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Technical Specification

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-System (RACS); Rr interface based on the DIAMETER protocol

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

1   Scope

The present document defines a specification applicable to the Rr interface between Generic Resource Admission Control Function (x-RACF) instances, based on the Diameter protocol. Other alternative protocols which may also be used for this interface such as ANCP are not specified in the present document.

Whenever it is possible the present document specifies the requirements for this protocol by reference to specifications produced by the IETF within the scope of Diameter. Where this is not possible, extensions to Diameter are defined within the present document.

2   References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.

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2.1   Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1]   ETSI ES 282 001 (V3.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture".

[2]   ETSI ES 282 003 (V3.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-System (RACS): Functional Architecture".

[3]   ETSI ES 282 004 (V3.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture; Network Attachment Sub-System (NASS)".

[4]   ETSI ES 283 034 (V2.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Network Attachment Sub-System (NASS); e4 interface based on the DIAMETER protocol".

[5]   ETSI TS 183 017 (V3.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN);Resource and Admission Control: DIAMETER protocol for session based policy set-up information exchange between the Application Function (AF) and the Service Policy Decision Function (SPDF); Protocol specification".

[6]   IETF RFC 4006: "Diameter Credit-Control Application".

[7]   ETSI TS 129 209: "Universal Mobile Telecommunications System (UMTS); Policy control over Gq interface (3GPP TS 29.209)".

[8]   IETF RFC 3588: "Diameter Base Protocol".

[9]   IETF RFC 4005: "Diameter Network Access Server Application".

[10]   ETSI TS 183 026 (V3.y.z): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control; Protocol for QoS reservation information exchange between the Service Policy Decision Function (SPDF) and the Access Resource and Admission Control Function (A-RACF) In the Resource and Protocol specification".

[11]   ETSI TS 133 210: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; 3G security; Network Domain Security (NDS); IP network layer security (3GPP TS 33.210)".

[12]   IETF RFC 4960: "Stream Control Transmission Protocol".

[13]   ETSI TS 129 207: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Policy control over Go interface (3GPP TS 29.207)".

[14]   IETF RFC 3554: "On the Use of Stream Control Transmission Protocol (SCTP) with IPSec".

[15]   ETSI TS 129 329: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Sh interface based on the Diameter protocol; Protocol details (3GPP TS 29.329)".

2.2   Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Not applicable.

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document, the following terms and definitions apply:

delegated x-RACF: x-RACF instance which works in the Rr delegated Model and performs admission control for the resources delegated by the delegating x-RACF

delegating x-RACF: x-RACF instance which works in the Rr delegated Model and delegates a bulk of resources to another x-RACF instance for admission control

3.2   Abbreviations

For the purposes of the present document, the following abbreviations apply:

AAA   AA-Answer
AAR   AA-Request
ABNF   Augmented Backus–Naur Form
AF   Application Function
ANCP   Access Node Control Protocol
ASA   Abort-Session-Answer
ASR   Abort-Session-Request

ATM	Asynchronous Transfer Mode
AVP	Attribute-Value Pair
CCA	CC-Answer
CCR	CC-Request
CEA	Capabilities-Exchange-Answer
CER	Capabilities-Exchange-Request
DHCP	Dynamic Host Configuration Protocol
FQDN	Fully Qualified Domain Name
IANA	Internet Assigned Numbers Authority
ID	IDentifier
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPSec	IP Security
NASREQ	Network Access Server Application
NASS	Network Attachment Sub-System
PNA	Push-Notification-Answer
PNR	Push-Notification-Request
QoS	Quality of Service
RAA	Re-Auth-Answer
RACS	Resource and Admission Control Sub-System
RAR	Re-Auth-Request
RCEF	Resource Control Enforcement Function
RFC	Request For Comments
Rr	reference point Rr
RTCP	Realtime Transport Control Protocol
SCTP	Stream Control Transport Protocol
SDI	Session Description Information
SPDF	Service-based Policy Decision Function
STA	Session-Termination-Answer
STR	Session-Termination-Request
TISPAN	Telecommunications and Internet converged Services and Protocols for Advanced Networking
UDA	User-Data-Answer
UDR	User-Data-Request
UE	User Equipment
VC	Virtual Channel
VP	Virtual Path
x-RACF	Generic Resource Admission Control Function

4 Overview

The present document specifies the Diameter protocol for the RACS Rr interface. The Rr interface is used for QoS resource reservation between x-RACF instances of RACS within a single administrative domain. The functional requirements and the stage 2 specifications of the Rr interface are contained in ES 282 001 [1] and ES 282 003 [2].
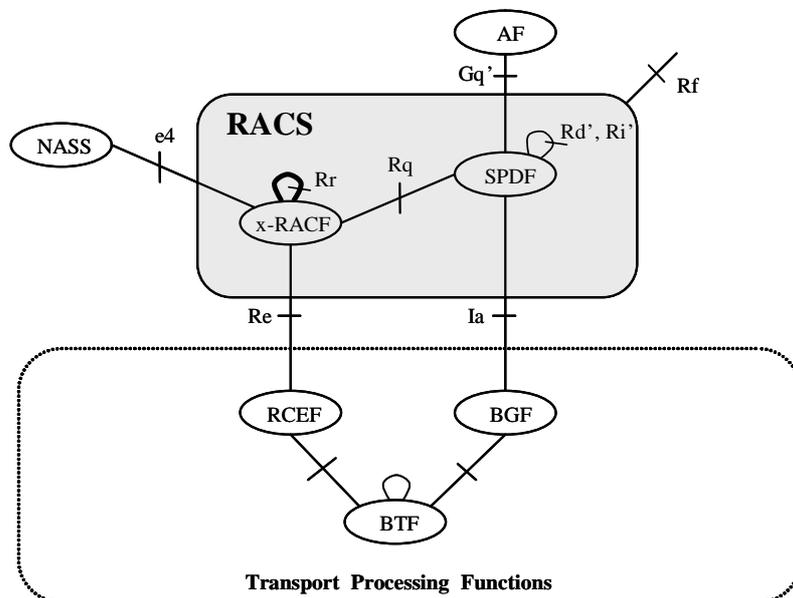
Figure 4.1: Rr interface

5 Procedure descriptions

5.1 General

5.1.1 Information elements

The following clauses describe the realization of the functional procedures defined in the RACS (ES 282 003 [2]) using Diameter commands described in clauses 6 and 7. This involves describing a mapping between the Information Elements defined in the RACS specification (ES 282 003 [2]) and Diameter AVPs.

In the tables that describe this mapping, each Information Element is marked as (M) Mandatory, (C) Conditional or (O) Optional:

- A mandatory Information Element (marked as (M) in the table) shall always be present in the command. If this Information Element is absent, an application error occurs at the receiver and an answer message shall be sent back to the originator of the request with the Result-Code set to DIAMETER_MISSING_AVP. This message shall also include a Failed-AVP AVP containing the missing Information Element i.e. the corresponding Diameter AVP defined by the AVP Code and the other fields set as expected for this Information Element.

- A conditional Information Element (marked as (C) in the table) shall be present in the command if certain conditions are fulfilled:

  - If the receiver detects that those conditions are fulfilled and the Information Element is absent, an application error occurs and an answer message shall be sent back to the originator of the request with the Result-Code set to DIAMETER_MISSING_AVP. This message shall also include a Failed-AVP AVP containing the missing Information Element i.e. the corresponding Diameter AVP defined by the AVP Code and the other fields set as expected for this Information Element. If multiple Information Elements are missing, all corresponding AVP codes shall be included in the Failed-AVP AVP.

-    If those conditions are not fulfilled, the Information Element shall be absent. If however this Information
     Element appears in the message, it shall not cause an application error and it may be ignored by the
     receiver if this is not explicitly defined as an error case. Otherwise, an application error occurs at the
     receiver and an answer message with the Result-Code set to DIAMETER_AVP_NOT_ALLOWED shall
     be sent back to the originator of the request. A Failed-AVP AVP containing a copy of the corresponding
     Diameter AVP shall be included in this message.

- An optional Information Element (marked as (O) in the table) may be present or absent in the command, at the
  discretion of the application at the sending entity. Absence or presence of this Information Element shall not
  cause an application error and may be ignored by the receiver.

5.2   Procedures on the Rr interface

5.2.1   Resource control procedures for Request Model

The resource control process supports the following operations:

1)   Resource Reservation: the resources are admitted by the requested entity (e.g. lower-tier x-RACF). In relation
     to the enforcement operations performed in the co-located RCEF, it can be divided into the following
     categories:

     -    Reservation only: the resources are reserved but not allocated.

     -    Commit only: the pre-reserved resources are allocated.

     -    Reservation and commit: the resources are reserved and allocated.

2)   Resource Modification: the pre-reserved/committed resources are updated upon the request of the originating
     entity (e.g. top-tier x-RACF).

3)   Resource Release: the pre-reserved/committed resources are terminated upon the request of the originating
     entity.

4)   Event notification: a specific action is requested when a pre-defined event occurs (e.g. reservation expiration).

The Flow-Status AVP is used to define the action to be taken for each AA-Request made by the top-tier x-RACF to the
lower-tier x-RACF. The rules for interpreting the Flow-Status AVP are the following:

- Resource Reservation: can be invoked by any of the following status:

     -    Reservation only: New Media-Description-Component AVP(s) and optionally Media-Sub-Component
          AVP(s) with Flow-Status AVP(s) set to DISABLED (3).

     -    Commit only: Media-Description-Component AVP(s) and optionally Media-Sub-Component AVP(s) of
          existing reservations with Flow-Status AVP(s) set to ENABLED-UPLINK (0),
          ENABLED-DOWNLINK (1) or ENABLED (2).

     -    ReservationAndCommit: New Media-Component-Description AVP(s) and optionally
          Media-Sub-Component AVP(s). Flow-Status AVP(s) set to ENABLED-UPLINK (0),
          ENABLED-DOWNLINK (1) or ENABLED (2).

  NOTE: For the purpose of the resource admission and reservation, any of above status triggers the procedure. The
           distinction of above flow status is only meaningful in the case the lower-tier x-RACF needs to control the
           enforcement operations (e.g. Opening the gate) in the co-located RCEF.

- Resource Modification: Updated Media-Description-Component AVP(s) and Media-Sub-Component AVP(s).
  Flow-Status AVP not modified, unless the state needs to be modified (e.g. for committing a resource
  reservation, or for releasing a resource reservation).

- Resource Release: Media-Description-Component AVP(s) and optionally Media-Sub-Component AVP(s) of
  existing reservations with Flow-Status AVP(s) set to REMOVED (4).

These resource control operations are described in the following clauses. During the operations Diameter AVPs are passed between the top-tier x-RACF and the lower-tier x-RACF.

5.2.1.1   Procedures at the Top-tier x-RACF

5.2.1.1.1   Resource Reservation Session Establishment and Initial Resource Reservation

Upon the receipt of a new request from the SPDF, the top-tier x-RACF sends an initial request to the lower-tier x-RACF for initiating a resource reservation session. The AA-Request issued to request an initial reservation contains a new Session-Id assigned by the top-tier x-RACF. As specified in RFC 3588 [8], the Session-Id is globally unique and is meant to uniquely identify a resource session without reference to any other information. The Session-Id begins with the sender's identity encoded in the DiameterIdentity type.

This AA-Request message contains one or more Media-Component-Description Attribute-Value Pair(s) (AVP(s)). Each Media-Component-Description AVP describes the set of flows of a particular media type (i.e. it may contain one or more Media-Sub-Component AVP(s) and requirements for the flows).

The top-tier x-RACF may forward an AF-Charging-Identifier AVP from the SPDF in the message for charging correlation purposes between AF and RACS.

The resource admission and reservation operation that shall be performed by the lower-tier x-RACF for each individual media and flow is triggered by the following value of the Flow-Status AVP, as indicated in table 5.1:

- Reservation; the value of the Flow-Status AVP shall be set to DISABLED (3).

- ReservationAndCommit; the value of the Flow-Status AVP shall be set to ENABLED-UPLINK (0), ENABLED-DOWNLINK (1) or ENABLED (2).

- The Flow-Status AVP shall be specified in the Media-Component-Description AVP and in the Media-Sub-Component AVP(s). The Flow-Status AVP shall be set to the same value in both these AVPs.

Table 5.1: Initial Reservation operations

Message Type	Flow-Status AVP at the level of		Meaning
	Media	Sub-Media	
AAR	New Media, DISABLED	New flow, DISABLED	Reserve Resources for all the flows in the request. The media(s) and flow(s) descriptions MUST be new ones.
AAR	[New Media, ENABLE*]	New flow, ENABLE*	Reserve Resources. In addition, instruct the co-located RCEF to commit resources for some of the flows. The media(s) and flow(s) descriptions MUST be new ones (see note).
NOTE:	The control of committing resources in the co-located RCEF is an implementation choice and out of scope in the present document.		

As specified in clause 8.9 of RFC 3588 [8], the top-tier x-RACF may specify the Authorization-Lifetime AVP in the AA-Request to request a maximum lifetime for a session. To request a hard-state session the top-tier x-RACF shall omit the Authorization-Lifetime AVP in the AA-Request. To request a soft-state session the top-tier x-RACF shall specify this AVP in the AA-Request.

The AA-Answer may contain the Authorization-Lifetime AVP. The AA-Answer may contain the Auth-Grace-Period AVP in addition to the Authorization-Lifetime AVP. The Authorization-Lifetime AVP specifies the maximum number of seconds before the Session must be refreshed by the top-tier x-RACF.   The Auth-Grace-Period AVP contains the number of seconds the lower-tier x-RACF will wait for a Refresh following the expiration of the Authorization-Lifetime AVP.

Whether the Authorization-Lifetime AVP and Auth-Grace-Period need to be included in the AA-Answer is a local decision of the lower-tier x-RACF.   This means that the top-tier x-RACF may be offered a soft-state reservation although it asked for hard-state or a hard-state reservation although it asked for soft-state. Should the top-tier x-RACF not accept what is offered by the lower-tier x-RACF it must explicitly release the resources through issuing another AAR command.

The top-tier x-RACF may specify, in the Specific-Action AVP of the AA-Request through which the initial reservation request is made, the events of which it wants to be informed. The supported events are listed in clause 6.5.9.

The behaviour when the top-tier x-RACF does not receive an AA-Answer, or when it arrives after the internal timer waiting for it has expired, or when it arrives with an indication different than DIAMETER_SUCCESS, is outside the scope of the present document.

5.2.1.1.2 Resource Modification and Release for Media Flows

The top-tier x-RACF may modify an existing session by sending an AA-Request to the lower-tier x-RACF with zero or more updated Media-Component-Description AVP(s) and optional Media-Sub-Component AVP(s). The Session-Id shall be an existing one and refer to the session that is to be modified. The top-tier x-RACF may perform the following operations:

- Add a new flow within a media component by providing a new Media-Sub-Component AVP within the corresponding Media-Component-Description AVP.

- Add a new flow within a new media component by providing a new Media-Component-Description AVP.

- Modify a media component by updating the corresponding Media-Component-Description AVP (e.g. increase or decrease the allocated bandwidth).

- Modify a flow within a media component by updating the corresponding Media-Sub-Component AVP.

- Modify a media flow state from Reserved to Committed by providing a Flow-Status AVP of the corresponding Media-Component-Description AVP and/or Media-Sub-Component AVP(s). The Flow-Status AVP shall be set to one of the values ENABLED-UPLINK, ENABLED-DOWNLINK or ENABLED, according to the direction in which the resources are to be committed. This operation requires that the media and flows are in the Reserved state prior to the AA-Request.

- Release a media component by providing the corresponding Media-Component-Description AVP with the Flow-Status AVP set to the value REMOVED.

- Release a flow within a media by providing the corresponding Media-Sub-Component AVP with the Flow-Status AVP set to the value REMOVED.

- Refresh a soft-state session by providing an AA-Request message containing the Session-Id of the session that is to be refreshed. The AA-Request may contain the Authorization-Lifetime AVP to request a maximum lifetime of the refreshed session. If this AVP is not included, the refresh message requests the lifetime to be extended by a default value. The AA-Request may contain Media-Component-Description AVP(s) and Media-Sub-Component AVP(s) (e.g. to modify media, flows and/or commit status).

The Flow-Status AVP in the Media-Sub-Component AVP shall always be the same as the Flow-Status AVP in the Media-Component-Description AVP containing the Media-Sub-Component AVP.

The top-tier x-RACF SHALL NOT use the RAA to modify the session service information. As an option, the top-tier x-RACF MAY send an AAR command following an RAA to update the session service information after the local RACF responds with the RAR.

Table 5.2: Modification operations

Message Type	Flow-Status AVP at the level of		Meaning
	Media	Sub-Media	
AAR	Existing Media	Existing Flow, Unchanged Flow-Status	Modify a media. In addition, modify a flow according to the new parameters specified in the Media-Sub-Component AVP. The Media and Flow must exist (see notes 1, 2 and 5).
AAR	Existing Media	New flow. Same Flow-Status AVP as in the media. (see note 3)	Modify a media. In addition, add a new flow in a media. The Flow must be new (see notes 3 and 5).
AAR	Existing Media (see note 4)	REMOVED	Modify a media. In addition, release an existing flow within an existing media. If the flow does not exist, the request shall be ignored by the lower-tier x-RACF (see notes 2 and 5).
AAR	Existing Media, Modified Flow-Status AVP = REMOVED	Existing Flow, Flow-Status AVP = REMOVED	Release the resources of the media.
AAR	Existing Media	Existing Flow	(see note 5).
NOTE 1: If the media is not an existing one, the AAR is interpreted as a reservation for a new media (clause 5.2.1.1).			
NOTE 2: The parameters specified at flow-level (in the Media-Sub-Component AVP(s)) take precedence over the parameters specified at media-level (in the updated Media-Component-Description AVP).			
NOTE 3: The Flow-Status AVP of a new flow within a media shall be the same as the Flow-Status of the media.			
NOTE 4: As the Modification operation is also used for the Commit operation, the Flow-Status AVP of the Media-Component-Description AVP may actually be modified.			
NOTE 5: In the case of a soft-state reservation, extend its lifetime.			

The behaviour when the top-tier x-RACF does not receive an AA-Answer, or when it arrives after the internal timer waiting for it has expired, or when it arrives with an indication different than DIAMETER_SUCCESS, is outside the scope of the present document.

5.2.1.1.3 Termination and Release of the Resources for a Resource Reservation Session

The top-tier x-RACF may issue a Session-Termination-Request (STR) command to the lower-tier x-RACF when it decides to terminate a resource reservation session and release all the resources. The session termination may be triggered by the explicit request from the SPDF or the expiry of the session or the inactivity of applications based on network policy. This command releases all the resources associated with the session identified by the provided Session-Id AVP.

Table 5.3: Resource release operations

Message Type	Flow-Status AVP at the level of		Meaning
	Media	Sub-Media	
STR			Release a session: all the media(s) and flow(s) within that session are released.

When receiving an Abort-Session-Request (ASR) message from the lower-tier x-RACF, the top-tier x-RACF shall – if the session involves the resources in other network segments – release those resources and inform the SPDF of that the resources identified by the Session-Id AVP have been released. If the ASR message contains one or more Session-Bundle-Id AVPs the top-tier x-RACF shall perform these procedures for all sessions associated with the Session-Bundle-Id AVP(s).

5.2.1.1.4 Event notification

Notifications for specific events may be implicitly requested through policies established in the lower-tier x-RACF. The top-tier x-RACF may further specify, in the Specific-Action AVP of an initial AA-Request command, the events of which it wants to be informed. The supported events are listed in clause 6.5.9.

5.2.1.2 Procedures at the lower-tier x-RACF

5.2.1.2.1 Initial Resource Reservation

When the lower-tier x-RACF receives a reservation request in which the Session-Id is new, it is interpreted by the lower-tier x-RACF as a new resource reservation session.

An initial AA-Request may contain one or more Media-Component-Description AVP(s) optionally including one or more Media-Sub-Component AVP(s). If the initial AA-Request does not contain any Media-Component-Description AVP(s), the lower-tier x-RACF will establish the Diameter session as the idle state without further operations.

Upon reception of an AF-Application-Identifier AVP in an initial AA-Request from the top-tier x-RACF, the lower-tier x-RACF shall store this identifier together with the states created and maintained for the new session for the purpose of charging correlation between AF and RACS. The identifier is opaque to the lower-tier x-RACF.

As defined in ES 282 003 [2], the top-tier x-RACF identifies a QoS profile based on the Subscriber ID and/or the Globally Unique IP Address. The QoS profile includes the Physical Access ID, Logical Access ID and Access Network Type.

The lower-tier x-RACF does not interact with the NASS directly. Instead, the top-tier x-RACF maintains the QoS profiles, selects the right one and pushes the relevant information (e.g. QoS info) down to the lower-tier x-RACF.

To identify a specific customer on the lower-tier x-RACF, the top-tier x-RACF shall convey the Logical Access ID, and optionally the Globally Unique IP Address.

The mapping of these parameters to the Diameter AVPs is described in table 5.4. If the lower-tier x-RACF does not receive one of these parameters at least the Logical-Access-Id AVP, it shall return an AA-Answer that include a Result-Code AVP set to the value DIAMETER_MISSING_AVP. The Failed-AVP AVP should be included in the message. The Failed-AVP AVP must contain an example of the missing AVP. The value field of the missing AVP example should be of correct minimum length and contain zeroes.

Table 5.4: Mapping of information element names to Diameter AVPs

Information element name	Mapping to Diameter AVP	Categorie
Logical Access ID (The identity of the logical access to which the user equipment is connected. See note)	Logical-Access-Id	M
Subscriber ID in RACS [2] and in NASS [3]	User-Name	O
Globally Unique IP Address in RACS [2] and in NASS [3]	Globally-Unique-Address	O
Requestor Name in RACS [2]	AF-Application-Identifier	O
Media Type in NASS [3] and in RACS [2]	Media-Type	O
Reservation Class in RACS [2]	Reservation-Class	O
Transport Service Class in RACS [2] and in NASS [3]	Transport-Class	O
Service Class in RACS [2]	Service-Class	O
NOTE: The Logical Access ID identifies the logical access used by the attached user equipment. In the xDSL case, the Logical Access ID may explicitly contain the identifier of VP and/or VC carrying the traffic. Can be used as the agent circuit ID present in DHCP option 82, including <Access-Node-Identifier> atm <rack>/<shelf>/<slot>/<DSL-Line>:<VPI.<VCI>.		

Any value of the Flow-Status AVP received in an initial AA-Request (in which the Session-Id is new) different from ENABLED-UPLINK, ENABLED-DOWNLINK, ENABLED or DISABLED shall result in an error. If the Flow-Status AVP has the value REMOVED the lower-tier x-RACF shall return an AA-Answer containing a Failed-AVP AVP and a Result-Code AVP with the value DIAMETER_INVALID_AVP_VALUE.

In case the operation fails due to lack of resources, the lower-tier x-RACF shall include the Experimental-Result-Code AVP set to the value INSUFFICIENT_RESOURCES.

An initial reservation request can be admitted by the lower-tier x-RACF if for all media streams in the session, the resource requirements fit within the constraints of remaining envelopes of unused resources. The lower-tier x-RACF is presumed to exhibit "atomic" reservation semantics (i.e. either all reservations are admitted, or none of them). Once a reservation is admitted, the corresponding amount of resources is removed from the pool of available resources.

If the request is admitted the lower-tier x-RACF must send an AA-Answer back to the top-tier x-RACF and include the Result-Code AVP set to the value DIAMETER_SUCCESS.

Upon successful reservation, the lower-tier x-RACF shall store the Diameter base protocol Session-Id received in the AA-Request through which the initial reservation request was made, and the Media-Component-Number(s) and Flow-Number(s). The AA-Request may contain the Authorization-Lifetime AVP. The lower-tier x-RACF shall interpret the presence of the Authorization-Lifetime AVP as a request for a soft-state reservation and the absence of this AVP as a request for a hard-state reservation. The lower-tier x-RACF may however return the Authorization-Lifetime AVP or the pair of Authorization-Lifetime AVP and Auth-Grace-Period AVP although the AA-Request did not contain the Authorization-Lifetime AVP. The lower-tier x-RACF thereby offers a soft-state reservation although the request was for hard-state. The lower-tier x-RACF may also choose not to return the Authorization-Lifetime AVP and the Auth-Grace-Period AVP although the AA-Request contained the Authorization-Lifetime AVP. The lower-tier x-RACF thereby offers a hard-state reservation although the request was for soft-state reservation.

The Authorization-Lifetime indicates when the lower-tier x-RACF expects a Refresh from the top-tier x-RACF. The Auth-Grace-Period AVP can only be specified in addition to the Authorization-Lifetime AVP.

As specified in clause 8.9 of RFC 3588 [8] the Diameter server (i.e. the lower-tier x-RACF) may return the Authorization-Lifetime AVP set to a value equal to, or smaller than the value of the Authorization-Lifetime AVP provided by the top-tier x-RACF.

The lower-tier x-RACF may include one or more Session-Bundle-Id AVPs in the AA-Answer. The Session-Bundle-Id AVP identifies a group of sessions to which the session belongs. The value of this AVP and the sessions that belong to a certain such value are chosen by the lower-tier x-RACF. The value of the Session-Bundle-Id AVP is meaningful only for the lower-tier x-RACF. If the Specific-Action AVP is included in the initial AA-Request, notification for the given event(s) shall be activated by the lower-tier x-RACF. The supported events are listed in clause 6.5.8.

5.2.1.2.2 Resource Modification and Release for Media Flows

When the lower-tier x-RACF receives requests in which both the Session-Id and the Media-Component-Number(s) and Flow-Number(s) of existing reservations are existing ones, it performs the resource admission and reservation for modified flows.

An AA-Request issued to modify an existing session may contain zero or more Media-Component-Description AVP(s) optionally including one or more Media-Sub-Component AVP(s). Media-Component-Number(s) and Flow-Number(s) of new Media-Component-Description AVP(s) and Media-Sub-Component AVP(s) are interpreted by the lower-tier x-RACF as new ones.

For an AA-Request issuing a session modification operation the Flow-Status AVP must be set to a value representing a state to which the session is allowed to enter from its current state. Should the Flow-Status AVP be set to a disallowed value the lower-tier x-RACF shall return an AA-Answer containing a Failed-AVP AVP and a Result-Code AVP with the value DIAMETER_INVALID_AVP_VALUE.

In the case the lower-tier x-RACF also needs to control the enforcement of the resources, if the lower-tier x-RACF is unable to modify the status of a reservation to ENABLED-UPLINK, ENABLED-DOWNLINK or ENABLED, the lower-tier x-RACF shall issue an error message to the top-tier x-RACF with an Experimental-Result-Code AVP set to the value COMMIT_FAILURE. If the status of a reservation is one of the values ENABLED-UPLINK, ENABLED-DOWNLINK or ENABLED, the AA-Request should not contain a Flow-Status AVP set to DISABLED. If it does, the lower-tier x-RACF shall return an AA-Answer to the top-tier x-RACF with an Experimental-Result-Code AVP set to the value MODIFICATION_FAILURE. If the lower-tier x-RACF is not able to re-initialize the lifetime of the reservation, it shall return an AA-Answer to the top-tier x-RACF with an Experimental-Result-Code AVP set to the value REFRESH_FAILURE.

If a flow-level operation fails, the entire Resource Modification operation fails. In the case the lower-tier x-RACF determines that the request cannot be admitted due to insufficient resources, it shall return an Experimental-Result-Code AVP to the top-tier x-RACF set to the value INSUFFICIENT_RESOURCES.

In case the Specific-Action AVP, the AF-Charging-Identifier AVP, the User-Name AVP or the Globally-Unique-Address AVP was provided in an initial AA-Request with a value different from the value of the AVP(s) in a modifying AA-Request, the lower-tier x-RACF shall return an AA-Answer containing a Failed-AVP AVP and a Result-Code AVP with the value DIAMETER_INVALID_AVP_VALUE.

Upon successful session modification, the lower-tier x-RACF must send an AA-Answer back to the top-tier x-RACF with the Result-Code AVP set to DIAMETER_SUCCESS.

Upon a successful refresh operation, the lower-tier x-RACF shall in the AA-Answer return the Authorization-Lifetime AVP with a value equal or smaller than the Authorization-Lifetime AVP of the AA-Request (if any). The Auth-Grace-Period AVP can only be specified in addition to the Authorization-Lifetime AVP.

Whether Authorization-Lifetime AVP and Auth-Grace-Period AVP need to be specified in the AA-Answer is a local decision for the lower-tier x-RACF.

If a reference to a previously negotiated Media-Component-Description AVP and/or Media-Sub-Component AVP for the session in question is omitted in the AA-Request, the corresponding flow is not impacted by the Modification operation.

5.2.1.2.3   Termination and Release of the Resources for a Resource Reservation Session

If all resources within an established resource reservation session need to be terminated, the lower-tier x-RACF shall inform the top-tier x-RACF about this event by sending an Abort-Session-Request (ASR) message with the appropriate Abort-Cause AVP value, and all resources within the authorized session will be released. The lower-tier x-RACF may include one or more Session-Bundle-Id AVPs in order to inform the top-tier x-RACF of that several sessions identified by the provided Session-Bundle-Id AVP(s) are terminated.

Upon receipt of a Session-Termination-Request (STR) message from the top-tier x-RACF the lower-tier x-RACF shall release all the resources associated with the session identified through the provided Session-Id AVP. If an unknown Session-Id is provided in the STR the lower-tier x-RACF shall return a Session-Termination-Answer (STA) message to the top-tier x-RACF with the Result-Code AVP set to DIAMETER_UNKNOWN_SESSION_ID.

5.2.1.2.4   Event Notification

If an event for which notification is required occurs, the lower-tier x-RACF shall send an unsolicited Re-Auth-Request (RAR) message to the top-tier x-RACF containing:

- The value of the Specific-Action AVP, indicating the event that occurred.

- Optionally, the appropriate Abort-Cause AVP value.

5.2.2   Procedures for Delegated Model

5.2.2.1   Delegation Push triggered by the delegating x-RACF

This procedure is used for the delegating x-RACF to push the delegation information to the delegated x-RACF. This information flow occurs at the initial provisioning stage or when the delegating x-RACF decides to synchronize the delegation information between the delegating x-RACF and the delegated x-RACF. This procedure is mapped to the commands Push-Notification-Request/Answer in the Diameter application specified in clause 7.

5.2.2.1.1   Procedures at the delegating x-RACF

The delegating x-RACF shall obtain the address of the delegated x-RACF entity where the information should be pushed (e.g. from configuration data).

The delegating x-RACF shall populate the Push-Notification-Request as follows:

- The Network-Resource-Id AVP shall be present and   shall contain the identifier of the network resource to be delegated.

- At least one of Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVP shall be present.

- The presence of Total-Bandwidth-UL and Total-Bandwidth-DL AVP depends on the network resource and local policy rules.

The Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL, Required-Delegated-Bandwidth-UL, Required-Delegated-Bandwidth-DL and Reservation-priority AVPs shall not be present.

5.2.2.1.2   Procedures at the delegated x-RACF

On receipt of the Push-Notification-Request with at least either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVPs, the delegated x-RACF take the Push-Notification-Request as the delegation push request.

If there is no delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, the delegated x-RACF shall create an internal record to store the received information for future use.

If there is a delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, the delegated x-RACF shall replace the entire content of the internal record with the received information for future use. Such an update shall not have any impact on ongoing application sessions for which an authorization has already been provided by the delegating x-RACF.

If the contents of the request are invalid the delegated x-RACF shall return a Push-Notification-Answer with a Result-Code AVP value set to the appropriate value as described in clause 5.1.

If the delegated x-RACF cannot fulfil the received request for reasons not stated in the above steps, e.g. due to database error, it shall stop processing the request and return a Push-Notification-Answer with a Result-Code AVP value set to DIAMETER_UNABLE_TO_COMPLY or an Experimental-Result-Code AVP set to DIAMETER_SYSTEM_UNAVAILABLE. In the later case, the delegating x-RACF is expected to retry after a provisioned time period.

Otherwise, the requested operation shall take place and the delegated x-RACF shall return the Result-Code AVP set to DIAMETER_SUCCESS in the Push-Notification-Answer.

The Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL should not be present in the Push-Notification-Answer.

5.2.2.2   Delegation Negotiation triggered by the delegated x-RACF

This procedure is used for the delegated x-RACF to negotiate the delegation with the delegating x-RACF. This information flow occurs normally when there is insufficient delegated bandwidth for a new application session on the delegated x-RACF. This procedure is mapped to the commands User-Data-Request/Answer in the Diameter application specified in clause 7.

5.2.2.2.1   Procedures at the delegated x-RACF

The delegated x-RACF shall populate the User-Data-Request as follows:

- The Network-Resource-Id AVP shall be present and   shall contain the identifier of the network resource to be delegated.

- At least one of the Required-Delegated-Bandwidth-UL and Required-Delegated-Bandwidth-DL AVP shall be present.

- The Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL and Reservation-priority AVPs may be present optionally. If the Required-Delegated-Bandwidth-UL AVP is not present, the Preferred-Delegated-Bandwidth-UL AVP shall not be present. If the Required-Delegated-Bandwidth-DL AVP is not present, the Preferred-Delegated-Bandwidth-DL AVP shall not be present.

On receipt of the corresponding User-Data-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and at least either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVPs, the delegated x-RACF updates the corresponding content of the internal record with the received information for future use (e.g. allocating the resource for pending application sessions).

5.2.2.2.2   Procedures at the delegating x-RACF

On receipt of the User-Data-Request with at least either of the Required-Delegated-Bandwidth-UL and Required-Delegated-Bandwidth-DL AVPs, the delegating x-RACF takes the User-Data-Request as the delegation negotiation request.

If the contents of the request are invalid the delegating x-RACF shall return a User-Data-Answer with a Result-Code AVP value set to the appropriate value as described in clause 5.1.

The delegating x-RACF shall, in the following order:

1) If the network resource identified by the Network-Resource-Id AVP is unknown or is not handled in the delegating x-RACF or is not allowed to be delegated to the delegated x-RACF, return a User-Data-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_UNAVAILABLE.

2) If the network resource identified by the Network-Resource-Id AVP is handled in the delegating x-RACF and is allowed to be delegated to the delegated x-RACF, decide if the delegated bandwidth can be changed to the value indicated by the messages for each requested direction.

    a) If Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP is present and the uplink (downlink) delegated bandwidth to be delegated can be changed to the amount carried in this AVP without affecting the ongoing application sessions admitted by the delegating x-RACF and violating any policy rules in the delegating x-RACF, the delegating x-RACF changes the uplink (downlink) delegated bandwidth to the amount carried in the Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP.

    b) If Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP is not present or the uplink (downlink) delegated bandwidth can not be changed to the value carried in the Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegating x-RACF and violating any policy rules in the delegating x-RACF, the delegating x-RACF decides if the uplink (downlink) delegated bandwidth can be changed to the value indicated by the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP:

        i) If the uplink (downlink) delegated bandwidth can be changed to the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegating x-RACF and violating any policy rules in the delegating x-RACF, the delegating x-RACF changes the uplink (downlink) delegated bandwidth to the amount carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP.

        ii) If the uplink (downlink) delegated bandwidth can not be changed to the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegating x-RACF and violating any policy rules in the delegating x-RACF, and if the Reservation-priority AVP is present, the delegating x-RACF evaluates if the uplink (downlink) delegated bandwidth can reach the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP by releasing sufficient ongoing application sessions with lower reservation priority than the value carried in the Reservation-priority AVP. If it can, then the delegating x-RACF releases sufficient ongoing application sessions with lower reservation priority, and changes the uplink (downlink) delegated bandwidth to the amount carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP.

    c) If either direction of the delegated bandwidth can not be changed as requested in the above steps, the delegating x-RACF shall return a User-Data-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_INSUFFICIENT. Otherwise, the delegating x-RACF shall return a User-Data-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and with the delegated bandwidth(s) in both or either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVP. If the uplink delegated bandwidth is requested, the Granted-Delegated-Bandwidth-UL AVP must be included in the successful answer. If the downlink delegated bandwidth is requested, the Granted-Delegated-Bandwidth-DL AVP must be included in the successful answer.

5.2.2.3 Delegation Negotiation triggered by the delegating x-RACF

This procedure is used for the delegating x-RACF to negotiate the delegation with the delegated x-RACF. This information flow occurs normally when there is insufficient delegated bandwidth for a new application session on the delegating x-RACF. This procedure is mapped to the commands Push-Notification-Request/Answer in the Diameter application specified in clause 7.

5.2.2.3.1   Procedures at the delegating x-RACF

The delegating x-RACF shall populate the Push-Notification-Request as follows:

- The Network-Resource-Id AVP shall be present and   shall contain the identifier of the network resource to be delegated.

- At least one of the Required-Delegated-Bandwidth-UL and Required-Delegated-Bandwidth-DL AVP shall be present.

- The Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL and Reservation-priority AVPs may be present optionally. If the Required-Delegated-Bandwidth-UL AVP is not present, the Preferred-Delegated-Bandwidth-UL AVP shall not be present. If the Required-Delegated-Bandwidth-DL AVP is not present, the Preferred-Delegated-Bandwidth-DL AVP shall not be present.

On receipt of the corresponding Push-Notification-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and at least either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVPs, the delegating x-RACF updates the corresponding content of the internal record with the received information for future use (e.g. allocating the resource for the pending application sessions).

5.2.2.3.2   Procedures at the delegated x-RACF

On receipt of the Push-Notification-Request with at least either of the Required-Delegated-Bandwidth-UL and Required-Delegated-Bandwidth-DL AVPs, the delegated x-RACF takes the Push-Notification-Request as the delegation negotiation request.

If the contents of the request are invalid the delegated x-RACF shall return a Push-Notification-Answer with a Result-Code AVP value set to the appropriate value as described in clause 5.1.

The delegated x-RACF shall, in the following order:

1) If there is no delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, return a Push-Notification-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_UNAVAILABLE.

2) If there is a delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, decide if the delegated bandwidth can be changed to the value indicated by the messages for each requested direction.

   a) If Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP is present and the uplink (downlink) delegated bandwidth to be delegated can be changed to the amount carried in this AVP without affecting the ongoing application sessions admitted by the delegated x-RACF, the delegated x-RACF changes the uplink (downlink) delegated bandwidth to the amount carried in the Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP.

   b) If Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP is not present or the uplink (downlink) delegated bandwidth can not be changed to the value carried in the Preferred-Delegated-Bandwidth-UL (Preferred-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegated x-RACF, the delegated x-RACF decides if the uplink (downlink) delegated bandwidth can be changed to the value indicated by the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP:

      i) If the uplink (downlink) delegated bandwidth can be changed to the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegated x-RACF, the delegated x-RACF changes the uplink (downlink) delegated bandwidth to the amount carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP.

ii) If the uplink (downlink) delegated bandwidth can not be changed to the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP without affecting the ongoing application sessions admitted by the delegated x-RACF, and if the Reservation-priority AVP is present, the delegated x-RACF evaluates if the uplink (downlink) delegated bandwidth can reach the value carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP by releasing sufficient ongoing application sessions with lower reservation priority than the value carried in the Reservation-priority AVP. If it can, then the delegated x-RACF releases sufficient ongoing application sessions with lower reservation priority, and changes the uplink (downlink) delegated bandwidth to the amount carried in the Required-Delegated-Bandwidth-UL (Required-Delegated-Bandwidth-DL) AVP.

c) If either direction of the delegated bandwidth can not be changed as requested in the above steps, the delegated x-RACF shall return a Push-Notification-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_INSUFFICIENT. Otherwise, the delegated x-RACF shall return a Push-Notification-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and with the delegated bandwidth(s) in both or either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVP. If the uplink delegated bandwidth is requested, the Granted-Delegated-Bandwidth-UL AVP must be included in the successful answer. If the downlink delegated bandwidth is requested, the Granted-Delegated-Bandwidth-DL AVP must be included in the successful answer.

5.2.2.4 Delegation Query triggered by the delegating x-RACF

This procedure is used for the delegating x-RACF to query the delegation from the delegated x-RACF. This information flow occurs normally when the delegating x-RACF discovers there is a possibility of inconsistency of the delegation between the delegating x-RACF and the delegated x-RACF. This procedure is mapped to the commands Push-Notification-Request/Answer in the Diameter application specified in clause 7.

5.2.2.4.1 Procedures at the delegating x-RACF

The delegating x-RACF shall populate the Push-Notification-Request as follows:

- The Network-Resource-Id AVP shall be present and   shall contain the identifier of the network resource to be delegated.

- None of the Granted-Delegated-Bandwidth-UL, Granted-Delegated-Bandwidth-DL, Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL, Required-Delegated-Bandwidth-UL, Required-Delegated-Bandwidth-DL and Reservation-priority AVPs shall be present.

On receipt of the corresponding Push-Notification-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and at least either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVPs, the delegating x-RACF may take the result of the query into account in deciding whether synchronization is needed and how much bandwidth should be delegated.

5.2.2.4.2 Procedures at the delegated x-RACF

On receipt of the Push-Notification-Request with none of the Granted-Delegated-Bandwidth-UL, Granted-Delegated-Bandwidth-DL, Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL, Required-Delegated-Bandwidth-UL, Required-Delegated-Bandwidth-DL and Reservation-priority AVPs, the delegated x-RACF takes the Push-Notification-Request as the delegation query request.

If the contents of the request are invalid the delegated x-RACF shall return a Push-Notification-Answer with a Result-Code AVP value set to the appropriate value as described in clause 5.1.

The delegated x-RACF shall, in the following order:

1) If there is no delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, return a Push-Notification-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_UNAVAILABLE.

2) If there is a delegation record with the network resource identifier contained in the Network-Resource-Id AVP as a key, return a Push-Notification-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and populate the Push-Notification-Request as follows:

   a) The Granted-Delegated-Bandwidth-UL shall be present if the uplink bandwidth has been delegated to the delegated x-RACF.

   b) The Granted-Delegated-Bandwidth-DL shall be present if the downlink bandwidth has been delegated to the delegated x-RACF.

   c) The Total-Bandwidth-UL shall be present if the total uplink bandwidth has been provisioned by the delegating x-RACF.

   d) The Total-Bandwidth-DL shall be present if the total downlink bandwidth has been provisioned by the delegating x-RACF.

5.2.2.5 Delegation Query triggered by the delegated x-RACF

This procedure is used for the delegated x-RACF to query the delegation from the delegating x-RACF. This information flow occurs normally when the delegated x-RACF discovers there is a possibility of inconsistency of the delegation between the delegated x-RACF and the delegating x-RACF. This procedure is mapped to the commands User-Data-Request/Answer in the Diameter application specified in clause 7.

5.2.2.5.1 Procedures at the delegated x-RACF

The delegated x-RACF shall populate the User-Data-Request as follows:

- The Network-Resource-Id AVP shall be present and shall contain the identifier of the network resource to be delegated.

- None of the Granted-Delegated-Bandwidth-UL, Granted-Delegated-Bandwidth-DL, Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL, Required-Delegated-Bandwidth-UL, Required-Delegated-Bandwidth-DL and Reservation-priority AVPs shall be present.

On receipt of the corresponding User-Data-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and at least either of the Granted-Delegated-Bandwidth-UL and Granted-Delegated-Bandwidth-DL AVPs, the delegated x-RACF updates the corresponding content of the internal record with the received information for future use (e.g. allocating the resource for new application sessions).

5.2.2.5.2 Procedures at the delegating x-RACF

On receipt of the User-Data-Request with none of the Granted-Delegated-Bandwidth-UL, Granted-Delegated-Bandwidth-DL, Preferred-Delegated-Bandwidth-UL, Preferred-Delegated-Bandwidth-DL, Required-Delegated-Bandwidth-UL, Required-Delegated-Bandwidth-DL and Reservation-priority AVPs, the delegating x-RACF takes the User-Data-Request as the delegation query request.

If the contents of the request are invalid the delegating x-RACF shall return a User-Data-Answer with a Result-Code AVP value set to the appropriate value as described in clause 5.1.

The delegating x-RACF shall, in the following order:

1) If the network resource identified by the Network-Resource-Id AVP is unknown or is not handled in the delegating x-RACF or is not allowed to be delegated to the delegated x-RACF, return a User-Data-Answer with the Experimental-Result-Code AVP set to NETWORK_RESOURCE_UNAVAILABLE.

2) If the network resource identified by the Network-Resource-Id AVP is handled in the delegating x-RACF and is allowed to be delegated to the delegated x-RACF, return a User-Data-Answer with the Result-Code AVP set to DIAMETER_SUCCESS and populate the Push-Notification-Request as follows:

   a) The Granted-Delegated-Bandwidth-UL shall be present if the uplink bandwidth has been delegated to the delegated x-RACF.

   b) The Granted-Delegated-Bandwidth-DL shall be present if the downlink bandwidth has been delegated to the delegated x-RACF.

5.2.2.6   Event Notification triggered the delegating x-RACF

If an event for which notification is requested occurs, the delegating x-RACF shall send a CCR message to the delegated x-RACF containing:

- The value of the Specific-Action AVP, indicating the event that occurred.

- Optionally, the address of the UE that requested the multicast flow and the flow description of the flow.

- Optionally, the appropriate Abort-Cause AVP value.

The delegating x-RACF shall send a CCA message to the delegated x-RACF in response to the CCR message.

5.2.2.7   Event Notification at the delegated x-RACF

If an event for which notification is requested occurs, the delegated x-RACF shall send an unsolicited RAR message to the delegating x-RACF containing:

- The value of the Specific-Action AVP, indicating the event that occurred.

- Optionally, the address of the UE that requested the multicast flow and the flow description of the flow.

- Optionally, the appropriate Abort-Cause AVP value.

The delegated x-RACF shall send a RAA message to the delegating x-RACF in response to the RAR message.

6   DIAMETER application for Request Model

6.1   Use of the Diameter base protocol

The Rr protocol is based on Diameter (RFC 3588 [8]).

The Diameter Base Protocol as specified in RFC 3588 [8] used to support information transfer on the Rr interface. RFC 3588 [8] shall apply except as modified by the defined Rr application specific procedures, Attribute-Value Pairs (AVPs) as well as Experimental-Result-Code AVP and Specific-Action AVP values defined in the present document. Unless otherwise specified, the procedures of RFC 3588 [8] (including error handling and unrecognized information handling) are unmodified. In addition to the AVPs defined in clause 7.3, the Diameter AVPs from the Diameter base application (RFC 3588 [8]) are reused within the Diameter messages sent over the Rr reference point.

The support of AVPs from the Diameter Network Access Server Application (NASREQ) (RFC 4005 [9]) is not required for Diameter implementations that conform to the present document. Accounting functionality (Accounting Session State Machine, related command codes and AVPs) is not used in the Rr specification.

With regard to the Diameter protocol defined over the Rr reference point for request model, the lower-tier x-RACF acts as a Diameter server, in the sense that it is the network element that handles authorization requests for a particular realm. The top-tier x-RACF acts as the Diameter Client, in the sense that is the network element requesting authorization to use bearer path network resources.

The support of Diameter agents between the lower-tier x-RACF and the top-tier x-RACF, is optional where the Rr is intra operator i.e. lower-tier x-RACF and top-tier x-RACF are all in the same domain.

6.1.1   Securing Diameter Messages

For secure transport of Diameter messages, see TS 133 210 [11].

6.1.2   Accounting functionality

Accounting functionality (Accounting Session State Machine, related command codes and AVPs) is not used on the Rr interface for the Diameter application for the Rr request model.

6.1.3   Use of sessions

The Session-Termination-Request (STR) and Session-Termination-Answer (STA) commands defined in RFC 3588 [8] shall be used in order to terminate the sessions.

6.1.4   Transport protocol

Diameter messages over the Rr reference point shall make use of SCTP RFC 4960 [12] and shall utilize the new SCTP checksum method specified in RFC 4960 [12].

6.1.5   Routing considerations

Both the Destination-Realm and Destination-Host AVPs shall be present in the request.

6.1.6   Advertising Application Support

The Capabilities-Exchange-Request (CER) and Capabilities-Exchange-Answer (CEA) commands are specified in the Diameter Base Protocol RFC 3588 [8].

The top-tier x-RACF and lower-tier x-RACF shall advertise the support of the Rr specific application for request model by including the value 16777278 of the application identifier in the Auth-Application-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The vendor identifier value of ETSI (13019) shall be included in the Vendor-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands, and in the Vendor-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands. Additionally, the top-tier x-RACF and the lower-tier x-RACF shall advertise the support of additional Vendor-ID AVPs by including the values 10415 (3GPP) in different Supported-Vendor-Id AVP of the CER and CEA commands.

> NOTE: The Vendor-Id AVP included in Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands that is not included in the Vendor-Specific-Application-Id AVPs as described above indicates the manufacturer of the Diameter node as per RFC 3588 [8].

6.2   Commands

Existing Diameter command codes from the Diameter base protocol RFC 3588 [8] and RFC 4005 [9] are used at the Rr interface.

6.2.1   AA-Request (AAR) Command

The AA-Request command (AAR), indicated by the Command-Code field set to 265 and the "R" bit set in the Command Flags field, is sent by the top-tier x-RACF to the lower-tier x-RACF for reserve, commit, modify and refresh operations.

Message Format:

```
<AA-Request> ::= < Diameter Header: 265, REQ, PXY, 16777278 >
                 < Session-Id >
                 { Auth-Application-ID }
                 { Origin-Host }
                 { Origin-Realm }
                 { Destination-Realm }
                 [ Destination-Host ]
                *[ Specific-Action ]
                 [ AF-Charging-Identifier ]
                *[ Media-Component-Description ]
                 [ User-Name ]
                 [Logical-Access-Id]
                 [ Globally-Unique-Address ]
                 [ Service-Class ]
                 [ Authorization-Lifetime ]
                *[ Proxy-Info ]
```

```
                *[ Route-Record ]
                *[ AVP ]
```

6.2.2   AA-Answer (AAA) Command

The AA-Answer command (AAA), indicated by the Command-Code field set to 265 and the "R" bit cleared in the Command Flags field, is sent by the lower-tier x-RACF to the top-tier x-RACF in response to the AAR command.

Message Format:

```
<AA-Answer> ::=  < Diameter Header: 265, PXY, 16777278 >
                  < Session-Id >
                  { Auth-Application-ID }
                  { Origin-Host }
                  { Origin-Realm }
                  [ Result-Code ]
                  [ Experimental-Result ]
                  [ Error-Message ]
                  [ Error-Reporting-Host ]
                  [ Auth-Grace-Period ]
                  *[ Session-Bundle-Id ]
                  [ Authorization-Lifetime ]
                  *[ Failed-AVP ]
                  *[ Proxy-Info ]
                  *[ AVP ]
```

6.2.3   Re-Auth-Request (RAR) Command

The RAR command, indicated by the Command-Code field set to 258 and the "R" bit set in the Command Flags field, is sent by the lower-tier x-RACF to the top-tier x-RACF in order to indicate a specific action.

The values INDICATION_OF_RELEASE_OF_BEARER, INDICATION_OF_SUBSCRIBER_DETACHMENT, INDICATION_OF_RESERVATION_EXPIRATION of the Specific-Action AVP shall not be combined with each other in a Re-Auth-Request.

Message Format:

```
<RA-Request> ::= < Diameter Header: 258, REQ, PXY, 16777278 >
                  < Session-Id >
                  { Origin-Host }
                  { Origin-Realm }
                  { Destination-Realm }
                  { Destination-Host }
                  { Auth-Application-Id }
                  *{ Specific-Action }
                  *[ Flows ]
                   [ Abort-Cause ]
                  [ Origin-State-Id ]
                  *[ Proxy-Info ]
                  *[ Route-Record ]
                  *[ AVP ]
```

6.2.4   Re-Auth-Answer (RAA) Command

The RAA command, indicated by the Command-Code field set to 258 and the "R" bit cleared in the Command Flags field, is sent by the top-tier x-RACF to the lower-tier x-RACF in response to the RAR command.

Message Format:

```
<RA-Answer> ::= < Diameter Header: 258, PXY, 16777278 >
                  < Session-Id >
                  { Origin-Host }
                  { Origin-Realm }
                  [ Result-Code ]
                  [ Experimental-Result ]
                  *[ Media-Component-Description ]
                  [ Origin-State-Id ]
                  [ Error-Message ]
                  [ Error-Reporting-Host ]
                  *[ Failed-AVP ]
                  *[ Proxy-Info ]
```

```
                  *[ AVP ]
```

6.2.5   Session-Termination-Request (STR) Command

The STR command, indicated by the Command-Code field set to 275 and the "R" bit set in the Command Flags field, is sent by the top-tier x-RACF to inform the lower-tier x-RACF that an authorized session shall be terminated.

Message Format:

```
<ST-Request> ::= < Diameter Header: 275, REQ, PXY, 16777278 >
                  < Session-Id >
                  { Origin-Host }
                  { Origin-Realm }
                  { Destination-Realm }
                  { Auth-Application-ID }
                  { Termination-Cause }
                  [ Destination-Host ]
                 *[ Class ]
                  [ Origin-State-Id ]
                 *[ Proxy-Info ]
                 *[ Route-Record ]
                 *[ AVP ]
```

6.2.6   Session-Termination-Answer (STA) Command

The STA command, indicated by the Command-Code field set to 275 and the "R" bit cleared in the Command Flags field, is sent by the lower-tier x-RACF to the top-tier x-RACF in response to the STR command.

Message Format:

```
<ST-Answer> ::=  < Diameter Header: 275, PXY, 16777278 >
                  < Session-Id >
                  { Origin-Host }
                  { Origin-Realm }
                  [ Result-Code ]
                  [ Experimental-Result ]
                  [ Error-Message ]
                  [ Error-Reporting-Host ]
                 *[ Failed-AVP ]
                  [ Origin-State-Id ]
                 *[ Redirect-Host ]
                  [ Redirect-Host-Usage ]
                  [ Redirect-Max-Cache-Time ]
                 *[ Proxy-Info ]
                  [ AVP ]
```

6.2.7   Abort-Session-Request (ASR) Command

The ASR command, indicated by the Command-Code field set to 274 and the "R" bit set in the Command Flags field, is sent by the lower-tier x-RACF to inform the top-tier x-RACF that all resources for the authorized session have become unavailable.

Message Format:

```
<AS-Request> ::= < Diameter Header: 274, REQ, PXY, 16777278 >
                  < Session-Id >
                  { Origin-Host }
                  { Origin-Realm }
                  { Destination-Realm }
                  { Destination-Host }
                  { Auth-Application-ID }
                  { Abort-Cause }
                 *[ Session-Bundle-Id ]
                  [ Origin-State-Id ]
                 *[ Proxy-Info ]
                 *[ Route-Record ]
                  [ AVP ]
```

6.2.8   Abort-Session-Answer (ASA) Command

The ASA command, indicated by the Command-Code field set to 274 and the "R" bit cleared in the Command Flags field, is sent by the top-tier x-RACF to the lower-tier x-RACF in response to the ASR command.

Message Format:

```
<AS-Answer> ::=  < Diameter Header: 274, PXY, 16777278 >
                   < Session-Id >
                   { Origin-Host }
                   { Origin-Realm }
                   [ Result-Code ]
                   [ Experimental-Result ]
                   [ Origin-State-Id ]
                   [ Error-Message ]
                   [ Error-Reporting-Host ]
                  *[ Failed-AVP ]
                  *[ Redirected-Host ]
                   [ Redirected-Host-Usage ]
                   [ Redirected-Max-Cache-Time ]
                  *[ Proxy-Info ]
                  *[ AVP ]
```

6.3   Experimental-Result-Code AVP values

6.3.1   Experimental-Result-Code AVP values imported from TS 129 209

This clause lists the specific values of the Experimental-Result-Code AVP imported from TS 129 209 [7] (vendor-id is 3GPP):

- INVALID_SERVICE_INFORMATION (5061):

  - The service information provided by the top-tier x-RACF is invalid or insufficient for the lower-tier x-RACF to perform the requested action.

- FILTER_RESTRICTIONS (5062):

  - The Flow-Description AVP(s) cannot be handled by the lower-tier x-RACF because restrictions defined in clause 7.3.7 are not observed.

6.3.2   Experimental-Result-Code AVP values imported from TS 183 026

This clause lists the specific values of the Experimental-Result-Code AVP imported from TS 183 026 [10] (vendor-id is ESTI):

- INSUFFICIENT_RESOURCES (4041):

  - The lower-tier x-RACF indicates insufficient resources to perform the requested action.

- MODIFICATION_FAILURE (5041):

  - The lower-tier x-RACF or BGF indicates that the resources reservation could not be modified. This is a permanent failure.

- COMMIT_FAILURE (4043):

  - The lower-tier x-RACF indicates that the resources reservation could not be committed.

- REFRESH_FAILURE (4044):

  - The lower-tier x-RACF indicates that the lifetime of a reservation could not be extended.

- QOS_PROFILE_FAILURE (4045):

  - The lower-tier x-RACF indicates that the request did not match the QoS profile.

- ACCESS_PROFILE_FAILURE (4046):

    - The lower-tier x-RACF indicates that the request did not match any access profile.

- PRIORITY_NOT_GRANTED (4047):

    - The lower-tier x-RACF indicates that the priority level of the request is not accepted.

6.4   Use of namespaces

This clause contains the namespaces that have either been created in the present document for the Rr request model, or the values assigned to existing namespaces managed by IANA.

6.4.1   AVP codes

The present document does not define any new AVPs for the Diameter application for the Rr request model.

6.4.2   Experimental-Result-Code AVP values

The present document does not define any new Experimental-Result-Code AVP values for the Diameter application for the Rr request model.

6.4.3   Command Code values

The present document does not assign command code values but uses existing command codes for the Diameter application for the Rr request model.

6.4.4   Application-ID value

The present document uses value 16777278, allocated by IANA, as application identifier for the Diameter application for the Rr request model.

6.5   AVPs

This clause summarizes the AVPs used in the present document for the Diameter application for the Rr request model, beyond those defined in the Diameter Base Protocol.

The present document does not define any new AVPs for the Diameter application for the Rr request model.

Table 6.1 describes the Diameter AVPs imported from 129 209 [7]. The Vendor-Id header for these AVPs shall be set to 3GPP (10415).

Table 6.1: Diameter AVPs imported from TS 129 209 [7]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				
				Must	May	Should not	Must not	May encrypt
Abort-Cause	500	6.5.1	Enumerated	M,V	P			Y
AF-Application-Identifier	504	6.5.2	OctetString	M,V	P			Y
AF-Charging-Identifier	505	6.5.3	OctetString	M,V	P			Y
Flow-Description	507	6.5.4	IPFilterRule	M,V	P			Y
Flow-Number	509	6.5.5	Unsigned32	M,V	P			Y
Flows	510	6.5.6	Grouped	M,V	P			Y
Flow-Status	511	6.5.7	Enumerated	M,V	P			Y
Flow-Usage	512	6.5.8	Enumerated	M,V	P			Y
Specific-Action	513	6.5.9	Enumerated	M,V	P			Y
Max-Requested-Bandwidth-DL	515	6.5.10	Unsigned32	M,V	P			Y
Max-Requested-Bandwidth-UL	516	6.5.11	Unsigned32	M,V	P			Y
Media-Component-Description	517	6.5.12	Grouped	M,V	P			Y
Media-Component-Number	518	6.5.13	Unsigned32	M,V	P			Y
Media-Sub-Component AVP	519	6.5.14	Grouped	M,V	P			Y
Media-Type	520	6.5.15	Enumerated	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8]. NOTE 2: The value types are defined in RFC 3588 [8].								

Table 6.2 describes the Diameter AVPs imported from TS 183 017 [5]. The Vendor-Id header for these AVPs shall be set to ETSI (13019).

Table 6.2: Diameter AVPs imported from TS 183 017 [5]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				
				Must	May	Should not	Must not	May encrypt
Reservation-Class	456	6.5.16	Unsigned32	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8]. NOTE 2: The value types are defined in RFC 3588 [8].								

Table 6.3 describes the Diameter AVPs imported from ES 283 034 [4]. The Vendor-Id header for these AVPs shall be set to ETSI (13019).

Table 6.3: Diameter AVPs imported from [4]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				
				Must	May	Should not	Must not	May encrypt
Globally-Unique-Address	300	6.5.17	Grouped	M, V	P			Y
Address-Realm	301	6.5.18	OctetString	M, V	P			Y
Logical-Access-Id	302	6.5.19	OctetString	M,V	P			Y
Transport-Class	311	6.5.20	Unsigned32	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8]. NOTE 2: The value types are defined in RFC 3588 [8].								

Table 6.4 describes the Diameter AVPs imported from TS 183 026 [10]. The Vendor-Id header for these AVPs shall be set to ETSI (13019).

Table 6.4: Diameter AVPs imported from TS 183 026 [10]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				May encrypt
				Must	May	Should not	Must not	
Session-Bundle-Id	400	6.5.21	Unsigned32	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8]. NOTE 2: The value types are defined in RFC 3588 [8].								

6.5.1 Abort-Cause AVP

The Abort-Cause AVP (AVP code 500) is of type Enumerated, and it determines the cause of an ASR. The following values defined in 129 209 [7] are used:

- BEARER_RELEASED (0):

    - This value is used when the bearer has been deactivated as a result from normal signalling handling. For xDSL, the bearer may refer to an ATM VC.

- INSUFFICIENT_SERVER_RESOURCES (1):

    - This value is used to indicate that the lower-tier x-RACF is overloaded and needs to abort the session.

- INSUFFICIENT_BEARER_RESOURCES (2):

    - This value is used when the bearer has been deactivated due to insufficient bearer resources at a transport gateway (e.g. RCEF policies being removed on an xDSL line).

6.5.2 AF-Application-Identifier AVP

The AF-Application-Identifier AVP (AVP code 504) is of type OctetString, and contains information that identifies the RACS client requesting the resources (e.g. name of an ASP or group of ASPs).

6.5.3 AF-Charging-Identifier AVP

The AF-Charging-Identifier AVP (AVP code 505) is of type OctetString, contains the AF Charging Identifier that is sent by the AF. This information may be used for charging correlation between AF and RACS functional entities.

6.5.4 Flow-Description AVP

- The Flow-Description AVP (AVP code 507) is of type IPFilterRule, and defines a packet filter for an IP flow with the following information: Direction (in or out).

- Source and destination IP address (possibly masked).

- Protocol.

- Source and destination port (list or ranges).

The IPFilterRule type shall be used with the following restrictions:

- Only the Action "permit" shall be used.

- No "options" shall be used.

- The invert modifier "!" for addresses shall not be used.

- The keyword "assigned" shall not be used.

If any of these restrictions is not observed by the top-tier x-RACF, the lower-tier x-RACF shall send an error response to the top-tier x-RACF containing the Experimental-Result-Code AVP with value FILTER_RESTRICTIONS.

The Flow description AVP shall be used to describe a single IP flow.

The direction "in" refers to IP flows from the subscriber into the access network ("uplink"), and the direction "out" refers to IP flows from the access network to the subscriber ("downlink").

6.5.5   Flow-Number AVP

The Flow-Number AVP (AVP code 509) is of type Unsigned32, and it contains the ordinal number of the IP flow(s), assigned according to the rules in annex C of TS 129 207 [13].

6.5.6   Flows AVP

The Flows AVP (AVP code 510) is of type Grouped, and it indicates IP flows via their flow identifiers. If no Flow-Number AVP(s) are supplied, the Flows AVP refers to all Flows matching the media component number.

AVP Format:

```
Flows::=      < AVP Header: x >
              { Media-Component-Number}
             *[ Flow-Number]
```

6.5.7   Flow-Status AVP

The Flow-Status AVP (AVP code 511) is of type Enumerated, and describes whether the IP flow(s) are enabled or disabled. The Flow-Status AVP may be present in the Media-Description-Component AVP and/or in the Media-Sub-Component AVP. The following values are defined:

- ENABLED-UPLINK (0):

    - This value shall be used to commit the corresponding resource reservation in the uplink direction.

- ENABLED-DOWNLINK (1):

    - This value shall be used to commit the corresponding resource reservation in the downlink direction.

- ENABLED (2):

    - This value shall be used to commit a resource reservation in both directions.

- DISABLED (3):

    - This value shall be used to indicate that the corresponding resource reservation is reserved only and not (yet) committed.

- REMOVED (4):

    - This value shall be used to release all resources associated with the corresponding resource reservation.

6.5.8   Flow-Usage AVP

The Flow-Usage AVP (AVP code 512) is of type Enumerated, and it provides information about the usage of IP Flows. The following values are defined:

- NO_INFORMATION (0):

    - This value is used to indicate that no information about the usage of the IP flow is being provided.

- RTCP (1):

  - This value is used to indicate that an IP flow is used to transport RTCP.

- NO_INFORMATION is the default value.

6.5.9 Specific-Action AVP

The Specific-Action AVP (AVP code 513) is of type Enumerated. Within an initial AA-Request the top-tier x-RACF may use the Specific-Action AVP to request from the lower-tier x-RACF notification of specific actions. If the Specific-Action AVP is omitted within the initial AA-Request, no notification of any of the events defined below is requested.

The following event from TS 129 209 [7] is supported:

- INDICATION_OF_RELEASE_OF_BEARER (4):

  - Within an AAR, this value shall be used when the lower-tier x-RACF reports to the top-tier x-RACF the release of a bearer (e.g. RCEF policies being removed on an xDSL line). In the AAR, this value indicates that the top-tier x-RACF requests the lower-tier x-RACF to provide a notification at the removal of a bearer.

The following events from TS 183 026 [10] are supported:

- INDICATION_OF_SUBSCRIBER_DETACHMENT (6):

  - Within an AAR, this value shall be used when the lower-tier x-RACF reports to the top-tier x-RACF that a subscriber has been detached. In the AAR, this value indicates that the top-tier x-RACF requests the lower-tier x-RACF to provide a notification at the detachment of a subscriber.

- INDICATION_OF_RESERVATION_EXPIRATION (7):

  - Within an AAR, this value shall be used when the lower-tier x-RACF reports to the top-tier x-RACF that a reservation is about to expire. In the AAR, this value indicates that the top-tier x-RACF requests the lower-tier x-RACF to provide a notification when a reservation expires.

Other events but the above-listed ones defined by TS 129 209 [7] are not relevant at the Rr interface and are not supported. If specified by the top-tier x-RACF, these values are ignored by the lower-tier x-RACF.

6.5.10 Max-Requested-Bandwidth-DL AVP

The Max-Requested-Bandwidth-DL AVP (AVP code 515) is type Unsigned32, and it indicates the maximum requested bandwidth in bits per second for a downlink IP flow. The bandwidth includes the bandwidth of the IP payload, including the overhead coming from the IP header.

6.5.11 Max-Requested-Bandwidth-UL AVP

The Max -Bandwidth-UL AVP (AVP code 516) is of type Unsigned32, and it indicates the maximum requested bandwidth in bits per second for an uplink IP flow. The bandwidth includes the bandwidth of the IP payload, including the overhead coming from the IP header.

6.5.12 Media-Component-Description AVP

The Media-Component-Description AVP (AVP code 517) is of type Grouped, and it contains service information for a single media component within a session. It may be based on the SDI exchanged between the AF and the AF client in the UE. The information shall be used by the lower-tier x-RACF to determine the QoS requirements.

Within one Diameter message, a single IP flow shall not be described by more than one Media-Component-Description AVP.

The Media-Component-Description AVP may contain the Flow-Status AVP, which indicates the particular reservation operation to be performed on the media, as described in clauses 5.1 and 5.2.

Bandwidth information provided within the Media-Component-Description AVP applies to all those IP flows within the media component, for which no corresponding information is being provided within Media-Sub-Component AVP(s).

If a Media-Component-Description AVP is not supplied, or if optional AVP(s) within a Media-Component-Description AVP are omitted, but corresponding information has been provided in previous Diameter messages, the previous information for the corresponding IP flow(s) remains valid.

AVP format:

```
Media-Component-Description ::=   < AVP Header: 517>
                                 { Media-Component-Number } ; Ordinal number of the media comp.
                               *[ Media-Sub-Component ]    ; Set of flows for one flow identifier
                                 [ AF-Application-Identifier ]
                                 [ Media-Type ]
                                 [ Max-Requested-Bandwidth-UL ]
                                 [ Max-Requested-Bandwidth-DL ]
                                 [ Flow-Status ]
                                 [ RS-Bandwidth ]
                                 [ RR-Bandwidth ]
                                 [ Reservation-Class ]
                                 [ Transport-Class ]
```

6.5.13   Media-Component-Number AVP

The Media-Component-Number AVP (AVP code 518) is of type Unsigned32, and it contains the ordinal number of the media component, assigned according to the rules in annex C of TS 129 207 [13].

6.5.14   Media-Sub-Component AVP

The Media-Sub-Component AVP (AVP code 519) is of type Grouped, and it contains the requested QoS and filters for the set of IP flows identified by their common Flow-Identifier. The Flow-Identifier is defined in TS 129 207 [13].

The Media-Sub-Component AVP may contain the Flow-Status AVP, which indicates the particular reservation operation to be performed on the flow, as described in clauses 5.1 and 5.2.

Possible Bandwidth information provided within the Media-Sub-Component AVP takes precedence over information within the encapsulating Media Component Description AVP. If a Media-Sub-Component AVP is not supplied, or if optional AVP(s) within a Media-Sub-Component AVP are omitted, but corresponding information has been provided in previous Diameter messages, the previous information for the corresponding IP flow(s) remains valid, unless new information is provided within the encapsulating Media-Component-Description AVP. If Flow-Description AVP(s) are supplied, they replace all previous Flow-Description AVP(s), even if a new Flow-Description AVP has the opposite direction as the previous Flow-Description AVP.

AVP Format:

```
Media-Sub-Component ::=   < AVP Header: 519 >
                          { Flow-Number }        ; Ordinal number of the IP flow
                          [ Flow-Status ]
                        0*2[ Flow-Description ] ; UL and/or DL
                          [ Flow-Usage ]
                          [ Max-Requested-Bandwidth-UL ]
                          [ Max-Requested-Bandwidth-DL ]
```

6.5.15   Media-Type AVP

The Media-Type AVP (AVP code 520) is of type Enumerated, and it determines the media type of a session component. The following values are defined:

- AUDIO (0).

- VIDEO (1).

- DATA (2).

- APPLICATION (3).

- CONTROL (4).

- TEXT (5).

- MESSAGE (6).

- OTHER (0xFFFFFFFF).

6.5.16   Reservation-Class AVP

The Reservation-Class AVP (AVP code 456) is of type Unsigned32, and it contains an integer used as an index pointing to the traffic characteristics of the flow (e.g. burstiness and packet size).

6.5.17   Globally-Unique-Address AVP

The Globally-Unique-Address AVP (AVP code 300) is of type Grouped.

AVP Format:

```
Globally-Unique-Address ::=  < AVP Header: 300 13019 >
                                 [Framed-IP-Address]
                                 [Framed-IPv6-Prefix]
                                 [Address-Realm]
```

6.5.18   Address-Realm AVP

The Address-Realm AVP (AVP code 301) is of type OctetString.

6.5.19   Logical-Access-ID AVP

The Logical-Access-ID AVP (AVP code 302 13019) is of type OctetString. It is defined in ES 283 034 [4].

6.5.20   Session-Bundle-Id AVP

The Session-Bundle-Id (AVP code 400) is of type Unsigned32. It may be specified by the lower-tier x-RACF in the AA-Answer, when the initial reservation is granted, in order to identify the group of sessions to which the session of the AA-Answer belongs. The value of the Session-Bundle-Id AVP is meaningful for the lower-tier x-RACF only. It may be included by the lower-tier x-RACF in subsequent Abort-Session-Request (ASR) messages sent to the top-tier x-RACF.

6.5.21   Transport-Class AVP

The Transport-Class AVP (AVP code 311) is of type Unsigned32, and it contains an integer used as an index pointing to a class of transport services to be applied (e.g. forwarding behaviour).

7   DIAMETER application for Delegated Model

With the clarifications listed in the following clauses the Diameter base protocol defined by RFC 3588 [8] shall apply.

7.1   Use of the Diameter base protocol

7.1.1   Securing Diameter messages

For secure transport of Diameter messages, IPSec may be used. Guidelines on the use of SCTP with IPSec can be found in RFC 3554 [14].

7.1.2   Accounting functionality

Accounting functionality (accounting session state machine, related command codes and AVPs) is not used for the delegated model of the Rr interface.

7.1.3   Use of sessions

Diameter sessions are implicitly terminated. An implicitly terminated session is one for which the server does not maintain state information. The client does not need to send any re-authorization or session termination requests to the server.

The Diameter base protocol includes the Auth-Session-State AVP as the mechanism for the implementation of implicitly terminated sessions.

The client (server) shall include in its requests (responses) the Auth-Session-State AVP set to the value NO_STATE_MAINTAINED (1), as described in RFC 3588 [8]. As a consequence, the server does not maintain any state information about this session and the client does not need to send any session termination request. Neither the Authorization-Lifetime AVP nor the Session-Timeout AVP shall be present in requests or responses.

7.1.4   Transport protocol

Diameter messages over the delegated model of the Rr interface shall make use of SCTP RFC 4960 [12] and shall utilize the new SCTP checksum method specified in RFC 4960 [12].

7.1.5   Routing considerations

This clause specifies the use of the Diameter routing AVPs Destination-Realm and Destination-Host.

Requests initiated by the delegating x-RACF towards the RACS shall include both Destination-Host and Destination-Realm AVPs. The delegating x-RACF obtains the Destination-Host AVP to use in requests towards a delegated x-RACF, from configuration data and/or the NASS User profile. Consequently, the Destination-Host AVP is declared as mandatory in the ABNF for all requests initiated by the delegating x-RACF.

Requests initiated by the delegated x-RACF towards the delegating x-RACF shall include both Destination-Host and Destination-Realm AVPs. The delegated x-RACF obtains the Destination-Host AVP to use in requests towards a delegating x-RACF, from the Origin-Host and Origin-Realm AVPs received in previous commands from the delegating x-RACF. Consequently, the Destination-Host AVP is declared as mandatory in the ABNF for all requests initiated by the delegated x-RACF.

Destination-Realm AVP is declared as mandatory in the ABNF for all requests.

7.1.6   Advertising application support

The delegating x-RACF and the delegated x-RACF shall advertise support of the Rr specific application for delegated model by including the value 16777279 of the application identifier in the Auth-Application-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

The vendor identifier value of ETSI (13019) shall be included in the Supported-Vendor-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands, and in the Vendor-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands. Additionally, support of 3GPP AVPs shall be advertised by adding the vendor identifier value of 3GPP (10415) to the Supported-Vendor-Id AVP of the Capabilities-Exchange-Request and Capabilities-Exchange-Answer commands.

   NOTE: The Vendor-Id AVP included in Capabilities-Exchange-Request and Capabilities-Exchange-Answer
            commands that is not included in the Vendor-Specific-Application-Id AVPs as described above indicates
            the manufacturer of the Diameter node as per RFC 3588 [8].

7.2   Commands

The Rr interface for Rr delegated model re-uses and modifies commands defined in TS 129 329 [15], RFC 3588 [8] or RFC 4006 [6] as follows.

Table 7.1: Command-code values

Command-Name	Abbreviation	Code	Defined In
User-Data-Request	UDR	306	TS 129 329 [15]
User-Data-Answer	UDA	306	TS 129 329 [15]
Push-Notification-Request	PNR	309	TS 129 329 [15]
Push-Notification-Answer	PNA	309	TS 129 329 [15]
Re-Auth-Request	RAR	258	RFC 3588 [8]
Re-Auth-Answer	RAA	258	RFC 3588 [8]
CC-Request	CCR	272	RFC 4006 [6]
CC-Answer	CCA	272	RFC 4006 [6]

AVPs defined in TS 129 329 [15], RFC 3588 [8] or RFC 4006 [6] and not used in the Rr interface for Rr delegated model are not shown in the below clauses. If received, these AVPs shall be ignored by the delegating x-RACF and the delegated x-RACF.

New AVPs are represented in bold.

7.2.1   User-Data-Request command

The User-Data-Request (UDR) command, indicated by the Command-Code field set to 306 and the "R" bit set in the Command Flags field, is sent by a delegated x-RACF to a delegating x-RACF to request an operation on delegation.

Message Format:

```
< User-Data -Request > ::=   < Diameter Header: 306, REQ, PXY, 16777279>
                             < Session-Id >
                             { Vendor-Specific-Application-Id }
                             { Auth-Session-State }
                             { Origin-Host }
                             { Origin-Realm }
                             [ Destination-Host ]
                             { Destination-Realm }
                             [Network-Resource-Id]
                             [Preferred-Delegated-Bandwidth-UL]
                             [Preferred-Delegated-Bandwidth-DL]
                             [Required-Delegated-Bandwidth-UL]
                             [Required-Delegated-Bandwidth-DL]
                             [Reservation-priority]
                             *[ AVP ]
                             *[ Proxy-Info ]
                             *[ Route-Record ]
```

7.2.2   User-Data-Answer command

The User-Data-Answer (UDA) command, indicated by the Command-Code field set to 306 and the "R" bit cleared in the Command Flags field, is sent by a delegating x-RACF in response to the User-Data-Request command.

Message Format:

```
< User-Data-Answer > ::=    < Diameter Header: 306, PXY, 16777279>
                            < Session-Id >
                            { Vendor-Specific-Application-Id }
                            [ Result-Code ]
                            [ Experimental-Result ]
                            { Auth-Session-State }
                            { Origin-Host }
                            { Origin-Realm }
                            [Granted-Delegated-Bandwidth-UL]
                            [Granted-Delegated-Bandwidth-DL]
                            [Total-Bandwidth-UL]
                            [Total-Bandwidth-DL]
                            *[ AVP ]
```

```
                              *[ Failed-AVP ]
                              *[ Proxy-Info ]
                              *[ Route-Record ]
```

7.2.3   Push-Notification-Request command

The Push-Notification-Request (PNR) command, indicated by the Command-Code field set to 309 and the "R" bit set in the Command Flags field, is sent by a delegating x-RACF to a delegated x-RACF to request an operation on delegation.

Message Format:

```
< Push-Notification-Request > ::=    < Diameter Header: 309, REQ, PXY, 16777279>
                                     < Session-Id >
                                     { Vendor-Specific-Application-Id }
                                     { Auth-Session-State }
                                     { Origin-Host }
                                     { Origin-Realm }
                                     { Destination-Host }
                                     { Destination-Realm }
                                      [Network-Resource-Id]
                                      [Granted-Delegated-Bandwidth-UL]
                                      [Granted-Delegated-DL]
                                      [Preferred-Delegated-Bandwidth-UL]
                                      [Preferred-Delegated-Bandwidth-DL]
                                      [Required-Delegated-Bandwidth-UL]
                                      [Required-Delegated-Bandwidth-DL]
                                      [Reservation-priority]
                                      [Total-Bandwidth-UL]
                                      [Total-Bandwidth-DL]
                                     *[ Authorization-Package-Id ]
                                     *[ AVP ]
                                     *[ Proxy-Info ]
                                     *[ Route-Record ]
```

7.2.4   Push-Notification-Answer command

The Push-Notifications-Answer (PNA) command, indicated by the Command-Code field set to 309 and the "R" bit cleared in the Command Flags field, is sent by a delegated x-RACF in response to the Push-Notification-Request command.

Message Format:

```
< Push-Notification-Answer > ::=    < Diameter Header: 309, PXY, 16777279>
                                    < Session-Id >
                                    { Vendor-Specific-Application-Id }
                                    [ Result-Code ]
                                    [ Experimental-Result ]
                                    { Auth-Session-State }
                                    { Origin-Host }
                                    { Origin-Realm }
                                     [Granted-Delegated-Bandwidth-UL]
                                     [Granted-Delegated-Bandwidth-DL]
                                     [Total-Bandwidth-UL]
                                     [Total-Bandwidth-DL]
                                    *[ AVP ]
                                    *[ Failed-AVP ]
                                    *[ Proxy-Info ]
                                    *[ Route-Record ]
```

7.2.5   Re-Auth-Request (RAR) Command

The RAR command, indicated by the Command-Code field set to 258 and the "R" bit set in the Command Flags field, is sent by the delegated x-RACF to the delegating x-RACF in order to indicate a specific action.

The values INDICATION_OF_RELEASE_OF_BEARER, INDICATION_OF_SUBSCRIBER_DETACHMENT and INDICATION_OF_RESERVATION_EXPIRATION of the Specific-Action AVP shall not be combined with each other in a Re-Auth-Request.

Message Format:

```
<RA-Request> ::=    < Diameter Header: 258, REQ, PXY, 16777279>
                    < Session-Id >
                    { Auth-Session-State }
                    { Origin-Host }
                    { Origin-Realm }
                    { Destination-Host }
                    { Destination-Realm }
                    { Auth-Application-Id }
                   *{ Specific-Action }
                   *[ Flow-Description ]
                    [ Globally-Unique-Address ]
                    [ Logical-Access-Id ]
                    [ Abort-Cause ]
                    [ Origin-State-Id ]
                   *[ Proxy-Info ]
                   *[ Route-Record ]
                   *[ AVP ]
```

7.2.6   Re-Auth-Answer (RAA) command

The RAA command, indicated by the Command-Code field set to 258 and the "R" bit cleared in the Command Flags field, is sent by the delegating x-RACF to the delegated x-RACF in response to the RAR command.

Message Format:

```
<RA-Answer> ::=     < Diameter Header: 258, PXY, 16777279>
                    < Session-Id >
                    { Auth-Session-State }
                    { Origin-Host }
                    { Origin-Realm }
                    [ Result-Code ]
                    [ Experimental-Result ]
                    [ Origin-State-Id ]
                    [ Error-Message ]
                    [ Error-Reporting-Host ]
                   *[ Failed-AVP ]
                   *[ Proxy-Info ]
                   *[ AVP ]
```

7.2.7   CC-Request (CCR) command

The CCR command, indicated by the Command-Code field set to 272 and the "R" bit set in the Command Flags field, is sent by the delegating x-RACF to the delegated x-RACF in order to report the occurrence of particular event.

Message Format:

```
<CC-Request> ::=    < Diameter Header: 272, REQ, PXY, 16777279>
                    < Session-Id >
                    { Auth-Session-State }
                    { Origin-Host }
                    { Origin-Realm }
                    { Destination-Realm }
                    { Destination-Host }
                    { Auth-Application-Id }
                   *{ Specific-Action }
                   *[ Flow-Description ]
                    [ Globally-Unique-Address ]
                    [ Logical-Access-Id ]
                    [ Abort-Cause ]
                    [ Origin-State-Id ]
                   *[ Proxy-Info ]
```

```
                        *[ Route-Record ]
                        *[ AVP ]
```

7.2.8   CC-Answer (CCA) Command

The Credit-Control-Answer message (CCA) is indicated by the command-code field being set to 272 and the "R" bit being cleared in the Command Flags field. It is sent by the delegated x-RACF to the delegating x-RACF in answer to the CCR.

Message Format:

```
<CC-Answer> ::=        < Diameter Header: 272, PXY, 16777279>
                       < Session-Id >
                       { Auth-Session-State }
                       { Origin-Host }
                       { Origin-Realm }
                       { Auth-Application-Id }
                        [ Result-Code ]
                        [ Experimental-Result ]
                        [ Origin-State-Id ]
                        [ Error-Message ]
                        [ Error-Reporting-Host ]
                       *[ Failed-AVP ]
                       *[ Proxy-Info ]
                       *[ AVP ]
```

7.3   Experimental-Result-Code AVP values

7.3.1   Experimental-Result-Code AVP values imported from ES 283 034

The present document reuses existing Experimental-Result-Code AVP values defined in ES 283 034 [4] as follows:

- DIAMETER_SYSTEM_UNAVAILABLE (4001):

    - This error is returned when a request could not be satisfied at the time that it was received due to a temporary internal failure or congestion. When this result code is used, the ETSI Vendor ID shall be included in the Vendor-Id AVP of the Experimental-Result AVP.

7.3.2   Experimental-Result-Code AVP values defined in the present document

This clause defines the specific values of the Experimental-Result-Code AVP (vendor-id is ETSI) for the Diameter application for the Rr delegated model:

- NETWORK_RESOURCE_UNAVAILABLE (4061):

    - The delegating or delegated x-RACF indicates the network resource identified by the Network-Resource-Id AVP is unknown or is not handled in the current entity or is not allowed to be delegated between the delegating x-RACF and the delegated x-RACF.

- NETWORK_RESOURCE_INSUFFICIENT (4062):

    - The delegating or delegated x-RACF indicates there is insufficient network resource to perform the requested action.

7.4   Use of namespaces

This clause contains the namespaces that have either been created in the present document for the Rr delegated model, or the values assigned to existing namespaces managed by IANA.

7.4.1 AVP codes

The present document assigns the AVP values in the 650 to 699 range from the AVP Code namespace managed by ETSI for the Diameter application for the Rr delegated model. See clause 7.5 for the assigned values.

7.4.2 Experimental-Result-Code AVP values

The present document assigns the Experimental-Result-Code AVP values from the AVP Code namespace managed by ETSI for the Diameter application for the Rr delegated model. See clause 7.3 for the assigned values.

7.4.3 Command Code values

The present document does not assign command code values but uses existing command codes for the Diameter application for the Rr delegated model.

7.4.4 Application-ID value

The present document uses value 16777279, allocated by IANA, as application identifier for the Diameter application for the Rr delegated model.

7.5 AVPs

This clause summarizes the AVPs used in the present document for the Diameter application for the Rr delegated model, beyond those defined in the Diameter Base Protocol.

Table 7.2 describes the Diameter AVPs defined in the present document, their AVP Code values, types, possible flag values and whether the AVP may be encrypted. The vendor-Id header of all AVPs defined in the present document shall be set to ETSI (13019).

Table 7.2: Diameter AVPs defined in the present document

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				May encrypt
				Must	May	Should not	Must not	
Network-Resource-Id	650	7.5.1	OctetString	M,V	P			Y
Preferred-Delegated-Bandwidth-UL	651	7.5.2	Unsigned32	M,V	P			Y
Preferred-Delegated-Bandwidth-DL	652	7.5.3	Unsigned32	M,V	P			Y
Required-Delegated-Bandwidth-UL	653	7.5.4	Unsigned32	M,V	P			Y
Required-Delegated-Bandwidth-DL	654	7.5.5	Unsigned32	M,V	P			Y
Granted-Delegated-Bandwidth-UL	655	7.5.6	Unsigned32	M,V	P			Y
Granted-Delegated-Bandwidth-DL	656	7.5.7	Unsigned32	M,V	P			Y
Total-Bandwidth-UL	657	7.5.8	Unsigned32	M,V	P			Y
Total-Bandwidth-DL	658	7.5.9	Unsigned32	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8].								
NOTE 2: The value types are defined in RFC 3588 [8].								

Table 7.3 describes the Diameter AVPs imported from TS 183 017 [5]. The Vendor-Id header of these AVPs shall be set to ETSI (13019).

Table 7.3: Diameter AVPs imported from TS 183 017 [5]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				
				Must	May	Should not	Must not	May encrypt
Reservation-Priority	458	7.5.10	Enumerated	V			M	Y
Authorization-Package-Id	461	7.5.11	UTF8String	V			M	Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8].								
NOTE 2: The value types are defined in RFC 3588 [8].								

Table 7.4 describes the Diameter AVPs imported from TS 129 209 [7]. The Vendor-Id header for these AVPs shall be set to 3GPP (10415).

Table 7.4: Diameter AVPs imported from TS 129 209 [7]

Attribute Name	AVP Code	Clause defined	Value Type (see note 2)	AVP Flag rules (see note 1)				
				Must	May	Should not	Must not	May encrypt
Abort-Cause	500	7.5.12	Enumerated	M,V	P			Y
Flow-Description	507	7.5.13	IPFilterRule	M,V	P			Y
Specific-Action	513	7.5.14	Enumerated	M,V	P			Y
NOTE 1: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see RFC 3588 [8].								
NOTE 2: The value types are defined in RFC 3588 [8].								

Table 7.5 describes the Diameter AVPs imported from ES 283 034 [4]. The Vendor-Id header of these AVPs shall be set to ETSI (13019).

Table 7.5: Diameter AVPs imported from e4 interface ES 283 034 [4]

Attribute Name	AVP Code	Clause defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encrypt
Globally-Unique-Address	300	7.5.15	Grouped	V			M	Y
Address-Realm	301	7.5.16	OctetString	V			M	Y
Logical-Access-Id	302	7.5.17	OctetString	V	M			Yes
NOTE: The AVP header bit denoted as "M", indicates whether support of the AVP is required. The AVP header bit denoted as "V", indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see TS 133 210 [11].								

Table 7.6 describes the Diameter AVPs imported from RFC 4005 [9]. No Vendor-Id header shall be included in these AVPs.

Table 7.6: Diameter AVPs imported from RFC 4005 [9]

Attribute Name	AVP Code	Section defined	Value Type	AVP Flag rules				
				Must	May	Should not	Must not	May Encrypt
Framed-IP-Address	8	7.5.18	OctetString				V,M	Y
Framed-IPv6-Prefix	97	7.5.19	OctetString				V,M	Y

7.5.1   Network-Resource-Id AVP

The Network-Resource-Id AVP (AVP code 650) is of type OctetString, it contains the identifier of the network resource.

7.5.2 Preferred-Delegated-Bandwidth-UL AVP

The Preferred-Delegated-Bandwidth-UL AVP (AVP code 651) is type Unsigned32, and it indicates the preferred delegated bandwidth requested in kbits per second in the uplink direction.

7.5.3 Preferred-Delegated-Bandwidth-DL AVP

The Preferred-Delegated-Bandwidth-DL AVP (AVP code 652) is type Unsigned32, and it indicates the preferred delegated bandwidth requested in kbits per second in the downlink direction.

7.5.4 Required-Delegated-Bandwidth-UL AVP

The Required-Delegated-Bandwidth-UL AVP (AVP code 653) is type Unsigned32, and it indicates the required delegated bandwidth requested in kbits per second in the uplink direction.

7.5.5 Required-Delegated-Bandwidth-DL AVP

The Required-Delegated-Bandwidth-DL AVP (AVP code 654) is type Unsigned32, and it indicates the required delegated bandwidth requested in kbits per second in the downlink direction.

7.5.6 Granted-Delegated-Bandwidth-UL AVP

The Granted-Delegated-Bandwidth-UL AVP (AVP code 655) is type Unsigned32, and it indicates the granted delegated bandwidth in kbits per second in the uplink direction.

7.5.7 Granted-Delegated-Bandwidth-DL AVP

The Granted-Delegated-Bandwidth-DL AVP (AVP code 656) is type Unsigned32, and it indicates the granted delegated bandwidth in kbits per second in the downlink direction.

7.5.8 Total-Bandwidth-UL AVP

The Total-Bandwidth-UL AVP (AVP code 657) is type Unsigned32, and it indicates the total bandwidth in kbits per second in the uplink direction.

7.5.9 Total-Bandwidth-DL AVP

The Total-Bandwidth-DL AVP (AVP code 658) is type Unsigned32, and it indicates the total bandwidth in kbits per second in the downlink direction.

7.5.10 Reservation-priority AVP

The Reservation-Priority AVP (AVP code 458) is of type Enumerated. The following values are specified.

DEFAULT (0): This is the lowest level of priority. If no Reservation-Priority AVP is specified in the AA-Request, this is the priority associated with the reservation.

- PRIORITY-ONE (1).

- PRIORITY-TWO (2).

- PRIORITY-THREE (3).

- PRIORITY-FOUR (4).

- PRIORITY-FIVE (5).

- PRIORITY-SIX (6).

- PRIORITY-SEVEN (7).

- PRIORITY-EIGHT (8).

- PRIORITY-NINE (9).

- PRIORITY-TEN (10).

- PRIORITY-ELEVEN (11).

- PRIORITY-TWELVE (12).

- PRIORITY-THIRTEEN (13).

- PRIORITY-FOURTEEN (14).

- PRIORITY-FIFTEEN (15).

7.5.11   Authorization-Package-Id AVP

The Authorization-Package-Id AVP (AVP code 461) is of type UTF8String, and it identifies an authorization context requested by the AF for the session and passed transparently through Rq. This information is used by the delegated x-RACF to derive the policy to be passed to an RCEF through the Re reference point for the session.

7.5.12   Abort-Cause AVP

The Abort-Cause AVP (AVP code 500) is of type Enumerated, and it determines the cause of an ASR. The following values defined in TS 129 209 [7] are used:

- INSUFFICIENT_SERVER_RESOURCES (1):

    - This value is used to indicate that the x-RACF is overloaded.

- INSUFFICIENT_BEARER_RESOURCES (2):

    - This value is used when the bearer has been deactivated due to insufficient bearer resources at a transport gateway (e.g. RCEF for xDSL).

7.5.13   Flow-Description AVP

The Flow-Description AVP (AVP code 507) is of type IPFilterRule, and defines a packet filter for an IP flow with the following information:

- Direction (in or out).

- Source and destination IP address (possibly masked).

- Protocol.

- Source and destination port (list or ranges).

The b type shall be used with the following restrictions:

- Only the Action "permit" shall be used.

- No "options" shall be used.

- The invert modifier "!" for addresses shall not be used.

- The keyword "assigned" shall not be used.

The direction "in" refers to uplink IP flows, and the direction "out" refers to downlink IP flows.

7.5.14   Specific-Action AVP

The Specific-Action AVP (AVP code 513) is of type Enumerated.

The following event from TS 129 209 [7] is supported:

- INDICATION_OF_RELEASE_OF_BEARER (4):

    - Within a RAR, this value shall be used when the delegated x-RACF reports to the delegating x-RACF the release of a bearer (e.g. RCEF policies being removed). In case of failure of a multicast request, the RAR message includes the address of the UE that requested the multicast flow and the flow description of the flow.

    - Within a CCR, this value shall be used when the delegating x-RACF reports to the delegated x-RACF the release of a bearer (e.g. RCEF policies being removed). In case of failure of a multicast request, the CCR message includes the address of the UE that requested the multicast flow and the flow description of the flow.

In addition, the present document defines two new events:

- INDICATION_OF_SUBSCRIBER_DETACHMENT (6):

    - Within a RAR, this value shall be used when the delegated x-RACF reports to the delegating x-RACF that a subscriber has been detached.

    - Within a CCR, this value shall be used when the delegating x-RACF reports to the delegated x-RACF that a subscriber has been detached.

- INDICATION_OF_RESERVATION_EXPIRATION (7):

    - Within a RAR, this value shall be used when the delegated x-RACF reports to the delegating x-RACF that a reservation is about to expire.

    - Within a CCR, this value shall be used when the delegating x-RACF reports to the delegated x-RACF that a reservation is about to expire.

Other events but the above-listed ones defined by TS 129 209 [7] are not relevant at the Rr interface and are not supported.

7.5.15   Globally-Unique-Address AVP

The Globally-Unique-Address AVP (AVP code 300) is of type Grouped.

AVP Format:

```
Globally-Unique-Address ::= < AVP Header: 300 13019 >
    [Framed-IP-Address]
    [Framed-IPv6-Prefix]
    [Address-Realm]
```

7.5.16   Address-Realm AVP

The Address-Realm AVP (AVP code 301) is of type OctetString and contains an address realm in the form of a FQDN.

7.5.17   Logical-Access-ID AVP

The Logical-Access-ID AVP (AVP code 302 13019) is of type OctetString. It is defined in ES 283 034 [4].

7.5.18   Framed-IP-Address AVP

The Framed-IP-Address AVP (AVP Code 8) is of type OctetString and contains an IPv4 address of the type specified in the attribute value to be configured for the user.

7.5.19 Framed-IPv6-Prefix AVP

The Framed-IPv6-Prefix AVP (AVP Code 97) is of type OctetString and contains the IPv6 prefix to be configured for the user.

History

Document history		
V3.1.1	February 2010	Publication