Tech Trends

All about the six-brained mobile AP, Exynos 5 Hexa!

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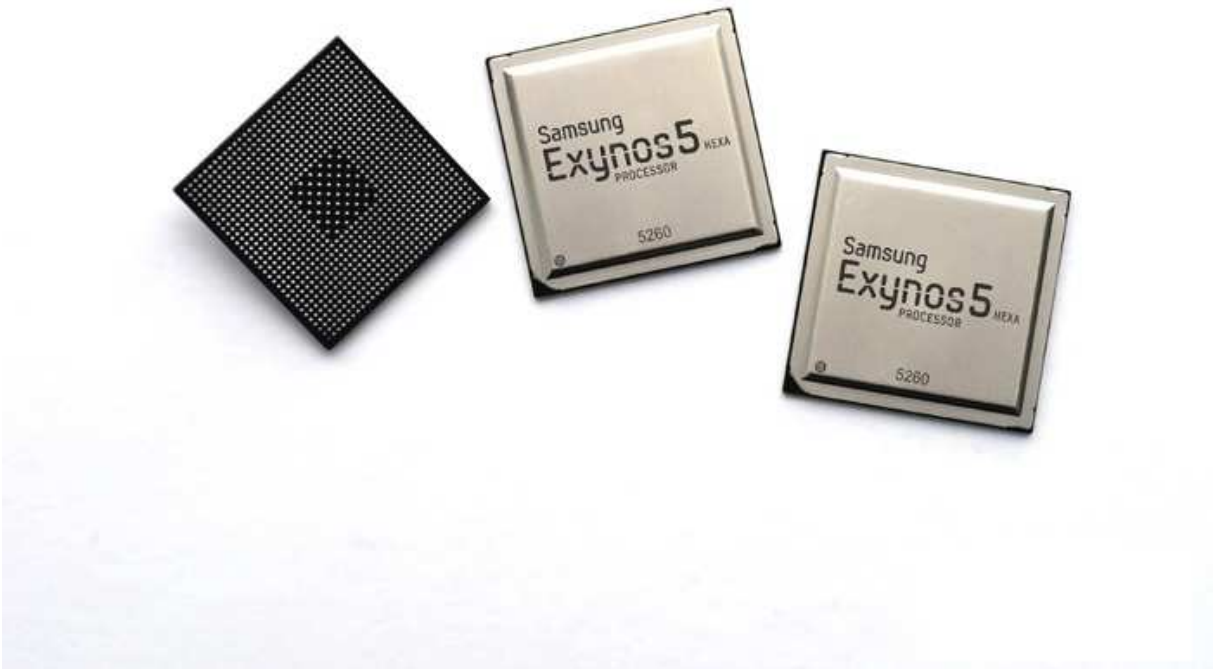
The MWC (Mobile World Congress) 2014 hosted by Barcelona, Spain in February is the world's largest mobile communications industry fair.

The MWC (Mobile World Congress) 2014 hosted by Barcelona, Spain in February is the world's largest mobile communications industry fair. MWC is a venue where cutting-edge technologies in various fields such as wireless communications, mobile computing, and mobile contents are introduced and where visitors can see global mobile trends and future technologies at a glance.

At MWC 2014, Samsung Electronics attracted much attention by unveiling 2 new mobile AP products, which act as the brains of mobile devices, together with image sensors, NFC, and Wifi chipsets.



The new Exynos 5 series lineup includes the octa-core "Exynos 5422" for premium mobile devices and the hexa-core "Exynos 5260" for mid-end smartphones. Through these two products, each optimized for their respective markets, Samsung Electronics seeks to expand its presence in the mobile AP market.

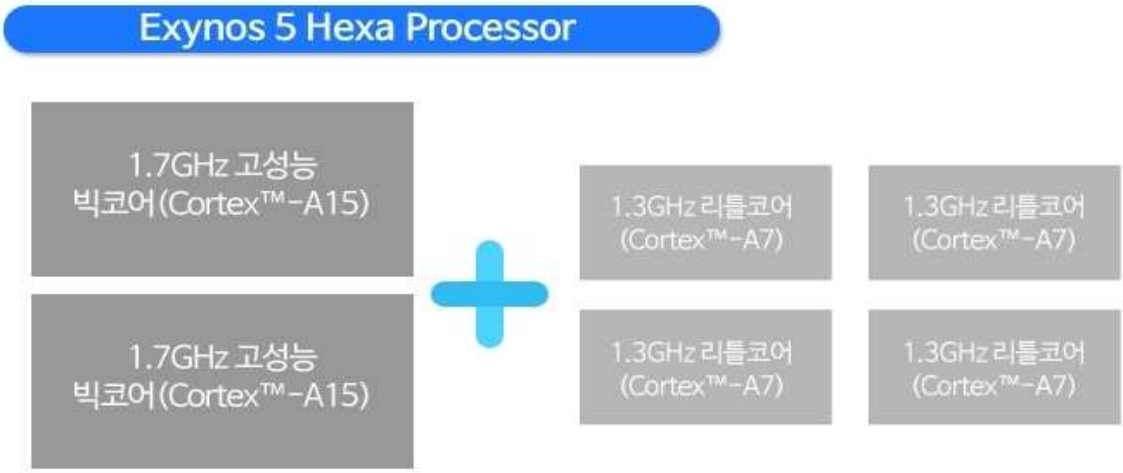
The "Exynos 5 Processor" has been armed with more powerful performance. How will this

transform the everyday mobile environment we encounter on a daily basis? Today, we will find out all there is to know about the six-brained hexa-core processor, "Exynos 5260"!

Hexa-core processor: the brain of mobile devices
Recently launched smartphones and tablet PCs require high performance to enable simultaneous processing of various tasks, including simple Internet surfing or e-mail tasks to 3D gaming and high-resolution video playback. Naturally, the system semiconductors that are in charge of computation and control for these tasks play an important role in these devices.

The "mobile AP" is a system semiconductor similar to the central processing unit (CPU) in computers. Known as the "brain" of the smartphone, the mobile AP is a System-on-Chip that drives the OS and applications required by smartphones or tablet PCs (CPU) while also controlling various systems and interfaces (video recording, camera operation, execution of mobile games).

The Exynos 5 Hexa (5260) unveiled at MWC 2014, as evident from the name "Hexa," has 6 cores. Exynos 5 Hexa is the world's first 6-core product equipped with two 1.7GHz high-performance big cores (Cortex™-A15) and four 1.3GHz low-power consuming little cores (Cortex™-A7), for a total of six.



Exynos 5 Hexa, like Exynos 5 Octa, employs "big.LITTLE multiprocessing technology". Using this technology, 1 to 6 of the 6 cores is used depending on the demands of the task environment. This method of CPU operation greatly enhances the performance and efficiency of the mobile AP. This has allowed for up to 42% performance improvements compared to the conventional Exynos 5 dual series, together with higher power efficiency.

For example, for high-performance tasks such as Full HD video playback or 3D gaming, the 6 big cores and little cores are all engaged to maximize performance, whereas only one little core is used for simple tasks such as web browsing or messaging to minimize power consumption. Along with this multiprocessing technology, 28nm HKMG (High-K Metal Gate) process technology has further enhanced power efficiency.

More realistic 3D gaming! Further enhance graphics processing performance
Users who frequently enjoy high-performance 3D gaming with their smartphones know how frustrating long loading times and low frame rates can be. The mobile AP is equipped with a

graphics processing unit that does away with these frustrations.

Exynos 5 hexa is equipped with the latest Mali T628 core GPU from ARM for realistic 3D graphics and high frame rates. GPU is a semiconductor in charge of graphics processing and is normally in charge of image signal conversion and display.

The product has a hidden weapon. The Mali T628 core is equipped with a "GPGPU" graphics processor that supports not only graphics processing but general computation as well, reducing CPU load and power consumption while allowing for more efficient data processing.

GPGPU can share the load of CPU when necessary, for a faster, smoother usage environment! This is the secret behind the graphics performance of Exynos 5 hexa, which handles high-resolution games with ease.

3D graphic processing performance has been enhanced from the Exynos 5 dual series, allowing users to enjoy multimedia contents at 1.2 times the performance. The unit is also characterized by MFC (Multi-Format Codec), which makes for an even more convenient high-spec multimedia contents environment wherein users can encode and decode various codecs including H.264, MPEG4, and VP8.

Exynos 5 hexa uses an embedded Display Port (eDP) that supports high memory bandwidth of up to 12.8GB/s. Wider bandwidth means increased data transmission speed. This means that data-intensive, high-resolution contents can be handled without a hitch. Video playback at high WQXGA (2560×1600) resolution and 60 frames per second allows users to enjoy an enriched mobile life.

Just as the development of mobile devices has transformed what our everyday lives look like, the development of mobile APs is enhancing the performance of the mobile devices we encounter on a daily basis. The 6-brained Exynos 5 hexa -- fast and efficient performance and remarkable graphics processing capabilities. What new possibilities lie in the future fast-changing mobile environment?

ODROID-XU4Q

is powered by ARM® big.LITTLE™ technology, the **Heterogeneous Multi-Processing (HMP)** solution.

ODROID-XU4 is a new generation of computing device with more powerful, more energy-efficient hardware and a smaller form factor. Offering open source support, the board can run various flavors of Linux, including the latest Ubuntu 16.04 and Android 4.4 KitKat, 5.0 Lollipop and 7.1 Nougat.

By implementing the eMMC 5.0, USB 3.0 and Gigabit Ethernet interfaces, the ODROID-XU4 boasts amazing data transfer speeds, a feature that is increasingly required to support advanced processing power on ARM devices.

This allows users to truly experience an upgrade in computing, especially with faster booting, web browsing, networking, and 3D games.

* Samsung Exynos5422 Cortex ™-A15 2Ghz (4 cores) and Cortex ™-A7 1.4Ghz (4 cores)
* Mali-T628 MP6(OpenGL ES 3.1/2.0/1.1 and OpenCL 1.2 Full profile) : GPU ARM
* 2Gbyte LPDDR3 RAM PoP stacked
* eMMC5.0 HS400 Flash Storage
* 2 x USB 3.0 Host, 1 x USB 2.0 Host
* Gigabit Ethernet port
* HDMI 1.4a for display
* Size : 83 x 58 x 20 mm approx.(excluding cooler)
* Power: 5V/4A input
* **Linux Kernel 4.14 LTS**

– ODROID-XU4 Board
– Active cooling fan / Passive cooler(XU4Q) mounted

A MicroSD card or an eMMC module is required to boot the OS. We strongly recommend an eMMC module for faster OS booting, quicker application launching, seamless multi-tasking and efficient access to the cloud.

NOTE:
1. The active cooling fan is mounted on the XU4 board by default. It spins only when the CPU load is high and the temperature of the CPU hits a minimum threshold temperature. Like most fans, a slight hum can be expected when active. The cooling fan is subject to be changed without notice.

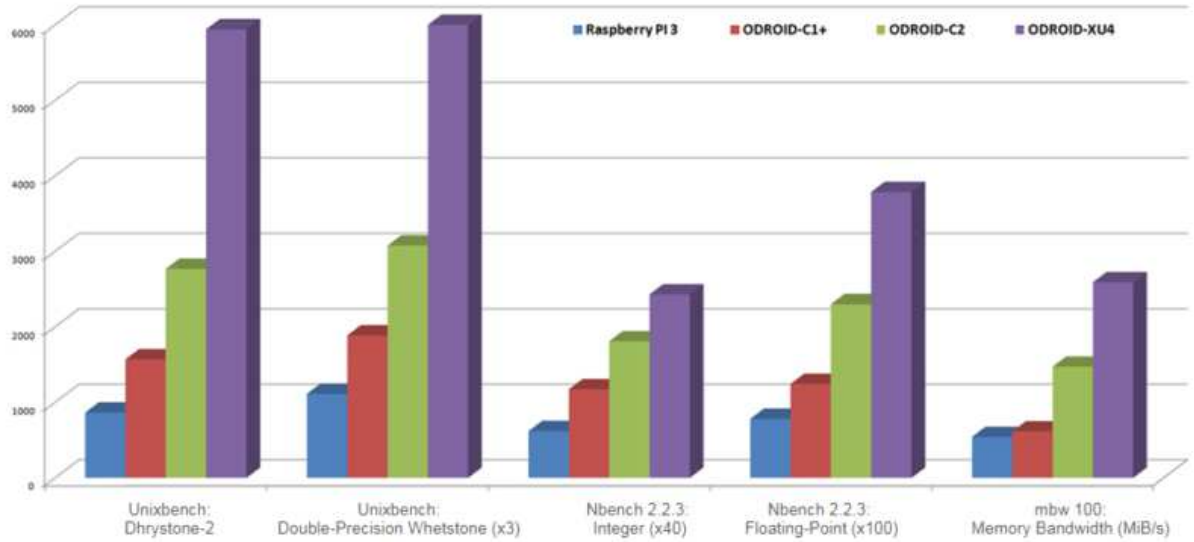
2. The passive tall-blue-heat-sink mounted on XU4Q is too tall to use the XU4 shifter shield and some other add-on shield.

CPU/RAM PERFORMANCE

We ran several benchmarks to measure the computing power on the XU4. The same tests were performed on the Raspberry Pi 3 Model B, ODROID-C1+, ODROID-C2 and ODROID-

XU4.
The values of the test results were scaled uniformly for comparison purposes. The computing power of the XU4 was measured to be ~7 times faster than the latest Raspberry Pi 3 thanks to the 2Ghz Cortex-A15 cores and much higher 64bit memory bandwidth. Using the XU4 as a computer provides a "desktop like" experience, unlike the sluggish performance of most single-board computers!

Particularly for developers, compiling code on the XU4 is super fast. The high-performance 2GB DDR3 RAM is an additional advantage allowing most programs to be compiled directly on the XU4.



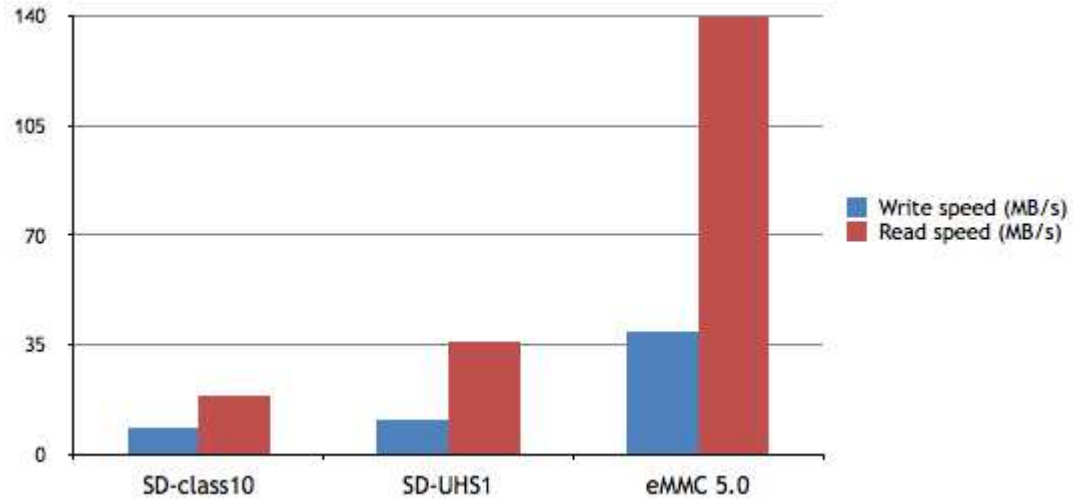
Benchmarks (Index Score)	Raspberry Pi 3	ODROID-C1+	ODROID-C2	ODROID-XU4
Unixbench: Dhrystone-2	865.4	1571.6	2768.2	5941.4
Unixbench: Double-Precision Whetstone (x3)	1113	1887.3	3076.8	6186.3
Nbench 2.2.3: Integer (x40)	619.92	1173.6	1808.92	2430.52
Nbench 2.2.3: Floating-Point (x100)	781.8	1245.3	2300.3	3787.3
mbw100: Memory Bandwidth (MiB/s)	542.912	616.339	1472.856	2591.461

SD/eMMC PERFORMANCE

The XU4 can boot from a MicroSD card or an eMMC module. An easy-access hardware switch is provided to select the boot interface (MicroSD/eMMC). The MicroSD interface supports the higher performance UHS-1 mode as well.

File access of a 512MB file (read/write) on three different storage options shows distinct performance differences.

The eMMC 5.0 storage is ~7x faster than the MicroSD Class-10 card in read tests. The MicroSD UHS-1 card is ~2x faster than the MicroSD Class-10 card in read tests. The MicroSD UHS-1 card provides a great low-cost option for many applications!



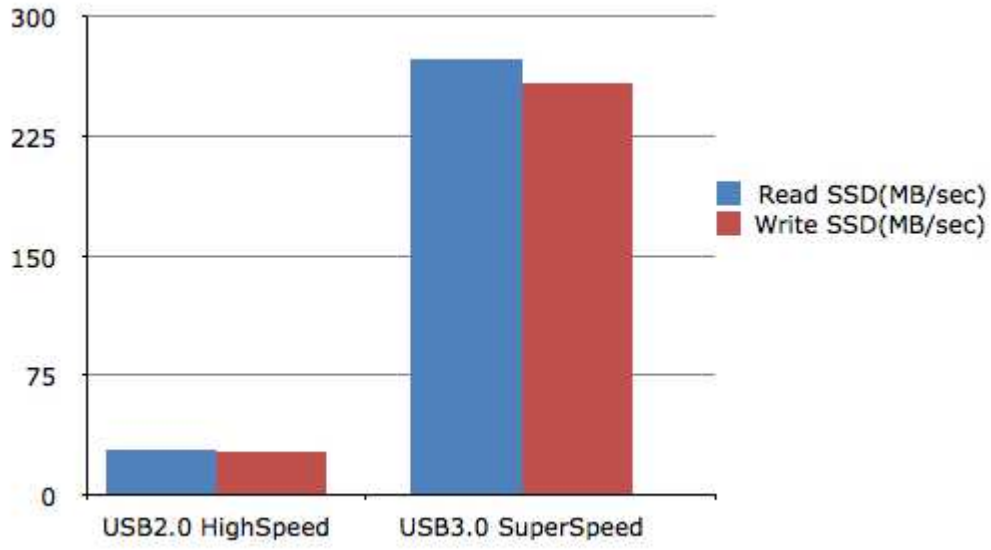
Write command
dd if=/dev/zero of=test oflag=direct bs=8M count=64

Read command
dd if=test of=/dev/null iflag=direct bs=8M

Following eMMC 5.0 test was done with 16GB model.
8GB model is slower than 16GB.

	SD-class10	SD-UHS1	eMMC 5.0
Write speed (MB/s)	8.5	10.8	39.3
Read speed (MB/s)	18.9	35.9	140

USB 3.0 PERFORMANCE



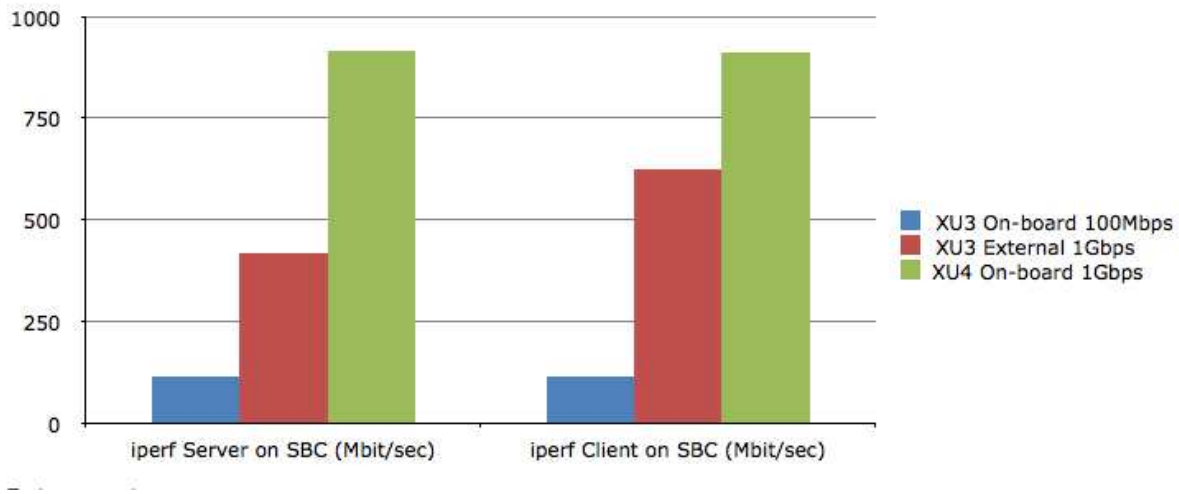
The XU4 has two standard-sized USB 3.0 SuperSpeed host ports. To measure the USB 3.0 performance, we connected an SSD via a USB-SATA bridge JMS567. We used the Samsung SSD 850 PRO 256GB model for this test.

USB 3.0 access speed is ~10x faster than USB 2.0 on the XU4!

USB storage performance	Read SSD(MB/sec)	Write SSD(MB/sec)
USB2.0 HighSpeed	27.6	26.2
USB3.0 SuperSpeed	273	258

ETHERNET PERFORMANCE

The XU4 has an on-board Gigabit Ethernet controller. Our bi-directional streaming speed was measured at **~910 Mbps**.
Thanks to the advanced technology of the RTL8153 controller, the XU4's Ethernet controller easily outperforms the connectivity solutions of prior generations.



Ethernet performance	XU3 On-board 100Mbps	XU3 External 1Gbps	XU4 On-board 1Gbps
iperf Server on SBC (Mbit/sec)	114.0	419	915.0
iperf Client on SBC (Mbit/sec)	114.0	625	911.0

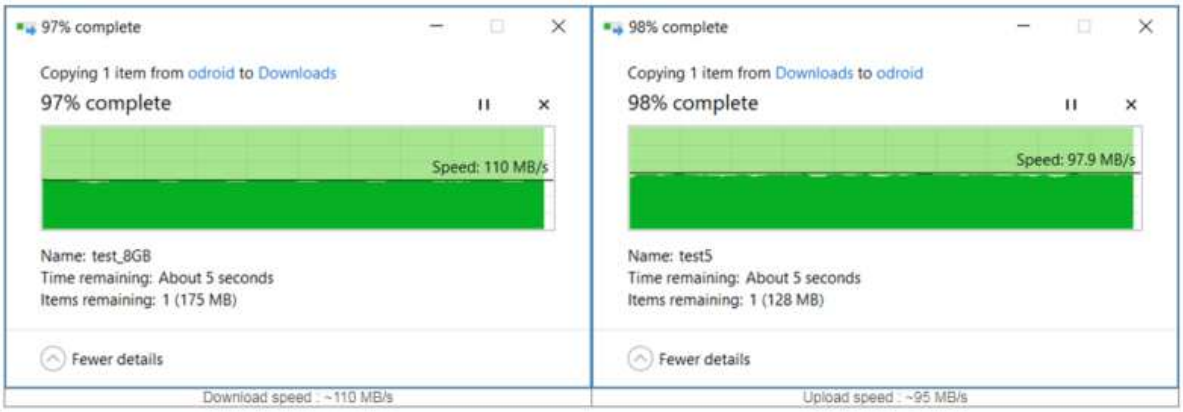
Test command
Server mode : iperf -s
Client Mode : iperf -c [ip address] -P 10 -W 32k

NETWORK STORAGE PERFORMANCE

These days, network storage applications like NAS and cloud services are popular. We ran the famous OMV (Open Media Vault) OS on the XU4 to measure network storage performance. Very affordable Seagate external 8TB HDD was connected to the XU4 via a USB 3.0 port. The Gigabit Ethernet port was connected to a Windows 10 PC via a simple switching hub.

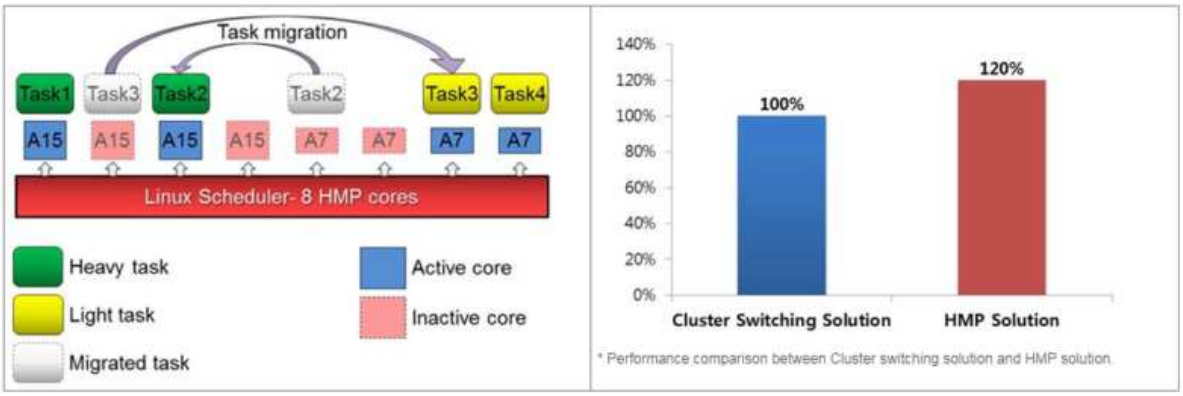
We copied a big 8GB file from the XU4 to the PC via a Samba connection. **This resulted in a download speed of ~110MB/sec. The upload speed was measured at ~95MB/sec.**
The transfer speed is very close to the high-end commercial NAS product in the market.

The XU4 is a great solution to make a DIY personal Network Storage Server!



Heterogeneous Multi-Processing (HMP) solution

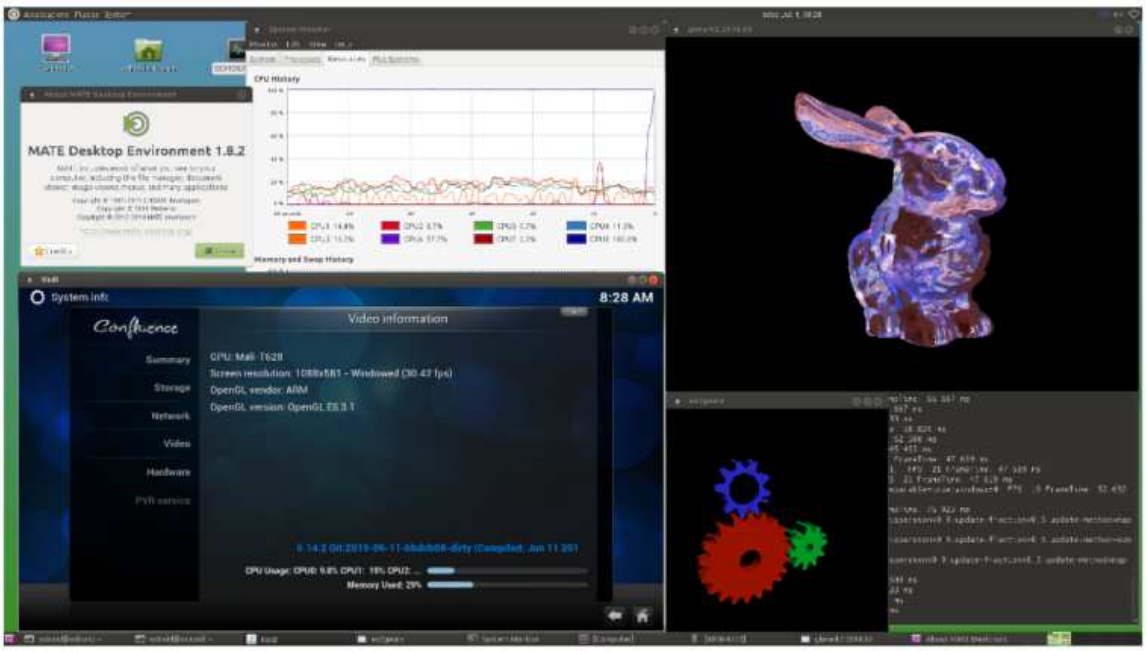
The ODROID-XU4, equipped with four big cores (ARM® Cortex® -A15™ up to 2.0GHz) and four small cores (ARM® Cortex® -A7™ up to 1.4 GHz), provides improved processing capabilities while maintaining the most efficient power consumption available. With the big.LITTLE™ HMP solution, the Exynos-5422 can utilize a maximum of all eight cores to manage computationally intensive tasks.



OpenGL ES 3.0 and OpenCL 1.2 for Linux and Android platforms

The ARM® Mali™-T628 MP6 GPU offers key API support for OpenGL ES 1.1, OpenGL ES 2.0 and OpenGL ES 3.0, OpenCL 1.2 Full Profile and Google RenderScript. Mali-T628 is the GPU of choice for use in the next generation of market-leading devices, optimized to bring breathtaking graphical displays to consumer applications such as 3D graphics, visual computing, augmented reality, procedural texture generation and voice recognition. You can download the full featured OpenGL ES and OpenCL SDK from ARM Mali Developer website. It's free!

This screen-shot shows OpenGL-ES applications and the Kodi media player with Ubuntu Mate desktop on the HMP enabled Kernel.


MATE Desktop Environment 1.8.2
CPU History
System Info
8:28 AM
Confluence
Video information
Summary
Storage
Network
Video
Hardware
PVR service
GPU: Mali-T628
Screen resolution: 1088x681 - Windowed (30.43 fps)
OpenGL vendor: ARM
OpenGL version: OpenGL ES 3.1