



life.augmented

**INDUSTRIAL
SUMMIT 2023**

SHENZHEN, CHINA | 28 SEPTEMBER



基于ST无线产品线的工业 物联网方案

李战兵/Alex LI

物联网技术创新中心

意法半导体

IoT
Competence
Center



1

ST物联网解决方案介绍

2

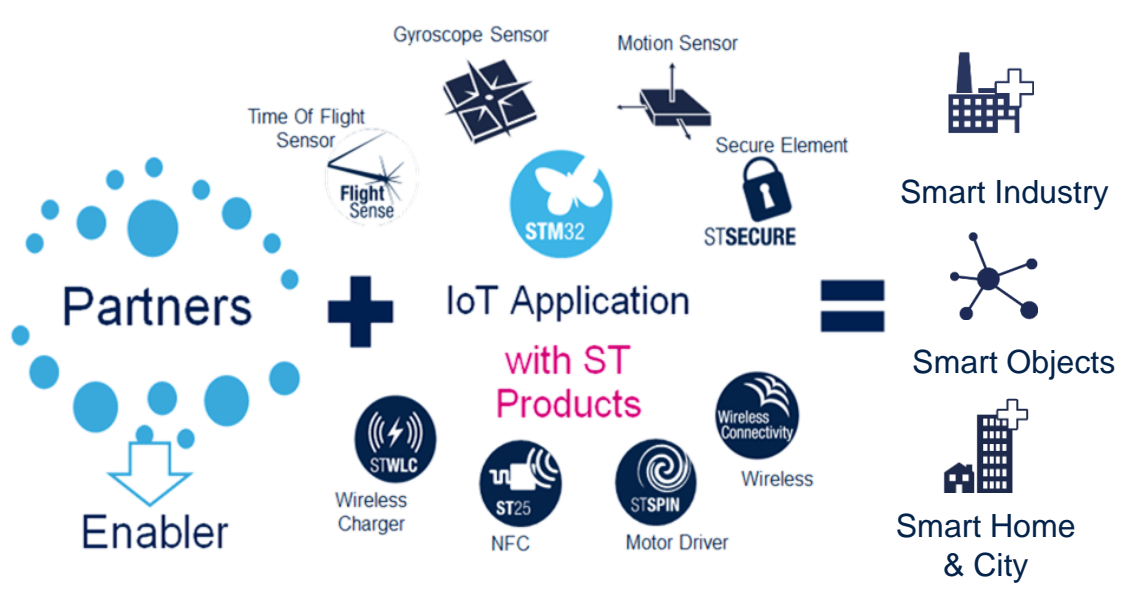
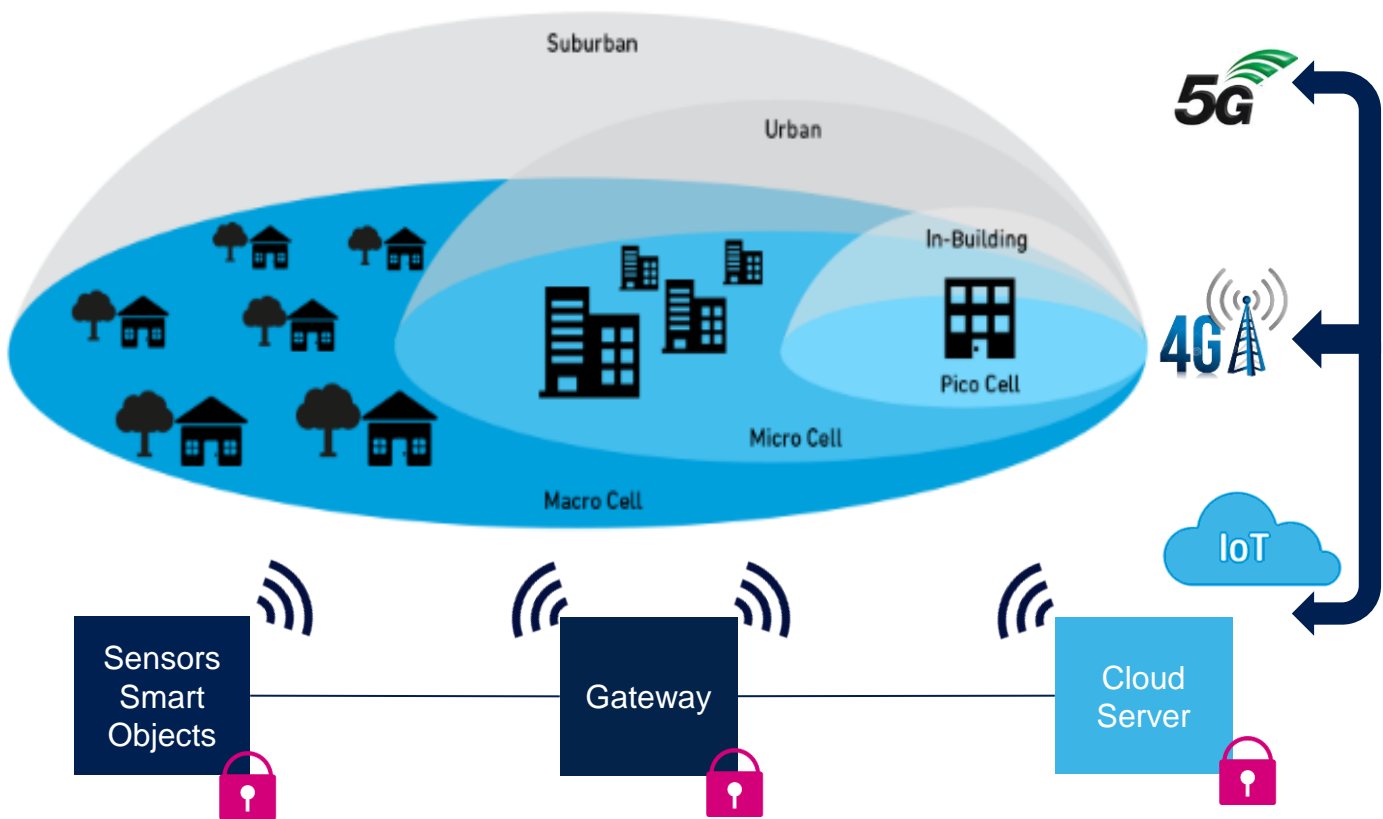
STM32无线通讯产品线介绍

3

工业物联网案例分享

ST物联网解决方案介绍

ST物联网系统解决方案



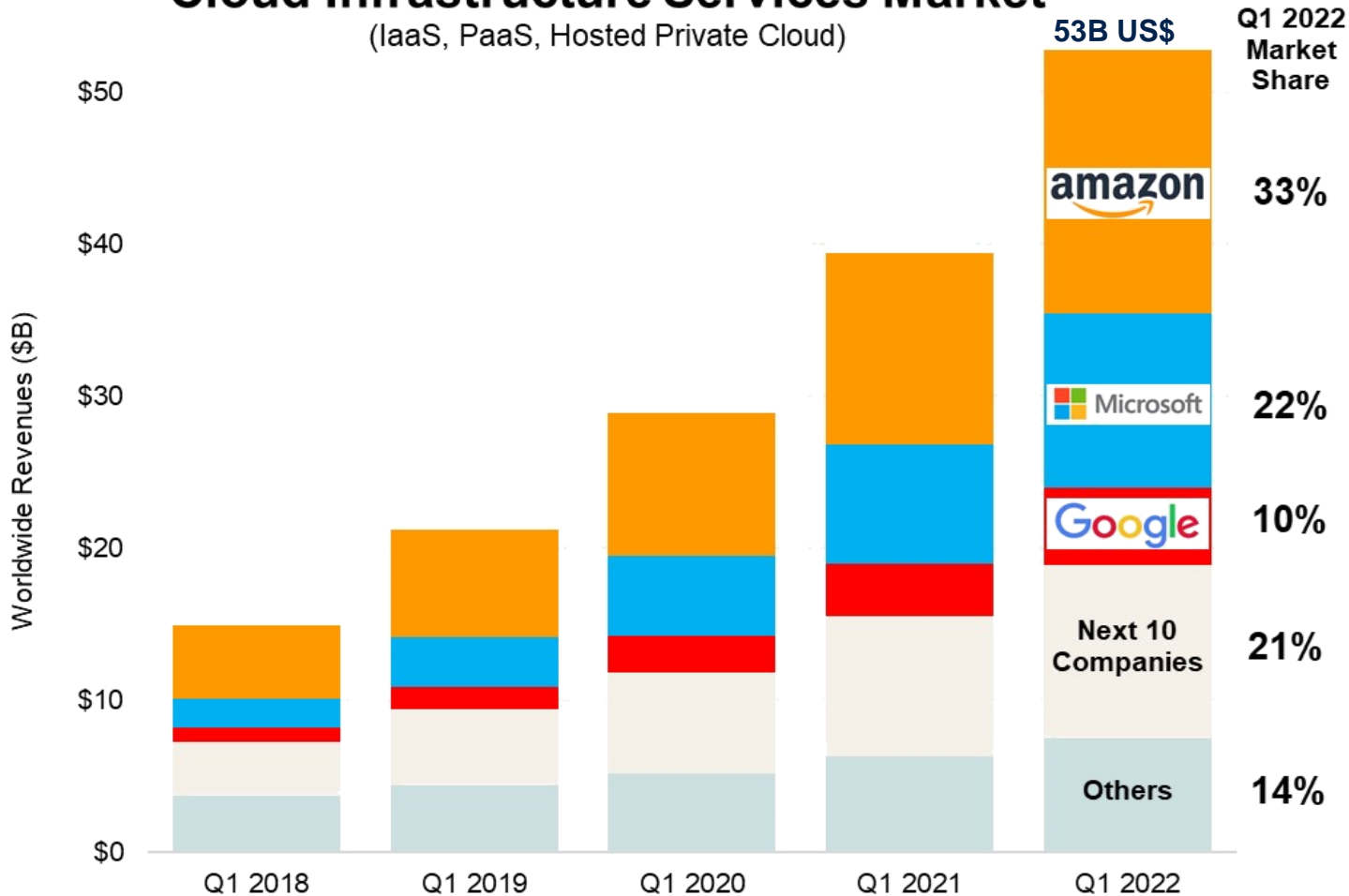
端到端的解决方案，确保网络安全的可信系统。

有着丰富的产品组合，ST可以提供完整的物联网系统解决方案。

全球市场：前三大云服务供应商占65%

Cloud Infrastructure Services Market

(IaaS, PaaS, Hosted Private Cloud)



Source: Synergy Research Group

- 2022年第一季度，企业对云基础设施服务的支出接近530亿美元，比2021年第一季度增长了34%
- Amazon, Microsoft and Google 的市场份额保持每年35-50%的速度增长，其他非中国的云供应商的增长率通常在10-20%之间
- 自2018年第一季度以来，其他非头部云提供商的总收入增长了150%以上，但由于其增长率仍远低于头部供应商，其总体市场份额已从48%降至36%
- 而在中国，市场仍然完全由中国本土公司主导

亚洲云服务领跑者

Cloud Services Leadership – APAC Region

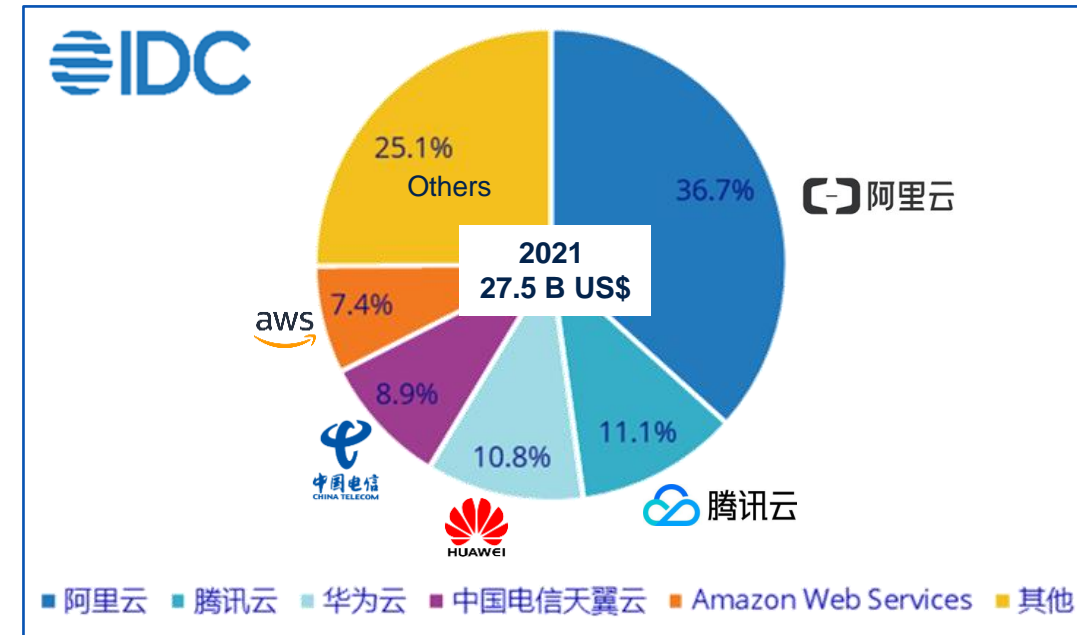
| Rank | Total Region | China | Japan | Rest of East Asia | South & Southeast | Oceania |
|--------|--------------|---------------|-----------|-------------------|-------------------|-----------|
| Leader | Amazon | Alibaba | Amazon | Amazon | Amazon | Amazon |
| #2 | Alibaba | Tencent | Microsoft | Microsoft | Microsoft | Microsoft |
| #3 | Microsoft | Baidu | Fujitsu | Google | Google | Google |
| #4 | Tencent | China Telecom | NTT | Alibaba | Alibaba | Telstra |
| #5 | Google | Huawei | Google | Naver | IBM | IBM |
| #6 | Baidu | China Unicom | Softbank | KT | NTT | Alibaba |

Based on IaaS, PaaS and hosted private cloud revenues in Q4 2021

Source: Synergy Research Group

- 亚马逊是亚洲云服务绝对领跑者
- 阿里巴巴在中国拥有强大的领先地位，并正在逐渐向APeC的其他地区扩张
- 微软目前在四个地区中排名第二，在整个亚太地区排名第三
- 亚太地区市场份额目前占全球市场的三分之一，并且相比其他地区明显增长地更快
- 到目前为止，中国大陆是该地区最大的市场（2021为27.5亿美元），其次是日本、印度、韩国、澳大利亚和中国香港
- 南亚和东南亚的增长率最高，这在很大程度上归功于印度

China public cloud IaaS+PaaS market share, H2 2021



<https://www.idc.com/getdoc.jsp?containerId=prCHC49130922>

全球与本地化的解决方案

CLOUD solutions @ ST



面向中国本土云连接的解决方案



Alibaba Cloud

I-CUBE-Aliyun

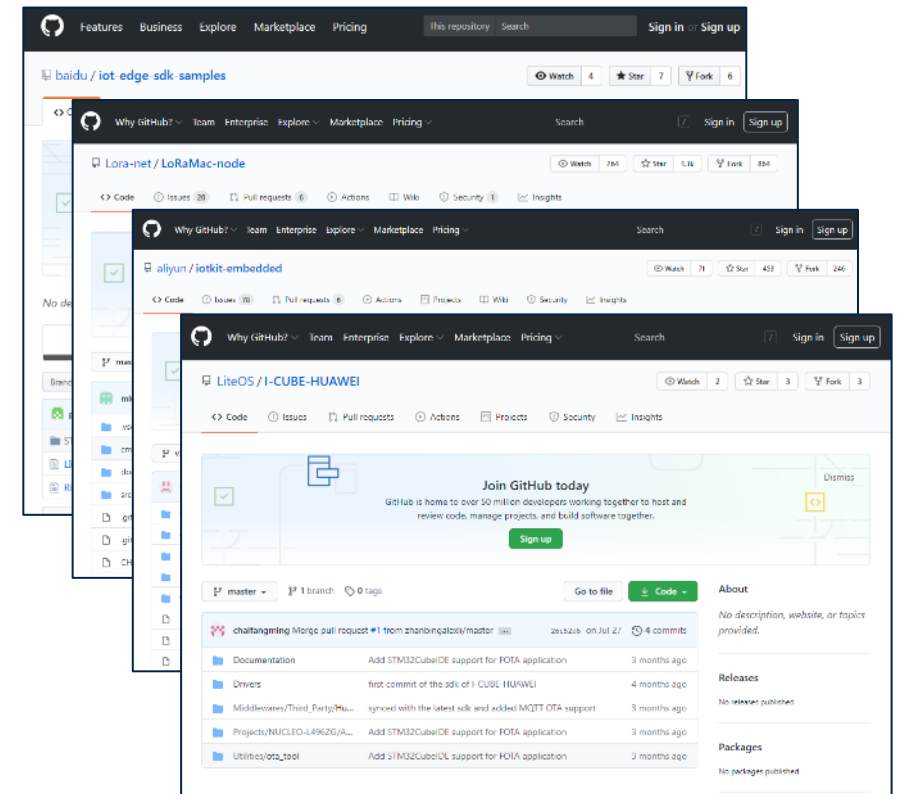
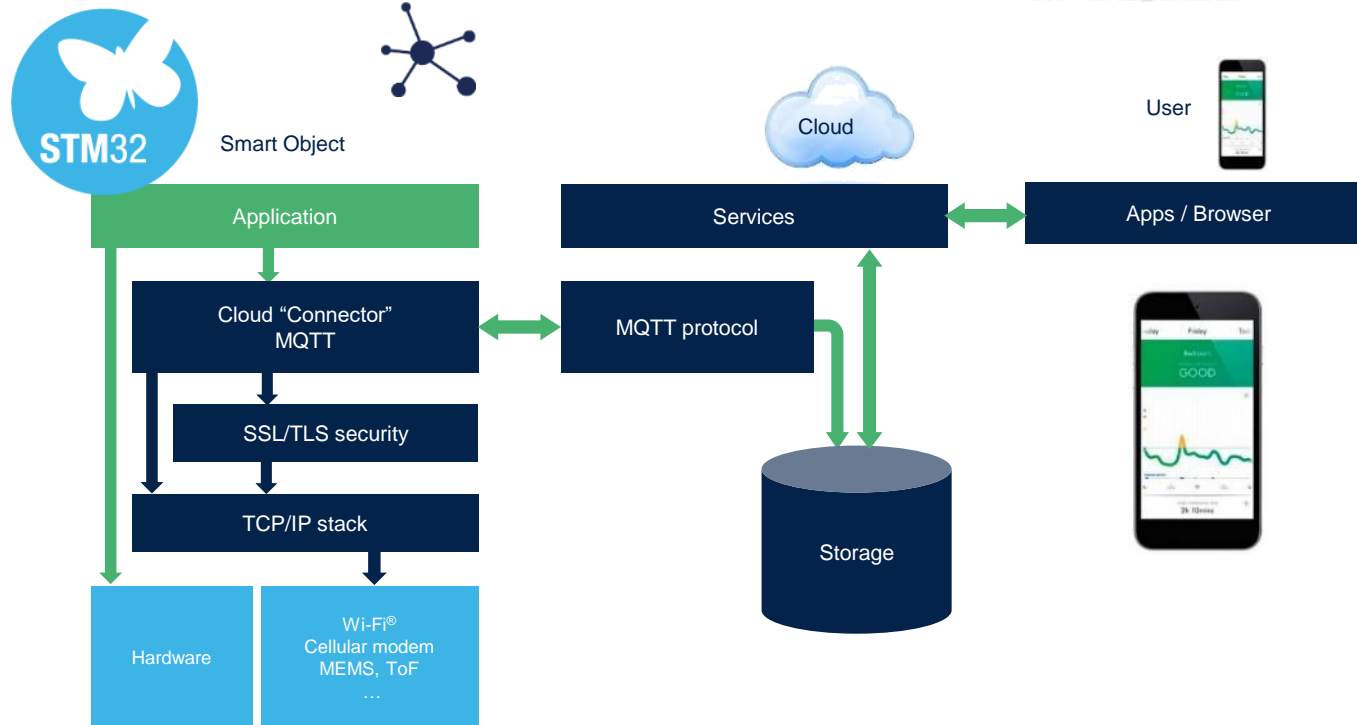
I-CUBE-Tencent



I-CUBE-Huawei



I-CUBE-Baidu



STM32U5+WiFi接入百度云



MXCHIP®
上海庆科信息技术有限公司



Hardware platform:
NUCLEO-U575ZI-Q + EXT-AT30380



**STM32
U575**

MXCHIP®
上海庆科信息技术有限公司

**MXCHIP
EMW30380**



**Baidu
Cloud**



Market Segment
IoT Applications

Market size
The overlap users
between ST and Baidu
1.9 million Baidu
cloud developers

Major customers
Smart city market user
Smart energy user
Intelligent
manufacturing user

❖ **Description**

- Due to STM32 innovation, We intend to connect to mainstream Chinese cloud vendors with our latest STM32 ICs. We reached an agreement with Baidu to first connect Baidu IoT core based on the latest STM32U5 to ease the development to connect the Baidu cloud for ST customer and enrich the ecosystem.

❖ **Applicable Scenario**

- Apply to IoT scenarios based on device, provide the access and management capability to device, and help developer to focus on business.

❖ **Feature Overview**

- Rapidly establish the IoT application with the core of device.
- Freely select two usage methods of unvarnished transmission and device shadow.



STM32 Baidu IoT Core Connection

2023-09-06 15:28:54

Device: STM32U575ZI

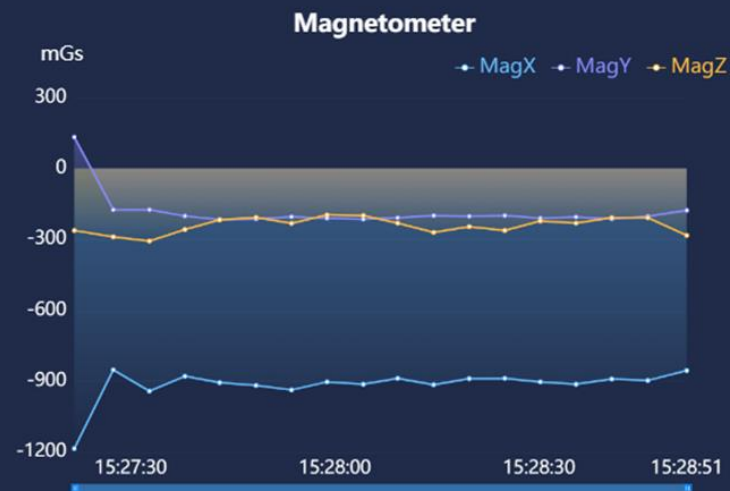
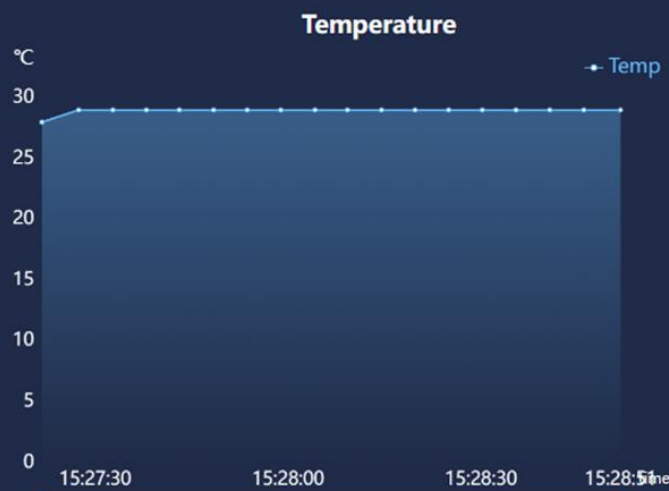
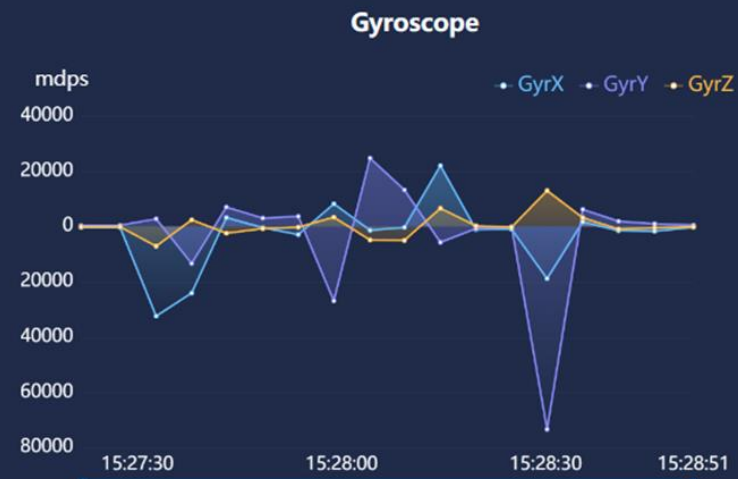
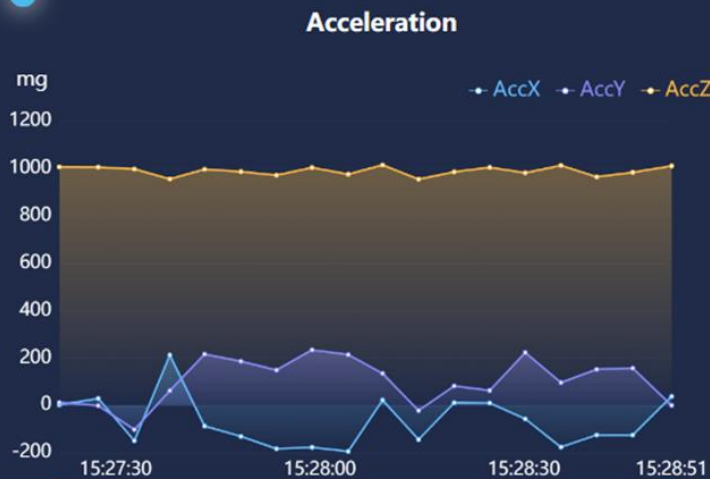
Device Status: ● Connected



Humidity



Pressure



华为云认证开发者课程



Fibocom

Hardware platform:
NUCLEO-U575ZI-Q + ADP-L610-
Arduino_V3.0.1



Market Segment
IoT Applications

Market size
The overlap users
between ST and
Huawei,
1.5 million Huawei
cloud developers

Major customers
IoT workers,
training and certification of
IoT terminal, tube, Cloud
technology and solutions



STM32
U575

Fibocom

Fibocom
L610-CN

IoT

HUAWEI
Cloud



❖ Description

- Due to STM32 innovation, We intend to connect to mainstream Chinese cloud vendors with our latest STM32 ICs. Huawei IoT department need to develop 1.5 million developers in 2023, HCCDP-IoT certification will be the main contributor which would like to involve ST and FIBOCOM to join to develop the related courses with technical support.

❖ Applicable Scenario

- Apply to IoT scenarios based on device, provide the access and management capability to device, and help developer to focus on business.

❖ Feature Overview

- Rapidly establish the IoT application with the core of device.
- Freely select two usage methods of unvarnished transmission and device shadow.

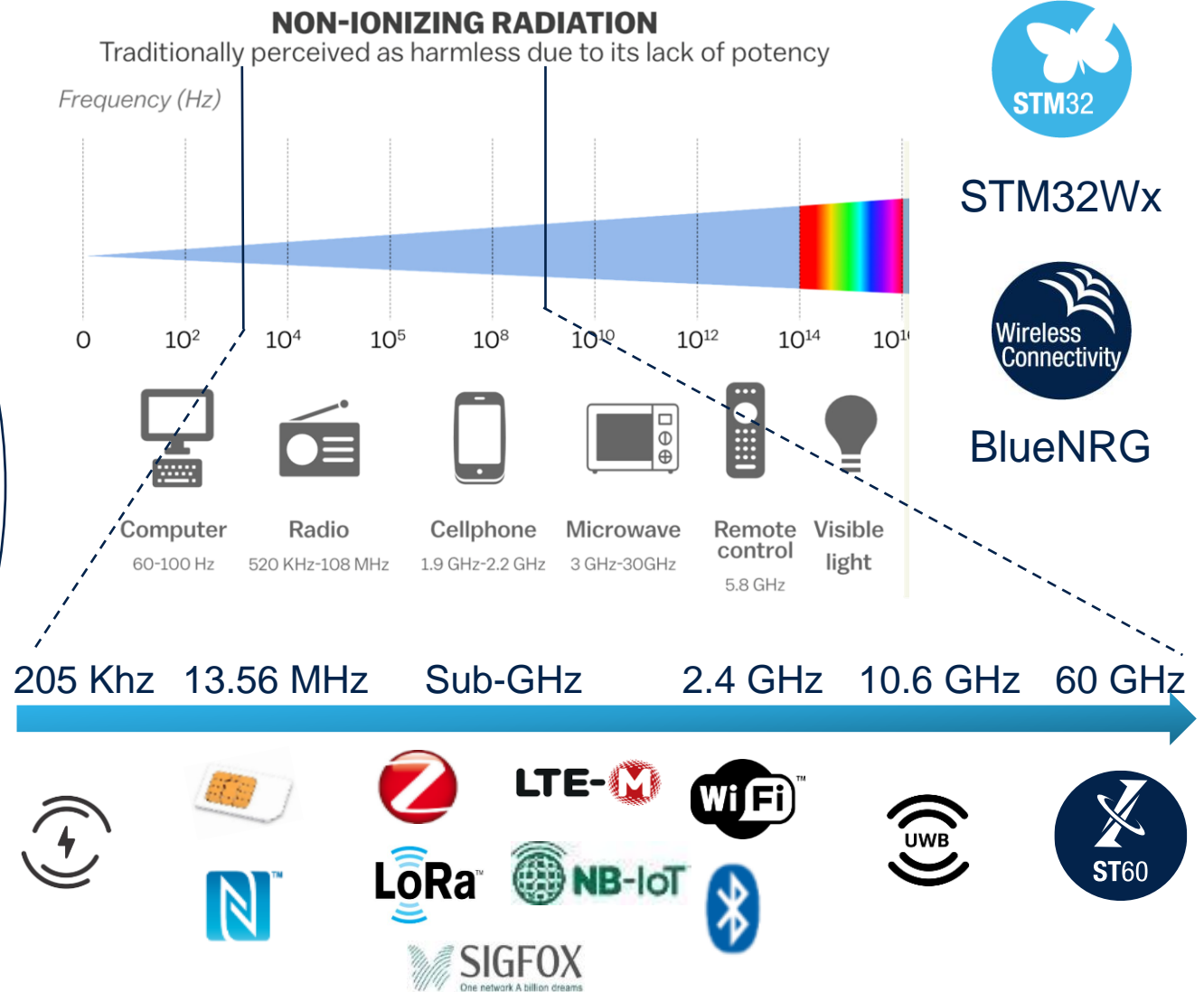
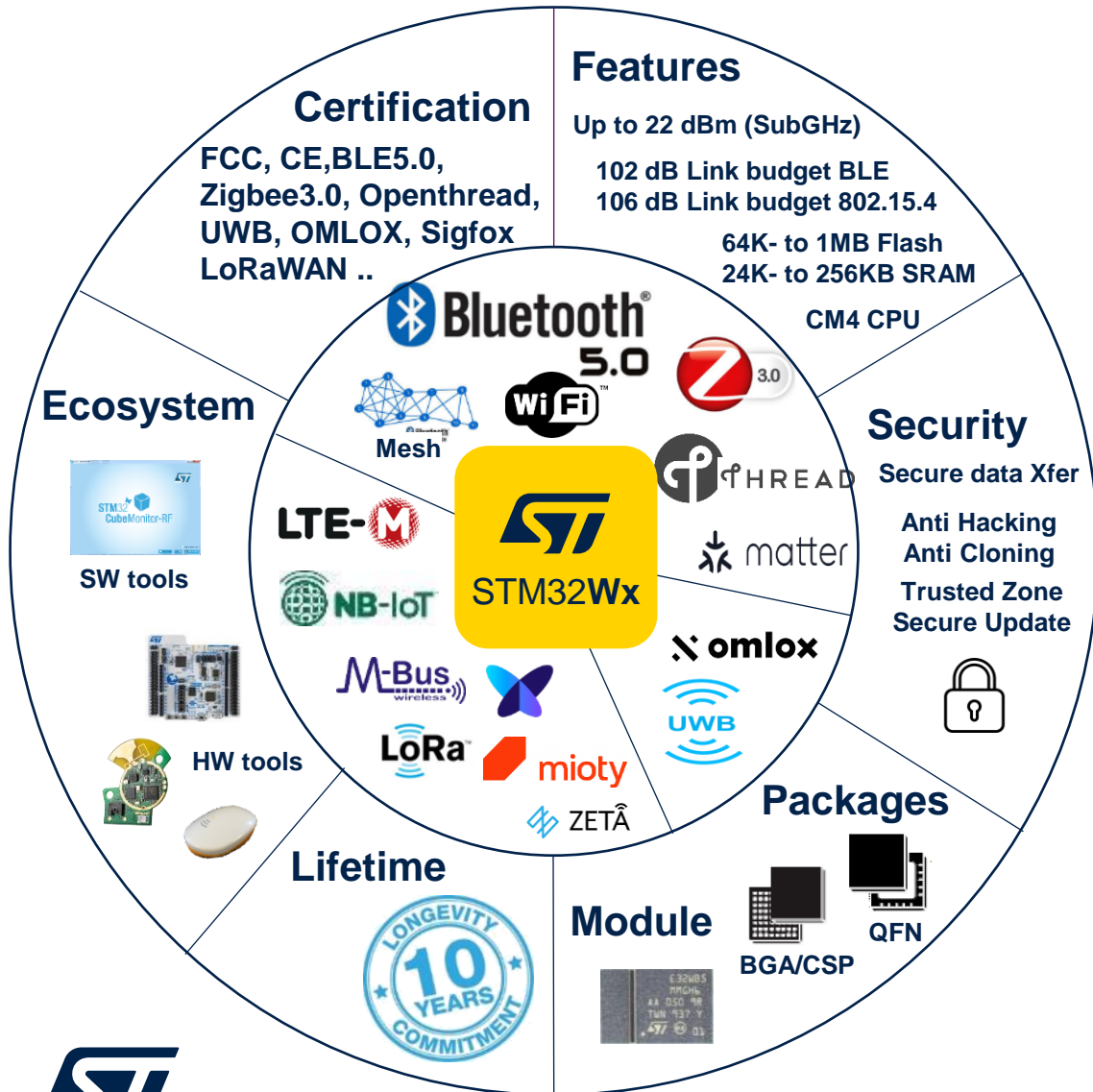


life.augmented

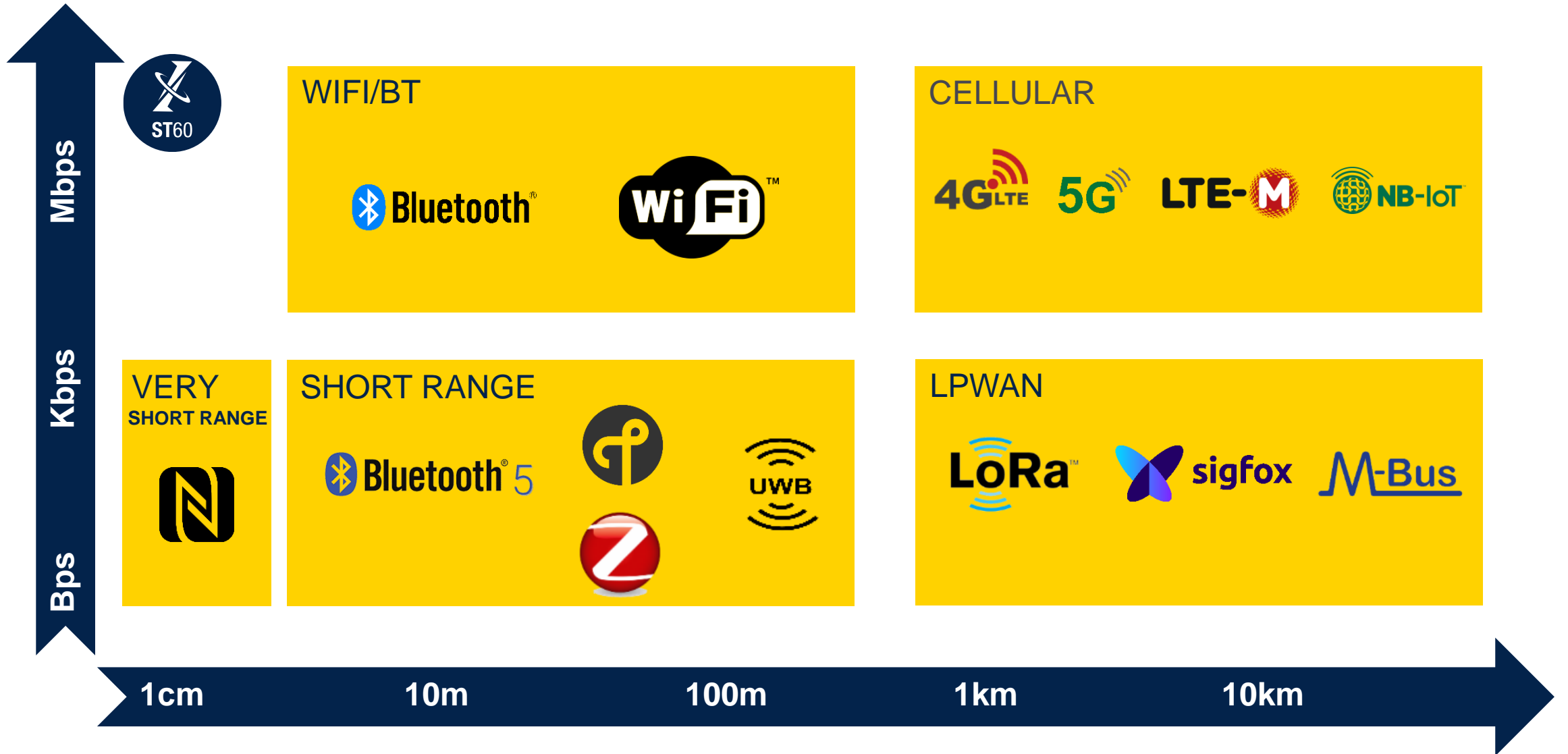
STM32无线产品线介绍



STM32 大步迈进无线领域



主流通信技术





STM32 完整的MCU产品组合



MPU

STM32MP1
Up to 1 GHz Cortex-A7
209 MHz Cortex-M4

STM32MP2
Dual 1.5 GHz Cortex-A35
400 MHz Cortex-M33

High-performance MCUs

STM32F2
Up to 398 CoreMark
120 MHz Cortex-M3

STM32F4
Up to 608 CoreMark
180 MHz Cortex-M4

STM32F7
1082 CoreMark
216 MHz Cortex-M7

STM32H5
Up to 1023 CoreMark
250 MHz Cortex-M33

STM32H7
Up to 3224 CoreMark
Up to 550 MHz Cortex-M7
240 MHz Cortex-M4

STM32N6
MCU with neural processing unit

Mainstream MCUs

STM32F3
245 CoreMark
72 MHz Cortex-M4

STM32G4
569 CoreMark
170 MHz Cortex-M4

Mixed-signal MCUs

STM32C0
114 CoreMark
48 MHz Cortex-M0+

STM32F0
106 CoreMark
48 MHz Cortex-M0

STM32G0
142 CoreMark
64 MHz Cortex-M0+

STM32F1
177 CoreMark
72 MHz Cortex-M3

Ultra-low-power MCUs

STM32L0
75 CoreMark
32 MHz Cortex-M0+

STM32L4
273 CoreMark
80 MHz Cortex-M4

STM32L4+
409 CoreMark
120 MHz Cortex-M4

STM32L5
443 CoreMark
110 MHz Cortex-M33

STM32U5
651 CoreMark
160 MHz Cortex-M33

Wireless MCUs

STM32WL
162 CoreMark
48 MHz Cortex-M4
48 MHz Cortex-M0+

STM32WB
216 CoreMark
64 MHz Cortex-M4
32 MHz Cortex-M0+

STM32WBA
407 CoreMark
100 MHz Cortex-M33



Latest product generation Radio co-processor only New series introduced in 2023 Pre-announcement

2.4GHz 产品系列

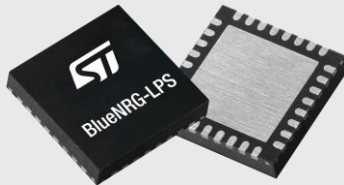


来看一下我们的2.4GHz产品家族

STM32WB & BlueNRG

Bringing the most comprehensive portfolio for Bluetooth and other 2.4GHz protocols !

- From **160KB to 1MB** Flash
- **Single** or **Dual-core** products
- Compliant with **5.3 standard**
- Multiple **stack variants** available
- From **32pins to 129pins**
- **Matter** and **LE Audio** coming soon



 **Bluetooth® 5**



OPENTHREAD
released by Google

 **zigbee**

 **matter**

 **Proprietary**



STM32 MCU 2.4GHz 产品组合

STM32WB MCU

STM32WB55

STM32WB35

STM32WB15

STM32WB50

STM32WB30

STM32WB10

Dual core & security (Arm® Cortex® -M4 /-M0+)

Up to **1MB** flash/**256KB** RAM

Bluetooth® Low Energy 5.3, Zigbee R22 & Thread, proprietary, Matter H1'23

STM32WBA MCU

STM32WBA52



Arm® Cortex® -M33 w/ **TrustZone®** @100MHz
1MB flash memory / **128KB** RAM
Bluetooth® Low Energy 5.3
(long-range, 2Mbps, adverting extension)
Up to **+10dBm** output power
Enhanced security



BlueNRG System-on-Chip

BlueNRG-1

BlueNRG-2

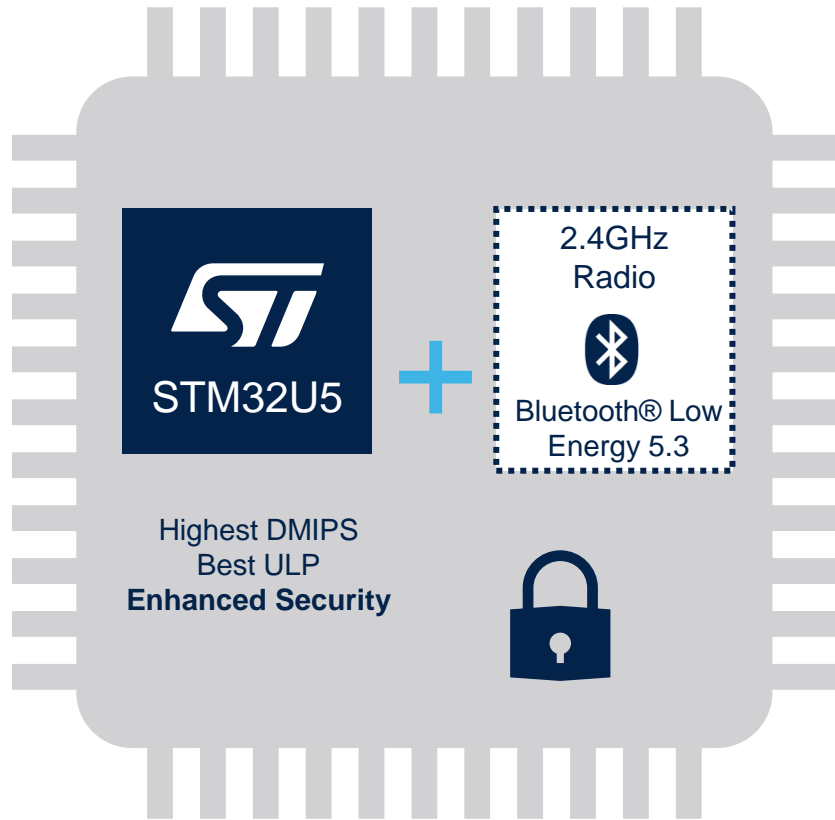
BlueNRG-LP

Arm® Cortex®-M0+
256KB flash/ 64KB RAM
Bluetooth® Low Energy 5.3
Long-range, 2Mbps,
Adverting Ext

BlueNRG-LPS

Arm® Cortex®-M0+
192KB flash memory / 24KB RAM
Bluetooth® Low Energy 5.3
(long-range, 2Mbps, adverting
extension, **AoA/AoD**)

STM32WBA: Ultra-low-power BLE 5.3 platform



STM32WBA

- **Bluetooth® Low Energy 5.3**
- Based on **Arm® Cortex® M33** at 100MHz with TrustZone® technology
- Leveraging **STM32U5 ultra-low-power platform**
 - low power background autonomous mode (LPBAM)
 - flexible power-saving states with fast wake-up times
 - same digital and analog peripherals
- Built using **40nm process technology**
- Supported by full **ecosystem** (Q1 2023)

STM32WBA52x features and circuit diagram

STM32WBA52CxU6

Architecture

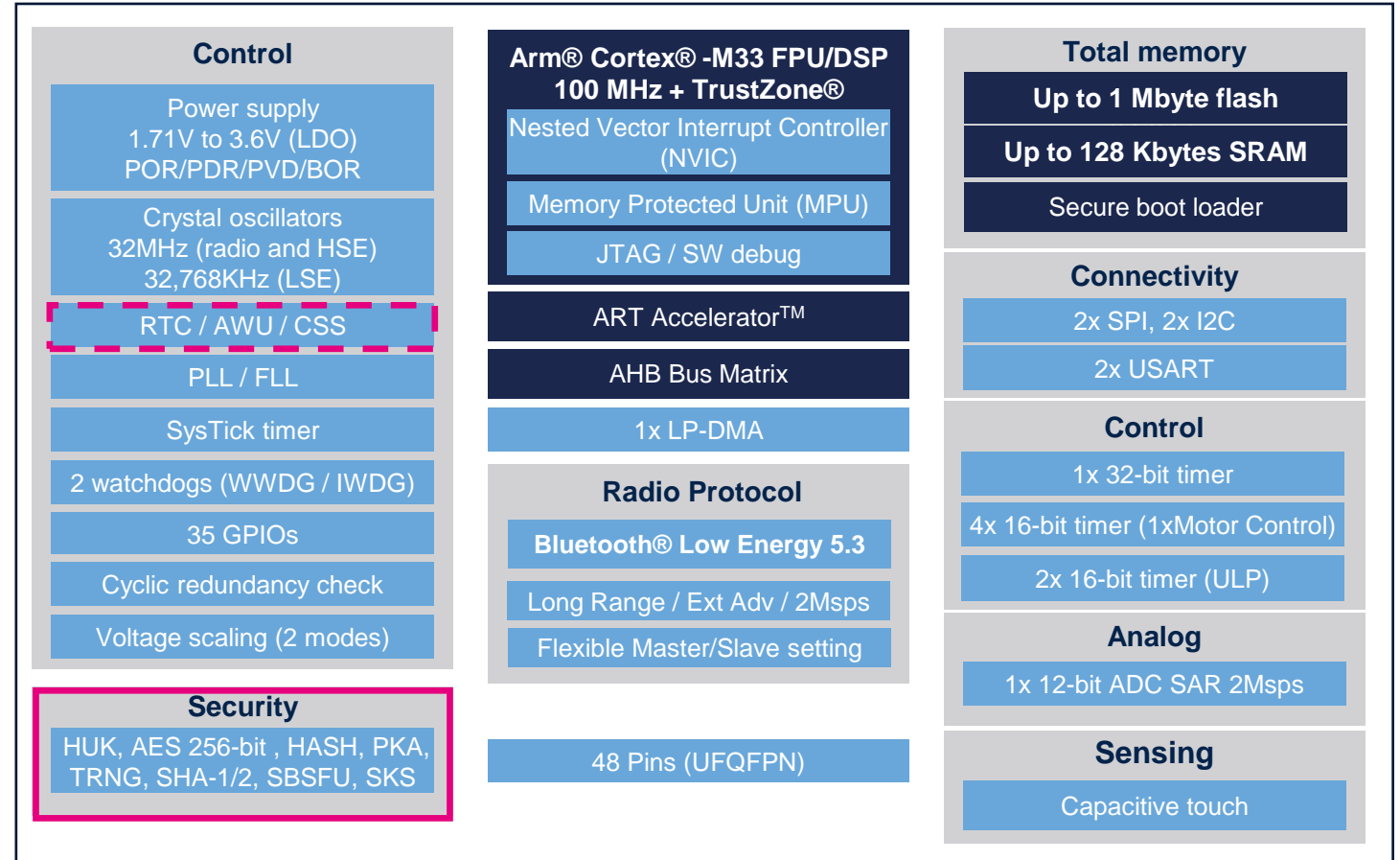
- 1 Mbyte of flash memory / 128Kbytes RAM
- Single Arm® Cortex® M33 @ 100MHz

Key features

- +10dBm max output power, integrated balun
- Bluetooth® Low Energy 5.3 certified with advertising extension, 2Mbps, long range
- up to 20 connections
- TX : 10.6mA @ 0dBm, RX: 7.4mA
- - 40 to + 85°C

Peripherals: touch sensor, LPBAM, ADC 12-bit, 3x UART, 2x SPI, 2x I²C

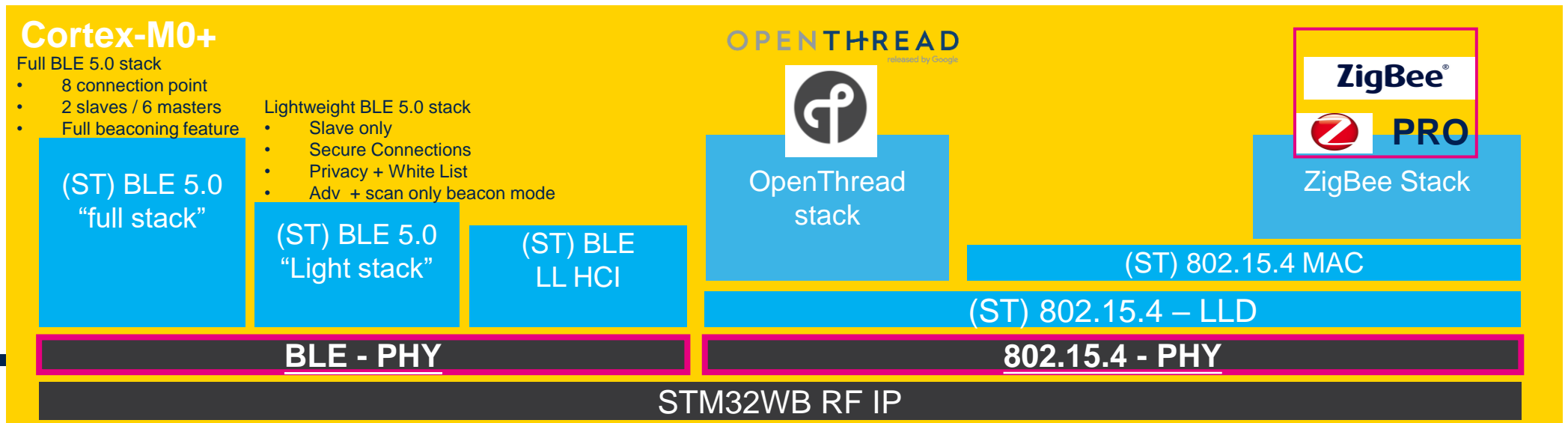
Package: UFQFN48 7 x 7 mm, 35 GPIOs



- Side attack resistant
- - Active antitamper

免费的各种协议栈和参考源码

Binary
源码
私有代码
硬件IP



| STM32WB55 | STM32WB35 | STM32WB15 |
|---|---|---|
| BLE 5.2/Zigbee 3.0 Open Thread/Matter proprietary (HCI, MAC, LLD) /802.15.4 Multi-protocols (BLE/Zigbee, BLE/Thread) | BLE 5.2 Zigbee 3.0 Open Thread proprietary (HCI, MAC, LLD) /802.15.4 | BLE 5.2 proprietary (HCI, LLD) /802.15.4 |



Smart industry



STEVAL-PROTEUS1 应用领域



数据分析

预测性维护

设置参数、触发器和趋势。

基于条件的监测

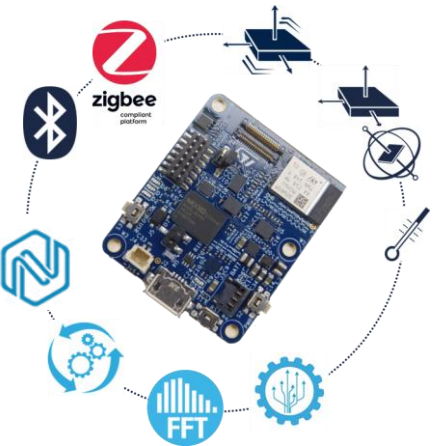
连接传感器+搜集数据

机器学习



工业 4.0 CBM & PdM 应用场景

Health equipment condition monitoring and status anytime and everywhere!



Gateway

Advertising

Connection

Monitoring

Alerting

The Gateway section shows a hardware device and a mobile app interface. The app interface displays a list of devices (PTR26, PTR028, PTR59) with their status (battery level) and a 'Settings' screen for monitoring and alerting. The Advertising section shows a hand holding a smartphone with a Bluetooth icon. The Connection section shows a hand holding a smartphone with a Bluetooth icon.

CLOUD

Azure IoT Central

The Cloud section shows a laptop displaying the Azure IoT Central interface. The interface displays a dashboard with various charts and graphs, including a 'Temperature' chart and a 'Battery %' chart. The Azure IoT Central logo is shown below the laptop.

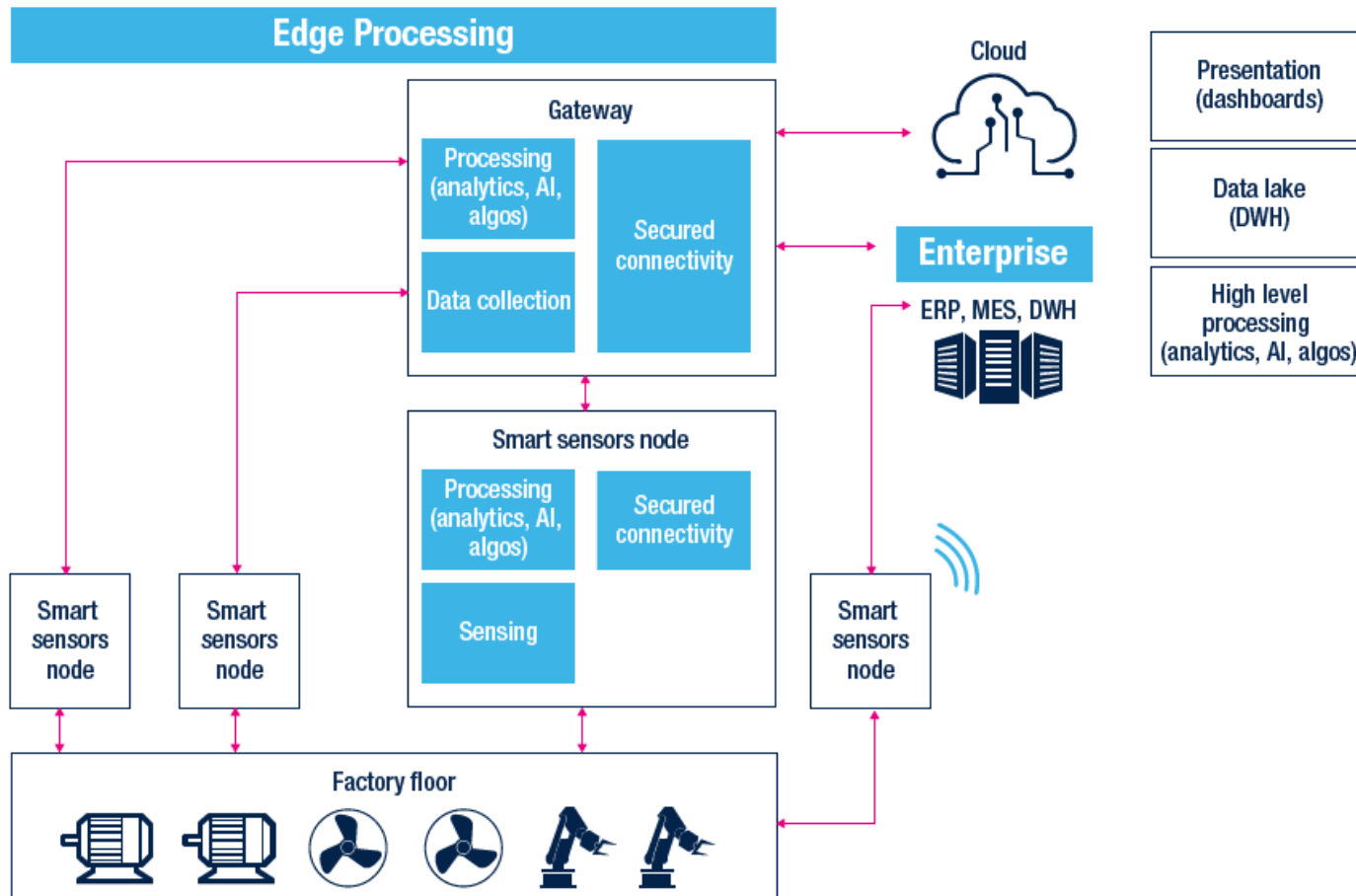
Advertising
To ensure a complete equipment overview status at all time

Connection
For settings and data details in a friendly view

Cloud
To monitor smart factory everywhere

应用程序块图

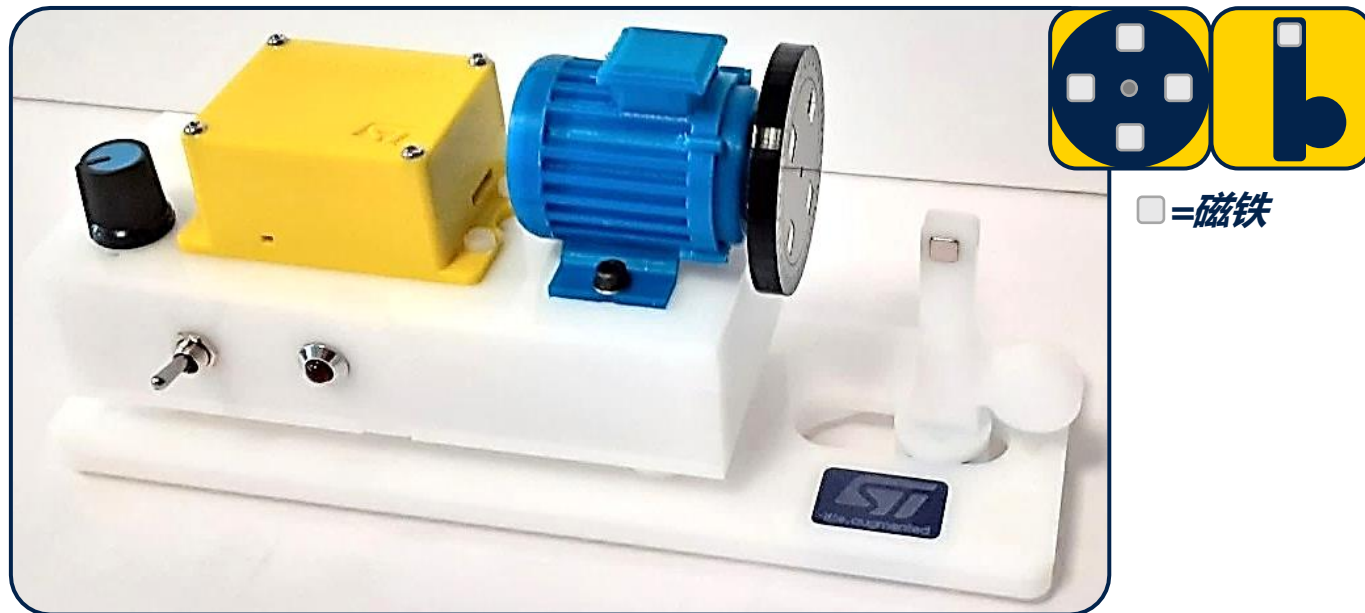
围绕智能传感器构建的工业4.0或工业5.0现场应用。



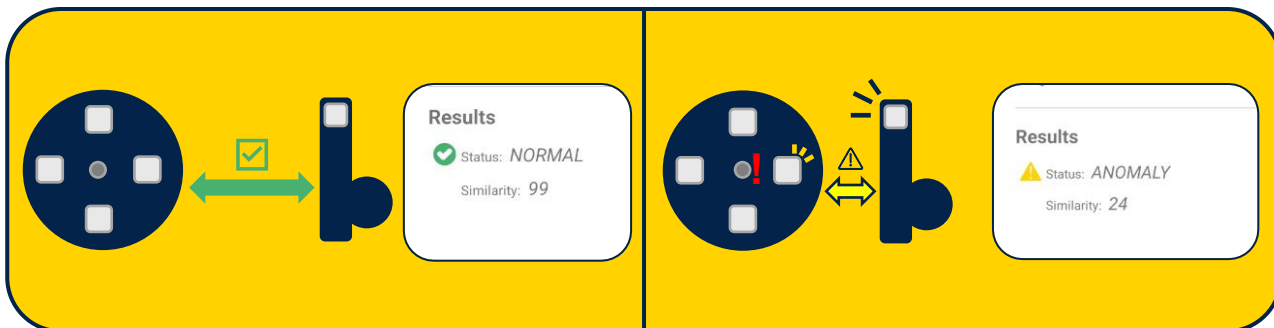
STEVAL-PROTEUS1

边缘处理

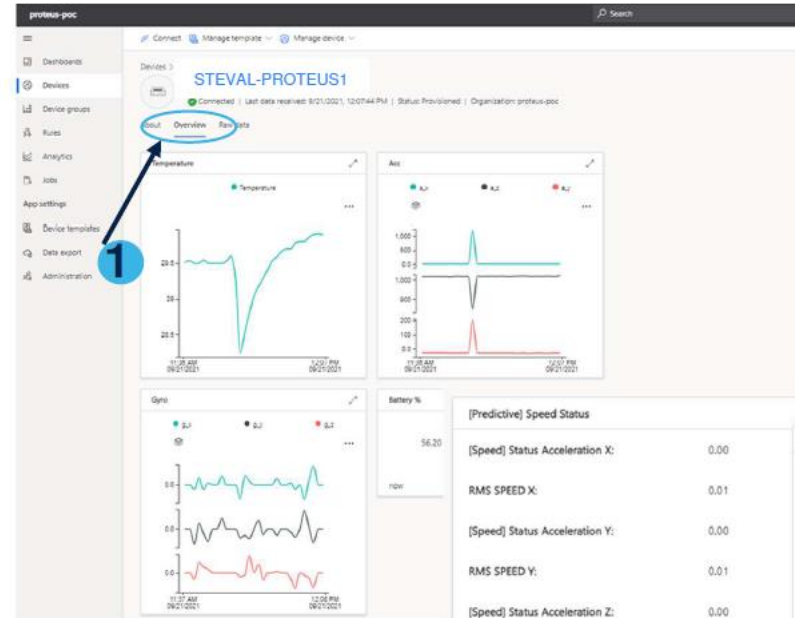
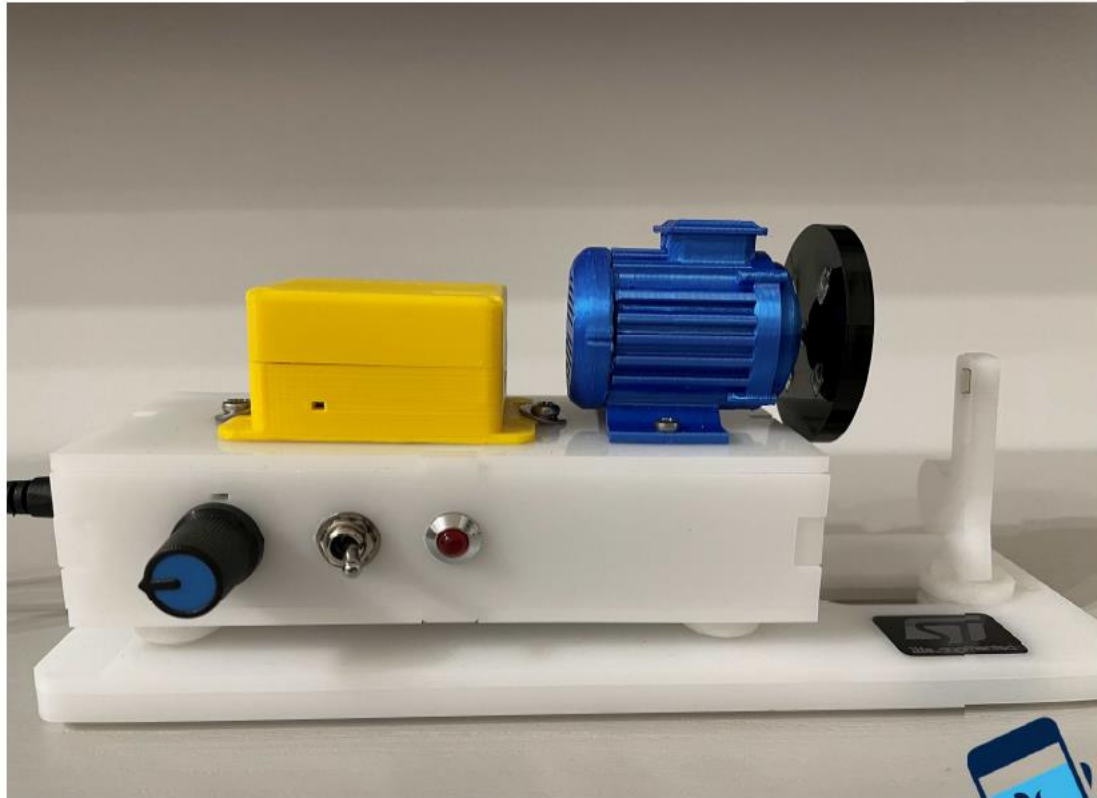
故障警告警报!



=磁铁



预测性维护Demo



1 Overview tab to show plot

| [Predictive] Speed Status | |
|--------------------------------|------|
| [Speed] Status Acceleration X: | 0.00 |
| RMS SPEED X: | 0.01 |
| [Speed] Status Acceleration Y: | 0.00 |
| RMS SPEED Y: | 0.01 |
| [Speed] Status Acceleration Z: | 0.00 |
| RMS SPEED Z: | 0.03 |

| [Predictive] Acceleration Peak Status | |
|---------------------------------------|------|
| [AccPeak] Status Acceleration X: | 0.00 |
| Acceleration Peak X: | 0.44 |
| [AccPeak] Status Acceleration Y: | 0.00 |
| Acceleration Peak Y: | 0.37 |
| [AccPeak] Status Acceleration Z: | 0.00 |
| Acceleration Peak Z: | 0.45 |

| [Predictive] Frequency Domain Status | |
|---|---------|
| [Frequency Domain] Status Acceleration X: | 0.00 |
| Max Amplitude X: | 0.00 |
| Frequency Domain X: | 2436.00 |
| [Frequency Domain] Status Acceleration Y: | 0.00 |
| Max Amplitude Y: | 0.00 |
| Frequency Domain Y: | 3300.20 |
| [Frequency Domain] Status Acceleration Z: | 0.00 |
| Max Amplitude Z: | 0.00 |
| Frequency Domain Z: | 1545.90 |

| [Predictive] Frequency Domain Status | |
|---|---------|
| [Frequency Domain] Status Acceleration X: | 0.00 |
| Max Amplitude X: | 0.00 |
| Frequency Domain X: | 2436.00 |
| [Frequency Domain] Status Acceleration Y: | 0.00 |
| Max Amplitude Y: | 0.00 |
| Frequency Domain Y: | 3300.20 |
| [Frequency Domain] Status Acceleration Z: | 0.00 |
| Max Amplitude Z: | 0.00 |
| Frequency Domain Z: | 1545.90 |



Industrial Summit 2023 Show Stopper

Cloud Dashboard

Servo Drives Orchestra

Homing

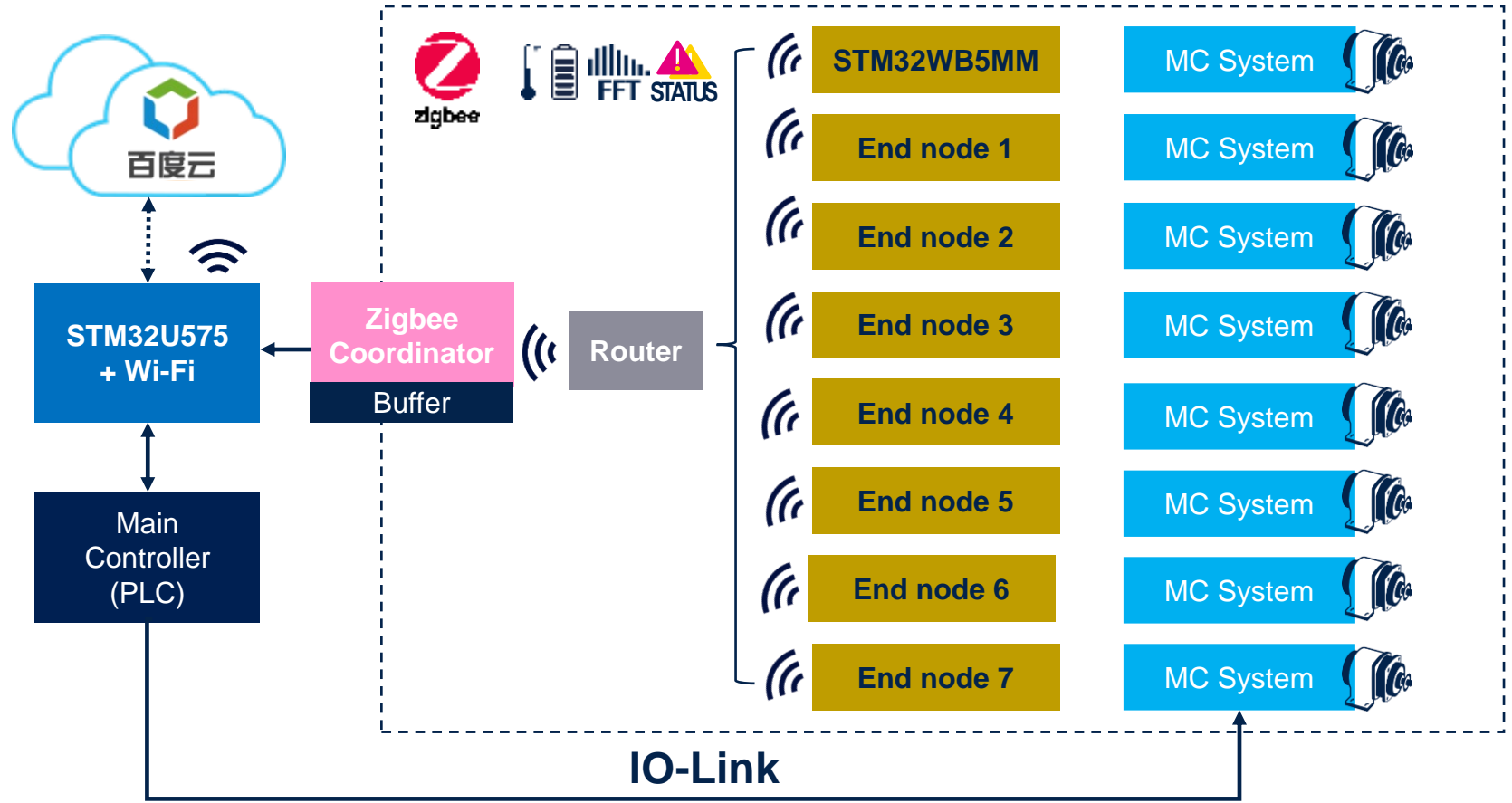
Stop

Game 1

Game 2

Status

OxAD = start-up
 OxBD = ready no homed
 OxB1 = ready homed
 OxCA = running homing
 OxC1 = running Game 1
 OxC2 = running Game 2
 OxC3 = running Game 3
 OxCF = running Stop
 OxED = Error Align
 OxE1 = Error Overcurrent



STM32 Baidu IoT Core Connection

Start Homing

Start Game1

Start Game2

Stop

Reset

Set Speed 25

1

2

3

4

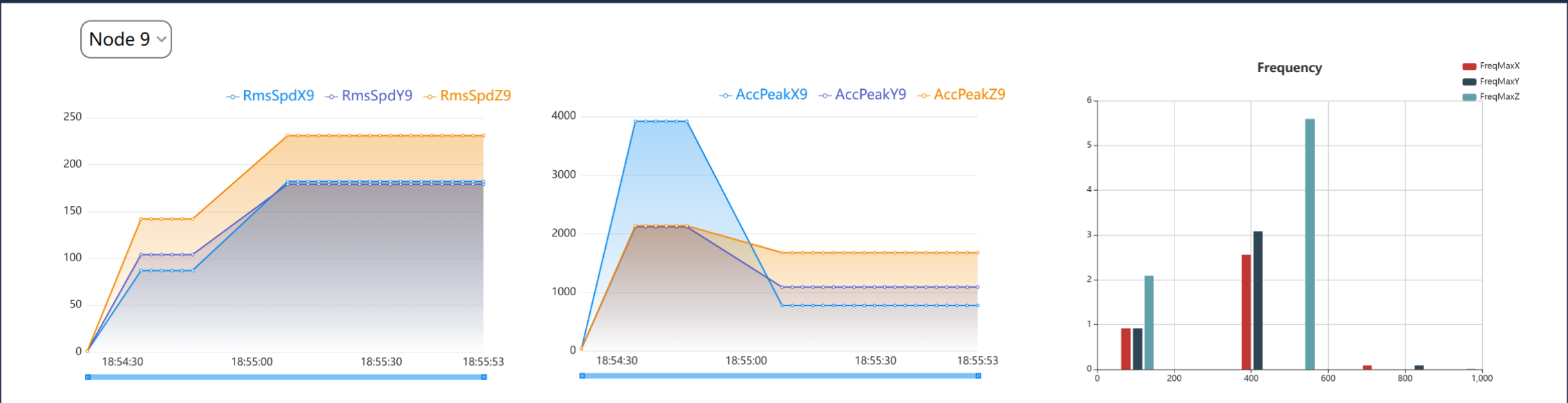
5

6

7

8

| Node ID | Address | Temp | Battery | RmsSts | AccSts | FreqSts |
|---------|---------|---------|---------|--------|--------|---------|
| 1 | 32 | 26.6 °C | 0 % | ● | ● | ● |
| 2 | 41 | 26.6 °C | 0 % | ● | ● | ● |
| 3 | 58 | 26.6 °C | 0 % | ● | ● | ● |
| 4 | 59 | 26.7 °C | 0 % | ● | ● | ● |
| 5 | 60 | 26.6 °C | 0 % | ● | ● | ● |
| 6 | 61 | 26.7 °C | 0 % | ● | ● | ● |
| 7 | 63 | 26.4 °C | 0 % | ● | ● | ● |
| 8 | 76 | 26.3 °C | 0 % | ● | ● | ● |
| 9 | 84 | 27.2 °C | 0 % | ● | ● | ● |

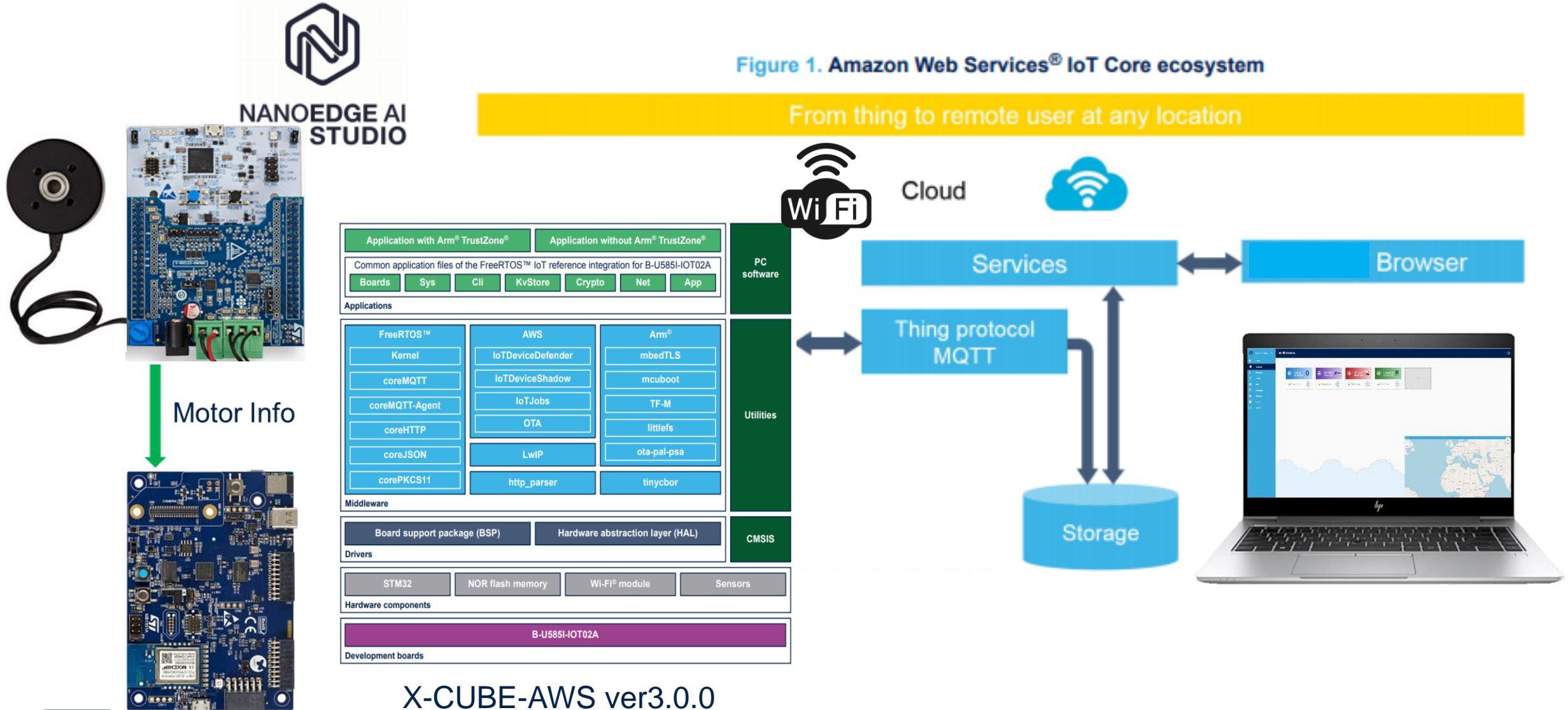


基于NEAI的风扇堵塞应用程序（接入AWS）



系统框图

Figure 1. Amazon Web Services® IoT Core ecosystem



市场与客户

- Description
 - Target is to provide to AIRCON customers (especially in Japan) a PoC showing simple AI implementation linked to AWS platform to detect remotely FAN filter clogging through information relayed onto AWS platform
 - Goal is to promote end to end solution reusing existing solutions developed
 - X-CUBE-AWS
 - NEAI Fan Clogging demo
- Target market
 - *Market segment: Home Automation*
 - *Applications: Aircon*
- Market size of the solution
 - Already 3Mu identified at below customers listed
 - TAM is higher but not all devices are connected through WiFi
- Major customers
 - Daikin
 - Panasonic
 - Hitachi
 - Fujitsu

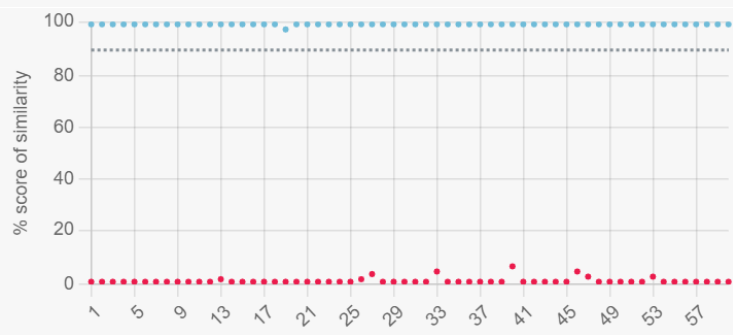
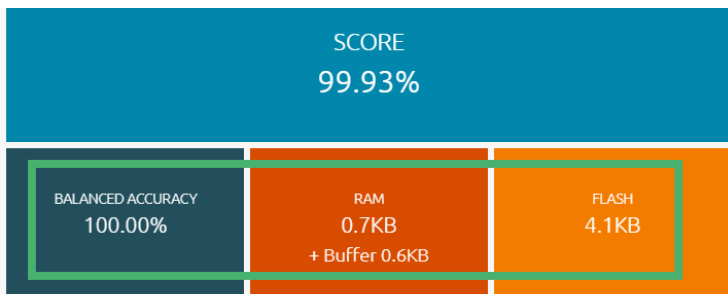




预测性维护的风扇堵塞演示

Demonstrate the effectiveness of NanoEdge AI library for the detection of fan filter clogging

- **Approach:** AI model automatically extracts features from current signal I_q , and then detect if the filter is clogged or not.
- **Features:** On-device learning to fine-tune the AI model so that it can adapt to the discrepancy of each specific equipment.
- **Hardware:** P-NUCLEO-IHM003 Motor Control kit with STM32G431 inside

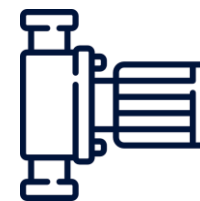
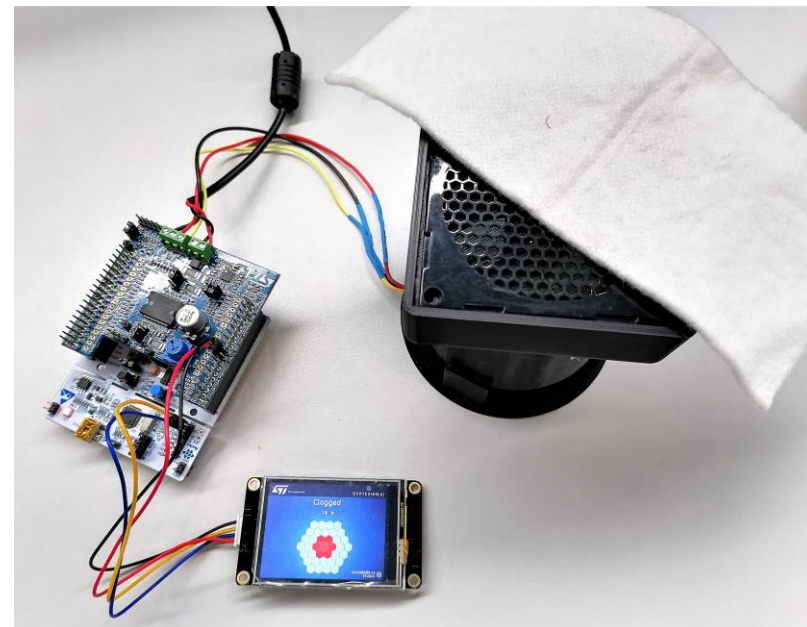


Key results of NanoEdge AI studio:

- Accuracy: **100%**
- RAM: **1.3 KB**

Target Application:

- Filter clogging detection for air conditioner.
- Anomaly detection for electric motor.
- Predictive maintenance.



Detect any abnormal torque, wrong starting sequence, friction due to aging or oil issue

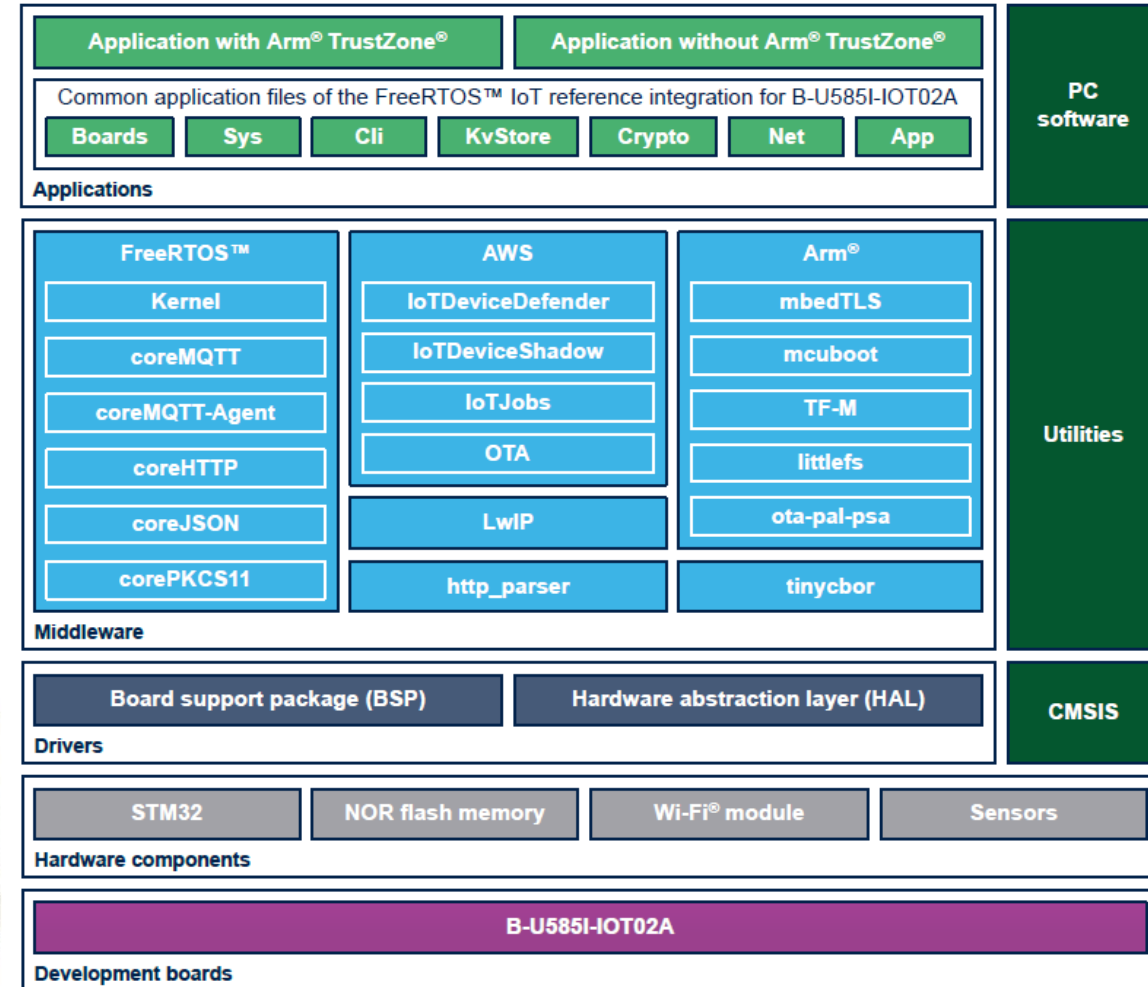
X-CUBE-AWS ver3.0.0

- Amazon **FreeRTOS™** IoT reference for the **B-U585I-IOT02A** Discovery kit
- Wi-Fi®
- Configurable TCP/IP stack
- **TLS encryption**
- Firmware update
- AWS IoT Core™ multi-account registration
- AWS IoT Core™ connection, device shadow, jobs, defender
- AWS IoT Core™ **OTA** firmware update
- Telemetry with on-board environmental and movement sensors
- Command-line interface:
 - Device provisioning
 - Configuration saving to NVM
 - Monitoring of the FreeRTOS™ kernel tasks and their memory usage
- Easy step-in project, without Arm® TrustZone®
- Arm® **TrustZone®** for Cortex®-M (TF-M) enabled project:
 - Secure boot
 - Private key and secrets storage
 - Sensitive operations executed in an isolated environment



B-U585I-IOT02A

- STM32U585AI MCU featuring:
 - Arm® Cortex®-M33 core with
 - Arm® TrustZone® and
 - Armv8-M mainline security extension
 - 2 Mbytes of Flash
 - 786 Kbytes of SRAM
- WiFi Module
- Bluetooth Module
- MEMS Microphones
- Sensors (Temp., Humidity, Magneto., acc, gyro, pressure, ToF, gesture detection)



资产追踪 - STEVAL-ASTRA1B



life.augmented



多连线能力资产追踪解决方案

| | | | | | | |
|-----------|--|-------|------|------|------|------|
| 物联网追踪 | | 奢侈品 | 个人设备 | 宠物追踪 | 人员追踪 | 社交距离 |
| | | | | | | |
| 户外即时监控 | | 货物搬运 | 车队管理 | 牲畜监控 | 牵引机 | 行动共享 |
| | | | | | | |
| 室内定位和仓储物流 | | RTLS* | 行动资产 | 栈板 | 智慧包裹 | 员工安全 |
| | | | | | | |
| 质量保证 | | 冷链 | 食物运输 | 医疗 | | |
| | | | | | | |

*RTLS = 即時定位系統

STEVAL-ASTRA1B



STEVAL-ASTRA1B



ST 资产追踪移动 APP

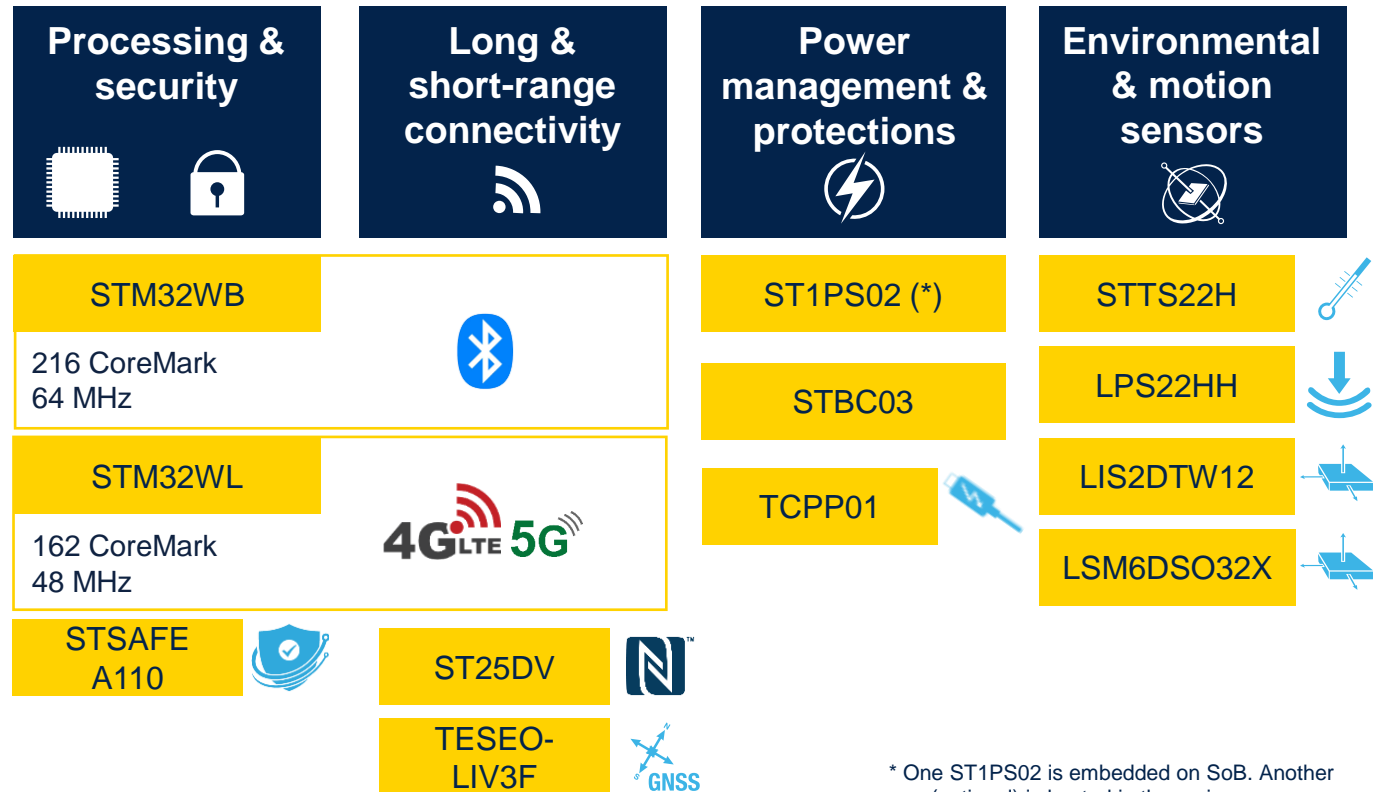


DHS-ASSETTRACKING 网页云端仪表板

资产跟踪解决方案 - STEVAL-ASTRA1B组件



STEVAL-ASTRA1B hardware overview



* One ST1PS02 is embedded on SoB. Another one (optional) is hosted in the main

资产跟踪应用场景

Evaluation board
STEVAL-ASTRA1B

Mobile app
ST asset tracking

Web-based dashboard
DSH-ASSETTRACKING

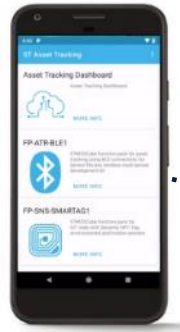


Schematics, Gerber,
... available online

Certified solution
(CE, RoHS, FSC)

Firmware package
FP-ATR-ASTRA1

Firmware source
code available



Network
Server



<https://dsh-assettracking.st.com>



life.augmented

扫描以下二维码
获得功率及模拟产品更多资讯



PDSA 微信公众号



能以致动子网站



Our technology starts with You



了解更多信息，请访问www.st.com

© STMicroelectronics - 保留所有权利。

ST徽标是STMicroelectronics International NV或其附属公司在欧盟和/或其他国家的商标或注册商标。若需意法半导体商标的更多信息，请参考www.st.com/trademarks。

其他所有产品或服务名称是其各自所有者的财产。



life.augmented