Network Working Group
Internet Draft
Intended status: Informational
Expires: September 2013

S. Okamoto
Keio University

March 15, 2013

Requirements of GMPLS Extensions for Energy Efficient Traffic Engineering
draft-okamoto-ccamp-midori-gmpls-extension-reqs-02.txt

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), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

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."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html

This Internet-Draft will expire on September 15, 2013.

Copyright Notice

Abstract

This document discusses some of extensions required in existing GMPLS OSPF routing protocol, RSVP signaling protocol, and LMP to support the energy efficient traffic engineering technology.

Table of Contents

1. Introduction 2
1.1. Conventions used in this document 3
2. Energy efficient traffic engineering extensions 3
2.1. TE link status 3
2.2. LSP status 4
2.3. Link power on/off control 4
2.4. Notify control 5
3. Security Considerations 5
4. IANA Considerations 5
5. References 5
5.1. Normative References 5
5.2. Informative References 6
6. Acknowledgments 7

1. Introduction

The Generalized Multiprotocol Label Switching (GMPLS) [RFC3945] protocol suite is designed to provide a control plane for a range of network technologies including packet/frame switching networks including MPLS routers and Ethernet switches, optical networks such as time division multiplexing (TDM) networks including SONET/SDH and Optical Transport Networks (OTNs), and lambda switching optical networks.

In GMPLS controlled networks, the network is described by label switch routers (LSRs) and traffic engineering (TE) links. A TE link is advertised as an adjunct to a "physical" link. When the link is up, both the regular Internal Gateway Protocol (IGP) properties of the link (basically, the Shortest Path First (SPF) metric) and the TE properties of the link (such as bandwidth and switching capability) are then advertised. Therefore, basically, if the link is down then the TE link is also down. A TE link is not only defined between IGP neighbors but also defined on a Forwarding Adjacency (FA) label switched path (LSP). An LSP is composed with cross-connection of TE links. Therefore, if the composed TE link is down then the LSP is also down.

An energy efficient Internet [I-D.winter-energy-effcient-internet], a power aware networking (PANET) [I-D.dong-panet-requirements], and an energy aware control plane [I-D.retana-rtgwg-eacp] are discussed.

Energy efficient traffic engineering technology is also discussed in [Yonezu][Cerutiti.ECOC][Cerutiti.JLT]. Under the energy efficient traffic engineering, LSPs are rerouted to use lest number of links, then some links are physically shutdown to reduce power consumption of equipment. In traditional GMPLS networks, TE links associated in shutdown links are also down. Therefore, when emergency occurred, such as traffic explosion and link/equipment failure, downed TE links are not able to use for calculating protection LSP and LSP rerouting.

This document defines requirements for extending GMPLS protocols to support the energy efficient traffic engineering features.

1.1. 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].

2. Energy efficient traffic engineering extensions

Protocol extensions of OSPF, RSVP, and Link Management Protocol (LMP) are required to support new TE link status, new LSP status, link power on/off capability, and new notify control feature.

2.1. TE link status

[RFC2328] defines Interface states for describing "Interface State changes" and "Interface State Machine". A link status "Up" and "Down" can be get from the Interface states.

[RFC3630] defines the Traffic Engineering properties of TE links and defines Link Type/Length/Value (TLV) for TE link properties advertisement. A Link-TLV has some sub-TLVs, however, there is no TE link status information. [RFC4203] adds some sub-TLVs to the Link-TLV in support of GMPLS.

As a conclusion, a TE link does not have any status indication. If Link becomes down then value(s) of the Traffic Engineering Metric sub-TLV, and/or the Maximum bandwidth sub-TLV, and/or the Maximum Reservable Bandwidth sub-TLV in associated TE links are changed according with the network operator's policy.

Under the energy efficient TE environment, the link down by administrative operation or link failure, and link power down by the energy efficient TE should be distinguished in the route calculation system such as Constraint Shortest Path First (CSPF) and Path Computation Entity (PCE).

A TE link state sub-TLV which indicates power off state of the TE link is required.

2.2. LSP status

[RFC3471], [RFC3473], and [RFC4974] defines the Administrative Status Information in the Admin_Status object. The defined status bits are Reflect (R), Testing (T), Administratively down (A), Deletion in progress (D), and Call Management (C).

In the energy efficient TE environment, an LSP which includes power off TE link(s) as LSP component can be defined. This LSP can be assigned as a backup LSP. The backup LSP which does not contain power of link(s) can be used as 1+1 protection, 1:N protection w/wo extra traffic, shared protection, and restoration. On the other hand, the backup LSP which contains power off link(s) can be used as 1:N protection wo extra traffic, shared protection, and restoration. When activating the LSP, power up of link(s) is required.

To distinguish the backup LSP which contains the power off link(s) or not, new LSP status should be defined in the Admin_Status object.

2.3. Link power on/off control

The energy efficient TE requires link power on/off control function. There are two possible implementation, one is using LMP the other is using RSVP.

When using LMP, power on (or off) initiator LSR sends power on (or off) request to the neighbor LSR. The neighbor LSR sends Ack to the initiator LSR and power on (or off) the link and changes the TE link status. Then the initiator LSR receives Ack and power on (or off) the link and changes the TE link status.

The power control should be included to the LMP.

Note: to apply the power on procedure, IP control channel (IPCC) should be always up. Therefore, a dedicated IPCC is required to apply the LMP control.

When using RSVP, sequentially concatenated TE links can be controlled. There are two procedure candidates in the power off procedure.

[Power On] All TE links along with the LSP are power on.

[Power Off]

1. All TE links along with the LSP are power off. If other LSPs share the TE links then the LSPs should be rerouted.

2. All TE links but not shared by other LSPs are power off.

Both procedures are used according with the network operator's policy.

It may be required with LSP graceful shutdown procedure to notify the link power off completion to the initiator.

Power control request may be implemented in the Admin_Status object.

2.4. Notify control

The power off procedure option #1 described in 2.3 can be applicable not only to a single layer network but also to a multi-layer network. If the server layer TE-link becomes the "power off" state, upper layer LSP segment detects the status change and sends NOTIFY message to an LSP ingress node. The ingress node reroutes the LSP or changes the LSP status to "power off".

3. Security Considerations

TBD

4. IANA Considerations

TBD

5. References

5.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

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

[RFC2328] Moy, J., "OSPF Version 2", RFC 2328, April 1998.

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

[RFC4203] Kompella, K., and Rekhter, Y. (Editors), "OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4203, October 2005.

[RFC3471] Berger, L. (Editor), "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.

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

[RFC4974] Papadimitriou, D., and Farrel, A., "Generalized MPLS (GMPLS) RSVP-TE Signaling Extensions", RFC 4974, August 2007.

5.2. Informative References

[I-D.winter-energy-efficient-internet] Winter, R., Jeong, S., Choi, JH., "Towards an Energy-Efficient Internet", draft-winter-energy-efficient-internet-01.txt (work in progress), October 2012.

[I-D.dong-panet-requirements] Dong, J., Zhang, M., Zhang, B., Boucadair, M., "Requirements for Power Aware Network", draft-dong-panet-requirements-01.txt (work in progress), February 2013.

[I-D.retana-rtgwg-eacp] Retana, A., White, R., Paul, M., "A Framework and Requirements for Energy Aware Control Planes", draft-retana-rtgwg-eacp-01.txt (work in progress), February 2013.

[Yonezu] Yonezu, H., Kikuta, K., Ishii, D., Okamoto, S., Oki, E., and Yamanaka, N., "QoS Aware Energy Optimal Network Topology Design and Dynamic Link Power Management", Proc. ECOC 2010 Tu.3.D.4.

[Cerutiti.ECOC] Cerutiti I., Sambo, N., and Castoldi, P., "Distributed support of link sleep mode foe energy efficient GMPLS networks", Proc. ECOC 2010 P5.11.

[Cerutiti.JLT] Cerutiti I., Sambo, N., and Castoldi, P., "Sleeping Link Selection for Energy-Efficient GMPLS Networks", IEEE Journal of Lightwave Technology, Vol. 29, No. 15, pp.2292-2298, Aug. 2011.

6. Acknowledgments

The author would like to thank Prof. Naoaki Yamanaka and all members of the Interoperability Working Group, Kei-han-na Open Laboratories for their useful comments and suggestions.

Author's Addresses

Satoru Okamoto
Keio University
3-14-1 Hiyoshi, Kohoku-ku
Yokohama, Kanagawa 223-8522 Japan
Email: okamoto@ieee.org