

WFI-101: Future of Wi-Fi in Low Power Devices

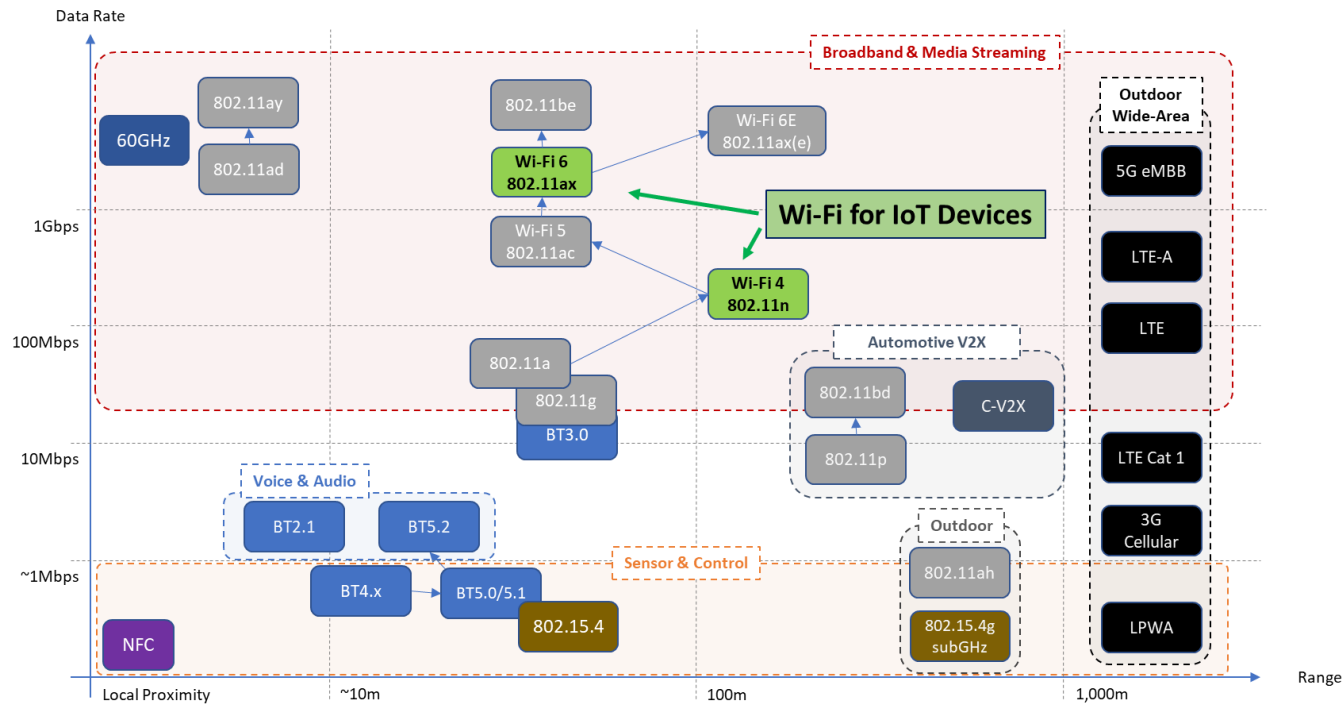
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Agenda

- Wireless connectivity trends in IoT devices
- Growth in Low Power Wi-Fi
- How does Wi-Fi 6 help in IoT?
- Silicon Labs' Wi-Fi

Wireless Connectivity Trends in IoT Devices



Silicon Labs is the leader in short range IoT wireless solutions!

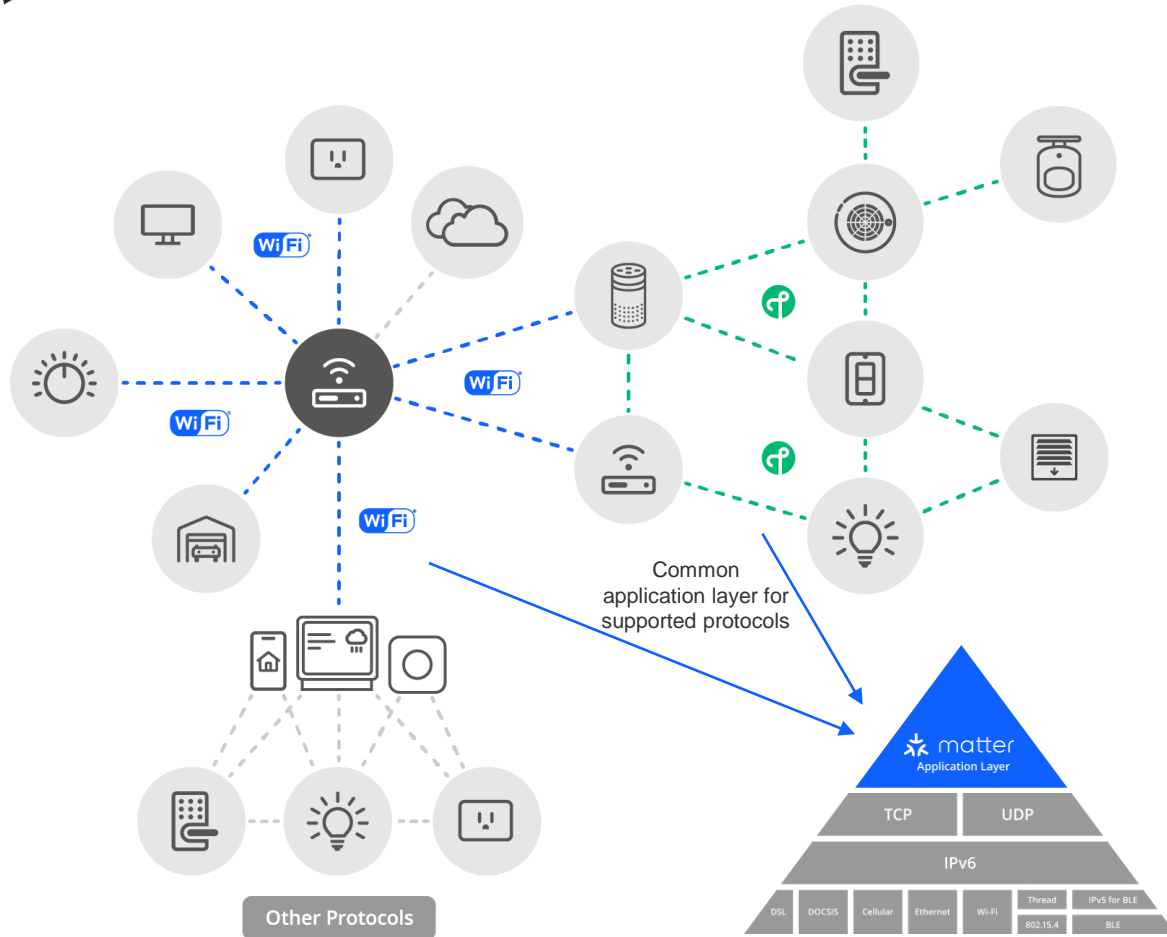
- **Large number of wireless protocols in IoT**
 - Wi-Fi, BT, BLE, 802.15.4, Cellular, NFC, proprietary
 - Application, cost, power, size dictate the protocol
- **Wi-Fi is the ubiquitous wireless standard**
 - Connects wireless ‘things’ to the Internet
 - Uses existing infrastructure
- **Massive annual Wi-Fi deployments**
 - 3-4Billion units per year (Smartphones etc.)
 - 800M are “things” (IoT type products)
 - 200M are battery powered (need low power)
- **Wi-Fi 4 is widely deployed in IoT**
 - Significant power and cost reduction in Wi-Fi solutions have enabled the growth
 - Wi-Fi 6 to further increase the deployment!

Requirements of Wi-Fi in IoT Devices



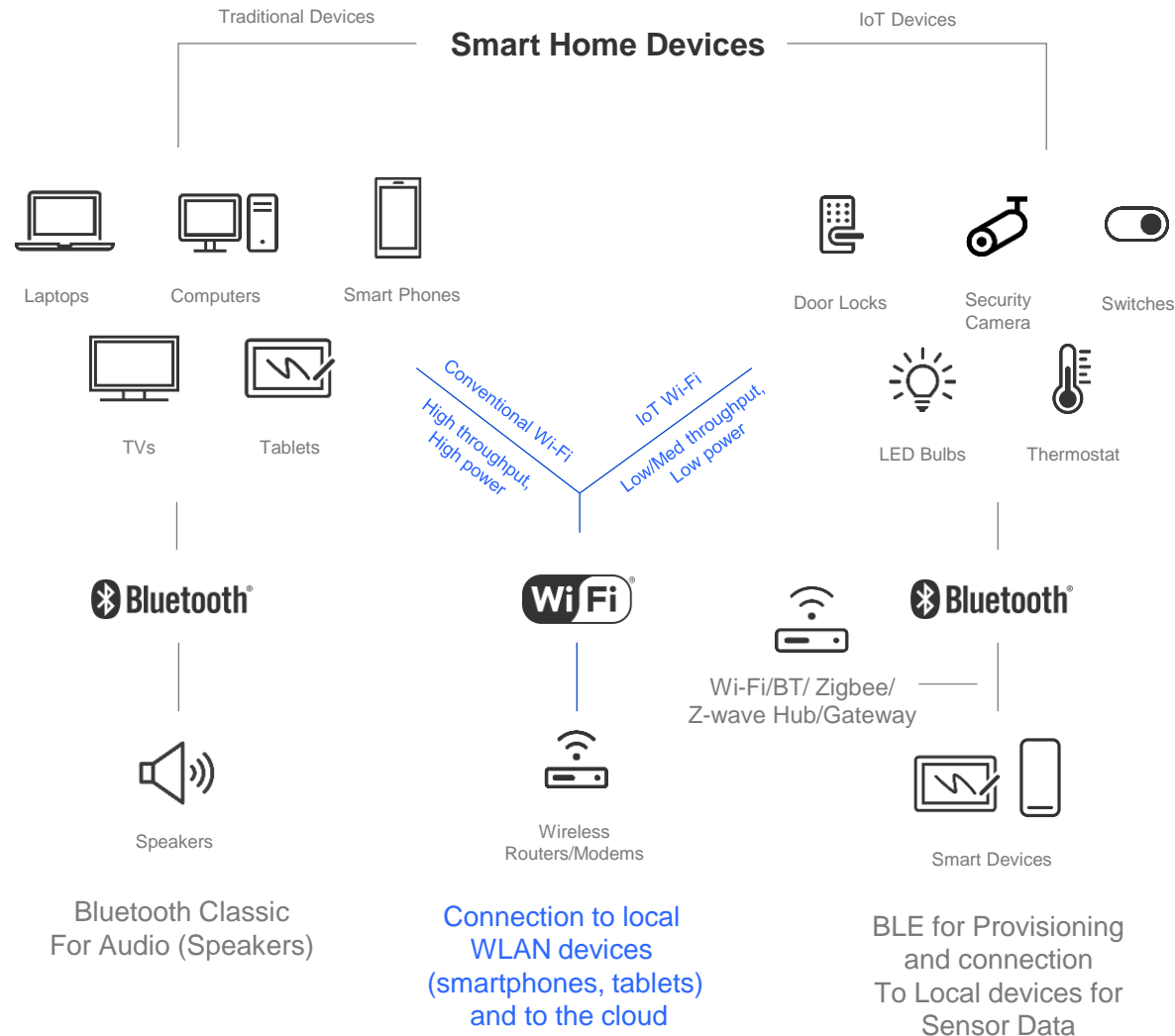
- **Traditional Wi-Fi is not well suited for IoT**
 - Meant for infrastructure, high bandwidth or mains powered devices
 - Used with highly resourced hardware (CPU, memory) running Linux/Android/Windows
- **Wi-Fi for IoT is different**
 - Limited device resources (MCU, memory etc.)
 - Low power consumption
 - Cost and size constrained devices
 - Challenges from crowded RF spectrum
 - Wireless, networking stack integration
 - Cloud connectivity to multiple cloud providers
 - Security from online and physical attacks
 - Coexistence and Interoperability
 - Limited User Interface options

Matter brings Wi-Fi to the Edge of IoT



- Improves end user experience by simplifying interoperability
- Application layer leveraging network protocols like Wi-Fi, Thread, and Bluetooth
- Devices are commissioned onto a Matter network via Bluetooth
- Matter devices connect to the network over Wi-Fi or Thread
- Thread devices connect to other IP networks through Border Routers
- Silicon Labs WFX200 Wi-Fi devices supports Matter today; plan to support in other Wi-Fi devices as well

Wi-Fi Usage in IoT Applications (Smart Home Use Case)



- Wi-Fi provides local and cloud connectivity
 - High power & throughput for traditional devices
 - Low power & low/medium throughput for IoT
- BLE used for provisioning, proximity detection, sensor connectivity etc.
- Ultra Low current consumption for battery operated devices
- Use existing Wi-Fi router/modem, no Hub/Gateway required

Wi-Fi 6 Benefits for IoT Devices



IEEE Protocol	802.11ax
WFA Naming	Wi-Fi (CERTIFIED) 6
Year Introduced	2019
Band(s) (GHz)	2.4, 5, 6 (SB, DB, TB)
Channel Bandwidth (MHz)	20, 40, 80, 160
Allowable Streams	8
Max Data Rates (Mbps)	143 (20MHz, 1 SS) 600 (80MHz, 1 SS) 9607 (160MHz, 8 SS)
MIMO	Multi User (DL MU-MIMO)
Subcarrier Spacing (KHz)	78.125
Symbol Duration (us)	12.8
Guard Interval (us)	0.8, 1.6, 3.2
PHY Modulation	DSSS, OFDM, HT-OFDM, VHT-OFDM, OFDMA
Multi-user Operation	Uplink and Downlink OFDMA - 72 Simultaneous Users Downlink MU MIMO - 8 Users (R2 adds UL MU MIMO)
Highest Order Modulation	1024-QAM
Power Saving Mechanisms	Target Wake Time
Spatial Reuse Mechanisms	BSS Coloring

Single Band Wi-Fi 6 (20 MHz BW) critical for low power IoT applications!

- Larger number of coexisting devices in dense environment (OFDMA, MU-MIMO)
- Lower power consumption due to TWT (Target Wake Time)
- Improved range (Beam forming and MU-MIMO)
- Higher connection reliability
- Wi-Fi 6 infrastructure deployments are ongoing – IoT end devices to grow significantly by 2023

Power Optimization in IoT Devices with Silicon Labs' RS9116



Smart Lock

	Wi-Fi Power Consumption	Estimated Battery Life (yrs)
RS9116	~ 55 uA	> 3 years
Off the shelf	~ 250 uA	< 1 year

- Smart Lock with battery (4) providing 1500mAh @ 6V
- Wi-Fi, Secure (SSL), robust, always-on TCP Cloud connectivity (1 second latency)

- Best in class current consumption (~55uA for DTIM 10) for always on Wi-Fi connectivity improves battery life
- Wi-Fi + BLE 5 support in a single SoC/module reduces, cost, size and integration effort
- 15-20Mbps application throughput in embedded mode (Note: depends on the environment, application and main processor)
- Highest BLE output power with integrated PA (18 dBm) providing longer range
- Integrated coexistence manager ensures seamless Wi-Fi + BLE operation
- Extensive security support (SSL, WPA/WPA2 and enterprise security) to ensure end user security

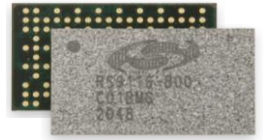
Further details on Wi-Fi Power Optimization in IoT Devices in [WFI-201 Course](#)

Silicon Labs' Wi-Fi Benefits for IoT



Ultra-Low Power Consumption for Battery Operated Devices

- **Industry leader in Low power Wi-Fi + BT/BLE 5**
 - 55uA stand-by associated current at DTIM10
- **Industry leader in small form-factor design**
- **Integrated wireless stacks, networking stacks, cloud connectivity and security**
 - Embedded Wi-Fi, BT/BLE and TCP/IP stacks
- **Integration with Silicon Labs' MCU/Wireless solutions, Simplicity Studio v5**
 - Low power MCUs, Simplified development and Security
- **Supports Matter over Wi-Fi for easier deployment**
- **Enables forward compatibility with next gen Wi-Fi 6 solutions**





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