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Foreword

This final draft European Telecommunication Standard (ETS) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the voting phase of the ETSI standards approval procedure.

This 2nd edition of ETS 300 404, upgrades the standard from interim (I-ETS) status to full ETS status and takes into account the latest edition of ITU-T Recommendation I.610 (1995).

This ETS describes the Operation And Maintenance (OAM) principles and functions for the Asynchronous Transfer Mode (ATM) based Broadband Integrated Services Digital Network (B-ISDN).

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This European Telecommunication Standard (ETS) identifies the minimum set of functions required to operate and maintain the Physical Layer and the Asynchronous Transfer Mode (ATM) layer aspects of the Broadband Integrated Services Digital Network (B-ISDN) User-Network Interface (UNI) as well as the individual Virtual Path (VP) and the Virtual Channel (VC) connections that may be routed through the B-ISDN.

The functions of the layers above the ATM layer are not considered.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-T Recommendation I.610 (1995): "B-ISDN operation and maintenance principles and functions".

[2] ITU-T Recommendation I.356: "B-ISDN ATM layer cell transfer performance".

[3] ITU-T Recommendation G.783: "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".

[4] ITU-T Recommendation I.361: "B-ISDN ATM layer specification".

3 Abbreviations

For the purpose of this ETS, the following abbreviations apply:

ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
BR	Backward Reporting
CC	Continuity Check
CP	Connection Point

NOTE: The use of the expression "Connecting Point" in Recommendation I.610 is ambiguous in the sense that, depending on the context, it may stand for either an actual "Connecting Point" as defined in Recommendation I.311 or for a "Connection Point" as defined in ITU-T Recommendation I.326. This ETS uses only the concept of "Connection Point", abbreviated as "CP" since it is more appropriate to describe OAM functions that apply at the VP/VC levels for a specific VP/VC connection.

CPID	Connection Point Identifier
FM	Forward Monitoring
LB	Loopback
LI	Loopback indication
LLID	Loopback Location Identifier
NNI	Network Node Interface
NPC	Network Parameter Control
OAM	Operation And Maintenance
PDH	Plesiochronous Digital Hierarchy
PM	Performance Management
PTI	Payload Type Identifier
SDH	Synchronous Digital Hierarchy
Seg.	Segment (of VPC/VCC)
T_B	T Reference Point in B-ISDN
UNI	User Network Interface
UPC	Usage Parameter Control

VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier
VC AIS	Alarm Indication for VC
VC RDI	Remote Defect Indication for VC
VP AIS	Alarm Indication for VP
VP RDI	Remote Defect Indication for VP

4 B-ISDN operation and maintenance principles and functions

The B-ISDN operation and maintenance principles and functions are specified in ITU-T Recommendation I.610 [1]. ITU-T Recommendation I.610 [1] has the following structure, which is given here for information:

Clause 1:	Introduction
Clause 2:	OAM principles
Clause 3:	OAM levels and flows
Clause 4:	Mechanisms to provide OAM flows
Clause 5:	OAM functions of the Physical Layer
Clause 6:	OAM functions of the ATM Layer
Clause 7:	ATM Layer OAM cell format
Annex A:	Virtual Channel / Virtual Path Status Monitoring
Annex B:	SDLs for activation / deactivation using OAM cells
Annex C:	Procedures to be performed when receiving Loopback OAM cells
Appendix A:	Examples of OAM Cell Error Detection Codes

5 Requirements for the application of ITU-T Recommendation I.610 as an European Telecommunication Standard

This ETS endorses ITU-T Recommendation I.610 [1], with the following changes/additions/clarifications. The following statements give the interpretation of open issues in this Recommendation, to apply in this ETS.

subclause 1.2 Scope

The functions of the layers above the ATM layer are not considered. Results of the further study of these layers in ITU-T may not be included in this ETS at a later stage.

subclause 4.2.1 F4 flow mechanism

Intermediate points along the VPC or along the VPC segment may monitor OAM cells passing through them and insert new OAM cells, but they can not terminate the OAM flow except when ***segment*** loopbacks are performed.

NOTE: In ITU-T Recommendation I.361 [4] a modification of the PTI field is allowed. If this is done without control of the type of cell, this can lead to a loss of OAM F5 cells.

Table 3/I.610

The reference to ITU-T Recommendation G.783 [3] in note 4 shall not be considered.

Add the following note in the last row (about Cell Delineation function), last column (about Path RDI):

NOTE 6: In future release of I.432 the appropriate information could be transmitted in the payload dependent byte.

Table 5/I.610 and subclause 6.2.1.1.1.1

System protection and failure information for VP/VC failures at the ATM level will be proposed for a later version of this ETS as soon as they are agreed for inclusion in ITU-T Recommendation I.610 [1].

subclause 6.2.1.1.2 VPC continuity check

Permanent end-to-end CC mechanisms (source and sink processes) shall be provided simultaneously for all reserved, permanent and semi-permanent VPCs. It is recognized that this requirement may not be fulfilled by some existing ATM equipments that have been already deployed at the time this ETS was published. Nevertheless it is intended that ATM equipment OAM capabilities shall evolve to satisfy this requirement.

This requirement applies to the VPCs which are terminated, at both ends, within the domain controlled by one network operator (e.g. all VPCs which link VC Switches within the network operator domain or VPCs which link ATM MUXs under the control of one network operator) and to the VPC Segments corresponding to such VPCs.

The handling of CC of VPCs terminated in domains controlled by different network operators is subject to bilateral agreement between those network operators.

Activation / deactivation of the CC mechanisms shall be performed by using the Telecommunications Management Network (TMN) procedure at the setting-up/release of the VPC or the VPC Segment. However, depending on the operational requirement of a network operator, the CC mechanism may be activated / deactivated at any time by using the TMN procedure.

Whether the end-to-end or Segment CC mechanisms can be activated or not for reserved, permanent and semi-permanent VPCs terminated, at both ends, within the domain controlled by Customers, depends on the Customer Equipment capability and is under Customer responsibility.

Only option 1) is retained, that is a CC cell is sent downstream by a VPC source-point or a VPC Segment source-point when no user cell has been sent for a period of nominally 1 second.

subclause 6.2.1.1.3.2 Principles of operation

Replace the second sentence under item 1 by the following text.

There is no need to remove a Seg_LB cell at the intermediate CP along the VPC, that originated the Seg_LB cell since the Seg_LB will be removed at the Segment end point. This applies also to annex C of ITU-T Recommendation I.610 [1].

Replace the third sentence under item 2 by the following text.

The possibility to analyze the content of the LLID field of Seg_LB cell shall be provided so as to identify the CPs where the loopback action has to be performed. It shall be possible to use the default all "1s" value for the LLID field. In this case Seg_LB cells shall be copied and forwarded in the opposite direction from any CP within the Segment for which the LLID option is enabled by the TMN.

NOTE: See also annex II/ETS 300 404.

subclause 6.2.1.2 VP performance management functions

Forced insertion of performance monitoring cells is permitted at segment level for the VP and VC level.

NOTE: Concerning the forced and non-forced insertion of Forward monitoring cells see also annex I/ETS 300 404.

subclause 6.2.1.4 Non intrusive monitoring function

This subclause is an addition to the existing ITU-T Recommendation I.610 [1] text.

Non intrusive monitoring of any type of end-to-end Fault and Performance Management OAM flows may be performed at any intermediate CP along a VPC, this includes intermediate CPs within a VPC Segment (see note). If implemented, this monitoring capability shall be provided simultaneously for a certain number of selected VPCs per interface (UNI, NNI). The specification of this number is beyond the scope of this ETS.

NOTE: The purpose of the non intrusive monitoring function is to provide to network operators, additional OAM information which cannot be derived from the content of Segment OAM flows. As an example monitoring both the VP-RDI and the corresponding VP-BR flow gives the possibility to assess, from any CP, both the status (available/unavailable) and the end-to-end performance of a VPC. As another example, monitoring the VP-FM in conjunction with the VP-Segment FM flows established for all network operator's domains can help to localize performance impairments in case those impairments are located within the customer network.

subclause 6.2.2.1.2 VCC continuity check

The possibility to activate the end-to-end CC mechanisms shall be provided simultaneously for a certain number of reserved, permanent and semi-permanent VCCs (see note). This requirement applies to VCCs which are terminated, at both ends, within the domain controlled by network operators. Activation/deactivation of the CC mechanisms at the setting-up/release of reserved, permanent or semi-permanent VCC remains as an option.

NOTE: The end-to-end CC mechanism is intended to be used for VCCs providing a service which needs an AIS information for "upper layers" in case of defect occurring in the lower layers.

In the general case, whenever PM is performed end-to-end on VCCs terminated, at both ends, within the domain controlled by network operators, the end-to-end CC mechanisms (source and sink processes) shall be activated (see note 1). However it should be possible to activate PM only which might be interesting if the ATM nodes located at one or both ends are not able to provide the CC mechanisms. The activation of the end-to-end CC mechanisms shall be performed either before the activation of the PM process or at the same time by using one of the activation procedures described in subclause 6.2.3 of ITU-T Recommendation I.610 [1] (see note 2).

In the general case, whenever PM is performed on VCC Segments terminated, at both ends, within the domain controlled by network operators, the Segment CC mechanisms (source and sink processes) shall be activated (see note 1). However it should be possible to activate PM only. which might be interesting if the ATM nodes located at one or both Segment ends are not able to provide the CC mechanisms. The activation / deactivation of the Segment CC mechanisms shall be performed for each VCC by using the TMN procedure at any time during setting-up, established state or release of the VCC Segment.

NOTE 1: Performing PM with CC allows the performance to be assessed only during the available time of the VCC or VCC Segment as stated in ITU-T Recommendation I.356 [2].

NOTE 2: There may be a need to retain a single procedure (e.g. the TMN procedure) for the sake of simplicity of ATM equipment. This requires further study.

Whether the end-to-end or Segment CC mechanisms can be activated or not for reserved, permanent and semi-permanent VCCs terminated, at both ends, within the domain controlled by Customers, depends on the Customer Equipment capability and is under Customer responsibility.

Only option 1) is retained, that is a CC cell is sent downstream by a VCC source-point or a VCC Segment source-point when no user cell has been sent for a period of nominally 1 second.

subclause 6.2.2.1.3.2 Principles of Operation

Replace the second sentence under item 1 by the following text.

There is no need to remove a Seg_LB cell at the intermediate CP along the VCC, that originated the Seg_LB cell since the Seg_LB will be removed at the Segment end point. This applies also to annex C of ITU-T Recommendation I.610 [1].

Replace the third sentence under item 2 by the following text.

The possibility to analyze the content of the LLID field of Seg_LB cell shall be provided so as to identify the CPs where the loopback action has to be performed. It shall be possible to use the default all "1s" value for the LLID field. In this case Seg_LB cells shall be copied and forwarded in the opposite direction from any CP within the Segment for which the LLID option is enabled by the TMN.

NOTE: See also annex II/ETS 300 404.

subclause 6.2.2.2 VC Performance Management Functions

Since the potential interference between performance monitoring and UPC/NPC actions is still a matter under study, impact on OAM functions has not been considered in this ETS (last paragraph).

subclause 6.2.2.4 Non intrusive monitoring function

This subclause is an addition to the existing ITU-T Recommendation I.610 [1] text.

Non intrusive monitoring of any type of end-to-end Fault and Performance Management OAM flows may be performed at any intermediate CP along a VCC, this includes intermediate CPs within a VCC Segment (see note). If implemented, this monitoring capability shall be provided simultaneously for a certain number of selected VCCs per interface (UNI, NNI). The specification of this number is beyond the scope of this ETS.

NOTE: The purpose of the non intrusive monitoring function is to provide to network operators, additional OAM information which cannot be derived from the content of Segment OAM flows. As an example monitoring both the VC-RDI and the corresponding VC-BR flow gives the possibility to assess, from any CP, both the status (available/unavailable) and the end-to-end performance of a VCC. As another example, monitoring the VC-FM in conjunction with the VC-Segment FM flows established for all network operator's domains can help to localize performance impairments in case those impairments are located within the customer network.

subclause 7.2.1 AIS/RDI fault management cell

If the use of the defect type and defect location field of the AIS/RDI cells is supported by the ATM equipment terminating the VPC/VCC, the fields of the RDI cell shall contain the same values as which were received in the corresponding AIS cell.

subclause 7.2.4 Loopback cell

Add the following text. at the end of item 2.

Consecutively generated Correlation Tag should be different in order to verify that the received LB cell actually corresponds to the one which was forwarded and successfully Loopbacked.

Replace item 3 by the following text.

Loopback Location ID Field (16 octets). This field identifies the CP along the virtual connection or connection segment, where the Loopback is to occur.

For end-to-end Loopback cells, the default value all 1's represents the connection end-point.

For Segment Loopback cells, the default value all 1's represents:

- the connection segment end-point;

- and any other intermediate CP within the Segment, for which the LLID option is ended by the TMN.

NOTE: Detailed description of the procedure for Segment Loopback cells is provided in annex B of ETS 300 404.

Replace item 4 by the following text.

Source ID Field (16 Octets). The content of this field shall be fixed to the default value all 1's.

subclause 7.3 Specific fields for performance management cell

Add the following text. at the end of the note under item 6.

NOTE: ./.

In the case that the source cannot recognize the loss of FM cells the calculations of lost "user" cells can be erroneous. This may be observed in the case that two or more consecutive FM cells are lost while performance analysis is performed at the far end by using the content of BR cells.

Annex C of ITU-T Recommendation I.610

NOTE: Detailed description of the procedure for Segment Loopback cells is provided in annex II of ETS 300 404.

Annex I (informative): Insertion process applicable to end-to-end or segment Forward Monitoring (FM) cells

This annex contains informative material related to the insertion process applicable to end-to-end or Segment Forward Monitoring and Backward Reporting cells.

I.1 Processes applicable to Forward Monitoring (FM) cells

I.1.1 Forced insertion

This process is applicable to end-to-end FM OAM cells and could be used also for the Segment FM OAM cells.

Figure I.1 (of ETS 300 404) shows the relationship between the insertion requests, produced every N user cells, and the actual insertion of the FM OAM cells in the case of the "forced insertion" process. In this figure events N° 1, 3, 5, and 7 represent the time of the insertion requests while events N° 2, 4, 6 and 8 represent the time of the corresponding actual insertion.

Events N°2 and 6 correspond to a "normal" insertion, i.e. immediately after the insertion request, in the first free cell time slot.

Event N°4 corresponds to a "forced" insertion, i.e. immediately after N+N/2 user cells have been received, in the first cell time slot. In this case user cells may experience some additional delay.

Event N°8 corresponds to a "delayed" insertion, i.e. immediately after N+x user cells have been received in the first free cell time slot (x < N/2).

The resulting block sizes are then equal to (N+N/2) for block A, (N-N/2) for block B and (N+x) for block C. Block sizes may vary in the range [N/2, 3N/2] and the average block size is roughly equal to N.

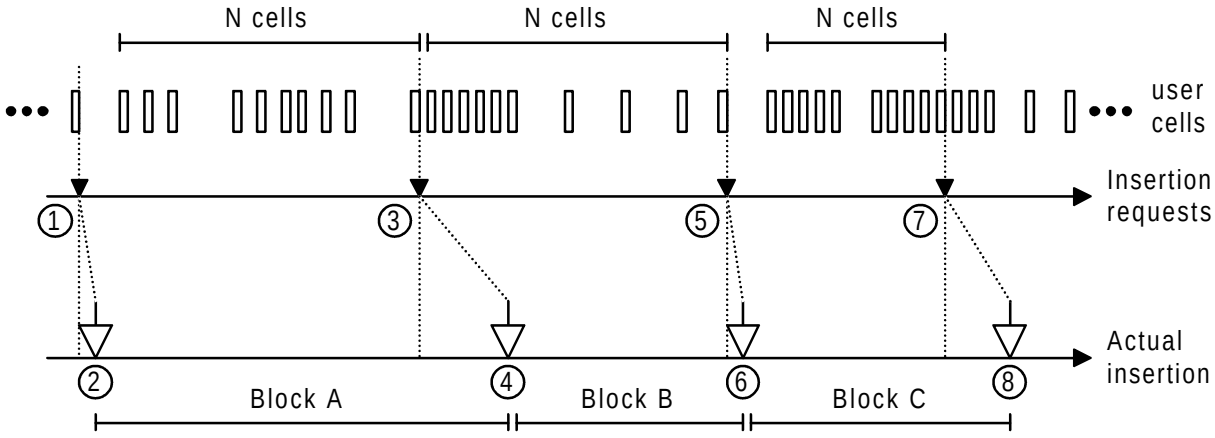


Figure I.1 Forced insertion case for FM cells

I.1.2 Non-forced insertion

This process could be used only for Segment FM OAM cells.

Figure I.2 (of ETS 300 404) shows the relationship between the insertion requests and the actual insertion of the FM OAM cells in the case of the “forced insertion” process. Insertion requests are produced after N user cells observed since the last forwarded FM OAM cell.

In this figure events N° 1, 3, and 5 represent the time of the insertion requests while events N 2, N 4, and N 6 represent the time of the corresponding actual insertion.

Event N°2 corresponds to a "normal" insertion, i.e. immediately after the insertion request in the first free cell time slot.

Events N°4 and N 6 correspond to "delayed" insertions, the insertion is performed in the first free cell time slot after the insertion request.

The resulting block sizes are not limited in principle, the average block size is greater than or equal to N.

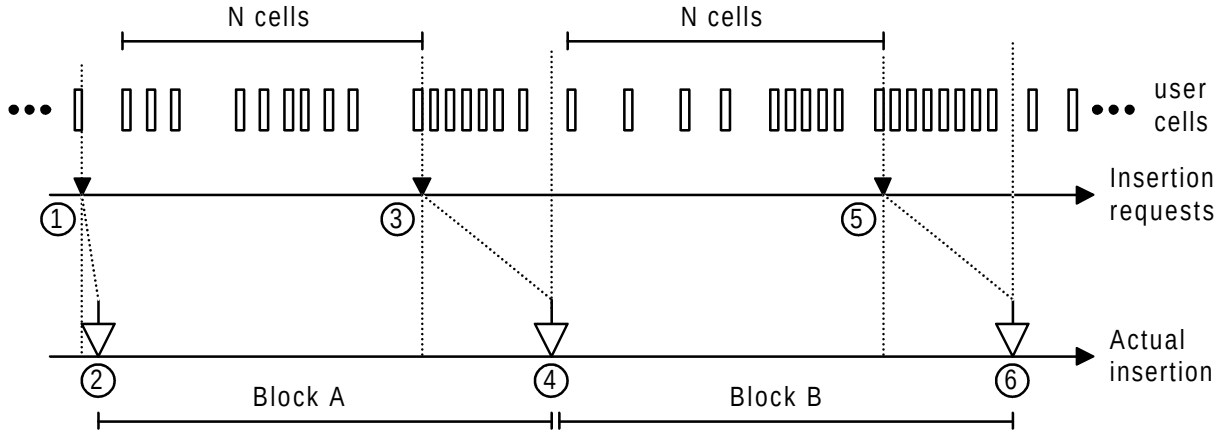


Figure I.2: Non forced insertion case for FM cells

I.2 Process applicable to Backward Reporting (BR) cells

The insertion of those OAM cells could be performed according to one of the following processes.

I.2.1 Forced insertion

This process is used for Segment or end-to-end BR OAM cells.

Figure I.3 (of ETS 300 404) shows the relationship between the arrival time of FM OAM cells and the actual insertion of the BR OAM cells in the opposite direction. Insertion requests of BR OAM cells are produced after a FM OAM cell has been correctly received and its content processed.

In this figure events N° 1, 3, and 5 represent the time of the BR cell insertion requests while events N° 2, 4, and 6 represent the time of the corresponding actual insertion.

Event N°2 corresponds to a "normal" insertion, i.e., immediately after the insertion request in the first free cell location.

Event N°6 corresponds to a "delayed" insertion. A forced insertion is illustrated by event N°4.

It should be noted that this insertion method may produce at most a clump of two BR cells. Also, in some cases, the forced insertion of a BR cell could be coincident with the forced insertion of a FM cell on the same direction of the VP/VC connection. The priority scheme between the two forced insertion actions is not considered in this annex but needs to be solved at the ATM equipment level.

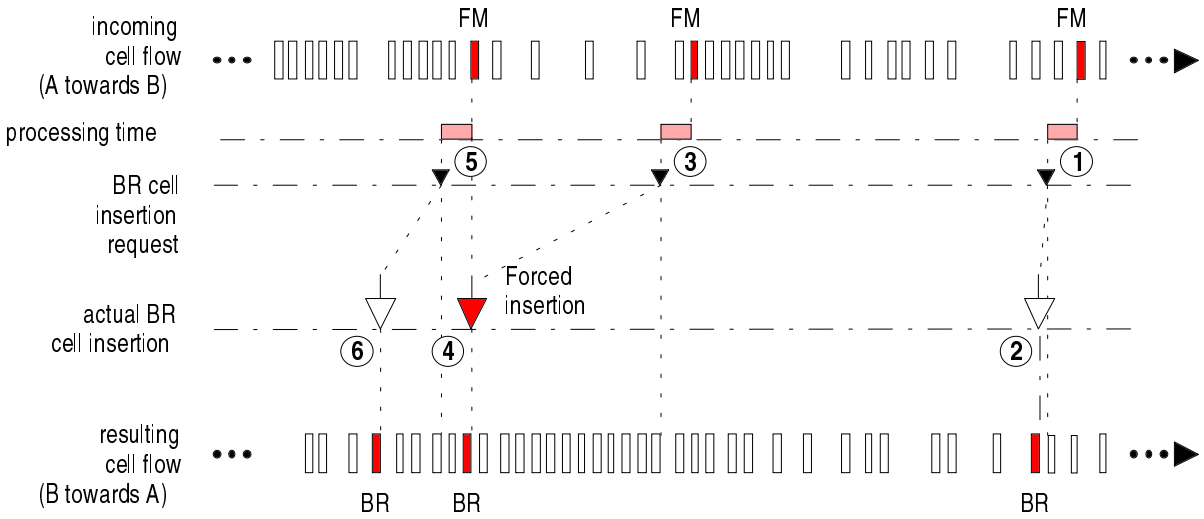


Figure I.3: Insertion mechanism for BR OAM cells

I.2.2 Non-forced insertion

F.F.S.

Annex II (informative): A guide to performing Loopbacks

This annex contains an informative material related to the way to perform Loopbacks.

The following diagram and text constitute an enhancement of the current content of Annex C/I.610 which is supported by this ETS, it specifies the procedure to be used for Loopback cells. The corresponding material is intended to be incorporated later in the main body of this ETS when this issue has been clarified within ITU-T Recommendation I.610 [1]. The content of this annex may be used as a basis for designing ATM equipment in case they implement the Loopback procedure for Loopback cells.

Amended Annex C/I.610

Figure II.1 (of ETS 300 404) provides the procedures to be performed when receiving end-to-end or Segment Loopback OAM cells (referred to as end-to-end LB / Seg_LB cells) at a Segment end-point, a connection end-point, or at any intermediate CP. The procedure uses the concept of Loopback state which is defined as follows:

- A CP shall enter the Loopback state as soon as either a Seg_LB or an end-to-end LB cell is forwarded from this CP (cell sent with LI=1);

- Exit from this state shall occur after a waiting time of (to be defined, suggested: 6) seconds ± (to be defined, suggested: ± 1) second;

- While in the Loopback state, a CP shall not initiate any other end-to-end or Seg_LB procedure;

- During the Loopback state, "Returned" Loopback cells (LI=0) shall be further analyzed

The following requirements constitute the detailed procedure which applies to Segment Loopback (Seg_LB) cells.

The main features of the Loopback procedure are the following:

a) bounds of a Segment shall be defined prior the use of any Seg_LB cells;

b) Seg_LB cells can be issued from the Segment Source end point or from any CP within a Segment;

c) the content of the incoming Seg_LB cells shall be analyzed at all crossed CPs along the Connection Segment (this includes the Sink/Source Segment end points). Analyzing an incoming Seg_LB cell shall be a non intrusive process. The following analysis shall be performed:

   - if the Loopback Indication field (LI) of the incoming Seg_LB cell is equal to '1' (in which case this cell is referred to as a "parent call"), then two cases have to be considered:

     if the Loopback Location ID (LLID) value matches either the ID of the CP (referred to as the CPID) or the default all '1's value, then a Seg_LB cell (referred to as the "returned" Seg_LB cell) shall be transmitted as soon as possible in the opposite direction within (to be defined, suggested: 1-3) seconds from the CP which received the "parent" Seg_LB cell (see note 1). The "returned" Seg_LB cell shall have its fields filled as follows:

     LI is set to '0';
     Correlation Tag is set to the value of the corresponding field of the "parent" Seg_LB cell;
     LLID is set to the value of the CPID (ID of the CP which returns the loopback cell);
     Source ID is set to all '1's (see note 2);
     Unused octets are set to 6AH.

     otherwise no "returned" Seg_LB cell is produced;

- if the LI field of the incoming Seg_LB cell is equal to '0', then two cases have to be considered:

  the CP is in the "Loopback state" in which case the Correlation Tag of the incoming Seg_LB cell shall be analyzed so as to check whether the Loopback was successful or not. If the Loopback is successful (see note 3) then the value of the LLID field of the "returned" Seg_LB cell shall be stored in the NE for further processing;

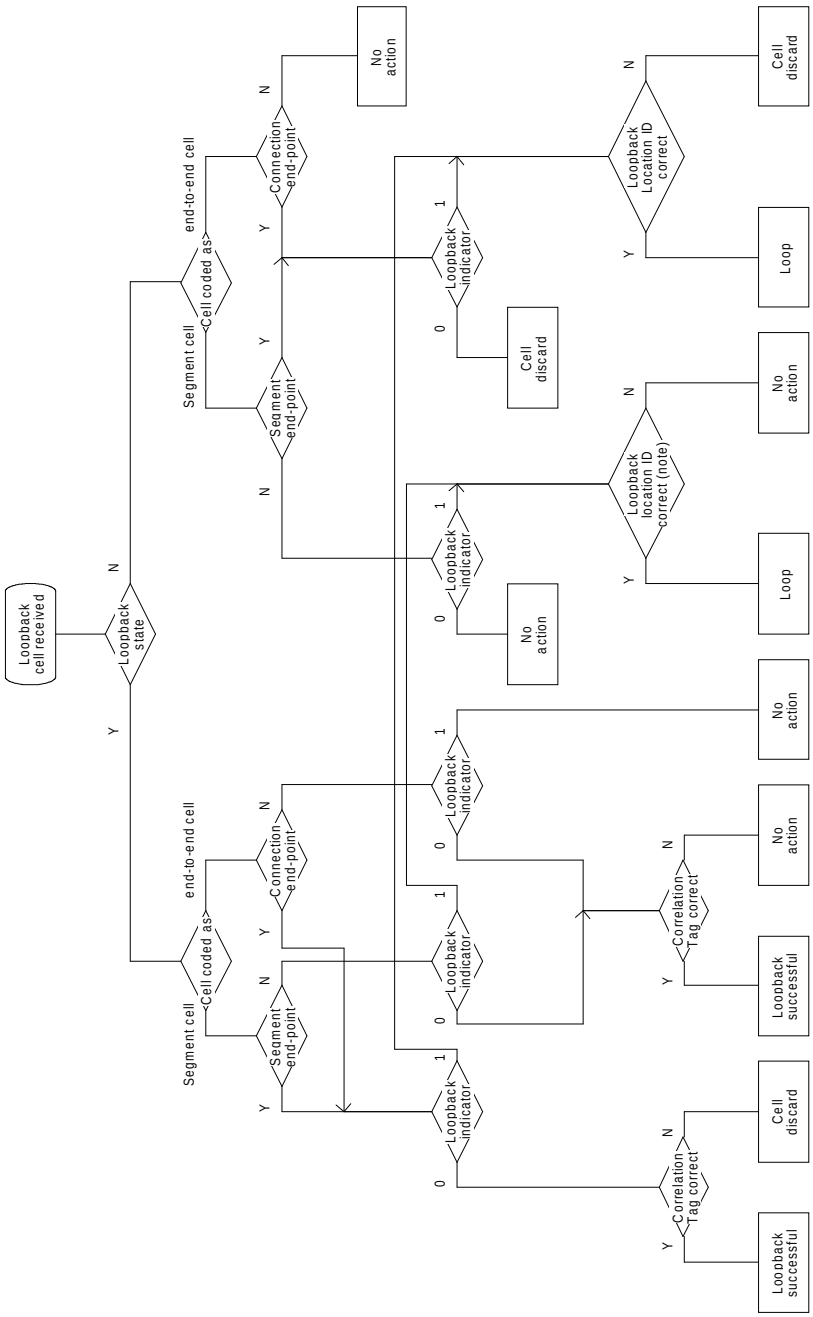
  otherwise no further analysis is performed;

d) all types of Seg_LB cells (LI='1' or '0') shall be removed at the Seg. Sink end point.

NOTE 1: This corresponds to the "LOOP" action mentioned in the diagram provided in figure II.1 (of ETS 300 404).

NOTE 2: This is stated to be consistent with the modification of subclause 7.2.4/I.610.

NOTE 3: This corresponds to the "LOOPBACK SUCCESSFUL" action mentioned in the diagram provided in figure II.1 (of ETS 300 404).



NOTE: If the Loopback Location ID option is not enabled by the TMN, then the LLID field is not examined at an intermediate CP and this decision should be set to direction 'N'.

Same decision applies also in the case where an intermediate CP does not support Loopback functions.

Cell coded as:	Seg_LB or end-to-end LB cells are considered
Loopback Indication:	LI=1 or 0 in the case the cell was already looped back
Correlation Tag correct:	This is obtained when the Correlation Tag value of the "returned" loopback cell (LI=0) matches the Correlation Tag value of the "parent" loopback cell (i.e. forwarded from the CP with LI=1)
Loopback Location ID correct:	This is obtained when the LLID value of the "parent" loopback cell matches either the CPID or the default all '1's value.
Loopback successful:	This is obtained when "returned" loopback cells are received with a correct Correlation Tag at a given CP while this CP is in the "loopback state". How to handle the resulting information requires further study

Figure II.1

History

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April 1995	First Edition		
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