I n t e r n a t i o n a l   T e l e c o m m u n i c a t i o n   U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.798

Amendment 2

(04/2012)

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 (2010) – Amendment 2

ITU-T

International Telecommunication Union

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
General	G.700–G.709
Coding of voice and audio signals	G.710–G.729
Principal characteristics of primary multiplex equipment	G.730–G.739
Principal characteristics of second order multiplex equipment	G.740–G.749
Principal characteristics of higher order multiplex equipment	G.750–G.759
Principal characteristics of transcoder and digital multiplication equipment	G.760–G.769
Operations, administration and maintenance features of transmission equipment	G.770–G.779
Principal characteristics of multiplexing equipment for the synchronous digital hierarchy	G.780–G.789
Other terminal equipment	**G.790–G.799**
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999

For further details, please refer to the list of ITU-T Recommendations.

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 (2010) contains text additions that include support of hitless resizing of ODUflex for Ethernet client transport and ODU multiplexing, an update of the TCM monitoring, an update of the multiplexing structure indication processing and an update of the optical modulation and wavelength multiplexing processes for support of WDM interfaces.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.798	2002-01-06	15
1.1	ITU-T G.798 (2002) Amd. 1	2002-06-13	15
2.0	ITU-T G.798	2004-06-13	15
3.0	ITU-T G.798	2006-12-14	15
3.1	ITU-T G.798 (2006) Amd. 1	2008-12-12	15
3.2	ITU-T G.798 (2006) Cor.1	2009-01-13	15
4.0	ITU-T G.798	2010-10-22	15
4.1	ITU-T G.798 (2010) Cor. 1	2011-04-13	15
4.2	ITU-T G.798 (2010) Amd. 1	2011-07-22	15
4.3	ITU-T G.798 (2010) Cor. 2	2012-02-13	15
4.4	ITU-T G.798 (2010) Amd. 2	2012-04-06	15

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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/.

© ITU 2013

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

		Page
1)	Scope	1
2)	Text modifications for ITU-T G.798	1
2.1)	Modifications in clause 2, References	1
2.2)	Modifications in clause 3.1, Terms defined elsewhere	1
2.3)	Modifications in clause 4, Abbreviations and acronyms	1
2.4)	Modifications to clause 6.2.9, Multiplex structure identifier mismatch supervision defect (dMSIM)	2
2.5)	Modifications to clause 8.7.2, Multiplex structure identifier (MSI) acceptance process	2
2.6)	Modifications to clause 8.11.1, Optical modulation and wavelength multiplexing processes	3
2.7)	Modifications in clause 14.2.1.2, ODUkP trail termination sink function (ODUkP_TT_Sk)	3
2.8)	Modifications to clause 14.3.7, ODU0P to client adaptation function (ODU0P/CBRx_A) ($0 \leq x \leq 1.25G$)	6
2.9)	Modifications to clause 14.3.9.2, ODUkP to ODU[i]j adaptation sink function (ODUkP/ODU[i]j_A_Sk)	7
2.10)	Modifications to Figures 14-65 and 14-66	11
2.11)	Modifications to clause 14.3.10.1, ODUkP to ODUj payload type 21 adaptation source function (ODUkP/ODUj-21_A_So)	11
2.12)	Modifications to clause 14.3.10.2, ODUkP to ODUj payload type 21 adaptation sink function (ODUkP/ODUj-21_A_Sk)	13
2.13)	New clauses 14.3.11 and 14.3.12 for ODU/ETH client adaptations	16
2.14)	Modifications to clause 14.5.1.1.1, ODUkT trail termination source function (ODUkT_TT_So)	43
2.15)	Modifications to clause 14.5.1.1.2, ODUkT trail termination sink function (ODUkT_TT_Sk)	44
2.16)	Modifications to clause 14.5.1.3, ODUkT TCM control functions (ODUkT_TCMC)	47
2.17)	Modifications to the Bibliography	48

Recommendation ITU-T G.798

Characteristics of optical transport network hierarchy equipment functional blocks

1) Scope

This amendment contains modified text to be added to Recommendation ITU-T G.798 (2010), Characteristics of optical transport network hierarchy equipment functional blocks.

2) Text modifications for ITU-T G.798

2.1) Modifications in clause 2, References

Add the new references shown below:

[ITU-T G.694.1]	Recommendation ITU-T G.694.1 (2002), *Spectral grids for WDM applications: DWDM frequency grid.*
[ITU-T G.7044]	Recommendation ITU-T G.7044/Y.1347 (2011), *Hitless adjustment of ODUflex (GFP).*

Update the version of existing references as shown below:

[ITU-T G.709]	Recommendation ITU-T G.709/Y.1331 (2012), *Interfaces for the Optical Transport Network.*
[ITU-T G.870]	Recommendation ITU-T G.870/Y.1352 (2012), *Terms and definitions for optical transport networks (OTP).*

2.2) Modifications in clause 3.1, Terms defined elsewhere

Add the following definitions:

3.1.26.1 GMP normal mode: [ITU-T G.870].

3.1.26.2 GMP special mode: [ITU-T G.870].

3.1.47.1 OPUk multiframe: [ITU-T G.870].

3.1.56.1 resize multiframe (RMF): [ITU-T G.870].

2.3) Modifications in clause 4, Abbreviations and acronyms

Add the following abbreviations:

ACK	Acknowledgement
BWR	Bandwidth Resize
Cm	*number of m-bit client data entities*
Cn	*number of n-bit client data entities*
CnD	*difference between Cn and (m/n x Cm)*
CTRL	Control
HAO	Hitless Adjustment of ODUflex
LCR	Link Connection Resize
NACK	Negative Acknowledgement

NCS Network Connectivity Status

NOS Not_Operational

RCOH Resize Control Overhead

RCOHM Resize Control Overhead Missmatch

RMF Resize Multiframe

RP Resizing Protocol

SDL Specification and Description Language

TPID Tributary Port ID

TSCC Tributary Slot Connectivity Check

TSGS Tributary Slot Group Status

xI CI or MI or AI

2.4) Modifications to clause 6.2.9, Multiplex structure identifier mismatch supervision defect (dMSIM)

Modify clause 6.2.9 as follows:

6.2.9 Multiplex structure identifier mismatch supervision defect (dMSIM)

6.2.9.1 dMSIM at the ODU layer

Refer to clause 8.7.2 for a description of AcMSI~~[i]~~ and ExMSI~~[i]~~.

The defect dMSIM~~[i]~~ shall be declared ~~for the ODU tributary port #i~~ if the AcMSI~~[i]~~ is not equal to the ExMSI~~[i]~~. dMSIM~~[i]~~ shall be cleared if the AcMSI~~[i]~~ is equal to the ExMSI~~[i]~~.

ExMSI~~[i]~~ is either a fixed value or configured via the management interface. For details, see clauses 14.3.9.2 and 14.3.10.2 (ODUkP/ODU[i]j_A_Sk and ODUkP/ODUj-21_A_Sk function).

For the AcMSI~~[i]~~ acceptance process, see clause 8.7.2.

NOTE – The dMSIM defect as detected on a lower order structure does not detect all possible wrong configurations on both sides of the link. So for instance, if there are unallocated tributary slots that are carrying an ODU with a tributary port that is also not allocated, such mismatch will not lead to dMSIM defect detection. Also in cases where timeslots in a received multiplexed signal are part of a tributary ODUj structure which are not configured to be allocated as timeslots at the ODUk/ODUj adaptation sink for that tributary ODUj, this condition will not be detected and alarmed. The dLOFLOM defect will be detected in such cases.

2.5) Modifications to clause 8.7.2, Multiplex structure identifier (MSI) acceptance process

Modify clause 8.7.2 as follows:

8.7.2 Multiplex structure identifier (MSI) acceptance process

The multiplex structure identifier (MSI) consist of 2, 4, 8, 16, 32 or 80 bytes, which are located in the multiframed PSI overhead as illustrated in Table 8-1. The MSI contains one byte per tributary slot.

The MSI describes the allocation of tributary slots to ODTUs that contain the client ODUs. Each ODTU is identified by means of either a 2-tuple <ODTU type, tributary port number> (k = 1, 2, 3), or <tributary slot occupation, tributary port number> (k = 4).

An ODTU is carried in one or more tributary slots a, b, .., n. The MSI byte(s) associated with this/those tributary slot(s) is/are configured with a common 2-tuple value in the adaptation source function. The value of these 2-tuples is the same for every MSI byte in this set.

The adaptation sink function gets its ODTU to tributary slot allocation configured via the 2-, 4-, 8-, 16-, 32- or 80- byte expected MSI (ExMSI). The ExMSI bytes with the same 2-tuple value specify in which tributary slots an ODTU is expected to be carried; e.g., A, B, .., N (A<B<..<N).

A new multiplex structure identifier is accepted (AcMSI) if a new consistent value is received in the MSI bytes of the PSI overhead for ~~The Received MSI bytes associated with tributary slots A, B, .. , N are accepted (AcMSI[i]) if a new consistent value is received in these MSI bytes in~~ X consecutive multiframes. X shall be 3.

~~NOTE – The minimum number of AcMSI[i] instances is 1 and the maximum number of AcMSI[i] instances is the number of tributary slots.~~

Table 8-1 – MSI bytes within PSI multi-frame

ODUk Type	Payload type of tributary	Tributary Slots	MSI bytes in PSI position range
ODU1	20	TS[1,2]	PSI[2,3]
ODU2	20	TS[1..4]	PSI[2..5]
ODU2	21	TS[1..8]	PSI[2..9]
ODU3	20	TS[1..16]	PSI[2..17]
ODU3	21	TS[1..32]	PSI[2..33]
ODU4	21	TS[1..80]	PSI[2..81]

For details of the MSI values, refer to clause 19.4 of [ITU-T G.709].

2.6) Modifications to clause 8.11.1, Optical modulation and wavelength multiplexing processes

Modify clause 8.11.1 as follows:

8.11.1 Optical modulation and wavelength multiplexing processes

The processes listed below are mandatory when they are listed in atomic functions. Specific parameters of these processes depend on the interface type. Refer to [ITU-T G.959.1] and [ITU-T G.694.1] for the currently standardized OTN interfaces and central frequencies.

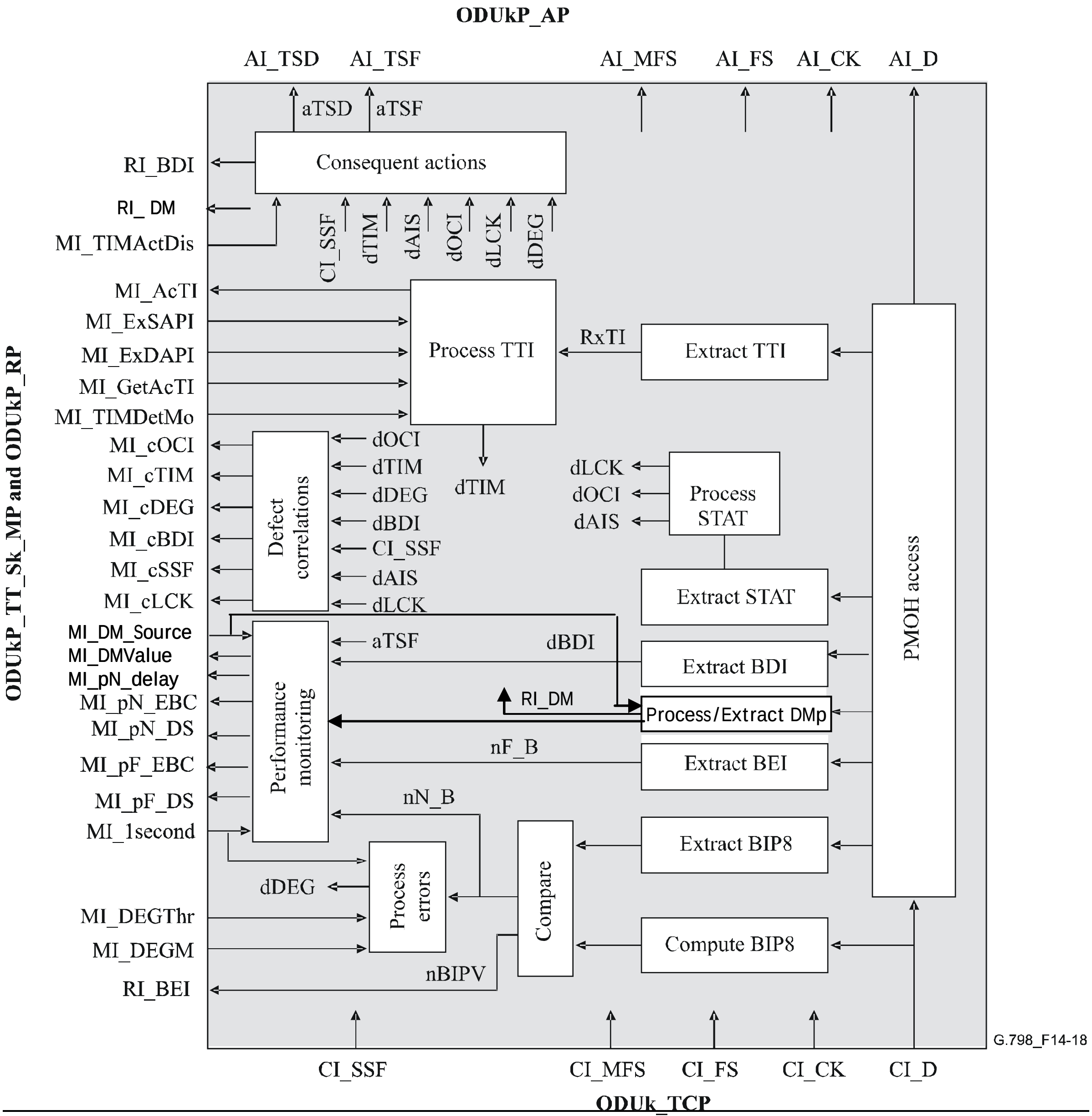
2.7) Modifications in clause 14.2.1.2, ODUkP trail termination sink function (ODUkP_TT_Sk)

Amend text of last "Processes" items in Processes list as shown below:

PMOH-DMp: If MI_DM_Source is false, then the value of the DMp bit is output to RI_DM. If MI_DM_Source is true and MI_DMValue toggles, then a count of CI_FS transitions is started and the incoming DMp value (RxDMp) is monitored. A change of value of RxDMp, from (NOT MI_DMValue) to MI_DMValue, validated by a 3-frame persistency check, stops the counting. The delay frame count (nN_delay) is represented by the count minus the persistency check~~ and is ouput as MI_pN_delay~~.

NOTE 2 – Equipment developed prior to the 2010 version of this Recommendation will not support the DMp processing.

Adopt Figure 14-18 – ODUkP_TT_Sk processes as shown below:


ODUkP_AP
AI_TSD
AI_TSF
AI_MFS
AI_FS
AI_CK
AI_D
aTSD
aTSF
RI_BDI
Consequent actions
RI_DM
MI_TIMActDis
CI_SSF
dTIM
dAIS
dOCI
dLCK
dDEG
MI_AcTI
MI_ExSAPI
MI_ExDAPI
MI_GetAcTI
MI_TIMDetMo
Process TTI
RxTI
Extract TTI
ODUkP_TT_Sk_MP and ODUkP_RP
MI_cOCI
MI_cTIM
MI_cDEG
MI_cBDI
MI_cSSF
MI_cLCK
Defect correlations
dOCI
dTIM
dDEG
dBDI
CI_SSF
dAIS
dLCK
dTIM
dLCK
dOCI
dAIS
Process STAT
Extract STAT
PMOH access
MI_DM_Source
MI_DMValue
MI_pN_delay
MI_pN_EBC
MI_pN_DS
MI_pF_EBC
MI_pF_DS
MI_1second
Performance monitoring
aTSF
dBDI
Extract BDI
RI_DM
Process/Extract DMp
nF_B
Extract BEI
nN_B
Extract BIP8
dDEG
Process errors
Compare
MI_DEGThr
MI_DEGM
Compute BIP8
RI_BEI
nBIPV
G.798_F14-18
CI_SSF
CI_MFS
CI_FS
CI_CK
CI_D
ODUk_TCP

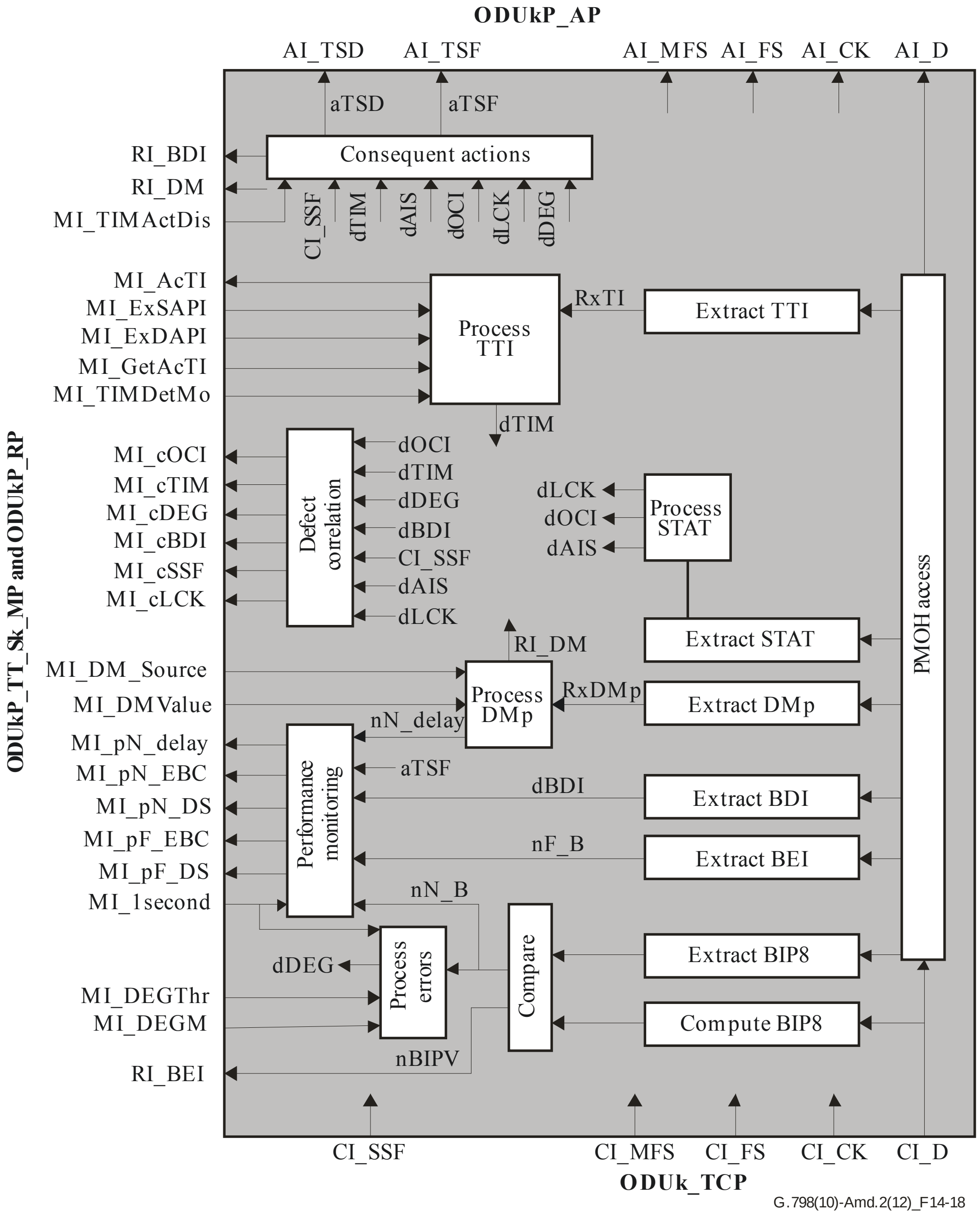


Figure 14-18 – ODUkP_TT_Sk processes

Adopt text in performance monitoring paragraph as shown below:

NOTE 3 – During CI_SSF, dAIS, dLCK and dOCI, no errored blocks shall be counted.

pF_EBC ← $\sum$ nF_B

NOTE 4 – During CI_SSF, dAIS, dLCK and dOCI, no errored blocks shall be counted.

pN_delay ← nN_delay ($\sum$ number of frames ~~since~~ between DMValue toggle event and the received DMp signal value toggle event)

NOTE 5 – This count is triggered by the ODUkP_TT_S~~o~~k_MI_DMValue toggle event, which is equal to the ODUkP_TT_So_MI_DMValue toggle event.

NOTE 6 – This value is a snapshot value.

2.8) Modifications to clause 14.3.7, ODU0P to client adaptation function (ODU0P/CBRx_A) (0 ≤ x ≤ 1.25G)

Add information to Table 14.20 in clause 14.3.7 as shown below:

Table 14-20 – Defined values for x for ODU0 clients

x	PTI	Maximum buffer hysteresis	Bit rate	Clock range
155M	Hex code 0A	1 byte	155 520 kbit/s ± 20 ppm	155 520 kHz ± 20 ppm
622M	Hex code 0B	1 byte	622 080 kbit/s ± 20 ppm	622 080 kHz ± 20 ppm
1G25 (Note) ETC3	Hex code 07	1 byte	1 171 875 kbit/s ± 100 ppm	1 171 875 kHz ± 100 ppm
FC100	Hex code 0C	1 byte	1 062 500 kbit/s ± 100 ppm	1 062 500 kHz ± 100 ppm
SBCON/ ESCON	Hex code 18	1 byte	200 000 kbit/s ± 200 ppm	200 000 kHz ± 200 ppm
NOTE – The original bit rate and clock range of the associated 1000BASE-X Ethernet client signal is 1 250 000 kbit/s ± 100 ppm. The bit rate and clock range in this table are for the CBR stream that is produced after mapping the client signal into a GFP-T.				

Add information to Table 14.22 in clause 14.3.7.2 as shown below:

Table 14-22 – Defined replacement signals and jitter specification references for ODU0 clients

Client	PTI	Replacement signal	Bit rate	Jitter Standard
155M CBR	Hex code 0A	Generic-AIS	155 520 kbit/s ± 20 ppm	[ITU-T G.825]
622M CBR	Hex code 0B	Generic-AIS	622 080 kbit/s ± 20 ppm	[ITU-T G.825]
1G25 ETC3	Hex code 07	Link Fault	1 250 000 kbit/s ± 100 ppm	[IEEE 802.3]
FC100	Hex code 0C	Link Fault	1 062 500 kbit/s ± 100 ppm	[b-ANSI INCITS 352]
SBCON	Hex code 18	NOS	200 000 kbit/s ± 200 ppm	[b-ANSI INCITS 296]

Add information to the consequent actions section of 14.3.7.2 as shown below:

Consequent actions

aSSF ← AI_TSF or dPLM or (not MI_Active)

aAIS ← AI_TSF or dPLM or (not MI_Active)

NOTE 3 – The state of the determination process of the C_m and its contribution to AIS consequent action is for further study.

For 1GE clients, on declaration of aAIS the function shall output a link fault pattern/signal as defined in clause 17.7.1 of [ITU-T G.709] within two frames. For SBCON and FC100 clients, on declaration of aAIS the function shall output a NOS pattern/signal as defined in clause 17.7.1 of [ITU-T G.709] within two frames. For other clients, on declaration of aAIS the function shall output a GenericAIS pattern/signal as defined in clause 16.6 of [ITU-T G.709] within two frames. On clearing of aAIS the GenericAIS pattern/signal shall be removed within two frames and normal data being output. The link fault or GenericAIS clock start shall be independent from the incoming clock. The link fault or GenericAIS clock has to be within the frequency, jitter, and wander tolerance specifications of the associated client signal.

2.9) Modifications to clause 14.3.9.2, ODUkP to ODU[i]j adaptation sink function (ODUkP/ODU[i]j_A_Sk)

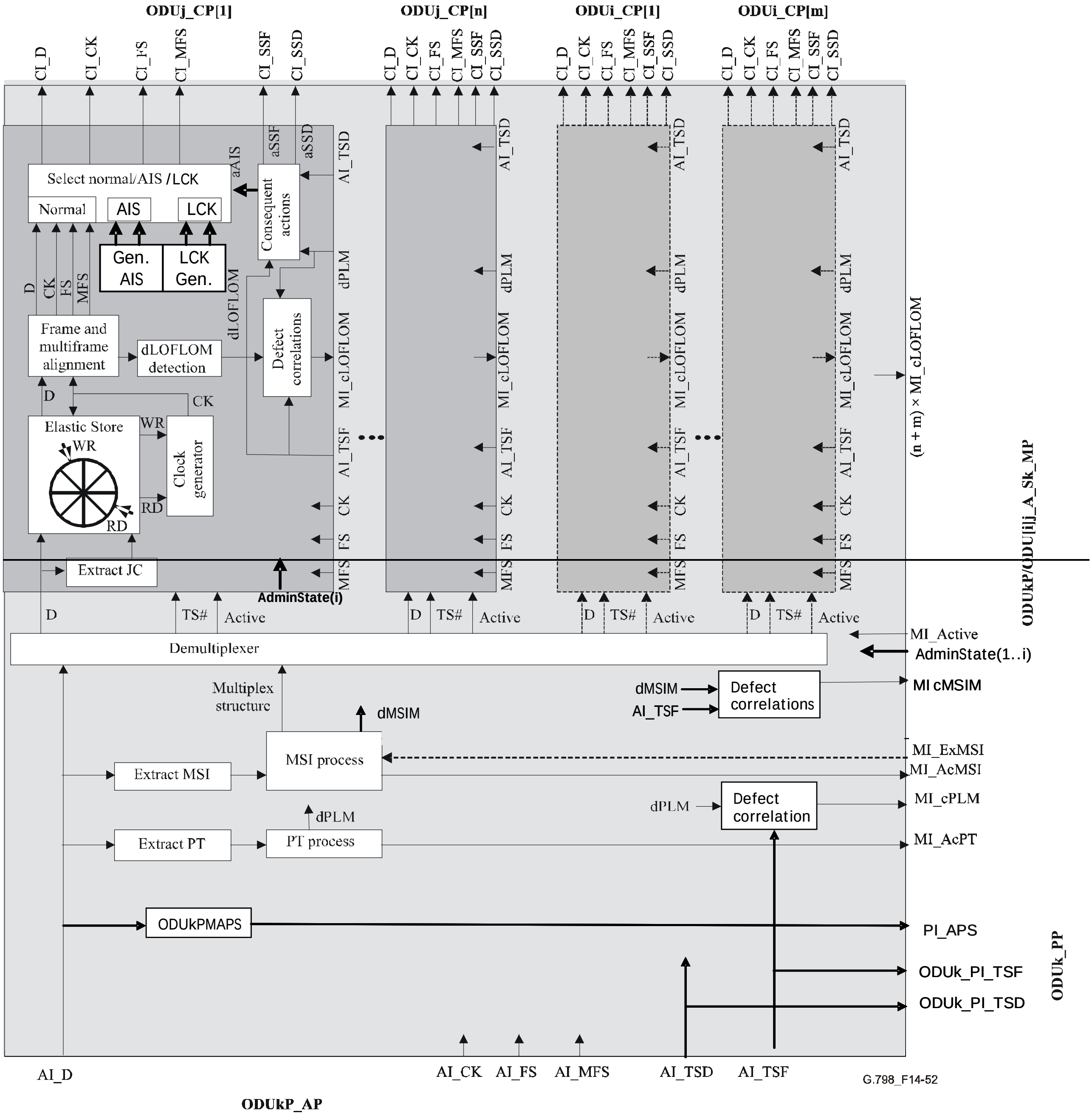
Modify the information relative to clause 14.3.9.2 as shown below with respect to AcMSI[p], dMSI processing and cMSIM[p] reporting.

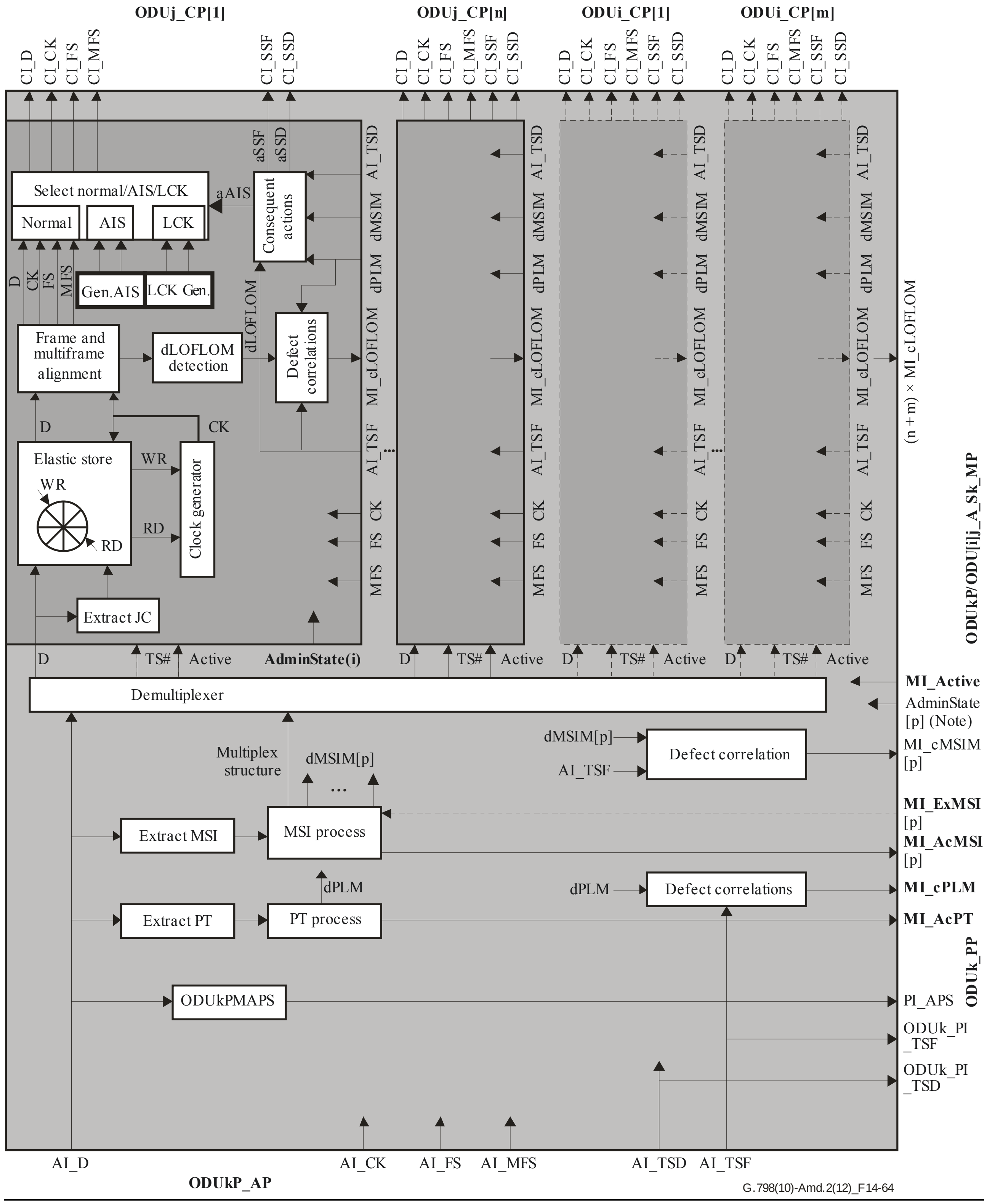
Modify Table 14-32 as shown:

Table 14-32 – ODUkP/ODU[i]j_A_Sk inputs and outputs

Input(s)	Output(s)
ODUkP_AP: ODUkP_AI_CK ODUkP_AI_D ODUkP_AI_FS ODUkP_AI_MFS ODUkP_AI_TSF ODUkP_AI_TSD **ODUkP/ODU[i]j_A_Sk_MP**: ODUkP/ODU[i]j_A_Sk_MI_Active ODU3P/ODU12_A_Sk_MI_ExMSI[p] ~~[n+m] (Note)~~ ODUkP/ODU[i]j_A_Sk_MI_AdminState[~~n+m~~p] (Note 2)	**n × ODUj_CP**: ODUj_CI_CK ODUj_CI_D ODUj_CI_FS ODUj_CI_MFS ODUj_CI_SSF ODUj_CI_SSD **m × ODUi_CP**: (Note 1) ODUi_CI_CK ODUi_CI_D ODUi_CI_FS ODUi_CI_MFS ODUi_CI_SSF ODUj_CI_SSD **ODUk_PP**: ODUk_PI_APS ODUk_PI_TSF ODUk_PI_TSD **ODUkP/ODU[i]j_A_Sk_MP**: ODUkP/ODU[i]j _A_Sk_MI_cPLM ODUkP/ODU[i]j _A_Sk_MI_cMSIM[p] ~~[1..maxTS]~~ ODUkP/ODU[i]j _A_Sk_MI_AcPT ODUkP/ODU[i]j _A_Sk_MI_AcMSI[p] ~~[1..maxTS]~~ n × ODUkP/ODUj_A_Sk_MI_cLOFLOM m × ODUkP/ODUi_A_Sk_MI_cLOFLOM (Note 1)
NOTE 1 – For ODU3P/ODU12_A_Sk only. NOTE 2 – [p] = [1..n], when doing n × ODUj_CP and [p] = [1..m] when doing m × ODUi_CP respectively.	

Modify Figure 14-64 to the following:





NOTE – [p] = [1..n], when doing n × ODUj_CP and [p] = [1..m] when doing m × ODUi_CP respectively.

Figure 14-64 – ODUkP/ODU[i]j_A_Sk processes

Modify the MSI process specification:

MSI: The function shall extract the MSI from the PSI overhead ~~per configured tributary signal~~ as defined in clause 8.7.2. The accepted MSI for a tributary signal #~~i~~ p (AcMSI[~~i~~p]) is available at the

MP (MI_AcMSI[ip]). The multiplex structure is defined by ExMSI, which is either fixed or is configurable via MI_ExMSI as shown in Table 14-33.

Modify the Defects specification:

Defects

The function shall detect for dPLM, dMSIM and dLOFLOM.

dPLM: See clause 6.2.4.1. The expected payload type is "0010 0000" (ODU multiplex structure) as defined in [ITU-T G.709].

dMSIM[p]: See clause 6.2.9.1. dMSIM is detected per active ODUj[/i].

dLOFLOM[p]: See clause 6.2.5.3. dLOFLOM is detected per active ODUj[/i].

Modify the Consequent actions specification:

Consequent actions

PI_TSF ← AI_TSF

PI_TSD ← AI_TSD

For each ODUj[/i] tributary port #p:

aSSF ← ((AI_TSF or dPLM or dMSIM[p] or dLOFLOM[p]) and (not MI_AdminState[p] = LOCKED)) or (not Active)

For each ODUj[/i] tributary port #p:

aSSD ← AI_TSD and (not MI_AdminState[p] = LOCKED)

For each ODUj[/i] tributary port #p:

aAIS ← ((AI_TSF or dPLM or dMSIM[p] or dLOFLOM[p]) and (not MI_AdminState[p]= LOCKED)) or (not Active)

Modify the Defect correlation specification:

Defect correlations

cPLM ← dPLM and (not AI_TSF)

For each ODUj[/i] tributary port #p:

cMSIM-[p] ← dMSIM[p] and (not dPLM) and (not AI_TSF)

For each ODUj[/i] tributary port #p:

cLOFLOM ← dLOFLOM[p] ~~and (not MSIM)~~ and (not dPLM) and (not AI_TSF) and (Active)

2.10) Modifications to Figures 14-65 and 14-66

Replace Figures 14-65 and 14-66 as follows:

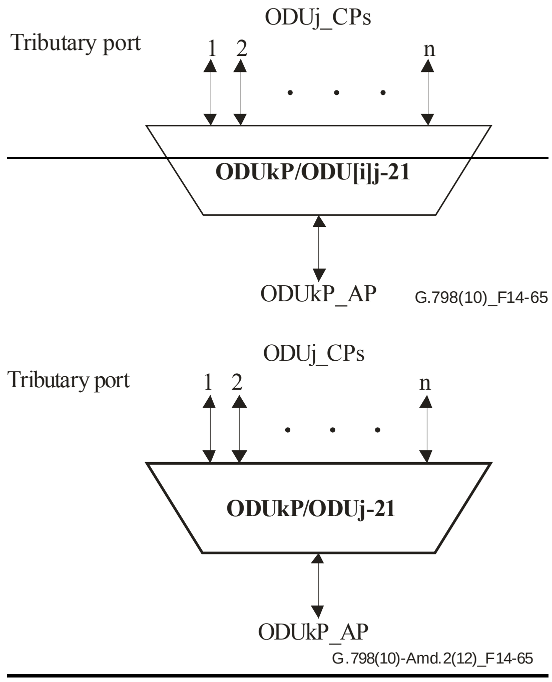


Figure 14-65 – ODUkP/ODUj-21_A function

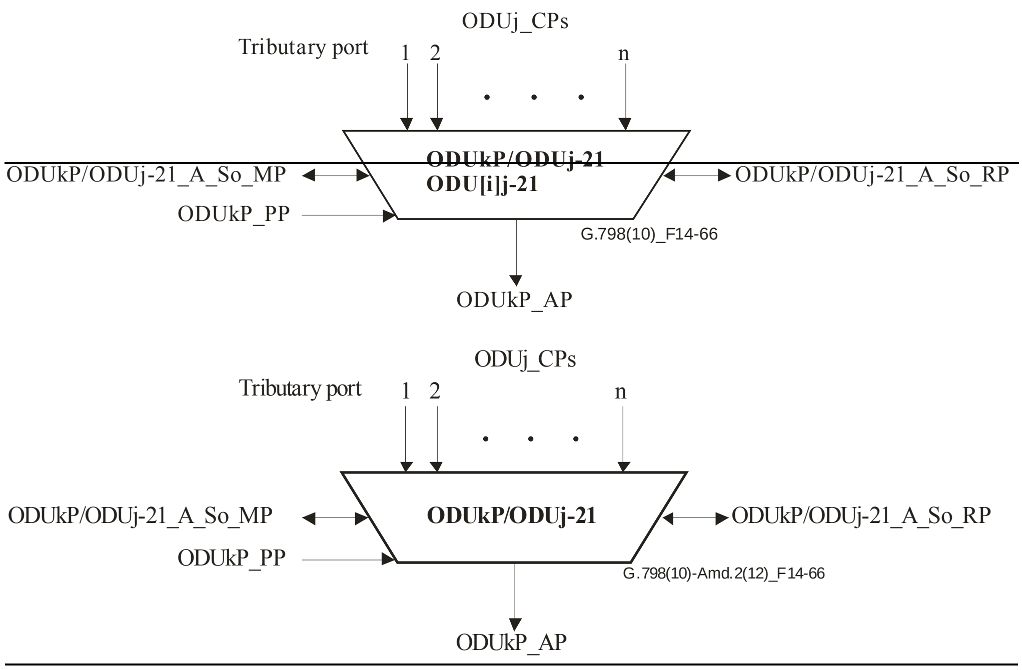


Figure 14-66 – ODUkP/ODUj-21_A_So function

2.11) Modifications to clause 14.3.10.1, ODUkP to ODUj payload type 21 adaptation source function (ODUkP/ODUj-21_A_So)

Modify the PT process specification:

PT: The function shall insert code "0010 0001" (ODU multiplex structure supporting ODTUk.ts or ODTUk.ts and ODTUjk) into the PT byte position of the PSI overhead as defined in clause 15.9.2.1 of [ITU-T G.709] for k = 4.

For k = 2, 3 the inserted PT code shall default to code "0010 0001". This code must be replaced by code "0010 0000" under control of the PT=21-to-PT=20 interworking process described hereafter. When MI AUTOpayloadtype is activated, the function shall adapt a PT21 supporting port to a PT20 structure.

If the corresponding adaptation sink provides the information of a PT = 20 at the RI_AcPT, the function shall fall back to PT=20 under the following conditions: The MI_AUTOpayloadtype is true and the HO ODU source is either not provisioned for any traffic signal structure, or the HO ODU2 source configured for one or more ODU1 signals to be mapped into TS1/TS5 and/or TS2/TS6 and/or TS3/TS7 and/or TS4/TS8, or the HO ODU3 source is configured to support one or more ODU1 signals mapped into TS1/TS17, TS2/TS18, TSi/TS16+I and/or one or more ODU2 signals mapped into TSa/TS16+a/TSb/TS16+b/TSc/TS16+c/TSd/TS16+16 and no other ODU type signals. In this case, the function shall insert PT20 into the PSI positions.

The default value of the MI_AUTOpayloadtype activation shall be "true".

Subsequent to a situation when a PT21 capable port has operated in PT20 mode and afterwards is taken out of service or receives PT21, the port shall fall back to a PT21 structure.

NOTE 1 – Equipment developed prior to the 2010 version of the Recommendation may implement a different setting with respect to the default value of the MI_AUTOpayloadtype.

In the case the ODU2 or ODU3 adaptation source is configured for either ODU0, or an ODUflex, or an ODU2e, or for an ODU1 in TSi/TSj with j<>4+i (for ODU2) or j<>16+I (for ODU3) then PT21 is to be inserted. The inserted PT shall be reported at the ODUkP/ODUj-21_A_So_RI_TrPT to the corresponding adaptation sink function and the ODUkP/ODUj-21_A_So_MI_TrPT.

NOTE 2 – The change to PT20 or PT21 means a full adaptation to the related signal structure including the default OH byte insertion.

2.12) Modifications to clause 14.3.10.2, ODUkP to ODUj payload type 21 adaptation sink function (ODUkP/ODUj-21_A_Sk)

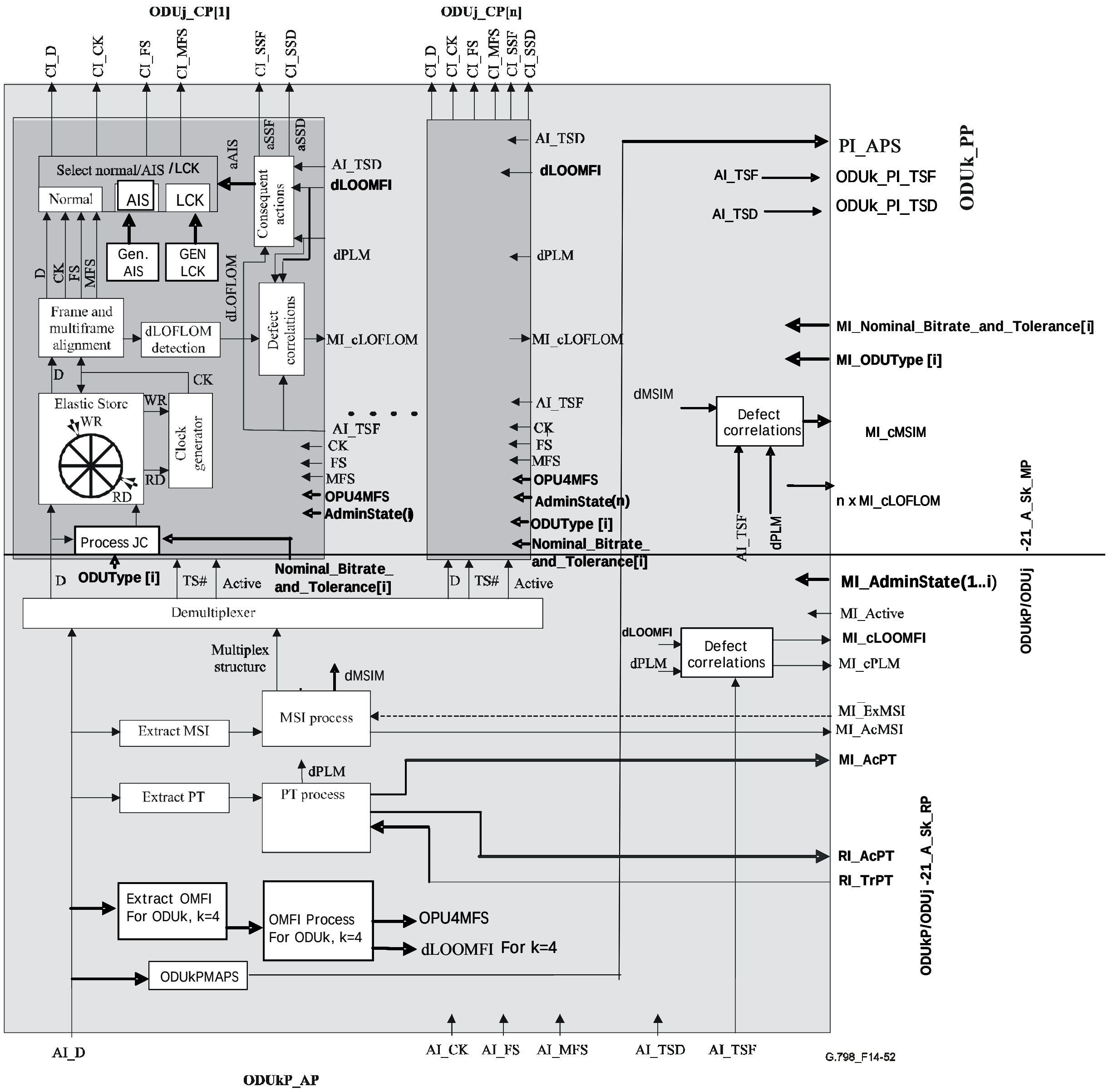
Modify information to 14.3.10.2 as shown below in respect to AcMSI[p], dMSI processing and cMSIM[p] reporting.

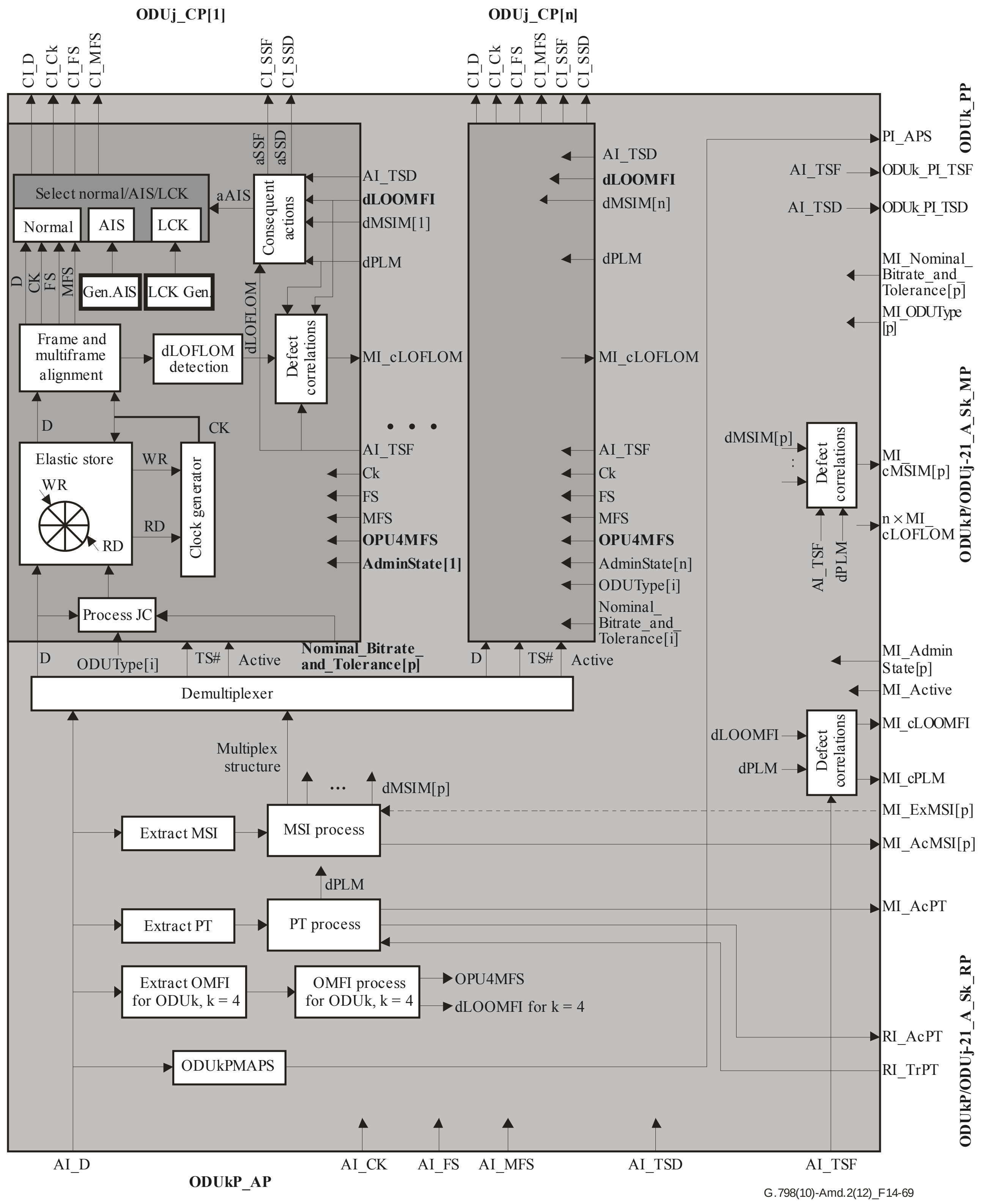
Modify Table 14-36:

Table 14-36 – ODUkP/ODUj-21_A_Sk inputs and outputs

Input(s)	Output(s)
ODUkP_AP: ODUkP_AI_CK ODUkP_AI_D ODUkP_AI_FS ODUkP_AI_MFS ODUkP_AI_TSF ODUkP_AI_TSD **ODUkP/ODUj21_A_Sk_MP**: ODUkP/ODUj21_A_Sk_MI_Active ODU3P/ODUj21_A_Sk_MI_ExMSI[p] ODUkP/ODUj-21_A_Sk_MI_AdminState[~~n~~p] ODUkP/ODUj-21_A_Sk_MI_Nominal_Bitrate_and_Tolerance[~~i~~p] ODUkP/ODUj-21_A_Sk_MI_ODUType [~~i~~p] **ODUkP/ODUj-21_A_Sk_RP**: ODUkP/ODUj-21_A_Sk_RI_TrPT	**n × ODUj_CP**: ODUj_CI_CK ODUj_CI_D ODUj_CI_FS ODUj_CI_MFS ODUj_CI_SSF ODUj_CI_SSD **ODUk_PP**: ODUk_PI_APS ODUk_PI_TSF ODUk_PI_TSD **ODUkP/ODU[i]j_A_Sk_MP**: ODUkP/ODUj-21_A_Sk_MI_cPLM ODUkP/ODUj-21_A_Sk_MI_cLOOMFI ODUkP/ODUj-21_A_Sk_MI_cMSIM~~[i]~~ ODUkP/ODUj-21_A_Sk_MI_AcPT ODUkP/ODUj-21_A_Sk_MI_AcMSI[p] ~~[i]~~ ODUkP/ODUj-21_A_Sk_MI_cLOFLOM[~~i~~p] **ODUkP/ODUj-21_A_Sk_RP**: ODUkP/ODUj-21_A_Sk_RI_AcPT
NOTE – [p] = [1..n], when doing n × ODUj_CP.	

Modify Figure 14-69 as shown below:





NOTE – [p] = [1..n], when doing n × ODUj_CP.

Figure 14-69 – ODUkP/ODUj-21_A_Sk processes

Modify the MSI process specification:

MSI: The function shall extract the MSI from the PSI overhead as defined in clause 8.7.2. The accepted MSI for a tributary signal #~~i~~ p (AcMSI[~~i~~p]) is available at the MP (MI_AcMSI[~~i~~p]). The multiplex structure is defined by ExMSI, which is either fixed or is configurable via MI_ExMSI.

Modify the Defects specification:

Defects

The function shall detect for dPLM, dMSIM, dLOOMFI and dLOFLOM.

dPLM: See clause 6.2.4.1. The expected payload type is "0010 0001" (ODU multiplex structure supporting ODTUk.ts or ODTUk.ts and ODTUjk) as defined in [ITU-T G.709].

dLOOMFI: dLOOMFI is detected per OPUk with k = 4. See the OPU multiframe (OMFI) detection process for OPUk with k = 4.

dMSIM[ip]: See clause 6.2.9.1. dMSIM is detected per active ODUj.

dLOFLOM[ip]: See clause 6.2.5.3. dLOFLOM is detected per active ODUj.

Modify the Consequent actions specification:

Consequent actions

PI_TSF ← AI_TSF

PI_TSD ← AI_TSD

For each ODUj tributary port #p:

aSSF[ip] ← ((AI_TSF or dPLM or dLOOMFI or dMSIM[ip] or dLOFLOM[p]) and (not MI_AdminState[p] = LOCKED)) or (not Active)

For each ODUj tributary port #p:

aSSD[ip] ← AI_TSD and (not MI_AdminState[p] = LOCKED)

For each ODUj tributary port #p:

aAIS[ip] ← ((AI_TSF or dPLM or dLOOMFI or dMSIM[ip] or dLOFLOM[p]) and (not MI_AdminState[p] = LOCKED)) or (not Active)

Modify the Defect correlation specification:

Defect correlations

cPLM ← dPLM and (not AI_TSF)

For ODUk with k = 4

cLOOMFI ← dLOOMFI and (not AI_TSF)

For each ODUj tributary port #p:

cMSIM[pi] ← dMSIM[pi] and (not dPLM) and (not dLOOMFI) and (not AI_TSF)

For each ODUj tributary port #p:

cLOFLOM[p] ← dLOFLOM[p] ~~and (not MSIM)~~ and (not dLOOMFI) and (not dPLM) and (not AI_TSF) and (Active)

2.13) New clauses 14.3.11 and 14.3.12 for ODU/ETH client adaptations

Add new clauses as shown below:

14.3.11 ODUk to ETH adaptation functions (ODUkP /ETH_A; k = 0,1,2,3,4,flex)

The ODUkP to Ethernet adaptation using GFP mapping is given in [ITU-T G.8021].

14.3.12 HAO capable ODUk to ETH adaptation functions (ODUkP-h/ETH_A; k = flex)

14.3.12.1 HAO capable ODUk to ETH adaptation source function (ODUkP-h/ETH_A_So)

The ODUkP-h/ETH_A_So function creates the ODUk signal from a free running clock. It maps the ETH_CI information into the payload of the OPUk (k = flex), adds OPUk overhead (CSF, RCOH, RES, PT) and default ODUk overhead.

Symbol

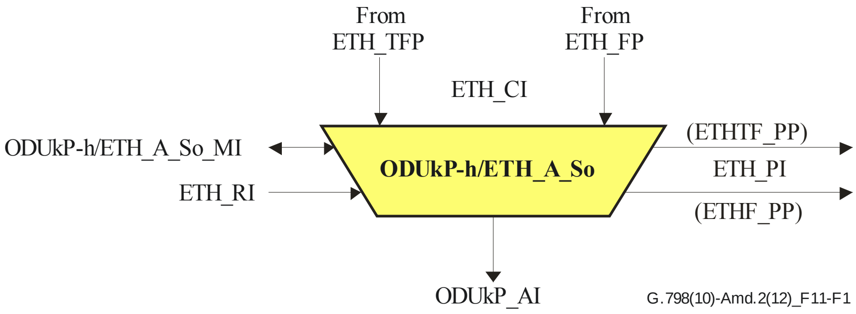


Figure 14-F1 – ODUkP-h/ETH_A_So symbol

Interfaces

Table 14-F1 – ODUkP-h/ETH_A_So interfaces

Inputs	Outputs
ETH_TFP: ETH_CI_D ETH_CI_P ETH_CI_DE **ETH_FP**: ETH_CI_D ETH_CI_P ETH_CI_DE ETH_CI_SSF ETH_CI_SSFrdi ETH_CI_SSFfdi **ODUkP_RP**: ODUkP_RI_RP ODUkP_RI_TSCC ODUkP_RI_NCS **ODUkP-h/ETH_A_So_MP**: ODUkP-h/ETH_A_So_MI_Active ODUkP-h/ETH_A_So_MI_CSFEnable ODUkP-h/ETH_A_So_MI_CSFrdifdiEnable ODUkP-h/ETH_A_So_MI_INCREASE ODUkP-h/ETH_A_So_MI_DECREASE ODUkP-h/ETH_A_So_MI_TSNUM ODUkP-h/ETH_A_So_MI_ODUflexRate	**ODUkP_AP**: ODUkP_AI_Data ODUkP_AI_Clock ODUkP_AI_FrameStart ODUkP_AI_MultiframeStart ODUkP_(A/M)I_RP ODUkP_(A/M)I_TSCC **ETHTF_PP**: ETH_PI_D ETH_PI_P ETH_PI_DE **ETHF_PP**: ETH_PI_D ETH_PI_P ETH_PI_DE **ODUkP-h/ETH-m_A_So_MP**: ODUkP-h/ETH-m_A_So_MI_ADJSTATE
NOTE – (A/M)I_xxx indicates that the xxx signal may either be An AI_xxx or a MI_xxx signal.	

Processes

A process diagram of this function is shown in Figure 14-F2.

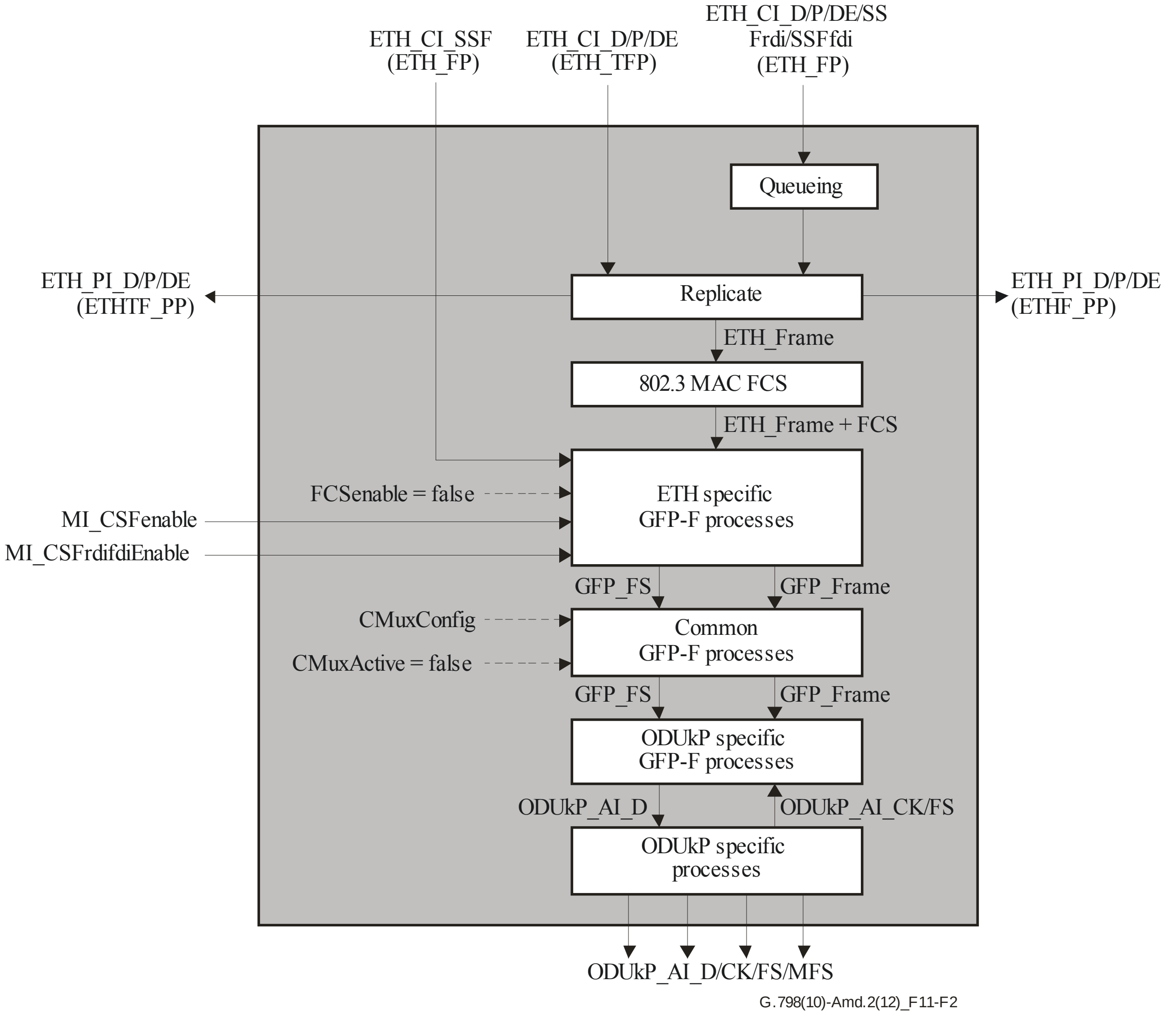


Figure 14-F2 – ODUkP-h/ETH_A_So process

"Queuing" process:

See clause 8.2 of [ITU-T G.8021].

"Replicate" process:

See clause 8.4 of [ITU-T G.8021].

802.3 MAC FCS generation:

See clause 8.8.1 of [ITU-T G.8021].

Ethernet specific GFP-F source process:

See clause 8.5.4.1.1 of [ITU-T G.806]. GFP pFCS generation is disabled (FCSenable = false). The UPI value for frame-mapped Ethernet shall be inserted (Table 6-3 of [ITU-T G.7041]). The Ethernet frames are inserted into the client payload information field of the GFP-F frames according to clause 7.1 of [ITU-T G.7041].

Common GFP source process:

See clause 8.5.3.1 of [ITU-T G.806]. GFP channel multiplexing is not supported (CMuxActive = false).

ODUkP specific GFP source process:

See clause 8.5.2.1 of [ITU-T G.806]. The GFP frames are mapped into the ODUk payload area according to clause 17.4 of [ITU-T G.709].

ODUkP specific source process:

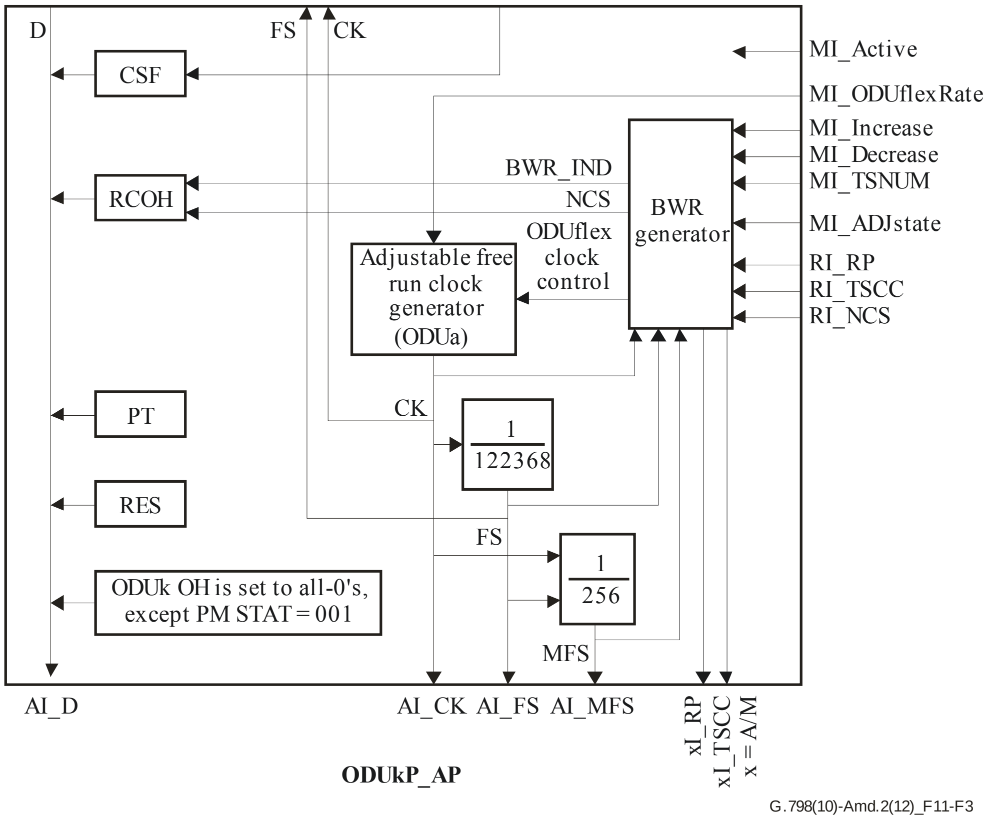


Figure 14-F3 – ODUkP-h (k = flex) specific source process

Adjustable Clock and (Multi)Frame Start signal generation:

The function shall generate a local ODUk clock (ODUkP_AI_CK) with a clock rate within the minimum to maximum clock rate of the ODUflex signal as given in Table 14-2. The jitter and wander requirements as defined in Annex A of [ITU-T G.8251] (ODCa clock) apply.

The function shall generate the (multi)frame start reference signals AI_FS and AI_MFS for the ODUk signal. The AI_FS signal shall be active once per 122 368 clock cycles. AI_MFS shall be active once every 256 frames.

PT: The payload type information is derived directly from the Adaptation function type. The value for "GFP mapping" shall be inserted into the PT byte position of the PSI overhead as defined in clause 15.9.2.1.1 of [ITU-T G.709]. The PT value of a HAO capable adaptation function should remain the same as a non-HAO capable one.

RES: The function shall insert all-0's into the RES bytes.

CSF: The function shall signal the failure of the client signal to the far end by use of the bit 1 of the PSI[2] byte of the payload structure identifier as defined in clause 17.1 of [ITU-T G.709].

All other bits of the ODUk overhead should be sourced as "0"s, except the ODUk-PM STAT field which should be set to the value "normal path signal" (001).

Counter processes:

For further study.

RCOH Generator: This process inserts NCS generated by HAO process into the NCS field of the RCOH in OPUflex.

BWR_Generator: This process is used for BWR protocol adjustment processing and generation of BWR protocol overhead. It contains the following processes as shown in Figure 14-F3.1.

Adjustment activation: When MI_INCREASE or MI_DECREASE is true, BWR protocol is activated and RI processing is started.

Rate adjustment control: Generates ODUflex clock control signal. Original ODUflex clock rate will gradually change to new ODUflex clock rate such that no GMP buffer overflow or underflow will occur in the ODUflex network connection. Refer to [ITU-T G.7044].

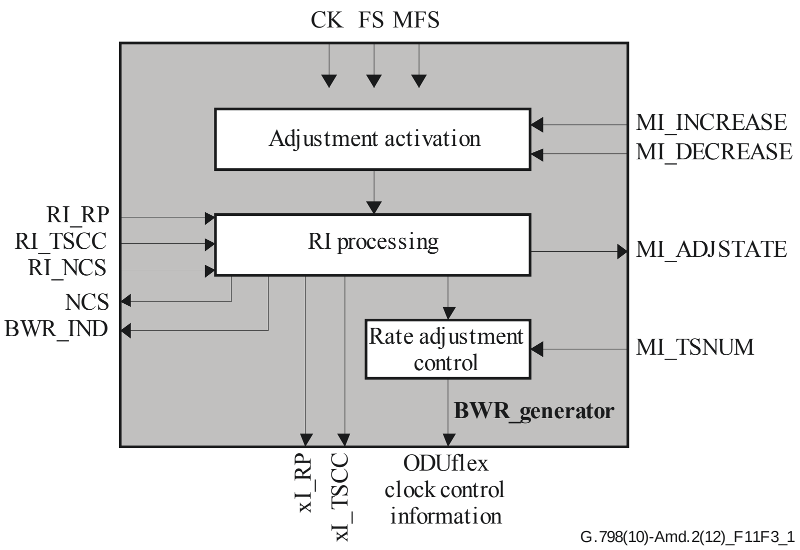


Figure 14-F3–1 – BWR_Generator process

RI processing: This process performs BWR protocol according to RI_RP, RI_TSCC, RI_NCS signals received from the BWR_Receiver process.

– When RI processing is activated, xI_RP and xI _TSCC (x is A or M) signals are set to one (1).

– The value of the NCS signal is set to ACK(1) when receiving RI_RP = 1 and the value of RI_TSCC is changed from 0 to 1.

– Rate adjustment control is activated when receiving RI_RP = 1 and RI_TSCC = 1 and RI_NCS = ACK(1).

– BWR_IND is set to "1" x µs before ODUflex signal's bit rate adjustment starts, and is set to "0" y µs before ODUflex signal's bit rate adjustment completes. x is almost equal to y and shall be in the range of 125 to 250 µs.

– The value of xI_TSCC signal is set to 0 when rate adjustment is completed.

– The value of NCS signal is set to NACK(0) when receiving RI_RP = 1 and the value of RI_TSCC is changed from 1 to 0.

– The value of RP signal is set to 0 when receiving RI_NCS=NACK(0) and sending NCS=NACK(0).

– The completion of the resize process is reported to NMS when receiving RI_RP=0.

Defects None.

Consequent actions

aCSF-RDI ← CI_SSFrdi and CSFrdifdiEnable and CSFEnable

aCSF-FDI ← CI_SSFfdi and CSFrdifdiEnable and CSFEnable

aCSF-LOS ← CI_SSF and CSFEnable

aCSF-OPU ← CI_SSF and CSFEnable

Defect correlations None.

Performance monitoring For further study.

14.3.12.2 HAO capable ODUk to ETH adaptation sink function (ODUkP-h/ETH_A_Sk)

The ODUkP-h/ETH_A_Sk extracts ETH_CI information from the ODUkP payload area, delivering ETH_CI to ETH_TFP and ETH_FP. It extracts the OPUk overhead (PT, RCOH, CSF and RES) and monitors the reception of the correct payload type.

Symbol

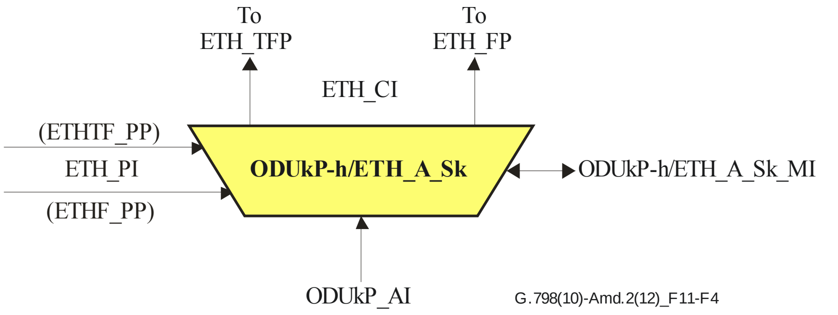


Figure 14-F4 – ODUkP-h/ETH_A_Sk symbol

Interfaces

Table 14-F2 – ODUkP-h/ETH_A_Sk interfaces

Inputs	Outputs
ODUkP_AP: ODUkP_AI_Data ODUkP_AI_ClocK ODUkP_AI_FrameStart ODUkP_AI_MultiframeStart ODUkP_AI_TSF ODUkP_(A/M)I_RP ODUkP_(A/M)I_TSCC **ETHTF_PP**: ETH_PI_D ETH_PI_P ETH_PI_DE **ETHF_PP**:	**ETH_TFP**: ETH_CI_D ETH_CI_P ETH_CI_DE ETH_CI_SSF **ETH_FP**: ETH_CI_D ETH_CI_P ETH_CI_DE ETH_CI_SSF ETH_CI_SSFrdi ETH_CI_SSFfdi **ODUkP_RP**:

Table 14-F2 – ODUkP-h/ETH_A_Sk interfaces

Inputs	Outputs
ETH_PI_D ETH_PI_P ETH_PI_DE **ODUkP-h/ETH_A_Sk_MP**: ODUkP/ETH-h_A_Sk_MI_Active ODUkP/ETH-h_A_Sk_MI_FilterConfig ODUkP/ETH-h_A_Sk_MI_CSF_Reported ODUkP/ETH-h_A_Sk_MI_MAC_Length ODUkP/ETH-h_A_Sk_MI_CSFrdifdiEnable ODUkP-h/ETH-m_A_Sk_MI_INCREASE ODUkP-h/ETH-m_A_Sk_MI_DECREASE	ODUkP_RI_RP ODUkP_RI_TSCC ODUkP_RI_NCS **ODUkP-h/ETH_A_Sk_MP**: ODUkP/ETH_A_Sk_MI_AcPT ODUkP/ETH_A_Sk_MI_AcEXI ODUkP/ETH_A_Sk_MI_AcUPI ODUkP/ETH_A_Sk_MI_cPLM ODUkP/ETH_A_Sk_MI_cLFD ODUkP/ETH_A_Sk_MI_cUPM ODUkP/ETH_A_Sk_MI_cEXM ODUkP/ETH_A_Sk_MI_cCSF ODUkP/ETH_A_Sk_MI_pFCSErrors

Processes

A process diagram of this function is shown in Figure 14-F5.

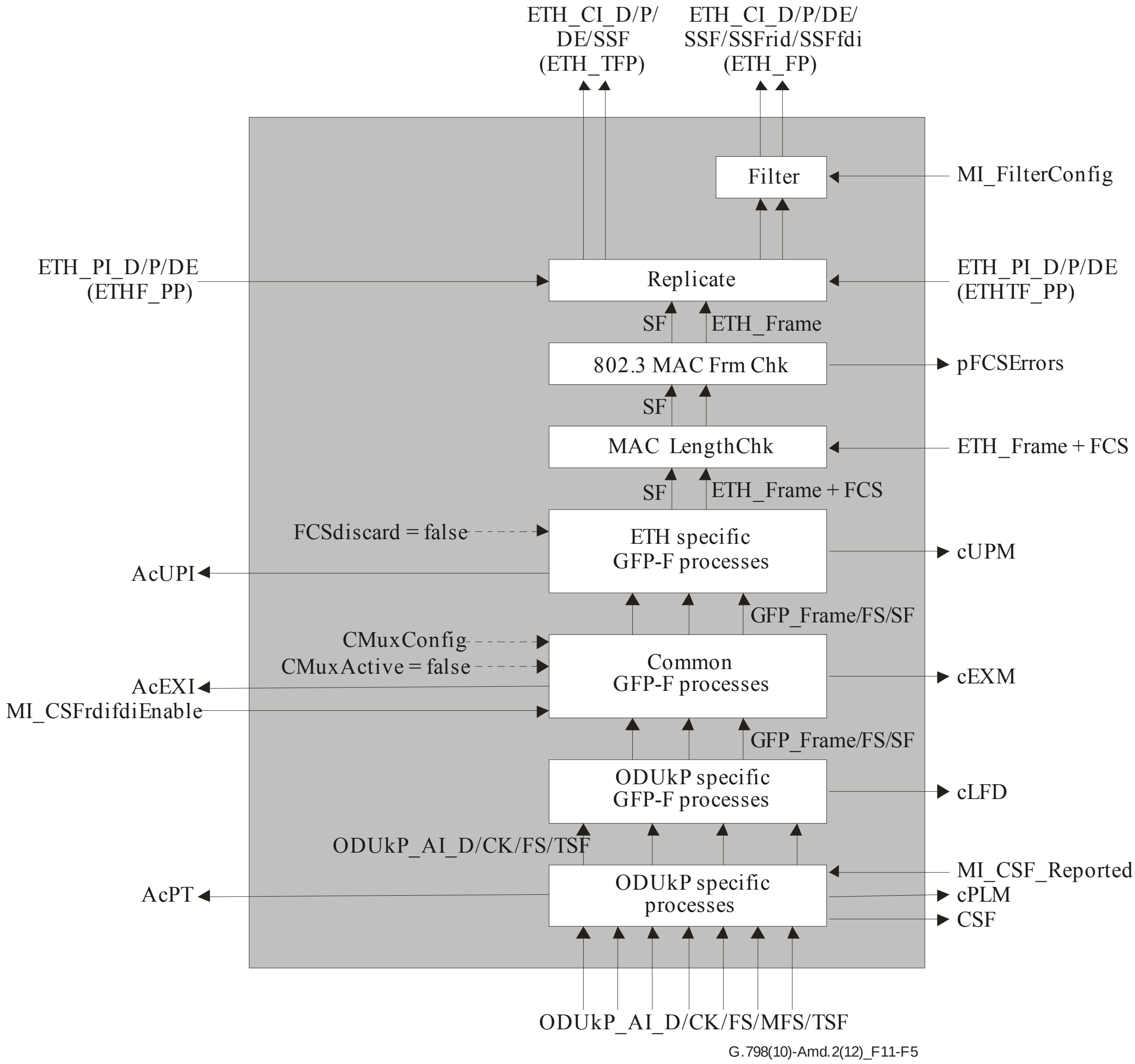


Figure 14-F5 – ODUkP-h/ETH_A_Sk process

"Filter" process:

See clause 8.3 [ITU-T G.8021].

"Replicate" process:

See clause 8.4 [ITU-T G.8021].

"802.3 MAC FCS Check" process:

See clause 8.8.2 [ITU-T G.8021].

Ethernet specific GFP-F sink process:

See clause 8.5.4.1.2 of [ITU-T G.806]. GFP pFCS checking, GFP p_FCSError, p_FDis are not supported (FCSdiscard = false). The UPI value for frame-mapped Ethernet shall be expected (Table 6-3 of [ITU-T G.7041]). The Ethernet frames are extracted from the client payload information field of the GFP-F frames according to clause 7.1 of [ITU-T G.7041].

Common GFP sink process:

See clause 8.5.3.2 of [ITU-T G.806]. GFP channel multiplexing is not supported (MI_CMuxActive = false).

ODUkP specific GFP sink process:

See clause 8.5.2.2 of [ITU-T G.806]. The GFP frames are demapped from the ODUk payload area according to clause 17.4 of [ITU-T G.709].

ODUkP specific sink process:

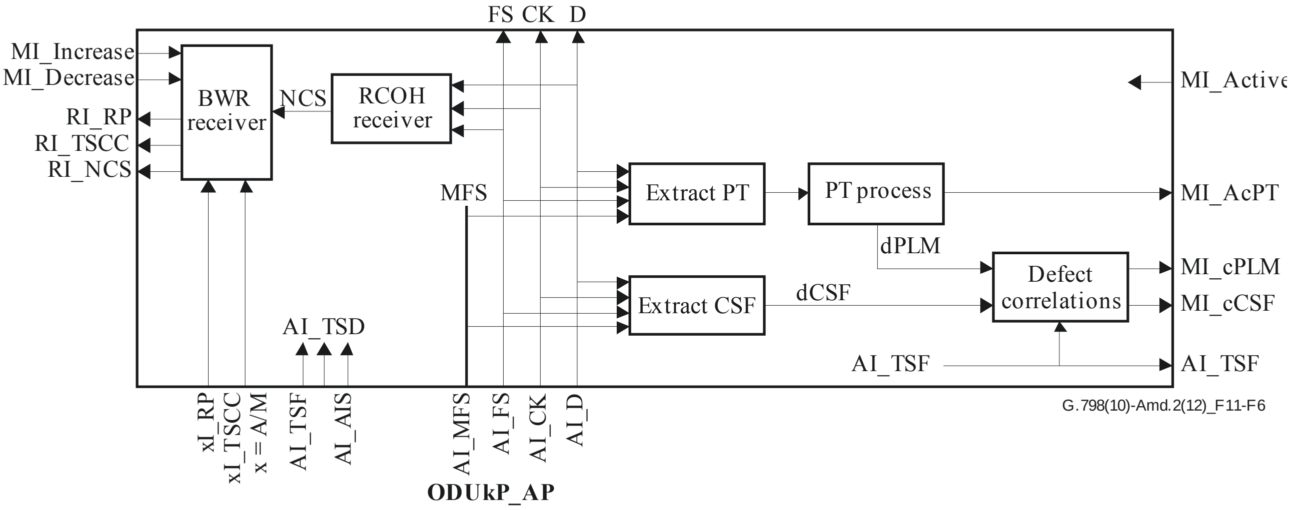


Figure 14-F6 – ODUkP (k = flex) specific sink process

PT: The function shall extract the PT byte from the PSI overhead as defined in clause 8.7.1 of [ITU-T G.798]. The payload type value for "GFP mapping" in clause 15.9.2.1.1 of [ITU-T G.709] shall be expected. The accepted PT value is available at the MP (MI_AcPT) and is used for PLM defect detection. The PT value of a hao capable adaptation function should remain the same as a non-hao capable one.

CSF: The function shall extract the CSF signal indicating the failure of the client signal out of the Bit 1 of the PSI[2] byte of the payload structure identifier as defined in clause 17.1 of [ITU-T G.709].

RES: The value in the RES bytes shall be ignored.

RCOH Receiver: This process extracts NCS from RCOH overhead area, and then forwards it to BWR_Receiver.

BWR_Receiver: This process extracts and detects the BWR protocol overhead, with the exception of the BWR_IND signal. It is shown in Figure 14-F7.

When MI_INCREASE or MI_DECREASE is true, BWR protocol is activated and starts to receive AI_RP/MI_RP, AI_TSCC/MI_TSCC from BWR_RELAY_Receiver process and NCS from Extract NCS process. Then the detected value of RP, TSCC and NCS are sent to BWR_Generator.

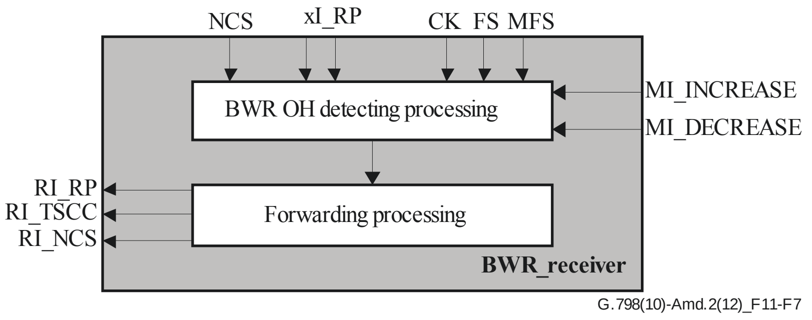


Figure 14-F7 – BWR_Receiver process

Defects

dPLM – See clause 6.2.4.1 of [ITU-T G.798].

dLFD – See clause 6.2.5.2 of [ITU-T G.806].

dUPM – See clause 6.2.4.3 of [ITU-T G.806].

dEXM – See clause 6.2.4.4 of [ITU-T G.806].

dCSF-LOS – See clause 8.8.6.2 of [ITU-T G.8021].

dCSF-RDI – See clause 8.8.6.2 of [ITU-T G.8021].

dCSF-FDI – See clause 8.8.6.2 of [ITU-T G.8021].

dCSF-OPU – See clause 6.2.10.

Consequent actions

The function shall perform the following consequent actions:

aSSF ← AI_TSF or dPLM or dLFD or dUPM or dEXM or dCSF-LOS

aSSFrdi ← dCSF-RDI and CSFrdifdiEnable

aSSFfdi ← dCSF-FDI and CSFrdifdiEnable

Defect correlations

The function shall perform the following defect correlations to determine the most probable fault cause (see clause 6.4 of [ITU-T G.806]). This fault cause shall be reported to the EMF.

cPLM ← dPLM and (not AI_TSF);

cLFD ← dLFD and (not dPLM) and (not AI_TSF);

cUPM ← dUPM and (not dEXM) and (not dPLM) and (not dLFD) and (not AI_TSF);

cEXM ← dEXM and (not dPLM) and (not dLFD) and (not AI_TSF)

cCSF ← (dCSF-LOS or dCSF-OPU or dCSF-FDI) and (not dEXM) and (not dUPM) and (not dPLM) and (not dLFD) and (not AI_TSF) and CSF_Reported

Performance monitoring

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

pFCSErrors: count of FrameCheckSequenceErrors per second.

NOTE – This primitive is calculated by the MAC FCS Check process.

14.3.13 HAO capable ODUkP-h to ODUj payload type 21 adaptation function (ODUkP-h/ODUj-21_A)

The HAO capable ODUkP to ODUj payload type 21 adaptation functions perform the adaptation between the ODUkP (k = 2, 3, 4) layer adapted information and the characteristic information of ODUj (j = 0, 1, 2, 2e, 3, flex) signals.

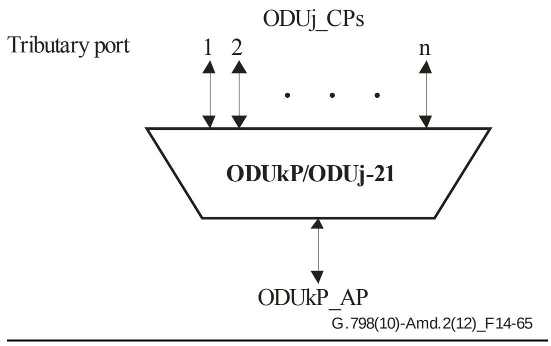


Figure 14-F8 – HAO capable ODUkP/ODUj-21_A function

Three different types of functions are possible:

– the ODU2P/ODUj-21_A performs multiplexing/demultiplexing of any LO ODU with a bit rate less than the OPU2 Payload bit rate into an OPU2;

– the ODU3P/ODUj-21_A performs multiplexing/demultiplexing of any LO ODU with a bit rate less than the OPU3 Payload bit rate into an OPU3;

– the ODU4P/ODUj-21_A performs multiplexing/demultiplexing of any LO ODU with a bit rate less than the OPU4 Payload bit rate into an OPU4.

Tributary ports are dynamically created and deleted under control of management. Each tributary port is associated with one ODUj connection point at one hand, and M OPUk tributary slots at the other hand. The multiplex structure identifier (MSI) carries the configuration of tributary ports to tributary slots.

14.3.13.1 HAO capable ODUkP to ODUj payload type 21 adaptation source function (ODUkP-h/ODUj_A_So)

The HAO capable ODUkP/ODUj-21_A_So function creates the ODUk signal from a free-running clock. It asynchronously maps the ODUj client signal from the ODUj CPs into ODTUjk or ODTUk.M including justification control (JC) information. The ODTUjk and ODTUk.M are multiplexed into the tributary slots of the OPUk. It adds OPUk overhead (RES, PT, MSI, OMFI) and default ODUk Overhead. It provides access to ODUk PM APS Overhead.

The information flow and processing of the HAO capable ODUkP/ODUj-21_A_So function is defined with reference to Figures 14-F9 and 14-F10.

Symbol

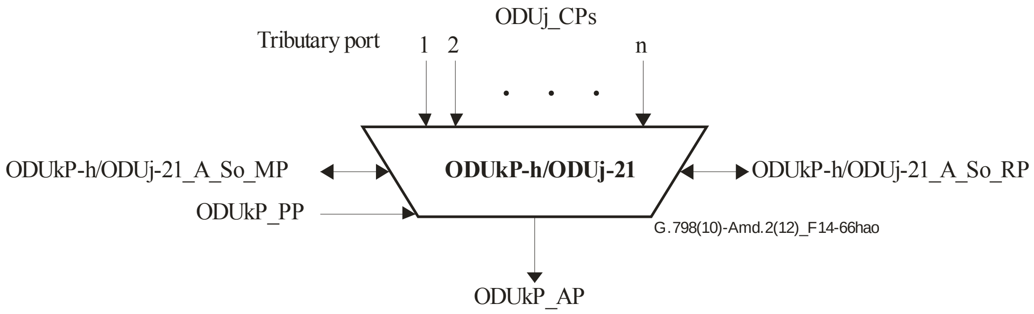


Figure 14-F9 – ODUkP-h/ODUj-21_A_So function

Interfaces

Table 14-F3 – ODUkP-h/ODUj-21_A_So inputs and outputs

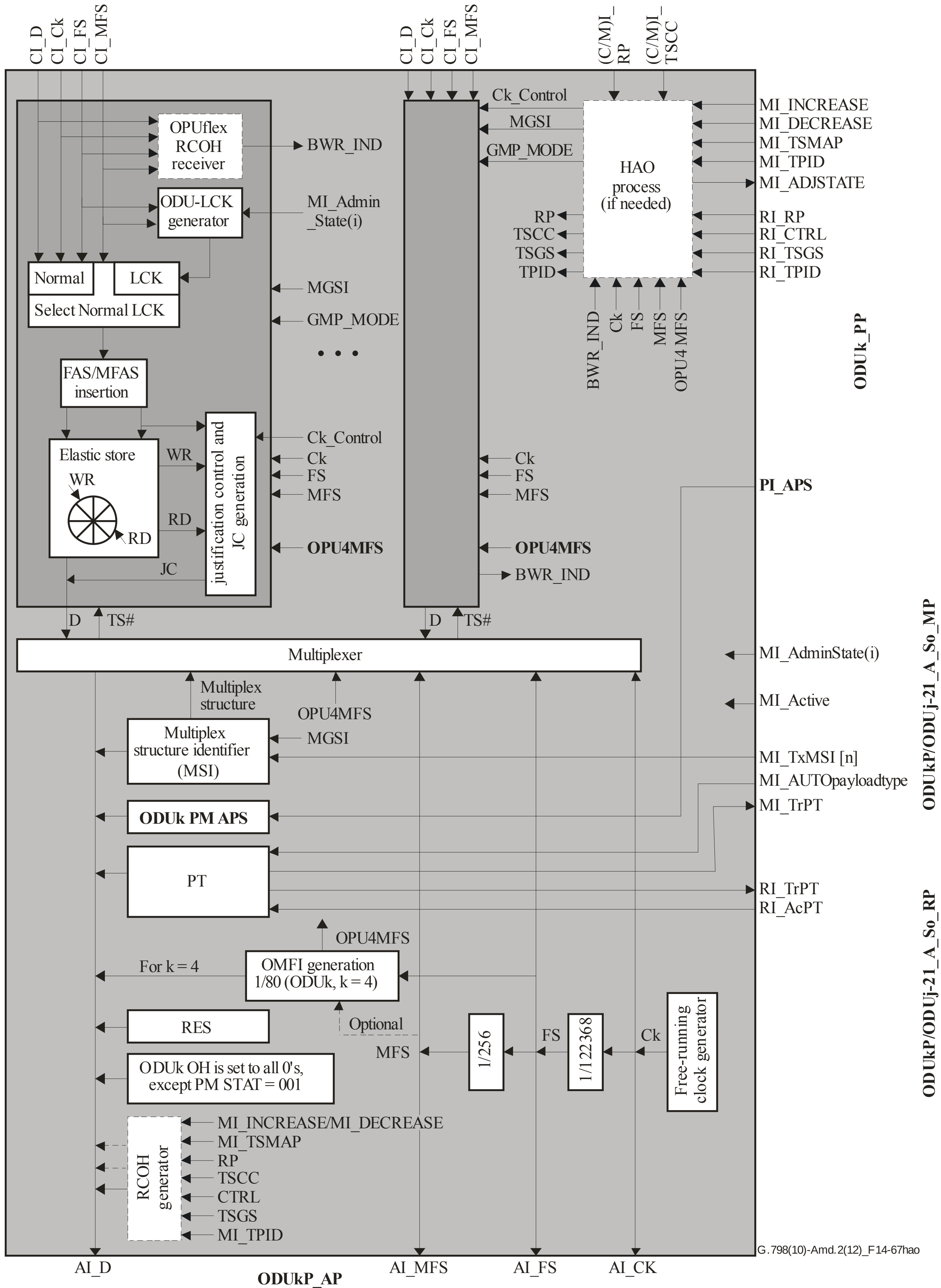
Input(s)	Output(s)
n x ODUj_CP: ODUj_CI_CK ODUj_CI_D ODUj_CI_FS ODUj_CI_MFS ODUj-21_(C/M)I_RP ODUj-21_(C/M)I_TSCC **ODUk_PP**: ODUk_PI_APS **ODUkP-hao/ODUj-21_A_So_MP**: ODUkP-hao/ODUj-21_A_So_MI_Active ODUkP-hao/ODUj-21_A_So_MI_TxMSI[p] ODUkP-hao/ODUj-21_A_So_MI_AUTOpayloadtype ODUkP-hao/ODUj_A_So_MI_AdminState[n] ODUkP-hao/ODUj-21_A_So_MI_INCREASE ODUkP-hao/ODUj-21_A_So_MI_DECREASE ODUkP-hao/ODUj-21_A_So_MI_TSMAP ODUkP-hao/ODUj-21_A_So_MI_TPID **ODUkP-hao/ODUj-21_A_So_RP**: ODUkP-hao/ODUj-21_A_So_RI_AcPT ODUkP-hao/ODUj-21_A_So_RI_RP ODUkP-hao/ODUj-21_A_So_RI_CTRL ODUkP-hao/ODUj-21_A_So_RI_TSGS ODUkP-hao/ODUj-21_A_So_RI_TPID	**ODUkP_AP**: ODUkP_AI_CK ODUkP_AI_D ODUkP_AI_FS ODUkP_AI_MFS **ODUkP-hao/ODUj-21_A_So_RP**: ODUkP-hao/ODUj-21_A_So_RI_TRPT **ODUkP-hao/ODUj-21_A_So_MP**: ODUkP-hao/ODUj-21_A_So_MI_TRPT
NOTE 1 – Red signals are HAO related signals. (C/M)I_xxx indicates that the xxx signal may either be a CI_xxx or a MI_xxx signal. NOTE 2 – [p] = [1...n], when doing n × ODUj_CP.	

Processes

Activation

The HAO capable ODUkP-hao/ODUj-21_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

The processes associated with the HAO capable ODUkP-hao/ODUj-21_A_So function are specific processes for each ODUj_CP and common processes for the compound (multiplexed) signal as depicted in Figure 14-F10.



NOTE – [p] = [1..n] , and [p] = [1..m] respectively.

Figure 14-F10 – ODUkP-hao/ODUj-21_A_So processes

Specific processes

The specific processes are performed independently for each ODUj client signal that is multiplexed into the OPUk. The specific processes perform the mapping of the ODUj into an ODTUjk or ODTUk.M.

FAS/MFAS insertion: The function shall extend the ODUj with the frame alignment overhead (FAS and MFAS) in row one bytes 1 to 7 as described in clause 15.6.2 of [ITU-T G.709]. Bytes 8 to 14 of row one are set to all-zero.

Mapping, frequency justification and bit rate adaptation: The function shall provide an elastic store (buffer) process for the ODUj client signal. The data signal ODUj_CI shall be written into the buffer under control of the associated input clock.

Two justification methods as described below are provided, AMP (*ODTUjk*) and GMP (*ODTUk.M*). The ODU type and rate, as configured via the HAO capable ODUkP-hao/ODUj-21_A-So_MI_ODUType_Rate[i] input for the related trib port, determine the mapping method and, in the case of GMP mapping, the base value and ranges for the parameters Cn and Cm.

ODTUjk: The data shall be read out of the buffer and written onto the D, NJO, PJO1 and PJO2 bytes of the selected ODTUjk frame under control of the ODUk clock and the AMP justification decisions as defined in clause 19.5 of [ITU-T G.709].

A justification decision shall be performed two times per OPUk multiframe (jk = 12, 13) and eight times per OPUk multiframe (jk = 23). Justification decisions are taken at the beginning of the OPUk frame carrying an instance of the ODTUjk justification overhead. Each justification decision results in a corresponding double positive, positive, negative or no justification action in this OPUk frame. Upon a double positive justification action, the reading of two data bytes out of the buffer shall be cancelled once. No ODUj data shall be written onto the PJO2, PJO1 or NJO bytes. Upon a positive justification action, the reading of one data byte out of the buffer shall be cancelled once. No ODUj data shall be written onto the PJO1 or NJO bytes and data shall be written onto the PJO2 byte. Upon a negative justification action, one extra data byte shall be read once out of the buffer. ODUj data shall be written onto the PJO2, PJO1 and NJO bytes. If no justification action is to be performed, ODUj data shall be written onto the PJO2 and PJO1 bytes and no ODUj data shall be written onto the NJO byte. The OPUk frame that contains the PJO2, PJO1 and NJO bytes depends on the tributary slots occupied by the ODTUjk.

The justification decisions determine the phase error introduced by the function.

ODTUk.M: The data shall be read out of the buffer and written onto groups of M successive bytes of the ODTUk.M payload area under control of the ODUk clock and the GMP data/stuff control mechanism as defined in clause 19.6 of [ITU-T G.709].

Buffer size: In the presence of jitter as specified by [ITU-T G.8251] and a frequency within the range specified in Table 14-2, this mapping process shall not introduce any errors. The maximum buffer hysteresis, and therefore the maximum phase error introduced, shall be as listed in Table 14-F4.

Table 14-F4 – Maximum buffer hysteresis

Mapping	Maximum buffer hysteresis
ODUj → ODTUk.M	4*M bytes
ODUj → ODTUjk	2 bytes (j = 1) 8 bytes (j = 2)

ODTUjk JC: The function shall generate the justification control bits based on the justification decision according to the specification in clause 19.5 of [ITU-T G.709]. It shall insert the justification control bits in bit 7 and 8 of all three JC bytes of the frame in which the justification is performed. The remaining (RES) bits of the JC byte shall be set to all-zero. The ODUk frame that contains the JC bytes depends on the time slot(s) of the ODTUjk.

ODTUk.M JC1/JC2/JC3, JC4/JC5/JC6: The function shall generate the GMP C_m and GMP ΣC_{nD} information and insert this into the JC1/JC2/JC3 and JC4/JC5/JC6 bytes, respectively, according to the specification in clause 19.6 and Annex D of G.709.

The function shall generate the GMP C_m information (without the GMP ΣC_{nD} information) and insert this into the JC1/JC2/JC3 bytes during the GMP special mode as defined in clauses 7.1.2 and 7.2.2 of [ITU-T G.7044].

ODUk-LCK: The function shall generate the ODUk-LCK signal as defined in clause 16.5 of [ITU-T G.709]. The clock, frame start and multiframe start are defined by the incoming ODUk signal.

Selector: The normal signal may be replaced by the ODUk-LCK signal. ODUk-LCK signal is selected if the MI_AdminState is LOCKED.

OPUflex RCOH Receiver: This function shall monitor the OPUflex RCOH overhead and extract BWR_IND signal as defined in clause 6.2.7 of [ITU-T G.7044].

RCOH generator: When MI_INCREASE or MI_DECREASE is true, this process inserts the RP, TSCC, CTRL, TSGS and TPID to in the RCOH fields of the tributary slots identified in the MI_TSMAP.

Common processes

Clock and (multi)frame start signal generation: The function shall generate a local ODUk clock (ODUkP_AI_CK) of "$239/(239 - k) \times 4^{(k-1)} \times 2\,488\,320$ kHz ± 20 ppm" (k=2,3) or "$239/227 \times 40 \times 2\,488\,320$ kHz ± 20 ppm" (k = 4) from a free-running oscillator. The clock parameters, including jitter and wander requirements, as defined in Annex A of [ITU-T G.8251] (ODCa clock), apply.

The function shall generate the (multi)frame start reference signals AI_FS and AI_MFS for the ODUk signal. The AI_FS signal shall be active once per 122 368 clock cycles. AI_MFS shall be active once every 256 frames.

OPU multiframe (OMFI) start signal generation for OPUk with k = 4: For OPU4 in addition to MFAS, a dedicated 80-frame OPU multiframe indicator is used for the multiplexing of LO ODUs into the OPU4. This multiframe structure is locked to bits 2, 3, 4, 5, 6, 7 and 8 of the OMFI byte as shown in Table 19-4 [ITU-T G.709] and to be inserted into the OPU overhead. The function shall generate OPU4 multiframe and the related start signal (OPU4MFS) dividing the frame signal sequence by 80. The OMFI start signal may optionally be phase aligned to the ODU multiframe signal. In this case the OMFI = 0 position is aligned with MFAS = 0 position every 1280 frame periods. See clause 19.4.4 [ITU-T G.709].

Multiplexing: The function assigns the individual ODTUjk or ODTUk.M to specific time slots of the OPUk payload area as defined by the multiplex structure (see clauses 19.3 and 19.4.1 of [ITU-T G.709]).

MSI: The function shall insert the TxMSI[p] into the MSI byte positions of the PSI overhead as defined in clause 19.4.1.4, 19.4.1.5, 19.4.1.6 of [ITU-T G.709]. The TxMSI[p] value, and as such the multiplex structure, is configurable via MI_TxMSI[p]. *During HAO process, TxMSI[p] value should be configured X resizing multiframe prior to re-enabling of the dMSIM[p] detection as defined in clause 14.3.10.2. X shall be three.*

PT: The function shall insert code "0010 0001" (ODU multiplex structure supporting ODTUk.ts or ODTUk.ts and ODTUjk) into the PT byte position of the PSI overhead as defined in clause 15.9.2.1 of [ITU-T G.709] for k = 4.

For k = 2, 3, the inserted PT code shall default to code "0010 0001". This code must be replaced by code "0010 0000" under control of the PT=21-to-PT=20 interworking process described hereafter.

When MI AUTOpayloadtype is activated the function shall adapt a PT21 supporting port to a PT20 structure.

If the corresponding adaptation Sink provides the information of a PT=20 at the RI_ AcPT the function shall fall back to PT=20 under the following conditions: The MI_AUTOpayloadtype is true and the HO ODU source is either not provisioned for any traffic signal structure, or the HO ODU2 source configured for one or more ODU1 signals to be mapped into TS1/TS5 and/or TS2/TS6 and/or TS3/TS7 and/or TS4/TS8, or the HO ODU3 source is configured to support one or more ODU1 signals mapped into TS1/TS17, TS2/TS18, TSi/TS16+I and/or one or more ODU2 signals mapped into TSa/TS16+a/TSb/TS16+b/TSc/TS16+c/TSd/TS16+16 and no other ODU type signals. In this case the function shall insert PT20 into the PSI positions.

The default value of the MI_AUTOpayloadtype activation shall be "true".

Subsequent to a situation when a PT 21 capable port has operated in PT20 mode and afterwards is taken out of service or receives PT21, the port shall fall back to a PT21 structure.

In the case the ODU2 or ODU3 adaptation source is configured for either ODU0, or an ODUflex, or an ODU2e, or for an ODU1 in TSi/TSj with j<>4+i (for ODU2) or j<>16+I (for ODU3) then PT21 is to be inserted. The inserted PT shall be reported at the ODUkP-hao/ODUj-21_A_So_RI_TrPT to the corresponding adaptation sink function and the ODUkP-hao/ODUj-21_A_So_MI_TrPT.

NOTE – The change to PT20 or PT21 means a full adaptation to the related signal structure including the default OH byte insertion.

HAO processes: HAO process includes LCR_Generator and BWR_RELAY _Generator processes.

LCR_Generator: This process is used for LCR protocol adjustment processing and generation of LCR protocol overhead.

Tributary Slot (TS) adjustment activation: When the MI_INCREASE or MI_DECREASE signal's value changes from false to true, the Link Connection Resize (LCR) protocol is activated.

– For the case MI_INCREASE is true and MI_DECREASE is false, the *CTRL* field is set to ADD(01) and the *TSGS* bit is set to NACK(0).

– For the case MI_DECREASE is true and MI_INCREASE is false, the *CTRL* field is set to REMOVE(10) and the *TSGS* bit is set to NACK(0).

– In any other case, the *CTRL* field is set to IDLE(00) and the *TSGS* bit is set to NACK(0).

Table 14-F5 – Significance of the control fields during LCR generator processing

MI_INC	MI_DEC	RMF boundary	CTRL	TSGS
0	0	0	00	NACK
0	0	1	00	NACK
0	1	0	10	NACK
0	1	1	10	NACK
1	0	0	01	NACK
1	0	1	01	NACK
1	1	0	N/A	N/A
1	1	1	N/A	N/A

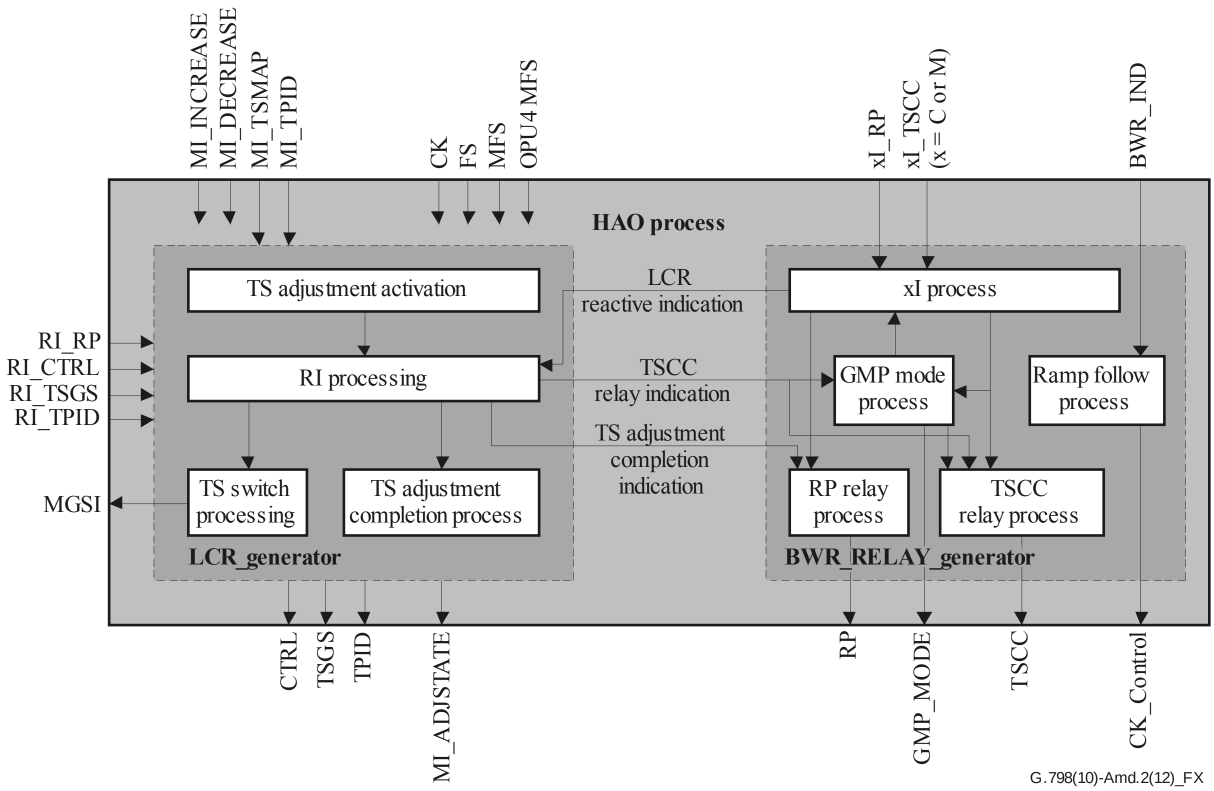


Figure 14-F11 – LCR_Generator and BWR_RELAY_generator processes

Remote Information (RI) processing: This process performs LCR protocol according to RI_RP, RI_CTRL, RI_TSGS, and RI_TPID signals received from the LCR_Receiver process.

Increase case:

– The *TSGS* signal is set to ACK(1) when receiving RI_RP = 1 and RI_CTRL = ADD(01).

– The *TS switch processing* is activated when receiving RI_RP = 1 and RI_CTRL = ADD(01) and RI_TSGS = ACK(1).

– The *TS adjustment completion* process is activated when receiving RI_RP = 1 and RI_CTRL = NORM(11) and RI_TSGS = ACK(1).

– The *TSCC relay indication* signal is generated and sent to the BWR_RELAY_generator process when receiving RI_RP = 1 and RI_CTRL = IDLE(00) and RI_TSGS = NACK(0).

Decrease case:

– The *TSCC relay indication* signal is generated and sent to the BWR_RELAY_generator process and the LCR protocol is put on hold when receiving RI_RP = 1 and RI_CTRL = REMOVE(10)

– The *TSGS* signal is set to ACK(1) when the *LCR reactive indication* signal is valid.

– The *TS switch processing* process is activated when receiving RI_RP = 1 and RI_CTRL = NORM(11) and RI_TSGS = ACK(1)

– The *TS adjustment completion* process is activated when receiving RI_RP = 1 and RI_CTRL = NORM(11) and RI_TSGS = ACK(1)

– The *TS adjustment completion indication* signal is generated and send to the BWR_Generator_Relay process when receiving RI_RP = 1 and RI_CTRL = IDLE(00) and RI_TSGS = NACK(0).

Table 14-F6 – Significance of the control fields during RI processing

RI_RP	RI_TSGS	RI_CTRL	INCREASE	DECREASE
0	0	00		
0	0	01		
0	0	10		
0	0	11		
0	1	00		
0	1	01		
0	1	10		
0	1	11		
1	0	00	*TSCC relay indication*	*TS adjustment completion indication*
1	0	01	TSGS = ACK	
1	0	10		*TSCC relay indication*
1	0	11		
1	1	00		
1	1	01	TSGS = ACK *TS Switch processing*	
1	1	10		*TSCC relay indication* *TS switch processing*
1	1	11	*TS adjustment completion*	*TS adjustment completion*

Output adjustment state signal (*MI_ADJSTATE*).

TS switch processing:

– The *CTRL* signal is set to NORM(11) and the *TSGS* signal is set to ACK(1) when MFAS is 0 (k = 2, 3) or MFAS and OMFI are both 0 (k = 4).

– The *mapping granularity switch indication* (MGSI) signal is generated and send towards the mapping process.

– The related MSI overhead bytes are to be updated according to the renewed TS information at the resize multiframe boundary (see clause 7.1.2 and 7.2.2 of [ITU-T G.7044]).

Table 14-F7 – Significance of the control fields during TS switch processing

TS adjustment completion	**TS switch**	**RMF boundary**	**CTRL**	**TSGS**	**MGSI**
0	0	0			
0	0	1			
0	1	0	FFS	FFS	1
0	1	1	11	ACK	1
1	0	0	FFS	FFS	
1	0	1	00	NACK	
1	1	0	N/A	N/A	1
1	1	1	N/A	N/A	1

TS adjustment completion processing: The *CTRL* signal is set to IDLE and the *TSGS* signal is set to NACK(0) when MFAS is zero (k = 2, 3) or OMFI and MFAS are both zero (k = 4).

BWR_Generator_Relay process: This process forwards the RP signal and TSCC signal of BWR protocol, determines the status of GMP mode and triggers the resize ramp follow mode according to the transition of BWR_IND bit to prevent buffer overflow or underflow in the downstream nodes.

xI process (x=C or M): This process detects the input xI_RP and xI_TSCC from BWR_Generator or BWR_RELAY_receiver.

– In decrease case, the *LCR reactive indication* signal is set to TRUE when xI_RP = 1 and the value of xI_TSCC changes from 1 to 0 and GMP Source is in normal mode.

– In the increase case, this process is not deployed.

GMP Mode process: The *GMP MODE* signal is set to "special mode" when the *TSCC relay indication* signal is True. The *GMP MODE* signal is set to "normal mode" when the value of the xI_TSCC signal changes from 1 to 0.

TSCC Relay process: The value of the xI_TSCC signal is passed-through to the *TSCC signal* when TSCC relay indication signal has the value true and the GMP MODE is set to special mode; otherwise TSCC is zero.

RP Relay process: When MI_INCREASE or MI_DECREASE is true, the RP signal is set to one. The value of xI_RP is passed-through to the RP signal (RP = xI_RP) when TS adjustment completion indication is true; otherwise RP = 1.

Ramp Follow process: This process detects the BWR_IND signal from OPUflex RCOH monitor. Once the process detects the transition of BWR_IND signal from "0" to "1", the ODUflex source shall start ramp follow mode. When the process detects the transition of BWR_IND signal from "1" to "0", the ODUflex source shall stop ramp follow mode as defined in clauses 7.1.1 and 7.2.1 of [ITU-T G.7044]. The CK_control signal is generated and sent to Justification control and JC generation process to control the ODUflex mapping clock.

RES: The function shall insert all-zeros into the RES bytes.

ODUk PM APS: The function shall insert the PI_APS value into the ODUk Path APS/PCC field, which is available once per 8 ODUk frames when MFAS bits 6, 7, 8 are 000.

All other bits of the ODUk overhead should be sourced as "0"s, except the ODUk-PM STAT field which should be set to the value "normal path signal" (001).

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

14.3.13.2 HAO capable ODUkP to ODUj payload type 21 adaptation sink function (HAO capable ODUkP-h/ODUj-21_A_Sk)

The HAO capable ODUkP-hao/ODUj-21_A_Sk function extracts the OPUk overhead (PT, MSI, RES and OMFI) and monitors the reception of the correct payload type. It demultiplexes the individual ODTUjk and ODTUk.M from the payload area of the OPUk and recovers the ODUj signals using the justification control information (JC, JC1/2/3/4/5/6 overhead). It determines the frame and multiframe structure of the ODUj. It provides access to ODUk PM APS Overhead.

The information flow and processing of the HAO capable ODUkP-hao/ODUj-21_A_Sk function is defined with reference to Figures 14-F12 and 14-F13.

Symbol

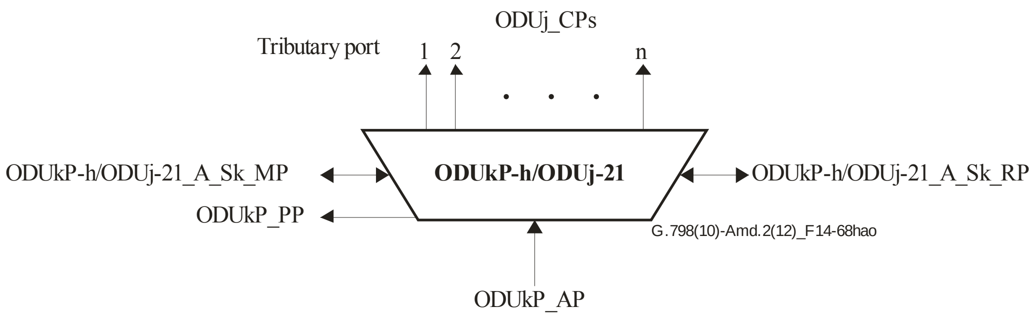


Figure 14-F12 – HAO capable ODUkP-hao/ODUj-21_A_Sk function

Interfaces

Table 14-F8 – ODUkP-hao/ODUj-21_A_Sk inputs and outputs

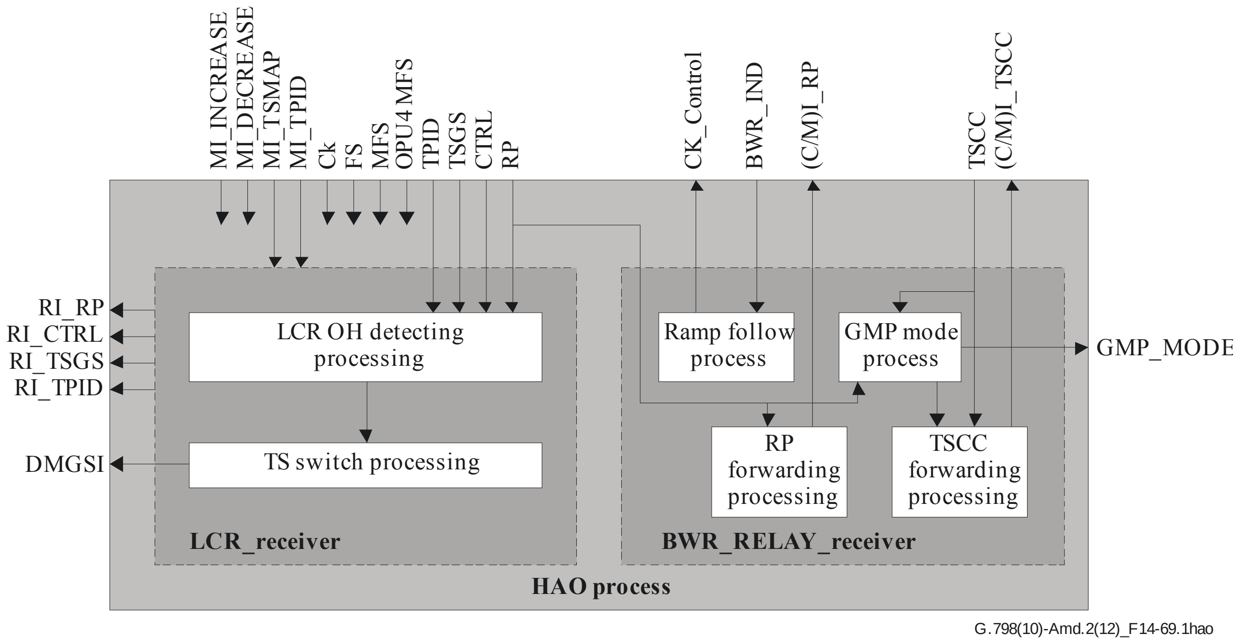
Input(s)	Output(s)
ODUkP_AP: ODUkP_AI_CK ODUkP_AI_D ODUkP_AI_FS ODUkP_AI_MFS ODUkP_AI_TSF ODUkP_AI_TSD **ODUkP**-hao/**ODUj21_A_Sk_MP**: ODUkP-hao/ODUj21_A_Sk_MI_Active ODU3P-hao /ODUj21_A_Sk_MI_ExMSI[p] ODUkP-hao /ODUj-21_A_Sk_MI_AdminState[p] ODUkP-hao /ODUj-21_A_Sk_MI_Nominal_Bitrate_and_Tolerance[p] ODUkP-hao/ODUj-21_A_Sk_MI_INCREASE ODUkP-hao/ODUj-21_A_Sk_MI_DECREASE ODUkP-hao/ODUj-21_A_Sk_MI_TSMAP ODUkP-hao/ODUj-21_A_Sk_MI_TPID **ODUkP**-hao/**ODUj-21_A_Sk_RP**: ODUkP-hao/ODUj-21_A_Sk_RI_TRPT	**n × ODUj_CP**: ODUj_CI_CK ODUj_CI_D ODUj_CI_FS ODUj_CI_MFS ODUj_CI_SSF ODUj_CI_SSD ODUj-21_(C/M)I_RP ODUj-21_(C/M)I_TSCC **ODUk_PP**: ODUk_PI_APS ODUk_PI_TSF ODUk_PI_TSD **ODUkP**-hao/**ODU[i]j_A_Sk_MP**: ODUkP-hao/ODUj-21_A_Sk_MI_cPLM ODUkP-hao/ODUj-21_A_Sk_MI_cLOOMFI ODUkP-hao/ODUj-21_A_Sk_MI_cMSIM[p] ODUkP-hao/ODUj-21_A_Sk_MI_AcPT ODUkP-hao/ODUj-21_A_Sk_MI_AcMSI[p] ODUkP-hao/ODUj-21_A_Sk_MI_cLOFLOM[i] ODUkP-hao/ODUj-21_A_Sk_MI_cRCOHM **ODUkP**-hao/**ODUj-21_A_Sk_RP**: ODUkP-hao/ODUj-21_A_Sk_RI_AcPT ODUkP-hao/ODUj-21_A_Sk_RI_RP ODUkP-hao/ODUj-21_A_Sk_RI_CTRL ODUkP-hao/ODUj-21_A_Sk_RI_TSGS ODUkP-hao/ODUj-21_A_Sk_RI_TPID
NOTE – [p] = [1...n], when doing n × ODUj_CP.	

Processes

Activation

The HAO capable ODUkP-hao/ODUj-21_A_Sk function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

The processes associated with the HAO capable ODUkP-hao/ODUj-21_A_Sk function are specific processes for each ODUj_CP and common processes for the compound (multiplexed) signal as depicted in Figure 14-F13.



NOTE – [p] = [1...n], when doing n × ODUj_CP.

Figure 14-F13 – ODUkP-hao/ODUj-21_A_Sk processes

Common processes

OPU multiframe (OMFI) reception for OPUk with k = 4: For OPU4 in addition to MFAS, a dedicated 80-frame OPU multiframe indicator is used for the multiplexing of LO ODUs into the OPU4. This multiframe structure is locked to bits 2, 3, 4, 5, 6, 7 and 8 of the OMFI byte as shown in Table 19-4 of [ITU-T G.709]. The function shall detect OPU multiframe by searching for the framing pattern in the bits indicated above. The process has two states, out-of-multiframe (OOM) and in-multiframe (IM). The IM state shall be entered if this set is found and confirmed one frame period later and an error free multiframe sequence is found in the byte positions of the two frames. In the IM state, the frame alignment signal shall be continuously checked with the presumed OMFI frame start position and the expected multiframe sequence. The OOM state shall be entered if this subset is not found at the correct position in 5 consecutive frames or the received OMFI does not match with the expected multiframe number in 5 consecutive frames. The OPU4 multiframe start (OPU4MFS) shall be maintained during the OOM state of the OMFI detection process. The defect dLOOMFI shall be generated based on the state of the OMFI alignment process.

If the OMFI alignment process is persistently in the out-of-multiframe (OOM) state for 3 ms, dLOOMFI shall be declared. dLOOMFI shall be cleared immediately when the OMFI alignment process is in the in-multiframe (IM) state

PT: The function shall extract the PT byte from the PSI overhead as defined in clause 8.7.1. The accepted PT value is available at the MP (MI_AcPT) and is used for PLM defect detection. The accepted PT is provisioned to the RP (RI_AcPT) for automatic PT adaptation. The PLM detection shall be based on the comparison of the accepted PT with the provided PT on the RP at the RI_TrPT input.

MSI: The function shall extract the MSI from the PSI overhead as defined in clause 8.7.2. The accepted MSI for a tributary signal #~~i~~ p (AcMSI[~~i~~p]) is available at the MP (MI_AcMSI[~~i~~p]).,The multiplex structure is defined by ExMSI[p], which is either fixed or is configurable via MI_ExMSI[p]. During HAO process, ExMSI [p] updates should be configured at the resizing multiframe boundary with signals [NORM, (TPID#), ACK].

RES: The value in the RES bytes shall be ignored.

ODUk PM APS: The function shall extract the information from the ODUk Path APS/PCC field, which is available once per 8 ODUk frames when MFAS bits 6, 7, 8 are 000 and apply this to the PI_APS.

Demultiplexing: The function activates the ODTUjk or ODTUk.M and assigns the time slots of the ODUk payload area to the individual ODTUjk or ODTUk.M as defined by the multiplex structure (see clauses 19.3 and 19.4.1 of [ITU-T G.709]) and clauses 7.1 and 7.2 of [ITU-T G.7044]).

Specific processes

The specific processes are performed independently for each ODUj client signal that is multiplexed into the OPUk. The specific processes recover the ODUj from the ODTUjk or ODTUk.M.

Two justification methods as described below are provided, AMP (*ODTUjk*) and GMP (*ODTUk.M)*. The ODU type and rate, as configured via the ODUkP-hao/ODUj-21 A-So_MI_ODUType_Rate[i] input for the related trib port, determine the mapping method and, in the case of GMP mapping, the base value and ranges for the parameters C_n and C_m.

ODTUjk JC: The function shall interpret the justification control information in bit 7 and 8 of the JC bytes as defined in clause 19.5 of [ITU-T G.709] in order to determine the justification action (double positive, positive, negative, none) for the current frame. A 2 out of 3 majority decision is used. RES bits in the JC bytes shall be ignored. The ODUk frame that contains the JC bytes depends on the time slot(s) of the ODTUjk.

ODTUk.ts JC1/2/3 and JC4/5/6: The function shall interpret the GMP overhead information in the JC1/2/3 and JC4/5/6 bytes as defined in clause 19.6 of [ITU-T G.709] and in clauses 7.1.2 and 7.2.2 of [ITU-T G.7044] in order to determine the number of M-byte ODUj entities in the next ODTUk.M multiframe. The OPUk frame that contains the JC1/2/3 and JC4/5/6 bytes depends on the last tributary slot that is occupied by the ODTUk.M.

Demapping, CBR clock generation: The function shall provide an elastic store (buffer) process.

ODTUjk: The ODUj data shall be written into the buffer from the D, NJO, PJO1 and PJO2 bytes in the ODTUjk frame. The information extraction of the PJO2, PJO1 and NJO bytes shall be under control of the justification control information.

Upon a double positive justification action, the writing of two data bytes into the buffer shall be cancelled once. No ODUj data shall be read from the PJO2, PJO1 or NJO bytes. Upon a positive justification action, the writing of one data byte into the buffer shall be cancelled once. No ODUj data shall be read from the PJO1 or NJO bytes and data shall be read from the PJO2 byte. Upon a negative justification action, one extra data byte shall be written into the buffer once. ODUj data shall be read from the PJO2, PJO1 and NJO bytes. If no justification action is to be performed, ODUj data shall be read from the PJO2 and PJO1 bytes and no ODUj data shall be read from the NJO bytes. The OPUk frame that contains the PJO2, PJO1 and NJO bytes depends on the tributary slots occupied by the ODTUjk.

ODTUk.M: The ODUj data shall be extracted from the groups of M successive bytes of the ODTUk.M payload area under control of the GMP data/stuff control mechanism as defined in clause 19.6 of [ITU-T G.709] and clauses 7.1 and 7.2 of [ITU-T G.7044] and be written into the buffer. The C_n information associated with the ODUj is computed from the GMP C_m and ΣC_{nD} parameters carried within the JC1/2/3 and JC 4/5/6 overhead of the ODTUk.M as specified in clause 19.6 of [ITU-T G.709]. For the GMP data/stuff control mechanism refer to Annex D of [ITU-T G.709].

The ODUj data (CI_D) shall be read out of the buffer under control of the ODUj clock (CI_CK).

Smoothing and jitter limiting process: The function shall provide for a clock smoothing and elastic store (buffer) process. The ODUj data signal shall be written into the buffer under control of the associated (gapped) OPUk input clock (with a frequency accuracy within ± 20 ppm). The data signal shall be read out of the buffer under control of a smoothed (equally spaced) ODUj clock (the rate is determined by the ODUj signal at the input of the remote ODUkP-hao/ODUj-21_A_So).

The clock parameters, including jitter and wander requirements, as defined in Annex A of [ITU-T G.8251] (ODCp clock), apply.

Buffer size: In the presence of jitter as specified by [ITU-T G.8251] and a frequency within the tolerance range specified for the ODUj signal in Table 14-2, this justification process shall not introduce any errors.

Following a step in frequency of the ODUj signal transported (for example, due to reception of ODUj_CI from a new ODUj_TT_So at the far end or removal of a ODUj-AIS signal with a frequency offset), there will be a maximum recovery time of X seconds after which this process shall not generate any bit errors. The value of X is for further study; a value of one second has been proposed.

RCOH receiver: When MI_INCREASE or MI_DECREASE is True, this process extracts RP, TSCC, CTRL, TPID and TSGS signals from RCOH overhead for the set of M tributary slots configured via MI_TSMAP. The values of the RCOH fields for each of the TS in TSMAP are compared. If the values are the same and the received TPID value matches the MI_TPID, those values are forwarded to the HAO process. If the values are not the same, a RCOH Mismatch defect (dRCOHM) is detected. When MI_INCREASE or MI_DECREASE is False, this process is disabled and RP, TSCC, CTRL, TPID and TSGS signals are all set to 0.

OPUflex RCOH Receiver: This function shall monitor the OPUflex RCOH overhead and extract BWR_IND signal as defined in clause 6.2.7 of [ITU-T G.7044].

Frame and multiframe alignment: The function shall perform frame and multiframe alignment as described in clause 8.2.3.

ODUj-LCK, ODUj-AIS: The function shall generate the ODUj-LCK and ODUj-AIS signals as defined in [ITU-T G.709]. The clock, frame start and multiframes start shall be independent from the incoming clock. The clock has to be within the ODUj frequency tolerance range as specified in Table 14-2 provisioned by the MI_Nominal_Bitrate_and_Tolerance from a free-running oscillator. Jitter and wander requirements, as defined in Annex A of [ITU-T G.8251] (ODCa clock), apply.

Selector: The normal signal may be replaced by the ODUj-AIS. ODUj-AIS is selected if aAIS is true.

HAO processes

HAO process includes LCR_Receiver and BWR_RELAY_Receiver process.

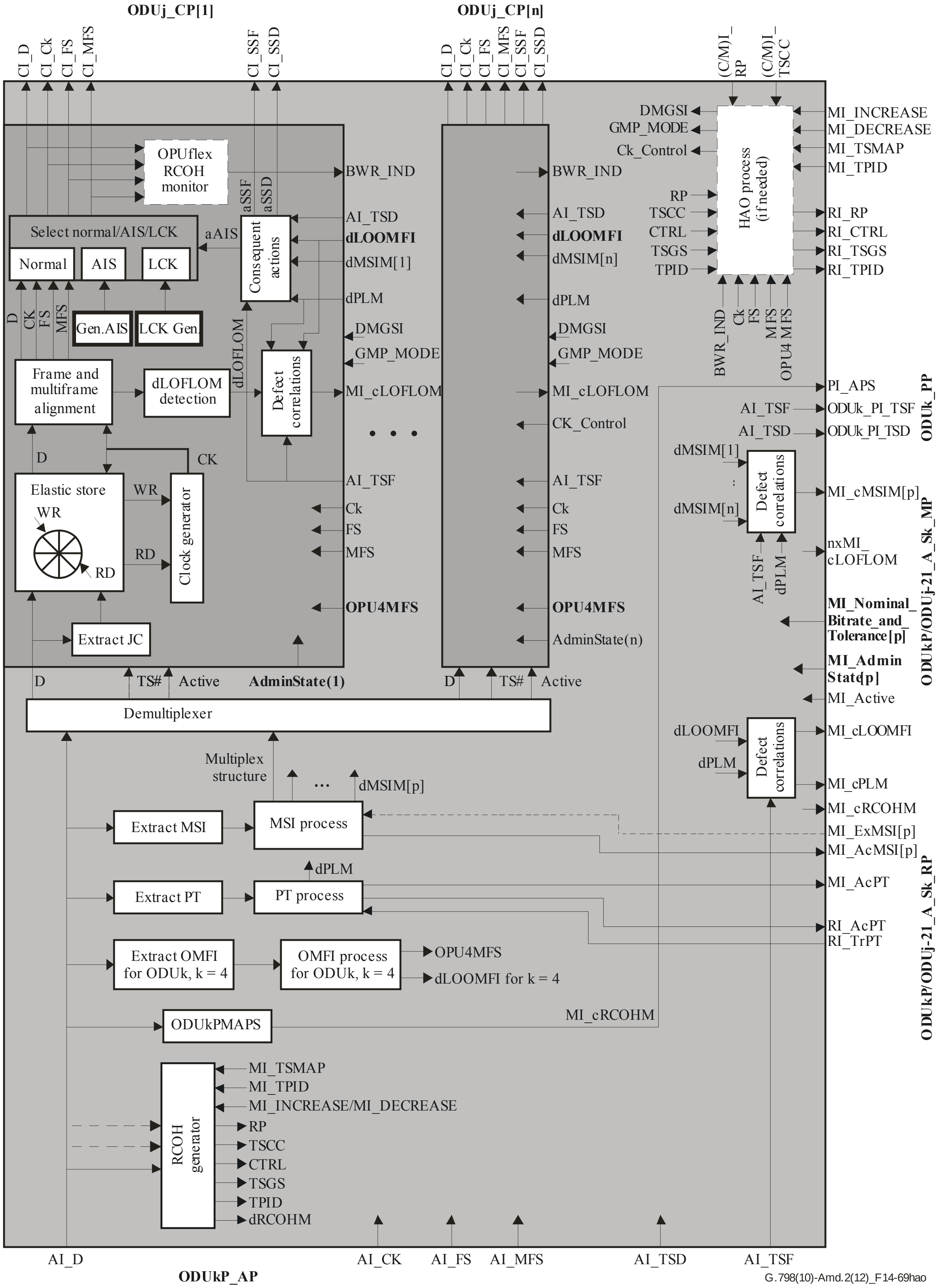


Figure 14-F14 – LCR_Receiver and BWR_Receiver_Relay processes

LCR_Receiver: This process completes the receiving LCR protocol. It contains the following sub-processes:

LCR OH detecting processing: When MI_INCREASE or MI_DECREASE is True, LCR protocol would be activated and RCOH information (RP, CTRL, TPID, TSGS) would be detected. This information is then sent to LCR_Generator.

TS switch processing: When CTRL is detected as NORM, *demapping granularity switch indication* (DMGSI) signal would be generated towards demapping processing.

BWR_Receiver_Relay: This process forwards the RP signal and TSCC signal of BWR protocol, determines the status of GMP mode and triggers the resize ramp follow mode according to the transition of BWR_IND bit to prevent buffer overflow or underflow in the downstream nodes. It contains the following sub-processes:

GMP mode process: Change of TSCC from 0 to 1 is used to trigger GMP process into special mode. Change of *TSCC from 1 to 0* is used to trigger GMP process into normal mode.

TSCC forwarding process: Passes-through TSCC = 1 when *GMP process is set into special mode*, that is (C/M)I_TSCC = TSCC(1). Passes-through TSCC = 0 when *GMP have also be set into normal mode*, that is (C/M)I_TSCC = TSCC(0). The initial value of CI_TSCC is zero.

RP forwarding process: RP is passed-through to either a BWR_RELAY_Generator process or a BWR_Receiver process ((C/M)I_RP = RP).

Ramp Follow process: This process detects the BWR_IND signal from OPUflex RCOH monitor. Once the process detects the transition of BWR_IND signal from "0" to "1", the ODUflex source shall start ramp follow mode. When the process detects the transition of BWR_IND signal from "1" to "0", the ODUflex source shall stop ramp follow mode as defined in clauses 7.1.1 and 7.2.1 of [ITU-T G.7044]. The CK_control signal is generated and sent to Clock Generator process to control the ODUflex demapping clock.

Defects

The function shall detect for dPLM, dMSIM, dLOOMFI and dLOFLOM.

dPLM: See clause 6.2.4.1. The expected payload type is "0010 0001" (ODU multiplex structure supporting ODTUk.ts or ODTUk.ts and ODTUjk) as defined in [ITU-T G.709].

dLOOMFI: dLOOMFI is detected per OPUk with k = 4. See the OPU multiframe (OMFI) detection process for OPUk with k = 4**.**

dMSIM: See clause 6.2.9.1. dMSIM[p] is detected per active ODUj. During HAO process, the detection of dMSIM[p] is disabled at the next resize multiframe boundary after receiving of RP = 1 as defined in clause 6.2.6 of [ITU-T G.7044]. The detection of dMSIM[p] is enabled at the next resize multiframe boundary after receiving of RP = 0 as defined in clause 6.2.6 of [ITU-T G.7044].

dLOFLOM[i]: See clause 6.2.5.3. dLOFLOM is detected per active ODUj.

dRCOHM: RCOH mismatch defect. The value of the RCOH fields for each of the TS in TSMAP are compared. If the values are not the same, a RCOH Mismatch defect (dRCOHM) is raised. If the values are the same and the received TPID value matches the MI_TPID, those values are forwarded to the HAO process and the dRCOHM is cleared.

Consequent actions

PI_TSF ← AI_TSF

PI_TSD ← AI_TSD

For each ODUj tributary port #p:

aSSF[p] ← ((AI_TSF or dPLM or dLOOMFI or dMSIM[p] or dLOFLOM[p]) and (not MI_AdminState[p]= LOCKED)) or (not Active)

For each ODUj tributary port #p:

aSSD[p] ← AI_TSD and (not MI_AdminState[p] = LOCKED)

For each ODUj tributary port #p:

aAIS[p] ← ((AI_TSF or dPLM or dMSIM[p] or dLOOMFI or dLOFLOM[p]) and (not MI_AdminState[p] = LOCKED)) or (not Active)

NOTE – The state of the determination process of the C_m and its contribution to AIS consequent action is FFS.

On declaration of aAIS the function shall output an all-ONEs pattern/signal within 2 frames. On clearing of aAIS the all-ones pattern/signal shall be removed within two frames, with normal data being output. The AIS clock, frame start and multiframe start shall be independent from the incoming clock, frame start and multiframe start. The clock has to be within the ODUj frequency tolerance range as specified in Table 14-2 provisioned by the MI_Nominal_Bitrate_and_Tolerance from a free-running oscillator. Jitter and wander requirements, as defined in Annex A of [ITU-T G.8251] (ODCa clock), apply.

Defect correlations

cPLM ← dPLM and (not AI_TSF)

For ODUk with k=4

cLOOMFI ← dLOOMFI and (not AI_TSF)

For each ODUj tributary port #p:

cMSIM[p] ← dMSIM[p] and (not dPLM) and (not dLOOMFI) and (not AI_TSF)

For each ODUj tributary port #p:

cLOFLOM[p] ← dLOFLOM[p] and (not dLOOMFI) and (not dPLM) and (not AI_TSF) and (Active)

cRCOHM ← dRCOHM and (not AI_TSF)

2.14) Modifications to clause 14.5.1.1.1, ODUkT trail termination source function (ODUkT_TT_So)

Modify the text of the last item of the processes list as shown below:

~~PMOH~~TCMOH-DMti: If TCMCI_Mode is OPERATIONAL and if MI_DM_Source is false, then the value of the DMti bit is determined by the RI_DM. If MI_DM_Source is True, then the value of the DMti bit is set to MI_DMValue.

NOTE – Equipment developed prior to the 2010 version of this Recommendation will not support the DMti processing.

2.15) Modifications to clause 14.5.1.1.2, ODUkT trail termination sink function (ODUkT_TT_Sk)

Add the following text after the STAT byte process item of the processes list (TCMOH-STAT):

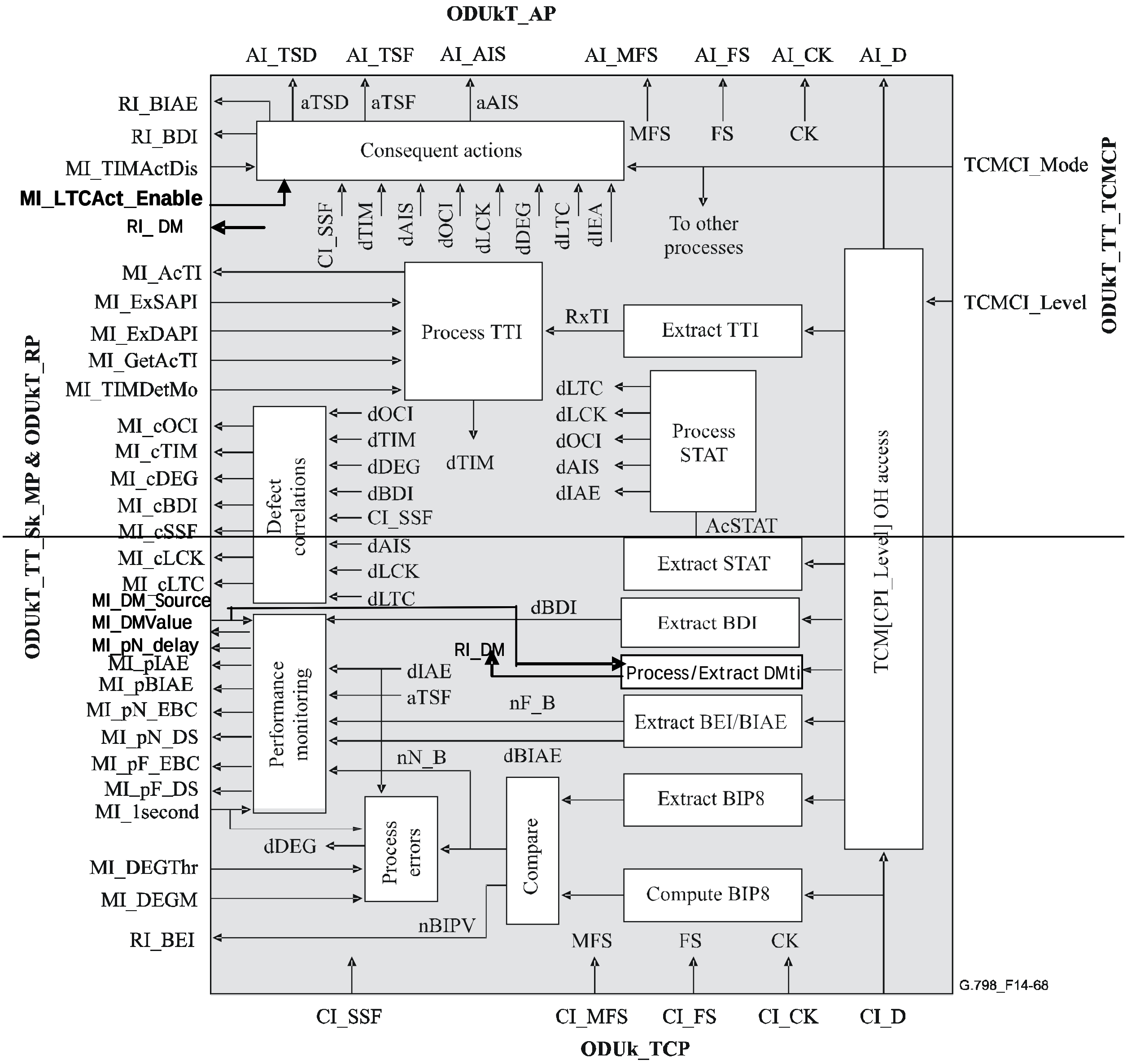
NOTE – During an incoming frame jump events of the TCM trail, transient defects may trigger cases that wrong bytes are read and accepted under particular conditions for STAT byte processing. Those wrong bytes may lead to transient consequent actions which are neither visible in alarming (due to F4 filtering) nor in performance monitoring (due to the use of the IAE defect to suppress wrong PM data (EBC and DS)). Such possible transient consequent action could also lead to cases where a high number of subsequent NEs could be affected by the frame jump in such TCM trails (for example triggering a protection switch). The classical defined means to overcome such switch on transient defect conditions is the use of an appropriate hold-off time.

Modify the text of the last item of the processes list as shown below:

TCMOH-DMti: If the TCMCI_Mode has the value OPERATIONAL and if MI_DM_Source is false, then the value of the DMti bit is output to RI_DM. If MI_DM_Source is true and MI_DMValue toggles, then a count of CI_FS transitions is started and the incoming DMti value (RxDMti) is monitored. A change of value of RxDMti, from (NOT MI_DMValue) to MI_DMValue, validated by a 3-frame persistency check, stops the counting. The delay frame count (nN_delay) is represented by the count minus the persistency check ~~and is ouput as MI_pN_delay~~.

NOTE – Equipment developed prior to the 2010 version of this Recommendation will not support the DMti processing.

Modify Figure 14-85 – ODUkT_TT_Sk processes as shown below:



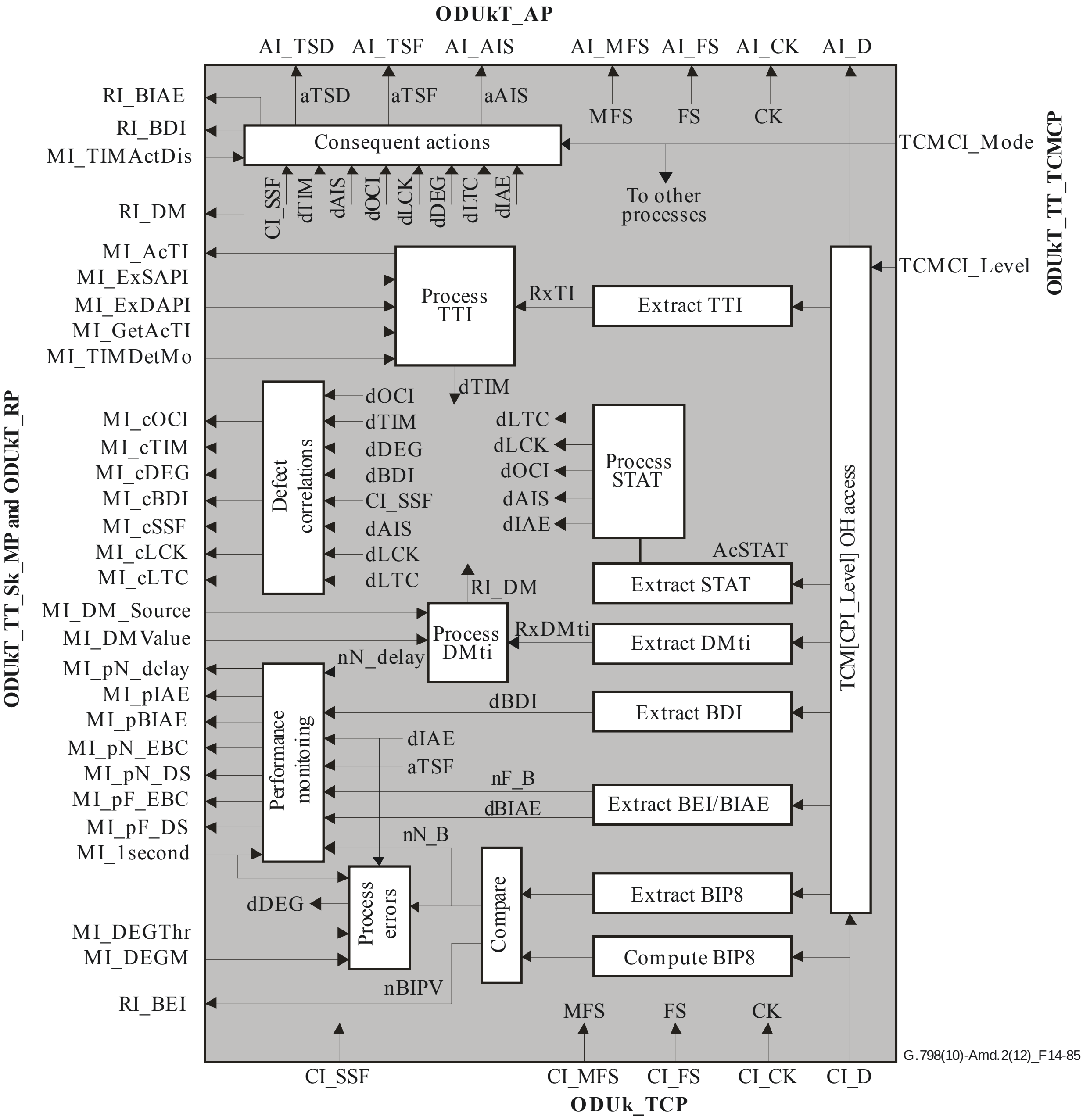


Figure 14-85 – ODUkT_TT_Sk processes

Introduce additions to the Performance monitoring paragraph as shown below:

Performance monitoring

If the TCMCI_Mode has the value OPERATIONAL or MONITOR, the function shall perform the following performance monitoring primitives processing (see clause 6.5 of [ITU-T G.806]). The performance monitoring primitives shall be reported to the EMF.

pN_DS ← CI_SSF or dAIS or dLTC or dOCI or dLCK or dTIM

pF_DS ← dBDI

pN_EBC ← $\sum$ nN_B

NOTE ~~2~~ 1 – During CI_SSF, dAIS, dLTC, dLCK and dOCI, no errored blocks shall be counted.

pF_EBC ← $\sum$ nF_B

NOTE ~~3~~ 2 – During CI_SSF, dAIS, dLTC, dLCK and dOCI, no errored blocks shall be counted.

pBIAE ← dBIAE

NOTE ~~4~~ 3 – pBIAE is activated at the end of a second if dBIAE was active once during the second.

pIAE ← dIAE

NOTE ~~5~~ 4 – pIAE is activated at the end of a second if dIAE was active once during the second.

NOTE ~~6~~ 5 – pIAE and pBIAE are used for the suppression of the PM data in the equipment management functions (see [ITU-T G.874]). If pBIAE is active, the F_DS and F_EBC values of the previous and current second have to be discarded (EBC = 0 and DS = false). If pIAE is active, the N/F_DS and N/F_EBC values of the previous and current second have to be discarded (EBC = 0 and DS = false). The previous second has to be included due to the delay of the IAE information coming from the remote source.

pN_delay ← nN_delay (∑ number of frames ~~since~~ between DMValue toggle event and the received DMp signal value toggle event)

NOTE ~~7~~ 6 – This count is triggered by the ODUkP_TT_S~~o~~k_MI_DMValue toggle event, which is equal to the ODUkP_TT_So_MI_DMValue toggle event.

NOTE ~~8~~ 7 – This value is a snapshot value.

2.16) Modifications to clause 14.5.1.3, ODUkT TCM control functions (ODUkT_TCMC)

Add new entry to Table 14-47 as shown below

Table 14-47 – ODUkT_TCMCm inputs and outputs

Input(s)	Output(s)
ODUkT_TCMCm_MP: ODUkT_TCMCm_MI_Level ODUkT_TCMCm_MI_ModeSo ODUkT_TCMCm_MI_ModeSk ODUkT_TCMCm_MI_TCM_Extension **ODUkT/ODUk_A_So_TCMCP**: ODUkT/ODUk_A_So_TCMCI_AcSTAT[1..6] **ODUkT/ODUk_A_Sk_TCMCP**: ODUkT/ODUk_A_Sk_TCMCI_AcSTAT[1..6]	**ODUkT_TCMCm_MP**: ODUkT_TCMCm_MI_AcSTATSo[1..6] ODUkT_TCMCm_MI_AcSTATSk[1..6] **ODUkT/ODUk_A_So_TCMCP**: ODUkT/ODUk_A_So_TCMCI_Mode ODUkT/ODUk_A_So_TCMCI_Level ODUkT/ODUk_A_So_TCMCI_ACTEn **ODUkT/ODUk_A_Sk_TCMCP**: ODUkT/ODUk_A_Sk_TCMCI_Mode ODUkT/ODUk_A_Sk_TCMCI_Level ODUkT/ODUk_A_Sk_TCMCI_ACTEn **ODUkT_TT_So_TCMCP**: ODUkT_TT_So_TCMCI_Mode ODUkT_TT_So_TCMCI_Level **ODUkT_TT_Sk_TCMCP**: ODUkT_TT_Sk_TCMCI_Mode ODUkT_TT_Sk_TCMCI_Level

Add new text to the processes descriptions as shown below:

Processes

The processes associated with the ODUkT_TCMCm function are as depicted in Figure 14-95.

As the TCM ACT bytes are not used, TCMCI_ACTEn for sink and source is fixed set to "false".

The TCM level is provided by the management via MI_Level and distributed to sink and source termination and adaptation functions.

The mode is provided independently for sink and source by the management (MI_ModeSo and MI_ModeSk).

The sink and source TCM status of all 6 levels is provided to the management (MI_AcSTATSo[1..6] and MI_AcSTATSk[1..6]).

TCM information forwarding and erasing.: The TCM information can be forwarded or erased for continuing TCM information into sections after the end of TCM section and the related ODUkT_TT_Sk function. With the MI_TCM_Extension control that can take three values: normal, pass-through, or erase, this function is controlled to either terminate the TCM Information or let it continue or erase. The default of the MI_TCM_Extension must be set to "Normal".

NOTE – Equipment designed to earlier versions of [ITU-T G.798] does not provide the MI_TCM_Extension and will always behave as configured "Normal".

Replace Figure 14-95 with the following:

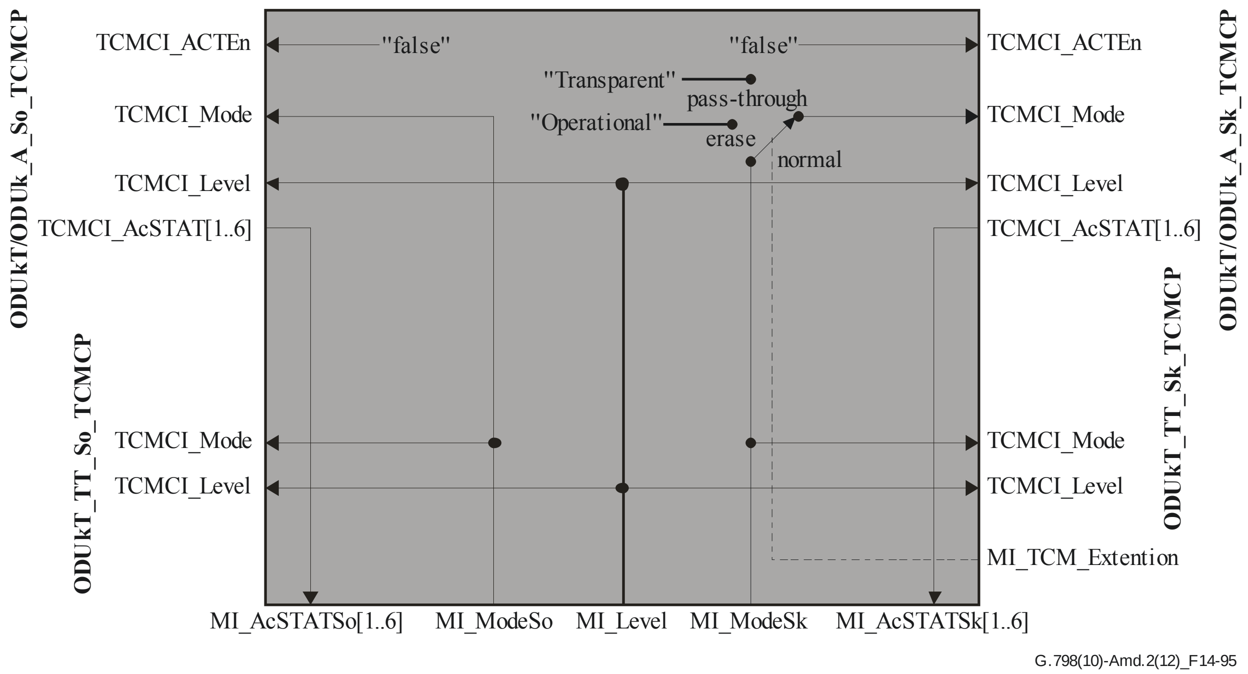


Figure 14-95 – ODUkT_TCMCm processes

2.17) Modifications to the Bibliography

Add the following entry to the Bibliography:

[b-ANSI INCITS 296] ANSI INCITS 296-1997, *Single-Byte Command Code Sets CONnection (SBCON) Architecture* (formerly ANSI X3.296-1997).

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2013