System On Chip
教育部商管學程系統晶片應用課程

IoT Chip comparison between TI/ Intel/ Qualcomm/ ARM

The Institute of Communication Engineering

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Outline

- **Introduction**
- **Case Study**
  - **Texas Instrument, CC3200 SimpleLink Wi-Fi**
  - **Intel, 12th Intel® Core™**
  - **Qualcomm, QCS8250**
  - **ARM, Cortex-M85**
- **Market Analysis**

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- **Introduction**
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Introduction

- **IoT Definition: A module can be embedded in objects, machine or things, and it's called "IoT chip". It's in charge of connecting to wireless network for sending and receiving data.**

- **Features:**

  - Always on
  - Extreme durability and longevity

Outline

Case Study

- **Texas Instrument, CC3200 SimpleLink Wi-Fi Architecture**
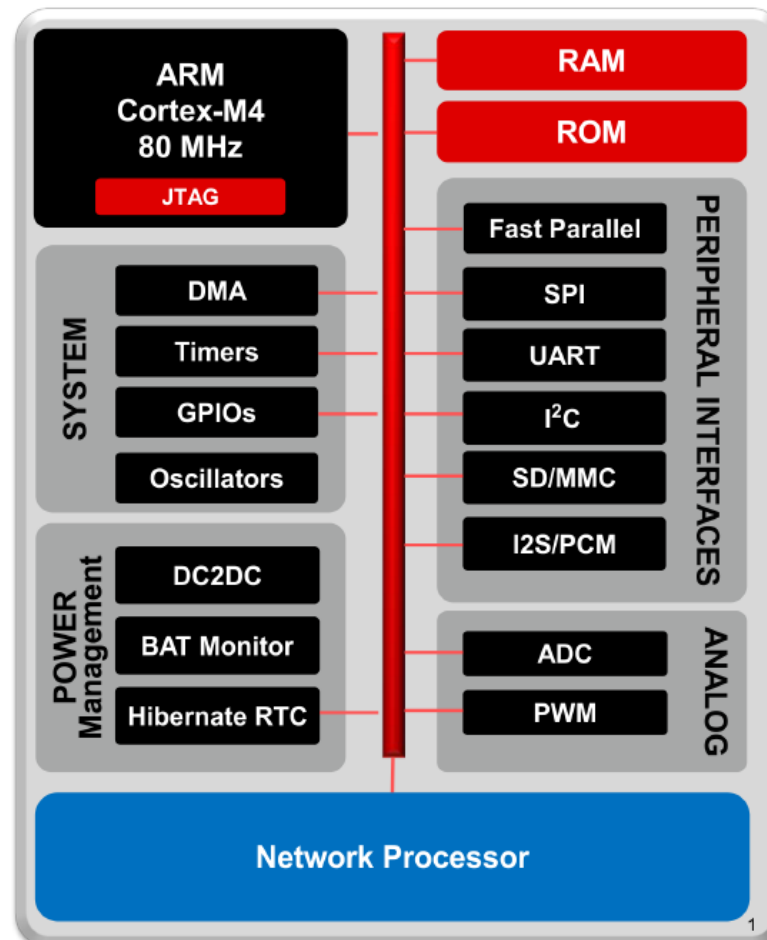
  - Application Microcontroller
    - ARM® Cortex™-M4 MCU
    - RAM: 256KB
    - Peripheral Drivers in ROM
    - 32-Channel Direct Memory Access(µDMA)
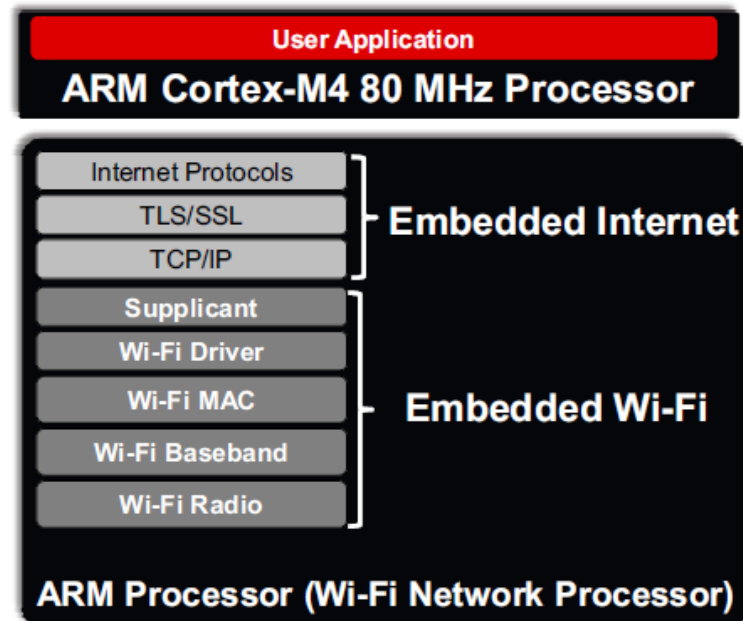   - Hardware Crypto Engine: AES, DES & 3DES
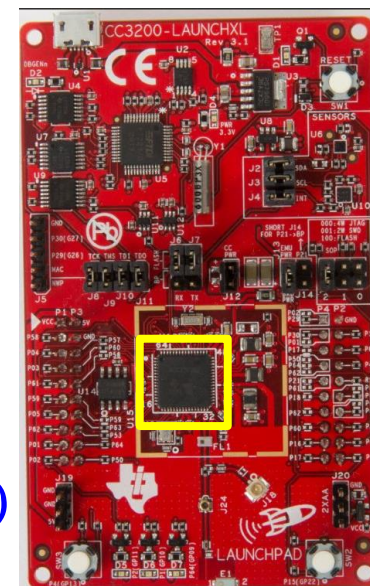
Case Study

■ Application Microcontroller Block Diagram

Case Study

Wi-Fi Network Processor

- Wi-Fi Internet-On-a-Chip
- Wi-Fi and Internet Protocols in ROM
- 802.11 b/g/n Radio, Baseband, Medium Access Control(MAC)
- TCP/IP Stack

User Application
ARM Cortex-M4 80 MHz Processor

Internet Protocols	
TLS/SSL	**Embedded Internet**
TCP/IP	
Supplicant	
Wi-Fi Driver	
Wi-Fi MAC	**Embedded Wi-Fi**
Wi-Fi Baseband	
Wi-Fi Radio	

ARM Processor (Wi-Fi Network Processor)

Case Study

- **CC3200 SimpleLink Wi-Fi Performance**
  - TX Power
    - 18.0 dBm @ 1 DSSS
    - 14.5 dBm @ 54 OFDM
  - RX Sensitivity
    - –95.7 dBm @ 1 DSSS
    - –74.0 dBm @ 54 OFDM
  - Application Throughput
    - UDP: 16 Mbps
    - TCP: 13 Mbps

Case Study

- **Texas Instrument, CC3200 SimpleLink Wi-Fi Application**
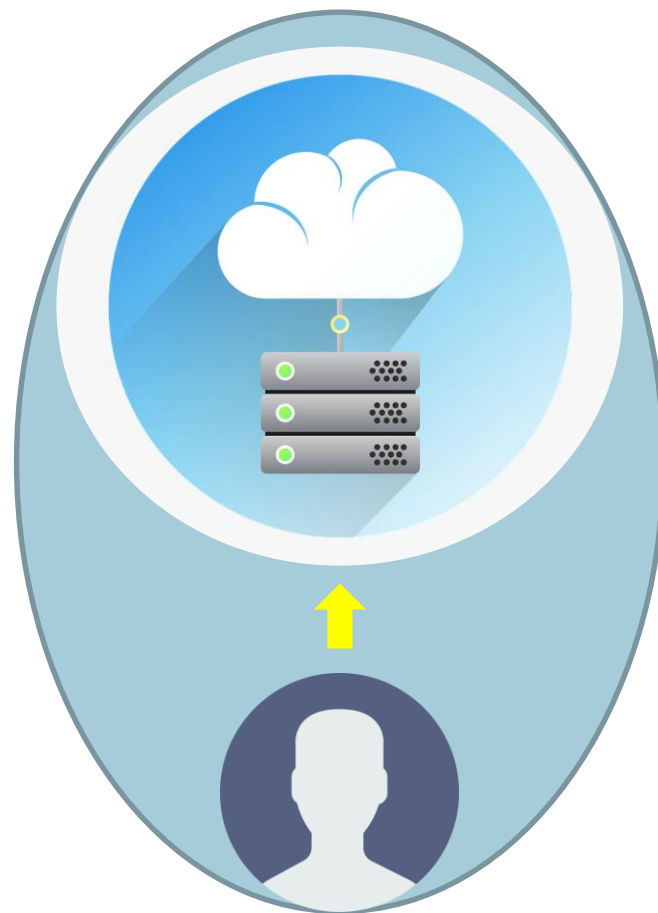 - Cloud Connectivity
    - AWS
  - Home Automation
  - Home Appliances
  - Security Systems
  - Industrial Control
  - Wireless Audio

Outline

Case Study

- **12th Intel® Core™ Architecture**

  - Processor cores(P+E): 8+8
  - Intel UHD Graphics 770
  - Intel DL Boost
  - DDR5-4800
    & DDR4-3200
  - PCIe 5.0 & PCIe 4.0

Introducing
Alder Lake
Reinventing Multi Core Architecture

Single, Scalable SoC Architecture
All Client Segments – 9W to 125W – built on Intel 7 process

All-New Core Design
Performance Hybrid with Intel Thread Director

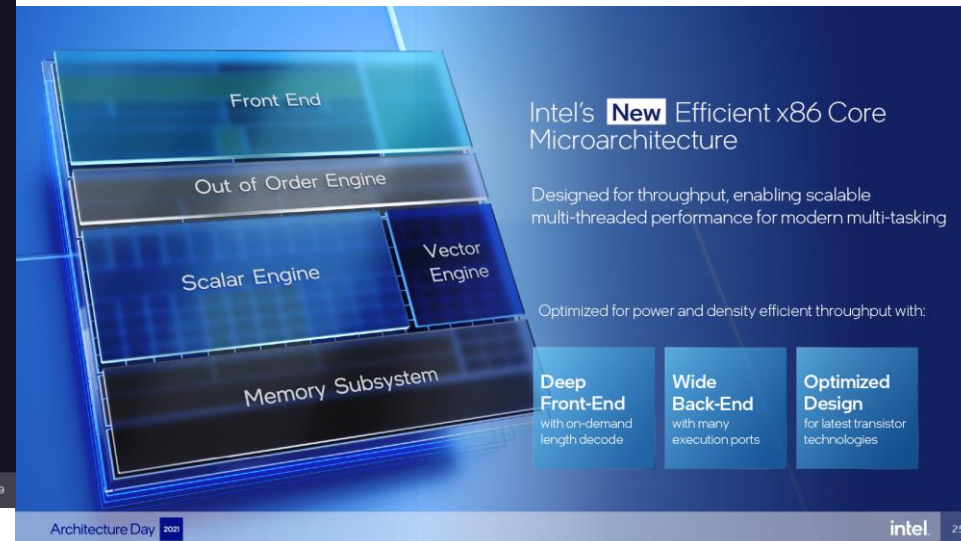**Industry-Leading Memory & I/O**
DDR5, PCIe Gen5, Thunderbolt™ 4, Wi-Fi 6E
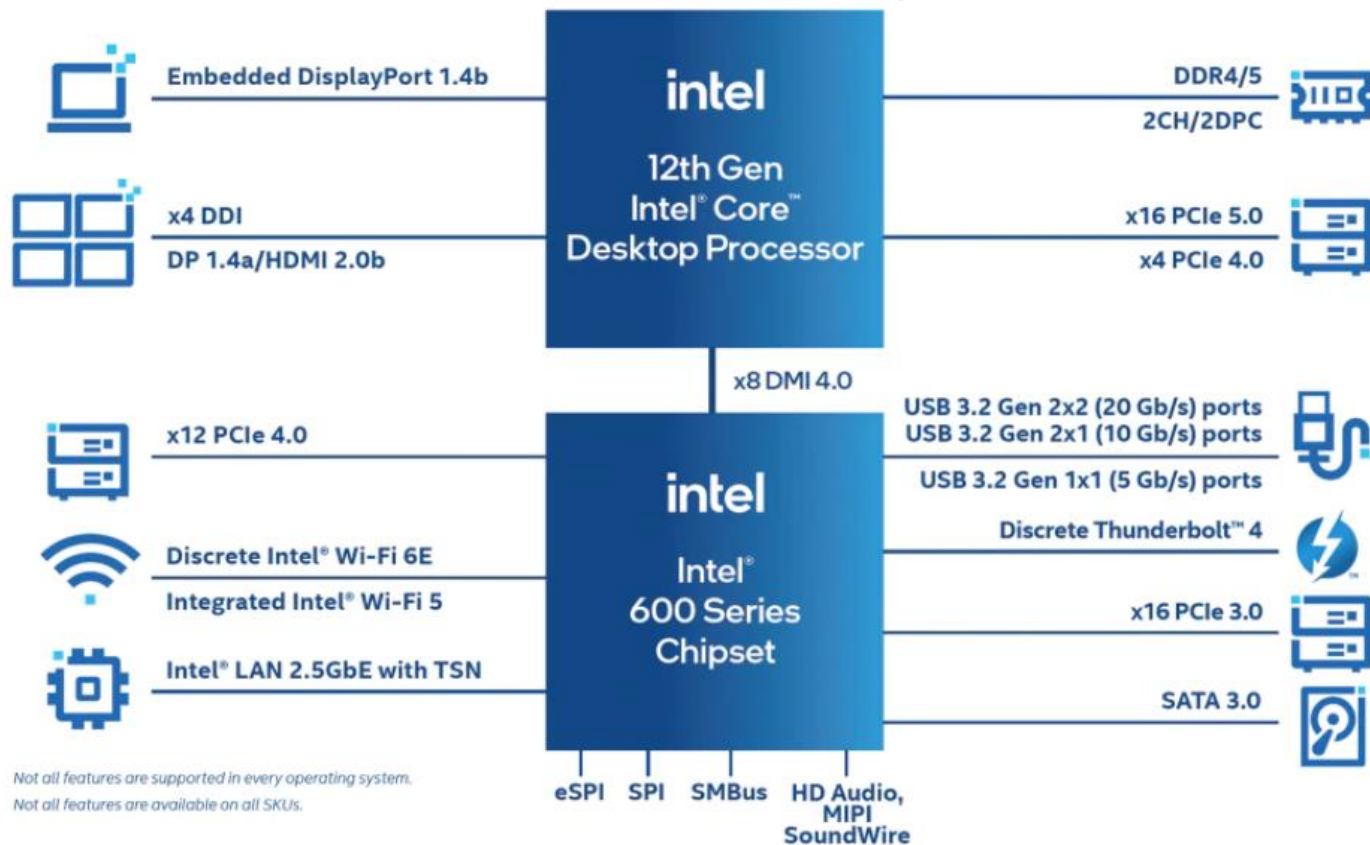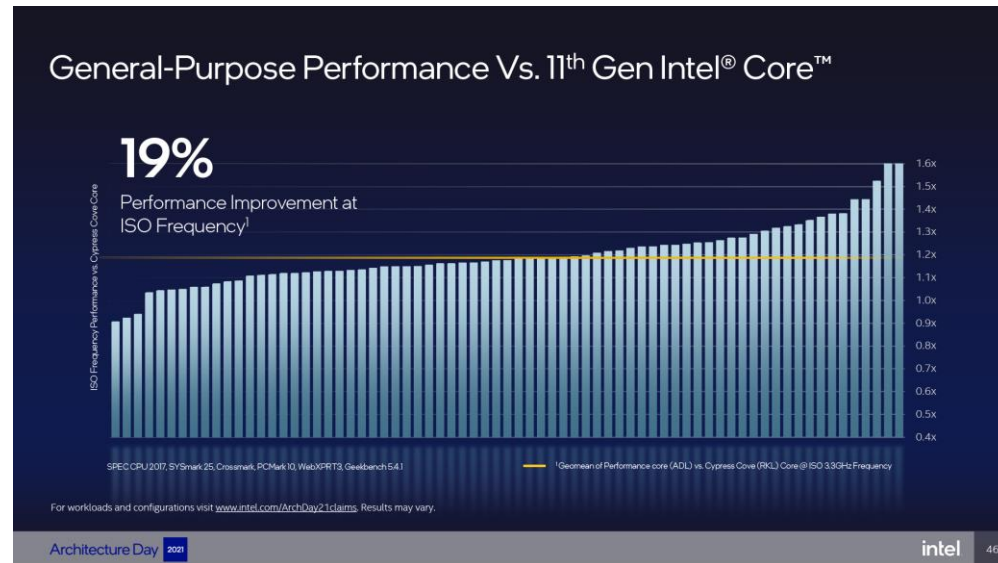
Case Study

■ 12ᵗʰ Intel® Core™: P-Core and E-Core

P-Core

E-Core
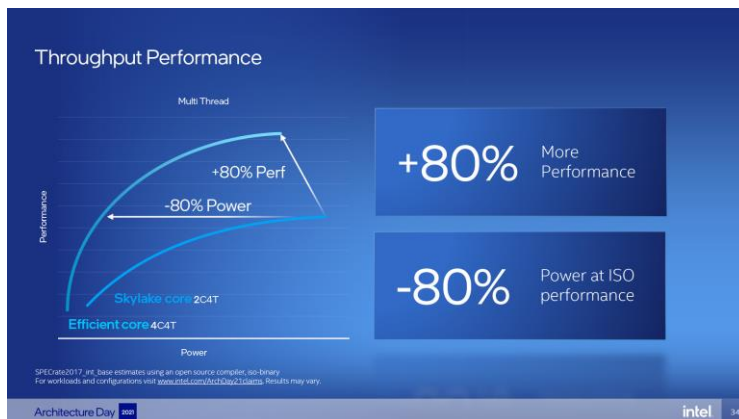
Case Study

■ 12ᵗʰ Intel® Core™ Block Diagram
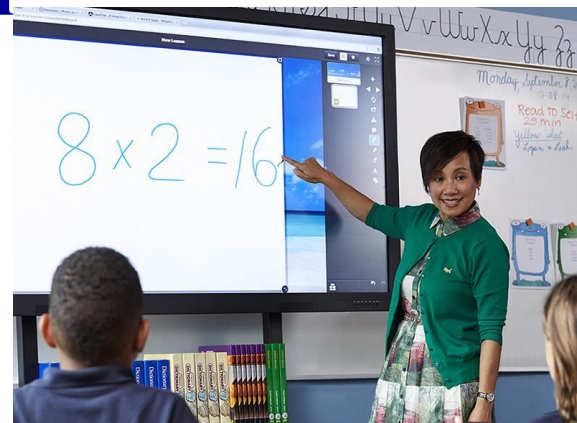
Case Study

■ 12th Intel® Core™ Performance

Case Study

■ **12th Intel® Core™ Application**

■ Interactive Flat Panel Displays

■ Industrial PC

■ Edge Server

■ Ultrasound Imaging

■ AI Box Analytics

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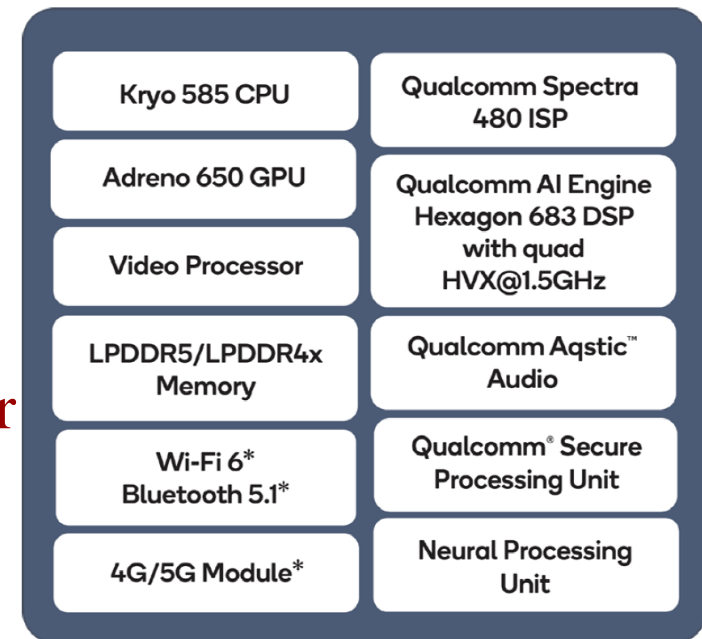- **Market Analysis**

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Case Study

Qualcomm, QCS8250 Architecture

- Kryo 585 CPU
- Adreno 650 GPU
- LPDDR5/ LPDDR4x
- Hexagon DSP V66Q
- Dedicated NPU 230
- Spectra 480 image signal processor

QCS8250 Block Diagram

Kryo 585 CPU	Qualcomm Spectra 480 ISP
Adreno 650 GPU	Qualcomm AI Engine Hexagon 683 DSP with quad HVX@1.5GHz
Video Processor	
LPDDR5/LPDDR4x Memory	Qualcomm Aqstic™ Audio
Wi-Fi 6* Bluetooth 5.1*	Qualcomm® Secure Processing Unit
4G/5G Module*	Neural Processing Unit

Case Study

■ **Qualcomm, QCS8250 Performance**

Case Study

- **Qualcomm, QCS8250 Application**
  - Connected Cameras
  - Unattended Retail/ Frictionless Retail
  - Video Collaboration
  - Healthcare

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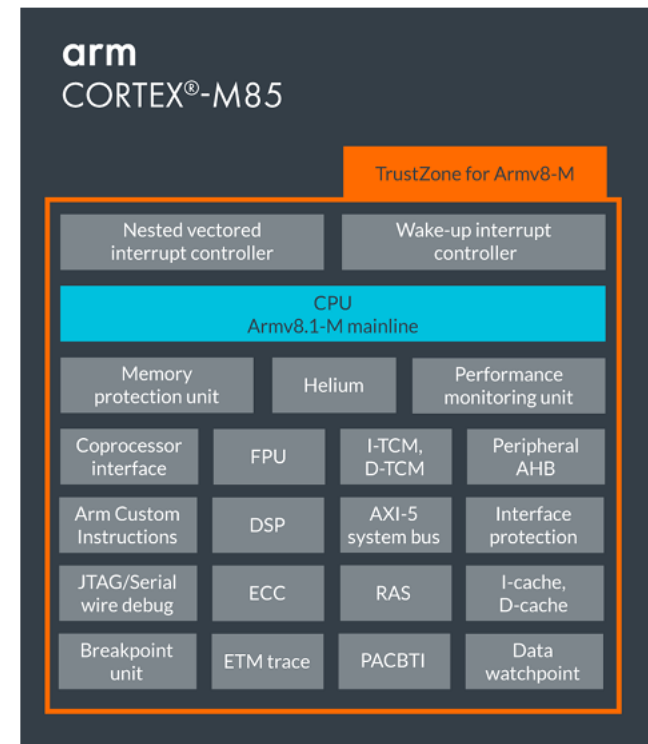 - Qualcomm, QCS8250
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Case Study

ARM, Cortex-M85 Architecture

- Armv8.1-M
- AMBA 5 AXI 64-bit Main system bus
- 32-bit DSP/SIMD extension
- ARM Helium
- I-cache & D-cache up to 64KB
- ITCM & DTCM up to 16MB
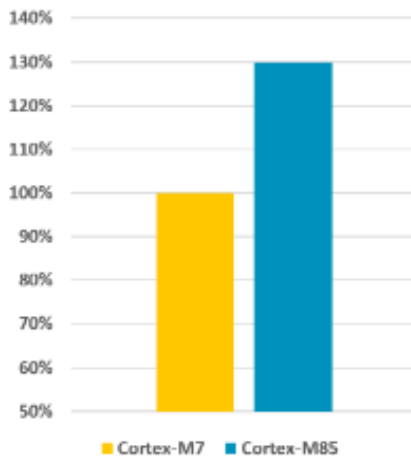- FPU for half precision(fp16), single precision(fp32) and double precision(fp64)
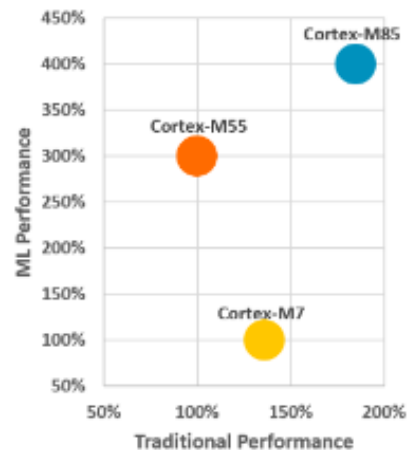
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■ARM, Cortex-M85 Performance
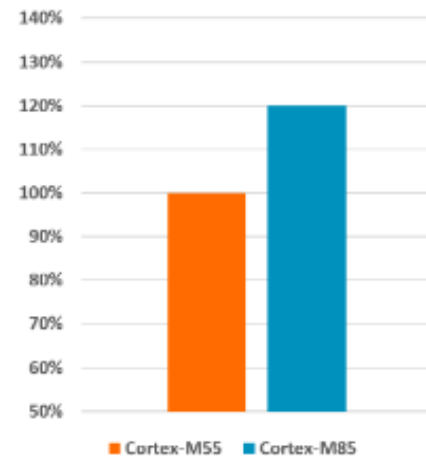
Case Study

■ **ARM, Cortex-M85 Application**

■ IoT/Embedded

■ Smart speakers

■ Utility robots

■ Drone control

■ Client

■ AR/VR

■ Secured system controller

■ Sensor hubs

■ Automotive

■ Radar

■ EV motor control

Outline

Market Analysis

	Strength	Weakness	Opportunity	Thread
Texas Instrument CC3200 SimpleLink Wi-Fi	• Low Power • Embedded Wi-Fi • Crypto Engine	• Out-dated CPU	• Change CPU • Promote RAM	• ESP32
Intel 12th Intel® Core™	• P-core + E-core • Strong GPU	• High Power • LPDDR Speed	• More E-core • Reduce Power	• Apple M1
Qualcomm QCS8250	• AI Optimization • Wi-Fi 6/5G Connection	• No output for 8K • High Price	• AI Expansion • Output for 8K display	• Rock-chip RK3588
ARM Cortex-M85	• Armv8.1 • Helium	• High Price • Hard to use	• Low Price • Power Management	No

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- https://www.intel.com.tw/content/www/tw/zh/products/docs/processors/embedded/12th-gen-iot-desktop-processors-brief.html

- https://www.inside.com.tw/article/24570-intel-architecture-day

- https://blog.csdn.net/CSDN_X_W/article/details/84629409

- https://www.2cm.com.tw/2cm/zh-tw/news/C16D77EBB93247D9B53C238A24C07011

- https://www.cirmall.com/articles/28207/

Reference

- https://www.digikey.tw/zh/product-highlight/t/texas-instruments/cc3100-and-cc3200-simplelink-wi-fi-and-iot-solution

- https://news.xfastest.com/intel/99538/intel-architecture-day-alder-lake-p-e-core/

- https://www.bnext.com.tw/article/63060/armv9-cpu-gpu

- https://ijiwei.com/n/820362

- https://www.techbang.com/posts/95883-arm-cortex-m85

- https://www.scensmart.com/news/comparative-analysis-of-rockchip-rk3588-and-qualcomm-qcs8250/