Annex 1
Event Driven Procedures

(Normative)

The following text is taken from ITU draft recommendation Q.frnni1, 1994.

Frame Relay Services
Network-to-Network Signalling Protocol For Permanent Virtual Connections Monitoring

1 General

1.1 Scope and purpose

The default NNI PVC management procedures are as defined in Q.933 Annex A. The event driven procedures contained herein may optionally be supported by bilateral agreement.

This draft recommendation describes the means for notification of an outage of a permanent virtual connection (PVC), and of recovery from such a condition at the network-to-network interface. These PVC status signaling procedures apply whether a given network-to-network interface (NNI) supports only PVCs, or supports both PVCs and SVCs. These procedures may be initiated by network equipment on either side of the network-to-network interface.

The procedures include:

- Notification of the addition of a PVC segment within a multi-network PVC
- Notification of the deletion of a PVC segment within a multi-network PVC
- Notification of the availability (active state) or unavailability (inactive state) of a multi-network PVC
    - Inactive means the multi-network PVC is configured but not available to be used
    - Active means the multi-network PVC is available to be used

When a permanent virtual connection between two users involves more than one network, the portion of the PVC provided by each network is termed a "PVC segment." A multi-network PVC is a concatenation of two or more PVC segments. This is depicted in figure 1/Q.frnni1.

A configured PVC segment is one for which the network operator has assigned a virtual connection between two endpoints.

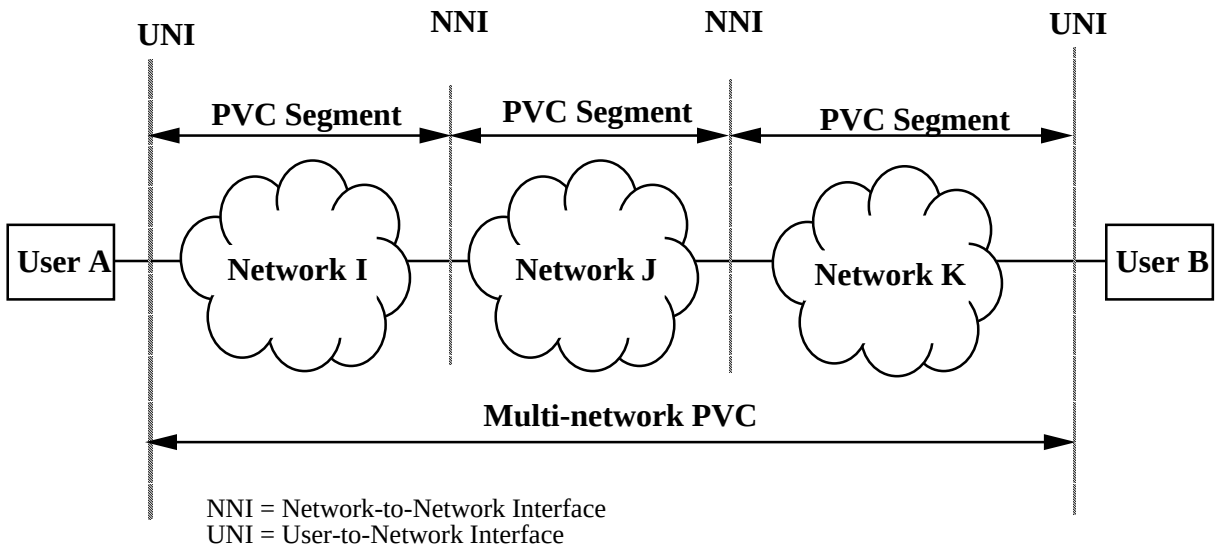


Figure 1/Q.frnni1
Multi-network PVC

NNI procedures shall be used to communicate status between networks. Each network at the network-to-network interface shall support both the reporting procedures and the receiving procedures simultaneously. The reporting entity performs the reporting procedures, and the receiving entity performs the receiving procedures. The reporting entity initiates PVC status reports as changes in PVC states occur. A status report is a PVC STATUS message which reports status. The receiving entity processes PVC status reports, and propagates this status information towards the UNI. This is depicted in figure 2/Q.frnni1:

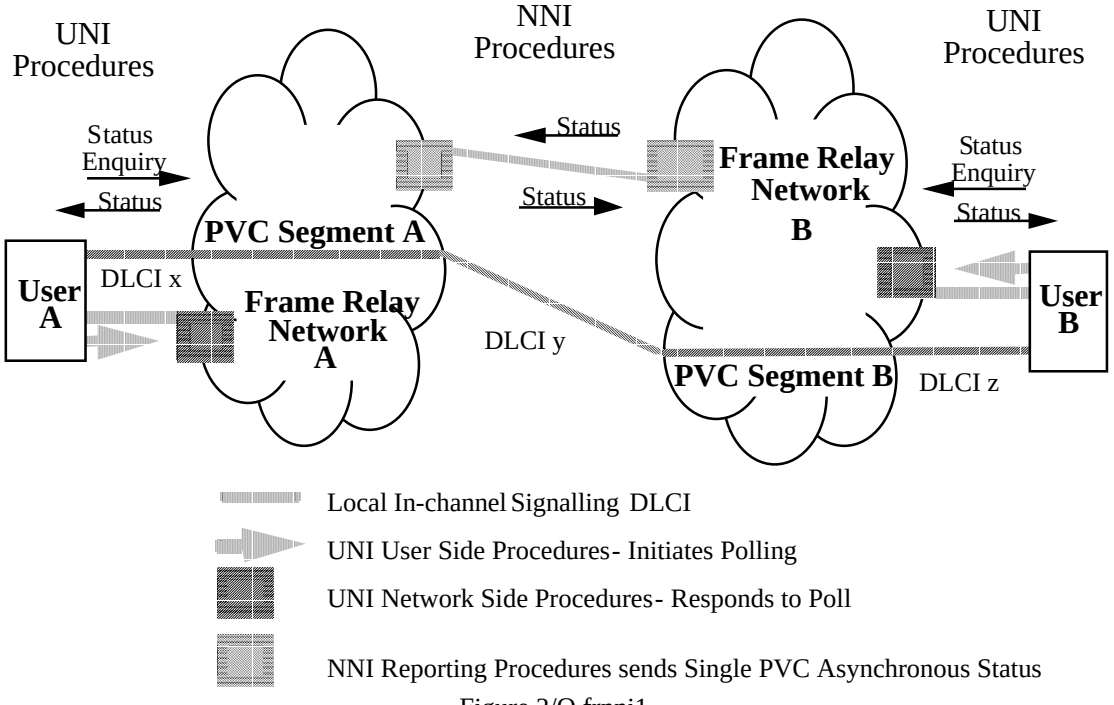


Figure 2/Q.frnni1
NNI procedures

Each network has two views of the other connected network at a given NNI:

1. Communication protocol operation - this concerns communications across the NNI and includes the sending of PVC STATUS messages.

2. PVC status signaling -- this concerns exchanging information about multi-network PVCs. Each network indicates to the other which PVC segments are configured, and which of the configured PVC segments are available to be used. The status reported for a multi-network PVC may be affected by many things, including conditions in the reporting network, conditions in any network through which a PVC segment passes, and the user equipment.

The layer 3 messages are transferred across the network-to-network interface using layer 2 information frames (as defined in CCITT Recommendation Q.922) on DLCI 0. The forward explicit congestion notification, backward explicit congestion notification, and the discard eligibility indicator bits shall be set to 0 on transmission.

1.2 References

1. CCITT Recommendation Q.922 - ISDN Data Link Layer Specification for Frame Mode Bearer Services, 1991

3. ITU Recommendation Q.933, DSS1 Signalling Specification for Frame Mode Basic Call Control, ITU, Geneva, 1992

4. CCITT Recommendation I.370 - Congestion Management for the ISDN Frame Relay Bearer Service, 1991

5. CCITT Recommendation I.372 - Frame Relaying Bearer Service Network -to-Network Interface Requirements, 1992

6. CCITT Recommendation E.164 / I.331 - Numbering Plan for the ISDN era

7. CCITT Recommendation T.50 - International Reference Alphabet (formerly International Alphabet No. 5 or IA5) - Information Technology - 7 bit coded character set for information interchange

1.3 Abbreviations

UNI	User-to-Network Interface
NNI	Network-to-Network Interface
PVC	Permanent Virtual Connection
SVC	Switched Virtual Connection

2 PVC Status message

This message is sent, when required, to indicate the status of one or more PVC segments.

Message type: PVC STATUS Direction: both

Significance: local

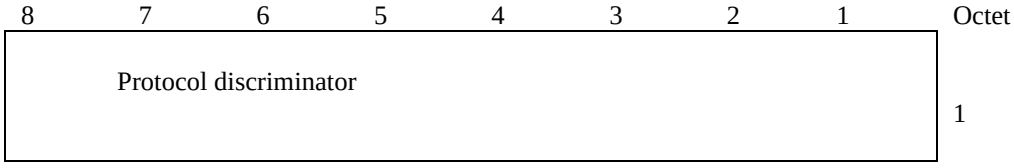
Information element	Reference	Direction	Type	Length
Protocol discriminator		both	M	1
Call reference		both	M	1
Message type		both	M	1
Report type		both	M	3
PVC status (Note 1)		both	M	5-16

Note 1 - One or more PVC status information elements will be included.

3 Information elements

3.1 Protocol discriminator

The protocol discriminator is the first element of every message.



Bits
87654321
00001000

Figure 3/Q.frnni1
Protocol discriminator

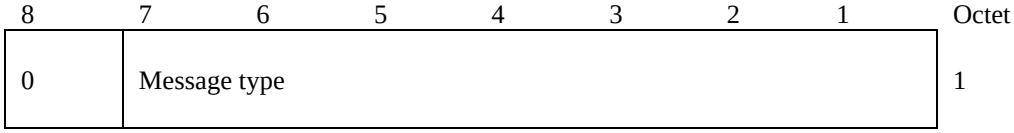
3.2 Call reference

The dummy call reference value is used for these procedures.

3.3 Message type

The purpose of the message type is to identify the function of the message.

The message type is the third element of every message. Bit 8 is reserved for possible future use as an extension bit.



Bits
87654321
01111100 PVC STATUS
All other values are reserved.

Figure 4/Q.frnni1
Message type

3.4 Report type

The purpose of the report type information element is to indicate the contents of the PVC STATUS message. The length of this information element is 3 octets.

8	7	6	5	4	3	2	1	Octet
0	Report type 1	0	1	0	0	0	1	1
	information element identifier							
Length of the report type contents								2
Type of report								3

Type of report (octet 3)

Bits
87654321
00000000 Reserved - used in Q.933 Annex A.
00000001 Reserved - used in Q.933 Annex A
00000010 Reserved - used in Q.933 Annex A
00000011 Update PVC Status
All other values are reserved.

Figure 5/Q.frnni1
Report type information element

3.5 PVC status

The purpose of the PVC status information element is to indicate the status of a PVC segment. The maximum length of the PVC status information element is 14 octets when the default address format (2 octets) is used.

8	7	6	5	4	3	2	1	Octet
0	PVC status 1 information element identifier	0	1	0	1	1	1	1
Length of PVC status contents								2
0	0 spare	Data link connection identifier (Most significant 6 bits)						3 Note 1
0/1 ext	Data link connection identifier (next most significant 4 bits)				0	0 spare	0	3a Note 2
0/1 ext	0	0 spare	0	New "N"	Delete "D"	Active "A"	0 Reserved	4 Note 3
0	CC/ DCC	Country Code Length				Inactive Reason		4a*
0/1 ext	Country Code Most Significant Digit							4b*
0/1 ext	Country Code							4c* Note 4
0/1 ext	Country Code Least Significant Digit							4d*
0/1 ext	National Network Identifier Most Significant Digit							4e* Note 5
0/1 ext	National Network Identifier Next Most Significant Digit							4f*
0/1 ext	National Network Identifier Next Most Significant Digit							4g*
0/1 ext	National Network Identifier Next Most Significant Digit							4h*
1 ext	National Network Identifier Least Significant Digit							4i*

Note 1 - Bit 6 of octet 3 is the most significant bit in the data link connection identifier.
Note 2 - When address extension octets are implemented, the structure (octets 3b and 3c) given in Figure 4.3/Q.933 will apply.
Note 3 - When the active bit is set to 0, then octets 4a - 4b will be included.
Note 4- Octet 4c is included when the country code is 2 or 3 digits. Octet 4d is included when the country code is 3 digits.
Note 5 - The length of the Network Identifier field is from 0 to 5 octets.

Figure 6/Q.frnni1
PVC status information element for default 2-octet address.

Data link connection identifier (octet 3 bits 6-1 and octet 3a bits 7-4)

The data link connection identifier is coded in binary.

New (octet 4)

Bit 4	
0	PVC is already present
1	PVC is new

Note - The New bit is propagated from end to end of a multinetwork PVC as described in section 4.1.4 Reporting New PVC Segments.

Delete (octet 4)

Bit 3	
0	PVC is configured
1	PVC is deleted

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

Note - The Delete bit has only local significance. It terminates at the receiving entity.

Active (octet 4)

Bit 2	
0	PVC is inactive
1	PVC is active

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

Note - The Active bit is propagated from end to end of a multinetwork PVC as described in section 4.1.6 Reporting the Availability of a PVC.

CC/DCC (octet 4a)

Bit 7	
0	Country code is CC (E.164)
1	Country code is DCC (X.121)

Country Code Length (octet 4a)

Bit 6 5	
0 0	Reserved
0 1	CC (E.164) Country code is 1 octet in length
1 0	CC (E.164) Country code is 2 octets in length
1 1	CC (E.164) Country code is 3 octets in length

Country Code (octet 4b, 4c, 4d)

The country code is encoded using IA5 as defined in recommendation T.50. It is always 3 octets in length when indicating the DCC as defined in X.121. The country code is 1 to 3 octets in length when indicating the CC as defined in E.164

National Network Identifier (octet 4e, 4f)

The National Network Identifier is encoded using IA5 as defined in recommendation T.50 and is 0 to 5 octets in length. The assignment of the network identifier will be made nationally. In countries which have no national network identifer administrator, or if there is only one network in a given country, the octets 4e - 4i are not present.

Inactive Reason (octet 4a)

The inactive reason field is used to indicate why a PVC has become inactive and it is coded by the network reporting the inactive status. Some networks may support only Q.933 Annex A bidirectional procedures at the NNI. Also, user equipment supports Q.933 Annex A procedures (unidirectional or optionally bidirectional). For interworking with such networks, and with users, some codes indicate that the event occurred in, or passed through, an adjacent network (or user) connected by an NNI (or UNI) which does not support reporting of the network ID and inactive reason. The figure below is provided to illustrate this.

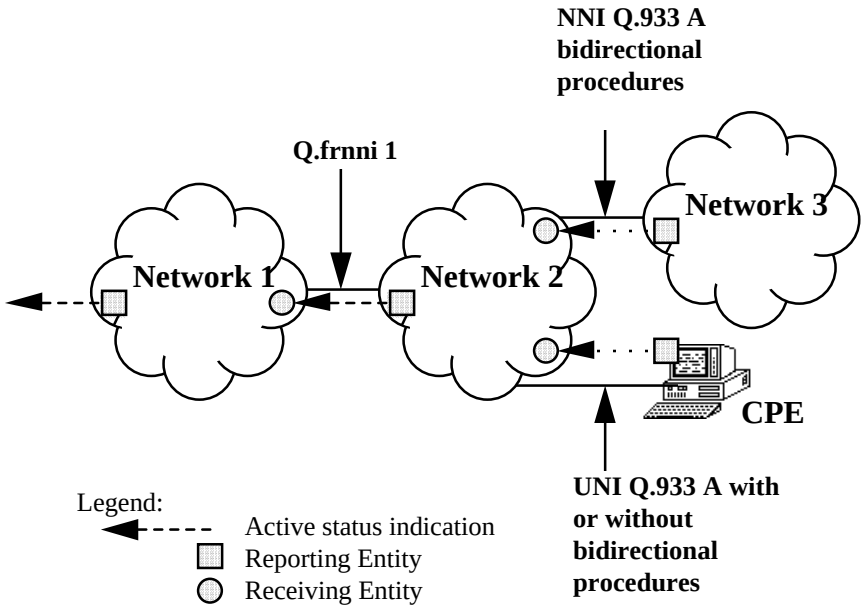


Figure 7
Q.933 Annex A Interoperability

Coding of the Inactive Reason is shown below. The first three codes apply when the event occurs on, or is reported over, an interface which does not support reporting of the network ID and inactive reason (e.g., Q.933 Annex A). The other codes apply when the event occurs in a network which supports Q.frnni 1 or the event occurs on, or is reported over, a Q.frnni 1 interface.

Bits
4 3 2 1
0 0 0 0

PVC inactive in adjacent network or user - - The receiving entity received a PVC status report with the A-bit = 0 on an NNI, or a UNI with bidirectional procedures, which does not support reporting of the network ID and inactive reason. The network ID identifies the network of the receiving entity.

0 0 0 1 PVC segment deleted in adjacent network or user - - The receiving entity received a PVC status report on an NNI, or a UNI with bidirectional procedures, which does not support reporting of the network ID and inactive reason and determined the PVC was deleted. The network ID identifies the network of the receiving entity.

0 0 1 0 Interface inactive to adjacent network or user - - A service affecting condition is detected on an NNI, or a UNI with or without bidirectional procedures, which does not support reporting of the Network ID and inactive reason. The network ID identifies the network that is reporting this inactive reason.

0 1 0 0 PVC non-operational in this network - - The PVC segment is non-operational in the network identified by the network ID.

0 1 0 1 PVC deleted in this network - - The PVC segment was deleted from this network. The inactive status is propagated to the next network along with the Delete bit set to 1 and the network ID of this network.

0 1 1 0 Interface inactive to adjacent network - - The LAPF link of the NNI is in the released state. The network ID identifies the network that is reporting this inactive reason.

All other values reserved

The following table shows the relationship between the identified network and the adjacent network.

Code	Description	Network ID identifies the network which:	Type of Interface to the Adjacent Equipment
0000	PVC inactive in adjacent network or user.	Received PVC Status report with A=0 and not indicating a network ID.	UNI using Bidirectional procedures, or NNI (Note 1).
0001	PVC segment deleted in adjacent network or user.	Received PVC Status report indicating that a PVC was deleted, and not indicating a network ID.	UNI using Bidirectional procedures, or NNI (Note 1).
0010	Interface inactive to adjacent network or user.	Determined that a service affecting condition exists on the UNI or NNI. (Note 2)	UNI (with or without Bidirectional procedures), or NNI (Note 1).
0100	PVC non-operational in this network.	Determined that the PVC segment is not operational.	NNI (Q.frnni 1)
0101	PVC segment deleted from this network.	Deleted the PVC segment.	NNI (Q.frnni 1)
0110	Interface inactive to adjacent network.	Determined that the LAPF link of the NNI is released. (Note 2)	NNI (Q.frnni 1)

TABLE 1

Note 1: The interface to the adjacent entity is either a UNI (Q.933 Annex A) or an NNI (based on Q.933 Annex A), therefore it does not support reporting of the Network ID and Inactive Reason.

Note 2: Inactive Reasons 00010 and 00110 both indicate that the PVC is inactive because the interface to the adjacent network is not active. In both cases the Network ID identifies the network which has determined that the interface is not active.

4 Procedures

When one or more PVC segments' status has changed within the network (i.e., active, inactive, or deleted), or when a PVC segment is initially configured, the network sends a PVC STATUS message with report type 'update status.' Also, the reporting of all configured PVCs on the NNI is necessary during link initialization.

PVC status information elements shall be sent in the sequence in which the events they report were detected. The grouping of PVC status information elements into PVC STATUS messages is implementation dependent. Therefore, it is possible for two or more PVC status information elements in one PVC STATUS message to specify the same DLCI.

PVCs whose status has not changed must not be included in the PVC status report. The only exception to this is following LAPF data link establishment procedures.

PVC status information from PVC status reports shall be propagated towards the user-to-network interface (UNI) of the multi-network PVC. The PVC status signaled from one network to another shall not affect the PVC status signaled in the opposite direction.

The presence or absence of a PVC status information element in a full status report at the user-to-network interface indicates only the presence or absence of a particular PVC segment within the multi-network PVC.

4.1 LAPF acknowledged information transfer procedures

4.1.1 LAPF link establishment

The layer 3 entity on either side of the NNI initiates the LAPF procedures for DLCI 0 with the layer-to-layer signaling primitive DL-establish-request as shown in Figure 3/Q.922 and the SDLs in Figure B-5/Q.922 and Figure B-7/Q.922. When LAPF for DLCI 0 is set up, layer 2 enters the multiple frame established state, and the layer-to-layer signaling primitive DL-establish-indication or DL-establish-confirm is used to notify the layer 3 entity at both sides of the NNI.

The NNI shall be considered operational when LAPF is in the multiple frame established state for DLCI 0.

Whenever the layer 3 entity receives the DL-establish-indication or the DL-establish-confirm, the reporting entity sends the status of all configured PVCs.

See Section 4.8 for an example of adding a multi-network PVC.

4.1.2 LAPF link release

When the LAPF link is released, the layer 3 entity either sends the layer-to-layer primitive DL-release-request or receives the layer-to-layer signaling primitive DL-release-indication as shown in Figure 5/Q.922. In that event, the channel will be considered inoperative and inactive status is propagated towards the remote end of each associated PVC.

4.1.3 NNI status

The NNI shall be considered non-operational until the LAPF link is established and remains operational until the LAPF link is released. The Data Link Monitor Function defined in section 5.10 of Q.921 shall be used to verify link integrity.

4.1.4 Multi-network PVC active status criteria

The network shall report a multi-network PVC as "active" (i.e., active bit =1) at the UNI only if all the following criteria are met:

1. All PVC segments are configured.

2. All UNIs and NNIs associated with the multi-network PVC are operational (i.e., there are no service affecting conditions).

3. All PVC segments within the multi-network PVC are operational (i.e., there are no service affecting conditions).

4. The remote users, when required to support bidirectional procedures at the UNI, reports that the PVC is active by setting the active bit to 1 in a PVC status information element.

Whenever these criteria are not fully met, the active bit indication propagated toward the UNI shall be set to 0.

Only a network with a PVC terminating at a UNI running Q.933 Annex A non-bidirectional procedures may set the active bit to 1 towards the remote UNI (considered the "target UNI"). Each succeeding network along the multi-network PVC may either pass the active bit unchanged or set the active bit to 0. If any PVC segment is not active along the multi-network PVC, an inactive status is propagated (when possible) to the target UNI.

4.1.5 Reporting new PVC segments

One of the functions of the PVC status report is to notify the receiving entity of newly added PVC segments. A PVC segment must be deleted before another PVC segment is added which uses the same DLCI. The PVC reporting procedures are defined as follows:

1) When a new PVC segment has been added, the reporting entity sets the new bit to 1 in a PVC STATUS message.

2) When the receiving entity receives a PVC status report containing a PVC STATUS message and the new bit is set to 1, one of the following two events will occur: If the corresponding PVC segment is not configured in the network of the receiving entity, a "delete" PVC STATUS message is returned. If the corresponding PVC segment is configured in the network of the receiving entity, a status message indicating either "Active" or "Inactive" is returned.

The New bit received by the receiving entity shall be propagated to the distant reporting entity of the associated PVC. The reporting entity shall then propagate it to the next receiving entity. This results in the end user at the UNI eventually receiving a New bit indication. This procedure assures the end user (e.g., a router) does not miss the fact that a transit network deleted a PVC and then quickly re-used the same DLCI for a new PVC to a new destination. This can occur because the Q.933 Annex A UNI procedures involve polling for status. The PVC status can change from active to inactive and back to active between two consecutive full status messages without the user detecting the change.

Since a multi-network PVC consists of a number of PVC segments, each managed by a different network, the PVC segments in a multi-network PVC may not be added simultaneously. The PVC segments can be thought of as being added one at a time in an arbitrary order.

As each PVC segment is added to a multi-network PVC, the network-to-network interface(s) and the user device (if applicable) are notified that the PVC segment has been added (i.e., new bit set to 1). The active status in a multi-network PVC is set according to the criteria given in Section 4.1.6 and propagated towards the target UNI.

See Section A.3 for an example of adding a multi-network PVC.

4.1.6 Determining the availability of a PVC

The receiving entity determines that a PVC is inactive whenever any of the following is true:

- The NNI LAPF link is released, or
- The PVC segment is not present (it is deleted) in the adjacent network, or
- The adjacent network is reporting the PVC segment as inactive (A = 0).

Otherwise it is active. The network propagates the resulting status to the reporting entity at the other end of the PVC segment. See Section 4.1.7.

4.1.7 Reporting the availability of a PVC

The active bit of the PVC status information element is used to report the availability or unavailability of a PVC segment initially, and when the value of the active status changes.

The reporting entity sends a PVC status report to indicate a change in the active status whenever one of the following events occurs:

1. If the previously reported active status was A=1 when the PVC segment becomes non-operational, then the reporting entity sends a PVC STATUS message with A=0 (inactive).

2. If the previously reported active status was A=1 when an active status of A=0 is received from the other end of the PVC segment, then the reporting entity sends a PVC STATUS message with A=0 (inactive).

3. If the previously reported active status was A=0 and the PVC segment is operational when an active status of A=1 is received from the other end of the PVC segment, then the reporting entity sends a PVC STATUS message with A=1 (active).

4. If the previously reported active status was A=0 and the most recently received active status from the other end of the PVC segment was A=1 when the PVC segment becomes operational, then the reporting entity sends a PVC STATUS message with A=1 (active).

The receiving entity uses the PVC status report to detect a change in status of configured PVC segments. The action of the receiving entity is based on the value of the active bit and is independent of the action based on the new bit. The user equipment at the end points of a multi-network PVC shall stop transmitting frames on the inactive multi-network PVC until it receives a PVC status information element for the multi-network PVC with the active bit set to 1.

Since there is a delay between the time the networks make a multi-network PVC available and the time they transmit a PVC status information element notifying the user equipment, there is a possibility of the user equipment receiving frames on a multi-network PVC marked as unavailable. The action the user equipment takes on receipt of frames on an inactive multi-network PVC is implementation dependent.

Since there is a delay between the time the networks detect that a multi-network PVC has become unavailable and the time the propagated PVC status information element notifies the user equipment, there is a possibility of the networks receiving frames on an unavailable multi-network PVC. The action the networks take on receipt of frames for an inactive PVC is network dependent and may include the dropping of frames on the unavailable multi-network PVC.

When the receiving entity receives a PVC STATUS message indicating 'new,' 'active' or 'inactive,' for a DLCI for which there is no corresponding PVC, the reporting entity of the same NNI replies with a PVC STATUS message indicating 'delete.'

See section 5 for conditions under which the network sets the active bit to zero.

4.1.8 Setting the network ID/Inactive reason fields

The inactive reason and the network ID provides for problem isolation in a multi-network PVC environment. The network shall include the inactive reason and network ID.

The network ID and inactive reason identify the network which first recognizes the event as closely as possible. There are three cases:

1. If the network experiences the event itself, it encodes the network ID to identify itself and encodes the inactive reason as one of the following:

- PVC non-operational in this network
- PVC deleted in this network
- Interface inactive to adjacent network (in the case of a Q.frnni 1 interface)
- Interface inactive to adjacent network or user (in the case of a Q.933 Annex A interface)

2. The network ID and inactive reason received by the receiving entity is propagated to the distant reporting entity of the corresponding PVC.

3. If the network receives the PVC deleted or inactive status from an NNI or UNI which uses the Q.933 Annex A bidirectional procedures, then it encodes the network ID to identify itself, and encodes the inactive reason as one of the following:

- PVC inactive in adjacent network or user
- PVC deleted in adjacent network or user

4.1.9 Reporting deleted PVCs

A multi-network PVC is considered deleted if every PVC segment in the multi-network PVC is deleted. Since a multi-network PVC consists of a number of concatenated PVC segments, each managed by a different network, the PVC segments in a multi-network PVC may not be deleted simultaneously. The PVC segments can be thought of as being deleted one at a time in an arbitrary order.

When the receiving entity receives a PVC STATUS message with the delete bit set to 1 and the corresponding PVC segment is present, an inactive status is propagated towards the other end of the PVC segment. Otherwise, no action is required.

If a network deletes a PVC segment, the NNI reporting entity sends a PVC STATUS message with the delete bit set to 1.

See Section A.4 for an example of deleting a multi-network PVC.

5 Error conditions

5.1 Layer 3 protocol errors

Layer 3 status signalling protocol errors are handled according to procedures defined in Q.933, Section 7.7 (i.e., protocol discriminator, message type, call reference and mandatory information element errors). Ignore messages containing these errors.

5.2 Response to UNI failures

When a network detects that the user-to-network interface is inoperative, it notifies users of the multi-network PVCs associated with the failed UNI that the multi-network PVCs are inactive. The PVC status changes are propagated through the adjacent network(s) to the remote user.

See Section A.5 for an example of response to a UNI failure.

5.3 Response to PVC segment failures

When a network determines that its PVC segment has become inoperative, it notifies the adjacent network(s) and/or UNI that the multi-network PVC is inactive. The PVC status change is propagated through the adjacent network(s) to the remote user(s).

See Section A.6 for an example of PVC segment failure.

5.4 Response to NNI failures

When a network detects that the network-to-network interface is inoperative, each network notifies users of the PVCs associated with the NNI that the multi-network PVCs are inactive. The PVC status changes are propagated through the adjacent network(s) to the remote users.

See Section A.7 for an example of response to NNI failure.

Appendix A- Examples of multi-network permanent virtual connection (PVC) status signaling at the network-to-network interface (NNI)

This section contains examples of multi-network PVC status signaling in the following scenarios:

- adding a multi-network PVC (See Section A.3)
- deleting a multi-network PVC (See Section A.4)
- UNI failure & restoration (See Section A.5)
- PVC segment failure & restoration (See Section A.6)
- NNI failure & restoration (See Section A.7)
- LAPF data link establishment (See Section A.8)

The UNIs shown in these examples are based on Q.933 Annex A.

A.1 General comments

Status enquiry/status report exchanges occur at both UNI interfaces to indicate that the interface is operational. The status enquiry/status report exchanges are shown only when a change in link integrity verification state occurs or when multi-network PVC signaling is affected. The PVC status information elements are shown only when the associated PVC segment has a status change.

All examples deal with the following multi-network PVC consisting of two PVC segments:

- PVC segment in Network I interfaces to User A with DLCI 16 and Network J with DLCI 32.
- PVC segment in Network J interfaces to Network I with DLCI 32 and User B with DLCI 48.

Note that the default values of 3 errors for N392 and 4 monitored events for N393 at the UNI are used throughout the examples.

A.2 Nomenclature

Notation	Meaning
SE	This is the status enquiry message used at the UNI as described in Q.933 Annex A, section A.1.2. The request for a full status report need not be present.
S	This is the link integrity verification status report used at the UNI as described in Q.933 Annex A, section A.1.1.
FS(16,N,I)	This is a full status report used at the UNI as described in Q.933 Annex A, section A.1.1. The report type indicates a full status report. A full status report request is not necessary for a full status report response. In this case, DLCI 16 reported the status of "new" and "inactive" for the PVC segment.
SR(16,N,I)	This is a PVC status report as described in section B.1 of this document. In this case, DLCI 16 reported the status of "new" and "inactive" for the PVC segment.
FS()	This is a full status report used at the UNI as described in Q.933 Annex A, section A.1.1. The report type indicates a full status report. A full status report request is not necessary for a full status report response. In this case, the PVC segment of interest is not present (i.e., no longer configured).
I->J	This indicates the status generated by Network I as seen by Network J.
A_{16}-I-J_{32}	This designates a PVC segment from User A through Network I to Network J. At the User A to Network I UNI, DLCI 16 is used. At the Network I to Network J NNI, DLCI 32 is used.
C	The "C" status for a particular PVC segment indicates that the PVC is configured and the PVC status information element is present in the full status report at the UNI. At the NNI, the last PVC status report had the delete bit set to 0.
Not C	The "Not C" status for a particular PVC segment indicates that the PVC is not configured and the PVC status information element is not present in the full status report at the UNI. At the NNI, the last PVC status report did have the delete bit set to 1 or no PVC status report were received for this DLCI.
N	The "N" status for a particular PVC segment indicates that the "new" bit is set to 1 in the PVC status information element at the indicated interface. The absence of an "N" in the diagrams indicates that the "new" bit is set to 0.)
A	The "A" status for a particular PVC segment indicates that the "active" bit is set to 1 in the PVC status information element at the indicated interface.
I	The "I" status for a particular PVC segment indicates that the "active" bit is set to 0 in the PVC status information element at the indicated interface.
D	The "D" status for a particular PVC segment indicates that the "delete" bit is set to 1 in the PVC status information element at the NNI.

CI	The "CI" indicates that the channel is inactive at the NNI as detected by LAPF or the network determined NNI service affecting condition (e.g., data set signals down).

A.3 Example of adding a multi-network PVC

When configuring a multi-network PVC, each PVC segment must be added through its local network management system. Figure A-1/Q.frnni1 shows the addition of the multi-network PVC:

- Network I to User A using DLCI 16
- Network I to Network J using DLCI 32
- Network J to User B using DLCI 48

Configuration of both PVC segments in the multi-network PVC is may not be possible. After the PVC segment is configured in Network I and before the PVC segment in Network J is configured, Network I detects that the PVC segment in Network J is not present and informs User A with a full status report indicating that the PVC segment is inactive. Network J returns a PVC status report indicating that the PVC is not configured in Network J.

Note that the PVC segment has been configured locally and is therefore present (on the user interface to User A) but inactive because it is not configured on the remote network (Network J). As far as User B is concerned, the entire multi-network PVC has not been configured until the PVC segment is configured on its local network (Network J).

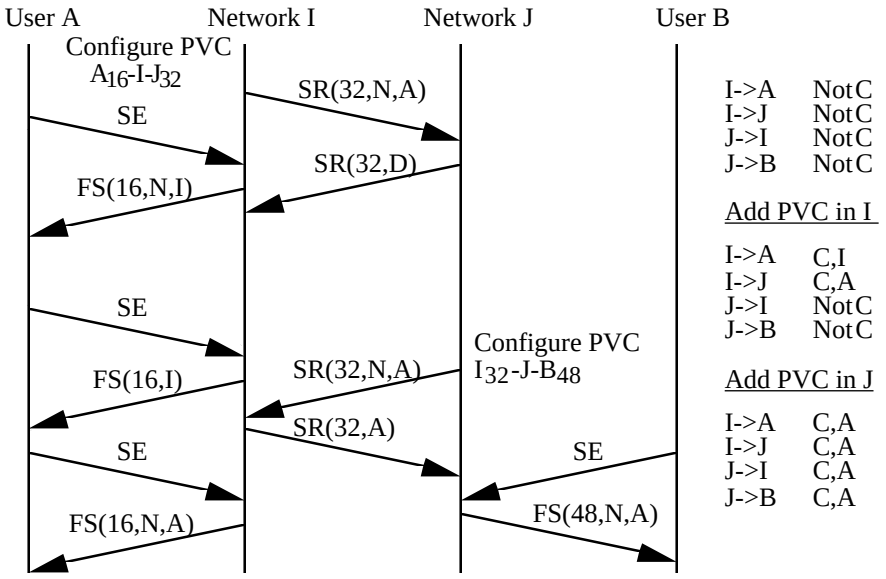


Figure A-1/Q.frnni1
Adding a multi-network PVC

A.4 Example of deleting a multi-network PVC

When deleting a multi-network PVC, each PVC segment must be deleted through its local network management system. Figure A-2/Q.frnni1 shows the deletion of the multi-network PVC:

- Network I to User A using DLCI 16
- Network I to Network J using DLCI 32
- Network J to User B using DLCI 48

Deletion of both PVC segments in the multi-network PVC may not be possible. User A receives a full status report with DLCI 16 deleted (absent) from Network I. After the PVC segment is deleted in Network I, Network J receives a PVC status report for DLCI 32 with the delete bit set to 1 and informs User B with a full status report indicating that the PVC segment is inactive. Note that the PVC segment on Network J has not been deleted locally and is therefore present (on the user interface to User B) but inactive because it is not configured on the remote network (Network I). As far as User B is concerned, the multi-network PVC is not deleted until the PVC segment is deleted on its local network (Network J).

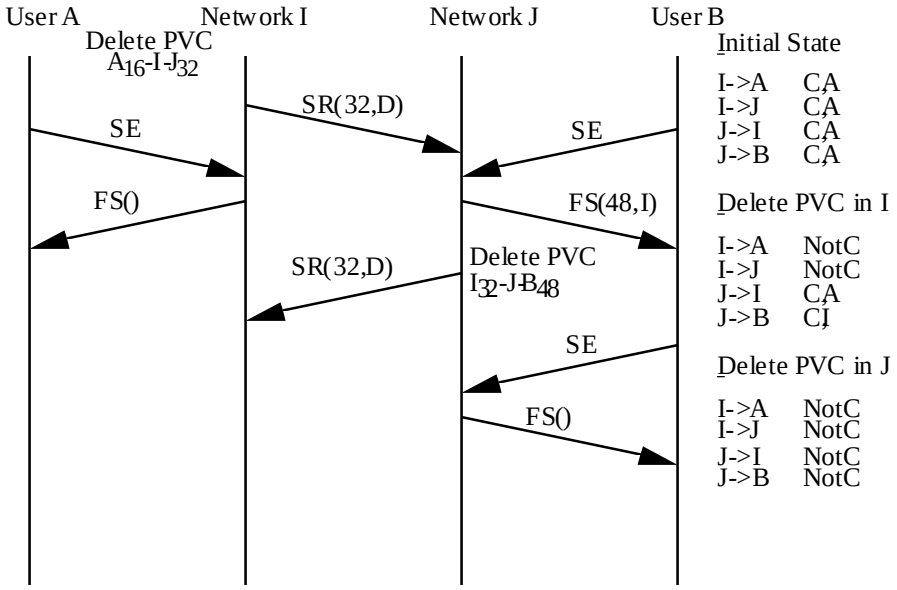


Figure A-2/Q.frnni1
Deletion of a multi-network PVC

A.5 Example of UNI failure and restoration

Figure A-3/Q.frnni1 shows the detection of an inactive channel (UNI channel) between User A and Network I. Network I notifies Network J that DLCI 32 is inactive. The inactive indication is forwarded to the PVC endpoint (User B) on Network J. The active/inactive indication from Network I to Network J is independent of active/inactive indication from Network J to Network I. In Figure A-3/Q.frnni1 the PVC segment from user B to Network I is still active for DLCI 32.

Figure A-3/Q.frnni1 also shows the detection of an active channel (UNI restoration) between User A and Network I. Network I notifies Network J that DLCI 32 is active. The active indication is forwarded to the PVC endpoint (User B) on Network J. The active/inactive indication from Network I to Network J is independent of the active/inactive indication from Network J to Network I.

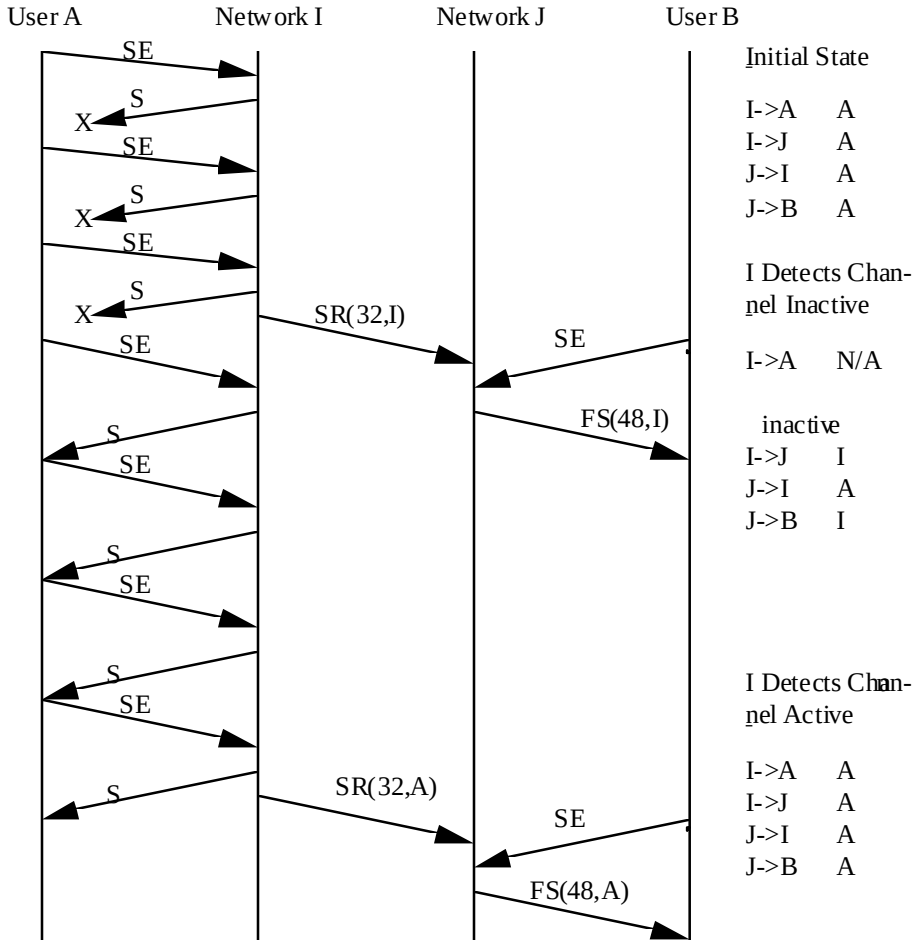


Figure A-3/Q.frnni1
UNI failure and restoration

A.6 Example of PVC segment failure and restoration

Figure A-4/Q.frnni1 shows the failure of a PVC segment in Network I. Network I notifies Network J that DLCI 32 is inactive. The inactive indication is forwarded to the PVC endpoint (User B) via Network J. The active/inactive indication from Network I to Network J is independent of the active/inactive indication from Network J to Network I. In Figure A-4/Q.frnni1, the PVC segment from user B to Network I is still active for DLCI 32.

Figure A-4/Q.frnni1 also shows the notification of a PVC segment becoming operational in Network I. Network I notifies Network J that DLCI 32 is active. The active indication is forwarded to the PVC endpoint (User B) on Network J. The active/inactive indication from Network I to Network J is independent of the active/inactive indication from Network J to Network I.

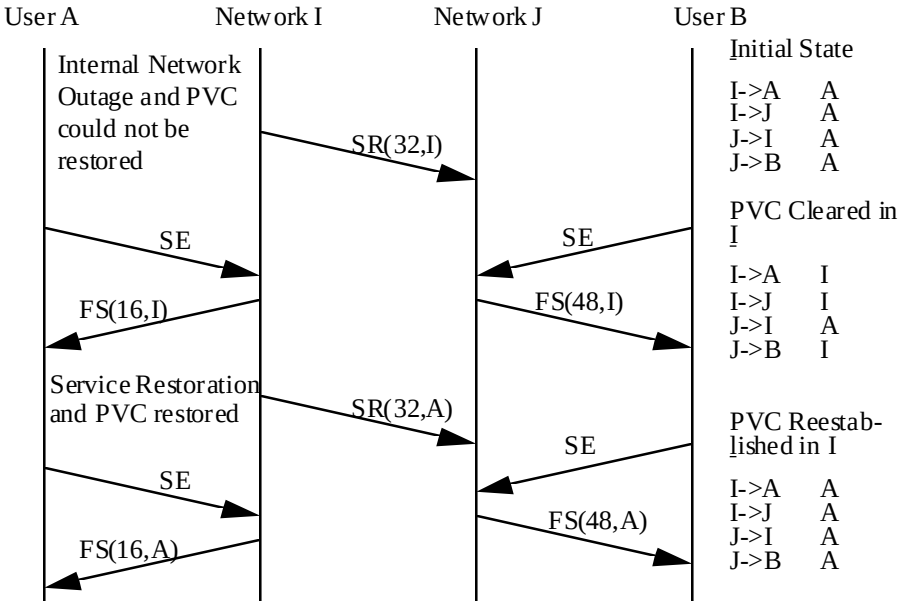


Figure A-4/Q.frnni1
PVC segment failure and restoration

A.7 Example of NNI failure and restoration

Figure A-5/Q.frnni1 shows the detection of an inactive channel (NNI failure) between Network I and Network J. Network I notifies the User A that DLCI 16 is inactive. Network J notifies the User B that DLCI 48 is inactive.

Figure A-5/Q.frnni1 also shows the detection of an active channel (NNI recovery) between Network I and Network J. Network I notifies the User A that DLCI 16 is active. Network J notifies the User B that DLCI 48 is active. Both networks indicate to the other that DLCI 32 is active.

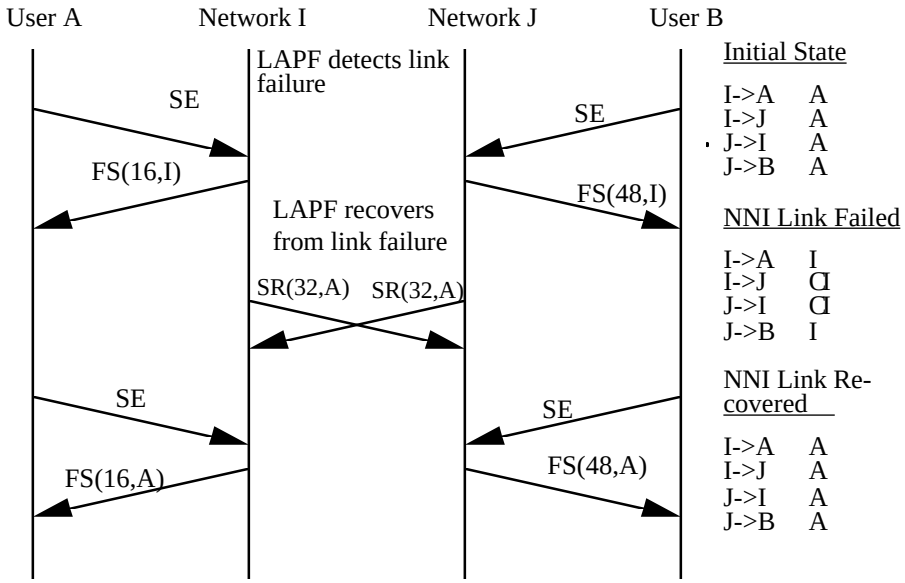


Figure A-5/Q.frnni1
NNI failure and restoration

A.8 Example of LAPF data link establishment

Figure A-6/Q.frnni1 and Figure A-7/Q.frnni1 show the PVC status signaling after LAPF data link establishment.

When both networks at the NNI have the PVC segments of a multi-network PVC configured as shown in Figure A-6/Q.frnni1, each network sends a PVC status report for its configured PVC segment.

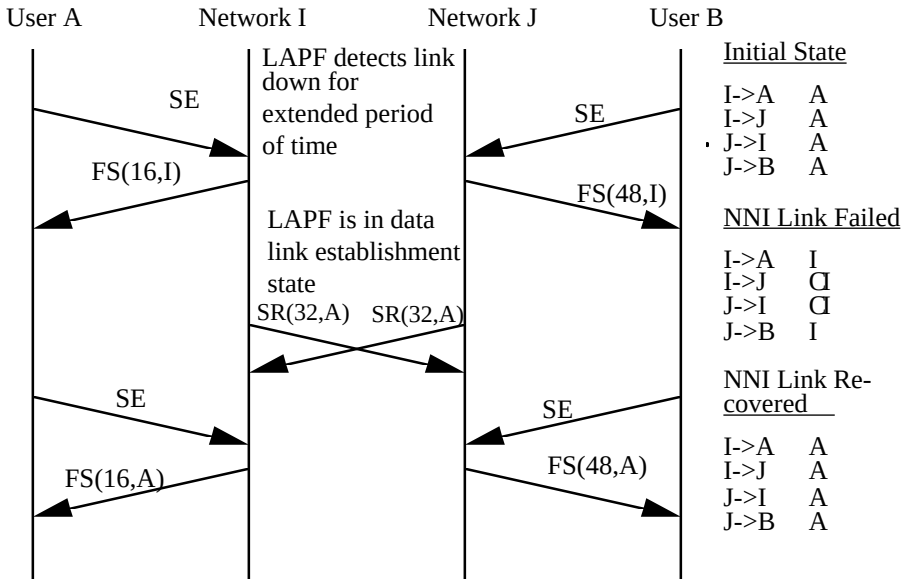


Figure A-6/Q.frnni1
LAPF data link establishment with configured multi-network PVC

When only one network at the NNI (Network I) has a PVC segment of a multi-network PVC configured as shown in Figure A-7/Q.frnni1, the network with the configured PVC segment (Network I) sends a PVC status report with the delete bit set to 0 (in the PVC status information element) to the other network (Network J). When the adjacent network (Network J) receives a PVC STATUS message indicating 'new,' 'active' or 'inactive,' for a DLCI for which there is no corresponding PVC, the reporting entity of the same NNI replies with a PVC STATUS message indicating 'delete.'

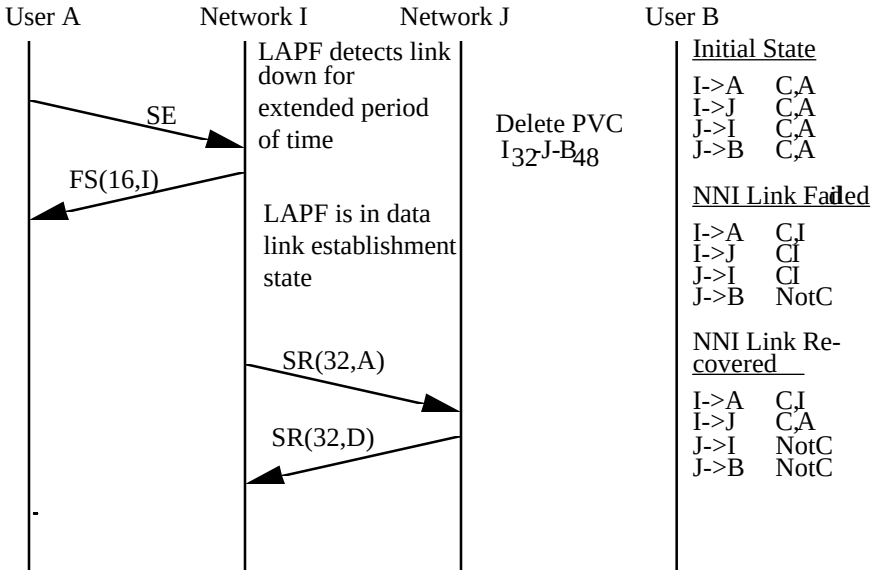


Figure A-7/Q.frnni1

LAPF data link establishment with deleted PVC segment