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# Information technology — Telecommunications and information exchange between systems — Intermediate system to Intermediate system intra-domain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)

## AMENDMENT 2: Extensions for group composition and related MST multicast routeing



*Technologies de l'information — Communication de données et échange d'informations entre systèmes — Protocole intra-domaine de routage d'un système intermédiaire à un système intermédiaire à utiliser conjointement avec le protocole fournissant le service de réseau en mode sans connexion (ISO 8473)*

*AMENDEMENT 2: Extensions pour la composition de groupe et routage de la diffusion sélective de MST liée*

Reference number
ISO/IEC 10589:1992/Amd.2:1999(E)

## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Amendment 2 to ISO/IEC 10589:1992 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

# Information technology — Telecommunications and information exchange between systems — Intermediate system to Intermediate system intra-domain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)

AMENDMENT 2: Extensions for group composition and related MST multicast routeing

*Add the following new annex G.*

## Annex G

(normative)

### Extensions for group composition and related MST multicast routeing

#### Introduction

The main intention of this annex is the specification of mechanisms for the distribution and handling of Minimum Spanning Tree (MST) multicast address information within the level 1 routeing area as well as the specification of the computation of the MST used for routeing of multicast NPDUs. The mechanisms specified herein enforce that each Intermediate system has the complete information about all existing address groups and their composition, that is the NSAP addresses of all members belonging to a particular address group. Since the distribution of this group information on larger networks would use a not negligible network bandwidth, the restriction on the level 1 area as mentioned above has been done. In a future step the MST multicasting mechanisms specified herein shall be expanded for the level 2 routeing area. This kind of multicasting is referred to as MST multicasting within the document.

In ISO/IEC 10589:1992 there is no mean for using multicast addresses. This annex proposes the usage of multicast addresses, as defined in ISO 8348:1987 and the replication of NPDUs making use of a computed MST in those Intermediate systems, where the destination addresses divert to multiple links. This new definition can be used on all types of subnetworks and is downward compatible with the specification in the main body of this International Standard.

This Annex also refers to Annex D of ISO 9542, Addition of group composition information, which specifies a mechanism for the distribution of group composition information between Intermediate systems and End systems.

## G.1 Scope

This annex describes procedures for the distribution and interpretation of MST multicast information between network entities residing in Intermediate Systems within a single routeing domain.

## G.2 Normative references

ISO 9542:1988/Annex D, Information technology - Telecommunications and information exchange between systems - End system to Intermediate system routeing exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473) - Annex D: Addition of group composition information

C.-H. Chow; On Multicast Path Finding Algorithms; Proc. of Infocom. '91; pp 1274-1283

## G.3 Definitions

For the purposes of this annex the following definition applies.

**group:** a set of systems, which can be identified by their network addresses.

## G.4 Abbreviations

For the purposes of this annex, the following abbreviations apply in addition to those defined in the main body of the specification

| | |
|---|---|
| ESGC PDU | End System Group Composition Protocol Data Unit (ISO 9542 Annex D) |
| GSP | Group State Protocol Data Unit |
| ISGC PDU | Intermediate System Group Composition Protocol Data Unit (ISO 9542 Annex D) |
| ID | Identification |
| L | Level |
| MO | Managed Object |
| MST | Minimum Spanning Tree |
| SPF | Shortest Path First |

## G.5 Overview of the protocol

### G.5.1 Subnetwork independent functions

As a new subnetwork independent function the multicast routeing is introduced as follows:

- Group addresses are handled between Intermediate systems as a set of unicast addresses.

- The mechanism of handling NPDUs with a group address as the target address of this NPDU is available within all Intermediate systems of this routeing domain.

- For routeing of multicast NPDUs from the entry Intermediate system to the target Intermediate systems a minimum spanning tree (see annex C) is constructed. This routeing algorithm guarantees that in the case where non-broadcast subnetworks are used for connecting two adjacent Intermediate systems, NPDUs are only replicated at those Intermediate systems, where more than one subtree is used towards the target unicast NSAP addresses.

- MST multicast information is flooded within the intradomain routeing area using a new type of PDUs, called "Group State PDUs (GSPs)". These GSPs are handled like LSPs and are exchanged on all types of subnetwork connections, as proposed in Amendment 2 for LSPs (especially for exchanging LSPs and GSPs on DA circuits).

- Group addresses are either created, modified or deleted by systems operations at every Intermediate system or at an End system, exchanging group address information between End systems and their designated Intermediate system using additional PDU types "End System Group Composition PDU (ESGC)" and "Intermediate System Group Composition PDU (ISGC)" (extended operation). In the case the option is not used, End systems are not informed about the members of a group, only about the existence of a group. In this case End systems are only able to use group addresses (e.g. as target addresses for multicast NPDUs), to subscribe to an existing group address or to unsubsribe itself from a group address.

### G.5.2 Design goals

This annex supports the following design goals:

- *Replication:* The replication function determines the number of different outgoing paths depending on the decomposition of the multicast addresses within a NPDU. Based on this number of different paths the NPDU is than replicated n times within an Intermediate System and these replicated NPDUs are sent once per determined outgoing path.

- *MST multicastness:* Exchange of group composition information in the optional or mandatory mode between End Systems and Intermediate Systems using ESGC PDUs and ISGC PDUs (see ISO 9542 Annex D), exchange of group composition information in the basic or extended mode among Intermediate Systems using GSPs (see mechanisms described in this amendment) and replication of NPDUs with multicast addresses in the basic or extended mode (see mechanisms described in this amendment).

### G.5.3 Design non-goals

It is not a design goal of the procedures defined in this annex to guarantee delivery of all offered NPDUs to all defined destination addresses.

### G.5.4 Enhancements to the Decision Process

If the decision process has recognised that a NPDU is to be routed to a group address, the following actions are needed:

- expand the group to all addresses contained in the group - (15) in figure G-1.

- create the routeing decision according to the link state database for each of the group members and store it until replicated NPDU(s) are removed in the next step - (16) in figure G-1.

### G.5.5 Enhancements to the Update Process

This process constructs, receives and propagates Link State PDUs and Group State PDUs. Each Link State PDU contains information about the identity and routeing metric values of the adjacencies of the IS that originated the Link State PDU. Each Group State PDU contain a (new) group definition (or a part of it), that is just known at the adjacent IS.

The Update Process receives Link State, Group State and Sequence Numbers PDUs from the Receive Process - (4) in figure G-1. It places new routeing information in the routeing information base - (6) and propagates routeing information to other Intermediate systems - (7) and (8).



General characteristics of the Update Process are:

- Link State PDUs are generated as a result of topological changes, and also periodically. They may also be generated indirectly as a result of System Management actions (such as changing one of the routeing metrics for a circuit).



- Group State PDUs are generated as a result of changes in the Group State or based on Systems Management actions.

- Level 1 Link State PDUs are propagated to all Intermediate systems within an area, but not propagated out of an area.

- Level 2 Link State PDUs are propagated to all Level 2 Intermediate systems in the domain.

- Link State PDUs are not propagated outside of a domain.

- The update process, through a set of System Management parameters, enforces an upper bound on the amount of routeing traffic overhead it generates

### G.5.6 Enhancements to the Forwarding Process

After the decision process has resolved to which adjacencies the multicast NPDU is to be send, the NPDU has to be replicated and sent to these adjacencies with the group address as the destination address - (18) in figure G-1.

### G.5.7 Enhancements to the Receive Process

Additionally the Receive Process obtains its inputs from the group information handed to the group state database (both from ESs and ISs).

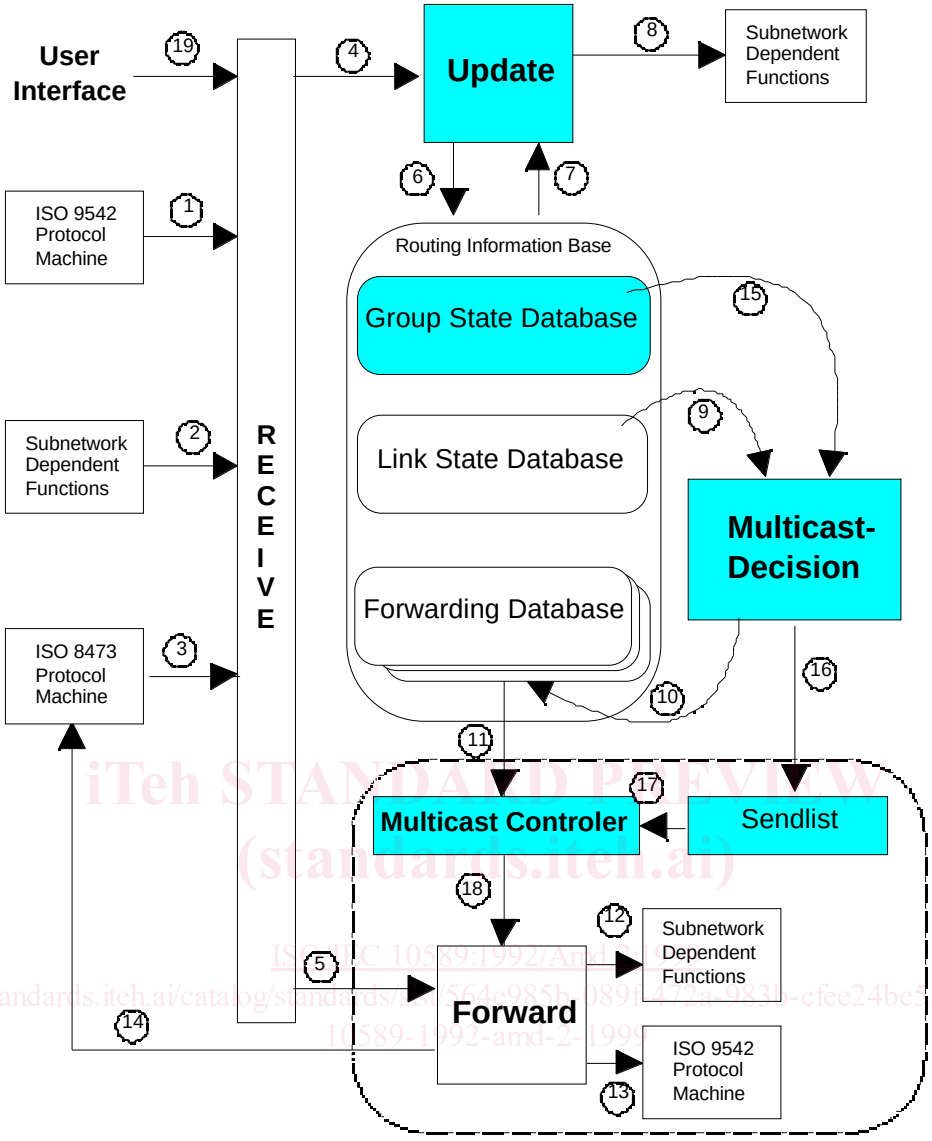


**Figure G-1 — Decomposition of Subnetwork Independent Functions**

## G.6 Subnetwork independent functions

This Annex introduces a new process, the Sendlist Creation Process (L2, L1), and a new database, the Group State data base (L2, L1).

### G.6.1 Decision process

This process uses the databases of Link State information and Group State information to calculate the forwarding database(s), from which the forwarding process can know the proper next hop(s) for each (replicated) NPDU. The Level 1 Link State Database is used for calculating the Level 1 Forwarding Database(s), and the Level 2 Link State Database is used for calculating the Level 2 Forwarding Databases(s). The Group State Database is used to calculate in addition both the Level 1 and Level 2 Forwarding Database(s).

#### G.6.1.1 Input for the Decision Process

As a new input for the Decision Process this annex makes use of the Group State Database, which is a set of MST multicast information from the latest Group State PDUs from all known Intermediate Systems (within this

area, for Level 1, or within the level 2 subdomain, for Level 2), and from the latest Group Hello PDUs from all adjacent End Systems. This database is received from the Update Process.

#### G.6.1.2 Output for the Decision Process

This Annex generates the following new outputs for the Decision Process:

- Level 1 MST Multicast Forwarding Databases - one per routeing metric
- (Level 2 Intermediate systems only) Level 2 MST Multicast Forwarding Databases - one per routeing metric

#### G.6.1.3 MST multicast enhancements to the decision process

This clause contains the enhancements to the decision process necessary to support MST multicasting.

##### G.6.1.3.1 Exchange of GSPs

In addition to the exchange of LSPs, GSPs are send to all Intermediate systems neighbours (also ISO 9542 ISGC PDUs are sent to all End Systems, if the extended mode of ISO/IEC 9542/Annex D is used) under two circumstances:

a) The Intermediate System receives a GSP with a new multicast address or with a known multicast address but with a higher sequence number

b) (optional): The MST multicast announcement timer triggers a periodical resent of the local group addresses.

The Update process is also capable of dividing a single logical GSP into a number of separate PDUs for the purpose of transmitting large group definitions.



##### G.6.1.3.2 Multicast routeing algorithm



The routeing algorithm used by the Decision Process is a Minimum Spanning Tree algorithm. Each Intermediate system executes the Minimum Spanning Tree algorithm autonomously to define a loopless tree of legal paths to all destination systems in a routeing domain. This routeing algorithm is specified in more detail in G.10.



##### G.6.1.3.3 Processing of multicast NPDUs

If the Decision Process recognises that a destination address is not a group address ((1) within figure G-2), no expanding is carried out. Otherwise (2) the first activity must be marking the source link, from which the NPDU is received. After the group list expansion a Sendlist is created. This list will contain all adjacencies to which the NPDU has to be forwarded. The following actions are carried out in a loop (3) for all members of a group:

- calculate the path to the members of the group list
- check whether a link exists in the Link State Database
- verify that the adjacency on this link is not the source link from which the NPDU is received (4)
- add the adjacency to the Sendlist, if it is not already in the list (5). This is to prevent sending duplicated PDUs to the same adjacency (6).
- create an Error Event to the System Management if the only available link is the source link (7). This event indicates a possible loop condition caused by backward routeing.

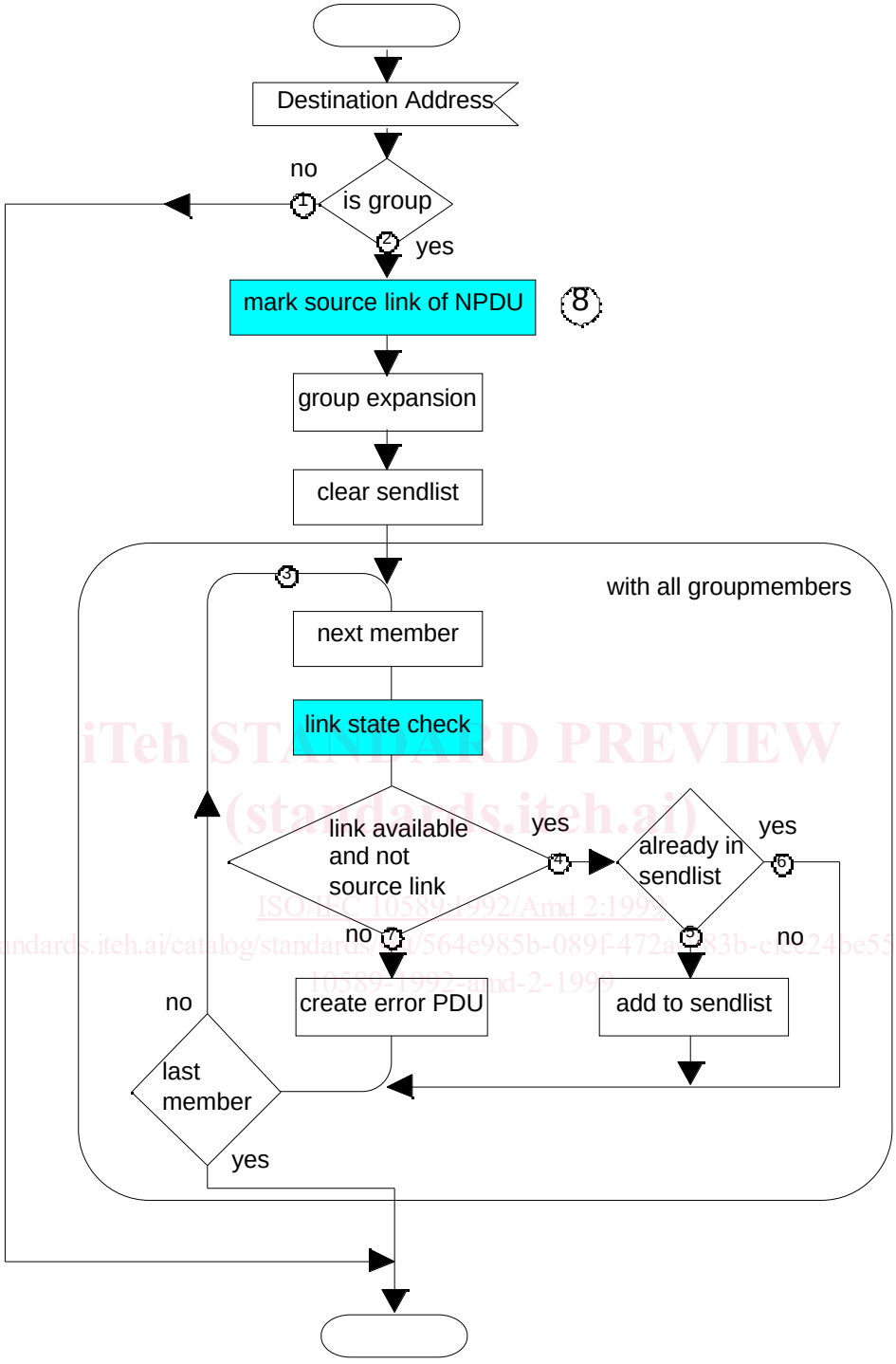


**Figure G-2 — Processing of multicast NPDUs**

## G.6.2 Update process

### G.6.2.1 Input for the Update Process

- As a new input for the Update Process this annex makes use of the Group State PDUs, which are passed by the Receive Process to the Update process along with an indication of which adjacency it was received from.

**G.6.2.2 Output for the Decision Process**

This annex generates the following new outputs for the Decision Process:

- Group State Database

Note: As a result of the Receive Process the Group State Database is maintained. A signal to the Decision Process is created as an event which is either the receipt of a Group State PDU with information different from the stored one, or the purging of groups from the database.

**G.6.2.3 Parameters**

This annex adds the following parameter to those defined in the main body of this International Standard.

maximumGSPGenerationInterval - This is the maximum amount of time allowed to elapse between generation of Group State PDUs by a source and will be used only for the optional periodic GSP generation. It shall be less than MaxAge.

A reasonable setting is 15 min.

**G.6.2.4 Multiple GSPs**

Because the GSP is limited in its size by ReceiveGSPBufferSize, it may not be possible to include all members of a big group in a single GSP. In such a case, a system may use multiple GSPs to convey this information. The recipient system recognises that they all pertain to a common originating system because they all use the same Sequence Number.



Because of interpreting the first area address in the variable length field as the group address, this entry must be the same in every following GSP.



**G.6.2.5 Periodic GSP generation (optional)**



The Update Process may optionally periodically re-generate and propagate on every circuit with an IS or ES adjacency the locally known group definitions. The Intermediate System may re-generate each GSP at intervals of at most maximumGSPGenerationLevel, with jitter applied as described in 10.1 of this specification.

**G.6.2.6 Event driven GSP generation**

An Intermediate System shall as normal operation generate a GSP when an event occurs which would cause the information content to change. The following events may cause such a change:

- receipt of a new group composition
- receipt of a modified group composition
- receipt of a deletion of an existing group
- modification of the Group State database by systems management actions

**G.6.2.7 Propagation of GSPs**

The Update Process is responsible for propagating Group State PDUs throughout the domain.

The basic mechanism is flooding, in which each Intermediate system propagates GSPs to all its neighbour Intermediate systems except the neighbour from which it received the PDU. Duplicates are detected and dropped.

Group State PDUs are received from the Receive Process.