

CCAMP  
Internet-Draft  
Intended status: Standards Track  
Expires: September 10, 2015

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March 9, 2015

Information Encoding for WSON with Impairments Validation  
draft-martinelli-ccamp-wson-iv-encode-05

Abstract

Impairment-Aware (IA) Routing and Wavelength Assignment (RWA) function might be required in Wavelength Switched Optical Networks (WSON) that already support RWA. This document defines proper encoding to support this operation. It goes in addition to the available impairment-free WSON encoding and it is fully compatible with it.

As the information model, the encoding is independent from control plane architectures and protocol implementations. Its definitions can be used in related protocol extensions.

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## 1. Introduction

In case of WSON where optical impairments play a significant role, the framework document [RFC6566] defines related control plane architectural options for Impairment Aware Routing and Wavelength Assignment (IA-RWA). This document provides a suitable encoding for the related WSON impairment information model as defined [I-D.ietf-ccamp-wson-iv-info].

This document directly refers to ITU recommendations [ITU.G680] and [ITU.G697] as already detailed in the information model.

### 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. Encoding

This section details encoding for all elements defined within [I-D.ietf-ccamp-wson-iv-info]. Elements to encode are:

Optical Parameter (OPTICAL\_PARAM)

Optical Impairment Vector (OIV)

Impairment Matrix

Impairment Resource Block Information

### 2.1. Optical Parameter

The OPTICAL\_PARAM is defined as a sub-TLV object.

0										1										2										3									
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1								
S V										Reserved										ParamSource										ParamID									
										Value																													
										Variance (Optional)																													

The following flag is defined:

S: Standard bit.

S=1 identifies a set of parameters standardized by ITU; while  
S=0 identifies a non-standardized set of parameters.

V: Variance bit.

V=0 only parameter value, V=1 parameter value and variance.

With the flag S=1 the following parameters are defined:

ParamSource = 1.

Identify the ITU document that defines the following parameter list. Currently [ITU.G697] defines this value 1 for this parameter.

**ParamID.**

Parameter identifier according to the source. [ITU.G697] table V.3 defines the following identifiers:

1. Total Power (dBm)  
Not reported within [I-D.ietf-ccamp-wson-iv-info] parameter list but relates to Channel Power through the number of channels.
2. Channel Power (dBm).  
Referred as parameter L-3 in [I-D.ietf-ccamp-wson-iv-info]
3. Reserved ("Frequency Deviation from Nominal, GHz", defined in [ITU.G697] but not used)
4. Reserved ("Wavelength Deviation from Nominal, nm", defined in [ITU.G697] but not used)
5. OSNR (db).  
Referred as parameter G-1 in [I-D.ietf-ccamp-wson-iv-info]
6. Reserved. (Q Factor, a pure number).  
Not reported within [I-D.ietf-ccamp-wson-iv-info] parameter list but is a known index for assessing channel quality.
7. PMD (ps).  
Referred as parameter G-3 in [I-D.ietf-ccamp-wson-iv-info]
8. Residual Chromatic Dispersion (ps/nm).  
Referred as parameter G-2 in [I-D.ietf-ccamp-wson-iv-info]

**Value.**

Value for the parameter. As defined by [ITU.G697], it is a 32 bit IEEE floating point number.

**Variance.**

Variance for the parameter, a 32 bit IEEE floating point number.

According to [I-D.ietf-ccamp-wson-iv-info], there are some parameters required for the IV function not listed within [ITU.G697]. Current information source for such parameters is [LS78] hence, this document proposes to use a different value for the field parameter source.

ParamSource = 0 (proposal).

List of parameters within [I-D.ietf-ccamp-wson-iv-info].

[Editor Note: Value to be confirmed through ITU Liaison].

ParamID.

A number that take the following list of values.

1. Ripple (dBm). L-4 in [I-D.ietf-ccamp-wson-iv-info].
2. Channel signal-spontaneous noise figure. L-5 in [I-D.ietf-ccamp-wson-iv-info].
3. DGD, Differential Group Delay. L-8 in [I-D.ietf-ccamp-wson-iv-info].
4. Reflectance. L-11 in [I-D.ietf-ccamp-wson-iv-info].
5. Isolation. L-12 in [I-D.ietf-ccamp-wson-iv-info].
6. Channel extinction. L-13 in [I-D.ietf-ccamp-wson-iv-info].
7. Attenuation Coefficient. L-14 in [I-D.ietf-ccamp-wson-iv-info].

## 2.2. Impairment Vector

This sub-TLV is a list of optical parameters and they MAY have a wavelength dependency information.

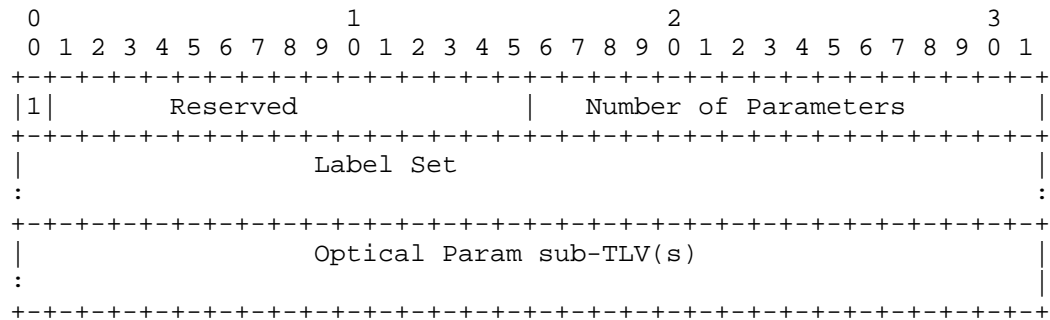
0										1										2										3									
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
0										Reserved										Number of Parameters																			
Optical Param sub-TLV(s)																																							
:																																							

Where:

W = 0. Wavelength Dependency flag. There is no wavelength dependency.

Number of Parameters contained in this vector.

Optical Param sub-TLV(s) present a list of Object as defined in Section 2.1.



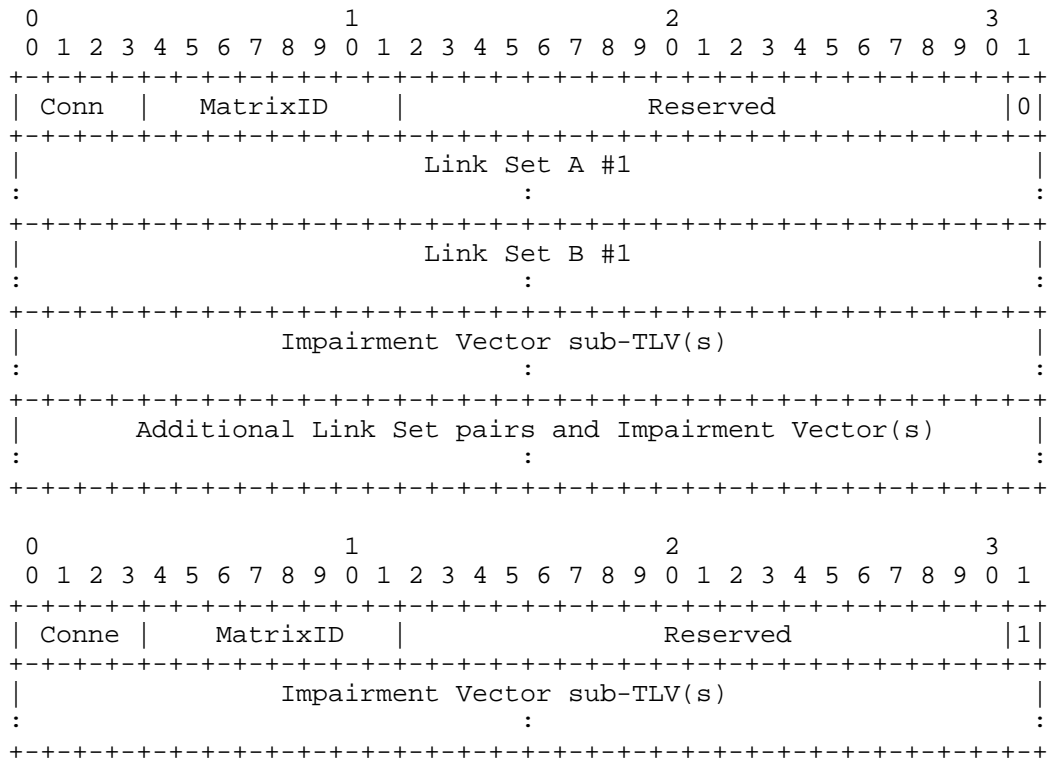
Where:

W = 1. Wavelength Dependency flag. There is wavelength dependency.

The Label Set object is defined in [I-D.ietf-ccamp-general-constraint-encode] Section 2.1. Likely an inclusive range will be the only option required by the Action defined in the Label Set.

### 2.3. Impairment Matrix

As defined by the [I-D.ietf-ccamp-wson-iv-info], the impairment matrix follows the same structure as the connectivity matrix.



Where:

Connectivity (Conn) (4 bits) has value 2 for the impairment matrix (Values 0 and 1 defined by [I-D.ietf-ccamp-general-constraint-encode]).

MatrixID: matrix identifier, following same rules as [I-D.ietf-ccamp-general-constraint-encode].

N: Node scope flag. With this flag set there's no Link Set information but only a list of optical parameters TLVs that apply to the whole optical node.

The usage of multiple matrixes with connectivity type equal to 2 (Impairment Matrix) MIGHT be used to group optical parameters by connectivity. For example, if a subset of parameters apply to the whole node, a unique matrix with flag N=1 is used. At the same some another subset of parameters applies only to some LinkSet pairs, a specific Impairment Matrix will be added.

## 2.4. Resource Block Information

As defined by [I-D.ietf-ccamp-wson-iv-info], the concept of resource block is extended to support the description of the impairments related to that block. The encoding follows the same structure as the one defined in [I-D.ietf-ccamp-rwa-wson-encode], with the addition of an optional Impairment Vector sub-object:

```

      0               1               2               3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     RB Set Field                                     |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+
| I | O |                                     Reserved                               |
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     Optical Interface Class List(s) (opt)           |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     Acceptable Client Signal Type (opt)             |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     Input Bit Rate List (opt)                      |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     Processing Capabilities List (opt)              |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+
|                                     OIV-Impairment Vector (opt)                     |
|                                                                                     |
+-----+-----+-----+-----+-----+-----+-----+-----+

```

The Impairment Vector is defined within Section 2.2. All the other fields are defined within [I-D.ietf-ccamp-rwa-wson-encode].

## 3. Acknowledgements

Authors would like to acknowledge Greg Bernstein and Moustafa Kattan as authors of a previous similar draft whose content partially converged here.

Authors would like to thank ITU SG15/Q6 and in particular Peter Stassar and Pete Anslow for providing useful information and text to CCAMP through join meetings and liaisons.



#### 4. IANA Considerations

This document does not contain any IANA request.

#### 5. Security Considerations

This document defines an protocol-neutral encoding for an information model describing impairments in optical networks and it does not introduce any security issues. If such a encoding is put into use within a network it will by its nature contain details of the physical characteristics of an optical network. Such information would need to be protected from intentional or unintentional disclosure.

#### 6. References

##### 6.1. 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.

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##### 6.2. Informative References

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Bernstein, G., Lee, Y., Li, D., and W. Imajuku, "Routing and Wavelength Assignment Information Encoding for Wavelength Switched Optical Networks", draft-ietf-ccamp-rwa-wson-encode-28 (work in progress), February 2015.

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- [LS78] International Telecommunications Union SG15/Q6, "LS/s on  
CCAMP Liaison to ITU-T SG15 Q6 and Q12 on WSON", LS  
<https://datatracker.ietf.org/liaison/1288/>, October 2013.
- [RFC6566] Lee, Y., Bernstein, G., Li, D., and G. Martinelli, "A  
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