Information Model for Wavelength Switched Optical Networks (WSON) with Optical Impairments Validation.

draft-martinelli-ccamp-wson-iv-info-01

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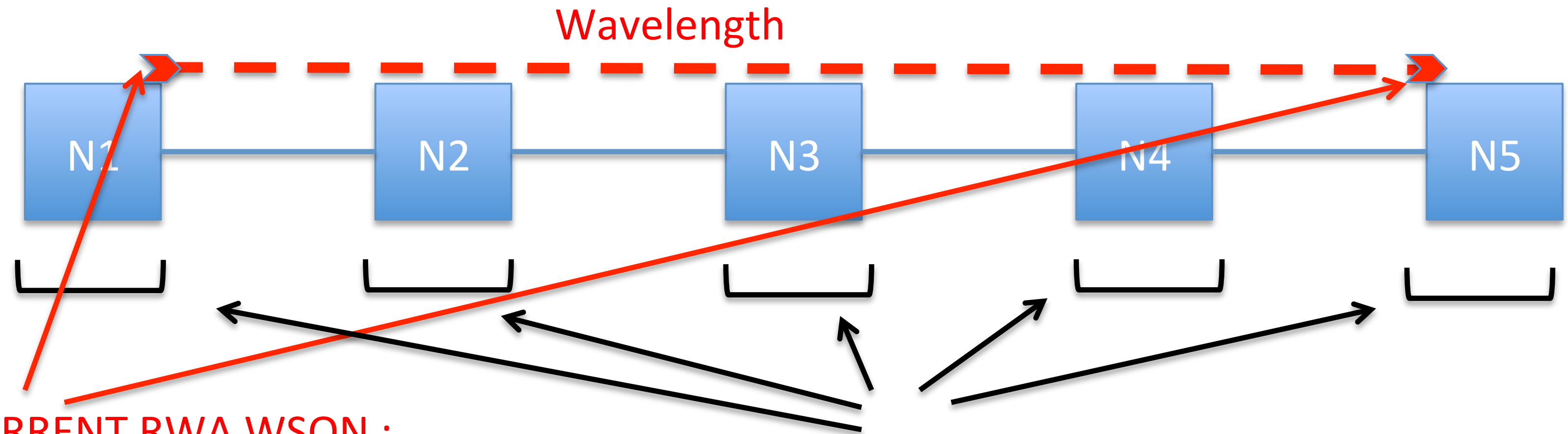
Optical Impairment Reload

- This model was first presented at IETF85 in Atlanta.
- It extends the current RWA-WSON approach (current WG documents) to allow Impairment Validation function.
- Specific Parameters are strictly derived from ITU documents (G.680, G697 Appendix V).
- IETF Context:
  - RFC6566, Sec. 4.1.1, **Approximated Impairment Calc**.
  - Not perfect but better than nothing.

The Computational Model (ITU-G.680)



CURRENT RWA WSON :
It solves Signal Compatibility Problem:

- Apply to end points (optical i/f transceivers)
- Use of Optical Interface Class (i.e. ITU Application Codes)

TRANSFER FUNCTIONs

- Parameters: single contribution vs. end-to-end.
- ITU-G.680 transfer functions for: OSNR, CD, PMD/PDL.

Example:

$$osnr_{out} = \frac{1}{\frac{1}{osnr_{in}} + \frac{1}{osnr_{one}}} \qquad (9\text{-}1)$$

G.680 Models (Sec. 9.1): OSNR

$$osnr_{out} = \frac{1}{\frac{1}{osnr_{in}} + \frac{1}{osnr_{one}}} \qquad (9\text{-}1)$$

$$OSNR_{out} = -10\log\left(10^{-\left(\frac{OSNR_{in}}{10}\right)} + 10^{-\left(\frac{P_{in} - NF - 10\log(h\nu\nu_r)}{10}\right)}\right) \qquad (9\text{-}2)$$

$$OSNR_{out} = -10\log\left(10^{-\left(\frac{P_{in1} - NF_1 - 10\log(h\nu\nu_r)}{10}\right)} + 10^{-\left(\frac{P_{in2} - NF_2 - 10\log(h\nu\nu_r)}{10}\right)} + \ldots + 10^{-\left(\frac{P_{inN} - NF_N - 10\log(h\nu\nu_r)}{10}\right)}\right) \qquad (9\text{-}3)$$

NODE 1 **NODE 2** **NODE N**

G.680 Models (Sec. 9.2): CD

$$Residual\ dispersion = \underbrace{\sum fibre\ dispersion}_{\text{LINK}} + \underbrace{\sum DCM\ dispersion + \sum ONE\ dispersion}_{\text{NODE}} \quad (9\text{-}5)$$

- Two approaches to evaluate terms of (9-5)
- Worst case
- Statistical: means and std deviation may be available
- Likely shows wavelength dependency

G.680 Model (Sec. 9.3): PMD/PDL

$$DGD\max_{link} = \left[DGD\max_F^2 + S^2 \sum_i PMD_{Ci}^2 \right]^{1/2} \qquad (9\text{-}6)$$

$$Mean\ PDL = \sqrt{\frac{8}{3\pi}} \left[\sum_i PDL_i^2 \right]^{1/2} (\mathrm{dB}) \qquad (9\text{-}7)$$

- PMD and PDL have a "per node" component.
- PDL available as a computational model, not available as Parameter ID in G.697

From Computational (ITU) **To** Information (IETF) Model

- For each parameter
  - it's possible to provide a by node/by link contribution,
  - there is a simple function to put together all contributions (Sum, …).
- No hypothesis are done on how each single contribution is provided (e.g. provisioned, computed, known a priori, ….).
- Even if the Computational Model is not perfect allows path computation to choose better paths.

The Information Model (IETF)

- Makes room for a list of parameters:
  - Does not look at parameter semantic.
  - Does not look at specific transfer functions.

- Defines basic building blocks to be added to control plane objects
  - Impairment Vector (For Node or Link Information)
  - Impairment Matrix (For Node Information)

- Generalized from existing RWA-WSON (no I.V.) approach.

Info Model: Impairment Vector

Info Model just provide the Parameter Identifiers and encoding.

- The encoding draft details how identifiers are mapped.

G.697 Appendix V

V.2 Parameter ID source (8 bits)

This field defines the source of the parameter ID lookup table. The value "1" corresponds to this Recommendation, all other values are reserved for future use.

V.3 Parameter ID (8 bits)

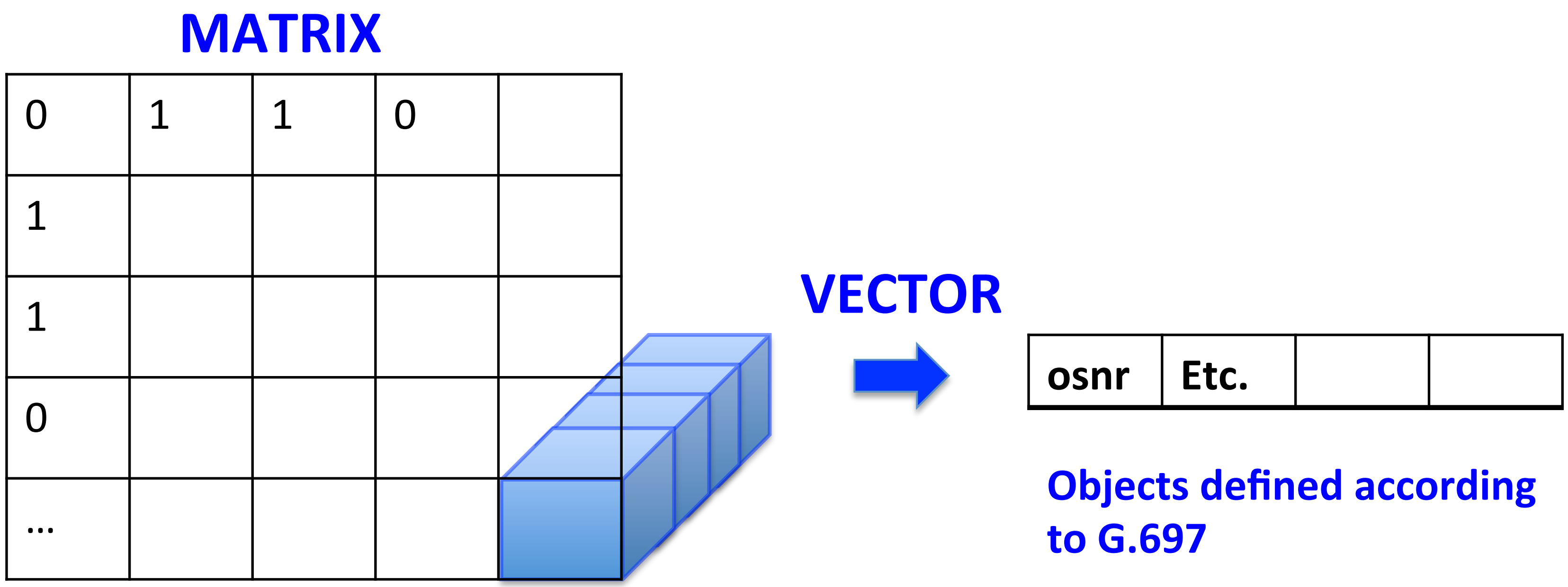
When the parameter ID source is equal to "1", the parameter encoding shown in Table V.3 applies. For all other values of the parameter ID source, the parameter encoding is given in the document referred to in V.2.

Table V.3 – Parameter ID encoding

Value	Parameter	Unit	Notes
1	Total power	dBm	
2	Channel power	dBm	
3	Frequency deviation from nominal	GHz	For DWDM channels
4	Wavelength deviation from nominal	nm	For CWDM channels
5	OSNR	dB (0.1 nm)	Referred to a 0.1 nm noise bandwidth
6	Q	–	Linear Q
7	PMD	ps	Mean DGD. This parameter is normally only measured at time of installation
8	Residual dispersion	ps/nm	This parameter is normally only measured at time of installation

All other values of the parameter ID are reserved for future use.

Info Model: Impairment Matrix



- Existing WSON Connectivity Matrix only represents a binary information.
- Impairment Matrix extends Conn.Matrix with a set of optical values: the impairment vector.

Next Steps

- Does this approach seem a good way to go?
  - Yes: refine (need anyway!), wg adoption, …
  - No: suggestions, abandon, …
  - Don't know

- There were already two individual drafts: plan to work together.

THANK YOU!

Q for Q6

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Questions (1)

- What impairment data are relevant/stable for control plane to collect for its path computation and what ITU-T references are good to reference?
- Does the IETF Information Model currently represent the G.680 computational model ?
- G.697 is used to derive a suitable encoding for parameters (the once currently computed by G. 680). Is there any update foreseen on G.697? E.g. PDL is in G.680 not in G.697.

Questions (2)

- Are there new modulation formats under standardizations? They generate new Computational Models? They imply new optical parameters?
- Does ITU is working on additional computational models (e.g. coherent technology / Non linear effects / ...)? IETF Information model tries to be generic enough.