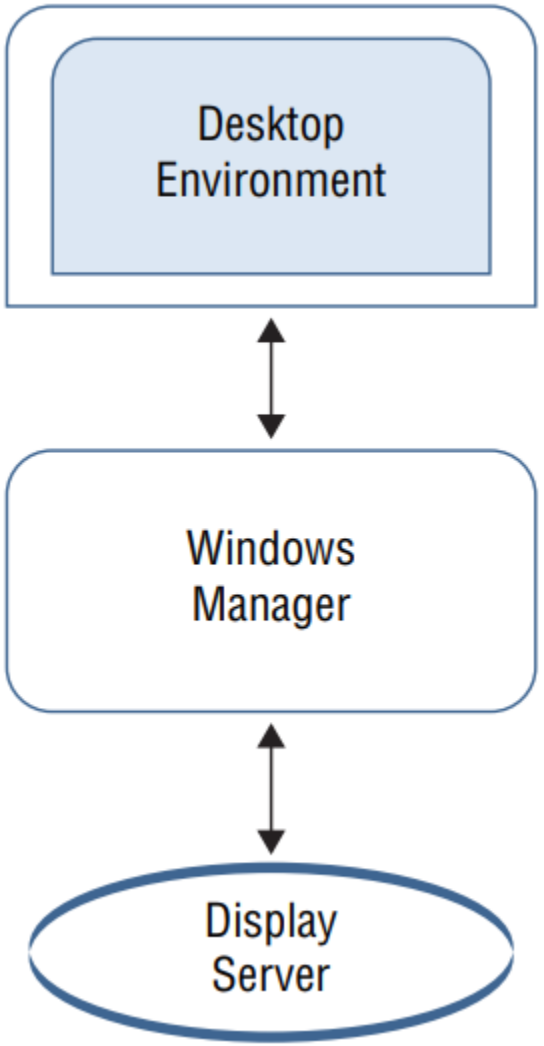
Configuring the GUI, Localization, and Printing

Objectives:

- ✓ 106.1 Install and configure X11
- ✓ 106.2 Graphical Desktops
- ✓ 106.3 Accessibility
- ✓ 107.3 Localization and internationalization
- ✓ 108.4 Manage printers and printing

Serving the GUI components

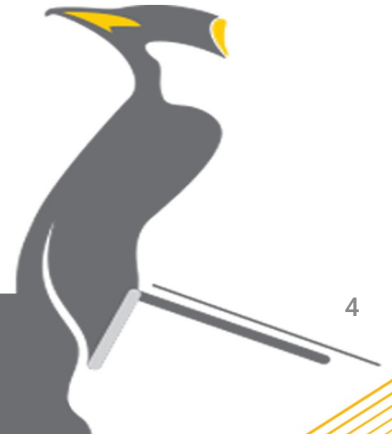


Understanding the GUI

- Many players are involved in providing a Linux system user interface.
- The desktop environment that you see on your monitor display is only a piece of this puzzle.
- A windows manager is a program that communicates with the display server (sometimes called a windows server) on behalf of the UI.
- Each particular desktop environment has its own default window manager, such as Mutter, Kwin, Muffin, Marco, and Metacity.
- The display server is a program that uses a communication protocol to transmit the desires of the UI to the operating system, and vice versa.
- The communication protocol, called the display server protocol, can operate over a network.
- A compositor program arranges various display elements within a window to create a screen image to be passed back to the client.

UNDERSTANDING THE X11 ARCHITECTURE

The X Window System (X for short) is the display server used for Linux systems. It was developed in the 1980s, so it has been around for a long time. This display server has endured the test of time.



Understanding the X11 Architecture

- Originally in Linux there was only one software package that supported X, called XFree86.
- However, in 2004 the XFree86 project changed their licensing requirements, which caused many Linux distributions to switch to the X.Org foundation's implementation of X, simply called X.Org.
- The X.Org's display server fully implements the X Window System version 11 standards, including using the same configuration file format as the original XFree86 package.
- However, many distributions created their own customizations of the X.Org server; thus, you will see a wide variety of names concerning the Linux X display server, such as X.org-X11, X, X11, and X.Org Server.
- Within the past few years, a new X display server package called Wayland has made headway in the Linux world.
- The Wayland package provides more advanced features that support newer display hardware and security, and supports additional types of input devices.
- Wayland is quickly gaining followers in the Linux world and may soon become the default display server used in most Linux distributions.

Examining X.Org

- The X.Org package keeps track of display card, monitor, and input device information in a configuration file, using the original XFree86 format.
- The primary configuration file is `/etc/X11/xorg.conf`, though the file is sometimes stored in the `/etc/` directory.
- Typically, however, this file is no longer used.
- Instead, individual applications or devices store their own X11 settings in separate files stored in the `/etc/X11/xorg.conf.d` directory.
- When the X11 server boots, it reads the configuration settings stored in those files to customize how it interacts with different display cards, monitors, keyboards, mice, and other input or output devices

Examining X.Org

- The X.Org software can detect most common hardware devices, so no manual configuration is required.
- However, in some cases, auto-detection might not work properly, and you need to make X11 configuration changes. In this case, you can manually create the configuration file.
  - ✓ To do this, shut down the X Server by going to a command prompt, using the command `sudo telinit 3`, and using super user privileges to generate the file via the `Xorg -configure` command.
  - ✓ The file, named `xorg.conf.new`, will be in your local directory.
  - ✓ Make any necessary tweaks, rename the file, move the file to its proper location, and restart the X server

xorg.conf Sections Information

- `Input Device:` Configures the session's keyboard and mouse
- `Monitor:` Sets the session's monitor configuration
- `Modes:` Defines video modes
- `Device:` Configures the session's video card(s)
- `Screen:` Sets the session's screen resolution and color depth
- `Module:` Denotes any modules that need to be loaded
- `Files:` Sets file path names, if needed, for fonts, modules, and keyboard layout files
- `Server Flags:` Configures global X server options
- `Server Layout:` Links together all the session's input and output devices

Examining X.Org

- If something goes wrong with the display process, the X.Org server generates the .xsession-errors file in your Home directory (often referred to as ~/.xsession-errors).
- In addition, two utilities are available that can help:
  - ✓ xdpyinfo
    - Provides information about the X.Org server, including the different screen types available, the default communicate parameter values, protocol extension information, and so on.
  - ✓ xwininfo
    - Provides window information.
    - If no options are given, an interactive utility asks you to click on the window for which you desire statistics.
    - The displayed stats include location information, the window's dimensions (width and height), color map ID, and so on.

Figuring Out Wayland

- Wayland is a replacement for the X.Org display server.
- It is designed to be simpler, more secure, and easier to develop and maintain than the X.Org software.
- Wayland specifically defines the communication protocol between a display server and its various clients.
- However, Wayland is also an umbrella term that covers the compositor, the window server, and the display server.
- The Wayland protocol was initially released back in 2009, and it is now used by many current Linux desktop environments such as GNOME Shell and KDE Plasma.

Wayland compositor

- The Wayland compositor is Weston.
- However, Weston provides a rather basic desktop experience.
- It was created as a Wayland compositor reference implementation.
  - ✓ The term **reference implementation** means that Weston was created to be a compositor requirements example for those developers who want to create their own Wayland compositor.
- Thus, Weston's core focus is correctness and reliability.
- Wayland's compositor is swappable.
- In other words, you can use a different compositor if you need a more full-featured desktop experience.
- Several compositors are available for use with Wayland, including Arcan, Sway, Lipstick, and Clayland, to name a few.
- Many desktop environments create their own Wayland compositors, which is typically embedded within
- their windows manager.
  - ✓ For example, Kwin and Mutter both fully handle Wayland compositor tasks.

Troubleshooting Wayland

- **Try the GUI without Wayland.**
  - ✓ If your Linux distribution has multiple flavors of the desktop environment (with Wayland or with X11), log out of your GUI session and pick the desktop environment without Wayland. If your UI problems are resolved, then you know it has most likely something to do with Wayland.
  - ✓ If you do not have multiple flavors of the desktop environment and you are using the GNOME shell user interface, turn off Wayland by following these steps:
    1. Using super user privileges, edit the `/etc/gdm3/custom.conf` file.
    2. Remove the # from the `#WaylandEnable=false` line and save the file.
    3. Reboot the system and log in to a GUI session and see if the problems are gone.
- **Check your system's graphics card.**
  - ✓ f your system seems to be running fi ne under X11 but gets problematic when running under Wayland, check your graphics card.
- **Use a different compositor.**
  - ✓ If you are using a desktop environment's built-in compositor or one of the other compositors, try installing and using the Weston compositor package instead.

MANAGING THE GUI

With some operating systems, your GUI is fairly rigid. You may be able to move or add a few icons, change a background picture, or tweak a few settings. However, with Linux, the GUI choices are almost overwhelming and the flexibility is immense. This flexibility comes from lots of different components working together, with each one customizable in its own way. This section walks through the different components in the standard GUI environment.

Standard GUI Features

- On Linux a GUI is a series of components that work together to provide the graphical setting for the UI.
- One of these components is the desktop environment.
  - ✓ A desktop environment provides a pre-determined look and feel to the GUI. It is typically broken up into the following graphical sections and functions:
  - ✓ **Desktop Settings**
  - ✓ **Display Manager**
  - ✓ **File Manager**
  - ✓ **Icons**
  - ✓ **Favorites Bar**
  - ✓ **Launch**
  - ✓ **Menus**
  - ✓ **Panels**
  - ✓ **System Tray**
  - ✓ **Widgets**
  - ✓ **Windows Manager**

The X GUI Login System

- The display manager component is responsible for controlling the graphical login feature.
- Every Linux display manager package uses the X Display Manager Control Protocol (XDMCP) to handle the graphical login process.
- The X Display Manager (XDM) package is the basic display manager software available for Linux.
  - ✓ It presents a generic user ID and password login screen, passing the login attempt off to the Linux system for verification.
  - ✓ If the system authenticates the login attempt, XDM starts up the appropriate X server environment and Windows desktop environment.

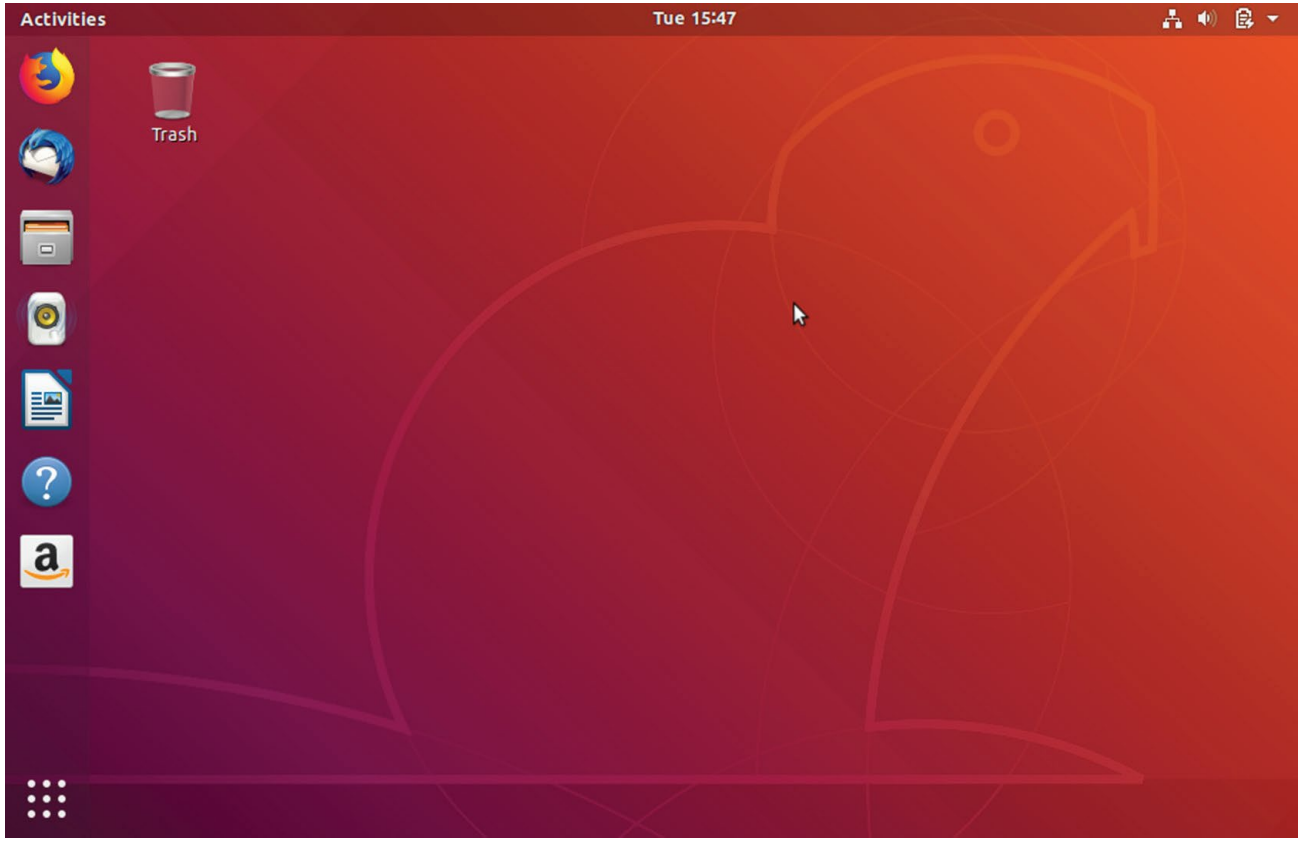
XDM Display Manager

- Although the XDM display manager is somewhat generic, there are some configuration features you can modify to change things a bit.
- The main configuration file is `/etc/X11/xdm/xdm-config`.
- In most situations, you'll never need to modify any of these settings.
- Most window managers create their own display manager and expand the capabilities of the XDM display manager.
- Here are a few of the more popular display managers you'll see:
  - ✓ **KDM**: The default display manager used by the KDE desktop environment
  - ✓ **GDM**: The default display manager used by the GNOME desktop environment
  - ✓ **LightDM**: A bare-bones display manager used in lightweight desktop environments such as Xfce

Common Linux Desktop Environments

Getting to Know GNOME

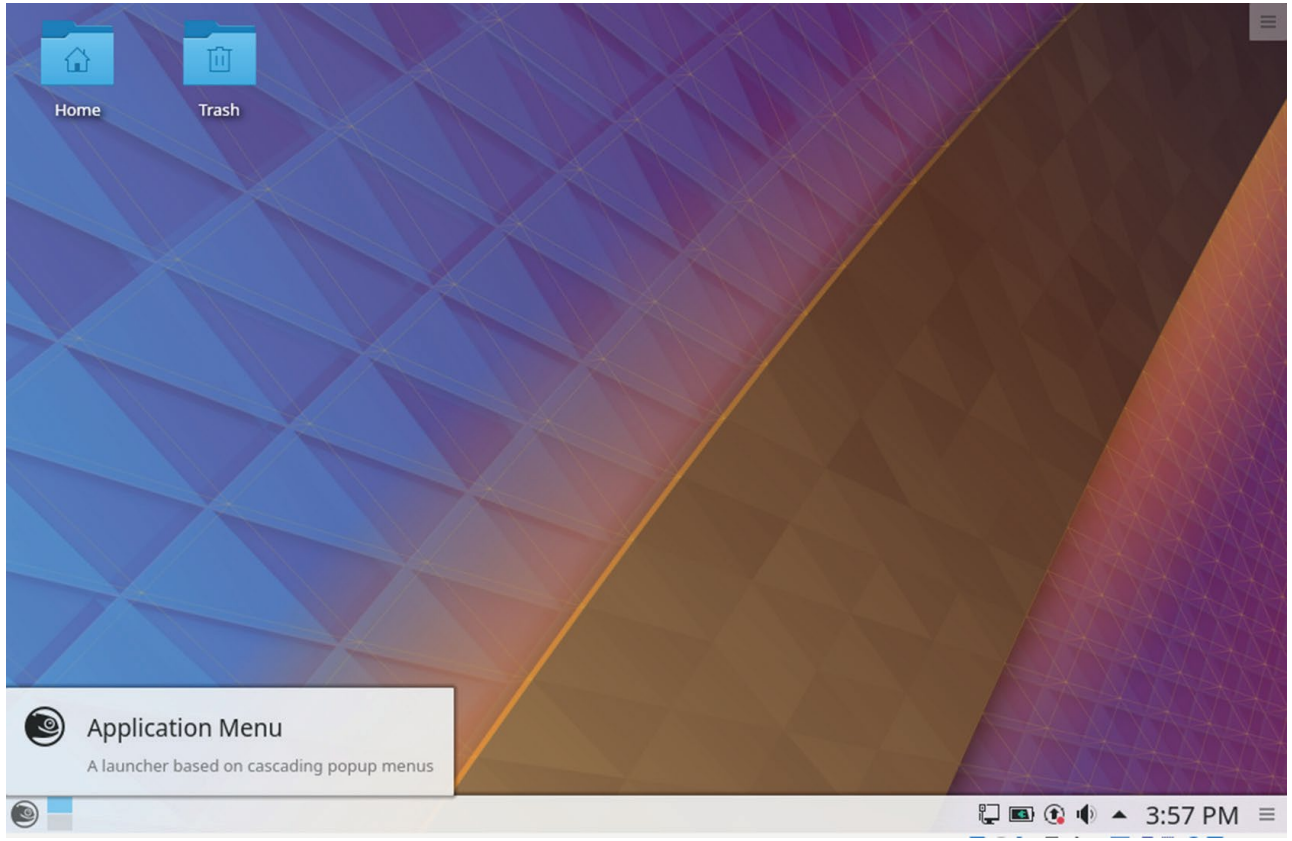
Name	Program name and/or description
Display Manager	GNOME Display Manager (GDM).
File Manager	GNOME Files (sometimes just called Files). Formerly called Nautilus.
Favorites Bar	GNOME Shell Dash (sometimes called the Dock).
Panels	A single panel located at GNOME Shell frame's top.
System Tray	Located on the right-hand side of the single panel
Windows Manager	Mutter



Common Linux Desktop Environments

Probing KDE Plasma

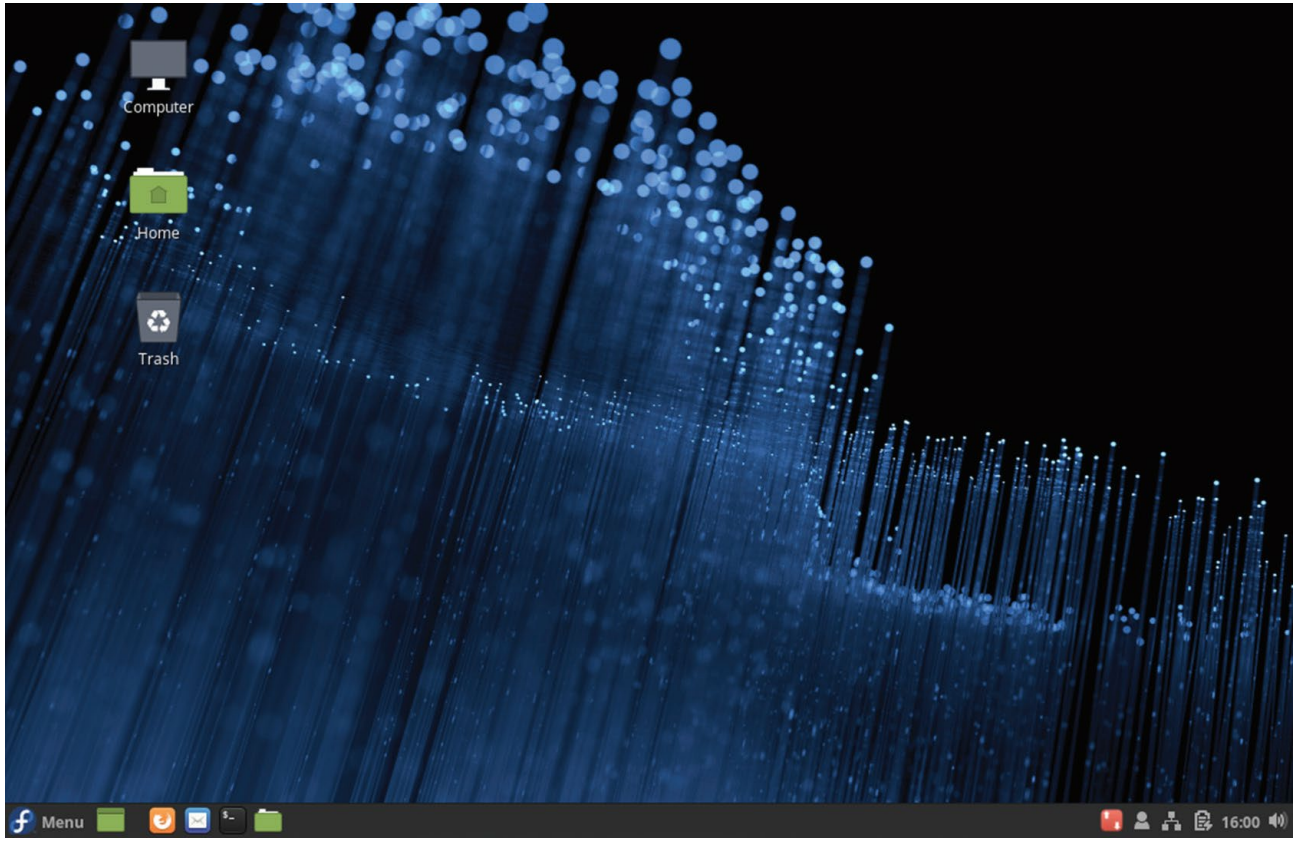
Name	Program name and/or description
Display Manager	SDDM (Simple Desktop Display Manager)
File Manager	Dolphin
Favorites Bar	Displayed inside Application menu
Panels	A single panel located at the Plasma frame's bottom
System Tray	Located on the right side of the single panel
Widgets	Called Plasmoids
Windows Manager	Kwin



Common Linux Desktop Environments

Considering Cinnamon

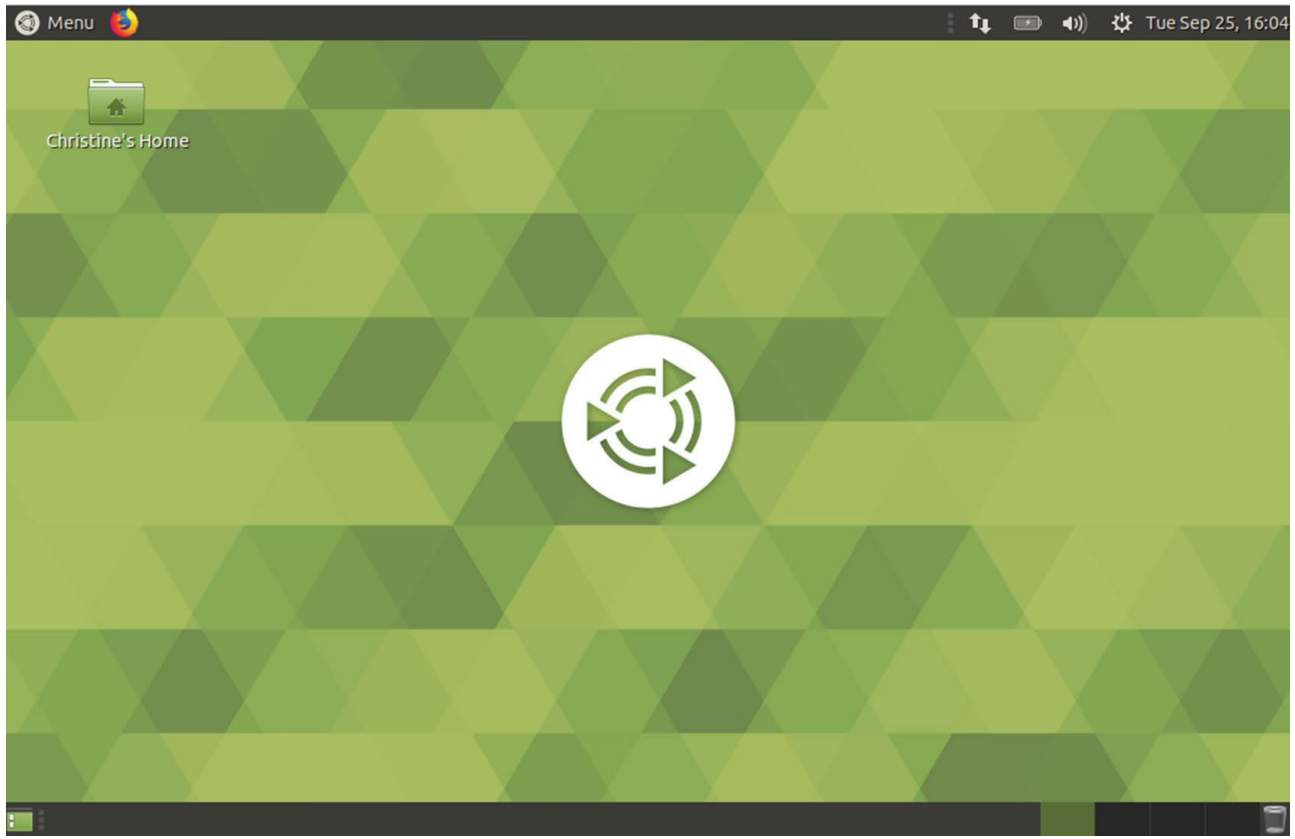
Name	Program name and/or description
Display Manager	LightDM
File Manager	Nemo (a fork of Nautilus)
Favorites Bar	Displayed inside Application menu
Panels	A single panel (called the Cinnamon panel) located at the Cinnamon frame's bottom
System Tray	Located on the right side of the single panel
Widgets	Cinnamon Spices
Windows Manager	Muffin (a fork of GNOME Shell's Mutter)



Common Linux Desktop Environments

Making Acquaintance with MATE

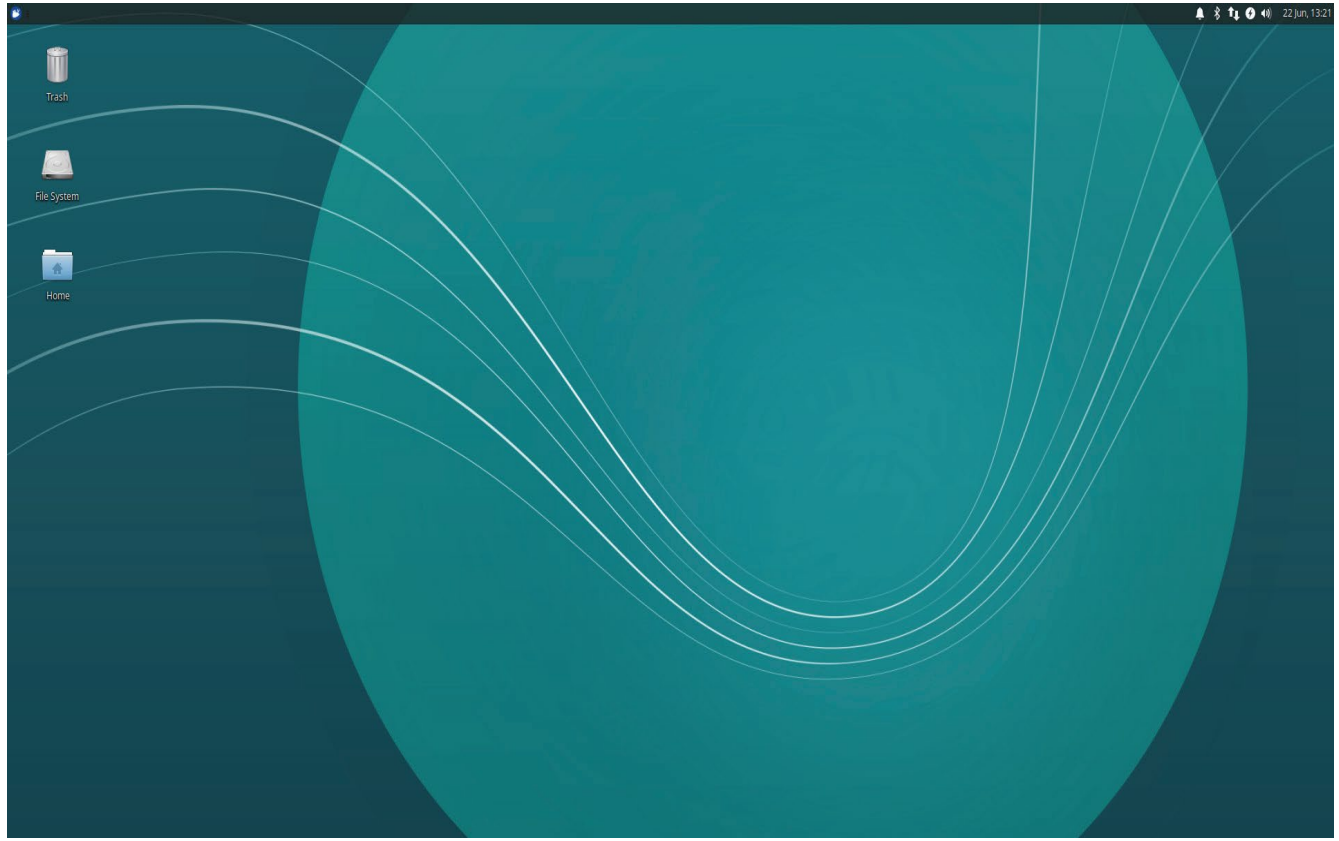
Name	Program name and/or description
Display Manager	LightDM
File Manager	Caja (a fork of Nautilus)
Favorites Bar	A Favorites Menu is used instead and is accessed via the Applications menu–driven launcher.
Panels	One panel at the bottom of the MATE frame and the other panel at the top of the MATE UI.
System Tray	Located on the right side of the top panel.
Windows Manager	Marco (a fork of Metacity).



Common Linux Desktop Environments

Going Bare-Bones with Xfce

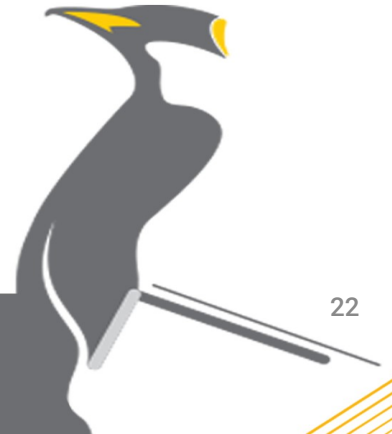
Name	Program name and/or description
Display Manager	LightDM
File Manager	Thunar
Favorites Bar	A single icon at the left side of the panel; displays favorites, recent applications, and the application menu
Panels	A single panel located at the top of the window
System Tray	A set of icons on the right side of the panel
Windows Manager	The specialized Xfwm, which utilizes its own compositor manager



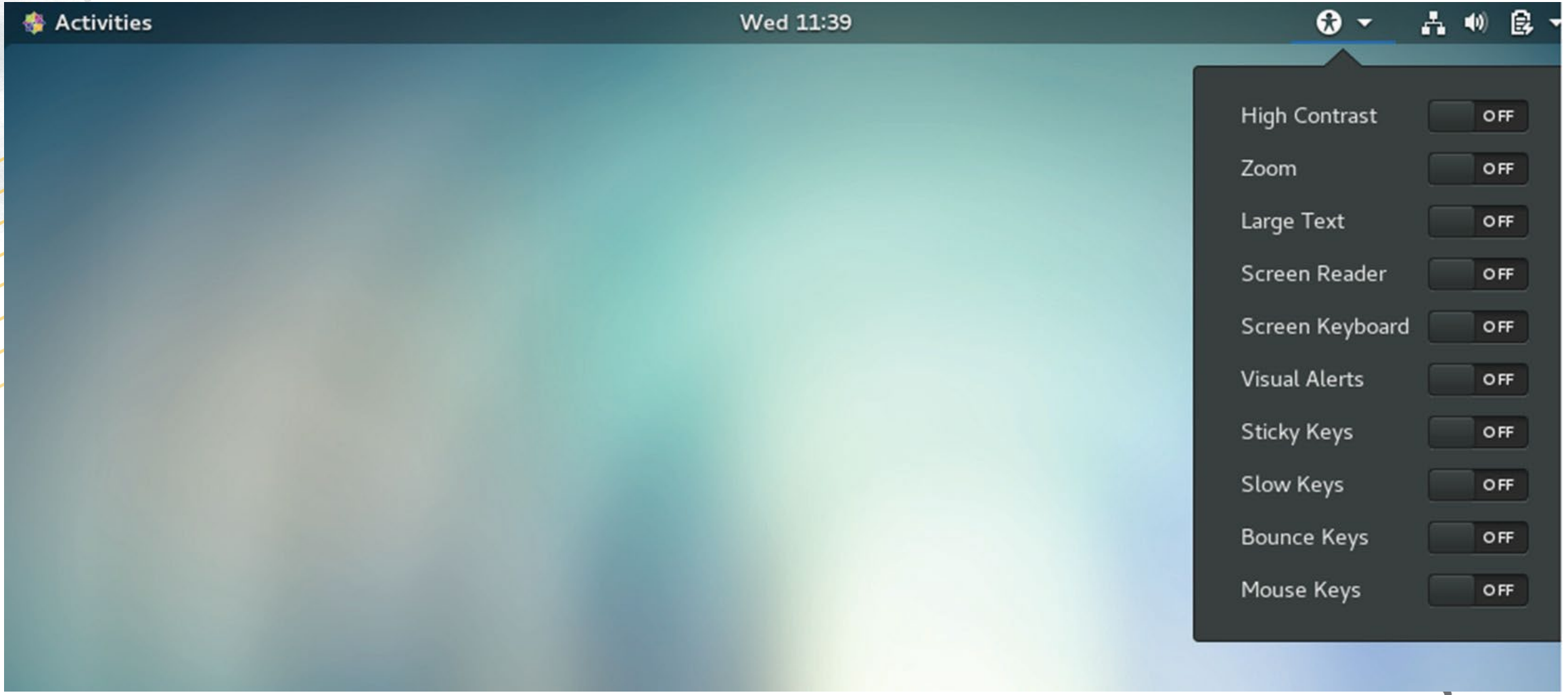
PROVIDING ACCESSIBILITY

In a GUI environment, accessibility deals with a user's ability to use the desktop environment. While the default desktop environment provided by a Linux distribution works for many people, accessibility settings allow the accommodation of all potential users. This includes individuals who may have vision impairment, who have concerns with using the mouse, who deal with finger movement issues, and so on.

It's important to know the desktop environment configurations for these accommodations so that you can help to provide access for all.



Universal access top panel menu in GNOME Shell



Common visual impairment accessibility settings

Name	Description
Cursor Blinking	Modifies the cursor blink rate to make it easier to locate the cursor on the screen.
Cursor Size	Modifies the cursor size.
High Contrast	Increases the windows' and buttons' brightness and darkens window edges as well as text and the cursor.
Large Text	Modifies the font size, often called a screen magnifier.
Screen Reader	Uses a screen reader to read the UI aloud. Popular choices include Orca screen reader and Emacspeak.
Sound Keys	Beeps when Caps Lock or Num Lock is turned on (off). Also called toggle keys.
Zoom	Amplifies the screen or a screen portion to different magnification levels.

Common hand and finger impairment accessibility settings

Name	Description
Bounce Keys	Keyboard option that helps to compensate for single keys accidentally pressed multiple times.
Double-Click Delay	Mouse option that modifies the amount of time allowed between double mouse clicks.
Gestures	Mouse option that activates programs and/or options by combining both mouse clicks and keyboard presses.
Hover Click	Mouse option that triggers a mouse click when the pointer is hovered over an item.
Mouse Keys	Mouse option that allows you to use keyboard keys to emulate the mouse functions.
Repeat Keys	Keyboard option that modifies how long a key must be pressed down as well as a delay to acknowledge the key repeat. Also called keyboard repeat rate.
Screen Keyboard	Keyboard option that displays a visual keyboard on the UI that can be manipulated by a mouse or other pointing device to emulate keystrokes.
Simulated Secondary Click	Mouse option that sets a primary key to be pressed along with a mouse click to emulate secondary mouse clicks.
Slow Keys	Keyboard option that modifies how long a key must be pressed down to acknowledge the key
Sticky Keys	Keyboard option that sets keyboard modifier keys, such as Ctrl and Shift, to maintain their pressed status until a subsequent key is pressed.

brltty Package

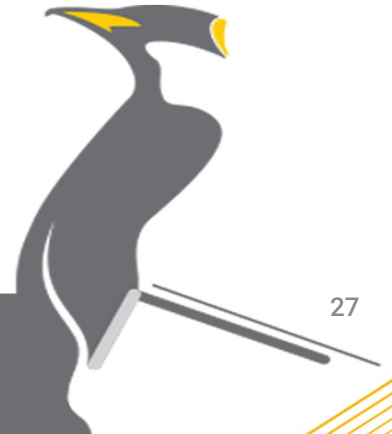
- If a blind user has access to a braille display, you can install the brltty package, which is available in most Linux distributions' repositories.
- The brltty package operates as a Linux daemon and provides console (text mode) access via a braille display.
- You can find out more about this software at its official headquarters, http://mielke.cc/brltty/.
- Be aware that you can also use the Orca screen reader with a refreshable braille display.

USING X11 FOR REMOTE ACCESS

The X11 system utilizes a classic client/server model for serving up graphical desktops. In most situations, the client and server both run on the same physical device, but that doesn't need to be the case.

You can have a remote X11 client connect to the X11 server to display the graphical desktop on a remote system. There are several different techniques for implementing remote connections of X11 desktop environments.

This section walks through the most popular ones.



Tunneling Your X11 Connection

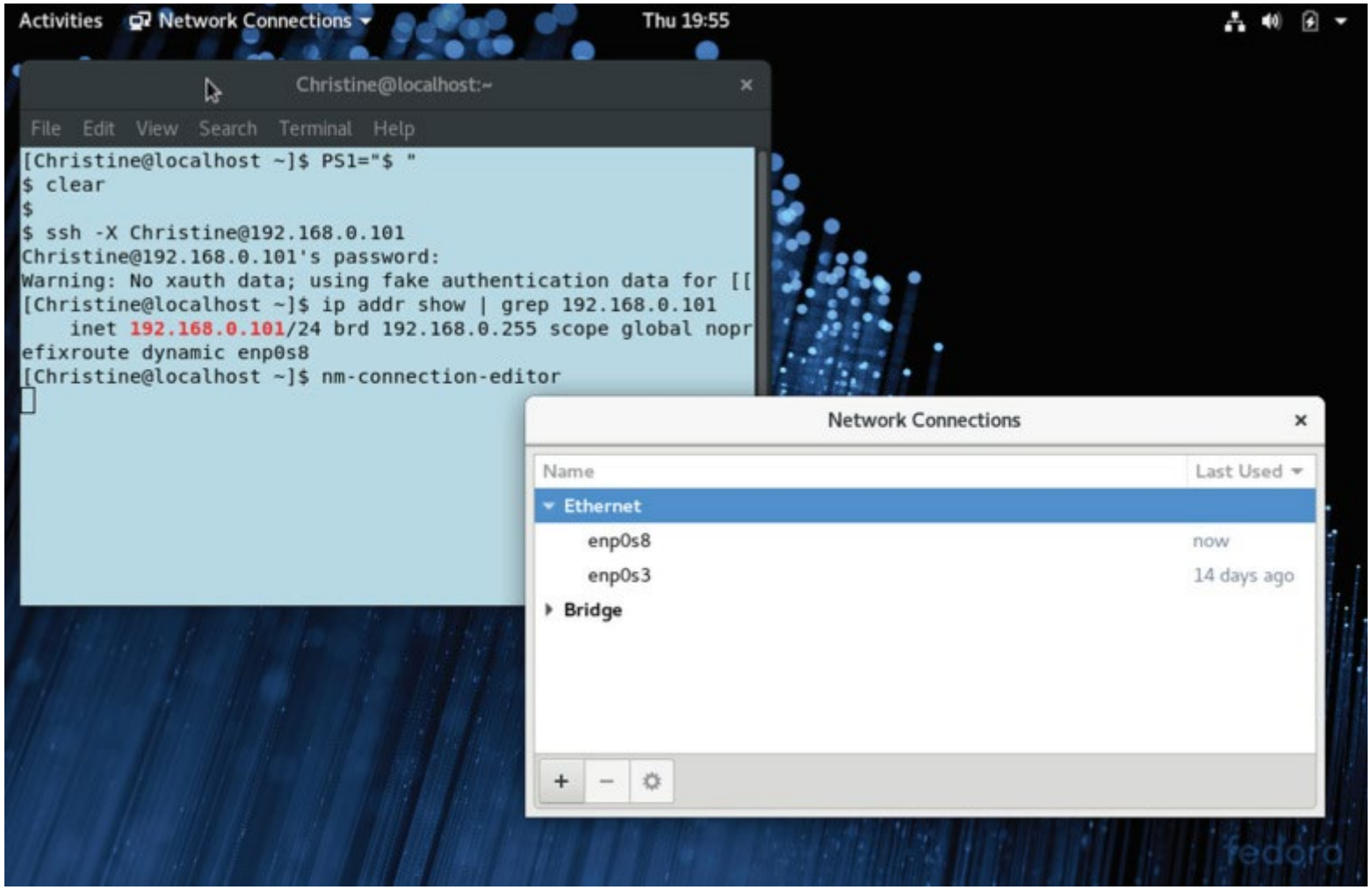
- X11 forwarding allows you to interact with various X11-based graphical utilities on a remote system through an encrypted network connection.
- This method is enacted using the openSSH service.
- First you need to check to see if X11 forwarding is permitted.
- This setting is in the openSSH configuration file, /etc/ssh/sshd_config.
- The directive X11Forwarding should be set to yes in the remote system's configuration file.
- If the directive is set to no, then you must modify it to employ X11 forwarding.

```
# grep "X11Forwarding yes" /etc/ssh/sshd_config
X11Forwarding yes
```

Tunneling Your X11 Connection

- After you have made any necessary configuration file modifications, the command to use is `ssh -X user@remote-host`.
- Similar to earlier `ssh` command uses, the user is the user account that resides on the remote-host system.
- The remote-host has the GUI utilities you wish to employ and can be designated via an IP address or a hostname.

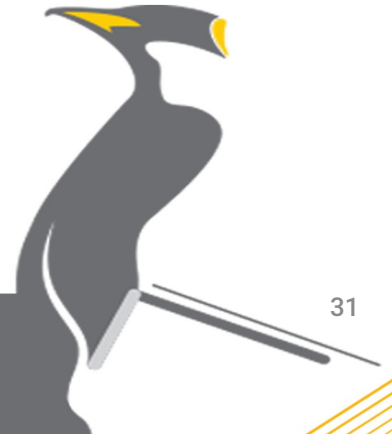
Tunneling Your X11 Connection



USING REMOTE DESKTOP SOFTWARE

While using the built-in client/server feature of X11 is nice, it can be a bit cumbersome. Fortunately, there's a whole crop of remote desktop applications available in Linux that do the hard work for us. Remote desktop software uses a client/server model to provide a server application on a remote host and a client application on a local host. All you need to do is point the client application to the remote application and you're in business. No messing with complicated forwarding or tunneling schemes.

In this section we will take a look at some of common remote desktop implementations for Linux. They include VNC, Xrdp, NX, and SPICE.



Viewing VNC

- Virtual network computing (VNC) was developed by the Olivetti & Oracle Research Lab.
- The VNC software is multiplatform and employs the Remote Frame Buffer (RFB) protocol.
  - ✓ This protocol allows a user on the client side to send GUI commands, such as mouse clicks, to the server.
  - ✓ The server sends desktop frames back to the client's monitor.
- The VNC server offers a GUI service at TCP port 5900+n, where n equals the display number, usually 1 (port 5901).
- On the command line you point the VNC client (called a viewer) to the VNC server's hostname and TCP port.
- Alternatively, you can use the display number instead of the whole TCP port number.
- The client user is required to enter a predetermined password, which is for the VNC server and not Linux system authentication.
- After the client user has authenticated with VNC, the user is served up the desktop environment's display manager output so that system authentication can take place.
- The VNC server is flexible in that you can also use a Java-enabled web browser to access it.
  - ✓ It provides that service at TCP port 5800 + n.
  - ✓ HTML5 client web browsers are supported as well.

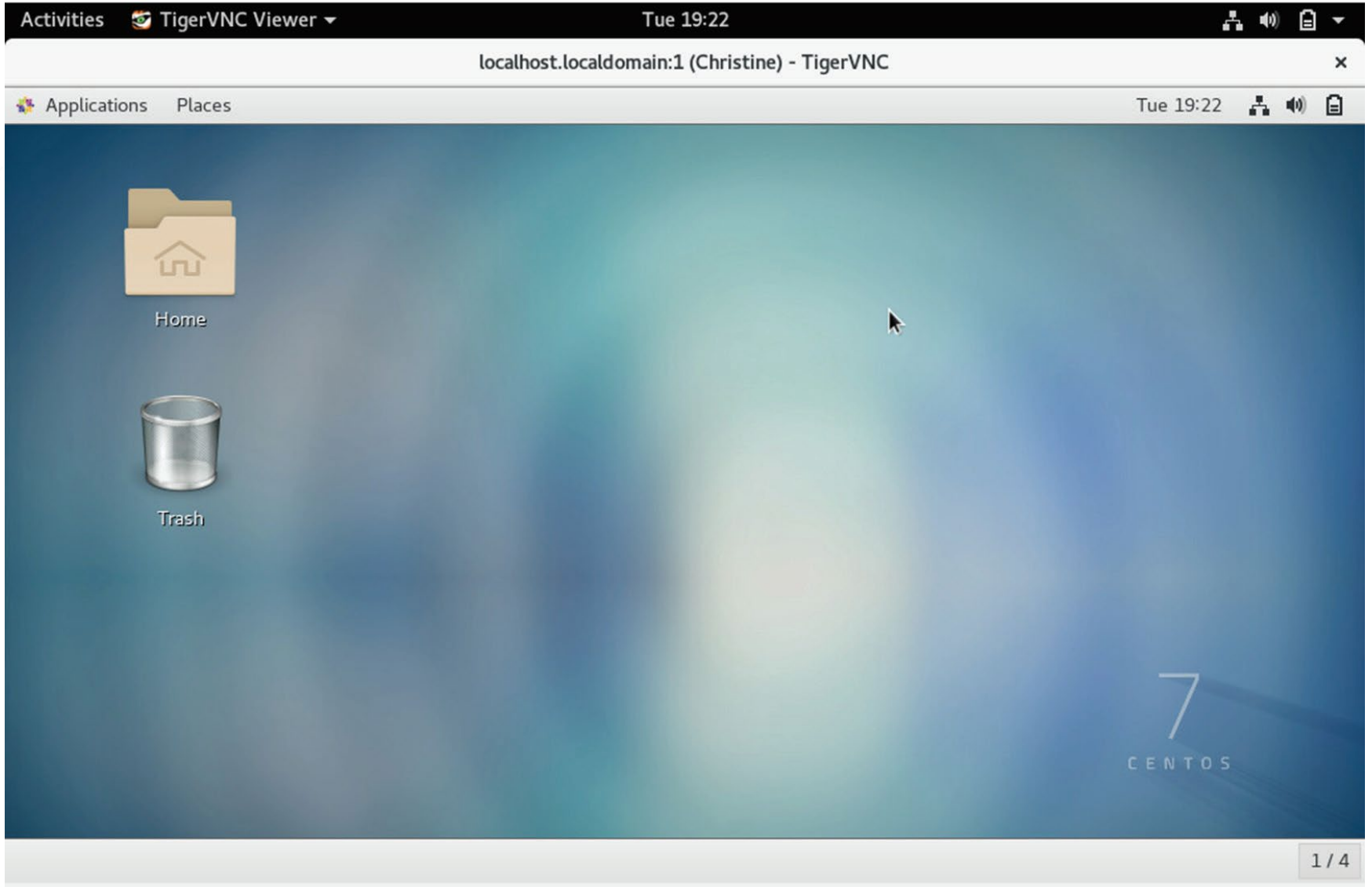
Viewing VNC

- **The following are positive benefits when using VNC:**
  - ✓ It has lots of flexibility in providing remote desktops.
  - ✓ Desktops are available for multiple users.
  - ✓ Both persistent and static desktops are available.
  - ✓ It can provide desktops on an on-demand basis.
  - ✓ An SSH tunnel can be employed via ssh or a client viewer command-line option to encrypt traffic.
- **The following are potential difficulties or concerns with VNC:**
  - ✓ The VNC server handles only mouse movements and keystrokes. It does not deal with file and audio transfer or printing services for the client.
  - ✓ VNC, by default, does not provide traffic encryption, so you must employ another means of protection, such as tunneling through openSSH.
  - ✓ The VNC server password is stored as plaintext in a server file.

Alternatives of VNC

- A popular implementation of VNC for Linux is TigerVNC.
- The TigerVNC website is at https://tigervnc.org/.
- It also works on Windows, so you can connect to either a remote Linux or Windows system.
- For installing the server on a Linux system, use the `tigervnc-server` package name.
- If you want to install the VNC client, just use the `tigervnc` package name.
- When you have the TigerVNC server installed, you control it with the `vncserver` and `vncconfig` commands.
- After making the appropriate server firewall modifications, the client can use the `vncviewer` command to connect to the server system and get a remote desktop.
  - ✓ For example, a server (example.com) has been configured properly to serve a remote desktop to you at display number 1.
  - ✓ You would access the desktop from another system via the `vncviewer example.com:1`

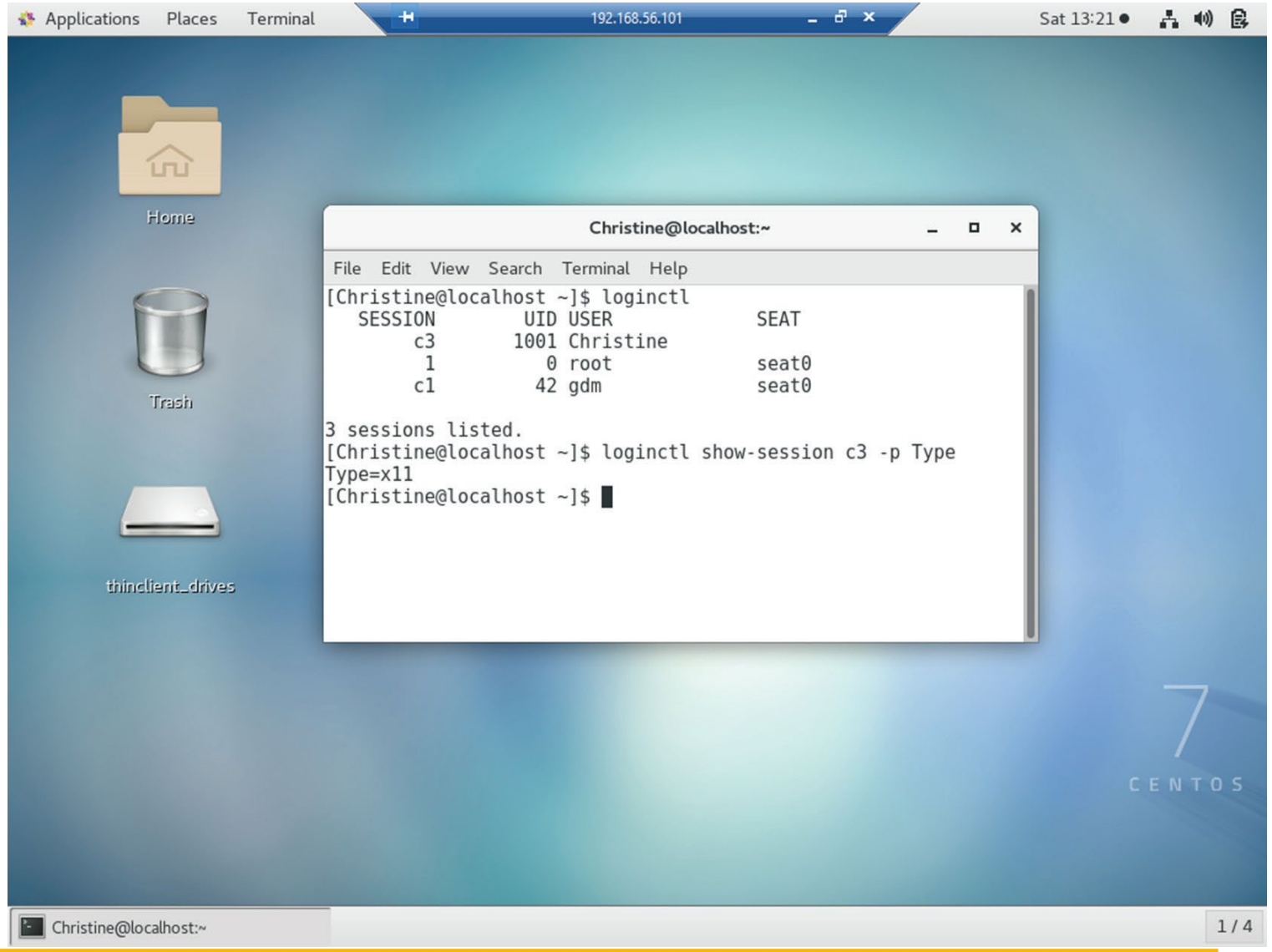
Using TigerVNC



Grasping Xrdp

- Xrdp is an alternative to VNC.
- It supports the Remote Desktop Protocol (RDP) and uses X11rdp or Xvnc to manage the GUI session.
- Xrdp provides only the server side of an RDP connection.
- It allows access from several RDP client implementations, such as rdesktop, FreeFDP, and Microsoft Remote Desktop Connection.
- The package name on Linux is `xrdp`.
- After installing and starting the Xrdp server, adjust the firewall so that traffic can access the standard RDP port (TCP 3389).
- Now direct your RDP client choice to the server via its hostname or IP address, and if necessary, provide the client the RDP port number.

Using Xrdp



Grasping Xrdp

- **The following are positive benefits of using Xrdp:**
  - ✓ Xrdp uses RDP, which encrypts its traffic using Transport Layer Security (TLS).
  - ✓ A wide variety of open source RDP client software is available.
  - ✓ You can connect to an already existing connection to provide a persistent desktop.
  - ✓ The Xrdp server handles mouse movements and keystrokes as well as with audio transfers and mounting of local client drives on the remote system.

Grasping Xrdp

- You can determine the various Xrdp configuration settings in the `/etc/xrdp/xrdp.ini` file.
- An important setting in this file is the `security_layer` directive.
  - If set to **negotiate**, the default, the Xrdp server will negotiate with the client for the security method to use.
- Three methods are available:
  - **tls**: Provides SSL (TLS 1.0) encryption for server authentication and data transfer. Be aware that this falls short of the encryption level needed for compliance with the Payment Card Industry (PCI) standards.
  - **negotiate**: Sets the security method to be the highest the client can use. This is problematic if the connection is over a public network and the client must use the standard RDP security method.
  - **Rdp**: Sets the security method to standard RDP security. This method is not safe from man-in-the-middle attacks.

Exploring NX

- The NX protocol, sometimes called NX technology, was created by NoMachine around 2001.
- Its v3.5's core technology was open source and available under the GNU GPL2 license.
- Yet, when version 4 was released, NX became proprietary and closed source.
- However, there are several open source variations available based on the NX3 technology.
- They include FreeNX and X2Go.
- The following are positive benefits of using NX products:
  - ✓ They provide excellent response times even over low-bandwidth connections that have high-latency issues.
  - ✓ They are faster than VNC-based products.
  - ✓ They use openSSH tunneling by default, so traffic is encrypted.
  - ✓ They support multiple simultaneous users through a single network port.
- NX technology compresses the X11 data so that there is less data to send over the network, which improves response times.
- It also heavily employs caching data to provide an improved remote desktop experience.

Studying SPICE

- Another interesting remote connection protocol is Simple Protocol for Independent Computing Environments (SPICE).
- Originally it was a closed source product developed by Qumranet in 2007.
- However, Red Hat purchased Qumranet in 2008 and made SPICE open source.
  - ✓Its website is here: www.spice-space.org.
- Now, typically Spice is used for providing connections with KVM virtual machines, moving into VNC's territory.

Studying SPICE

- **Spice is platform independent and has some very nice additional features as well. They include:**
  - ✓ Spice's client side uses multiple data socket connections, and you can have multiple clients.
  - ✓ Spice delivers desktop experience speeds similar to a local connection.
  - ✓ Spice consumes low amounts of CPU, so you can use it with various servers that have multiple virtual machines and not adversely affect their performance.
  - ✓ Spice allows high-quality video streaming.
  - ✓ Spice provides live migration features, which means there are no connection interruptions if the virtual machine is being migrated to a new host.

Studying SPICE

- **While Spice has a single server implementation, it has several client implementations.**
- **These include remote-viewer and GNOME Boxes.**
- **Another benefit of employing Spice is its strong security features.**
  - ✓ Transmitted data can be sent plaintext or traffic can be encrypted using TLS.
  - ✓ Authentication between the Spice client and remote Spice server is implemented using Simple Authentication and Security Layer (SASL).
  - ✓ This framework allows various authentication methods, as long as they are supported by SASL.
  - ✓ Kerberos is a supported method.
- **If you are still dealing with X11, you can use X.Org-created Xspice to act as a standalone Spice server as well as an X server.**