Adreno

The **Adreno** series of graphics processing units (GPUs) are semiconductor intellectual property cores developed by Qualcomm and used in a variety of their SoCs. The core was initially developed under the *Imageon* brand name by ATI Technologies, which was acquired by AMD in 2006. After the buyout in 2008, Qualcomm renamed the Imageon products to Adreno.

1 Technical details

1.1 Variants

The company offers the chip in various flavors as component of their Snapdragon SoCs:

Notes

[1] Adreno ALU = ALU x MP amount

- Direct3D Mobile, SVGT 1.2, Direct Draw and GDI

- **Adreno 200** (AMD Z430) inside the QSD8x50 (1 GHz) and MSM7x27 (600 MHz A11+L2 cache). It offers a programmable function pipeline and streaming textures with support for OpenGL ES 1.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, SVGT 1.2 and DirectDraw. (22M triangles/second, 133M pixels/second, clock speed up to 128 MHz).

- **Adreno 200 enhanced** inside the MSM7x25A (800 MHz), MSM7x27A (1 GHz+L2 cache). It supports OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, SVGT 1.2, Direct Draw and GDI. (40M triangles/second, 200M pixels/second, clock speed up to 200 MHz).

- **Adreno 203** inside the MSM8225 (1.0-1.2 GHz), MSM8225Q (1.2 GHz). It is an improvement over Adreno 205. It features a higher frequency, has better pixel fillrate, lower power consumption, better 3D performance. It is about 50-100% faster than Adreno 200 (enhanced), and 10-25% than Adreno 205. It could clock 2x times higher than Adreno 205. It supports OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, DirectX 9.0c, SVGT 1.2, Direct Draw and GDI. (42-50M triangles/second, 250-300M pixels/second, clock speed from 192-400 MHz)

- **Adreno 205** inside the QSD8x50A (1.3 GHz), MSM7x30 (800 MHz+L2 cache), MSM8x55 (1 GHz+L2 cache). Its improvements include Hardware-accelerated SVG and Adobe Flash and better shader-performance than the Adreno 200. It supports OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, SVGT 1.2, Direct Draw and GDI. (57M triangles/second, 250M pixels/second, clock speed up to 400 MHz)

- **Adreno 220** inside the MSM8660 or MSM8260 (1.2 GHz–1.5 GHz+1 MB L2 Cache) with single channel memory. It supports OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, DirectX 9.0c, SVGT 1.2, Direct Draw and GDI. (88M triangles/second, 500M pixels/second, standard clock speed up to 266 MHz, overclock up to 400 MHz).

- **Adreno 225** inside the MSM8960 (1.5 GHz–1.7 GHz+1 MB L2 cache), with unified shader architecture and dual channel memory. It supports Direct3D 9.0c in addition to OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, SVGT 1.2, Direct Draw and GDI.

- **Adreno 320** inside the Qualcomm S4 Pro & Prime Series, with unified shader architecture and dual channel memory. It supports Direct3D feature level 9_3 in addition to OpenGL ES 3.0, OpenGL ES 2.0, OpenGL ES 1.1, OpenVG 1.1, EGL 1.4, Direct3D Mobile, SVGT 1.2[5]

- **Adreno 330** inside the Nexus 5, Amazon Kindle HDX series tablets, Amazon Fire phone, Nokia Lumia 2520 tablet, Nokia Lumia 1520, Nokia Lumia ICON, Nokia Lumia 930, Samsung Galaxy S5, Samsung Galaxy Note 3, Sony Xperia Z1, Sony Xperia Z1 Compact, Sony Xperia Z2, Sony Xperia Z3, Sony Xperia Z3 Compact, Sony Xperia Z Ultra, Xiaomi Mi3, Xiaomi Mi4, OnePlus One, HTC One (M8) and LG G2/G3 smartphones.

- **Adreno 420** inside the Qualcomm Snapdragon 805 supports Direct3D 11.2 runtime (feature level 11_1). Inside the Google Nexus 6, Samsung Galaxy S5 LTE-A, Samsung Galaxy Note 4, Samsung Galaxy Note Edge, LG G3 Cat. 6, Amazon Fire HDX 8.9 (2014).

1.2   Operating system support

See also: Free and open-source graphics device driver §
Qualcomm

There are proprietary drivers for the Linux-based mo-
bile operating system Android available from Qualcomm
themselves. There are no drivers available for any other
Linux-based operating systems, but through libhybris, it
became possible to use the Android drivers. Especially
mer-based systems such as the Sailfish OS rely on this
solution.

There is an ongoing endeavor of writing a Gallium3D-
style graphics device drivers for the Adreno series of
GPUs called **freedreno**.

As of September 2013, the kernel components (DRM
and KMS driver) of freedreno have been accepted into
mainline Linux kernel version 3.12.[8] These components
are used together with user-space parts libDRM and
Mesa 3D.

2   History

The **Imageon** (previously **ATI Imageon**) is a line of me-
dia processors developed by ATI providing graphics ac-
celeration and other multimedia features for handheld de-
vices such as mobile phones and Personal Digital Assis-
tants (PDA).

Designed as system-on-a-chip (SoC), the Imageon line of
media processors was introduced in 2002 to bring inte-
grated graphics (from 2D in 2002 to 3D in latest prod-
ucts) to handheld devices, cellphones and tablet PCs.

The system-on-a-chip design incorporates an embedded
CPU core, baseband sub-system CPU interface, memory
controller, power management (ATI PowerPlay), internal
RAM and stacked RAM with memory buffer, two dis-
play engines (for dual monitors on cellphones), imaging
engine, image/video/audio capture engine, TV and audio
output, dual digital signal processors for audio and video,
and video acceleration engine.

The Imageon line was rebranded under AMD, after
AMD acquired ATI in Q3 2006, as **AMD Imageon**, with
official claims to have shipped nearly 250 million Ima-
geon units to customers since 2003. However as a result
of company restructuring, AMD divested the handheld
chipset business starting from the second quarter of 2008,
thus the line is deemed officially discontinued.

At the end of 2008, the handheld branch was sold off
to Qualcomm,[9] following an earlier sale of the Xilleon
branch to Broadcom. AMD retained the Imageon name
and will provide support for existing customers, although
no future Imageon products will be introduced.[10]

3   Product line

3.1   Discontinued/Past generations

- **Imageon 100**, the first product of the Imageon line.

- **Imageon 3200**.

- **Imageon 2200/2250**. Integrated a 2D graphics en-
  gine, a MPEG decoder, JPEG decoding and encod-
  ing capabilities, with embedded SRAM on-die as
  frame buffer.

- **Imageon 2240**.

- **Imageon 2260/2262**.

- **Imageon 2300**. Included 2D and 3D graphics
  engine (3D S/W), MPEG-4 video decoder, JPEG
  encoding/decoding, and 2-megapixel camera sub-
  system processing engine.

- **Imageon 2182**.

- **Imageon 2282**.

- **Imageon 2388/2380**. Featuring industry first
  OpenGL for embedded systems (OpenGL ES) 1.1+
  extensions support, for 3D acceleration.

- **Imageon 2192**. For mainstream devices with sup-
  port for 3.1-megapixel camera sensor.

3.2   Current generation

- **Imageon 2294/2298**, renamed **Imageon M100 se-
  ries**. Current top-of-line product, processor in-
  cludes DVD quality recording and playback, HD TV
  output, and supports up to a 12-megapixel camera
  sensor. Products include Imageon M180.

- **Imageon TV**. Announced in February 2006, as the
  first Imageon product in the line featuring Digital
  Video Broadcasting - Handheld (DVB-H) signal re-
  ceiving support, allowing handhelds devices to re-
  ceive digital broadcast TV (DVB-H) signals and en-
  ables watching TV programs on these devices, the
  chipset includes tuner, demodulator, decoder, and a
  full software stack.

Newest Brazilian Tectoy Console called Zeebo uses the
ATI Imageon Chip to deliver fast and reliable graphics
plus 3G access to download updates and new games for
the console.

Announced in 2008 Mobile World Congress in
Barcelona, AMD renews the Imageon line with the
following products:

- **Imageon A250 application processor**

- Standalone multimedia and graphics subsystem
- D1 resolution video (720×486)
- Support for 8-megapixel camera sensor, JPEG, dual display
- USB, SD and NAND support
- Vector graphics
- Flash applications and UI supported
- Energy efficiency

- **Imageon D160 mobile TV solution**

  - Free-to-air DVB-T and DVB-H reception
  - quality of service and Doppler compensation for DVB signals for high speed mobility
  - Complete DVB-T/H receiver module
  - Multi-channel decode with PiP, fast channel change, and video recording
  - AMD software stack (including Middleware) and 3rd party support
  - Energy efficiency

In addition to the application processor and the mobile TV solution chip, AMD also licenses several technologies to other firms and partners, such technologies include audio and graphics processors, as listed below:

- **Imageon M210 audio processor**

  - Multi-band equalizer
  - Automatic gain control
  - 99 db signal-to-noise ratio
  - Supporting over 30 codecs including
    - MP3, AAC, AAC+, WMA, AC3, DTS, MIDI with SMAF support, 3D audio, MPEG-4 SLS, FLAC
    - support for 3rd party codecs and other codecs through downloading
  - Standalone audio playback
  - Energy efficiency of about 33 mW allowing 100 hours of audio playback[11] with integrated power management
  - Integrated memory
  - Integrated analog audio codec
  - USB 2.0, NAND, SD and Bluetooth support

- **Imageon Z460 3D graphics core** - this is an IP core synthesized in for example Freescale's i.MX5x series of application processors

  - OpenGL ES 2.0 support
  - Unified shaders

- Programmable vertex shaders and pixel shaders
- Support for WVGA (800×480, 848×480, or 854×480) and qHD (960x540) resolutions
- Claimed on par with high-end portable game consoles in terms of performance

- **Imageon Z180 vector graphics core**

  - Hardware OpenVG 1.x rendering acceleration
  - Claimed 20-40x faster than software-based implementations[12]
  - Support for HD resolution
  - 16X antialiasing for fonts and vector graphics
  - Flash support for web application
  - Energy efficiency

4 See also

- PowerVR, available as SIP block to 3rd parties
- Mali, available as SIP block to 3rd parties
- Vivante, available as SIP block to 3rd parties
- Tegra, family of SoCs for mobile computers, the graphics core *could* be available as SIP block to 3rd parties
- VideoCore, family of SOCs, by Broadcom, for mobile computers, the graphics core *could* be available as SIP block to 3rd parties.
- Atom family of SoCs, with Intel graphics core, not licensed to 3rd parties
- AMD mobile APUs, with AMD graphics core, not licensed to 3rd parties
- Mitsubishi Z3D family media co-processors
- Toshiba T4G media co-processor

5 References

[1] "The Freedreno driver". Rob Clark @ FOSDEM2013.

[2] "The Freedreno driver". Rob Clark @ FOSDEM2013.

[3]

[4]

[5] AnandTech - Adreno 320 performance preview

[6] "The Freedreno driver". Rob Clark @ FOSDEM2013.

[7] http://www.qualcomm.com/media/releases/2013/11/20/qualcomm-technologies-announces-next-generation-qualcomm-snapdragon-

[8] "Pull-Request for the mainline Linux kernel 3.12". Retrieved 2013-10-02.

[9] AMD sells handheld graphics unit to Qualcomm for $65M

[10] Qualcomm grabs AMD handheld, graphics tech

[11] "AMD Handheld Multimedia Technology – Unleash The Ultimate Mobile Entertainment Experience" (PDF). AMD. 2008-02-12. p. 17. Retrieved 2008-02-15. ~32mW Audio Subsystem for playing from SD/NAND (900mAh/3.7V battery; 150mV$_{rms}$ into 16 Ω headphones).

[12] "Product fact sheet for Imagon Z460 ans Z180" (PDF). AMD. 2008-02-12. p. 17. Retrieved 2008-02-15. [baseline performance] measured on ARM9 Versatile (ARM926EJ-S) at 210 MHz using a commercially available software rasterizer.

6   External links

- Official website

7   Text and image sources, contributors, and licenses

7.1   Text

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