Telecommunications and Information Exchange Between Systems

ISO/IEC JTC 1/SC 6

Document Number:	N14008
Date:	2009-06-10
Replaces:	
Document Type:	Other Document (Defined)
Document Title:	Text of ISO/IEC FDIS 24792 Multicast Session Management Protocol (MSMP)
Document Source:	SC 6/WG 7 Tokyo meeting
Project Number:	
Document Status:	As per the SC 6 Tokyo resolution 6.7.2, this document is approved for FDIS ballot.
Action ID:	FYI
Due Date:	
No. of Pages:	24

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SC6 N14008
7TOK-28

ISO/IEC JTC 1/SC 6
TELECOMMUNICATION AND INFORMATION
EXCHANGE BETWEEN SYSTEMS

Title: The DIS text of Multicast Session Management Protocol (MSMP)

Source: Editors (Hyun-Kook Kahng, Maryam Roshanaei)

Project: ISO/IEC JTC 1 06.33.07.00

Status: This is the output document of the MSMP(Multicast Session Management Protocol), which has been produced in the joint meeting of JTC1/SC6/WG 7 and ITU-T Q1.1/17, held in Tokyo, Japan on 1 - 5 June, 2009. It is proposed that this text should be circulated for DIS ballot processing by JTC1/SC6.

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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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Summary

MSMP (Multicast Session Management Protocol) is an application-layer control protocol for managing the quality of service for a group communication. Generally it is assumed that there are one MSMP server, one session creating client (or Session Creator), and one or more session participating clients (or Session Participants). MSMP is composed of QoS management (QM) function.

Keyword

QoS Server, QoS Management, Multicast Session Management, Group Management.

Introduction

MSMP will operate over the conventional transport protocols and/or ECTP as shown in Figure 1.

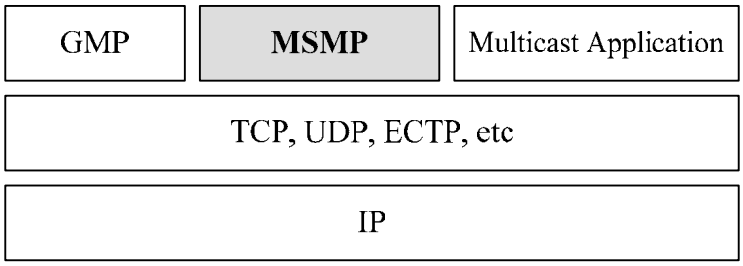


Figure 1 – MSMP Model (MSMP Protocol Stack)

INTERNATIONAL STANDARD

INFORMATION TECHNOLOGY – GROUP MANAGEMENT PROTOCOL

1. Scope

This| International Standard provides a specification of a Multicast Session Management Protocol (MSMP), which is an application-layer control protocol for managing a quality of service for a group. MSMP consists of QoS management (QM) functions.

2. Normative references

The following ITU-T Recommendations and International Standards contain provisions that, through references in the text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All Recommendations and International Standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and International Standards listed below. ISO and IEC members maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU-T maintains a list of currently valid ITU-T documents.

- ITU-T Recommendation X.601 (2000), Information technology – Multi-Peer Communications Framework
- ITU-T Recommendation X.602 (2004) | ISO/IEC 16513: 2005, Information technology –Grou Management Protocol
- 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: S`pecification of Simplex Multicast Transport
- ITU-T Recommendation X.606.1 (2002) | ISO/IEC 14476-2: 2003, Information technology – Enhanced Communications Transport Protocol: Specification of QoS Management for Simplex Multicast Transport

3. Definitions

3.1 Terms defined in ITU-T Rec. X.601

This International Standard is based on the concepts developed in Multi-Peer Communications Framework (ITU-T Rec. X.601) and makes use of the following terms defined in that Recommendation:

a) Multi-peer;

b) Multi-peer communication; and

c) Multicast transmission.

3.2 Terms defined in ITU-T Rec. X.602 | ISO/IEC 16513

This International Standard is based on the concepts developed in Group Management Protocol Definition (ITU-T Rec. X.602 | ISO/IEC 16513) and makes use of the following terms defined in that Recommendation | International Standard:

a) GMP Client;

b) GMP Server;

c) Session Creator;

d) Session client; and

e) Session Participant.

3.3 Terms defined in ITU-T Rec. X.605 | ISO/IEC 13252

This International Standard is based on the concepts developed in Enhanced Communications Transport Service Definition (ITU-T Rec. X.605 | ISO/IEC 13252) and makes use of the following terms defined in that Recommendation | International Standard:

a) Enrolled Group;

b) Registered Group;

c) Active Group;

d) TC-owner;

e) QoS parameters;

f) QoS negotiation; and

g) QoS arbitration.

3.4 Terms defined in ITU-T Rec. X.606 | ISO/IEC 14476-1

This International Standard is based on the concepts developed in Enhanced Communications Transport Protocol: Specification of simplex multicast transport (ITU-T Rec. X.606 | ISO/IEC 14476-1) and makes use of the following terms defined in that Recommendation | International Standard:

a) TO (Top owner);

b) LO (Local Owner); and

c) LE (Leaf entity).

3.5 Terms defined in ITU-T Rec. X.606.1 | ISO/IEC 14476-2

This International Standard is based on the concepts developed in Enhanced Communications Transport Protocol: Specification of QoS Management for simplex multicast transport (ITU-T Rec. X.606.1 | ISO/IEC 14476-2) and makes use of the following terms defined in that Recommendation | International Standard:

a) QoS monitoring; and

b) QoS maintenance.

3.6 Terms defined in this International Standard

a) MSMP Server: A server is an application program that is responsible for QoS management. The MSMP server will aggregate the QoS parameter values from all session participants and arbitrate the QoS parameter values. After arbitration, the MSMP server will announce the arbitrated QoS parameter values to all session participants. The MSMP server will keep and update the QoS parameter values.

b) MSMP Client: An application program that sends and receives MSMP messages. Clients store and acquire information through a MSMP server. All clients must log in to the server to acquire information from the server. Clients are largely divided between a session creator and session participants.

c) Session Creator: A client who creates and who may terminate a session. The session creator is defined in ITU-T Rec. X.602 | ISO/IEC 16513, GMP. The session creator is the sender and sends the QoS parameter values for the traffic characteristics of the data that the sender will transmit to receivers.

d) Session participant: A client who registers to a session intending to participate in that session. After registration, the session participant will join the session to be an active member. A session participant may be a sender in the session. The session participant has to respond to a QoS Reporting Request message, QRREQ via a QoS Reporting Response message, QRRES. A session participant may be a TC-participant defined in ITU-T Rec. X.605 | ISO/IEC 13252, ECTS.

4. Abbreviations

This International Standard uses the following abbreviations.

4.1 Message types

4.1.1. Session Management message types

The session management message types are defined in ITU-T Rec. X.602 | ISO/IEC 16513, GMP.

SCREQ	Session Creation Request message
SCACC	Session Creation Acceptance message
SCREJ	Session Creation Reject message
SDREQ	Session Deletion Request message
SDRES	Session Deletion Response message
SCINF	Session Creation Information message
SCCON	Session Creation Confirm message
SRREQ	Session Registration Request message
SRACC	Session Registration Acceptance message
SRREJ	Session Registration Reject message
SRRES	Session Registration Response message
SJREQ	Session Join Request message
SJRES	Session Join Response message
SAREQ	Session Activation Request message

4.1.2. QoS Management message types

QRREQ	QoS Reporting Request message
QRRES	QoS Reporting Response message
QSREQ	QoS Setting Request message
QSRES	QoS Setting Response message
QSREP	QoS Setting Report message
QUREQ	QoS Updating Request message
QURES	QoS Updating Response message
QVREQ	QoS Value Request message
QVRES	QoS Value Response message
QTREQ	QoS Termination Request message
QTIND	QoS Termination Indication message
QSCREQ	QoS Session Creation Request message
QSCACC	QoS Session Creation Acceptance message
QSCCON	QoS Session Creation Confirm message
QSJIND	QoS Session Join Indication message

4.2 Miscellaneous

ECTP	Enhanced Communications Transport Protocol
ECTS	Enhanced Communications Transport Service
GMP	Group Management Protocol
SM	Session Management
MM	Membership Management
RMT	Reliable Multicast Transport
SAP	Session Announcement Protocol
SDP	Session Description Protocol
IP	Internet Protocol
CHQ	Controlled Highest Quality

OT	Operating Target
LQA	Lowest Quality Allowed
MSS	Maximum Segment Size
QoS	Quality of Service
RSVP	Resource Reservation Protocol

5. Conventions

In International Standard, the key words “MUST”, “REQUIRED”, “SHALL”, “MUST NOT”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “MAY”, and “OPTIONAL” are to be interpreted as described in IETF RFC 2119., and indicate requirement levels for compliant MSMP implementations. Those key words are case-sensitive.

6. Overview

6.1 General MSMP

The MSMP is an application-layer control protocol for managing a quality of service for a group session. The MSMP would be designed to provide the IP multicast-based multimedia applications with a QoS management required for the group multicasting such as QoS monitoring and reporting. The MSMP will operate over the conventional transport protocols and/or ECTP, and can be used as a control protocol together with the GMP.

Generally it is assumed that there are one MSMP server, one GMP server, one session creating client (or Session Creator), and one or more session participating clients (or Session Participants) as shown in Figure 2.

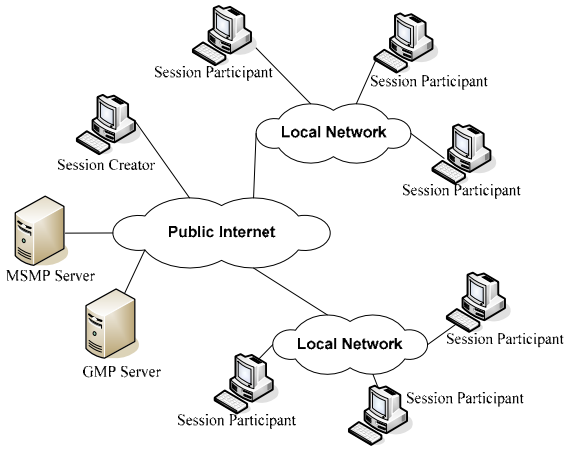


Figure 2 – Network Configuration for MSMP

6.2 Session Management

Session Management (SM) is a part defined in the session management (section 6.1) of ITU-T Rec. X.602 | ISO/IEC 16513, GMP.

SM may be achieved in eight distinct phases: creation, announcement, registration, enrollment, activation, de-registration, de-enrollment, and de-activation.

A particular client, called a session creator, creates a session. Then, SM updates the session list.

The session creator will send a Session Creation Request message, SCREQ to the GMP server with initial QoS parameter values for a session creation. The GMP server sends the MSMP server a QoS Session Creation Request message, QSCREQ, which includes session creation information and QoS parameter values for a session creation. QSCREQ is to ask whether the QoS parameter values are available or not for a session creation. Considering the network environment and its application, the MSMP server may allow the request from the GMP server by replying with a QoS Session Creation Acceptance message, QSCACC. After receiving QSCACC, if the session creation is

possible, the GMP server sends a Session Creation Acceptance message, SCACC. Then the session creator will send the detailed session information to the server and receive the confirmation message with a modified and more specified QoS parameter values. The GMP server reply with a Session Creation Confirm message, SCCON and then the server notifies the MSMP server of a session creation via a QoS Session Creation Confirm message, QSCCON. If the session can not be created or the session creator does not have the necessary rights, then a Session Creation Reject message, SCREJ will be returned.

After successful session creation, the server will announce the new session to the clients with the more specified QoS parameter values. The announcement may be done by e-mail, web posting, and so on. From this point on, those clients may register in multicast groups.

A client may register for the session, considering those QoS parameter values. After successful registration, the client belongs to the registered group.

When the session starts, the session's registered members will start a group application to send and receive session data. At this time, all preparations for the data transfer and group management are accomplished. The session's registered group member belongs to the enrolled group. After that, the GMP server sends the MSMP server a QoS Session Join Indication message, QSJIND. The MSMP server starts the QoS Reporting Request and Response.

6.3 QoS Management

The MSMP server aggregates the QoS parameter values such as throughput, delay, delay jitter, and loss from all participants. After aggregation of the QoS parameter values, the MSMP server arbitrates them and will send the QoS parameter values to the session creator via a QoS Setting Request message, QSREQ. The session creator will acknowledge with the final arbitrated the QoS parameter values to the MSMP server via a QoS Setting Response message, QSRES. After receiving QSRES, the MSMP server announces the final arbitrated QoS parameter values to all session participants via QoS Setting Report message, QSREP.

The QoS reporting is performed to maintain and update the QoS parameter values. The MSMP server will send periodically a QoS Reporting Request message, QRREQ, to all participants to gather the QoS parameter values. Each participant will acknowledge with own QoS parameter values for receiving a data via a QoS Reporting Response message, QRRES. If the session participant is a session creator or a sender, the participant will reply with own QoS parameter values for sending and receiving data via QRRES. After receiving QRRES, the MSMP server arbitrates them and will send the QoS parameter values to the session creator via QSREQ. The session creator will reply with the final arbitrated the QoS parameter values to the MSMP server via QSRES. After receiving QSRES, the MSMP server will update and keep the QoS parameter values and announces the values to all session participants.

Figure 3 shows an example of MSMP operations. After a session is created and announced, four session participants, A, B, C, and D register for a session in the session registration phase. The session creator and clients send a session join request to the GMP server to be ready to communicate with each other in the session enrollment phased. After that, the session creator and the clients belong to the enrolled group. A session creator and three participants, A, B and D enter the active state by sending a session activation request message to the GMP server. In Figure 3, the participant C who is a late-joiner will send a session activation request message to the GMP server after the session activation. In the late join case, the late-joiner comes to send a QoS Value Request message, QVREQ, to the MSMP server in order to get QoS parameter values of the on-going session. Now, the participant D comes to be a troublemaker who reports QoS parameter values lower than the QoS parameter values of the on-going session. If a troublemaker could not maintain the QoS parameter values at a desired level in the on-going session, the troublemaker may be ejected from the on-going session as shown in Figure 3. For some reason there may be a case that the troublemaker does not leave the session(see subsection 7.2.4)

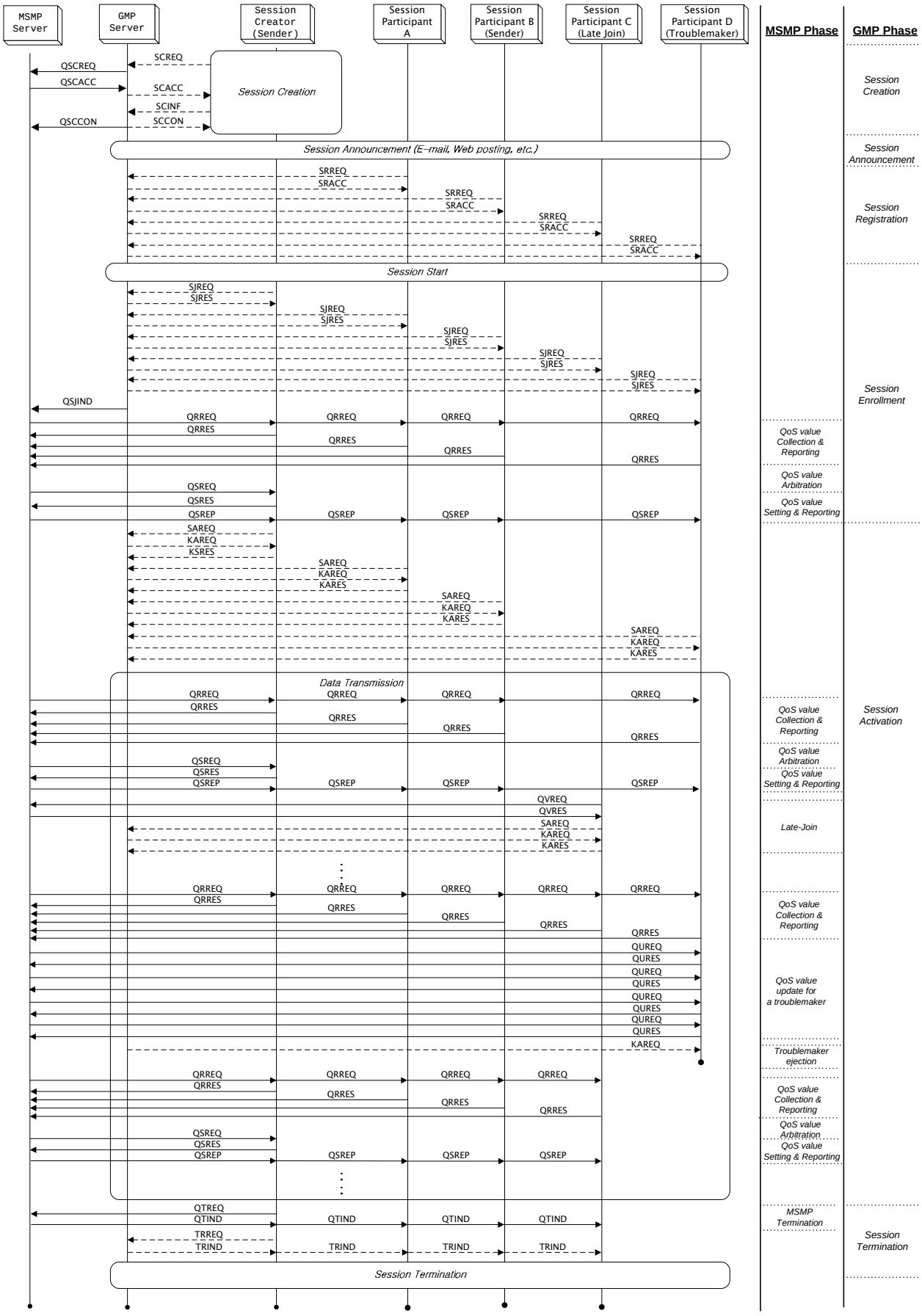


Figure 3 – An example of the MSMP control

7. Protocol operations

7.1 Session Management

Note: Session Management (SM) is a part defined in the session management (subsection 7.1) of ITU-T Rec. X.602 | ISO/IEC 16513, GMP.

7.1.1 Session creation

Session creation is effected by a session creator, who will define and characterize the session with initial QoS parameter values including media type, application type, additional information, and so on.

Figure 4 shows the successful session creation procedure. A Session Creator defines and characterizes a session with initial QoS parameter values and sends the GMP server a Session Creation Request message, SCREQ.

The GMP server sends the MSMP server a QoS Session Creation Request message, QSCREQ, which includes session creation information and the QoS parameter values for a session creation. QSCREQ is to ask whether the QoS parameter values are available or not for a session creation. Considering the network environment and its application, the MSMP server may allow the request from the GMP server by replying with a QoS Session Creation Acceptance message, QSCACC.

After receiving QSCACC, the GMP server considers the multicast environment and its application. If the session creation is possible, the GMP server sends a Session Creation Acceptance message, SCACC. Then, the Session Creator will send the GMP server detailed session information in a Session Creation Information message, SCINF, which may include media type, application type, etc. The server will acknowledge successful session creation with a Session Creation Confirm message, SCCON, to the session creator and then the GMP server sends the MSMP server a QoS Session Creation Confirm message, QSCCON.

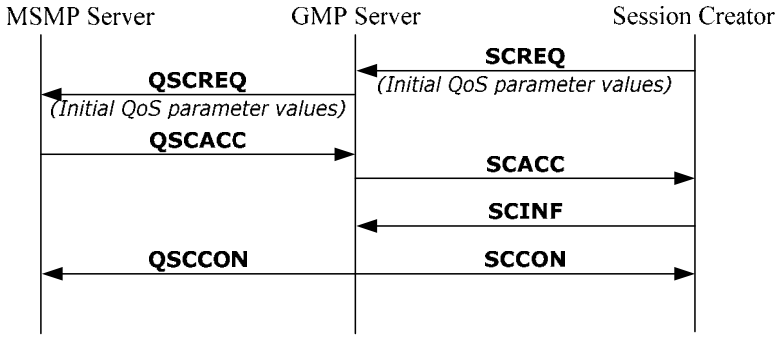


Figure 4 – Successful session creation procedure

7.1.2 Session registration

Session registration is to select a session and to let the server and creator know the intention of the participation.

In the open mode session, the session client will select a session and send the GMP server a Session Registration Request message, SRREQ, considering the announced QoS parameter values. The server will simply add the requesting client to the Registered Group Membership list, and reply to the requestor with a Session Registration Acceptance message, SRACC, as shown in Figure 5 or Figure 6 according to the session mode. The session modes are defined in the session registration (section 7.1.3) of ITU-T Rec. X.602 | ISO/IEC 16513, GMP.

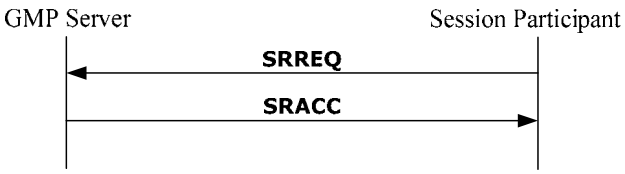


Figure 5 – Successful session registration procedure (Open mode)

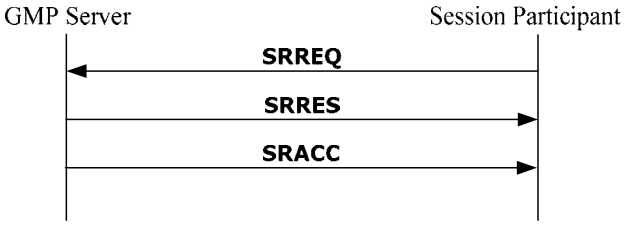


Figure 6 – Successful session registration procedure (Close mode)

7.1.3 Session enrollment

Session enrollment is the state where communication is possible among a session creator and session participants. Session participants, including the session creator, should send the GMP server a Session Join Request message, SJREQ. The server will add the participants to the Enrolled Group Membership list and reply to the participant with a Session Join Response message, SJRES, as shown in Figure 7.

After receiving SJRES from the session creator and the session participants, the GMP server sends the MSMP server a QoS Session Join Indication message, QSJIND to inform the MSMP server of the session enrolled state. After the MSMP server receives QSJIND, the MSMP server will start the QoS management.

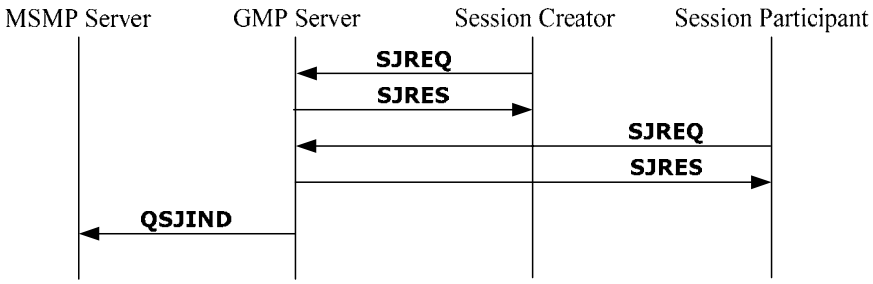


Figure 7 – Successful session enrollment procedure

7.2 QoS Management

7.2.1 General QM

QoS Management (QM) may have five operations such as QoS Report request and response, QoS Setting request and response, QoS Updating request and response, QoS Value request and response, and QoS Termination request and response.

QoS Management is responsible for the following functions:

a) QoS reporting request and response: The MSMP server sends periodically the QoS reporting request to all session participants to gather and maintain QoS parameter values. After receiving the QoS reporting response, the MSMP server arbitrates the QoS parameter values and keeps the values.

b) QoS setting request and response: The MSMP server sends the arbitrated QoS parameter values to the session creator. The session creator will acknowledge with the final arbitrated QoS parameter values to the MSMP server. After receiving the QoS setting response message, the MSMP server will announce the final arbitrated QoS parameter values to all session participants.

c) QoS updating request and response: The QoS updating request and response are performed by the MSMP server to maintain the QoS status. If a participant could not maintains the QoS parameter values of the on-going session, the participant becomes a troublemaker in the session. MSMP server will send the QoS Updating Request message, QUREQ to check the status of the troublemaker and to keep him a notice of the violation. The participant who is a troublemaker has to reply with own QoS parameter values via a QoS Updating Response message, QURES to report his current status. If the QoS parameter values in QURES are restored to the previous one, the MSMP server will stop the QoS updating procedure. If the QoS parameter values in QURES are still lower than the original one, the MSMP server will send the QUREQ message

several times so that the troublemaker restores his QoS parameter values.

d) QoS value request and response: In the late join case, a late-joiner will send the QoS value request in order to get the QoS parameter values of the on-going session. The MSMP server will reply with the QoS parameter values.

e) QoS termination request and indication: To terminate a QoS management, the session creator will send the QoS termination request to the MSMP server. The MSMP will send the QoS termination indication message all participants in active session participants.

7.2.2 QoS reporting request and response

The MSMP server aggregates and maintains QoS parameter values using a periodic QoS reporting.

After receiving QSJIND from the GMP server, the MSMP server will start the QoS reporting request. The MSMP server sends periodically the QoS Reporting Request message, QRREQ, along the multicast control tree to all participants.

Each participant will acknowledge with own QoS parameter values via a QoS Reporting Response message, QRRES. If a session participant is a session creator, the session creator sends the MSMP server the QoS parameter values for sending a data. A session participant who may send a multicast data sends the server the QoS parameter values for sending and receiving the data. A session participant who may receive a multicast data sends the server the QoS parameter values for receiving the data.

After receiving QRRES, the MSMP server could be aware whether the session participant is a sender or a receiver.

The MSMP server arbitrates the QoS parameter values reported from all participants and keeps the updated QoS parameter values.

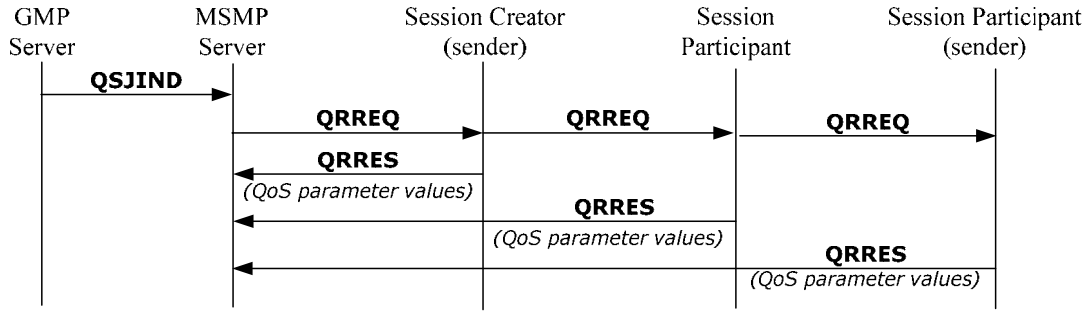


Figure 8 – QoS reporting procedure

Figure 9 shows a QoS reporting procedure in the MSMP server. Upon receiving QRRES from all session participants, the MSMP server will arbitrate the QoS parameter values and keep the updated QoS parameter values. After that, the MSMP server will reset the QoS reporting (QR) timer and send the next QRREQ.

If QoS parameter values in QRRES are lower than the QoS parameter values of the on-going session, the participant becomes a troublemaker and then the MSMP server starts QoS updating procedure.

If the MSMP server does not receive the QRRES from a session participant and the QR timer to the session participant expires, the MSMP server will reset the QR timer and send the next QRREQ to the session participant.

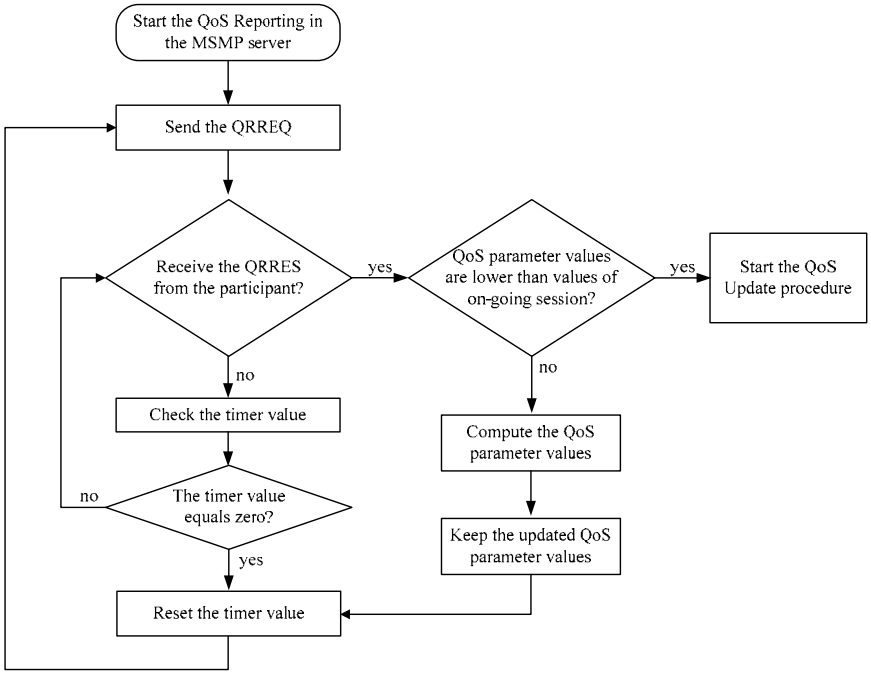


Figure 9 – QoS reporting operation in the MSMP server

7.2.3 QoS setting request and response

The MSMP server aggregates QoS parameter values from the all participants using QRREQ and QRRES. After the server receives QRRES, the server will send the session creator a QoS Setting Request message, QSREQ to let the session creator to reserve the resource. The QoS Setting Request message includes QoS parameter values such as throughput, delay, delay jitter, and loss rate which are previously arbitrated.

After receiving the QSRES from the server, the session creator finalizes the arbitrated the QoS parameter values. The session creator will acknowledge with the QoS parameter values to the server via a QoS Setting Response message, QSRES.

After receiving the final QoS setting response message, the server will announce the final arbitrated QoS parameter values to all session participants via a QoS Setting Report message, QSREP.

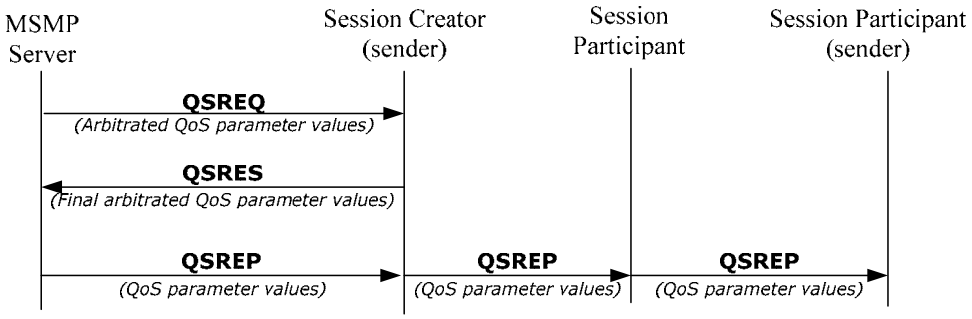


Figure 10 – QoS setting procedure

7.2.4 QoS updating request and response

The QoS updating procedure is performed by the MSMP server to maintain the QoS status. If a participant reports QoS parameter values lower than the QoS parameter values of the on-going session, the MSMP server sends a QoS Updating Request message, QUREQ to the participant to demand that the participant should restore previous QoS parameter values. If a participant could not maintain the QoS parameter values of the on-going session, the participant becomes a troublemaker in the session.

The participant who is a troublemaker has to reply with own QoS parameter values via a QoS Updating Response

message, QURES. If the QoS parameter values in QURES are still not restored, the MSMP server will send the QUREQ message several times to check the status of the troublemaker.

Note- It is a implementation problem to decide how many times the MSMP server sends QUREQ.

If the troublemaker sends back the restored QoS parameter values of the on-going session, the MSMP stops the QoS updating procedure.

If the troublemaker could not maintain the QoS parameter values at a desired level, the troublemaker may be ejected from the on-going session such as figure 11. A detailed scheme of the troublemaker ejection can be made differently by implementations.

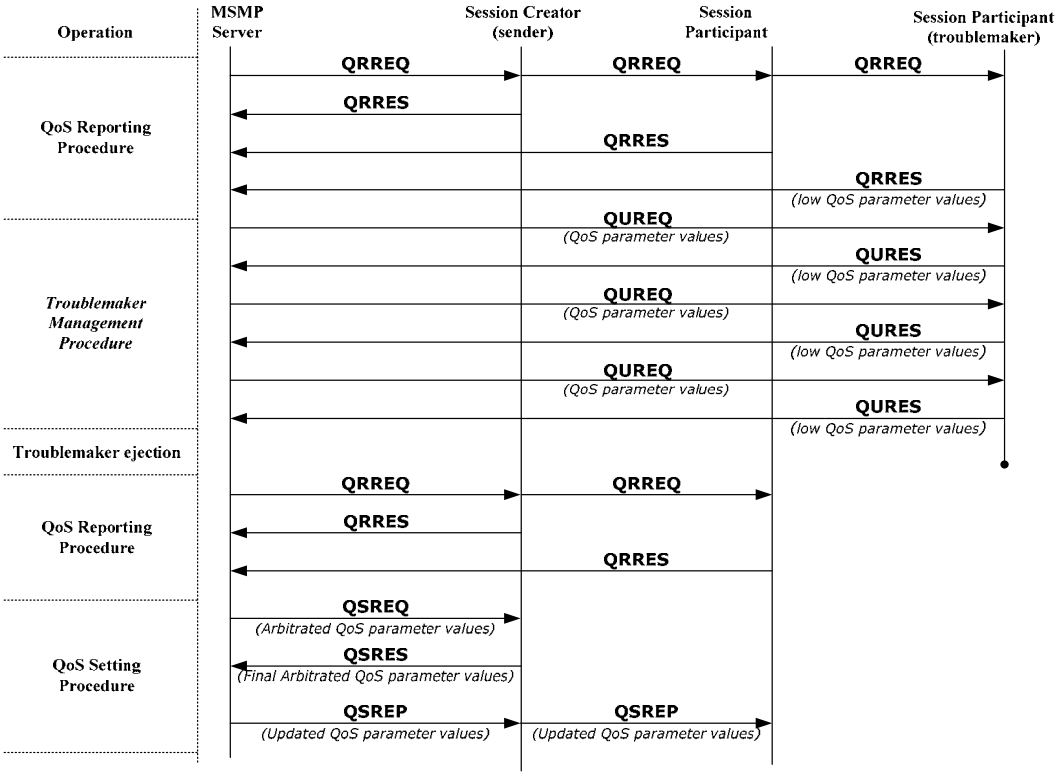


Figure 11 – QoS updating procedure in the case that a troublemaker is ejected form the session

Sometimes, although the troublemaker maintains the low QoS parameter values in the session, the troublemaker may not be ejected from the session depending on the group membership characteristics. For example, the troublemaker may be a key member of the group. If the troublemaker does not be ejected from the session, the MSMP server begins the QoS reporting procedure and the QoS setting procedure using the proposed low QoS parameter values from the troublemaker and other participants as shown Figure 12.

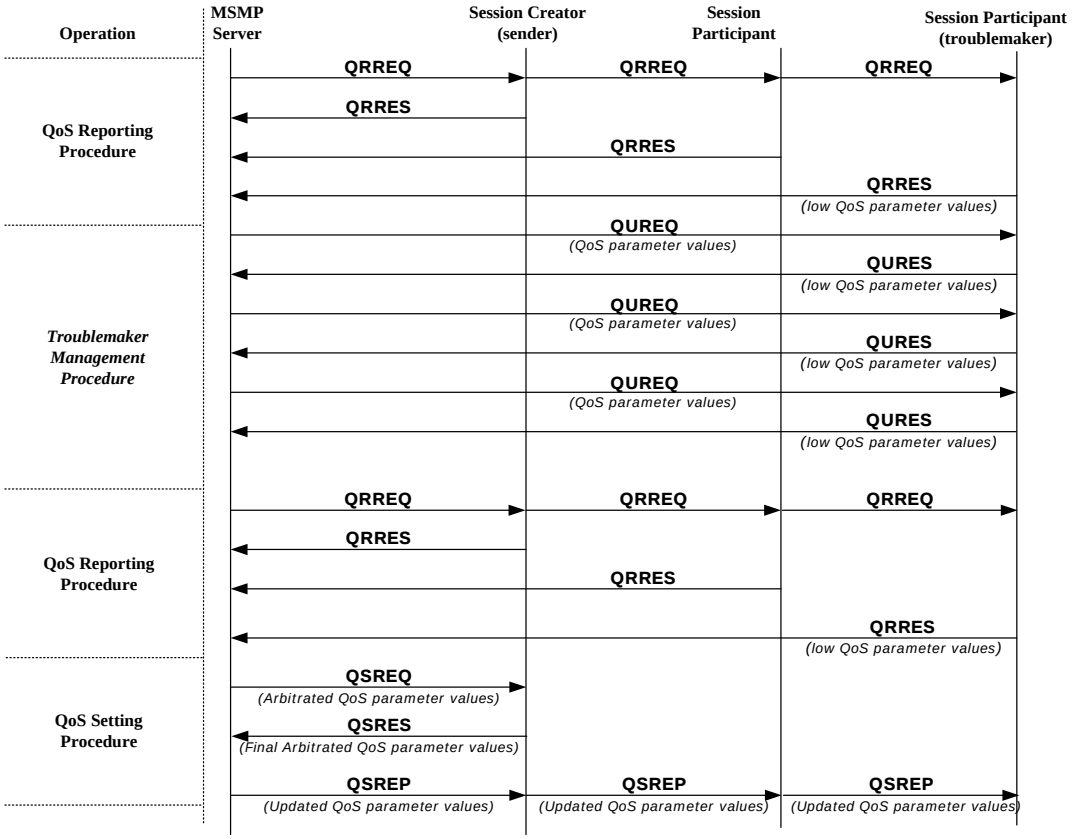


Figure 12 – QoS updating procedure in the case that a troublemaker is not ejected form the session

Figure 13 shows a QoS updating procedure in the MSMP server. If QoS parameter values in QRRES are lower than the QoS parameter values of the on-going session, the participant becomes a troublemaker and then the MSMP server starts QoS updating procedure.

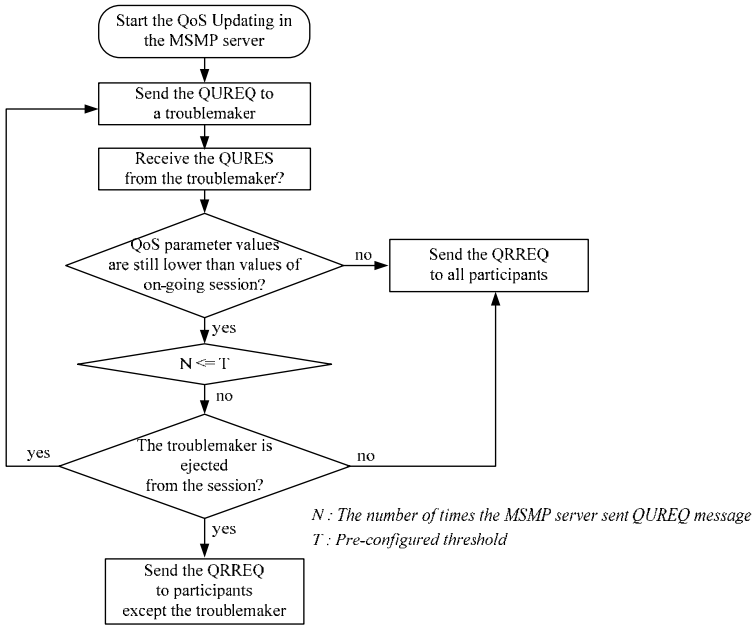


Figure 13 – QoS Updating operation in the MSMP server

7.2.5 QoS value request and response

In the late join case, the late-joiner will send a QoS Value Request message, QVREQ, to the MSMP server in order to get QoS parameter values of the on-going session. The MSMP server will reply with the QoS parameter values via a QoS Value Response message, QVRES.

In Figure 14, the late-joiner sends the MSMP server QVREQ, and then the server will reply with the QoS parameter values of the on-going session via QVRES. The late-joiner reserves the resource using the QoS parameter values. After that, the late-joiner sends the GMP server the Session Activation Request message to join the on-going session.

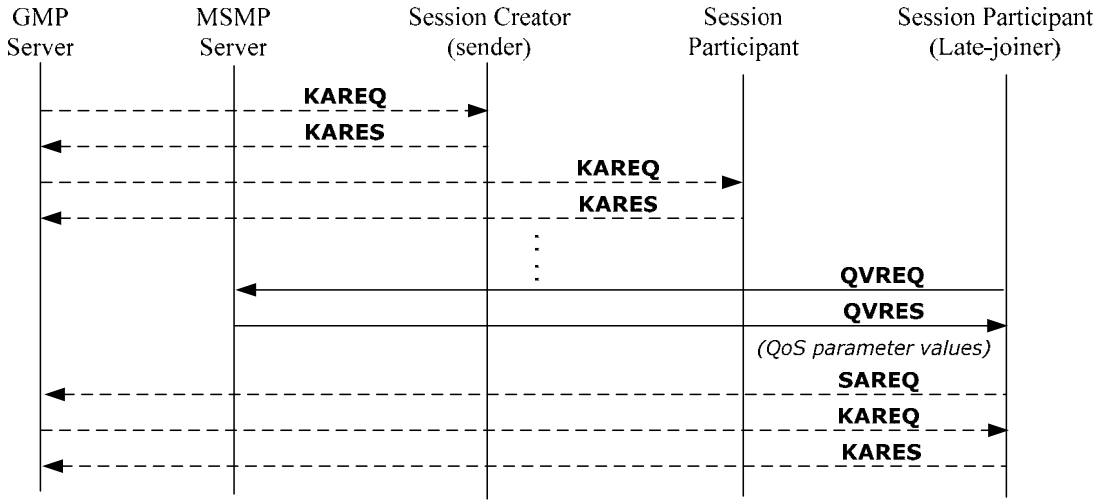


Figure 14 – QoS value request and response for late joiner

7.2.6 QoS termination request and indication

To terminate a QoS management in the session, a session creator will send a QoS Termination Request message, QTREQ, to the MSMP server. The MSMP will send a QoS Termination Indication message, QTIND, all participants in active session.

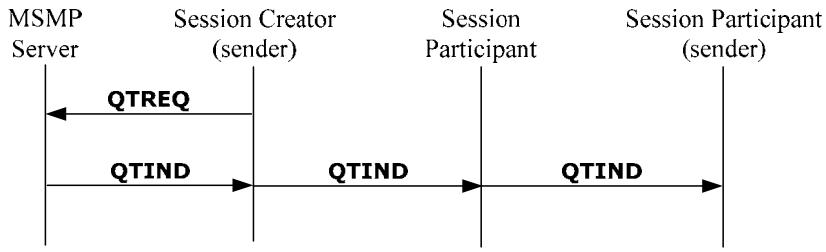


Figure 15 – QoS termination request and indication

8. MSMP messages

8.1 Session Management message types and the format

Table 1 summarizes the Session Management messages and their descriptions used in MSMP. The Session Management message types and the format are defined in Session Management message types and the format

(subsection 8.1 and subsection 8.2) of ITU-T Rec. X.602 | ISO/IEC 16513, GMP.

Table 1 – Session Management message types

Message Type	Generated by	Description
SCREQ	Session Creator	Session Creation Request message
SCACC	GMP Server	Session Creation Acceptance message
SCREJ	GMP Server	Session Creation Request Rejection message
SDREQ	Session Creator	Session Deletion Request message
SDRES	GMP Server	Session Deletion Response message
SCINF	Session Creator	Session Creation Information message
SCCON	GMP Server	Session Creation Information Confirmation message
SRREQ	Session Creator, Session Participant	Session Registration Request message
SRACC	GMP Server	Session Registration Acceptance message
SRREJ	GMP Server	Session Registration Rejection message
SRRES	GMP Server	Session Registration Response message
SJREQ	Session Creator, Session Participant	Session Join Request message
SJRES	GMP Server	Session Join Response message
SAREQ	Session Creator, Session Participant	Session Activation Request message

8.2 QoS Management message types

Table 2 summarizes the QoS Management messages and their descriptions used in MSMP.

Table 2 – QoS Management message types

Message Type	Generated by :	Description
QRREQ	MSMP Server	QoS Reporting Request message
QRRES	Session Creator, Session Participants	QoS Reporting Response message
QSREQ	MSMP Server	QoS Setting Request message
QSRES	Session Creator	QoS Setting Response message
QSREP	MSMP Server	QoS Setting Report message
QUREQ	MSMP Server	QoS Updating Request message
QURES	Session Participant (troublemaker)	QoS Updating Response message
QVREQ	Session Participant (Late-joiner)	QoS Value Request
QVRES	MSMP Server	QoS Value Response
QTREQ	Session Creator	QoS Termination Request
QTIND	MSMP Server	QoS Termination Indication

a) QRREQ: The MSMP server generates this message and sends it to a session creator and participants periodically to gather the QoS parameter values and maintain the QoS status. This message will be delivered toward the sender along the multicast control tree hierarchy.

b) QRRES: Each participant reports the own QoS parameter values to the MSMP server via this message. The MSMP server aggregates the QRRES message from participants and arbitrates the QoS parameter values. The MSMP server keeps the updated QoS parameter values for sending and receiving a multicast data.

c) QSREQ: The MSMP server generates this message to a session creator to give the arbitrated QoS parameter values such as throughput, delay, delay jitter, and loss.

d) QSRES: The session creator generates this message and sends it to the MSMP server with the final arbitrated QoS parameter values for sending a multicast data.

e) QSREP: The MSMP server generates this message and sends it to all participants.

f) QUREQ: If a participant reports QoS parameter values lower than the QoS parameter values of the on-going session, the participant becomes a troublemaker and the MSMP server sends a QoS Updating Request message, QUREQ to the troublemaker to demand that the troublemaker should raise own QoS parameter.

g) QURES: The participant who is a troublemaker has to reply with own QoS parameter values via a QoS Updating Response message, QURES.

h) QVREQ: The late-joiner sends the MSMP server this message to get the QoS parameter values of the on-going session..

i) QVRES: The MSMP server generates this message and sends the QoS parameter values to the late-joiner.

j) QTREQ: The session creator generates this message and sends the MSMP server the message to terminate the QoS management.

k) QTIND: The MSMP server generates this message. This message will be delivered toward the session creator and participants along the multicast control tree.

8.3 QoS management message format

Figure 16 shows the format of the QoS Management message format in the MSMP.

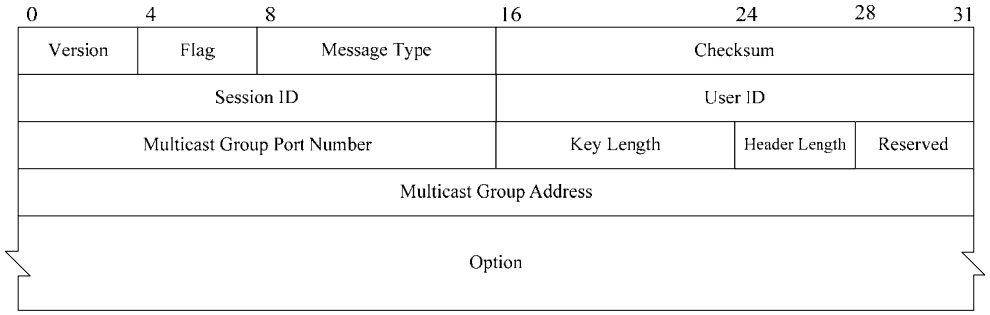
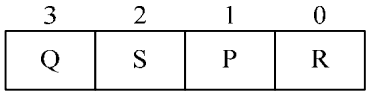


Figure 16 – QoS Management message format

The QoS Management header contains the following information:

a) Version (4 bits) – Defines the current version of the MSMP protocol. It starts at ‘1’.

b) Flag (4 bits) – flag bits. Depending on the message types, it has a different purpose. Encoding of this byte is depicted in the following figure.



- Q: Indicates whether the mode is QoS or non-QoS.
  QoS mode : ‘Q=1’ Non-QoS mode : ‘Q=0’
- S: Indicates whether the mode is secure or non-secure.
  Secure mode : ‘S=1’ Non-Secure mode : ‘S=0’

- P: Indicates whether the participant is a sender or receiver.
  Sender : ‘P=1’ Receiver : ‘P=0’
- R: Reserved for future use.

c) Message Type (8 bits) – Indicates the types of QoS Management message. Table 3 summarizes the message types and encodings.

Table 3 – Encoding table of QoS Management message types

Message Type	Encoding
QRREQ	0001 0000
QRRES	0010 0000
QSREQ	0011 0000
QSRES	0100 0000
QSREP	0101 0000
QUREQ	0110 0000
QURES	0111 0000
QVREQ	1000 0000
QTREQ	1001 0000
QTREQ	1010 0000
QTIND	1011 0000

d) Checksum (16 bits) – Check the segment validity of the message.

e) Session ID (16 bits) – Identifies each session.

f) User ID (16 bits) – Identifies each session participant. The ID for Session Creator and other participants will be assigned by the MSMP server at creation phase and registration phase, respectively.

g) Key Length (8 bits) – Key Length values in MSMP in units of 8 bits

h) Header Length (4 bits) – Length of header in 32-bit words. The minimum value is four, for a minimum header length of 16 octets

i) Reserved (4 bits) – Reserved for future use

j) Multicast Group Port Number (16 bits) – Port number for multicast group communication

k) Multicast Group Address (32 bits) – Multicast group address

l) Option (32 bits×3)

- This field will be attached to the QoS management message if ‘Q flag’ bit is set to ‘1’. Figure 17 shows the format of the option field in QoS Management.

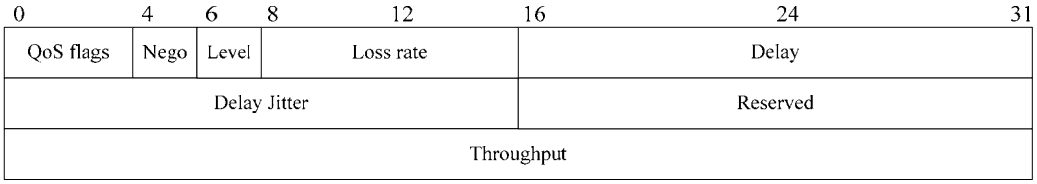
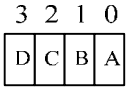


Figure 17 – Option field in QoS Management message

- QoS flags (4 bits) – are flag bits to specify if the QoS parameters are used in the QoS management session. Encoding of this byte is depicted in the following figure.



  1) A – throughput;
  2) B – transit delay;
  3) C – transit delay jitter;
  4) D – data loss rate;

- Nego (2 bits) – is a flag byte to specify which QoS negotiation procedure is used in the QoS management session. The QoS negotiation procedures are defined in QoS negotiation mechanisms (section 10.3) of ITU-T Rec. X.605 | ISO/IEC 13252, ECTS, namely the Owner Arbitration (OA) QoS negotiation and Step-wise Arbitration (SWA) QoS negotiation procedure. Encoding of this byte is depicted in the following figure.

  1) A – the Owner Arbitration (OA) QoS negotiation;
  2) B – Step-wise Arbitration (SWA) QoS negotiation;

- Level (2 bits) – is a flag byte to specify the level of QoS agreement. The levels of QoS agreement are defined in level of QoS agreement (section 10.2) of ITU-T Rec. X.605 | ISO/IEC 13252, ECTS, namely the best effort level of agreement and guaranteed level of agreement. Encoding of this byte is depicted in the following figure.

  1) A – best effort levels;
  2) B – guaranteed level;

- Throughput (32 bits) – The throughput value is a 32-bit unsigned integer in byte per second. The throughput value is valid only if ‘A’ bit of QoS flag is set to ‘1’
- Transit Delay (16 bits) – The transit delay value is a 16-bit unsigned integer in millisecond. The transit delay value is valid only if ‘B’ bit of QoS flag is set to ‘1’.
- Transit Delay Jitter (16 bits) – The transit delay jitter value is a 16-bit unsigned integer in millisecond. The transit delay value is valid only if ‘C’ bit of QoS flag is set to ‘1’.
- Data Loss rate (8 bits) – The data loss rate value is a 16-bit unsigned integer ranged from 0 to 100 in percent. The data loss rate value is valid only if ‘D’ bit of QoS flag is set to ‘1’
- Reserved (16 bits) – is reserved for future use.

9. MSMP variables

9.1 Variables

MSMP QM (QoS Management) maintains and processes the following parameters as summarized in Table 4.

Table 4 – QoS parameters in MSMP

Parameter	**Description**

Throughput	An amount of application data output over a specific time period
Transit delay	End-to-end transmission time from a sender to a receiver
Transit delay jitter	Variations of transit delay values
Data loss rate	A ratio of the amount of lost data over the amount of totally transmitted data

9.2 Timer

QoS reporting period is defined in the MSMP in units of 100 milliseconds.

a) QoS Reporting period: the MSMP server sends QRREQ to Senders every QoS Reporting period.

b) QoS Reporting time: After the MSMP server sends QRREQ, it activates the QoS Reporting (QR) timer. The QR timer expires after QoS Reporting time.

Appendix A. Relationship between MSMP, GMP, and ECTP

This annex summarizes the relationship between MSMP, GMP, and ECTP

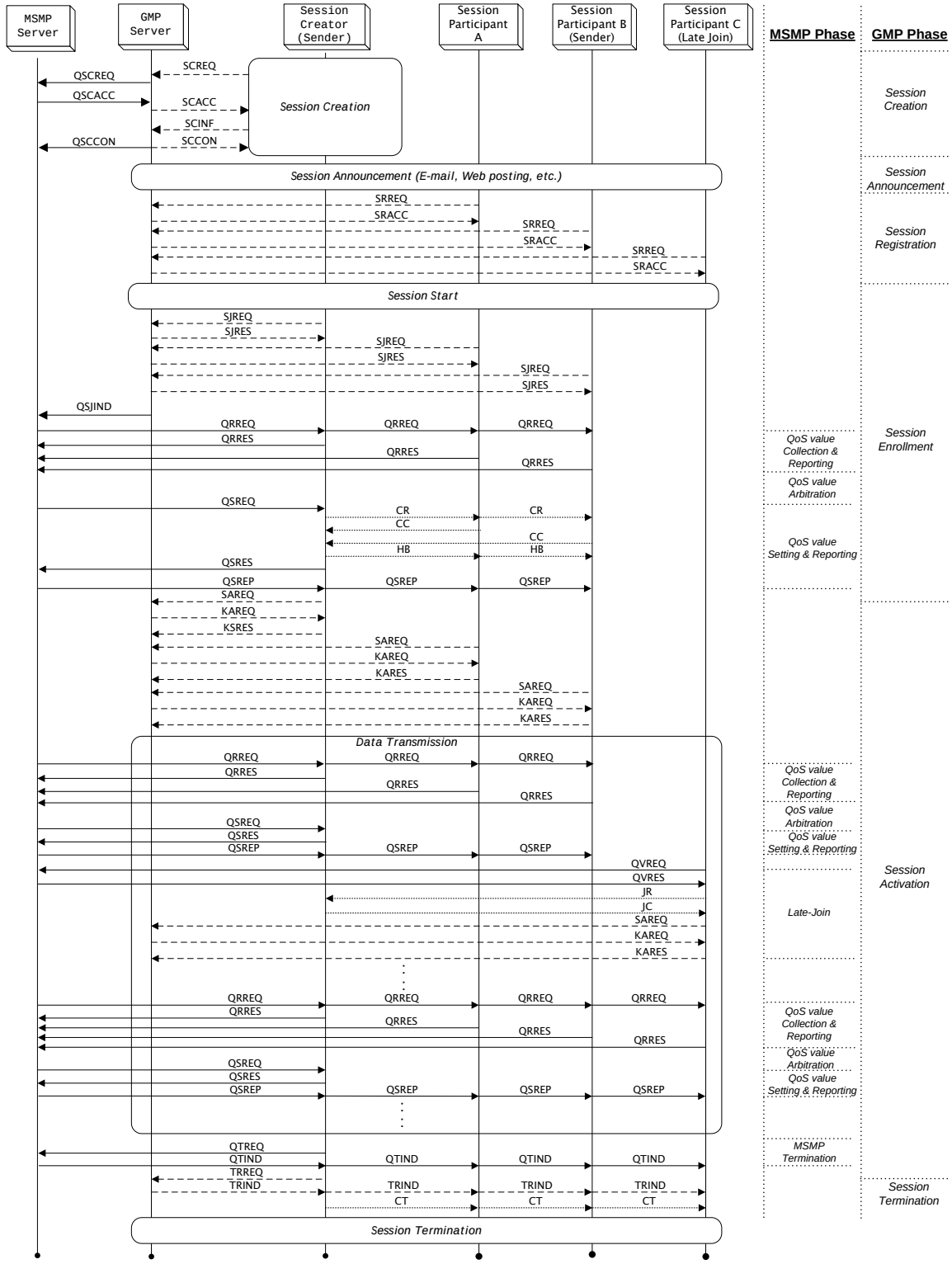


Figure A.1 – Relationship between MSMP, GMP, and ECTP

Appendix B. Messages exchange between MSMP server and GMP server

B.1 Introduction

This annex summarizes the messages exchange between MSMP server and GMP server.

The MSMP will give an API to the GMP to exchange the session information and the membership information. Figure B.1 shows the MSMP control protocol together with the legacy multicast application and Group Management Protocol, or GMP. The GMP server provides the MSMP server with the session information and the membership information. Based on the information, the MSMP server provides the QoS management to the participants in the session.

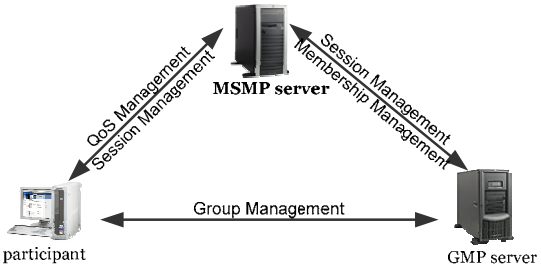


Figure B.1 – Protocol model

B.2 Messages between MSMP server and GMP sever

To support information exchange between the MSMP server and the GMP server, the MSMP should have four message types such as QoS Session Creation Request message, QoS Session Creation Acceptance message, QoS Session Creation Confirm message, and QoS Session Join Indication message. Figure B.2 shows the messages exchange between the MSMP server and GMP server.

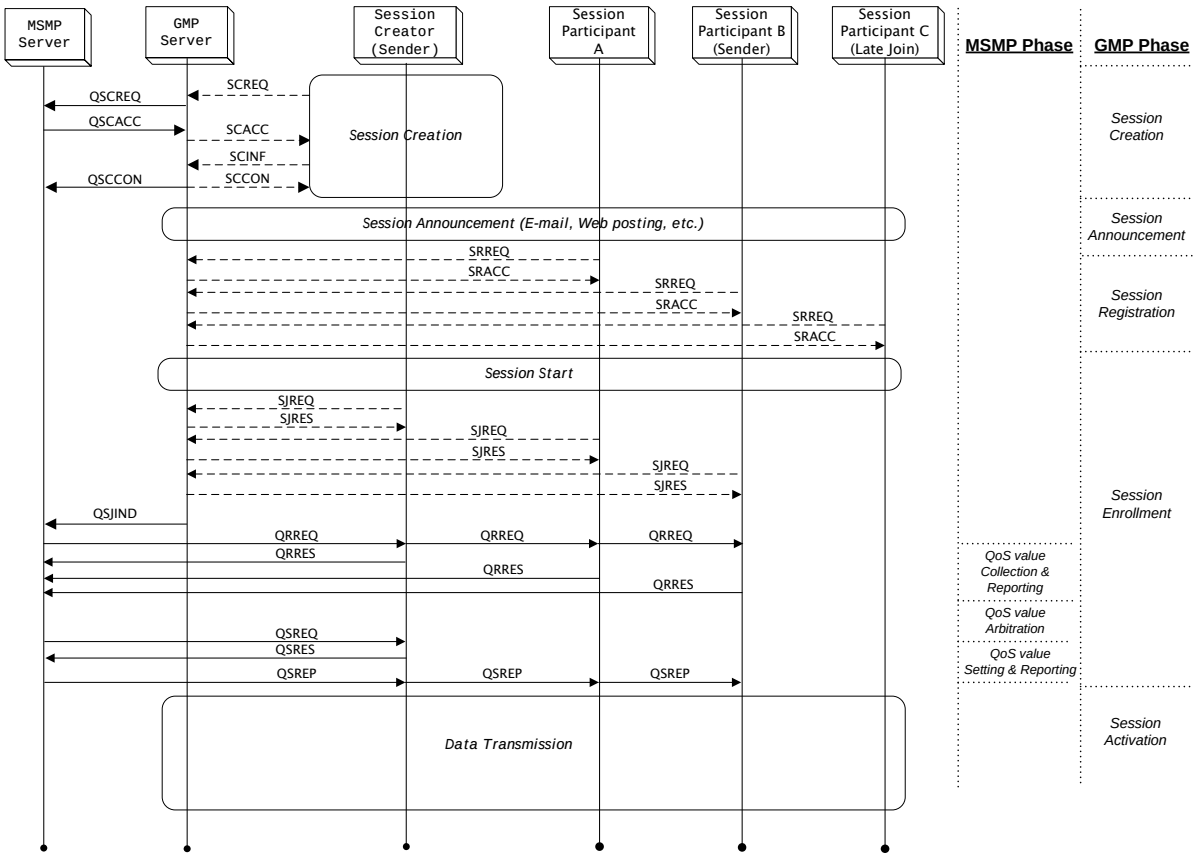


Figure B.2 – Messages exchange between the MSMP server and GMP server

B.2.1 Messages in session creation phase

In Figure B.3 the session creator sends the GMP server a Session Creation Request message, SCREQ to create the new session. SCREQ includes QoS parameter values for a session.

The GMP server sends the MSMP server a QoS Session Creation Request message, QSCREQ, which includes session creation information and QoS parameter values for a session. QSCREQ is to ask whether the QoS parameter values are available or not for a session creation.

Considering the network environment and its application, the MSMP server may allow the request from the GMP server by replying with a QoS Session Creation Acceptance message, QSCACC.

After receiving QSCACC, if the session creation is possible, the GMP server sends the session creator a Session Creation Acceptance message, SCACC. Then, the Session Creator will send the GMP server detailed session information in a Session Creation Information message, SCINF, which may include media type, application type, etc.

The GMP server will acknowledge successful session creation with a Session Creation Confirm message, SCCON, to the session creator and then the GMP server sends the MSMP server a QoS Session Creation Confirm message, QSCCON. By receiving QSCCON, the MSMP server can know session information such session ID, a multicast address, and a multicast port number for a session.

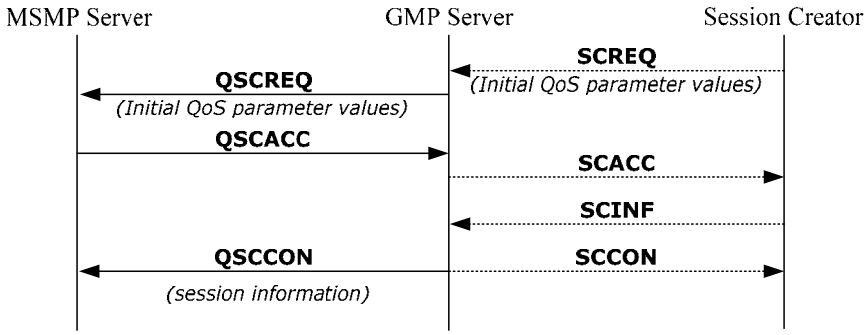


Figure B.3 – Message in Session Creation

B. 2.2 Message in session enrollment phase

After receiving SJRES from the session creator and the session participants, the GMP server sends the MSMP server a QoS Session Join Indication message, QSJIND to inform the MSMP server of the session enrolled state.

After receiving QSJIND from the GMP server, the MSMP server will start the QoS management via a QoS Reporting Request message.

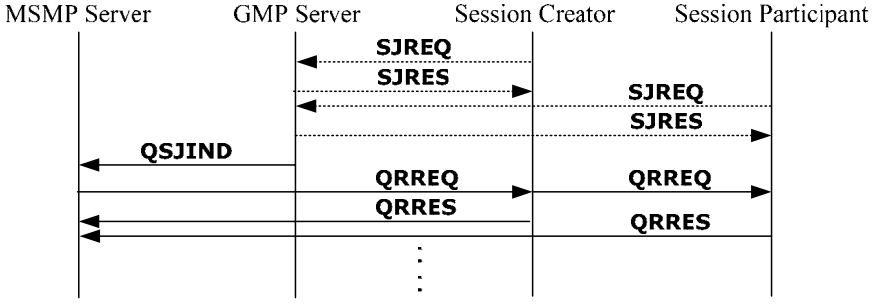


Figure B.4 – Message in Session Enrollment

B.3 Messages

B.3.1 Message types

Table B.1 summarizes the messages and their descriptions used in MSMP and GMP

Table B.1 – Message Types between MSMP and GMP

Message Type	Generated by :	Description
QSCREQ	GMP Server	QoS Session Creation Request message
QSCACC	MSMP Server	QoS Session Creation Acceptance message
QSCCON	GMP Server	QoS Session Creation Confirm message
QSJIND	GMP Server	QoS Session Join Indication message

a) QSCREQ: The GMP generates this message. This message includes the initial QoS parameter values for a new session. QSCREQ is to ask whether the QoS parameter values are available or not for a session creation.

b) QSCACC: The MSMP generates this message and sends it to the GMP server to indicate that the QoS parameter values are available for a session creation

c) QSCCON: The GMP generates this message and sends it to the MSMP server with session information such as a session ID, a multicast address, a port number and so on.

d) QSJIND: The GMP generates this message. The message is to let the MSMP server start the QoS management.

B.3.2 Message format

Figure B.5 shows the format of the message.

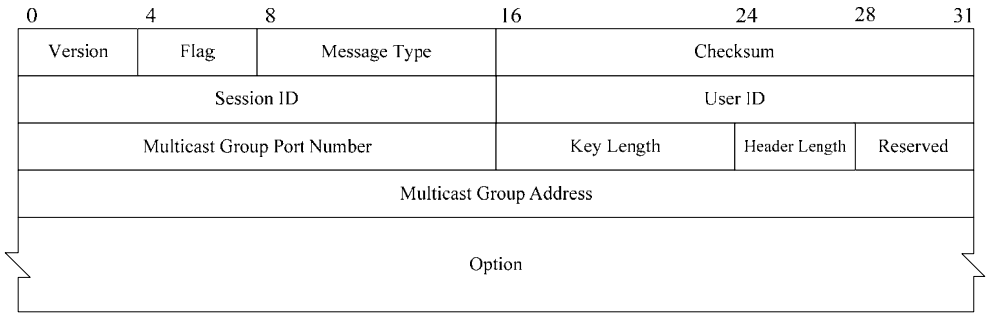
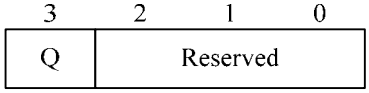


Figure B.5 – Message format

The message header contains the following information:

a) Version (4 bits) – Defines the current version. It starts at ‘1’.

b) Flag (4 bits) – flag bits. Depending on the message types, it has a different purpose. Encoding of this byte is depicted in the following figure.



- Q: Indicates whether the mode is QoS or non-QoS.
  QoS mode : ‘Q=1’ Non-QoS mode : ‘Q=0’
- Reserved: Reserved for future use.

c) Message Type (8 bits) – Indicates the type of message. Table B.2 summarizes the message types and encodings.

Table B.2 – Encoding Table of Message Types

Message Type	**Encoding**
QSCREQ	0001 0001
QSCACC	0001 0010
QSCCON	0001 0011
QSJIND	0001 0100

d) Checksum (16 bits) – Check the segment validity of the message.

e) Session ID (16 bits) – Identifies each session.

f) User ID (16 bits) – Identifies each session participant. The ID for Session Creator and other participants will be assigned by the GMP server at creation phase and registration phase, respectively.

g) Key Length (8 bits) – Key Length values in units of 8 bits

h) Header Length (4 bits) – Length of header in 32-bit words. The minimum value is four, for a minimum header length of 16 octets

i) Reserved (4 bits) – Reserved for future use

j) Multicast Group Port Number (16 bits) – Port number for multicast group communication

k) Multicast Group Address (32 bits) – Multicast group address

l) Option (32 bits × 3)

- This field will be attached to the QSCREQ message if 'Q flag' bit is set to '1'. Figure B.6 shows the format of the option field in QoS Management.

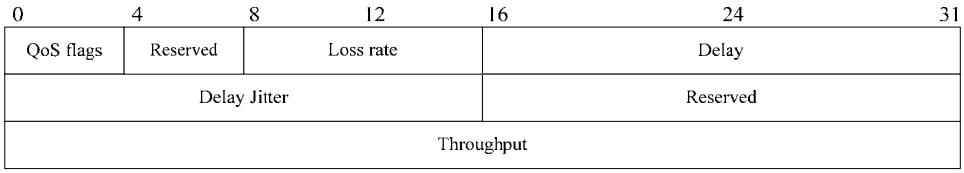
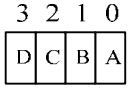


Figure B.6 – Option Field in Message

- QoS flags (4 bits) – is a flag byte to specify if the QoS parameters are used in the QoS management session. Encoding of this byte is depicted in the following figure.



5) A – throughput;

6) B – transit delay;

7) C – transit delay jitter;

8) D – data loss rate;