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**A Novel Encoding of ROADM in GMPLS Controlled Wavelength Switched  
Optical Network(WSON)  
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Reconfigurable add/drop optical multiplexers(ROADM) featured highly asymmetric switching capability, is an essential element in current wavelength switched optical network(WSON).Because the multiple degree Reconfigurable add/drop optical multiplexer(ROADM) can not only add/drop wavelength but also switch wavelength, it is necessary to know the switch connectivity offered by such a network element. With the development of ROADM, the constraint of wavelength and direction is abated, so the encoding of the ROADM needs improvement. This memo provides a novel encoding for different ROADMs, Which is applicable to the encoding of different kind of ROADMs.

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**[1. Introduction](#)**

Reconfigurable add/drop optical multiplexers is an essential element in current WSON. As the multiple degree ROADM has properties of both a switch and a multiplexer, it is necessary to know the switch connectivity offered by such a network element.[\[WSON-Framework\]](#) In a ROADM, there are some connectivity constraints between line side port and add/drop port. An ingress or more typically an egress (drop) port restricted to a single channel of fixed wavelength is known as colored port, while the port without such constraint is called colorless port. With the development of ROADM towards colorless and directionless add drop switching, the constraints mentioned above is abated, so the encoding of the ROADM needs improvement to accommodate the novel ROADMs.[\[ROADM-ARCH\]](#) The current encoding retains lots of redundancy, in our encoding we describe the connectivity of ROADM as sets of the line side port's properties to reduce the information's redundancy.

**[2. Encoding of ROADM](#)**

The current encoding of ROADM is represented as Connectivity Matrix Sub-TLV by encoding pairs of links, each pairs represent one direction of transmission. Considering the application of bi-directional fiber, some link identifiers (especially line side

links identifiers) appear repeatedly. Lots of redundancies due to the repetitional encoding of the same links will degrade the performance

of encoding. Our novel encoding of ROADM describes the connectivity as the line side port's property which contains the links that can connect to the port. In online routing and wavelength assignment (RWA), processing delay influences the blocking probability of the request. Improving the encoding can relieve the massive processing of information and reduce the blocking probability.

The encoding of a ROADM is:

```

      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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|con|  format  |               reserved               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| Lid  | act1| act2|special1 |special2 | Number1  | Number 2  |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|               Link Identifier1               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
:               :               :
:               :               :
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|               Link Identifier N               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Where

Con (2 bits) is the device type.

0-FOADM

1-normal ROADM

2-colorless ROADM

3-colorless and directionless ROADM

Format: The format of the link identifier (6 bits)

0 -- Link Local Identifier

Indicates that the links are identified by link local identifiers. All link local identifiers are supplied in the context of the advertising node.

1 -- Local Interface IPv4 Address

2 -- Local Interface IPv6 Address

Indicates that the links are identified by Local Interface IP Address . All Local Interface IP Address are supplied in the context of the advertising node. Others TBD.

Note that all link identifiers in the same list must be of the same type.

Lid:4 bits

Indicates the ID of the local line side port.

act:3 bits

act1 and act2 represents the direction of the add links and drop links respectively.

000:Inclusive List

Indicates that one or more link identifiers are included in the following. Each identifies a separate link.

**001:Inclusive Ranges**

Indicates that several discontinuous ranges of links are included in the following link identifier set. Each range of links contains two link identifiers. The first identifier indicates the start of the range (inclusive). The second identifier Indicates the end of the range(inclusive) .

**010:Inclusive Range**

Indicates that a range of links are included in the following link identifier set. It contains two link identifiers. The first identifier indicates the start of the range(inclusive) . The second identifier indicates the end of the range(inclusive).

**011:Inclusive Range + Exclusive of List**

Indicates that a range of links excluding a list of links is included in the following link identifier set. It contains two link identifiers which constitute a range, and some other link identifiers which are excluded in the following link identifier set.

**100:Inclusive Range + Inclusive List**

Indicates that a range of links embracing additional lists of links are included in the following link identifier set. It contains two link identifiers constituting a range, and some other link identifiers which are included in the following link identifier set.

when

Con=11

The links that cannot connect to the line side port are enumerated in the following link identifier set, if there is no constraint, the 3 bits of act will be padded with 111.

special:5 bits

special1 indicates links that can add to the line side port.

special2 indicates links that can drop from the line side port.

when

Act= 001 special indicates the number of the discontinuous ranges.

Act= 011 special indicates the number of links excluding from range.

Act= 100 special indicates the number of links which are not included in the range but can connect to the line side port.

otherwise, special =00000

Number:6 bits

Number1 indicates the number of link identifiers representing links that can add to the line side port.

Number2 indicates the number of link identifiers representing links that can drop from the line side port.

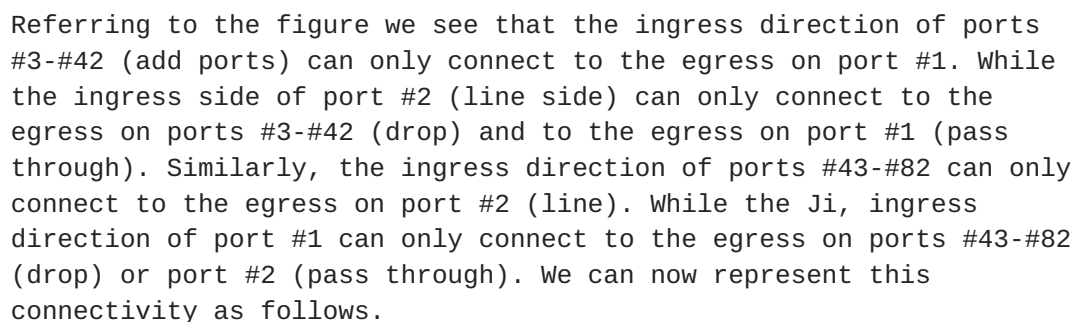
An example of encoding

We use the example in [[WSON-Encode](#)] to explain the encoding in detail. Using our novel encoding, this representation uses only 11

32-bit words. The more degrees of the ROADM the better our novel encoding performs. Suppose we have a typical 2-degree 40 channel



(Tributary) Ports #3-#42



```

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: the links that can connect with the line side port 1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|01 |0 0 0 0 0 0|          reserved          | 1

```

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```
|0 0 0 1|0 1 0|0 1 0|0 0 0 0 0|0 0 0 0 0|0 0 0 0 1 0|0 0 0 0 1 0| 2
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
link Identifiers set
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #3 | 3
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #42 | 4
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #43 | 5
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #82 | 6
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
Note: the links that can connect with the line side port 2
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
|0 0 1 0|0 1 0|0 1 0|0 0 0 0 0|0 0 0 0 0|0 0 0 0 1 0|0 0 0 0 1 0| 7
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
link Identifiers set
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #43 | 8
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #82 | 9
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #3 | 10
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

```
| Link Local Identifier = #42 | 11
```

```
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

### 3. Security Considerations

(None).

### 4. IANA Considerations

(None).

### 5. References

#### 5.1. Normative References

(None).

#### 5.2. Informative References

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