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CONNECTED INTELLIGENCE

Wi-Fi Power Optimization Examples for Six IoT Devices

How distinguished wireless specialists optimize power for Wi-Fi IoT devices - Six examples

Authors: Nicola Wrachien, Kalevi Ratschunas, Tristan Cool, Jeremy Stacy, Mikko Nurmimaki, Divya Chilukoti

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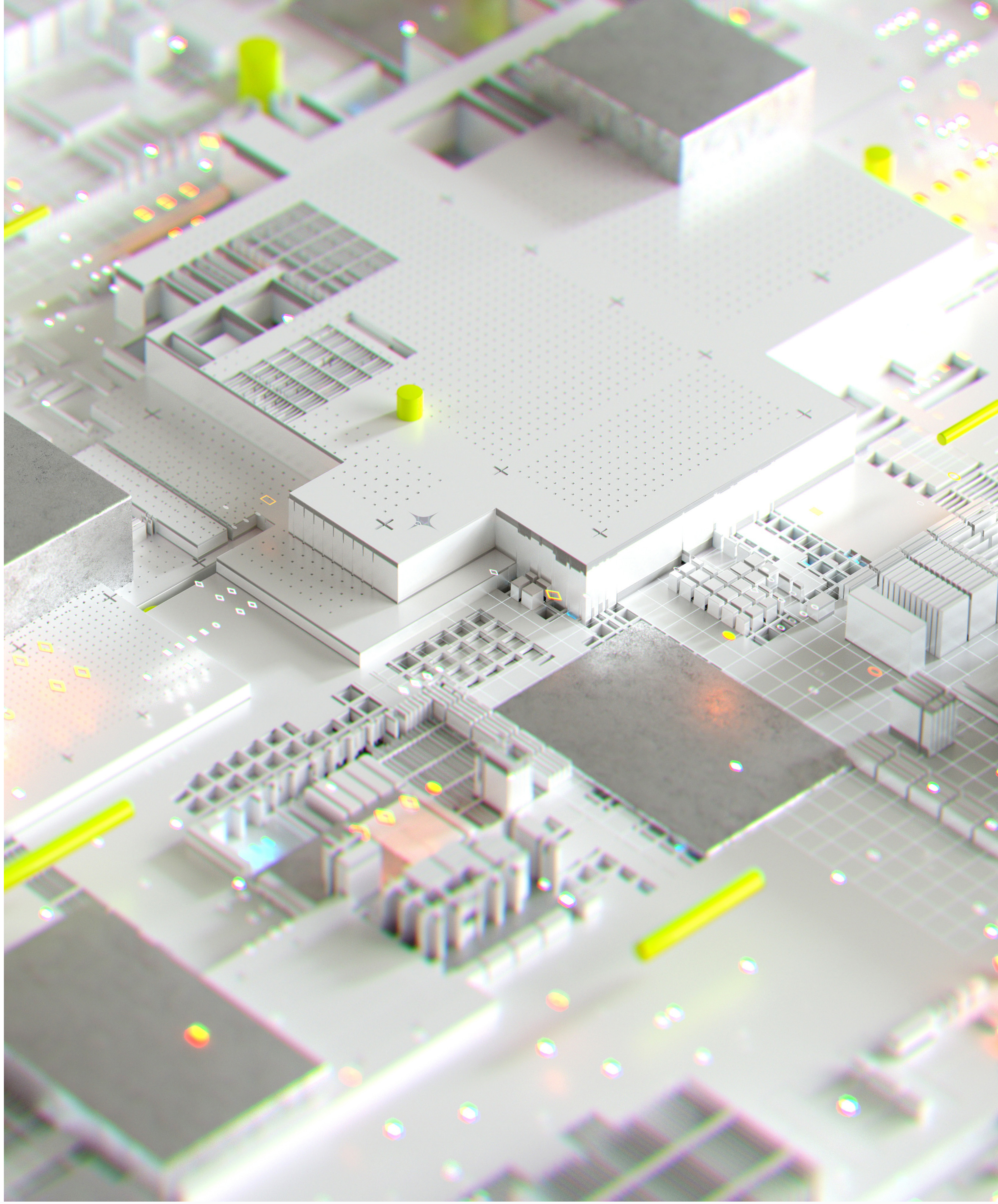
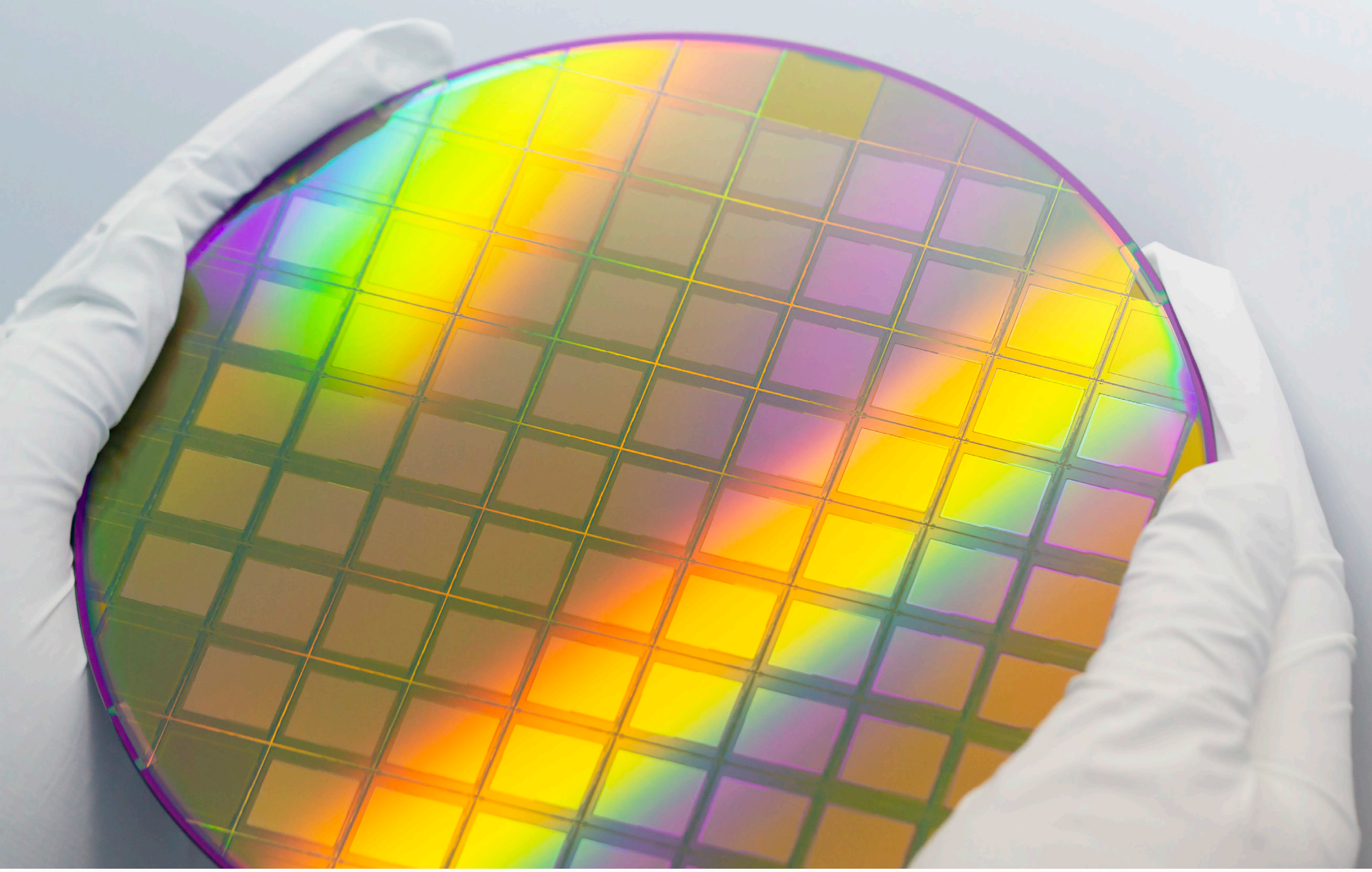


About this Whitepaper

Silicon Labs' SiWx917 is an ultra-low-power Wi-Fi 6 wireless MCU tested to enable years of battery-life and low standby current on smart IoT devices. However, optimizing the SiWx917 and the Wi-Fi protocol for your design can be challenging. In this whitepaper, specialists from the Silicon Labs Developer Services Team and Sigma Connectivity, a global design and engineering service provider, share their best-practice design guidelines for six low-power Wi-Fi IoT device examples, helping you to avoid common pitfalls and save time.



Six Low-Power Wi-Fi Device Examples

1. IoT Sensor
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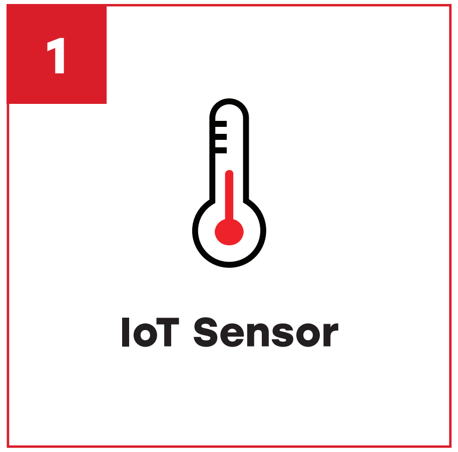


IoT Sensor

This section describes the basic principles of low-power Wi-Fi design for IoT sensor devices that sleep most of the time, read and store a sensor reading in short intervals, and transmit the collected data to the cloud periodically. The sensor is disconnected from the Wi-Fi AP during the sensing cycles and it transmits the data to the cloud server (e.g. MQTT) periodically based on a timer. Examples of these types of IoT sensors with intermittent connectivity include home weather stations, humidity and temperature sensors, oxygen sensors, occupancy sensors, and window/door intrusion alarm contacts.

For wireless IoT sensors, data transmission is the most power consuming operation. For Wi-Fi, this could translate to hundreds of milliamperes (mA). To reduce power consumption, transmission frequency and duration must be minimized. The SiWx917 provides a highly energy-efficient platform for these types of sensors. The ULP and analog peripherals can collect data while the network processor (NWP) and/or application MCU are idle. This keeps the total system power at an extremely low level during the sensing cycles. The NWP and application MCU wake up periodically only for communicating the data.

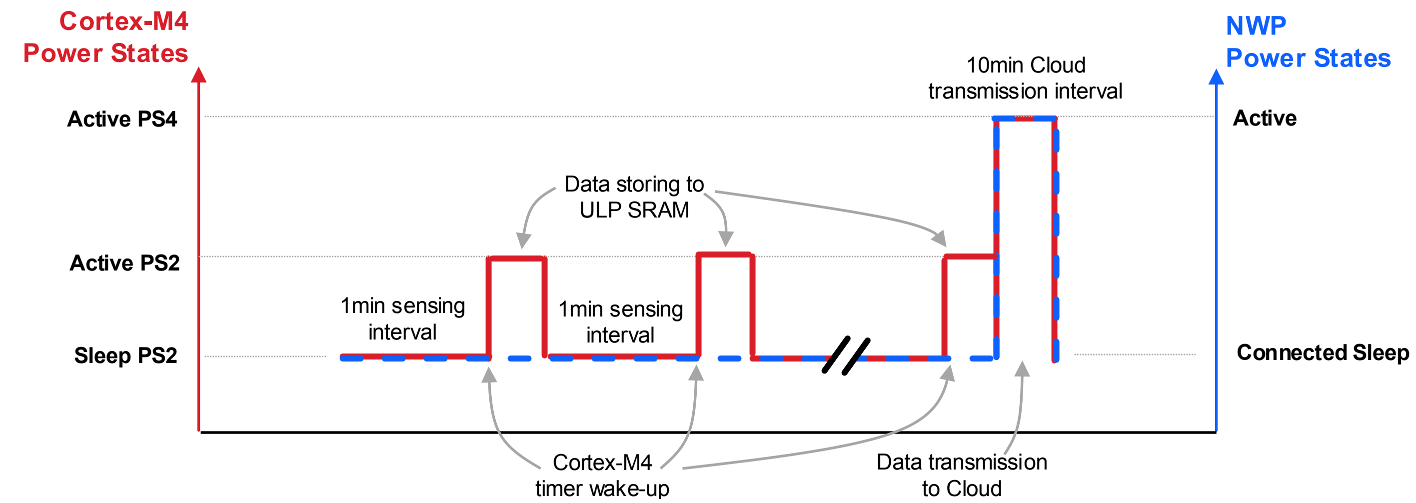
If the sensor device operates in a Wi-Fi 6 network, it can establish a target wake time (TWT) agreement with the AP. The longer the sleep interval, the more the device saves power. Typically, the temperature or humidity vary slowly, so the TWT interval can be set to one minute or even longer. TWT also reduces the probability of collisions with other clients, minimizing retransmission events, and saving power.

The SiWx917 ultra-low-power (ULP) peripherals in combination with Wi-Fi 6 TWT are an ideal solution for IoT sensors that only transmit data periodically. Because the sensing cycle can run on the ULP peripherals while NWP and/or application MCU are idle, you can extend the TWT interval to reduce power consumption and maximize battery life.

If the IoT sensor must support ad-hoc interrupt signals received from peripherals and transmit data outside of the agreed TWT service period (SP), there are a couple of options to enable this. If frequent transmissions are expected with a short notification time (e.g. a few seconds), a short TWT interval is recommended. If the occurrence of transmissions is very sporadic (e.g. fire alarm), transmitting outside the SP could turn out to be a more energy-efficient solution. However, in this case a power consumption penalty should be factored in. If the sensor is expected to receive large amounts of data (e.g. firmware update), TWT teardown or re-negotiation of TWT agreement should be considered.

Power State Transitions

IoT Sensor, Periodic Cloud Connectivity



This is an example of the power state transitions of an IoT sensor scheduled to collect/store data at frequent intervals and transmit data to the cloud periodically. With relatively short idle periods like one minute, you can use the Sleep PS2 mode with RAM retention for the application MCU. It allows the MCU to go to Active PS2 after wake-up, saving boot up time. In Shutdown PS0, the application would have to boot up and initialize, which consumes power and time, so it is recommended for longer sleep periods such as several hours.

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1010
1010

Data Logger

Data Logger

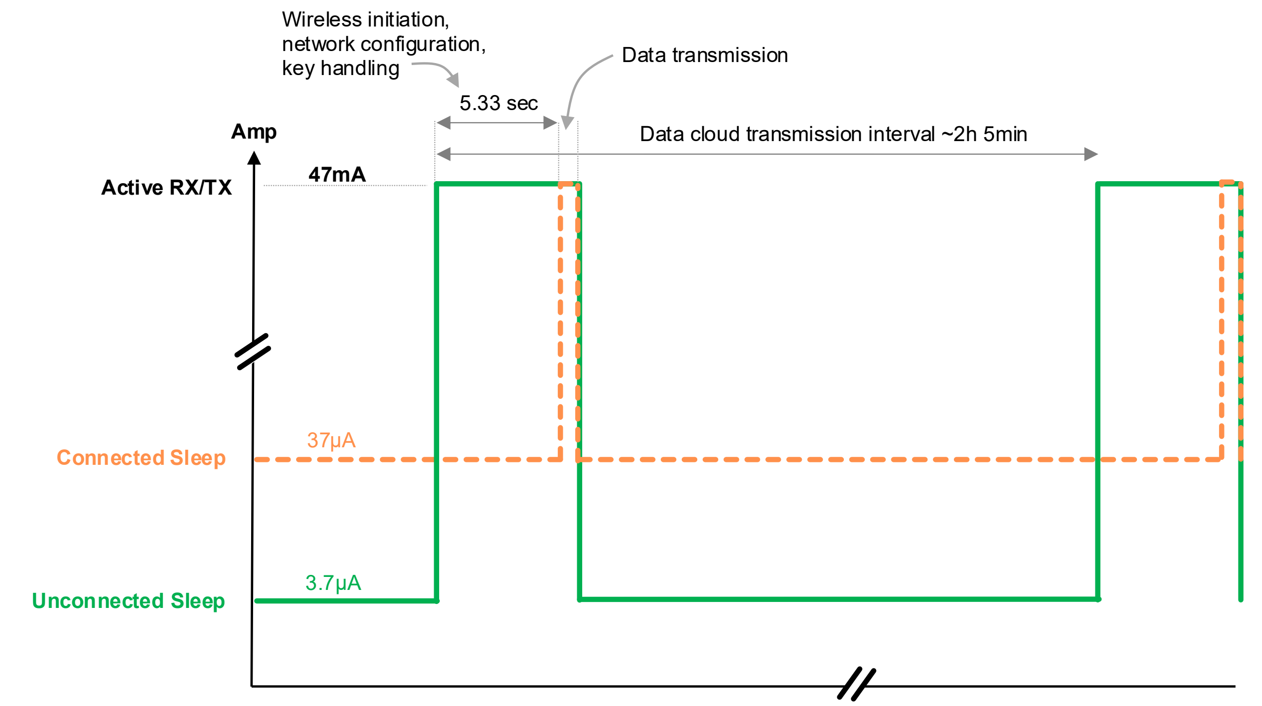
This section considers low-power Wi-Fi design principles for Wi-Fi IoT devices with a very long connectivity interval. So-called data loggers collect data with a certain interval and the data is uploaded to the cloud periodically over Wi-Fi. In this case, the interval of communicating with the cloud could be several hours or even longer.

The SiWx917 provides at least two feasible Wi-Fi power-saving solutions for data loggers: the connected sleep and unconnected sleep modes. The optimal choice depends on your application requirements, especially the cloud connection interval. The following example examines optimal connectivity interval using nominal values based on the [AN1430 SiWx917 Low-Power Application Note].

The nominal current consumption of the connected sleep mode is 37 μA, which is roughly one order of magnitude higher than the unconnected sleep with PS0 shutdown mode, 3.7μA. However, with the unconnected sleep, you must factor in the extra power consumed by the wireless initiation process, which is not needed in the connected sleep mode (AP connection and network context are maintained during sleeping).

The entire wireless initiation process can take several seconds (assuming 5.33 sec here) for the device including the wake-up, network scanning, completion of the IP connection, and establishment of transport layer security. During this process the average current consumption can be tens of milliamperes (47 mA assumed here).

When the wireless initiation overhead is factored in, it takes 7,500 seconds (2h and 5 minutes) for the unconnected sleep mode to get on a par with connected sleep, when the nominal current consumption is used for connected and unconnected sleep modes. In conclusion, connected sleep gives you a better overall power budget than unconnected sleep when the connectivity interval is approximately two hours or shorter. For intervals longer than two hours, the unconnected sleep with its extremely low average current consumption and high-power wireless initiation will deliver lower total energy consumption. Note, this estimation is based on nominal values per the [AN1430 SiWx917 Low-Power Application Note] and actual values will depend on local RF conditions.



Connected Sleep vs. Unconnected Sleep: Despite the significantly lower current consumption of unconnected sleep, connected sleep provides a lower total energy consumption with connectivity intervals below 2h 5 min. Because of the high wireless initiation overhead and thus longer active transmit and receive duration involved in unconnected sleep, it is optimal for applications with a long cloud communication interval (here 2h 5 min or longer). Note, this estimation is based on nominal values (AN1430) and actual values will depend on local RF conditions, AP model, and other parameters.

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Cloud-Connected Smart Device

Cloud-Connected Smart Device

In this section we will discuss the low-power Wi-Fi design aspects of always-on cloud connected devices such as smart locks, motorized window and closures, burglar alarms, and water leak detection sensors.

Always-on cloud connected smart devices differ from the IoT sensor devices because of their requirement for low-latency, bi-directional data communication. The open/close request can come to a smart door lock or a window shade remotely from the cloud, meaning that the device must frequently wake-up and check if there is data pending on the Wi-Fi AP buffer. A leak detection sensor or burglar alarm might provide an interrupt signal to the device any moment and an immediate wake-up and connection is required. For these use-cases, the device's wake-up interval should be short, for example one second, or a few seconds at maximum depending on the application.

Wi-Fi Protocol Power-Saving Strategies for Cloud-Connected Smart devices

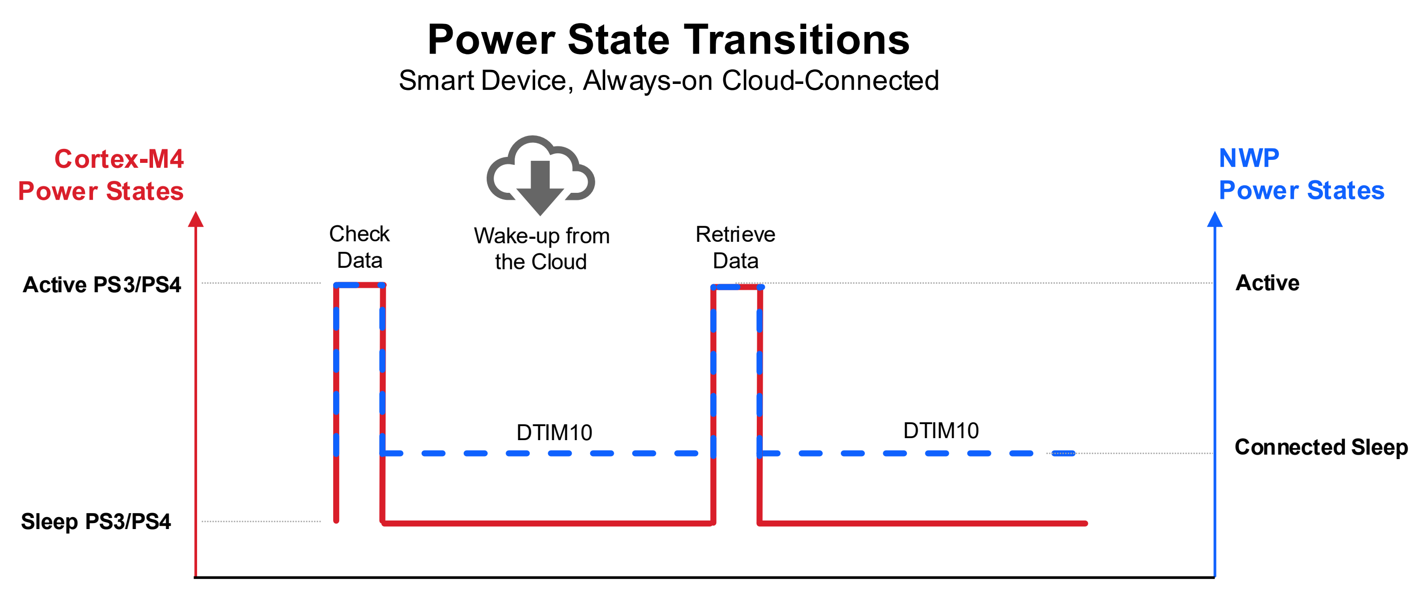
Using Legacy Power Saving

When an alert is triggered by a local interrupt signal (e.g., motion sensor detects an intrusion, CO level exceeds a threshold), the device shall wake-up immediately and communicate the event to the cloud as soon as possible.

In case there is no alert, (i.e. oxygen level is good, no intrusion detected), the device wakes up based on its DTIM interval setting to check the AP for incoming packets. Also, the report (transmission) of the status can be performed with a more relaxed frequency. Status reporting is recommended even in case there is no alert to ensure that the device is working correctly.

Using TWT

The longer the sleep interval is, the more energy-efficient TWT gets. However, a long TWT interval increases latency and can deteriorate the user experience of some applications such as a smart lock. Example: Opening or closing a smart door lock using the cloud/app should be executed within seconds for the best user experience. A long TWT would not be feasible in this scenario.



Examples of power state transitions of a smart cloud-connected device. There are multiple alternatives for the MCU power management depending on the application characteristics. For high-throughput and low latency applications such as smart video doorbell, the Cortex-M4 MCU can be configured to switch states between the Sleep PS4 and Active PS4 states (full clock speed). For low-throughput applications such as a smart lock, the MCU can be configured to switch states between the Sleep PS3 and Active PS3 states (decreased clock speed). DTIM10 means that the NWP wakes up at a 1 sec interval to check the AP if there is pending data. Should there be data coming from the Cloud, the client retrieves it per DTIM schedule.

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Solar-Powered Wi-Fi Sensor

Solar-Powered Wi-Fi Sensor

Historically, Wi-Fi has been a power-intensive wireless protocol, prohibiting its use in energy-efficient applications such as long-life battery-powered IoT devices and devices powered by energy harvested from the environment. Thanks to the sheer energy-efficiency of the SiWx917 ultra-low-power Wi-Fi 6 wireless MCU, it is now technically and commercially viable to build compact, energy harvesting Wi-Fi connected IoT devices.

This section introduces a Wi-Fi connected smart home sensor powered by indoor light that doubles as a wall mounted notepad. The device is equipped with a Silicon Labs SiWx917 Wi-Fi 6 module that communicates the temperature readings to the cloud periodically. The system is developed for demonstration purposes by Sigma Connectivity, a global design house and engineering services group, and a long-term partner of Silicon Labs.

Main Components

This section provides a brief overview of the main components of the solar-powered Wi-Fi sensor board.

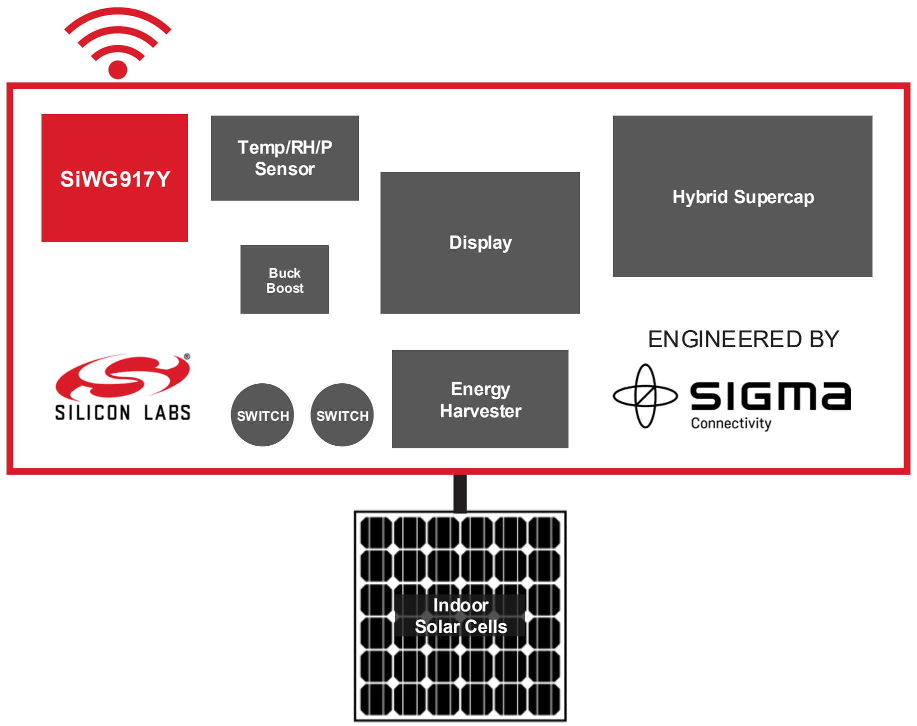
Wi-Fi Connectivity: The Silicon Labs SiWx917 Wi-Fi 6 module provides ultra-low-power Wi-Fi connectivity on the board at ~40 mA of power consumption while in sleep and connected to the Wi-Fi 6 Access Point (WLAN associated mode) using the TWT power saving.

Solar Cells: The board uses Epishine indoor solar cells in a multicell configuration with nine 6-cell units, each with an active area of 5x5 cm (total area 225 cm2), 3.6 voltage, maximum power point (MPP) at 500 LUX of 450 mW. The lamination on the cell surface can be partially used as a blackboard/notepad mounted e.g. on a wall or fridge.

Energy Harvester: The e-peas AEM10300 ambient energy management circuit extracts DC power from the solar cell element and stores energy in the hybrid super capacitor with a very high efficiency.

Buck Boost Converter: Texas Instruments TPS63900 buck-boost converters take energy from the super cap and provides stable 3.3V and 1.8V rails on the board. It provides a conversion efficiency of 90% at even low load currents (10mA). High efficiency is essential to minimize losses in conversation of energy from storage to the consumers of energy on board, especially in low duty-cycle applications (the system spends a large portion of its operation in sleep).

Hybrid Supercap: The Vinatech hybrid super capacitor provides a compact and thin, high capacitance, and low-leakage current energy storage for the system. The high-pulsed current rating of the hybrid super cap allows for providing current to the SiWx917 Wi-Fi 6 module during the TWT transmission bursts.



Display: Mikroe eINK click display adapter combined with a Waveshare E-paper display are connected via the SiWx917 GPIOs/ SPI bus to provide an on-board display for the system.

Temperature Sensor: Bosch BME688 multi-sensor is configured to provide temperature, relative humidity (RH) and air pressure measurements, consuming ~4 mA per 1 Hz reading. The sensor is powered from 1.8V domain to reduce power consumption.

Buttons: The board contains two switches; one for hardware reset and another one for future purposes such as passing Wi-Fi credentials over Bluetooth LE for commissioning.

How Does it Work?

The E-peas energy harvester circuit starts the system (buck boost regulators) when the voltage is above 2.7 V in the super cap storage and continues to charge the super cap up to a safe maximum rated voltage (customizable with all e-peas energy harvesters) as long as there is a sufficient level of illuminance. If consumed power is higher than the harvested energy and the storage voltage drops below 2.5 V the buck boost regulators are disabled.

The operational cycle of the system is straightforward. The ambient sensor measurement readings are fetched every two minutes, the on-board display is updated (if the values are changed), and the readings are sent to the cloud over Wi-Fi connection. The operational cycle starts over.

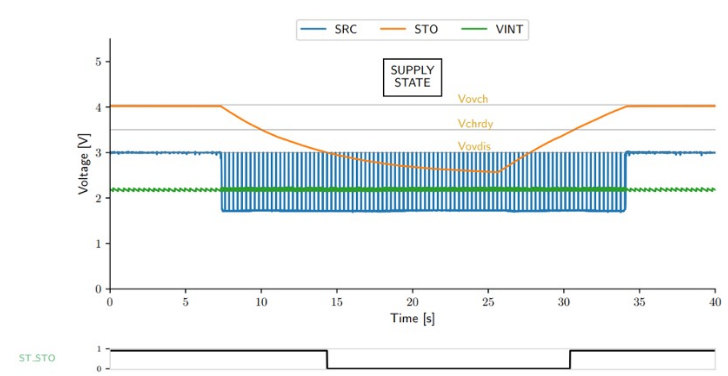


Figure: Supply state (e-peas)

Power Consumption

The indoor light powered Wi-Fi sensor features a 36 μA idle time current consumption (measured on a 3.2 V rail fed externally to buck-boost regulators) and 60 μA with TWT messages sent at frequent intervals. The overall average system current consumption is ~200 μA with a 2-minute display update and Wi-Fi transmission interval. (More energy can be saved by updating the display only if the sensor readings have changed).

For Wi-Fi connectivity, the initial Wi-Fi connection to the AP requires more energy than the average steady-state current consumption, which is ~25 mA during the first 30 seconds after the device wake-up. Retries are limited to avoid draining the harvested energy during connection outages such as the AP not available. For very short periods of Wi-Fi transmission the system reaches it's maximum peak power consumption of roughly 200 mA.

The power budget of the system is dimensioned assuming that the device is exposed to 200 LUX illuminance for 8 hours a day. The harvesting capacity of the indoor solar cells is estimated to be 6mW per cm2 at 200 LUX after factoring in degradation effect of the intentionally placed laminated surface. The total cell area of 225cm2 is estimated to yield 10,800 mWh, with exposure to light for eight hours over the course of 24 hours.

Watch a video describing the solar-powered Wi-Fi sensor demo **Learn More**

Breakdown of the system power consumption (measured with harvesting circuitry bypassed, and feeding the buck-boosts with 3.2 V are as follows:

	Initial 30-sec avg. Power	System Sleep Current	2-min Interval avg. with One Transmission to AP
With Display	25 μA	40 μA	207 μA (incl. Display Update)
Without Display	9.2 μA	20.7 μA	105 μA

Wi-Fi 6 Settings for the Solar-Powered Wi-Fi Sensor

- TWT RX latency: 60 sec
- Device average throughput: 20 Mbps
- Estimated extra wake duration: 0%
- TWT tolerable deviation: 10%
- TWT default wake interval: 1024 msec
- TWT default wake duration: 8 msec
- Max beacon wake up after service period (SP): 2 (the number of beacons after the SP completion for when the NWP wakes up to listen for pending RX)
- TCP keep alive time: 240 sec

Operational Lifetime of the System

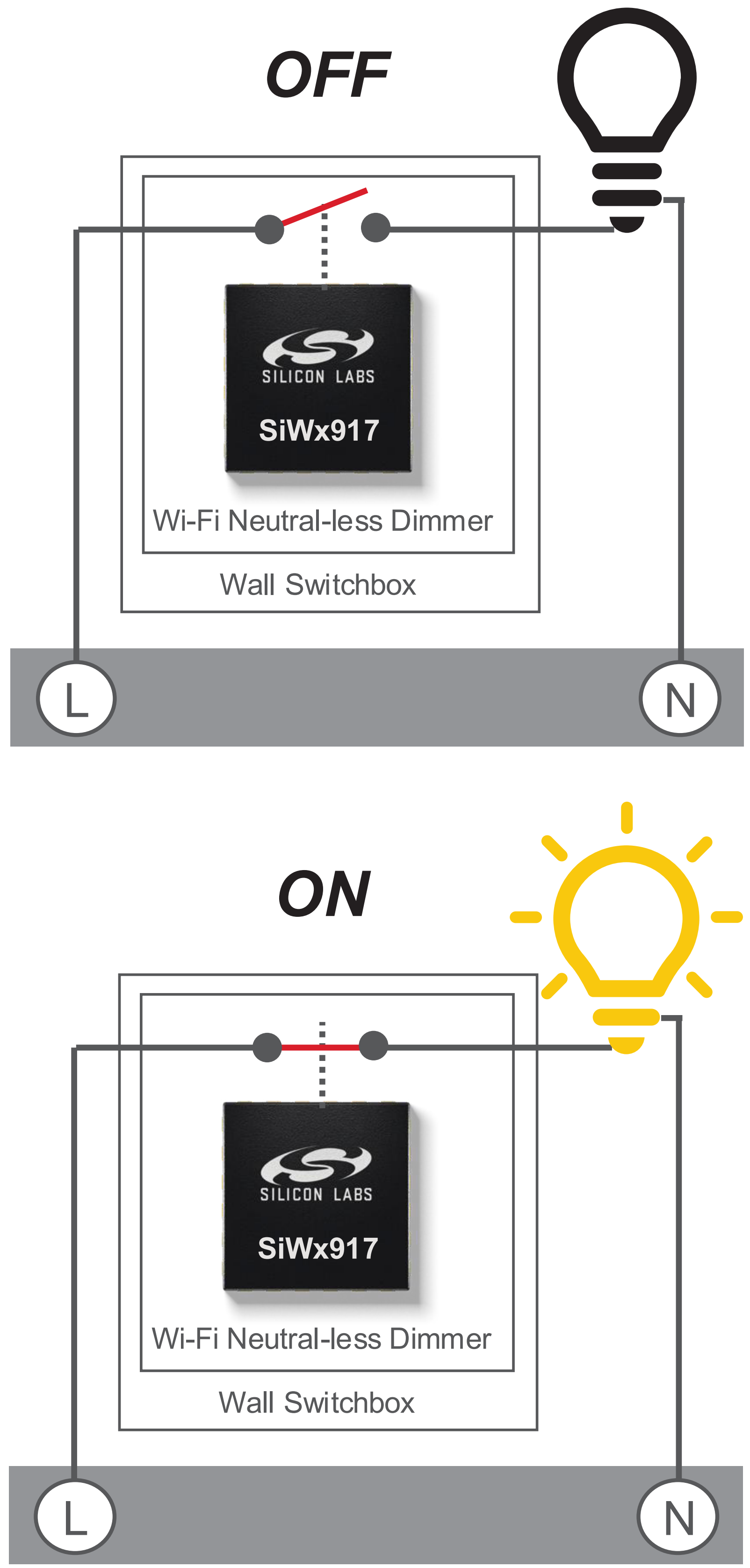
With the hybrid super cap technology and the amount of average current and peak current the indoor light powered Wi-Fi sensor board draws, it is expected to sustain tens of thousands of charging cycles with a capacity above 80% of the original specification. The operational lifetime of the device is estimated to be over 10 years.

5

Neutral-less Switch/Dimmer

Neutral-less Smart Switch/ Dimmer

Wireless smart switches and dimmers are becoming more common in smart homes thanks to their affordable pricing and easy retrofit possibilities. However, it is not uncommon that older houses lack the neutral wiring needed for light-controlling switchboxes. This can cause DIY installers and average homeowners extra headaches and costly wiring upgrades. In this section, we introduce a solution for a neutral-less Wi-Fi dimmer switch based on the SiWx917 Wi-Fi 6 wireless MCU. Thanks to its ultra-low-power consumption, device makers can now develop retrofit Wi-Fi switches and dimmers that do not need the neutral wire, unlocking a new market segment.



A neutral-less dimmer switch is a complex application because of two opposite working conditions. The AC-DC converter of the dimmer shall need to operate in two completely different scenarios:

- When the light is off applies to LED lights, the dimmer shall consume very little power to avoid the lightbulb flickering
- When the lightbulb is fully on when the voltage across the dimmer shall be theoretically zero, and the current is high. The dimmer switch should ideally have a 0-voltage across it. This is not possible as the dimmer itself needs some power. The solution is to reserve a fraction of the sinewave to power the dimmer itself. During this time, the switch is open. This means that the maximum power provided to the light is reduced. The lower the power consumption of the dimmer switch, the smaller the minimum time the switch must stay open, and thus closer to 100% brightness will be achieved.

Thanks to the ultra-low average current consumption of SiWx917, both cases are easily met. A neutral-less dimmer switch can be implemented using an AC-DC converter, which charges a storage capacitor. The capacitor acts as reservoir for a second stage step-down converter, which powers the SiWx917 and can provide bursts of short-lived high-value currents at a regulated voltage. The voltage of the storage capacitor can vary a lot, and it is slowly replenished when the circuit is idle (i.e. outside radio operations). To keep the charging current low, it might take several sine wave cycles to fully charge the storage capacitor (see the figure below).

The light must not flicker when it is off, therefore the current passing through it shall be very low. With the incandescent lightbulbs, flickering is not an issue (the lightbulb will not even glow with several milliamperes). Modern LED lightbulbs are much more sensitive to flickering; therefore, the current shall be kept as low as possible. When the LED light is on, the voltage across the dimmer shall be as low as possible to minimize power consumption, and to maximize brightness.

Consequently, low power is the common nominator for both operating conditions. When the light is fully on, a traditional leading-edge dimming technique can be used in the neutral-less dimmer: each half-wave is divided into two parts. In the first part, the dimmer element (usually a TRIAC) is off, so the voltage drops across the dimmer.

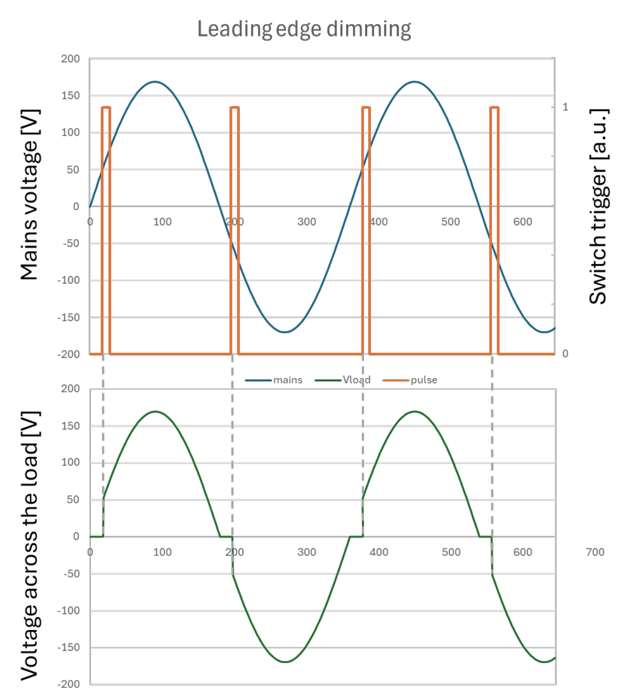


Figure: Leading edge dimming with a phase angle of π/10. This corresponds to the maximum power provided by the neutral-less dimmer to the load. This small delay allows to progressively recharge the internal neutral-less dimmer capacitor for the next radio operation. The blue line represents the mains voltage, the orange is the trigger sent to the TRIAC. The green curve is the voltage provided to the load.

In the second part, the element stays on until the load current drops to zero. If the light is fully on, the voltage across the dimmer would be very small for the whole duration of the sine wave, 1.5 V or less, depending on the used dimmer. This complicates the design of the power supply, which needs to be able to work at low voltages with high current and high voltage with low currents. The reference design solves this with a fixed minimum-off time set to 10% of the halfwave period. In a 110VAC system, this means that the voltage across the dimmer always reaches:

$$\min(V_{sw,peak}) = V_{AC} \cdot \sqrt{2} \cdot \sin(0.1 \cdot \pi) = 48V$$

Such voltage is large enough to provide power to the circuit even with a reasonably small current while keeping the maximum brightness close to 100%. The power delivered to the system is proportional to the following integral:

$$P \propto \int_{\alpha}^{\pi} \sin^2(\theta)\, d\theta = \frac{\pi}{2} - \frac{2\alpha - \sin(2\alpha)}{4}$$

The term α is the phase angle when the switch of the dimmer is turned on. The maximum value of the above integral (α = 0) is π / 2, or ~1.57. If α is 10% of π (~0.314), the integral yields 1.56, which is 99.3% of the maximum value. This means that just 0.7 % of the power is not delivered to the load, which cannot be perceived by the human eye.

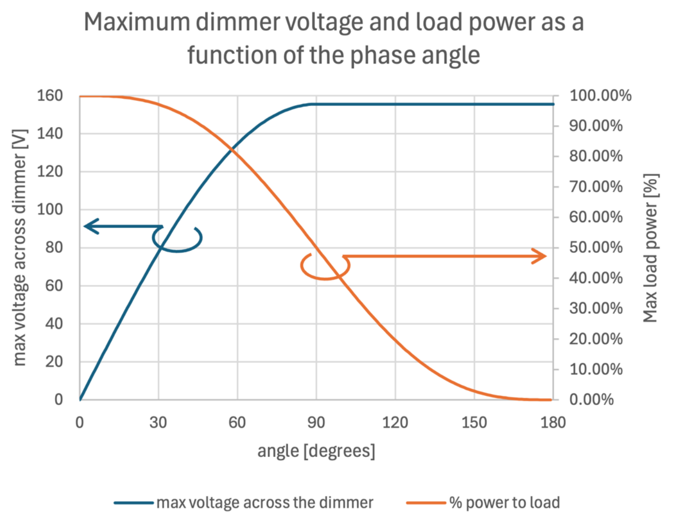


Figure: The maximum voltage across the dimmer and power to the load (in percentage) as a function of the phase angle.

When the dimmer is always open and the light is fully off, the current is ideally zero and the dimmer would have all the mains voltage across it. The AC-DC converter will draw a much lower current because of the higher voltage budget.

However, in both cases, the amount of current drawn strongly depends on the load, which in our cases is determined by the Wi-Fi operation of the SiWx917.

For better comfort, the light should turn on with a very short delay, especially with local control. For this reason, the SiWx917 ULP GPIOs can be configured as wake-up sources so that when the dimmer is activated, the system reacts almost instantaneously. Also, remote control shall have a reasonably short delay, preferably not more than 1 second, to give the user instant feedback, especially if the light being controlled is in the same room.

The choice of TWT or legacy power saving is different with respect to a battery powered device. In fact, in a battery powered device, the trade-off is between battery life and user experience. The battery has a finite amount of energy. Here, the constraint is not the energy, but the maximum power it can draw without causing light flickering. The power the AC-DC converter must draw is proportional to how frequently the device turns on its radio, and since there is a limit on the maximum power, this limits how frequently we can receive and transmit.

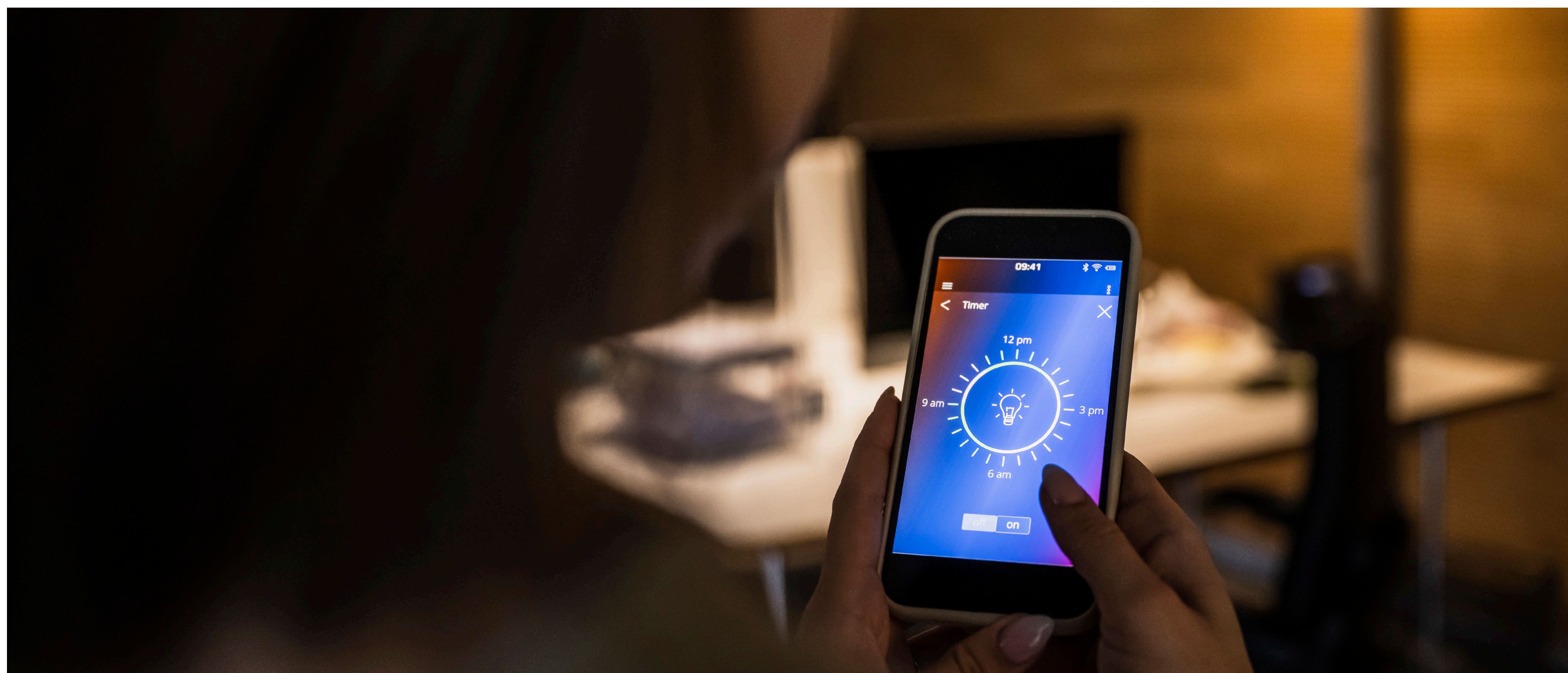
Wi-Fi power-Saving Strategies for a Neural-less Smart Switch/Dimmer

Using Legacy Power Saving

If a dimmer is expected to work in a Wi-Fi network where there are very few nodes, legacy power saving is probably the most convenient choice. In large networks, channel congestions can lead to additional delays.

Using TWT

If the network is expected to be Wi-Fi 6 enabled with many nodes, the TWT is a better power saving option because the AP can arrange the service periods to minimize collisions.



6

Connectionless Wi-Fi Tracker

Connectionless Wi-Fi Tracker

Constructing a full-coverage location and asset tracking device is a true multi-technology play for product developers. You need LTE/GSM for cloud connectivity and outdoor locationing in cellular coverage areas. The challenge with LTE/GSM is its high cost, high power consumption, and lack of indoor positioning. GNSS/GPS on the other hand gives you accurate positioning everywhere except for indoors and in dense high-riser areas. Wi-Fi is a crucial technology complementing cellular and satellite positioning. It augments the accuracy of LTE/GSM in cellular areas, provides indoor positioning in warehouses, commercial buildings, hospitals, and homes, and can also provide indoor cloud connectivity to complement cellular connectivity.

This section describes how to construct a highly energy-efficient and compact full-coverage asset tracking device using the SiWx917.

Connectionless SSID Tracking

In connectionless SSID tracking, as the term suggests, the Wi-Fi client in the tracker device doesn't connect to the AP. The device scans surrounding Wi-Fi APs to retrieve information such as SSID and signal strength and convert this information to a specific location using an API to a Wi-Fi network location database.

Connectionless SSID tracking enables efficient network discovery without a persistent connection, significantly reducing power usage compared to traditional active scanning methods. This is crucial for applications like asset tracking, where quick and energy-efficient AP scanning is essential to maximize device longevity.

Thanks to its optimized current consumption and short time to cold-start and capturing of a list of SSIDs, the SiWx917 excels in low-power AP scanning. Whether it is used in a SoC mode or radio transceiver mode, its intelligent power management allows you to minimize energy consumption during network scanning, making it ideal for battery-operated tracking devices.

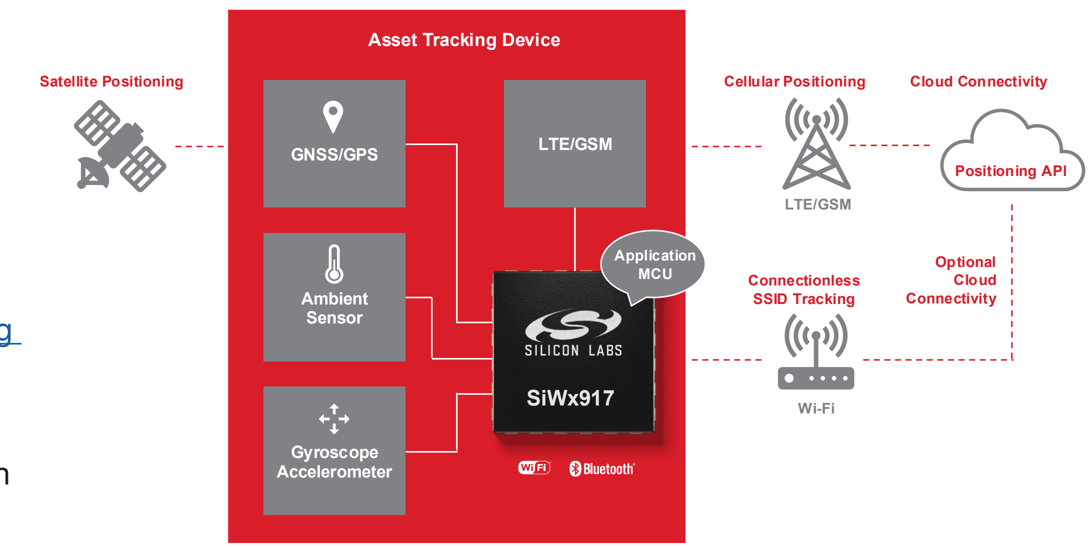
The SiWx917 supports MQTT cloud communication protocol simplifying integration with various IoT solutions, ecosystems, and location databases. MQTT provides lightweight and reliable data exchange compatible with a host of 3rd party cloud providers and location services databases.

Using SiWx917 for Asset Tracking Devices

The SiWx917 is a comprehensive, fully integrated wireless MCU, giving you a perfect platform to build a multi-technology asset tracking device. Having the SiWx917 as the centerpiece of the tracker device architecture allows you to take full advantage of its ultra-low-power capabilities, minimizing the system power and achieving a long battery life and low energy consumption for your tracker.

- The SiWx917 provides a rich set of peripherals and GPIO for system integration, tying together all the required components such as the GNSS/GPS receiver, LTE/GSM, gyroscope/accelerometer, and an ambient sensor.
- Its ample memory capacity of 672kB SRAM, 8MB of flash/PSRAM, and an interface for up to 16MB of external flash and PSRAM accommodate all necessary firmware, application software, location data, leaves room for OTA updates and future code growth.
- The powerful application MCU with up to 180MHz clock speed and an AI/ML accelerator remove the need for an additional standalone MCU, reducing your BoM, power consumption, and board footprint.
- The Wi-Fi 6 SoC enables energy-efficient connectionless SSID tracking and indoor cloud connectivity while the integrated Bluetooth LE radio enables for example smartphone commissioning and user interface.
- Integrated IP networking stack, TLS and MQTT support simplify integration to IoT solutions, ecosystems, and Wi-Fi network location databases.
- The SiWx917 modules integrate antenna and worldwide RF-certifications in a 16x21mm PCB package, simplifying your RF design and certification work and reducing the development costs and time.

Figure: A block diagram of a full-coverage asset tracking device based on SiWx917.



Learn More: See a prototype implementation of [Connectionless SSID tracking solution on SiWx917] based on commercially available developer tools on the Silicon Labs Community.

Conclusions – IoT-Optimized Wi-Fi

We hope you have found these examples helpful for advancing your low-power Wi-Fi design. However, IoT is more than just optimizing divice power consumption. Modern IoT-optimized Wi-Fi devices must have powerful compute, sophisticated features, and robust security to deliver upon the requirements of the fast-paced consumer and enterprise markets. The SiWx917 Wi-Fi 6 wireless MCU is an IoT-optimized solution that provides you with a perfect balance of ultra-low-power and advanced computing and features.

Features of IoT-Optimized Wi-Fi

The lowest system power for Wi-Fi 6 and application MCU	Dual processor for application and wireless networking	The largest SRAM, PSRAM, and Flash memory in the class	Dedicated AI/ML processor for Edge computing
Single-chip Matter solution - Pre-certified Matter and Bluetooth LE 5.4	A dedicated security engine. Broad security feature set. PSA level 2 certifiable	A dedicated security engine. Broad security feature set. PSA level 2 certifiable	Customize at order: your part number, markings, software, and other settings!
A rich set of peripherals, GPIO, and Analogs with ultra-low-power operation			

Benefits of SiWx917

Maximize Battery Life

Minimize Standby Current

Score Better Energy Ratings

Explaining the SiWx917 Wi-Fi Power Saving Features for the IoT

A Comprehensive Overview of the Low-power Features of the SiWx917 Wi-Fi 6 Wireless MCU for IoT product developers

Silicon Labs SiWx917 is an ultra-low-power Wi-Fi 6 wireless MCU optimized for the IoT. It has been tested to enable up to five years of battery-life on smart IoT devices. However, to achieve ultimate energy-efficiency requires knowledge of dozens of low-power features on the SiWx917 wireless MCU. This whitepaper is your starting point to become a master in developing energy-efficient, yet powerful and smart IoT devices. It provides you with a comprehensive overview of the low-power features of the SiWx917 and Wi-Fi 6 protocol including best-practice tips.

Learn More

About Sigma Connectivity

Sigma Connectivity is a global design house and engineering services group. Together with the coolest tech companies in the world they redefine innovation. With one of Europe's most advanced design, test, and verification labs, they meet their clients' specific needs of bringing smart, connected products to market. They have, since being acquired from Sony Mobile in 2013, successfully increased the number of active engineers from 180 to 700 and are operating from 13 sites worldwide.

About Silicon Labs Developer Services

Silicon Labs Developer Services Team helps device makers transform their IoT visions into actual products faster by creating concepts, reference designs, and prototypes. The global team of more than forty engineers works according to our field-proven execution model to ensure effective and timely project completion. The team members are distinguished experts in the IoT, embedded hardware, and software, with a proven record of working with significant customer accounts for over five years. Contact a Silicon Labs sales representative to accelerate your IoT product launch with the Developer Services Team.

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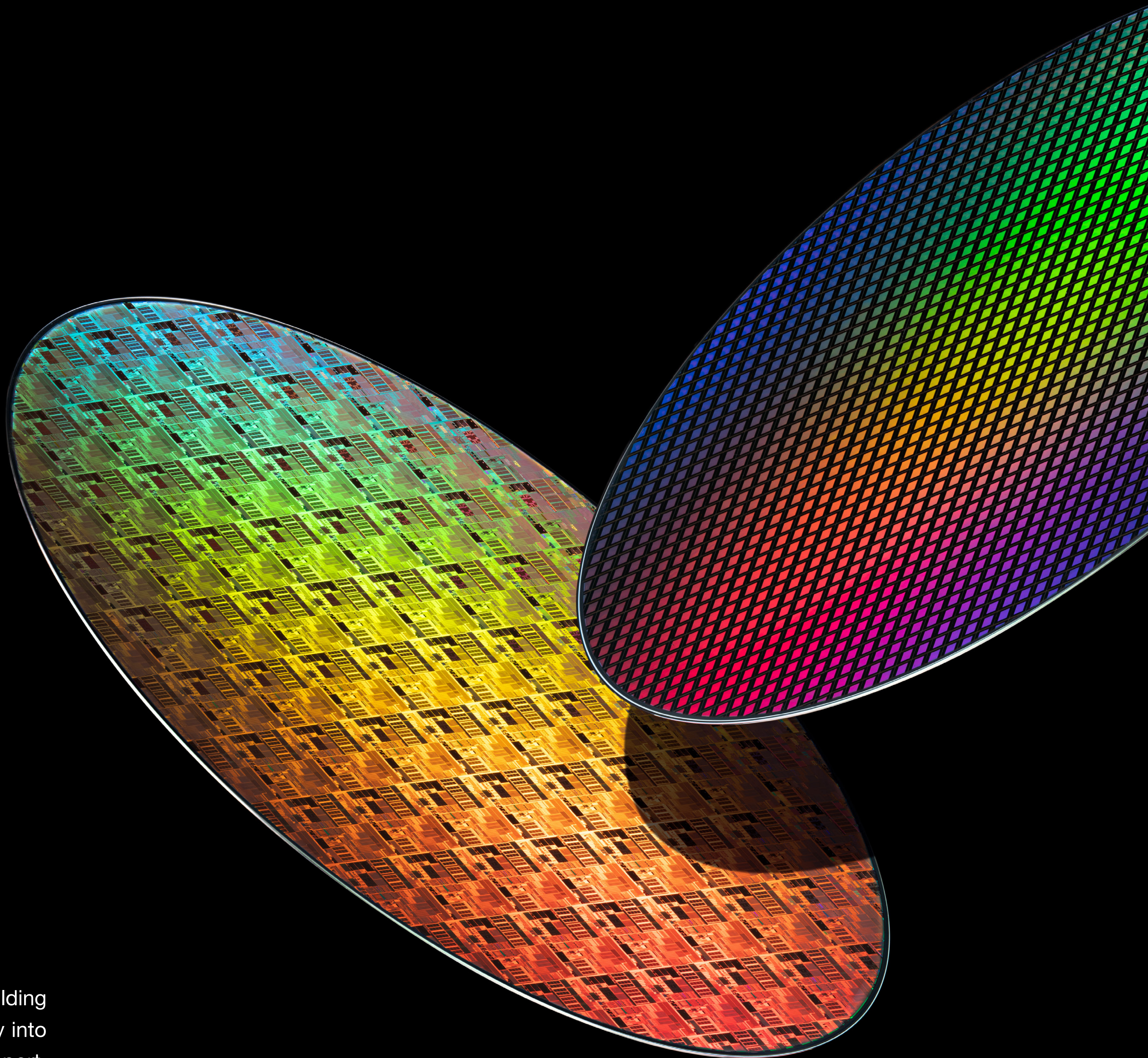

Silicon Labs

Silicon Labs (NASDAQ: SLAB) is the leading innovator in low-power wireless connectivity, building embedded technology that connects devices and improves lives. Merging cutting-edge technology into the world's most highly integrated SoCs, Silicon Labs provides device makers with the solutions, support, and ecosystems needed to create advanced edge connectivity applications. Headquartered in Austin, Texas, Silicon Labs has operations in over 16 countries and is the trusted partner for innovative solutions in the smart home, industrial IoT, and smart cities markets. Learn more at www.silabs.com.