

ANNEX G

(to Recommendation Q.2931)

Status Monitoring Procedures for Semi-Permanent Virtual Channel Connections

The support of the procedures of this annex is optional for both the use and the network provider. When supported, their provision requires bilateral agreement between the subscribers and the network provider.

If implemented, these procedures are supported to co-exist with I.610 procedures; the functionality provided by the procedures of this annex is supported to complement the I.610 functions.

The procedures of this annex are intended to be used for real time operational purposes. In the following, they are specified in terms of protocol elements (messages, information elements and procedures) for the monitoring of the status of semi-permanent virtual channel connections (SPCs).

These procedures include:

- real time notification of the
 - SPC initial configuration
 - SPC activation
 - SPC addition (indication: "new" SPC)
 - SPC deactivation
 - SPC deletion (indication: "delete" SPC)

- interrogation of the bulk status of the availability (i.e., SPC in activated state) or unavailability (i.e., SPC in deactivated state) of configured SPCs.

The procedures for status monitoring of SPCs may be initiated by management entities in the equipment on either side of the user-network interface that supports SPCs and the un-assured data transfer procedures specified in the Annex B of Recommendation Q.2130 (SSCF at UNI for SPC control).

The procedures comprise of a real time bi-directional query / response transaction between management entities in user equipment and in the network, regarding the operational status of SPCs previously configured.

The high level sequence diagram is shown in Figure G-4 / Q.2931.

Although these procedures perform a real time SPC status monitoring function, they are based on a small subset of the Q.2931 protocol and the messages use the protocol discriminator of Recommendation Q.2931 messages. As such they constitute higher layer management procedures for monitoring SPCs and provide information that complements the information provided by other management procedures such as OAM, F5 flows, etc. They are meant to enable the management entities on the user side and on the side of the service provider to take necessary action.

The status monitoring procedures require that the management entity at the network side of the user-network interface is always aware of the status of the SPCs. The means by which this can be guaranteed (e.g., OAM F5 flow) is outside the scope of this annex. Furthermore, the establishment and the release of SPCs is outside the scope of this annex.

G.1 Messages used for SPC status

All messages for SPC monitoring use the SPC call reference. These messages are SPC UPDATE STATUS, SPC UPDATE STATUS ACK, SPC STATUS ENQUIRY and SPC STATUS REPORT. The messages are sent on the virtual channel for SPC control (VCI=31).

Editors' note:

VCI=31 is the present working assumption. Verify whether this working assumption applies and correct value for the virtual channel for SPC control as appropriate; please note that SG 13 may possibly allocate VCI=8 instead.

They are sent across the UNI using the un-assured data transfer procedures of the Annex B of Recommendation Q.2130 (definition of SSCF at UNI for SPC control).

Message	Reference
Messages:	
SPC STATUS REPORT	G.1.1
SPC UPDATE STATUS ACK	G.1.2
SPC STATUS ENQUIRY	G.1.3
SPC UPDATE STATUS	G.1.4

G.1.1 SPC STATUS REPORT message

This message is sent in response to an SPC STATUS ENQUIRY message to indicate the status of one or more SPCs. This message is used only for reporting the availability of the requested existing SPCs.

Message type: SPC STATUS REPORT
Direction: both
Significance: local

Information element	Q.2931 Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	both	M	1
Call reference ⁽¹⁾	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Transaction number	G.3.1	both	M	5
SPC report type	G.3.2	both	M	5
SPC status	G.3.3	both	O ⁽²⁾	9 - 10

Note 1 - Only the SPC call reference is used.

Note 2 - If the SPC report type indicates SPC list, it contains one SPC status information element for each SPC request. If the SPC report type indicates SPC range, it contains SPC status information elements up to 256 for the configured SPCs. In the case of SPC range, the SPC status information elements are arranged in the ascending order of the connection identifier (VPCI/VCI).

G.1.2 SPC UPDATE STATUS ACK message

The SPC UPDATE STATUS ACK message is sent in response to an SPC UPDATE STATUS message to acknowledge the SPC UPDATE STATUS message.

Message type: SPC UPDATE STATUS ACK
Direction: both
Significance: local

Information element	Q.2931 Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	both	M	1
Call reference ⁽¹⁾	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Transaction number	G.3.1	both	M	5
SPC status	G.3.3	both	O ⁽²⁾	9 - 10

Note 1 - Only the SPC call reference is used.

Note 2 - Only included if the status of particular SPC is different from the status report in the SPC UPDATE STATUS message.

G.1.3 SPC STATUS ENQUIRY message

The SPC STATUS ENQUIRY message is sent to request the status of one or more SPCs. Sending an SPC STATUS REPORT message in response to an SPC STATUS ENQUIRY is mandatory.

Message type: SPC STATUS ENQUIRY
 Direction: both
 Significance: local

Information element	Q.2931 Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	both	M	1
Call reference ⁽¹⁾	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Transaction number	G.3.1	both	M	5
SPC report type	G.3.2	both	M	5
Connection identifier	4.5	both	O	9 ⁽²⁾

Note 1 - Only the SPC call reference is used.

Note 2 - If the SPC report type indicates SPC list, the connection identifier information element may be repeated to request the status of more than one SPC. If the SPC report type indicates SPC range, the connection identifier information element will indicate the start of the SPC range.

G.1.4 SPC UPDATE STATUS message

The SPC UPDATE STATUS message is sent to indicate a change in the status of 1 or more SPCs. The change of status includes notification of SPC addition or deletion and notification of SPC availability (active) or unavailability (inactive).

Message type: SPC UPDATE STATUS
Direction: both
Significance: local

Information element	Q.2931 Reference	Direction	Type	Length (octets)
Protocol discriminator	4.2	both	M	1
Call reference ⁽¹⁾	4.3	both	M	4
Message type	4.4	both	M	2
Message length	4.4	both	M	2
Transaction number	G.3.1	both	M	5
SPC status	G.3.3	both	M	9 - 10 ⁽²⁾

Note 1 - Only the SPC call reference is used.

Note 2 - The SPC STATUS REPORT message contains 1 or more SPC information elements each of which is 9 or 10 octets long. The SPC UPDATE STATUS message contains one SPC status information element for each SPC that has experienced a status change.

G.2 General information elements

G.2.1 Protocol discriminator

See 4.2 of Recommendation Q.2931.

G.2.2 Call reference

The SPC call reference shall be used. The value of the SPC call reference is all 1. See 4.3 of Recommendation Q.2931.

G.2.3 Message type

See 4.4 of Recommendation Q.2931.

G.2.4 Message length

See 4.4 of Recommendation Q.2931.

G.2.5 Connection identifier

See 4.5 of Recommendation Q.2931.

G.3 Other information elements

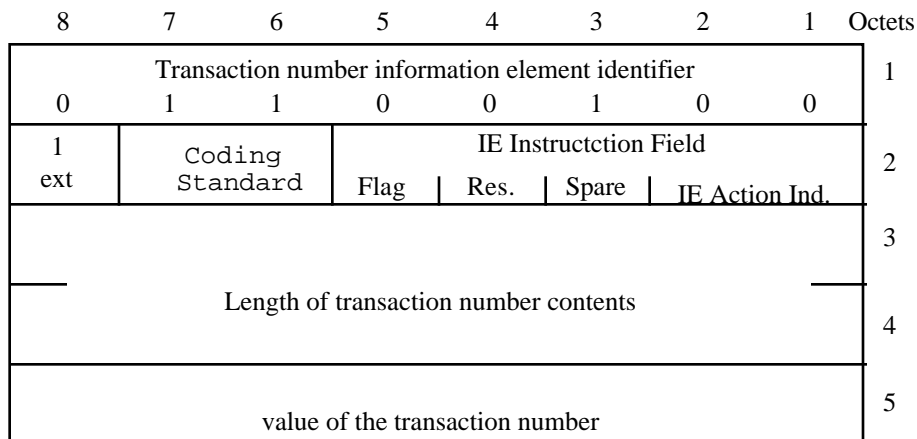
The following other information element identifiers are used.

- Information element identifiers

Bits								
8	7	6	5	4	3	2	1	
0	1	1	0	0	1	0	0	- Transaction Number
0	1	1	0	0	1	0	1	- SPC Status
0	1	1	0	0	1	1	0	- SPC Report Type

G.3.1 Transaction number

The purpose of the transaction number is to associate a response with a request. Each new SPC STATUS ENQUIRY message or SPC UPDATE STATUS message will have a new transaction number.



- **Value of the transaction number (octet 5)** (Note)
The transaction number is binary encoded.

Note: It is suggested that implementations avoid immediate reuse of the transaction number after the transaction is completed.

Figure G-1 / Q.2931 Transaction number information element

G.3.2 SPC report type

The purpose of the SPC report type information element is to indicate the type of report requested when included in an SPC STATUS ENQUIRY message or to indicate the contents of the SPC STATUS REPORT message. The length of this information element is 5 octets.

8	7	6	5	4	3	2	1	Octets
SPC report type information element identifier								1
0	1	1	0	0	1	1	0	
1 ext	Coding Standard		IE Instructction Field				2	
			Flag	Res.	Spare	IE Action Ind.		
Length of SPC report type contents								3
Length of SPC report type contents								4
Type of report								5

- Type of report (octet 5)

Bits

87654321

00000100 SPC list

00000101 SPC range (Note)

Note - In the case of the SPC report type is SPC range, the SPC STATUS REPORT message may contain an order list of the provision SPCs up to a maximum number of 256.

Figure G-2 / Q.2931 SPC report type information element

G.3.3 SPC status

The purpose of the SPC status information element is to indicate the status of configured SPCs. This information element can be repeated, as necessary, in a message to indicate the status of 2 or more SPCs. The maximum length of this information element is 10 octets.

8	7	6	5	4	3	2	1	Octets
SPC status information element identifier								
0	1	1	0	0	1	0	1	1
1 ext	Coding Standard	IE Instruction Field						2
		Flag	Res.	Spare	IE Action Ind.			
Length of SPC status content								3
VPCI								4
VCI								5
VCI								6
VCI								7
VCI								8
ext 1/0	n	spare n	n	new "N"	delete "D"	active "A"	spare 0	9 Note
ext 1	n	spare n	Inactive reason					9a *Note

Note - If the active bit is set to 0, then octet 9a will be included.

- **VPCI (octets 5 and 6)**
see 4.5 of Recommendation Q.2931.
- **VCI (octets 7 and 8)**
see 4.5 of Recommendation Q.2931.
- **New "N" (octet 9)**

Bit	
4	
0	SPC is already present
1	SPC is new

- **Delete "D" (octet 9)**

Bit	
3	
0	SPC is configured
1	SPC is deleted

Note - When this bit is set to 1, the new and active bits have no significance and should be set to 0. The delete bit is set to 0 when the new or active bits have significance and are set to 1.

- **Active "A" (octet 9)**

Bit	
2	
0	SPC is inactive
1	SPC is active

Note - The reporting entity sets this bit to 0 when it determines that the SPC is not operational.

- **Inactive reason (octet 9a)**
The inactive reason field is used to indicate why an SPC has become inactive. Coding for this field is as follows:

Bits	
5 4 3 2 1	
0 0 0 0 0	SPC inactive in adjacent network
0 0 1 0 0	SPC deleted in adjacent network
0 1 0 0 1	Interface inactive to adjacent network or user
0 1 0 1 0	SPC non-operational in the network
0 1 0 1 1	SPC inactive at UNI
0 1 1 0 0	SPC deleted in this network

All other values are reserved

Figure G-3 / Q.2931 SPC status information element

A new SPC is one that has been recently configured but for which a status report has not yet been sent across the UNI. A new SPC is indicated by setting the new (N) bit to 1.

An SPC is active if it is operational and it is inactive if it is configured but not available for use. The active (A) bit is set to 1 for an active SPC and set to 0 for an inactive SPC.

An SPC is deleted if it is not configured. The deleted (D) bit is set to indicate the SPC is not configured when it is necessary to explicitly do so as described in section G.4.

G.4 Procedures across the UNI

G.4.1 SAAL procedures

The un-assured mode of the SAAL is used to provide the transport for these signalling procedures. All message used in these procedures are sent in the order they were generated and with the same priority using AAL-UNIT-DATA primitive.

G.4.2 Initial UNI status

At the time of SAAL initialization, both the user equipment and the network may report the status of all configured SPCs through one or more SPC UPDATE STATUS messages.

While a SAAL is released, no SPC UPDATE STATUS message can be delivered. Therefore, the reporting entity will be unable to clear the "new" status of a newly configured SPC. When the SAAL is restored, the new bit will be set for that SPC in the SPC UPDATE STATUS message that is sent as a result of SAAL restoration. Section G.4.5 describes these procedures.

G.4.3 Requesting SPC status

The status of one or more SPCs can be requested at any time. When the SPC report type indicates "SPC list", a connection identifier information element shall be included for each requested SPC. When the SPC report type indicates "SPC range", a connection identifier information element shall be included which indicates the start of the range.

The SPC STATUS ENQUIRY message includes a transaction number, which is used to verify that the SPC STATUS ENQUIRY message is acknowledged with a subsequent SPC STATUS REPORT message. When the SPC STATUS ENQUIRY message is sent, Timer T393 is started, and retry counter N394 is set to 1. When an SPC STATUS REPORT message is received, the transaction number is verified. If the transaction number matches the transaction number of the last transmitted SPC STATUS ENQUIRY message, Timer T393 is stopped, and the status of each reported SPC may be updated. If the transaction number does not match the transaction number of the last transmitted SPC STATUS ENQUIRY message, the SPC STATUS REPORT message is discarded.

If Timer T393 expires before the receipt of an SPC STATUS REPORT message with the correct transaction number, and the maximum retry count has not been exceeded, then the same SPC STATUS ENQUIRY message with the same transaction number may be retransmitted. If the message is retransmitted, Timer T393 is restarted, and retry counter N394 is incremented.

If the maximum retry count has been exceeded (check before retransmission), SAAL (the link) shall be considered to be inactive.

These procedures assume that only one SPC STATUS ENQUIRY message may be outstanding at any time.

G.4.4 Reporting SPC status

When an SPC STATUS ENQUIRY message is received, an SPC STATUS REPORT message is sent which reports the current status of the requested SPCs. The SPC report type and transaction number contained in the SPC STATUS ENQUIRY message will be included

If the SPC report type indicates "SPC range", the SPC STATUS REPORT message contains an order list of the provision SPCs up to maximum number of 256.

One SPC status information element is included for each requested SPCs. An SPC STATUS REPORT message shall not contain more than one SPC status information element for a given SPC. The receiving entity is not required to check for duplicate SPC status information elements.

If the SPC STATUS ENQUIRY message requests the status of an SPC that is not configured within the SPC list (SPC report type equal to SPC list), the receiving entity shall respond with an SPC STATUS REPORT message that contains a corresponding SPC status information element with the D bit set to 1.

Use of the above reporting procedures will not clear a status of 'new' for any SPC.

G.4.5 Reporting asynchronous status

When the status of one or more SPC has changed (i.e., active, inactive, or deleted), or when an SPC is initially configured, an SPC UPDATE STATUS message is sent. Also, the reporting of all configured SPCs is necessary during SAAL initialization.

SPC status information elements shall be ordered in the sequence in which the events they report were detected. The grouping of SPC status information elements into SPC UPDATE STATUS message is implementation option to send the single or group (up to 256) of SPC status information element in SPC UPDATE STATUS message. Therefore, it is possible for two or more SPC status information elements in an SPC UPDATE STATUS message to specify the same SPC. The support of receiving SPC UPDATE STATUS message with a single or multiple SPC status information element is mandatory.

An SPC UPDATE STATUS message shall not include SPC status information elements for SPCs whose status has not changed.

The SPC UPDATE STATUS message includes a transaction number, which is used to verify that the SPC UPDATE message is acknowledged with a subsequent SPC UPDATE STATUS ACK message. When the SPC UPDATE STATUS message is sent, Timer T394 is started and retry counter N395 is set to 1. When an SPC UPDATE STATUS ACK message is received, the transaction number is verified. If the transaction number matches the transaction number of the last transmitted SPC UPDATE STATUS message, Timer T394 is stopped, and the status of each reported SPC shall be updated. If the transaction number does not match the transaction number of the last transmitted SPC UPDATE STATUS message, the SPC UPDATE STATUS ACK message is discarded.

If the Timer T394 expires before the receipt of an SPC UPDATE STATUS ACK message with the correct transaction number, and the maximum retry count has not been exceeded, the same SPC UPDATE STATUS message with the same transaction number shall be retransmitted. If the message is retransmitted, Timer T394 is started, and retry counter N395 is incremented.

If the maximum retry count has been exceeded (check before transmission), SAAL (the link) shall be considered to be inactive.

G.4.5.1 Reporting new SPCs

One of the functions of the SPC UPDATE STATUS message is to notify the receiving entity of the newly configured SPCs. An SPC must be deleted by the SPC management entity before another SPC is added with the same VPCI/VCI. The procedures are as follows:

- When a new SPC has been added the reporting entity sends an SPC UPDATE STATUS message with the 'new' (N) bit in the status information element set to 1.
- When a SPC is newly configured, its initial status may be inactive or active. This is indicated in the initial status report.

The 'new' status of an SPC will not be cleared until the SPC UPDATE STATUS message reporting the 'new' status has been acknowledged.

G.4.5.2 Reporting the availability of SPCs

One of the functions of the SPC UPDATE STATUS message is to indicate the changes in status of configured SPCs. The SPC UPDATE STATUS message is sent whenever the status of an SPC changes. The changed status, inactive or active, is indicated by setting the 'active' (A) bit to 0 or 1 respectively.

Since there is a delay between the time an SPC becomes active and the time the SPC's change in status is received by the other entity, a receiving entity may receive cells for an inactive SPC. The action of the user equipment at the UNI is implementation dependent. The action the network takes is also implementation dependent and may include discarding of received cells.

If the network receives an SPC UPDATE STATUS message for an SPC which is not configured, there are two cases. If the 'delete' (D) bit is 0, then the network sends an SPC UPDATE STATUS message with the 'delete' (D) bit set to 1. Otherwise, no action concerning the status is required.

G.4.5.3 Reporting deleted SPCs

To indicate that a SPC has been deleted, an SPC UPDATE STATUS message is sent with the 'delete' (D) bit set to 1 for the affected SPC. The 'deleted' status in one direction is independent of the 'deleted' status in the other direction.

When an entity receives an SPC UPDATE STATUS message with 'delete' (D) bit set to 1, and the corresponding SPC is present, an inactive status may be propagated toward the remote user. Otherwise, no action concerning the status is required.

G.4.6 Acknowledgment of SPC UPDATE STATUS message

When an SPC UPDATE STATUS message is received, an SPC UPDATE STATUS ACK message shall be sent with the same transaction number that was indicated in the received SPC UPDATE STATUS message.

G.4.7 ATM OAM Flow 5 procedures

On the ATM connection used for these SPC status procedures, the OAM F5 fault and performance monitoring management procedures (see Recommendation I.610) can be used. The F5 fault management procedures provide detection and verification of the availability of the ATM connection.

G.5 Error conditions

G.5.1 UNI procedures for operational errors

The reporting entity at the UNI shall report an SPC as inactive if it detects a service affecting condition.

G.5.2 Signalling protocol errors

Layer 3 status signalling protocol errors are handled according to procedures defined in Recommendation Q.2931, section 5.6 and 5.7 (i.e., protocol discriminator, message type, message length, call reference and mandatory information element errors).

G.5.3 UNI failure

When the network detects that the UNI is inoperative, it notifies users of the SPCs that the SPCs are in active.

G.5.4 Network response to SPC status change

When the network determines that the status of a SPC has changed, either because of a network failure or repair or because it has received a SPC UPDATE STATUS message from the user specifying a status change for the SPC, the SPC status change may be propagated toward the remote user.

If the network element at the UNI receives an indication from the remote interface that a SPC's status has changed, it reports this across the UNI to the user.

G.6 System timers

Timer	Description	Range (seconds)	Default (seconds)	Cause for started	Cause for normal stop	Action at the expire
T393	SPC STATUS ENQUIRY timer	5 - 30	10	SPC STATUS ENQUIRY sent	SPC STATUS REPORT received	the same SPC STATUS ENQUIRY is retransmitted N394 is incremented
T394	SPC UPDATE STATUS timer	5 - 30	10	SPC UPDATE STATUS sent	SPC UPDATE STATUS ACK received	the same SPC UPDATE STATUS is retransmitted N395 is incremented

G.7 System parameters

Parameter	Description	Default value	Action at the expire
N394	Maximum value of retry counter N394 for SPC STATUS ENQUIRY/REPORT procedures	3	considered to be inactive
N395	Maximum value of retry counter N395 for SPC UPDATE STATUS/ACK procedures	3	considered to be inactive

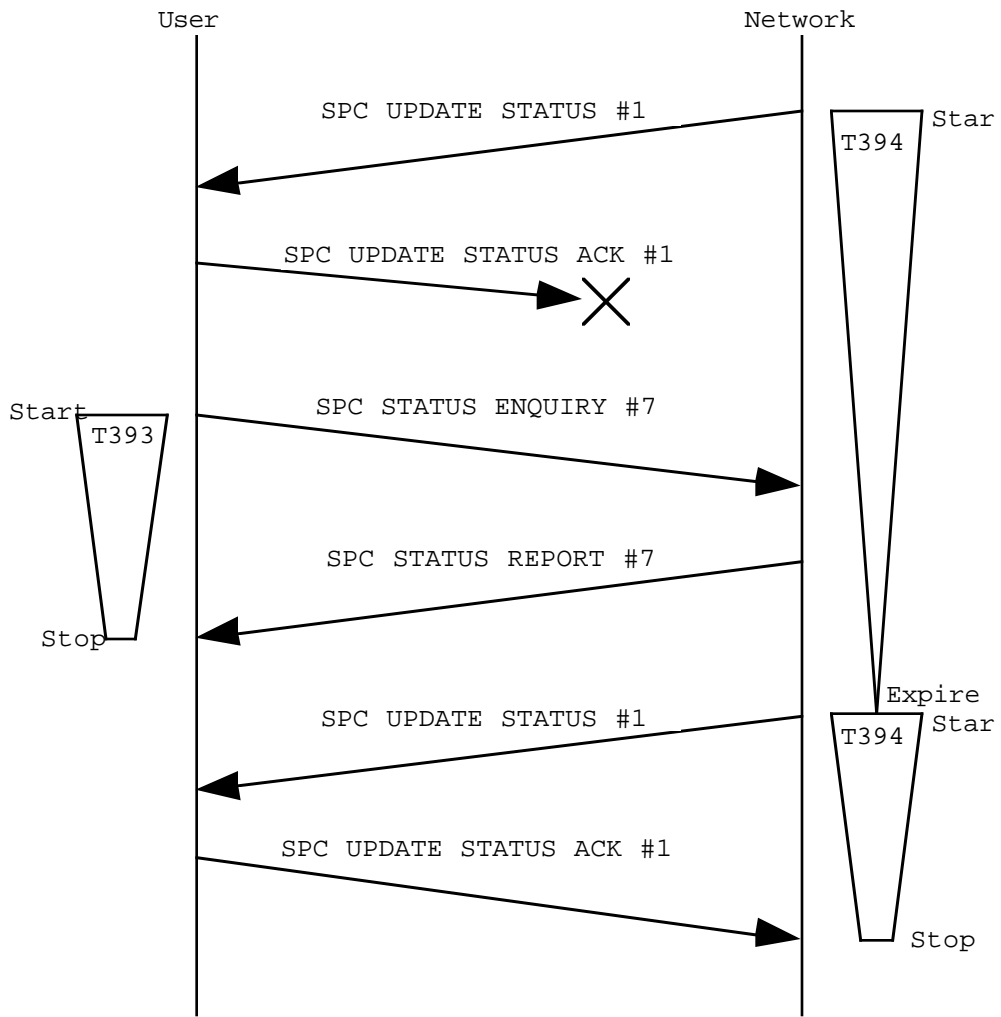


Figure G.4 / Q.2931
 Independent processing of SPC STATUS UPDATE
 versus SPC STATUS REPORT messages