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          Framework for Session Set-up with Media Authorization

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Abstract

   Establishing multimedia streams must take into account requirements
   for end-to-end QoS, authorization of network resource usage and
   accurate accounting for resources used. During session set up,
   policies may be enforced to ensure that the media streams being
   requested lie within the bounds of the service profile established
   for the requesting host. Similarly, when a host requests resources
   to provide a certain QoS for a packet flow, policies may be enforced
   to ensure that the required resources lie within the bounds of the
   resource profile established for the requesting host.

   To prevent fraud and to ensure accurate billing, this document
   describes various scenarios and mechanisms that provide the linkage
   required to verify that the resources being used to provide a
   requested QoS are in-line with the media streams requested (and
   authorized) for the session.

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1. Introduction

   Various mechanisms have been defined through which end hosts can use
   a session management protocol (e.g., SIP [6]) to indicate that QoS
   requirements must be met in order to successfully set up a session.
   However, a separate protocol (e.g., RSVP [7]) is used to request the
   resources required to meet the end-to-end QoS of the media stream.
   To prevent fraud and to ensure accurate billing, some linkage is

required to verify that the resources being used to provide the
requested QoS are in-line with the media streams requested (and
authorized) for the session.

This document describes such a linkage through use of a "token" that
provides capabilities similar to that of a gate in [12] and of a
ticket in the push model of [10]. The token is generated by a policy
server (or a session management server) and is transparently relayed
through the end host to the edge router where it is used as part of
the policy-controlled flow admission process.

In some environments, authorization of media streams can exploit the
fact that pre-established relationships exist between elements of the
network (e.g., session management servers, edge routers, policy
servers and end hosts). Pre-established relationships assume that
the different network elements are configured with the identities of
the other network elements and, if necessary, are configured with
security keys, etc. required to establish a trust relationship. In
other environments, however, such pre-established relationships may
not exist either due to the complexity of creating these associations
a priori (e.g., in a network with many elements), or due to the
different business entities involved (e.g., service provider and
access provider), or due to the dynamic nature of these associations
(e.g., in a mobile environment).

In this document, we describe these various scenarios and the
mechanisms used for exchanging information between network elements
in order to authorize the use of resources for a service and to
coordinate actions between the session and resource management
entities. Specific extensions to session management protocols (e.g.,
SIP [6], H.323), to resource reservation protocols (e.g., RSVP [4],
YESSIR) and to policy management protocols (e.g., COPS-PR [9], COPS-
RSVP [3]) required to realize these scenarios and mechanisms are
beyond the scope of this document.

For clarity, this document will illustrate the media authorization
concepts using SIP for session signalling, RSVP for resource
reservation and COPS for interaction with the policy servers. Note,
however, that the framework could be applied to a multimedia services
scenario using different signalling protocols.

2. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in BCP 14, RFC 2119 [1].

3. Definition of terms

   Figure 1 introduces a generic model for session establishment, QoS
   and policy enforcement.

```
                +-------------------------------------+   +---+
                | SCD - Service Control Domain        |   |   |
                | +----------------------+ +--------+ |   | I |
                | |Session management    | |Policy  | |   | n |
                | |server                | |Server  | |   | t |
                | | +---------+ +------+  | | +----+ ||<->| e |
                | | |SIP Proxy| |PEP   |<-|-|->|PDP | ||   | r |
                | | +---------+ +------+  | | +----+ ||   | - |
                | +----------------------+ +--------+ |   | c |
                |                                     |   | o |
                +-------------------------------------+   | n |
                                                          | n |
                +-------------------------------------+   | e |
                | RCD - Resource Control Domain       |   | c |
                |                                     |   | t |
                |                                     |   | i |
                |  +------------+   +-------------+   |   | n |
    +----------+  |  |Edge Router |   |Policy Server|   |   | g |
    | End      |  |  |            |   |             |   |   |   |
    | Host     |  |  | +----------+|   +----------+  |   |   | N |
    |+--------+|  |  | |RSVP Agent||   ||PDP       |  |   |   | e |
    ||RSVP    ||<->|  | +----------+|<-->|+----------+  |   |<->| t |
    ||Client  ||  |  | +----------+|   |             |   |   | w |
    |+--------+|  |  | || PEP     ||   |             |   |   | o |
    ||SIP User||  |  | |+----------+|   |             |   |   | r |
    ||Agent   ||  |  | +------------+   +-------------+   |   | k |
    |+--------+|  |  |                                 |   |   |
    +----------+  +-------------------------------------+   +---+
```
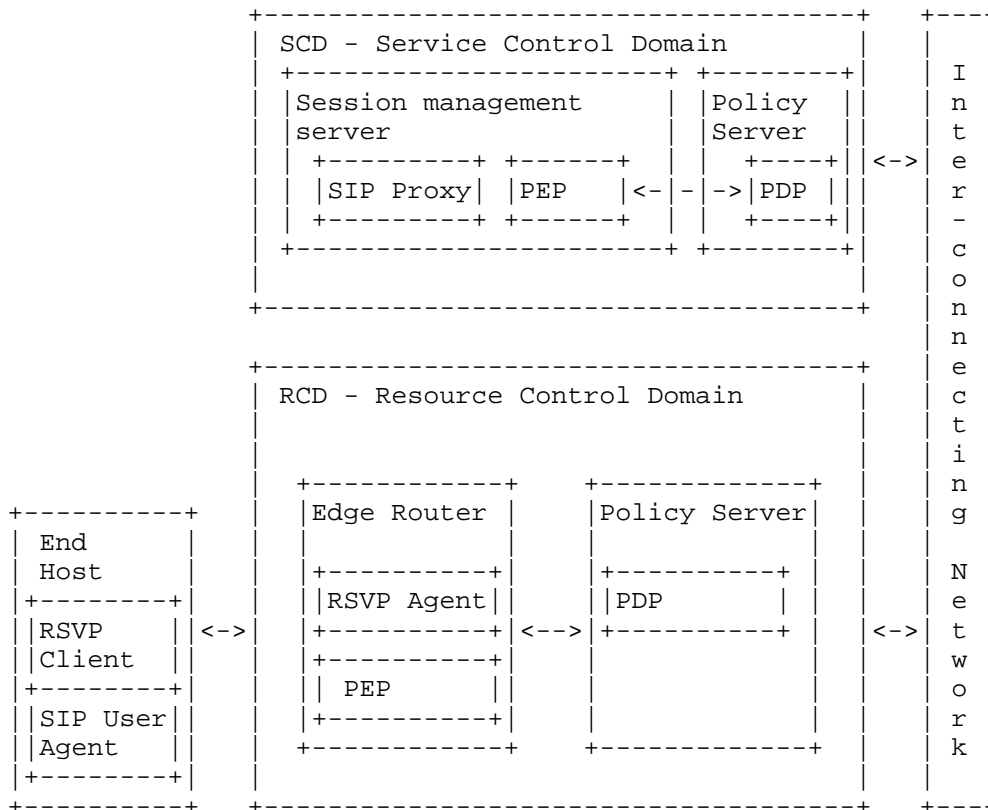
              Figure 1: Generic media authorization network model

   EH - End Host: The End Host is a device used by a subscriber to
   access network services. The End Host includes a client for
   requesting network services (e.g., through SIP) and a client for
   requesting network resources (e.g., through RSVP).

   ER - Edge Router: The Edge Router is a network element connecting the
   end host to the rest of the Resource Control Domain. The Edge Router
   contains a PEP to enforce policies related to resource usage in the
   Resource Control Domain by the End Host. It also contains a
   signalling agent (e.g., for RSVP) for handling resource reservation
   requests from the End Host.

PDP - Policy Decision Point: The PDP is a logical entity located in the Policy Server that is responsible for authorizing or denying access to services and/or resources.

PEP - Policy Enforcement Point: The PEP is a logical entity that enforces policy decisions made by the PDP. Note that other PEPs may reside in other network elements not shown in the model of Figure 1, however they will not be discussed in this document.

PS - Policy Server: The Policy Server is a network element that includes a PDP. Note that there may be a PS in the Service Control Domain to control use of services and there may be a separate PS in the Resource Control Domain to control use of resources along the packet forwarding path. Note also that network topology may require multiple Policy Servers within either Domain, however they provide consistent policy decisions to offer the appearance of a single PDP in each Domain.

RCD - Resource Control Domain: The Resource Control Domain is a logical grouping of elements that provide connectivity along the packet forwarding paths to and from an End Host. The RCD contains ER and PS entities whose responsibilities include management of resources along the packet forwarding paths. Note that there may be one or more RCDs within an autonomous domain.

SCD - Service Control Domain: The Service Control Domain is a logical grouping of elements that offer applications and content to subscribers of their services. The Session Management Server resides in the SCD along with a PS. Note that there may be one or more SCDs within an autonomous domain.

SMS - Session Management Server: The Session Management Server is a network element providing session management services (e.g., telephony call control). The Session Management Server contains a PEP to enforce policies related to use of services by the End Host. It also contains a signalling agent or proxy (e.g., for SIP) for handling service requests from the End Host.

4. The Coupled Model

In some environments, a pre-established trust relationship exists between elements of the network (e.g., session management servers, edge routers, policy servers and end hosts). We refer to this as the "coupled model", indicating the tight relationship between entities that is presumed. The key aspects of this scenario are the following:

   - Policy decisions, including media authorization, are made by a
      single Policy Server.

   - The Edge Router, Session Management Servers and Policy Server
      involved in establishing the session are known a priori. For
      example, the End Host may be configured to use a Session
      Management Server associated with the Edge Router to which the EH
      is connected.

   - There are pre-defined trust relationships between the SMS and the
      PS and between the ER and the PS.

```
                                                  +--------+
                                                  |        |
         +------+                                 |        |
         |      |   1     +--------------------+  2 |        |
         |      |-------->| Session Management |----->|        |
         |      |<--------|       Server       |<-----|        |
         |      |   4     +--------------------+  3 |        |
         | End  |                                 | Policy |
         | Host |                                 | Server |
         |      |                                 |        |
         |      |   5     +--------------------+  6 |        |
         |      |-------->|       Edge         |----->|        |
         |      |<--------|      Router        |<-----|        |
         |      |   8     +--------------------+  7 |        |
         +------+                                 |        |
                                                  +--------+
```
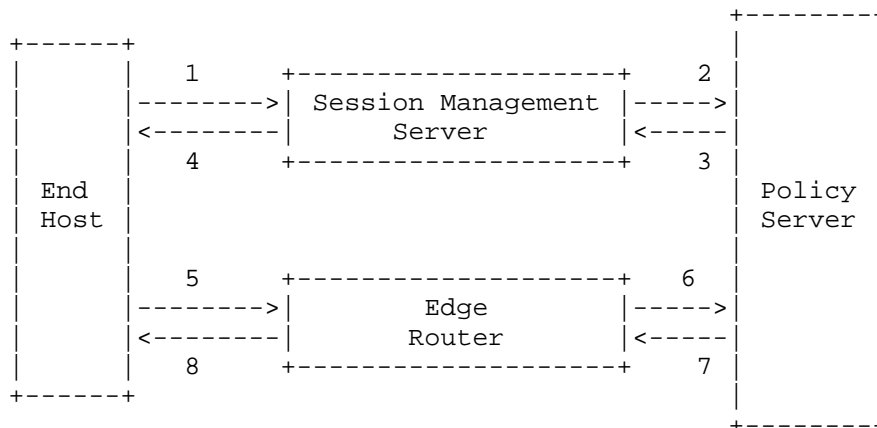
                     Figure 2: The Coupled Model

4.1   Coupled Model Message Flows

   In this model, it is assumed that there is one Policy Server serving
   both the Service Control and Resource Control Domains and that there
   are pre-defined trust relationships between the PS and SMS and
   between the PS and ER. Communications between these entities are
   then possible as described below. Only the originating side flows
   are described for simplicity. The same concepts apply to the
   terminating side.

   1. The End Host issues a session set-up request (e.g., SIP INVITE) to
      the Session Management Server indicating, among other things, the
      media streams to be used in the session. As part of this step,
      the End Host may authenticate itself to the Session Management
      Server.

2. The Session Management Server, possibly after waiting for
   negotiation of the media streams to be completed, sends a policy
   decision request (e.g., COPS REQ) to the Policy Server in order to
   determine if the session set-up request should be allowed to
   proceed.

3. The Policy Server sends a decision (e.g., COPS DEC) to the Session
   Management Server, possibly after modifying the parameters of the
   media to be used. Included in this response is a "token" that can
   subsequently be used by the Policy Server to identify the session
   and the media it has authorized.

4. The Session Management Server sends a response to the End Host
   (e.g., SIP 200 or 183) indicating that session set-up is complete
   or is progressing. Included in this response is a description of
   the negotiated media along with the token from the Policy Server.

5. The End Host issues a request (e.g., RSVP PATH) to reserve the
   resources necessary to provide the required QoS for the media
   stream. Included in this request is the token from the Policy
   Server provided via the Session Management Server.

6. The Edge Router intercepts the reservation request and sends a
   policy decision request (e.g., COPS REQ) to the Policy Server in
   order to determine if the resource reservation request should be
   allowed to proceed. Included in this request is the token from
   the Policy Server provided by the End Host. The Policy Server
   uses this token to correlate the request for resources with the
   media authorization previously provided to the Session Management
   Server.

7. The Policy Server sends a decision (e.g., COPS DEC) to the Edge
   Router, possibly after modifying the parameters of the resources
   to be reserved.

8. The Edge Router, possibly after waiting for end-to-end negotiation
   for resources to be completed, sends a response to the End Host
   (e.g., RSVP RESV) indicating that resource reservation is complete
   or is progressing.

4.2   Coupled Model Authorization Token

   In the Coupled Model, the Policy Server is the only network entity
   that needs to interpret the contents of the token. Therefore, in
   this model, the contents of the token are implementation dependent.
   Since the End Host is assumed to be untrusted, the Policy Server
   SHOULD take measures to ensure that the integrity of the token is
   preserved in transit; the exact mechanisms to be used are also
   implementation dependent.

4.3   Coupled Model Protocol Impacts

   The use of a media authorization token in the Coupled Model requires
   the addition of new fields to several protocols:

   - Resource reservation protocol. A new protocol field or object
     MUST be added to the resource reservation protocol to
     transparently transport the token from the End Host to the Edge
     Router. The content and internal structure (if any) of this
     object SHOULD be opaque to the resource reservation protocol. For
     example, this is achieved in RSVP with the Policy Data object
     defined in [8].

   - Policy management protocol. A new protocol field or object MUST
     be added to the policy management protocol to transparently
     transport the token from the Policy Server to the Session
     Management Server and from the Edge Router to the Policy Server.
     The content and internal structure (if any) of this object SHOULD
     be opaque to the policy management protocol. For example, this is
     achieved in COPS-RSVP with the Policy Data object defined in [8].

   - Session management protocol. A new protocol field or object MUST
     be added to the session management protocol to transparently
     transport the media authorization token from the Session
     Management Server to the End Host. The content and internal
     structure (if any) of this object SHOULD be opaque to the session
     management protocol (e.g., SIP [6]).

5. The Associated Model <<using One Policy Server>>

   In this scenario, there are multiple instances of the Session
   Management Servers, Edge Routers and Policy Servers. This leads to a
   network of sufficient complexity that it precludes distributing
   knowledge of network topology to all network entities. The key
   aspects of this scenario are the following:

  - Policy decisions, including media authorization, are made by the
    same Policy Server for both the Session Management Server and the
    Edge Router. However, the Policy Server may change on a per-
    transaction basis, i.e., on a per policy request basis.

  - The Edge Router, Session Management Server and Policy Server
    involved in establishing the session are not known a priori. For
    example, the End Host may be dynamically configured to use one of
    a pool of Session Management Servers and each of the Session
    Management Servers may be statically configured to use one of a
    pool of Policy Servers.

    In another example, the End Host may be mobile and continually
    changing the Edge Router that its point of attachment uses to
    communicate with the rest of the network.

  - There are pre-defined trust relationships between the SMS and the
    PS and between the ER and the PS.

```
                        +--------------------+   +---------+
                        |      SMS 'n'       |<-->|  PS 'm' |
                        +--------------------+   +--------+ |
   +------+                    : : :                   |   | |
   |      |      1     +--------------------+     2 |        | |
   |      |--------->| Session Management |----->|        | |
   |      |<--------|     Server 1       |<-----|        | |
   |      |      4     +--------------------+     3 |        | |
   | End  |                                          | Policy | |
   | Host |          +--------------------+        | Server | |
   |      |          |      ER 'n'        |        |   1    | |
   |      |      5     +-+----------------+ |        |        | |
   |      |--------->|     Edge         |-+  6 |        | |
   |      |<--------|     Router       |----->|        | |
   |      |      8     +--------------------+     7 |        | |
   +------+                                  <-----|        |-+
                                             +--------+
```

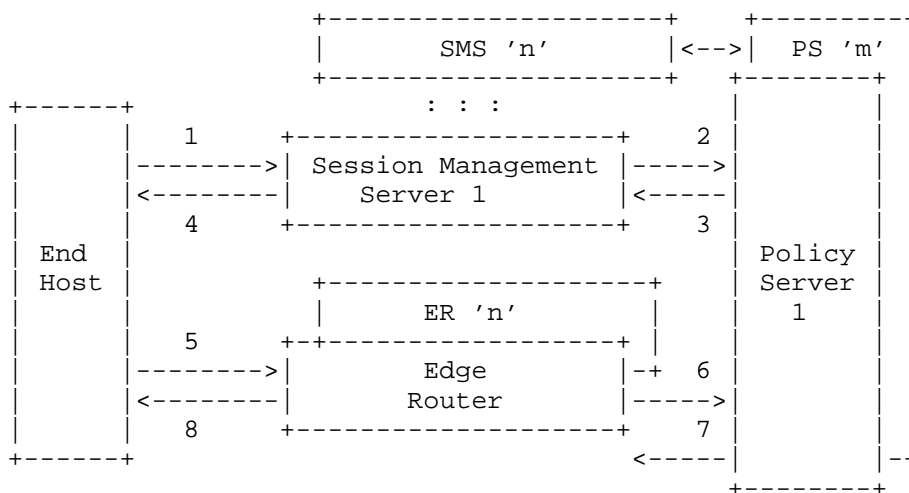   Figure 3: The Associated Model using One Policy Server

5.1   Associated Model Message Flows <<using One Policy Server>>

   In this model, it is assumed that a Policy Server can make decisions
   for both the Service Control and Resource Control Domains and that
   there are pre-defined trust relationships between the PS and SMS and
   between the PS and ER. Communications between these entities are
   then possible as described below. Only the originating side flows
   are described for simplicity. The same concepts apply to the
   terminating side.

1. The End Host issues a session set-up request (e.g., SIP INVITE) to
   the Session Management Server indicating, among other things, the
   media streams to be used in the session. As part of this step,
   the End Host may authenticate itself to the Session Management
   Server.

2. The Session Management Server, possibly after waiting for
   negotiation of the media streams to be completed, sends a policy
   decision request (e.g., COPS REQ) to the Policy Server in order to
   determine if the session set-up request should be allowed to
   proceed.

3. The Policy Server sends a decision (e.g., COPS DEC) to the Session
   Management Server, possibly after modifying the parameters of the
   media to be used. Included in this response is a "token" that can
   subsequently be used by the Policy Server to identify the session
   and the media it has authorized.

4. The Session Management Server sends a response to the End Host
   (e.g., SIP 200 or 183) indicating that session set-up is complete
   or is progressing. Included in this response is a description of
   the negotiated media along with the token from the Policy Server.

5. The End Host issues a request (e.g., RSVP PATH) to reserve the
   resources necessary to provide the required QoS for the media
   stream. Included in this request is the token from the Policy
   Server provided via the Session Management Server.

6. The Edge Router intercepts the reservation request and inspects
   the token to learn which Policy Server authorized the media. It
   then sends a policy decision request to that Policy Server in
   order to determine if the resource reservation request should be
   allowed to proceed. Included in this request is the token from
   the Policy Server provided by the End Host. The Policy Server
   uses this token to correlate the request for resources with the
   media authorization previously provided to the Session Management
   Server.

7. The Policy Server sends a decision to the Edge Router, possibly
   after modifying the parameters of the resources to be reserved.

8. The Edge Router, possibly after waiting for end-to-end negotiation
   for resources to be completed, sends a response to the End Host
   (e.g., RSVP RESV) indicating that resource reservation is complete
   or is progressing.

5.2   Associated Model Authorization Token <<using One Policy Server>>

   Since the ER does not know which SMS and PS are involved in session
   establishment, the token MUST include:

   - A correlation identifier. This is information that the Policy
      Server can use to correlate the resource reservation request with
      the media authorized during session set up. The Policy Server is
      the only network entity that needs to interpret the contents of
      the correlation identifier therefore, in this model, the contents
      of the correlation identifier are implementation dependent. Since
      the End Host is assumed to be untrusted, the Policy Server SHOULD
      take measures to ensure that the integrity of the correlation
      identifier is preserved in transit; the exact mechanisms to be
      used are also implementation dependent.

   - The identity of the authorizing entity. This information is used
      by the Edge Router to determine which Policy Server should be used
      to solicit resource policy decisions.

   In some environments, an Edge Router may have no means for
   determining if the identity refers to a legitimate Policy Server
   within its domain. In order to protect against redirection of
   authorization requests to a bogus authorizing entity, the token
   SHOULD also include:

   - Authentication data. This authentication data is calculated over
      all other fields of the token using an agreed mechanism. The
      mechanism used by the Edge Router is beyond the scope of this
      document.

   The detailed semantics of an authorization token are defined in [4].

5.3   Associated Model Protocol Impacts <<using One Policy Server>>

   The use of a media authorization token in this version of the
   Associated Model requires the addition of new fields to several
   protocols:

   - Resource reservation protocol. A new protocol field or object
      MUST be added to the resource reservation protocol to
      transparently transport the token from the End Host to the Edge
      Router. The content and internal structure of this object MUST be
      specified so that the Edge Router can distinguish between the
      elements of the token described in Section 5.2. For example, this
      is achieved in RSVP with the Policy Data object defined in [8].

   - Policy management protocol. A new protocol field or object MUST
      be added to the policy management protocol to transparently
      transport the token -- or at least the correlation identifier --
      from the Edge Router to the Policy Server. The content and
      internal structure of this object SHOULD be opaque to the policy
      management protocol. For example, this is achieved in COPS-RSVP
      with the Policy Data object defined in [8].

   - Session management protocol. A new protocol field or object MUST
      be added to the session management protocol to transparently
      transport the media authorization token from the Session
      Management Server to the End Host. The content and internal
      structure of this object SHOULD be opaque to the session
      management protocol (e.g., SIP [6]).

5.4   Associated Model Network Impacts <<using One Policy Server>>

   The use of a media authorization token in this version of the
   Associated Model requires that the Edge Router inspect the token to
   learn which Policy Server authorized the media. In some
   environments, it may not be possible for the Edge Router to perform
   this function; in these cases, an Associated Model using Two Policy
   Servers (section 6) is required.

   This version of the Associated Model also requires that the Edge
   Router interact with multiple Policy Servers. Policy decisions are
   made by the same Policy Server for both the Session Management Server
   and the Edge Router, however the Policy Server may change on per-
   transaction basis. Note that the COPS framework does not currently
   allow PEPs to change PDP on a per-transaction basis. To use this
   model, a new framework must be defined for policy decision
   outsourcing. This model also implies that the Policy Servers are
   able to interact and/or make decisions for the Edge Router in a
   consistent manner (e.g., as though there is only a single RCD Policy
   Server). How this is accomplished is beyond the scope of this
   document.

6. The Associated Model <<using Two Policy Servers>>

   In this scenario, there are multiple instances of the Session
   Management Servers, Edge Routers and Policy Servers. This leads to a
   network of sufficient complexity that it precludes distributing
   knowledge of network topology to all network entities. The key
   aspects of this scenario are the following:

   - Policy decisions, including media authorization, are made by
      Policy Servers.

-   There is a PS in the Resource Control Domain that is separate from
    the PS in the Service Control Domain.

-   The Edge Router, Session Management Server and Policy Servers
    involved in establishing the session are not known a priori. For
    example, the End Host may be dynamically configured to use one of
    a pool of Session Management Servers or the End Host may be mobile
    and continually changing the Edge Router that it uses to
    communicate with the rest of the network.

-   There is a pre-defined trust relationship between the SMS and the
    SCD PS.

-   There is a pre-defined trust relationship between the ER and the
    RCD PS.

-   There is a pre-defined trust relationship between the RCD and SCD
    Policy Servers.

```
                         +-------------------+   +--------+
+------+                 |      SMS 'n'      |   |        |
|      |    1    +-+-----------------+ |   |   SCD  |
|      |-------->| Session Management |-+  2 | Policy |
|      |<--------|      Server       |----->| Server |
|      |    4    +-------------------+<-----|        |
| End  |                              3 +--------+
|      |                              7 ^  |
| Host |         +-------------------+   | v 8
|      |         |      ER 'n'       |   +--------+
|      |    5    +-+-----------------+ |   |        |
|      |-------->|      Edge          |-+  6 |  RCD   |
|      |<--------|     Router         |----->| Policy |
|      |    10   +-------------------+<--- -| Server |
+------+                              9 |        |
                                         +--------+
```
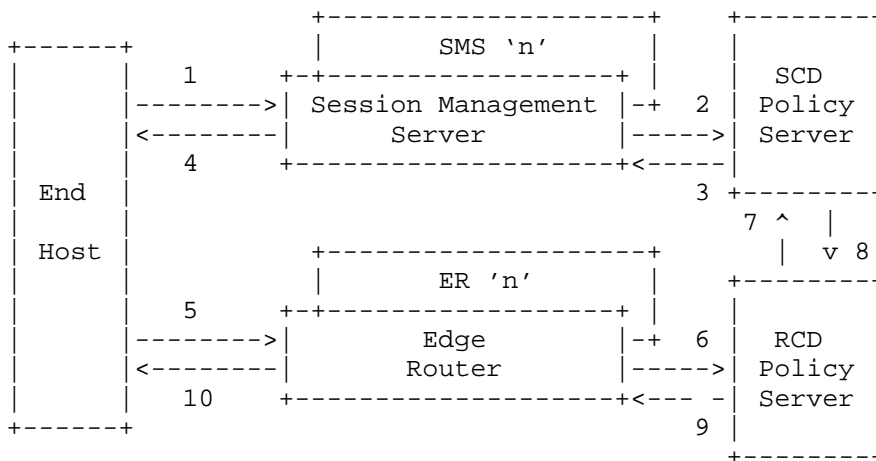
                Figure 4: The Associated Model using Two Policy Servers

6.1   Associated Model Message Flows <<using Two Policy Servers>>

   In this model, it is assumed that there is one Policy Server for the
   Service Control Domain and a different Policy Server for the Resource
   Control Domain. There are pre-defined trust relationships between
   the SCD PS and SMS, between the RCD PS and ER and between the RCD and
   SCD Policy Servers. Communications between these entities are then
   possible as described below. Only the originating side flows are
   described for simplicity. The same concepts apply to the terminating
   side.

1. The End Host issues a session set-up request (e.g., SIP INVITE)
    to the Session Management Server indicating, among other things,
    the media streams to be used in the session. As part of this
    step, the End Host may authenticate itself to the Session
    Management Server.

2. The Session Management Server, possibly after waiting for
    negotiation of the media streams to be completed, sends a policy
    decision request (e.g., COPS REQ) to the SCD Policy Server in
    order to determine if the session set-up request should be
    allowed to proceed.

3. The SCD Policy Server sends a decision (e.g., COPS DEC) to the
    Session Management Server, possibly after modifying the
    parameters of the media to be used. Included in this response is
    a "token" that can subsequently be used by the SCD Policy Server
    to identify the session and the media it has authorized.

4. The Session Management Server sends a response to the End Host
    (e.g., SIP 200 or 183) indicating that session set-up is complete
    or is progressing. Included in this response is a description of
    the negotiated media along with the token from the SCD Policy
    Server.

5. The End Host issues a request (e.g., RSVP PATH) to reserve the
    resources necessary to provide the required QoS for the media
    stream. Included in this request is the token from the SCD
    Policy Server provided via the Session Management Server.

6. The Edge Router intercepts the reservation request and sends a
    policy decision request (e.g., COPS REQ) to the RCD Policy Server
    in order to determine if the resource reservation request should
    be allowed to proceed. Included in this request is the token
    from the SCD Policy Server provided by the End Host.

7. The RCD Policy Server uses this token to learn which SCD Policy
    Server authorized the media. It then sends an authorization
    request [11] to that SCD Policy Server in order to determine if
    the resource reservation request should be allowed to proceed.
    Included in this request is the token from the SCD Policy Server
    provided by the End Host.

8. The SCD Policy Server uses this token to correlate the request
    for resources with the media authorization previously provided to
    the Session Management Server. The SCD Policy Server sends a
    decision [11] to the RCD Policy Server on whether the requested
    resources are within the bounds authorized by the SCD Policy
    Server.

9. The RCD Policy Server sends a decision (e.g., COPS DEC) to the
    Edge Router, possibly after modifying the parameters of the
    resources to be reserved.

10. The Edge Router, possibly after waiting for end-to-end
    negotiation for resources to be completed, sends a response to
    the End Host (e.g., RSVP RESV) indicating that resource
    reservation is complete or is progressing

6.2   Associated Model Authorization Token <<using Two Policy Servers>>

   Since the RCD Policy Server does not know which SMS and SCD PS are
   involved in session establishment, the token MUST include:

   - A correlation identifier. This is information that the SCD Policy
      Server can use to correlate the resource reservation request with
      the media authorized during session set up. The SCD Policy Server
      is the only network entity that needs to interpret the contents of
      the correlation identifier therefore, in this model, the contents
      of the correlation identifier are implementation dependent. Since
      the End Host is assumed to be untrusted, the SCD Policy Server
      SHOULD take measures to ensure that the integrity of the
      correlation identifier is preserved in transit; the exact
      mechanisms to be used are also implementation dependent.

   - The identity of the authorizing entity. This information is used
      by the RCD Policy Server to determine which SCD Policy Server
      should be used to verify the contents of the resource reservation
      request.

   In some environments, an RCD Policy Server may have no means for
   determining if the identity refers to a legitimate SCD Policy Server.
   In order to protect against redirection of authorization requests to
   a bogus authorizing entity, the token SHOULD include:

   - Authentication data. This authentication data is calculated over
      all other fields of the token using an agreed mechanism. The
      mechanism used by the RCD Policy Server is beyond the scope of
      this document.

   Note that the information in this token is the same as that in
   Section 5.2 for the "One Policy Server" scenario.

   The detailed semantics of an authorization token are defined in [4].

6.3   Associated Model Protocol Impacts <<using Two Policy Servers>>

   The use of a media authorization token in this version of the
   Associated Model requires the addition of new fields to several
   protocols:

   - Resource reservation protocol. A new protocol field or object
      MUST be added to the resource reservation protocol to
      transparently transport the token from the End Host to the Edge
      Router. The content and internal structure of this object SHOULD
      be opaque to the resource reservation protocol. For example, this
      is achieved in RSVP with the Policy Data object defined in [8].

   - Policy management protocol. A new protocol field or object MUST
      be added to the policy management protocol to transport the token
      from the SCD Policy Server to the Session Management Server and
      from the Edge Router to the RCD Policy Server. The content and
      internal structure of this object MUST be specified so that the
      Policy Servers can distinguish between the elements of the token
      described in Section 6.2. For example, this is achieved in COPS-
      RSVP with the Policy Data object defined in [8].

   - Session management protocol. A new protocol field or object MUST
      be added to the session management protocol to transparently
      transport the media authorization token from the Session
      Management Server to the End Host. The content and internal
      structure of this object SHOULD be opaque to the session
      management protocol (e.g., SIP [6]).

   Note that these impacts are the same as those discussed in Section
   5.3 for the "One Policy Server" scenario. However the use of two
   Policy Servers has one additional impact:

   - Authorization protocol. A new protocol field or object MUST be
      added to the authorization protocol to transport the token from
      the RCD Policy Server to the SCD Policy Server. The content and
      internal structure of this object MUST be specified so that the
      Policy Servers can distinguish between the elements of the token
      described in Section 6.2.

7. The Non-Associated Model

   In this scenario, the Session Management Servers and Edge Routers are
   associated with different Policy Servers, the network entities do not
   have a priori knowledge of the topology of the network and there are
   no pre-established trust relationships between entities in the
   Resource Control Domain and entities in the Service Control Domain.
   The key aspects of this scenario are the following:

   - Policy decisions, including media authorization, are made by
      Policy Servers.

   - The PS in the Resource Control Domain is separate from the PS in
      the Service Control Domain.

   - There is a pre-defined trust relationship between the SMS and the
      SCD PS.

   - There is a pre-defined trust relationship between the ER and the
      RCD PS.

   - There are no pre-defined trust relationships between the ER and
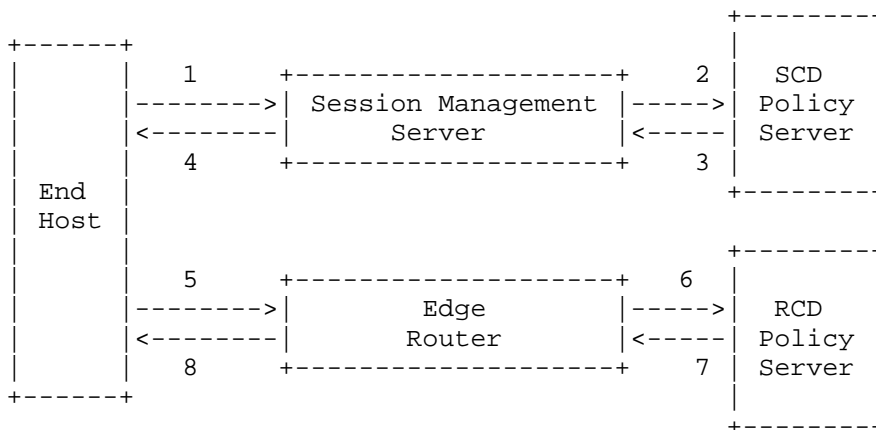   SMS or between the RCD and SCD Policy Servers.

```
                                           +--------+
                                           |        |
  +------+                           2     |  SCD   |
  |      |    1     +------------------+    2  |        |
  |      |-------->| Session Management |----->| Policy |
  |      |<--------|       Server       |<-----| Server |
  |      |    4     +------------------+    3 |        |
  | End  |                                    +--------+
  | Host |
  |      |                                    +--------+
  |      |    5     +------------------+    6 |        |
  |      |-------->|       Edge        |----->|  RCD   |
  |      |<--------|      Router       |<-----| Policy |
  |      |    8     +------------------+    7 | Server |
  +------+                                    |        |
                                              +--------+
```

                 Figure 5: The Non-Associated Model

7.1   Non-Associated Model Message Flow

   In this model it is assumed that the policy servers make independent
   decisions for their respective domains, obviating the need for
   information exchange between policy servers. This model also enables
   session authorization when communication between policy servers is
   not possible for various reasons. It may also be used as a means to
   speed up session setup and still ensure proper authorization is
   performed.

   This model does not preclude the possibility that the policy servers
   may communicate at other times for other purposes (e.g., exchange of
   accounting information).

Communications between network entities in this model is described
below. Only the originating side flows are described for simplicity.
The same concepts apply to the terminating side.

1. The End Host issues a session set-up request (e.g., SIP INVITE) to
   the Session Management Server indicating, among other things, the
   media streams to be used in the session. As part of this step,
   the End Host may authenticate itself to the Session Management
   Server.

2. The Session Management Server, possibly after waiting for
   negotiation of the media streams to be completed, sends a policy
   decision request (e.g., COPS REQ) to the SCD Policy Server in
   order to determine if the session set-up request should be allowed
   to proceed.

3. The SCD Policy Server sends a decision (e.g., COPS DEC) to the
   Session Management Server, possibly after modifying the parameters
   of the media to be used. Included in this response is a "token"
   that can subsequently be used by the RCD Policy Server to
   determine what media has been authorized.

4. The Session Management Server sends a response to the End Host
   (e.g., SIP 200 or 183) indicating that session set-up is complete
   or is progressing. Included in this response is a description of
   the negotiated media along with the token from the SCD Policy
   Server.

5. The End Host issues a request (e.g., RSVP PATH) to reserve the
   resources necessary to provide the required QoS for the media
   stream. Included in this request is the token from the SCD Policy
   Server provided via the Session Management Server.

6. The Edge Router intercepts the reservation request and sends a
   policy decision request (e.g., COPS REQ) to the RCD Policy Server
   in order to determine if the resource reservation request should
   be allowed to proceed. Included in this request is the token from
   the SCD Policy Server provided by the End Host.

7. The RCD Policy Server uses this token to extract information about
   the media that was authorized by the SCD Policy Server. The RCD
   Policy Server uses this information in making its decision on
   whether the resource reservation should be allowed to proceed.

   The Policy Server sends a decision (e.g., COPS DEC) to the Edge
   Router, possibly after modifying the parameters of the resources
   to be reserved.

   8. The Edge Router, possibly after waiting for end-to-end negotiation
      for resources to be completed, sends a response to the End Host
      (e.g., RSVP RESV) indicating that resource reservation is complete
      or is progressing

7.2 Non-Associated Model Authorization Token

   In this model, the token MUST contain sufficient information to allow
   the RCD Policy Server to make resource policy decisions autonomously
   from the SCD Policy Server. The token is created using information
   about the session received by the SMS. The information in the token
   MUST include:

   - Calling party name or IP address (e.g., from SDP "c=" parameter).

   - Called party name or IP address (e.g., from SDP "c=" parameter).

   - The characteristics of (each of) the media stream(s) authorized
     for this session (e.g., codecs, maximum bandwidth from SDP "m="
     and/or "b=" parameters).

   - The authorization lifetime. To protect against replay attacks,
     the token should be valid for only a few seconds after the start
     time of the session.

   - The identity of the authorizing entity to allow for validation of
     the token.

   - Authentication data used to prevent tampering with the token.
     This authentication data is calculated over all other fields of
     the token using an agreed mechanism. The mechanism used by the
     RCD Policy Server is beyond the scope of this document.

   Furthermore, the token MAY include:

   - The lifetime of (each of) the media stream(s) (e.g., from SDP "t="
     parameter). This field may be useful in pre-paid scenarios in
     order to limit the lifetime of the session.

   - The Calling and called party port numbers (e.g., from the "m="
     parameter).

   The detailed semantics of an authorization token are defined in [4].

7.3 Non-Associated Model Protocol Impacts

   The use of a media authorization token in the Non-Associated Model
   requires the addition of new fields to several protocols:

- Resource reservation protocol. A new protocol field or object
  MUST be added to the resource reservation protocol to
  transparently transport the token from the End Host to the Edge
  Router. The content and internal structure of this object SHOULD
  be opaque to the resource reservation protocol. For example, this
  is achieved in RSVP with the Policy Data object defined in [8].

- Policy management protocol. A new protocol field or object MUST
  be added to the policy management protocol to transport the token
  from the SCD Policy Server to the Session Management Server and
  from the Edge Router to the RCD Policy Server. The content and
  internal structure of this object MUST be specified so that the
  Policy Servers can distinguish between the elements of the token
  described in Section 7.2. For example, this is achieved in COPS-
  RSVP with the Policy Data object defined in [8].

- Session management protocol. A new protocol field or object MUST
  be added to the session management protocol to transparently
  transport the media authorization token from the Session
  Management Server to the End Host. The content and internal
  structure of this object SHOULD be opaque to the session
  management protocol (e.g., SIP [6]).

8. Conclusions

   This document defines three models for session set-up with media
   authorization:

   - The Coupled Model which assumes a priori knowledge of network
     topology and where pre-established trust relationships exist
     between network entities.

   - The Associated Model where there are common or trusted policy
     servers but knowledge of the network topology is not known a
     priori.

   - The Non-Associated Model where knowledge of the network topology
     is not known a priori, where there are different policy servers
     involved and where a trust relationship does not exist between the
     policy servers.

   The Associated Model is applicable to environments where the network
   elements involved in establishing a session have a pre-determined
   trust relationship but where their identities must be determined
   dynamically during session set up. The Non-Associated Model is
   applicable to environments where there is a complex network topology
   and/or where trust relationships between domains do not exist (e.g.,
   when they are different business entities).

In any given network, one or more of these models may be applicable.
Indeed, the model to be used may be chosen dynamically during session
establishment based on knowledge of the end points involved in the
call. In all cases, however, there is no need for the End Host or
the Session Management Server to understand or interpret the
authorization token - to them it is an opaque protocol element that
is simply copied from one container protocol to another.

Finally, the framework defined in this document is extensible to any
kind of session management protocol coupled to any one of a number of
resource reservation and/or policy management protocols.

9. Security Considerations

The purpose of this document is to describe a mechanism for media
authorization to prevent theft of service.

For the authorization token to be effective, its integrity MUST be
guaranteed as it passes through untrusted network entities such as
the End Host. This can be achieved by using authentication data.
There is no requirement for encryption of the token since it does not
contain confidential information that may be used by malicious users.

This document assumes that trust relationships exist between various
network entities, as described in each of the models. The means for
establishing these relationships are beyond the scope of this
document.

The different interfaces between the network entities described in
this document have different natures requiring different security
characteristics:

- The edge router and RCD policy server MUST have a trust
  relationship. If necessary, this relationship can be enforced
  through a formal security association [14].

- The network policies exchanged over the interface between edge
  router and RCD policy server SHOULD be integrity protected. This
  can be accomplished using integrity mechanisms built into the
  policy control protocol (e.g., the Integrity object in COPS [2])
  or through generic IP security mechanisms [14].

- The SCD and RCD policy servers MUST have a trust relationship in
  the associated model. If necessary, this relationship can be
  enforced through a formal security association [14].

-   The information exchanged over the interface between policy
    servers SHOULD be integrity protected. This can be accomplished
    using integrity mechanisms built into the policy exchange protocol
    [2] or through generic IP security mechanisms [14].

-   The end host SHOULD be authenticated by the RCD to protect against
    identity theft. The network resource request/responses should be
    protected against corruption and spoofing. Thus, the interface
    between host and edge router SHOULD provide integrity and
    authentication of messages. For example, [13] provides integrity
    and authentication of RSVP messages.

-   The end host SHOULD be authenticated by the SCD to protect against
    identity theft. The session setup request/response should be
    protected against corruption and spoofing. Thus, the interface
    between host and SMS SHOULD provide integrity and authentication
    of messages.

-   The SMS and the SCD policy server MUST have a a trust
    relationship. If necessary, this relationship can be enforced
    through a formal security association [14].

-   The network policies exchanged over the interface between the SMS
    and SCD policy server SHOULD be integrity protected. This can be
    accomplished using integrity mechanisms built into the policy
    control protocol (e.g., the Integrity object in COPS [2]) or
    through generic IP security mechanisms [14].

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