

# CISN-34-01-21309

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A dark blue diagonal gradient bar that starts from the bottom left corner and extends towards the top right corner, covering the lower half of the page.

# Key Features

Fedora 35

Client Workstation

- Thunderbird
- Libre Word

Virtualized Server

- Containerized programs using Linux Containers
  - Apache
  - Samba and FTP

# Linux Container - LXD/LXC



# LXD with Snap

## Install snap

- `sudo dnf install snapd -y`

## Install lxd

- `sudo snap install lxd`
- `sudo snap start lxd`

```
[mc@fedora ~]$ sudo snap install lxd
2021-12-01T19:26:34-08:00 INFO Waiting for automatic snapd restart...
lxd 4.20 from Canonical✓ installed
[mc@fedora ~]$
```

## Add user to lxd

- `sudo usermod -aG lxd username`
- `newgrp lxd`

```
[mc@fedora ~]$ sudo usermod -aG lxd mc
[mc@fedora ~]$ newgrp lxd
```

# lxc init

Name of storage backend changed to  
“dir” everything else was left as default.

```
[mc@fedora ~]$ lxd init
Would you like to use LXD clustering? (yes/no) [default=no]:
Do you want to configure a new storage pool? (yes/no) [default=yes]:
Name of the new storage pool [default=default]:
Name of the storage backend to use (btrfs, dir, lvm, ceph) [default=btrfs]: dir
Would you like to connect to a MAAS server? (yes/no) [default=no]:
Would you like to create a new local network bridge? (yes/no) [default=yes]:
What should the new bridge be called? [default=lxdbr0]:
What IPv4 address should be used? (CIDR subnet notation, “auto” or “none”) [default=auto]:
What IPv6 address should be used? (CIDR subnet notation, “auto” or “none”) [default=auto]:
Would you like the LXD server to be available over the network? (yes/no) [default=no]:
Would you like stale cached images to be updated automatically? (yes/no) [default=yes]:
Would you like a YAML “lxd init” preseed to be printed? (yes/no) [default=no]:
[mc@fedora ~]$
```

# Internet access for containers

- `sudo firewall-cmd --permanent --add-interface=lxdbrio --zone=trusted`
- `sudo firewall-cmd --reload`

```
[mc@fedora ~]$ sudo firewall-cmd --permanent --add-interface=lxdbrio --zone=trusted
[sudo] password for mc:
success
[mc@fedora ~]$ sudo firewall-cmd --reload
success
```

# Common LXC command

## List images by alias

- `lxc image alias list images: | grep -i fedora`

## Test network

- `lxc exec instancename ping 1.1.1.1`

## How to login as different user

- `lxc exec instancename -- su -- login username`

## Enters bash of container

- `lxc exec instancename -- bash`

# APACHE





# Apache Installation – Creating the Container

## Create the container

- `lxc launch images:fedora/35/amd64 web`

```
[gl@fedora ~]$ lxc launch images:fedora/35/amd64 web
Creating web
Starting web
[gl@fedora ~]$ _
```

## Check for container

- `lxc list`

```
[gl@fedora ~]$ lxc list
+-----+-----+-----+-----+-----+-----+
| NAME | STATE | IPV4 | | IPV6 | | TYPE |
+-----+-----+-----+-----+-----+-----+
| smb | RUNNING | 10.83.180.159 (eth0) | fd42:9b49:fae9:4260:216:3eff:fed6:6572 (eth0) | CONTAINER |
| 0 | | | | | |
+-----+-----+-----+-----+-----+-----+
| web | RUNNING | 10.83.180.9 (eth0) | fd42:9b49:fae9:4260:216:3eff:fedc:c80e (eth0) | CONTAINER |
| 0 | | | | | |
+-----+-----+-----+-----+-----+-----+
[gl@fedora ~]$
```

## Enter the container

- `lxc exec web – bash`

# Apache Installation

## Install Apache

- `sudo dnf install httpd -y`
- `systemctl enable httpd --now`

```
[root@web ~]# systemctl enable httpd --now
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service + /usr/lib/systemd/system/httpd.service.
[root@web ~]# _
```

## Adjust the Firewalls

- `sudo firewall-cmd --add-port=80/tcp --add-port=443/tcp --permanent`

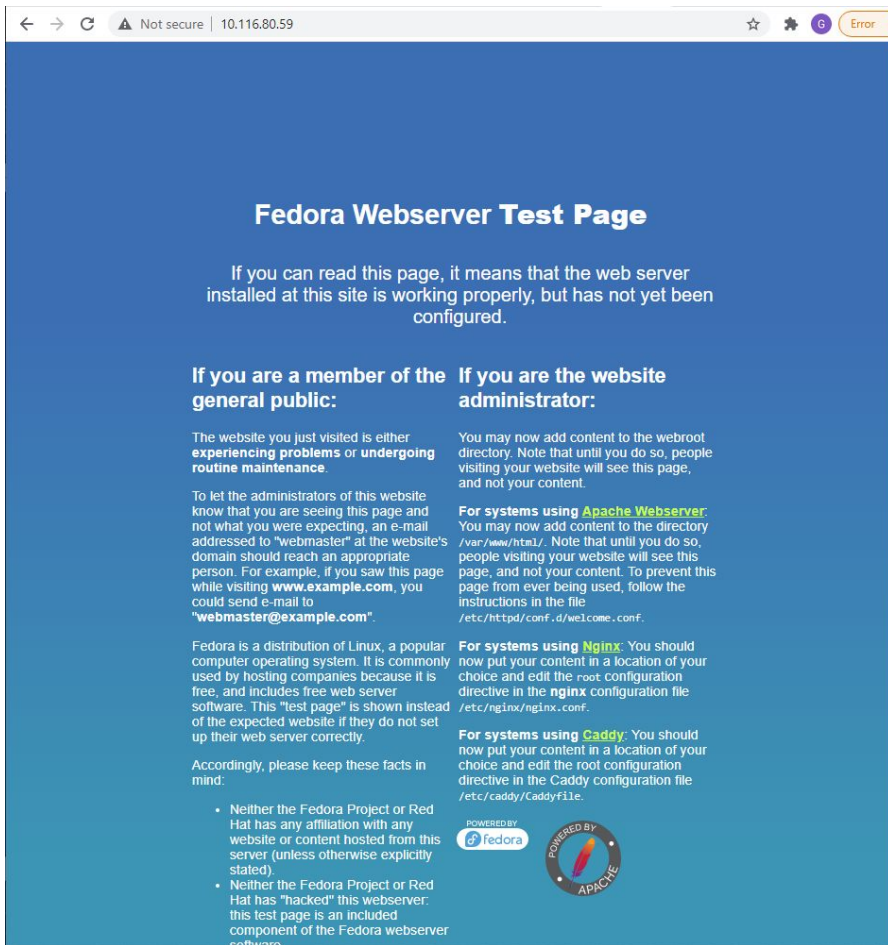
## Port Forwarding

- `sudo firewall-cmd --permanent --add-forward-port=port=80:proto=tcp:toport=80:toaddr=10.212.121.40`

```
gl@fedora:~
gl@fedora ~]$ sudo firewall-cmd --add-port=80/tcp --add-port=443/tcp --permanent
[sudo] password for gl:
Warning: ALREADY_ENABLED: 80:tcp
Warning: ALREADY_ENABLED: 443:tcp
success
gl@fedora ~]$
```

# Accessing the Web page

We are accessing the web server by typing the IP address of the host machine on an internet browser



The screenshot shows a web browser window with the address bar displaying "10.116.80.59". The page has a blue background and white text. The title is "Fedora Webserver Test Page". Below the title, a message states: "If you can read this page, it means that the web server installed at this site is working properly, but has not yet been configured." The page is divided into two columns. The left column is titled "If you are a member of the general public:" and contains text about the website's configuration and a list of disclaimers. The right column is titled "If you are the website administrator:" and contains instructions for adding content to the webroot directory for different web servers: Apache, Nginx, and Caddy. At the bottom right, there are logos for "POWERED BY Fedora" and "POWERED BY APACHE".

## Fedora Webserver Test Page

If you can read this page, it means that the web server installed at this site is working properly, but has not yet been configured.

### If you are a member of the general public:

The website you just visited is either **experiencing problems** or **undergoing routine maintenance**.

To let the administrators of this website know that you are seeing this page and not what you were expecting, an e-mail addressed to "webmaster" at the website's domain should reach an appropriate person. For example, if you saw this page while visiting [www.example.com](http://www.example.com), you could send e-mail to "webmaster@example.com".

Fedora is a distribution of Linux, a popular computer operating system. It is commonly used by hosting companies because it is free, and includes free web server software. This "test page" is shown instead of the expected website if they do not set up their web server correctly.

Accordingly, please keep these facts in mind:

- Neither the Fedora Project or Red Hat has any affiliation with any website or content hosted from this server (unless otherwise explicitly stated).
- Neither the Fedora Project or Red Hat has "hacked" this webserver: this test page is an included component of the Fedora webserver software.



### If you are the website administrator:

You may now add content to the webroot directory. Note that until you do so, people visiting your website will see this page, and not your content.

**For systems using Apache Webserver:** You may now add content to the directory `/var/www/html/`. Note that until you do so, people visiting your website will see this page, and not your content. To prevent this page from ever being used, follow the instructions in the file `/etc/httpd/conf.d/welcome.conf`.

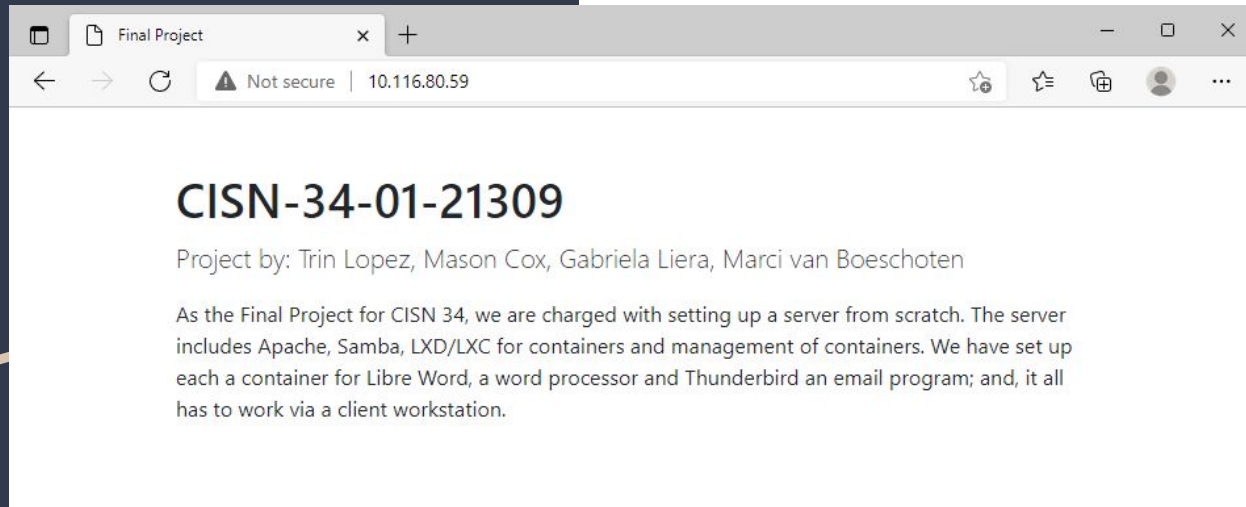
**For systems using Nginx:** You should now put your content in a location of your choice and edit the root configuration directive in the **nginx** configuration file `/etc/nginx/nginx.conf`.

**For systems using Caddy:** You should now put your content in a location of your choice and edit the root configuration directive in the Caddy configuration file `/etc/caddy/Caddyfile`.

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# Customizing the web page

We used a basic HTML boilerplate and imported Bootstrap 5 for the basic CSS styling.



# SAMBA



# Creating container

## Create the container

- `lxc launch images:fedora/35/amd64 smb`

```
[gl@test ~]$ [gl@test ~]$ lxc launch images:fedora/35/amd64 smb
Creating smb
Starting smb
[gl@test ~]$
```

## Check for container

- `Lxc list`

```
[gl@test ~]$ lxc list
+-----+-----+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+-----+-----+
| smb  | RUNNING | 10.83.180.159 (eth0) | fd42:9b49:fae9:4260:216:3eff:fed6:6572 (eth0) | CONTAINER | 0 |
+-----+-----+-----+-----+-----+-----+
[gl@test ~]$
```

## Enter the container

- `lxc exec smb -- bash`

```
[gl@test ~]$ lxc exec smb -- bash
[root@smb ~]#
```



# Adjust Firewall

- `sudo firewall-cmd --permanent --add-service=samba`
- `sudo firewall-cmd --permanent --add-forward-port=port=137:proto=udp:toport=137:toaddr=10.212.121.96`  
`--add-forward-port=port=138:proto=udp:toport=138:toaddr=10.212.121.96`  
`--add-forward-port=port=139:proto=tcp:toport=139:toaddr=10.212.121.96`  
`--add-forward-port=port=445:proto=tcp:toport=445:toaddr=10.212.121.96`

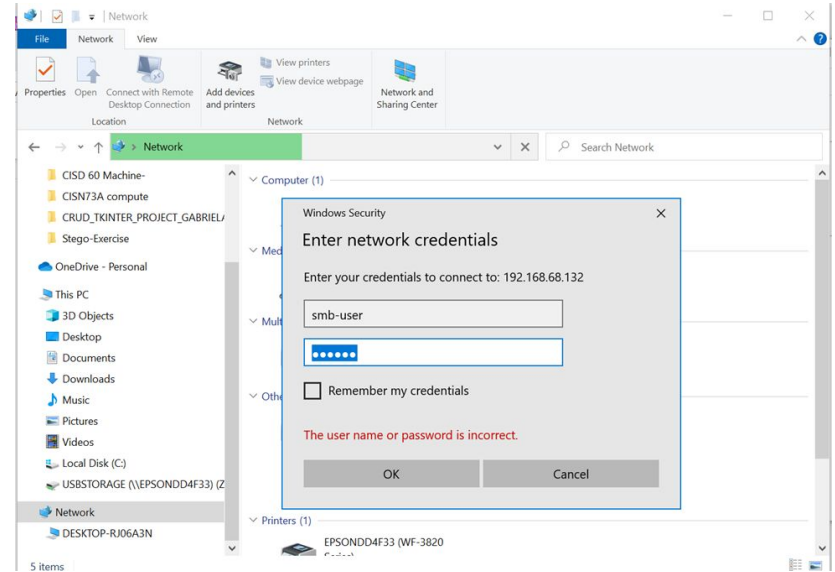
The toaddr IP address will be the IP address of the container.

```
firewall-cmd: error: unrecognized argument: --permanent  
[gl@test ~]$ sudo firewall-cmd --permanent --add-service=samba  
success
```

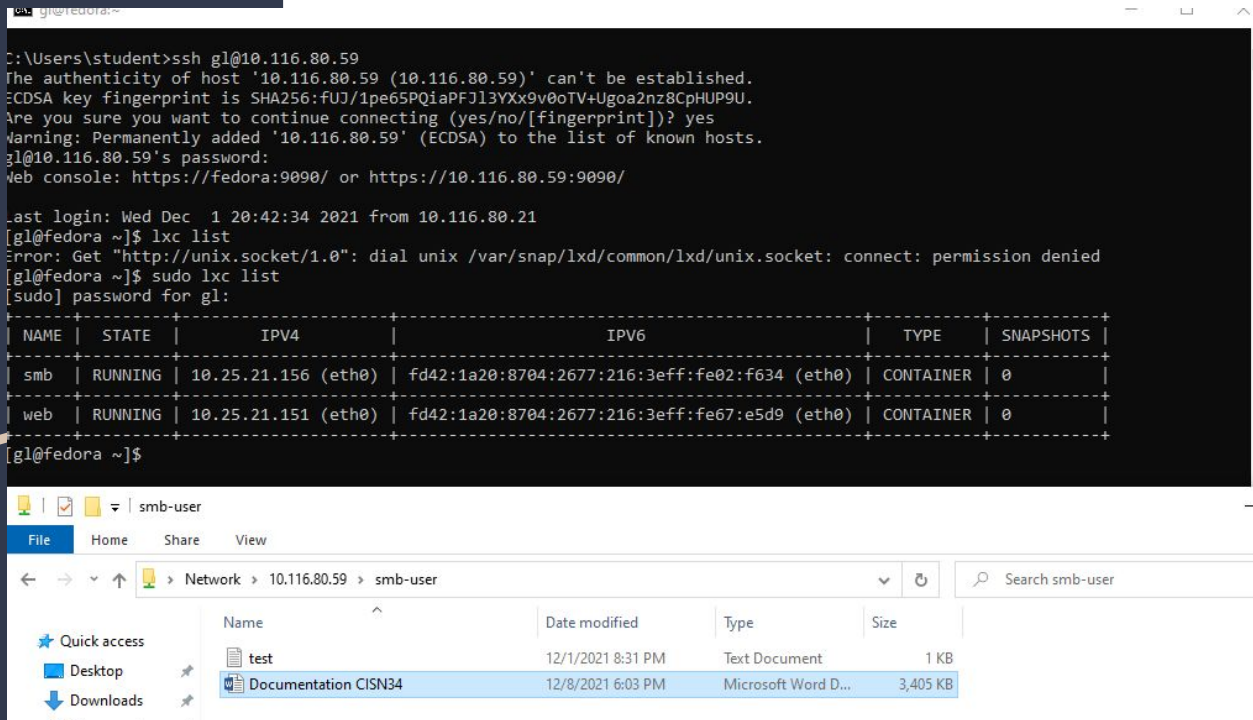


# Accessing Samba Shared Folder

Use the IP address of the host server, not the container.



# Accessing Samba Shared Folder



The image shows two screenshots illustrating how to access a Samba shared folder. The top screenshot is a terminal window where a user connects to a remote host via SSH and runs the 'lxc list' command. The bottom screenshot is a Windows File Explorer window showing the contents of the 'smb-user' share on the 10.116.80.59 host.

**Terminal Output:**

```
C:\Users\student>ssh gl@10.116.80.59
The authenticity of host '10.116.80.59 (10.116.80.59)' can't be established.
ECDSA key fingerprint is SHA256:fUJ/1pe65PQiaPFJl3YXx9v0oTV+Ugoa2nz8CpHUP9U.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.116.80.59' (ECDSA) to the list of known hosts.
gl@10.116.80.59's password:
Web console: https://fedora:9090/ or https://10.116.80.59:9090/

Last login: Wed Dec  1 20:42:34 2021 from 10.116.80.21
[gl@fedora ~]$ lxc list
Error: Get "http://unix.socket/1.0": dial unix /var/snap/lxd/common/lxd/unix.socket: connect: permission denied
[gl@fedora ~]$ sudo lxc list
[sudo] password for gl:
+-----+-----+-----+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 | TYPE | SNAPSHOTS |
+-----+-----+-----+-----+-----+-----+-----+
| smb  | RUNNING | 10.25.21.156 (eth0) | fd42:1a20:8704:2677:216:3eff:fe02:f634 (eth0) | CONTAINER | 0 |
+-----+-----+-----+-----+-----+-----+-----+
| web  | RUNNING | 10.25.21.151 (eth0) | fd42:1a20:8704:2677:216:3eff:fe67:e5d9 (eth0) | CONTAINER | 0 |
+-----+-----+-----+-----+-----+-----+-----+
[gl@fedora ~]$
```

**File Explorer View:**

Network > 10.116.80.59 > smb-user

Name	Date modified	Type	Size
test	12/1/2021 8:31 PM	Text Document	1 KB
Documentation CISN34	12/8/2021 6:03 PM	Microsoft Word D...	3,405 KB

# FTP - File Transfer Protocol



# Installation

## Install Ftp

- Dnf install vsftpd -y
- systemctl enable vsftpd --now

## Install text editor for configuration file

- nano /etc/vsftpd/vsftpd.conf
  - userlist\_file=/etc/vsftpd/user\_list
  - userlist\_deny=NO
  - local\_root=/
  - pasv\_enable=NO (Disabled = Active only. With it disabled we don't have to set range of ports to be enabled for passive mode)

```
root@ftp:~
GNU nano 5.8 /etc/vsftpd/vsftpd.conf
# (default follows)
#chroot_list_file=/etc/vsftpd/chroot_list
#
# You may activate the "-R" option to the builtin ls. This is disabled by
# default to avoid remote users being able to cause excessive I/O on large
# sites. However, some broken FTP clients such as "ncftp" and "mirror" assume
# the presence of the "-R" option, so there is a strong case for enabling it.
#ls_recurse_enable=YES
#
# When "listen" directive is enabled, vsftpd runs in standalone mode and
# listens on IPv4 sockets. This directive cannot be used in conjunction
# with the listen_ipv6 directive.
listen=NO
#
# This directive enables listening on IPv6 sockets. By default, listening
# on the IPv6 "any" address (::) will accept connections from both IPv6
# and IPv4 clients. It is not necessary to listen on "both" IPv4 and IPv6
# sockets. If you want that (perhaps because you want to listen on specific
# addresses) then you must run two copies of vsftpd with two configuration
# files.
# Make sure, that one of the listen options is commented !!
listen_ipv6=YES
pam_service_name=vsftpd
userlist_enable=YES
userlist_file=/etc/vsftpd/user_list
userlist_deny=NO
local_root=/
pasv_enable=Yes
pasv_min_port=64000
pasv_max_port=64321
pasv_address=
H Help      W Write Out  R Where Is   N Cut       J Execute    C Location  A-U Undo    A-M Set Mark  A-L To Bracket M-Q Previous
X Exit     R Read File  M Replace   P Paste     D Justify   G Go To Line A-E Redo    C Copy      W Where Was  N-N Next
```

# Add ftp-user

Create user to access ftp server

- `useradd ftp-user`

Add user to ftp user\_list

- `echo "ftp-user" >> /etc/vsftpd/user_list`

Restart vsftpd

- `systemctl restart vsftpd`

```
[root@ftp vsftpd]# ls
ftpusers  user_list  vsftpd.conf  vsftpd_conf_migrate.sh  vsftpd_copy.conf
[root@ftp vsftpd]# cat user_list
# vsftpd userlist
# If userlist_deny=NO, only allow users in this file
# If userlist_deny=YES (default), never allow users in this file, and
# do not even prompt for a password.
# Note that the default vsftpd pam config also checks /etc/vsftpd/ftpusers
# for users that are denied.
root
bin
daemon
adm
lp
sync
shutdown
halt
mail
news
uucp
operator
games
nobody
ftp-user
[root@ftp vsftpd]#
```

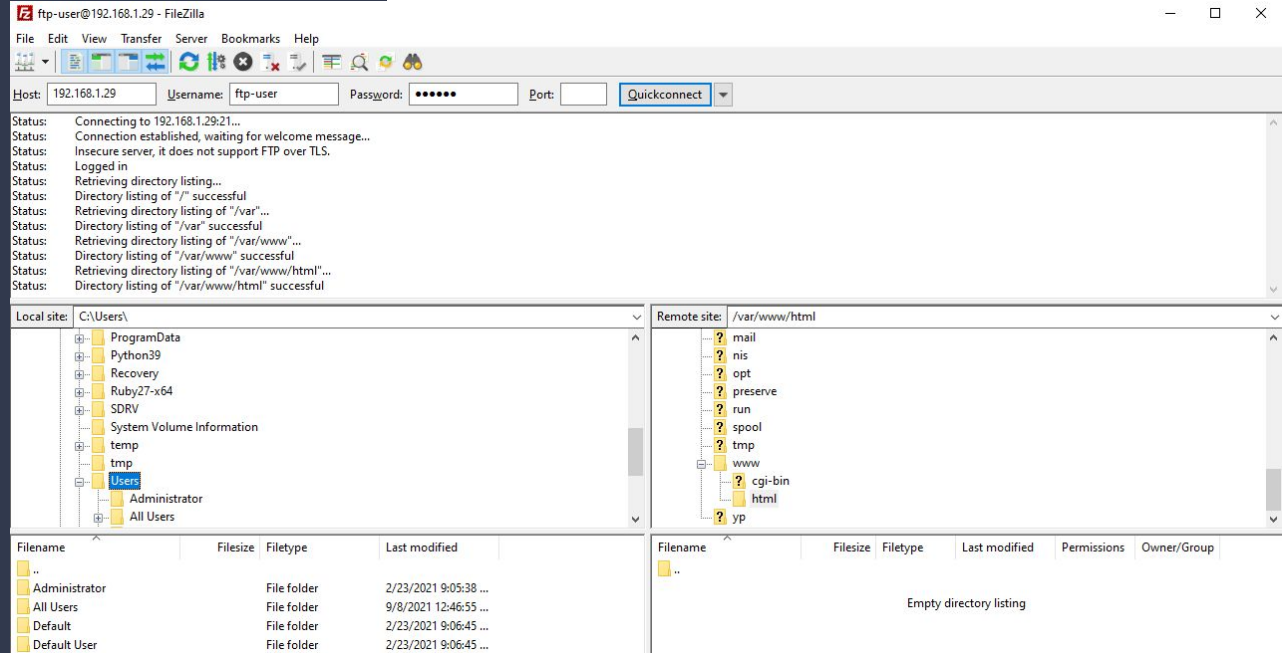
# Firewalls and Port Forwarding

Use port-forwarding method similar to other services

```
sudo firewall-cmd --permanent  
--add-forward-port=port=20:proto=tcp:toport=20:toaddr=10.25.21.151  
--add-forward-port=port=21:proto=tcp:toport=21:toaddr=10.25.21.151
```

```
@fedora ~]$ sudo firewall-cmd --permanent --add-forward-port=port=20:proto=tcp:toport=20:toaddr=10.25.21.151 --add-forward-port=port=21:proto=tcp:toport=21:toaddr=10.25.21.151  
success  
@fedora ~]$ sudo firewall-cmd --reload  
success  
@fedora ~]$
```

# FTP Access



# Thunderbird





# Install ThunderBird container

1. `sudo dnf install snapd`
  - Install *snapd* packaging/deployment tool onto newly built Fedora 35 workstation
2. Verify all *snapd* packages have downloaded and installed

```
[trin@fedora ~]$ sudo dnf install snapd

We trust you have received the usual lecture from the local System
Administrator. It usually boils down to these three things:

#1) Respect the privacy of others.
#2) Think before you type.
#3) With great power comes great responsibility.
```

```
Installed:
  snap-confine-2.53.1-2.fc35.x86_64          snapd-2.53.1-2.fc35.x86_64
  snapd-selinux-2.53.1-2.fc35.noarch

Complete!
[trin@fedora ~]$
```

# Install/run basic configuration for LXD

- Install/run basic configuration for LXD

```
[trin@fedora ~]$ sudo lxd init
[sudo] password for trin:
Would you like to use LXD clustering? (yes/no) [default=no]:
Do you want to configure a new storage pool? (yes/no) [default=yes]:
Name of the new storage pool [default=default]:
Name of the storage backend to use (ceph, btrfs, dir, lvm) [default=btrfs]:
Would you like to create a new btrfs subvolume under /var/snap/lxd/common/lxd? (
yes/no) [default=yes]:
Would you like to connect to a MAAS server? (yes/no) [default=no]:
Would you like to create a new local network bridge? (yes/no) [default=yes]:
What should the new bridge be called? [default=lxdbr0]:
What IPv4 address should be used? (CIDR subnet notation, "auto" or "none") [defa
ult=auto]:
What IPv6 address should be used? (CIDR subnet notation, "auto" or "none") [defa
ult=auto]:
Would you like the LXD server to be available over the network? (yes/no) [defaul
t=no]:
Would you like stale cached images to be updated automatically? (yes/no) [defaul
t=yes]:
Would you like a YAML "lxd init" preseed to be printed? (yes/no) [default=no]:
```

# Create new 'Thunderbird' container using Fedora 35 image

- 'Voilà! Thunderbird container

```
ket: connect: permission denied
[trin@fedora ~]$ sudo lxc launch images:fedora/35/amd64 thunderbird
Creating thunderbird
Starting thunderbird
[trin@fedora ~]$ lxd list
```

```
ket: connect: permission denied
[trin@fedora ~]$ sudo lxc list
+-----+-----+-----+-----+
| NAME | STATE | IPV4 | IPV6 |
| TYPE | SNAPSHOTS | | |
+-----+-----+-----+-----+
| thunderbird | RUNNING | | fd42:ba40:2e8e:8898:216:3eff:fe6b:774a (eth0) |
| CONTAINER | 0 | | |
+-----+-----+-----+-----+
[trin@fedora ~]$
```

# Disable and restart firewall

- Disable and restart firewall

```
link/ether c6:7f:fd:c7:69:07 brd ff:ff:ff:ff:ff:ff link-netnsid 0
[trin@fedora ~]$ firewall-cmd --add-interface=lxdbr0 --zone=trusted --permanent
success
[trin@fedora ~]$ firewall-cmd --reload
success
[trin@fedora ~]$
```

# Install Thunderbird app within 'Thunderbird' container

- `sudo lxc exec thunderbird -- dnf install thunderbird`

```
[trin@fedora ~]$ sudo lxc exec thunderbird -- dnf install thunderbird
[sudo] password for trin:
Last metadata expiration check: 0:06:35 ago on Thu Nov 25 00:35:39 2021.
Dependencies resolved.
=====
Package                                Arch      Version                                Repo      Size
=====
Installing:
thunderbird                            x86_64    91.3.0-1.fc35                        updates   96 M
Installing dependencies:
ModemManager-glib                      x86_64    1.18.2-1.fc35                        fedora    300 k
NetworkManager-libnm                  x86_64    1:1.32.12-2.fc35                     updates   1.7 M
adwaita-cursor-theme                   noarch    41.0-1.fc35                          fedora    625 k
adwaita-icon-theme                     noarch    41.0-1.fc35                          fedora    11 M
alsa-lib                               x86_64    1.2.5.1-4.fc35                       updates   491 k
at-spi2-atk                            x86_64    2.38.0-3.fc35                        fedora    86 k
at-spi2-core                           x86_64    2.42.0-1.fc35                        fedora    176 k
atk                                     x86_64    2.36.0-4.fc35                        fedora    269 k
avahi-glib                             x86_64    0.8-14.fc35                          fedora    15 k
avahi-libs                             x86_64    0.8-14.fc35                          fedora    68 k
bluez-libs                             x86_64    5.62-2.fc35                          updates   84 k
bubblewrap                             x86_64    0.5.0-1.fc35                         fedora    53 k
cairo                                   x86_64    1.17.4-4.fc35                        fedora    664 k
```

# Re-verify status of Thunderbird container within LXD

- Thunderbird container now up and running


```
[trin@fedora ~]$ sudo lxc list
[sudo] password for trin:
+-----+-----+-----+-----+
| NAME           | STATE   | IPV4      | IPV6      |
| TYPE           | SNAPSHOTS |           |           |
+-----+-----+-----+-----+
| thunderbird    | RUNNING | 10.19.25.103 (eth0) | fd42:ba40:2e8e:8898:216:3eff:fe6b:774a (eth0) |
| CONTAINER      | 0        |           |           |
+-----+-----+-----+-----+
[trin@fedora ~]$
```

# Word processor



# Verify LXC container list

- Show existing LXC container list
- LXD already installed



```
trin@fedora:~  
[trin@fedora ~]$ sudo lxc list
```

NAME	STATE	IPV4	IPV6
	TYPE	SNAPSHOTS	
thunderbird	RUNNING	10.19.25.103 (eth0)	fd42:ba40:2e8e:8898:216:3eff:fe6b:774a (eth0)
	CONTAINER	0	

```
[trin@fedora ~]$
```



# Create new container named 'wordprocessor'

- `sudo lxc launch images:fedora/35/amd64 wordprocessor`
- Verify new container is built (`sudo lxc list`)

```
trin@fedora:~  
-----+-----+-----+  
| thunderbird | RUNNING | 10.19.25.103 (eth0) | fd42:ba40:2e8e:8898:216:3eff:fe6  
b:774a (eth0) | CONTAINER | 0 |  
-----+-----+-----+  
[trin@fedora ~]$ sudo lxc launch images:fedora/35/amd64 wordprocessor  
Creating wordprocessor  
Starting wordprocessor  
[trin@fedora ~]$ sudo lxc list  
-----+-----+-----+  
| NAME | STATE | IPV4 | IPV6 |  
| TYPE | SNAPSHOTS | | |  
-----+-----+-----+  
| thunderbird | RUNNING | 10.19.25.103 (eth0) | fd42:ba40:2e8e:8898:216:3eff:f  
e6b:774a (eth0) | CONTAINER | 0 |  
-----+-----+-----+  
| wordprocessor | RUNNING | 10.19.25.11 (eth0) | fd42:ba40:2e8e:8898:216:3eff:f  
e75:e6a2 (eth0) | CONTAINER | 0 |  
-----+-----+-----+  
[trin@fedora ~]$
```

# Install snapd into container

- Install snapd into container named “wordprocessor”:

```
trin@fedora:~ — sudo lxc exec wordprocessor -- dnf install snapd
[trin@fedora ~]$ sudo lxc exec wordprocessor -- dnf install snapd
Fedora 35 - x86_64 2.7 MB/s | 61 MB 00:22
Fedora 35 openh264 (From Cisco) - x86_64 3.1 kB/s | 2.5 kB 00:00
Fedora Modular 35 - x86_64 1.0 MB/s | 2.6 MB 00:02
Fedora 35 - x86_64 - Updates 7.3 MB/s | 14 MB 00:01
Fedora Modular 35 - x86_64 - Updates 461 kB/s | 714 kB 00:01
Last metadata expiration check: 0:00:01 ago on Thu Dec 2 05:19:42 2021.
Dependencies resolved.
=====
Package Arch Version Repository Size
=====
Installing:
snapd x86_64 2.53.2-1.fc35 updates 14 M
Installing dependencies:
bash-completion noarch 1:2.11-3.fc35 fedora 291 k
checkpolicy x86_64 3.3-1.fc35 updates 338 k
dracut x86_64 055-6.fc35 updates 347 k
kernel-debug-core x86_64 5.15.5-200.fc35 updates 37 M
kernel-debug-modules x86_64 5.15.5-200.fc35 updates 33 M
libkcapi-hmaccalc x86_64 1.3.1-3.fc35 fedora 24 k
libpkgconf x86_64 1.8.0-1.fc35 fedora 36 k
linux-firmware noarch 20211027-126.fc35 updates 200 M
linux-firmware-whence noarch 20211027-126.fc35 updates 45 k
lzo x86_64 2.10-5.fc35 fedora 65 k
```

## Verify snapd install is complete

- Verify snapd install is completed:

```
linux-firmware-20211027-126.fc35.noarch
linux-firmware-whence-20211027-126.fc35.noarch
lzo-2.10-5.fc35.x86_64
memstrack-0.2.3-2.fc35.x86_64
pkgconf-1.8.0-1.fc35.x86_64
pkgconf-m4-1.8.0-1.fc35.noarch
pkgconf-pkg-config-1.8.0-1.fc35.x86_64
policycoreutils-python-utils-3.3-1.fc35.noarch
python3-audit-3.0.6-1.fc35.x86_64
python3-libselinux-3.3-1.fc35.x86_64
python3-libsemanage-3.3-1.fc35.x86_64
python3-policycoreutils-3.3-1.fc35.noarch
python3-setools-4.4.0-3.fc35.x86_64
python3-setuptools-57.4.0-1.fc35.noarch
rpm-plugin-selinux-4.17.0-1.fc35.x86_64
selinux-policy-35.5-1.fc35.noarch
selinux-policy-targeted-35.5-1.fc35.noarch
snap-confine-2.53.2-1.fc35.x86_64
snapd-2.53.2-1.fc35.x86_64
snapd-selinux-2.53.2-1.fc35.noarch
squashfs-tools-4.5-3.20210913gite048580.fc35.x86_64

Complete!
[trin@fedora ~]$
```

# Install LibreOffice

- Attempt to install LibreOffice; encountered 'squashfs' error

```
trin@fedora:~  
pkgconf-1.8.0-1.fc35.x86_64  
pkgconf-m4-1.8.0-1.fc35.noarch  
pkgconf-pkg-config-1.8.0-1.fc35.x86_64  
policycoreutils-python-utils-3.3-1.fc35.noarch  
python3-audit-3.0.6-1.fc35.x86_64  
python3-libselinux-3.3-1.fc35.x86_64  
python3-libsemanage-3.3-1.fc35.x86_64  
python3-policycoreutils-3.3-1.fc35.noarch  
python3-setools-4.4.0-3.fc35.x86_64  
python3-setuptools-57.4.0-1.fc35.noarch  
rpm-plugin-selinux-4.17.0-1.fc35.x86_64  
selinux-policy-35.5-1.fc35.noarch  
selinux-policy-targeted-35.5-1.fc35.noarch  
snap-confine-2.53.2-1.fc35.x86_64  
snapd-2.53.2-1.fc35.x86_64  
snapd-selinux-2.53.2-1.fc35.noarch  
squashfs-tools-4.5-3.20210913gite048580.fc35.x86_64  
  
Complete!  
[trin@fedora ~]$ sudo lxc exec wordprocessor -- snap install libreoffice  
[sudo] password for trin:  
error: system does not fully support snapd: cannot mount squashfs image using "squashfs":  
mount: /tmp/sanity-mountpoint-235544522: mount failed: Operation not permitted.  
[trin@fedora ~]$
```

# Install kernel modules

- Install kernel modules into 'Wordprocessor' module to fix 'squashfs' error:

```
trin@fedora:~$ sudo lxc exec wordprocessor -- dnf install kernel-modules -y
Last metadata expiration check: 0:08:46 ago on Thu Dec  2 05:19:42 2021.
Dependencies resolved.
=====
Package                        Architecture      Version           Repository        Size
=====
Installing:
kernel-modules                 x86_64            5.15.5-200.fc35  updates          33 M
Installing dependencies:
kernel-core                    x86_64            5.15.5-200.fc35  updates          35 M
=====
Transaction Summary
=====
Install 2 Packages

Total download size: 67 M
Installed size: 108 M
Downloading Packages:
(1/2): kernel-modules-5.15.5-200.fc35.x86_64.rpm      10 MB/s | 33 MB    00:03
(2/2): kernel-core-5.15.5-200.fc35.x86_64.rpm        11 MB/s | 35 MB    00:03
-----
Total                                                    18 MB/s | 67 MB    00:03
Running transaction check
Transaction check succeeded.
```

# Fix 'squashfs' error encountered during snapd install

- Install squashfuse to fix 'squashfs' error encountered during snapd install:

```
trin@fedora:~  
Complete!  
[trin@fedora ~]$ sudo lxc exec wordprocessor -- snap install libreoffice  
error: system does not fully support snapd: cannot mount squashfs image using "squashfs":  
mount: /tmp/sanity-mountpoint-847696302: mount failed: Operation not permitted.  
[trin@fedora ~]$ sudo lxc exec wordprocessor -- dnf install fuse squashfuse  
Last metadata expiration check: 0:10:43 ago on Thu Dec  2 05:19:42 2021.  
Dependencies resolved.  
=====
```

Package	Architecture	Version	Repository	Size
Installing:				
fuse	x86_64	2.9.9-13.fc35	fedora	78 k
squashfuse	x86_64	0.1.102-9.fc35	fedora	23 k
Installing dependencies:				
fuse-common	x86_64	3.10.5-1.fc35	fedora	8.3 k
fuse-libs	x86_64	2.9.9-13.fc35	fedora	97 k
squashfuse-libs	x86_64	0.1.102-9.fc35	fedora	29 k

```
=====
```

Transaction Summary	
Install 5 Packages	
Total download size: 235 k	
Installed size: 627 k	

# Install LibreOffice

- Install LibreOffice into container named 'wordprocessor'
- `sudo lxc exec wordprocessor -- snap install libreoffice`

```
trin@fedora:~ — sudo lxc exec wordprocessor -- snap install libreoffice
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing      : 1/1
  Installing     : squashfuse-libs-0.1.102-9.fc35.x86_64 1/5
  Installing     : fuse-libs-2.9.9-13.fc35.x86_64 2/5
  Installing     : fuse-common-3.10.5-1.fc35.x86_64 3/5
  Installing     : fuse-2.9.9-13.fc35.x86_64 4/5
  Installing     : squashfuse-0.1.102-9.fc35.x86_64 5/5
  Running scriptlet: squashfuse-0.1.102-9.fc35.x86_64 5/5
  Verifying      : fuse-2.9.9-13.fc35.x86_64 1/5
  Verifying      : fuse-common-3.10.5-1.fc35.x86_64 2/5
  Verifying      : fuse-libs-2.9.9-13.fc35.x86_64 3/5
  Verifying      : squashfuse-0.1.102-9.fc35.x86_64 4/5
  Verifying      : squashfuse-libs-0.1.102-9.fc35.x86_64 5/5

Installed:
  fuse-2.9.9-13.fc35.x86_64          fuse-common-3.10.5-1.fc35.x86_64
  fuse-libs-2.9.9-13.fc35.x86_64    squashfuse-0.1.102-9.fc35.x86_64
  squashfuse-libs-0.1.102-9.fc35.x86_64

Complete!
[trin@fedora ~]$ sudo lxc exec wordprocessor -- snap install libreoffice
Copy snap "snapd" data
```

# list of running containers

- Re-verify list of running containers:

```
trin@fedora:~  
[trin@fedora ~]$ sudo lxc list  
+-----+-----+-----+-----+  
| NAME | STATE | IPV4 | IPV6 |  
| TYPE | SNAPSHOTS | | |  
+-----+-----+-----+-----+  
| thunderbird | RUNNING | 10.19.25.103 (eth0) | fd42:ba40:2e8e:8898:216:3eff:fe6b:774a (eth0) |  
| CONTAINER | 0 | | |  
+-----+-----+-----+-----+  
| wordprocessor | RUNNING | 10.19.25.11 (eth0) | fd42:ba40:2e8e:8898:216:3eff:fe75:e6a2 (eth0) |  
| CONTAINER | 0 | | |  
+-----+-----+-----+-----+  
[trin@fedora ~]$
```



# Summary

Servers are a multi-directional and multi-configurable IT device. When planning for the use of a server, one of the first questions include what type or service does this server need to fulfill? There are multiple ways and configurations available to set up a server. Is this server going to be used for email, storage, remote access or something else? Will it be used for different purposes? This project is just one of the many different configurations that can be used on a server. The Left Team's server has been set up to transfer data using FTP. Apache has been installed and configured to be able to access the server from a workstation. We have created this server to be able to take advantage of container software. There are two container images on this server, an email program, Thunderbird in one container and a word processor, Libre Word in the other container.