SIMAP Modelling Discussion

IETF 124 NMOP

NMOP SIMAP Side Meeting

4 Nov 2025

Montreal, Canada

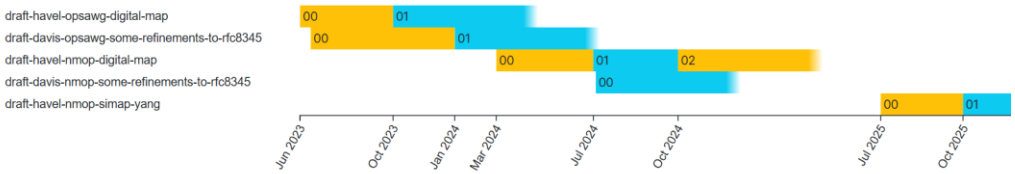
Agenda

- Side Meeting Goal
- SIMAP YANG Modelling Draft Intro
- SIMAP requirements identified as gaps / for further study
- Some proposals for discussions (as the time permits)

Side Meeting Goal

Discussion about the SIMAP modelling based on SIMAP requirements and identified gaps for RFC8345. Present and discuss the proposed approaches in draft-havel-nmop-simap-yang based on requirements from draft-ietf-nmop-simap-concept, in order to get feedback and hopefully consensus for some proposals and present the summary at NMOP Session 2 tomorrow

SIMAP YANG Modelling Draft



Document	Type	Active Internet-Draft (individual)
	Authors	Olga Havel ✉, Nigel Davis ✉, Benoît Claise ✉, Oscar Gonzalez de Dios ✉, Thomas Graf ✉

1. Introduction
2. Terminology
3. Why RFC8345 is a good approach for SIMAP Modelling
4. Requirements Categorization (generic for all YANG, supported by RFC8345, RFC8345 gap)
5. Modelling approach in this draft version
6. API Scope (read for live and historical, read/write for potential and intended)
7. Per SIMAP requirement identified as RFC8345 gap
   - modelling analysis
   - implementation proposal
8. YANG module tree for ietf-simap-topology YANG module
9. The full ietf-simpa-topology YANG module

```
module: ietf-simap-topology
  +--ro networks-history
     +--ro network-history* [live-network-ref timestamp]
        +--ro live-network-ref    -> /nw:networks/network/network-id
        +--ro timestamp           yang:date-and-time
        +--ro file-id?            inet:uri

  augment /nw:networks/nw:network:
    +--rw name?          string
    +--rw label*         string
    +--rw description?   string
    +--ro extension?     <anydata>
  augment /nw:networks/nw:network/nw:node:
    +--rw name?          string
    +--rw label*         string
    +--rw description?   string
    +--ro extension?     <anydata>
  augment /nw:networks/nw:network/nw:node/nt:termination-point:
    +--rw name?          string
    +--rw label*         string
    +--rw description?   string
    +--ro extension?     <anydata>
  augment /nw:networks/nw:network/nt:link:
    +--rw name?          string
    +--rw label*         string
    +--rw description?   string
    +--ro extension?     <anydata>
  augment /nw:networks/nw:network:
    +--rw network-category?   identityref
    +--rw live-network-ref?   -> /nw:networks/network/network-id
    +--rw timestamp?          yang:date-and-time
  augment /nw:networks/nw:network/nt:link:
    +--rw link-type?        identityref
    +--rw link-direction?   identityref
    +--rw tp* [network-ref node-ref tp-ref]
       +--rw tp-ref          -> /nw:networks/
network[nw:network-id=current()/../network-ref]/
node[nw:node-id=current()/../node-ref]/nt:termination-point/tp-id
       +--rw node-ref        -> /nw:networks/
network[nw:network-id=current()/../network-ref]/node/node-id
       +--rw network-ref     -> /nw:networks/network/network-id
       +--rw tp-role?        identityref
       +--rw tp-direction?   identityref
  augment /nw:networks/nw:network:
    +--rw subnetwork* [network-ref]
       +--rw network-ref     -> /nw:networks/network/network-id
```

Figure 12: The Structure of the SIMAP Data Model

https://datatracker.ietf.org/doc/draft-havel-nmop-simap-yang/01/

SIMAP YANG Modelling Goal

- ❑ Analyze if SIMAP requirements (defined in draft-ietf-nmop-simap-concept) are supported by RFC8345 and identify/confirm the gaps
- ❑ Analyze each requirement identified as gap and propose a solution or candidate solutions for evaluation
- ❑ Implement at Hackathons, for candidate solutions compare and evaluate
- ❑ Engage more people in SIMAP modelling, get more feedback (NMOP mailing list, side meetings, interim meetings, hackathons)

What we are leaving for later

Initially done via RFC8345 augment just to focus on the modelling candidates and not where/what module they would be.

Candidate approaches (for the later discussion):

- via new SIMAP YANG module, augmenting RFC8345 YANG modules.
- via RFC8345 bis YANG modules, backward compatible
- via new SIMAP model that does not augment RFC8345 YANG modules (either new YANG module or some other way).
- different approach for different groups of requirements.
- any other

SIMAP Requirements identified as RFC8345 Gaps

The following SIMAP requirements require extensions/changes to ietf-network and ietf-network-topology YANG modules. Some proposals to be discussed today (time permitting):

1. **REQ-BIDIR:** SIMAP must provide a mechanism to model bidirectional links.
2. **REQ-MULTI-POINT:** SIMAP must provide a mechanism to model multipoint links.
3. **REQ-SUBNETWORK:** SIMAP must provide a mechanism to model network decomposition into sub-networks.
4. **REQ-MULTI-DOMAIN:** SIMAP must provide a mechanism to model links between networks.
5. **REQ-EXTENSIBLE:** Extensible via metadata.
6. **REQ-PROPERTIES:** SIMAP entities should mainly contain properties used to identify topological entities at different layers, identify their roles, and topological relationships between them.
7. **REQ-PLUGG:** SIMAP must be pluggable.
8. **REQ-SNAPSHOT:** Network snapshot topology.
9. **REQ-POTENTIAL:** Potential new network topology.
10. **REQ-INTENDED:** Intended topology.
11. **REQ-GRAPH-TRAVERSAL:** Graph Traversal.

- **REQ-PROG-OPEN-MODEL:** Open and programmable SIMAP. Gap: what-if and snapshots part. REQ-POTENTIAL and REQ-INTENDED
- **REQ-STD-API-BASED:** Standard based SIMAP models and APIs, for multi-vendor support. REQ-PLUGG
- **REQ-STATUS:** Links and nodes that are down must appear in the topology. Via REQ-INTENDED + REQ-PLUGG/REQ-EXTENSIBLE

For further study:

REQ-SEMANTIC: Network topology semantics. Gap: some semantic missing.
REQ-SUPPORTING: SIMAP must provide a mechanism to model supporting relationships between different types of topological entities
REQ-RELATIONSHIPS: SIMAP should contain all topological relationships inside each layer or between the layers (underlay/overlay).
REQ-TEMPO-HISTORY: Must support geo-spatial, temporal, and historical data.

SIMAP Requirements that need to be analyzed further

The following requirements need to be analyzed further to determine if they can be supported by RFC8345:

- **REQ-TOPOLOGY-ABSTRACTION:** Navigation across the abstraction levels inside a single network layer.
- **REQ-SHARED:** Share nodes, links, and termination points between different networks.

The following requirements have to be analyzed further to capture all generic networking semantics missing from RFC8345 and from additional requirements defined as gaps.

- **REQ-SEMANTIC:** Network topology semantics.

Meeting with Nigel, Italo and Olga, 23 July 2025:

REQ-TOPOLOGY-ABSTRACTION:

- we need additional semantic as the current supporting underlay
  - not semantically rich, we may need supporting properties
  - we need an exercise that shows all different scenarios can be modelled: primary/backup, load balancing, parallel, sequential
- supporting (already requested in **REQ-SUPPORTING)**:
  - TP to Node (Olga) – if I want to go via supporting from top to physical, without having to go via containment
  - Node->Network (Italo) – for abstraction
  - Do we do it by allowing generic supporting any to any or add specific supporting (tp->node, node->network)

REQ-SEMANTIC: If I can draw it non-ambiguously, I do not need richer semantics

1. REQ-BIDIR: SIMAP must provide a mechanism to model bidirectional links.

```
identity link-direction {
   description "Base identity for the directionality of the link";
 }

 identity link-direction-uni {
   base "st:link-direction";
   description "Unidirectional link";
 }

 identity link-direction-bi {
   base "st:link-direction";
   description "Bidirectional link";
 }
```

```
identity tp-direction {
   description "Base identity for the directionality of the tp";
 }

 identity tp-direction-symmetric {
   base "st:tp-direction";
   description "TP in the bidirectional link";
 }

 identity tp-direction-source {
   base "st:tp-direction";
   description "TP is the source tp in the link";
 }

 identity tp-direction-destination {
   base "st:tp-direction";
   description "TP is the destination tp in the link";
 }
```

```
augment "/nw:networks/nw:network/nt:link" {

   :
   leaf link-direction {
     type identityref {
       base st:link-direction;
     }
     description
       "The direction of the link: unidirectional (link-direction-uni)
       or bidirectional (link-direction-bi). It can also be any other
       custom identity defined with base link-direction. It is
       optional, so the model supports the solution without the link
       direction information, either if not known or for backward
       compatible case.";
   }

   list tp {
     key "network-ref node-ref tp-ref";
     description "List of termination points in the link";
     uses nt:tp-ref;
       :
     leaf tp-direction {
       type identityref {
         base st:tp-direction;
       }
       description
         "The direction of the point in the link";
     }
   }
```

1. REQ-BIDIR: SIMAP must provide a mechanism to model bidirectional links.

Feedback:

1. Reshad suggested to explain the reasoning for introduction bidir better, some statements in the draft are vague – e.g. like error prone. Also add explanation about the lifecycle.
2. Italo shared an opinion about his preference to keep 2 unidirectional links
3. Nigel shared his opinion about why bidirectional is needed and explained that it worked well in other standards
4. Our proposal still allows for unidirectional, but provides semantics for bidirectional and to model lifecycle for bidirectional with single entity
5. Thomas says that service model does not have the path information, he also mentioned physical links
6. Mike mentioned we can encode in the model if it is bidirectional that we want to model as 2 directional

Actions:

- Update based on point 1 and 6
- Nigel to add what we learned from other standards - point 3
- Bring to the mailing list when updated

2. REQ-MULTIPOINT: SIMAP must provide a mechanism to model multipoint links.

```
identity link-type {
    description
      "Base identity for the internal structure of the link";
 }
 identity link-type-p2p {
    base "st:link-type";
    description "Point to point link";
 }
 identity link-type-p2mp {
    base "st:link-type";
    description "Point to multi-point link";
 }
 identity link-type-mp2mp {
    base "st:link-type";
    description "Multi-point to multi-point link";
 }
 identity link-type-hybrid {
    base "st:link-type";
    description
      "Hybrid links, combination of the other three.
      The multi-point link is an abstraction of underlying structure
      detail. The underlying structure is currently expressed in
      terms of a simple identity which essentially references
      a pattern of underlying flow where that pattern describes the
      effect (another abstraction) of that flow between each point
      of the link. There are currently a few well understood
      patterns, but the list will expand. The list of patterns, not
      surprisingly, will be the same as for  service, for
      connectivity and for flow (as the link arises from them). The
      approach of introduction of hybrid links allows for a
      solution to express a complex arrangement in abstraction without
      needing, for each instance, to lay out the detail. It also
      allows the client application to “understand” the effect
      without having to probe that detail.";
 }
```

```
augment "/nw:networks/nw:network/nt:link" {

   :
   :
   leaf link-type {
    type identityref {
     base st:link-type;
    }
    description
     "The reference to the specification for the internal structure
     of the link. It can be point to point (link-type-p2p), point to
     multipoint (link-type-p2mp) or multipoint to multipoint
     (link-type-mp2mp). It can also be any other custom identity
     defined with base link-type. It is optional, so the model
     supports the solution without the link type information,
     either if not known or for backward compatible case.";
   }
   list tp {
    key "network-ref node-ref tp-ref";
    description "List of termination points in the link";
    uses nt:tp-ref;

    leaf tp-role {
     type identityref {
      base st:tp-role;
     }
     description
      "The role of the termination point in the link defined in the
       link-type spec.";
     }
:
   :
   }
  }
```

2. REQ-MULTIPOINT: SIMAP must provide a mechanism to model multipoint links.

Feedback:

1. Italo thinks that the current solution of having pseudo-node for link + RFC 8795 profiles (that adds semantic for multipoint and unidirectional links to other TPs) should be used. The proposal for profiles is in draft-ietf-teas-te-topology-profiles
2. Others mentioned that it multiplies number of managed entities at interface (node for link, tps, unidirectional link). For 3 only endpoints instead of 1 link, we have 1 node, 3 tps, 6 links, 6 tps. What about VPN with 10000 endpoints? 1 node, 10000 links (x2) + 10000 tps, instead of one link.
3. Nigel mentions efficiency, simplicity at the interface
4. How to evaluate the 2 solutions and compare
5. Nigel says that TE profiles cannot be in teas if generic solution for any topology – it should go to NMOP
6. Thomas: In regards to TE profiles – if NETMOD is not interested in this, there is no way forward. There is no tooling, versioning, the profile must be defined programmatically, it must be generic. One YANG module – many profiles, how does it work in regards to schema?

Action:

- See summary actions at the end of 4 requirements analysis

3. REQ-SUBNETWORK: SIMAP must provide a mechanism to model network decomposition into sub-networks.

Candidate 1 - network->subnetwork direction

```
augment "/nw:networks/nw:network" {
    list subnetwork {
      key "network-ref";
        description
          "A subnetwork of the network, supports partitioning";
        leaf network-ref {
          type leafref {
            path "/nw:networks/nw:network/nw:network-id";
          require-instance false;
          }
          description
            "References the subnetworks";
        }
    }
  }
```

Candidate 2 - subnetwork->network direction:

```
augment "/nw:networks/nw:network" {
    leaf parent-ref {
      type leafref {
        path "/nw:networks/nw:network/nw:network-id";
        require-instance false;
      }
      description "References the parent network from subnetworks";
    }
  }
```

3. REQ-SUBNETWORK: SIMAP must provide a mechanism to model network decomposition into sub-networks.

Feedback:

1. Mike thinks put it on many side, simpler, Olga agrees
2. Vivek says there is a third candidate and supporting relation can be used with additional semantic
3. Italo not sure if this could be supported by RFC 8795 profiles

Action:

- Implement candidate suggestion for 2, implement at hackathon bot suggestions and compare
- See actions summary at the end of 4 requirements analysis

4. REQ-MULTI-DOMAIN: SIMAP must provide a mechanism to model links between networks.

```
augment "/nw:networks/nw:network/nt:link" {

    list tp {
      key "network-ref node-ref tp-ref";

    }
  }
```

This way we can model the links in 2 ways:

- link belongs to one network (e.g. IS-IS Area) but pointing to remote point of another network (e.g. IS-IS Area)
- link belongs to the parent domain (e.g. IS-IS AS Domain), but points to termination points of children domains (e.g. different IS-IS Areas)

4. REQ-MULTI-DOMAIN: SIMAP must provide a mechanism to model links between networks.

Feedback:

- 8795 already describes the drawbacks of this proposal, we can analyze how they propose
- Agree what requirements are addressed by 8795 – we can discuss at interim

Actions (Same as previous):

- See actions summary at the end of 4 requirements analysis

ACTIONS SUMMARY

1. Make updates as suggested for REQ-BIDIR and REQ-SUBNETWORK
2. Core question to the NMOP/NETMOD/TEAS – could TE profiles be used at all if they are not part of YANG (YANG library, versioning, tooling). We want to close this discussion about profiles as soon as possible and agree if they can be used or not? Should the profiles discussion continue in teas or in NMOP or in NETMOD? Should we have the interim SIMAP meeting and close this issue about the profiles? Chairs please recommend the next steps.
3. Italo will provide info which SIMAP requirements identified as gaps can be supported by RFC 8795 profiles and how
4. Italo can provide the draft or proposal for this SIMAP requirements with RFC8795 profile and we will discuss and than community/industry decides
5. Organize interim meeting for SIMAP Modelling

Comments, Questions?

Anyone interested to get involved or to discuss any aspects, please contact any of the co-authors in Montreal.

5. REQ-EXTENSIBLE: Extensible via metadata.

Add the following to network, node, termination-point and link, and to supporting relations:

```
anydata extension {
      config false;
      description
        "The extension point for any other meta info or data or any
        unknown extensions. Proposed solution for SIMAP requirement
        REQ-EXTENSIBLE. Any additional info that is topologically
        significant can also be added this way for requirement
        REQ-TOPO-ONLY or REQ-PROPERTIES.";
    }
```

Do we need some formal way for adding some meta data at different layers via identity?

Do we need sublayer? If we want to split a layer into some sublayers (e.g):

- Service layer into e2e and path
- L2 into L2 Logical and L2 virtual

Do we need generic and technology specific roles at different layers (e.g.):

- Generic (L2 Link)
- Technology Specific (L2 LAG Link, L2 LAG Member Link)

6. REQ-PROPERTIES: SIMAP entities should mainly contain properties used to identify topological entities at different layers, identify their roles, and topological relationships between them.

```
/*
  * Common SIMAP groupings for optional RFC8345 extensions
  * Addressing requirements REQ-PROPERTIES as name, label and
  *  description may be important properties that
  * clarify the topological roles for different layers and technologies
  */

 grouping simap-common {
   description "A reusable set of optional extensions for network,
              node, termination point and link";
   leaf name {
     type string;
     description
       "The user friendly name, if required.
       It is optional, for backward compatibility";
   }
   leaf-list label {
     type string;
     description
       "Used for optionally adding any labels to the instances,
        if required";
   }
   leaf description {
     type string;
     description
       "Used for optionally adding any description to the instances,
       if required";
   }
   anydata extension {
     :
     :
 }
```

Maybe sublayer, generic and technology specific meta data mentioned in the previous slide may be added via common properties as optional properties

Proposal not done yet

7. REQ-PLUGG: SIMAP must be pluggable.

1. **Via YANG (proposed draft, hackathon)**
   Draft: External Relationship model for SIMAP: draft-vivek-nmop-simap-external-relationship
   Hackathon: SIMAP for Services provided over SRv6, relying on External Relationship models
   We will not discuss the proposal today, but please read the draft and share the feedback/comments on the mailing list

2. **Via Knowledge Graph / Ontology**
   Hackathon: Knowledge Graphs for Network Operations
   SIMAP YANG data model and data converted into Knowledge Graph, relations to external data models via Knowledge Graph

8. REQ-SNAPSHOT: Different snapshots

Candidates: 1) generic solution outside of SIMAP for historical 2) via files 3) via duplicated containers

Candidate 2 proposed:

```
container networks-history {
    config false;
    list network-history {
      key "live-network-ref timestamp";
      description
        "Historical network. Snapshot is generated for each historical
         instance, network-ref is the reference for the live network";
      leaf live-network-ref {
        type leafref {
          path "/nw:networks/nw:network/nw:network-id";
      }
      leaf timestamp {
        type yang:date-and-time;
      }
      leaf file-id {
        type inet:uri;
      }
    }
  }
```

9. REQ-POTENTIAL: Potential new network topology

Candidates: 1) via separate endpoint 2) add semantics to the model

```
identity network-category {
    description "Base identity for the network category";
  }

  identity network-category-none {
    base "st:network-category";
    description "This is used when endpoint selection identifies if
                 live, potential or intended. This is the default";
  }

  identity network-category-potential {
    base "st:network-category";
    description "Potential topology. There may be optionally one or
                 multiple instances of the potential network, related
                 to the current network. Timestamp determines what
                 historical snapshot has been used when
                 creating the potential network instance";
  }
```

```
augment "/nw:networks/nw:network" {
    description
      "Adding optional capability for modelling of potential
       and intended network";

    leaf network-category {
      type identityref {
        base st:network-category;
      }
      description
        "The network category: none, live, potential, intended.
         Default is none.";
    }
    leaf live-network-ref {
      description
        "Required for potential and intended only to connect
         to the live network instance";
      type leafref {
        path "/nw:networks/nw:network/nw:network-id";
      require-instance false;
    }
    leaf timestamp {
      description
        "Required for potential only to connect to the
         historical snapshot";
      type yang:date-and-time;
    }
  }
```

10. REQ-INTENDED: Intended topology

Candidates: 1) via separate endpoint 2) add semantics to the model

```
identity network-category {
    description "Base identity for the network category";
  }

  identity network-category-none {
    base "st:network-category";
    description "This is used when endpoint selection identifies if
            live, potential or intended. This is the default";
  }

identity network-category-intended {
  base "st:network-category";
  description "Intended topology, there is optionally 1 instance of
          intended network related to the live network instance";
 }
```

```
augment "/nw:networks/nw:network" {

 description
  "Adding optional capability for modelling of potential and
  intended network";

 leaf network-category {
  type identityref {
   base st:network-category;
  }
  description
   "The network category: live, potential, intended.
   Default is live.";
 }
 leaf live-network-ref {
  description
   "Required for potential and intended only to connect to the
   live network instance";
   type leafref {
    path "/nw:networks/nw:network/nw:network-id";
   require-instance false;
   }
 }
 :
 :
}
```