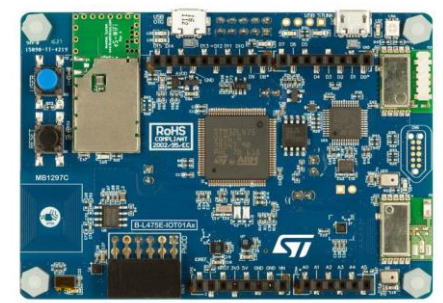
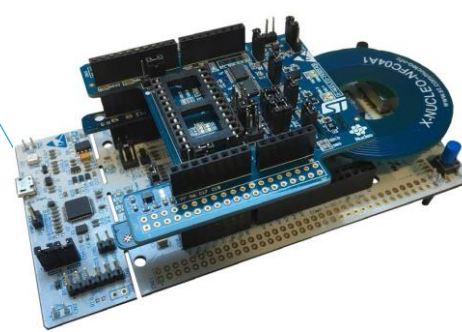
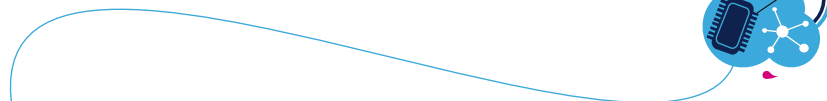
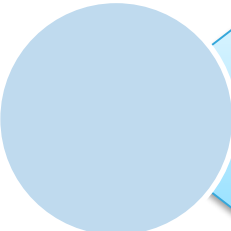


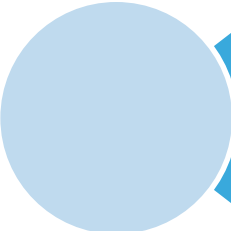
Quick Start Guide

STM32Cube function pack for IoT node with Wi-Fi, NFC and sensors for vibration analysis, connected to IBM Watson IoT cloud (FP-CLD-WATSON1)





FP-CLD-WATSON1: STM32Cube function pack for IoT node with Wi-Fi, NFC and sensors for vibration analysis, connected to IBM Watson IoT cloud



Setup & Demo Examples
Documents & Related Resources



STM32 Open Development Environment: Overview

Motion MEMS and environmental sensor expansion board (X-NUCLEO-IKS01A2)

3

X-NUCLEO-IKS01A2 Hardware description

- The X-NUCLEO-IKS01A2 is a motion MEMS and environmental sensor evaluation board system.
- It is compatible with the Arduino UNO R3 connector layout, and is designed around ST's latest sensors.

Key products on board

LSM6DSL

MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g) + 3D gyroscope ($\pm 125/\pm 245/\pm 500/\pm 1000/\pm 2000$ dps)

LSM303AGR

MEMS 3D magnetometer (± 50 gauss) + MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g)

LPS22HB

MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

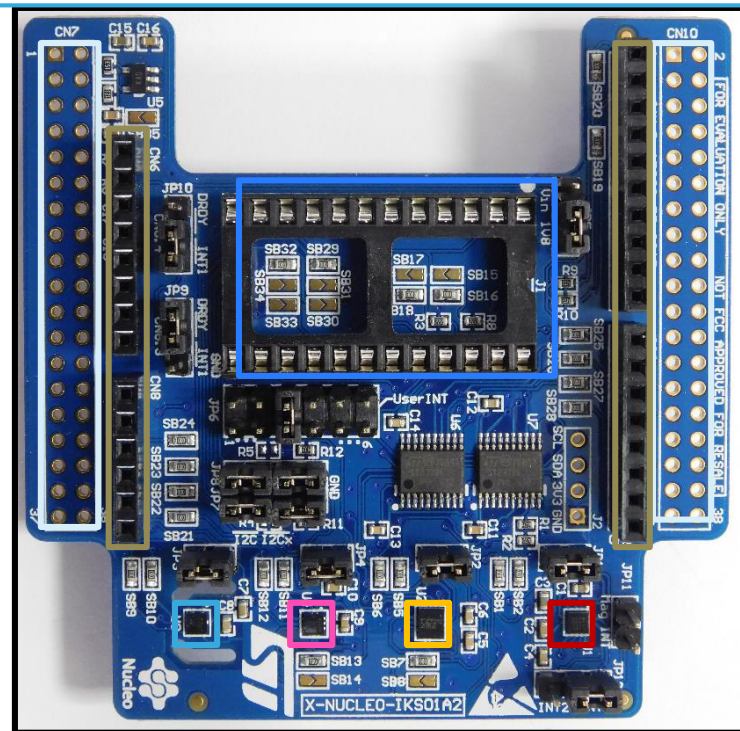
HTS221

Capacitive digital relative humidity and temperature

DIL 24-pin

Socket available for additional MEMS adapters and other sensors (UV index)

Hardware overview (1/4)



- | | | |
|---|---|--|
|  HTS221 |  LSM6DSL |  ST morpho connector** |
|  LPS22HB |  LSM303AGR |  Arduino UNO R3 connector |
| | |  DIL 24-pin |

Latest info available at www.st.com
X-NUCLEO-IKS01A2

** Connector for the STM32 Nucleo Board

Dynamic NFC tag expansion board

Hardware Overview (2/4)

4

X-NUCLEO-NFC04A1 Hardware Description

- The X-NUCLEO-NFC04A1 dynamic NFC/RFID tag IC expansion board is based on the ST25DV04K NFC Type V/RFID tag IC with a dual interface 4 Kbits EEPROM that also features an I²C interface. It can be powered by the pin of Arduino connector or directly by the received carrier electromagnetic field.
- The X-NUCLEO-NFC04A1 expansion board is compatible with the Arduino™ UNO R3 connector pin assignment and can easily be plugged onto any STM32 Nucleo board. Various expansion boards can also be stacked to evaluate different devices operating together with the dynamic NFC tag. The board also features an antenna with a 54 mm ISO 24.2 diameter, single layer, copper etched on PCB.

Key products on board

ST25DV04KV

Dynamic NFC/RFID tag IC with 4-Kbit, 16-Kbit or 64-Kbit EEPROM, and Fast Transfer Mode capability



NUCLEO-F429ZI board

Hardware Overview (3/4)

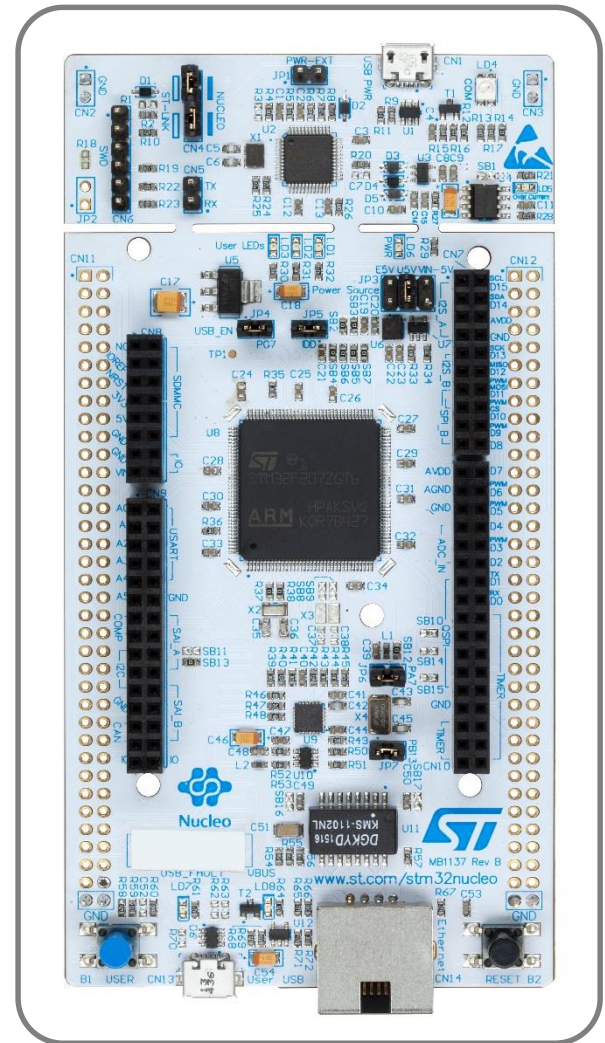
5

NUCLEO-144 Hardware Description

The STM32 Nucleo-144 boards (NUCLEO-F207ZG, NUCLEO-F303ZE, NUCLEO-F412ZG, NUCLEO-F413ZH, NUCLEO-F429ZI, NUCLEO-F446ZE, NUCLEO-F722ZE, NUCLEO-F746ZG, NUCLEO-F767ZI and NUCLEO-H743ZI) provide an affordable and flexible way for users to try out new concepts and build prototypes, by choosing from the various combinations of performance and power consumption features provided by the STM32 microcontroller.

Key Product on board

- 2 types of extension resources:
 - ST Zio connector including: support for Arduino™ Uno V3 connectivity (A0 to A5, D0 to D15) and additional signals exposing a wide range of peripherals
 - ST morpho extension pin header footprints for full access to all STM32 I/Os
- USB OTG or full-speed device with Micro-AB connector (depending on STM32 support)
- IEEE-802.3-2002 compliant Ethernet connector
- Flexible board power supply:
 - 5 V from ST-LINK/V2-1 USB VBUS
 - External power sources: 3.3 V and 7 - 12 V on ST Zio or ST morpho connectors, 5 V on ST morpho connector
- On-board ST-LINK/V2-1 debugger/programmer with SWD connector



Latest info available at www.st.com
NUCLEO-F429ZI

STM32L4 Discovery Board for IoT node (B-L475E-IOT01A)

Hardware Overview (4/4)

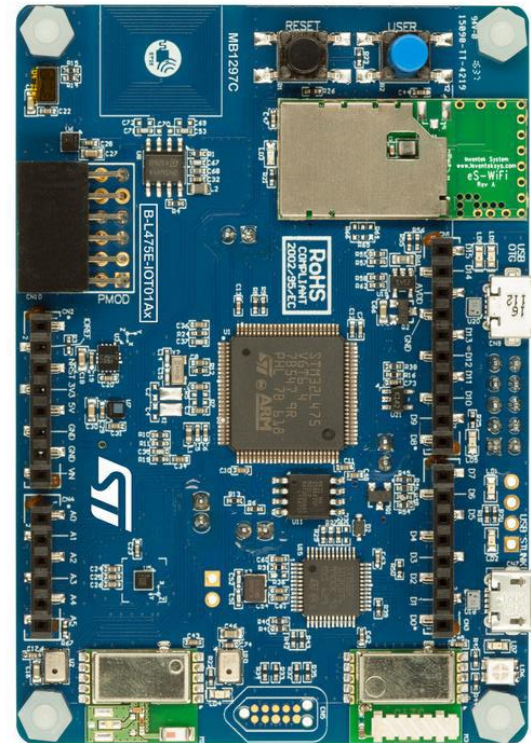
6

STM32L4 Discovery Board for IoT node (B-L475E-IOT01A) Hardware Description

The STM32L4 Discovery kit for the IoT node (B-L475E-IOT01A) allows users to develop applications with direct connection to cloud servers. The STM32L4 Discovery kit enables a wide diversity of applications by exploiting low-power multilink communication (BLE, Sub- GHz), multiway sensing (detection, environmental awareness) and ARM® Cortex®-M4 core-based STM32L4 Series features. Arduino™ Uno V3 and PMOD connectivity provide unlimited expansion capabilities with a large choice of specialized add-on boards.

Key Product on board

- Ultra-low-power STM32L4 Series MCUs based on ARM® Cortex® -M4 core with 1 Mbyte of Flash memory and 128 Kbytes of SRAM, in LQFP100 package
- Bluetooth® V4.1 module (SPBTLE-RF)
- Sub-GHz (868 or 915 MHz) low-power-programmable RF module (SPSGRF-868 or SPSGRF-915)
- Wi-Fi® module Inventek ISM43362-M3G-L44 (802.11 b/g/n compliant)
- Dynamic NFC tag based on M24SR with its printed NFC antenna
- 2 digital omnidirectional microphones (MP34DT01)
- Capacitive digital sensor for relative humidity and temperature (HTS221)
- High-performance 3-axis magnetometer (LIS3MDL), 3D accelerometer and 3D gyroscope (LSM6DSL), 260-1260 hPa absolute digital output barometer (LPS22HB), Time-of-Flight and gesture-detection sensor (VL53L0X)
- USB OTG FS with Micro-AB connector
- Expansion connectors: Arduino™ Uno V3, PMOD
- Flexible power-supply options: ST LINK USB VBUS or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port and debug port



Latest info available at www.st.com
B-L475E-IOT01A

FP-CLD-WATSON1 Software Description

FP-CLD-WATSON1 is an STM32Cube function pack. It can connect an IoT node based on the STM32L4 Discovery kit IoT node (B-L475E-IOT01A) or the NUCLEOF429ZI to IBM Watson IoT, transmit sensor data and receive commands from remote applications. This package lets you jump-start end-to-end IoT development so that you can focus on adding desired functions..

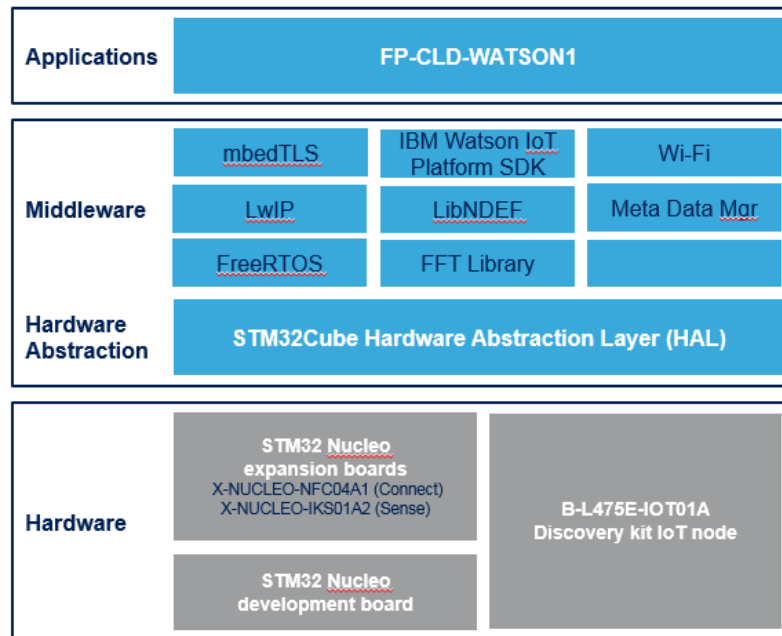
Key features

- Complete middleware to build applications based on Wi-Fi/Ethernet connectivity, inertial and environmental sensors, and to connect an STM32 Nucleo-144 development board with STM32F429ZI MCU, or an STM32L4 Discovery kit IoT node (B-L475E-IOT01A) to IBM Watson IoT Cloud.
- Provide software interface to access temperature and humidity sensor (HTS221), pressure sensor (LPS25HB), motion sensors (LIS3MDL, LSM303AGR, LSM6DS0, LSM6DSL) and to write and read the RFID/NFC tag (ST25DV04K)
- Integrated mbedTLS and MQTT protocol middleware
- Integrated Fast Fourier Transform (FFT) algorithm for vibration analysis
- Sample implementation based on Wi-Fi connectivity available for STM32L4 Discovery kit IoT node (B-L475E-IOT01A), based on Ethernet connectivity available for X-NUCLEO-IKS01A2, and X-NUCLEO-NFC04A1, when both connected to a NUCLEO-F429ZI
- Easy access to IBM Watson IoT Cloud services for sensors data visualization and processing.

FP-CLD-WATSON1 Software Overview

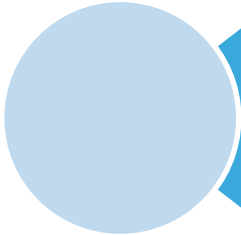
7

Overall Software Architecture

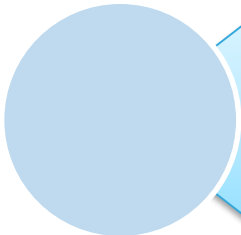


Latest SW available at www.st.com

FP-CLD-WATSON1



FP-CLD-WATSON1: STM32Cube function pack for IoT node with Wi-Fi, NFC and sensors for vibration analysis, connected to IBM Watson IoT cloud



Setup & Demo Examples
Documents & Related Resources



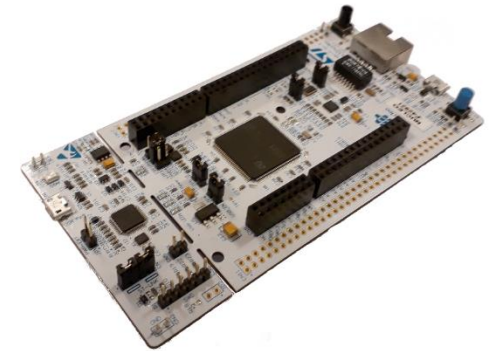
STM32 Open Development Environment: Overview

Setup & Demo Examples

HW prerequisites (1/2)

9

- 1x Motion MEMS and environmental sensor expansion board for STM32 Nucleo (**X-NUCLEO-IKS01A2**)
 - **Note:** the vibration analysis application is available only when using the X-NUCLEO-IKS01A2 board
- 1x Dynamic NFC tag expansion board expansion board for STM32 Nucleo (**X-NUCLEO-NFC04A1**) (optional)
- 1x STM32 Nucleo development board (**NUCLEO-F429ZI**)
- NFC-enabled Android™ device (optional)
- Windows 7 or higher - Laptop/PC
- Ethernet port for connectivity supporting DHCP
- 1 x micro USB cable



NUCLEO-F429ZI



Micro USB Cable



X-NUCLEO-IKS01A2



X-NUCLEO-NFC04A1
(optional)

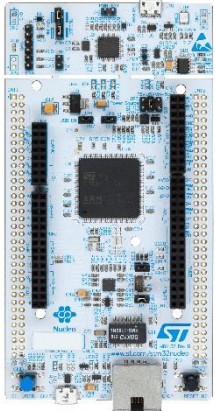
Setup & Application Examples

HW prerequisites for Nucleo and expansion board with Ethernet connectivity (2/2)

10

X-NUCLEO-IKS01A2


NUCLEO-F429ZI



+

+



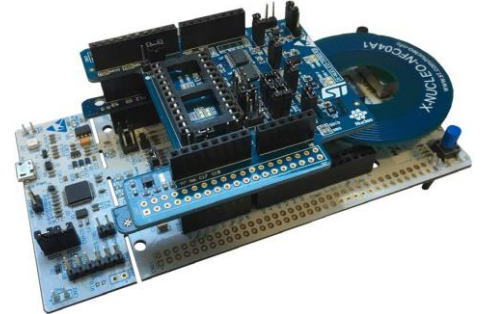
STM32 Nucleo-144

Sensors



Dynamic NFC

X-NUCLEO-NFC04A1



Setup & Application Examples (Azure_Sns_DM)

HW prerequisites for B-L475E-IOT01A

11

- 1x B-L475E-IOT01A development board
- NFC-enabled Android™ device (optional)
- Laptop/PC with Windows 7, 8 or 10
- 1 x microUSB cable
- Wi-Fi Router or access to a Wi-Fi network



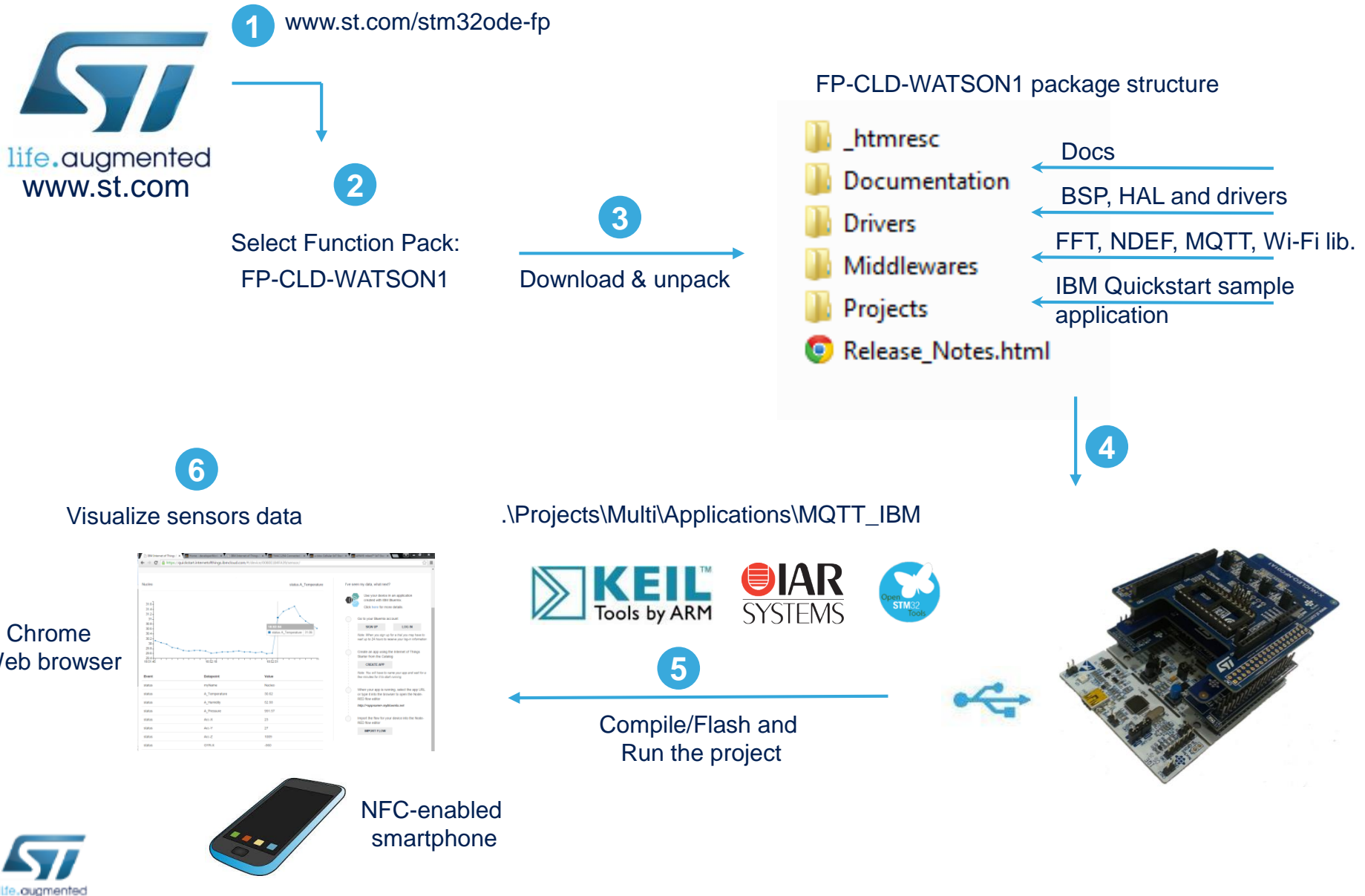
MicroUSB Cable

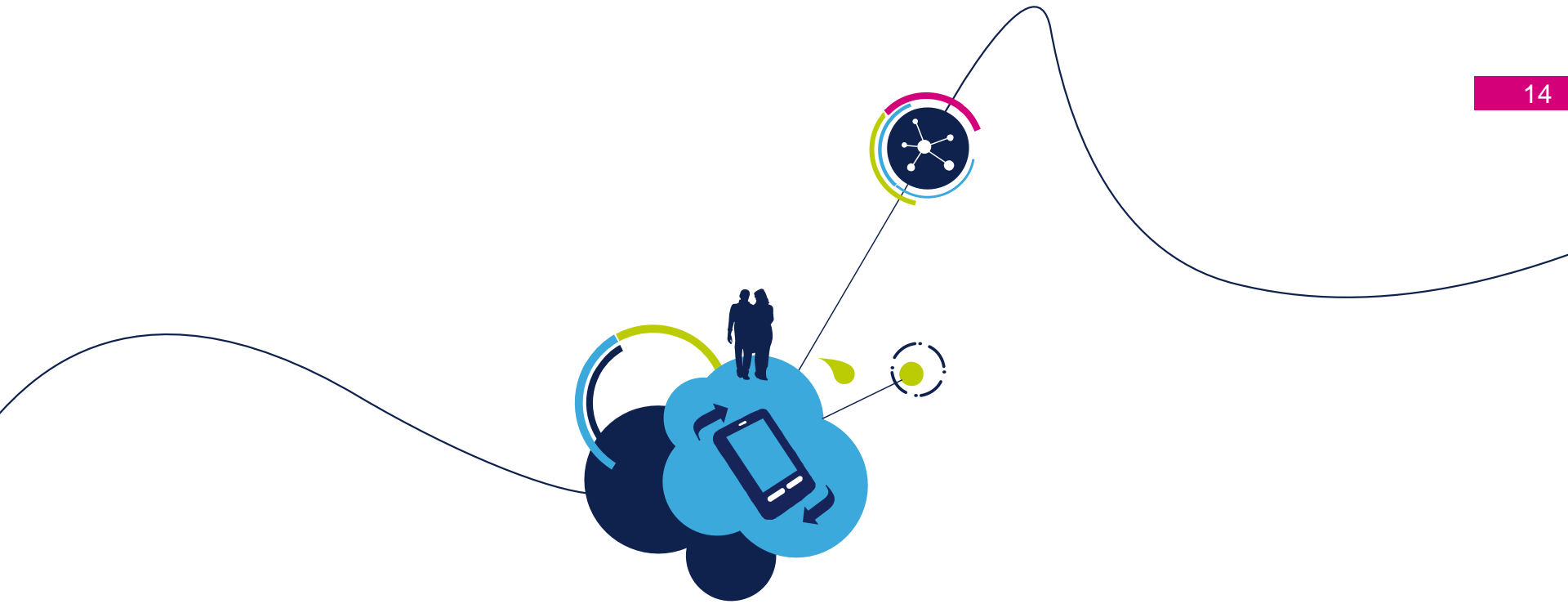


B-L475E-IOT01A

- **STSW-LINK009**
 - ST-LINK/V2-1 USB driver
- **STSW-LINK007:**
 - ST-LINK/V2-1 firmware upgrade
- **FP-CLD-WATSON1**
 - Copy the .zip file content into a folder on your PC. The package will contain source code example (Keil, IAR, System Workbench) based only on NUCLEO-F429ZI
- **Serial line terminal** (e.g. TeraTerm, <https://ttssh2.osdn.jp/>)
- A mobile application for **Android/iOS** capable to read/write NFC tag (i.e. ST25 NFC <https://play.google.com/store/apps/details?id=com.st.demo>)

Wi-Fi, NFC and sensors software for Cloud connectivity





Quickstart mode configuration

Configure IBM Cloud Configuration Parameters via serial interface(1/2)

1. Configure a serial terminal with the following parameters to view log messages and write AP parameters. Tested with Teraterm version 4.96
 - BaudRate : 115200
 - Data : 8 bit
 - Parity : none
 - Stop : 1 bit
 - Flow Control : none
 - NewLine RX AUTO
 - NewLine TX : CR+LF
 - Local echo: Enabled
2. B-L475E-IOT01A requires Wi-Fi connectivity, provide Wi-Fi Credentials using terminal. This step is not needed for Nucleo-F429ZI based configuration:

```
*** WIFI connection ***

Push the User button (Blue) within the next 5 seconds if you want to update the
WiFi network configuration.

Your WiFi parameters need to be entered to proceed.

Enter SSID: nono
You have entered nono as the ssid.

Enter Security Mode (0 - Open, 1 - WEP, 2 - WPA, 3 - WPA2):3
You have entered 3 security mode.

Enter password: 12345678

Initializing the WiFi module
Module initialized successfully: Inventek eS-WiFi ISM43362-M3G-L44-SPI C3.5.2.3.
BETA9
Retrieving the WiFi module MAC address: c4:7f:51:03:8a:16
```

Configure IBM Cloud Configuration Parameters via serial interface(1/2)

16

3. Configure a serial terminal with the following parameters to view log messages and write AP parameters. Tested with Teraterm version 4.96
 - BaudRate : 115200
 - Data : 8 bit
 - Parity : none
 - Stop : 1 bit
 - Flow Control : none
 - NewLine RX AUTO
 - NewLine TX : CR+LF
 - Local echo: Enabled
4. Press RESET (Black) button on STM32 Nucleo to trigger initialization phase. Enter the root CA when firmware asks for it:
 - (copy-paste from Projects\Common\Bluemix\comodo_bluemix.pem):

```

*** Board personalization ***

*** Ethernet connection ***
Initializing LwIP on Ethernet interface

Starting DHCP client to get IP address...
IPAddress = 192.168.0.4
Mac address: 3e:1d:6d:aa:fc:0a
Retrieving the IP address.
IP address: 192.168.0.4

Updating TLS security credentials.

Enter the x509 certificates or keys as per the following format:
-----BEGIN CERTIFICATE-----
YMPGn8u67GB9t+aEMr5P+1gmIgNb1LTU+/%jli5wwOQuvfwu7uJBUCa0Ln0kcmnL
R7EUQIN9Z/SG9jGr8XmksrUuEvmEF/Bibyc+E1ixUA0hmnM3oTDPb5Lc9un8rNsu
-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
YMPGn8u67GB9t+aEMr5P+1gmIgNb1LTU+/%jli5wwOQuvfwu7uJBUCa0Ln0kcmnL
-----END CERTIFICATE-----
\n.....

Enter your root CA:

```

Configure IBM Cloud Configuration Parameters via serial interface(2/2)

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3. Enter Registration mode.

```
Enter Registration Mode (1 - Quickstart, 2 - Simple):
1
```

4. Enter Bluemix Configuration String.

```
Enter the Bluemix connection string of your device: (template: DeviceType=xxx;DeviceId=xxx)
DeviceType=device_type;DeviceId=id1
```

5. Device will start streaming sensor data to IBM Watson IoT platform service.

```
Setting the RTC from the network time.
Configuring the RTC from Date: Wed, 13 Jun 2018 06:56:21 GMT
fft library initialized
Device Client Connected to quickstart.messaging.internetofthings.ibmcloud.com Platform in QuickStart Mode

You can see your published data at https://quickstart.internetofthings.ibmcloud.com
Device Id is id1

When user button is pushed shortly, application publishes the sensor values, a 0/1 toggle value (the green Led switches accordingly) and a timestamp
On double button push, application enters in a loop and publishes automatically every second. Next double push returns to previous mode

FFTMxAmpl: 969, FFTMaxFreq: 0
PayloadBuffer: {"d":{"temperature": 30.50, "humidity": 56.10, "pressure": 970.91, "acc_x": 0, "acc_y": 0, "acc_z": 979, "Motor_status": "OK", "FFTMxFreqAmp": 969, "FFTMxFreq": 0 }}
publishing sensor data
FFTMxAmpl: 969, FFTMaxFreq: 0
PayloadBuffer: {"d":{"temperature": 30.50, "humidity": 56.20, "pressure": 970.98, "acc_x": 0, "acc_y": 0, "acc_z": 948, "Motor_status": "OK", "FFTMxFreqAmp": 969, "FFTMxFreq": 0 }}
publishing sensor data
```

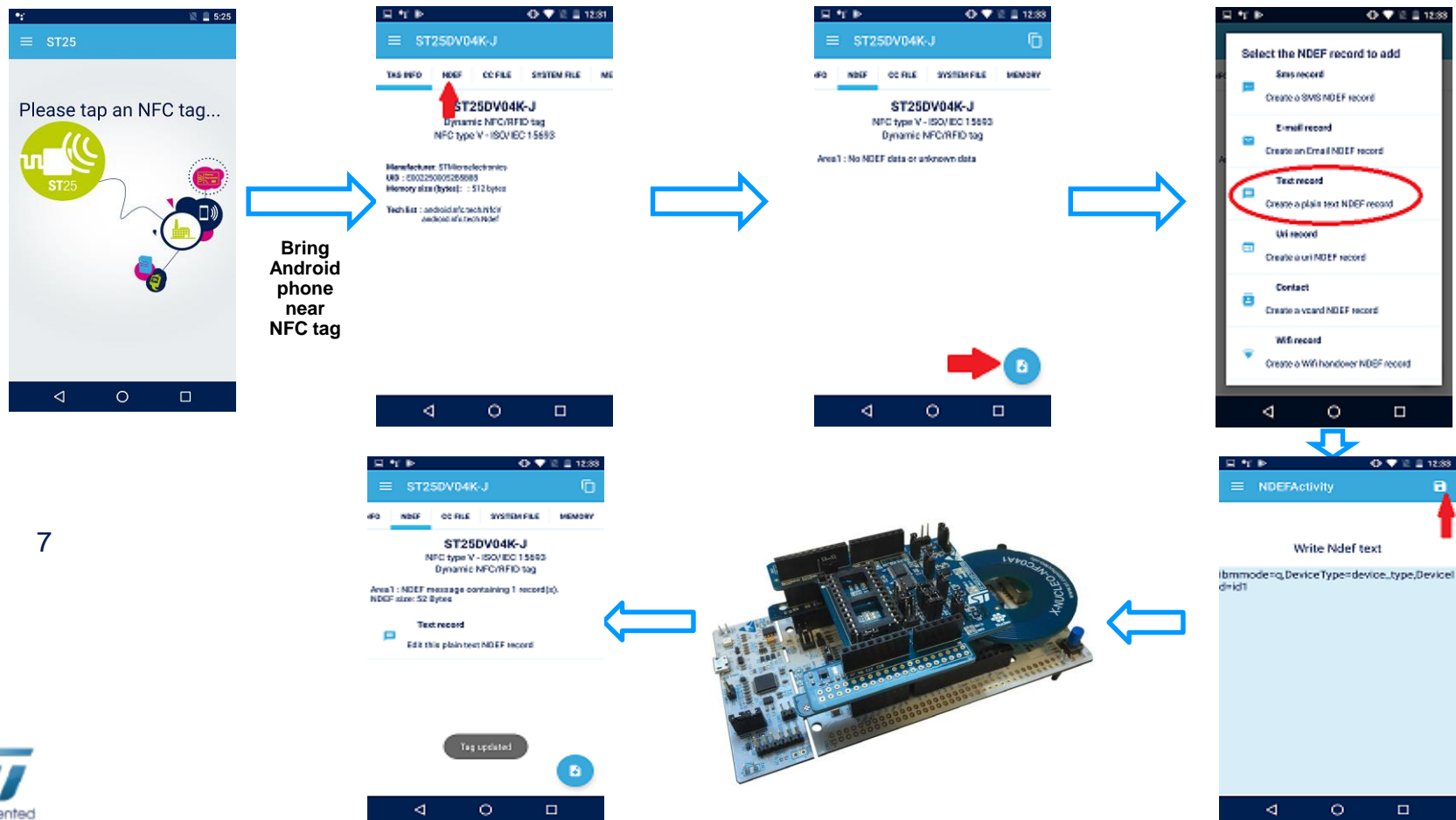
Provision of device credentials using NFC (optional)(1/2)

18



This feature is only available for NUCLEO-F429ZI based configuration. NFC Usage for device credential provisioning is optional. And it requires usage of the X-NUCLEO-NFC04A1 expansion board.

1. Write Bluemix Configuration parameters to X-NUCLEO-NFC04A1 using a mobile application. E.g. with ST25 NFC mobile application for Android devices:



2. 7

Provision of device credentials using NFC (optional) (2/2)

2. Format of configuration string passed in step #5 above:

- `ibmmode=q;DeviceType=your_device_type;DeviceId=id1`

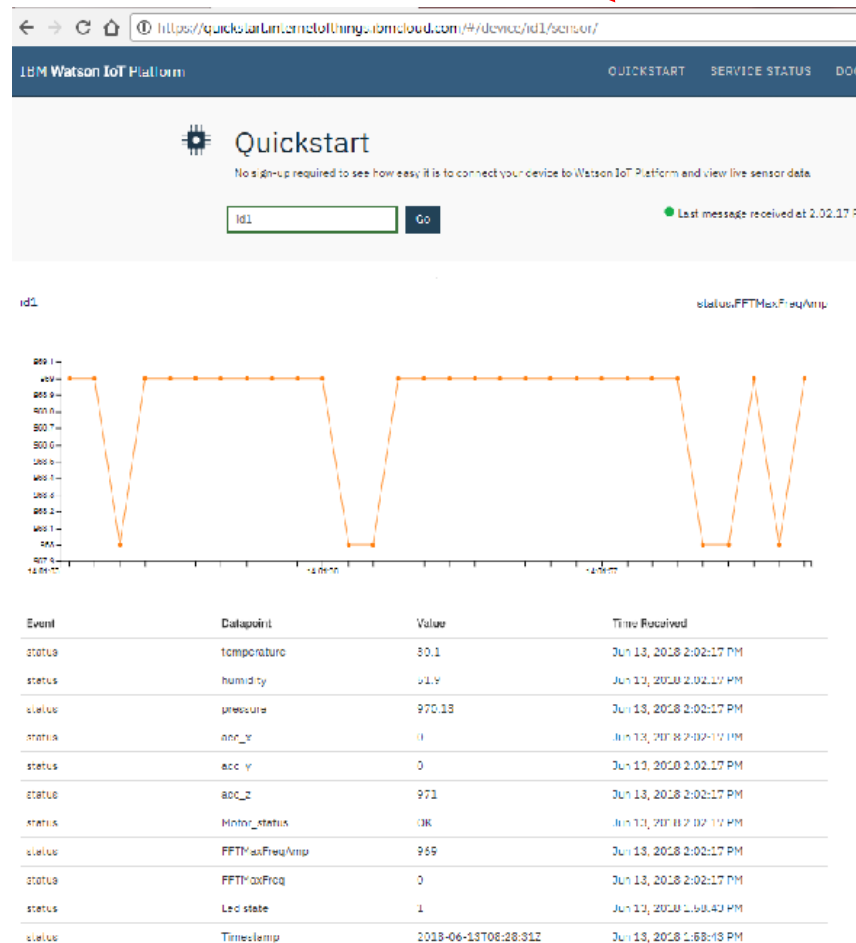
FP-CLD-WATSON1

Quickstart URL to visualize sensors data

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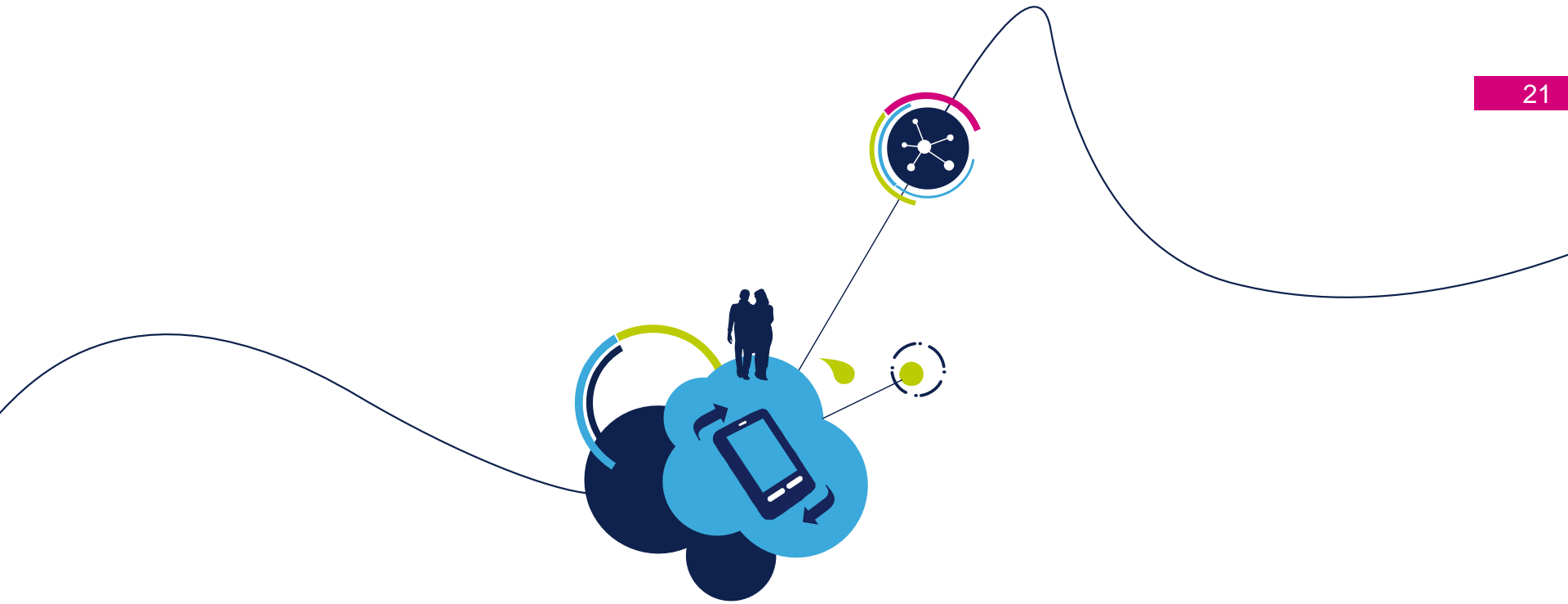
- Paste Quickstart URL in Chrome web browser

Paste the URL in the web browser



One set of sensors data are visualized at a time, selected from the list below i.e. FFT_max_f

List of sensors Data received



Registered mode configuration

Create dashboard in IBM Cloud

FP-CLD-WATSON1: Registered mode

Create Watson IoT Platform IBM Cloud

- “Registered mode” enables to connect your **STM32 Nucleo and expansion boards** to **IBM Cloud** and build scalable IoT applications based IBM Watson IoT platform
- Create a free account at IBM cloud by following instructions at <https://console.bluemix.net/registration/>
- Once you have an IBM cloud user account, use your credentials to create ***Internet of Things Platform Starter*** cloud foundry app

Create a Cloud Foundry App

Internet of Things Platform Starter

Get started with IBM Watson IoT platform using the Node-RED Node.js sample application. With the Starter, you can quickly simulate an Internet of Things device, create cards, generate data, and begin analyzing and displaying data in the Watson IoT Platform dashboard.

View Docs

VERSION 0.7.0
TYPE Starterplate
REGION Germany, US South, United Kingdom

App name: FFTSensor

Host name: FFTSensor

Domain: eu-gb.mybluemix.net

Choose a region/location to deploy in: United Kingdom

Choose an organization: stm098217

Choose a space: uk

Selected Plan:

SDK for Node.js™ Default

Cloudant NoSQL DB Lite

Internet of Things Platform Lite

Develop, deploy, and scale server-side JavaScript apps with ease. The IBM SDK for Node.js™ provides enhanced performance, security, and serviceability.

Create

Need Help?
Contact IBM Cloud Sales ☎

Estimate Monthly Cost
Cost Calculator

FP-CLD-WATSON1: Registered mode

Launch Watson IoT Platform (1/2)

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- Click on the **xxxx-iotf-service** link in your IBM cloud dashboard

The screenshot shows the IBM Cloud dashboard interface. At the top, there's a navigation bar with 'IBM Cloud' and links for 'Catalog', 'Docs', 'Support', and 'Manage'. Below this, the 'Dashboard' section is visible, showing filters for 'RESOURCE GROUP' (None), 'REGION' (United Kingdom), 'CLOUD FOUNDRY ORG' (stm090217), and 'CLOUD FOUNDRY SPACE' (uk). A 'Create resource' button is on the right.

Under 'Cloud Foundry Apps', there's a table with 512 MB/2 GB Used. The table has columns: Name, Route, Memory (MB), and State. It lists two apps: 'FFTSensor' with two routes, both in 'Running (1/1)' state.

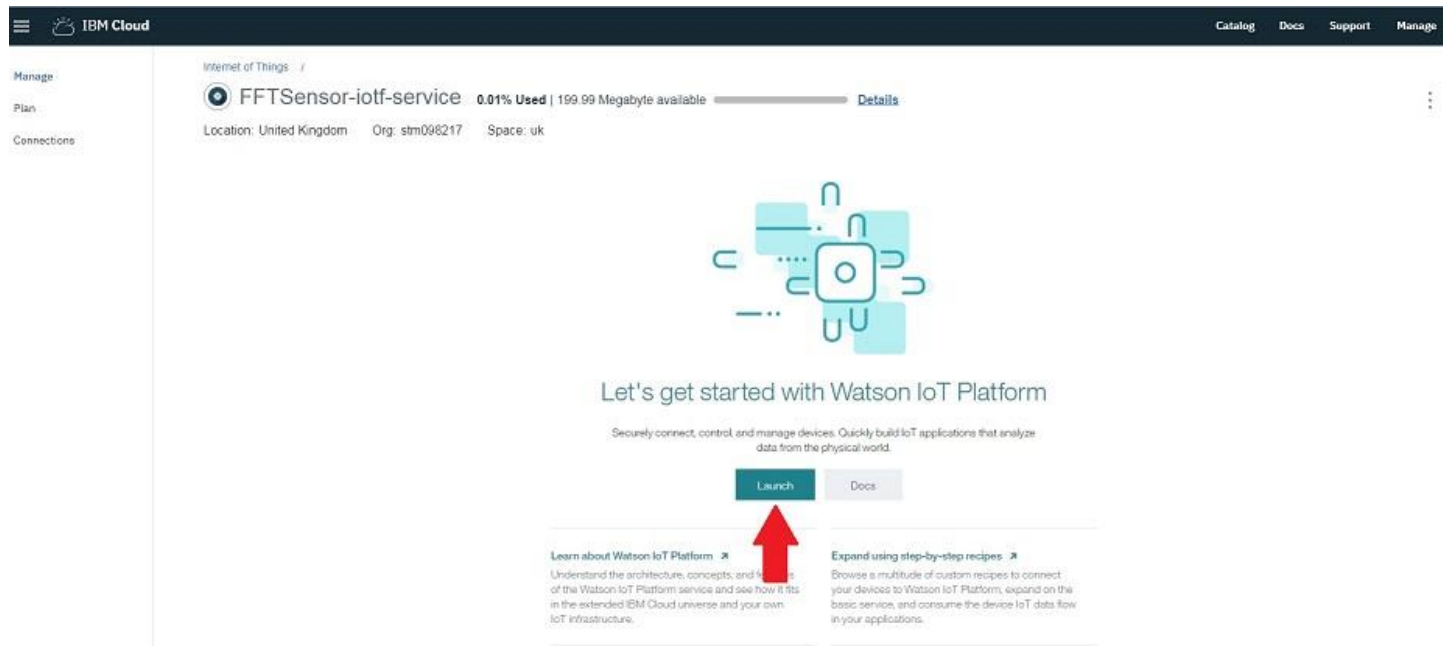
Below that, 'Cloud Foundry Services' are listed, with 5/10 Used. The table has columns: Name, Service Offering, and Plan. It lists three services: 'FFTSensor-cloudantNoSQLDB' (Cloudant NoSQL DB, Life plan), 'FFTSensor-iotf-service' (Internet of Things Platform, Life plan), and an empty row. A red arrow points to the 'FFTSensor-iotf-service' row.

FP-CLD-WATSON1: Registered mode

Launch Watson IoT Platform (2/2)

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- Click on **Launch** to open IBM Watson IoT platform service



FP-CLD-WATSON1: Registered mode

Create a device type (1/2)

- Click on **Device** then **Device Types**

The screenshot shows the IBM Watson IoT Platform dashboard. The left sidebar contains a menu with options: BOARDS, DEVICES (highlighted with a red box), MEMBERS, APPS, ACCESS MANAGEMENT, USAGE, RULES, SECURITY, SETTINGS, and EXTENSIONS. The main content area is titled 'Device Types' and shows a table with one device type listed. The table has columns for Device Type, Class ID, Date Added, and Descriptive Location. The device type listed is STM32, with Class ID Device, Date Added Mar 5, 2018 11:17 AM, and Descriptive Location -F401. A red box highlights the 'Device Types' link in the top navigation bar.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG hem.dabral@st.com ID: (xl3q5c)

Device Types

+ Add Device

Devices

View of all devices that have been added. It can be filtered, organized, and searched on. If you have not yet started, you can add devices by using the Add Device button, or by using API.

Device Type	Class ID	Date Added	Descriptive Location
1 result			
-F401	STM32	Device	Mar 5, 2018 11:17 AM

FP-CLD-WATSON1: Registered mode

Create a device type (2/2)

- Select Device as Device Type, enter **Device Type** name then click on **Next**


Browse Diagnose Action **Device Types**

Add Type Identity Device Information ×

Select Type

Device types group devices that have similar characteristics, such as model number, firmware version, or location. Give the device type a unique name and a description that identifies characteristics that are shared by devices of this type.

Type Device Or Gateway Open in new tab

Name 

The device type name is used to identify the device type uniquely and uses a restricted set of characters to make it suitable for API use.

Description

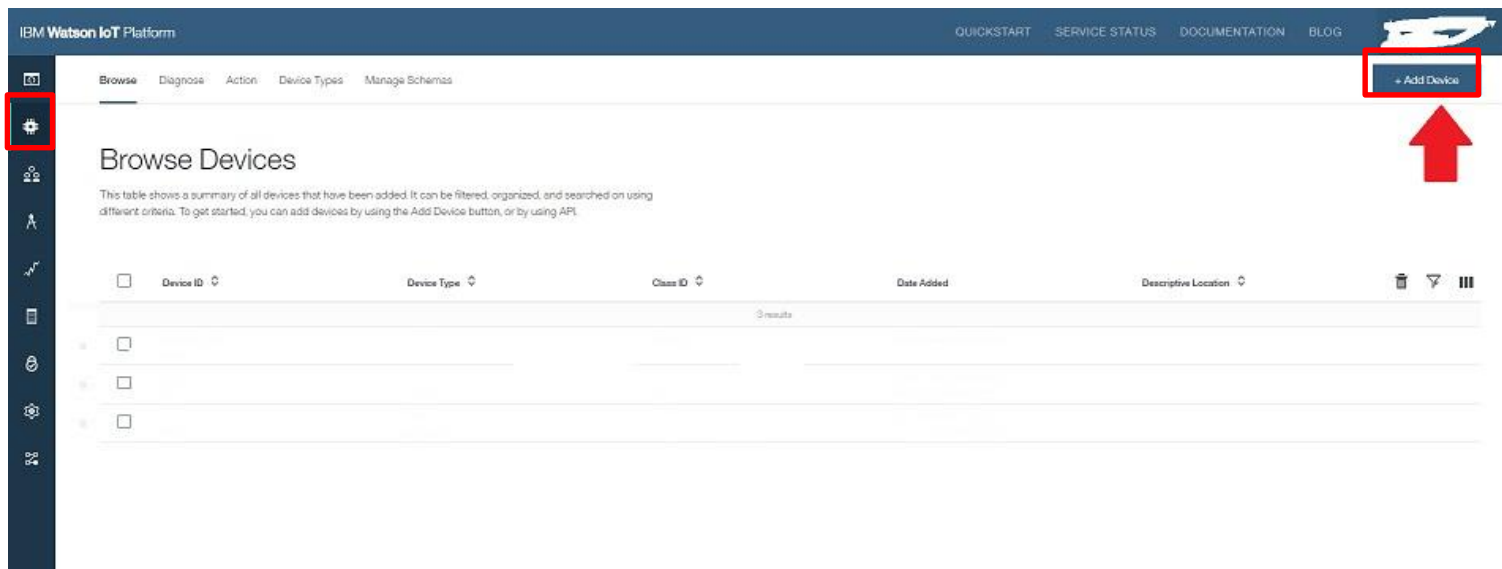
Cancel **Next**

FP-CLD-WATSON1: Registered mode

Add a device (1/4)

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- Select BroweDevices in left side bar, then add your device by clicking on **Add Device**
 - Please note that you might have to create a device type first



FP-CLD-WATSON1: Registered mode

Add a device (2/4)

- Select Auto-generated authentication token, then click on **Next**

Browse Diagnose Action Device Types

Add Device Identity Device Information **Security** Summary

Device Security

There are two options for selecting a device authentication token.

Auto-generated authentication token (default)

Allow the service to generate an authentication token for you. Tokens are 18 characters and contain a mix of alphanumeric characters and symbols. The token is returned to you at the end of the device registration process.

Authentication Token

Make a note of the generated token. Lost authentication tokens cannot be recovered. Tokens are encrypted before being stored.

Authentication token are encrypted before we store them.

Self-provided authentication token

Provide your own authentication token for this device. The token must be between 8 and 36 characters and contain a mix lowercase and uppercase letters, numbers, and symbols, which can include hyphens, underscores, and periods. Do not use repeated characters, dictionary words, user names, or other predefined sequences.

< **Next**

FP-CLD-WATSON1: Registered mode

Add a device (3/4)

- Select Device Type, enter your Device ID, then click on **Next**

Browse Diagnose Action Device Types

Add Device Identity Device Information Security Summary

Identity

Select a device type for the device that you are adding and give the device a unique ID.

Select Existing Device Type STM32

Device ID STM32-Nucleo-F401

Cancel Next

FP-CLD-WATSON1: Simple Registration mode

Add a device (4/4)

- Take note of device credentials generated for your device


DEVICE DRILLDOWN
[Device Credentials](#)
Connection Information
Recent Events
State
Device Information
Metadata
Extension Configuration
Diagnostics
Connection Logs
Device Actions

Device STM32-Nucleo-F401

Device Credentials

You registered your device to the organization. Add these credentials to the device to connect it to the platform. After the device is connected, you can navigate to view connection and event details.

Organization ID	xl3q5c
Device Type	STM32
Device ID	STM32-Nucleo-F401
Authentication Method	use-token-auth
Authentication Token	K7*KfFCEX&yeXrk5mK

 Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the device to generate a new authentication token.

Find out how to add these credentials to your device [➔](#)

FP-CLD-WATSON1: Simple Registration mode

Provision credentials to STM32 Nucleo

- Reboot the STM32 Nucleo board. When requested select Registered mode. Enter device credentials as shown below

```
Enter Registration Mode <1 - Quickstart, 2 - Simple>:  
2  
You have selected the Simple registration mode.  
Enter the Bluemix connection string of your device: <template: OrgId=xxx;Device  
Type=xxx;DeviceId=xxx;Token=xxx>  
OrgId=yuzagl;DeviceType=f429zi;DeviceId=i1;Token=hdd1hdd1
```

Simple Registration Mode = 2

Device i1

Device Credentials

You registered your device to the organization. Add the
After the device is connected, you can navigate to view

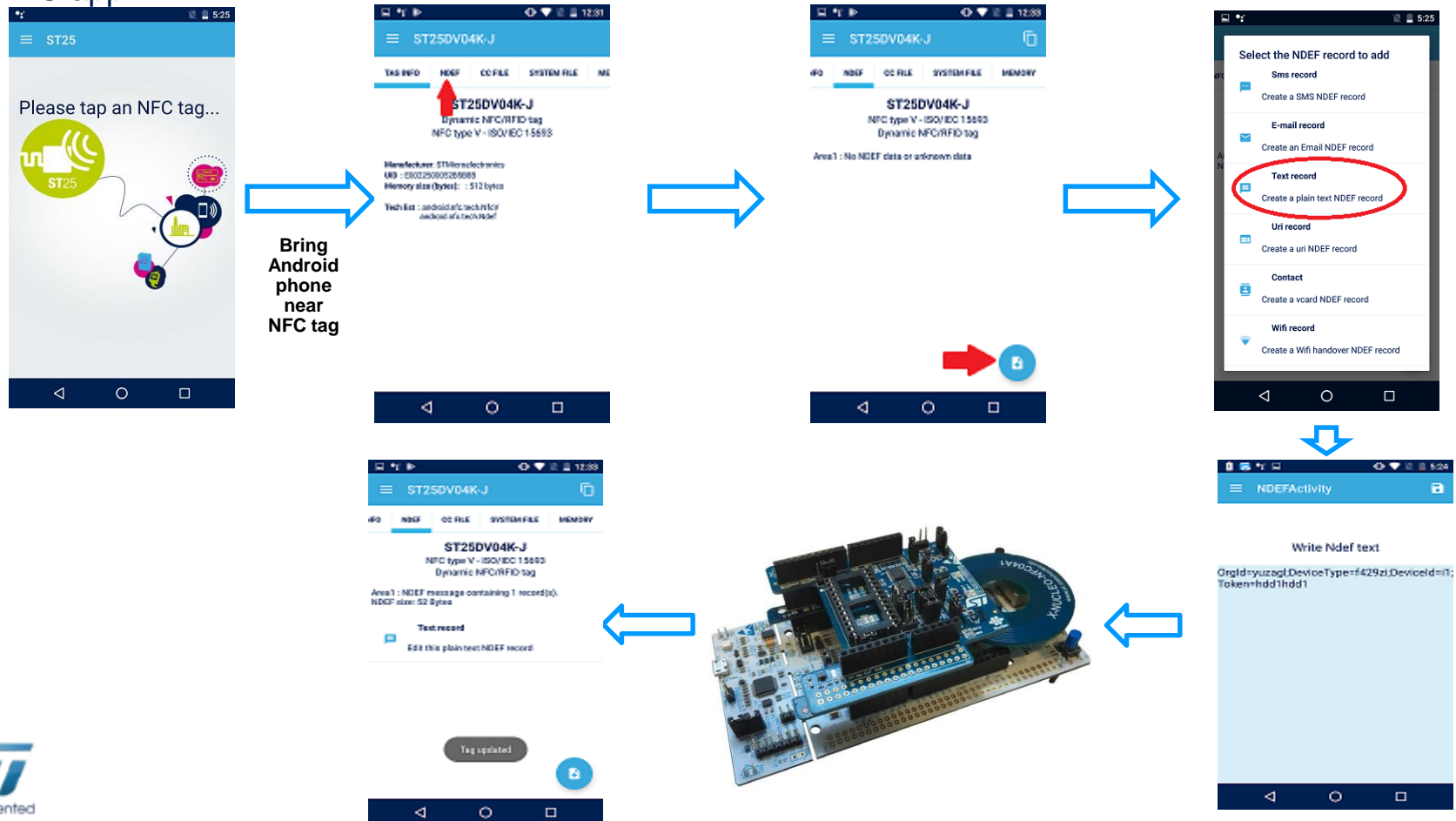
Organization ID	yuzagl
Device Type	f429zi
Device ID	i1
Authentication Method	use-token-auth
Authentication Token	hdd1hdd1

Provision of device credentials using NFC (optional)(1/2)



This feature is only available for Nucoe-F429ZI based configuration. NFC Usage for device credential provisioning is optional. And it requires usage of X-NUCLEO-NFC04A1 expansion board.

- Device credentials can also be written to device via NFC by using a mobile application. E.g. with ST25 NFC app:



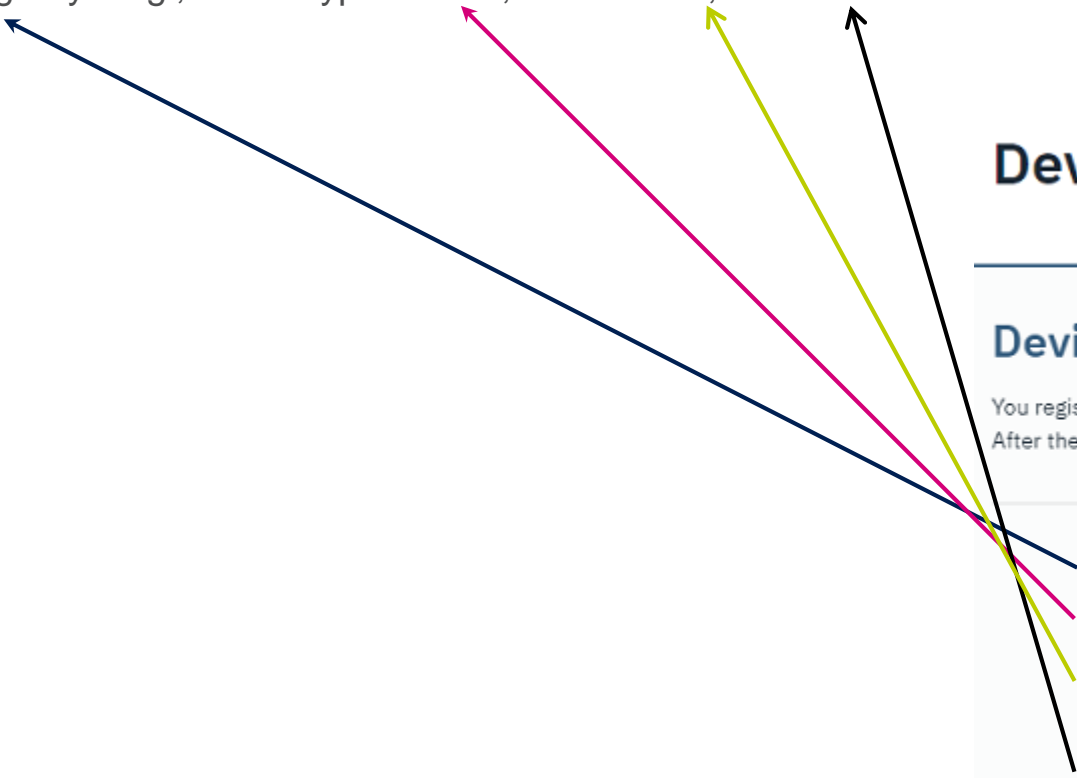
- Format of configuration string passed in step #5 on last slide:

- OrgId=yuzagl;DeviceType=f429zi;DeviceId=i1;Token=hdd1hdd1

Device i1

Device Credentials

You registered your device to the organization. Add the
After the device is connected, you can navigate to view



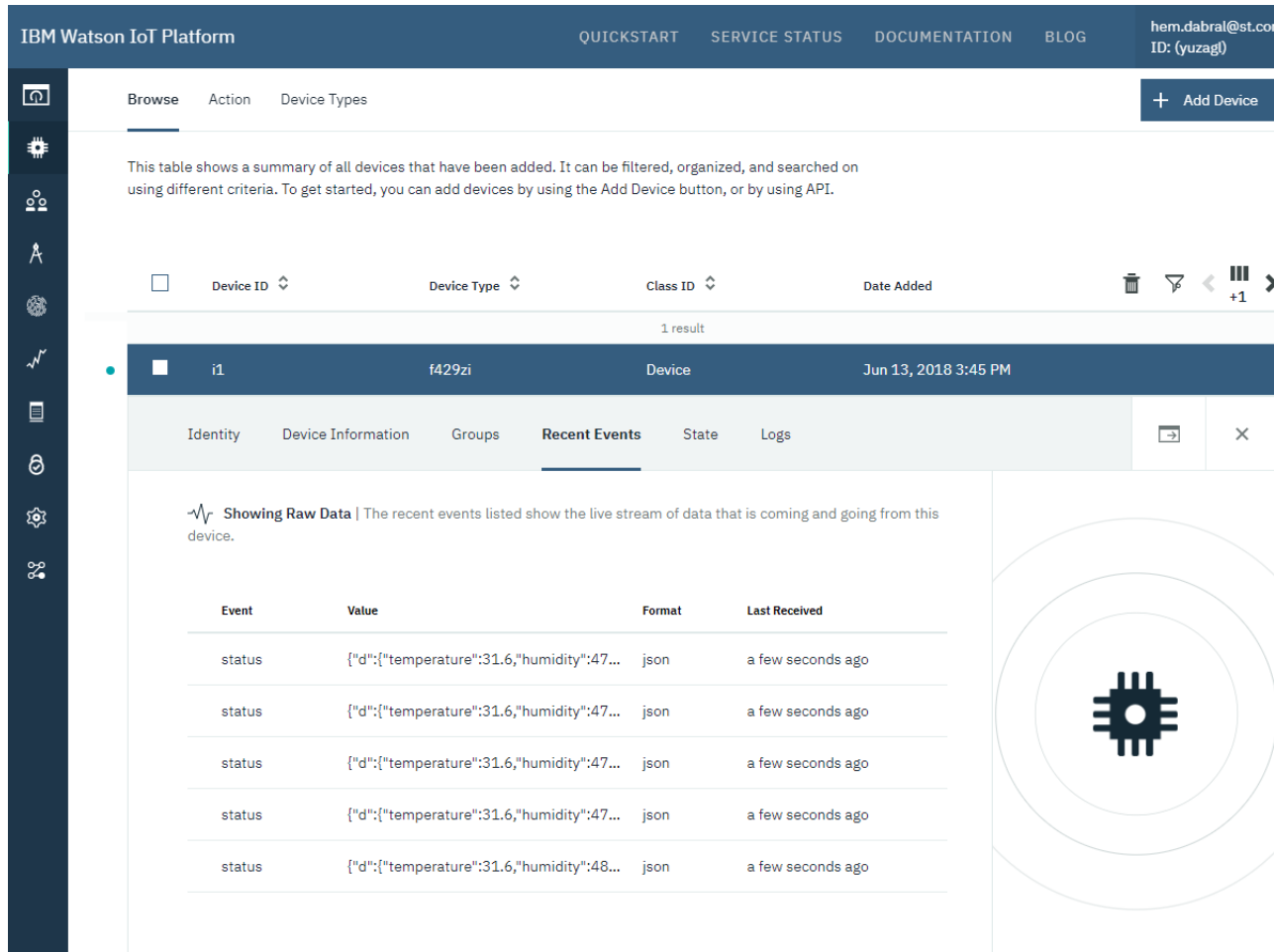
The diagram shows four arrows originating from the configuration string 'OrgId=yuzagl;DeviceType=f429zi;DeviceId=i1;Token=hdd1hdd1' and pointing to the corresponding values in the table below. A blue arrow points from 'OrgId=yuzagl' to 'Organization ID yuzagl'. A pink arrow points from 'DeviceType=f429zi' to 'Device Type f429zi'. A yellow arrow points from 'DeviceId=i1' to 'Device ID i1'. A black arrow points from 'Token=hdd1hdd1' to 'Authentication Token hdd1hdd1'.

Organization ID	yuzagl
Device Type	f429zi
Device ID	i1
Authentication Method	use-token-auth
Authentication Token	hdd1hdd1

FP-CLD-WATSON1: Registered mode

Visualize messages received from STM32 Nucleo

- Browse devices, select your device ID, then click on **Recent Events** tab



The screenshot displays the IBM Watson IoT Platform interface. The top navigation bar includes links for QUICKSTART, SERVICE STATUS, DOCUMENTATION, and BLOG, along with a user profile for hem.dabral@st.com. The left sidebar contains various icons for navigation. The main content area shows a table of devices with columns for Device ID, Device Type, Class ID, and Date Added. A single device, 'i1' of type 'f429zi', is listed. Below the table, the 'Recent Events' tab is selected, showing a live stream of data. The events are listed in a table with columns for Event, Value, Format, and Last Received. The events are status messages containing temperature and humidity data, received a few seconds ago. A large circular graphic with a microcontroller icon is visible on the right side of the interface.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG hem.dabral@st.com ID: (yuzagl)

Browse Action Device Types + Add Device

This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.

Device ID	Device Type	Class ID	Date Added
i1	f429zi	Device	Jun 13, 2018 3:45 PM

1 result

Identity Device Information Groups **Recent Events** State Logs

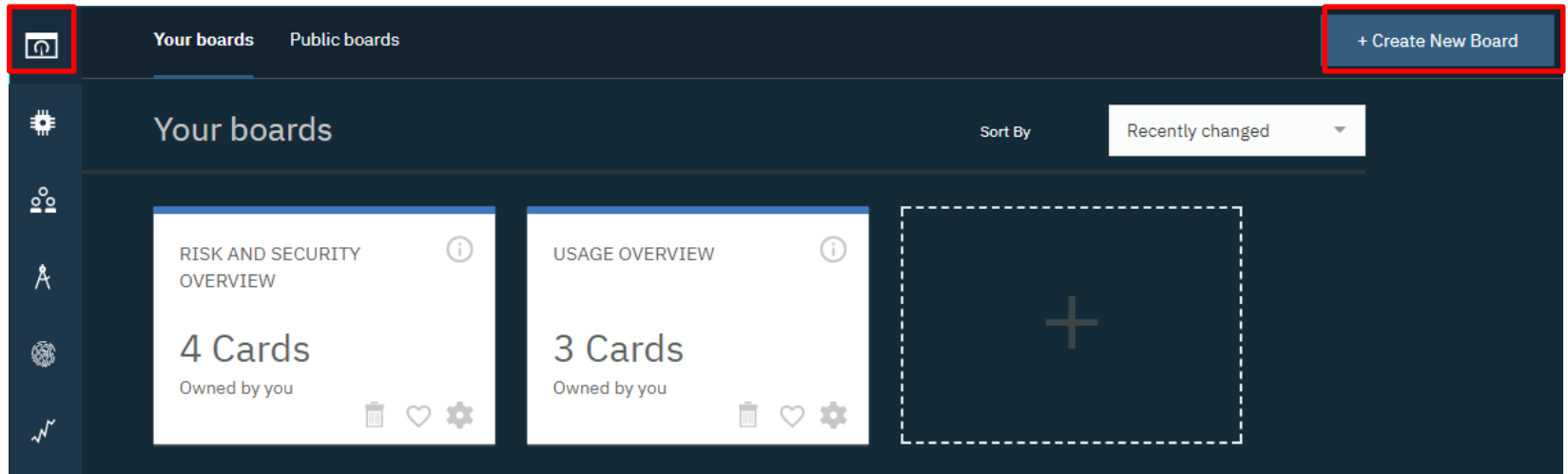
Showing Raw Data | The recent events listed show the live stream of data that is coming and going from this device.

Event	Value	Format	Last Received
status	{"d":{"temperature":31.6,"humidity":47...	json	a few seconds ago
status	{"d":{"temperature":31.6,"humidity":47...	json	a few seconds ago
status	{"d":{"temperature":31.6,"humidity":47...	json	a few seconds ago
status	{"d":{"temperature":31.6,"humidity":47...	json	a few seconds ago
status	{"d":{"temperature":31.6,"humidity":48...	json	a few seconds ago

FP-CLD-WATSON1: Registered mode

Create dashboard to visualize data (1/4)

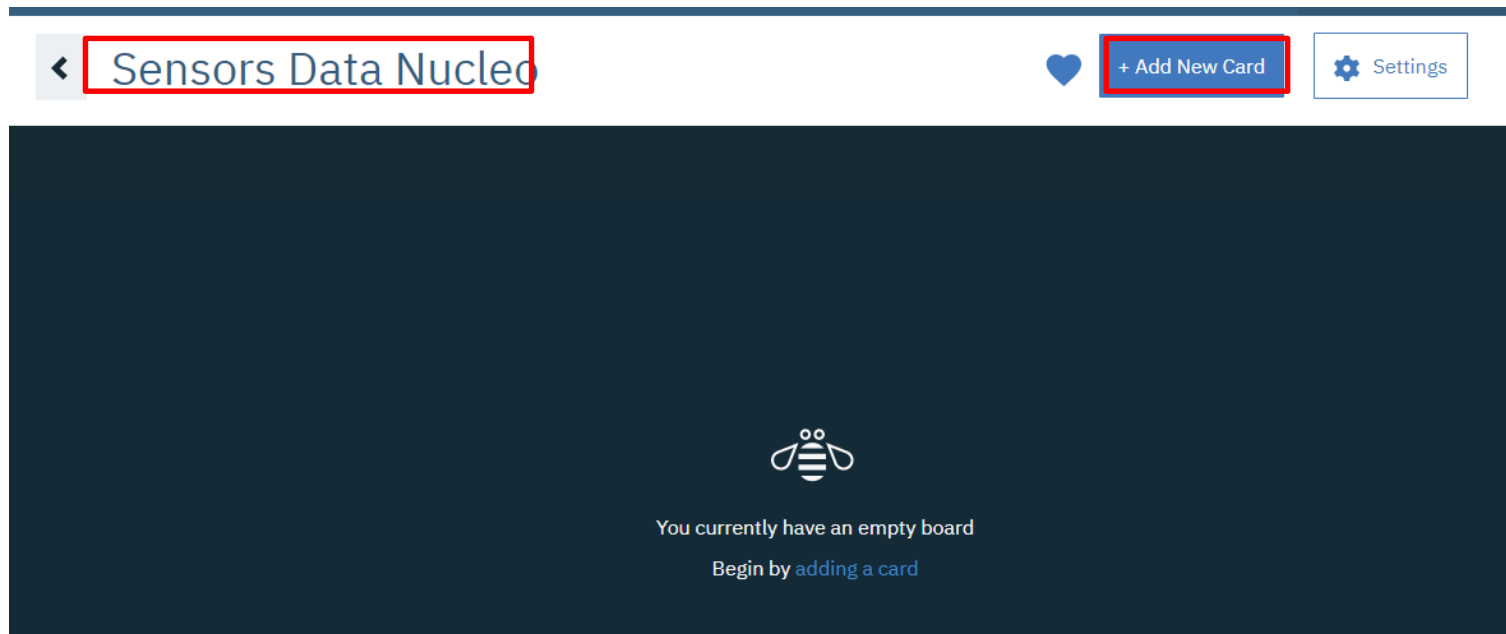
- Click on **Boards** in left bar, then **Create New Board**



FP-CLD-WATSON1: Registered mode

Create dashboard to visualize data (2/4)

- Name your board, then click on **Add New Card**



FP-CLD-WATSON1: Registered mode

Create dashboard to visualize data (3/4)

- Select Card Type, click on your device ID, then click on Connect data set.
- Select status as **Event**; select one among **data set** available in the messages received, select type and unit of the data set, then click **Next**

Card source data

STM32-Nucleo-F401

Card preview

Card information

Create Gauge Card

Connect data set

+ Connect new data set

New data set

Event

status

Property

Name

New data set

Type

Text

Unit

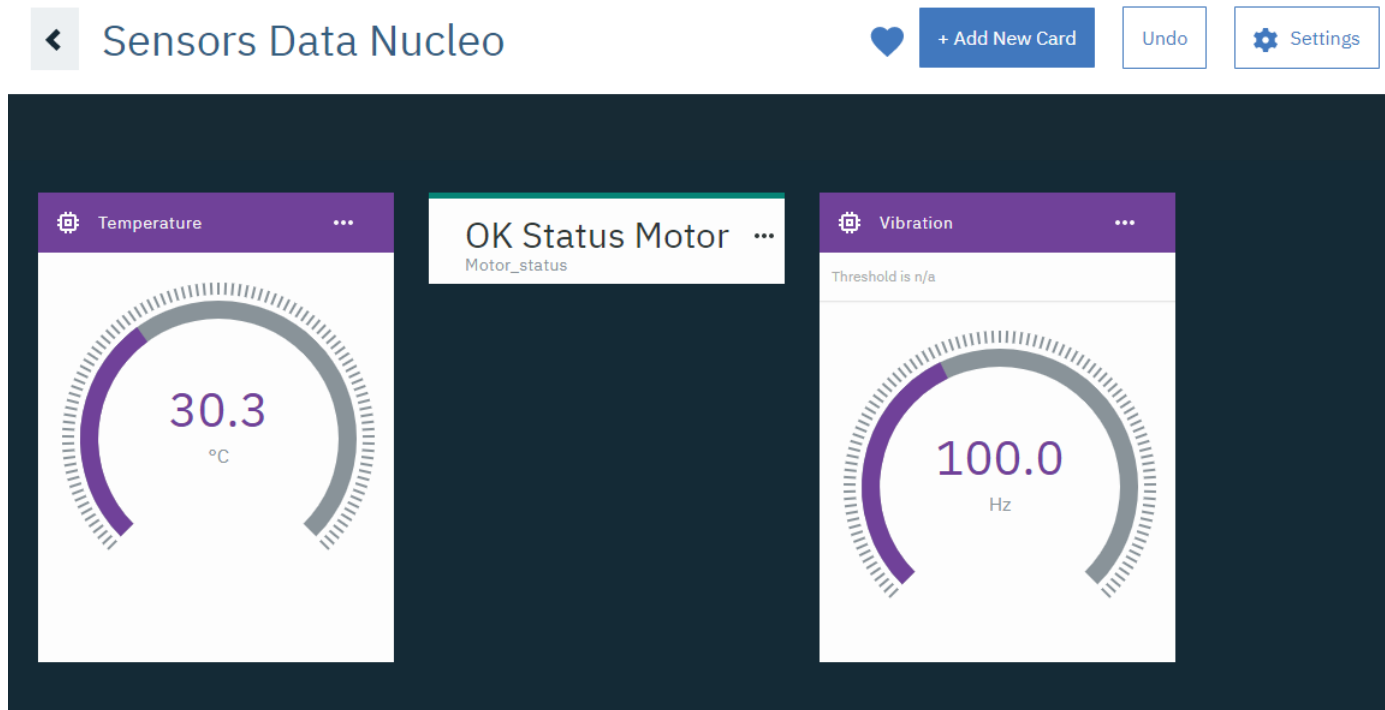
Back

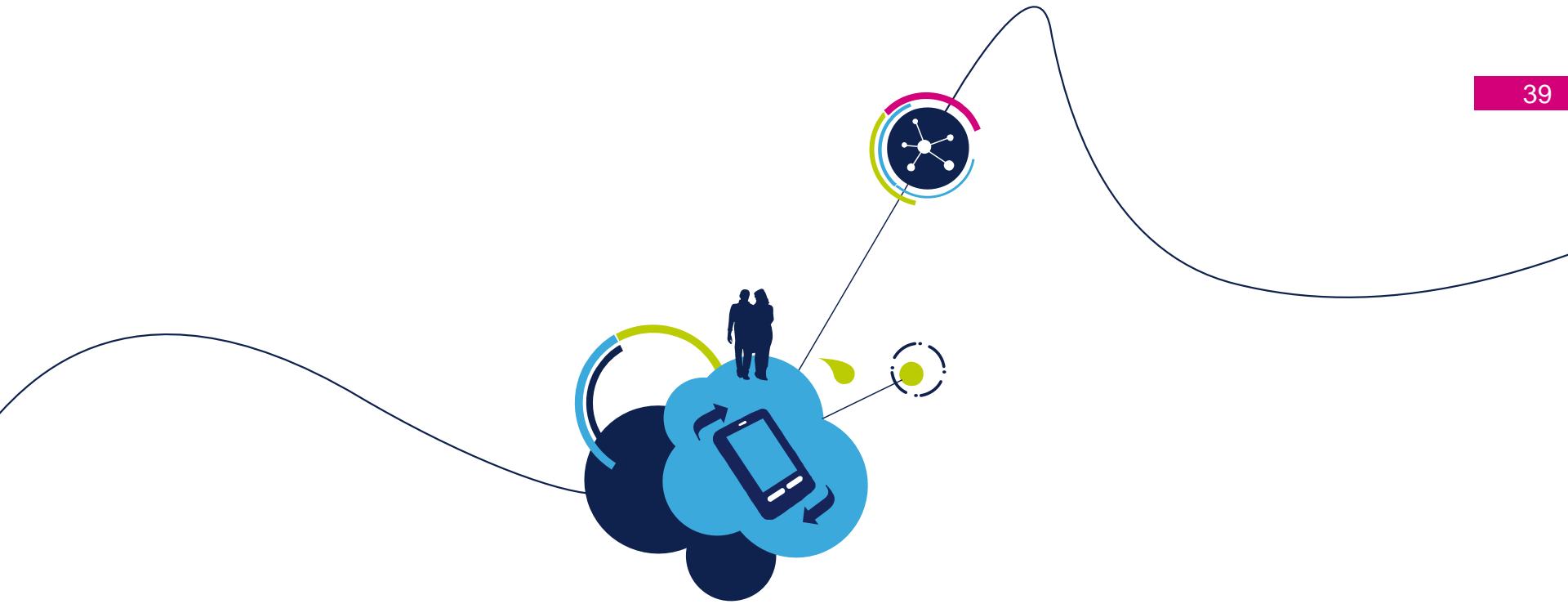
Next

FP-CLD-WATSON1: Registered mode

Create dashboard to visualize data (4/4)

- For each data set contained in the messages generated by STM32 Nucleo (Temperature, Humidity, etc.), a different card can be added





Registered mode configuration

Connect device to a NodeRED application

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

- Node-RED is a flow-based development tool for wiring together hardware devices, APIs and online services (nodered.org)
- Node-RED is pre-integrated in Watson IoT Platform

Node-RED on IBM Bluemix for IBM Watson IoT Platform

Node-RED

Flow-based programming for the Internet of Things

Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.

The version running here has been customized for the IBM Watson IoT Platform.

More information about Node-RED, including documentation, can be found at nodered.org.

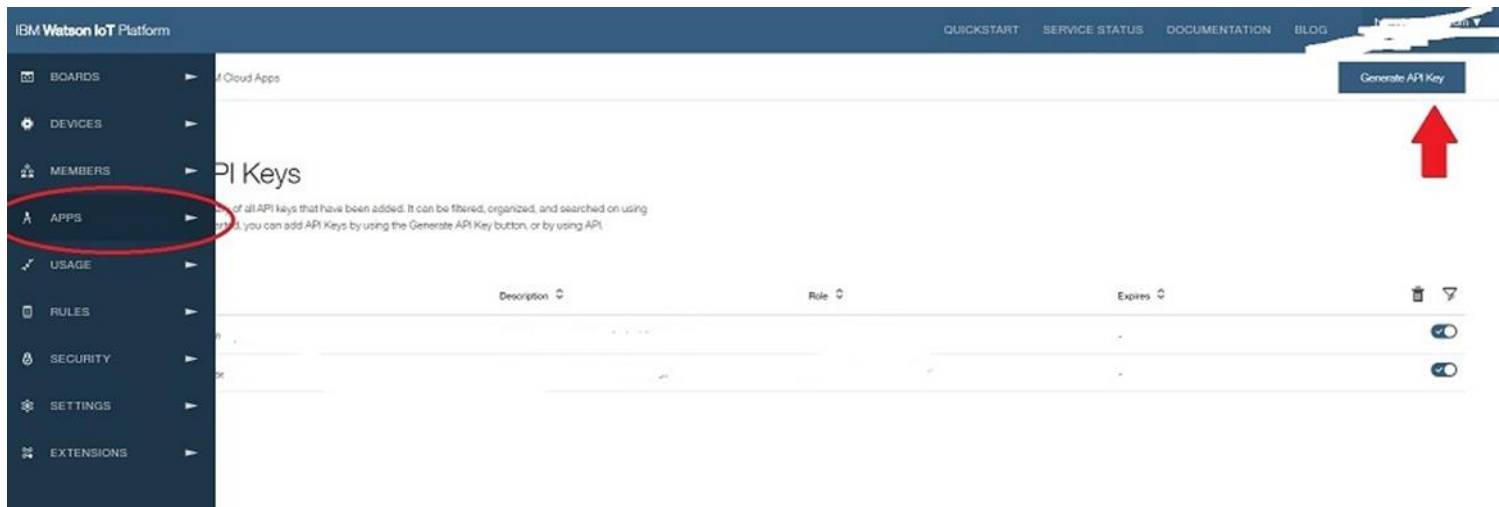
[Go to your Node-RED flow editor](#)

[Learn how to customise Node-RED](#)

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

- Before connecting your devices to Node-RED, you have to generate API keys in IBM Watson IoT dashboard



FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

- Select **Standard Application**, then click on **Generate Key**

Browse IBM Cloud Apps

Generate API Key

Information


Permissions

×

The application will have access for the following roles:

Role

Standard Application



[+ Add Another Role](#)

[<](#) [Generate Key](#)

FP-CLD-WATSON1: Registered mode



Connect device to Node-RED application

- Note down API Key and Authentication token

You've just added a new API Key: NodeRED application for NUCLEO Here are it's credentials:


Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the API key to generate a new authentication token.

Generated Details

API Key	a-xl3q5c-mbbfk18mob	
Authentication Token	yfYAB@Q3x8*~@k0o1T	

API Key Information

Description	NodeRED application for NUCLEO
Role	Standard Application
Expires	Never



Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the API key to generate a new authentication token.

[View API Key](#) [Add Another](#) [Dismiss](#)

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

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- Go back to your IBM Cloud [dashboard](#) and click on your app URL to open Node-RED flow editor. It is optional to secure it using a username/password

The screenshot shows the IBM Cloud Dashboard interface. At the top, there's a navigation bar with the IBM Cloud logo and a 'Catalog' link. Below this, the 'Dashboard' title is followed by several filters: 'RESOURCE GROUP' (None), 'REGION' (United Kingdom), 'CLOUD FOUNDRY ORG' (stm090217), and 'CLOUD FOUNDRY SPACE' (uk). A search bar labeled 'Filter by resource name...' is also present. The main section is titled 'Cloud Foundry Apps' with a subtitle '768 MB/2 GB Used'. Below this is a table with the following columns: 'Name', 'Route', 'Memory (MB)', and 'State'. The table contains one entry: 'FFTSensor' with the route 'FFTSensor.eu-gb.mybluemix.net', a memory usage of '256', and a state of 'Running (1/1)'. A red arrow points to the 'Route' column for the 'FFTSensor' entry.

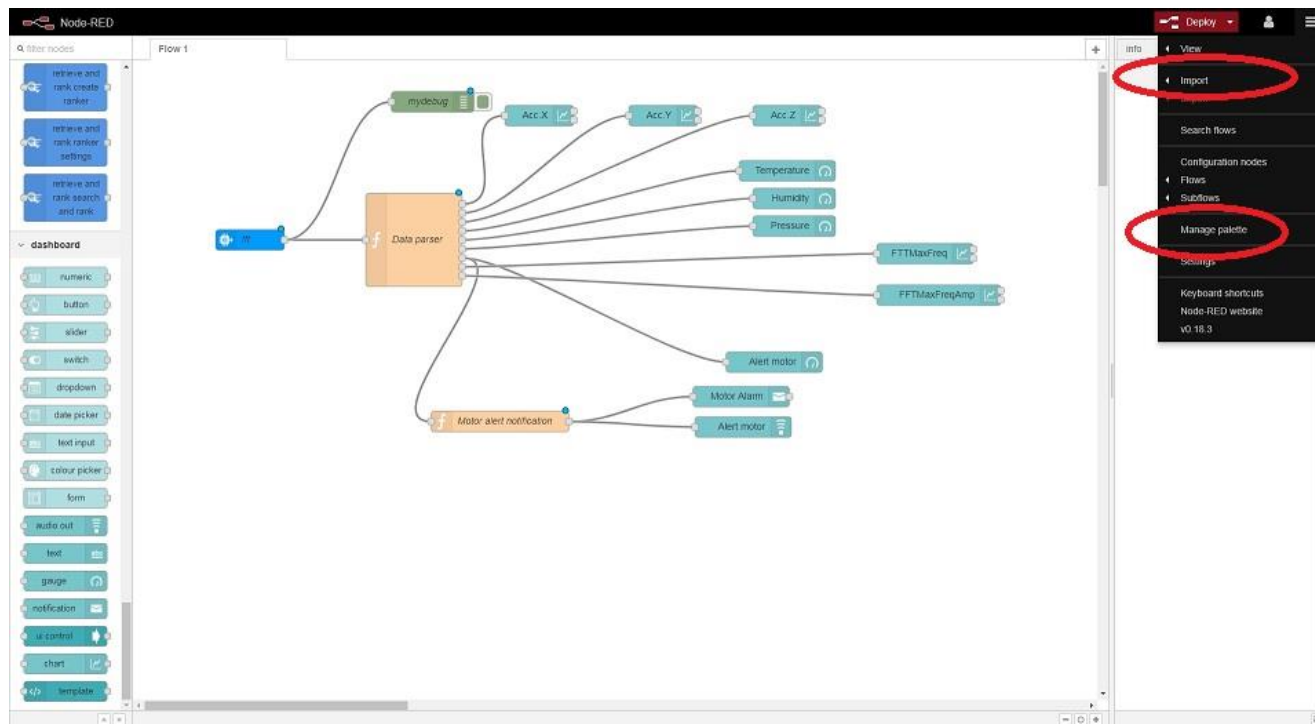
Name	Route	Memory (MB)	State
FFTSensor	FFTSensor.eu-gb.mybluemix.net	256	Running (1/1)

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

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- In Node-RED flow editor, select **Manage Palette** from menu option, click on **install tab** and install **node-red-dashboard** in your Node-RED palette
- Select **Import** to import the flow described in file *FFTSensorFlow.json* that can be found inside folder *STM32CubeFunctionPack_WATSON1_F4_V2.1.1/Utilities/NodeRED*
- Copy and paste the content of the JSON file to clipboard



FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

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- Configure the **Watson IoT platform node** using following parameters:
 - API key and authentication token
 - Device Type
 - Device ID

The screenshot displays the Node-RED web interface. On the left, a flow diagram shows a 'Watson IoT platform node' (highlighted with a red box) connected to a 'Data parser' node, which then branches out to several output nodes including 'my2000', 'Acc X', 'Acc Y', 'Motor alert notification', and 'Alert motor'. On the right, the 'Edit ibmiot in node' configuration panel is open. The 'node properties' section contains the following fields: 'Authentication' (set to 'API Key'), 'API Key' (set to 'Feb'), 'Input Type' (set to 'Device Event'), 'Device Type' (set to 'All or' with a red box around the 'Enter your device type here' input field), 'Device Id' (set to 'All or' with a red box around the 'Enter your device name here' input field), 'Event' (set to 'All or'), 'Format' (set to 'All or' with 'json' in the adjacent field), 'QoS' (set to '0'), and 'Name' (set to 'm'). A red arrow points to the 'Authentication' field. A red box highlights the 'Device Type' and 'Device Id' fields. A yellow information box at the bottom right provides instructions on how to use the 'Input Type' property.

Use the Input Type property to configure this node to receive Events sent by IoT Devices, Commands sent to IoT Devices, Status Messages referring to IoT Devices, or Status Messages referring to IoT Applications. Check the info tab, to get more information about each of the fields

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

Edit ibmiot in node

Delete Cancel Done

node properties

Authentication API Key

API Key STM32 Nucleo

Input Type Device Event

Device Type All or STM32

Device Id All or STM32-Nucleo-F401

Event All or +

Format All or json

QoS 0

Name fft

Use the Input Type property to configure this node to receive Events sent by IoT Devices, Commands sent to IoT Devices, Status Messages referring to IoT Devices, or Status Messages referring to IoT Applications

Check the info tab, to get more information about each of the fields

Edit ibmiot in node > Edit ibmiot node

Delete Cancel Update

Name STM32 Nucleo

API Key a-xl3q5c-mbbfk18mob

API Token

Server-Name xl3q5c.messaging.internetofthings.ibmcloud.com

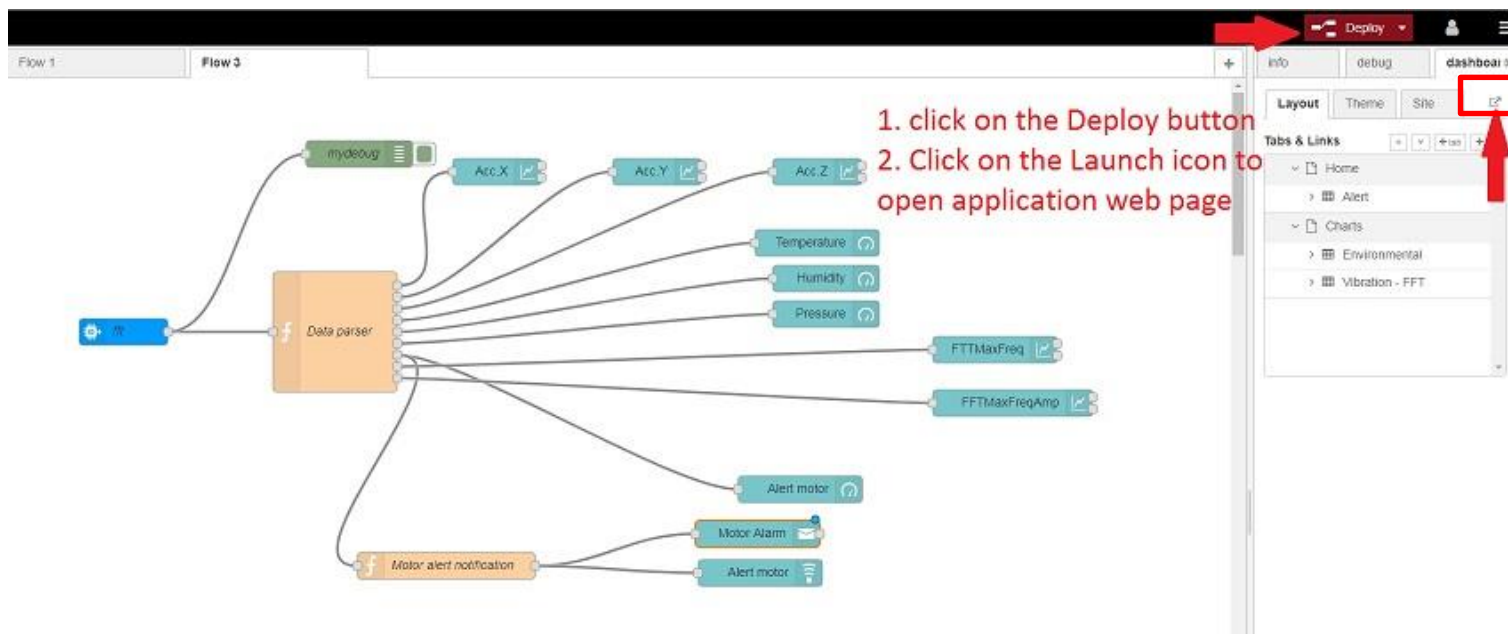
Scalable Application ID

Keep Alive 60 Seconds Use Clean Session

FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

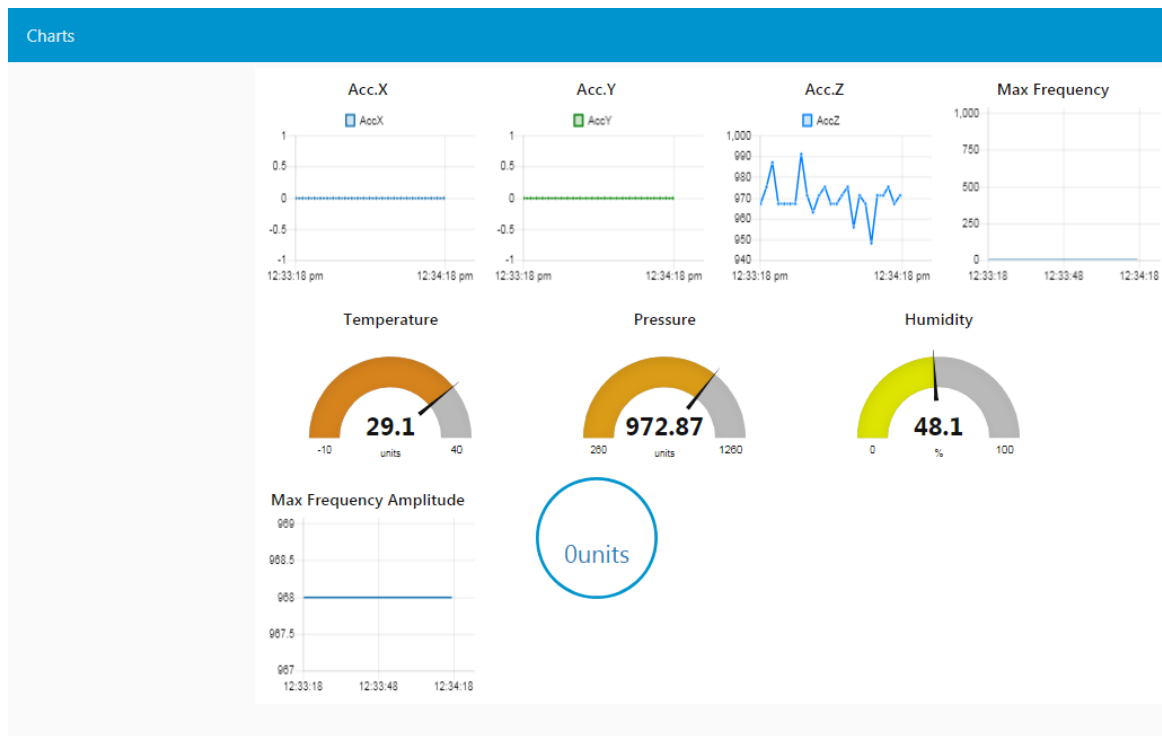
- In order to visualize the sensor data received from STM32 Nucleo in Node-RED dashboard:
 - Click on the Deploy button on top-right of the Node-RED application page
 - Click launch icon in dashboard tab

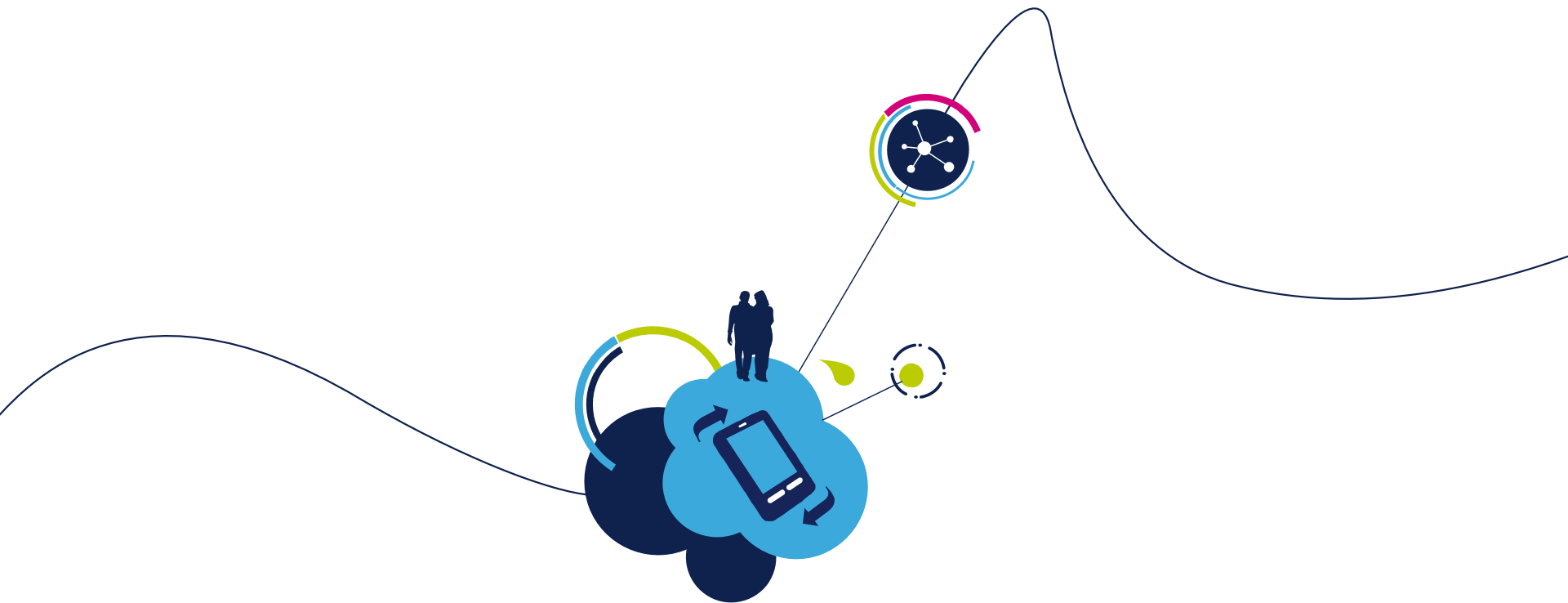


FP-CLD-WATSON1: Registered mode

Connect device to Node-RED application

- A web based dashboard will appear. Sensor data from STM32 Nucleo is visualized in real time





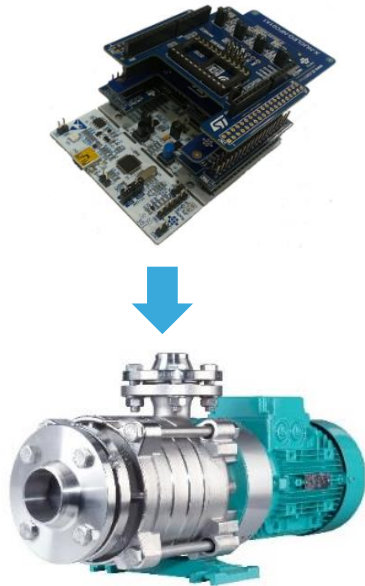
Application scenario

Condition Monitoring Sensor to Cloud

Pre-Integrated Application Packages

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FP-CLD-WATSON1 - Condition monitoring data Wi-Fi to Cloud



Demo kit mounted on top of Motor/Pump/Fan

Vibration data pushed to IBM cloud over WIFI.
Condition levels for motor: “OK, Warning, Failure”

- Condition monitoring and preventive maintenance
- Vibration monitoring of motors, fans and pumps
- Identification of load unbalance and misalignment
- Alarming of equipment failures

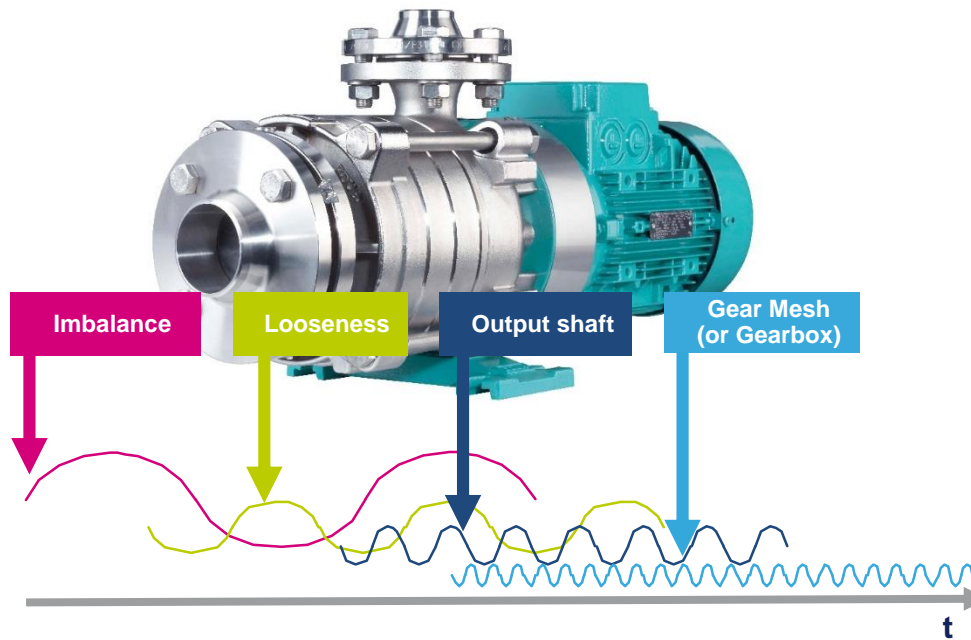
Typical Use Case of Monitoring Industrial Motor

52



Mechanical vibration

- Displacement
- Speed
- Acceleration
- Acoustic noise
- Angular speed
- Torque



Functionality

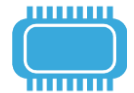
Vibration Capture



Connectivity

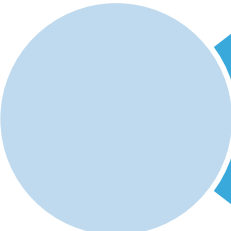


Processing

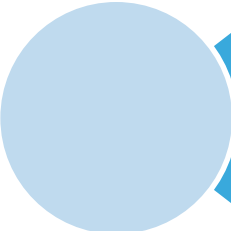


Secure Connections

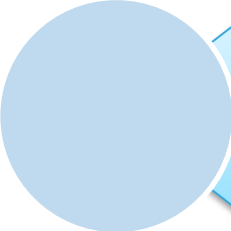




FP-CLD-WATSON1: STM32Cube function pack for IoT node with Wi-Fi, NFC and sensors for vibration analysis, connected to IBM Watson IoT cloud



Setup & Demo Examples
Documents & Related Resources



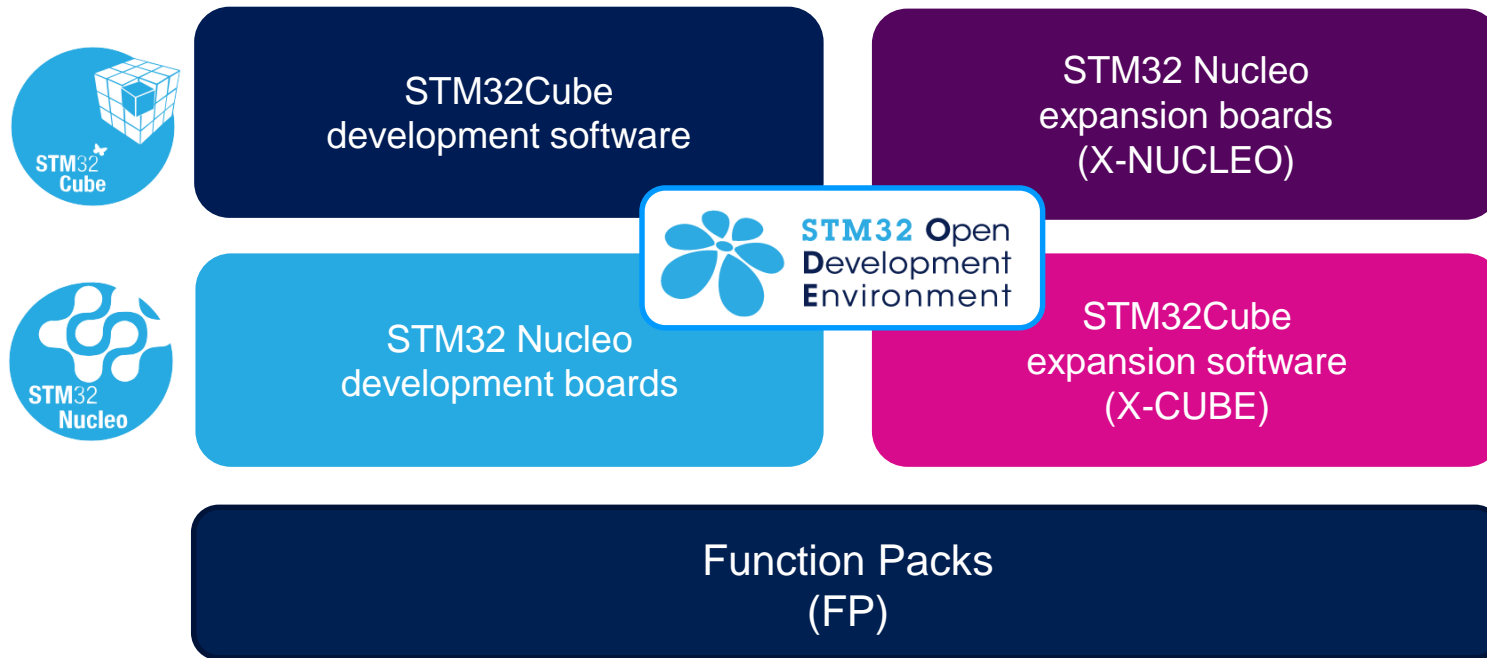
STM32 Open Development Environment: Overview

STM32 Open Development Environment

Fast, affordable Prototyping and Development

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- The STM32 Open Development Environment (ODE) consists of a set of stackable boards and a modular open SW environment designed around the STM32 microcontroller family.

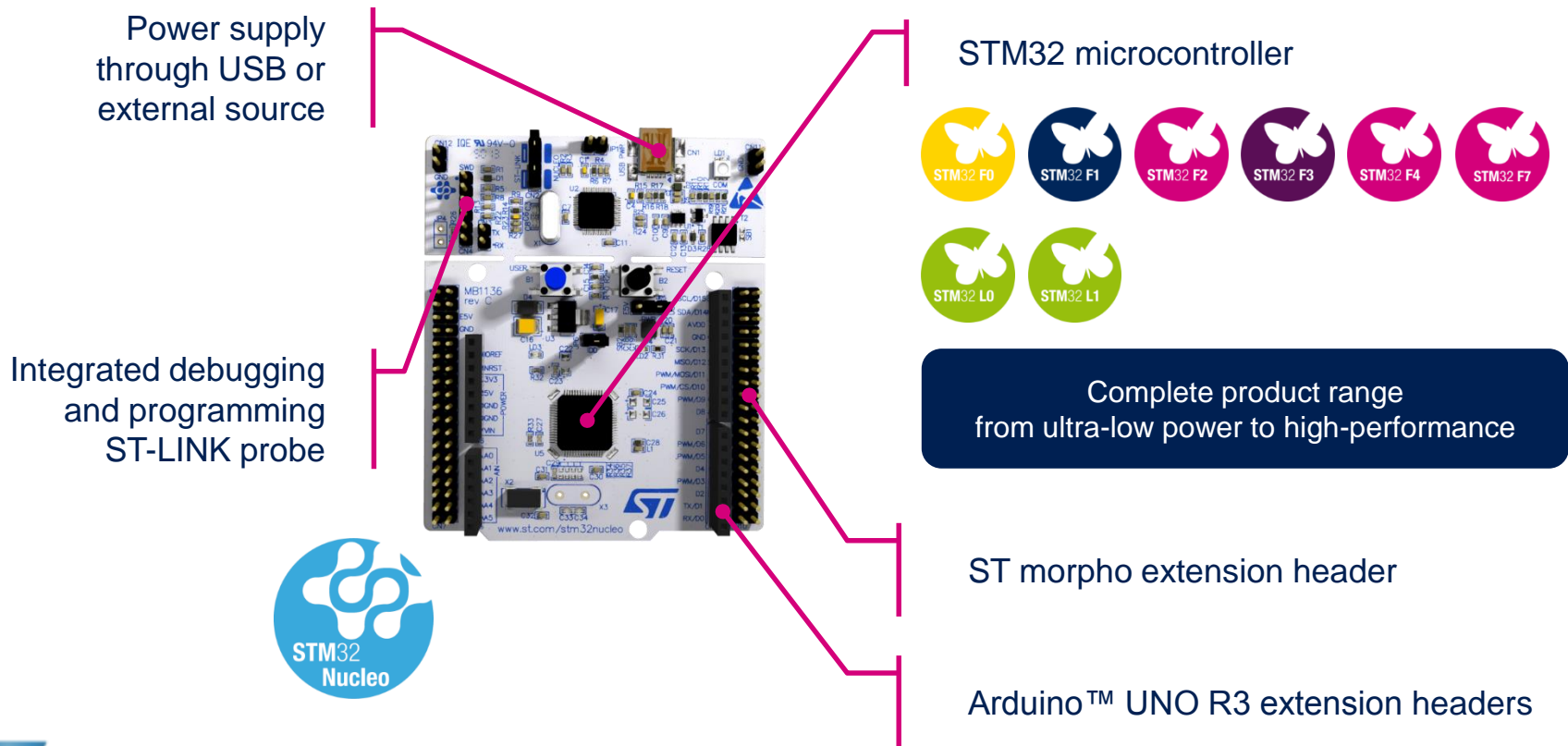


www.st.com/stm32ode

STM32 Nucleo Development Boards (NUCLEO)

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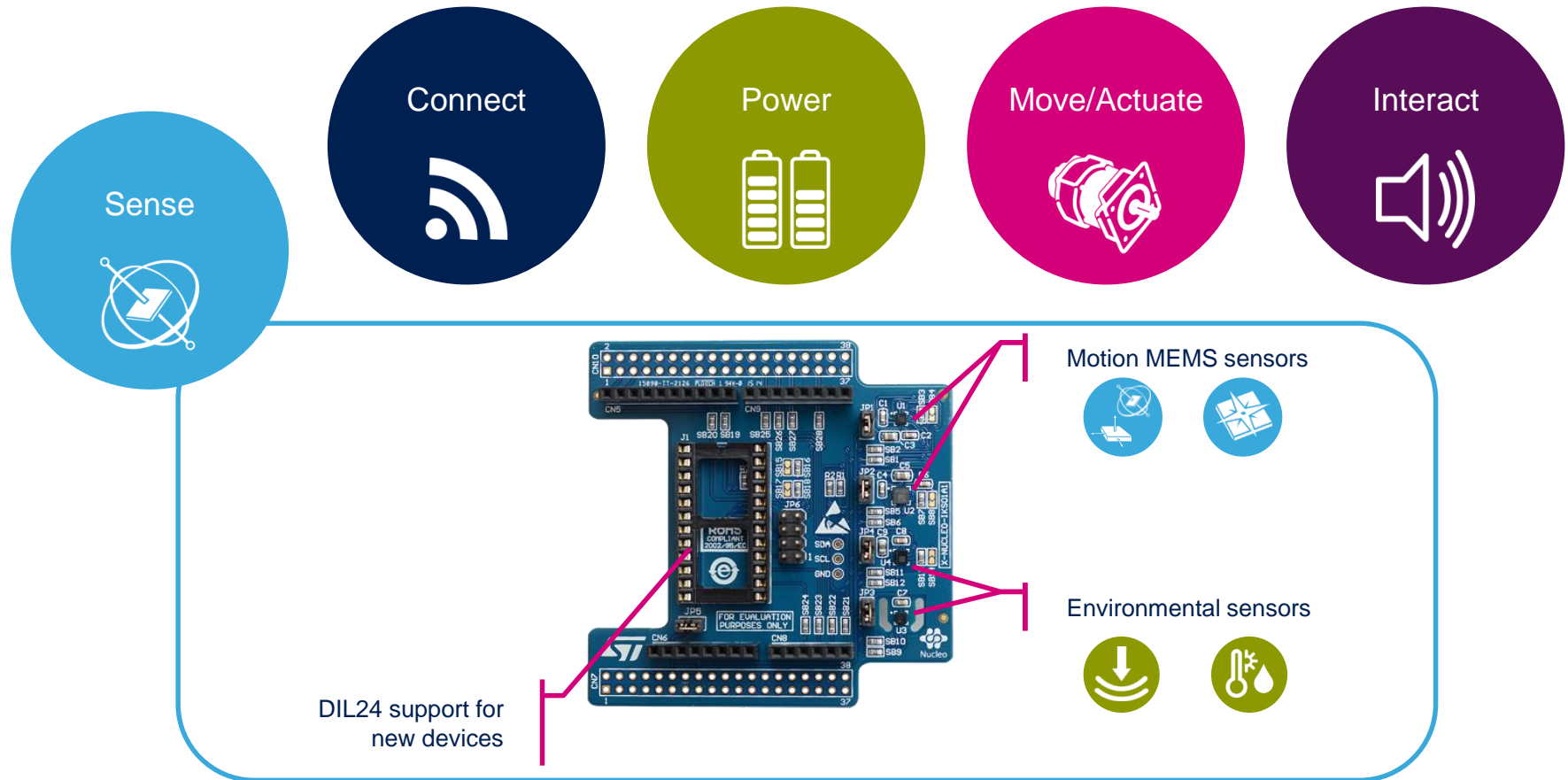
- A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.



STM32 Nucleo Expansion Boards (X-NUCLEO)

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- Boards with additional functionality that can be plugged directly on top of the STM32 Nucleo development board directly or stacked on another expansion board.



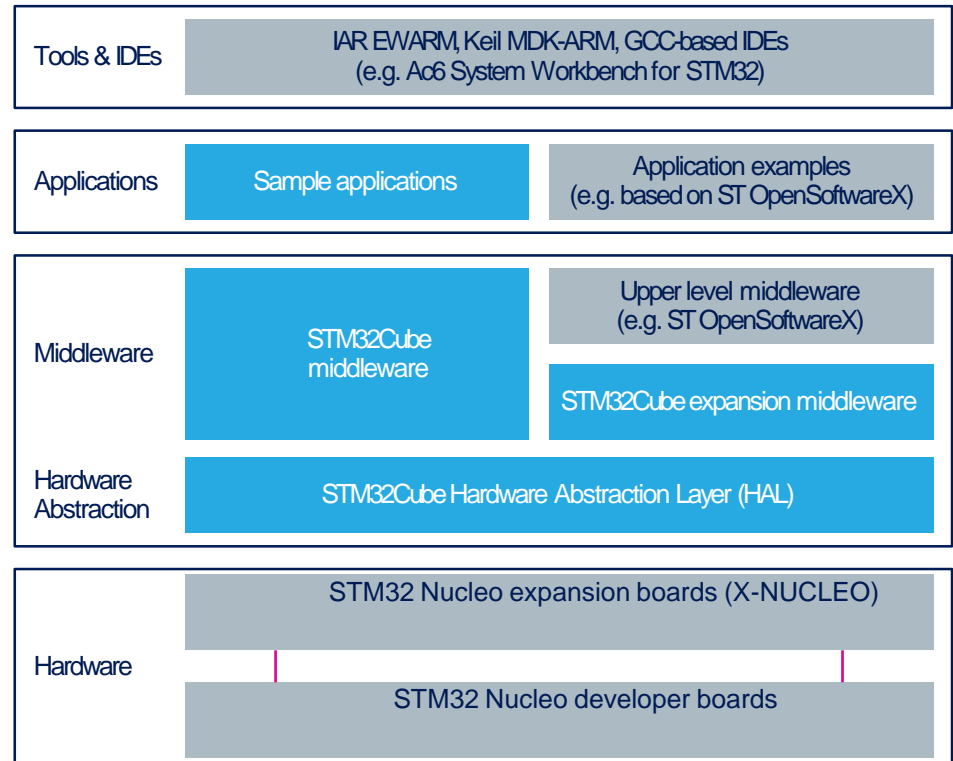
Example of STM32 expansion board (X-NUCLEO-1KS01A1)

STM32 Open Development Environment

Software components

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- **STM32Cube software (CUBE)** - A set of free tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer and middleware bricks.
- **STM32Cube expansion software (X-CUBE)** - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.



- **Compatibility with multiple Development Environments** - The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, and GCC-based environments. Users can choose from three IDEs from leading vendors, which are free of charge and deployed in close cooperation with ST. These include Eclipse-based IDEs such as Ac6 System Workbench for STM32 and the MDK-ARM environment.

STM32 Open Development Environment

Building block approach

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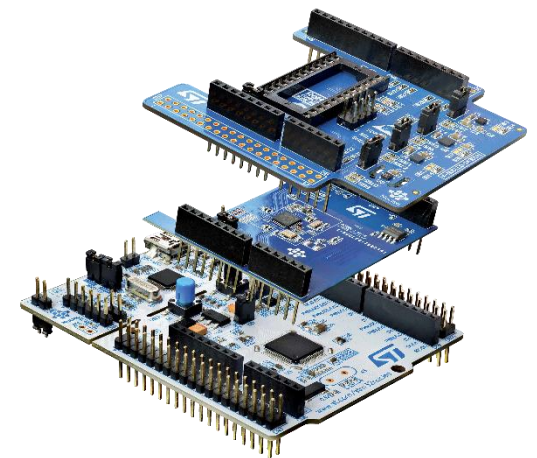
The building blocks

Your need

Our answer



 **STM32 Open Development Environment**



www.st.com/stm32code