Cisco Prime Network 3.10 Supported Technologies and Topologies

November, 2012

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Text Part Number: OL-28074-01

Cisco Prime Network 3.10 Reference Guide

1 Table of Contents

2 Supported Technologies in Prime Network 1
3 Supported Topologies in Prime Network 6
3.1 Supported Topology Types 6
3.1.1 ATM 7
3.1.2 BFD 7
3.1.3 BGP 7
3.1.4 Business 7
3.1.5 Ethernet 8
3.1.6 LAG 8
3.1.7 Frame Relay 9
3.1.8 MPLS 9
3.1.9 PPP or HDLC 9
3.1.10 MLPPP 10
3.1.11 Physical Layer 10
3.1.12 Pseudowire 10
3.1.13 GRE Tunnel 10
3.1.14 VPN 11
3.1.15 VLAN Service Links 11
3.1.16 MPLS-TE Tunnel 11
3.1.17 MPLS-TP Tunnel 11
3.2 Discovery Techniques 12
3.2.1 ATM VC Counters 12
3.2.2 CDP (Cisco Discovery Protocol) 13
3.2.3 LLDP (Link Layer Discovery Protocol) 13
3.2.4 PNNI Information 13
3.2.5 BFD Session Source and Destination 13
3.2.6 BGP Information 13
3.2.7 MAC 13
3.2.8 REP (Resilient Ethernet Protocol) 14
3.2.9 LACP 14
3.2.10 OAM 14
3.2.11 MLPPP Endpoint Identifier 14
3.2.12 GRE Tunnel Information 14
3.2.13 Pseudowire Information 14
3.2.14 VLAN ID Matching 14
3.2.15 Route Targets 15
3.2.16 Physical Layer Counters 15
3.2.17 IP Testing 15
3.2.18 STP (Spanning Tree Protocol) 16
3.2.19 MPLS-TE Information 16
3.2.20 MPLS-TP Information 16

3.2.21 Static 16

2 Supported Technologies in Prime Network

These topics outline the technologies supported in Prime Network 3.10, which are listed in Table 11-1. The fact that a specific technology is listed in Table 11-1 does not imply that all aspects of a relevant standard is represented and supported. In addition, the specific level of support provided for a particular technology on individual network elements can vary. For details on technology support on individual VNEs, see the *Cisco Prime Network Reference Guide*.

The supported technologies table indicates the following levels of support that Prime Network provides for the various technologies:

- Element modeling—Device-level inventory, support for events.
- Network modeling—Support for flows (correlation, path trace).
- Topology view—Technologies for which links are auto-discovered, and technologies that can be viewed in the context of topological links in a map.

Note: Please refer to the Prime Network Technology Center on Cisco Developer Network (CDN) for information about technology IMOs and their attributes.

Table 1-1 Supported Technologies

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
Network (L3)	IP	IP (including IPv6)	Yes	Yes	
		Address Resolution Protocol (ARP)	Yes	Yes	
		Hot Standby Router Protocol (HSRP)	Yes		
		Generic Routing Encapsulation (GRE)	Yes	Yes	Yes
		Carrier Grade NAT	Yes		
		IP SLA Responder	Yes		
		6PE	Yes	Yes	
		6RD	Yes		
		X-LAT	Yes		
		Access Control Lists (ACLs)	Limited		
		VRRP	Yes		
		IP Address Pool	Yes		

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
Network (L3) *(cont'd)*	Routing Protocols	Border Gateway Protocol (BGP), Multiprotocol extensions (MP-BGP), external BGP (eBGP), internal BGP (iBGP)	Yes	Yes	Yes
		Open Shortest Path First (OSPF) and OSPFv3	Yes		
		Intermediate System to Intermediate System (IS-IS)	Yes		
	Multicast Protocols	Internet Group Management Protocol (IGMP)	Yes		
		Protocol Independent Multicasting (PIM)	Yes		
	VPN and VRF	Virtual Routing and Forwarding (VRF)	Yes	Yes	Yes
		VRF-Lite (Multi-VRF)	Yes	Yes	
		VPN		Yes	Yes
		CSCVPN	Yes		
		6VPE	Yes	Yes	Yes
		Multicast VPN (mVPN)	Yes		
	BFD	Bidirectional Forwarding Detection	Yes		Yes
	SBC	Session Border Controller	Yes		
	BNG (Broadband Network Gateway)	Subscriber Access Points (1:1, 1:N access VLAN config)	Yes		
		BBA (Broadband Access Group)	Yes		
		Dynamic config templates	Yes		
		IPV4 DHCP Profiles	Yes		
Hybrid Network/ Data Link (L3/2)	MPLS	Multiprotocol Label Switching (MPLS)	Yes	Yes	Yes
		Label Distribution Protocol (LDP)	Yes		
		Multicast Label Distribution Protocol (mLDP)	Yes		
	MPLS TP	MPLS TP	Yes	Yes	Yes

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
	MPLS TE	Multiprotocol Label Switching Traffic Engineering (MPLS TE)	Yes	Yes	Yes
		P2MP (Point-to-Multipoint) TE			
		MPLS TE Fast Reroute (MPLS TE FRR)	Yes		
	Pseudowire	Pseudowire Emulation Edge to Edge (PWE3)	Yes	Yes	Yes
		VCCV	Yes		
		Pseudowire Redundancy	Yes		
		Static Pseudowire	Yes		
		TDM Pseudowire	Yes	Yes	Yes
		Multi-segment Pseudowire	Yes	Yes	Yes
		ATM over Pseudowire (ATM PW)	Yes	Yes	Yes
		PW-to-TP Tunnel Mapping	Yes	Yes	
		PW-to-TE Tunnel Mapping	Yes	Yes	
Hybrid Network/ Data Link (L3/2) *(cont'd)*	Clocking	IE1588	Yes		
		SyncE	Yes		
		ACR	Yes		

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
Data Link/MAC (L2)	Ethernet	Ethernet (IEEE 802.3)	Yes	Yes	Yes
		VLAN (IEEE 802.1Q)	Yes	Yes	Yes
		QinQ (IEEE 802.1ad)	Yes	Yes	
		LAG (IEEE 802.3ad)	Yes	Yes	Yes
		Ethernet Channel	Yes	Yes	Yes
		STP (IEEE 802.1D)	Yes		Yes
		RSTP (IEEE 802.1w)	Yes		Yes
		PvSTP	Yes		Yes
		MST (IEEE 802.1s)	Yes		Yes
		SVI	Limited		
		VTP	Yes		
		REP	Yes		REP
		VPLS	Yes	Yes	Yes
		H-VPLS	Yes	Yes	Yes
		VSI	Yes	Yes	Yes
		PBB	Yes		
		EFP	Yes	Yes	Yes
		Access Gateway	Yes		
		mLACP (ICCP Redundancy Group)	Yes		
		Virtual Port Channel (vPC)	Yes		
		Fabric Path	Yes		
	Ethernet OAM	CFM (Cisco and Draft 8.1)	Yes		
		Link OAM	Yes		
		Ethernet LMI	Yes		
		Y.1731 Probes	Yes		
	ATM	ATM	Yes	Yes	
		IMA	Yes	Yes	
		ATM Cross-Connect	Yes	Yes	
		ATM OAM	Yes		
		IP over ATM (MPoA 1483R)	Yes	Yes	
		Ethernet over ATM (MPoA1483B)	Yes	Yes	

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
Data Link/MAC (L2) *(cont'd)*	Frame Relay	Frame Relay	Yes	Yes	
	ISDN	Integrated Services Digital Network (ISDN)	Limited		
	PPP	Point To Point Protocol (PPP)	Yes	Yes	
		PPPoA, PPPoE, PPPoFR	Yes		
		Multilink PPP	Yes	Yes	Yes
	HDLC	High-Level Data Link Control (HDLC)	Yes	Yes	
	L2TP	Layer 2 Tunnel Protocol (L2TP)	Limited		
	Discovery Protocols	CDP, LLDP	Yes		
	Local Switching	Local Switching	Yes	Yes	
Physical Layer (L1)	xDSL	Digital Subscriber Line (xDSL)	Yes		
	IPoDWDM	Internet Protocol over Dense Wave Division Multiplexing (IPoDWDM)	Yes		
	SONET/SDH	SONET/SDH	Yes		
	TDM/DSx	TDM	Yes		
		DSx	Yes		
		CEM	Yes		
		T3/E3	Yes		
		Channelized T3, OC3, DS3 interface	Yes		
	Serial	Serial	Yes		
	Hardware	Pluggable Transceiver	Yes		
Mobility	GGSN	GGSN	Yes		
	APN	APN	Yes		
	GTPU	GTPU	Yes		
	S-GW	S-GW	Yes		
	P-GW	P-GW	Yes		
	SAE-GW	SAE-GW	Yes		
	EGTP	EGTP	Yes		

Technology Family	Technology Group	Technology	Element Modeling	Network Modeling	Topology View
	GTPP	GTPP	Yes		
	QCI-QoS Mapping	QCI-QoS Mapping	Yes		
	APN Profile	APN Profile	Yes		
	APN Remap	APN Remap	Yes		
	Operator Policy	Operator Policy	Yes		
	Active Charging Services	Active Charging Services	Yes		
AAA	Radius	Radius	Yes		
	Diameter	Diameter	Yes		
QoS	QoS	QoS	Yes		
	Access control & Service Policy	Access control & Service Policy	Yes		
Virtualization	Compute Virtualization	Hypervisor, Virtual Machines, Virtual Data Stores	Yes		
	Network Virtualization	Satellite/Cluster	Yes		Yes

3 Supported Topologies in Prime Network

The following topics describe the types of topologies supported by Prime Network. It also explains how Prime Network discovers and displays these topologies.

3.1 Supported Topology Types

The following topology types are supported by Prime Network 3.10:

- ATM
- BFD
- BGP
- Business
- Ethernet
- LAG
- Frame Relay

- MPLS
- PPP or HDLC
- MLPPP
- Physical Layer
- Pseudowire
- GRE Tunnel
- VPN
- VLAN Service Links
- MPLS-TE Tunnel
- MPLS-TP Tunnel

3.1.1 ATM

The ATM topology represents the link between two ATM ports that are connected in the network. In the VNE model, the endpoints of the link are ATM IMOs (ATM Interface (IAtm)), which represent the ATM port or interface.

Link type: ATM or PNNI

Discovery technique for ATM link:

- ATM VC Counters
- CDP (Cisco Discovery Protocol)
- Static

Verification Technique: Physical Layer Counters

Discovery technique for PNNI link:

- PNNI Information

Note: PNNI support is very limited.

3.1.2 BFD

The BFD topology represents a BFD session with verified BFD connectivity between two endpoints in the network. In the VNE model, the endpoints of the link are the BFD Service IMOs (BFD Service (IBfdService)), which represent the BFD service running on the router.

Link type: BFD

Discovery and verification technique: BFD Session Source and Destination

3.1.3 BGP

The BGP topology represents a TCP connection between two BGP entities which facilitate the “BGP neighborhood” in the network. In the VNE model, the endpoints of the link are the MPBgp IMOs (Multi Protocol BGP Entity (IMPBgp))which represent the BGP service running on the router.

Link type: BGP

Discovery and verification technique: BGP Information

3.1.4 Business

The Business topology does not represent any specific link or relationship in the network. It can represent the relationship between any two objects in the model, which can be

business objects or network objects. These links are created in the Prime Network gateway.

3.1.5 Ethernet

The Ethernet topology represents a link between two Ethernet ports, which are connected in the network. In the VNE model, the endpoints of the link are Ethernet IMOs (Ethernet Interface (IEthernet)), which represent the Ethernet ports.

Prime Network conducts a discovery of the Ethernet data link layer topology by using various types of data. This includes information from, for example, OAM, CDP, LLDP, STP, and can include MAC learning information. All types of data are collected and, based on priority, used to verify the adjacency between two ports.

Certain data that is used for discovery might be device specific. For example Inter Chassis Link and Inter Rack Link information that is available only for specific device type.

Note: Many service providers use L2PT to configure customer access to VLAN ports. This avoids the need to process Layer 2 protocols such as CDP. In these scenarios, discovery may create links between ports that are not directly connected, because the Layer 2 protocol information is tunneled and does not reflect the actual physical links. This problem can be overcome by configuring static links on these ports. These static links will override any incorrect dynamically discovered links.

Link type: Ethernet

Discovery techniques:

- OAM
- MAC
- CDP (Cisco Discovery Protocol)
- LLDP (Link Layer Discovery Protocol)
- STP (Spanning Tree Protocol)
- REP (Resilient Ethernet Protocol)
- LACP
- Inter Chassis Link / Inter Rack Link
- Static

Verification Technique: All of the above discovery techniques and Physical Layer Counters.

3.1.6 LAG

The LAG topology represents a link between two LAG or EtherChannel interfaces that are connected in the network. The underlying physical links do not have to be discovered for the LAG link to be discovered.

In the VNE model, the endpoints of the link are indicated in the Data Link Aggregation Container IMO (IDataLinkAggregationContainer), which points to the LAG or EtherChannel underline ports.

Link type: LAG

Discovery and verification techniques:

- MAC
- STP (Spanning Tree Protocol)

- REP (Resilient Ethernet Protocol)
- LACP
- Static

3.1.7 Frame Relay

The Frame Relay topology represents a link between two Frame Relay ports that are connected in the network. In the VNE model, the endpoints of the link are FrameRelay IMOs (Frame Relay Interface (IFrameRelay/IFrTrunk)), which represent the Frame Relay ports.

Frame Relay links between Cisco devices with CDP enabled can be discovered dynamically. For all other cases, static topology configuration should be used.

Link type: Frame Relay

Discovery techniques:

- CDP (Cisco Discovery Protocol)
- Static

Verification Techniques: The above discovery techniques and Physical Layer Counters.

3.1.8 MPLS

The MPLS topology represents adjacent MPLS interfaces in the network. These MPLS interfaces forward MPLS (labeled) traffic between them. Labels may be learned using discovery protocols, such as LDP or TDP (Cisco), or may be manually configured. In the VNE model, the endpoints of the link are MPLS IMOs (IMpls), which represent the MPLS interfaces.

Prime Network discovers MPLS network layer topology by searching for the existence of the local IP subnet in any one-hop-away remote side's MPLS Interface. In particular, it compares the local and remote IP subnets gathered from the upper IP network layers.

Link type: MPLS

Discovery and verification techniques: IP Testing

3.1.9 PPP or HDLC

The PPP or HDLC topology represents a link between two PPP or HDLC ports that are connected in the network. In the VNE model, the endpoints of the link are PPP and HDLC IMOs (IEncapsulation), which represent the PPP / HDLC encapsulation of the port.

Prime Network performs discovery of PPP or HDLC topologies by searching for the local IP subnet in any one-hop-away remote side's PPP or HDLC interface. In particular, it compares the local and remote IP subnets gathered from the upper IP Network layers.

Link type: PPP/HDLC

Discovery techniques:

- IP Testing
- CDP (Cisco Discovery Protocol)
- Static

Verification Techniques: Physical Layer Counters.

3.1.10 MLPPP

The Multilink PPP topology represents a link between two Multilink PPP Interfaces. Multilink PPP is a named virtual interface with aggregate multiple PPP member interfaces.
Link type: MLPPP
Discovery and Verification Technique: MLPPP Endpoint Identifier.

3.1.11 Physical Layer

The Physical Layer topology represents a link between the physical layers of two ports connected in the network. In the VNE model, the endpoints are IMOs that inherit from the physical layer IMO (IPhysicalLayer), such as SONET/SDH Physical (ISonetSdh) and DS3 Channelized Interface (IDS3PdhChannelized), which represent physical layers of a port.
In Prime Network's topology discovery implementation, physical layer (Layer 1) discovery is coupled with data link layer (Layer 2) discovery.
Link type: Physical
Discovery techniques:
By default, the physical layer does not have techniques for discovery, but rather complements the discovery of Layer 2 in the following ways:

- Ports from the same device are not connected (this validation is done in the physical layer).
- Static

Verification Technique: Physical Layer Counters

3.1.12 Pseudowire

The Pseudowire topology represents a link between the endpoints of an MPLS-based pseudowire tunnel in the network. In the VNE model, the endpoints of the link are PTP Layer 2 MPLS tunnel IMOs (IPTPLayer2MplsTunnel), which represent the pseudowire tunnel endpoints.
Prime Network discovers PWE3 Network layer topology by searching for matches between the local and remote router IP addresses in any one-hop-away remote side's PTP Layer 2 MPLS tunnel. In particular, it compares the local and remote router IP addresses and tunnel identifications.
Link type: Tunnel
Discovery and verification technique: Pseudowire Information

3.1.13 GRE Tunnel

The GRE Tunnel topology represents a link between the endpoints of a GRE tunnel in the network. In the VNE model, the endpoints of the link are GRE Tunnel IMOs (Generic Routing Encapsulation (GRE) Tunnel Interface (ITunnelGRE)), which represent the GRE tunnel endpoints.
Prime Network discovers the GRE topology by comparing the source and destination IP address on both sides accordingly.
Link type: GRE tunnel
Discovery and verification technique: GRE Tunnel Information

3.1.14 VPN

The VPN topology represents a link between two VRFs that are part of a VPN. In other words, VPN traffic can pass between customer sites connected to these VRFs. In the VNE model, the endpoints of the link are VRF IMOs (Virtual Routing Forwarding (VRF) Entity (IVrf)), which represent the VRF forwarding entities in the network element.

Prime Network discovers MPLS-BGP-based VPN network topology by searching for the existence of a local VRF entity's imported route taget among the exported route targets of any remote side.

Link type: VPN or VPNv6

Discovery and verification techniques: Route Targets for either IPv4 or IPv6 address families.

3.1.15 VLAN Service Links

A VLAN service link represents either an Ethernet or a LAG link in the context of a specific VLAN. It connects two Ethernet Flow Point entities, which represent Ethernet or LAG ports in the context of a specific VLAN, or with VLAN match criteria.

The two Ethernet Flow Points can reside in the same Layer 2 domain, or connect between two different Layer 2 domains when a VLAN TAG manipulation is used.

The VLAN service links are not discovered using the standard topology mechanism that resides in the VNE layer, but rather by the Carrier Ethernet discovery. The discovery mechanism uses Ethernet and LAG links, VNE inventory modeling information of the Ethernet/LAG interfaces, and Ethernet Flow Point entities as inputs for the VLAN service link discovery process.

Link type: VLAN

Discovery and verification techniques: VLAN ID Matching.

3.1.16 MPLS-TE Tunnel

The MPLS-TE Tunnel topology represents a unidirectional link between the TE tunnel interface, which is the head of the TE tunnel, and the Label Switching Entity (LSE), which is the tail of the TE tunnel. The head of the TE tunnel is represented by the MPLS-TE Tunnel IMO (IMplsTETunnel) and the tail of the TE tunnel is represented by the Label Switching Entity IMO (ILSE), which is the MPLS forwarding component on the destination VNE.

MPLS TE tunnels also have mid-points, which are not represented in the MPLS-TE tunnel topology.

Link type: MPLS-TE.

The link is unidirectional and represents a flow from the head to the tail of the TE tunnel.

Discovery and verification techniques: MPLS-TE Information

3.1.17 MPLS-TP Tunnel

The MPLS-TP Tunnel topology represents a bidirectional link between two TP tunnel interfaces, which represent the two edges of the TP tunnel.

A TP tunnel interface is represented by the IMPLSTPTunnelEP IMO. MPLS-TP tunnels also have mid-points, which are not represented as part of the MPLS-TP tunnel topology.

Link type: MPLS-TP.
The link is bidirectional.
Discovery and verification techniques: MPLS-TP Information

3.2 Discovery Techniques

Discovery takes place in two phases:

1. Discovery of existing links.
2. Verification that the link still exists (for each discovered link).

This following discovery techniques are used by Prime Network:

- ATM VC Counters
- CDP (Cisco Discovery Protocol)
- LLDP (Link Layer Discovery Protocol)
- PNNI Information
- BFD Session Source and Destination
- BGP Information
- MAC
- REP (Resilient Ethernet Protocol)
- LACP
- OAM
- MLPPP Endpoint Identifier
- GRE Tunnel Information
- Pseudowire Information
- VLAN ID Matching
- Route Targets
- Physical Layer Counters
- IP Testing
- STP (Spanning Tree Protocol)
- MPLS-TE Information
- MPLS-TP Information
- Static

Note: All supported discovery techniques are enabled by default. Only MAC discovery can be disabled using the registry. See the Cisco Prime Network Administrator Guide for more information.

3.2.1 ATM VC Counters

3.2.1.1 Same Active VCs

In this technique, each side identifies a set of active ATM Virtual Connections (VCs) and looks for a match on another port in the network. An active VC is a VC that has a configured level of traffic.

This technique supports configurations that have either the same VCs or the same VPs on both sides. It does not support a mixture of VCs on one side and VPs on the other side.

3.2.1.2 VC Traffic Signature

Traffic signature is based on traffic pattern analysis. The underlying assumption of traffic pattern analysis is that network traffic variety ensures that every active link or active ATM VC in the network maintains a differential traffic "fingerprint".
Consequently, any two connected ports or VCs will have similar trend functions, which can be matched within reliable statistical significance.

3.2.2 CDP (Cisco Discovery Protocol)

For Cisco devices, if CDP is enabled, its information will be used for discovery and verification. This includes any upper layer techniques, such as VC-related techniques in ATM or MAC in Ethernet. In this technique, the matching criterion is the CDP neighbor information.
Please note the following limitations:

- If a port has more than one CDP neighbor, no links will be created.
- Ports in a multi chassis device will not be connected by CDP if there is no entry for them in the CDP neighbors table.

3.2.3 LLDP (Link Layer Discovery Protocol)

If LLDP is enabled, its information will be used for discovery and verification. In this technique, the matching criterion is the LLDP neighbor information.

3.2.4 PNNI Information

In this technique, each port in the ATM switch is identified with two values:

- Node ID.
- Port ID.

3.2.5 BFD Session Source and Destination

In this technique, the source and destination addresses of a BDF session are verified by matching them against the source and destination addresses of the potential adjacent neighbors. The session's source address is matched to the neighbor's destination address and the session's destination source is matched to the neighbor's source address since one side's source is the other side's destination. This method works on the assumption that multiple BFD sessions running on the same router cannot have the same source and destination address.

3.2.6 BGP Information

In this technique, the local BGP identifier is compared to the remote BGP identifier or a potential neighbor for each BGP Neighbor Entry. This topology technique assumes uniqueness of the BGP identifier in the network.

3.2.7 MAC

In this technique, the Ethernet port MAC is checked to see if it is the only one learned on the other Ethernet port (using bridge and ARP tables).

This technique discovers links between two routers or the router and switch, but not between two switches (includes the generic VNE).

3.2.8 REP (Resilient Ethernet Protocol)

If REP is enabled between switches, the information that is provided by the 'show REP topology' command is used to connect the topology according to the REP configuration.

3.2.9 LACP

If the LAG is configured as LACP, actor and partner system ID are compared between the two devices (local actor = remote partner and vice versa).

3.2.10 OAM

If OAM is configured between two devices, local and remote OAM MACs are compared between the two devices (local OAM MAC = remote OAM MAC and vice versa).
This protocol has the highest priority and hence will be the first to be checked if it is enabled.

3.2.11 MLPPP Endpoint Identifier

In this technique, the Local and the Remote MLPPP End Point Identifier are verified by matching them against the Remote and the Local MLPPP End Point Identifier of the potential adjacent neighbors.
The Local MLPPP End Point Identifier is matched to the neighbor Remote MLPPP End Point Identifier.

3.2.12 GRE Tunnel Information

In this technique, each GRE tunnel is identified by the following criteria:

1. Source IP.
2. Destination IP.

Taking the example of two tunnels T1 and T2 to match, the source IP address of T1 is compared to the destination IP address of T2. Similarly, the destination IP address of T1 is compared to the source IP address of T2.

3.2.13 Pseudowire Information

In this technique, each pseudowire is identified by the following criteria:

- Local and Remote router IP.
- Tunnel ID.

Taking the example of two pseudowire tunnels Pw1 and Pw2 to match:

- The local IP of Pw1 is compared to the remote IP of Pw2 and the remote IP of Pw1 is compared to the local IP of Pw2.
- Tunnel ID

3.2.14 VLAN ID Matching

In this technique, the VLAN configuration aspects of each pair of VLAN-enabled physically connected Ethernet ports will be inspected to identify which VLAN tagged traffic crosses this link. The type of VLAN configurations that are inspected include:

- Switchport in all configuration modes (Access, Trunk, Dot1q_Tunnel), including the VLAN allowed and VLAN mapping.
- L2 sub-interfaces/service instances configured on the Ethernet port, specifically the VLAN tag matching criteria.
- L3 sub-interfaces configured on the Ethernet port, specifically the VLAN tag matching criteria.

3.2.15 Route Targets

In this technique, each VRF is identified with the set of its import and export route targets (for either IPv4 or IPv6 address families).
Atleast one pair of import or export route target of one VRF entity is matched to the export or import route target or the other VRF entity.

3.2.16 Physical Layer Counters

The physical layer is used for topology verification (that is, if a link has already been discovered, it is tested periodically), which is done using counters. Physical layer counters are based on the port traffic signature, using octet-based or octet- and packet–based traffic.
Using the port traffic signature, it is possible to disqualify a connection between two ports based on their counters.

3.2.17 IP Testing

Prime Network uses IP testing (IPv4) to discover the topology for PPP/HDCL and MPLS technologies. In both cases, the IP test checks the IP configuration on the relevant interface(s) and verifies that there is a match. In this context, finding a match means that the IP configuration is compared using the primary IP subnet configured on the local and remote interfaces, and the local IP subnet is equal to or contained in the remote IP subnet. Note that there is an inherent limitation in using only the primary address and mask to define the IP subnet to be compared. This can cause issues when two interfaces are connected but have more than one address and, in either or both cases, the primary is from a different subnet. For example: We have two devices, Device1 and Device2. POS2/1 on Device1 is connected to POS1/1 on Device2. The configuration of Device1 is:

```
interface POS2/1
      description Connected to POS1/1 on Device2
      encapsulation ppp ip address 10.0.0.1 255.255.255.252
      ip address 11.0.0.1 255.255.255.252 secondary
```

The configuration of Device is:

```
interface POS1/1 description Connected to POS2/1 on Device1
  encapsulation ppp ip address 11.0.0.2 255.255.255.252
  ip address 10.0.0.2 255.255.255.252 secondary
```

In this case, the two devices will not be connected.

3.2.18 STP (Spanning Tree Protocol)

If STP is enabled between switches, the STP port information is used as follows: bridge ID, designated bridge, and port identifier are compared with the relevant remote information. If a match is found, a link is created.

This STP discovery technique will only work when the same STP protocol is running on both ports.

3.2.19 MPLS-TE Information

The MPLS-TE tunnel source IP, destination IP and the tunnel ID information from the tunnel head (taken from the MPLS TE Tunnel) are compared with destination IP, source IP and the tunnel ID on the tail (taken from the MPLS TE Tunnel Segment of the LSE).

3.2.20 MPLS-TP Information

The local router ID, remote router ID and the tunnel ID of one MPLS-TP tunnel edge are compared to the remote router ID, local router ID and tunnel ID of another MPLS-TP tunnel edge.

The information is taken from the MPLS TP Tunnel EP.

3.2.21 Static

Static topology is simply a manual configuration of the topological links. The information on the links is persisted in the Prime Network registry under the VNE registry section.