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

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Abstract

   A wavelength switched optical network (WSON) requires that certain
   key information elements are made available to facilitate path
   computation and the establishment of label switching paths (LSPs).
   The information model described in "Routing and Wavelength Assignment
   Information for Wavelength Switched Optical Networks" shows what
   information is required at specific points in the WSON. Part of the
   WSON information model contains aspects that may be of general
   applicability to other technologies, while other parts are fairly
   specific to WSONs.

   This document provides efficient, protocol-agnostic encodings for the
   WSON specific information elements. It is intended that protocol-
   specific documents will reference this memo to describe how
   information is carried for specific uses. Such encodings can be used
   to extend GMPLS signaling and routing protocols. In addition these
   encodings could be used by other mechanisms to convey this same
   information to a path computation element (PCE).

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].

Table of Contents

1. Introduction

   A Wavelength Switched Optical Network (WSON) is a Wavelength Division
   Multiplexing (WDM) optical network in which switching is performed
   selectively based on the center wavelength of an optical signal.

   [WSON-Frame] describes a framework for Generalized Multiprotocol
   Label Switching (GMPLS) and Path Computation Element (PCE) control of

a WSON. Based on this framework, [WSON-Info] describes an information model that specifies what information is needed at various points in a WSON in order to compute paths and establish Label Switched Paths (LSPs).

This document provides efficient encodings of information needed by the routing and wavelength assignment (RWA) process in a WSON. Such encodings can be used to extend GMPLS signaling and routing protocols. In addition these encodings could be used by other mechanisms to convey this same information to a path computation element (PCE). Note that since these encodings are relatively efficient they can provide more accurate analysis of the control plane communications/processing load for WSONs looking to utilize a GMPLS control plane.

Note that encodings of information needed by the routing and label assignment process applicable to general networks beyond WSON are addressed in a separate document [Gen-Encode].

1.1. Revision History

1.1.1. Changes from 00 draft

Edits to make consistent with update to [Otani], i.e., removal of sign bit.

Clarification of TBD on connection matrix type and possibly numbering.

New sections for wavelength converter pool encoding: Wavelength Converter Set Sub-TLV, Wavelength Converter Accessibility Sub-TLV, Wavelength Conversion Range Sub-TLV, WC Usage State Sub-TLV.

Added optional wavelength converter pool TLVs to the composite node TLV.

1.1.2. Changes from 01 draft

The encoding examples have been moved to an appendix. Classified and corrected information elements as either reusable fields or sub-TLVs. Updated Port Wavelength Restriction sub-TLV. Added available wavelength and shared backup wavelength sub-TLVs. Changed the title and scope of section 6 to recommendations since the higher level TLVs that this encoding will be used in is somewhat protocol specific.

1.1.3. Changes from 02 draft

Removed inconsistent text concerning link local identifiers and the link set field.

Added E bit to the Wavelength Converter Set Field.

Added bidirectional connectivity matrix example. Added simple link set example. Edited examples for consistency.

1.1.4. Changes from 03 draft

Removed encodings for general concepts to [Gen-Encode].

Added in WSON signal compatibility and processing capability information encoding.

1.1.5. Changes from 04 draft

Added encodings to deal with access to resource blocks via shared fiber.

1.1.6. Changes from 05 draft

Revised the encoding for the "shared access" indicators to only use one bit each for ingress and egress.

1.1.7. Changes from 06 draft

Removed section on "WSON Encoding Usage Recommendations"

2. Terminology

CWDM: Coarse Wavelength Division Multiplexing.

DWDM: Dense Wavelength Division Multiplexing.

FOADM: Fixed Optical Add/Drop Multiplexer.

ROADM: Reconfigurable Optical Add/Drop Multiplexer. A reduced port count wavelength selective switching element featuring ingress and egress line side ports as well as add/drop side ports.

RWA: Routing and Wavelength Assignment.

Wavelength Conversion. The process of converting an information
bearing optical signal centered at a given wavelength to one with
"equivalent" content centered at a different wavelength. Wavelength
conversion can be implemented via an optical-electronic-optical (OEO)
process or via a strictly optical process.

WDM: Wavelength Division Multiplexing.

Wavelength Switched Optical Network (WSON): A WDM based optical
network in which switching is performed selectively based on the
center wavelength of an optical signal.

[3]. Resource Accessibility/Availability

In this section we define the sub-TLVs for dealing with accessibility
and availability of resource blocks. These include the
ResourceBlockAccessibility, ResourceWaveConstraints, and RBPoolState
sub-TLVs. All these sub-TLVs are concerned with sets of resources.

In a WSON node that includes resource blocks (RB) we will want to
denote subsets these blocks to efficiently describe common properties
the blocks and to describe the structure, if non-trivial, of the
resource pool. The RB Set field is defined in a similar manner to the
label set concept of [RFC3471].

The information carried in a RB set field is defined by:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Action     |E|C| Reserved  |          Length               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     RB Identifier 1           |        RB Identifier 2        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   :                              :                               :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     RB Identifier n-1         |        RB Identifier n        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Action: 8 bits

      0 - Inclusive List

Indicates that the TLV contains one or more RB elements that are
included in the list.

2 - Inclusive Range

Indicates that the TLV contains a range of RBs. The object/TLV
contains two WC elements. The first element indicates the start of
the range. The second element indicates the end of the range. A value
of zero indicates that there is no bound on the corresponding portion
of the range.

E (Even bit): Set to 0 denotes an odd number of RB identifiers in
the list (last entry zero pad); Set to 1 denotes an even number of RB
identifiers in the list (no zero padding).

C (Connectivity bit): Set to 0 to denote fixed (possibly multi-
cast) connectivity; Set to 1 to denote potential (switched)
connectivity. Used in resource pool accessibility sub-TLV. Ignored
elsewhere.

Reserved: 6 bits

This field is reserved. It MUST be set to zero on transmission and
MUST be ignored on receipt.

Length: 16 bits

The total length of this field in bytes.

RB Identifier:

The RB identifier represents the ID of the resource block which is a
16 bit integer.

3.1. Block Accessibility Sub-TLV

This sub-TLV describes the structure of the resource pool in relation
to the switching device. In particular it indicates the ability of an
ingress port to reach a resource block and of a resource block to
reach a particular egress port. This is the PoolIngressMatrix and
PoolEgressMatrix of [WSON-Info].

The resource block accessibility sub-TLV is defined by:

```
       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
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       | Connectivity  |                  Reserved                     |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                  Ingress Link Set Field A #1                  |
       :                                                               :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                      RB Set Field A #1                        |
       :                                                               :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |        Additional Link set and RB set pairs as needed to      |
       :                   specify PoolIngressMatrix                   :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |               Egress Link Set Field B #1                      |
       :                                                               :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |           RB Set B Field #1 (for egress connectivity)         |
       :                                                               :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |         Additional Link Set and RB set pairs as needed to     |
       :                   specify PoolEgressMatrix                    :
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Where

   Connectivity indicates how the ingress/egress ports connect to the
   resource blocks.

        0 -- the device is fixed (e.g. a connected port must go through
        the resource block)

        1 -- the device is switched(e.g., a port can be configured to
        go through a resource but isn't required)

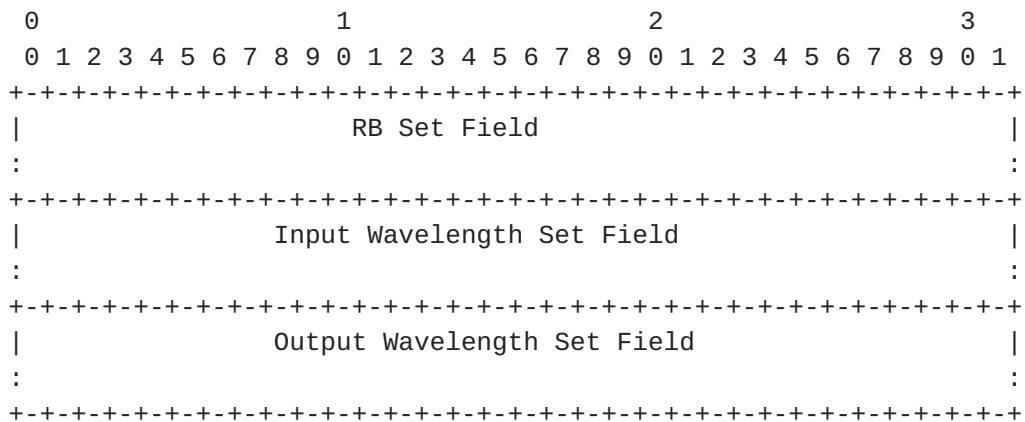   The Link Set Field is defined in [Gen-Encode].

   Note that the direction parameter within the Link Set Field is used
   to indicate whether the link set is an ingress or egress link set,
   and the bidirectional value for this parameter is not permitted in
   this sub-TLV.

   See Appendix A.1 for an illustration of this encoding.

3.2. Wavelength Constraints Sub-TLV

Resources, such as wavelength converters, etc., may have a limited
input or output wavelength ranges. Additionally, due to the structure
of the optical system not all wavelengths can necessarily reach or
leave all the resources. These properties are described by using one
or more resource wavelength restrictions sub-TLVs as defined below:

```
 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                          |
:                                                              :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Input Wavelength Set Field                 |
:                                                              :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Output Wavelength Set Field                 |
:                                                              :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

    RB Set Field:

A set of resource blocks (RBs) which have the same wavelength
restrictions.

    Input Wavelength Set Field:

Indicates the wavelength input restrictions of the RBs in the
corresponding RB set.

    Output Wavelength Set Field:
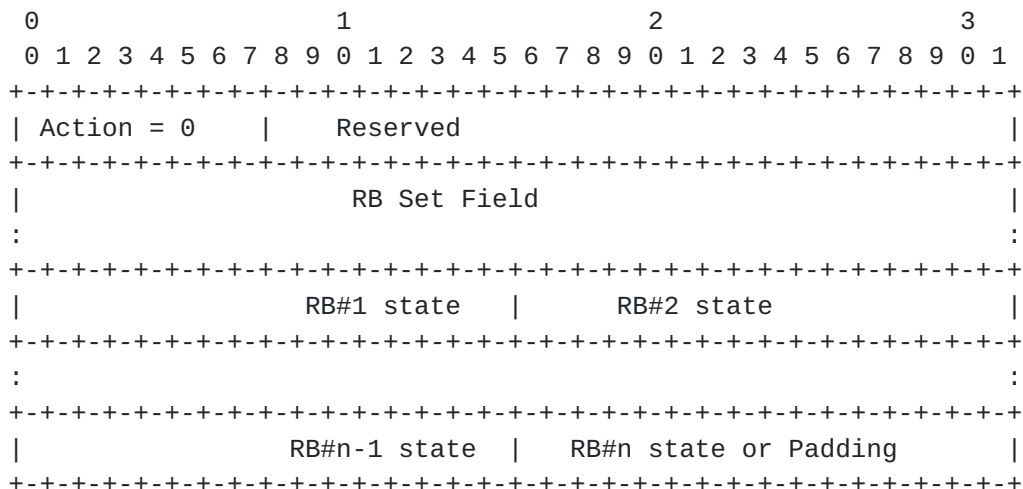
Indicates the wavelength output restrictions of RBs in the
corresponding RB set.
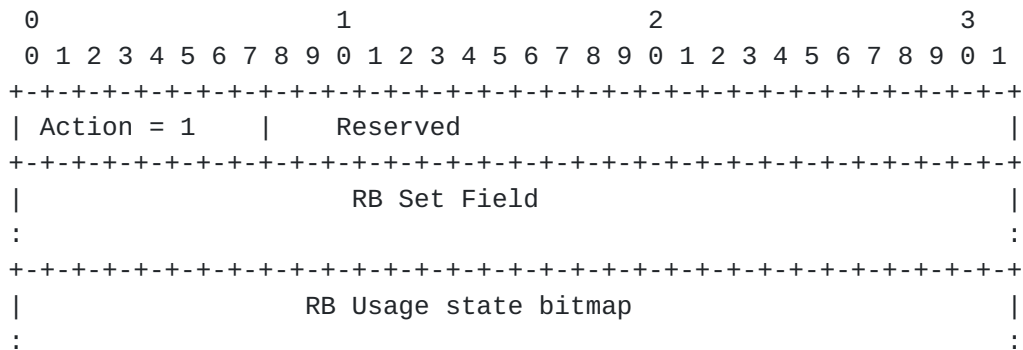
3.3. Block Pool State Sub-TLV

The usage state of a resource is encoded as either a list of 16 bit
integer values or a bit map indicating whether a single resource is
available or in use. This information can be relatively dynamic,
i.e., can change when a connection is established or torn down.

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     | Action       |   Reserved                                    |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   RB Set Field                               |
     :                                                              :
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   RB Usage state                             |
     :                                                              :
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
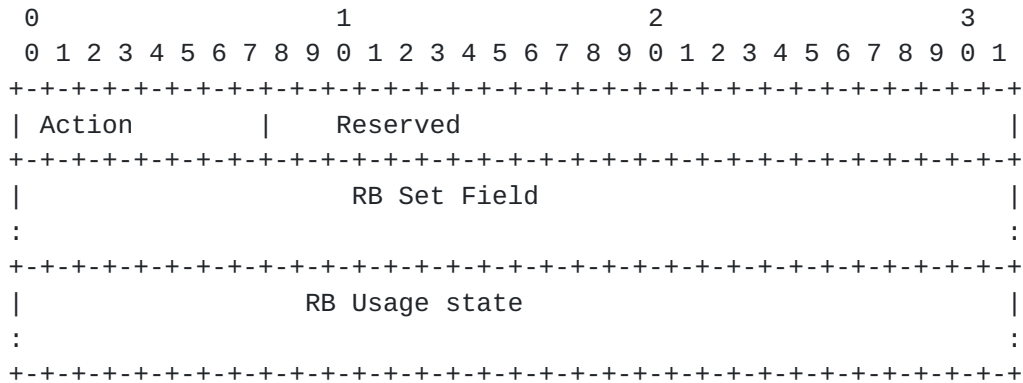
Where Action = 0 denotes a list of 16 bit integers and Action = 1
denotes a bit map. In both cases the elements of the RB Set field are
in a one-to-one correspondence with the values in the usage RB usage
state area.

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     | Action = 0   |   Reserved                                    |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   RB Set Field                               |
     :                                                              :
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |            RB#1 state        |       RB#2 state              |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     :                                                              :
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |            RB#n-1 state      |   RB#n state or Padding       |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Whether the last 16 bits is a wavelength converter (RB) state or
padding is determined by the number of elements in the RB set field.

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     | Action = 1   |   Reserved                                    |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   RB Set Field                               |
     :                                                              :
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   RB Usage state bitmap                      |
     :                                                              :
```

```
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                     ......             |   Padding bits    |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

RB Usage state: Variable Length but must be a multiple of 4 byes.

Each bit indicates the usage status of one RB with 0 indicating the
RB is available and 1 indicating the RB is in used. The sequence of
the bit map is ordered according to the RB Set field with this sub-
TLV.

Padding bits: Variable Length

3.4. Block Shared Access Wavelength Availability sub-TLV

Resources blocks may be accessed via a shared fiber. If this is the
case then wavelength availability on these shared fiber is needed to
understand resource availability.

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Resource Block ID        |I|E|            Reserved         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           Ingress Available Wavelength Set Field             |
   :                                                             :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           Egress Available Wavelength Set Field              |
   :                                                             :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Resource Block ID:

The 16 bit integer used to identify a particular resource block.

I bit:

Indicates whether the ingress available wavelength set field is
included (1) or not (0).

E bit:

Indicates whether the egress available wavelength set field is
included (1) or not (0).

Ingress Available Wavelength Set Field:

Indicates the wavelengths currently available (not being used) on the ingress fiber to this resource block.

Egress Available Wavelength Set Field:

Indicates the wavelengths currently available (not being used) on the egress fiber from this resource block.

4. Resource Properties Encoding

Within a WSON network element (NE) there may be resources with signal compatibility constraints. Such resources typically come in "blocks" which contain a group on identical and indistinguishable individual resources. These resource blocks may consist of regenerators, wavelength converters, etc... Such resource blocks may also constitute the network element as a whole as in the case of an electro optical switch. In this section we primarily focus on the signal compatibility and processing properties of such a resource block, i.e., <ResourceBlockInfo> of section Error! Reference source not found. the accessibility aspects of a resource in a shared pool, except for the shared access indicators, were encoded in the previous section.
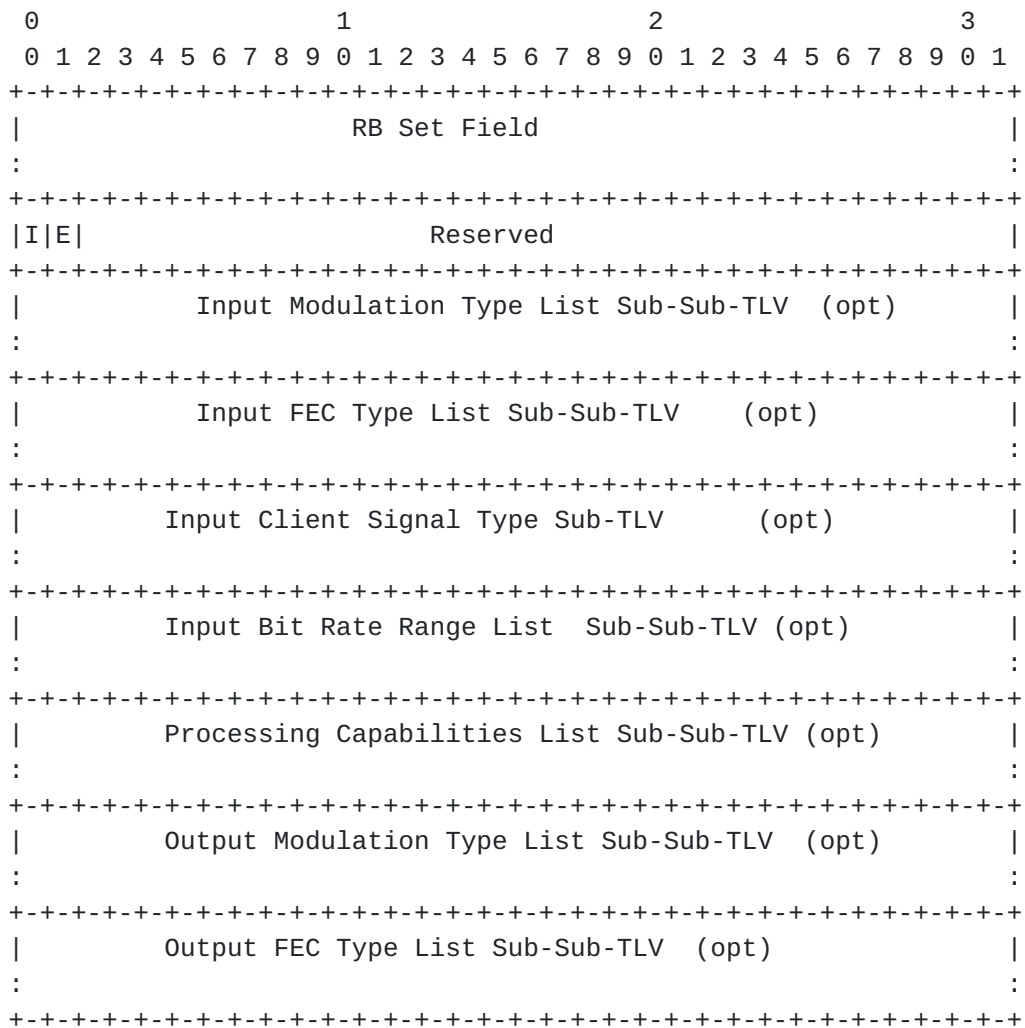
The fundamental properties of a resource block, such as a regenerator or wavelength converter, are:

(a)Input constraints (shared ingress, modulation, FEC, bit rate, GPID)

(b)Processing capabilities (number of resources in a block, regeneration, performance monitoring, vendor specific)

(c)Output Constraints (shared egress, modulation, FEC)

4.1. Resource Block Information Sub-TLV

Resource Block descriptor sub-TLVs are used to convey relatively static information about individual resource blocks including the resource block properties of section 3. and the number of resources in a block.

This sub-TLV has the following format:

```
    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|E|                     Reserved                             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Input Modulation Type List Sub-Sub-TLV  (opt)         |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |          Input FEC Type List Sub-Sub-TLV    (opt)            |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Input Client Signal Type Sub-TLV      (opt)           |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Input Bit Rate Range List  Sub-Sub-TLV (opt)          |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Processing Capabilities List Sub-Sub-TLV (opt)        |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Output Modulation Type List Sub-Sub-TLV  (opt)        |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |         Output FEC Type List Sub-Sub-TLV  (opt)             |
   :                                                              :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Where I and E, the shared ingress/egress indicator, is set to 1 if
   the resource blocks identified in the RB set field utilized a shared
   fiber for ingress/egress access and set to 0 otherwise.

4.2. Input Modulation Format List Sub-Sub-TLV

   This sub-TLV contains a list of acceptable input modulation formats.

   Type := Input Modulation Format List

   Value:= A list of Modulation Format Fields

4.2.1. Modulation Format Field

Two different types of modulation format fields are defined: a
standard modulation field and a vendor specific modulation field.
Both start with the same 32 bit header shown below.

```
 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|I|     Modulation ID         |           Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where S bit set to 1 indicates a standardized modulation format and S
bit set to 0 indicates a vendor specific modulation format. The
length is the length in bytes of the entire modulation type field.

Where I bit set to 1 indicates it is an input modulation constraint
and I bit set to 0 indicates it is an output modulation constraint.

Note that if an output modulation is not specified then it is implied
that it is the same as the input modulation. In such case, no
modulation conversion is performed.

The format for the standardized type for the input modulation is
given by:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|1|1|     Modulation ID         |           Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Possible additional modulation parameters depending upon    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:   the modulation ID                                           :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Modulation ID (S bit = 1); Input modulation (I bit = 1)

Takes on the following currently defined values:

    0   Reserved

    1   optical tributary signal class NRZ 1.25G

       2   optical tributary signal class NRZ 2.5G

       3   optical tributary signal class NRZ 10G

       4   optical tributary signal class NRZ 40G

       5   optical tributary signal class RZ 40G

   Note that future modulation types may require additional parameters
   in their characterization.

   The format for vendor specific modulation field (for input
   constraint) is given by:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |0|1|  Vendor Modulation ID     |            Length             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                        Enterprise Number                      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   :   Any vendor specific additional modulation parameters        :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


   Vendor Modulation ID

     This is a vendor assigned identifier for the modulation type.

   Enterprise Number

     A unique identifier of an organization encoded as a 32-bit integer.
     Enterprise Numbers are assigned by IANA and managed through an IANA
     registry [RFC2578].

   Vendor Specific Additional parameters

     There can be potentially additional parameters characterizing the
     vendor specific modulation.

4.3. Input FEC Type List Sub-Sub-TLV

   This sub-TLV contains a list of acceptable FEC types.

Type := Input FEC Type field List

Value:= A list of FEC type Fields

4.3.1. FEC Type Field

The FEC type Field may consist of two different formats of fields: a standard FEC field or a vendor specific FEC field. Both start with the same 32 bit header shown below.

```
  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|I|     FEC ID              |           Length               |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |    Possible additional FEC parameters depending upon         |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 :    the FEC ID                                                :
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where S bit set to 1 indicates a standardized FEC format and S bit set to 0 indicates a vendor specific FEC format. The length is the length in bytes of the entire FEC type field.

Where I bit set to 1 indicates it is an input FEC constraint and I bit set to 0 indicates it is an output FEC constraint.

Note that if an output FEC is not specified then it is implied that it is the same as the input FEC. In such case, no FEC conversion is performed.

The length is the length in bytes of the entire FEC type field.

The format for input standard FEC field is given by:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|1|1|       FEC ID              |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Possible additional FEC parameters depending upon          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:   the FEC ID                                                 :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Takes on the following currently defined values for the standard
FEC ID:

   0   Reserved

   1   G.709 RS FEC

   2   G.709V compliant Ultra FEC

   3   G.975.1 Concatenated FEC
             (RS(255,239)/CSOC(n0/k0=7/6,J=8))

   4   G.975.1 Concatenated FEC (BCH(3860,3824)/BCH(2040,1930))

   5   G.975.1 Concatenated FEC (RS(1023,1007)/BCH(2407,1952))

   6   G.975.1 Concatenated FEC (RS(1901,1855)/Extended Hamming
             Product Code (512,502)X(510,500))

   7   G.975.1 LDPC Code

   8   G.975.1 Concatenated FEC (Two orthogonally concatenated
             BCH codes)

   9   G.975.1 RS(2720,2550)

   10   G.975.1 Concatenated FEC (Two interleaved extended BCH
             (1020,988) codes)

   Where RS stands for Reed-Solomon and BCH for Bose-Chaudhuri-
   Hocquengham.

   The format for input vendor-specific FEC field is given by:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|1|      Vendor FEC ID        |           Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Enterprise Number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:    Any vendor specific additional FEC parameters             :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
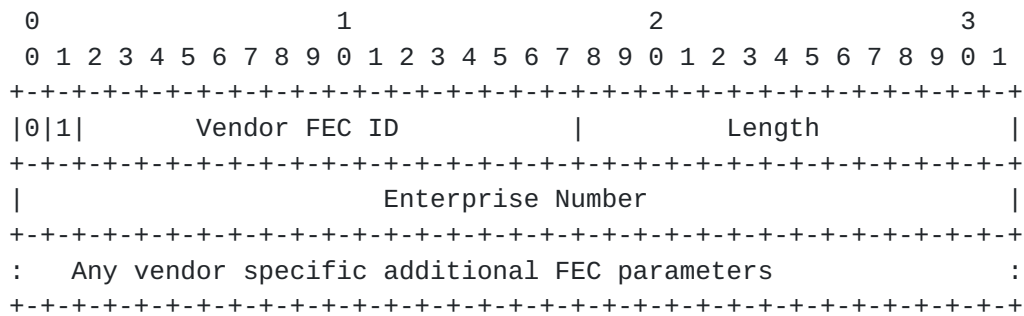
Vendor FEC ID

   This is a vendor assigned identifier for the FEC type.

Enterprise Number

   A unique identifier of an organization encoded as a 32-bit integer.
   Enterprise Numbers are assigned by IANA and managed through an IANA
   registry [RFC2578].

Vendor Specific Additional FEC parameters

   There can be potentially additional parameters characterizing the
   vendor specific FEC.

4.4. Input Bit Range List Sub-Sub-TLV

   This sub-TLV contains a list of acceptable input bit rate ranges.

   Type := Input Bit Range List

   Value:= A list of Bit Range Fields

   4.4.1. Bit Range Field

   The bit rate range list sub-TLV makes use of the following bit rate
   range field:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Starting Bit Rate                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Ending Bit Rate                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The starting and ending bit rates are given as 32 bit IEEE floating
point numbers in bits per second. Note that the starting bit rate is
less than or equal to the ending bit rate.

The bit rate range list sub-TLV is then given by:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-+-+-+-+-+-+-+-+-+-+ Bit Range Field #1  +-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                               :                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-+-+-+-+-+-+-+-+-+-+ Bit Range Field #M  +-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

4.5. Input Client Signal List Sub-Sub-TLV

This sub-TLV contains a list of acceptable input client signal types.

Type := Input Client Signal List

Value:= A list of GPIDs

The acceptable client signal list sub-TLV is a list of Generalized
Protocol Identifiers (GPIDs). GPIDs are assigned by IANA and many are
defined in [RFC3471] and [RFC4328].

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        Number of GPIDs        |            GPID #1            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   :                              |                               :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |            GPID #N            |                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
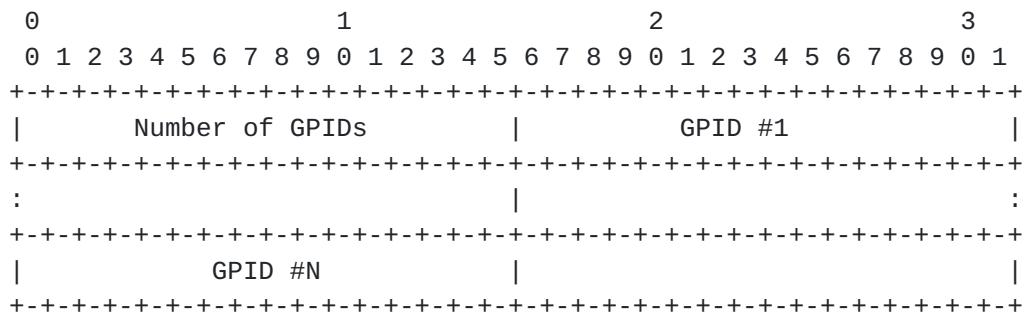
Where the number of GPIDs is an integer greater than or equal to one.

4.6. Processing Capability List Sub-Sub-TLV

This sub-TLV contains a list of resource block processing
capabilities.

Type := Processing Capabilities List

Value:= A list of Processing Capabilities Fields

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

4.6.1. Processing Capabilities Field

The processing capability field is then given by:

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |           Processing Cap ID     |            Length            |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |   Possible additional capability parameters depending upon    |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 :   the processing ID                                           :
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

When the processing Cap ID is "number of resources" the format is
simply:

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |           Processing Cap ID     |           Length = 8         |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                  Number of resources per block                |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

When the processing Cap ID is "regeneration capability", the
following additional capability parameters are provided in the sub-
TLV:

```
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
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  | T  | C |                  Reserved                           |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where T bit indicates the type of regenerator:

   T=0: Reserved

   T=1: 1R Regenerator

   T=2: 2R Regenerator

   T=3: 3R Regenerator

Where C bit indicates the capability of regenerator:

C=0: Reserved

C=1: Fixed Regeneration Point

C=2: Selective Regeneration Point

Note that when the capability of regenerator is indicated to be
Selective Regeneration Pools, regeneration pool properties such as
ingress and egress restrictions and availability need to be
specified. This encoding is to be determined in the later revision.

4.7. Output Modulation Format List Sub-Sub-TLV

This sub-TLV contains a list of available output modulation formats.

Type := Output Modulation Format List

Value:= A list of Modulation Format Fields

4.8. Output FEC Type List Sub-Sub-TLV

This sub-TLV contains a list of output FEC types.

Type := Output FEC Type field List

Value:= A list of FEC type Fields

5. Security Considerations

This document defines protocol-independent encodings for WSON
information and does not introduce any security issues.

However, other documents that make use of these encodings within
protocol extensions need to consider the issues and risks associated
with, inspection, interception, modification, or spoofing of any of
this information. It is expected that any such documents will
describe the necessary security measures to provide adequate
protection.

6. IANA Considerations

TBD. Once our approach is finalized we may need identifiers for the various sub-sub-TLVs.

7. Acknowledgments

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APPENDIX A: Encoding Examples

A.1. **Wavelength Converter Accessibility Sub-TLV**

    Example:

    Figure 1 shows a wavelength converter pool architecture know as
    "shared per fiber". In this case the ingress and egress pool matrices
    are simply:

```
            +-----+           +-----+
            | 1 1 |           | 1 0 |
       WI =|     |,  WE =|     |
            | 1 1 |           | 0 1 |
            +-----+           +-----+



                +-----------+                      +------+
                |           |--------------------->|      |
                |           |--------------------->|  C   |
            /|      |           |--------------------->|  o   |
            /D+--->|           |--------------------->|  m   |
           + e+--->|           |                      |  b   |========>
    =======>| M|     |  Optical  |    +-----------+    |  i   | Port E1
  Port I1  + u+--->|   Switch  |    |  WC Pool  |    |  n   |
           \x+--->|           |    |   +-----+   |    |  e   |
            \|      |           +----+->|WC #1|--+---->|  r   |
                |           |    |   +-----+   |    +------+
                |           |    |           |    +------+
            /|      |           |    |   +-----+   |    |      |
            /D+--->|           +----+->|WC #2|--+---->|  C   |
           + e+--->|           |    |   +-----+   |    |  o   |
    =======>| M|     |           |    +-----------+    |  m   |========>
  Port I2  + u+--->|           |                      |  b   | Port E2
           \x+--->|           |--------------------->|  i   |
            \|      |           |--------------------->|  n   |
                |           |--------------------->|  e   |
                |           |--------------------->|  r   |
                +-----------+                      +------+
```
         Figure 1 An optical switch featuring a shared per fiber wavelength
                          converter pool architecture.

    This wavelength converter pool can be encoded as follows:
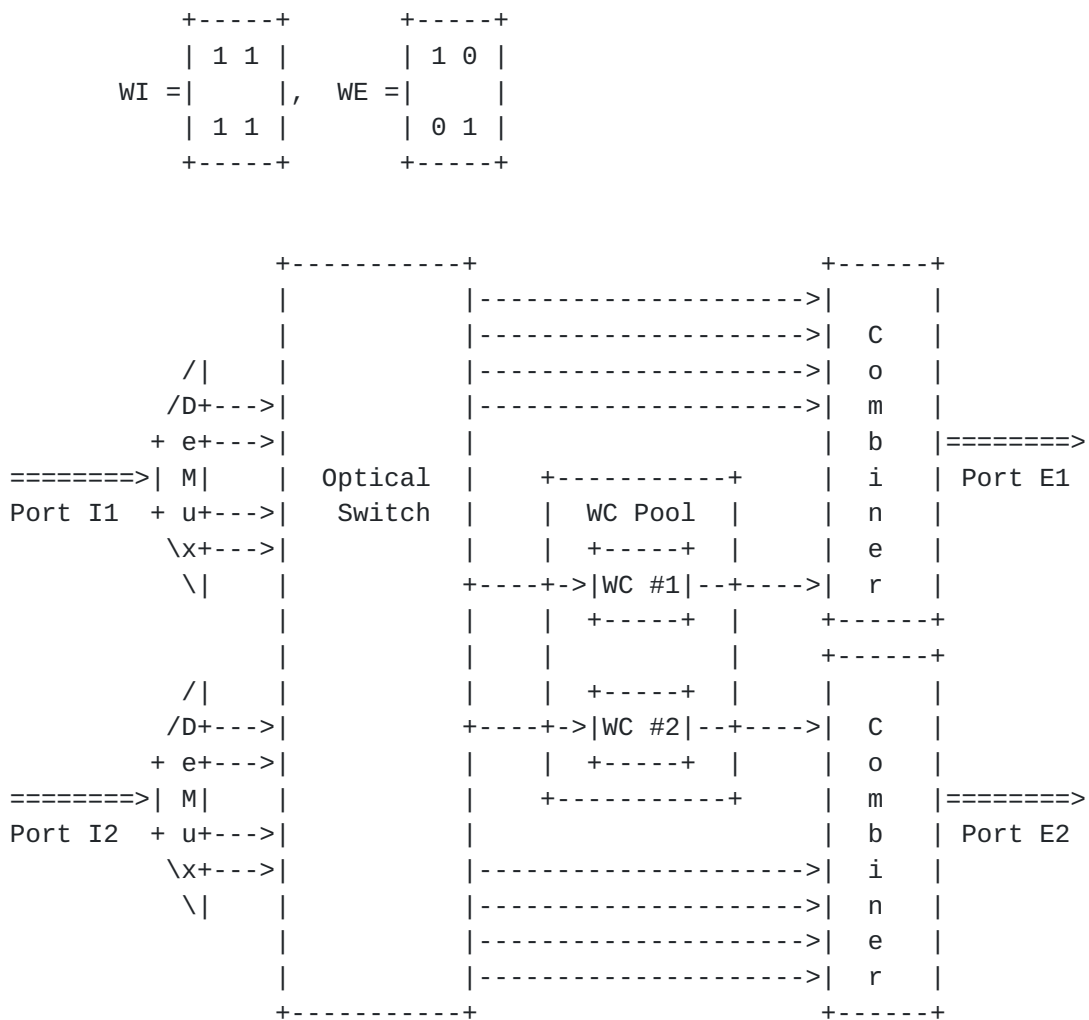
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Connectivity=1|                  Reserved                     |
          Note: I1,I2 can connect to either WC1 or WC2
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |0 1|0 0 0 0 0 0|            Length = 12         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Link Local Identifier = #1                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Link Local Identifier = #2                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |1|  Reserved   |            Length = 8         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          RB ID = #1           |         RB ID = #2            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
              Note: WC1 can only connect to E1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |0|  Reserved   |            Length = 8         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          RB ID = #1           |        zero padding           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |1 0|0 0 0 0 0 0|            Length = 8         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Link Local Identifier = #1                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
              Note: WC2 can only connect to E2
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |0|             |            Length = 8         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          RB ID = #2           |        zero padding           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Action=0     |1 0|0 0 0 0 0 0|            Length = 8         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Link Local Identifier = #2                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

A.2. Wavelength Conversion Range Sub-TLV

Example:

We give an example based on figure 1 about how to represent the
wavelength conversion range of wavelength converters. Suppose the

wavelength range of input and output of WC1 and WC2 are {L1, L2, L3, L4}:

```
    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
                        Note: WC Set
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  Action=0     |1| Reserved   |        Length = 8             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           WC ID = #1         |         WC ID = #2            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     Note: wavelength input range
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | 2   | Num Wavelengths = 4     |          Length = 8          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |Grid |  C.S. |     Reserved    | n for lowest frequency = 1   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     Note: wavelength output range
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | 2   | Num Wavelengths = 4     |          Length = 8          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |Grid |  C.S. |     Reserved    | n for lowest frequency = 1   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

A.3. An OEO Switch with DWDM Optics

In Figure 2 we show an electronic switch fabric surrounded by DWDM optics. In this example the electronic fabric can can handle either G.709 or SDH signals only (2.5 or 10 Gbps). To describe this node we have the potential information:

<Node_Info> ::= <Node_ID>[Other GMPLS sub-TLVs][<ConnectivityMatrix>...] [<ResourcePool>][<RBPoolState>]

In this case there is complete port to port connectivity so the <ConnectivityMatrix> is not required. In addition since there are sufficient ports to handle all wavelength signals we will not need the <RBPoolState> element.

Hence our attention will be focused on the <ResourcePool> sub-TLV:

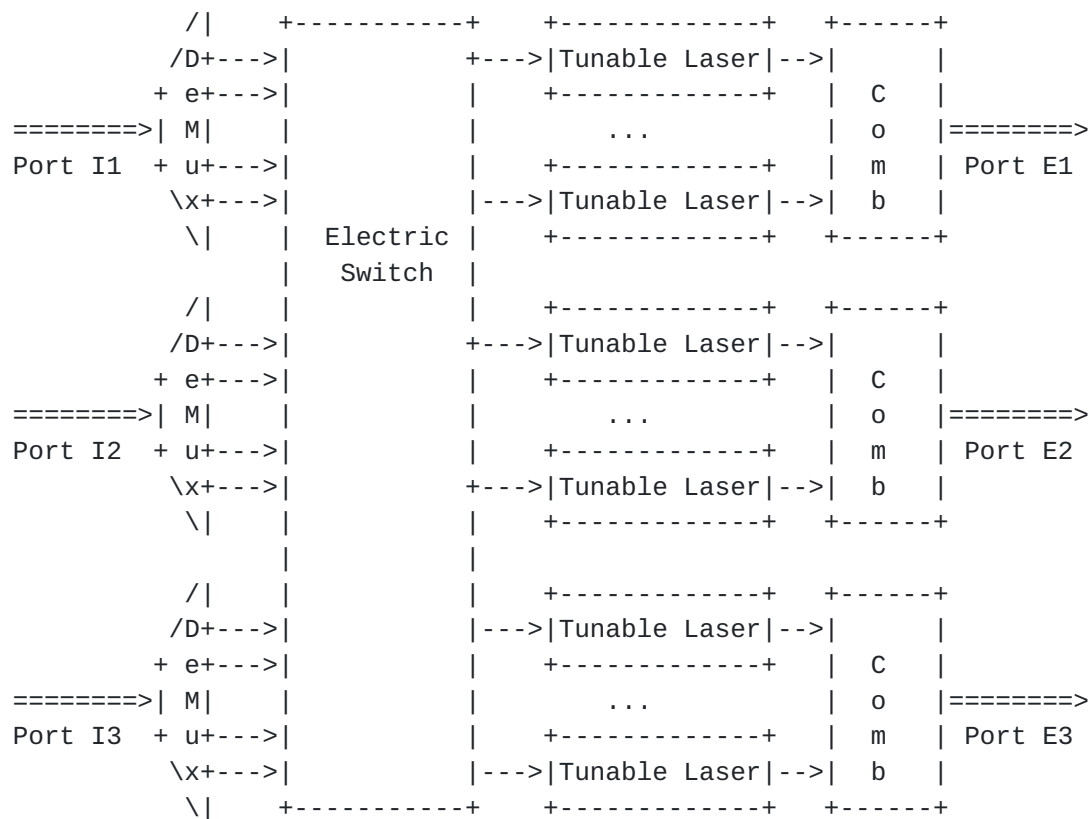<ResourcePool> ::= <ResourceBlockInfo>[<ResourceBlockAccessibility>...][<ResourceWaveConstraints>...]

```
             /|    +----------+    +-------------+   +------+
            /D+--->|              +--->|Tunable Laser|-->|      |
           + e+--->|              |    +-------------+   |  C   |
  ========>| M|    |              |         ...          |  o   |========>
  Port I1  + u+--->|              |    +-------------+   |  m   | Port E1
           \x+--->|              |--->|Tunable Laser|-->|  b   |
            \|     |   Electric | +-------------+   +------+
                   |   Switch   |
             /|    |              |    +-------------+   +------+
            /D+--->|              +--->|Tunable Laser|-->|      |
           + e+--->|              |    +-------------+   |  C   |
  ========>| M|    |              |         ...          |  o   |========>
  Port I2  + u+--->|              |    +-------------+   |  m   | Port E2
           \x+--->|              +--->|Tunable Laser|-->|  b   |
            \|     |              |    +-------------+   +------+
                   |              |
             /|    |              |    +-------------+   +------+
            /D+--->|              |--->|Tunable Laser|-->|      |
           + e+--->|              |    +-------------+   |  C   |
  ========>| M|    |              |         ...          |  o   |========>
  Port I3  + u+--->|              |    +-------------+   |  m   | Port E3
           \x+--->|              |--->|Tunable Laser|-->|  b   |
            \|     +----------+    +-------------+   +------+
```

         Figure 2 An optical switch built around an electronic switching
                               fabric.

   The resource block information will tell us about the processing
   constraints of the receivers, transmitters and the electronic switch.
   The resource availability information, although very simple, tells us
   that all signals must traverse the electronic fabric (fixed
   connectivity). The resource wavelength constraints are not needed
   since there are no special wavelength constraints for the resources
   that would not appear as port/wavelength constraints.

   <ResourceBlockInfo>:

```
      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                           |
      :  (only one resource block in this example with shared        |
      |                     input/output case)                       |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |0|0|                    Reserved                              |
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |          Input Modulation Type List Sub-Sub-TLV              |
      :          (The receivers can only process NRZ)                :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |             Input FEC Type List Sub-Sub-TLV                  |
      :            (Only Standard SDH and G.709 FECs)                :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |           Input Client Signal Type Sub-TLV                   |
      :               (GPIDs for SDH and G.709)                      :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |          Input Bit Rate Range List  Sub-Sub-TLV              |
      :                     (2.5Gbps, 10Gbps)                        :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |          Processing Capabilities List Sub-Sub-TLV            |
      :                   Fixed (non optional) 3R regeneration       :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |          Output Modulation Type List Sub-Sub-TLV             |
      :                          NRZ                                 :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
      |            Output FEC Type List Sub-Sub-TLV                  |
      :                  Standard SDH, G.709 FECs                    :
      +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Since we have fixed connectivity to resource block (the electronic
switch) we get <ResourceBlockAccessibility>:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Connectivity=1|Reserved       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                   Ingress Link Set Field A #1                 |
   :                   (All ingress links connect to resource)    :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                        RB Set Field A #1                      |
   :               (trivial set only one resource block)          :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                  Egress Link Set Field B #1                   |
   :                   (All egress links connect to resource)     :
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

8. References

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