Internet Engineering Task Force
Internet-Draft
Intended status: Standards Track
Expires: January 4, 2016

H. Chen
Huawei Technologies
M. Toy
Comcast
V. Liu
China Mobile
L. Liu
Fijitsu

July 3, 2015

Extensions to MPLS for Temporal LSP
draft-chen-teas-rsvp-tts-00.txt

Abstract

This document specifies extensions to RSVP-TE for creating and maintaining a Traffic Engineering (TE) Label Switched Path (LSP) in a time interval or a sequence of time intervals.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on January 4, 2016.

Table of Contents

1. Introduction

Once an existing multiprotocol label switching (MPLS) traffic engineering (TE) label switched path (LSP) is set up, it is assumed to carry traffic forever until it is down. When an MPLS TE LSP tunnel is up, it is assumed that the LSP consumes its reserved network resources forever even though the LSP may only use network resources during some period of time. As a result, the network resources are not used efficiently. Moreover, a tunnel service can not be reserved or booked in advance in a period of time.

This document specifies extensions to RSVP-TE for creating and maintaining an MPLS TE LSP in a period of time called a time interval or a sequence of time intervals. It is assumed that the LSP carries traffic during this time interval or each of these time intervals. Thus the network resources are efficiently used. More importantly, some new services can be provided. For example, a consumer can book a tunnel service in advance for a given time interval. Tunnel services may be scheduled as requested.

2. Terminology

A Time Interval: a time period from time Ta to time Tb.

LSP: Label Switched Path. An LSP is a P2P (point-to-point) LSP or a P2MP (point-to-multipoiint) LSP.

LSP in a time interval: LSP that carries traffic in the time interval.

LSP in a sequence of time intervals: LSP that carries traffic in each of the time intervals.

Temporal LSP: LSP in a time interval or LSP in a sequence of time intervals.

TEDB: Traffic Engineering Database.

This document uses terminologies defined in RFC3209 and RFC4875.

3. 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 RFC2119.

4. Temporal LSP Overview

This section briefs the architecture for supporting temporal LSPs and some operations on temporal LSPs.

4.1. Architecture Overview

Based on the existing architecture for supporting TE LSPs, we can extend a few of components to support temporal LSPs. These components include OSPF, CSPF and RSVP-TE.

OSPF is extended to distribute and maintain TE inforamtion for a link in a sequence of time intervals. CSPF is extended to compute a path for a temporal LSP based on the TEDB containing TE information for every link in a sequence of time intervals. RSVP-TE is extended to create a temporal LSP and maintain the status of the temporal LSP.

4.2. Operations Overview

On the ingress of a temporal LSP, a user configures it with a time interval or a sequence of time intervals. A simple time interval is a time interval from start time Ta to end time Tb, which may be represented as [Ta, Tb].

When an LSP is configured with time interval [Ta, Tb], a path satisfying the constraints for the LSP in the time interval is computed and the LSP along the path is set up to carry traffic from Ta to Tb.

For time interval from start time Ta to infinite as end time, it may be represented as [Ta, INFINITE].

In addition to simple time intervals, there are recurrent time intervals and elastic time intervals.

A recurrent time interval represents a series of repeated simple time intervals. It has a simple time interval such as [Ta, Tb], a number of repeats such as 10 (repeats 10 times), and a repeat cycle/time such as a week (repeats every week).

Recurrent time interval "[Ta, Tb] repeats n times with repeat cycle C" represents n+1 simple time intervals as follows:

[Ta, Tb], [Ta+C, Tb+C], [Ta+2C, Tb+2C], . . ., [Ta+nC, Tb+nC]

When an LSP is configured with a recurrent time interval such as "[Ta, Tb] repeats 10 times with a repeat cycle a week", a path

satisfying the constraints for the LSP in each of the simple time intervals (such as 11 simple time intervals) represented by the recurrent time interval is computed and the LSP along the path is set up to carry traffic in each of the simple time intervals.

An elastic time interval represents a time period with an elastic range. It has a simple time interval such as [Ta, Tb] with an elastic range such as within -P and Q.

Elastic time interval "[Ta, Tb] within -P and Q" means a time period from (Ta+X) to (Tb+X), where -P <= X <= Q, P and Q is an amount of time such as 600 seconds.

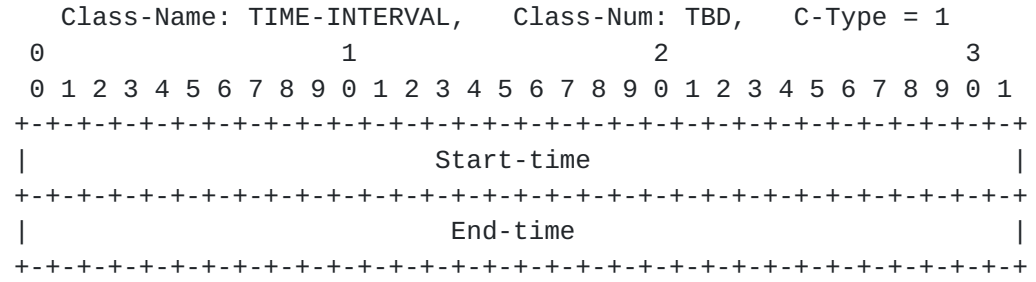
When an LSP is configured with an elastic time interval such as "[Ta, Tb] within -P and Q", a path is computed such that the path satisfies the constraints for the LSP in the time period from (Ta+X) to (Tb+X) and |X| is the minimum value from -P to Q. That is that [Ta+X, Tb+X] is the time interval closest to [Ta, Tb] within the elastic range. The LSP along the path is set up to carry traffic in the time period from (Ta+X) to (Tb+X).

5. TIME INTERVAL Object

This section presents a few of TIME-INTERVAL objects, which are the internal representations of time intervals. A Class-Num for the objects is TBD, which is to be assigned by IANA.

5.1. Absolute TIME INTERVAL Object

The format of an absolute TIME-INTERVAL object body is illustrated below.



- o Start-time: The time LSP starts to carry traffic
- o End-time: The time LSP ends carrying traffic

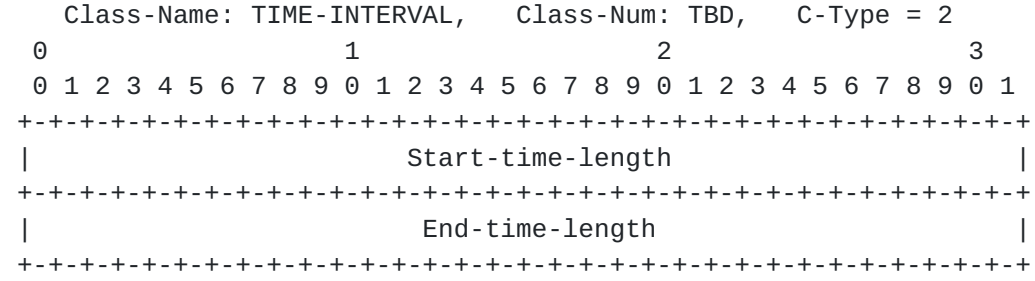
An absolute TIME-INTERVAL object contains a Start-time and an End-time, representing time interval [Start-time, End-time]. All bits in

End-time field set to one represents INFINITE. Both of these two times are the times that are synchronized among all network nodes.

Thus the clocks on all the nodes MUST be synchronized if an absolute TIME-INTERVAL object is used. The time period represented in an absolute TIME-INTERVAL object is more accurate.

5.2. Relative TIME INTERVAL Object

The format of a relative TIME-INTERVAL object body is shown below.



- o Start-time-length: The time length in seconds from current time to the time LSP starts to carry traffic
- o End-time-length: The time length in seconds from current time to the time LSP ends carrying traffic

A relative TIME-INTERVAL object contains a Start-time-length and an End-time-length, which represents time interval below:

[current-time + Start-time-length, current-time + End-time-length]

where current-time is the current local time on a node. All bits in End-time-length field set to one represents INFINITE.

When a time interval from time Ta to time Tb is configured on a node, these two time lengths are the time lengths that are computed on the node using the current local time as follows.

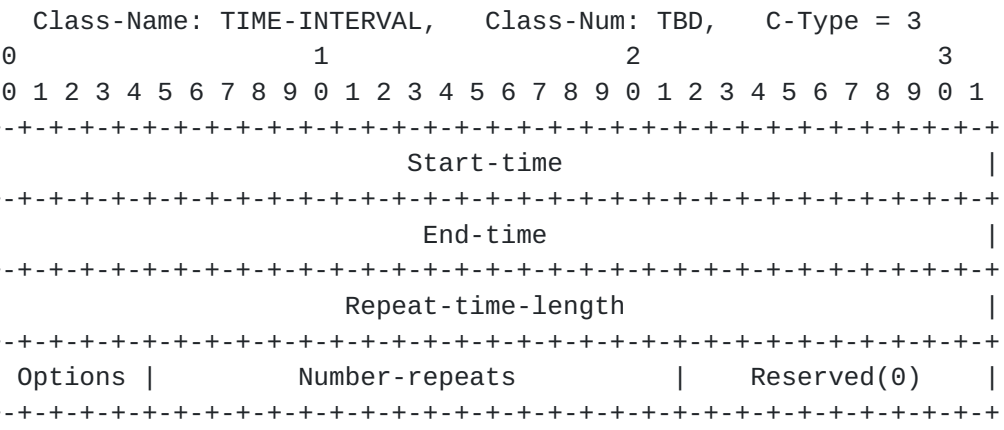
```
Start-time-length = Ta - current-time;
End-time-length   = Tb - current-time;
```

For a relative TIME-INTERVAL object, the clocks/times on all the nodes can be different.

5.3. Recurrent Absolute TIME INTERVAL Object

For a recurrent absolute TIME-INTERVAL object, its body contains a Start-time, an End-time, a Repeat-time-length, a Options field and a Number-repeats field. The format of its body is illustrated below:

The Start-time and End-time represents time interval [Start-time, End-time]. The Repeat-time-length represents a repeat cycle/time, which is valid if the Options field is set to indicate the way to repeat is "repeat every Repeat-time-length". The Options field indicates a way to repeat. The Number-repeats indicates the number of repeats of time interval [Start-time, End-time].



Start-time: The time LSP starts to carry traffic.

End-time: The time LSP ends carrying traffic.

Repeat-time-length: The time length in seconds after which LSP starts to carry traffic again for (End-time - Start-time).

Options: Indicates a way to repeat.

Options = 1: repeat every day;

Options = 2: repeat every week;

Options = 3: repeat every month;

Options = 4: repeat every year;

Options = 5: repeat every Repeat-time-length.

Number-repeats: The number of repeats. In each of repeats, LSP carries traffic.

5.4. Recurrent Relative TIME INTERVAL Object

For a recurrent relative TIME-INTERVAL object, the format of its body is illustrated below. it contains a Start-time-length, an End-time-length, a Repeat-time-length, a Options field and a Number-repeats field.

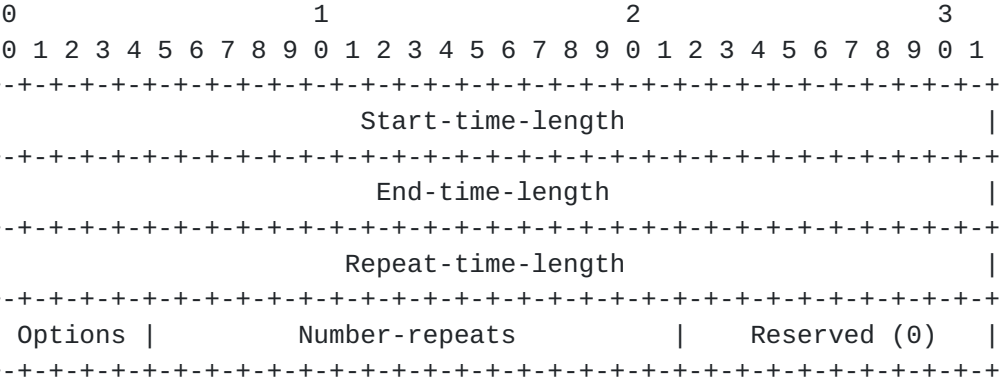
The Start-time-length and End-time-length represents time interval

[current-time + Start-time-length, current-time + End-time-length]

where current-time is a current local time.

The Repeat-time-length represents a repeat cycle/time, which is valid if the Options field is set to indicate the way to repeat is "repeat every Repeat-time-length". The Options field indicates a way to repeat. The Number-repeats indicates the number of repeats of the time interval above.

Class-Name: TIME-INTERVAL, Class-Num: TBD, C-Type = 4



Start-time-length: The time length in seconds from a current local time to the time LSP starts to carry traffic.

End-time-length: The time length in seconds from a current local time to the time LSP ends carrying traffic.

Repeat-time-length: The time length in seconds after which LSP starts to carry traffic again for (End-time-length - Start-time-length).

Options: Indicates a way to repeat.

Options = 1: repeat every day;

Options = 2: repeat every week;

Options = 3: repeat every month;

Options = 4: repeat every year;

Options = 5: repeat every Repeat-time-length.

Number-repeats: The number of repeats. In each of repeats, LSP carries traffic.

6. Path Message

A Path message is enhanced to carry the information about a time interval or a sequence of time intervals through including a time interval list. The format of the message is illustrated below.

```
<Path Message> ::= <Common Header> [ <INTEGRITY> ]
                   [ [<MESSAGE_ID_ACK> | <MESSAGE_ID_NACK>] ...]
                   [ <MESSAGE_ID> ]<SESSION> <RSVP_HOP> <TIME_VALUES>
                   [ <EXPLICIT_ROUTE> ]
                   <LABEL_REQUEST> [ <PROTECTION> ] [ <LABEL_SET> ...]
                   [ <SESSION_ATTRIBUTE> ] [ <NOTIFY_REQUEST> ]
                   [ <ADMIN_STATUS> ] [ <POLICY_DATA> ... ]
                   <sender descriptor> [<S2L sub-LSP descriptor list>]
                   [<time interval list>]
```

The time interval list in the message is defined below. It is a sequence of TIME-INTERVAL objects, each of which describes a time interval or a series of time intervals.

```
<time interval list> ::=
                    <time interval descriptor>
                    [ <time interval list> ]

<time interval descriptor> ::= <TIME-INTERVAL>
```

7. Behaviors for Temporal LSP

To set up a temporal LSP, the ingress of the LSP MUST include the TIME-INTERVAL objects representing the time intervals configured for the LSP in the PATH message for the LSP.

In addition, the ingress computes a shortest path satisfying the constraints for the LSP in each of the time intervals. it MUST include the ERO for the path in the PATH message for the LSP.

For every node along the path for the LSP, when receiving a PATH message with TIME-INTERVAL objects, it obtains the time intervals represented by the objects in the message received and MUST forward the objects unchanged to the next hop if there is one.

It adds the time intervals into the state for the LSP and checks whether there is enough bandwidth in each of the time intervals. If there is, it reserved the bandwidth on the link to the next hop (if there is a next hop) in each of the time intervals. If there is not, a PathErr message is returned.

8. Security Considerations

The mechanism described in this document does not raise any new security issues for the RSVP-TE protocols.

9. IANA Considerations

This section specifies requests for IANA allocation.

10. Acknowledgement

The author would like to thank people for their valuable comments on this draft.

11. References

11.1. Normative References

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

[RFC4875] Aggarwal, R., Papadimitriou, D., and S. Yasukawa, "Extensions to Resource Reservation Protocol - Traffic Engineering (RSVP-TE) for Point-to-Multipoint TE Label Switched Paths (LSPs)", RFC 4875, May 2007.

[RFC3630] Katz, D., Kompella, K., and D. Yeung, "Traffic Engineering (TE) Extensions to OSPF Version 2", RFC 3630, September 2003.

11.2. Informative References

[RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.

Authors' Addresses

Huaimo Chen
Huawei Technologies
Boston, MA
US

Email: huaimo.chen@huawei.com

Mehmet Toy
Comcast
1800 Bishops Gate Blvd.
Mount Laurel, NJ 08054
USA

Email: mehmet_toy@cable.comcast.com

Vic Liu
China Mobile
No.32 Xuanwumen West Street, Xicheng District
Beijing, 100053
China

Email: liuzhiheng@chinamobile.com

Lei Liu
Fijitsu
USA

Email: lliu@us.fujitsu.com