
UniMgr

Release master

OpenDaylight Project

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USER NETWORK INTERFACE MANAGER PLUG-IN (UNIMGR) DEVELOPER GUIDE

1.1 Overview

The User Network Interface (UNI) Manager project within OpenDaylight provides data models and APIs that enable software applications and service orchestrators to configure and provision connectivity services; in particular, Carrier Ethernet services as defined by MEF Forum, in physical and virtual network elements.

1.2 Unimgr Architecture

Unimgr provides support for both service orchestration, via the Legato API, and network resource provisioning, via the Presto API. These APIs, and the interfaces they provide, are defined by YANG models developed within MEF in collaboration with ONF and IETF. An application/user can interact with Unimgr at either layer. Presto and Legato APIs are for LSO Architecture reference points defined in [MEF 55 specification](#).

1.2.1 Presto layer

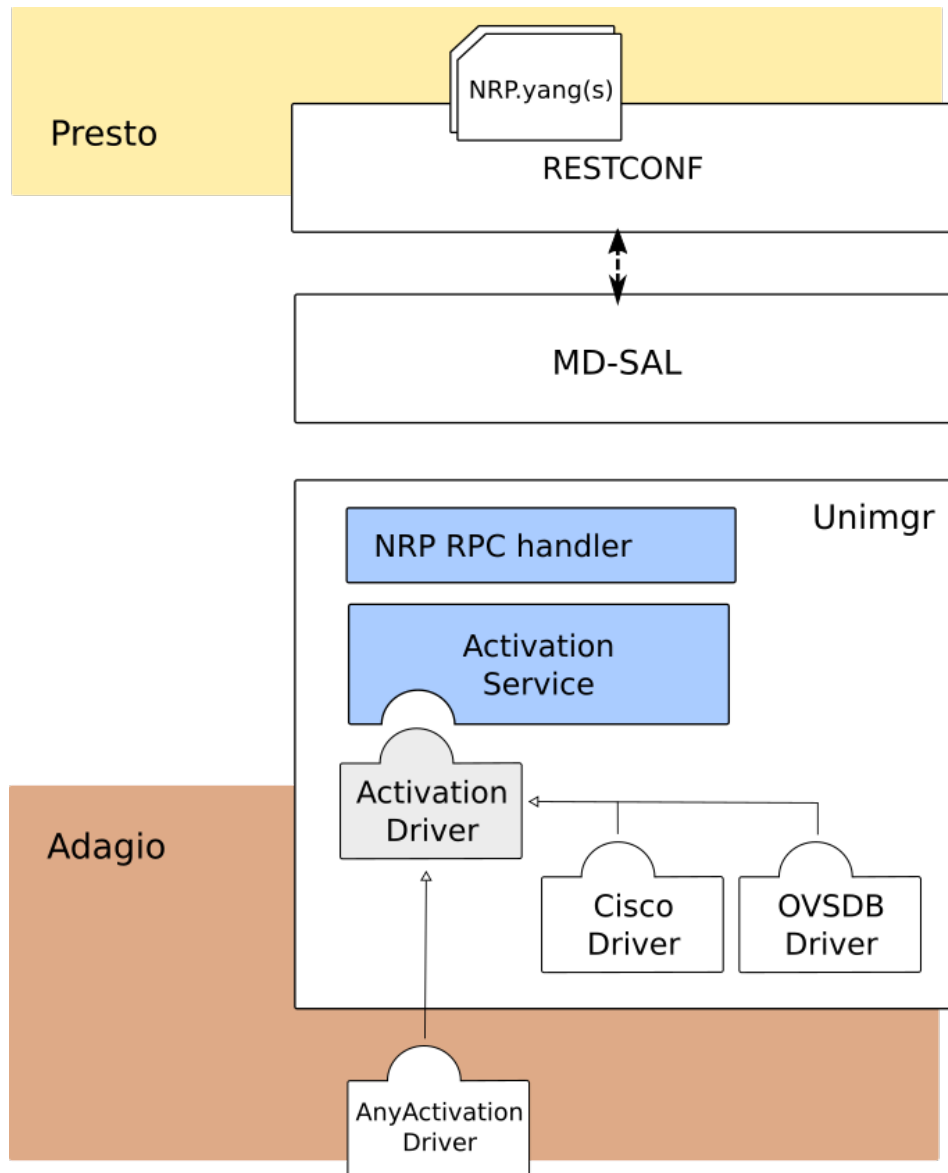
In current version of Unimgr the recent version of Presto NRP is supported. This model is based on Transport API (TAPI) from ONF. This API allows for management of connectivity services and exposes abstract topology of the managed infrastructure. By its nature Presto NRP write and update operations are defined as set of RPC calls. All the reads operation can be either specific RPCs or via RESTCONF data tree.

Presto layer architecture is depicted in figure above. There are two distinctive parts of Presto NRP business logic Activation Service and Activation Driver. Activation Service part of the framework is to encapsulate the common logic whereas Activation Driver is a way to encapsulate business logic to transform Presto Request into a given underlying technology. This way we are able to handle multi-vendor infrastructures and address various use cases as vendors specific code is encapsulated in drivers.

Activation Service

Activation service is responsible for handling the connectivity request. In case of service activation following steps are performed:

1. Validation of a request (e.g. if all endpoints exists)
2. Decomposition of a request into number of drivers sub-requests
3. Activation of the request for selected drivers
4. Update of the data model and creating `ConnectivityService` and `Connection` objects for the request

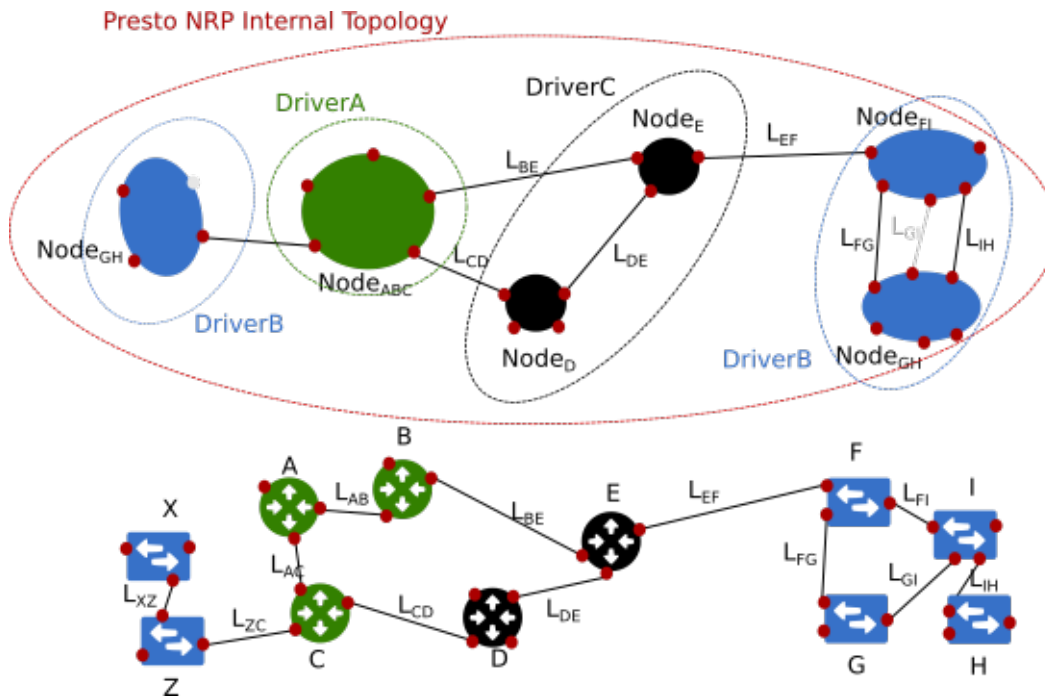


Step 1. Implements only minimal functionality.

Step 2. Allows for multi-vendor configuration as decomposition mechanisms defines all drivers required to satisfy given connectivity request. Currently only p2p connectivity services are supported in the decomposition mechanism.

Both validation and decomposition mechanisms are plug-able thus users can support more sophisticated scenarios.

Activation Driver



Activation Driver has two main responsibilities:

- to handle connectivity service requests
- to contribute to Presto Topology with abstract nodes driver can handle

In figure above example topology and drivers are shown. As you can see it is up to driver how to model infrastructure it manages. Thus, driver A has decided to model all devices as single virtual node, whereas driver C is exposing every single device as a node.

The connectivity service is defined between `ServiceInterfacePoint` (SIP) which are mapped to `NodeEdgePoint` (NEP). A SIP can have UNI, ENNI or INNI role. Assigning a SIP to NEP can be done automatically by driver or with the use of Unimgr extension API. It is assumed that driver can connect any number of SIPs related to NEPs for every Node it exposes.

There is a contract for a given Karaf bundle to be recognized as a driver. The following must be fulfilled:

- A driver have to expose an OSGI service that implements `org.opendaylight.unimgr.mef.nrp.api.ActivationDriverBuilder`
- Implement a component that is responsible for writing to topology (in general the requirement is to add at least a single node to topology with id `org.opendaylight.unimgr.mef.nrp.api.TapiConstants#PRESTO_SYSTEM_TOPO`)

There are three drivers maintained as part of Unimgr project:

template-driver Which is intended as a template for real drivers development. It is not connected to infrastructure.

ovs-driver Which is a driver for OpenFlow infrastructure.

cisco-xr-driver A netconf driver for Cisco XR devices for MPLS inter-connectivity

1.3 Key APIs and Interfaces

Legato YANG models: <https://git.opendaylight.org/gerrit/gitweb?p=unimgr.git;a=tree;f=legato-api/src/main/yang;hb=refs/heads/stable/nitrogen>

Presto YANG models: <https://git.opendaylight.org/gerrit/gitweb?p=unimgr.git;a=tree;f=presto-api/src/main/yang;hb=refs/heads/stable/nitrogen>

1.4 Legato API Tree

module: mef-services

```
+--rw mef-services
  +--rw mef-service* [svc-id]
    +--rw evc
      | +--rw unis
      | | +--rw uni* [uni-id]
      | | +--rw evc-uni-ce-vlans
      | | | +--rw evc-uni-ce-vlan* [vid]
      | | | +--rw vid -> /mef-interfaces:mef-interfaces/unis/uni[mef-
↪ interfaces:uni-id = current()/../../../../../uni-id]/ce-vlans/ce-vlan/vid
      | | | +--rw ingress-bwp-flows-per-cos!
      | | | +--rw coupling-enabled? boolean
      | | | +--rw bwp-flow-per-cos* [cos-name]
      | | | +--rw cos-name -> /mef-global:mef-global/profiles/cos-names/
↪ cos-name/name
      | | | +--rw bw-profile -> /mef-interfaces:mef-interfaces/unis/
↪ uni[mef-interfaces:uni-id = current()/../../../../../uni-id]/ingress-envelopes/envelope/
↪ env-id
      | | | +--rw egress-bwp-flows-per-eec!
      | | | +--rw coupling-enabled? boolean
      | | | +--rw bwp-flow-per-eec* [eec-name]
      | | | +--rw eec-name -> /mef-global:mef-global/profiles/eec-names/
↪ eec-name/name
      | | | +--rw bw-profile -> /mef-interfaces:mef-interfaces/unis/
↪ uni[mef-interfaces:uni-id = current()/../../../../../uni-id]/egress-envelopes/envelope/
↪ env-id
      | | | +--rw status
      | | | | +--ro oper-state-enabled? boolean
      | | | | +--ro available-status? mef-types:svc-endpoint-availability-type
      | | | +--rw uni-id -> /mef-interfaces:mef-interfaces/
↪ unis/uni/uni-id
      | | | +--rw role mef-types:evc-uni-role-type
      | | | +--rw admin-state-enabled? boolean
      | | | +--rw color-id? mef-types:cos-color-identifier-
↪ type
      | | +--rw data-svc-frn-cos? -> /mef-global:mef-global/
↪ profiles/cos/cos-profile/id
```

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```

| |      +--rw l2cp-svc-frm-cos?          -> /mef-global:mef-global/
↪profiles/l2cp-cos/l2cp-profile/id
| |      +--rw soam-svc-frm-cos?          -> /mef-global:mef-global/
↪profiles/cos/cos-profile/id
| |      +--rw data-svc-frm-eec?          -> /mef-global:mef-global/
↪profiles/eec/eec-profile/id
| |      +--rw l2cp-svc-frm-eec?          -> /mef-global:mef-global/
↪profiles/l2cp-eec/l2cp-profile/id
| |      +--rw soam-svc-frm-eec?          -> /mef-global:mef-global/
↪profiles/eec/eec-profile/id
| |      +--rw ingress-bw-profile-per-evc? -> /mef-interfaces:mef-interfaces/
↪unis/uni[mef-interfaces:uni-id = current()../../uni-id]/ingress-envelopes/envelope/
↪env-id
| |      +--rw egress-bw-profile-per-evc? -> /mef-interfaces:mef-interfaces/
↪unis/uni[mef-interfaces:uni-id = current()../../uni-id]/egress-envelopes/envelope/env-
↪id
| |      +--rw src-mac-addr-limit-enabled? boolean
| |      +--rw src-mac-addr-limit?        uint32
| |      +--rw src-mac-addr-limit-interval? yang:timeticks
| |      +--rw test-meg-enabled?          boolean
| |      +--rw test-meg?                  mef-types:identifier45
| |      +--rw subscriber-meg-mip-enabled? boolean
| |      +--rw subscriber-meg-mip?        mef-types:identifier45
| +--rw status
| | +--ro oper-state-enabled?    boolean
| | +--ro available-status?     mef-types:virt-cx-availability-type
| +--rw sls-inclusions-by-cos
| | +--rw sls-inclusion-by-cos* [cos-name]
| | +--rw cos-name -> /mef-global:mef-global/profiles/cos-names/cos-
↪name/name
| +--rw sls-uni-inclusions!
| | +--rw sls-uni-inclusion-set* [pm-type pm-id uni-id1 uni-id2]
| | +--rw pm-type -> /mef-global:mef-global/slss/sls[mef-global:sls-id_
↪= current()../../evc-performance-sls]/perf-objs/perf-obj/pm-type
| | +--rw pm-id -> /mef-global:mef-global/slss/sls[mef-global:sls-id_
↪= current()../../evc-performance-sls]/perf-objs/perf-obj[mef-global:pm-type =_
↪current()../../pm-type]/pm-id
| | +--rw uni-id1 -> ../../../../unis/uni/uni-id
| | +--rw uni-id2 -> ../../../../unis/uni/uni-id
| +--rw sls-uni-exclusions!
| | +--rw sls-uni-exclusion-set* [pm-type pm-id uni-id1 uni-id2]
| | +--rw pm-type -> /mef-global:mef-global/slss/sls[mef-global:sls-id_
↪= current()../../evc-performance-sls]/perf-objs/perf-obj/pm-type
| | +--rw pm-id -> /mef-global:mef-global/slss/sls[mef-global:sls-id_
↪= current()../../evc-performance-sls]/perf-objs/perf-obj[mef-global:pm-type =_
↪current()../../pm-type]/pm-id
| | +--rw uni-id1 -> ../../../../unis/uni/uni-id
| | +--rw uni-id2 -> ../../../../unis/uni/uni-id
| +--rw evc-id mef-types:evc-id-type
| +--ro evc-status? mef-types:evc-status-type
| +--rw evc-type mef-types:evc-type
| +--rw admin-state-enabled? boolean
| +--rw elastic-enabled? boolean
| +--rw elastic-service? mef-types:identifier45
| +--rw max-uni-count? uint32
| +--rw preserve-ce-vlan-id? boolean
| +--rw cos-preserve-ce-vlan-id? boolean

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```

|   +--rw evc-performance-sls?          -> /mef-global:mef-global/slss/sls/sls-id
|   +--rw unicast-svc-frn-delivery?      mef-types:data-svc-frame-delivery-type
|   +--rw multicast-svc-frn-delivery?     mef-types:data-svc-frame-delivery-type
|   +--rw broadcast-svc-frn-delivery?     mef-types:data-svc-frame-delivery-type
|   +--rw evc-meg-id?                    mef-types:identifier45
|   +--rw max-svc-frame-size?             mef-types:max-svc-frame-size-type
+--rw svc-id                             mef-types:retail-svc-id-type
+--rw sp-id?                             -> /mef-global:mef-global/svc-providers/svc-provider/sp-id
+--rw svc-type?                           mef-types:mef-service-type
+--rw user-label?                         mef-types:identifier45
+--rw svc-entity?                         mef-types:service-entity-type

```

module: mef-global

```

+--rw mef-global
+--rw svc-providers!
|   +--rw svc-provider* [sp-id]
|       +--rw sp-id      mef-types:svc-provider-type
+--rw cens!
|   +--rw cen* [cen-id]
|       +--rw cen-id     mef-types:cen-type
|       +--rw sp-id?     -> /mef-global/svc-providers/svc-provider/sp-id
+--rw slss!
|   +--rw sls* [sls-id]
|       +--rw perf-objs
|           +--rw pm-time-interval          uint64
|           +--rw pm-time-interval-increment uint64
|           +--rw unavail-flr-threshold-pp   mef-types:simple-percent
|           +--rw consecutive-small-time-intervals uint64
|           +--rw perf-obj* [pm-type pm-id]
|               +--rw pm-type                mef-types:performance-
↪metric-type
|           +--rw pm-id                mef-types:identifier45
|           +--rw cos-name              -> /mef-global/profiles/
↪cos-names/cos-name/name
|           +--rw fd-pp                  mef-types:simple-percent
|           +--rw fd-range-pp            mef-types:simple-percent
|           +--rw fd-perf-obj            uint64
|           +--rw fd-range-perf-obj      uint64
|           +--rw fd-mean-perf-obj       uint64
|           +--rw ifdv-pp                 mef-types:simple-percent
|           +--rw ifdv-pair-interval     mef-types:simple-percent
|           +--rw ifdv-perf-obj          uint64
|           +--rw flr-perf-obj           uint64
|           +--rw avail-pp               mef-types:simple-percent
|           +--rw hli-perf-obj           uint64
|           +--rw chli-consecutive-small-time-intervals uint64
|           +--rw chli-perf-obj         uint64
|           +--rw min-uni-pairs-avail    uint64
|           +--rw gp-avail-pp            mef-types:simple-percent
|       +--rw sls-id                     mef-types:cen-type
|       +--rw sp-id?                     -> /mef-global/svc-providers/svc-provider/sp-id
+--rw subscribers!
|   +--rw subscriber* [sub-id]
|       +--rw sub-id      mef-types:subscriber-type
|       +--rw sp-id?     -> /mef-global/svc-providers/svc-provider/sp-id
|       +--rw cen-id?    -> /mef-global/cens/cen/cen-id

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```

+--rw profiles!
+--rw cos-names
|   +--rw cos-name* [name]
|       +--rw name      mef-types:identifier45
+--rw eec-names
|   +--rw eec-name* [name]
|       +--rw name      mef-types:identifier45
+--rw ingress-bwp-flows
|   +--rw bwp-flow* [bw-profile]
|       +--rw bw-profile      mef-types:identifier45
|       +--rw user-label?     mef-types:identifier45
|       +--rw cir?            mef-types:bwp-cir-type
|       +--rw cir-max?       mef-types:bwp-cir-type
|       +--rw cbs?            mef-types:bwp-cbs-type
|       +--rw eir?            mef-types:bwp-eir-type
|       +--rw eir-max?       mef-types:bwp-eir-type
|       +--rw ebs?            mef-types:bwp-ebs-type
|       +--rw coupling-enabled? boolean
|       +--rw color-mode?     mef-types:bwp-color-mode-type
|       +--rw coupling-flag?  mef-types:bwp-coupling-flag-type
+--rw egress-bwp-flows
|   +--rw bwp-flow* [bw-profile]
|       +--rw bw-profile      mef-types:identifier45
|       +--rw user-label?     mef-types:identifier45
|       +--rw cir?            mef-types:bwp-cir-type
|       +--rw cir-max?       mef-types:bwp-cir-type
|       +--rw cbs?            mef-types:bwp-cbs-type
|       +--rw eir?            mef-types:bwp-eir-type
|       +--rw eir-max?       mef-types:bwp-eir-type
|       +--rw ebs?            mef-types:bwp-ebs-type
|       +--rw coupling-enabled? boolean
|       +--rw color-mode?     mef-types:bwp-color-mode-type
|       +--rw coupling-flag?  mef-types:bwp-coupling-flag-type
+--rw l2cp-cos
|   +--rw l2cp-profile* [id]
|       +--rw l2cps
|           |   +--rw l2cp* [dest-mac-addr peering-proto-name]
|           |       |   +--rw dest-mac-addr      yang:mac-address
|           |       |   +--rw peering-proto-name  mef-types:identifier45
|           |       |   +--rw protocol?           mef-types:l2cp-peering-protocol-type
|           |       |   +--rw protocol-id?        yang:hex-string
|           |       |   +--rw cos-name?            -> /mef-global/profiles/cos-names/cos-
↪name/name
|           |       +--rw handling?                mef-types:l2cp-handling-type
|           |       +--rw subtype*                 yang:hex-string
|           |       +--rw id                        mef-types:identifier45
|           |       +--rw user-label?               mef-types:identifier45
+--rw l2cp-eec
|   +--rw l2cp-profile* [id]
|       +--rw l2cps
|           |   +--rw l2cp* [dest-mac-addr peering-proto-name]
|           |       |   +--rw dest-mac-addr      yang:mac-address
|           |       |   +--rw peering-proto-name  mef-types:identifier45
|           |       |   +--rw protocol?           mef-types:l2cp-peering-protocol-type
|           |       |   +--rw protocol-id?        yang:hex-string
|           |       |   +--rw eec-name?            -> /mef-global/profiles/eec-names/eec-
↪name/name

```

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```

|         |         +--rw handling?          mef-types:l2cp-handling-type
|         |         +--rw subtype*          yang:hex-string
|         +--rw id          mef-types:identifier45
|         +--rw user-label? mef-types:identifier45
+--rw l2cp-peering
|   +--rw l2cp-profile* [id]
|   +--rw l2cps
|   |   +--rw l2cp* [dest-mac-addr peering-proto-name]
|   |   |   +--rw dest-mac-addr          yang:mac-address
|   |   |   +--rw peering-proto-name      mef-types:identifier45
|   |   |   +--rw protocol?              mef-types:l2cp-peering-protocol-type
|   |   |   +--rw protocol-id?           yang:hex-string
|   |   |   +--rw subtype*              yang:hex-string
|   |   +--rw id          mef-types:identifier45
|   |   +--rw user-label? mef-types:identifier45
+--rw elmi
|   +--rw elmi-profile* [id]
|   +--rw id          mef-types:identifier45
|   +--rw user-label? mef-types:identifier45
|   +--rw polling-counter? mef-types:elmi-polling-counter-type
|   +--rw status-error-threshold? mef-types:elmi-status-error-threshold-
↪type
|   +--rw polling-timer?          mef-types:elmi-polling-timer-type
|   +--rw polling-verification-timer? mef-types:elmi-polling-verification-
↪timer-type
+--rw eec
|   +--rw eec-profile* [id]
|   +--rw id          mef-types:identifier45
|   +--rw (eec-id)?
|   |   +--:(pcp)
|   |   |   +--rw eec-pcp!
|   |   |   +--rw default-pcp-eec-name? -> /mef-global/profiles/eec-names/
↪eec-name/name
|   |   |   +--rw default-pcp-color?          mef-types:cos-color-type
|   |   |   +--rw pcp* [pcp-value]
|   |   |   |   +--rw pcp-value          mef-types:ieee8021p-priority-type
|   |   |   |   +--rw discard-value?      boolean
|   |   |   +--rw eec-name?              -> /mef-global/profiles/eec-names/eec-
↪name/name
|   |   |   +--rw color?                  mef-types:cos-color-type
|   |   +--:(dscp)
|   |   |   +--rw eec-dscp!
|   |   |   +--rw default-ipv4-eec-name? -> /mef-global/profiles/eec-names/
↪eec-name/name
|   |   |   +--rw default-ipv4-color?          mef-types:cos-color-type
|   |   |   +--rw default-ipv6-eec-name?      -> /mef-global/profiles/eec-names/
↪eec-name/name
|   |   |   +--rw default-ipv6-color?          mef-types:cos-color-type
|   |   |   +--rw ipv4-dscp* [dscp-value]
|   |   |   |   +--rw dscp-value          inet:dscp
|   |   |   |   +--rw discard-value?      boolean
|   |   |   +--rw eec-name?              -> /mef-global/profiles/eec-names/eec-
↪name/name
|   |   |   +--rw color?                  mef-types:cos-color-type
|   |   |   +--rw ipv6-dscp* [dscp-value]
|   |   |   |   +--rw dscp-value          inet:dscp
|   |   |   |   +--rw discard-value?      boolean

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```

|          +--rw eec-name?          -> /mef-global/profiles/eec-names/eec-
↪name/name
|          +--rw color?             mef-types:cos-color-type
+--rw cos
  +--rw cos-profile* [id]
    +--rw id             mef-types:identifier45
    +--rw (cos-id)?
      +--:(evc)
        | +--rw cos-evc!
        | +--rw default-evc-cos-name? -> /mef-global/profiles/cos-names/
↪cos-name/name
        | +--rw default-evc-color?    mef-types:cos-color-type
      +--:(pcp)
        | +--rw cos-pcp!
        | +--rw default-pcp-cos-name? -> /mef-global/profiles/cos-names/
↪cos-name/name
        | +--rw default-pcp-color?    mef-types:cos-color-type
        | +--rw pcp* [pcp-value]
        |   +--rw pcp-value          mef-types:ieee8021p-priority-type
        |   +--rw discard-value?     boolean
        |   +--rw cos-name?          -> /mef-global/profiles/cos-names/cos-
↪name/name
        |   +--rw color?             mef-types:cos-color-type
      +--:(dscp)
        +--rw cos-dscp!
        +--rw default-ipv4-cos-name? -> /mef-global/profiles/cos-names/
↪cos-name/name
        +--rw default-ipv4-color?    mef-types:cos-color-type
        +--rw default-ipv6-cos-name? -> /mef-global/profiles/cos-names/
↪cos-name/name
        +--rw default-ipv6-color?    mef-types:cos-color-type
        +--rw ipv4-dscp* [dscp-value]
        | +--rw dscp-value          inet:dscp
        | +--rw discard-value?     boolean
        | +--rw cos-name?          -> /mef-global/profiles/cos-names/cos-
↪name/name
        | +--rw color?             mef-types:cos-color-type
        +--rw ipv6-dscp* [dscp-value]
        +--rw dscp-value          inet:dscp
        +--rw discard-value?     boolean
        +--rw cos-name?          -> /mef-global/profiles/cos-names/cos-
↪name/name
        +--rw color?             mef-types:cos-color-type

```

1.5 Presto API Tree

module: onf-core-network-module

```

+--rw forwarding-constructs
  +--rw forwarding-construct* [uuid]
    +--rw uuid          string
    +--rw layerProtocolName? onf-cnt:LayerProtocolName
    +--rw lowerLevelFc*  -> /forwarding-constructs/forwarding-construct/uuid
    +--rw fcRoute* [uuid]

```

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```

|   +--rw uuid      string
|   +--rw fc*       -> /forwarding-constructs/forwarding-construct/uuid
+--rw fcPort* [topology node tp]
|   +--rw topology      nt:topology-ref
|   +--rw node          nt:node-ref
|   +--rw tp            nt:tp-ref
|   +--rw role?         onf-cnt:PortRole
|   +--rw fcPortDirection? onf-cnt:PortDirection
+--rw fcSpec
|   +--rw uuid?          string
|   +--rw fcPortSpec* [uuid]
|   |   +--rw uuid      string
|   |   +--rw ingressFcPortSet* [topology node tp]
|   |   |   +--rw topology      nt:topology-ref
|   |   |   +--rw node          nt:node-ref
|   |   |   +--rw tp            nt:tp-ref
|   |   +--rw egressFcPortSet* [topology node tp]
|   |   |   +--rw topology      nt:topology-ref
|   |   |   +--rw node          nt:node-ref
|   |   |   +--rw tp            nt:tp-ref
|   |   +--rw role?         string
|   +--rw nrp:nrp-ce-fcspec-attrs
|       +--rw nrp:connectionType?      nrp-types:NRP_ConnectionType
|       +--rw nrp:unicastFrameDelivery? nrp-types:NRP_ServiceFrameDelivery
|       +--rw nrp:multicastFrameDelivery? nrp-types:NRP_ServiceFrameDelivery
|       +--rw nrp:broadcastFrameDelivery? nrp-types:NRP_ServiceFrameDelivery
|       +--rw nrp:vcMaxServiceFrame?    nrp-types:NRP_PositiveInteger
|       +--rw nrp:vcId?                 nrp-types:NRP_PositiveInteger
+--rw forwardingDirection? onf-cnt:ForwardingDirection

```

augment /nt:network-topology/nt:topology/nt:node/nt:termination-point:

```

+--rw ltp-attrs
+--rw lpList* [uuid]
|   +--rw uuid      string
|   +--rw layerProtocolName? onf-cnt:LayerProtocolName
|   +--rw lpSpec
|   |   +--rw adapterSpec
|   |   |   +--rw nrp:nrp-conn-adapt-spec-attrs
|   |   |   |   +--rw nrp:sourceMacAddressLimit
|   |   |   |   |   +--rw nrp:enabled?      boolean
|   |   |   |   |   +--rw nrp:limit?       NRP_NaturalNumber
|   |   |   |   |   +--rw nrp:timeInterval? NRP_NaturalNumber
|   |   |   |   +--rw nrp:CeExternalInterface
|   |   |   |   |   +--rw nrp:physicalLayer?      nrp-types:NRP_PhysicalLayer
|   |   |   |   |   +--rw nrp:syncMode* [linkId]
|   |   |   |   |   |   +--rw nrp:linkId      string
|   |   |   |   |   |   +--rw nrp:syncModeEnabled? boolean
|   |   |   |   |   +--rw nrp:numberOfLinks?      nrp-types:NRP_NaturalNumber
|   |   |   |   +--rw nrp:resiliency?      nrp-types:NRP_
↪InterfaceResiliency
|   |   |   |   |   +--rw nrp:portConvsIdToAggLinkMap
|   |   |   |   |   |   +--rw nrp:conversationId? NRP_NaturalNumber
|   |   |   |   |   |   +--rw nrp:linkId?       NRP_NaturalNumber
|   |   |   |   |   +--rw nrp:maxFrameSize?      nrp-types:NRP_NaturalNumber
|   |   |   |   |   +--rw nrp:linkOamEnabled?    boolean
|   |   |   |   +--rw nrp:tokenShareEnabled?    boolean

```

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```

| | | | | +--rw nrp:serviceProviderUniId?      string
| | | | | +--rw nrp:colorIdentifier
| | | | |   +--rw (identifier)?
| | | | |     +--:(sap-color-id)
| | | | |       | +--rw nrp:serviceAccessPointColorId
| | | | |       |   +--rw nrp:color?      nrp-types:NRP_FrameColor
| | | | |     +--:(pcp-color-id)
| | | | |       | +--rw nrp:pcpColorId
| | | | |       |   +--rw nrp:vlanTag?      nrp-types:NRP_VlanTag
| | | | |       |   +--rw nrp:pcpValue*     nrp-types:NRP_NaturalNumber
| | | | |       |   +--rw nrp:color?      nrp-types:NRP_FrameColor
| | | | |     +--:(dei-color-id)
| | | | |       | +--rw nrp:deiColorId
| | | | |       |   +--rw nrp:vlanTag?      nrp-types:NRP_VlanTag
| | | | |       |   +--rw nrp:deiValue*     nrp-types:NRP_NaturalNumber
| | | | |       |   +--rw nrp:color?      nrp-types:NRP_FrameColor
| | | | |     +--:(desp-color-id)
| | | | |       +--rw nrp:despColorId
| | | | |       +--rw nrp:ipVersion?      nrp-types:NRP_IpVersion
| | | | |       +--rw nrp:dscpValue*     nrp-types:NRP_NaturalNumber
| | | | |       +--rw nrp:color?      nrp-types:NRP_FrameColor
| | | | | +--rw nrp:ingressBwpFlow
| | | | |   +--rw nrp:bwpFlowIndex?      nrp-types:NRP_PositiveInteger
| | | | |   +--rw nrp:cir?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:cirMax?             nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:cbs?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:eir?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:eirMax?             nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:ebs?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:couplingFlag?      nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:colorMode?         nrp-types:NRP_ColorMode
| | | | |   +--rw nrp:rank?              nrp-types:NRP_PositiveInteger
| | | | |   +--rw nrp:tokenRequestOffset? nrp-types:NRP_NaturalNumber
| | | | | +--rw nrp:egressBwpFlow
| | | | |   +--rw nrp:bwpFlowIndex?      nrp-types:NRP_PositiveInteger
| | | | |   +--rw nrp:cir?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:cirMax?             nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:cbs?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:eir?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:eirMax?             nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:ebs?                nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:couplingFlag?      nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:colorMode?         nrp-types:NRP_ColorMode
| | | | |   +--rw nrp:rank?              nrp-types:NRP_PositiveInteger
| | | | |   +--rw nrp:tokenRequestOffset? nrp-types:NRP_NaturalNumber
| | | | | +--rw nrp:l2cpAddressSet?      nrp-types:NRP_L2cpAddressSet
| | | | | +--rw nrp:l2cpPeering* [linkId]
| | | | |   +--rw nrp:destinationMacAddress? string
| | | | |   +--rw nrp:protocolType?      NRP_ProtocolFrameType
| | | | |   +--rw nrp:linkId             string
| | | | |   +--rw nrp:protocolId?        string
| | | | | +--rw nrp:nrp-ivc-endpoint-conn-adapt-spec-attrs
| | | | |   +--rw nrp:ivcEndPointId?      string
| | | | |   +--rw nrp:testMegEnabled?      boolean
| | | | |   +--rw nrp:ivcEndPointRole?    nrp-types:NRP_EndPointRole
| | | | |   +--rw nrp:ivcEndPointMap* [vlanId]
| | | | |   +--rw nrp:vlanId             nrp-types:NRP_PositiveInteger

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```

| | | | | +--rw (endpoint-map-form)?
| | | | |   +--:(map-form-e)
| | | | |     | +--rw nrp:enni-svid* [vid]
| | | | |     |   +--rw nrp:vid      nrp-types:NRP_PositiveInteger
| | | | |   +--:(map-form-t)
| | | | |     | +--rw nrp:root-svid?   nrp-types:NRP_PositiveInteger
| | | | |     |   +--rw nrp:leaf-svid?  nrp-types:NRP_PositiveInteger
| | | | |   +--:(map-form-v)
| | | | |     | +--rw nrp:vuni-vid?    nrp-types:NRP_PositiveInteger
| | | | |     |   +--rw nrp:enni-cevid* [vid]
| | | | |     |     +--rw nrp:vid      nrp-types:NRP_PositiveInteger
| | | | |   +--:(map-form-u)
| | | | |     +--rw nrp:cvid* [vid]
| | | | |       +--rw nrp:vid      nrp-types:NRP_PositiveInteger
| | | | | +--rw nrp:subscriberMegMipEnabled?  boolean
| | | +--rw nrp:nrp-evc-endpoint-conn-adapt-spec-attrs
| | |   +--rw nrp:sourceMacAddressLimit
| | |     | +--rw nrp:enabled?      boolean
| | |     | +--rw nrp:limit?        NRP_NaturalNumber
| | |     | +--rw nrp:timeInterval? NRP_NaturalNumber
| | |   +--rw nrp:CeExternalInterface
| | |     | +--rw nrp:physicalLayer?      nrp-types:NRP_PhysicalLayer
| | |     | +--rw nrp:syncMode* [linkId]
| | |     |   | +--rw nrp:linkId          string
| | |     |   | +--rw nrp:syncModeEnabled? boolean
| | |     |   +--rw nrp:numberOfLinks?    nrp-types:NRP_NaturalNumber
| | |     |   +--rw nrp:resiliency?       nrp-types:NRP_
+--InterfaceResiliency
| | | | | +--rw nrp:portConvsIdToAggLinkMap
| | | | |   | +--rw nrp:conversationId?  NRP_NaturalNumber
| | | | |   | +--rw nrp:linkId?         NRP_NaturalNumber
| | | | |   +--rw nrp:maxFrameSize?      nrp-types:NRP_NaturalNumber
| | | | |   +--rw nrp:linkOamEnabled?    boolean
| | | | |   +--rw nrp:tokenShareEnabled? boolean
| | | | |   +--rw nrp:serviceProviderUniId? string
| | | +--rw nrp:colorIdentifier
| | |   +--rw (identifier)?
| | |     +--:(sap-color-id)
| | |       | +--rw nrp:serviceAccessPointColorId
| | |       |   +--rw nrp:color?  nrp-types:NRP_FrameColor
| | |     +--:(pcp-color-id)
| | |       | +--rw nrp:pcpColorId
| | |       |   +--rw nrp:vlanTag?  nrp-types:NRP_VlanTag
| | |       |   +--rw nrp:pcpValue* nrp-types:NRP_NaturalNumber
| | |       |   +--rw nrp:color?    nrp-types:NRP_FrameColor
| | |     +--:(dei-color-id)
| | |       | +--rw nrp:deiColorId
| | |       |   +--rw nrp:vlanTag?  nrp-types:NRP_VlanTag
| | |       |   +--rw nrp:deiValue* nrp-types:NRP_NaturalNumber
| | |       |   +--rw nrp:color?    nrp-types:NRP_FrameColor
| | |     +--:(desp-color-id)
| | |       +--rw nrp:despColorId
| | |       +--rw nrp:ipVersion?   nrp-types:NRP_IpVersion
| | |       +--rw nrp:dscpValue*   nrp-types:NRP_NaturalNumber
| | |       +--rw nrp:color?       nrp-types:NRP_FrameColor
| | | +--rw nrp:ingressBwpFlow
| | |   +--rw nrp:bwpFlowIndex?    nrp-types:NRP_PositiveInteger

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				++rw nrp:cir?	nrp-types:NRP_NaturalNumber
				++rw nrp:cirMax?	nrp-types:NRP_NaturalNumber
				++rw nrp:cbs?	nrp-types:NRP_NaturalNumber
				++rw nrp:eir?	nrp-types:NRP_NaturalNumber
				++rw nrp:eirMax?	nrp-types:NRP_NaturalNumber
				++rw nrp:ebs?	nrp-types:NRP_NaturalNumber
				++rw nrp:couplingFlag?	nrp-types:NRP_NaturalNumber
				++rw nrp:colorMode?	nrp-types:NRP_ColorMode
				++rw nrp:rank?	nrp-types:NRP_PositiveInteger
				++rw nrp:tokenRequestOffset?	nrp-types:NRP_NaturalNumber
				++rw nrp:egressBwpFlow	
				++rw nrp:bwpFlowIndex?	nrp-types:NRP_PositiveInteger
				++rw nrp:cir?	nrp-types:NRP_NaturalNumber
				++rw nrp:cirMax?	nrp-types:NRP_NaturalNumber
				++rw nrp:cbs?	nrp-types:NRP_NaturalNumber
				++rw nrp:eir?	nrp-types:NRP_NaturalNumber
				++rw nrp:eirMax?	nrp-types:NRP_NaturalNumber
				++rw nrp:ebs?	nrp-types:NRP_NaturalNumber
				++rw nrp:couplingFlag?	nrp-types:NRP_NaturalNumber
				++rw nrp:colorMode?	nrp-types:NRP_ColorMode
				++rw nrp:rank?	nrp-types:NRP_PositiveInteger
				++rw nrp:tokenRequestOffset?	nrp-types:NRP_NaturalNumber
				++rw nrp:l2cpAddressSet?	nrp-types:NRP_L2cpAddressSet
				++rw nrp:l2cpPeering* [linkId]	
				++rw nrp:destinationMacAddress?	string
				++rw nrp:protocolType?	NRP_ProtocolFrameType
				++rw nrp:linkId	string
				++rw nrp:protocolId?	string
				++rw nrp:evcEndPointId?	nrp-types:NRP_PositiveInteger
				++rw nrp:testMegEnabled?	boolean
				++rw nrp:evcEndPointRole?	nrp-types:NRP_EvcEndPointRole
				++rw nrp:evcEndPointMap* [vid]	
				++rw nrp:vid	nrp-types:NRP_PositiveInteger
				++rw nrp:subscriberMegMipEabled?	boolean
				++rw terminationSpec	
				++rw nrp:nrp-termination-spec-attrs	
				++rw nrp:physicalLayer?	nrp-types:NRP_PhysicalLayer
				++rw nrp:syncMode* [linkId]	
				++rw nrp:linkId	string
				++rw nrp:syncModeEnabled?	boolean
				++rw nrp:numberOfLinks?	nrp-types:NRP_NaturalNumber
				++rw nrp:resiliency?	nrp-types:NRP_InterfaceResiliency
				++rw nrp:portConvsIdToAggLinkMap	
				++rw nrp:conversationId?	NRP_NaturalNumber
				++rw nrp:linkId?	NRP_NaturalNumber
				++rw nrp:maxFrameSize?	nrp-types:NRP_NaturalNumber
				++rw nrp:linkOamEnabled?	boolean
				++rw nrp:tokenShareEnabled?	boolean
				++rw nrp:serviceProviderUniId?	string
				++rw nrp:nrp-uni-termination-attrs	
				++rw nrp:defaultCeVlanId?	nrp-types:NRP_PositiveInteger
				++rw nrp:uniMegEnabled?	boolean
				++rw nrp:elmiEnabled?	boolean
				++rw nrp:serviceprovideruniprofile?	string
				++rw nrp:operatoruniprofile?	string
				++rw nrp:ingressBwpUni	
				++rw nrp:bwpFlowIndex?	nrp-types:NRP_PositiveInteger

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```

| | | | +--rw nrp:cir?                nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:cirMax?            nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:cbs?                nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:eir?                nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:eirMax?            nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:ebs?                nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:couplingFlag?      nrp-types:NRP_NaturalNumber
| | | | +--rw nrp:colorMode?         nrp-types:NRP_ColorMode
| | | | +--rw nrp:rank?              nrp-types:NRP_PositiveInteger
| | | | +--rw nrp:tokenRequestOffset? nrp-types:NRP_NaturalNumber
| | | +--rw nrp:egressBwpUni
| | |   +--rw nrp:bwpFlowIndex?      nrp-types:NRP_PositiveInteger
| | |   +--rw nrp:cir?                nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:cirMax?            nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:cbs?                nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:eir?                nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:eirMax?            nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:ebs?                nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:couplingFlag?      nrp-types:NRP_NaturalNumber
| | |   +--rw nrp:colorMode?         nrp-types:NRP_ColorMode
| | |   +--rw nrp:rank?              nrp-types:NRP_PositiveInteger
| | |   +--rw nrp:tokenRequestOffset? nrp-types:NRP_NaturalNumber
| | +--rw adapterPropertySpecList* [uuid]
| | | +--rw uuid      string
| | | +--rw providerViewSpec
| | | +--rw serverSpecList* [uuid]
| | |   +--rw uuid      string
| +--rw configuredClientCapacity?  string
| +--rw lpDirection?              onf-cnt:TerminationDirection
| +--rw terminationState?         string
+--rw ltpSpec
+--rw ltpDirection?  onf-cnt:TerminationDirection

```

USER NETWORK INTERFACE MANAGER PLUG-IN (UNIMGR) USER GUIDE

2.1 Overview

The User Network Interface (UNI) Manager project within OpenDaylight provides data models and APIs that enable software applications and service orchestrators to configure and provision connectivity services; in particular, Carrier Ethernet services as defined by MEF Forum, in physical and virtual network elements.

MEF has defined the Lifecycle Service Orchestration (LSO) Reference Architecture for the management and control of domains and entities that enable cooperative network services across one or more service provider networks. The architecture also identifies LSO Reference Points, which are the logical points of interaction between specific functional management components. These LSO Reference Points are further defined by interface profiles and instantiated by APIs.

The LSO Reference Architecture is shown below. Note that this is a functional architecture that does not describe how the management components are implemented (e.g., single vs. multiple instances), but rather identifies management components that provide logical functionality as well as the points of interaction among them.

Unimgr provides support for both the Legato as well as the Presto interfaces. These interfaces, and the APIs associated with them, are defined by YANG models developed within MEF in collaboration with ONF and IETF. For the Carbon release, these are as follows:

Legato YANG modules: <https://git.opendaylight.org/gerrit/gitweb?p=unimgr.git;a=tree;f=legato-api/src/main/yang;hb=refs/heads/stable/carbon>

Presto YANG modules: <https://git.opendaylight.org/gerrit/gitweb?p=unimgr.git;a=tree;f=presto-api/src/main/yang;hb=refs/heads/stable/carbon>

An application/user can interact with Unimgr at either the service orchestration layer (Legato) or the network resource provisioning layer (Presto).

2.2 Unimgr Architecture

Unimgr is comprised of the following OpenDaylight Karaf features:

odl-unimgr-api	OpenDaylight :: UniMgr :: api
odl-unimgr	OpenDaylight :: UniMgr
odl-unimgr-console	OpenDaylight :: UniMgr :: CLI
odl-unimgr-rest	OpenDaylight :: UniMgr :: REST
odl-unimgr-ui	OpenDaylight :: UniMgr :: UI

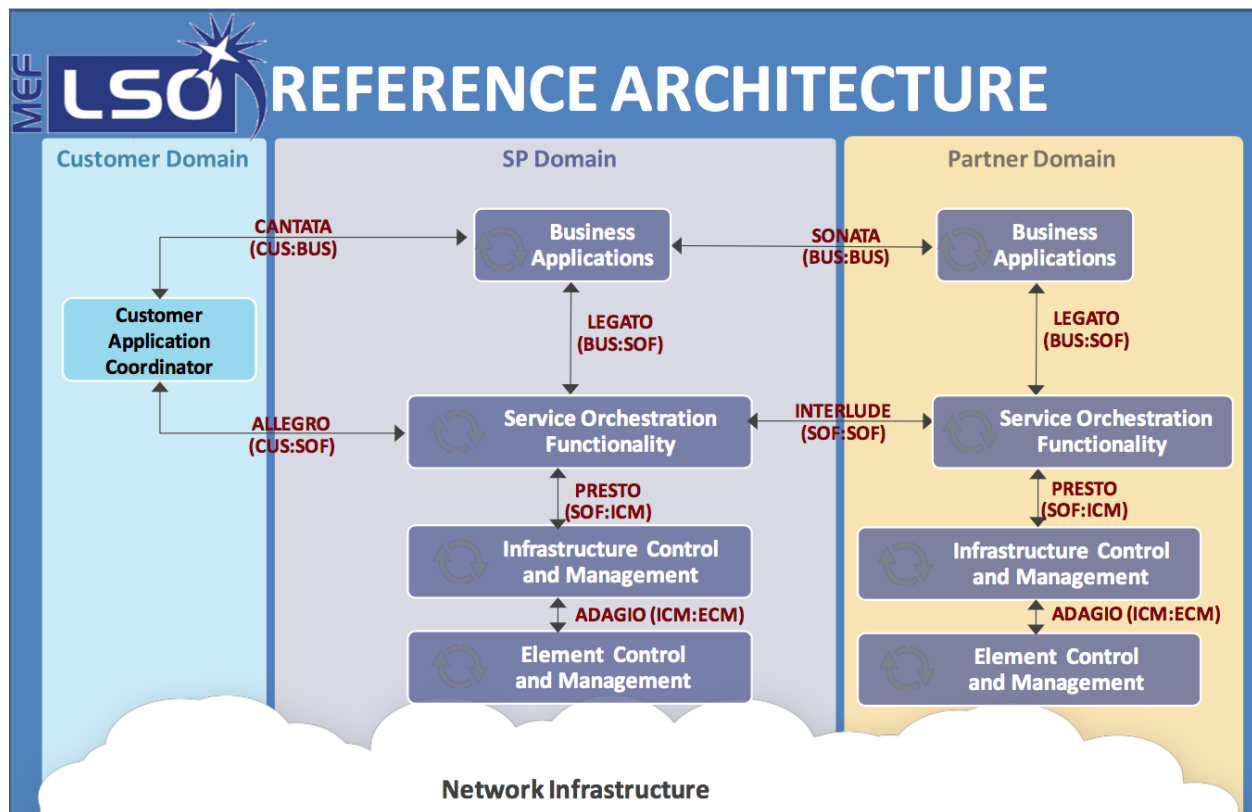


Fig. 1: MEF LSO Reference Architecture

2.3 Configuring Unimgr

After launching OpenDaylight, install the feature for Unimgr. From the karaf command prompt execute the following command:

```
$ feature:install odl-unimgr-ui
```

2.4 Explore and exercise the Unimgr REST API

To see the Unimgr API, browse to this URL: <http://localhost:8181/apidoc/explorer/index.html>

Replace localhost with the IP address or hostname where OpenDaylight is running if you are not running OpenDaylight locally on your machine.

See also the Unimgr Developer Guide for a full listing of the API.