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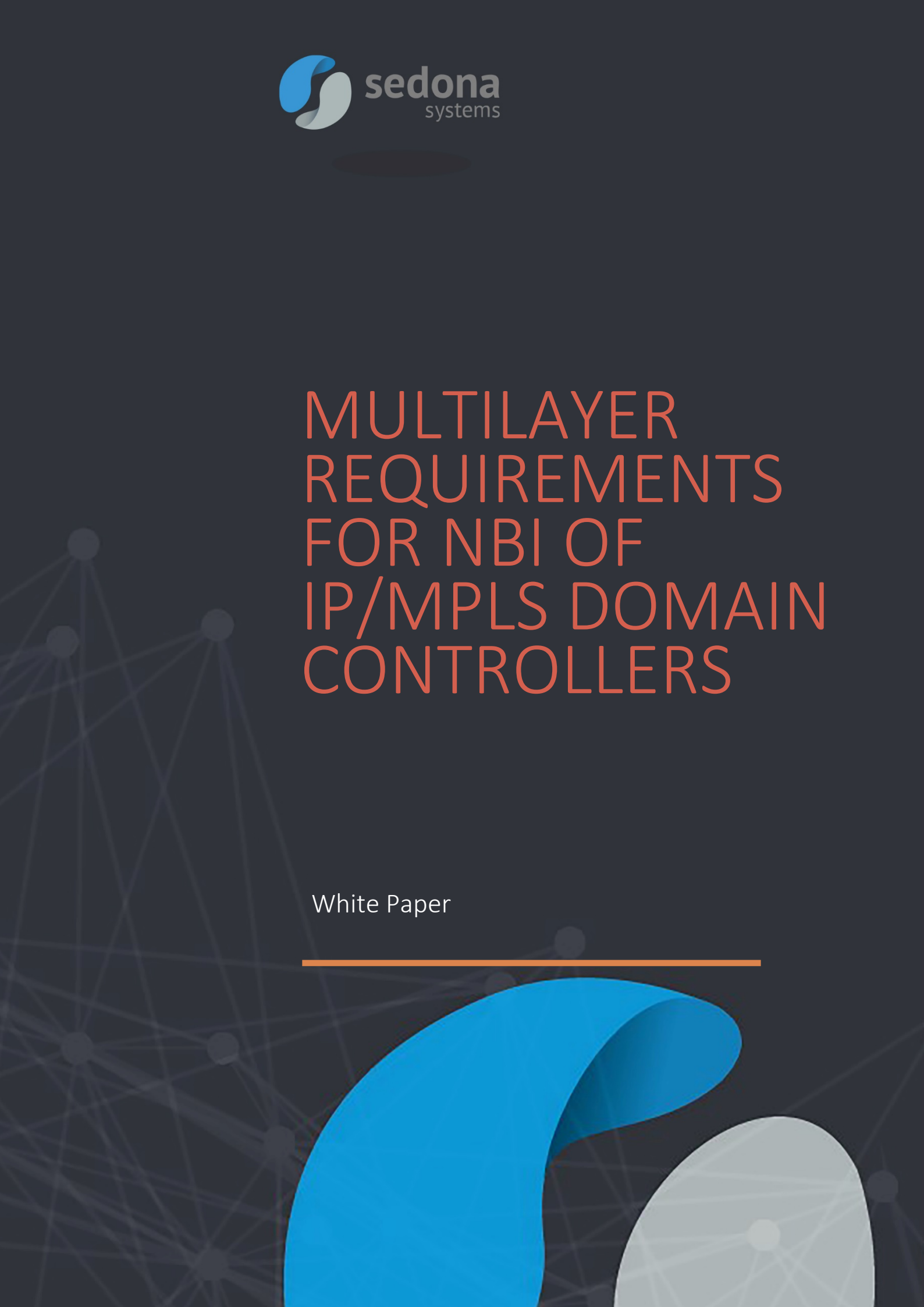
MULTILAYER REQUIREMENTS FOR NBI OF IP/MPLS DOMAIN CONTROLLERS

White Paper



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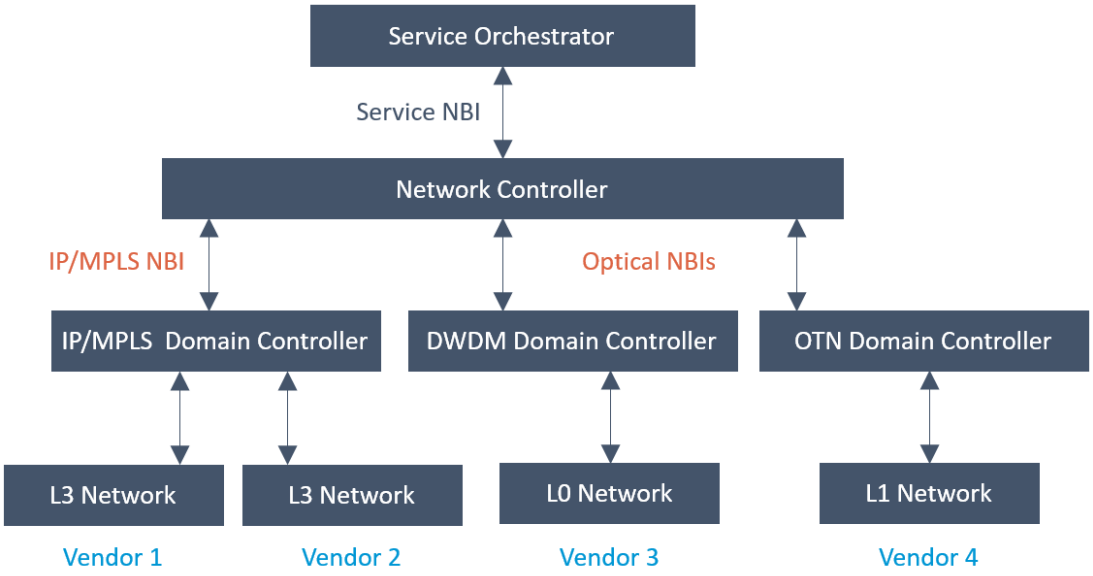
Scope

The control architecture for multilayer networking typically comprises of technology-specific and layer-specific controllers for different optical domains and IP/MPLS domains, a network controller (network orchestrator), and a service orchestrator. This multilayer architecture places specific requirements on the NBI between layer-specific domain controllers and the network controller (shown in orange in the following figure). This paper focuses on requirements for the NBI of IP/MPLS domain controllers in a multilayer architecture.

While standardization of this NBI is in progress both via IETF and ONF, and while there seems to be consensus on the RESTful format, the industry has not yet agreed on the actual data model. This paper does not dictate a particular data model, although an implementation of a subset of the ONF model in YANG is preferred. Instead, it defines the functional requirements for the NBI of IP/MPLS domain controllers and leaves the implementation of these functions open for the vendor.



NBI Requirements for IP/MPLS Domain Controller

The NBI of the IP/MPLS domain controller has four main functions: topology and traffic discovery, monitoring, provisioning, and simulations for what-if analysis.

Topology and Traffic Discovery Requirements

The NBI of the IP/MPLS domain controller must support the following functions to properly discover the network.

- Provide a list of sites, including their names and geographical locations. Typically, the desired resolution is one or a few sites per city. (This information might not reside on the network elements, but can exist on the domain controllers.)
- Provide the IP/MPLS layer topology.

  - The set of core and edge routers, including their names and loopback addresses
  - Association between routers and sites
  - Adjacencies between routers in the core and edge of the network
- Provide IP link, MPLS LSP, and routing information.
  - IGP (OSPF or IS-IS) metric per adjacency
  - ECMP configuration
  - Link bundle names and the names of link members within them
  - Other data affecting traffic routing, such as SRLGs and affinities
- Provide MPLS configuration.
  - List of LSPs and their priorities
  - LSP hop-by-hop routes
  - Working and protection LSPs
  - Fast Reroute configuration
- Provide measured end-to-end IP/MPLS layer traffic matrix across the network.
  - Both peak and average traffic
  - How traffic is split between different priorities
  - Actual and reserved MPLS LSP bandwidth
  - Traffic entering the network from other networks
  - Historical traffic matrix for a requested point in time
- Provide a list of active, core-facing interfaces for each router and the remote peer for each connection between routers.
- Provide a list of spare core-facing router interfaces: inactive interfaces per router that are available for use but currently not connected to a peer.
- Issue unsolicited updates to the network controller regarding changes to any of the attributes and to changes in the end-to-end traffic pattern.

Monitoring Requirements

The NBI of the IP/MPLS domain controller must support the following functions to properly monitor the network.

- Provide notifications for link failures and equipment failures, including both a summary of current alarms and unsolicited messages when conditions change within two seconds of the event.
- Turn on and off the client side of a router interface (towards the optical NE). When off, the laser towards the optical NE is not emitting light and no alarms are emitted towards management systems.
- Send a notification if a router interface stops receiving light from the Optical layer. The notification should be sent within one second of the event.

- Mark an IP interface as down for maintenance, which causes all traffic to be gracefully rerouted away from the interface. During this time, no critical alarms are issued to management systems.
- Upon request, get current packet statistics for an interface, including packet count and/or byte count. The resulting measurement must be accurately relayed within one to two seconds from the time of the request.

Provisioning Requirements

The NBI of the IP/MPLS domain controller must support the following functions to properly provision the network.

- Change IP link configurations that might be impacted by the Optical layer: SRLGs, IGP metrics, and affinities.
- Set up an IP link by defining the salient attributes for the link and the router interfaces at both ends of the link (for example, IP address, IGP metric, and link bundling properties).
- Add and remove members from a link bundle.
- Allow costing out a link either as a specialized operation or by changing its IGP metric (this is a fallback option to putting a link in maintenance mode).

Simulation (What-If Analysis) Requirements

The NBI of the IP/MPLS domain controller must support the following functions to properly simulate the network for what-if analysis.

- Simulate a failure of one or more IP links or routers, and reflect the behavior of the IP/MPLS layer under such conditions for a given traffic matrix.
- The traffic matrix used for this analysis can be a historically measured matrix, the current traffic matrix, or an artificial traffic matrix provided by the orchestrator.
- The topology of the IP/MPLS layer used for this analysis can be the current topology, a derived topology, or an artificial topology provided by the orchestrator.

Acronymns

Acronym	Description
DWDM	dense wavelength division multiplexing
ECMP	equal-cost multipath
IETF	Internet Engineering Task Force
IGP	Interior Gateway Protocol
IP	Internet Protocol
IS-IS	Intermediate System to Intermediate System

Acronym	Description
LSP	labeled-switched path
MPLS	Multiprotocol Label Switching
NBI	north-bound interface
NE	network element
ONF	Open Networking Foundation
OSPF	Open Shortest Path First
OTN	Optical Transport Network
REST	Representational State Transfer
SRLG	shared-risk link group

About Sedona Systems

Sedona Systems has created the market's first multivendor control platform for the Optical and IP/MPLS layers (L0-L3) of service provider core and metro networks. Enabling both optically-aware IP/MPLS routing and IP/MPLS-informed optical switching, it doubles effective WAN capacity, boosts agility and flexibility, and saves up to 50% of network costs.

For further details, contact us at mailto:info@sedonasys.com or visit http://sedonasys.com.

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