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         RSVP-TE Signaling Extension for Links with Variable Discrete
                                Bandwidth
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Abstract

   Packet switching network may contain links with variable bandwidth,
   e.g., copper, radio, etc. The bandwidth of such link is sensitive to
   external environment. Availability is typically used for describing
   the link during network planning. This document describes an
   extension for RSVP-TE signaling for setting up a label switching
   path (LSP) in a Packet Switched Network (PSN) network which contains
   links with discretely variable bandwidth by introducing an optional
   availability field in RSVP-TE signaling.

Status of this Memo

Copyright Notice

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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].

The following acronyms are used in this draft:

RSVP-TE   Resource Reservation Protocol-Traffic Engineering

LSP   Label Switched Path

PSN   Packet Switched Network

SNR   Signal-to-noise Ratio

TLV   Type Length Value

PE   Provider Edge

LSA   Link State Advertisement

1. Introduction

The RSVP-TE specification [RFC3209] and GMPLS extensions [RFC3473] specify the signaling message including the bandwidth request for setting up a label switching path in a PSN network.

Some data communication technologies allow seamless change of maximum physical bandwidth through a set of known discrete values. For example, in mobile backhaul network, microwave links are very popular for providing connection of last hops. In case of heavy rain, to maintain the link connectivity, the microwave link may lower the modulation level since demodulating lower modulation level need lower signal-to-noise ratio (SNR). This is called adaptive modulation technology [EN 302 217]. However, lower modulation level also means lower link bandwidth. When link bandwidth reduced because of modulation down-shifting, high priority traffic can be maintained, while lower priority traffic is dropped. Similarly the cooper links may change their link bandwidth due to external interference.

The parameter, availability [G.827, F.1703, P.530], is often used to describe the link capacity during network planning. Assigning different availability classes to different types of service over such kind of links provides more efficient planning of link capacity. To set up a LSP across these links, availability information is required for the nodes to verify bandwidth satisfaction and make bandwidth reservation. The availability information should be inherited from the availability requirements of the services expected to be carried on the LSP, voice service usually needs ''five nines'' availability, while non-real time services may adequately perform at four or three nines availability. Since different service types may need different availabilities guarantee, multiple <availability, bandwidth> pairs may be required when signaling.

To fulfill LSP setup by signaling in these scenarios, this document specifies a new availability sub-TLV as the sub-TLV of Ethernet bandwidth profiles [RFC6003]. Multiple bandwidth profiles with different availability can be carried in the SENDER_TSPEC object.

2. Overview

   A PSN tunnel may span one or more links in a network. To setup a
   label switching path (LSP), a PE node may collect link information
   which is spread in routing message, e.g., OSPF TE LSA message, by
   network nodes to get to know about the network topology, and
   calculate out an LSP route based on the network topology, and send
   the calculated LSP route to signaling to initiate a PATH/RESV
   message for setting up the LSP.

   In case that there is(are) link(s) with variable discrete bandwidth
   in a network, a <bandwidth, availability> requirement list should be
   specified for an LSP. Each <bandwidth, availability> pair in the
   list means that listed bandwidth with specified availability is
   required. The list could be inherited from the results of service
   planning for the LSP.

   When a PE node initiates a PATH/RESV signaling to set up an LSP, the
   PATH message SHOULD carry the <bandwidth, availability> requirement
   list as bandwidth request. Intermediate node(s) will allocate the
   bandwidth resource for each availability requirement from the
   remaining bandwidth with corresponding availability. An error
   message may be returned if any <bandwidth, availability> request
   cannot be satisfied.

   If there is a hop that cannot support the availability sub-TLV, the
   availability sub-TLV is ignored, and the requirement will be treated
   as the highest availability.

3. Extension to RSVP-TE Signaling

3.1. SENDER_TSPEC Object

   The SENDER_TSPEC object (Class-Num = 12) has the following format:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |             Length            | Class-Num (12)|    C-Type     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Switching Granularity      |              MTU              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   ~                             TLVs                              ~
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
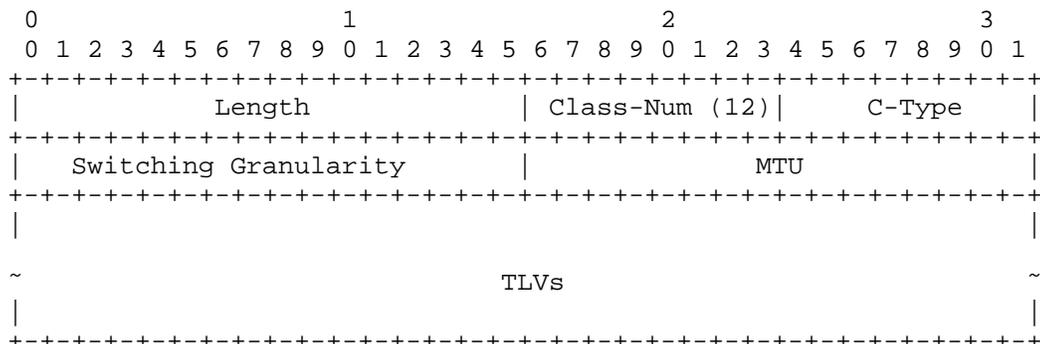
   Switching Granularity (SG): 16 bits

      See [RFC6003] section 4.

   MTU: 16bits

      See [RFC6003] section 4.

   TLV (Type-Length-Value):

      The SENDER_TSPEC object MUST include at least one TLV and MAY
      include more than one TLV.

3.1.1. Bandwidth Profile TLV

   The Bandwidth Profile TLV has the following format.

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |             Type              |             Length            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Profile    |     Index     |            Reserved           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                              CIR                              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                              CBS                              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                              EIR                              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                              EBS                              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
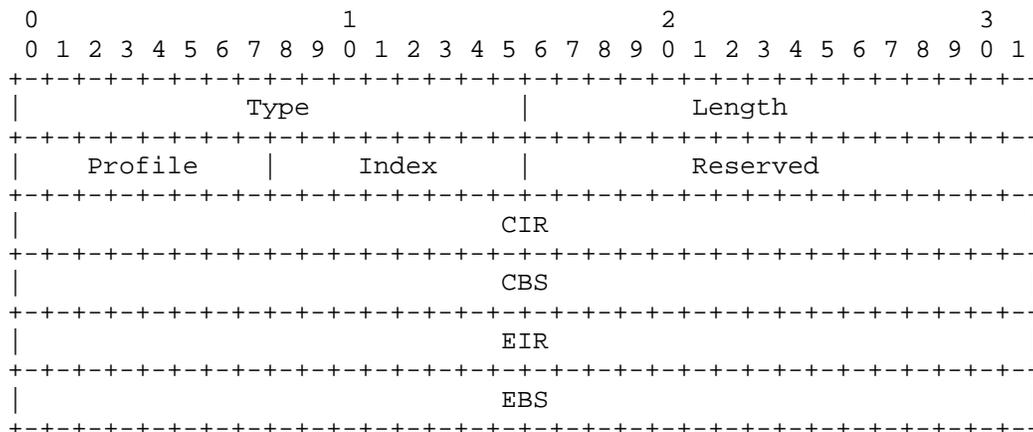
      Type: 0x02, 16 bits;

      Length: 16 bits;

      Profile: 8 bits

         This field is defined as a bit vector of binary flags. In RFC
         6003, the following flags are defined:

            Flag 1 (bit 0): Coupling Flag (CF)

            Flag 2 (bit 1): Color Mode (CM)

A new flag is defined in this document:

Flag 3 (bit 2): Availability Flag (AF)

Index: 8 bits

CIR (Committed Information Rate): 32 bits

CBS (Committed Burst Size): 32 bits

EIR (Excess Information Rate): 32 bits

EBS (Excess Burst Size): 32 bits

See [RFC6003] section 4.1.

When the Flag 3 is set to value 1, there is an availability sub-
TLV included in this Bandwidth Profile TLV. When the Flag 3 is set
to value 0, there won't be an availability sub-TLV. The
availability sub-TLV has the following format:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Type              |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Availability                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
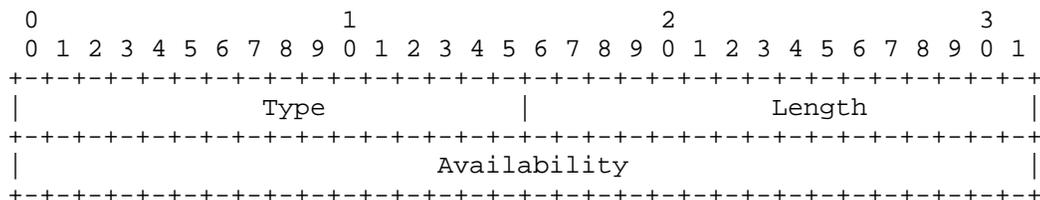
Type (2 octets): TBD

Length (2 octets): 4

Availability (4 octets): a 32-bit floating number describes
availability requirement for this bandwidth request. The value
must be less than 1.

3.2. FLOWSPEC Object

The FLOWSPEC object (Class-Num = 9, Class-Type = TBD) has the same
format as the Ethernet SENDER_TSPEC object.

3.3. Signaling Process

The source node initiates PATH messages including one or more
Bandwidth Profile TLVs with different availability value in the

SENDER_TSPEC object. Each Bandwidth Profile TLV specifies the
portion of bandwidth request with referred availability requirement.

The destination node checks whether it can satisfy the bandwidth
requirements by comparing each bandwidth requirement inside the
SENDER_TSPEC objects with the remaining link sub-bandwidth resource
with respective availability guarantee when received the PATH
message.

o   If all bandwidth requirements can be satisfied, it should
    reserve the bandwidth resource from each remaining sub-
    bandwidth portion to set up this LSP. Optionally, the higher
    availability bandwidth can be allocated to lower availability
    request when the lower availability bandwidth cannot satisfy
    the request.

o   If at least one bandwidth requirement cannot be satisfied, it
    should generate PathErr message with the error code "Admission
    Control Error" and the error value "Requested Bandwidth
    Unavailable" (see [RFC2205]).

4. Security Considerations

This document does not introduce new security considerations to the
existing RSVP-TE signaling protocol.

5. IANA Considerations

IANA maintains registries and sub-registries for RSVP-TE used by
GMPLS. IANA is requested to make allocations from these registries
as set out in the following sections.

5.1 RSVP Objects Class Types

This document introduces two new Class Types for existing RSVP
objects. IANA is requested to make allocations from the "Resource
ReSerVation Protocol (RSVP) Parameters" registry using the "Class
Names, Class Numbers, and Class Types" sub-registry.

Class Number	Class Name	Reference
9	FLOWSPEC	[RFC2205]
	Class Type (C-Type):	

```
                      6    Ethernet SENDER_TSPEC        [RFC6003]
```

```
      Class Number  Class Name                          Reference

      ------------  -----------------------             ---------

      12            SENDER_TSPEC                         [RFC2205]

                    Class Type (C-Type):

                    6    Ethernet SENDER_TSPEC           [RFC6003]
```

5.2 Ethernet Bandwidth Profile TLV

   IANA maintains a registry of GMPLS parameters called ''Generalized
   Multi-Protocol Label Switching (GMPLS) Signaling Parameters''.

   IANA has created a new sub-registry called ''Ethernet Bandwidth
   Profiles'' to contain bit flags carried in the Ethernet Bandwidth
   Profile TLV of the Ethernet SENDER_TSPEC object.

   Bits are to be allocated by IETF Standards Action. Bits are numbered
   from bit 0 as the low order bit. A new bit flag is as follow:

```
   Bit     Hex             Description           Reference

   ---     ----            ------------------    -----------

   2       0x03            Availability Flag (AF) [This ID]
```

   Sub-TLV types for Ethernet Bandwidth Profiles are to be allocated by
   IETF Standard Action. Initial values are as follows:

```
   Type    Length          Format                Description

   ---     ----            ------------------    -----------

   0       -               Reserved              Reserved value

   TBD     4               see Section 3.1       Availability sub-
                                                 TLV
```

6. References

6.1. Normative References

   [RFC2210] Wroclawski, J., ''The Use of RSVP with IETF Integrated
             Services'', RFC 2210, September 1997.

   [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.

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

   [RFC6003] Papadimitriou, D. ''Ethernet Traffic Parameters'', RFC 6003,
             October 2010.

   [G.827]   ITU-T Recommendation, ''Availability performance parameters
             and objectives for end-to-end international constant bit-
             rate digital paths'', September, 2003.

   [F.1703] ITU-R Recommendation, ''Availability objectives for real
             digital fixed wireless links used in 27 500 km
             hypothetical reference paths and connections'', January,
             2005.

   [P.530]   ITU-R Recommendation,'' Propagation data and prediction
             methods required for the design of terrestrial line-of-
             sight systems'', February, 2012

   [EN 302 217] ETSI standard, ''Fixed Radio Systems; Characteristics
             and requirements for point-to-point equipment and
             antennas'', April, 2009

6.2. Informative References

   [MCOS]   Minei, I., Gan, D., Kompella, K., and X. Li, "Extensions
             for Differentiated Services-aware Traffic Engineered
             LSPs", Work in Progress, June 2006.

7. Acknowledgments

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