CYW89459: High Performance and Low Power Wi-Fi and Bluetooth 5.1 Combo Chip for IoT and Automotive

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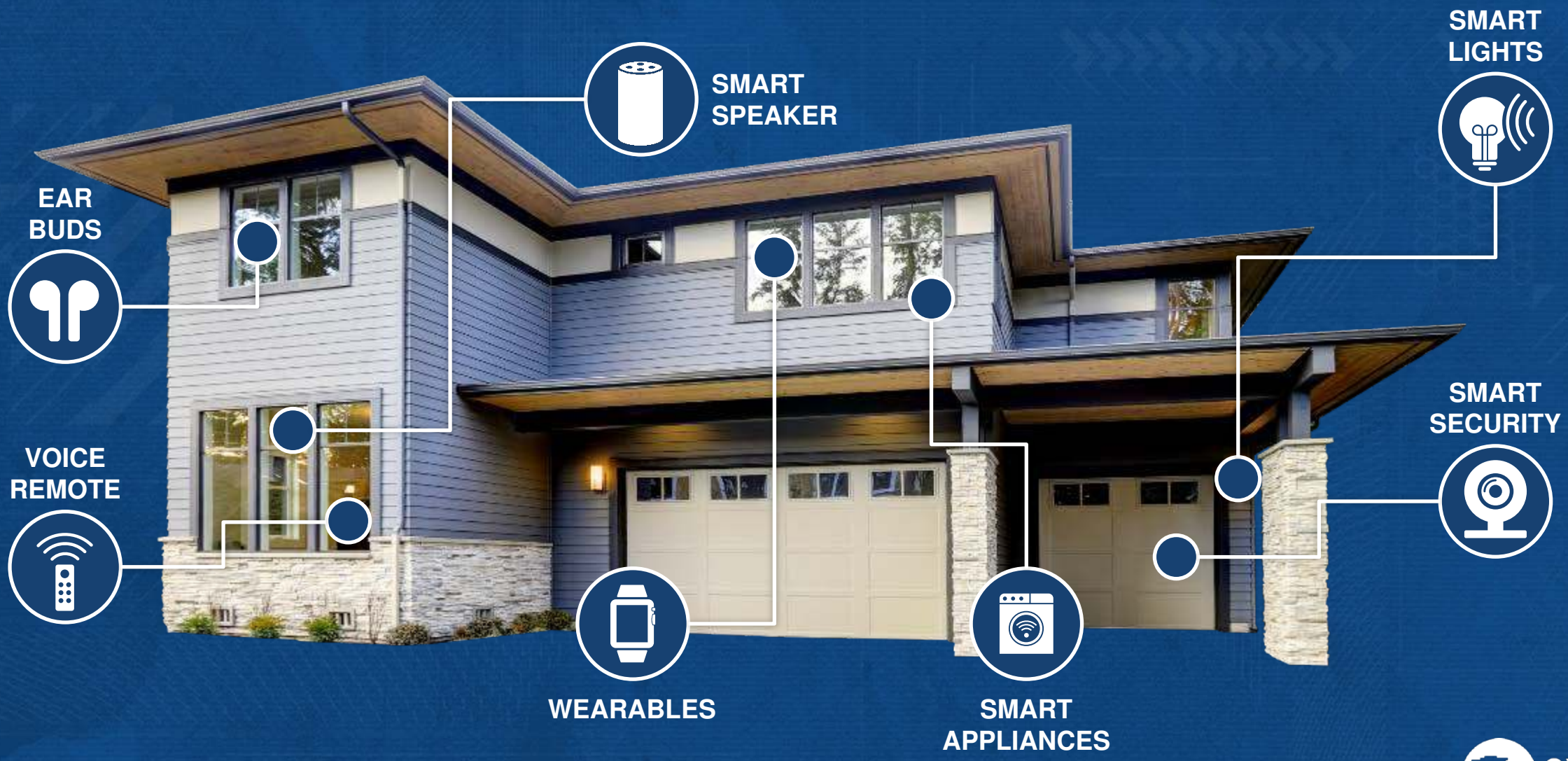
Great connectivity is essential for IoT



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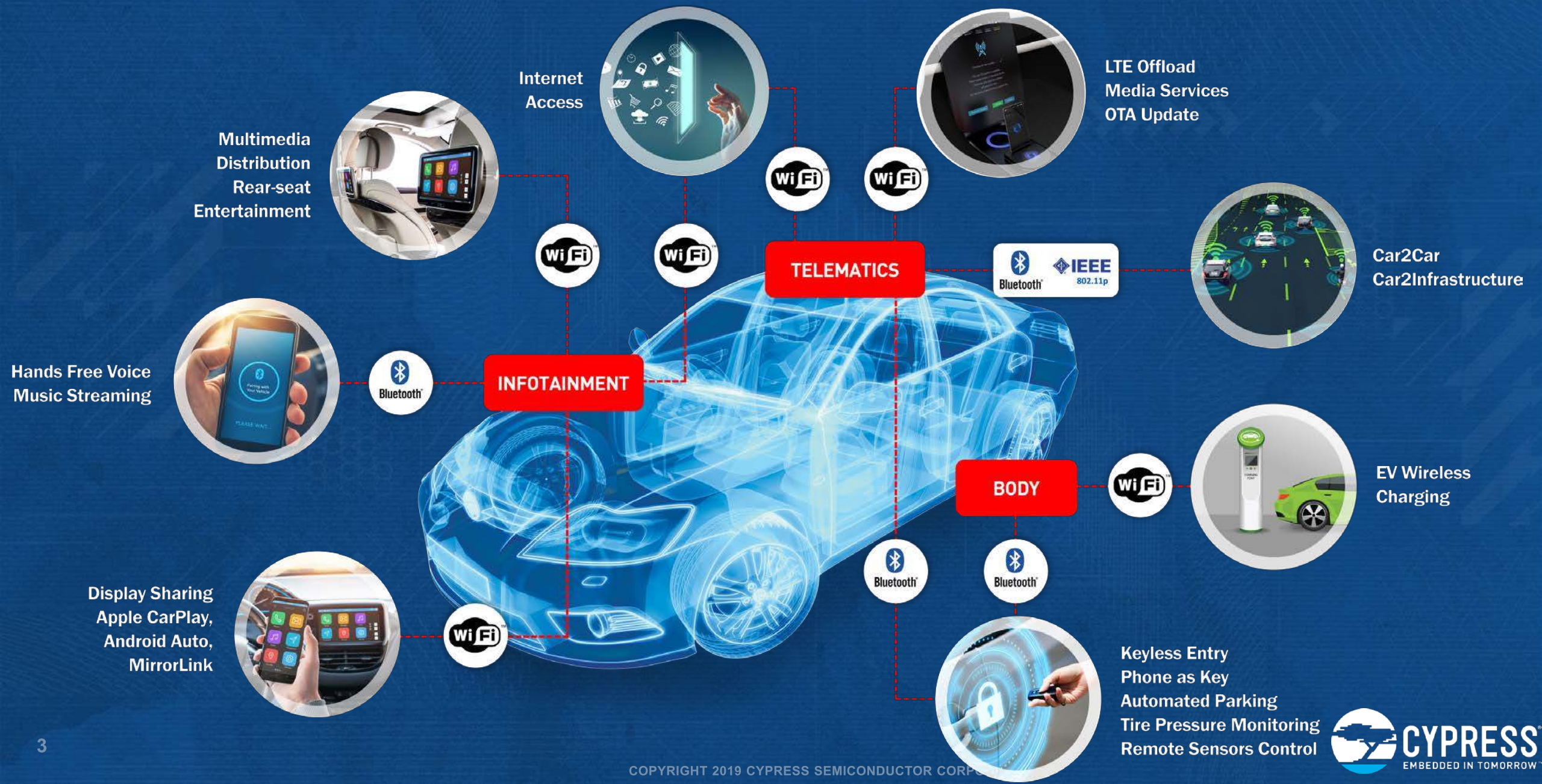
…and Automotive



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CYW89459: World's First Wi-Fi/BT Combo chip featuring

High Performance Wi-Fi	✓ 2x2 MIMO Wi-Fi 11ac Wave-2 with integrated PA-s
	✓ Real Simultaneous Dual-Band Wi-Fi (2.4G/5G)
Advanced Bluetooth 5.1	✓ Dual-mode BT/BLE with advanced modem/RF
	✓ Asset Tracking and Indoor Positioning (BT5.1)
Unique System Architecture	✓ Dynamically switch MIMO/RSDB modes of Wi-Fi
	✓ Dynamic Coexistence of Wi-Fi/BT/BLE Technologies
IoT and Automotive Solution SW	✓ On-chip solutions for Complex multi-radio use cases and Automotive temp range (-40C to +85C)
	✓ Consumer, Industrial and IoT Gateway Applications

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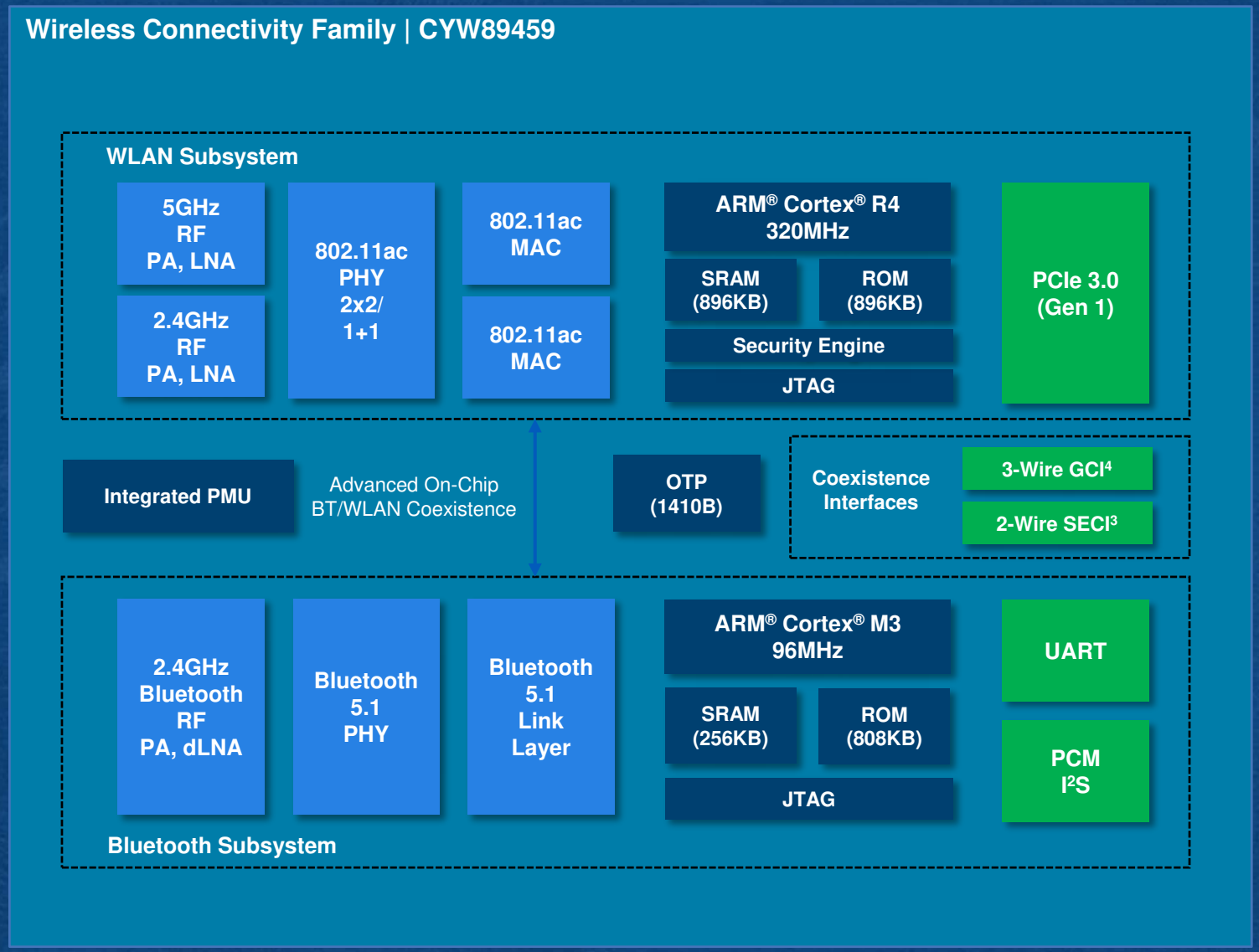
CYW89459 System Overview



5.16mmx7.7mm WLBGA package

194 balls, 0.4mm pitch

40LP, <3mW idle, <3W peak

-40 to +85C operation

Production Q4 2019

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Wi-Fi and Bluetooth Features

Wi-Fi	Bluetooth
▪ 802.11ac Wave 2 (MU-MIMO) in STA mode ▪ Integrated 2x2 2.4GHz and 5GHz RF, PA, LNA ▪ Dynamic switching between MIMO and RSDB ▪ Access to cleaner DFS channels (Radar detection) ▪ CYNC: Cypress Hi-Fi Wi-Fi Surround Speaker Solution ▪ Wi-Fi Location: Fine Timing Measurement (11mc) ▪ Newer Wi-Fi Alliance features (OCE, MBO) ▪ Multiple roles with various degrees of concurrency ✓ AP ✓ STA ✓ P2P ✓ DFS Master	▪ BT 5.0 Features ✓ LE-2Mbps PHY ✓ LE-Long Range ✓ Advertising Extensions ✓ Slot Availability Mask ▪ BT 5.1 Features ✓ Direction Finding (AoA/AoD) ✓ Stable Modulation Index ✓ Low-latency Reconnection ✓ RSSI Filtering ✓ Additional Advertising Channel ▪ Advanced BLE Receiver and Transmitter

On Industry Standards and Compliance…

Standards focus on Interoperability

- ✓ AP/Station from different vendors can interoperate
- ✓ Rapid world-wide proliferation of Wi-Fi and BT/BLE

Algorithms, Architectures are left out

- ✓ Not all Wi-Fi/BT devices are created equal
- ✓ Vendors must innovate in algorithms and architectures

Cypress optimizes for IoT/Automotive

- ✓ Go beyond mere Certification and Compliance
- ✓ Focus on what matters to IoT/Automotive (Range, Cost, Performance, Power, Robustness…)
- ✓ Optimal System design needs excellent sub-systems (RF, Analog, Baseband, SW, Antennas..)
- ✓ Rich SW for customer use-cases, System know-how

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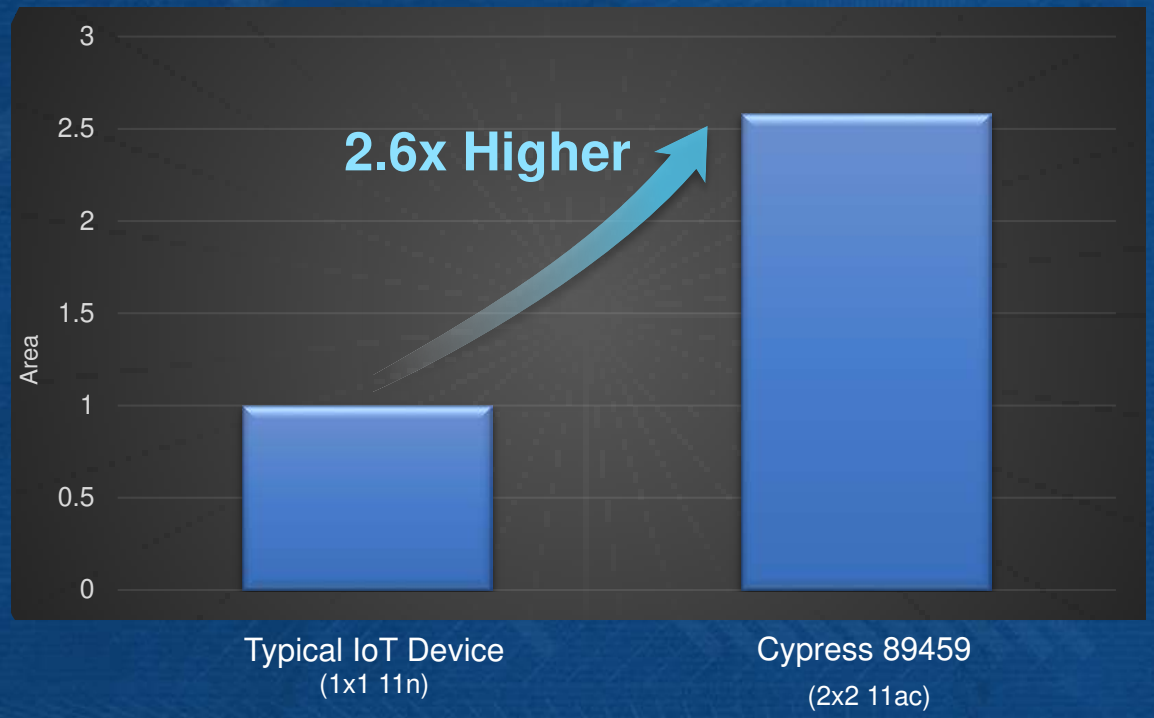
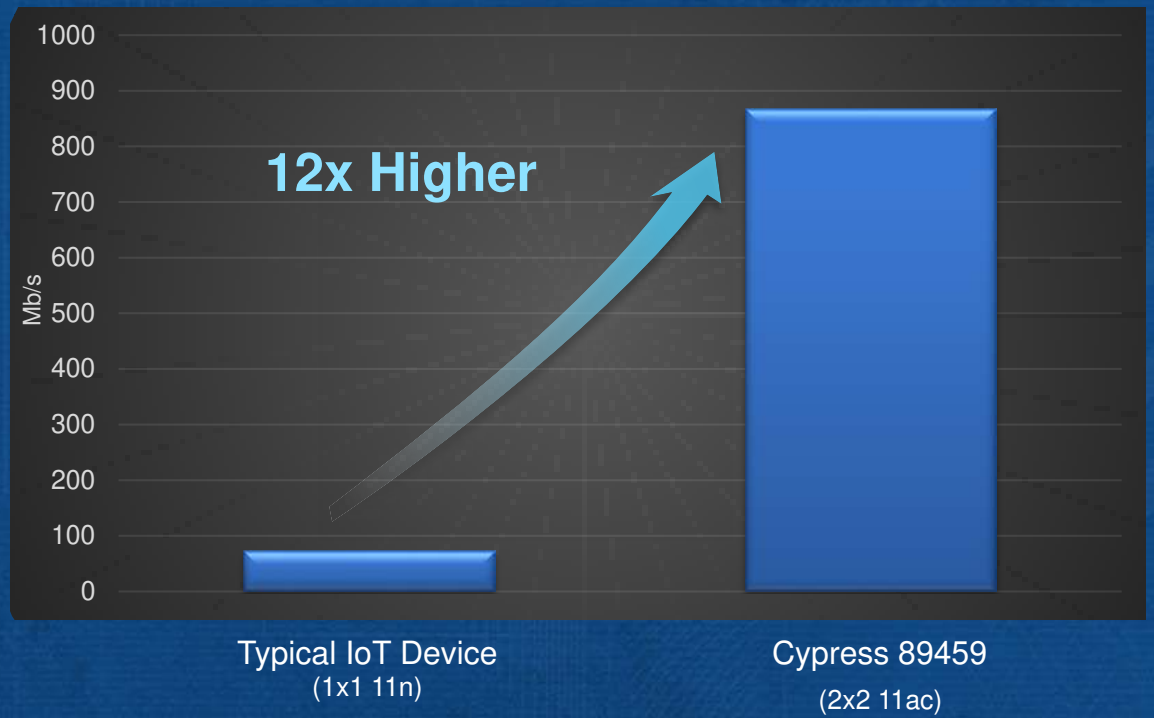
Wi-Fi Range and Throughput Performance

Coverage Area



Throughput

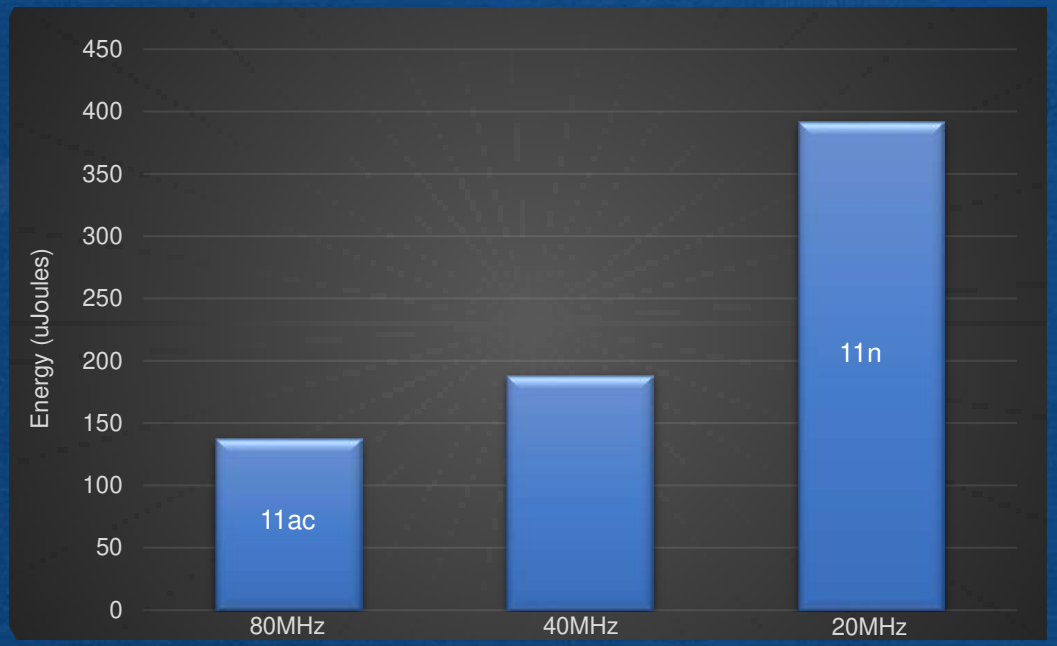


Normalized Coverage Area for 2.4G MCS0 higher output power with internal PA-s compared to TI CC3235S. Close to 4x increase against SLAB WF200. Assumes Free space path loss model with propagation exponent 3.4.

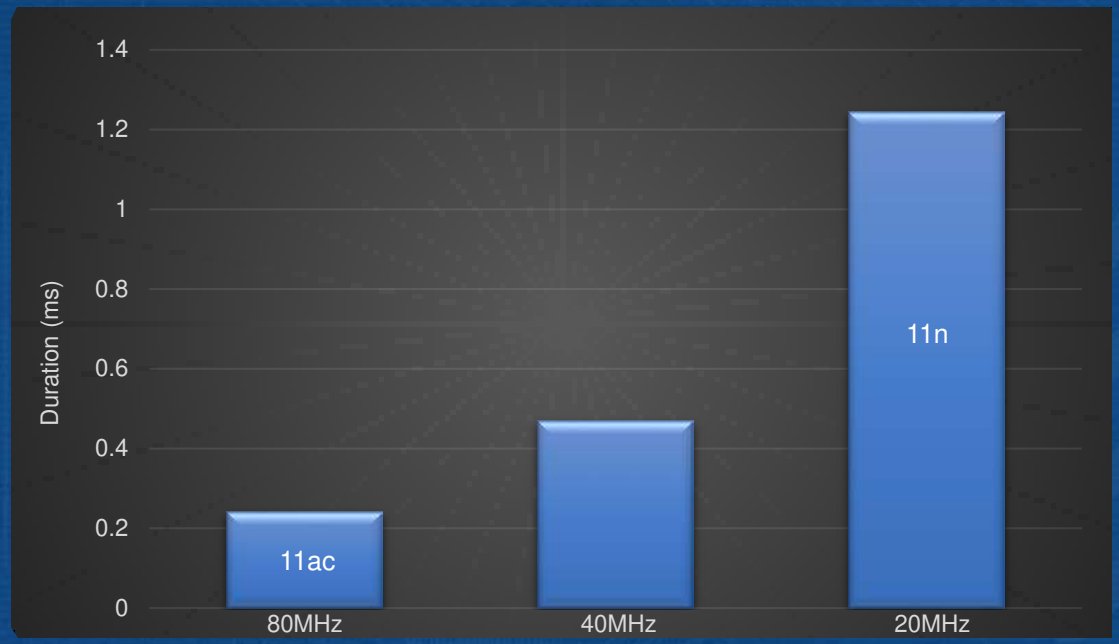
Peak PHY Throughput comparison of 1x1 11n (20MHz MCS7) vs 2x2 11ac (80MHz MCS9)

Wi-Fi 11ac Saves Battery and Frees up Congestion

Energy spent in transferring 10KB of data



Air-time used for 10KB transfer



Lower Energy/Bit = Better Battery Life

Less Air-time used = Less Wi-Fi congestion

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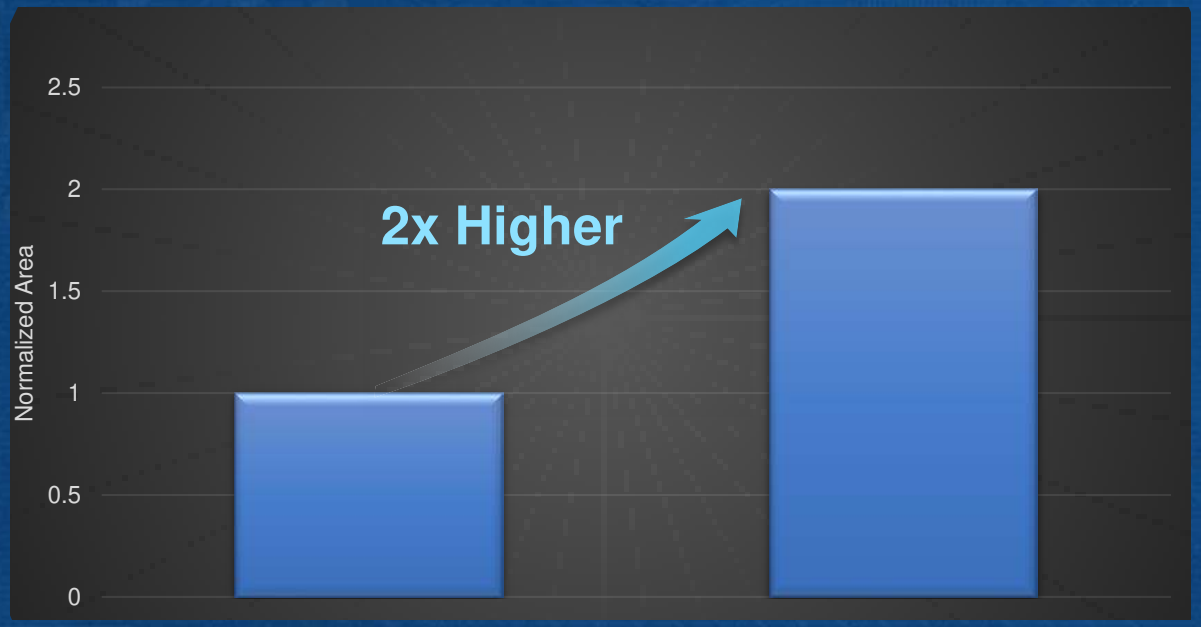
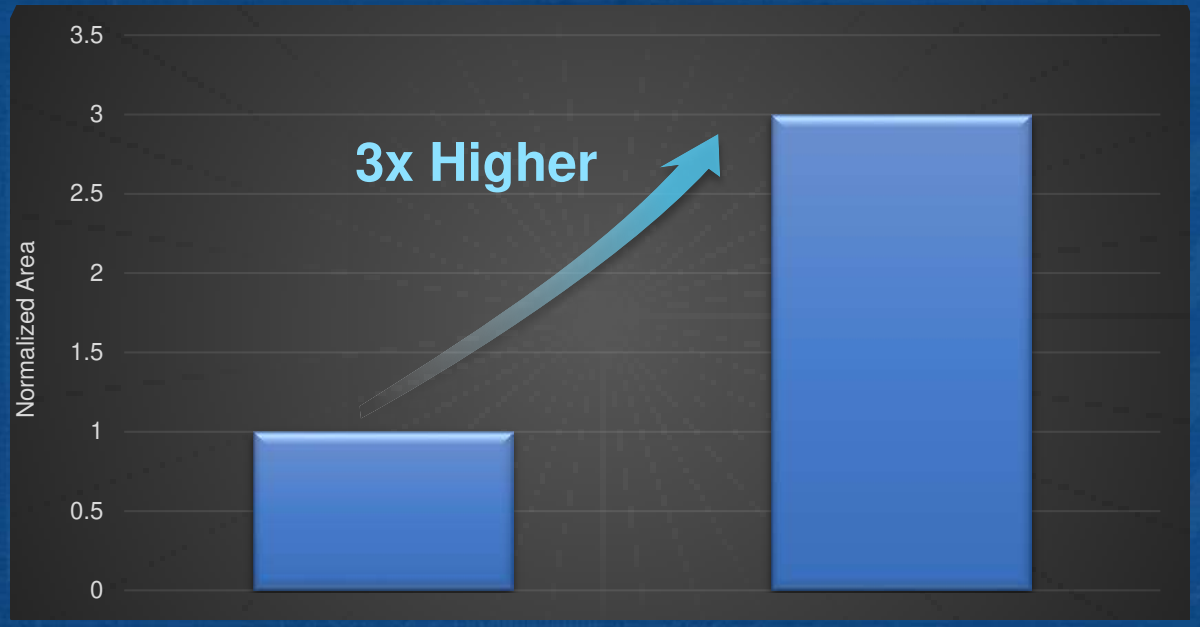
BLE 2Mb/s Receive and Transmit Range

Receive



Transmit



Normalized Coverage Area for BLE 2M Sensitivity improvement over Dialog DA1469x dirty Tx OFF. Increase is ~3x compared to Nordic nRF52840. Assumes Free space path loss model with propagation exponent 2. Transmit coverage area for BLE 2M improvement over nRF52840. Increase is ~5x compared to DA1469x.

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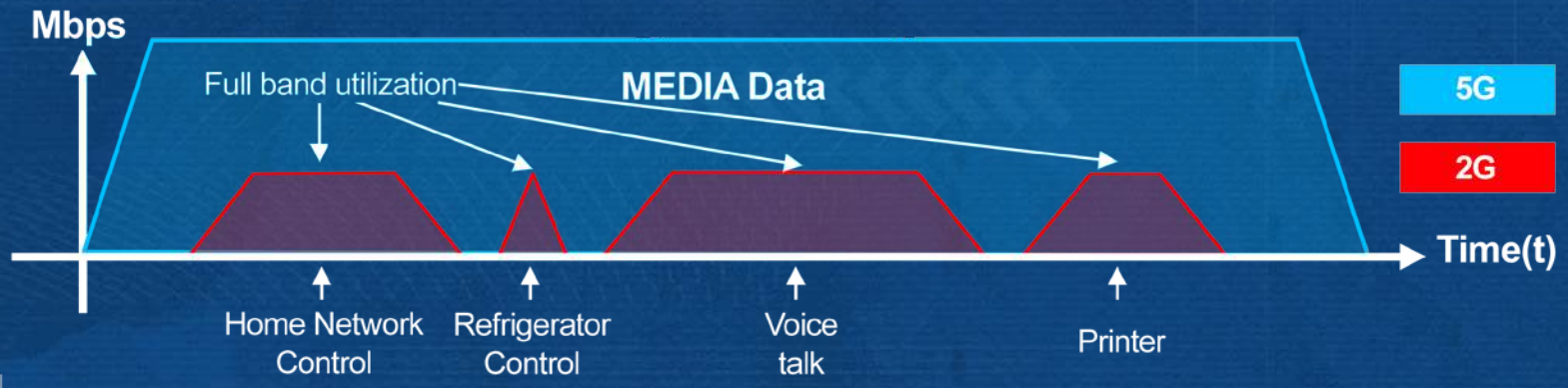
Emerging RSDB and CYNC Use Cases in Consumer IoT



Automotive Infotainment: Increasingly Complex Use-Cases

Infotainment Head Unit

Ethernet or
4G/LTE for Data Connection

External Wi-Fi

1. External hotspot for data access
2. OEM Over-the-air (OTA) Software updates
3. OEM Yard Software Installation
4. Dealership Service/Maintenance

External-Vehicle Applications

Driver Phone

1. Hands-free calling (BT) + Internet Access
2. Display Mirroring: CarPlay, Android Auto, Mirrorlink
3. Tethering: Use phone internet data for Head Unit

Passenger Devices

1. Internet Access: Laptops, Phones, Tablets etc.
2. Hands-free calling

OEM Equipment

1. Rear-seat Entertainment Units
2. Wireless Cameras
3. Remote Controls

In-Vehicle Applications

Automotive Infotainment use-cases require multi-role, dual-band concurrent operation

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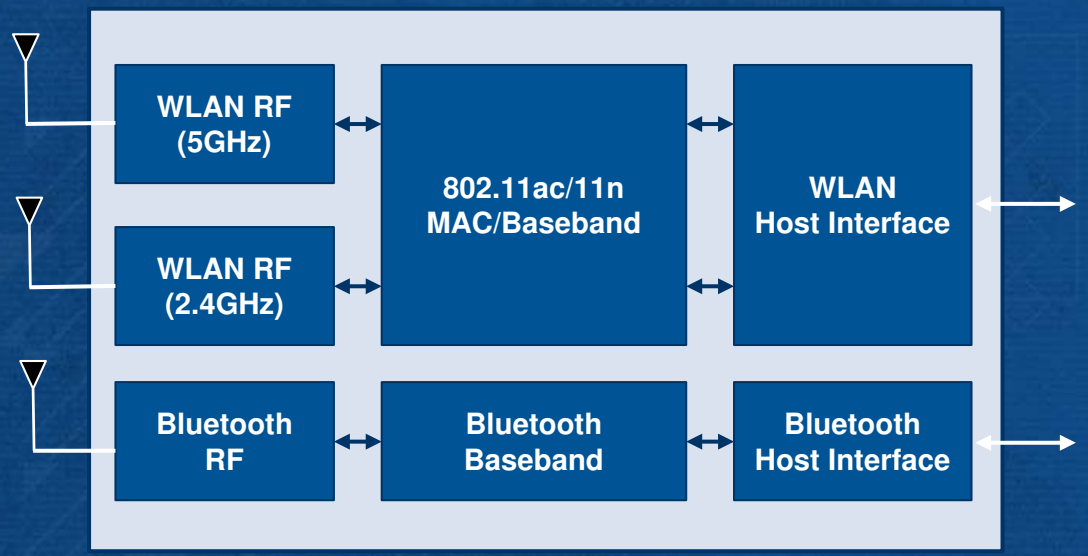
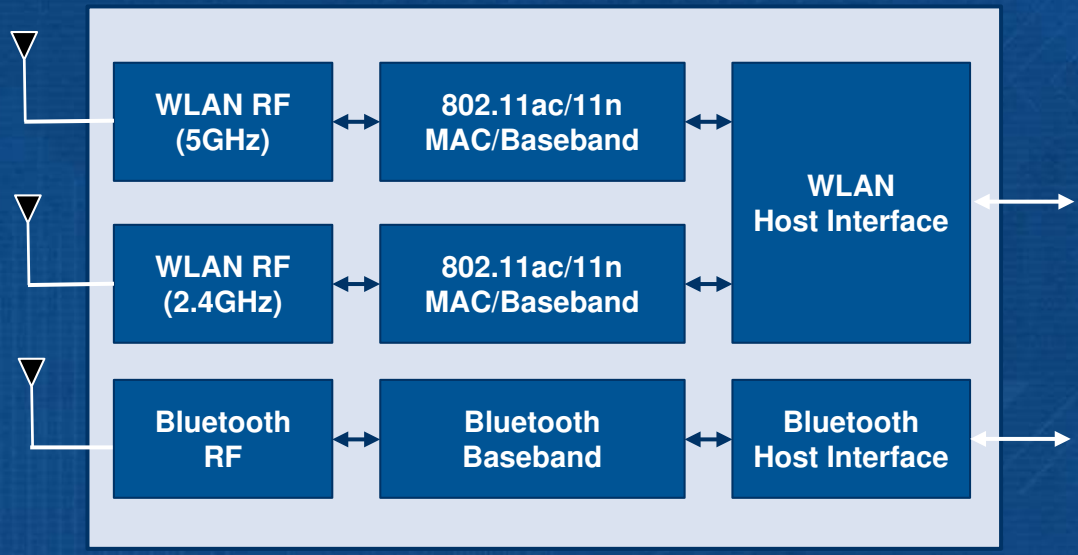
Virtual vs Real Simultaneous Dual Band Wi-Fi (VSDB vs RSDB)

VSDB Architecture



- Dual-band non-concurrent operation
- Single WLAN MAC, PHY, RF time shared

RSDB Architecture



- Dual-band concurrent operation
- Dual WLAN MAC, PHY, RF independent

RSDB Architecture provides 2.5x Higher Throughput and Enables Complex Use-Cases (AP+AP)

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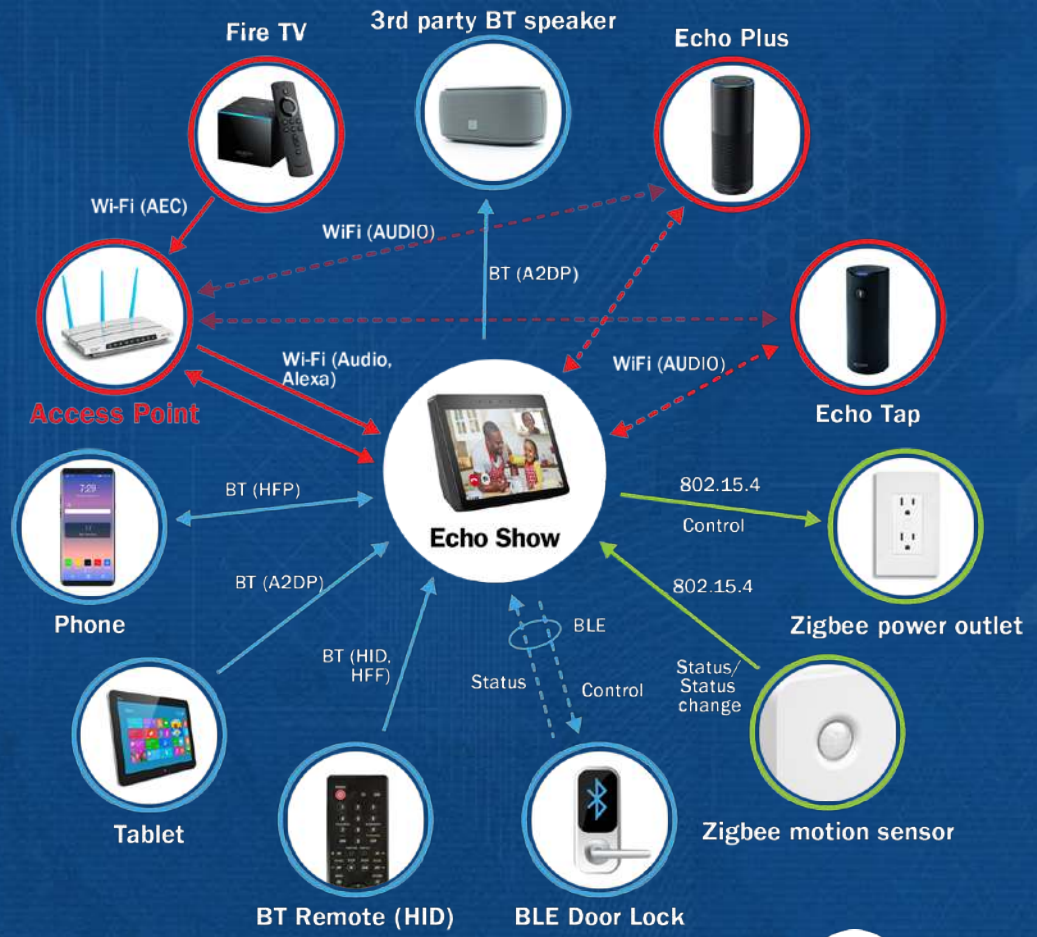
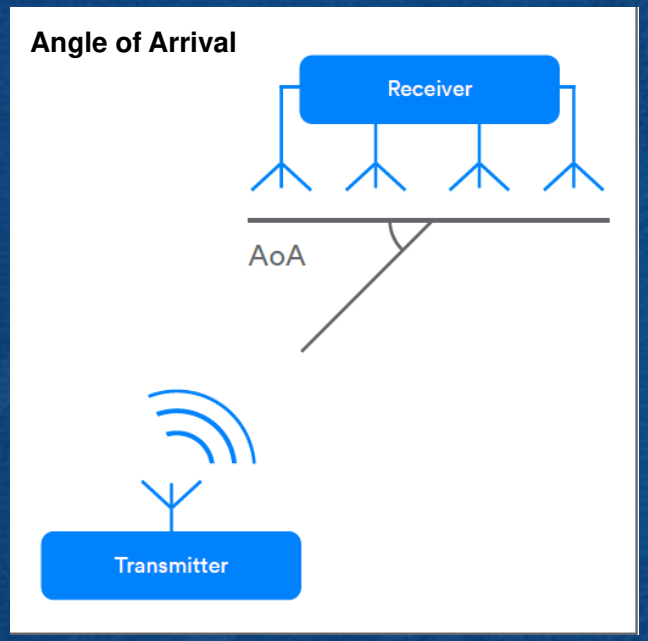
Multi-radio Coexistence Solution

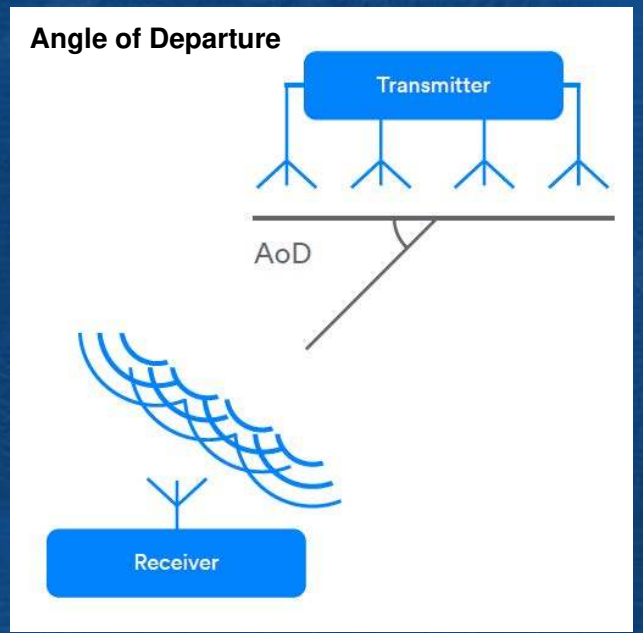
- Smart Home devices feature Wi-Fi, BT/BLE and sometimes 802.15.4 all in 2.4GHz band
- Multiple concurrent connectivity use cases must be supported
- CYW89459 pushes the limits of Coex
  - Concurrent on-chip operation of 2.4G, 5G and BT/BLE
  - Support independent Transmit and Receive
  - Dynamically switch Wi-Fi MIMO and RSDB modes
- CYW89459 Coexistence Solution
  - On-chip HW communication between modems (GCI)
  - Excellent RF design ensures high on-chip isolation
  - PMU, Clock and XTAL sharing
  - Real-time arbitration algorithms
  - Dynamic mode switching
  - Platform know-how (e.g. antenna isolation)
- Automotive brings its own set of challenges including LTE Coex that CYW89459 solves



AEC – Acoustic Echo Cancellation
HFP – Hands Free Profile
HID – Human Interface Device
A2DP – Advanced Audio Distribution Profile

Direction Finding using BT5.1





- Asset Tracking
  - Consumer and Industrial (Track IoT devices, Crates etc.)
  - Automotive (Passive Entry, Passive Start, Phone as Key)
- Indoor Positioning
  - Low cost devices can locate themselves
  - Indoor navigation
- Cypress Solution goes beyond mere BT5.1 compliance
  - Algorithms for angle estimation and localization
  - Antenna Design
  - System solution with multiple sensors/BLE devices
  - Synergies with Wi-Fi

https://www.bluetooth.com/bluetooth-resources/bluetooth-direction-finding/

IoT and Automotive Solution Software

- Host offload and simplified platform integration for IoT and Automotive
  - Wi-Fi Full-dongle PCIe firmware and security implementation offloads host
  - Open source PCIe Linux Drivers (FMAC) and many host platforms supported
  - Embedded BT/BLE controller firmware and stack options
  - RSDB Application use-cases supported on-chip, greatly simplifying customer implementation

- Extended temperature support for Automotive, Industrial
  - To maximize reliability of the chip operation, on-chip HW and SW solutions are implemented
  - Real-time temperature and thermal management techniques ensure junction temperature is controlled ~ 3W peak power
  - Multiple package options supported with different thermal performance

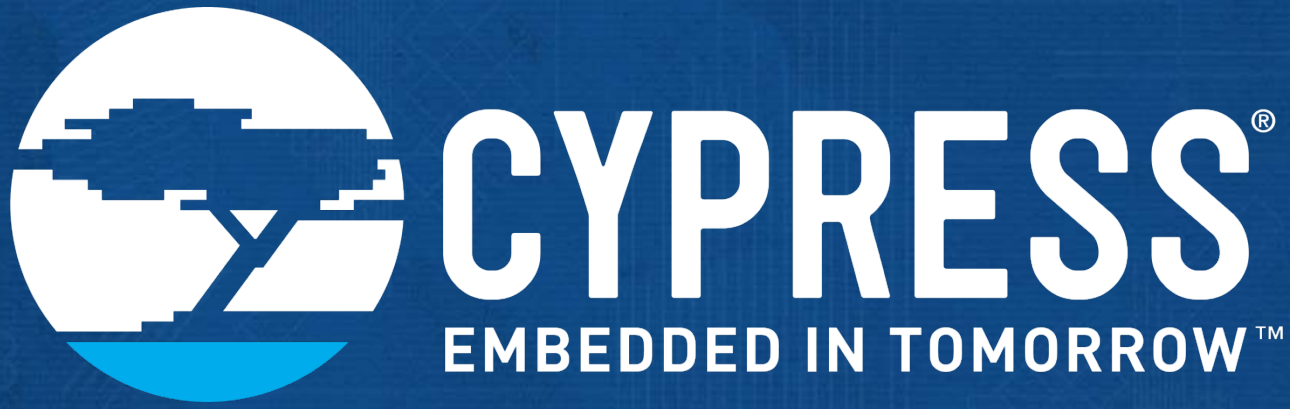
- Software Compatibility across Automotive/Industrial/Consumer IoT Product families (89459/5459x)

Versatile Software SDK to address diverse IoT and Automotive Markets

Summary

CYW89459/5459 Family Introduction	✓ World's First Wi-Fi/BT Combo chip featuring Wi-Fi 11ac Wave-2, BT5.1, Dynamic MIMO/RSDB and IoT/Automotive Software
Brings several advantages to IoT/Automotive Applications	✓ Wi-Fi 11ac frees up congestion, saves battery life, range and robustness (Multi-antenna)
	✓ BT5.1 brings in new use-cases such as Asset Tracking and Localization
	✓ Cypress Wireless implementation goes above/beyond "standard" Wi-Fi and BT
System Design challenges solved on-chip	✓ RSDB and Dynamic switching of RSDB/MIMO
	✓ Multi-radio Coexistence
	✓ Extended Temperature range operation
Versatile SW SDK for Platform Integration	✓ Production ready silicon and software Q4 2019

Questions, Comments?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