UNUM Fabric Automation Guide

Pluribus UNUM Fabric Automation


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Introduction

Pluribus Networks’ UNUM is a unified fabric management, automation and analytics platform that enables administrators to significantly reduce fabric deployment times, execute everyday fabric management life cycle tasks and conduct effective traffic analysis, all from the same graphical interface.

UNUM has two major components:

The first is the fabric management and automation component that comes with the base license. Administrators can perform network tasks such as creating VLANs, adding ports, monitoring fabric health, and many other standard functions. With this license, users can also save time by automating the provisioning of switches, creating fabrics, and building underlays.

The second component is Insight Analytics, a real-time analytics and performance management module that uses telemetry from the fabric nodes. With the Insight Analytics license, administrators can view traffic flow patterns, monitor fabric activity, or even analyze VMWare virtual machine traffic.

In this document, we will examine UNUM’s Day-0 automation capabilities concerning underlay fabric deployments. Our intended audience comprises system engineers and administrators with a basic understanding of data center networking who are interested in deploying fabrics in an open networking environment.

UNUM incorporates two forms of automation:

- **ONIE Switch Provisioning** – Also known as Zero Touch Provisioning or ZTP, UNUM provisions bare metal switches with a built-in DHCP server, installing the Pluribus Netvisor ONE operating system onto bare metal switches.

- **Fabric Creation** – UNUM automates the various steps of creating a spine/leaf fabric, leveraging a series of playbooks to meet customer design requirements. Today UNUM can create leaf/spine underlay fabrics using an Out-of-Band management network.

We’ll examine both of these topics with the intent of creating some examples of a fabric, familiarizing the reader with the steps necessary to create their own.
Considerations

Administrators need to decide on the characteristics of the fabric based on customer business needs. Is the fabric for a small data center with only a few nodes? Perhaps a Layer-2 Fabric will suffice. Will the customer need VXLAN to extend across a third-party fabric? Layer-3 is necessary, but which routing protocol? BGP? OSPF? Is this a typical production deployment where switch redundancy is essential or a lab automation environment where redundancy is optional?

Determining these requirements before you read this guide will help you determine which playbook to use when creating a fabric.
The first two fabrics created in this guide use the same physical leaf/spine topology as shown above (Lab Automation is a bit different, so we will cover the topology later in the document).

There are six DELL S4112T-ON and two DELL S4148 leafs connected to two DELL Z9100-ON spine switches in our testbed. UNUM is installed on an ESXi server (not shown) and configured to communicate with all of the switches through the management network.

All switches are racked, cabled, and powered on.

**Note:** Throughout this guide, we will be providing specific IP address and network configuration information as part of our examples that are particular to our setup topology. Customers will need to tailor these settings to their specific deployment environments.
Before You Begin

Before you begin, please refer to the following sections regarding setting and licensing.

- UNUM Day-0 ONIE Switch Provisioning Prerequisites
- UNUM and Netvisor ONE Licensing
If you are using UNUM’s automation to install the Netvisor ONE operating system onto bare metal switches, you will need to gather several pieces of information:

1) The desired switch names.
2) The desired switch management IPs.
3) Switch MAC addresses – found on the Dell switch label.
4) Switch device IDs – found on the Dell switch label.
5) Console connection information for the switches. While it is technically possible to provision switches without a console connection, we highly recommend all switches have one for troubleshooting purposes.

The switch names and IP scheme will be needed even if the automated ONIE install process isn’t used.

For example, below is a table with the information we’ll be using to build our fabrics:

<table>
<thead>
<tr>
<th>Host Name</th>
<th>IP Address</th>
<th>MAC Address</th>
<th>Device-ID</th>
<th>Console IP</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf-1</td>
<td>10.13.44.12</td>
<td>20:04:0f:52:2f:d8</td>
<td>1XH1PK2</td>
<td>10.13.44.11</td>
<td>2002</td>
</tr>
<tr>
<td>Leaf-2</td>
<td>10.13.44.13</td>
<td>20:04:0f:52:2a:d8</td>
<td>7WH1PK2</td>
<td>10.13.44.11</td>
<td>2003</td>
</tr>
<tr>
<td>Leaf-3</td>
<td>10.13.44.14</td>
<td>20:04:0f:52:2f:58</td>
<td>2XH1PK2</td>
<td>10.13.44.11</td>
<td>2004</td>
</tr>
<tr>
<td>Leaf-4</td>
<td>10.13.44.15</td>
<td>20:04:0f:52:2b:58</td>
<td>BWH1PK2</td>
<td>10.13.44.11</td>
<td>2005</td>
</tr>
<tr>
<td>Leaf-5</td>
<td>10.13.44.16</td>
<td>50:9a:4c:d3:f6:f0</td>
<td>4DD1XC2</td>
<td>10.13.44.11</td>
<td>2006</td>
</tr>
<tr>
<td>Leaf-6</td>
<td>10.13.44.17</td>
<td>50:9a:4c:d3:ee:70</td>
<td>3CD1XC2</td>
<td>10.13.44.11</td>
<td>2007</td>
</tr>
<tr>
<td>Leaf-7</td>
<td>10.13.44.18</td>
<td>14:18:77:25:49:B9</td>
<td>5LP6XC2</td>
<td>10.13.44.11</td>
<td>2008</td>
</tr>
<tr>
<td>Leaf-8</td>
<td>10.13.44.19</td>
<td>14:18:77:25:56:B9</td>
<td>1MP6XC2</td>
<td>10.13.44.11</td>
<td>2009</td>
</tr>
<tr>
<td>Spine-1</td>
<td>10.13.44.20</td>
<td>8c:ea:1b:72:82:e3</td>
<td>771632X1650002</td>
<td>10.13.44.11</td>
<td>2011</td>
</tr>
<tr>
<td>Spine-2</td>
<td>10.13.44.21</td>
<td>00:10:18:01:30:18</td>
<td>1729AC7700025</td>
<td>10.13.44.11</td>
<td>2010</td>
</tr>
</tbody>
</table>

Table - Host Information for ONIE Switch Provisioning

Our UNUM IP address is 10.13.35.132.
UNUM and Netvisor ONE Licensing

Before creating a fabric, install UNUM and activate licenses for both UNUM and individual switches. Activate these licenses through the Pluribus Networks Cloud or PNCloud.

The PNCloud is simply a portal for downloading software and activating licenses and is accessible through our customer portal. New customers will receive an e-mail with credentials and login instructions.

While a detailed walk-through of license activation is outside the scope of this document, please refer to the appropriate sections of the UNUM Installation and Configuration guide below.

1) Installing UNUM.
2) Activate UNUM Licenses.
3) Activate Switch Licenses. This link opens an introductory video to the PNCloud and switch license activation.

Use your mobile device to access the Introductory Video.

Once UNUM is installed, it is accessed by typing the management IP address into a browser window. Chrome or Firefox are recommended browsers.
Provisioning Netvisor ONE Onto Bare-Metal Switches

Before creating a fabric, you must install the Netvisor ONE operating system onto the switches that will become the fabric nodes.

Dell switches and the Pluribus Netvisor ONE operating system use the Open Network Install Environment (ONIE) to provision bare-metal switches. After racking, cabling, and powering on a new switch, it comes up in the ONIE install environment, and the switch awaits communication with a DHCP server (among other things). Once establishing communication, the Netvisor ONE install files will be pushed to the individual switch, and the install process will start.

Refer to the following sections for configuring the ZTP Server and assigning switches.

- Configuring the UNUM ZTP Server (DHCP)
- Assigning Switches to be Provisioned
Configuring the UNUM ZTP Server (DHCP)

UNUM incorporates a DHCP or “ZTP” Server. You must configure the ZTP Server before use. The ZTP server only needs to run until the switch provisioning process is completed and shut off after provisioning to avoid network conflicts.

**TIP:** Before activating the DHCP server in UNUM, make sure to temporarily disable any other DHCP servers on the management VLAN or subnet to avoid conflicts.

**TIP:** All of the switches and UNUM must be able to communicate. If both are not in the same management VLAN or subnet, be sure to enable a DHCP relay to allow communication.

1) To configure the UNUM ZTP (DHCP) server:

![Figure 2 - Configure ZTP Server](image-url)
Configuring the UNUM ZTP Server (DHCP)

2) Populate the ZTP fields server with the appropriate network settings for the management network (eth0 interface for UNUM). The information here such as management interface, subnet and gateway is info to be populated in ZTP switches.

3) Start the ZTP Server by clicking on the blue **Start** button.

---

**Figure 3** - Fabric ZTP Server Settings

**Figure 4** - Fabric ZTP Server Start
Assigning Switches to be Provisioned

Next, we'll designate which switches to provision by assigning the hostname, management IP address, MAC Address, and Device ID. We'll also choose which software version of Netvisor ONE to install, choose the Activation Key type and designate which switches are leafs or spines.

Tip: UNUM offers both ONLINE and OFFLINE license management. By temporarily enabling internet access and associating your PNCloud account with UNUM, Netvisor ONE software files and associated license keys are available for automatic download. Click here for the procedure procedure documenting both the Online and Offline methods.

1) Click on Manager → Fabric → ZTP Switch and click on the blue Add Switch button.

   Figure 5 - ZTP Server Add Switch

2) This opens the Provision Switch window.

   Figure 6 - ZTP Provision Switch

3) Populate the switch fields for each switch in the deployment from your previously gathered information. Ensure a software version is selected in the top pane. Also, designate whether this switch is to be a leaf or a spine.

   Figure 7 - Provision Switch Settings
Assigning Switches to be Provisioned

In the activation key drop-down, chose the required license keys. A list of options will appear in an environment where UNUM connects directly to the Internet using an associated PNCloud account (see the UNUM and Netvisor ONE licensing section).

License keys obtained from PNCloud for an OFFLINE environment are then uploaded to UNUM and selected for the impacted switches. The ‘**’ mark denotes previously uploaded keys.

If you are in an ONLINE environment, select the appropriate license key type that matches the license type from your PNCloud account.

Figure 8 - Upload Key

Select or upload the Software Version of the ONIE-installer file to be used. Click on the blue Done button once all information has been entered and verified.

Figure 9 - All Switches Entered
Assigning Switches to be Provisioned

4) Provisioning begins. Hover over a switch’s status indicator to see the status on screen.

Figure 10 - Switch Status

Status Indicators are color coded:

- **Green**: ONIE provision successful.
- **Spinner**: ONIE provision in progress.
- **Grey**: ONIE provision not started or connectivity issues exist (check to see that the device is powered on and/or that the IP address is reachable from the UNUM management IP).
- **Red**: ONIE Provision Error. Process will need to be re-executed.

5) Once installation is complete, a green status indicator shows in the status column.

Figure 11 - Green Status Indicators

When all switches show a green status Netvisor ONE is installed on all switches, the management IP addresses are configured, and all switches are ready to be added to a fabric.

Note: Software provisioning occurs in parallel, resulting in a drastic deployment time reduction.
Creating a Fabric

UNUM Day-0 fabric automation consists of two steps:

1) **Initial/Basic Fabric Setup** – UNUM will detect the physical topology via LLDP and deploy the Pluribus Adaptive Cloud Fabric.

   The Adaptive Cloud Fabric or ACF is Pluribus Networks software-defined, controller-less solution that enables the administration and automation of multiple switches from a single point of management across multiple geographic locations.

2) **Configure the Fabric via Playbook** – Administrators will choose one of six playbooks to tailor the fabric underlay, including options such as Layer-2, Layer-3, VRRP, BGP, OSPF, or 3rd party spines.

   After completing these two steps, customers will have a fabric in place that establishes initial (Day-0) connectivity.

   Within each step, there are a significant amount of additional options to tweak a fabric. The walk-through will focus on the essential information. Administrators who wish to use the advanced options should refer to the UNUM Installation & User Guide.

   **Note:** When initially writing this document, UNUM Day-0 fabric automation is usable only to create Out-of-Band (OOB) managed fabrics. Customers wishing to use UNUM to manage In-Band (IB) fabrics will need to build one with the CLI and then add it to UNUM via the seed switch option.

   Again, we’ll provide examples using IP addresses and network information that is particular to our setup. Customers will, of course, need to substitute their IP addresses and other values respective to their network environment.

   - Basic Fabric Setup
   - Configure the Fabric
   - Playbook Example – L3 BGP VRRP with Netvisor Spines
   - Quick Start Example
Basic Fabric Setup

During the basic fabric setup, we will create a fabric named “DellFabric,” define which switches will be used in the fabric and assign fabric credentials such as the management IP subnet, gateway, and DNS.

In our examples the essential information to be entered is:

- **Mgmt. IP Subnet** = 24
- **Gateway IP** = 10.13.44.1
- **DNS IP** = 8.8.8.8
- **DNS Secondary IP** = 8.8.4.4

We’ll also need to check the ‘I accept the End User License Agreement’ box.

Before starting, it’s important to understand that UNUM can add or create a fabric in one of four methods:

- **Seed Switch**
  - Add an existing fabric to UNUM, created via the CLI or another UNUM instance.

- **Netvisor Fabric License**
  - Create a new fabric with at least two spines and two leafs.

- **Netvisor Enterprise L2/L3 License**
  - Create a fabric with one switch or a two switch cluster.

- **Quick Start**
  - Build a simple Layer-2 fabric with routing between the spines as a fast start option for small or edge data center environments, using a minimal amount of information. This option combines the initial fabric setup/playbook operations.

We’ll use the Netvisor Fabric License option to deploy our ten-switch fabric.

Another helpful, optional tool, UNUM, can save some configuration information in a Host File. Host files are simple text or .csv files that capture data for use, later on, to re-build a fabric with the same characteristics or edited to create a new fabric. We’ll be entering all information manually in our examples but will call out when it’s possible to save a host file for future use.
Basic Fabric Setup

To perform the basic fabric setup:

1) Navigate from **Dashboards → Topology** and in the gray Global pane, right-click on Global and click **+ Add Fabric** to add a Fabric to UNUM.

In the add fabric pop-up, click the blue **Netvisor Fabric License** button.

Figure 12 - Add Fabric

Figure 13 - Add Fabric Selection Menu
Basic Fabric Setup

2) Populate the Fabric name, and enter the username/password for the switches.

Caution: Currently, the initial fabric User Name needs to be "network-admin" and the initial Password needs to be "test123." The password can and should be changed after the fabric is built.

Click on the blue Next button.

Figure 14 - Add Fabric Parameters
Basic Fabric Setup

3) Populate switch information fields with the appropriate switch names and management IP addresses, and identify if the switch is a **Spine**, **Leaf** or a **Third Party** switch. Click the blue **Save** button to store switch information and then click **Next** to continue.

**Optional:** Click on the blue **Download File** button to save a text file with the entered information. This file will be saved in your browser's download window and edited or used to rebuild a fabric with the same information at a later time via the **Choose File** button in Step Two.

*Figure 15 - Populate Switch Information*
4) Update the Management IP Subnet, Gateway IP address, and DNS settings based on the management interface/network. Validate the fabric-related settings that match the desired deployment, including the DNS, domain, and subnet. Check the “I accept the EULA” box and click on Add to add the fabric to UNUM.

Note: The RESET FABRIC box is used to permanently delete switch configuration information, excepting setup info such as the management IP address. It is only used where fabrics need to be rebuilt on switches with existing configurations, primarily for customer demos. In general, do not select this option.

Figure 16: Additional Configuration Parameters
Basic Fabric Setup

5) At this point, UNUM will accept the switch EULA, discover the topology via LLDP and deploy the adaptive cloud fabric. Light green circle animations appear on the switch icons in the topology view and popup messages as specific operations complete during this process.

You will also see a blue progress indicator providing an approximate time for completion of the fabric setup.

Figure 17 - Provisioning Process Running

6) When the process is finished, you will see a topology view similar to this image on the right.

Figure 18 - Provisioning Process Complete

The Dell-Fabric appears in the left-hand navigation pane, along with the ten switches in the fabric. Switch details such as IP addresses, software version, status, and CPU/Memory indicators appear in the Details pane below.

During or after the setup process, administrators can click on the Playbook Logs button to see the specific tasks completed by UNUM.
Configure the Fabric

Our basic fabric is complete at this point in the process, but we need to configure it.

UNUM offers six different playbooks to choose from to complete the Day-0 fabric automation and establish basic connectivity.

- L2 VRRP with Netvisor Spines
- L3 VRRP BGP with Netvisor Spines
- L3 VRRP OSPF with Netvisor Spines
- L2 VRRP with 3rd Party Spines
- L3 VRRP BGP with 3rd Party Spines
- L3 VRRP OSPF with 3rd Party Spines

We’ll walk through some examples of playbook execution to finish our Day-0 fabric deployments. The UNUM Installation and Configuration Guide contains various examples of the playbooks.

Important: Each playbook example assumes that the fabric setup has been completed, per the Initial Fabric Setup section, and that no other playbook has been deployed. Once deployed, the only way to use another playbook would be to re-run the initial fabric setup with the RESET fabric box checked, deleting the original fabric.
Playbook Example – L3 BGP VRRP with Netvisor Spines

In this example, we’ll build a fabric with Layer-3 at both the leafs and spines and deploy VRRP between two leafs in a cluster. The spines will be running Netvisor ONE.

1) After the initial fabric setup has been initiated or completed, click on the blue Launch Playbook link on the right of the screen.

   ![Launch Playbook](image1)

2) From the popup menu choose the L3 VRRP EBGP playbook from the left menu and click on the blue Next button.

   ![L3 VRRP EBGP Playbook](image2)
3) This opens the Playbook setting page. We’ll be using the default Inter-switch Link and iBGP fabric peering information, but we do need to configure a VLAN to enable Day-0 connectivity. Under the VRRP configuration info section, click on the blue Manual Input button.

Figure 21 - VRRP Configuration
4) In the CSV file screen, enter the following information:

VLAN ID = 10
VRRP IP = 10.10.10.1/24

This is the virtual IP address of what will be our VLAN gateway.

Switch Name (first) = LEAF-1
Switch Name (Second) = LEAF-2

These switches will be the master/slave for VRRP.

VRRP ID = 18
Switch Name (Third) = LEAF-1

This field designates which switch will be the master for VRRP.

Finally click on the blue Add+ button.
5) From the Playbook setting screen, click on the blue **Next** button.

Figure 23 - VRRP Configuration
6) From the playbook **Advanced Settings** window, click on the blue **Add** button to accept the default advanced settings.

Figure 24 - Advanced Settings
7) At this point UNUM automation creates the BGP fabric. Note the progress bars in the Details pane.

UNUM measures progress by the task and provides a rough time estimate. These indicators can vary based on the switch models chosen for the fabric but can be a rough indicator of how long the fabric will need to complete.

Figure 25 - Fabric Provisioning

Tip: BGP fabrics are more complex than simple Layer-2 fabrics and can take longer to configure depending on the configuration choices. In our ten switch fabric, given the switches we are using, we can expect the playbook configuration to last for around 45-50 minutes.

8) Our L3 VRRP BGP fabric has been created and is ready for use.

Adding host ports to VLAN 10 and configuring host IPs on any of the leaf switches, enables the communication between hosts.

Figure 26 - Fabric Provisioning
Complete
9) It’s always a good idea to check the Fabric Health Dashboard on a new fabric to review any potential issues. Click on Dashboards in the top menu and select Fabric Health.

![Fabric Health Dashboard](image)

Everything is green and good to go!

Now add host ports to VLAN 10, and the servers can communicate with each other.

You may have noticed that we only provisioned one VLAN, but UNUM is reporting 69. As UNUM builds a fabric, some VLANs are necessary for internal use, such as for vRouter Interfaces, and these also appear in the Global Fabric Resources widget. In these cases, UNUM assigns the internal VLAN starting with VLAN 4092 and subtracting by one as needed (4092, 4091, 4090...).
Quick Start Example

Quick Start is a new fabric automation option available as of the UNUM 5.2 release.

Quick Start creates a simple Layer-2 fabric with routing between the spines, with minimal configuration, as a fast start option for small or edge data center environments with four to ten switches. This option combines the initial fabric setup and fabric configuration steps to simplify the build process. Quick Start can create a fabric with or without 3rd party spines.

Important: Quick Start imports some network information from the ZTP Server such as DNS values and ntp servers (refer to the Configuring the UNUM ZTP Server section for more information). If you have added a pre-configured fabric, or did not use zero-touch switch provisioning, you will need to fill out the management network information in the ZTP server and save the settings. It is not necessary for the ZTP server to be running, just that the network information is saved.

Below is an example of creating a L2 VRRP Quick Start fabric with Pluribus Spines:

1) From the Topology Dashboard in the gray Global pane, right-click on Global and click Add Fabric to add a Fabric to UNUM.

Figure 28 - Add Fabric

2) From the Add Fabric popup, click on the Quick Start button.

Figure 29 - Add Fabric Quick Start
Quick Start Example

3) From the Add Fabric window, choose the Quick Start L2 VRRP playbook option.

Figure 30  Quick Start L2 VRRP Playbook
4) Next, populate the Setup window with the essential information necessary to build the fabric, including one VLAN for initial Day-0 connectivity (see below).

Here we’re creating the DELLFabric again, on the 10.13.44.x/24 OOB management network, with VLAN 10 and a VRRP IP 10.10.10.1/24.

Note: The VRRP virtual IP address can either be an x.x.x.1 with a master router of x.x.x.2 and an alternate of x.x.x.3 or x.x.x.254 with a master router of x.x.x.253 and an alternate of x.x.x.252. Administrators should choose the high or low option based on their fabric requirements.

Figure 31 - Quick Start L2 VRRP Playbook Setup Menu

**TIP:** The green check mark ✓ on each line of switch information indicates that the switch is reachable and is in the desired, unconfigured state. If a red X appears instead, administrators should check to see if they have an unreachable switch or already has a configuration applied. In the latter case, the switch will need to have the switch-config-reset command run on it to remove the configuration. This command deletes the current config information, so use it with caution.
5) Once you have entered and verified the fabric information, click on the blue Add button. This action brings up the progress screen.

The fabric Details pane now includes an overall progress indicator at the top for the entire fabric build process. Individual switch progress displays to the right in each switch row.

UNUM measures progress by task and provides a time estimate. These indicators can vary based on the switch models chosen for the fabric but are helpful as an approximate indicator of how long the fabric will need to complete.

Figure 32 - Quick Start L2 VRRP Playbook Provisioning
Quick Start Example

6) Clicking on the blue **Playbook Logs** button to the right of the Details pane brings up a list of the tasks executed by UNUM.

![Playbook Logs Table]

---

Figure 33 - Quick Start L2 VRRP

Playbook Logs

<table>
<thead>
<tr>
<th>Switch Name</th>
<th>Message</th>
<th>Exception</th>
<th>Created On</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEAF-5</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-6</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-4</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-3</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-2</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
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<td>LEAF-1</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-8</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>SPINE-B</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>LEAF-7</td>
<td>Eula accepted</td>
<td></td>
<td>27-01-2020 11:04:54 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned switch-name: SPINE-A</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned mgmt-ip: 10.13.44.20/24</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned inband-ip: 192.168.1.1/24</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned gateway-ip: 10.13.44.1</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned dns-ip: 10.136.2.13</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned dns-secondary-ip: 172.16.1.4</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned domain-name: pluribusnetworks.com</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Assigned ntp-server: 0.us.pool.ntp.org</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Created fabric &quot;DELLfabric&quot;</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Auto-trunk disabled</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-A</td>
<td>Jumbo enabled in ports</td>
<td></td>
<td>27-01-2020 11:05:05 AM</td>
</tr>
<tr>
<td>SPINE-B</td>
<td>Assigned switch-name: SPINE-B</td>
<td></td>
<td>27-01-2020 11:05:44 AM</td>
</tr>
<tr>
<td>SPINE-B</td>
<td>Assigned mgmt-ip: 10.13.44.21/24</td>
<td></td>
<td>27-01-2020 11:05:44 AM</td>
</tr>
</tbody>
</table>
7) Below our Layer-2 VRRP fabric has been created and is ready for use.

**TIP:** If the fabric appears to have gone over the estimated time, try refreshing your browser window.

Figure 34 - Quick Start L2 VRRP Fabric Provisioning Complete

8) Check the Fabric Health Dashboard on a new fabric to see if there are any issues. Click on Dashboards in the top menu and select Fabric Health.

Everything is green and good to go!

Now add host ports to VLAN 10, and the hosts can communicate with each other.

Figure 35 - Quick Start Provisioning Fabric Health
Conclusion

The Pluribus UNUM platform incorporates powerful Day-0 automation that can simplify underlay fabric creation and significantly reduce deployment times.

For more information on UNUM and its many capabilities, please visit https://www.pluribusnetworks.com/products/pluribus-unum/.

For technical support please visit our customer support portal https://www.pluribusnetworks.com/support/customer-portal/, or contact us at support@pluribusnetworks.com.
## Glossary

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONIE</td>
<td>The <strong>Open Network Install Environment</strong> (ONIE) is an open source initiative that defines an open &quot;install environment&quot; for bare metal network switches.</td>
</tr>
<tr>
<td>ZTP</td>
<td>Zero Touch Provisioning. A feature that allows the devices to be provisioned and configured automatically, eliminating most of the manual labor involved with adding them to a fabric.</td>
</tr>
<tr>
<td>PNC</td>
<td>Pluribus Network Cloud – portal/repository for Pluribus Networks software</td>
</tr>
<tr>
<td>Bare-Metal</td>
<td>An industry term that indicates a hardware platform without an operating system, in our case a DELL switch without Netvisor ONE installed.</td>
</tr>
<tr>
<td>DHCP</td>
<td>The <strong>Dynamic Host Configuration Protocol</strong> is a network management protocol used on UDP/IP networks whereby a DHCP server dynamically assigns an IP address and other network configuration parameters to each device on a network so they can communicate with other IP networks.</td>
</tr>
<tr>
<td>DNS</td>
<td><strong>Domain Name System</strong> – a hierarchical and decentralized naming system for computers, services, or other resources connected to the Internet or a private network.</td>
</tr>
<tr>
<td>Seed Switch</td>
<td>In Pluribus Networks software defined fabrics, a seed switch is a fabric node which acts as a central point of communication between UNUM and the fabric.</td>
</tr>
<tr>
<td>Netvisor ONE</td>
<td><strong>Netvisor® ONE</strong> is an open, secure and programmable next-generation Network OS that is purpose-built to optimize the power and performance of bare metal Open Networking hardware.</td>
</tr>
<tr>
<td>Host File</td>
<td>In UNUM environments, an editable file used to preserve fabric configuration information for future use.</td>
</tr>
<tr>
<td>EULA</td>
<td><strong>End User License Agreement</strong></td>
</tr>
<tr>
<td>VRRP</td>
<td>The <strong>Virtual Router Redundancy Protocol (VRRP)</strong> is a computer networking protocol that provides for automatic assignment of available Internet Protocol (IP) routers to participating hosts.</td>
</tr>
<tr>
<td>BGP</td>
<td>The <strong>Border Gateway Protocol (BGP)</strong> is a standardized exterior gateway protocol designed to exchange routing and reachability information among autonomous systems (AS) on the Internet.</td>
</tr>
<tr>
<td>OSPF</td>
<td><strong>Open Shortest Path First (OSPF)</strong> is a routing protocol for Internet Protocol (IP) networks.</td>
</tr>
<tr>
<td>Adaptive Cloud Fabric (ACF)</td>
<td>The <strong>Adaptive Cloud Fabric</strong> or ACF is Pluribus Networks software-defined, controller-less solution that enables the administration and automation of multiple switches from a single point of management, across multiple geographic locations.</td>
</tr>
<tr>
<td>Out-of-Band (OOB)</td>
<td>A management network, separate from the data fabric. Required for UNUM Day-0 automation.</td>
</tr>
<tr>
<td>IP VirtualWire (IPVW)</td>
<td>IP Virtual Wire is a form of Lab Automation over a L3 BGP fabric with VXLAN tunnels and VTEPS. The primary construct of Lab Automation is a vLE or virtual Link Extension.</td>
</tr>
<tr>
<td>Virtual Link Extension (vLE)</td>
<td>Virtual Link Extension is a Netvisor ONE technology that enables the creation of Layer links that can emulate a direct connection between devices on top of an IP network.</td>
</tr>
</tbody>
</table>

For the complete Glossary of UNUM and Netvisor One Terms click [here](#).
Appendix A - Supplement Lab Automation

The goal of this appendix is to demonstrate how to create a fabric for Lab Automation and Packet Broker environments using UNUM Day-0 automation.

Lab Automation and Packet Broker fabrics can differ from those deployed in a data center. They generally require non-redundant leaf switches and possibly non-redundant spine designs (particularly for Lab Automation applications).

Customers wishing to create fabrics for their lab automation environments can use this walk through to deploy a fabric with a single spine in a non-redundant leaf topology. If customers want to deploy a redundant fabric with clustered leafs and multiple spines, please refer to the earlier "Creating a Fabric" section of this document.

- Initial Setup
- Topology
- Basic Fabric Setup
- Configure the Playbook
Initial Setup

Before attempting to create a fabric, several pre-requisite steps, which were covered earlier in this guide, need to be completed. It is required that customers read and follow the procedures in the first twelve pages of the UNUM Fabric Automation guide that lead up to the Creating a Fabric section.

Before building a fabric all switch(es):

- Must be cabled in a spine/leaf topology.
- Must have their switch setup completed and the OOB management interfaces configured.
- Must have connectivity between the UNUM management interface and the switch management interfaces over an OOB network. Using ping is a sufficient test.
- Licenses must be enabled.
- Must be running the same version of the Netvisor ONE operating system.
- Must be in a “factory-reset” state. This means logging into the switch with the default credentials results in Netvisor asking for the End User License Agreement approval (do not accept).
For this walk through we will be using a Leaf/Spine topology with one spine, and four non-clustered leaves. Note that even though there is a single spine in this deployment, having a minimum of two uplink connections (not shown) between spines and leaves should be considered to provide protection against accidental cable pulls and to ensure adequate bandwidth is available on the uplinks.
Basic Fabric Setup

Since we are building a fabric for both lab automation and packet broker environments, during the basic fabric setup, we will:

- Create a fabric named “TME-LAPB,”
- Define which switches will be used in the fabric and assign fabric particulars such as the management IP subnet, gateway, and DNS.

In our examples, the essential information to be entered is:

<table>
<thead>
<tr>
<th>Mgmt. IP Subnet</th>
<th>=</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway IP</td>
<td>=</td>
<td>10.37.20.254</td>
</tr>
<tr>
<td>DNS IP</td>
<td>=</td>
<td>8.8.8.8</td>
</tr>
<tr>
<td>DNS Secondary IP</td>
<td>=</td>
<td>8.8.4.4</td>
</tr>
</tbody>
</table>

We’ll also need to check the "I accept the End User License Agreement" box.
Basic Fabric Setup

To perform the basic fabric setup for **lab automation** and **Packet Broker** environments:

1) Navigate from Dashboards → Topology and click on the blue **Add** button to add a Fabric to UNUM.
   
   In the add fabric pop-up, click the blue Netvisor Fabric License button.

Figure 37 - Add Fabric
2) Populate the Fabric name, and enter the **username/password** for the switches.

**Caution:** Currently, the initial fabric User Name needs to be "network-admin" and the initial Password needs to be "test123." The password can and should be changed after the fabric is built.

Click on the blue **Next** button.

*Figure 38 - Add Fabric General Settings*
3) Populate switch information fields with the appropriate switch names and management IP addresses, and identify if the switch is a **Spine**, **Leaf**, or a **Third Party** switch. Click the blue Save button to store switch information and then click **Next** to continue.

Notice the green checkmarks ✓ in each row, to the left of the switch name. These indicate that the switches are reachable by UNUM over the management network and that the switches are in a "Reset" state, with no fabric configuration. If a **red X** appears, the switches are either unreachable or not in a reset state.

Optional: Click on the blue Download File button to save a text file with the entered information. This file will be saved in your browser’s download window and edited or used to rebuild a fabric with the same information at a later time via the +Choose File button in Step Two.

Note: If customers wish to have a redundant fabric, they will need to have added a second spine and add the appropriate switch information to the Add fabric popup.

Figure 39 - Add Fabric Setup Settings
4) Update the Management IP Subnet, Gateway IP address and DNS settings based on the management interface/network. Validate the fabric related settings match the desired deployment, including the DNS, domain and subnet. Check the "I accept the EULA" box and click on Add to add the fabric to UNUM.

Note: The RESET FABRIC box is used to permanently delete switch configuration information, excepting setup info such as the management IP address. It is only used where fabrics need to be rebuilt on switches with existing configurations, primarily for customer demos. In general, do not select this option.

Figure 40: Add Fabric Advanced Settings
5) At this point, UNUM will accept the switch EULA, discover the topology via LLDP and deploy the adaptive cloud fabric. Light green circle animations appear on the switch icons in the topology view and popup messages as specific operations complete during this process.

You will also see a blue progress indicator providing an approximate time for completion of the fabric setup.

Figure 41 - Add Fabric Provisioning Icon Animations

6) At this point, admins can either immediately proceed to the “Configuring the Playbook” step or wait until the process finishes, where you will see a topology view similar to the image on the right.

Figure 42 - Initial Topology
Basic Fabric Setup

The TME-LAPB fabric now appears in the left-hand navigation pane and the five switches in the fabric. Switch details such as IP addresses, software version, status, and CPU/Memory indicators appear in the Details pane below.

During or after the setup process, administrators can click on the Playbook Logs button to see the specific tasks executed by UNUM.
Configure the Playbook

At this point in the process our basic fabric is set up, but we need to configure it for lab automation and/or packet broker environments. To do this we will be using the “L3 VRRP BGP with Netvisor Spines” playbook.

1) Click on the blue Launch Playbook link in the details pane on the right of the screen.

   Figure 43 - Launch Playbook

2) From the popup menu, choose the L3 VRRP EBGP playbook from the left menu. This step brings us to a description of all the operations UNUM will automate by applying this playbook. Note the creation of VTEPS and (VXLAN)Tunnels, essential to lab automation and Packet Broker Environments. Click on the blue Next button.

   Figure 44 - L3 VRRP EBGP Playbook
3) This action opens the Playbook setting page. We’ll be using the default Inter-switch Link and iBGP fabric peering information, but we do need to configure a VLAN per leaf to enable VTEP creation. Under the VRRP configuration info section, click on the blue Manual Input button.

Figure 45 - VTEP Creation

4) To create a VXLAN overlay for lab automation, a VLAN ID, a VRRP IP, and Switch Name will need configuring for each leaf in the fabric. As these switches are not part of a cluster, no VRRP configuration will be created. Instead, UNUM will use the information for VTEP and VXLAN tunnel automation. Leave the last three fields in each row blank. Use the blue Add+ button to create additional rows.

Click on the blue Save button.

Note: It is possible to have clustered switches in lab automation or Packet Broker environments. In these cases, please refer to the L3 BGP VRRP playbook example earlier in this guide.

Figure 46 - CVS File
5) From the Playbook setting screen, click on the blue Next> button.

Figure 47 - VRRP Settings
6) From the playbook **Advanced Settings** window, click on the blue **Add** button to accept the default advanced settings.

![Advanced Settings Default Values](image-url)
7) At this point, UNUM automation creates the BGP fabric. Note the progress bars in the Details pane.

UNUM measures progress by task and provides a rough time estimate. These indicators can vary based on the switch models chosen for the fabric and used as a rough indicator of how long the fabric will need to complete.

**TIP:** BGP fabrics are more complex than simple Layer-2 fabrics and can take longer to configure depending on the configuration choices made and the switch models. In the case of our five-switch fabric, given the switches we are using, we can expect the playbook configuration to last for around 10-15 minutes.

Figure 49 - Lab Provisioning Progress

8) Once the process completes, an L3 BGP fabric has been created along with VTEPS, a full mesh of VXLAN tunnels, and is ready for use in a lab automation (IPVW) or Packet Broker environment.

Figure 50 - Fully Configured Lab Environment
Appendix B - Blank Table of Switch Information

Use the table below to collect the necessary switch information for building fabrics with UNUM. The MAC Address and Device-ID are required when using UNUM to provision bare-metal switches with the Netvisor ONE operating system. Device-IDs are on the Dell service tag on the switch itself.

<table>
<thead>
<tr>
<th>Host Name</th>
<th>IP Address</th>
<th>MAC Address</th>
<th>Device-ID</th>
<th>Console IP</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Table - Blank Table Switch Configuration Information
About Pluribus Networks

Pluribus Networks delivers an open, controllerless software-defined network fabric for modern data centers, multi-site data centers, and distributed cloud edge environments.

The Linux-based Netvisor® ONE operating system and the Adaptive Cloud Fabric™ have been purpose-built to deliver radically simplified networking and comprehensive visibility along with white box economics by leveraging hardware from our partners Dell EMC, Edgecore, Celestica and Champion ONE, as well as Pluribus’ own Freedom™ Series of switches.

The Adaptive Cloud Fabric provides a fully automated underlay and virtualized overlay with comprehensive visibility and brownfield interoperability and optimized to deliver rich and highly secure per-tenant services across data center sites with simple operations having no single point of failure.

Further simplifying network operations is Pluribus UNUM™, an agile, multi-functional web management portal that provides a rich graphical user interface to manage the Adaptive Cloud Fabric. UNUM has two key modules - UNUM Fabric Manager for provisioning and management of the fabric and UNUM Insight Analytics to quickly examine billions of flows traversing the fabric to ensure quality and performance.

Pluribus is deployed in more than 275 customers worldwide, including the 4G and 5G mobile cores of more than 75 Tier 1 service providers delivering mission-critical traffic across the data center for hundreds of millions of connected devices. Pluribus is networking, simplified.

For additional information contact Pluribus Networks at info@pluribusnetworks.com or visit www.pluribusnetworks.com

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