes

Defects

The **OSx**/CBRx-b_A_Sk function shall detect the loss of FEC word alignment defect (dLFA).

dLFA: The detection of dLFA depends on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Consequent actions

The OSx/CBRx_A_Sk function performs the following consequent actions:

aSSF ← AI_TSF or (dLFA and FECEn)

aAIS ← AI_TSF or (dLFA and FECEn)

On declaration of aAIS, the function shall output a replacement signal as defined in Table A.1B for fibre channel type interfaces within X ms. On clearing of aAIS, the replacement signal shall be removed within Y ms, with normal data being output. The values for X and Y are for further study.

The replacement signal clock start shall be independent from the incoming clock. For the defined values of x, the replacement signal clock has to be within the range defined in Table A.1A for fibre channel type interfaces.

Defect correlations

The OSx/CBRx-b_A_Sk function shall perform the following defect correlation:

cLOA ← dLFA and FECEn and (not AI_TSF)

Performance monitoring: The function shall perform the following performance monitoring primitives processing. The performance monitoring primitives shall be reported to the EMF.

pFECcorrErr ← ∑ nFECcorrErr

pFECuncorrErr ← ∑ nFECuncorrErr

NOTE – During AI_TSF no corrected or uncorrectable errors shall be counted.

A.3.1.7 OSx to CBRx adaptation sink function for 64B/66B encoded clients with mandatory FEC (OSx/CBRx-c_A_Sk) (x = FC-y)

The information flow and processing of the OSx/CBRx_A_Sk function is defined with reference to Figures A.19 and A.20.

Symbol

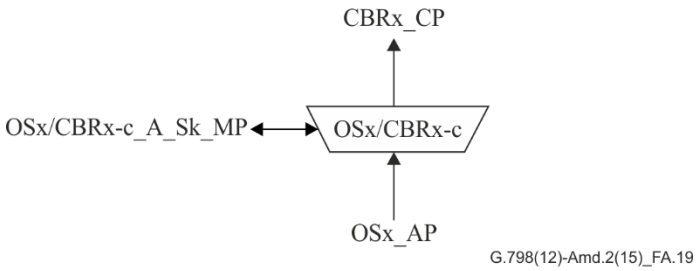

Figure A.19 – OSx/CBRx-c_A_Sk function

Interfaces

Table A.10 – OSx/CBRx-c_A_Sk inputs and outputs

Input(s)	Output(s)
OSx_AP: OSx_AI_D OSx_AI_TSF **OSx/CBRx-c_A_Sk_MP:** OSx/CBRx-c_A_Sk_MI_Active OSx/CBRx-c_A_Sk_MI_1second	**CBRx_CP:** CBRx_CI_D CBRx_CI_CK CBRx_CI_SSF **OSx/CBRx-c_A_Sk_MP:** OSx/CBRx-c_A_Sk_MI_cLFA OSx/CBRx-c_A_Sk_MI_pFECcorrErr OSx/CBRx-c_A_Sk_MI_pFECuncorrErr

Processes

The processes associated with the OSx/CBRx-c_A_Sk function are depicted in Figure A.20.

Activation

– The OSx/CBRx-c_A_Sk function shall access the access point and perform the common and specific processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CP) and not report its status via the management point.

FEC code word alignment: The function shall recover the FEC code word start (FCWS). This process is specific for the CBRx client type, as defined in the specifications referenced in Table A.1B.

Descrambler: Descrambling of the FEC code words might be required. The specific descrambling process depends on the CBRx client type, as defined in the specifications referenced in Table A.1B.

FEC decoder: The function shall extract the FEC data and perform error correction. The specific processes and FEC coding scheme depend on the CBRx client type, as defined in the specifications referenced in Table A.1B. Uncorrectable FEC words shall be replaced with the corresponding number of 66B error control blocks. The number of corrected and uncorrectable errors shall be reported (nFECcorrErr, nFECuncorrErr).

Transdecoder: Transdecoding to 64B/66B blocks might be required. The specific transdecoding processes depend on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Optical signal post-conditioning: Post-conditioning of the single wavelength signal might be required. The specific conditioning processes depend on the OSx interface type. For optical post-conditioning processes, see clause 8.11.2.

DMod (optical carrier demodulation): See clause 8.11.1.

Clock recovery: The function shall recover the clock signal from the incoming data. For fibre channel type interfaces, the input clock ranges are defined in Table A.1A and the jitter and wander requirements, as defined in the specifications referenced in Table A.1B, apply.

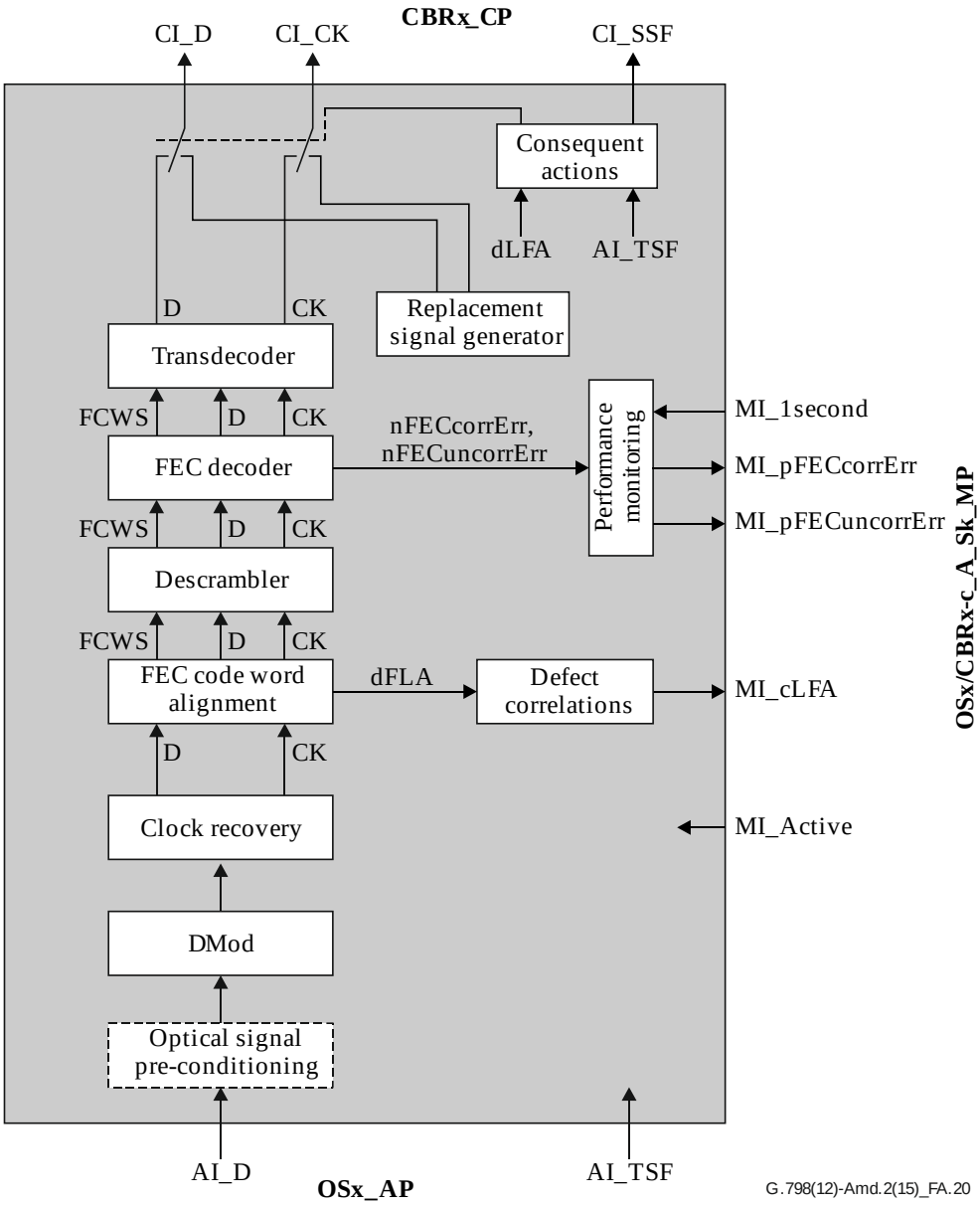

Figure A.20 – OSx/CBRx-c_A_Sk processes

Defects

The OSx/CBRx-b_A_Sk function shall detect the loss of FEC word alignment defect (dLFA).

dLFA: The detection of dLFA depends on the CBRx client type, as defined in the specifications referenced in Table A.1B.

Consequent actions

The OSx/CBRx_A_Sk function performs the following consequent actions:

aSSF ← AI_TSF or dLFA or (not MI_Active)

aAIS ← AI_TSF or dLFA or (not MI_Active)

On declaration of aAIS, the function shall output a replacement signal as defined in Table A.1B for fibre channel type interfaces within X ms. On clearing of aAIS, the replacement signal shall be removed within Y ms, with normal data being output. The values for X and Y are for further study.

The replacement signal clock start shall be independent from the incoming clock. For the defined values of x, the replacement signal clock has to be within the range defined in Table A.1A for fibre channel type interfaces.

Defect correlations

The OSx/CBRx-c_A_Sk function shall perform the following defect correlation:

cLFA ← dLFA and (not AI_TSF)

Performance monitoring: The function shall perform the following performance monitoring primitives processing. The performance monitoring primitives shall be reported to the EMF.

pFECcorrErr ← ∑ nFECcorrErr

pFECuncorrErr ← ∑ nFECuncorrErr

NOTE – During AI_TSF no corrected or uncorrectable errors shall be counted.

2.7) Bibliography

Add the following reference to the bibliography:

[b-INCITS 470] INCITS 470:2011, *Information Technology – Fibre Channel – Framing and Signaling – 3 (FC-FS-3).*

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