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低功耗蓝牙音频-加载 Auracast™ 的 STM32WBA55

意法半导体

中国区微控制器、数字 IC 与射频产品部

STM32 无线产品线

我们是科技的创新者和创造者

世界排名前列的半导体公司

5万名员工，其中包含**9,500**多名研发人员

2023年全年营收**173亿美元**

在全球设立**80**多个营销办事处，服务**超过20万**家客户

14个制造基地

联合国全球契约（UNGC）企业，负责任商业联盟（RBA）成员

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截至2023年12月31日

应用场景

让**驾驶**变得
更安全，更环保，
更智联

让**工业**向更智能、
更安全、更高效的工厂
和工作场所发展

让**家居和城市**变得更智能，让生活更美好，更安全，更好地利用现有资源

让**日常设备**变得更智能，
更智联，富有更强的情
景感知能力

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通用MCU & MPU, 安全方案 & NFC

通用32位MCU & MPU

- STM32* 32位通用微控制器 (MCU) 和32/64位微处理器 (MPU)
- Arm® Cortex® 内核
- 高性能、主流、超低功耗MCU产品
- 资源丰富的生态系统

无线32位MCU

- Bluetooth®低功耗芯片
- Zigbee、Thread、Matter
- Sub-1 GHz收发器、Sigfox兼容设备 LoRaWAN®技术
- STM32 DNA、RF扩展生态系统

安全方案

- 手机支付交易
- 身份验证和品牌保护
- 安全支付解决方案
- 车载互联服务

NFC &存储器

- NFC / RFID 标签
- 动态 NFC标签
- NFC / RFID读取器
- 高性能和高读写次数 EEPROM

** 意法半导体或其关联公司在欧盟和/或其他地方的注册和/或未注册商标*

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STM32：一种始于2007年的开发人员优先工作策略

STM32堪称关键的推动因素：全球的嵌入式开发人员均可在STM32的协助下发挥出自身的创造力。

我们能够为嵌入式开发人员提供尖端的硬件和软件技术、全方位的支持以及高品质的可靠产品。这将帮助他们打造出更加智能、连接性能更强且更加安全的设计方案。

32位MCU
开发人员的第一选择

来源：2022年Aspencore嵌入式产品调查

#1 GP MCU Worldwide

来源：2022和2023年OMDIA CLT

客户数量已超过100,000家

以人为本的技术解决方案

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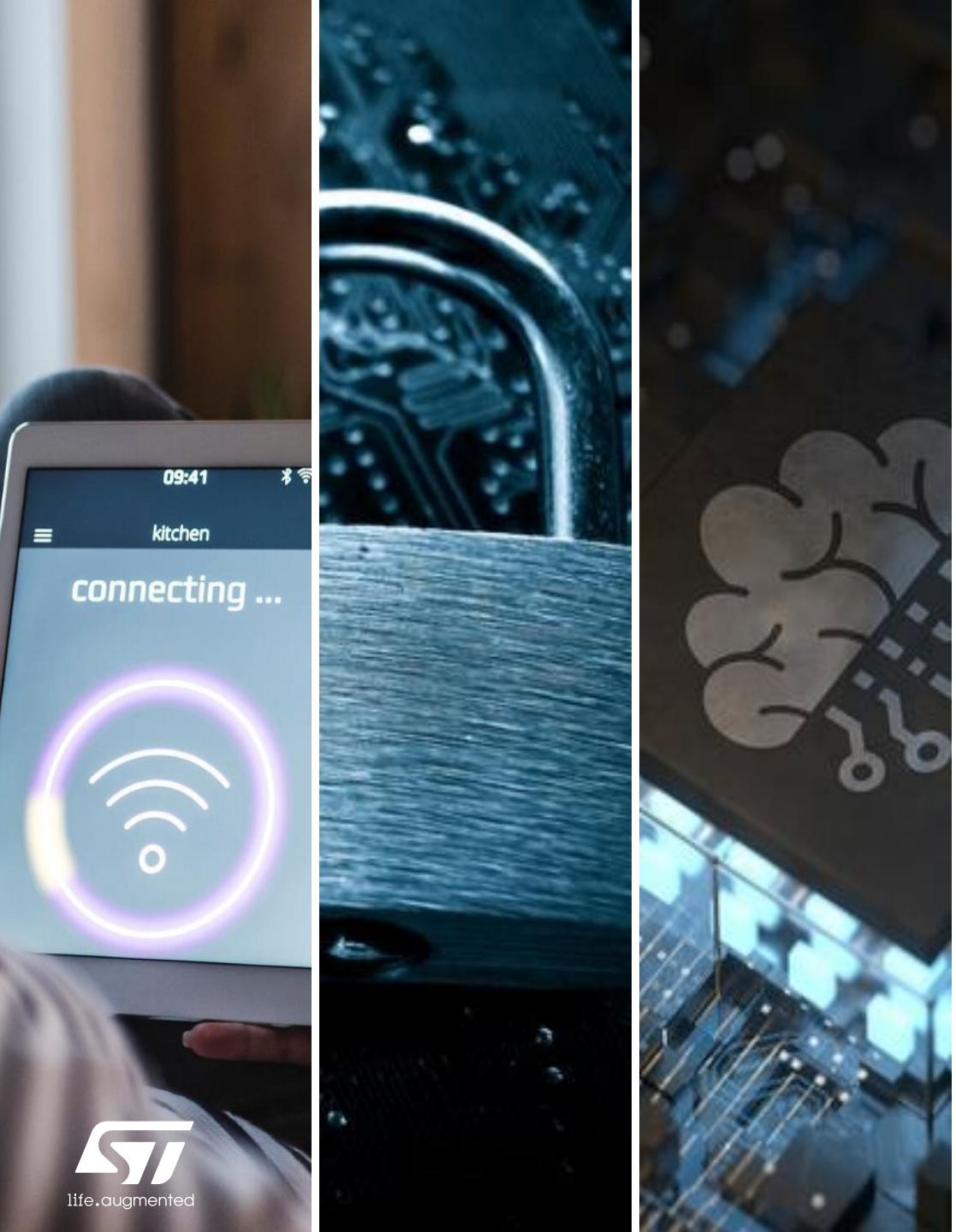

充分满足开发人员的需求

STM32

更多的无线连接

更高的安全性

STM32 Trust

更多的自主决策嵌入式AI

更多面向具体应用的增值IP

更多的有线连接

更低的功耗

更出色的计算能力
32位CPU
基于Arm® Cortex®
的实时操作系统
(多达两个内核)

灵活的存储器接口

更多的嵌入式Flash存储器 可选

https://www.st.com/content/st_com/en/stm32-mcu-developer-zone.html

STM32 portfolio

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

- STM32**F7** — 1082 CoreMark, 216 MHz Cortex-M7
- **STM32H7** — Up to 3224 CoreMark, Up to 600 MHz Cortex -M7, 240 MHz Cortex -M4
- **STM32N6** — MCU with neural processing unit
- STM32**F2** — Up to 398 CoreMark, 120 MHz Cortex-M3
- STM32**F4** — Up to 608 CoreMark, 180 MHz Cortex-M4
- **STM32H5** — Up to 1023 CoreMark, 250 MHz Cortex-M33

Mainstream MCUs

- STM32**F3** — 245 CoreMark, 72 MHz Cortex-M4
- **STM32G4** — 569 CoreMark, 170 MHz Cortex-M4

Mixed-signal MCUs

- **STM32C0** — 114 CoreMark, 48 MHz Cortex M0+
- STM32**F0** — 106 CoreMark, 48 MHz Cortex-M0
- **STM32G0** — 142 CoreMark, 64 MHz Cortex-M0+
- STM32**F1** — 177 CoreMark, 72 MHz Cortex-M3

Ultra-low-power MCUs

- STM32**L0** — 75 CoreMark, 32 MHz Cortex-M0+
- **STM32U0** — 140 CoreMark, 48 MHz Cortex-M0+
- STM32**L4** — 273 CoreMark, 80 MHz Cortex-M4
- STM32**L4+** — 409 CoreMark, 120 MHz Cortex-M4
- STM32**L5** — 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+
- **STM32WB0** — 64 MHz Cortex-M0+
- **STM32WB** — 216 CoreMark, 64 MHz Cortex-M4, 32 MHz Cortex-M0+ ●
- **STM32WBA** — 407 CoreMark, 100 MHz Cortex-M33

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Latest product generation ● Radio co-processor only ▭ New series & lines introduced in 2024 ▭ Pre-announcement

STM32 MCU 2.4 GHz 产品组合

STM32WB series

- **Dual core** & security (Arm® Cortex® -M4 / -M0+)
- Up to **1 Mbyte** of flash memory / **256 Kbytes** of RAM

MCUs: STM32WB55, STM32WB35, STM32WB15, STM32WB50, STM32WB30, STM32WB10

Modules: STM32WB5M, STM32WB1M

matter

5.4 & Mesh

https://www.st.com/en/microcontrollers-microprocessors/stm32wb-series.html

STM32WBA series

STM32WBA55

STM32WBA52

matter

- Arm® Cortex® -M33 / **TrustZone®** 100 MHz
- **1 Mbyte of** flash memory / **128 Kbytes** of RAM
- Up to **+10 dBm** output power

https://www.st.com/en/microcontrollers-microprocessors/stm32wba-series.html

BlueNRG series

- Arm® Cortex® -M0/M0+
- Up to **256 Kbytes** of flash memory / **64 Kbytes** of RAM

System on Chips: BlueNRG-1, BlueNRG-2/2N, BlueNRG-LP, BlueNRG-LPS

5.2 to 5.4 & Mesh

Module: BlueNRG-M2SP/SA

https://www.st.com/en/wireless-connectivity/bluetooth-low-energy-application-processors.html

EVOLUTION

STM32WB0 series

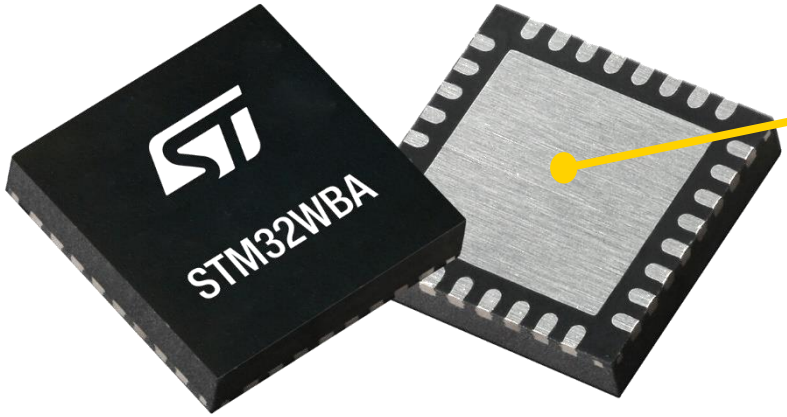
STM32WB09

5.3

- Arm® Cortex® -M0+ at 64 MHz
- **512 Kbytes** of flash memory / **64K bytes** of RAM
- Bluetooth® Low Energy 5.3 (long-range, 2 Mbps, Adverting ext, **AoA/AoD, Isochronous channel**)
- Up to **+8 dBm** of output power

https://www.st.com/en/microcontrollers-microprocessors/stm32wb0-series.html#

STM32WBA series enables faster time to market and higher wireless performance



Built using **40 nm process technology**

Enhanced wireless performance for a greater user experience

- Arm® Cortex®-M33 at 100MHz. CoreMark score at 407.
- Multiprotocol support: Bluetooth® Low Energy 5.4, Zigbee, OpenThread, Matter
- +10 dBm output power with low power consumption
- Ultra-low-power radio performance (only 30 µA/MHz when running at 100MHz)
- Switched-mode power supplies (SMPS) for low power applications

Reliable and compliant with the latest regulations

- SESIP Level 3 target certification: compliance with the US Cyber Trust Mark and the EU Radio Equipment Directive (RED) regulations due to become mandatory in 2025
- 10-year rolling longevity commitment for continuous supply

Simpler and faster development thanks to proven STM32 ecosystem

- Rich ecosystem offering hardware, embedded software & tools, documentation

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STM32WBA55系统框图

Control

- Power supply 1.71 V to 3.6 V (LDO/DCDC) POR/PDR/PVD/BOR
- Crystal oscillators 32MHz (radio and HSE) 32,768 kHz (LSE)
- Internal RC oscillators 32,768 kHz (500 ppm)
- PLL / FLL
- SysTick timer
- 2 watchdogs (WWDG / IWDG)
- Up to 35 GPIOs
- Cyclic redundancy check
- Voltage scaling (2 modes)

Security

- **TZ, HUK, AES 256-bit, HASH, PKA, TRNG, SHA-1/2**

Arm® Cortex®-M33 FPU/DSP 100 MHz + TrustZone®

- Nested vector interrupt controller (NVIC)
- Memory protected unit (MPU)
- JTAG / software debug

- ART Accelerator™
- AHB bus matrix
- 1x LPDMA
- 32 to 59 pins (QFN/BGA/CSP)

Multiprotocol radio

- **Bluetooth® Low Energy 5.4**
- **Zigbee / Thread / Matter**
- **Long Range / Ext adv / 2 Mbps**
- **Isochronous channel**
- **LE power control**

Total memory

- Up to 1 Mbyte flash memory
- Up to 128 Kbytes SRAM
- Secure bootloader

Connectivity

- 2x SPI, 2x I²C, SAI (1ch)
- 2x USART, LPUART

Control

- 1x 32-bit timer
- 4x 16-bit timer (1xMotor control)
- 2x 16-bit timer (ULP)

Analog

- 1x 12-bit ADC SAR 2 Msps
- 2x ULP Comparator

Sensing

- Capacitive touch

Side attack resistant
Active antitamper

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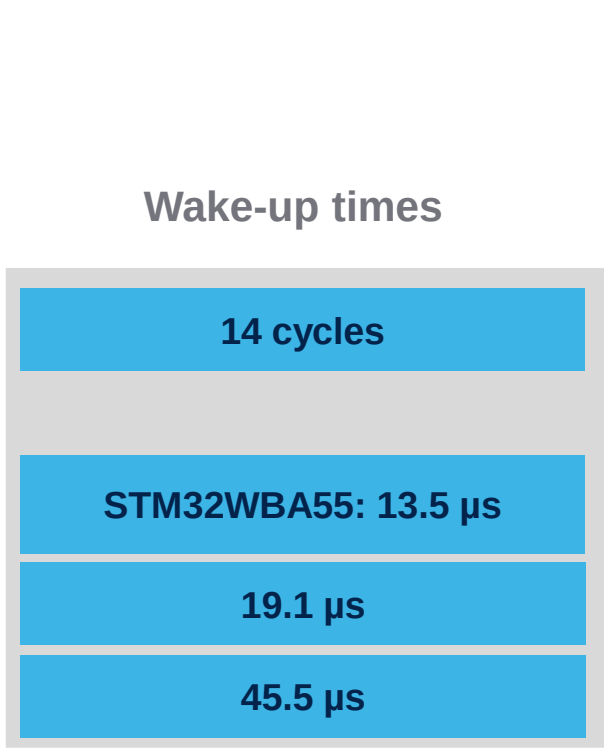
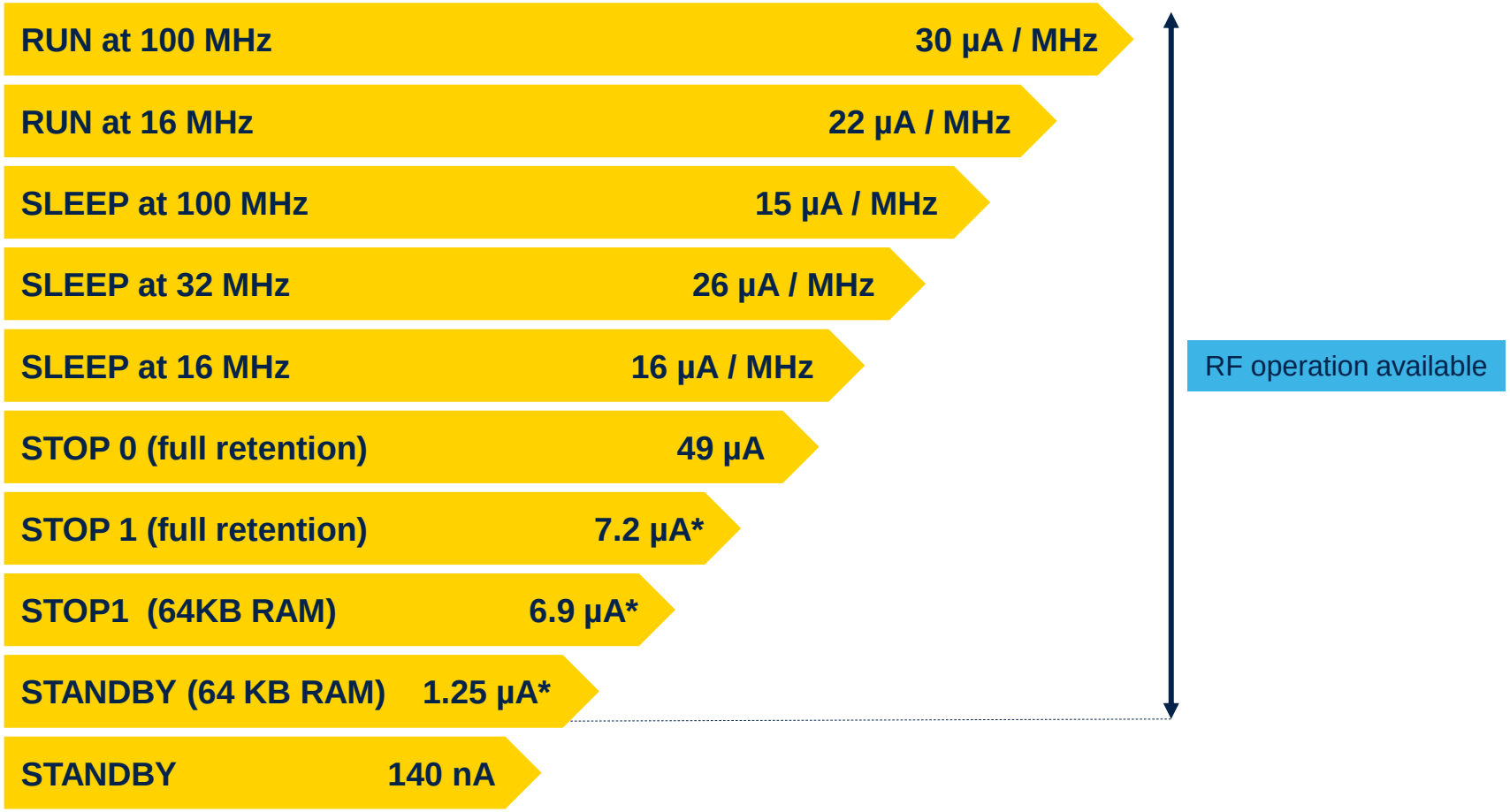
STM32WBA55 低功耗架构





Typ @ SMPS ON 3 V @ 25°C

** with RTC*

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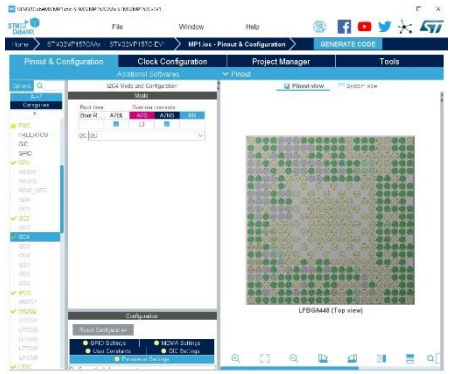
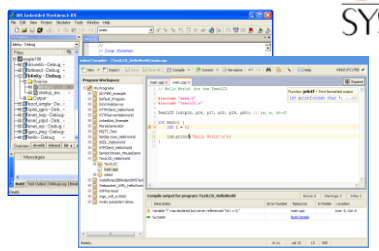
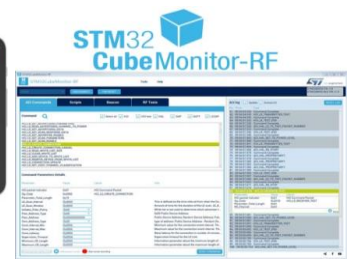
适用于STM32WBA的软件工具

完全支持Arm® Cortex®-M33架构







STM32CubeMX

方便配置的图形化工具

- 配置和代码生成
- 集成RTOS 支持和可选软件中间件
- **集成可配置Bluetooth® Low Energy (GUI)**

IDEs
Compile and debug

强大易用的方案

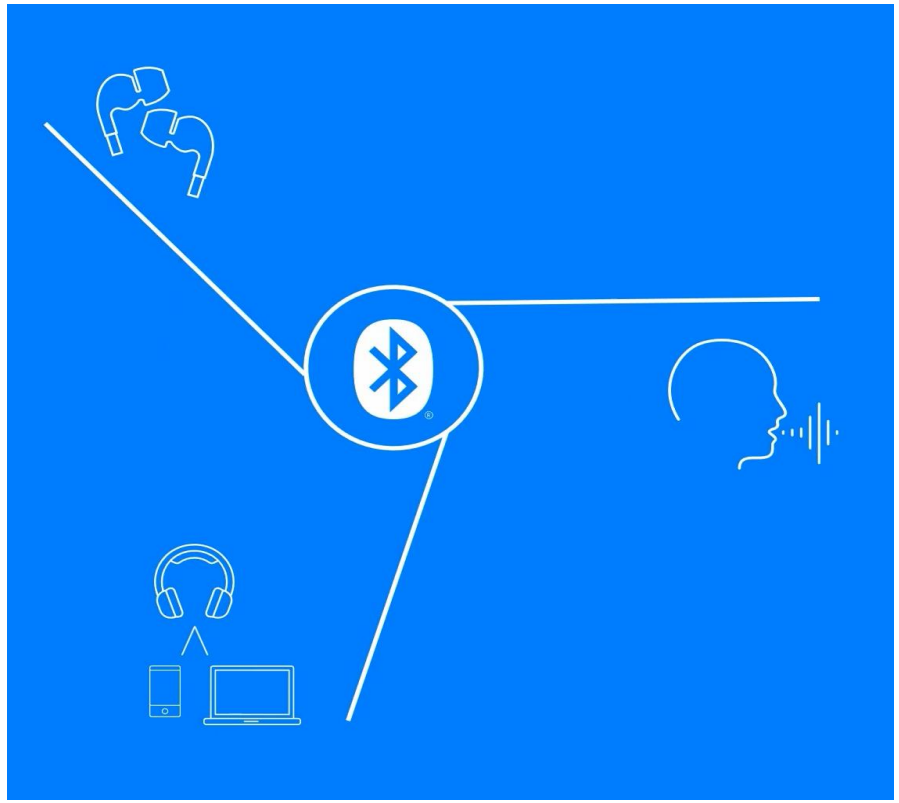
- Partners IDE (Arm® Keil®)
- IDE based on Eclipse — FREE
- RTOS aware debug — FREE

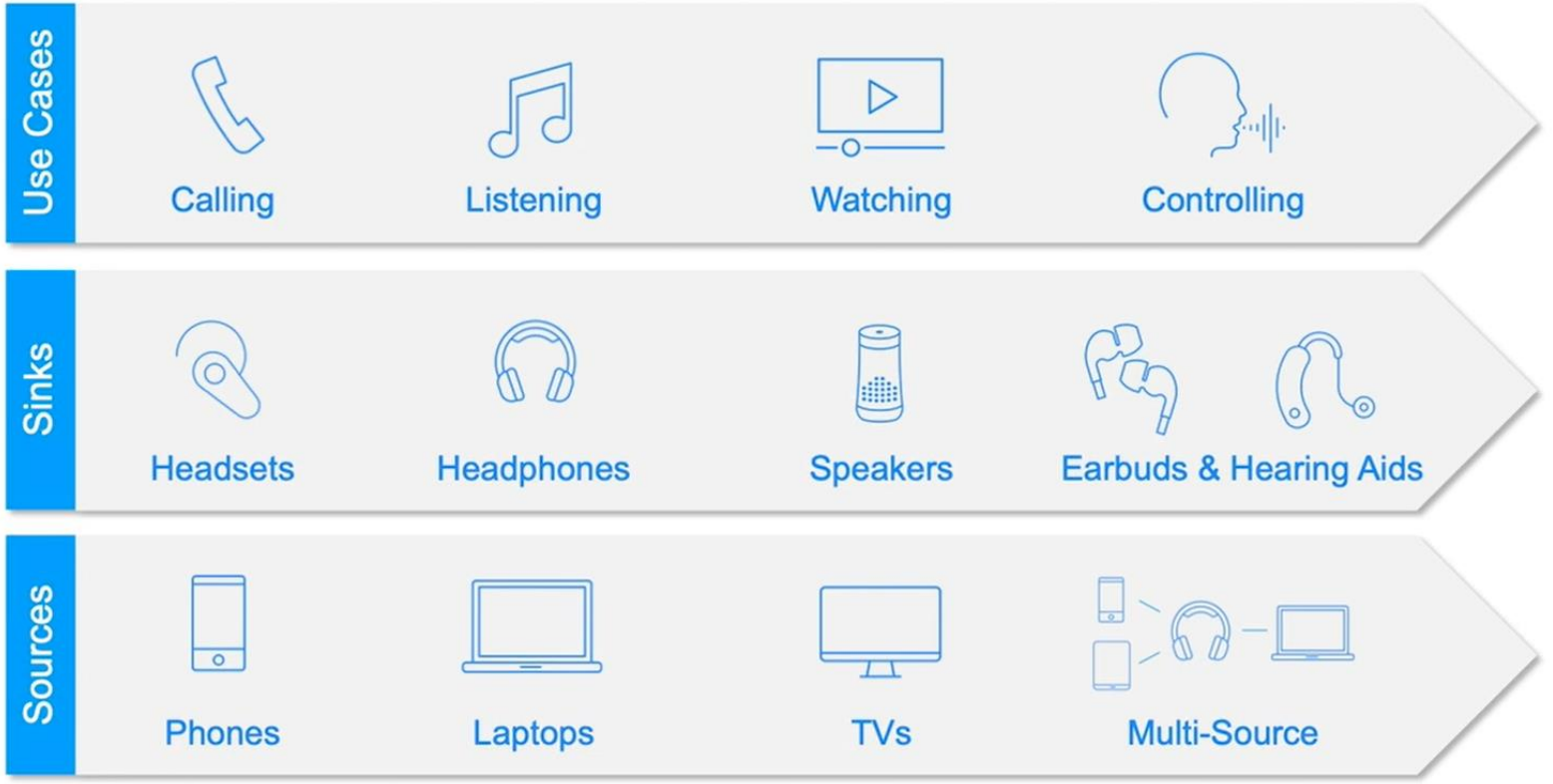
STM32 programming & monitoring tools

STM32CubeProg
STM32CubeMonitor/
STM32CubeMonitorRF

- **射频测试**
- **功耗测量**
- **高级脚本功能**

Audio with Bluetooth® Low Energy 5.2





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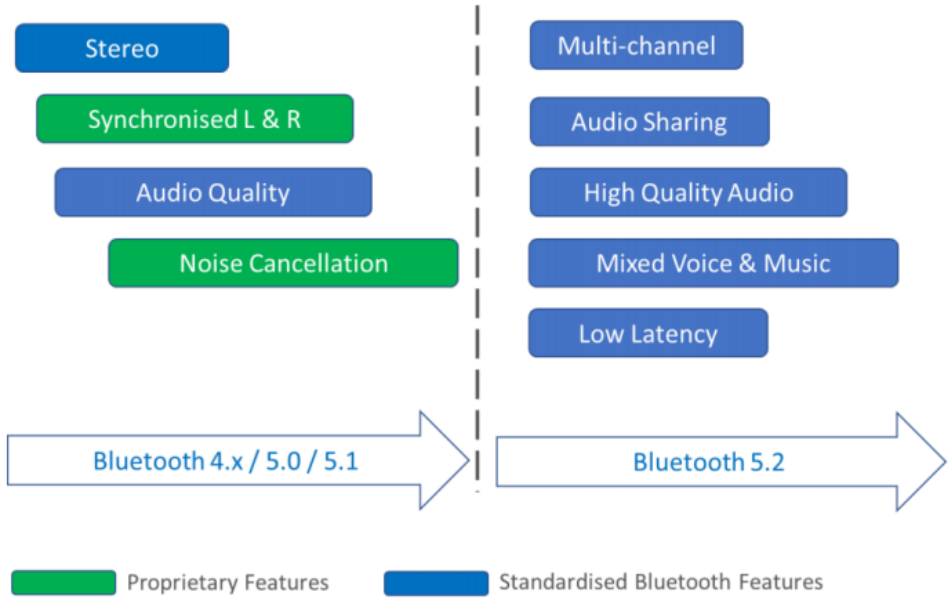
LE Audio 的演进



LC3

Audio Quality

Hearing Aids

Audio Loss

Low power,
High quality
Multi-stream

Multi Stream

Audio streams

Multiple
Independent
Synchronized

Broadcast

Audio Sharing

Unlimited Broadcast

Speaker

Car Radio

Earbuds

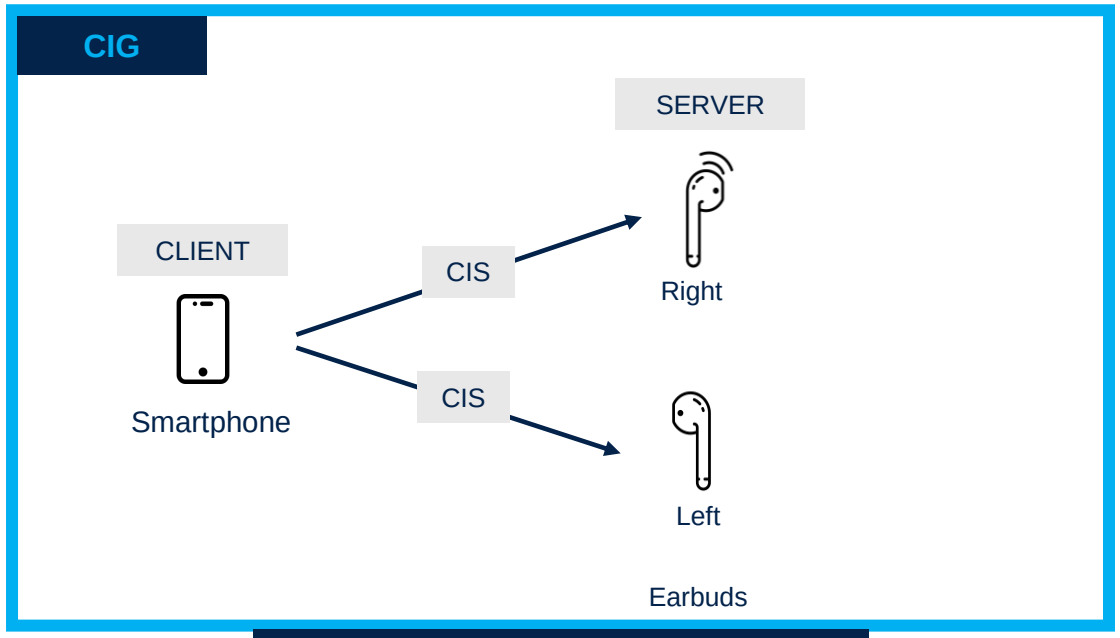
Headset

Hearing Aid

Headphone

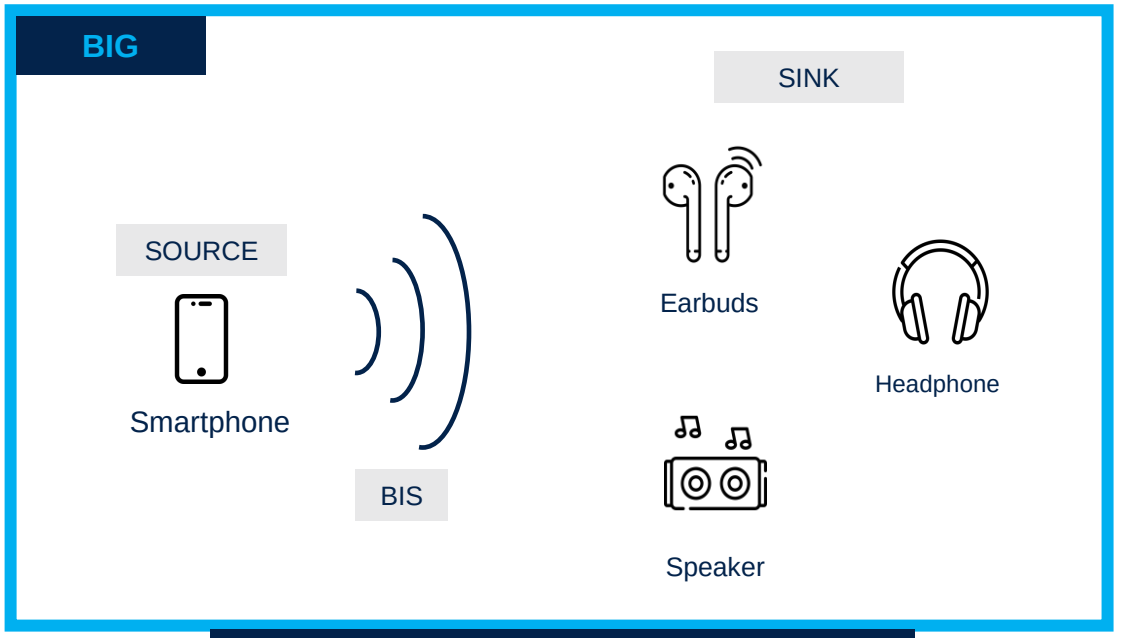
Unicast vs Broadcast roles Isochronous stream

Unicast



CIG : Connected Isochronous Stream

Broadcast



BIG : Broadcasted Isochronous Stream

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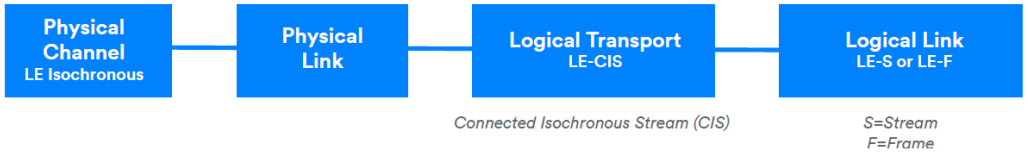
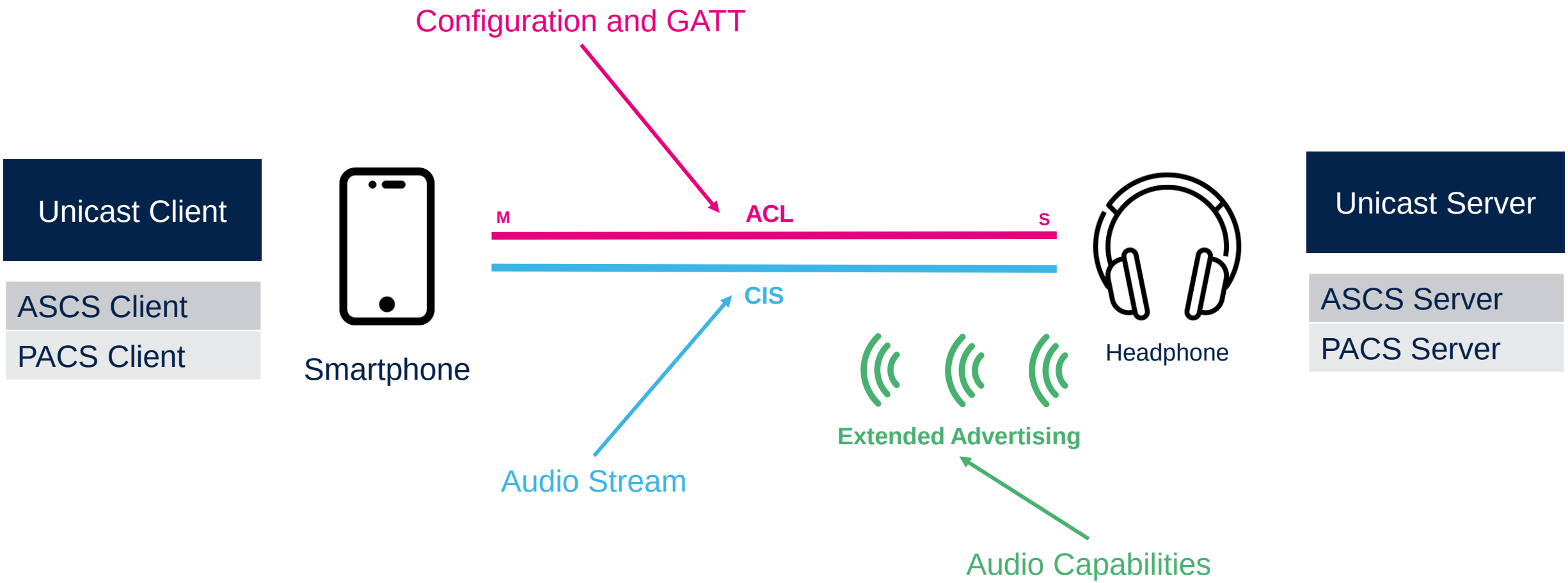


Example of Unicast use-case



ACL: Async Connection Logical layer
CIS: Connected Isochronous Stream
ASCS: Audio Stream Control **Service**
PACS: Published Audio Capabilities **Service**

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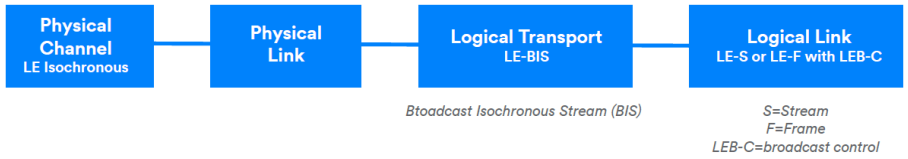

Example of Broadcast Use Case

Broadcast Source

Train station annoncements

BIS

Extended Advertising + Periodic Advertising

Audio Stream

BIS information and capabilities

Headphone

Broadcast Sink

Scan Delegator

PACS Server

BASS Client

S

ACL

M

Smartphone

Broadcast Assistant

BASS Server

Transfer of BIS information and capabilities

ACL: Async Connection Logical layer
CIS: Connected Isochronous Stream
BIS: Broadcast Isochronous Streams
PACS: Published Audio Capabilities **Service**

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Focus application domains

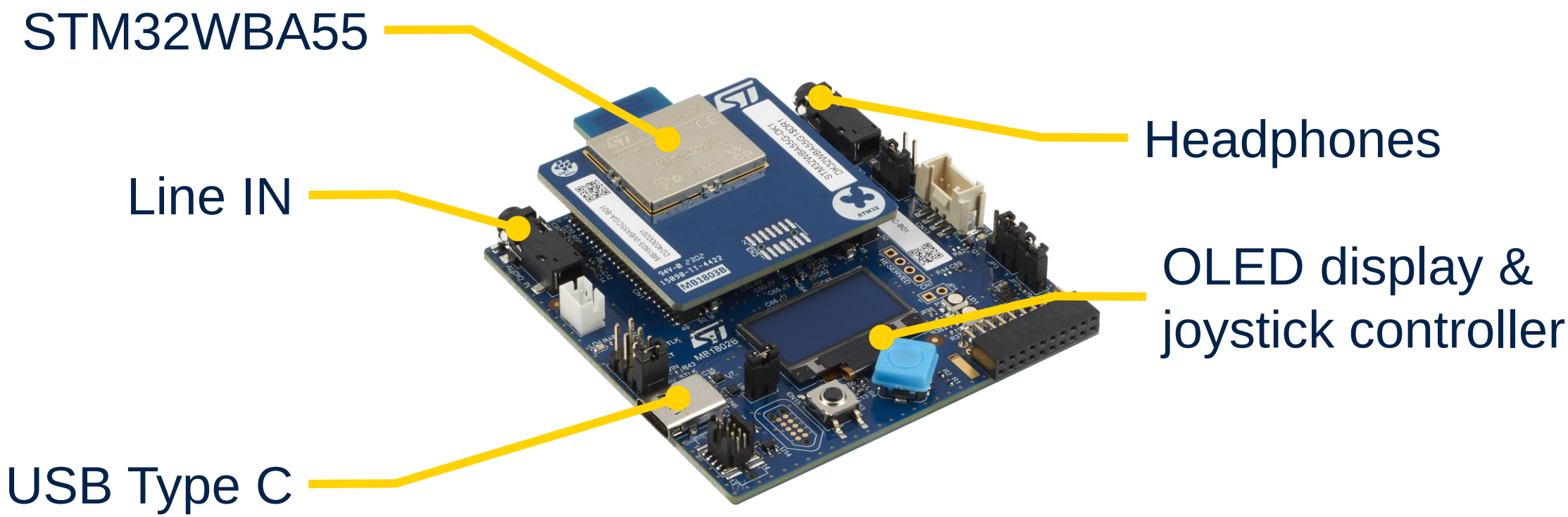
Audio sharing

Multi-stream

New LC3 Codec

Public broadcast

Discovery board for your Bluetooth® LE Audio applications



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Telephony & media unicast

TMAP
Unicast Client

Telephony: Bidirectional 32 KHz CIS
OR
Media: Unidirectional 48 KHz CIS

ACL
Volume Control
Call & Media Control

TMAP
Unicast Server

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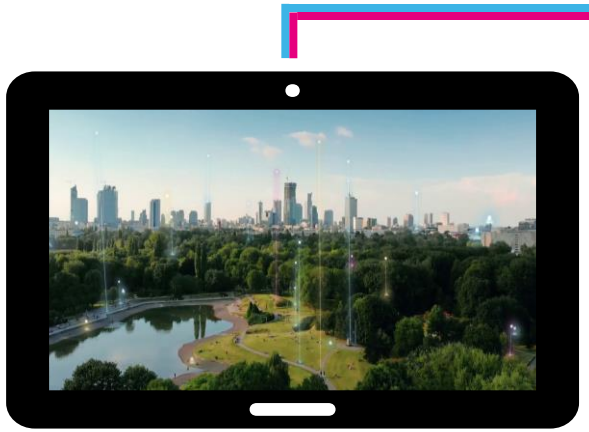
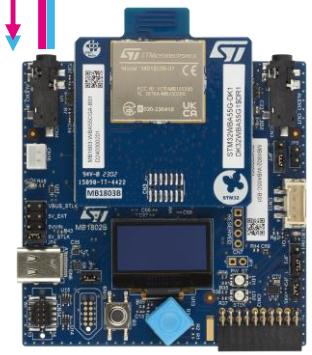
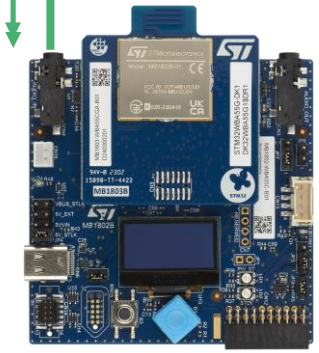
Auracast™

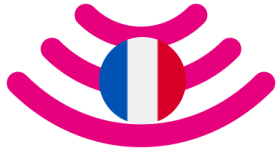




Public Broadcast Source



BIS #1
24 KHz Mono

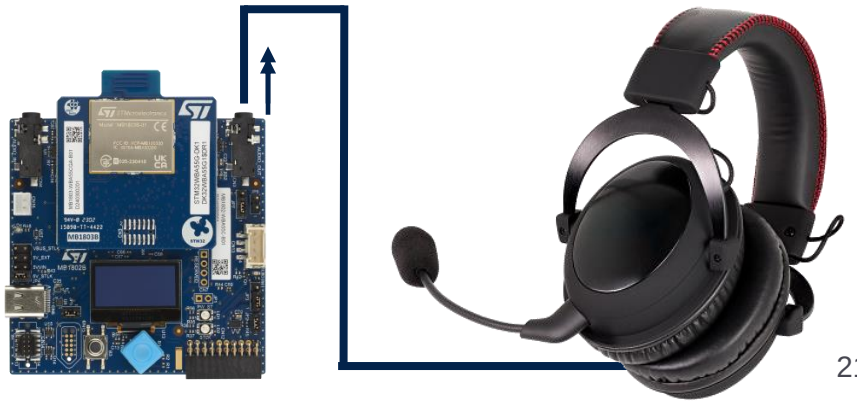


BIS #2
24 KHz Mono

BIS #1
48 KHz Stereo

AURACAST™

Public Broadcast Sink



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Earbud Unicast

TMAP
Unicast Client

CIS – Left 48KHz

ACL
Volume Control
Media & Call Control

CIS – Right 48KHz

ACL
Volume Control
Media & Call
Control

TMAP
Unicast Server
Coordinated Set Member #1

TMAP
Unicast Server
Coordinated Set Member #2

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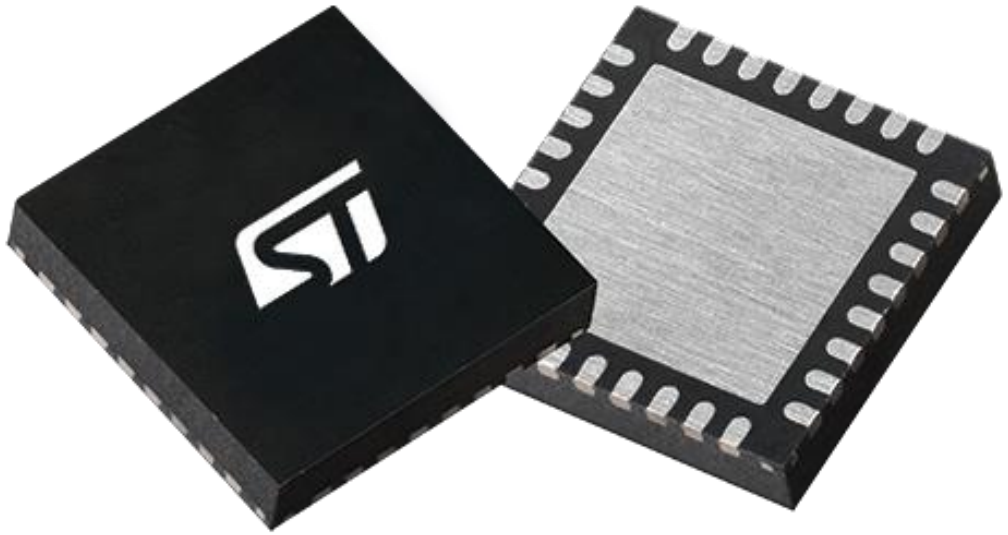
The most affordable solution for Bluetooth® LE Audio



STM32**WBA55**

Online resources

st.com/stm32wba

wiki.st.com
Category: BLE Audio

bluetooth.com/auracast

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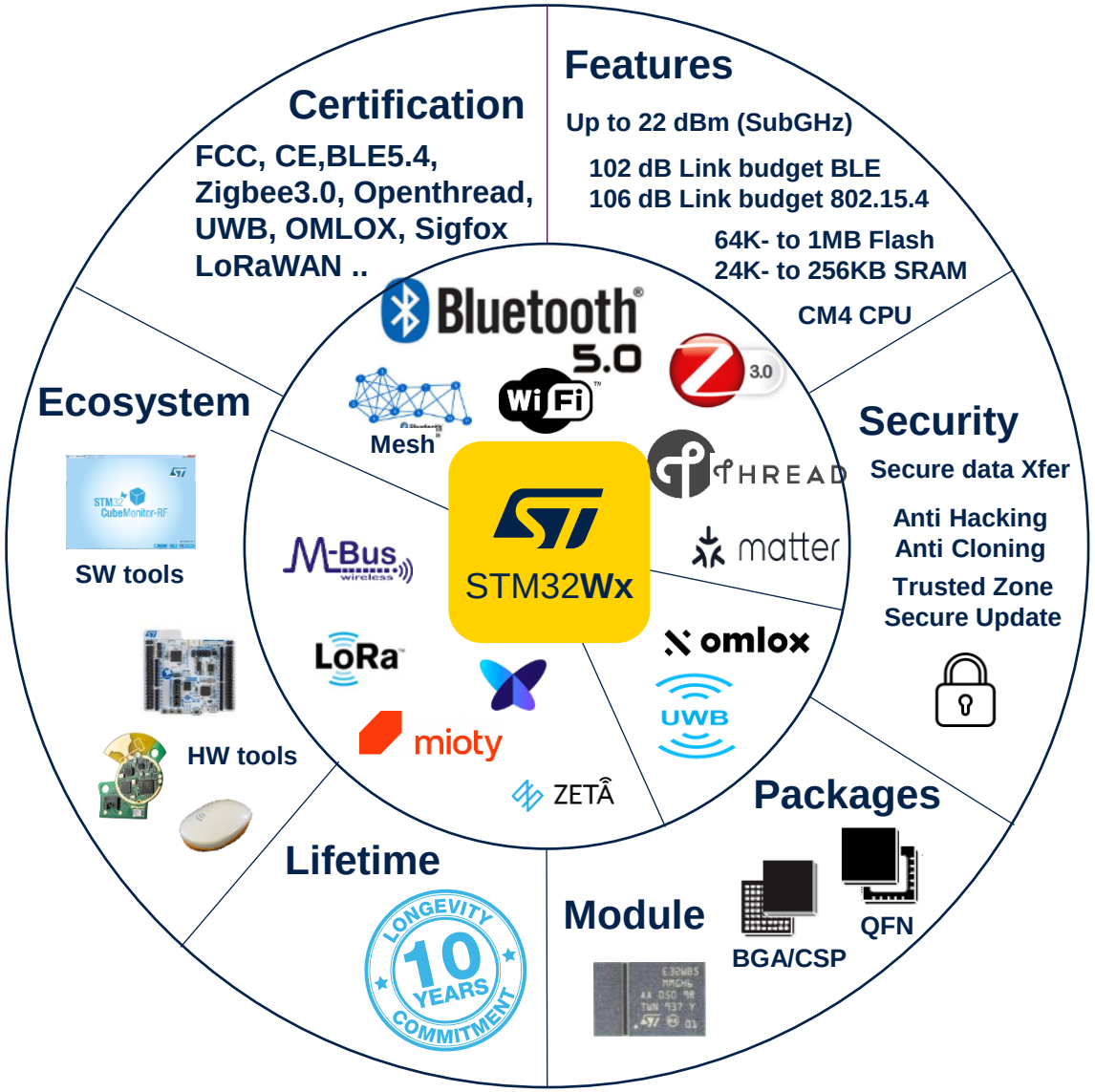
STM32Wx 向无线进击



STM32 本地化资源, 提供海量信息

ST 官网
www.ST.com

STM32 中文官网
www.STMCU.com.cn

STM32中文技术支持邮箱:
mpu.china@st.com
mcu.china@st.com

大学计划联络邮箱:
edu.china@st.com

技术培训报名网页:
www.stmcu.com.cn/training

ST 中文论坛
shequ.stmicroelectronics.cn

ST Community 全球论坛
https://community.st.com/s/

STM32 21ic论坛
http://www.21ic.com/stm32

STM32 MCUs Wiki 页面
wiki.st.com/stm32mcu

STM32 MPUs Wiki 页面
wiki.st.com/stm32mpu

STM32 GitHub页面:
github.com/STMicroelectronics

STM32微信订阅号

STM32视频号

STM32微信服务号

线上课程平台

bilibili **@STM32单片机**

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Our technology starts with You

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