

Network Working Group
Internet Draft
Intended status: Informational
Expires: January 2012

Y. Lee
Huawei

G. Bernstein
Grotto Networking

Jonas Martensson
Acreo

T. Takeda
NTT

T. Tsuritani
KDDI

July 6, 2011

PCEP Requirements for WSON Routing and Wavelength Assignment

[draft-ietf-pce-wson-routing-wavelength-05.txt](#)

Status of this Memo

This Internet-Draft is submitted to IETF 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 6, 2011.

Copyright Notice

Copyright (c) 2011 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the [Trust Legal Provisions](#) and are provided without warranty as described in the Simplified BSD License.

Abstract

This memo provides application-specific requirements for the Path Computation Element communication Protocol (PCEP) for the support of Wavelength Switched Optical Networks (WSON). Lightpath provisioning in WSONs requires a routing and wavelength assignment (RWA) process. From a path computation perspective, wavelength assignment is the process of determining which wavelength can be used on each hop of a path and forms an additional routing constraint to optical light path computation. Requirements for Optical impairments will be addressed in a separate document.

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](#) 0.

Table of Contents

1.	Introduction.....	3
1.1.	WSON RWA Processes.....	4
2.	WSON PCE Architectures and Requirements.....	5
2.1.	RWA PCC to PCE Interface.....	6
2.1.1.	RWA Computation Type and Wavelength Assignment Option6	
2.1.2.	Bulk RWA path request/reply.....	6
2.1.3.	An RWA path re-optimization request/reply.....	7
2.1.4.	Wavelength Range Constraint.....	7
2.1.5.	Wavelength Policy Constraint.....	7

3.	Manageability Considerations.....	8
3.1.	Control of Function and Policy.....	8
3.2.	Information and Data Models, e.g. MIB module.....	8
3.3.	Liveness Detection and Monitoring.....	9
3.4.	Verifying Correct Operation.....	9
3.5.	Requirements on Other Protocols and Functional Components.	9
3.6.	Impact on Network Operation.....	9
4.	Security Considerations.....	9
5.	IANA Considerations.....	9
6.	Acknowledgments.....	10
7.	References.....	10
7.1.	Normative References.....	10
7.2.	Informative References.....	11
	Authors' Addresses.....	11
	Intellectual Property Statement.....	12
	Disclaimer of Validity.....	13

1. Introduction

[RFC4655] defines the PCE based Architecture and explains how a Path Computation Element (PCE) may compute Label Switched Paths (LSP) in Multiprotocol Label Switching Traffic Engineering (MPLS-TE) and Generalized MPLS (GMPLS) networks at the request of Path Computation Clients (PCCs). A PCC is shown to be any network component that makes such a request and may be for instance an Optical Switching Element within a Wavelength Division Multiplexing (WDM) network. The PCE, itself, can be located anywhere within the network, and may be within an optical switching element, a Network Management System (NMS) or Operational Support System (OSS), or may be an independent network server.

The PCE communications Protocol (PCEP) is the communication protocol used between PCC and PCE, and may also be used between cooperating PCEs. [RFC4657] sets out the common protocol requirements for PCEP. Additional application-specific requirements for PCEP are deferred to separate documents.

This document provides a set of application-specific PCEP requirements for support of path computation in Wavelength Switched Optical Networks (WSON). WSON refers to WDM based optical networks in which switching is performed selectively based on the wavelength of an optical signal.

The path in WSON is referred to as a lightpath. A lightpath may span multiple fiber links and the path should be assigned a wavelength for each link. A transparent optical network is made up of optical devices that can switch but not convert from one wavelength to

another. In a transparent optical network, a lightpath operates on the same wavelength across all fiber links that it traverses. In such case, the lightpath is said to satisfy the wavelength-continuity constraint. Two lightpaths that share a common fiber link can not be assigned the same wavelength. To do otherwise would result in both signals interfering with each other. Note that advanced additional multiplexing techniques such as polarization based multiplexing are not addressed in this document since the physical layer aspects are not currently standardized. Therefore, assigning the proper wavelength on a lightpath is an essential requirement in the optical path computation process.

When a switching node has the ability to perform wavelength conversion the wavelength-continuity constraint can be relaxed, and a lightpath may use different wavelengths on different links along its route from origin to destination. It is, however, to be noted that wavelength converters may be limited due to their relatively high cost, while the number of WDM channels that can be supported in a fiber is also limited. As a WSON can be composed of network nodes that cannot perform wavelength conversion, nodes with limited wavelength conversion, and nodes with full wavelength conversion abilities, wavelength assignment is an additional routing constraint to be considered in all lightpath computation.

In this document we first review the processes for routing and wavelength assignment (RWA) used when wavelength continuity constraints are present and then specify requirements for PCEP to support RWA.

The remainder of this document uses terminology from [[RFC4655](#)].

1.1. WSON RWA Processes

In [[WSON-Frame](#)] three alternative process architectures were given for performing routing and wavelength assignment. These are shown schematically in Figure 1.

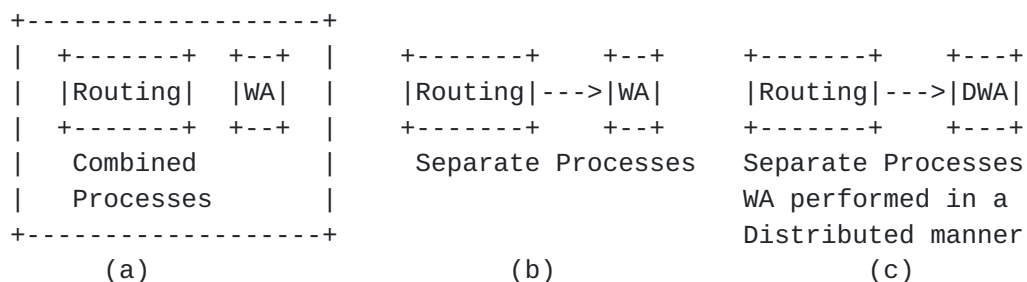


Figure 1 RWA process alternatives.

Figure 2 Combined Process (R&WA) architecture

2.1. RWA PCC to PCE Interface

The requirements for the PCC to PCE interface of Figure 2 are specified in this section.

2.1.1. RWA Computation Type and Wavelength Assignment Option

1. The PCReq Message MUST include the path computation type. This can be:

- (i) Both Routing and Wavelength Assignment (RWA), or
- (ii) Routing only.

This requirement is needed to differentiate between the currently supported routing with distributed wavelength assignment option and combined RWA. In case of distributed wavelength assignment option, wavelength assignment will be performed at each node of the route.

2. When the PCReq Message is RWA path computation type, the PCReq Message MUST further include the wavelength assignment options. At the minimum, the following option should be supported:

- (i) Explicit Label Control (ELC) [[RFC4003](#)]
- (ii) Non-Explicit labels in the form of Label Sets (This will allow Distributed WA at a node level where each node would select the wavelength from the Label Sets)

3. The PCRep Message MUST include the route, wavelengths assigned to the route and indication of which wavelength assignment option has been applied (ELC or Label Sets).
4. In the case where a valid path is not found, the PCRep Message MUST include why the path is not found (e.g., no route, wavelength not found, optical quality check failed, etc.)

2.1.2. Bulk RWA path request/reply

1. The PCReq Message MUST be able to specify an option for bulk RWA path request. Bulk path request is an ability to request a number of simultaneous RWA path requests.

2. The PCRep Message MUST include the route, wavelength assigned to the route for each RWA path request specified in the original bulk PCReq Message.

2.1.3. An RWA path re-optimization request/reply

1. For a re-optimization request, the PCReq Message MUST provide the path to be re-optimized and include the following options:
 - a. Re-optimize the path keeping the same wavelength(s)
 - b. Re-optimize wavelength(s) keeping the same path
 - c. Re-optimize allowing both wavelength and the path to change
2. The corresponding PCRep Message for the re-optimized request MUST provide the Re-optimized path and wavelengths.
3. In case that the path is not found, the PCRep Message MUST include why the path is not found (e.g., no route, wavelength not found, both route and wavelength not found, etc.)

2.1.4. Wavelength Range Constraint

For any PCReq Message that is associated with a request for wavelength assignment the requester (PCC) MUST be able to specify a restriction on the wavelengths to be used.

Note that the requestor (PCC) is NOT required to furnish any range restrictions. This restriction is to be interpreted by the PCE as a constraint on the tuning ability of the origination laser transmitter.

2.1.5. Wavelength Policy Constraint

The PCReq Message May include specific operator's policy information for WA (E.g., random assignment, descending order, ascending order, etc.)

2.1.6. Signal Processing Capability Restriction

The PCReq Message MUST be able to specify restrictions for signal compatibility either on the endpoint or any given link. The following signal processing capability should be supported at a minimum:

- o Modulation Type List
- o FEC Type List

3. Manageability Considerations

Manageability of WSON Routing and Wavelength Assignment (RWA) with PCE must address the following considerations:

3.1. Control of Function and Policy

In addition to the parameters already listed in [Section 8.1 of \[RFC5440\]](#), a PCEP implementation SHOULD allow configuring the following PCEP session parameters on a PCC:

- o The ability to send a WSON RWA request.

In addition to the parameters already listed in [Section 8.1 of \[RFC5440\]](#), a PCEP implementation SHOULD allow configuring the following PCEP session parameters on a PCE:

- o The support for WSON RWA.
- o The maximum number of bulk path requests associated with WSON RWA per request message.

These parameters may be configured as default parameters for any PCEP session the PCEP speaker participates in, or may apply to a specific session with a given PCEP peer or a specific group of sessions with a specific group of PCEP peers.

3.2. Information and Data Models, e.g. MIB module

As this document only concerns the requirements to support WSON RWA, no additional MIB module is defined in this document. However, the corresponding solution draft will list the information that should be added to the PCE MIB module defined in [\[PCEP-MIB\]](#).

3.3. Liveness Detection and Monitoring

Mechanisms defined in this document do not imply any new liveness detection and monitoring requirements in addition to those already listed in [section 8.3 of \[RFC5440\]](#).

3.4. Verifying Correct Operation

Mechanisms defined in this document do not imply any new verification requirements in addition to those already listed in [section 8.4 of \[RFC5440\]](#).

3.5. Requirements on Other Protocols and Functional Components

The PCE Discovery mechanisms ([\[RFC5089\]](#) and [\[RFC5088\]](#)) may be used to advertise WSON RWA path computation capabilities to PCCs.

3.6. Impact on Network Operation

Mechanisms defined in this document do not imply any new network operation requirements in addition to those already listed in [section 8.6 of \[RFC5440\]](#).

4. Security Considerations

This document has no requirement for a change to the security models within PCEP [\[RFC5440\]](#). However the additional information distributed in order to address the RWA problem represents a disclosure of network capabilities that an operator may wish to keep private. Consideration should be given to securing this information.

5. IANA Considerations

A future revision of this document will present requests to IANA for codepoint allocation.

6. Acknowledgments

The authors would like to thank Adrian Farrel for many helpful comments that greatly improved the contents of this draft.

This document was prepared using 2-Word-v2.0.template.dot.

7. References

7.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC3471] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", [RFC 3471](#), January 2003.
- [RFC3473] Berger, L., Ed., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", [RFC 3473](#), January 2003.
- [RFC4655] Farrel, A., Vasseur, J., and J. Ash, "A Path Computation Element (PCE)-Based Architecture", [RFC 4655](#), August 2006.
- [RFC4657] Ash, J. and J. Le Roux, "Path Computation Element (PCE) Communication Protocol Generic Requirements", [RFC 4657](#), September 2006.
- [RFC5440] Vasseur, JP., Ed. and JL. Le Roux, Ed., "Path Computation Element (PCE) communication Protocol", [RFC 5440](#), March 2009.
- [PCEP-MIB] Koushik, K, et al., "PCE communication protocol(PCEP) Management Information Base", [draft-ietf-pce-pcep-mib](#), work in progress.

7.2. Informative References

- [WSON-IMP] Lee, Y. and Bernstein, G. (Editors), D. Li and G. Martinelli "A Framework for the Control and Measurement of Wavelength Switched Optical Networks (WSON) with Impairments, [draft-ietf-ccamp-wson-impairments](#), work in progress.
- [WSON-Frame] Lee, Y. and Bernstein, G. (Editors), and W. Imajuku, "Framework for GMPLS and PCE Control of Wavelength Switched Optical Networks", [draft-ietf-ccamp-rwa-wson-framework](#), work in progress.
- [RFC5088] Le Roux, JL., Ed., Vasseur, JP., Ed., Ikejiri, Y., and R. Zhang, "OSPF Protocol Extensions for Path Computation Element (PCE) Discovery", [RFC 5088](#), January 2008.
- [RFC5089] Le Roux, JL., Ed., Vasseur, JP., Ed., Ikejiri, Y., and R. Zhang, "IS-IS Protocol Extensions for Path Computation Element (PCE) Discovery", [RFC 5089](#), January 2008.

Authors' Addresses

Young Lee (Ed.)
Huawei Technologies
1700 Alma Drive, Suite 100
Plano, TX 75075, USA
Phone: (972) 509-5599 (x2240)
Email: ylee@huawei.com

Greg Bernstein (Ed.)
Grotto Networking
Fremont, CA, USA
Phone: (510) 573-2237
Email: gregb@grotto-networking.com

Jonas Martensson
Acreo
Email: Jonas.Martensson@acreo.se

Tomonori Takeda
NTT Corporation
3-9-11, Midori-Cho
Musashino-Shi, Tokyo 180-8585, Japan
Email: takeda.tomonori@lab.ntt.co.jp

Takehiro Tsuritani
KDDI R&D Laboratories, Inc.
2-1-15 Ohara Kamifukuoka Saitama, 356-8502. Japan
Phone: +81-49-278-7357
Email: tsuri@kddilabs.jp

Intellectual Property Statement

The IETF Trust takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in any IETF Document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights.

Copies of Intellectual Property disclosures made to the IETF Secretariat and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement any standard or specification contained in an IETF Document. Please address the information to the IETF at ietf-ipr@ietf.org.

Disclaimer of Validity

All IETF Documents and the information contained therein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY, THE IETF TRUST AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION THEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Acknowledgment

Funding for the RFC Editor function is currently provided by the Internet Society.