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# Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM) Signalling ATM Adaptation Layer (AAL) requirements

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## Foreword

This ETSI Technical Report (ETR) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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# 1 Scope

This ETR describes the Broadband Integrated Services Digital Network (B-ISDN) Asynchronous Transfer Mode (ATM) ATM Adaptation Layer (AAL) requirements to support the transfer of signalling messages. The AAL operates over an ATM virtual channel connection to provide a signalling link for the transfer of messages between two signalling entities. This is applicable for both User Network Interfaces (UNIs) and Network Node Interfaces (NNIs). As such, the Signalling ATM Adaptation Layer (SAAL) shall be able to provide the services provided by both Link Access Procedure on the D-channel (LAPD) and Message Transfer Part (MTP) layer 2.

This ETR specifies the SAAL requirements. It is designed to assist the protocol experts in the design of a service specific SAAL. These are minimum requirements, i.e. based on services provided by the existing link layers of the UNI (ITU-T Recommendation Q.921 [5]) and NNI (ITU-T Recommendation Q.703 [4]). The requirements are not intended to limit the protocol definition to only these capabilities, but form a basis for starting the work.

# 2 References

For the purposes of this ETR, the following references apply:

[1] ITU-T Recommendation I.361 (1993): "B-ISDN ATM layer specification".

[2] ITU-T Recommendation I.362 (1993): "B-ISDN ATM Adaptation Layer (AAL) functional description".

[3] ITU-T Recommendation I.363 (1993): "B-ISDN ATM Adaptation Layer (AAL) specification".

NOTE: ITU-T Recommendation I.363 [3] includes the specification of the Common Part (CP) of the AAL types 3 and 4.

[4] ITU-T Recommendation Q.703 (1993): "Signalling link".

[5] ITU-T Recommendation Q.921 (1993): "ISDN user-network interface - Data link layer specification".

# 3 Definitions, symbols and abbreviations

For the purposes of this ETR, the following abbreviations apply:

| | |
|---|---|
| AAL | ATM Adaption Layer |
| ATM | Asynchronous Transfer Mode |
| B-ISDN | Broadband Integrated Services Digital Network |
| CP | Common Part |
| LAPD | Link Access Procedure on the D-channel |
| MTP | Message Transfer Part |
| NNI | Network Node Interface |
| OSI | Open Systems Interconnection |
| SAAL | Signalling AAL |
| SAP | Service Access Point |
| SDH | Synchronous Digital Hierarchy |
| SDU | Signalling Data Unit |
| SSP | Service Specific Part |
| UNI | User Network Interface |

# 4 General

## 4.1 Concept and terminology

The basic structuring technique in the Open Systems Interconnection (OSI) reference model is layering. According to this technique, communication among application processes is viewed as being logically partitioned into an ordered set of layers represented in a vertical sequence as shown in figure 1.

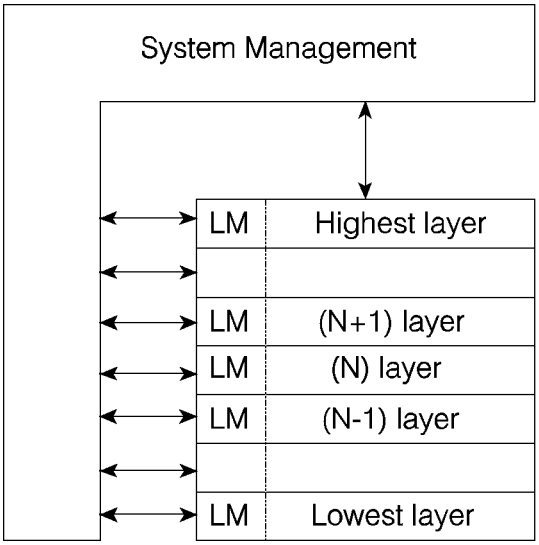



**Figure 1: Layering**

A SAAL Service Access Point (SAP) is the point at which the SAAL provides services to layer 3. Associated with each SAAL SAP are one or more SAAL connection endpoints, see figure 2.

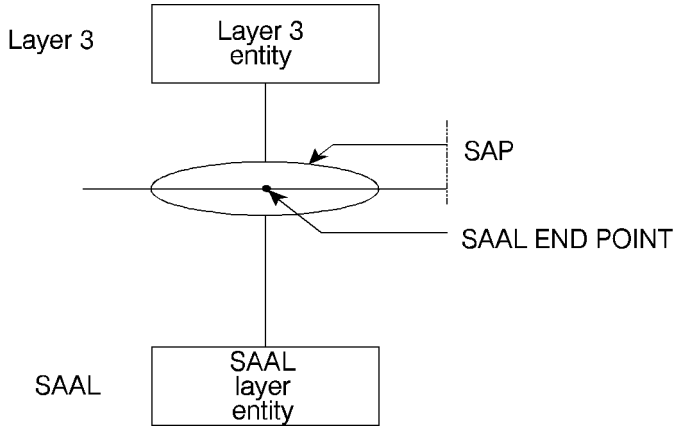



**Figure 2: Entities, service access points and endpoints**

Entities exist in each layer. Entities in the same layer but in different systems which need to exchange information to achieve a common objective are called "peer entities". Entities in adjacent layers interact through their common boundary. The services provided by the data link layer are the combination of the services and functions provided by the SAAL Service Specific Part (SSP), SAAL Common Part (CP) and the ATM layer.

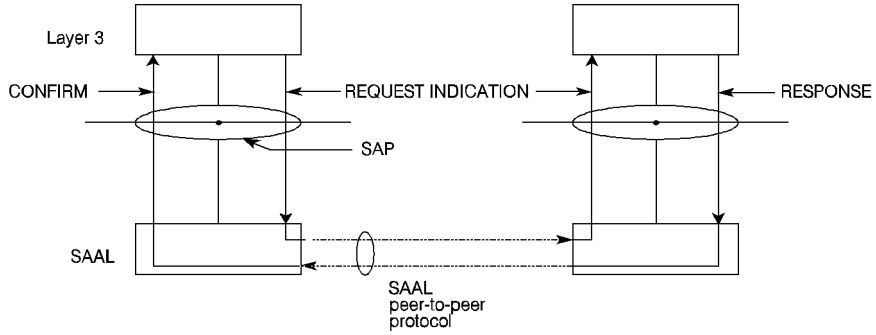
Cooperation between SAAL entities is governed by a peer-to-peer protocol specific to the layer.

SAAL Signalling Data Units (SDUs) are conveyed between SAAL entities by means of a physical connection.

Layer 3 requests services from the SAAL via service primitives. The same applies for the interaction between the SAAL and the ATM layer. The primitives represent, in an abstract way, the logical exchange of information and control between the SAAL and the adjacent layers and between the SAAL SSP and the SAAL CP. They do not specify or constrain implementation.

The primitives that are exchanged between the SAAL and adjacent layers are of the following four types (see also figure 3):

a) request;
b) indication;
c) response;
d) confirm.




NOTE: The same principle applies for SAA-ATM interactions.

**Figure 3: Primitive action sequence**

The request primitive type is used when a higher layer is requesting a service from the next lower layer.

The indication primitive type is used by a layer providing a service to notify the next higher layer of any specific activity which is service related. The indication primitive may be the result of an activity of the lower layer related to the primitive type request at the peer entity.

The response primitive type is used by a layer to acknowledge receipt from a lower layer of the primitive type indication.

The confirm primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

Information is transferred, in various types of SDUs, between peer entities and between entities in adjacent layers (and sublayers) that are attached to a specific SAP. The SDUs are of two types:

- SDUs of a peer-to-peer protocol; and

- SDUs that contain layer-to-layer information concerning status and specialized service requests.

The SDUs of the layer 3 peer-to-peer protocol are carried by the SAAL connection. The SDUs containing layer-to-layer information concerning status and specialized service requests are never conveyed over a SAAL connection or an ATM (physical) connection.

### 4.2 AAL structure for signalling applications

The AAL is functionally divided into the CP and SSP as shown in figure 4.

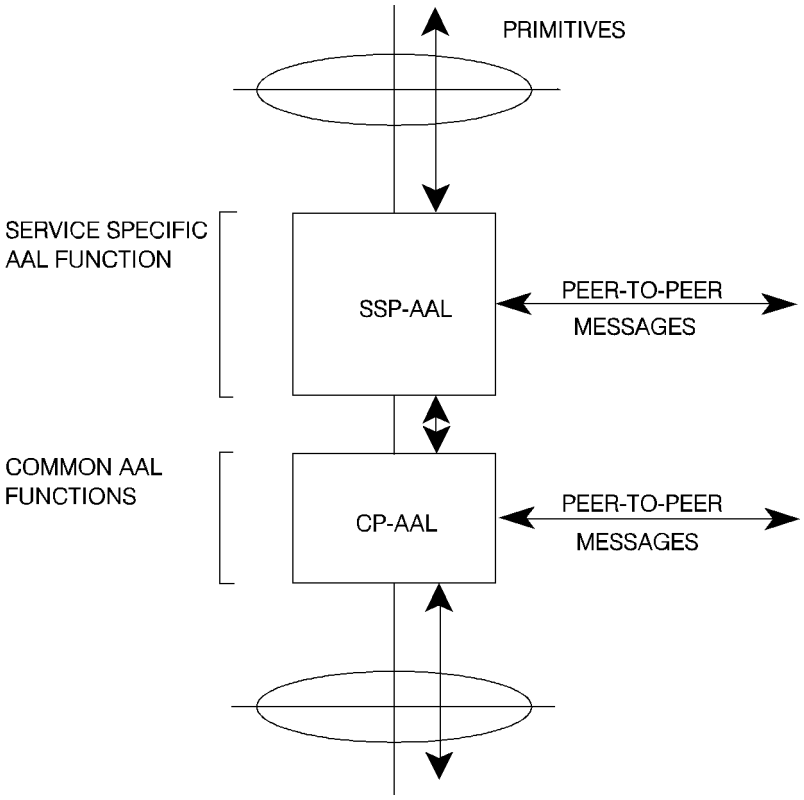



**Figure 4: AAL structure for signalling applications**

The CP may be used by different SSPs; the SSP is specific to the needs of the service application. The requirements in this ETR address the SSP. The CP protocol is specified in ITU-T Recommendation I.363 [3]; the SSP protocol is in the responsibility of ETSI STCs SPS3/SPS5.

Figure 5 shows the application topology of the CP and the SSP of the AAL. The CP and SSP are both peer-to-peer protocols with as much commonality between them as possible. Commonality between the UNI and NNI is desirable.

NOTE 1: One of the overall objectives in B-ISDN studies has been to achieve as much commonality as possible between UNI and NNI. In view of this, ETSI STC SPS3 requests ETSI STCs SPS2 and SPS5 to consider a common protocol in their study of the AAL to support signalling.

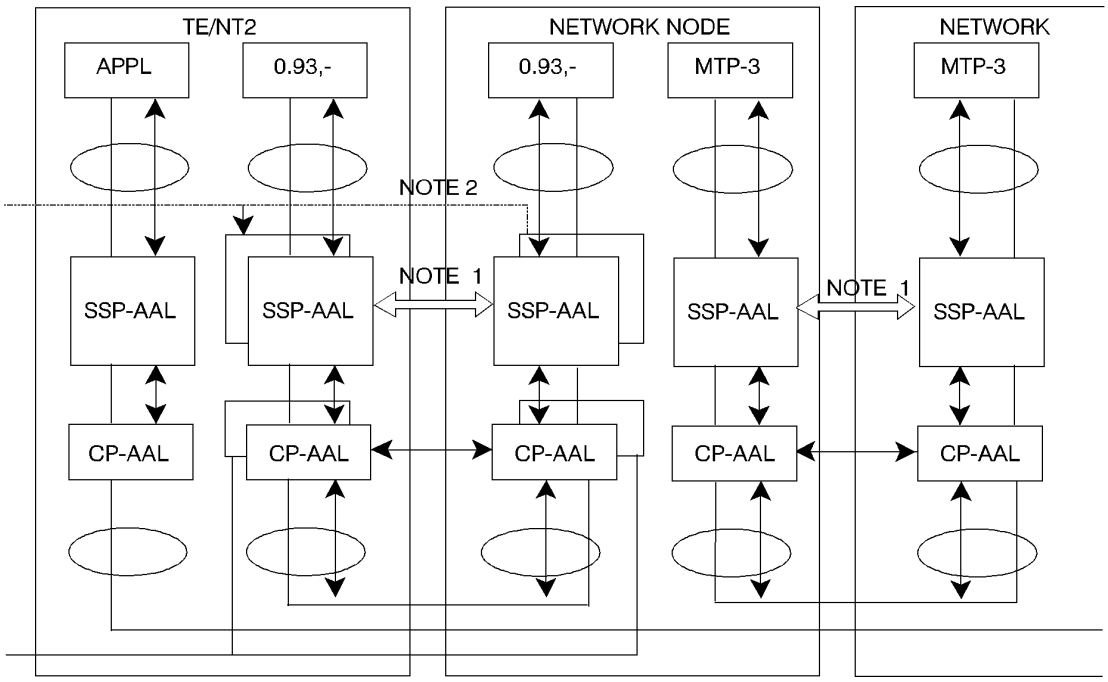



**Figure 5: AAL signalling structure application example**

It is hoped that this commonality, without increasing the complexity at the UNI, will have the following benefits:

- reduce complexity at network nodes;
- reduce time required for production of two protocols;
- allow for flexibility in network operation and configuration (due to a common signalling mechanism);
- make for more efficient operation and maintenance of the network;
- reduce operating costs;
- reduce manufacturing costs.

However, the above should be taken into account with the need to have a SAAL available for release 1.

NOTE 2: For the point-to-multipoint connection, a subset of the protocol used for point-to-point is used.

# 5 Service specific part

## 5.1 SSP-AAL services

The following services are provided by the signalling adaptation layer:

**a) Independence of underlying layers**

The AAL service relieves AAL service users from all concerns regarding which configuration is available (e.g. point-to-point connection) or which physical facilities are used.

**b) Unacknowledged transfer of data**

The AAL service provides for the transfer of AAL service user-data on point-to-point and point-to-multipoint ATM connections. The AAL service does not relieve the user from loss, insertion and misordering of data which may occur.

**c) Assured transfer of data**

The AAL service provides for the transfer of AAL service user-data on point-to-point ATM connections. The AAL service relieves the user from loss, insertion, corruption and misordering of data which may occur. In some cases unrecoverable errors in the AAL, duplication or loss of SDUs may occur.

**d) Transparency of transferred information**

The AAL service provides for the transparent transfer of AAL service user-data. It does not restrict the content, format or coding of information, nor does it ever need to interpret its structure or meaning.

**e) Establishment and release of AAL connections for assured transfer of data**

The AAL service provides for a means to establish and release AAL connections which operate in assured mode. Alternatively, the AAL service provider may release the AAL connection. Depending on the conditions, release of an AAL connection may result in loss of AAL user-data.

**f) SDU retrieval**

The AAL service makes available to the AAL service user the means by which the sending AAL service user may retrieve SDUs already handed over to the AAL.

**g) Status reporting**

The AAL service provides for a means to inform the AAL service user of the status of the AAL.

The signalling SSP-AAL may be operated in the following manner:

- LAPD emulation: the LAPD (ITU-T Recommendation Q.921 [5]) service can be emulated by means of services a) to e).

- MTP level 2 emulation: MTP level 2 (ITU-T Recommendation Q.703 [4]) can be emulated by means of services a) and c) to g).

### 5.2 Operational attributes

The operational attributes of the SSP-AAL include:

a) symmetry: operation is symmetric on point-to-point virtual channel connections. Operation on multipoint connections is asymmetric;

b) SDU size: a maximum of 4 096 octets shall be conveyed. SDUs are octet aligned;

c) operational speed: the minimum signalling rate is 16 kbit/s and the maximum signalling rate is protocol and traffic load dependent. The desired signalling rate is in the range of megabits per second.

d) performance requirements:

- undetected SDU loss rate - less than 1 in $10^7$;
- undetected SDU error rate - less than 1 in $10^{10}$;
- maximum establishment time: the maximum allowable time for establishment of a connection upon request from the user is less than one second for non-satellite connections and less than two seconds for satellite connections.

# 6 Common part

The requirements for the signalling SSP-AAL have been defined based on the definition of services, operational attributes and primitives and supported by the CP-AAL as contained in this Clause.

## 6.1 CP-AAL services

### a) Independence of underlying layers

The CP-AAL service relieves CP-AAL service users from all concerns regarding which configuration is available (e.g. point-to-point connection) or which physical facilities are used.

### b) Transparency of transferred information

The CP-AAL service provides for the transparent transfer of AAL-CP service user-data. It does not restrict the content, format or coding of information, nor does it ever need to interpret its structure or meaning.

### c) Transfer of data

The CP-AAL service provides for the transfer of CP-AAL service user-data on point-to-point and point-to-multipoint ATM connections. The CP-AAL service provides for CP-AAL service user-data integrity, but does not relieve the CP-AAL service user from loss, insertion and misordering of data which may occur.

### d) Error reporting

The CP-AAL service indicates to the CP-AAL service user whether the received user-data is corrupted (the need for this service is still under study).

## 6.2 Operational attributes

The operational attributes of the CP-AAL include:

a) SDU size: a maximum of 4 096 octets plus the service specific overhead shall be conveyed. SDUs are octet aligned;

b) operational speed: the minimum signalling rate is 16 kbit/s modified appropriately to include the service specific overhead and the maximum signalling rate is protocol and traffic dependent. The desired signalling rate is in the order of Mbit/s;

c) performance requirements: the requirements need to be provided by ITU-T Study Group 13 (formerly CCITT Study Group XVIII).

### 6.3 Primitives

The proposed primitives across the service specific AAL-common AAL service boundary are as follows:

- ALC-Unit-Data.Request: used to convey a service data unit to the common AAL. Signalling does not need the priority parameter. This parameter would be set to "high" priority in each primitive.

- ULC-Unit-Data.Indication (error/no error parameter): used to convey DSUs to the user of the common AAL. The error/no error parameter indicates that the SDU is in error or has been received correctly according to the error detection capabilities of the AAL.

## 7 Service specific part functions

The signalling SSP of the AAL performs the following functions:

**a) Sequence integrity**

This function preserves the order of SSP-SDUs that were submitted to the SSP sub-layer.

**b) Error correction by retransmission**

Through some sequencing mechanism, the receiving SSP-entity detects missing SSP-SDUs. The SSP service corrects any error that occurred in the underlying service by retransmission.

**c) Flow control**

This function controls the rate at which the peer SSP-entity may send information.

**d) Error reporting to layer management**

This function indicates to layer management errors which have occurred.

**e) Keep alive**

This function assures that the two peer SSP-entities participating in a connection are remaining in link connection established state even in the case of a prolonged absence of data transfer.

**f) Processor outage recovery**

This function assures that both peer SSP-entities stop the processing of user-data in the case of a failure of one of the users of the AAL if the user goes back into operational mode, this function assures that both peer SSP-entities resume processing of user-data again.

**g) Local data retrieval**

This function allows the local AAL-SSP user to retrieve SDUs which have not yet been transmitted by the SSP-entity or which have not yet been acknowledged by the peer SSP-entity.

**h) Link management**

This function performs the establishment, release and reset of an SSP-connection.

**i) Transfer of user-data**

This function is used for the conveyance of user-data between users of the AAL-SSP.

**j) PDU-error detection**

This function detects errors in the PDU.

Functions a) to e) and h) to j) are needed at the UNI and functions a) to d) and f) to j) are needed at the NNI.

# 8 Definition of the AAL boundary

A distinction is made between primitives and the associated state diagrams to support higher layer protocols at the UNI and at the NNI. The AAL boundary for high-speed data transfer has not been defined, since this does not form part of signalling requirements.

## 8.1 Definition of the AAL boundary at the UNI

### 8.1.1 Primitives

The primitives required to support the AAL-user at the UNI are shown in table 1.

**Table 1: Primitives used at the UNI**

| Generic name | Type | | | | Parameters | Message unit contents |
|---|---|---|---|---|---|---|
| | Request | Indication | Response | Confirm | Message Unit | |
| AAL-ESTABLISH | x | x | | x | | |
| AAL-RELEASE | x | x | | x | | |
| AAL-DATA | x | x | | | x | L3 peer-to-peer message |
| AAL-UNIT DATA | x | x | | | x | L3 peer-to-peer message |

These primitives are equivalent to Q.921 primitives, as shown in table 2.

**Table 2: Equivalent Q.921 primitives**

| AAL primitive | Q.921 primitive |
|---|---|
| AAL-ESTABLISH | DL-ESTABLISH |
| AAL-RELEASE | DL-RELEASE |
| AAL-DATA | DL-DATA |
| AAL-UNIT DATA | DL-UNIT DATA |

The definition of these primitives is as follows:

- establish request/indication/confirm: this is used for establishing assured information transfer between AAL entities at the UNI. This is only required in conjunction with point-to-point ATM connections;

- release request/indication/confirm: this is used for terminating assured information transfer between AAL entities at the UNI. This is only required in conjunction with point-to-point ATM connections;

- data request: this is used in conjunction with assured SDU data transfer at the UNI. It is assumed that assured information transfer was initiated with the establish primitive. This is only required in conjunction with point-to-point ATM connections;

- unitdata request/indication: this is used in conjunction with unacknowledged SDU data transfer at the UNI. This is required in conjunction with multipoint and point-to-point ATM connections.

### 8.1.2 State diagram

The link state diagram at the UNI is shown in figure 6.

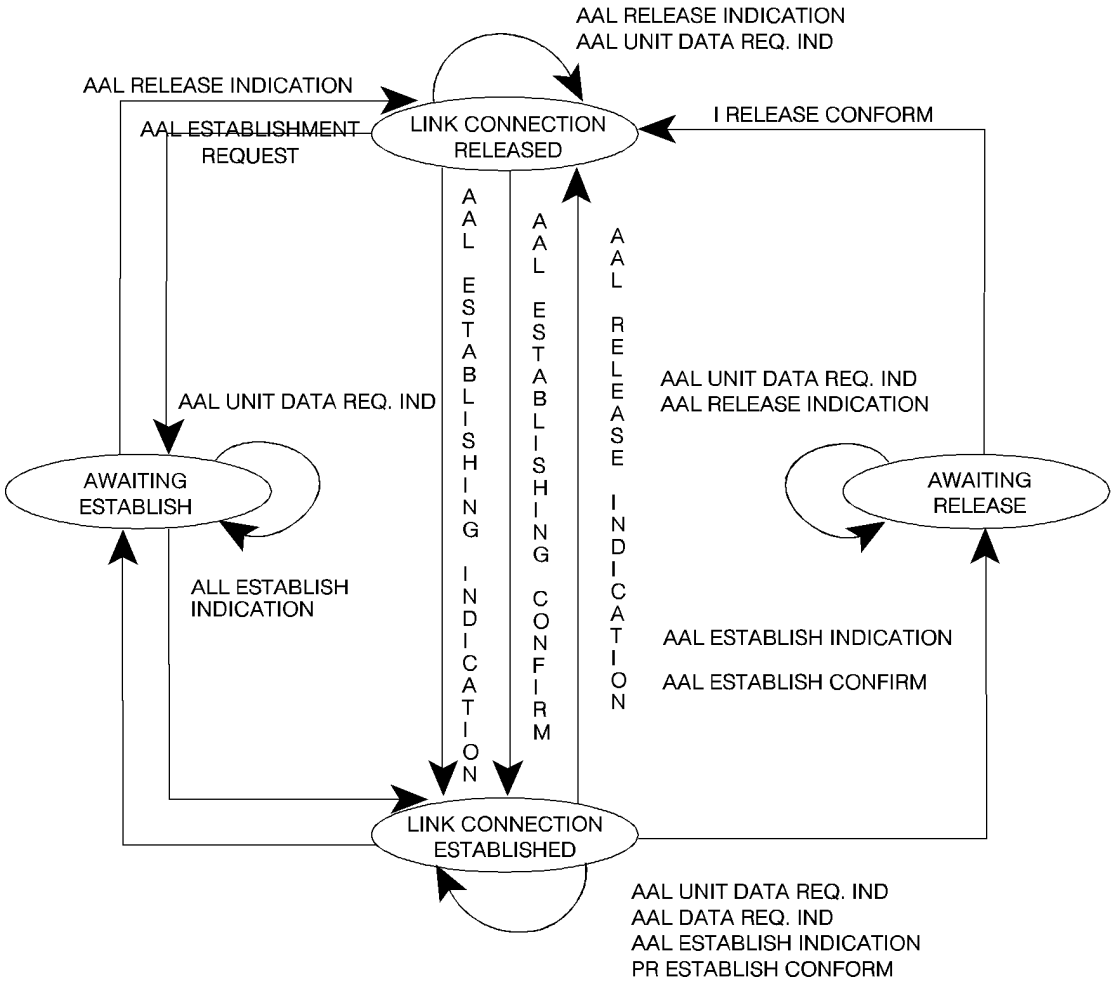



**Figure 6: State diagram for UNI**

## 8.2 Definition of the AAL boundary at the NNI

### 8.2.1 Primitives

The primitives required to support AAL user at the NNI are shown in table 3. Their names are consistent with the names of the messages which are exchanged between MTP level 2 and MTP level 3.

**Table 3: Primitives used at the NNI**

| Generic name | Type | | | | Parameters | | | Message unit contents |
|---|---|---|---|---|---|---|---|---|
| | Req | Ind | Resp | Conf | Message unit | FSNC | BSNT | |
| AAL-Transmit-Data | X | | | | X | | | L3 peer-peer message |
| AAL-Receive-Data | | X | | | X | | | L3 peer-peer message |
| AAL-Congestion | | X | | | | | | |
| AAL-Congestion-Ceased | | X | | | | | | |
| AAL-Emergency | X | | | | | | | |
| AAL-Emergency-Ceased | X | | | | | | | |
| AAL-Stop | X | | | | | | | |
| AAL-Start | X | | | | | | | |
| AAL-In-Service | | X | | | | | | |
| AAL-Out-of-Service | | X | | | | | | |
| AAL-Remote-Processor-Outage | | X | | | | | | |
| AAL-Remote-Processor-Recovery | | X | | | | | | |
| AAL-Retrieve-BSNT | X | | | | | | | |
| AAL-Retrieve-Request-and-FSNC | X | | | | | | | |
| AAL-Retrieved-Message | | X | | | X | | | Message to be retrieved |
| AAL-Retrieved-Complete | | | | X | | X | | |
| AAL-Retrieved-Message-BSNT | | | | X | | | X | |
| AAL-Flush-Buffers | X | | | | | | | |
| AAL-BSNT-not-retrievable | | | | X | | | | |

The primitives as defined in table 3 are used as indicated in table 4.

**Table 4: Use of NNI-primitives**

| Primitive | Operation |
|---|---|
| AAL-Transmit-Data | Used by AAL user to send data |
| AAL-Receive-Data | Used by the AAL to deliver data |
| AAL-Congestion | Indicates transmitter congestion |
| AAL-Congestion-Ceased | Indicates congestion has ceased |
| AAL-Emergency | Request reduction of link proving |
| AAL-Emergency-Ceased | Return to normal link proving |
| AAL-Stop | Inhibits peer-to-peer communication |
| AAL-Start | Used to establish communications |
| AAL-In-Service | Link available |
| AAL-Out-of-Service | Link not usable |
| AAL-Remote-Processor-Outage | Notifies AAL user that its peer is out |
| AAL-Remote-Processor-Recovery | Notifies AAL user that its peer is okay |
| AAL-Retrieve-BSNT | Requests BSNT to be retrieved |
| AAL-Retrieve-Request-and-FSNC | Requests non-acknowledged messages to be delivered |
| AAL-Retrieved-Message | Delivery of non-acknowledged messages |
| AAL-Retrieved-Complete | Delivery of non-acknowledged messages completed |
| AAL-Retrieved-Message-BSNT | Delivery of BSNT value |
| AAL-Flush-Buffers | Empties buffers of the AAL |
| AAL-BSNT-Not-Retrievable | Notifies AAL user that BSNT cannot be retrieved |

### 8.2.2 State diagram

The link state diagram at the NNI is shown in figure 7.

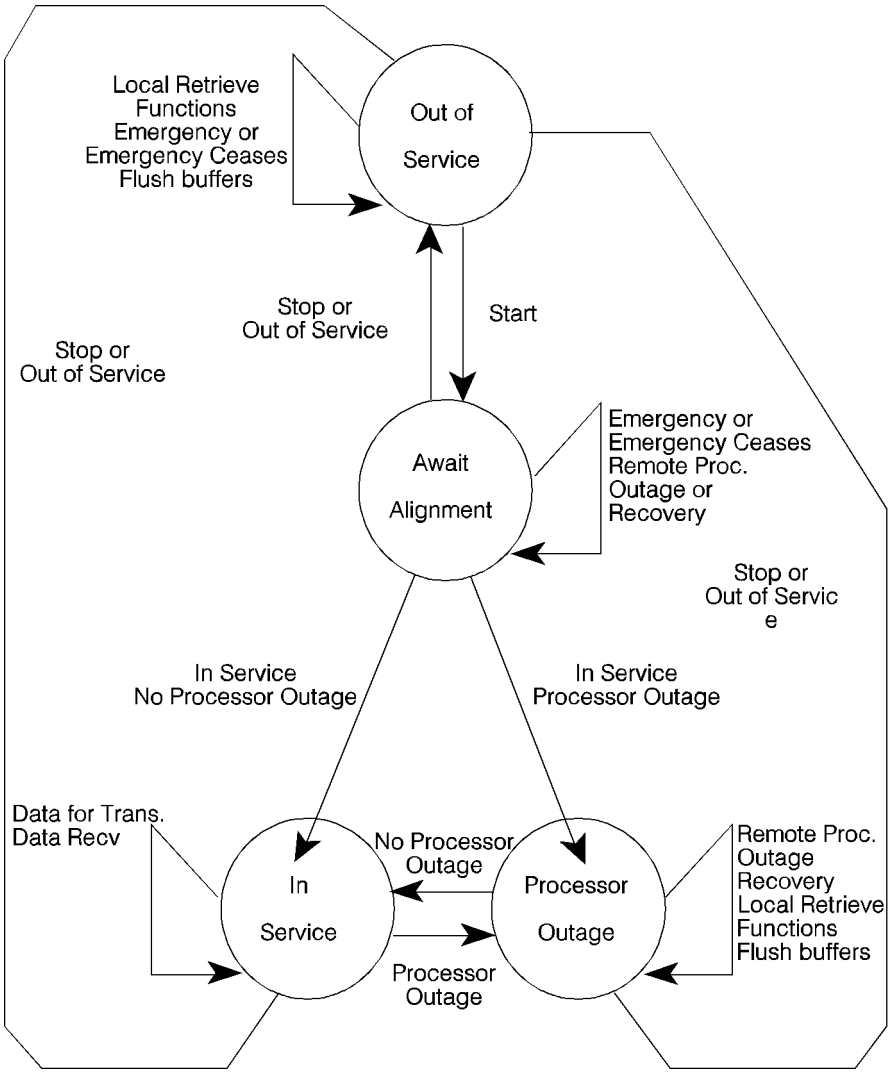



**Figure 7: Link State Diagram for NNI**

## Annex A: Example flow diagrams

The following figures are example flow diagrams depicting how the primitives can be mapped to peer-to-peer protocols. These may serve as a basis for generating operation procedures.

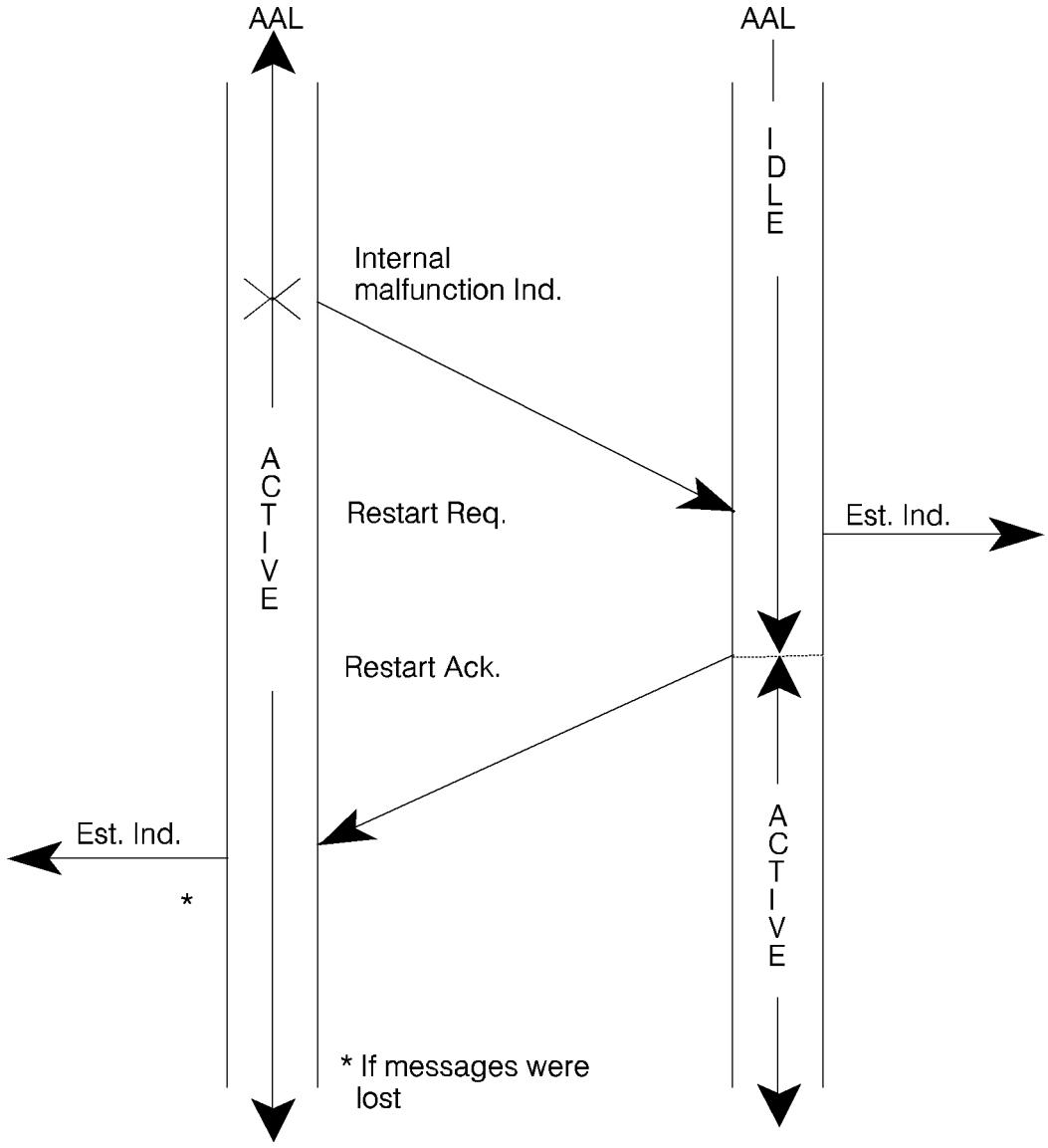



**Figure A.1 (sheet 1 of 6): AAL example flow**

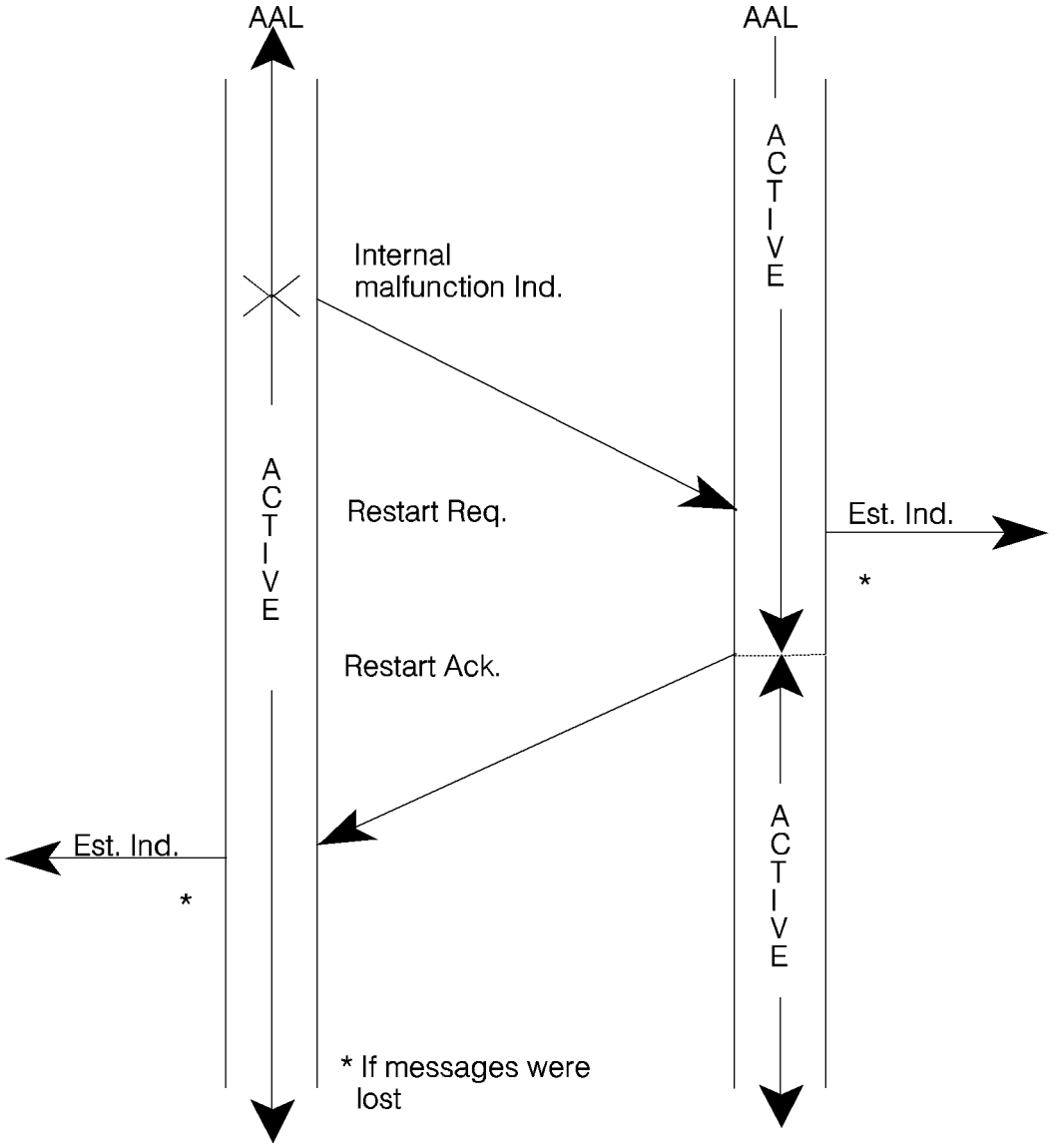



**Figure A.1 (sheet 2 of 6): AAL example flow**

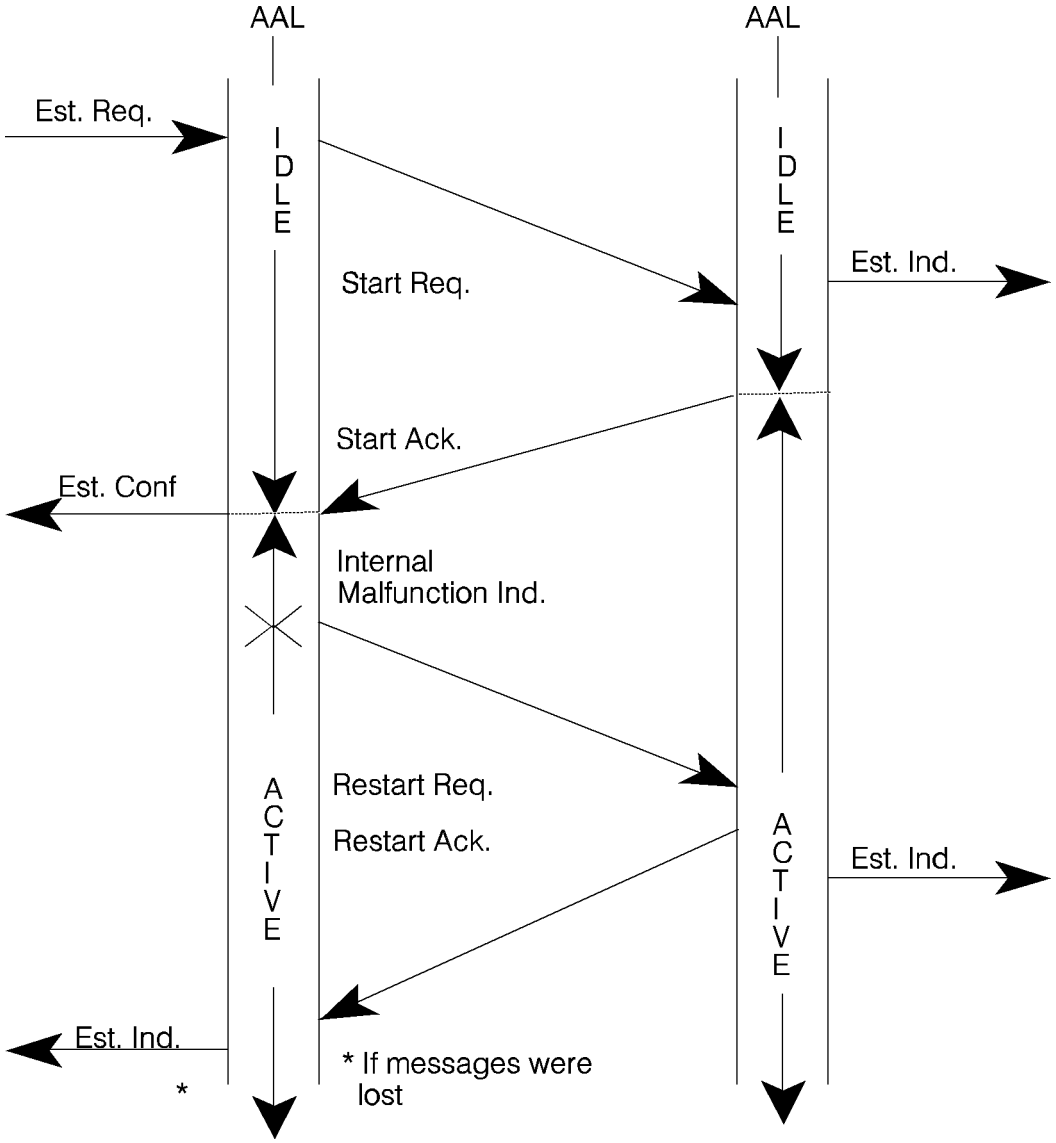



**Figure A.1 (sheet 3 of 6): AAL example flow**

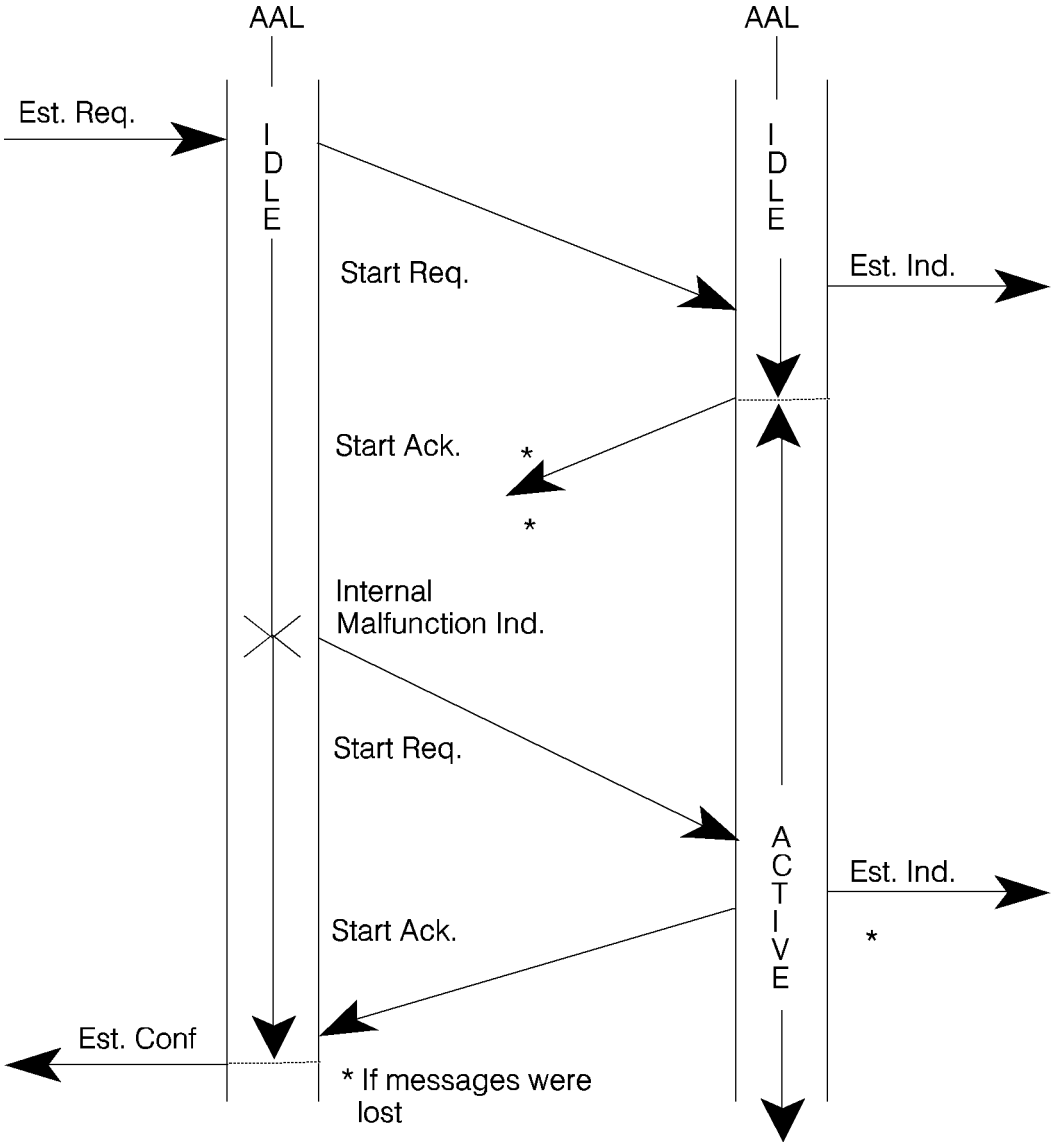



**Figure A.1 (sheet 4 of 6): AAL example flow**

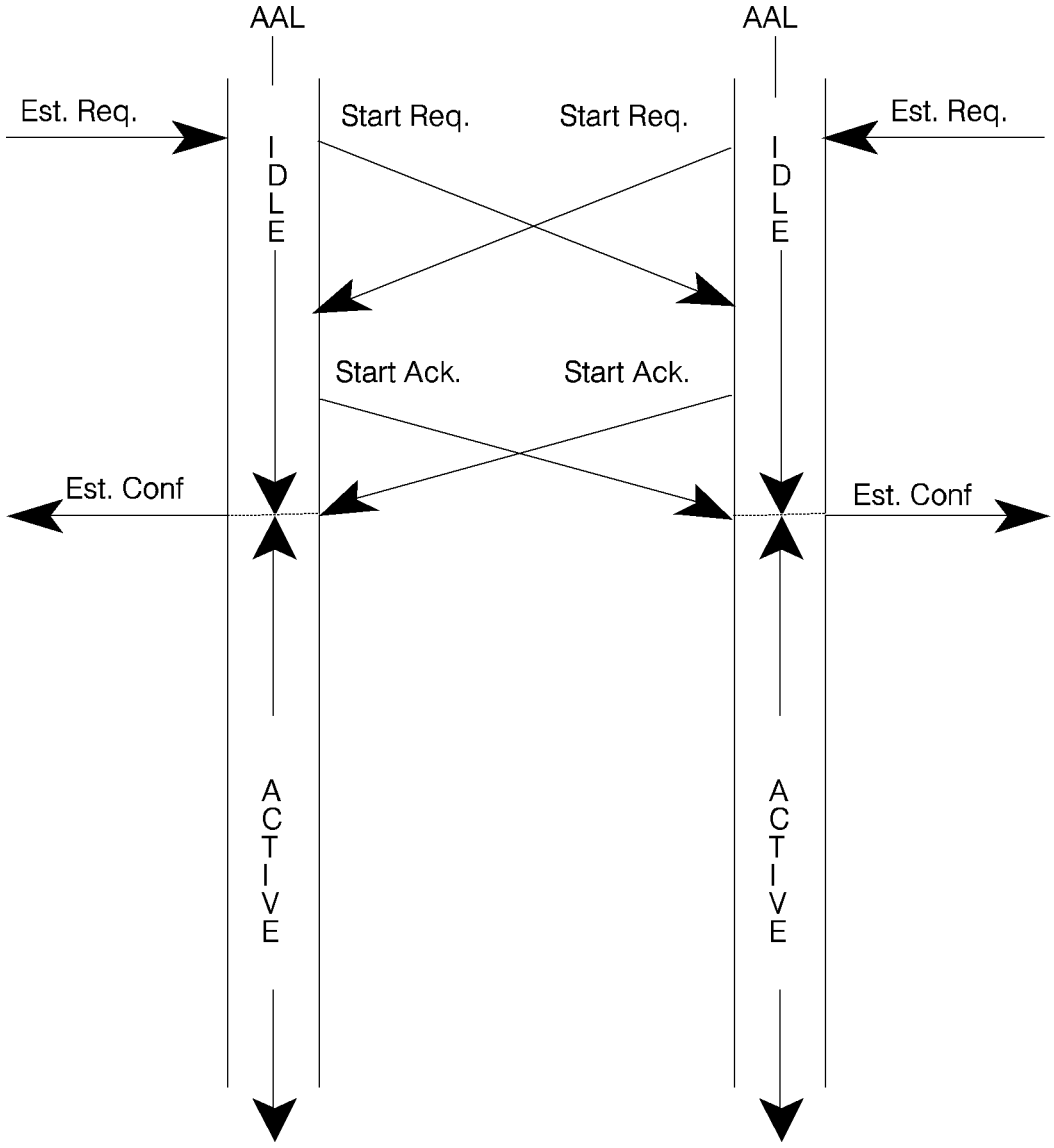



**Figure A.1 (sheet 5 of 6): AAL example flow**

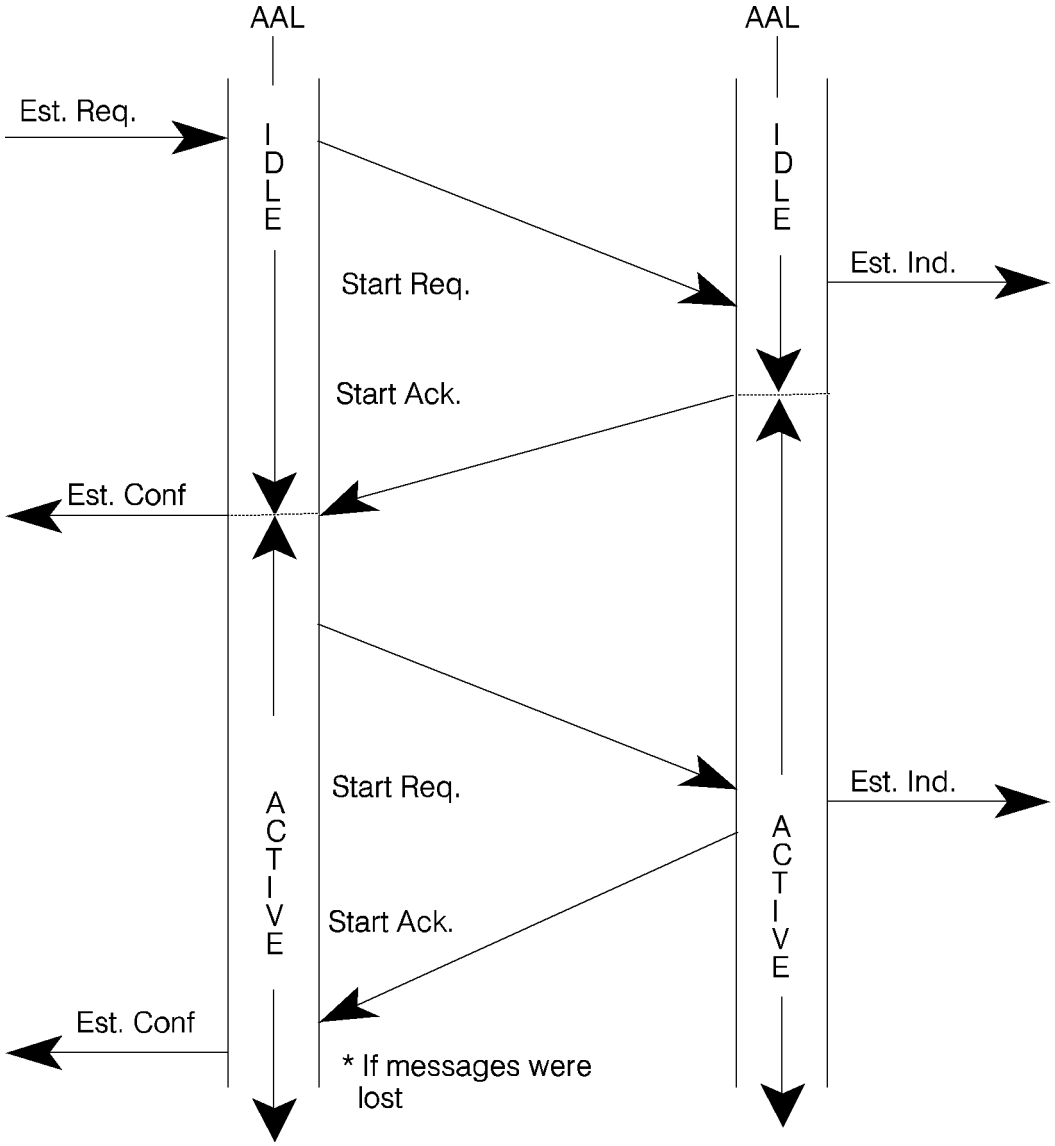



**Figure A.1 (sheet 6 of 6): AAL example flow**

## Annex B: Bibliography

1) ETS 300 349: "Broadband Integrated Services Digital Network; Asychronous Transfer Mode (ATM) ATM Adaptation Layer (AAL) specification - type 3/4".

2) ETS 300 353: "Broadband Integrated Services Digital Network; Asychronous Transfer Mode (ATM) ATM Adaptation Layer (AAL) specification - type 1".

## History

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|---|---|
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