SUSE

Setting Up and Managing Network Connections Using NetworkManager

WHAT?

NetworkManager is a dynamic network control and configuration tool that enables you to keep network devices up and running.

WHY?

This article provides a complete overview of NetworkManager and how to configure, manage, monitor and edit network connections using NetworkManager.

EFFORT

It takes 15 minutes to install and configure NetworkManager. You need up to an hour to fully understand the NetworkManager concept and functionalities.

GOAL

Basic understanding of managing network connections.

REQUIREMENTS

- Root access to install and manage NetworkManager
- A package manager to install NetworkManager
- Basic understanding of networking and IP addresses

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1 The NetworkManager concept

NetworkManager is a tool that enables managing network connections and devices. NetworkManager allows you to create, configure and manage network connections and devices.

On SUSE Linux Micro, NetworkManager has been designed to be fully automatic by default. It is enabled by default and is shipped with all necessary service unit files for managing primary network connection and other network interfaces. NetworkManager supports state-of-the-art encryption types and standards for network connections, including connections to 802.1X protected networks. 802.1X is the IEEE Standard for Local and Metropolitan Area Networks—Port-Based Network Access Control.

You can switch between wired or wireless networks seamlessly, as NetworkManager automatically connects to known wireless networks and manages several network connections in parallel. You can also manually switch between available networks.

NetworkManager typically consists of the following parts:

- NetworkManager daemon—you can interact with the daemon using standard `systemd` commands
- the **`nmcli`** command-line interface
- the ncurses interface `nmtui`
- NetworkManager libraries
- configuration files.

2 Installing and Configuring NetworkManager

On SUSE Linux Micro, NetworkManager is installed and enabled by default and thus runs out of the box. Usually, you do not have to reinstall it or change the configuration, but if such an action is needed, these sections provide guidance.

2.1 Installing NetworkManager

You can install NetworkManager using **`zypper`**. Once you install, you can enable NetworkManager to start automatically at boot time.

Install NetworkManager:

```
> sudo zypper install NetworkManager
```

Enable NetworkManager:

```
> sudo systemctl enable NetworkManager
```

Once NetworkManager is enabled, the change persists across reboots.

2.2 Configuring NetworkManager behavior

The behavior of NetworkManager is defined in its central configuration file `/usr/lib/NetworkManager/NetworkManager.conf`. The system runs with the built-in defaults and the `NetworkManager.conf` file is not mandatory. To modify the behavior of NetworkManager, create spinoff files in the directory `/etc/NetworkManager/conf.d`.

`NetworkManager.conf` is the primary location for viewing the default behavior and settings of NetworkManager, including logging, connection management, and network device handling.

The file consists of sections of key-value pairs. Each key-value pair must belong to a section. A section starts with a name enclosed in `[]`. Lines beginning with a `#` are considered comments. A common configuration includes the `[main]` section with the `plugins` value, `[logging]`, and `[connectivity]`:

```
[main] ❶
plugins=keyfile ❷
dhcp=dhclient

[connectivity] ❸
uri=http://name.org

[logging] ❹
level=INFO
domains=ALL
```

❶ Controls the general settings for NetworkManager.

❷ Manages how the connection profiles are stored. The [keyfile] plug-in supports all the connection types and capabilities of NetworkManager.

❸ Defines connection defaults and options and specifies the URI to check the network connection.

❹ Manages the NetworkManager logging levels and domains.

PROCEDURE 1: CONFIGURING NETWORKMANAGER.CONF

1. Stop the NetworkManager service:

```
> sudo  systemctl stop network
```

2. Create spinoff files in the `/etc/NetworkManager/conf.d/` if they do not exist.
3. To prevent NetworkManager from managing specific interfaces such as Ethernet ports, add them to `/etc/NetworkManager/conf.d/unmanaged-devices.conf`.
4. Alternatively, back up the existing configuration files before modifying them.
5. Modify the spinoff files to suit your needs.
6. Save the changes.
7. Start NetworkManager:

```
> sudo systemctl start network
```

8. View the existing configuration and settings:

```
> sudo  nmcli general show
```

3 Managing the NetworkManager daemon

The NetworkManager daemon is a standard `systemd` service so you can use the **`systemctl`** command to manage the daemon.

You can use any of the following commands to manage the NetworkManager daemon:

Checking status

To check if the NetworkManager daemon is running and thus the network should be active:

```
> systemctl status network
```

Restarting the daemon

For example, in cases of networking problem, you can try to restart the NetworkManager Daemon by using the following command:

```
> sudo systemctl restart network
```

Stopping the daemon

You can stop NetworkManager during network configuration changes or to switch to manual control. You can also stop the service for troubleshooting or debugging network issues. Stopping NetworkManager prevents it from automatically managing the interface or changing your manual configuration. You can also stop NetworkManager to manually address specific requirements for network interfaces.

To stop the NetworkManager daemon:

```
> sudo systemctl stop network
```

Starting the NetworkManager daemon

If you stopped the daemon, you need to start it again to manage all network connections:

```
> sudo systemctl start NetworkManager
```

4 Creating network connections

You can create a network connection profile using the **`nmcli`** command.

NetworkManager stores all network configurations as a connection profile, which is a collection of data that describes how to create or connect to a network. These connection profiles are stored as files in the `/etc/NetworkManager/system-connections/` directory by default. Each network connection profile (Wi-Fi, Ethernet, VPN) is represented by a separate file in this directory.

A connection is an instance of a particular connection profile that is active when a particular device uses the connection. The device may have more than one connection profile configured. The other connections can be used to fast switch from one connection to another. For example, if the active connection is not available, NetworkManager tries to connect the device to another configured connection.

The NetworkManager daemon manages network connections. You can interact with it using a command-line interface: **`nmcli`** or ncurses interface: **`nmtui`**.

4.1 Creating an Ethernet connection

Configure the Ethernet connection using the **`nmcli`** command and proceed as follows:

1. List available devices to get the exact device name:

```
> nmcli device
```

2. View the list of connections to make sure the profile name you want to use is not already taken:

```
nmcli connection show
```

The NetworkManager creates a profile for each Network Interface Controller (NIC). To connect the NIC to networks with different settings, you must create separate profiles for each network.

3. Create a new connection profile:

```
> sudo nmcli connection add con-name CONNECTION_NAME ifname DEVICE_NAME type
 ethernet
```

4. View the existing network settings of the new connection profile:

```
> nmcli connection show CONNECTION_NAME
```

5. Configure the connection profile.
The generic command syntax is the following:

```
> sudo nmcli connection modify CONNECTION_NAME SETTING VALUE
```

For example, automatic IP address assignment through DHCP or SLAAC is enabled by default. You may want to configure a static IP address:

- for IPv4

```
> sudo nmcli connection modify CONNECTION_NAME ipv4.method manual
 ipv4.addresses 192.0.2.1/24 ipv4.gateway 192.0.2.254 ipv4.dns 192.0.2.200
 ipv4.dns-search example.com
```

- for IPv6

```
> sudo nmcli connection modify INTERNAL-LAN ipv6.method manual ipv6.addresses
 2001:db8:1::fffe/64 ipv6.gateway 2001:db8:1::fffe ipv6.dns 2001:db8:1::ffbb
 ipv6.dns-search example.com
```

6. Configure the system to handle network-dependent services. To prevent services from failing or experiencing race conditions if they are activated before the static IP address is fully assigned by NetworkManager, choose one of the following methods:

- a. Enable `NetworkManager-wait-online.service` to force the system to wait until network interfaces are up before proceeding with the boot target:

```
> sudo systemctl enable NetworkManager-wait-online.service
```

b. Individual systemd unit overrides: For each service binding to a specific static IP, manually create a systemd unit override that enforces proper startup ordering and behavior:

```
/etc/systemd/system/sshd.service.d/override.conf
[Unit]
After=network-online.target
[Service]
Restart=always
```

- a. Centralized Non-Local Binding (Alternative): Instead of managing overrides per service, you can allow applications to safely bind to IPv4 and IPv6 addresses that are not yet fully initialized on the system. Create a custom sysctl file at `/etc/sysctl.d/90-nonlocal_bind.conf` containing the following lines:

```
net.ipv4.ip_nonlocal_bind = 1
net.ipv6.ip_nonlocal_bind = 1
```

b. Apply the sysctl configuration immediately by running:

```
> sudo sysctl --system
```

Note

Non-local binding should not be enabled by default unless required, as it may cause unexpected behavior or errors in certain strict or legacy applications.

7. Activate the profile:

```
> sudo nmcli connection up CONNECTION_NAME
```

8. Verify the configurations:

a. Verify the IP settings of the NIC:

```
> ip address show HOSTNAME
```

b. Verify the default IPv4 gateway:

```
> ip route show default
```

c. Verify the default IPv6 gateway:

```
> ip -6 route show default
```

d. View the DNS settings:

```
> cat /etc/resolv.conf
```

4.2 Creating a Wi-Fi connection profile

You can connect to a Wi-Fi using the **`nmcli`** command. The NetworkManager creates a new connection profile when you connect to a Wi-Fi for the first time. You can configure the profile after connecting to the Wi-Fi.

1. Enable the Wi-Fi radio:

```
> sudo nmcli radio wifi on
```

2. View the list of available devices:

```
> sudo nmcli device
```

3. Connect to Wi-Fi:

```
> sudo nmcli device wifi connect WI-FI_CONNECTION_NAME
    PASSWORD
```

4. View the existing network settings of the new connection profile:

```
> sudo nmcli connection show CONNECTION_NAME
```

5. Configure the connection profile as needed, using the command:

```
> sudo nmcli connection modify CONNECTION_NAME
  SETTING VALUE
```

For example, to configure a static IPv4:

```
> sudo nmcli connection modify WI-FI_CONNECTION_NAME ipv4.method manual
 ipv4.addresses IP_ADDRESS/SUBNET_MASK
```

To configure a static IPv6 address

```
> sudo nmcli connection modify WI-FI_CONNECTION_NAME ipv6.method manual
 ipv6.addresses IP_ADDRESS/SUBNET_MASK
```

6. Restart the connection:

```
> sudo nmcli connection up WI-FI_CONNECTION_NAME
```

7. Verify the connection using the command: .

```
> nmcli connection show --active
```

The list of available active connections appears.

4.3 Creating a network bond

A network bond combines physical and virtual network interfaces and provides a logical interface. You can create network bonds on Ethernet devices, Virtual LANs, and so on. Network bonding can increase bandwidth and/or provide redundancy.

REQUIREMENTS

- Network connection: two or more physical or virtual networks installed on the server
- Existing network interfaces to include in the bonded device
- Switch support, depending on the bonding mode
- To use Ethernet devices for network bonding, you must install the physical or virtual Ethernet devices on the server.
- When using network teams, bridges or VLAN devices as ports for a bond, you can create them either during the bond creation process or beforehand.

RESTRICTIONS

- Do not split bonds over multiple switches.
  In most hardware setups, all network interfaces in a bonded device must be connected to the same switch. For more information, consult your switch vendor documentation.
- IBM POWER: Bonding modes 5 and 6 (`balance-tlb` and `balance-alb`) unsupported by ibmveth.

The bonding drivers in `tlb` or `alb` modes send Ethernet Loopback packets with both the source and destination MAC addresses listed as the Virtual Ethernet MAC address. These packets are not supported by POWER firmware. Therefore, bonding modes 5 and 6 are unsupported by ibmveth.

- Bonding and virtualization: Bonded devices are made up of multiple network interfaces. In most configurations, you should only configure bonding in the host. Virtual interfaces to guests are then created as a bridge with the bonded devices, simplifying guest creation and deployment.
  It is possible, but not recommended, to configure bonding in a guest. When configuring bonding in a guest, you must assign multiple interfaces to the guest and configure the host without bonding. You must also be careful to configure the host and its network bridges so that you do not mix bonding in the host and guests.

BONDING MODES

The following bonding modes are available:

- (*0*) *balance-rr*
  Packets are transmitted in round-robin fashion from the first to the last available interface. Provides fault tolerance and load balancing. Requires switch support. Certain switches might fail with this mode.
- (*1*) *active-backup*
  Only one network interface is active. If it fails, a different interface becomes active. Provides fault tolerance. This is the default mode. No specific switch support is required.
- (*2*) *balance-xor*
  Traffic is split between all available interfaces based on the number of interfaces included in the bonded device. Provides fault tolerance and load balancing. Requires switch support. Certain switches might fail with this mode.
- (*3*) *broadcast*
  All traffic is broadcast on all interfaces. Provides fault tolerance. Requires switch support. Certain switches might fail with this mode. If possible, use mode *1* instead, or use this mode to provide sniffing capability by connecting each member of the bond to a different switch or device.
- (*4*) *802.3ad*
  Also called *LACP*. All interfaces in the LACP group must share the same speed and duplex settings, and must be connected to the same switch. Provides fault tolerance and load balancing. Requires **`ethtool`** support in the interface drivers, and a switch that supports and is configured for IEEE 802.3ad Dynamic link aggregation. If your switch supports it, this is the preferred mode.
- (*5*) *balance-tlb*

Adaptive transmit load balancing. Provides fault tolerance and load balancing. Requires **`ethtool`** support in the interface drivers. No specific switch support is required, but certain switches might fail with this mode.

- (*6*) *balance-alb*
  Adaptive load balancing. Provides fault tolerance and load balancing. Requires **`ethtool`** support in the interface drivers. No specific switch support is required, but certain switches might fail with this mode.

Consult your hardware manual to check which modes your switch supports.

For a more detailed description of the modes, see https://www.kernel.org/doc/Documentation/networking/bonding.txt.

PROCEDURE 2: CREATING A NETWORK BOND

1. Create a bond interface:

```
> sudo nmcli connection add type bond con-name NWBOND ifname NWBOND bond.options
 "mode=active-backup"
```

   A network bond, *`NETWORK_BOND`* that uses `active-backup` mode is created.

2. View the list of network interfaces:

```
> nmcli device status

   DEVICE         TYPE      STATE                   CONNECTION
   wlan0          wifi      connected               Vision
   virbr0         bridge    connected (externally)  virbr0
   p2p-dev-wlan0  wifi-p2p  disconnected            --
   eth0           ethernet  unavailable             --
   lo             loopback  unmanaged               --
```

   The list of available network interfaces appears. You can also add devices that are not configured to the bond. In the given list, `p2p-dev-wlan0` is not configured, while `virbr0` is configured and has a connection profile.

3. To configure `p2p-dev-wlan0` as a port, create a connection profile:

```
> sudo nmcli connection add type wifi-p2p slave-type bond con-name bond0-port1
 ifname p2p-dev-wlan0 master bond0
```

   This creates a new profile for `p2p-dev-wlan0` and adds it to the `bond0` connection. The name of the bond is `bond0`.

4. To assign `virbr0` to a bond:

```
> sudo nmcli connection modify virbr0 master bond0
```

   The connection profile for `virbr0` is added to the `bond0` connection.

5. Activate the connection:

```
> sudo nmcli connection up virbr0
```

6. Configure the IPv4 settings:

   - To use `bond0` as a port for other devices:

```
> sudo nmcli connection modify bond0 ipv4.method disabled
```

   - To use DHCP, no configuration is required.
   - To configure a static IPv4 address, network mask, default gateway and DNS server to the `bond0` connection:

```
> sudo nmcli connection modify bond0 ipv4.addresses '192.0.2.1/24'
 ipv4.gateway '192.0.2.254' ipv4.dns '192.0.2.253' ipv4.dns-search
 'example.com' ipv4.method manual
```

7. Configure the IPv6 settings:

   - To use this bond device as a port of other devices:

```
> sudo nmcli connection modify bond0 ipv6.method disabled
```

   - To use stateless address autoconfiguration (SLAAC), no action is required.
   - To set a static IPv6 address, network mask, default gateway and DNS server to the `bond0` connection:

```
> sudo nmcli connection modify bond0 ipv6.addresses '2001:db8:1::1/64'
 ipv6.gateway '2001:db8:1::fffe' ipv6.dns '2001:db8:1::fffd' ipv6.dns-search
 'example.com' ipv6.method manual
```

8. Activate the connection:

```
> sudo nmcli connection up bond0
```

9. View and verify the connections:

```
> nmcli device
```

The list of connections appears.

4.4 Configuring a network team

Network teaming combines two or more network interfaces into a single teamed device to increase bandwidth and/or provide redundancy. The behavior of the teamed device is configured using teaming modes. Network teaming can increase bandwidth and/or provide redundancy.

REQUIREMENTS

- Network connection
- Existing network interfaces to include in the teamed device
- Switch support in kernel, depending on the teaming mode
- The package `libteam-tools` is installed
- Install the `teamd` and `NetworkManager-team` packages:

```
> sudo  zypper install teamd
> sudo  zypper install NetworkManager-team
```

The `teamd`, `NetworkManager-team` and `libteam-tools` packages are deprecated in SUSE Linux Micro 6.2 as the upstream activities are deprecated. You must migrate existing team interfaces to bonding configurations managed through NetworkManager. NetworkManager bonding supports many bonding scenarios, including LACP.

- Install two or more physical or virtual devices on the server:
- To use Ethernet devices as ports of the team, the physical or virtual Ethernet devices must be installed on the server and connected to a switch.
- To use bond, bridge or VLAN devices as ports of the team, create them in advance or when you create the team.

RESTRICTIONS

- Do not split teams over multiple switches.

In most hardware setups, all network interfaces in a teamed device must be connected to the same switch. For more information, consult your switch vendor documentation.

- Teaming and virtualization:
  Teamed devices are made up of multiple network interfaces. In most configurations you should only configure teaming in the host. Virtual interfaces to guests are then created as a bridge with the teamed devices, simplifying guest creation and deployment.
  It is possible, but not recommended, to configure teaming in a guest. When configuring teaming in a guest, you must assign multiple interfaces to the guest and configure the host without teaming. You must also be careful to configure the host and its network bridges so that you do not mix teaming in the host and guests.

TEAMING MODES

The following teaming modes are available:

- *broadcast*
  All traffic is broadcast on all interfaces. Provides fault tolerance. Requires switch support.
- *roundrobin*
  Packets are transmitted in round-robin fashion from the first to the last available interface. Provides fault tolerance and load balancing. Requires switch support.
- *activebackup*
  Only one network interface is active. If it fails, a different interface becomes active. Provides fault tolerance.
- *loadbalance*
  The teamed device transmits packets via all its interfaces, performing load balancing (passive or active) with a use of hash functions. For passive load balancing, only the BPF hash function is used. For active load balancing, the runner finds the best balance by moving hashes between available interfaces. Provides fault tolerance and load balancing. No specific switch support is required.
- *lacp*
  All interfaces in the LACP group must share the same speed and duplex settings, and must be connected to the same switch. Provides fault tolerance and load balancing. Requires **`ethtool`** support in the interface drivers, and a switch that supports and is configured for IEEE 802.3ad Dynamic link aggregation. If your switch supports it, this is the preferred mode.

Consult your hardware manual to check which modes your switch supports.

PROCEDURE 3: CREATING A NETWORK TEAM

1. Create a team interface:

```
> sudo nmcli connection add type team con-name CONNECTION_NAME ifname TEAM_NAME
 team.runner RUNNER-TYPE
```

   For example, to create a network team `team0` with the `activebackup` runner, run:

```
> sudo nmcli connection add type team con-name team0 ifname team0 team.runner
 active.backup
```

2. View the list of network interfaces:

```
> nmcli device status
```

```
DEVICE         TYPE      STATE                   CONNECTION
    wlan0          wifi      connected               Vision
    virbr0         bridge    connected (externally)  virbr0
    p2p-dev-wlan0  wifi-p2p  disconnected            --
    eth0         ethernet  unavailable             --
    lo             loopback  unmanaged               --
```

   You can add the listed devices to the team. The following examples use `p2p-dev-wlan0` and `virbr0`. Note that `p2p-dev-wlan0` is not configured, while `virbr0` has a connection profile.

3. Configure port interfaces to the team:

```
> sudo nmcli connection add type wifi-p2p slave-type team con-name team0-port1
 ifname p2p-dev-wlan0 master team0
```

   A new profile is created for `p2p-dev-wlan0` and added to the `team0` connection.

4. Assign the existing connection to the team:

```
> sudo nmcli connection modify bond0 master team0
```

   The connection profile for `bond0` is added to the `team0` connection.

5. Activate the connection:

```
> sudo nmcli connection up bond0
```

6. Configure the IPv4 settings:

    - To use the team device as a port of other devices:

      ```
      > sudo nmcli connection modify team0 ipv4.method disabled
      ```

    - To use DHCP, no configuration is required.

    - To configure a static IPv4 address, network mask, default gateway and DNS server to the `bond0` connection, run the command:

      ```
      > sudo nmcli connection modify team0 ipv4.addresses '192.0.2.1/24'
       ipv4.gateway '192.0.2.254' ipv4.dns '192.0.2.253' ipv4.dns-search
       'example.com' ipv4.method manual
      ```

7. Configure the IPv6 settings:

    - To use this team device as a port of other devices:

      ```
      > sudo nmcli connection modify team0 ipv6.method disabled
      ```

    - To use stateless address autoconfiguration (SLAAC), no action is required.

    - To set a static IPv6 address, network mask, default gateway and DNS server to the `team0` connection:

      ```
      > sudo nmcli connection modify team0 ipv6.addresses '2001:db8:1::1/64'
       ipv6.gateway '2001:db8:1::fffe' ipv6.dns '2001:db8:1::fffd' ipv6.dns-search
       'example.com' ipv6.method manual
      ```

8. Activate the connection:

   ```
   > sudo nmcli connection up team0
   ```

9. To view the status of the team:

   ```
   > sudo teamdctl team0 state
   ```

4.5 Configuring a network bridge

A network bridge is a device that facilitates communication between two or more network segments, creating a single network from multiple segments

To configure a network bridge, ensure the following:

- Install two or more physical or virtual devices on the server.
- To use Ethernet devices as ports for the bridge, ensure the server has physical or virtual Ethernet devices installed and connected to a switch.
- When using team, bond or VLAN devices as ports for the bridge, you can create these devices either during bridge creation or beforehand.

PROCEDURE 4: CREATING A NETWORK BRIDGE

1. Create a bridge interface:

```
> sudo nmcli connection add type bridge con-name CONNECTION_NAME ifname BRIDGE_NAME
```

   For example, create a bridge `bridge0` by running the command:

```
> sudo nmcli connection add type bridge con-name bridge0 ifname bridge0
```

2. View the list of network interfaces to verify that `bridge0` is created:

```
> nmcli device status

    DEVICE         TYPE      STATE                                  CONNECTION
    wlan0                wifi      connected                              Vision
    virbr0               bridge    connected (externally)                 virbr0

    p2p-dev-wlan0        wifi-p2p  disconnected                           --

    eth0                 ethernet  unavailable                            --

    lo                   loopback  unmanaged                              --
    bridge0              bridge    connecting (getting IP configuration)  brdige0
```

   The bridge is in the state *getting IP configuration*, because you have not assigned interfaces to it yet. Later you will assign the interfaces: `p2p-dev-wlan0` (not configured) and `virbr0` (configured with a connection profile).

3. Add interfaces to the bridge:

```
> sudo nmcli connection add type wifi-p2p slave-type bridge con-name bridge0-port1
 ifname p2p-dev-wlan0 master bridge0
```

   This creates a new profile for p2p-dev-wlan0 and adds it to the `bridge0` connection.

4. To assign an existing connection to the bridge:

```
> sudo nmcli connection modify bond0 master bridge0
```

   This adds the connection profile for `bond0` to the `bridge0` connection.

5. Restart the connection:

```
> sudo nmcli connection up bond0
```

6. Configure the IPv4 settings:

   - To use the bridge device as a port of other devices:

```
> sudo nmcli connection modify bridge0 ipv4.method disabled
```

   - To use DHCP, no configuration is required.
   - To configure a static IPv4 address, network mask, default gateway and DNS server to the `bridge0` connection:

```
> sudo nmcli connection modify bridge0 ipv4.addresses '192.0.2.1/24'
 ipv4.gateway '192.0.2.254' ipv4.dns '192.0.2.253' ipv4.dns-search
 'example.com' ipv4.method manual
```

7. Configure the IPv6 settings:

   - To use this bridge device as a port of other devices:

```
> sudo nmcli connection modify bridge0 ipv6.method disabled
```

   - To use stateless address autoconfiguration (SLAAC), no action is required.
   - To set a static IPv6 address, network mask, default gateway and DNS server to the `bridge0` connection:

```
> sudo nmcli connection modify bridge0 ipv6.addresses '2001:db8:1::1/64'
 ipv6.gateway '2001:db8:1::fffe' ipv6.dns '2001:db8:1::fffd' ipv6.dns-search
 'example.com' ipv6.method manual
```

8. Activate the connection:

```
> sudo nmcli connection up bridge0
```

9. Verify the connection:

```
> nmcli device
```

When you activate any port of the connection, NetworkManager also activates the bridge, but not the other ports of it.
Enable all ports automatically when the bridge is enabled:

```
> sudo nmcli connection modify bridge0 connection.autoconnect-slaves 1
```

10. View the link status of Ethernet devices that are ports of a specific bridge.

```
> sudo ip link show master bridge0
```

11. View the status of Ethernet devices that are ports of any bridge device.

```
> sudo bridge link show
```

4.6 Configuring a VPN connection

A VPN (Virtual Private Network) connection is a secure, encrypted tunnel between your device and another network over the Internet.

You can configure a VPN connection using the **`nmcli`** command.

PROCEDURE 5: INSTALLING AND CONFIGURING A VPN CONNECTION

1. Install OpenVPN:

```
> sudo  zypper install networkmanager-openvpn
```

2. Create a VPN connection:

```
> sudo nmcli connection add type vpn con-name MyOpenVPN ifname -- vpn-type openvpn
```

3. Configure the settings:

```
> sudo nmcli connection modify MyOpenVPN vpn.data "remote=VPN-SERVER-
ADDRESS,username=YOUR-USERNAME"
```

```
> sudo nmcli connection modify MyOpenVPN vpn.secrets "password=YOUR-PASSWORD"
```

4. Configure DNS settings:

```
> sudo nmcli connection modify MyOpenVPN ipv4.dns "8.8.8.8 8.8.4.4"
```

5. Add routes:

```
> sudo nmcli connection modify MyOpenVPN ipv4.routes "192.168.1.0/24 192.168.1.1"
```

6. Activate the VPN connections:

```
> sudo nmcli connection up MyOpenVPN
```

7. Verify if the configured connection is active:

```
> nmcli connection show --active
```

4.7 Convert teamd configuration to NetworkManager

In SUSE Linux Micro6.2, **`libteam`** and **`teamd`** are deprecated and hence Network Load Balancing configurations that relied on **`libteam`** in the past must be converted to a NetworkManager based bonding interface.

PROCEDURE 6: ACTIVE LOAD BALANCING WITH LACP

1. A sample `team0` interface configuration (`/etc/sysconfig/network/ifcfg-team0`) is mentioned below based on which the commands are described.

```
BOOTPROTO="static"
STARTMODE="onboot"

TEAM_RUNNER="lacp"
TEAM_LACP_TX_HASH="l4,l3,eth,vlan"
TEAM_LACP_TX_BALANCER_NAME="basic"
TEAM_LACP_TX_BALANCER_INTERVAL="100"
TEAM_LACP_ACTIVE=true
TEAM_LACP_SELECT_POLICY="lacp_prio"
TEAM_LW_NAME="ethtool"
TEAM_LW_ETHTOOL_DELAY_UP="10"
TEAM_LW_ETHTOOL_DELAY_DOWN="10"
IPADDR="10.1.1.1"
NETMASK="255.255.255.0"
IPADDR_0="2001:db8::1"
PREFIXLEN_0="64"
TEAM_PORT_DEVICE_0="eth0"
```

```
TEAM_PORT_DEVICE_1="eth3"
```

This configuration describes a network bond using active transmit load balancing. Any load balancing that happens on incoming traffic is performed by the switch.

2. Run the following **`nmcli`** commands to configure a bonding interface (bond0), and add the Ethernet ports to it:

```
> sudo  nmcli connection add type bond bond-options "...." \
ifname bond0 con-name bond0 \
ipv4.method manual ipv4.address 10.1.1.1/24 \
ipv6.method manual ipv6.address 2001:db8::1/64
> sudo  nmcli connection add type ethernet ifname eth0 con-name eth0 master bond0
> sudo  nmcli connection add type ethernet ifname eth3 con-name eth3 master bond0
> sudo  nmcli connection modify bond0 connection.autoconnect-slaves yes
```

3. For the specific `ifcfg-team0` example shown above, you can translate the LACP settings into options for the bond device shown as "..." as given below:

   - **`TX_BALANCER_NAME=basic`** indicates active load balancing. There is no other balancer in `teamd`, so this is actually redundant and can be ignored.
   - The protocol chosen for managing the bond needs to be provided to the kernel via the mode option. The **`TEAM_RUNNER`** variable above specifies LACP, the Link Aggregation Protocol. This is defined by IEEE 802.3ad, and that's also the name by which it is referred to in the kernel bond documentation. So the corresponding option is **`mode=802.3ad`**
   - The **`TX_HASH`** setting describes which headers are used to distribute outgoing packets to links. The bonding equivalent to the above settings is **`xmit_hash_policy=layer3+4`**
   - The **`TX_BALANCER_INTERVAL`** describes how frequently the status of the Ethernet ports is inspected (in milliseconds). The corresponding option is **`miimon=100`**.
   - The **`LW_NAME`** variable specifies the link watch method. The bonding driver can check the availability of a link using one of two methods; one, by using some generic ioctls, or by using the NIC driver's internal **`netif_carrier_ok`** logic. When **`LW_NAME`** is set to **`ethtool`**, choose **`use_carrier=0`**; otherwise, choose **`use_carrier=1`**.
     When ethtool is used, the corresponding DELAY values can be translated to bonding options updelay; and downdelay, respectively.
     So with all of the above together, the first **`nmcli`** command would use bond-options **`mode=802.3ad,miimon=100,xmit_hash_policy=layer3+4,use_carrier=0,updelay=10,downdelay=10`**.

The resulting configuration is persistent, it activates whenever the system reboots.

PROCEDURE 7: ACTIVE-PASSIVE SETUPS USING MII MONITORING

1. This is another way of using is active-backup, where two or more Ethernet ports are used for redundancy in the face of network failures. Usually, each NIC is connected to a different switch in order to establish a separate network path. When the active link is failing, the connection will automatically fail over to the secondary port.
   A typical ifcfg file for a teaming based active-backup setup would look like this (excluding the BOOTPROTO, IPADDR settings and so on from the example given above).

```
TEAM_RUNNER="activebackup"
TEAM_LW_NAME="ethtool"
TEAM_PORT_DEVICE_0="eth0"
TEAM_PORT_DEVICE_1="eth3"
```

2. Run the following command to migrate configurations to NetworkManager based bonding connections.

   - The mode parameter needs to be set as **`mode=active-backup`**.
   - The link watch method chosen here is ethtool, which translated to **`miimon=100 use_carrier=0`**.

PROCEDURE 8: ACTIVE-PASSIVE SETUPS USING ARP FOR LINK MONITORING

1. The activebackup runner in teamd supports other link watch methods apart from ethtool; in particular, ARP pings. A typical configuration snippet would look like this:

```
TEAM_RUNNER="activebackup"
TEAM_LW_NAME="arp_ping"
TEAM_LW_ARP_PING_TARGET=10.1.2.3
TEAM_LW_ARP_PING_INTERVAL=60
```

2. This is translated to bond-options **`mode=active-backup arp_ip_target=10.1.2.3 arp_interval=60`**.
   Other link watch types supported by teams are not supported by the kernel bonding driver. In particular, if you are using **`nsna_ping`**, you need to change to using ARP pings.

PROCEDURE 9: MANAGING UNUSED INTERFACES

By default, NetworkManager manages all network interfaces available on the system. This may sometimes cause issues in some configurations. In this case, you can configure NetworkManager to not manage the NIC by adding them to **`/etc/NetworkManager/conf.d/unmanaged-devices.conf`**.

- To ignore eth1 completely,including across reboots, add the following content to **`/etc/NetworkManager/conf.d/unmanaged-devices.conf`**:

```
[keyfile]
unmanaged-devices=interface-name:eth1
```

5 Modifying network connections

You can use the **`nmcli connection modify`** command to modify network connections. The generic syntax of the command follows:

```
> sudo nmcli connection modify
      CONNECTION-NAME PROPERTY VALUE
```

To obtain the value of *`CONNECTION-NAME`*, list connections using the command: **`nmcli connection show`**. Available properties and their possible values are described in the following section.

5.1 Connections attributes

This section lists and describes attributes you can modify on connections:

TABLE 1: CONNECTIONS DETAILS

Property	Description	Values
ipv4.method	It defines how the interface obtains and handles its IPv4 address configuration	• `auto`—the default value used to allocate IP

Property	Description	Values
		addresses dynamically using DHCP • `manual`—to configure a static IP address You must set `ipv4.address1` if you set `ipv4.method` as `manual`. • `link-local`—to use IPv4 link-local addressing only (169.254.0.0/16) • `shared`—to share the connection with other computers • `disabled`—to disable IPv4.
ipv4.dns	A space separated list of DNS IP addresses	For example, "8.8.8.8 8.8.4.4"
ipv4.gateway	The property is the router address that your system uses to reach networks beyond your local network	An IP address of the gateway
connection.id	It renames the connection	a string representing the new connection name

Property	Description	Values
802-11-wireless.ssid	The property renames a Wi-Fi network	A string representing the new Wi-Fi SSID
connection.autoconnect	Toggles on/off automatic connection when the device is online	`on` or `off`

6 Establishing and terminating network connections

Enable the network connection to access and connect devices and resources.

6.1 Enabling network connections

Particular connections may be disabled, or all of the connections may be disabled. To activate all connections, run the command:

```
> sudo nmcli networking on
```

Bear in mind that the command does not activate manually disabled connections. To activate such a connection, proceed as described in the following procedure:

PROCEDURE 10: ACTIVATING AN EXISTING CONNECTION

1. View the list of existing connections:

   ```
   > sudo nmcli connection show
   ```

2. Enable a connection using the name or UUID:

   ```
   > sudo nmcli connection up uuid CONNECTION-UUID
   ```

3. Check the connection status:

   ```
   > sudo nmcli connection show --active
   ```

6.2 Disabling network connections

You can temporarily disconnect your system from external networks using the **`nmcli`** command to disable your network connection.

To disable a particular connection, proceed as described in the following procedure:

1. View the list of active connections:

```
> sudo nmcli connection show --active

NAME                UUID                                  TYPE      DEVICE
Wired connection 2  7b0c32ee-851e-3015-a658-f4372b426273  ethernet  enp6s0f3u1u4
lo                  8041ed2a-e4ae-4bf7-a0db-d4b513b9d745  loopback  lo
virbr0              1bec1271-4bb6-46a7-a50a-4b329fa318d3  bridge    virbr0
vnet0               ac196c81-0505-49f0-9328-b78e1746b4a9  tun       vnet0
```

2. Terminate a specific connection:

```
> sudo nmcli connection down CONNECTION-NAME/CONNECTION-UUID
```

For example:

```
> sudo nmcli connection down virbr0
```

To disable **all** connections temporarily, run:

```
> sudo nmcli networking off
```

Note: Temporal changes only

In both cases, the changes persist only till the system reboots. After reboot, NetworkManager and connections are active again.

7 Monitoring network connections

Use the **`nmcli`** command to view the status, activity and details of network connections managed by NetworkManager.

The following list provides commands for basic monitoring of network connections.

View the list of active connections

```
> nmcli connection show --active
```

View the status of NetworkManager

```
> nmcli monitor
```

The real-time updates about the network states and connections appear.

View details of a specific network connection

```
> nmcli connection monitor CONNECTION-NAME
```

Each time the connection changes, NetworkManager prints a line.

Monitor the status of network devices

```
> nmcli device monitor
```

The list of all network devices with device name, type, state and connection name appears.

View the signal strength of Wi-Fi connections

```
> nmcli device wifi list
```

The list of available Wi-Fi networks with SSID, signal strength (in %) and security type appears.

8 NetworkManager logging

NetworkManager activities are logged by the `journald` system logging mechanism. The NetworkManager logs are saved in `/var/log/syslog`, and you can access the details using the **`journalctl`** command.

The type of logged NetworkManager activities differs according to the current logging level. Available levels are described below:

- *ERR*—logs only error messages. For example, connection failures.
- *WARN*—logs warnings and errors. For example, authentication issues.
- *INFO*—logs informational messages. That is the default level for all logging domains.
- *DEBUG*—logs detailed debugging information. For example, detailed DHCP negotiations
- *TRACE*—logs very detailed, usually unimportant events. For example, packet-level details.

To check the current logging level, run:

```
> nmcli general logging
INFO    PLATFORM,RFKILL,ETHER,WIFI,BT,MB,DHCP4,DHCP6,PPP,IP4,IP6,AUTOIP4,DNS,VPN,SHARING,
SUPPLICANT,AGENTS,SETTINGS,SUSPEND,CORE,DEVICE,OLPC,INFINIBAND,FIREWALL,ADSL,BOND,VLAN,
BRIDGE,TEAM,CONCHECK,DCB,DISPATCH,AUDIT,SYSTEMD,PROXY
```

The output shows that the logging level is INFO for all domains—that is the default setting. You can modify logging levels on particular domains and then the command outputs only the modified domains.

To change the logging level on all domains, run:

```
> sudo general logging level LEVEL domains ALL
```

For example, to revert changes to the default setting:

```
> sudo nmcli general logging level INFO domains ALL
```

To change a logging level on particular domains, for example, to set `DEBUG` on `DNS` and `FIREWALL`, run:

```
> sudo nmcli general logging level DEBUG domains FIREWALL,DNS
```

The following list provides commands to manage NetworkManager logs using **`journald`**.

MANAGING NETWORKMANAGER LOGS

Viewing logs

To view the NetworkManager logs

```
> sudo journalctl -u NetworkManager
```

To view the NetworkManager logs in real time:

```
> sudo journalctl -u NetworkManager -f
```

To view only specific logs, use **`grep`** to filter the **`journalctl`** output. For example, for log related to DHCP, run:

```
> sudo journalctl -u NetworkManager | grep DHCP
```

Saving logs

To save NetworkManager logs to a file, for example, to `networkmanager.log`:

```
> sudo journalctl -u NetworkManager > networkmanager.log
```

To save the NetworkManager logs of a specific time to a file, for example, to `networkmanager_timerange.log`:

```
> sudo journalctl -u NetworkManager --since "YYYY-MM-DD HH:MM:SS" --until "YYYY-MM-DD HH:MM:SS" > networkmanager_timerange.log
```

To save the NetworkManager logs with real-time monitoring and save them as and when generated:

```
> sudo journalctl -u NetworkManager -f >> live_networkmanager.log
```

9 The **nmcli** command reference

This section provides a summary of options and subcommands of the **nmcli** command you can use to interact with NetworkManager daemon to manage the network.

The **nmcli** command has the following generic syntax:

```
# nmcli OPTIONS SUBCOMMAND SUBCOMMAND_ARGUMENTS
```

where *OPTIONS* are described in *Section 9.1, "The **nmcli** command options"* and *SUBCOMMAND* can be any of the following:

connection
: enables you to configure your network connection. For details, refer to *Section 9.2, "The **connection** subcommand"*.

device
: used for network device management. For details, refer to *Section 9.3, "The **device** subcommand"*.

general
: shows status and permissions. For details refer to *Section 9.4, "The **general** subcommand"*.

monitor
: monitors activity of NetworkManager and watches for changes in the state of connectivity and devices. This subcommand does not take any arguments.

networking
: queries the networking status. For details, refer to *Section 9.5, "The **networking** subcommand"*.

9.1 The **nmcli** command options

Besides the subcommands and their arguments, the **nmcli** command can take the following options:

`-a|--ask`
: The command stops its run to ask for any missing arguments, for example, for a password to connect to a network.

`-c|--color {yes|no|auto}`

controls the color output: `yes` to enable the colors, `no` to disable them, and `auto` creates color output only when the standard output is directed to a terminal.

`-m|--mode {tabular|multiline}`

switches between `tabular` (each line describes a single entry, columns define particular properties of the entry) and `multiline` (each entry comprises more lines, each property is on its own line). `tabular` is the default value.

`-h|--help`

prints help.

`-w|--wait seconds`

sets a time-out period for which to wait for NetworkManager to finish operations. Using this option is recommended for commands that might take longer to complete, for example, connection activation.

9.2 The **`connection`** subcommand

The **`connection`** command enables you to manage connections or view any information about particular connections. The **`nmcli connection`** provides the following commands to manage your network connections:

`show`

to list connections:

```
> nmcli connection show
```

You can also use this command to show details about a specified connection:

```
> nmcli connection show CONNECTION_ID
```

where *`CONNECTION_ID`* is any of the identifiers: *a connection name, UUID or a path*

`up`

to activate the provided connection. Use the command to reload a connection. Also run this command after you perform any change to the connection.

```
> sudo nmcli connection up [--active] [CONNECTION_ID]
```

When `--active` is specified, only the active profiles are displayed. The default is to display both active connections and static configuration.

down

to deactivate a connection.

```
> sudo nmcli connection down CONNECTION_ID
```

where: *CONNECTION_ID* is any of the identifiers: *a connection name, UUID or a path*
If you deactivate the connection, it will not reconnect later even if it has the `autoconnect` flag.

modify

to change or delete a property of a connection.

```
> sudo nmcli connection modify CONNECTION_ID SETTING.PROPERTY PROPERTY_VALUE
```

where:

- *CONNECTION_ID* is any of the identifiers: *a connection name, UUID, or a path*
- *SETTING.PROPERTY* is the name of the property, for example, `ipv4.addresses`
- *PROPERTY_VALUE* is the desired value of *SETTING.PROPERTY*

The following example deactivates the `autoconnect` option on the `ethernet1` connection:

```
> sudo nmcli connection modify ethernet1 connection.autoconnect no
```

add

to add a connection with the provided details. The command syntax is similar to the **modify** command:

```
> sudo nmcli connection add CONNECTION_ID save YES|
NO SETTING.PROPERTY PROPERTY_VALUE
```

You should at least specify a `connection.type` or use `type`. The following example adds an Ethernet connection tied to the `eth0` interface with DHCP and disables the connection's `autoconnect` flag:

```
> sudo nmcli connection add type ethernet autoconnect no ifname eth0
```

edit

to edit an existing connection using an interactive editor.

```
> sudo nmcli connection edit CONNECTION_ID
```

clone

to clone an existing connection. The minimal syntax follows:

```
> sudo nmcli connection clone CONNECTION_ID NEW_NAME
```

where *CONNECTION_ID* is the connection to be cloned.

delete

to delete an existing connection:

```
> sudo nmcli connection delete CONNECTION_ID
```

monitor

to monitor the provided connection. Each time the connection changes, NetworkManager prints a line.

```
> sudo nmcli connection monitor CONNECTION_ID
```

reload

to reload all connection files from the disk. As NetworkManager does not monitor changes performed to the connection files, you need to use this command whenever you make changes to the files. This command does not take any further subcommands.

load

to load/reload a particular connection file, run:

```
> sudo nmcli connection load CONNECTION_FILE
```

For details about the above-mentioned commands, refer to the **nmcli** documentation (https://networkmanager.dev/docs/api/latest/nmcli.html).

9.3 The **device** subcommand

The **device** subcommand enables you to show and manage network interfaces. The **nmcli device** command recognizes the following commands:

status

to print the status of all devices.

```
> nmcli device status
```

show

shows detailed information about a device. If no device is specified, all devices are displayed.

```
> mcli device show [DEVICE_NAME]
```

connect

to connect a device. NetworkManager tries to find a suitable connection to activate. If there is no compatible connection, a new profile is created.

```
> sudo nmcli device connect DEVICE_NAME
```

modify

performs temporary changes to the configuration that is active on the particular device. The changes are not stored in the connection profile.

```
> sudo nmcli device modify DEVICE_NAME [+|-] SETTING.PROPERTY VALUE
```

For possible *SETTING.PROPERTY* values, refer to *nm-settings-nmcli(5)*.

The example below starts the IPv4 shared connection sharing on the device `con1`.

```
> sudo nmcli dev modify con1 ipv4.method shared
```

disconnect

disconnects a device and prevents the device from automatically activating further connections without manual intervention.

```
> sudo nmcli device disconnect DEVICE_NAME
```

delete

to delete the interface from the system. You can use the command to delete only software devices like bonds and bridges. You cannot delete hardware devices with this command.

```
> sudo nmcli device delete DEVICE_NAME
```

wifi

lists all available access points.

```
> nmcli device wifi
```

wifi connect

connects to a Wi-Fi network specified by its SSID or BSSID. The command takes the following options:

- `password` - password for secured networks
- `ifname` - interface used for activation
- `name` - you can give the connection a name

```
> sudo nmcli device wifi connect SSID [password PASSWORD_VALUE]
 [ifname INTERFACE_NAME]
```

To connect to a Wi-Fi *GUESTWiFi* with a password `pass$word2#@@`, run:

```
> sudo nmcli device wifi connect GUESTWiFi password pass$word2#@@
```

9.4 The **general** subcommand

You can use this command to view NetworkManager status and permissions, and change the host name and logging level. The **`nmcli general`** recognizes the following commands:

`status`

displays the overall status of NetworkManager. Whenever you do not specify a command to the **`nmcli general`** command, status is used by default.

```
> nmcli general status
```

`hostname`

if you do not provide a new host name as an argument, the current host name is displayed. If you specify a new host name, the value is used to set a new host name.

```
> sudo nmcli general hostname [HOSTNAME]
```

For example, to set `MyHostname`, run:

```
> sudo nmcli general hostname MyHostname
```

`permissions`

shows your permission for NetworkManager operations like enabling or disabling networking, modifying connections, etc.

```
> nmcli general permissions
```

`logging`

shows and changes NetworkManager logging levels and domains. Without any arguments, the command displays current logging levels and domains.

```
> sudo nmcli general logging [level LEVEL domains DOMAIN]
```

`LEVEL` is any of the values: `OFF`, `ERR`, `WARN`, `INFO`, `DEBUG`, or `TRACE`.
`DOMAIN` is a list of values that can be as follows: `PLATFORM, RFKILL, ETHER, WIFI, BT, MB, DHCP4, DHCP6, PPP, WIFI_SCAN, IP4, IP6, AUTOIP4, DNS, VPN, SHARING, SUPPLICANT, AGENTS, SETTINGS, SUSPEND, CORE, DEVICE, OLPC, WIMAX, INFINIBAND, FIREWALL, ADSL, BOND, VLAN, BRIDGE, DBUS_PROPS, TEAM, CONCHECK, DCB, DISPATCH, AUDIT, SYSTEMD, VPN_PLUGIN, PROXY`.

9.5 The `networking` subcommand

The subcommand enables you to query the status of the network. Also, by using this command, you can enable or disable networking. The **`nmcli networking`** command takes the following commands:

`on/off`

enables or disables networking. The **`off`** command deactivates all interfaces managed by NetworkManager.

```
> sudo nmcli networking on
```

connectivity

displays the network connectivity state. If `check` is used, NetworkManager performs a new check of the state. Otherwise, the last detected state is displayed.

```
> nmcli networking connectivity
```

Possible states are the following:

- *none* - the host is not connected to any network.
- *portal* - the host is behind a captive portal and cannot reach the full Internet.
- *limited* - the host is connected to a network, but it has no access to the Internet.
- *full* - the host is connected to a network and has full access to the Internet.
- *unknown* - NetworkManager could not determine the network state.

10 Troubleshooting

Learn how to debug and troubleshoot NetworkManager installation and configuration issues.

10.1 Network is not running

If the network is not working, this may be caused by NetworkManager itself. To check that, proceed as follows:

1. Check that NetworkManager is enabled and active:

```
> sudo systemctl status network
```

2. If NetworkManager is disabled, enable it:

```
> sudo systemctl enable NetworkManager
```

3. If NetworkManager is inactive, restart it:

```
> sudo restart NetworkManager
```

10.2 Wi-Fi connectivity issue

If you are experiencing problems with Wi-Fi connectivity, proceed as described below:

1. View the list of Wi-Fi connections:

```
> sudo nmcli device wifi list
```

2. If a particular device is listed, make sure its Wi-Fi connection is active:

```
> sudo nmcli connection show --active
```

3. If the Wi-Fi connection is not listed, verify the Wi-Fi status:

```
> sudo nmcli device status
```

   a. If the status is `disconnected`, activate the connection.

```
> sudo nmcli connection up CONNECTION_NAME
```

   b. If the status is `unavailable`, restart NetworkManager:

```
> sudo systemctl restart NetworkManager
```

4. Inspect the NetworkManager logs for error messages.

```
> sudo journalctl -u NetworkManager -n 100
```

5. The Wi-Fi device may be blocked:

   a. Check if the device is blocked:

```
> sudo rfkill list

phy0: Wireless LAN
```

```
Soft blocked: yes
Hard blocked: no
```

b. Unblock the device:

```
> sudo rfkill unblock all
```

6. IPv4 static address may be configured incorrectly, to check that, reset to use DHCP:

```
> sudo nmcli connection modify SSID ipv4.method auto
```

7. Try to activate the connection again:

```
> sudo nmcli connection up SSID
```

8. Try to reconnect to the Wi-Fi network:

```
> sudo nmcli device wifi connect SSID password PASSWORD
```

10.3 Network bonding issues

To troubleshoot network bonding issues, verify connection status, check the bonding interface's status, and restart network services using the **`nmcli`** command.

PROCEDURE 11: NETWORK BONDING TROUBLESHOOTING

1. List and view status of connections:

```
nmcli connection status
```

2. Check the status of network devices, including the bonded interface.

```
nmcli device status
```

3. Check the bonding interface status in `/proc/net/bonding/bond0`
   This file provides information about the bonding mode, active slaves, and other relevant details.

4. If the connections are inactive, activate the connections:

```
nmcli con up connectionname
```

5. Modify the connection if required.

```
nmcli con edit connectionname
```

6. Restart the connection.

```
> sudo  nmcli connection up bond0
```

10.4 Network teaming issues

Verify the error messages related to network teaming in `/var/log/messages`.

You can troubleshoot network teaming issues by analyzing the devices and team connection details, enabling the device if it is disabled, and modifying the bonding mode if required. After making any changes, reload the network team connection and restart NetworkManager.

PROCEDURE 12: NETWORK TEAMING TROUBLESHOOTING

1. View the list of devices:

```
nmcli device
```

2. View the team connection details:

```
nmcli connection show teamname
```

3. Enable interface:

```
nmcli connection modify teamname bond.options "mode=active-backup"
```

4. Reload the network team connection:

```
nmcli connection reload teamname
```

5. Restart the NetworkManager.

```
> sudo systemctl restart NetworkManager.service
```

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