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G. Martinelli
M. Kattan
G. Galimberti
Cisco
A. Zanardi
CREATE-NET

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Information Model for Wavelength Switched Optical Networks (WSON) with Optical Impairments Validation. draft-martinelli-ccamp-wson-iv-info-00

Abstract

This document defines the Information Model to support Impairment-Aware (IA) Routing an Wavelength Assignment (RWA) function. This operation might be required in Wavelength Switched Optical Networks (WSON) that already support RWA and the Information model defined here goes in addition and it is fully compatible with the already defined information model for WSON.

This information model shall support all control plane architectural options defined for WSON with impairment validation.

Status of this Memo

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

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This Internet-Draft will expire on January 31, 2013.

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1. Introduction

In the context of Wavelength Switched Optical Network (WSON), [RFC6163] defines the basic framework for a GMPLS control plane. The associated info model [I-D.ietf-ccamp-rwa-info] defines all parameters required for the related RWA process. These references are the foundation but they do not consider the Optical Impairment case.

In case of WSON where optical impairments plays a significant role, the framework document [RFC6566] defines related control plane architectural options for an Impairment Aware routing and wavelength assignment (IA-RWA). Options include different combinations of Impairment Validation (IV) and RWA functions through control plane elements and operations (PCE, Routing, Signaling).

This document intent to provide the information model for the impairment aware case to allow the impairment validation function. It goes in addition with [I-D.ietf-ccamp-rwa-info] and the model itself is independ of any architectural option described by the framework and shall support all of them.

Models for the optical impairments are defined by ITU and the only available models are reported in [ITU.G680] to cover only the linear impairment case while non-linear case is left for further study. The information model defined here however provide a generic enough mechanism that could be easily extended to additional impairments models.

1.1. Requirements Language

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. Properties of an Impairment Information Model

An information model may have several attributes or properties that need to be defined for each optical parameter made available to the control plane. The properties will help to determine how the control plane can deal with it depending on architectural options chosen within the overall impairment framework [RFC6566]. In some case properties value will help to identify the level of approximation supported by the IV process.

- Time Dependency.
  This will identify how the impairment may vary with time. There could be cases where there is no time dependency, while in other cases there may be need of impairment re- evaluation after a certain time. In this category, variations in impairments due to environmental factors such as those discussed in [G.sup47] are considered. In some cases a level of approximation will consider an impairment that has time dependency as constant. In this Information Model we do neglect this property.

- Wavelength Dependency.
  This property will identify if an impairment value can be considered as constant over all the wavelength spectrum of interest or if it has different values. Also in this case a detailed impairment evaluation might lead to consider the exact value while an approximation IV might take a constant value for all wavelengths. In this Information Model we consider both case: dependency / not dependency from a specific wavelengths. This property may appear directly in the Information model definitions or in the related encoding.

- Linearity.
  As impairments are representation of physical effects there are some that have a linear behavior while other are non-linear. Linear approximation is in scope of scenario C of [RFC6566]. The linearity implies the additivity optical quantities considered during an Impairment Validation process. As an additional approximation level, non-linear impairments as contribution into linear ones. This Information Model deals with the linear properties of optical impairments.

- Multi-Channel.
  There are cases where a channel's impairments take different values depending on the aside wavelengths already in place. In this case a dependency among different LSP is introduced and is typically a result of linear effects. This Information Model neglect this effects on neighbor LSPs.

The following table summarize the above considerations where in the first column reports the list of properties to be considered for each optical parameters, while second column state if this property is taken into account or not by this Information Model.

Property	Info Model Awareness
Time Dependency	no
Wavelength Dependency	yes
Linearity	yes
Multi-channel	no

Table 1: Optical Impairment Properties

3. Background from WSON Information Model

In this section we report terms already defined for the WSON-RWA (not impairment aware) as in [I-D.ietf-ccamp-rwa-info] and [I-D.ietf-ccamp-general-constraint-encode]. The purpose is to provide essential information that will be reused or extended for the impairment case.

In particular [I-D.ietf-ccamp-rwa-info] defines the connectivity matrix as the follow:

ConnectivityMatrix ::= <MatrixID> <ConnType> <Matrix>

However according to [I-D.ietf-ccamp-general-constraint-encode] this definitions can be further detailed as:

```
ConnectivityMatrix ::=
      <MatrixID> <ConnType> ((<LinkSet> <LinkSet>) ...)
```

This second definition highlights how the connectivity matrix is built by pairs of LinkSet objects identifying the internal node connectivity capability.

As a additional note, Connectivity Matrix belong to Node Information.

4. Optical Impairment Information Model

The idea behind this Information Model is to reuse the concept of the Connectivity Matrix and defines an Impairment Matrix that summarize optical impairments provided by the Node.

The goal of the information model is not to rephrase content from [ITU.G680] but only provide necessary building blocks that allow the IW-RWA process to apply the computational model defined by such recommendation. Then the [ITU.G680] model defined in section 9 provide information to calculate the following parameters:

- OSNR. Section 9.1
- Chromatic Dispersion (CD). Section 9.2
- Polarization Mode Dispersion (PMD). Section 9.3
- Polarization Dependent Loss (PDL). Section 9.3

It should be noted that [ITU.G697] already defines an encoding for all these parameters and in Section 5 we report some encoding consideration. The [ITU.G697] is mainly oriented for monitoring so the purpose is only reuse parameter definitions for those parameters required by Impairment Validation process.

The information model defined here make the assumption that the Optical Node is able to provide it's own contribution to such parameters. To this extend the information model intentionally ignore all internal detailed parameters that are used to by the formulas. As an additional note, as reported in in [ITU.G680] Section 10, each parameter can be reported as an OSNR contribution, in such way the Optical Node not necessarily embed optical computational capability but can provide an approximated contribution to optical impairments.

With the above considerations this Information Model is able provide an abstract view for an optical node to enable WSON protocol extension with optical impairments validation.

4.1. Node Information

This model defines the Impairment Matrix as the following:

```
ImpairmentMatrix ::=  <MatrixID> <ConnType>
      ((<LinkSet> <LinkSet> <ImparimemtVector>) ...)
```

Where:

MatrixID. Is a unique identifier for the Matrix. This ID shall be unique in scope among all connectivity matrix defined in [I-D.ietf-ccamp-rwa-info] and all impairment matrix defined here.

ConnType. The type of matrix. Since values 0 and 1 are already defined. This document defines the value 2.

LinkSet. Same object definition and usage as [I-D.ietf-ccamp-general-constraint-encode].

ImpairmentVector is defined as list of optical parmeters associated to the internal node connection.

```
ImpairmentVector ::= <OPTICAL_PARAM> ...
```

The set of OPTICAL_PARAM is identified by [ITU.G697] since they match with parameters required by the linear impairments evaluation provided by [ITU.G680]. This info model does not preclude any of such parameters and eventually new parameters can be added to the list.

4.2. Link Information

Currently not evaluated yet any information is required at Link Level however the same approach can be used as in case of Node Information section. The Link information defined in [I-D.ietf-ccamp-rwa-info] is extend in the following way:

```
<DynamicLinkInfo> ::=  <LinkID> <AvailableLabels>
        [<SharedBackupLabels>]
        <ImpairmentVector>
```

With ImpairmentVector defined as previous section.

5. Encoding Considerations

Details about encoding will be defined in a separate document however worth remembering that, within [ITU.G697] Appending V, ITU already provides a guideline for encoding some optical parameters.

In particular [ITU.G697] indicates that each parameters shall be represented by a 32 bit floating point number.

As an additional consideration, actual values for parameters defined in the information models are provided by the Optical Node and it could provide by direct measurement or from some internal computation starting from indirect measurement. In any case the encoding shall

provide an the possibility to associate a variance with the parameter. This information will enable the function implementing IV-RWA process to make some additional considerations on wavelength feasibility.

6. Acknowledgements

TBD

7. IANA Considerations

This document does not have ant IANA requirement.

8. Security Considerations

All drafts are required to have a security considerations section. See RFC 3552 [RFC3552] for a guide.

9. References

9.1. Normative References

[ITU.G680] International Telecommunications Union, "Physical transfer functions of optical network elements", ITU-T Recommendation G.680, July 2007.

[ITU.G697] International Telecommunications Union, "Optical monitoring for dense wavelength division multiplexing systems", ITU-T Recommendation G.697, February 2012.

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

9.2. Informative References

[I-D.ietf-ccamp-general-constraint-encode] Bernstein, G., Lee, Y., Li, D., and W. Imajuku, "General Network Element Constraint Encoding for GMPLS Controlled Networks", draft-ietf-ccamp-general-constraint-encode-08 (work in progress), July 2012.

[I-D.ietf-ccamp-rwa-info]

Lee, Y., Bernstein, G., Li, D., and W. Imajuku, "Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks", draft-ietf-ccamp-rwa-info-14 (work in progress), March 2012.

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[RFC2629] Rose, M., "Writing I-Ds and RFCs using XML", RFC 2629, June 1999.

[RFC3552] Rescorla, E. and B. Korver, "Guidelines for Writing RFC Text on Security Considerations", BCP 72, RFC 3552, July 2003.

[RFC6163] Lee, Y., Bernstein, G., and W. Imajuku, "Framework for GMPLS and Path Computation Element (PCE) Control of Wavelength Switched Optical Networks (WSONs)", RFC 6163, April 2011.

[RFC6566] Lee, Y., Bernstein, G., Li, D., and G. Martinelli, "A Framework for the Control of Wavelength Switched Optical Networks (WSONs) with Impairments", RFC 6566, March 2012.

Appendix A. G.680 Essential information

TBD if we need some info instead of reading [ITU.G680]

Authors' Addresses

Giovanni Martinelli
Cisco
via Philips 12
Monza, 20900
Italy

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

Moustafa Kattan
Cisco
DUBAI, 500321
UNITED ARAB EMIRATES

Phone:
Email: mkattan@cisco.com

Gabriele M. Galimberti
Cisco
Via Philips,12
Monza 20900
Italy

Phone: +39 039 2091462
Email: ggalimbe@cisco.com

Andrea Zanardi
CREATE-NET
via alla Cascata 56 C, Povo
Trento 38100
Italy

Email: andrea.zanardi@create-net.org