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**Abstract:** Attached is the revised text of Section 5 Q.2931 which reflects the results of the June 13 - 21 1994 SG 11/2 meeting in Edinburgh, U K.

## 5 B-ISDN Call/Connection Control Procedures

This clause describes the general procedures for call/connection control in B-ISDN. Clause 6 specifies the particular features required to provide 64 kbit/s based circuit-mode ISDN services in B-ISDN and to support access signalling interworking between B-ISDN and N-ISDN.

These procedures apply only to the point-to-point access configuration. For point-to-point access configurations, VCI = 5 is used as the signalling channel.

Recommendation Q.2931 procedures are used to establish B-ISDN connections over a signalling virtual channel connection that has already been established for B-ISDN. For subsequent connections over the same B-ISDN interface, the connections are distinguished through additional signalling over the signalling virtual channel to set up additional VCCs. Typically, the call reference value also uniquely identifies the connection.

For call/connection to be established it must satisfy the following general criteria determined by the network and end systems:

- Basic service support;
- VC availability;
- Physical and virtual network resource availability to provide quality of service requested;
- End system resource availability to provide quality of service requested;
- End to end compatibility.

Note - Annex H also contains extensions to the call/connection establishment procedures described in clause 5 for symmetrical operations.

The call states referred to in this section cover the states perceived by the network, states perceived by the user and states which are common to both user and network. Unless specifically qualified, all states described in the following text should be understood as common.

Detailed Specification and Description Language (SDL) diagrams for the procedures specified in this section are contained in Annex A. When there is an ambiguity in the narrative text, the SDL diagrams should be used to resolve the conflict. Where the text and the SDL are in disagreement, the text should be used as the prime source.

### 5.1 Call/Connection establishment at the originating interface

Before these procedures are invoked, an assured mode signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the signalling AAL using a AAL-DATA-REQUEST primitive. The data link services described in B-ISDN Signalling ATM Adaptation layer (SAAL) Specification for Application at the User-network Interface are assumed.

Establishment of Signalling AAL connections is initiated by transferring an AAL\_ESTABLISH.request primitive to the signalling AAL.

On receipt of an AAL\_ESTABLISH.confirm or AAL\_ESTABLISH.indication primitive from the SAAL, access signalling procedures may begin. The AAL\_ESTABLISH.indication primitive will be received in the case of SAAL establishment request by the peer entity, and AAL\_ESTABLISH.confirm in response to a local request to establish an SAAL connection.

#### 5.1.1 Call/Connection request

The calling party initiates call establishment by transferring a SETUP message on the assigned signalling virtual channel across the interface and start timer T303. Following the transmission of the SETUP message, the call is considered by the calling party to be in the Call Initiated state. The message shall always contain a call reference, selected according to the procedures given in subclause 4.3. In selecting a call reference, the dummy call reference value shall not be used. The ATM user cell rate traffic descriptor, Broadband bearer capability, and QOS parameter information elements are mandatory in the SETUP message.

Furthermore the SETUP message may also contain all or part of the call information (i.e., address) necessary for call establishment depending on whether en-bloc or overlap procedures (see clause 6) are being used respectively.

If en-bloc sending is used, the SETUP message shall contain all the information required by the network to process the call. In particular, the called party address information, if present, is contained in the Called party

number information element possibly supplemented by the Called party subaddress information element. The Broadband sending complete information shall be included by the B-TEs.

If no response to the SETUP message is received by the user before the first expiry of timer T303, the SETUP message will be retransmitted and timer T303 restarted. If the user has not received any response to the SETUP message after the final expiry of timer T303, the user shall internally clear the call internally.

## **5.1.2 Connection identifier (VPCI/VCI) allocation/selection**

Two cases exist:

(i) Associated Signalling

The layer 3 signalling entity exclusively controls the VCs in the VPC which carries its signalling VC.

(ii) Non-Associated Signalling

The layer 3 signalling entity controls the VCs in the VPC which carries its signalling VC and may control VCs in other VPCs.

The network shall support both associated and non-associated signalling procedures. The network and the user shall support the non-associated signalling procedures and may as an option support the associated signalling procedures. The associated signalling procedures are used only by bilateral agreement between the user and the network.

When the network receives a connection identifier information element with the VP-associated signalling field (see Table 4-16/Q.2931) coded with a value not supported by the network, the call shall be rejected with cause #36, "VPCI/VCI assignment failure".

### **5.1.2.1 Connection Identifier Allocation/Selection - Origination**

#### **5.1.2.1.1 Associated Signalling**

For associated signalling, the user requests a virtual channel in the VPC carrying the signalling VC. The VPC carrying the signalling VC is implicitly indicated.

In the Connection identifier information element, the VP associated signalling field is coded as "VP associated signalling" in the Connection identifier information element and one of the following values is indicated in the Preferred/exclusive field:

- a) Exclusive VPCI; any VCI; or,
- b) Exclusive VPCI; exclusive VCI.

In case a), the network selects any available VCI within the VPC carrying the signalling VC.

In case b), if the indicated VCI within the VPC carrying the signalling VC is available, the network selects it for the call.

The selected VCI value is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (e.g., CALL PROCEEDING message). The VP associated signalling field is coded as "VP associated signalling". The Preferred/exclusive field is coded as Exclusive VPCI; exclusive VCI.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the network.

In case b), if the indicated VCI is not available, a RELEASE COMPLETE message with the cause #35, "requested VPCI/VCI not available", is sent by the network.

#### **5.1.2.1.2 Non-Associated Signalling**

In the user's request for a virtual channel in the SETUP message, the user shall indicate one of the following:

- a) Exclusive VPCI; any VCI,
- b) Exclusive VPCI; exclusive VCI, or
- c) No indication is included (i.e., the Connection identifier information element is not included in the SETUP message).

In cases a) and b), the VP associated signalling field is coded as "explicit indication of VPCI" in the connection identifier information element.

In cases a) and b), if the indicated VPCI is available, the network selects it for the call. In case a), the network selects any available VCI in the VPCI. In case b), if the indicated VCI is available within the VPCI, the network selects it for the call.

In case c), the network selects any available VPCI and VCI.

The selected VPCI/VCI value is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (e.g., CALL PROCEEDING message). The VP associated signalling field is coded as "explicit indication of VPCI". The Preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In cases a) and b), if the specified VPCI is not available, a RELEASE COMPLETE message with cause #35, "requested VPCI/VCI not available", is sent by the network.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the network.

In case b), if the VCI in the indicated VPCI is not available, a RELEASE COMPLETE message with cause #35, "requested VPCI/VCI not available", is sent by the network.

In case c), if the network is not able to allocate a VCI in any VPCI, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the network.

#### 5.1.2.2 Use of VPCIs

The Connection identifier information element is used in signalling messages to identify the corresponding user information flow. The Connection identifier information element contains the Virtual Path Connection Identifier (VPCI) and the Virtual Channel Identifier (VCI). The VPCI is used instead of the Virtual Path Identifier (VPI) since Virtual Path Cross Connects may be used in the access and multiple interfaces could be controlled by the signalling virtual channel.

Both the user and the network must understand the relationship between the VPCI used in the signalling protocol and the actual VPI used for the user information flow. VPCIs only have significance with regard to a given signalling virtual channel.

If the signalling virtual channel only controls a single interface at the user side, the VPI and the VPCI have the same numerical value at the user side. The figure below illustrates this.

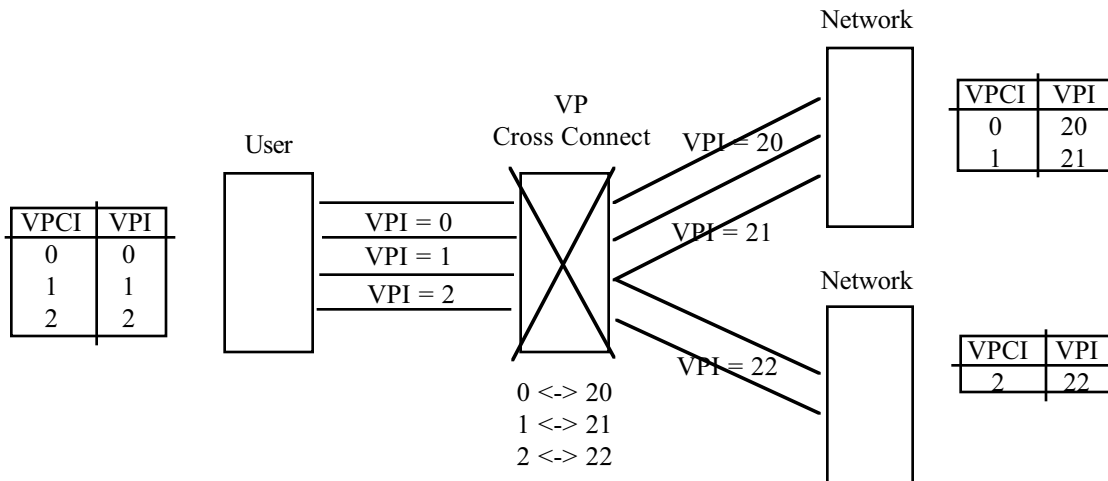


FIGURE 5-1/Q.2931

#### Single interface controlled by SVC

If the signalling channel controls multiple interfaces at the user side, the VPCI corresponds to both the interface and a VPI on the interface.

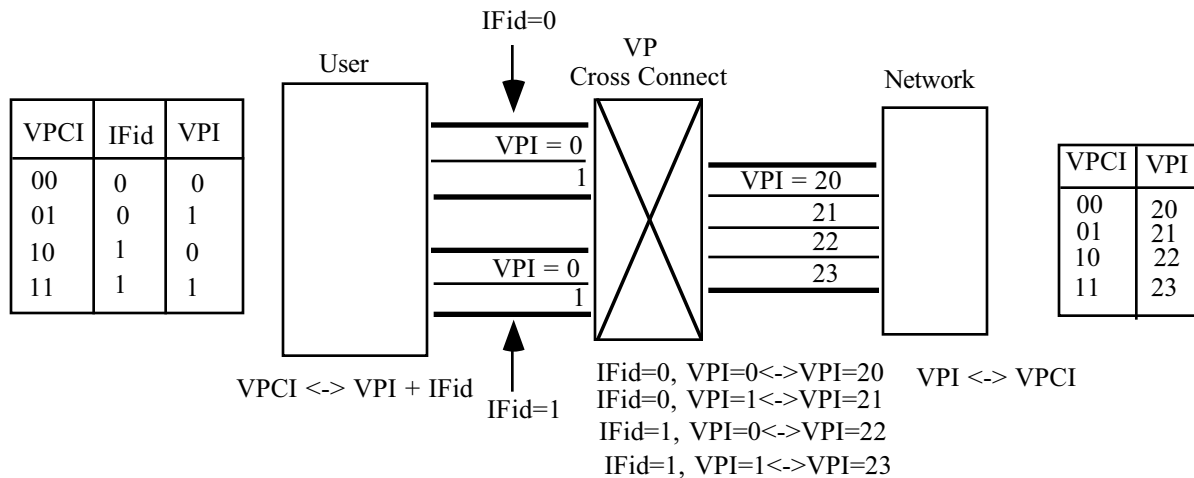


FIGURE 5-2/Q.2931

**Multiple interfaces controlled by SVC**

**5.1.2.3 VCI Range**

The range of valid VCI values is indicated below:

- 0 through 31 not used for on-demand user plane connections
- 321 through 65535 Identifier of the Virtual Channel (Note)

Note - Some values in the range may not be available for use (e.g., some values may be used for permanent connections).

**5.1.3 QOS and Traffic parameters selection procedures**

The user shall indicate the QOS class in the Quality of service parameter information element.

If the network is able to provide the requested QOS class, the network shall progress the call to the called user. If the network is not able to provide the requested QOS class, the network shall reject the call, returning a RELEASE COMPLETE message with cause #49, "Quality of service unavailable".

The user shall indicate the requested peak cell rate in the ATM traffic descriptor user cell rate information element.

If the network is able to provide the requested peak cell rate, the network shall progress the call to the called user. If the network is not able to provide the requested peak cell rate, the network shall reject the call, returning a RELEASE COMPLETE message with cause #51, "user cell rate unavailable".

**5.1.4 Invalid Call/Connection control information**

If upon receiving the SETUP message, the network determines that the call information received from the user is invalid (e.g., invalid number), then the network shall initiate call clearing in accordance with subclause 5.4 with a cause such as the following:

- #1 unassigned (unallocated) number;
- #3 no route to destination;
- #22 number changed; or,
- #28 invalid number format (address incomplete).

**5.1.5 Call/Connection proceeding**

If the network can determine that access to the requested service is authorized and available, the network shall: send a CALL PROCEEDING message to the user to acknowledge the SETUP message and to indicate that the call is being processed; and enter the Outstanding Call Proceeding state. When the user receives the CALL

PROCEEDING message, the user shall stop timer T303, start timer T310, and enter the Outgoing Call Proceeding state.

If the network determines that a requested service is not authorized or is not available, the network shall initiate call clearing in accordance with subclause 5.4 with one of the following causes:

- #57 *bearer capability not authorized;*
- #58 *bearer capability not presently available;*
- #63 *service or option not available, unspecified;* or,
- #65 *bearer service not implemented.*

If the user has received a CALL PROCEEDING message, but does not receive an ALERTING, CONNECT, or RELEASE message prior to the expiration of timer T310, then the user shall: initiate clearing procedures towards the network with cause #102, "recovery on timer expiry".

#### **5.1.6 Call/Connection confirmation indication**

Upon receiving an indication that user alerting has been initiated at the called address, the network shall: send an ALERTING message across the user-network interface of the calling address; and enter the Call Delivered state. When the user receives the ALERTING message, the user may begin an internally-generated alerting indication; stop T303 or T310 (if running) and shall enter the Call Delivered state.

#### **5.1.7 Call/Connection acceptance**

Upon receiving an indication that the call has been accepted, the network shall: send a CONNECT message across the user-network interface to the calling user and enter the Active state.

This message indicates to the calling user that a connection has been established through the network and stops a possible local indication of alerting.

On receipt of the CONNECT message, the calling user shall: stop timer T303 or T310 (if running); stop any user-generated alerting indication; attach to the user plane virtual channel if not already done; send a CONNECT ACKNOWLEDGE message; and enter the Active state. The network shall not take any action on receipt of a CONNECT ACKNOWLEDGE message when it perceives the call to be in the Active state.

At this point an end-to-end connection is established.

The network shall not take any action on receipt of a CONNECT ACKNOWLEDGE message when it perceives the call to be in the Active state.

#### **5.1.8 Call/Connection rejection**

Upon receiving an indication that the network or the called user is unable to accept the call, the network shall initiate clearing at the originating user-network interface as described in subclause 5.4, using the cause provided by the terminating network or the called user.

#### **5.1.9 Transit network selection**

When the Transit network selection information element is present, the call shall be processed according to Annex D/Q.2931. Some networks may not support transit network selection.

### **52 Call/Connection establishment at the destination interface -- point-to-point access configuration call offering**

Before these procedures are invoked, an assured mode Signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the signalling AAL using an AAL-DATA-REQUEST primitive.

#### **5.2.1 Incoming Call/Connection request**

The network will indicate the arrival of a call at the user-network interface by transferring a SETUP message across the interface. The message shall always contain a call reference, selected according to the procedures given in subclause 4.3. The network shall start timer T303 and enter the Call Present state. This message is sent by the network only if resources for the call are available; otherwise, the call is cleared towards the calling user .

If en-bloc receiving is used, the SETUP message shall contain all the information required by the called user to process the call. In this case, the SETUP message may contain the Broadband Sending complete information element.

Upon receipt of a SETUP message, the user shall enter the Call Present state.

If the SETUP message includes the Broadband Sending complete information element, en-bloc receiving procedure shall be followed. Therefore, those users who support overlap receiving procedure shall recognize the Broadband Sending complete information element.

If no response to SETUP message is received by the network before the first expiry of timer T303, the SETUP message will be retransmitted and timer T303 restarted.

For the actions to be performed by the network on expiry of T303 for the second time, see subclause 5.2.5.4.

## **5.2.2 Address and compatibility check**

### **5.2.2.1 Address check**

If an address check is not possible because address information is not included required, the user shall perform compatibility checking.

The user shall evaluate called party addressing information received in the SETUP message and proceed as described in subclause B.3.1.

### **5.2.2.2 Compatibility check**

#### **5.2.2.2.1 General principles**

The user shall perform the compatibility check based on the compatibility information received in the SETUP message. In B-ISDN, there are two categories of compatibility information:

Broadband category 1 compatibility information is provided for information required by both the network and the user to determine the attributes of the ATM connection. The broadband category 1 compatibility information is:

- Broadband bearer capability information;
- End-to-end transit delay information;
- ATM traffic descriptor;
- Quality of service parameter; and
- OAM traffic descriptor.

Broadband category 1 compatibility information is always checked by the called user; if the compatibility check fails, the user is incompatible.

Broadband category 2 compatibility information is provided for the called information only required by the end users. The broadband category 2 compatibility information is:

- ATM adaptation layer parameter information (describing the user plane AAL); and
- Optional Broadband low layer information.
- Optional Broadband high layer information.

Note - In this subclause the term "called user" is the endpoint entity which is explicitly addressed. This may be an addressed interworking unit (IWU).

Broadband category 2 compatibility information is always checked by the called user; if the compatibility check fails, the user is incompatible.

#### **5.2.2.2.2 Point-to-point Ccall/Connection offering**

A user receiving a SETUP message shall perform compatibility checking before responding to that SETUP message. Any reference to "user" in subclauses 5.2.3 through 5.2.78 implicitly refers to a compatible user equipment. Annex B/Q.2931 defines compatibility checking to be performed by users upon receiving a SETUP message.

An incompatible user shall respond with a RELEASE COMPLETE message with cause #88, "incompatible destination", and enter the Null state. The network shall process this RELEASE COMPLETE message in accordance with subclause 5.2.5.3.

## **5.2.3 Connection identifier (VPCI/VCI) allocation/selection -- destination**

Two cases exist:

1. Associated Signalling

The layer 3 signalling entity exclusively controls the VCs in the VPC which carries its signalling VC.

## 2. Non-Associated Signalling

The layer 3 signalling entity controls the VCs in the VPC which carries its signalling VC and may control VCs in other VPCs.

The network shall support both associated and non-associated signalling procedures. The network and the user shall support the non-associated signalling procedures and may as an option support the associated signalling procedures. The associated signalling procedures are used only by bilateral agreement between the user and the network.

When the network receives a connection identifier information element with the VP-associated signalling field (see Table 4-16/Q.2931) coded with a value not supported by the network, the call shall be rejected with cause #36, "VPCI/VCI assignment failure".

### 5.2.3.1 Associated Signalling

For associated signalling, the network indicates a virtual channel in the VPC carrying the signalling VC. The VPC carrying the signalling VC is implicitly indicated.

In the Connection identifier information element, the VP associated signalling field is coded as "VP associated signalling" in the Connection identifier information element and one of the following values is indicated in the Preferred/exclusive field:

- a) Exclusive VPCI; any VCI; or,
- b) Exclusive VPCI; exclusive VCI.

In case a), the user selects any available VCI within the VPC carrying the signalling VC. The selected VCI value is indicated in the Connection identifier information element in the first message returned by the user in response to the SETUP message (e.g., CALL PROCEEDING message). The VP associated signalling field is coded as "VP associated signalling". The Preferred/exclusive field is coded as "Exclusive VPCI; exclusive VCI".

In case b), if the indicated VCI within the VPC carrying the signalling VC is available, the user selects it for the call. If the Connection identifier information element is not present in the first response message, the connection identifier in the SETUP message shall be assumed.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the user.

In case b), if the indicated VCI is not available, a RELEASE COMPLETE message with the cause #35, "requested VPCI/VCI not available", is sent by the user.

### 5.2.3.2 Non-Associated Signalling

For non-associated signalling, the network shall indicate one of the following in the SETUP message:

- a) Exclusive VPCI; any VCI,
- b) Exclusive VPCI; exclusive VCI, or
- c) No indication is included (i.e., the Connection identifier information element is not included in the SETUP message).

In cases a) and b), if the indicated VPCI is available, the user selects it for the call. In case a), the user selects any available VCI in the VPCI. In case b), if the indicated VCI is available within the VPCI, the user selects it for the call. In case c), the user selects any available VPCI and VCI.

In cases a) and c), the selected VPCI/VCI value is indicated in the Connection identifier information element in the first message returned by the user in response to the SETUP message (e.g., CALL PROCEEDING message). The VP associated signalling field is coded as "explicit indication of VPCI". The Preferred/exclusive field is coded as "exclusive VPCI; exclusive VCI".

In case b), if the Connection identifier information element is not present in the first response message, the connection identifier in the SETUP message shall be assumed.

In cases a) and b), if the specified VPCI is not available, a RELEASE COMPLETE message with cause #35, "requested VPCI/VCI not available", is sent by the user.

In case a), if no VCI is available, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the user.

In case b), if the VCI in the indicated VPCI is not available, a RELEASE COMPLETE message with cause #35, "requested VPCI/VCI not available", is sent by the user.

In case c), if the user is not able to allocate a VCI in any VPCI, a RELEASE COMPLETE message with cause #45, "no VPCI/VCI available", is sent by the user.

#### **5.2.4 QOS and Traffic parameter selection procedures**

The network shall indicate the QOS class in the Quality of service parameter information element.

If the user is not able to provide the requested QOS class, the user shall reject the call, returning a RELEASE COMPLETE message with cause #49, "Quality of service unavailable".

The cumulative end-to-end transit delay is indicated in the End-to-end transit delay information element. If the user is not able to accept the indicated end-to-end transit delay, the user shall reject the call, returning a RELEASE COMPLETE message with cause #49, "Quality of service unavailable".

The network shall indicate the peak cell rate in the ATM traffic descriptor user cell rate information element.

If the user is not able to provide the indicated peak cell rate, the user shall reject the call, returning a RELEASE COMPLETE message with cause #47, "Resources unavailable, unspecified".

#### **5.2.5 Call/Connection confirmation**

##### **5.2.5.1 Response to en-bloc SETUP or completion of overlap receiving**

When the user determines that sufficient call setup information has been received and compatibility requirements (see Annex B) have been satisfied, the user responds with either a CALL PROCEEDING, ALERTING, or CONNECT message (see Note), and enters the Incoming Call Proceeding, Call Received, or Connect Request state, respectively.

Note - The CALL PROCEEDING message may be sent by the user that cannot respond to a SETUP message with an ALERTING, CONNECT, or RELEASE COMPLETE message before expiry of timer T303.

An incompatible user shall respond by sending a RELEASE COMPLETE message with a cause value as specified in Annex B, and enter the Null state. The network processes this RELEASE COMPLETE message in accordance with subclause 5.2.5.3.

A busy user that satisfies the compatibility requirements indicated in the SETUP message shall normally respond with a RELEASE COMPLETE message with a cause #17, "user busy". The network processes this RELEASE COMPLETE message in accordance with subclause 5.2.5.3.

If the user wishes to refuse the call, a RELEASE COMPLETE message shall be sent with cause #21, "call rejected", and the user returns to the Null state. The network processes this RELEASE COMPLETE message in accordance with subclause 5.2.5.3.

##### **5.2.5.2 Receipt of CALL PROCEEDING and ALERTING**

Upon receipt of the CALL PROCEEDING message from a user, the network shall: stop timer T303; start timer T310; and enter the Incoming Call Proceeding state.

Upon receipt of the ALERTING message from a user, the network shall: stop timers T303 or T310 (if running); start timer T301 (unless another internal alerting supervision timer function exists; e.g., incorporated in call control); enter the Call Received state; and send a corresponding ALERTING message to the calling user.

##### **5.2.5.3 Called user clearing during incoming call establishment**

If a RELEASE COMPLETE or RELEASE message is received before a CONNECT message has been received, the network shall: stop timer T303, T310 or T301 (if running); continue to clear the call to the called user as described in subclause 5.4.3; and clear the call to the calling user with the cause received in the RELEASE COMPLETE or RELEASE message.

##### **5.2.5.4 Call failure**

If the network does not receive any response to the retransmitted SETUP message prior to the expiration of timer T303, then the network shall enter the Null state and initiate clearing procedures towards the calling user with cause #18, "no user responding".

If the network has received a CALL PROCEEDING message, but does not receive an ALERTING, CONNECT, or RELEASE message prior to the expiration of timer T310, then the network shall: initiate clearing procedures towards the calling user with cause #18, "no user responding", and initiate clearing procedures towards the called user with cause #102, "recovery on timer expiry".

If the network has received an ALERTING message, but does not receive a CONNECT or RELEASE message prior to the expiration of timer T301 (or a corresponding internal alerting supervision timing function), then the network shall initiate clearing procedures towards the calling user with cause #19, "no answer from user (user alerted)", and initiate clearing procedures towards the called user.

#### **5.2.6 Call/Connection acceptance**

A user indicates acceptance of an incoming call by sending a CONNECT message to the network. Upon sending the CONNECT message, the user shall: start timer T313 and enter the Connect Request state. If an ALERTING message had previously been sent to the network, the CONNECT message may contain only the call reference.

If a call can be accepted using the VPCI/VCI indicated in the SETUP message, and no user alerting is required, a CONNECT message may be sent without a previous ALERTING message.

#### **5.2.7 Active indication**

On receipt of the CONNECT message, the network shall: stop (if running) timers T301, T303 and T310; send a CONNECT ACKNOWLEDGE message to the user; initiate procedures to send a CONNECT message towards the calling user; and enter the Active state.

The CONNECT ACKNOWLEDGE message indicates completion of the connection establishment procedures. There is no guarantee of an end-to-end connection until a CONNECT message is received at the calling user. Upon receipt of the CONNECT ACKNOWLEDGE message the called user shall: stop timer T313; attach to the user plane virtual channel and enter the Active state.

When timer T313 expires prior to receipt of a CONNECT ACKNOWLEDGE message, the called user shall initiate clearing with cause #102, "recovery on timer expiry", in accordance with subclause 5.4.3.

### **5.3 Call/Connection establishment at the destination -- Point-to-multipoint access arrangement call offering**

This capability is outside the scope of this RecommendationFor further study.

## **5.4 Call/Connection clearing**

### **5.4.1 Terminology**

The following terms are used in this Recommendation in the description of clearing procedures:

- A virtual channel is connected when the virtual channel is part of a B-ISDN virtual connection established according to this Recommendation.
- A virtual channel is disconnected when the virtual channel is no longer part of a B-ISDN virtual connection, but is not yet available for use in a new virtual connection.
- A virtual channel is released when the virtual channel is not part of a B-ISDN virtual connection and is available for use in a new virtual connection. Similarly, a call reference that is released is available for reuse.

### **5.4.2 Exception conditions**

Under normal conditions, call clearing is usually initiated when the user or the network sends a RELEASE message and follows the procedures defined in subclauses 5.4.3 and 5.4.4 respectively. The only exception to the above rule is in response to a SETUP message, the user or network can reject a call/connection (e.g., because of the unavailability of a suitable virtual channel) by: responding with a RELEASE COMPLETE message provided no other response has previously been sent; releasing the call reference; and entering the Null state.

### **5.4.3 Clearing initiated by the user**

Apart from the exceptions identified in subclauses 5.4.2 and 5.6, the user shall initiate clearing by: sending a RELEASE message; starting timer T308 ; disconnecting the virtual channel; and entering the Release Request state.

The network shall enter the Release Request state upon receipt of a RELEASE message. This message then prompts the network to disconnect the virtual channel, and to initiate procedures for clearing the network connection to the remote user. Once the virtual channel used for the call has been disconnected, the network shall: send a RELEASE COMPLETE message to the user; release both the call reference and virtual channel (i.e., connection identifier); and enter the Null state.

Note - The RELEASE COMPLETE message has only local significance and does not imply an acknowledgment of clearing from the remote user.

On receipt of the RELEASE COMPLETE message the user shall: stop timer T308; release the virtual channel; release the call reference; and return to the Null state.

If timer T308 expires for the first time, the user shall: retransmit a RELEASE message to the network with the cause number originally contained in the first RELEASE message; restart timer T308 and remain in the Release Request state. In addition, the user may indicate a second Cause information element with cause #102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the network before timer T308 expires a second time, the user shall: place the virtual channel in a maintenance condition; release the call reference; and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

When user initiates normal call/connection clearing, cause #16,"normal clearing" is used in the first clearing message.

#### **5.4.4 Clearing initiated by the network**

Apart from the exception conditions identified in subclause 5.4.2 and 5.6, the network shall initiate clearing by: sending a RELEASE message; starting T308; disconnecting the virtual channel; and entering the Release Indication state.

The user shall enter the Release Indication state upon receipt of a RELEASE message. Once the virtual channel used for the call has been disconnected, the user shall: send a RELEASE COMPLETE message to the network; release both its call reference and the virtual channel; and return to the Null state.

On receipt of the RELEASE COMPLETE message, the network shall: stop timer T308; release both the virtual channel and call reference; and return to the Null state.

If timer T308 expires for the first time, the network shall retransmit the RELEASE message to the user with the cause number originally contained in the first RELEASE message; start timer T308; and remain in the Release Indication state. In addition, the network may indicate a second Cause information element with cause #102, "recovery on timer expiry". If no RELEASE COMPLETE message is received from the user before timer T308 expires a second time, the network shall: place the virtual channel in a maintenance condition; release the call reference; and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

#### **5.4.5 Clear collision**

Clear collision can occur when both sides simultaneously transfer RELEASE messages related to the same call reference value. If the user receives a RELEASE message while in the Release Request state, the user shall: stop timer T308; release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message). If the network receives a RELEASE message while in the RELEASE Indication state, the network shall: stop timer T308, release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message).

### **5.5 Restart procedure**

When a point-to-point configuration exists, then the user and the network shall implement these procedures.

The restart procedure is used to return a virtual channel, all virtual channels in a virtual path, or all virtual channels controlled by the signalling virtual channel to the idle condition. The procedure is usually invoked when the other side of the interface does not respond to other call control messages or a failure has occurred (e.g., following the expiry of timer T308 due to the absence of response to a clearing message). It may also be initiated as a result of local failure, maintenance action or mis-operation.

Note - The call reference flag of the global call reference applies to restart procedures. In the case when both sides of the interface initiate simultaneous restart requests, they shall be handled independently. In the case when the same user plane virtual channel(s) are specified, they shall not be considered free for reuse until all the relevant restart procedures are completed. In the RESTART message, the call reference flag of the global call reference is set to "0", in the RESTART ACKNOWLEDGE message sent in response to a RESTART message, the call reference flag of the global call reference is set to "1".

#### **5.5.1 Sending RESTART**

##### **5.5.1.1 Normal procedure**

A RESTART message is sent by the network or user equipment in order to return virtual channels to the idle condition. The Restart indicator information element shall be present in the RESTART message to indicate

whether an “indicated virtual channel”, “all user plane virtual channels in the indicated VPC controlled via signalling virtual channel in which the RESTART message is sent”, or “all virtual channels controlled by the layer 3 entity” are to be restarted. If the Restart indicator information element is coded as "indicated virtual channel" or "all user plane virtual channels in the indicated VPC controlled via signalling virtual channel in which the RESTART message is sent", then the Connection identifier information element shall be present to indicate which virtual channel or virtual path is to be returned to the idle condition. If the Restart indicator information element is coded as "all virtual channels controlled by layer 3 entity which sends the RESTART message", then the Connection identifier information element shall not be included.

Upon transmitting the RESTART message the sender enters the Restart Request state, starts timer T316, and waits for a RESTART ACKNOWLEDGE message. Also, no further RESTART messages shall be sent until a RESTART ACKNOWLEDGE is received or timer T316 expires. Receipt of a RESTART ACKNOWLEDGE message stops timer T316 and indicates that the virtual channel(s) and associated resources (e.g., call reference value(s)) can be freed for reuse. The Null state shall be entered after the virtual channel and call reference value are released.

The RESTART and RESTART ACKNOWLEDGE message shall contain the global call reference value (all zeros) to which the Restart Request state is associated. These messages are transferred using the AAL-DATA-REQUEST primitive.

Calls associated with restart user plane virtual channels shall be cleared towards the remote parties using cause #41, "temporary failure".

#### **5.5.1.2 Exceptional procedures**

If a RESTART ACKNOWLEDGE message is not received prior to the expiry of timer T316, one or more subsequent RESTART messages may be sent until a RESTART ACKNOWLEDGE message is returned. While timer T316 is running, the virtual channel(s) being restarted shall not be used to support new calls requested using the call setup procedure; no calls shall be placed or accepted over the virtual channel(s) by the originator of the RESTART message. The number of consecutive unsuccessful restart attempts has a default limit of two. When this limit is reached, the originator of RESTART message shall make no further restart attempts and shall enter the Null state (REST 0). An indication will be provided to the appropriate maintenance entity. The virtual channel(s) is considered to be in an out-of-service condition until maintenance action has been taken.

If a RESTART ACKNOWLEDGE message is received indicating a different set of virtual channels from the set indicated in the RESTART message, the RESTART ACKNOWLEDGE message shall be discarded.

### **5.5.2 Receipt of RESTART**

#### **5.5.2.1 Normal procedures**

Upon receiving a RESTART message the recipient shall enter the Restart state associated to the global call reference and start timer T317; it shall then initiate the appropriate internal actions to return the specified virtual channels to the idle condition and release all call references associated with the specified virtual channels. Upon completion of internal clearing, timer T317 shall be stopped and a RESTART ACKNOWLEDGE message transmitted to the originator, and the Null state (REST 0) entered. The RESTART ACKNOWLEDGE message shall indicate a Restart indicator information element containing the same information as received in the related RESTART message. In addition the RESTART ACKNOWLEDGE message shall contain a Connection identifier information element containing the same information as received in the related RESTART message, if this included.

Calls associated with restart user plane virtual channels shall be cleared towards the remote parties using cause #41, "temporary failure".

Even if all the specified virtual channels are in the idle condition, they are already in the process of restart to the idle condition, receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

If the Restart indicator information element is coded as "all virtual channels controlled by the layer 3 entity which sends the RESTART message", then all calls on all interfaces associated with the signalling virtual channel shall be cleared.

If a semi-permanent virtual connections established by management procedures are implicitly specified (by specifying "all virtual channels that are controlled by the layer 3 entity which sends the RESTART message" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent"), no action shall be taken on these virtual channels, but a RESTART ACKNOWLEDGE message shall be returned containing the appropriate indications (i.e., "all virtual channels

controlled by the layer 3 entity which sends the RESTART message" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent").

If a semi-permanent virtual connections established by management procedures or reserved VPCI/VCI (e.g., the point-to-point signalling virtual channel) are explicitly specified (by including a Connection identifier information element in the RESTART message), no action shall be taken on these virtual channels and a STATUS message may as an option should be returned with cause # 82, "identified channel does not exist", optionally indicating in the diagnostic field the virtual channel or virtual path that could not be handled.

The following entities are released as a result of the Restart Procedures:

- virtual channels established by Q.2931 procedures
- all resources associated with the released virtual channel (e.g., call reference value)

The following entities are not released as a result of the Restart Procedures:

- permanent connections established by a network
- management system reserved virtual channels (e.g., point-to-point signalling virtual channel)

#### **5.5.2.21 Exceptional procedures**

If timer T317 expires prior to completion of internal clearing an indication shall be sent to the maintenance entity (i.e., a primitive shall be transmitted to the system management entity) and the Null state (REST 0) shall be entered.

If the Restart indicator information element is coded as "all virtual channels controlled by the layer 3 entity which sends the RESTART message" and a Connection identifier information element is included, the Connection identifier information element is treated as described in subclause 5.6.8.3.

If the Restart indicator information element is coded as "indicated virtual channel" and the Connection identifier information element is not included, then the procedures in subclause 5.6.7.1 shall be followed.

If the Restart indicator information element is coded as "indicated virtual channel" or "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent" and the Connection identifier information element contains an unrecognized VPCI, then the procedures in subclause 5.6.7.2 shall be followed.

If the RESTART message is received in the Restart state, then the procedures in subclause 5.6.4 shall be followed.

### **5.6 Handling of error conditions**

All messages which use the protocol discriminator Q.2931 user-network call control message must pass the checks described in subclauses 5.6.1 through 5.6.8.

Detailed error handling procedures are implementation dependent and may vary from network to network. However, capabilities facilitating the orderly treatment of error conditions are provided for in this section and shall be provided in each implementation.

Subclauses 5.6.1 through 5.6.8 are listed in order of precedence.

#### **5.6.1 Protocol discrimination error**

When a message is received with a protocol discriminator coded other than Q.2931 user-network call control message, that message shall be ignored. "Ignore" means to do nothing, as if the message had never been received.

#### **5.6.2 Message too short**

When a message is received that is too short to contain a complete Message length information element, that message shall be ignored.

#### **5.6.3 Call reference error**

##### **5.6.3.1 Invalid call reference format**

If the Call reference information element octet 1, bits 5 through 8 do not equal 0000, then the message shall be ignored.

If the Call reference information element octet 1, bits 1 through 4 indicate a length other than 3 octets (see subclause 4.3), then the message shall be ignored.

### 5.6.3.2 Call reference procedural errors

- a) Whenever any message except SETUP, RELEASE COMPLETE, STATUS ENQUIRY, or STATUS, is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the receiver shall initiate clearing by sending a RELEASE COMPLETE message with cause #81, "invalid call reference value", specifying the call reference in the received message and shall remain in the Null state.
- b) When a RELEASE COMPLETE message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, no action shall be taken.
- c) When a SETUP message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, and with a call reference flag incorrectly set to "1", this message shall be ignored.
- d) When a SETUP message is received specifying a call reference which is recognized as relating to an active call or to a call in progress, this SETUP message shall be ignored.
- e) When any message except RESTART, RESTART ACKNOWLEDGE, or STATUS is received using the global call reference, no action shall be taken on this message and a STATUS message using the global call reference with a call state indicating the current state associated with the global call reference and cause #81, "invalid call reference", shall be returned.
- f) When a STATUS message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the procedures of subclause 5.6.12 shall apply.
- g) When a STATUS ENQUIRY message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the procedures of subclause 5.6.11 shall apply.

### 5.6.4 Message type or message sequence errors

The error procedures in this section apply only if the flag in the message compatibility instruction indicator instruction ide is set to '0'. If it is set to '1', the procedures in subclause 5.7 take precedence.

Whenever an unexpected message, except RELEASE, RELEASE COMPLETE, or an unrecognized message is received in any state other than the Null state, no state change shall occur and a STATUS message shall be returned with one of the following causes:

- a) cause #97, message type non-existent or not implemented; or,
- b) cause #101, message not compatible with call state.

However, two exceptions to this procedure exist. The first exception is when the network or the user receives an unexpected RELEASE message in response to a SETUP message. In this case no STATUS or STATUS ENQUIRY message is sent. Whenever the network receives an unexpected RELEASE message, the network shall: release the virtual channel; clear the network connection and the call to the remote user with the cause in the RELEASE message sent by the user or, if not included, cause #31, "normal, unspecified"; return a RELEASE COMPLETE message to the user; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE message, the user shall: release the virtual channel; return a RELEASE COMPLETE message to the network; release the call reference; stop all timers; and enter the Null state.

The second exception is when the network or the user receives an unexpected RELEASE COMPLETE message. Whenever the network receives an unexpected RELEASE COMPLETE message, the network shall: disconnect and release the virtual channel; clear the network connection and the call to the remote user with the cause indicated by the user or, if not included, cause #111, "protocol error, unspecified"; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE COMPLETE message, the user shall: disconnect and release the virtual channel; release the call reference; stop all timers; and enter the Null state.

### 5.6.5 Message length error

If the message length indicated in the Message length information element is inconsistent with the length of the message actually received, the message shall be handled normally as far as possible and, if necessary, the error handling procedures of subclause 5.6.6 shall be followed.

### 5.6.6 General information element errors

The general information element error procedures may also apply to information elements in codesets other than 0. In that case, the diagnostics in the Cause information element may indicate information elements other than those in codeset 0 by applying the locking or non-locking shift procedures as described in subclause 4.5

#### **5.6.6.1 Information element sequence**

The first four information elements (Protocol discriminator, Call reference, Message type, and Message length) shall appear in the order specified in subclause 4.1. Variable length information elements may appear in any order within a message except for cases described in subclause 4.5.1. If more than one information element of the same type is included in a message, and the repeated information elements do not immediately follow the first occurrence of this element type (see subclause 4.5.1), the receiving entity ignore the information element of this type which do not follow the preceding occurrence of this information element type.

#### **5.6.6.2 Duplicated information elements**

If an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of the information element appearing first shall be handled and where all subsequent repetitions of the information element shall be ignored. When repetition of information elements is permitted, and when only the contents of permitted information elements shall be handled. If the limit on repetition of information elements is exceeded, the contents of information elements appearing first up to the limit of repetitions shall be handled and all subsequent repetitions of the information element shall be ignored.

#### **5.6.6.3 Coding standard error**

If the user or the network receives an information element with the coding standard field indicating a coding standard that is not supported by the receiver, this information element shall be treated as an information element with a content error. Depending on the information element, the procedures as described in subclause 5.6.7.2 or subclause 5.6.8.2 shall be followed.

### **5.6.7 Mandatory information element error**

#### **5.6.7.1 Mandatory information element missing**

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action shall be taken on the message and no state change should occur. A STATUS message is then returned with cause #96, "mandatory information element is missing".

When a SETUP message is received which has one or more mandatory information elements missing, a RELEASE COMPLETE message with cause #96, "mandatory information element is missing", shall be returned.

When a RELEASE message is received with the Cause information element missing, the actions taken shall be the same as if a RELEASE message with cause #31, "normal, unspecified", was received (see subclause 5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause #96, "mandatory information element is missing".

When a RELEASE COMPLETE message is received with a Cause information element missing, it will be assumed that a RELEASE COMPLETE message was received with cause #31, "normal, unspecified".

#### **5.6.7.2 Mandatory information element content error**

The error procedures in this section apply only if the flag (bit 5) in the instruction field is set to "IE instruction field not significant" '0'. If it is set to "follow explicit instruction" '1', the procedures in subclause 5.7 take precedence.

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements with invalid content, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause #100, "invalid information element contents".

When a SETUP message is received which has one or more mandatory information elements with invalid content, a RELEASE COMPLETE message with cause #100, "invalid information element contents", shall be returned.

When a RELEASE message is received with invalid content of the Cause information element, the actions taken shall be the same as if a RELEASE message with cause #31, "normal, unspecified", was received (see subclause 5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause #100, "invalid information element contents".

When a RELEASE COMPLETE message is received with invalid content of the Cause information element, it will be assumed that a RELEASE COMPLETE message was received with cause #31, "normal, unspecified".

Information elements with a length exceeding the maximum length (given in clause 3) will be treated as information element with content error.

Note - As an option of user equipment (e.g., B-NT2), cause values, location codes, and diagnostics which are not understood by the B-NT2 may be passed on to another entity (e.g., user or B-NT2) instead of treating the cause value as if it were cause #31, "normal, unspecified", and sending cause #100, "invalid information element contents", with the RELEASE COMPLETE message. This option is intended to aid user equipment to be compatible to future additions of cause values, location codes and diagnostics to the Recommendation.

### **5.6.8 Non-mandatory information element errors**

The error procedures in this section apply only if the flag (bit 5) in the instruction field is set to '0'. If it is set to '1', the procedures in subclause 5.7 take precedence.

The following sections identify actions on information elements not recognized as mandatory.

#### **5.6.8.1 Unrecognized information element**

When a message is received that has one or more unrecognized information elements, then the receiving entity shall proceed as follows:

Action shall be taken on the message and those information elements which are recognized and have valid content. When the received message is other than RELEASE or RELEASE COMPLETE, a STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause #99, "information element non-existent or not implemented", and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized. Subsequent actions are determined by the sender of the unrecognized information elements.

If a clearing message contains one or more unrecognized information elements, the error is reported to the local user in the following manner:

- a) When a RELEASE message is received which has one or more unrecognized information elements, a RELEASE COMPLETE message with cause #99, "information element non-existent or not implemented", shall be returned. The Cause information element diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized.
- b) When a RELEASE COMPLETE message is received which has one or more unrecognized information elements, no action shall be taken on the unrecognized information.

Note - The diagnostic(s) of cause #99 facilitates the decision in selecting an appropriate recovery procedure at the reception of a STATUS message. Therefore, it is recommended to provide cause #99 with diagnostic(s) if a layer 3 entity expects the peer to take an appropriate action at the receipt of a STATUS message, although inclusion of diagnostic(s) is optional.

#### **5.6.8.2 Non-mandatory information element content error**

When a message is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which are recognized and have valid content. A STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause #100, "invalid information element contents", and the diagnostic field, if present, shall contain the information element identifier for each information element which has invalid contents.

Information elements with a length exceeding the maximum length (given in clause 3) will be treated as an information element with content error. But for access information elements (see Annex J, e.g., Called party subaddress information element), cause #43, "access information discarded" is used instead of cause #100, "invalid information element contents". However, in some networks, access information elements may be truncated and processed.

Note - As an option of user equipment (e.g., B-NT2), cause values, location codes, and diagnostics which are not understood by the B-NT2 may be accepted and passed on to another entity (e.g., user or B-NT2) instead of ignoring the Cause information element contents and optionally sending a STATUS message with cause #100, "invalid information element contents". This option is intended to aid user equipment to be compatible to future additions of cause values, location codes and diagnostics to the Recommendation.

#### **5.6.8.3 Unexpected recognized information element**

When a message is received with a recognized information element that is not defined to be contained in that message, the receiving entity shall (except as noted below) treat the information element as an unrecognized information element and follow the procedures defined in subclause 5.6.8.1

Note - Some implementations may choose to process unexpected recognized information elements when the procedure for processing the information element is independent of the message in which it is received.

### 5.6.9 Signalling AAL connection reset

Whenever a Q.2931 entity is informed of a spontaneous Signalling AAL reset by means of the AAL-ESTABLISH-INDICATION primitive, the following procedures apply:

- a) For calls in the clearing phase (states N11, N12, U11, and U12), no action shall be taken.
- b) For calls in the establishment phase (states N1, N3, N4, N6, N7, N8, N9, U1, U3, U4, U6, U7, U8 and U9) shall be maintained according to the procedures contained in other parts of clause 5. Optionally the status enquiry procedure may be invoked.
- c) Calls in the Active state shall be maintained, and the entity shall invoke the status enquiry procedure described according to the procedures in subclause 5.6.11.

### 5.6.10 Signalling AAL connection release

Whenever a Q.2931 entity is notified of by its Signalling AAL connection release by means of the AAL-RELEASE-INDICATION primitive, the following procedure shall apply:

- a) Any calls not in the Active state shall be cleared locally.
- b) If there is at least one call in the Active state controlled by the released Signalling AAL connection, then timer T309 shall be started. If timer T309 is already running, it shall not be restarted.

The Q.2931 entity shall request Signalling AAL re-establishment by sending an AAL-ESTABLISH-REQUEST primitive.

When informed of signalling AAL re-establishment by means of the AAL-ESTABLISH-CONFIRM primitive, the following procedure shall apply:

Stop timer T309; and

Perform the status enquiry procedure according to subclause 5.6.11 to verify the call state of the peer entity per each call/connection.

If timer T309 expires prior to Signalling AAL re-establishment, the network shall: clear the network connection and call to the remote user with cause #27, "destination out of order"; disconnect and release the bearer virtual channel; release the call reference; and enter the Null state.

If timer T309 expires prior to Signalling AAL re-establishment, the user shall: disconnect and release the virtual channel; release the call reference; and enter the Null state. The user may clear the attached internal connection (if any) with cause #27, "destination out of order".

### 5.6.11 Status enquiry procedure

To check the correctness of a call state at a peer entity, a STATUS ENQUIRY message may be sent requesting the call state. This may, in particular, apply to procedural error conditions described in subclauses §§ 5.6.9 and 5.6.10.

In addition whenever indication is received from the Signalling AAL that a disruption has occurred at the data link layer, a STATUS ENQUIRY message shall be sent to check the correctness of the call state at the peer entity.

Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for call state information shall exist. Therefore, if timer T322 is already running, it shall not be restarted. If a clearing message is received before timer T322 expires, timer T322 shall be stopped and call clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiver shall respond with a STATUS message, reporting the current call state (the current state of an active call or a call in progress, or the Null state if the call reference does not relate to an active call or to a call in progress) and cause #30, "response to STATUS ENQUIRY" (see subclause 5.6.4). Receipt of the STATUS ENQUIRY message does not result in a state change.

The sending or receipt of the STATUS message in such a situation will not directly affect the call state of either the sender or receiver. The side having received the STATUS message shall inspect the Cause information element. If a STATUS message is received that contains cause #30, "response to STATUS ENQUIRY", timer T322 shall be stopped and the appropriate action taken, based on the information in that STATUS message, relative to the current state of the receiver.

If timer T322 expires, and no STATUS message was received, the STATUS ENQUIRY message may be retransmitted one or more times until a response is received. The number of times the STATUS ENQUIRY message is retransmitted is an implementation dependent value. If following the maximum number of

retransmissions of the STATUS ENQUIRY message, no STATUS message is received before expiry of T322 for the last time, the call shall be cleared to the local interface with cause #41, "temporary failure". If appropriate, the network shall also clear the network connection, using cause #41, "temporary failure".

#### **5.6.12 Receiving a STATUS message**

On receipt of a STATUS message reporting an incompatible state, the receiving entity shall:

- a) clear the call by sending the appropriate clearing message with cause #101, "message not compatible with call state"; or,
- b) take other actions which attempt to recover from a mismatch and which are an implementation option.

Except for the following rules, the determination of which states are incompatible is left as an implementation decision:

- a) If a STATUS message indicating any call state except the Null state is received in the Null state, then the receiving entity shall send a RELEASE COMPLETE message with cause #101, "message not compatible with call state"; and remain in the Null state.
- b) If a STATUS message indicating any call state except the Null state is received in the Release Request or Release Indication state no action shall be taken.
- c) If a STATUS message, indicating the Null state, is received in any state except the Null state, the receiver shall release all resources and move into the Null state.

When in the Null state, the receiver of a STATUS message indicating the Null state shall take no action other than to discard the message and shall remain in the Null state.

A STATUS message may be received indicating a compatible call state but containing one of the following causes:

- #96 mandatory information element is missing;
- #97 message type non-existing or not implemented
- #99 information element non-existent or not implemented; or
- #100 invalid information element contents.
- #101 Message not compatible with call state

In this case, the actions to be taken are an implementation option. If other procedures are not defined, the receiver shall clear the call with the appropriate procedure defined in subclause 5.4, using the cause specified in the received STATUS message.

On receipt of a STATUS message specifying the global call reference and reporting an incompatible state in the Restart Request or Restart state, the receiving Q.2931 entity shall inform layer management and take no further action on this message.

When in the Null state, then on receipt of a STATUS message with the global call reference no action shall be taken.

Note - Further actions as a result of higher layer activity (e.g., system or layer management) are implementation dependent (including the retransmission of RESTART).

Except for the above case, the error handling procedures when receiving a STATUS message specifying the global call reference are an implementation option.

### **5.7 Error procedures with explicit action indication**

The procedures of this section shall only be used if the flag of the message compatibility instruction indicator or information element instruction field is set to "follow explicit instructions".

#### **5.7.1 Unexpected or unrecognized message type**

If an unexpected or unrecognized message type is received the following procedures are applicable.

If the action indicator bits of the instruction field of a Message type information element are set to "clear call", the call shall be cleared in accordance with procedures of subclause 5.4.3 or 5.4.4, except that a Cause information element indicating cause #97, "message type non-existent or not implemented", or cause #101, "message not compatible with call state", shall be sent.

If the action indicator bits of the instruction field of a Message type information element are set to "discard and ignore/proceed", the message shall be ignored.

If the action indicator bits of the instruction field of a Message type information element are set to "discard, proceed and report status", no action shall be taken on the message but a STATUS message shall be sent with a Cause information element indicating cause #97, "message type non-existent or not implemented" or cause #101, message not compatible with call state".

### **5.7.2 Information element errors**

When a message other than a RELEASE or RELEASE COMPLETE message is received which has one or more unexpected information elements, unrecognized information elements or information elements with unrecognized contents, the receiving entity shall examine the information element action indicator, and follows the procedures described in a), b), c), d) or e) below as appropriate.

When a RELEASE message is received with one or more information elements in error, a RELEASE COMPLETE message with cause #99, "information element non-existent or not implemented" or with cause #100 "invalid information element contents", shall be returned.

When a RELEASE COMPLETE message is received with one or more information elements in error, no action shall be taken on the information elements in error. The message shall be processed as if received without the errored information elements.

If more than one information element is received in error only one response shall be given. The response shall be according to the handling of the action indicator field according to the following order of priority: "clear call" (highest priority), "discard message and report status", "discard message, and ignore", "discard information element, proceed and report status", "discard information element and proceed".

- a) action indicator field = Clear call:

If the action indicator field is equal to "clear call", the call shall be cleared according to the procedures defined in subclause 5.4. except that the Cause information element shall contain cause #99, "information element non-existent or not implemented" or cause #100, "invalid information element contents".

- b) If the action indicator field = discard message and report status

The message shall be ignored and a STATUS message shall be sent with a cause #99 "information element non-existent or not implemented" or #100 "invalid information element contents".

- c) If the action indicator field is equal to "discard message" the message shall be ignored.

- d) action indicator field = Discard information element, proceed and report status:

If the message contains sufficient information to proceed, the following shall apply:

If the action indicator field specifies "discard information element, proceed and report status" the information element shall be discarded, the handling of the message shall proceed and a STATUS message shall be returned indicating the call state of the receiver after taking action on the message and containing cause #99, "information element non-existent or not implemented" or cause #100, "invalid information element contents".

- e) action indicator field = Discard information element and proceed:

If the action indicator field is equal to "discard information element and proceed" the information element shall be ignored and the message shall be processed as if the information element was not received. No STATUS message shall be sent.

### **5.8 Handling of messages with insufficient information**

If insufficient information for the protocol entity to act upon a message is available, the procedures of subclause 5.6.7.1 shall apply if the flag of the message compatibility instruction indicator is set to "Message instruction field not significant0" or the procedures of subclause 5.7.1 shall apply if the flag of the message compatibility instruction indicator is set to "follow explicit instructions" with the difference that when a Cause information element is to be returned it shall include cause #96 "mandatory information element is missing".

### **5.9 Notification procedure**

The delivery of bearer-related notifications shall use an active call reference of the call/connection the notification is associated with. In this context, a call reference shall be active from the initiation of call establishment

(i.e.,including the SETUP message) to the initiationcompletion of call clearing (i.e.,including the RELEASE message).

If the delivery of the notification coincides with call/connection establishment or clearing procedures, the notification information can be carried in the associated call control messages. In all other cases, the notification information shall be delivered in a NOTIFY message. In addition a NOTIFY message may be sent or received by the user or by the network only after the first response to a SETUP message has been sent or received and before clearing of the call reference is initiated.

If a notification is received by the network, the network shall: optionally ensure that the contents of the notification are a valid coding; and forward the notification to the other user involved in the call.

No call state change shall occur at either side of the interface following the sending or receipt of a NOTIFY message.