RivieraWaves

CEVA®

ARM

Fast and Easy Design of Low Power Wi-Fi SoC for IoT

2016

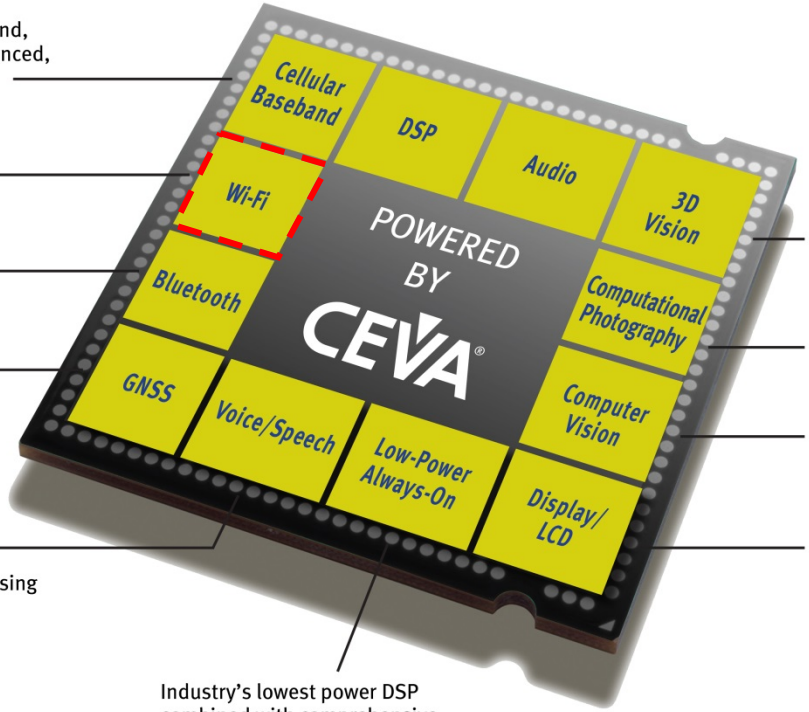
CEVA®

www.ceva-dsp.com

Agenda

- Low Power Wi-Fi in IoT products
- ARM® help SoC designers create IoT products
- CEVA RivieraWaves Low power Wi-Fi IP platforms
- Conclusion

About CEVA: Silicon IP Vendor for Low Power Embedded Systems



Industry's #1 DSP for cellular baseband, powering 2G, 3G through to LTE-advanced, for both terminals and infrastructure

Complete PHY + MAC platforms For Wi-Fi 802.11a/b/g/n/ac up to 4X4 for terminals, access points and small cells

Complete PHY + MAC platforms for Bluetooth Classic, Smart and Smart Ready

DSP for any location-based technology including GPS, Glonass and Beidou

Industry's most deployed DSP for audio and voice combined with codecs, vocoders, noise reduction, beam forming and audio post-processing

Industry's lowest power DSP combined with comprehensive software offerings for 'always-on' voice and face activation and sensing

Intelligent vision processor for Camera/ ISP, Image registration, depth map generation, point cloud processing, 3D scanning and content creation and more

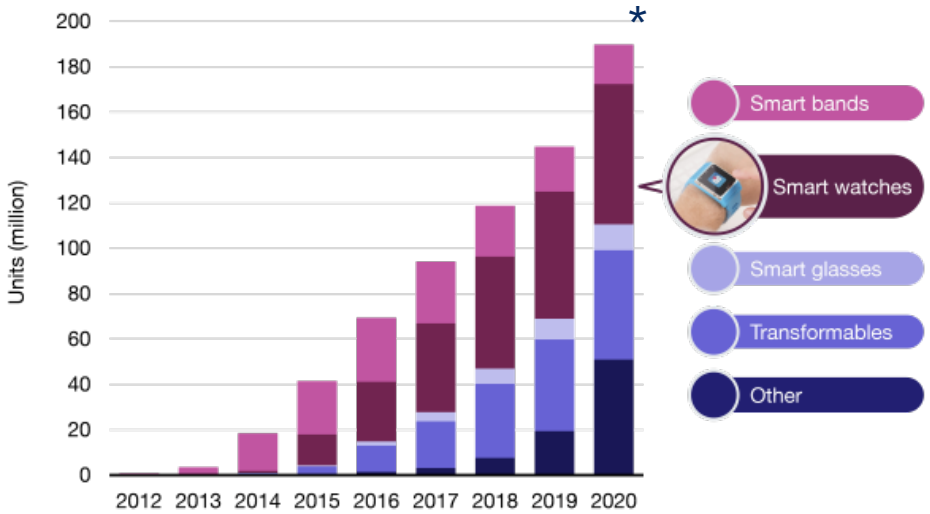
Intelligent vision processor engine and software offerings including HDR, Stabilizer, Super-Resolution, Noise Reduction and more

Intelligent vision processor, CV libraries and software offerings including face and object detection, gesture recognition, augmented reality, ADAS and more

Intelligent vision processor for post processing

IoT & Wearable Markets – Key Trends

- The Internet Of Things becomes personal
  - Smart City → Smart Home → Smart People/Body
- Wearable devices to become fastest ramping consumer technology device to date
  - Faster than even smartphones and tablets
  - CAGR of 50% between 2014 and 2020
- Mass adoption depends highly on price
  - Cost-down cycle requires further system integration
  - Many Wi-Fi enabled SoC design opportunities

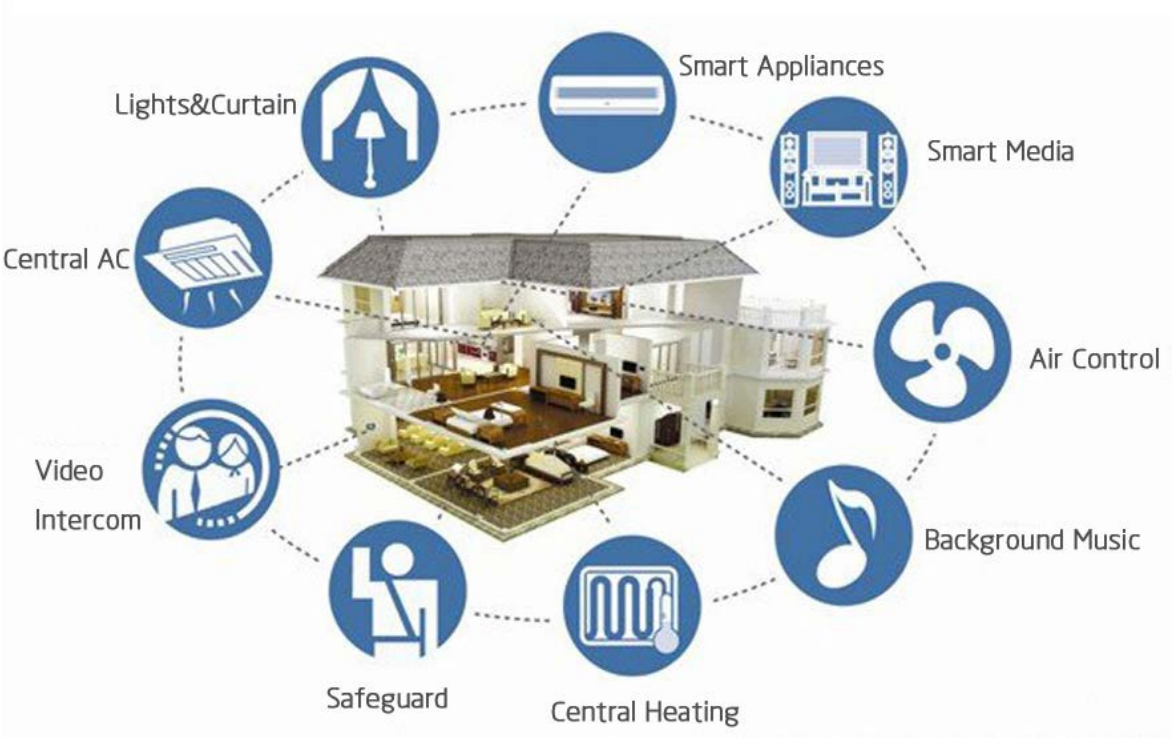


*Source: Smart wearable unit sales by device category, developed markets, 2012–2020 [Source: Analysys Mason, 2014]

Wireless Technologies in IoT Devices

- IoT devices are all getting wirelessly connected
- Wi-Fi and Bluetooth are by far the most popular wireless technologies in IoT Devices
- Wi-Fi and/or Bluetooth in more than 30 billion devices by 2020
- Wi-Fi connections forecast to overtake Bluetooth by 2020!
- Wi-Fi in IoT devices:
  - Smart Home to represent more than 50%
  - Attach rate approaching 20% in wearable

A big IoT market: The Smart Home



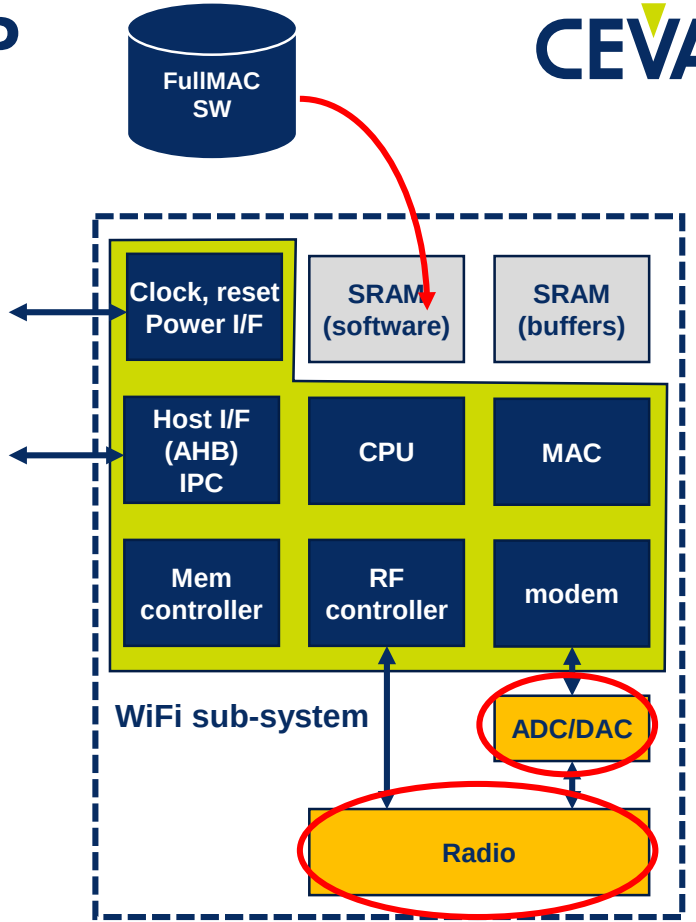
- Market potential of 100+ nodes in 600+ million households, creating a 60+ billion market! *
- Huge potential for WiFi:
  - Multi room video and audio streaming
  - Surveillance camera
  - Smart appliances
  - …
- TV and OEM remote control to become the biggest Wi-Fi markets in Smart Home

(*) According to GreenPeak Technologies, 2015

Wi-Fi IP: a complex system IP

- A Wi-Fi IP is a complex System IP with
  - hardware accelerators,
  - software protocol stack,
  - CPU platform: CPU, bus system, interfaces
  - memories,
  - Clock and power management
  - analogue & radio (process dependent)

- CEVA shave the complexity by providing a fully integrated sub-system for easy and fast integration into SoC



Wi-Fi IP creating minimal constraints

- Constraints on MCU/APU should be minimized
  - No real time constraints
  - No interference with application, and vice versa
  - Maximum task off loading
- CEVA simplify application development by providing a self contained isolated system IP which does not interfere with the MCU/APU

Low Power Wi-Fi IP

- Low Power is key, particularly in wearable
- Supports all protocol level low power features
  - Ex: WMM-PS
- Efficient clock gating during active and sleep modes
  - Functional clock gating: functions are gated when not in use
  - Friendly design with automatic clock gating (done at synthesis level)
- Efficient power gating
  - Several power domains
  - Switch off most of the design when in low power mode
  - Small retention memory, short wake up time

Interoperable Wi-Fi IP

- Wi-Fi is a complex standard
- Need to ensure interoperable Wi-Fi IP for best user experience
- Need to ensure good interoperability with the standard
  - Wi-Fi Alliance CERTIFICATION
- Need to ensure good interoperability with 3rd party solutions
  - Some may have bugs or limitations
- Need to be easily patchable
  - Highest flexibility so that a bug or a bad behavior with a buggy 3rd party device can be fixed or worked around thanks to a software patch

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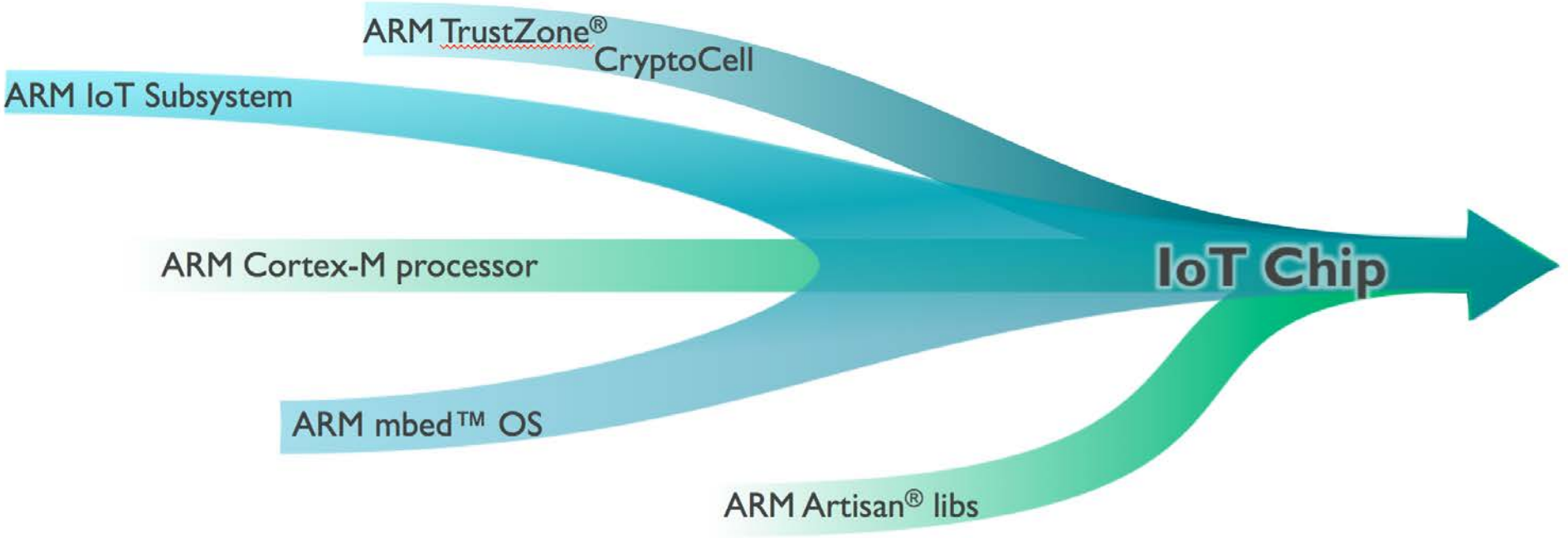
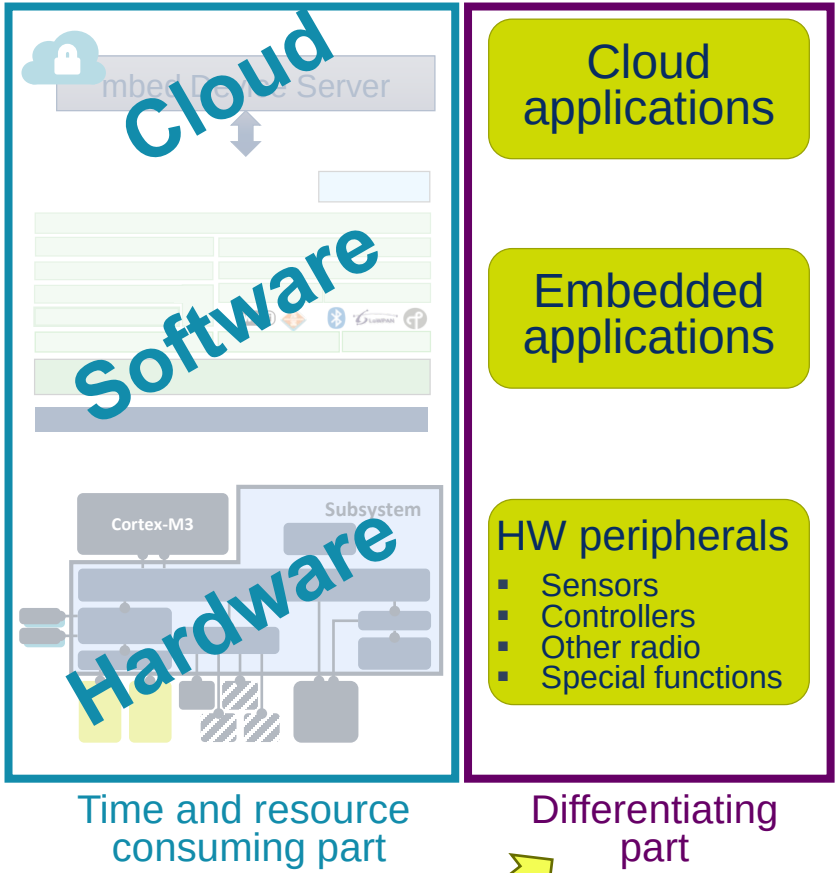
ARM IoT Subsystem for Cortex®-M

Building IoT chips easily

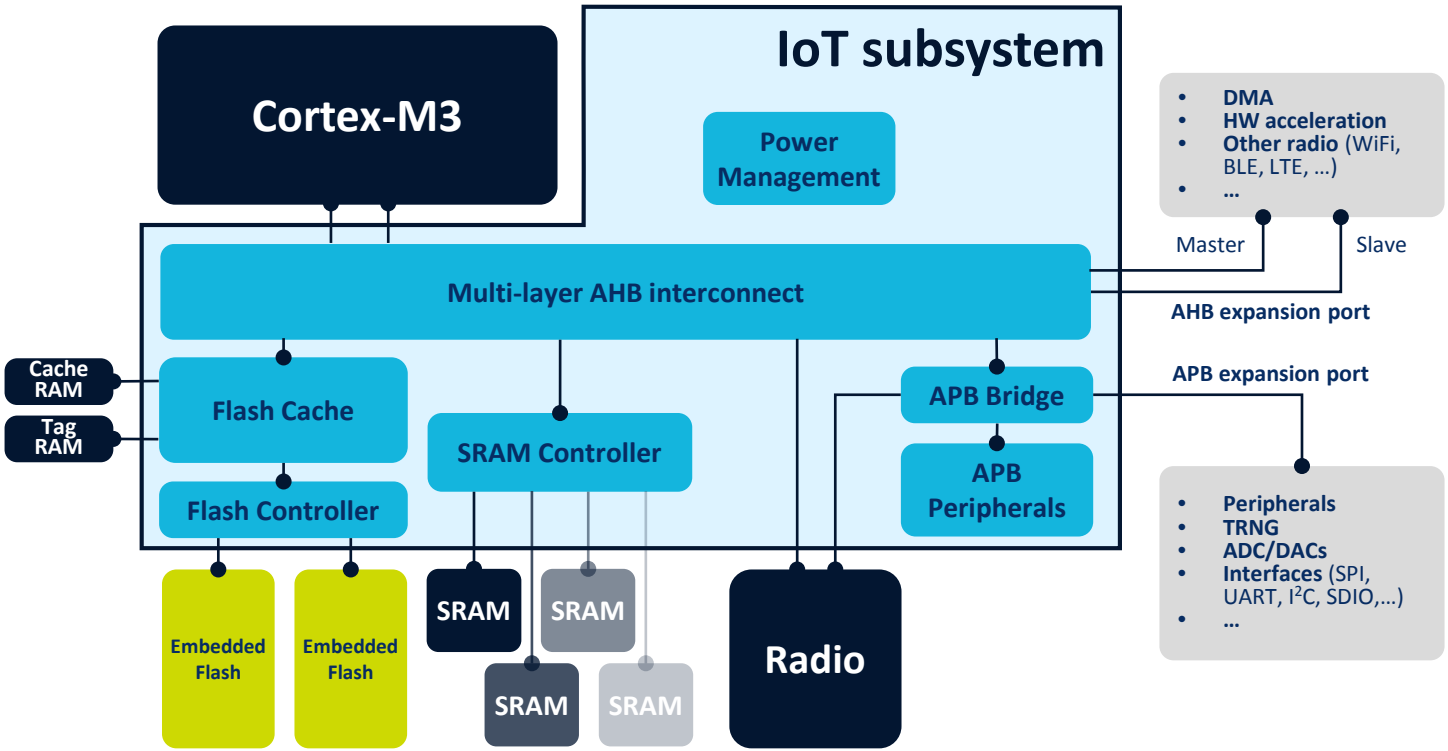


ARM IoT Subsystem for Cortex-M

- Reference solution
  - Pre-integrated, validated, HW+SW subsystem
- Hardware – Cortex-M3 subsystem
  - Radio pre-integrated (option)
  - Flash ready
  - Designed for low power
- Software stack
  - mbed OS runs out of the box with the radio
  - Drivers available in mbed OS
    - Connected to the mbed Device Server



IoT Subsystem Hardware Blocks



ARM TrustZone CryptoCell

- Family of security subsystems applicable to any ARM platform
- CryptoCell-300 series for Cortex-M
- Enhances usability
- Acts as Root of Trust / Trust Anchor for the system
- Robust security solution suitable for most use cases
- Simplifies security implementations

mbed OS – Software for IoT

ARM CEVA

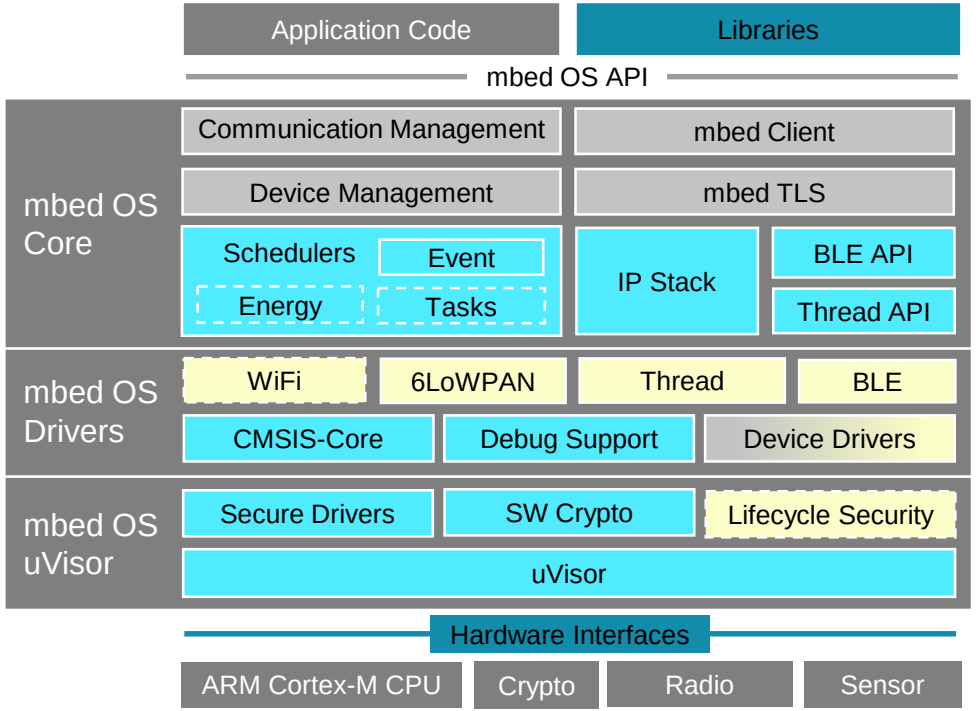
Efficiency

Security

Connectivity

Management

Productivity

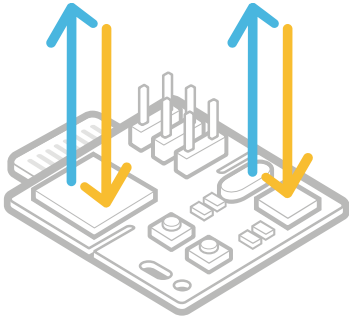


150K developers 2015

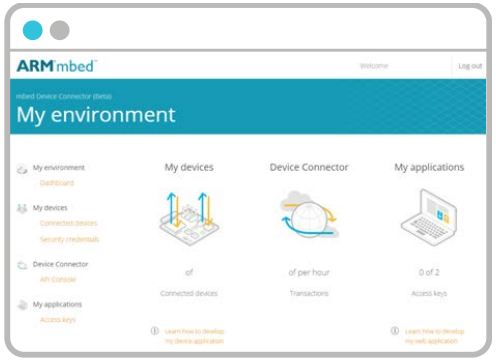
60K developers 2014

mbed Device Connector

- Eases development, management and scaling of IoT
- Available at connector.mbed.com. Easy transition to commercial service providers



Build IoT Device



Connect your devices

Build application with example code

Utilize cloud solutions

Prototyping on FPGA

- Designed for evaluation and prototyping
  - IoT subsystem and Cortex-M3 on FPGA
  - Daughter board with Radio
  - **mbed pre-ported**, ready to extend with differentiating IP
- **Rapid** Software and Hardware development
  - Ready for software development
  - Code porting, debugging and profiling
  - Ready for hardware integration with differentiating IP
- Expandable
  - Large FPGA for user logic
  - Arduino shield adapter
  - IO expansion and multiple debug connectors for tool vendors

Demonstrated at
ARM TechCon 2015

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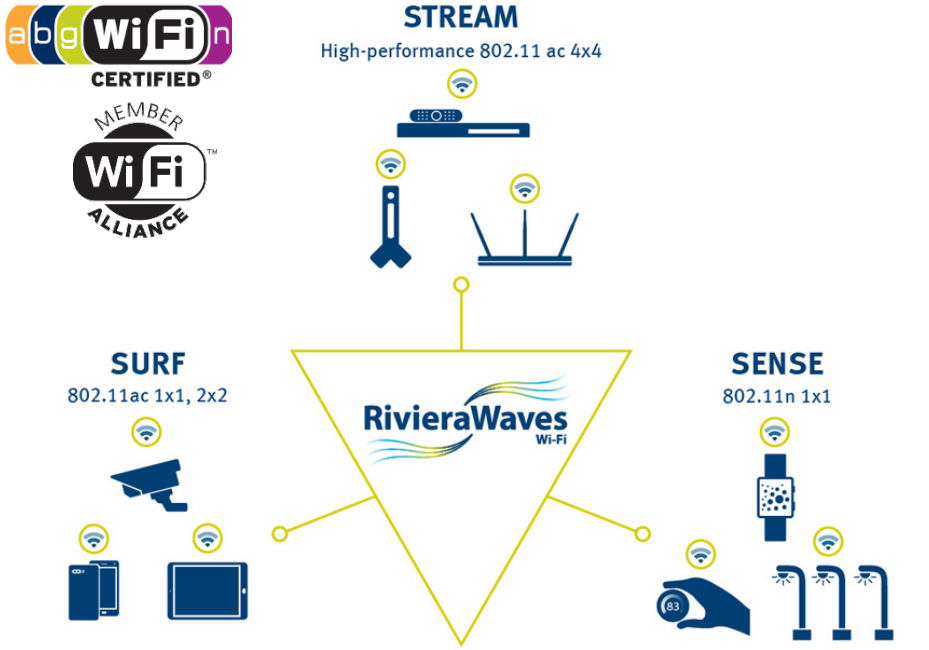
RivieraWaves Wi-Fi IP platforms

CEVA

Industry's Smallest, Most Power-Efficient Wi-Fi IP Platforms for SoC Integration

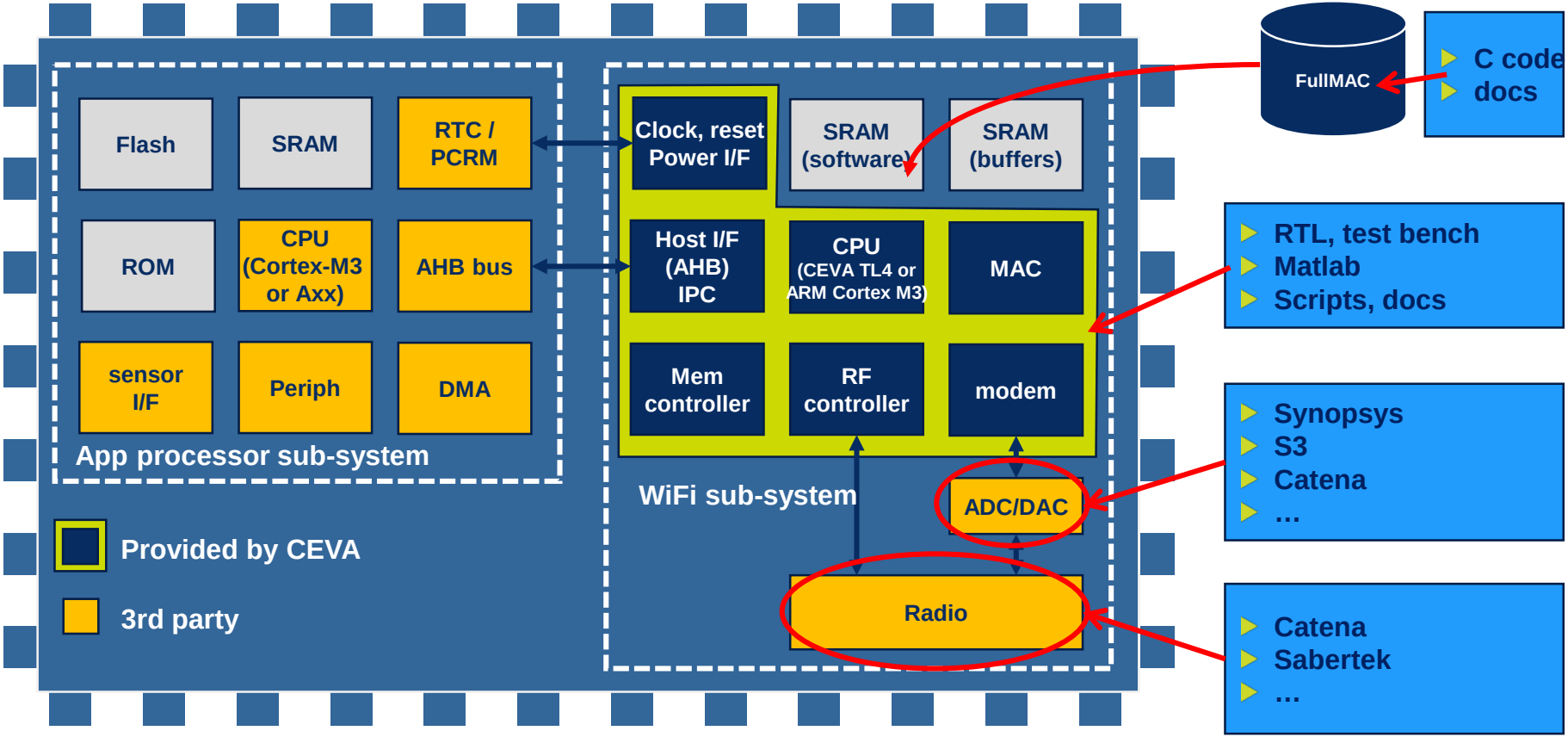
- Long legacy in Wi-Fi:
  - Licensing since 2002
  - Widely adopted IPs: more than 50 customers in Asia, Europe and U.S.
- Range of options, from 802.11bgn 1x1 up to 802.11ac 4x4
- IP platforms consist of
  - MAC sub-system
    - with FullMAC WiFi software protocol stack
  - Modem sub-system
    - Hardwired (low power), or
    - DSP based (flexible ,allowing differentiation)



Wi-Fi Licensees Include:

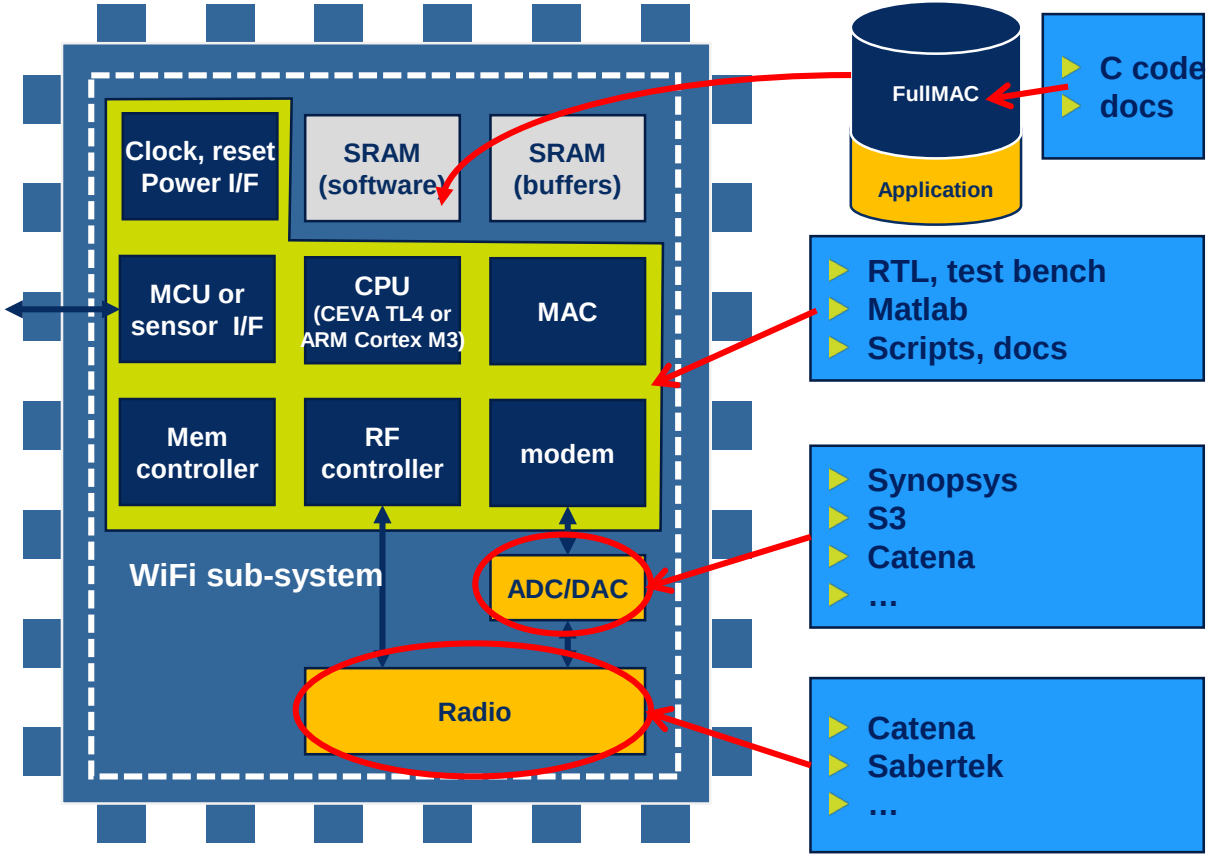
Celeno Wireless Communications · RENESAS · BEKEN · FCI

RivieraWaves Wi-Fi IP integrated into APU or MCU



Standalone single CPU Wi-Fi SoC

- Recommended for low constraints applications
- FullMAC Wi-Fi stack, network protocol and application running on a single CPU



Provided by CEVA

3rd party

RivieraWaves Wi-Fi IP differentiating features

- Standalone system IP with bus host interface (AHB or AXI) for easy integration into SoC, particularly with the ARM IoT subsystem
- Support all Wi-Fi modes simultaneously: STA, AP, Wi-Fi Direct
- Software defined AGC/CCA mechanism for highest flexibility in supporting any Wi-Fi radio
- Lowest power consumption → longest battery life
  - Optimized active and sleep power consumption
- Smallest die size → cheapest solution
  - Low gate count, low memory requirement (small buffers)

Example of integration:
CEVA Wi-Fi + ARM IoT Subsystem on MPS2

- CEVA and ARM collaborated for low power802.11n on ARM Cortex-M IoT Subsystem
- Demo of Wi-Fi Smart Home Station
  - Check temperature, humidity and proximity detector from your smartphone!
- Easy and fast integration
- Serial interface between ARM IoT Subsystem and WiFi subsystem
- Demo completed by **1 engineer in 1 month!**

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Conclusion

- Wi-Fi in IoT is a huge market
- Requirements for a successful Wi-Fi SoC for IoT:
  - Fast and easy design
  - Reliable IPs
  - Low power
  - Low cost
  - Allow differentiation
- CEVA and ARM are the right partners for your Wi-Fi SoC projects!

CEVA® ARM

Q & A?

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