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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Public data networks – Interfaces

Procedures for the provision of an extended multicast service for Data Terminal Equipments (DTEs) using Recommendation X.25

ITU-T Recommendation X.49

(Previously CCITT Recommendation)

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FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation X.49 was prepared by ITU-T Study Group 7 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 5th of October 1996.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

This Recommendation which specifies the procedures for a Data Terminal Equipment (DTE) operating in accordance with Recommendation X.25 for the realization of the multicast service described in Recommendation X.6. The multicast service provided by this Recommendation requires additional protocol elements and other elements of procedures beyond that specified in X.25 Packet Layer Protocol (PLP).

Recommendation X.49

PROCEDURES FOR THE PROVISION OF AN EXTENDED MULTICAST SERVICE FOR DATA TERMINAL EQUIPMENTS (DTEs) USING RECOMMENDATION X.25

(Geneva, 1996)

1 Scope and field of application

Recommendation X.6 describes a connection-oriented multicast service, in the sense that the multicast user must first establish a connection (virtual call or permanent virtual circuit) before it is able to send or receive any multicast data. The multicast service defined in Recommendation X.6 is designed to work over a variety of transmission technologies.

In a Packet Switched Public Data Network (PSPDN) environment, this Recommendation specifies the procedures for a Data Terminal Equipment (DTE) operating in accordance with Recommendation X.25 for the realization of the multicast service described in Recommendation X.6. The multicast service provided by this Recommendation requires additional protocol elements and other elements of procedures beyond those specified in the X.25 Packet Layer Protocol (PLP).

The provision of a basic subset of the multicast service capabilities specified in Recommendation X.6 that does not require protocol elements or other elements of procedures in addition to the X.25 PLP procedures is specified in Recommendation X.48.

Members of a multicast group with interfaces operating in the extended mode (i.e. in accordance with this Recommendation) are able to participate in a multicast call with participants with interfaces operating in the basic mode (i.e. in accordance with Recommendation X.48).

2 Normative references

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of currently valid ITU-T Recommendations is regularly published.

2.1 Identical Recommendations | International Standards

– ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.

– ITU-T Recommendation X.213 (1995) | ISO/IEC 8348:1996, *Information technology – Open Systems Interconnection – Network service definition.*

2.2 Paired Recommendations | International Standards equivalent in technical content

– ITU-T Recommendation X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*

ISO/IEC 8208:1995, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment*.

– ITU-T Recommendation X.223 (1993), *Use of X.25 to provide the OSI connection-mode network service for ITU-T applications*.

ISO/IEC 8878:1992, *Information technology – Telecommunications and information exchange between systems – Use of X.25 to provide the OSI Connection-mode Network Service*.

2.3 Additional references

- ITU-T Recommendation X.6 (1993), *Multicast service definition.*
- ISO 8648:1988, *Information processing systems – Open Systems Interconnection – Internal organization of the Network Layer*.
- ISO/IEC 10028:1993, *Information technology – Telecommunications and information exchange between systems – Definition of the relaying functions of a Network layer intermediate system*.
- ISO/IEC 10177:1993, *Information technology – Telecommunications and information exchange between systems – Provision of the connection-mode Network internal layer service by intermediate systems using ISO/IEC 8208, the X.25 Packet Layer Protocol*.

3 Definitions

3.1 Reference Model definitions

The following terms are defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

- Protocol Data Unit (PDU);
- Service Data Unit (SDU).

3.2 X.25 Packet Layer Protocol definitions

The following terms are defined in ITU-T Rec. X.25 and in ISO/IEC 8208:

- DTE/DCE Interface;
- logical channel;
- M-bit Sequence;
- Qualifier bit (Q-bit);
- virtual circuit.

3.3 Multicast service definitions

The following terms are defined in Recommendation X.6:

- multicast group;
- multicast call;
- active group;
- call initiator;
- one-way mode of communication;
- two-way mode of communication;
- N-way mode of communication;
- multicast server;
- participant;
- capability;
- ordering.

In addition, the following terms are defined:

3.3.1 multicast service: A service to a specified group of service users such that when any one submits a Service Data Unit (SDU), it is delivered to all members of the group. There may be no restrictions on how many users may submit SDUs at a given time.

3.3.2 basic multicast service: Packet multicast service provided to Data Terminal Equipments (DTEs) operating in accordance to the X.25 PLP specified in Recommendation X.25 with no additional protocol elements or other elements of procedures. A subset of the multicast service capabilities specified in Recommendation X.6 is provided to DTEs operating in this mode.

3.3.3 extended multicast service: Packet multicast service provided to DTEs operating protocol elements or other elements of procedures in addition to the X.25 PLP specified in Recommendation X.25. The multicast service capabilities specified in Recommendation X.6 are provided to DTEs operating in this mode.

3.3.4 active group integrity (AGI): Set of conditions concerning the active group which must be true in order, for the participants in a multicast call, to transfer data. In principle if the AGI is not met, the multicast call may be either terminated or halted, i.e. the data transfer is ceased and the multicast call enters the Pause state. The data transfer is resumed when the AGI is satisfied. The Pause and Resume services are not supported in this Recommendation, i.e. the multicast call is terminated if the AGI is not met.

A set of conditions may also be defined concerning the policies for detection of lost and duplicate PDUs and flow control during the data transfer phase.

A special case of AGI which deals only with a single number is called Quorum.

The AGI applies to a particular multicast call and relates to the characteristics of the active group. AGI is not an attribute of the individual active group members but is an attribute of the active group.

3.3.5 quorum: Minimum number of entities in the active group which meets the AGI when it is expressed in terms of a single condition which specifies a number for the execution of a certain function or policy (e.g. for a multicast call to enter the data transfer phase, for a multicast call to remain in the data transfer phase, for a sender to detect lost and/or duplicate PDUs, etc.).

Note the following distinction between AGI and Quorum. AGI is the necessary and sufficient conditions for a multicast call to enter and/or remain in the data transfer phase. Quorum is the necessary condition to enter and/or remain in the data transfer phase. Note that if an AGI is just a pure number (i.e. AGI is a single condition which is the Quorum requirement), then Quorum is necessary and sufficient.

3.3.6 dialogue control: Categorization of an active group as either centralized or decentralized.

3.3.6.1 centralized active group: An active group in which a single (designated) member is permitted to originate multicast transmissions. The designation of a member as originator may be dynamic and change from one member to another as long as only a single member is allowed to originate multicast transmissions at any given time.

3.3.6.2 decentralized active group: An active group in which any member is permitted to originate multicast transmissions at the same time as other members. It is possible to place restrictions on individual members of the active group on whether they are permitted to originate multicast transmissions. An example of such restrictions is that only a subset of the active members may be permitted to originate multicast transmissions.

4 Abbreviations

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

AGI	Active Group Integrity
CUG	Closed User Group
D-bit	Delivery confirmation bit
DCE	Data Circuit-terminating Equipment
DSP	Domain Specific Part
DTE	Data Terminal Equipment
IDP	Initial Domain Part
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
LI	Length Indicator

M-bit	More bit
MSE	Multicast Service Entity
MSP	Multicast Service Protocol
NI	Network Internal
NILS	Network Internal Layer Service
NISDU	Network Internal Service Data Unit
NPI	Numbering Plan Identification
NS	Network Service
NSAP	Network Service Access Point
NSDU	Network Service Data Unit
NUI	Network User Identification
OSI	Open Systems Interconnection
PCI	Protocol Control Information
PDU	Protocol Data Unit
PLP	Packet Layer Protocol
PSPDN	Packet Switched Public Data Network
PT	Parameter Type
PV	Parameter Value
Q-bit	Qualifier bit
QOS	Quality of Service
ROA	Recognized Operating Agency
SDU	Service Data Unit
SMM	Subnetwork Multicast Mapping
SNAcF	Subnetwork Access Function
SNAcP	Subnetwork Access Protocol
SNDME	Subnetwork Dependent Mapping Entity
TOA	Type of Address

5 Description of multicast service for members of a multicast group with interfaces operating in the extended mode

A member of a multicast group with an interface operating in the extended mode has the following basic capabilities (see Recommendation X.48):

- initiate capability;
- send capability;
- receive capability;
- terminate capability;
- capability to participate in a one-way, two-way, or n-way multicast service (see Recommendation X.6).

In addition, the member with an interface operating in the extended mode can be included in the following list of capabilities of the members of the group (see Recommendation X.6):

- *Group Status Request List*: List of members who are authorized to request status information regarding the status of a multicast group.
- *Call Status Request List*: List of members who are authorized to request status information regarding the status of a multicast call.

– *Join Permission Capability List*: List of members who confirm or deny a request to join a multicast call by a potential participant.

– *Join/Leave Notification Receive Capability List*: List of members who receive join/leave notifications.

– *Invite Capability List*: List of members who are allowed to invite a potential participant to join a multicast call in progress.

– *Exclude Capability List*: List of members who are allowed to exclude a participant from a multicast call in progress.

– *Group Controller List*: List which contains the members [or third party(ies)] who are authorized to create, modify and destroy the multicast group.

A Group Controller may use static administrative means or on-line procedures provided by an extension of the standard ITU-T systems management protocols (see 6.1.1/X.6).

NOTE 1 – Group management and control (see 6.1/X.6) will be realized by administrative means or protocol procedures.

Members of a multicast group with interfaces operating in the extended mode are able to participate in a one-way, two-way, or n-way multicast service. Local ordering applies for these modes of communications. Global ordering is not applicable for the following modes of communications: one-way with single sender and two-way with single sender.

NOTE 2 – It is for further study whether global ordering applies to: one-way with multiple senders, two-way with multiple senders and n-way.

Members of a multicast group with interfaces operating in the extended mode are able to participate in a multicast call with participants with interfaces operating in the basic mode. A single multicast call per multicast group is permitted if any call participant operates interfaces in the basic mode. More than one multicast call per multicast group is permitted if all the participants in these calls operate interfaces in the extended mode. The number of multicast calls, permitted in this case, is service dependent.

6 X.25 protocol element restrictions for DTEs operating in the extended mode

Packet layer operation as described in clause 4/X.25 applies to DTEs operating in the extended mode with the following restrictions:

- A DTE operating in the extended mode may use the M-bit if the value of the multicast call Dialogue Control is Centralized. A DTE operating in the extended mode is not permitted to use the M-bit if the value of the multicast call Dialogue Control attribute is Decentralized. The reason is that it will not be possible to distinguish among M-bit sequences from several senders.

- A DTE operating in the extended mode is not permitted to use the Delivery confirmation bit (D-bit) because multiple participants may be present in a multicast call.

- A DTE operating in the extended mode is not permitted to use the Interrupt procedure specified in 4.3.7/X.25 because of the following complexities that result from supporting this procedure:

  – The Interrupt procedure has an end-to-end significance. If a DTE operating in the extended mode is permitted to send a DTE Interrupt packet, the multicast service provider will only send a DCE Interrupt Confirmation packet on that DTE's DTE/DCE interface after all other participants confirm the interrupt with DTE Interrupt Confirmation packets. A global reset procedure (see 12.1) results if a participant fails to send or excessively delays the sending of the DTE Interrupt Confirmation packet.

– Since the Interrupt procedure allows a DTE to transmit data to the remote DTE(s) without following the normal flow control procedure applying to data packets, it could cause a large number of packets to be queued within the multicast service with possible subsequent loss of data. In particular, this is true when more than one participating DTE in a multicast call is allowed to use the Interrupt Data Transfer. The multicast service will not transmit on the DTE/DCE interface of a participant, a second DCE Interrupt packet until the first one is confirmed with a DTE Interrupt Confirmation packet.

7 Multicast group creation and membership control

7.1 General

All group definition and management procedures are done through static administrative means or through protocol elements which are beyond the scope of this Recommendation.

NOTE – The support of the Create Group, Add Member, Remove Member, Group Created, Member Added, and Member Removed messages defined in Recommendation X.6 for group definition and management is not provided in this Recommendation. The use of X.25 for group definition and management is for further study.

When a multicast group is created, a set of default values for the multicast calls must be assigned.

A multicast group is identified by a Multicast Group Address. The Multicast Group Address can be any format of address defined in Recommendation X.25, as well as the Group Network Address per ITU-T Rec. X.213 | ISO/IEC 8348.

7.2 Group attributes

For a member of a multicast group with an interface operating in the extended mode, the group attributes specified in Recommendation X.6 apply as follows:

– *Group Controller attribute*: Although the member can be included in the list of members [or third party(ies)] who are authorized to create, modify and destroy the multicast group, the use of X.25 for group control and management is for further study.

– *Group ID attribute*: No restrictions.

– *Group Status Request attribute*: The member can be included in the list of members authorized to request information regarding the status of the multicast group.

– *Initiator attribute*: The member can be included in the list of members who may initiate multicast calls.

– *May Send attribute*: The member can be included in the list of members who may be senders (or sender/receivers).

– *May Receive attribute*: The member can be included in the list of members who may be receivers (or receiver/senders).

– *May Receive Join/Leave Notification attribute*: The member can be included in the list of members who may receive Join/Leave Notification.

– *May Hold Join Permission attribute*: The member can be included in the list of members who may confirm or deny a request to join a call by a potential participant.

– *May Invite attribute*: The member can be included in the list of members who may invite other members into a call in progress.

– *May Exclude attribute*: The member can be included in the list of members who may exclude other members from a call in progress.

– *May Terminate attribute*: The member can be included in the list of members who may terminate calls in progress.

– *Multicast Calls Establishment attribute*: The value of this attribute may be one of two values: “Member Initiated” or “Multicast Server Initiated.”

– *Default Join Origination Selection attribute*: The default value of this attribute may be one of the two values: "True, i.e. the multicast server sends invitations to members to join the call" or "False, i.e. the members join on their own." It is set to "True" if the Multicast Calls Establishment attribute is set to "Multicast Server Initiated."

– *Default Active Group Integrity attribute*: No restrictions.

– *Default Quorum attribute*: No restrictions.

– *Default Data Flow Direction attribute*: No restrictions.

– *Default Priority attributes*:

  - *Default Connect Priority attribute*: For further study.
  - *Default Retain Priority attribute*: For further study.
  - *Default Transfer Priority attribute*: For further study.

– *Default Aggregate Time-out attributes*: The following Default time-out attributes are defined:

  - *Default Pending Call Creation Time-out attribute*: No restrictions.
  - *Default Pending Disconnect Response Time-out attribute*: No restrictions.
  - *Default Pending Exclude Response Time-out attribute*: No restrictions.
  - *Default Pending Join Time-out attribute*: No restrictions.
  - *Default Pending Invitation to Join Time-out attribute*: No restrictions.
  - *Default Pending Include Time-out attribute*: No restrictions.
  - *Default Pending Invitation to Include Time-out attribute*: No restrictions.
  - *Default Pending Call Termination Time-out attribute*: No restrictions.

– *Default Source Identification attribute*: The value of this default attribute is set to "Not Provided". No source identification is possible using X.25 in the extended mode.

– *Dialogue Control attribute*: No restrictions.

8 Multicast Call attributes

8.1 Multicast Call Establishment attributes

The multicast call attributes apply as follows:

– *Call ID attribute*: A single multicast call per multicast group is permitted if at least one participant in a multicast call operates an interface in the basic mode. In this case, a Call ID is not needed to identify the multicast call. More than one multicast call per multicast group is permitted if all the participants in these calls operate interfaces in the extended mode. In this case, a Call ID is needed to differentiate among the multicast calls belonging to the same multicast group.

– *Exclusion/Inclusion attribute*: The list of members of the multicast group that may participate in the multicast call could be expressed explicitly using network dependent capabilities (e.g. use of complementary addresses as defined in Appendix IV/X.25, allocation of several X.121 addresses to the multicast group) or implicitly as a rule using Closed User Groups. These lists are determined by mechanisms outside the scope of this Recommendation. A DTE operating in the extended mode supports the capability of changing these lists on a per-call basis (e.g. to include and/or exclude additional members).

NOTE 1 – An example that illustrates the use of the Exclusion/Inclusion attribute is as follows: assume a multicast group that consists of members A, B, C, D, E and F. Members A, B and C belong to Closed User Groups X and Y. Members E, F and G belong to Closed User Groups Y and Z. To include all the members of the multicast group in a multicast call, the call is placed by specifying Closed User Group Y. To exclude members A, B and C from participating in a multicast call, the call is placed by specifying Closed User Group Z. To establish a call that includes all the members of the multicast group with the exception of member G, the call is placed by specifying Closed User Group Y and explicitly excluding member G. To establish a call that includes members A, B, C and E, the call is placed by specifying Closed User Group X and explicitly including member E.

– *Join Origination Selection attribute*: The value of this attribute may be one of the two values: "True" or "False" which determines whether the multicast server, in order to establish a multicast call, sends join invitations to members of the group or the members join on their own. If the default value for the group attribute is set to "False, i.e. the members join on their own", then the value that applies to the call may be either set to "False, i.e. taken from the default value for the group" or selected on a per-call basis by the DTE initiating the establishment of the call and operating in the extended mode. If the default value for the group attribute is set to "True, i.e. the multicast server sends join invitations to members of the group", then the value that applies to the call must be set to "True, i.e. taken from the default value for the group." It cannot be selected on a per-call basis.

– *Active Group Integrity attribute*: The value of this attribute may be one of the two values: "AGI applies" or "AGI does not apply." The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

– *Quorum attribute*: The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

– *Priority attributes*:

  - *Connect Priority*: For further study.
  - *Retain Priority*: For further study.
  - *Transfer Priority*: For further study.

– *Aggregate Time-out values*: For each of the following timers, the timer value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

  - Pending Call Creation Time-out;
  - Pending Disconnect Response Time-out;
  - Pending Exclude Response Time-out;
  - Pending Join Time-out;
  - Pending Invitation to Join Time-out;
  - Pending Include Time-out;
  - Pending Invitation to Include Time-out;
  - Pending Call Termination Time-out.

– *Send capability*: At a given time, the list of members who may transmit data in the call is created from the intersection of the following lists: the group May Send list and the list of members that are participating in the call. Note that this list may change with time as members join and/or leave the call.

– *Receive capability*: At a given time, the list of members who may receive data in the call is created from the intersection of the following two lists: the group May Receive list and the list of members that are participating in the call. Note that this list may change with time as members join and/or leave the call.

– *Receive Join/Leave Notification capability*: At a given time, the list of members who may receive join/leave notifications is created from the intersection of the following two lists: the group May Receive Join/Leave Notification list and the list of members that are participating in the call. Note that this list may change with time as members join and/or leave the call.

– *Join Permission capability*: A DTE operating in the extended mode can be designated as the member who may confirm or deny a request to join the call by a potential participant.

– *Terminate capability*: At a given time, the list of members who may terminate the call is created from the intersection of the following two lists: the group May Terminate list and the list of members that are participating in the call. Note that this list may change with time as members join and/or leave the call.

– *Dialogue Control attribute*: The value of this attribute may be one of the two values: "Centralized" or "Decentralized." The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

– *Source Identification capability*: A DTE operating in the extended mode does not support this capability.

NOTE 2 – On a DTE/DCE interface operating in the extended mode, the multicast service provider does not provide the source identification of the data it sends to the DTE.

– *Invite capability*: The list of members who may invite other members into the call in progress is taken from the group May Invite list.

– *Exclude capability*: The list of members who may exclude other members from the call in progress is taken from the group May Exclude list.

– *Call Status Request attribute*: A DTE operating in the extended mode can be included in the list of members authorized to request information regarding the status of a call.

8.2 Data Transfer attributes

The Data Transfer attributes given in Recommendation X.6 apply as follows:

– *Data Flow Direction*: The value of this attribute may be one of the following values: "one-way," "two-way," or "n-way". The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

– *Data Integrity*: This capability is supported as follows: loss of data between a sender and the multicast server is indicated to all participants in the call and results in a global reset procedure (see 12.1). Loss of data between the multicast server and a receiver (e.g. because of buffer overflow) results in a local reset procedure (see 12.1).

– *Synchronized Data Delivery*: The support of this capability is for further study.

– *Data Ordering*: Local data ordering by the multicast server is supported. Global data ordering is for further study.

– *Throughput*: The value of this attribute may be one of three values: "at pace of slowest active receiver," "at minimum pace with no loss" or "at minimum pace with possible loss." The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

– *Flow Control*: The value of this attribute may be one of two values: "True" or "False," which determines whether the multicast server is able to flow control any participant transmitting data packets to prevent data loss. The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.

NOTE – The value of the Flow Control attribute should be set to "False" if the value of the Throughput attribute is set to "at minimum pace with possible loss." The value of the Flow Control attribute should be set to "True" if the value of the Throughput attribute is set to either "at pace of slowest active receiver" or "at minimum pace with no loss."

8.3 Types of Data Transfer

One-way, two-way, and n-way types of data transfer are supported. The type of data transfer that applies to the call may be either taken from the default value of the group Data Flow attribute or selected on a per-call basis by a DTE operating in the extended mode. The list of members who may transmit data in the call is taken from the group May Send list. The

list of members who may receive data in the multicast call is taken from the group May Receive list. The multicast server keeps for each active participant a role in the data transfer depending on the type of data transfer as given in the table below:

For Data Flow	Participant may be
One-way	Sender Receiver
Two-way	Sender/Receiver Receiver/Sender
N-way	N-way participant

The type of data transfer for the call is enforced by the multicast server. If a participant in the call attempts to transfer data inappropriately (e.g. if a receiver in a one-way call transmits a data packet), no error message will be returned to the participant. However, the packet will not be transmitted to other participants in the call.

The multicast server places the call in the data transfer state when the AGI is met.

NOTE – An AGI condition may specify that at least one of the participants should have the Send capability in order to place the multicast call in the data transfer state.

A participant with the Send (Send/Receive) capability considers its DTE/DCE interface in the data transfer state when the interface is in the established state and DTE Data packets can be sent. A participant with the Receive (or Receive/Send) capability places its DTE/DCE interface in the data transfer state when it receives a DCE Data packet.

Data transfer is accomplished using DTE and DCE Data packets.

9 Multicast service model

Following the model for the internal organization of the Network Layer in ISO 8648, the network layer in the DTE and in the multicast server may be modeled as consisting of three sub-layers (see Figure 1):

- *Multicast Service Sublayer*: The modeling of this sublayer permits the definition of a peer-peer Multicast Service Entity (MSE) communication in terms of the multicast messages defined in Recommendation X.6.

- *Subnetwork-Dependent Mapping Sublayer*: This sublayer operates over the Subnetwork Access Protocol (SNAcP) (which is the X.25 protocol in case of this Recommendation) and is used to provide the capabilities assumed by the multicast service sublayer. It permits to decouple the peer-peer communication between multicast service entities from the detailed operation of particular SNAcPs. The realization of this sublayer may consist simply of a set of rules for manipulating the subnetwork access protocol and may not involve explicit exchange of PCI (protocol control information). The modeling of this sublayer provides for the application of the X.6 peer-peer MSE communication over other subnetwork technologies. For example, over a Frame Relay subnetwork, a new set of mapping rules need to be defined while the X.6 peer-peer MSE communication remains unchanged.

- *Subnetwork Access Protocol (SNAcP)*: This sublayer is to provide the SNAcP which is the X.25 protocol in the case of this Recommendation.

The above sub-division of the network layer into sublayers is for modeling purposes and should not be interpreted as implying a particular implementation.

A further decomposition of the Network Layer is illustrated in Figure 2.

The X.6 multicast service can be realized in a single entity or can be distributed among several logical entities. As illustrated in Figure 3, the model applies irrespective of the location of the entity(ies) providing the X.6 Multicast Service (in a DCE, inside the network, in a DTE outside the network).

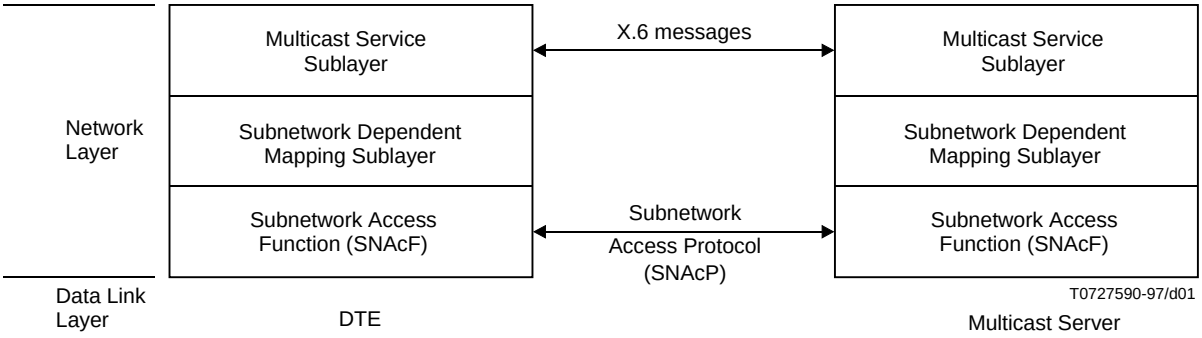


FIGURE 1/X.49

Decomposition of the Network Layer into three sublayers

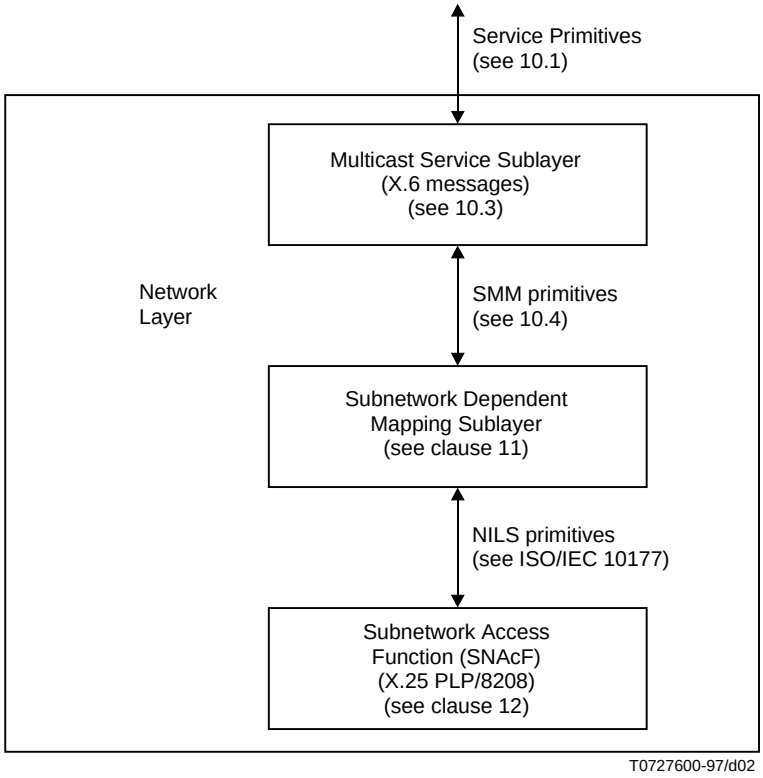
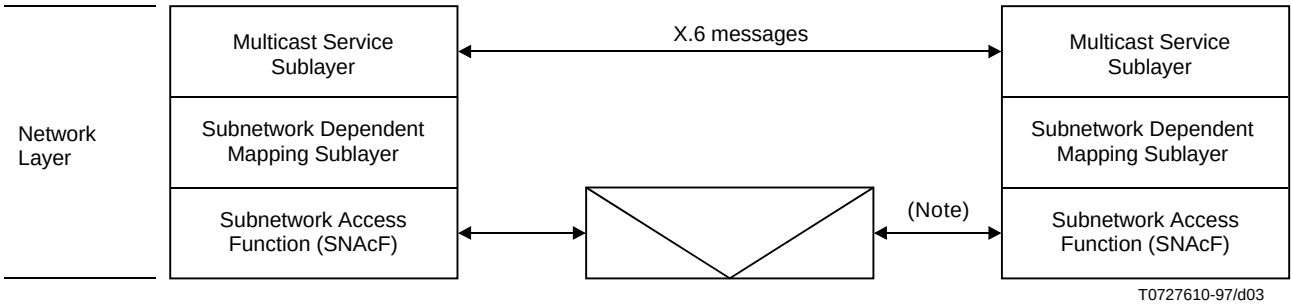


FIGURE 2/X.49

Further decomposition of the Network Layer



NOTE – Internal protocol in case the server is inside the network or SNAcP in case the server is outside the network.

FIGURE 3/X.49

Realization of the multicast service functionality

10 Multicast Service Sublayer

10.1 Services Provided by the Multicast Service Sublayer

The service primitives and parameters provided by the Multicast Service Sublayer are those defined in Table 1.

TABLE 1/X.49

Service primitives and parameters

Service primitives	Parameters
N_BIND.request	(Called group address, Calling address, QOS, GC requirements)
N_BIND.indication	(Called group address, Calling address, QOS, GC requirements)
N_JOIN.request	(Called group address, Calling address, QOS)
N_JOIN.indication	(Called group address, Calling address, QOS)
N_JOIN.response	(Called group address, Calling address, QOS)
N_JOIN.confirm	(Called group address, Calling address, QOS)
N_DATA.request	(Called group address, Calling address, NS-user-data)
N_DATA.indication	(Called group address, Calling address, NS-user-data)
N_LEAVE.request	(Called group address, Calling address, reason, NS-user-data)
N_LEAVE.indication	(Called group address, originator reason, NS-user-data)
N_UNBIND.request	(Called group address, Calling address)
N_UNBIND.indication	(Called group address, Calling address)
NOTE 1 – It is for further study as to whether information about the GC, e.g. QOS, AGI and SRC_REF should be passed as parameters on the service primitives or made available through system management. NOTE 2 – The BIND and UNBIND service primitives are for the use of management procedures. NOTE 3 – The Group ID is part of the Called group address.	

10.2 Services assumed by the Multicast Service Sublayer

The primitives of the service assumed by the Multicast Service Sublayer on its lower service boundary will be referred to with the prefix “SMM” (for “Subnetwork Multicast Mapping”). They are given in Table 2.

TABLE 2/X.49

SMM primitives and parameters

Service primitives	Parameters
SMM_CONNECT.request SMM_CONNECT.indication	SMM Connect Type (i.e. Create Multicast Call, Invitation to Join, Join Request) SMM Calling Address SMM Called Address (e.g. Group ID, Call ID) SMM Multicast Call Attributes (e.g. Join Origination Selection, Quorum, AGI, Data Flow, Throughput, Flow Control, Time-out Values) SMM QOS Parameter Set SMM User-Data
SMM_CONNECT.response SMM_CONNECT.confirm	SMM Connect Type (i.e. Multicast Call Created, Join Accepted) SMM Responding Address SMM Multicast Call Attributes (e.g. Group ID, Call ID, Join Origination Selection, Quorum, AGI, Data Flow, Throughput, Flow Control, Time-out Values) SMM QOS Parameter Set SMM User-Data
SMM_DISCONNECT.request SMM_DISCONNECT.indication	SMM Disconnect Type (i.e. Leave request, Terminate Multicast Call, Multicast Call Rejected, Join Rejected) SMM Reason SMM Originator (Note 1) SMM Multicast Call Attributes SMM User-Data SMM Responding Address (Note 2) SMM Called Address
SMM_DATA.request SMM_DATA.indication	SMM Data Type (i.e. User Data, Control Data) SMM Called Address SMM User-Data SMM Control Data Type (e.g. Include Member, Member Included, Exclude Member, Member Excluded, Join Permission Request, Join Permission Response, Join/Leave Notification, Group Status Request, Group Status Response, Call Status Request, Call Status Response) SMM Control Data Attributes (e.g. Group ID, Call ID, Address, Join Accepted/Rejected, Exclusion Completed, Join Permission Granted/Denied, Join/Leave Notification)
NOTE 1 – The SMM Originator parameter is permitted only in the SMM_DISCONNECT.indication primitive. NOTE 2 – The SMM Responding Address parameter is permitted only when the SMM Disconnect Type parameter is Join Rejected.	

10.3 Multicast Service Sublayer Protocol Procedures

10.3.1 Procedures for establishing a multicast call

The procedures for originating a multicast call may be initiated either by a member with the Initiate capability or by the multicast server through a trigger from some out-of-band control mechanism (e.g. administrative agreements to set up the multicast call at a pre-determined time).

10.3.1.1 Member Initiated

When receiving an N_JOIN.request primitive from the NS user of a member with the Initiate capability, the member's Multicast Service Entity (MSE) sends an X.6 Create Multicast Call message to its peer MSE in the multicast server. In the X.6 Create Multicast Call message, the Calling Address field contains the address of this member. The Called

Address field may contain the identity (Group ID, Call ID) of the call that is being created. The Group ID shall be present if the member belongs to more than one single multicast group, otherwise it may be absent. The Call ID shall be present if more than one single multicast call is permitted per the multicast group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

The Multicast Call Attributes field carries requests for values for call attributes. The absence of a requested value is an indication that the default value of the attribute is requested for the call.

When the X.6 Create Multicast Call message is received by the multicast server MSE, the following applies:

1) The Multicast Server MSE determines the value of the multicast call AGI attribute either from:

   – the group default value if no value is requested in the received message; or

   – the requested value in the received message. If the requested value of "AGI applies" cannot be accepted by the multicast server MSE, it either selects the value of "AGI does not apply" for the call or it transmits an X.6 Multicast Call Rejected message to the member who originated the call. In this case, the Reason field of the X.6 Multicast Call Rejected message indicates that the requested AGI attribute value is not acceptable.

   NOTE 1 – When the value of the multicast call AGI attribute is set to "AGI does not apply", the multicast call Quorum attribute must not have a value (i.e. must be "missing value").

   NOTE 2 – It will not be possible by negotiation to change the AGI attribute from "AGI does not apply" to "AGI applies". Also, it will not be possible by negotiation to change the "missing value" of the Quorum attribute.

   If the value of the multicast call AGI attribute is set to "AGI applies", the MSE of the multicast server starts timer MT_{est} "Multicast Call Establishment Time-out". The value of MT_{est} is taken either from:

   – the group default Pending Call Creation Time-out if no value is requested for the Timer in the received X.6 Join Request message; or

   – the requested value for the timer in the received message. If the requested value cannot be accepted by the multicast server MSE, it either selects an acceptable value or it transmits an X.6 Multicast Call Rejected message to the member who originated the call. In this case, the Reason field of the X.6 Multicast Call Rejected message indicates that the requested timer value is not acceptable.

2) The multicast server MSE adds the member who initiated the establishment of the multicast call to the list of call participants.

3) In case the value of the Join Origination Selection attribute is such that the multicast server MSE sends join invitations to the members of the group, the procedures specified in 10.3.2 are followed. In this case, the multicast server MSE receives an X.6 Join Accepted message from each member who accepted to join the call. The Responding Address field in this message contains the address of the member. The multicast server MSE adds this member to the list of call participants.

4) In case the value of the Join Origination Selection attribute is such that members have to join on their own (i.e. the multicast server does not send the invitation requests), the procedures specified in 10.3.3 are followed. In this case, the multicast server MSE adds a member to the list of call participants if it accepts that member request to join the call.

If the value of the multicast call AGI attribute is set to "AGI applies" and the AGI is satisfied, the following applies:

1) The multicast server MSE stops timer MT_{est}, if running.

   NOTE 3 – The quorum requirement is an example of an AGI. If the quorum requirement is the only condition specified for AGI, then the multicast call Quorum attribute shall have a value (i.e. it must not be "missing value").

2) The multicast server MSE transmits an X.6 Multicast Call Created message to the member who initiated the establishment of the call. The Responding Address field of this message must unambiguously identify (Group ID, Call ID) the call that is created. The Group ID shall be present if the member who initiated the establishment of the call belongs to more than one multicast group, otherwise it may be absent. The Call ID may be absent:

   – if the Call ID that applies to the call is the one that was requested by the member who initiated the establishment of the call; or

   – if no Call ID was requested and only a single multicast call is permitted per the multicast group.

   NOTE 4 – The Group ID shall be present if the Call ID is present.

If the value of the AGI attribute is set to "AGI applies" and timer MT_{est} expires, the multicast server MSE sends an X.6 Leave Request message to each member on the list of call participants. The Reason field in this message shall indicate that the AGI is not satisfied (e.g. the Quorum requirement is not met).

When the X.6 Multicast Call Created message is received by the MSE of the member who initiated the call, it sends an N_JOIN.confirm primitive to its NS user.

The interpretation of the call attributes in the X.6 Create Multicast Call message sent to originate the call and the received X.6 Multicast Call Created message is as follows:

– The absence of an attribute in the X.6 Create Multicast Call message indicates that the default attribute value is requested for the call. The default value may be present in the X.6 Multicast Call Created message. Its absence is an indication that the default value is acceptable.

– The presence of an attribute in the X.6 Create Multicast Call message indicates a request for an attribute value to apply to the call. If the requested attribute value is accepted, it may be present in the X.6 Multicast Call Created message. If the requested attribute value is not acceptable, the attribute value that applies to the call is contained in the X.6 Multicast Call Created message.

  The modification of any of the call attribute values may not be accepted by the member who has originated the call. Its MSE may either terminate the call, if it has the Terminate capability (see 10.3.9.2), or leave the call (see 10.3.9.3).

10.3.1.2 Multicast server initiated

The procedures specified in 10.3.2 are followed. In addition, if the value of the multicast call AGI attribute is set to "AGI applies", the multicast server MSE starts timer MT_{est}. The value of MT_{est} is taken as specified above.

When executing the procedures in 10.3.2, the multicast server MSE receives an X.6 Join Accepted message from each member who accepted to join the call. The Responding Address field in this message contains the address of the member. The multicast server MSE adds this member to the list of call participants.

If the value of the multicast call AGI attribute is set to "AGI applies" and the AGI is satisfied, the multicast server MSE stops timer MT_{est}, if running.

NOTE – The quorum requirement is an example of an AGI condition. If the quorum requirement is the only condition specified for AGI, then the multicast call Quorum attribute shall have a value (i.e. it must not be "missing value").

If the value of the AGI attribute is set to "AGI applies" and timer MT_{est} expires, the multicast server MSE sends an X.6 Leave Request message to each member on the list of call participants. The Reason field in this message shall indicate that the AGI is not satisfied (e.g. the Quorum requirement is not met).

10.3.2 Procedures for inviting member to join a multicast call

The procedures specified in this subclause apply to two cases:

- When setting up a multicast call and the value of the Join Origination Selection attribute is such that the multicast server MSE sends join invitations to the members of the group.

- When inviting a member to join a multicast call in-progress. The multicast server MSE receives an indication to invite a member to join a call in-progress either through some mechanism outside the scope of this Recommendation or from a member with the Include capability (see 10.3.5). Note that the member with the Include capability need not be participating in the multicast call to invite other members.

The multicast server MSE sends an X.6 Invitation to Join message to an invited member. In this message, the Called Address field must unambiguously identify (Group ID, Call ID) the call. The Group ID must be present if the invited member belongs to more than one multicast group, otherwise it must be absent. The Call ID shall be present if more than one multicast call is permitted per the multicast group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

The Multicast Call Attributes field carries requests for values for call attributes. The absence of a requested value for an attribute is an indication that the default value of the attribute is requested for the call.

When the X.6 Invitation to Join message is received by the MSE of the invited member, it sends an N_JOIN.indication primitive to its NS user:

1) If the invitation to join the call is accepted (the invited member NS user responds with an N_JOIN.response primitive), the member MSE responds to the multicast server MSE with an X.6 Join Accepted message. When the multicast server MSE receives this message, it adds the member to the list of call participants.

2) If the invitation to join the call is not accepted (the invited member NS user responds with an N_LEAVE.request primitive), the member MSE responds to the multicast server with an X.6 Join Rejected message. The Reason field in this message contains the cause for not accepting the invitation to join.

The interpretation of the call attributes in the X.6 Invitation to Join message sent to invited member and the X.6 Join Accepted message received by the multicast server MSE is as follows:

- The absence of an attribute in the X.6 Invitation to Join message indicates that the default attribute value is requested for the call. The default value may be present in the X.6 Join Accepted message.

- The presence of an attribute in the X.6 Invitation to Join message indicates a request for an attribute value to apply to the call. If the requested attribute value is accepted, it may be present in the X.6 Join Accepted message. If the requested attribute value is not acceptable, the invited member MSE may modify the value by including a request for a new value in the X.6 Join Accepted message.

  NOTE 1 – It will not be possible by negotiation to change the AGI attribute from “AGI does not apply” to “AGI applies”. Also, it will not be possible by negotiation to change the “missing value” of the Quorum attribute.

  NOTE 2 – In case the X.6 Invitation to Join message is used to invite a member to join a multicast call in-progress, the Multicast Call Attributes field indicates the attribute values that apply to the call in-progress. The modification of any of these values by the invited member may not be accepted by the multicast server MSE and may result in requesting the invited member to leave the call. See 10.3.4.2.

  If the modification of any of the call attribute values cannot be accepted by the multicast server MSE, it will request the member to leave the call by sending an X.6 Leave Request message. The cause field in this message will indicate that the requested parameter value is not acceptable. See 10.3.4.2.

10.3.3 Procedures for joining a multicast call

The procedures specified in this section apply to two cases:

- when setting up a multicast call and members have to join on their own (i.e. the value of the Join Origination Selection attribute is such that the multicast server MSE does not send join invitations to the members of the group);

- when requesting to join a multicast call in-progress.

When receiving an N_JOIN.request primitive from the NS user of a member wishing to join the call, the member MSE sends an X.6 Join Request message to the multicast server MSE. In this message, the Calling Address field contains the address of the member requesting to join. The Called Address field must unambiguously identify (Group ID, Call ID) the multicast call to be joined. The Group ID shall be present if the member requesting to join belongs to more than one multicast group, otherwise it may be absent. The Call ID shall be present if more than one multicast call is permitted per the multicast group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

The Multicast Call Attributes field carries requests for values for call attributes. The absence of a requested value for an attribute is an indication that the default value of the attribute is requested for the call.

When the multicast server MSE receives the X.6 Join Request message, the following applies:

1) If the request to join the call is accepted, the multicast server MSE responds with an X.6 Join Accepted message. When the member MSE receives this message, it sends an N_JOIN.confirm primitive to its NS user.

2) If the request to join the call is not accepted, the multicast server MSE responds with an X.6 Join Rejected message. The Reason field in this message contains the cause for denying the join request. See 10.3.4.2. When the member MSE receives this message, it sends an N_LEAVE.indication primitive to its NS user.

The interpretation of the call attributes in the X.6 Join Request message sent by the member requesting to join and the X.6 Join Accepted message received from the multicast server MSE is as follows:

- The absence of an attribute in the X.6 Join Request message indicates that the default attribute value is requested for the call. The default value may be present in the X.6 Join Accepted message.

- The presence of an attribute in the X.6 Join Request message indicates a request for an attribute value to apply to the call. If the requested attribute value is accepted, it may be present in the X.6 Join Accepted message. If the requested attribute value is not acceptable, the multicast server MSE may modify the value by including a request for a new value in the X.6 Join Accepted message.

- If the modification of any of the call attribute values cannot be accepted (the NS user of the member requesting to join sends an N_LEAVE.request primitive), the member MSE will leave the call by sending an X.6 Leave Request message. The Reason field in this message shall indicate that the requested parameter value is not acceptable. The Clearing Address field in this message shall contain the address of the member refusing to join the call. See 10.3.4.3.

10.3.4 Procedures for leaving/refusing to join a multicast call

10.3.4.1 Procedures for leaving a multicast call by a call participant

A participant (except a participant with the Terminate capability or the participant who initiated the establishment of the call in case no participant in the call has the Terminate capability) may leave the multicast call at any time. When receiving an N_LEAVE.request primitive from the NS user, the participant's MSE sends an X.6 Leave Request message to its peer in the multicast server. In this message, the Reason field indicates the cause for the leave request. The Called Address field must unambiguously identify the call (Group ID, Call ID). The Group ID shall be present if the participant

is participating in more than one multicast call that does not belong to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one multicast call for the same group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

When the X.6 Leave Request message is received by the multicast server MSE, it removes the participant from the list of call participants.

10.3.4.2 Procedures for requesting a call participant to leave a multicast call

The multicast server MSE will request a participant to leave the call by sending an X.6 Leave Request message when one of the following conditions occurs:

- The multicast server MSE determines that the agreed to minimum throughput cannot be maintained (see clause 12).

- The multicast server MSE receives an indication to exclude a participant from the call. This indication may be either through some mechanism outside the scope of this Recommendation or from a member with the Exclude capability (see 10.3.8). Note that the member with the Exclude capability need not be participating in the multicast call to exclude active participants.

In the X.6 Leave Request message sent by the multicast server MSE, the Reason field contains the cause for the leave request. The Called Address field must unambiguously identify the call (Group ID, Call ID). The Group ID shall be present if the participant that is requested to leave is participating in more than one multicast call not belonging to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one multicast call belonging to the same group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

When the X.6 Leave Request message is received by the MSE of the participant who is requested to leave, it sends an N_LEAVE.indication primitive to the participant's NS user.

10.3.4.3 Procedures for refusing to join a multicast call

A member may refuse to accept an invitation to join a multicast call. When receiving an N_LEAVE.request primitive from the NS user, the member's MSE sends an X.6 Leave Request message to its peer in the multicast server. In this message, the Clearing Address field contains the address of the member refusing to join the call. The Reason field indicates the cause for the leave request. The Called Address field must unambiguously identify the call (Group ID, Call ID). The Group ID shall be present if the participant is participating in more than one multicast call that do not belong to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one multicast call for the same group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

When the X.6 Leave Request message is received by the multicast server MSE, it does not add the member to the list of call participants.

10.3.5 Procedures for multicast call termination

10.3.5.1 General

The procedure for multicast call termination is initiated when one of the following conditions occurs:

- A participant in the call with the Terminate capability sends an X.6 Terminate message to the multicast server.

- A member with the Terminate capability and not participating in the multicast call sends an X.6 Terminate message to the multicast server to terminate the call.

- The participant who has originated the call sends an X.6 Leave Request message to the multicast server in case the AGI call attribute is set to "AGI does not apply" and no participant in the call has the Terminate capability.

NOTE 1 – The multicast call may not be terminated without specifying these conditions. If another participant has the Terminate capability, then the call will be terminated when that member sends an X.6 Terminate message. If no member has the Terminate capability but the AGI attribute is set to "AGI applies", then the call will be terminated when the AGI are no longer satisfied.

NOTE 2 – In order that the call is not prematurely disconnected, a participant, if included in the Call status Request list, will be able to request information regarding the status of the multicast call to determine whether or not other participants in the call have the Terminate capability.

- The Active Group Integrity is no longer satisfied.

NOTE 3 – If the quorum requirement is the only condition specified for AGI, then the procedure for multicast call termination is initiated when the number of participants in the call falls below the number required by the call attribute Quorum.

- The multicast server receives an indication to terminate the multicast call through some mechanisms outside the scope of this Recommendation.

10.3.5.2 Termination by participant with Terminate capability

When receiving an N_LEAVE.request primitive from the NS user of a participant with the Terminate capability, the participant MSE sends an X.6 Terminate message to the multicast server MSE. In this message, the Called Address field must unambiguously identify the multicast call to be terminated. The Group ID shall be present if the participant is participating in more than one call not belonging to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one call for the same identified group, otherwise it may be absent. The Group ID shall be present if the Call ID is present. The Reason field indicates the cause for the termination request.

When the X.6 Terminate message is received at the multicast server MSE, the following applies:

1) If the value of the multicast call AGI attribute is set to "AGI applies," the multicast server MSE starts Timer MT_{term} "Multicast Call Termination Time-out." The value of MT_{term} is taken either from:

   – the group default Pending Call Termination Time-out if no value was requested for the Timer when the call was established; or

   – the requested value for the timer when the call was established.

   If the AGI attribute is set to "AGI does not apply," the multicast server MSE responds to the member requesting call termination with an X.6 Multicast Call Terminated message. The Called Address field in this message contains the address of the member requesting call termination.

2) The multicast server MSE issues an X.6 Multicast Call Terminated message to each participant in the call to be terminated. In each message sent, the Called Address field must unambiguously identify the call to be terminated. The Group ID shall be present if the participant is participating in more than one call not belonging to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one call for the identified group, otherwise it may be absent. The Group ID shall be present if the Call ID is present. The Reason field indicates the cause provided by the member requesting call termination.

   When the X.6 Multicast Call Terminated message is received by each participant in the call (with the exception of the participant who requested the call termination), the participant MSE sends an N_LEAVE.indication primitive to its NS user.

3) If the value of the multicast call AGI attribute is set to "AGI applies" and the AGI is no longer satisfied, the multicast server MSE stops timer MT_{term}, if running, and sends an X.6 Multicast Call Terminated message to the member who has requested the call termination.

   NOTE – In case the quorum requirement is the only condition specified for AGI, then the multicast server MSE stops timer MT_{term} and sends the X.6 Multicast Call Terminated message if the number of participants who have left the call falls below the minimum required by the Quorum attribute.

   If the value of the multicast call AGI attribute is set to "AGI applies" and timer MT_{term} expires, the multicast server MSE sends an X.6 Multicast Call Terminated message to the member who has requested the call termination.

The member who has requested the call termination will not receive the X.6 Multicast Call Terminated message because the subnetwork dependent mapping sublayer of the multicast server MSE discards the X.6 Multicast Call Terminated message when it maps its corresponding SMM_DISCONNECT.request primitive (see 10.4) into Network Internal Layer Service (NILS) primitive (see 11.2.2.1). The reason is that the virtual circuit on the SNAcP (X.25 PLP/8208) sublayer has already been cleared with a Clear Confirmation packet that was sent back by this sublayer when it received the X.25 Clear Request packet containing the X.6 Terminate message from the member who has requested the call termination. Note that according to Recommendation X.6, it is an optional procedure for the member who has requested the call termination to receive an X.6 Call Terminated message as a confirmation for its request to terminate the call.

10.3.5.3 Termination by member with Terminate capability

A member with the Terminate capability may initiate the procedures to terminate a multicast call without being a participant in the call.

A member with the Terminate capability sends an X.6 Terminate message to the multicast server. The Reason field indicates the cause for the termination request. The Called Address field must unambiguously identify the multicast call to be terminated. The Group ID shall be present if the member belongs to more than one multicast group, otherwise it may be absent. The Call ID shall be present if more than one multicast call is permitted for the same identified group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

When the multicast server receives the X.6 Terminate message, it follows the procedures specified in 10.3.5.2 above.

10.3.5.4 Termination by initiator

In case the AGI call attribute is set to "AGI does not apply" and no participant in the call has the Terminate capability, the member who has initiated the call may initiate the procedures to terminate the call.

When receiving an N_LEAVE.request primitive from its member NS user, the MSE sends an X.6 Leave Request message to its peer in the multicast server. The Reason field indicates the cause to leave the call. The Called Address field must unambiguously identify the multicast call to be terminated. The Group ID shall be present if the participant is participating in more than one multicast call not belonging to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one call belonging to the identified group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

When the multicast server MSE receives the X.6 Leave Request message, the following applies:

1) The multicast server MSE determines that the X.6 Leave Request message was sent by the participant who initiated the establishment of the call. If no call participant has the Terminate capability and the AGI does not apply, the multicast server MSE responds back to the participant requesting the leave with an X.6 Multicast Call Terminated message. The Called Address field in this message contains the address of the member requesting the leave.

   The member who has requested to leave will not receive an indication that the leave request has resulted in the termination of the call because the subnetwork dependent sublayer of the multicast server MSE discards the X.6 Multicast Call Terminated message when it maps its corresponding SMM_DISCONNECT.request primitive (see 10.4) into NILS primitive (see 11.2.2.1). The reason is that the virtual circuit on the SNAcP (X.25 PLP/8208) sublayer has already been cleared with a Clear Confirmation packet that was sent back by this sublayer when it received the X.25 Clear Request packet containing the X.6 Leave Request message from the member who has initiated the call.

   NOTE 1 – If a call participant has the Terminate capability, the procedures specified in 10.3.5.2 apply.

   NOTE 2 – If the AGI does apply for the call, the procedures in 10.3.5.5 apply.

2) The multicast server MSE issues an X.6 Multicast Call Terminated message to each participant in the call to be terminated. The procedures specified in step 2) of 10.3.5.2 are followed.

10.3.5.5 Loss of AGI

If the multicast call AGI attribute is set to "AGI does not apply" and the AGI is no longer satisfied, the multicast server issues an X.6 Call Terminated message to the participants in the call to be terminated. The Reason field indicates the cause for call termination (in this case, loss of AGI). The Called Address field must identify the call to be terminated. The Group ID shall be present if the participant in the call is participating in more than one multicast call that does not belong to the same group, otherwise it may be absent. The Call ID shall be present if the participant is participating in more than one call that does belong to the identified group, otherwise it may be absent. The Group ID shall be present if the Call ID is present.

NOTE – In case the quorum requirement is the only condition specified for AGI, then the multicast server MSE sends the X.6 Multicast Call Terminated message if the number of participants in the call falls below the minimum required by the Quorum attribute.

When the X.6 Multicast Call Terminated message is received by a participant in the call, its MSE sends an N_LEAVE.indication primitive to its NS user.

10.3.5.6 Multicast server initiated termination

The multicast server may initiate the procedures to terminate a multicast call:

- when it receives an indication to terminate the call through some mechanisms outside the scope of this Recommendation; or
- for service-specific reasons.

The procedures specified in 10.3.5.5 above are followed.

10.3.6 Procedures for Join/Leave Notification

A member with the Receive Join/Leave Notification capability may receive notifications when other members of the group join and/or leave a multicast call. The member needs to be participating in the call to receive the notifications.

The multicast server MSE sends an X.6 Join/Leave Notification message to the member with the Receive Join/Leave Notification capability. A single X.6 Join/Leave Notification message may identify more than one multicast call in case the member with the Receive Join/Leave Notification capability is participating in more than one call. The multicast call must be unambiguously identified as follows. The Group ID shall be present if the member with the Receive Join/Leave Notification capability is participating in more than one call that not belonging to the same group, otherwise it may be absent. The Call ID shall be present if the member is participating in more than one call for the same group, otherwise it may be absent. For each call, the message contains the address of each member that has joined or has left that call. For each member, an indication is given whether the notification is join or leave.

10.3.7 Procedures to include a member in a multicast call in progress

A member with the Invite capability may invite another member of the multicast group to join a multicast call in progress. The member need not be participating in the call to invite another member into the call.

NOTE 1 – The Invite capability applies to a given multicast group, i.e. a member with the Invite capability in a given group cannot invite members that belong to another group to join a call in progress.

The MSE of the member with the Invite capability sends an X.6 Include Member message to the multicast server. The Calling Address field in the X.6 Include Member message contains the address of the member sending the invitations. A single X.6 Include Member message may identify more than one multicast call and for each call, the message may identify more than one member to be invited (the message contains the address of each invited member to a given multicast call). A multicast call must be unambiguously identified. The Group ID may be absent if the inviting member holds the Invite capability for a single group, otherwise it shall be present. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

NOTE 2 – The Group ID and the Call ID may be absent in case the member with the Invite capability is participating in a single call and is inviting members to join that call.

When the X.6 Include Member message is received by the multicast server, its MSE shall follow the procedures specified in 10.3.2 for inviting each member to join the call.

When receiving X.6 Join Accepted messages and/or Join Rejected messages from the invited members, the multicast server MSE responds back to the member who has sent the X.6 Include message with an X.6 Member Included message. A single X.6 Member Included message may identify more than one multicast call and for each call, the message contains the address of each invited member with an indication of whether the join is accepted or rejected. A multicast call must be unambiguously identified. The Group ID may be absent if the member who has sent the X.6 Include message has the Invite capability for a single group, otherwise it shall be present. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

NOTE 3 – The Group ID and the Call ID may be absent in case the member who has sent the X.6 Include message is participating in a single multicast call and the X.6 Member Included message reports on the invitations extended to participate in that call.

10.3.8 Procedures to exclude a member from a multicast call in progress

A member with the Exclude capability may exclude another member of the multicast group from a multicast call in progress. The member need not be participating in the call to exclude another member from the call.

NOTE 1 – The Exclude capability applies to a given multicast group, i.e. a member with the Exclude capability in a given group cannot exclude members that belong to another group from a call in progress.

The MSE of the member with the Exclude capability sends an X.6 Exclude Member message to the multicast server. The Calling Address field in the X.6 Exclude Member message contains the address of the member sending the exclude requests. A single X.6 Exclude Member message may identify more than one multicast call and for each call, the message may identify more than one member to be excluded (the message contains the address of each member to be excluded from a given multicast call). A multicast call must be unambiguously identified. The Group ID may be absent if the excluding member holds the Exclude capability for a single group, otherwise it shall be present. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

NOTE 2 – The Group ID and the Call ID may be absent in case the member with the Exclude capability is participating in a single call and is excluding members from that call.

When the X.6 Exclude Member message is received by the multicast server, its MSE shall follow the procedures specified in 10.3.4.2 for requesting each member to leave the call.

After completing the procedures specified in 10.3.4.2, the multicast server MSE responds back to the member who has sent the X.6 Exclude message with an X.6 Member Excluded message. A single X.6 Member Excluded message may identify more than one multicast call and for each call, the message contains the address of each excluded member. A multicast call must be unambiguously identified. The Group ID may be absent if the member who has sent the X.6 Exclude message has the Exclude capability for a single group, otherwise it shall be present. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

NOTE 3 – The Group ID and the Call ID may be absent in case the member who has sent the X.6 Exclude message is participating in a single multicast call and the X.6 Member Excluded message reports on the exclusions from that call.

10.3.9 Procedures for Join Permission

Only one member of a multicast group can be designated as the member with the Join Permission capability. This member confirms or denies requests by potential participants to join a multicast call established among the members of the group. The member need not be participating in the call to confirm or deny the join requests.

NOTE 1 – The Join Permission capability applies to a given multicast group, i.e. a member with the Join Permission capability in a given group cannot confirm or deny requests by potential participants to join a multicast call established among members of another group.

The multicast server MSE sends an X.6 Permission Request message to the member with the Join Permission capability. A single X.6 Permission Request message may identify more than one multicast call and for each call, the message may identify more than one member for which permission to join is requested (the message contains the address of each member). A multicast call must be unambiguously identified. The Group ID shall be present if the member granting permission holds the Join Permission capability for a single group, otherwise it may be absent. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

NOTE 2– The Group ID and the Call ID may be absent in case the member with the Join Permission capability is participating in a single call and permissions are requested to join that call.

When the X.6 Join Permission Request message is received by the member with the Join Permission capability, its MSE responds back to the multicast server with an X.6 Join Permission Response message. A single X.6 Join Permission Response message may identify more than one multicast call and for each call, the message contains the address of each member for which a join permission is requested. For each member, an indication is given whether the join permission is granted or denied. A multicast call must be unambiguously identified. The Group ID may be absent if the member who has sent the X.6 Join Permission Request message has the Join Permission capability for a single group, otherwise it shall be present. The Call ID may be absent if a single multicast call is permitted per the unambiguously identified multicast group, otherwise it shall be present.

10.3.10 Multicast status

10.3.10.1 Multicast Group Status

The Group Status capability (see 6.7.1/X.6) provides information about a multicast group. A member who is authorized to request group status information need not be participating in a multicast call to request group status information. The following information may be provided:

- the list of members of the multicast group;
- the capabilities (e.g. initiator, sender, receiver, etc.) of each member of the multicast group;
- the default group attributes (see 7.2); and
- the multicast calls that are active in the group.

Other items are for further study.

The member MSE sends an X.6 Group Status Request message to its multicast server peer. The message must unambiguously identify the group for which the status is requested. The Group ID shall be present if the member belongs to more than one multicast group, otherwise it may be absent.

When the multicast server receives the X.6 Group Status Request message, its MSE responds back to the member requesting the information with an X.6 Group Status Response message. If the member is not authorized to receive the group status information, the X.6 Group Status Response message will contain an indication that the request is denied. If authorized, it will contain the requested information.

10.3.10.2 Multicast Call Status

The Call Status capability (see 6.7.2/X.6) provides information about a multicast call. A member who is authorized to request call status information need not be participating in the call to request call status information. The following information may be provided:

- the list of the members participating in the call;
- the capabilities (e.g. initiator, sender, receiver, etc.) of each member participating in the call; and
- the call attributes.

Other items are for further study.

The member MSE sends an X.6 Call Status Request message to its multicast service peer. The message must unambiguously identify the multicast call for which the status is requested. The Group ID shall be present if the member belongs to more than one multicast group, otherwise it may be absent. The Call ID shall be present if more than one multicast call is permitted per the unambiguously identified group, otherwise it may be absent.

When the multicast server receives the X.6 Call Status Request message, its MSE responds back to the member requesting the information with an X.6 Call Status Response message. If the member is not authorized to receive the call status information, the X.6 Call Status Response message will contain an indication that the request is denied. If authorized, it will contain the requested information.

10.4 Mapping between X.6 messages and SMM primitives

The mapping between X.6 messages and SMM primitives is defined in Table 3. The interpretation of Table 3 is as follows:

- The X.6 messages do not correspond one-to-one to the SMM primitives. For instance, it is possible to map a Create Multicast Call, a Join Request or an Invitation to Join message to an SMM_CONNECT.request or from an SMM_CONNECT.indication primitive. The particular message to be mapped is identified by the SMM Connect Type parameter in the primitive.
- The fields of a given X.6 message correspond one-to-one-to the parameters of the SMM primitive that mapped to that message.

11 Subnetwork Dependent Mapping Sublayer

11.1 Services provided by the Subnetwork Dependent Mapping Sublayer

The service primitives and parameters provided by the Subnetwork Dependent Mapping Sublayer are those defined in Table 2.

11.2 Services assumed by the Subnetwork Dependent Mapping Sublayer

The service assumed by the Subnetwork Dependent Mapping Sublayer on its lower service boundary, referred to in this Recommendation with the prefix "NI" (for "Network Internal"), is the Network Internal Layer Service (NILS) specified in ISO/IEC 10177 with the following extensions:

- The sequence of NI_DATA.request primitives corresponding to a single NSDU, as defined in ISO/IEC 10028, corresponds in the protocol mapping to an ISO/IEC 8208 M-bit sequence of DATA packets, with each packet having the Qualifier Bit (Q-bit) set to the same value. The Q-bit in each DATA packet is set to zero if the sequence of NI_DATA.request primitives conveys user data. The Q-bit in each DATA packet is set to one if the sequence of NI_DATA.request primitives conveys control data.

  NOTE – According to ISO/IEC 10177, the Q-bit in each Data packet is always set to zero.

- The NI-User-Data parameter in this Recommendation corresponds to NS-User Data parameter in ISO/IEC 10177.

11.2.1 SMM CONNECT

11.2.1.1 SMM_CONNECT.request

When receiving an SMM_CONNECT.request primitive, the Subnetwork Dependent Mapping Entity (SNDME) constructs a message block as follows:

a) A one octet protocol identifier coded as "1010 0100" that serves to identify the multicast service.

b) A message code attribute (attribute type and attribute value fields) that is used to identify the type of X.6 message as Create Multicast Call, Join Request or Invitation to Join. The type of X.6 message is taken from the SMM Connect Type parameter of the received SMM_CONNECT.request primitive.

c) The Call ID attribute (attribute type and attribute value fields) if the Call ID is present in the SMM Called Address parameter of the received primitive.

d) The contents of the SMM Multicast Call Attributes parameter of the received primitive.

e) The contents of the SMM User-Data parameter, if present in the received primitive.

TABLE 3/X.49

Mapping between X.6 messages and SMM primitives

X.6 Message and Fields	SMM Primitive and Parameters
Create Multicast Call **Join Request** **Invitation to Join**	**SMM_CONNECT.request** **SMM_CONNECT.indication**
	SMM Connect Type
Calling Address	SMM Calling Address
Called Address	SMM Called Address
Multicast Call Attributes	SMM Multicast Call Attributes
QOS	SMM QOS Parameter Set
User-Data	SMM User-Data
Multicast Call Created **Join Accepted**	**SMM_CONNECT.response** **SMM_CONNECT.confirm**
	SMM Connect Type
Responding Address	SMM Responding Address
Multicast Call Attributes	SMM Multicast Call Attributes
QOS	SMM QOS Parameter Set
User-Data	SMM User-Data
Terminate Multicast Call **Leave Request**	**SMM_DISCONNECT.request** **SMM_DISCONNECT.indication**
	SMM Disconnect Type
Reason	SMM reason
Multicast Call Attributes	SMM Multicast Call Attributes
User-Data	SMM User-Data
Called address	SMM Called Address
Multicast Call Terminated **Join Rejected**	**SMM_DISCONNECT.indication** **SMM_DISCONNECT.request**
	SMM Disconnect Type
Reason	SMM reason
Originator	SMM originator (Note 1)
Multicast Call Attributes	SMM Multicast Call Attributes
User-Data	SMM User-Data
Responding Address (Note 2)	SMM Responding Address (Note 3)
Called address	SMM Called Address
Data **Include Member** **Member Included** **Exclude Member** **Member Excluded** **Join Permission Request** **Join Permission Response** **Join/Leave Notification** **Group Status Request** **Group Status Response** **Call Status Request** **Call Status Response**	**SMM_DATA.request** **SMM_DATA.indication**
	SMM Data Type (Note 4)
Called address	SMM Called Address
User-Data	SMM User-Data
	SMM Control Data Type (Note 5)
Multicast Attributes	SMM Control Data Attributes

NOTE 1 – The SMM Originator parameter is permitted only in the SMM_DISCONNECT.indication primitive.

NOTE 2 – The Responding Address field is permitted only in the X.6 Join Rejected message.

NOTE 3 – The SMM Responding Address parameter is permitted only when the SMM Disconnect Type parameter is Join Rejected.

NOTE 4 – The SMM Data Type parameter is either User Data or Control Data.

NOTE 5 – The SMM Control Data Type parameter is one of the following: Include Member, Member Included, Exclude Member, Member Excluded, Join Permission Request, Join Permission Response, Join/Leave Notification, Group Status Request, Group Status Response, Call Status Request or Call Status Response. Depending on the type, the attributes are given in the SMM Control Data Attributes parameter.

Two cases are identified:

Case 1: If the length of the resulting message block is not longer than 128 octets and if the Fast Select facility is available at the X.25 PLP/8208 sublayer, the SNDME constructs an NI_CONNECT.request primitive as follows:

1) The NI Calling Address parameter is set to the contents of the SMM Calling Address parameter, if present in the received primitive. If not present, it is set to the local SNDME NI-address.

2) The NI Called Address parameter is set to the Group ID, if present in the SMM Called Address parameter of the received primitive. If not present, the entity belongs to a single multicast group and the NI Called Address parameter is set to that Multicast Group ID.

3) The NI Expedited Data Selection parameter is not set.

4) The NI QOS Parameter Set is set to the contents of the SMM QOS Parameter Set.

5) The NI User-Data parameter is set to the constructed message block.

The SNDME delivers the NI_CONNECT.request primitive to the X.25 PLP/8208 sublayer.

Case 2: If the length of the resulting message block is longer than 128 octets or if the Fast Select facility is not available at the X.25 PLP/8208 sublayer, the SNDME constructs an NI_CONNECT.request primitive as follows:

1) the NI Calling Address parameter is set as above;

2) the NI Called Address parameter is set as above;

3) the NI Expedited Data Selection parameter is not set;

4) the NI QOS Parameter Set is set as above;

5) the NI User-Data parameter is set as follows:

   a) A one octet protocol identifier coded as “1010 0100” that serves to identify the multicast service.

   b) The Continuation attribute (attribute type and attribute value fields). The Continuation parameter indicates that the additional information regarding the multicast call will be conveyed in a sequence of NI_DATA.request primitives.

The SNDME delivers the NI_CONNECT.request primitive to the X.25 PLP/8208 sublayer and enters the Wait_to_Deliver_Multicast_Call_Attributes state.

The SNDME awaits the receipt of an NI_CONNECT.confirm primitive. When it is received, the SNDME composes an NISDU from the previously constructed message block. The SNDME sends the NISDU as a sequence of NI_DATA.request primitives, as defined in ISO/IEC 10028 and transfers from the Wait_to_Deliver_Multicast_Call_Attributes state to the Wait_to_Confirm_Multicast_Call_Attributes state.

NOTE – Throughout this Recommendation, a sequence of NI_DATA primitives may consist of a single primitive.

11.2.1.2 SMM_CONNECT.indication

When receiving an NI_CONNECT.indication primitive, the SNDME determines if the Fast Select facility was used at the X.25 PLP/8208 sublayer. This information shall be held for use in processing the SMM_CONNECT.response primitive as described in 11.2.1.3.

Case 1: The SNDME determines that the Fast Select facility was used at the X.25 PLP/8208 sublayer. The SNDME constructs an SMM_CONNECT.indication primitive as follows:

1) The SMM Connect Type parameter is copied from the message code attribute (i.e. Create Multicast Call, Join Request, Invitation to Join) in the received NI-User-Data parameter.

2) The SMM Calling Address parameter is copied from the NI Calling Address parameter of the received primitive.

3) The SMM Called Address parameter is constructed as follows:

   a) The Group ID is copied from the NI Called Address parameter of the received primitive.

   b) The Call ID is copied from the NI-User-Data parameter, if present. If not present, the SMM Called Address parameter will not contain a Call ID.

4) The SMM QOS Parameter Set is copied from the NI QOS Parameter Set of the received primitive.

5) The SMM Multicast Call Attributes parameter is copied from the NI-User-Data parameter.

6) The SMM User-Data parameter is copied from the NS-user-data parameter, if present in the NI User-Data parameter of the received primitive.

The SNDME delivers the SMM_CONNECT.indication primitive to the MSE.

Case 2: The SNDME determines that the Fast Select facility was not used at the X.25 PLP/8208 sublayer. In this case, the Continuation attribute is present in the NI-User-Data parameter of the received NI_CONNECT.indication primitive. The SNDME responds with an NI_CONNECT.response primitive and enters the Wait_to_Receive_Multicast_Call_Attributes state. The SNDME awaits the receipt of the multicast call attributes in a sequence of NI_DATA.indication primitives that corresponds to a single NISDU, as defined in ISO/IEC 10028. When the NISDU is received, the SNDME constructs an SMM_CONNECT.indication primitive as follows:

1) The SMM Connect Type parameter is copied from the message code attribute (i.e. Create Multicast Call, Join Request, Invitation to Join) in the received NISDU.

2) The SMM Calling Address parameter is copied from the NI Calling Address parameter of the received NI_CONNECT.indication primitive.

3) The SMM Called Address parameter is constructed as follows:

   a) The Group ID is copied from the NI Called Address parameter of the received NI_CONNECT.indication primitive.

   b) The Call ID is copied from the received NISDU, if present. If not present, the SMM Called Address parameter will not contain a Call ID.

4) The SMM QOS Parameter Set is copied from the NI QOS Parameter Set of the received NI_CONNECT.indication primitive.

5) The SMM Multicast Call Attributes parameter is copied from the received NISDU.

6) The SMM User-Data parameter is copied from the NS-user-data parameter, if present in the received NISDU.

The SNDME delivers the SMM_CONNECT.indication primitive to the MSE and exits the Wait_to_Receive_Multicast_Call_Attributes state.

11.2.1.3 SMM_CONNECT.response

When receiving an SMM_CONNECT.response primitive, the SNDME constructs a message block as follows:

a) A one octet protocol identifier coded as “1010 0100” that serves to identify the multicast service.

b) A message code attribute (attribute type and attribute value fields) that is used to identify the type of X.6 message as Multicast Call Created or Join Accepted. The type of X.6 message is taken from the SMM Connect Type parameter of the received primitive.

c) The Call ID attribute (attribute type and attribute value fields) if the Call ID is present in the SMM Responding Address parameter of the received primitive.

d) The contents of the SMM Multicast Call Attributes parameter of the received primitive.

e) The contents of the SMM User-Data parameter, if present in the received primitive.

Two cases are identified:

Case 1: The Fast Select facility was used at the X.25 PLP/8208 sublayer (See Section 11.2.1.2). In this case, two subcases are identified:

Case A: If the length of the resulting message block is not longer than 128 octets, the SNDME constructs an NI_CONNECT.response primitive as follows:

- The NI Responding Address parameter is set to contents of the SMM Responding Address parameter, if present in the received primitive. If not present, the entity belongs to a single multicast group and the NI Responding Address parameter is set to that Multicast Group ID.
- The NI Expedited Data Selection parameter is not set.
- The NI QOS Parameter Set is set to the contents of the SMM QOS Parameter Set.
- The NI User-Data parameter is set to the constructed message block.

The SNDME delivers the NI_CONNECT.response primitive to the X.25 PLP/8208 sublayer.

Case B: If the length of the resulting message block is longer than 128 octets, the SNDME constructs an NI_CONNECT.response primitive as follows:

- the NI Responding Address parameter is set as above;
- the NI Expedited Data Selection parameter is not set;
- the NI QOS Parameter Set is set as above;
- the NI User-Data parameter is set as follows:

  a) A one octet protocol identifier coded as "1010 0100" that serves to identify the multicast service.

  b) The Continuation attribute (attribute type and attribute value fields). The Continuation parameter indicates that the additional information regarding the multicast call will be conveyed in a sequence of NI_DATA.request primitives.

The SNDME delivers the NI_CONNECT.response primitive to the X.25 PLP sublayer and enters the Wait_to_Deliver_Multicast_Call_Attributes state. The SNDME then composes an NISDU from the previously constructed message block. The SNDME sends the NISDU as a sequence of NI_DATA.request primitives (as defined in ISO/IEC 10028) and exits the Wait_to_Deliver_Multicast_Call_Attributes state.

Case 2: The Fast Select facility was not used at the X.25 PLP/8208 sublayer (See 11.2.1.2). In this case, the SNDME composes an NISDU from the constructed message block. The SNDME sends the NISDU as a sequence of NI_DATA.request primitives, as defined in ISO/IEC 10028.

11.2.1.4 SMM_CONNECT.confirm

The SNDME determines if the Fast Select facility was used at the X.25 PLP/8208 sublayer.

Case 1: The SNDME determines that the Fast Select facility was used at the X.25 PLP/8208 sublayer. When receiving an NI_CONNECT.confirm primitive, the SNDME examines the NI-User-Data parameter.

Case A: If the Continuation attribute is not present, the SNDME constructs an SMM_CONNECT.confirm primitive as follows:

- the SMM Connect Type parameter is copied from the message code attribute (i.e. Multicast Call Created, Join Accepted) in the received NI-User-Data parameter;

- the SMM Responding Address parameter is copied from the NI Responding Address parameter of the received primitive;
- the SMM QOS Parameter Set is copied from the NI QOS Parameter Set of the received primitive;
- the SMM Multicast Call Attributes parameter is copied from the NI-User-Data parameter;
- the SMM User-Data parameter is copied from the NS-user-data parameter, if present in the NI User-Data parameter of the received primitive.

The SNDME delivers the SMM_CONNECT.confirm primitive to the MSE.

Case B: If the Continuation attribute is present, the SNDME enters Wait_to_Receive_Multicast_Call_Attributes state. The SNDME awaits the receipt of the multicast call attributes in a sequence of NI_DATA.indication primitives that corresponds to a single NISDU, as defined in ISO/IEC 10028. When the NISDU is received, the SNDME constructs an SMM_CONNECT.confirm primitive as follows:

- the SMM Connect Type parameter is copied from the message code attribute (i.e. Multicast Call Created, Join Accepted) in the received NISDU;
- the SMM Responding Address parameter is copied from the NI Responding Address parameter of the received NI_CONNECT.confirm primitive;
- the SMM QOS Parameter Set is copied from the NI QOS Parameter Set of the received NI_CONNECT.confirm primitive;
- the SMM Multicast Call Attributes parameter is copied from the received NISDU;
- the SMM User-Data parameter is copied from the NS-user-data parameter, if present in the received NISDU.

The SNDME delivers the SMM_CONNECT.confirm primitive to the MSE and exits the Wait_to_Receive_Multicast_Call_Attributes state.

Case 2: The SNDME determines that the Fast Select facility was not used at the X.25 PLP/8208 sublayer. In this case, the SNDME is in the Wait_to_Confirm_Multicast_Call_Attributes state. In this state, the SNDME awaits the receipt of the multicast call attributes in a sequence of NI_DATA.indication primitives that corresponds to a single NISDU, as defined in ISO/IEC 10028. When the NISDU is received, the SNDME constructs an SMM_CONNECT.confirm primitive as follows:

1) the SMM Connect Type parameter is copied from the message code attribute (i.e. Multicast Call Created, Join Accepted) in the received NISDU;
2) the SMM Responding Address parameter is copied from the NI Responding Address parameter of the previously received NI_CONNECT.confirm primitive;
3) the SMM QOS Parameter Set is copied from the NI QOS Parameter Set of the previously received NI_CONNECT.confirm primitive;
4) the SMM Multicast Call Attributes parameter is copied from the received NISDU;
5) the SMM User-Data parameter is copied from the NS-user-data parameter, if present in the received NISDU.

The SNDME delivers the SMM_CONNECT.confirm primitive to the MSE and exits the Wait_to_Confirm_Multicast_Call_Attributes state.

11.2.1.5 Sequence of SMM CONNECT Primitives

Figure 4 illustrates the sequence of SMM CONNECT primitives.

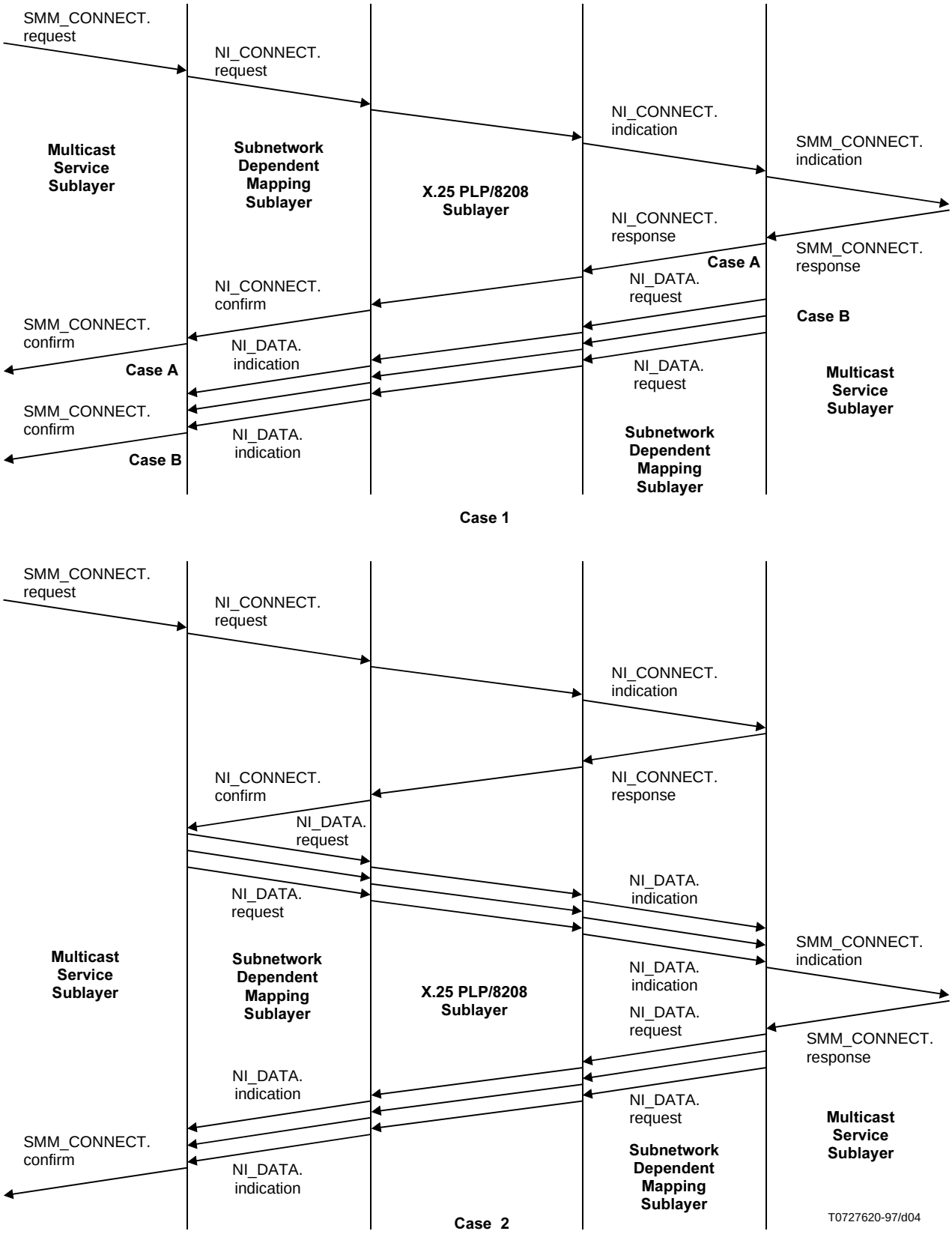


FIGURE 4/X.49

Sequence of SMM CONNECT Primitives

11.2.2 SMM DISCONNECT

11.2.2.1 SMM_DISCONNECT.request

When receiving an SMM_DISCONNECT.request primitive, a distinction is made between two cases:

Case 1: The multicast call was set up using the Fast Select facility. The SNDME first constructs a message block as follows:

a) A one octet protocol identifier coded as "1010 0100" that serves to identify the multicast service.

b) A message code attribute (attribute type and attribute value fields) that is used to identify the type of X.6 message as Join Rejected, Leave Request, Terminate Multicast Call or Multicast Call Terminated. The type of X.6 message is taken from the SMM Disconnect Type parameter of the received primitive.

c) The Group ID attribute (attribute type and attribute value fields) if the Group ID is present in the SMM Called Address parameter of the received primitive.

d) The Call ID attribute (attribute type and attribute value fields) if the Call ID is present in the SMM Called Address parameter of the received primitive.

e) The NS-user-data (attribute type and attribute value fields) if the SMM User-Data parameter is present in the received primitive.

The SNDME then constructs an NI_DISCONNECT.request primitive as follows:

1) The NI Responding Address parameter is set to the contents of the SMM Responding Address parameter in case the received SMM_DISCONNECT.request primitive is the result of refusal to join the multicast call.

2) The NI Reason parameter is set to the contents of the SMM Reason parameter in the received SMM_DISCONNECT.request primitive.

3) The NI User-Data parameter is set to the constructed message block.

The SNDME delivers the NI_DISCONNECT.request primitive to the X.25 PLP/8208 sublayer.

Case 2: The multicast call was set up without the Fast Select facility. The SNDME first constructs an NISDU as follows:

a) A one octet protocol identifier coded as "1010 0100" that serves to identify the multicast service.

b) A message code attribute (attribute type and attribute value fields) that is used to identify the type of X.6 message as Join Rejected, Leave Request, Terminate Multicast Call or Multicast Call Terminated. The type of X.6 message is taken from the SMM Disconnect Type parameter of the received SMM_DISCONNECT.request primitive.

c) The NI Responding Address parameter is set to the local SNDME N-address in case the received SMM_DISCONNECT.request primitive is the result of refusal to join the multicast call.

d) The Group ID attribute (attribute type and attribute value fields) if the Group ID is present in the SMM Called Address parameter of the received SMM_DISCONNECT.request primitive.

e) The Disconnect Reason parameter is set to disconnection-normal condition.

f) The Call ID attribute (attribute type and attribute value fields) if the Call ID is present in the SMM Called Address parameter of the received SMM_DISCONNECT.request primitive.

g) The NS-user-data (attribute type and attribute value fields) if the SMM User-Data parameter is present in the received primitive.

The multicast server then delivers the NISDU as a sequence of NI_DATA.request primitives as defined in ISO/IEC 10028 to the X.25 PLP/8208 sublayer. The Data Type parameter in this sequence indicates Control Data.

It is recommended that the X.25 PLP/8208 sublayer sends the last Data packet that corresponds to the sequence of primitives using the Delivery confirmation bit (D-bit) set to 1. The reason is to ensure that the last Data packet is received by the remote end before the NI_DISCONNECT.request primitive.

Next, the SNDME delivers an NI_DISCONNECT.request primitive to the X.25 PLP sublayer.

11.2.2.2 SMM_DISCONNECT.indication

A distinction is made between two cases:

Case 1: An NI_DISCONNECT.indication primitive is received which contains an NI User-Data parameter. The SNDME constructs an SMM_DISCONNECT.indication primitive as follows:

1) The SMM Disconnect Type parameter is copied from the message code attribute (i.e. Join Rejected, Leave Request, Terminate or Multicast Call Terminated) in the received NI User-Data parameter.

2) The SMM Reason parameter is copied from the NI Reason parameter of the received NI_DISCONNECT.indication primitive.

3) The SMM Responding Address parameter is copied from the NI Responding Address parameter, if present in the received primitive.

4) The SMM Called Address parameter is constructed as follows:

   a) The Group ID is copied from the NI User-Data parameter, if present. If not present, the SMM Called Address parameter will not contain a Group ID.

   b) The Call ID is copied from the NI User-Data parameter, if present. If not present, the SMM Called Address parameter will not contain a Call ID.

5) The SMM Originator parameter is copied from the NI Originator parameter if present in the received primitive. If not present, the SMM_DISCONNECT.indication primitive will not contain the SMM Originator parameter.

6) The SMM User-Data parameter is copied from the NS-user-data parameter, if present in the NI User-Data parameter of the received NI_DISCONNECT.indication primitive.

The SNDME delivers the SMM_DISCONNECT.indication primitive to the MSE.

Case 2: A sequence of NI_DATA.indication primitives that corresponds to an NISDU is received. The message code attribute in the received NISDU indicates Join Rejected, Leave Request, Terminate Multicast Call or Multicast Call Terminated. The SNDME constructs an SMM_DISCONNECT.indication primitive as follows:

1) The SMM Disconnect Type parameter is copied from the message code attribute (i.e. Join Rejected, Leave Request, Terminate Multicast Call or Multicast Call Terminated) in the received NISDU.

2) The SMM Reason parameter is copied from the Disconnect Reason parameter of the received NISDU.

3) The SMM Responding Address parameter is copied from the NI Responding Address parameter, if present in the received NISDU.

4) The SMM Originator parameter is copied from the NI Originator parameter if present in the received NISDU. If not present, the SMM_DISCONNECT.indication primitive will not contain the SMM Originator parameter.

5) The SMM User-Data parameter is copied from the NS-user-data parameter, if present in the received NISDU.

The SNDME then delivers the SMM_DISCONNECT.indication primitive to the MSE. The SNDME discards any subsequent NI_DISCONNECT.indication primitive it receives from the X.25 PLP/8208 sublayer.

11.2.2.3 Sequence of SMM DISCONNECT Primitives

Figure 5 illustrates the sequence of SMM DISCONNECT primitives.

11.2.3 SMM DATA

11.2.3.1 General

A distinction is made between User Data and Multicast Control Data. Multicast Control Data is exchanged either over the virtual circuit associated with the multicast call or over a separate virtual circuit reserved for control. When supporting the following X.6 multicast services:

- include member in a multicast call in progress;
- exclude member from a multicast call in progress;
- grant or deny join permissions;

- terminate multicast call;
- request group status information;
- request Call status information.

The use of a reserved virtual circuit for multicast control provides a member with the following capabilities:

– The use of the procedures associated with these services without actually taking part in a multicast call. For instance a member with the Join Permission capability may respond to an X.6 Join Notification requesting to join another member without participating in the call.

– The use of the procedures associated with these services in association with one or more multicast calls in which the member is participating.

– The separation of the flow control that applies to the exchange of actual multicast data from the flow control that applies to the exchange of messages associated with these services.

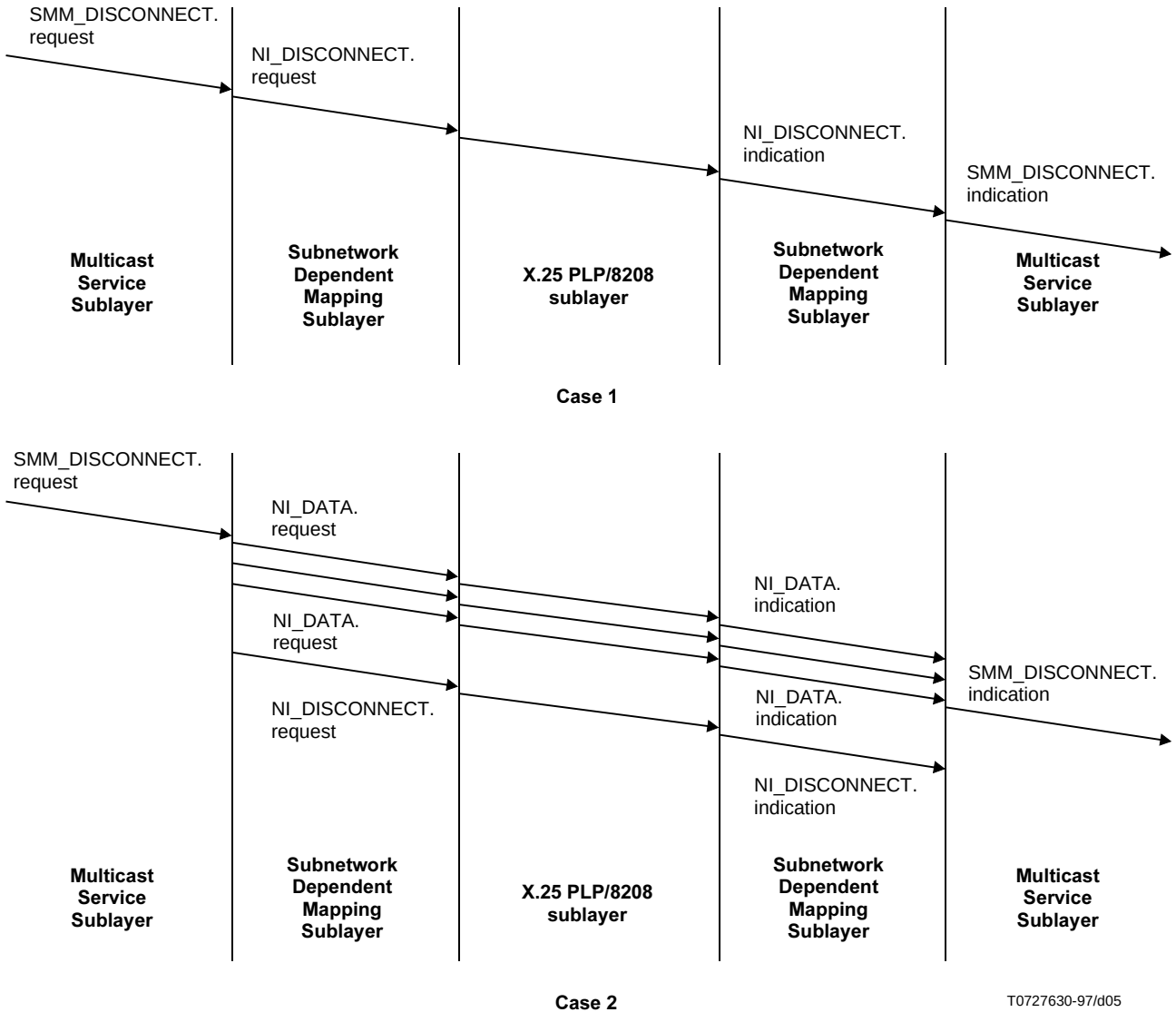


FIGURE 5/X.49

Sequence of SMM DISCONNECT primitives

11.2.3.2 SMM_DATA.request

When receiving an SMM_DATA.request primitive, a distinction is made between two cases.

Case 1: The SMM Data Type parameter of the received primitive indicates Control Data. In this case, the SNDME constructs an NISDU that contains:

1) A one octet protocol identifier coded as "1010 0100" that serves to identify the multicast service.

2) A message code attribute (attribute type and attribute value fields) that is used to identify the type of X.6 message as Include Member, Member Included, Exclude Member, Member Excluded, Join Permission Request, Join Permission Response, Join/Leave Notification, Group Status Request, Group Status Response, Call Status Request, Call Status Response. The type of X.6 message is taken from the SMM Control Data Type parameter in the received SMM_DATA.request primitive.

3) The contents of the SMM Control Data Attributes parameter in the received primitive.

The SNDME delivers the NISDU to the X.25 PLP/8208 sublayer as a sequence of NI_DATA.request primitives which corresponds in the protocol mapping to an ISO/IEC 8208 M-bit sequence of DATA packets with each packet having the Qualifier bit (Q-bit) set to one.

NOTE – The above is an extension to ISO/IEC 10177. According to ISO/IEC 10177, the Q-bit is always set to 0.

The SNDME delivers the NISDU for protocol mapping either over the virtual circuit associated with the multicast call or over a separate virtual circuit that is reserved for control.

Case 2: The SMM Data Type parameter in the received primitive indicates User Data. In this case, the SNDME constructs an NISDU that will contain the contents of the SMM User Data parameter in the received primitive.

The SNDME delivers the NISDU to the X.25 PLP/8208 sublayer as a sequence of NI_DATA.request primitives which corresponds in the protocol mapping to an ISO/IEC 8208 M-bit sequence of DATA packets with each packet having the Q-bit set to 0. The SNDME delivers the NISDU for protocol mapping over the virtual circuit associated with the multicast call.

11.2.3.3 SMM_DATA.indication

When receiving a sequence of NI_DATA.indication primitives that corresponds to a single NISDU, the SNDME examines the NISDU to determine if the data is either multicast control data (identified by the "0101 0000" octet) or user data.

Case 1: The received data is multicast control data. In this case, the SNDME constructs an SMM_DATA.indication primitive as follows:

1) The SMM Data Type parameter is set to indicate Control Data.

2) The SMM Control Data Type parameter (i.e. Include Member, Member Included, Exclude Member, Member Excluded, Join Permission Request, Join Permission Response, Join/Leave Notification, Group Status Request, Group Status Response, Call Status Request, Call Status Response) is copied from the message code attribute in the received NISDU.

3) The contents of the SMM Control Data Attributes parameter are copied from the received NISDU.

Case 2: The received data is user data. In this case, the SNDME constructs an SMM_DATA.indication primitive as follows:

1) The SMM Data Type parameter is set to indicate User Data.

2) The contents of the SMM User-Data parameter is copied from the received NISDU.

The SNDME delivers the SMM_DATA.indication primitive to the MSE.

12 Encoding Principles for SNDME

12.1 General

The Multicast Service Protocol (MSP) encoding makes use of X.25 features wherever possible. Where it is not possible to convey the appropriate message or parameter using X.25 features, then MSP encoding is used in the Call, Called and Clear User Data Fields of X.25/8208 Call Set-up and Clearing packets or in an M-bit sequence of one or more DATA packets, each packet having the Q bit set to 1.

The structure of the MSP encoding is as follows:

8	7	6	5	4	3	2	1
MSP Identifier							
1	0	1	0	0	1	0	0
Parameter Type (PT)							
Parameter Value (PV)							
Further parameter types and values							

The encoding of the Parameter Type Field is based on the encoding used for the X.25 Facility Field. That is, bits 8 and 7 of the Parameter Type (PT) indicate the length class of the associated Parameter Value (PV) Field.

	8	7	6	5	4	3	2	1
1-octet parameter value field	0	0	x	x	x	x	x	x
2-octet parameter value field	0	1	x	x	x	x	x	x
3-octet parameter value field	1	0	x	x	x	x	x	x
variable-length parameter value field	1	1	x	x	x	x	x	x

For the variable-length field, the octet after the PT Field is a Length Indicator (LI) defining the length of the associated PV Field.

Where there is an equivalent X.25 facility, the encoding of the PT is the same as the facility code of that facility. Otherwise, the parameter type field is encoded with bit 5 set to 1 to ensure that the PT value does not conflict with any currently used ITU-T facility codes and/or PT values already assigned by ITU-T or ISO/IEC for other purposes.

Octets from service parameters that are defined using the terms “most significant bit” shall be transmitted over the X.25/8208 sublayer with the least significant bit sent first. Bit 1 corresponds to the least significant bit while bit 8 corresponds to the most significant bit of an octet.

Octets in a packet type are consecutively numbered starting from 1 and are transmitted in this order.

12.2 Parameter Type Encoding

8	7	6	5	4	3	2	1	HEX	
0	0	0	1	0	0	0	1	11	Join Origination Selection
0	0	0	1	0	0	1	0	12	Active Group Integrity
0	0	0	1	0	0	1	1	13	Data Flow Direction
0	0	0	1	0	1	0	0	14	Throughput
0	0	0	1	0	1	0	1	15	Flow Control
0	0	0	1	0	1	1	0	16	Dialogue Control
0	0	0	1	1	0	1	0	1A	Response to Join Permission
0	0	0	1	1	0	1	1	1B	Response to Inclusion Request
0	0	0	1	1	1	0	0	1C	Response to Status Request
0	0	0	1	1	1	0	1	1D	Reason for Denying Status Request

0	0	1	0	0	0	0	0	20	Message Code
0	0	1	0	1	0	0	1	29	Disconnect Originator
0	0	1	0	1	0	1	1	2B	Disconnect Reason
0	0	1	0	1	1	0	1	2D	Continuation
0	1	0	1	0	0	0	1	51	Member's Capabilities
1	1	0	1	0	0	0	0	D0	Group ID (Note)
1	1	0	1	0	0	0	1	D1	Member to Include (Note)
1	1	0	1	0	0	1	0	D2	Member to Exclude (Note)
1	1	0	1	0	0	1	1	D3	Member to Identify (Note)
1	1	0	1	0	1	0	0	D4	Join Notification (Note)
1	1	0	1	0	1	0	1	D5	Leave Notification (Note)
1	1	0	1	1	0	1	0	DA	Call ID
1	1	0	1	1	0	1	1	DB	Quorum
1	1	1	1	0	0	0	0	F0	Pending Call Creation Time-out Value
1	1	1	1	0	0	0	1	F1	Pending Disconnect Response Time-out Value
1	1	1	1	0	0	1	0	F2	Pending Exclude Response Time-out Value
1	1	1	1	0	0	1	1	F3	Pending Join Time-out Value
1	1	1	1	0	1	0	0	F4	Pending Invitation to Join Time-out Value
1	1	1	1	0	1	0	1	F5	Pending Include Time-out Value
1	1	1	1	0	1	1	0	F6	Pending Invitation to Include Time-out Value
1	1	1	1	0	1	1	1	F7	Pending Call Termination Time-out Value
1	1	1	0	0	1	0	1	E4	NS-user-data

NOTE – The value of this parameter is an address, (see 12.2.3.16).

12.3 Parameter Value Encoding

12.3.1 Join Origination Selection

The encoding of the Join Origination shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	True, i.e. Multicast Server sends join invitations
0	0	0	0	0	0	1	0	02	False, i.e. Members join on their own

12.3.2 Active Group Integrity

The encoding of the Active Group Integrity shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	AGI applies
0	0	0	0	0	0	1	0	02	AGI does not apply

12.3.3 Data Flow Direction

The encoding of the Data Flow Direction shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	One-way
0	0	0	0	0	0	1	0	02	Two-way
0	0	0	0	0	0	1	1	03	n-way

12.3.4 Throughput

The encoding of the Throughput shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Throughput at pace of slowest active receiver
0	0	0	0	0	0	1	0	02	Throughput at minimum pace with no loss
0	0	0	0	0	0	1	1	03	Throughput at minimum pace with possible loss

12.3.5 Flow Control

The encoding of the Flow Control shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	True, i.e. Multicast Service is allowed to flow control any participant transmitting data packets to prevent data loss
0	0	0	0	0	0	1	0	02	False, i.e. Multicast Service is not allowed to flow control a participant transmitting data packets

12.3.6 Dialogue Control

The encoding of the Dialogue Control shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Centralized
0	0	0	0	0	0	1	0	02	Decentralized

12.3.7 Response to Join Permission

The encoding of the Join Permission Response shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Join Permission is granted
0	0	0	0	0	0	1	0	02	Join Permission is denied

12.3.8 Response to Inclusion Request

The encoding of the Response to an Inclusion Request shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Member is included
0	0	0	0	0	0	1	0	02	Member is not included

12.3.9 Response to Status Request

The encoding of the Response to a Group Status Request or a Call Status Request shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Response to Status Request is granted
0	0	0	0	0	0	1	0	02	Response to Status Request is denied

12.3.10 Reason for Denying Status Request

The encoding of the Reason for Denying a Group Status Request or a Call Status Request shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	Member Requesting Status is not authorized
Other Values are Reserved									

12.3.11 Message Code

Message codes are used to identify the type of MSP message when it is carried either in the Call, Called and Clear User Data Fields of X.25/8208 Call Set-up and Clearing packets or in an M-bit sequence of one or more DATA packets with each packet having the Q-bit set to 1. In the latter case, message codes appear in the first parameter after the MSP Identifier. The one-octet PV contains the Message Code value, as shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	1	0	0	04	Create Multicast Call
0	0	0	0	0	1	0	1	05	Join Request
0	0	0	0	0	1	1	0	06	Invitation to Join
0	0	0	0	0	1	1	1	07	Multicast Call Created
0	0	0	0	1	0	0	0	08	Join Accepted
0	0	0	0	1	0	0	1	09	Terminate Multicast Call
0	0	0	0	1	0	1	0	0A	Leave Request
0	0	0	0	1	0	1	1	0B	Multicast Call Terminated
0	0	0	0	1	1	0	0	0C	Join Rejected
0	0	0	1	0	0	0	0	10	Include Member
0	0	0	1	0	0	0	1	11	Member Included
0	0	0	1	0	0	1	0	12	Exclude Member
0	0	0	1	0	0	1	1	13	Member Excluded
0	0	0	1	0	1	0	0	14	Join Permission Request
0	0	0	1	0	1	0	1	15	Join Permission Response
0	0	0	1	0	1	1	0	16	Join/Leave Notification Indication
0	0	0	1	1	0	1	0	1A	Group Status Request
0	0	0	1	1	0	1	1	1B	Group Status Response
0	0	0	1	1	1	0	0	1C	Call Status Request
0	0	0	1	1	1	0	1	1D	Call Status Response
For Further Study									Create Group
For Further Study									Group Created
For Further Study									Modify Group
For Further Study									Group Modified
For Further Study									Add Member
For Further Study									Member Added
For Further Study									Remove Member
For Further Study									Member Removed
For Further Study									Member Modified

12.3.12 Disconnect Originator

The encoding of the Disconnect Originator is the same as the encoding specified in ISO/IEC 8878. The encoding shall have the values shown below:

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	NS User
0	0	0	0	0	0	1	0	02	NS Provider

12.3.13 Disconnect reason

The encoding of the Disconnect Reason is as shown below:

NS Reason	Disconnect Reason Code Hex (Decimal)
Disconnection – Permanent condition	E2 (226)
Disconnection – Transient condition	E2 (225)
Connection Rejection – NSAP Address Unknown Permanent	E8 (238)
Connection Rejection – NSAP Address Unreachable Transient	E7 (231)
Connection Rejection – QOS Not Available Permanent	E6 (230)
Connection Rejection – QOS Not Available Transient	E6 (229)
Connection Rejection – Reason Unspecified Transient	E4 (228)
Disconnection – Normal Condition	F1 (241)
Disconnection – Abnormal Condition	F2 (242)
Connection Rejection – Permanent Condition	F2 (245)
Connection Rejection – Transient Condition	F4 (244)
Connection Rejection – QOS Not Available Permanent	F7 (247)
Connection Rejection – QOS Not Available Transient	F6 (246)
Connection Rejection – Incompatible Information in NI-User-Data	F8 (248)

12.3.14 Continuation

The Continuation parameter denotes that more parameters follow in an M-bit sequence of one or more DATA packets, with each packet having the Q-bit set to 1. The PV field in incoming packets is ignored. For outgoing packets, the PV shall be zero.

12.3.15 Member's capabilities

The two octets following the PT Field indicate the capabilities of a member as follows:

Bit 8 of the first octet

1	Member has the Initiate capability
0	Member does not have the Initiate capability

Bit 7 of the first octet

1	Member has the Terminate capability
0	Member does not have the Terminate capability

Bit 6 of the first octet

1	Member has the Send capability
0	Member does not have the Send capability

Bit 5 of the first octet

1	Member has the Receive capability
0	Member does not have the Receive capability

Bits 4 to 1 of the first octet

set to 0	Reserved

Bit 8 of the second octet

1	Member has the capability to receive Join/Leave Notification
0	Member does not have the capability to receive Join/Leave Notification

Bit 7 of the second octet

1	Member has the Join Permission capability
0	Member does not have the Join Permission capability

Bit 6 of the second octet

1	Member has the Invite capability
0	Member does not have the Invite capability

Bit 5 of the second octet

1	Member has the Exclude capability
0	Member does not have the Exclude capability

Bits 4 to 1 of the second octet

set to 0	Reserved

12.3.16 Address parameter

The various formats of Network Addresses are described in ITU-T Rec. X.213 | ISO/IEC 8348.

The PV Field of an Address parameter shall be encoded as shown below:

	8	7	6	5	4	3	2	1
PV1	Address Length in semi-octets							
PV2	1st semi-octet				2nd semi-octet			
PV(last)								

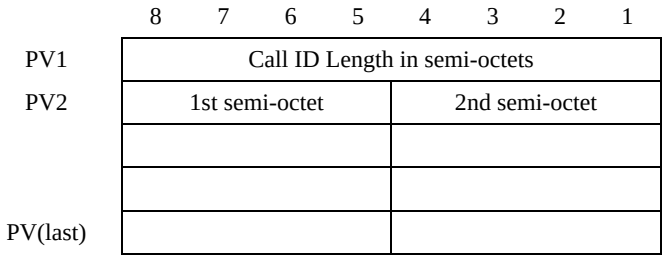
NOTE 1 – The value of PV1 shall not exceed 40 (decimal).

NOTE 2 – For Network Addresses containing a decimal-based DSP, each digit of the IDP and DSP shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6 and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2 and 1 of the last octet [PV(last)] shall be all ones.

NOTE 3 – For Network Addresses containing a binary-based DSP, each digit of the IDP shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6 and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2 and 1 of the last octet containing the IDP shall be all ones. After the IDP, the next octet of the PV Field contains the first octet of the DSP. Each octet of the DSP shall be encoded in two-semi-octets, where bit 8 is the high-order bit and bit 1 is the low-order bit.

12.3.17 Call ID

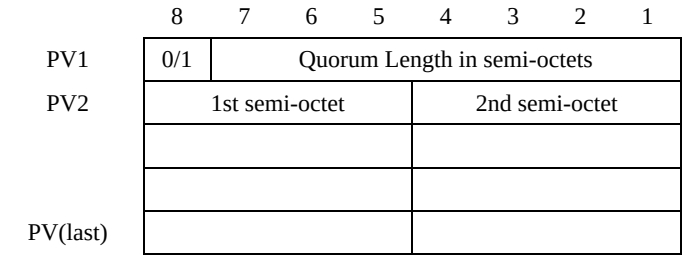
The PV Field of the Call ID parameter shall be encoded as shown below:



Each digit of the Call ID shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6 and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2 and 1 of the last octet [PV(last)] shall be all ones.

12.3.18 Quorum

The PV Field of the Quorum parameter shall be encoded as shown below:



Bit 8 of the first octet (PV1 Field)

1 Quorum is expressed as a percentage
0 Quorum is expressed as an integer

Each digit of the Quorum shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6 and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2 and 1 of the last octet [PV(last)] shall be all ones.

12.3.19 Time-out values

The octet following the PT Field indicates the length, in octets, of the following PV Field. The PV Field indicates the time-out value which is expressed in milliseconds and is binary-coded, with bit 8 of the first octet being the high-order bit and bit 1 of the last octet being the low-order bit.

12.3.20 NS-user-data

NS-user-data is encoded as a string of octets.

13 X.25 PLP/8208 sublayer

The procedures specified in ISO/IEC 10177 apply with the extensions specified in 11.2.

13.1 Procedures for Flow Control

Flow Control is unchanged from Recommendation X.25. As in Recommendation X.25, flow control does not have end-to-end significance.

If a participant in a call flow controls the multicast server (either by failing to issue a Receiver Ready packet or by issuing a Receiver Not Ready packet), the multicast server will queue Data packets for that participant until the participant indicates window rotation by transmitting a Receiver Ready packet.

If the number of Data packets queued for transmission on a participant's interface exceeds the storage capacity of the multicast server, the multicast server selects one of the following options depending on the value of the multicast call Flow Control attribute:

- If Flow Control does not apply, discard Data packets queued for that participant and initiate the reset procedure on that participant's interface (see "Local Reset procedures").
- If Flow Control applies, trigger the issuing of a DCE Receiver Not Ready packet on the interface of each participant in the call with the Send capability.
- If Flow Control applies and the multicast server determines that the agreed to minimum throughput cannot be maintained, initiate the release procedure on the participant's interface.

13.2 Procedure for Reset

In multicast communications, some reset procedures are local (i.e. apply only to a single participant interface) and some are global (i.e. apply to every participant interface in the multicast call). A local reset procedure of a particular participant interface does not affect other participant interfaces; it only affects data packets, windows, flow control, and numbering for that particular participant interface. A global reset procedure causes every interface participating in the call to be reset (i.e. every participant receives on its interface a Reset Indication packet).

The conditions for a multicast call participant (in the role of a sender, sender/receiver, or receiver) to send a Reset Request are the following:

- Condition 1: A request from the upper layers.
- Condition 2: A timer expiry.
- Condition 3: A detection of an error condition in the received packets from the DCE and that error condition cannot be recovered.

The following table examines the conditions for the multicast service to treat a Reset Request sent by a participant as either a local reset or a global reset:

	Participant in the role of a		
	Sender	Sender/Receiver	Receiver
Condition 1	Global Reset	Global Reset	Global Reset
Condition 2	Global Reset	Global Reset	Not applicable
Condition 3	Not applicable	Local Reset	Local Reset

It is recommended that the participant includes the diagnostic code field in the Reset Request packet so that appropriate treatment as a local reset or a global reset can be determined by the multicast service subnetwork dependent mapping entity sublayer.

NOTE – There are no changes to the operation of an X.25 DCE.

13.3 Other procedures

The procedures for restart and diagnostic packets are unchanged from ITU-T Rec. X.25 and ISO/IEC 8208.

13.4 Optional user facilities

Operation of the optional user facilities is unchanged from ITU-T Rec. X.25 and ISO/IEC 8208. However, some facilities do not apply in the multicast environment or have a meaning which is different from that in point-to-point X.25 environment.

Facility	Multicast notes
Extended Packet Sequence Numbering	No change (of local significance only)
Super Extended Packet Sequence Numbering	No change (of local significance only)
D-bit Modification	Not allowed
Packet Retransmission	No change
Incoming calls barred	No change
Outgoing calls barred	No change
One-way logical channel outgoing	No change
One-way logical channel incoming	No change
Non-standard default packet sizes	Value must be the same for all participants in a multicast call
Default throughput class negotiation	For further study
Flow control parameter negotiation	For further study
Basic throughput class negotiation	For further study
Extended throughput class negotiation	For further study
Closed User Group (CUG) related facilities	No change
Bilateral CUG facilities	For further study
Fast select	No change
Fast select acceptance	No change
Reverse charging	For further study
Reverse charging acceptance	No change
Local charging prevention	For further study
Network User Identification (NUI) facilities	For further study
Charging information	For further study
ROA related facilities	For further study
Hunt group	No change (Note 1)
Call redirection and Call deflection facilities	Not allowed (Note 2)
Called line address modification notification	Does not apply (Note 3)
Transit delay selection and indication	For further study
TOA/NPI address subscription	No change

NOTE 1 – If an individual address of the DTE/DCE interface is associated with the multicast group address, then the DTE/DCE interface is addressed when that address is used. If the address of the hunt group of which the DTE/DCE interface is a member is associated with the multicast group address, then the hunt group is addressed when that address is used.

NOTE 2 – The Call Redirection and Call Deflection facilities are not allowed. The reason is that the interface to which the call is redirected to or deflected to, should also be a member of the multicast group. Since it is a member of the multicast group, it will therefore receive an invitation to join anyway (unless excluded during the establishment of the call in which case it should not be invited to join through a redirection or deflection).

NOTE 3 – The Called Line Address Modification Notification facility does not apply for the following reason. The Called Line Address Modification Notification facility is used to indicate the reason for called address modification. The reasons for called address modification are:

- Call redirection or call deflection, which does not apply in the multicast case (see Note 2).
- Hunt group. In this case, the DTE requesting the multicast call establishment addresses the multicast group and not the hunt group.

Annex A

Summary of Group and Call attributes

A.1 Group attributes

The tables below summarize the Group, Call, and Data Transfer attributes and explain how they apply in the extended service described in this Recommendation.

Group attribute	Definition	Value or notes
Group Controller	List of members [or third party(ies)] who are authorized to create, modify and destroy the multicast group.	Although a DTE operating in the extended mode can be included in the Group Controller list, the use of X.25 for group control and management is for further study.
Group ID	Unique identifier of the multicast group	No restrictions on assigning Group IDs
Group Status Request	List of members authorized to request information regarding the status of the multicast group	A DTE operating in the extended mode can be included in the Group Status Request list
Initiator	List of members who may initiate multicast calls	A DTE operating in the extended mode can be included in the Initiator list
May Send	List of members who may be senders (or sender/receivers)	A DTE operating in the extended mode can be included in the May Send list
May Receive	List of members who may be receivers (or receiver/senders)	A DTE operating in the extended mode can be included in the May Receive list
May Receive Join/Leave Notification	List of members who may receive Join/Leave Notification	A DTE operating in the extended mode can be included in the May Receive Join/Leave Notification list
May Hold Join Permission	List of members who may confirm or deny a request to join a multicast call by a potential participant	A DTE operating in the extended mode can be included in the May Hold Join Permission list
May Invite	List of members who may invite other members into a call in progress	A DTE operating in the extended mode can be included in the May Invite list
May Exclude	List of members who may exclude other members from a call in progress	A DTE operating in the extended mode can be included in the May Exclude list
May Terminate	List of members who may terminate calls in progress	A DTE operating in the extended mode can be included in the May Terminate list
Multicast Calls Establishment	Attribute that determines whether the calls belonging to the multicast group are either member initiated or multicast sever initiated	The value of this attribute may be one of two values: “Member Initiated” or “Multicast Server Initiated.”
Default Join Origination Selection	Attribute that determines whether the multicast server, in order to establish a call, send join invitations to members of the group or the members join on their own.	The default value of this attribute may be one of the two values: “True, i.e. the multicast server sends join invitations” or “False, i.e. the members join on their own.” It is set to “True” if the Multicast Calls Establishment attribute is set to “Multicast Server Initiated.”
Active Group Integrity	Attribute which determines whether the AGI applies or does not apply to the calls belonging to the multicast group	The default value of this attribute may be one of two values: “AGI applies” or “AGI does not apply.”

(concluded)

Group attribute	Definition	Value or notes
Quorum	Minimum number of members needed to meet the AGI when it is expressed in terms of a single condition which specifies a number for the execution of a certain function or policy (e.g. for a multicast call to enter the data transfer phase)	The default value of this attribute is expressed either as an integer or as some other value, such as a percentage.
Data Flow Direction	Attribute which specifies the direction of data transfer in the calls belonging to the multicast group	The default value of this attribute may be one of the following values: "one-way," "two-way" or "n-way".
Connect Priority	Attribute which specifies the priority of establishing calls belonging to the multicast group	For further study
Retain Priority	Attribute which specifies the priority of keeping calls belonging to the multicast group	For further study
Transfer Priority	Attribute which specifies the priority for data transfer in the calls belonging to the multicast group	For further study
Aggregate Time-out Values	Attributes which specify timer values which apply to the calls belonging to the multicast group	No restrictions on assigning values to these timers
Source Identification	Capability to indicate the source of data to the receivers of that data	The default value of this attribute is set to "Not Provided". No source identification is possible using X.25 in the extended mode.
Dialogue Control	Attribute which specifies whether a single (designated) member is permitted to send data or any member is permitted to send data at the same time as other members	The default value of this attribute may be one of the two values: "Centralized, i.e. a single (designated) member is permitted to send data" or "Decentralized, i.e. any member is permitted to send data at the same time as other members"

A.2 Call Attributes

Call attribute	Definition	Value or notes
Call ID	A Call ID is needed to differentiate among the calls belonging to the same multicast group	The Call ID is expressed as an integer
Exclusion/Inclusion	List of members of the multicast group that may participate in the multicast call	A DTE with an interface operating in the extended mode is capable of overriding the list on a per-call basis (e.g. to include and/or exclude additional members)
Join Origination Selection	Attribute which determines whether the multicast server, in order to establish a call, sends invitations to members to join the call "value = True" or the members join on their own "value = False."	If the default value for the group attribute is set to "False," then the value that applies to the call may be either set to "False" or selected on a per-call basis by the DTE initiating the establishment of the call and operating in the extended mode. If the default value for the group attribute is set to "True," then the value that applies to the call must be set to "True."
Active Group Integrity	Attribute which determines whether the AGI applies or does not apply to the call	The value that applies to the call (AGI applies or AGI does not apply) may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode

(concluded)

Call attribute	Definition	Value or notes
Quorum	Minimum number of members needed to meet the AGI when it is expressed in terms of a single condition which specifies a number for the execution of a certain function or policy (e.g. for a multicast call to enter the data transfer phase)	The value that applies to the call (integer, or some other value, such as a percentage) may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.
Connect Priority	Attribute which specifies the priority of establishing the call	For further study
Retain Priority	Attribute which specifies the priority of keeping the call	For further study
Transfer Priority	Attribute which specifies the priority for data transfer in the call	For further study
Aggregate Time-out Values	Attributes which specify timer values that apply to the call	A timer value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode
Send Capability	List of members who may transmit data in the call	At a given time, the list is created from the intersection of the following two lists: the group May Send list and the list of members that are participating in the call.
Receive Capability	List of members who may receive data in the call	At a given time, the list is created from the intersection of the following two lists: the group May Receive list and the list of members that are participating in the call.
Receive Join/Leave Notification Capability	List of members who may receive Join/Leave Notifications regarding this call	At a given time, the list is created from the intersection of the following two lists: the group Join/Leave Notification list and the list of members that are participating in the call.
Join Permission Capability	The single member, if any, who may confirm or deny a request to join a call in progress by a potential participant.	A DTE with an interface operating in the extended mode can be designated as the member who may confirm or deny a request to join the multicast call by a potential participant
Terminate Capability	List of members who may terminate the call	At a given time, the list is created from the intersection of the following two lists: the group Terminate list and the list of members that are participating in the call.
Dialogue Control	Attribute which specifies whether a single (designated) member is permitted to send data or any member is permitted to send data at the same time as other members	The value that applies to the call (Centralized or Decentralized) may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode
Source Identification Capability	Capability to indicate the source of data in the call to the receivers of that data	A DTE operating in the extended mode does not support this capability. It is not possible to provide the source identification of the data in X.25 DATA packets.
Invite Capability	List of members who may invite other members into a call in progress	The list is taken from the multicast group Invite Capability attribute
Exclude Capability	List of members who may exclude other members from a call in progress	The list is taken from the multicast group Exclude Capability attribute
Call Status Request	List of members authorized to request information regarding the status of the call	A DTE with an interface operating in the extended mode can be included in the Call Status Request list

A.3 Data Transfer attributes

Data Transfer attribute	Definition	Value or notes
Data Flow Direction	Attribute which specifies the direction of data transfer in the call	The value that applies to the call ("one-way," "two-way" or "n-way") may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode.
Data Integrity	Attribute which specifies that data units received by a member shall not be corrupted	NOTE – No additional procedures beyond those in X.25.
Synchronized Data Delivery	Attribute which specifies that all recipients of a synchronized data unit receive it within a certain defined time window	For further study
Data Ordering	Attribute which determines how PDUs of a single sender are presented to the receivers in the call and how a single receiver gets PDUs from the sender(s)	Local data ordering is supported. Global data ordering is for further study.
Throughput	Attribute which specifies several rules for data transfer in the call	The value that applies to the call ("at pace of slowest active receiver," "at minimum pace with no loss" or "at minimum pace with possible loss") may be either taken from the default value for the group or indicated on a per-call basis by a DTE operating in the extended mode.
Flow Control	Attribute which determines whether the multicast server is able to flow control any participant transmitting data packets in the call to prevent data loss	The value that applies to the call may be either taken from the default value for the group or selected on a per-call basis by a DTE operating in the extended mode

Annex B

Protocol Encoding of Multicast parameters in X.25 packets

B.1 Establishment of Multicast Call with Attribute values Different from Default values

B.1.1 Call Request and Incoming Call packets when Fast Select is used

The following encoding is used when the multicast parameters can be contained in 128 octets of X.25 Call User Data.

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	0	1	1
Address Block (5.2.1/X.25)							
Facility Length							
Facilities							
Protocol ID							
1	0	1	0	0	1	0	0
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Message Code Value (Note 1)							
Multicast parameters (Note 2)							

NOTE 1 – The allowed Message Code values are: Create Multicast Call, Join Request or Invitation to Join.

NOTE 2 – The allowed multicast parameters, which may be in any order, are:

Join Origination Selection	PT = 11 (+ PV)
Active Group Integrity	PT = 12 (+ PV)
Data Flow Direction	PT = 13 (+ PV)
Throughput	PT = 14 (+ PV)
Flow Control	PT = 15 (+ PV)
Dialogue Control	PT = 16 (+ PV)
Group ID	PT = D0 (+ LI, PV)
Member to Include	PT = D1 (+ LI, PV)
Member to Exclude	PT = D2 (+ LI, PV)
Call ID	PT = DA (+ LI, PV)
Quorum	PT = DB (+ LI, PV)
Pending Call Creation Time-out Value	PT = F0 (+ LI, PV)
Pending Disconnect Response Time-out Value	PT = F1 (+ LI, PV)
Pending Exclude Response Time-out Value	PT = F2 (+ LI, PV)
Pending Join Time-out Value	PT = F3 (+ LI, PV)
Pending Invitation to Join Time-out Value	PT = F4 (+ LI, PV)
Pending Include Time-out Value	PT = F5 (+ LI, PV)
Pending Invitation to Include Time-out Value	PT = F6 (+ LI, PV)
Pending Call Termination Time-out Value	PT = F7 (+ LI, PV)
NI-User-Data	PT = E4 (+ LI, PV)

B.1.2 Call Accepted and Call Connected packets when Fast Select is used

The following encoding is used in response to an Incoming Call packet with the Fast Select facility and when the multicast parameters can be contained in 128 octets of X.25 Called User Data.

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	1	1	1
Address Block (5.2.1/X.25)							
Facility Length							
Facilities							
Protocol ID							
1	0	1	0	0	1	0	0
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Message Code Value (Note 1)							
Multicast parameters (Note 2)							

NOTE 1 – The allowed Message Code values are: Multicast Call Created or Join Accepted.

NOTE 2 – The allowed multicast parameters, which may be in any order, are:

Join Origination Selection	PT = 11 (+ PV)
Active Group Integrity	PT = 12 (+ PV)
Data Flow Direction	PT = 13 (+ PV)
Throughput	PT = 14 (+ PV)
Flow Control	PT = 15 (+ PV)
Dialogue Control	PT = 16 (+ PV)
Group ID	PT = D0 (+ LI, PV)
Call ID	PT = DA (+ LI, PV)
Quorum	PT = DB (+ LI, PV)
Pending Call Creation Time-out Value	PT = F0 (+ LI, PV)
Pending Disconnect Response Time-out Value	PT = F1 (+ LI, PV)
Pending Exclude Response Time-out Value	PT = F2 (+ LI, PV)
Pending Join Time-out Value	PT = F3 (+ LI, PV)
Pending Invitation to Join Time-out Value	PT = F4 (+ LI, PV)
Pending Include Time-out Value	PT = F5 (+ LI, PV)
Pending Invitation to Include Time-out Value	PT = F6 (+ LI, PV)
Pending Call Termination Time-out Value	PT = F7 (+ LI, PV)
NI-User-Data	PT = E4 (+ LI, PV)

B.1.3 Call Request and Incoming Call packets when Fast Select is not used

The following encoding is used if the Fast Select facility is not available or when 128 octets of X.25 Call User Data are not enough to contain the multicast parameters. The only parameter that is mandatory in the Call User Data field is the Continuation parameter. The Continuation parameter is an indication that the multicast parameters will be conveyed in an M-bit sequence of one or more DATA packets, with each packet having the Q-bit set to 1.

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	0	1	1
Address Block (5.2.1/X.25)							
Facility Length							
Facilities							
Protocol ID							
1	0	1	0	0	1	0	0
Parameter Type = Continuation							
0	0	1	0	1	1	0	1
Continuation Value							
0	0	0	0	0	0	0	0

B.1.4 Call accepted and Call Connected packets when Fast Select is not used

The following encoding is used in response to:

- an Incoming Call packet with the Fast Select facility and when 128 octets of X.25 Called User Data are not enough to contain the multicast parameters; or
- an Incoming Call packet which contains the Continuation parameter in the Call User Data field.

  The only parameter that is mandatory in the Called User Data field is the Continuation parameter. The Continuation parameter is an indication that the multicast parameters will be conveyed in an M-bit sequence of one or more DATA packets, with each packet having the Q-bit set to 1.

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	1	1	1
Address Block (5.2.1/X.25)							
Facility Length							
Facilities							
Protocol ID							
1	0	1	0	0	1	0	0
Parameter Type = Continuation							
0	0	1	0	1	1	0	1
Continuation Value							
0	0	0	0	0	0	0	0

B.1.5 DATA packets for multicast establishment

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Q = 1	D	0	1				
Logical Channel Number							
P(R)			M	P(S)			0
Protocol ID							
1	0	1	0	0	1	0	0
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Message Code Value (Note 2)							
Multicast parameters (Note 3)							

NOTE 1 – The example assumes modulo 8 sequence numbering.

NOTE 2 – If the multicast parameters are to be conveyed in an M-bit sequence of one or more DATA packets, then the Message Code parameter (i.e. the Message Code Type and the Message Code Value) is present only in the first X.25 DATA packet of the M-bit sequence. The allowed Message Code Values are: Create Multicast Call, Join Request or Invitation to Join.

NOTE 3 – The allowed multicast parameters, which may be in any order, are:

Join Origination Selection	PT = 11 (+ PV)
Active Group Integrity	PT = 12 (+ PV)
Data Flow Direction	PT = 13 (+ PV)
Throughput	PT = 14 (+ PV)
Flow Control	PT = 15 (+ PV)
Dialogue Control	PT = 16 (+ PV)
Group ID	PT = D0 (+ LI, PV)
Member to Include	PT = D1 (+ LI, PV)
Member to Exclude	PT = D2 (+ LI, PV)
Call ID	PT = DA (+ LI, PV)
Quorum	PT = DB (+ LI, PV)
Pending Call Creation Time-out Value	PT = F0 (+ LI, PV)
Pending Disconnect Response Time-out Value	PT = F1 (+ LI, PV)
Pending Exclude Response Time-out Value	PT = F2 (+ LI, PV)
Pending Join Time-out Value	PT = F3 (+ LI, PV)
Pending Invitation to Join Time-out Value	PT = F4 (+ LI, PV)
Pending Include Time-out Value	PT = F5 (+ LI, PV)
Pending Invitation to Include Time-out Value	PT = F6 (+ LI, PV)
Pending Call Termination Time-out Value	PT = F7 (+ LI, PV)
NI-User-Data	PT = E4 (+ LI, PV)

B.1.6 Clear Request and Clear Indication packets when Fast Select is used

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Logical Channel Number							
Packet Type Identifier							
0	0	0	1	0	0	1	1
Clearing Cause							
Diagnostic Code							
Address Block (5.2.1/X.25)							
Facility Length							
Facilities							
Protocol ID							
1	0	1	0	0	1	0	0
Message Code							
0	0	1	0	0	0	0	0
Message Code Value (Note 1)							
Multicast parameters (Note 2)							

NOTE 1 – The allowed Message Code values are: Terminate Multicast Call, Leave Request, Multicast Call Terminated or Join Rejected.

NOTE 2 – The allowed multicast parameters, which may be in any order, are:

Group ID	PT = D0 (+ LI, PV)
Call ID	PT = DA (+ LI, PV)
Disconnect Originator	PT = 29 (+ PV)
Disconnect Reason	PT = 2B (+ PV)
NI-User-Data	PT = E4 (+ LI, PV)

B.2 Support of Recommendation X.6 Multicast services

B.2.1 General

X.6 messages which do not have corresponding X.25 packets are transferred in the User Data field of X.25 DATA packets as shown below:

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group Number			
Q = 1	D	0	1				
Logical Channel Number							
P(R)			M	P(S)			0
Protocol ID							
1	0	1	0	0	1	0	0
X.6 Message (B.2.2 through B.2.12)							

NOTE – The example assumes modulo 8 sequence numbering.

B.2.2 X.6 Join Permission Request

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Join Permission Request							
0	0	0	1	0	1	0	0
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Member to Identify (Note 3)							
1	1	0	1	0	0	1	1
Parameter Value = Address							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The Member to Identify parameter may be repeated. Each parameter identifies a member for which a join permission is requested.

B.2.3 X.6 Join Permission Response

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Join Permission Response							
0	0	0	1	0	1	0	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Member to Identify (Note 3)							
1	1	0	1	0	0	1	1
Parameter Value = Address							
Parameter Type = Response to Join Permission (Note 3)							
0	0	0	1	1	0	1	0
Parameter Value = Join Permission Response Value							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The pair of parameters (Member to Identify and Response to Join Permission) may be repeated. Each pair of parameters is associated with a member.

B.2.4 X.6 Join/Leave Notification Indication

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Join/Leave Notification Indication							
0	0	0	1	0	1	1	0
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Join Notification (Notes 3 and 4)							
1	1	0	1	0	1	0	0
Parameter Value = Address							
Parameter Type = Leave Notification (Notes 3 and 4)							
1	1	0	1	0	1	0	1
Parameter Value = Address							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – Both parameters (Join Notification and Leave Notification) need not be present in the same message.

NOTE 4 – The parameter may be repeated. Each parameter identifies a member.

B.2.5 X.6 Include Member

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Include Member							
0	0	0	1	0	0	0	0
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Member to Include (Note 3)							
1	1	0	1	0	0	0	1
Parameter Value = Address							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The parameter may be repeated. Each parameter identifies a member to be invited to join the multicast call.

B.2.6 X.6 Member Included

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Member Included							
0	0	0	1	0	0	0	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	0	1	0	1
Parameter Value = Call ID Value							
Parameter Type = Member to Include (Note 3)							
1	1	0	1	0	0	0	1
Parameter Value = Address							
Parameter Type = Response to Inclusion Request (Note 3)							
0	0	0	1	1	0	1	1
Parameter Value = Response to Inclusion Request Value							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The pair of parameters (Member to Include and Response to Inclusion Request) may be repeated. Each pair of parameters is associated with a member.

B.2.7 X.6 Exclude Member

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Exclude Member							
0	0	0	1	0	0	1	0
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Member to Exclude (Note 3)							
1	1	0	1	0	0	1	0
Parameter Value = Address							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The parameter may be repeated. Each parameter identifies a member to be excluded from the multicast call.

B.2.8 X.6 Member Excluded

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Member Excluded							
0	0	0	1	0	0	1	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Member to Exclude (Note 3)							
1	1	0	1	0	0	1	0
Parameter Value = Address							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The parameter may be repeated. Each parameter identifies a member that was excluded from the multicast call.

B.2.9 X.6 Group Status Request

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Group Status Request							
0	0	0	1	1	0	1	0
Parameter Type = Group ID (Note)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
NOTE – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.							

B.2.10 X.6 Group Status Response

a) In case the Group Status request is not authorized:

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Group Status Response							
0	0	0	1	1	0	1	1
Parameter Type = Group ID (Note)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Response to Status Request							
0	0	0	1	1	1	0	0
Parameter Value = Response to Status Request Value							
0	0	0	0	0	0	1	0
Parameter Type = Reason for Denying Status Request							
0	0	0	1	1	1	0	1
Parameter Value = Reason for Denying Status Request Value							
NOTE – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.							

b) In case the Group Status request is authorized:

The following group status information (see 6.7.1/X.6) may be provided:

- the list of members of the multicast group;
- the capabilities (e.g. initiator, sender, receiver, etc.) of each member of the multicast group;
- the default group attributes (see 6.2); and
- the multicast calls that are active in the group.

Other items are for further study.

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Group Status Response							
0	0	0	1	1	0	1	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Response to Status Request							
0	0	0	1	1	1	0	0
Parameter Value = Response to Status Request Value							
0	0	0	0	0	0	0	1
Parameter Type = Member to Identify (Notes 2 and 3)							
1	1	0	1	0	0	1	1
Parameter Value = Address							
Parameter Type = Member's Capabilities (Notes 2 and 3)							
0	1	0	1	0	0	0	1
Parameter Value = Member's Capabilities Value							
Multicast parameters (Note 4)							
Parameter Type = Call ID (Note 5)							
1	1	0	1	1	0	1	0
Parameter Value = Call Identifier							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Member to Identify parameter identifies a member for which capabilities are listed in the Member's Capabilities parameter.

NOTE 3 – The pair of parameters (Member to Identify and Member's Capabilities) may be repeated. Each pair of parameters is associated with a member.

NOTE 4 – The allowed multicast parameters, which may be in any order, are:

Default Join Origination Selection	PT = 11 (+ PV)
Default Active Group Integrity	PT = 12 (+ PV)
Default Data Flow Direction	PT = 13 (+ PV)
Default Throughput	PT = 14 (+ PV)
Default Flow Control	PT = 15 (+ PV)
Default Dialogue Control	PT = 16 (+ PV)
Default Quorum	PT = DB (+ LI, PV)
Default Pending Call Creation Time-out Value	PT = F0 (+ LI, PV)
Default Pending Disconnect Response Time-out Value	PT = F1 (+ LI, PV)
Default Pending Exclude Response Time-out Value	PT = F2 (+ LI, PV)
Default Pending Join Time-out Value	PT = F3 (+ LI, PV)
Default Pending Invitation to Join Time-out Value	PT = F4 (+ LI, PV)
Default Pending Include Time-out Value	PT = F5 (+ LI, PV)
Default Pending Invitation to Include Time-out Value	PT = F6 (+ LI, PV)
Default Pending Call Termination Time-out Value	PT = F7 (+ LI, PV)

NOTE 5 – The Call ID parameter may be repeated. Each Call ID identifies a multicast call in currently existence for the group.

B.2.11 X.6 Call Status Request

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Call Status Request							
0	0	0	1	1	1	0	0
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

B.2.12 X.6 Call Status Response

a) In case the Call Status request is not authorized:

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Call Status Response							
0	0	0	1	1	1	0	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Response to Status Request							
0	0	0	1	1	1	0	0
Parameter Value = Response to Status Request Value							
0	0	0	0	0	0	1	0
Parameter Type = Reason for Denying Status Request							
0	0	0	1	1	1	0	1
Parameter Value = Reason for Denying Status Request Value							
NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity. NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.							

b) In case the Call Status request is authorized:

The following call status information (6.7.2/X.6) may be provided:

- the list of members participating in the call;
- the capabilities (e.g. initiator, sender, receiver, etc.) of each member participating in the call; and
- the call attributes.

Other items are for further study.

8	7	6	5	4	3	2	1
Parameter Type = Message Code							
0	0	1	0	0	0	0	0
Parameter Value = Message Code Value = Call Status Response							
0	0	0	1	1	1	0	1
Parameter Type = Group ID (Note 1)							
1	1	0	1	0	0	0	0
Parameter Value = Group ID Value							
Parameter Type = Call ID (Note 2)							
1	1	0	1	1	0	1	0
Parameter Value = Call ID Value							
Parameter Type = Response to Status Request							
0	0	0	1	1	1	0	0
Parameter Value = Response to Status Request Value							
0	0	0	0	0	0	0	1
Parameter Type = Member to Identify (Notes 3 and 4)							
1	1	0	1	0	0	1	1
Parameter Value = Address							
Parameter Type = Member's Capabilities (Notes 3 and 4)							
0	1	0	1	0	0	0	1
Parameter Value = Member's Capabilities Value							
Multicast parameters (Note 5)							

NOTE 1 – The Group ID parameter is optional if the multicast group can be uniquely identified with no ambiguity.

NOTE 2 – The Call ID parameter is optional if the multicast call can be uniquely identified with no ambiguity.

NOTE 3 – The Member to Identify parameter identifies a member for which capabilities are listed in the Member's Capabilities parameter.

NOTE 4 – The pair of parameters (Member to Identify and Member's Capabilities) may be repeated. Each pair of parameters is associated with a member.

NOTE 5 – The allowed multicast parameters, which may be in any order, are:

Join Origination Selection	PT = 11 (+ PV)
Active Group Integrity	PT = 12 (+ PV)
Data Flow Direction	PT = 13 (+ PV)
Throughput	PT = 14 (+ PV)
Flow Control	PT = 15 (+ PV)
Dialogue Control	PT = 16 (+ PV)
Quorum	PT = DB (+ LI, PV)
Pending Call Creation Time-out Value	PT = F0 (+ LI, PV)
Pending Disconnect Response Time-out Value	PT = F1 (+ LI, PV)
Pending Exclude Response Time-out Value	PT = F2 (+ LI, PV)
Pending Join Time-out Value	PT = F3 (+ LI, PV)
Pending Invitation to Join Time-out Value	PT = F4 (+ LI, PV)
Pending Include Time-out Value	PT = F5 (+ LI, PV)
Pending Invitation to Include Time-out Value	PT = F6 (+ LI, PV)
Pending Call Termination Time-out Value	PT = F7 (+ LI, PV)

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