

Cygwin/X User's Guide

Harold L Hunt, II

Jon Turney

Cygwin/X User's Guide

by Harold L Hunt, II

by Jon Turney

Copyright (c) 2000 Harold L Hunt II. Copyright © 2009-2015 Jon Turney. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.3 or any later version published by the Free Software Foundation; with no Invariant Sections, with no Front-Cover Texts, and with no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

Table of Contents

1. Cygwin/X Overview	1
2. Setting Up Cygwin/X	2
Installing Cygwin/X	2
3. Configuring Cygwin/X	10
Configuration overview	10
Windowing mode	10
Command line parameters	12
XWinrc configuration file	12
4. Using Cygwin/X	13
Starting Cygwin/X	13
Starting in multiwindow mode (startxwin)	13
Starting an X desktop environment session or X window manager in windowed mode	13
Starting an X session with XLaunch	13
Starting in windowed mode (startx)	14
Notes for advanced users	14
Obsolete startup methods	15
Switching out of Cygwin/X	15
Stopping Cygwin/X	15
Window managers	15
Windows Clipboard integration	16
Shared memory support	16
Displaying remote clients	17
Secure ssh	17
Insecure telnet or rsh (Not recommended)	18
Remote sessions via XDMCP	19
OpenGL (GLX)	20
Input internationalization	22
Compose key ('Multi_key')	22
Input Method Editors (IMEs)	22
Starting the ibus IME	22
Starting other IMEs	23
Terminal Server or Fast User Switching	23
Customizing the notification area icon menu	23
A. GNU Free Documentation License	25
Colophon	32

List of Tables

4-1. Summary of OpenGL rendering options	20
--	----

Chapter 1. Cygwin/X Overview

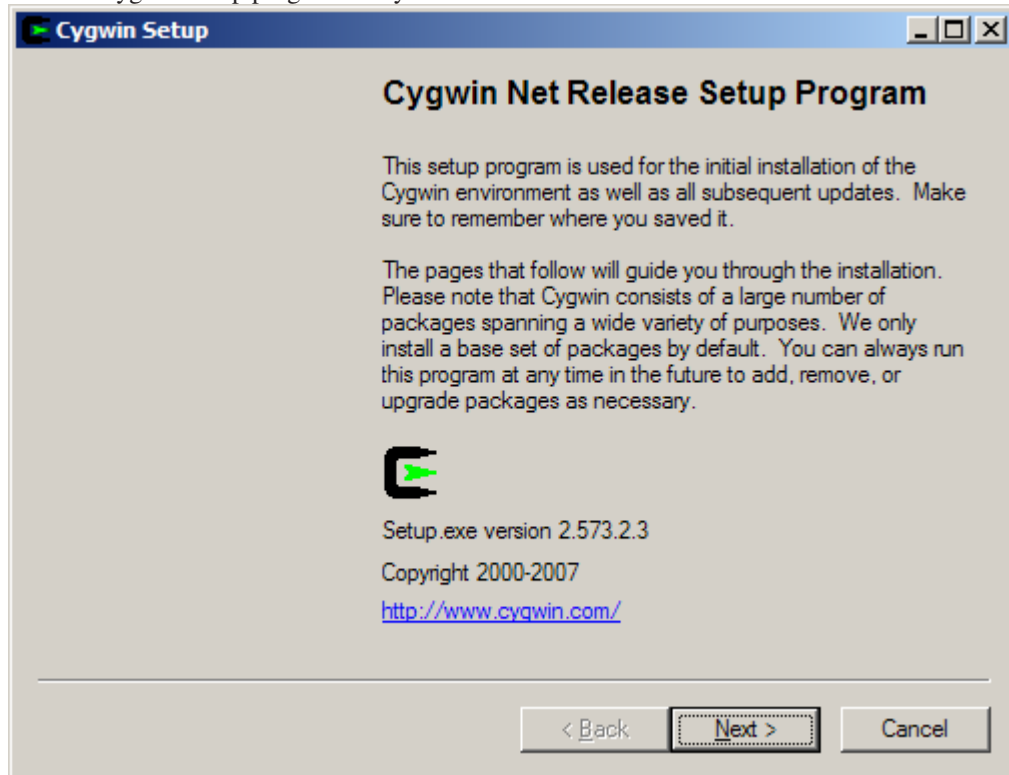
Cygwin/X is a port of the X Window System to Cygwin. The Cygwin library provides a UNIX-like API on the Win32 platform.

Chapter 2. Setting Up Cygwin/X

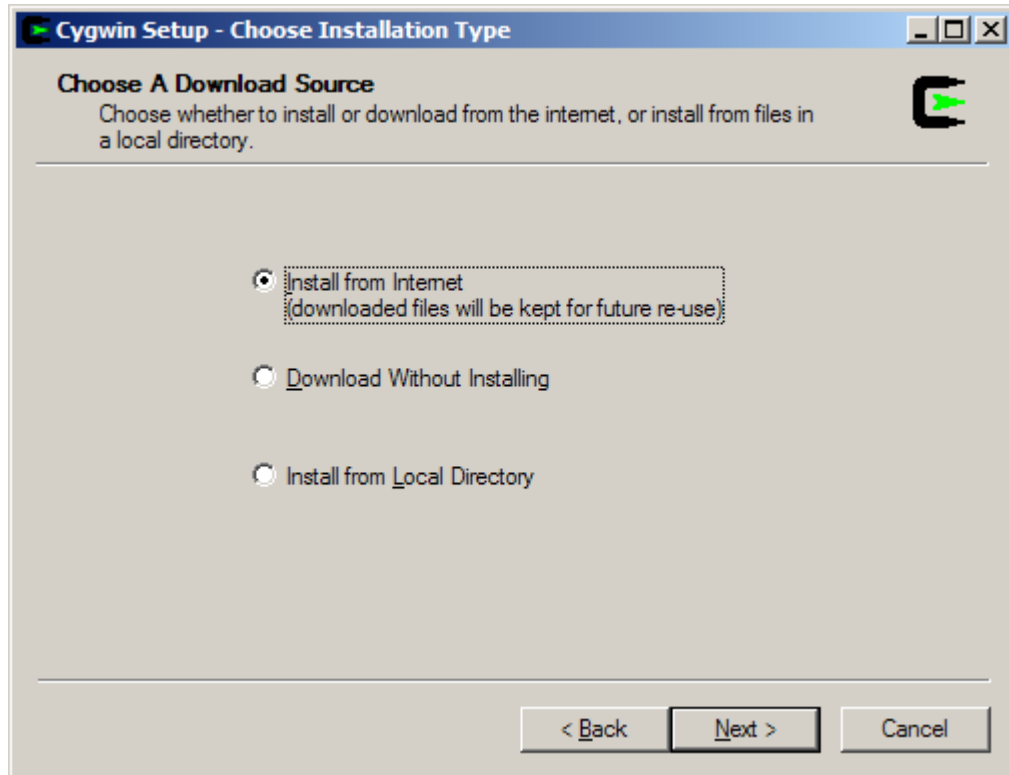
Installing Cygwin/X

Cygwin has a nice setup program that downloads and installs the necessary Cygwin packages for you.

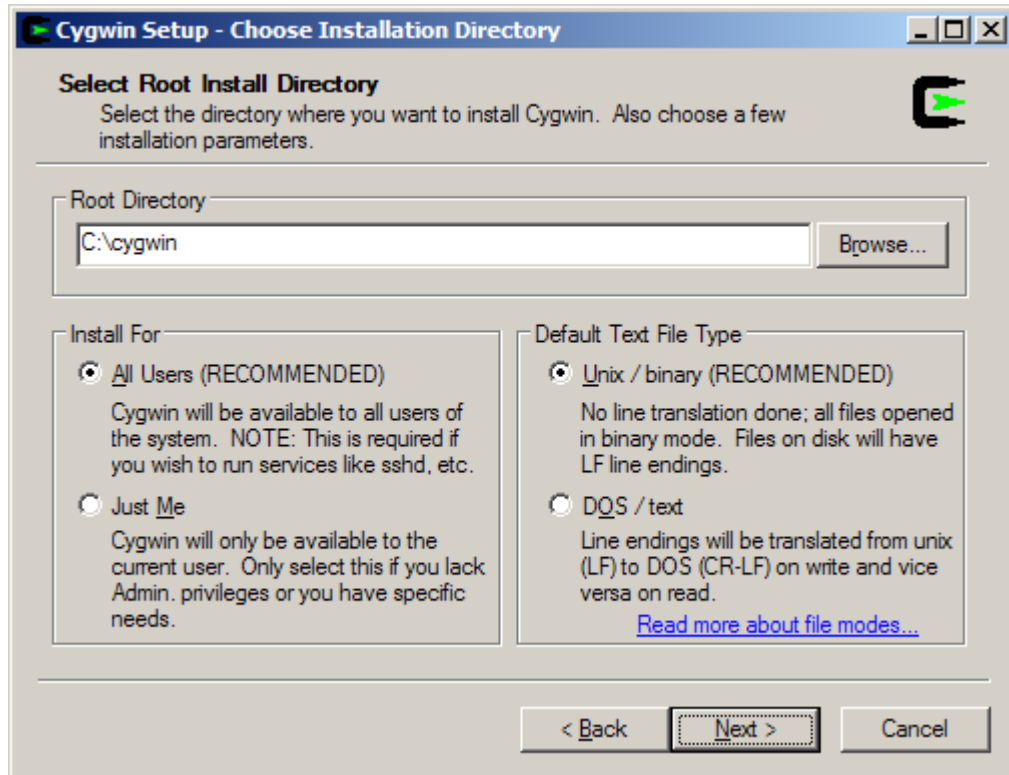
1. Open the Cygwin, <http://cygwin.com/> page in your web browser
2. Click on the “setup-x86.exe” (<http://cygwin.com/setup-x86.exe>) (32-bit installation) or “setup-x86_64.exe” (http://cygwin.com/setup-x86_64.exe) (64-bit installation) link to download the appropriate setup program from the primary Cygwin server. Save it to the directory that you would like to store the downloaded packages in (e.g. `c:\download`). Do not save to `c:\cygwin`, as that is the default directory for the extraction and installation of the downloaded packages.
3. Run the Cygwin setup program and you will see the welcome screen:



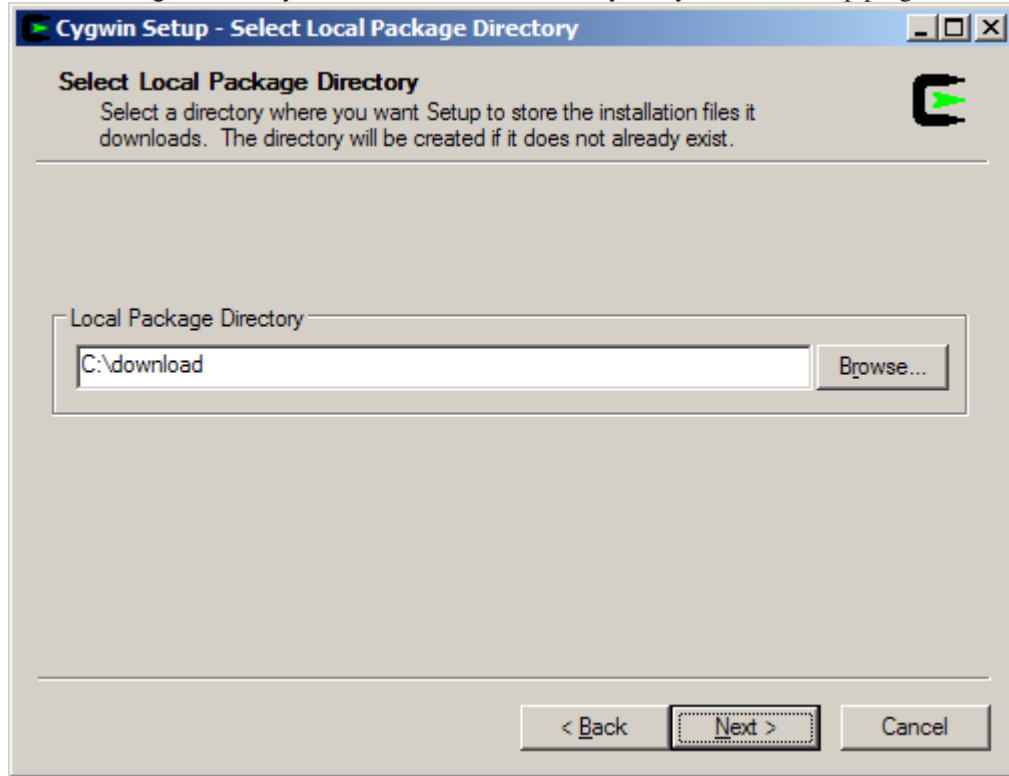
4. Click Next to proceed to the next screen.
5. Choose, Install from Internet, this will still save the package files to your download directory so that you can install Cygwin on any number of machines:



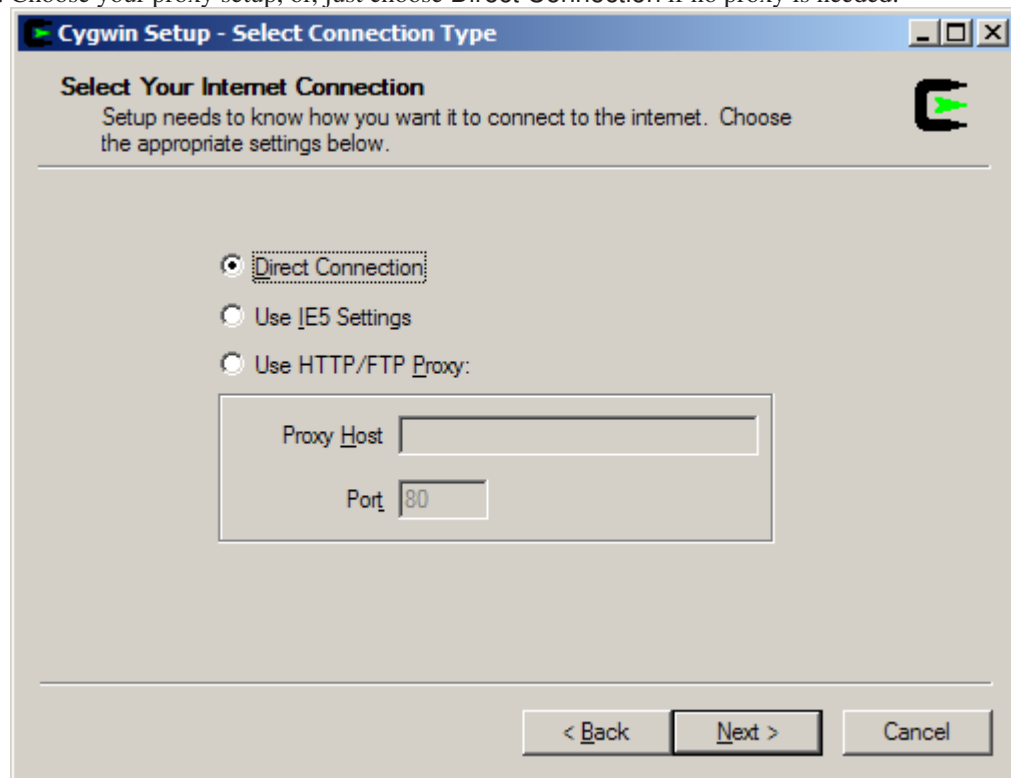
6. Click Next to proceed to the next screen.
7. The default Install Root is `c:\cygwin` which should be fine for most installations. Leave Default Text File Type as UNIX. Leave Install For set to All unless you lack local administrative privileges.



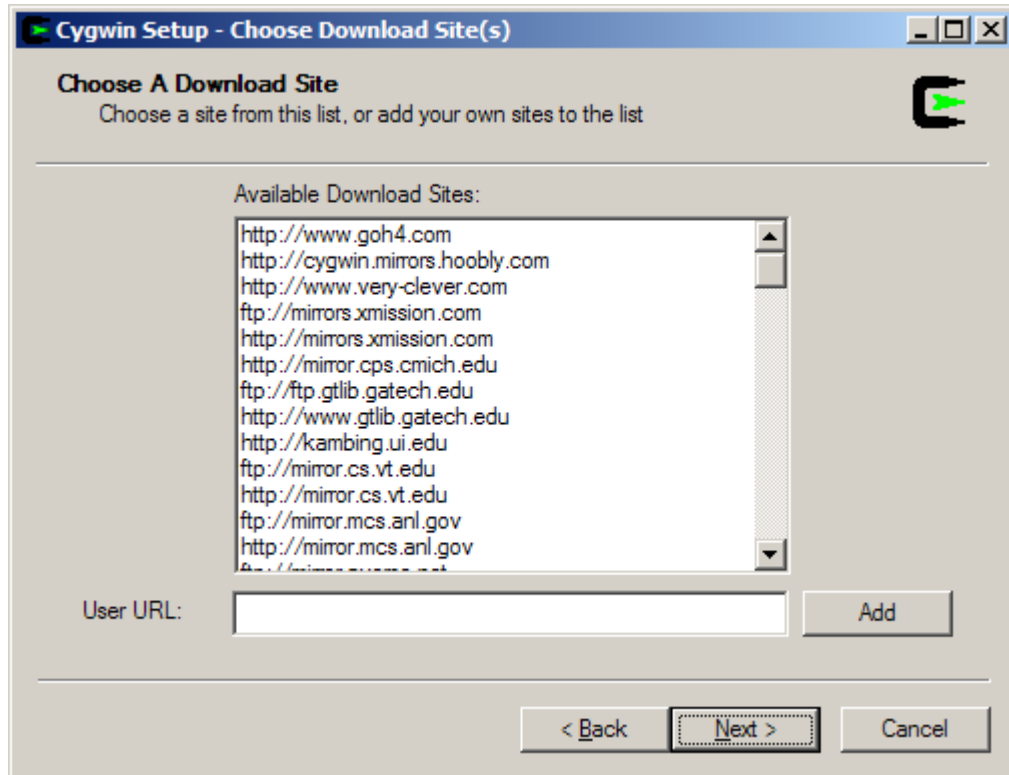
8. Click Next to proceed to the next screen.
9. Local Package Directory should default to the directory that you ran the setup program from:



10. Click Next to proceed to the next screen.
11. Choose your proxy setup, or, just choose Direct Connection if no proxy is needed:



12. Click Next to proceed to the next screen.
13. Select your nearest mirror for downloading:

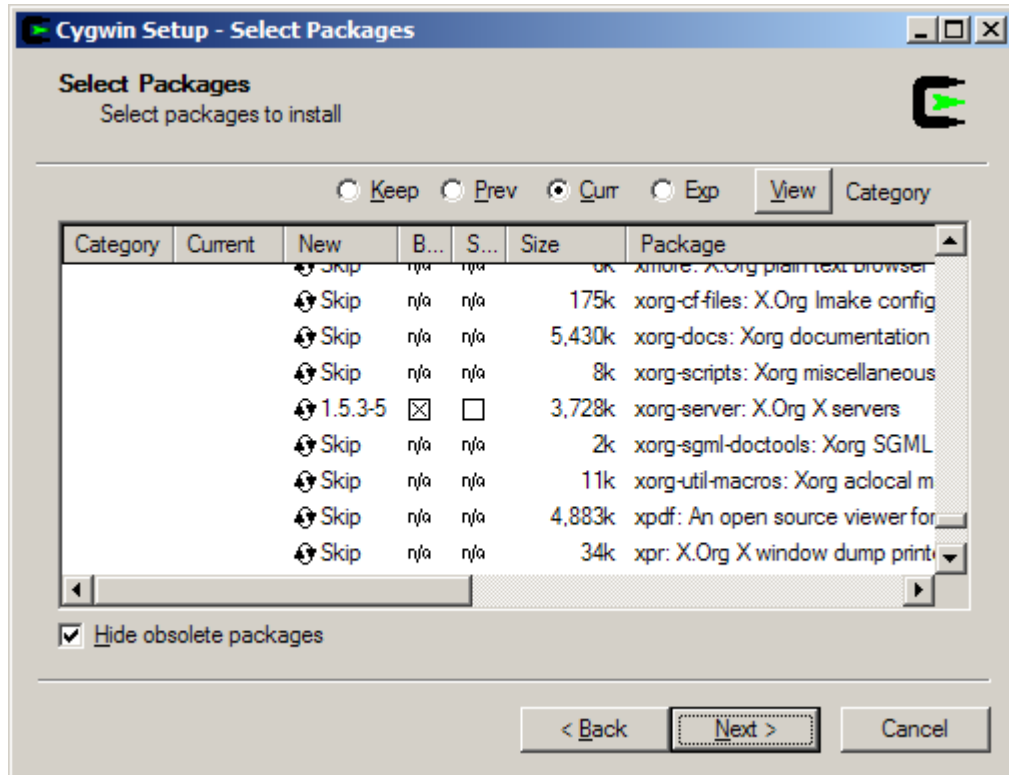


14. Click Next to proceed to the next screen; setup will download a list of available packages as it moves to the next screen.
15. On the next screen you will select the packages that will be downloaded and installed. A listing of the Cygwin/X packages is given below; a listing of the general Cygwin packages would be beyond the scope of this document.

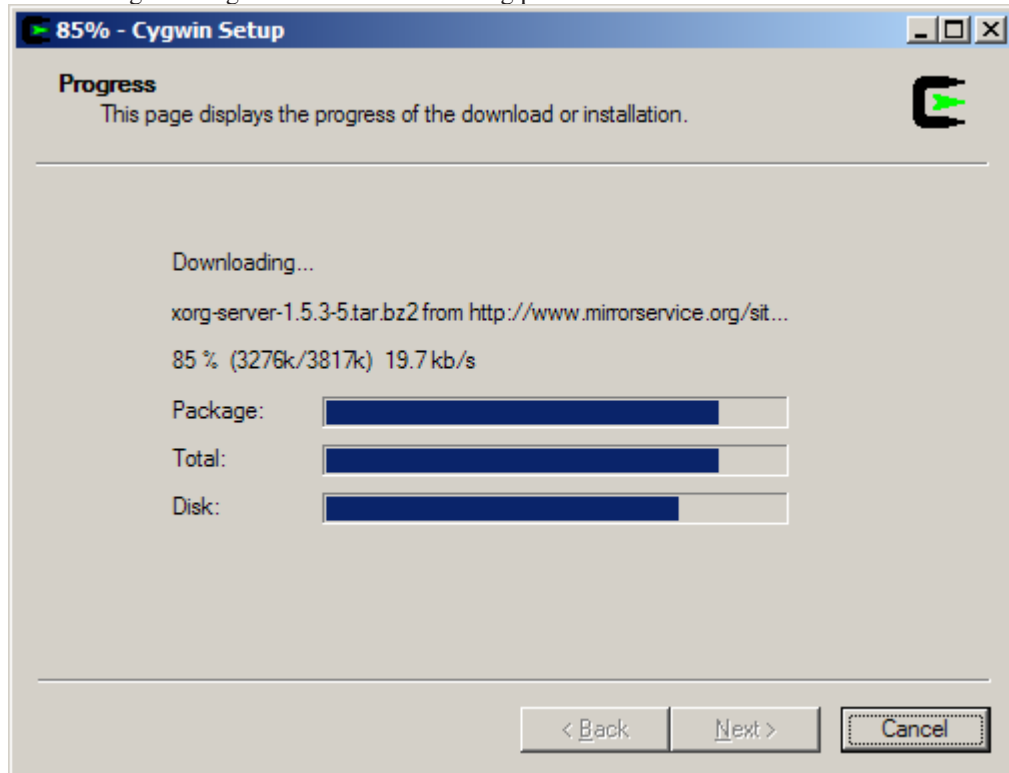
Cygwin/X packages are located in the x11 category.

- `xorg-server` (required, the Cygwin/X X Server)
- `xinit` (required, scripts for starting the X server: **xinit**, **startx**, **startwin** (and a shortcut on the Start Menu to run it), **startxdmcp.bat**)
- `xorg-docs` (optional, **man** pages)
- `xlaunch` (optional, a wizard for starting X sessions)
- You may also select any X client programs you want to use, and any fonts you would like to have available.
- You may also want to ensure that the `openssh` package is selected if you wish to use **ssh** connections to run remote X clients.
- You may also want to ensure that the `inetutils` or `rsh` packages are selected if you wish to use **telnet** or **rsh** connections to run remote X clients. (not recommended)

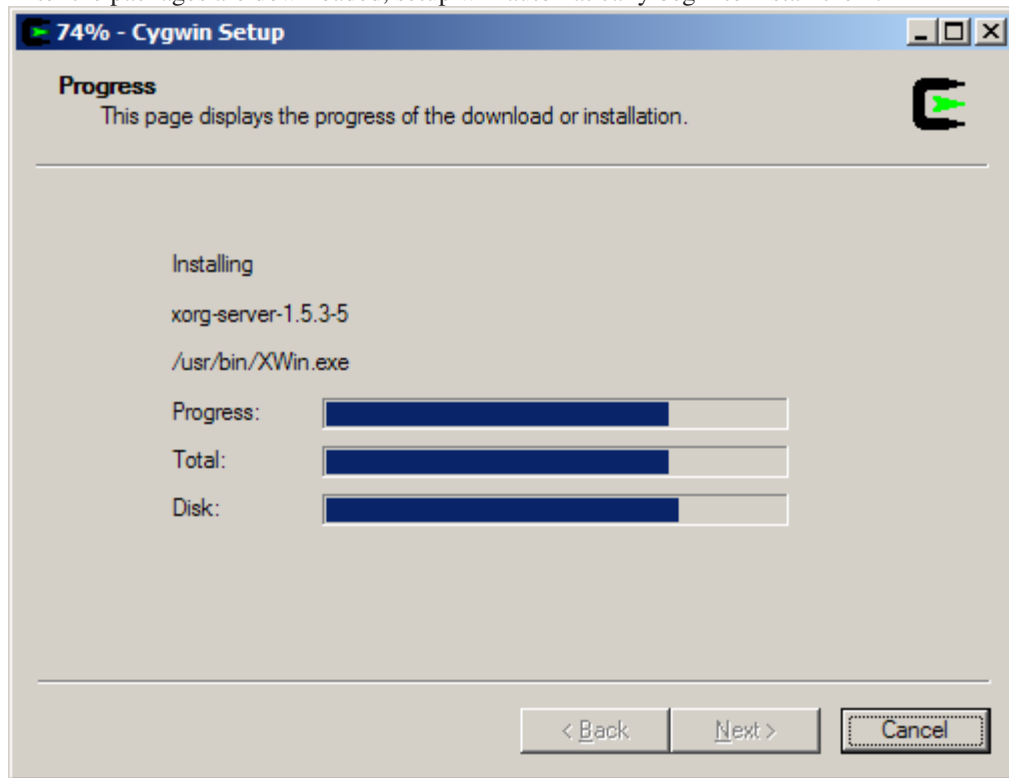
You can run setup again in the future to add more packages.



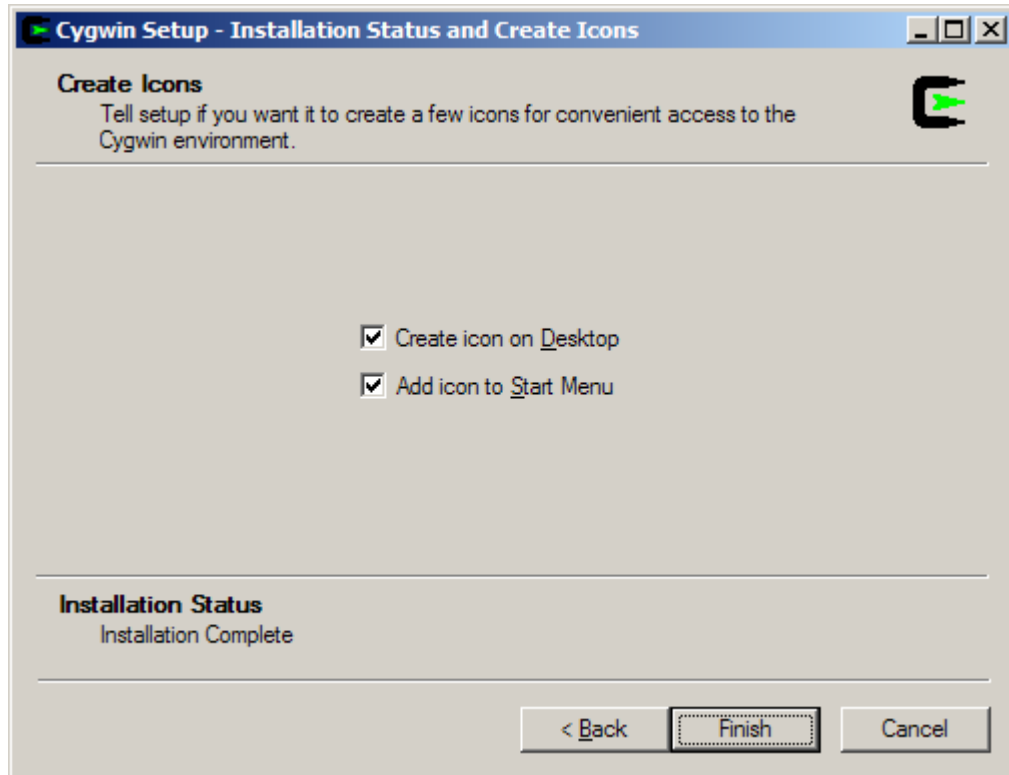
16. Click Next to begin the download process, you may want to try another mirror if you see a “Connecting” message on this screen for a long period of time:



17. After the packages are downloaded, setup will automatically begin to install them:



18. I highly recommend allowing Cygwin Setup to create Desktop and Start Menu icons for you; these icons simply launch a bash shell:



19. Click Finish to close the setup program.

You have now successfully installed Cygwin/X.

Chapter 3. Configuring Cygwin/X

Configuration overview

Cygwin/X settings are configured primarily through command-line parameters passed to X.

A `XWinrc` file is used to configure the notification area icon menu, and customize window appearance in multiwindow mode.

Windowing mode

Cygwin/X can be configured to present X windows for an X screen in three different ways:

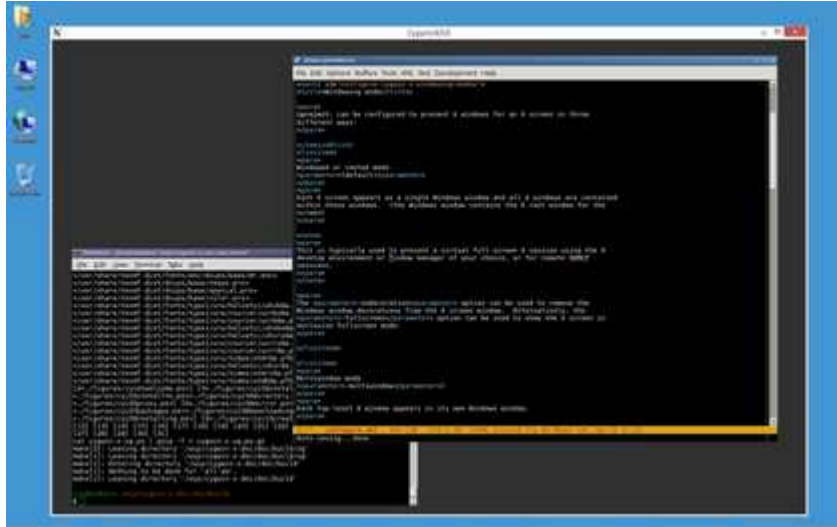
- Windowed or rooted mode. (*default*)

Each X screen appears as a single Windows window and all X windows are contained within those windows. (the Windows window contains the X root window for the screen)

Note: This is typically used to present a virtual full-screen X session using the X desktop environment or window manager of your choice, or for remote XDMCP sessions, e.g.:



An XDMCP session to a remote Fedora host



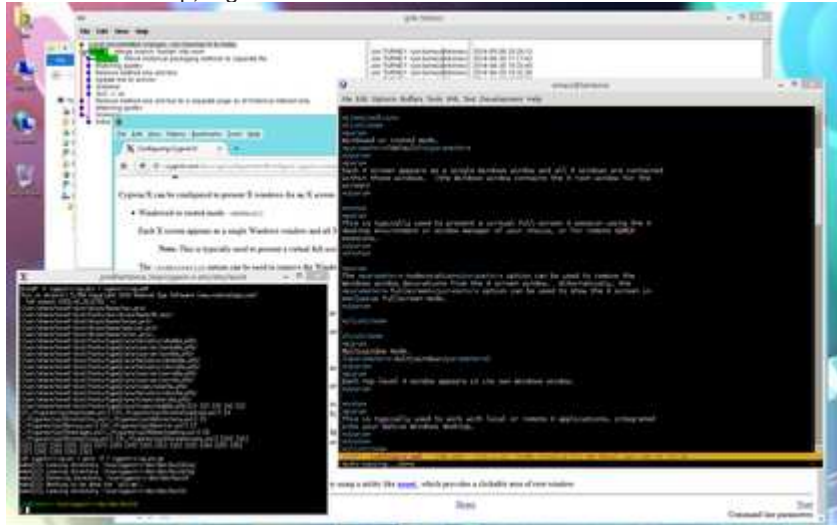
xfce4-terminal and emacs under the Openbox window manager in windowed mode

The `-nodecoration` option can be used to remove the Windows window decorations from the X screen window. Alternatively, the `-fullscreen` option can be used to show the X screen in exclusive fullscreen mode.

- Multiwindow mode. (`-multiwindow`)

Each top-level X window appears in its own Windows window.

Note: This is typically used to work with local or remote X applications, integrated into your native Windows desktop, e.g.:



X applications (emacs, gitk and xterm) and Windows applications (explorer and firefox) in multiwindow mode

- Rootless mode. (`-rootless`)

The X root window is hidden from view, but top-level X windows are drawn.

Note: This is typically used to work with local or remote X applications, integrated into your native Windows desktop, but controlled using the X window manager of your choice.

Because the X root window is hidden in this mode, this is not particularly useful with X window managers with which you need to interact with the root window (for example, clicking on the root window to get a menu listing programs you can launch) ¹, but is more useful with X window managers which work with a dock or panel window for selecting applications from.

Also note that the X window manager has no knowledge of the stacking of Windows windows, and vice versa, so raising one X window above a Windows window raises all of the X windows, and raising one Windows window above an X window raises it above all of the X windows. Exactly as if all X windows were being drawn into a hidden Windows window :-)

Command line parameters

Cygwin/X, by default, runs in windowed mode with the largest window that will fit on your Windows desktop, using the best performing engine that is installed on your system, with clipboard integration enabled. You do not need to pass any parameters to **X** to use the default behavior.

Up to date documentation of **X** options can be read with **man XWin** (<http://x.cygwin.com/docs/man1/XWin.1.html>).

XWinrc configuration file

With the `.XWinrc` configuration file it is possible to:

- Add items and submenus into the menu opened by right-clicking on the notification area icon.
- In multiwindow mode: add items and submenus into the Windows window system menu (opened by clicking on the icon in the top-left of the Windows window frame) and override the window icon and window styles for Windows windows, by window name or window class name.

Full documentation of the **XWinrc** file format and command can be read with **man XWinrc** (<http://x.cygwin.com/docs/man5/XWinrc.5.html>).

Notes

1. Although this can be worked around, to some extent, by using a utility like **xroot** (<http://www.sealiesoftware.com/xroot.c>), which provides a clickable area of root window.

Chapter 4. Using Cygwin/X

Starting Cygwin/X

Described below are several methods of starting up the Cygwin/X X Server with a startup utility that optionally starts initial clients (for example, a terminal, a window manager, or a desktop environment) and performs X server configuration (for example, loading a keyboard map).

Starting in multiwindow mode (**startxwin**)

The custom XWin startup utility **startxwin**¹ starts the X server in multiwindow mode.

startxwin is included in the `xinit` package (installed by following the instructions in the Section called *Installing Cygwin/X* in Chapter 2).

Run **startxwin** by:²

- using the "XWin Server" shortcut under "Cygwin-X" on the Start Menu
- Starting `/usr/bin/startxwin` in a Cygwin shell:

```
$ startxwin
```

You can then start X clients from the right-click menu of the notification area icon, or (after setting `DISPLAY` appropriately) from the Cygwin terminal.

You may create a `~/.startxwinrc` script to customize the client programs started, rather than using the default `/etc/X11/xinit/startxwinrc` script.

Full documentation for **startxwin** can be read with **man startxwin** (<http://x.cygwin.com/docs/man1/startxwin.1.html>).

Starting an X desktop environment session or X window manager in windowed mode

Several of these are packaged for Cygwin.

- MATE Desktop Environment: install the `mate-session-manager` package
- Openbox window manager: install the `openbox` package
- WindowMaker window manager: install the `WindowMaker` package
- Xfce Desktop Environment: install the `xfce4-session` package

and use the provided Start Menu shortcut.³

Packages for several other desktop environments (e.g. GNOME, KDE, LXDE, ROX, Sugar) and window managers (e.g. Blackbox, dwm, Enlightenment, Fluxbox) are available in [cygwinports](http://cygwinports.org/). (<http://cygwinports.org/>)

Starting an X session with XLaunch

XLaunch is a GUI wizard for starting the Cygwin/X X server and a local or remote X client. These sessions can be saved and shared as `.xlaunch` files.

XLaunch is included in the `xlaunch` package (installed by following the instructions in the Section called *Installing Cygwin/X* in Chapter 2).

Run **xlaunch** using the "XLaunch" shortcut under "Cygwin-X" on the Start Menu.

Documentation for **xlaunch** is available at <http://x.cygwin.com/docs/xlaunch/> and as online help within the program.

Starting in windowed mode (startx)

Use the standard X Window System **startx** command and its associated `~/.xinitrc` configuration file.

Run **startx** in a Cygwin shell:

```
$ startx
```

Full documentation for **startx** can be read with **man startx** (<http://www.x.org/releases/X11R7.5/doc/man/man1/startx.1.html>).

You may create a `~/.xinitrc` from the template in `/etc/X11/xinit/xinitrc` and then customize `~/.xinitrc` to start client programs and configure your X server.

```
$ cp /etc/X11/xinit/xinitrc ~/.xinitrc
[edit ~/.xinitrc as desired]
```

Note: **startx** waits until `~/.xinitrc` exits (which is often waiting for a window manager started by it to exit) and then kills X, so the last client started by should be started with **exec** and without **&**.

Alternatively, if you just want to start a single client program (perhaps a window manager), you don't need to use a `~/.xinitrc`, and can start the client directly from **startx**, e.g. ⁴

```
$ startx /usr/bin/fvwm2
```

Note: The client name supplied to **startx** must begin with `/` or `.`, otherwise it is treated as an option to the default **xterm** client.

Notes for advanced users

Advanced users may wish to start the X server by invoking **XWin** directly, for example, to start XDMCP sessions (See the Section called *Remote sessions via XDMCP*).

If you want to have a Start Menu shortcut which runs **startxwin** with custom options, you should use a copy of the Start Menu shortcut installed by `xinit`, so that your changes are not overwritten when the `xinit` package is updated.

Obsolete startup methods

The MS-DOS batch file `startxwin.bat` and bash shell script `startxwin.sh` previously used to start the X server are no longer provided. This implementation made it difficult to reliably wait until the X server had started before starting any clients. Use `startxwin` instead.

The executable `startxwin.exe` previously used to start the X server has been retired and replaced with a shell script **startxwin**.

Switching out of Cygwin/X

When running in windowed mode, press **Alt-Tab** to switch from Cygwin/X to your Windows desktop or other running Windows applications.

Stopping Cygwin/X

When you are done using Cygwin/X, you can shutdown the X server by:

- Selecting the "Exit..." option from the notification area icon menu
- In Windowed mode: Press **Alt-F4** to shutdown the X Server. This can be disabled using the `-nowinkill` option.
- In Windowed mode: Close the X server window in the conventional ways, e.g. by clicking on the "X" button at the upper-right corner of the X screen window frame, or choosing "Close" from the control menu opened by left-clicking on the X logo icon at the upper-left corner of the X screen window frame.
- Using the `-unixkill` option allows the **Ctrl-Alt-Backspace** key combination to shutdown the X Server.

If clients are still connected to the X server, you will be prompted to confirm you wish to shutdown the X server.

Window managers

A window manager is required in order to decorate, move, resize, and perform other operations on individual X windows.

Cygwin/X can work with window managers in several different ways:

- Internal window manager for multiwindow mode. The internal window manager that creates a Windows window for each top-level X window is automatically started when using the `-multiwindow` command-line parameter to **X**. See the Section called *Command line parameters* in Chapter 3 for more information on the `-multiwindow` command-line parameter.
- External local window managers (e.g. **twm**, **mwm** (part of the motif package), **fvwm2**, **openbox**, **aewm++**, **WindowMaker**). These local window managers must be installed on Cygwin and run locally.
- Remote window managers started by logging into an XDMCP session. You can read more about XDMCP in the Section called *Remote sessions via XDMCP*.
- Remote window manager launched through an **ssh** tunnel. This is not Cygwin/X-specific, so you should be able to find information about launching remote window managers from other sources. See the Section called *Secure ssh* for more information on using **ssh**.

Windows Clipboard integration

The X Window System uses its own clipboard system that is distinct from the clipboard system used by Windows. Copying and pasting text between these two clipboard systems requires a clipboard integration program that watches for updates to either clipboard and copies data between them when either one is updated. Cygwin/X has an internal clipboard integration program that is enabled by default.

The clipboard integration monitors the X PRIMARY (selected/highlighted text) and CLIPBOARD (cut/copied text) selections for changes in ownership, and makes the contents of the most recent one to change available to paste from the Windows clipboard. It also monitors the contents of the Windows clipboard for changes, taking ownership of the PRIMARY and CLIPBOARD selections, and making the contents of the Windows clipboard available in them.

Note: Some X clients, notably ones written in Tcl/Tk, do not re-assert ownership of the PRIMARY selection or update it's timestamp when it's contents change, which currently prevents the clipboard integration program from correctly noticing that the PRIMARY selection's contents have changed.

Note: With some X clients, it may be inconvenient that updating the PRIMARY selection causes that to overwrite the Windows clipboard contents you were just about to paste, so monitoring of the X PRIMARY selection can be disabled using the `-noprimary` option, or temporarily using the "Clipboard may use PRIMARY selection" toggle on the notification area icon menu.

See the Section called *Command line parameters* in Chapter 3 for more information on the `-[no]clipboard` and `-[no]primary` command-line options.

Shared memory support

Shared memory is needed by the MIT-SHM and XFree86-BigFont extensions, which may provide better performance for local applications which use large images or fonts and are written to use those extensions.

In Cygwin, XSI shared memory is provided by the **cygserver** Windows service. To install **cygserver**, install it using the setup program, run the **cygserver-config** script to install the service, and then reboot or use **cygrunsrv -S cygserver** to start the service.

Note: *This note is applicable to Cygwin 1.5 only. Cygwin 1.7 automatically enables shared memory if the **cygserver** Windows service is running.*

Shared memory will only be used if the `CYGWIN` environment variable contains the `server` keyword.

For example, starting **X** with

```
CYGWIN=server X
```

or setting the `CYGWIN` environment variable in the Windows control panel to contain `server` will enable shared memory support if the **cygserver** service is running.

Displaying remote clients

Displaying remote X clients with Cygwin/X is identical to displaying remote X clients with any other X Server.

It is recommended that you use the secure method of tunnelling the X connection over **ssh**.

Alternatively, you can use the host-based access control provided by the X server, connecting to the remote machine using **telnet** or **rsh** and directing clients to connect to the server by setting the `DISPLAY` environment variable. This method is insecure and not recommended.

Secure ssh

On your Windows machine:

1. Make sure you have the `openssh` package installed.
2. Launch Cygwin/X
3. Ensure the `DISPLAY` environment variable is set correctly. (This step is not necessary if you are entering your commands into an X terminal, as `DISPLAY` must already be set in that case)

```
$ export DISPLAY=:0.0
```

4. Run the **ssh** command to connect to the remote host:

```
$ ssh -Y username@remote_hostname_or_ip_address
```

5. Enter your password when prompted by **ssh**.

6. Your **ssh** session should now show you a shell prompt for your remote machine.

Note: The ssh server will automatically set the DISPLAY environment variable appropriately, typically to something like `localhost:10.0`, so clients will connect to a proxy X11 display on the remote host from which the X11 protocol will be forwarded over ssh to your X server.

If your login scripts unconditionally set DISPLAY to something else, this will break X11 forwarding.

7. You can now launch remote X clients in your **ssh** session, for example:

```
$ xterm &
```

will launch an xterm running on your remote host that will display on your Cygwin/X screen.

8. Launch other remote clients in the same manner. I recommend starting the remote clients in the background, by appending `&` to the command name, so that you don't have to open several **ssh** sessions.

Note: By default, the OpenSSH server does not allow forwarded X connections. This must be configured on the remote host by adding `X11Forwarding yes` to the `sshd_config` configuration file. The OpenSSH server must be restarted or SIGHUP'ed to re-read the configuration file after it is changed.

Note: The OpenSSH server requires the **xauth** command to be available to forward X connections. Consequently, it must be installed on the remote host.

Insecure telnet or rsh (Not recommended)

An example of connecting remote clients using host-based authorization.

On your Windows machine:

1. Make sure you have the `inetutils` package installed (for **telnet**) or `rsh` package (for **rsh**).
2. Launch Cygwin/X

Note: You must provide the `-listen tcp` option to **startx** or **startxwin** so that the X server will listen for TCP/IP connections. (See this FAQ ([../faq/cygwin-x-faq.html#q-remote-clients-cant-connect](http://faq/cygwin-x-faq.html#q-remote-clients-cant-connect)) for more details).

3. In an X terminal, use the **xhost** command to allow the remote host access to make connections to your X server:

```
$ xhost remote_hostname_or_ip_address
```

4. Run the **telnet** or **rsh** command to connect to the remote host:

```
$ /usr/bin/telnet remote_hostname_or_ip_address
```

or

```
$ rsh remote_hostname_or_ip_address
```

Note: Use the explicit path to ensure that Cygwin's **telnet** is run instead of Microsoft's **telnet**. Microsoft's **telnet** cannot read input or display output correctly when run from a Cygwin shell.

5. Login to your remote machine

6. Ensure the **DISPLAY** environment variable is set correctly in your remote session.

```
$ export DISPLAY=windows_hostname_or_ip_address:0.0
```

7. You can now launch remote X clients in your **ssh** session, for example:

```
$ xterm &
```

will launch an xterm running on your remote host that will display on your Cygwin/X screen.

8. Launch other remote clients in the same manner. I recommend starting the remote clients in the background, by appending **&** to the command name, so that you don't have to open several **telnet** or **rsh** sessions.

Note: This is *insecure* because (1) when you log in, your username and password may be transmitted in clear across the network between you and the remote host (2) the X protocol is transmitted in clear across the network between you and the remote host, and (3) you have allowed any user on the remote host to connect to your X server and monitor your X session. For these reasons, use ssh forwarding, if at all possible.

Remote sessions via XDMCP

Cygwin/X can be used login to one or several remote sessions using XDMCP (X Display Manager Control Protocol).

Start Cygwin/X with a command similar to the following to login to a single remote session using XDMCP:

```
X -query remote_hostname_or_ip_address
```

You may login to several remote sessions with a single or multiple hosts using XDMCP. Each session will need a separate display number, specified by the `:display_number` parameter, such as `:0`. A display number is not the same as a screen number, as a single display can have multiple screens associated with it. Each display listens on a different network port number, so each display can connect

to multiple machines. Start Cygwin/X with command lines similar to the following to login to several remote sessions using XDMCP:

```
X :0 -query remote_hostname_or_ip_address_0
```

```
X :1 -query remote_hostname_or_ip_address_1
```

Note that the `:display_number` parameter is a general X Server parameter, not specific to Cygwin/X. Further documentation of the `:display_number` parameter can be found in the X Server manual page (<http://x.cygwin.com/docs/man1/Xserver.1.html>). XDMCP is a complex system that is not specific to Cygwin/X; further discussion of XDMCP is beyond the scope of this document. You may wish to read the Linux XDMCP HOWTO (<http://en.tldp.org/HOWTO/XDMCP-HOWTO/>) or the X Server XDMCP Options (<http://x.cygwin.com/docs/man1/Xserver.1.html#lbAH>) for more information.

Note: For security reasons, XDMCP is not enabled by default on most modern UNIX distributions. You will have to enable remote logins to your X Display Manager (**x**dm, **k**dm, **g**dm, etc.). See the configuration documentation for your X Display Manager and/or UNIX distribution. The Cygwin/X FAQ section on XDMCP (<http://x.cygwin.com/docs/faq/cygwin-x-faq.html#xdmcp>) may also be helpful.

Note: XDMCP suffers from some of the same security problems noted in the previous section, but unfortunately cannot be tunnelled over **ssh** due to its use of UDP. A similar effect can be achieved with a command like `ssh -Y remote_hostname_or_ip_address Xnest :1 -query localhost`

Note: In some cases, e.g. if you have multiple network interfaces, it may be necessary to use the `-from local_ip` parameter to specify the local IP address to be used.

OpenGL (GLX)

Note: Hardware-accelerated OpenGL is still under active development and should be considered beta quality, but should be working well enough to be useful. Please report problems with specific OpenGL applications to the cygwin mailing list.

The Cygwin/X X Server supports both software OpenGL rendering (using the mesa software renderer), and hardware accelerated OpenGL rendering (using the native Windows OpenGL (WGL) interface).

The X server command line options `-wgl` and `-nowgl` turn on and off the use of the native Windows OpenGL implementation. Currently `-wgl` is only supported in multiwindow mode, and is on by default in that mode. `-wgl` has no effect if your display driver does not support hardware-accelerated OpenGL.

The creation of indirect GLX contexts is disabled by default, The `+iglx` option is required to allow them.

Table 4-1. Summary of OpenGL rendering options

	software rendering ^a	hardware-accelerated rendering
indirect (Uses GLX protocol, limited to OpenGL 1.4)	start server with <i>+iglx</i> <i>-nowgl</i> options export LIBGL_ALWAYS_INDIRECT=1	start server with <i>+iglx -wgl</i> options export LIBGL_ALWAYS_INDIRECT=1
direct		start server with <i>-wgl</i> option export LIBGL_USE_WGL=1 ^b (local clients only)
Notes: a. The software renderer used (e.g. llvmpipe, softpipe) can be selected using the GALLIUM_DRIVER environment variable. b. Since direct accelerated rendering is currently experimental, the LIBGL_USE_WGL environment variable is required to enable it, but that will be removed when the feature is mature, at which point it will be the default and export LIBGL_ALWAYS_SOFTWARE=1 will be required to force software rendering.		

Currently the default configurations are:

- For local clients the default is direct, software rendering.

To use the experimental direct, hardware-accelerated rendering, you must do **export LIBGL_USE_WGL=1** before starting the client application.

- For remote clients, Mesa's libGL prefers to use client-side software rendering and then transfer the rendered image to the server.

To force indirect rendering (which takes place on the server), you must start the server with the *+iglx* option and do **export LIBGL_ALWAYS_INDIRECT=1** before starting the client application.

There is a performance trade-off between rendering performance and network latency, so you might wish to try both direct and indirect rendering and see which performs best in your specific circumstances.

If **glxinfo | grep OpenGL** outputs something mentioning your graphics card vendor, you have hardware-accelerated rendering. If it mentions Mesa, you have software rendering.

Please ensure you are using the latest display drivers for your graphics hardware before reporting any visual issues with WGL.

Known issues:

- OpenGL drawing is just drawn on top of the X window. This works well enough when the OpenGL window is a top-level window, or is non-top-level and has no occluding relatives and is drawn after anything it occludes, but can mis-render in more complex scenarios.
- OpenGL windows with static contents aren't re-drawn when occluded by a native Window and then exposed. Workaround: force the window to redraw, e.g. by resizing it.
- When an OpenGL window is behind a native application window which uses layered windows for translucency, the OpenGL rendering is drawn over the top, flickering.
- Rendering to GLX pixmaps is only partially implemented due to WGL limitations.

Input internationalization

Compose key ('Multi_key')

The compose key is a dead key which introduces a multi-key sequence to generate a character.

You can configure the compose key by using **setxkbmap** e.g. `setxkbmap -option compose:rctrl` or starting the X server with the `-xkboptions` option, e.g. `X -xkboptions compose:ralt`. The possibilities for the compose key, e.g. `ralt`, `lwin`, `rwin`, `menu`, `lctrl`, `rctrl`, `caps`, etc. are listed in the `xkeyboard-config(7)` (<http://www.x.org/releases/current/doc/man/man7/xkeyboard-config.7.html>) man page.

Alternatively, the option `lv3:ralt_switch_multikey` configures Right Alt as 3rd-level shift, Shift + Right Alt⁵ as Compose. Note that this option is on by default in the `gb` layout.

The standard compose key sequences available are determined by the locale. Refer to the compose key sequence charts (<http://www.x.org/releases/current/doc/libX11/i18n/compose/libX11-keys.html>) for the available compose key sequences for each locale. Note that most locales using a Microsoft codepage character set (e.g. with a `LANG` environment variable of the form `LL_CC.CPnnn`) are not currently recognized by Xlib.

See the `Compose(5)` (<http://www.x.org/releases/current/doc/man/man5/Compose.5.html>) man page for more details on how the locale is mapped to a compose key sequence file and how to configure custom compose key sequences.

Input Method Editors (IMEs)

If an IME is configured, it should be started as part of a remote session (See the Section called *Remote sessions via XDMCP*).

To use an IME with remote clients started from a command line (See the Section called *Displaying remote clients*), the IME must be started explicitly, e.g.

Starting the ibus IME

After configuring `ibus` with **ibus-setup**, start the `ibus` daemon

```
$ ibus-daemon -drx
```

and set XMODIFIERS so XIM clients will use ibus

```
$ export XMODIFIERS="@im=ibus"
```

Starting other IMEs

Similarly for fcitx, gcin, iiimf, scim, uim, etc.

Terminal Server or Fast User Switching

When multiple users may start X servers on same computer, each X server must have a unique display number.

Instead of specifying a display number using the `:display_number` option, such as `:0`, starting the X server with the `-displayfd` option, locates an unused display number and writes it to the specified file descriptor.

startx, **xinit** and **startxwin** notice this option, and transparently use it to determine the display number for any clients they start, and then pass on the display number to the specified file descriptor.

Note: It may be necessary to also use the `-engine 1` option (GDI drawing) for the X server windows to draw correctly when connecting to a Terminal Server using RDP, depending on the Windows version and/or graphics driver in use.

Note: Automatically communicating the allocated display number to all future X clients started by the user who started the X server is left as an exercise for the reader.

Customizing the notification area icon menu

You can customize the right-click menu for the XWin icon in the Windows notification area (system tray) using the XWinrc file. e.g.

```
$ cp /etc/X11/system.XWinrc./etc/X11/xinit/xinitrc ~/.XWinrc
[edit ~/.Xwinrc as desired]
```

See the Section called *XWinrc configuration file* in Chapter 3 for more details.

Notes

1. **startxwin** is a specialized version of **startx** with a few differences appropriate to running in multiwindow mode, rather than windowed mode.
- **startxwin** supplies the **-multiwindow** option to X
- It uses a different script to start clients (`~/ .startxwinrc` rather than `~/ .xinitrc`), because `~/ .xinitrc` will normally end by starting a window manager, which would be incorrect for `~/ .startxwinrc` (as it would discover the internal window manager is already running and exit immediately).
- Note that **startxwin** *no longer* exits after `~/ .startxwinrc` has completed, leaving X running, but, similar to **startx**, waits until `~/ .startxwinrc` exits and then kills X.

If you don't want the X server to exit until explicitly told to do so, end your `~/ .startxwinrc` with something like **exec sleep infinity**.

2. It's not recommended to start **startxwin** from a MS-DOS shell or by double-clicking it in Windows Explorer. To do so means that the X server is not started from a login shell, and programs started from the notification area icon menu will not inherit the environment of a login shell. This may lead to unexpected behaviour, for example, if you have customizations to your login shell start-up scripts which set environment variables.
3. Alternatively, these sessions can be started from the command line, e.g.

```
startx /usr/bin/dbus-launch mate-session
```

or

```
echo "/usr/bin/dbus-launch startxfce4" > ~/ .xinitrc
```

and then running **startx**.

4. Note that **startxwin** and **startx** use the special option `--` to mark the end of client options and the beginning of server options. So, for example, if you wish to also start the X server with the options `-emulate3buttons` and `-noclipboard`, as described in the Section called *Command line parameters* in Chapter 3, use the following command:

```
$ startx /usr/bin/fvwm2 -- -emulate3buttons -noclipboard
```

5. pressing the keys in that order. Right Alt + Shift is 4th-level shift.

Appendix A. GNU Free Documentation License

Version 1.3, 3 November 2008

Copyright © 2000, 2001, 2002, 2007, 2008 Free Software Foundation, Inc. (<http://www.fsf.org/>)

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document “free” in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of “copyleft”, which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The “Document”, below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as “you”. You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A “Modified Version” of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A “Secondary Section” is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document’s overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The “Invariant Sections” are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The “Cover Texts” are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A “Transparent” copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not “Transparent” is called “Opaque”.

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The “Title Page” means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, “Title Page” means the text near the most prominent appearance of the work’s title, preceding the beginning of the body of the text.

The “publisher” means any person or entity that distributes copies of the Document to the public.

A section “Entitled XYZ” means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as “Acknowledgements”, “Dedications”, “Endorsements”, or “History”.) To “Preserve the Title” of such a section when you modify the Document means that it remains a section “Entitled XYZ” according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.

- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
- H. Include an unaltered copy of this License.
- I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
- J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
- K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
- L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
- M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.
- N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.
- O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties — for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the

Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled “History” in the various original documents, forming one section Entitled “History”; likewise combine any sections Entitled “Acknowledgements”, and any sections Entitled “Dedications”. You must delete all sections Entitled “Endorsements”.

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an “aggregate” if the copyright resulting from the compilation is not used to limit the legal rights of the compilation’s users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document’s Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled “Acknowledgements”, “Dedications”, or “History”, the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, or distribute it is void, and will automatically terminate your rights under this License.

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, receipt of a copy of some or all of the same material does not give you any rights to use it.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See Copyleft (<http://www.gnu.org/copyleft/>).

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License “or any later version” applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation. If the Document specifies that a proxy can decide which future versions of this License can be used, that proxy’s public statement of acceptance of a version permanently authorizes you to choose that version for the Document.

11. RELICENSING

“Massive Multiauthor Collaboration Site” (or “MMC Site”) means any World Wide Web server that publishes copyrightable works and also provides prominent facilities for anybody to edit those works. A public wiki that anybody can edit is an example of such a server. A “Massive Multiauthor Collaboration” (or “MMC”) contained in the site means any set of copyrightable works thus published on the MMC site.

“CC-BY-SA” means the Creative Commons Attribution-Share Alike 3.0 license published by Creative Commons Corporation, a not-for-profit corporation with a principal place of business in San Francisco, California, as well as future copyleft versions of that license published by that same organization.

“Incorporate” means to publish or republish a Document, in whole or in part, as part of another Document.

An MMC is “eligible for relicensing” if it is licensed under this License, and if all works that were first published under this License somewhere other than this MMC, and subsequently incorporated in whole or in part into the MMC, (1) had no cover texts or invariant sections, and (2) were thus incorporated prior to November 1, 2008.

The operator of an MMC Site may republish an MMC contained in the site under CC-BY-SA on the same site at any time before August 1, 2009, provided the MMC is eligible for relicensing.

ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

Copyright © YEAR YOUR NAME

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.3 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled “GNU Free Documentation License”.

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the “with... Texts.” line with this:

with the Invariant Sections being LIST THEIR TITLES, with the Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.

Colophon

This document was produced from DocBook (<http://docbook.org/>) source XML using OpenJade (<http://openjade.sourceforge.net/>) and the DocBook DSSSL Stylesheets.

The production process for this instance of this document was started at 2015-08-19 18:01 .