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RSVP-TE extensions to GMPLS Calls

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Abstract

Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) extensions are used to support Calls. Although it is stated that these mechanisms are applicable to any environment (including multi-area), the "Call Path" is determined hop-by-hop by each "Call Manager" in sequence along the path of the Call.

However, it is desirable to allow the Call-initiator to identify the Call Path explicitly in some cases (especially in the multi-domain case).

This document describes RSVP-TE signaling extensions to allow the Call-initiator to identify the Call Path explicitly when transit nodes (besides the Call-initiator and Call-terminator) are involved in these Calls.

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 RFC-2119 [RFC2119].

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1. Introduction

The concept of a Generalized Multi-Protocol Label Switching (GMPLS) Call is introduced in [RFC4974]. A Call is an association between endpoints and possibly between key transit points (such as network boundaries) in support of an instance of a service. The requirements of Calls and the RSVT-TE extensions in support of Calls are also described in [RFC4974].

A Call is usually established between end-points to verify polices and authorization applied on these end-points. However, in a multi-domain environment, some key polices and authorization are usually

deployed on the corresponding domain border nodes (domain ingress or egress nodes), so these border nodes are also involved in processing the Call when the Call is going through these domains. These nodes that process the Call are known as "Call Managers".

Although it is stated that the mechanisms proposed in [RFC4974] are applicable to any environment (including multi-area), the "Call Path" is determined hop-by-hop by each Call Manager in sequence along the path of the Call. That is, each Call Manager forwards the Notify message that is used to manage the Call to the next Call Manager along the Call Path. The Notify messages are targeted at (i.e., carry the IP address of) the next Call Manager, and the route that the messages follow through the network to reach the next Call Manager is not important.

However, it is desirable to allow the Call-initiator to determine the Call Path and to signal it explicitly in some cases (especially in the multi-domain case).

This document describes RSVP-TE signaling extensions to allow the Call-initiator to identify the Call Path explicitly when transit Call Managers (besides the Call-initiator and Call-terminator) are involved in a Call.

Note that Call and Connection are separated in the signaling, and Call procedures do not impact the Connection procedures, so this document does not modify any Connection procedures defined in [RFC3471], [RFC3473], [RFC4208], and other existing protocol family.

2. Motivation

In some cases, it is desirable to set up a Call through not only the Call-initiator and Call-terminator, but also some transit Call Manager nodes (e.g., transit border domain nodes) to verify the corresponding polices and authorization applied on these nodes.

For instance, in the multi-domain case as shown in Figure 1, there are three interconnected domains. Nodes I, D11, and D12 are in Domain 1, and the nodes D11 and D12 are the border nodes. Nodes D21, D22, D23, and D24 are the border nodes of Domain 2, and the internal nodes of Domain 2 are not shown in the figure. Nodes D31, D32, and E are in Domain 3, and the nodes D31 and D32 are the border nodes.

Policies and authorization are often applied in domain border nodes, such as the nodes D11, D12, D21, D22, D23, D24, D31, and D32 in this example. Therefore, in this case, when a Call between Call-initiator (node I) and Call-terminator (node E) is going to be setup, the Call

should be processed in some domain border nodes (for example, the nodes D11, D21, D23, D31 should process the Call when the Call Path I-D11-D21-D23-D31-E is selected).

Note that in this case, there may be several alternative Call Paths between Call-initiator and Call-terminator. For example, in the Figure 1, the possible Call paths may be I-D11-D21-D23-D31-E or I-D12-D22-D24-D32-E, or some other path depending on the interconnectivity across the domains.

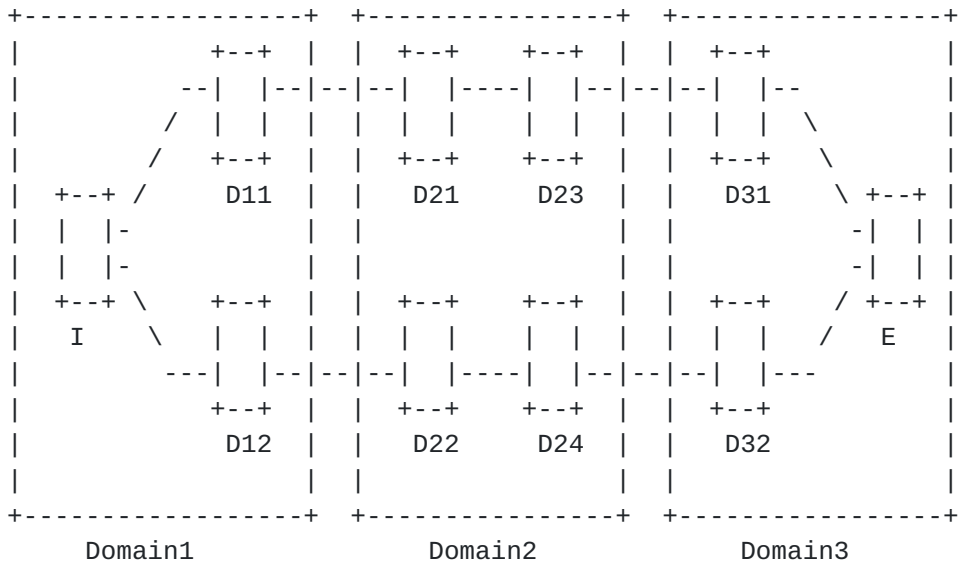

Figure 1: Multi-domain Scenario

Note that how to determine the Call Path is out of the scope of this document.

According to the Section 7.3.1 of [RFC 4974], it is already supported that the third parties (i.e., non-end points such as External Call Managers) are involved in the Call, but there is no mechanisms for the Call-initiator to control the Call Path. The Call Path is determined by each Call Manager in turn selecting the next Call Manager on the path to the Call-terminator and forwarding the Notify message that sets up the Call.

However, in the case of a multi-domain Call, commercial and policy motivations normally play a role in selecting the Call Path. This selection may be at a coarse level (for example, identifying which domains should or should not be used), or may be at a finer level (for example, identifying which Call Managers to use). Note that there is no concept of specifying links or resources within the Call

Path as the Call is an ordered association of Call Managers, and not a data path in the network.

Therefore, it is desirable to allow full control for the Call-initiator, which means that the Call-initiator can identify the full Call Path explicitly. Moreover, the management plane needs to be able to identify the Call Path explicitly as an instruction to the Call-initiator.

This document defines protocol extensions that provide a solution for these requirements.

3. Solution

In order to identify the Call Path explicitly for the Call-initiator, the explicit Call Path can be specified by the EXPLICIT_ROUTE object (ERO) [RFC3209].

A new C_Type of ERO is suggested, C_Type = 2 (suggested, TBD by IANA)), Call Explicit Route.

It is obvious that the Call Path can also be recorded by the RECORD_ROUTE object (RRO) [RFC3209].

A new C_Type of RRO is suggested, C_Type = 2 (suggested, TBD by IANA), Call Record Route.

Note that the procedures of ERO and RRO for Call Path are similar as defined in [RFC3209].

The revised Notify message is as follows using the meta-language described in [RBNF]:

```
<Notify message>  ::= <Common Header> [ <INTEGRITY> ]

                      [[ <MESSAGE_ID_ACK> | <MESSAGE_ID_NACK>]...]

                      [ <MESSAGE_ID> ]

                      <ERROR_SPEC>

                      <notify session list>
```

Where

```
<notify session list> ::= [ <notify session list> ]
```

```
                              <notify session>

   <notify session>  ::= <SESSION> [ <ADMIN_STATUS> ]

                         [ <POLICY_DATA>...]

                         [ <LINK_CAPABILITY> ]

                         [ <SESSION_ATTRIBUTE> ]

                         [ <ERO> ]

                         [ <RRO> ]

                         [ <sender descriptor> | <flow descriptor> ]
```

And where:

```
   <sender descriptor> ::= see [RFC3473]

   <flow descriptor> ::= see [RFC3473]
```

4. Operations

The processes for the revised Notify message comply with the procedures described in [RFC3974] except that the ERO and RRO are processed at the Call Managers. The processes for the ERO and RRO are similar to the Connection ERO and RRO [RFC3209].

The procedures of Call Setup for the revised Notify message are summarized as follows (other procedures are the same as [RFC3974]):

(1)The Call-initiator initiates Call setup and processes the Call locally (e.g., verifies the policy, etc.). After that, it adds the ERO to the Notify message, including the sub-objects to identify the Call Path. If RRO is required, it also should add RRO to the Notify message. Then the Call-initiator sends the Notify message to the first Call Manager indicated by the first sub-object of the ERO (Note that there is no Label Recording in this case).

(2)The transit Call Managers process the Call when they receive the Notify messages. After that, they remove themselves from the ERO. If RRO is presented in the Notify message, it should also process RRO similar to [RFC3209]. Then it sends the Notify message to the next Call Manager identified by the ERO.

(3)Step 2 recurs until the Notify message gets to the Call-terminator. And the corresponding Notify message returns to Call-initiator in the inverse direction (Note that the inverse Notify message may include RRO object if needed, but it should not include ERO object).

If, at any time, the ERO is absent or present but empty (for example, when a transit Call Manager removes itself from the ERO), a Call Manager MUST select a next Call Manager on the Call Path toward the Call-terminator (identified in the Session object of the Notify message). This next Call Manager may be another transit Call Manager or may be the Call-terminator itself. The Call Manager MAY create a new ERO if none exists to define hops to the Call-terminator, or may add hops to the existing ERO between itself and the next hop in the received ERO. Such actions are subject to local policy.

4.1. User-Initiated Calls

The extensions in this document can also be applied in user-initiated calls, although the example described in this document is about network-initiated Call. Note that, in this case, the first node within the first network domain may be responsible for specifying the Call Path explicitly in the Notify message. The procedures should comply with the description in the Section 7.2 of [RFC 4974].

5. Security Considerations

The security considerations about Call setup in single domain are described in [RFC 4974]. In the case of multi-domain environment, the security about Call is similar to that of Connection which is described in [RFC 5151]. Therefore, please refer to the corresponding Security Consideration sections in [RFC 4974] and [RFC 5151] to take into account the security issues.

6. Manageability Considerations

The mechanisms defined in this document call upon the use of policy at Call Managers. Such policy SHOULD be available for configuration by the operator either directly acting on the Call Manager or through a policy server. Important information for the application of policy is carried in the Call establishment messages (Notify messages) in the Session, Session_Attributes, Sender_Template, Link_Capability, and Policy_Data objects.

The mechanism used to determine the entire Call Path or next Call Manager in a Call Path is beyond the scope of this document. One solution is to allow configuration of the Call Path from the operator

as part of the service request (just as the explicit path of a label switched path (LSP) can be specified by the operator).

Operators will expect to be able to inspect Call Managers and determine for which Calls they are initiator, transit, or terminator. Furthermore, they will expect to be able to inspect a Call at any Call Manager that it uses, and determine all information about the Call including its Call Path.

7. IANA Considerations

This document introduces a new C_Type ERO and RRO.

7.1. ERO Object

Class-Num = 20

C-Type=2 (suggested, TBD by IANA), Call Explicit Route

This type indicates that this ERO is used for Call messages in Notify messages.

7.2. RRO Object

Class-Num = 21

C-Type=2 (suggested, TBD by IANA), Call Record Route

This type indicates that this RRO is used for Call messages in Notify messages.

7.3. RSVP Error Codes and Error Values

The Call message (Notify message) should be rejected when any Call Manager which receives the Call message including ERO does not recognize the ERO.

- Error Codes:
  - Call Management (value 32)
- Error Values:
  - Call Management/Unknown ERO (value=TBD)

8. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4974] D. Papadimitriou, A. Farrel, "Generalized MPLS (GMPLS) RSVP-TE Signaling Extensions in Support of Calls ", RFC 4974, August 2007.

[RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V. and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[RFC3471] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.

[RFC3473] Berger, L., Ed., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.

[RFC4208] Swallow, G., Drake, J., Ishimatsu, H., and Y. Rekhter, "Generalized Multiprotocol Label Switching (GMPLS) User-Network Interface (UNI): Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Support for the Overlay Model", RFC 4208, October 2005.

[RFC5151] A. Farrel, A. Ayyangar, JP. Vasseur, "Inter-Domain MPLS and GMPLS Traffic Engineering-Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 5151, February 2008.

[RBNF] Farrel, A., "Reduced Backus-Naur Form (RBNF) A Syntax Used in Various Protocol Specifications", draft-farrel-rtg-common-bnf, work in progress.

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Acknowledgment

TBD.

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