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Network Markup Language Base Schema version 1

Status of This Document

Group Working Draft (GWD), candidate Recommendations Proposed (R-P).

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Abstract

This document describes a normative schema which allows the description of a computer network topology.

Contents

1 Introduction

This document describes the base schema of the Network Markup Language (NML) as well as a XML and RDF syntax to describe. These basic classes may be extended, or sub-classed, to represent technology specific classes. These basic objects and extended objects will also be representable in multiple syntaxes, including at least XML and RDF.

Section 2.1 defines the NML classes and their attributes. Section 2.2 describes the relations defined between NML classes.

Section 4 describes the RNC and XSD schema for the XML syntax. Section 5 describes the OWL 2 schema for the XML/RDF and Turtle syntaxes.

1.1 Notational Conventions

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in [RFC 2119].

1.2 Scope

The Network Markup Language is designed to create a functional description of multi-layer networks (including virtualised networks) and multi-domain networks (including aggregated or abstracted networks). It can not only describe a statics network topology, but also its capabilities and its configuration.

NML is aimed at logical connection-oriented network topologies. It can also be used to describe physical networks or packet-oriented networks, although the current base schema current version does contain classes or properties to explicitly deal with signal degradation, or complex routing tables.

NML only attempts to describe the data plane of a computer network, not the control plane. It does contain extension mechanism to easily tie it with network provisioning standards and with network monitoring standards.

Finally, you will not find a definition for the terms *Network* or *capacity* in this document. This has been a conscious choice. The term *Network* has become so widely used for so many diverse meanings that it is impossible to create a definition that everyone can agree on, while still expressing something useful. See *Topology* for the concept of a network domain and a *Link* with multiple sources and sinks for the concept of a local area network. The term *capacity* is used by different technologies in such a different way (e.g. including or excluding

the packet overhead) that it is better to let technology-specific extensions make an explicit definition.

2 NML Base Schema

The NML Base schema describes an information model with elements and their relations that describe computer networks. This schema is kept intentionally general, with provisions to extend the schema to describe layer-specific information.

The URI of the all objects, relations and parameters is `http://http://schemas.ogf.org/nml/2012/10/ba`

2.1 Classes

Figure 1 shows an overview of all the objects in the NML schema in a UML class diagram. The figure also shows the relations between the objects, and their cardinalities. In the sections below we discuss each of the elements of the schema.

2.1.1 Network Object

The basic abstract element of the schema is the *Network Object*. Other basic elements inherit from it.

The *Network Object* can be associated with a *Location* using the *locatedAt* attribute, can be related to other instances via *Relation*s and can have a *Lifetime*. Every Network Object MUST have an *id* attribute, which MUST be a unique URI. These characteristics are inherited by the subclasses of the *Network Object* class.

The base *Network Object* has three related objects that describe the *Network Object* and its relationships:

- Location
- Lifetime
- Relation

The location of an object in the physical world can be described using the *Location* object. The actual location is then described using properties of the *Location* object. The Location and a Network object are related to each other using the *locatedAt* relationship.

All *Network Objects* can potentially have a *Lifetime*, that consists of vector of *time* elements, which contain a start time and an end time.

The Relations between different network objects are represented using relation objects. These are discussed in more detail in section 2.2.

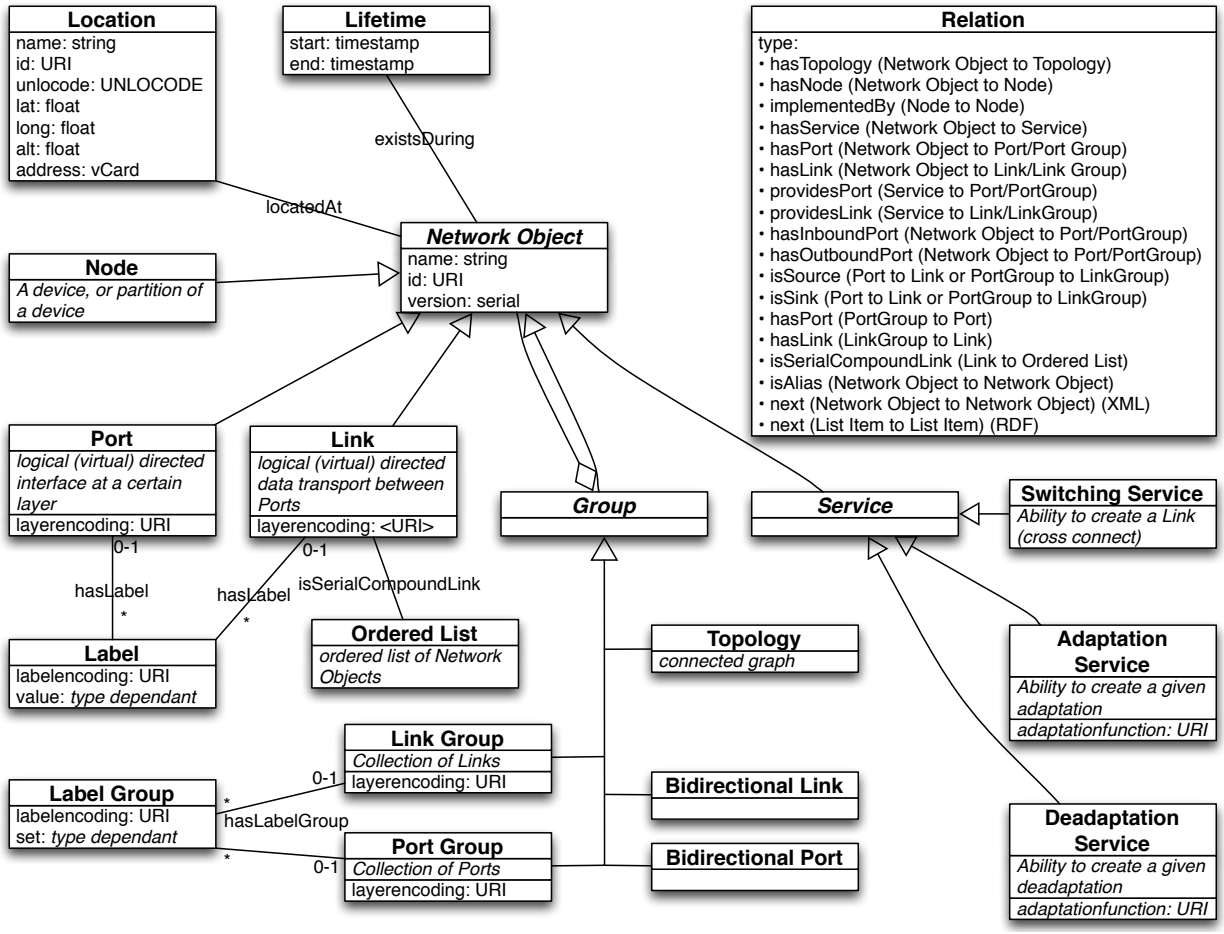

Figure 1: A UML class diagram of the objects in the NML schema and their relations

The base *Network Object* is subclassed into the top-level topology components, that are sufficient to cover the description of networks. The top-level network objects in this schema are:

- Node
- Port
- Link
- Service
- Group

These objects are described in more detail below.

2.1.2 Node

A *Node* is generally a device connected to, or part of, the network. A Node does not necessarily correspond to a physical machine. It MAY be a virtual device or a group of devices. *Node* inherits from *Network Object*.

A *Node* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasInboundPort* to one or more *Port*s or *PortGroup*s
- *hasOutboundPort* to one or more *Port*s or *PortGroup*s
- *hasService* to one or more *Service*s of type *Switch*
- *implementedBy* to one or more *Node*s
- *isAlias* to one or more *Node*s
- *locatedAt* to one *Location*

A *Node* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.3 Port

A *Port* defines connectivity from a *Network Object* to the rest of the network. A *Port* object is unidirectional. A *Port* does not necessarily correspond to a physical interface. It

represents a logical transport entity at a fixed place in the network. A *Port* inherits from *Network Object*.

A *Port* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasLabel* to one *Label*
- *hasService* to one or more *Service*s of type *Adaptation* or type *Deadaptation*
- *isAlias* to one or more *Port*s
- *isSink* to one or more *Link*s
- *isSource* to one or more *Link*s

A *Port* may have the following attributes:

- *encoding* to assign a data encoding identifier
- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.4 Link

A *Link* object describes that there is a unidirectional data transport from one or more sources to one or more sinks.

A source of a Link is a Network Object that has a *isSource* relation to the Link. A sink of a Link is a Network Object that has a *isSink* relation to the Link.

A *Link* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasLabel* to one *Label*
- *isAlias* to one or more *Link*s
- *isSerialCompoundLink* to one ordered *List* of *Link*s

A *Link* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

A *Link* may have the following parameter:

- *noReturnTraffic* A value of `true` changes the definition of the data transport to: from each sources to all sinks, except that there is no data transport from a source to a sink if the source and sink are grouped together in a *BidirectionalPort* group.

2.1.5 Service

In the diagram we also show that we have three different services, the *Switching Service* the *AdaptationService* and the *DeadaptationService*. These are described in more detail below.

2.1.6 Switching Service

A *SwitchingService* describes the ability to create cross connects between its ports. *SwitchingService* inherits from *Service*.

A *Switching Service* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasInboundPort* to one or more *Port*s or *PortGroup*s
- *hasOutboundPort* to one or more *Port*s or *PortGroup*s
- *isAlias* to one or more *Switching Service*s
- *providesLink* to one or more *Link*s or *LinkGroup*s

A *SwitchingService* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.7 Adaptation Service

An *AdaptationService* describes the capability that data from one or more ports can be embedded in the data encoding of one other port. This is commonly referred to as the embedding of client layer ports in a server layer port. *AdaptationService* inherits from *Service*.

An *AdaptationService* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *isAlias* to one or more *AdaptationService*s
- *providesPort* to one or more *Port*s or *PortGroup*s

An *AdaptationService* may have the following attributes:

- *adaptationfunction* to assign an adaptation technology identifier
- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.8 Deadaptation Service

A *DeadaptationService* describes the capability that data of one or more ports can be extracted from the data encoding of one other port. This is commonly referred to as the extraction of client layer ports from the server layer port. *DeadaptationService* inherits from *Service*.

A *DeadaptationService* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *isAlias* to one or more *DeadaptationService*s
- *providesPort* to one or more *Port*s or *PortGroup*s

A *DeadaptationService* may have the following attributes:

- *adaptationfunction* to assign a adaptation technology identifier
- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.9 Group

To describe collections of network objects, there is a group element. Any element defined above can be part of a group, including another group.

We also define a set of special groups:

- Bidirectional Link
- Bidirectional Port
- Topology
- Domain
- Network

2.1.10 Bidirectional Link

A *BidirectionalLink* is a group of two (unidirectional) *Link*s or *LinkGroup*s together forming a bidirectional link.

A *BidirectionalLink* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasLink* to exactly two *Link*s or two *LinkGroup*s

A *BidirectionalLink* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.11 Bidirectional Port

A *BidirectionalPort* is a group of two (unidirectional) *Port*s or *PortGroup*s together forming a bidirectional representation of a physical or virtual port.

A *BidirectionalPort* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasPort* to exactly two *Port*s or two *PortGroup*s

A *BidirectionalPort* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.12 Topology

A *Topology* is a set of connected Network Objects.

A *Topology* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasNode* to one or more *Node*s
- *hasInboundPort* to one or more *Port*s or *PortGroup*s
- *hasOutboundPort* to one or more *Port*s or *PortGroup*s
- *hasService* to one or more *Service* of type *Switch*

- *hasTopology* to one or more *Topology*s
- *isAlias* to one or more *Topology*s
- *locatedAt* to one *Location*

A *Topology* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string
- *version* to assign a serial number

2.1.13 Port Group

A *PortGroup* is an unordered set of *Port*s.

A *PortGroup* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasLabelGroup* to one *LabelGroup*
- *hasPort* to one or more *Port*s or *PortGroups*
- *isAlias* to one or more *PortGroup*s
- *isSink* to one or more *LinkGroup*s
- *isSource* to one or more *LinkGroup*s

A *PortGroup* may have the following attributes:

- *encoding* to assign a data encoding identifier
- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.14 Link Group

A *LinkGroup* is an unordered set of *Link*s.

A *LinkGroup* may have the following relations:

- *existsDuring* to one or more *Lifetime*s
- *hasLabelGroup* to one *LabelGroup*

- *hasLink* to one or more *Link*s or *LinkGroup*s
- *isAlias* to one or more *LinkGroup*s
- *isSerialCompoundLink* to one ordered *List* of *LinkGroup*s

A *LinkGroup* may have the following attributes:

- *id* to assign a persistent globally unique URI
- *name* to assign a human readable string

2.1.15 Label

A *Label* is the technology-specific value to distinguish a single data stream embedded in a larger data stream. The*value* can either be a resource label, or a pair of source and destination labels.

A *Label* may have the following attributes:

- *type* to refer to a technology-specific labelset
- *value* is one specific value taken from the labelset

Technology extensions of NML may define additional attributes.

2.1.16 Label Group

A *LabelGroup* is an unordered set of *Label*s.

A *LabelGroup* may have the following attributes:

- *type* to refer to a technology-specific labelset
- *values* is a set of specific values taken from the labelset

Technology extensions of NML may define additional attributes.

2.1.17 Location

A *Location* is a reference to a geographical location or area.

A *Location* may have the following attributes:

- *long* is the longitude in WGS84 coordinate system (in decimal degrees)
- *lat* is the lattitude in WGS84 coordinate system (in decimal degrees)
- *alt* is the altitude in WGS84 coordinate system (in decimal meters)

- *unlocode* is the UN/LOCODE location identifier
- *address* is a vCard address
- *name* is a human-readable string

2.1.18 Lifetime

A *Lifetime* is an interval between which the object is said to be active.

A *Lifetime* may have the following attributes:

- *start* is the start time and date in ISO datetime notation
- *end* is the end time and date in ISO datetime notation

2.1.19 Ordered List

An *OrderedList* is an ordered list of *Network Object*s.

The representation of an *OrderedList* depends on the syntax.

2.2 Relations

*Relation*s describe how different *Network Object*s can be combined to form a network topology description. The relations have been described above, but for ease of reference we also give a full list and definition here (in alphabetical order). In principle a *Relation* can go from any object to any other object. The list below includes definitions for a subset of the possible relations. If a particular *Relation* between two *Network Objects* is not listed below, it is undefined.

existsDuring relates a *LifeTime* object to a *Network Object*

hasInboundPort defines the relation between a *Node*, a *SwitchingService* or a *Topology* and their respective *Port*s or *PortGroup*s

hasLabelGroup assigns one *LabelGroup* to a *PortGroup*

hasLabel assigns one *Label* to a *Port*

hasLink is used for:

- *Bidirectional Link* to relate exactly two *Link*s or two *LinkGroup*s
- *LinkGroup* to one or more *Link*s or *LinkGroup*s to define membership of that group

hasNode relates a *Network Object* to a *Node*, meaning that a *Node* is part of a *Topology*

hasOutboundPort relates either a *Node*, *SwitchingService* or a *Topology* to one or more *Port*s or *PortGroup*s as an outbound port

hasPort is used for:

- *BidirectionalPort* to relate exactly two *Port*s or two *PortGroup*s
- *PortGroup* to one or more *Port*s or *PortGroups*

hasService relates a *Network Object* to a *Service*. This schema only defines the meaning of:

- *Port* to *AdaptationService*, relating one server-layer *Port* to an adaptation function
- *Port* to *DeadaptationService*, relating one server-layer *Port* to a deadaptation function
- *Node* or *Topology* to *SwitchingService*, describing a switching capability of that *Node* or *Topology*.

hasSink relates a *Link* to one *Port* to define the outgoing traffic port

hasSource relates a *Link* to one *Port* to define its incoming traffic port

hasTopology defines a relation between one *Topology* to one or more *Topology*s for aggregation purposes

implementedBy relates a *Node* to one or more *Node*s to describe virtualization

isAlias is a relation from a *Network Object* to a *Network Object* to describe that one can be used as the alias of another.

isSerialCompoundLink is used to define that a *Link* or *LinkGroup* represents an ordered *List* of *Link*s or *LinkGroup*s. This must include cross-connects. It MAY also be derived from an existing description, for example:

```
Port P1 --isSource--> Link L1
Port P2 --isSink--> Link L1
Port P2 --isSource--> Link L2
Port P3 --isSink--> Link L2
Port P1 --isSource--> Link L3
Port P3 --isSink--> Link L3
```

locatedAt relates a *Network Object* to one *Location*

providesLink is used to relate a *SwitchingService* to one or more *Link*s or *LinkGroup*s to define that these have been created by that *SwitchingService*

providesPort is used to relate an *AdaptationService* or *DeadaptationService* to one or more *Port*s or *PortGroup*s to define that these have been created by that *AdaptationService* or *DeadaptationService*

The *hasTopology*, *hasNode*, *implementedBy hasPort*, *hasLabel*, *hasLabelGroup*, and *hasLink* are defined as implicit relations.

3 Identifiers

3.1 Object Identifiers

The namespace for the class objects defined in this document is `http://schemas.ogf.org/nml/base/2013/`
TODO: change to correct year and month of the schema.

All objects and attributes defined in this document reside in this namespace. For example, the link object is identified by `http://schemas.ogf.org/nml/2013/10/base/link`

3.2 Instance Identifiers

Section 2.1.1 requires that instances of Network Objects MUST have an *id* attribute, which MUST be a unique URI.

Implementations that receive a network topology description MUST be prepared to accept any valid URI as an identifier.

Implementations that publish a network topology description instance identifiers MAY adhere to the syntax of Global Network Identifiers as defined in [URN-OGF-NETWORK], which ensures global uniqueness and that easy recognition of Network Object instances.

Two different Network Objects instance MUST have two different identifiers.

Once an identifier is assigned to a resource, it MUST NOT be re-assigned to another resource.

A URI MAY be interpreted as an International Resource Identifier (IRI) for display purposes, but URIs from external source domains MUST NOT be IRI-normalised before transmitting to others.

3.2.1 Lexical Equivalence

Two identifier are lexical equivalent if they are binary equivalent after case-normalisation.

No interpretation of percent-encoding or PUNYCODE decoding should take place.

For the purpose of equivalence comparison, any possible fragment part or query part of the URI is considered part of the URI.

For example the following identifiers are equivalent:

```
1 - urn:ogf:network:example.net:2012:local_string_1234
2 - URN:OGF:network:EXAMPLE.NET:2012:Local_String_1234
```

while the following identifiers are not equivalent (in this case, the percentage encoding even make URI #3 an invalid Global Network Identifier.):

```
1 - urn:ogf:network:example.net:2012:local_string_1234
3 - urn:ogf:network:example.net:2012:local%5Fstring%5F1234
```

3.2.2 Further Restrictions

An assigning organisation MUST NOT assign Network Object Identifier longer than 255 characters in length.

Parsers MUST be prepared to accept identifiers of up to 255 characters in length.

A Parser SHOULD verify if an identifier adheres to the general URI syntax rules, as specified in RFC 3986 [RFC 3986].

Parsers SHOULD reject identifiers which do not adhere to the specified rules. A parser encountering an invalid identifier SHOULD reply with an error code that includes the malformed identifier, but MAY accept the rest of the message, after purging all references to the Network Object with the malformed identifier.

3.2.3 Interpreting Identifiers

A Network Object identifier MUST be treated as a opaque string, only used to uniquely identify a Network Object. The local-part of a Global Network Identifier MAY have certain meaning to it's assigning organisation, but MUST NOT be interpreted by any other organisation.

3.2.4 Network Object Attribute Change

A Network Object may change during its lifetime. If these changes are so drastic that the assigning organisation considers it a completely new Network Object, the assigning organisation should be assigned a new identifier. In this case, other organisations MUST treat this object as completly new Network Resource.

If the assigning organisation considers the changes are small, it MUST retain the same identifier for the Network Object, and use some mechanism to signal it's peers of the changes in the attributes of the Network Object.

4 XML Schema

5 OWL Schema

6 Examples

The following snippets represent NML structures in the XML format.

- *Topology*

```
<nml:Topology xmlns:nml="http://schemas.ogf.org/nml/2012/10/nml"
              id="urn:ogf:network:example.net:2012:org"
              version="20120814">

  <!-- ... -->

</nml:Topology>
```

- *Node*

```
<nml:Node id="urn:ogf:network:example.net:2012:nodeA">
  <nml:name>Node_A</nml:name>
  <nml:Location idRef="urn:ogf:network:example.net:2012:redcity"/>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:out"/>
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:out"/>
  </nml:Relation>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:in"/>
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:in"/>
  </nml:Relation>
</nml:Node>
```

- *Ports*
  - *UnidirectionalPort*

```
<nml:Port id="urn:ogf:network:example.net:2012:port_X:out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
</nml:Port>
```

  - *BidirectionalPort*

```
<nml:BidirectionalPort id="urn:ogf:network:example.net:2012:port_X">
  <nml:name>X</nml:name>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port_X:out"/>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port_X:in"/>
</nml:BidirectionalPort>
```

  - *PortGroup*

```
<nml:PortGroup id="urn:ogf:network:example.net:2012:portgroup_X:out">
  <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1780-1783
  </nml:LabelGroup>
</nml:PortGroup>
```

- *Link*

- *UnidirectionalLink*

```
<nml:Link id="urn:ogf:network:example.net:2012:linkA:XY"/>

<nml:Port id="urn:ogf:network:example.net:2012:port_X:out">
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSource">
    <nml:Link idRef="␣urn:ogf:network:example.net:2012:linkA:XY"/>
  </nml:Relation>
</nml:Port>

<nml:Port id="urn:ogf:network:example.net:2012:port_Y:in">
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSink">
    <nml:Link idRef="␣urn:ogf:network:example.net:2012:linkA:XY"/>
  </nml:Relation>
</nml:Port>
```

- *UnidirectionalLink that is composed of more than one sub-link*

```
<nml:Relation type="http://schemas.ogf.org/nml/2012/10/isSerialCompoundLink">
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:XY">
    <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ"/>
    </nml:Relation>
  </nml:Link>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ">
    <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
    </nml:Relation>
  </nml:lLink>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
</nml:Relation
```

- *BidirectionalLink*

```
<nml:BidirectionalLink id="urn:ogf:network:example.net:2012:link_XWX">
  <nml:name>Link between ports X and W</nml:name>
  <nml:Link idRef="urn:ogf:network:example.net:2012:link_XW"/>
  <nml:Link idRef="urn:ogf:network:example.net:2012:link_WX"/>
</nml:BidirectionalLink>
```

- *LinkGroup*

```
<nml:LinkGroup id="urn:ogf:network:example.net:2012:domainy_domainx">
  <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1780-1783
  </nml:LabelGroup>
</nml:LinkGroup>
```

- *Labels*
  - *Label*

```
<nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
```

  - *LabelGroup*

```
<nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
  1780-1783
</nml:LabelGroup>
```

- *Location*

```
<nml:Location id="urn:ogf:network:example.net:2012:redcity">
  <nml:name>Red City</nml:name>
  <nml:latitude>30.600</nml:latitude>
  <nml:longitude>12.640</nml:longitude>
</nml:Location>
```

- *Services*
  - *SwitchingService*

```
<nml:Node id="urn:ogf:network:example.net:2012:nodeA">
  <nml:name>Node_A</nml:name>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:in" />
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:in" />
  </nml:Relation>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:out"/>
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:out"/>
  </nml:Relation>
  <nml:SwitchingService idRef="urn:ogf:network:example.net:2012:nodeA:switchingService"/>
</nml:Node>

<nml:SwitchingService id="urn:ogf:network:example.net:2012:nodeA:switchingService">
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:in" />
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:in" />
  </nml:Relation>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_X:out"/>
    <nml:Port idRef="urn:ogf:network:example.net:2012:nodeA:port_Y:out"/>
  </nml:Relation>
</nml:SwitchingService>
```

  - *AdaptationService*

```
<nml:Port id="urn:ogf:network:example.net:2012:port_X:in">
  <nml:AdaptationService
       idRef="urn:ogf:network:example.net:2012:port_X:in:adaptationService"/>
</nml:Port>

<nml:AdaptationService
     id="urn:ogf:network:example.net:2012:port_X:in:adaptationService">
  <nml:Port idRef="urn:ogf:network:example.net:2012:port_X.1501:in"/>
</nml:AdaptationService>

<nml:Port id="urn:ogf:network:example.net:2012:port_X.1501:in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
</nml:Port>
```

  - *DeadaptationService*

```
<nml:Port id="urn:ogf:network:example.net:2012:port_X.1501:in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:DeadaptationService
       idRef="urn:ogf:network:example.net:2012:port_X.1501:in:deadaptationService" />
</nml:Port>

<nml:DeadaptationService
     id="urn:ogf:network:example.net:2012:port_X.1501:in:deadaptationService">
  <nml:Port idRef="urn:ogf:network:example.net:2012:port_X:in" />
</nml:DeadaptationService >
```

7 Security Considerations

There are important security concerns associated with the generation and distribution of network topology information. For example, ISPs frequently consider network topologies to be proprietary. We do not address these concerns in this document, but implementers are encouraged to consider the security implications of generating and distributing network topology information.

8 Glossary

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13 Full Copyright Notice

Appendix A NML example - first use case

```
<?xml version="1.0" encoding="utf-8" ?>


<!--                                                                    -->
<!--     port X                port Y              port Z                port W        -->
<!--      O--------------------O-------------------O--------------------O          -->
<!--               link A              link B               link C                  -->
<!--                                                                    -->
<!--      (-------------------------------------------------------------)           -->
<!--                                  link XWX                                      -->
<!--                                                                    -->


<nml:Topology xmlns:nml="http://schemas.ogf.org/nml/2012/10/nml"
              id="urn:ogf:network:gn3.net:2012:org"
              version="201207019">


  <nml:name>OGF Test Topology</nml:name>


  <!--  --------------- Links --------------- -->

  <nml:Link id="urn:ogf:network:example.net:2012:link_XW">
    <nml:Relation type="http://schemas.ogf.org/nml/2013/10/isSerialCompoundLink">
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:XY">
        <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
          <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ"/>
        </nml:Relation>
      </nml:Link>
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ">
        <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
          <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
        </nml:Relation>
      </nml:lLink>
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
        </nml:Relation>
  </nml:Link>


  <nml:Link id="urn:ogf:network:example.net:2012:link_WX">
    <nml:Relation type="http://schemas.ogf.org/nml/2013/10/isSerialCompoundLink">
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:WZ">
        <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
          <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:ZY"/>
        </nml:Relation>
      </nml:Link>
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:ZY">
        <nml:Relation type="http://schemas.ogf.org/nml/2012/10/next">
          <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:YX"/>
        </nml:Relation>
      </nml:Link>
      <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:YX"/>
        </nml:Relation>
  </nml:Link>


  <nml:BidirectionalLink id="urn:ogf:network:example.net:2012:link_XWX">
    <nml:name>Bidirectional link between ports X and W</nml:name>
    <nml:Link idRef="urn:ogf:network:example.net:2012:link_XW"/>
    <nml:Link idRef="urn:ogf:network:example.net:2012:link_WX"/>
  </nml:BidirectionalLink>


  <nml:Link id="urn:ogf:network:example.net:2012:linkA:XY"/>
  <nml:Link id="urn:ogf:network:example.net:2012:linkA:YX"/>

  <nml:BidirectionalLink id="urn:ogf:network:example.net:2012:linkA">
    <nml:name>A</nml:name>
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:XY"/>
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:YX"/>
  </nml:BidirectionalLink>


  <nml:Link id="urn:ogf:network:example.net:2012:linkB:YZ"/>
  <nml:Link id="urn:ogf:network:example.net:2012:linkB:ZY">
```

```
<nml:BidirectionalLink id="urn:ogf:network:example.net:2012:linkB">
  <nml:name>B</nml:name>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ"/>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:ZY"/>
</nml:BidirectionalLink>


<nml:Link id="urn:ogf:network:example.net:2012:linkC:ZW"/>
<nml:Link id="urn:ogf:network:example.net:2012:linkC:WZ"/>

<nml:BidirectionalLink id="urn:ogf:network:example.net:2012:linkC">
  <nml:name>C</nml:name>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
  <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:WZ"/>
</nml:BidirectionalLink>


<!--  --------------- Ports --------------- -->


<nml:Port id="urn:ogf:network:example.net:2012:port-X:out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSource">
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:XY"/>
  </nml:Relation>
</Port>


<nml:Port id="urn:ogf:network:example.net:2012:port-X:in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSink">
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:YX"/>
  </nml:Relation>
</Port>


<nml:BidirectionalPort id="urn:ogf:network:example.net:2012:port-X">
  <nml:name>X</nml:name>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port-X:out"/>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port-X:in"/>
</nml:BidirectionalPort>


<nml:Port id="urn:ogf:network:example.net:2012:port-Y:out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSource">
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:YX"/>
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ"/>
  </nml:Relation>
</Port>


<nml:Port id="urn:ogf:network:example.net:2012:port-Y:in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSink">
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkA:XY"/>
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:ZY"/>
  </nml:Relation>
</Port>


<nml:BidirectionalPort id="urn:ogf:network:example.net:2012:port-Y">
  <nml:name>Y</nml:name>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port-Y:out"/>
  <nml:Port idRef="urn:ogf:network:example.net:2012:port-Y:in"/>
</nml:BidirectionalPort>


<nml:Port id="urn:ogf:network:example.net:2012:port-Z:out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSource">
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:ZY"/>
    <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
  </nml:Relation>
</Port>


<nml:Port id="urn:ogf:network:example.net:2012:port-Z:in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSink">
```

```
        <nml:Link idRef="urn:ogf:network:example.net:2012:linkB:YZ"/>
        <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:WZ"/>
      </nml:Relation>
    </Port>


    <nml:BidirectionalPort id="urn:ogf:network:example.net:2012:port-Z">
      <nml:name>Z</nml:name>
      <nml:Port idRef="urn:ogf:network:example.net:2012:port-Z:out"/>
      <nml:Port idRef="urn:ogf:network:example.net:2012:port-Z:in"/>
    </nml:BidirectionalPort>


    <nml:Port id="urn:ogf:network:example.net:2012:port-W:out">
      <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSource">
        <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:WZ"/>
      </nml:Relation>
    </Port>


    <nml:Port id="urn:ogf:network:example.net:2012:port-W:in">
      <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">1501</nml:Label>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/isSink">
        <nml:Link idRef="urn:ogf:network:example.net:2012:linkC:ZW"/>
      </nml:Relation>
    </Port>


    <nml:BidirectionalPort id="urn:ogf:network:example.net:2012:port-W">
      <nml:name>W</nml:name>
      <nml:Port idRef="urn:ogf:network:example.net:2012:port-W:out"/>
      <nml:Port idRef="urn:ogf:network:example.net:2012:port-W:in"/>
    </nml:BidirectionalPort>


</nml:Topology>
```

Appendix B NML example - second use case

```
<?xml version="1.0" encoding="utf-8" ?>

<!--                Domain X                                          Domain Y                                  -->
<!--      ----------------------    ------------------------------------------------------------      -->
<!--     |                        |  |                                                            |     -->
<!--     |  Node A                |  |                  Node B                                    Node C  |     -->
<!--     |      Port ge-0/2/9     |  |  Port ge-1/0/9        Port ge-1/0/8          Port ge-5/2/7      |     -->
<!--     |      vlan:             |  |  vlan:                vlan:                  vlan:              |     -->
<!--     |       1501,1780-1783   |  |   1501,1780-1783       1501                   1501              |     -->
<!--     |     O------------------------------------------O-------------------------------------O     |     -->
<!--     |                        |  |                                                            |     -->
<!--     |                        |  |                                                            |     -->
<!--      ----------------------    ------------------------------------------------------------      -->


<nml:Topology xmlns:nml="http://schemas.ogf.org/nml/2012/10/nml"
              id="urn:ogf:network:gn3.net:2012:org"
              version="20120709">

  <nml:name>OGF Test Topology #1</nml:name>

  <!-- --------------------------------- Domain X ---------------------------------  -->

  <nml:Topology id="urn:ogf:network:domainx.net:2012:org">


    <nml:name>Domain X</nml:name>


    <nml:Node id="urn:ogf:network:domainx.net:2012:nodeA">
      <nml:name>Node-A</nml:name>

      <nml:Location idRef="urn:ogf:network:domainx.net:2011:redcity"/>

      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
        <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-out"/>
        <nml:Port idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
        <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-in"/>
        <nml:Port idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-in"/>
      </nml:Relation>

    </nml:Node>


    <nml:PortGroup id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-out">
      <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
        1780-1783
      </nml:LabelGroup>
    </nml:PortGroup>


    <nml:PortGroup id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-in">
      <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
        1780-1783
      </nml:LabelGroup>
    </nml:PortGroup>

    <nml:Port id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-out">
      <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
        1501
      </nml:Label>
    </nml:Port>


    <nml:Port id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-in">
      <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
        1501
      </nml:Label>
    </nml:Port>


    <nml:BidirectionalPort id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9">
      <nml:name>ge-0/2/9</nml:name>
      <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-out"/>
```

```
      <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-in"/>
    </nml:BidirectionalPort>


    <nml:BidirectionalPort id="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501">
      <nml:name>ge-0/2/9 vlan 1501</nml:name>
      <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-out"/>
      <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-in"/>
    </nml:BidirectionalPort>


    <nml:LinkGroup id="urn:ogf:network:domainx.net:2012:domainx-domainy">
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSource">
        <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-out"/>
        <nml:Port idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSink">
        <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-in"/>
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:A:port_ge-1.0.9.1501-in"/>
      </nml:Relation>
    </nml:LinkGroup>


    <nml:LinkGroup id="urn:ogf:network:domainx.net:2012:domainy-domainx">
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSource">
        <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-out"/>
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSink">
        <nml:PortGroup idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9-in"/>
        <nml:Port idRef="urn:ogf:network:domainx.net:2012:A:port_ge-0.2.9.1501-in"/>
      </nml:Relation>
    </nml:LinkGroup>


    <nml:BidirectionalLink id="urn:ogf:network:domainx.net:2012:domainx-domainy-domainx">
      <nml:name>Link between domain x and domain y</nml:name>
      <nml:LinkGroup idRef="urn:ogf:network:domainx.net:2012:domainx-domainy"/>
      <nml:LinkGroup idRef="urn:ogf:network:domainx.net:2012:domainy-domainx"/>
    </nml:BidirectionalLink>


    <nml:Location id="urn:ogf:network:domainx.net:2011:redcity">
      <nml:name>Red City</nml:name>
      <nml:latitude>15.600</nml:latitude>
      <nml:longitude>32.640</nml:longitude>
    </nml:Location>


  </nml:Topology>


  <!-- ---------------------------------- Domain Y ----------------------------------  -->

  <nml:Topology id="urn:ogf:network:domainy.net:2012:org">


    <nml:name>Domain Y</nml:name>


    <nml:Node id="urn:ogf:network:domainy.net:2012:nodeB">
      <nml:name>Node-B</nml:name>

      <nml:Location idRef="urn:ogf:network:domainy.net:2011:whitecity"/>

      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-out"/>
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-out"/>
        <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-in"/>
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-in"/>
        <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-in"/>
      </nml:Relation>

      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasService">
        <nml:SwitchingService idRef="urn:ogf:network:domainy.net:2012:B:switchingService_vlan1501"/>
      </nml:Relation>

    </nml:Node>
```

```
<nml:Node id="urn:ogf:network:domainy.net:2012:nodeC">
  <nml:name>Node-C</nml:name>
  <nml:Location idRef="urn:ogf:network:domainy.net:2011:whitecity"/>

  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-out"/>
  </nml:Relation>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-in"/>
  </nml:Relation>

</nml:Node>


<nml:SwitchingService id="urn:ogf:network:domainy.net:2012:B:switchingService_vlan1501">
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasInboundPort">
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-in" />
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-in" />
  </nml:Relation>
  <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasOutboundPort">
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-out" />
    <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-out" />
  </nml:Relation>
</nml:SwitchingService>


<nml:PortGroup id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-out">
  <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1780-1783
  </nml:LabelGroup>
</nml:PortGroup>


<nml:PortGroup id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-in">
  <nml:LabelGroup encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1780-1783
  </nml:LabelGroup>
</nml:PortGroup>


<nml:Port id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
</nml:Port>


<nml:Port id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
</nml:Port>


<nml:Port id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
</Port>


<nml:Port id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
</Port>


<nml:Port id="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-out">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
</Port>


<nml:Port id="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-in">
  <nml:Label encoding="http://schemas.ogf.org/nml/2012/10/ethernet/vlan">
    1501
  </nml:Label>
```

```
    </Port>

    <nml:BidirectionalPort id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9">
      <nml:name>ge-1/0/9</nml:name>
      <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-out"/>
      <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9-in"/>
    </nml:BidirectionalPort>
    <nml:BidirectionalPort id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501">
      <nml:name>ge-1/0/9 vlan 1501</nml:name>
      <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-out"/>
      <nml:PortGroup idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.9.1501-in"/>
    </nml:BidirectionalPort>
    <nml:BidirectionalPort id="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501">
      <nml:name>ge-1/0/8 vlan 1501</nml:name>
      <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-out"/>
      <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-in"/>
    </nml:BidirectionalPort>
    <nml:BidirectionalPort id="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501">
      <nml:name>ge-5/2/7 vlan 1501</nml:name>
      <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-out"/>
      <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-in"/>
    </nml:BidirectionalPort>

    <nml:BidirectionalLink id="urn:ogf:network:domainy.net:2012:domainx-domainy-domainx">
      <nml:Relation type"http://schemas.ogf.org/nml/2012/10/relation/isAlias">
        <nml:BidirectionalLink idRef="urn:ogf:network:domainx.net:2012:domainx-domainy-domainx"/>
      <nml:Relation>
    </nml:BidirectionalLink>

    <nml:Link id="urn:ogf:network:domainy.net:2012:B-to-C">
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSource">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSink">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-in"/>
      </nml:Relation>
    </nml:Link>

    <nml:Link id="urn:ogf:network:domainy.net:2012:C-to-B">
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSource">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:C:port_ge-5.2.7.1501-out"/>
      </nml:Relation>
      <nml:Relation type="http://schemas.ogf.org/nml/2012/10/relation/hasSink">
        <nml:Port idRef="urn:ogf:network:domainy.net:2012:B:port_ge-1.0.8.1501-sink"/>
      </nml:Relation>
    </nml:Link>

    <nml:BidirectionalLink id="urn:ogf:network:domainy.net:2012:B-C-B">
      <nml:name>Link between boxes B and C</nml:name>
      <nml:Link idRef="urn:ogf:network:domainy.net:2012:B-to-C"/>
      <nml:Link idRef="urn:ogf:network:domainy.net:2012:C-to-B"/>
    </nml:Link>

    <nml:Location id="urn:ogf:network:domainy.net:2011:whitecity">
      <nml:name>White City</nml:name>
      <nml:latitude>30.600</nml:latitude>
      <nml:longitude>12.640</nml:longitude>
    </nml:Location>

  </nml:Topology>

</nml:Topology>
```

References

Normative References

[URN-OGF-NETWORK] Freek Dijkstra. URN:OGF:network specification. GWD-R-P (Work in Progress), May 2011.

[RFC 2119] Scott Bradner. Key words for use in RFCs to Indicate Requirement Levels. RFC 2119 (Best Current Practice), March 1997. URL `http://tools.ietf.org/html/rfc2119`.

[RFC 3986] Tim Berners-Lee, Roy T. Fielding, and Larry Masinter. Uniform Resource Identifier (URI): Generic Syntax RFC 3986 (Standards Track), January 2005. URL `http://tools.ietf.org/html/rfc3986`.

Informative References