Accredited Standards Committee X3, INFORMATION PROCESSING SYSTEMS

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To: X3S3.3

From: D. Marlow (NSWC-DD)

Re: Multicast extensions to the ES-IS routeing exchange protocol

NSWC, Dahlgren Division has provided this new version of text to support the New Project ballot for the multicast extensions to the End system to Intermediate system routeing exchange protocol (SC6N7509). The update covers changes to separate the unicast Configuration function from the Multicast Announcement function as well as adding multicast address mapping functions to support mapping a paired SNPA address from a group Network address. It is proposed that this be the text for a PDAM ballot for this project.

U.S. discussion on this input is planned for the ANSI X3S3.3 committee's January meeting in Menlo Park, CA.

This amendment is one component of a number of standardization actions on-going to support an OSI connectionless-mode multicast capability. Additional proposals are on-going to provide additions to the connectionless-mode Network service definition and addressing addenda and the connectionless-mode Network layer protocol.

Preface

This amendment provides detailed changes to ISO 9542 to permit multicast transfer as an option. Additional functionality in ISO 9542 is required for Intermediate Systems to find which multicast NPDUs are needed on which subnetworks. The optional functionality is enabled by End Systems passing End System Group Hello (ESGH) PDUs stating their intentions to receive specific multicast NPDUs (identified by specific group Network addresses contained within the ESGH PDU).

In developing the detailed changes to ISO 9542 a number of differences were noted in the operation of ES-IS operations to support multicast transfer and that which are provided now. The following differences were noted:

a) The dynamic activity needed for multicast transfer are not the unicast configuration and redirection functions. For multicast transfer an ES needs to periodically announce their intentions to receive specific multicast NPDUs and what SNPA address they expect these group Network Addresses to be paired with. Note that a number of ESs on the same subnetwork may want to receive the same multicast NPDUs. If a multicast IS is attached to the subnetwork, it needs to receive the announcements, record which multicast NPDUs are needed on which subnetworks and check that the SNPA address being assumed for each multicast transfer is correct. While multiple multicast capable ISs may be attached to the subnetwork, only one will serve as the Active Multicast IS. The selection of the Active Multicast IS, if multiple multicast capable ISs are attached to the subnetwork, is outside the scope of this amendment. Whenever a problem is noted with the SNPA address that is being used (or assumed) by an ES for a particular multicast transfer, the Active Multicast IS sources a MAM PDU to provide the correct group Network address to SNPA address mapping to all multicast capable ESs on the subnetwork. In addition a means is provided to ensure that ESs which send out multicast NPDUs, but are not receivers of such NPDUs (i.e. are not members of the group) are using the correct SNPA address. The means for ISs to exchange information among themselves in support of multicast transfer is outside of the scope of this amendment.

b) Query Configuration (and thus the corresponding Configuration Response function) cannot be requested by ESs. The operation, if performed, would result in an ES receiving the SNPA address of another ES and not the group SNPA address it is seeking.

c) An ES will report group Network addresses only on subnetworks for which it wants to receive such multicast NPDUs and not necessarily all subnetworks to which it has SNPAs. Reports on multiple SNPAs is a request for duplicate NPDUs.

Date: 1992-12-02

Information processing systems - 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)

Amendment 2: Addition of connectionless-mode multicast capability

0 Introduction

This Amendment to ISO 9542 adds optional functionality to support multicast transfer. The entire ES - IS protocol is contained in ISO 9542.

ISO 9542 provides the capability to support the routeing of non-multicast NPDUs; however, it does not directly support the exchange of multicast NPDUs. The capabilities required to support End Systems sourcing or sinking multicast NPDUs include the means for Intermediate Systems to find which multicast NPDUs are needed on which subnetworks.

This Amendment defines the optional additional functionality to the ES - IS Routeing Protocol (ISO 9542) which supports the transfer of multicast NPDUs. It is an explicit goal of this Amendment that ESs and ISs, some of which will have multicast capabilities and some without, will be able to fully function on the same subnetworks. This amendment does not change any aspect of a currently defined (i.e. non-multicast) ISO 9542 implementation, it adds new optional functionality not modifying current functionality.

1 Scope and Field of Application

This Amendment makes no changes to clause 1 of ISO 9542.

2 References

This Amendment makes no changes to clause 2 of ISO 9542.

3 Definitions

This Amendment makes no changes to clause 3 of ISO 9542.

4 Symbols and Abbreviations

This Amendment makes no changes to clause 4 of ISO 9542.

5 Overview of the protocol

Replace the present two bullets in clause 5.1 with:

*Configuration Information,

*Route redirection information,

*Multicast announcement information, and

*Multicast address mapping information

Add two new paragraphs at the end of clause 5.1:

Multicast announcement information allows ISs with the optional capability to support multicast transfer to dynamically discover which multicast NPDUs are needed on a particular subnetwork by the ESs that are attached to that subnetwork. This eliminates the need for manual intervention at ESs and ISs to establish which multicast NPDUs are needed.

Multicast address mapping information allows ESs to dynamically associate a SNPA address to a particular group Network address. Allowing an IS to inform the ESs of such addresses provides a dynamic allocation of group SNPA addresses which can meet the needs and capabilities of the Network entities attached to a particular subnetwork.

Add a third and fourth bullet to 5.3.1:

* All Multicast Network entities

*group SNPA address corresponding to a group Network address

Add to the beginning of the second sentence in the (c) paragraph of 5.4.2.1:

For the purposes of unicast data transfer,

Add a paragraph d) and a Note to 5.4.2.1:

d) Intermediate Systems with the optional OSI multicast capabilities are informed of the group Network addresses which End Systems on this subnetwork need to receive.

Editor's Note: Intermediate Systems with the optional OSI multicast capabilities do receive information identifying the SNPA address of ESs on the broadcast network that want NPDUs with particular group Network addresses as their destination address; however, the critical information is which multicast NPDUs are needed not which ESs need them.

6 Protocol Functions

Replace the last sentence in the first paragraph of clause 6.1 with:

The four types of timers employed by the protocol are the Configuration Timer (CT), the Holding Timer (HT), the Multicast Announcement Timer (MAT) and Multicast Address Mapping Timer (MAMT).

Replace the first sentence in the first paragraph of clause 6.1.2 with:

The Holding Timer applies to configuration, route redirection, multicast announcement and multicast address mapping information.

Replace the last sentence in the first paragraph of clause 6.1.2 with:

Old configuration, route redirection, multicast announcement or multicast address mapping information shall be discarded after the Holding Timer expires to ensure the correct operation of the protocol.

Add two new clauses following clause 6.1.2:

6.1.3 Multicast Announcement Timer

The Multicast Announcement Timer is a local timer (i.e. maintained independently by each End System with the optional OSI multicast capabilities for receiving particular multicast NPDUs) which assists in performing the Report Multicast Announcement function (see 6.14). The timer determines how often an End System reports its desire to receive multicast NPDUs with that group Network address as its destination address parameter. Considerations in setting this timer are similar to those described for the Configuration timer (see 6.1.1)

6.1.4 Multicast Address Mapping Timer

The Multicast Address Mapping TImer is a local timer (i.e. maintained independently by an Intermediate System which is actively participating with End Systems to transfer multicast NPDUs) which assists in performing the Report Multicast Address Mapping function (see 6.17). The timer determines how often an Intermediate System, actively participating with End Systems for the transfer of multicast NPDUs, reports the Multicast Address Mapping for a particular group Network address. The shorter the Multicast Address Mapping Timer, the more quickly End Systems on the subnetwork will become aware of the correct address mapping which may change due to the Intermediate System becoming available or unavailable. There is a trade off between increased responsiveness and increased use of resources in the subnetwork and in the End Systems.

Add to paragraph (c) of 6.5 prior to the words "PDU destined":

unicast

Add a Note under point (c) of 6.5:

Note: The Query Configuration function cannot be performed to find the corresponding SNPA address of a group Network address since the addressing information needed is the corresponding group SNPA address and not the SNPA address of a particular End System responding. On a large broadcast subnetwork, many different Configuration Responses could result each incorporating a different End System Address. While it is possible to design a Query Configuration for use with multicast, this function does not appear to be required given the use of the "All Multicast Network Entities" address for supplying a SNPA address when the group SNPA address is not known.

Add ten new clauses for the new functions at the end of clause 6 (following the present 6.13):

6.14 Report Multicast Announcement Function by End Systems

An End System which needs to receive or continue to receive any multicast NPDUs (i.e. NPDUs with group Network addresses as their destination address), constructs and transmits ESGH PDUs to inform multicast capable Intermediate Systems of the multicast NPDUs it needs to receive. This may be done by constructing ESGH PDUs for each group Network address. Alternatively, ESGH PDUs may be constructed which convey information about more than one group Network address at a time, up to the limits imposed by the permitted SNSDU size and the maximum header size of the ESGH PDU. Each ESGH PDU is transmitted by issuing an SN-UNITDATA.Request with the following parameters:

SN_Userdata (SNSDU) <- ESGH PDU

SN_Destination _Address <- multi-destination address that indicates "All Multicast Network Entities"

Where an End System supports more than one SNPA, the information about each group Network address desired for receiving on a particular SNPA serving the End System shall be transmitted via that SNPA. It is permissible for an End System to report group Network addresses on multiple SNPAs; however, duplicate multicast NPDUs should be anticipated.

The Holding Time (HT) field is set to approximately twice the ES's Multicast Announcement Timer (MAT) parameter. The value shall be large enough so that even if every other ESGH PDU is discarded (due to lack of resources), or otherwise lost in the subnetwork, the multicast announcement information will still be maintained. The value should be set small enough so that Intermediate Systems resources are not needlessly consumed when such multicast NPDUs are no longer needed.

Note: -- When more than one group Network address is contained within a single ESGH PDU, their Multicast Announcement Timers should either be of equal or near equal values.

In order to support the optional Damping function it is recommended that the ES apply a 25% jitter to its Multicast Announcement Timer (MAT) parameter. Specification of generating jitter on timers is contained in ISO 10589, clause 10.1 (Generating jitter on timers).

Note: -- Given the use of the Suggested ES Multicast Announcement Timer (ESMAT) option, it is very likely that all End Systems wishing to receive a particular multicast NPDU on a particular subnetwork will have the same value for their Multicast Announcement Timer and these timers may all become synchronised. Such synchronisation will result with the traffic distribution containing peaks. Where there are a large number of synchronised systems, this can cause overloading of both the transmission medium and the systems receiving the PDUs. This will also negate any beneficial use of the Damping function (since systems may be attempting to transmit their own ESGH PDUs at the time they receive ESGH PDUs sourced by other ESs with the same group Network address).

6.15 Record Multicast Announcement Function

The Record Multicast Announcement function receives ESGH PDUs, extracts the multicast announcement information and updates the information in the local Network entity's routeing information base.

The receiving system is not required to process any option fields in a received ESGH PDU.

Note: -- When a system chooses to process these optional fields, the precise actions are not specified by this International Standard.

6.15.1 Record Multicast Announcement Function by Intermediate Systems

On receipt of an ESGH PDU an IS with the optional multicast capabilities extracts the configuration information and stores the {group Network address, SNPA} in its local multicast routeing information base replacing any other information for the same entry.

The Active Multicast IS upon receipt of an ESGH also extracts the Paired SNPA Address parameter corresponding to each group Network address in the ESGH PDU. If an erroneous Paired SNPA address is found, the Report Multicast Address Mapping function is performed.

6.15.2 Optional Damping Function

An ES with the optional capabilities to support multicast transfer may decide to process ESGH PDUs multicast by other End Systems. There is potentially some reduction in network traffic by doing this. An ES requesting to receive multicast NPDUs is permitted to reset its Multicast Announcement Timer corresponding to one group Network address on one SNPA upon receiving an ESGH PDU from another ES under the following circumstances:

a) The {group Network address, paired SNPA address, SNPA} of the ESGH PDU received matches that of the ES processing the ESGH PDU.

Note: -- The SNPA needs to be considered when the ES is attached to multiple subnetworks.

b) The Multicast Holding Timer parameter value in the ESGH PDU received is equal to or greater than the Multicast Holding Timer value for the, group Network address, being used by the ES processing this PDU.

6.16 Flush Old Multicast Announcement Function

The Flush Old Multicast Announcement function is executed to remove multicast announcement entries in the routeing information base whose Holding Timer has expired. When the Holding Timer for a group Network address expires, this function removes the corresponding entry from the routeing information base of the local IS for the corresponding SNPA.

The Flush Old Multicast Announcement function is also executed whenever a subnetwork service provider re-initializes a local SNPA. When the SNPA is either disabled or re-initialized, all multicast announcement information for any group Network address associated with that SNPA is removed.

6.17 Report Multicast Address Mapping Function by Intermediate Systems

The Active Multicast Intermediate System constructs a MAM PDU, corresponding to a group Network address for which it received via the Record Multicast Announcement function, and issues these PDUs under the following circumstances:

a) The IS initializes either as the Active Multicast IS after an election with other multicast capable ISs or initializes determining it is the only multicast capable IS (the determination of such conditions are outside of the scope of this standard),

b) The IS receives an ESGH PDU with a group Network address paired to an incorrect SNPA address,

Note: -- The Active Multicast IS determines which mappings are correct. Pre-configured mappings which are used prior to the initialization of the Active Multicast IS may be determined incorrect by the Active Multicast IS.

c) The expiration of the IS's Multicast Address Mapping Timer for that group Network address, and

Note: -- This is to prevent the expiration of Mapping Holding Timers in ESs and to ensure that ESs which source specific multicast NPDUs but are not receivers of such NPDUs use the correct SNPA destination address.

d) The IS receives a multicast NPDU sourced on the subnetwork which used an incorrect destination SNPA address.

Note: -- How the IS receives such NPDUs is outside the scope of this standard.

The IS serving as the Active Multicast Intermediate System may construct a MAM PDUs for each group Network address. Alternatively, MAM PDUs may be constructed which convey information about more than one group Network address at a time, up to the limits imposed by the permitted SNSDU size and the maximum header size of the MAM PDU. The IS performs all multicast address mapping functions independently for each of its SNPAs even if this IS is the Active Multicast IS on multiple subnetworks. Each MAM PDU is transmitted by issuing an SN-UNITDATA.Request with the following parameters:

SN_Userdata (SNSDU) <- MAM PDU

SN_Destination _Address <- multi-destination address that indicates “All Multicast Network Entities”

The Holding Time (HT) field is set to approximately twice the Intermediate System's Multicast Address Mapping Timer (MAMT) parameter. This variable shall be set to a value large enough so that even if every other MAM PDU, for a particular group Network address, is discarded (due to lack of resources), or otherwise lost in the subnetwork, the multicast address mapping information will still be maintained. The value should be set small enough so that End Systems will quickly cease to use the multicast address mappings supplied by ISs that have failed.

Note: -- The Holding Timer parameter value applies to all group Network addresses called out in the MAM PDU.

An IS may optionally suggest a value for End Systems on the local subnetwork to use as their Multicast Announcement Timers, for a specific group Network address, by including the ESMAT option in the transmitted MAM PDU. Setting this option permits the Active Multicast IS to influence the frequency with which ESs transmit ESGH PDUs.

Note: -- If the ESMAT option is used, the one value permitted in the MAM PDU is suggested for all group Network addresses called out in the MAM PDU.

Editor's Note: A useful extension has been considered to provide the capability for ESs on a subnetwork without a multicast capable IS to elect a "Multicast Address Mapping Agent". This is left at this time for further study.

6.18 Record Multicast Address Mapping Function by End Systems

An End System always has a paired SNPA address for every active group Network address in use on a particular subnetwork. This mapping is obtained by:

a) recording a multicast address mapping which is maintaining an active holding timer, or if there has been no dynamic information received, by

b) having pre-configured multicast address mapping information, or if neither dynamic nor pre-configured information is available, by

c) mapping the "All Multicast Network Entities" multi-destination address to the group Network address.

An ES will always map the "All Multicast Network Entities" multi-destination address to a particular group Network address under the following circumstances:

a) the End System has a multicast NPDU to source,

b) the End System is attached to a broadcast subnetwork,

c) there is a multicast capable IS reachable on the subnetwork, (i.e. an ISH containing a Multicast Capable optional parameter has been received and the Holding Timer associated with this routeing information received is still active),

d) there is no current multicast address mapping information for the group Network address corresponding to the multicast NPDU that is to be sourced, (i.e. no MAM PDU have been received with this group Network address since the last information was removed by the Flush Old Multicast Address Mapping Function),

e) the group Network address of the NPDU to be sourced is not a group Network address that this ES is performing the Report Multicast Announcement function, (i.e. this station is not requesting to receive such NPDUs).

Note: -- While an ES may process ESGH PDUs multicast by other ESs to support the optional Damping function, an ES is not permitted to change its own mapping due to the mapping found in other ES's ESGH PDUs.

The Record Multicast Address Mapping function receives MAM PDUs, extracts the multicast address mapping information and updates the information in the local Network entity's routeing information base. The receiving system is not required to process any option fields in a received MAM PDU.

Note: -- When a system chooses to process these optional fields, the precise actions are not specified by this International Standard.

On receipt of a MAM PDU an ES with the optional multicast capabilities extracts the configuration information and stores the {group Network address, paired SNPA address, SNPA} in its local multicast routeing information base replacing any other information for the same entry.

In addition, an ES may also recompute it Multicast Announcement Timer corresponding to the group Network address for which it is performing the Record Multicast Address Mapping function based on receipt of a MAM PDU containing the Suggested ES Multicast Announcement Timer (ESMAT) optional field.

6.19 Flush Old Multicast Address Mapping Function

The Flush Old Multicast Address Mapping function is executed to remove multicast address mapping entries in the routeing information base whose corresponding Holding Timer has expired. When such a Holding Timer for a multicast address mapping expires, this function removes the corresponding entry from the routeing information base of the local ES for the corresponding SNPA.

The Flush Old Multicast Address Mapping function is also executed whenever a subnetwork service provider re-initializes a local SNPA. When the SNPA is either disabled or re-initialized, all multicast address mapping information for any multicast address mapping associated with that SNPA is removed.

7 Structure and Encoding of PDUs

Add a new entry to Table 2, determine actual binary values at a later time:

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ESGH PDU a b c d e
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Add a phrase to the third sentence of clause 7.2.1 right before "the ISH PDU carries":

the ESGH PDU carries one or more group Network addresses (GNAs);

Replace the text of clause 7.3.2 with:

The Destination and Source Addresses are Network Service Access Point addresses as defined in Annex A of ISO 8348 | CCITT Recommendation X.213. The Group Network Address parameter is a group Network address as defined in Annex A of ISO 8348 | CCITT Recommendation X.213. The Network Entity Title is a Network entity title as defined in Annex A of ISO 8348 | CCITT Recommendation X.213. The Destination Address, Source Address, Group Network Address, and Network Entity Title are encoded as NPAI using the binary syntax defined in clause A.5.3 of ISO 8348 | CCITT Recommendation X.213.

Add a new clause 7.3.7 and a new Figure X between the present Figure 6 and Figure7:

7.3.7 Group Address Pair Parameter for ESGH and MAM PDUs

The Group Address Pair parameter is a list of one or more group Network addresses each with their associated Paired SNPA address. The group Network address identifies specific multicast NPDUs and the Paired SNPA address is the SNPA address used (or assumed) by a Network Entity for transferring such multicast NPDUs on the subnetwork where an NPDU containing this parameter is sourced. It is encoded in the ESGH and MAM PDUs as shown in Figure X.

	Octet
Number of Group Address Pairs	10
Group Network Address Length Indicator (GNAL)	11
Group Network Address (GNA)	12
Paired SNPA Address Length Indicator (PSAL)	
Paired SNPA Address (PSA)	
GNAL	
GNA	
PSAL	
PSA	m-1

Figure X - ESGH and MAM PDUs - - Group Address Pair Parameter

Change clause 7.4.2 by replacing the two occurrences of "ESH" with:

ESH, ESGH

Add the following Editor's note to the end of clause 7.4.2

Editor's note: There is no Security option for the MAM PDU.

Change clause 7.4.4 by replacing the two occurrences of "ESH" with:

ESH, ESGH

Add the following Editor's note to the end of clause 7.4.4

Editor's note: There is no Priority option for the MAM PDU.

Add two new clauses to the Options Part after the present clause 7.4.7

7.4.8 Suggested ES Multicast Announcement Timer

The ESMAT option may appear only in the MAM PDU

The ESMAT parameter conveys the value that an IS would like the receiving ESs to use as their local Multicast Announcement Timer.

Parameter Code: To Be Determined

Parameter Length: two octets

Parameter Value: ESMAT in units of seconds.

7.4.9 Multicast Capable

The Multicast Capable option may appear only in the ISH PDU

The Multicast Capable options consists only of a one octet code and a one octet parameter length field, there is no parameter field.

Parameter Code: To Be Determined

Parameter Length: zero octets

Parameter Value: none (parameter does not exist).

Editor's Note: Work is in process to provide Address Mask and SNPA Mask options for the MAM PDU. Such options will provide the means for a single MAM PDU to provide mapping services for many different group Network address and their paired SNPA addresses.

7.4.10 Group Address Mask

The GAM parameter indicates that the multicast address mapping information applies to a larger population of group Network Addresses than the group Network address contained in the MAM PDU indicates. When this option is provided in a MAM PDU, the masking relationship contained must be valid for all group Network addresses contained in this PDU.

The Group Network Address field of this option establishes an equivalence class of group Network addresses to which the same multicast address mapping applies. To determine whether or not a trial group Network address falls within the equivalence class, the ES aligns the trial group Network address with the Group Network Address Mask field of the Group Address Mask padding the latter with trailing zero octets if necessary. If in bit positions where the Group Network Address Mask is “1” the trial group Network address matches the Group Network Address field of the Group Address Pair of the MAM PDU, the trial group Network address belongs to the equivalence class described by the MAM PDU.

Given that a group Network address has been found to belong to the equivalence class described by the MAM PDU, the paired SNPA address for this group Network address is found by using the Paired SNPA Address Mask field of the Group Address Mask. The Paired SNPA Address Mask supplies the mapping information by indicating certain bit positions within the space “below” the Group Network Address Mask field. Specifically the Paired SNPA Address Mask field indicates the location of the paired SNPA address in the group Network Address

	Octet
Parameter Code	1
Parameter Length	2
Group Network Address Mask Length Indicator (GNAML)	
Group Network Address Mask (GNAM)	
Paired SNPA Address Mask Length Indicator (PSAML)	
Paired SNPA Address Mask (PSAM)	

Group Address Mask Option Format

Parameter Code: To Be Determined

Parameter Length: variable

Parameter Value: two comparison masks of octets to be aligned with the Group Network Address and Paired SNPA Address fields of the Group Address Pair parameter of the MAM PDU.

Add section 7.8 and a new Figure Y after the present Figure 12:

7.8 End System Group Hello (ESGH) PDU

The ESGH PDU has the format shown in figure Y:

Field	Octet
Network Layer Protocol Identifier	1
Length Indicator	2
Version / Protocol Id Extension	3
reserved (must be zero)	4
0 | 0 | 0 | Type	5
Holding Time	6,7
Checksum	8,9
Number of Group Address Pairs	10
Group Network Address Length Indicator (GNAL)	11
Group Network Address (GNA)	12
Paired SNPA Address Length Indicator (PSAL)	
Paired SNPA Address (PSA)	
GNAL	
GNA	
PSAL	
PSA	m-1
Options	m p-1

Figure Y- ESGH PDU Format

Add section 7.9 and a new Figure Z after Figure Y:

7.9 Multicast Address Mapping (MAM) PDU

The MAM PDU has the format shown in figure Z.

Field	Octet
Network Layer Protocol Identifier	1
Length Indicator	2
Version / Protocol Id Extension	3
reserved (must be zero)	4
0 0 0 Type	5
Holding Time	6,7
Checksum	8,9
Number of Group Address Pairs	10
Group Network Address Length Indicator (GNAL)	11
Group Network Address (GNA)	12
Paired SNPA Address Length Indicator (PSAL)	
Paired SNPA Address (PSA)	
GNAL	
GNA	
PSAL	
PSA	m-1
Options	m p-1

Figure Z - MAM PDU Format

8 Conformance

Changes to the Conformance (section 8) are needed. Changes to the Static Conformance Requirements (8.1, 8.1.1, 8.1.2) and the Protocol Implementation Conformance Statement will be supplied at a later time. All capabilities to support multicast transfer are to be optional.