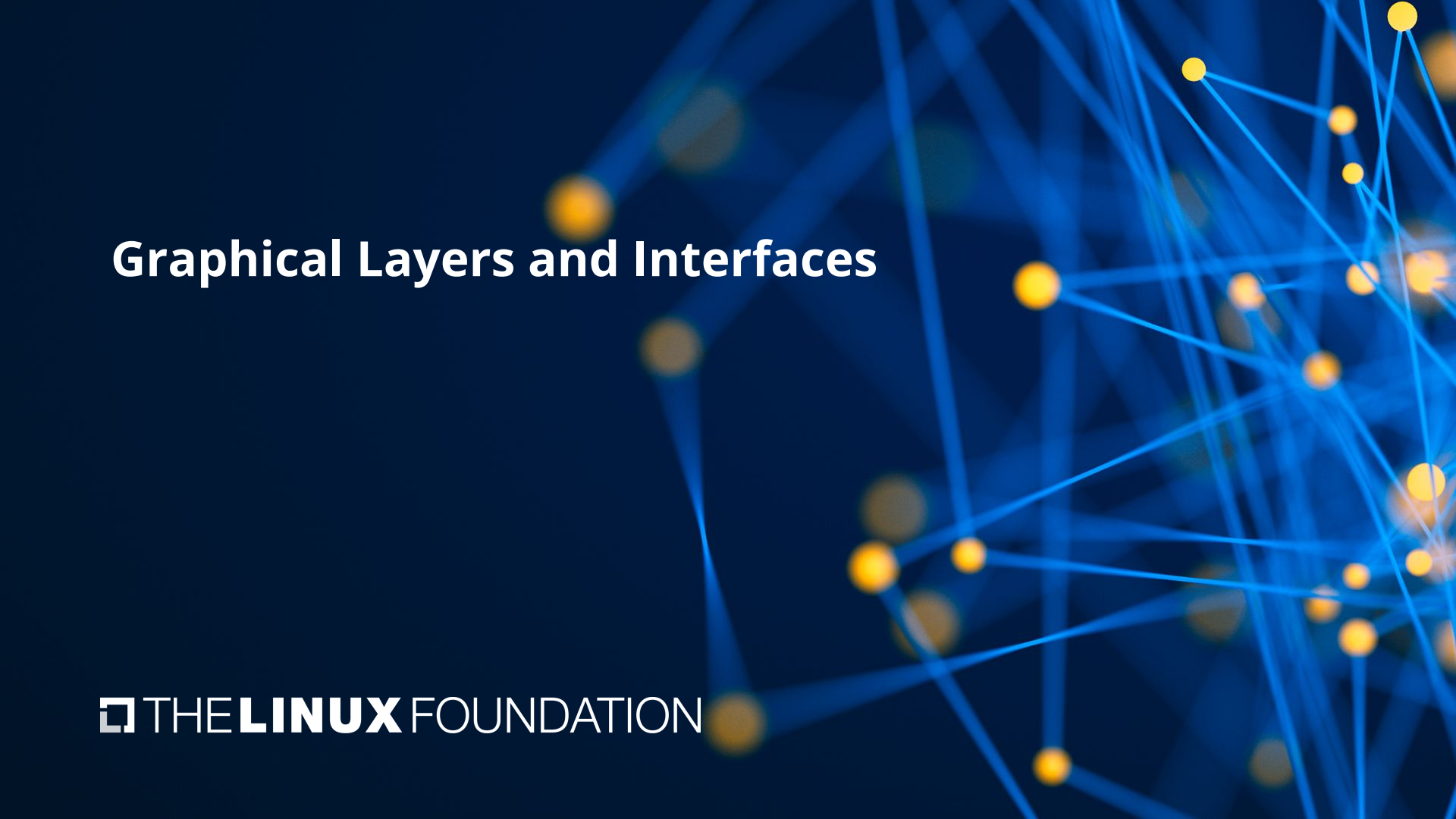
Graphical Layers and Interfaces

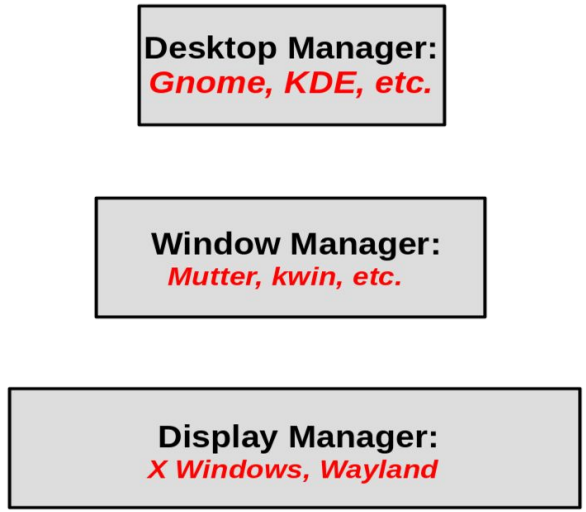


THE LINUX FOUNDATION

Graphical Layers

The Linux graphical interface is actually composed of a number of layers, each of which having a choice of options. The three basic layers are:

- The X Window System
- The Window Manager
- The Desktop Manager



X Window System: Overview

- The **X Window System** (often called just X, Xorg or X11) has a long history in the UNIX world - its original versions can be traced back at least since 1984
- Since its inception, X was designed to handle displaying the results of activities on remote computers; at its roots it is fundamentally a communication protocol
  - This is unlike the graphical interfaces used in some other well-known operating systems, which were designed originally only to display programs running on the local machine, which may or may not have had network connections
- As far as the user experience, X's main function is to handle keyboard and pointer input, and handle showing the results on the screen in multiple **windows** (X is very strong at handling multiple screens, or terminals simultaneously)

Nomenclature

- In X nomenclature,
  - The **server** is what runs on your local machine which handles the input and display
  - The **client** is the application being displayed and is as likely to be anywhere on the network and worldwide Internet as it is on the local machine
- This differs from the usual server/client distinction you may be used to, where the server is a remote machine, and the client the local machine

Criticism

- A criticism of X sometimes heard is that it has a high inherent overhead because it works on a network paradigm, which also leads to a complicated design
- While this might have been true with early versions, modern implementations make very efficient use of **unix domain sockets**, **shared memory** and other optimizations, and the criticism does not hold weight anymore

Configuration

- There are many standard programs that ship with X, but the normal user will probably never have to interact with them directly, but will adjust properties and preferences through the graphical interface
- Almost all Linux distributions use the version of X that is supplied by X.org
  - The basic configuration file can be found at **`/etc/X11/xorg.conf`** and controls things like color-depth, display resolution, scanning rates, what pointers are available, which video card to use, etc.
  - If you are lucky, you will never have to touch **`xorg.conf`** directly; it is best to let it be generated by the installation program and then subsequently tweaked through graphical interfaces
  - In most modern Linux distributions this file has actually disappeared, and X is auto-configured on system start, although one can always substitute a custom file; sometimes, manual intervention is required (e.g. if you have recent or unusual hardware)

Wayland

- X is a rather old system; it dates back to the mid 1980s and as such has certain deficiencies on modern systems (with security for example) as it has been stretched rather far from its original purposes
- A newer system known as **Wayland** is expected to gradually supersede it and was adopted as the default display system in Fedora 25

Window Managers: Overview

- By itself, X has only limited functions; it does not control the exact placement and appearance of windows in the graphical interface
- This is the job of the **window manager**; some of its functions include:
  - Controlling the appearance of a window
  - Controlling pointer focus properties
  - Handling multiple desktops
  - Providing tabbed windows
  - Controlling visual effects
- This is not a complete list, and the line between window manager and desktop manager is not always well-defined
- Also, the window manager itself gives you the capability of altering many of these properties and different window managers can be tweaked to look very much alike

Window Managers for Linux

- There are a number of window managers available for Linux, and desktop managers have default choices:
  - For GNOME 3, the default is **mutter**
  - For KDE it is **kwin**
  - Other ones in use include **metacity**, **fvwm**, **fluxbox**, **enlightenment**, **sawfish**, and **xfwm**
- Some of the alternatives are very flashy, while some (such as **fvwm** and **fluxbox**) are very minimal, very fast, and work beautifully on limited hardware

Desktop Managers: Overview

- The **desktop manager** sits above X and the window manager; it is what the user is most likely to directly interact with
- The tasks of the desktop manager include:
  - Providing taskbars, menu bars, drop-down menus, and methods of configuring them
  - Offering applications (e.g. clocks, performance monitors, volume controls, etc.)
  - Enabling placing icons and program launchers on the desktop and/or the taskbar
  - Giving choices for themes, desktop backgrounds and wallpaper, screensavers, etc.
  - Providing methods for drag and drop functionality, etc.
  - Making it possible to save the desktop state from one session to another subsequent login

Desktop Managers for Linux

- The most common desktop managers in use for Linux are:
  - **GNOME** (heavily dependent on the **gtk** set of graphical libraries)
  - **KDE** (built upon the **QT** libraries)
  - Others exist including **XFCE**
- Furthermore, some of the lightweight window managers, such as **fluxbox** and **fvwm** do not even require a desktop manager, as they have already have enough functionality to survive on their own
- Many distributions give you a choice of selecting one or the other desktop during installation; some let you choose both at installation or let you install the other at a later point
- Then you can choose which desktop manager you would like when you login

GNOME and KDE

- It is entirely possible to run KDE programs when running the GNOME desktop and vice versa, as long as the underlying libraries are installed; you can even drag and drop between the two, as the developers have tried hard to maintain interoperability
- If your distribution has done a sensible job of controlling dependencies on installing programs and their requisites, this should all be transparent to the user
- Because each window manager is so flexible, they can be made to look very much the same; for example, on RHEL systems, the default themes for GNOME and KDE look so much alike it can be hard to tell which one you are actually using

Terminal Window Options

- Linux users often take advantage of the command line to accomplish tasks
- While one can always bring up a one shot launch box (usually by hitting **`Alt-F2`** in most desktop managers), one needs a **terminal window** program to open up a window that can be used repeatedly
- The GNOME desktop contains the **gnome-terminal** program, which is very full-featured; it can be always be invoked from menus, which vary slightly between distributions, and also added to the *Favorites* panel
- If the **nautilus-open-terminal** package is installed on any but some of the most recent GNOME-based distributions, you can always open a terminal by right clicking anywhere on the desktop background and selecting *Open in Terminal* (this may work even if the package is not installed)

Terminal Window Options (Cont.)

- Menu items on the top bar make the presentation extremely flexible; right clicking anywhere in the terminal also provides configuration controls
- Extremely useful is the opportunity to use multiple tabs as in browsers, within the same terminal
- The KDE desktop contains the **konsole** program, which is similarly flexible; opening new tabs is termed as opening shells
- Desktop managers generally have a preferred applications menu choice in which you can pick the default terminal application
- The full-featured terminals, such as **gnome-terminal** and **konsole**, can be slower to display many lines of text, as compared to more ancient programs such as **xterm** or **rxvt**; however, in most modern systems this will not be noticeable, and the enhancements are well worth it