# STM32 Voice Solutions

ST Voice Solutions Platform Overview

Advanced Audio Front End
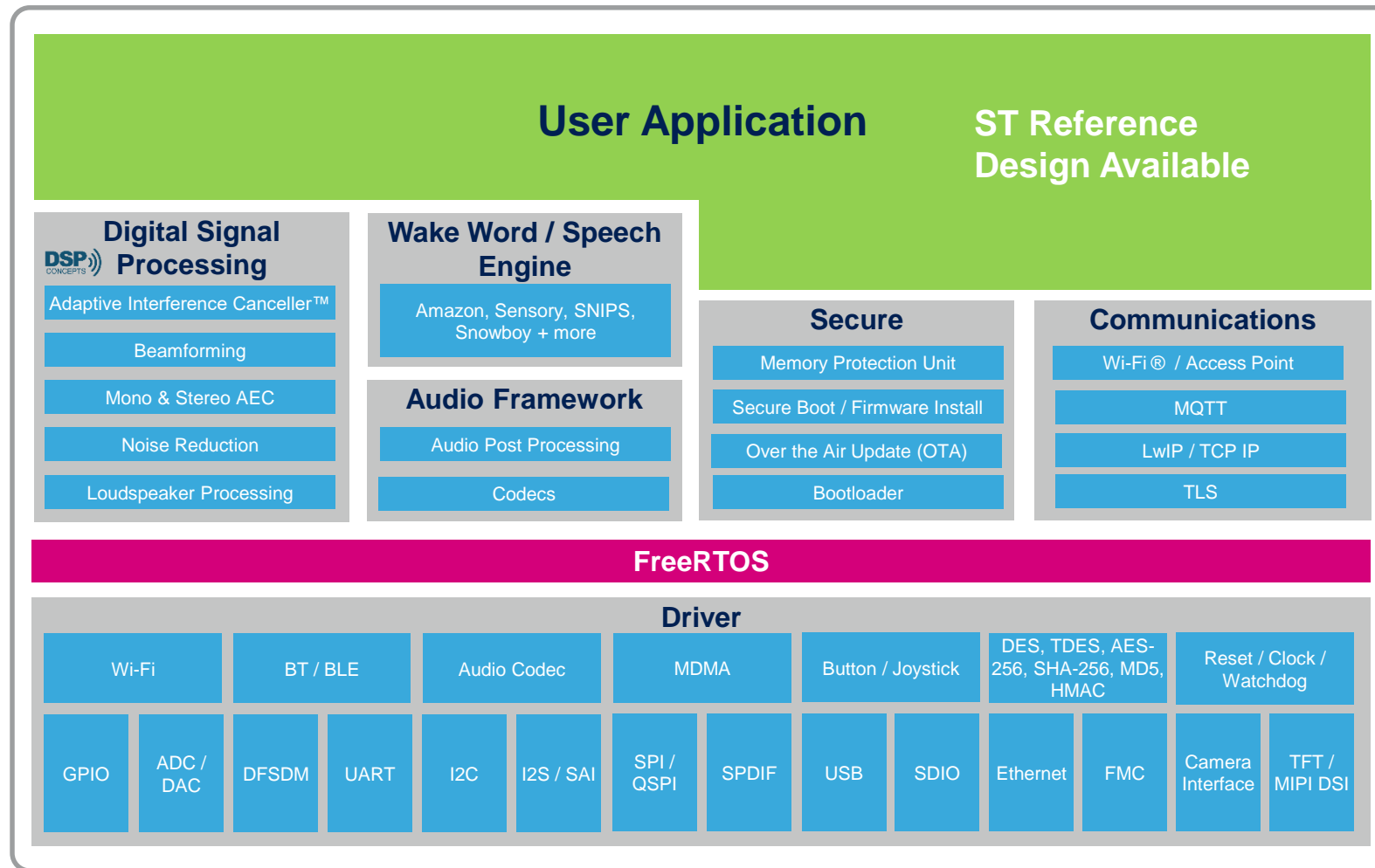
STM32H7 Demonstration

STM32MP1 Demonstration

STM32

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# ST Voice Solutions Platform Overview

## ST Voice Solutions Platform  - Software Overview

**User Application**

**ST Reference Design Available**

### Digital Signal Processing
DSP CONCEPTS

- Adaptive Interference Canceller™
- Beamforming
- Mono & Stereo AEC
- Noise Reduction
- Loudspeaker Processing

### Wake Word / Speech Engine

- Amazon, Sensory, SNIPS, Snowboy + more

### Audio Framework

- Audio Post Processing
- Codecs

### Secure

- Memory Protection Unit
- Secure Boot / Firmware Install
- Over the Air Update (OTA)
- Bootloader

### Communications

- Wi-Fi® / Access Point
- MQTT
- LwIP / TCP IP
- TLS

**FreeRTOS**

### Driver

| Wi-Fi | BT / BLE | Audio Codec | MDMA | Button / Joystick | DES, TDES, AES-256, SHA-256, MD5, HMAC | Reset / Clock / Watchdog |
|---|---|---|---|---|---|---|

| GPIO | ADC / DAC | DFSDM | UART | I2C | I2S / SAI | SPI / QSPI | SPDIF | USB | SDIO | Ethernet | FMC | Camera Interface | TFT / MIPI DSI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Platform designed to allow significant remaining systems resources for your application

Modular software components scale across many STM32 devices in full production

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# ST Voice Solutions Platform Overview

**Simple & Cost Optimized Solution**



MEMS Digital Microphones

Wi-Fi® Module

Audio Amp

Power

ST Addressable Content

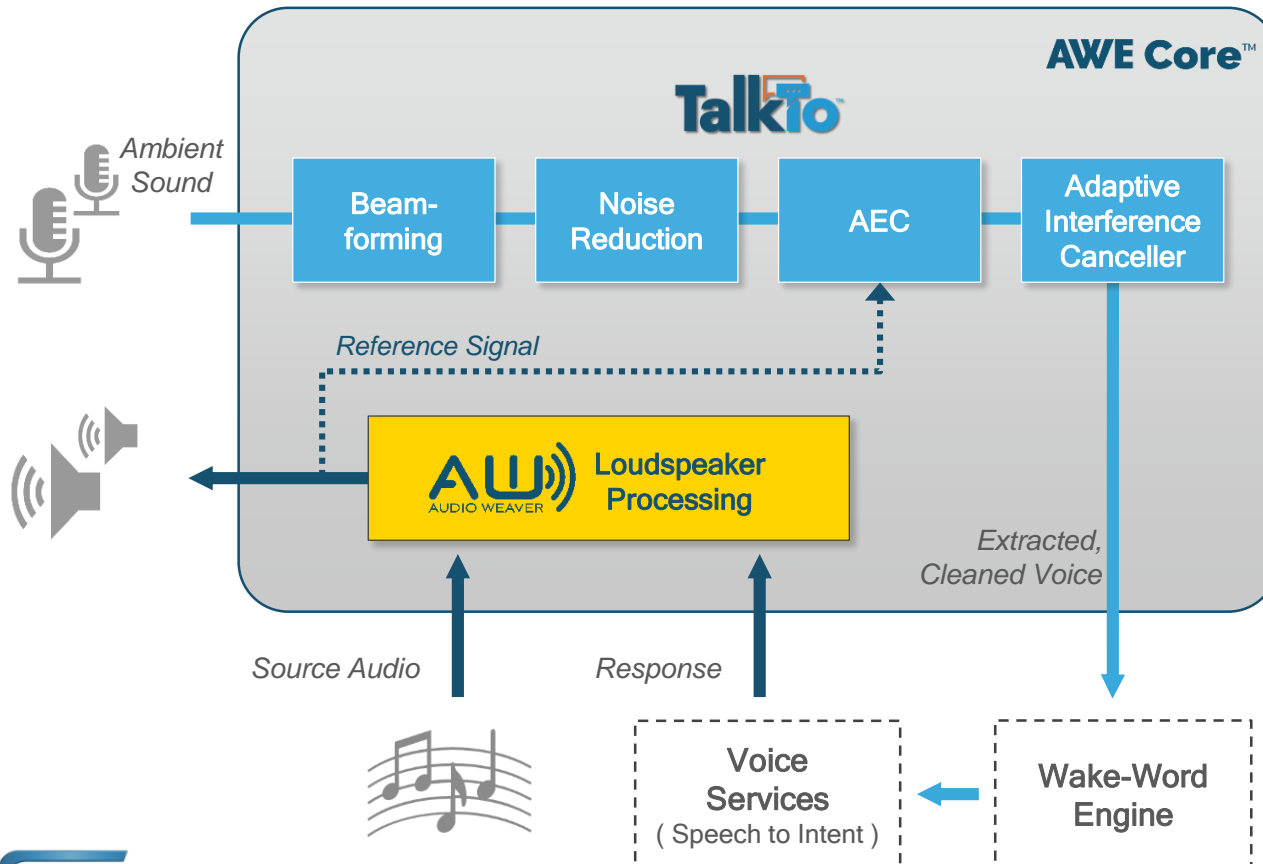**Runs in a single low cost STM32 without any external memories!**

# ST Voice Solutions Platform Overview
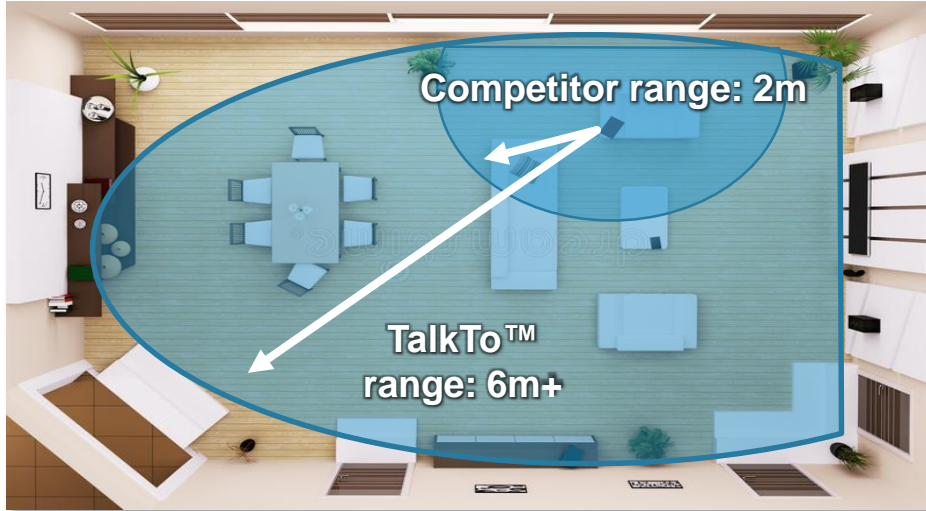
## ST Voice Services Platform Summary

- **Free** High performance Far-Field Audio-Front-End (AFE) for all STM32 devices in partnership with DSP Concepts

- **Free** Audio Weaver AFE tuning and audio post processing tools

- **Free** drivers, stacks including Wi-Fi® are provided by ST

- **Free** STM32 Configuration tools and IDE

- **Cost optimized** platform runs in a single cost effective STM32 microcontroller with no external memories required

- Amazon AVS for AWS IoT (AIA) certification in progress

- Extremely scalable solution supports connected (Amazon and Google) and pure embedded voice applications

- Scales to many STM32 Microcontroller and Microprocessor devices

- Reference SDKs available

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# Advanced Audio Front End

- High performance Far-Field Performance

- Multi microphone Beamforming

- Mono & Stereo *Acoustic Echo Cancellation* for reliable 'barge-in' at a distance

- *Adaptive Interference Canceller*™ provides noise immunity

- Wake-word & Ecosystem agnostic

- Integrated Playback Processing

- High Quality / Free tuning tools

- Reference Designs available

- AVS Certified

**Provided FREE of charge for all STM32 devices!**

# Advanced Audio Front End Tools



Competitor range: 2m

TalkTo™ range: 6m+

Every dB of noise-rejection expands the area where a high-quality Voice User Experience is available
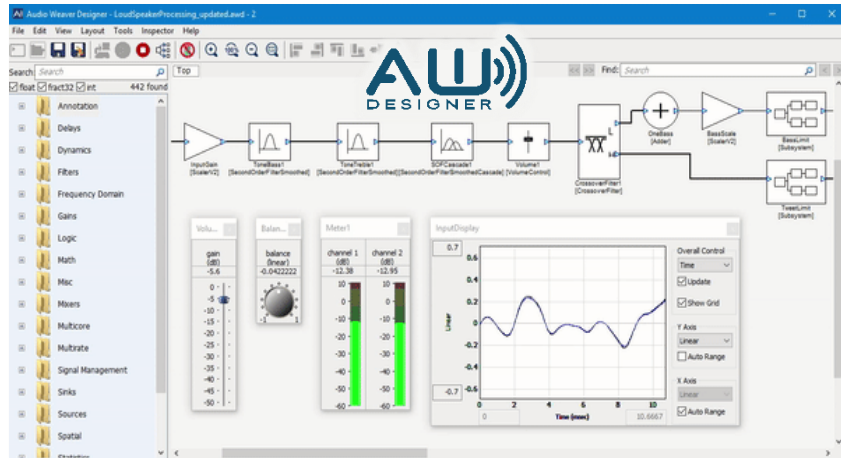


- **Four Premium AFE Designs for Audio Weaver ST**
  High-performance, two-mic AFEs with integrated playback processing

  - AVS for AWS IoT (AIA)
  - Near-Field for Wearables
  - Speakerphone / communications (single mic)
  - Point of Sale Kiosk

- **AWE Designer™ ST**
  Graphical Tool to customize & tune audio-processing models

- **AWE Core™ ST Voice**
  Embedded audio-processing engine for Cortex-M4 and M7

- **Voice-UI Quick-start Bundle**
  Get to market fast with need-to-know design guidelines and tools

# Audio Weaver Voice Module Pack

- **Acoustic Echo Canceler (AEC)**
  - Provides up to 30 dB of echo cancellation (performance varies per loudspeaker)
  - Supports Mono & Stereo reference signals
  - Adjustable echo tail allows the designer to balance memory usage and performance

- **Single Channel Noise Reduction (SCNR)**
  - Targets stationary noise like fans, road noise, and microphone self noise
  - Configurable level of noise reduction (≤15dB)
  - Operates in the frequency domain

- **Microphone Beamformer**
  - Supports up-to eight mics with custom geometry
  - GUI for array-design and performance analysis

- **Adaptive Interference Canceller™ (AIC)**
  - Uses machine learning techniques to identify and eliminate persistent noise sources
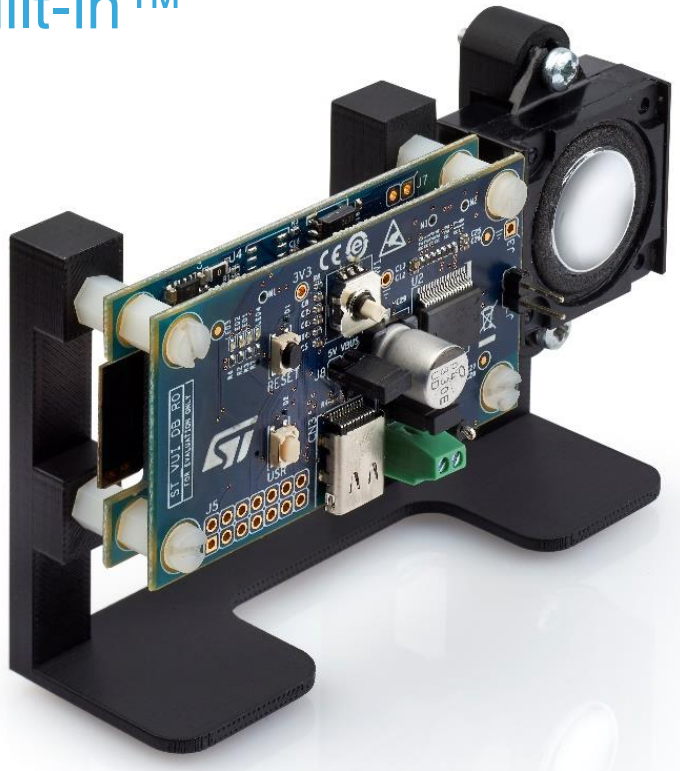  - 2-mic variant cancels up to 12 dB of noise

- **Quiescent Sound Detector (QSD)**
  - Activates when 'interesting sounds' are detected
  - Adjusts processing load for low-power operation

# STM32H7 SDK Demonstration

## Alexa Built-in™

- Application runs in a single low cost STM32H7 microcontroller with no external memories required

- Modular design allows users to change / expand audio inputs (mics), output stages, user input and IO

- Complete ST Reference Design SDKs

- Low cost two-layer PCBs (35mm x 65mm)

- Cost optimized BOM

- Amazon AVS for AWS IoT (AIA) certification in progress

# STM32H7 SDK Demonstration

# STM32H7 Series



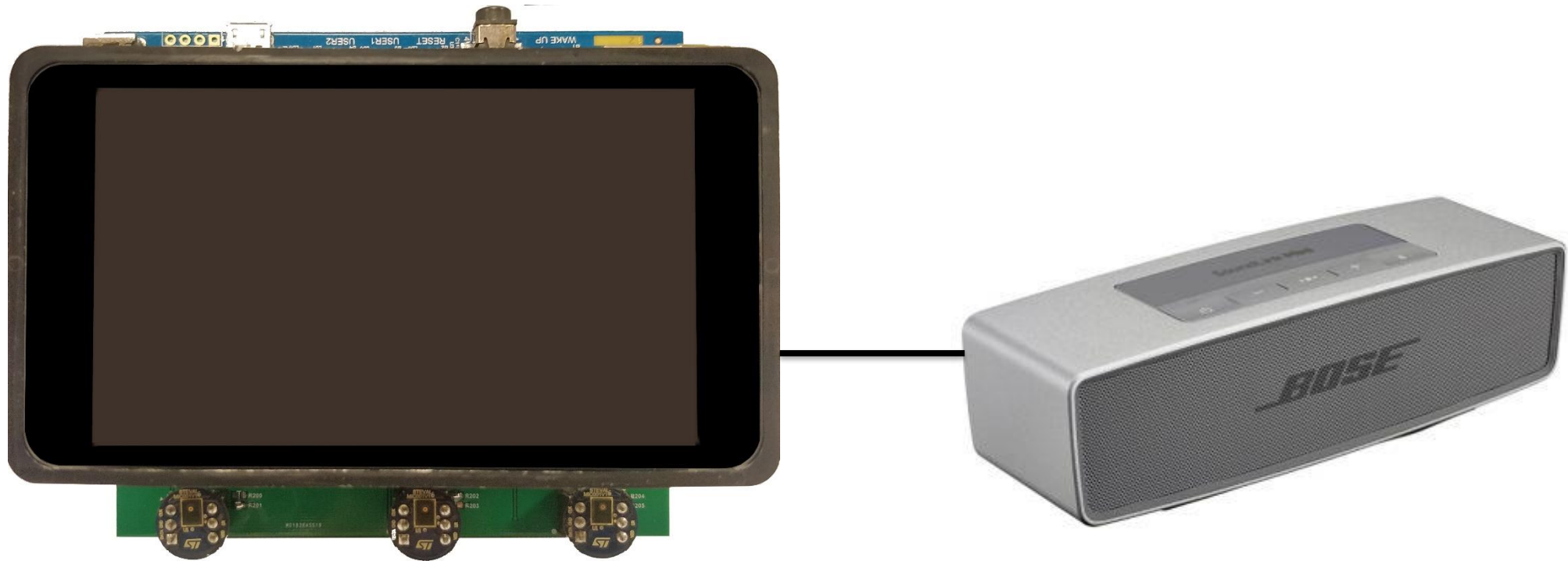| CORE, MEMORIES AND ACCELERATION | STM32 H7 Product line | F_cpu (MHz) | DB Flash (bytes) | RAM (bytes) | Graphic | Power supply | T° range |
|---|---|---|---|---|---|---|---|
| **Dual core lines** | | | | | | | |
| | STM32H7x7 | 480 + 240 | Up to 2MB | 1 MB (incl.128 K DTCM) + 64 K ITCM + 64 KB bckup1 + 4 K bckup2 | TFT-LCD JPEG codec MIPI-DSI | DCDC + LDO | Standard 85 °C |
| | STM32H7x5 | 480 + 240 | Up to 2MB | 1 MB (incl.128 K DTCM) + 64 K ITCM + 64 KB bckup1 + 4 K bckup2 | TFT-LCD JPEG codec | DCDC + LDO | Standard 85 °C (Opt. Industrial CPN 125 °C)⁵ |
| **Single core lines** | | | | | | | |
| | STM32H7x3 | 480 | Up to 2MB | 1 MB (incl.128 K DTCM) + 64 K ITCM + 64 KB bckup1 + 4 K bckup2 | TFT-LCD JPEG codec | LDO | Standard 85 °C |
| | STM32H742 | 480 | Up to 2MB | 692 K (incl.128 K DTCM) + 64 K ITCM + 16 KB bckup1 + 4 K bckup2 | no | LDO | Standard 85 °C |
| **Value line** | | | | | | | |
| | STM32H750 | 480 | 128K | 1 MB (incl.128 K DTCM) + 64 K ITCM + 64 KB bckup1 + 4 K bckup2 | TFT-LCD JPEG codec | LDO | Standard 85 °C |

**Arm® Cortex®-M7 – 480 MHz**

**CORE, MEMORIES AND ACCELERATION**
- Single core Cortex-M7 480 MHz
- Dual core Cortex-M7 480 MHz and Cortex-M4 240 MHz (STM32H7x5 and STM32H7x7 only)
- Flash an RAM acceleration
- SP-FPU and DP-FPU
- 4 x DMA

**CONNECTIVITY**
- 2 x USB2.0 OTG FS/HS
- 2 x SDMMC
- USART, UART, SPI, I²C
- 2 x CAN (1 x FD and 1 x TT)
- HDMI-CEC
- FMC, Dual Q-SPI
- Ethernet MAC IEEE1588
- Camera I/F
- Analog (comp, AOP)

**AUDIO**
- 3 x I²S + audio PLL
- 4 x SAI
- 2 x 12-bit DAC
- SPDIF-RX

**GRAPHIC**
- Chrom-ART Accelerator™

**OTHER**
- Crypto/Hash (except H742)¹
- Security services (except H742)²
- TRNG
- DFSDM
- 16- and 32-bit timers
- 3 x 16-bit ADC (up to 3.6 Msps)
- Voltage range 1.62 to 3.6 V (except 100-pin package : 1.71 to 3.6 V)
- Multi-power domains

## Tailored for Your Needs

- 40nm Embedded Flash Process
- Single and Dual core versions
- High performance up to 480MHz
- 2MB Flash Dual Bank with ECC
- 1MB RAM with ECC
- More security features (Boot, Tamper …) and security services (optional)
- 35 communication peripherals
- New generation of peripherals including fast 16-bit ADC up to 3.6Msps, up to 5MSPS in 12-bit, Comparators, Op Amp
- New connectivity (TT-CAN and FD-CAN)
- High-Resolution timer (2.1ns)
- Several Low-Power Timers
- SMPS on Dual core variants
- Up to 140C junction temperature (optional, avail Q4-2019)
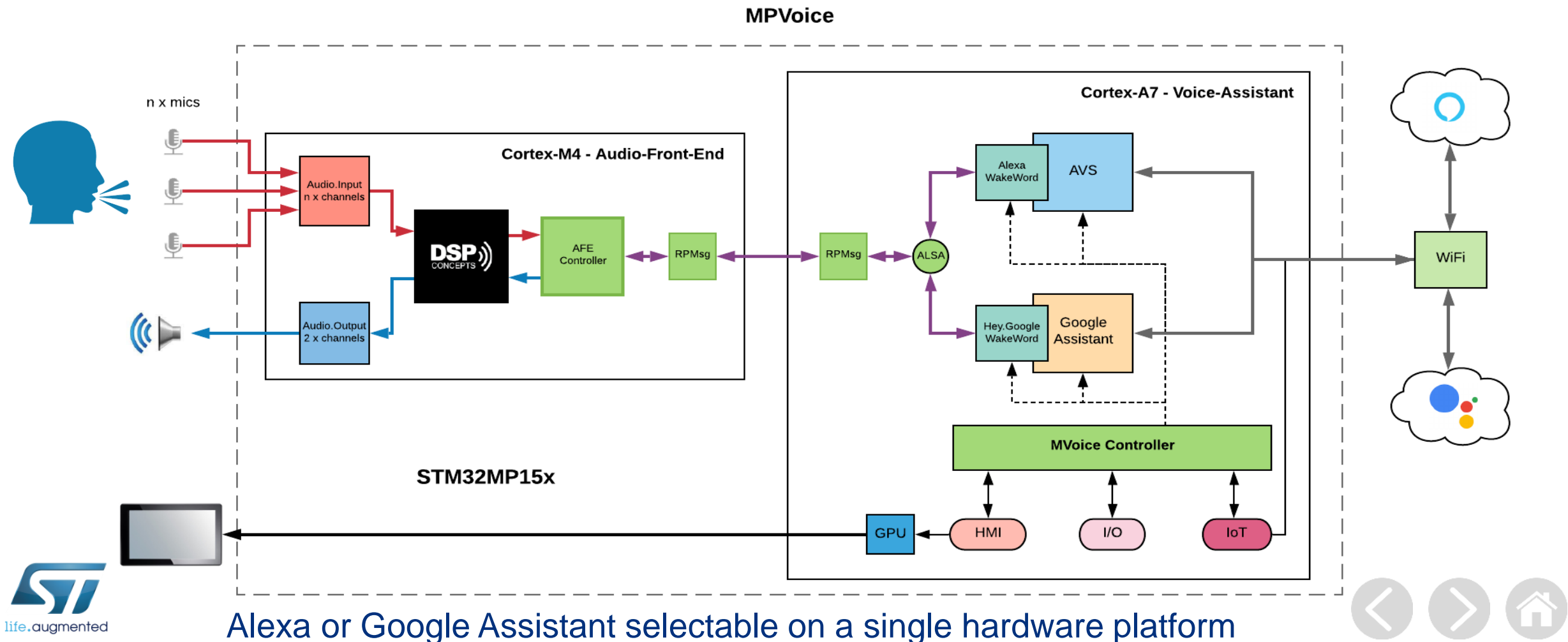
# High Performance STM32MP1 Demonstration

Standard STM32MP157C-DK2 interfaced to a custom microphone board

# High Performance STM32MP1 Demonstration

Alexa or Google Assistant selectable on a single hardware platform

# STM32MP1 Series



**Tailored for Multiple Applications**

24 Sales Type in Production Now

## STM32MP15x

### System

- 5x LDOs
- Crystal & Internal oscillators
- MDMA + 2x DMA
- Reset and Clock
- Watchdogs (2x I & W)
- 96-bit unique ID
- Up to 176 GPIOs

### Security

- TrustZone
- DES, TDES, AES-256
- SHA-256, MD5, HMAC
- 3x Tamper Pins with 1 active
- T°, V and 32KHz detection
- Secure ROM and RAMs
- Secure Peripherals
- Secure RTC
- Analog true RNG

### Dual Cortex-A7 @ 800MHz

| Core 1 @ 800MHz L1 32KB I / 32KB D | Core 2 @ 800MHz L1 32KB I / 32KB D |
| --- | --- |
| NEON SIMD | NEON SIMD |

256KB L2 cache

### Cortex-M4 @ 209MHz

| FPU | MPU |
| --- | --- |

### DDR3/DDR3L 32-bit @ 533MHz
### LPDDR2/LPDDR3 32-bit @ 533MHz

| System RAM 256KB | MCU System RAM 384KB |
| --- | --- |
| Retention RAM 64KB | Backup RAM 4KB |
| Boot ROM 128KB | OTP Fuse 3Kb |

### Control

- 2x 16-bit motor control PWM synchronized AC timer
- 10x 16-bit timer
- 5x 16-bit LP timer
- 2x 32-bit timer

### 3D GPU OpenGL ES2.0 @ 533MHz

26Mtri/sec, 133Mpix/sec

### Connectivity

| 24-bit Parallel RGB Display | MIPI DSI 2 lanes @ 1Gbps |
| --- | --- |
| Camera Interface | HDMI CEC |
| 1Gbps Ethernet | 2x CAN FD / TTCAN |
| 2x USB2.0 Host HS | USB2.0 OTG FS/HS |
| MDIO | DFSDM 8 channels / 6 filters |
| 6x I²C | 4x UART, 4x USART |
| 6x SPI / 3x I²S | 4x SAI |
| SPDIF Tx / Rx 4 inputs | Dual Quad SPI |
| 3x SDIO3.0 / SD3 / eMMC 4.51 | 16-bit SLC NAND, 8-bit-ECC |

### Analog

- 2x 16-bit ADC
- 2x 12-bit DAC
- Temperature sensor