INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

I.233-1
Annex F
(07/96)

SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Service capabilities – Bearer services supported by an ISDN

Frame mode bearer services: ISDN frame relaying bearer service

Annex F: Frame relay multicast

ITU-T Recommendation I.233-1 – Annex F

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION I.233.1

FRAME MODE BEARER SERVICES: ISDN FRAME RELAYING BEARER SERVICE

Annex F

Frame relay multicast

Source

ITU-T Recommendation I.233.1, Annex F was revised by ITU-T Study Group 1 (1993-1996) and was approved under the WTSC Resolution N°1 procedure on the 19th of July 1996.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

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FRAME MODE BEARER SERVICES: ISDN FRAME RELAYING BEARER SERVICE

Annex F

Frame relay multicast

(Geneva, 1996)

F.1 Introduction

This annex describes optional multipoint configurations for the Frame Relaying Bearer Service. These configurations are known as Frame Relay Multicast. The definition and description of these configurations are the basis for defining the network capabilities required for the support of the service in an ISDN. Recommendation I.233.1 describes the ISDN Frame Relaying Bearer Service.

Recommendation X.6 was used as a basis for this annex. In some instances definitions have been modified to more appropriately fit the frame relay model.

References

– CCITT Recommendation I.233 (1991), *Frame mode bearer services.*

– CCITT Recommendation I.233.1 (1991), *Frame mode bearer services: ISDN frame relaying bearer service.*

– CCITT Recommendation Q.922 (1992), *ISDN data link layer specification for frame mode bearer services.*

– ITU-T Recommendation Q.933 (1995), Signalling *specification for frame mode basic call control.*

– CCITT Recommendation I.370 (1991), *Congestion management for the ISDN frame relaying bearer service.*

– ITU-T Recommendation 1.372 (1993), *Frame relaying bearer service network-to-network interface requirements.*

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

F.2 Definition

The **multicast services** provide the capability for frame relay service suppliers to offer point-to-multipoint frame delivery services. The services in this annex are *connection-oriented*. That is, before a user of a multicast service is able to send or receive any multicast data, the user must first establish a connection (permanent virtual connection) to the multicast server.

F.3 Description

F.3.1 General description

This service description describes the frame relay multicast services from the user perspective. It addresses only the case where the multicast service is provided on a Permanent Virtual Connection (PVC) and is configured by network administration. Multicast services on Switched Virtual Connections (SVCs) are for further study. Dynamic modifications to the multicast service configuration by the user is also for further study.

In general, a frame relay data unit is addressed to a specific destination. When the data unit arrives at the destination, the address has been modified and is delivered with an address reflecting the sender's return path. A multicast service may take advantage of this function and combine it with a copy function to allow a user to send a single message to multiple destinations. These destinations may reside on a single network or multiple networks.

F.3.2 Specific terminology

These terms are provided as a tool for better understanding of this annex. Some definitions, however, are complex and may not be fully defined here. In these cases, in order to restrict duplication of text, the term indicates a paragraph number to refer to for further explanation.

F.3.2.1 active group: The subset of a Multicast Group which is currently operational. (Refer to F.4)

F.3.2.2 data link connection identifier (DLCI): It is the identifier of a frame relay connection. These values have only local significance. DLCI is defined in Annex A/Q.922.

F.3.2.3 frame relay multicast service: One in which a single data unit transmitted by a source is received by multiple destinations; it is a **one-in, many-out** service.

F.3.2.4 leaf: A member of a one-way or two-way multicast group which receives multicast frames.

F.3.2.5 multicast group: A set of members participating in a frame relay multicast service.

F.3.2.6 member: A participant in a multicast group.

F.3.2.7 multicast connection: A connection established by the service provider for the purpose of facilitating the sending of a single frame to multiple destinations.

F.3.2.8 multicast DLCI (Mdlci): The DLCI assigned to designate a particular multicast connection at a particular frame relay access interface.

F.3.2.9 one-way: A type of multicast service. (Refer to F.5.1.)

F.3.2.10 root: The member of a one-way or two-way multicast group which transmits multicast frames.

F.3.2.11 two-way: A type of multicast service. (Refer to F.5.2.)

F.3.2.12 N-way: A type of multicast service. (Refer to F.5.3.)

F.3.2.13 station: A frame relay DTE. That is any machine (router, host, etc.,) that uses the services of a frame relay network. In the context of this annex, station does not refer to those devices that are a part of the frame relay network itself.

F.3.3 Qualifications

No restrictions have been identified.

F.4 Multicast service model

Much of the multicast service model is taken directly from the X.6 Multicast Service Definition. This is a general purpose model and frame relay specifics are discussed in subsequent subclauses.

The multicast service model shows a *multicast group* consisting of members that participate in a multicast communication using an intermediate entity called the *multicast server*. The multicast server is a logical entity which provides the multicast service to all members. Figure F.1 illustrates the multicast service model.

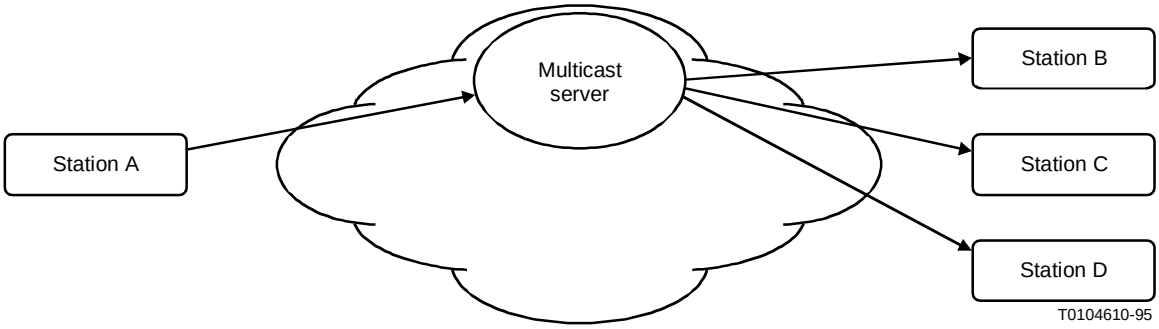

FIGURE F.1/I.233.1

Multicast service model

The multicast server may be a centralized server as shown in Figure F.1 or it may be a distributed service with several units providing the multicasting function. There is no limit to where the multicast servers reside (either internal to, or outside of the network) but for the purposes of discussion, the multicast servers will be viewed as a single logical unit internal to the frame relay network.

A multicast group is an entity that defines a domain in which members may participate in multicast communication and precludes communication with users not in the group. Each multicast group is independent of any other and therefore, a member of one multicast group may belong to other multicast group simultaneously.

The set of members participating in multicast communications is called the *active group* and a member participating in a particular multicast group is called a *participant*. For example, in Figure F.1, the active group consists of stations A, B, C, and D. If participant C leaves the group (loses connectivity or is removed from the multicast group), the active group becomes participants A, B, and D.

F.5 Service description

These multicast services, in general, provide the ability to establish a multicast relationship between the members of a group and allow them to participate in point-to-multipoint data transfer. The data transfer occurs only for the active group. That is, a multicast server receiving a data unit at time *t*, will deliver that unit to the members of the active group as of time *t*. Members that join the active group (it may have been inactive before this time) after time *t*, may or may not receive the data unit.

There are three types of multicast service. All require a one to many mapping of source to destination, but each requires the service provider to interpret the meaning of multiple destinations differently. These applications are described in the following subclauses. Note that the questions of where data unit duplication occurs, how address transformation is performed, and how to provide multicasting are implementation issues and are not specified. The following descriptions are models only, and may or may not reflect actual implementations of a given multicast service.

In general, it will not be useful for a participant sending data to receive a copy of its own transmission. Therefore, the multicast model assumes that the originator does not receive its own transmissions. This does not, however, exclude the possibility that some future application may wish to design a service in which the sender does receive its own transmissions.

F.5.1 One-way multicast service

This multicast service requires that the root have point-to-point frame relay connections established to all leaves in the multicast group. The root will also maintain a separate one-way multicast connection to the multicast server.

With this configuration, the root sends multicast frames via the one-way multicast connection identified by a one-way multicast DLCI (Mdlci). The multicast server will accept frames from the Mdlci and will send the frame to each leaf member of the active multicast group. Additionally, when the multicast service is distributed across an NNI (see F.7.1.2), the multicast server will also send the frame to the NNI Mdlci. Frames delivered in this manner arrive as though they were transmitted on the individual point-to-point connections established between the root and leaves. That is the DLCI (address) in the received frame reflects the source of the message and will not retain the Mdlci (multicast address).

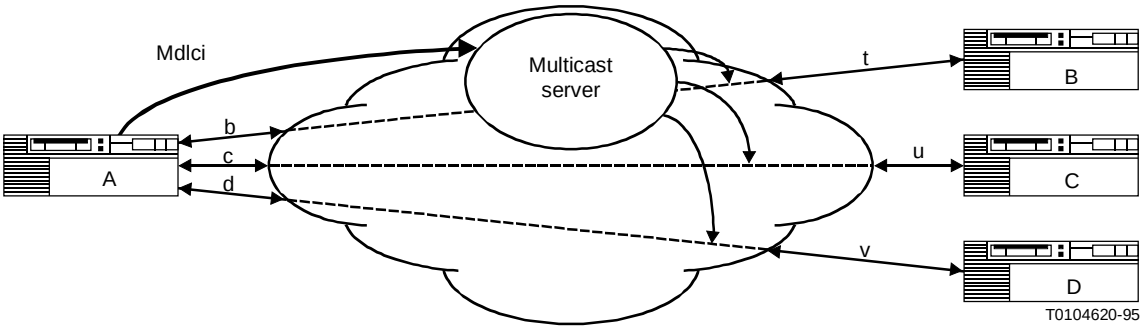

FIGURE F.2/I.233.1

One-way multicast

For example, Figure F.2 shows the root, station A, with a single frame relay interface (station A may have other interfaces which are not shown here). The multicast group may be viewed logically as the group of PVCs b, c, and d. The one-way multicast service will accept a frame on Mdlci from Station A and transmit it to each destination designated by the active multicast group. As these frames traverse the network, they are treated no differently than other frames and therefore, arrive at the destination stations as though they had been transmitted on each of the separate PVCs from Station A. Station B will receive the frame on its connection t, Station C on its connection u and Station D on its connection v.

This service is useful in applications where the stations are routers or bridges. The multicast frame will typically be used for obtaining or verifying the presence or identification of the multicast group members.

As defined, the Mdlci is a one-way DLCI. That is, frames are never sent from the network to the root on it. Frames transmitted on the Mdlci which arrive at Station B have no different characteristics from those frames sent from Station A on DLCI "b". Frames from the one-way multicast group members to Station A are transmitted on DLCIs "t-v" and arrive on DLC1s "b-d" respectively. Station A may also exchange frames with a single member of the multicast group over one of the DLCIs "b-d".

It is important to remember that multicast and unicast are separate services offered by the frame relay network. Frames maintain time ordering within a service not among services. For example, if, in Figure F.2, station A sends one frame on DLCI b and then another on the Mdlci. If the service provider merges unicast and multicast traffic to station B on DLCI t, the frames are not guaranteed to arrive at station B with the unicast frame first and the multicast frame second.

Note that the one-way multicast model does. not mandate that all PVCs registered to Station A participate. Conversely, any and all PVCs registered to Station A may participate regardless of their destination. That is, Station A may have many other PVCs that are not associated with the multicast group for the one-way multicast connection. Station A may also have several PVCs for the same destination station included in the multicast group without conflict.

PVCs that are members of the multicast group and the Mdlci itself, are required to share the same physical firm relay interface. There is no conceptual limit to the number of one-way multicast connections allowed per interface.

F.5.2 Two-way multicast service

The two-way multicast service provides for duplex transmissions. In one direction the data units are multicast, while in the other, they are concentrated. One participant in a two-way multicast connection is defined as the root; it functions to send the data units into the multicast server for multicasting. The rest of the participants are defined as the leaves. The following rules apply to the two-way multicast service.

- Any data units sent by the root are transmitted to all leaves in the active multicast group.
- Any data units sent by a leaf are transmitted to the root of the active multicast group, but not to the other leaves.

Figure F.3 depicts the two-way multicast service.

Station A is the root and station B, C, and D are the leaf members of the multicast group. Each participant (both the root and leaves) has two-way connections. The multicast service will accept a frame from Station A on the Mdlci a, and transmit it to each of the leaf members of the active multicast group.

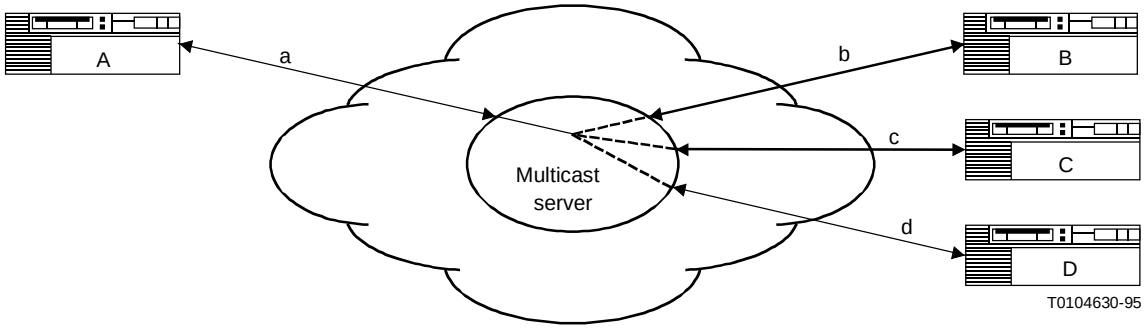

FIGURE F.3/I.233.1

Two-way multicast

Leaves may return data to the root via the same DLCL For example Station C will send frames to Station A on DLCI c and they will arrive on station A's Mdlci a.

This service is useful in an environment where the root does not need to communicate individually with the leaves and where the number of leaf stations prohibits the establishment of individual PVCs between the root and each of the leaves. For example, in large SNA or similar polled networks, there may be many terminals connected to a limited number of host ports. The host broadcasts to a group of terminals over a multi-drop line; only one terminal has permission to respond at a time. The two-way multicast service could be used to transparently replace multi-drop lines, between the host and terminals.

F.5.3 N-way multicast service

The third multicast service is n-way multicasting. All transmissions in this scheme are duplex and all are multicast. All members of the multicast group are transmission peers. Any data sent on a n-way multicast connection is sent to every other member of the active multicast group.

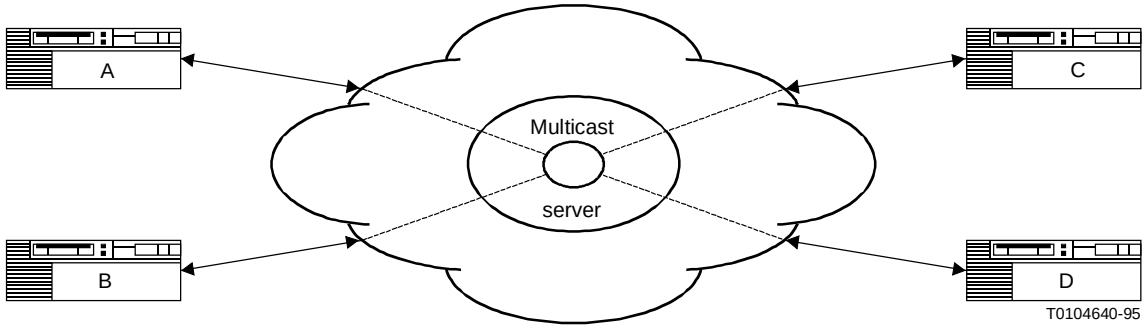

FIGURE F.4/I.233.1

N-way multicast

For example, Figure F.4 shows four stations participating in an n-way multicast exchange. The n-way multicast service will accept a frame on the Mdlci from Station A and transmit it to each of the other members of the active multicast group (stations, B, C, and D). When the frames reach the destination stations, the DLCI will reflect the multicast connection which the station may use to address the multicast group.

This type of multicast service is convenient for applications that require all participants to acquire the same data. One might envision this type of multicast for use with teleconferencing or routing update protocols.

F.6 Procedures

F.6.1 Provision/withdrawal

Multicast services are available only through prior arrangement with the service provider. When requesting a multicast service, there are several subscription options. These options vary slightly by multicast service. The options are summarized below by type of multicast service.

F.6.1.1 One-way multicast service

Subscription option	Value
Root	Root of the Multicast group
Mdlci	DLCI of the VC from the Root to the multicast service. This may be any valid DLCI value supported by the network. The value has only local significance
Other members of the multicast group	The members of the multicast group, designated by the DLCI values of the VCs to those members at the root

F.6.1.2 Two-way multicast service

Subscription option	Value
Membership	The members of the Multicast Group
Root	Root of the Multicast group
Mdlci of each member of the multicast group	Any valid DLCI value supported by the network. The value has only local significance

F.6.1.3 N-way multicast service

Subscription option	Value
Membership	The members of the Multicast Group
Mdlci of each member of the multicast group	Any valid DLCI value supported by the network. The value has only local significance

F.6.2 Normal procedures

The establishment of multicast service is an administrative operation and requires coordination between the service provider and the service subscriber. The Data Link Connection Management Interface, required by Annex A/Q.933, announces the availability of the multicast connection and indicates that it is established for use.

F.6.2.1 Activation/deactivation/registration

Multicast service activation/deactivation/registration is accomplished by the user requesting service or service changes from the service provider. The method used for requesting these services is network dependent. Automatic and signalled changes are for further study. The types of changes a user can request are that:

- A group be added.
- A group be deleted.
- A member be added to a group.
- A member be deleted from a group.

F.6.2.2 Invocation and operation

The multicast service is invoked by sending frames on the previously established multicast connection. There are no additional procedures necessary.

F.6.2.3 Interrogation/editing

If the user wishes to modify the configuration of the multicast group, the user must request this modification by contacting the service provider. There is no automatic configuration modification from the user to the provider.

F.6.3 Exceptional procedures

F.6.3.1 Activation/deactivation/registration

Not applicable.

F.6.3.2 Invocation and operation

In case of failure situations due to user error, user state, or network conditions, appropriate failure indications may be signalled from the network.

F.6.3.3 Interrogation/editing

Not applicable.

F.6.4 Alternate procedures

F.6.4.1 Use of two-way multicast to provide a one-way multicast service

Another means of providing a one-way multicast service is to use a special case of two-way Multicast in conjunction with the point-to-point connections between the root and each leaf. It is a special case only in that there is no traffic from the leaves to the root. The service differs from the one-way service in that at the leaves, the multicast frames arrive on the Mdlci which is distinct from the DLCI of the point-to-point connection.

F.6.4.2 Management

A service provider may make out-of-band management available to the user, e.g. through an extension of the Frame Relay Service MIB, giving the user the ability to obtain full status information about the multicast group.

F.6.5 Verification

No verification procedures have been mandated.

F.7 Interworking requirements

In an interworking scenario, the multicast function can reside in a single network or be distributed across several networks. In the non-distributed scenario, no special requirements are made of the non-multicast side of the NNI. Each connection through a network without a multicast server is a standard PVC segment.

Multicast services may be distributed between the networks, which should serve to reduce the total network traffic.

In the distributed scenario there are specific requirements for managing the multicast PVCs.

F.7.1 Multicast servers distributed across the NNI

Point-to-point configurations across a Network-to-Network Interface are discussed in Recommendation I.372.

A multicast service involving two or more networks may be configured to minimize the internetwork traffic so that:

- Each network is responsible for duplicating messages in order to deliver them to directly attached destinations as well as to adjacent networks as necessary.
- No message is delivered more than once to any participating network.

Figure F.5 illustrates this option. Though the figure is drawn as a two-way multicast service, the scenario is applicable to the n-way multicast service as well. A similar scenario for one-way multicast involves a small extension to the basic service. This is discussed in F.7.1.2 below.

The requirement that no message be delivered to any network more than once is a procedural issue. In fact it is permissible that a multicast connection could traverse more than one NNI between the same two networks. The network administrators must make certain that the multicast connections are not circular in nature.

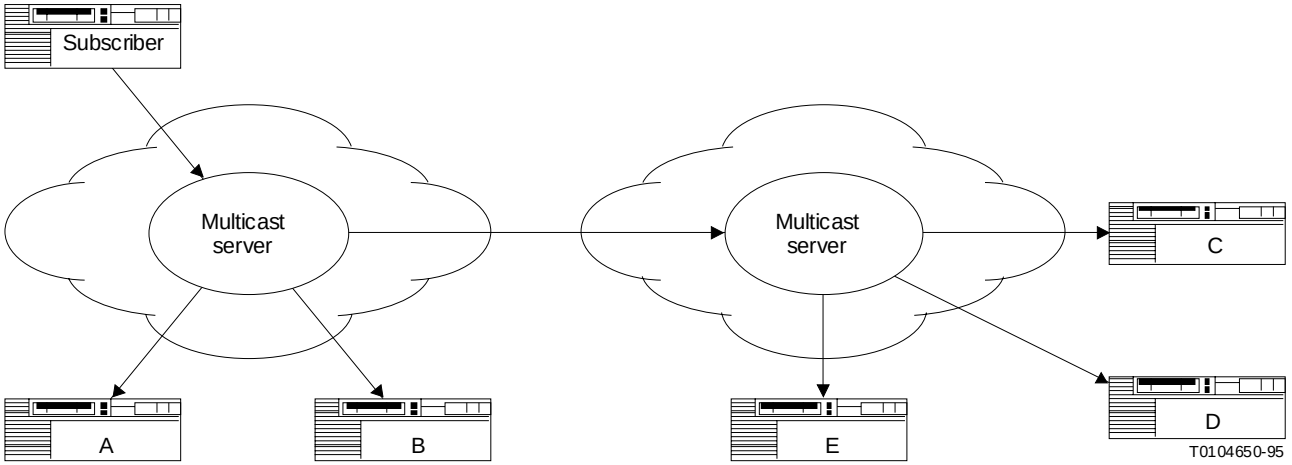

FIGURE F.5/I.233.1

Multicast network-to-network

F.7.1.1 Distributed multicast servers for the two-way and n-way services

In Figure F.5, the subscriber (the data unit initiator) represents the root of a two-way multicast service or any participant in an n-way service. The subscriber sends a frame addressed with the multicast DLCI. The service provider will then send the frame to each of the active group members. One or more of these members may be another multicast service on another network, reached via an NNI. When the frame arrives at the other network, the frame is sent to each member of the active group registered with the second multicast server. In this way, the duplication effort is shared by both the source network and the destination network.

For the two-way Service, the multicast servers act as concentrators for traffic in the reverse direction. Thus a frame sent by station D on the multicast DLCI would first be concentrated onto the DLCI across the multicast server on the right, and then concentrated on to the subscribers multicast DLCI by the server on the left.

F.7.1.2 Distributed multicast servers for the one-way service

In order to support the one-way multicast service across the NNI, the multicast server replicates the frame on one additional DLCI called the NNI Mdlci. This differs from the normal service in that there is no VC from the root to the NNI corresponding to this DLCI. One can conceptualize it as a VC from the Multicast server to the NNI which receives a copy of every frame sent by the root on the root's Mdlci. Figure F.6 illustrates this technique. The NNI Mdlci is used to propagate the Mdlci from the multicast server in network A to the multicast server in network B. Like any Mdlci in the one-way Service, the VC is unidirectional in that no traffic flows in the reverse direction. The multicast service in network B is standard in all respects except that the NNI acts as the root.

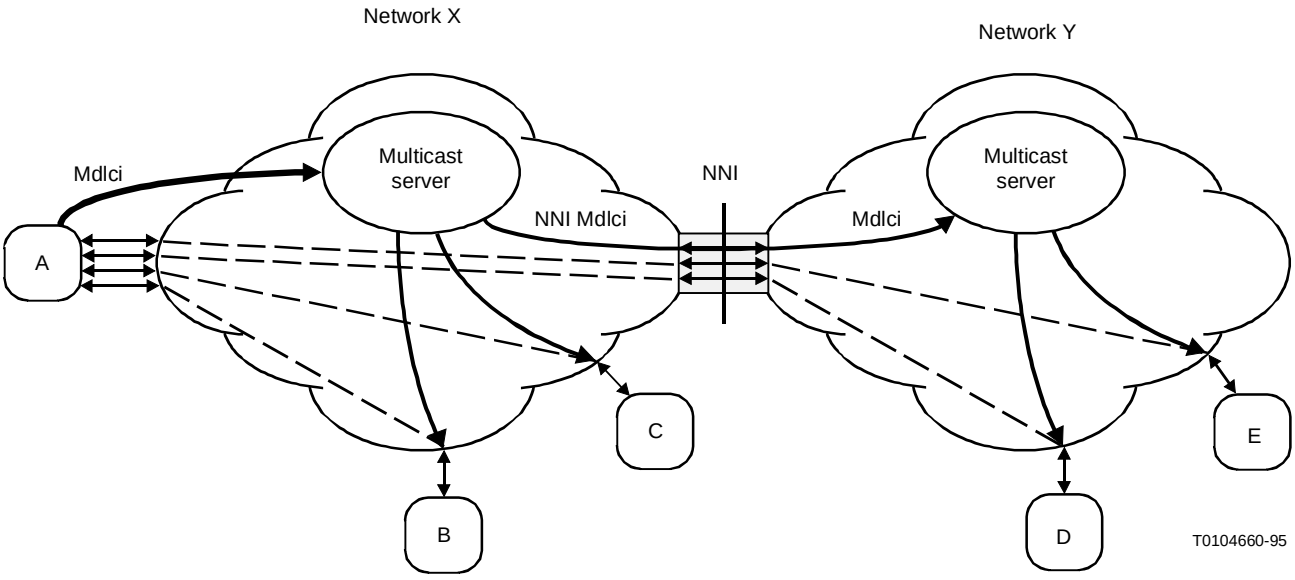

FIGURE F.6/I.233.1

One-way multicast across an NNI

F.7.2 PVC management procedures for the NNI

PVC management capabilities shall be as in Recommendation I.372.

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