Release Notes for X11R7.5

The X.Org Foundation[1]

October 2009

These release notes contains information about features and their status in the X.Org Foundation X11R7.5 release.

Table of Contents

Introduction to the X11R7.5 Release

This release is the sixth modular release of the X Window System. The next full release will be X11R7.6 and is expected in 2010.

For help with how to build and develop in the modular tree see the Modular Developer's Guide[2] in the X.Org wiki.

We encourage you to submit bug fixes and enhancements to freedesktop.org's bug tracking system[3] using the xorg product, and to discuss them on `<xorg@lists.freedesktop.org>`. More details on patch submission and review process are available on the SubmittingPatches[4] page of the X.Org wiki.

The release numbering is based on the original MIT X numbering system. X11 refers to the version of the network protocol that the X Window system is based on: Version 11 was first released in 1988 and has been stable for 21 years, with only upward compatible additions to the core X protocol, a record of stability envied in computing. Formal releases of X started with X version 9 from MIT; the first commercial X products were based on X version 10. The MIT X Consortium and its successors, the X Consortium, the Open Group X Project Team, and the X.Org Group released versions X11R3 through X11R6.6. Since the founding of the X.Org Foundation in early 2004, many further releases have been issued, from X11R6.7 to the current 7.5.

The next section describes what is new in the latest version (7.5) compared with the previous full release (7.4).

Summary of new features in X11R7.5

This is a sampling of the new features in X11R7.5. A more complete list of changes can be found in the ChangeLog files that are part of the source of each X module.

- *Multi-Pointer X (MPX)* provides the user with multiple independent mouse cursors and multiple independent keyboard foci. Each cursor is a true system cursor and different pointers can operate in multiple applications simultaneously.

- *Input device properties* allow you to attach properties to a device. These properties can be of arbitrary type and can be changed without the server having to know their details.

- The *X Input Extension version 2.0 (XI2)* is designed to replace both core input processing and prior versions of the X Input Extension. Besides MPX, it provides a number of other enhancements over version 1.5, including:
  - use of XGE and GenericEvents.
  - explicit device hierarchy of master and slave devices.
  - the ability for devices to change capabilities at runtime.
  - raw device events

- *Resize, Rotate and Reflect Extension (RANDR) version 1.3* builds on the changes made with version 1.2 and adds some new capabilities without fundmentally changing the extension again. The following features are added in this version:

  Projective Transforms

  > The implementation work for general rotation support made it trivial to add full projective transformations. These can be used to scale the screen up/down as well as perform projector keystone correct or other effects.

  Panning

  > Panning was removed with RandR 1.2 because the old semantics didn't fit any longer. With RandR 1.3 panning can be specified per crtc.

- The *DRI2 extension* is designed to associate and access auxillary rendering buffers with an X drawable. It is a essentially a helper extension to support implementation of direct rendering drivers/libraries/technologies. The main consumer of this extension will be a direct rendering OpenGL driver, but the DRI2 extension is not designed to be OpenGL specific. Direct rendering implementations of OpenVG, Xv, cairo and other graphics APIs should find the functionality exposed by this extension helpful and hopefully sufficient.

- *Video and input driver enhancements.* Please see the ChangeLog files for individual drivers; there are far too many updates to list here.

- ... and the usual assortment of correctness and crash fixes.

Drivers

Video Drivers

X11R7.5 includes the following video drivers:

Driver Name	Description	Further Information
apm	Alliance Pro Motion	README.apm5
ark	Ark Logic	
ast	ASPEED Technology	
ati	ATI Mach64	README.ati5
chips	Chips & Technologies	README.chips5, chips(4)5
cirrus	Cirrus Logic	
cyrix (*)	Cyrix MediaGX	README.cyrix5
fbdev	Linux framebuffer device	fbdev(4)5
glint	3Dlabs, TI	glint(4)5
i128	Number Nine	README.I1285, i128(4)5
i740	Intel i740	README.i7405
intel	Intel i8xx/i9xx	README.intel5, intel(4)5
impact	SGI Indigo Impact	impact(4)5
imstt	Integrated Micro Solns	
mga	Matrox	mga(4)5
neomagic	NeoMagic	neomagic(4)5
newport (-)	SGI Newport	README.newport5, newport(4)5
nsc	National Semiconductor	nsc(4)5
nv	NVIDIA	nv(4)5
ati	ATI Rage128	README.r1285, r128(4)5
radeon	ATI Radeon	radeon(4)5
rendition	Rendition	README.rendition5, rendition(4)5
s3	S3 (not ViRGE or Savage)	

`s3virge`	S3 ViRGE	README.s3virge[5], s3virge(4)[5]
`savage`	S3 Savage	savage(4)[5]
`siliconmotion`	Silicon Motion	siliconmotion(4)[5]
`sis`	SiS	README.SiS[5], sis(4)[5]
`sisusb`	SiS USB	sisusb(4)[5]
`sunbw2` (+)	Sun bw2	
`suncg14` (+)	Sun cg14	
`suncg3` (+)	Sun cg3	
`suncg6` (+)	Sun GX and Turbo GX	
`sunffb` (+)	Sun Creator/3D, Elite 3D	
`sunleo` (+)	Sun Leo (ZX)	
`suntcx` (+)	Sun TCX	
`tdfx`	3Dfx	tdfx(4)[5]
`tga`	DEC TGA	README.DECtga[5]
`trident`	Trident	trident(4)[5]
`tseng`	Tseng Labs	
`v4l`	Video4Linux	
`vesa`	VESA	vesa(4)[5]
`vmware`	VMware guest OS	vmware(4)[5]
`voodoo`	3Dfx Voodoo	
`wsfb`	Workstation Framebuffer	wsfb(4)[5]

Drivers marked with (*) are present in a preliminary form in this release, but are not complete and/or stable yet.

Drivers marked with (+) are for Linux/Sparc only.

Drivers marked with (-) are for Linux/mips only.

Darwin/Mac OS X uses IOKit drivers and does not use the module loader drivers listed above. Further information can be found in README.Darwin[5].

Input Drivers

X11R7.5 includes the following input drivers:

Driver Name	Description	Further Information
`acecad`	Acecad Flair	acecad(4)[6]
`aiptek(*)`	Aiptek USB tablet	aiptek(4)[6]
`elographics`	EloGraphics	
`evdev(*)`	EvDev	evdev(4)[6]
`fpit`	Fujitsu Stylistic Tablet PCs	fpit(4)[6]
`hyperpen`	Aiptek HyperPen 6000	

joystick	Joystick	
kbd	generic keyboards (non-evdev systems)	kbd(4)[6]
microtouch	MicroTouch	
mouse	most mouse devices (non-evdev systems)	mouse(4)[6]
mutouch	MicroTouch	
penmount	PenMount	
synaptics	Synaptics & ALP touchpads	
vmmouse	VMWare virtual mouse	
void	dummy device	void(4)[6]

Drivers marked with (*) are available for Linux only.

Overview of X11R7.5

On most platforms, X11R7.5 has a single hardware-driving X server binary called **Xorg**. This binary can dynamically load the video drivers, input drivers, and other modules that are needed. **Xorg** has currently has support for Linux, Solaris, and some BSD OSs on Alpha, PowerPC, IA-64, AMD64, Intel x86, Sparc, and MIPS platforms.

Additional specialized X server binaries may be found depending on the platform and build configuration, including:

Xdmx

is a proxy X server that uses one or more other X servers as its display devices. It provides multi-head X functionality for displays that might be located on different machines.

Xnest

is a nested X server, that operates as both an X client and X server. **Xnest** is a client of the real server which manages windows and graphics requests on its behalf. **Xnest** is a server to its own clients, and manages windows and graphics requests on their behalf. To these clients, it appears to be a conventional server.

Xephyr

is a X server that outputs to a window on a pre-existing "host" X display. Unlike **Xnest** which is an X proxy, and thus limited to the capabilities of the host X server, **Xephyr** is a full X server which uses the host X server window as "framebuffer" via fast SHM XImages.

Xvfb

is a virtual framebuffer X server that can run on machines with no display hardware and no physical input devices. It emulates a dumb framebuffer using virtual memory.

Xquartz

is an X server that interacts with the MacOS X native Aqua window system, displaying windows on the Mac desktop and accepting input from the Mac system devices, allowing X11 applications to be used in a native Mac desktop session.

Xwin

is an X server that runs under the Cygwin environment, interacting with the Microsoft Windows native window system, displaying windows on the Windows desktop and accepting input from the Windows system devices, allowing X11 applications to be used in a native Windows desktop session.

Loader and Modules

The Xorg server relies on the operating system's native module loader support for handling program modules. The X server makes use of modules for video drivers, X server extensions, font rasterisers, input device drivers, framebuffer layers, and internal components used by some drivers (like XAA).

The module interfaces (both API and ABI) used in this release are subject to change without notice. While we will attempt to provide backward compatibility for the module interfaces, we cannot guarantee this. Compatibility in the other direction is explicitly not guaranteed because new modules may rely on interfaces added in new releases.

Note about module security

The X server runs with root privileges, i.e., the X server loadable modules also run with these privileges. For this reason we recommend that all users be careful to only use loadable modules from reliable sources, otherwise the introduction of viruses and contaminated code can occur and wreak havoc on your system. We hope to have a mechanism for signing/verifying the modules that we provide available in a future release.

Configuration File

The X server uses a configuration file as the primary mechanism for providing configuration and run-time parameters. The configuration file format is described in detail in the xorg.conf(5)[6] manual page.

Note that this release features significant improvements for running the server without a configuration file, so many users may find that that they don't need a configuration file.

If you do need to customize the configuration file, see the xorg.conf manual page[7] . You can also check the driver-specific manual pages and the related documentation (found at driver tables also.

The recommended method for generating a configuration file is to use the Xorg server itself. Run as root:

```
Xorg -configure
```

and follow the instructions.

Command Line Options

Command line options can be used to override some default parameters and parameters provided in the configuration file. These command line options are described in the Xorg(1)[8] manual page.

XAA

The XFree86 Acceleration Architecture (XAA) was completely rewritten from scratch for XFree86 4.x and is used in X11R7.5. Most drivers implement acceleration by making use of the XAA module.

EXA

EXA was created as a new driver acceleration architecture to replace XAA. EXA was designed specifically to accelerate Render operations. This release features improved driver support for EXA. See the individual driver changelogs for details. Users should beware that EXA support is considered to be incomplete in X11R7.5.

Multi-head

Some multi-head configurations are supported in X11R7.5, primarily with multiple PCI/AGP cards.

One of the main problems is with drivers not sufficiently initializing cards that were not initialized at boot time. This has been improved somewhat with the INT10 support that is used by most drivers (which allows secondary card to be "soft-booted", but in some cases there are other issues that still need to be resolved. Some combinations can be made to work better by changing which card is the primary card (either by using a different PCI slot, or by changing the system BIOS's preference for the primary card).

Xinerama

Xinerama is an X server extension that allows multiple physical screens to behave as a single screen. With traditional multi-head in X11, windows cannot span or cross physical screens. Xinerama removes this limitation. Xinerama does, however, require that the physical screens all have the same root depth, so it isn't possible, for example, to use an 8-bit screen together with a 16-bit screen in Xinerama mode.

Xinerama is not enabled by default, and can be enabled with the `+xinerama` command line option for the X server.

Known problems:

- Most window managers are not Xinerama-aware, and so some operations like window placement and resizing might not behave in an ideal way. This is an issue that needs to be dealt with in the individual window managers, and isn't specifically an X server problem.

DGA version 2

DGA 2.0 is included in 7.5. Documentation for the client libraries can be found in the XDGA(3)[9] man page. A good degree of backward compatibility with version 1.0 is provided. DGA should be considered deprecated; if you are relying on it, please let us know what you need it for so we can find better solutions.

DDC

The VESA® Display Data Channel (DDC™) standard allows the monitor to tell the video card (or on some cases the computer directly) about itself; particularly the supported screen resolutions and refresh rates.

Partial or complete DDC support is available in most of the video drivers. DDC is enabled by default, but can be disabled with a "Device" section entry: `Option "NoDDC"`. We have support for DDC versions 1 and 2; these can be disabled independently with `Option "NoDDC1"` and `Option "NoDDC2"`.

At startup the server prints out DDC information from the display, and can use this information to set the default monitor parameters, or to warn about monitor sync limits if those provided in the configuration file don't match those that are detected.

Changed behavior caused by DDC.

Several drivers uses DDC information to set the screen size and pitch. This can be overridden by explicitly resetting it to the and non-DDC default value 75 with the `-dpi 75` command line option for the X server, or by specifying appropriate screen dimensions with the "DisplaySize" keyword in the "Monitor" section of the config file.

GLX and the Direct Rendering Infrastructure (DRI)

Direct rendered OpenGL® support is provided for several hardware platforms by the Direct Rendering Infrastructure (DRI). Further information about DRI can be found at the DRI Project's web site[10]. The 3D core rendering component is provided by Mesa[11].

Of note is that this release supports building the X server using the system-wide libdrm. Previously, drm was kept in the server's tree and loaded as a module, rather than using the standard OS mechanisms for managing shared libraries of code. This requires that the server be built using a version of libdrm of 2.3.0 or newer if it is to use DRM.

Font support

Details about the font support in X11R7.5.x can be found in the README.fonts[12] document.

Type1 Font support

Previous versions of X came with two Postscript Type1 font backends. The functionality from the 'Type1' backend has been replaced by the Type1 support in the 'FreeType' backend.

Xlib Compose file support and extensions

A more flexible Compose file processing system was added to Xlib in X11R7.5. The compose file is searched for in the following order:

1. If the environment variable $XCOMPOSEFILE is set, its value is used as the name of the Compose file.

2. If the user's home directory has a file named ".XCompose", it is used as the Compose file.

3. The old method is used, and the compose file is "*<xlocaledir>*/*<localename>*/Compose".

Compose files can now use an "include" instruction. This allows local modifications to be made to existing compose files without including all of the content directly. For example, the system's iso8859-1 compose file can be included with a line like this:

```
include "/usr/X11R6/lib/X11/locale/iso8859-1/Compose"
```

There are two substitutions that can be made in the file name of the include instruction. *%H* expands to the user's home directory (the *$HOME* environment variable), and *%L* expands to the name of the locale specific Compose file (i.e., "*<xlocaledir>*/*<localename>*/Compose").

For example, you can include in your compose file the default Compose file by using:

```
include "%L"
```

and then rewrite only the few rules that you need to change. New compose rules can be added, and previous ones replaced.

Finally, it is no longer necessary to specify in the right part of a rule a locale encoded string in addition to the keysym name. If the string is omitted, Xlib figures it out from the keysym according to the current locale. I.e., if a rule looks like:

```
<dead_grave> <A> : "\300" Agrave
```

the result of the composition is always the letter with the "\300" code. But if the rule is:

```
<dead_grave> <A> : Agrave
```

the result depends on how Agrave is mapped in the current locale.

Luxi fonts from Bigelow and Holmes

The X distribution includes the "Luxi" family of Type 1 fonts and TrueType fonts. This family consists of the fonts "Luxi Serif", "Luxi Sans" and "Luxi Mono" in Roman, oblique, bold and bold oblique variants. The TrueType version have glyphs covering

the basic ASCII Unicode range, the Latin 1 range, as well as the *Extended Latin* range and some additional punctuation characters. In particular, these fonts include all the glyphs needed for ISO 8859 parts 1, 2, 3, 4, 9, 13 and 15, as well as all the glyphs in the Adobe Standard encoding and the Windows 3.1 character set.

The glyph coverage of the Type 1 versions is somewhat reduced, and only covers ISO 8859 parts 1, 2 and 15 as well as the Adobe Standard encoding.

The Luxi fonts are original designs by Kris Holmes and Charles Bigelow from Bigelow and Holmes Inc., who developed the Luxi typeface designs in Ikarus digital format. URW++ Design and Development GmbH converted the Ikarus format fonts to TrueType and Type 1 font programs and implemented the grid-fitting "hints" and kerning tables in the Luxi fonts.

The license terms for the Luxi fonts are included in the file 'COPYRIGHT.BH', as well as in the License document[13]. For further information, please contact <design@bigelowandholmes.com> or <info@urwpp.de>, or consult the URW++ web site[14].

Miscellaneous

This section describes other items of note for the X11R7.5 release.

Socket directory ownership and permissions

The socket directories created in /tmp are now required to be owned by root and have their sticky-bit set. If the permissions are not set correctly, the component using this directory will print an error message and fail to start. Common socket directories that are known to be affected include:

```
/tmp/.font-unix
/tmp/.ICE-unix
/tmp/.X11-unix
```

These directories are used by the font server, **xfs**, applications using the Inter-Client Exchange protocol (ICE) and the X server, respectively.

There are several solutions to the problem of when to create these directories. They could be created at install time by the system's installer if the /tmp dir is persistent. They could be created at boot time by the system's boot scripts (e.g., the init.d scripts). Or, they could be created by PAM modules at service startup or user login time.

The solution chosen is platform dependent, and the system administrator should be able to handle creating those directories on any systems that do not have the correct ownership or permissions.

Composite exposes extra visuals

When the Composite extension is enabled, a new visual is created. This visual is different from the other visuals used by X applications in that it includes an alpha component. It is used by the compositing manager and other Composite aware applications.

Most X applications ignore this visual since it is not useful to them; however some applications mistakenly try to use it, which will cause them to fail. An environment variable, XLIB_SKIP_ARGB_VISUALS, was added to the X11 library to hide this visual from applications that mistakenly try to use it. If an application fails only when

the Composite is enabled, try setting this environment variable before starting the application.

Deprecated components and removal plans

This section lists current plans for removal of obsolete or deprecated components in the X.Org releases. As our releases are open source, users who continue to require these can find the source in previous releases and continue to use these, but the X.Org Foundation and its volunteers have decided the burden of continued maintenance and distribution in the core X11 releases outweighs the benefits of doing so. In some cases, this is simply because no one has volunteered to do continued maintenance, so if software is listed here that you need, you can contact `<xorg@lists.freedesktop.org>` to volunteer to take over maintainership, either inside or outside of the Xorg release process.

Xprint

The Xprint server and extension have been removed in this release. Xprint support in a number of client programs has also been removed.

Unmaintained extensions

Support has been removed from the X servers for the following extensions, which were obsolete, not widely used, or not working:

- AppGroup
- EVI
- MIT-SUNDRY-NONSTANDARD
- TOG-CUP
- XTrap
- XFree86-Misc
- XEvIE

Xorg configuration utilities

The **xorgcfg** GUI and **xorgconfig** CLI utilities have been removed in this release. See the Configuration File section for alternative methods of Xorg configuration.

ioport

The ioport utility and its aliases (inb, inw, inl, outb, outw, and outl) for manipulating I/O space addresses directly have been removed in this release.

Attributions/Acknowledgements/Credits

THIS IS A DRAFT OF THE X11R7.5 CREDITS SECTION.: If you find missing credits, incorrect attributions, or other errors, please send details to `<xorg@lists.freedesktop.org>`.

This section lists the credits for the X11R7.5 release. For a more detailed breakdown, refer to the ChangeLog file in the source tree for each module, the history in the

xorg product in freedesktop.org's git repositories[15] or the '`git log`' information for individual source files.

The X Window System has been a collaborative effort from its inception. Our apologies for anyone or organization inadvertently overlooked. Many individuals (including major contributors) who worked on X are represented by their employers in this list. If you feel we have left anyone out, please let us know.

These people contributed in some way to X11R7.5:

Aaron Plattner	Joe Krahn
Aaron Zang	Joel Bosveld
Adam Hoka	John Hein
Adam Jackson	John McKernan
Adam Tkac	John Nielsen
Adel Gadllah	John Tapsell
Adrian Friedli	Jon TURNEY
Alan Coopersmith	Jordan Crouse
Alan Cox	Joseph Adams
Alan Curry	Juan RP
Alan Hourihane	Julien Cristau
Albert Damen	Julien Plissonneau Duquene
Alberto Milone	Juliusz Chroboczek
Alex Deucher	Kalev Lember
Alex Villacís Lasso	Kazuhiro Inaoka
Alexey Ten	Kees Cook
Ander Conselvan de Oliveira	Keith Packard
Andre Herms	Kel Modderman
Andreas Luik	Kevin E Martin
Andres Salomon	Kim Woelders
Andrew Randrianasulu	Kristian Høgsberg
Arkadiusz Miśkiewicz	Krzysztof Halasa
Arnaud Patard	Kshitij Kulshreshtha
Arthur HUILLET	Kyle McMartin
Asbjøannes	Lee Leahu
Barry Scott	Li Peng
Bart Massey	Li Shao Hua
Bart Trojanowski	Luc Verhaegen
Bastien Nocera	Luk´š Hejtm´nek
Batchty	Lukasz Kurylo
Ben Byer	Ma Ling
Ben Gamari	Maarten Maathuis
Ben Hutchings	Maciej Cencora
Ben North	Magnus Kessler
Ben Skeggs	Magnus Vigerlöf
Benjamin Close	Manuel Bouyer
Benjamin Defnet	Marcel Dejean
Benjamin Herrenschmidt	Marcin 'Qrczak' Kowalczyk
Benjamin Tissoires	Mark Kettenis
Bernhard R. Link	Mark van Doesburg
Bernhard Rosenkraenzer	Markus Gapp
Bill Nottingham	Markus Kuhn
Bob Ham	Mart Raudsepp
Bob Long	Martin-Éric Racine
Brad Smith	Mathieu Bérard
Branden Robinson	Matt Helsley
Brian Rogers	Matt Turner
Brice Goglin	Matthias Hopf

Bryce Harrington	Matthieu Herrb
Calvin Fong	Mattia Dongili
Caolan McNamara	Maxim Levitsky
Carl Worth	Micah Dowty
Charlie	Michael Chapman
Chris Ball	Michael Lorenz
Chris Salch	Michael Scherer
Chris Wilson	Michael Vogt
Christiaan van Dijk	Michael Witrant
Christian Aistleitner	Michael Witten
Christian Beier	Michel Dänzer
Christian Koenig	Mikhail Gusarov
Christian Schmitt	Nathael Pajani
Christoph Brill	Nathaniel McCallum
Coleman Kane	Neale Pickett
Colin Guthrie	Nicolai Hähnle
Colin Harrison	Nicos Gollan
Cooper Yuan	Niels de Vos
Corbin Simpson	Oliver McFadden
Dan	Olivier Blin
Dan Nicholson	Olivier Fourdan
Daniel Drake	Otavio Salvador
Daniel Stone	Owain G. Ainsworth
Daniel Vetter	Owen Taylor
Darren Smith	Owen W. Taylor
Dave Airlie	Patrick Haller
Dave Miller	Paul Bender
David Jander	Paul Menzel
David Marx	Paul "TBBle" Hampson
David Miller	Pauli Nieminen
David Nolden	Paulo César Pereira de Andrade
David Nusinow	Paulo Ricardo Zanoni
David Schleef	Peter Alfredsen
Dennis Kasprzyk	Peter Åstrand
Derek Upham	Peter Breitenlohner
Derek Wang	Peter Harris
Diego Elio 'Flameeyes' Pettenò	Peter Hutterer
Dima Kogan	Peter Korsgaard
Dmitry Torokhov	Petr Salinger
Dodji Seketeli	Philip Langdale
Donald Kayser	Pierre Ossman
Donnie Berkholz	Pierre Willenbrock
Doug Chapman	Pierre-Loup A. Griffais
Drew Parsons	RALOVICH, Kristóf
Eamon Walsh	Rami Ylimaki
Ed Catmur	Ramon van der Stelt
Eduard Bagrov	Rémi Cardona
Eduard Fuchs	Richard Hughes
edward shu	Robert Lowery
Egbert Eich	Robert Noland
Eric Anholt	Roland Bär
Eric Paris	Roland Scheidegger
Éric Piel	Ross Burton
Erik Andren	Ryan Hill
Erkin Bahceci	Ryan Lortie
Evgeny M. Zubok	Samuel Thibault
Eygene Ryabinkin	Sascha Hlusiak
Fabio	Sayamindu Dasgupta
Federico Mena Quintero	Shaohua Li

Fedor P. Goncharov (Fredy)	Shelley Gong
Felix Kuehling	Shuang He
Fernando Carrijo	Shunichi Fuji
Francis Giraldeau	Simon Farnsworth
Francisco Jerez	Simon Munton
Fredrik Höglund	Simon Thum
Gaetan Nadon	Søren Hauberg
George Peter Staplin	Søren Sandmann Pedersen
George Sapountzis	Stefan Dirsch
George Staplin	Stijn van Drongelen
Giuseppe Bilotta	Stuart Bennett
Goneri Le Bouder	Stuart Kreitman
Guillem Jover	Tero Saarni
Hans de Goede	Thomas Bodzar
Hasso Tepper	Thomas Jaeger
Havoc Pennington	Thomas Klausner
Helge Bahmann	Thomas Petazzoni
Henrik Rydberg	Thorvald Natvig
Henry unbongo	Tiago Vignatti
Hong Liu	Tibi Nagy
Hugo Jacques	Tilman Sauerbeck
Ian Romanick	Timo Aaltonen
Imranullah Syed	Tom Jaeger
Ivaylo Boyadzhiev	Tomas Carnecky
Jakob Bornecrantz	Tomas Janousek
Jakub Bogusz	Topi Kanerva
James Cloos	Tormod Volden
Jamie Lentin	Vincent Mussard
Jason Vas Dias	Werner LEMBERG
Jasper Lievisse Adriaanse	William Grant
Jay Cotton	Winfried Grünewald
Jeff Smith	Wolke Liu
Jens Granseuer	Wu Fengguang
Jeremy C. Reed	Xavier Bestel
Jeremy Huddleston	Xiang, Haihao
Jeremy Jay	Y.C. Chen
Jeremy Lainé	Yaakov Selkowitz
Jeremy Uejio	Yan Li
Jerome Glisse	Yang Zhao
Jerome Pinot	Yann Droneaud
Jesse Adkins	Yannick Heneault
Jesse Barnes	<50724><50976><50672>(Yu-yeon Oh)
Jesse Ruffin	Zdenek Kabelac
Jie Luo	Zhao Yakui
Jim Huang	Zhenyu Wang
Jochen Voss	Zou Nan hai

This product includes software developed by:

2d3d Inc.	Kristian Høgsberg
3Dlabs Inc. Ltd.	Larry Wall
Aaron Plattner	Lars Knoll
Adam de Boor	Lawrence Berkeley Laboratory
Adam Jackson	Leif Delgass
Adobe Systems Inc.	Lennart Augustsson
After X-TT Project	Leon Shiman

AGE Logic Inc.
Alan Coopersmith
Alan Cox
Alan Hourihane
Alexander Gottwald
Alex Deucher
Alex Williamson
Anders Carlsson
Andreas Luik
Andreas Monitzer
Andreas Robinson
Andrei Barbu
Andrew C Aitchison
Andy Ritger
Angus Lees
Ani Joshi
Anton Zioviev
Apollo Computer Inc.
Apple Computer Inc.
Ares Software Corp.
AT&T Inc.
ATI Technologies Inc.
BEAM Ltd.
Benjamin Herrenschmidt
Benjamin Rienfenstahl
Ben Skeggs
Bigelow and Holmes
Bill Reynolds
Bitstream Inc.
Bogdan Diaconescu
Branden Robinson
Brian Fundakowski Feldman
Brian Goines
Brian Paul
Bruno Haible
Bryan Stine
Carl Switzky
Catharon Productions Inc.
Charles Murcko
Chen Xiangyang
Chisato Yamauchi
Chris Constello
Christian Zietz
Cognition Corp.
Compaq Computer Corporation
Concurrent Computer Corporation
Conectiva S.A.
Corin Anderson
Craig Struble
Daewoo Electronics Co. Ltd.
Dag-Erling Smørgrav
Dale Schumacher
Damien Miller
Daniel Berrange
Daniel Borca
Daniel Stone
Daniver Limited
Daryll Strauss

Lexmark International Inc.
Linus Torvalds
Luc Verhaegen
Machine Vision Holdings Inc.
Manfred Brands
Marc Aurele La France
Mark Adler
Mark J. Kilgard
Mark Leisher
Mark Smulders
Mark Vojkovich
Marvin Solomon
Massachusetts Inst. Of Technology
Matrox Graphics
Matthew Grossman
Matthias Hopf
Matthieu Herrb
Metro Link Inc.
Michael Bax
Michael H. Schimek
Michael P. Marking
Michael Schimek
Michael Smith
Michel Dänzer
Mike A. Harris
Mike Harris
Ming Yu
MIPS Computer Systems Inc.
National Semiconductor
NCR Corporation Inc.
NetBSD Foundation
Netscape Communications Corp.
Network Computing Devices Inc.
Nicholas Joly
Nicholas Miell
Nicholas Wourms
Nicolai Haehnle
Noah Levitt
Nolan Leake
Novell Inc.
Nozomi YTOW
NTT Software Corporation
Number Nine Computer Corp.
Number Nine Visual Technologies
NVIDIA Corp.
Oivier Danet
Oki Technosystems Laboratory Inc.
OMRON Corporation
Open Software Foundation
Orest Zborowski
Owen Taylor
Pablo Saratxaga
Panacea Inc.
Panagiotis Tsirigotis
Paolo Severini
Pascal Haible
Patrick Lecoanet
Patrick Lerda

Data General Corporation
Dave Airlie
David Bateman
David Dawes
David E. Wexelblat
David Holland
David J. McKay
David McCullough
David Mosberger-Tang
David Reveman
David S. Miller
David Woodhouse
Davor Matic
Deron Johnson
Digeo Inc.
Digital Equipment Corporation
Dirk Hohndel
Dmitry Golubev
Donnie Berkholz
DOS-EMU-Development-Team
Doug Anson
Drew Parsons
Earle F. Philhower III
Edouard TISSERANT
Eduard Fuchs
Eduardo Horvath
Egbert Eich
Egmont Koblinger
Elliot Lee
Eric Anholt
Eric Fortune
Eric Sunshine
Erik Fortune
Erik Nygren
Evans & Sutherland Computer Corp.
Fabio Massimo Di Nitto
Fabrizio Gennari
Felix Kuehling
Felix Kühling
Finn Thoegersen
Francesco Zappa Nardelli
Frank C. Earl
Frederic Lepied
Fredrik Höglund
Free Software Foundation
Fujitsu Limited
Fujitsu Open Systems Solutions Inc.
Fuji Xerox Co. Ltd.
Geert Uytterhoeven
George Fufutos
Gerrit Jan Akkerman
Gerry Toll
Glenn G. Lai
GNOME Foundation
Go Watanabe
Greg Kroah-Hartman
Gregory Mokhin

Paul Anderson
Paul Elliott
Paul Mackerras
Peter Breitenlohner
Peter Kunzmann
Peter Trattler
Philip Homburg
Philip Langdale
Precision Insight Inc.
Prentice Hall
Quarterdeck Office Systems
Radek Doulik
Ralf Habacker
Randy Hendry
Ranier Keller
Red Hat Inc.
Regis Cridlig
Rene Cougnenc
Richard A. Hecker
Richard Burdick
Rich Murphey
Rickard E. Faith
Rik Faith
Robert Chesler
Robert Millan
Robert V. Baron
Robin Cutshaw
Roland Mainz
Roland Scheidegger
Ronny Vindenes
Russ Blaine
Ryan Breen
Ryan Lortie
Ryan Underwood
S3 Graphics Inc.
Sam Leffler
Santa Cruz Operation Inc.
SciTech Software
Scott Laird
Sebastien Marineau
Shigehiro Nomura
ShoGraphics Inc.
Shunsuke Akiyama
Silicon Graphics Computer Systems
Silicon Integrated Systems Corp
Silicon Motion Inc.
Simon P. Cooper
Snitily Graphics Consulting Services
Sony Corporation
Søren Sandmann
SRI
Stanislav Brabec
Stefan Dirsch
Stephane Marchesin
Stephan Lang
Steven Lang
Stuart Kreitman

Greg Parker
GROUPE BULL
Guy Martin
Hans Oey
Harald Koenig
Harm Hanemaayer
Harold L Hunt II
Harry Langenbacher
Henry A. Worth
Hewlett-Packard Company
Hitachi Ltd
Holger Veit
Hong Bo Peng
Howard Greenwell
Hummingbird Communications Ltd.
Ian Romanick
IBM Corporation
Inst. of Software Academia Sinica
Intel Corporation
INTERACTIVE Systems Corporation
Itai Nahshon
Ivan Kokshaysky
Ivan Pascal
Jakub Jelinek
James Tsillas
Jason Bacon
Jaymz Julian
Jean-loup Gailly
Jeff Hartmann
Jeff Kirk
Jeffrey Hsu
Jehan Bing
Jeremy C. Reed
Jeremy Katz
Jerome Glisse
Jesse Barnes
Jim Gettys
Jim Tsillas
John Dennis
John Harper
John Heasley
Jonathan Adamczewski
Jon Block
Jon Smirl
Jon Tombs
Jorge Delgado
José Fonseca
Joseph Friedman
Joseph V. Moss
Julio M. Merino Vidal
Juliusz Chroboczek
Jyunji Takagi
Kaleb Keithley
Kazushi (Jam) Marukawa
Kazuyuki (ikko-) Okamoto

Sun Microsystems Inc.
SunSoft Inc.
SuSE Inc
Sven Luther
Takis Psarogiannakopoulos
Takuma Murakami
Takuya SHIOZAKI
T. A. Phelps
Tektronix Inc.
Theo de Raadt
Theodore Ts'o
The Open Group
The Weather Channel Inc.
Thomas E. Dickey
Thomas G. Lane
Thomas Hellström
Thomas Mueller
Thomas Roell
Thomas Thanner
Thomas Winischhofer
Thomas Wolfram
Thorsten.Ohl
Tiago Gons
Tilman Sauerbeck
Todd C. Miller
Tomohiro KUBOTA
Torrey Lyons
Torrey T. Lyons
TOSHIBA Corp.
Toshimitsu Tanaka
Travis Tilley
Trolltech AS
Tungsten Graphics Inc.
Tuomas J. Lukka
Ty Sarna
UCHIYAMA Yasushi
Unicode Inc.
UniSoft Group Limited
University of California
University of Utah
University of Wisconsin
UNIX System Laboratories Inc.
URW++ GmbH
Valery Inozemtsev
VA Linux Systems
VIA Technologies Inc.
Video Electronics Standard Assoc.
VMware Inc.
Vrije Universiteit
Wittawat Yamwong
Wyse Technology Inc.
X Consortium
XFree86 Project Inc.
Xi Graphics Inc.
X-Oz Technologies

Kean Johnston	X-TrueType Server Project
Keith Packard	Yu Shao
Keith Whitwell	Zack Rusin
Kensuke Matsuzaki	Zephaniah E. Hull
Kevin E. Martin	Zhenyu Wang

This product includes software developed by The XFree86 Project, Inc (http://www.xfree86.org/) and its contributors.

This product includes software that is based in part of the work of the FreeType Team (http://www.freetype.org/).

This product includes software developed by the University of California, Berkeley and its contributors.

This product includes software developed by Christopher G. Demetriou.

This product includes software developed by the NetBSD Foundation, Inc. (http://www.netbsd.org/) and its contributors.

This product includes software developed by X-Oz Technologies (http://www.x-oz.com/).

Notes

1. http://www.x.org/wiki/XorgFoundation
2. http://wiki.x.org/wiki/ModularDevelopersGuide
3. https://bugs.freedesktop.org/
4. http://www.x.org/wiki/Development/Documentation/SubmittingPatches
5. Darwin.html
6. xorg.conf.5.html
7. xorg.conf.5.html
8. Xorg.1.html
9. XDGA.3.man
10. http://dri.sf.net/
11. http://www.mesa3d.org
12. fonts.html
13. LICENSE.html
14. http://www.urwpp.de
15. http://cgit.freedesktop.org/xorg/