Rockchip

Coordinates: 26°06′46″N 119°15′54″E / 26.112846°N 119.264960°E

Rockchip (Fuzhou Rockchip Electronics Co., Ltd.) is a Chinese fabless semiconductor company based in Fuzhou, Fujian province. It designs SoCs using licensed SIP cores from other companies. Due to its evolution from the MP3/MP4 player market, most Rockchip SoCs feature advanced media decoding logic but lack integrated cellular radio basebands.

Rockchip is a leading supplier of SoC solutions to Chinese white-box tablet manufacturers[4][5][6] as well as supplying OEMs such as Asus,[7][8] HP[9] and Toshiba.[10][11]

Rockchip is an ARM licensee and uses the ARM architecture for the majority of its projects.[12]

However, on 27 May 2014 Intel announced that it has entered into a strategic agreement with Rockchip to accelerate the adoption of the Intel architecture and Intel's communication-based solutions for a range of entry-level tablets targeted at the worldwide market.[3]

1 Markets and competition

In the market for SoC solutions for tablets, Rockchip faces competition from Allwinner Technology,[13] MediaTek,[5] Intel,[14] Actions Semiconductor,[15] Spreadtrum,[16] Leadcore Technology,[17] Samsung Semiconductor, Qualcomm, Broadcom, VIA Technologies[13] and Amlogic.[13]

After establishing a leading position early in the developing Chinese tablet SoC market, in 2012 it faced a challenge by Allwinner.[2] In 2012, Rockchip shipped 10.5 million tablet processors, compared to 27.5 million for Allwinner.[13]

However, Rockchip subsequently improved its competitive position. For Q3 2013, Rockchip was forecast to ship 6 million tablet-use application processors in China, compared to 7 million for Allwinner who mainly shipped single-core solutions.[18] Rockchip was reported to be the number one supplier of tablet-use application processors in China in Q4 2013, Q1 2014 and Q2 2014.[4][6]

Chinese SoC suppliers that do not have cellular baseband technology are at a disadvantage compared to companies such as MediaTek that also supply the smartphone market as white-box tablet makers increasingly add phone or cellular data functionality to their products.[19]

Intel Corporation has made significant investments into becoming a player in the tablet processor market and was heavily subsidizing its entry into the low-cost tablet market as of 2014.[14]

1.1 Cooperation with Intel

In May 2014, Intel announced a strategic agreement with Rockchip to jointly deliver an Intel-branded mobile SoC platform based on Intel's Atom processor and 3G modem technology.[3] Under the terms of the agreement, the two companies will deliver an Intel-branded mobile SoC platform. The quad-core platform will be based on an Intel Atom processor core integrated with Intel's 3G modem technology, and is expected to be available in the first half of 2015.[3] Both Intel and Rockchip will sell the new part to OEMs and ODMs, primarily into each company's existing customer base.[3]

As of October 2014, Rockchip was already offering a low-end smartphone solution, Intel's XMM 6321, through its customer base.[20] It is a two chip solution consisting of a dual-core application processor (either with Intel processor cores or ARM Cortex-A5 cores) with integrated modem (XG632) and an integrated RF chip (AG620) that originates from the cellular chip division of Infineon (which Intel acquired some time ago). The application processor may also originate from Infineon or Intel. Rockchip has not earlier targeted the smartphone space in a material way.

2 Products

2.1 Early Products

RK26xx series - Released 2006.

RK27xx series - Rockchip was first known for their RK 27xx series that was very efficient at MP3/MP4 decoding and was integrated in many low-cost personal media player (PMP) products.

2.2 RK28xx series

The **RK2806** was targeted at PMPs.

- ARM926EJC 600 MHz CPU + DSP Core
- SD, DDR RAM support

Tronsmart MK908, a Rockchip-based quad-core Android "mini PC", with a microSD card next to it for a size comparison.

- Up to 1280×720 H.263 and H.264 software video acceleration.
- RTOS support

The **RK2808A** is an ARM926EJ-S derivative. Along with the ARM core a DSP coprocessor is included. The native clock speed is 560 MHz. ARM rates the performance of the ARM926EJ-S at 1.1 DMIPS/MHz the performance of the Rockchip 2808 when executing ARM instructions is therefore 660 DMIPS roughly 26% the speed of Apple's A4 processor. The DSP coprocessor can support the real-time decoding of 720p video files at bitrates of up to 2.5 Mbit/s. This chip was the core of many Android and Windows Mobile-based mobile internet devices..

- ARM9 core + DSP clocked at up to 560 MHz
- Wi-Fi, 3G, GPS
- Accelerometer
- SD/SDHC/MMC
- Up to 800×600 display support
- DDR and DDR2 RAM support, up to 1 GB
- RTOS and Android

The **RK2816** was targeted at PMP devices, and MIDs. It has the same specifications as the RK2806 but also includes HDMI output, Android support, and up to 720p hardware video acceleration..

The **RK2818**[21] was targeted at MID and E-reader devices. As of 2013, it was targeted at E-readers.[22]

- ARM9 core + DSP clocked at up to 640 MHz
- USB connection to Wi-Fi/Bluetooth chip
- Accelerometer
- SD/SDHC/MMC
- Up to 1024×768 display support
- DDR and DDR2 RAM support, up to 4 GB
- Up to 720p hardware video acceleration for H.264
- Arteris FlexNoc interconnect technology
- RTOS and Android

2.3 RK29xx series

The Rockchip RK291x is a family of SoCs based on the ARM Cortex-A8 CPU core. They were presented for the first time at CES 2011. The RK292x are single core SoCs based on ARM Cortex-A9 and were first introduced in 2012.

The **RK2918**[23] was the first chip to decode Google WebM VP8 in hardware. It uses a dynamically configurable companion core to process various codecs. It encodes and decodes H.264 at 1080p, and can decode many standard video formats including Xvid, H.263, AVS, MPEG4, RV, and WMV. It includes a Vivante GC800 GPU that is compatible with OpenGL ES 2.0 and OpenVG. The RK2918 is compatible with Android Froyo (2.2), Gingerbread (2.3), HoneyComb (3.x) and Ice Cream Sandwich (4.0).[24] Unofficial support for Ubuntu and other Linux flavours exists. As of 2013, it was targeted at E-readers.[22]

- ARM Cortex-A8 processor, clocked at up to 1.2 GHz (due to stability reasons often limited to 1 GHz)
- 512 KB L2 cache
- NEON SIMD support
- Vivante GC800 GPU at 575 MHz supporting Open GL ES 2.0 and Open VG 1.1 support[25]
- VPU (Video Processing Unit) supporting 1080p image and video decoding for H.264, Xvid, H.263, AVS, MPEG4, RV, and WMV
- DDR, DDR2, DDR3 RAM support
- HDMI 1.2 Interface
- USB 1.1 Host, USB 2.0 Host and USB 2.0 Device Interface
- SD/MMC Interface
- Adobe Flash Player 10.1

The **RK2906** is basically a cost-reduced version of the RK2918, also targeted at E-readers as of 2013.[22]

The Rockchip **RK2926** and **RK2928**[26] feature a single core ARM Cortex A9 running at a speed up to 1.0 GHz.

It replaces the Vivante GC800 GPU of the older RK291x series with an ARM Mali-400 GPU. As of 2013, the RK2926 was targeted at tablets, while the RK2928 was targeted at tablets and Android TV dongles and boxes.[22]

- Single core ARM Cortex A9 clocked up to 1.0 GHz
- 128 KB L2 cache[22]
- 55 nm low power process
- ARM Mali-400 GPU (single core, up to 330 MHz)
- 1080P multi format video decoding
- 1080P video encoding for H.264
- Embedded HDMI 1.4b transmitter, audio codec, GPS baseband
- Embedded LVDS transmitter

2.4 RK30xx series

The **RK3066** is a high performance dual-core ARM Cortex-A9 mobile processor similar to the Samsung Exynos 4 Dual Core chip. In terms of performance, the RK3066 is between the Samsung Exynos 4210 and the Samsung Exynos 4212.[27][28][29][30][31] As of 2013, it was targeted at tablets and Android TV dongles and boxes.[22] It has been a popular choice for both tablets and other devices since 2012.

- 40 nm process
- Dual-core ARM Cortex-A9 processor (ARMv7 architecture) clocked up to 1.6 GHz
- 512 KB L2 cache[22]
- NEON SIMD support
- Quad core Mali-400 GPU, clocked at 250 MHz supporting OpenGL ES 2.0, OpenVG 1.1 support, 9 GFLOPS[25]
- VPU (Video Processing Unit) multimedia processor supporting 1080p image and video decoding
- DDR, DDR2, DDR3 support, up to 2 GB
- HDMI 1.4 interface
- 2-channels TFT LCD Interface with 5 layers and 3D display (1920×1080 maximum display Size)
- USB 2.0 interface
- SD/MMC interface

The **RK3068** is a version of the RK3066 specifically targeted at Android TV dongles and boxes. Its package is much smaller than the RK3066.[22]

The **RK3028** is a low-cost dual-core ARM Cortex-A9-based processor clocked at 1.0 GHz with ARM Mali-400 GPU. It is pin-compatible with the RK2928. It is used in a few kids tablets and low-cost Android HDMI TV dongles.[32]

The **RK3026** is an updated ultra-low-end dual-core ARM Cortex-A9-based tablet processor clocked at 1.0 GHz with ARM Mali-400 MP2 GPU. Manufactured at 40 nm, it is pin-compatible with the RK2926. It features 1080p H.264 video encoding and 1080p decoding in multiple formats.[33] Supporting Android 4.4,[34] it has been adopted for low-end tablets in 2014.

The **RK3036** is a low-cost dual-core ARM Cortex-A7-based processor released in Q4 2014 for smart set-top boxes with support for H.265 video decoding.[35]

2.5 RK31xx series

The **RK3188** was the first product in the RK31xx series, announced for production in the 2nd quarter of 2013. The RK3188 features a quad-core ARM Cortex-A9 clocked up to 1.6 GHz frequency.[36][37] It is targeted at tablets and Android TV dongles and boxes,[22] and has been a popular choice for both tablets and other devices requiring good performance.

- 28 nm HKMG process[37] at GlobalFoundries[38]
- Quad-core ARM Cortex-A9, up to 1.6 GHz
- 512 KB L2 cache[22]
- Mali-400 MP4 GPU, up to 600 MHz (typically 533 MHz) supporting OpenGL ES 1.1/2.0, Open G 1.1[25][37]
- High performance dedicated 2D processor[37]
- DDR3, DDR3L, LPDDR2 support[37]
- Dual-panel display up to 2048x1536 resolution[37]

The **RK3188T** is a lower-clocked version of the RK3188, with the CPU cores running at a maximum speed of 1.4 GHz instead of 1.6 GHz. The Mali-400MP4 GPU is also clocked at a lower speed. As of early 2014, many devices advertised as using a RK3188 with a maximum clock speed of 1.6 GHz actually have a RK3188T with clock speed limited to 1.4 GHz. Operating system ROMs specifically made for the RK3188 may not work correctly with a RK3188T.[39]

The **RK3168**, first shown in April 2013, is a dual-core Cortex A9-based CPU, also manufactured using the 28 nm process.[40][41] It is targeted at low-end tablets.[22] The chip has seen only limited use as of May 2014.

- 28 nm HKMG process[41] at GlobalFoundries[38]
- Dual-core ARM Cortex-A9, up to 1.2/1.5 GHz[41]
- 256 KB L2 cache[22]
- PowerVR SGX54x GPU (originally listed as SGX540[22]), up to 600 MHz (typically 500 MHz) GPU, supporting OpenGL ES 1.1/2.0, OpenVG 1.1[25][41]
- High performance dedicated 2D processor[41]
- 1080p multi format video decoding[41]
- 1080p video encoding for H.264[41]
- DDR3, DDR3L, LPDDR2 support[41]
- Dual-panel display up to 1920x1080 resolution[41]

The **RK3126** is an entry-level tablet processor introduced in Q4 2014. Manufactured using a 40 nm process, it features a quad-core Cortex-A7 CPU up to 1.3 GHz and a Mali-400 MP2 GPU. It is pin-compatible with RK3026 and RK2926.[42]

- 40 nm process
- Quad-core ARM Cortex-A7, up to 1.3 GHz
- Mali-400 MP2 GPU
- High performance dedicated 2D processor
- DDR3, DDR3L memory interface
- 1080p multi-format video decoding and 1080p video encoding for H.264

The **RK3128** is a higher-end variant of RK3126, also to be introduced in Q4 2014, that features more integrated external interfaces, including CVBS, HDMI, Ethernet MAC, S/PDIF, Audio DAC, and USB. It targets more fully featured tablets and set-top boxes.[43]

2.6 RK32xx series

Rockchip has announced the RK3288 for production in the second quarter of 2014.[44] Recent information suggests that the chip uses a quad-core ARM Cortex-A17 CPU, although technically ARM Cortex-A12,[45] which as of October 1, 2014, ARM has decided to also refer to as Cortex-A17 because the latest production version of Cortex-A12 performs at a similar performance level as Cortex-A17.[46]

- 28 nm HKMG process.
- Quad-core ARM Cortex-A17, up to 1.8 GHz
- Quad-core ARM Mali-T760 MP4 (also called Mali-T764) GPU clocked at 600 MHz[25] supporting OpenGL ES 1.1/2.0/3.0/3.1, OpenCL 1.1, Renderscript, Direct3D 11.1[47]
- High performance dedicated 2D processor
- 1080P video encoding for H.264 and VP8, MVC
- 4K H.264 and 10 bits H.265 video decode, 1080p multi-video decode
- Supports 4Kx2K H.265 resolution
- Dual-channel DDR3, DDR3L, LPDDR2, LPDDR3
- Up to 3840x2160 display output, HDMI 2.0

2.6.1 Inconsistent information about CPU cores used in RK3288

Early reports including Rockchip first suggested in summer 2013 that the RK3288 was originally designed using a quad-core ARM Cortex-A12 configuration.[48] Rockchip's primary foundry partner GlobalFoundries announced a partnership with ARM to optimize the ARM Cortex-A12 for their 28 nm-SLP process.[49] This is the same process used for earlier Rockchip chips such as the RK3188, and matches the choice of Cortex-A12 cores in the design of the RK3288.

In January 2014, official marketing materials listed the CPU cores as ARM Cortex-A17. At the CES electronics show in January 2014, someone apparently corrected the CPU specification as being ARM Cortex-A12 instead of Cortex-A17 on one of the panels of their show booth.[50] However, since then, official specifications from Rockchip's website and marketing materials as well specifications used by device manufacturers have continued to describe the CPU as a quad-core ARM Cortex-A17.

Recent testing of early RK3288-based TV boxes (August/September 2014) provided evidence that the RK3288 technically contains Cortex-A12 cores, since the "*ARM 0xc0d*" CPU archtitecture reported by CPU-Z for Android is the reference for Cortex-A12, while the original Cortex-A17 is referred to as "*ARM 0xc0e*".[45]

However, on the ARM community website, ARM clarified the situation on October 1, 2014, saying that Cortex-A12, for which Rockchip is one of the few known customers, will be called Cortex-A17 from now on, and that all references to Cortex-A12 have been removed from ARM's website.[46] ARM explained that the latest production revision of Cortex-A12 now performs close to the level of Cortex-A17 because the improvements of the Cortex-A17 now also have been applied to the latest version of Cortex-A12. In this way, Rockchip now gets the official blessing from ARM for listing the cores inside the RK3288 as Cortex-A17.

The first Android TV stick based on RK3288 was launched in November 2014 ("ZERO Devices Z5C Thinko"[51]).

2.6.2 The solution based on RK3288

EM3288 is a single board computer based on the Rockchip RK3288, it features powerful graphics processing and video decoding ability.

MiQi SBC is a single board computer in a metal case, with HDMI output, Gigabit Ethernet and 4xUSB 2.0 ports

2.7 RK33xx series

Rockchip announced the first member of the RK33xx family at the CES show in January 2015. The RK3368 is a SoC targeting tablets and media boxes featuring a 64-bit octa-core Cortex-A53 CPU and an OpenGL ES 3.1-class GPU.[52]

- Octa-core Cortex-A53 up to 1.5 GHz
- High-performance PowerVR SGX6110 GPU with support for OpenGL 3.1 and OpenGL ES 3.0
- 4Kx2K H.264/H.265 real-time video playback
- HDMI 2.0 with 4Kx2K @ 60 fps display output

The RK3399 announced by ARM at Mobile World Congress in February 2016, features six 64 bit CPUs, including 2 Cortex-A72 and 4 Cortex-A53.[53]

3 List of Rockchip SoC

3.1 ARMv5-based

3.2 Tablet application processors (ARMv7-A)

3.3 Tablet application processors (ARMv8-A)

3.4 Tablet processors with integrated modem

4 See also

- Allwinner Technology
- Amlogic
- Actions Semiconductor
- Leadcore Technology
- MediaTek
- Nufront
- Spreadtrum

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6 External links

- Fuzhou Rockchip Electronics Company website
- Linux-Rockchip community
- Forum for all RK3066 devices
- German based forum with international support for custom kernels and custom roms of Rockchip based tablets

- RK3288 SoC specification, 22 February 2014
- RK3368 SoC specification, 19 April 2015

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