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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.

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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. A more detailed example on the bandwidth availability can be found in Appendix A. 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.

If the availability requirement is not specified in the signaling message, the bandwidth will be reserved as the highest availability. For example, the bandwidth with 99.999% availability of a link is 100Mbps; the bandwidth with 99.99% availability is 200Mbps. When a

video application requests for 120Mbps without availability requirement, the system will compare 120Mbps with 100Mbps, therefore cannot set up the LSP path. But in fact, video application doesn't need 99.999% availability, 99.99% availability is enough. In this case, the LSP could be set up if availability is specified in the signaling message.

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.

A node which has link(s) with variable discrete bandwidth attached SHOULD contain a <bandwidth, availability> information list in its OSPF TE LSA messages. The list provides the information that how much bandwidth a link can support for a specified availability. This information is used for path calculation by the PE node(s). The routing extension for availability can be found in [ARTE].

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.

3. Extension to RSVP-TE Signaling

The RSVP-TE signaling extension in this document is based on RFC6003: a new sub-TLV for Ethernet Bandwidth Profile TLV is defined.

3.1.1. Availability sub-TLV

The Ethernet Bandwidth Profile TLV in RFC6003 has the following format. A new filed is defined in this document as shown in Figure 1.

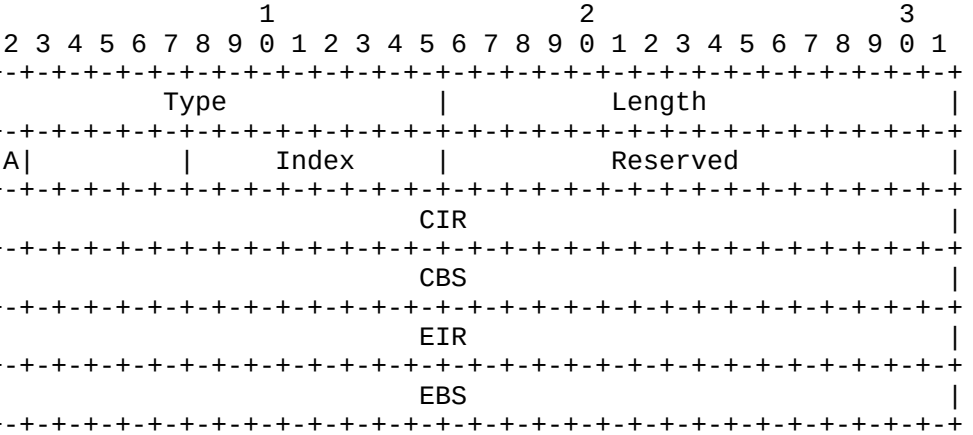

Figure 1: A new "AF" filed in Ethernet Bandwidth Profile TLV

A new filed is defined in this document:

AF filed (bit 2): Availability Field (AF)

If the AF filed is set to 1, Availability sub-TLV MUST be included in the Bandwidth Profile TLV. If the AF field is set to value 0, then an Availability sub-TLV SHOULD NOT be included. The availability sub-TLV has the following format:

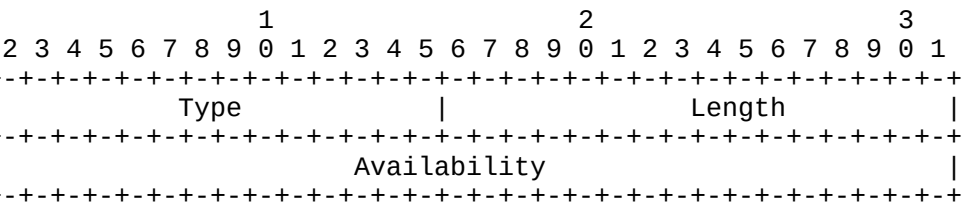

Figure 2: Availability sub-TLV

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.

As the Ethernet Bandwidth Profile TLV can be carried for one or more times in the Ethernet SENDER_TSPEC object, the availability sub-TLV can also be present for one or more times.

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.

- If all <bandwidth, availability> 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.

- If at least one <bandwidth, availability> 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]).

If two LSP request for the bandwidth with the same availability requirement, a way to resolve the contention is comparing the node ID, the node with the higher node ID will win the contention. More details can be found in [RFC3473].

If a node does not support the Availability sub-TLV, then it MUST ignore the sub-TLV and only use the bandwidth request in the

Ethernet Bandwidth Profile TLV. The [RFC6003] states that a node that does not support a flag should ignore it. Thus a legacy implementation will ignore the Availability Flag.

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 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 field is as follow:

Bit	Hex	Description	Reference
2	0x03	Availability Field (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

[ARTE] H., Long, M., Ye, Mirsky, G., Alessandro, A., Shah, H., "OSPF Routing Extension for Links with Variable Discrete Bandwidth", Work in Progress, December, 2013

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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Appendix A

Presuming that a link has three discrete bandwidth levels:

The link bandwidth under modulation level 1, e.g., QPSK, is 100M;

The link bandwidth under modulation level 2, e.g., 16QAM, is 200M;

The link bandwidth under modulation level 3, e.g., 256QAM, is 400M.

In sunny day, the modulation level 3 can be used to achieve 400M link bandwidth.

A light rain with X mm/h rate triggers the system to change the modulation level from level 3 to level 2, with bandwidth changing from 400M to 200M. The probability of X mm/h rain in the local area is 53 minutes in a year. Then the dropped 200M bandwidth has 99.99% availability.

A heavy rain with Y(Y>X) mm/h rate triggers the system to change the modulation level from level 2 to level 1, with bandwidth changing from 200M to 100M. The probability of Y mm/h rain in the local area is 26 minutes in a year. Then the dropped 100M bandwidth has 99.995% availability.

For the 100M bandwidth of the modulation level 1, only the extreme weather condition can cause the whole system unavailable, which only happens for 5 minutes in a year. So the 100M bandwidth of the modulation level 1 owns the availability of 999.99%.

In a word, the maximum bandwidth is 400Mbps. According to the weather condition, the sub-bandwidth and its availability are shown as follows:

Sub-bandwidth(Mbps)	Availability
200	99.99%
100	99.995%

100	99.999%

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