Ubuntu Server documentation

Ubuntu Server is a version of the Ubuntu operating system designed and engineered as a backbone for the internet.

Ubuntu Server brings economic and technical scalability to your datacentre, public or private. Whether you want to deploy an OpenStack cloud, a Kubernetes cluster or a 50,000-node render farm, Ubuntu Server delivers the best value scale-out performance available.

Introduction

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In this documentation

Tutorials Get started - a hands-on introduction to Ubuntu Server for new users	How-to guides Step-by-step guides covering key operations and common tasks
Explanation Concepts - discussion and clarification of key topics	Reference Technical information - package specifications, APIs, architecture

Project and community

Ubuntu Server is a member of the Ubuntu family. It's an open source project that welcomes community projects, contributions, suggestions, fixes and constructive feedback.

If you find any errors or have suggestions for improvements to pages, please use the link at the bottom of each topic titled: "Help improve this document in the forum." This link will take you to the Server Discourse forum for the specific page you are viewing. There you can share your comments or let us know about bugs with any page.

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Thinking about using Ubuntu Server for your next project? Get in touch!

PDFs and previous releases

Below are links to the previous Ubuntu Server release server guides as well as an offline copy of the current version of this site:

Ubuntu 20.04 LTS (Focal Fossa) and later: PDF
Ubuntu 18.04 LTS (Bionic Beaver): Web and PDF

Basics

This section is dedicated to the basic tasks we can perform in ubuntu Linux

Basics

How to add user in Ubuntu Lniux

Ubuntu-logo.png

At some point in your Ubuntu Linux server or desktop administration journey, you will need to create a user. Usually, we create users in the servers for administration on more than one person or a service account that needs to be created in order for the service to only run as that user. This creates a security barrier in the services you run.
Here we have steps on how to complete this function. Follow the instructions and if you encounter an error, please email support.

> **This tutorial assumes that:**
> You know the IP address of the machine intended for changes, and
> can Login the machine with **Telnet**, **Serial** or, **SSH**

> **Note:**
> Only "sudo" can create a user, So, the first thing we have to do is check if the user you login with is a "sudo".
> Check with the command `sudo -l`

1. Check "sudo" privileges by running `sudo -l`

code:

```
mslsadmin@remote01:~$ sudo -l
[sudo] password for mslsadmin:
Matching Defaults entries for mslsadmin on remote01:
    env_reset, mail_badpass,
secure_path=/usr/local/sbin\:/usr/local/bin\:/usr/sbin\:/usr/bin\:/sbin\:/bin
```

```
\:/snap/bin, use_pty

User mslsadmin may run the following commands on remote01:
    (ALL : ALL) ALL
mslsadmin@remote01:~$
```

2. Use the `sudo adduser` command to add the new user and follow the prompt:

code:

```
mslsadmin@remote01:~$ sudo adduser test
Adding user `test' ...
Adding new group `test' (1001) ...
Adding new user `test' (1001) with group `test' ...
Creating home directory `/home/test' ...
Copying files from `/etc/skel' ...
```

3. Continue the prompt and create a password for the new user :

code:

```
New password: ****
Retype new password:*******
passwd: password updated successfully
Changing the user information for test
```

> note:
> While entering the password you might not see that keys are actually being entered. This is completely normal and may differ from other Linux distributions or console applications.

4. Next the `adduser` prompt will ask you for more information about the user, Enter relevant information or, if you want to skip the prompt, leave the options blank and press ENTER.

code:

```
Changing the user information for test
Enter the new value, or press ENTER for the default
        Full Name []: Test User
        Room Number []:
        Work Phone []:
        Home Phone []: d
        Other []:
```

5. Confirm your changes and choose "Y"

code:

```
Is the information correct? [Y/n] Y
```

Congratulations! You successfully created an user in Ubuntu Linux

Basics

Install Docker Engine on Ubuntu

To get started with Docker Engine on Ubuntu, make sure you meet the prerequisites, and then follow the installation steps.

Prerequisites

> **Note**
>
> *If you use ufw or firewalld to manage firewall settings, be aware that when you expose container ports using Docker, these ports bypass your firewall rules. For more information, refer to Docker and ufw.*

OS requirements

To install Docker Engine, you need the 64-bit version of one of these Ubuntu versions:

- Ubuntu Lunar 23.04
- Ubuntu Kinetic 22.10
- Ubuntu Jammy 22.04 (LTS)
- Ubuntu Focal 20.04 (LTS)

Docker Engine for Ubuntu is compatible with x86_64 (or amd64), armhf, arm64, s390x, and ppc64le (ppc64el) architectures.

Uninstall old versions

Before you can install Docker Engine, you must first make sure that any conflicting packages are uninstalled.

Distro maintainers provide an unofficial distributions of Docker packages in APT. You must uninstall these packages before you can install the official version of Docker Engine.

The unofficial packages to uninstall are:

- `docker.io`
- `docker-compose`
- `docker-doc`
- `podman-docker`

Moreover, Docker Engine depends on `containerd` and `runc`. Docker Engine bundles these dependencies as one bundle: `containerd.io`. If you have installed the `containerd` or `runc` previously, uninstall them to avoid conflicts with the versions bundled with Docker Engine.

Run the following command to uninstall all conflicting packages:

```
$ for pkg in docker.io docker-doc docker-compose podman-docker containerd
runc; do sudo apt-get remove $pkg; done
```

`apt-get` might report that you have none of these packages installed.

Images, containers, volumes, and networks stored in `/var/lib/docker/` aren't automatically removed when you uninstall Docker. If you want to start with a clean installation, and prefer to clean up any existing data, read the uninstall Docker Engine section.

Installation methods

You can install Docker Engine in different ways, depending on your needs:

- Docker Engine comes bundled with Docker Desktop for Linux. This is the easiest and quickest way to get started.
- Set up and install Docker Engine from Docker's `apt` repository.
- Install it manually and manage upgrades manually.
- Use a convenience script. Only recommended for testing and development environments.

Install using the apt repository

Before you install Docker Engine for the first time on a new host machine, you need to set up the Docker repository. Afterward, you can install and update Docker from the repository.

Set up the repository

1. Update the `apt` package index and install packages to allow `apt` to use a repository over HTTPS:

```
$ sudo apt-get update
$ sudo apt-get install ca-certificates curl gnupg
```

2. Add Docker's official GPG key:

```
$ sudo install -m 0755 -d /etc/apt/keyrings
$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg
--dearmor -o /etc/apt/keyrings/docker.gpg
$ sudo chmod a+r /etc/apt/keyrings/docker.gpg
```

3. Use the following command to set up the repository:

```
$ echo \
  "deb [arch="$(dpkg --print-architecture)" signed-
by=/etc/apt/keyrings/docker.gpg]
https://download.docker.com/linux/ubuntu \
  "$(. /etc/os-release && echo "$VERSION_CODENAME")" stable" | \
  sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
```

> **Note**
>
> *If you use an Ubuntu derivative distro, such as Linux Mint, you may need to use `UBUNTU_CODENAME` instead of `VERSION_CODENAME`.*

4. Update the `apt` package index:

```
$ sudo apt-get update
```

Install Docker Engine

1. Install Docker Engine, containerd, and Docker Compose.

To install the latest version, run:

```
$ sudo apt-get install docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
```

---

2. Verify that the Docker Engine installation is successful by running the `hello-world` image.

   ```
   $ sudo docker run hello-world
   ```

   This command downloads a test image and runs it in a container. When the container runs, it prints a confirmation message and exits.

You have now successfully installed and started Docker Engine.

> **Tip**
>
> *Receiving errors when trying to run without root?*
>
> *The `docker` user group exists but contains no users, which is why you're required to use `sudo` to run Docker commands. Continue to Linux postinstall to allow non-privileged users to run Docker commands and for other optional configuration steps.*

Upgrade Docker Engine

To upgrade Docker Engine, follow the installation instructions, choosing the new version you want to install.

Install from a package

If you can't use Docker's `apt` repository to install Docker Engine, you can download the `deb` file for your release and install it manually. You need to download a new file each time you want to upgrade Docker Engine.

1. Go to `https://download.docker.com/linux/ubuntu/dists/`open_in_new.
2. Select your Ubuntu version in the list.
3. Go to `pool/stable/` and select the applicable architecture (`amd64`, `armhf`, `arm64`, or `s390x`).
4. Download the following `deb` files for the Docker Engine, CLI, containerd, and Docker Compose packages:
   1. `containerd.io_<version>_<arch>.deb`
   2. `docker-ce_<version>_<arch>.deb`
   3. `docker-ce-cli_<version>_<arch>.deb`
   4. `docker-buildx-plugin_<version>_<arch>.deb`
   5. `docker-compose-plugin_<version>_<arch>.deb`
5. Install the `.deb` packages. Update the paths in the following example to where you downloaded the Docker packages.

   ```
   $ sudo dpkg -i ./containerd.io_<version>_<arch>.deb \
     ./docker-ce_<version>_<arch>.deb \
     ./docker-ce-cli_<version>_<arch>.deb \
     ./docker-buildx-plugin_<version>_<arch>.deb \
     ./docker-compose-plugin_<version>_<arch>.deb
   ```

   The Docker daemon starts automatically.
6. Verify that the Docker Engine installation is successful by running the `hello-world` image.

   ```
   $ sudo service docker start
   $ sudo docker run hello-world
   ```

This command downloads a test image and runs it in a container. When the container runs, it prints a confirmation message and exits.

You have now successfully installed and started Docker Engine.

> **Tip**
>
> *Receiving errors when trying to run without root?*
>
> *The `docker` user group exists but contains no users, which is why you're required to use `sudo` to run Docker commands. Continue to Linux postinstall to allow non-privileged users to run Docker commands and for other optional configuration steps.*

Upgrade Docker Engine

To upgrade Docker Engine, download the newer package files and repeat the installation procedure, pointing to the new files.

Install using the convenience script

Docker provides a convenience script at https://get.docker.com/open_in_new to install Docker into development environments non-interactively. The convenience script isn't recommended for production environments, but it's useful for creating a provisioning script tailored to your needs. Also refer to the install using the repository steps to learn about installation steps to install using the package repository. The source code for the script is open source, and you can find it in the `docker-install` repository on GitHubopen_in_new.

Always examine scripts downloaded from the internet before running them locally. Before installing, make yourself familiar with potential risks and limitations of the convenience script:

- The script requires `root` or `sudo` privileges to run.
- The script attempts to detect your Linux distribution and version and configure your package management system for you.
- The script doesn't allow you to customize most installation parameters.
- The script installs dependencies and recommendations without asking for confirmation. This may install a large number of packages, depending on the current configuration of your host machine.
- By default, the script installs the latest stable release of Docker, containerd, and runc. When using this script to provision a machine, this may result in unexpected major version upgrades of Docker. Always

test upgrades in a test environment before deploying to your production systems.

- The script isn't designed to upgrade an existing Docker installation. When using the script to update an existing installation, dependencies may not be updated to the expected version, resulting in outdated versions.

> *Tip: preview script steps before running*
>
> *You can run the script with the `--dry-run` option to learn what steps the script will run when invoked:*
>
> ```
> $ curl -fsSL https://get.docker.com -o get-docker.sh
> $ sudo sh ./get-docker.sh --dry-run
> ```

This example downloads the script from https://get.docker.com/open_in_new and runs it to install the latest stable release of Docker on Linux:

```
$ curl -fsSL https://get.docker.com -o get-docker.sh
$ sudo sh get-docker.sh
Executing docker install script, commit:
7cae5f8b0decc17d6571f9f52eb840fbc13b2737
<...>
```

You have now successfully installed and started Docker Engine. The `docker` service starts automatically on Debian based distributions. On `RPM` based distributions, such as CentOS, Fedora, RHEL or SLES, you need to start it manually using the appropriate `systemctl` or `service` command. As the message indicates, non-root users can't run Docker commands by default.

> ***Use Docker as a non-privileged user, or install in rootless mode?***
>
> *The installation script requires `root` or `sudo` privileges to install and use Docker. If you want to grant non-root users access to Docker, refer to the post-installation steps for Linux. You can also install Docker without `root` privileges, or configured to run in rootless mode. For instructions on running Docker in rootless mode, refer to run the Docker daemon as a non-root user (rootless mode).*

Install pre-releases

Docker also provides a convenience script at https://test.docker.com/open_in_new to install pre-releases of Docker on Linux. This script is equal to the script at `get.docker.com`, but configures your package manager to use the test channel of the Docker package repository. The test channel includes both stable and pre-releases (beta versions, release-candidates) of Docker. Use this script to get early access to new releases, and to evaluate them in a testing environment before they're released as stable.

To install the latest version of Docker on Linux from the test channel, run:

```
$ curl -fsSL https://test.docker.com -o test-docker.sh
$ sudo sh test-docker.sh
```

Upgrade Docker after using the convenience script

If you installed Docker using the convenience script, you should upgrade Docker using your package manager directly. There's no advantage to re-running the convenience script. Re-running it can cause issues if it attempts to re-install repositories which already exist on the host machine.

Uninstall Docker Engine

1. Uninstall the Docker Engine, CLI, containerd, and Docker Compose packages:

   ```
   $ sudo apt-get purge docker-ce docker-ce-cli containerd.io docker-
   buildx-plugin docker-compose-plugin docker-ce-rootless-extras
   ```

2. Images, containers, volumes, or custom configuration files on your host aren't automatically removed.
   To delete all images, containers, and volumes:

```
$ sudo rm -rf /var/lib/docker
$ sudo rm -rf /var/lib/containerd
```

You have to delete any edited configuration files manually.

Configuring networks

Ubuntu ships with a number of graphical utilities to configure your network devices. This document is geared toward server administrators and will focus on managing your network on the command line.

Ethernet interfaces

Ethernet interfaces are identified by the system using predictable network interface names. These names can appear as *eno1* or *enp0s25*. However, in some cases an interface may still use the kernel *eth#* style of naming.

Identify Ethernet interfaces

To quickly identify all available Ethernet interfaces, you can use the ip command as shown below.

```
ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group
default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s25: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
group default qlen 1000
    link/ether 00:16:3e:e2:52:42 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.102.66.200/24 brd 10.102.66.255 scope global dynamic eth0
       valid_lft 3257sec preferred_lft 3257sec
    inet6 fe80::216:3eff:fee2:5242/64 scope link
       valid_lft forever preferred_lft forever
```

Another application that can help identify all network interfaces available to your system is the `lshw` command. This command provides greater details around the hardware capabilities of specific adapters. In the example below, `lshw` shows a single Ethernet interface with the logical name of *eth4* along with bus information, driver details and all supported capabilities.

```
sudo lshw -class network
  *-network
       description: Ethernet interface
       product: MT26448 [ConnectX EN 10GigE, PCIe 2.0 5GT/s]
       vendor: Mellanox Technologies
       physical id: 0
       bus info: pci@0004:01:00.0
       logical name: eth4
       version: b0
       serial: e4:1d:2d:67:83:56
       slot: U78CB.001.WZS09KB-P1-C6-T1
       size: 10Gbit/s
       capacity: 10Gbit/s
       width: 64 bits
       clock: 33MHz
       capabilities: pm vpd msix pciexpress bus_master cap_list ethernet
physical fibre 10000bt-fd
       configuration: autonegotiation=off broadcast=yes driver=mlx4_en
driverversion=4.0-0 duplex=full firmware=2.9.1326 ip=192.168.1.1 latency=0
link=yes multicast=yes port=fibre speed=10Gbit/s
       resources: iomemory:24000-23fff irq:481 memory:3fe200000000-
3fe2000fffff memory:240000000000-240007ffffff
```

Ethernet Interface logical names

Interface logical names can also be configured via a Netplan configuration. If you would like control which interface receives a particular logical name use the `match` and `set-name` keys. The `match` key is used to find an adapter based on some criteria like MAC address, driver, etc. The `set-name` key can be used to change the device to the desired logical name.

```
network:
  version: 2
  renderer: networkd
  ethernets:
    eth_lan0:
      dhcp4: true
      match:
        macaddress: 00:11:22:33:44:55
      set-name: eth_lan0
```

Ethernet Interface settings

`ethtool` is a program that displays and changes Ethernet card settings such as auto-negotiation, port speed, duplex mode, and Wake-on-LAN. The following is an example of how to view the supported features and configured settings of an Ethernet interface.

```
sudo ethtool eth4
Settings for eth4:
    Supported ports: [ FIBRE ]
    Supported link modes:   10000baseT/Full
    Supported pause frame use: No
    Supports auto-negotiation: No
    Supported FEC modes: Not reported
    Advertised link modes:  10000baseT/Full
    Advertised pause frame use: No
    Advertised auto-negotiation: No
    Advertised FEC modes: Not reported
    Speed: 10000Mb/s
    Duplex: Full
    Port: FIBRE
    PHYAD: 0
    Transceiver: internal
    Auto-negotiation: off
    Supports Wake-on: d
    Wake-on: d
    Current message level: 0x00000014 (20)
                   link ifdown
    Link detected: yes
```

IP addressing

The following section describes the process of configuring your system's IP address and default gateway needed for communicating on a local area network and the Internet.

Temporary IP address assignment

For temporary network configurations, you can use the `ip` command which is also found on most other GNU/Linux operating systems. The `ip` command allows you to configure settings which take effect immediately – however they are not persistent and will be lost after a reboot.

To temporarily configure an IP address, you can use the `ip` command in the following manner. Modify the IP address and subnet mask to match your network requirements.

```
sudo ip addr add 10.102.66.200/24 dev enp0s25
```

The `ip` can then be used to set the link up or down.

```
ip link set dev enp0s25 up
ip link set dev enp0s25 down
```

To verify the IP address configuration of `enp0s25`, you can use the `ip` command in the following manner:

```
ip address show dev enp0s25
10: enp0s25: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state
UP group default qlen 1000
    link/ether 00:16:3e:e2:52:42 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.102.66.200/24 brd 10.102.66.255 scope global dynamic eth0
       valid_lft 2857sec preferred_lft 2857sec
    inet6 fe80::216:3eff:fee2:5242/64 scope link
       valid_lft forever preferred_lft forever6
```

To configure a default gateway, you can use the `ip` command in the following manner. Modify the default gateway address to match your network requirements.

```
sudo ip route add default via 10.102.66.1
```

You can also use the `ip` command to verify your default gateway configuration, as follows:

```
ip route show
default via 10.102.66.1 dev eth0 proto dhcp src 10.102.66.200 metric 100
10.102.66.0/24 dev eth0 proto kernel scope link src 10.102.66.200
10.102.66.1 dev eth0 proto dhcp scope link src 10.102.66.200 metric 100
```

If you require DNS for your temporary network configuration, you can add DNS server IP addresses in the file `/etc/resolv.conf`. In general, editing `/etc/resolv.conf` directly is not recommended, but this is a temporary and non-persistent configuration. The example below shows how to enter two DNS servers to `/etc/resolv.conf`, which should be changed to servers appropriate for your network. A more lengthy description of the proper

(persistent) way to do DNS client configuration is in a following section.

```
nameserver 8.8.8.8
nameserver 8.8.4.4
```

If you no longer need this configuration and wish to purge all IP configuration from an interface, you can use the `ip` command with the flush option:

```
ip addr flush eth0
```

> ***Note***
> *Flushing the IP configuration using the `ip` command does not clear the contents of `/etc/resolv.conf`. You must remove or modify those entries manually (or re-boot), which should also cause `/etc/resolv.conf`, which is a symlink to `/run/systemd/resolve/stub-resolv.conf`, to be re-written.*

Dynamic IP address assignment (DHCP client)

To configure your server to use DHCP for dynamic address assignment, create a Netplan configuration in the file `/etc/netplan/99_config.yaml`. The following example assumes you are configuring your first Ethernet interface identified as `enp3s0`.

```
network:
  version: 2
  renderer: networkd
  ethernets:
    enp3s0:
      dhcp4: true
```

The configuration can then be applied using the `netplan` command:

```
sudo netplan apply
```

Static IP address assignment

To configure your system to use static address assignment, create a `netplan` configuration in the file `/etc/netplan/99_config.yaml`. The example below assumes you are configuring your first Ethernet interface identified as `eth0`. Change the `addresses`, `routes`, and `nameservers` values to meet the requirements of your network.

```
network:
  version: 2
  renderer: networkd
  ethernets:
    eth0:
      addresses:
        - 10.10.10.2/24
      routes:
        - to: default
          via: 10.10.10.1
      nameservers:
          search: [mydomain, otherdomain]
          addresses: [10.10.10.1, 1.1.1.1]
```

The configuration can then be applied using the `netplan` command.

```
sudo netplan apply
```

> **NOTE**
>
> *`netplan` in Ubuntu Bionic 18.04 LTS doesn't understand the "`to: default`" syntax to specify a default route, and should use the older `gateway4: 10.10.10.1` key instead of the whole `routes:` block.*

The loopback interface is identified by the system as `lo` and has a default IP address of 127.0.0.1. It can be viewed using the `ip` command.

```
ip address show lo
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group
```

```
default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
```

Name resolution

Name resolution (as it relates to IP networking) is the process of mapping hostnames to IP addresses, and vice-versa, making it easier to identify resources on a network. The following section will explain how to properly configure your system for name resolution using DNS and static hostname records.

DNS client configuration

Traditionally, the file `/etc/resolv.conf` was a static configuration file that rarely needed to be changed, or it automatically changed via DCHP client hooks. `systemd-resolved` handles nameserver configuration, and it should be interacted with through the `systemd-resolve` command. Netplan configures `systemd-resolved` to generate a list of nameservers and domains to put in `/etc/resolv.conf`, which is a symlink:

```
/etc/resolv.conf -> ../run/systemd/resolve/stub-resolv.conf
```

To configure the resolver, add the IP addresses of the appropriate nameservers for your network to the `netplan` configuration file. You can also add optional DNS suffix search-lists to match your network domain names. The resulting file might look like the following:

```
network:
  version: 2
  renderer: networkd
  ethernets:
    enp0s25:
      addresses:
        - 192.168.0.100/24
      routes:
        - to: default
          via: 192.168.0.1
      nameservers:
```

```
            search: [mydomain, otherdomain]
            addresses: [1.1.1.1, 8.8.8.8, 4.4.4.4]
```

The *search* option can also be used with multiple domain names so that DNS queries will be appended in the order in which they are entered. For example, your network may have multiple sub-domains to search; a parent domain of `example.com`, and two sub-domains, `sales.example.com` and `dev.example.com`.

If you have multiple domains you wish to search, your configuration might look like the following:

```
network:
  version: 2
  renderer: networkd
  ethernets:
    enp0s25:
      addresses:
        - 192.168.0.100/24
      routes:
        - to: default
          via: 192.168.0.1
      nameservers:
          search: [example.com, sales.example.com, dev.example.com]
          addresses: [1.1.1.1, 8.8.8.8, 4.4.4.4]
```

If you try to ping a host with the name `server1`, your system will automatically query DNS for its Fully Qualified Domain Name (FQDN) in the following order:

1. `server1.example.com`
2. `server1.sales.example.com`
3. `server1.dev.example.com`

If no matches are found, the DNS server will provide a result of *notfound* and the DNS query will fail.

Static hostnames

Static hostnames are locally defined hostname-to-IP mappings located in the file `/etc/hosts`. Entries in the `hosts` file will have precedence over DNS by default. This means that if your system tries to resolve a hostname and it matches an entry in `/etc/hosts`, it will not attempt to look up the record in DNS. In some configurations, especially when Internet access is not required, servers that communicate with a limited number of resources can be conveniently set to use static hostnames instead of DNS.

The following is an example of a `hosts` file where a number of local servers have been identified by simple hostnames, aliases and their equivalent Fully Qualified Domain Names (FQDN's):

```
127.0.0.1   localhost
127.0.1.1   ubuntu-server
10.0.0.11   server1 server1.example.com vpn
10.0.0.12   server2 server2.example.com mail
10.0.0.13   server3 server3.example.com www
10.0.0.14   server4 server4.example.com file
```

> **Note**
> *In this example, notice that each of the servers were given aliases in addition to their proper names and FQDN's. Server1 has been mapped to the name vpn, server2 is referred to as mail, server3 as www, and server4 as file.*

Name Service Switch (NSS) configuration

The order in which your system selects a method of resolving hostnames to IP addresses is controlled by the Name Service Switch (NSS) configuration file `/etc/nsswitch.conf`. As mentioned in the previous section, typically static hostnames defined in the systems `/etc/hosts` file have precedence over names resolved from DNS. The following is an example of the line responsible for this order of hostname lookups in the file `/etc/nsswitch.conf`.

```
hosts:          files mdns4_minimal [NOTFOUND=return] dns mdns4
```

- **`files`** first tries to resolve static hostnames located in `/etc/hosts`.
- **`mdns4_minimal`** attempts to resolve the name using Multicast DNS.
- **`[NOTFOUND=return]`** means that any response of `notfound` by the preceding `mdns4_minimal` process should be treated as authoritative and that the system should not try to continue hunting for an answer.
- **`dns`** represents a legacy unicast DNS query.
- **mdns4** represents a multicast DNS query.

To modify the order of these name resolution methods, you can simply change the `hosts:` string to the value of your choosing. For example, if you prefer to use legacy unicast DNS versus multicast DNS, you can change the

string in `/etc/nsswitch.conf` as shown below:

```
hosts:          files dns [NOTFOUND=return] mdns4_minimal mdns4
```

Bridging multiple interfaces

Bridging is a more advanced configuration, but is very useful in multiple scenarios. One scenario is setting up a bridge with multiple network interfaces, then using a firewall to filter traffic between two network segments. Another scenario is using bridge on a system with one interface to allow virtual machines direct access to the outside network. The following example covers the latter scenario:

Configure the bridge by editing your `netplan` configuration found in `/etc/netplan/`, entering the appropriate values for your physical interface and network:

```
network:
  version: 2
  renderer: networkd
  ethernets:
    enp3s0:
      dhcp4: no
  bridges:
    br0:
      dhcp4: yes
      interfaces:
        - enp3s0
```

Now apply the configuration to enable the bridge:

```
sudo netplan apply
```

The new bridge interface should now be up and running. The `brctl` provides useful information about the state of the bridge, controls which interfaces are part of the bridge, etc. See `man brctl` for more information.

networkd-dispatcher for hook scripts

Users of the former `ifupdown` may be familiar with using hook scripts (e.g., pre-up, post-up) in their interfaces file. Netplan configuration does not currently support hook scripts in its configuration definition.

Instead, to achieve this functionality with the `networkd` renderer, users can use networkd-dispatcher. The package provides both users and packages with hook points when specific network states are reached, to aid in reacting to network state.

> ***Note**:*
> *If you are on Desktop (not Ubuntu Server) the network is driven by Network Manager - in that case you need NM Dispatcher scripts instead.*

The Netplan FAQ has a great table that compares event timings between `ifupdown`/`systemd-networkd`/`network-manager`.

It is important to be aware that these hooks run asynchronously; i.e. they will not block transition into another state.

The Netplan FAQ also has an example on converting an old `ifupdown` hook to `networkd-dispatcher`.

Resources

- The Ubuntu Wiki Network page has links to articles covering more advanced network configuration.
- The Netplan website has additional examples and documentation.
- The Netplan man page has more information on Netplan.
- The systemd-resolved man page has more information on systemd-resolved service.
- For more information on *bridging* see the netplan.io examples page

Tutorials

This section of our documentation contains step-by-step tutorials to help outline what Ubuntu Server is capable of while helping you achieve specific aims.

Basic installation

This chapter provides an overview of how to install Ubuntu Server Edition. You can also refer to this guide on how to operate the installer for more information on using the installer, and to this screen-by-screen reference guide for more information about each of the installer screens.

Preparing to install

This section explains various aspects to consider before starting the installation.

System requirements

Ubuntu Server Edition provides a common, minimalist base for a variety of server applications, such as file/print services, web hosting, email hosting, etc. This version supports four 64-bit architectures:

- amd64 (Intel/AMD 64-bit)
- arm64 (64-bit ARM)
- ppc64el (POWER8 and POWER9)
- s390x (IBM Z and LinuxONE)

The recommended system requirements are:

- CPU: 1 gigahertz or better
- RAM: 1 gigabyte or more
- Disk: a minimum of 2.5 gigabytes

Perform a system back up

Before installing Ubuntu Server Edition you should make sure all data on the system is backed up.

If this is not the first time an operating system has been installed on your computer, it is likely you will need to re-partition your disk to make room for Ubuntu.

Any time you partition your disk, you should be prepared to lose everything on the disk should you make a mistake or something goes wrong during partitioning. The programs used in installation are quite reliable, most have seen years of use, but they also perform destructive actions.

Download the server ISO

You can obtain the amd64 server download from https://releases.ubuntu.com/. Select the version you wish to install and select the “server install image” download. Note that the server download includes the installer.

There are platform specific how-to guides for installations on:

- s390x LPAR
- z/VM
- ppc64el

Create a bootable USB

There are many ways to boot the installer but the simplest and most common way is to create a bootable USB stick to boot the system to be installed with (tutorials for other operating systems are also available).

Boot the installer

Plug the USB stick into the system to be installed and start it.

Most computers will automatically boot from USB or DVD, though in some cases this is disabled to improve boot times. If you don’t see the boot message and the “Welcome” screen which should appear after it, you will need to set your computer to boot from the install media.

There should be an on-screen message when the computer starts telling you what key to press for settings or a boot menu. Depending on the manufacturer, this could be `Escape`, `F2`, `F10` or `F12`. Simply restart your computer and hold down this key until the boot menu appears, then select the drive with the Ubuntu install media.

If you are still having problems, check out the Ubuntu Community documentation on booting from CD/DVD.

After a few moments, the installer will start in its language selection screen.

Welcome screen of the Server installer showing the language selection options

Using the installer

The installer is designed to be easy to use and have sensible defaults so for a first install you can mostly just accept the defaults for the most straightforward install:

- Choose your language
- Update the installer (if offered)
- Select your keyboard layout
- Do not configure networking (the installer attempts to configure wired network interfaces via DHCP, but you can continue without networking if this fails)
- Do not configure a proxy or custom mirror unless you have to in your network
- For storage, leave “use an entire disk” checked, and choose a disk to install to, then select “Done” on the configuration screen and confirm the install
- Enter a username, hostname and password
- On the SSH and snap screens, select “Done”
- You will now see log messages as the install is completed
- Select restart when this is complete, and log in using the username and password provided

Tutorials

How to operate the Server installer

How to operate the Server installer

This document explains how to use the installer in general terms. For a step-by-step guide through the screens of the installer, you can use our screen-by-screen reference guide.

Get the installer

Installer images are made (approximately) daily and are available from https://cdimage.ubuntu.com/ubuntu-server/daily-live/current/. These are not tested as extensively as the images from release day, but they contain the latest packages and installer, so fewer updates will be required during or after installation.

You can download the server installer for amd64 from https://ubuntu.com/download/server and other architectures from http://cdimage.ubuntu.com/releases/20.04/release/.

Installer UI navigation

In general, the installer can be used with the `up` and `down` arrows and `space` or `Enter` keys and a little typing.

`Tab` and `Shift + Tab` move the focus down and up respectively. `Home` / `End` / `Page Up` / `Page Down` can be used to navigate through long lists more quickly in the usual way.

Running the installer over serial

By default, the installer runs on the first virtual terminal, `tty1`. This is what is displayed on any connected monitor by default. However, servers do not always have a monitor. Some out-of-band management systems provide a remote virtual terminal, but some times it is necessary to run the installer on the serial port. To do this, the kernel command line needs to have an appropriate console specified on it – a common value is `console=ttyS0` but this is not something that can be generically documented.

When running on serial, the installer starts in a basic mode that does using only the ASCII character set and black and white colours. If you are connecting from a terminal emulator such as gnome-terminal that supports Unicode and rich colours you can switch to “rich mode” which uses Unicode, colours and supports many languages.

Connecting to the installer over SSH

If the only available terminal is very basic, an alternative is to connect via SSH. If the network is up by the time the installer starts, instructions are offered on the initial screen in basic mode. Otherwise, instructions are available from the help menu once networking is configured.

In addition, connecting via SSH is assumed to be capable of displaying all Unicode characters, enabling more translations to be used than can be displayed on a virtual terminal.

Help menu

The help menu is always in the top right of the screen. It contains help – both general and for the currently displayed screen – and some general actions.

Switching to a shell prompt

You can switch to a shell at any time by selecting “Enter shell” from the help menu, or pressing `Control + Z` or `F2`.

If you are accessing the installer via `tty1`, you can also access a shell by switching to a different virtual terminal (`Control + Alt` + arrow, or `Control + Alt` + number keys, move between virtual terminals).

Global keys

There are some global keys you can press at any time:

KEY	ACTION

ESC	Go back
F1	Open help menu
Control + Z, F2	Switch to shell
Control + L, F3	Redraw screen
Control + T, F4	Toggle rich mode (colour, Unicode) on and off

Screen-by-screen installer guide

The installer is designed to be easy to use without the need to refer to documentation. However, this reference guide provides more information for each of the screens of the installer.

Language selection

welcome_c

This screen selects the language for the installer and the default language for the installed system.

More languages can be displayed if you connect via SSH.

Refresh

refresh

This screen is shown if there is an update for the installer available. This allows you to get any improvements and bug fixes made since release.

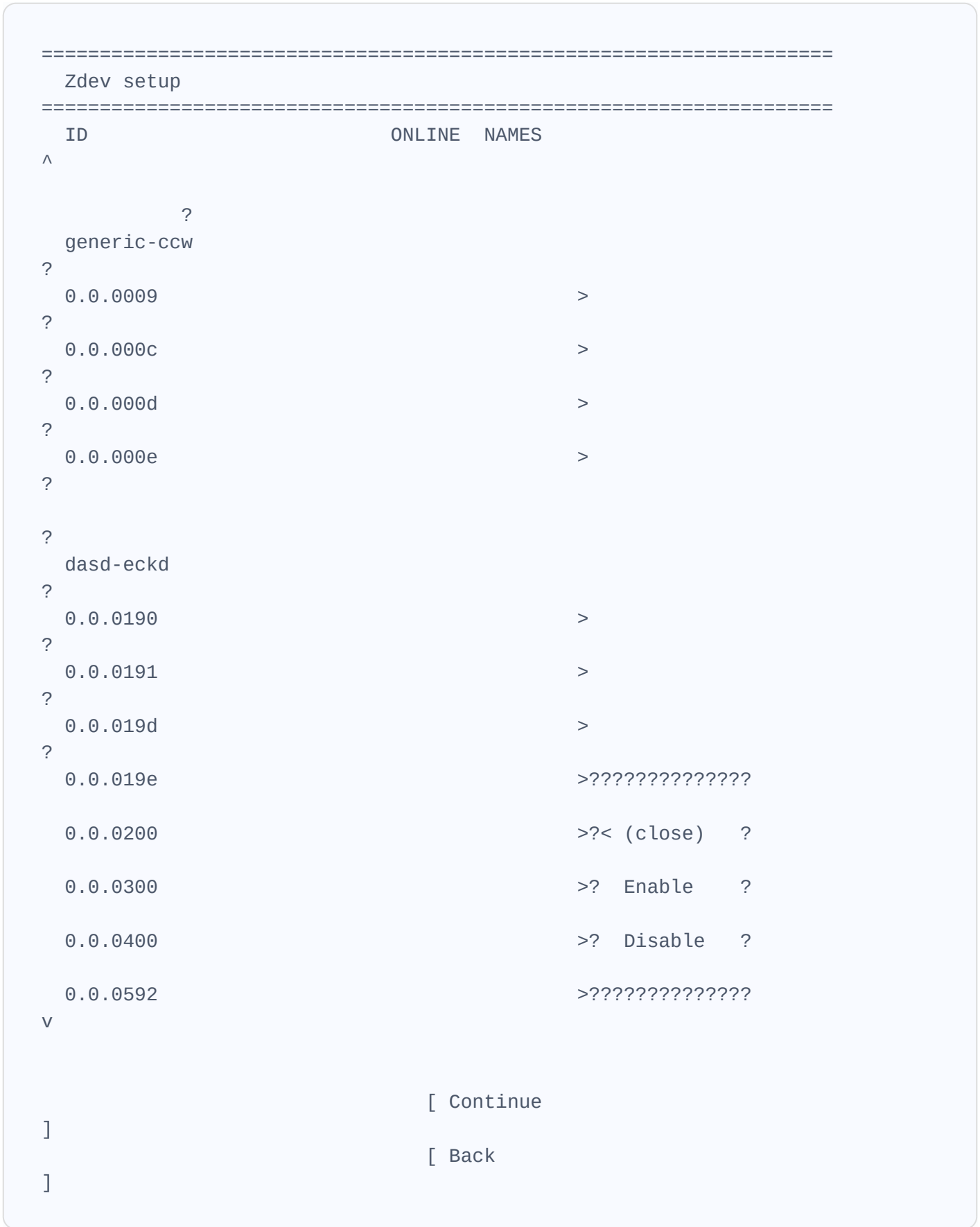
If you choose to update, the new version will be downloaded and the installer will restart at the same point of the installation.

Keyboard

keyboard

Choose the layout and variant of keyboard attached to the system, if any. When running in a virtual terminal, it is possible to guess the layout and variant by answering questions about the keyboard.

Zdev (s390x only)



This screen is only shown on s390x and allows z-specific configuration of devices.

The list of devices can be long. `Home` / `End` / `Page Up` / `Page Down` can be used to navigate through the list more quickly.

Network

network

This screen allows the configuration of the network. Ubuntu Server uses NetPlan to configure networking and the UI of the installer can configure a subset of NetPlan's capabilities. In particular it can configure DHCP or static addressing, VLANs and bonds.

If networking is present (defined as "at least one interface has a default route") then the installer will install updates from the archive at the end of installation.

Proxy

proxy

The proxy configured on this screen is used for accessing the package repository and the snap store both in the installer environment and in the installed system.

Mirror

mirror

The installer will attempt to use `geoip` to look up an appropriate default package mirror for your location. If you want or need to use a different mirror, enter its URL here.

Storage

storage_config

Storage configuration is a complicated topic and has its own page for documentation.

storage_confirm

Once the storage configuration is confirmed, the install begins in the background.

Identity

identity

The default user will be an administrator, able to use `sudo` (this is why a password is needed, even if SSH public key access is enabled on the next screen).

SSH

ssh

A default Ubuntu install has no open ports. It is very common to administer servers via SSH so the installer allows it to be installed with the click of a button.

You can import keys for the default user from GitHub or Launchpad.

If you import a key, then password authentication is disabled by default but it can be re-enabled again if you wish.

Snaps

snaps

If a network connection is enabled, a selection of snaps that are useful in a server environment are presented and can be selected for installation.

Installation logs

install_progress

The final screen of the installer shows the progress of the installer and allows viewing of the full log file. Once the install has completed and security updates installed, the installer waits for confirmation before restarting.

install_done

Configuring storage in the Server installer

Guided options

storage_guided

Selecting “Use an entire disk” on the Guided storage configuration screen will install Ubuntu onto the selected disk, replacing any partitions or data already there.

You can choose whether or not to set up LVM, and if you do, whether or not to encrypt the volume with LUKS. If you encrypt the volume, you need to choose a passphrase that will need to be entered each time the system boots.

If you select “Custom storage layout”, no configuration will be applied to the disks.

In either case, the installer moves onto the main storage customisation screen.

The main storage screen

storage_manual

This screen presents a summary of the current storage configuration. Each device or partition of a device corresponds to a different row (which can be selected), and pressing `Enter` or `space` while a device is selected opens a menu of actions that apply to that device.

Partitions

add_partition_menu

To add a partition to a device, select “Add GPT Partition” for that device.

add_dialog

You can leave “Size” blank to use all the remaining space on the device.

RAID

add_raid

Linux software RAID (RAID stands for “Redundant Array of Inexpensive Disks”) can be used to combine several disks into a single device that is (usually) tolerant to any one disk failure.

A software RAID device can be created out of entire disks or unformatted partitions. Select the “Create software RAID (“MD”)” button to open the creation dialog.

The server installer supports creating devices with RAID level 0, 1, 5, 6 or 10. It does not allow customising other options such as metadata format or RAID10 layout at this time. See the Linux RAID documentation for more details.

A software RAID device can be formatted and mounted directly, can be partitioned into several partitions, or even be used as part of another RAID device or LVM volume group.

Logical Volume Manager (LVM)

add_lvm

The LVM is a system of managing logical volumes, or filesystems, that is much more advanced and flexible than the traditional method of partitioning a disk into one or more segments and formatting that partition with a filesystem. It can be used to combine several disks into one larger pool of storage but it offers advantages even in a single disk system, such as snapshots and easy resizing of logical volumes.

As with RAID, a LVM volume group can be created out of entire disks or unformatted partitions. Select the “Create LVM volume group” button to open the creation dialog.

Once a volume group has been created, it can be divided into named logical volumes which can then be formatted and mounted. It generally makes sense to leave some space in the volume group for storage of snapshots and creation of more logical volumes as needed.

The server installer does not supported configuring any of the many, many options that LVM supports when creating volume groups and logical volumes.

Selecting boot devices

add_boot_device

On all architectures other than s390x, the bootloader needs to be installed to a disk in such a way that the system firmware can find it on boot. By default, the first device to have a partition created on it is selected as a boot device but this can be changed later.

On amd64 and arm64 systems, multiple disks can be selected as boot devices, which means a system can be configured so that it will continue to boot after a failure of any one drive (assuming the root filesystem is placed on a RAID). The bootloader will be installed to each of these drives, and the operating system configured to install new versions of GRUB to each drive as it is updated.

amd64 systems use GRUB as the bootloader. amd64 systems can boot in either UEFI or legacy (sometimes called “BIOS”) mode (many systems can be configured to boot in either mode) and the bootloader is located completely differently in the two modes.

In legacy mode, the bootloader is read from the first “sector” of a hard drive (exactly which hard drive is up to the system firmware, which can usually be configured in a vendor-specific way). The installer will write GRUB to the start of all disks selected as a boot devices. As GRUB does not entirely fit in one sector, a small unformatted partition is needed at the start of the disk, which will automatically be created when a disk is selected as a boot device (a disk with an existing GPT partition table can only be used as a boot device if it has this partition).

In UEFI mode, the bootloader loaded from a “EFI System Partition” (ESP), which is a partition with a particular type GUID. The installer automatically creates a 512MiB ESP on a disk when it is selected as a boot device and will install GRUB there (a disk with an existing partition table can only be used as a boot device if it has an ESP – bootloaders for multiple operating systems can be installed into a single ESP). UEFI defines a standard way to configure the way in which the operating system is chosen on boot, and the installer uses this to configure the system to boot the just-installed operating system. One of the ESPs must be mounted at `/boot/efi`.

Supported arm64 servers boot using UEFI, and are configured the same way as an UEFI-booting amd64 system.

ppc64el systems also load their bootloader (Petitboot, a small linux kernel) from a “PReP” partition with a special flag, so in most ways they are similar to a UEFI system. The installer only supports one PReP partition at this time.

Limitations and workarounds

Currently, the installer cannot *edit* partition tables. You can use existing partitions or reformat a drive entirely but you cannot, for example, remove a large partition and replace it with two smaller ones.

The installer allows the creation of LVM volume groups and logical volumes and MD raid devices, but does not allow tweaking of the parameters – for example, all logical volumes are linear and all MD raid devices use the default metadata format (1.2).

These limits can both be worked around in the same way: drop to a shell and use the usual shell commands to edit the partition table or create the LV or RAID with desired parameters, and then select these partitions or devices as mount points in the installer. Any changes you make while the installer is running but before altering the storage configuration will reflected in the installer.

The installer cannot yet configure iSCSI mounts, ZFS at all, or btrfs subvolumes.

Tutorials

? How to Mount NFS Storage on Linux (with Proper Permissions)

Purpose

Mount a remote NFS share on a Linux server for use by **Docker containers**, ensuring stable operation, correct permissions, and automatic remounting.

---

1. Install NFS Client on the Server

```
sudo apt update
sudo apt install nfs-common -y
```

---

2. Create a Local Mount Directory

Create a local directory where the NFS share will be mounted:

```
sudo mkdir -p /srv/nfs-mount
sudo chown $(whoami):$(whoami) /srv/nfs-mount
```

> *(You can replace `/srv/nfs-mount` with your preferred path.)*

---

3. Mount the NFS Share (Manual Test)

Example:

```
sudo mount -t nfs4 192.168.100.11:/mnt/hdd-storage/my-nfs-share /srv/nfs-mount
```

- `nfs4`: Use NFS version 4 for better performance and locking.
- `proto=tcp`: Reliable transport protocol.
- `hard`: Wait for server recovery instead of failing immediately.
- `timeo=600`: Timeout setting for NFS operations.
- `retrans=2`: Retry failed operations twice.
- `sec=sys`: Default authentication method.
- `_netdev`: Ensure mount occurs only after network is ready.

---

4. Verify That the Mount Worked

```
mount | grep nfs
```

You should see output like:

```
192.168.100.11:/mnt/hdd-storage/my-nfs-share on /srv/nfs-mount type nfs4 (...)
```

---

5. Make the Mount Persistent (Auto-Mount on Boot)

Edit your `/etc/fstab` file:

```
sudo nano /etc/fstab
```

Add the following line at the bottom:

```
192.168.100.11:/mnt/hdd-storage/my-nfs-share /srv/nfs-mount nfs4
rw,relatime,hard,proto=tcp,timeo=600,retrans=2,sec=sys,_netdev 0 0
```

Save and exit (`Ctrl+O`, `Enter`, `Ctrl+X`).

---

6. Test the fstab Entry Without Rebooting

```
sudo mount -a
```

No errors = success! ?

---

7. Using the NFS Mount with Docker

When running your containers, bind-mount the NFS storage into the container:

```
docker run -d \
  --name my-container \
  -v /srv/nfs-mount:/app/data \
  my-docker-image
```

This will allow your Docker containers to directly access the NFS storage.

? Summary

- **Use NFSv4** (`nfs4`) whenever possible.
- **Always** include `_netdev` in your `/etc/fstab` entries.
- **Use `hard` mounts** to protect container file operations during NFS issues.
- **Bind-mount** NFS paths carefully into containers.
- **Avoid** using NFS for database storage unless network latency is extremely low.

□□ Useful Commands

- Check NFS mounts: `mount | grep nfs`
- Manual remount all: `sudo mount -a`
- Test connectivity: `ping nfs-server-ip`

? Additional Notes

- If the NFS server reboots, containers **may pause** temporarily.
- If using `docker-compose.yml`, you can map volumes to `/srv/nfs-mount`.
- For production, consider creating a **systemd mount unit** for better recovery behavior.

Tutorials

How to delete a folder with contents on ubuntu cli

To delete a folder and its contents in Ubuntu 23.04 using the command line interface (CLI), you can use the `rm` command with the `-r` (recursive) option. Be very careful when using the `rm` command, as it will permanently delete files and folders.

Here's the basic syntax:

```
rm -r /path/to/your/folder
```

Replace "/path/to/your/folder" with the actual path to the folder you want to delete.

For example, if you want to delete a folder named "myfolder" located in your home directory, you can use the following command:

```
rm -r ~/myfolder
```

Again, be cautious when using the `rm -r` command, as it will not prompt you for confirmation, and the deletion is irreversible. Double-check the path to the folder before running the command to avoid accidental data loss.

If you want to confirm each file deletion, you can use the `-i` option:

```
rm -ri /path/to/your/folder
```

This will prompt you for confirmation before deleting each file and subdirectory.

Always exercise caution when using the `rm` command, especially with the `-r` option, to avoid unintentional data loss.

Tutorials

? Expanding Root Filesystem on Ubuntu with LVM (Virtual Machine)

□□ Use Case

When a virtual machine runs out of space on the root (`/`) partition, and the underlying disk has already been expanded via the hypervisor or cloud platform.

This guide applies to systems using:

- Ubuntu Server (e.g., 22.04 LTS)
- LVM-managed disks
- A single-root disk layout (e.g., `/dev/mapper/ubuntu--vg-ubuntu--lv`)

□□ Prerequisites

- A snapshot or backup of the VM (highly recommended)
- Root/sudo access
- Disk already expanded in the hypervisor (e.g., from 72GB to 250GB)

□□ Step-by-Step Instructions

1. Check Current Disk Usage

bash
```
df -h /
```

2. List Disks and Partitions

bash
```
lsblk
```

Look for:

- The disk (e.g., `xvda`)
- The root LVM volume (e.g., `/dev/mapper/ubuntu--vg-ubuntu--lv`)
- Confirm that a partition (e.g., `xvda3`) is larger than the mounted root volume

3. Extend the Logical Volume

bash
```
sudo lvextend -l +100%FREE /dev/ubuntu-vg/ubuntu-lv
```

4. Resize the Filesystem

Assuming you're using `ext4`:

bash
```
sudo resize2fs /dev/ubuntu-vg/ubuntu-lv
```

> *? To confirm the filesystem type:*

bash
```
df -T /
```

5. Verify Expansion

bash
```
df -h /
```

You should now see the full size available (e.g., ~146GB instead of 72GB).

□□ Optional: Clean Up Old Snapshots & Logs

Free up even more space:

bash
```
sudo journalctl --vacuum-time=10d
sudo apt autoremove
sudo apt clean
```

□ Outcome

The root filesystem is now successfully extended. The server will run normally with more disk space, avoiding future outages caused by full disks.

Tutorials

? NFS Permissions Fix -Boot Script

Purpose

Ensure that a mounted NFS share has correct ownership and permissions for Docker containers every time the server boots.

---

1. Create a Permission Fix Script

Create a simple script that will reset ownership and permissions on the NFS mount point after boot.

bash

```
sudo nano /usr/local/bin/fix-nfs-permissions.sh
```

Paste inside the script:

```
#!/bin/bash
# Fix NFS ownership
chown -R youruser:yourgroup /srv/nfs-mount
chmod -R 775 /srv/nfs-mount
```

(Replace `youruser` and `yourgroup` with your actual username and group.)

---

2. Make the Script Executable

```
sudo chmod +x /usr/local/bin/fix-nfs-permissions.sh
```

3. Create a systemd Service

Create a small service that runs the script automatically at boot:

```
sudo nano /etc/systemd/system/fix-nfs-permissions.service
```

Add this content:

```
[Unit]
Description=Fix NFS Permissions at Boot
After=network.target nfs-client.target remote-fs.target

[Service]
Type=oneshot
ExecStart=/usr/local/bin/fix-nfs-permissions.sh

[Install]
WantedBy=multi-user.target
```

4. Enable and Start the Service

```
# Reload systemd to recognize the new service
sudo systemctl daemon-reload

# Enable it to start at every boot
sudo systemctl enable fix-nfs-permissions.service

# Run it now without rebooting (optional)
```

```
sudo systemctl start fix-nfs-permissions.service
```

□□ Summary

- Creates a simple fix script for NFS permissions
- Automates it via systemd on every reboot
- Useful for Docker setups that rely on consistent NFS access

---

□□ Useful Commands

```
# Check service status
sudo systemctl status fix-nfs-permissions.service

# Manually trigger the script
sudo /usr/local/bin/fix-nfs-permissions.sh
```

Tip: You can combine this technique with your Docker container volumes to ensure permissions stay stable even after a server or NFS reboot! ?

Tutorials

? Optimizing Linux Swappiness

By default, Linux has a "swappiness" value of 60. Lowering this to **10** tells the kernel to avoid using the slow disk swap and prioritize the fast physical RAM, which is critical for Wazuh Indexer performance.

1

Check Current Swappiness

Run this command to see your current value. It will likely return `60`.

```
sudo cat /proc/sys/vm/swappiness
```

2

Apply Immediate Change

Use the `sysctl` command to lower the value to 10 instantly without a reboot.

```
sudo sysctl vm.swappiness=10
```

3

Make Change Permanent

Add the configuration to `/etc/sysctl.conf` so the setting persists after the VM reboots.

```
sudo echo 'vm.swappiness=10' | sudo tee -a /etc/sysctl.conf
```

Verification

You have successfully reduced disk I/O wait times for the Wazuh Indexer. This helps prevent the VM from hanging when memory usage spikes during large data ingestions.