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# Xorg, X11, Wayland? Linux Display Servers And Protocols Explained

An explanation of the technologies your Linux desktop environment relies on.



by Bobby Borisov · Updated October 20, 2021 · 5



**Have you ever wondered what exactly X server, Xorg, X11, Wayland and stuff like that does? Wayland vs Xorg, what is better? This guide is for you.**

You always stumble upon those terms, and know they have something to do regarding the graphics, but you'd like to know more.

# What is Display Server in Linux?

A display server is a program whose primary task is to coordinate the input and output of its clients to and from the rest of the operating system, the hardware, and each other. The display server communicates with its clients over the display server protocol.

The display server is a key component in any graphical user interface, specifically the windowing system. It is the basic component of Graphical User Interface (GUI) which sits between the graphical interface and the kernel. So, thanks to a display server, you can use your computer with GUI. Without it, you would only be restricted to a command line interface.

It is very important to not confuse display server with desktop environment. The desktop environments ([Gnome](#), [KDE](#), [Xfce](#), [MATE](#), etc.) uses display server underneath it.

The display server communicates with its clients over the display server protocol. There are three display server protocols available in Linux. X11 and Wayland are two of them. The third, [Mir](#), is beyond the scope of this tutorial.

## X Window System, Xorg, X11, Explained

**X Window System**, often referred to merely as X, is really old. First originating in 1984, it ended up being the default windowing system for most UNIX-like operating systems, including Linux.

**X.Org server** is the free and open-source implementation of the X Window System display server stewarded by the [X.Org Foundation](#). It is an application that interacts with client applications via the X11 protocol to draw things on a display and to send input events like mouse movements, clicks, and keystrokes. Typically, one would start an X server which will wait for clients applications to connect to it. Xorg is based on a client/server model and thus allows clients to run either locally or remotely on a different machine.

If it's not obvious, it's implicit in the design of X11 that the application and the display don't have to be on the same computer. At the time X was developed, it was very common that the X server would run on a workstation and the users would run applications on a remote computer with more processing power.

**X11** is a network protocol. It describes how messages are exchanged between a client (application) and the display (server). These messages typically carry primitive drawing commands like “draw a box”, “write these character at this position”, “the left mouse button has been clicked”, etc.

But X11 is old, and it was still a pile of hacks sitting on top of a protocol not truly overhauled for over 30 years. Most of the features that the X Server protocol provided were not used anymore. Pretty much all of the work that X11 did was redelegated to the individual applications and the window manager. And yet all of those old features are still there, weighing down on all of these applications, hurting performance and security.

## Wayland, the Next-generation Display Server

**Wayland** was begun by Kristian Hogsberg, an X.Org developer, as a personal project in 2008. It is a communication protocol that specifies the communication between a display server and its clients. Wayland is developed as a free and open-source community-driven project with the aim of replacing the X Window System (also known as X11, or Xorg ) with a modern, secure, and simpler windowing system.

In Wayland, the compositor is the display server.

**Compositor**, is a window manager that provides applications with an off-screen buffer for each window. The window manager composites the window buffers into an image representing the screen and writes the result into the display memory.

The Wayland protocol lets the compositor send the input events directly to the clients and lets the client send the damage event directly to the compositor.

As in the X case, when the client receives the event it updates the user interface (UI) in response. But, in the Wayland rendering happens in the client, and the client just sends a request to the compositor to indicate the region that was updated.

Wayland's main advantage over X is that it is starting from scratch. One of the main reasons for X's complexity is that, over the years, its role has changed. As a result, today, X11 acts largely as "a really terrible" communications protocol between the client and the window manager.

Wayland is also superior when it comes to security. With X11, it's possible to do something known as "keylogging" by allowing any program to exist in the background and read what's happening with other windows open in the X11 area. With Wayland this simply won't happen, as each program works independently.

## Conclusion

However, the X Window System still has many advantages over Wayland. Even though Wayland eliminates most of the design flaws of the Xorg it has its own issues. Even though the Wayland project has

been up for more than ten years things are not 100% stable. As of 2020, the majority of video games and graphics-intensive applications for Linux are still written for X11. Also, many closed-source graphics drivers, such as those for NVIDIA GPUs, do not yet offer complete support for Wayland.

X cannot last and Wayland, in many ways, is an improvement. But for now the vast majority of native applications that exist were written for Xorg. Until those apps are all ported, Xorg needs to be maintained. Wayland is not very stable yet, compared to Xorg.

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## 5 COMMENTS



Anonymous

May 2, 2021 at 4:16 am

Fascinating, but how does one use it?  
Maybe you can point to as tutorial. I'm trying to get my x-client to display on my x-server running wayland.

Reply



Steve G

July 30, 2021 at 3:04 am

Came with my Fedora 34 KDE  
Plasma install when I got my new  
laptop this spring.

Reply



BT

October 29, 2021 at 1:02 pm

But X is available under Wayland as  
XWayland. That makes it not a big deal to  
run under Wayland and let X applications  
run with xwayland ???

Reply



Lost

December 13, 2021 at 6:07 pm

I think X is on top of Wayland as a  
compatibility layer.  
Once people start writing apps to Wayland,  
XWayland (X over Wayland) will see less  
and less use.  
It it not?

Reply



DStevenson

January 21, 2022 at 3:38 pm

Came across this article after suddenly seeing errors on my CentOS 8 server when I tried to give a remote support tech access to troubleshoot an issue with backup software. We were trying to use Team Viewer which worked fine before I migrated from CentOS 8 to CentOS 8 Stream. Now I get an error when trying to launch a connection “Wayland detected, incoming connection will fail” or something to that effect. Now I need to search for an alternative remote support program or find a workaround. Anyone know if Wayland can be temporarily disabled? Since it seems to be a new feature of CentOS 8 Stream I don’t want to try to completely uninstall it.

Reply

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