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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Data transmission – Interfaces

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

ITU-T Recommendation X.48

(Previously «CCITT Recommendation»)

ITU-T X-SERIES RECOMMENDATIONS

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For further details, please refer to ITU-T List of Recommendations.

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

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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 specifies the procedures for a Data Terminal Equipment (DTE) opereating in accordance with Recommendation X.25 to participate in a multicast data transmission service described in Recommendation X.6. The overriding goal of this Recommendation is to make no changes to the DTE which wishes to participate in this service

Recommendation X.48

PROCEDURES FOR THE PROVISION OF A BASIC 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 Data Terminal Equipment (DTE) operating in accordance with Recommendation X.25 for the realization of a basic subset of the multicast service described in Recommendation X.6. The basic multicast service provided by this Recommendation does not require additional protocol elements or other elements of procedures beyond those specified in X.25 Packet Layer Protocol (PLP).

The provision of the multicast service capabilities specified in Recommendation X.6 that requires protocol elements or other elements of procedures in addition to the X.25 PLP procedures is beyond the scope of this Recommendation. It is specified in Recommendation X.49.

2   Normative references

The following Recommendations | International Standards 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 | International Standards are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent editions of the Recommendations | International Standards listed below. Members of IEC, ISO and ITU maintain registers of currently valid Recommendations | International Standards.

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   Additional references

–   ITU-T Recommendation X.6 (1993), *Multicast service definition*.

–   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*.

–   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 Recommendation 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.

- **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.

- **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 are used.

AGI	Active Group Integrity
CUG	Closed User Group
D-bit	Delivery confirmation bit
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
M-bit	More bit
MSE	Multicast Service Entity
NI	Network Internal
NILS	Network Internal Layer Service
NISDU	Network Internal Service Data Unit
NPI	Numbering Plan Identification
NS	Network Service
NUI	Network User Identification
PCI	Protocol Control Information
PDU	Protocol Data Unit
PLP	Packet Layer Protocol
PSPDN	Packet Switched Public Data Network

Q-bit	Qualifier bit
QOS	Quality of Service
ROA	Recognized Operating Agency
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 basic mode

The burden of operation of the basic service is placed on the service provider. To eliminate changes to these interfaces, only out-of-band control mechanisms and group management mechanisms are used.

NOTE 1 – In this Recommendation, the reference to out-of-band control mechanisms means the use of administrative mechanisms or protocol procedures that are outside the scope of this Recommendation.

A member of a multicast group with an interface operating in the basic mode can be included in the following lists of capabilities of the members of the group (see Recommendation X.6):

– Initiator Capability List: List of members who may initiate a multicast call.

– Send Capability List: List of members who may act as senders of data in a multicast call.

– Receive Capability List: List of members who may act as receivers of data in a multicast call.

– Terminate Capability List: List of members who may terminate a multicast call in progress.

Members of a multicast group with interfaces operating in the basic 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 basic mode are able to participate in a multicast call with participants with interfaces operating in the extended mode. A single multicast call per multicast group is permitted if any call participant operates an interface in the basic mode.

A member of a multicast group with an interface operating in the basic mode cannot be included in the following lists of capabilities of the members of the group:

– 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.

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

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

- A DTE operating in the basic mode may use the M-bit if the value of the multicast call Dialogue Control is Centralized. A DTE operating in the basic 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 basic 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 basic 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 basic 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 clause 12) 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.

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 basic mode, the group attributes specified in Recommendation X.6 apply as follows:

– Group Controller attribute: The member cannot be included in the list of members [or third party(ies)] who are authorized to create, modify and destroy the multicast group.

– Group ID attribute: No restrictions.

– Group Status Request attribute: The member cannot 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 cannot be included in the list of members who may receive Join/Leave Notification.

– May Hold Join Permission attribute: The member cannot 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 cannot be included in the list of members who may invite other members into a call in progress.

– May Exclude attribute: The member cannot 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 a call 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. However, a DTE operating in the basic mode does not support this timer.

  • 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. However, a DTE operating in the basic mode does not support this timer.

  • Default Pending Invitation to Include Time-out attribute: No restrictions. However, a DTE operating in the basic mode does not support this timer.

  • 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 basic 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: A Call ID is not needed in the basic service because a single multicast call is permitted per the multicast group.

- Exclusion/Inclusion: 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 basic mode does not support the capability to change 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 D, E and F 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.

- Join Origination Selection Attribute: The value that applies to the call may be one of two values, taken from the default value for the group: "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.

- Active Group Integrity Attribute: The value that applies to the call may be one of two values, taken from the default value for the group: "AGI applies" or "AGI does not apply".

- Quorum Attribute: The value that applies to the call is taken from the default value for the group.

- 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 is taken from the default value for the group.

  - Pending Call Creation Time-out.

  - Pending Disconnect Response Time-out.

  - Pending Join Time-out.

  - Pending Invitation to Join Time-out.

  - Pending Call Termination Time-out.

  A DTE operating in the basic mode does not support the following timers:

  - Pending Exclude Response Time-out.

  - Pending Include Time-out.

  - Pending Invitation to Include 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 two 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: A DTE operating in the basic mode cannot support this capability.

–   Join Permission Capability: A DTE operating in the basic mode cannot be designated as the member who may confirm or deny a request to join the multicast 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 that applies to the call may be one of two values, taken from the default value for the group: "Centralized" or "Decentralized".

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

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

–   Invite Capability: A DTE operating in the basic mode cannot support this capability.

–   Exclude Capability: A DTE operating in the basic mode cannot support this capability.

–   Call Status Request Attribute: A DTE operating in the basic mode cannot 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 that applies to the call may be one of the following values, taken from the default value for the group: "one-way," "two-way," or "n-way".

–   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 clause 12). Loss of data between the multicast server and a receiver (e.g. because of buffer overflow) results in a local reset procedure (see clause 12).

–   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 that applies to the call may be one of three values, taken from the default value for the group: "at pace of slowest active receiver," "at minimum pace with no loss" or "at minimum pace with possible loss".

–   Flow Control: The value of this attribute that applies to the call may be one of two values, taken from the default value for the group: "True" or "False," which determines whether the multicast server is able to flow control any participant transmitting data packets to prevent data loss.

    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   Type of data transfer

One-way, two-way, and n-way types of data transfer are supported. The type of data transfer for the call is taken from the default value of the group Data Flow attribute. 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 call is taken from the group May Receive list. The multicast server keeps for each participant in the call 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.

- The subnetwork dependent mapping sublayer operates over the Subnetwork Access Function (SNAcF) sublayer and is used to provide the capabilities assumed by the multicast service sublayer. It permits decoupling of the peer-peer communication between multicast service entities from the detailed operation of a particular Subnetwork Access Protocol (SNAcP) (which is the X.25 protocol in case of this Recommendation). 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 needs 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 subdivision 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).
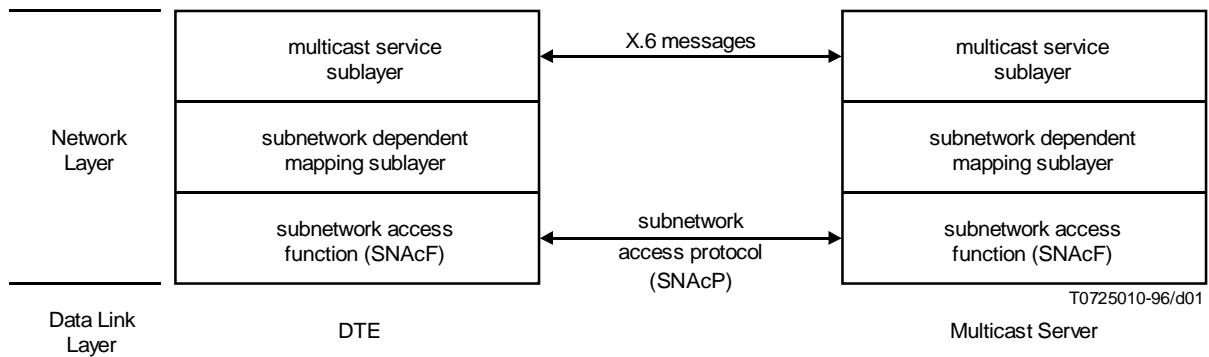
FIGURE 1/X.48

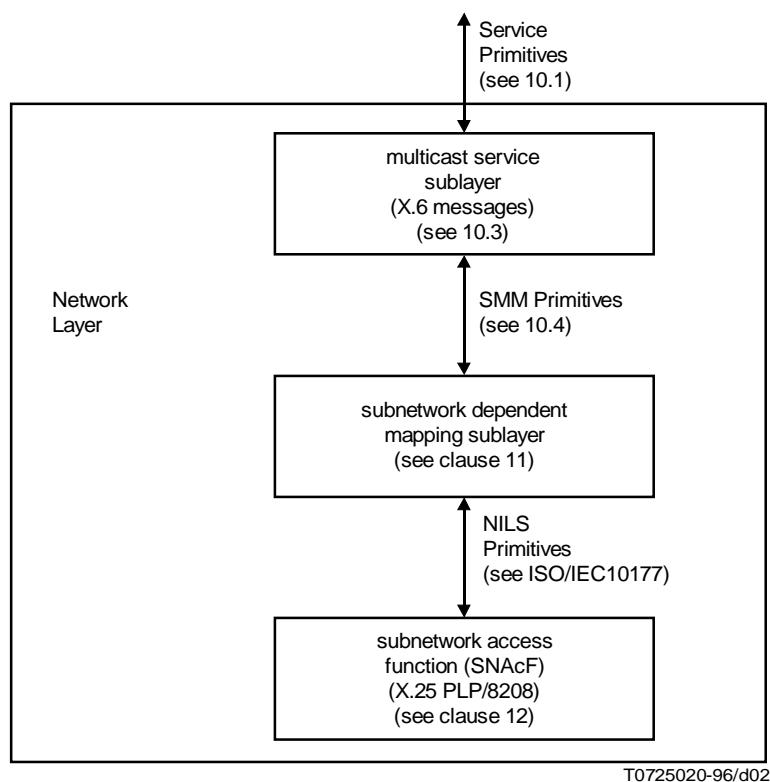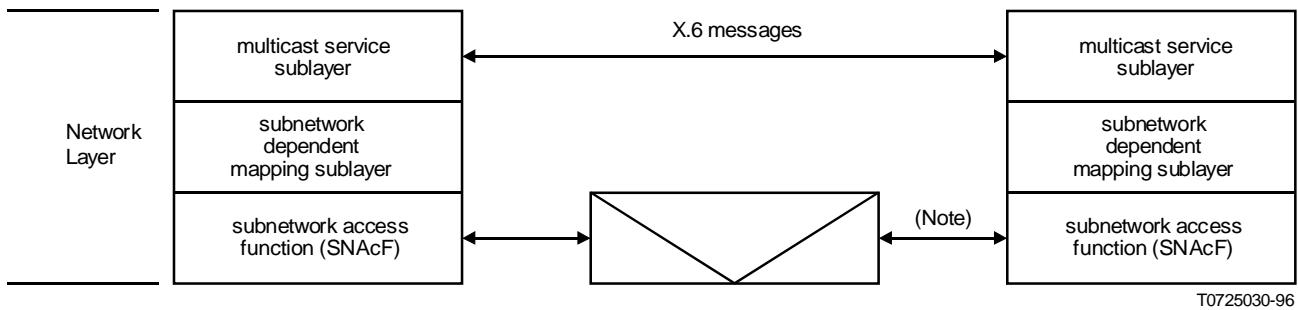**Decomposition of the network layer into three sublayers**

FIGURE 2/X.48

Further decomposition of the network layer

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 defined in Table 1.

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

FIGURE 3/X.48

Realization of the multicast service functionality

TABLE 1/X.48

Service primitives and parameters

Service primitive	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)
NOTES	
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.	
2 The BIND and UNBIND service primitives are for the use of management procedures.	
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.48

SMM Primitives and parameters

Service Primitive	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) (Note 1) SMM Multicast Call Attributes (Note 2) 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 (Note 2) 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 3) SMM Multicast Call Attributes SMM User-Data SMM Responding Address (Note 4) SMM Called Address
SMM_DATA.request SMM_DATA.indication	SMM Data Type (i.e. User Data) (Note 5) SMM Called Address SMM User-Data SMM Control Data Type (Note 6) SMM Control Data Attributes (Note 2)

NOTES

1   For the purposes of this Recommendation (no changes to X.25 protocol elements and elements of procedures), the Call ID is not allowed because a single multicast call is permitted per multicast group.

2   For the purposes of this Recommendation, the SMM Multicast Call attributes parameter and the SMM Control Data attributes parameter is not allowed because the values of the call attributes must be taken from the default values for the group.

3   The SMM Originator parameter is permitted only in the SMM_DISCONNECT.indication primitive.

4   The SMM Responding Address parameter is permitted only when the SMM_Disconnect Type.parameter is Join Rejected.

5   For the purposes of this Recommendation, the SMM Data Type is always set to User-Data. The Control Data type is not used because its transfer requires changes to X.25 protocol elements and elements of procedures.

6   For the purposes of this Recommendation, the SMM Control Data Type is not permitted. See Note 5.

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 must unambiguously identify a multicast group. The Group ID shall be present if the member belongs to more than one multicast group, otherwise it may be absent.

The effect of simultaneous attempts to create a multicast call needs special consideration because a single multicast call is permitted per multicast group.

From the point of view of the multicast server although more than one member of a multicast group may have the Initiate capability, the first X.6 Create Multicast message received by the multicast server from any of these members results in the establishment of the call. In other words, simultaneous attempts to create a multicast call from members with the Initiate capability result in the establishment of a single multicast call. The first X.6 Create Multicast Call message received by the multicast server results in applying the procedures specified in this subclause. Any subsequent X.6 Create Multicast Call message received by the multicast server is treated as a join request (see 10.3.3) if 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 sent join invitations). The subsequent X.6 Create Multicast Call message is rejected if the value of the Join Origination Selection attribute is such that the multicast server sends join invitations. Assuming that simultaneous attempts by members with the Initiate capability resulted in the establishment of a call, only one of these members is considered by the multicast server as the initiator of the call. In addition, assume that no participants in the call have the Terminate capability. A leave request from the participant that is considered to be the call initiator results in the termination of the call. A leave request from another participant with the Initiate capability results in that participant leaving the call. Therefore the following is recommended:

–   either only one member of the group will have the Initiate capability;

–   or the value of the Join Origination Selection attribute is such that the multicast server sends join invitations in case more than one member will have the Initiate capability.

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 from the group default value.

   > 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").

   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 from the group default Pending Call Creation Time-out.

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.

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.

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.

When executing the procedures in 10.3.3, the multicast server MSE adds a member to the list of call participants if it accepts that member's 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 2 – 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 the call that is created. The Group ID shall be present if the member belongs to more than one multicast group, otherwise it may be absent. The Group ID identifies the call that is created because a single multicast call is permitted per group.

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.

> NOTE 3 – In case the multicast call is established as a result of simultaneous attempts by members with the Initiate capability to create the call and the value of the Join Origination Selection attribute is such that members have to join on their own, the multicast server will have treated one of these requests as a request to create the call and the other requests as join requests. The N_JOIN.confirm primitive does not provide the NS user with an indication to whether the confirmation is related to the creation of the call or to joining the call.

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 from the group default Pending Call Creation Time-out.

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. 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 are used by the multicast server MSE in 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/X.49). 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 the call. The Group ID shall be present if the invited member belongs to more than one multicast group, otherwise it may be absent. The Group ID identifies the call that is created because a single multicast call is permitted per group.

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.

10.3.3 Procedures for joining a multicast call

The procedures specified in this subclause 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 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 Group ID identifies the call that is created because a single multicast call is permitted per group.

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 10.3.4.3. When the member MSE receives this message, it sends an N_LEAVE.indication primitive to its NS user.

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. The Called Address field shall be present and contain the multicast Group ID if the participant is participating in more than one multicast call not belonging to the same group, otherwise it may be absent. The Group ID identifies the call because a single multicast call is permitted per group.

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 10.3.6/X.49). 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. The Group ID shall be present if the participant requested to leave is participating in more than one multicast call not belonging to the same group, otherwise it may be absent. The multicast Group ID identifies the call because a single multicast call is permitted per group.

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. 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.

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

10.3.5 Procedures for multicast call termination

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.

• 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 is no longer satisfied.

• The Active Group Integrity is no longer satisfied.

NOTE 2 – 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.

10.3.5.1 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 Reason field indicates the cause for the termination request.

> NOTE 1 – If the participant does not have the Terminate capability, the procedures specified in Section 10.3.4.1 for leaving a multicast call by a call Participant are followed.

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 from the group default Pending Call Termination Time-out.

   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.

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 Reason field indicates the cause provided by the member requesting call termination.

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 2 – 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 | ISO/IEC 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.

10.3.5.2 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 initiated the establishment of 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.

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 contains the address of the member requesting the leave.

   The member who has requested to leave will not receive back 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 | ISO/IEC 8208) sublayer has already been cleared with a Clear Confirmation packet that was sent back by this sublayer when it has received the X.25 Clear Request packet containing the X.6 Leave Request message from the member who has initiated the call.

   NOTES

   1   If a call participant has the Terminate capability, the procedures specified in this subclause apply.

   2   If the AGI does apply for the call, the procedures in 10.3.5.3 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 10.3.5.1 are followed.

10.3.5.3 Loss of AGI

If the multicast call AGI attribute is set to "AGI does 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 unambiguously 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 not belonging to the same group, otherwise it may be absent.

   NOTES

   1   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.

   2   The Pause and Resume services are not supported.

10.3.5.4 Multicast server initiated termination

The multicast server MSE 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 10.3.5.3 above are followed.

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 and from an SMM_CONNECT.request or 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.

TABLE 3/X.48

Mapping between X.6 messages and SMM primitives

X.6 Message and Fields	SMM primitives and parameters
Create Multicast Call Join Request Invitation to Join 　　Calling Address 　　Called Address 　　QOS 　　User-Data	SMM_CONNECT.request SMM_CONNECT.indication 　　SMM Connect Type 　　SMM Calling Address 　　SMM Called Address 　　SMM QOS Parameter Set 　　SMM User-Data
Multicast Call Created Join Accepted 　　Responding Address 　　QOS 　　User-Data	SMM_CONNECT.response SMM_CONNECT. confirm 　　SMM Connect Type 　　SMM Responding Address 　　SMM QOS Parameter Set 　　SMM User-Data
Terminate Multicast Call Leave Request 　　Reason 　　User-Data 　　Called Address	SMM_DISCONNECT.request SMM_DISCONNECT.indication 　　SMM Disconnect Type 　　SMM Reason 　　SMM User-Data 　　SMM Called Address
Multicast Call Terminated Join Rejected 　　Reason 　　Originator 　　User-Data 　　Responding Address (Note 2) 　　Called Address	SMM_DISCONNECT.indication SMM_DISCONNECT.request 　　SMM Disconnect Type 　　SMM Reason 　　SMM Originator (Note 1) 　　SMM User-Data 　　SMM Responding Address (Note 3) 　　SMM Called Address
Data 　　User-Data	SMM-DATA.request SMM-DATA.indication 　　SMM Data Type (Note 4) 　　SMM Called Address (Note 5) 　　SMM User-Data 　　SMM Control Data Type (Note 5) 　　SMM Control Data Attributes (Note 5)

NOTES

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

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

3   The SMM Responding Address parameter is permitted only when the SMM Connect Type parameter is Join Rejected.

4   The SMM Data Type parameter is either User Data or Control Data. For the purposes of this Recommendation, the SMM Data Type parameter is not used because its transfer requires changes to X.25 protocol elements and elements of procedures.

5   For the purposes of this Recommendation, the SMM Called Address, SMM Control Data Type and the SMM Control Data Attributes parameters are not used (see Note 4).

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 above.

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 exception:

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

This Recommendation assumes no changes to the X.25 PLP protocol elements and elements of procedures. An implication of this constraint is that no NI Connect parameters could be specified to correspond to the SMM Connect Type parameter in the SMM_CONNECT primitives and the SMM Disconnect Type parameter in the SMM_DISCONNECT primitives. As a result, the Subnetwork Dependent Mapping Sublayer should maintain information about the state of the calls and the multicast attributes of the multicast group members in order to correctly map the SMM Connect Type and SMM Disconnect parameters. For example, the SMM Connect Type parameter in an SMM_CONNECT.request primitive received by a Subnetwork Dependent Mapping Entity (SNDME) may indicate Create Multicast Call, Join Request or Invitation to Join. This information will not be mapped when constructing the NI_CONNECT.request primitive. The SNDME should then store this information to use in processing the NI_CONNECT.confirm when it is received.

11.2.1 SMM CONNECT

11.2.1.1 SMM_CONNECT.request

On receiving an SMM_CONNECT.request primitive, 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 contents of the SMM User-Data parameter, if present in the received primitive.

The SNDME delivers the NI_CONNECT.request primitive to the X.25 PLP | ISO/IEC 8208 sublayer. The SNDME also stores the contents of the SMM Connect Type parameter to use in processing the NI_CONNECT.confirm when it is received.

11.2.1.2 SMM_CONNECT.indication

On receiving an NI_CONNECT.indication primitive, the SNDME constructs an SMM_CONNECT.indication primitive as follows:

1) The SMM Connect Type parameter is set to Invitation to Join.

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

3) The SMM Called Address parameter contains the Group ID which is copied from the NI Called Address parameter of the received primitive.

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

5)   The SMM User-Data parameter is copied from the NI User-Data parameter, if present in the received primitive.

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

11.2.1.3   SMM_CONNECT.response

When receiving an SMM_CONNECT.response primitive, the SNDME constructs an NI_CONNECT.response primitive as follows:

1)   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.

2)   The NI Expedited Data Selection is not set.

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

4)   The NI User-Data parameter is set to the contents of the SMM User-Data, if present in the received primitive.

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

11.2.1.4   SMM_CONNECT.confirm

When receiving an NI_CONNECT.confirm primitive, the SNDME constructs an SMM_CONNECT.confirm primitive as follows:

1)   The SMM Connect Type parameter is set according to the information stored about the call (see 12.2.1.1).

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

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

4)   The SMM User-Data parameter is copied from the NI User-Data parameter, if present in the received primitive.

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

11.2.2   SMM DISCONNECT

11.2.2.1   SMM_DISCONNECT.request

When receiving an SMM_DISCONNECT.request primitive, the SNDME first 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. The encoding of the Disconnected Reason parameter is as shown below.

3)   The NI User-Data parameter is set to the contents of the SMM User-Data parameter, if present in the received SMM_DISCONNECT.request primitive.

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

NS Reason	NS Originator	Cause Value
Disconnection – Permanent Condition	NS Provider	00000001
Disconnection – Transient Condition	NS Provider	00000010
Connection Rejection – NSAP Address Unknown Permanent	NS Provider	00000011
Connection Rejection – NSAP Address Unreachable Transient	NS Provider	00000100
Connection Rejection – QOS Not Available Permanent	NS Provider	00000101
Connection Rejection – QOS Not Available Transient	NS Provider	00000110
Connection Rejection – Reason Unspecified Transient	NS Provider	00000111
Disconnection – Normal Condition	NS User	00001000
Disconnection – Abnormal Condition	NS User	00001001
Connection Rejection – Permanent Condition	NS User	00001010
Connection Rejection – Transient Condition	NS User	00001011
Connection Rejection – QOS Not Available Permanent	NS User	00001100
Connection Rejection – QOS Not Available Transient	NS User	00001101
Connection Rejection – Incompatible Information in NI-User-Data	NS User	00001110

11.2.2.2 SMM_DISCONNECT.indication

When receiving an NI_DISCONNECT.indication primitive, the SNDME constructs an SMM_DISCONNECT.indication primitive as follows:

1) The SMM Disconnect Type parameter (i.e. Join Rejected, Leave Request, Terminate or Multicast Call Terminated) is set according to the information stored about the call. For example if the call is being established (i.e. the NI_DISCONNECT.indication primitive is received as a response to an NI_CONNECT.request), then the SMM Disconnect Type parameter is set to "Join Rejected." However if the call is already being established, then the SMM Disconnect Type parameter is set to "Leave Request".

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

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

4) The SMM Originator parameter is copied from the NI Originator parameter of the received primitive.

5) The SMM User-Data parameter is copied from the NI User-Data parameter, if present in the received primitive.

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

11.2.3 SMM DATA

11.2.3.1 SMM_DATA.request

When receiving an SMM_DATA.request primitive, 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 | ISO/IEC 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.

11.2.3.2 SMM_DATA.indication

When receiving a sequence of NI_DATA.indication primitives that corresponds to a single NISDU, 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   X.25 PLP | ISO/IEC 8208 sublayer

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

In addition, the following applies:

– *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.

– *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 sublayer.

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

– *Other procedures*

The procedures for restart and diagnostic packets are unchanged from Recommendation X.25 and ISO/IEC 8208.

13 Optional user facilities

Operation of the optional user facilities is unchanged from Recommendation X.25. 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)
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

NOTES

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.

2   The Call Redirection and Call Deflection facilities are not allowed. The reason is that the interface 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).

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.

•   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

(This annex forms an integral part of this Recommendation)

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	A DTE operating in the basic mode cannot be included in the Group Controller list
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 basic mode can be included in the Group Status Request list Requesting Group Status is not supported in the basic service through X.25 packets
Initiator	List of members who may initiate multicast calls	A DTE operating in the basic 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 basic 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 basic mode can be included in the May Receive list
May Receive Join/Leave Notification	List of members who may receive Join/Leave Notifications	A DTE operating in the basic mode cannot be included in the May Receive Join/Leave Notification list Receiving Join/Leave Notifications is not supported in the basic service through X.25 packets
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 basic mode cannot be included in the May Hold Join Permission list Requesting Join Permissions is not supported in the basic service through X.25 packets
May Invite	List of members who may invite other members into a call in progress	A DTE operating in the basic mode cannot be included in the May Invite list Invitation is not supported in the basic service through X.25 packets
May Exclude	List of members who may exclude other members from a call in progress	A DTE operating in the basic mode cannot be included in the May Exclude list Exclusion is not supported in the basic service through X.25 packets
May Terminate	List of members who may terminate calls in progress	A DTE operating in the basic mode can be included in the May Terminate list

Group Attribute	Definition	Value or notes
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"
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"
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 basic 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"

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 operating in the basic mode is not capable of changing 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"	The value that applies to the call is taken from the default value for the group: "True" or "False"
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) is taken from the default value for the group
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) is taken from the default value for the group
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 which apply to the call	A timer value that applies to the call is taken from the default value for the group
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 basic mode cannot be designated as the member who may confirm or deny a request to join the multicast call by a potential participant

Call Attribute	Definition	Value or Notes
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) is taken from the default value for the group
Source Identification Capability	Capability to indicate the source of data in the call to the receivers of that data	A DTE operating in the basic 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 | A DTE operating in the basic mode cannot be included in this list

Invitation is not supported in the basic service through X.25 packets |
| Exclude Capability | List of members who may exclude other members from a call in progress | A DTE operating in the basic mode cannot be included in this list

Exclusion is not supported in the basic service through X.25 packets |
| Call Status Request | List of members authorized to request information regarding the status of the call | A DTE operating in the basic mode cannot be included in the Call Status Request list

Requesting Call Status is not supported in the basic service through X.25 packets |

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) is taken from the default value for the group
Data Integrity	Attribute which specifies that data units received by a member shall not be corrupted	NOTE – No additional procedures beyond those in Rec. 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") is taken from the default value for the group
Flow Control	Attributes which determine 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 is taken from the default value for the group

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