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This draft provides the latest draft G.8121.1 (v.2.11) that updates TD55/3.

Document history:

Version	Date	Description
2.00	2016/04	- G.8121.1/Y.1381.1 (04/2016) in-force version
2.1	2017/04 (TD55/3)	Containing; - G.8121.1/Y.1381.1 (04/2016) in-force version - Cor1 to G.8121.1 (11/2016)
2.11	2018/02 (This draft)	Update CSF Insertion/Extract process and MT/ETH_A per C.464 and C.723. (See WD10-06r1 as well)

International Telecommunication Union

ITU-T G.8121.1/Y.1381.1

(2/2018)

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Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.1/Y.1372.1 OAM mechanisms

Editor draft

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Recommendation ITU-T G.8121.1/Y.1381.1

Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.1/Y.1372.1 OAM mechanisms

+ Corrigendum 1

Summary

Recommendation ITU-T G.8121.1/Y.1381.1 specifies both the functional components and the methodology that should be used in order to specify multi-protocol label switching – transport profile (MPLS-TP) layer network functionality of network elements based on the protocol neutral constructs defined in Recommendation ITU-T G.8121 and on the tools defined in Recommendation ITU-T G.8113.1/Y.1372.1.

Corrigendum 1:

– Clarifies the configuration of MI_CC_Enable and MI_CVp_Enable

– Adds missing "OAM_Tool" MIs for AIS and LCK at MT_TT_Sk

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8121.1/Y.1381.1	2013-11-06	15	11.1002/1000/12019
2.0	ITU-T G.8121.1/Y.1381.1	2016-04-13	15	11.1002/1000/12805
2.1	ITU-T G.8121.1/Y.1381.1 (2016) Cor. 1	2016-11-13	15	11.1002/1000/13101

Keywords

Atomic functions, equipment functional blocks, MPLS-TP layer network, MPLS-TP, OAM, PTN.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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Recommendation ITU-T G.8121.1/Y.1381.1

Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.1/Y.1372.1 OAM mechanisms

+ Corrigendum 1

1 Scope

This Recommendation describes both the functional components and the methodology that should be used in order to describe multi-protocol label switching – transport profile (MPLS-TP) layer network functionality of network elements; it does not describe individual MPLS-TP network equipment as such.

This Recommendation provides protocol-specific extensions of the protocol-neutral constructs defined in [ITU-T G.8121] to support the operation, administration and maintenance (OAM) tools defined in [ITU-T G.8113.1].

This Recommendation provides a description of the MPLS-TP functional technology using the same methodologies that have been used for other transport technologies [e.g., synchronous digital hierarchy (SDH), optical transport network (OTN) and Ethernet].

This Recommendation forms part of a suite of Recommendations covering the full functionality of network equipment. In addition to this Recommendation, these Recommendations are [ITU-T G.806], [ITU-T G.8121], [ITU-T G.798], [ITU-T G.783], [ITU-T G.705] and [ITU-T G.8021]. This Recommendation also follows the principles defined in [ITU-T G.805].

These Recommendations specify a library of basic building blocks and a set of rules by which they may be combined in order to describe digital transmission equipment. The library comprises the functional building blocks needed to specify completely the generic functional structure of the MPLS-TP layer network. In order to be compliant with this Recommendation, equipment needs to be describable as an interconnection of a subset of these functional blocks contained within this Recommendation. The interconnections of these blocks should obey the combination rules given.

Not every atomic function defined in this Recommendation is required for every application. Different subsets of atomic functions may be assembled in different ways according to the combination rules given in this Recommendation to provide a variety of different capabilities. Network operators and equipment suppliers may choose which functions must be implemented for each application.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.705] Recommendation ITU-T G.705 (2000), *Characteristics of plesiochronous digital hierarchy (PDH) equipment functional blocks*.

[ITU-T G.783] Recommendation ITU-T G.783 (2006), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.

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

[ITU-T G.805] Recommendation ITU-T G.805 (2000), *Generic functional architecture of transport networks.*

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

[ITU-T G.8021] Recommendation ITU-T G.8021/Y.1341 (2015), *Characteristics of Ethernet transport network equipment functional blocks.*

[ITU-T G.8101] Recommendation ITU-T G.8101/Y.1355 (2015), *Terms and definitions for MPLS transport profile.*

[ITU-T G.8113.1] Recommendation ITU-T G.8113.1/Y.1372.1 (2016), *Operations, administration and maintenance mechanisms for MPLS-TP in packet transport networks*.

[ITU-T G.8121] Recommendation ITU-T G.8121/Y.1381 (2016), *Characteristics of MPLS-TP equipment functional blocks.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 access point [ITU-T G.805].

3.1.2 adapted information [ITU-T G.805].

3.1.3 associated channel header [ITU-T G.8101].

3.1.4 bottom of stack [ITU-T G.8101].

3.1.5 characteristic information [ITU-T G.805].

3.1.6 client/server relationship [ITU-T G.805].

3.1.7 connection [ITU-T G.805].

3.1.8 connection point [ITU-T G.805].

3.1.9 G-ACh label [ITU-T G.8101].

3.1.10 generic associated channel [ITU-T G.8101].

3.1.11 label [ITU-T G.8101].

3.1.12 label stack [ITU-T G.8101].

3.1.13 label switched path [ITU-T G.8101].

3.1.14 label value [ITU-T G.8101].

3.1.15 layer network [ITU-T G.805].

3.1.16 MPLS label stack [ITU-T G.8101].

3.1.17 network [ITU-T G.805].

3.1.18 network connection [ITU-T G.805].

3.1.19 per-hop behaviour [ITU-T G.8101].

3.1.20 reference point [ITU-T G.805].

3.1.21 subnetwork [ITU-T G.805].

3.1.22 subnetwork connection [ITU-T G.805].

3.1.23 termination connection point [ITU-T G.805].

3.1.24 time to live [ITU-T G.8101].

3.1.25 traffic class [ITU-T G.8101].

3.1.26 trail [ITU-T G.805].

3.1.27 trail termination [ITU-T G.805].

3.1.28 transport [ITU-T G.805].

3.1.29 transport entity [ITU-T G.805].

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AI	Adapted Information
AIS	Alarm Indication Signal
AP	Access Point
APS	Automatic Protection Switching
CC	Continuity Check
CC/CV	Continuity Check and Connectivity Verification
CCM	Continuity Check Message
CI	Characteristic Information
CoS	Class of Service
CP	Connection Point
CSF	Client Signal Fail
CV	Connectivity Verification
CW	Control Word
DM	Delay Measurement
DP	Drop Precedence
G-ACh	Generic Associated Channel
GAL	G-ACh Label
GFP-F	Frame-mapped Generic Framing Procedure

LBM	Loopback Message
LBR	Loopback Reply
LCK	Locked
LM	Loss Measurement
LMM	Loss Measurement Message
LMR	Loss Measurement Reply
LStack	Label Stack
MCC	Maintenance Communication Channel
MEG	Maintenance Entity Group (New)
MEP	Maintenance entity group (MEG) End Point
MIP	Maintenance entity group (MEG) Intermediate Point
MP	Management Point
MPLS-TP	Multi-Protocol Label Switching – Transport Profile
MT	Multi-Protocol Label Switching – Transport Profile
MTDe	MPLS-TP MEP Diagnostic function
MTDi	MPLS-TP MIP Diagnostic function
OAM	Operation, Administration and Maintenance
OTN	Optical Transport Network
PDU	Protocol Data Unit
PHB	Per-Hop Behaviour
PM	Performance Monitoring
PSC	PHB Scheduling Class
RDI	Remote Detect Indication
RI	Remote Information
RP	Remote Point
RT	Route Tracing
SCC	Signalling Communication Channel
SDH	Synchronous Digital Hierarchy
SSF	Server Signal Fail
TCP	Termination Connection Point
TH	Throughput
TLV	Type-Length-Value
TSD	Trail Signal Degrade
TSF	Trail Signal Fail
TTL	Time-To-Live

5 Conventions

The diagrammatic convention for connection-oriented layer networks described in this Recommendation is that of [ITU-T G.805].

In this Recommendation, MI_LMC_Enable and MI_LML_Enable are used to mean MI_1LMp_Enable and MI_LMp_Enable as described in [ITU-T G.8121].

6 Supervision

The generic supervision functions are defined in clause 6 of [ITU-T G.806]. Protocol neutral supervision functions for the MPLS-TP network are defined in clause 6 of [ITU-T G.8121]. Specific supervision functions for the MPLS-TP network are defined in this clause.

6.1 Defects

The defect Entry and Exit conditions are based on events. Occurrence or absence of specific events may raise or reset specific defects.

The events used by this recommendation are defined in Table 6-1 of [ITU-T G.8121].

6.2 Consequent actions

For generic consequent actions, see [ITU-T G.806]. For the specific consequent actions applicable to MPLS-TP, refer the specific atomic functions.

6.3 Defect correlations

For the defect correlations, see the specific atomic functions.

6.4 Performance filters

For further study.

7 Information flow across reference points

Information flow for MPLS-TP functions is defined in clause 9. A generic description of information flow is defined in clause 7 of [ITU-T G.806].

8 MPLS-TP processes

8.1 G-ACh Process

See clause 8.1 of [ITU-T G.8121].

8.2 TC/Label processes

See clause 8.2 of [ITU-T G.8121].

8.3 Queuing process

See clause 8.3 of [ITU-T G.8121].

8.4 MPLS-TP-specific GFP-F processes

See clause 8.4 of [ITU-T G.8121].

8.5 Control word (CW) processes

See clause 8.5 of [ITU-T G.8121].

8.6 OAM related Processes used by Server adaptation functions

8.6.1 Selector Process

See clause 8.6.1 of [ITU-T G.8121].

8.6.2 AIS (alarm indication signal) Insert Process

Figure 8-1 shows the AIS Insert Process Symbol as shown in Figure 8-13 of [ITU-T G.8121] and Figure 8-2 defines the behaviour. If the aAIS signal is true, the AIS Insert Process continuously generates MT_CI traffic units where the MT_CI_D signal contains the AIS signal until the aAIS signal is false. The generated AIS traffic units are inserted in the incoming stream, i.e., the output stream contains the incoming traffic units and the generated AIS traffic units.

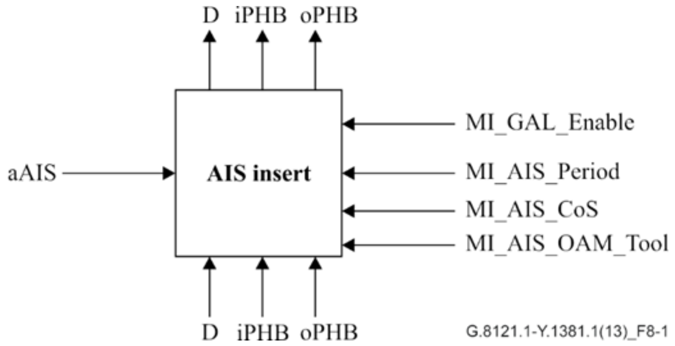

Figure 8-1 – Alarm indication signal Insert process

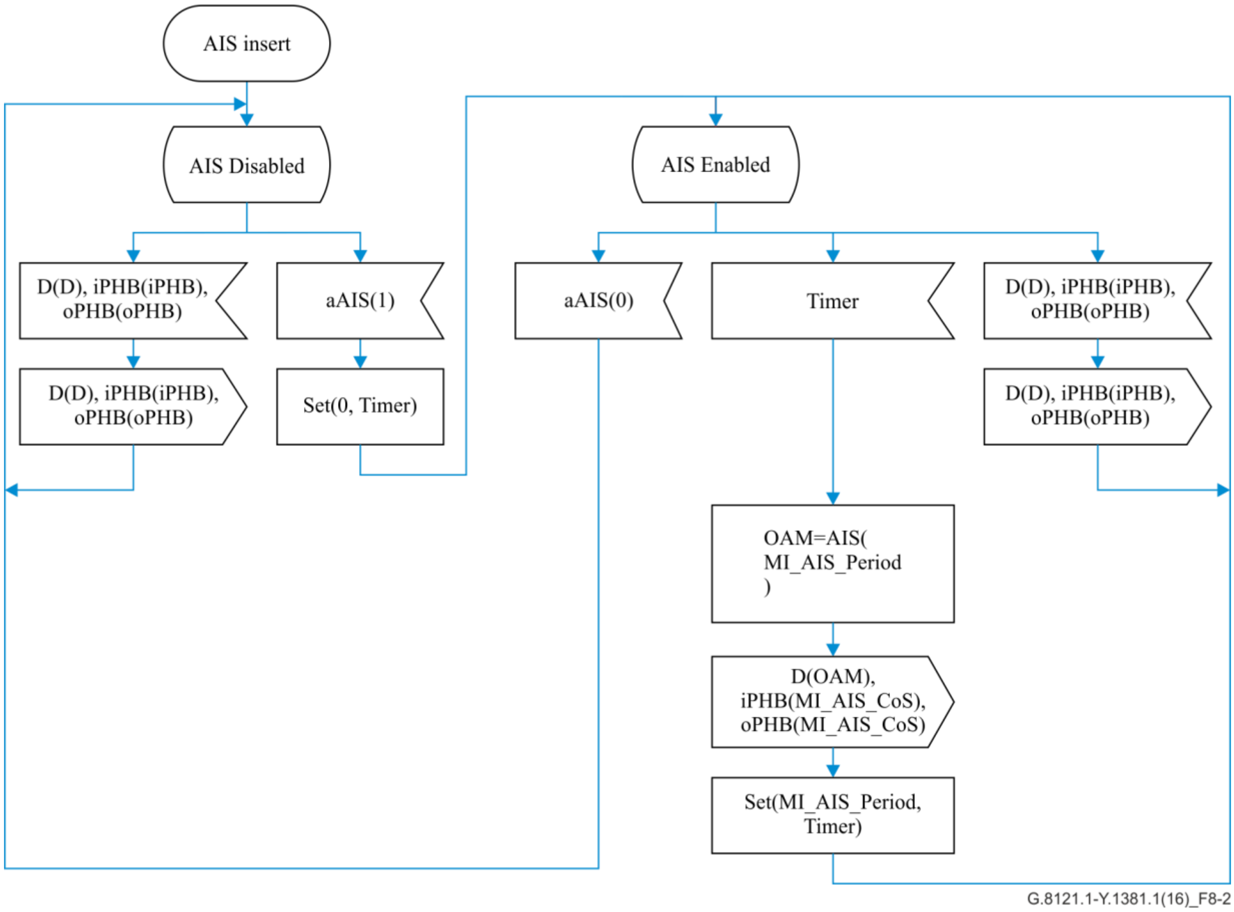

Figure 8-2 – AIS Insert behaviour

The period between consecutive AIS traffic units is determined by the MI_AIS_Period parameter. Allowed values are once per second and once per minute; the encoding of these values is defined in Table 8-1. Note that these encodings are the same as for the locked (LCK) generation process.

Table 8-1 – AIS period values

3-bits	Period value	Comments
000–011	Invalid value	Invalid value for AIS PDUs
100	1 s	1 packet/s
101	Invalid value	Invalid value for AIS PDUs
110	1 min	1 packet/min
111	Invalid value	Invalid value for AIS PDUs

The MT_CI_D signal contains an M_SDU field. The format of the M_SDU field for AIS traffic units is defined in [ITU-T G.8113.1].

The periodicity (as defined by MI_AIS_Period) is encoded in the three least significant bits of the Flags field in the AIS protocol data unit (PDU) using the values from Table 8-2.

8.6.3 LCK (Lock Reporting) Generate Process

Figure 8-3 shows the LCK Generation Process Symbol as shown in Figure 8-14 of [ITU-T G.8121]. The LCK Generation Process generates MT_CI traffic units where the MT_CI_D signal contains the LCK signal. Figure 8-4 defines the behaviour of the LCK Generation Process as shown in Figure 8-15 of [ITU-T G.8121].

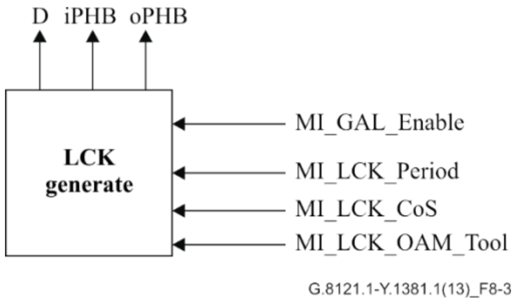

Figure 8-3 – LCK Generation Process

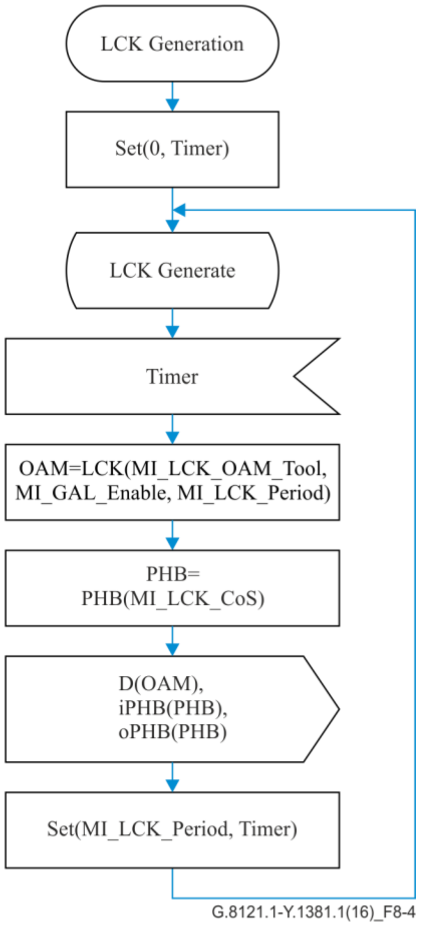

Figure 8-4 – LCK Generation behaviour

The LCK Generation Process continuously generates LCK Traffic Units; every time the Timer expires, an LCK Traffic Unit is generated. The period between two consecutive traffic units is determined by the MI_LCK_Period input signal. Allowed values are defined in Table 8-2.

Table 8-2 – LCK period values

3-bits	Period value	Comments
000–011	Invalid value	Invalid value for LCK PDUs

100	1 s	1 packet/s
101	Invalid value	Invalid value for LCK PDUs
110	1 min	1 packet/min
111	Invalid value	Invalid value for LCK PDUs

The MT_CI_D signal contains an M_SDU field. The format of LCK units is defined in [ITU-T G.8113.1].

The periodicity (as defined by MI_LCK_Period) is encoded in the three least significant bits of the Flags field in the LCK PDU using the values from Table 8-1.

The value of the MT_CI_PHB signal associated with the generated LCK traffic units is defined by the MI_LCK_CoS input parameter.

8.7 OAM related Processes used by adaptation functions

8.7.1 MCC/SCC Mapping Insert and De-mapping Process

See clause 8.7.1 of [ITU-T G.8121].

8.7.2 APS Insert and Extract Process

See clause 8.7.2 of [ITU-T G.8121].

8.7.3 CSF Insert and Extract Process

To support CSF, the client signal fail (CSF) PDU as described in clause 8.2.9 of [ITU-T G.8113.1] is used. Clause 8.7.3 of [ITU-T G.8121] provides an overview of the processes that support the CSF OAM function.

8.7.3.1 CSF Insert process

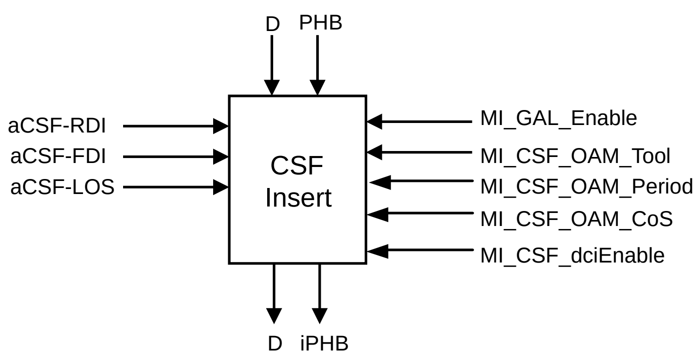

Figure 8-4a – CSF Insert process

Figure 8-4a shows the CSF insert process symbol. MI_CSFdciEnable is a further input to the CSF Insert process as specified in specified in 8.7.3.1 of [ITU-T G.8121].

Figure 8-4b illustrates the behaviour. If any of the aCSF-RDI, aCSF-FDI or aCSF-LOS signals are true, the CSF Insert process periodically generates MT_CI traffic units where the MT_CI_D signal contains the CSF signal until the condition no longer holds, i.e., all of aCSF-RDI, aCSF-FDI and aCSF-LOS are false. At this point, CSF traffic unit(s) with DCI (Defect Clear Information) are generated indicating that the defect has been cleared, if MI_CSFdciEnable = True. A generated CSF traffic unit is inserted in the incoming stream, i.e., the output stream contains the incoming traffic units and the generated CSF traffic unit encapsulated in a G-ACh traffic unit as described in clause

8.1 of [ITU-T G.8121] following a GAL or not depending on MI_GAL_Enable. The period between consecutive CSF traffic units is determined by the MI_CSF_OAM_Period parameter.

The specific CSF traffic unit is in [ITU-T G.8113.1].

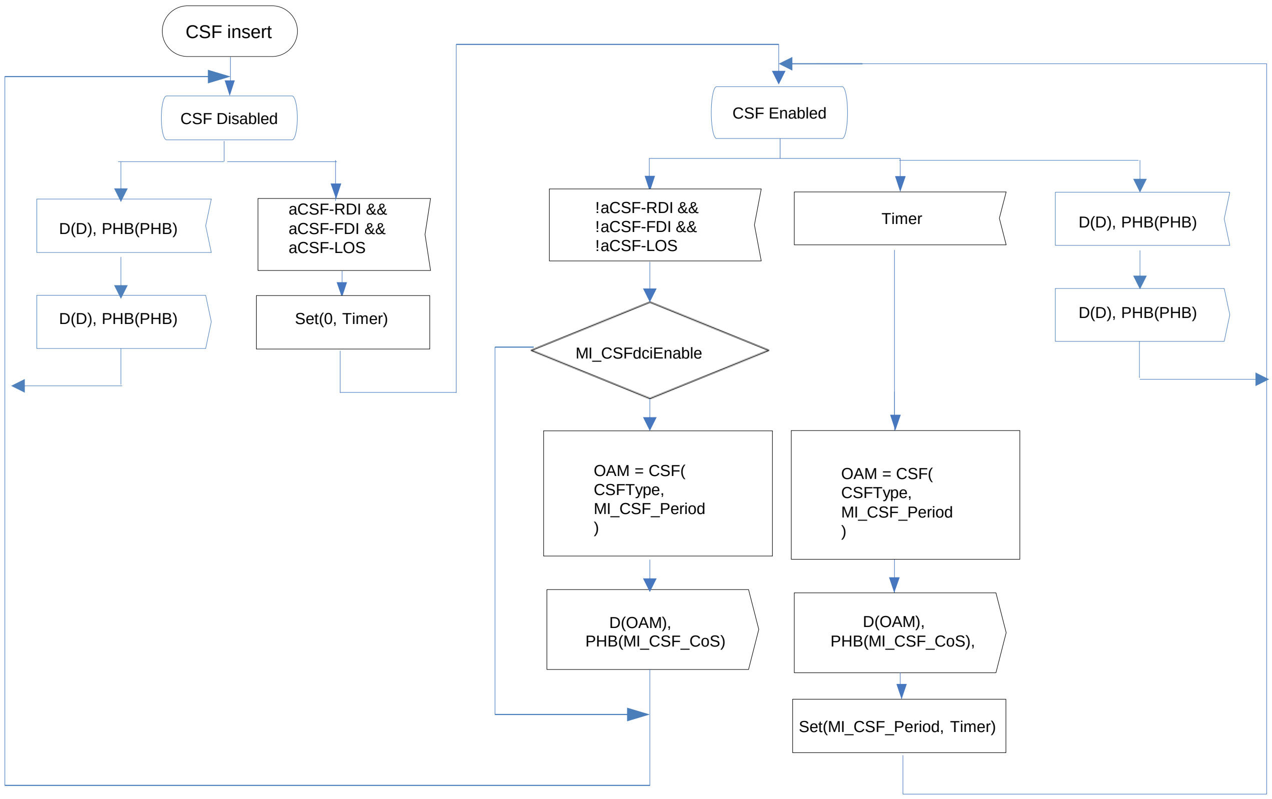

Figure 8-4b – CSF insert behaviour

8.7.3.2 CSF Extract process

The CSF Extract process is located extracts MT_AI_CSF and is symbolized as specified in 8.7.3.2 of [ITU-T G.8121].

The MT_AI_CSF is the CSF specific information contained in the received CSF traffic unit. All other traffic units are transparently forwarded.

The criteria for filtering are based on the values of the fields within the MT_CI_D signal:

– GAL included to the MT_ CI _D if GAL usage is enabled via MI_GAL_Enable;

– OAM type that is defined in the channel type of G-ACh indicates CSF.

This behaviour is illustrated in Figure 8-4c. The function CSF(D) extracts the CSF specific information from the received traffic unit.

NOTE – The G-ACh process is carried out as defined in clause 8.1 of [ITU-T G.8121]. The CSF traffic unit in MT_CI_D is forwarded to the CSF Extract process.

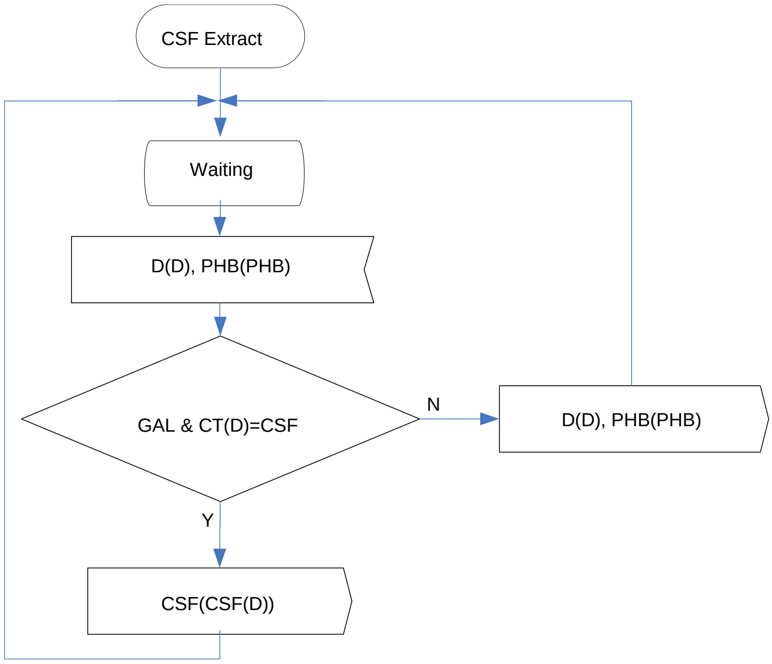

Figure 8-4c/G.8121.1/Y.1381.1 – CSF Extract behaviour

8.8 Proactive and on-demand OAM related Processes

8.8.1 Proactive continuity check and connectivity verification (CC/CV)

8.8.1.1 Overview

To support CC/CV, the continuity check message (CCM) as described in clause 8.2.1 of [ITU-T G.8113.1] is used.

Figure 8-5 provides an overview of the processes that support the CC/CV function by using CCM. The CCM Generation process generates the CCM packets if MI_CC_Enable is true.

NOTE – MI_CVp_Enable defined in [ITU-T G.8121] is automatically configured true by setting MI_CC_Enable true.

The MI_MEG_ID and MI_MEP_ID are the maintenance entity group (MEG) and MEG end point (MEP) IDs of the MEP itself and these IDs are carried in the CCM packet. The CCM packets are generated with a periodicity determined by MI_CC_Period and with a priority determined by MI_CC_CoS. If MI_LMC_Enable is set, the CCM packets also carry loss measurement (LM) information. The Generated CCM Traffic Units are inserted in the flow of MT_CI by the OAM MEP Source Insertion Process. MI_MEP_ID contains an integer value in the range 1–8191.

The CCM packets pass transparently through MEG intermediate points (MIPs).

The OAM MEP Sink Extraction process extracts the CCM Unit from the flow of MT_CI and the CCM Reception process processes the received CCM Traffic Unit. It compares the received MEG ID with the provisioned MI_MEG_ID and the received MEP_ID with the provisioned MI_PeerMEP_ID; this contains the list of all expected peer MEPs in the MEG. Based on the processing of this packet, one or more events may be generated that serve as input for the Defect Detection Process (not shown in Figure 8-5).

Remote detect indication (RDI) information is carried in the CCM packet based upon the RI_CC_RDI input. It is extracted in the CCM Reception Process.

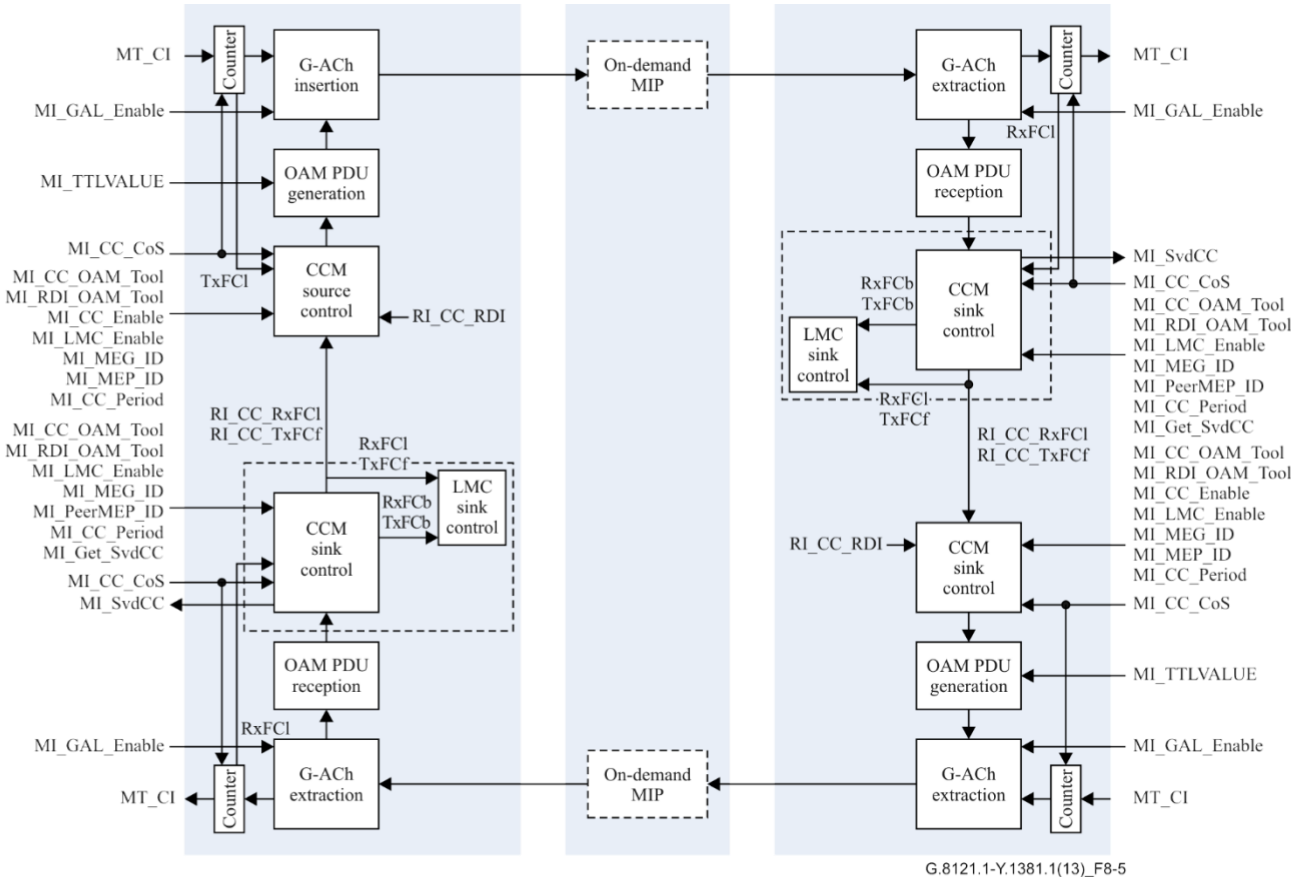

Figure 8-5 – Overview of Processes involved with CCM

8.8.1.2 CCM Generation Process

Figure 8-6 describes the behaviour for the CCM Generation Process.

This process generates MPLS-TP CI traffic units where the MT_CI_D signal contains CCM traffic units for pro-active monitoring and counts all data packets with per-hop behaviour (PHB) equal to MI_CC_CoS (TxPCl).

The D, iPHB and oPHB signals are forwarded unchanged as indicated by in Figure 8-6.

The CCM Generation process can be enabled and disabled using the MI_CC_Enable signal.

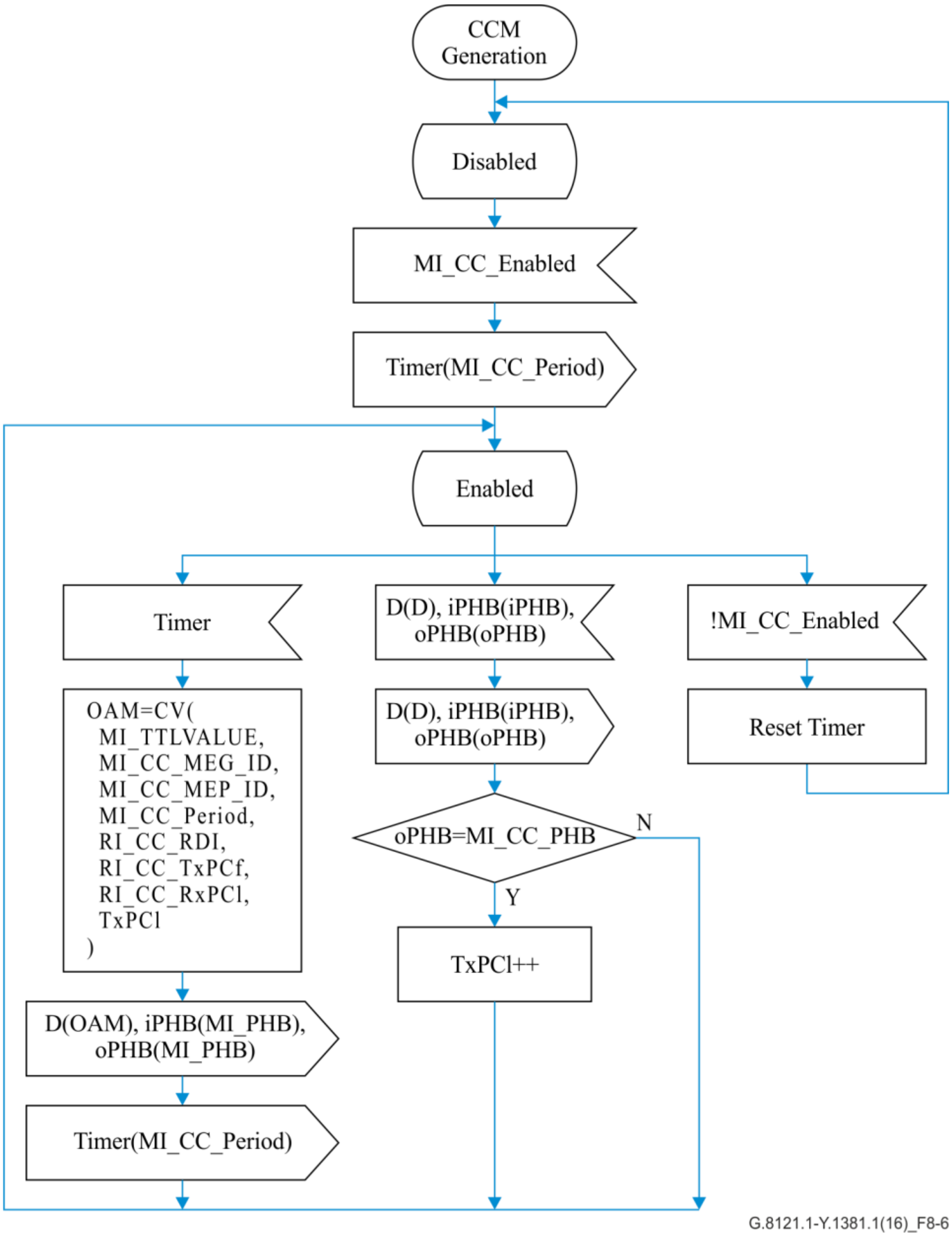

Figure 8-6 – CCM Generation process

The period between the generation of consecutive CCM traffic units is determined by the MI_CC_Period parameter. Allowed values and the encoding of these values are defined in Table 8-3.

Table 8-3 – CCM period values

MI_CV_Period	Period value	Comments
000	Invalid value	Invalid value for CC-V PDUs
001	3.33 ms	300 packets per second
010	10 ms	100 packets per second
011	100 ms	10 packets per second
100	1 s	1 packet per second

101	10 s	6 packets per minute
110	1 min	1 packet per minute
111	10 min	6 packet per hour

8.8.1.3 CCM Reception Process

Figure 8-7 describes the behaviour for the CCM Reception Process.

The CCM reception process transparently forwards all the data packets and counts all data packets that have PHB equal to MI_CC_CoS.

Furthermore, the CCM reception process processes receives CCM OAM traffic units. It checks the various fields of the OAM PDU and generates the corresponding events (as defined in clause 6).

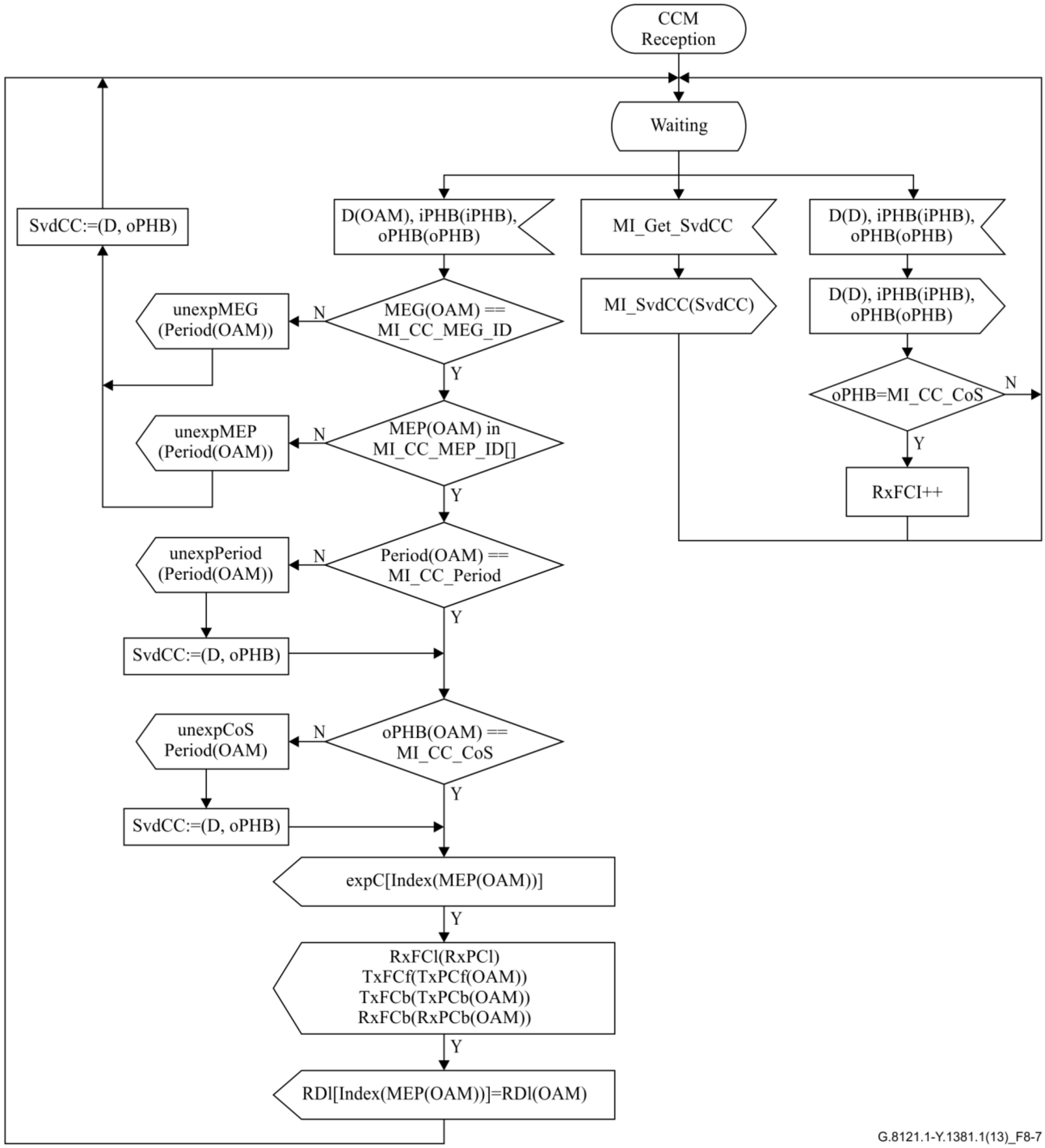

Figure 8-7 – CCM Reception process

8.8.1.4 Counter process for Dual-Ended Proactive Packet Loss Measurement

This process counts the number of transmitted and received packets.

The counter process for CCM generation (see Figure 8-8) forwards data packets and counts all the traffic units that are transmitted as MT_AI by the MT/Client_A_So. It counts the number of transmitted traffic units that have the oPHB corresponding to the lowest drop precedence (DP) within the CoS defined by the MI_CC_CoS input parameter, determined by the PHB(MI_CC_CoS) function. The D, iPHB and oPHB signals are forwarded unchanged.

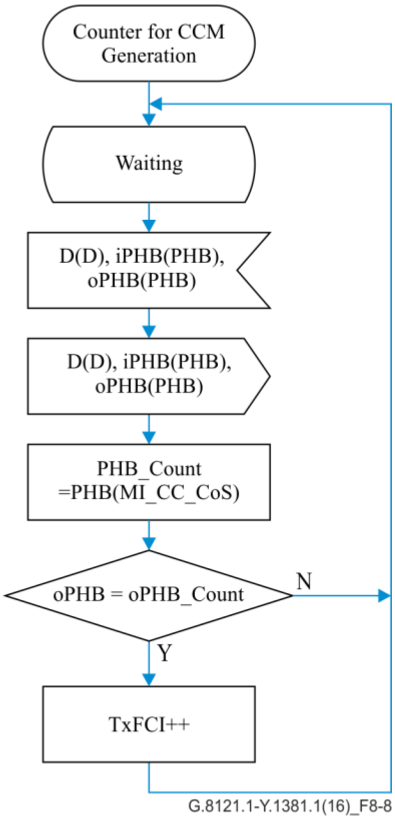

Figure 8-8 – Counter behaviour for CCM generation

The counter process for CCM reception (see Figure 8-9) forwards data packets and counts all the traffic units that are sent as MT_AI to the MT/Client_A_Sk. It counts the number of received traffic units that have the oPHB corresponding to the lowest DP within the CoS defined by the MI_CC_CoS input parameter, determined by the PHB(MI_CC_CoS) function.

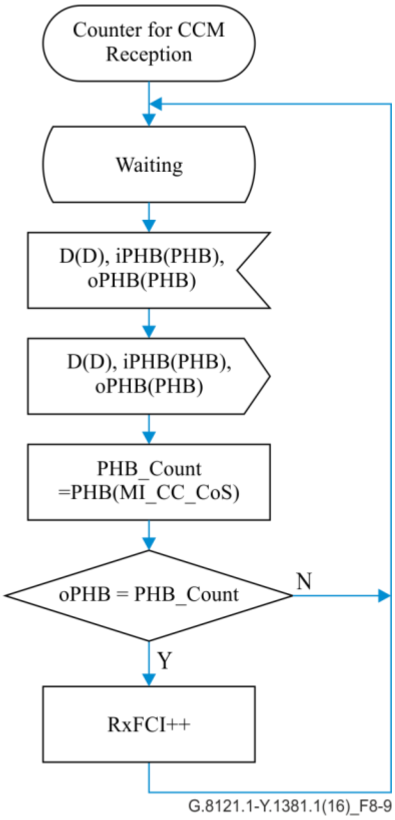

Figure 8-9 – Counter behaviour for CCM reception

8.8.1.5 Proactive Loss Measurement (LMp) Process

Figure 8-10 shows proactive LM Process behaviour by CCM. This process calculates the number of transmitted and lost packets per second.

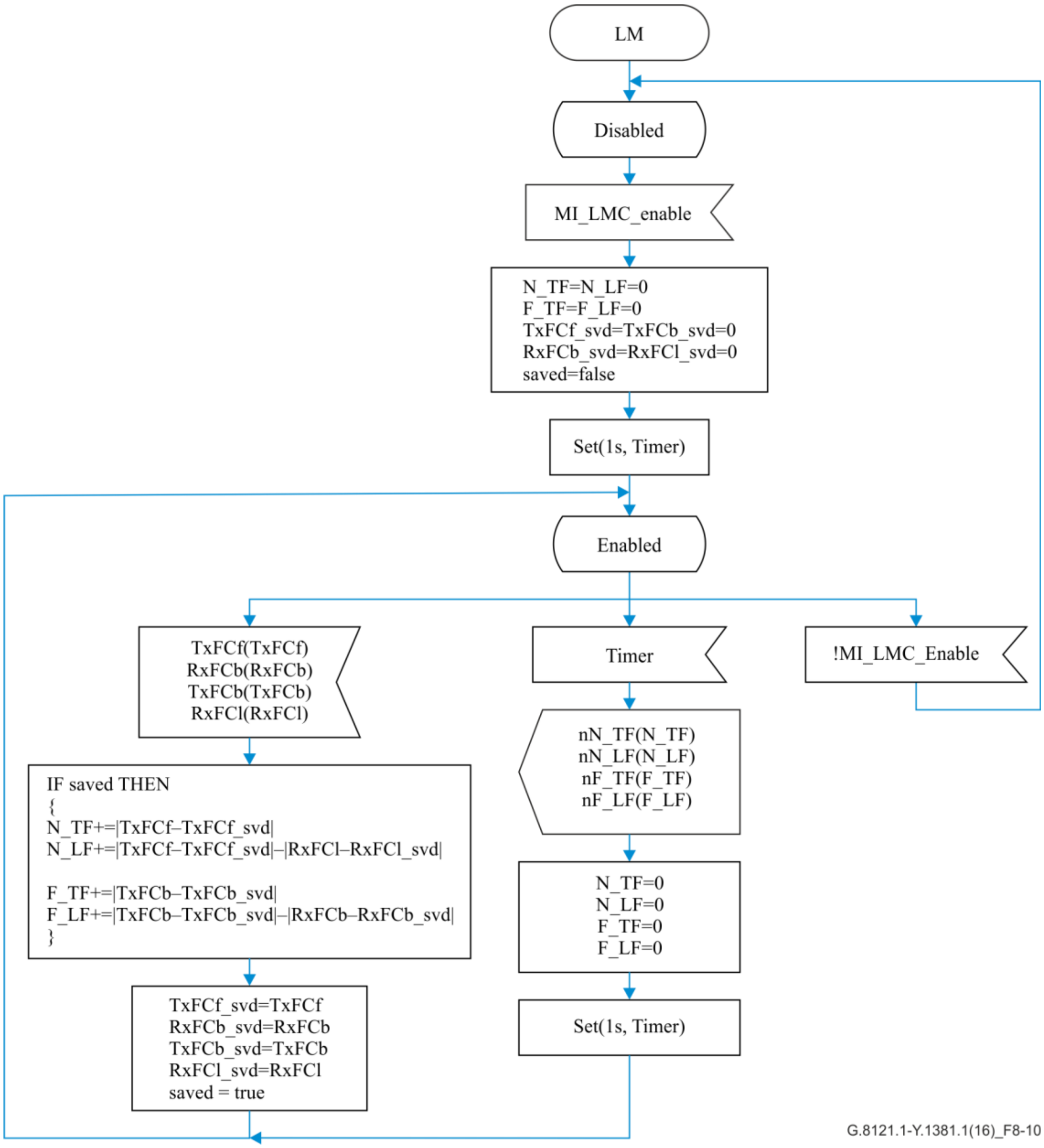

Figure 8-10 – LM Process behaviour

8.8.2 Remote Defect Indication (RDI)

As described in clause 8.8.2 of [ITU-T G.8121], RDI information associated with proactive CC/CV and carried in the CC/CV packets is based upon the RI_CC/CV_RDI input.

See clause 8.8.1 for further information. As shown in Figure 8-5, RDI information associated with proactive CCM and carried in the CCM packets is based upon the RI_CC_RDI input.

8.8.3 On-demand connectivity verification (CV)

8.8.3.1 Overview

To support on-demand CV, the loopback message/loopback reply (LBM/LBR) as described in clause 8.2.2 of [ITU-T G.8113.1] is used.

Figure 8-11 provides the different processes inside MEPs and MIPs that are involved in the Loopback Protocol.

The MEP On-Demand OAM Source insertion process is defined in clause 9.4.1.1, the MEP On-Demand OAM Sink extraction process in clause 9.4.1.2, the MIP On-Demand OAM Sink Extraction process in clause 9.4.1.2 and the MIP On-Demand OAM Source insertion process in clause 9.4.2. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_CI_D Traffic Units. The other processes are defined in this clause.

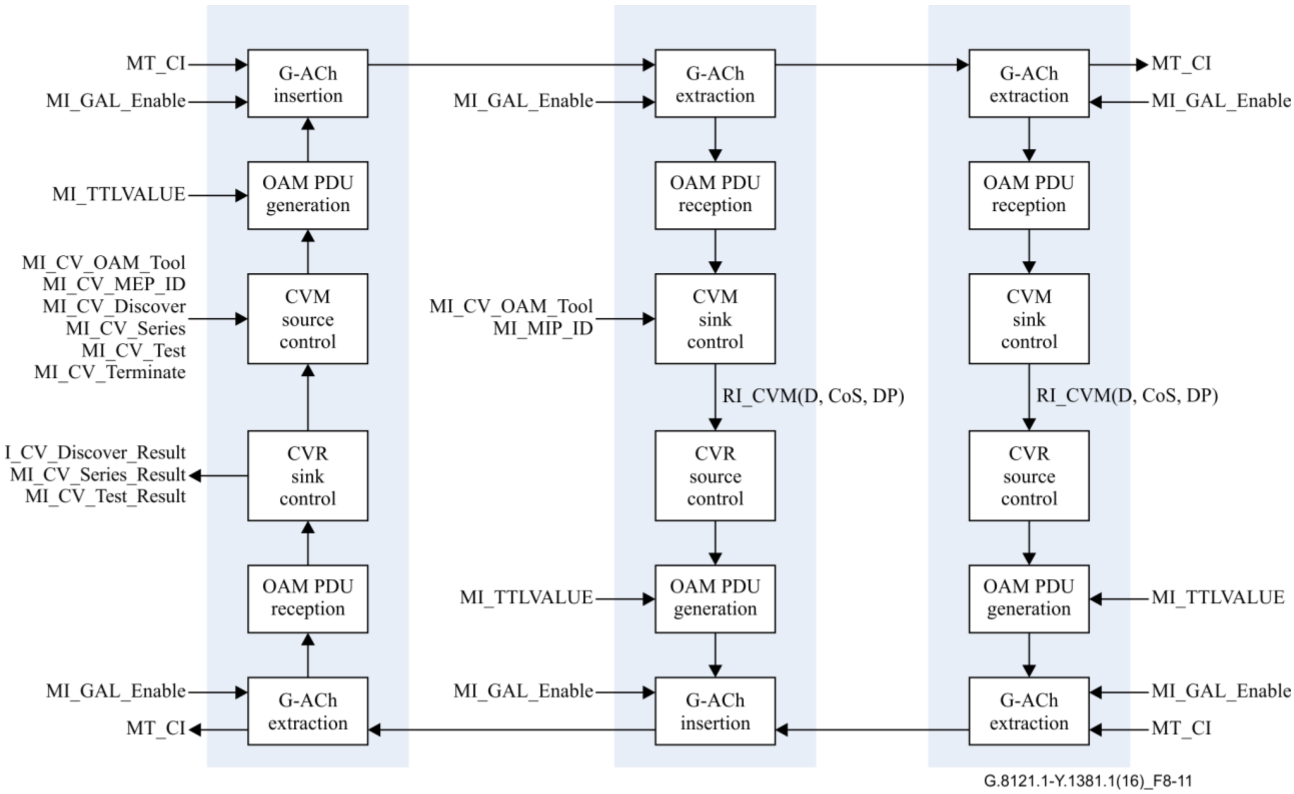

Figure 8-11 – Overview of Processes involved with on-demand CV

The on-demand CV Protocol is controlled by the CVM and CMR Control Processes. Two MI signals that can trigger the LB protocol are defined below:

- MI_CV_Series(CoS,N,Length,Period): To send a series of N LB messages to a particular MEP/MIP; these LB messages are generated every 'Period'.
- MI_CV_Test(CoS,Pattern,Length,Period): To send a series of LB messages carrying a Test Pattern to a particular MEP; these LB messages are generated every 'Period' until the MI_CV_Test_Terminate signal is received. The CoS parameter is used to set the PHB, and the Length and Pattern specify the length of the packet and the pattern to use.

The details are described later in this clause. The CVM Source Control processes a generated LBM Traffic Unit that is received and forwarded by MIPs and received by MEPs in the same MEG. The CVM Control process controls the number of LBMs generated and the period between consecutive LBM Traffic Units.

The CVM MIP/MEP Sink control processes the received LBM Traffic Units and as a result the LBR Generation Process may generate an LBR Traffic Unit in response. The LBR Reception Process receives and processes the LBR Traffic Units.

The CVM Sink Control processes these received values to determine the result of the requested LB operation. The result is communicated back using the following MI signals:

- MI_CV_Series_Result(REC, ERR, OO): Reports back the total number of received LBR packets (REC), as well as counts of specific errors (ERR):
  - OO: Number of LBR Traffic Units that were received out of order (OO).
- MI_CV_Test_Result(Sent, REC, CRC, BER, OO): Reports back the total number of LBM packets sent (Sent) as well as the total number of LBR packets received (REC); for the latter, counts of specific errors are reported:
  - CRC: Number of LBR packets where the CRC in the pattern failed.
  - BER: Number of LBR packets where there was a bit error in the pattern.
  - OO: Number of LBR packets that were received out of order.

The detailed functionality of the various processes is defined in clauses 8.8.3.2 to 8.8.3.7.

8.8.3.2 CVM Source Control Process

The CVM Source Control Process can receive several MI signals to trigger the LB protocol; this is shown in Figure 8-12.

NOTE – CV Control behaviour for Test is for further study.

Figure 8-13 defines the behaviour of the LB Control Process after the reception of the MI_CV_Series(DP, CoS, N, Length, Period) signal.

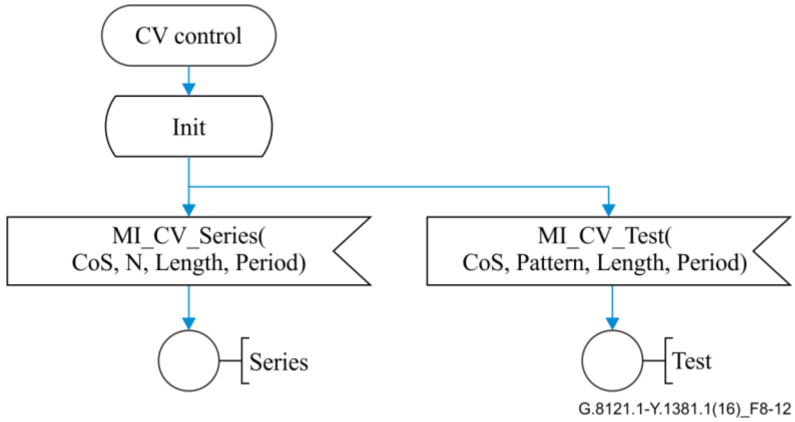

Figure 8-12 – CV Control behaviour

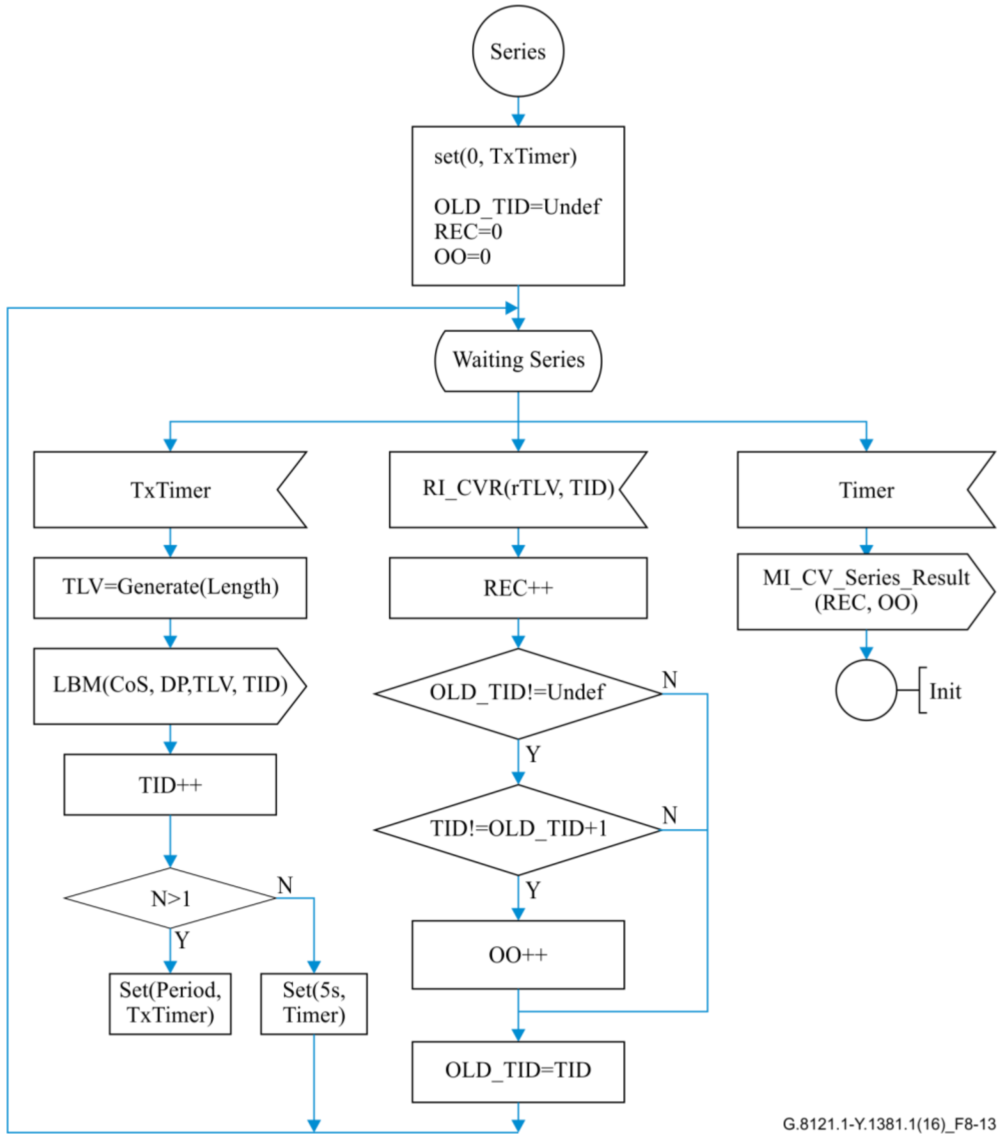

Figure 8-13 – CV Control Series behaviour

The type-length-value (TLV) field of the LBM packets is determined by the Generate(Length) function. Generate(Length) generates a Data TLV with length 'Length' of arbitrary bit pattern to be included in the LBM packet.

After the receipt of the MI_CV_Series signal, the LBM Generation Process is requested *N* times to generate an LBM packet (where Period determines the interval between two LBM packets); this is done by issuing the LBM(D, DP, CoS, TLV,TID) signal.

Whenever an RI_CV(rTLV, TID) signal is received, the number of received LBR packets is increased (REC++). If the TID value from the RI_LBR signal does not consecutively follow the last received TID value, the counter for out of order packets is incremented by one (OO++).

At a period of 5 s after sending the last LBM packet (i.e., after sending the *N*th LBM packet), the REC and OO counters are reported back in the MI_CV_Series_Result signal.

8.8.3.3 CVM Generation Process

The CVM Generation process that is in CVM Source Control Process generates a *single* LBM OAM Traffic Unit (MT_CI_D) complemented with MT_CI_CoS and MT_CI_DP signals on receipt of the LBM() signal. The process is defined in Figure 8-14.

From the LBM() signal, the CoS field determines the value of the MT_CI_CoS signal, the DP field determines the value of the MT_CI_DP signal. The TLV and TID fields are used in the construction of the MT_CI_D signal that carries the LBM Traffic Unit.

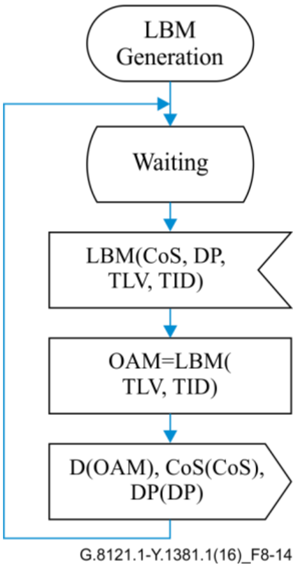

Figure 8-14 – MEP LBM Generation behaviour

8.8.3.4 MIP CVM Sink Control Process

The MIP CVM Sink Control Process receives MT_CI Traffic Units containing LBM PDUs complemented by the P and D signals.

The behaviour is defined in Figure 8-15. If TLV(D) equals MI_MIP_ID, the Loopback is intended for this MIP and the information is forwarded to the Loopback Reply Generation Process using the RI_CVM(D,DP,CoS) signal; otherwise the information is ignored and no action is taken.

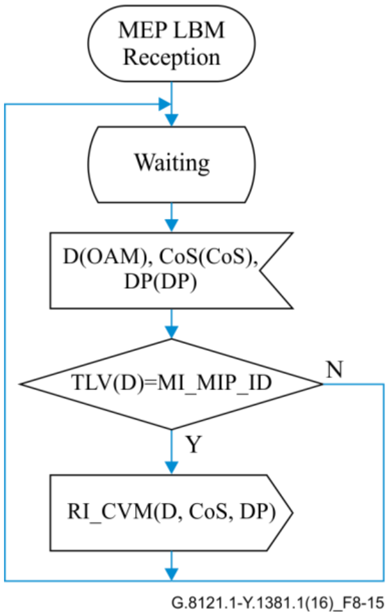

Figure 8-15 – MIP LBM Reception behaviour

8.8.3.5 MEP CVM Sink Control Process

The MEP CVM Sink Control Process receives MT_CI Traffic Units containing LBM PDUs complemented by the CoS and D signals.

The behaviour is defined in Figure 8-16.

If the TLV field in the LBM Traffic Unit (D signal) equals the MI_MEP_ID, the Loopback is intended for this MEP and the information is forwarded to the Loopback Reply Generation Process (RI_CVM(D,CoS,DP)).

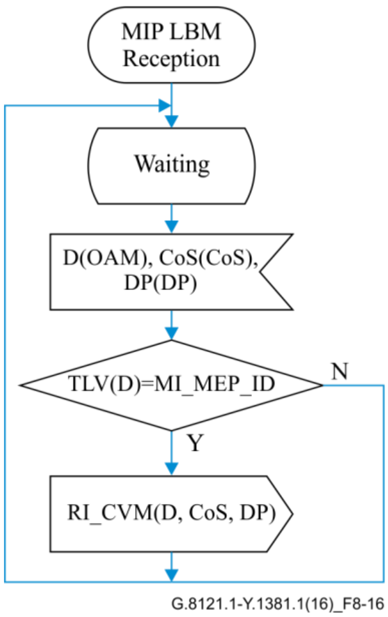

Figure 8-16 – MEP LBM Reception behaviour

8.8.3.6 CVR Source Control Process

Note that the CVR Source Control Process is the same for MEPs and MIPs.

Upon receipt of the LBM Traffic Unit and accompanying signals (RI_CVM(D,P,DE)) from the LBM reception process, the LBR Generation Process generates an LBR Traffic Unit together with the complementing P and DE signals.

The generated traffic unit is the same as the received RI_CVM(D) Traffic Unit except:

- the Opcode is set to LBR opcode.

8.8.3.7 CVR Sink Control Process

The CVR Sink Control receives LBR Traffic Units (D signal) together with the complementing CoS and signals. The LBR Reception process inspects the received Traffic Unit; if the traffic units is valid, TID and TLV values are extracted from the LBR PDU and signalled to the CV Control Process using the RI_CVR(TID,TLV) signal. The behaviour is defined in Figure 8-17.

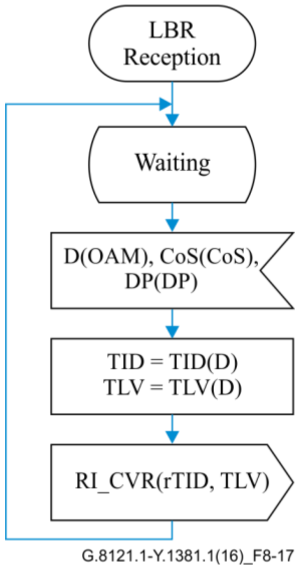

Figure 8-17 – LBR Reception behaviour

8.8.4 Proactive Packet Loss Measurement (LMp)

8.8.4.1 Overview

To support this functionality, Proactive loss measurement message/loss measurement reply (LMM/LMR) as described in clause 8.2.6 of [ITU-T G.8113.1] or proactive packet loss measurement by suing CCM is used. The proactive packet loss measurement by CCM is described in clause 8.8.1.4.

Figure 8-18 provides the different processes inside MEPs and MIPs that are involved in the Loss Measurement Protocol for Proactive Loss Measurement (LMM/LMR).

The MEP proactive OAM insertion process is defined in clause 9.2.1.1, the MEP OAM proactive extraction process in clause 9.2.1.2. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_CI_D traffic units and the complementing CoS and D signals going through an MEP and MIP.

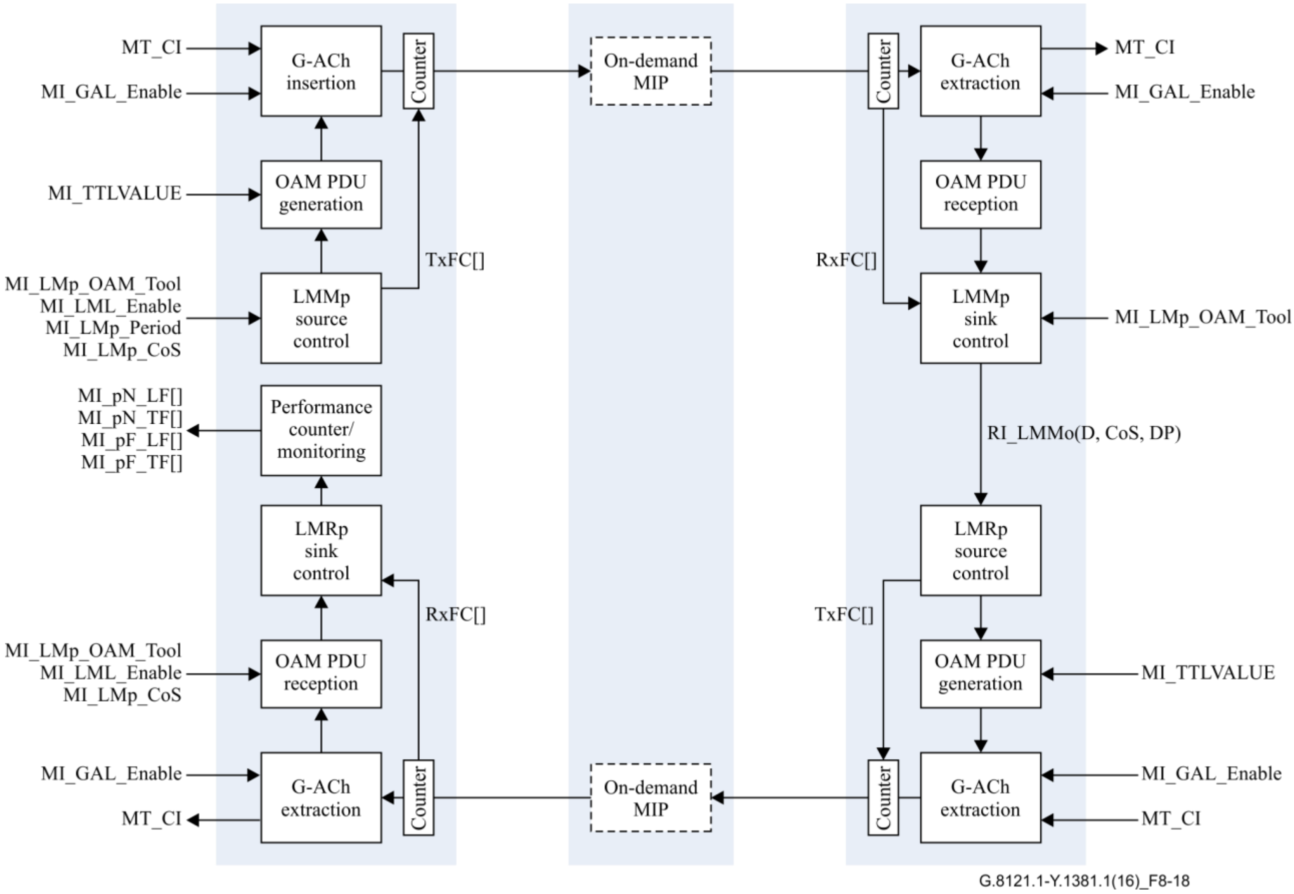

Figure 8-18 – Overview of processes involved with proactive loss measurement

The proactive LM control process controls the proactive LM protocol. If MI_LML_Enable is set, the LMM packets are sent periodically. The LMM packets are generated with a periodicity determined by MI_LMp_Period and with a priority determined by MI_LMp_CoS. The result (N_TF, N_LF, F_TF, F_LF) is reported via an LMRp reception. If the proactive LM control process activates the multiple monitoring on different CoS levels simultaneously, each result is independently managed per CoS level.

The behaviour of the processes is described in clauses 8.8.4.2 to 8.8.4.7.

8.8.4.2 Proactive LM Source Control Process

The behaviour of the proactive LM control process is defined in Figure 8-19. If the MI_LML_Enable is asserted, the process starts to generate LMM packets. The result (N_TF, N_LF, F_TF, F_LF) is reported via an LMR reception.

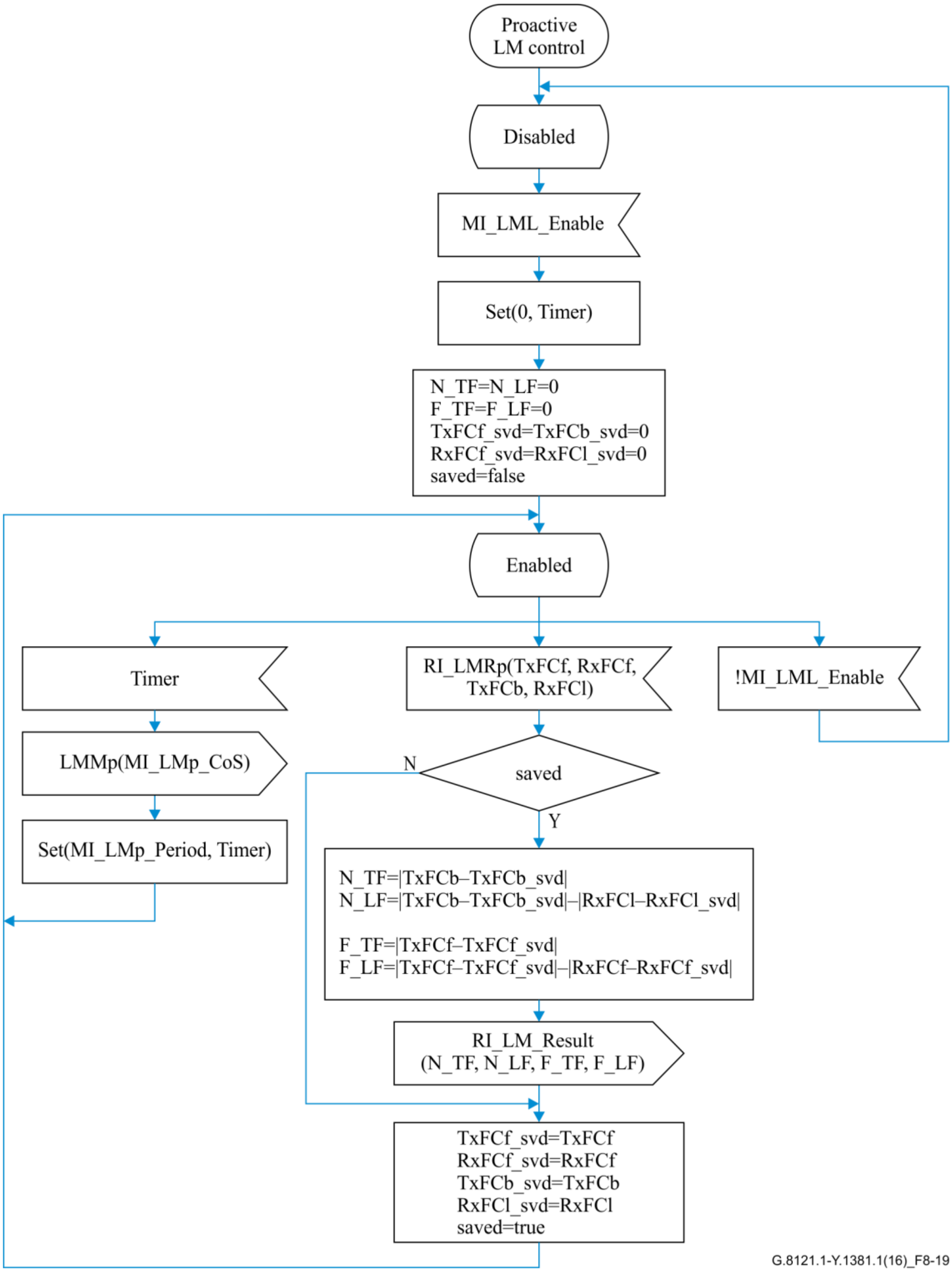

Figure 8-19 – Proactive LM control behaviour

8.8.4.3 Proactive LMM generation process

The behaviour of the LMMp generation process that is in the LMMp Source control process is defined in Figure 8-20.

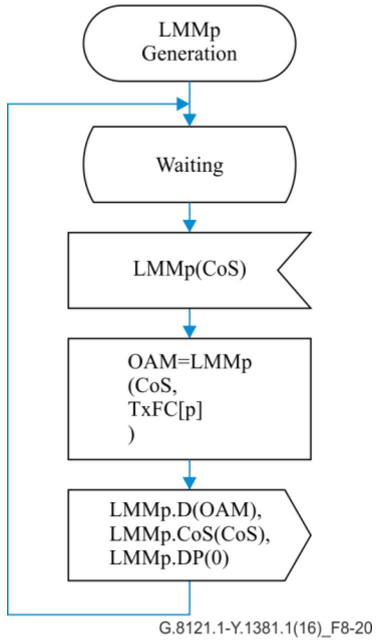

Figure 8-20 – LMM generation behaviour

Upon receiving the LMM(CoS), a single LMM traffic unit is generated together with the complementing CoS and DP(0) signals.

8.8.4.4 Proactive LMM Reception Process

The proactive LMM reception process that is in proactive DMM Sink control process processes the received proactive LMM traffic units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-21.

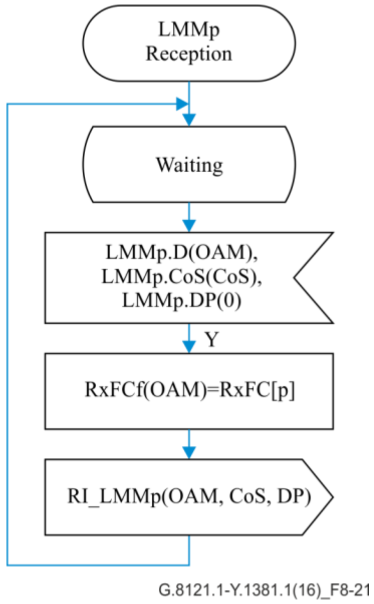

Figure 8-21 – LMM reception behaviour

The Traffic Unit and the complementing CoS and DP signals are forwarded as remote information (RI) to the LMR Generation Process.

8.8.4.5 Proactive LMR Generation Process

The Proactive LMR Generation Process that is in DMRp Source control process generates an LMRp Traffic Unit and its complementing CoS and DP signals. The behaviour is defined in Figure 8-22.

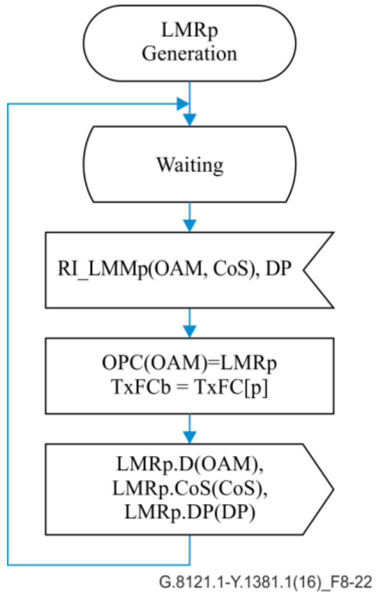

Figure 8-22 – LMR generation behaviour

Upon the receipt of RI containing an LMMp Traffic Unit, the LMRp generation process generates a DMR Traffic Unit and forwards it to the OAM insertion Process.

As part of the DMR generation:

– the Opcode is changed into DMRp Opcode;

– the TxFCb field is assigned the value of the Tx counter;

– all the other fields are copied from the RI containing the original DMMp Traffic Unit.

8.8.4.6 Proactive LMR Reception Process

The proactive LMR Reception Process that is in LMRp Sink control process processes the received LMRp Traffic Units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-23.

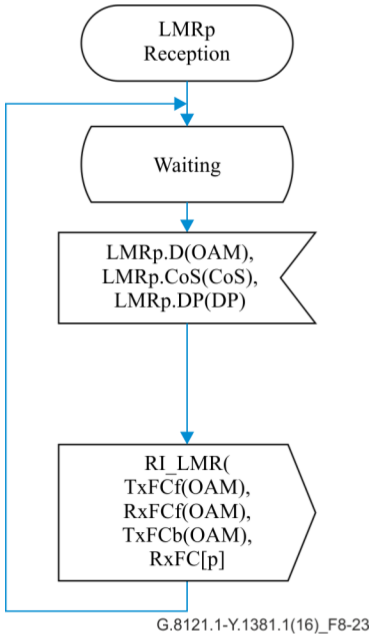

Figure 8-23 – LMR generation behaviour

8.8.4.7 Counter Process for Single-Ended Proactive Packet Loss Measurement

This process counts the number of transmitted and received packets.

The counter process for LMM/LMR generation forwards data packets and counts all the traffic units that are transmitted as MT_CI by the MT_TT_So. It counts the number of transmitted traffic units that have the oPHB corresponding to the lowest DP within the CoS associated with that PHB, as determined by the PHB(CoS) and CoS(oPHB) functions, respectively. See Figure 8-24.

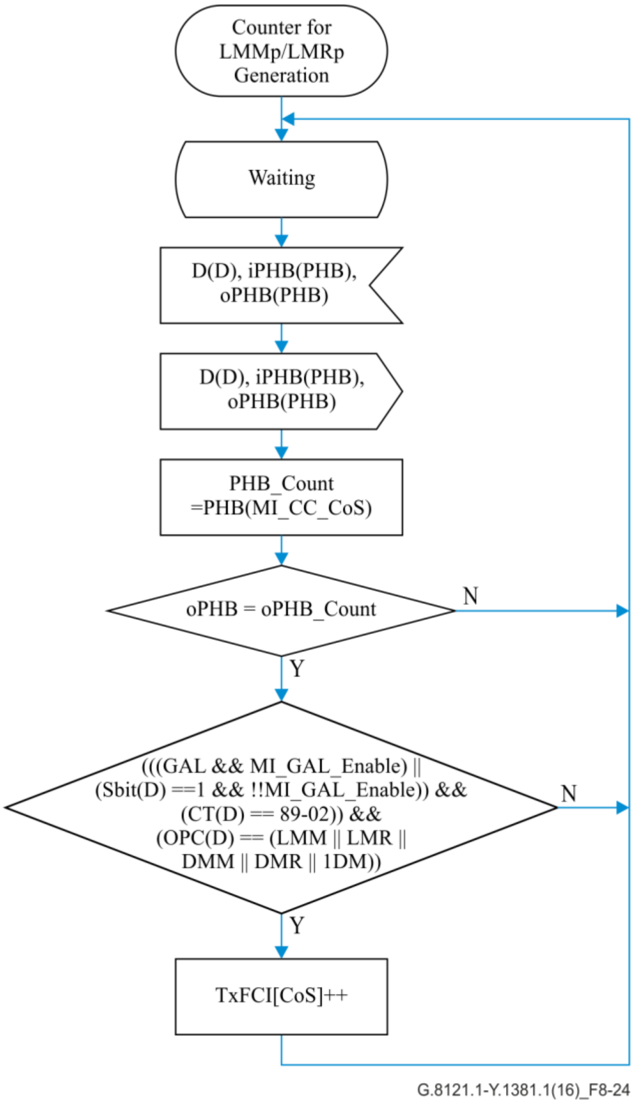

Figure 8-24 – Counter behaviour for LMM/LMR generation

The counter process for LMM/LMR generation forwards data packets and counts all the traffic units that are received as MT_CI by the MT_TT_Sk. It counts the number of received traffic units that have the oPHB corresponding to the lowest DP within the CoS associated with that PHB, as determined by the PHB(CoS) and CoS(PHB) functions, respectively. See Figure 8-25.

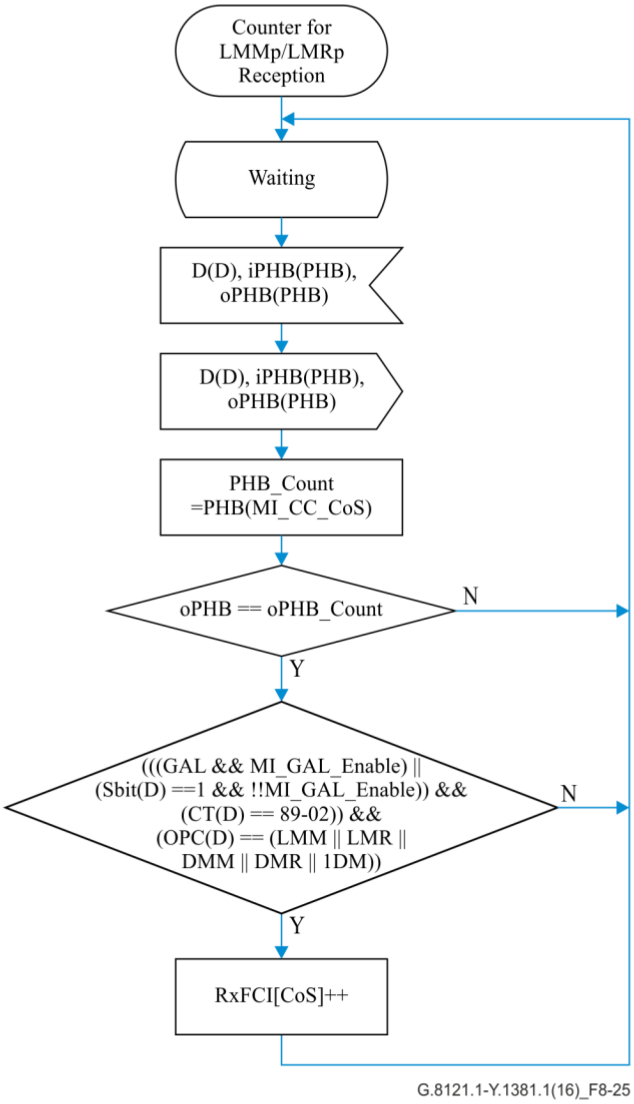

Figure 8-25 – Counter behaviour for LMM/LMR reception

NOTE 1 – To maintain the same behaviour as that specified in [ITU-T G.8021], the counter process for LMM/LMR generation and reception excludes the counting of OAM frames that are applicable to both proactive and on-demand performance monitoring (PM), i.e., LMM, LMR, DMM, DMR and 1DM. The type of OAM packet is determined by the function OAMType (D, MI_GAL_Enable), which identifies the packets as OAM packets based on the presence of the GAL (if MI_GAL_Enable is true), the ACH Channel Type and the OpCode.

NOTE 2 – This Recommendation assumes that this process activates the needed TxFCl and RxFCl frame counters before any loss measurement is initiated. The mechanisms for activating these counters, as well as the behaviour when a loss measurement is initiated before these counters are activated, are outside the scope of this Recommendation.

8.8.5 On-demand Packet Loss Measurement (LMo) Process

8.8.5.1 Overview

To support this functionality, On-demand Loss Measurement (LMM/LMR) as described in clause 8.2.6 of [ITU-T G.8113.1] is used.

Figure 8-26 provides the different processes inside MEPs and MIPs that are involved in the Loss Measurement Protocol.

The MEP On-Demand OAM Source insertion process is defined in clause 9.2, the MEP On-Demand OAM Sink extraction process in clause 9.2, the MIP On-Demand OAM Sink Extraction process in clause 9.4 and the MIP On-Demand OAM Source insertion process in clause 9.4. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_CI_D Traffic Units together with the complementing PHB signals going through an MEP and MIP.

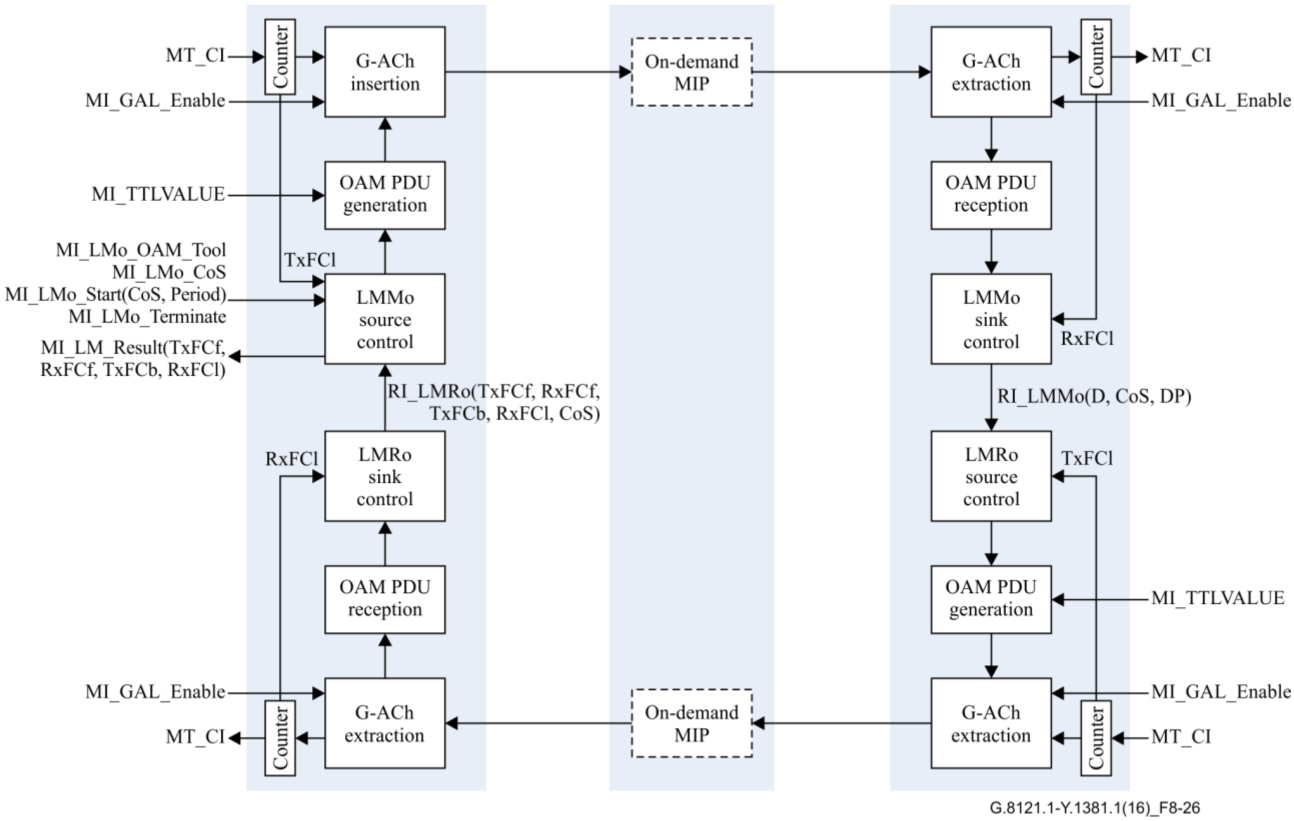

Figure 8-26 – Overview of Processes involved with On-demand Loss Measurement

The LMMo source control process controls the LM protocol. The protocol is activated upon receipt of the MI_LMo_Start(CoS,Period) signal and remains activated until the MI_LMo_Terminate signal is received.

The result is communicated via the MI_LMo_Result(N_TF, N_LF, F_TF, F_LF) signal.

The LMMo Source control Protocol generates an LMM Traffic Unit that passes transparently through MIPs, but that is processed by the LMMo Sink control Process in MEPs. The LMRo Source Process generates an LMR Traffic Unit in response to the receipt of an LMMo Traffic Unit. The LMRo Reception process receives and processes the LMRo Traffic Units.

The behaviour of the processes is described in clauses 8.8.5.2 to 8.8.5.7.

8.8.5.2 On-demand LM Source Control Process

The behaviour of the LMMo Source Control Process is defined in Figure 8-27.

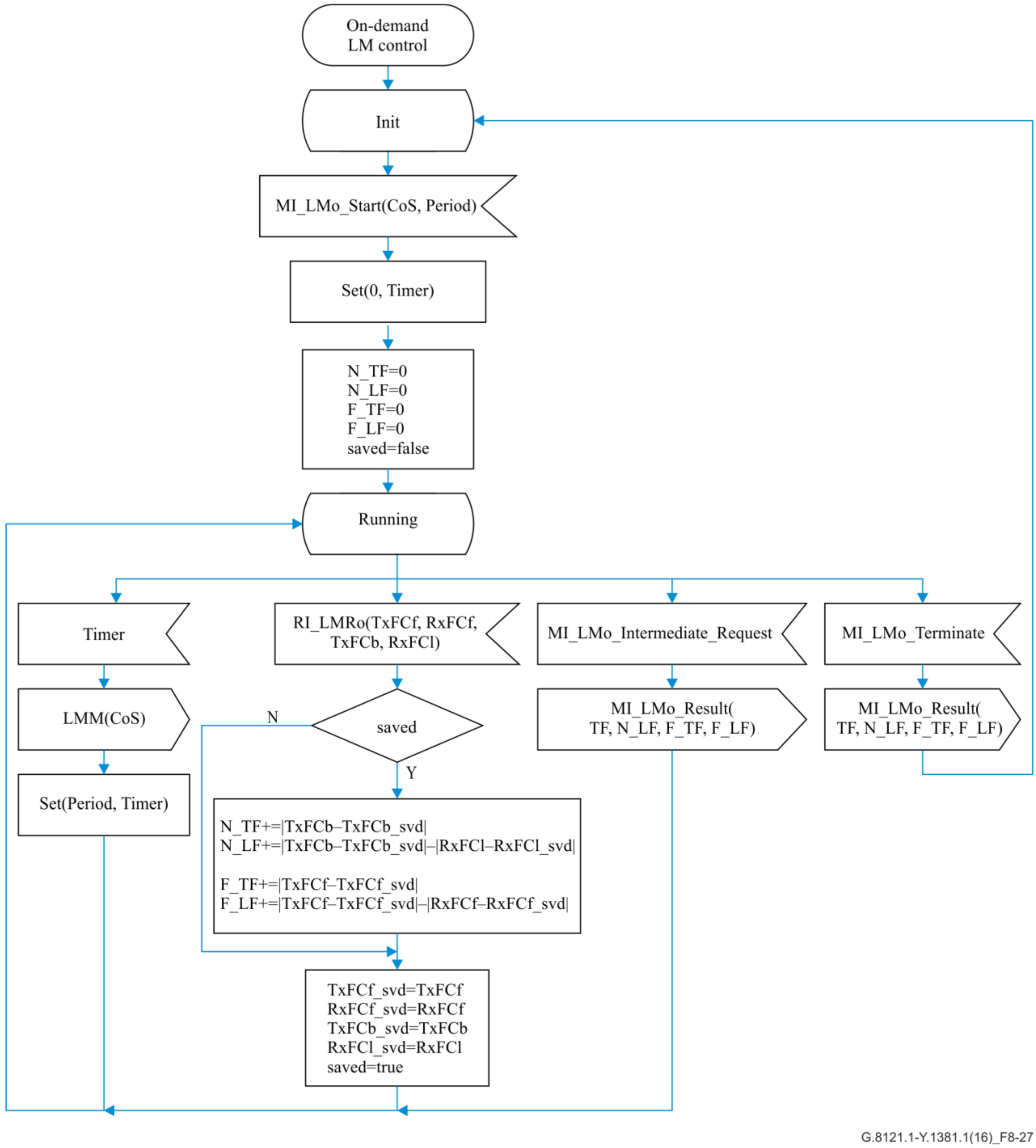

Figure 8-27 – LMMo Source Control behaviour

Upon receipt of the MI_LMo_Start(CoS,Period), the LM protocol is started. Every Period, the generation of an LMM packet is triggered (using the LMMo(CoS) signal) until the MI_LMo_Terminate signal is received.

The received counters are used to count the near end and far end transmitted and lost packets. This result is reported using the MI_LMo_Result(N_TF, N_LF, F_TF, F_LF) signal after the receipt of the MI_LMo_Terminate signal.

8.8.5.3 On-demand LMM Generation Process

The behaviour of the LMMo generation process that is in the LMMo Source control process is defined in Figure 8-28.

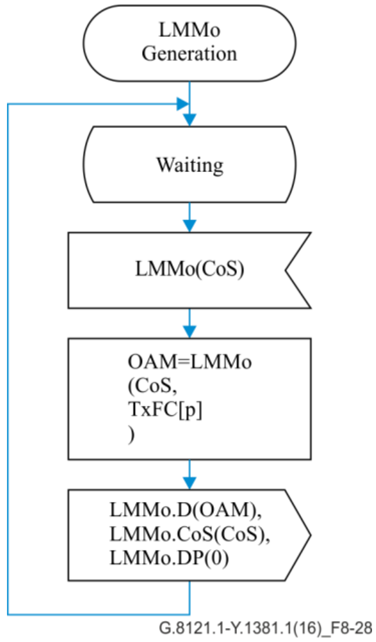

Figure 8-28 – LMM generation behaviour

Upon receiving the LMM(CoS), a single LMM traffic unit is generated together with the complementing CoS and DP(0) signals.

8.8.5.4 On-demand LMM Reception Process

The on-demand LMM reception process that is in the LMMo Sink control process processes the received proactive LMM traffic units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-29.

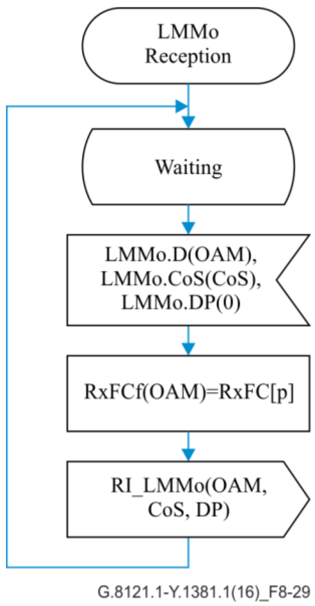

Figure 8-29 – LMM reception behaviour

The Traffic Unit and the complementing CoS and DP signals are forwarded as RI to the LMR Generation Process.

8.8.5.5 On-demand LMR Generation Process

The on-demand LMR Generation Process that is in the DMRo Source control process generates an LMRo Traffic Unit and its complementing CoS and DP signals. The behaviour is defined in Figure 8-30.

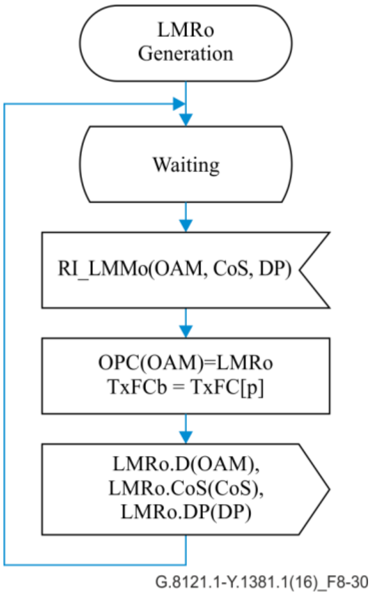

Figure 8-30 – LMR generation behaviour

Upon receipt of RI containing an LMMo Traffic Unit, the LMRo generation process generates a DMR Traffic Unit and forwards it to the OAM insertion Process.

As part of the DMR generation:

– the Opcode is changed into DMRo Opcode;

– the TxFCb field is assigned the value of the Tx counter;

– all the other fields are copied from the RI containing the original DMMo Traffic Unit.

8.8.5.6 On-demand LMR Reception Process

The on-demand LMR Reception Process that is in the on-demand LMRo Sink control process processes the received LMRo Traffic Units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-31.

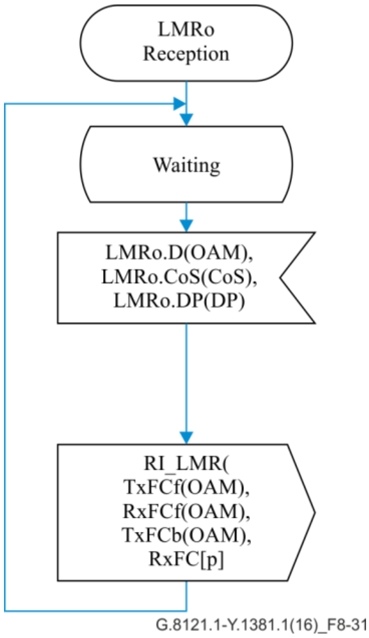

Figure 8-31 – LMR reception behaviour

8.8.5.7 Counter Process for Single-ended on-demand Packet Loss Measurement

This process counts the number of transmitted and received packets.

This counter process counts exactly the same packets as the counter process defined in clause 8.8.4.7.

8.8.6 packetProactive Packet Delay Measurement (DMp)

8.8.6.1 Overview

To support this functionality, proactive delay measurement (DM) as described in clause 8.2.8 of [ITU-T G.8113.1] for single-ended DM and clause 8.2.7 of [ITU-T G.8113.1] for dual-ended DM is used.

Figure 8-32 provides the different processes inside MEPs and MIPs that are involved in the single-ended Delay Measurement Protocol.

The MEP proactive OAM insertion process is defined in clause 9.2.1.1, the MEP OAM proactive extraction process in clause 9.2.1.2. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_CI_D traffic units and the complementing CoS and D signals going through an MEP and MIP; the extraction is based on the OAM_Tool.

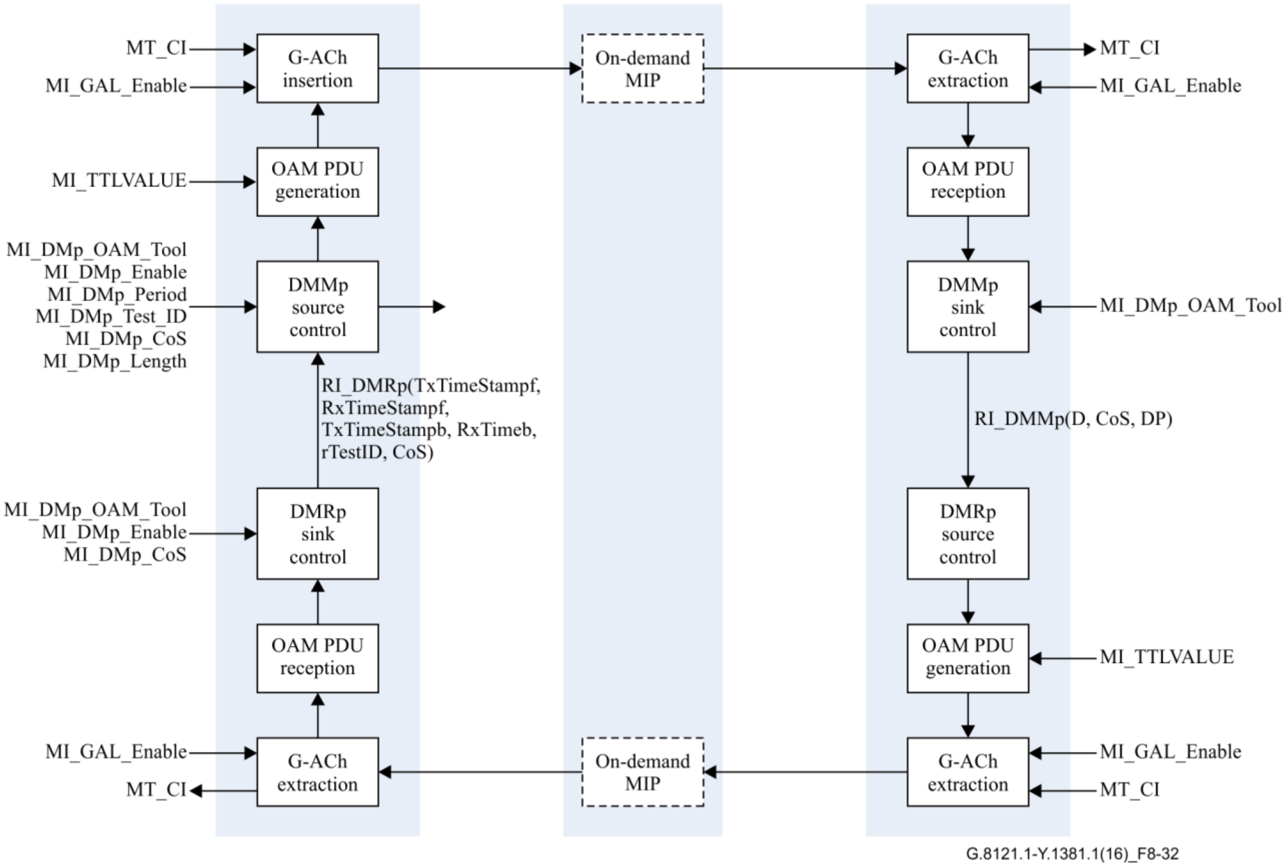

Figure 8-32 – Overview of processes involved with proactive single-ended delay measurement

The proactive DM control process controls the proactive DM protocol. If MI_DMp_Enable is set, the DMM packets are sent periodically. The DMM packets are generated with a periodicity determined by MI_DMp_Period and with a priority determined by MI_DMp_CoS. The result (B_FD, F_FD, N_FD) is reported via a DMRp Sink Control process. If the proactive DM control process activates multiple monitoring on different CoS levels simultaneously, each result is independently managed per CoS level. Optional test ID TLVs can be utilized to distinguish each measurement, if multiple measurements are simultaneously activated in an ME.

Figure 8-33 provides the different processes inside MEPs and MIPs that are involved with proactive dual-ended DM.

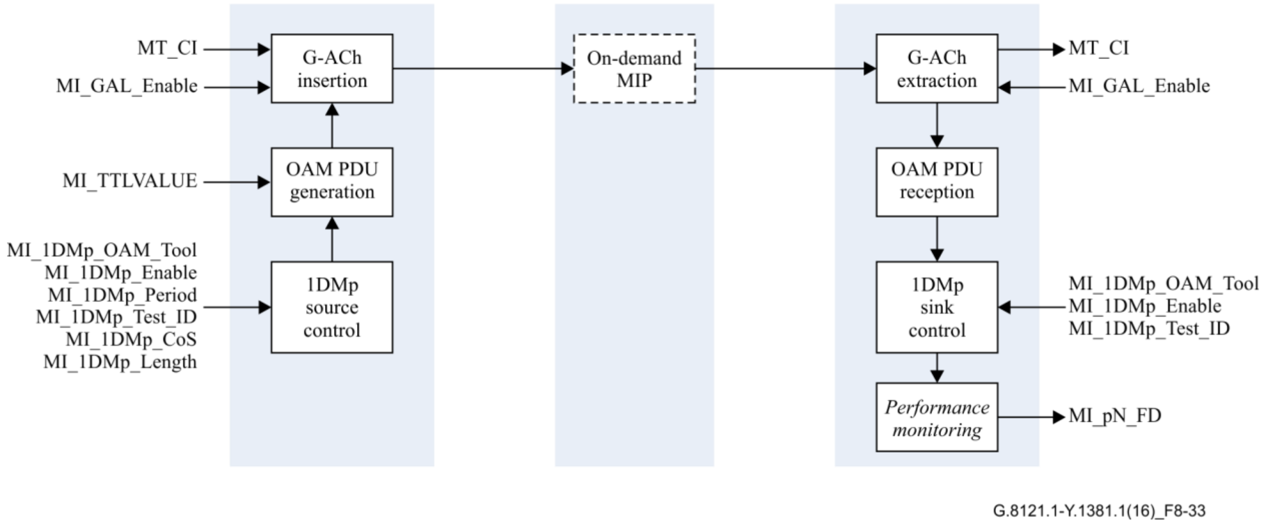

Figure 8-33 – Overview of processes involved with proactive dual-ended delay measurement

The MEP proactive-OAM source insertion process is defined in clause 9.2.1.1, the MEP proactive OAM sink extraction process in clause 9.2.1.2 and the MIP on-demand OAM sink extraction process in clause 9.4.2.2.

The 1DMp Source Control process triggers the generation of 1DMp traffic units if MI_1DM_Enable signal is set. The 1DM packets are generated with a periodicity determined by MI_1DMp_Period and with a priority determined by MI_1DMp_CoS. The result (N_FD) is reported via 1DMp Sink Control process.

8.8.6.2 Proactive DM Source Control Process

The behaviour of the proactive DM control process is defined in Figure 8-34. If the MI_DMp_Enable is asserted, the process starts to generate DMM packets (using the DMM(MI_DM_CoS,1, Test ID TLV,TLV) signal). The result (B_FD, F_FD, N_FD) is reported via a DMR reception.

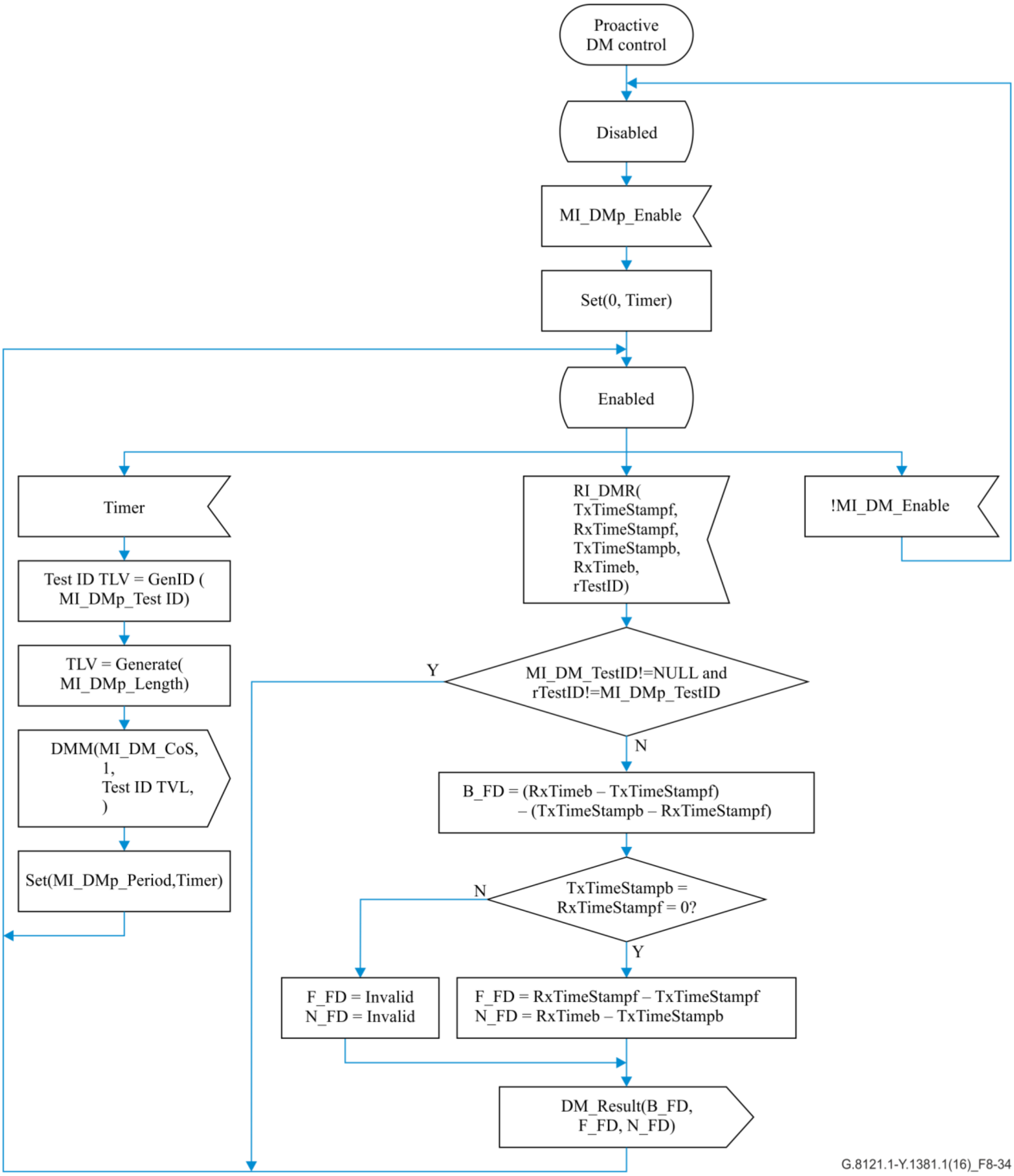

Figure 8-34 – Proactive DM control behaviour

8.8.6.3 Proactive DMM Generation Process

The behaviour of the DMMp generation process that is in the DMM Source control process is defined in Figure 8-35.

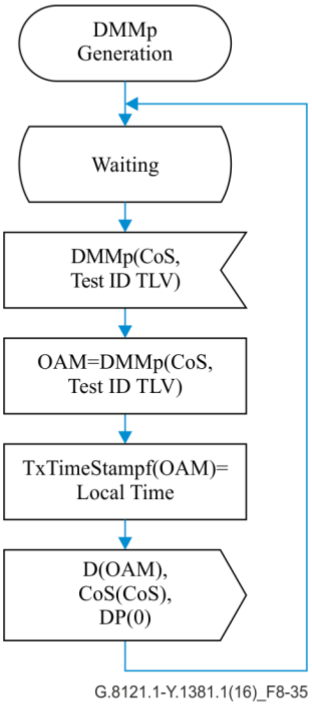

Figure 8-35 – DMM generation behaviour

Upon receiving the DMM(CoS, Test ID TLV), a single DMM traffic unit is generated together with the complementing CoS and DP signals. The TxTimeStampf field is assigned the value of the local time.

The CoS signal value is defined by DMM(CoS). The DP signal is set to 0. The test ID signal is determined by the DMM(Test ID TLV) signal.

8.8.6.4 Proactive DMM Reception Process

The proactive DMM reception process that is in the proactive DMM Sink control process processes the received proactive DMM traffic units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-36.

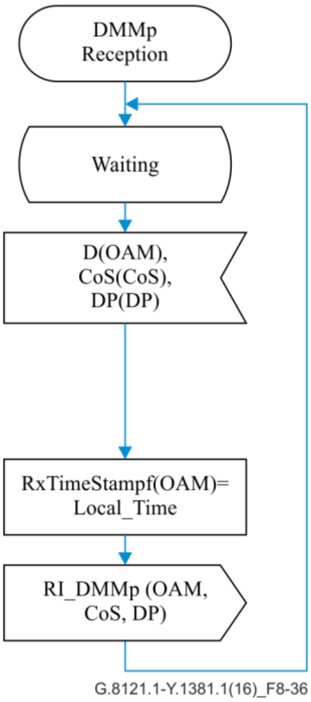

Figure 8-36 – DMM reception behaviour

Traffic Unit and the complementing CoS and DP signals are forwarded as RI to the DMR Generation Process.

8.8.6.5 Proactive DMR Generation Process

The Proactive DMR Generation Process that is in the DMR Source control process generates a DMRp Traffic Unit and its complementing CoS and DP signals. The behaviour is defined in Figure 8-37.

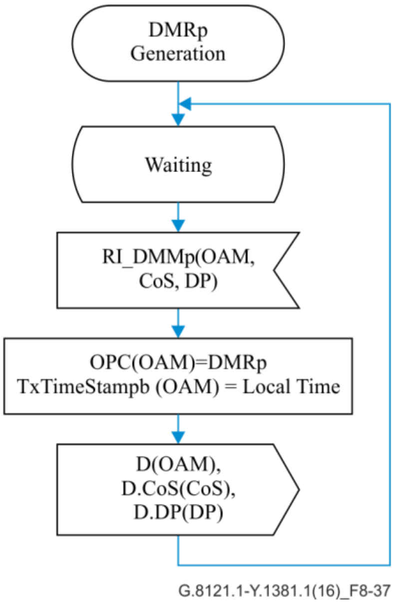

Figure 8-37 – Proactive DMR Generation behaviour

Upon the receipt of RI containing a DMMp Traffic Unit, the DMR generation process generates a DMR Traffic Unit and forwards it to the OAM insertion Process.

As part of the DMR generation:

– the Opcode is changed into DMRp Opcode;

– the TxTimeStampb field is assigned the value of the Local Time;

– all the other fields (including TLVs and padding after the End TLV) are copied from the RI containing the original DMM Traffic Unit.

The TLVs are copied from the RI containing the original DMM Traffic Unit. If multiple TLVs exist, the order of the TLVs is unchanged.

8.8.6.6 Proactive DMR Reception Process

The proactive DMR Reception Process that is in the DMRp Sink control process processes the received DMRp Traffic Units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-38.

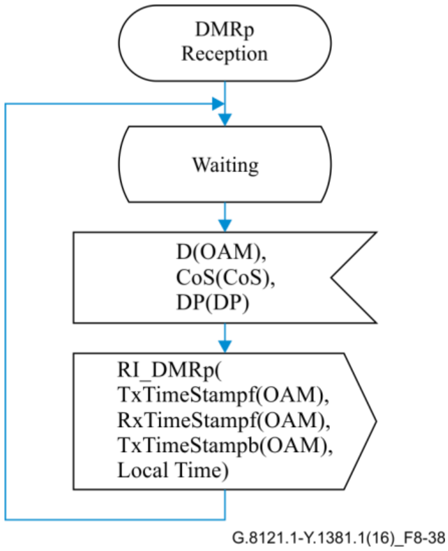

Figure 8-38 – DMR Reception behaviour

If the DMR Traffic Unit is processed, the TxTimeStampf, RxTimeStampf, TxTimeStampb and Test ID are extracted from the Traffic Unit and signalled together with the Local Time.

8.8.6.7 Proactive 1DM Source Control Process

The behaviour of the proactive 1DM control process is defined in Figure 8-39.

If the MI_1DMp_Enable is asserted, the process starts to generate 1DMp packets (using the 1DMp(MI_1DMp_CoS, Test ID TLV) signal.

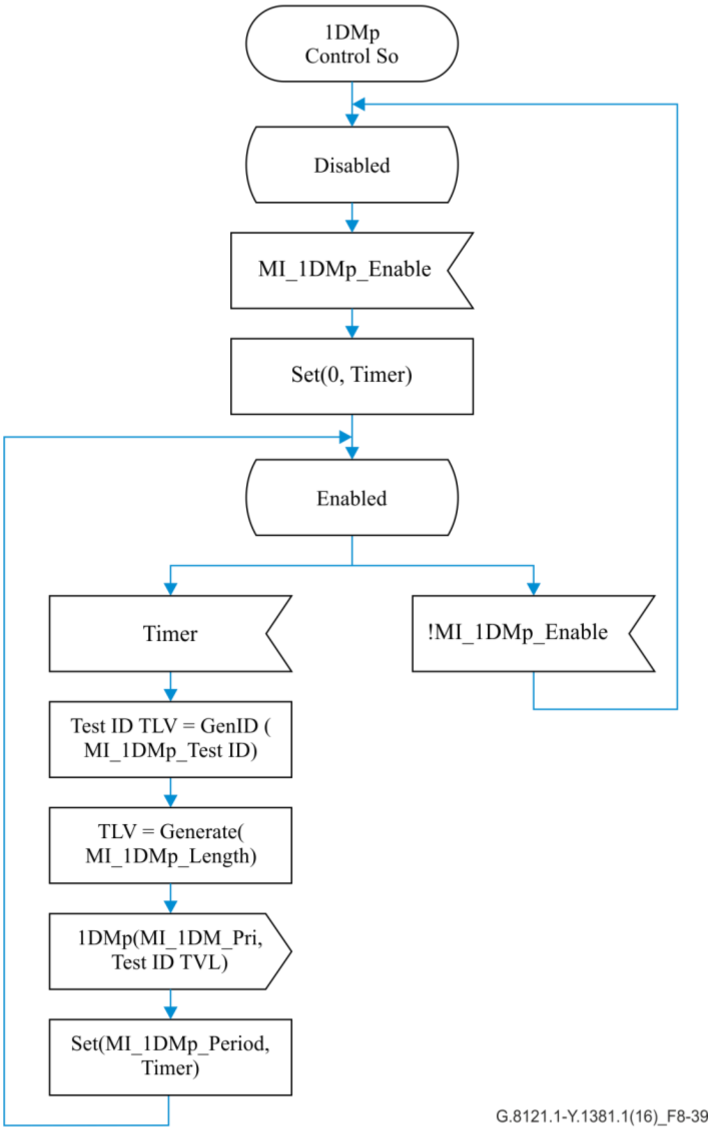

Figure 8-39 – Proactive 1DM Control_So behaviour

8.8.6.8 Proactive 1DM Generation Process

Figure 8-40 shows the proactive 1DM Generation Process in the 1DM Source control process. Upon receiving the 1DMp(CoS) signal, a single 1DM Traffic Unit is generated by the OAM=1DM (CoS, LocalTime) call.

Together with this 1DMp Traffic Unit, the complementing CoS and DP signals are generated. The TxTimeStampf field is assigned the value of the Local Time. The value of the CoS signal is determined by the 1DMp(CoS) signal. The DP signal is set to 0.

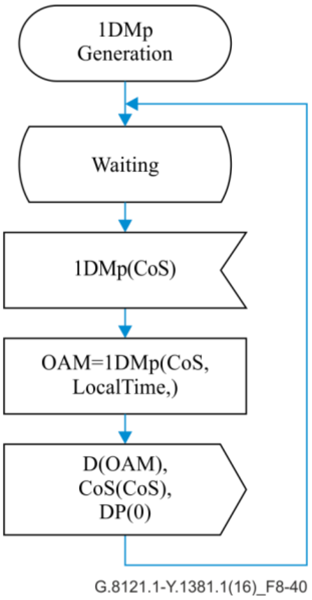

Figure 8-40 – 1DM Generation behaviour

8.8.6.9 Proactive 1DM Reception Process

The proactive 1DM Reception Process in the 1DM Sink control process processes the received 1DMp Traffic Units and the complementing P and CoS signals. The behaviour is defined in Figure 8-41.

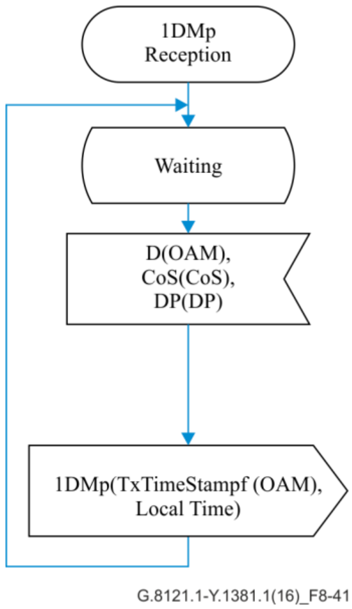

Figure 8-41 – 1DM Reception behaviour

If the 1DMp Traffic Unit is processed, the TxTimeStampf fields are extracted and forwarded to the 1DMp Control_Sk process together with the Local Time using the 1DMp (TxTimeStampf, RxTimef) signal.

8.8.6.10 Proactive 1DM Sink Control_Sk Process

The behaviour of the proactive 1DMp Control Sink Process is defined in Figure 8-42. If the MI_1DMp_Enable is asserted, the result (N_FD) is reported via a 1DMp reception.

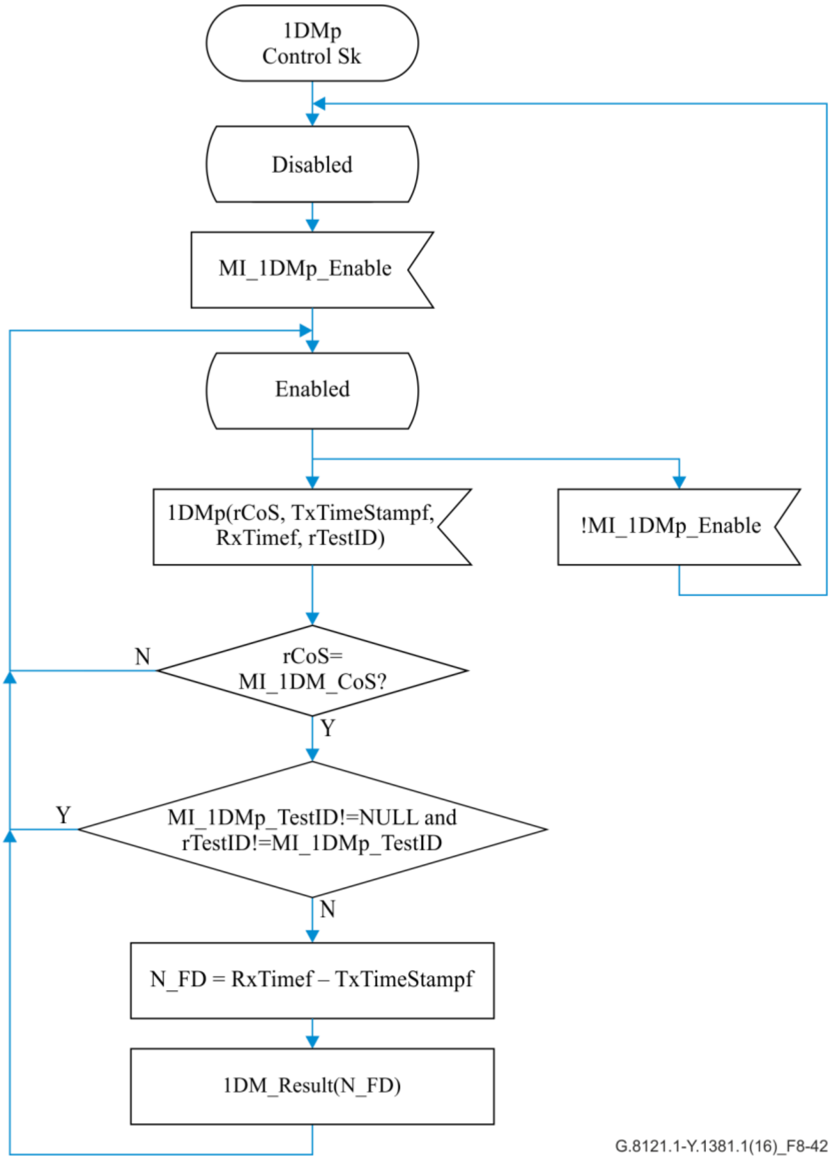

Figure 8-42 – Proactive 1DM Control Sink Process

8.8.7 On-Demand Packet Delay Measurement (DMo)

8.8.7.1 Overview

To support this functionality, on-demand Delay Measurement (DMM/DMR) as described in clause 8.2.7 of [ITU-T G.8113.1] for dual-ended and clause 8.2.8 of [ITU-T G.8113.1] for single-ended is used.

Figure 8-43 provides the different processes inside MEPs and MIPs that are involved in the single-ended Delay Measurement Protocol.

The MEP On-Demand-OAM Source insertion process is defined in clause 9.2, the MEP On-Demand OAM Sink extraction process in clause 9.2, the MIP On-Demand OAM Sink Extraction process in clause 9.4 and the MIP On-Demand OAM Source insertion process in clause 9.4. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_C_D Traffic Units and the complementing PHB signals going through an MEP and MIP;

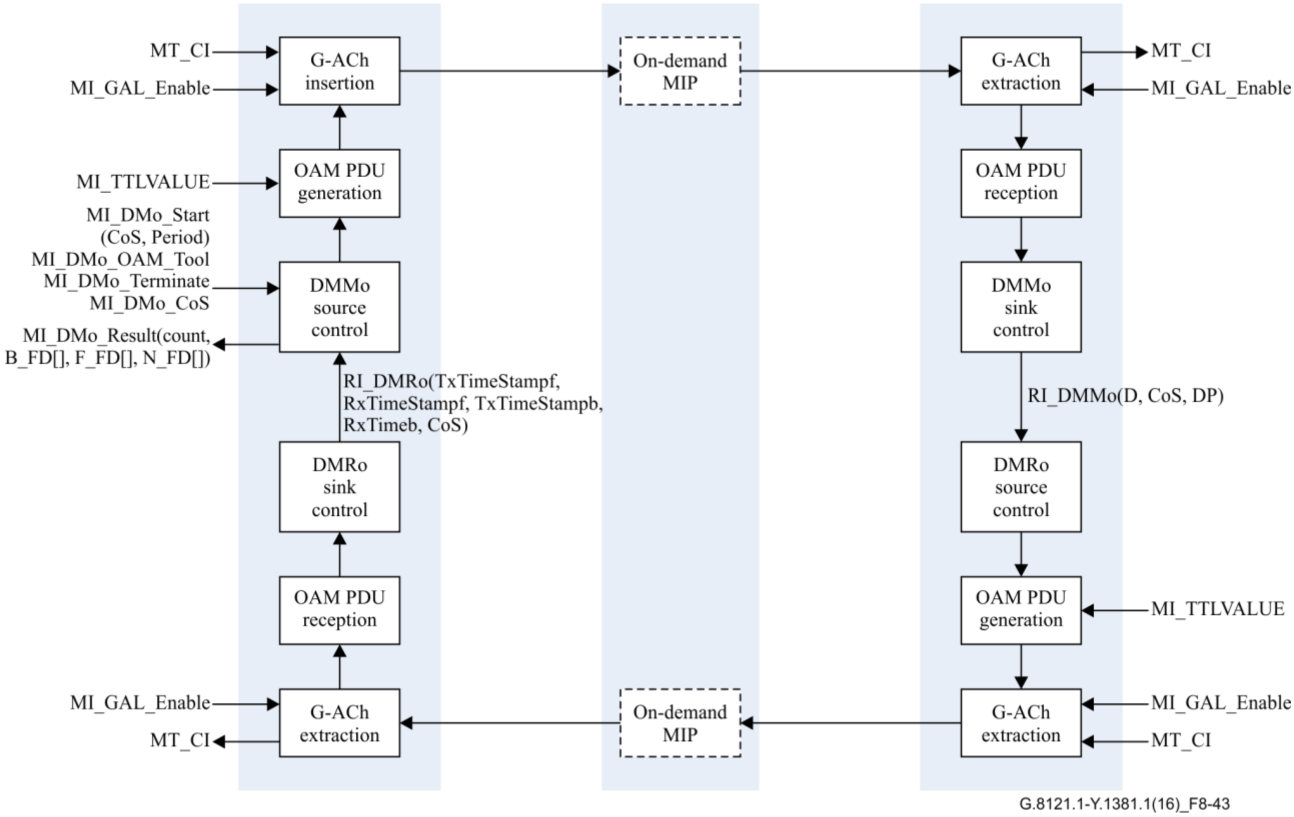

Figure 8-43 – Overview of Processes involved with on-demand Delay Measurement

The DMMo source control process controls the DM protocol. The protocol is activated upon receipt of the MI_DMo_Start(CoS,Period) signal and remains activated until the MI_DMo_Terminate signal is received. The result is communicated via the MI_DMo_Result(count, B_FD[], F_FD[], N_FD[]) signal.

The DMMo source control process generates DMMo Traffic Units that pass through MIPs transparently, but are received and processed by DMMo sink control processes in MEPs. The DMRo source control process may generate a DMRo Traffic Unit in response. This DMRo Traffic Unit also passes transparently through MIPs, but is received and processed by DMRo sink control processes in MEPs.

On the Source MEP side, the DMMo source control process stamps the value of the Local Time to the TxTimeStampf field in the DMMo message when the first bit of the packet is transmitted. Note that on the sink MEP side, the DMMo sink control process stamps the value of the Local Time to the RxTimeStampf field in the DMMo message when the last bit of the packet is received.

The DMRo source and sink control process stamps with the same way as the DMMo source and sink control process.

Figure 8-44 provides the different processes inside MEPs and MIPs that are involved in the dual-ended Delay Measurement Protocol.

The MEP On-Demand OAM Source insertion process is defined in clause 9.2, the MEP On-Demand-OAM Sink extraction process in clause 9.2, the MIP On-Demand OAM Sink Extraction process in clause 9.4 and the MIP On-Demand OAM Source insertion process in clause 9.4. In summary, these processes insert and extract MT_CI OAM signals into and from the stream of MT_CI_D Traffic Units and the complementing PHB signals going through an MEP and MIP.

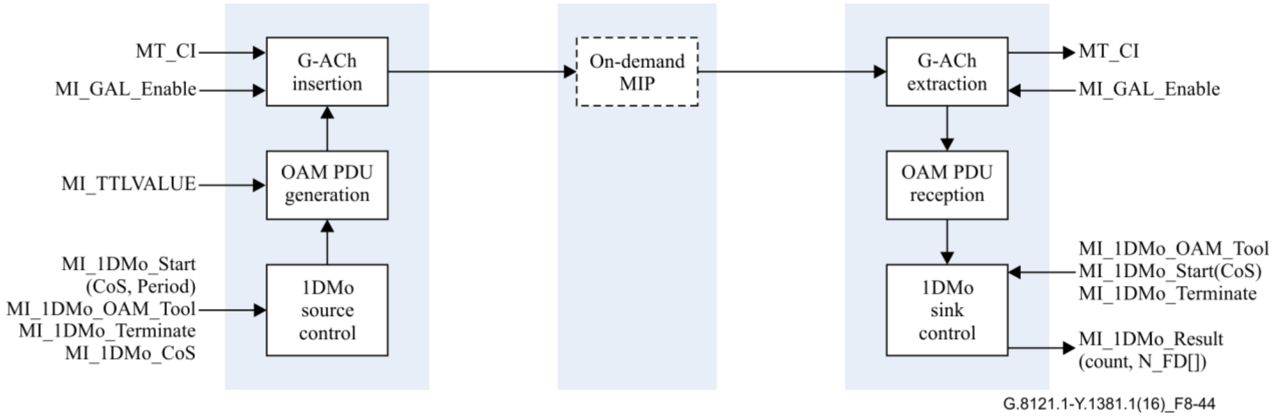

Figure 8-44 – Overview of Processes involved with on-demand One Way Delay Measurement

The 1DM protocol is controlled by the 1DM Source Control and 1DM Sink Control processes. The 1DM Source Control process triggers the generation of 1DM Traffic Units upon the receipt of an MI_1DM_Start(iPHB, oPHB, Period) signal. The 1DM Sink Control process processes the information from received 1DM Traffic Units after receiving the MI_1DM_Start(iPHB, oPHB, Period) signal.

The 1DM Source control process generates 1DM messages that pass transparently through MIPs and are received and processed by the 1DM Sink Control Process in MEPs.

On the Source MEP side, the 1DM source control process stamps the value of the Local Time to the TxTimeStampf field in the 1DM message when the first bit of the packet is transmitted. Note that on the sink MEP side, the 1DM sink control process records the value of the Local Time when the last bit of the packet is received.

8.8.7.2 On-demand DM Source Control Process

The behaviour of the DMMo Control Process is defined in Figure 8-45.

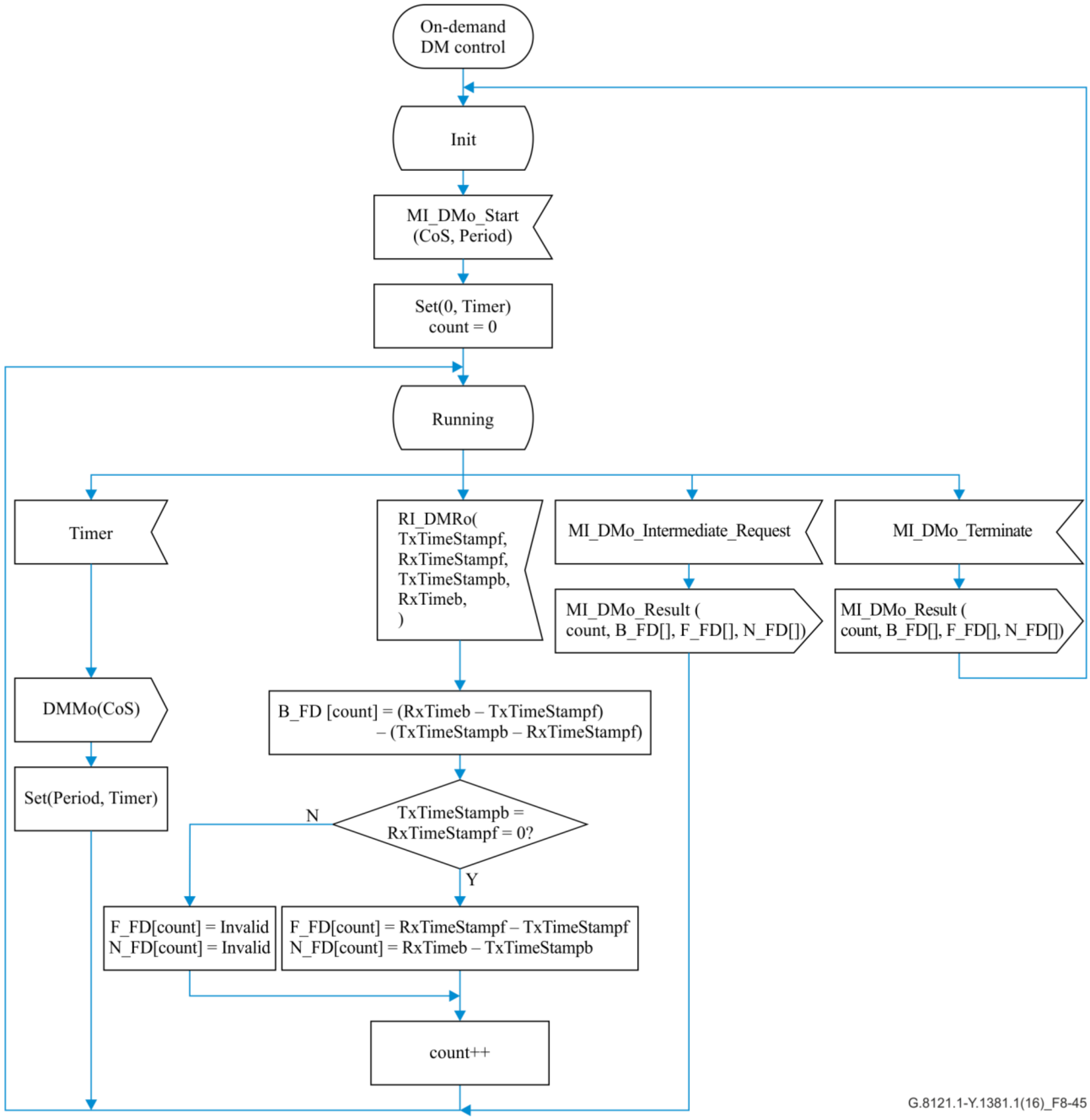

Figure 8-45 – DMMo Control behaviour

Upon receipt of the MI_DMo_Start(CoS, Period), the DM protocol is started. Every Period, the generation of a DMM packet is triggered (using the DMMo(CoS) signal) until the MI_DMo_Terminate signal is received. Upon receipt of a DMR Traffic Unit, the Delay value recorded by this particular DMRo Traffic Unit is calculated. This result is reported using the MI_DMo_Result(count, B_FD[], F_FD[], N_FD[]) signal after the receipt of the MI_DMo_Terminate signal. Note that the measurements of F_FD and N_FD are not supported by peer MEP if both TxTimeStampb and TxTimeStampf are zero.

8.8.7.3 On-demand DMM Generation Process

The behaviour of the DMM Generation Process that is in the DMMo Source control process is defined in Figure 8-46.

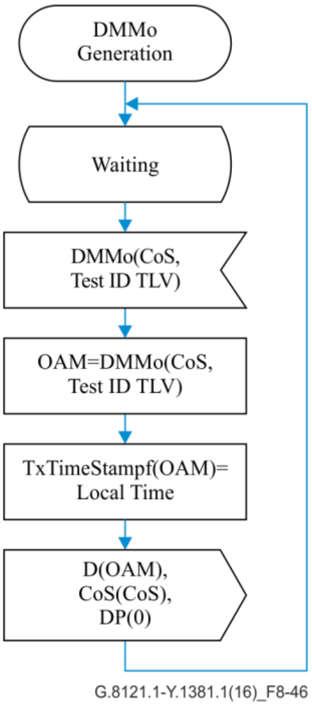

Figure 8-46 – DMMo Generation behaviour

Upon receiving the DMMo(CoS), a single DMM Traffic Unit is generated together with the complementing CoS and DP signals. The DA of the generated Traffic Unit is determined by the DMM(DA) signal. The TxTimeStampf field is assigned the value of the local time.

The CoS signal value is defined by DMMo(CoS).

8.8.7.4 On-demand DMM Reception Process

The DMMo Sink Control Process processes the received DMMo Traffic Units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-47.

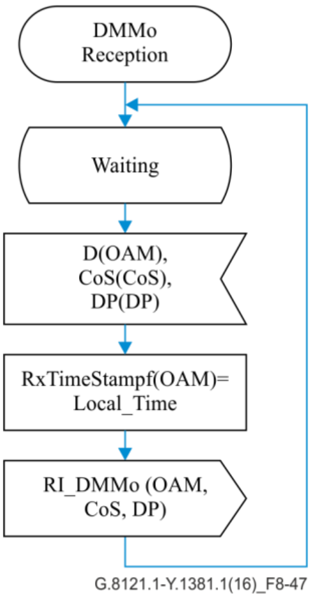

Figure 8-47 – DMMo Reception behaviour

The Traffic Unit and the complementing CoS and DP signals are forwarded as RI to the DMR Generation Process.

8.8.7.5 On-demand DMR Generation Process

The On-demand DMR Generation Process that is in the DMRo Source control process generates a DMRo Traffic Unit and its complementing CoS and DP signals. The behaviour is defined in Figure 8-48.

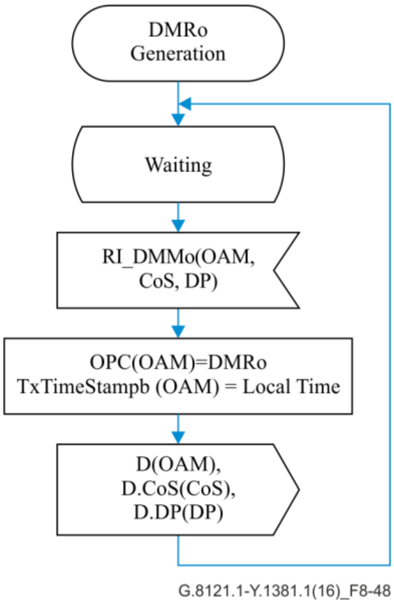

Figure 8-48 – On-demand DMR Generation behaviour

Upon the receipt of RI containing a DMMo Traffic Unit, the DMR generation process generates a DMR Traffic Unit and forwards it to the OAM insertion Process.

As part of the DMR generation:

– the Opcode is changed into DMRo Opcode;

– the TxTimeStampb field is assigned the value of the Local Time;

– all the other fields (including TLVs and padding after the End TLV) are copied from the RI containing the original DMM Traffic Unit.

The TLVs are copied from the RI containing the original DMM Traffic Unit. If multiple TLVs exist, the order of the TLVs is unchanged.

8.8.7.6 On-demand DMR Reception Process

The On-demand DMR Reception Process that is in the DMRo Sink control process processes the received DMRo Traffic Units and the complementing CoS and DP signals. The behaviour is defined in Figure 8-49.

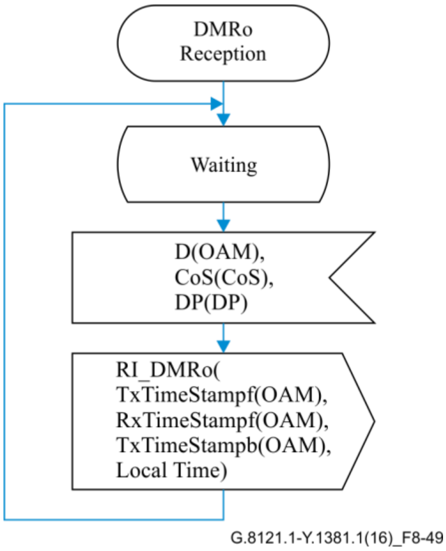

Figure 8-49 – DMR Reception behaviour

If the DMR Traffic Unit is processed, the TxTimeStampf, RxTimeStampf, TxTimeStampb and Test ID are extracted from the Traffic Unit and signalled together with the Local Time.

8.8.7.7 On-Demand 1DM Source Control Process

Figure 8-50 shows the behaviour of the on-demand 1DM Source Control Process. Upon receipt of the MI_1DMo_Start (D, CoS, Period) signal the 1DM protocol is started. The protocol runs until the receipt of the MI_1DM_Terminate signal.

If the On-demand DM protocol is running every Period (as specified in the MI_1DMo_Start signal), the generation of a 1DMo message is triggered by generating the 1DMo(CoS) signal towards the 1DMo Generation Process.

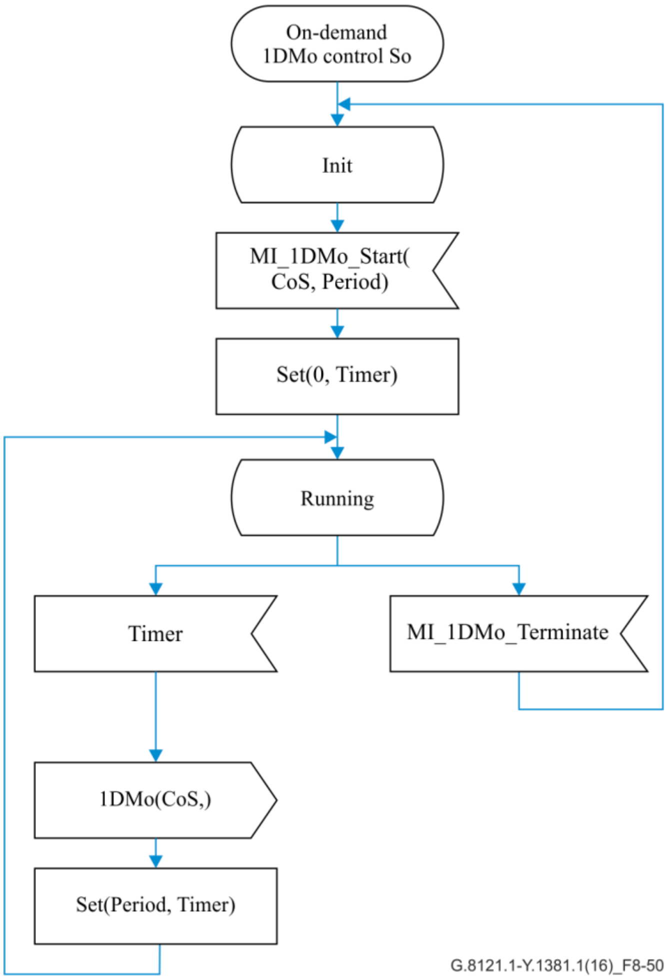

Figure 8-50 – On-demand 1DM Source Control behaviour

8.8.7.8 On-Demand 1DM Generation Process

Figure 8-51 shows the On-demand 1DM Generation Process in the 1DM Source control process. Upon receiving the 1DM(CoS) signal, a single 1DM Traffic Unit is generated by the OAM=1DM (CoS, LocalTime,) call.

Together with this 1DMo Traffic Unit, the complementing P and DE signals are generated. The TxTimeStampf field is assigned the value of the Local Time. The value of the P signal is determined by the 1DM(CoS) signal. The DP signal is set to 0.

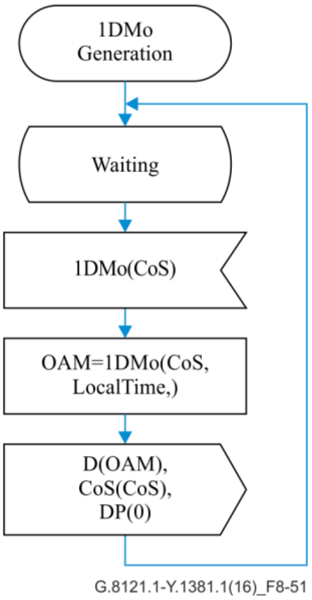

Figure 8-51 – 1DM Generation behaviour

8.8.7.9 On-Demand 1DM Reception Process

The On-demand 1DM Reception Process in the 1DM Sink control process processes the received 1DMo Traffic Units and the complementing P and CoS signals. The behaviour is defined in Figure 8-52.

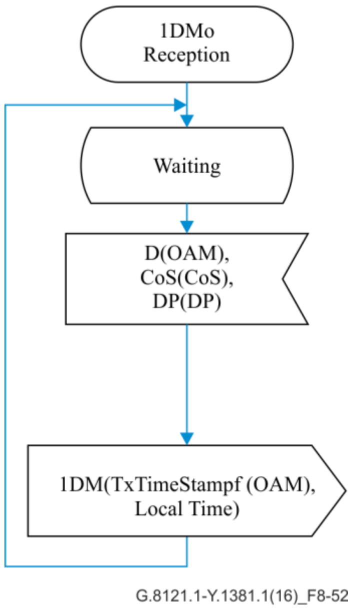

Figure 8-52 – 1DM Reception behaviour

If the 1DMo Traffic Unit is processed, the TxTimeStampf fields are extracted and forwarded to the 1DMo Control_Sk process together with the Local Time using the 1DMo (TxTimeStampf, RxTimef) signal.

8.8.7.10 On-Demand 1DM Sink Control_Sk Process

Figure 8-53 shows the behaviour of the on-demand 1DM Sink Control_Sk process. The protocol runs until the receipt of the MI_1DM_Terminate signal.

While running, the process processes the received 1DMo(TxTimeStampf,RxTimef,) information. Otherwise the Delay from the single received 1DM Traffic Unit is calculated. This result is reported using the MI_1DMo_Result(count, N_FD[]) signal after the receipt of the MI_1DM_Terminate signal.

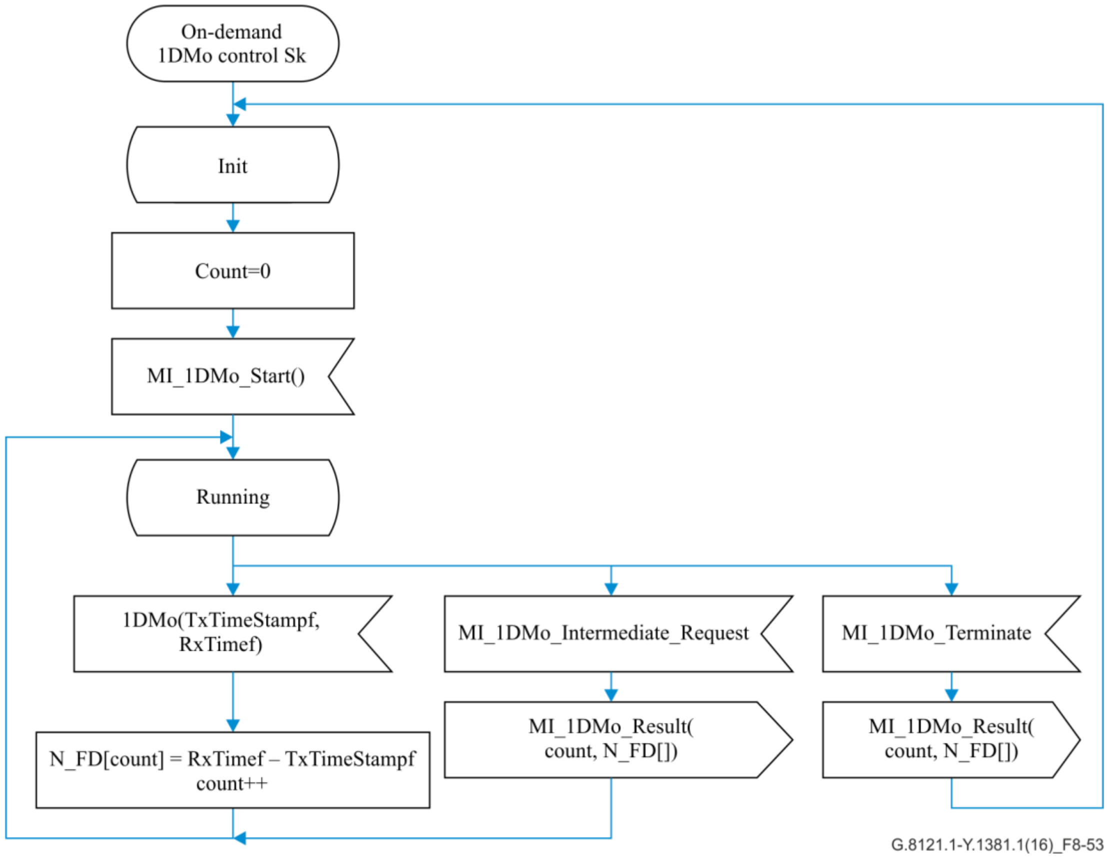

Figure 8-53 – On-demand 1DM Control_Sk Process

8.8.8 Test (TST) Process

8.8.8.1 Overview

To support OAM for a dual-ended Throughput (TH) Test, TST as described in clause 8.2.5 of [ITU-T G.8113.1] can be used. The control process specific to the TH Test is for further study.

Figure 8-54 provides the different processes inside MEPs and MIPs that are involved in the Test Protocol.

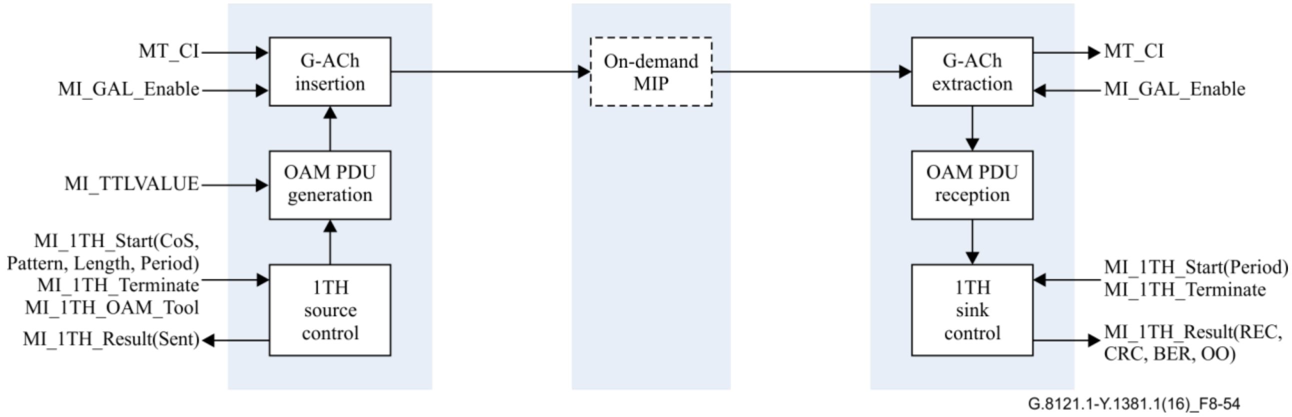

Figure 8-54 – Overview of Processes involved with Test Protocol

The TST(1TH) protocol is controlled by the TST(1TH) Source Control and TST(1TH) Sink Control processes. The TST(1TH) Source Control process triggers the generation of TST(1TH) Traffic Units after the receipt of an MI_1TH_Start (CoS, Pattern, Length, Period) signal. The TST(1TH) Sink Control process processes the information from received TST Traffic Units after receiving the MI_1TH_Start (Pattern) signal.
The TST Source control process generates TST messages that pass transparently through MIPs and are received and processed by the TST Sink Control Reception Process in MEPs.

The processes are described in clauses 8.8.8.2 to 8.8.8.5.

8.8.8.2 TST Source Control Process

Figure 8-55 defines the behaviour of the TST Source Control Process. This process triggers the transmission of TST Traffic Units after receiving the MI_Test(CoS, DP, Pattern,Length,Period) signal. The transmission of TST(1TH) Traffic Units is triggered by the generation of the 1TH(CoS, DP,TLV,TID) signal. This is continued until the receipt of the MI_1TH_Terminate signal. After receiving this signal, the number of triggered TST Traffic Units is reported back using the MI_1TH_Result(Sent) signal.

The TLV field of the 1TH packets is determined by the Generate(Pattern, Length) function. For Pattern, the following types are defined:

0: "Null signal without CRC-32"

1: "Null signal with CRC-32"

2: "PRBS 2^31-1 without CRC-32"

3: "PRBS 2^31-1 with CRC-32"

The Length parameter determines the length of the generated TLV.

Generate(Pattern, Length) generates a Test TLV with length 'Length' to be included in the 1TH packet. Therefore, this TLV is passed using the 1TH(CoS,DP,TLV,TID) signal to the TST Generation Process.

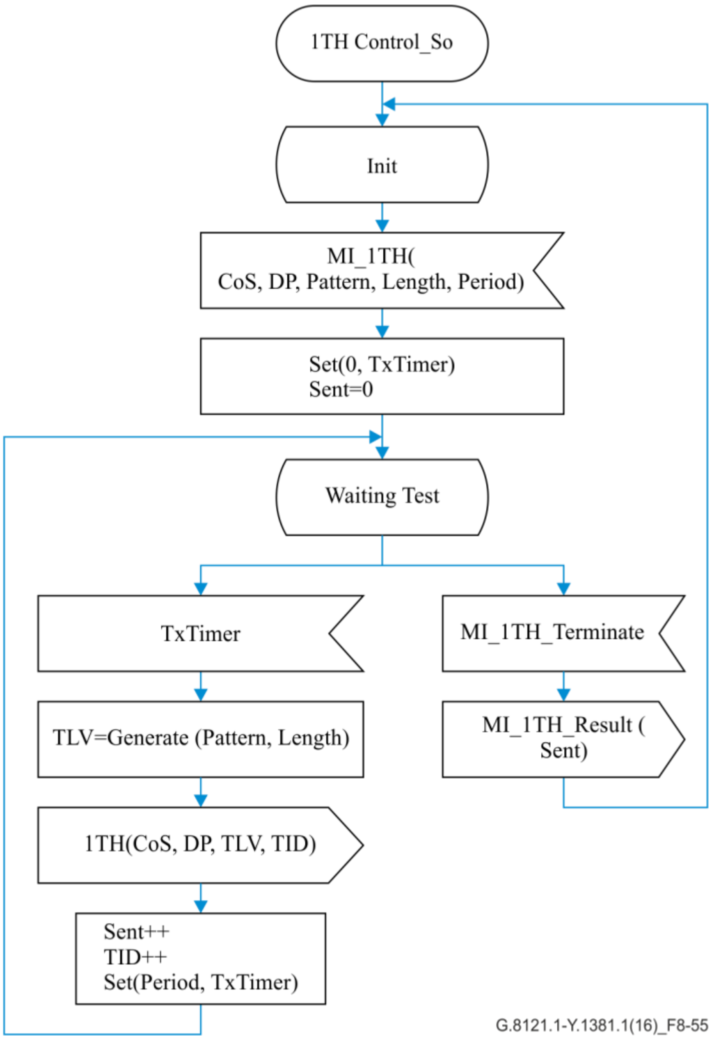

Figure 8-55 – TST Source Control behaviour

8.8.8.3 TST Generation Process

Figure 8-56 defines the behaviour of the TST Generation Process in Source control process.

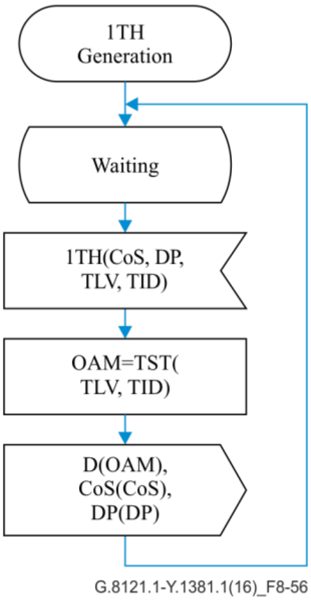

Figure 8-56 – TST Generation behaviour

Upon receiving the 1TH(CoS,DP,TLV,TID), a single 1TH Traffic Unit is generated together with the complementing CoS and DP signals. The 1TH Traffic Unit is generated by:

OAM=1TH(TLV,TID).

The Transaction Identifier field gets the value of 1TH(TID); the TLV field is populated with TST(TLV).

The CoS signal is determined by the 1TH(CoS) signal.

The DP signal is determined by the 1TH(DP) signal.

8.8.8.4 TST Reception Process

Figure 8-57 defines the behaviour of the TST Reception Process that is in the Sink control process.

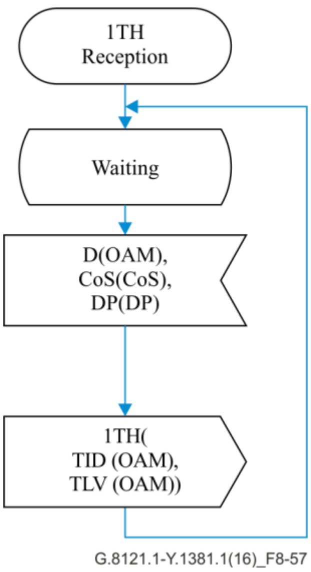

Figure 8-57 – TST Reception behaviour

8.8.8.5 TST Sink Control Process

Figure 8-58 shows the behaviour of the TST Sink Control process. The MI_1TH_Start signal starts the processing of 1TH messages coming from a MEP The protocol is running until the receipt of the MI_1TH_Terminate signal.

While running, the process processes the received 1TH(rTLV,TID) information.

First, the received 1TH counter is incremented by one (REC++). Furthermore, if the TLV contains a CRC (Pattern 1 or 3), the CRC counter is incremented by one (CRC++) if the CRC check fails. The function Check(Pattern, TLV) compares the received Test Pattern with the expected Test Pattern. If there is a mismatch, the BERR counter is incremented by one. If the TID value from the RI_LBR signal does not follow the last received TID value the counter for out of order packets is incremented by one (OO++).

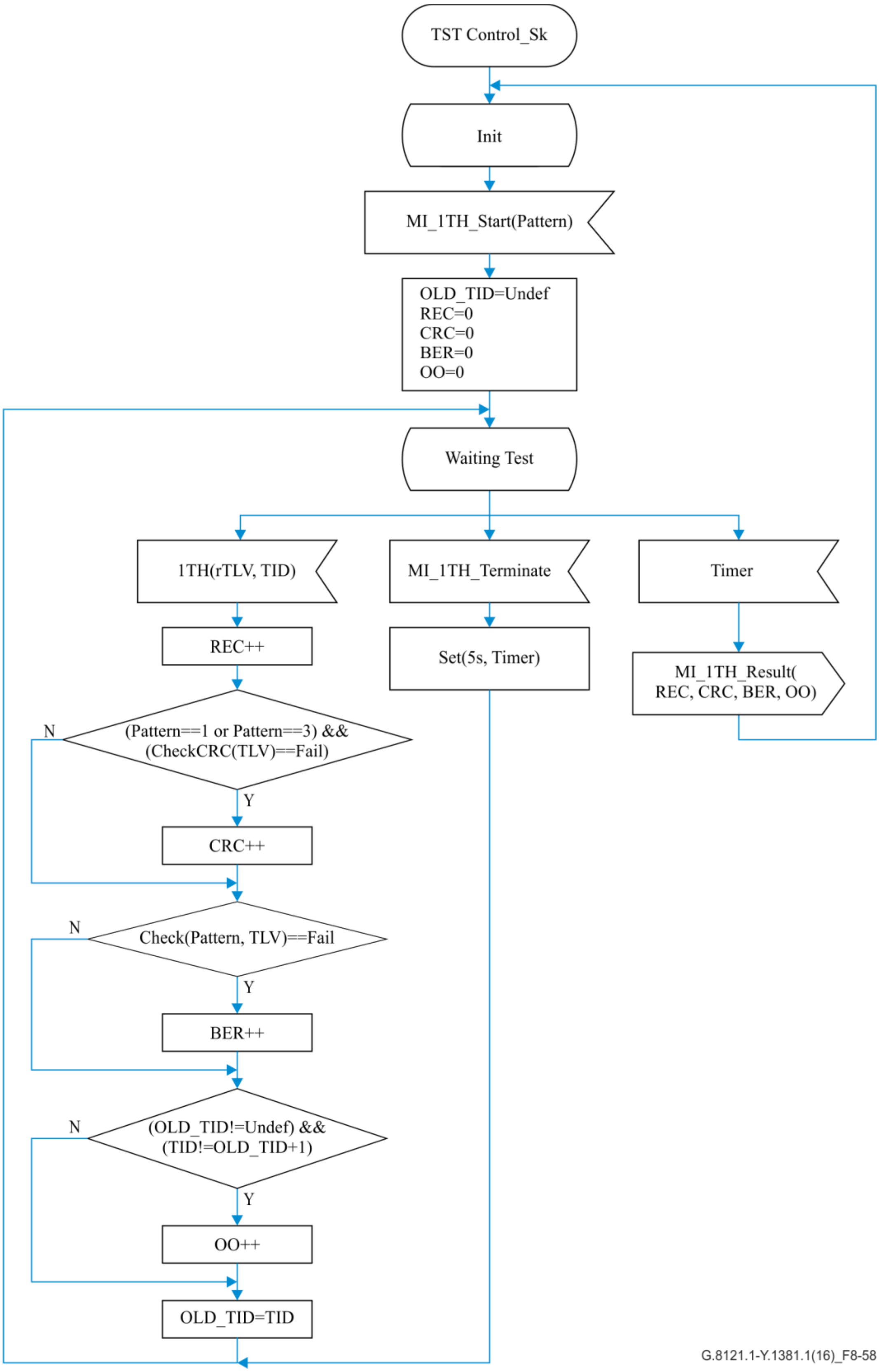

Figure 8-58 – TST Sink Control behaviour

8.8.9 Route Tracing (RT)

For further study.

8.8.10 LCK/AIS Reception

See clause 8.8.10 of [ITU-T G.8121].

9 MPLS-TP processes

9.1 Connection Functions (MT_C)

See clause 9.1 of [ITU-T G.8121].

9.1.1 Sub-network connection protection process

See clause 9.1.1 of [ITU-T G.8121].

9.2 Termination functions

9.2.1 MPLS-TP Trail Termination function (MT_TT)

The bidirectional MPLS-TP Trail Termination (MT_TT) function terminates the MPLS-TP OAM to determine the status of the MPLS-TP (sub)layer trail. The MT_TT function is performed by a co-located pair of the MPLS-TP trail termination source (MT_TT_So) and sink (MT_TT_Sk) functions, as shown in Figure 9-1.

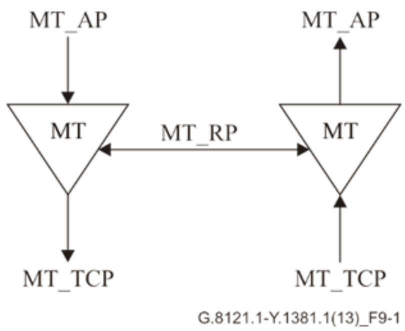

Figure 9-1 – MT_TT

9.2.1.1 MPLS-TP Trail Termination Source function (MT_TT_So)

The MT_TT_So function determines and inserts the time-to-live (TTL) value in the shim header TTL field and adds MPLS-TP OAM for pro-active monitoring to the MT_AI signal at its MT_AP.

- **Symbol**:

The MT_TT_So function symbol is shown in Figure 9-2.

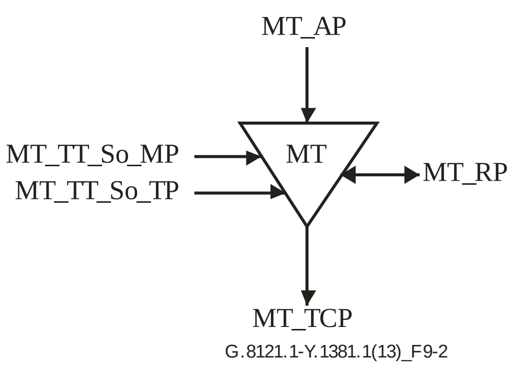

Figure 9-2 – MT_TT_So function

• **Interfaces**:

Table 9-1 – MT_TT_So inputs and outputs

Input(s)	Output(s)
MT_AP: MT_AI_D MT_AI_PHB **MT_RP:** MT_RI_CC_RDI MT_RI_CC_Blk MT_RI_CC_RxFCl MT_RI_CC_TxFCf MT_RI_OAM_Info(D,CoS,DP) **MT_TT_So_MP:** MT_TT_So_MI_GAL_Enable MT_TT_So_MI_TTLVALUE MT_TT_So_MI_ MEG_ID MT_TT_So_MI_ MEP_ID MT_TT_So_MI_CC_OAM_Tool MT_TT_So_MI_RDI_OAM_Tool MT_TT_So_MI_LMC_Enable MT_TT_So_MI_CC_CoS MT_TT_So_MI_CC_Period MT_TT_So_MI_CC_Enable (Note) MT_TT_So_MI_LMp_OAM_Tool MT_TT_So_MI_LML_Enable[1...M_{LMp}] MT_TT_So_MI_LMp_Period[1...M_{LMp}] MT_TT_So_MI_LMp_CoS[1...M_{LMp}] MT_TT_So_MI_DMp_OAM_Tool MT_TT_So_MI_DMp_Enable[1...M_{DMp}] MT_TT_So_MI_DMp_Period[1...M_{DMp}] MT_TT_So_MI_DMp_Test_ID[1...M_{DMp}] MT_TT_So_MI_DMp_CoS[1...M_{DMp}] MT_TT_So_MI_DMp_Length[1...M_{DMp}]	**MT_TCP:** MT_CI_D MT_CI_oPHB MT_CI_iPHB **MT_RP:**

Table 9-1 – MT_TT_So inputs and outputs

Input(s)	Output(s)
MT_TT_So_MI_1DMp_OAM_Tool MT_TT_So_MI_1DMp_Enable[1...M_{1DMp}] MT_TT_So_MI_1DMp_Period[1...M_{1DMp}] MT_TT_So_MI_1DMp_Test_ID[1...M_{1DMp}] MT_TT_So_MI_1DMp_Length[1...M_{1DMp}] MT_TT_So_MI_1DMp_CoS[1...M_{1DMp}] MT_TP: MT_TT_So_TI_TimeStampl	
NOTE – MI_CVp_Enable defined in [ITU-T G.8121] is automatically configured true by setting MI_CC_Enable true.	

• **Processes**:

The processes associated with the MT_TT_So function are as depicted in Figure 9-3.

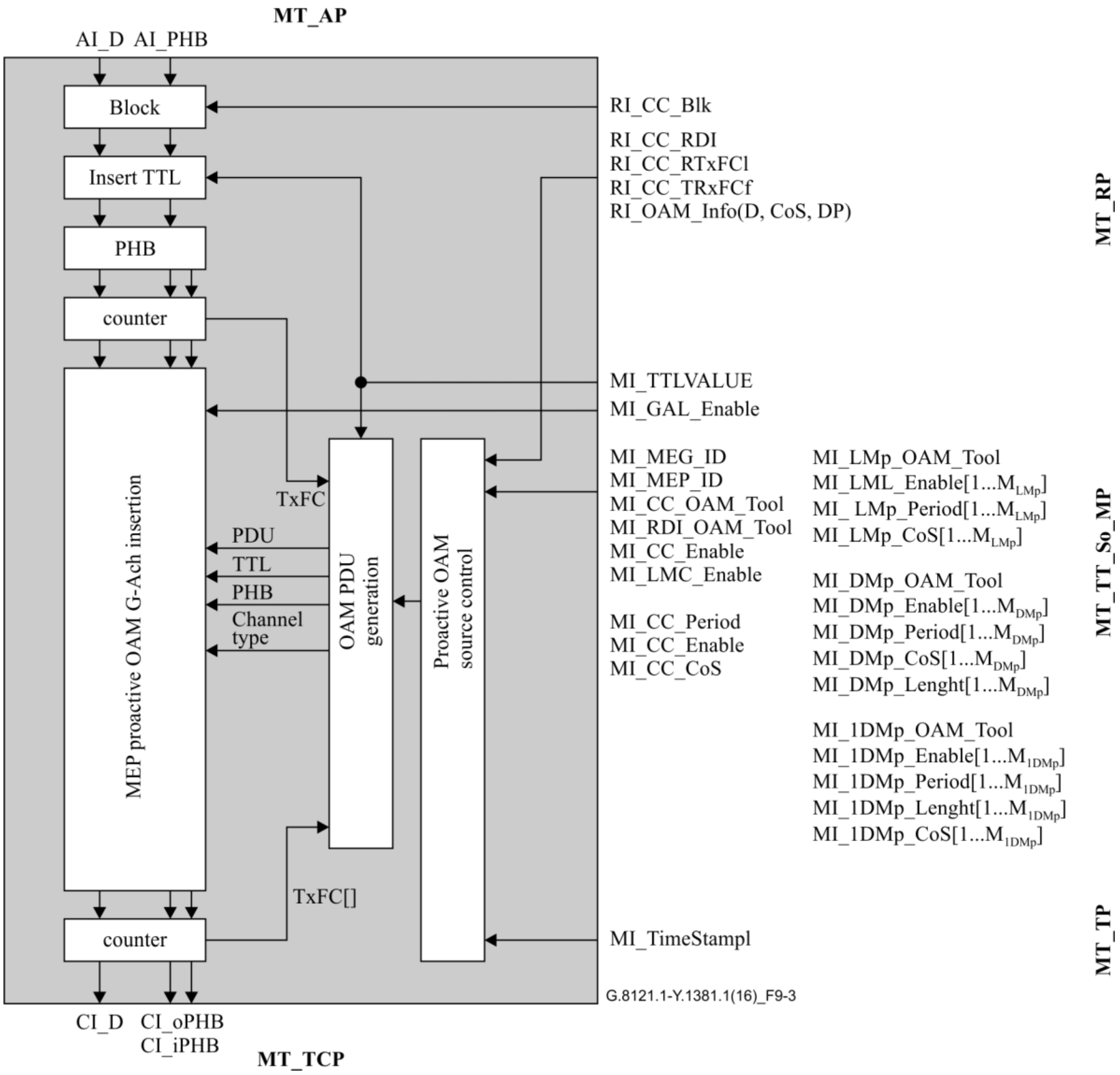

Figure 9-3 – MT_TT_So process diagram

PHB: See clause 9.2 of [ITU-T G.8121].

Extract TTL: See clause 9.2 of [ITU-T G.8121].

Block: See clause 9.2 of [ITU-T G.8121].

Counter: A counter is used to count packets for proactive loss measurements. See clause 8.8.1.4 for the upper counter in Figure 9-3 and clause 8.8.4.7 for the lower counter in Figure 9-3.

G-ACh/GAL Insertion: See clause 8.1 of [ITU-T G.8121].

Pro-active OAM Source Control: This process consists of the sub-processes shown in Figure 9-4. These details are in clause 8.8.

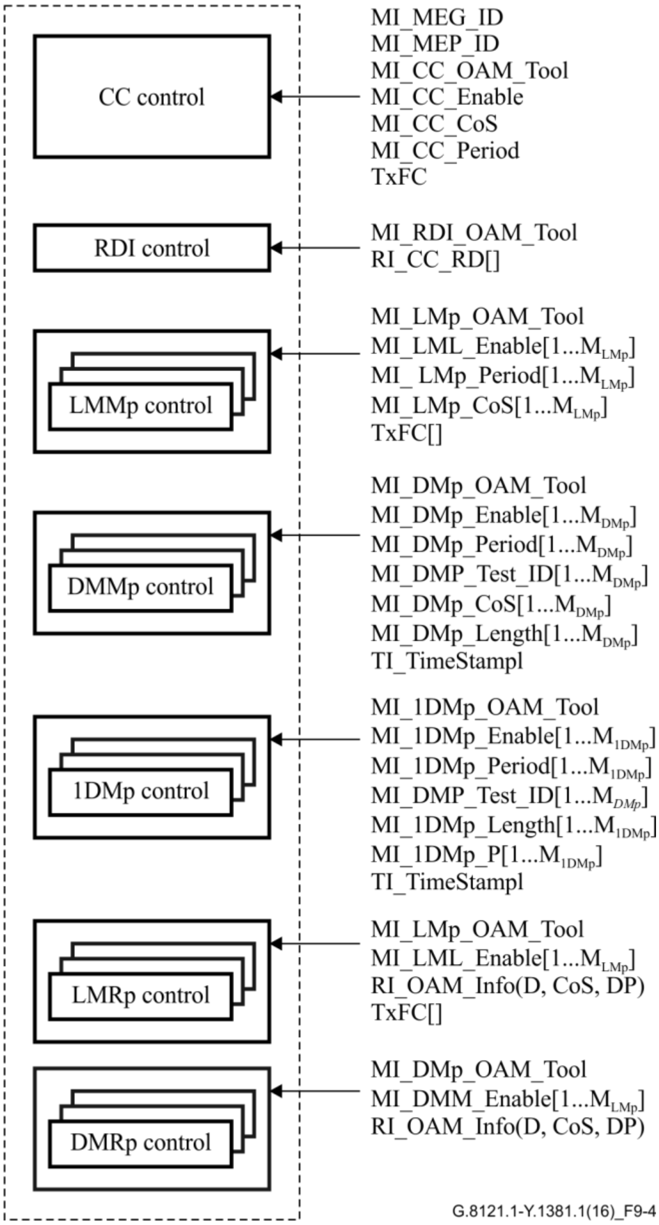

Figure 9-4 – Pro-active OAM Source Control Process

OAM PDU Generation Process: See clause 9.2 of [ITU-T G.8121].

- **Defects**:

None.

- **Consequent actions**:

None.

- **Defect correlations**:

None.

- **Performance monitoring**:

None.

9.2.1.2 MPLS-TP Trail Termination Sink function (MT_TT_Sk)

The MT_TT_Sk function reports the state of the MPLS-TP Trail (Network Connection). It extracts MPLS-TP trail OAM – for pro-active monitoring – from the MPLS-TP signal at its MT_TCP, detects defects, counts during 1 s periods errors and defects to feed PM when connected and forwards the defect information as backward indications to the companion MT_TT_So function.

NOTE – The MT_TT_Sk function extracts and processes one level of MPLS-TP OAM irrespective of the presence of more levels.

- **Symbol**:

The MT_TT_So function symbol is shown in Figure 9-5.

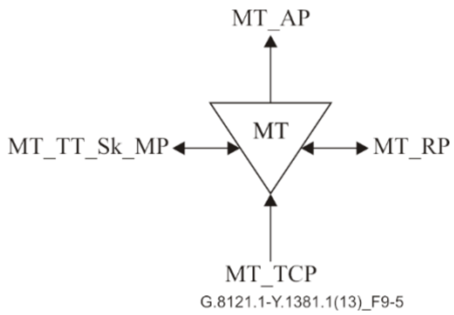

Figure 9-5 – MT_TT_Sk function

- **Interfaces**:

Table 9-2 – MT_TT_Sk inputs and outputs

Input(s)	Output(s)

Input(s)	Output(s)
MT_TCP: MT_CI_D MT_CI_iPHB MT_CI_oPHB MT_CI_SSF MT_CI_Lstack **MT_RP:** **MT_TT_Sk_MP:** MT_TT_Sk_MI_GAL_Enable MT_TT_Sk_MI_MEG_ID MT_TT_Sk_MI_PeerMEP_ID MT_TT_Sk_MI_CC_OAM_Tool MT_TT_Sk_MI RDI_OAM_Tool MT_TT_Sk_MI_CC_Enable (Note) MT_TT_Sk_MI_LMC_Enable MT_TT_Sk_MI_CC_Period MT_TT_Sk_MI_CC_CoS MT_TT_Sk_MI_Get_SvdCC MT_TT_Sk_MI_LM_DEGM MT_TT_Sk_MI_LM_M MT_TT_Sk_MI_LM_DEGTHR MT_TT_Sk_MI_LM_TFMIN MT_TT_Sk_MI_LMp_OAM_Tool [1... M_{LMp}] MT_TT_Sk_MI_LML_Enable[1... M_{LMp}] MT_TT_Sk_MI_LMp_CoS[1... M_{LMp}] MT_TT_Sk_MI_DMp_OAM_Tool[1… M_{DMp}] MT_TT_Sk_MI_DMp_Enable[1… M_{DMp}] MT_TT_Sk_MI_DMp_CoS[1… M_{DMp}] MT_TT_Sk_MI_1DMp_OAM_Tool[1...M_{1DMp}] MT_TT_Sk_MI_1DMp_Enable[1...M_{1DMp}] MT_TT_Sk_MI_1DMp_Test_ID[1...M_{1DMp}] MT_TT_Sk_MI_AIS_OAM_Tool MT_TT_Sk_MI_LCK_OAM_Tool MT_TT_Sk_MI_1second **MT_TP:** MT_TT_Sk_TI_TimeStampl	**MT_AP:** MT_AI_D MT_AI_PHB MT_AI_TSF MT_AI_TSD MT_AI_AIS MT_AI_LStack **MT_RP:** MT_RI_CC_RDI MT_RI_CC_Blk MT_RI_CC_RxFCl MT_RI_CC_TxFCf MT_RI_OAM_Info(D,CoS,DP) **MT_TT_Sk_MP:** MT_TT_Sk_MI_SvdCC MT_TT_Sk_MI_cSSF MT_TT_Sk_MI_cLCK MT_TT_Sk_MI_cLOC MT_TT_Sk_MI_cMMG MT_TT_Sk_MI_cUNM MT_TT_Sk_MI_cUNP MT_TT_Sk_MI_cUNC MT_TT_Sk_MI_cDEG MT_TT_Sk_MI_cRDI MT_TT_Sk_MI_pN_LF[1...P] MT_TT_Sk_MI_pN_TF[1...P] MT_TT_Sk_MI_pF_LF[1...P] MT_TT_Sk_MI_pF_TF[1...P] MT_TT_Sk_MI_pF_DS MT_TT_Sk_MI_pN_DS MT_TT_Sk_MI_pB_FD[1...P] MT_TT_Sk_MI_pB_FDV[1...P] MT_TT_Sk_MI_pN_FD[1...P] MT_TT_Sk_MI_pN_FDV[1...P] MT_TT_Sk_MI_pF_FD[1...P] MT_TT_Sk_MI_pF_FDV[1...P]
NOTE – MI_CVp_Enable defined in [ITU-T G.8121] is automatically configured true by setting MI_CC_Enable true.	

- **Processes**:

The processes associated with the MT_TT_Sk function are as depicted in Figure 9-6.

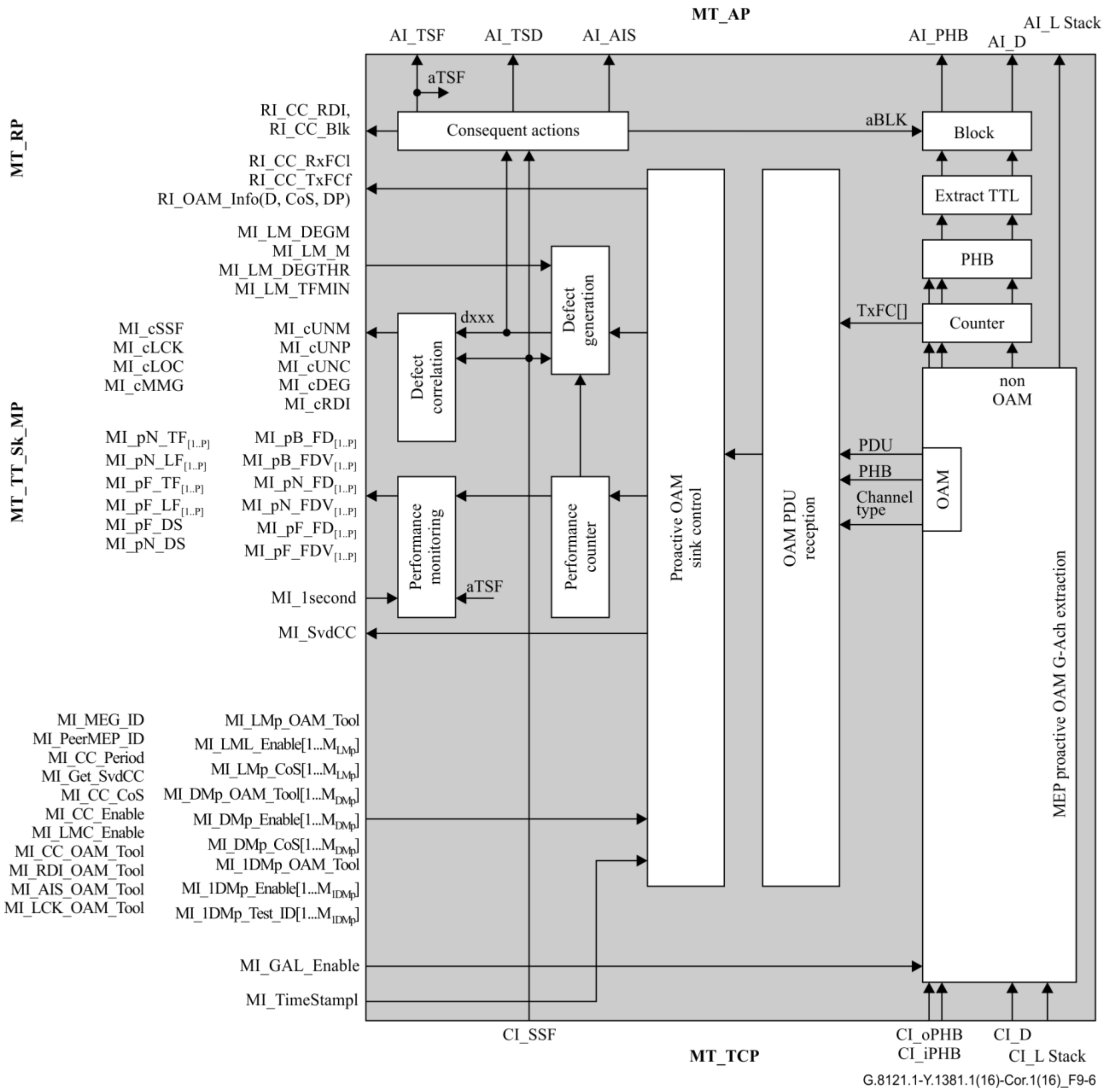

Figure 9-6 – MT_TT_Sk process diagram

PHB: The CI_oPHB signal is assigned to the AI_PHB signal at the reference point MT_AP.

Note that the CI_iPHB signal is not used by any of the processes in the function.

Extract TTL: The TTL value is extracted from the outer shim header's TTL field within the MT_CI traffic unit.

Block: When the aBlock consequent action is asserted, this process drops all traffic units arriving at its input.

Counter: A counter is used to count packets for proactive loss measurements. See clause 8.8.1.4 for the upper counter in Figure 9-6 and clause 8.8.4.7 for the lower counter in Figure 9-6.

G-ACh/GAL Extraction: See clause 8.1 of [ITU-T G.8121].

Pro-active OAM Sink Control: This process consists of the sub-processes shown in Figure 9-7 Thee details are in clause 8.8.

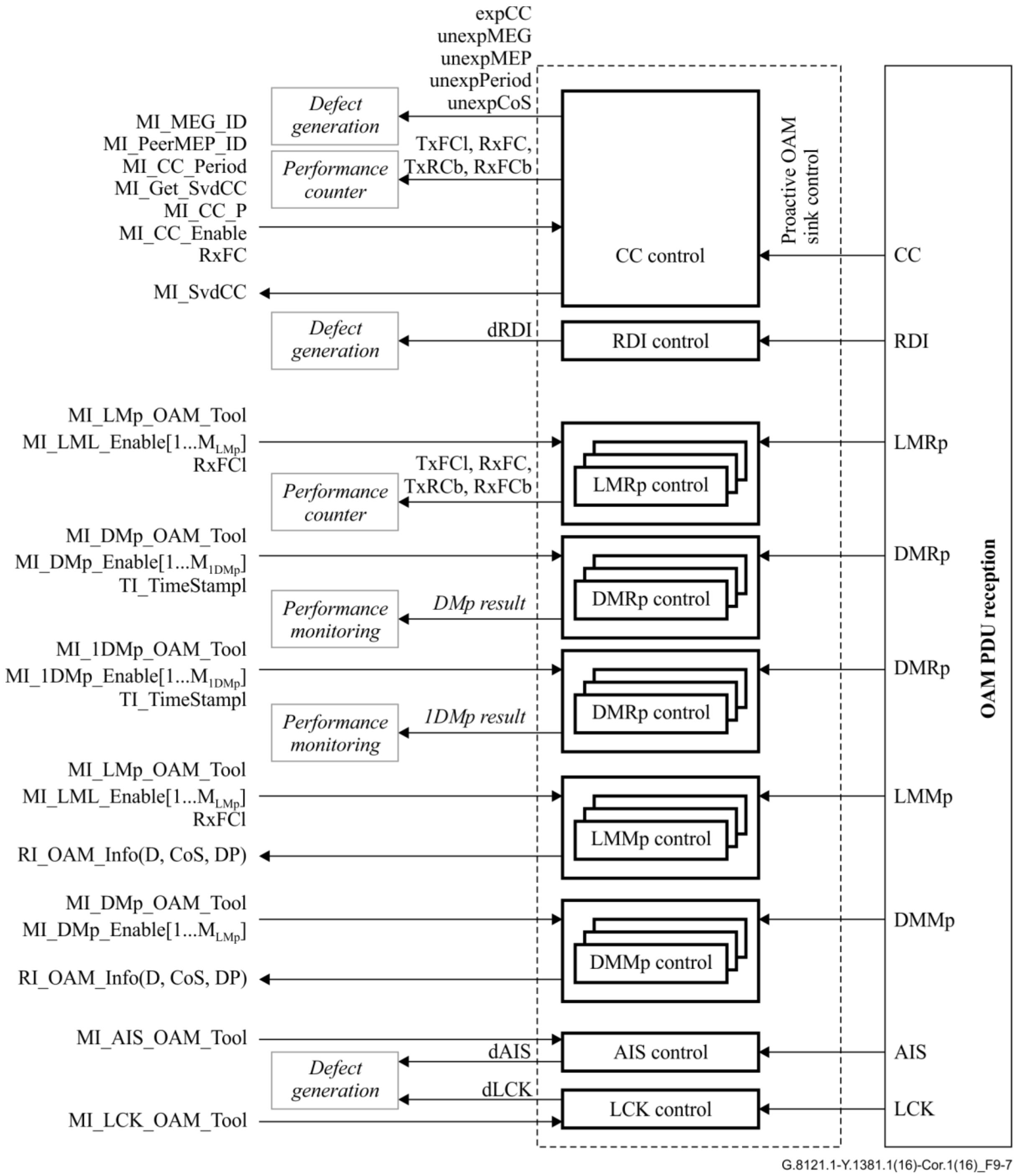

Figure 9-7 – Pro-active OAM Sink Control Process

OAM PDU Receptions: See clause 8.8 of [ITU-T G.8121].

Defect Generation: This process raises and clears the defects as defined in clause 6.1 of [ITU-T G.8121] that are dLOC, dMMG, dUNM, dDEG, dUNP, dUNPr, dRDI, dAIS, dLCK.

- **Defects**:

This function detects dLOC[i], dUNL, dMMG, dUNM, dDEG, dUNP, dUNPr, dRDI[i], dAIS, dLCK.

- **Consequent actions**:

aBLK ← (dUNL or dMMG or dUNM)

Note that dUNP and dUNPr do not contribute to aBLK, because a mismatch of periodicity is not considered to be a security issue.

aTSF ← (dLOC and MI_CC_Enable) or (dAIS and not(MI_CC_Enable)) or (dLCK and not(MI_CC_Enable)) or dUNL or dMMG or dUNM or CI_SSF

aTSD ← dDEG and (not aTSF)

aAIS ← aTSF

aRDI ← aTSF

- **Defect correlations:**

cLOC[i] ← dLOC[i] and (not dAIS) and (not dLCK) and (not CI_SSF) and (MI_CC_Enable)

cUNL ← dUNL

cMMG ← dMMG

cUNM ← dUNM

cDEG[1] ← dDEG[1] and (not dAIS) and (not dLCK) and (not CI_SSF) and (not (dLOC[1..n] or dUNL or dMMG or dUNM)) and (MI_CC_Enable))

cUNP ← dUNP

cUNPr ← dUNPr

cRDI ← (dRDI[1..n]) and (MI_CC_Enable)

cSSF ← CI_SSF or dAIS

cLCK ← dLCK and (not dAIS)

- **Performance monitoring**:

pN_TF ← N_TF

pN_LF ← N_LF

pF_TF ← F_TF

pF_LF ← F_LF

pN_DS ← aTSF

pF_DS ← aRDI[1]

pB_FD ← B_FD

pB_FDV ← B_FDV

pF_FD ← F_FD

pF_FDV ← F_FDV

pN_FD ← N_FD

pN_FDV ← N_FDV

9.3 Adaptation functions

9.3.1 MPLS-TP to MPLS-TP adaptation function (MT/MT_A)

This atomic functions are defined in clause 9.3.1 of [ITU-T G.8121]. They use the OAM protocol specific AIS insertion process and LCK generation process as defined in clauses 8.6.2 and 8.6.3, respectively.

9.4 MT Diagnostic Function

9.4.1 MT Diagnostic Trail Termination Functions for MEPs (MTDe)

The bidirectional MTDe Frail Termination (MTDe_TT) function is performed by a co-located pair of MTDe flow termination source (MTDe_TT_So) and sink (MTDe_TT_Sk) functions as shown in Figure 9-8.

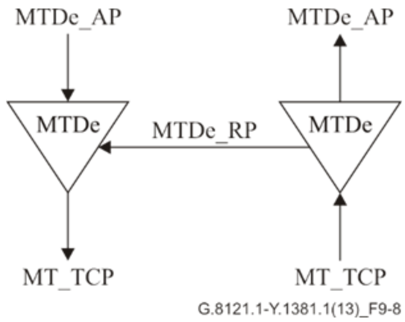

Figure 9-8 – MTDe_TT

9.4.1.1 MT Diagnostic Trail Termination Source Function for MEPs (MTDe_TT_So)

Symbol

The MTDe_TT_So function symbol is shown in Figure 9-9.

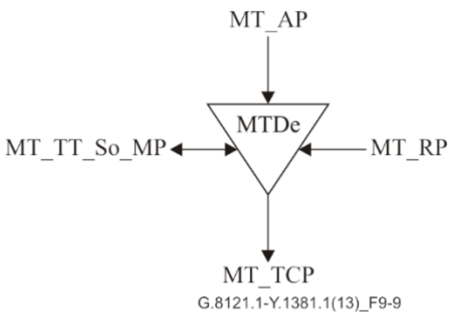

Figure 9-9 – MTDe_TT_So symbol

Interfaces

Table 9-3 – MTDe_TT_So interfaces

Input(s)	Output(s)
MTDe_AP: MTDe_AI_D MTDe_AI_oPHB MTDe_AI_iPHB MTDe_TT_RP: MTDe_RI_LMRo(TxFCf,RxFCf,TxFCb,RxFCl,CoS) MTDe_RI_DMRo(TxTimeStampf,RxTimeStampf, TxTimeStampb,RxTimeb,CoS) MTDe_RI_LMMo(D, CoS, DP) MTDE_RI_DMMo(D, CoS, DP) MTDE_RI_CVM(D, CoS, DP) MTDE_RI_CVR(rTLV, TID) **MTDe_TT_So_MP:** MTDe_TT_So_MI_ GAL_Enable MTDe_TT_So_MI_TTLVALUE MTDe_TT_So_MI_MEP_ID MTDe_TT_So_MI_CV_OAM_Tool MTDe_TT_So_MI_CV_Series (Target MEP/MIP ID,CoS,N,Length,Period) MTDe_TT_So_MI_CV_Test(CoS, Pattern, Length,Period) MTDe_TT_So_MI_CV_Terminate MTDe_TT_So_MI_1TH_OAM_Tool MTDe_TT_So_MI_1TH_Start(CoS, Pattern, Length,Period) MTDe_TT_So_MI_1TH_Terminate MTDe_TT_So_MI_ LMo_OAM_Tool[1...M_{LMo}] MTDe_TT_So_MI_LMo_Start(CoS,Period) [1...M_{LMo}] MTDe_TT_So_MI_LMo_Intermediate_Request[1...M_{LMo}] MTDe_FT_So_MI_LMo_Terminate[1...M_{LMo}] MTDe_TT_So_MI_ DMo_OAM_Tool[1...M_{DMo}] MTDe_TT_So_MI_DMo_Start (CoS, ,Period)[1...M_{DMo}] MTDe_TT_So_MI_DMo_Intermediate_Request[1...M_{DMo}] MTDe_TT_So_MI_DMo_Terminate[1...M_{DMo}] MTDe_TT_So_MI_ 1DMo_OAM_Tool[1...M_{1DMo}] MTDe_TT_So_MI_1DMo_Start (CoS, Period)[1...M_{1DMo}] MTDe_TT_So_MI_1DMo_Terminate[1...M_{1DMo}] MTDe_TT_So_TP: MTDe_TT_So_TI_ TimeStampl	**MT_TCP:** MT_CI_D MT_CI_oPHB MT_CI_iPHB **MTDe_TT_So_MP:** MTDe_TT_So_MI_CV_Series_Result(REC,ERR,OO) MTDe_TT_So_MI_CV_Test_Result(Sent, REC, REC,ERR,OO) MTDe_TT_So_MI_1TH_Result(Sent) MTDe_TT_So_MI_LMo_Result(N_TF,N_LF,F_TF,F_LF)[1...M_{LMo}] MTDe_TT_So_MI_DMo_Result(count,B_FD[],F_FD[],N_FD[])[1...M_{DMo}]

Processes

The processes associated with the MTDe_TT_So function are as depicted in Figure 9-10.

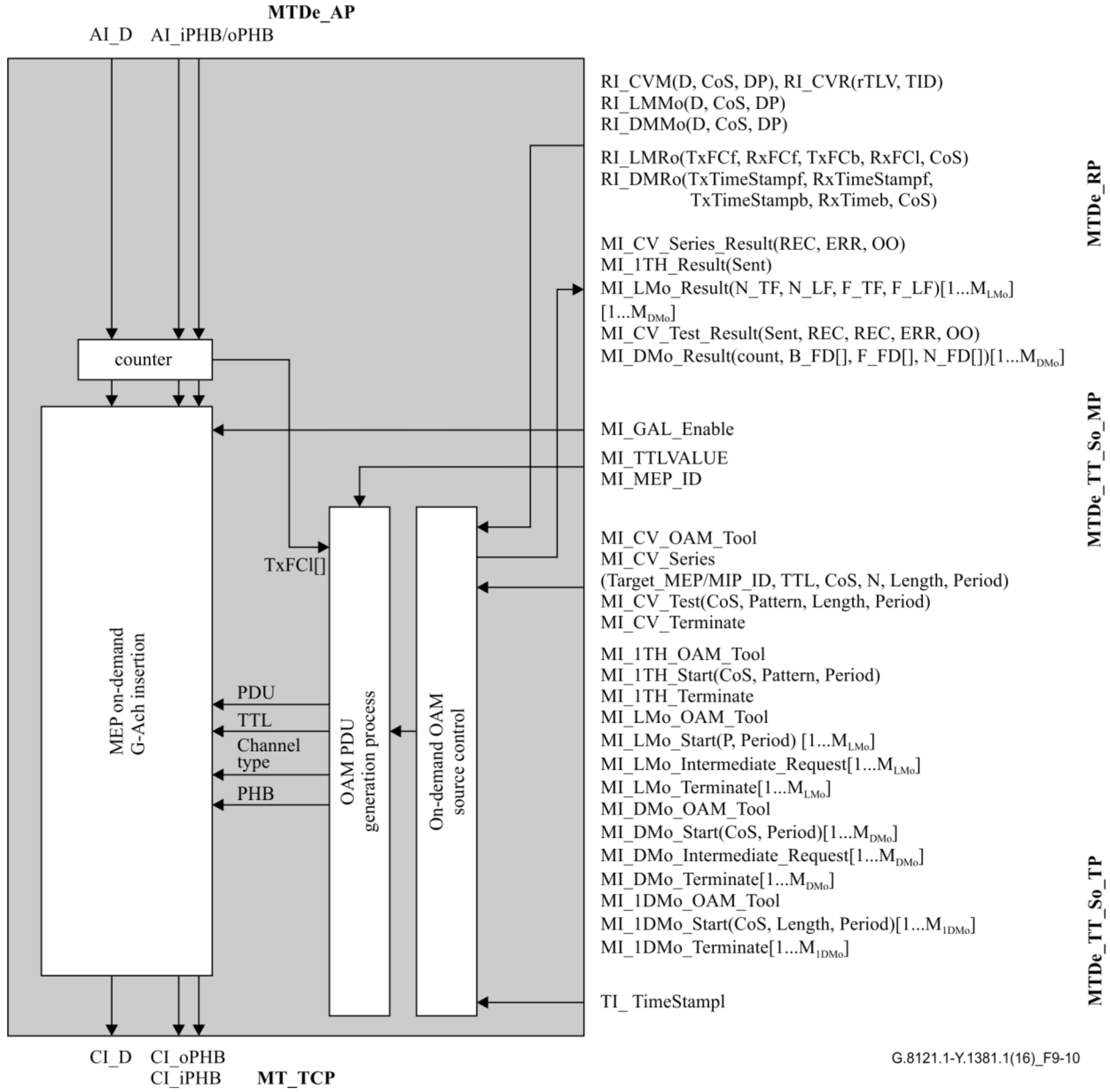

Figure 9-10 – MTDe_TT_So Process

G-ACh/GAL Insertion: See clause 8.1 of [ITU-T G.8121].

On-demand OAM Source Control:

This process consists of the following sub-processes, in conjunction with the OAM PDU Generation Process, as shown in Figure 9-11. These details are in clause 8.8 of [ITU-T G.8121.1].

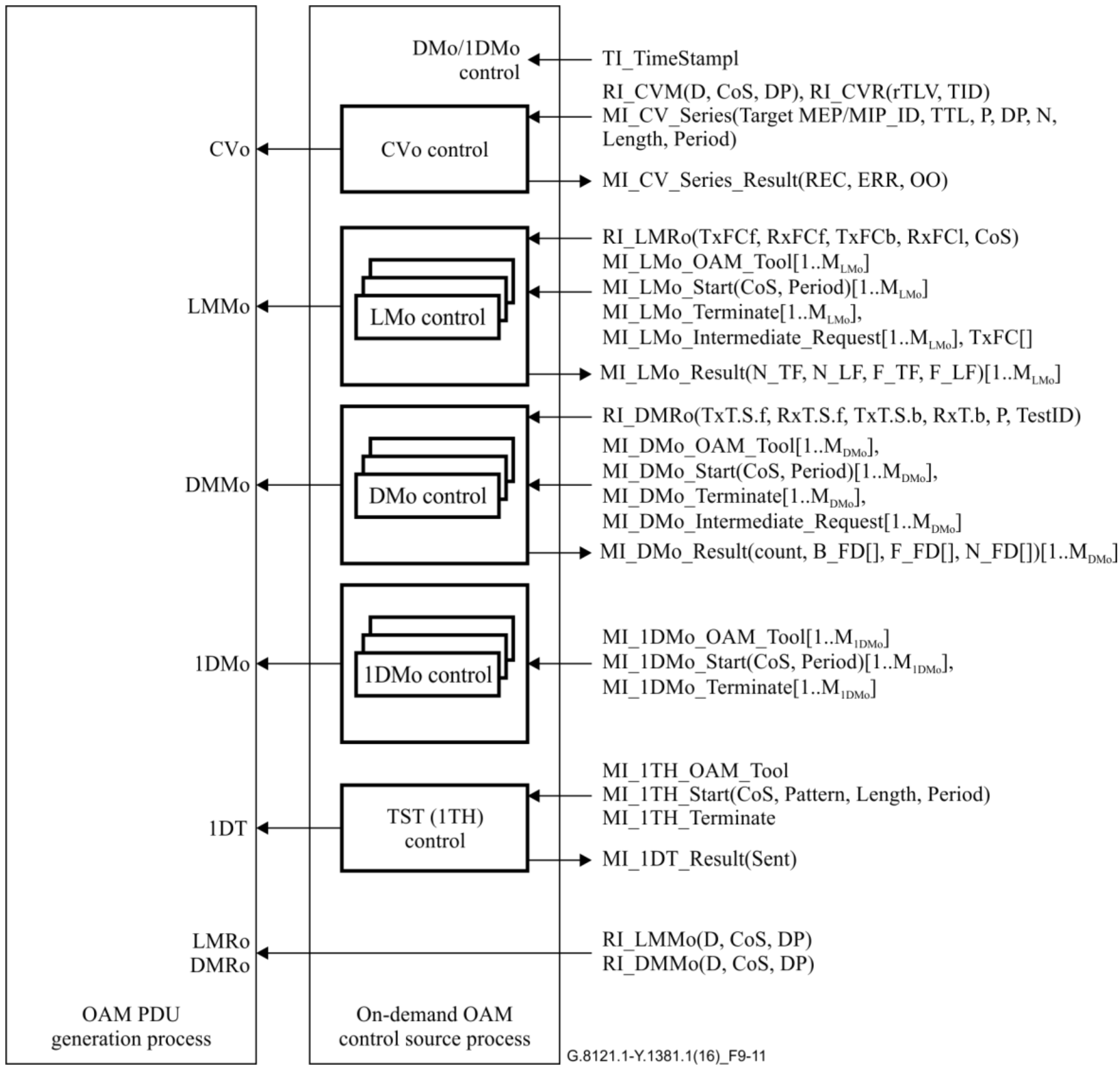

Figure 9-11 – On-demand OAM Source Control Process

On-demand OAM PDU Generation Process: See clause 8.8 of [ITU-T G.8121].

Counter: See clause 8.8.5.7 of [ITU-T G.8121.1].

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

9.4.1.2 MT Diagnostic Trail Termination Sink Function for MEPs (MTDe_TT_Sk)

Symbol

The MTDe_TT_Sk function symbol is shown in Figure 9-12.

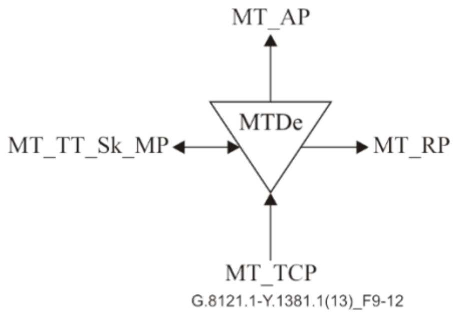

Figure 9-12 – MTDe_TT_Sk symbol

Interfaces

Table 9-4 – MTDe_TT_Sk interfaces

Input(s)	Output(s)
MT_TCP: MT_CI_D MT_CI_iPHB MT_CI_oPHB MT_CI_LStack **MT_RP**: **MTDe_TT_Sk_MP**: MTDe_TT_Sk_MI_GAL_Enable MTDe_TT_Sk_MI_MEP_ID MTDe_TT_Sk_MI_CV_OAM_Tool MTDe_TT_Sk_MI_1TH_OAM_Tool MTDe_TT_Sk_MI_1TH_Start(Period) MTDe_TT_Sk_MI_1TH_Terminate MTDe_TT_Sk_MI_LMo_OAM_Tool[1...M_{LMo}] MTDe_TT_Sk_MI_DMo_OAM_Tool[1...M_{DMo}] MTDe_TT_Sk_MI_1DMo_OAM_Tool[1...M_{1DMo}] MTDe_TT_Sk_MI_1DMo_Start(CoS)[1...M_{1DMo}] MTDe_TT_Sk_MI_1DMo_Intermediate_Request[1...M_{LMo}] MTDe_TT_Sk_MI_1DMo_Terminate[1...M_{1DMo}] **MTDe_TP**: MTDe_TT_Sk_TI_TimeStampl	**MTDe_AP**: MTDe_AI_D MTDe_AI_oPHB MTDe_AI_iPHB MTDe_AI_LStack **MTDe_RP**: MTDe_RI_CVM(D, CoS, DP) MTDe_RI_CVR(rTLV, TID) MTDe_RI_LMMo(D, CoS, DP) MTDE_RI_DMMo(D, CoS, DP) MTDe_RI_LMRo(TxFCf,RxFCf,TxFCb,RxFCl,CoS) MTDe_RI_DMRo(TxTimeStampf,RxTimeStampf,TxTimeStampb,RxTimeb,CoS,TestID) **MTDe_TT_Sk_MP**: MTDe_TT_Sk_MI_1TH_Result(REC,CRC,BER,OO) MTDe_TT_Sk_MI_1DMo_Result(count,N_FD[])[1..M_{DMo}]]

Processes

The processes associated with the MTDe_TT_Sk function are as depicted in Figure 9-13.

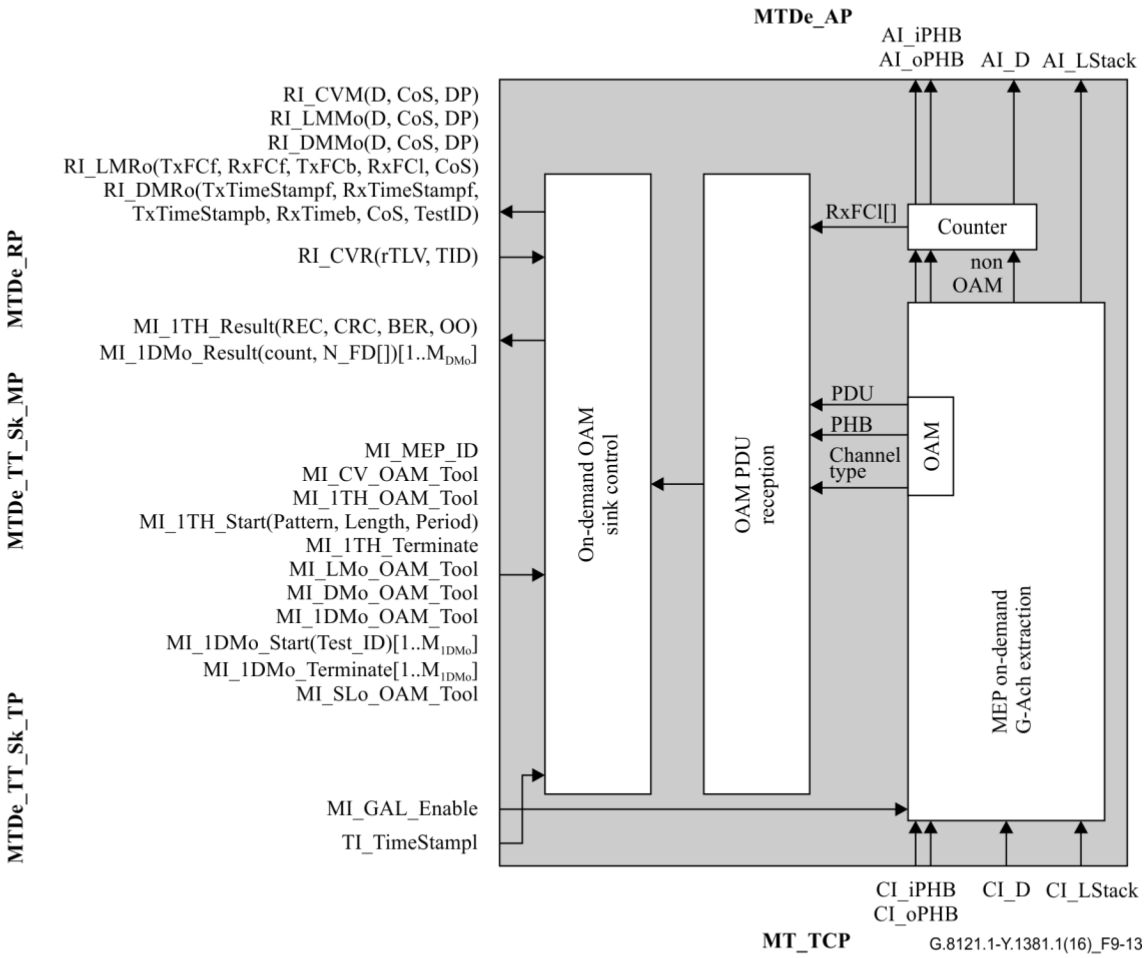

Figure 9-13 – MTDe_TT_Sk Process

G-ACh/GAL Extraction: See clause 8.1 of [ITU-T G.8121].

On-demand OAM PDU Reception: See clause 8.8 of [ITU-T G.8121].

On-demand OAM Sink Control: This process consists of following sub-processes, in conjunction with OAM PDU Generation Process, as shown Figure 9-13. These details are in clause 8.8.

Counter: See clause 8.8.5.7 of [ITU-T G.8121.1].

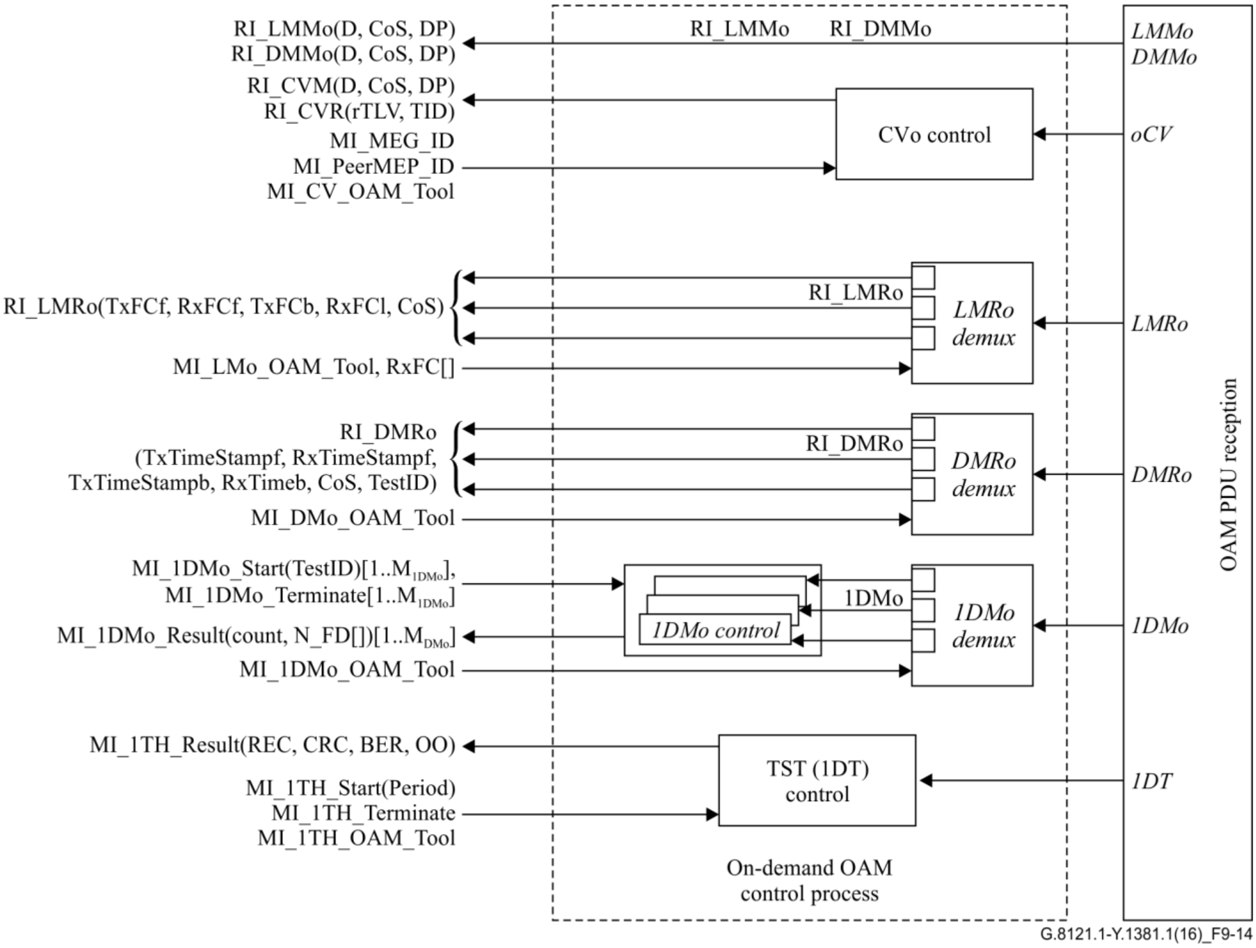

Figure 9-14 – On-Demand OAM Sink Control Process

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

9.4.2 MT Diagnostic Trail Termination Functions for MIPs

9.4.2.1 MT Diagnostic Trail Termination Functions for MIPs

The MTDi/MT adaptation function is an empty function; it is included to satisfy the modelling rules.

The bidirectional MTD/MT adaptation function is performed by a co-located pair of MTDi/MT adaptation source (MTDi/MT_A_So) and sink (MTDi/MT_A_Sk) functions.

9.4.2.1.1 MT Diagnostic Trail Termination Source Function for MIPs (MTDi_TT_So)

Symbol

The MTDi_TT_So function symbol is shown in Figure 9-15.

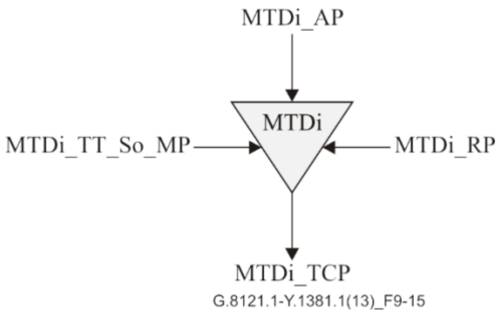

Figure 9-15 – MTDi_TT_So symbol

Interfaces

Table 9-5 – MTDi_TT_So interfaces

Inputs	Outputs
MTDi_AP MT_AI_D MT_AI_iPHB MT_AI_oPHB MT_AI_LStack **MTDi_RP** MTDi_RI_CV_Info (D, CoS, DP) **MTDi_TT_So_MP** MTDi_TT_So_MI_GAL_Enable MTDi_TT_So_MI_TTLVALUE MTDi_TT_So_MI_MIP_ID MTDi_TT_So_MI_CV_OAM_Tool	**MTDi_TCP** MT_CI_D, MT_CI_iPHB, MT_CI_oPHB, MT_CI_LStack

Processes

The processes associated with the MTDi_TT_So function are as depicted in Figure 9-16.

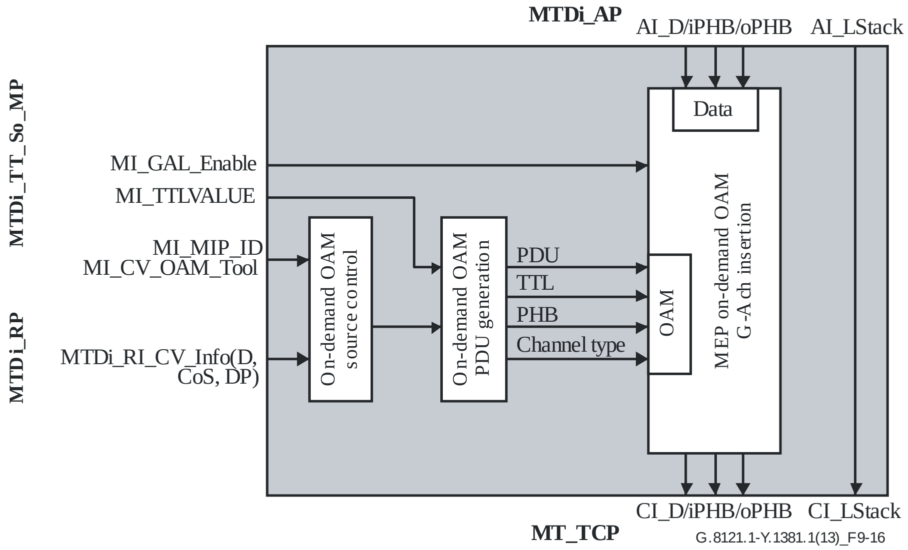

Figure 9-16 – MTDi_TT_So Process

MIP OAM insertion*:* See clause 9.4.2.1.1 of [ITU-T G.8121].

On-demand OAM PDU Generation: See clause 9.4.2.1.1 of [ITU-T G.8121].

On-demand OAM Source Control: This process consists of oCV and RT sub-processes. These details are in 8.8/G.8121.1.

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

MT Diagnostic Trail Termination Sink Function for MIPs (MTDi_TT_Sk)

Symbol

The MTDi_TT_Sk function symbol is shown in Figure 9-17.

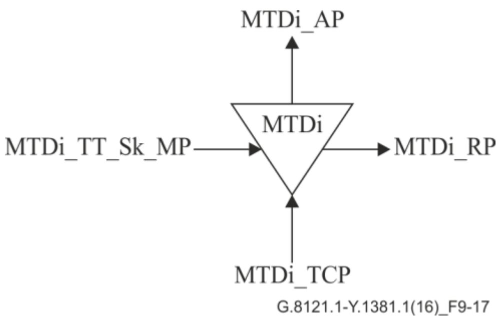

Figure 9-17 – MTDi_TT_Sk symbol

Interfaces

Table 9-6 – MTDi_TT_Sk interfaces

Inputs	Outputs
MTDi_TCP MT_CI_D MT_CI_iPHB MT_CI_oPHB MT_CI_LStack **MTDi_TT_Sk_MP** MTDi_TT_Sk_MI_GAL_Enable MTDi_TT_Sk_MI_MIP_ID MTDi_TT_Sk_MI_CV_OAM_Tool	**MTDi_AP** MT_AI_D MT_AI_iPHB MT_AI_oPHB MT_AI_LStack **MTDi_RP** MTDi_RI_CV_Info (D, CoS, DP)

Processes

The processes associated with the MTDi_TT_So function are as depicted in Figure 9-18.

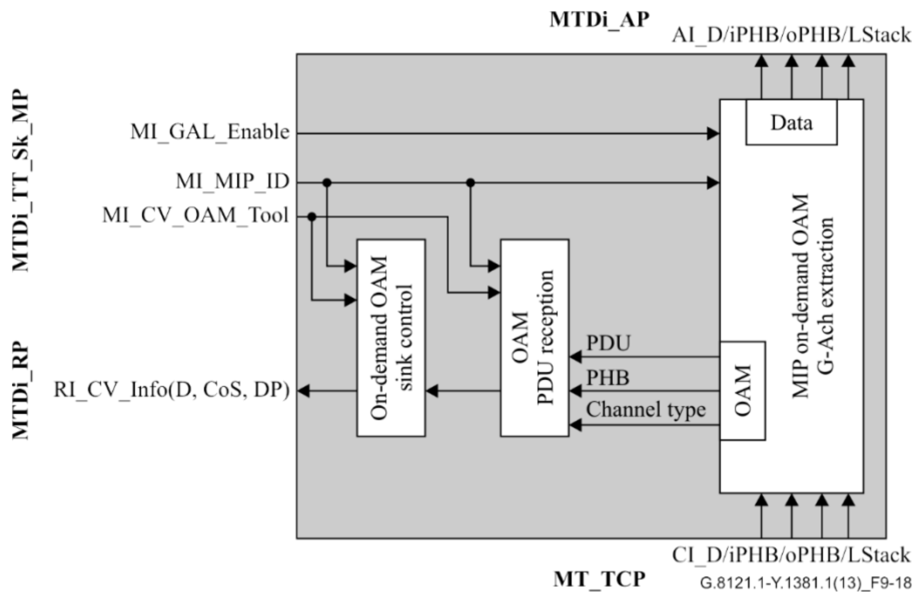

Figure 9-18 – MTDi_TT_Sk Process

MIP OAM extraction: See clause 9.4.2.1.2 of [ITU-T G.8121].

On-demand OAM PDU Reception: See clause 9.4.2.1.2 of [ITU-T G.8121].

On-demand OAM Sink Control:

This process consists of oCV sub-processes. These details are in clause 8.8.

Defects: None.

Consequent actions: None.

Defect correlations: None.

Performance monitoring: None.

9.4.2.2 MTDi to MT Adaptation functions (MTDi/MT_A)

See clause 9.4.2.2 of [ITU-T G.8121].

10 MPLS-TP to Non-MPLS-TP client adaptation functions

These atomic functions except MPLS-TP to ETH adaptation function are defined in clause 10 of [ITU-T G.8121].

10.1 MPLS-TP to ETH adaptation function (MT/ETH_A)

10.1.1 MPLS-TP to ETH adaptation source function (MT/ETH_A_So)

This function maps the ETH_CI information for transport in a MT_AI signal.

The information flow and processing of the MT/ETH_A_So function is defined with reference to Figure 10-1.

Symbol

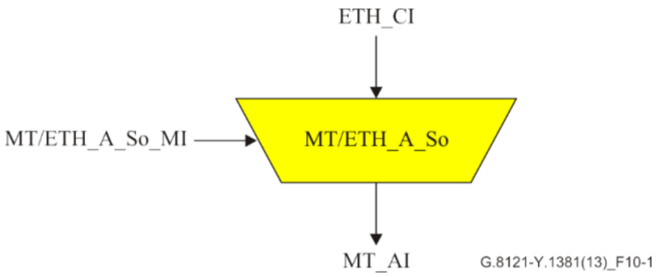

Figure 10-1 – MT/ETH_A_So function

Interfaces

The MT/ETH_A_So interfaces are described in Table 10-1.

Table 10-1 – MT/ETH_A_So inputs and outputs

Input(s)	Output(s)
ETH_FP: ETH_CI_Data ETH_CI_P ETH_CI_DE **MT/ETH_A_So_MP**: MT/ETH_A_So_MI_Active MT/ETH_A_So_MI_AdminState MT/ETH_A_So_MI_FCSEnable MT/ETH_A_So_MI_CWEnable MT/ETH_A_So_MI_SQUse MT/ETH_A_So_MI_PRI2CoSMapping	**MT_AP**: MT_AI_Data MT_AI_PHB

Table 10-1 – MT/ETH_A_So inputs and outputs

Input(s)	Output(s)
MT/ETH_A_Sk_MI_GAL_Enable MT/ETH_A_Sk_MI_CSF_OAM_Tool MT/ETH_A_So_MI_CSF_Period MT/ETH_A_So_MI_CSF_CoS MT/ETH_A_So_MI_CSFdciEnable MT/ETH_A_So_MI_CSF_Enable MT/ETH_A_So_MI_CSFrdifdiEnable MT/ETH_A_So_MI_MEP_MAC* MT/ETH_A_So_MI_Client_MEL* MT/ETH_A_So_MI_LCK_Period* MT/ETH_A_So_MI_LCK_Pri* MT/ETH_A_So_MI_MEL* * ETH OAM related	

Processes

The processes associated with the MT/ETH_A_So function are as depicted in Figure 10-2.

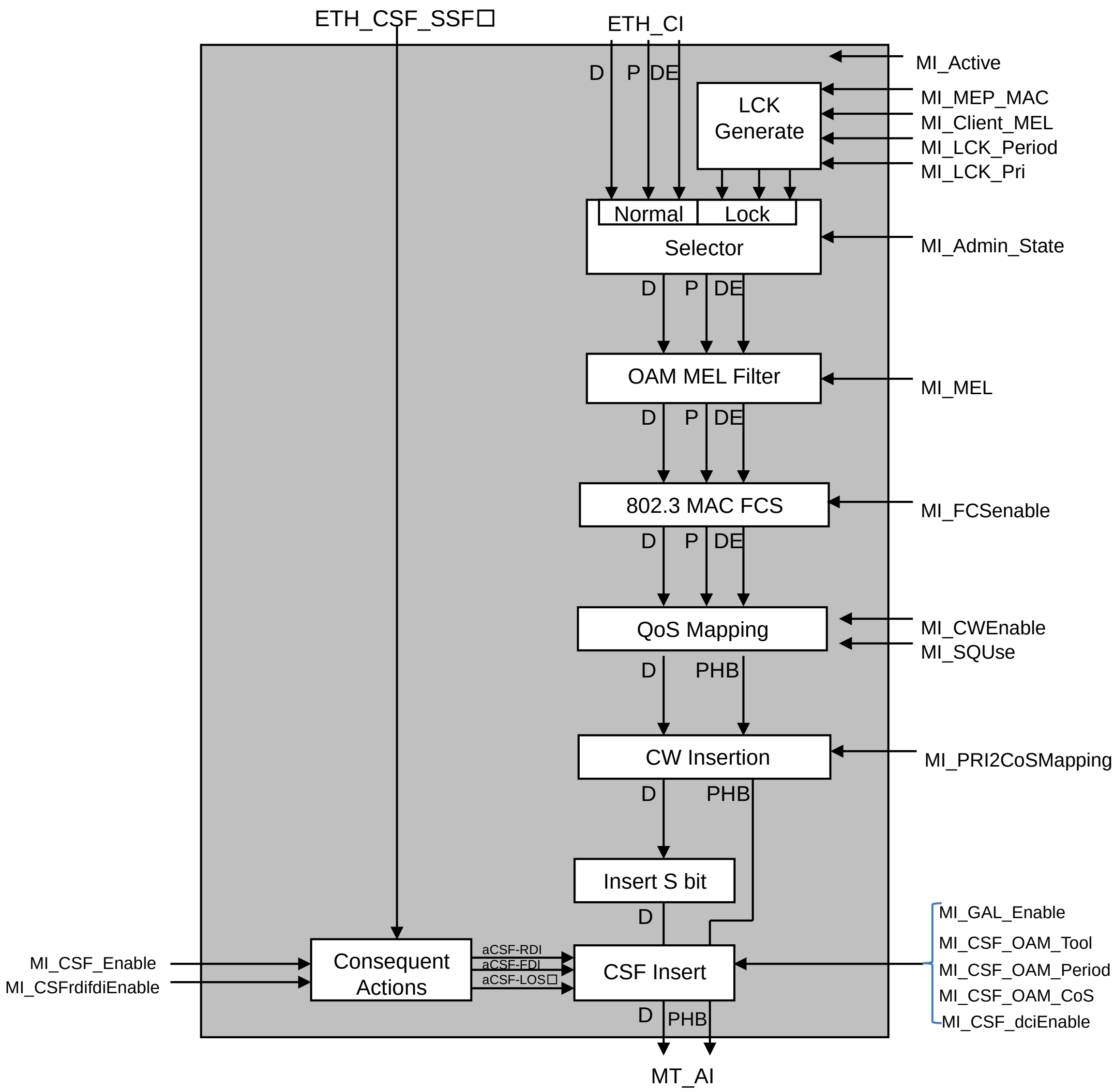

Figure 10-2 – MT/ETH_A_So process diagram

- *CSF insert process*

As defined in clause 8.7.3.

Other processes without consequent actions in Figure 10-2 are defined in clause 10.1.1 of [ITU-T G.8121].

Defects: **None**

Consequent actions:

aCSF-LOS ← CI_SSF and MI_CSF_Enable

aCSF-RDI ← CI_SSFrdi and MI_CSFrdifdiEnable and MI_CSF_Enable

aCSF-FDI ← CI_SSFfdi and MI_CSFrdifdiEnable and MI_CSF_Enable

Defect correlations: None.

Performance monitoring: None.

10.1.2 MPLS-TP to ETH adaptation sink function (MT/ETH_A_Sk)

This function extracts the ETH_CI information from a MT_AI signal.

The information flow and processing of the MT/ETH_A_Sk function is defined with reference to Figure 10-3.

Symbol

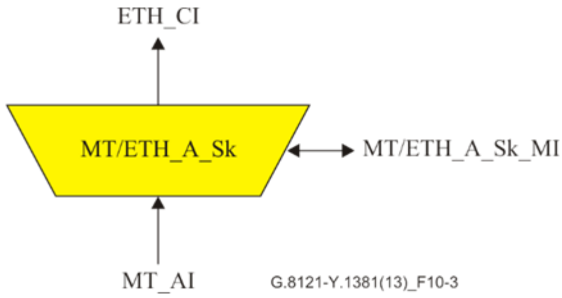

Figure 10-3 – MT/ETH_A_Sk function

Interfaces

The MT/ETH_A_Sk interfaces are described in Table 10-2.

Table 10-2 – MT/ETH_A_Sk Inputs and Outputs

Input(s)	Output(s)
Each MT_AP: MT_AI_Data MT_AI_PHB MT_AI_TSF MT_AI_AIS **MT/ETH_A_Sk_MP**: MT/ETH_A_Sk_MI_Active MT/ETH_A_Sk_MI_FCSEnable MT/ETH_A_Sk_MI_CWEnable MT/ETH_A_Sk_MI_SQUse MT/ETH_A_Sk_MI_GAL_Enable MT/ETH_A_Sk_MI_CoS2PRIMapping MT/ETH_A_Sk_MI_GAL_Enable MT/ETH_A_Sk_MI_CSF_OAM_Tool MT/ETH_A_Sk_MI_CSF_Reported MT/ETH_A_Sk_MI_CSFrdifdiEnable MT/ETH_A_Sk_MI_MEL *	**ETH_FP**: ETH_CI_Data ETH_CI_P ETH_CI_DE ETH_CI_SSF **MT/ETH_A_Sk_MP**: MT/ETH_A_MI_pFCSErrors MT/ETH_A_Sk_MI_cCSF

Table 10-2 – MT/ETH_A_Sk Inputs and Outputs

Input(s)	Output(s)
MT/ETH_A_Sk_MI_Admin_State MT/ETH_A_Sk_MI_LCK_Period * MT/ETH_A_Sk_MI_LCK_Pri * MT/ETH_A_Sk_MI_Client_MEL * MT/ETH_A_Sk_MI_MEP_MAC * MT/ETH_A_Sk_MI_AIS_Pri * MT/ETH_A_Sk_MI_AIS_Period * * ETH OAM related	

Processes

The processes associated with the MT/ETH_A_Sk function are as depicted in Figure 10-4.

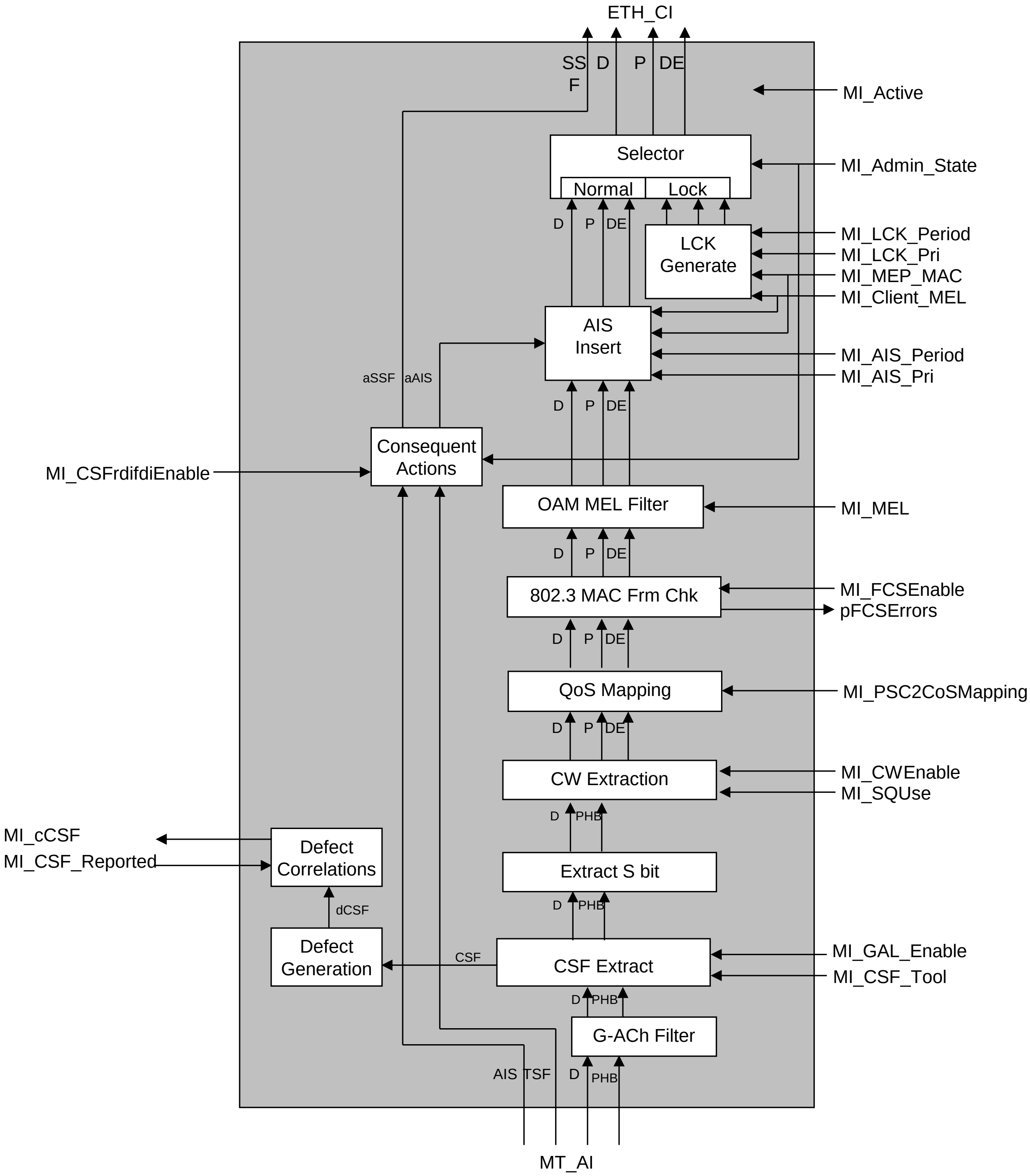

Figure 10-4 – MT/ETH_A_Sk process diagram

- *CSF extract process*

As defined in clause 8.7.3.

Other processes without consequent actions, Defect Correlations, and Defect Generation in Figure 10-4 are defined in clause 10.1.1 of [ITU-T G.8121].

Defects: None.

Consequent actions:

The function shall perform the following consequent actions:

aSSF ← (AI_TSF or dCSF-LOS) and (not MI_Admin_State == Locked)

aSSFrdi ← dCSF-RDI and MI_CSFrdifdiEnable

aSSFfdi ← dCSF-FDI and MI_CSFrdifdiEnable

aAIS ← AI_AIS

Defect correlations:

cCSF ← (dCSF-LOS or dCSF-RDI or dCSF-FDI) and (not AI_TSF) and MI_CSF_Reported

Performance monitoring: None.

11 Non-MPLS-TP Server to MPLS-TP adaptation functions

These atomic functions are defined in clause 11 of [ITU-T G.8121]. They use the OAM protocol specific AIS insertion process and LCK generation process as defined in clauses 8.6.2 and 8.6.3.

Appendix I

Counting OAM Packets

(This appendix does not form an integral part of this Recommendation.)

Table I.1 provides Counting OAM Packets for proactive Dual-Ended LM. The counter process is described in clause 8.8.1.4.

Table I.1 – Counting OAM Packets for proactive Dual-Ended LM

OAM Packet type	Counted or Not Counted	Atomic Function that receives the PDU
APS	Counted	MT/MT_A_Sk Or MT/MTp_A_Sk
CCM	Not counted	MT_TT_Sk
LBM, LBR	Not counted	MTDe_TT_Sk
TST	Not counted	MTDe_FT_Sk
AIS	Not Specified, (See Note)	MT/MT_A_Sk
LCK	Not Specified, (See Note)	MT/MT_A_Sk
DMM, DMR, 1DM	Not counted	MTDe_TT_Sk or MT_TT_Sk
LMM, LMR	Not counted	MTDe_TT_Sk or MT_TT_Sk
NOTE – As OAM frames for AIS and LCK are only sent in the defect conditions where the result of loss measurements is invalid, it is unnecessary to count these frames.		

Table I.2 provides Counting OAM Packets for both proactive and on-demand Single-Ended LM. The counter process is described in clause 8.8.4.7.

Table I.2 – Counting OAM Packets for Single-Ended LM

OAM Frame OpCode	Counted or Not Counted	Atomic Function that receives the PDU
APS	Counted	MT/MT_A_Sk Or MT/MTp_A_Sk
CCM	Counted	MT_TT_Sk
LBM, LBR,	Not counted	MTDe_TT_Sk
TST	Not counted	MTDe_FT_Sk
AIS	Not Specified, (See Note)	MT/MT_A_Sk
LCK	Not Specified, (See Note)	MT/MT_A_Sk
DMM, DMR, 1DM	Not counted	MTDe_TT_Sk or MT_TT_Sk
LMM, LMR	Not counted	MTDe_TT_Sk or MT_TT_Sk

NOTE – As OAM frames for AIS and LCK are only sent in the defect conditions where the result of loss measurements is invalid, it is unnecessary to count these frames.

Appendix II

SDL descriptions

(This appendix does not form an integral part of this Recommendation.)

In this Recommendation, detailed characteristics of equipment functional blocks are described with SDL diagrams specified in [b-ITU-T Z.100]. The SDL diagrams use the following conventions.

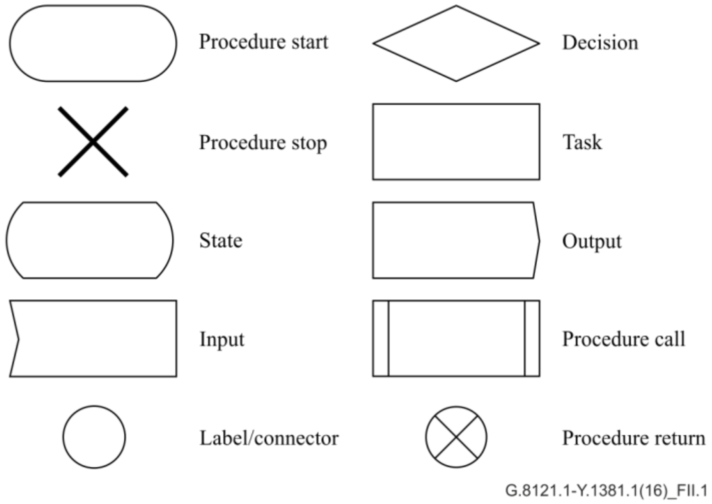

Figure II.1 – SDL symbols

Bibliography

[b-ITU-T Z.100] Recommendation ITU-T Z.100 (2011), *Specification and Description Language – Overview of SDL-2010.*

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