Graphics stack

Contents

Like most UNIX/Linux operating systems, OpenIndiana's GUI environment is based on the X Window System bundled with libraries and applications developed by the freedesktop.org community.

Therefore the Graphic Stack is comprised of: * the opensource X11 display server Xorg, client libraries and utilities developed by the X.org Project, * an OpenGL implementation in the form of the opensource Mesa library, * and illumos kernel drivers for different graphics adapters provided by the gfx-drm gate, * together with the libdrm implementing communication between kernel drivers and user-space components through the Direct Rendering Infrastructure (DRI) protocol.

All these components can be installed using the unified build system oi-userland or simply installed from the package repositories.

Notes concerning different components are provided:

Component	Scope
Xorg	Building the Xorg display server, protocol headers, client libraries and applications.
Mesa	Building the Mesa library and testing OpenGL capabilities.
Fonts	Packaging new fonts for OpenIndiana.
Nvidia	Installation of Nvidia's proprietary graphics driver for Solaris.
gfx-drm	Building the illumos KMS drivers and libdrm from the gfx-drm gate.

1   Xorg

All the Xorg components are build in oi-userland and located in the x11 directory:

https://github.com/OpenIndiana/oi-userland/tree/oi/hipster/components/x11

A bogus component is provided to rebuild the X11 gate: https://github.com/OpenIndiana/oi-userland/tree/oi/hipster/components/x11/x11-gate

The upstream Solaris code is located at:

https://github.com/oracle/solaris-userland/tree/master/components/x11

2   Mesa

To build Mesa use the x11/mesa component.

3   Fonts

Font components in oi-userland are located in the components/fonts directory.

4   Nvidia

Nvidia provides Solaris x86-64/x86 packages of their proprietary driver for different families of graphic adapters.

The Nvidia driver shipped with OpenIndiana is built using openindiana/nvidia-XXX e.g. openindiana/nvidia-470 component.

The list of currently supported and legacy drivers is updated on the Unix Drivers page.

Series	Label	Models	Notes
430.xx	Current long lived branch	Quadro RTX 4000-8000, Quadro, Quadro Blade, Quadro NVS, NVS	
415.xx	Current short lived branch	Quadro RTX 4000-6000, Quadro, Quadro Blade, Quadro NVS, NVS	
396.xx	Legacy GPU	GeForce 400 to Geforce GTX 10	Driver 396.24
340.xx	Legacy GPU	GeForce 8 to GeForce 700 series	Driver 340.106 ; Delivers libvdpau as part of the package.
304.xx	Legacy GPU	GeForce 6 to GeForce 600 series	Driver 304.137

The drivers series 340.xx, 390.xx, and 490.xx are currently part of oi-userland, others may be installed manually following Nvidia's instructions.

The 390.xx drivers are current default.

Note on switching driver versions

```
# beadm create nvidia-460
# beadm mount nvidia-460 /tmp/nvidia-460
# pkg -R /tmp/nvidia-460 uninstall xorg-video nvidia nvidia-390
# pkg -R /tmp/nvidia-460 install nvidia-460
# beadm activate nvidia-460
# init 6
```

Note on manual driver installations:

```
# beadm create oi-nvidia
# beadm mount oi-nvidia /mnt
# pkg -R /mnt uninstall x11/server/xorg/driver/xorg-video driver/graphics/nvidia
# /bin/sh NVIDIA-Solaris-x86-390.48.run --extract-only
# cd NVIDIA-Solaris-x86-390.48
# pkgadd -R /mnt -d . NVDAgraphics NVDAgraphicsr
# bootadm update-archive -R /mnt
# beadm unmount -f oi-nvidia
# beadm activate oi-nvidia
# init 6
```

5   gfx-drm

The gfx-drm gate consists of different kernel components for support of various graphic adapters in the illumos and the Direct Rendering Infrastructure (DRI) library, libdrm.

Component	Description
libdrm	The library enables communication between kernel components and user-space libraries through the DRI protocol.
agpart	Kernel driver for the Graphics Address Remapping Table (GART) / Graphics Translation Table (GTT) support.
header-drm	System headers for DRM/KMS kernel drivers and user-space libraries.
i915	Intel KMS driver for Intel Graphics Media Accelerator (GMA) and Intel HD Graphics adapters.

5.1   Intel KMS driver

The xorg-video-intel package is the open-source 2D graphics driver for the X Window System as implemented by X.org. It supports a variety of Intel graphics chipsets including:

- i810/i810e/i810-dc100,i815,
- i830M,845G,852GM,855GM,865G,
- 915G/GM,945G/GM/GME,946GZ
- G/GM/GME/Q965,
- G/Q33,G/Q35,G41,G/Q43,G/GM/Q45
- PineView-M (Atom N400 series)
- PineView-D (Atom D400/D500 series)
- Intel(R) HD Graphics,
- Intel(R) Iris(TM) Graphics,
- Intel(R) Iris(TM) Pro Graphics.

Open source kernel driver(s) by Oracle:

https://github.com/oracle/solaris-userland/tree/master/components/x11/kernel/sun-src

The relevant kernel code is located in drm and i915 subfolders.

An illumos port of Oracle code is available here:

https://github.com/illumos/gfx-drm

Martin Bochnig, creator of OpenSXCE, initially backported the S12 driver to illumos available in oi-userland until December 20, 2016.

It was then superseeded by the new gate providing improvements to the gfx_private interface and agpgart driver, as well as containing userland libraries used by graphics, like libdrm.

5.1.1 References

Alan Coopersmith pointed to the following documents regarding DRI/KMS:

- http://www.phoronix.com/scan.php?page=news_item&px=Solaris-DRM-KMS-2015
- http://www.x.org/wiki/Events/XDC2015/Program/#Fishel_status_drm_i915_solaris
- https://en.wikipedia.org/wiki/Direct_Rendering_Manager
- http://dri.freedesktop.org/wiki/
- https://wiki.archlinux.org/index.php/kernel_mode_setting
- https://web.archive.org/web/20170711030533/http://lanyrd.com/topics/x-window-system/

Additionally, information about driver development:

- https://01.org/linuxgraphics
- http://dri.freedesktop.org/docs/drm/
- http://blog.ffwll.ch/2013/01/i915gem-crashcourse-overview.html
- blog posts from the i915 Linux maintainer http://blog.ffwll.ch/

5.1.2 Known Issues

5.1.2.1 SNA   SNA may cause segmentation faults if enabled. If so, just disable SNA and you can copy the attached 20-intel-uxa.conf to /etc/X11/xorg.conf.d/.

For now UXA mode is set by default.

5.1.3 Sandy Bridge GT1

A hardware bug required implementing a workaround in the Intel ringbuffer implementation, occasional 1-2 second hangs may occur.

5.1.4 Gen >= 8

Generation 8 (and later) devices are not supported at all. They require Intel ringbuffer support, which is not implemented.

5.2 Hardware Matrix

Reference:

- https://github.com/torvalds/linux/blob/master/include/drm/i915_pciids.h
- https://en.wikipedia.org/wiki/List_of_Intel_graphics_processing_units
- http://src.illumos.org/source/xref/gfx-drm/usr/src/uts/intel/io/i915/i915_drv.c#294

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
2nd	I830	Almador	0x3577	I830M, I830MG		
2nd	I845G	Brookdale	0x2562	I845G, I845GL, I845GV		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
2nd	I85X	Montara	0x3582	855GM		
2nd	I85X	Montara	0x358d	855GM		
2nd	I865G	Springdale	0x2572	865G		
3rd	I915G	Grantsdale	0x2582	915G		
3rd	I915G	Grantsdale	0x258a	E7221G		
3rd	I915GM	Alviso	0x2592	915GM		
3rd	I945G	Lakeport	0x2772	945G		
3rd	I945GM	Calistoga	0x27a2	945GM		
3rd	I945GM	Calistoga	0x27ae	945GME		
3rd	G33	Bearlake	0x29b2	Q35G		
3rd	G33	Bearlake	0x29c2	G33G		
3rd	G33	Bearlake	0x29d2	Q33G		
3rd	PINEVIEW	Pineview	0xa001			
3rd	PINEVIEW	Pineview	0xa011			
4th	I965G	Lakeport	0x2972	946GZ		
4th	I965G	Bearlake	0x2982	G35G		
4th	I965G	Broadwater	0x2992	965Q		
4th	I965G	Broadwater	0x29a2	965G		
4th	I965GM	Crestline	0x2a02	965GM		
4th	I965GM	Crestline	0x2a12	965GME		
4th	GM45	Cantiga	0x2a42	GM45G		
4th	G45	Eaglelake	0x2e02	IGDEG		
4th	G45	Eaglelake	0x2e12	Q45G		
4th	G45	Eaglelake	0x2e22	G45G		
4th	G45	Eaglelake	0x2e32	G41G		
4th	G45	Eaglelake	0x2e42	B43G		
4th	G45	Eaglelake	0x2e92	B43G.1		
5th	IRONLAKE D	Ironlake (Clarkdale)	0x0042			
5th	IRONLAKE M	Ironlake (Arrandale)	0x0046			
6th	SANDY BRIDGE D	Sandy Bridge	0x0102			
6th	SANDY BRIDGE D	Sandy Bridge	0x0112			
6th	SANDY BRIDGE D	Sandy Bridge	0x0122			
6th	SANDY BRIDGE D	Sandy Bridge	0x010A			

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
6th	SANDY BRIDGE M	Sandy Bridge	0x0106		HW bug causes GPU hangs. Work-around in place, but one may see brief render delays.	
6th	SANDY BRIDGE M	Sandy Bridge	0x0116		HW bug causes GPU hangs. Work-around in place, but one may see brief render delays.	
6th	SANDY BRIDGE M	Sandy Bridge	0x0126		HW bug causes GPU hangs. Work-around in place, but one may see brief render delays.	
7th	IVY BRIDGE M	Ivy Bridge	0x0156	GT1 mobile		
7th	IVY BRIDGE M	Ivy Bridge	0x0166	GT2 mobile		
7th	IVY BRIDGE D	Ivy Bridge	0x0152	GT1 desktop		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	IVY BRIDGE D	Ivy Bridge	0x0162	GT2 desktop		
7th	IVY BRIDGE D	Ivy Bridge	0x015a	GT1 server		
7th	IVY BRIDGE D	Ivy Bridge	0x016a	GT2 server		
7th	HASWELL D	Haswell	0x0402	GT1 desktop		
7th	HASWELL D	Haswell	0x0412	GT2 desktop		
7th	HASWELL D	Haswell	0x0422	GT3 desktop		
7th	HASWELL D	Haswell	0x040a	GT1 server		
7th	HASWELL D	Haswell	0x041a	GT2 server		
7th	HASWELL D	Haswell	0x042a	GT3 server		
7th	HASWELL D	Haswell	0x040B	GT1 reserved		
7th	HASWELL D	Haswell	0x041B	GT2 reserved		
7th	HASWELL D	Haswell	0x042B	GT3 reserved		
7th	HASWELL D	Haswell	0x040E	GT1 reserved		
7th	HASWELL D	Haswell	0x041E	GT2 reserved		
7th	HASWELL D	Haswell	0x042E	GT3 reserved		
7th	HASWELL D	Haswell	0x0C02	SDV GT1 desktop		
7th	HASWELL D	Haswell	0x0C12	SDV GT2 desktop		
7th	HASWELL D	Haswell	0x0C22	SDV GT3 desktop		
7th	HASWELL D	Haswell	0x0C0A	SDV GT1 server		
7th	HASWELL D	Haswell	0x0C1A	SDV GT2 server		
7th	HASWELL D	Haswell	0x0C2A	SDV GT3 server		
7th	HASWELL D	Haswell	0x0C0B	SDV GT1 reserved		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	HASWELL D	Haswell	0x0C1B	SDV GT2 reserved		
7th	HASWELL D	Haswell	0x0C2B	SDV GT3 reserved		
7th	HASWELL D	Haswell	0x0C0B	SDV GT1 reserved		
7th	HASWELL D	Haswell	0x0C1B	SDV GT2 reserved		
7th	HASWELL D	Haswell	0x0C2B	SDV GT3 reserved		
7th	HASWELL D	Haswell	0x0A02	ULT GT1 desktop		
7th	HASWELL D	Haswell	0x0A12	ULT GT2 desktop		
7th	HASWELL D	Haswell	0x0A22	ULT GT3 desktop		
7th	HASWELL D	Haswell	0x0A0A	ULT GT1 server		
7th	HASWELL D	Haswell	0x0A1A	ULT GT2 server		
7th	HASWELL D	Haswell	0x0A2A	ULT GT3 server		
7th	HASWELL D	Haswell	0x0A0B	ULT GT1 reserved		
7th	HASWELL D	Haswell	0x0A1B	ULT GT2 reserved		
7th	HASWELL D	Haswell	0x0A2B	ULT GT3 reserved		
7th	HASWELL D	Haswell	0x0D02	CRW GT1 desktop		
7th	HASWELL D	Haswell	0x0D12	CRW GT2 desktop		
7th	HASWELL D	Haswell	0x0D22	CRW GT3 desktop		
7th	HASWELL D	Haswell	0x0D0A	CRW GT1 server		
7th	HASWELL D	Haswell	0x0D1A	CRW GT2 server		
7th	HASWELL D	Haswell	0x0D2A	CRW GT3 server		
7th	HASWELL D	Haswell	0x0D0B	CRW GT1 reserved		
7th	HASWELL D	Haswell	0x0D1B	CRW GT2 reserved		
7th	HASWELL D	Haswell	0x0D2B	CRW GT3 reserved		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	HASWELL D	Haswell	0x0D0E	CRW GT1 reserved		
7th	HASWELL D	Haswell	0x0D1E	CRW GT2 reserved		
7th	HASWELL D	Haswell	0x0D2E	CRW GT3 reserved		
7th	HASWELL M	Haswell	0x0406	GT1 mobile		
7th	HASWELL M	Haswell	0x0416	GT2 mobile		
7th	HASWELL M	Haswell	0x0426	GT2 mobile		
7th	HASWELL M	Haswell	0x0C06	SDV GT1 mobile		
7th	HASWELL M	Haswell	0x0C16	SDV GT2 mobile		
7th	HASWELL M	Haswell	0x0C26	SDV GT3 mobile		
7th	HASWELL M	Haswell	0x0A06	ULT GT1 mobile		
7th	HASWELL M	Haswell	0x0A16	ULT GT2 mobile		
7th	HASWELL M	Haswell	0x0A26	ULT GT3 mobile		
7th	HASWELL M	Haswell	0x0A0E	ULX GT1 mobile		
7th	HASWELL M	Haswell	0x0A1E	ULX GT2 mobile		
7th	HASWELL M	Haswell	0x0A2E	ULT GT3 reserved		
7th	HASWELL M	Haswell	0x0D06	CRW GT1 mobile		
7th	HASWELL M	Haswell	0x0D16	CRW GT2 mobile		
7th	HASWELL M	Haswell	0x0D26	CRW GT3 mobile		
7th	VALLEY VIEW M	Valley View (Bay Trail)	0x0f30			
7th	VALLEY VIEW M	Valley View (Bay Trail)	0x0f31			
7th	VALLEY VIEW M	Valley View (Bay Trail)	0x0f32			
7th	VALLEY VIEW M	Valley View (Bay Trail)	0x0f33			
7th	VALLEY VIEW M	Valley View (Bay Trail)	0x0157			

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	VALLEY VIEW D	Valley View (Bay Trail)	0x0155			
8th	BROADWELL GT12M	Broadwell	0x1602	GT1 ULT	Gen >=8 **NOT** supported at all.	
8th	BROADWELL GT12M	Broadwell	0x1606	GT1 ULT		
8th	BROADWELL GT12M	Broadwell	0x160B	GT1 Iris		
8th	BROADWELL GT12M	Broadwell	0x160E	GT1 ULX		
8th	BROADWELL GT12M	Broadwell	0x1612	GT2 Halo		
8th	BROADWELL GT12M	Broadwell	0x1616	GT2 ULT		
8th	BROADWELL GT12M	Broadwell	0x161B	GT2 ULT		
8th	BROADWELL GT12M	Broadwell	0x161E	GT2 ULX		
8th	BROADWELL GT12D	Broadwell	0x160A	GT1 Server		
8th	BROADWELL GT12D	Broadwell	0x160D	GT1 Workstation		
8th	BROADWELL GT12D	Broadwell	0x161A	GT2 Server		
8th	BROADWELL GT12D	Broadwell	0x161D	GT2 Workstation		
8th	BROADWELL GT3M	Broadwell	0x1622	GT3 ULT		
8th	BROADWELL GT3M	Broadwell	0x1626	GT3 ULT		
8th	BROADWELL GT3M	Broadwell	0x162B	GT3 Iris		
8th	BROADWELL GT3M	Broadwell	0x162E	GT3 ULX		
8th	BROADWELL GT3D	Broadwell	0x162A	GT3 Server		
8th	BROADWELL GT3D	Broadwell	0x162D	GT3 Workstation		
8th	BROADWELL RSVDM	Broadwell	0x1632	ULT		
8th	BROADWELL RSVDM	Broadwell	0x1636	ULT		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
8th	BROADWELL RSVDM	Broadwell	0x163B	ris		
8th	BROADWELL RSVDM	Broadwell	0x163E	ULX		
8th	BROADWELL RSVDD	Broadwell	0x163A	Server		
8th	BROADWELL RSVDD	Broadwell	0x163D	Workstation		
8th	CHERRY VIEW	Cherry View (Braswell, Cherry Trail)	0x22b0			
8th	CHERRY VIEW	Cherry View (Braswell, Cherry Trail)	0x22b1			
8th	CHERRY VIEW	Cherry View (Braswell, Cherry Trail)	0x22b2			
8th	CHERRY VIEW	Cherry View (Braswell, Cherry Trail)	0x22b3			
9th	SKYLAKE GT1	Skylake	0x1906	ULT GT1		
9th	SKYLAKE GT1	Skylake	0x190E	ULX GT1		
9th	SKYLAKE GT1	Skylake	0x1902	DT GT1		
9th	SKYLAKE GT1	Skylake	0x190B	Halo GT1		
9th	SKYLAKE GT1	Skylake	0x190A	SRV GT1		
9th	SKYLAKE GT2	Skylake	0x1916	ULT GT2		
9th	SKYLAKE GT2	Skylake	0x1921	ULT GT2F		
9th	SKYLAKE GT2	Skylake	0x191E	ULX GT2		
9th	SKYLAKE GT2	Skylake	0x1912	DT GT2		
9th	SKYLAKE GT2	Skylake	0x191B	Halo GT2		
9th	SKYLAKE GT2	Skylake	0x191A	SRV GT2		
9th	SKYLAKE GT2	Skylake	0x191D	WKS GT2		
9th	SKYLAKE GT3	Skylake	0x1923	ULT GT3		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
9th	SKYLAKE GT3	Skylake	0x1926	ULT GT3		
9th	SKYLAKE GT3	Skylake	0x1927	ULT GT3		
9th	SKYLAKE GT3	Skylake	0x192B	Halo GT3		
9th	SKYLAKE GT3	Skylake	0x192A	SRV GT3		
9th	SKYLAKE GT4	Skylake	0x1932	DT GT4		
9th	SKYLAKE GT4	Skylake	0x193B	Halo GT4		
9th	SKYLAKE GT4	Skylake	0x193D	WKS GT4		
9th	SKYLAKE GT4	Skylake	0x193A	SRV GT4		
9th	BROXTON	Goldmont (Apollo Lake)	0x0A84			
9th	BROXTON	Goldmont (Apollo Lake)	0x1A84			
9th	BROXTON	Goldmont (Apollo Lake)	0x1A85			
9th	BROXTON	Goldmont (Apollo Lake)	0x5A84	APL HD Graphics 505		
9th	BROXTON	Goldmont (Apollo Lake)	0x5A85	APL HD Graphics 500		
9th	KABY LAKE GT1	Kaby Lake	0x5913	ULT GT1.5		
9th	KABY LAKE GT1	Kaby Lake	0x5915	ULX GT1.5		
9th	KABY LAKE GT1	Kaby Lake	0x5917	DT GT1.5		
9th	KABY LAKE GT1	Kaby Lake	0x5906	ULT GT1		
9th	KABY LAKE GT1	Kaby Lake	0x590E	ULX GT1		
9th	KABY LAKE GT1	Kaby Lake	0x5902	DT GT1		
9th	KABY LAKE GT1	Kaby Lake	0x5908	Halo GT1		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
9th	KABY LAKE GT1	Kaby Lake	0x590B	Halo GT1		
9th	KABY LAKE GT1	Kaby Lake	0x590A	SRV GT1		
9th	KABY LAKE GT2	Kaby Lake	0x5916	ULT GT2		
9th	KABY LAKE GT2	Kaby Lake	0x5921	ULT GT2F		
9th	KABY LAKE GT2	Kaby Lake	0x591E	ULX GT2		
9th	KABY LAKE GT2	Kaby Lake	0x5912	DT GT2		
9th	KABY LAKE GT2	Kaby Lake	0x591B	Halo GT2		
9th	KABY LAKE GT2	Kaby Lake	0x591A	SRV GT2		
9th	KABY LAKE GT2	Kaby Lake	0x591D	WKS GT2		
9th	KABY LAKE GT3	Kaby Lake	0x5923	ULT GT3		
9th	KABY LAKE GT3	Kaby Lake	0x5926	ULT GT3		
9th	KABY LAKE GT3	Kaby Lake	0x5927	ULT GT3		
9th	KABY LAKE GT4	Kaby Lake	0x593B	Halo GT4		
9th	COFFEE LAKE	Coffee Lake	0x3E90	GT1		
9th	COFFEE LAKE	Coffee Lake	0x3E91	DT GT2		
9th	COFFEE LAKE	Coffee Lake	0x3E92	DT GT2		
9th	COFFEE LAKE	Coffee Lake	0x3E93	GT1		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
9th	COFFEE LAKE	Coffee Lake	0x3E94	GT2		
9th	COFFEE LAKE	Coffee Lake	0x3E95	GT3		
9th	COFFEE LAKE	Coffee Lake	0x3E96	GT2		
9th	COFFEE LAKE	Coffee Lake	0x3E9B	GT2		
9th	COFFEE LAKE	Coffee Lake	0x3EA6	GT3		
9th	COFFEE LAKE	Coffee Lake	0x3EA7	GT3		
9th	COFFEE LAKE	Coffee Lake	0x3EA8	GT3		
9th	CANNON LAKE	Cannon Lake	0x5A52	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A5A	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A42	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A4A	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A51	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A59	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A41	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A49	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A71	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A79	GT2		

5.3 How to checkout Linux drm code only

```
$ mkdir linux-drm
$ cd linux-drm/
$ git init
$ git remote add origin https://github.com/freedesktop/drm-intel.git
$ git config core.sparsecheckout true
$ echo "drivers/gpu/drm/*" >> .git/info/sparse-checkout
$ echo "include/drm/*" >> .git/info/sparse-checkout
$ git pull --depth=1 origin drm-intel-fixes
```