

USER MANUAL

CALYPSO IOT DESIGN KIT FOR
MICROSOFT AZURE

2610059035001

VERSION 1.0

JUNE 26, 2023

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

MUST READ

Check for firmware updates

Before using the product make sure you use the most recent firmware version, data sheet and user manual. This is especially important for Wireless Connectivity products that were not purchased directly from Würth Elektronik eiSos. A firmware update on these respective products may be required.

We strongly recommend to include in the customer system design, the possibility for a firmware update of the product.

Revision history

| Manual version | Notes | Date |
|----------------|-----------------|-----------|
| 1.0 | Initial version | June 2023 |

Abbreviations

| Abbreviation | Name | Description |
|--------------|-------------------------------------|--|
| API | Application programming interface | A way for two computer programs to communicate with each other. |
| DPS | Device provisioning service | A service of Microsoft Azure |
| HTTP(S) | Hyper Text Transfer Protocol | An application layer protocol |
| IoT | Internet of Things | |
| Li-Po | Lithium polymer | A type of rechargeable Battery |
| MQTT | Message Queuing Telemetry Transport | A light weight messaging protocol for TCP/IP based network |
| (a)PaaS | (application) Platform as a Service | A category of cloud computing services. |
| REST | Representational state transfer | A software architecture style. |
| SNTP | Simple Network Time Protocol | A Protocol to synchronize time on the network |
| UI | User Interface | The user interface is the space where interactions between humans and machines occur |
| UX | User experience | The user experience (UX) is how a user interacts with and experiences a product, system or service |

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1 General description

1.1 Introduction

The Würth Elektronik eiSos's Calypso IoT design kit is an evaluation board set with pre-installed firmware that enables easy creation and evaluation of a secure end-to-end IoT solution using Microsoft's Azure IoT central.

Azure IoT Central is a ready-made UX and API surface for connecting and managing devices at scale, delivering reliable data for business insights. It pre-assembles platform as a service (PaaS) offerings, bringing together each service beneath it for an easy-to-configure, comprehensive, and secure IoT offering.

This design kit offers a reliable hardware platform for rapid prototyping using FeatherWings. The Würth Elektronik eiSos's FeatherWing development boards are open source and fully compatible with the Feather form factor from Adafruit. Through these development boards, Würth Elektronik brings a range of wireless connectivity modules, sensors, and power modules to the Feather ecosystem.

This hardware platform with pre-installed open-source reference firmware and Microsoft's IoT central cloud platform supercharges prototyping of any IoT solution.

This document gives a detailed description of the steps involved in creating an IoT solution using the hardware in the design kit and the IoT central platform.

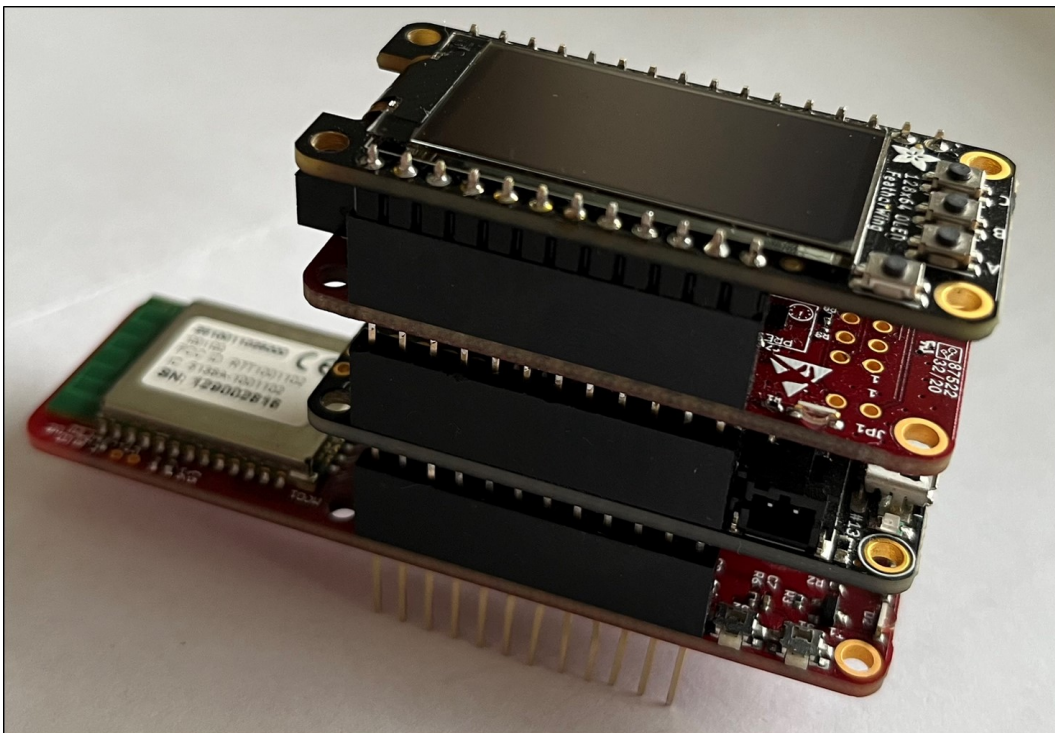


Figure 1: Calypso IoT design kit

1.2 Block diagram

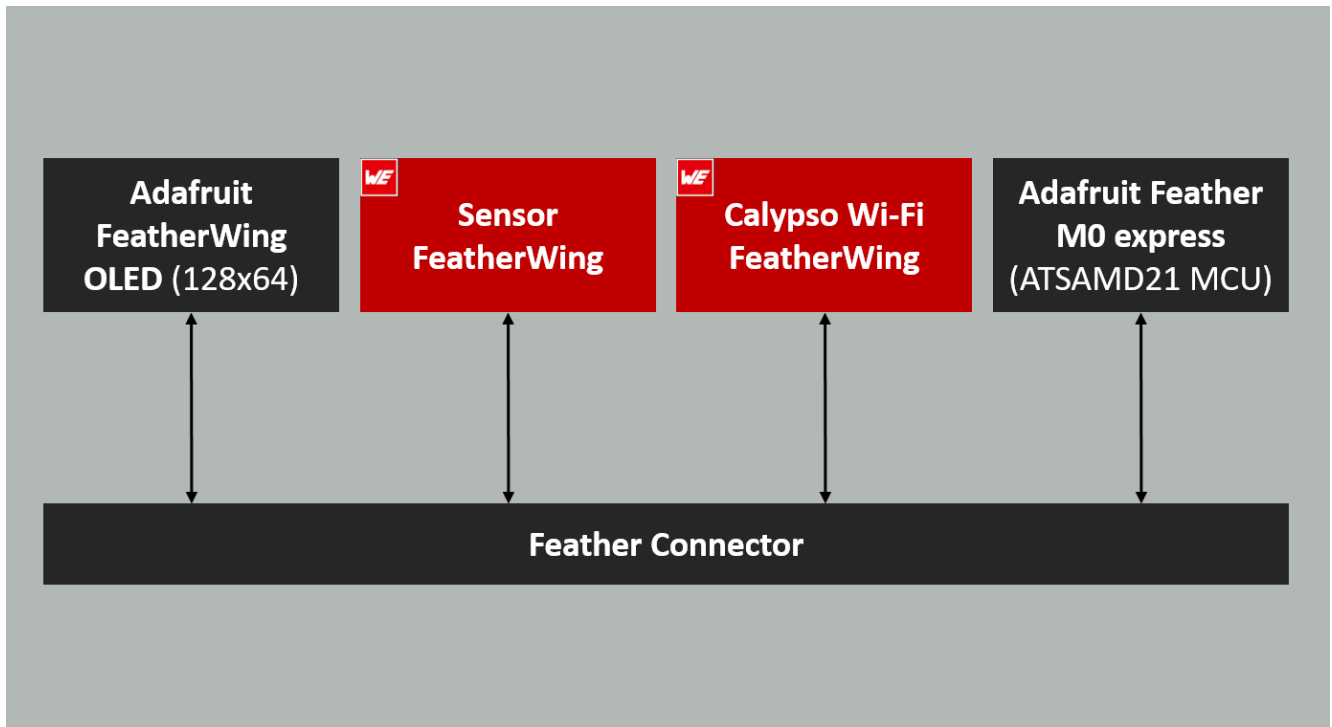


Figure 2: Block diagram - Calypso IoT design kit

1.3 Contents

| Description | Quantity |
|---|----------|
| Würth Elektronik Sensor FeatherWing | 1 |
| Würth Elektronik Calypso Wi-Fi FeatherWing | 1 |
| Adafruit FeatherWing OLED | 1 |
| Adafruit Feather M0 pre-flashed with firmware from Würth Elektronik | 1 |
| Packaging: ESD safe bag | 1 |

Table 1: Contents of the design kit (2610059035001)

2 Functional description

The Calypso IoT design kit was created to simplify the development of an IoT application. The Internet of Things (IoT) can be broadly defined as an umbrella term for a range of technologies that enable devices to connect and interact with each other. Interconnected devices generating data provide for a range of new applications. Industrial automation, healthcare, smart home, smart cities, smart grids, and smart farming are some of the areas in which IoT provides substantial benefits.

Dubbed the "fourth industrial revolution" or Industry 4.0, the Industrial IoT (IIoT) is the digitization of industrial assets and processes that connects products, machines, services, and locations/sites to workers, managers, suppliers, and partners. Closer networking of the digital world with the physical world of machines helps achieve higher productivity, safety, efficiency, and sustainability.

This chapter begins by describing the parts of a typical IoT application. Further, all the components of the design kit are described in detail. Finally, a step-by-step guide for creating a sensor-to-cloud IoT solution prototype using tools from Würth Elektronik eiSos and the IoT central platform from Microsoft is presented in the following chapters.

2.1 Parts of an IoT application

Irrespective of the area of application, an end-to-end IoT solution consists of the following components (figure 3).

- **Sensors and actuators:** This is a part of the system that directly interfaces with the physical environment. Sensors measure the state of the environment and interpret the same as analog or digital data. On the other hand, actuators activate a physical change in the measured environment. Advances in the field of electronics in general and semiconductors, in particular, have led to the availability of a wide range of sensors and actuators which are highly efficient and yet very compact.
- **Wireless connectivity:** Sensors and actuators are typically installed in devices with limited access to the digital world. Consider, for example, a temperature sensor mounted inside an industrial boiler. Wireless connectivity provides in addition to many advantages the reachability necessary for such applications. A wide variety of standards as well as proprietary wireless connectivity solutions are available today. A number of factors including range, throughput, spectrum regulations, local statutory requirements, and power budget determine the choice of wireless connectivity solution.

Modern embedded designs usually combine the above components into a single device (sensor node) interacting with a gateway.

- **Gateway device:** A gateway device acts as a bridge between the physical and the digital worlds. It interprets the multitude of wireless connectivity protocols, collects the data, and forwards the same in a format understood by the entities above. In certain applications, the gateway device also performs basic analytics like threshold detection.

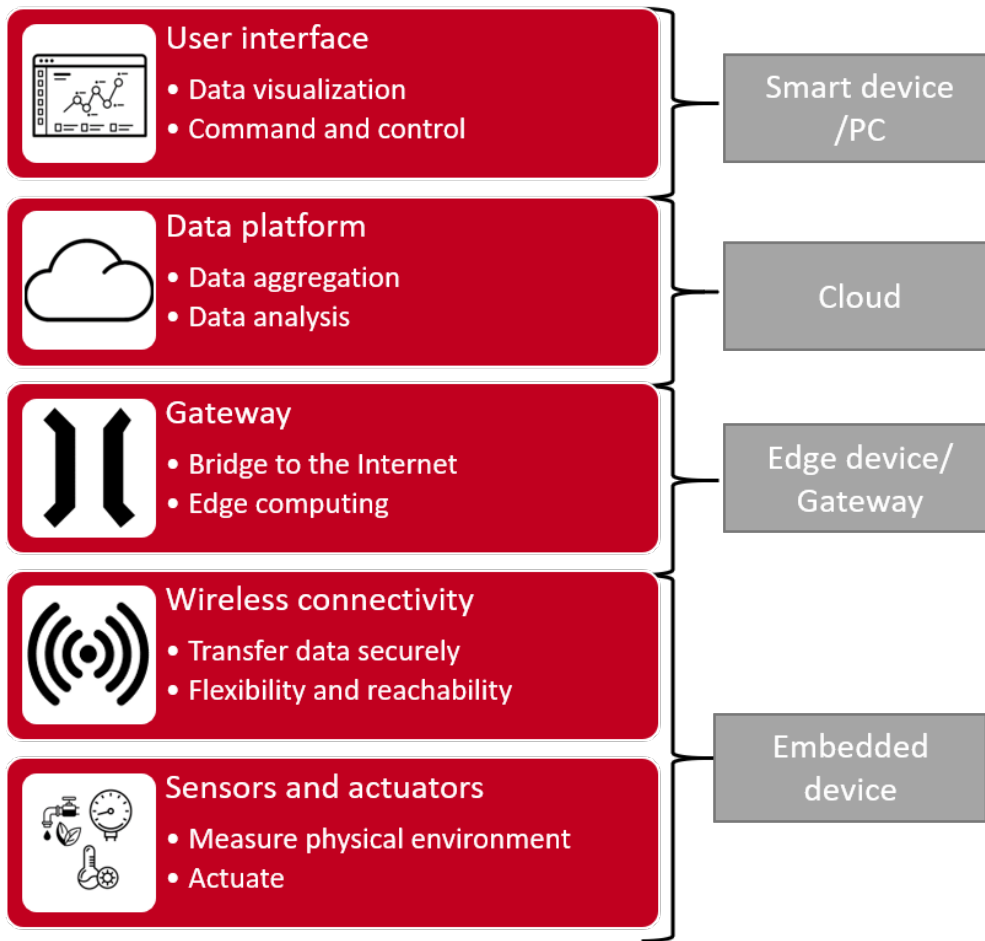


Figure 3: IoT application stack

- **Data platform:** This is the platform where the data is finally stored and presented for further analysis. Options here can range from a local database to a cloud server with redundancies. A typical platform consists of the components as shown in figure 4. The data platform enables the use of technologies like Artificial Intelligence (AI) and Machine Learning (ML) to perform advanced data analytics that generates value additions to the application.

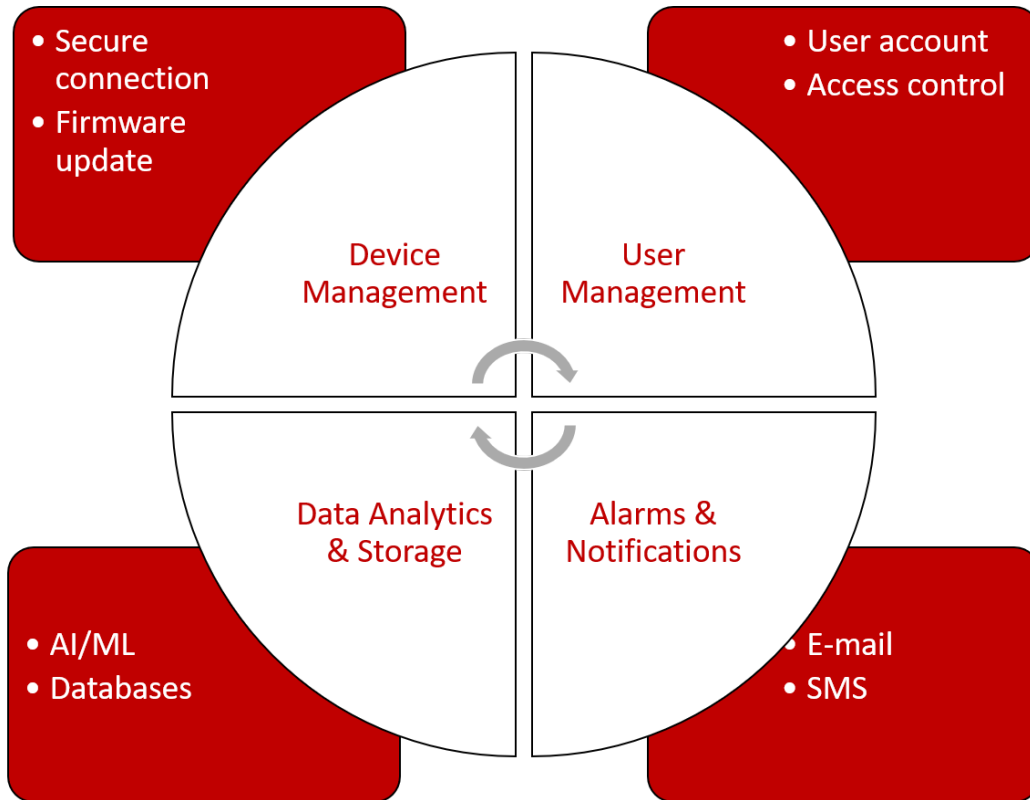


Figure 4: Components of a data platform

- **User interface:** This is the interface between human users and the digital world. Here the status of the observed environment is presented in a human-readable format. The user can take the necessary actions by interacting with this application

2.2 Remote Monitoring and Control using the design kit

The IoT creates a universe of sensors that enables accelerated deep learning of existing operations that allows rapid contextualization, automatic pattern, and trend detection. This leads to true quantitative capture of qualitative operations resulting in better quality, efficiency, higher safety, lower costs, and several other benefits. This has led to the use of IoT in several application use cases.

Remote monitoring and control of the operational environment (temperature, humidity, pressure, etc.) is one of the essential tasks in the industry. Maintaining optimal conditions and automating this process have been a challenge. This use case is considered out-of-the-box for this design kit presented here.

2.2.1 System architecture

The above-mentioned task requires sensors/actuators to interact with the environment, a wireless connectivity method, to collect the data, a cloud platform to store data, and a user interface to enable human interaction. The architecture of such a system is as shown in figure 5.

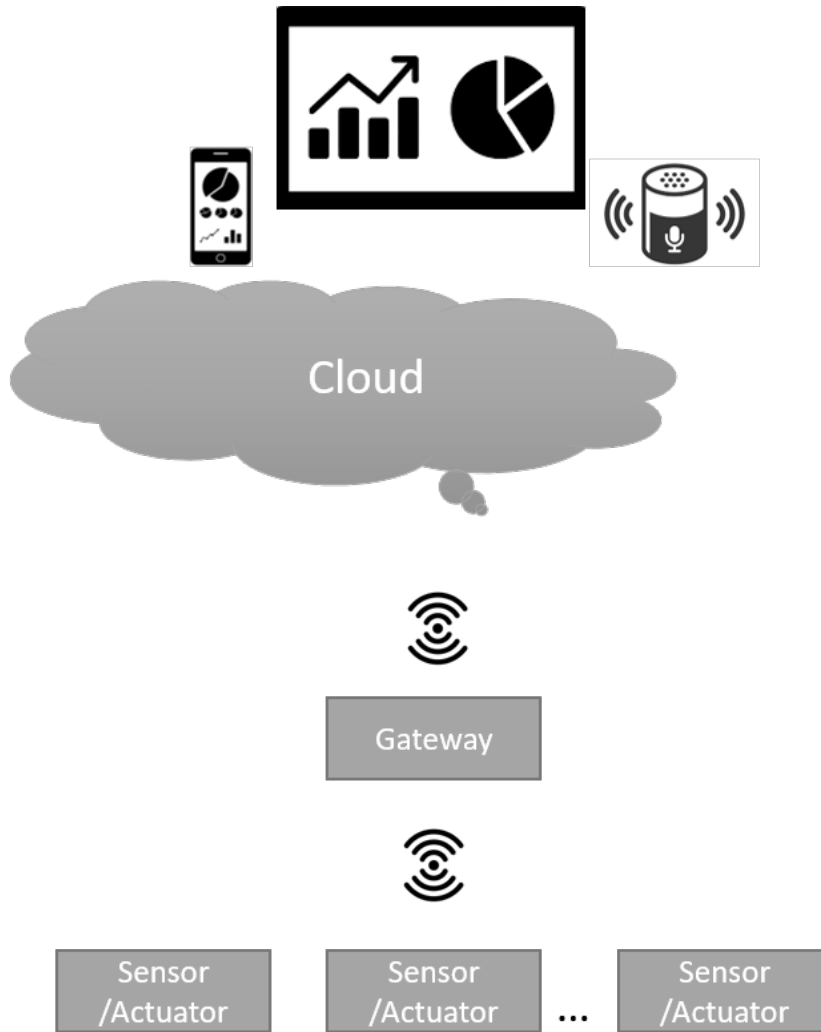


Figure 5: System architecture

2.2.2 System design using the design kit

Figure 6 illustrates the design that realizes the architecture described in chapter 2.2.1. The sensor values of the WE Sensors FeatherWing are read by the Feather M0 express MCU and transferred to the IoT central cloud platform over Wi-Fi where it is stored, visualized, and processed. The data is also displayed locally on the OLED. It is also possible to set parameters like sensor read frequency and trigger operations like changing the LED colour from the cloud. Hence, performing remote monitoring as well as control from the cloud.

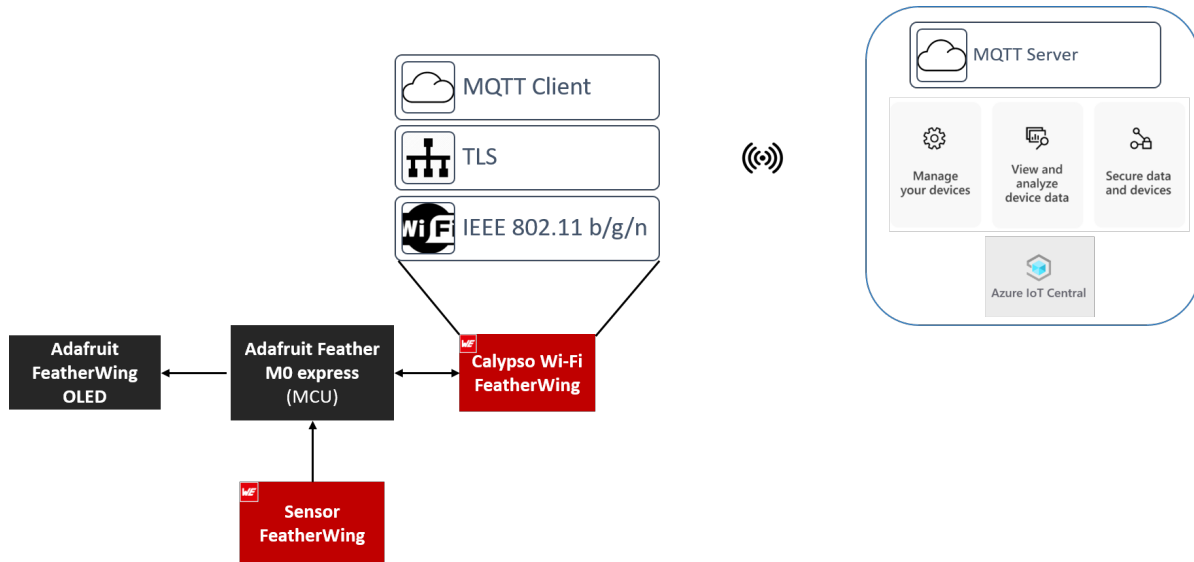


Figure 6: System design

2.3 Constituents of the IoT design kit

In this section, all the constituents of this design kit are described.

2.3.1 WE sensors FeatherWing

The Würth Elektronik eiSos *Sensor FeatherWing* is a sensor development board fully compatible with the popular Adafruit Feather line of development boards. It consists of the following four sensors,

- WSEN-PADS - Absolute pressure sensor (2511020213301)
- WSEN-ITDS - 3-axis acceleration sensor (2533020201601)
- WSEN-TIDS - Temperature sensor (2521020222501)
- WSEN-HIDS - Humidity sensor (2523020210001)

All four sensors are connected over the shared I²C bus and hence can be connected to any of the Feather microcontroller boards. The Arduino (C/C++) drivers and examples are made available under the following link, <https://github.com/WurthElektronik/FeatherWings> makes it easy to build a prototype to kick-start the application development. This development kit comes pre-flashed with code that reads the sensor data and forwards the same to the cloud platform.

The Sensor FeatherWing also has the 4-pin JST QWIIC[®] connector on-board. SparkFun's QWIIC[®] Qwiic Connect System uses 4-pin JST connectors to quickly interface development boards with sensors, LCDs, relays and more. Additionally, a 6-pin connector enables the extension of the FeatherWing with several evaluation boards from Würth Elektronik eiSos.

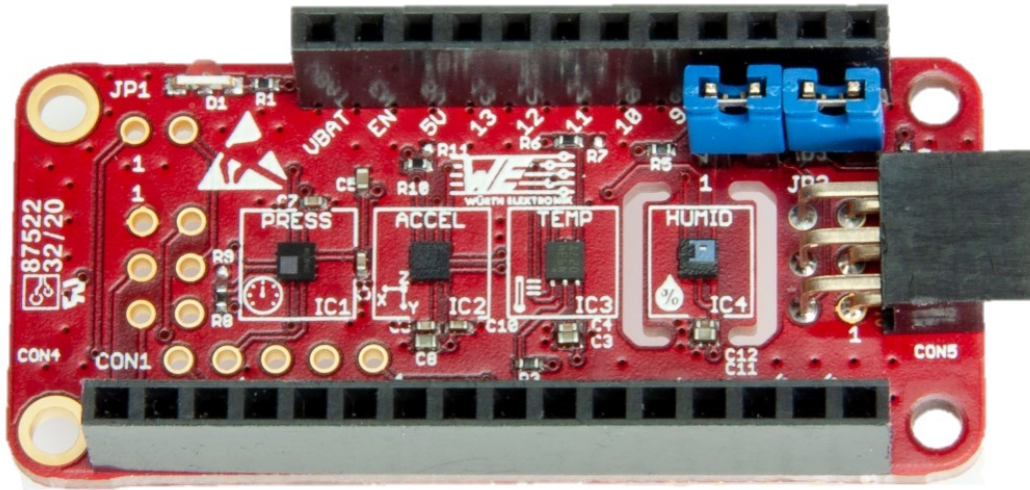


Figure 7: The WE Sensor FeatherWing (2501000201291)

2.3.2 WE Calypso Wi-Fi FeatherWing

The Würth Elektronik eiSos *Calypso Wi-Fi FeatherWing* is a development board that offers a secure 2.4 GHz Wi-Fi connectivity solution. It is fully compatible with the popular Adafruit Feather line of development boards and extends the Feathers with Wi-Fi connectivity.

The Calypso IoT design kit consists of the Calypso radio module that offers Wi-Fi connectivity based on IEEE 802.11 b/g/n with a fully featured TCP/IP (IPv4 and IPv6) stack. With out-of-the-box support for commonly used network applications like SNMP, HTTP(S), and MQTT(S), Calypso offers an easy and secure solution to any IoT application.

It has an AT-style command interface on the standard UART and hence can be connected to any of the Feather microcontroller boards. The Arduino (C/C++) drivers and examples made available the following link, <https://github.com/WurthElektronik/FeatherWings> make it easy to build a prototype to kick-start the application development. This development kit comes pre-flashed with code that reads the sensor data and forwards the same to the cloud platform.

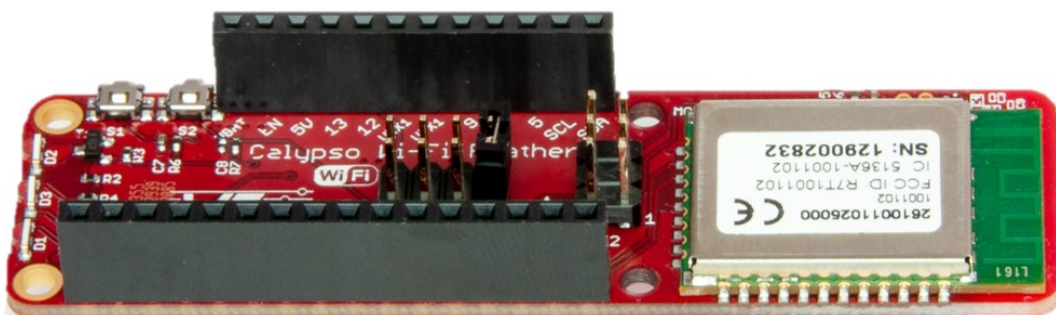


Figure 8: The WE Calypso FeatherWing (2610039025001)

2.3.3 Adafruit Feather M0 Express

The *Adafruit Feather M0 express* is built around the ATSAM21G18 ARM Cortex M0+ processor, clocked at 48 MHz and at 3.3 V logic, the same one used in the new Arduino Zero. This chip has 256K of FLASH and 32K of RAM and comes with built-in USB so that it has USB-to-Serial program and debug capability built in with no need for an FTDI-like chip. It comes with a Mini NeoPixel, 2 MB SPI Flash storage, and can be powered using a Li-Po battery.

The MCU on this board is pre-flashed with firmware that configures the sensors and the wireless module. It performs all the necessary steps to provision and connect to the IoT central platform. Once the connection is established, the sensor data is read periodically and sent to the cloud.

The code for this firmware can be found under the following link,
<https://github.com/WurthElektronik/Calypso-Azure-IoT-design-kit>

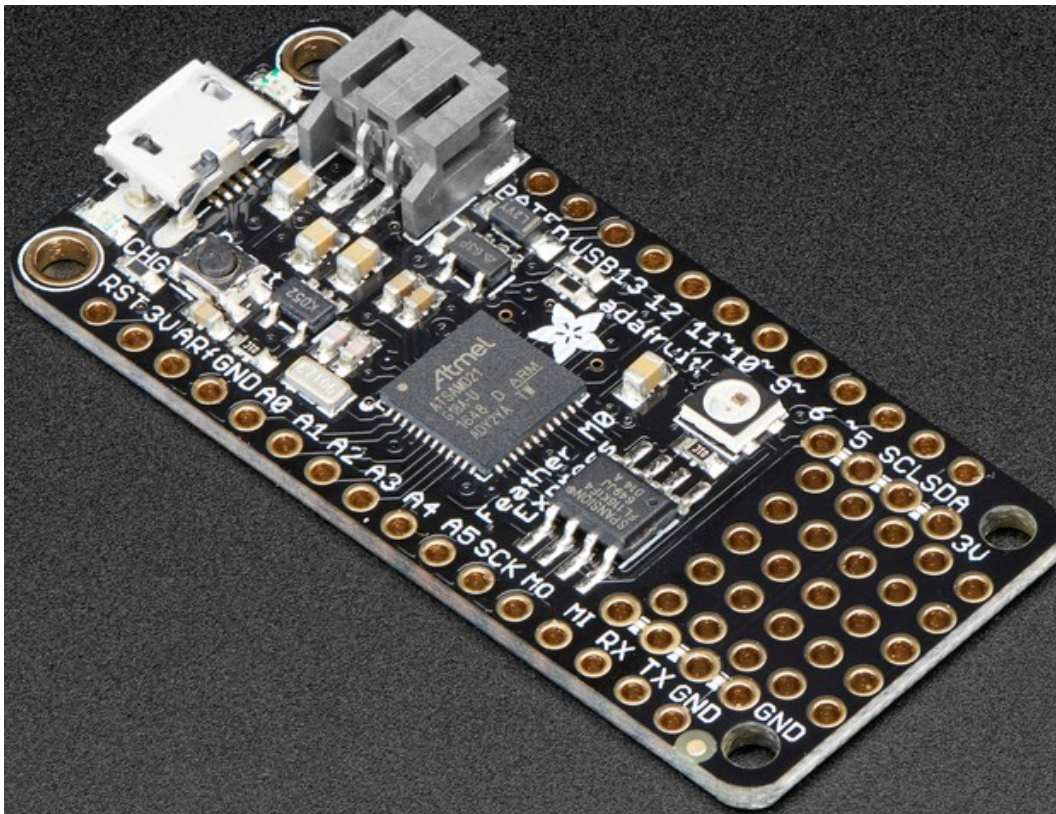


Figure 9: The Adafruit Feather M0 express

2.3.4 Adafruit FeatherWing OLED

The *Adafruit FeatherWing OLED* is a 128X64 pixel monochrome OLED display in the feather form factor. Using the Feather pin header, this board adds a display and three user buttons to any Feather main board.

These displays are small, only about 1.3" diagonal, but very readable due to the high contrast of an OLED display. This screen is made of 128x64 individual white OLED pixels and because

the display makes its own light, no backlight is required. This reduces the power required to run the OLED and is why the display has such high contrast. The three mini tactile buttons as well as the reset button along with the display add a miniature user interface to the Feather.

The OLED uses only the two I²C pins on the Feather, and you can pretty much stack it with any other FeatherWing, even ones that use I²C since that is a shared bus.

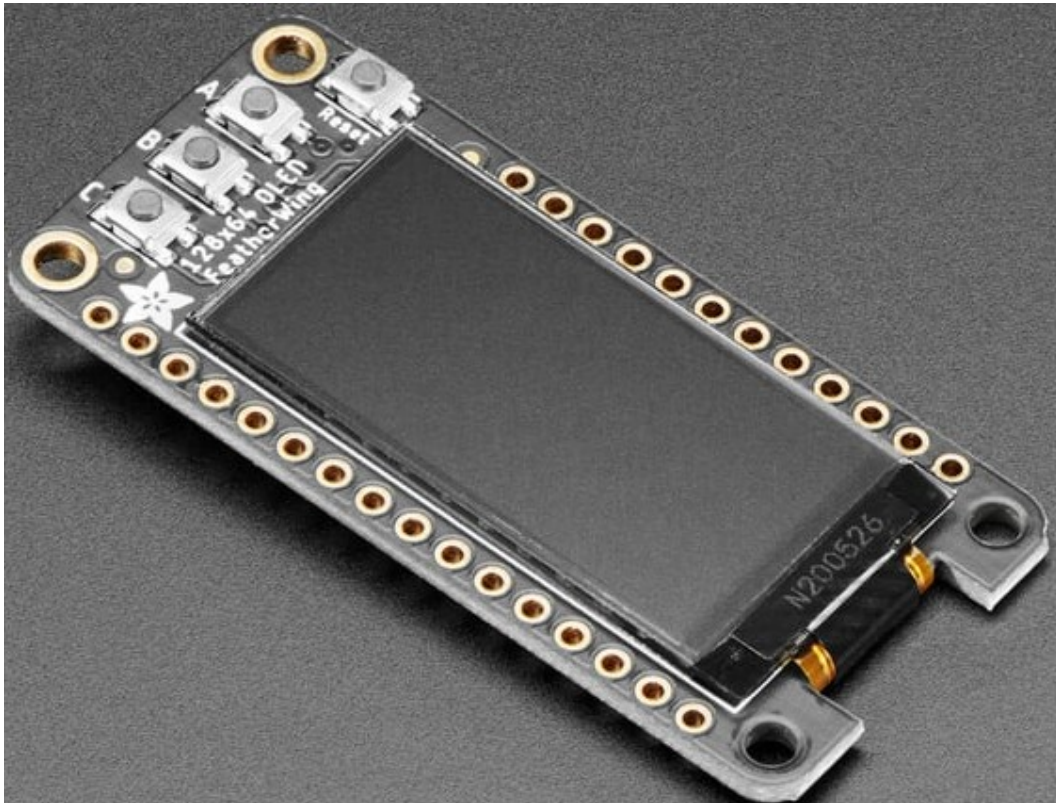


Figure 10: Adafruit FeatherWing OLED

2.3.5 Microsoft Azure IoT central platform

IoT Central is an IoT application platform as a service (aPaaS), developed by Microsoft that reduces the burden and cost of developing, managing, and maintaining enterprise-grade IoT solutions. Choosing to build with IoT Central allows the opportunity to focus time, money, and energy on transforming the business with IoT data, rather than just maintaining and updating a complex and continually evolving IoT infrastructure.

The web UI lets quick connection of devices, monitoring of device conditions, creating rules, and managing millions of devices and their data throughout their life cycle. Furthermore, it enables acting on device insights by extending IoT intelligence into line-of-business applications.

IoT Central is a ready-made environment for IoT solution development. It's an application platform as a service (aPaaS) IoT solution and its primary interface is a web UI. There is also a REST API that lets interaction with the application programmatically.

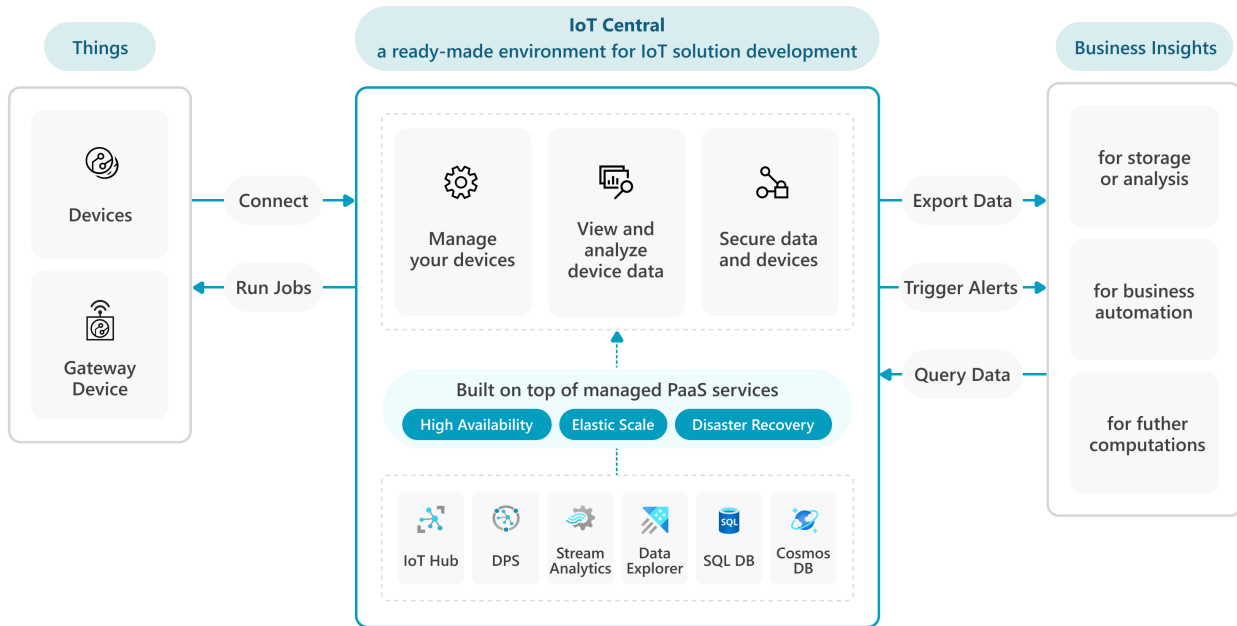


Figure 11: Architecture of IoT central platform.

Source: <https://learn.microsoft.com/en-us/azure/iot-central/core/concepts-architecture>

More information about the IoT central platform can be found under the link, <https://learn.microsoft.com/en-us/azure/iot-central/>.

3 Quick start guide

The Calypso IoT design kit comes pre-flashed and ready-to-use out-of-the-box. This chapter describes the steps to get the kit up and running in a few minutes.

3.1 Prerequisites

The following items are necessary to go through this process.

- The design kit with M0 Feather stacked with Calypso Wi-Fi FeatherWing, the Sensor Featherwing, and the OLED FeatherWing.

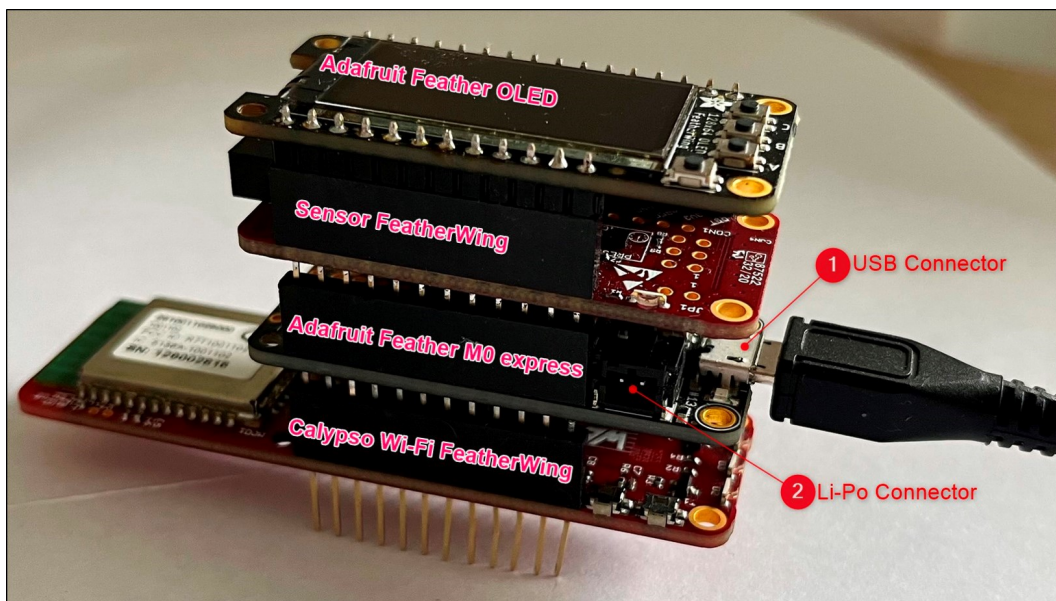


Figure 12: The design kit

- A Micro-USB cable to power up the design kit stack.
- A Wi-Fi access point (IEEE 802.11 b/g/n compatible) with internet access.
- Wi-Fi enabled computer with a browser (Chrome or edge recommended).
- A Microsoft Azure account. This can be created under the following link, <https://azure.microsoft.com/en-us/free/>



A valid credit card is required for creating an Azure subscription. The free tier can be used to run through this example without any charges on the credit card.

- The WE certificate generator tool. This can be downloaded from, <https://www.we-online.com/certificategenerator>



This tool works only on Windows platform



The design kit will always be delivered with the latest Firmware version (> v2.2.0). In case you use a Calypso FeatherWing which you received separately, make sure that the Calypso FeatherWing has a Firmware version > v2.2.0.

3.2 Create an IoT central application

- Sign in to the Azure portal, <https://portal.azure.com/> If a subscription does not exist, please create a subscription as described in this [link](#).
- From the Azure homepage, select the "+ Create a resource button" and then enter "IoT Central application" in the "Search service and marketplace" field.
- Select "IoT Central application" from the search results and then select "Create".

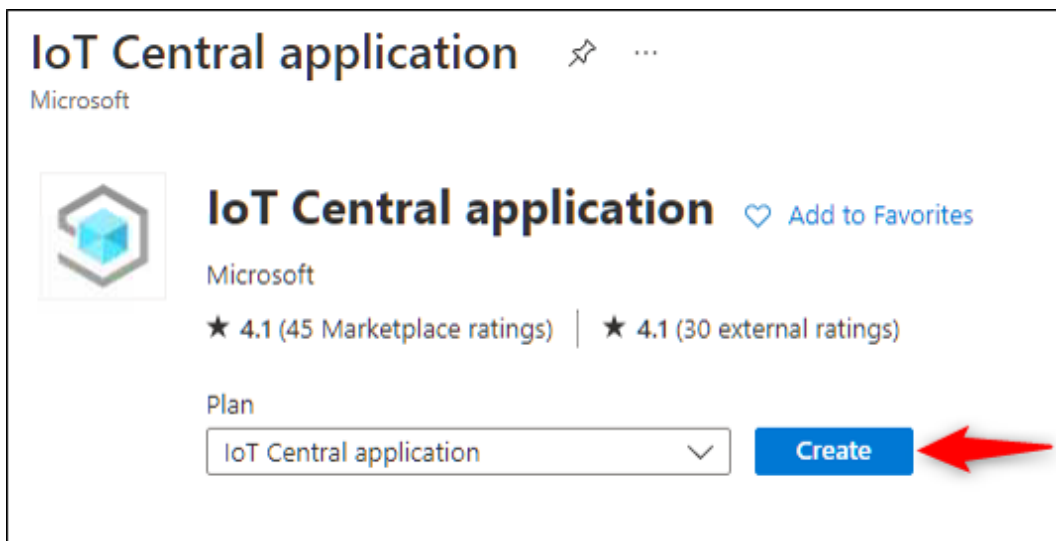


Figure 13: IoT central application

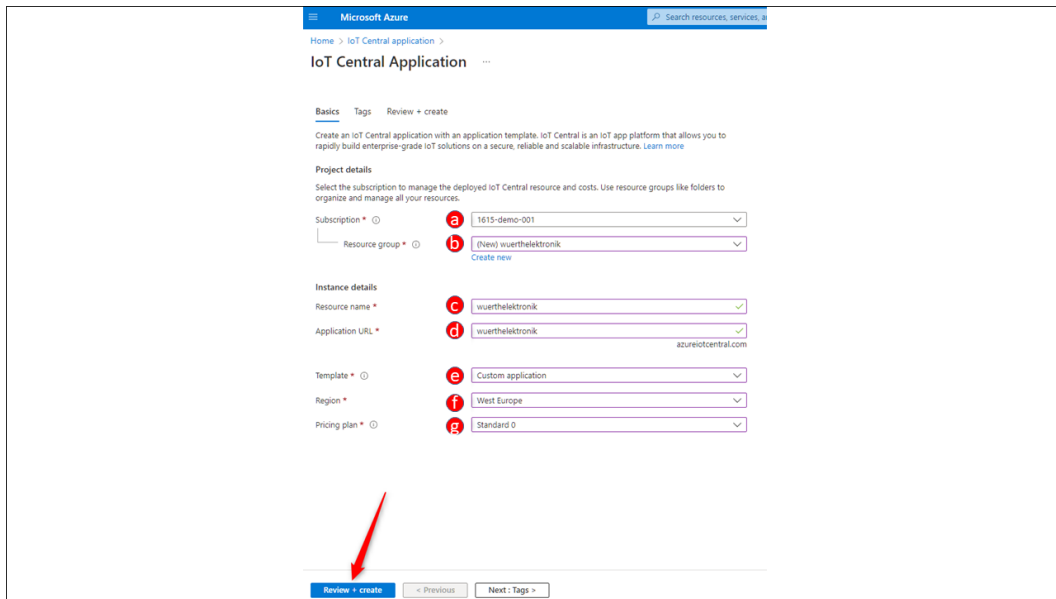


Figure 14: IoT central application parameters

- On the Basics tab, complete the fields as follows:
 1. **Subscription:** Select the subscription to use for the application.
 2. **Resource group:** Select a resource group or create a new one. To create a new one, select Create new and fill in the name you want to use. To use an existing resource group, select that resource group. For more information, see Manage Azure Resource Manager resource groups.
 3. **Resource name:** Type in a name for the IoT central application. For example, "wuerthelektronik".
 4. **Application URL:** This will be automatically set to <Resource name>.azureiotcentral.com. In this example "wuerthelektronik.azureiotcentral.com"
 5. **Template:** From the drop-down, select "Custom application".
 6. **Region:** Select the region in which the application will be located. Select a location that is geographically the closest. For example, West Europe.
 7. **Pricing Plan:** Choose the appropriate pricing tier. The standard tier 0 is good to start prototyping. More details on pricing can be found under, <https://azure.microsoft.com/en-us/pricing/details/iot-central/>
- Click on "Review + Create".
- In the following page, review the terms and click on "Create".
- Wait for the deployment to complete. After the process is complete, click on the "Go to resource" button to open the application.

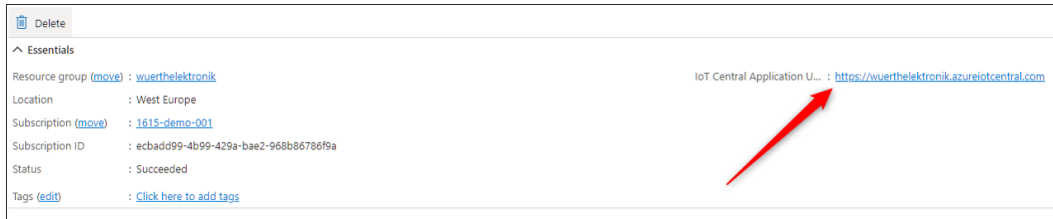


Figure 15: IoT central application URL

- Click on the IoT central application URL to open the newly created IoT central platform.

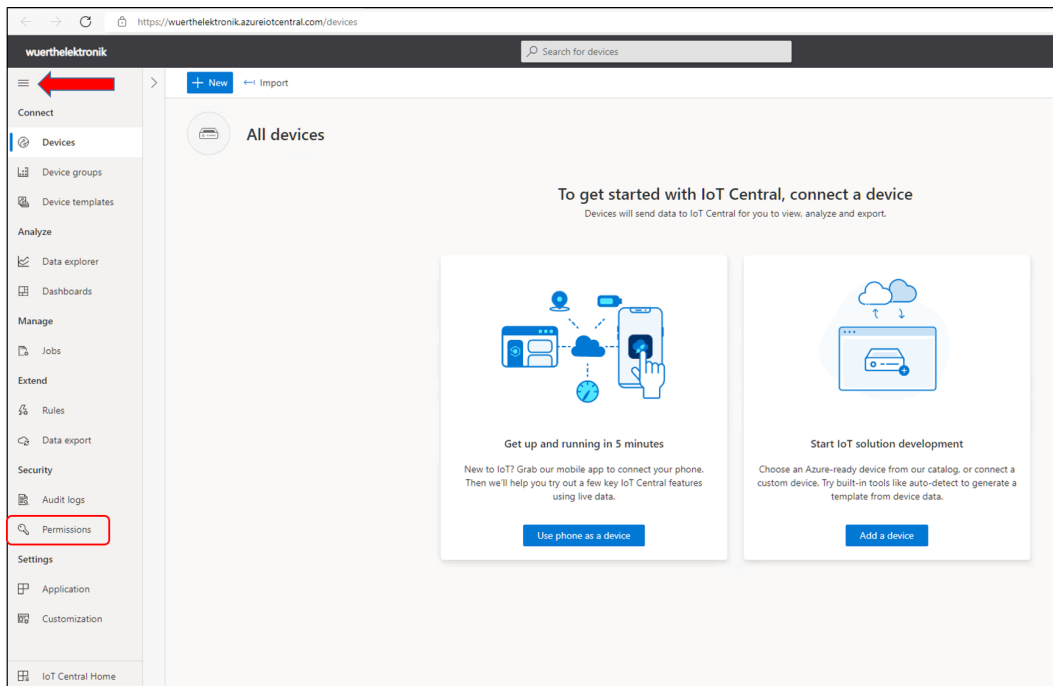


Figure 16: IoT central application homepage

- In the IoT central app open, "Permissions > Device connection groups" and note down the ID scope parameter for use in further steps.

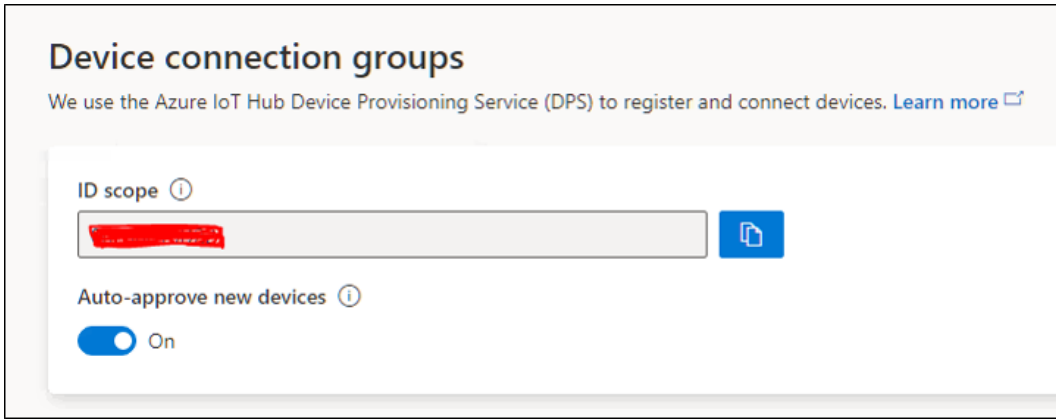


Figure 17: ID scope for the created IoT central application



For more information on creating an IoT central application, please refer to the following link <https://learn.microsoft.com/en-us/azure/iot-central/core/howto-create-iot-central-application>

3.3 Create certificates and the device configuration file

In order to securely connect the device to IoT central application, the device needs to implement a certain method for authentication. In this case, the X.509 certificate-based authentication is implemented. This method requires the creation of certificates for every device. In order to enable easy prototyping, Würth Elektronik eiSos's Certificate creation tool can be used. This tool creates all the certificates necessary to get started. Further, the device needs a configuration file that provides the parameters such as Wi-Fi credentials. This PC tool also generates the device configuration file.



This tool is for evaluation purposes only. Do not use the certificates generated for deployment on end devices for security reasons.

- Download the WE certificate generator tool from <https://www.we-online.com/certificategenerator>
- Unzip to a suitable location on the computer and open the executable "WECertificate-Generator.exe"
- In order to configure the device and generate certificates, the following parameters are necessary,

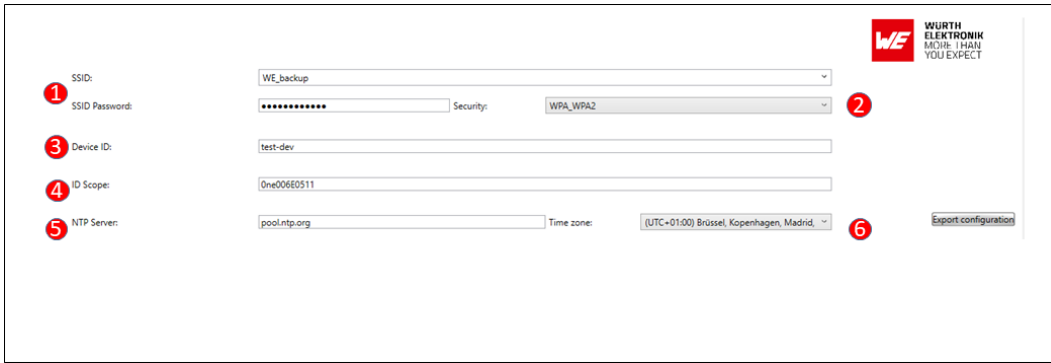


Figure 18: Parameters to configure the device

1. **SSID:** Select the Wi-Fi connection to be used by the device from the drop-down menu. This is the name of the Wi-Fi access point that the device needs to connect to the internet.
 2. **Password:** The password corresponds to the selected Wi-Fi network.
 3. **Security:** Check if the correct security type is selected for the Wi-Fi network.
 4. **Device ID:** This is the name of the device as it appears on the IoT central app. It should be unique per device. In this example, "test-dev" is used. Please use a device name of your choice.
 5. **ID scope:** Type in the ID scope noted in the previous section. ID scope is unique per application but common across devices.
 6. **NTP server:** If needed change the time server of choice that the module will use to get the current time.
 7. **Time zone:** Select the appropriate time zone.
- **Device root certificate:** This is the self-signed certificate that acts as the root of trust for all devices. The device root certificate is used to generate leaf certificates. Each device has a unique leaf certificate that identifies the device. The root certificate can be generated once and used for generating leaf certificates for several devices. The WE certificate uploader tool allows the creation on a new root certificate, saving the same and loading it back for subsequent usage.

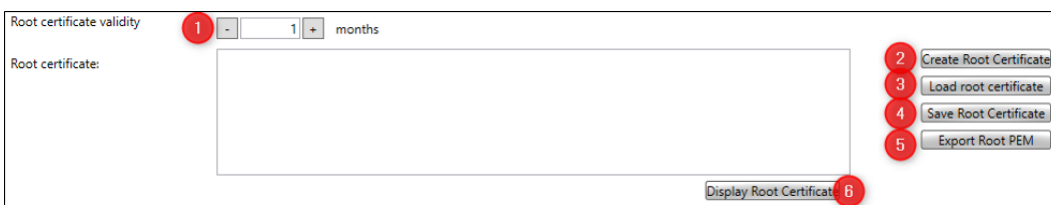


Figure 19: Device root certificate options

1. On first-time use set the validity time in months. For example, 1 month is chosen. The device will be securely connected for this period after which the device will be disconnected. The certificates need to be renewed for continuous operation.

2. Click on "Create root certificate" to create a new root certificate.
 3. **{Optional}** If a root certificate already exists, click on "Load root certificate". This opens a file browser. Browse to the correct location to choose the previously used root certificate. Use .pfx format certificate file.
 4. **{Optional}** Click on "Save root certificate" to save the generated root certificate for future use. This can be used to generate a file in .pfx format which can be reloaded for later use.
 5. **{Optional}** Click on "Export root PEM" to export the certificate in PEM format. This file needs to be uploaded to the IoT central application as will be explained in the subsequent sections.
 6. **{Optional}** Click on "Display root certificate" to view the certificate in the standard Windows format.
- **Device certificate:** Every device requires a unique device certificate to securely connect to the IoT central application. Each device certificate generated is exclusively linked to the device through the device ID and cannot be used on any other device.

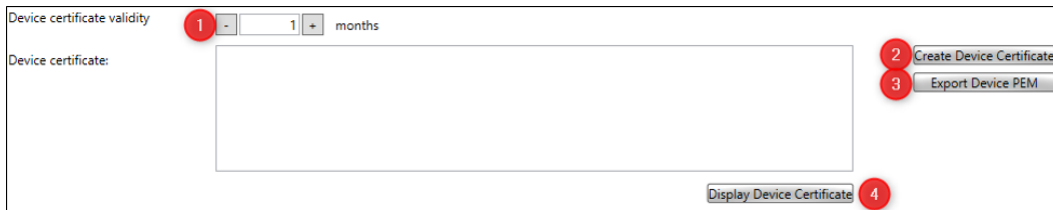


Figure 20: Device certificate options

1. For every device ID, set the validity time in months. For example, 1 month is selected. The device will be securely connected for this period after which the device will be disconnected. The certificates need to be renewed for continuous operation. The validity period of the device certificate cannot be longer than the validity of the root certificate.
2. Click on "Create device certificate" to create a new device certificate.
3. **{Optional}** Click on "Export device PEM" to export the certificate in PEM format. This file needs to be uploaded to the device as will be explained in the subsequent sections.
4. **{Optional}** Click on "Display device certificate" to view the certificate in the standard Windows format.



Figure 21: Device key options

- **Device private key:** This is the private key corresponding to the public key in the device certificate and is also uniquely linked to a device ID. Click on "Export Device Private key" to export the key in PEM format. This file needs to be uploaded to the device as will be explained in the subsequent sections.
- **Export all files:** On creating all the files, click the "Export all files" button to save all the necessary files. After exporting all the necessary files, a new directory will be created in the same folder as the executable file with all the necessary configuration file and certificates.

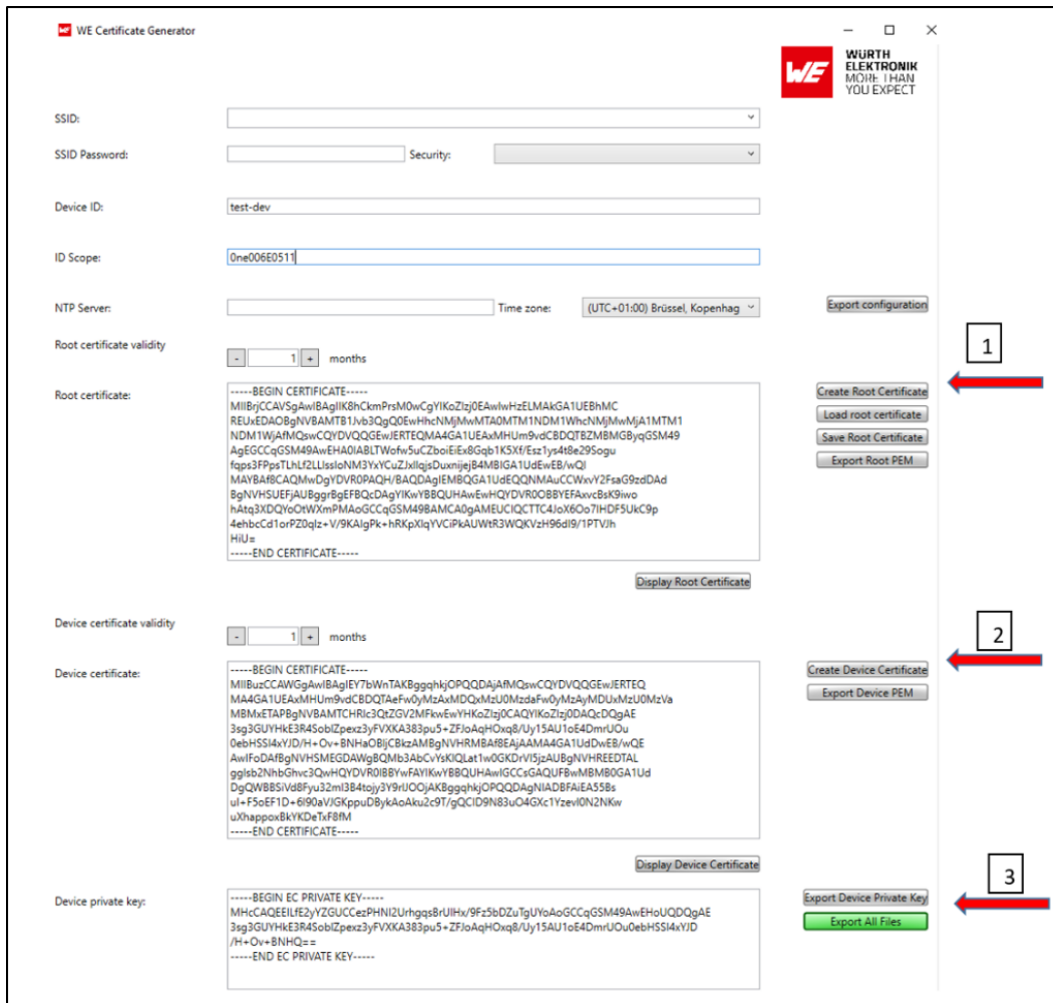


Figure 22: Certificate generation steps

(C:) > Projects > calypso_cert_generator > CalypsoCertificateUploader > bin > Debug > net6.0-windows > Azure > test-dev

| Name | Änderungsdatum | Typ | Größe |
|------------------|------------------|-------------|-------|
| device_root_cert | 14.06.2023 20:05 | Dateiordner | |
| azdevcert | 14.06.2023 20:05 | Datei | 2 KB |
| azdevconf | 14.06.2023 20:05 | Datei | 1 KB |
| azdevkey | 14.06.2023 20:05 | Datei | 1 KB |
| azrootca | 16.01.2023 11:19 | Datei | 2 KB |
| azrootca1 | 16.01.2023 11:19 | Datei | 2 KB |

Figure 23: Files exported

3.4 Upload the Root certificate to IoT central

In this step, the device root certificate is uploaded and a policy is set to allow all devices with leaf certificates that are generated from this root, to be allowed to connect to the platform. If an organization does not exist, create an organization as described in <https://learn.microsoft.com/en-us/azure/iot-central/core/howto-create-organizations>.

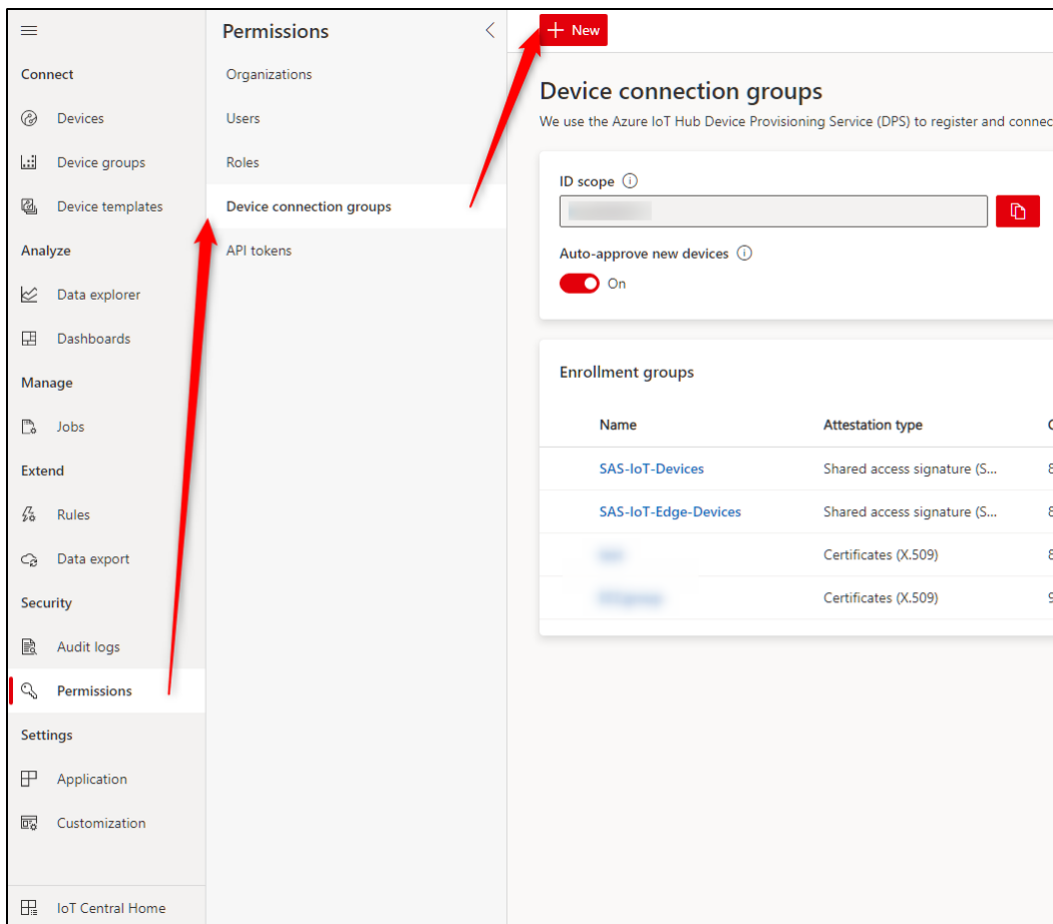


Figure 24: Create a new device enrolment group

- In the IoT central app open, "Permissions > Device connection groups" and click on "+ New"

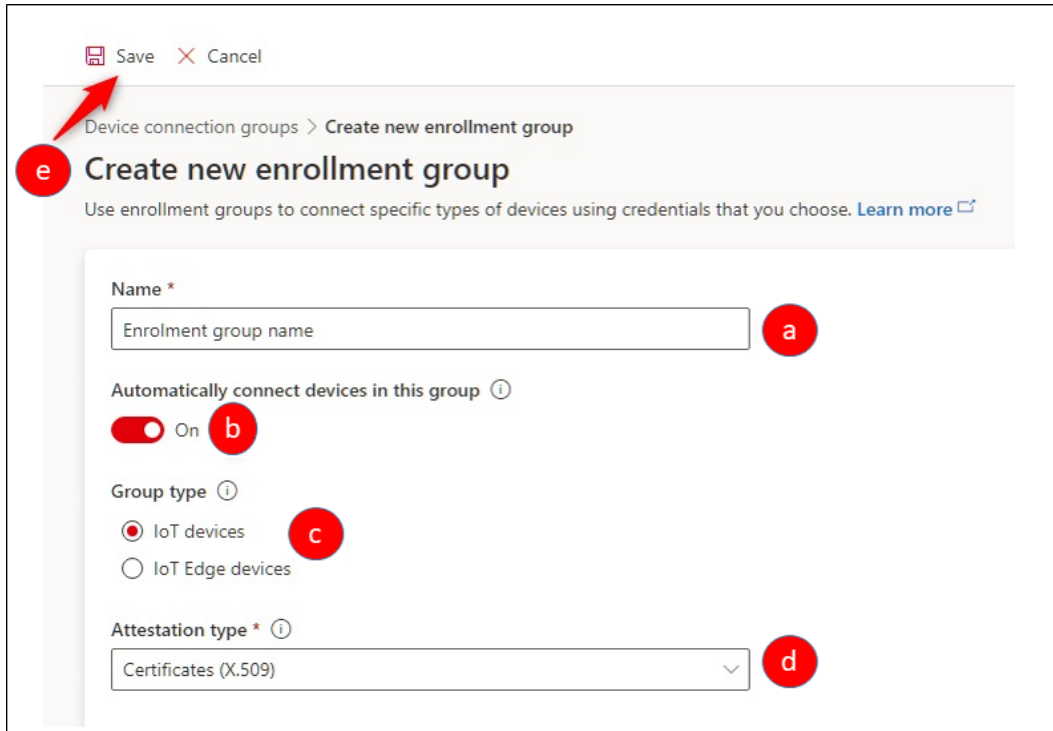


Figure 25: Enrolment group options

- In the subsequent window,
 1. Enter a name for the enrolment group.
 2. Set the "Automatically connect devices in this group" to "On".
 3. Set the group type to "IoT devices"
 4. Set the attestation type to "Certificates (X.509)"
 5. Click on "Save".
- Once the enrolment group is created, the root certificate needs to be added to this group. In order to do this,

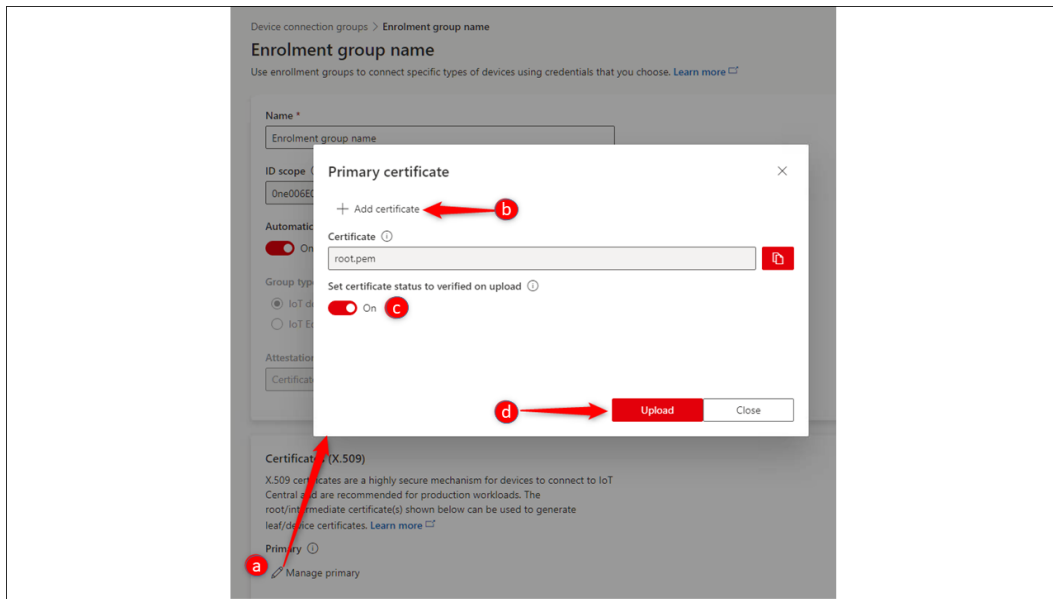


Figure 26: Upload device root certificate

1. Click on "Manage primary" in the "Certificates (X.509)" section of the enrolment group.
2. In the pop-up window, click on "Add certificate" and select the device root file generated using the WE certificate generator.
3. Set the "Set certificate status to verified on upload" option to "On".
4. Click on "Upload"
5. On completion of the upload process, close the pop-up window.

3.5 Configure the device

The design kit comes with the Firmware pre-installed. In this step, a one-time configuration of the kit is done which enables connection to the desired Wi-Fi network and the previously create IoT central application.

- Ensure that all four boards are stacked up correctly with the Adafruit FeatherWing OLED on the top.
- Power up the design kit stack via USB or a Li-Po connector on the Adafruit M0 Feather board.

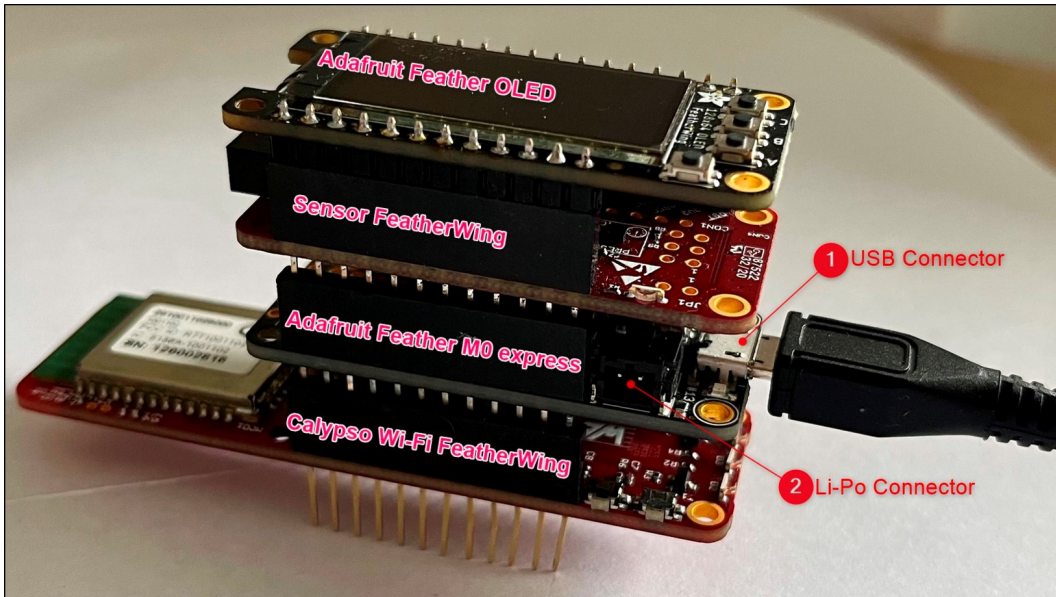


Figure 27: Power-up the design kit

- After a short initialization process, the device waits for the user to start the configuration process. The following message appears on the display "Device not configured. To configure double press button C".
- Double press button C on the OLED display FeatherWing to enter the configuration mode.

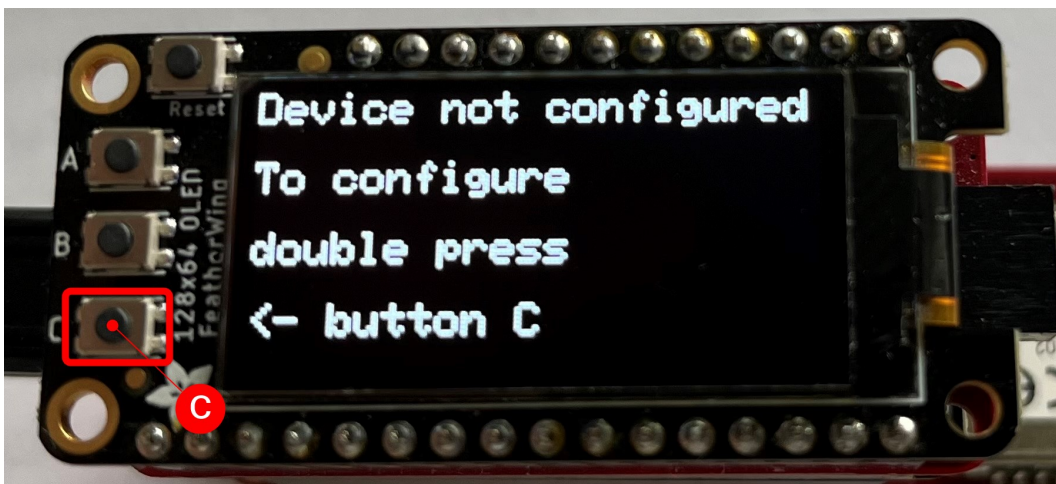


Figure 28: Double press on button C

- In the configuration mode, perform the following five steps,
 1. In the configuration mode, the Calypso Wi-Fi module is set to access point mode with an SSID "calypso_<MAC_ADDRESS>" and the key "calypsowlan". Connect your PC (Laptop/tablet/smartphone) to this access point, displayed on the screen.

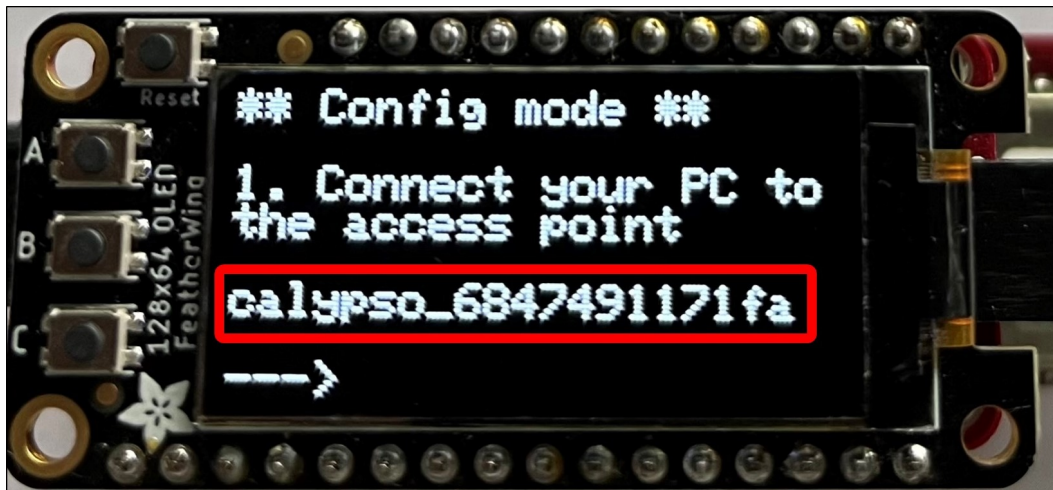


Figure 29: Device in access point mode

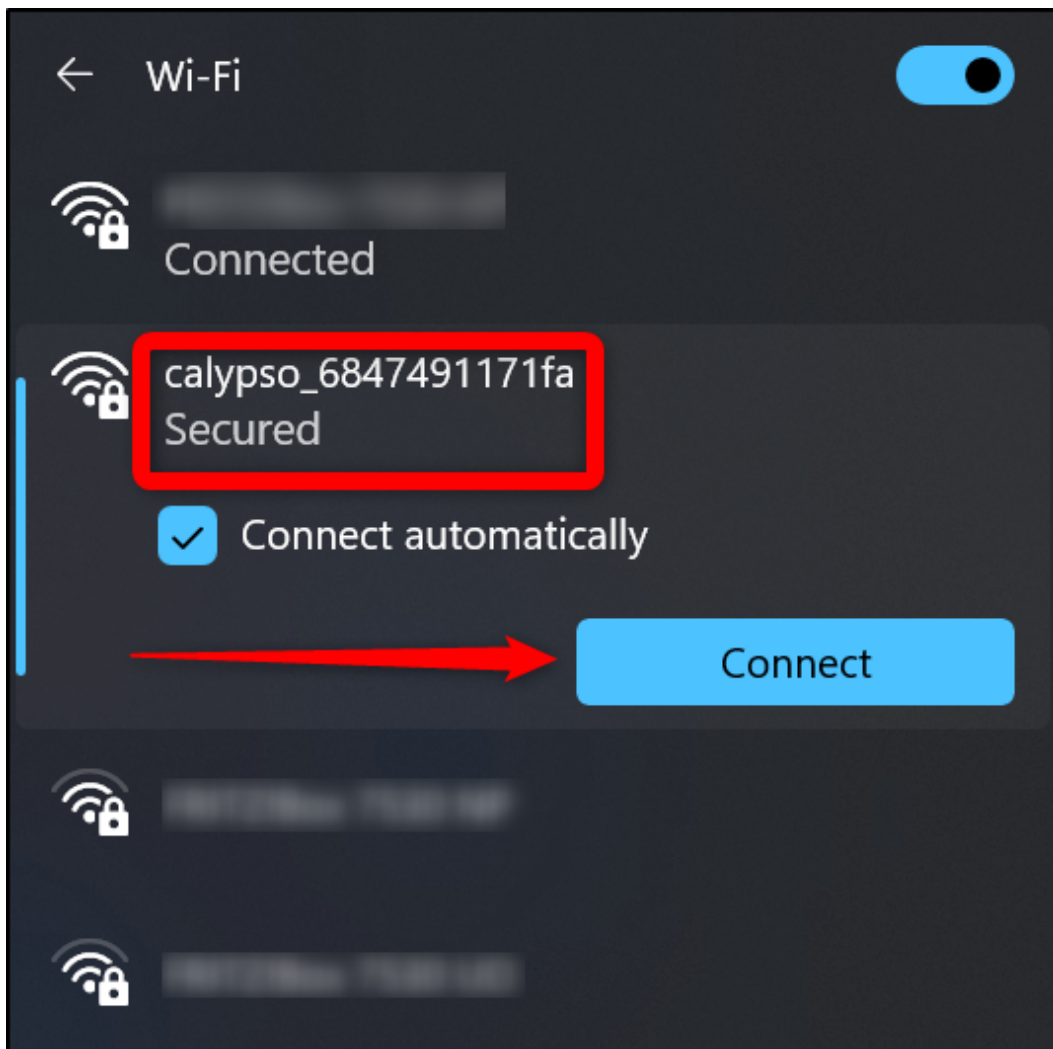


Figure 30: Connect to the device in access point mode

2. On the PC, open a browser.
3. In the browser, navigate to *http://calypso.net/azure.html*.

- Click on the "Choose Files" button. This opens the file browser. Browse to the location where the configuration files were generated as described in section 3.3. The files are stored under the path "working directory > Azure > <Device ID>". Select all the files in the directory and click on the "Upload" button. On success, the message "Success: 204 No content" at the bottom of the page indicates a successful configuration of the device.

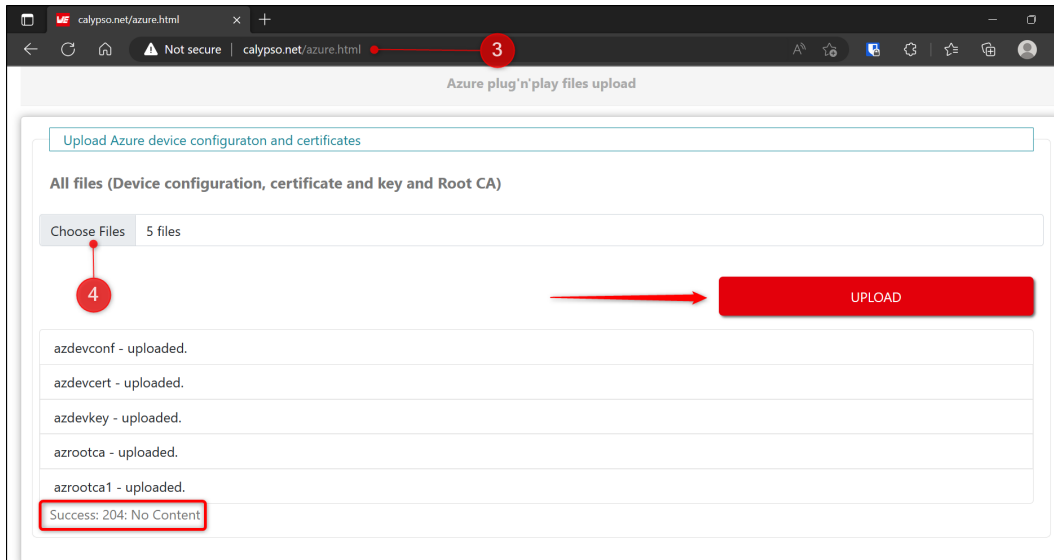


Figure 31: Select and upload files

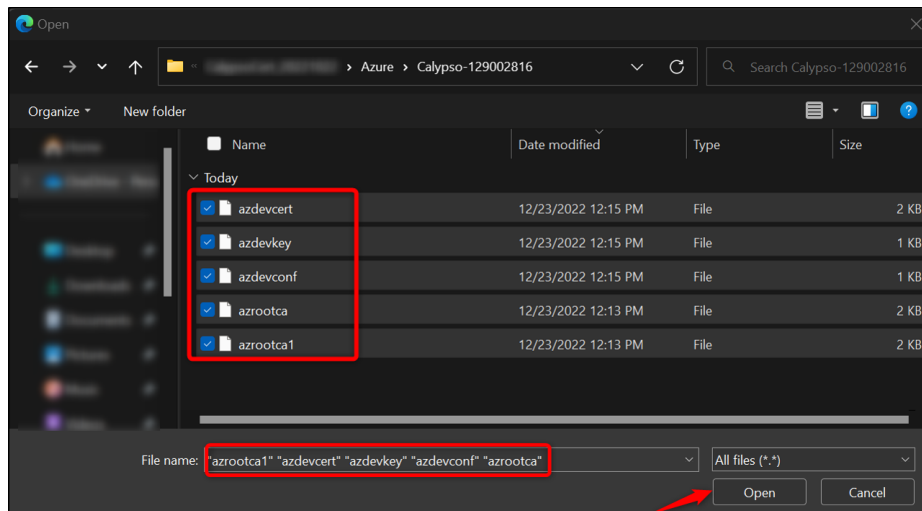


Figure 32: Select all the files generated by the PC tool

- Restart the device by clicking the "Reset" button.



Figure 33: Reset the device

- On restarting, the device goes through the following steps automatically,
 1. Initialize the hardware.
 2. Connect to the configured Wi-Fi network.
 3. Connect to the Microsoft Azure Device Provisioning Service (DPS).
 4. After authentication, the DPS assigns the address of the IoT hub (Device management service of Azure) to connect.
 5. This address is saved in the secure storage of the Calypso Wi-Fi module for further use.
 6. Finally, the device connects securely to the IoT central platform and starts the exchange of data.

At this stage, the device is fully configured, securely connected, and ready to use. On subsequent boot-up, the device directly connects to the platform using the saved address and starts exchanging data with the platform.



Figure 34: Device online

3.6 View the device default dashboard

To access the device on the IoT platform, navigate to "Devices -> All devices -> <Device ID>". Click on the device name to open the device page.

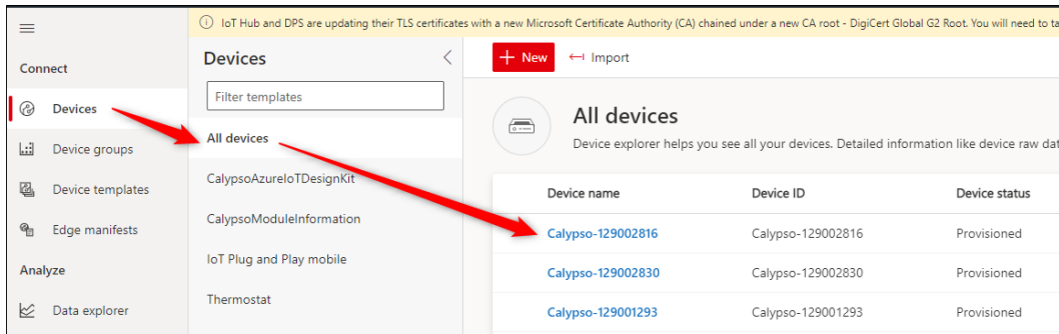


Figure 35: Device list on IoT central

In the "about" tab, the properties are displayed.

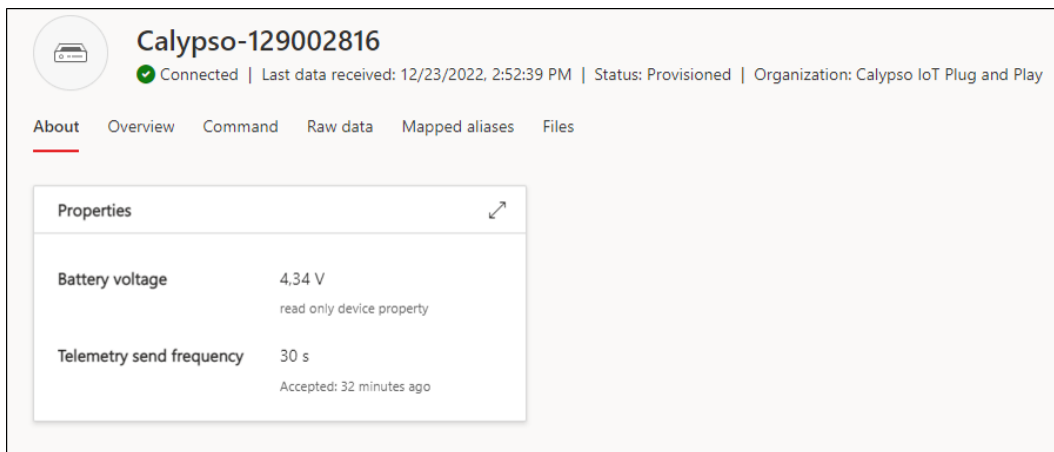


Figure 36: About the device

The telemetry data is displayed graphically in the "Overview" tab.

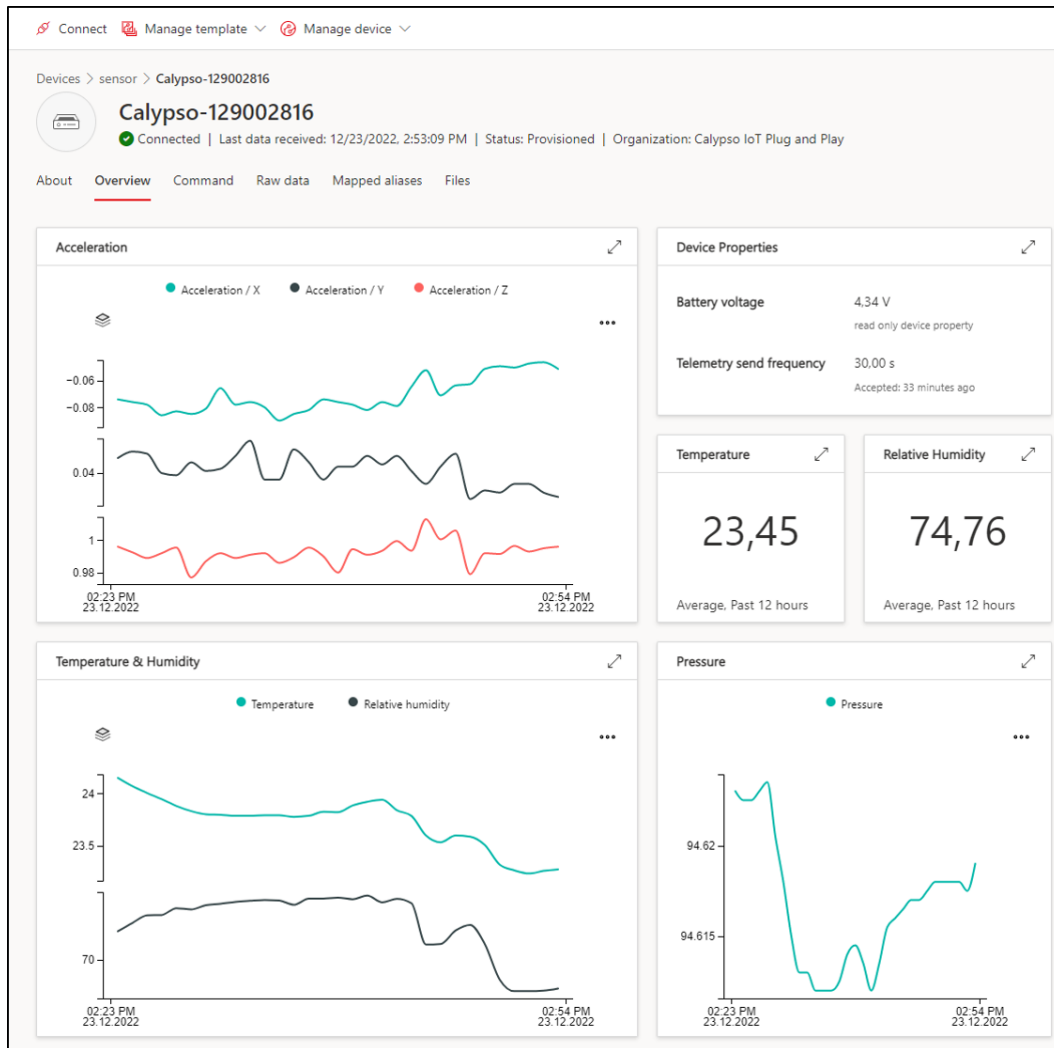


Figure 37: Overview of telemetry data

3.7 Send commands to device

To send a command to change the mini neo-pixel LED on the device, click on the command tab on the device page. Enter the RGB values and click on Run. The message is processed by the device and the colour of the LED is changed accordingly. A few sample colours,

| Colour | R | G | B |
|--------|-----|-----|-----|
| Red | 255 | 0 | 0 |
| Green | 0 | 255 | 0 |
| Blue | 0 | 0 | 255 |
| Yellow | 255 | 255 | 0 |
| White | 255 | 255 | 255 |
| Cyan | 0 | 255 | 255 |

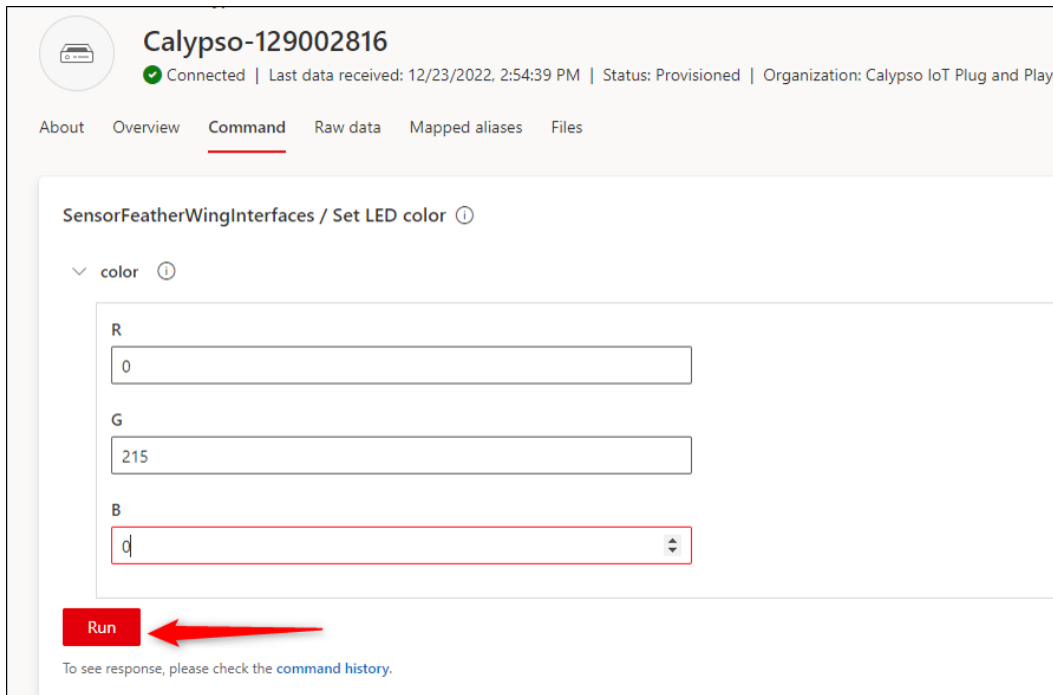


Figure 38: Set the LED using the command

3.8 Update device property

This device allows changing the frequency with which the sensor data is read and sent to the platform. This can be done from the IoT central platform. To do so, open click on the "Manage device" drop-down and select "Device properties". This opens the property update page.

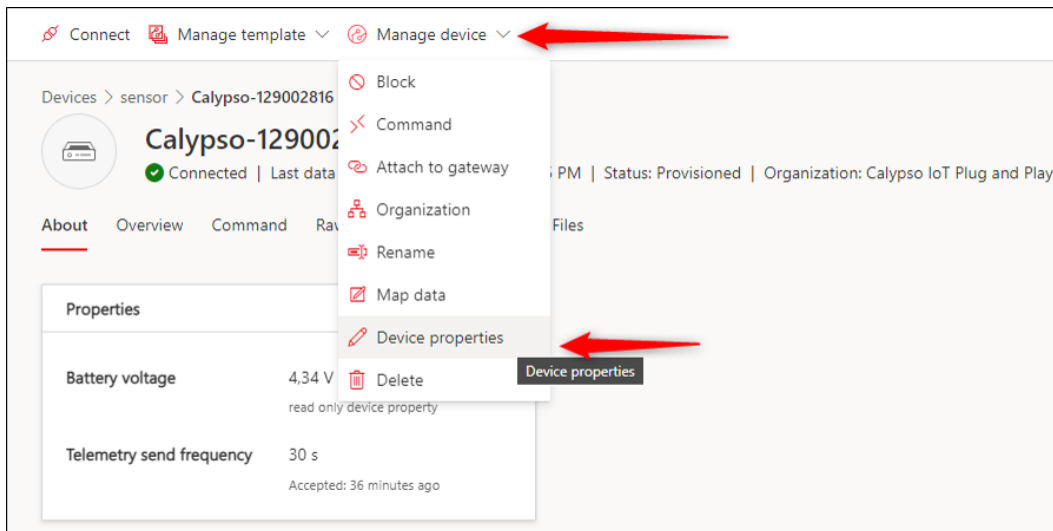


Figure 39: Set the send interval property

To update the send frequency, type in `"telemetrySendFrequency": <Send frequency in seconds>` and click on "Send to device". This update the device sends frequency on the device itself.



Figure 40: Set writable property

3.9 Factory reset

In order to reset the device to factory state, press the "button C" once, then Press and hold "button C" till the following message is displayed on the screen, "Reset device to factory state". This procedure resets the device to default state. Follow the device configuration process defined earlier to reconfigure the device.

4 Software description

Würth Elektronik eiSos provides a Software Development Kit (SDK) with examples to support all the FeatherWings created by Würth Elektronik eiSos. In this chapter, the salient features of the WE FeatherWing SDK are described.

- The SDK is open-source and well-documented.
- It uses a popular open-source toolchain including an IDE.
- The examples are written in Arduino-styled C/C++ for quick prototyping.
- The core components of the SDK are written in pure C to enable easy porting to any microcontroller platform.
- Development platform independent (Windows, Linux, or MAC).
- Modular structure of the software stack makes it easy to integrate into any project.

Specifically for this Evaluation Kit, the GitHub repository contains the software to interact with Microsoft IoT central as a plug-and-play device. This SDK provides a perfect software platform to build and test prototypes rapidly.

The SDK can be accessed on GitHub at github.com/WurthElektronik/Calypso-IoT-PnP-Design-Kit.

4.1 Software architecture

The Würth Elektronik eiSos FeatherWing SDK is built up in a modular way using a set of open-source tools to enable complete flexibility for the user.

The figure 41 shows the architecture of the Würth Elektronik eiSos FeatherWing SDK.

- **PlatformIO:** is a cross-platform, cross-architecture, multiple framework professional tool for embedded software development. It provides the toolchain necessary for software development including building, debugging, code-upload, and many more. PlatformIO works well on all modern operating systems and supports a host of development boards including the Feathers from Adafruit. Further details about PlatformIO can be found under platformio.org
- **Platform interface:** this layer provides an abstraction to the peripheral drivers for the platform being used. Currently, this SDK implements an abstraction to the Arduino peripheral drivers for the Feather M0 express platform.
- **Würth Elektronik eiSos SDK:** this is a layer of platform-independent pure C drivers for sensors and wireless connectivity modules from Würth Elektronik eiSos. These drivers implement all the necessary functions to utilize the full feature set of the sensors and wireless connectivity modules.
More details on the SDK and downloads under github.com/WurthElektronik. One SDK addresses Sensors and the second one the Wireless Connectivity modules.

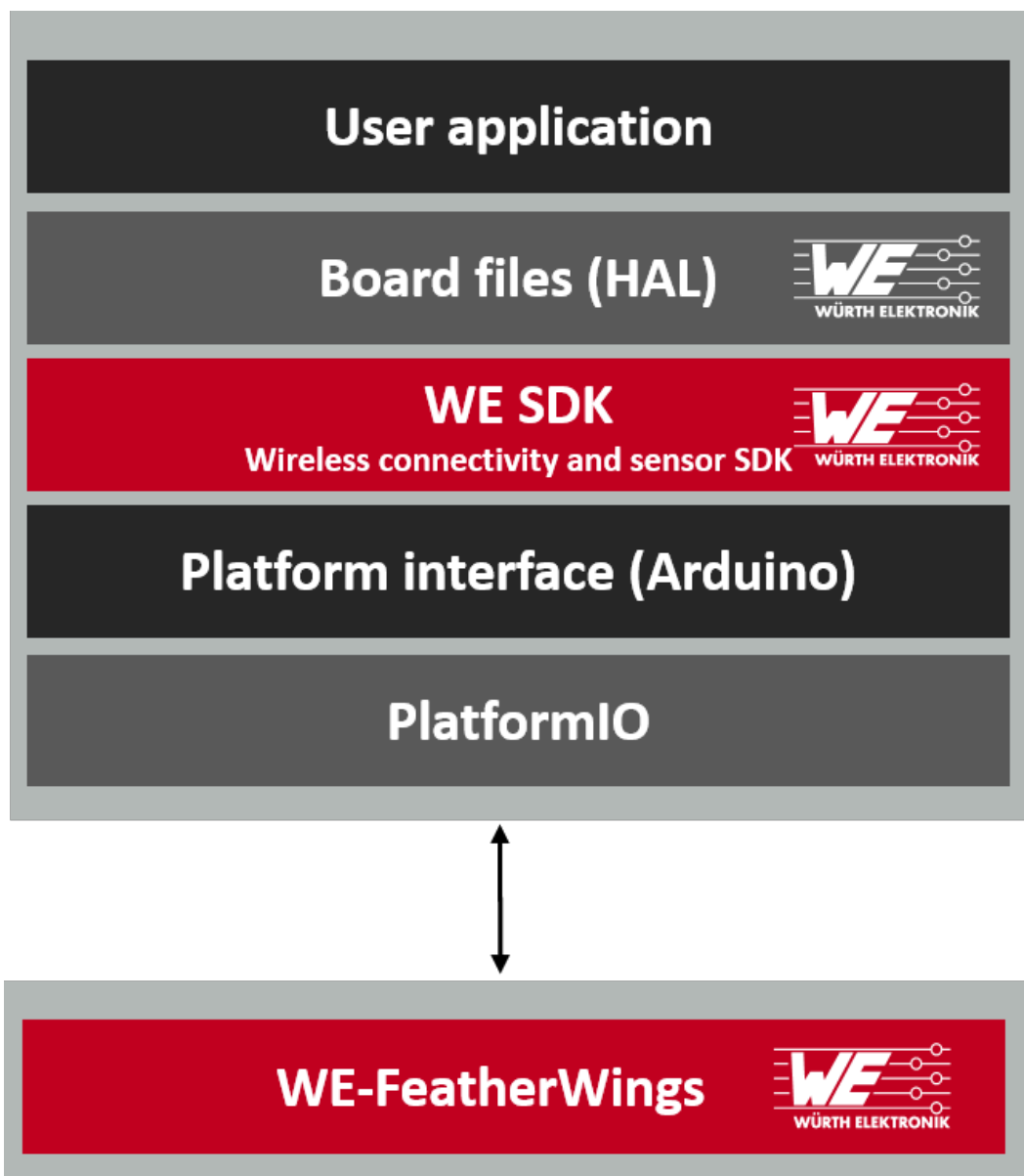


Figure 41: Software architecture

- **Board files:** this layer provides abstraction at a board level and provides functions to configure and control individual FeatherWings from Würth Elektronik eiSos.
- **User application:** The SDK currently implements an example to connect to the Microsoft IoT central platform.

5 Regulatory compliance information

Pursuant to Article 1 (2.) of the EU directive 2014/53/EU, Article 1 (2.) the directive does not apply to equipment listed in Annex I (4.): custom-built evaluation kits destined for professionals to be used solely at research and development facilities for such purposes.

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We recommend you to be updated about the status of new firmware and software, which is available on our website or in our data sheet and manual, and to implement new software in your device where appropriate.

By ordering a product, you accept these license terms in all terms.

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