Implementing Wireless Networking on Linux on the ThinkEdge SE360 V2

Planning / Implementation

The ThinkEdge SE360 V2 edge server optionally supports wireless LAN (WLAN) to enable connectivity to Wi-Fi as clients. Red Hat, SUSE, and Ubuntu Enterprise OSes are supported on the ThinkEdge SE360 V2 server. However, the wireless setting guide is in the different Linux OS distribution document. This article consolidates all different Linux OS distribution setting methods and provides the customer with the practice of setting wireless function in all supported Linux OS distributions.

Figure 1. Lenovo ThinkEdge SE360 V2 with wireless LAN functionality

This article contains three sections. The first one introduces the wireless network devices provided by the SE360 V2 system. The second one lists wireless network connection methods used by different Linux OSes. The last one includes all the wireless setting examples of different Linux OSes to enable users to quickly configure wireless network settings.

Prerequisites

Before setting up a wireless network, make sure that the system includes the wireless network module. See the SE360 V2 product guide for detailed information about the server for reference:
https://lenovopress.lenovo.com/lp1677-thinkedge-se360-v2-server

The SE360 V2 WLAN solution is equipped with Intel AX210 module. For Intel AX210 wireless solution, user can refer to Intel website for more information:
https://www.intel.com/content/www/us/en/support/articles/000005511/wireless.html

Before you set up the system, you can refer to the Lenovo OS interoperability guide to get the latest support information:
https://lenovopress.lenovo.com/osig

Firmware settings

Make sure the wireless chip is listed on the system via XCC browser interface, as shown in the following figure.

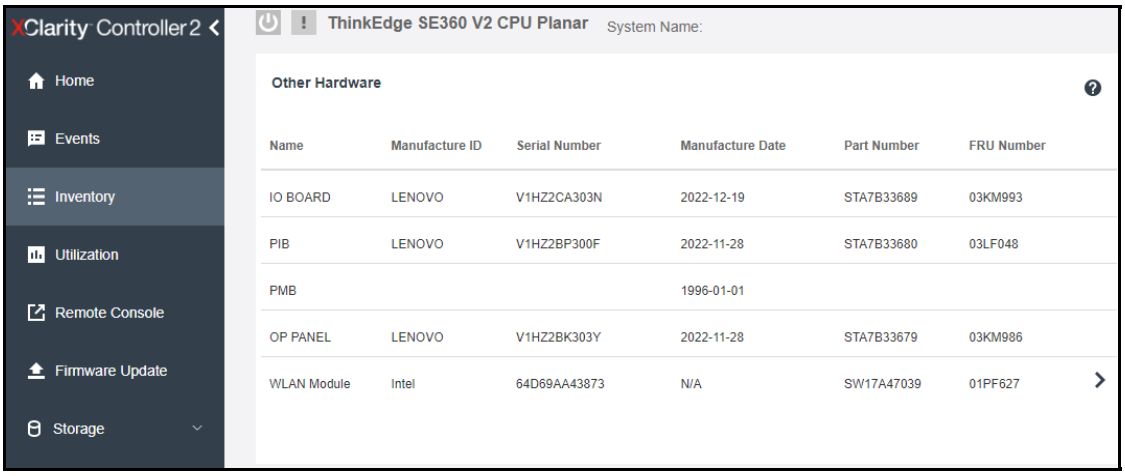

Figure 2. Check wireless device via XCC interface

Refer to the XCC manual for all other XCC configuration details:
https://pubs.lenovo.com/xcc2/iot_servers

OS driver checking

Before you proceed with the wireless connection settings, ensure that the AX210 device is visible in your operating system and that the driver iwlwifi is being used for it.

1. Check the device is existed in OS.

```
# root@se360v2:/home/conie# lspci |grep -i ax210
0000:05:00.0 Network controller: Intel Corporation Wi-Fi 6 AX210/AX211/AX411 16
0MHz (rev 1a)
```

2. Check the driver in use:

```
root@se360v2:/home/conie# lspci -s 0000:05:00.0 -vvv|grep -i kernel
Kernel driver in use: iwlwifi
Kernel modules: iwlwifi
```

3. Check the device via command “ip a” as shown in the following figure.

```
root@se360v2:/home/conie# ip a
```

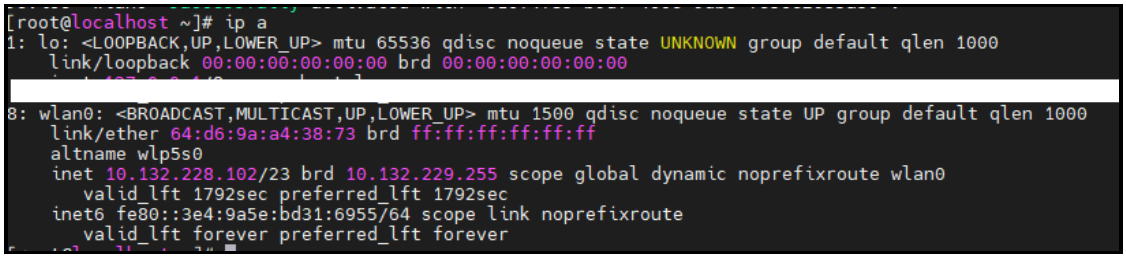

Figure 3. Check wireless device

NetworkManager wireless software

NetworkManager is a software tool that can manage both wired and wireless network interfaces, including Wi-Fi and ethernet. It also provides users with multiple options for manually configuring their network connections, based on their specific requirements. These options include using the graphical interface or the command-line interface.

To use NetworkManager, you need to start it. Currently, most Linux operating systems employ the systemd service to launch NetworkManager. Once NetworkManager is enabled and started, it will also initiate other required services, such as WPA and 802.1x.

Details about NetworkManager in key Linux distributions:

- **SUSE**
  The SLES operating system includes NetworkManager for connecting to wireless networks. You can find more detailed information in the below official documentation:
  https://documentation.suse.com/sles/15-SP5/single-html/SLES-gnome-user/index.html#sec-gnomeuser-start-network-connect

  For more SUSE NetworkManager information, please also check SUSE document:
  https://documentation.suse.com/sles/15-SP5/single-html/SLES-administration/#cha-nm
- **Red Hat**
  Red Hat Linux Enterprise Server OS introduces various NetworkManager methods to configure the NetworkManager connection. It includes:
  - nmcli: Network configuration via command line
  - nmtui: Network configuration via text-based user interface
  - nmstatectl: Network configuration via nmstatectl API
  - RHEL System Roles: Use RHEL System Roles to automate the configuration of connections on one or multiple hosts.

  For details, see the following page:
  https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/html-single/configuring_and_managing_networking/index#configuring-an-ethernet-connection_configuring-and-managing-networking
- **Ubuntu and Debian**
  Ubuntu document introduces NetworkManager as a tool for wireless configuration. Ubuntu also introduces NetworkManager along with nmcli, for the practice, we will use the nmcli command as the wireless setting example:
  https://help.ubuntu.com/community/NetworkManager?action=show&redirect=WifiDocs%2FNetworkManager

Wireless configuration steps for RHEL

To configure wireless on Red Hat, use the following steps. We used RHEL 8.6 and nmcli in our lab.

1. Check the wireless device by running the 'lspci' command and make sure the wireless device is displayed in OS.

```
[root@localhost ~]# lspci -vvv|grep ax210
[root@localhost ~]# lspci -vvv|grep -i ax210
0000:05:00.0 Network controller: Intel Corporation Wi-Fi 6 AX210/AX211/AX411 160MHz (rev 1a)
        Subsystem: Intel Corporation Wi-Fi 6 AX210 160MHz
[root@localhost ~]#
```

   Figure 4. Check network device

2. Enable Wi-Fi function and list Wi-Fi access point.

```
[root@localhost ~]# nmcli r wifi on
[root@localhost ~]# nmcli d wifi list
```

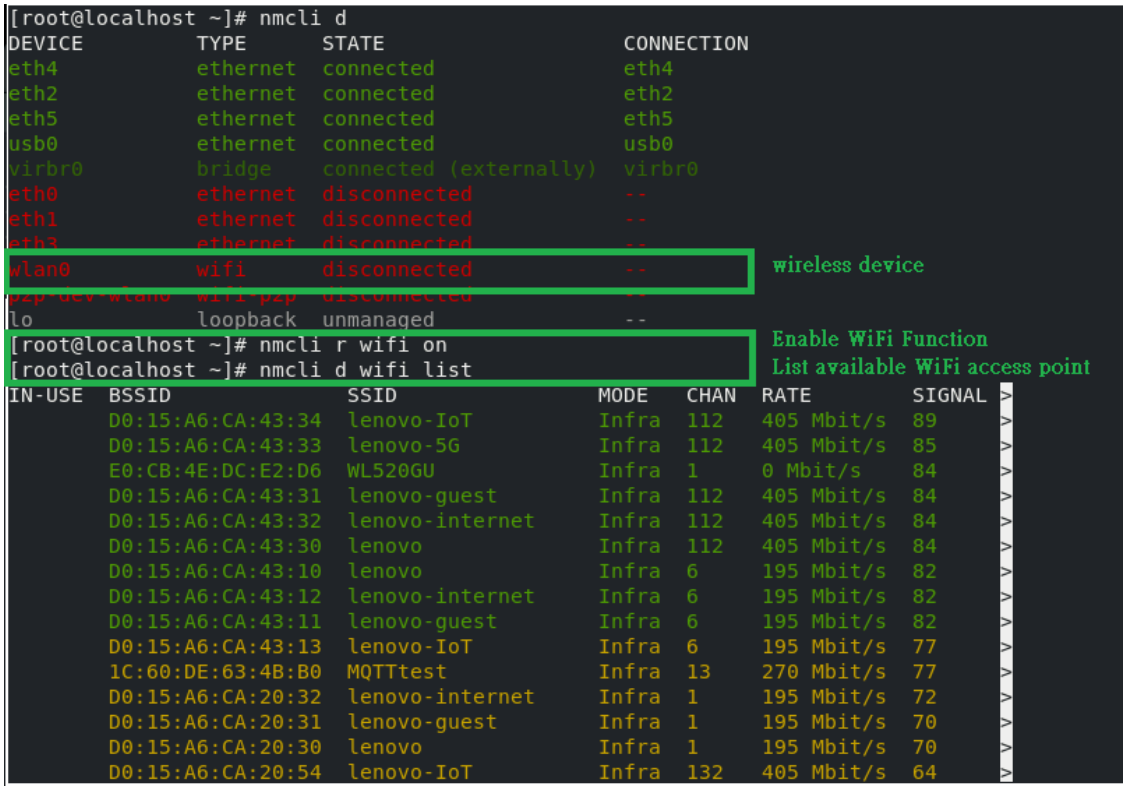

Figure 5. Check network device, turn on the wireless radio, and list all access point

3. Connect to AP and check the connectivity.

```
[root@localhost ~]# nmcli d wifi connect lenovo-internet password [password]
[root@localhost ~]# ip a
```

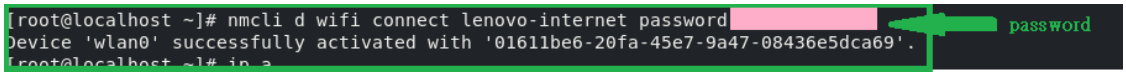

Figure 6. Connect to lenovo-internet AP

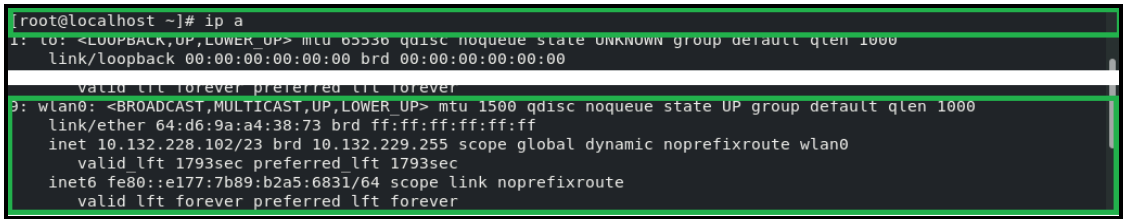

Figure 7. Check the wireless, such as wlan0,by command “ip a”

4. Disable all wired network and only leave wireless network, and then check again the connection by ping command.

```
[root@localhost ~]# ip a|grep -i 241
    inet 10.241.99.247/24 brd 10.241.99.255 scope global dynamic noprefixroute eth2
[root@localhost ~]# ip a|grep -i 241
[root@localhost ~]# ping www.google.com
PING www.google.com (142.250.207.68) 56(84) bytes of data.
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=1 ttl=56 time=20.3 ms
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=2 ttl=56 time=22.1 ms
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=3 ttl=56 time=18.9 ms
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=4 ttl=56 time=19.8 ms
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=5 ttl=56 time=28.2 ms
64 bytes from hkg12s32-in-f4.1e100.net (142.250.207.68): icmp_seq=6 ttl=56 time=21.4 ms
^C
```

Figure 8. Check the wireless by command “ip a”

5. If there is not any requirement to use Wi-Fi function, we can disable the wireless connection.

```
#nmcli r wifi off
```

Wireless configuration steps for SLES

In the SLES OS document, it suggests using NetworkManager applet to configure the wireless connection. To set up the wireless connection, follow the steps below:

https://documentation.suse.com/sles/15-SP5/html/SLES-all/cha-network.html#sec-network-yast-netcard-global

1. Install the NetworkManager
   When installing the SLES OS, such as SLES15 SP5, ensure that NetworkManager is included in the OS's installation list before proceeding with the installation. Make sure to check if the SUSE Enterprise Workstation Extension is listed in the software. If it's not listed, add it to the installation list.

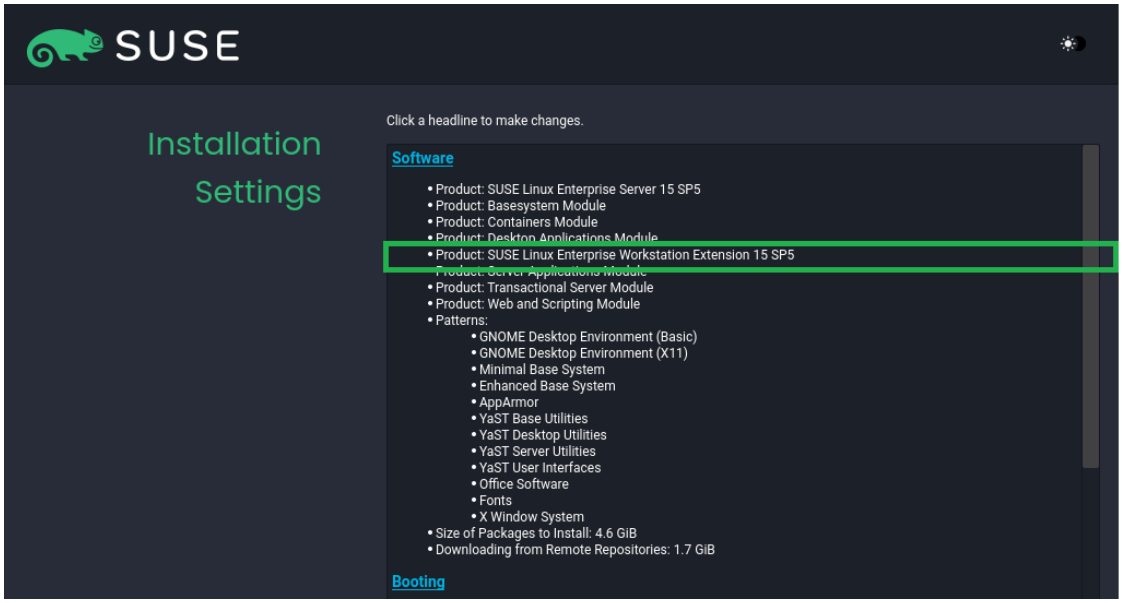

Figure 9. SUSE Enterprise Workstation Extension listed in Software

Make sure the NetworkManager software is in the Software Selection and System Tasks list.

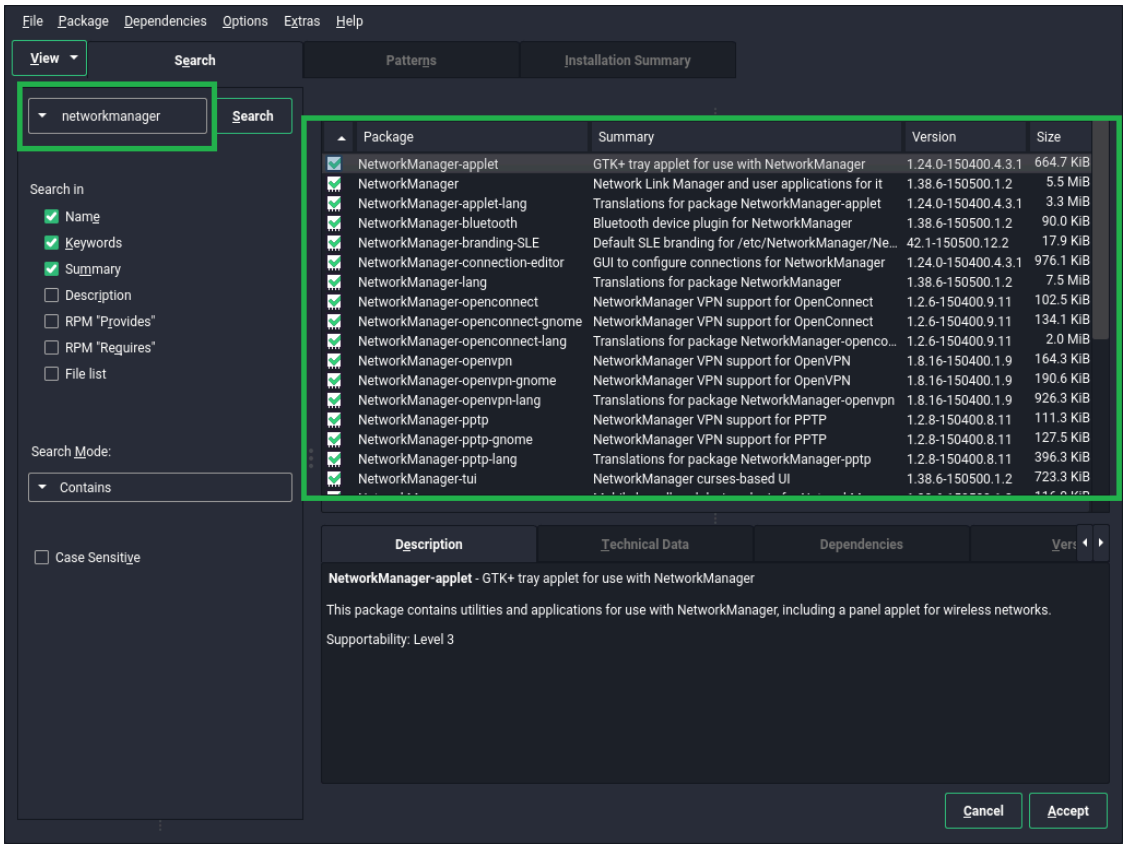

Figure 10. NetworkManager in the Software Selection and System Tasks list

If SLES OS is installed, but NetworkManager software is not installed yet:

a. Install NetworkManager and make sure the NetworkManager installed in OS using SUSE yast2 tool.

```
#yast2 sw_single
```

b. Locate the SLES-workstation repository as shown in the figure below. Follow the instructions in the SLES network document to install NetworkManager. Refer to preceding figure for an example.

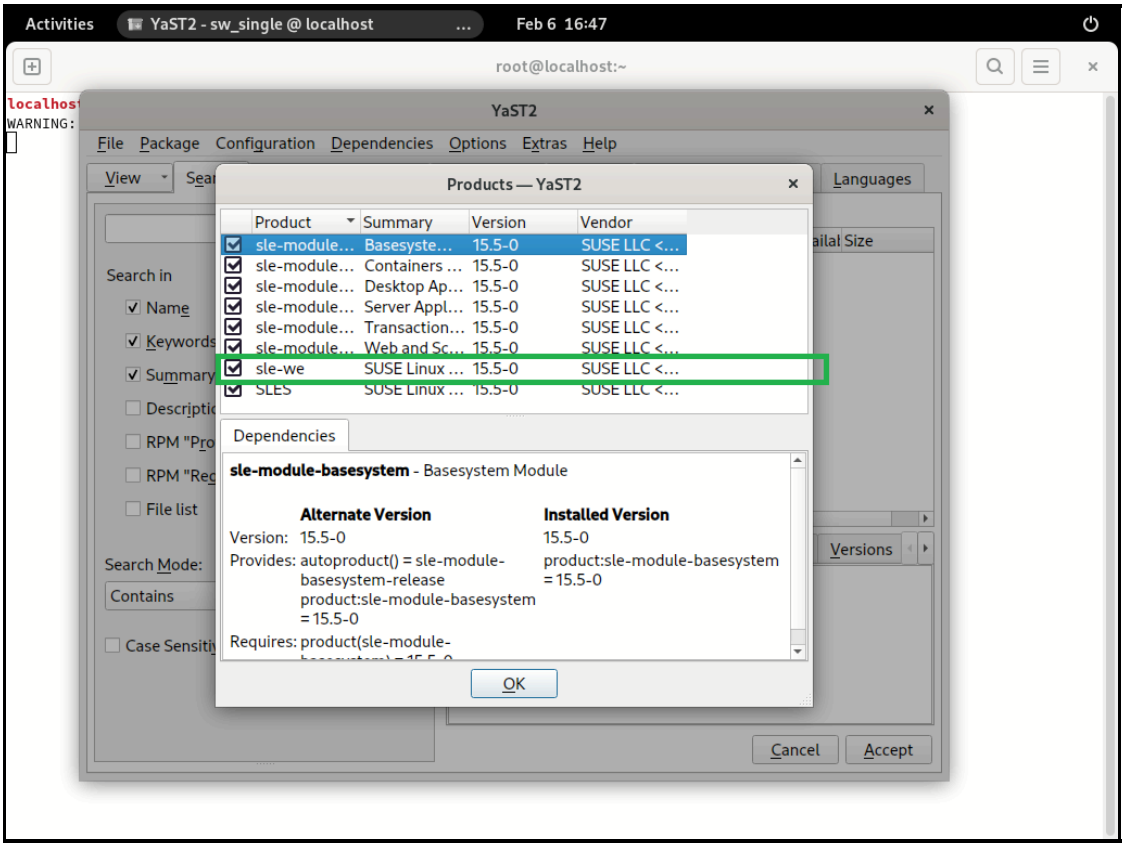

Figure 11. Find the repository SLES-workstation

2. After completing NetworkManager installation, configure wireless setting of NetworkManager
   a. Open the network setting via yast2 tool and make sure NetworkManager is being used.

```
#yast2 lan
```

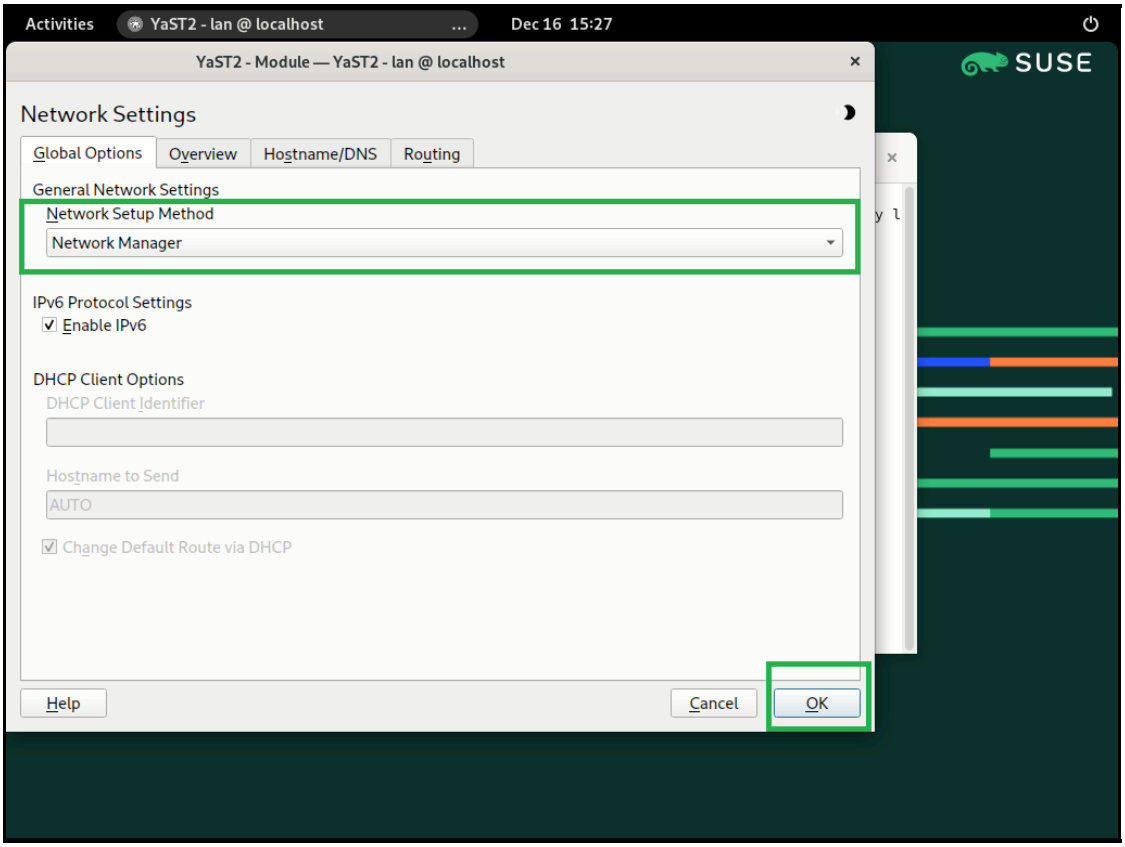

Figure 12. Check the NetworkManager is being used via yast2 lan

b. The warning message appears. And then press “ok” to close the dialog.

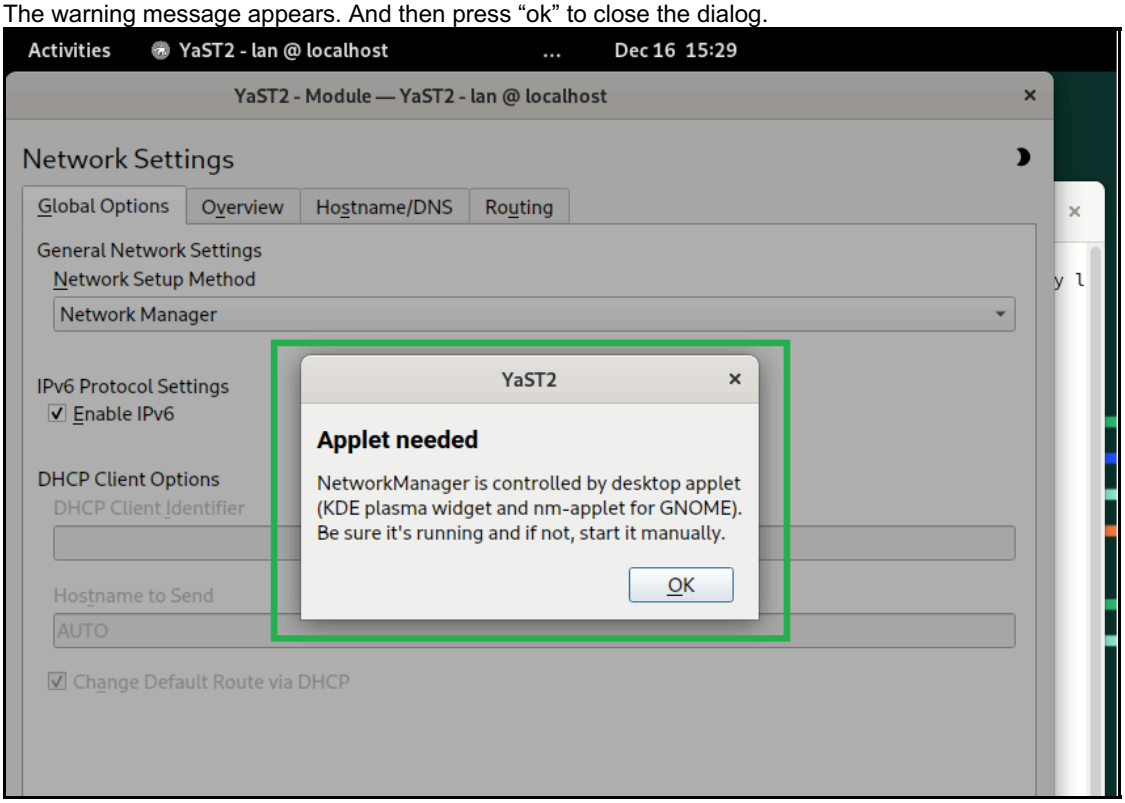

Figure 13. Warning message

c. Open one terminal and make sure the NetworkManager is working by systemctl command.

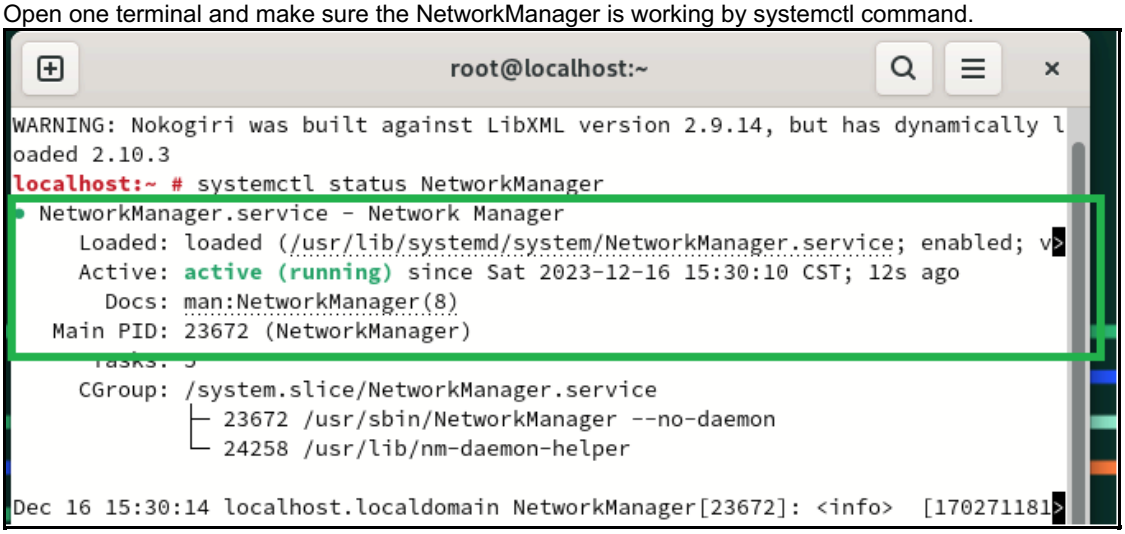

Figure 14. Make sure the NetworkManager is working

d. Use the yast2 tool to select network configuration and ensure that the Wi-Fi device is listed in the Overview section. Then, follow the yast2 tool's suggestion to use NetworkManager for wireless configuration and close the yast2 tool.

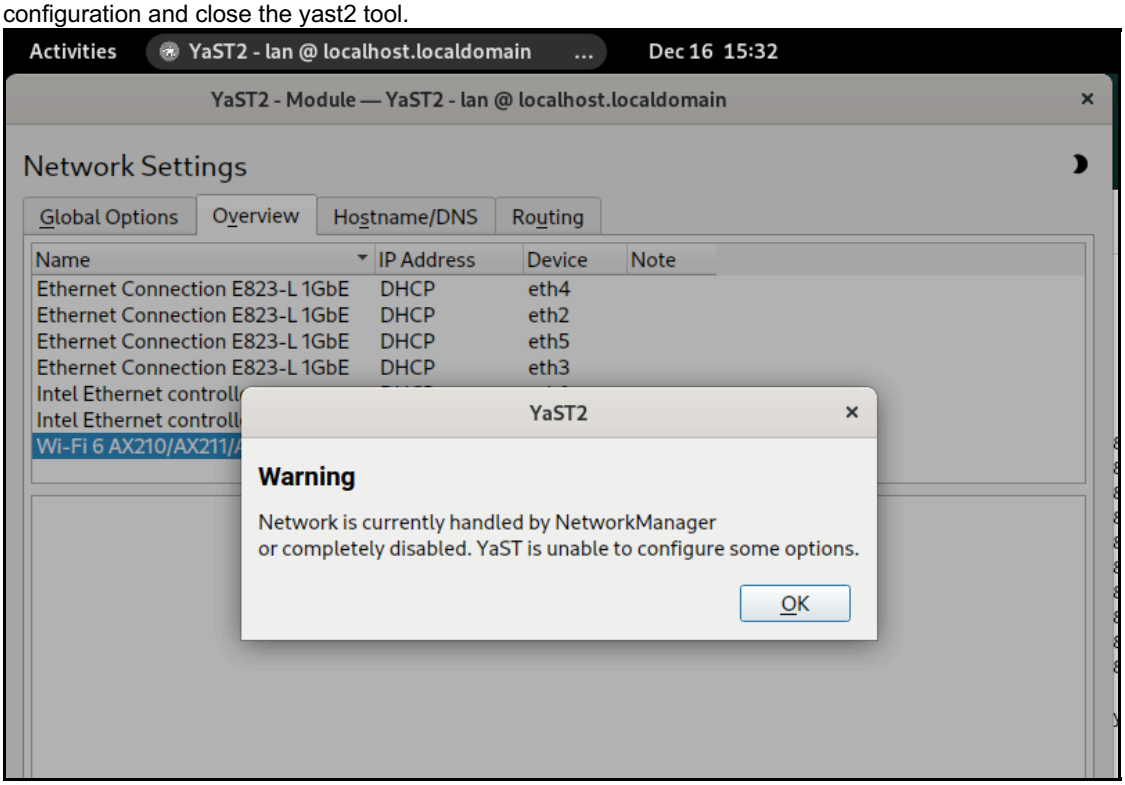

Figure 15. Confirm the Wi-Fi device is listed in Overview listed

e. As shown in the figure below, click on the “Network Connection” button in the upper right corner, and select the “Select Network” option from the 'Wi-Fi Not Connected' menu.

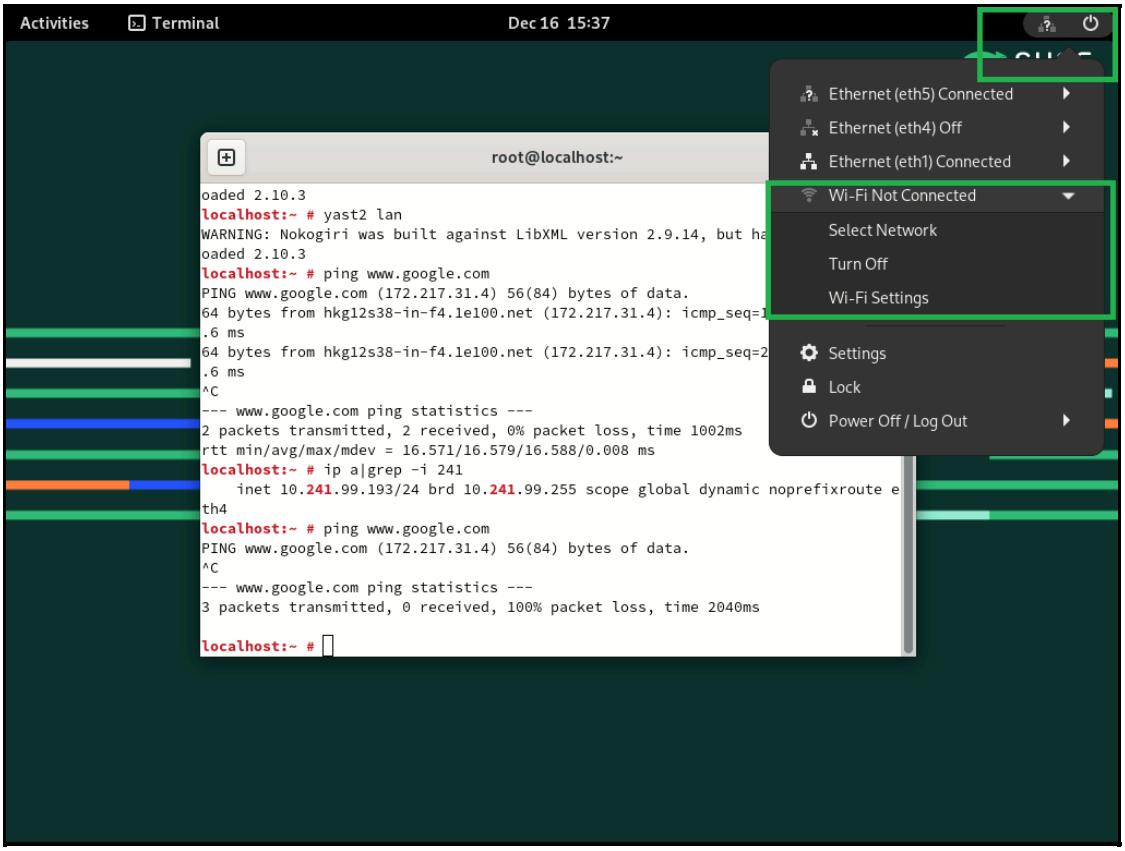

Figure 16. “Select Network” of “Wi-Fi Not Connected”

f. Go to the “Wi-Fi Settings” and choose the appropriate AP/Security method to connect and then enter the password.

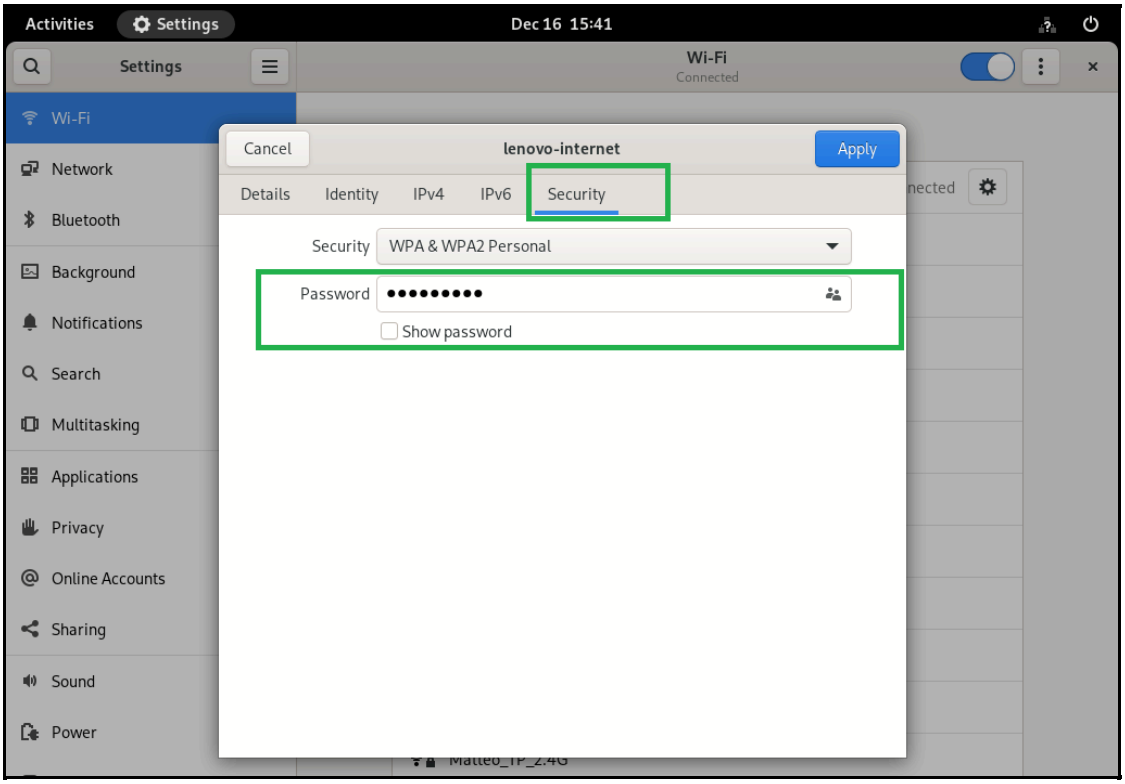

Figure 17. Choose the appropriate AP/Security method

3. After completing the wireless configuration, open one terminal to double check if the connection works by command ping.

```
#ip a |grep wlan
#ping www.google.com
```

```
localhost:~ # ip a|grep wlan0
4: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    inet 10.132.228.102/23 brd 10.132.229.255 scope global dynamic noprefixroute wlan0
localhost:~ # ip a|grep -i 192
    inet 192.168.0.6/24 brd 192.168.0.255 scope global dynamic noprefixroute eth1
    inet 192.168.0.41/24 brd 192.168.0.255 scope global dynamic noprefixroute eth5
localhost:~ # ping www.google.com
^C
localhost:~ # ping www.google.com
PING www.google.com (142.250.66.68) 56(84) bytes of data.
64 bytes from hkg12s27-in-f4.1e100.net (142.250.66.68): icmp_seq=1 ttl=56 time=18.1 ms
64 bytes from hkg12s27-in-f4.1e100.net (142.250.66.68): icmp_seq=2 ttl=56 time=90.6 ms
64 bytes from hkg12s27-in-f4.1e100.net (142.250.66.68): icmp_seq=3 ttl=56 time=102 ms
^C
```

Figure 18. Check if the connection works by command ping

Wireless configuration steps for other Linux

For other Linux distributions, we use Ubuntu 22.04 LTS as our example.

```
root@hakuba:~# uname -mrs
root@hakuba:~# cat /etc/os-release
```

```
root@se360v2:/home/conie# uname -mrs
Linux 6.2.0-39-generic x86_64
root@se360v2:/home/conie# cat /etc/os-release
PRETTY_NAME="Ubuntu 22.04.3 LTS"
NAME="Ubuntu"
VERSION_ID="22.04"
VERSION="22.04.3 LTS (Jammy Jellyfish)"
VERSION_CODENAME=jammy
ID=ubuntu
ID_LIKE=debian
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu/"
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/terms-and-policies/privacy-policy"
UBUNTU_CODENAME=jammy
```

Figure 19. OS information checking

To configure wireless, perform these steps:

1. Check and install NetworkManager tool, such as network-manager.

```
root@se360v2:~# apt-cache search network-manager
root@se360v2:~# apt install -y network-manager
```

2. First, determine the name of the Wi-Fi interface:

```
root@se360v2:~# nmcli d
```

3. Make sure the Wi-Fi radio is on (which is its default state):

```
root@se360v2:~# nmcli r wifi on
```

```
root@se360v2:/home/conie# nmcli d
DEVICE          TYPE      STATE         CONNECTION
wlp5s0          wifi      disconnected  --
eno1            ethernet  unmanaged     --
eno2            ethernet  unmanaged     --
eno3np3         ethernet  unmanaged     --
eno4np2         ethernet  unmanaged     --
eno5np1         ethernet  unmanaged     --
eno6np0         ethernet  unmanaged     --
lo              loopback  unmanaged     --
p2p-dev-wlp5s0  wifi-p2p  unmanaged     --
root@se360v2:/home/conie# nmcli r wifi on
```

Figure 20. Wi-Fi radio checking

4. Then, list the available Wi-Fi networks:

```
root@se360v2:~# nmcli d wifi list
```

```
root@se360v2:/home/conie# nmcli r wifi on
root@se360v2:/home/conie# nmcli d wifi list
IN-USE  BSSID              SSID            MODE   CHAN  RATE        SIGNAL  BARS  SECURITY
        E0:CB:4E:DC:E2:D6  WL520GU         Infra  1     54 Mbit/s   85      ▂▄▆▇  WPA2
        D0:15:A6:CA:43:11  lenovo-guest    Infra  6     195 Mbit/s  82      ▂▄▆▇  --
        D0:15:A6:CA:43:13  lenovo-IoT      Infra  6     195 Mbit/s  82      ▂▄▆▇  --
        D0:15:A6:CA:43:12  lenovo-internet Infra  6     195 Mbit/s  80      ▂▄▆_  --
        D0:15:A6:CA:43:10  lenovo          Infra  6     195 Mbit/s  80      ▂▄▆_  WPA2 802.1X
        1C:60:DE:63:4B:B0  MQTTtest        Infra  13    270 Mbit/s  77      ▂▄▆_  WPA1 WPA2
        D0:15:A6:CA:43:34  lenovo-IoT      Infra  128   405 Mbit/s  77      ▂▄▆_  --
        D0:15:A6:CA:43:33  lenovo-5G       Infra  128   405 Mbit/s  74      ▂▄▆_  WPA2 802.1X
        D0:15:A6:CA:43:30  lenovo          Infra  128   405 Mbit/s  74      ▂▄▆_  WPA2 802.1X
        D0:15:A6:CA:43:32  lenovo-internet Infra  128   405 Mbit/s  74      ▂▄▆_  --
```

Figure 21. List the available Wi-Fi networks

5. Connect the access point “lenovo-internet” (you might access the available access point in your wireless network) with the following command:

```
root@se360v2:~# nmcli d wifi connect [SSID] password [password]
```

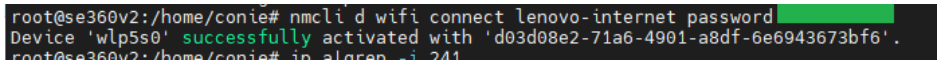

Figure 22. Connect to the access point

6. Close all wired network, and then use the command “ping” to double confirm the wireless client network connection.

```
root@se360v2:~# ping www.google.com
```

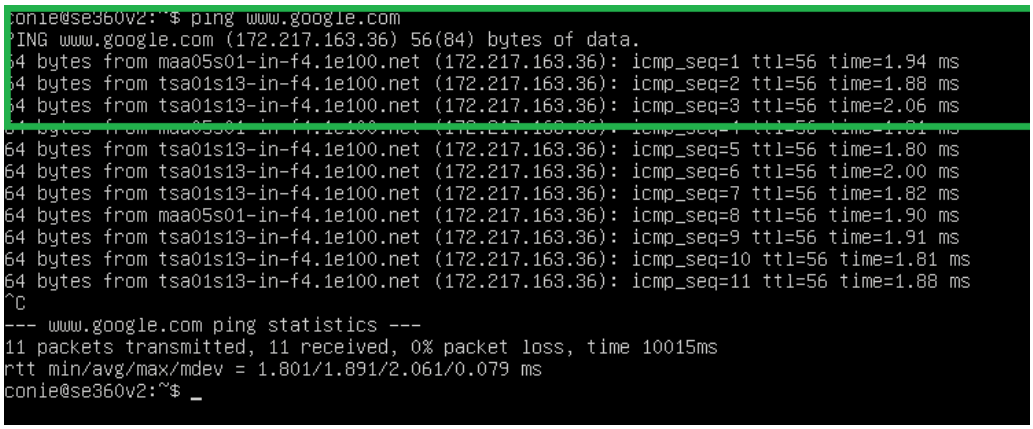

Figure 23. Confirm the wireless client network connection

Author

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- Adrian Huang, Senior Linux Kernel Engineer
- David Watts, Lenovo Press

Related product families

Product families related to this document are the following:

- Edge Servers
- ThinkEdge SE360 V2 Server

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