

Diameter Maintenance and Extensions (DIME)
Internet-Draft
Intended status: Standards Track
Expires: September 14, 2017

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March 13, 2017

Diameter Group Signaling
draft-ietf-dime-group-signaling-08.txt

Abstract

In large network deployments, a single Diameter node can support over a million concurrent Diameter sessions. Recent use cases have revealed the need for Diameter nodes to apply the same operation to a large group of Diameter sessions concurrently. The Diameter base protocol commands operate on a single session so these use cases could result in many thousands of command exchanges to enforce the same operation on each session in the group. In order to reduce signaling, it would be desirable to enable bulk operations on all (or part of) the sessions managed by a Diameter node using a single or a few command exchanges. This document specifies the Diameter protocol extensions to achieve this signaling optimization.

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1. Introduction

In large network deployments, a single Diameter node can support over a million concurrent Diameter sessions. Recent use cases have revealed the need for Diameter nodes to apply the same operation to a large group of Diameter sessions concurrently. For example, a policy decision point may need to modify the authorized quality of service for all active users having the same type of subscription. The Diameter base protocol commands operate on a single session so these use cases could result in many thousands of command exchanges to enforce the same operation on each session in the group. In order to reduce signaling, it would be desirable to enable bulk operations on all (or part of) the sessions managed by a Diameter node using a single or a few command exchanges.

This document describes mechanisms for grouping Diameter sessions and applying Diameter commands, such as performing re-authentication, re-authorization, termination and abortion of sessions to a group of sessions. This document does not define a new Diameter application. Instead it defines mechanisms, commands and AVPs that may be used by any Diameter application that requires management of groups of sessions.

These mechanisms take the following design goals and features into account:

- o Minimal impact to existing applications
- o Extension of existing commands' Command Code Format (CCF) with optional AVPs to enable grouping and group operations
- o Fallback to single session operation
- o Implicit discovery of capability to support grouping and group operations in case no external mechanism is available to discover a Diameter peer's capability to support session grouping and session group operations

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

This document uses terminology defined in [RFC6733].

3. Protocol Overview

3.1. Building and Modifying Session Groups

Client and Server can assign a new Diameter session to a group, e.g. in case the subscription profile of the associated user has similar characteristics as the profile of other users whose Diameter session has been assigned to one or multiple groups. A single command can be issued and applied to all sessions associated with such group(s), e.g. to adjust common profile or policy settings.

The assignment of a Diameter session to a group can be changed mid-session. For example, if a user's subscription profile changes mid-session, a Diameter server may remove the session from its current group and assign the session to a different group that is more appropriate for the new subscription profile.

In case of mobile users, the user's session may get transferred to a new Diameter client during handover and assigned to a different group, which is maintained at the new Diameter client, mid-session.

A session group, which has sessions assigned, can be deleted, e.g. due to a change in multiple users' subscription profile so that the group's assigned sessions do not share certain characteristics anymore. Deletion of such group requires subsequent individual treatment of each of the assigned sessions. A node may decide to assign some of these sessions to any other existing or new group.

3.2. Issuing Group Commands

Changes in the network condition may result in the Diameter server's decision to close all sessions in a given group. The server issues a single Session Termination Request (STR) command, identifying the group of sessions which are to be terminated. The Diameter client treats the STR as group command and initiates termination of all sessions associated with the identified group. Subsequently, the client confirms successful termination of these sessions to the server by sending a single Session Termination Answer (STA) command, which includes the identifier of the group.

3.3. Permission Considerations

Permission considerations in the context of this draft apply to the permission of Diameter nodes to build new session groups, to assign/remove a session to/from a session group and to delete an existing session group.

This specification follows the most flexible model where both, a Diameter client and a Diameter server can create a new group and assign a new identifier to that session group. When a Diameter node decides to create a new session group, e.g. to group all sessions which share certain characteristics, the node builds a session group identifier according to the rules described in Section 7.3 and becomes the owner of the group. This specification does not constrain the permission to add or remove a session to/from a session group to the group owner, instead each node can add a session to any known group or remove a session from a group. A session group is deleted and its identifier released after the last session has been removed from the session group. Also the modification of groups in terms of moving a session from one session group to a different session group is permitted to any Diameter node. A Diameter node can delete a session group and its group identifier mid-session, resulting in individual treatment of the sessions which have been previously assigned to the deleted group. Prerequisite for deletion of a session group is that the Diameter node created the session beforehand, hence the node became the group owner.

The enforcement of more constrained permissions is left to the specification of a particular group signaling enabled Diameter application and compliant implementations of such application MUST enforce the associated permission model. Details about enforcing a more constraint permission model are out of scope of this specification. For example, a more constrained model could require that a client MUST NOT remove a session from a group which is owned by the server.

The following table depicts the permission considerations as per the present specification:

Operation	Server	Client
Create a new Session Group (Diameter node becomes the group owner)	X	X
Assign a Session to an owned Session Group	X	X
Assign a Session to a non-owned Session Group	X	X
Remove a Session from an owned Session Group	X	X
Remove a Session from a non-owned Session Group	X	X
Remove a Session from a Session Group where the Diameter node created the assignment	X	X
Remove a Session from a Session Group where a different Diameter node created the assignment		
Overrule a different Diameter node's group assignment *)		
Delete a Session Group which is owned by the Diameter node	X	X
Delete a Session Group which is not owned by the Diameter node		

Default Permission as per this Specification

*) Editors' note: The protocol specification in this document does not consider overruling a node's assignment of a session to a session group. Here, overruling is to be understood as a node changing the group(s) assignment as per the node's request. Group signaling enabled applications may take such protocol support and associated protocol semantics into account in their specification. One exception is adopted in this specification, which allows a Diameter server to reject a group assignment as per the client's request.

4. Protocol Description

4.1. Session Grouping Capability Discovery

Diameter nodes SHOULD assign a session to a session group and perform session group operations with a node only after having ensured that the node announced associated support beforehand.

4.1.1. Explicit Capability Discovery

New Diameter applications may consider support for Diameter session grouping and for performing group commands during the standardization process. Such applications provide intrinsic discovery for the support of group commands and announce this capability through the assigned application ID.

System- and deployment-specific means, as well as out-of-band mechanisms for capability exchange can be used to announce nodes' support for session grouping and session group operations. In such case, the optional Session-Group-Capability-Vector AVP, as described in Section 4.1.2 can be omitted in Diameter messages being exchanged between nodes.

4.1.2. Implicit Capability Discovery

If no explicit mechanism for capability discovery is deployed to enable Diameter nodes to learn about nodes' capability to support session grouping and group commands, a Diameter node SHOULD append the Session-Group-Capability-Vector AVP to any Diameter messages exchanged with its nodes to announce its capability to support session grouping and session group operations. Implementations following the specification as per this document set the BASE_SESSION_GROUP_CAPABILITY flag of the Session-Group-Capability-Vector AVP.

When a Diameter node receives at least one Session-Group-Capability-Vector AVP from a node with the BASE_SESSION_GROUP_CAPABILITY flag set, the Diameter node maintains a log to remember the node's capability to support group commands.

4.2. Session Grouping

This specification does not limit the number of session groups, to which a single session is assigned. It is left to the application to determine the policy of session grouping. In case an application facilitates a session to belong to multiple session groups, the application MUST maintain consistency of associated application session states for these multiple session groups.

Either Diameter node (client or server) can initiate the assignment of a session to a single or multiple session groups. Modification of a group by removing or adding a single or multiple user sessions can be initiated and performed mid-session by either Diameter node. Diameter AAA applications typically assign client and server roles to the Diameter nodes, which are referred to as relevant Diameter nodes to utilize session grouping and issue group commands. Section 5 describes particularities about session grouping and performing group commands when relay agents or proxies are deployed.

Diameter nodes, which are group-aware, MUST store and maintain an entry about the group assignment together with a session's state. A list of all known session groups should be locally maintained on each node, each group pointing to individual sessions being assigned to the group. A Diameter node MUST also keep a record about sessions, which have been assigned to a session group by itself.

4.2.1. Group assignment at session initiation

To assign a session to a group at session initiation, a Diameter client sends a service specific request, e.g. NASREQ AA-Request [RFC4005], containing one or more session group identifiers. Each of these groups MUST be identified by a unique Session-Group-Id contained in a separate Session-Group-Info AVP as specified in Section 7.

The client may choose one or multiple session groups from a list of existing session groups. Alternatively, the client may decide to create a new group to which the session is assigned and identify itself in the <DiameterIdentity> portion of the Session-Group-Id AVP as per Section 7.3

The client MUST set the SESSION_GROUP_ALLOCATION_ACTION flag of the Session-Group-Control-Vector AVP in each appended Session-Group-Info AVP to indicate that the session contained in the request should be assigned to the identified session group.

The client may also indicate in the request that the server is responsible for the assignment of the session in one or multiple sessions owned by the server. In such a case, the client MUST include the Session-Group-Info AVP in the request including the Session-Group-Control-Vector AVP with the SESSION_GROUP_ALLOCATION_ACTION flag set but no Session-Group-Id AVP.

If the Diameter server receives a command request from a Diameter client and the command comprises at least one Session-Group-Info AVP having the SESSION_GROUP_ALLOCATION_ACTION flag in the Session-Group-Control-Vector AVP set, the server can accept or reject the request

for group assignment. Reasons for rejection may be e.g. lack of resources for managing additional groups. When rejected, the session MUST NOT be assigned to any session group.

If the Diameter server accepts the client's request for a group assignment, the server MUST assign the new session to each of the one or multiple identified session groups when present in the Session-Group-Info AVP. In case one or multiple identified session groups are not already stored by the server, the server MUST store the new identified group(s) to its local list of known session groups. When sending the response to the client, e.g. a service-specific auth response as per NASREQ AA-Answer [RFC4005], the server MUST include all Session-Group-Info AVPs as received in the client's request.

In addition to the one or multiple session groups identified in the client's request, the server may decide to assign the new session to one or multiple additional groups. In such a case, the server MUST add to the response the additional Session-Group-Info AVPs, each identifying a session group to which the new session is assigned by the server. Each of the Session-Group-Info AVP added by the server MUST have the SESSION_GROUP_ALLOCATION_ACTION flag set in the Session-Group-Control-Vector AVP set.

If the Diameter server rejects the client's request for a group assignment, the server sends the response to the client, e.g. a service-specific auth response as per NASREQ AA-Answer [RFC4005], and MUST include all Session-Group-Info AVPs as received in the client's request (if any) while clearing the SESSION_GROUP_ALLOCATION_ACTION flag of the Session-Group-Control-Vector AVP. The server MAY accept the client's request for the identified session but refuse the session's assignment to any session group. The server sends the response to the client indicating success in the result code. In such case the session is treated as single session without assignment to any session group by the Diameter nodes.

If the Diameter server accepts the client's request for a group assignment, but the assignment of the session to one or some of the multiple identified session groups fails, the session group assignment is treated as failure. In such case the session is treated as single session without assignment to any session group by the Diameter nodes. The server sends the response to the client and MAY include as information to the client only those Session-Group-Info AVPs for which the group assignment failed. The SESSION_GROUP_ALLOCATION_ACTION flag of included Session-Group-Info AVPs MUST be cleared.

If the Diameter server receives a command request from a Diameter client and the command comprises one or multiple Session-Group-Info

AVPs and none of them includes a Session-Group-Id AVP, the server MAY decide to assign the session to one or multiple session groups. For each session group, to which the server assigns the new session, the server includes a Session-Group-Info AVP with the Session-Group-Id AVP identifying a session group in the response sent to the client. Each of the Session-Group-Info AVPs included by the server MUST have the SESSION_GROUP_ALLOCATION_ACTION flag of the Session-Group-Control-Vector AVP set.

If the Diameter server receives a command request from a Diameter client and the command does not contain any Session-Group-Info AVP, the server MUST NOT assign the new session to any session group but treat the request as for a single session. The server MUST NOT return any Session-Group-Info AVP in the command response.

If the Diameter client receives a response to its previously issued request from the server and the response comprises at least one Session-Group-Info AVP having the SESSION_GROUP_ALLOCATION_ACTION flag of the associated Session-Group-Control-Vector AVP set, the client MUST add the new session to all session groups as identified in the one or multiple Session-Group-Info AVPs. If the Diameter client fails to add the session to one or more session groups as identified in the one or multiple Session-Group-Info AVPs, the client MUST terminate the session. The client MAY send a subsequent request for session initiation to the server without requesting the assignment of the session to a session group

If the Diameter client receives a response to its previously issued request from the server and the one or more Session-Group-Info AVPs have the SESSION_GROUP_ALLOCATION_ACTION flag of the associated Session-Group-Control-Vector AVP cleared, the client MUST terminate the assignment of the session to the one or multiple groups. If the response from the server indicates success in the result code but solely the assignment of the session to a session group has been rejected by the server, the client treats the session as single session without group assignment.

A Diameter client, which sent a request for session initiation to a Diameter server and appended a single or multiple Session-Group-Id AVPs but cannot find any Session-Group-Info AVP in the associated response from the Diameter server proceeds as if the request was processed for a single session. When the Diameter client is confident that the Diameter server supports session grouping and group signaling, the Diameter client SHOULD NOT retry to request group assignment for this session, but MAY try to request group assignment for other new sessions.

4.2.2. Removing a session from a session group

When a Diameter client decides to remove a session from a particular session group, the client sends a service-specific re-authorization request to the server and adds one Session-Group-Info AVP to the request for each session group, from which the client wants to remove the session. The session, which is to be removed from a group, is identified in the Session-Id AVP of the command request. The `SESSION_GROUP_ALLOCATION_ACTION` flag of the Session-Group-Control-Vector AVP in each Session-Group-Info AVP MUST be cleared to indicate removal of the session from the session group identified in the associated Session-Group-id AVP.

When a Diameter client decides to remove a session from all session groups, to which the session has been previously assigned, the client sends a service-specific re-authorization request to the server and adds a single Session-Group-Info AVP to the request which has the `SESSION_GROUP_ALLOCATION_ACTION` flag cleared and the Session-Group-Id AVP omitted. The session, which is to be removed from all groups, to which the session has been previously assigned, is identified in the Session-Id AVP of the command request.

If the Diameter server receives a request from the client which has at least one Session-Group-Info AVP appended with the `SESSION_GROUP_ALLOCATION_ACTION` flag cleared, the server MUST remove the session from the session group identified in the associated Session-Group-Id AVP. If the request comprises at least one Session-Group-info AVP with the `SESSION_GROUP_ALLOCATION_ACTION` flag cleared and no Session-Id AVP present, the server MUST remove the session from all session groups to which the session has been previously assigned. The server MUST include in its response to the requesting client all Session-Group-Id AVPs as received in the request.

When the Diameter server decides to remove a session from one or multiple particular session groups or from all session groups to which the session has been assigned beforehand, the server sends a Re-Authorization Request (RAR) or a service-specific server-initiated request to the client, indicating the session in the Session-Id AVP of the request. The client sends a Re-Authorization Answer (RAA) or a service-specific answer to respond to the server's request. The client subsequently sends service-specific re-authorization request containing one or multiple Session-Group-Info AVPs, each indicating a session group, to which the session had been previously assigned. To indicate removal of the indicated session from one or multiple session groups, the server sends a service-specific auth response to the client, containing a list of Session-Group-Info AVPs with the `SESSION_GROUP_ALLOCATION_ACTION` flag cleared and the Session-Group-Id AVP identifying the session group, from which the session should be

removed. The server MAY include to the service-specific auth response a list of Session-Group-Info AVPs with the SESSION_GROUP_ALLOCATION_ACTION flag set and the Session-Group-Id AVP identifying session groups to which the session remains subscribed. In case the server decides to remove the identified session from all session groups, to which the session has been previously assigned, the server includes in the service-specific auth response at least one Session-Group-Info AVP with the SESSION_GROUP_ALLOCATION_ACTION flag cleared and Session-Group-Id AVP absent.

4.2.3. Mid-session group assignment modifications

Either Diameter node (client or server) can modify the group membership of an active Diameter session according to the specified permission considerations.

To update an assigned group mid-session, a Diameter client sends a service-specific re-authorization request to the server, containing one or multiple Session-Group-Info AVPs with the SESSION_GROUP_ALLOCATION_ACTION flag set and the Session-Group-Id AVP present, identifying the session group to which the session should be assigned. With the same message, the client may send one or multiple Session-Group-Info AVP with the SESSION_GROUP_ALLOCATION_ACTION flag cleared and the Session-Group-Id AVP identifying the session group from which the identified session is to be removed. To remove the session from all previously assigned session groups, the client includes at least one Session-Group-Info AVP with the SESSION_GROUP_ALLOCATION_ACTION flag cleared and no Session-Group-Id AVP present. When the server received the service-specific re-authorization request, it MUST update its locally maintained view of the session groups for the identified session according to the appended Session-Group-Info AVPs. The server sends a service-specific auth response to the client containing one or multiple Session-Group-Info AVPs with the SESSION_GROUP_ALLOCATION_ACTION flag set and the Session-Group-Id AVP identifying the new session group to which the identified session has been assigned.

When a Diameter server enforces an update to the assigned groups mid-session, it sends a Re-Authorization Request (RAR) message to the client identifying the session, for which the session group lists are to be updated. The client responds with a Re-Authorization Answer (RAA) message. The client subsequently sends a service-specific re-authorization request containing one or multiple Session-Group-Info AVPs with the SESSION_GROUP_ALLOCATION_ACTION flag set and the Session-Group-Id AVP identifying the session group to which the session had been previously assigned. The server responds with a service-specific auth response and includes one or multiple Session-Group-Info AVP with the SESSION_GROUP_ALLOCATION_ACTION flag set and

the Session-Group-Id AVP identifying the session group, to which the identified session is to be assigned. With the same response message, the server may send one or multiple Session-Group-Info AVPs with the SESSION_GROUP_ALLOCATION_ACTION flag cleared and the Session-Group-Id AVP identifying the session groups from which the identified session is to be removed. When server wants to remove the session from all previously assigned session groups, it sends at least one Session-Group-Info AVP with the response having the SESSION_GROUP_ALLOCATION_ACTION flag cleared and no Session-Group-Id AVP present.

4.3. Deleting a Session Group

To delete a session group and release the associated Session-Group-Id value, the owner of a session group appends a single Session-Group-Info AVP having the SESSION_GROUP_STATUS_IND flag cleared and the Session-Group-Id AVP identifying the session group, which is to be deleted. The SESSION_GROUP_ALLOCATION_ACTION flag of the associated Session-Group-Control-Vector AVP MUST be cleared.

4.4. Performing Group Operations

4.4.1. Sending Group Commands

Either Diameter node (client or server) can request the recipient of a request to process an associated command for all sessions being assigned to one or multiple groups by identifying these groups in the request. The sender of the request appends for each group, to which the command applies, a Session-Group-Info AVP including the Session-Group-Id AVP to identify the associated session group. Both, the SESSION_GROUP_ALLOCATION_ACTION flag as well as the SESSION_GROUP_STATUS_IND flag MUST be set.

If the CCF of the request mandates a Session-Id AVP, the Session-Id AVP MUST identify one of the single sessions which is assigned to at least one of the groups being identified in the appended Session-Group-Id AVPs.

The sender of the request MUST indicate to the receiver how follow up message exchanges should be performed by appending a single instance of the Group-Response-Action AVP. Even if the request includes multiple instances of a Session-Group-Info AVP, the request MUST NOT comprise more than a single instance of a Group-Response-Action AVP. If the sender wants the receiver to perform follow up exchanges with a single command for all impacted groups, the sender sets the value of the Group-Response-Action AVP to ALL_GROUPS (1). If follow up message exchanges should be performed on a per-group basis in case multiple groups are identified in the group command, the value of the

Group-Response-Action AVP is set to PER_GROUP (2). A value set to PER_SESSION (3) indicates to the receiver that all follow up exchanges should be performed using a single message for each impacted session.

If the sender sends a request including the Group-Response-Action AVP set to ALL_GROUPS (1) or PER_GROUP (2), it MUST expect some delay before receiving the corresponding answer(s) as the answer(s) will only be sent back when the request is processed for all the sessions or all the session of a session group. If the process of the request is delay-sensitive, the sender SHOULD NOT set the Group-Response-Action AVP to ALL_GROUPS (1) or PER_GROUP (2). If the answer can be sent before the complete process of the request for all the sessions or if the request timeout timer is high enough, the sender MAY set the Group-Response-Action AVP to ALL_GROUPS (1) or PER_GROUP (2).

If the sender wants the receiver of the request to process the associated command solely for a single session, the sender does not append any group identifier, but identifies the relevant session in the Session-Id AVP.

4.4.2. Receiving Group Commands

A Diameter node receiving a request to process a command for a group of sessions, identifies the relevant groups according to the appended Session-Group-Id AVP in the Session-Group-Info AVP and processes the group command according to the appended Group-Response-Action AVP . If the received request identifies multiple groups in multiple appended Session-Group-Id AVPs, the receiver SHOULD process the associated command for each of these groups. If a session has been assigned to more than one of the identified groups, the receiver MUST process the associated command only once per session.

4.4.3. Error Handling for Group Commands

When a Diameter node receives a request to process a command for one or more session groups and the result of processing the command is an error that applies to all sessions in the identified groups, an associated protocol error MUST be returned to the source of the request. In such case, the sender of the request MUST fall back to single-session processing and the session groups, which have been identified in the group command, MUST be deleted according to the procedure described in Section 4.3.

When a Diameter node receives a request to process a command for one or more session groups and the result of processing the command succeeds for some sessions identified in one or multiple session groups, but fails for one or more sessions, the Result-Code AVP in

the response message SHOULD indicate `DIAMETER_LIMITED_SUCCESS` as per Section 7.1.2 of [RFC6733].

In case of limited success, the sessions, for which the processing of the group command failed, MUST be identified using a Failed-AVP AVP as per Section 7.5 of [RFC6733]. The sender of the request MUST fall back to single-session operation for each of the identified sessions, for which the group command failed. In addition, each of these sessions MUST be removed from all session groups to which the group command applied. To remove sessions from a session group, the Diameter client performs the procedure described in Section 4.2.2.

4.4.4. Single-Session Fallback

Either Diameter node can fall back to single session operation by ignoring and omitting the optional group session-specific AVPs. Fallback to single-session operation is performed by processing the Diameter command solely for the session identified in the mandatory Session-Id AVP. In such case, the response to the group command MUST NOT identify any group but identify solely the single session for which the command has been processed.

5. Operation with Proxy Agents

In case of a present stateful Proxy Agent between a Diameter client and a Diameter server, this specification assumes that the Proxy Agent is aware of session groups and session group handling. The Proxy MUST update and maintain consistency of its local session states as per the result of the group commands which are operated between a Diameter client and a server. In such case, the Proxy Agent MUST act as a Diameter server in front of the Diameter client and MUST act as a Diameter client in front of the Diameter server. Therefore, the client and server behavior described in Section 4 applies respectively to the stateful Proxy Agent.

In case a stateful Proxy Agent manipulates session groups, it MUST maintain consistency of session groups between a client and a server. This applies to a deployment where the Proxy Agent utilizes session grouping and performs group operations with, for example, a Diameter server, whereas the Diameter client is not aware of session groups. In such case the Proxy Agent must reflect the states associated with the session groups as individual session operations towards the client and ensure the client has a consistent view of each session. The same applies to a deployment where all nodes, the Diameter client and server, as well as the Proxy Agent are group-aware but the Proxy Agent manipulates groups, e.g. to adopt different administrative policies that apply to the client's domain and the server's domain.

Stateless Proxy Agents do not maintain any session state (only transaction state are maintained). Consequently, the notion of session group is transparent for any stateless Proxy Agent present between a Diameter client and a Diameter server handling session groups. Session group related AVPs being defined as optional AVP SHOULD be ignored by stateless Proxy Agents and SHOULD NOT be removed from the Diameter commands. If they are removed by the Proxy Agent for any reason, the Diameter client and Diameter server will discover the absence the related session group AVPs and will fall back to single-session processing, as described in Section 4.

6. Commands Formatting

This document does not specify new Diameter commands to enable group operations, but relies on command extensibility capability provided by the Diameter Base protocol. This section provides the guidelines to extend the CCF of existing Diameter commands with optional AVPs to enable the recipient of the command applying the command to all sessions associated with the identified group(s).

6.1. Formatting Example: Group Re-Auth-Request

A request for re-authentication of one or more groups of users is issued by appending one or multiple Session-Group-Id AVP(s), as well as a single instance of a Group-Response-Action AVP to the Re-Auth-Request (RAR). The one or multiple Session-Group-Id AVP(s) identify the associated group(s) for which the group re-authentication has been requested. The Group-Response-Action AVP identifies the expected means to perform and respond to the group command. The recipient of the group command initiates re-authentication for all users associated with the identified group(s). Furthermore, the sender of the group re-authentication request appends a Group-Response-Action AVP to provide more information to the receiver of the command about how to accomplish the group operation.

The value of the mandatory Session-Id AVP MUST identify a session associated with a single user, which is assigned to at least one of the groups being identified in the appended Session-Group-Id AVPs.

```

<RAR> ::= < Diameter Header: 258, REQ, PXY >
        < Session-Id >
        { Origin-Host }
        { Origin-Realm }
        { Destination-Realm }
        { Destination-Host }
        { Auth-Application-Id }
        { Re-Auth-Request-Type }
        [ User-Name ]
        [ Origin-State-Id ]
        * [ Proxy-Info ]
        * [ Route-Record ]
        [ Session-Group-Capability-Vector ]
        * [ Session-Group-Info ]
        [ Group-Response-Action ]
        * [ AVP ]
    
```

7. Attribute-Value-Pairs (AVP)

Attribute Name	AVP Code	Value Type	AVP Flag rules			
			MUST	MAY	SHOULD NOT	MUST NOT
Session-Group-Info	TBD1	Grouped		P		V
Session-Group-Control-Vector	TBD2	Unsigned32		P		V
Session-Group-Id	TBD3	OctetString		P		V
Group-Response-Action	TBD4	Unsigned32		P		V
Session-Group-Capability-Vector	TBD5	Unsigned32		P		V

AVPs for the Diameter Group Signaling

7.1. Session-Group-Info AVP

The Session-Group-Info AVP (AVP Code TBD1) is of type Grouped. It contains the identifier of the session group as well as an indication of the node responsible for session group identifier assignment.

```

Session-Group-Info ::= < AVP Header: TBD1 >
                        < Session-Group-Control-Vector >
                        [ Session-Group-Id ]
                        * [ AVP ]
    
```

7.2. Session-Group-Control-Vector AVP

The Session-Group-Control-Vector AVP (AVP Code TBD2) is of type Unsigned32 and contains a 32-bit flags field to control the group assignment at session-group aware nodes.

The following capabilities are defined in this document:

`SESSION_GROUP_ALLOCATION_ACTION (0x00000001)`

This flag indicates the action to be performed for the identified session. When this flag is set, it indicates that the identified Diameter session is to be assigned to the session group as identified by the Session-Group-Id AVP or the session's assignment to the session group identified in the Session-Group-Id AVP is still valid. When the flag is cleared, the identified Diameter session is to be removed from at least one session group. When the flag is cleared and the Session-Group-Info AVP identifies a particular session group in the associated Session-Group-Id AVP, the session is to be removed solely from the identified session group. When the flag is cleared and the Session-Group-Info AVP does not identify a particular session group (Session-Group-Id AVP is absent), the identified Diameter session is to be removed from all session groups, to which it has been previously assigned.

`SESSION_GROUP_STATUS_IND (0x00000010)`

This flag indicates the status of the session group identified in the associated Session-Group-Id AVP. The flag is set when the identified session group has just been created or is still active. If the flag is cleared, the identified session group is deleted and the associated Session-Group-Id is released. If the Session-Group-Info AVP does not comprise a Session-Group-Id AVP, this flag is meaningless and MUST be ignored by the receiver.

7.3. Session-Group-Id AVP

The Session-Group-Id AVP (AVP Code TBD3) is of type UTF8String and identifies a group of Diameter sessions.

The Session-Group-Id MUST be globally and eternally unique, as it is meant to uniquely identify a group of Diameter sessions without reference to any other information.

The default format of the Session-Group-id MUST comply to the format recommended for a Session-Id, as defined in the section 8.8 of the [RFC6733]. The <DiameterIdentity> portion of the Session-Group-Id MUST identify the Diameter node, which owns the session group.

7.4. Group-Response-Action AVP

The Group-Response-Action AVP (AVP Code TBD4) is of type Unsigned32 and contains a 32-bit address space representing values indicating how the node SHOULD issue follow up exchanges in response to a command which impacts multiple sessions. The following values are defined by this application:

ALL_GROUPS (1)

Follow up exchanges should be performed with a single message exchange for all impacted groups.

PER_GROUP (2)

Follow up exchanges should be performed with a message exchange for each impacted group.

PER_SESSION (3)

Follow up exchanges should be performed with a message exchange for each impacted session.

7.5. Session-Group-Capability-Vector AVP

The Session-Group-Capability-Vector AVP (AVP Code TBD5) is of type Unsigned32 and contains a 32-bit flags field to indicate capabilities in the context of session-group assignment and group operations.

The following capabilities are defined in this document:

BASE_SESSION_GROUP_CAPABILITY (0x00000001)

This flag indicates the capability to support session grouping and session group operations according to this specification.

8. Result-Code AVP Values

This document does not define new Result-Code [RFC6733] values for existing applications, which are extended to support group commands. Specification documents of new applications, which will have intrinsic support for group commands, may specify new Result-Codes.

9. IANA Considerations

This section contains the namespaces that have either been created in this specification or had their values assigned to existing namespaces managed by IANA.

9.1. AVP Codes

This specification requires IANA to register the following new AVPs from the AVP Code namespace defined in [RFC6733].

- o Session-Group-Info
- o Session-Group-Control-Vector
- o Session-Group-Id
- o Group-Response-Action
- o Session-Group-Capability-Vector

The AVPs are defined in Section 7.

10. Security Considerations

The security considerations of the Diameter protocol itself are discussed in [RFC6733]. Use of the AVPs defined in this document MUST take into consideration the security issues and requirements of the Diameter base protocol. In particular, the Session-Group-Info AVP (including the Session-group-Control-Vector and the Session-Group-Id AVPs) should be considered as a security-sensitive AVPs in the same manner than the Session-Id AVP in the Diameter base protocol [RFC6733].

The management of session groups relies upon the existing trust relationship between the Diameter client and the Diameter server managing the groups of sessions. This document defines a mechanism that allows a client or a server to act on multiple sessions at the same time using only one command. if the Diameter client or server is compromised, an attacker could launch DoS attacks by terminating a large number of sessions with a limited set of commands using the session group management concept.

According to the Diameter base protocol [RFC6733], transport connections between Diameter peers are protected by TLS/TCP, DTLS/SCTP or alternative security mechanisms that are independent of Diameter, such as IPsec. However, the lack of end-to-end security features makes it difficult to establish trust in the session group related information received from non-adjacent nodes. Any Diameter agent in the message path can potentially modify the content of the message and therefore the information sent by the Diameter client or the server. The DIME working group is currently working on solutions for providing end-to-end security features. When available, these features should enable the establishment of trust relationship

between non-adjacent nodes and the security required for session group management would normally rely on this end-to-end security. However, there is no assumption in this document that such end-to-end security mechanism will be available. It is only assume that the solution defined on this document relies on the security framework provided by the Diameter based protocol.

In some cases, a Diameter Proxy agent can act on behalf of a client or server. In such a case, the security requirements that normally apply to a client (or a server) apply equally to the Proxy agent.

11. Acknowledgments

The authors of this document want to thank Ben Campbell and Eric McMurry for their valuable comments to early versions of this draft. Furthermore, authors thank Steve Donovan and Mark Bales for the thorough review and comments on advanced versions of the WG document, which helped a lot to improve this specification.

12. Normative References

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Appendix A. Session Management -- Exemplary Session State Machine

A.1. Use of groups for the Authorization Session State Machine

Section 8.1 in [RFC6733] defines a set of finite state machines, representing the life cycle of Diameter sessions, and which MUST be observed by all Diameter implementations that make use of the authentication and/or authorization portion of a Diameter application. This section defines, as example, additional state transitions related to the processing of the group commands which may impact multiple sessions.

The group membership is session state and therefore only those state machines from [RFC6733] in which the server is maintaining session state are relevant in this document. As in [RFC6733], the term Service-Specific below refers to a message defined in a Diameter application (e.g., Mobile IPv4, NASREQ).

The following state machine is observed by a client when state is maintained on the server. State transitions which are unmodified from [RFC6733] are not repeated here.

The Diameter group command in the following tables is differentiated from a single-session related command by a preceding 'G' (Group). A Group Re-Auth Request, which applies to one or multiple session groups, has been exemplarily described in Section 6.1. Such Group RAR command is denoted as 'GRAR' in the following table. The same notation applies to other commands as per [RFC6733].

CLIENT, STATEFUL				
State	Event		Action	New State
Idle	Client or Device Requests access		Send service specific auth req optionally including groups	Pending
Open	GASR received with Group-Response-Action = ALL_GROUPS, session is assigned to received group(s) and client will comply with request to end the session		Send GASA with Result-Code = SUCCESS, Send GSTR.	Discon
Open	GASR received with Group-Response-Action = PER_GROUPS, session is assigned to received group(s) and client will comply with request to end the session		Send GASA with Result-Code = SUCCESS, Send GSTR per group	Discon
Open	GASR received with Group-Response-Action = PER_SESSION, session is assigned to received group(s) and		Send GASA with Result-Code = SUCCESS, Send STR	Discon

	client will comply with request to end the session	per session	
Open	GASR received, client will not comply with request to end all session in received group(s)	Send GASA with Result-Code != SUCCESS	Open
Discon	GSTA Received	Discon. user/device	Idle
Open	GRAR received with Group-Response-Action = ALL_GROUPS, session is assigned to received group(s) and client will perform subsequent re-auth	Send GRAA, Send service specific group re-auth req	Pending
Open	GRAR received with Group-Response-Action = PER_GROUP, session is assigned to received group(s) and client will perform subsequent re-auth	Send GRAA, Send service specific group re-auth req per group	Pending
Open	GRAR received with Group-Response-Action = PER_SESSION, session is assigned to received group(s) and client will perform subsequent re-auth	Send GRAA, Send service specific re-auth req per session	Pending
Open	GRAR received and client will not perform subsequent re-auth	Send GRAA with Result-Code != SUCCESS, Discon. user/device	Idle
Pending	Successful service-specific group re-authorization answer received.	Provide service	Open
Pending	Failed service-specific group re-authorization answer	Discon. user/device	Idle

received.

The following state machine is observed by a server when it is maintaining state for the session. State transitions which are unmodified from [RFC6733] are not repeated here.

SERVER, STATEFUL			
State	Event	Action	New State
Idle	Service-specific authorization request received, and user is authorized	Send successful service specific answer optionally including groups	Open
Open	Server wants to terminate group(s)	Send GASR	Discon
Discon	GASA received	Cleanup	Idle
Any	GSTR received	Send GSTA, Cleanup	Idle
Open	Server wants to reauth group(s)	Send GRAR	Pending
Pending	GRAA received with Result-Code = SUCCESS	Update session(s)	Open
Pending	GRAA received with Result-Code != SUCCESS	Cleanup session(s)	Idle
Open	Service-specific group re-authorization request received and user is authorized	Send successful service specific group re-auth answer	Open
Open	Service-specific group re-authorization request received and user is not authorized	Send failed service specific group re-auth answer, cleanup	Idle

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