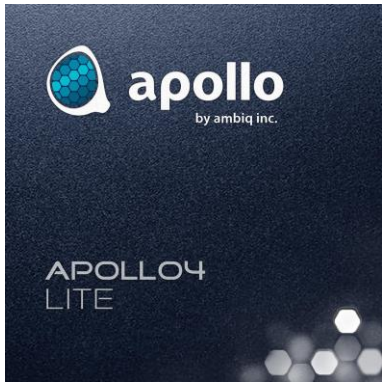
ambiq
endpoint intelligence

Propel the Grow of Digital Health

with the New Generation of Apollo SoC

July 2023

Agenda



- About Ambiq
- Market Overview
- SPOT’s Advantage
- The Apollo4 Lite & Blue Lite
- Design Resources

Ambiq's **Mission**

To enable intelligent devices everywhere by developing

the lowest-power semiconductor solutions

to drive a more energy-efficient, sustainable,
and data-driven world

Ambiq: Revolutionizing Low Power Processing

Key Facts

Founded: 2010

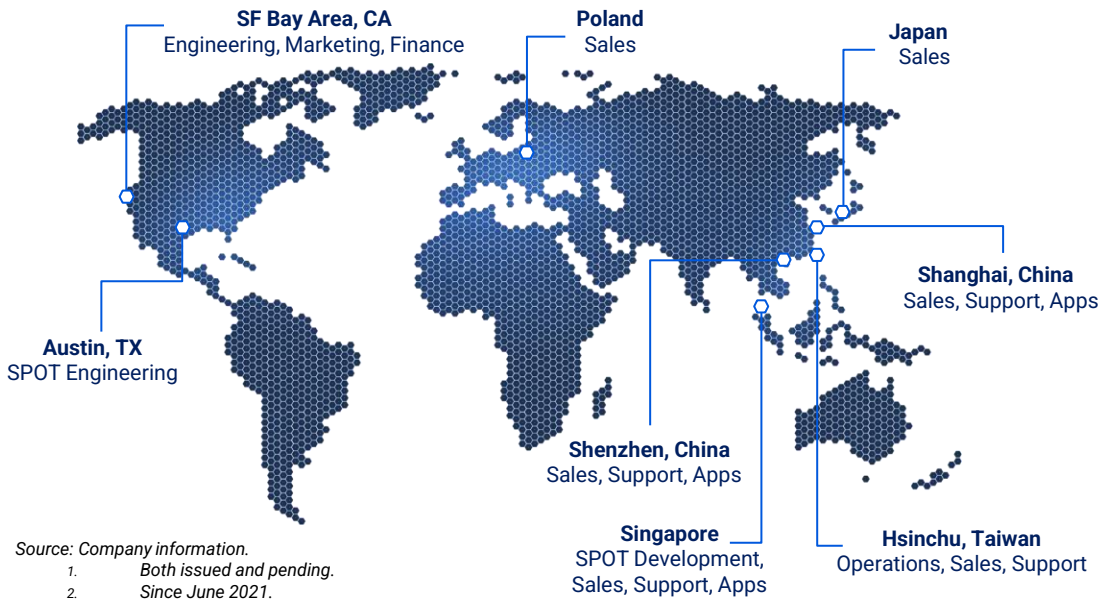
Global HQ: Austin, TX
Other Key Locations: China, Japan, Poland, Singapore, Taiwan

Key Investors: Kleiner Perkins, ARM, Conductive Ventures, Fujitsu Semiconductor Memory Solutions

Key Metrics

Operational Metrics				
	230	150+	63	200M+
	Employees	Customers	Patents	Units Shipped

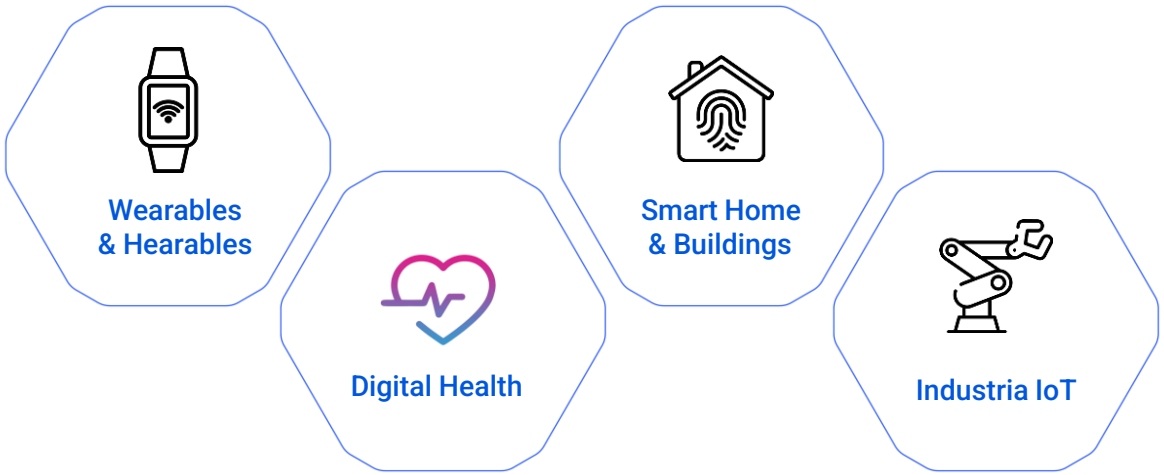
Solutions Experts Globally



Source: Company information.

1. *Both issued and pending.*
2. *Since June 2021.*

Addressing High-Growth End Markets



Defining **Milestones**

>200 millions devices sold

2010 - Ambiq Founded

2012 - 1st commercial Real Time Clock (RTC) launched

2014 - 1 millionth Real Time Clock (RTC) sold 17x lower power

2015 - 1st SPOT SoC launched 10X lower power

Idemia

Fossil

2016 - 1 Million Apollo SoC parts sold

Garmin

2017 - 2nd generation Apollo SoC launched; neural networks deployed on SPOT-enabled products

Huawei

2018 - 3rd generation Apollo SoC launched

2019 - New and derivative SKUs launched for broader market segments; Leading supplier in the wearables market

Fitbit

2020 - 100 millionth part sold 4th generation Apollo SoC launched & sampling

Online technology symposium **2021**

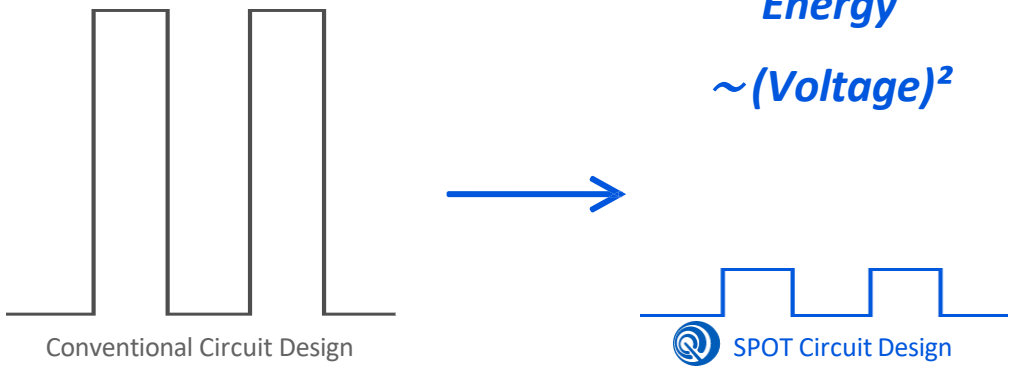
2022 - Launch of Apollo4 Plus

Industry recognition

Differentiated Subthreshold Power Optimization Technology (SPOT®)

Backed by 63 issued and pending patents

Unique Subthreshold Power Optimized Technology



Processing | AI Acceleration | Connectivity | Sensing

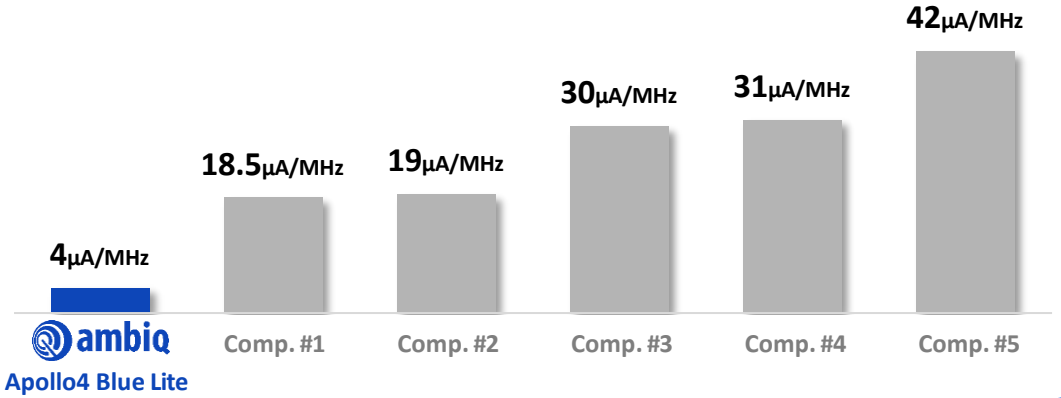
Key Advantages

Our Advantage	Why it Matters	Our Momentum
• 3x-20x energy savings • 13+ years of experience • Broad applications across digital, analog and RF	• Energy consumption always matters • Compute, sensing, inference, security, and connectivity all in a small package	• Millions of different use cases, huge volume market • Shipped 200M+ devices • Go-wide for diverse IoT segments

Complex Design & Process Challenges

Process Variations | **Voltage Fluctuations** | **Temperature Fluctuations**

Significant Power Advantage Over Competitors



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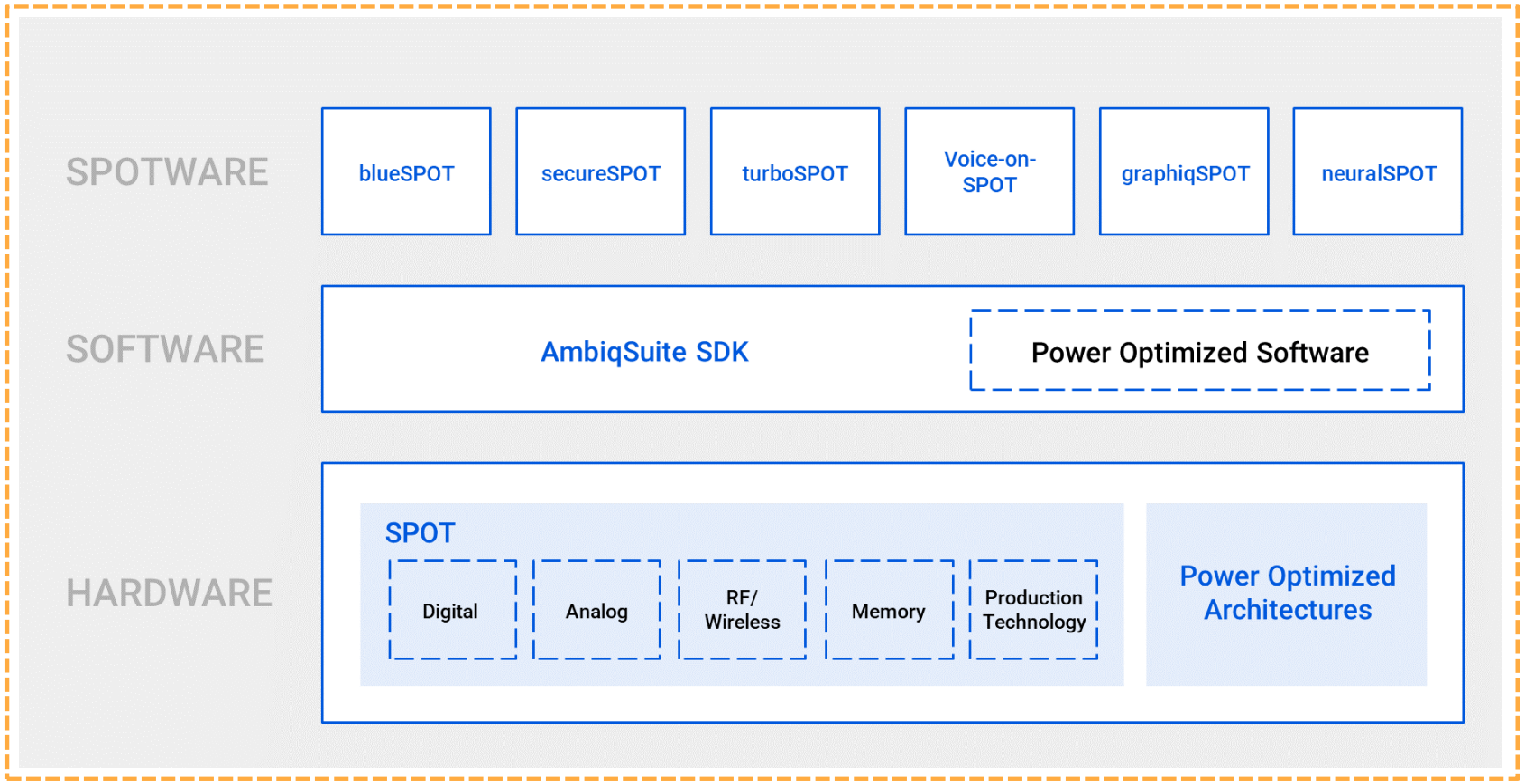
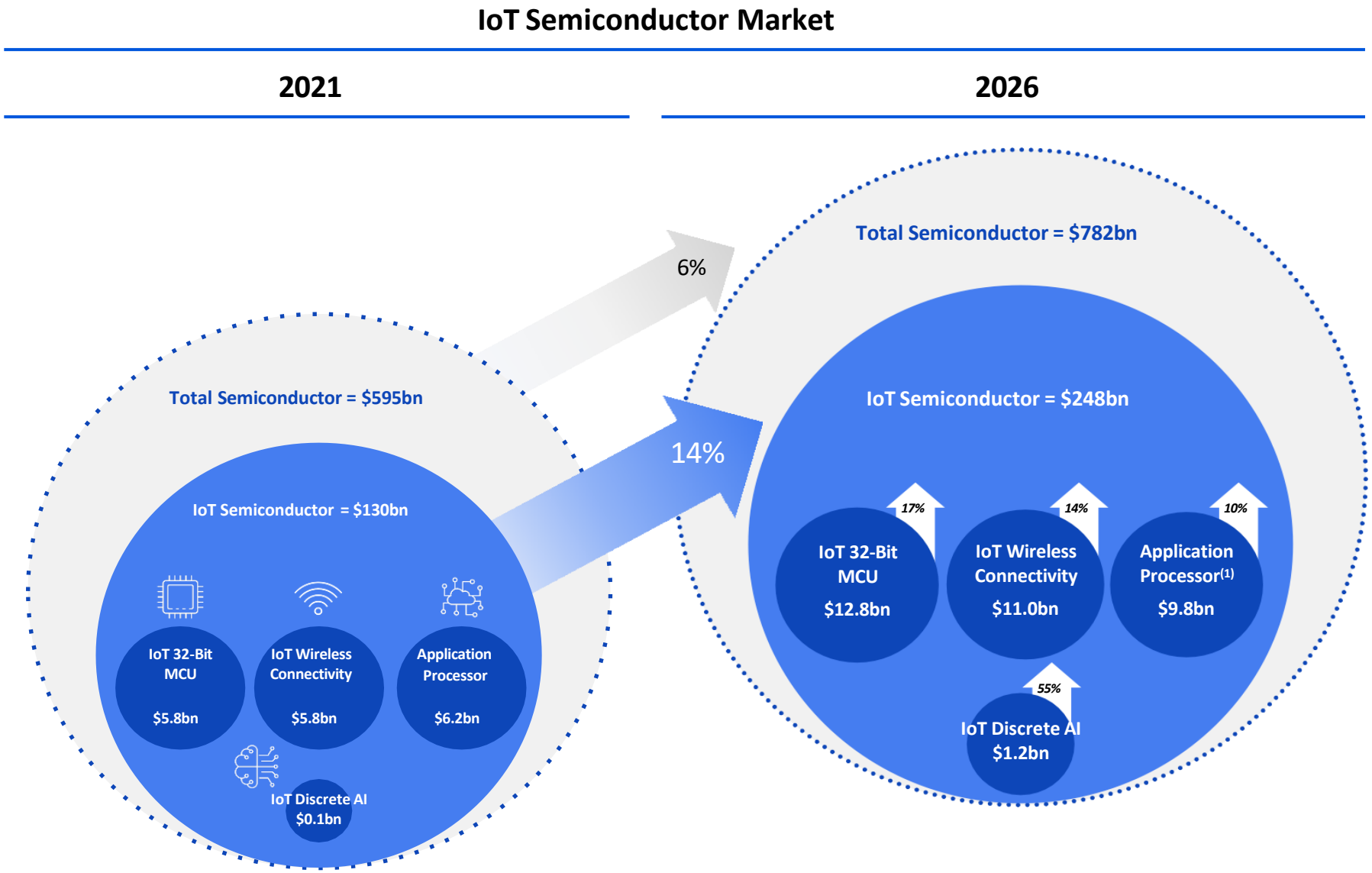
SPOT Is a **Platform** for SoC Design



- Sub-Threshold circuits are exponentially sensitive to process/voltage/temp fluctuations
- This requires a completely NEW way of designing chips from the ground up

- Design IP and know-how with **>60** blocking patents
- Manufacturing IP and know-how with **>200M** units shipped
- Testing/validation IP and know-how with proprietary **hardware/software**

Large and Growing TAM



1.

Sources: Gartner's Forecast: AI Semiconductors, Worldwide, 2020-2026; Forecast: IoT Semiconductors, Worldwide, 3Q22 Update; Semiconductor and Electronics Forecast Database, Worldwide, 3Q22 Update. Calculations performed by Ambiq Micro, Inc.

Limited to specific applications: Agriculture, Appliances, Automation, Commercial Amusement, DVD Player/Recorder, Energy Management, Medical/Healthcare, Other Industrial Electronics, Safety, Security, Smart Speakers, Solid-State Lighting, Test/Measurement, Transportation and Wearables

Digital Health Market Overview

GLOBAL REMOTE PATIENT MONITORING MARKET TREND

53.6 USD Billion 2022-e

175.2 USD Billion 2027-p

CAGR of **26.7 %**

The global remote patient monitoring market is projected to reach USD 175.2 Billion by 2027 from USD 53.6 Billion in 2022, at a CARG of 26.7% during the forecast period

Patient Safety

Diagnostic imaging

Physician decision-making

Clinical trials

Why Lite and Blue Lite

- The 3rd variant to the award-winning Apollo4 SoC to support the growing digital health trends among diversifying IoT use cases
- Optimized with features to enable user-centric core functionalities, including
  - optimized memory for data processing
  - powerful graphics to enhance visual effects
  - secureSPOT® for robust security
  - a lightweight solution for compact wearables
- The Apollo4 Blue Lite offers secure Bluetooth® Low Energy connectivity for communication to handheld devices, host equipment, and the Cloud
- Provides the backbone for precise data mining with power efficiency
- Supports Ambiq HeartKit™ ModelZoo via neuralSPOT

1/4

¼ or less dynamic power consumption

Sensors

High-compute with multiple smart sensor interfaces

AI

secureSPOT for VoS and neuralSPOT

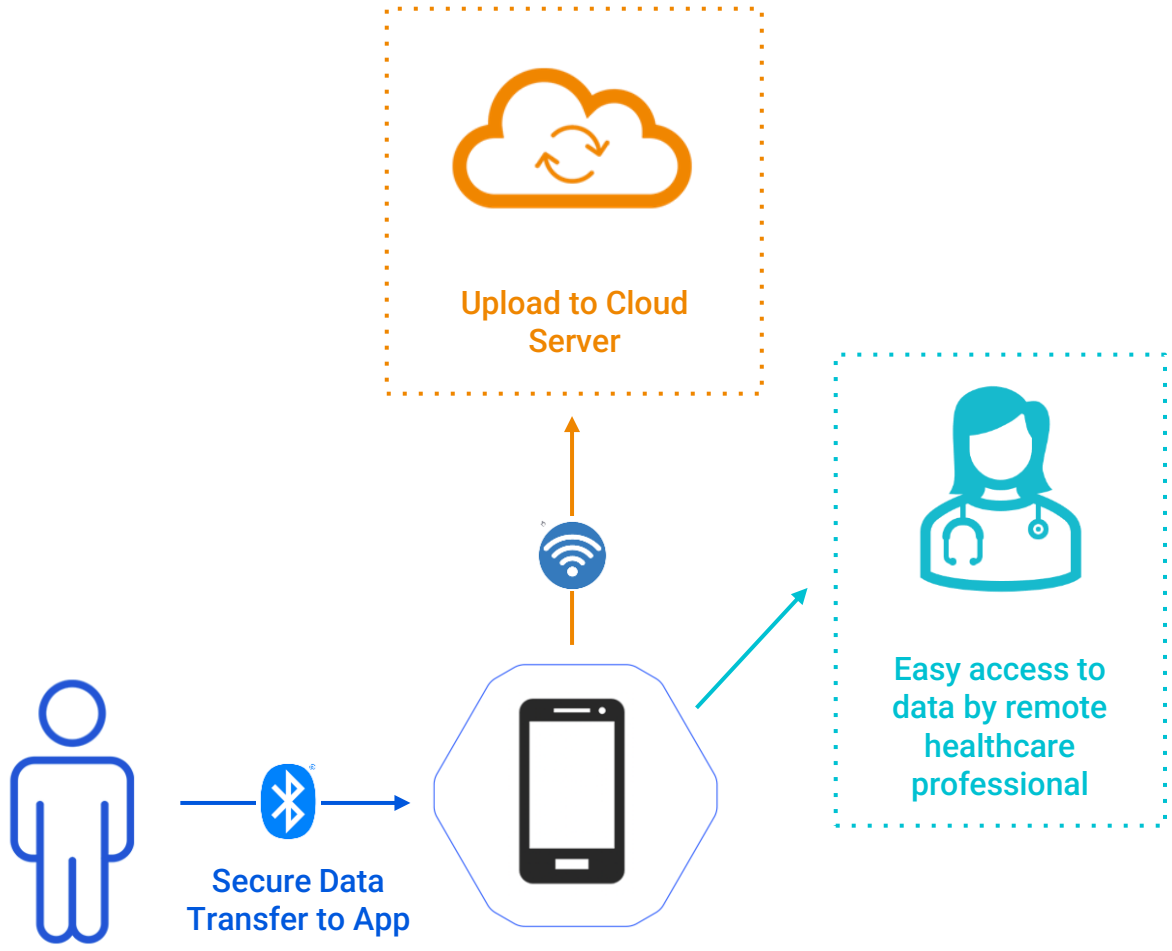
60 FPS[1]

Compelling graphics with HW accelerator

1. Up to 60 FPS

High-compute, low-power sensor processing for battery operated devices

- Digital Spirometer
  Detect Lung Obstruction / Weakened Breathing
- Smart Scale
  BMI /Bone Density / Hydration Level
- Pulse Oximeter / Blood Oxygen Health
- Sleep Apnea / Obstruction
- Cardiac Monitoring / Abnormal Heart Rhythm Detection
- Elderly Care / Fall Detection and SOS Assistance



What Sports Watch/Fitness Band Care-about

PRODUCT FORM	MARKET MOVEMENT	FEATURE IMPROVEMENT	SILICON UPGRADE

TYPICAL PRODUCT
Redmi Watchx

TYPICAL PRODUCT
MiBand/HBand

Display

- Graphic
- Memory size
- Peripherals

Health

- Processing power
- Memory size
- Peripherals

New Functions

- Processing power
- Memory size
- Peripherals

Higher power efficiency

What Apollo4 Lite/Blue Lite Bring to Market on Graphic

Rich memory footprint

- 384KB TCM
- 1MB SRAM
- 2MB on-chip NVM

High throughput memory/display interface

- Overall 3x multi-bit SPI working @96MHz clock
- HSPI interface for PSRAM
- QSPI interface for display support DDR mode
- Internal high bandwidth AXI bus

High-efficiency HW GPU

- 2.5D GPU
- TSC4/6 compression supports up to 6 times the compression ratio
- Hardware anti-alias and dithering

- ✓ Support up to 500x500 resolution
- ✓ Up to 60FPS @390x390 in most scenarios
- ✓ HW anti-aliasing and dithering
- ✓ High compression ratio
- ✓ Minimize CPU load with DMA and CQ
- ✓ Ultra low power graphic blending based on SPOT

Apollo4 Lite Block Diagram

Core Sub-System

- Cortex-M4 MCU 96 / 192 MHz
- I-Cache 64KB
- D-TCM 384KB
- DMA Controller
- IPC/CMDQ Controller

Display Sub-System

- 2D/2.5D GPU
- QSPI Display Interface

Audio Sub-System

- 1x PDM Interface
- 1x I^2S (full-duplex)

Memory Sub-system

- 2MB NVM
- 1MB SRAM

Peripheral Sub-System

- 2x QSPI/OSPI
- 7x Master SPI/I^2C
- 12-bit ADC
- 1x QSPI/OSPI/HSPI
- Up to 75 GPIO
- VCOMP
- 4x UART
- 1x SPI/ I^2C Slave
- 1x SDIO/eMMC

Security

- Secure Boot
- Key Storage
- Crypto Accel
- RNG

Timers/Clocks

- SIMO DCDC
- 2x HFRC
- LFRC
- Timers
- 32 kHz XTAL
- RTC/ WDT
- HF XTAL

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Apollo4 Blue Lite Block Diagram

Core Sub-System

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Display Sub-System

- 2D/2.5D GPU
- QSPI Display Interface

Audio Sub-System

- 1x PDM Interface
- 1x I^2S (full-duplex)

BLE Radio

- Cortex-M0 MCU 32 MHz
- SRAM 64KB
- eFlash 256KB
- DMA
- AES
- Baseband
- RF TX/RX
- Wi-Fi Coexistence

Memory Sub-system

- 2MB NVM
- 1MB SRAM

Peripheral Sub-System

- 2x QSPI/OSPI
- 8x Master SPI/I^2C
- 12-bit ADC
- 1x QSPI/OSPI/HSPI
- Up to 84 GPIO
- VCOMP
- 4x UART
- 1x SPI/ I^2C Slave
- 1x SDIO/eMMC

Security

- Secure Boot
- Key Storage
- Crypto Accel
- RNG

Timers/Clocks

- SIMO DCDC
- 2x HFRC
- LFRC
- Timers
- 32 kHz XTAL
- RTC/ WDT
- HF XTAL

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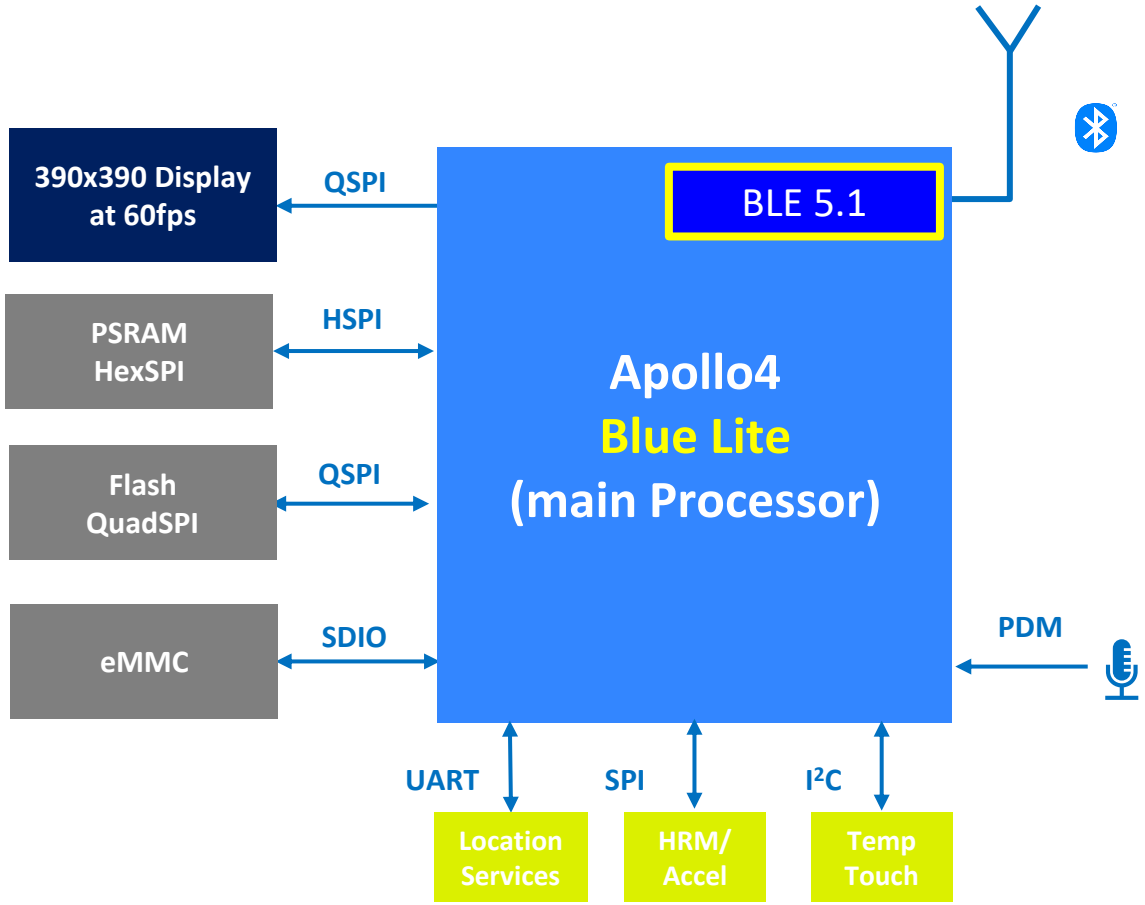
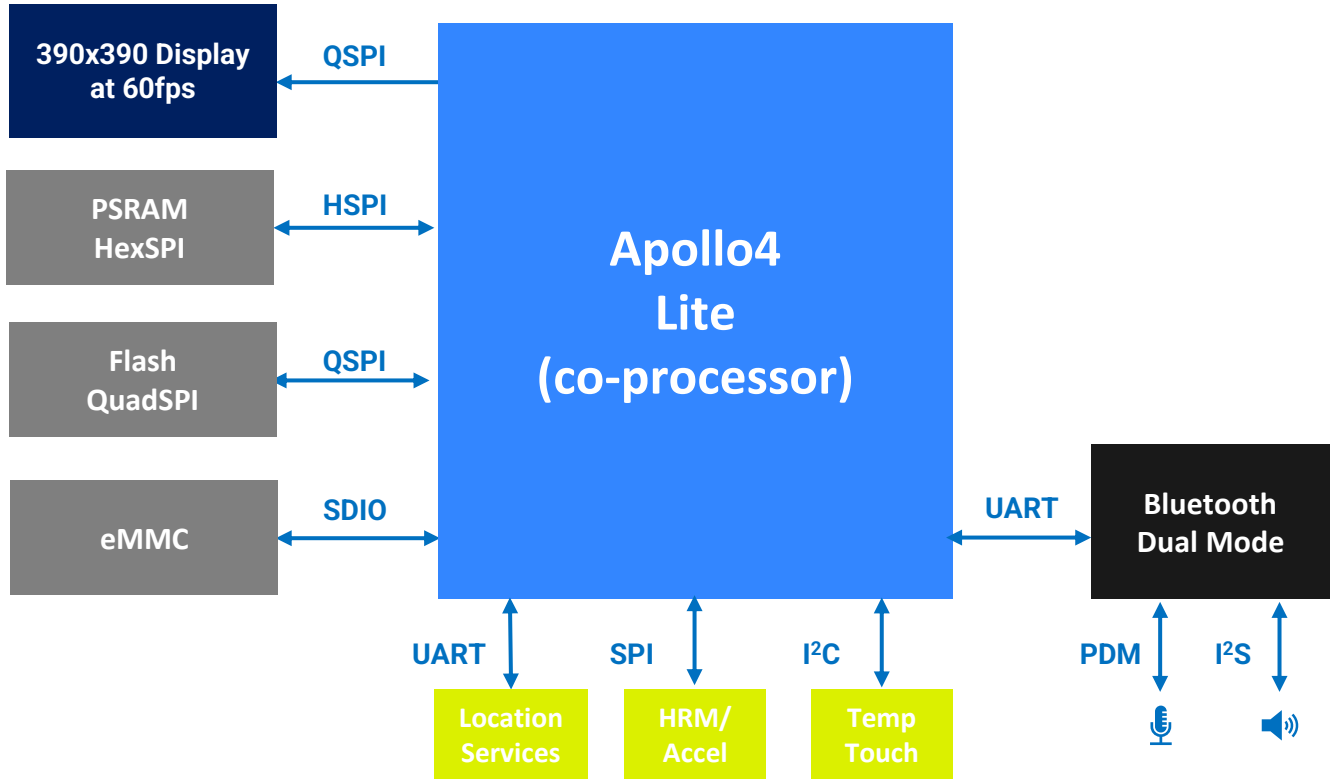
Apollo4 Blue Lite – For *Fitness Band*

- Executes all processing functions while delivering rich graphics
- Drive 390x390 display with up to 60fps framerate
- Embedded BLE 5.1 radio for Bluetooth connectivity to phone or other devices
- Higher throughput interface via Hex-SPI to access PSRAM
- Expanded data storage for with external Flash and eMMC card
- Multiple UART/SPI/I²C interfaces
- Up to 75 GPIOs



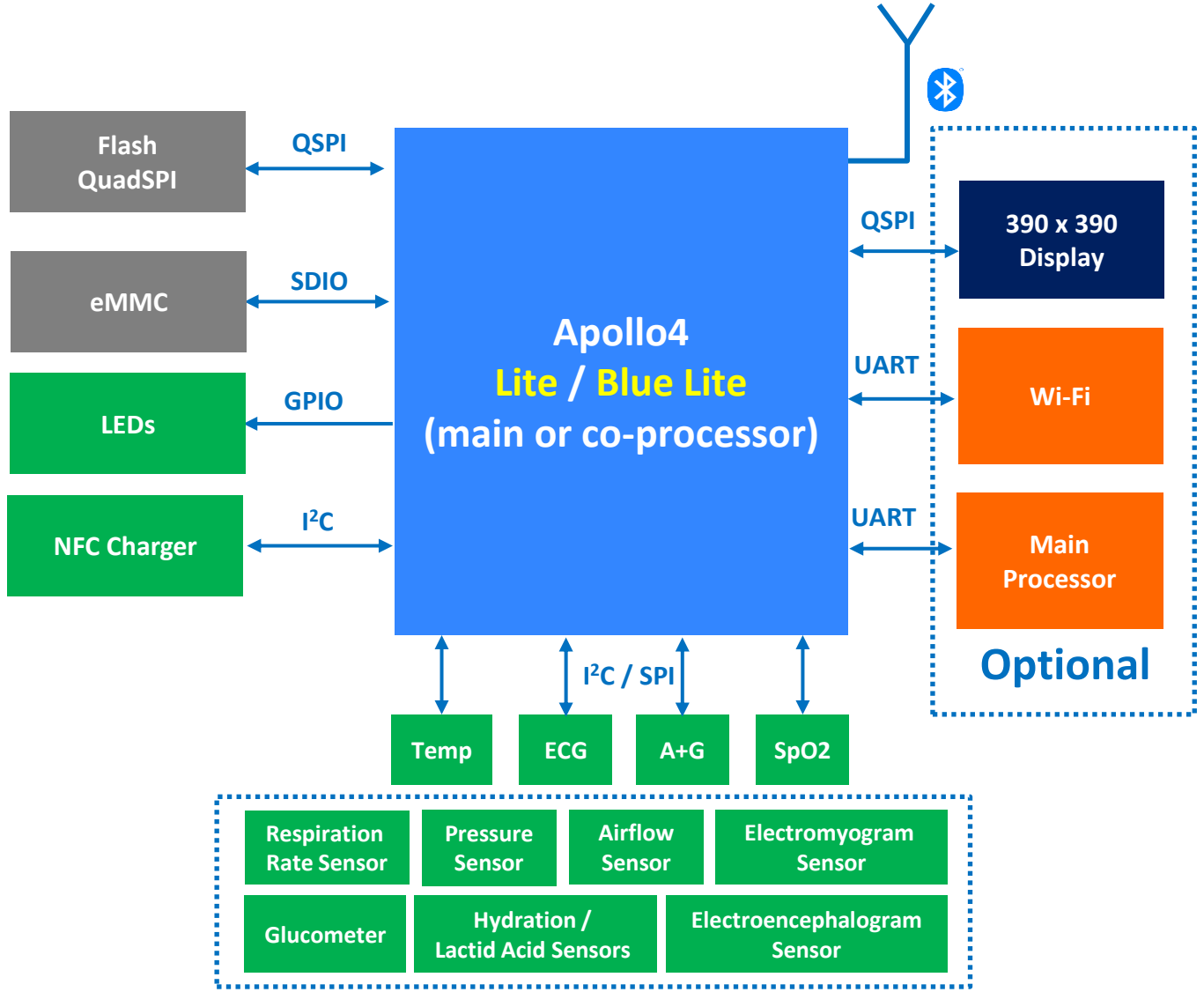
Apollo4 Lite – *For Sports Watch*

- Executes all processing functions while delivering rich graphics
- Drive 390x390 display with up to 60fps framerate
- Embedded BLE 5.1 radio for Bluetooth connectivity
- Higher throughput interface via Hex-SPI to access PSRAM
- Expanded data storage interface for external Flash and eMMC card
- Multiple UART/SPI/I²C interfaces
- Up to 84 GPIOs



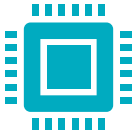
Apollo4 Lite – *For Digital Health*

- Ultra low power sensor hub with multiple I²S/SPI for personal health datamining and monitoring
  - Pulse oximeter
  - Accelerometer & gyroscope
  - Electrocardiogram
  - Body temperature
- Flexible interfaces to expand application capability with additional connectivity or processing
- Embedded Bluetooth Low Energy 5.1 for secure data transfer to smart app
- Expanded data storage interface for external Flash and eMMC card



Apollo Product Comparison

Pin Compatible

	Apollo3 Blue Plus	Apollo4 Blue Lite	Apollo4 Blue Plus
Cortex-M4F 	48MHz/96MHz	96MHz / 192MHz (turboSPOT®)	96MHz/192MHz (turboSPOT)
	0.75MB SRAM 2MB NVM 16KB Code Cache	1.4MB SRAM 2MB NVM 64KB Code Cache	2.75MB SRAM 2MB NVM 64KB Code Cache
	AHB (32-bit)	AXI (128-bit) 32x data cache buffers	AXI (128-bit) 32x data cache buffers
	1x OSPI, 2x QSPI (up to 48MHz)	1x HexSPI, 2x OSPI (up to 96MHz) SDIO/eMMC	1x HexSPI, 2x OSPI (up to 96MHz) SDIO/eMMC, USB FS/HS
	While Loop: 6 µA/MHz Coremark: 10.3 µA/MHz Deep Sleep (no Ret): 1.2 µA Deep Sleep (384K Ret): 3.7 µA	While Loop: 4 µA/MHz Coremark: 11 µA/MHz Deep Sleep (no Ret): 6.0 µA Deep Sleep (384K Ret): 8.2 µA	While Loop: 4 µA/MHz Coremark: 8.9 µA/MHz Deep Sleep (no Ret): 7.7 µA Deep Sleep (384K Ret): 14.1µA
	Software Composition Only	2.5D GPU QSPI 390 x 390 resolution; 60 fps	2.5D GPU 4-layer Display Controller MIPI DSI (2x) 500 x 500 resolution; 60 fps
		Anti-aliasing, Dithering	Anti-aliasing, Dithering Vector Graphics
	Stereo PDM (1x) I²S Slave Voice-on-SPOT® (VoS®)	Stereo PDM (1x) I²S full duplex Voice-on-SPOT (VoS)	Stereo PDM (4x) Low power AUDADC (1x) I²S full duplex w/ASRC Voice-on-SPOT (VoS)
	+3 dBm Output Power -93 dBm RF Sensitivity Bluetooth LE® 5.0	+6 dBm Output Power -95 dBm RF Sensitivity Bluetooth LE® 5.1	+6 dBm Output Power -95 dBm RF Sensitivity Bluetooth LE® 5.1
	secureSPOT® 1.0	secureSPOT 2.0 PSA-L1	secureSPOT 2.0 PSA-L1

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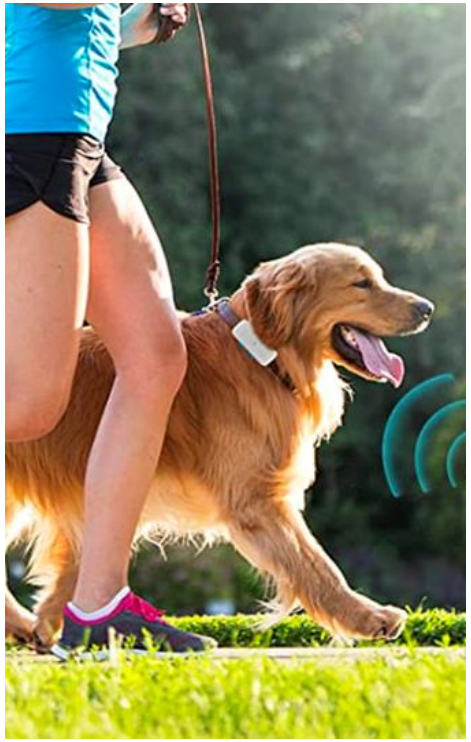
Ideal Endpoint Applications

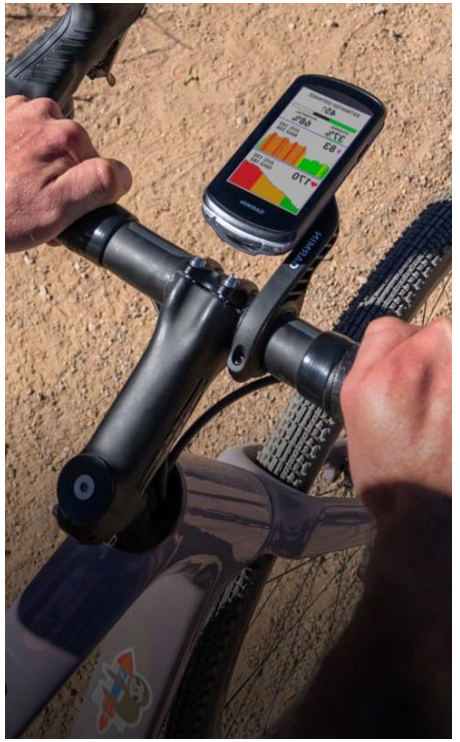
Fitness Bands
Smartwatches

Cardiac
Monitoring

Continuous Blood
Glucose Monitoring



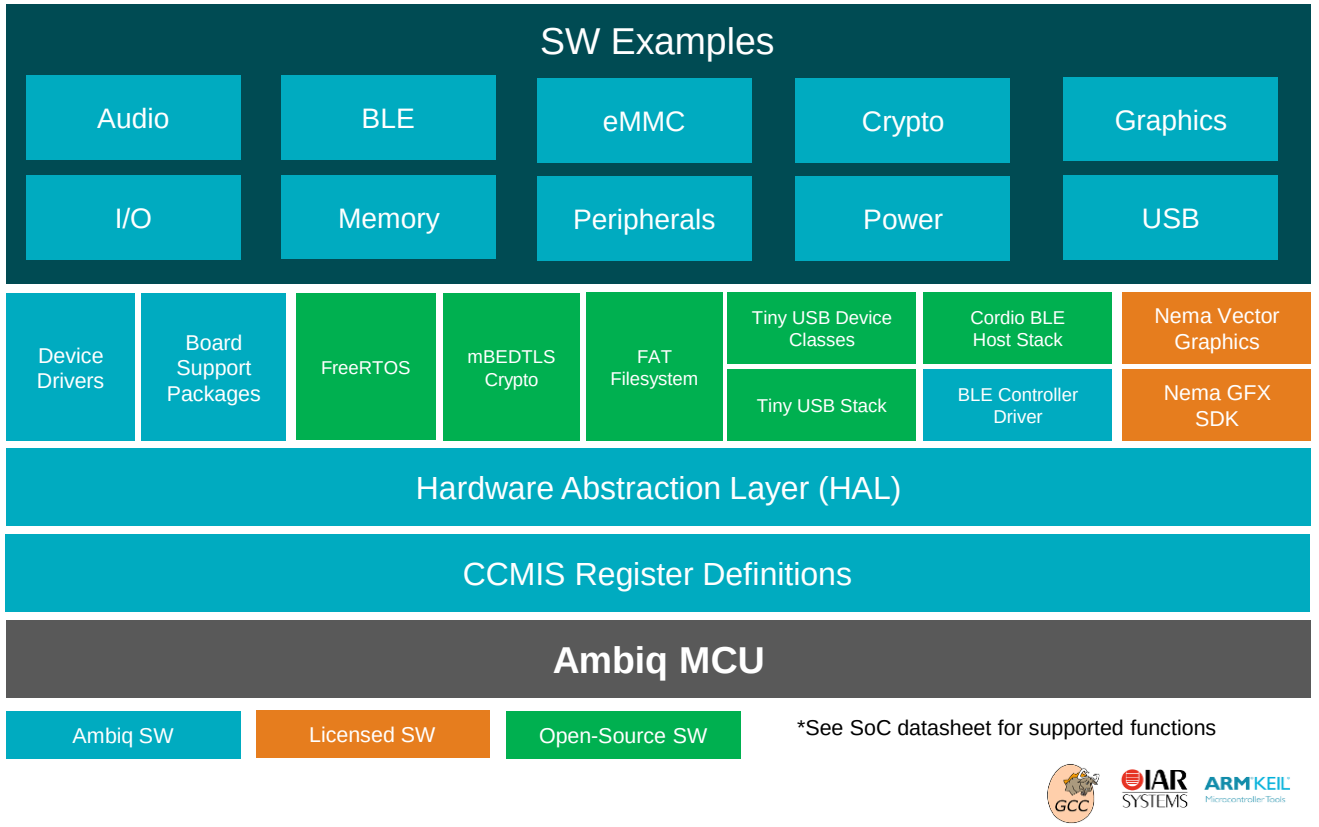
Asset
Tracking



Bike
Computer

Apollo4 Lite Family Development Platform

- **AmbiqSuite 4.4 SDK**
  - No license fees for developers
  - Supports GCC, Keil, and IAR
  - HAL source code
  - Cordio BLE Stack
  - Standard ARM Cortex SWD debug interface
  - AmbiqVoS SDK – *Q3'23*
- **Evaluation Hardware**
  - Apollo4 Lite EVB (AMAP4LEVB)
  - Apollo4 Blue Lite EVB (AMA4BLEVB)
  - Compatible w/Apollo4 Audio Kit (AMA4AUD)
- **Developer Resources**
  - Ambiq Content Portal
  - Ambiq Knowledge Base



Apollo4 Blue Lite AMA4B2KL-KXR

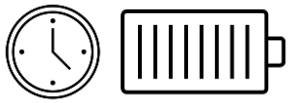
Apollo4 Lite AMAP42KL-KBR

Apollo4 Blue Lite EVB AMA4BLEVB

Apollo4 Lite EVB AMAP4LEVB

Ambiq is Your Best Partner for Innovation

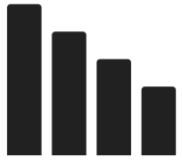
BENEFIT TO CUSTOMER



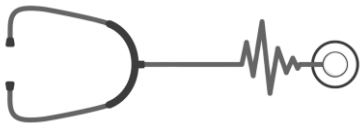
Longer Battery Life

Voice
ECG/Glucose
Graphics
Analytics

Higher level performance Without sacrificing Battery Life

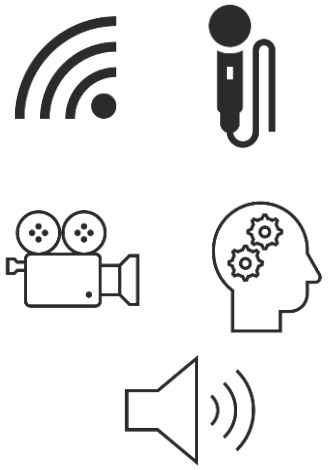


Better connectivity



More accurate sensing

Performance tailored for your product portfolio



Partner with us for your future product definition

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Thank **You**!