RISC-V of Samsung in the age of 5G and AI

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System LSI Business, Samsung Electronics
RISK of Samsung

Since 1969

1974: Semiconductor
1983: Memory
1997: System LSI
2002: Display Driver IC No.1
2006: MP3 AP No.1
2015: Navigation AP, SIM No.1
2019: 5G 1-chip World’s 1st 64/108Mp
World’s 1st 5G Commercial Service
World’s 1st 6CA LTE Modem
World’s 1st 1.0um Pixel

Change Everything !!!

RISK !!!

External RISK

Internal RISK

Nov. 1st, 2019
50th Birthday
50 to 100

50th Birthday

50 to 100

World’s 1st 64/108Mp

World’s 1st 1.0um Pixel

World’s 1st 6CA LTE Modem

World’s 1st 5G Commercial Service

5G 1-chip

World’s 1st 5G Commercial Service

World’s 1st 5G Commercial Service
RISK of Samsung in the age of 5G and AI
RISC-V of Samsung in the age of 5G and AI
System LSI
Unique Fabless
with Wide Range of Products

SoC
AP/Modem/RF/Connectivity

CMOS Image Sensor

Display Driver IC
Touch Controller

NFC/eSE/SIM Banking/ID

Power Management IC

DTV SoC

Mobile Devices

Consumer Devices

Automotive
Age of 5G

The Mass Connected Era
Inspires creativity to all connected dots

5G

Enhanced Mobile Broadband
Ultra Reliable & Low Latency
Massive Machine Type Communication

2018
3GPP 5G NR Phase 1
Standard Release

2019
Commercial Device
& Service Release

2020
5G NR
Commercialization

5G Mobile Subscriptions to
Reach 1 Billion by 2023
(Ericsson Mobility Report, Nov 2017)
Cellular Modem

600 million+
Exynos Modems have been commercialized in 150 Countries

Exynos Modem

2009
Released World 1st Commercial LTE Modem

2009
300Mbps Carrier Aggregation

3G/4G
Exynos Modem 300/303

2014
1Gbps LTE Cat.16

3G/4G
Exynos 8895
Exynos Modem 359

2017
1.2Gbps LTE Cat.18

3G/4G
Exynos 9810
Exynos 9610

2018
1.2Gbps LTE Cat.18

3G/4G
Exynos Modem 5100
Exynos Modem 5123

2019
2Gbps LTE Cat.18

5G/LTE Advanced
Exynos Modem 5123
Exynos 9810
Exynos 9820

2020
2Gbps
5G New Radio

5G NR Rel.15 Compliant
Multi-mode 5G Chipset Series

Exynos Modem 5123
Exynos 9810
Exynos 9820

CDMA
FR1 2Gbps, FR2 6Gbps
Exynos Modem 5100
Exynos Modem 5123
Exynos 9820

FR1 2.55Gbps~3.55Gbps
5G 1 Chip SOC
Exynos 9810
Exynos 9820

FR1 7.35Gbps SA/NSA, EN-DC
Exynos 9820

FR1 5.1Gbps, FR2 7.35Gbps SA/NSA, EN-DC
Exynos Modem 5123
Exynos 9820

SA/NSA, EN-DC
Exynos 9810
Exynos 9820
Exynos RF System

mmWave RF
RISC-V in 5G

RISC-V in mmWave RF

[2017] The 1st RFIC test chip was taped out - Offset calibration
[2018] The 1st generation (center / phased array) RFICs were taped out
[2018] The 1st multiple band phased array RFIC was taped out in 2018.
[2019] The 2nd center RFIC were taped out
Age of AI

AI/Deep Learning through the Industries

On-device intelligence combining with 5G, IoT brings the innovation in everyday life and services, which is enabled by advanced semiconductor technologies.
AI Accelerator

Exynos for Device Intelligence

Neural Processing Unit
An Intelligent Powerhouse

- High Performance, Low Power Processing
- Flexible and Scalable Architecture
- Android NN API, Caffe2, Tensorflow-lite

Intelligent Image Processing, Face/Object/Voice Recognition, IoT/Machine Learning, Smart Mobility

GPU, DSP, NPU, CPU
Intelligent Camera

- **Ultra-high Resolution**
  - More Pixels in a Small Sensor

- **Small and Slim**
  - Tiny Camera Fit for Full Front Display

- **Intelligent Camera**
  - Scene-Adaptive HDR Processing,
    Face Detection/Recognition, Fast AF

- **Multiple Cameras**
  - Dual, Triple and Quad Cameras
    for Various User Scenarios

- **High Light-sensitivity**
  - Bright and Clear Image under Low Light

- **3D Depth Sensing**
  - DVS, ToF for Game, VR/AR

*DVS: Dynamic Vision Sensor
*ToF: Time-of-Flight
RISC-V in Sensors

Competitiveness

Scalable and Flexible design options
Open Source ISA
Matured core designs available
SW eco built-up

Image Sensor IC
Large variant of requirements based on applications
Different resolution, frames, pre-processing, precisions, etc.
Development of large number of line-ups in parallel
Development environment and base HW/SW design must be unified, regardless of varying requirements and specifications
RISC-V base environment with base ISA, additional project-dedicated features with applicable extensions
Intelligent Driving Experience

AI accelerated SOC and Sensors

Exynos Auto for Infotainment
Exynos Modem for Telematics
Exynos Auto for ADAS
ISOCELL Image Sensor
RISC-V of Samsung

MOBILE
AI Computing and Control
RF Calibration and Control
Security Management

AUTOMOTIVE
AI Computing and Control
Security Management
Safety Island
Next Generation System Architect

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