WF-201

The Wi-Fi IoT Developer Journey to Achieve Ultra-Low-Power

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SILICON LABS

Agenda

1 Developing an IoT Application

2 Wi-Fi Developer Journey

3 Getting Started

4 Develop

5 Deploy Product

6 Conclusion

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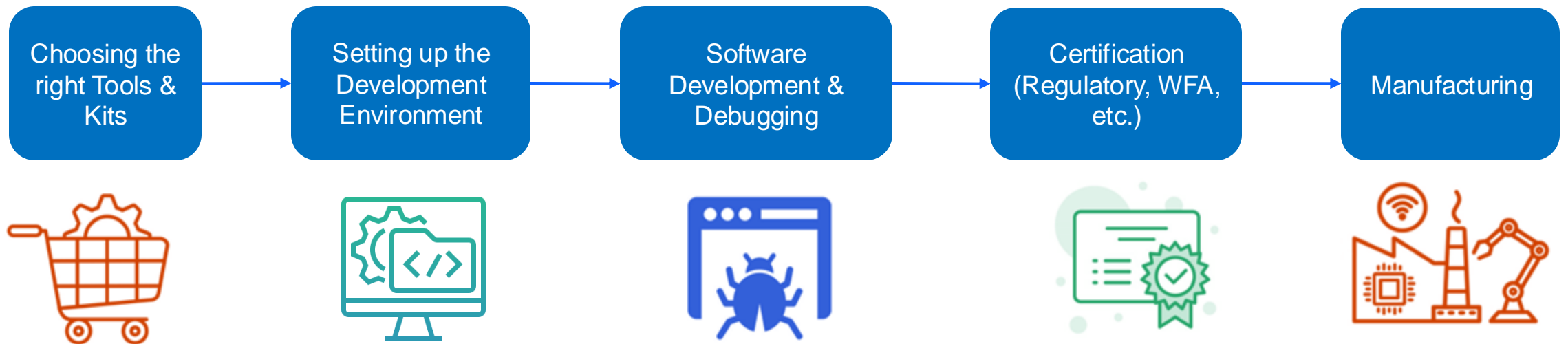# Developing an IoT Application

- **Development tools**
  - How to choose the right tool set for your project?

- **Power design**
  - How to optimize SW to minimize energy consumption?

- **Certifications**
  - WFA, Bluetooth SIG, CSA, RF regulations, etc
  - How to minimize effort and time?

- **Security design**
  - How to protect against remote and local threats?

- **Manufacturing**
  - Flash Programming, Security Keys, Certificates, etc
  - How to reduce risks, costs, and time to launch?

LAUNCH

START

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What's Wi-Fi Developer Journey?

End-to-End Guide for IoT developers

- Available https://www.silabs.com/wireless/wi-fi/wi-fi-developer-journey

| Choosing the right Tools & Kits | → | Setting up the Development Environment | → | Software Development & Debugging | → | Certification (Regulatory, WFA, etc.) | → | Manufacturing |

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Wi-Fi Developer Journey

Getting Started   Develop   Deploy Product

Learn More on www.silabs.com/wi-fi-development
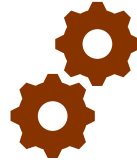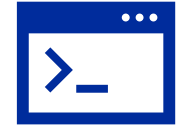
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Getting Started

Buy a Kit

Download Development Tools

Set Up Development Environment

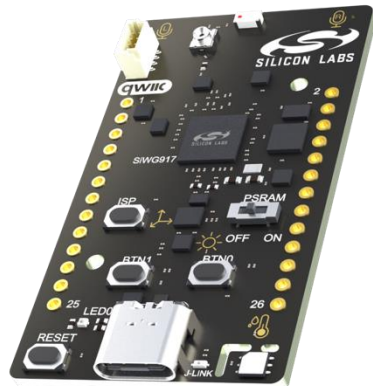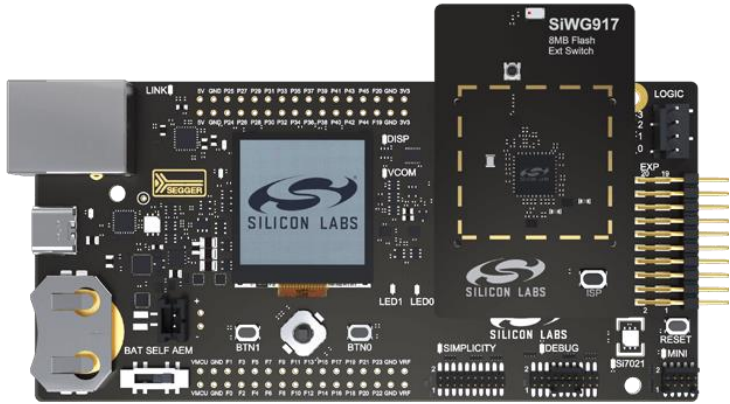**Flash a Demo**

Explore Demos

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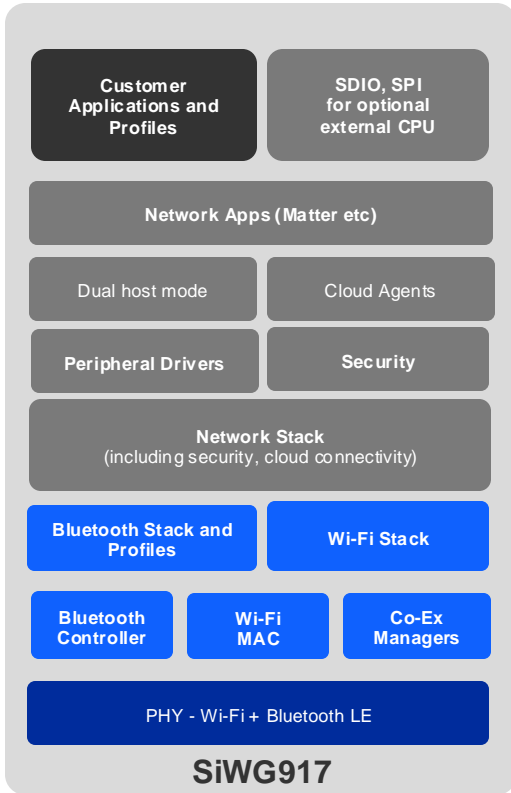
Choosing the Right Kit
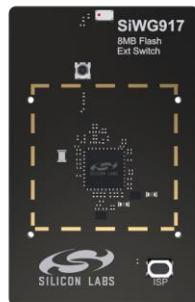
- **Software Architecture:**
  - SoC, NCP, RCP

- **IC or Module?**

- **Flash Requirement**

- **Memory Requirements**

- **Host Processor:**
  - Linux (x86/Arm) ⟶ RCP
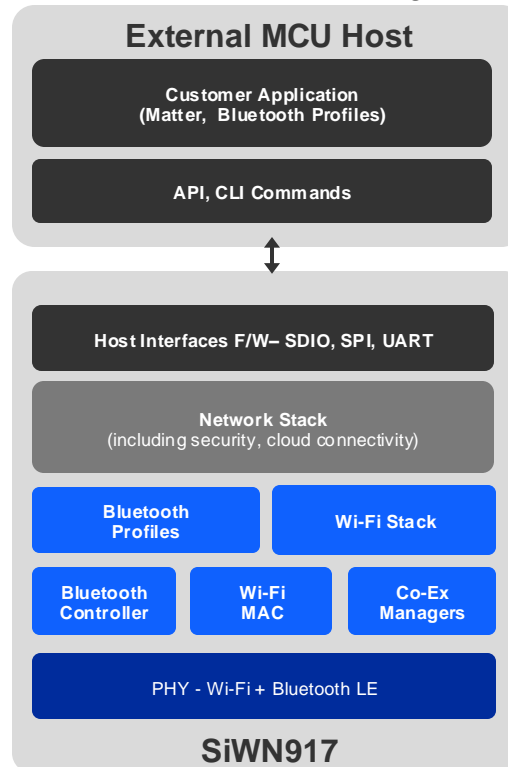 - FreeRTOS ⟶ NCP

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SiWx917 Software Architecture

SOC- MCU FOR APPS

- Hostless – No external host needed

- Application, Wireless, and networking stacks run on SiWG917

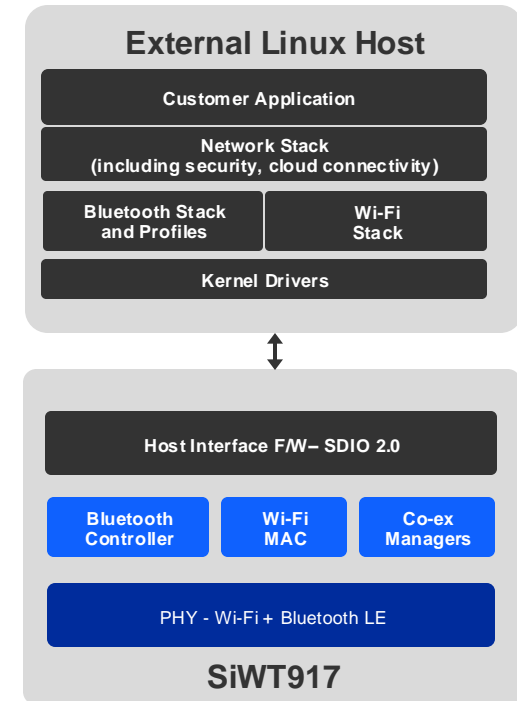| Customer Applications and Profiles	SDIO, SPI for optional external CPU
Network Apps (Matter etc)	
Dual host mode	Cloud Agents
Peripheral Drivers	Security
Network Stack (including security, cloud connectivity)	
Bluetooth Stack and Profiles	Wi-Fi Stack
Bluetooth Controller / Wi-Fi MAC / Co-Ex Managers	
PHY - Wi-Fi + Bluetooth LE	

SiWG917

NETWORK CO-PROCESSOR

- Hosted – Network Co-Processor (NCP)

- Host MCU runs RTOS, application code, cloud agent, and Matter

- SiWN917 runs Wi-Fi and Bluetooth radios, wireless and networking stacks

External MCU Host

Customer Application (Matter, Bluetooth Profiles)
API, CLI Commands

Host Interfaces F/W– SDIO, SPI, UART
Network Stack (including security, cloud connectivity)
Bluetooth Profiles / Wi-Fi Stack
Bluetooth Controller / Wi-Fi MAC / Co-Ex Managers
PHY - Wi-Fi + Bluetooth LE

SiWN917

RADIO CO-PROCESSOR

- Hosted - Radio Co-Processor (RCP)

- SiWT917 radio transceiver mode for Wi-Fi and Bluetooth

- Linux host runs wireless, networking, and security stacks

External Linux Host

Customer Application
Network Stack (including security, cloud connectivity)
Bluetooth Stack and Profiles / Wi-Fi Stack
Kernel Drivers

Host Interface F/W– SDIO 2.0
Bluetooth Controller / Wi-Fi MAC / Co-ex Managers
PHY - Wi-Fi + Bluetooth LE

SiWT917

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SiWx917 SoC Pro Kit (PK6031A)

Supports Standalone SoC Mode

- Includes an SDK for Wi-Fi, Bluetooth, Matter, and networking functionality
- Examples for Matter, ultra-low power, IoT Cloud connectivity with AWS and Azure
- Additional sample demo code for peripherals I/Os (timers, interrupts, SPI, I2C, PWM, ADC, UART, etc.)

Radio Board
RB4338A

Main Board
Si-MB4002A
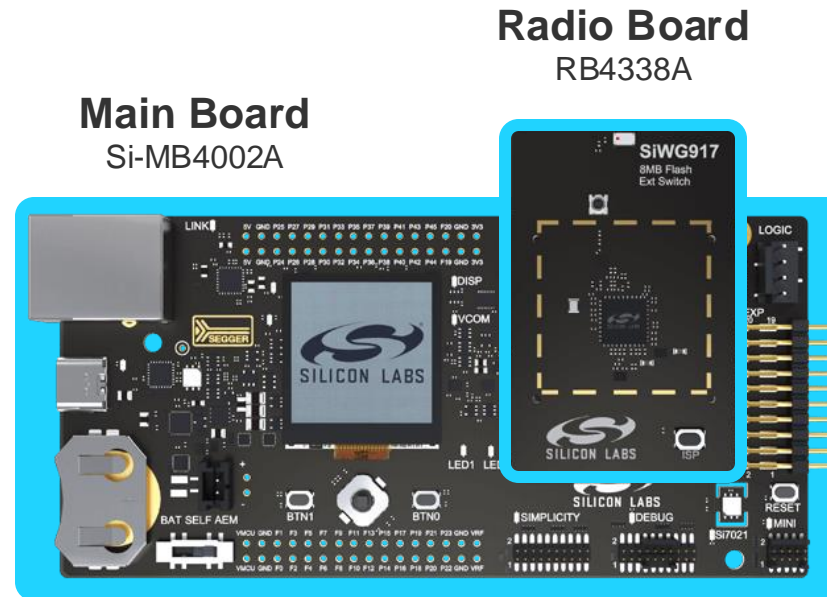
Development Environment

- Simplicity Studio IDE and Debugger Integration
- Advanced Energy Measurement for ultra-low power
- Command line interface, Universal Configurator
- Datasheet, Getting Started Guide, API and HW Reference Manuals

* Planned/roadmap

SoC Dev Kit: SiWx917-DK2605A

Supported Wi-Fi Modes

- Station Mode: Connect Dev Kit to an Access Point
- Access Point Mode: Connect to Dev Kit Access Point

Simplicity Connect Mobile App

- Connect SiWx917 using BLE
- Provision Dev Kit into Wi-Fi Network
- Display sensor data (Windows Browser can be used if Mobile app isn't available)
- User Settings (e.g. Sensor update rate)

Station Mode

AP

BLE

Dev Kit

Simplicity Connect Mobile app
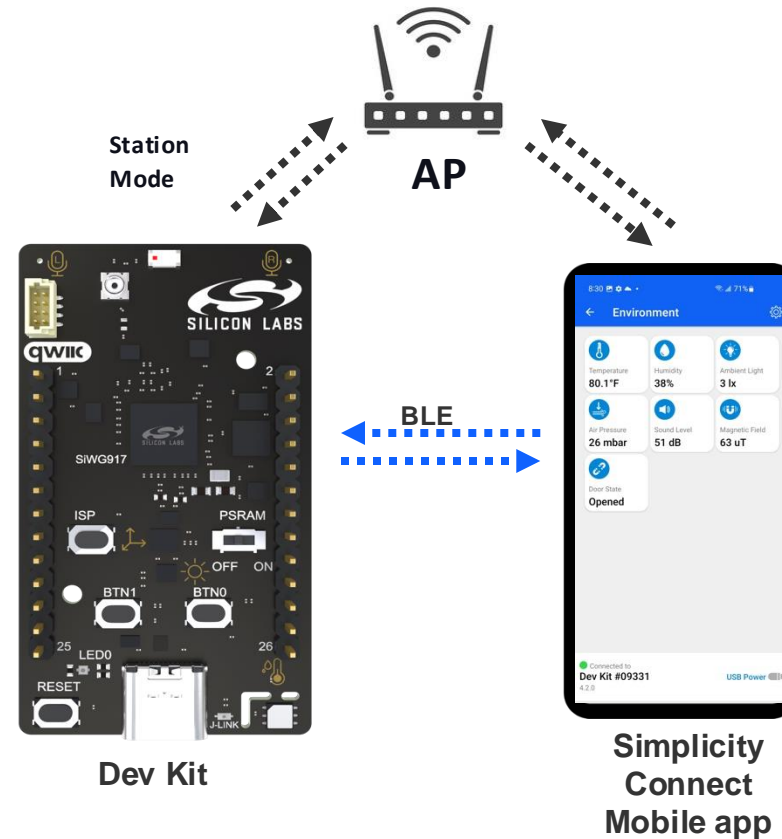
Demo Capabilities

- Report raw sense data (Temp, Humid, Ambient light)
- SiWx917 can go into sleep mode, if idling (low-power supported in Station Mode)
- Wake up by pressing user button or on motion sense detection

On-Board Sensors

- Temperature Sensor (Si7021)
- Humidity Sensor (Si7021)
- 6-axis inertial sensor (ICM-20689)
- 2x Digital Microphones (ICS-43434)
- Ambient Light Sensor (VEML6035)

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SiWN917 Adapter Kits for External MCU Connected to NCP

Silicon Labs EFR32

SPI | **SDIO** | **UART**

STM32 Nucleo-64
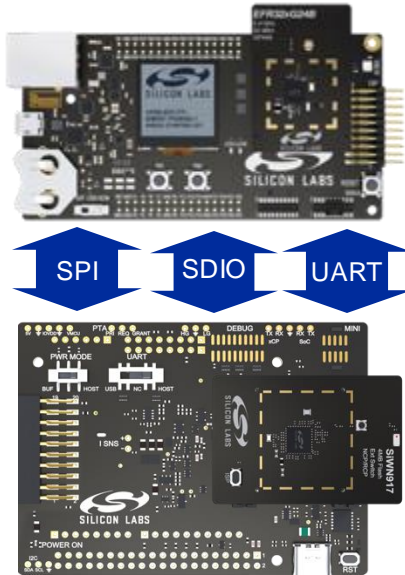
SPI | **UART**

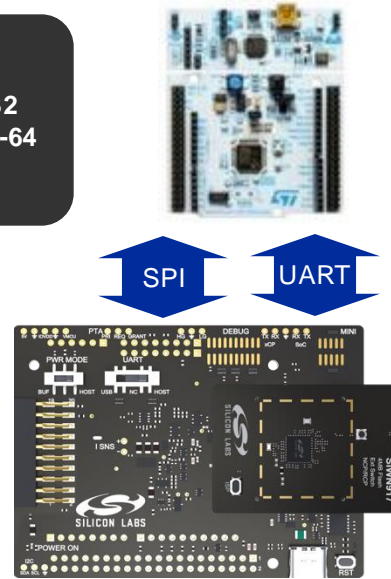## EFR32 ADAPTER (SI-EB8045A)

Adapter Si-EB8045A

- EFR32 MCU host on a Pro Kit
- SiWN917 Network Co-Processor

EXP

- SPI, UART, SDIO*
- Packet Traffic Arbitration
- Power and Power save control signals

STM32 ADAPTER (SI-EB8045C)

Adapter Si-EB8045C

- STM32 Nucleo-64 host (Arduino Shield compatible)
- SiWN917 Network Co-Processor

Arduino Shield

- SPI, UART
- Packet Traffic Arbitration
- Power and Power save control signals

GETTING STARTED

- **WiSeConnect v3 for NCP**

- **WiSeConnect™ SDK v3.x:**
  - EFR32™ Host in NCP Mode
  - STM32™ Host in NCP Mode

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SiWT917 RCP Adapter/Expander Kits for Linux on SDIO

Rasperry Pi
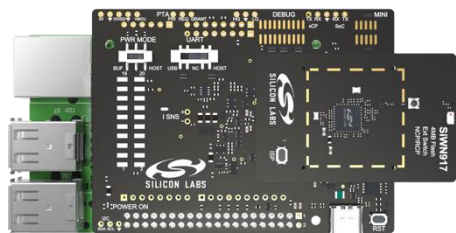
SDIO

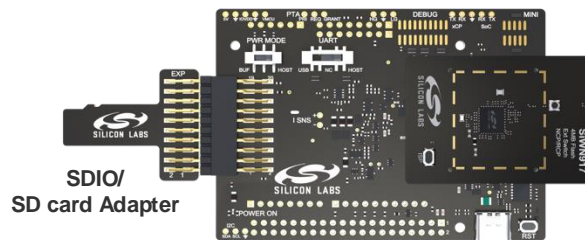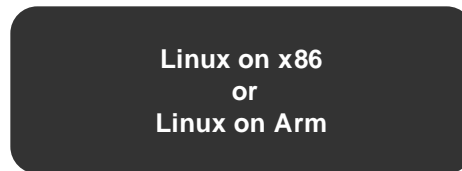## RASPBERRY PI 4 ADAPTER (SI-EB8045B)

Adapter Si-EB8045B

Preferred

- Raspberry Pi 4 host
- Silicon Labs provided Linux image
- SiWT917 RCP Co-Processor

RPI Hardware Attached on Top (HAT)

- SDIO data interface
- Power

Linux on x86
or
Linux on Arm

SDIO

SDIO/
SD card Adapter

SDIO / SD CARD ADAPTER (SI-EB8045A)

Adapter Si-EB8045A

- Linux x86 or Arm Host
- SiWT917 RCP Co-Processor

SDIO microSD form factor

- SDIO 2.0 adapter, 4bit full speed mode
- 50MHz Clock

GETTING STARTED

- Linux Kernel support 3.18 – 5.93
- [Link to Release Notes](#)
- Datasheet 0.5

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Develop

Create a sample application

Develop & Debug

Test and Iterate

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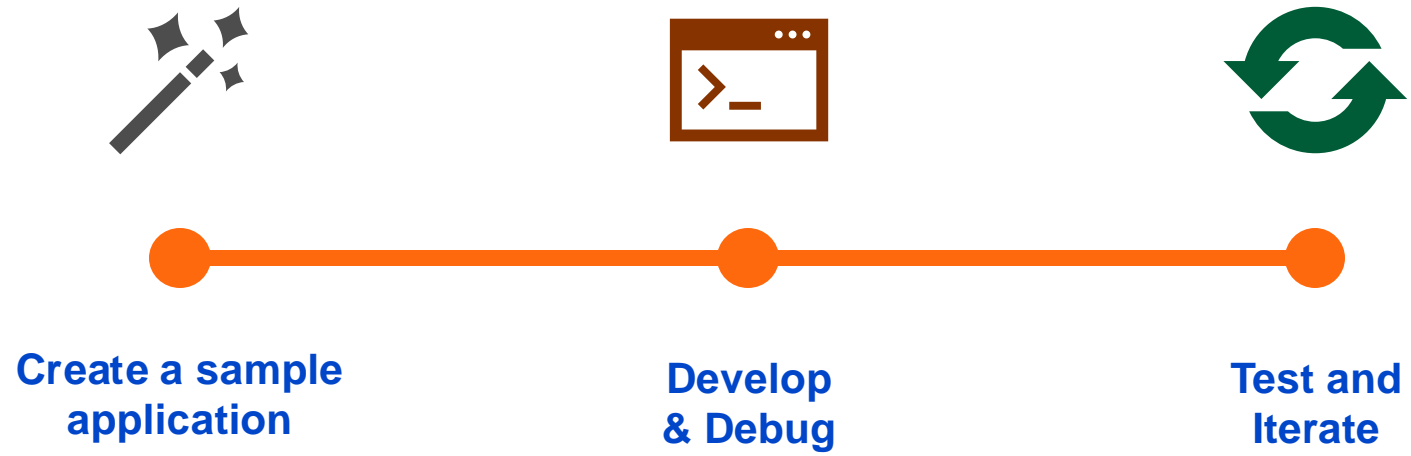
Set Up Development Environment

Simplicity Studio is Silicon Labs' main IDE for all IoT products

- Includes programmer and debugger functions

- No manual setup

- Recognizes your board, identifies applicable sample applications and SDKs

- Simplicity Commander
  - Device Information – OPN, flash mode, firmware version, MAC address etc.,
  - Update connectivity firmware and application images
  - Mass production

Download here:

- https://www.silabs.com/developers/simplicity-studio

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Explore Applications

- Many applications available

- Modify reference code

- Simplify your development

Cloud Connectivity (AWS, Azure)

Low Power

Throughput

Peripherals

FW Upgrade (OTA)

Learn more on Simplicity Studio…

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Create your own Application

Create your own Application (SiWx917 SoC)

Memory Requirement

- 672 kB total SRAM shared between NWP and M4 available

- Three memory configurations available:
  1. 352 kB (NWP) and 320 kB (M4)
  2. 416 kB (NWP) and 256 kB (M4)
  3. 480 kB (NWP) and 192 kB (M4)

Create your own Application (SiWx917 SoC)

- Wi-Fi Requirement
  - Station mode
  - Access Point mode
  - Concurrent mode (STA + AP)
  - Multi protocol (Wi-Fi STA + BLE)

Wi-Fi - Station Ping (SoC)
Demonstrates how to send an ICMP ping request.
CREATE
View Project Documentation

Wi-Fi - Access Point (SoC)
Start a Wi-Fi Access Point with WPA2 security
CREATE
View Project Documentation

Wi-Fi - Concurrent Mode (SoC)
Start Wi-Fi Client and Wi-Fi Access Point with WPA2 security
CREATE
View Project Documentation

Wi-Fi Coex - Wi-Fi Client BLE Provisioning (SoC)
This application explains how to connect to a Wi-Fi access point using BLE provisioning functionality.
CREATE
View Project Documentation

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Create your own Application (SiWx917 SoC)

Peripheral Requirement

- GSPI
- SSI
- I2C
- I2S
- ADC
- DAC
- PWM
- SDIO
- UART
- USART
- Watchdog Timer
- GPIO

SL Si91x - GSPI
Demonstrates how to use the GSPI interface on the Si91x SoC device.
View Project Documentation
[CREATE]

SL Si91x - SSI Master
Demonstrates how to to use SSI Master.
View Project Documentation
[CREATE]

SL Si91x - SSI Slave
Demonstrates how to to use SSI Slave.
View Project Documentation
[CREATE]

SL Si91x - I2C Driver Follower
Demonstrates how to use I2C Peripheral.'
View Project Documentation
[CREATE]

SL Si91x - I2C Driver Leader
Demonstrates how to use I2C Peripheral.
View Project Documentation
[CREATE]

SL Si91x - ULP I2C Driver Leader
Demonstrates how to use I2C Peripheral in ULP mode.
View Project Documentation
[CREATE]

SL Si91x - I2S Loopback
Demonstrates how to use the I2S loopback on the Si91x SoC device.
View Project Documentation
[CREATE]

SL Si91x - I2S Primary
Demonstrates how to use the I2S primary interface on the Si91x SoC device.
View Project Documentation
[CREATE]

SL Si91x - I2S Secondary
Demonstrates how to use the I2S secondary interface on the Si91x SoC device.
View Project Documentation
[CREATE]

SL Si91x - ADC FIFO Mode
Demonstrates the how to configure and use the ADC peripheral on the fifo mode on the the SiWx917 SoC device.
View Project Documentation
[CREATE]

SL Si91x - ADC Static Mode
Demonstrates the how to configure and use the ADC peripheral on the static mode on the the SiWx917 SoC device.
View Project Documentation
[CREATE]

SL Si91x - DAC
Demonstrates how to configure and use the DAC peripheral on the the SiWx917 SoC device.
View Project Documentation
[CREATE]

SL Si91x - ULP DAC
Demonstrates the how to configure and use the ULP DAC peripheral on the the SiWx917 SoC device.
View Project Documentation
[CREATE]

SL Si91x - PWM
Demonstrates how to to use pwm.
View Project Documentation
[CREATE]

SL Si91x - SDIO Secondary
Demonstrates how to to use SDIO Secondary.
View Project Documentation
[CREATE]

SL Si91x - UART
This example project configures UART transmits and receives data in full duplex mode.
View Project Documentation
[CREATE]

SL Si91x - ULP UART
Demonstrates how to to use ULP Uart.
View Project Documentation
[CREATE]

SL Si91x - USART SYNCHRONOUS MASTER
This example project configures USART master and transmits and receives data in synchronous full duplex mode.
View Project Documentation
[CREATE]

SL Si91x - USART SYNCHRONOUS SLAVE
This example project configures USART slave and transmits and receives data in synchronous full duplex mode.
View Project Documentation
[CREATE]

SL Si91x - Watchdog Timer
Demonstrates how to use the watchdog timer on the the SiWx917 SoC device
View Project Documentation
[CREATE]

SL Si91x - GPIO Example
Demonstrates pin interrupt for HP GPIO instance.
View Project Documentation
[CREATE]

SL Si91x - GPIO Group Example
Demonstrates group interrupts for GPIO HP, ULP instance.
View Project Documentation
[CREATE]

SL Si91x - GPIO ULP Example
Demonstrates toggling of GPIO pin and pin interrupts for ULP instance.
View Project Documentation
[CREATE]

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Create your own Application (SiWx917 SoC)

Application Protocol

- TCP
- UDP
- TLS
- MQTT/MQTTS
- HTTP/HTTPS
- SNTP
- ICMP

Wi-Fi - TWT Use case demo app (SoC)

Wi-Fi - TWT TCP Client (SoC)

Wi-Fi - Three TLS Concurrent Client Sockets (SoC)

n a TCP client

EATE

Wi-Fi - Embedded MQTT Client (SoC)

: will cor

Wi-Fi - AWS IoT MQTT Client (SoC)

Wi-Fi - Concurrent HTTP Server Provisioning (SoC)
Start a Wi-Fi Client and Wi-Fi Access Point in IPv4 and IPv6 simultaneously through provisioning from HTTP Server

CREATE

Wi-Fi - Concurrent HTTP Server(SoC)
Demonstrates how to create HTTP Server in concurrent mode

CREATE

View Project Documentation

Wi-Fi - Station Ping (SoC)
Demonstrates how to send an ICMP ping request.

CREATE

View F

Wi-Fi - Throughput

W

De

Wi-Fi - HTTP Client (SoC)
Demonstrates how to create HTTP c
operations with the server opened or

View Project Documentation

Vi

View Project Documentation

CREATE

Wi-Fi - Embedded MQTT Client TWT
Demonstrates how to build an MQTT client with

Wi-Fi - Station Ping V6
Demonstrates how to send an ICMPv6 ping request.

CREATE

CREATE

View Project Documentation

Wi-Fi - HTTP OTAF Update (SoC)
Demonstrates how to perform firmware upgrad
a cloud storage server

View Project Documentation

a cloud storage server with TWT

HTTP(S) server or

CREATE

View Project Documentation

Wi-Fi Coex - Wi-Fi Client BLE Provisioning with AWS (SOC)

Wi-Fi Coex - Wi-Fi Client HTTPS BLE Dual Role(SOC)
This example demonstrates the ability of SiWx91x device connecting and transferring the data simultaneously in BLE/WiFi wireless interfaces.

CREATE

REATE

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Create your own Application (SiWx917 SoC)

Low Power Requirements

M4 Power Modes

Active

Standby

Sleep

Deepsleep/ Shutdown

Cortex M4 + Network Processor

SiWG917

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NWP Low Power Modes

Connected

Legacy Associated Power Save

Target Wake Time based Power Save

Unconnected

Standby Power Save with Retention

Standby Power Save without Retention
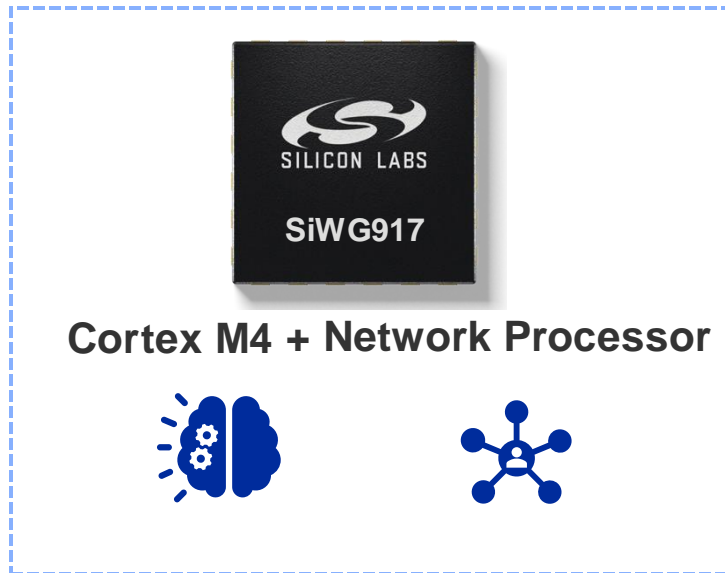
AN1430: SiWG917 Low-Power Application Note

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Debug

- Compilation Errors

- Task handling

- Memory Issues

- Blocking APIs

- Application prints

- Data transfer Issue

Your design

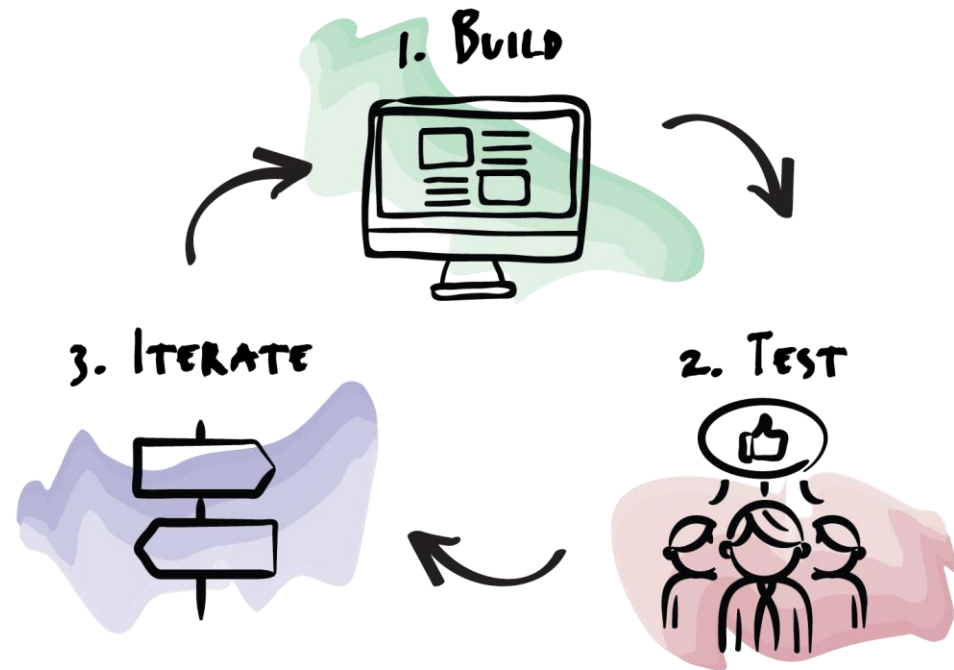works with | SILICON LABS
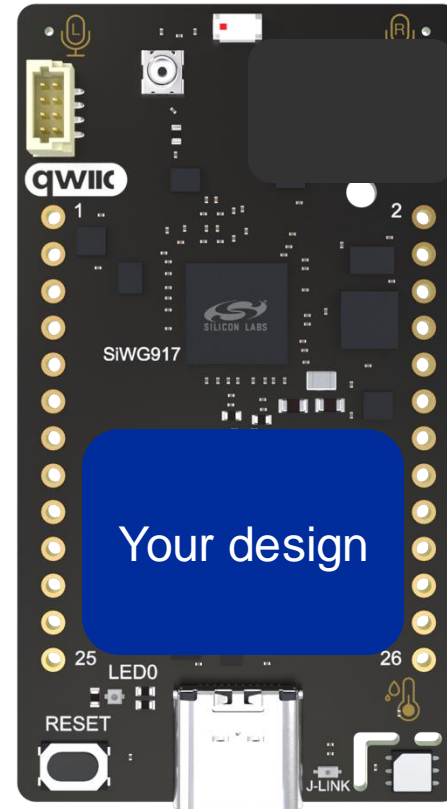
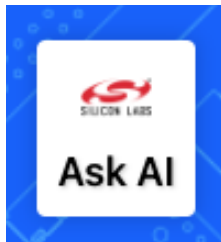# Test and iterate

Based on your application requirement

- Low-power consumption

- Throughput

- Latency

- Connectivity Issues

Make your application robust

Wi-Fi Software Development / Support

- [WiSeConnect support](#)

- [Docs.silabs.com / AskAI](#)

- [Application Notes](#)

- [Silicon Labs Community](#)

- [Tech Talks / On-demand webinars](#)

Deploy Product

Qualify Product

Manufacturing

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Qualify Product

- Regulatory Certifications

- SiWx917 is a Wi-Fi pre-certified IC

- RF certified modules: Turnkey certification

- Wi-Fi Alliance Certification:
  - Quick Track enabled for customers
  - Certification FW & collateral provided

- Silicon Labs RF certification guidelines
  - AN1437: SiWx917 RF Regulatory Testing

AN1437: SiWx917 RF Regulatory Testing

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Manufacturing

Manufacturing utility guide covers various device configuration aspects such as memory, security, flashing, and much more:

- **UG574: SiWx917 SoC Manufacturing Utility User Guide**

- **UG575: SiWx917 NCP Manufacturing Utility User Guide**

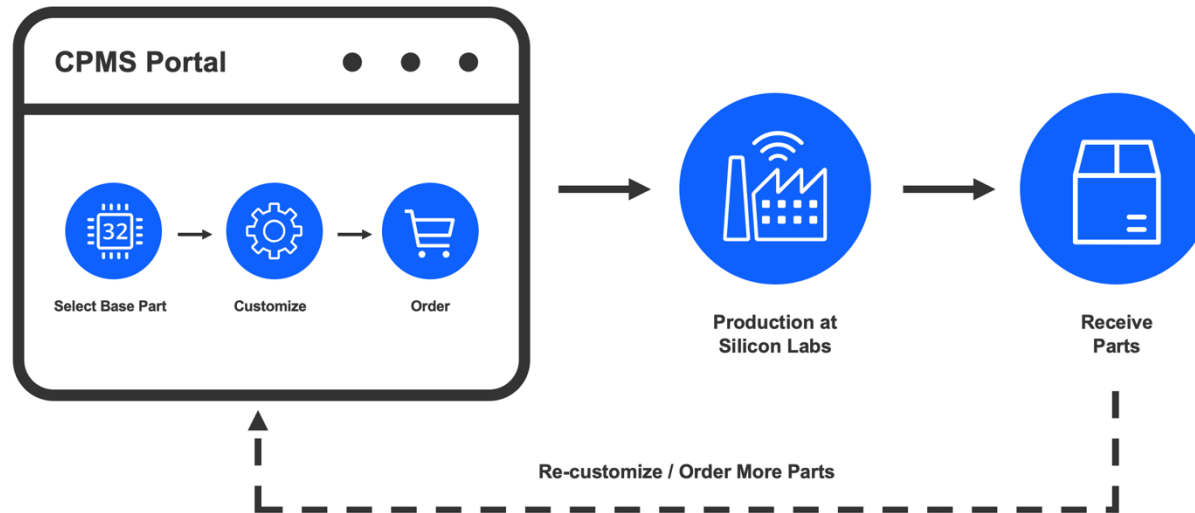For final RF adjustments, please check our AN1440: SiWx917 Gain Offset Calibration guide.

- **AN1440: SiWx917 Gain Offset Calibration**

Note: Silicon Labs Radio Boards and Kits have been calibrated and to be used as layout reference. IC customers need to calibrate their custom board's gain and frequency offset values.
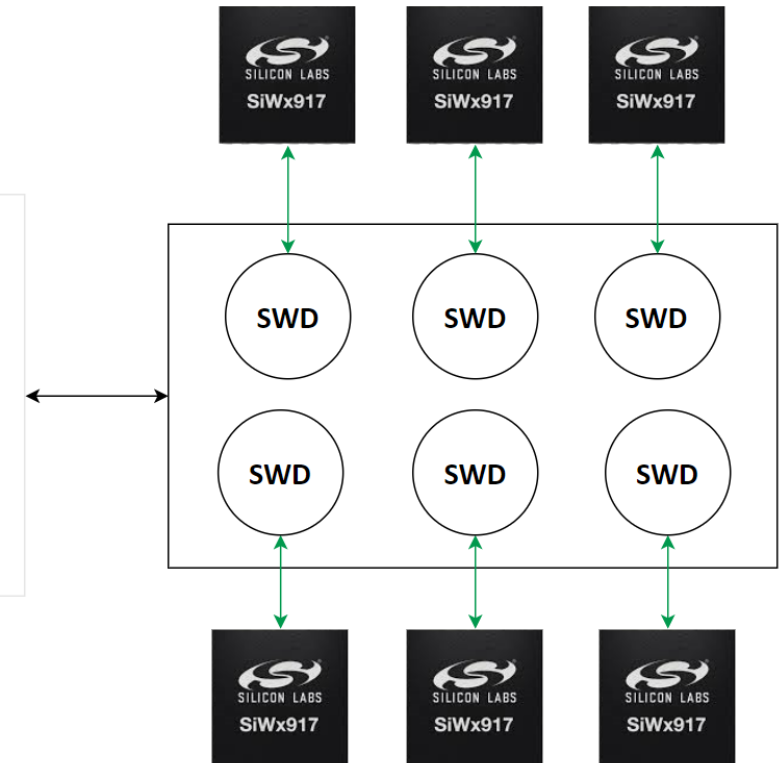
Custom Part Programming for Wi-Fi

- CPMS – Custom Part Manufacturing Service
  - Secure programming for ordering customized Silicon Labs products

CPMS Portal

Select Base Part → Customize → Order

Production at Silicon Labs → Receive Parts

Re-customize / Order More Parts

- SiWx917 ICs and modules
  - Features include: Unique Ordering part number, FW flash programming, custom IC package markings

- Benefits:
  - Pre-programmed parts save you time and effort in manufacturing
  - Avoids the risks of a CM programming your parts
  - Prevents programming errors
  - Unique part number prevents unauthorized over-production and over-pricing
  - Custom-markings hide the technology you are using, preserving your competitive advantage

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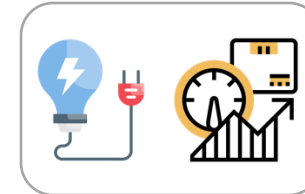
Conclusion

New Application Requirement

Evaluate the SiWx917 Wi-Fi and familiarize with the development environment
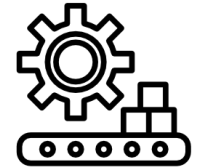
Create the hardware design

Develop and debug your application

Test & Iterate - power consumption, throughput etc.,

Qualify the product (Certification)

Manufacturing the product

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www.silabs.com/wi-fi-development

Thank You