

Network Working Group
Internet Draft
Intended status: Standard Track
Expires: April 2011

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October 25, 2010

OSPF-TE Extensions for WSON-specific Network Element Constraints

draft-peloso-ccamp-wson-ospf-oeo-02.txt

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Abstract

This document describes OSPF routing protocols extensions to support blocking nodes and O-E-O pools in all-optical networks under the control of Generalized MPLS (GMPLS).

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].

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1. Introduction

The goal of all-optical meshed networks consists in the transport of optical circuit connections, with limited usage of Optical-Electrical-Optical conversion through photonic nodes. The gain brought by the use of fewer regenerators is balanced by the constraint of maintaining the optical signal continuity between the source and the destination nodes. In GMPLS controlled networks, the induced signal continuity brings the technological challenge of wavelength assignment using control plane protocols, which is discussed in [WSON-Frame].

The drawback of wavelength assignment computation in a single entity is the need to gather and convey all relevant and up-to-date information to this single entity. Whether the computing entity takes the form of a PCE or the form of a Constrained-Shortest-Path-First (C-SPF) engine in each node of the network, the IGP is supposed to do the job of gathering this information.

This document defines extensions to the OSPF routing protocol based on [WSON-Encode] to enhance the Traffic Engineering (TE) properties of GMPLS TE which are defined in [RFC3630], [RFC4202], and [RFC4203]. The enhancements to the Traffic Engineering (TE) properties of GMPLS TE links can be announced in OSPF TE LSAs. The TE LSA, which is an opaque LSA with area flooding scope [RFC3630], has only one top-level Type/Length/Value (TLV) triplet and has one or more nested sub-TLVs for extensibility. The top-level TLV can take one of three values (1) Router Address [RFC3630], (2) Link [RFC3630], (3) Node Attribute [RFC5786]. In this document, we introduce a new top-level TLV containing Resource Block Attribute (RBA).

[WSON-Encode] introduce the concept of RBA to include all information that are specific to WSON nodes. This information may introduce some additional constrains that needs to be considered to perform a correct RWA. This document does not define any additional encoding but maps information from [WSON-Info] and [WSON-Encode] on OSPF.

The detailed encoding of OSPF extensions are not defined in this document. [WSON-Encode] provides encoding detail.

2. Resource Block Attribute

This draft defines a new top-TLV named "Resource Block Attribute" TLV. It carries attributes related to a pool of Optical-Electric-Optical regeneration resource, thus allowing route computation to take into account available signal regenerators in the network.

Available OEO resource introduce different kind of constrains. One is the signal compatibility as defined in [WSON-Signal]. Another constrain comes from WSON node topologies (for technology reasons or cost of resources). This draft mainly refers to the latter.

Multiple O-E-O resources are logically gathered in a pool when they share a common transmission media before (and after) entering (exiting) the actual switching matrix of the node. A common transmission media is characterized by the sharing of at least a short section of fiber: hence an amplifier or a wavelength selective switch does also correspond to a common transmission media.

When several regenerators' pools are available on a node, several "Resource Block Attribute" will be used (one for each pool). As a matter of fact, the split into blocks of the O-E-O resources comes from the architectural structure of the node. This Node Attribute TLV contains two or more sub-TLVs.

The resource block attributes related to OEO pools in WSON nodes include Block ID, lists of available wavelengths on the ingress and egress side of the pool, and the features of the resources in the block. These pieces of information are described in this document and refer to . The Resource Block Attribute would also include some sub-TLVs identical to sub-TLVs of the TE-link top-TLV: TE-metric [rfc3630], Administrative Group [rfc3630], Link Local/Remote Identifiers [rfc4203], Shared-Risk Link Group [rfc4203].

The following new sub-TLVs are added to the "Resource Block Attribute" TLV. Detailed description for newly defined sub-TLVs is provided at the end of the section.

Sub-TLV Type	Length	Name
TBD	4 Bytes	Block ID
TBD Availability	variable	Block Shared Access Wavelength
TBD	fixed	Resource Element Information

In "Resource Block Attribute", the sub-TLV "Block Shared Access Wavelength Availability" and "Resource Block Information" are mandatory, the other sub-TLV listed above is optional.

The following sub-TLVs to the "Resource Block Attribute" TLV are identical to the ones defined respectively in [RFC3630] and [RFC4203], and being defined for the TE-link top-TLV. Detailed description for newly defined sub-TLV is provided at the end of the section.

Sub-TLV Type	Length	Name
TBD	4 Bytes	TE-metric [alike RFC3630]
TBD	4 Bytes	Administrative Group [alike RFC3630]
TBD RFC4203]	8 Bytes	Link Local/Remote Identifiers [alike
TBD	variable	Shared Risk Link Group [alike RFC4203]

In "Resource Block Attribute", the sub-TLV "Link Local/Remote Identifiers" is mandatory as it is needed to ensure the consistency with the Node Information described in [Gen-OSPF] and [Gen-Encode]. The other sub-TLVs listed above are optional.

2.1. Pool ID

This optional sub-TLV can be used to provide an identifier to the regenerator pool.

2.2. Block Shared Access Wavelength Availability

This block includes information from [WSON-Encode] section 4.4 "Block Shared Access Wavelength Availability". It is used to describe the wavelengths available on the shared fibers (ingress and egress sides) of the pool.

At every RWA process the OEO pool may or may-not be used. The status of the wavelength availability will change. The information is fairly dynamic.

2.3. Resource Element Information

This sub-TLV advertises information that describes the features of the resource elements inside the resource block itself. The features are the accepted bit-rates, modulation format, FEC formats, etc...

Actually this sub-TLV is replicated in a list of such sub-TLVs in order to depict all the resource elements available in the pool. The description of the encoding of this sub-TLV is available in [WSON-encode] section 5 (Hence needs a slight adaptation of TLV described in 5.1: Resource Block Information).

The features of a given element are fairly static as they refer to the characteristics of the device, which mean that the content of a given sub-TLV is static. On the other hand, the elements composing the list are subject to change, when a device is used, its corresponding sub-TLV will disappear from the list.

2.4. Relation with Node

Accessing resource block is also subject to switching constraints. These switching constraints can be both spatial and spectral.

In order to convey this information, the Connectivity Matrix sub-TLV shall depict the ports of the O-E-O pool, and referring their Link Local/Remote Identifiers sub-TLV as described in section 2.

Hence the number of ports described by the connectivity matrix is:

Ingress ports (CM): # incoming links (Node) + # O-E-O pools

Egress ports (CM): # outgoing links (Node) + # O-E-O pools

3. Security Considerations

This document does not introduce any further security issues other than those discussed in [RFC 3630], [RFC 4203].

4. IANA Considerations

[RFC3630] says that the top level Types in a TE LSA and Types for sub-TLVs for each top level Types must be assigned by Expert Review, and must be registered with IANA.

IANA is requested to allocate new Types for the sub-TLVs as defined in Sections 2, 3, 3.1, 3.2 and 3.3 as follows:

4.1. Resource Block attributes

This document introduces the "O-E-O Pool Attribute" top-TLV, value TBD with the following sub-TLVs:

Type	Name
TBD	Pool ID
TBD	Block Shared Access Wavelength Availability
TBD	Resource Element Information
TBD	TE-metric [alike RFC3630]
TBD	Administrative Group [alike RFC3630]
TBD	Link Local/Remote Identifiers [alike RFC4203]
TBD	Shared Risk Link Group [alike RFC4203]

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Acknowledgment

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