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Intended status: Informational   G. Bernstein
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                                               February 13, 2014

    **Routing and Wavelength Assignment Information Model for Wavelength
                    Switched Optical Networks**

                  draft-ietf-ccamp-rwa-info-21.txt

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Abstract

   This document provides a model of information needed by the routing
   and wavelength assignment (RWA) process in wavelength switched
   optical networks (WSONs). The purpose of the information described
   in this model is to facilitate constrained lightpath computation in
   WSONs. This model takes into account compatibility constraints
   between WSON signal attributes and network elements but does not
   include constraints due to optical impairments. Aspects of this
   information that may be of use to other technologies utilizing a
   GMPLS control plane are discussed.

Table of Contents

1. Introduction

The purpose of the following information model for WSONs is to
facilitate constrained lightpath computation and as such is not a
general purpose network management information model. This
constraint is frequently referred to as the "wavelength continuity"
constraint, and the corresponding constrained lightpath computation
is known as the routing and wavelength assignment (RWA) problem.
Hence the information model must provide sufficient topology and
wavelength restriction and availability information to support this
computation. More details on the RWA process and WSON subsystems and
their properties can be found in [RFC6163]. The model defined here
includes constraints between WSON signal attributes and network
elements, but does not include optical impairments.

In addition to presenting an information model suitable for path
computation in WSON, this document also highlights model aspects
that may have general applicability to other technologies utilizing
a GMPLS control plane. The portion of the information model
applicable to other technologies beyond WSON is referred to as
"general" to distinguish it from the "WSON-specific" portion that is
applicable only to WSON technology.

2. Terminology

Refer to [RFC6163] for ROADM, RWA, Wavelength Conversion, WDM and
WSON.

3. **Routing and Wavelength Assignment Information Model**

   The following WSON RWA information model is grouped into four
   categories regardless of whether they stem from a switching
   subsystem or from a line subsystem:

   o   Node Information

   o   Link Information

   o   Dynamic Node Information

   o   Dynamic Link Information

   Note that this is roughly the categorization used in [G.7715]
   section 7.

   In the following, where applicable, the reduced Backus-Naur form
   (RBNF) syntax of [RBNF] is used to aid in defining the RWA
   information model.

   3.1. Dynamic and Relatively Static Information

   All the RWA information of concern in a WSON network is subject to
   change over time. Equipment can be upgraded; links may be placed in
   or out of service and the like. However, from the point of view of
   RWA computations there is a difference between information that can
   change with each successive connection establishment in the network
   and that information that is relatively static and independent of
   connection establishment. A key example of the former is link
   wavelength usage since this can change with connection
   setup/teardown and this information is a key input to the RWA
   process. Examples of relatively static information are the
   potential port connectivity of a WDM ROADM, and the channel spacing
   on a WDM link.

   This document separates, where possible, dynamic and static
   information so that these can be kept separate in possible encodings
   and hence allowing for separate updates of these two types of
   information thereby reducing processing and traffic load caused by
   the timely distribution of the more dynamic RWA WSON information.

4. **Node Information (General)**

   The node information described here contains the relatively static
   information related to a WSON node. This includes connectivity

constraints amongst ports and wavelengths since WSON switches can
exhibit asymmetric switching properties. Additional information
could include properties of wavelength converters in the node if any
are present. In [Switch] it was shown that the wavelength
connectivity constraints for a large class of practical WSON devices
can be modeled via switched and fixed connectivity matrices along
with corresponding switched and fixed port constraints. These
connectivity matrices are included with the node information while
the switched and fixed port wavelength constraints are included with
the link information.

Formally,

<Node_Information> ::= <Node_ID> [<ConnectivityMatrix>...]

Where the Node_ID would be an appropriate identifier for the node
within the WSON RWA context.

Note that multiple connectivity matrices are allowed and hence can
fully support the most general cases enumerated in [Switch].

4.1. Connectivity Matrix

The connectivity matrix (ConnectivityMatrix) represents either the
potential connectivity matrix for asymmetric switches (e.g. ROADMs
and such) or fixed connectivity for an asymmetric device such as a
multiplexer. Note that this matrix does not represent any particular
internal blocking behavior but indicates which input ports and
wavelengths could possibly be connected to a particular output port.
Representing internal state dependent blocking for a switch or ROADM
is beyond the scope of this document and due to its highly
implementation dependent nature would most likely not be subject to
standardization in the future. The connectivity matrix is a
conceptual M by N matrix representing the potential switched or
fixed connectivity, where M represents the number of input ports and
N the number of output ports. This is a "conceptual" matrix since
the matrix tends to exhibit structure that allows for very compact
representations that are useful for both transmission and path
computation.

Note that the connectivity matrix information element can be useful
in any technology context where asymmetric switches are utilized.

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

Where

<MatrixID> is a unique identifier for the matrix.

<ConnType> can be either 0 or 1 depending upon whether the
connectivity is either fixed or switched.

<Matrix> represents the fixed or switched connectivity in that
Matrix(i, j) = 0 or 1 depending on whether input port i can connect
to output port j for one or more wavelengths.

5. Node Information (WSON specific)

As discussed in [RFC6163] a WSON node may contain electro-optical
subsystems such as regenerators, wavelength converters or entire
switching subsystems. The model present here can be used in
characterizing the accessibility and availability of limited
resources such as regenerators or wavelength converters as well as
WSON signal attribute constraints of electro-optical subsystems. As
such this information element is fairly specific to WSON
technologies.

A WSON node may include regenerators or wavelength converters
arranged in a shared pool. As discussed in [RFC6163] this can
include OEO based WDM switches as well. There are a number of
different approaches used in the design of WDM switches containing
regenerator or converter pools. However, from the point of view of
path computation the following need to be known:

1. The nodes that support regeneration or wavelength conversion.

2. The accessibility and availability of a wavelength converter to
   convert from a given input wavelength on a particular input port
   to a desired output wavelength on a particular output port.

3. Limitations on the types of signals that can be converted and the
   conversions that can be performed.

Since resources tend to be packaged together in blocks of similar
devices, e.g., on line cards or other types of modules, the
fundamental unit of identifiable resource in this document is the
"resource block". A resource block may contain one or more
resources. A resource is the smallest identifiable unit of
processing allocation. One can group together resources into blocks
if they have similar characteristics relevant to the optical system
being modeled, e.g., processing properties, accessibility, etc.

This leads to the following formal high level model:

```
<Node_Information> ::= <Node_ID> [<ConnectivityMatrix>...]
[<ResourcePool>]
```

Where

```
<ResourcePool> ::= <ResourceBlockInfo>...
[<ResourceAccessibility>...] [<ResourceWaveConstraints>...]
[<RBPoolState>]
```

First the accessibility of resource blocks is addressed then their properties are discussed.

5.1. Resource Accessibility/Availability

A similar technique as used to model ROADMs and optical switches can be used to model regenerator/converter accessibility. This technique was generally discussed in [RFC6163] and consisted of a matrix to indicate possible connectivity along with wavelength constraints for links/ports. Since regenerators or wavelength converters may be considered a scarce resource it is desirable that the model include, if desired, the usage state (availability) of individual regenerators or converters in the pool. Models that incorporate more state to further reveal blocking conditions on input or output to particular converters are for further study and not included here.

The three stage model is shown schematically in Figure 1 and Figure 2. The difference between the two figures is that Figure 1 assumes that each signal that can get to a resource block may do so, while in Figure 2 the access to sets of resource blocks is via a shared fiber which imposes its own wavelength collision constraint. The representation of Figure 1 can have more than one input to each resource block since each input represents a single wavelength signal, while in Figure 2 shows a single multiplexed WDM input or output, e.g., a fiber, to/from each set of block.

This model assumes N input ports (fibers), P resource blocks containing one or more identical resources (e.g. wavelength converters), and M output ports (fibers). Since not all input ports can necessarily reach each resource block, the model starts with a resource pool input matrix $RI(i,p) = \{0,1\}$ whether input port i can reach potentially reach resource block p.

Since not all wavelengths can necessarily reach all the resources or the resources may have limited input wavelength range the model has a set of relatively static input port constraints for each resource. In addition, if the access to a set of resource blocks is via a shared fiber (Figure 2) this would impose a dynamic wavelength

availability constraint on that shared fiber. The resource block
input port constraint is modeled via a static wavelength set
mechanism and the case of shared access to a set of blocks is
modeled via a dynamic wavelength set mechanism.

Next a state vector $RA(j) = \{0,...,k\}$ is used to track the number of
resources in resource block j in use. This is the only state kept in
the resource pool model. This state is not necessary for modeling
"fixed" transponder system or full OEO switches with WDM interfaces,
i.e., systems where there is no sharing.

After that, a set of static resource output wavelength constraints
and possibly dynamic shared output fiber constraints maybe used. The
static constraints indicate what wavelengths a particular resource
block can generate or are restricted to generating e.g., a fixed
regenerator would be limited to a single lambda. The dynamic
constraints would be used in the case where a single shared fiber is
used to output the resource block (Figure 2).

Finally, to complete the model, a resource pool output matrix
$RE(p,k) = \{0,1\}$ depending on whether the output from resource block
p can reach output port k, may be used.

```
  I1   +-------------+                        +-------------+ O1
 ----->|             |         +--------+     |             |----->
  I2   |             +------+ Rb #1  +-------+             | O2
 ----->|             |         +--------+     |             |----->
       |             |         |              |             |
       | Resource    |         +--------+     | Resource    |
       | Pool        +------+           +-------+ Pool       |
       |             |       + Rb #2   +       |             |
       | Input       +------+           +-------| Output     |
       | Connection  |         +--------+       | Connection |
       | Matrix      |              .           | Matrix     |
       |             |              .           |             |
       |             |              .           |             |
  IN   |             |         +--------+       |             | OM
 ----->|             +------+ Rb #P  +-------+             |----->
       |             |         +--------+       |             |
       +-------------+   ^                  ^   +-------------+
                         |                  |
                         |                  |
                         |                  |
                         |                  |

            Input wavelength    Output wavelength
            constraints for     constraints for
            each resource       each resource
```

                Figure 1 Schematic diagram of resource pool model.

```
  I1    +-------------+                    +-------------+ O1
 ----->|             |       +--------+    |             |----->
  I2    |             +======+ Rb #1  +-+   +             | O2
 ----->|             |       +--------+ |   |             |----->
        |             |                 |====|             |
        | Resource    |       +--------+ |   | Resource    |
        | Pool        |     +-+ Rb #2  +-+   | Pool        |
        |             |     | +--------+     +             |
        | Input       |====|                 | Output      |
        | Connection  |     | +--------+     | Connection  |
        | Matrix      |     +-| Rb #3  |======| Matrix      |
        |             |       +--------+      |             |
        |             |           .          |             |
        |             |           .          |             |
        |             |           .          |             |
  IN    |             |       +--------+      |             | OM
 ----->|             |       +======+ Rb #P  +======+      |----->
        |             |       +--------+      |             |
        +-------------+   ^                ^  +-------------+
                         |                |
                         |                |
                         |                |
              Single (shared) fibers for block input and output

              Input wavelength          Output wavelength
              availability for          availability for
              each block input fiber    each block output fiber
```

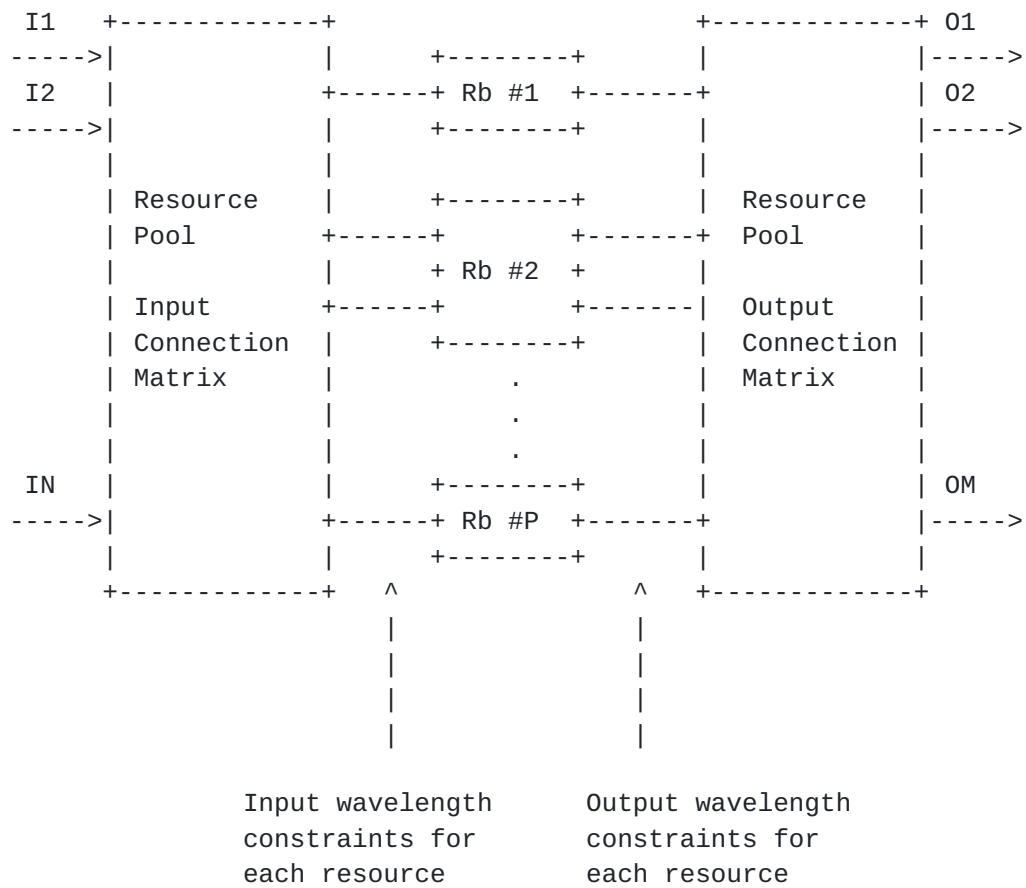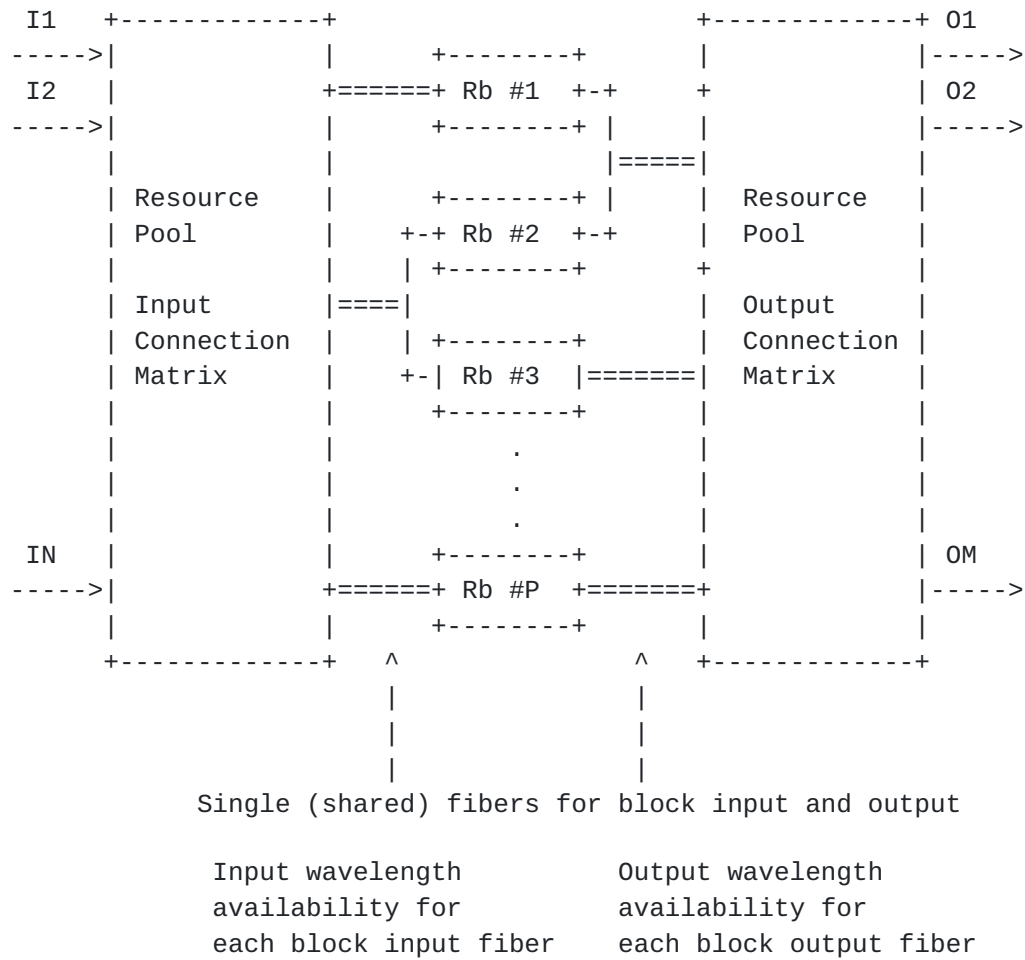   Figure 2 Schematic diagram of resource pool model with shared block
                                  accessibility.

    Formally the model can be specified as:

    <ResourceAccessibility ::= <PoolInputMatrix> <PoolOutputMatrix>

    <ResourceWaveConstraints> ::= <InputWaveConstraints>
    <OutputOutputWaveConstraints>

    <RBSharedAccessWaveAvailability> ::= [<InAvailableWavelengths>]
    [<OutAvailableWavelengths>]

```
<RBPoolState> ::=<ResourceBlockID> <NumResourcesInUse>
[<RBSharedAccessWaveAvailability>] [<RBPoolState>]
```

Note that except for <RBPoolState> all the other components of
<ResourcePool> are relatively static. Also the
<InAvailableWavelengths> and <OutAvailableWavelengths> are only used
in the cases of shared input or output access to the particular
block. See the resource block information in the next section to see
how this is specified.

5.2. Resource Signal Constraints and Processing Capabilities

The wavelength conversion abilities of a resource (e.g. regenerator,
wavelength converter) were modeled in the <OutputWaveConstraints>
previously discussed. As discussed in [RFC6163] the constraints on
an electro-optical resource can be modeled in terms of input
constraints, processing capabilities, and output constraints:

```
<ResourceBlockInfo> ::= <ResourceBlockSet> [<InputConstraints>]
[<ProcessingCapabilities>] [<OutputConstraints>]
```

Where <ResourceBlockSet> is a list of resource block identifiers
with the same characteristics. If this set is missing the
constraints are applied to the entire network element.

The <InputConstraints> are signal compatibility based constraints
and/or shared access constraint indication. The details of these
constraints are defined in section 5.3.

```
<InputConstraints> ::= <SharedInput> [<OpticalInterfaceClassList>]
[<ClientSignalList>]
```

The <ProcessingCapabilities> are important operations that the
resource (or network element) can perform on the signal. The details
of these capabilities are defined in section 5.3.

```
<ProcessingCapabilities> ::= [<NumResources>]
[<RegenerationCapabilities>] [<FaultPerfMon>] [<VendorSpecific>]
```

The <OutputConstraints> are either restrictions on the properties of
the signal leaving the block, options concerning the signal
properties when leaving the resource or shared fiber output
constraint indication.

```
<OutputConstraints> := <SharedOutput>
[<OpticalInterfaceClassList>][<ClientSignalList>]
```

5.3. Compatibility and Capability Details

5.3.1. Shared Input or Output Indication

As discussed in the previous section and shown in Figure 2 the input
or output access to a resource block may be via a shared fiber. The
<SharedInput> and <SharedOutput> elements are indicators for this
condition with respect to the block being described.

5.3.2. Optical Interface Class List

```
<OpticalInterfaceClassList> ::= <OpticalInterfaceClass> ...
```

The Optical Interface Class is a unique number that identifies
all information related to optical characteristics of a physical
interface. The class may include other optical parameters
related to other interface properties. A class always includes
signal compatibility information.

The content of each class is out of the scope of this draft and
can be defined by other entities (e.g. ITU, optical equipment
vendors, etc.).

Since even current implementation of physical interfaces may
support different optical characteristics, a single interface may
support multiple interface classes. Which optical interface
class is used among all the ones available for an interface is
out of the scope of this draft but is an output of the RWA
process.

5.3.3. Acceptable Client Signal List

The list is simply:

```
< ClientSignalList>::=[<G-PID>]...
```

Where the Generalized Protocol Identifiers (G-PID) object
represents one of the IETF standardized G-PID values as defined
in [RFC3471] and [RFC4328].

5.3.4. Processing Capability List

The ProcessingCapabilities were defined in Section 5.2.

The processing capability list sub-TLV is a list of processing functions that the WSON network element (NE) can perform on the signal including:

1. Number of Resources within the block

2. Regeneration capability

3. Fault and performance monitoring

4. Vendor Specific capability

Note that the code points for Fault and performance monitoring and vendor specific capability are subject to further study.

6. Link Information (General)

MPLS-TE routing protocol extensions for OSPF and IS-IS [RFC3630], [RFC5305] along with GMPLS routing protocol extensions for OSPF and IS-IS [RFC4203, RFC5307] provide the bulk of the relatively static link information needed by the RWA process. However, WSON networks bring in additional link related constraints. These stem from WDM line system characterization, laser transmitter tuning restrictions, and switching subsystem port wavelength constraints, e.g., colored ROADM drop ports.

In the following summarize both information from existing GMPLS route protocols and new information that maybe needed by the RWA process.

<LinkInfo> ::= <LinkID> [<AdministrativeGroup>] [<InterfaceCapDesc>] [<Protection>] [<SRLG>...] [<TrafficEngineeringMetric>] [<PortLabelRestriction>...]

Note that these additional link characteristics only applies to line side ports of WDM system or add/drop ports pertaining to Resource Pool (e.g., Regenerator or Wavelength Converter Pool). The advertisement of input/output tributary ports is not intended here.

6.1. Administrative Group

AdministrativeGroup: Defined in [RFC3630]. Each set bit corresponds to one administrative group assigned to the interface. A link may belong to multiple groups. This is a configured quantity and can be used to influence routing decisions.

6.2. Interface Switching Capability Descriptor

InterfaceSwCapDesc: Defined in [RFC4202], lets us know the different switching capabilities on this GMPLS interface. In both [RFC4203] and [RFC5307] this information gets combined with the maximum LSP bandwidth that can be used on this link at eight different priority levels.

6.3. Link Protection Type (for this link)

Protection: Defined in [RFC4202] and implemented in [RFC4203, RFC5307]. Used to indicate what protection, if any, is guarding this link.

6.4. Shared Risk Link Group Information

SRLG: Defined in [RFC4202] and implemented in [RFC4203, RFC5307]. This allows for the grouping of links into shared risk groups, i.e., those links that are likely, for some reason, to fail at the same time.

6.5. Traffic Engineering Metric

TrafficEngineeringMetric: Defined in [RFC3630]. This allows for the identification of a data channel link metric value for traffic engineering that is separate from the metric used for path cost computation of the control plane.

 Note that multiple "link metric values" could find use in optical networks, however it would be more useful to the RWA process to assign these specific meanings such as link mile metric, or probability of failure metric, etc...

6.6. Port Label Restrictions

Port label restrictions could be applied generally to any label types in GMPLS by adding new kinds of restrictions. Wavelength is a type of label.

Port label (wavelength) restrictions (PortLabelRestriction) model
the label (wavelength) restrictions that the link and various
optical devices such as OXCs, ROADMs, and waveband multiplexers may
impose on a port. These restrictions tell us what wavelength may or
may not be used on a link and are relatively static. This plays an
important role in fully characterizing a WSON switching device
[Switch]. Port wavelength restrictions are specified relative to the
port in general or to a specific connectivity matrix (section 4.1.
Reference [Switch] gives an example where both switch and fixed
connectivity matrices are used and both types of constraints occur
on the same port.

```
<PortLabelRestriction> ::= <MatrixID> <RestrictionType>
            <Restriction parameters list>

<Restriction parameters list> ::=
      <Simple label restriction parameters> |
      <Channel count restriction parameters> |
      <Label range restriction parameters> |
      <Simple+channel restriction parameters> |
      <Exclusive label restriction parameters>

<Simple label restriction parameters> ::= <LabelSet> ...

<Channel count restriction parameters> ::= <MaxNumChannels>

<Label range restriction parameters> ::=
      <MaxLabelRange> (<LabelSet> ...)

<Simple+channel restriction parameters> ::=
      <MaxNumChannels> (<LabelSet> ...)

<Exclusive label restriction parameters> ::= <LabelSet> ...
```

Where

MatrixID is the ID of the corresponding connectivity matrix (section
4.1.

The RestrictionType parameter is used to specify general port
restrictions and matrix specific restrictions. It can take the
following values and meanings:

SIMPLE_LABEL: Simple label (wavelength) set restriction; The label
set parameter is required.

CHANNEL_COUNT: The number of channels is restricted to be less than
or equal to the Max number of channels parameter (which is
required).

LABEL_RANGE: Used to indicate a restriction on a range of labels
that can be switched. For example, a waveband device with a tunable
center frequency and passband. This constraint is characterized by
the MaxLabelRange parameter which indicates the maximum range of the
labels, e.g., which may represent a waveband in terms of channels.
Note that an additional parameter can be used to indicate the
overall tuning range. Specific center frequency tuning information
can be obtained from dynamic channel in use information. It is
assumed that both center frequency and bandwidth (Q) tuning can be
done without causing faults in existing signals.

SIMPLE LABEL & CHANNEL COUNT: In this case, the accompanying label
set and MaxNumChannels indicate labels permitted on the port and the
maximum number of labels that can be simultaneously used on the
port.

LINK LABEL_EXCLUSIVITY: A label (wavelength) can be used at most
once among a given set of ports. The set of ports is specified as a
parameter to this constraint.

Restriction specific parameters are used with one or more of the
previously listed restriction types. The currently defined
parameters are:

   LabelSet is a conceptual set of labels (wavelengths).

   MaxNumChannels is the maximum number of channels that can be
   simultaneously used (relative to either a port or a matrix).

   LinkSet is a conceptual set of ports.

   MaxLabelRange indicates the maximum range of the labels.

For example, if the port is a "colored" drop port of a ROADM then
there are two restrictions: (a) CHANNEL_COUNT, with MaxNumChannels =
1, and (b) SIMPLE_WAVELENGTH, with the wavelength set consisting of
a single member corresponding to the frequency of the permitted
wavelength. See [Switch] for a complete waveband example.

This information model for port wavelength (label) restrictions is
fairly general in that it can be applied to ports that have label
restrictions only or to ports that are part of an asymmetric switch
and have label restrictions. In addition, the types of label
restrictions that can be supported are extensible.

6.6.1. Port-Wavelength Exclusivity Example

Although there can be many different ROADM or switch architectures
that can lead to the constraint where a lambda (label) maybe used at
most once on a set of ports Figure 3 shows a ROADM architecture
based on components known as a Wavelength Selective Switch
(WSS)[OFC08]. This ROADM is composed of splitters, combiners, and
WSSes. This ROADM has 11 output ports, which are numbered in the
diagram. Output ports 1-8 are known as drop ports and are intended
to support a single wavelength. Drop ports 1-4 output from WSS #2,
which is fed from WSS #1 via a single fiber. Due to this internal
structure a constraint is placed on the output ports 1-4 that a
lambda can be only used once over the group of ports (assuming uni-
cast and not multi-cast operation). Similarly the output ports 5-8
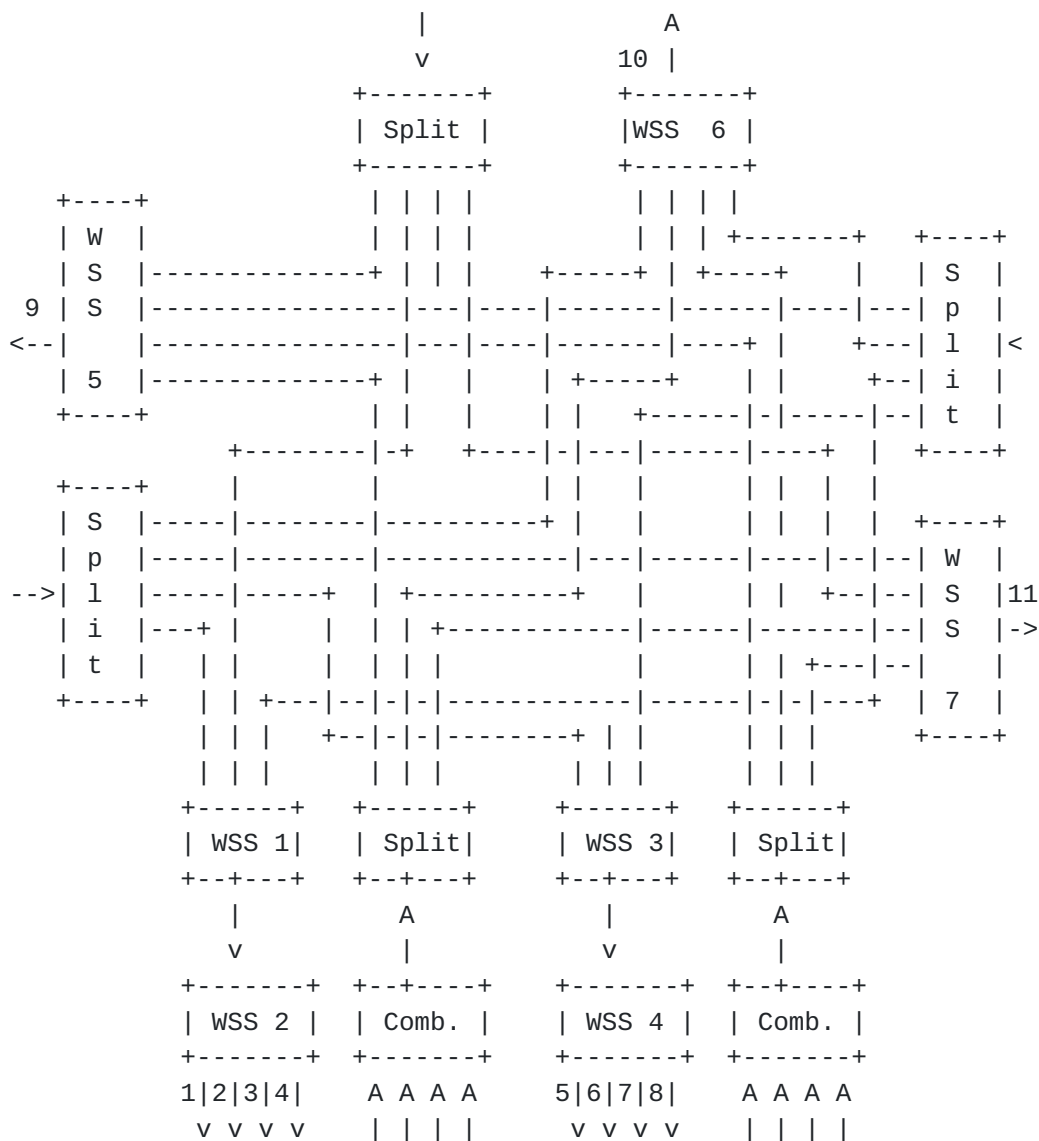have a similar constraint due to the internal structure.

```
                               |                A
                               v             10 |
                         +-------+          +-------+
                         | Split |          |WSS  6 |
                         +-------+          +-------+
       +----+              | | | |            | | | |
       | W  |              | | | |            | | | +-------+    +----+
       | S  |--------------+ | | |      +-----+ | +----+    |    | S  |
     9 | S  |----------------|---|----|-------|------|----|---| p  |
     <--|    |----------------|---|----|-------|----+ |    +---| l  |<
       | 5  |--------------+ |   |    | +-----+     | |      +--| i  |
       +----+              | |   |    | |   +------|-|-----|--| t  |
             +---------|-+   +----|-|---|------|----+   |    +----+
       +----+      |         |       | |   |    | | | |
       | S  |-----|--------|----------+ |   |    | | | |   +----+
       | p  |-----|--------|------------|---|------|----|--|--| W  |
     -->| l  |-----|-----+   | +----------+    |      | |  +--|--| S  |11
       | i  |---+ |     | | | +------------|------|-------|--| S  |->
       | t  |   | |     | | | |            |      | | +---|--|    |
       +----+   | | +---|--|-|-|------------|------|-|-|---+  | 7  |
                | | |   +--|-|-|--------+ | |      | | |      +----+
                | | |      | | |          | | |      | | |
             +------+   +------+       +------+   +------+
             | WSS 1|   | Split|       | WSS 3|   | Split|
             +--+---+   +--+---+       +--+---+   +--+---+
                |          A              |          A
                v          |              v          |
             +-------+  +--+----+      +-------+  +--+----+
             | WSS 2 |  | Comb. |      | WSS 4 |  | Comb. |
             +-------+  +-------+      +-------+  +-------+
             1|2|3|4|    A A A A       5|6|7|8|    A A A A
              v v v v    | | | |        v v v v    | | | |
```

        Figure 3 A ROADM composed from splitter, combiners, and WSSs.

7. Dynamic Components of the Information Model

   In the previously presented information model there are a limited
   number of information elements that are dynamic, i.e., subject to
   change with subsequent establishment and teardown of connections.
   Depending on the protocol used to convey this overall information
   model it may be possible to send this dynamic information separate
   from the relatively larger amount of static information needed to
   characterize WSON's and their network elements.

7.1. Dynamic Link Information (General)

For WSON links wavelength availability and wavelengths in use for
shared backup purposes can be considered dynamic information and
hence are grouped with the dynamic information in the following set:

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

AvailableLabels is a set of labels (wavelengths) currently available
on the link. Given this information and the port wavelength
restrictions one can also determine which wavelengths are currently
in use. This parameter could potential be used with other
technologies that GMPLS currently covers or may cover in the future.

SharedBackupLabels is a set of labels (wavelengths) currently used
for shared backup protection on the link. An example usage of this
information in a WSON setting is given in [Shared]. This parameter
could potential be used with other technologies that GMPLS currently
covers or may cover in the future.

Note that the above does not dictate a particular encoding or
placement for available label information. In some routing protocols
it may be advantageous or required to place this information within
another information element such as the interface switching
capability descriptor (ISCD). Consult routing protocol specific
extensions for details of placement of information elements.

7.2. Dynamic Node Information (WSON Specific)

Currently the only node information that can be considered dynamic
is the resource pool state and can be isolated into a dynamic node
information element as follows:

<DynamicNodeInfo> ::= <NodeID> [<ResourcePool>]

8. Security Considerations

This document discussed an information model for RWA computation in
WSONs. Such a model is very similar from a security standpoint of
the information that can be currently conveyed via GMPLS routing
protocols. Such information includes network topology, link state
and current utilization, and well as the capabilities of switches
and routers within the network. As such this information should be
protected from disclosure to unintended recipients. In addition,

the intentional modification of this information can significantly
affect network operations, particularly due to the large capacity of
the optical infrastructure to be controlled. A general discussion on
security in GMPLS networks can be found in [RFC5920].

9. IANA Considerations

This informational document does not make any requests for IANA
action.

10. Acknowledgments

This document was prepared using 2-Word-v2.0.template.dot.

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