AMD Linux® Graphics Driver (LGD) Specification

Advanced Micro Devices

Please note that in this document, references to "DVI" and "HDMI" may refer to:

(1) the function of the integrated DVI/HDMI interface; or

(2) the capability of the TMDS interface, multiplexed on the PCIe® external graphics interface, to enable DVI or HDMI through passive enabling circuitries. Any statement in this document on any DVI- or HDMI-related functionality must be understood to apply to (1), (2), or both, according to the immediate context of the reference. Advanced Micro Devices, Inc., will not provide any indemnity, pay any royalty, nor provide any license/sublicense to any:

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Revision History

Date	Revision	Description
January 2012	1.5	2012 Q1 Release • Updated driver architecture diagram • Updated OS distribution support table • Updated various release versions • Added new sections for Supported Color Depth, HDCP, and X window Manager
September 2011	1.4	2011 Q4 Release • Updated driver architecture diagram • Updated various release versions
July 2011	1.3	2011 Q3 Release • Updated supported OS distribution table • Added mode table • Updated driver architecture diagram • Updated various release versions
March 2011	1.2	Initial Release

Chapter 1   General

1.1   Supported ASICs

The proprietary Linux® Graphics Driver (LGD) from AMD provides unified driver support for R600 and later ASICs, including desktop ASICs (HD2000 series and later), mobile ASICs (M72 and later), IGP ASICs (RS780 and later), and AMD Fusion APUs (Accelerated Processing Units).

1.2   Platform, OS, X Server, Linux® Distribution Support

As of Oct 10, 2011 (8.89, AMD Catalyst™ 11.9 software)

	Distro	Tier	Included in distro	Supported releases	Notes
openSUSE	openSUSE	1	✓[1]	11.3, **11.4**	
Novell	SUSE LINUX Enterprise Server (SLES)	2	✓[1]	10sp4, **11sp1**	
Novell	SUSE LINUX Enterprise Desktop (SLED)	2	✓[1]	10sp4, **11sp1**	
Linux	Red Flag Desktop	2	✓[2]	7	
redhat	Red Hat Enterprise Linux—Workstation (RHEL-WS)	1	✗	5.6, **5.7**	RHEL-D+W (workstation option)
	Red Hat Enterprise Linux—Desktop			**6.1**	
redhat	Red Hat Enterprise Linux—Enterprise Server (RHEL-ES)	2	✗	5.6, 5.7	
	Red Hat Enterprise Linux—Server			6.1	
ubuntu	Ubuntu	2	✓	11.10	

1.3   Display Modes

The LGD provides different ways to customize the X window mode list through its configuration file:

- The X window system provides different ways to switch modes via the RandR extension (xrandr)

- Alternately, the ADL (AMD Display Library) provides a function API that allows applications to directly communicate with the driver for custom mode setting

The first two are the traditional switching modes and can only be used to switch resolution, but not refresh rate. The RandR extension switching mode has been widely used in modern control panel resolution switcher applets. All three methods of mode switching are supported by the LGD. However, there is no standard user interface for changing modes. It is up to the individual Linux distributor to include a control panel applet for mode switching. The LGD does not currently provide a utility for doing this.

Screen resolution changes can also be achieved via the amdcccle GUI or aticonfig command-line utility.

Driver Supported Standard Modes

	HD 5000 or Lower		HD 6000 or Higher	
	Resolution	Refresh Rate (Hz)	Resolution	Refresh Rate (Hz)
Minimum	640x480	60, 72, 75, 85, 90, 100, 120, 160, 200	640x480	60, 75, 85
Maximum	2048x1536	60, 66, 70, 75, 85	2048x1536	60, 75

1.4   Supported Color Depth

Color Depth	Supported ASIC
24 bpp	Consumer/Embedded GPU/APU products
30 bpp	Workstation GPU/APU products

1.5   Supported Display Types

The LGD supports the following display types: CRT, TMDS, LVDS.

1.6   Supported Port Types

The LGD supports the following port types: VGA, DVI, HDMI™ and DisplayPort.

1.7   Multi-Display Support

The LGD supports multiple displays on a single card in the following desktop setup configurations: single, clone, single large desktop, big desktop and dual head. All these modes are best supported in the AMD Eyefinity configuration panel in amdcccle.

- Single: Only one display is enabled even when multiple displays are connected.

- Clone: The contents of the primary monitor are duplicated on the second monitor. Two displays can run at different resolutions and refresh rates. This is similar to Windows® clone mode.

- Single Large Desktop (SLD): SLD with one display output mapping to each viewport.

- Big Desktop: There is a single big frame buffer that gets split either horizontally or vertically and each half is sent to a single monitor. This is similar to Windows stretching mode.

- Dual Head: In this mode, the X server is configured to have two screens on two different channels of the same adapter. This will create two independent desktops managed by the window manager. This is similar to Windows extended desktop mode, but you cannot drag a window from one display to another. You cannot enable Xinerama in this mode because of the limitation in X window.

- Eyefinity Technology: Supports up to six monitors simultaneously with boards equipped with DP1.2 ports, or two display outputs of either DVI, HDMI, or VGA can be combined with the DisplayPort outputs up to a total of six monitors per GPU. Eyefinity is only supported with RandR1.2 and higher.

	Clone Mode	Big Desktop	SLD	Multihead	Multiview	Panning	Transform
RandR1.1	√	√		√	√		
RandR1.2	√		√	√	√		
RandR1.3	√		√	√	√	√	√

1.8   Multi-Card Support

AMD CrossFire™ platform is supported for HD 4xxx (E4690) ASIC and up, it allows load-balancing for graphs rendering between multiple GPUs to greatly improve performance. It is enabled for OpenGL applications.

- Active only in full screen exclusive mode

- AMD CrossFire platform modes

  o Split Frame Rendering (SFR) - each GPU processes a portion of each rendered frame

  o SuperAA – each GPU renders a frame with slightly different MSAA sample pattern

  o Alternate Frame Rendering (AFR) – each GPU processes a different frame

1.9   Display Switching Support

The LGD provides support for display switching triggered by hotkey, docking event, user event, and hot plug event. Due to the limitation of current X server, hotkey and docking event triggered display switching is only supported on some specific laptops through OEM program and certain Linux distributions. Display hot-plug is not supported on VGA connections.

1.10   ACPI Power Management Support

The LGD supports ACPI power management events for suspend-to-RAM and suspend-to-disk. Due to the nature of ACPI implementation on Linux, event trigger relies on user configuration, usually through (but not limited to) configuration files in /etc/acpid/sleep. Also suspend and resume will only work in X window environment and will not work in console even switch from VT to console manually.

1.11   PowerPlay™ Technology Support

The LGD supports PowerPlay™ technology. A command line utility is provided to let users setup their own policy for changing PowerPlay state with any triggering events available on their system. PowerPlay support level is ASIC dependent and must be installed with a PowerPlay enabled VBIOS.

1.12   OpenGL Support

The LGD provides hardware accelerated OpenGL support.

- OpenGL version 2.0 to 4.1, and 4.2-beta are currently supported

- GLX extension 1.4 is supported on client side

- GLX extension 1.2 is supported on server side.

- OGLES2.0 is shipping along with the AMD Catalyst™ software application releases, but currently has no official support.

- Most of driver options for customizing 3D, and display behavior are provided by the Catalyst™ Control Center software, Linux Edition (amdcccle).

1.13   OpenCL™ Support

The LGD supports OpenCL™ AMD APP (Accelerated Parallel Processing) SDK V2.6 for OpenCL1.2, and aligns with the Linux distributions the current AMD Linux driver supports.

http://developer.amd.com/sdks/AMDAPPSDK/downloads/Pages/default.aspx

1.14   XvBA

The driver supports HD video acceleration utilizing the UVD video decode engine via the XvBA API SDK. The SKD is available for public download at:

http://developer.amd.com/zones/opensource/Pages/default.aspx

1.15   HDCP

HDCP (High-bandwidth Digital Content Protection) is currently not implemented in the driver.

1.16   Control Panel Support

AMD Catalyst Control Center software, Linux Edition (amdcccle) features a flexible architecture that supports multiple Linux distributions, and supports AMD's Linux-based workstations and graphics with features including:

- Key hardware and software information

- Display and panel settings

- 3D settings

- Color adjustments

- AMD CrossFire platform

- PowerPlay technology

- Vsync, anti-aliasing

1.17   Tear-Free Desktop

This feature supports tear-free vsync experience covers 2D, 3D and video applications across the entire desktop. It can be enabled/disabled with amdcccle under Display Options. An enhanced 2D accelerated TFD mode is planned to be included after AMD Catalyst 11.10 software release.

1.18   Configuration

The X server must be correctly configured before it can run properly on the LGD. Currently this process is done automatically through running aticonfig during the installation process for default setup. After configuration, X server must be restarted for it to take effect (however, reboot is not required).

1.19   Installer

The LGD installer provides both console and graphics interfaces for easy installation. It is a unified installer that works on all supported versions of X server and Linux kernel. Since Linux kernel is constantly changing, it is impossible to build a pre-compiled kernel for every system. The LGD must be linked to the version of kernel on the user's system at installation time. Check the latest Driver Release Notes (included with driver download) for driver installation environment requirements.

Chapter 2   Supported X window Features

With the evolution of X window, many new features are being added in every release. The LGD will include support for new features at the appropriate time. The LGD will not officially support new features that are still in the development stage. The following sub-sections highlight a few X server features that are supported by the current LGD.

2.1   X window Managers

The driver only tested under the standard environment with KDM (KDE Display Manager) and GDM (GNOME Display Manager) window managers that are part of the supported Linux Distribution (section 1.2) installations. The driver might work with other window managers but they are not in the QA test list.

2.2   2D Acceleration - AAA

AAA (**A**MD 2D **A**cceleration **A**rchitecture) driver architecture makes 2D acceleration available to the X server. 2D acceleration in the AMD driver is implemented based on this model. Under certain conditions where GPU acceleration is either impractical to implement or functions are not yet implemented, the Enhanced Tear-Free Desktop (ETFD) mode can be enabled to improve performance for some applications.

2.3   DRI / DRI2

The Direct Rendering Infrastructure provides a mechanism for a client (like OpenGL driver) to directly render to hardware without going through X window. The LGD uses DRI / DRI2 based mechanism for OpenGL and 2D acceleration.

2.4   AIGLX

AIGLX provides a windowing system support for OpenGL-based 3D desktop on X window. They use different methods for providing such support.

AIGLX sends the commands indirectly via the X server to the graphics hardware.

LGD supports AIGLX for 3D desktop.

2.5   XV

The X video extension is a video output mechanism under the X window system. It allows hardware scalable video playback, color space conversion and video attributes control. XV extension does not include decoding acceleration support as in XvMC. The current LGD graphics driver supports XV based video playback acceleration support.

2.6   X RandR

Resize and Rotate Extension allows clients to change the size and rotation of the root window of a screen, along with the ability to reflect the screen about either axis. Currently, the LGD supports RandR 1.3 for screen resize.

2.7   Render/Damage/Composite Extensions

Starting from Xorg 6.8, there is a new X protocol – Composite Extension that allows windows to be rendered into an off-screen buffer first, and then blended together automatically or by external compositing managers with the DAMAGE and RENDER extensions. The current LGD provides basic support for these extensions.

Chapter 3   Linux® Driver Configuration Tools

3.1   aticonfig

The aticonfig tool is included in the fglrx driver and installed by default driver installation. The list of the commands can be displayed with the "aticonfig --help" command.

3.2   amdcccle

GUI interface for driver configuration; runs under X window.

3.3   Xorg.conf

An alternative to the aticonfig and amdcccle commands to configure the driver behavior, the xorg.conf file can be edited manually. However, it is recommended to use the aticonfig or amdcccle wherever possible.

3.4   AMD Display Library (ADL) SDK ver3.0

ADL is designed to access display driver functionality for AMD Radeon™ graphics technology and AMD FirePro™ graphics cards.

http://developer.amd.com/gpu/adlsdk/Pages/default.aspx

LGD Driver Architecture Overview