Network Working Group H. Long, M. Ye
Internet Draft Huawei Technologies Co., Ltd
Intended status: Standards Track G. Mirsky
ZTE
A.D'Alessandro
Telecom Italia S.p.A
H. Shah
Ciena
Expires: September 2019 March 6, 2019

Ethernet Traffic Parameters with Availability Information
draft-ietf-ccamp-rsvp-te-bandwidth-availability-14.txt

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 (e.g., climate). Availability is typically used for describing these links when doing network planning. This document introduces an optional Availability TLV in Resource ReSerVation Protocol - Traffic Engineer (RSVP-TE) signaling. This extension can be used to set up a Generalized Multi-Protocol Label Switching (GMPLS) Label Switched Path (LSP) in conjunction with the Ethernet SENDER_TSPEC object.

This Internet-Draft will expire on September 6, 2019.

Copyright Notice

Table of Contents

1. Introduction 3
2. Overview 4
3. Extension to RSVP-TE Signaling............................... 5
   3.1. Availability TLV.. 5
   3.2. Signaling Process....................................... 6
4. Security Considerations...................................... 7
5. IANA Considerations 7
   5.1 Ethernet Sender TSpec TLVs 7
6. References 8
   6.1. Normative References.................................... 8
   6.2. Informative References.................................. 8
7. Appendix: Bandwidth Availability Example..................... 9
8. Acknowledgments 10

Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

The following acronyms are used in this draft:

RSVP-TE Resource Reservation Protocol-Traffic Engineering

LSP   Label Switched Path

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 Switched Path in a packet switching 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 based on a time scale, which is a proportion of the operating time that the requested bandwidth is ensured. A more detailed example on the bandwidth availability can be found in Appendix A. Assigning different bandwidth availability classes to different types of services over such kind of links provides for a more efficient planning of link capacity. To set up an LSP across these links, bandwidth availability information is required for the nodes to verify bandwidth satisfaction and make bandwidth reservation. The bandwidth availability information should be inherited from the bandwidth availability requirements of the services expected to be carried on the LSP. For example, voice service usually needs "five nines" bandwidth availability, while non-real time services may adequately perform at four or three nines bandwidth availability. Since different service types may need different availabilities guarantees, multiple <availability, bandwidth> pairs may be required when signaling.

If the bandwidth availability requirement is not specified in the signaling message, the bandwidth will be reserved as the highest bandwidth availability. Suppose, 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 bandwidth availability requirement, the system will consider the request as 120 Mbps with 99.999% bandwidth availability, while the available bandwidth with 99.999% bandwidth availability is only 100 Mbps, therefore the LSP path cannot be set up. But, in fact, the video application doesn't need 99.999% bandwidth availability; 99.99% bandwidth availability is enough. In this case, the LSP could be set up if bandwidth availability is also specified in the signaling message.

To fulfill LSP setup by signaling in these scenarios, this document specifies an Availability TLV. The Availability TLV can be applicable to any kind of physical links with variable discrete bandwidth, such as microwave or DSL. Multiple Availability TLVs together with multiple Ethernet Bandwidth Profiles can be carried by the Ethernet SENDER_TSPEC object [RFC6003]. Since the Ethernet FLOWSPEC object has the same format as the Ethernet SENDER_TSPEC object [RFC6003], the Availability TLV can also be carried by the Ethernet FLOWSPEC object.

2. Overview

A tunnel in a packet switching network may span one or more links in a network. To setup a Label Switched Path (LSP), a node may collect link information which is advertised in a routing message, e.g., OSPF TE LSA message, by network nodes to obtain network topology information, and then calculate an LSP route based on the network topology. The calculated LSP route is signaled using 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 at setup. Each <bandwidth, availability> pair in the list means the listed bandwidth with specified availability is required. The list could be derived 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 mapping between the link nominal bandwidth and its availability level. This information can then be used for path calculation by the node(s). The routing extension for availability can be found in [RFC8330].

When a node initiates a PATH/RESV signaling to set up an LSP, the PATH message should carry the <bandwidth, availability> requirement list as a 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

3.1. Availability TLV

An Availability TLV is defined as a TLV of the Ethernet SENDER_TSPEC object [RFC6003] in this document. The Ethernet SENDER_TSPEC object MAY include more than one Availability TLV. The Availability 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           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Index      |                   Reserved                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Availability                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Availability TLV

Type (2 octets): 0x04

Length (2 octets): 0x0C. Indicates the length in bytes of the whole TLV including the Type and Length fields, in this case 12 bytes.

Index (1 octet):

When the Availability TLV is included, it MUST be present along with the Ethernet Bandwidth Profile TLV. If the bandwidth requirements in the multiple Ethernet Bandwidth Profile TLVs have different Availability requirements, multiple Availability TLVs SHOULD be carried. In such a case, the Availability TLV has a one to one correspondence with the Ethernet Bandwidth Profile TLV by having the same value of Index field. If all the bandwidth requirements in the Ethernet Bandwidth Profile have the same Availability requirement, one Availability TLV SHOULD be carried. In this case, the Index field is set to 0.

Reserved (3 octets): These bits SHOULD be set to zero when sent and MUST be ignored when received.

Availability (4 octets): a 32-bit floating point number describes the decimal value of availability requirement for this bandwidth request. The value MUST be less than 1and is usually expressed in the value of 0.99/0.999/0.9999/0.99999.

3.2. Signaling Process

The source node initiates a PATH message which may carry a number of bandwidth requests, including one or more Ethernet Bandwidth Profile TLVs and one or more Availability TLVs. Each Ethernet Bandwidth Profile TLV corresponds to an availability parameter in the associated Availability TLV.

The intermediate and destination nodes check whether they can satisfy the bandwidth requirements by comparing each bandwidth request inside the SENDER_TSPEC objects with the remaining link sub-bandwidth resource with respective availability guarantee on the local link when the PATH message is received.

- o When all <bandwidth, availability> requirement requests 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), the node SHOULD reserve the bandwidth resource from each remaining sub-bandwidth portion on its local link to set up this LSP. Optionally, a higher availability bandwidth can be allocated to lower availability request when the lower availability bandwidth cannot satisfy the request.

- o When at least one <bandwidth, availability> requirement request cannot be satisfied, the node SHOULD generate PathErr message with the error code "Admission Control Error" and the error value "Requested Bandwidth Unavailable" (see [RFC2205]).

When two LSPs request bandwidth with the same availability requirement, contention MUST be resolved by comparing the node IDs, with the LSP with the higher node ID being assigned the reservation. This is consistent with general contention resolution mechanism provided in section 3.2 of [RFC3473].

When a node does not support the Availability TLV, the node SHOULD generate a PathErr message with the error code "Extended Class-Type Error" and the error value "Class-Type mismatch" (see [RFC2205]). When a node receives Availability TLVs which mixed of zero index and non-zero index, the message MAY be ignored and SHOULD NOT be propagated. When a node receives Availability TLVs (non-zero index) with no matching index value among the bandwidth-TLVs, the message MAY be ignored and SHOULD NOT be propagated. When a node receives several <bandwidth, availability> pairs, but there're are extra bandwidth-TLVs without matching index Availability-TLV, the extra bandwidth-TLVs MAY be ignored and SHOULD NOT be propagated.

4. Security Considerations

This document defines an Availability TLV in RSVP-TE signaling used in GMPLS network. [RFC3945] notes that authentication in GMPLS systems may use the authentication mechanisms of the component protocols. [RFC5920] provides an overview of security vulnerabilities and protection mechanisms for the GMPLS control plane. Especially section 7.1.2 of [RFC5920] discuss the control-plane protection with RSVP-TE by using general RSVP security tools, limiting the impact of an attack on control-plane resources, and authentication for RSVP messages. Moreover, the GMPLS network is often considered to be a closed network such that insertion, modification, or inspection of packets by an outside party is not possible.

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 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. The sub-registry needs to be updated to include the Availability TLV which is defined as follow. This document proposes a suggested value for the Availability sub-TLV; it is requested that the suggested value be granted by IANA.

Type	Description	Reference
0x04	Availability	[This ID]

The registration procedure for this registry is Standards Action as defined in [RFC8126].

6. References

6.1. Normative References

[RFC2205] Braden, R., Ed., Zhang, L., Berson, S., Herzog, S., and S.Jamin, "Resource ReSerVation Protocol (RSVP) - Version 1 Functional Specification", RFC 2205, 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.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, May 2017.

6.2. Informative References

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

[RFC8126] Cotton,M. and Leiba,B., and Narten T., "Guidelines for Writing an IANA Considerations Section in RFCs", RFC 8126, June 2017.

[RFC3945] Mannie, E., "Generalized Multi-Protocol Label Switching (GMPLS) Architecture", RFC 3945, October 2004.

[RFC5920] Fang, L., "Security Framework for MPLS and GMPLS Networks", RFC 5920, July 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

[RFC8330] H., Long, M., Ye, Mirsky, G., Alessandro, A., Shah, H., "OSPF Traffic Engineering (OSPF-TE) Link Availability Extension for Links with Variable Discrete Bandwidth", RFC8330, February 2018

7. Appendix: Bandwidth Availability Example

In a mobile backhaul network, microwave links are very popular for providing connections of last hops. In case of heavy rain conditions, to maintain the link connectivity, the microwave link MAY lower the modulation level since demodulating to a lower modulation level provides for a lower Signal-to-Noise Ratio (SNR) requirement. 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, 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.

On a 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 to be 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%.

Therefore, 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%

8. Acknowledgments

The authors would like to thank Deborah Brungard, Khuzema Pithewan, Lou Berger, Yuji Tochio, Dieter Beller, and Autumn Liu for their comments and contributions on the document.

Authors' Addresses

Hao Long
Huawei Technologies Co., Ltd.
No.1899, Xiyuan Avenue, Hi-tech Western District
Chengdu 611731, P.R.China

Phone: +86-18615778750
Email: longhao@huawei.com

Min Ye (editor)
Huawei Technologies Co., Ltd.
No.1899, Xiyuan Avenue, Hi-tech Western District
Chengdu 611731, P.R.China

Email: amy.yemin@huawei.com

Greg Mirsky (editor)
ZTE

Email: gregimirsky@gmail.com

Alessandro D'Alessandro
Telecom Italia S.p.A

Email: alessandro.dalessandro@telecomitalia.it

Himanshu Shah
Ciena Corp.
3939 North First Street
San Jose, CA 95134
US

Email: hshah@ciena.com