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Pierre Peloso
Alcatel-Lucent
Julien Meuric
France Telecom
Giovanni Martinelli
Cisco

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OSPF Extensions in support of O-E-O pools in GMPLS controlled all-optical networks

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Status of this Memo

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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.

Hence, this solution demands the flooding of a detailed view of the network comprising more information than the usual topological ones, [WSON-Info] and [WSON-encode] are addressing these concerns.

In order to complement this work and to extend the Traffic Engineering (TE) properties of OSPF TE which are defined in [RFC3630], [RFC4202], and [RFC4203], this draft proposes a layout of information inside OSPF-TE LSAs. The TE LSA, is an opaque LSA with one (at least) top-level TLV containing several sub-TLVs. The top-level TLV can take one of five values (1) Router Address [RFC3630], (2) Link [RFC3630], (3) Router IPv6 address [RFC5329], (4) Link Local [RFC4203], (5) Node Attribute [OSPF-Node]. In this document, we enhance the sub-TLVs for the Node Attribute TLV and we also introduce a 6th type of top-level TLV, (6) O-E-O Pool Attribute.

The detailed encoding of OSPF extensions are not yet defined in this document.

2. O-E-O Pool Information

This draft defines a new top-TLV named “O-E-O pool 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. 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 “O-E-O pool attribute” will be used (one for each pool). As a matter of fact, the split into pools 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 O-E-O pool information related to pools in WSON nodes include Pool ID, lists of available wavelength on the ingress and egress side of the pool, and the features of the O-E-O in the pool on the ingress and egress side of the pool. These pieces of information are defined in this document. The O-E-O pool information 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 “O-E-O Pool 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	Pool ID
TBD	variable	Ingress Available Wavelength
TBD	variable	Egress Available Wavelength
TBD	fixed	Ingress O-E-O Features
TBD	fixed	Egress O-E-O Features

In “O-E-O Pool”, the sub-TLVs “Ingress Available Wavelength” and “Ingress O-E-O Features” are mandatory, the other sub-TLVs listed above are optional. The omission of egress sub-TLV implies a symmetry status of egress and ingress.

The following sub-TLVs to the “O-E-O Pool 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	8 Bytes	Link Local/Remote Identifiers [alike RFC4203]
TBD	variable	Shared Risk Link Group [alike RFC4203]

In “O-E-O Pool”, the sub-TLV “Link Local/Remote Identifiers” is mandatory as it is needed to ensure the consistency with the Node Information described in Section 3. 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. Ingress/Egress Available Wavelength

These sub-TLVs provide the list of available wavelength respectively to reach the pool from the Node and to reach the Node from the pool (meaning first before and second after the signal crosses the O-E-O). These sub-TLVs share the same format as the Available Wavelength sub-TLVs depicted in [WSON-Encode].

This sub-TLV is not depicting the switching constraints of the node architecture, but the usage of some wavelengths by other resources in the pool. Hence this sub-TLV is dynamic.

The omission of the egress sub-TLV is depicting a symmetrical usage of wavelength on each side of the pool.

2.3. Ingress/Egress O-E-O Features

Both these sub-TLVs provide the features of a given O-E-O resource, respectively on its incoming and on its outgoing side. The encoding of this sub-TLV is not provided yet, but is likely to resemble elements of [OSPF-signal-compatibility] and of Wavelength Converter Range define in [WSON-encode]

Elements of the sub-TLVs:

- Signal Type: Modulation Format, Bit-Rate, Modulation parameters, etc...
- Wavelength constraints: This is describing the wavelengths that can actually be handled by the given equipment described by the O-E-O Features instance, the form of this sub-sub-TLV would probably be alike Wavelength Converter Range.

A given O-E-O piece of equipment is described by a pair of these sub-TLVs (namely Ingress O-E-O Features followed by an Egress O-E-O Features). Hence there will be an instance of such pairs for each O-

E-O resource present in the pool, which shall in fine construct a list of these sub-TLVs to describe the list of O-E-O resource.

The omission of the egress sub-TLV translates symmetry in the features of the O-E-O on its ingress and on its egress side.

3. Node Information

The node information includes Node ID and Connectivity Matrix. The Node ID should comply with Routing Address described in [RFC3630], the Connectivity Matrix is defined in this document.

[OSPF-Node] defines a new top TLV named the Node Attribute TLV which carries attributes related to a router/node. This Node Attribute TLV contains one or more sub-TLVs. This draft introduces a new one which description can be found at the end of the section:

Sub-TLV Type	Length	Name
TBD	variable	Connectivity Matrix

This TLV is optional. Usually this Connectivity Matrix sub-TLV would appear in the LSA because the all-optical switches would present some switching constraints (spatial and/or spectral). Omitting this sub-TLV from the LSA would mean a fully flexible switch.

3.1. Connectivity Matrix

The Connectivity Matrix is a sub-TLV (the type is TBD by IANA) of the Node Attribute TLV. The length is the length of value field in octets. The meaning and format of this sub-TLV are defined in Section 4.3 of [WSON-Encode]. One sub-TLV contains one matrix. The Connectivity Matrix sub-TLV may occur more than once to contain multi-matrices within the Node Attribute TLV.

Note: Check that connectivity matrix uses interfaces references consistent with Link Local/Remote Identifiers sub-TLV of the Top TLV type 2 (Link) in order to ensure the consistency of the objects.

3.2. Relation with O-E-O resources

Accessing O-E-O pool 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

4. Security Considerations

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

5. 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:

5.1. Node Information

This document introduces the following sub-TLVs of Node Attribute TLV (Value TBD, see [OSPF-Node])

Type	sub-TLV
TBD	Connectivity Matrix
TBD	Wavelength Converter Accessibility
TBD	Wavelength Conversion Range
TBD	WC Usage State

5.2. O-E-O Pool Information

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

Type	Name
TBD	Pool ID
TBD	Ingress Available Wavelength
TBD	Egress Available Wavelength

TBD	Ingress O-E-O Features
TBD	Egress O-E-O Features
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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7. Author's Addresses

Peloso Pierre
Alcatel-Lucent
Rte de Villejust
91620 Nozay, France

Phone: +33 130 702 662
Email: pierre.peloso@alcatel-lucent.com

Julien Meuric
France Telecom
2, av Pierre Marzin
22307 Lannion Cedex, France

Phone: +33 296 052 828
Email: julien.meuric@orange-ftgroup.com

Giovanni Martinelli
Cisco
Via Philips 12
20052 Monza, Italy

Phone: +39 039 2092044
Email: giomarti@cisco.com

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