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Ethernet Traffic Parameters with Availability Information
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Abstract

A Packet switching network may contain links with variable bandwidth, e.g., copper, radio, etc. The bandwidth of such links is sensitive to external environment. Availability is typically used for describing the link during network planning. This document introduces an Extended Ethernet Bandwidth Profile TLV and an optional Availability sub-TLV in Resource ReSerVation Protocol - Traffic Engineer (RSVP-TE) signaling. This extension can be used to set up a label switching path (LSP) in a Packet Switched Network (PSN) that contains links with discretely variable bandwidth.

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Table of Contents

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

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. The parameter availability [G.827, F.1703, P.530] is often used to describe the link capacity during network planning. The availability is a time scale that the requested bandwidth is ensured. 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 an 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. For example, 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 guarantees, 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 100 Mbps; the bandwidth with 99.99% availability is 200 Mbps. When a video application requests for 120 Mbps without availability requirement, the system will consider the request as 120 Mbps with 99.999% availability, while the available bandwidth with 99.999% availability is only 100 Mbps, therefore the LSP path cannot be set up. 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 an Extended Ethernet Bandwidth Profile and an Availability

sub-TLV. The Availability sub-TLV can be applicable to any kind of physical links with variable discrete bandwidth, such as microwave or DSL. Multiple Extended Ethernet Bandwidth Profiles with different availability can be carried in the Ethernet 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 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 node(s). The routing extension for availability can be found in [ARTE].

When a 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 initial idea is to define an Availability sub-TLV under Ethernet Bandwidth Profile TLV [RFC6003]. However the Ethernet Bandwidth Profile TLV doesn’t have the ability to carry a sub-TLV according to RFC6003. Therefore, an Extend Ethernet Bandwidth Profile TLV is defined in this document to avoid the backward compatibility issue. The Extended Ethernet Bandwidth Profile TLV includes Ethernet BW TLV and has variable length. It MAY include Availability sub-TLV which is also defined in this document.

3.1.1. Extended Ethernet Bandwidth Profile TLV

The Extended Ethernet Bandwidth Profile TLV is included in the Ethernet SENDER_TSPEC, and MAY be included for more than one time. The Extended Ethernet Bandwidth Profile TLV has the following format.

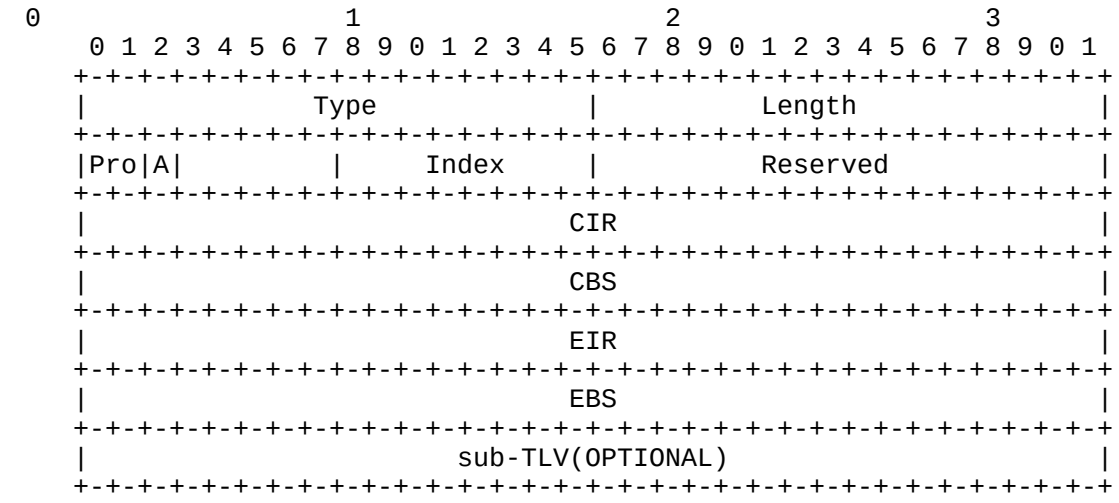

Figure 1: A new "AF" filed in Extended Ethernet Bandwidth Profile TLV

The difference between the Extended Ethernet Bandwidth Profile TLV and Ethernet Bandwidth Profile TLV is that a new AF field to indicate the sub-TLV is defined in the Extended Ethernet Bandwidth Profile TLV. The rest definitions are the same.

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 Extended Ethernet Bandwidth Profile TLV. If the AF field is set to value 0, then an Availability sub-TLV SHOULD NOT be included.

3.1.2. Availability sub-TLV

The Availability sub-TLV has the following format:

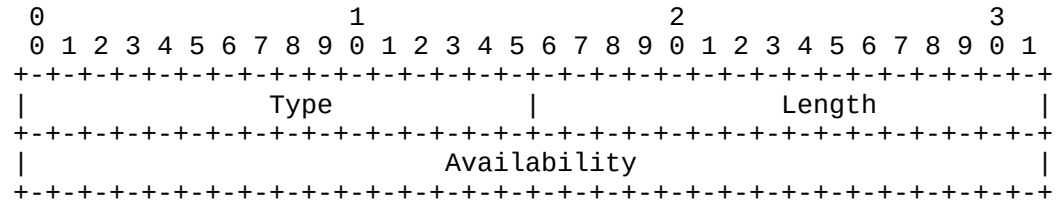

Figure 2: Availability sub-TLV

Type (2 octets): TBD

Length (2 octets): 4

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

As the Extended 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 Extended Bandwidth Profile TLVs with different availability values in the SENDER_TSPEC object. Each Extended Bandwidth Profile TLV specifies the bandwidth request with referred availability requirement.

The intermediate and destination nodes check whether they 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 (the requested bandwidth under each availability parameter is smaller than or equal to the remaining bandwidth under the corresponding availability parameter on its local link), it SHOULD reserve the bandwidth resource from each remaining sub-bandwidth portion on its local link 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 LSPs 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 Extended Bandwidth Profile TLV and Availability sub-TLV, it SHOULD generate PathErr message with the error code "Extended Class-Type Error" and the error value "Class-Type mismatch" (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 Ethernet Sender TSpec TLVs

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 Sender TSpec TLVs / Ethernet Flowspec TLVs" to contain the TLV type values for TLVs carried in the Ethernet SENDER_TSPEC object. A new value is as follow:

Type	Description	Reference
TBD	Extended Ethernet Bandwidth Profile	[This ID]

5.2 Extended Ethernet Bandwidth Profile TLV

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

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

Bit	Hex	Description	Reference
0	0x01	Coupling Flag (CF)	[RFC6003]
1	0x02	Color Mode (CM)	[RFC6003]
2	0x04	Availability Field (AF)	[This ID]

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

Type	Length	Format	Description
0	-	Reserved	Reserved value
0x01	4	see Section 3.1.2 of this ID	Availability

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.

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.

[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, June, 2015

7. Appendix: Bandwidth Availability 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 the lower modulation level needs a lower Signal-to-Noise Ratio (SNR). This is called adaptive modulation technology [EN 302 217]. However, a lower modulation level also means lower link bandwidth. When link bandwidth is reduced because of modulation down-shifting, high-priority traffic can be maintained, while lower-priority traffic is dropped. Similarly, the copper links MAY change their link bandwidth due to external interference.

Presuming that a link has three discrete bandwidth levels:

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

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

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

In sunny day, the modulation level 3 can be used to achieve 400 Mbps 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 400 Mbps to 200 Mbps. The probability of X mm/h rain in the local area is 52 minutes in a year. Then the dropped 200 Mbps 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 200 Mbps to 100 Mbps. The probability of Y mm/h rain in the local area is 26 minutes in a year. Then the dropped 100 Mbps 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 100 Mbps bandwidth of the modulation level 1 owns the availability of 99.999%.

In a word, the maximum bandwidth is 400 Mbps. 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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