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Y. Lee (Editor)
D. Dhody
Huawei

A. Guo
ADVA

V. Lopez
Telefonica

D. King
U. of Lancaster

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A Yang Data Model for WSON Optical Networks

draft-lee-ccamp-wson-yang-02

Abstract

This document provides a YANG data model for the routing and wavelength assignment (RWA) TE topology in wavelength switched optical networks (WSONs).

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Table of Contents

1. Introduction.....	3
2. Routing and Wavelength Assignment Informational Model.....	3
2.1. Connectivity Matrix Model.....	3
2.2. Resource Pool Model.....	4
2.3. Port Label Restriction Model.....	8
2.4. Wavelength Availability on Links.....	9
3. YANG Model (Tree Structure).....	10
4. WSON-RWA YANG Model.....	11
5. Security Considerations.....	17
6. IANA Considerations.....	17
7. Acknowledgments.....	17
8. References.....	18
8.1. Normative References.....	18
8.2. Informative References.....	18
9. Contributors.....	18
Authors' Addresses.....	18

<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.

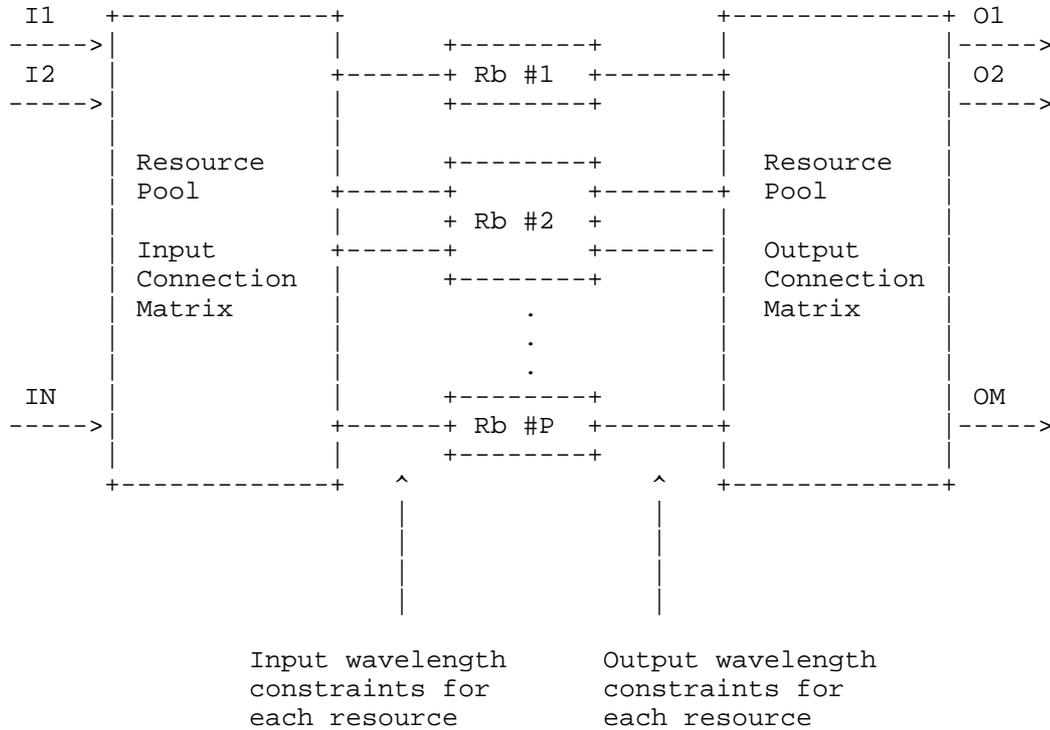
<Matrix> represents the fixed or switched connectivity in that $\text{Matrix}(i, j) = 0$ or 1 depending on whether input port i can connect to output port j for one or more wavelengths.

2.2. Resource Pool Model

A WSON node may include regenerators or wavelength converters arranged in a shared pool. As discussed in [RFC6163] this can include Optical-Electronic-Optical (OEO) based Wavelength Division Multiplexing (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.

The following Figures show resource pool architecture of WSON.



Note: Rb is a Resource Block.

Figure 1 Schematic diagram of resource pool model.

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>]

<ResourceAccessibility> ::= <PoolInputMatrix>

<PoolOutputMatrix>

<ResourceWaveConstraints> ::= <InputWaveConstraints>

<OutputOutputWaveConstraints>

<RBSharedAccessWaveAvailability> ::= [<InAvailableWavelengths>]

[<OutAvailableWavelengths>]

<RBPoolState> ::= <ResourceBlockID>

<NumResourcesInUse>

[<RBSharedAccessWaveAvailability>]

[<RBPoolState>]

<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.

<InputConstraints> ::= <SharedInput>

[<OpticalInterfaceClassList>]

[<ClientSignalList>]

<ProcessingCapabilities> ::= [<NumResources>]

[<RegenerationCapabilities>]

[<FaultPerfMon>]

[<VendorSpecific>]

<OutputConstraints> := <SharedOutput>

[<OpticalInterfaceClassList>]

[<ClientSignalList>]

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

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

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.

2.3. Port Label Restriction Model

```
<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.

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

<Restriction parameters list> ::=
                            <LabelSet> ...
```

Where

MatrixID is the ID of the corresponding connectivity matrix.

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.

2.4. Wavelength Availability on Links

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.

```
<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.

3. YANG Model (Tree Structure)

(Editor's Note: This version is based on the augmentation of draft-ietf-teas-yang-te-topo [TE-TOPO].)

```
module: ietf-wson-topology
augment /tet:te-topologies/tet:topology/tet:topology-types/tet:te-
topology:
  +--rw wson-topology
augment /tet:te-topologies/tet:topology/tet:node/tet:te-node-
attributes/tet:connectivity-matrix:
  +--rw wson-matrix
    +--rw device-type?          devicetype
    +--rw dir?                  directionality
    +--rw matrix-interface* [in-port-id]
      +--rw in-port-id         wson-interface-ref
      +--rw out-port-id?      wson-interface-ref
augment /tet:te-topologies/tet:topology/tet:node/tet:te-node-
attributes/tet:te-link:
  +--rw wavelength-available-bitmap*  boolean
augment /tet:te-topologies/tet:topology/tet:node:
  +--rw resource-pool* [resource-pool-id]
    +--rw resource-pool-id  uint32
    +--rw pool-state?      boolean
    +--rw matrix-interface* [in-port-id]
      +--rw in-port-id     wson-interface-ref
      +--rw out-port-id?  wson-interface-ref
```

4. WSON-RWA YANG Model

<CODE BEGINS>

```
module ietf-wson-topology {
  namespace "urn:ietf:params:xml:ns:yang:ietf-wson-topology";

  prefix wson;

  import ietf-inet-types {
    prefix inet;
  }

  import ietf-te-topology {
    prefix "tet";
  }

  organization
    "IETF CCAMP Working Group";

  contact
    "Editor: Young Lee <leeyoung@huawei.com>";

  description
    "This module contains a collection of YANG definitions for
    RWA WSON.

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```

```
Provisions Relating to IETF Documents
(http://trustee.ietf.org/license-info).";

revision 2015-07-01 {
  description
    "version 2.";

reference
  "RFC XXX: A Yang Data Model for WSON Optical Networks ";
}

typedef wson-topology-id {
  type inet:uri;
  description
    "The WSON Topology ID";
}

typedef wson-node-id {
  type inet:ip-address;
  description
    "The WSON Node ID";
}

typedef devicetype {
  type enumeration {
    enum adm {
      value 1;
      description
        "Device is ADM";
    }

    enum roadm {
      value 2;
      description
        "Device is ROAMD/OXC";
    }
  }
  description
    "device type: fixed (ADM) or switched (ROADM/OXC)";
}
```

```
typedef directionality {
  type enumeration {
    enum bidir {
      value 0;
      description
        "bi-directional";
    }
    enum input {
      value 1;
      description
        "input direction";
    }
    enum output {
      value 2;
      description
        "output direction";
    }
  }
  description
    "The directionality of link set";
}

typedef wson-interface-ref {
  type leafref {
    path "/tet:te-topologies/tet:topology/tet:node"
      + "/tet:te-node-attributes/tet:te-link"
      + "/tet:te-link-id";
  }
  description
    "This type is used by data models that need to
    reference WSON interface.";
}

augment "/tet:te-topologies/tet:topology/tet:topology-types"
  + "/tet:te-topology" {
  description "WSON augmentation.";
  container wson-topology{
    description
      "An empty WSON container to identify
```

```
        the topology type.";
    }
}

augment "/tet:te-topologies/tet:topology/tet:node"
  +"/tet:te-node-attributes"
  +"/tet:connectivity-matrix" {
  when "/tet:te-topologies/tet:topology/tet:topology-types"
    +"/tet:te-topology/wson-topology" {
    description
      "This augment is only valid for WSON.";
  }
  description "WSON Connectivity Matrix augmentation.";
  container wson-matrix{
    description "WSON specific Matrix.";
    leaf device-type {
      type devicetype;
      description
        "device type: fixed (ADM) or switched
        (ROADM/OXC)";
    }
    leaf dir {
      type directionality;
      description
        "bi-directionality or input or output
        of link set";
    }
  }

  list matrix-interface {
    key "in-port-id";

    description
      "matrix-interface describes input-ports
      and out-ports around a connectivity
      matrix";

    leaf in-port-id {
      type wson-interface-ref;
      description
        "The reference to in-port";
    }
  }
}
```

```
        leaf out-port-id {
            type wson-interface-ref;
            description
                "The reference to out-port";
        }
    }
}

augment "/tet:te-topologies/tet:topology/tet:node"
+ "/tet:te-node-attributes/tet:te-link" {

    when "/tet:te-topologies/tet:topology/tet:topology-types"
+ "/tet:te-topology/wson-topology" {
        description
            "This augment is only valid for WSON.";
    }
    description "WSON Link augmentation.";

    leaf-list wavelength-available-bitmap {
        type boolean;
        description
            "array of bits (i.e., bitmap) that indicates
            if a wavelength is available or not on each
            channel.";
    }
}

augment "/tet:te-topologies/tet:topology/tet:node" {
    when "/tet:te-topologies/tet:topology/tet:topology-types"
+ "/tet:te-topology/wson-topology" {
        description
            "This augment is only valid for WSON.";
    }
    description "WSON Node augmentation.";

    list resource-pool {
        key "resource-pool-id";
        description
            "The resource pool list";
    }
}
```


5. Security Considerations

TDB

6. IANA Considerations

TDB

7. Acknowledgments

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

8. References

8.1. Normative References

- [RFC7446] Y. Lee, G. Bernstein, D. Li, W. Imajuku, "Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks", RFC 7446, February 2015.
- [Gen-Encode] G. Bernstein, Y. Lee, D. Li, W. Imajuku, "General Network Element Constraint Encoding for GMPLS Controlled Networks", work in progress: draft-ietf-ccamp-general-constraint-encode.
- [WSON-Encode] G. Bernstein, Y. Lee, D. Li, W. Imajuku, "Routing and Wavelength Assignment Information Encoding for Wavelength Switched Optical Networks", work in progress: draft-ietf-ccamp-rwa-wson-encode.
- [TE-TOPO] X. Liu, et al., "YANG Data Model for TE Topologies", work in progress: draft-ietf-teas-yang-te-topo.

8.2. Informative References

9. Contributors

Xian Zhang
Huawei Technologies
Email: zhang.xian@huawei.com

Authors' Addresses

Young Lee (ed.)
Huawei Technologies
5340 Legacy Drive, Building 3
Plano, TX 75023
USA

Phone: (469) 277-5838
Email: leeyoung@huawei.com

Dhruv Dhody
Huawei Technologies India Pvt. Ltd,
Near EPIP Industrial Area, Kundalahalli Village, Whitefield,
Bangalore - 560 037 [H1-2A-245]

Email: dhruv.dhody@huawei.com

Aihua Guo
ADVA
Email: AGuo@advaoptical.com

Victor Lopez
Telefonica
Email: victor.lopezalvarez@telefonica.com

Daniel King
University of Lancaster
Email: d.king@lancaster.ac.uk

