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Diameter Accounting Extensions

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Abstract

The Diameter protocol provides Authentication, Authorization and Accounting for network access technologies, such as NASREQ, ROAMOPS and Mobile IP. This extension describes how accounting records can be securely transmitted over the Diameter protocol. When combined with the Strong Security extension, accounting records MAY traverse intermediate proxies in a secure fashion and is compatible with the referral broker model. This extension allows real-time accounting transfers.

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[1.0](#) Introduction

This accounting protocol is based on an authorization-server directed model with capabilities for real-time delivery of accounting information. Several fault resilience methods [[11](#)] have been built in to the protocol in order minimize loss of accounting data in various fault situations and under different assumptions about the capabilities of the used devices.

[1.1](#) Requirements language

In this document, the key words "MAY", "MUST", "MUST NOT", "optional", "recommended", "SHOULD", and "SHOULD NOT", are to be interpreted as described in [[6](#)].

[1.2](#) Authorization-Server Directed Model

The authorization-server directed model means that at authorization time, the device generating the accounting data gets information from the authorization server regarding the way accounting data shall be forwarded. This information includes accounting record timeliness requirements.

As discussed in [[11](#)], real-time transfer of accounting records is a requirement, such as the need to perform credit limit checks and fraud detection. However, [[10](#)] states that batch accounting is not a current requirement, and is therefore not supported by this extension. Should Batched Accounting be required in the future, a new Diameter extension will need to be created, or it could be handled using another protocol.

The authorization server (chain) directs the selection of proper transfer strategy, based on its knowledge of the user and relationships of roaming partnerships. The server (or proxies in

between) uses the Accounting-Interim-Interval AVP to control the operation of the Diameter peer operating as a client. The Accounting-Interim-Interval AVP, when present, instructs the Diameter node acting as a client to produce accounting records continuously even during a session.

The Extension number for this draft is five (5). This value is used in the Extension-Id Attribute value Pair (AVP) as defined in [\[1\]](#).

[1.3](#) Protocol Messages

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The Diameter peer, acting as a client, generating the accounting data will use the Accounting-Request message to send accounting records to its peer. The receiver (server) MUST reply with the Accounting-Answer message with appropriate confirmations.

Upon receipt of an Accounting-Request, a home Diameter server MUST generate a response. A home server is the node that "owns" the realm portion of the user's NAI. The response includes the Result-Code, which MAY contain an error if the accounting information is incorrect.

Each Diameter Accounting protocol message MAY be compressed using IPComp [\[12\]](#) in order to reduce the used network bandwidth, which MAY use IKE [\[7\]](#) to negotiate the compression parameters.

[1.4](#) Accounting Info, Usage and Service Specific AVPs

There are three separate type of classes of Accounting AVPs; Informational, Usage and Service-Specific. The first two are specified in this document, while Service-Specific AVPs are described in service-specific extension documents. Informational Accounting AVPs are used describe the accounting message, including numbering, the type of record, interim accounting intervals, etc. The Accounting Usage AVPs, on the other hand, describe usage information for a given session, and are described in [section 4.0](#).

[1.4.1](#) Extension document requirements

Each Service-Specific Diameter extension (e.g. NASREQ, MobileIP), MUST define their Service-Specific AVPs that MUST be present in the Accounting-Request message in a section entitled "Accounting Considerations". The extension MUST assume that the AVPs described in this document will be present in all Accounting messages, so only their respective service-specific AVPs need to be defined in this section.

[1.5](#) Fault Resilience

Diameter Base protocol [\[11\]](#) mechanisms are used to overcome small message loss and network faults of temporary nature.

Diameter peers acting as clients MUST implement the use of alternate servers to guard against server failures and certain network failures. Diameter peers acting as servers or related off-line processing systems MUST detect duplicate accounting records caused by

the sending of same record to several servers and duplication of messages in transit. This detection MUST be based on the inspection of the Session-Id [\[1\]](#) and Accounting-Record-Number AVP pairs.

Diameter clients MAY have non-volatile memory for the safe storage of accounting records over reboots or extended network failures, network partitions, and server failures. If such memory is available the client SHOULD store new accounting records there as soon as the records are created and until a positive acknowledgement of their reception from the Diameter Server has been received. Upon a reboot, the client MUST start sending the records in the non-volatile memory to the accounting server with appropriate modifications in termination cause, session length, and other relevant information in the records.

A further extension of this protocol may include AVPs to control how many accounting records may at most be stored in the Diameter client without committing them to the non-volatile memory or transferring them to the Diameter server.

The client SHOULD NOT remove the accounting data from any of its memory areas before the correct Accounting-Answer has been received.

The client MAY remove oldest, undelivered or yet unacknowledged accounting data if it runs out of resources such as memory. It is an implementation dependent matter for the client to accept new sessions under this condition.

[1.6](#) Session Records

In all accounting records the Session-Id and User-Name AVPs MUST be present. If strong authentication is required, as described in [\[9\]](#), the CMS-Data AVP may be used to authenticate the Accounting Data and Service Specific AVPs. It is not typically necessary, nor recommended, that the strong authentication cover any additional AVPs since the Data and Service Specific AVP, and associated CMS-Data, MAY need to be submitted to a third party (see [section 1.7](#) below).

Different types of session records are sent depending on the actual type of accounted service and the authorization server's directions for interim accounting. If the accounted service is a one-time event, meaning that the start and stop of the event are simultaneous, then the Accounting-Record-Type AVP MUST be present and set to the value EVENT_RECORD.

If the accounted service is of a measurable length, then the AVP MUST use the values START_RECORD, STOP_RECORD, and possibly, INTERIM_RECORD. If the authorization server has directed interim

accounting to be enabled for the session, but no interim interval was specified, two accounting records MUST be generated for each service of type session. When the initial Accounting-Request is sent for a given session is sent, the Accounting-Record-Type AVP MUST be set to the value START_RECORD. When the last Accounting-Request is sent, the value MUST be STOP_RECORD.

If a specified interim interval exists, the Diameter client MUST produce additional records between the START_RECORD and STOP_RECORD, marked INTERIM_RECORD. The production of these records is directed both by Accounting-Interim-Interval as well as any re-authentication or re-authorization of the session. The Diameter client MUST overwrite any previous interim accounting records that are locally stored for delivery, if a new record is being generated for the same session. This ensures that only one pending interim record can exist

on a NAS for any given session.

[1.7](#) Accounting in brokering environments

The Diameter base protocol [\[1\]](#) describes brokers that provide redirect services, by allowing AAA servers within a roaming consortium to directly communicate. Referral services can be secured using the strong security extension defined in [\[9\]](#). Since brokers can also provide settlement services, they typically need to be aware of the accounting information exchange, and since they are no longer part of the message exchange, the Diameter protocol MUST allow the broker to receive the accounting record. The strong security [\[9\]](#) provides the broker with the assurances it needs that both parties agreed with the accounting information submitted.

When the local AAA server issues an Accounting-Request to the home AAA server, it includes accounting usage and service specific AVPs as well as a CMS-Data AVP [\[9\]](#), which contains the signature of the local AAA server. The home server MUST add it's own signature to the CMS-Data AVP, that covers both the same AVPs as above and the local AAA's signature. The whole is submitted to the local AAA server in the Accounting-Answer. The local AAA server MUST submit the accounting AVPs, and associated CMS-Data AVP to the broker. The broker can verify that both parties participated and accepted the accounting record, by validating the signatures.

[2.0](#) Command-Codes Values

This section defines new Command-Code [\[1\]](#) values that MUST be supported by all Diameter implementations that conform to this specification. The following Command Codes are currently defined in

this document:

Command-Name	Abbrev.	Code	Reference
Accounting-Answer	ACA	272	2.2
Accounting-Poll-Ind	API	273	2.4
Accounting-Request	ACR	271	2.1
Accounting-Status-Ind	ASI	279	2.3

[2.1](#) Accounting-Request (ACR) Command

The Accounting-Request command, indicated by the Command-Code field set to 271, is sent by a Diameter node, acting as a client, in order to exchange accounting information with a peer.

When the Accounting-Request is being submitted to a broker, and includes the CMS-Data AVP [\[9\]](#), the CMS-Data AVP MUST be signed by both the local and home Diameter server using the countersignature procedures described in [\[9\]](#).

The AVP listed below SHOULD include service specific accounting AVPs, as described in [section 1.4](#).

Message Format

```
<Accounting-Request> ::= < Diameter Header: 271 >
    < Session-Id >
    { Extension-Id }
    { Origin-FQDN }
    { Origin-Realm }
    { Destination-Realm }
    { Accounting-Record-Type }
    { Accounting-Record-Number }
    [ Accounting-Interim-Interval ]
    { Accounting-Session-Id }
    { Accounting-Authentication-Type }
    { Accounting-Input-Octets }
    { Accounting-Output-Octets }
    { Accounting-Session-Time }
    { Accounting-Input-Packets }
    { Accounting-Output-Packets }
    * [ AVP ]
    [ CMS-Data ]
    * [ Proxy-State ]
    * [ Route-Record ]
    0*1< Integrity-Check-Value >
```

[2.2](#) Accounting-Answer (ACA) Command

The Accounting-Answer command, indicated by the Command-Code field set to 272, is used to acknowledge an Accounting-Request command. The Accounting-Answer command contains the same Session-Id and MAY contain the same Accounting Description and Usage AVPs that were sent in the Accounting-Request command. If the CMS-Data AVP was present in the Accounting-Request, the corresponding ACA message MUST include the CMS-Data AVP signed by the responder to provide strong AVP authentication, which MAY be used for the purposes of repudiation.

Only the target Diameter Server, known as the home Diameter Server, SHOULD respond with the Accounting-Answer command.

The AVP listed below SHOULD include service specific accounting AVPs, as described in [section 1.4](#).

Message Format

```
<Accounting-Answer> ::= < Diameter Header: 272 >
                        < Session-Id >
                        { Extension-Id }
                        { Result-Code }
                        { Destination-Realm }
                        { Origin-FQDN }
                        { Origin-Realm }
                        { Accounting-Record-Type }
                        { Accounting-Record-Number }
                        { Accounting-Session-Id }
                        [ Error-Reporting-FQDN ]
                        [ Accounting-Interim-Interval ]
                        [ Accounting-Authentication-Type ]
                        [ Accounting-Input-Octets ]
                        [ Accounting-Output-Octets ]
                        [ Accounting-Session-Time ]
                        [ Accounting-Input-Packets ]
                        [ Accounting-Output-Packets ]
                        * [ AVP ]
                        [ CMS-Data ]
                        * [ Proxy-State ]
                        * [ Route-Record ]
                        0*1< Integrity-Check-Value >
```

[2.3](#) Accounting-Status-Ind (ASI) Command

The Accounting-Status-Ind command, indicated by the Command-Code

field set to 279, is sent by a Diameter node in order to inform its peer of whether Accounting messages will be sent in the future. A Diameter node that is about to be taken out of service SHOULD issue an Accounting-Status-Ind message, with the Accounting-State AVP set to DISABLED. A Diameter node that detected that it is able to issue Accounting messages MUST issue an Accounting-Status-Ind message, with the Accounting-State AVP set to ENABLED.

Message Format

```
<Accounting-Status-Ind> ::= <Diameter Header: 279 >
    { Extension-Id }
    { Origin-FQDN }
    { Origin-Realm }
    { Destination-Realm }
    { Accounting-State }
    * [ AVP ]
    * [ Proxy-State ]
    * [ Route-Record ]
    0*1< Integrity-Check-Value >
```

[2.3](#) Accounting-Poll-Ind (API) Command

The Accounting-Poll-Ind command, indicated by the Command-Code field set to 273, is sent by a Diameter Server in order to force the peer to send current accounting data. This data MUST include not yet sent accounting records from completed sessions, as well as INTERIM_RECORD records from all ongoing sessions.

Diameter implementations MAY support the Accounting-Poll-Ind command. An implementation still conforms to this specification if API is not supported.

The receiver MUST use the Accounting-Request command to send the accounting data.

The use of Accounting-Poll-Ind is useful in situations where a Diameter server comes up after an unscheduled downtime, and wishes to synchronize with the client(s) sooner than at the end of the next INTERIM_RECORD or at the end of a session.

Warning: The use of the Accounting-Poll-Ind message is discouraged in roaming networks, since it is unfeasible for a server to attempt to poll all of its roaming partner's Diameter peers.

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Message Format

```

<Accounting-Poll-Ind> ::= <Diameter Header: 273 >
    < Session-Id >
    { Extension-Id }
    { Destination-FQDN }
    { Origin-FQDN }
    { Origin-Realm }
    { Destination-Realm }
    { Accounting-Session-Id }
    [ Destination-FQDN ]
    * [ AVP ]
    * [ Proxy-State ]
    * [ Route-Record ]
    0*1< Integrity-Check-Value >

```

[3.0](#) Accounting Message Information AVPs

The following table describes the Diameter AVPs defined in the Accounting extension, their AVP Code values, types, possible flag values and whether the AVP MAY be encrypted.

					+-----+ AVP Flag rules +-----+					
Attribute Name	AVP Code	Section Defined	Value	Type	+-----+ MUST MAY SHLD MUST MAY +-----+					Encr
					MUST	MAY	SHLD	MUST	MAY	
Accounting-Authentication-Type	45	3.6	Unsigned32		M	P		V	Y	
Accounting-Interim-Interval	482	3.2	Unsigned32		M	P		V	Y	
Accounting-Record-Number	485	3.3	Unsigned32		M	P		V	Y	
Accounting-Record-Type	480	3.1	Unsigned32		M	P		V	Y	
Accounting-Session-Id	44	3.5	OctetString		M	P		V	Y	

[3.1](#) Accounting-Record-Type AVP

The Accounting-Record-Type AVP (AVP Code 480) is of type Unsigned32 and contains the type of accounting record being sent. The following values are currently defined for the Accounting-Record-Type AVP:

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EVENT_RECORD 1

An Accounting Event Record is used to indicate that a one-time event has occurred (meaning that the start and end of the event are simultaneous). This record contains all information relevant to the service, and is the only record of the service.

START_RECORD 2

An Accounting Start, Interim, and Stop Records are used to indicate that a service of a measurable length has been given. An Accounting Start Record is used to initiate an accounting session, and contains accounting information that is relevant to the initiation of the session.

INTERIM_RECORD 3

An Interim Accounting Record contains cumulative accounting information for an existing accounting session. Interim Accounting Records SHOULD be sent every time a re-authentication or re-authorization occurs. Further, additional interim record triggers MAY be defined by application-specific Diameter extensions. The selection of whether to use INTERIM_RECORD records is directed by the Accounting-Interim-Interval AVP.

STOP_RECORD 4

An Accounting Stop Record is sent to terminate an accounting session and contains cumulative accounting information relevant to the existing session.

[3.2](#) Accounting-Interim-Interval AVP

The Accounting-Interim-Interval AVP (AVP Code 482) is of type

Unsigned32 and is sent from the Diameter authenticating/authorizing server to the Diameter client. The client uses information in this AVP to decide how and when to produce accounting records. With different values in this AVP, service sessions can result in one, two, or two+N accounting records, based on the needs of the home-organization. The following accounting record production behaviour is directed by the inclusion of this AVP:

1. The omission of the Accounting-Interim-Interval AVP or its inclusion with Value field set to 0 means that EVENT_RECORD, START_RECORD, and STOP_RECORD are produced, as appropriate for the service.
2. The inclusion of the AVP with Value field set to a non-zero value means that INTERIM_RECORD records MUST be produced between the START_RECORD and STOP_RECORD records. The Value

field of this AVP is the nominal interval between these records in seconds. The Diameter node that originates the accounting information, known as the client, MUST produce the first INTERIM_RECORD record roughly at the time when this nominal interval has elapsed from the START_RECORD, the next one again as the interval has elapsed once more, and so on until the session ends and a STOP_RECORD record is produced.

The client MUST ensure that the interim record production times are randomized so that large accounting message storms are not created either among records or around a common service start time.

[3.3](#) Accounting-Record-Number AVP

The Accounting-Record-Number AVP (AVP Code 485) is of type Unsigned32 and identifies this record within one session. As Session-Id AVPs are globally unique, the combination of Session-Id and Accounting-Record-Number AVPs is also globally unique, and can be used in matching accounting records with confirmations. An easy way to produce unique numbers is to set the value to 0 for records of type EVENT_RECORD and START_RECORD, and set the value to 1 for the first INTERIM_RECORD, 2 for the second, and so on until the value for STOP_RECORD is one more than for the last INTERIM_RECORD.

[3.4](#) Accounting-State AVP

The Accounting-State AVP (AVP Code 486) is of type Unsigned32 and is used to communicate to a peer whether Accounting messages will be sent in the future. A node that issues an ASI with the Accounting-State AVP set to DISABLED is informing its peer that it will no longer be transmitting Accounting messages until a subsequent ASI message is sent with the Accounting-State AVP set to ENABLED.

The following values have been defined:

- 1 ENABLED
- 2 DISABLED

[3.5](#) Accounting-Session-Id AVP

The Accounting-Session-Id AVP (AVP Code 44) is of type OctetString, and SHOULD be encoded in UTF-8 format [[13](#)]. The Accounting-Session-Id is not used by the Diameter protocol, since the Session-Id defined in [[1](#)] is used for both authentication/authorization and accounting purposes. However, a RADIUS/Diameter gateway MAY need to include the

Accounting-Session-Id in Diameter accounting messages.

[3.6](#) Accounting-Authentication-Type AVP

The Accounting-Authentication-Type AVP (AVP Code 45) is of type Unsigned32, and specifies how the user was authenticated. The following values are supported:

- 1 RADIUS
- 2 Local
- 3 Remote
- 4 Diameter

[4.0](#) Accounting Usage AVPs

This section contains AVPs that describe accounting usage information related to a specific session.

					+-----+				
					AVP Flag rules				
					+-----+				
Attribute Name	AVP Code	Section Defined	Value	Type					
					MUST	MAY	SHLD NOT	MUST NOT	MAY Encr
-----					+-----+				
Accounting-Input-Octets	42	4.1	Unsigned32		M	P		V	Y
Accounting-Input-Packets	47	4.4	Unsigned32		M	P		V	Y
Accounting-Output-Octets	43	4.2	Unsigned32		M	P		V	Y
Accounting-Output-Packets	48	4.5	Unsigned32		M	P		V	Y
Accounting-Session-Time	46	4.3	Unsigned32		M	P		V	Y

[4.1](#) Accounting-Input-Octets AVP

The Accounting-Input-Octets AVP (AVP Code 42) is of type Unsigned64, and contains the number of octets in IP packets received by the user.

[4.2](#) Accounting-Output-Octets AVP

The Accounting-Output-Octets AVP (AVP Code 43) is of type Unsigned64, and contains the number of octets in IP packets sent to the user.

[4.3](#) Accounting-Session-Time AVP

The Accounting-Session-Time AVP (AVP Code 46) is of type Unsigned32, and indicates the length of the current session in seconds.

[4.4](#) Accounting-Input-Packets AVP

The Accounting-Input-Packets (AVP Code 47) is of type Unsigned64, and contains the number of IP packets received by the user.

[4.5](#) Accounting-Output-Packets AVP

The Accounting-Output-Packets (AVP Code 48) is of type Unsigned64, and contains the number of IP packets sent to the user.

[5.0](#) Result-Code Values

Errors defined in this section indicates a particular type of failure in the accounting data transfer process. Diameter clients MAY use this information in deciding a retransmission strategy after the error has happened. For instance, an out of space condition isn't typically recovered very soon, so a Diameter node might wait longer for the next retry than after network or server outage.

DIAMETER_OUT_OF_SPACE 4007
A Diameter node received the accounting request but was unable to commit it to stable storage due to a temporary lack of space.

[6.0](#) AVP Table

The following table presents the AVPs defined in this document, and specifies in which Diameter messages they MAY, or MAY NOT be present. Note that AVPs that can only be present within a Grouped AVP are not represented in this table.

The table uses the following symbols:

- 0 The AVP MUST NOT be present in the message.
- 0+ Zero or more instances of the AVP MAY be present in the message.
- 0-1 Zero or one instance of the AVP MAY be present in the message.
- 1 One instance of the AVP MUST be present in the message.

Attribute Name	+-----+-----+-----+-----+			
	Command-Code			
	+-----+-----+-----+-----+			
	ACR	ACA	API	ASI

-----+-----+-----+-----+					
Accounting-Authentication-Type	1	1	0	0	
Accounting-Input-Octets	1	1	0	0	
Accounting-Input-Packets	1	1	0	0	
Accounting-Interim-Interval	0-1	0-1	0	0	
Accounting-Output-Octets	1	1	0	0	
Accounting-Output-Packets	1	1	0	0	
Accounting-Record-Number	1	1	0	0	
Accounting-Record-Type	1	1	0	0	
Accounting-Session-Id	1	1	0	1	
Accounting-Session-Time	1	1	0	0	
Accounting-State	0	0	1	0	
Destination-FQDN	0+	1	0+	0-1	
Destination-Realm	1	1	1	1	
Error-Reporting-FQDN	0	0+	0	0	
Extension-Id	1	1	1	1	
Integrity-Check-Value	0-1	0-1	0-1	0-1	
Origin-FQDN	1	1	1	1	
Origin-Realm	1	1	1	1	
Proxy-State	0+	0+	0+	0+	
Route-Record	0+	0+	0+	0+	
Result-Code	0	1	0	0	
Session-Id	1	1	0	1	
-----+-----+-----+-----+					

7.0 IANA Considerations

The command codes defined in [Section 2.0](#) are values taken from the Command-Code [\[1\]](#) address space and extended in [\[2\]](#), [\[3\]](#) and [\[9\]](#). IANA should record the values as defined in [Section 2.0](#).

The AVPs defined in [section 3.0](#) and 5.0 were allocated from from the AVP numbering space defined in [\[1\]](#), and extended in [\[2\]](#), [\[3\]](#) and [\[9\]](#). IANA should record the values as defined in [Section 3.0](#).

This document introduces the Accounting-Record-Type AVP, which contains pre-defined values. This document defines the values 1-3. All remaining values are available for assignment via a Designated Expert [\[8\]](#).

8.0 Security Considerations

This Diameter extension assumes that the accounting data is secured either through a hop-by-hop authentication mechanism, as described in [1], or using a strong authentication mechanism as defined in [9].

9.0 Acknowledgments

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[11.0](#) Authors' Addresses

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