Solution Brief

anuta networks

L2VPN Service Automation with Anuta ATOM

Highly Scalable Vendor Agnostic Service Orchestration

Key Capabilities

- Supports IETF YANG & OpenConfig Models
- Ensures Service Compliance
- Automated delivery of Model-driven Service UI
- Supports brownfield network discovery
- Supports complete lifecycle management of services
- Dry-run mode to validate command generation
- Vendor Agnostic
- Integration into Internal & External IPAM, VLAN, RD & RT Manager
- Workflow Integration for Pre & Post Validations
- Quickly scale up to 1M+ devices across 45+ vendors

It is a well-known fact that Service Providers & Enterprises take time to introduce new services to the market. The networks end up playing an antagonist in most cases, purely due to how they are managed. In this digital age, as the world is getting ready to embrace the high speeds of 5G, existing service provisioning processes do not scale or meet the agile market requirements. With the growing OTT competitors' who preach rapid service delivery and intolerance among customers on the lack of timely delivery of services, it is evident that network service fulfillment is the elephant in the room.

Multi-vendor networks, manual processes, varied configuration data sets, the introduction of new vendor platforms, siloed automation, integration hassles, and proprietary vendor solutions contribute to this ineffective and passive delivery of services.

Anuta ATOM is built ground up to support agile network service delivery. It introduces network service orchestration as a replacement for the existing methodologies of service provisioning. ATOM utilized YANG models as the underpinning to facilitate end-to-end complex service provisioning in heterogeneous networks. ATOM's service models go beyond the initial provisioning of services and manage the complete lifecycle to ensure full control. It goes a long way to accommodate the dynamic nature of today's businesses. The multi-vendor support of 150+ platforms across 45+ vendors enables Anuta ATOM to be the force that propels service delivery in organizations.

The service models in Anuta ATOM is built on the following principles to form the network abstraction layer:

1. Offers a model-driven view of services and their configurations
2. Offers a model-driven view of devices by supporting both Native YANG & OpenConfig
3. Maintains the device & service configured state to support CRUD operations
4. Built-in exception handling to address unexpected issues during service provisioning
5. Dry run mode enables complete visibility to network teams before command provisioning
6. Supports atomic transaction to ensure data consistency across the network
7. Supports integration into other ecosystem tools such as IPAM
8. Integrated to ATOM's workflow engine for Pre & Post Service validations

Anuta ATOM supports several out-of-box service models. This catalog includes a wide range of services for Service Providers, Branch, Campus, and Datacenter networks. Some of the IETF & custom service models delivering VPN services are discussed below.

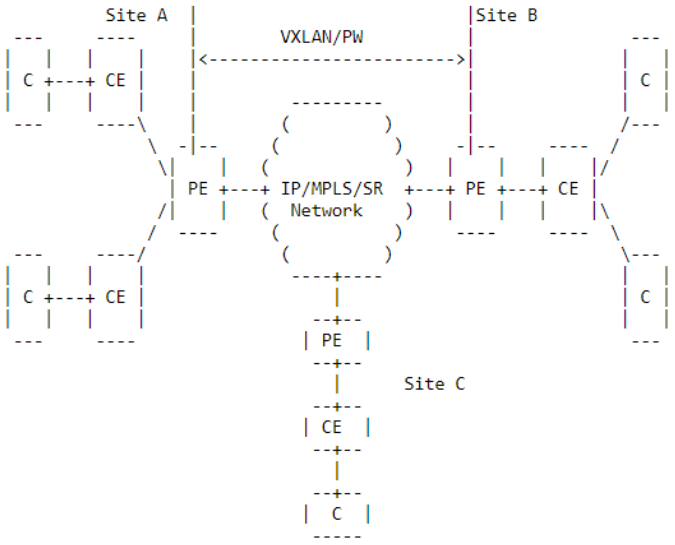
© 2020 Anuta Networks. All Rights Reserved

anuta networks

IETF L2VPN Automation

Anuta ATOM offers out-of-box support for IETF L2VPN. ATOM's L2VPN model is based on RFC 8466 YANG data model for a Layer 2 provider-provisioned VPN service. The YANG data model supports Virtual Private Wire Services (VPWS) and multipoint Virtual Private LAN Services (VPLS) that uses Pseudowire signaled using LDP and BGP. The model defines service configuration elements that can be used in communication protocols between customers and network operators.

The L2VPN service model is architected as a collection of sites that exchange traffic over a shared infrastructure. The provisioned model will deliver an end-to-end layer 2 connectivity between two or more customer sites.



ATOM's L2VPN Service model offers lifecycle management through an abstracted interface to request, configure, and manage L2VPN service components. The configuration of network elements may be done using the CLI or other southbound interfaces such as NETCONF in conjunction with ATOM's device models based on CLI, Native YANG, or OpenConfig.

ATOM L2VPN Service Model Design

The L2VPN service model is structured such that the Service Provider can list the multiple circuits that it serves for the same customer. The YANG module is divided into two primary containers: *sites* & *vpn-services.*

© 2020 Anuta Networks. All Rights Reserved

Sites

A site represents a connection of a customer office to one or more VPN services. The site container stores information regarding detailed implementation arrangements made with the customer. In ATOM, the following critical characteristics of a site are captured.

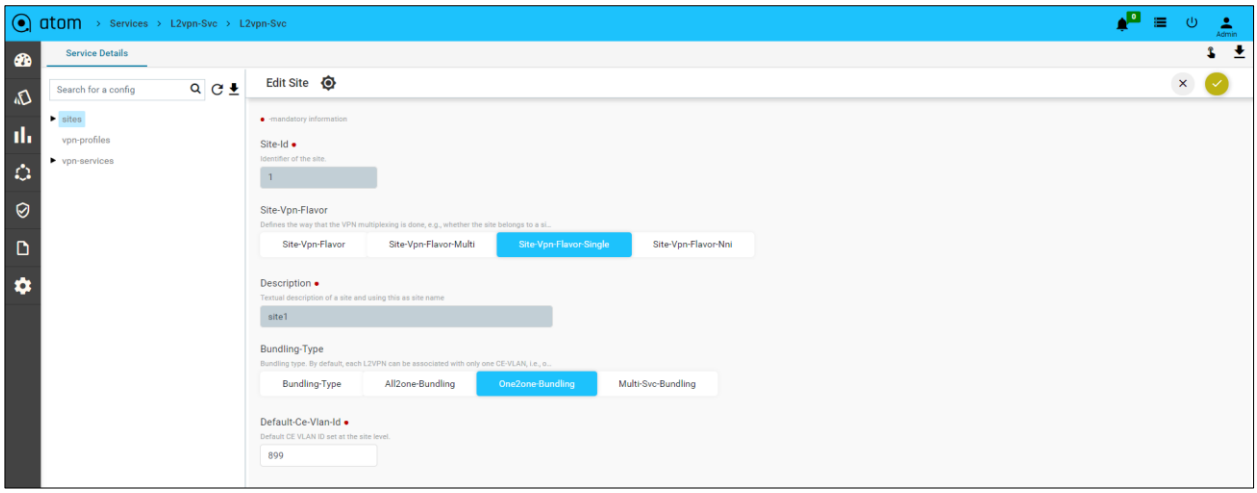
1. *Site-Id*: This field provides a unique identification of the site in the overall network infrastructure.
    1. *Site-VPN-Flavor*: Defines the way that the VPN multiplexing is done, e.g., whether the site belongs to a single VPN site or a multi-VPN site. The following options are supported.
        i. *Site-Vpn-Flavor*
        ii. *Site-Vpn-Flavor-Multi*
        iii. *Site-Vpn-Flavor-Single*
        iv. *Site-Vpn-Flavor-Nni*

        By default, the site belongs to a single VPN.
    2. *Bundling-Type*: The following options are supported
        i. *Bundling-Type*
        ii. *All2one-bundling*
        iii. *One2one-Bundling*
        iv. *Multi-Svc-Bundling*

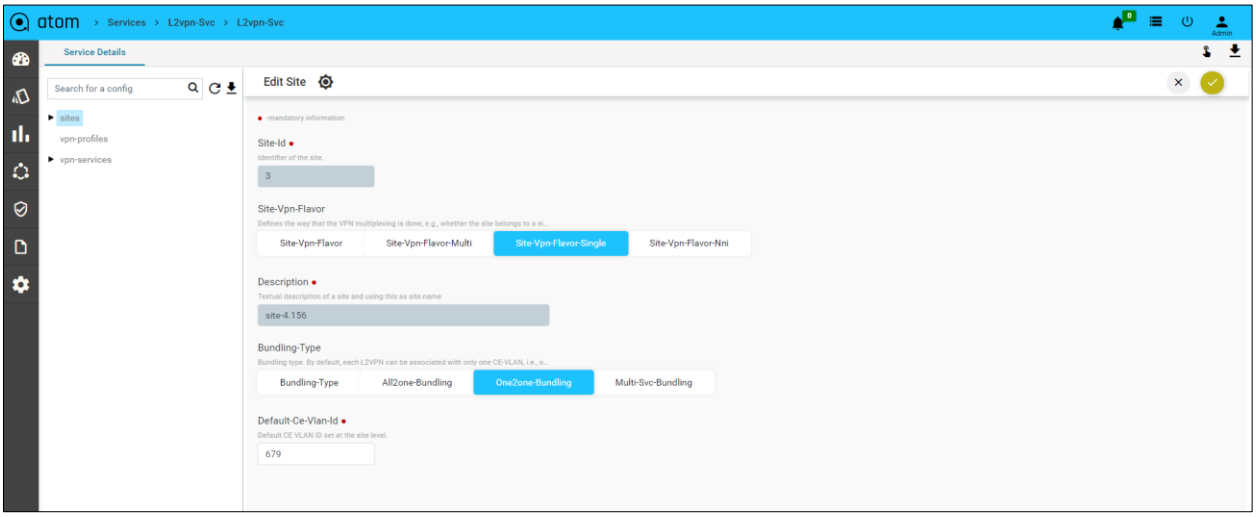
        By default, each L2VPN can be associated with only one CE-VLAN, i.e., one-to-one bundling is used.

    3. *Default-Ce-Vlan-Id*: The default VLAN Id set at the site level.

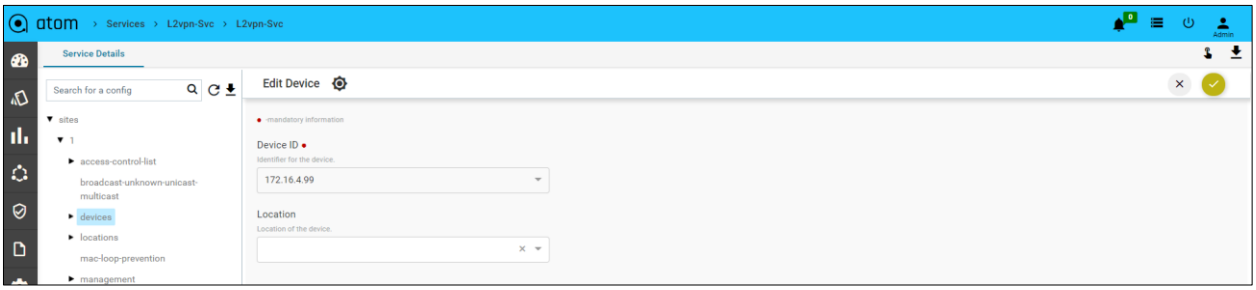
In the example illustrated in this brief, there are two sites, site-1, and site-3.

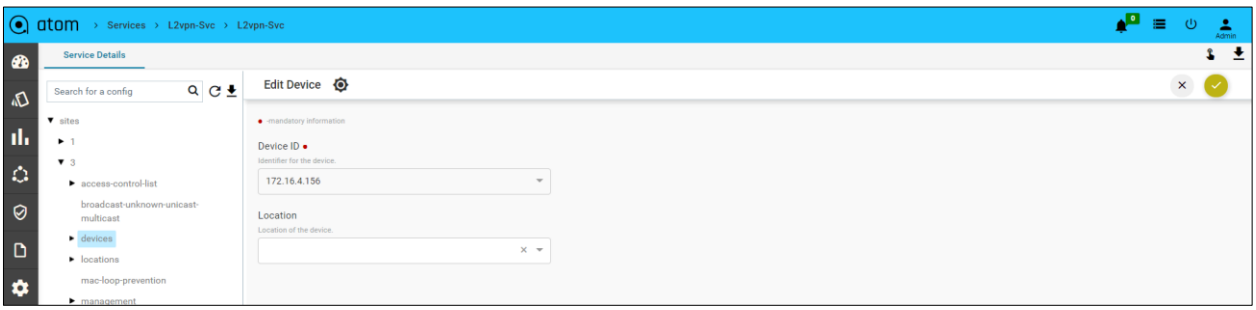


© 2020 Anuta Networks. All Rights Reserved



2. *Devices*: It denotes the Provider Edge (PE) devices to connect the Customer Edge (CE) devices. One or more PE devices can be created as part of the devices list. In the example, site-1 hosts PE device 172.16.4.99, while site-3 hosts PE device 172.16.4.156



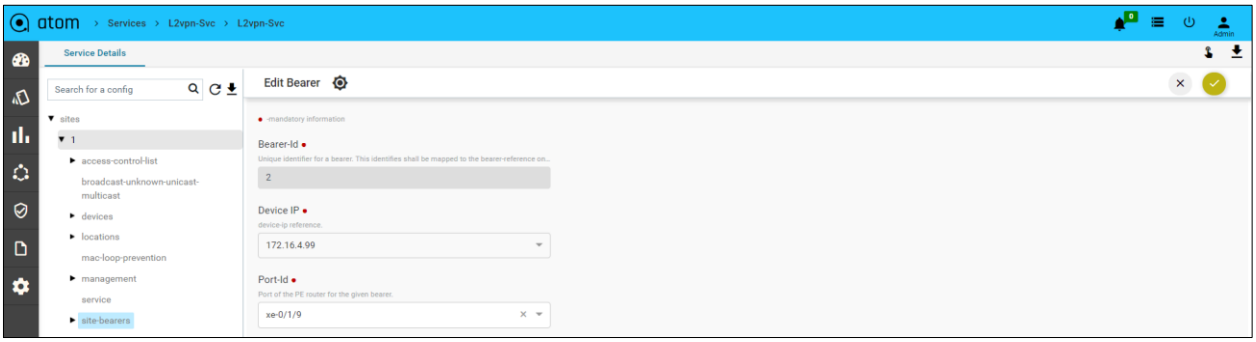


Creating a site in ATOM L2VPN service acts as a resource model that does not generate any commands. The site holds the device details involved in the L2VPN service.

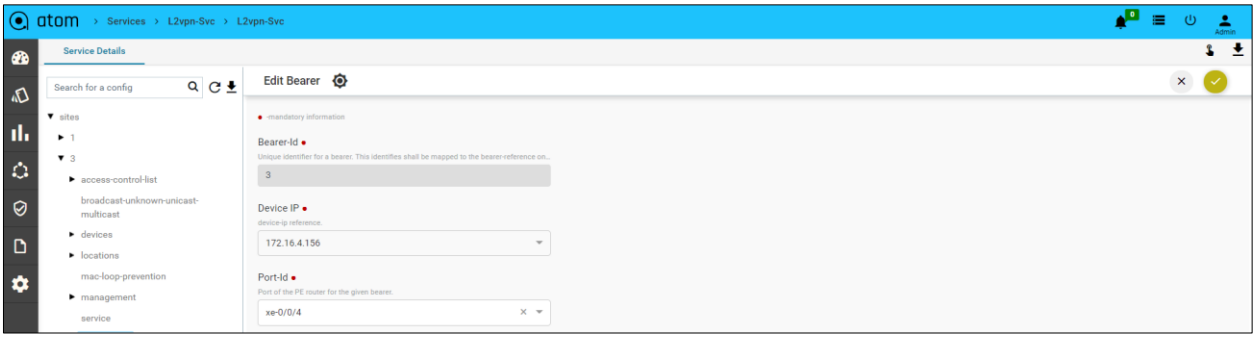
© 2020 Anuta Networks. All Rights Reserved

3. *Site-bearers*: Once the sites are created listing the devices involved, the physical port connected to the CE device is defined.

In the example below, the device 172.16.4.99 under Site-1 uses port xe-0/1/9



Device 172.16.4.156 under Site-3 uses port xe-0/0/4



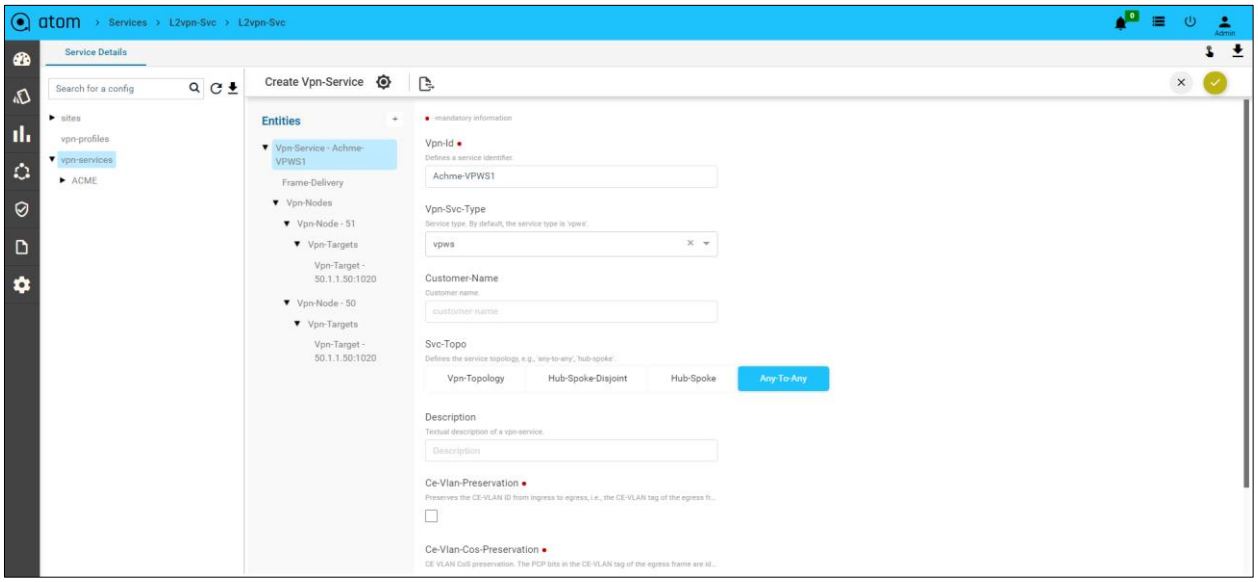
VPN Service

The VPN service in the L2VPN service model captures the generic information about the VPN service. It denotes the VRF for a customer on the Provider Edge (PE), allowing the use of overlapping IP addresses. The *vpn-service* list is composed of the following main attributes:

1. *Vpn-Id*: A vpn-id list uniquely references VPN services that a service provider offers. It reflects a VRF name on the device.
2. *Customer-Name*: This field identifies the customer served by the Service Provider.
3. *Vpn-Svc-Type*: This identifies the offered flavor of L2VPN services. ATOM supports VPLS and VPWS, which is the default value.
4. *Svc-Topo*: This identifies the type of VPN service topology. The topology could be one of Any-to-Any, Hub-Spoke, Hub-Spoke-Disjoint & Vpn-Topology. Any-to-Any appears as the default value.
5. *Ce-Vlan-Preservation & Ce-Vlan-Cos-Preservation*: Left to false by default, these fields allow a choice of CE-VLAN ID & CoS Preservation. This attribute is required when the customer edge is using VLAN header information between its locations.
6. *Carriers Carrier*: Utilized when VPN customers offer VPN services themselves to their customers.

The configuration parameters have been populated to create an L2VPN service “Achme-VPWS1” in the example below.

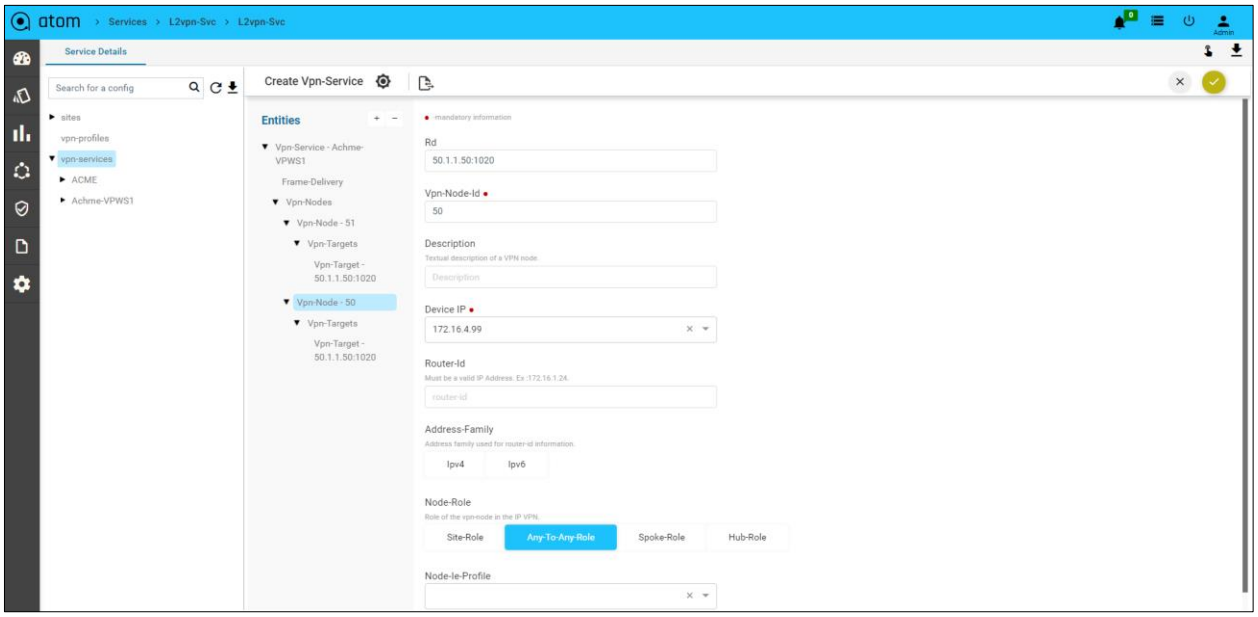
© 2020 Anuta Networks. All Rights Reserved



ATOM's L2VPN service model has been customized to ensure a smooth provisioning experience. The *vpn-service* list includes *vpn-nodes* list where route distinguisher (RD) and route targets (RT) for each PE device can be defined.

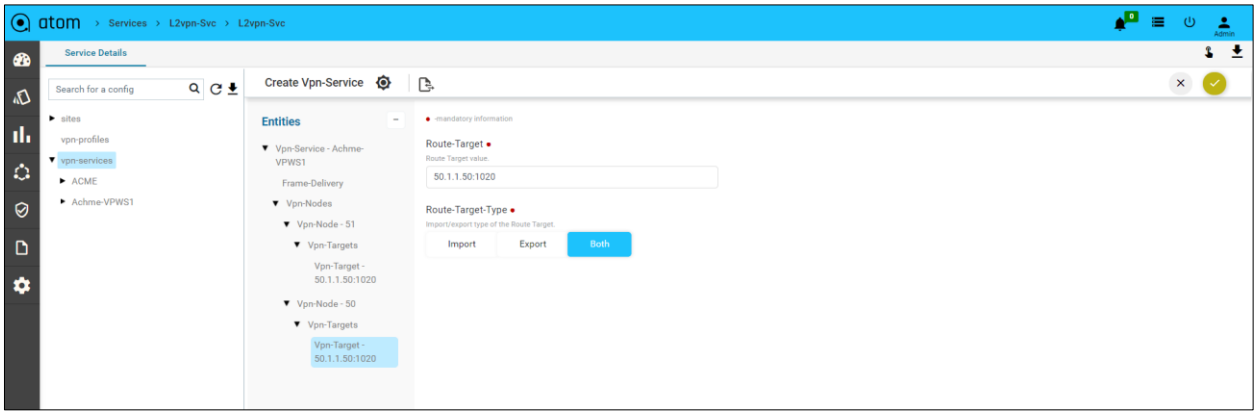
The *vpn-node* captures *rd* values to distinguish routes from each VRF and support type-0, type-1, and type-2 formats. The *vpn-targets* capture the rt values in type-0, type-1, and type-2 forms and supports options of import, export, and both to facilitate route sharing among VRFs. In the screenshot below, the RT values are defined as <IP-address: ASN>

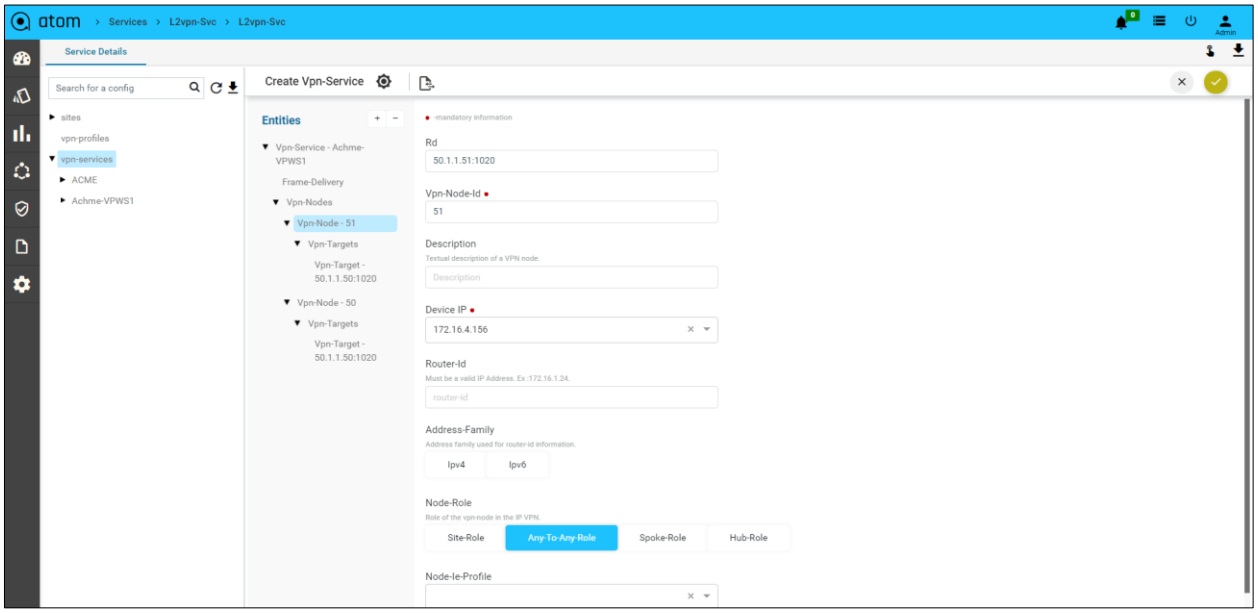
Continuing the L2VPN service "Achme-VPWS1" creation, VPN-Node 50 captures the RD and RT values for the device 172.16.4.99, while VPN-Node 51 captures the RD and RT values for the device 172.16.4.156

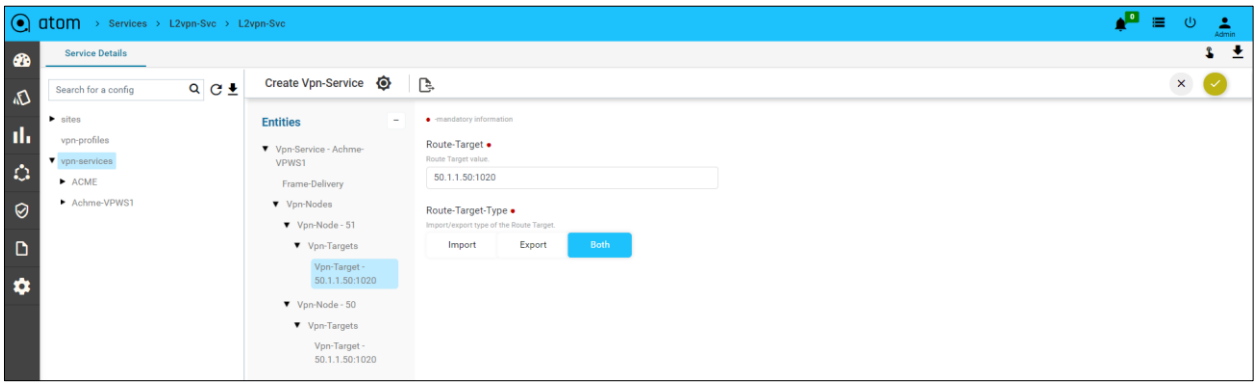


© 2020 Anuta Networks. All Rights Reserved

anuta networks

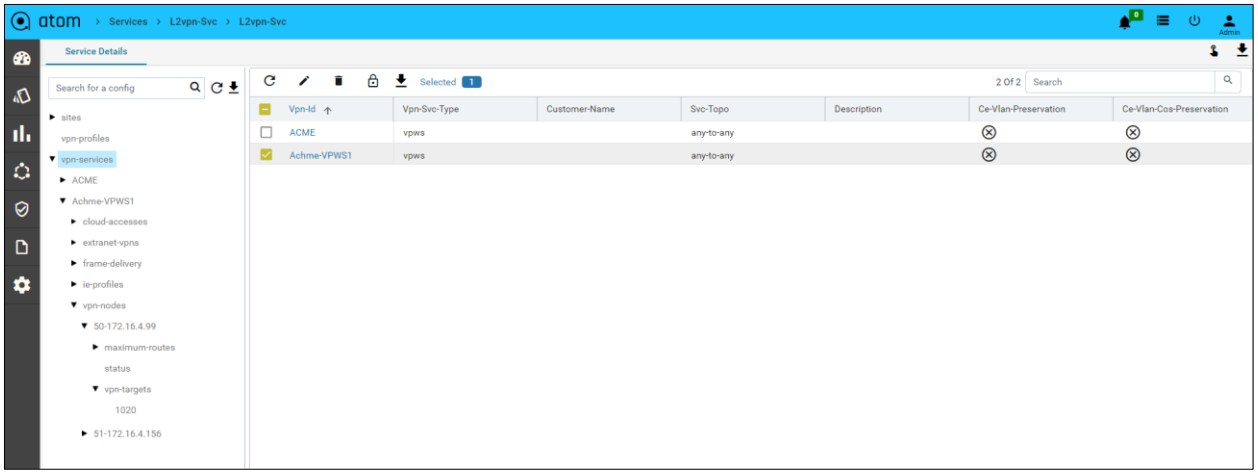




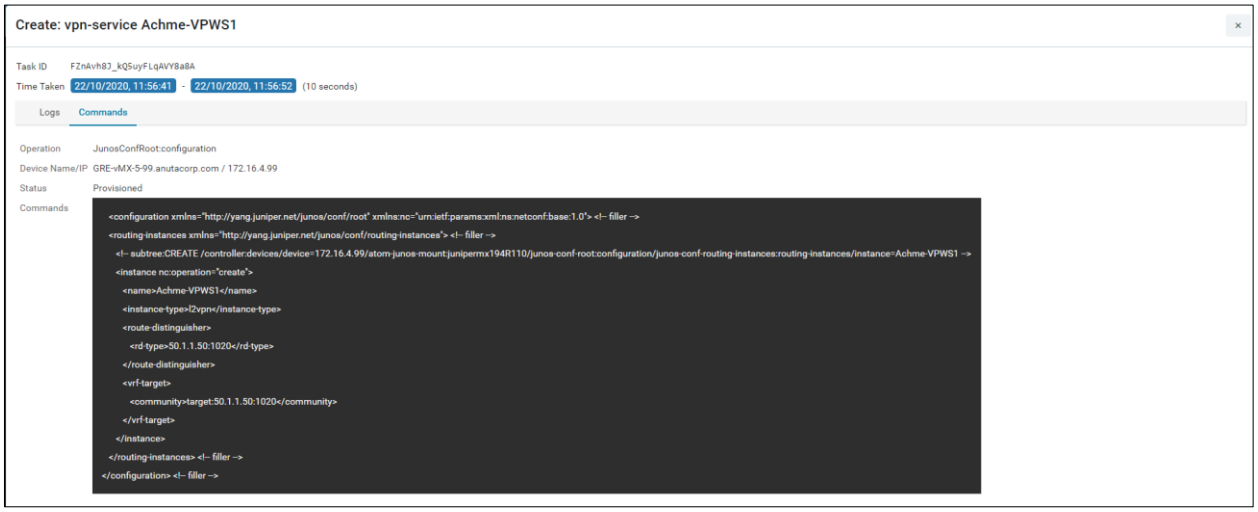


© 2020 Anuta Networks. All Rights Reserved

ATOM offers a one-click creation of services. The *vpn-services* list, when applied, ATOM generates the corresponding commands for the devices involved in the service. The device could be one or a combination of legacy CLI based devices, Native YANG, or OpenConfig based to complete an end-to-end service provisioning. In the example below, Juniper MX devices supporting Native YANG are provisioned with VPWS flavor for illustration purposes.



The below snapshot shows the NETCONF payload generated and provisioned on both 172.16.4.99 & 172.16.4.156.



© 2020 Anuta Networks. All Rights Reserved

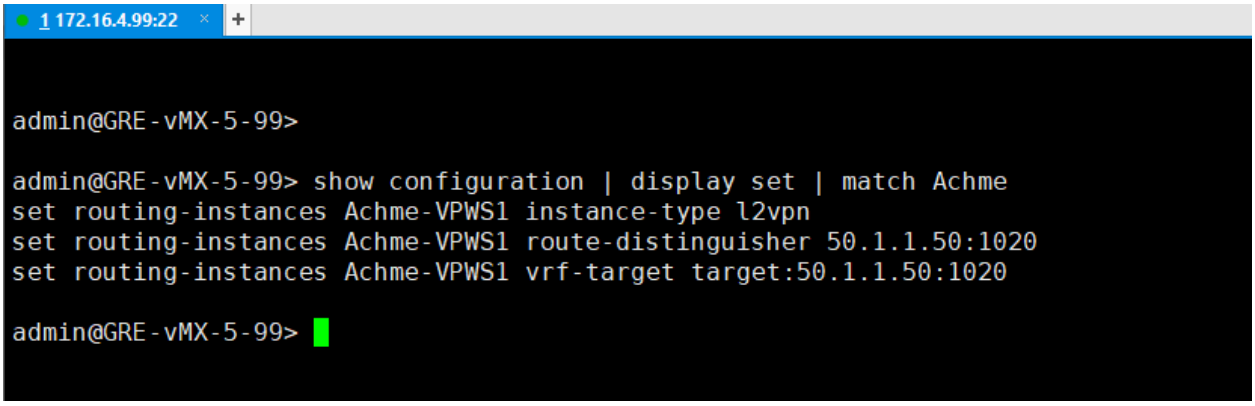
The below screenshot shows the service details on ATOM side.

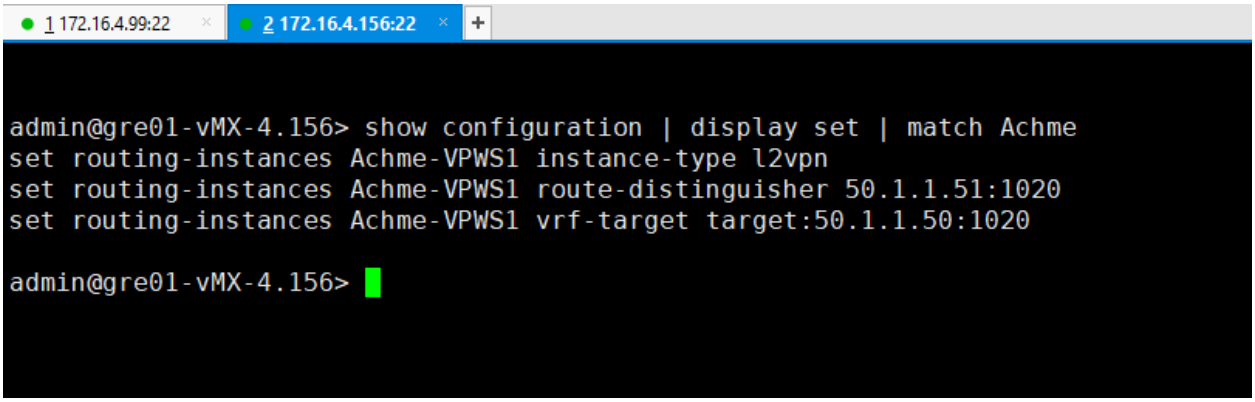
Vpn-Service

```
<vpn-services xmlns="urn:ietf:params:xml:ns:yang:ietf_l2vpn_svc">
   <vpn-service>
      <cloud-accesses/>
      <extranet-vpns/>
      <frame-delivery>
         <multicast-gp-port-mapping>dynamic-mapping</multicast-gp-port-mapping>
      </frame-delivery>
      <ie-profiles/>
      <vpn-nodes>
         <vpn-node>
            <vpn-targets>
               <vpn-target>
                  <route-target>50.1.1.50:1020</route-target>
                  <route-target-type>both</route-target-type>
               </vpn-target>
            </vpn-targets>
            <rd>50.1.1.51:1020</rd>
            <vpn-node-id>51</vpn-node-id>
            <device-ip>172.16.4.156</device-ip>
            <node-role>any-to-any-role</node-role>
         </vpn-node>
         <vpn-node>
            <vpn-targets>
               <vpn-target>
                  <route-target>50.1.1.50:1020</route-target>
                  <route-target-type>both</route-target-type>
               </vpn-target>
            </vpn-targets>
            <rd>50.1.1.50:1020</rd>
            <vpn-node-id>50</vpn-node-id>
            <device-ip>172.16.4.99</device-ip>
            <node-role>any-to-any-role</node-role>
            <maximum-routes/>
         </vpn-node>
      </vpn-nodes>
      <carrierscarrier>false</carrierscarrier>
      <ce-vlan-cos-preservation>false</ce-vlan-cos-preservation>
      <ce-vlan-preservation>false</ce-vlan-preservation>
      <svc-topo>any-to-any</svc-topo>
      <vpn-id>Achme-VPWS1</vpn-id>
      <vpn-svc-type>vpws</vpn-svc-type>
   </vpn-service>
</vpn-services>
```


© 2020 Anuta Networks. All Rights Reserved

The below screenshot shows the commands provisioned on both the Juniper MX devices.





Site Network Access

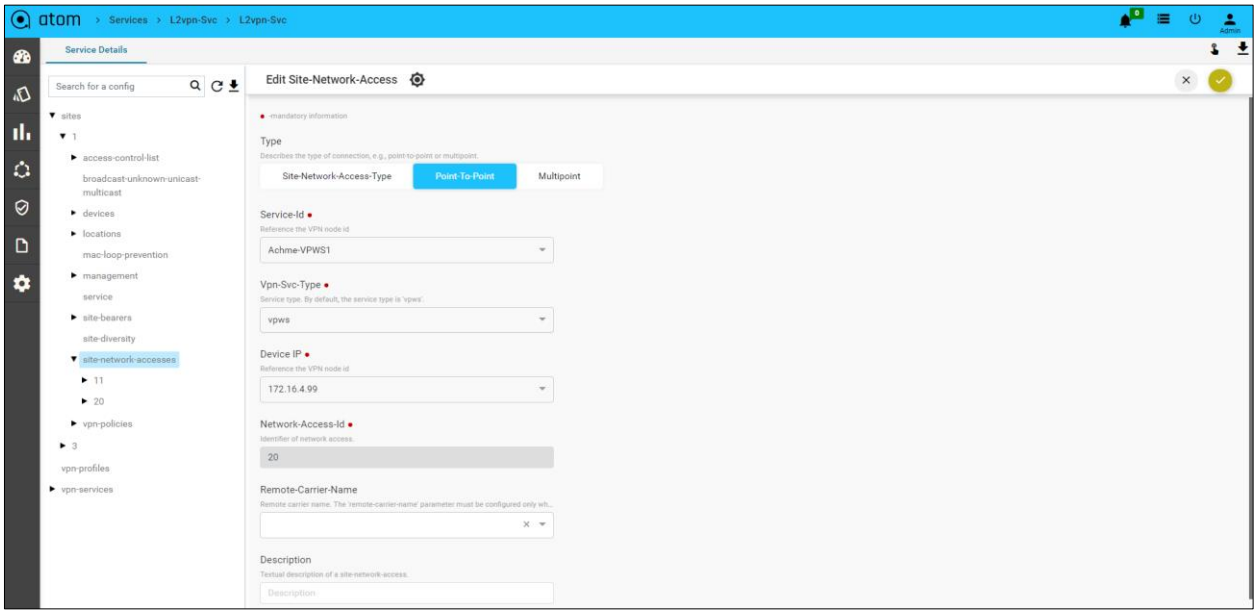
The *site-network-accesses* is a characteristic under the *site.* It defines the list of ports to the site and its properties. It is also the sub-container where the physical port or bearer is bound to the *vpn-service*. The site-network-access represents a logical ethernet connection to a site with multiple site-network-accesses, like in multi-homing. The following essential characteristics are grouped under site-network-access.

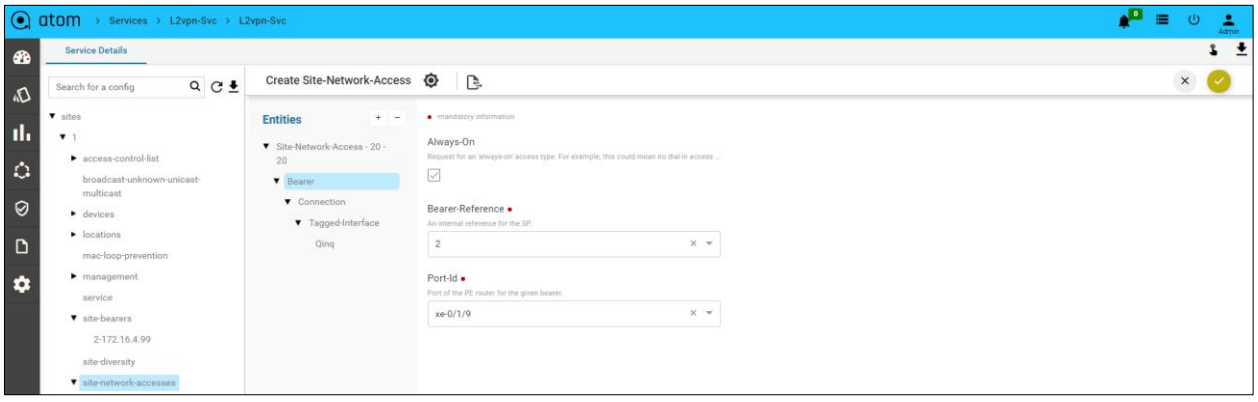
1. *Bearer*: Gives a reference back into the site-bearer created above and the PE device port.

© 2020 Anuta Networks. All Rights Reserved

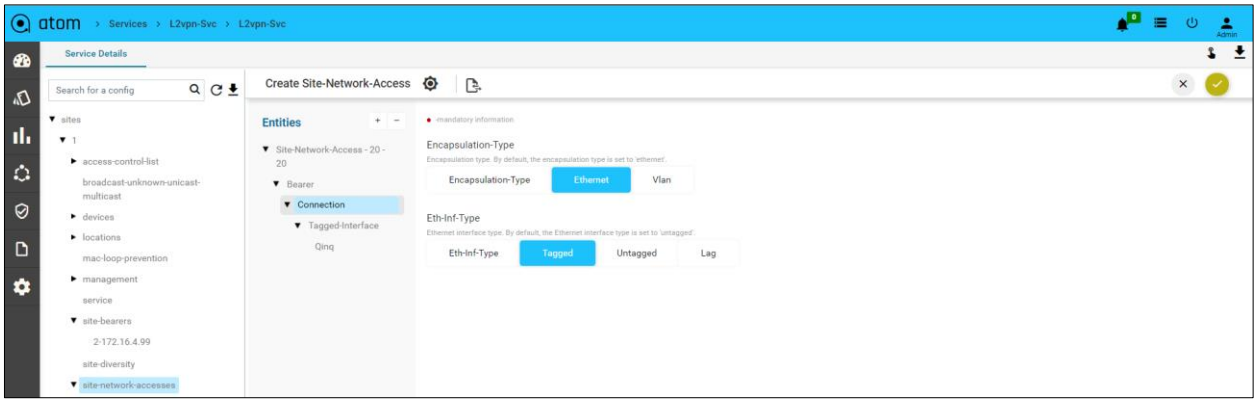
2. *Connection*: Offers the choice of encapsulation type & ethernet interface type. Options under each category is listed below.
    i. *Encapsulation-Type*
        a. *Ethernet*
        b. *Vlan*
    ii. *Eth-Inf-Type*
        a. *Tagged*
            a. *qinq*
            b. *vxlan*
            c. *dot1q*
            d. *qinany*
            e. *Priority-tagged*
        b. *Untagged*
        c. *Lag*

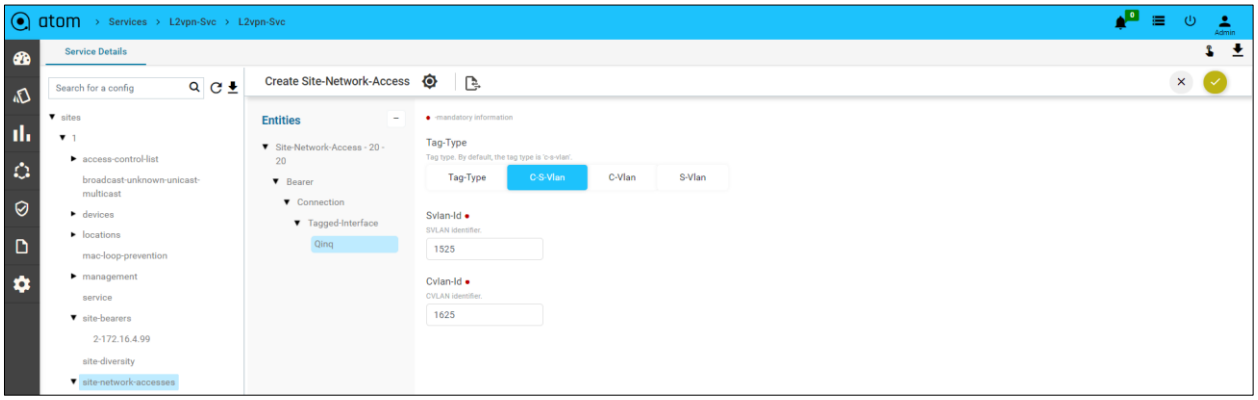
A tagged interface with qinq with tag type as C-S-Vlan is chosen for Site-1, Device-172.16.4.99, for illustration in the example below.



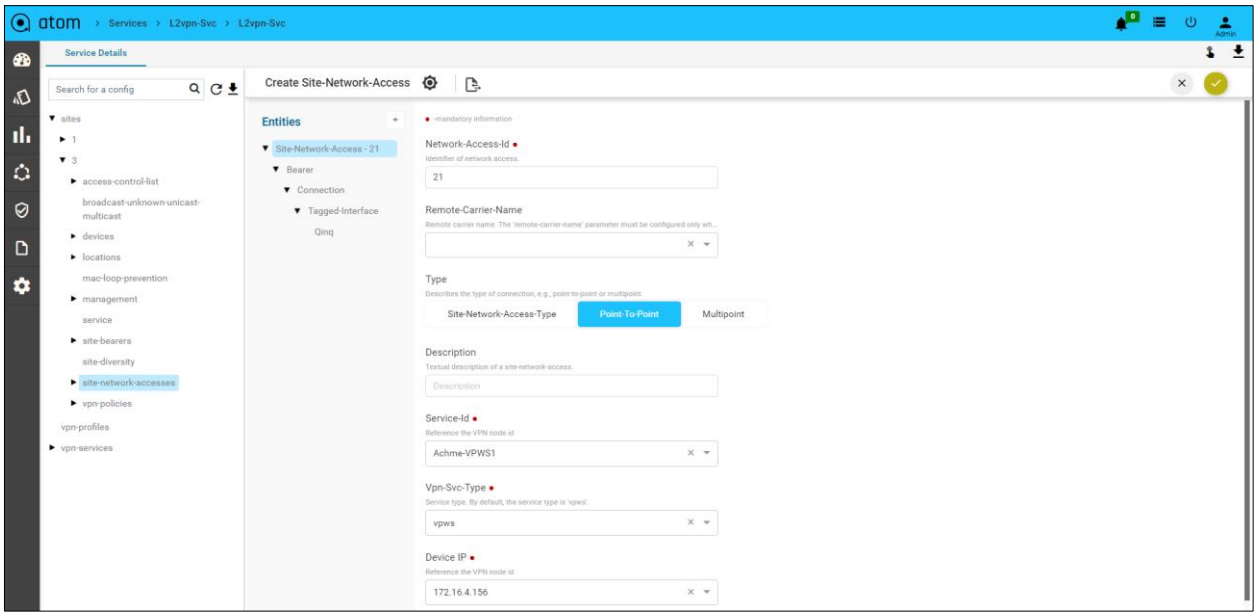


© 2020 Anuta Networks. All Rights Reserved

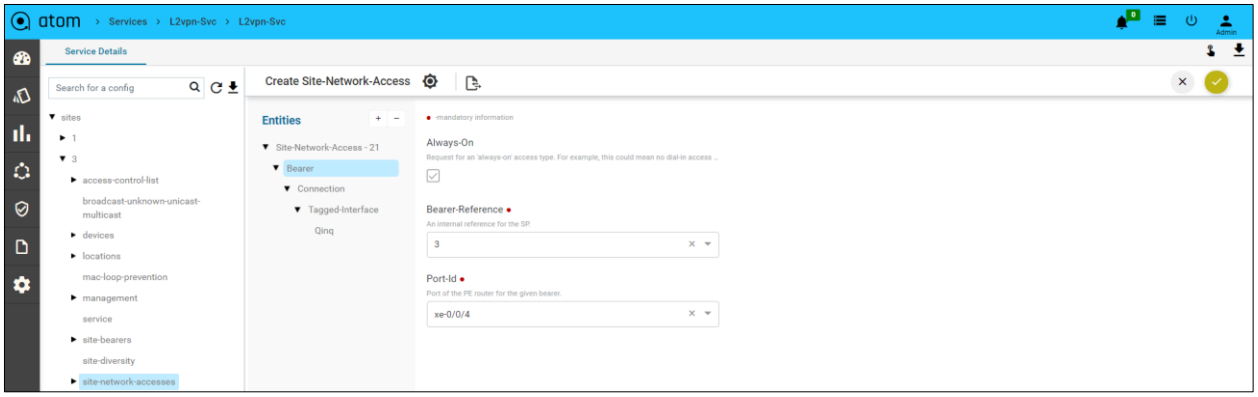


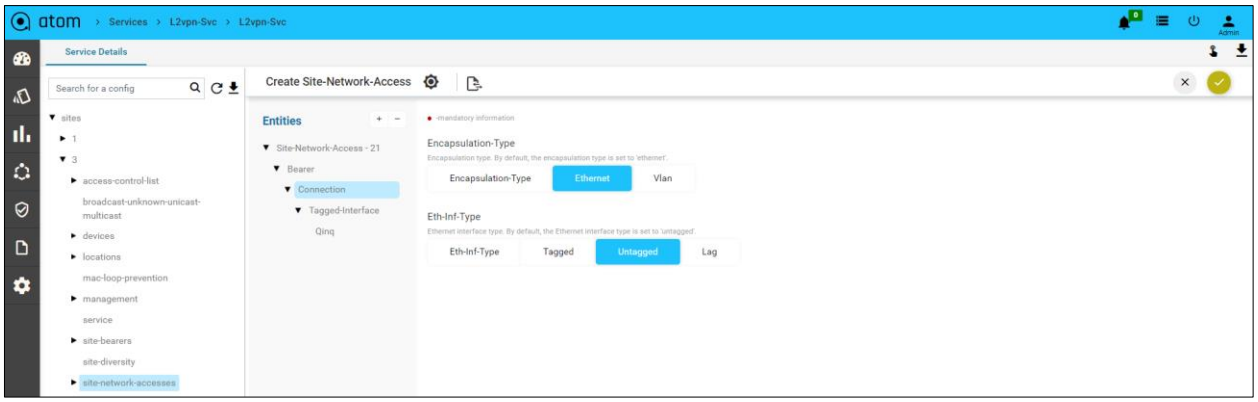


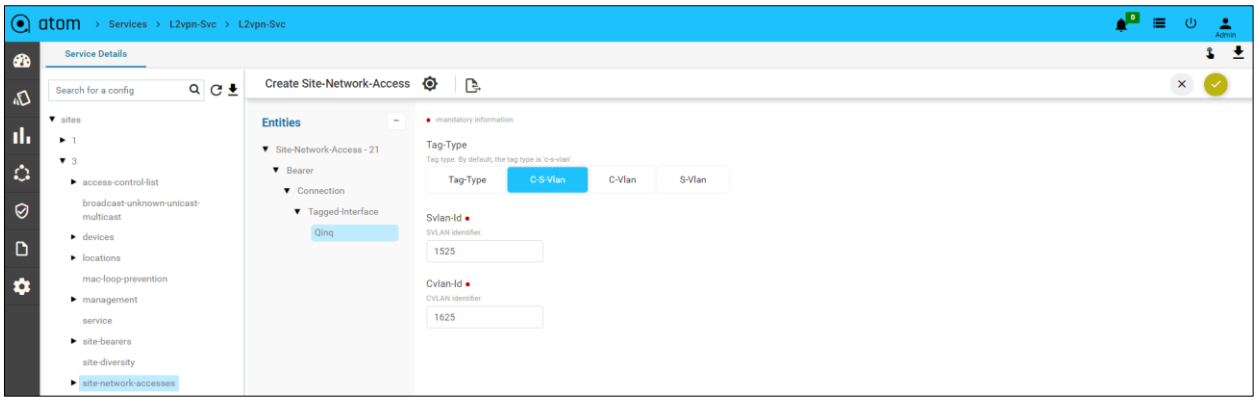
A tagged interface with qinq with tag type as C-S-Vlan is chosen for Site-3, Device-172.16.4.156, for illustration in the example below.



© 2020 Anuta Networks. All Rights Reserved

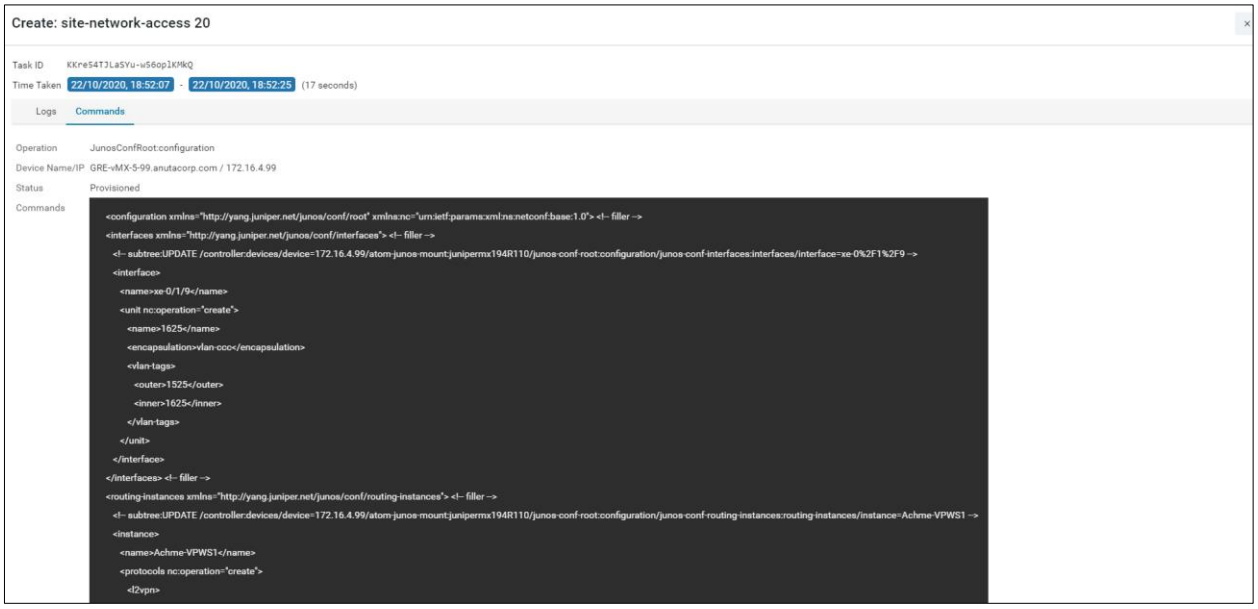


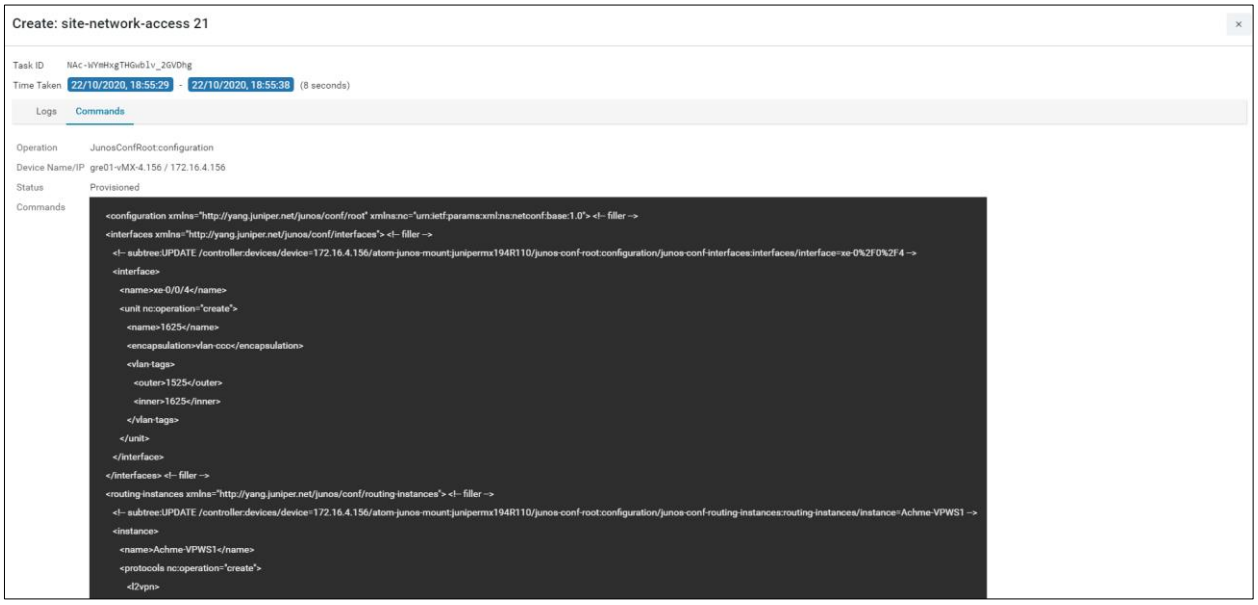




The below snapshot shows the NETCONF payload generated and provisioned on both 172.16.4.99 & 172.16.4.156.

© 2020 Anuta Networks. All Rights Reserved





The below screenshot shows the service details on ATOM side.

© 2020 Anuta Networks. All Rights Reserved

anuta networks

Site-Network-Access

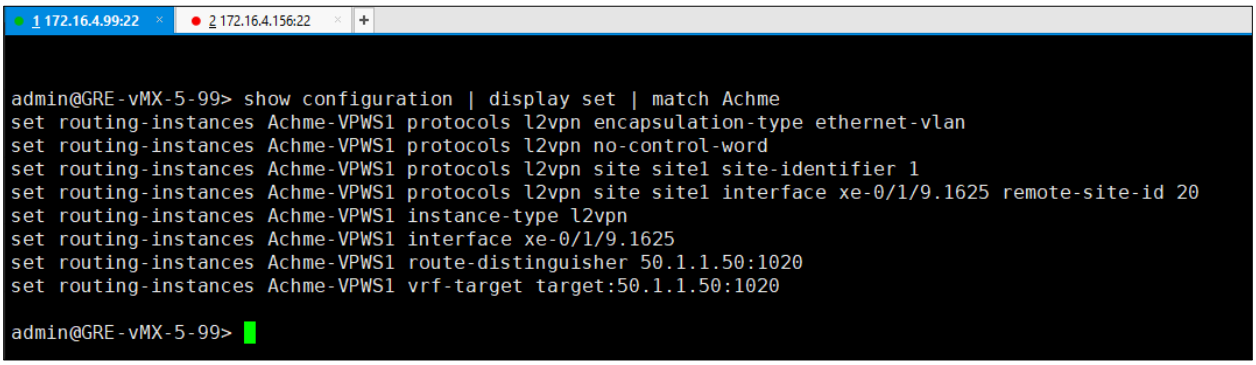
```
<site-network-accesses xmlns="urn:ietf:params:xml:ns:yang:ietf_l2vpn_svc">
   <site-network-access>
      <access-control-list/>
      <bearer>
         <always-on>true</always-on>
         <connection>
            <tagged-interface>
               <qinq>
                  <tag-type>c-s-vlan</tag-type>
                  <svlan-id>1525</svlan-id>
                  <cvlan-id>1625</cvlan-id>
               </qinq>
               <type>qinq</type>
            </tagged-interface>
            <encapsulation-type>ethernet</encapsulation-type>
            <eth-inf-type>tagged</eth-inf-type>
         </connection>
         <bearer-reference>2</bearer-reference>
         <port-id>xe-0/1/9</port-id>
      </bearer>
      <device-ip>172.16.4.99</device-ip>
      <network-access-id>20</network-access-id>
      <service-id>Achme-VPWS1</service-id>
      <type>point-to-point</type>
      <vpn-svc-type>vpws</vpn-svc-type>
   </site-network-access>
</site-network-accesses>
```


© 2020 Anuta Networks. All Rights Reserved

Site-Network-Access

```
<site-network-accesses xmlns="urn:ietf:params:xml:ns:yang:ietf_l2vpn_svc">
   <site-network-access>
      <access-control-list/>
      <bearer>
         <always-on>true</always-on>
         <connection>
            <tagged-interface>
               <qinq>
                  <tag-type>c-s-vlan</tag-type>
                  <svlan-id>1525</svlan-id>
                  <cvlan-id>1625</cvlan-id>
               </qinq>
               <type>dot1q</type>
            </tagged-interface>
            <encapsulation-type>ethernet</encapsulation-type>
            <eth-inf-type>untagged</eth-inf-type>
         </connection>
         <bearer-reference>3</bearer-reference>
         <port-id>xe-0/0/4</port-id>
      </bearer>
      <device-ip>172.16.4.156</device-ip>
      <network-access-id>21</network-access-id>
      <service-id>Achme-VPWS1</service-id>
      <type>point-to-point</type>
      <vpn-svc-type>vpws</vpn-svc-type>
   </site-network-access>
</site-network-accesses>
```

The below screenshot shows the commands provisioned on both the Juniper MX devices.



© 2020 Anuta Networks. All Rights Reserved

```
admin@GRE-vMX-5-99> show configuration | display set | match xe-0/1/9
set interfaces xe-0/1/9 flexible-vlan-tagging
set interfaces xe-0/1/9 encapsulation flexible-ethernet-services
set interfaces xe-0/1/9 unit 1144 encapsulation vlan-ccc
set interfaces xe-0/1/9 unit 1144 vlan-id 1144
set interfaces xe-0/1/9 unit 1502 encapsulation vlan-ccc
set interfaces xe-0/1/9 unit 1502 vlan-tags outer 1501
set interfaces xe-0/1/9 unit 1502 vlan-tags inner 1502
set interfaces xe-0/1/9 unit 1625 encapsulation vlan-ccc
set interfaces xe-0/1/9 unit 1625 vlan-tags outer 1525
set interfaces xe-0/1/9 unit 1625 vlan-tags inner 1625
set routing-instances ACME protocols l2vpn site site1 interface xe-0/1/9.1502 remote-site-id 11
set routing-instances ACME interface xe-0/1/9.1502
set routing-instances Achme-VPWS1 protocols l2vpn site site1 interface xe-0/1/9.1625 remote-site-id 20
set routing-instances Achme-VPWS1 interface xe-0/1/9.1625
set routing-instances VPWS-1144 protocols evpn interface xe-0/1/9.1144 vpws-service-id local 1144
set routing-instances VPWS-1144 protocols evpn interface xe-0/1/9.1144 vpws-service-id remote 1144
set routing-instances VPWS-1144 interface xe-0/1/9.1144
```

```
admin@gre01-vMX-4.156> show configuration | display set | match Achme
set routing-instances Achme-VPWS1 instance-type l2vpn
set routing-instances Achme-VPWS1 interface xe-0/0/4.1625
set routing-instances Achme-VPWS1 route-distinguisher 50.1.1.51:1020
set routing-instances Achme-VPWS1 vrf-target target:50.1.1.50:1020
set routing-instances Achme-VPWS1 protocols l2vpn encapsulation-type ethernet-vlan
set routing-instances Achme-VPWS1 protocols l2vpn no-control-word
set routing-instances Achme-VPWS1 protocols l2vpn site site-4.156 site-identifier 3
set routing-instances Achme-VPWS1 protocols l2vpn site site-4.156 interface xe-0/0/4.1625 remote-site-id 21

admin@gre01-vMX-4.156>
```

```
admin@gre01-vMX-4.156> show configuration | display set | match xe-0/0/4
set interfaces xe-0/0/4 flexible-vlan-tagging
set interfaces xe-0/0/4 encapsulation flexible-ethernet-services
set interfaces xe-0/0/4 unit 457 encapsulation vlan-ccc
set interfaces xe-0/0/4 unit 457 vlan-tags outer 456
set interfaces xe-0/0/4 unit 457 vlan-tags inner 457
set interfaces xe-0/0/4 unit 1625 encapsulation vlan-ccc
set interfaces xe-0/0/4 unit 1625 vlan-tags outer 1525
set interfaces xe-0/0/4 unit 1625 vlan-tags inner 1625
set routing-instances ACME interface xe-0/0/4.457
set routing-instances ACME protocols l2vpn site site-4.156 interface xe-0/0/4.457 remote-site-id 4
set routing-instances Achme-VPWS1 interface xe-0/0/4.1625
set routing-instances Achme-VPWS1 protocols l2vpn site site-4.156 interface xe-0/0/4.1625 remote-site-id 21

admin@gre01-vMX-4.156>
```

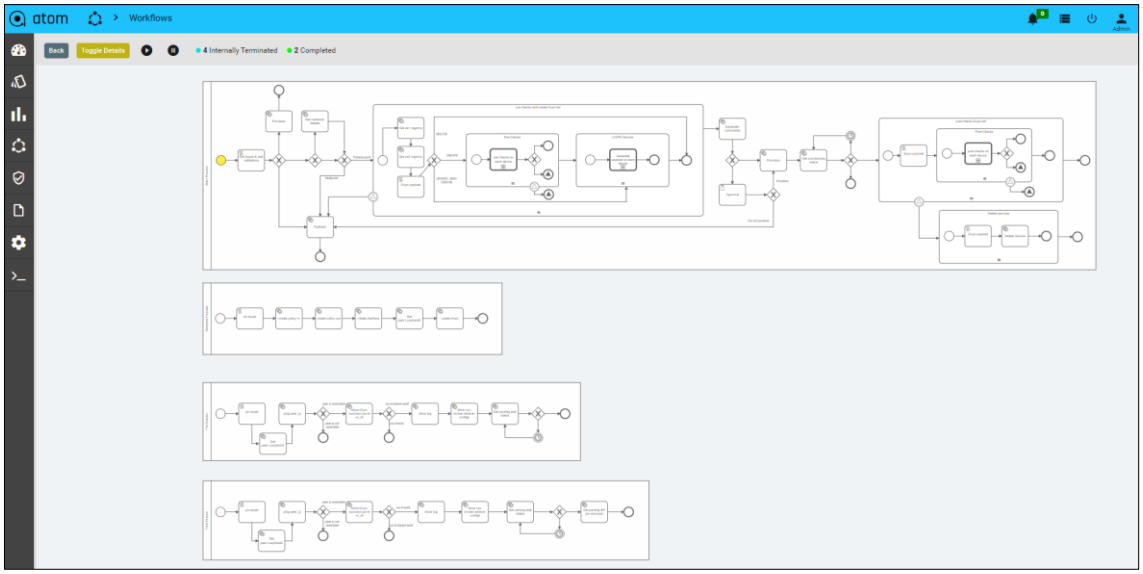

© 2020 Anuta Networks. All Rights Reserved

Service Compliance

Anuta ATOM's service modeling capabilities not only allows a smooth vendor agnostic provisioning, but also maintains the state and sanity of the services through its service compliance feature. The service compliance module detects the configuration drift to device configurations, performs service inventory to understand the nature of the changes and notifies upon deviation. ATOM also generates the difference in configuration along with the commands to be reconciled to ensure service compliance. The user is given the authority to overwrite the device or server (ATOM) service model configurations.

Workflow Integration

Every service provisioning is governed by a method-of-procedure in organizations. Integrating ATOM's service models into ATOM workflow engine, helps to execute a set of Pre-Checks, followed by the choice of services to be provisioned and Post-Checks to ensure a smooth and successful service provisioning. Below workflow executes an instance of VPN service with pre & post validations.



Additional Resources

Video-on-demand on ATOM L2VPN Service Automation

To learn how Anuta Network's ATOM Multi-Vendor Service Orchestration can accelerate your network automation journey, contact us at https://www.anutanetworks.com

© 2020 Anuta Networks. All Rights Reserved