# RK3588

**A high performance, low power AIoT processor**

## Features

### CPU

- Quad-core ARM Cortex-A76 processor and quad-core ARM Cortex-A55 processor
- Integrated 64KB L1 instruction cache, 64KB L1 data cache and 512KB L2 cache for each Cortex-A76
- Integrated 32KB L1 instruction cache, 32KB L1 data cache and 128KB L2 cache for each Cortex-A55
- Big cluster and little cluster share 3MB L3 cache
- MCU for low power control

### GPU

- ARM Mali-G610 MC4
- High performance OpenGL ES 1.1, 2.0 and 3.2, OpenCL 2.2, Vulkan1.2 etc.
- Embedded 4 shader cores with shared hierarchical tiler

### NPU

- 6TOPs@int8
- Support int4/int8/int16/FP16/BF16/TF32
- Support deep learning frameworks: TensorFlow, Caffe, Tflite, Pytorch, Onnx NN, Android NN, etc

### Memory

- 64bit LPDDR4/LPDDR4x/LPDDR5
- Support eMMC 5.1 with HS400, SDIO 3.0 with HS200,
- NVMe，SFC

### Multi-Media

- H.265/H.264/VP9/AV1/AVS2 video decoder，up to 8K@60fps
- H.264 AVC/MVC Main10 L6.0: 8K@30fps (7680x4320)
- VP9 Profile0/2 L6.1: 8K@60fps (7680x4320)
- H.265 HEVC/MVC Main10 L6.1: 8K@60fps (7680x4320)
- AVS2 Profile0/2 L10.2.6: 8K@60fps (7680x4320)
- AV1 Main Profile 8/10bit L5.3: 4K@60fps (3840x2160)
- 1080P other video decoders (VC-1, MPEG-1/2/4, VP8, AVS1)
- MPEG-1 up to MP: 1080p@60fps (1920x1088)
- MPEG-2 up to MP: 1080p@60fps (1920x1088)
- VC-1 up to AP level 3: 1080p@60fps (1920x1088)
- VP8 version2: 1080p@60fps (1920x1088)
- 8K@30fps video encoders for H.264/H.265

### Video Input

- 48M Pixel ISP with HDR&3DNR
- Multiple (4*4lanes or 4*2lanes+2*4Lanes) MIPI CSI-2 and DVP interface
- HDMI 2.0 input to 4K@60fps

### Display

- Multiple display engine max to 8K
- Dual HDMI2.1/eDP V1.4 Combo interface
- Dual MIPI-DSI TX, 4 lanes
- Dual DP v1.3 embed in USB 3.1, Audio, HDCP2.x

### Audio Interface

- I2S0/I2S1 with 8 channels
- I2S2/I2S3 with 2 channels
- SPDIF0/SPDIF1
- PDM0/PDM1 with 8 channels
- Digital Audio Codec with 2 channels
- VAD (Voice Activity Detection)

### High Speed Interface

- Dual port USB 3.1 with type-C & DP
- Dual port USB 2.0 OTG & dual port USB 2.0 host
- PCIe 3.0, 4 lanes or 2x2 lanes or 4x 1lane
- Three port PCIe 2.0/SATA 3.0
- Dual RGMII interface

### Security

- ARM Trustzone security extension
- Secure boot
- Secure JTAG to debug
- Key ladder
- Crypto (RSA 2K, HAS 256…)
- HDCP 2.x for HDMI and DP/eDP

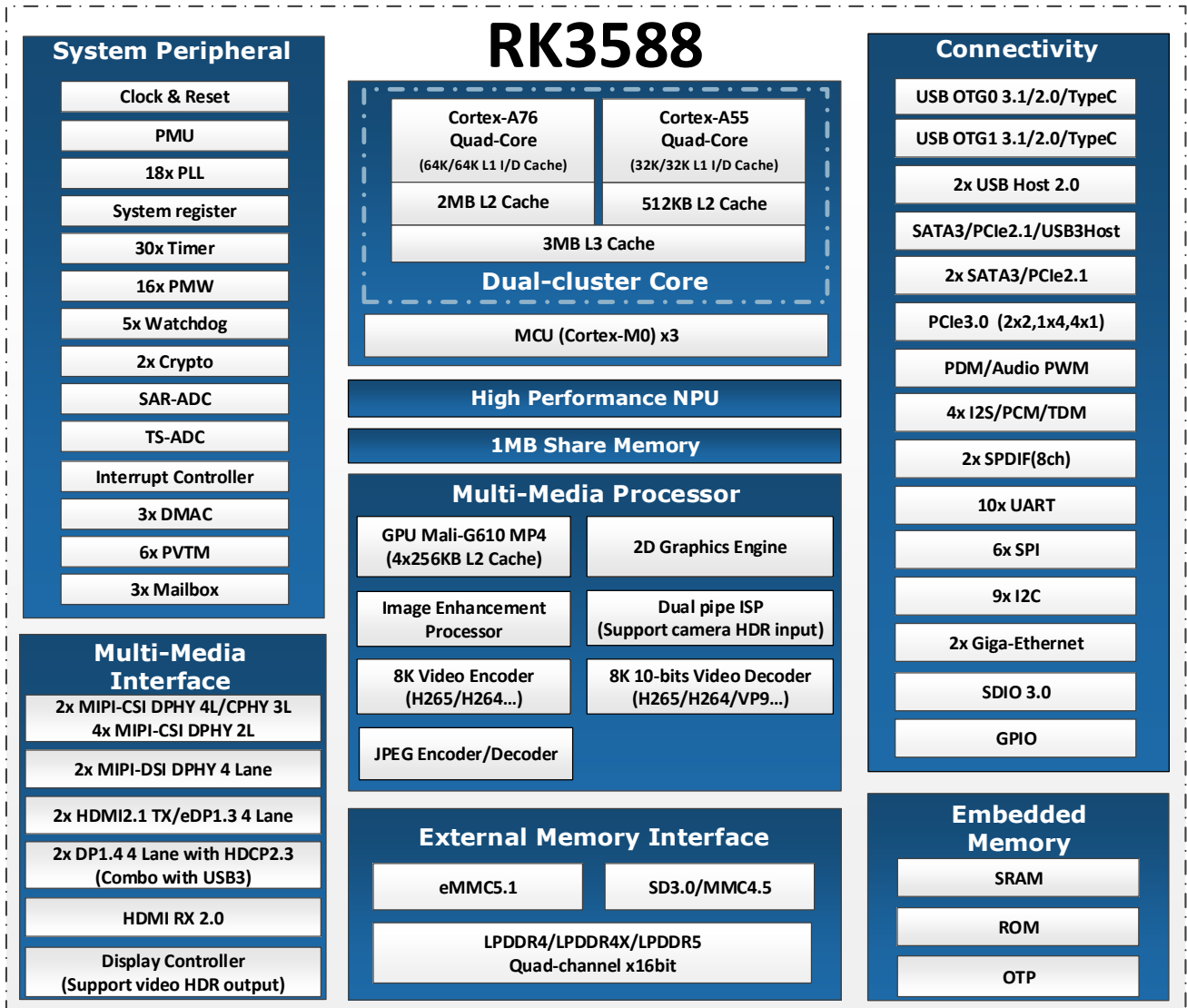### SDK

- Linux5.10
- Android12

## Device Information

Package:
- Package: FCBGA1088L
  Body: 23mm x 23mm
  Ball pitch: 0.65mm

# RK3588 Target Applications

- Cockpit
- Smart display
- AI Camera
- Edge Computing
- ARM PC
- Tablet
- NVR
- AR/VR

## Block Diagram

# RK3588

### System Peripheral

- Clock & Reset
- PMU
- 18x PLL
- System register
- 30x Timer
- 16x PMW
- 5x Watchdog
- 2x Crypto
- SAR-ADC
- TS-ADC
- Interrupt Controller
- 3x DMAC
- 6x PVTM
- 3x Mailbox

### Multi-Media Interface

- 2x MIPI-CSI DPHY 4L/CPHY 3L
  4x MIPI-CSI DPHY 2L
- 2x MIPI-DSI DPHY 4 Lane
- 2x HDMI2.1 TX/eDP1.3 4 Lane
- 2x DP1.4 4 Lane with HDCP2.3
  (Combo with USB3)
- HDMI RX 2.0
- Display Controller
  (Support video HDR output)

### Dual-cluster Core

| Cortex-A76 Quad-Core (64K/64K L1 I/D Cache) | Cortex-A55 Quad-Core (32K/32K L1 I/D Cache) |
| --- | --- |
| 2MB L2 Cache | 512KB L2 Cache |
| 3MB L3 Cache | |

MCU (Cortex-M0) x3

### High Performance NPU

### 1MB Share Memory

### Multi-Media Processor

| GPU Mali-G610 MP4 (4x256KB L2 Cache) | 2D Graphics Engine |
| --- | --- |
| Image Enhancement Processor | Dual pipe ISP (Support camera HDR input) |
| 8K Video Encoder (H265/H264...) | 8K 10-bits Video Decoder (H265/H264/VP9...) |

JPEG Encoder/Decoder

### External Memory Interface

| eMMC5.1 | SD3.0/MMC4.5 |
| --- | --- |
| LPDDR4/LPDDR4X/LPDDR5 Quad-channel x16bit | |

### Connectivity

- USB OTG0 3.1/2.0/TypeC
- USB OTG1 3.1/2.0/TypeC
- 2x USB Host 2.0
- SATA3/PCIe2.1/USB3Host
- 2x SATA3/PCIe2.1
- PCIe3.0 (2x2,1x4,4x1)
- PDM/Audio PWM
- 4x I2S/PCM/TDM
- 2x SPDIF(8ch)
- 10x UART
- 6x SPI
- 9x I2C
- 2x Giga-Ethernet
- SDIO 3.0
- GPIO

### Embedded Memory

- SRAM
- ROM
- OTP

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**RK3588**

## Typical Application Diagram – AIoT

Camera Sensor

MIPI Panel

eDP Panel/ HDMI

eDP Panel/ HDMI

HDMI2.0 RX

MIPI CSI RX *4

MIPI DSI TX*2

HDMI2.1 /eDP1.4

HDMI2.1 /eDP1.4

WiFi 6/BT/GPS Module

PCIe2.0

UART

DDR_Controller 4*16bit

LPDDR4/4X/LPDDR5

SATA

PCIe2.0/ SATA3.0

eMMC

eMMC

PCIe 3.0

SDMMC

SD Card

USB2.0 OTG/HOST *2

GMAC0

Gigabit PHY

**RK3588**

**4*A76+ 4*A55**

USB3.1/ TYPE-C/DP1.4 *2

GMAC1

Gigabit PHY

USB Type-C

System Power

I2S

PDM

OSC 24MHz

SPI/I2C

PMIC RK806-1

Audio Codec

MIC Array

Touch Panel

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