Lenovo Networking

OpenStack Neutron Plugin User Guide

for Liberty and Mitaka

Lenovo™

Note: Before using this information and the product it supports, read the general information in the *Safety information and Environmental Notices* and *User Guide* documents on the Lenovo *Documentation* CD, and the *Warranty Information* document that comes with the product.

Fourth Edition (January 2018)

Contents

Preface

The *Lenovo Networking OpenStack Neutron Plugin User's Guide* describes how to install, configure, and use the OpenStack Neutron Plugin User Guide.

Who Should Use This Guide

This guide is intended for network installers and system administrators engaged in configuring and maintaining a network. The administrator should be familiar with Ethernet concepts, IP addressing, Spanning Tree Protocol, and SNMP configuration parameters.

Typographic Conventions

The following table describes the typographic styles used in this book.

Table 1. *Typographic Conventions*

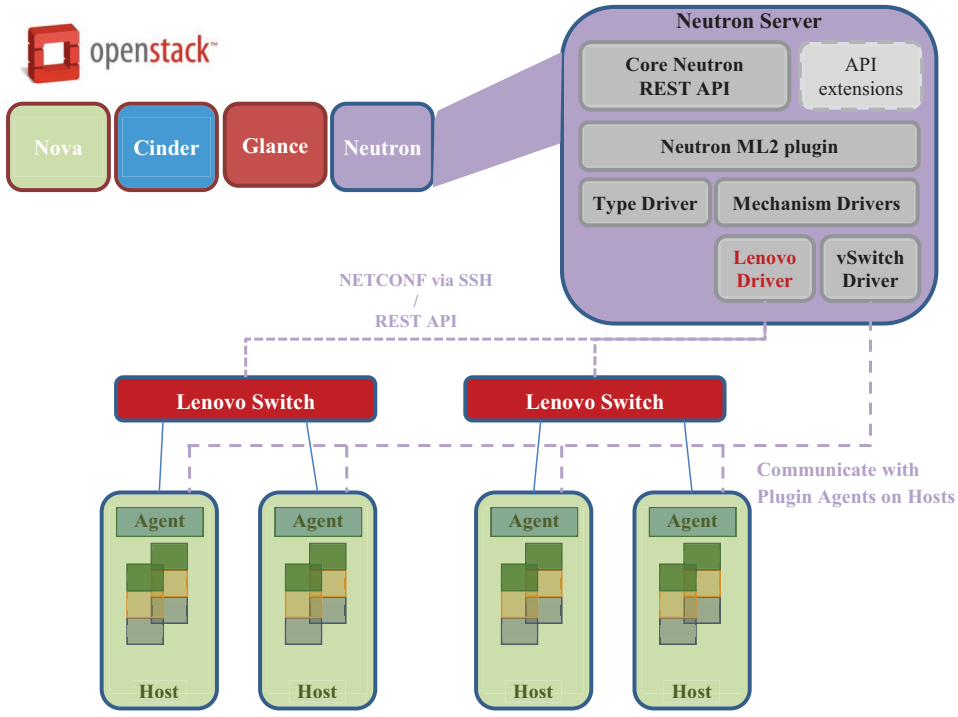
Typeface or Symbol	Meaning	Example
`ABC123`	This type is used for names of commands, files, and directories used within the text. It also depicts on-screen computer output and prompts.	View the `readme.txt` file. `Switch#`
`ABC123`	This bold type appears in command Example. It shows text that must be typed in exactly as shown.	`Switch#` **`sys`**
<ABC123>	This italicized type appears in command Example as a parameter placeholder. Replace the indicated text with the appropriate real name or value when using the command. Do not type the brackets. This also shows book titles, special terms, or words to be emphasized.	To establish a Telnet session, enter: `Switch#` **`telnet`** *<IP address>* Read your *User's Guide* thoroughly.
`{}`	Command items shown inside brackets are mandatory and cannot be excluded. Do not type the brackets.	`Switch#` **`ls {-a}`**
`[]`	Command items shown inside brackets are optional and can be used or excluded as the situation demands. Do not type the brackets.	`Switch#` **`ls [-a]`**
`|`	The vertical bar (**`|`**) is used in command Example to separate choices where multiple options exist. Select only one of the listed options. Do not type the vertical bar.	`Switch#` **`set {left|right}`**
AaBbCc123	This block type depicts menus, buttons, and other controls that appear in Web browsers and other graphical interfaces.	Click the **<Save>** button.

Overview

OpenStack is an open source infrastructure initiative for creating and managing large groups of virtual private servers in a cloud computing environment. Lenovo's OpenStack Neutron Plugin provides a means to orchestrate VLANs on Lenovo's physical switches.

In cloud environments where VMs are hosted by physical servers, the VMs see a new virtual access layer provided by the host machine. This new access layer can be typically created via many mechanisms e.g. Linux Bridges or a Virtual Switches. The policies of the virtual access layer (virtual network), when set must now be coordinated with the policies set in the hardware switches. Lenovo's Neutron Plugin helps coordinate this behavior automatically without any intervention from the administrator. Figure 1 provides an architectural overview of how Lenovo's ML2 Plugin and switches fits into an OpenStack deployment.

Figure 1. Lenovo Neutron Plugin Architecture



Support Matrix

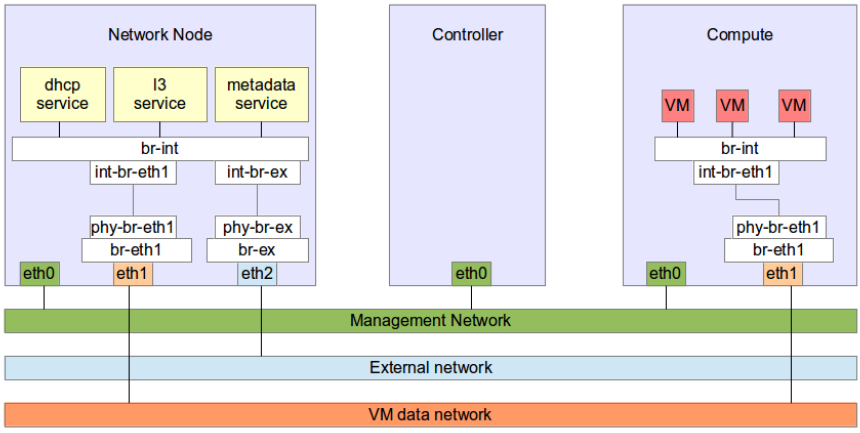
The following provides details on supported switches, Operating Systems and environments.

OpenStack version	NOS version	Supported Switches	Linux Distribution
Liberty	ENOS 7.9, 8.1, and later CNOS 10.1 and later	Lenovo RackSwitch: G7028, G7052, G8052, G8124-E, G8264, G8264CS, G8272, G8296, G8332 Lenovo Flex Embedded: CN4093, EN4093R, SI4091, SI4093 (non-SPAR mode)	Red Hat RHEL8 Ubuntu 14.04 TLS
Mitaka	CNOS 10.2 and later	Lenovo RackSwitch: G8272, G8296	Red Hat RHEL9 Ubuntu 14.04 TLS
	CNOS 10.3 and later	Lenovo RackSwitch G8332	
	CNOS 10.4 and later	Lenovo ThinkSystem: NE1032, NE1032T, NE1072T, NE10032, NE2572	

Recommended Network Topologies

Openstack has specific requirements for providing network connectivity to all nodes while allowing flexibility for using Vendor specific technologies.

Figure 2. Openstack Network Connections



As shown in Figure 2, there are three physical networks in the typical Openstack deployment:

- Management
- Internal Data Networks
- External Networks

Lenovo supports both single NIC attached servers as well as dual NIC using our VLAG technology. The following is an example deployment with single NIC attached Servers.

Figure 3. Single Port Connections

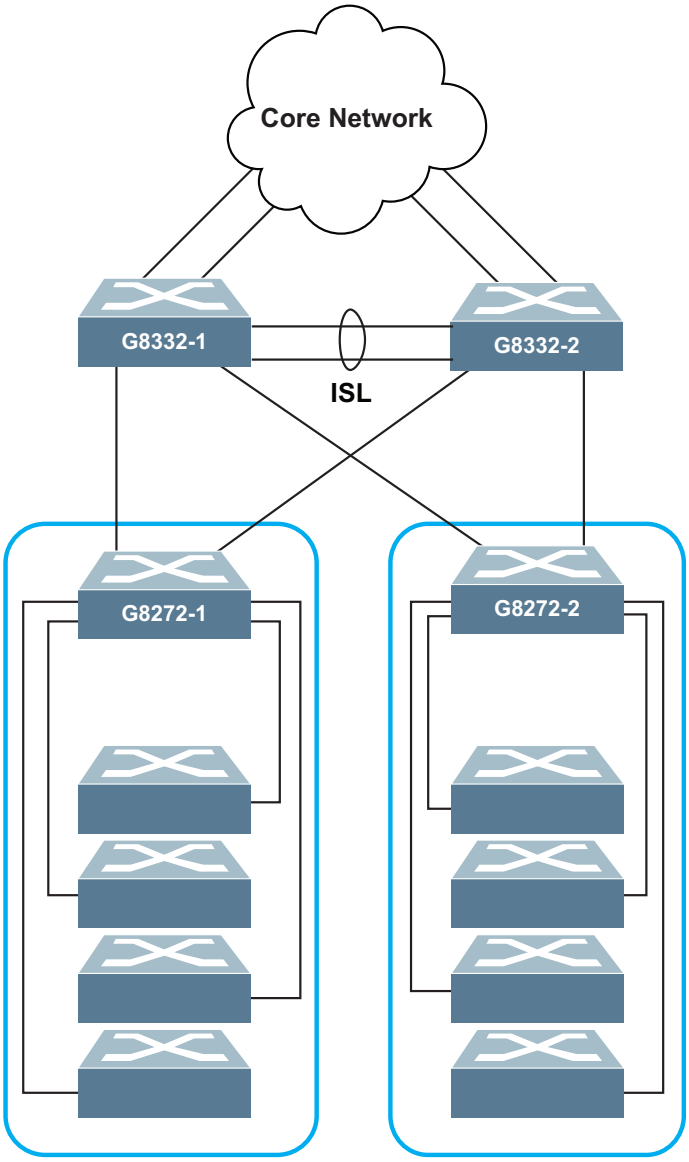


Figure 4 illustrates Lenovo Servers connecting to the Rack switches using the VLAG protocol which includes NIC Bonding on the server side.

Figure 4. Servers with VLAG Connectivity

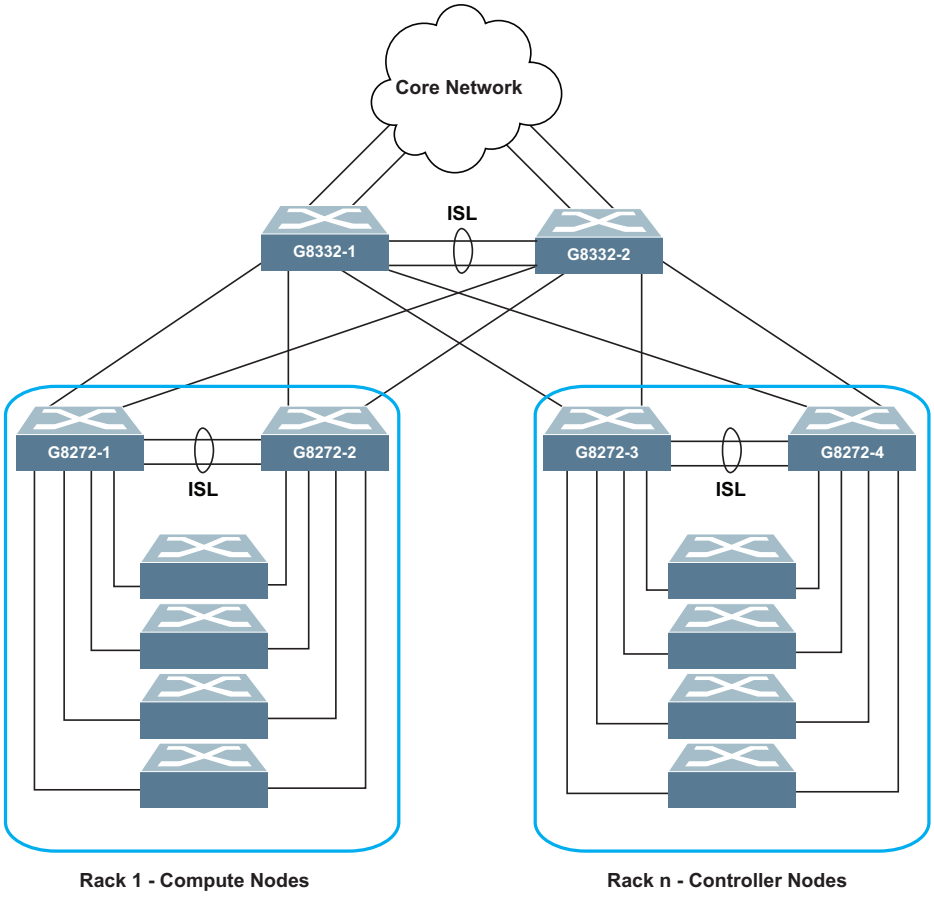
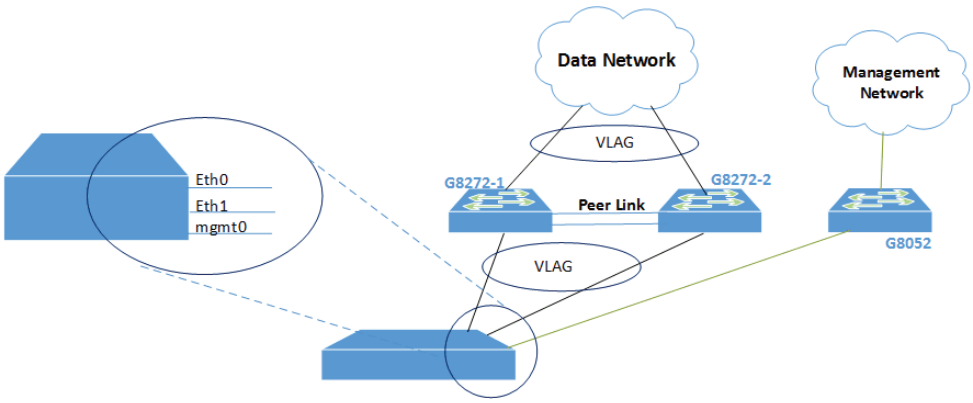


Figure 4 only shows the data path, but each device does have a management connection for communication with the OpenStack controller Node. Figure 5 provides more details on how this is done.

Figure 5. Data and Management Network



API Services Description

The ML2 Plugin exposes several APIs that allows Openstack Neutron to make configuration changes on Lenovo Switches.

Create_Network: Using this API, the OpenStack Neutron Plugin will create a VLAN on a Lenovo device whenever a Virtual Machine is associated on the connected Compute Node.

Create_Port: Using this API, the OpenStack Neutron Plugin will create a VLAN on the Lenovo Switch on the physical port connected to the compute node on which a Virtual Machine is created and added to a specified network.

Delete_Network: Using this API, the OpenStack Neutron Plugin will delete the VLAN on the Lenovo Switch corresponding to that Network. This occurs if the associated virtual Machine is migrated off the Compute node or the administrator manually deletes the network.

Delete_Port: Using this API, the OpenStack Neutron Plugin will delete a VLAN on the port connected to a compute node where the virtual machine was deleted or migrated to another port or Node.

Installing the OpenStack Neutron Plugin

Following are the detailed steps to set up your OpenStack deployment with the OpenStack Neutron Plugin managing Lenovo switches.

Prerequisites

The Lenovo OpenStack Neutron Plugin will provide dynamic VLAN configuration on access layer switches server facing ports that maps OpenStack networks into the physical infrastructure.

The following are pre-requisites for using the plugin:

- For Lenovo switches running CNOS 10.1 or later, enable RestAPI on the switches using the following switch CLI command:

```
Switch(config)# feature restApi
```

- Install python pip and git to allow the downloading of files from Github.
  - For Redhat use the following command:

```
% sudo yum install python-pip git
```

  - For Ubuntu, use the following command:

```
% sudo apt-get install python-pip git
```

- Install the ncclient v0.4.2 Python library for NETCONF clients. For more information on ncclient, see http://ncclient.grnet.gr/.
- Install with the ncclient library by using the *pip* package manager at your shell prompt:

```
% sudo pip install ncclient==0.4.2
```

- If you are using SNMP to configure the switch, you also need to install the *pysnmp* package:

```
% sudo pip install pysnmp
```

- Determine the VLAN pool for your Openstack Deployment, for example 1001-2001. This will be required for configuring the uplink ports and the plugin.
- Configure physical network topology; add the assigned VLAN pool to uplink ports and aggregation switches as required. Other protocols such as ACLs, switch access credential should be configured as needed.
- Enable SSH on all Lenovo Switches that are to be managed by Openstack. This is required for the NETCONF protocol.
- In VLAG mode, the ISL and Portchannel/LACP trunk should be created on the relevant switches as the plugin does not configure these attributes.

- Server NICs connected to VLAG Switches needs to have NIC bonding configured (see Network topology section for examples).
- Install Openstack Controller and Network nodes. Openstack needs to be running before installing the Lenovo Neutron driver.

ML2 Installation Procedure

This section covers installing the Lenovo Networking Openstack ML2 Driver plugin in a Multi Node environment with Redhat Enterprise Linux Openstack or Ubuntu LTS.

Download the Lenovo ML2 Driver

The ML2 installation files can be downloaded from Lenovo Stackforge Github site with "git clone" as shown here:

```
% sudo git clone https://github.com/lenovo/networking-lenovo.git
```

Setup the Lenovo ML2 Plugin

Next, install the plugin:

```
% cd networking-lenovo
% sudo python setup.py install
```

Redhat Openstack Setup

Follow the steps below to set up OpenStack on Redhat.

Update the ML2 Configuration

Edit the ml2 configuration files with some basic information on the use of VLANs for networking and add local switch information.

```
% cd /etc/neutron/plugins/ml2
```

Change the file `ml2_conf.ini` as follows:

```
% sudo vi ml2_conf.ini,
- change tenant_network_types = vlan
- change mechanism_drivers = openvswitch,lenovo
- copy everything in ml2_conf_lenovo.ino, and concatenate to ml2_conf.ini

*** change this section according to network setup requirements, add the
IP address of switch(es), connection details, and change the hostname for
servers
```

If you encounter any problems, see "Troubleshooting the Installation" on page 15.

Neutron Database Migration

Migrate the neutron database:

```
% sudo neutron-db-manage --config-file /etc/neutron/neutron.conf
--config-file /etc/neutron/plugins/ml2/ml2_conf.ini upgrade head
```

Restart the Neutron server:

```
% sudo systemctl restart neutron-server.service
```

Note: Exiting mysql is required for this step.

If you encounter any problems, see tblshint.

Ubuntu Openstack Setup

Follow the steps below to set up OpenStack on Ubuntu.

Update the ML2 Configuration

Edit the ml2 configuration files with some basic information on the use of VLANs for networking and add local switch information.

```
% cd /etc/neutron/plugins/ml2
```

Change the file `ml2_conf.ini` as follows:

```
% sudo vi ml2_conf.ini,
- change tenant_network_types = vlan
- change mechanism_drivers = openvswitch,lenovo
- copy everything in ml2_conf_lenovo.ino, and concatenate to ml2_conf.ini

*** change this section according to network setup requirements, add the
IP address of switch(es), connection details, and change the hostname for
servers
```

Neutron Database Migration

Migrate the neutron database:

```
% sudo neutron-db-manage -config-file /etc/neutron/neutron.conf
-config-file  /etc/neutron/plugins/ml2/ml2_conf.ini upgrade head
```

Start the neutron server:

```
% sudo service neutron-server restart
```

Note: Exiting mysql is required for this step.

If you encounter any problems, see "Troubleshooting the Installation."

Troubleshooting the Installation

If the server Neutron server does not start:

- Check the Neutron log file, located at `/var/log/neutron/server.log`.
- Verify that the OpenStack Neutron Plugin User Guide details are in the mysql database:

```
% sudo mysql -u root -p -h [your IP address]

mysql> use neutron;
mysql> show tables;
```

Verify that the table `lenovo_ml2_nosport_bindings` is present.

Configuring the OpenStack Neutron Plugin

You will need to modify two sections of the file: `/etc/neutron/plugins/ml2/ml2_conf.ini`

1. In the sections listed in the following table, include `lenovo` in `mechanism_drivers`, and define `network_vlan_ranges` in the `ml2_type_vlan` section.

```
[ml2]
tenant_network_types = vlan
type_drivers = local,flat,vlan,gre,vxlan
mechanism_drivers = openvswitch,lenovo
# (ListOpt) List of network type driver entrypoints to be loaded from
# the neutron.ml2.type_drivers namespace.
# type_drivers = local,flat,vlan,gre,vxlan
# Example: type_drivers = flat,vlan,gre,vxlan

# (ListOpt) Ordered list of network_types to allocate as tenant
# networks. The default value 'local' is useful for single-box testing
# But provides no connectivity between hosts.
# tenant_network_types = local
# Example: tenant_network_types = vlan,gre,vxlan

# (ListOpt) Ordered list of networking mechanism driver entrypoints
# to be loaded from the neutron.ml2.mechanism_drivers namespace.
# mechanism_drivers =
# Example: mechanism_drivers = openvswitch,mlnx
# Example: mechanism_drivers = arista
# Example: mechanism_drivers = cisco,logger
# Example: mechanism_drivers = openvswitch,brocade
# Example: mechanism_drivers = linuxbridge,brocade

# (ListOpt) Ordered list of extension driver entrypoints
# to be loaded from the neutron.ml2.extension_drivers namespace.
# extension_drivers =
# Example: extension_drivers = anewextensiondriver

[ml2_type_vlan]
# (ListOpt) List of <physical_network>[:<vlan_min>:<vlan_max>] tuples
# specifying physical_network names usable for VLAN provider and
# tenant networks, as well as ranges of VLAN tags on each
# physical_network available for allocation as tenant networks.
#
# Define the VLAN ranges (network_vlan_ranges).
# Example: network_vlan_ranges = physnet1:1000:2999,physnet2
network_vlan_ranges = default:1000:1999
```

2. Add the Lenovo switch information to the section `ml2_mech_lenovo` of this configuration file (see Figure 7). Include the following information:
   - the hostname/IP address of the Switch
   - the hostname and port of any servers connected to the switch
   - the Lenovo switch credential username and password
   - the Portchannel or LACP number for Host connected with VLAG
   - the SSH Port number for NETCONF (typically 830)

If SNMP is used to communicate with the switch, the information below is also required:

- SNMP port number
- SNMP version 3 is supported
- Community name
- SNMP user
- SNMP authentication and privacy keys (if they don't exist, assume the following values: `NO_AUTH` for the authentication key and `NO_PRIV` for the privacy key)
- SNMPv3 authentication option: `SHA-96`
- SNMPv3 privacy option: `AES-128`

Note: To ensure maximum security, only SNMP version 3 is supported. Also, the only available SNMPv3 authentication option is SHA-96 and the only available SNMPv3 privacy option is AES-128.

```
[ml2_mech_lenovo:1.1.1.1]
# This is to let driver know SNMP protocol will be used to communicate
# with this switch. If not exist, assume Netconf.
protocol = SNMP

# Hostname and port used on the switch for this compute host.
compute01 = 10
compute02 = portchannel:64

# Port number where the SSH will be running at the Switch. Default is 22
# so this variable only needs to be configured if different.
ssh_port = 830

# Provide the login information to the switch.
username = user1
password = passw0rd

# Port number for SNMP.
snmp_port = 161

# SNMP version: 3.
snmp_version = 3

# SNMP community name.
snmp_community = private

# SNMP username.
snmp_user = adminshaaes

# SNMP Auth key and Priv key, if not exist, assume NO_AUTH and NO_PRIV.
snmp_authkey = key1
snmp_privkey = key2

# SNMP v3 auth option: SHA-96.
snmp_auth = SHA

# SNMP v2 priv option: AES-128.
snmp_priv = AES-128
```

Note: To ensure that the communication between the OpenStack Neutron Plugin and the switch is working properly, you may need to configure the SNMP feature on the switch. To do this, consult the *Lenovo Network Command Reference* and the *Lenovo Network Application Guide* associated with the switch and its Lenovo network operating system.

If RestAPI is used to communicate with the switch, the information below must be added to the `ml2_conf.ini` configuration file:

- the Lenovo NOS version (`os` = cnos)
- the name of the protocol used to communicate (`protocol` = rest)
- the restAPI port number (`rest_tcp_port` - the default value is 8090)

```
[ml2_mech_lenovo:2.2.2.2]
# Lenovo NOS for switches running 10.1 version.
os = cnos

# This is to let the driver know the RestApi protocol will be used to
# communicate with this switch running Lenovo NOS 10.1.
protocol = rest

# Port number for RestApi.
rest_tcp_port = 8090

# Hostname and port used on the switch for this compute host.
compute1 = port:1/20
compute2 = portchannel:300

# Provide the login information to the switch.
username = admin
password = admin
```

There may be several servers to switch port mapping per switch; this is only limited by the number of available ports.

As more switches and servers are added to the network, you will need to update this file with those details.

Once this configuration is done, you can create networks from the Horizon dashboard or the OpenStack command line.

Removing the OpenStack Neutron Plugin

Follow the steps below to restore the network for OpenStack installation to the default state:

1. Uninstall Neutron:

```
% sudo pip uninstall neutron
```

2. Uninstall Lenovo vendor driver:

```
% sudo pip uninstall networking-lenovo
```

3. Re-install the default ML2 driver.
   - On Redhat:

```
% sudo yum install openstack-neutron openstack-neutron-ml2
```

   - On Ubuntu or Debian:

```
% sudo apt-get install neutron-server neutron-plugin-ml2
```

Your system is now running with the default Neutron configuration.

Product Support

This is a free and open source product from Lenovo. There are no support entitlements available for this plugin. Alternatively, customers can file an issue or request in the Openstack community with Launchpad.

Notices

Lenovo may not offer the products, services, or features discussed in this document in all countries. Consult your local Lenovo representative for information on the products and services currently available in your area.

Any reference to a Lenovo product, program, or service is not intended to state or imply that only that Lenovo product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any Lenovo intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any other product, program, or service.

Lenovo may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

Lenovo (United States), Inc.
1009 Think Place - Building One
Morrisville, NC 27560
U.S.A.

Attention: Lenovo Director of Licensing

LENOVO PROVIDES THIS PUBLICATION “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. Lenovo may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

The products described in this document are not intended for use in implantation or other life support applications where malfunction may result in injury or death to persons. The information contained in this document does not affect or change Lenovo product specifications or warranties.

Nothing in this document shall operate as an express or implied license or indemnity under the intellectual property rights of Lenovo or third parties. All information contained in this document was obtained in specific environments and is presented as an illustration. The result obtained in other operating environments may vary.

Lenovo may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any references in this publication to non-Lenovo Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this Lenovo product, and use of those Web sites is at your own risk.

Any performance data contained herein was determined in a controlled environment. Therefore, the result obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Trademarks

Lenovo, the Lenovo logo, Flex System, System x, NeXtScale System, and X-Architecture are trademarks of Lenovo in the United States, other countries, or both.

Intel and Intel Xeon are trademarks of Intel Corporation in the United States, other countries, or both.

Internet Explorer, Microsoft, and Windows are trademarks of the Microsoft group of companies.

Linux is a registered trademark of Linus Torvalds.

Other company, product, or service names may be trademarks or service marks of others.

Important Notes

Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1 024 bytes, MB stands for 1 048 576 bytes, and GB stands for 1 073 741 824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard-disk-drive bays with the largest currently supported drives that are available from Lenovo.

Maximum memory might require replacement of the standard memory with an optional memory module.

Each solid-state memory cell has an intrinsic, finite number of write cycles that the cell can incur. Therefore, a solid-state device has a maximum number of write cycles that it can be subjected to, expressed as total bytes written (TBW). A device that has exceeded this limit might fail to respond to system-generated commands or might be incapable of being written to. Lenovo is not responsible for replacement of a device that has exceeded its maximum guaranteed number of program/erase cycles, as documented in the Official Published Specifications for the device.

Lenovo makes no representations or warranties with respect to non-Lenovo products. Support (if any) for the non-Lenovo products is provided by the third party, not Lenovo.

Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

Recycling Information

Lenovo encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. Lenovo offers a variety of programs and services to assist equipment owners in recycling their IT products. For information on recycling Lenovo products, go to:

http://www.lenovo.com/recycling

Particulate Contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document.

Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If Lenovo determines that the levels of particulates or gases in your environment have caused damage to the device, Lenovo may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility..

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.2[1]. • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60%[2]. • The room must be free of conductive contamination such as zinc whiskers.

Contaminant	Limits
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-1985[3] • Silver: Corrosion rate of less than 300 Å in 30 days

[1] ASHRAE 52.2-2008 - *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

[2] The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction.

[3] ANSI/ISA-71.04-1985. *Environmental conditions for process measurement and control systems: Airborne contaminants*. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.

Telecommunication Regulatory Statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact a Lenovo representative or reseller for any questions.

Electronic Emission Notices

When you attach a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

Federal Communications Commission (FCC) Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used to meet FCC emission limits. Lenovo is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Industry Canada Class A Emission Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de Conformité à la Réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A Statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

European Union - Compliance to the Electromagnetic Compatibility Directive

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC (until April 19, 2016) and EU Council Directive 2014/30/EU (from April 20, 2016) on the approximation of the laws of the Member States relating to electromagnetic compatibility. Lenovo cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the installation of option cards from other manufacturers.

This product has been tested and found to comply with the limits for Class A equipment according to European Standards harmonized in the Directives in compliance. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

CE Lenovo, Einsteinova 21, 851 01 Bratislava, Slovakia

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Germany Class A Statement

Deutschsprachiger EU Hinweis:

Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU (früher 2004/108/EC) zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der Klasse A der Norm gemäß Richtlinie.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der Lenovo empfohlene Kabel angeschlossen werden. Lenovo übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der Lenovo verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der Lenovo gesteckt/eingebaut werden.

Deutschland:

Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Betriebsmittein

Dieses Produkt entspricht dem „Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln“ EMVG (früher „Gesetz über die elektromagnetische Verträglichkeit von Geräten“). Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU (früher 2004/108/EC) in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Betriebsmitteln, EMVG vom 20. Juli 2007 (früher Gesetz über die elektromagnetische Verträglichkeit von Geräten), bzw. der EMV EU Richtlinie 2014/30/EU (früher 2004/108/EC), für Geräte der Klasse A.

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen. Verantwortlich für die Konformitätserklärung nach Paragraf 5 des EMVG ist die Lenovo (Deutschland) GmbH, Meitnerstr. 9, D-70563 Stuttgart.

Informationen in Hinsicht EMVG Paragraf 4 Abs. (1) 4:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

Nach der EN 55022: „Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen und dafür aufzukommen.“

Nach dem EMVG: „Geräte dürfen an Orten, für die sie nicht ausreichend entstört sind, nur mit besonderer Genehmigung des Bundesministers für Post und Telekommunikation oder des Bundesamtes für Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Störungen zu erwarten sind.“ (Auszug aus dem EMVG, Paragraph 3, Abs. 4). Dieses Genehmigungsverfahrenist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Anmerkung: Um die Einhaltung des EMVG sicherzustellen sind die Geräte, wie in den Handbüchern angegeben, zu installieren und zu betreiben.

Japan VCCI Class A Statement

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI–A

This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

Japan Electronics and Information Technology Industries Association (JEITA) Statement

高調波ガイドライン適合品

Japan Electronics and Information Technology Industries Association (JEITA) Confirmed Harmonics Guidelines (products less than or equal to 20 A per phase)

高調波ガイドライン準用品

Japan Electronics and Information Technology Industries Association (JEITA) Confirmed Harmonics Guidelines with Modifications (products greater than 20 A per phase).

Korea Communications Commission (KCC) Statement

이 기기는 업무용(A급)으로 전자파적합기기로
서 판매자 또는 사용자는 이 점을 주의하시기
바라며, 가정외의 지역에서 사용하는 것을 목
적으로 합니다.

This is electromagnetic wave compatibility equipment for business (Type A). Sellers and users need to pay attention to it. This is for any areas other than home.

Russia Electromagnetic Interference (EMI) Class A statement

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать радиопомехи, для
снижения которых необходимы дополнительные меры

People's Republic of China Class A electronic emission statement

中华人民共和国“A类”警告声明

声 明

此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，
可能需要用户对其干扰采取切实可行的措施。

Taiwan Class A compliance statement

警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。