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SERIES Q: SWITCHING AND SIGNALLING

Signalling flows and parameter mapping for resource control

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Supplement 59 to ITU-T Q-series Recommendations (formerly TRQ.rsf)

Signalling flows and parameter mapping for resource control

Summary

This document specifies the signalling flows for NGN RACF, which includes the entities, viz., Policy Decision Physical Entity (PD-PE), Transport Resource Control Physical Entity (TRC-PE) and Policy Enforcement Physical Entity (PE-PE). And it specifies the QoS parameter mapping across the various protocols for different signalling flows.

1 Scope

This document specifies the signalling flows for NGN RACF, which includes the entities, viz., Policy Decision Physical Entity (PD-PE), Transport Resource Control Physical Entity (TRC-PE) and Policy Enforcement Physical Entity (PE-PE). The various interfaces involving these entities are Rs (rcp1), Rp (rcp2), Rw (rcp3), Rc (rcp4), Rt (rcp5), Rd (rcp6), Ru and Ri. In addition, this document specifies the QoS parameter mapping across the various protocols for different signalling flows.

Figure 1 shows the RACF architecture.

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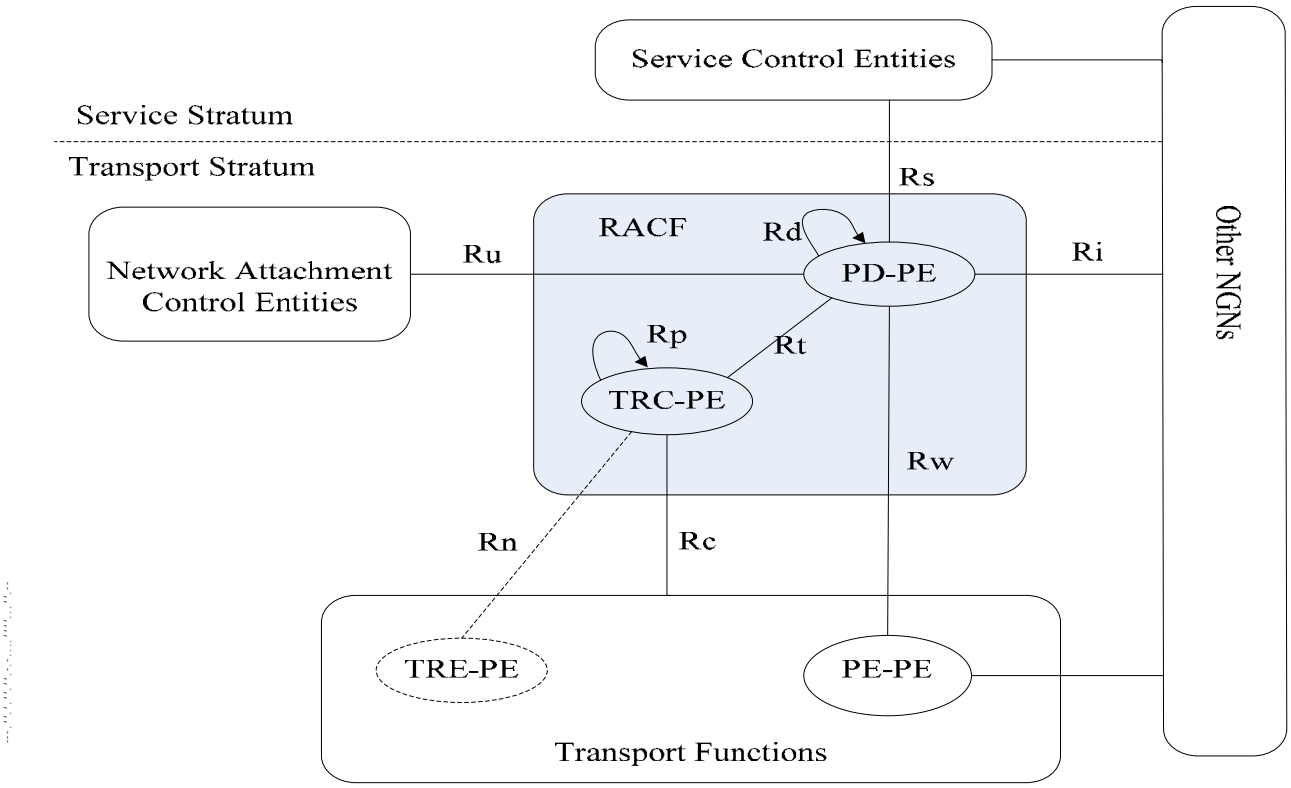

Figure 1 -- NGN RACF Architecture

2 References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2012] ITU-T Recommendation Y.2012 (2006), *Functional requirements and architecture of the NGN*.

[ITU-T Y.2111] ITU-T Recommendation Y.2111 (2006), *Functional requirements and architecture for resource and admission control in Next Generation Networks*.

[ITU-T Q.3300] ITU-T Recommendation Q.3300 (2008), *Architectural framework for the Q.33xx series of Recommendations*.

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[ITU-T Q.3301.1] ITU-T Recommendation Q.3301.1 (2007), *Resource control protocol No. 1 - Protocol at the Rs interface between service control entities and the policy decision physical entity.*

[ITU-T Q.3302.1] ITU-T Recommendation Q.3302.1 (2007), *Resource control protocol No. 2 - Protocol at the Rp interface between transport resource control physical entities.*

[ITU-T Q.3303.1] ITU-T Recommendation Q.3303.1 (2007), *Resource control protocol No. 3 - Protocol at the interface between a Policy Decision Physical Entity (PD-PE) and a Policy Enforcement Physical Entity (PE-PE): COPS alternative.*

[ITU-T Q.3303.2] ITU-T Recommendation Q.3303.2 (2007), *Resource control protocol No. 3 - Protocol at the interface between a Policy Decision Physical Entity (PD-PE) and a Policy Enforcement Physical Entity (PE-PE) (Rw interface): H.248 alternative.*

[ITU-T Q.3304.1] ITU-T Recommendation Q.3304.1 (2007), *Resource control protocol No. 4 - Protocol at the Rc interface between a transport resource control physical entity (TRC-PE) and a transport physical entity (T-PE) (Rc interface): COPS alternative.*

[ITU-T Q.3304.2] ITU-T Recommendation Q.3304.2 (2007), *Resource control protocol No. 4 - Protocol at the Rc interface between a transport resource control physical entity (TRC-PE) and a transport physical entity (T-PE) (Rc interface): SNMP profile.*

[ETSI TS 129 208] ETSI TS 129 208 V6.7.0 (2007-06), *Digital cellular telecommunications system (Phase 2+);Universal Mobile Telecommunications System (UMTS); End-to-end Quality of Service (QoS) signalling flows (3GPP TS 29.208 version 6.7.0 Release 6).*

[ETSI ES 282 003] ETSI ES 282 003 V1.1.1 (2006-06), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-system (RACS); Functional Architecture.*

[IETF RFC 3588] IETF RFC 3588 (2003), *Diameter Base Protocol.*

[IETF RFC 4005] IETF RFC 4005 (2005), *Diameter Access Server Application.*

[IETF RFC 2748] [IETF RFC 2748 (2000), *The COPS (Common Open Policy Service) Protocol.*

[IETF RFC 3084] IETF RFC 3084 (2001), *COPS Usage for Policy Provisioning (COPS-PR).*

[IETF RFC 3318] IETF RFC 3318 (2003), *Framework Policy Information Base.*

3 Definitions

<Check in the ITU-T Terms and definitions database on the public website whether the term is already defined in another Recommendation. It may be more consistent to refer to such a definition rather than redefine it>

3.1 Terms defined elsewhere:

<Normally terms defined elsewhere will simply refer to the defining document. In certain cases, it may be desirable to quote the definition to allow for a stand-alone document>

This Recommendation uses the following terms defined elsewhere:

3.1.1 Absolute QoS [ITU-T Y.2111]: Traffic delivery with numerical bounds on some or all QoS parameters. These bounds may be physical limits, or enforced limits such as those encountered through mechanisms like rate policing. The bounds may result from designating a class of network performance objectives for packet transfer.

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3.1.2 Attribute-Value Pair (AVP) [IETF RFC 3588]: An attribute-value pair corresponds to an Information Element in a Diameter message.

3.1.3 Common Open Policy Service Protocol (COPS) [IETF RFC 2748]: COPS is the simple query/response protocol defined in RFC 2748, a protocol used to exchange policy information between a Policy Decision Point (PDP) and a Policy Enforcement Point (PEP).

3.1.4 Gate [ITU-T Y.2111]: A construct used to enable or disable the forwarding of IP packets based on the policy decision. A gate is identified by the classifier (e.g. IPv4 5-tuple) and direction of a media flow or a group of media flows that are in conformance to the same set of policy decisions.

3.1.5 Gate control [ITU-T Y.2111]: The operation of opening or closing a gate. When a gate is open, the packets in the media flows are allowed to pass through; when a gate is closed, the packets in the media flows are not allowed to pass through.

3.1.6 Media flow [ITU-T Y.2111]: A unidirectional media stream, which is specified by two endpoint identifiers and bandwidth, as well as class of service if needed.

3.1.7 Network Address Translation [ITU-T Y.2111]: The operation by which IP addresses are translated (mapped) from one address domain to another address domain.

3.1.8 Network Address Port Translation (NAPT) [ITU-T Y.2111]: The operation by which IP addresses and transport or port identifiers such as TCP and UDP port numbers are translated (mapped) from one address domain to another address domain.

3.1.9 Network Address Translator (NAT) [ITU-T Y.2111]: An entity that implements Network Address Translation or NAPT functions. It consists of two types of NATs: near-end NAT that can be controlled by the operators directly, and far-end (remote) NAT that cannot be controlled by the operators directly.

3.1.10 NAPT control [ITU-T Y.2111]: The operation of providing network address mapping information and NAPT policy rules to a near-end NAT in the media flow.

3.1.11 NAT traversal [ITU-T Y.2111]: The operation of adapting the IP addresses so that the packets in the media flow can pass through a far-end (remote) NAT.

3.1.12 Path-coupled QoS signalling [ITU-T Y.2111]: A mode of signalling where the signalling messages follow a path that is tied to the data packets. Signalling messages are routed only through nodes that are in the data path.

3.1.13 Policy Decision Physical Entity (PD-PE) [ITU-T Q.3300]: The PD-PE is an implemented instance of the Policy Decision Functional Entity as defined in [ITU-T Y.2111].

3.1.14 Policy Enforcement Physical Entity (PE-PE) [ITU-T Q.3300]: The PE-PE is an implemented instance of the Policy Enforcement Functional Entity as defined in [ITU-T Y.2111].

3.1.15 Relative QoS [ITU-T Y.2111]: Traffic delivery where bounds on QoS parameters such as delay etc. are not expressed in absolute terms. It describes the circumstances where certain classes of traffic are handled differently from other classes of traffic, and the classes achieve different levels of QoS.

3.1.16 SCE session [ITU-T Q.3301.1]: A session established by a service/session control signalling protocol offered by the SCE that requires a session set-up with explicit session description before the use of the service.

NOTE – One example of a SCE session is an IMS session.

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3.1.17 SCE session signalling protocol [ITU-T Q.3301.1]: The signalling protocol used to control the SCE session.

NOTE – One example of an SCE session signalling protocol is SIP with SDP.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAA	AA-Answer
AAR	AA-Request
ASA	Abort-Session-Answer
ASR	Abort-Session-Request
COPS	Common Open Policy Service
DEC	COPS DECision message
NACE	Network Attachment Control Entity
PD-PE	Policy Decision Physical Entity
PE-PE	Policy Enforcement Physical Entity
QoS	Quality of Service
RAA	Re-Auth-Answer
RACF	Resource and Admission Control Functions
RAR	Re-Auth-Request
REQ	COPS REQuest message
RPT	COPS RePorT state message
SCE	Service Control Entity
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
STA	Session-Termination-Answer
STR	Session-Termination-Request
TRC-PE	Transport Resource Control Physical Entity
UE	User Equipment
RR	Resource Request message
RA	Resource Acceptance message
REJ	resource REJection message
RLR	Resource reLease Request message
RLP	Resource reLease resPonse message

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5 Conventions

None.

6 Signalling Flow Scenarios

The scenarios considered for the signalling flows are as follows.

6.1 Push Mode Scenarios

Three phase scheme of authorization, reservation and commitment is not applicable for push mode. Thus resource authorization and resource reservation (at least) will always be carried out together.

6.1.1 Resource Authorization and Reservation (and also Commitment in case of Single Phase Scheme)

The single phase scheme of authorization, reservation and commitment shall not involve path-coupled UEs. Two phase scheme shall involve authorization and reservation as first phase and commitment as second phase.

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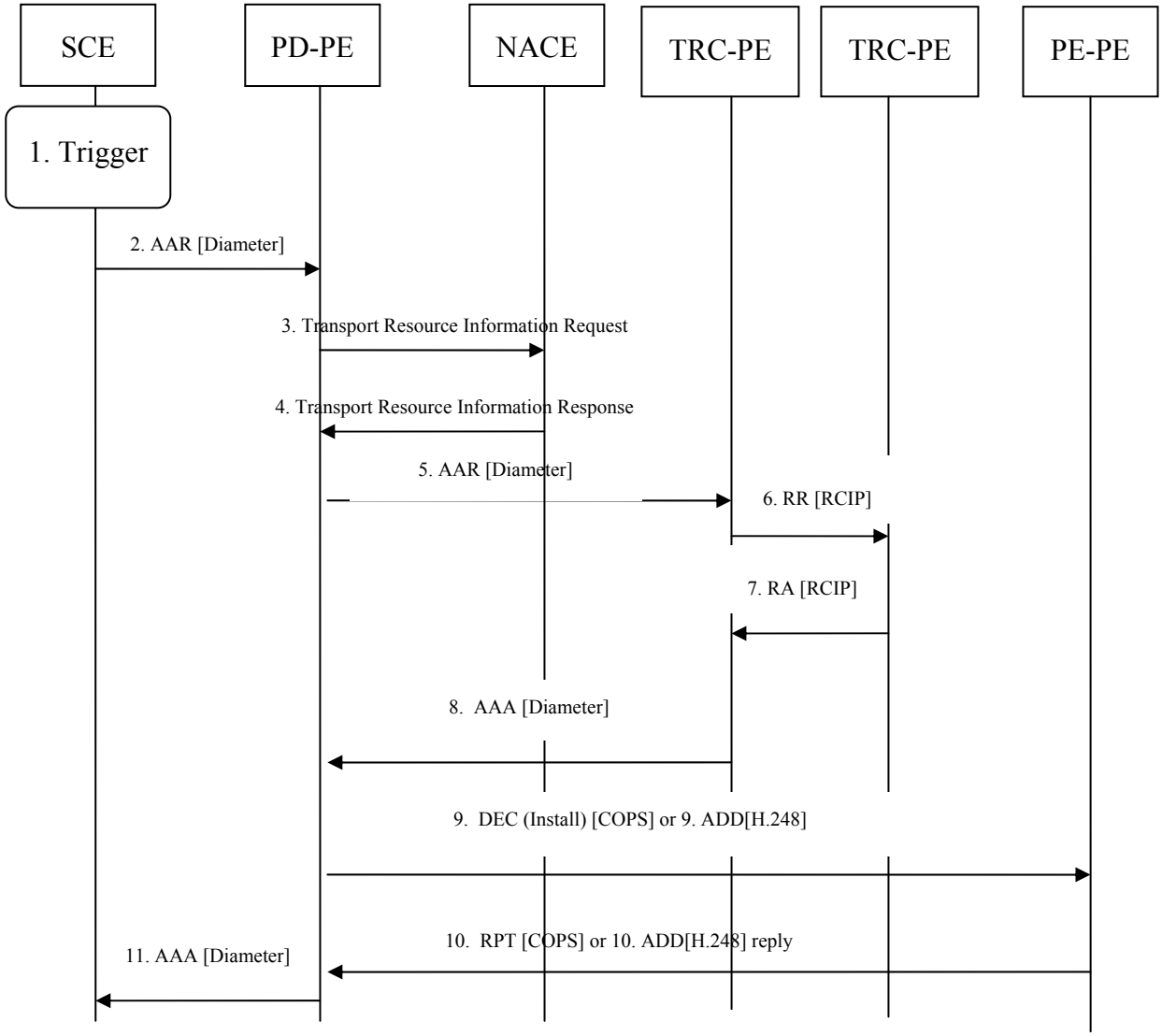

1. SCE receives a trigger for sending Resource Authorization, Reservation (and also Commitment in case of Single Phase) request towards PD-PE. This trigger could be a service request (e.g. SIP Invite) sent by UE, for requesting application-specific service. The Service Request may or may not contain any explicit service QoS requirement parameters.
2. The SCE extracts or derive the service QoS requirement parameters (e.g. bandwidth) of the requested service, and then request QoS resource authorization, reservation and commitment from the PD-PE by sending a Diameter AAR command which contains AVPs containing explicit QoS requirement parameters.
3. PD-PE sends Transport Resource Information Request (Stage 2 Message) message towards NACE for pulling user's transport profile.
4. NACE responds with Transport Resource Information Response (Stage 2 Message) which contains user's transport profile.
5. PD-PE, may optionally, send Diameter AAR command towards TRC-PE for detecting and determining the requested QoS resource in the involved access network and core network

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for media flows along the media flow path. In addition, PD-PE can relay the access network information from NACE to TRC-PE.

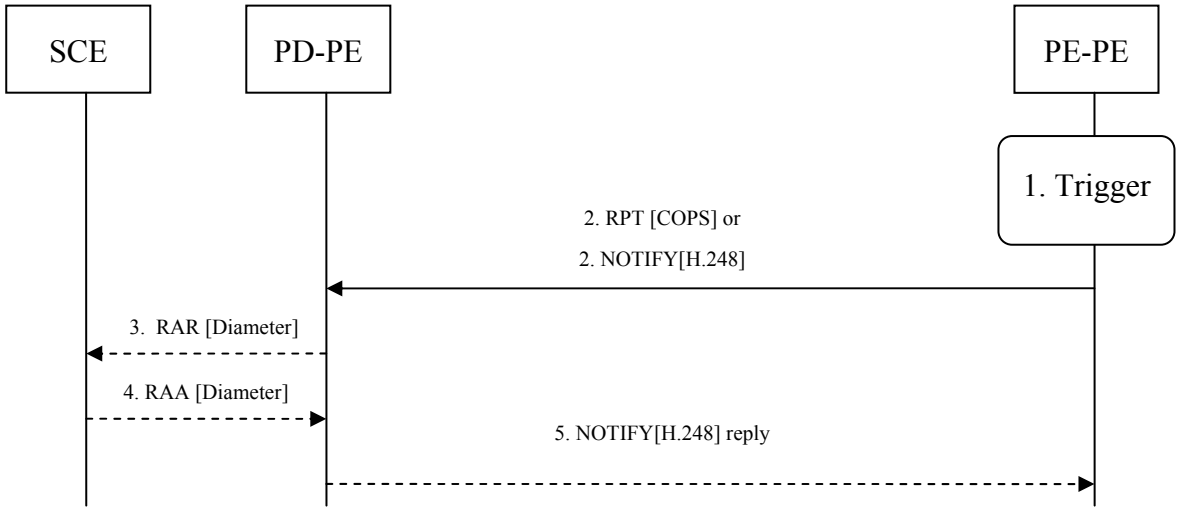
6. If there are multiple TRC-PE instances in the involved network, TRC-PE sends RCIP RR command towards the interconnected TRC-PE from edge to edge in the involved network for resource availability check.
7. The TRC-PE which receives the RCIP RR command responds with RCIP RA command if the resource is available.
8. TRC-PE responds to Diameter AAR command, sent in step number 5, by Diameter AAA command.
9. The PD-PE sends COPS DEC or H.248 ADD message(s) to the PE-PE to install (and open the 'gates' e.g. enable the use of the authorised QoS resources in case of single phase scheme).
10. PE-PE responds PD-PE with COPS RPT or H.248 ADD reply message informing the outcome of DEC or ADD message respectively.
11. PD-PE responds to Diameter AAR command sent in step number 2 with Diameter AAA command.

6.1.2 Resource Commitment

The separate resource commitment flow shall be applicable only in two phase scheme.

6.1.2.1 Path Coupled

6.1.2.1.1 Stateful PD-FE Case



1. PE-PE receives a trigger for sending COPS RPT or H.248 NOTIFY (Note) message. This trigger could be an UE initiated explicit QoS request for resource commitment to the PE-PE through a dedicated path-coupled transport QoS signalling.

   Note: Q.3303.2 has not yet provided any detailed H.248 command level procedure in clause 5.17.1.
2. PE-PE send COPS RPT or H.248 NOTIFY message to PD-PE to notify the commitment (if the event is subscribed).

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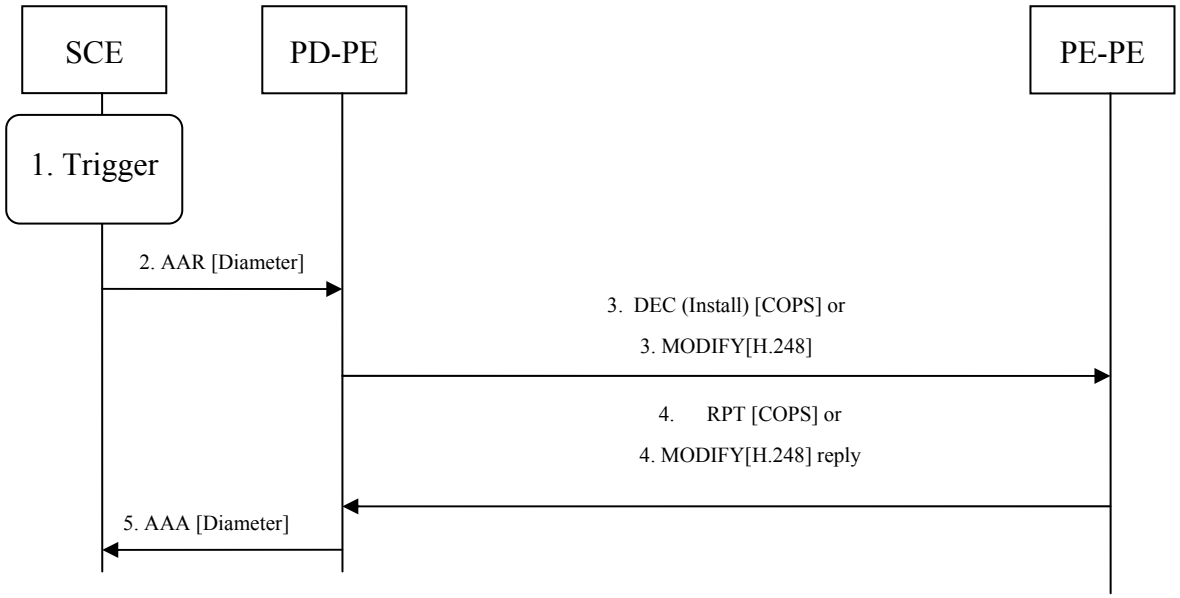
3. PD-PE may optionally, send Diameter RAR command towards SCE. This message will be send if SCE has subscribed for this event, earlier, through Diameter AAR command.
4. SCE responds with Diameter RAA command on receiving RAR request
5. If PD-PE received H.248 NOTIFY message in step number 2 then it sends H.248 NOTIFY reply message towards PE-PE.

6.1.2.1.2 Stateless PD-FE Case

For further study.

6.1.2.2 Path De-Coupled

6.1.2.2.1 Stateful PD-FE Case



1. SCE receives a trigger for sending Diameter AAR command. This trigger could be a service request sent by the UE.
2. SCE sends a Diameter AAR command towards PD-PE for resource commitment.
3. The PD-PE sends COPS DEC or H.248 MODIFY message(s) towards PE-PE for opening the installed 'gates'.
4. PE-PE responds PD-PE with COPS RPT or H.248 MODIFY reply message informing the outcome of DEC or MODIFY message respectively.
5. PD-PE responds to Diameter AAR command sent in step number 2 with Diameter AAA command.

6.1.2.2.2 Stateless PD-FE Case

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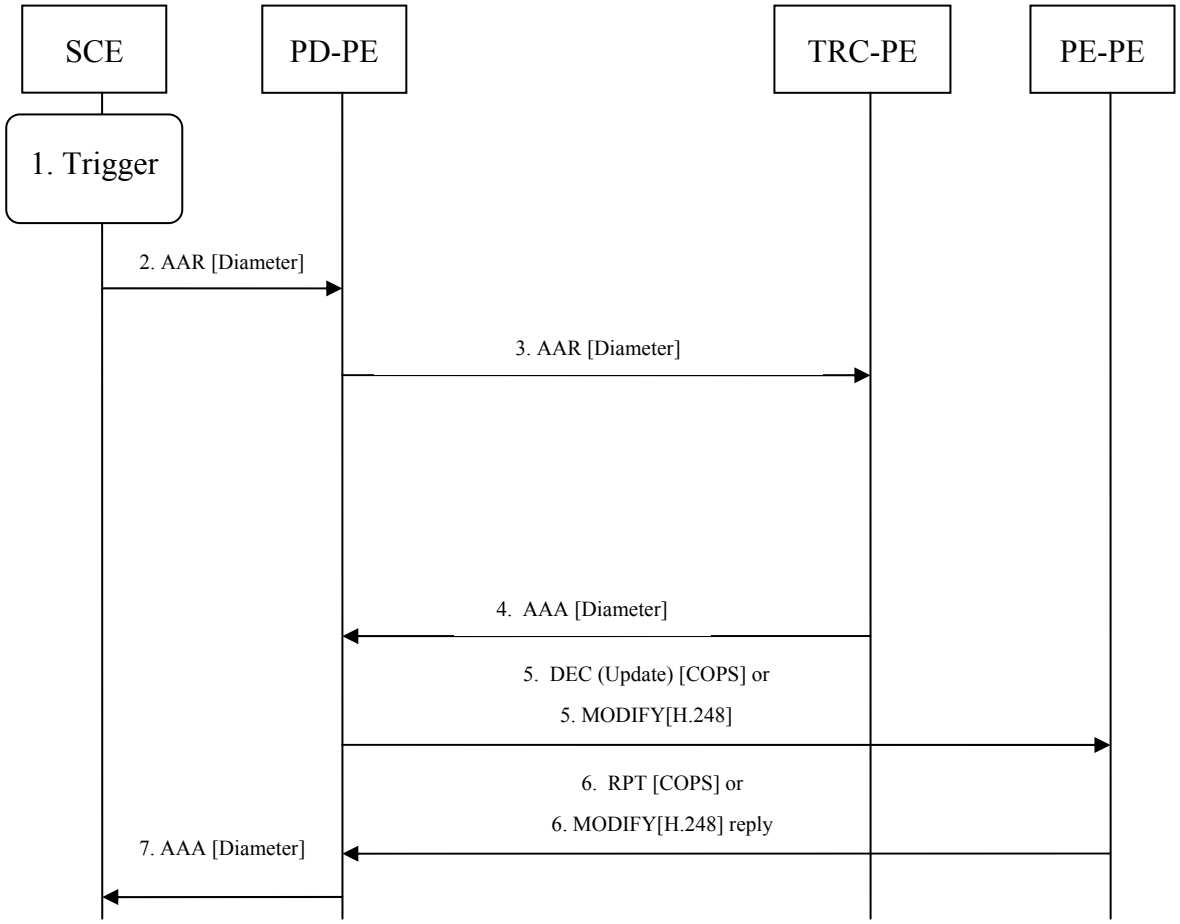
6.1.3 Resource Modification



1. SCE receives a trigger for sending Resource Modification Request towards PD-PE. This trigger could be a service request (e.g. SIP Update) sent by UE, for requesting application-specific service.
2. The SCE extracts or derives the service QoS requirement parameters (e.g. bandwidth) of the requested service, and then request QoS resource modification from the PD-PE by sending a Diameter AAR command which contains AVPs containing explicit QoS requirement parameters.
3. PD-PE sends Diameter AAR command towards TRC-PE for detecting and determining the requested QoS resource in the involved access network and core network for media flows along the media flow path.
4. TRC-PE responds to Diameter AAR command, sent in step number 3, by Diameter AAA command.
5. The PD-PE sends COPS DEC or H.248 MODIFY message(s) to the PE-PE to install and modify the 'gates'.
6. PE-PE responds PD-PE with COPS RPT or H.248 MODIFY reply message informing the outcome of DEC or MODIFY message respectively.
7. PD-PE responds to Diameter AAR command sent in step number 2 with Diameter AAA command.

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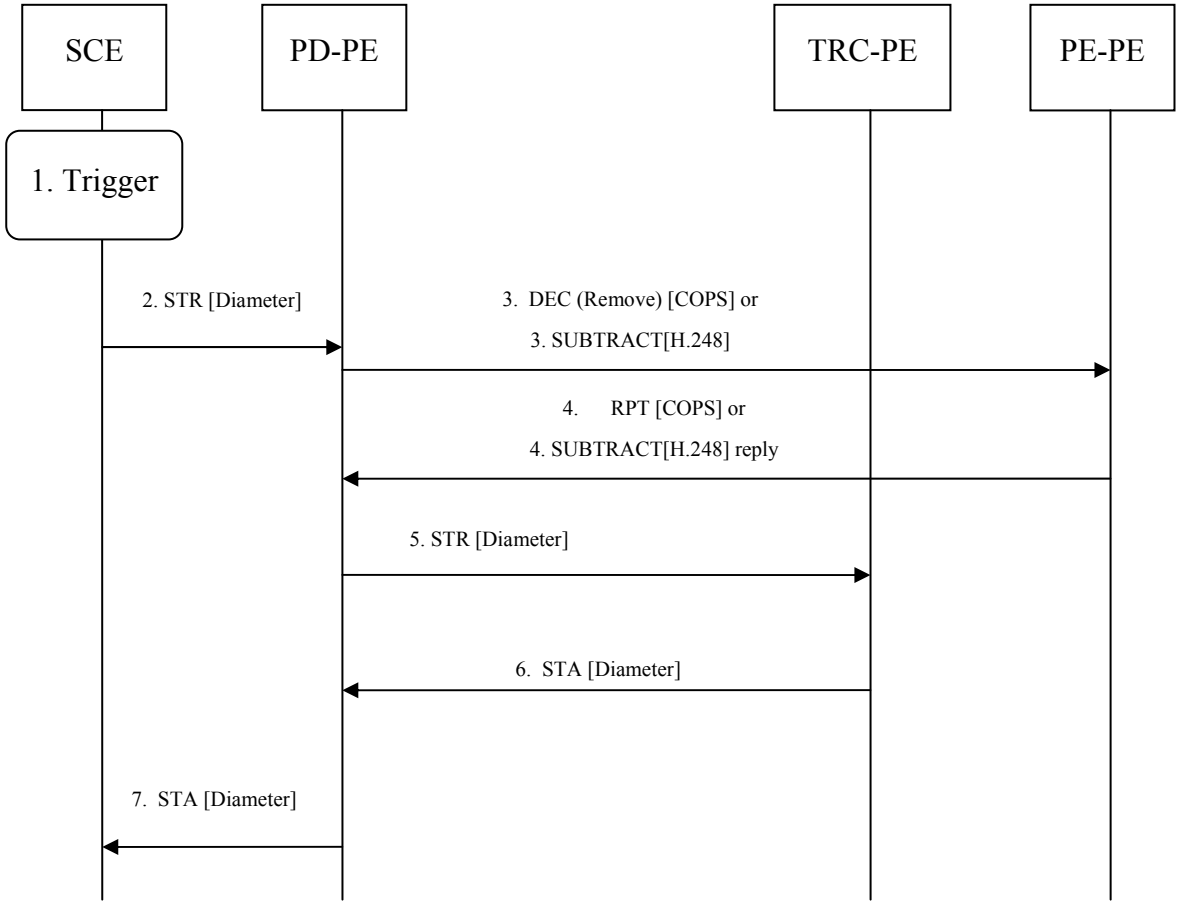
6.1.4 Resource De-Activation

Same as the flows for the Resource Commitment with a difference that instead of activating the resources will be de-activated.

6.1.5 Resource Release



1. SCE receives a trigger for sending Resource Release Request towards PD-PE.This trigger could be a service termination request (e.g. SIP BYE) sent by UE.
2. SCE sends Diameter STR command towards PD-PE . This command is used to relinquish the resources previously allocated.
3. PD-PE sends COPS DEC or H.248 SUBTRACT message towards PE-PE with request for releasing resources allocated for this particular SCE session media flow.
4. PE-PE responds PD-PE with COPS RPT or H.248 SUBTRACT reply message informing the outcome of DEC or H.248 SUBTRACT message respectively.
5. PD-PE sends Diameter STR command towards TRC-PE This command is used to inform TRC-PE of the removal of the resources of this particular session.
6. TRC-PE responds by sending Diameter STA command towards PD-PE.
7. PD-PE responds to STR command sent in step number 2 by STA command..

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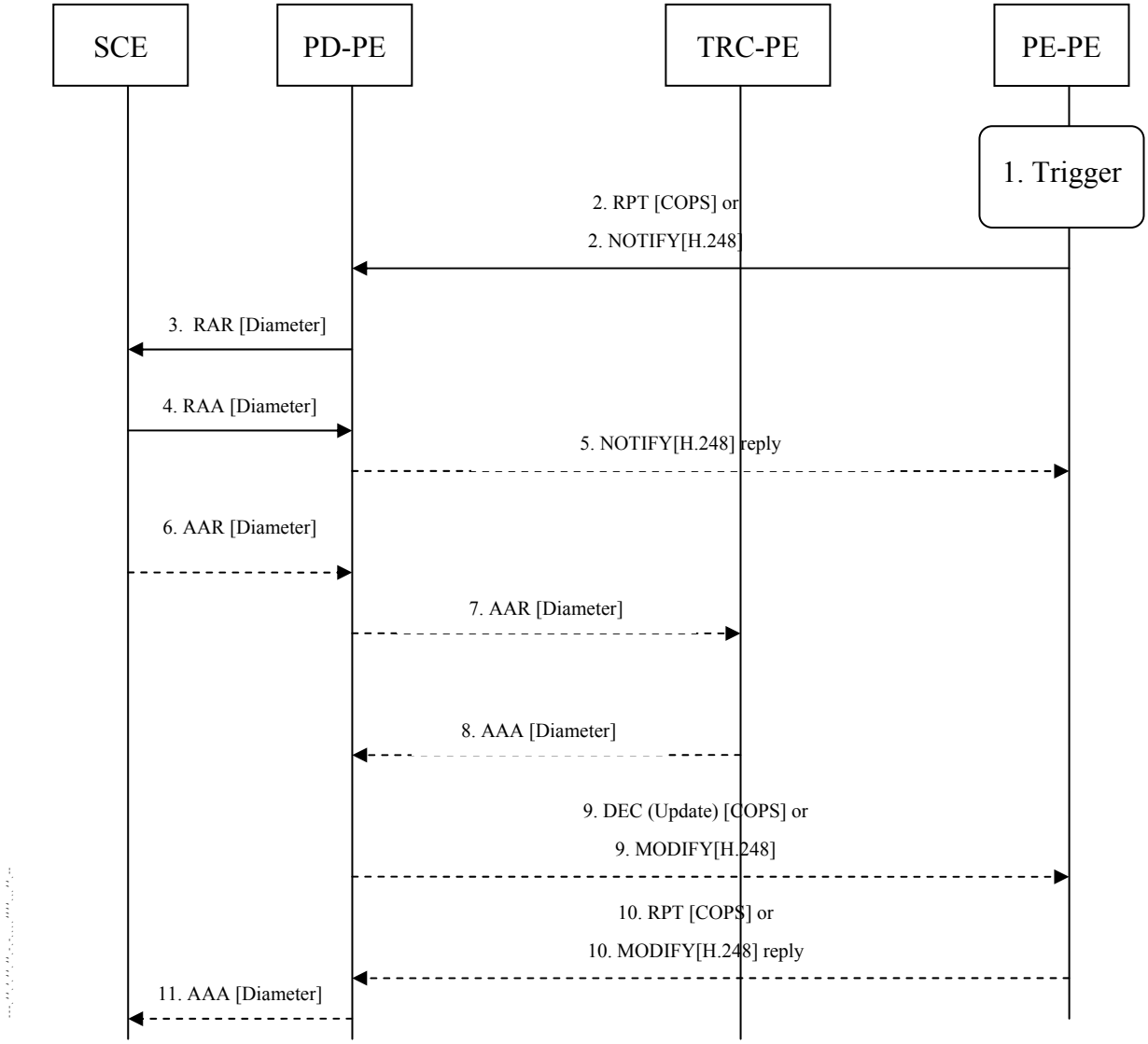
6.1.6 Event Notification

6.1.6.1 PE-PE Indicated Event Notification – Stateful PD-PE Case

6.1.6.1.1 Non-Failure Notification



1. PE-PE receives a trigger for sending COPS RPT or H.248 NOTIFY (Note) message towards PD-PE. This trigger could be a certain traffic condition which needs to be reported in accordance with a service previously requested by the PD-PE.

   Note: Q.3303.2 has not yet provided any detailed H.248 command level procedure in clause 5.17.1.
2. PE-PE sends a COPS RPT or H.248 NOTIFY message towards PD-PE, informing the occurrence of event.
3. PD-PE sends Diameter RAR command notifying SCE about the occurred event.
4. SCE responds PD-PE with Diameter RAA command.
5. If PD-PE received H.248 NOTIFY command in step number 2 then it sends H.248 NOTIFY reply message towards PE-PE.
6. SCE may optionally, send Diameter AAR command towards PD-PE.
7. PD-PE may optionally, send Diameter AAR command towards TRC-PE .

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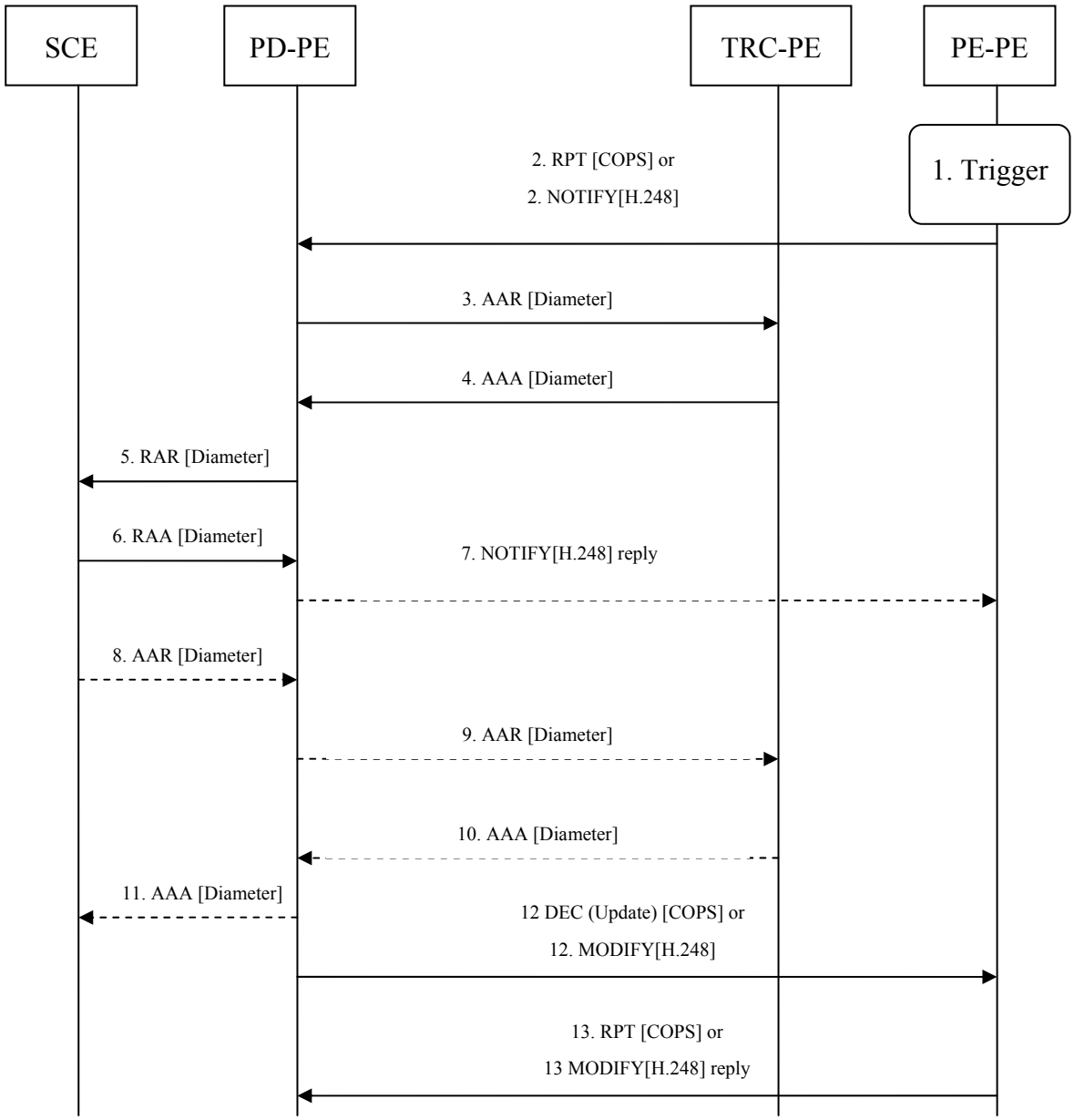
8. TRC-PE responds PD-PE with Diameter AAA command.
9. PD-PE, on receiving AAR, sends COPS DEC (update) or H.248 MODIFY message towards PE-PE.
10. PE-PE responds PD-PE with COPS RPT or H.248 MODIFY reply message informing the outcome of DEC or H.248 MODIFY message respectively.
11. PD-PE responds to AAR command sent in step number 5 by sending Diameter AAA command.

6.1.6.1.2 Failure Notification

6.1.6.1.2.1 Not All IP Flows Affected



1. PE-PE receives a trigger for sending COPS RPT or H.248 NOTIFY (Note) message towards PD-PE. This trigger could be a failure that affects an existing service (e.g. interface failure).

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Note: Q.3303.2 has not yet provided any detailed H.248 command level procedure in clause 5.17.1.

2. PE-PE sends a COPS RPT or H.248 NOTIFY message towards PD-PE, informing the occurrence of failure.
3. PD-PE sends Diameter AAR command towards TRC-PE informing the occurred failure.
4. TRC-PE responds PD-PE with Diameter AAA command.
5. PD-PE sends Diameter RAR command notifying SCE about the occurred failure.
6. SCE responds PD-PE with Diameter RAA command.
7. If PD-PE received H.248 NOTIFY message in step number 2 then it sends H.248 NOTIFY reply message towards PE-PE.
8. SCE may optionally, send Diameter AAR command towards PD-PE.
9. PD-PE may optionally, send Diameter AAR command towards TRC-PE.
10. TRC-PE responds PD-PE with Diameter AAA command.
11. PD-PE responds to AAR command by sending Diameter AAA command
12. PD-PE sends COPS DEC (update) or H.248 NOTIFY message towards PE-PE.
13. PE-PE responds PD-PE with COPS RPT or H.248 NOTIFY reply message informing the outcome of DEC or NOTIFY message respectively.

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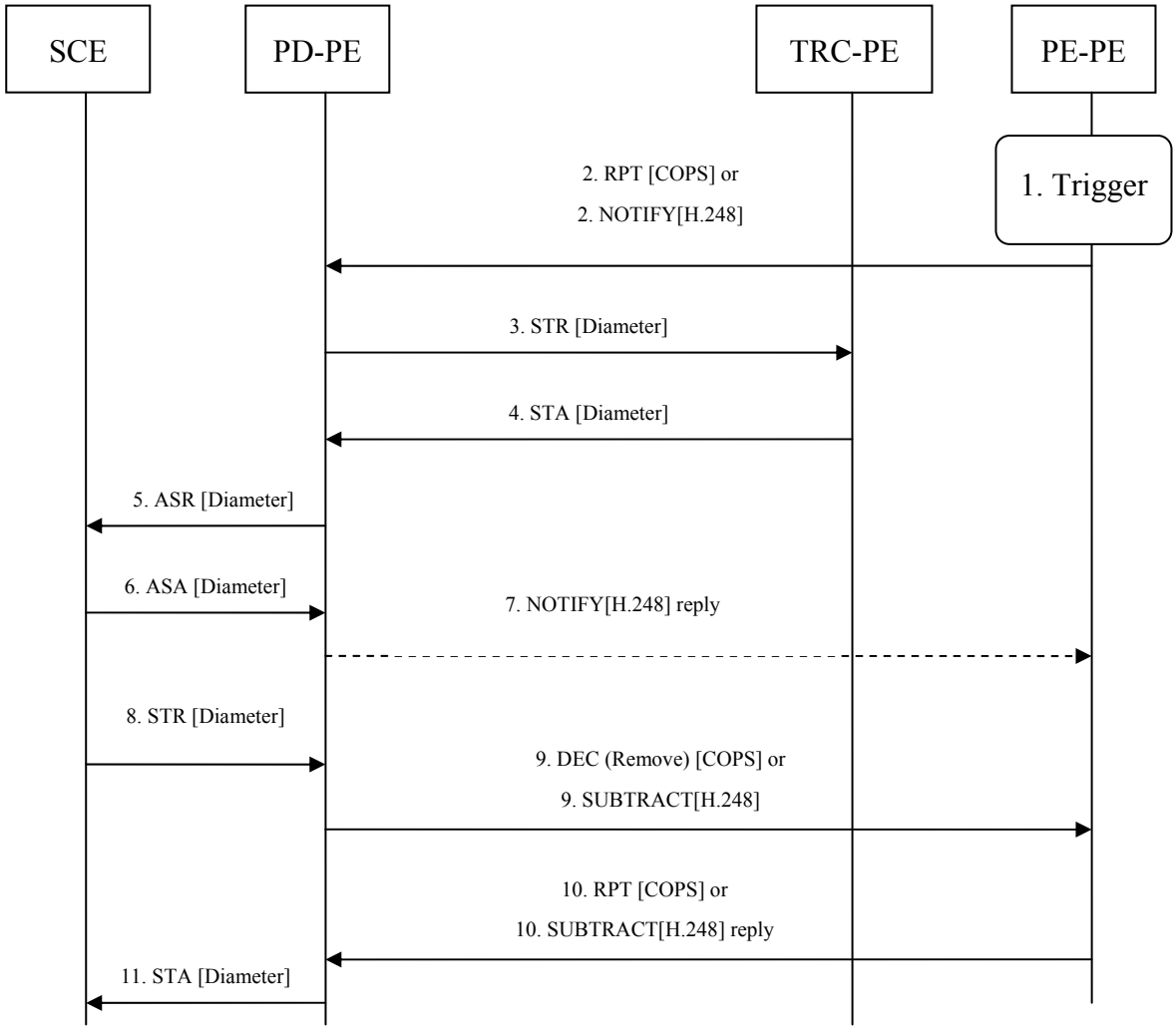
6.1.6.1.2.2 All IP Flows Affected



1. PE-PE receives a trigger for sending COPS RPT or H.248 NOTIFY (Note) message towards PD-PE. This trigger could be a failure that affects an existing service (e.g. interface failure).

   Note: Q.3303.2 has not yet provided any detailed H.248 command level procedure in clause 5.17.1.
2. PE-PE sends a COPS RPT or H.248 NOTIFY message towards PD-PE, informing the occurrence of failure.
3. PD-PE sends Diameter STR command towards TRC-PE informing the occurred failure.
4. TRC-PE responds PD-PE with Diameter STA command.
5. PD-PE sends Diameter ASR command towards SCE requesting SCE to abort the media session.
6. SCE responds PD-PE with Diameter ASA command.
7. If PD-PE received H.248 NOTIFY message in step number 2 then it sends H.248 NOTIFY reply message towards PE-PE
8. SCE sends Diameter STR command towards PD-PE for terminating the session.

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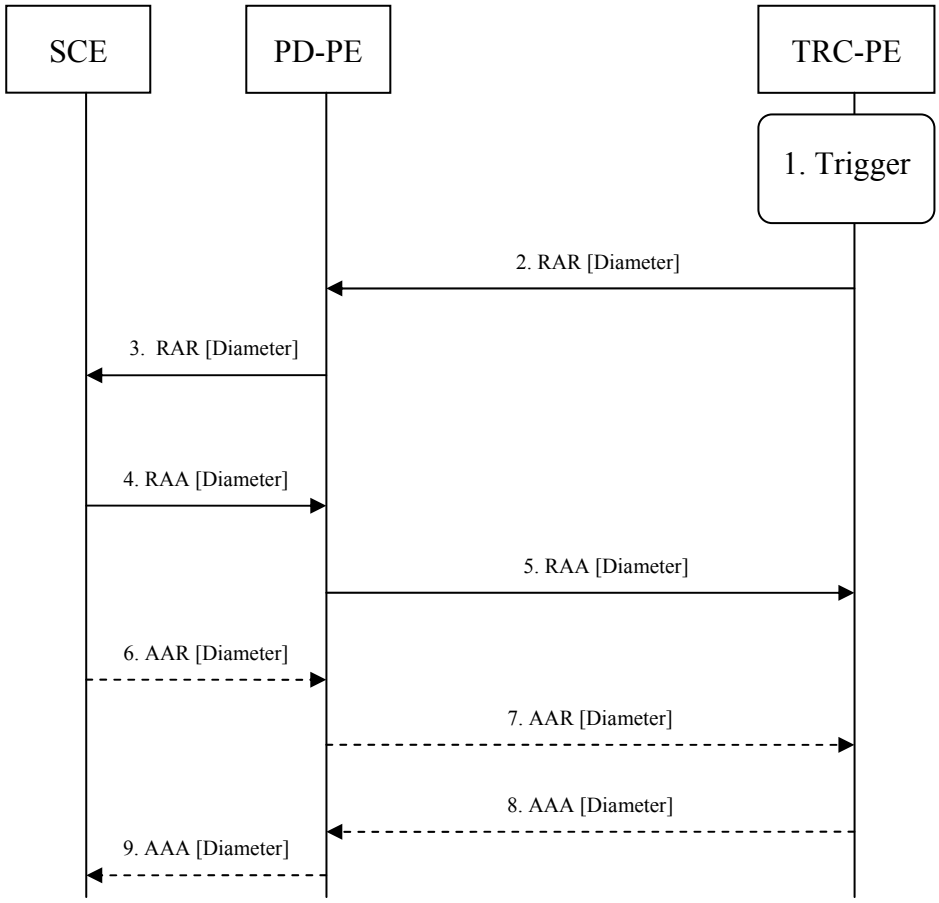
9. PD-PE sends COPS DEC (remove) or H.248 SUBTRACT message towards PE-PE for releasing resources allocated for this particular media flow.
10. PE-PE responds PD-PE with COPS RPT or H.248 SUBTRACT reply message informing the outcome of DEC or SUBTRACT message respectively.
11. PD-PE responds to STR command sent in step number 7 by sending Diameter STA command towards SCE.

6.1.6.2 PE-PE Indicated Event Notification – Stateless PD-PE Case

For further study.

6.1.6.3 TRC-PE Indicated Event Notification – Stateful PD-PE Case

6.1.6.3.1 Non-Failure Notification



1. TRC-PE receives a trigger for sending Diameter RAR command towards PD-PE. This trigger could be a certain traffic condition which needs to be reported in accordance with a service previously requested by the PD-PE.
2. TRC-PE sends a Diameter RAR command towards PD-PE, informing the occurred event.
3. PD-PE sends Diameter RAR command notifying SCE about the occurred event.
4. SCE responds PD-PE with Diameter RAA command.
5. PD-PE responds to RAR received in step number 2 by sending Diameter RAA command towards TRC-PE.
6. SCE may optionally, send Diameter AAR command towards PD-PE.

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