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INTERNATIONAL STANDARD 16512-2:2008/PDAM2
ITU-T RECOMMENDATION X.603.1(2007)/Amd.2

INFORMATION TECHNOLOGY –Relayed multicast protocol: Specification for simplex group applications

DRAFT AMENDMENT 2

Messages and code values

Summary

This Amendment 2 of the Recommendation X.603.1 (2007) | ISO/IEC 16512-2 is revision of messages and code values in the Recommendation X.603.1 (2007) | ISO/IEC 16512-2.

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INTERNATIONAL STANDARD 16512-2:2008/PDAM2
ITU-T RECOMMENDATION X.603.1(2007)/Amd.2

INFORMATION TECHNOLOGY – Relayed multicast protocol: Specification for simplex group applications

AMENDMENT 2

Messages and code values

1 Clause 2. Normative references

Delete the following references:

– ITU-T Recommendation X.601 (2000), *Multi-peer communications framework.*
– ITU-T Recommendation X.605 (1998) | ISO/IEC 13252:1999, *Information technology – Enhanced communications transport service definition.*
– ITU-T Recommendation X.606 (2001) | ISO/IEC 14476-1:2002, *Information technology – Enhanced communications transport protocol: Specification of simplex multicast transport.*
– ITU-T Recommendation X.606.1 (2003) | ISO/IEC 14476-2:2003, *Information technology – Enhanced*

2 Clause 4. Abbreviations

Delete the following abbreviation

'AUTH Authentication'

3 Sub-clause 6.1.2

At the end of the first paragraph, delete the following: 'and authentication information'

4 Sub-clause 7.3.

Replace 7.3 with the following text:

7.3 Messages

This sub-clause defines each message used in RMCP-2. RMCP-2 defines seven sets of request and answer messages and one heartbeat message. The message types and corresponding values for the messages are listed in Table 3.

7.3.1 SUBSREQ

The SUBSREQ message is used to subscribe to a RMCP-2 session. Issuing SUBSREQ message each MA can obtain bootstrapping information from the SM when it is acceptable. The message format is shown in Figure 40.

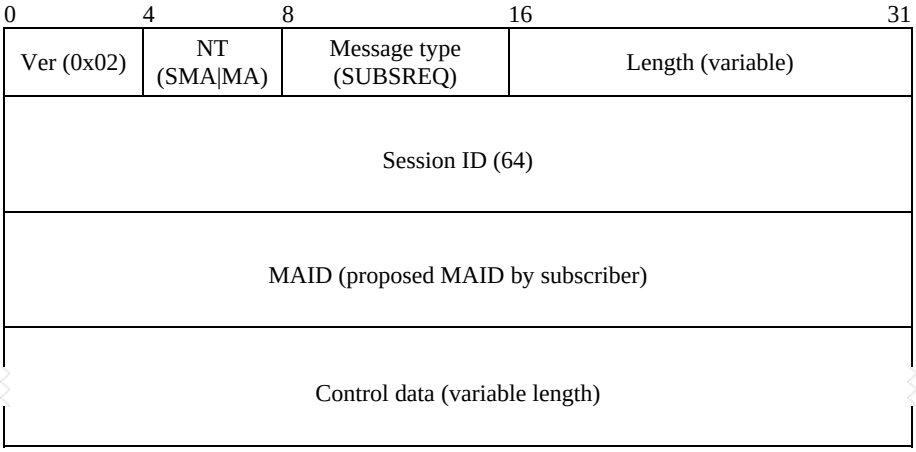

Figure 40 – SUBSREQ message

The description of each field is as follows:

a) *Ver* – It represents the version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SMA|MA).

c) *Message type* – It represents the type of the message. The value is set to SUBSREQ for the message.

d) *Length* – It shows the total length of SUBSREQ message in bytes.

e) *Session ID* – It is a 64-bit value of RMCP Session ID.

f) *Proposed MAID* – It is the unique value for identifying the entity.

g) *Control data* – It contains a set of information required to subscribe to the RMCP-2 session. It may include the following information:

• SYSINFO

This control tells the system power of MA, such as in/out bandwidth, controllable number of CMA.

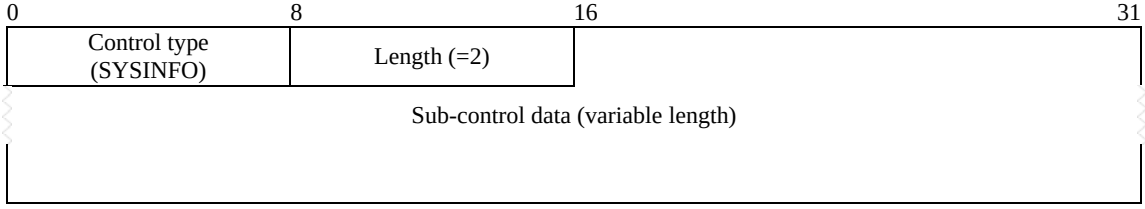

Figure 41 – SYSINFO control

a) *Control type* – SYSINFO.

b) *Length* – It represents the length of the SYSINFO control (in bytes).

c) *Sub-control data* – It includes one of sub-control defined in Table 7.

The sub-controls shown in Figures 42 and 43 are sub-controls that follow the SYSINFO control shown in Figure 41. If needed, other sub-controls described in clause 7.3.11 can be used in SUBSREQ message.

Figure 42 shows the report format of the SI_ROOM_CMA sub-control. The description of each field is as follows:

a) *Sub-control type* – denotes the SI_ROOM_CMA sub-control. Its value shall be set to 0x14 (see Table 7)

b) *Length* – denotes the length of the SI_ROOM_CMA sub-control. Its value shall be set to 0x06.

c) *Number of CMAs allocated* – shall be set to number of CMA places that have been allocated by the MA.

d) *Total CMA capacity* – shall be set to the total number of CMA places that the MA is able to support.

NOTE – The available number of CMAs will be the difference between the number of CMAs reserved and the number of CMAs allocated.

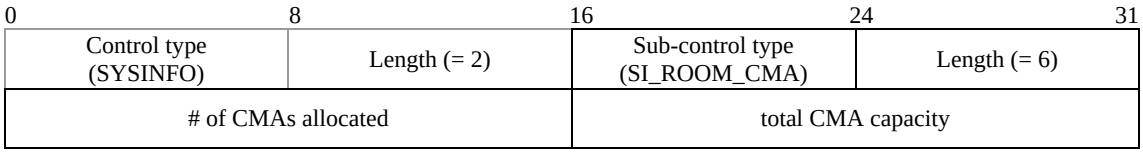

Figure 42 – SI_ROOM_CMA sub-control

Figure 43 shows a SYSINFO control followed by a SI_POSS_BW sub-control. The description of each field is as follows:

a) *Sub-control type* – SI_POSS_BW (one of SYSINFO subtypes).

b) *Length* – It represents the length of sub-control data (in bytes).

c) *Value* – It represents the possible forwarding bandwidth which MA can afford.

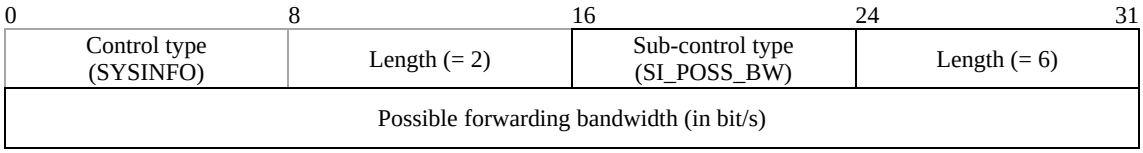

Figure 43 – SI_POSS_BW sub-control

Note – Two bytes length control frame precedes each sub-control.

- DATAPROFILE

DATAPROFILE control delivers controllable data profile of each MA. The purpose of this DATAPROFILE control is to make SM able to keep the classified neighbour list when the SM is aware of QoS.
Whenever MA does not include this control within SUBSREQ message, the SM is not concerned about QoS management for the MA. The description of each field is as follows:

a) *Control type* – DATAPROFILE.

b) *Length* – It represents the length of the data profile.

c) *Data profile* – It represents the data profile which MA wants to use.

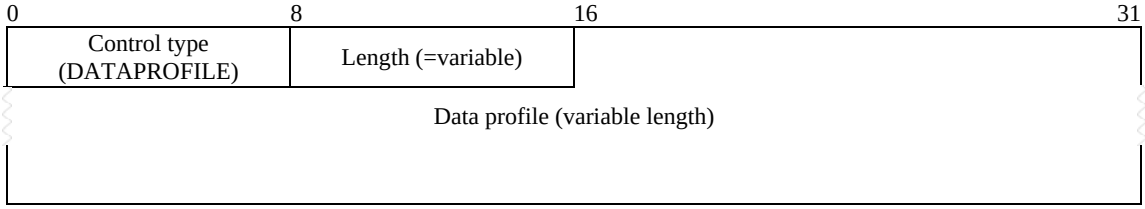

Figure 44 – DATAPROFILE control

Because DATAPROFILE control consists of text-based variable message, the size may vary. To align 4-byte length, each data profile pads zero or more 1-byte zero padding as shown in Figure 45. The description of each field is as follows:

a) *Data profile* – The data profile describes the characteristics of data channel and it follows SDL-like encoding scheme.

b) *Zero or more zero padding* – To adjust the length of data profile, zero or more zero padding follows.

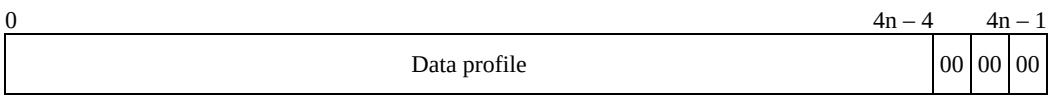

Figure 45 – DATAPROFILE control and its padding

7.3.2 SUBSANS

The SUBSANS message is used by SM to give the results of subscription request and bootstrapping information for the session. The message format is shown in Figure 46.

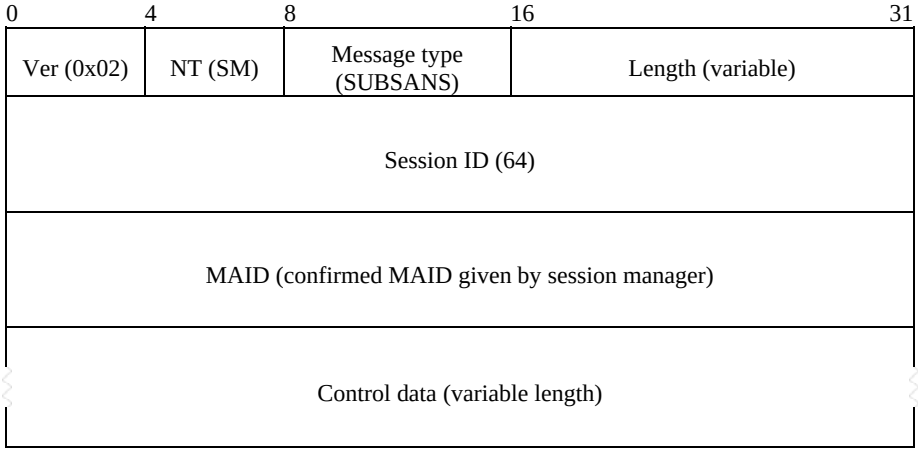

Figure 46 – SUBSANS message

The description of each field is as follows:

a) *Ver* – It represents the version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SM).

c) *Message type* – It represents the type of the message. The value is set to SUBSANS for the message.

d) *Length* – It shows the total length of the SUBSANS message (in bytes).

e) *Session ID* – It is a 64-bit value of RMCP Session ID.

f) *Confirmed MAID* – It is the identification number of the MA. SM provides the confirmed ID as a result of the provided MAID suggested by MA in the SUBSREQ message.

g) *Control data* – It contains a set of information required to join a RMCP relayed multicast tree. It may include the following information:

- RESULT

This control tells whether MA's subscription request is successful or not. If successful, it gives OK code within result code. If not, it gives appropriate error code such as resource exhaustion, destination unreachable. Figure 47 shows the control message format of RESULT control. The following controls are used to deliver the necessary information to join RMCP-2 tree. When subscription is disallowed, the following control cannot be included. The description of each field is as follows:

a) *Control type* – RESULT.

b) *Length* – It represents the length of the RESULT control (in bytes).

c) *Result code* – It represents the result caused by the requestor and the detailed codes are listed in Table 5.

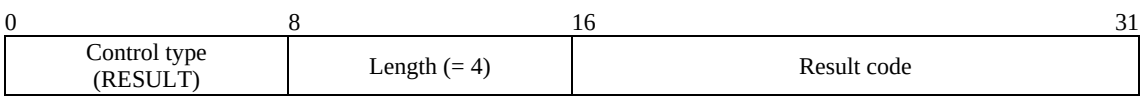

Figure 47 – RESULT control

- DATAPROFILE

DATAPROFILE control is used by SM to confirm data profile back to the subscriber. DATAPROFILE control is meaningful when SM affords extra session data information to each subscriber. The format of DATAPROFILE control is shown in Figure 44 and the content is in Figure 84.

- NEIGHBORLIST

When a subscription is successful, SM sends a list of MAs back to the subscriber. The NEIGHBORLIST control may be used as bootstrapping information by each subscriber. Figure 48 shows the format of NEIGHBORLISTcontrol. The description of each field is as follows:

a) *Control type* – denotes the NEIGHBORLIST control. Its value shall be set to 0x04 (see Table 4).

b) *Length* – shall be set to the length of the NEIGHBORLIST control

c) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

d) # of NLs – shall be set to the number of subsequent MAIDs listed in the control.

e) MAID(s) – The list of MAIDs provided by the SM.

Figure 48 – NEIGHBORLIST control

7.3.3 PPROBREQ

It is used to perform *Map discovery* procedure to discover actual network condition and to explore network neighbouring. It is also used to check whether its counterpart is still alive. Figure 49 illustrates the message format.

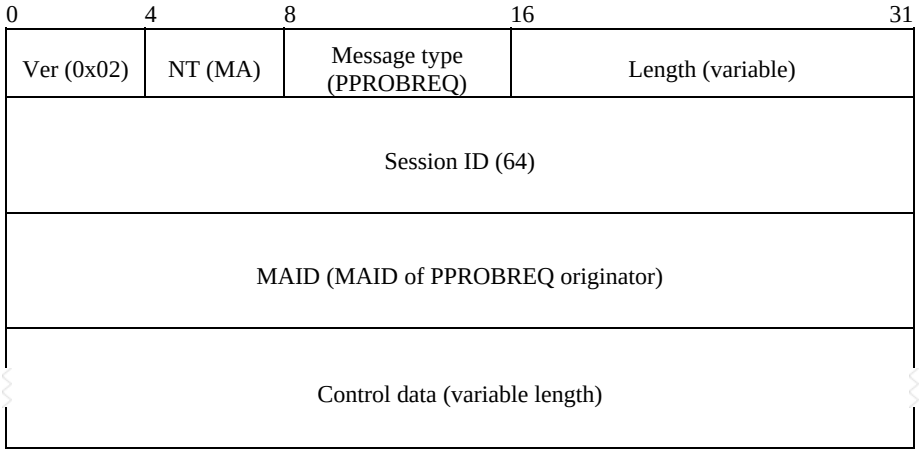

Figure 49 – PPROBREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (MA).

c) *Message type* – It represents the type of the message. The value is set to PPROBREQ for the message.

d) *Length* – It shows the total length of the PPROBREQ message including control (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the sender who sends the PPROBREQ message.

g) *Control data* – It may include the following information to inquire the map information:

- TIMESTAMP

Figure 50 shows a TIMESTAMP control which is used to examine the distance between two MAs. The description of each field is as follows:

a) *Control type* – TIMESTAMP.

b) *Length* – It represents the total length of TIMESTAMP control, the actual size is 16 (in bytes).

c) *Reserved* – It is reserved for further use.

d) *Time 1* – It is the time when the sender of PPROBREQ message sends the packet to its counterpart.

e) *Time 2* – It is the time when the PPROBREQ message appears to the counterpart.

f) *Time 3* – It is the time when the receiver of PPROBREQ message sends the TIMESTAMP control as a reply.

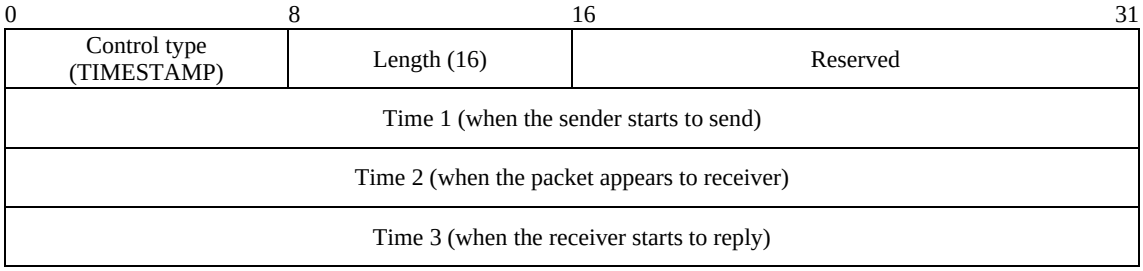

Figure 50 – TIMESTAMP control

- NEIGHBORLIST

To explore RMCP-2 participants, each MA may exchange information about their neighbour by using NEIGHBORLIST control. The control format and usage are shown in Figures 48.

- ROOTPATH

To prevent loop and solve triangular problem, probing MA may include its *from_root path* by using the ROOTPATH control which is shown in Figure 51. The description of each field is as follows:

a) *Control type* – ROOTPATH.

b) *Length* – It represents the length of ROOTPATH control, the size is 2 (in bytes).

c) *Sub-control data* – It includes one of sub-control defined in Table 6.

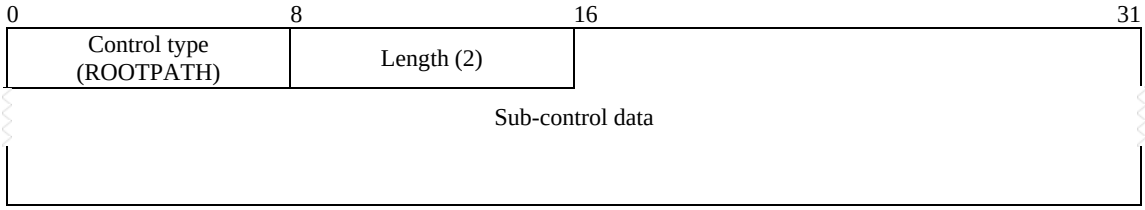

Figure 51 – ROOTPATH control

Figure 52 shows the general format of the RP_XXX sub-control. RP_XXX stands for one of the appropriate ROOTPATH types from the first six ROOTPATH types listed in Table 6 (see note). These ROOTPATH types represent different combinations of fields for MAIDs, bandwidth and delay. If the ROOTPATH type indicates that any of the

MAIDs, bandwidth or delay fields are not needed, these fields shall not be present in the ROOTPATH control. The length of the rootpath element, in bytes, for each of the ROOTPATH types is indicated in Table 6.

NOTE – RP_PSEUDO is a special ROOTPATH type used to indicate a pseudo HB message used in network partitioning, detection and recovery (see 6.2.5.3.b and 7.3.16) and applies only the RP_COMMAND for the HB message.

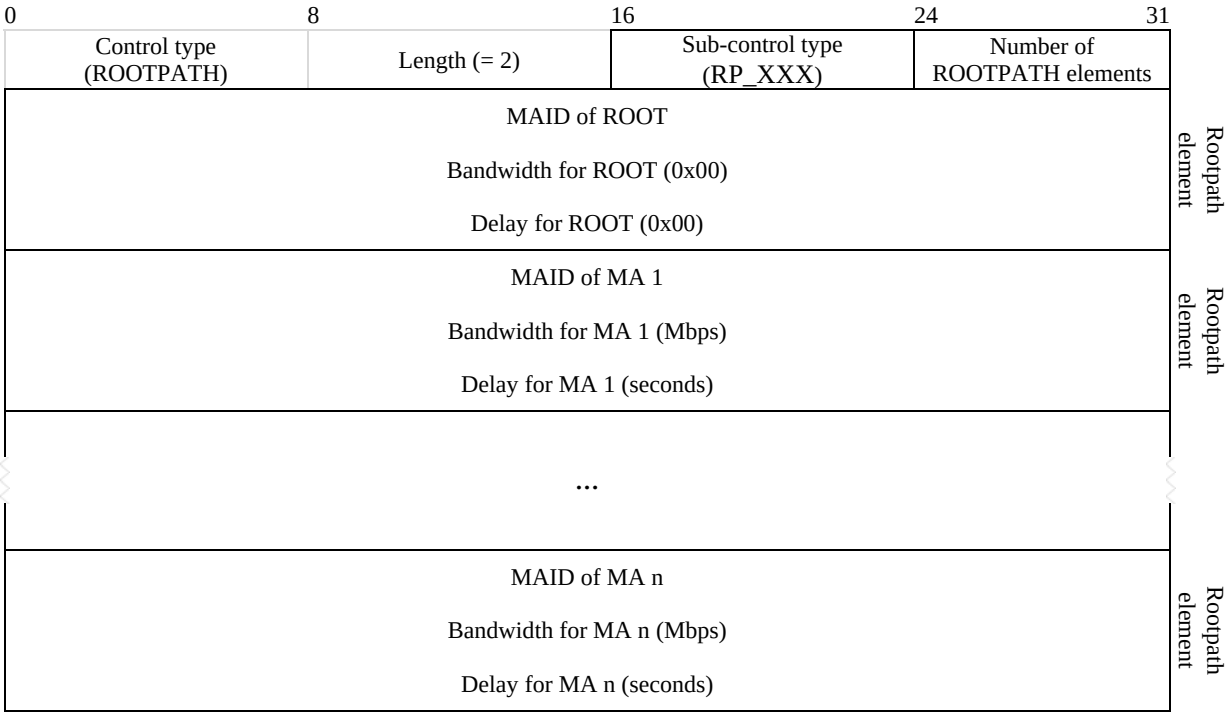

Figure 52 – General format for RP_XXX sub-control.

RP_XXX stands for one of the first six ROOTPATH types listed in Table 6. The description of each field of the RP_XXX sub-control is as follows:

- RP_XXX

  a) *Sub-control type* – denotes the RP_XXX sub-control. Its value shall be set to one of the first six code values in Table 7.
  b) *Number of ROOTPATH nodes* – shall be set to the number of ROOTPATH elements in the RP_XXX message.
  c) *MAID* – for each element in the ROOTPATH, listed in order from the ROOT, this field if present shall be set to that of the MAID corresponding to that element.
  d) *Bandwidth* – for each element in the ROOTPATH, listed in order from the ROOT, this field if present shall be set to the bandwidth, in Mbps, between the MA and its parent, as perceived by the MA. In the case of the ROOT element the value for the bandwidth shall be set to 0x00.
  e) *Delay* – for each element in the ROOTPATH, listed in order from the ROOT, this field if present shall be set to the delay in seconds from the ROOT as perceived by the MA. In the case of the ROOT element the value for the bandwidth shall be set to 0x00.

  NOTE – The values for the perceived bandwidth and delay for the ROOT node are set to 0x00 as the ROOTPATH is assumed to start at the ROOT.

- SYSINFO

To prevent only-leaf node or slow node may be positioned high within the tree hierarchy; it includes system information such as in-and-out bandwidth, affordable number of CMA, etc. Figure 41 shows SYSINFO control format. All of sub-controls in clause 7.3.1 and clause 7.3.11 can be used, if necessary.

- DATAPROFILE

DATAPROFILE control is used to verify whether the probed MA can afford the data delivery scheme which the probing MA wants to receive. Figure 44 shows the DATAPROFILE control format and Figure 84 shows its contents.

7.3.4 PPROBANS

It is an answer to the PPROBREQ message for performing the *map discovery* procedure and confirming if it is alive. It may contain actual network condition, and a series of its Neighbour information. Figure 53 illustrates the format of the PPROBANS message.

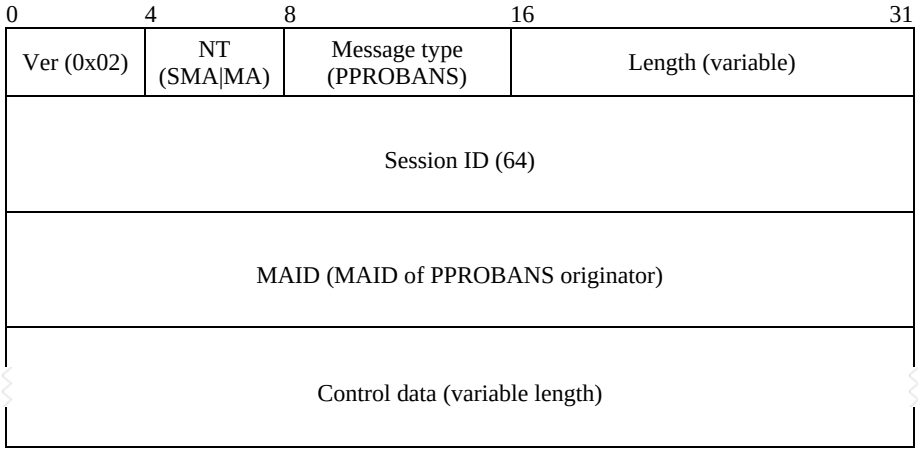

Figure 53 – PPROBANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SMA or MA).

c) *Message type* – It represents the type of the message. The value is set to PPROBANS for the message.

d) *Length* – It shows the total length of PPROBANS message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the PPROBANS message sender.

g) *Control data* – It should include information appropriate to the PPROBREQ. Control data field of this message may include the following information:

- TIMESTAMP

This control is used to examine the distance between two MAs during the sequence of parent probing. Figure 50 shows the format of TIMESTAMP control.

- NEIGHBORLIST

This NEIGHBORLIST control is designed to explore RMCP-2 participants. Each MA may gather information of its neighbour by using NEIGHBORLIST control as shown in Figures 48.

- ROOTPATH

This ROOTPATH control is used by each MA to prevent loop and solve triangular problem. The probing MA may include its information of *from_root path* by using ROOTPATH control. Figures 51 and 52 show the control format of ROOTPATH and sub-control format.

- SYSINFO

To prevent only-leaf node or slow node may be located in the high position within the tree hierarchy. PPROBANS message may include system information such as in-and-out bandwidth, affordable number of CMA, etc., by using SYSTEMINFO control. Figure 41 shows the SYSINFO control format. All of sub-controls in clause 7.3.1 and clause 7.3.11 can be used, if necessary.

- DATAPROFILE

DATAPROFILE control is used to verify whether the probed MA can afford data which the probing MA wants to use during data delivery. Figure 44 shows the DATAPROFILE control format and Figure 84 shows its contents.

7.3.5 HSOLICIT

HSOLICIT message is used to process self-organizing in a local network. The purpose of this is to find the HMA inside a local network. Figure 54 illustrates the message format of HSOLICIT.

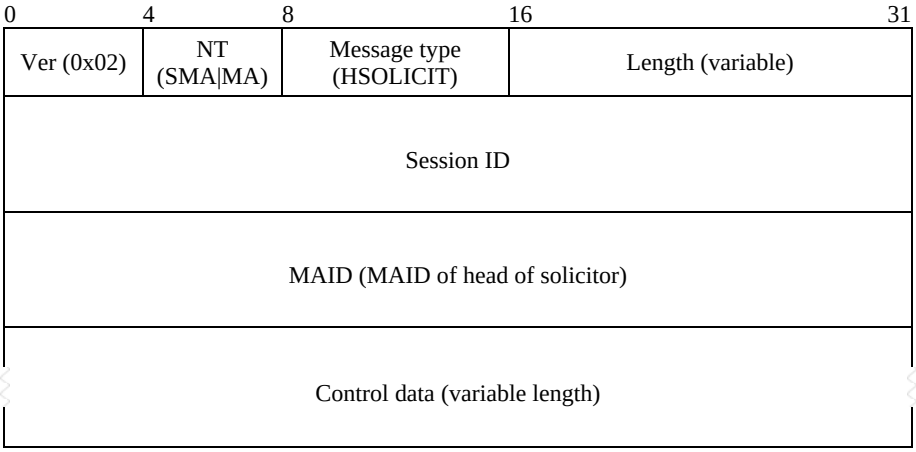

Figure 54 – HSOLICIT message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SMA or MA).

c) *Message type* – It represents the type of the message. The value is set to HSOLICIT for the message.

d) *Length* – It shows the total length of HSOLICIT message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the node who sends this HSOLICIT to the local network.

g) *Control data* – It may include information of its neighbour list. Control data field of this message may include the following information:

7.3.6 HANNOUNCE

As a reply of HSOLICIT, it is used to announce the HMA's existence in a local network. Figure 55 shows the format of this message.

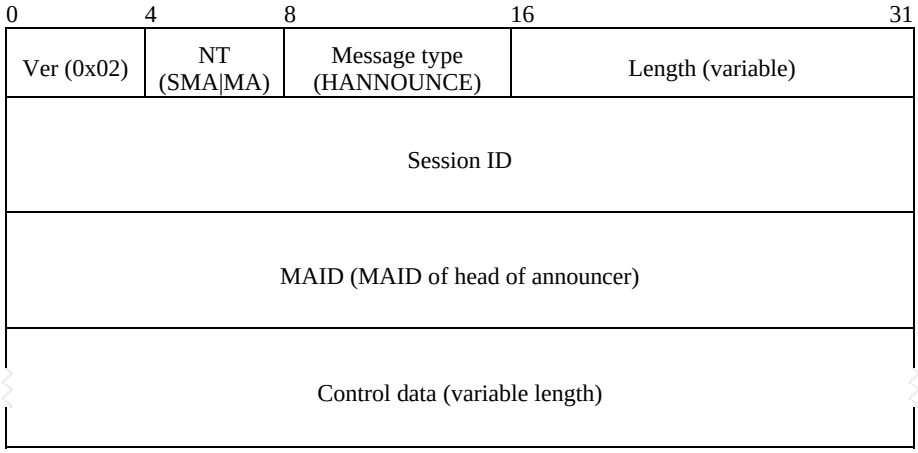

Figure 55 – HANNOUNCE message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SMA or MA).

c) *Message type* – It represents the type of the message. The value is set to HANNOUNCE for the message.

d) *Length* – It shows the total length of HANNOUNCE message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the HMA in the local network.

g) *Control data* – It may include the following information:

- SYSINFO

To inform the non-HMAs in the same multicast area with the system power of HMA, HMA may include system power of MA, such as in-and-out bandwidth, controllable number of CMA. Also HMA may include additional information such as MA uptime to recover from HANNOUNCE collision. All of sub-controls in clause 7.3.1 and clause 7.3.11 can be used, if necessary.

- NEIGHBORLIST

To share explored information by HMA with non-HMA in the same multicast-enabled area, HMA may include neighbour list as shown in Figure 48.

7.3.7 HLEAVE

It is used to announce the HMA's leaving from RMCP-2 session to its local network. Figure 56 illustrates the format of this message.

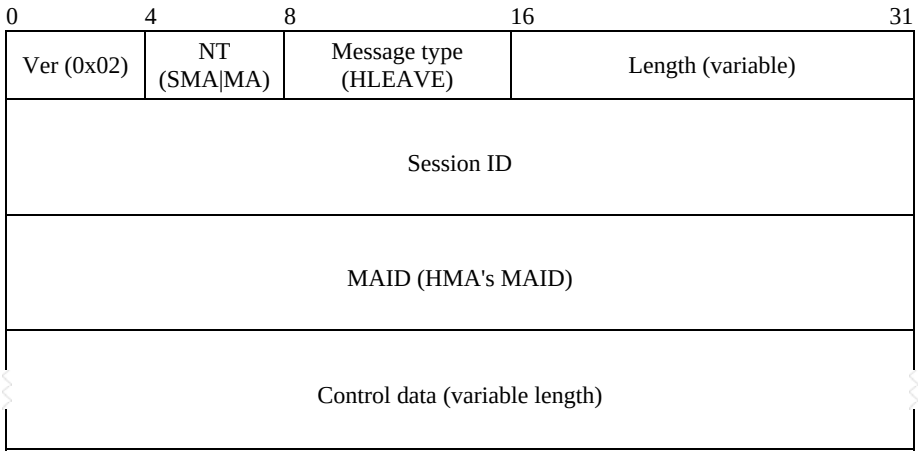

Figure 56 – HLEAVE message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (SMA or MA).

c) *Message type* – It represents the type of the message. The value is set to HLEAVE for the message.

d) *Length* – It shows the total length of the HLEAVE message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the HMA's MAID in the local network.

g) *Control data* – It may include the following information:

- CANDIDATEHMA

When an HMA leaves a session, every non-HMA in the multicast-enabled area may compete to become an HMA. This may drive the multicast-enabled area be filled with HANNOUNCE message. To prevent HMA selection collision, HMA may use CANDIDATEHMA control which is shown in Figure 57. The description of each field is as follows:

a) *Control type* – denotes the CANDIDATEHMA control. Its value shall be set to 0x0A

b) *Length* – shall be set to the length in bytes of the CANDIDATE HMA control.

c) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

d) *Number of MAIDs* – shall be set to the number of subsequent MAIDs listed in the control.

e) *MAID(s)* – shall contain the list of MAIDs of candidate HMAs provided by the leaving HMA.

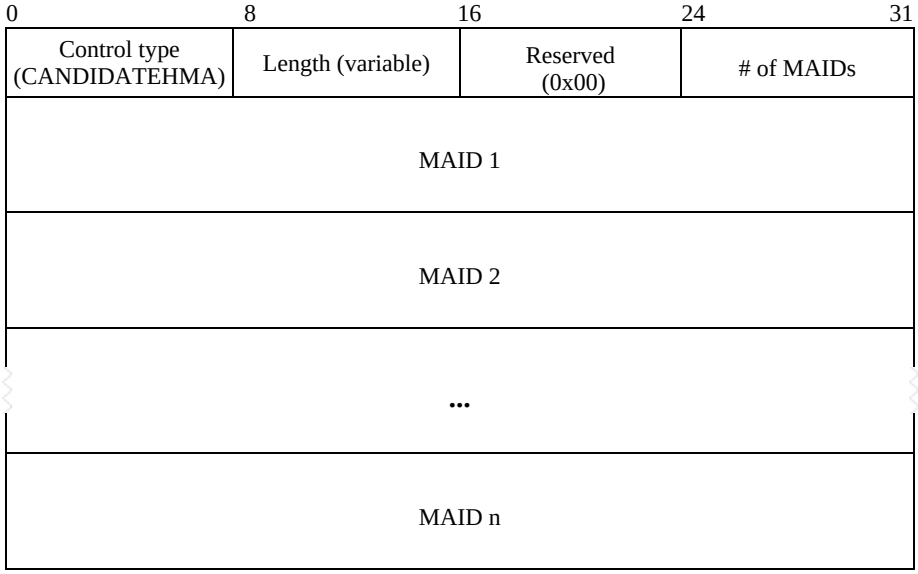

Figure 57 –CANDIDATEHMA control

- NEIGHBORLIST

To share explored information by HMA with non-HMA in the same multicast-enabled area, HMA may include NEIGHBORLIST control as shown in Figure 48.

- ROOTPATH

The leaving HMA may include its *from_root path* by using ROOTPATH control so that newly selected HMA can follow the same root path. The control data type is shown in Figures 51 and 52.

- REASON

The reason for HMA's leaving may vary according to the situation. For example, HMA may leave the session either of its own will or because the session has terminated. In the latter case, every non-HMA in the multicast-enabled area should leave the session promptly.

To give the reason why HMA leaves a session, HLEAVE message must include REASON control as shown in Figure 58. The description of each field is as follows:

a) *Control type* – This field represents the type of control.

b) *Length* – It represents the length of the control data and the size is 4 (in bytes).

c) *Reason code* – This 2-byte length field contains an integer value to indicate the specific reason for the leaving. The codes and their meaning are listed in Table 9.

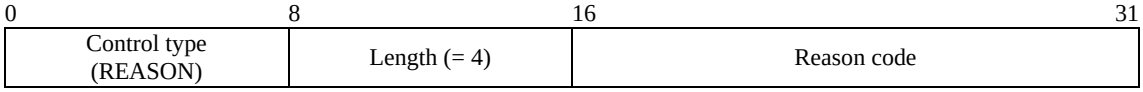

Figure 58 – REASON control

7.3.8 RELREQ

This message is used by the CMA to request to the PMA of data forwarding. It usually includes a data profile which can be negotiated through the message exchanges of RELREQ and RELANS. Figure 59 depicts the format of this message.

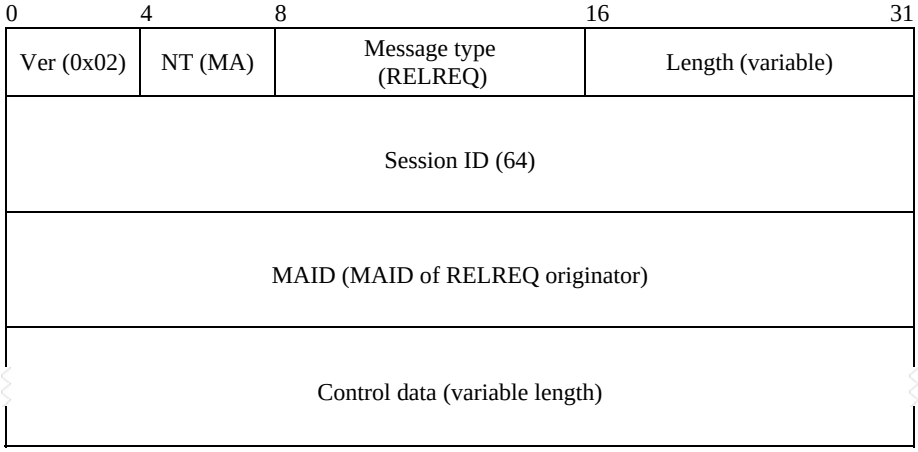

Figure 59 – RELREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type (MA).

c) *Message type* – It represents the type of the message. The value is set to RELREQ for the message.

d) *Length* – It shows the total length of the RELREQ message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the node who sends the RELREQ message.

g) *Control data* – It may include one or more requests related to the relay request. The controls used with this message are:

• RP_COMMAND

When CMA needs some information on PMA's rootpath, it can ask PMA by using RP_COMMAND control within RELREQ message.
For example, whenever a MA connects to PMA during joining or parent switching procedure, the MA needs information *from_root path* of its new PMA for network diagnosis and loop detection. In this case, the MA uses then RP_COMMAND control for ROOTPATH of newly attached PMA.
Figure 60 shows the RP_COMMAND control format. The description of each field is as follows:

a) *Control type* – This field represents the type of control.

b) *Length* – It represents the length of the control data and the size is 4 (in bytes).

c) *RP_Command code* – This 1-byte length field contains an integer value to indicate the specific reason for the leaving. The encoded value and their meaning are indicated in Table 6.

d) Reserved – This field is reserved for further use.

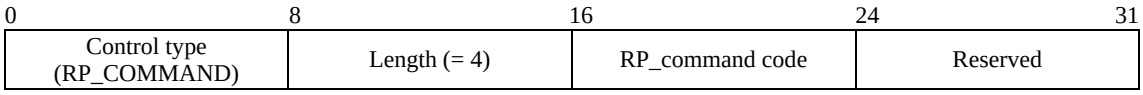

Figure 60 – RP_COMMAND control

• DATAPROFILE

Whenever CMA connects to PMA, both MAs should agree on a data delivery scheme. To make it feasible, each CMA uses DATAPROFILE control to negotiate with its PMA. Figures 44 and 45 show DATAPROFILE control format, and Figure 84 shows its contents.

• TIMESTAMP

Each CMA should measure hop-by-hop delay between PMA and itself. For this purpose, CMA includes TIMESTAMP control as shown in Figure 50 within RELREQ message.

7.3.9 RELANS

As a reply of RELREQ message, RELANS message is issued by the PMA to the CMA. The purpose of this message is to notify whether the relay request is allowed. It may also contain additional information which is necessary to negotiate the data channel between the PMA and itself. The message format of RELANS is shown in Figure 61.

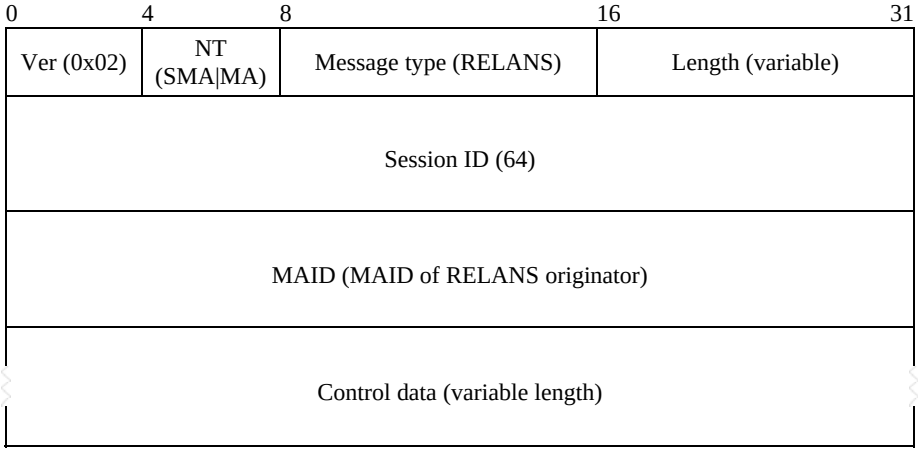

Figure 61 – RELANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type, because this message can be issued by the SMA and the MA, the node type for the message can be the SMA or the MA.

c) *Message type* – It represents the type of the message. The value is set to RELANS for the message.

d) *Length* – It shows the total length of the RELANS message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the node who sends RELANS message.

g) *Control data* – It may include one or more of the following controls:

• RESULT

To tell whether CMA's RELREQ message is successful, PMA uses RESULT control inside every RELANS message. If the relay request is successful, it gives OK as a result code of RESULT control. If not, it gives an appropriate error code, such as relay denial because of policy or resource exhaustion. Figure 47 shows the RESULT control format.

- DATAPROFILE

Whenever CMA connects to PMA, it sends RELREQ message with DATAPROFILE control to negotiate data delivery scheme. Figures 44 and 45 show DATAPROFILE control format, and Figure 84 shows its contents.

- TIMESTAMP

Figure 50 shows a TIMESTAMP control. TIMESTAMP control is used to examine the distance between two MAs.

- ROOTPATH

Whenever CMA asks *from_root path* with RP_COMMAND control, PMA answer its CMA with its ROOTPATH information. Figures 51 and 52 show ROOTPATH control.

7.3.10 STREQ

STREQ message is used for monitoring the status of MAs in the session. Figure 62 shows the format of this message.

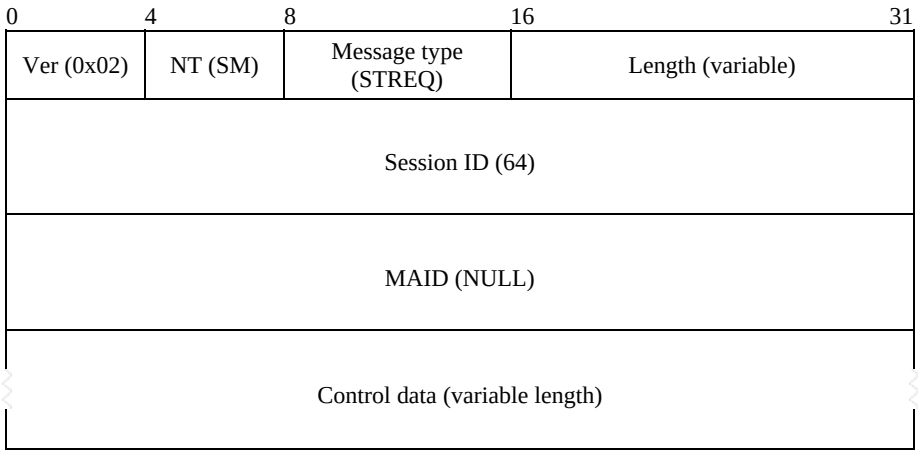

Figure 62 – STREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. Because this message can be issued only by the SM, the node type for the message is only the SM.

c) *Message type* – It represents the type of the message. It is set to STREQ for the message.

d) *Length* – It shows the total length of STREQ message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – Because SM does not have a MAID, this field should be set to zero.

g) *Control data* – It may include one or more requests on the status report. The controls to be considered are:

- SI_COMMAND

STREQ message should include the SI_COMMAND control shown in Figure 63 to express what status report it requires. To get MA's status, SM uses SI_COMMAND control within STREQ message. Table 8 summarizes considerable commands for status monitoring and its expected reports.
Figure 63 shows the format of the SI_COMMAND control. The description of each field is as follows:

a) *Control type* – This field represents the type of control.

b) *Length* – It represents the length of the control data and the size is 4 (in bytes).

c) *SI_Command code* – This 2-byte length field contains an integer value to indicate the combination of sub-control types required in the status report. The SI_Command code value is obtained by adding together the command codes in Table 8 for the individual sub-controls that are required.

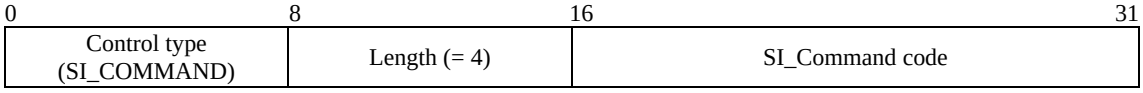

Figure 63 – SI_COMMAND control

• TREEEXPLOR

Inspecting whole tree status can cause hazards because of report implosion. So it is very important to limit the scope of tree to be inspected. Figure 64 shows TREEEXPLOR control which is used to limit the scope of tree. The fields of TREEEXPLOR control are as follows:

a) *Control type* – This field represents the control type which is TREEEXPLOR.

b) *Length* – It represents the length of the TREEEXPLOR control; the size should be 4 (in bytes).

c) *Reserved* – This field is reserved for further use.

d) *Tree depth* – It is an 8-bit integer value to specify the scope.

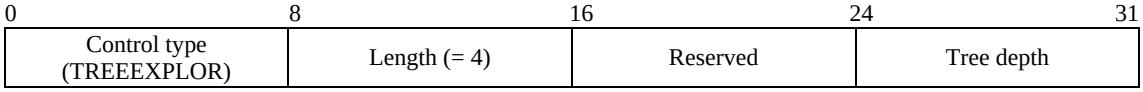

Figure 64 – TREEEXPLOR control

7.3.11 STANS

This message is used for monitoring the status of MAs in the session. Figure 65 shows the format of STANS message.

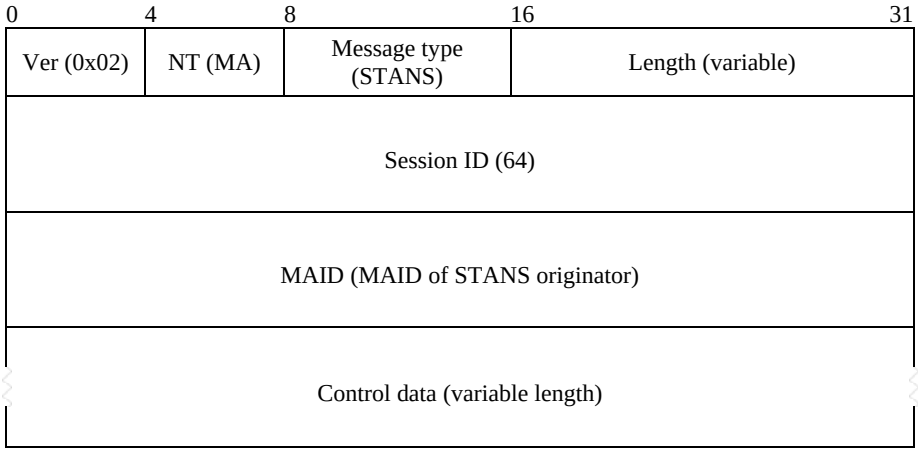

Figure 65 – STANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02)

b) *NT* – It is the message issuer's node type, because this message can be issued only by the MA, the node type for the message is set to the MA.

c) *Message type* – It represents the type of the message. It is set to STANS for the message.

d) *Length* – It shows the total length of STANS message including control (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the STANS message issuer.

g) *Control data* – It should include one or more answers for the status report request. Control data field of STANS message may include the following information:

• SYSINFO

According to SM's request, the MA should answer with an appropriate report. The format of each report has {control type, control subtype} form.

According to SM's request, listed in Table 7, each MA sends the appropriate report back to SM. Figure 66 through Figure 76 show the corresponding reports. All of sub-controls in clause 7.3.1 can be used, if necessary.

Figure 66 shows the report on the bandwidth that can be provided by a system. The description of each field is as follows:

a) *Sub-control type* – It defines the type of sub-control to be used.

b) *Length* – It represents the size of the sub-control (in bytes).

c) *Incoming BW of NIC* – It represents the maximum incoming bandwidth of network interface card (in Mbit/s).

d) *Outgoing BW of NIC* – It represents the maximum outgoing bandwidth of network interface card (in Mbit/s).

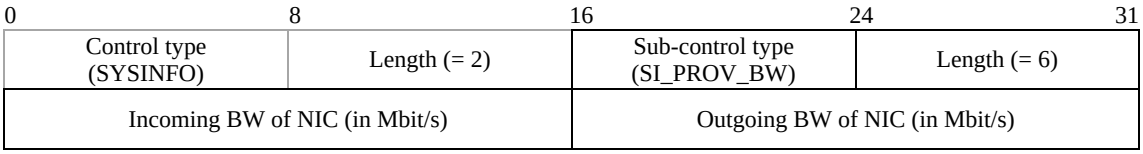

Figure 66 – SI_PROV_BW sub-control

Figure 67 shows the report on the system uptime after the MA joins the session. The description of each field is as follows:

a) *Sub-control type* – It defines the type of sub-control to be used.

b) *Length* – It represents the size of the sub-contro (in bytes)l.

c) *Uptime after MA joins session* – It indicates the time elapsed since the MA has joined the session in seconds.

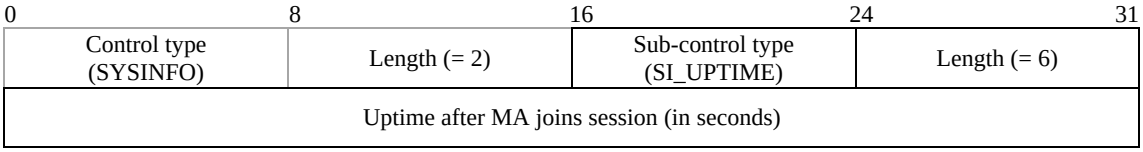

Figure 67 – SI_UPTIME sub-control

Figure 68 shows the report on the status of tree. The description of each field is as follows:

a) *Sub-control type* – It defines the type of sub-control to be used.

b) *Number of MAIDs* – It is a list of MAIDs of candidate HMA and which is provided by the leaving HMA.

c) *MAID of PMA* – It is a MAID of PMA attached directly.

d) *MAID of CMA* – It is a MAID list of CMAs attached directly.

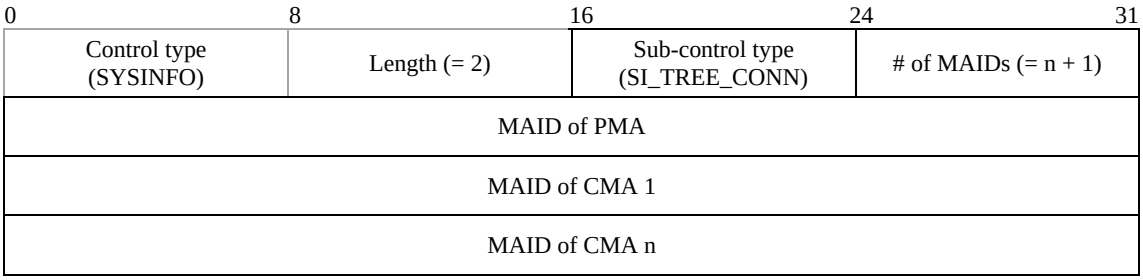

Figure 68 – SI_TREE_CONN sub-control

Figure 69 shows the report on the members of the tree. The description of each field is as follows:

a) *Sub-control type* – It defines the type of sub-control to be used.

b) *Number of MAIDs* – It is a list of MAIDs listed in the control.

c) *MAIDs* – It is a MAID list for a specific branch; for example, the top node of the specific branch will be presented in the field MAID 1, the bottom node will be presented in the field MAID n.

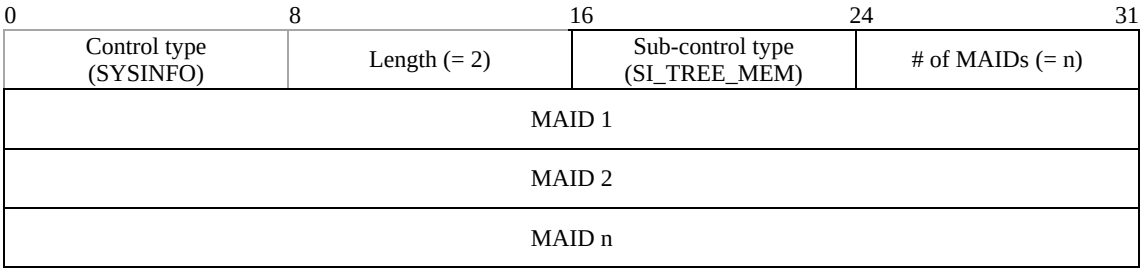

Figure 69 – SI_TREE_MEM sub-control

NOTE – Every report is preceded by a 2-byte long appropriate control.

Figure 70 shows the format of the SI_DELAY sub-control. The description of each field of the SI_DELAY sub-control is as follows:

- SI_DELAY

a) *Sub-control type* – denotes the SI_DELAY sub-control. Its value shall be set to 0x13 (see Table 7).
b) *Length* – denotes the length of the SI_DELAY sub-control. Its value shall be set to 0x06.
c) *Bandwidth* – shall be set to the delay in seconds from the ROOT, as perceived by the MA
d) *Delay* – is reserved for future use. Its value shall be set to 0x00.

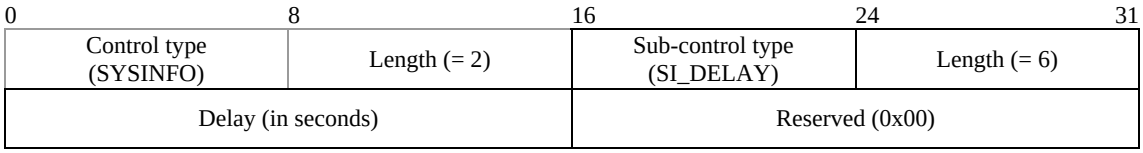

Figure 70 – SI_DELAY sub-control

Figure 71 shows the format of the SI_SND_BW sub-control. The description of each field of the SI_SND_BW sub-control is as follows:

- SI_SND_BW

a) *Sub-control type* – denotes the SI_SND_BW sub-control. Its value shall be set to 0x35 (see Table 7).
b) *Length* – denotes the length of the SI_SND_BW sub-control. Its value shall be set to 0x06
c) *Bandwidth* – shall be set to the total bandwidth in Mbps consumed by the MA to serve its CMAs
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

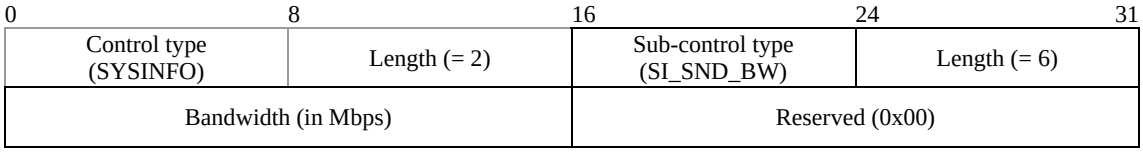

Figure 71 – SI_SND_BW sub-control

Figure 72 shows the format of the SI_SND_BW sub-control. The description of each field of the SI_SND_BW sub-control is as follows:

- SI_SND_PACKET

a) *Sub-control type* – denotes the SI_SND_PACKET sub-control. Its value shall be set to 0x36 (see Table 7).
b) *Length* – denotes the length of the SI_SND_PACKET sub-control. Its value shall be set to 0x06.
c) *Number of packets* – shall be set to the total number of packets sent by the MA from startup.
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

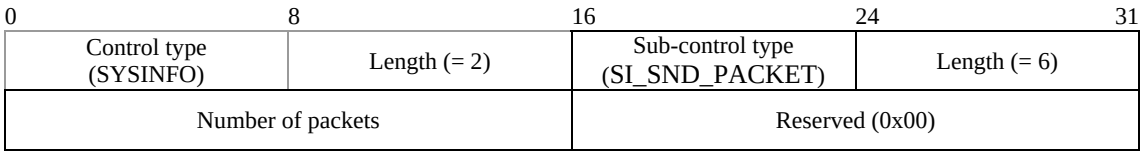

Figure 72 – SI_SND_PACKET sub-control

Figure 73 shows the format of the SI_SND_BW sub-control. The description of each field of the SI_SND_BYTES sub-control is as follows:

- SI_SND_BYTES

a) *Sub-control type* – denotes the SI_SND_BYTES sub-control. Its value shall be set to 0x37 (see Table 7).
b) *Length* – denotes the length of the SI_SND_BYTES sub-control. Its value shall be set to 0x06.
c) *Number of packets* – shall be set to the total number of bytes sent by the MA from startup.
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

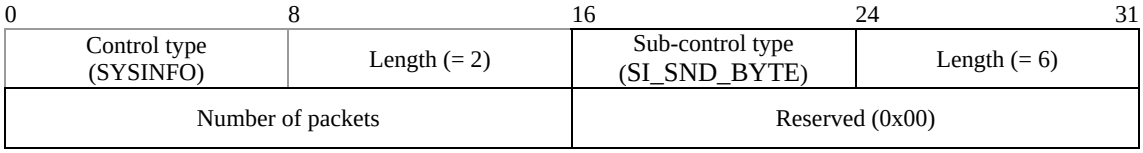

Figure 73 – SI_SND_BYTES sub-control

Figure 74 shows the format of the SI_RCV_BW sub-control. The description of each field of the SI_SND_BW sub-control is as follows:

- SI_RCV_BW

a) *Sub-control type* – denotes the SI_RCV_BW sub-control. Its value shall be set to 0x46 (see Table 7).
b) *Length* – denotes the length of the SI_RCV_BW sub-control. Its value shall be set to 0x06
c) *Number of packets* – shall be set to the bandwidth in Mbps perceived by the MA between its PMA.
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

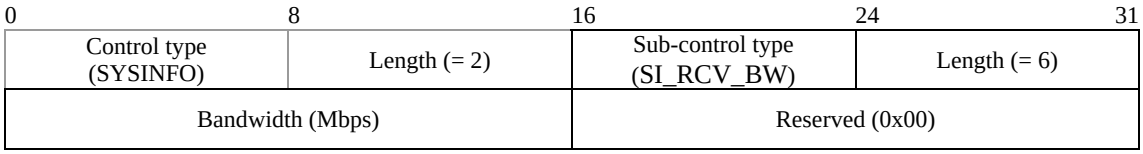

Figure 74 – SI_RCV_BW sub-control

Figure 75 shows the format of the SI_RCV_PACKET sub-control. The description of each field of the SI_RCV_PACKET sub-control is as follows:

- SI_RCV_PACKET

a) *Sub-control type* – denotes the SI_RCV_PACKET sub-control. Its value shall be set to 0x47 (see Table 7).
b) *Length* – denotes the length of the SI_RCV_PACKET sub-control. Its value shall be set to 0x06.
c) *Number of packets* – shall be set to the number of packets received by the MA from startup.
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

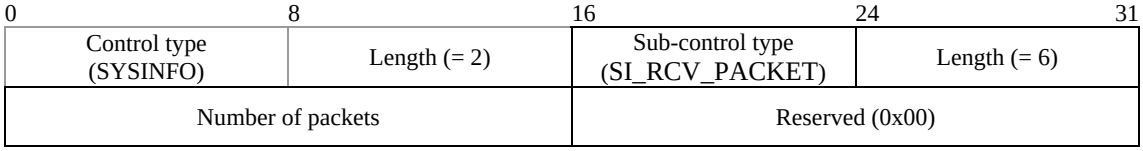

Figure 75 – SI_RCV_PACKET sub-control

Figure 76 shows the format of the SI_RCV_BYTES sub-control. The description of each field of the SI_RCV_BYTES sub-control is as follows:

- SI_RCV_ BYTES

a) *Sub-control type* – denotes the SI_RCV_ BYTES sub-control. Its value shall be set to 0x45 (see Table 7).
b) *Length* – denotes the length of the SI_RCV_ BYTES sub-control. Its value shall be set to 0x06.
c) *Number of packets* – shall be set to the number of bytes received by the MA from startup.
d) *Reserved* – is reserved for future use. Its value shall be set to 0x00.

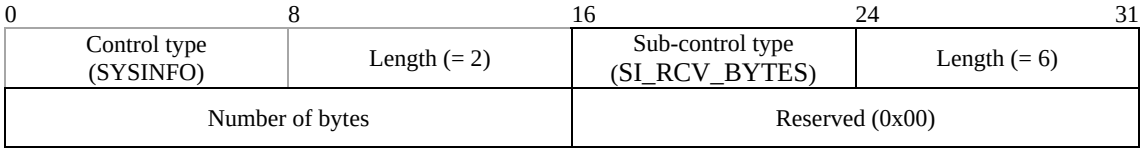

Figure 76 – SI_RCV_BYTES sub-control

7.3.12 STCOLREQ

STCOLREQ message is used for monitoring a RMCP-2 session similarly to STREQ message. But the difference is that firstly the scope of STREQ message is restricted to only one MA but that of STCOLREQ message can be expanded to a part or all the session. Secondly, STREQ message can be issued by SM only but STCOLREQ message is issued by PMA.
When a MA receives STCOLREQ message from the PMA, it starts the *status collection procedure* and forwards this message to its CMAs of limited area which is confined by the TREEEXPLOR control. Figure 77 shows the format of the STCOLREQ message.

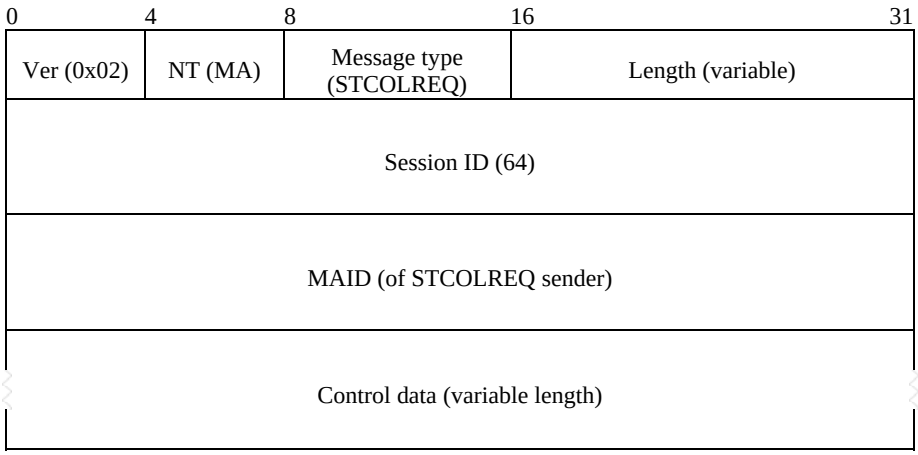

Figure 77 – STCOLREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. Because this message can be issued by the PMA, the node type for the message is set to the MA.

c) *Message type* – It represents the type of the message. It is set to STCOLREQ for the message.

d) *Length* – It shows the total length of STCOLREQ message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the STCOLREQ issuer; it appears normally to the CMA as the MAID of the PMA.

g) *Control data* – It may include one or more requests on the status report. Control data field of this message may include the following information:

- SI_COMMAND

When PMA asks its CMAs of its status, it includes the SI_COMMAND control in its STCOLREQ message. The SI_COMMAND control is specified in 7.3.10 and the format is shown in Figure 63.

- TREEEXPLOR

Inspecting whole tree status can cause hazards because of report implosion. So it is very important to limit the scope of tree to be inspected. Figure 64 shows TREEEXPLOR control which is used to limit the scope of tree.

7.3.13 STCOLANS

Figure 78 illustrates the format of the STCOLANS message which is used to respond to the STCOLREQ message. It informs the collected status of its downstream to its upstream. STCOLANS message follows the tree hierarchy back to reach the final destination which sends STCOLREQ message.

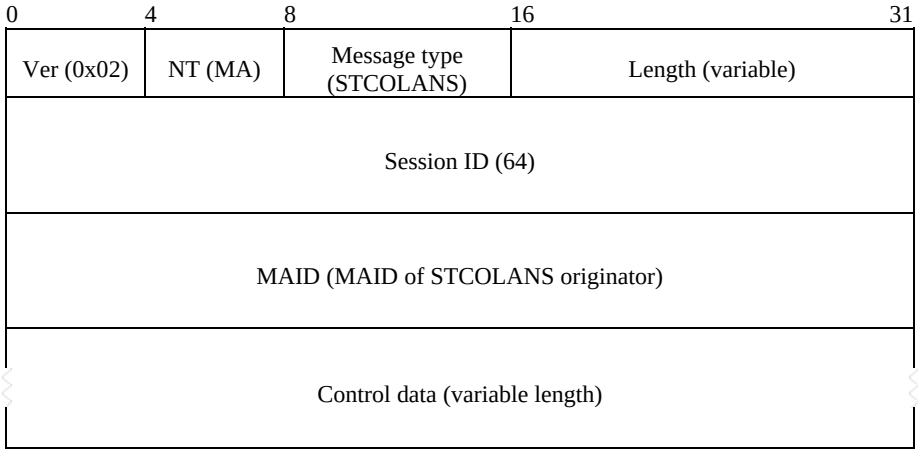

Figure 78 – STCOLANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. Because this message can be issued by the CMA, the node type for the message is set to the MA.

c) *Message type* – It represents the type of the message. It is set to STCOLANS for the message.

d) *Length* – It shows the total length of STCOLANS message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the STCOLANS issuer. Normally it appears to the PMA as the MAID of the CMA.

g) *Control data* – It may include one or more requests on the status report. Control data field of this message may include the following information:

- SYSINFO

According to PMA's request, CMA should answer with an appropriate report. The format of each report has {control type, control subtype} form.
According to the request listed in Table 7 each CMA sends appropriate reports to its PMA. Figure 42 through Figure 43 and Figure 66 through Figure 76 in clause 7.3.11 show the corresponding reports. All of sub-controls in clause 7.3.1 and clause 7.3.11 can be used, if necessary.

7.3.14 LEAVREQ

This message is used for three different purposes. The first is for leaving. When an MA leaves from the RMCP-2 session or when an MA leaves from its PMA for parent switching, it sends LEAVEQ message to the corresponding MAs by the leaving procedure.
SM and PMA may use this message but their targets are different. The target of the SM is any MA in the session, but that of PMA is only its own CMA.
The last purpose is for terminating a session. When the SMA leaves the session, this message should be forwarded to the end-most MA in the tree hierarchy. Figure 79 illustrates the format of LEAVREQ message.

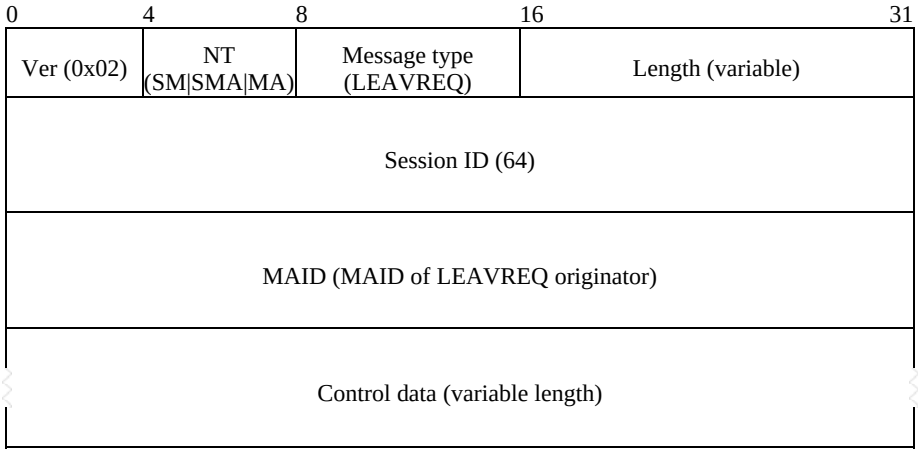

Figure 79 – LEAVREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. Because this message can be issued by all the RMCP-2 entities, the node type for the message may be set to SM, SMA, or MA.

c) *Message type* – It represents the type of the message. It is set to LEAVREQ.

d) *Length* – It shows the total length of the LEAVREQ message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the LEAVREQ originator. When this message is generated by SM, this field must be set to zero.

g) *Control data* – Control data field of this message may include the following information:

- REASON

To give the reason why MA tries to leave a session, LEAVREQ message must include REASON control. Figure 58 shows REASON control format.

7.3.15 LEAVANS

As a confirmation of the LEAVREQ message, the MA, which receives LEAVREQ message, sends a LEAVANS message back. Figure 80 illustrates the format of LEAVANS message.

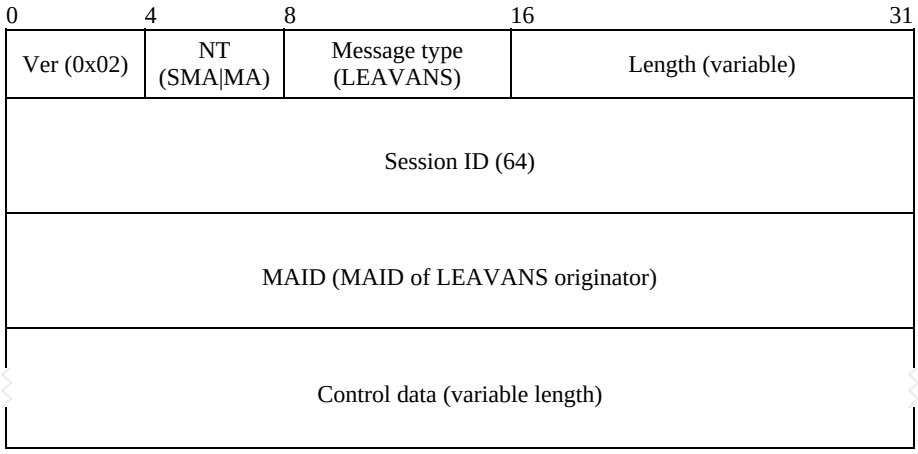

Figure 80 – LEAVANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. The node type for the message may be set to either SMA or MA.

c) *Message type* – It represents the type of the message. It is set to LEAVANS.

d) *Length* – It shows the total length of LEAVANS message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the LEAVANS originator.

g) *Control data* – Control data field of this message may include the following information:

- RESULT

LEAVANS message is used to indicate whether leaving MA's LEAVREQ message has successfully arrived. So the result code in RESULT control should always have the meaning of OK.

7.3.16 HB

The HB message is issued periodically by the SMA to give clock information through the RMCP-2 session. With the HB message, each MA can diagnose network condition. Figure 81 illustrates the format of HB message.

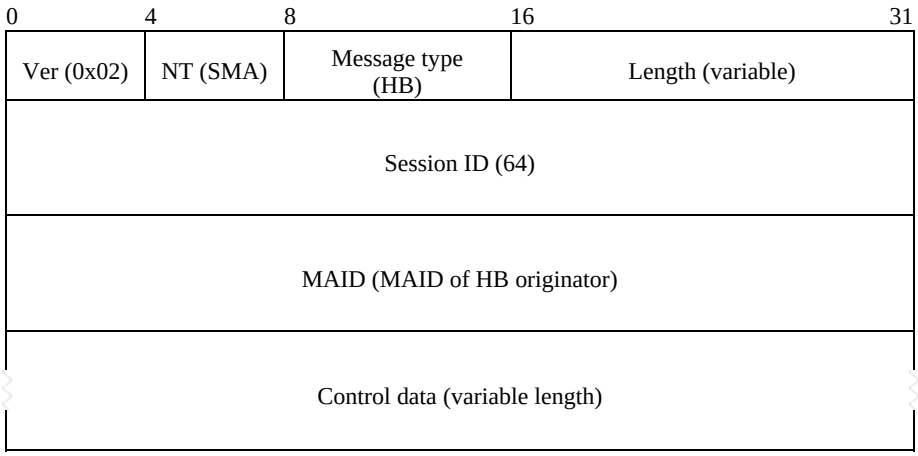

Figure 81 – HB message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. The node type for the message may be set to SMA.

c) *Message type* – It represents the type of the message. It is set to HB.

d) *Length* – It shows the total length of the HB message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the HB originator. Although HB is forwarded by the PMA to the CMA, this field is not changed by the intermediate node.

g) *Control data* – It should include the ROOTPATH control which is shown in Figure 51. Control data field of this message may include the following information:

- ROOTPATH

ROOTPATH control is updated by each MA. Beginning from the root, each MA who relays HB message appends its MAID as well as subsidiary information such as hop-by-hop delay, hop-by-hop bandwidth, according to its preceding session configuration. Figures 51 and 52 show ROOTPATH control and sub-control.

- RP_COMMAND

When a PMA tries to recover from network partition, its descendants may start network fault recovery procedure due to HB expectation timeout. In other words, a single point of partitioning may cause a fault recovery chain effect.
So it is necessary to generate a pseudo-HB message to delay its descendants' fault recovery procedure and means of notifying its pseudo-HB message to its descendants.
RP_PSEUDO command code in Table 6 is used to indicate that the ROOTPATH control in HB message with this RP_COMMAND control is a pseudo ROOTPATH. The format of the RP_COMMAND control is shown in Figure 60.

7.3.17 TERMREQ

TERMREQ message is used to terminate an existing RMCP-2 session. It is issued by the SM and then it is forwarded by the SMA to the end-most MAs along the tree hierarchy. Figure 82 shows the format of TERMREQ message.

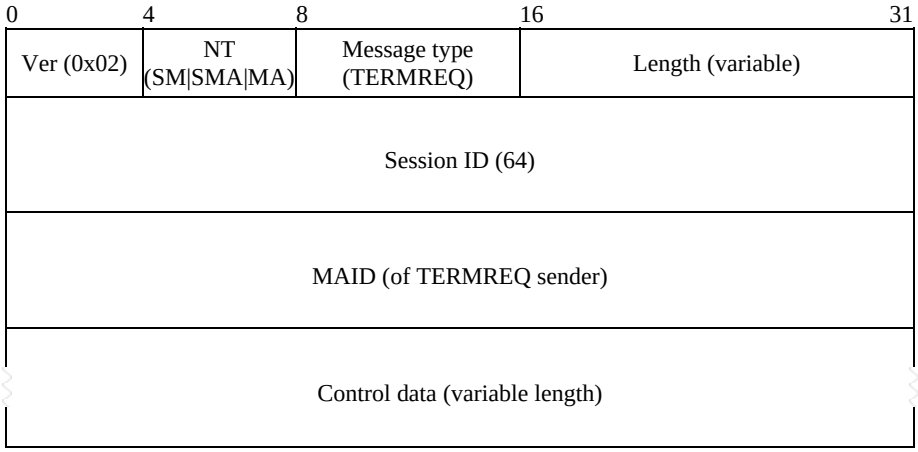

Figure 82 – TERMREQ message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type. Because this message can be issued by the SM and must be forwarded to the end-most MA along the RMCP-2 tree, the node type for the message may be set to SM, SMA or MA.

c) *Message type* – It represents the type of the message. It is set to TERMREQ.

d) *Length* – It shows the total length of the TERMREQ message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the TERMREQ message sender. When this message is sent by the SM, this field shall be set to zero. Normally the MAID of TERMREQ message appears to a MA as its PMA.

g) *Control data* – It may include the following reason code to explain session termination.

- REASON

To give the reason why a session is to be terminated, TERMREQ message should include REASON control as shown in Figure 58. The reason for session termination will be either SMA's non-existence or the termination by session owner.

7.3.18 TERMANS

Figure 83 illustrates the format of the TERMANS message.

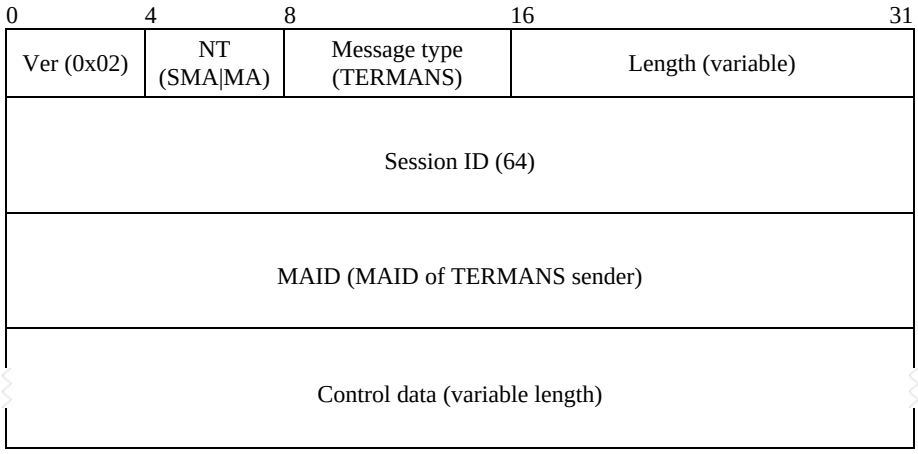

Figure 83 – TERMANS message

The description of each field is as follows:

a) *Ver* – It represents the current version of RMCP (0x02).

b) *NT* – It is the message issuer's node type because this message can be issued along the reverse direction of the RMCP-2 tree as a reply to the TERMREQ. The node type for the message may be set to either SMA or MA.

c) *Message type* – It represents the type of the message. It is set to TERMANS.

d) *Length* – It shows the total length of the TERMANS message including control data (in bytes).

e) *Session ID* – It is a 64-bit value of the RMCP Session ID.

f) *MAID* – It is the MAID of the TERMANS message sender. Normally the MAID of TERMANS message appears to the receiver as one of its CMAs.

g) *Control data* – Control data field of this message may include the following information:

• RESULT

TERMANS message is used to indicate whether TERMREQ message has successfully arrived. So the result code in Figure 47 should always be OK.

5 Sub-clause 8.3.

Delete the current sub-clause 8.3 and replace with the following text:

8.3 Code values used in RMCP-2

8.3.1 Codes values for basic RMCP-2 node types

Table 2 lists the node types (NT) for the basic RMCP-2 protocol and their corresponding 4-bit code values.

NOTE – The code value for the MA node type applies only to the basic RMCP-2 protocol defined in clauses 5 – 7 of this Recommendation | International Standard. The secure RMCP-2 protocol in Amendment 1 does not use the code value for MAs: it has its own code values for DMA and RMA node types.

Table 2 – Node type code values for basic RMCP-2

Node type	Code value (4 bits)
SM	0x1
SMA	0x2
MA	0x4

8.3.2 Code values for RMCP-2 message types

Table 3 lists the RMCP-2 message types and their corresponding code values.

Table 3 – Code values for RMCP-2 message types

Message type	Code value (Hexadecimal)
SUBSREQ	0x01
SUBSANS	0x02
PPROBREQ	0x03
PPROBANS	0x04
HSOLICIT	0x05
HANNOUNCE	0x06
HLEAVE	0x07
RELREQ	0x08
RELANS	0x09
STREQ	0x0A
STANS	0x0B
STCOLREQ	0x1A
STCOLANS	0x1B
LEAVREQ	0x0C
LEAVANS	0x0D
HB	0x10
TERMREQ	0x0E
TERMANS	0x0F

8.3.3 Code values for RMCP-2 control types

Table 4 lists the RMCP-2 control types and their corresponding code values

Table 4 – Code values for RMCP-2 control types

Control type	Value (Hexadecimal)
RP_COMMAND	0x01
SI_COMMAND	0x02
DATAPROFILE	0x03
NEIGHBORLIST	0x04
REASON	0x05
RESULT	0x06
ROOTPATH	0x07
SYSINFO	0x08
TIMESTAMP	0x09
CANDIDATEHMA	0x0A
TREEEXPLOR	0x0B

8.3.4 RMCP-2 return value

Table 5 lists the encoded values and meaning of the result codes, which are normally used as the return codes for an RMCP-2 request such as SUBSREQ message and RELREQ message.

Table 5 – Result codes

Result Code	Meaning
0x10	OK
0x20	System Problem
0x30	Administrative Problem

8.3.5 Values related to the ROOTPATH control

Table 6 lists the code values for both the sub-control types of the ROOTPATH and RP_command code of RP_COMMAND control. The length in bytes of each rootpath element is indicated for each ROOTPATH type.

Table 6 – Sub-control type codes for ROOTPATH control

Sub-control type	Code (8-bit)	Meaning	Length of rootpath element in bytes
The following six code values apply both to ROOTPATH and RP_COMMAND controls.			
RP_ID	0x11	The ROOTPATH control contains only the MAID for each node	8
RP_ BW	0x12	The ROOTPATH control contains only the bandwidth in Mbps as perceived by the MA for each node.	4
RP_ DL	0x14	The ROOTPATH control contains only the delay in seconds from the ROOT node as perceived by the MA for each node	4
RP_ID_BW	0x13	The ROOTPATH control contains the MAID and bandwidth in Mbps as perceived by the MA for each node.	12
RP_ID_DL	0x15	The ROOTPATH control contains the MAID and the delay in seconds from the ROOT node as perceived by the MA for each node.	12
RP_ID_BW_DL	0x17	The ROOTPATH control contains the MAID, bandwidth in Mbps and the delay in seconds as perceived by the MA for each node.	16

The following code value applies only to the RP_COMMAND control in HB messages.			
RP_PSEUDO	0x10	Indicates that the ROOTPATH control in the HB message is a pseudo-ROOTPATH for fault recovery	N/A

NOTE – The code values for RP_ID_BW, RP_ID_DL and RP_ID_BW_DL sub-controls are calculated by 0x10 plus the arithmetic sums of last four bits of the individual codes of the RP_ID, RP_BW and RP_DL components.

8.3.6 Values related to SYSINFO control

A single control may include zero or more sub-control. This clause defines codes for RMCP-2 sub-control.
SYSINFO control is used for exchange information related to MA. Table 7 lists the sub-control types, its code, and meaning.

Table 7 – Sub-control types for SYSINFO

Type	Code (8 bit)	Meaning
SI_UPTIME	0x12	Time of MA's uptime.
SI_DELAY	0x13	Status of delay as perceived by MA from ROOT.
SI_ROOM_CMA	0x14	The room for CMAs.
SI_PROV_BW	0x15	Maximum incoming / outgoing bandwidth of MA's network interface card.
SI_POSS_BW	0x25	The possible forwarding bandwidth that the MA can afford.
SI_SND _BW	0x35	Total bandwidth consumed by PMA to serve its CMAs.
SI_SND_PACKET	0x36	Total number of packets sent by MA from startup.
SI_SND _BYTES	0x37	Total number of bytes sent by MA from startup.
SI_RCV_BW	0x45	Bandwidth perceived by MA between its PMA.
SI_RCV_PACKET	0x46	Number of packets received by MA from startup.
SI_RCV_BYTES	0x47	Number of bytes received by MA from startup.
SI_TREE_CONN	0x68	PMA and CMA(s) of MA.
SI_TREE_MEM	0x69	List of tree members.

Table 8 lists the command codes corresponding to the sub-controls for the SYSINFO control. Combinations of different sub-control may be indicated by adding together the corresponding individual SI_Command codes.

NOTE 1 – Table 8 only contains the sub-control types that require a SI_COMMAND control for their initiation. There is, therefore no one-to-one correspondence with the sub-control in Table 7.

NOTE 2 – The 16-bit format column in Table 8 demonstrates how the SI_Command code values may be added together to give unique combinations. The bit positions can be considered as representing individual sub-control types and the 1 or 0 values can be interpreted as presence or absence of these sub-control types.

Table 8 – SI_Command codes for SYSINFO

Sub-control Type	Sub-control Code	Command Code	16-bit format
SI_UPTIME	0x12	0x00 02	0000 0000 0000 00**1**0
SI_DELAY	0x13	0x00 04	0000 0000 0000 0**1**00
SI_ROOM_CMA	0x14	0x00 08	0000 0000 0000 **1**000
SI_PROV_BW	0x15	0x00 10	0000 0000 000**1** 0000
SI_POSS_BW	0x25	0x00 20	0000 0000 00**1**0 0000

SI_SND _BW	0x35	0x00 40	0000 0000 0**1**00 0000
SI_SND_PACKET	0x36	0x00 80	0000 0000 **1**000 0000
SI_SND _BYTES	0x37	0x01 00	0000 000**1** 0000 0000
SI_RCV_BW	0x45	0x02 00	0000 00**1**0 0000 0000
SI_RCV_PACKET	0x46	0x04 00	0000 0**1**00 0000 0000
SI_RCV_BYTES	0x47	0x08 00	0000 **1**000 0000 0000
SI_TREE_CONN	0x68	0x10 00	000**1** 0000 0000 0000
SI_TREE_MEM	0x69	0x20 00	00**1**0 0000 0000 0000

8.3.7 Values related to the leave

Table 9 lists the reason codes for leaving. The four most significant bits of the code specify the main cause of leaving, and the four least significant bits specify further details for leaving, such as exhaustion of system resources or termination by the user's request.

Table 9 – Leave reason code

Category	Code	Meaning
Leave	0x10	Leave initiated by MA
	0x11	Leave of SMA
Kick out	0x20	Expulsion by SM
	0x21	Expulsion by PMA
Parent switching	0x40	Parent switching by MA

8.3.8 Values related to the session termination

Table 10 lists the reason codes for the session termination. The four most significant bits of the code specify the main reason for the session termination, and the four least significant bits specify the detailed reason for session termination.

Table 10 – Termination reason code

Category	Code	Meaning
Normal session termination	0xE0	Session is terminated normally
Abnormal session termination	0xF0	Session is terminated abnormally without reason
	0xF1	Session is terminated abnormally by user request