

Cygwin/XFree86 Frequently Asked Questions

Harold L Hunt, II

Questions and Answers

1. General Information

1.1. What is Cygwin/XFree86?

Cygwin/XFree86 is a port of XFree86 to Cygwin; Cygwin provides a UNIX-like API on the Win32 platform. At the time of writing, supported Win32 platforms are Windows 95, Windows 98, Windows Me, Windows NT 4.0, and Windows 2000. Windows CE, Windows 3.1, Windows 3.11, and Windows NT 3.51 are not supported.

1.2. What is Cygwin?

Cygwin tools are, in the words of the Cygwin homepage (<http://cygwin.com/>), “ports of the popular GNU development tools and utilities for Windows 95, 98, and NT. They function by using the Cygwin library which provides a UNIX-like API on top of the Win32 API.” Cygwin provides the compiler (gcc), libraries, headers, and other utilities which build and support the operation of Cygwin/XFree86.

1.3. What is the X Window System®?

[ScheiflerGettys92]

The X Window System, or X, is a network-transparent window system. With X, multiple applications can run simultaneously in windows, generating text and graphics in monochrome or color on a bitmap display. Network transparency means that application programs can run on machines scattered through the network.

1.4. What is XFree86?

XFree86, in the words of the XFree86 homepage, is “a freely redistributable open-source implementation of the X Window System that runs on UNIX(R) and UNIX-like (like Linux, the BSDs, Mac OS X (aka Darwin) and Solaris x86 series) operating systems and OS/2.”

1.5. What is an X Server?

An X Server is a program that provides display and user input services to other programs. In comparison, a file server provides other programs with access to file storage devices. File servers are typically located in a remote location and you use the services of a file server from the machine that you are located at. In contrast, an X Server is typically running on the machine that you are located at; display and user input services may be requested by programs running on your machine, as well as by programs running on remote machines.

1.6. What is an X client?

An X client is a program that utilizes the display and user input services provided by an X Server. X clients may run on the same or disparate machine as the X Server that is providing display and user input services.

1.7. Why port XFree86 to Microsoft Windows?

Porting XFree86 to Microsoft Windows benefits many people and projects in many ways:

- Prior to Cygwin/XFree86 only commercial, closed source X Servers were available for Microsoft Windows.
- An X Server on Windows may be used to display the output of programs running on remote UNIX machines.
- Cygwin/XFree86, in conjunction with Cygwin, provides a complete compatibility layer for compiling and running UNIX applications on Microsoft Windows.

1.8. Is there a Cygwin/XFree86 newsgroup?

No, Cygwin/XFree86 does not have a newsgroup; however, we do have a mailing list. See Q: 1.9.

1.9. Is there a Cygwin/XFree86 mailing list?

Yes, Cygwin/XFree86 has a mailing list, namely, cygwin-xfree@cygwin.com. Visit the Cygwin Mailing Lists (<http://cygwin.com/lists.html>) page to subscribe to cygwin-xfree@cygwin.com as well as to read and search an online archive of the mailing list traffic.

Tip: Post your X-related inquiries to cygwin-xfree@cygwin.com only; do not post nor cross post your inquiries to the cygwin@cygwin.com mailing list. Cygwin's mailing list is only for Cygwin API related inquiries that are not handled by another more-specific list.

2. Installation

2.1. What versions of Windows does Cygwin/XFree86 run on?

Cygwin/XFree86 supports Windows 95, Windows 98, Windows Me, Windows NT 4.0, and Windows 2000 as of 2001-05-19. Windows XP will be supported when it is officially released.

Cygwin/XFree86 requires Cygwin to compile and run. Cygwin is not currently available on Microsoft Windows CE, therefore Cygwin/XFree86 is not currently available on Microsoft Windows CE.

2.2. How is Cygwin/XFree86 installed?

The Cygwin/XFree86 User's Guide

(<http://www.msu.edu/~huntharo/xwin/docs/ug/cygwin-xfree-ug.html>) thoroughly documents the installation process.

2.3. Which archives do I need to download and install?

The Cygwin/XFree86 User's Guide

(<http://www.msu.edu/~huntharo/xwin/docs/ug/cygwin-xfree-ug.html>) lists the archives that need to be downloaded and installed.

2.4. Can I use WinZip to extract Cygwin/XFree86 archives?

No. WinZip is not aware of Cygwin's symlink handling, nor does WinZip properly handle the end of line characters in Cygwin/XFree86's archives. Extracting Cygwin/XFree86's archives with a utility other than Cygwin's tar and bzip2 will likely result in the X Server reporting that it cannot open a font file on startup; the server will shutdown immediately after giving this error.

2.5. bunzip2 reports: "It is possible that the compressed file(s) have become corrupted."

Short answer: the bzip2 files on the server are not corrupt.

Downloading the Cygwin/XFree86 archives using a web browser causes all sorts of problems, as web browsers sometimes attempt to "help" you by automatically decompressing downloaded files. However, the automatic decompression is broken in that the decompression process usually fails to remove the .bz2 extension from the decompressed file. You may be able to simply rename the downloaded file, leaving off the .bz2 extension; if that method fails, you will have to redownload the files, by using either a standard ftp client (e.g. **ftp** including with Cygwin), or by using your web browser and right-clicking the link to each file and choosing **Save Target As...**, **Save Link As...**, or a similarly named command. Choosing **Save Target As...**, **Save Link As...**, or a similarly named command instructs the web browser to save the file directly, without passing the

file through any interpretation steps, thus preventing the web browser from automatically decompressing the files.

3. Configuration

3.1. Why isn't there an XF86Config file?

Cygwin/XFree86 uses an entirely different server executable than XFree86. Cygwin/XFree86 queries Windows for configuration information and accesses your hardware in a device independent manner through the Win32 API, whereas the XFree86 server must read detailed information about your hardware from a configuration file.

3.2. What are the command line arguments for XWin.exe?

The Cygwin/XFree86 User's Guide

(<http://www.msu.edu/~huntharo/xwin/docs/ug/cygwin-xfree-ug.html>) documents the command line arguments for XWin.exe.

3.3. Why does XWin.exe ignore the display depth that I pass on the command line?

When running in windowed mode or GDI-based fullscreen mode, XWin.exe must run the X Server at whatever display depth Windows is currently using; in these cases the display depth passed on the command line is ignored. XWin.exe only uses the display depth parameter when running in a DirectDraw-based fullscreen mode, as DirectDraw allows applications to change the display resolution and depth when running in fullscreen mode.

3.4. I have a two button mouse, can I emulate a three button mouse?

Yes. Pass the `-emulate3buttons timeout_in_milliseconds` parameter to XWin.exe, where `timeout_in_milliseconds` is the, optional, maximum number of milliseconds between a button release and opposite button press that will trigger an emulated third button press.

4. Usage

4.1. Why is twm the only window manager included with Cygwin/XFree86?

twm resides in the XFree86 source tree, therefore it is compiled and released with Cygwin/XFree86 automatically. Other window managers are available, but they reside in other source trees and are therefore not released with the core Cygwin/XFree86 archives.

4.2. What precompiled window managers are available?

XFCE and vtwm are available

4.3. How do I use a non-U.S. keyboard layout?

See Q: 4.4. to obtain a modmap for your keyboard layout.

4.4. Where can I find an xmodmap for my non-U.S. keyboard layout?

You can try using an xmodmap file for your keyboard layout from a GNU/Linux distribution (e.g. RedHat).

Or, you can use **xkeycaps** to automatically generate a modmap for one of over 208 different layouts. See the xkeycaps home page (<http://www.jwz.org/xkeycaps/>) to download and for more information.

4.5. How do I get my non-U.S. keyboard modmap to be installed when using xdmcp?

This answer assumes that your non-U.S. keyboard modmap is located in `/etc/X11` and is called `xmodmap.country_code`, where `country_code` is your two-letter standardized country code (e.g. Australia = au, Deutschland = de, France = fr, Japan = jp, United Kingdom = uk).

First, you must create a script that tells **xmodmap** to load the modmap for your non-U.S. keyboard layout. One way to run **xmodmap** on X Server startup when using *xdmcp* is to add the following two lines to `/etc/X11/xdm/XSetup`:

```
#!/bin/sh
/usr/X11R6/bin/xmodmap /etc/X11/xmodmap.country_code
```

Now you must tell xdm to run the screen setup script on startup. In `/etc/X11/xdm/xdm-config`, add the following line:

```
DisplayManager*setup: /etc/X11/xdm/Xsetup
```

4.6. I have installed a modmap for my non-U.S. keyboard layout, but how do I get **bash to display accents and/or umlauts?**

Add the following two lines to `.inputrc` in your Cygwin home directory (e.g. `/home/harold/`):

```
set output-meta On # to show 8-bit characters
set convert-meta Off # to show it as character, not the octal
representation
```

4.7. How do I put `bash` into “8 bit” mode?

See Q: 4.6.

5. Troubleshooting

5.1. I have a specific error message, what does it mean?

See the Error and Warning Messages section for help with specific error messages. Return here if you do not find help for the error message that you have.

6. Error and Warning Messages

6.1. `_XSERVTransmkdir`: Owner of `/tmp/.X11-unix` should be set to root

This warning message can be ignored; it does not cause any known problems.

6.2. error opening security policy file `/usr/X11R6/lib/X11/xserver/SecurityPolicy`

From xfree86.org, “This is a only a warning message, and is mostly harmless. If your server is failing to startup, this is not the reason. Check the other messages.”

6.3. Fatal server error: could not open default font ‘fixed’

This error results from the end of line characters on the font files being incorrect; this is almost always caused by extracting the Cygwin/XFree86 archives using a non-Cygwin aware archival program, such as WinZip. See Q: 2.4.

6.4. Could not init font path element `/usr/X11R6/lib/X11/fonts/*/`, removing from list!

See Q: 6.3. and Q: 2.4.

6.5. The procedure entry point `_check_for_executable` could not be located

Programs that you are attempting to use were compiled against a newer version of Cygwin than is currently on your system. Run Cygwin’s setup program to update your installation to the latest version.

6.6. Exception: `STATUS_INTEGER_DIVIDE_BY_ZERO`

You are most likely running your primary Windows® display at a bit depth that requires palettized color, most likely 8 bits per pixel, in conjunction with a release of Cygwin/XFree86 that does not support palettized color modes. Palettized color support was added to Cygwin/XFree86 on 2001-06-05. You may either install a newer version of Cygwin/XFree86 that supports palettized color, or you may run your primary Windows display at 15, 16, 24, or 32 bits per pixel.

6.7. XDMCP fatal error: Session declined No valid address

Cygwin/XFree86 is sometimes unable to determine which local network interface's address should be reported to the *XDMCP* server; in these cases you need to pass *-from local_host_name_or_ip_address* to *XWin.exe* to specify which interface address to report.

6.8. Xlib: connection to "local_host_name_or_ip_address:0.0" refused by server Xlib: Maximum number of clients reached

Cygwin/XFree86 uses a value defined at compile time for the maximum number of client connections allowed; the default value is defined by `MAXCLIENTS` in `xc/programs/Xserver/include/misc.h`. `MAXCLIENTS` defaults to 256, but some users have received the above error when roughly 25 clients have connected; report your error to the cygwin-xfree@cygwin.com mailing list if you encounter this error message with fewer than 256 client connections.

6.9. Cannot Open Display: 127.0.0.1:0.0

Certain classes of software, such as that used for *Virtual Private Networking* and *fire-walling* may cause the IP address 127.0.0.1, or other local adapter addresses, to be redirected, to become inoperable in some way, or to be operated in a manner that violates the defined operation of IP address.

As a potential remedy, try removing all instances of such software; this may not always fix the problem though, as some software may leave artifacts even after uninstallation is completed. The only way to be sure that you have not found a Cygwin/XFree86 bug is to install Windows on a freshly formatted hard drive, followed by Cygwin and Cygwin/XFree86, and finally add your other software one application at a time until Cygwin/XFree86 stops working.

Some products that have been reported to cause problems:

Note: These products may not cause problems in all configurations. However, the Cygwin/XFree86 project has neither the time, ability, nor resources to help you correctly configure your third-party software.

- Aventail Connect
- Zonealarm PC Firewall from Zonelab

7. Contributing

7.1. Where do I get the Cygwin/XFree86 source code?

Cygwin/XFree86 source code is contained in, and distributed with, the XFree86 source tree. Periodically the Cygwin/XFree86 project releases a snapshot of the XFree86 source code that is known to compile. Read-only CVS access to the XFree86 source tree (<http://xfree86.org/cvs/>) is also available from the XFree86 project.

7.2. Do I need to be a member of XFree86 to contribute to Cygwin/XFree86?

No. Cygwin/XFree86 only needs one developer that is a member of the XFree86 organization; as of 2001-05-22 we have three members. XFree86 members have very few privileges over non-members; specifically, XFree86 members do not generally have CVS write access, so you aren't really missing out on anything if you aren't an XFree86 member.

Exceptional Cygwin/XFree86 contributors may occasionally be nominated for membership to XFree86.

7.3. Are there editors for Windows that understand and preserve UNIX end of line characters?

Yes. Emacs and XEmacs are available for Windows; they both understand and preserve UNIX end of line characters.

See the GNU Mirror List (<http://www.gnu.org/order/ftp.html>) for a mirror near you; Emacs is located under `gnu/pub/windows/emacs/`.

See the XEmacs Download Page (<http://xemacs.org/Download/index.html>) to download XEmacs for Windows.

7.4. How should I generate patches for Cygwin/XFree86?

Only submit patches that have UNIX end of line characters. See Q: 7.3. for information on editors for Windows that are aware of UNIX end of line characters.

Generally it is better for us if you generate your patches against the XFree86 CVS tree. For example, run `cvs -z4 diff -U3 hw/xwin/` from `xc/programs/Xserver/` to generate a diff file for all the modified files in `hw/xwin/`. CVS is smart enough to only generate diffs for files that are in the CVS repository; for example, CVS diff will not create diffs for Emacs temporary files.

In the case that you have modified a single file, create the diff with `cvs -z4 diff -U3 file_name`.

7.5. Where do I submit patches for Cygwin/XFree86?

Submit patches for Cygwin/XFree86 to the `cygwin-xfree@cygwin.com` mailing list.

See Q: 7.4. for more information on generating patches.

7.6. Where does Cygwin/XFree86's X Server source reside in the XFree86 source tree?

Cygwin/XFree86's X Server source code resides primarily in
`xc/programs/Xserver/hw/xwin/`.

7.7. How is compilation of Cygwin/XFree86 configured?

XFree86 uses platform independent Imakefiles to generate platform dependent Makefiles.
Cygwin/XFree86 specific parameters used to compile the Makefiles are contained in
`/xc/config/cf/cygwin.cf`.

7.8. How do I compile Cygwin/XFree86 after I have unpacked a source snapshot or after I have checked out the XFree86 CVS tree?

Note: Capitalization is important in the following command.

Open a Cygwin window, change to the `xc/` directory, and run **make World**; not that capitalization is important.

7.9. How do I recompile just XWin.exe if I have confined my changes to
`xc/programs/Xserver/hw/xwin/`?

Note: Capitalization is important in the following commands.

Change the current directory to `xc/programs/Xserver/hw/xwin/`.

Run **make Makefile** if you have modified `hw/xwin/Imakefile`.

Run **make depend** if you have modified the list of included files in any of the source files in
`hw/xwin/`.

Change the current directory to `xc/programs/Xserver/`.

Run **make XWin.exe** to rebuild the server executable.

7.10. Why doesn't XFree86 use GNU's **autoconf**?

XFree86 does not use **autoconf** because **autoconf** was not available when the X Window System project was started in 1984.

7.11. What compiler does Cygwin/XFree86 use, and which compilers are supported?

Cygwin/XFree86 uses the gcc compiler from the Free Software Foundation. Cygwin/XFree86 source code is mostly ANSI C compliant, but we cannot guarantee that Cygwin/XFree86 will compile with any other compiler, nor can we afford to support compilers other than gcc.

See the GCC Home Page (<http://gcc.gnu.org>) for more information on gcc.

7.12. Is cross-compiling from a non-Cygwin platform supported?

Cross-compiling from a non-Cygwin platform is not for beginners; as such, you should only be cross-compiling if you know what you are doing. You may submit simple questions regarding cross-compiling to the Cygwin/XFree86 mailing, but do not always expect an answer, as we may not currently have a subscriber that is actively cross-compiling.

See CrossGCC Frequently Asked Questions (<http://www.objsw.com/CrossGCC/>) for more information on cross compiling with gcc.

7.13. Where can I get help for installing DocBook on Cygwin?

See SGML for Windows NT: Setting up a free SGML editing and publishing system on Windows NT/Cygwin (http://ourworld.compuserve.com/homepages/hoenicka_markus/cygbook1.html) by Markus Hoenicka.

7.14. How can I build a debug version of the XFree86 CVS tree?

Simple: instead of running **make World** from `xc/`, run **config/util/makeg.sh World** from `xc/` instead. **makeg.sh** is a script that wraps **make** and creates a debug build for you, without you having to change any configuration files. Essentially, **makeg.sh** passes `-g` to **gcc** for every object and executable target.

8. Licenses, Patents, Trademarks, and Copyrights

8.1. What licenses apply to Cygwin/XFree86 source code?

Cygwin/XFree86 proper isn't covered by a single license, as Cygwin/XFree86 is made up of two parts that are covered by distinct licenses: Cygwin and XFree86.

See Q: 8.2. and Q: 8.3. for more information regarding the licenses that apply to Cygwin/XFree86.

8.2. What licenses apply to the XFree86 source code?

XFree86 source code is generally licensed under an X11 style license (<http://www.x.org/terms.htm>), which is certified by the Free Software Foundation (<http://www.fsf.org/philosophy/license-list.html#GPLCompatibleLicenses>) as compatible with the GNU GPL.

8.3. What license applies to Cygwin source code?

Cygwin source code is licensed under a modified version of the GNU GPL. Cygwin's modification specifically allows third-party software under an open source license to be linked with Cygwin without requiring that the source code for the third-party software be distributed under the terms of the GNU GPL. Cygwin's developers went to great trouble to obtain this modification and should be thanked for doing so, as without it the modification, Cygwin/XFree86 linking to Cygwin would be the subject of endless discussion.

8.4. Whom holds the copyright on the Cygwin/XFree86 source code?

Cygwin/XFree86 proper doesn't have a single copyright holder, as Cygwin/XFree86 is made up of two parts, namely Cygwin and XFree86, that follow different schemes in regards to whom will hold the copyright on source code.

See Q: 8.5. and Q: 8.6. for more information regarding whom holds the copyright on Cygwin/XFree86 source code.

8.5. Whom holds the copyright on the XFree86 source code?

Each source code file in XFree86 typically has its own license and copyright statement. Therefore, there is not a general rule for determining whom holds the copyright on a particular XFree86 source file, as each author is free to assign the copyright to someone else, to some group, or to keep the copyright themselves. You must inspect the source code file in question to determine whom holds the copyright for that file.

8.6. Whom holds the copyright on the Cygwin source code?

RedHat (<http://redhat.com/>) owns the copyright on the Cygwin source code. RedHat requires that copyright be assigned to RedHat for non-trivial changes to Cygwin. You must fill out a copyright transfer form if you are going to contribute substantial changes to Cygwin.

8.7. What license applies to Motif?

Motif is a closed source product produced by The Open Group (<http://www.opengroup.org/>). However, The Open Group released Open Motif (<http://www.opengroup.org/openmotif/>) on

2000-05-15 under a public license, The Open Group Public License (<http://www.opengroup.org/openmotif/license>), that allows Open Motif to be distributed with and used on Open Source platforms. Cygwin/XFree86 may qualify as a platform that Open Motif can be distributed with and used on, but work has yet to begin on determining if that is the case. Furthermore, no work has been done, as of 2001-05-24, to build Open Motif with Cygwin/XFree86.

8.8. Isn't "XWin" trademarked by StarNet Communications?

No. A quick search at the United States Patent and Trademark Office (<http://www.uspto.gov/>) for "XWin" turns up one dead record and one live record. The live record is for a logo belonging to a rock crusher manufacturer based out of Belgium. Neither trademark affects Cygwin/XFree86, as the dead record is no longer enforceable, while the live record is in an unrelated and distinct industry; there cannot be confusion between rock crushers and computer programs.

Bibliography

Books

- [ScheiflerGettys92] Robert W. Scheifler, James Gettys, Jim Flowers, and David Rosenthal, 1992, 1-55558-088-2, Butterworth-Heinemann, *X Window System: The Complete Reference to Xlib, X Protocol, ICCCM, and XLFD*.
- [Richter99] Jeffrey Richter, 1999, 1-57231-996-8, Microsoft® Press, *Programming Applications for Microsoft® Windows®: Mastering the critical building blocks of 32-bit and 64-bit Windows®-based applications*.
- [Petzold99] Charles Petzold, 1999, 1-57231-995-X, Microsoft® Press, *Programming Windows: The definitive guide to the Win32® API*.
- [McKay99] Everett N. McKay, 1999, 0-7356-0586-6, Microsoft® Press, *Developing User Interfaces for Microsoft® Windows®: Practical and effective methods for improving the user experience*.
- [JonesOhlund99] Anthony Jones and Jim Ohlund, 1999, 0-7356-0560-2, Microsoft® Press, *Network Programming for Microsoft® Windows®: Clear, practical guide to Microsoft's networking APIs*.
- [Yuan01] Feng Yuan, 2001, 0-13-086985-6, Prentice Hall PTR, *Windows® Graphics Programming: Win32® GDI and DirectDraw®*.

[CohenWoodring98] Aaron Cohen and Mike Woodring, 1998, 1-56592-296-4, O'Reilly & Associates, Inc., *Win32® Multithreaded Programming: Building Thread-Safe Applications*.

[CameronRosenblattRaymond96] Debra Cameron, Bill Rosenblatt, and Eric Raymond, 1996, 1991, 1-56592-152-6, O'Reilly & Associates, Inc., *Learning GNU Emacs: UNIX Text Processing*.

[Lewine91] Edited by Dale Dougherty, Donald A. Lewine, 1991, 0-937175-73-0, O'Reilly & Associates, Inc., *POSIX Programmer's Guide: Writing Portable UNIX Programs*.

[KernighanRitchie88] Brian W. Kernighan and Dennis M. Ritchie, 1998, 1978, 0-13-110370-9, Prentice Hall PTR, *The C Programming Language: ANSI C*.

Glossary

F

firewall

Firewall software attempts to protect an internal network from intrusions originating from an external network.

V

Virtual Private Network

Virtual Private Networks are encrypted tunnels through which private data can be safely transmitted over a private network (e.g. the Internet).

X

X Display Manager

An X Display Manager presents a graphical login screen to X users. Often an XDM will allow the user to select a desktop environment or window manager to be for their login session. Some X Display Managers are xdm, gdm (Gnome Display Manager), and kdm (KDE Display Manager).

X Display Manager Control Protocol

XDMCP allows XDM to process logins for users remote to the machine that XDM is running on; login sessions will be run on the machine running XDM. For example, at a university you may use XDMCP to login to an X session running on an engineering department computer from your dorm room.

See Also: X Display Manager.

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