



ATIS-1000654.1996(R2013)

**Broadband Integrated Services Digital Network (B-ISDN) –
Operations and Maintenance (OAM) Principles and
Functions**

AMERICAN NATIONAL STANDARD FOR TELECOMMUNICATIONS



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ATIS-1000654.1996(R2013), *Broadband Integrated Services Digital Network (B-ISDN) – Operations and Maintenance (OAM) Principles and Functions*

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American National Standard
for Telecommunications –

**Broadband Integrated Services Digital Network (B-ISDN) –
Operations and Maintenance (OAM)
Principles and Functions**

Secretariat

Alliance for Telecommunications Industry Solutions

Approved March 8, 1996

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard T1.654-1996.)

This American National Standard is one of a series of B-ISDN standards developed by Technical Subcommittee, T1S1, of Committee T1, Telecommunications. American National Standards for Telecommunications serve the public through improved understanding between carriers, end-users, and manufacturers.

This particular standard will be useful to anyone engaged in the provisioning and operation of telecommunications equipment to be used within the B-ISDN technology. The standard establishes the requirements for operations and maintenance principles and functions for B-ISDN. This standard has been developed as a delta document to ITU-T Recommendation I.610-1995. Those changes included within this standard are necessary to operate within the North American digital transmission hierarchy. This standard is subject to revision and updating as warranted by advances in B-ISDN technology.

There are two annexes in this standard. Both are informative and are not considered part of the standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.

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American National Standard for Telecommunications –

Broadband Integrated Services Digital Network(B-ISDN) – Operations and Maintenance(OAM) Principles and Functions

1 Scope, purpose, and application

This standard specifies the Operations and Maintenance (OAM) principles and functions for the Broadband aspects of the Integrated Services Digital Network (B-ISDN).

Specifically, it defines the OAM flow mechanisms for B-ISDNs and specifies OAM functions for the Physical and Asynchronous Transfer Mode (ATM) layers of the B-ISDN protocol reference model. The categories of operations addressed are Fault Management and Performance Management.

This standard is identical to ITU-T Recommendation I.610 (1995), with changes as described in clause 3.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the references indicated below.

ANSI T1.105-1995, *Telecommunications – Synchronous optical network (SONET) – Basic description including multiplex structure, rates, and formats*

ANSI T1.105.02-1995, *Telecommunications – Synchronous optical network (SONET) – Payload Mappings*

ANSI T1.107-1995, *Telecommunications – Digital hierarchy – Formats specifications*

ANSI T1.217-1991, *Telecommunications – Integrated services digital network (ISDN) management – Primary rate physical layer*

ANSI T1.231-1993, *Telecommunications – Digital hierarchy – Layer 1 in-service digital transmission performance monitoring*

ANSI T1.511-1994, *Telecommunications – B-ISDN ATM layer cell transfer – Performance parameters*

ANSI T1.640-1995, *Telecommunications – Broadband ISDN network node interfaces and internetwork interfaces – Rates and formats specifications*

ANSI T1.646-1995, *Telecommunications – Broadband ISDN – Physical layer specifications for user-network interfaces including DS1/ATM*

ITU-T Recommendation I.610(1995), *B-ISDN Operation and maintenance principles and functions*¹⁾

3 Requirements²⁾

This standard shall be identical to ITU-T Recommendation I.610 (1995), with the following changes made:

- 1) Change text of **Section 2.2/I.610 “Relation with the Telecommunication Management Network (TMN)”** with the following:

The B-ISDN OAM principles in this standard are intended to be consistent with the TMN principle [Ref. ITU-T Rec. M.3010 “Principles of a Telecommunication Management Network (TMN)”, Dec. 1991]. Figure 1 illustrates the relationship of this standard to TMN.

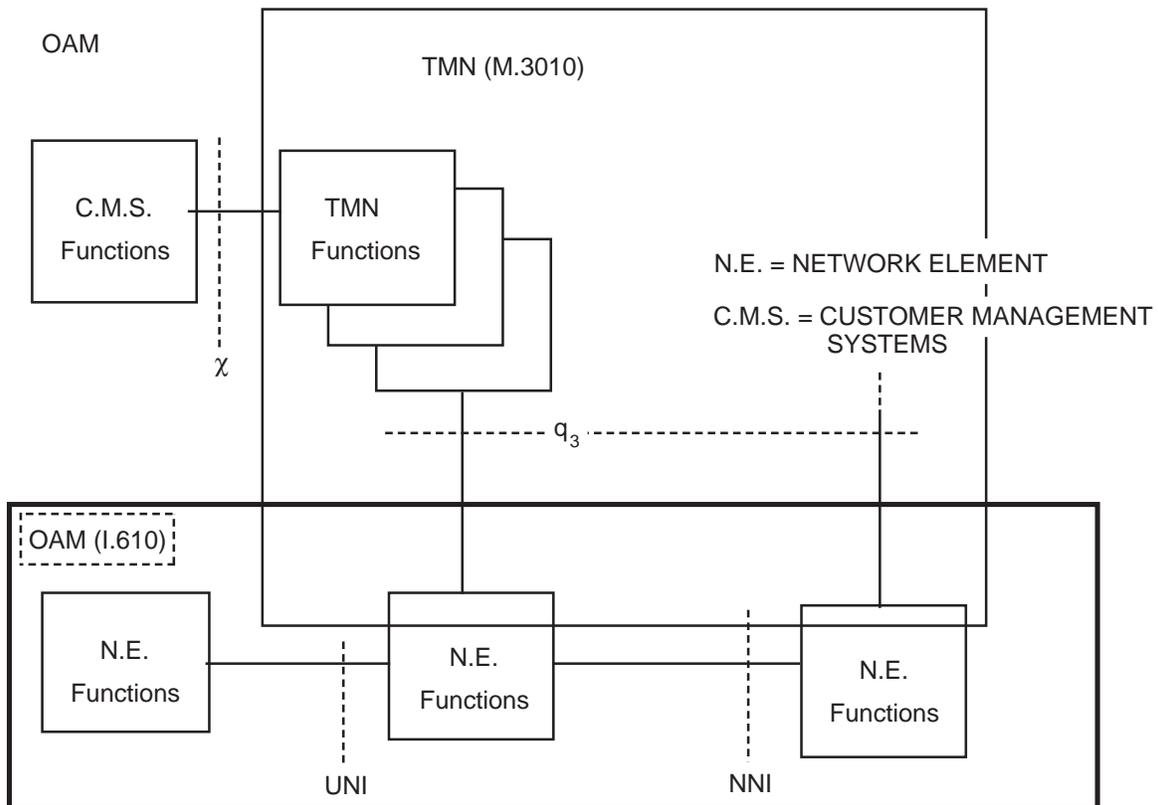


Figure 1 – B-ISDN OAM relation to TMN

¹⁾ Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

²⁾ ANSI guidelines specify two categories of requirements: mandatory and advisory. The mandatory requirements are designated by the word "shall" and the advisory criteria by the word "should." Mandatory requirements generally apply to the network element and interface functions specifying absolute, acceptable minimum functionality in those areas; advisory requirements generally refer to the optional features.

1.1) Include at the end of **Section 3.1/1.610 “OAM levels in the B-ISDN”** this table:

<u>Sublayer</u>	<u>SONET</u>	<u>SDH</u>	<u>PDH</u>	<u>OAM Flows</u>
Transmission Path *	Path	Dig. Path	Dig.Path	F3
Digital Section	Line	Mux. Sec.	N/A	F2
Regenerator Section	Reg. Sec.	Reg. Sec.	Line	F1

(*) includes ATM – Specific Physical Layer function

2) In **Section 4.1/1.610 “Physical layer mechanisms”**

- Replace last sentence with:

Only two types of transmission are required to be supported in ATM networks: SONET-based and DS1/DS3 frame-based systems. Type transmission to be supported in ATM networks shall be in accordance with ANSI T1.646 and T1.640.

- Supplement figure 2/1.610 with the following figure:

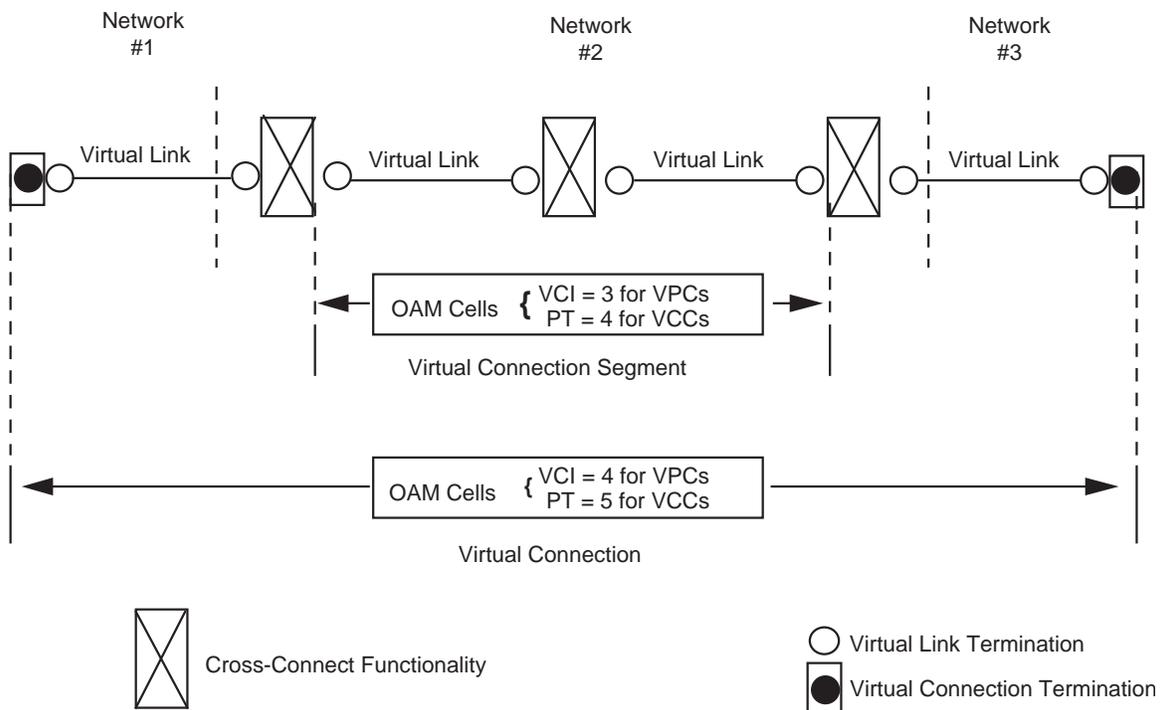


Figure 2 – Example of B-ISDN OAM flows

3) Replace **Section 4.1.1/1.610 “SDH-based transmission systems”** with following:

4.1.1 SONET-based transmission systems (Ref. ANSI T1.105-1995, ANSI T1.105.02-1995).

Flows F1 and F2 shall be carried on bytes in the Section and Line overhead, respectively as defined in ANSI T1.105. Flow F3 shall be carried in the Path overhead of the STS transmission frame as defined in ANSI T1.105.02. The F1, F2, and F3 flows shall also support the performance monitoring requirements defined in ANSI T1.231.

4) Support for the transmission system of **Section 4.1.2/I.610 “Cell-based transmission systems”** is not required.

5) **Section 4.1.3/I.610 “PDH-rate frame-based transmission systems”**

Only DS1 and DS3-based transmission systems as defined in ANSI T1.646 and T1.640 shall be supported. The F1, F2, and F3 flows shall also support the performance monitoring requirements defined in ANSI T1.231:

6) The following text is added at the beginning of **Section 4.2/I.610 “ATM layer mechanism”**:

Physical connections, such as SONET STS Paths, support two types of ATM virtual connections: Virtual Path Connections (VPCs) and Virtual Channel Connections (VCCs). For some VPCs or VCCs, connection-specific operations information such as failure indications, performance monitoring data and test requests (e.g., loopback commands) will need to be exchanged or communicated between VPC and VCC nodes (currently defined as any node terminating or accessing the VPC or VCC). Mechanisms to transmit such information at the VP and VC levels for both end-to-end connections and connection segments are described below.*

** There will be many VPCs and VCCs in a B-ISDN and it would be too costly and unreasonable to expect the network provider(s) to provide all OAM functions on all connections. There will, however, be some VPCs and VCCs (e.g., long duration or semi-permanent connections) that the network provider will choose to proactively and reactively maintain above and beyond that which is typically done for VPCs and VCCs.*

7) Replace text in **Section 5/I.610 “OAM functions of the Physical Layer”** with the following:

This section is intended to be consistent with Section 5 of ITU-T Rec. I.610, except that the cell-based Physical Layer is not required to be supported in American National Standards on B-ISDN UNI and NNI (ANSI T1.640 and T1.646).

SONET-based and DS1/DS3-based Physical Layers supporting ATM UNI and NNI/INI shall comply with the OAM requirements specified in ANSI T1.640 and T1.646.

Each Physical Layer supporting ATM will have its specific OAM capabilities and limitations. A minimum requirement is that the Physical Layer including the Transmission Convergence (TC) sublayer shall provide a Loss of Cell Delineation (LCD) defect indication to the ATM Layer. In the case of the DS1 and DS3 direct-mapped PDH systems, the TC sublayer shall provide the LCD defect indication to the ATM Layer.

A summary of SONET/ATM maintenance signal interactions is given in figure 3. A similar summary of DS1/ATM and DS3/ATM maintenance signal interactions is given in figure 4.

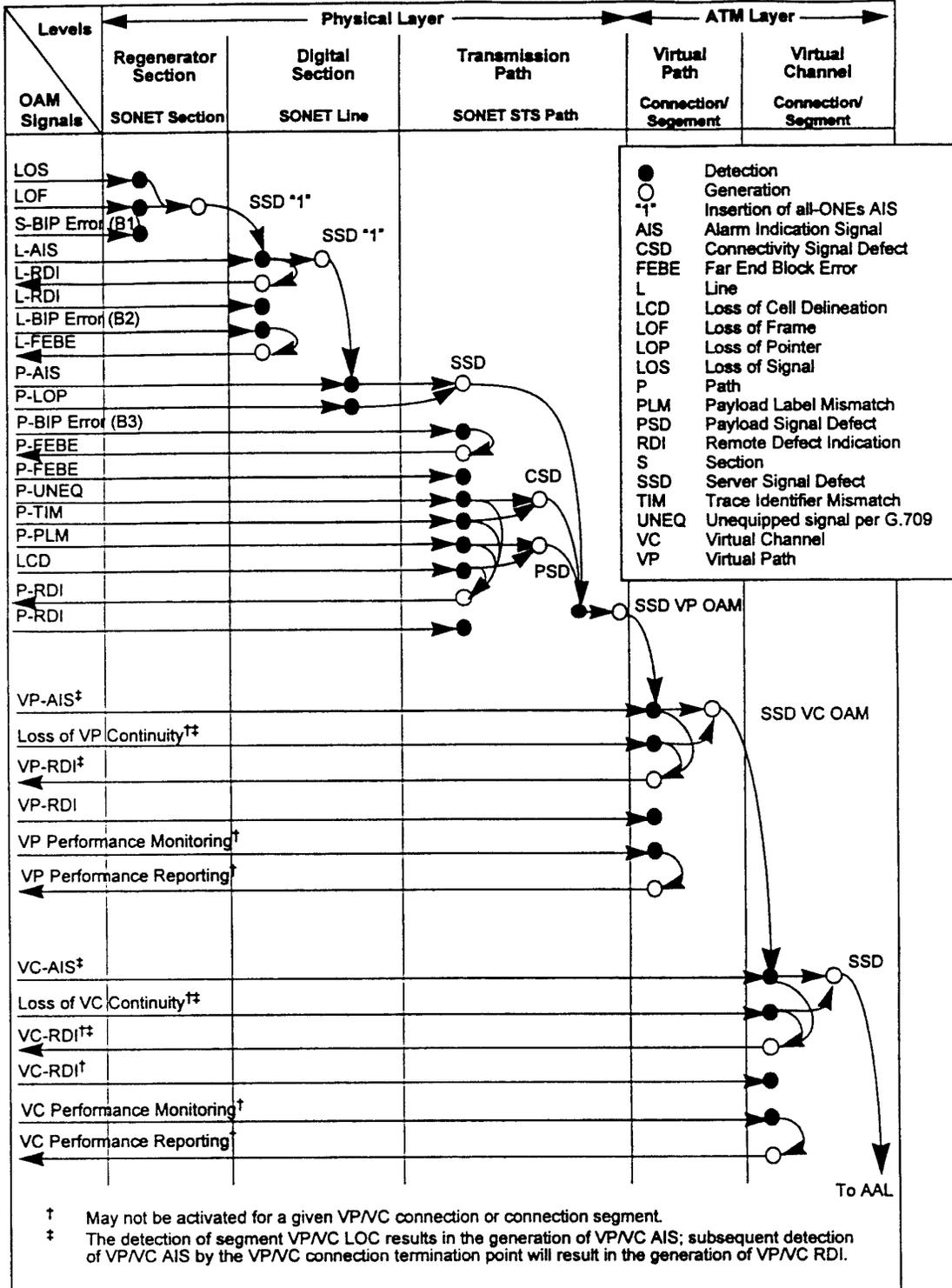


Figure 3 – SONET/ATM maintenance signal interaction

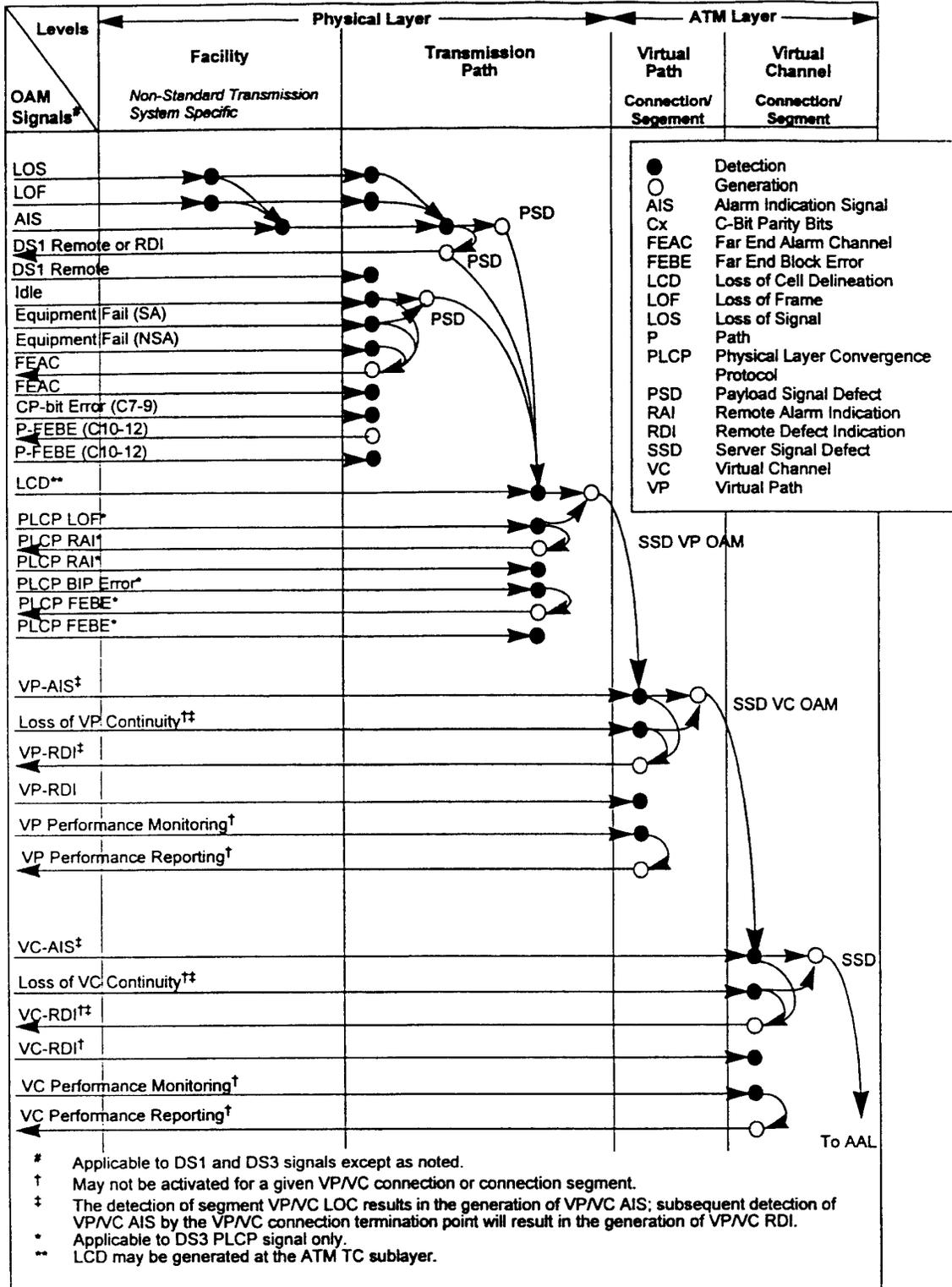


Figure 4 – Generic PDH/ATM maintenance signal interaction

8) Amend the notes to figure 4/I.610 **Section 5.1/I.610 “OAM flows in some physical configurations”** as follows:

- In note 1, “SDH” is replaced by “SONET”;
- Notes 2 and 3 are deleted.

9) Modify **Section 5.2.1/I.610 “OAM functions supported solely by the Flows F1 to F3”** as follows:

- Table 4/I.610 is not required to be supported.
- Table 3/I.610 is modified according to SONET specifications, namely:
 - SDH Multiplex Section (MS) is labeled SONET Line;
 - SDH Multiplex Section Adaptation (MSA) is merged into SONET Line;
 - SDH MS-RDI is labeled SONET RDI-L;
 - SDH Path-RDI is labeled SONET RDI-P;
 - Note 3 does not apply.
- ANSI T1.646, tables 13 and 14 shall be referenced for SONET physical layer management.
- ANSI T1.646, tables 18, 19, 21, and 22 shall be referenced for PDH physical layer management.
- If there’s any conflict between ANSI T1.646 and ITU-T Recommendation I.432, ANSI T1.646 takes precedence.

10) In **Section 5.2.2/I.610 “OAM functions with regard to the System Management”**, Support of the cell-based option list is not required and the SDH-based list of functions apply for SONET-based systems. This includes functions providing “uncorrectable header count” and “header error performance monitoring (degraded or not)”.

11) **Section 6.2.3/I.610 “Activation/Deactivation Procedures”**

Only TMN-based ATM OAM activation/deactivation capabilities and procedures described in this section are required. OAM cell-based activation/deactivation capabilities and procedures are optional.

12) Add the following informative annexes:

Annex A (informative)

Bandwidth requirements for OAM functions

Bandwidth requirements for OAM functions are important to consider when engineering point-to-point and point-to-multipoint connections. If OAM functions are desired, then these connections must include sufficient bandwidth for both forward and return-flow OAM messages. If sufficient bandwidth is not reserved, user traffic and/or OAM cells could be lost. Although OAM functions are very desirable, they may not be necessary on every connection, depending on the application and quality of service desired.

A.1 Bandwidth needs for point-to-point connections

If OAM cell flows are desired, then connections must have a non-zero return bandwidth, and it must be sufficient for both user data cells and OAM cells of each priority class (OAM cells can have priority 0 or 1). OAM cells are not policed separately from user data cells.

The traffic generated by OAM cells per connection in a given direction is as follows:

- 1 cell/second for AS and RDI functions;
- 1 activation/deactivation 'handshaking' cell per activation/deactivation request;
- For a connection on which one-way performance monitoring is active, PM cells will account for 0.078% to 0.78% of traffic (corresponding to block sizes of 1024 and 128, respectively). However, if two-way performance monitoring is active, each direction may have twice as much PM OAM cell traffic (worst case of 1.56%), due to the backward reports. The traffic doubles again if end-to-end and segment performance monitoring are both active at one reference point. Thus, the bandwidth overhead required for PM OAM function lies between 0.078%, and at most 3.125% per point-to-point connection;
- Only one loopback cell is needed to verify connectivity, but no formal limits have been established for the number of loopback cells that can be inserted in a connection/segment. In practice, loopback cells should need minimal bandwidth;
- For SVCs, the OAM F5 flow portion of the connection is established by the OAM traffic descriptor information element per ITU-T Recommendation Q.2931. The OAM traffic descriptor information element allows 1 cell/second, 0.1% of PCR, or 1.0% of PCR for F5 flow as a component of the connection;

From this information, one can determine OAM bandwidth needs if the service needs for OAM can be specified.

If a UPC or NPC receives too many cells, it will discard low priority cells first (making no distinction between OAM and user-data cells), and then high-priority cells, if needed (again, making no distinction between OAM and user-data cells), according to the operation of the UPC/NPC. If bandwidth is not reserved, the use of OAM cell functions could cause the delay or loss of user data or OAM traffic.

A.2 Bandwidth needs for multipoint connections

For further study.

Annex B
(informative)

Bibliography

ANSI T1.102-1993, *Telecommunications – Digital hierarchy – Electrical interfaces*

T1 Technical Report No. 36, *A Comparison of SONET (Synchronous Optical NETWORK) and SDH (Synchronous Digital Hierarchy)*, May, 1994³⁾

ITU-T Recommendation M.3010(1991), *Principles of a telecommunication management network (TMN)*¹⁾

ITU-T Recommendation Q.2931(1995), *Broadband integrated services digital network (B-ISDN) – Digital subscriber signalling system no. 2 (DSS2) – User–network interface (UNI) layer 3 specification for basic call/connection control*¹⁾

³⁾ Available from the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.