High Probability of Completion (HPOC) Version 1.0

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1 Introduction

[Informative]

This specification defines a capability for providing preferential access to network resources when attempting to access a network with limited available resources. This type of preferential access is needed when a network is experiencing high levels of traffic load. During these high-load events, there may be connections whose traffic is considered to be more important than the general traffic on the network. The network must provide some assurance that these connection requests will have a high probability of being completed under even heavily-loaded conditions. Preferential access to the network can be granted either by reserving bandwidth to which access is restricted, or by preempting connections in the network to free up bandwidth. A connection requiring a high probability of completion will request access to reserved resources, or preemption of resources, in the signalling message. The availability of reserved resources or preemptable resources in the network is considered during PNNI path selection. The allocation of reserved resources, or the need to preempt resources, is determined as the connection request progresses across the network.

This capability relies on the ability to limit access to authorized users. There are many possible mechanisms for providing this authorization. For example, authorization can be granted implicitly by point-of-attachment or authorization can be granted explicitly through additional authorization information included in the connection request. The type of authorization used will be network-specific and is not defined in this specification.

1.1 Scope

[Normative]

The High Probability of Completion capability is an optional capability of [SIG 4.1], [PNNI 1.1] and [AINI 1.1]. If a node supports the High Probability of Completion capability, it shall support either the Resource Access capability, or the Preemption capability, or both.

A node supporting the High Probability of Completion capability shall implement the procedures for point-to-point and point-to-multipoint calls. A node shall support the association of a High Probability of Completion service request with calls for a virtual channel connection (SVCC, soft PVCC) and calls for a virtual path connection (SVPC, soft PVPC).

A node supporting the High Probability of Completion capability at the UNI, PNNI or AINI shall be capable of forwarding the Priority services information element with the High Probability of Completion octet groups. A node supporting the High Probability of Completion capability at the UNI, inter-domain PNNI or AINI shall also be capable of assigning a High Probability of Completion service request to a call on behalf of the user.

The High Probability of Completion preemption level and service domain may be mapped at administrative boundaries. Procedures on how to map the High Probability of Completion preemption level and service domain are beyond the scope of this specification.

The type of authorization used for the High Probability of Completion service request will be network-specific, and is not defined in this specification.

This specification defines a stand-alone capability for ATM networks. The capabilities defined in this specification are not intended to interoperate with similar capabilities in the PSTN, nor are they intended to define the network mechanisms in support of Q.2959.

1.1.1 Applicability to PNNI 1.0

A device supporting PNNI 1.0 may implement functionality defined in this specification by treating this specification as if it were an optional capability of PNNI 1.0, including PNNI 1.0 Errata and PICS.

1.1.2 Applicability to SIG 4.0

A device supporting SIG 4.0 may implement functionality defined in this specification by treating this specification as if it were an optional capability of SIG 4.0.

1.1.3 Applicability to AINI 1.0

A device supporting AINI 1.0 may implement functionality defined in this specification by treating this specification as if it were an optional capability of AINI 1.0.

1.2 Motivations for HPOC

[Informative]

The typical connection request is made knowing that if sufficient resources are not available in the network, the request will be denied and the connection request will have to be re-attempted later. This “try again later” behavior when the network is at capacity is acceptable for most connections.

There are some connections where it is important that the connection be completed regardless of the current load on the network. These connections require that the network make an additional effort to complete the connection.

Connections requiring this additional effort are often in response to some type of event that could not be anticipated and that requires immediate action. The network must be able to respond dynamically without relying on operator intervention to free up the necessary resources in order to allow for the completion of high-priority calls.

1.3 Relationship to other Priority Standards

[Normative]

1.3.1 Relationship to the ISDN MLPP and GETS Services

This specification provides a service offering with characteristics similar to the services provided in ISDN networks by the Multi-Level Priority and Preemption (MLPP) capability and the Government Emergency Telecommunications System (GETS). Although the service may have similarities, the capabilities defined in this specification are not intended to interwork in any manner with MLPP or GETS. This specification defines a stand-alone capability for ATM networks.

1.3.2 Relationship to Q.2959

As an option, the High Probability of Completion capability provides a mechanism to transport transparently across a network a user-provided Priority information element as specified in the Call Priority ITU-T recommendation (Q.2959). A node that supports this option and receives a Q.2959 Priority information element shall not alter this information element or directly use it to prioritize the call. The node may use the Priority information element to derive a High Probability of Completion service request which will in turn be used across the network.

1.3.3 Relationship to Call Processing Priority

The High Probability of Completion feature is independent from the Call Processing Priority feature, although both use the same information element. The priority/preemption level for one feature does not imply a value for the other feature. However, it is recommended that the priority/preemption level of the two features be assigned in a complementary manner (e.g., avoid assigning a lower call processing priority to calls with a higher preemption level within the same service domain).

Both the HPOC feature and the Call Processing Priority feature may use information contained in the Q.2959 Priority information element to derive priority/preemption levels.

2 References

[Normative]

[Q.735] Stage 3 Description for Community of Interest Supplementary Services Using SS No. 7, March 1993

[Q.2931] Broadband Integrated Services Digital Network (B-ISDN) – Digital Subscriber Signalling System No. 2 (DSS 2) – User-Network Interface (UNI) Layer 3 Specification for Basic Call/Connection Control, February 1995

[Q.2931a4] Digital Subscriber Signalling System No. 2 User-Network Interface (UNI) Layer 3 specification for basic call/connection control Amendment 4, ITU-T Recommendation Q.2931 – Amendment 4, December 1999

[Q.2959] Digital Subscriber Signalling System No. 2 – Call Priority, July 1996

[af-sig-0061.000] ATM User-Network Interface (UNI) Signalling Specification Version 4.0, July 1996

[af-sig-0061.002] ATM User-Network Interface (UNI) Signalling Specification Version 4.1, April 2002

[af-pnni-0055.000] Private Network-Network Interface Specification Version 1.0 (PNNI 1.0), March 1996

[af-pnni-0081.000] PNNI v1.0 Errata and PICs, July 1997

[af-pnni-0055.002] Private Network-Network Interface Specification Version 1.1 (PNNI 1.1), April 2002

[af-pnni-0205.000] PNNI 1.1 Errata Version 1.0, July 2005

[af-sig-0125.000] ATM Inter-Network Interface (AINI) Specification, July 1999

[af-sig-0125.002] ATM Inter-Network Interface (AINI) Specification Version 1.1, September 2002

[af-sig-0182.000] Call Processing Priority Version 1.0, April 2002

3 Terminology
[Informative]

3.1 Acronyms

AINI	ATM Inter-Network Interface
ATM	Asynchronous Transfer Mode
AvCR	Available Cell Rate
AvCR_mT	Available Cell Rate Minimum Threshold
AvCR_PM	Available Cell Rate Proportional Multiplier
CAC	Connection Admission Control
DBR	Domain-Based Rerouting
GCAC	Generic Connection Admission Control
GETS	Government Emergency Telecommunications Service
HPOC	High Probability of Completion
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union – Telecom Standardization
LGN	Logical Group Node
MLPP	Multilevel Precedence and Preemption
PNNI	Private Network-Network Interface
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Connection
PVCC	Permanent Virtual Channel Connection
PVPC	Permanent Virtual Path Connection
PVP	Permanent Virtual Path
RAIG	Resource Availability Information Group
SPVC	Soft PVC
SPVP	Soft PVP
SVC	Switched Virtual Connection
SVCC	Switched Virtual Channel Connection
TLV	Type, Length, Value
UNI	User-Network Interface
VCC	Virtual Channel Connection
VCI	Virtual Connection Identifier
VPC	Virtual Path Connection
VPCI	Virtual Path Connection Identifier
VPI	Virtual Path Identifier

4 Overview of Operation

[Informative]

The HPOC feature defines two types of service: resource access and preemption. The resource access service reserves bandwidth for connections requesting this service. The preemption service allows a connection to preempt other connections in order to free up resources needed for the connection. A connection can request both resource access and preemption. Connections not using the HPOC feature are referred to as non-priority connections.

4.1 HPOC Resource Management

4.1.1 Resource Reservation for the Resource Access Service

The network may reserve resources in order to provide some assurance that priority connection requests will be completed. Connections with access to these reserved resources are referred to as *connections with resource access*. The amount of resources reserved for the resource access service is a network-specific option.

When Connection Admission Control is determining whether to accept a connection with resource access, it considers the amount of bandwidth available for all connections, plus the reserved bandwidth available for connections with resource access on a per-service category basis.

When a connection is accepted, bandwidth allocation should first be taken from the bandwidth available to the specified service category for all call requests. If this available bandwidth is not sufficient to support the connection, then the excess amount should be taken from the bandwidth reserved for resource access services. This method of resource allocation treats a connection with resource access as any other connection, if possible, and only allocates reserved resources when necessary.

4.1.2 Resources Available for Preemption

The network may allow a connection request to preempt established connections in the network in order to free up the resources necessary to complete the connection request. Connections with the ability to preempt other connections are referred to as *connections with preemption.*

When Connection Admission Control is determining whether to accept a connection with preemption, it first considers the resources available without consideration for preemptable resources. If sufficient resources are available, the connection is processed without considering the preemption request. If resource access has been requested, these resources are considered prior to checking for available preemptable resources.

If sufficient resources are not available, then the network must determine if sufficient resources can be freed. The network considers two parameters when making this decision: the service domain and the preemption level.

The service domain limits the scope of preemptable connections to cooperating users. This prevents a connection from preempting random connections in the network. A connection may only preempt connections within the same service domain.

The preemption level determines a connection’s ability to preempt other connections in the same service domain. A connection may only preempt connections with a lower preemption level. The

terms “lower preemption level” and “higher preemption level” refer to the priority of a connection relative to other connections, and not to the encoded value. The values used to represent the preemption priority assign a value of 0 as the highest level.

4.2 Signaling

Support for the HPOC service requires the following functions:

1. Service authentication and authorization,
2. Mapping of service parameters at administrative boundaries,
3. CAC (see section 4.1), and
4. Preemption.

Functions (1) and (4) are described below.

4.2.1 HPOC Service Authentication and Authorization

Networks will determine what level of HPOC services to apply when the first signaling message for a connection arrives at the network administrative boundary. The service request must be authenticated and authorized as follows:

1) Authentication: The network must authenticate the identity of the user requesting the service. The network must also verify that the service domain provided in the SETUP message (when requesting preemption) is an allowed service domain for the requesting user. If the network is unable to authenticate the request, the call shall be cleared. The mechanisms for performing authentication are beyond the scope of this document.

2) Authorization: At a minimum, the network must validate that the requested level is within the subscribed limits for the user. If the user is not authorized at the requested level, the network may change the requested level to an appropriate level for which the user is authorized. The traffic and QoS requirements of the call may be taken into account as part of the validation process. The mechanisms for performing authorization are beyond the scope of this document.

4.2.2 Preempting Connections

During the processing of a priority connection, CAC may determine that there are not sufficient resources available to satisfy the connection request. If preemption is requested, then the node must attempt to free up resources by preempting already established connections.

Not all connections are eligible to be preempted by the current connection request. Identifying candidate connections requires comparison of the preemption proprieties of the requesting connection with the already-established connections. A candidate connection is one that meets the following conditions:

1) Belongs to the same service domain
2) Has a lower preemption level
3) For point-to-point calls, the called party subscribes to the preemption service

A connection that does not meet these three conditions cannot be preempted.

After identifying candidate connections the node must determine if sufficient resources can be freed by preempting some or all of the candidate connections. If sufficient resources would not be made available by preempting all of the candidate connections, the preempting connection request is released.

Implementations may choose to limit the number of connections that can be preempted by any single connection request. The number of candidate connections may be limited by factors such as:

- a node or network-specified maximum value for the number of connections that can be preempted by a call at a given preemption level,
- constraining the preemption level according to the amount of bandwidth requested during authorization.

If the set of candidate connections represents sufficient resources to proceed with the preempting connection request, then the node must select the connection(s) to be preempted. The algorithm for selecting the connection(s) to be preempted from the set of candidates is implementation-dependent.

Connections identified for preemption are released. The cause code used at the interface where the preemption occurred indicates that the connection is being preempted and that the resources may be reserved. The cause code in clearing the connection beyond the interface where the preemption occurred indicates that the connection was preempted, but that the associated resources are not to be reserved.

When a node receives a RELEASE message with an indication of preemption specifying that resources are to be reserved, the node will continue to progress the release indication with an indication that resources should not be reserved (beyond this interface). It then releases the association between the resources of the preempted connection and the connection identifier.

The resources from the preempted connection may be reserved for connections requesting preemption arriving over the same interface. These resources will remain reserved for a limited time (controlled by a timer) after the connection has been preempted. After the specified amount of time has expired, the resources will be returned for general use. Support for bandwidth reservation for preempting connections is optional.

When a node receives a RELEASE message with an indication of preemption without an indication that resources are to be reserved (indicating that the preemption occurred beyond this interface), it will follow normal message processing procedures and the resources will be returned for general use.

These procedures are performed at both the preceding and succeeding side for the preempting call. Typically, if sufficient bandwidth is available at the preceding side, sufficient bandwidth will be available at the succeeding side. Performing these procedures at the succeeding side is necessary in case the two sides use different algorithms to determine the amount of capacity allocated to a link.

When the connection request reaches the called party, the network side of the destination UNI must check to determine if the called party subscribes to the preemption service. If the called

party subscribes to preemption, or if this is a point-to-multipoint connection, then the network side of the destination UNI will indicate the preemption service in the CONNECT message.

If the called party does not subscribe to preemption and this is a point-to-point call, the network side of the destination UNI will not indicate the preemption service in the CONNECT message. This connection cannot be preempted by another connection regardless of the priority of the preempting connection.

4.3 Routing

PNNI resource availability advertisements must include sufficient information to determine if an HPOC call has a reasonable chance of being completed through the network. As with other PNNI call requests, it is not possible to guarantee (during path selection) that a call request will complete. Information about the current state of the network may not yet have been reflected in the routing advertisements, due to either advertisement latency or significant change rules, or may be hidden due to topology aggregation.

The HPOC service provides resources beyond what is accessible to non-HPOC connection requests. In order to satisfy an HPOC request, the network must have information about the amount of resources available to HPOC users. This is accomplished by defining new PNNI information groups for HPOC services.

4.3.1 Advertising HPOC resources

The resources available to HPOC services must be advertised so that GCAC can determine which links and nodes are likely to have sufficient resources available to carry a given HPOC connection. In the case of Preemption services, resources are advertised on a per–preemption level basis.

HPOC resources are advertised within the Resource Availability Information Group (RAIG). In addition to the resources available to non-priority connections, the resources available to HPOC connections are also advertised. The advertisement will consider all bandwidth available to the advertised service.

The available resources are advertised for each combination of Resource Access, Service Domain and Priority level, and for Resource Access without preemption. Preemption levels need not be explicitly advertised when resource availability is not significantly different from lower levels.

Normal rules regarding significant change are applied separately to each advertised available cell rate value. Note that for preemptive bandwidth, the establishment of the first and subsequent connections within a preemptive service domain is only considered significant if the associated bandwidth crosses the threshold for advertising available bandwidth. If the change in the available cell rate does not cross a threshold, then it will not trigger an advertisement.

Unsupported combinations do not need to be advertised. For example, if it is known that all connection requests at a given priority level will request access to reserved bandwidth, then there is no need to advertise available resources for that preemption level without resource access.

4.3.2 Path Computation

The goal of the HPOC path computation process is to minimize the impact on the network by calls requesting HPOC service. To achieve this goal, the network will attempt to use non-priority resources whenever possible, using preemption only as a last resort.

The path computation process will consider available resources based upon the following information from the call establishment message:

a) HPOC Preemption Service Domain and level,
b) HPOC Resource Access Service (none, requested).

Path computation is performed using a three-step process: Step 1) consider only non-HPOC bandwidth; Step 2) consider reserved bandwidth, if requested; and Step 3) consider preemptable bandwidth, if requested.

The first step in the path computation process considers only normal resource advertisements, without consideration for reserved bandwidth or preemptable bandwidth. Avoiding the use of the reserved bandwidth helps to maximize the amount of reserved bandwidth available in the network for use when it is needed during high-utilization periods. Avoiding the use of preemptable bandwidth prevents the unnecessary preemption of existing calls.

The second step in the path computation process considers paths with reserved bandwidth. If a link does not advertise reserved bandwidth, then normal advertisements are used.

The third step in the path computation process considers paths with preemption resources for the specified service domain. There may be two advertisements for preemptable bandwidth: with and without reserved bandwidth. The appropriate advertisement is chosen based upon whether the connection is requesting to use reserved bandwidth.

5 Coding Requirements

[Normative]

5.1 Priority Services Information Element

The Priority services information element shall be coded as shown in Figure 5-1.

Bits 8	7	6	5	4	3	2	1	Octets
Priority Services Information Element identifier								
1	1	1	1	0	1	1	1	1
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Pass along Information Element Action Indicator				2
Length of Priority Services information element contents								3
Length of Priority Services information element contents (continued)								4
See af-cs-0182.00 for the definition of this octet group								5*
Resource Access indicator								6* (Note 1,2,3)
0	0	0	0	0	0	1	0	
Preemption identifier								7* (Note 1,2)
0	0	0	0	0	0	1	1	
Spare						Preemption Level		7.1*
Most significant bit								7.2*
								7.3*
Service Domain								7.4*
								7.5*
							Lease significant bit	7.6*

Note 1- Although octet groups 6 and 7 are optional within the context of the information element, at least one of these octet groups must be present within the context of this specification.

Note 2 – If either or both octet group 6 or 7 are present, then no other octet groups shall be present.

Note 3 – Only included in SETUP and MODIFY messages.

Figure 5-1 Priority services information element

Coding standard (octet 2)

Bits	Meaning
7 6	
1 1	ATM Forum specific

Flag (octet 2)

Bits	Meaning
5	
1	Follow explicit instructions

Pass Along (octet 2)

Bits	Meaning
4	
1	Pass-along request

Note: The Pass Along bit is used in PNNI and AINI messages only.

IE action indicator (octet 2)

Bits	Meaning
3 2 1	
0 0 1	Discard information element and proceed
0 1 0	Discard information element, proceed, and report status

Resource access indicator (Octet 6)

If this octet group is present, the call is requesting access to reserved resources.

Preemption Level (Octet 7.2)

The preemption level defines a relative priority, and is used to determine a call's eligibility for preemption. A call may only be preempted by another call with a higher preemption level. The preemption level for a given point-to-point or point-to-multipoint call is indicated in the first signalling message for that call (e.g. SETUP message) and in the CONNECT message for that call. Absence of the information element in the CONNECT message for a point-to-point call is an indication that the called party, or a transit network, does not subscribe to preemption services.

Three binary coded bits indicating the preemption level are coded as follows:

Bits 3 2 1	Meaning
0 0 0	Level 1 (highest priority)
0 0 1	Level 2
0 1 0	Level 3
0 1 1	Level 4
1 0 0	Level 5
1 0 1	Level 6
1 1 0	Level 7
1 1 1	Level 8 (lowest priority)

Service Domain (Octet 7.3 – 7.7)

The Service Domain for a given point-to-point or point-to-multipoint call is indicated in the first signalling message for that call (e.g. SETUP message) and in the CONNECT message for that call. The Service Domain is used by the preemption service to restrict preemption to calls that belong to the same domain.

An implementation of the HPOC capability that supports only one of the Resource Access or Preemption services shall treat both octet 6 and octet group 7 as recognized content.

If this information element is received with unrecognized content, or the information element exceeds its maximum length, it shall be treated as an unrecognized information element.

5.2 Priority Information Element

Refer to section 8.2.1/Q.2959.

6 UNI Support of High Probability of Completion

[Normative]

6.1 Additions to UNI Signalling Messages

6.1.1 Basic Point-to-Point Call at the UNI

Add the following to section 2.0/UNI 4.1 Basic point-to-point call:

3.1.7/Q.2931 SETUP:

Add the following to Table 3-8/Q.2931:

Information Element name	Reference	Direction	Type	Length
Priority services	Section 5.1	both	O (Note 1)	7-12
Priority	8.2.1/Q.2959	both	O	10

Note 1: This information element may occur up to 5 times. At most one instance may contain an HPOC identifier.

3.1.3/Q.2931 CONNECT:

Add the following to Table 3-4/Q.2931:

Information Element name	Reference	Direction	Type	Length
Priority services	Section 5.1	both	O (Note 1)	11

Note 1: This information element may occur up to 5 times. At most one instance may contain an HPOC identifier.

4.5.1/Q.2931 Coding Rules

Add the following to Table 2-1/UNI 4.1:

Bits		Information Element	Max Length	Min Length	Max no of Occurrences	Reference
8 7 6 5	4 3 2 1					
1 1 1 1	0 1 1 1	Priority services	12	7	5	5.1
1 0 0 0	1 0 0 0	Priority	10	10	1	8.2.1/Q.2959

6.1.2 Point-to-Multipoint calls at the UNI

Add the following to section 5/UNI 4.1 Point-to-Multipoint Calls:

8.2/Q.2971 ADD PARTY:

Add the following to Table 8-10/Q.2971:

Information Element name	Reference	Direction	Type	Length
Priority services	Section 5.1	both	O (Note 1)	7-12
Priority	8.2.1/Q.2959	both	O	10

Note 1: This information element may occur up to 5 times. At most one instance may contain an HPOC identifier.

8.2/Q.2971 ADD PARTY ACKNOWLEDGE:

Add the following to Table 8-11/Q.2971:

Information Element name	Reference	Direction	Type	Length
Priority services	Section 5.1	both	O (Note 1)	11

Note 1: This information element may occur up to 5 times. At most one instance may contain an HPOC identifier.

6.2 Signalling Procedures for High Probability of Completion

The procedures for basic call control in section 2/SIG 4.1 and section 5/SIG 4.1 shall apply. This section contains additional procedures related to the handling of the Priority services information element with High Probability of Completion.

The following procedures also provide, as an option, the mechanism to transport a user-provided Q.2959-specified Priority information element transparently across networks. If these procedures are used with af-cs-0182.000, only one instance of the Q.2959 priority information element will be transported.

Access to the High Probability of Completion (HPOC) service is by subscription only. Only users who have subscribed to this service will be allowed to request HPOC services.

6.2.1 Procedures at the Originating UNI interface

6.2.1.1 Procedures at the User Side

6.2.1.1.1 Procedures at the S_B and Coincident S_B and T_B Reference Points

A calling user not requesting High Probability of completion services shall not include the Priority Services information element with either the Resource access indicator or the Preemption identifier present.

A calling user requesting High Probability of Completion services shall include a Priority Services information element with either the Resource access indicator or the Preemption identifier, or both, as defined in section 5.1 in the SETUP message sent to the network. The allowable range of the Preemption priority values may be limited based upon user subscription.

In addition, the calling user may include a Q.2959 Priority information element as defined in section 2.2 in the SETUP message sent to the network.

6.2.1.1.1.1 Processing of Resource Access

While it is mandatory for a user-side implementation of the Resource Access capability to support origination of calls indicating Resource Access, the capability for the user side itself to reserve resources at the originating interface is optional.

The user side shall determine if it has sufficient resources to progress the call using normal connection admission control procedures, considering only bandwidth that has not been reserved for Resource Access services.

If sufficient resources can be identified, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available, and the setup request included a negotiation request, the user side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The user side shall then determine if it has sufficient resources to progress the call, including resources reserved for HPOC services. If sufficient resources can be identified, normal call processing procedures shall be used. The resources allocated to the call shall first be taken from

the resources available to all connections, and then the excess amount shall be taken from the resources available for the Resource Access service.

If the user side cannot identify sufficient resources to complete the call, it shall not proceed and the application shall be notified.

6.2.1.1.1.2 Processing of Preemption

While it is mandatory for a user side implementation of the Preemption capability to support origination of calls indicating Preemption, the capability for the user side itself to preempt calls at the originating interface is optional.

If the setup request includes the Resource Access indication, the procedures for the Resource Access service in section 6.2.1.1.1.1 shall be followed prior to processing of the Preemption Service.

The user side shall determine if it has sufficient resources to progress the call using normal connection admission control procedures. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available and preemption is being requested, the user side shall then determine if it can release sufficient resources to accept the call. If negotiation is being requested, the user side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

If the user side cannot identify sufficient resources to complete the call, it shall not proceed and the application shall be notified.

If the user side has identified calls that need to be preempted to complete the call, it shall issue a RELEASE message for each call being preempted, with cause code #9 *"preemption-circuit reserved for reuse"*. The user-side shall then progress the SETUP message to the network side.

Upon receipt of the CONNECT message, the user side shall check for the presence of the Priority services information element with preemption. It shall take action as follows:

- If this information element is present, this call shall remain preemptable
- If this information element is not present, this call shall become ineligible for preemption.

6.2.1.1.1.3 Preemption of Calls in Progress

The ability to preempt a call in progress (a CONNECT message has not been received) shall follow the same procedures as an already-established connection. The preemption information specified in the SETUP message shall be used to determine a call's eligibility to preempt another call..

If a call in progress is preempted, the call shall be cleared towards the calling party with cause code *#8, "preemption"* and shall be cleared towards the called party with cause code *#41, "temporary failure"*.

When a call in progress is cleared, it is not yet known whether the called party supports preemption. If the called party does not support preemption, it would be inappropriate to send a cause code #8. Instead, cause code #41 is sent to indicate that the call was cleared due to other than normal circumstances.

6.2.1.1.2 Procedures at the T_B Reference Points

The procedures of section 6.2.2.1 shall apply, changing "network" to "user", except for the terms "network-specific" and "network-generated", which shall remain unchanged.

6.2.1.2 Procedures at the Network Side

The following applies for all procedures in this section:

- If the Resource Access indicator or the Preemption octet group is removed, and after processing neither of these is present, then no instance of the Priority services information element with Resource Access or Preemption shall be present.

- If either of these are added during processing:

    - If a Priority services information element already exists, containing one of these, the indictor or octet group shall be added to the existing instance of the Priority services information element with Resource Access or Preemption.

    - Otherwise, create a new instance of the Priority services information element including the indicator or octet group.

6.2.1.2.1 Nodes not supporting Resource Access

If the network side supports High Probability of Completion but does not support the Resource Access service, and it receives a SETUP message with a Resource Access indication, then this indication shall be removed from the Priority Services information element.

6.2.1.2.2 Nodes not supporting Preemption

If the network side supports High Probability of Completion but does not support the preemption service, and it receives a SETUP message with the Preemption octet group, then this octet group shall be removed from the Priority Services information element.

6.2.1.2.3 Service Validation for Resource Access

The Resource Access service is a subscription-based service. Only users who have subscribed to this service may include the Priority Services information element with the Resource Access indication.

If the network side receives a SETUP message containing a Priority services information element with Resource Access, the following procedures shall apply:

- If the interface is not provisioned for the Resource Access service, remove the Resource Access indication from the Priority services information element.

- If the interface is provisioned for the Resource Access service, authenticate the service request by verifying that the requesting user is subscribed to the Resource Access service. If the authentication is rejected, the network shall release the call with cause code #50 "Requested facility not subscribed".

If the network receives a SETUP message for a call that does not contain a Priority services information element with a Resource Access, the following procedures shall apply:

- If the user does not subscribe to Resource Access, then no further action is taken
- If the user subscribes to Resource Access services, the network side shall either include a Priority Services information element with Resource Access or do nothing, based on subscription.

6.2.1.2.4 Service Validation for Preemption

The Preemption service is a subscription-based service. Only users who have subscribed to this service may include the Priority Services information element with preemption.

If the network side receives a SETUP message containing a Q.2959 Priority information element and there is not a Priority services information element with preemption present, then the network side shall take one of the following actions:

- Do nothing,
- Map the domain and priority from the Q.2959 Priority information element to the service domain and preemption level in a new preemption octet group in the Priority services information element, and apply the remaining procedures in this section as if the network side received a SETUP message containing a Priority services information element with preemption.

If the network side receives a SETUP message containing a Priority services information element with preemption, the following procedures shall apply:

- If the interface is not provisioned for the Preemption service, remove the preemption octet group from the Priority services information element.
- If the interface is provisioned for the Preemption service, authenticate the service request as follows:
  - Verify that the requesting user is subscribed to the preemption service, and
  - The user belongs to the indicated service domain.

  If the authentication is rejected, the network shall release the call with cause code #50 "Requested facility not subscribed".

  The service domain may be mapped from the requested service domain to a service domain supported by the network prior to authentication. The priority level may be mapped from the requested priority level to a new priority level prior to authentication.

If the received HPOC preemption level in the Priority services information element with preemption exceeds the user's highest allowed HPOC preemption level, the preemption level shall be changed to the user's highest allowed preemption level.

If the network receives a SETUP message for a call that does not contain a Priority services information element with preemption, the following procedures shall apply:

- If the user subscribes to Preemption services, the network side shall do one of the following, based upon subscription:
    - Do nothing, or
    - Include a Priority Services information element with the preemption octet group, setting the domain field to a subscribed domain and the priority level to the subscribed default level.

6.2.1.2.5 Processing of Resource Access

When referring to the contents of the SETUP message in this section, the refererence is to the contents of the SETUP message resulting from the validation procedures.

The network side shall determine if it has sufficient resources to accept the call using normal connection admission control procedures, considering only bandwidth that has not been reserved for Resource Access services.

If sufficient resources can be identified, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available, and the SETUP message includes a negotiation request, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The network side shall then determine if it has sufficient resources to accept the call, including resources reserved for HPOC services. If sufficient resources can be identified, normal call processing procedures shall be used. The resources allocated to the call shall first be taken from the resources available to all connections, and then the excess amount shall be taken from the resources available for the Resource Access service.

If the network side cannot identify sufficient resources to complete the call, it shall send a RELEASE or RELEASE COMPLETE message with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

6.2.1.2.6 Processing of Preemption

When referring to the contents of the SETUP message in this section, the reference is to the contents of the SETUP message resulting from the validation procedures.

If the network receives a Priority services information element with a Resource Access indication, the procedures for the Resource Access service in section 6.2.1.2.5 shall be followed prior to processing of the Preemption Service.

If the network receives a SETUP message containing a Q.2959 Priority information element and the network supports transport of the Q.2959 Priority information element, then if the call is progressed, the network shall include the received Priority information element in the forwarded setup indication without any alterations.

If the SETUP message does not contain the Priority services information element with the Preemption octet group, the remaining procedures in this section shall not apply.

The network side shall determine if it has sufficient resources to accept the call using normal connection admission control procedures.

If sufficient resources can be identified, the call shall progress without consideration for preemption services and the remaining procedures in this section shall not apply.

If sufficient resources cannot be identified, and the SETUP message includes a negotiation request, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The network side shall then determine if it can release sufficient resources to accept the call.

If the network side cannot identify sufficient resources to complete the call, it shall send a RELEASE complete message with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

If the network side has identified calls that need to be preempted to complete the call, it shall issue a RELEASE message for each call being preempted with cause code #8 "*preemption*". The network side shall continue to progress the SETUP message for the preempting call towards the called party.

Upon receipt of a connect indication, the network side shall check for the presence of the Priority services information element with preemption. It shall take action as follows:

- If this information element is present, it shall be included in the forwarded CONNECT message. If the service domain or preemption level in the connect indication is different from the SETUP message, the service domain and preemption level shall be set to the values indicated in the SETUP message.
- If this information element is not present, the network side shall remove the association of Preemption service from this call. This call shall become ineligible for preemption.

6.2.1.2.7 Preemption of Calls in Progress

The ability to preempt a call in progress (a connect request has not been received) shall follow the same procedures as an already established connection. The preemption information specified in the SETUP message shall be used to determine eligibility.

If a call in progress is preempted, the call shall be cleared towards the calling party with cause code *#8, "preemption"* and shall be cleared towards the called party with cause code *#41, "temporary failure"*.

When a call in progress is cleared, it is not yet known whether the called party supports preemption. If the called party does not support preemption, it would be inappropriate to send a cause code #8. Instead, cause code #41 is sent to indicate that the call was cleared due to other than normal circumstances.

6.2.2 Procedures at the Destination UNI

6.2.2.1 Procedures at the Network Side

The following applies for all procedures in this section.

- If the Resource Access indicator or the Preemption octet group is removed, and after processing neither of these is present, then no instance of the Priority services information element with Resource Access or Preemption shall be present.

- If either of these are added during processing:

    - If a Priority services information element already exists containing one of these, the indictor or octet group shall be added to the existing instance of the Priority services information element with Resource Access or Preemption.

    - Otherwise, create a new instance of the Priority services information element, including the indicator or octet group.

6.2.2.1.1 Service Validation for Resource Access

Upon receipt of a setup request containing the Priority Services information element with Resource Access, the following procedures shall apply:

- If the interface is not provisioned for Resource Access, or the called user does not subscribe to Resource Access, the Resource Access indication shall be removed from the forwarded SETUP message.
- If the called user subscribes to the Resource Access service, the Priority Services information element with Resource Access shall be included in the forwarded SETUP message.

6.2.2.1.2 Service Validation for Preemption

Upon receipt of a setup request containing the Priority Services information element with preemption, the following procedures shall apply:

- If the interface is not provisioned for preemption, the called user does not subscribe to preemption, or the called user is not in the same service domain, the Preemption octet group shall be removed from the forwarded SETUP message.
- If the called user subscribes to the Preemption service and is a member of the indicated domain, the Priority Services information element with preemption shall be included in the forwarded SETUP message.

6.2.2.1.3 Processing of Resource Access

When referring to the contents of the forwarded SETUP message in this section, the refererence is to the contents of the forwarded SETUP message resulting from the validation procedures.

If the Priority Services information element with Resource Access is not included in the forwarded SETUP message, normal call processing procedures shall be used.

If the Priority Services information element with Resource Access is included in the forwarded SETUP message, the network side shall determine if it has sufficient resources to accept the call, using normal connection admission control procedures, considering only bandwidth that has not been reserved for Resource Access services.

If sufficient resources are not available, and negotiation is requested, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The network side shall then determine if it has sufficient resources to accept the call, including resources reserved for Resource Access services. If sufficient resources can be identified, the call shall be progressed. The resources allocated to the call shall first be taken from the resources available to all connections, and then the excess amount shall be taken from the resources available for the Resource Access service.

If the network side cannot identify sufficient resources to complete the call, it shall clear the call with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

6.2.2.1.4 Processing of Preemption

When referring to the contents of the forwarded SETUP message in this section, the refererence is to the contents of the forwarded SETUP message resulting from the validation procedures.

If the setup request includes a Priority services information element with a Resource Access indication, the procedures for the Resource Access service in section 6.2.2.1.3 shall be followed prior to processing of the Preemption Service.

If the Priority Services information element with Preemption is not included in the forwarded SETUP message, normal call processing procedures shall be used. The remaining procedures in this section do not apply.

If the Priority Services information element with Preemption is included in the forwarded SETUP message, the network shall determine if it has sufficient resources to accept the call, using normal connection admission control procedures. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available and negotiation is requested, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The network side shall then determine if it can release sufficient resources to accept the call.

If the network side has identified calls that need to be preempted to complete the call, for each call being preempted, it shall issue a RELEASE message towards the user side with cause code #9 *"preemption-circuit reserved for reuse"*, and shall issue a release request with cause #8 "*preemption*" in the opposite direction. The network side shall then continue to progress the SETUP message for the preempting call towards the called party.

If the network cannot identify sufficient resources to complete the call request, the call shall be cleared with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

Prior to progressing the SETUP message, the network side may map the service domain and preemption level on behalf of the next routing domain.

If the network side receives a setup request containing a Q.2959 Priority information element and the network supports transport of the Q.2959 Priority information element, then if the call is progressed, the network shall include the received Priority information element in the forwarded SETUP message without any alterations.

If the Priority services information element with Preemption was present in the forwarded SETUP message, then upon receipt of a CONNECT message, the network side shall check for the presence of the Priority Services Information element with preemption. If the CONNECT message does not include this information element, the network side shall add the information element to the CONNECT message using the values specified in the associated SETUP message. If the CONNECT message includes this information element, and the preemption level or Service domain is different from what was specified in the SETUP message, the preemption level shall be set to the preemption level and Service domain indicated in the SETUP message.

If the called user does not support preemption and receives a release request, with cause code *#8, "preemption"*, the cause code shall be changed to cause code *#41, "temporary failure"*.

6.2.2.1.5 Preemption of calls in Progress

If the destination UNI supports preemption, the ability to preempt a call in progress (a CONNECT message has not been received) shall follow the same procedures as an already-established connection. The preemption information specified in the SETUP message shall be used to determine eligibility.

If a call in progress is preempted, the call shall be cleared towards the calling party with cause code *#8, "preemption"*, and shall be cleared towards the called party with cause code *#41, "temporary failure"*.

When a call in progress is cleared, it is not yet known whether the called party supports preemption. If the called party does not support preemption, it would be inappropriate to send a cause code #8. Instead, cause code #41 is sent to indicate that the call was cleared due to other than normal circumstances.

6.2.2.2 Procedures at the User Side

6.2.2.2.1 Procedures at the S_B and Coincident S_B and T_B Reference Points

Upon receipt of the SETUP message containing the Priority services information element with either Resource Access or Preemption services, the called user shall determine if it has sufficient resources to accept the call, or in the case of preemption, if it can release sufficient resources to accept the call.

If the called user cannot identify sufficient resources to complete the call, it shall send a RELEASE COMPLETE message with an indication of the restricting resource.

In the case of preemption, if the called user can identify sufficient resources to complete the preempting call, it shall issue a RELEASE message for each call being preempted with cause code (8) preemption.

Upon transmission of the last RELEASE message, the called user shall send a CONNECT message for preempting call.

6.2.2.2.2 Procedures at the T_B Reference Point

The procedures of section 6.2.1.2 shall apply, changing "network" to "user", except for the terms "network-generated" and "network-specific", which shall remain unchanged.

Add the following statement at the end of the second paragraph:

The user may apply other criteria or checks of the received level, including any possible association with the originating user.

6.2.2.3 Releasing Preempted Calls

Upon receipt of a RELEASE message with cause code #8 *"preemption"*, the call shall be cleared.

Upon receipt of a RELEASE message with cause code #9 *"preemption-circuit reserved for reuse"*, the call shall be cleared. The forwarded RELEASE message shall indicate cause code #8 *"preemption"*.

The resources associated with the preempted call at the preempting interface may be reserved for a limited time (controlled by a timer) after the connection has been preempted. After the specified amount of time has expired, the resources will be returned for general use. Support for bandwidth reservation for preempting connections is optional.

6.3 Compatibility with Nodes Not Supporting This Feature

Upon receipt of a SETUP message containing the Priority services information element with either Resource Access or Preemption, nodes not supporting this feature will treat the Priority services information element with HPOC Priority as an unrecognized information element.

Nodes supporting the High Probability of Completion Priority capability shall set the IE instruction field in the Priority services information element with High Probability of Completion Priority as follows:

- The IE instruction flag field (bit 5 of octet 2) shall be set to "follow explicit instructions", and
- The action indicator (bits 1-3 of octet 2) shall be set to "discard information element and proceed" or "discard information element, proceed, and report status".

With these settings, nodes that do not support the High Probability of Completion Priority capability will treat the calls/connections that include the Priority services information element with High Probability of Completion Priority the same as any other calls/connections that do not include the Priority services information element with High Probability of Completion Priority.

7 PNNI Signalling Support of High Probability of Completion

[Normative]

7.1 Additions to PNNI Signalling Messages

In section 6.4.5.1/PNNI 1.1, add the following to Table 6-5:

Bits		Information Element	Max Length	Min Length	Max no of Occurrences	Reference
8 7 6 5	4 3 2 1					
1 1 1 1	0 1 1 1	Priority services	12	7	5	5.1
1 0 0 0	1 0 0 0	Priority	10	10	1	8.2.1/Q.2959

7.1.1 SETUP

The following information elements are added to Figure 6-8 in 6.3.1.6/PNNI 1.1:

Information Element	Reference	Type	Length
Priority services	Section 5.1	O (Note)	7-12
Priority	8.2.1/Q.2959	O	10

Note: This information element may occur up to 5 times. At most one instance may contain a HPOC Resource Access or Preemption identifier.

7.1.2 CONNECT

The following information elements are added to Figure 6-5 in 6.3.1.3/PNNI 1.1:

Information Element	Reference	Type	Length
Priority services	Section 5.1	O (Note)	11

Note: This information element may occur up to 5 times. At most one instance may contain a HPOC Resource Access or Preemption identifier.

7.1.3 ADD PARTY

The following information elements are added to Figure 6-19 in 6.3.4.1/PNNI 1.1:

Information Element	Reference	Type	Length
Priority services	Section 5.1	O (Note)	7-12
Priority	8.2.1/Q.2959	O	10

Note: This information element may occur up to 5 times. At most one instance may contain a HPOC Resource Access or Preemption identifier.

7.1.4 ADD PARTY ACKNOWLEDGE

The following information elements are added to Figure 6-20 in 6.3.4.2/PNNI 1.1:

Information Element	Reference	Type	Length
Priority services	Section 5.1	O (Note)	11

Note: This information element may occur up to 5 times. At most one instance may contain a HPOC Resource Access or Preemption identifier.

7.2 Signalling Procedures for High Probability of Completion for PNNI

The procedures for basic call control in section 6.5/PNNI 1.1 and section 6.6/PNNI 1.1 shall apply. This section describes additional procedures to handle calls/connections that specify a Priority services information element with High Probability of Completion and procedures to transport the Q.2959 Priority information element end-to-end.

7.2.1 High Probability of Completion Feature for Intra-Domain PNNI

7.2.1.1 Preceding Side

If the preceding side receives a setup request containing a Priority services information element with High Probability of Completion, then if the call is progressed, the preceding side shall include the received Priority services information element with High Probability of Completion in the forwarded message.

If the preceding side receives a setup request containing a Q.2959 Priority information element and the preceding side supports transport of the Q.2959 Priority information element, then if the call is progressed, the preceding side shall include the received Priority information element in the forwarded message without any alteration.

7.2.1.1.1 Processing of Resource Access

Upon receipt of a setup request containing the Priority services information element with Resource Access, the preceding side shall determine if it has sufficient resources to accept the call using normal connection admission control procedures, considering only bandwidth that has not been reserved for HPOC services. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available and the SETUP request included a negotiation request, the preceding side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The preceding side shall then determine if it has sufficient resources to accept the call, including resources reserved for Resource Access service. If sufficient resources can be identified, the call shall be progressed. The resources allocated to the call shall first be taken from the resources available to all connections, and then the excess amount shall be taken from the resources available for the Resource Access service.

If the preceding side is unable to identify sufficient resources, it shall clear the call with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

7.2.1.1.2 Processing of Preemption

If the setup request includes the Resource Access indication, the procedures for the Resource Access service in section 7.2.1.1.1 shall be followed prior to processing of the Preemption Service.

Upon receipt of a setup request containing the Priority services information element with preemption, the preceding side shall determine if it has sufficient resources to accept the call, using normal connection admission control procedures. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available, and the SETUP message included a negotiation request, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The preceding side shall then determine if it can release sufficient resources to accept the call.

If the preceding side is unable to identify sufficient resources, it shall clear the call with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

If the preceding side can identify sufficient resources, it shall release the identified calls as follows:

- A RELEASE message will be sent to the succeeding side (relative to the preempting call) with a cause code #9 *"preemption-circuit reserved for reuse"*.
- A release indication shall be sent in the opposite direction with a cause code #8 *"preemption"*.
- The preceding side shall re-assign the necessary resources to the preempting call. Resources not required by the preempting call shall be released.

The preceding side shall progress the preempting call using normal call processing procedures.

Upon receipt of the CONNECT message, the preceding side shall check for the presence of the Priority services information element with preemption. It shall take action as follows:

- If this information element is present, it will be included in the forwarded CONNECT message. If the preemption level or service domain in the CONNECT message is different from the preemption level or service domain specified in the SETUP message, the preemption level and service domain shall be set to the values indicated in the SETUP message.
- If this information element is not present, the preceding side shall remove the association of Preemption service from this call. This call will then become ineligible for preemption.

7.2.1.2 Succeeding Side

If the succeeding side receives a SETUP message containing a Priority services information element with High Probability of Completion, then if the call is progressed, the succeeding side shall include the received Priority services information element with High Probability of Completion in the forwarded message.

If the succeeding side receives a SETUP message containing a Q.2959 Priority information element and transport of the Q.2959 Priority information element is supported, and if the call is progressed, the succeeding side shall include the received Priority information element in the forwarded setup indication without any alterations.

7.2.1.2.1 Processing of Resource Access

Upon receipt of a SETUP message containing the Priority services information element with Resource Access indication, the succeeding side shall determine if it has sufficient resources to accept the call, using normal connection admission control procedures, considering only bandwidth that has not been reserved for Resource Access services. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available and the SETUP message includes a negotiation request, the network side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The succeeding side shall then determine if it has sufficient resources to accept the call, including resources reserved for HPOC services. If sufficient resources can be identified, normal call processing procedures shall be used. The resources allocated to the call shall first be taken from the resources available to all connections, and then the excess amount shall be taken from the resources available for the Resource Access service.

If the preceding side is unable to identify sufficient resources, it shall clear the call with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

7.2.1.2.2 Processing of Preemption

If the succeeding side receives a Priority services information element with a Resource Access indication, the procedures for the Resource Access service in section 7.2.1.2.1 shall be followed prior to processing of the Preemption Service

If the SETUP message does not contain the Priority services information element with the Preemption octet group, the remaining procedures in this section shall not apply.

Upon receipt of a SETUP message containing the Priority services information element with preemption, the succeeding side shall determine if it has sufficient resources to accept the call, using normal connection admission control procedures. If sufficient resources are available, the call shall be progressed and the remaining procedures in this section shall not apply.

If sufficient resources are not available and the SETUP message includes a negotiation request, the succeeding side shall immediately negotiate down to the minimum requested bandwidth before proceeding.

The succeeding side shall then determine if it can release sufficient resources to accept the call.

If the succeeding side is unable to identify sufficient resources, it shall clear the call with cause:

#45 no VPCI/VCI available;
#47 resources unavailable, unspecified;
or
#51 user cell rate not available.

If sufficient preemptable resources can be identified by the succeeding side, it shall release the identified preemptable calls as follows:

- A RELEASE message will be sent to the preceding side (relative to the preempting call) with cause code #8 *"preemption"*.
- A RELEASE message will be sent in the opposite direction with cause code #8 *"preemption"*.

After transmission of the last RELEASE message, the succeeding side shall progress the preempting call.

Upon receipt of the connect indication, the succeeding side shall check for the presence of the Priority services information element with preemption. It shall take action as follows:

- If this information element is present, it shall be included in the forwarded CONNECT message. If the service domain or preemption level in the connect indication is different from the SETUP message, the service domain and preemption level shall be set to the values indicated in the SETUP message.
- If this information element is not present, the succeeding side shall remove the association of Preemption service from this call. This call shall then become ineligible for preemption.

7.2.1.3 Releasing Preempted Calls

Upon receipt of a RELEASE message with cause code #8 *"preemption"*, the call shall be cleared.

Upon receipt of a RELEASE message with cause code #9 *"preemption-circuit reserved for reuse"*, the call shall be cleared. The forwarded RELEASE message shall indicate cause code #8, *"preemption"*.

The resources associated with the preempted call may be reserved for a limited time (controlled by a timer) after the connection has been preempted. After the specified amount of time has expired, the resources will be returned for general use. Support for bandwidth reservation for preempting connections is optional.

7.2.1.4 Preemption of Calls in Progress

The ability to preempt a call in progress (a CONNECT message has not been received) shall follow the same procedures as an already-established connection. The preemption information specified in the SETUP message shall be used to determine eligibility.

If a call in progress is preempted, the call shall be cleared towards the calling party with cause code *#8, "preemption"*, and shall be cleared towards the called party with cause code *#41, "temporary failure"*.

When a call in progress is cleared, it is not yet known whether the called party supports preemption. If the called party does not support preemption, it would be inappropriate to send a cause code #8. Instead, cause code #41 is sent to indicate the call was cleared due to other than normal circumstances.

7.2.2 High Probability of Completion feature for Inter-Domain PNNI

7.2.2.1 Preceding Side

The following applies for all procedures in this section.

- If the Resource Access indicator or the Preemption octet group is removed, and after processing neither of these is present, then no instance of the Priority services information element with Resource Access or Preemption shall be present.

- If either of these are added during processing:

    - If a Priority services information element already exists, containing one of these, the indictor or octet group shall be added to the existing instance of the Priority services information element with Resource Access or Preemption.

    - Otherwise, create a new instance of the Priority services information element, including the indicator or octet group.

7.2.2.1.1 Service Validation for Resource Access

Upon receiving a setup request containing the Priority Services information element with Resource Access, the following procedures shall apply:

- If the interface is not provisioned for Resource Access, or the called user does not subscribe to Resource Access, the Resource Access indication shall be removed from the forwarded SETUP message.
- If the called user subscribes to the Resource Access service, the Priority Services information element with Resource Access shall be included in the forwarded SETUP message.

7.2.2.1.2 Service Validation for Preemption

Upon receiving a setup request containing the Priority Services information element with preemption, the following procedures shall apply:

- If the interface is not provisioned for preemption, the called user does not subscribe to preemption, or the called user is not in the same service domain, the Preemption octet group shall be removed from the forwarded SETUP message.
- If the called user subscribes to the Preemption service and is a member of the indicated domain, the Priority Services information element with preemption shall be included in the forwarded SETUP message.

7.2.2.1.3 Processing of Resource Access

When referring to the contents of the SETUP message in this section, the reference is to the contents of the SETUP message resulting from the validation procedures.

The call shall be progressed using the procedures in section 7.2.1.1.1.

7.2.2.1.4 Processing of Preemption

When referring to the contents of the SETUP message in this section, the reference is to the contents of the SETUP message resulting from the validation procedures.

The call shall be progressed using the procedures in section 7.2.1.1.2.

Prior to progressing the SETUP message, the preceding side may map the preemption level and service domain. The preceding side shall either:

- Progress the IE without changes, or
- Map the preemption level and service domain to an agreed-upon value for the inter-domain interface.

Upon receipt of a release request with cause code *#8, "preemption"*, with the Preemption octet group not included in the corresponding forwarded SETUP message, the cause code shall be changed to cause code *#41, "temporary failure"*.

7.2.2.2 Succeeding Side

The following applies for all procedures in this section.

- If the Resource Access indicator or the Preemption octet group is removed, and after processing neither of these is present, then no instance of the Priority services information element with Resource Access or Preemption shall be present.

- If either of these are added during processing:

    - If a Priority services information element already exists, containing the Resource Access indictor or the Preemption octet group, the indictor or octet group shall be added to the existing instance of the Priority services information element with Resource Access or Preemption.

    - Otherwise, create a new instance of the Priority services information element, including the indicator or octet group.

7.2.2.2.1 Nodes not supporting Resource Access

If the succeeding side supports High Probability of Completion but does not support the Resource Access service, and it receives a SETUP message with a Resource Access indication, then this indication shall be removed from the Priority Services information element.

7.2.2.2.2 Nodes not supporting Preemption

If the succeeding side supports High Probability of Completion but does not support the Preemption service, and it receives a SETUP message with the Preemption octet group, then this octet group shall be removed from the Priority Services information element.

7.2.2.2.3 Service Validation for Resource Access

The Resource Access service is a subscription-based service. Only users who have subscribed to this service may include the Priority Services information element with the Resource Access indication.

If the succeeding side receives a SETUP message containing a Priority services information element with Resource Access, the following procedures shall apply:

- If the interface is not provisioned for the Resource Access service, remove the Resource Access indication from the Priority services information element.
- If the interface is provisioned for the Resource Access service, authenticate the service request by verifying that the requesting user has subscribed to the Resource Access service. If the authentication is rejected, then the succeeding side shall release the call with cause code #50 “Requested facility not subscribed”.

If the succeeding side receives a SETUP message for a call that does not contain a Priority services information element with a Resource Access, the following procedures shall apply:

- If the user does not subscribe to Resource Access, then no further action is taken
- If the user subscribes to Resource Access services, the succeeding side shall either include a Priority Services information element with Resource Access or do nothing, based upon subscription.

7.2.2.2.4 Service Validation for Preemption

The Preemption service is a subscription-based service. Only users who have subscribed to this service may include the Priority Services information element with preemption.

If the succeeding side receives a SETUP message containing a Q.2959 Priority information element and there is not a Priority services information element with preemption present, then the succeeding side shall take one of the following actions:

- Do nothing,
- Map the domain and priority from the Q.2959 Priority information element to the service domain and preemption level in a new preemption octet group in the Priority services information element and apply the remaining procedures in this section as if the succeeding side received a SETUP message containing a Priority services information element with preemption.

If the succeeding side receives a SETUP message containing a Priority services information element with preemption, the following procedures shall apply:

- If the interface is not provisioned for the Preemption service, remove the preemption octet group from the Priority services information element.
- If the interface is provisioned for the Preemption service, authenticate the service request as follows:
  - The service domain may be mapped from the requested service domain to a service domain supported by the network prior to authentication. The priority level may be mapped from the requested priority level to a new priority level prior to authentication.
    - If the requested preemption service domain is recognized, map the preemption level and service domain to an agreed-upon value for the inter-domain interface.
    - If the requested preemption service domain is not recognized at the inter-domain interface, then the preemption indication shall be removed from the Priority Services information element.
  - Verify that the requesting user has subscribed to the preemption service, and
  - The user belongs to the indicated service domain.

  If the authentication is rejected, then the network shall release the call with cause code #50 "Requested facility not subscribed".

If the received HPOC preemption level in the Priority services information element with preemption exceeds the user's highest allowed HPOC preemption level, the preemption level shall be changed to the user's highest allowed preemption level.

If the succeeding side receives a SETUP message for a call that does not contain a Priority services information element with preemption, the following procedures shall apply:

- If the user subscribes to Preemption services, the succeeding side shall do one of the following, based upon subscription:
  - Do nothing, or
  - Include a Priority Services information element with the preemption octet group, setting the domain field to a subscribed domain and the priority level to the subscribed default level.

7.2.2.2.5 Processing of Resource Access

When referring to the contents of the SETUP message in this section, the reference is to the contents of the SETUP message resulting from the validation procedures.

The call shall be progressed using the procedures in section 7.2.1.2.1.

7.2.2.2.6 Processing of Preemption

When referring to the contents of the SETUP message in this section, the refererence is to the contents of the SETUP message resulting from the validation procedures.

The call shall be progressed using the procedures in section 7.2.1.2.2.

7.2.2.3 Releasing Preempted Calls

Upon receipt of a RELEASE message with cause code *#8 "preemption"*, the call shall be cleared.

Upon receipt of a RELEASE message with cause code *#9 "preemption-circuit reserved for reuse"*, the call shall be cleared. Upon receipt at the network side, the forwarded RELEASE message shall indicate cause code *#8 "preemption"*.

The resources associated with the preempted call may be reserved for a limited time (controlled by a timer) after the connection has been preempted. After the specified amount of time has expired, the resources will be returned for general use. Support for bandwidth reservation for preempting connections is optional.

7.2.2.4 Preemption of Calls in Progress

The ability to preempt a call in progress (a CONNECT message has not been received) shall follow the same procedures as an already-established connection. The preemption information specified in the SETUP message shall be used to determine eligibility.

When a call in progress is cleared, it is not yet known whether the called party supports preemption. If the called party does not support preemption, it would be inappropriate to send a cause code #8. Instead, cause code #41 is sent to indicate the call was cleared due to other than normal circumstances.

7.3 Compatibility with Nodes Not Supporting This Feature

Upon receiving a SETUP or ADD PARTY message containing Priority services information element with High Probability of Completion, nodes not supporting this feature will treat the Priority services information element with High Probability of Completion as an unrecognized information element.

Nodes supporting the High Probability of Completion capability shall set the IE instruction field in the Priority services information element with High Probability of Completion Priority as follows:

- The IE instruction flag field (bit 5 of octet 2) shall be set to "follow explicit instructions",
- The action indicator (bits 1-3 of octet 2) shall be set to "discard information element and proceed" or "discard information element, proceed, and report status", and
- The pass along request field (bit 4 of octet 2) shall be set to "pass along request".

With these settings, at nodes that do not support the High Probability of Completion capability, calls/connections that include the Priority services information element with High Probability of Completion Priority shall be treated the same as any other calls/connections that do not include the Priority services information element with High Probability of Completion Priority.

8 AINI Support of High Probability of Completion

[Normative]

8.1 AINI Signalling

8.1.1 Additions to AINI Signalling Messages

The message coding defined in section 5 shall apply.

8.1.2 Signalling procedures for High Probability of Completion for AINI

The procedures specified in Section 7.2.2 shall apply.

8.1.3 Compatibility with Nodes Not Supporting This Feature

The procedures in section 7.3 shall apply.

8.2 Interworking between AINI and PNNI

The procedures of section 4.2/AINI apply (i.e. information elements and messages are mapped to their equivalent counterparts).

9 Signalling Procedures for Point-to-multipoint

[Normative]

9.1 Setup of the Initial Party

The HPOC procedures for the processing of the SETUP message for point-to-multipoint calls shall follow the same HPOC procedures used for point-to-point calls.

The rules for including the Priority Services information element in the CONNECT message are the same as for point-to-point calls.

The presence or absence of the Priority Services information element in the CONNECT message does not change a call's eligibility for preemption for point-to-multipoint calls. A point-to-multipoint call shall remain preemptable if the SETUP message indicated preemption.

9.2 Procedures for Originating ADD PARTY Messages

The user side of the originating UNI at the S_B and coincident S_B and T_B reference points shall include the same HPOC information in the Priority Services information element in the ADD PARTY message as was indicated in the SETUP message for the initial party, and shall not include the Priority Services information element if it was not present in the SETUP message for the initial party.

9.3 Validation of ADD PARTY Messages

Upon reception of an ADD PARTY message, the following procedures shall apply:

- If the forwarded setup request did not contain a Priority services information element with either Resource Access or preemption, then no Priority services information element with either Resource Access or Preemption shall be included in the forwarded add party request.
- If the forwarded setup request contained a Priority services information element with Resource Access or Preemption, the same Priority services information element with the same Resource Access and Preemption shall be included in the forwarded add party request.

10 Routing Procedures

[Normative]

10.1 Advertising HPOC parameters

HPOC resources are advertised within the Resource Availability Information Group (RAIG). In addition to the resources available to non-priority connections, the resources available to HPOC connections shall also be advertised.

This section uses the term "service level" to describe the Resource Access service, and each combination of the tuple Service domain, Preemption Level, and Resource Access.

Logically at each service level there is an available cell rate and optional topology state parameters.

The available cell rate shall include all resources available to the indicated service level. This value will be the available cell rate used during path computations and GCAC.

If the values of any of the optional topology state parameters are the same as for non-priority connections, then the value need not be explicitly advertised. If an optional topology state parameter is not advertised at a given service level, but it is advertised in the containing RAIG, then the value from the containing RAIG shall apply at that service level.

For parameters not defined in the HPOC information groups, the value specified in the containing RAIG shall be used.

Normal rules regarding significant change shall be applied separately to each service level. If there is a significant change in a topology state parameter at a given service level, then that constitutes a significant change to the containing PTSE.

10.1.1 Resource Access

The HPOC Resource Access information group contains the resources available to connections requesting this service.

The advertised available cell rate includes the resources available to non-priority calls plus available resources reserved for the Resource Access service.

The advertisement of the HPOC Resource Access information group shall use a modified procedure for determining significant change. These rules shall determine when the HPOC Resource Access information group is first advertised, when its advertisement is updated, and when the information group is no longer advertised.

The decision to advertise the HPOC Resource Access information group shall be determined based upon whether the information group is currently being advertised.

If the HPOC Resource Access information group is not currently being advertised, then it shall only be advertised if the difference between a topology state parameter for Resource Access and the same topology state parameter for non-priority calls exceeds the significant change thresholds.

If the HPOC Resource Access information group is currently being advertised, then updates shall only be triggered if there is a significant change in the HPOC Resource Access information group. As for any other topology state parameter, the information group shall also be updated if the containing PTSE is updated for any reason.

The HPOC Resource Access information group shall be withdrawn from the containing RAIG when all differences between the topology state parameters for HPOC Resource Access and the same topology state parameters for non-priority calls fall below the significant change thresholds by a factor of HPOC-sigchange. The default value of this threshold is 80%, meaning that the HPOC Resource Access information group will be withdrawn when all topology state parameters for HPOC Resource Access are within 80% of the significant change threshold from the same topology state parameters for non-priority calls. This can be represented by the formula:

$$TopologyState_{RA} < TopologyState_{NP} + (TopologyState_{NP} * sigchange) * HPOC\text{-}sigchange$$

where:

RA is the topology state information for the Resource Access information group
NP is the topology state information for non-priority calls

10.1.2 Preemption

The HPOC Preemption Level Resources information groups contain the resources available to connections requesting the preemption service.

Logically at each service level there is an available cell rate and optional topology state parameters.

The advertised available cell rate for a given service level includes the resources available to non-priority calls, the resources used by preemptable connections in the same Service Domain up to and including the specified Preemption Level, and the available resources reserved for the Resource Access service, if indicated.

When resource availability is not significantly different (see procedures below) across a range of Preemption Levels, the resource availability for those levels shall be advertised in one HPOC Preemption Level Resources information group. The preemption level indicated in this information group is the lowest preemption level in the range. The advertised available resources apply to all higher preemption levels up to but not including the next higher explicitly advertised preemption level. The values advertised for the available resources shall come from the range bounded by the lowest preemption level and the highest preemption level covered by this advertisement.

Unsupported combinations do not need to be advertised. For example, if it is known that all connection requests at a given priority level will request access to reserved bandwidth, then there is no need to advertise available resources for that preemption level without resource access.

The advertisement of the HPOC Preemption Level Resources information group shall use a modified procedure for determining significant change. These rules shall determine when an HPOC Preemption Level Resources information group is first advertised, when its advertisement is updated, and when the information group is no longer advertised.

The advertisement of an HPOC preemption level is determined relative to other preemption levels and to non-preemptable resources. For preemption with resource access, the relationship is to other preemption levels with resource access, and to either the Resource Access information group (if included in the containing RAIG) or non-HPOC resources (if no Resource Access information group is included in the containing RAIG). For preemption without resource access, the relationship is to other preemption levels without resource access, and to non-HPOC resources. The relationship between preemption levels is shown in Figure 10.1.

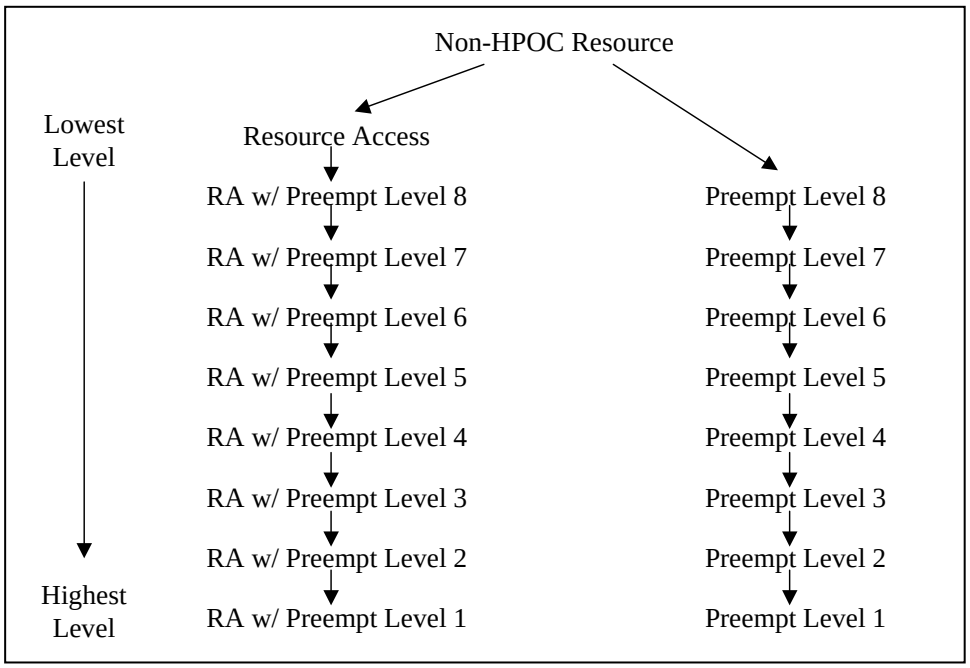

Figure 10-1 Relationship Between Preemption Levels for Significant Change

The decision to advertise the HPOC Preemption Level Resources information group for a specified level shall be determined based upon whether the information group is currently being advertised.

If the HPOC Preemption Level Resources information group is not currently being advertised, then it shall only be advertised if the difference between a topology state parameter for Resource Access and the same topology state parameter for the next lower level currently being advertised exceeds the significant change thresholds. Non-HPOC resources and resource access without preemption are considered to be the lowest level.

If the HPOC Preemption Level Resources information group is currently being advertised, then updates shall only be triggered if there is a significant change in the HPOC Preemption Level Resources information group. As for any other topology state parameter, the information group shall also be updated if the containing PTSE is updated for any reason.

The HPOC Preemption Level Resources information group shall be withdrawn from the containing RAIG when all differences between the topology state parameters for HPOC

Preemption Level Resources and the same topology state parameters for the next logically lower preemption level(see Figure 10.1) for which topology state parameters are being advertised falls below the significant change thresholds by a factor of HPOC-sigchange. The default value of this threshold is 80%, meaning that the HPOC Preemption Level Resources information group for the specified preemption level will be withdrawn when all topology state parameters for HPOC Preemption Level Resources for the specified priority are within 80% of the significant change threshold from the same topology state parameters for the next logically lower preemption level. This can be represented by the formula:

$$TopologyState_{Pn} < TopologyState_{Pn-1} + (TopologyState_{Pn-1} * sigchange) * HPOC\text{-}sigchange$$

where:

Pn is the current preemption level being considered

Pn-1 is the next logically lower preemption level for which topology state parameters are being advertised

10.2 TLV Definitions

10.2.1 Information Group Summary

Modify the first Table 5-18/PNNI1.1 as follows:

Type	IG Name	Contains IGs one level down
128	Outgoing resource availability (Notes 4, 6)	Optional GCAC parameters (160), Optional BeCR parameter (161), AccBCT parameter (162), System capabilities (640), Security (641), HPOC Resource Access (180), HPOC Preemption Service Domain (181)
129	Incoming resource availability (Notes 4, 6)	Optional GCAC parameters (160), Optional BeCR parameter (161), AccBCT parameter (162), System capabilities (640), Security (641), HPOC Resource Access (180), HPOC Preemption Service Domain (181)

180	HPOC Resource Access	Optional GCAC parameters (160), AccBCT parameter (162), System capabilities (640), Security (641)
181	HPOC Preemption Service Domain	HPOC Preemption Level Resources (182), System capabilities (640), Security (641)
182	HPOC Preemption Level Resources	Optional GCAC parameters (160), AccBCT parameter (162), System capabilities (640), Security (641)

Modify the second Table 5-18/PNNI1.1 as follows:

Type	IG Name	Contained in IG one level up	Contained in packets
160	Optional GCAC parameters	Outgoing resource availability (128), Incoming resource availability (129), HPOC Preemption Level Resources (182)	Hello (1), PTSP (2)
162	AccBCT Parameter	Outgoing resource availability (128), Incoming resource availability (129), HPOC Preemption Level Resources (182)	Hello (1), PTSP (2)
180	HPOC Resource Access	Outgoing resource availability (128), Incoming resource availability (129)	Hello (1), PTSP (2)
181	HPOC Preemption Service Domain	Outgoing resource availability (128), Incoming resource availability (129)	Hello (1), PTSP (2)
182	HPOC Preemption Level Resources	HPOC Preemption Service Domain (181)	Hello (1), PTSP (2)

10.2.2 The HPOC Resource Access Information Group

The HPOC Resource Access information group advertises the resources available to connections requesting the Resource Access Service. The available cell rate advertised is the sum of the resources available to non-priority connections plus the resources available which have been reserved specifically for the Resource Access service.

For backwards compatibility, the information group tags of the HPOC Resource Access information group shall be set to optional, summarizable, and non-transitive.

Offset	Size (Octets)	Name	Function/Description
0	2	Type	Type = 180 (HPOC Resource Access)
2	2	Length	
4	4	Available Cell Rate	Units : cells/second
Optional TLV groups: • Optional GCAC Parameters (type = 160) • AccBCT Parameter (type = 162)			

10.2.3 The HPOC Preemption Service Domain Information Group

The HPOC Preemption Service Domain information group contains the resource availability for preemption levels in the specified Service Domain.

The HPOC Preemption Level Resources information group advertises the resources available for a range of service levels. The available cell rate advertised is the sum of all resources currently used by preemptable connections up to and including the indicated preemption level within the specified service domain, as well as available resources for which no preemption is necessary.

For backwards compatibility, the information group tags of the HPOC Preemption Service Domain information group and the HPOC Preemption Level Resources shall be set to optional, summarizable, and non-transitive.

Offset	Size (Octets)	Name	Function/Description
0	2	Type	Type = 181 (HPOC Preemption Service Domain)
2	2	Length	
4	5	Service Domain	The Service Domain for which the contained IGs apply
9	3	*Reserved*	
Repeat for each advertised combination of Preemption Level and Resource Access:			
	2	Type	Type = 182 (HPOC Preemption Level Resources)
	2	Length	
	2	*Reserved*	
	1	Preemption Level	This indicates the highest preemption level of preemptable calls that are currently using these resources
	1	Resource Access	Set to 1 if Resource Access service resources are included in the advertisement, otherwise set to 0
	4	Available Cell Rate	This includes the resources used by all preemptable calls up to and including the specified preemption level as well as available resources for which no preemption is necessary Units : cells/second
Optional TLV groups: • Optional GCAC Parameters (type = 160) • AccBCT Parameter (type = 162)			

10.3 Path Computation

The path computation process for HPOC uses the same general procedures as is used for non-priority calls. The difference with HPOC is that when path computation fails, it will retry the path computation, considering additional resources available through the HPOC service.

The path computation process for HPOC calls shall first be performed without consideration for any of the requested HPOC services. If a path is found, then this path shall be used and the remaining procedures in this section do not apply.

If a suitable path cannot be found, and the requesting call includes the Priority Services information element with Resource Access indication, then the path computation process shall be repeated. For link or node advertisements including the HPOC Preemption Resource Access information group, the resources specified in this information group shall be used during path computation. If a path is found, then this path shall be used and the remaining procedures in this section do not apply.

If a suitable path cannot be found, and the requesting call includes the Priority Services information element with the Preemption octet group, then the path computation process shall be repeated using the following procedures, considering only the HPOC Preemption Level Resources information groups for the same Service Domain indicated in the Priority Services information element:

- If the Priority Services information element does not include the Resource Access indication, for each link or node, the available resources used during path computation shall be determined as follows:
    - The available resources from the first HPOC Preemption Level Resources without the Resource Access flag set and with a Preemption Level that is numerically higher than the requested preemption level.
    - If there is no HPOC Preemption Level Resources without the Resource Access flag set and with a Preemption Level that is numerically higher than the requested preemption level, then the available resources advertised for non-priority calls shall be used.
- If the Priority Services information element includes the Resource Access indication, for each link or node, the available resources used during path computation shall be determined as follows:
    - The available resources from the first HPOC Preemption Level Resources with the Resource Access flag set and with a Preemption Level that is numerically higher than the requested preemption level.
    - If there is no HPOC Preemption Level Resources with the Resource Access flag set and with a Preemption Level that is numerically higher than the requested preemption level, the resources advertised in the HPOC Resource Access information group shall be used, if present.
    - Otherwise, the available resources advertised for non-priority calls shall be used.

10.4 Compatibility with nodes not supporting this capability

The HPOC Resource Access information group is an optional information group. If the Resource Access service is not supported, the processing node shall ignore this information group. The information group shall continue to be flooded to neighboring nodes.

The HPOC Preemption Service Domain information group and the HPOC Preemption Level Resources information group are optional information groups. If the Preemption service is not supported, the processing node shall ignore these information groups. The information group shall continue to be flooded to neighboring nodes.

If the peer group leader does not support the either of these services, then the available resources for the unsupported service will not be summarized by the parent LGN.

11 Feature Interactions

[Normative]

11.1 Feature Interactions with Domain-Based Rerouting (DBR)

For nodes implementing both this specification and DBR [DBR] the following procedures shall apply:

Whenever a DBR reroute setup request is initiated:

- If the setup request progressed by call control to establish the initial connection did not contain a Priority services information element with High Probability of Completion, then no Priority services information element with High Probability of Completion shall be included in the DBR reroute setup request.
- If the setup request progressed by call control to establish the initial connection contained a Priority services information element with High Probability of Completion, the same Priority services information element with High Probability of Completion shall be included in the DBR reroute setup request.

11.2 Feature Interactions with Active Connection Modify

The action taken for the Resource Access and Preemption services on a connection modify are independent of any actions taken during the initial call setup.

11.2.1 Service Validation

The service validation procedures used for SETUP messages at the corresponding interface shall apply.

11.2.2 Procedures for Resource Access

The procedures used for SETUP messages at the corresponding interface shall apply, replacing SETUP messages with MODIFY REQUEST messages, CONNECT messages with MODIFY ACKNOWLEGE messages, and RELEASE MESSAGE with MODIFY REJECT messages.

11.2.3 Procedures for Preemption

The procedures used for SETUP messages at the corresponding interface shall apply with the following modifications:

If a call is not preemptable and a MODIFY REQUEST is received, the call remains not preemptable until a response is received. If a MODIFY ACKNOWLEDGE is received indicating that the call is preemptable, then the call becomes preemptable with the preemption priority specified in the corresponding MODIFY REQUEST message. Otherwise, the call remains not preemptable.

If a call is preemptable and a MODIFY REQUEST is received, indicating a higher preemption level than is currently being used, the call becomes preemptable with the preemption level specified in the MODIFY REQUEST message. If a MODIFY ACKNOWLEDGE is received indicating that the call is preemptable, then the call remains preemptable with the preemption level specified in the MODIFY ACKNOWLEDGE message. If a MODIFY ACKNOWLEDGE is received indicating that the call is not preemptable, the connection is modified to be non-

preememptable. If a MODIFY REJECT is received, the connection returns to the preemption level used before the corresponding MODIFY REQUEST message was received.

11.3 Feature Interactions with Active Connection Modify with protect and modify

If the original SETUP message, or subsequent MODIFY REQUEST messages, included either the Resource Access or the Preemption services, then the same indication shall be included on the reroute connection. The indication shall be the result of the original SETUP message as modified by subsequent MODIFY REQUEST messages.

For a soft reroute, if the reroute was successful, then do not include these indications on the incumbent modify.

It should be noted that for soft reroutes this procedure may cause the unnecessary preemption of connections in the network even though the network can successfully modify the incumbent connection. This is necessary in order to progress the Resource Access and preemption information in the MODIFY message beyond the current rerouting domain.

Networks may optionally choose to not support Active Connection Modify with preemptive service for soft reroutes.

For a hard reroute, it is possible that the resource access or preemption level used in the reroute connection is different from the incumbent connection if a MODIFY REQUEST was in progress when the hard reroute was initiated. The reroute destination shall include in the CONNECT message the values currently active for the connection at the reroute destination.

If a reroute domain spans an Inter-domain PNNI interface, then the forwarded CONNECT message shall include the preemption level specified in the received CONNECT message.

11.4 Feature Interactions with Policy Routing

A connection requesting the use of policy routing and either the Resource Access service or the Preemption service shall only consider resources acceptable according to the policy constraints specified in the Policy Constraint information element.

11.5 Feature Interactions with Alternate Traffic Descriptor

Support for preemption with an Alternate Traffic Descriptor is an implementation-dependent capability. The node may choose to:

- Ignore the Alternate traffic descriptor information element,
- Choose the “best” traffic descriptor, or
- Some other implementation-independent action.

12 Appendix A: Example Preemption Advertisement

[Informative]

Following is an example of how preemption levels would be advertised and withdrawn based upon the available cell rate of non-priority calls and the bandwidth being used by preemption calls.

AvCR_PM = 10%

HPOC-sigchange = 80%

AvCR for non-priority calls is 10 Mbps

- The resulting threshold for an advertisement of a higher level would be 11 Mbps

The bandwidth being used by calls in Levels 8, 7, 5, 4 and 2 are 95, 5, 5, 5, and 5 respectively

This results in AvCR values of 10, 105, 110, 115, 120 Mbps, repectively

- Note: Level 8 can't preempt calls, so the AvCr is the same as for non-priority
- The threshold for advertising of a higher level is 11, 115.5, 121, 126,5 and 132 Mbps
- Threshold for withdrawal of a higher level is 10.8, 113.4, 118.8, 124.2, and 129.6 Mbps

With these values, only levels 7 and 2 would be advertised since they are the first levels to exceed the significant change threshold of a lower level advertisement.

If the AvCr for Level 2 falls below 113.4 Mbps [105 + (105 * 1%)* 80%], then the advertisement for Level 1 will be withdrawn.

Note that if the AvCr for Level 7 falls below 104.5 Mbps it will cause Level 4 to be advertised.

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