

Graphics stack

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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 libvpdau 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 gfax-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	0x3582855GM			
2nd	I85X	Montara	0x358d855GM			
2nd	I865G	Springdale	0x2572865G			
3rd	I915G	Grantsdale	0x2582915G			
3rd	I915G	Grantsdale	0x258aE7221G			
3rd	I915GM	Alviso	0x2592915GM			
3rd	I945G	Lakeport	0x2772945G			
3rd	I945GM	Calistoga	0x27a2945GM			
3rd	I945GM	Calistoga	0x27ad945GME			
3rd	G33	Bearlake	0x29b2Q35G			
3rd	G33	Bearlake	0x29c2G33G			
3rd	G33	Bearlake	0x29d2Q33G			
3rd	PINEVIEW	Pineview	0xa001			
3rd	PINEVIEW	Pineview	0xa011			
4th	I965G	Lakeport	0x2972946GZ			
4th	I965G	Bearlake	0x2982G35G			
4th	I965G	Broadwater	0x2992965Q			
4th	I965G	Broadwater	0x29a2965G			
4th	I965GM	Crestline	0x2a02965GM			
4th	I965GM	Crestline	0x2a12965GME			
4th	GM45	Cantiga	0x2a42GM45G			
4th	G45	Eaglelake	0x2e02GDEG			
4th	G45	Eaglelake	0x2e12Q45G			
4th	G45	Eaglelake	0x2e22G45G			
4th	G45	Eaglelake	0x2e32G41G			
4th	G45	Eaglelake	0x2e42B43G			
4th	G45	Eaglelake	0x2e92B43G.1			
5th	IRONLAKE	Ironlake	0x0042			
	D	(Clarkdale)				
5th	IRONLAKE	Ironlake	0x0046			
	M	(Arrandale)				
6th	SANDY BRIDGE	Sandy Bridge	0x0102			
	D					
6th	SANDY BRIDGE	Sandy Bridge	0x0112			
	D					
6th	SANDY BRIDGE	Sandy Bridge	0x0122			
	D					
6th	SANDY BRIDGE	Sandy Bridge	0x010A			
	D					

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	0x0C08	SDV GT1 desktop		
7th	HASWELL D	Haswell	0x0C18	SDV GT2 desktop		
7th	HASWELL D	Haswell	0x0C28	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	Haswell D	0x0C15	SDV GT2 reserved		
7th	HASWELL	Haswell D	0x0C25	SDV GT3 reserved		
7th	HASWELL	Haswell D	0x0C05	SDV GT1 reserved		
7th	HASWELL	Haswell D	0x0C15	SDV GT2 reserved		
7th	HASWELL	Haswell D	0x0C25	SDV GT3 reserved		
7th	HASWELL	Haswell D	0xA021	JLT GT1 desktop		
7th	HASWELL	Haswell D	0xA121	JLT GT2 desktop		
7th	HASWELL	Haswell D	0xA221	JLT GT3 desktop		
7th	HASWELL	Haswell D	0xA0A1	JLT GT1 server		
7th	HASWELL	Haswell D	0xA1A1	JLT GT2 server		
7th	HASWELL	Haswell D	0xA2A1	JLT GT3 server		
7th	HASWELL	Haswell D	0xA0B1	JLT GT1 reserved		
7th	HASWELL	Haswell D	0xA1B1	JLT GT2 reserved		
7th	HASWELL	Haswell D	0xA2B1	JLT GT3 reserved		
7th	HASWELL	Haswell D	0xD021	CRW GT1 desktop		
7th	HASWELL	Haswell D	0xD121	CRW GT2 desktop		
7th	HASWELL	Haswell D	0xD221	CRW GT3 desktop		
7th	HASWELL	Haswell D	0xD0A1	CRW GT1 server		
7th	HASWELL	Haswell D	0xD1A1	CRW GT2 server		
7th	HASWELL	Haswell D	0xD2A1	CRW GT3 server		
7th	HASWELL	Haswell D	0xD0B1	CRW GT1 reserved		
7th	HASWELL	Haswell D	0xD1B1	CRW GT2 reserved		
7th	HASWELL	Haswell D	0xD2B1	CRW GT3 reserved		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	HASWELL	Haswell D	0x0D0E	CRW GT1 reserved		
7th	HASWELL	Haswell D	0x0D1E	CRW GT2 reserved		
7th	HASWELL	Haswell D	0x0D2E	CRW GT3 reserved		
7th	HASWELL	Haswell M	0x0406	GT1 mobile		
7th	HASWELL	Haswell M	0x0416	GT2 mobile		
7th	HASWELL	Haswell M	0x0426	GT2 mobile		
7th	HASWELL	Haswell M	0x0C06	SDV GT1 mobile		
7th	HASWELL	Haswell M	0x0C16	SDV GT2 mobile		
7th	HASWELL	Haswell M	0x0C26	SDV GT3 mobile		
7th	HASWELL	Haswell M	0xA06	JLT GT1 mobile		
7th	HASWELL	Haswell M	0xA16	JLT GT2 mobile		
7th	HASWELL	Haswell M	0xA26	JLT GT3 mobile		
7th	HASWELL	Haswell M	0xA0E	JLX GT1 mobile		
7th	HASWELL	Haswell M	0xA1E	JLX GT2 mobile		
7th	HASWELL	Haswell M	0xA2E	JLT GT3 reserved		
7th	HASWELL	Haswell M	0xD06	CRW GT1 mobile		
7th	HASWELL	Haswell M	0xD16	CRW GT2 mobile		
7th	HASWELL	Haswell M	0xD26	CRW GT3 mobile		
7th	VALLEY	Valley View	0x0f30			
7th	VALLEY	VIEW M (Bay Trail)				
7th	VALLEY	Valley View	0x0f31			
7th	VALLEY	VIEW M (Bay Trail)				
7th	VALLEY	Valley View	0x0f32			
7th	VALLEY	VIEW M (Bay Trail)				
7th	VALLEY	Valley View	0x0f33			
7th	VALLEY	VIEW M (Bay Trail)				
7th	VALLEY	Valley View	0x0157			
		VIEW M (Bay Trail)				

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
7th	VALLEY	Valley View	0x0155			
	VIEW D	(Bay Trail)				
8th	BROADWELL	Broadwell	0x1602	GT1 ULT	Gen >=8	
		GT12M			NOT	
					sup- ported	
					at all.	
8th	BROADWELL	Broadwell	0x1606	GT1 ULT		
		GT12M				
8th	BROADWELL	Broadwell	0x1608	GT1 Iris		
		GT12M				
8th	BROADWELL	Broadwell	0x160E	GT1 ULX		
		GT12M				
8th	BROADWELL	Broadwell	0x1612	GT2 Halo		
		GT12M				
8th	BROADWELL	Broadwell	0x1616	GT2 ULT		
		GT12M				
8th	BROADWELL	Broadwell	0x161E	GT2 ULT		
		GT12M				
8th	BROADWELL	Broadwell	0x161E	GT2 ULX		
		GT12M				
8th	BROADWELL	Broadwell	0x160A	GT1 Server		
		GT12D				
8th	BROADWELL	Broadwell	0x160D	GT1 Workstation		
		GT12D				
8th	BROADWELL	Broadwell	0x161A	GT2 Server		
		GT12D				
8th	BROADWELL	Broadwell	0x161D	GT2 Workstation		
		GT12D				
8th	BROADWELL	Broadwell	0x1622	GT3 ULT		
		GT3M				
8th	BROADWELL	Broadwell	0x1626	GT3 ULT		
		GT3M				
8th	BROADWELL	Broadwell	0x162E	GT3 Iris		
		GT3M				
8th	BROADWELL	Broadwell	0x162E	GT3 ULX		
		GT3M				
8th	BROADWELL	Broadwell	0x162A	GT3 Server		
		GT3D				
8th	BROADWELL	Broadwell	0x162D	GT3 Workstation		
		GT3D				
8th	BROADWELL	Broadwell	0x1632	ULT		
		RSVDM				
8th	BROADWELL	Broadwell	0x1636	ULT		
		RSVDM				

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
8th	BROADWELL	Broadwell RSVDM	0x163B	Bris		
8th	BROADWELL	Broadwell RSVDM	0x163E	JLX		
8th	BROADWELL	Broadwell RSVDD	0x163A	Server		
8th	BROADWELL	Broadwell RSVDD	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 GT1	0x1906	JLT GT1		
9th	SKYLAKE GT1	Skylake GT1	0x190E	JLX GT1		
9th	SKYLAKE GT1	Skylake GT1	0x1902	DT GT1		
9th	SKYLAKE GT1	Skylake GT1	0x190B	Halo GT1		
9th	SKYLAKE GT1	Skylake GT1	0x190A	SRV GT1		
9th	SKYLAKE GT2	Skylake GT2	0x1916	JLT GT2		
9th	SKYLAKE GT2	Skylake GT2	0x1921	ULT GT2F		
9th	SKYLAKE GT2	Skylake GT2	0x191E	JLX GT2		
9th	SKYLAKE GT2	Skylake GT2	0x1912	DT GT2		
9th	SKYLAKE GT2	Skylake GT2	0x191B	Halo GT2		
9th	SKYLAKE GT2	Skylake GT2	0x191A	SRV GT2		
9th	SKYLAKE GT2	Skylake GT2	0x191D	WKS GT2		
9th	SKYLAKE GT3	Skylake GT3	0x1923	JLT GT3		

Generation	Family	Codename	PCI id	Model	i915 support	xf86-video-intel support
9th	SKYLAKE	Skylake GT3	0x1926	JLT GT3		
9th	SKYLAKE	Skylake GT3	0x1927	JLT GT3		
9th	SKYLAKE	Skylake GT3	0x192B	Halo GT3		
9th	SKYLAKE	Skylake GT3	0x192A	SRV GT3		
9th	SKYLAKE	Skylake GT4	0x1932	DT GT4		
9th	SKYLAKE	Skylake GT4	0x193B	Halo GT4		
9th	SKYLAKE	Skylake GT4	0x193D	WKS GT4		
9th	SKYLAKE	Skylake GT4	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	Kaby Lake	0x5913	JLT GT1.5		
9th	KABY LAKE	Kaby Lake	0x5915	JLX GT1.5		
9th	KABY LAKE	Kaby Lake	0x5917	DT GT1.5		
9th	KABY LAKE	Kaby Lake	0x5906	JLT GT1		
9th	KABY LAKE	Kaby Lake	0x590E	JLX GT1		
9th	KABY LAKE	Kaby Lake	0x5902	DT GT1		
9th	KABY LAKE	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	JLT GT2		
9th	KABY LAKE GT2	Kaby Lake	0x5921	ULT GT2F		
9th	KABY LAKE GT2	Kaby Lake	0x591E	JLX 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	JLT GT3		
9th	KABY LAKE GT3	Kaby Lake	0x5926	JLT GT3		
9th	KABY LAKE GT3	Kaby Lake	0x5927	JLT 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	0x3E97	GT2		
9th	COFFEE LAKE	Coffee Lake	0x3E98	GT3		
9th	COFFEE LAKE	Coffee Lake	0x3E99	GT3		
9th	COFFEE LAKE	Coffee Lake	0x3E9A	GT3		
9th	CANNON LAKE	Cannon Lake	0x5A52	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A53	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A42	GT2		
9th	CANNON LAKE	Cannon Lake	0x5A43	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
```