

Introduction for i.MXRT Series and Turnkey Solutions for IOT

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Sr. Staff Field Application Engineer

Customer Application Solution & Support



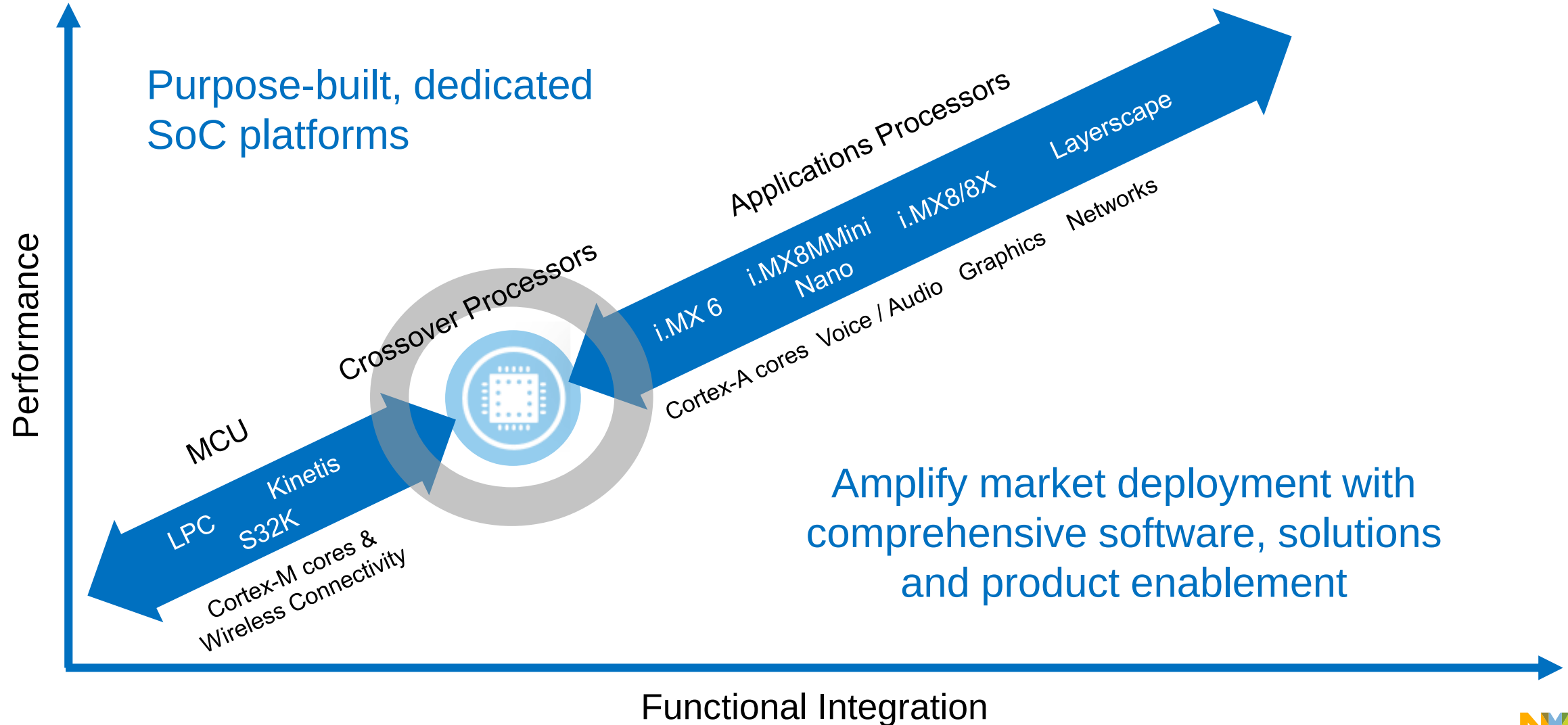
SECURE CONNECTIONS
FOR A SMARTER WORLD

AGENDA

1. NXP Leadership
2. NXP Crossover MCU i.MXRT
3. Ease-of-use & Product Enablement
4. Voice Assistants CLOUD VS. LOCAL
5. Face Recognition
6. IoT Solutions Summary

NXP'S SCALABLE EDGE COMPUTING CONTINUUM

MARKET NEED FOR DIFFERENTIATED PLATFORMS TO ADDRESS BROAD RANGE OF REQUIREMENTS



i.MX

APPLICATIONS PROCESSORS

- Arm® Cortex®-A class and Cortex-M cores
- 600 MHz to 2 GHz performance
- Rich HMI experience
- Full open-source OS platforms



APPLICATIONS PROCESSOR

PERFORMANCE + INTEGRATION



CROSSOVER
PROCESSORS

EASE OF USE + REAL TIME

MICROCONTROLLER

- Arm® Cortex®- M cores
- Performance up to 300 MHz
- Embedded memory
- Easy to use tools
- RTOS support



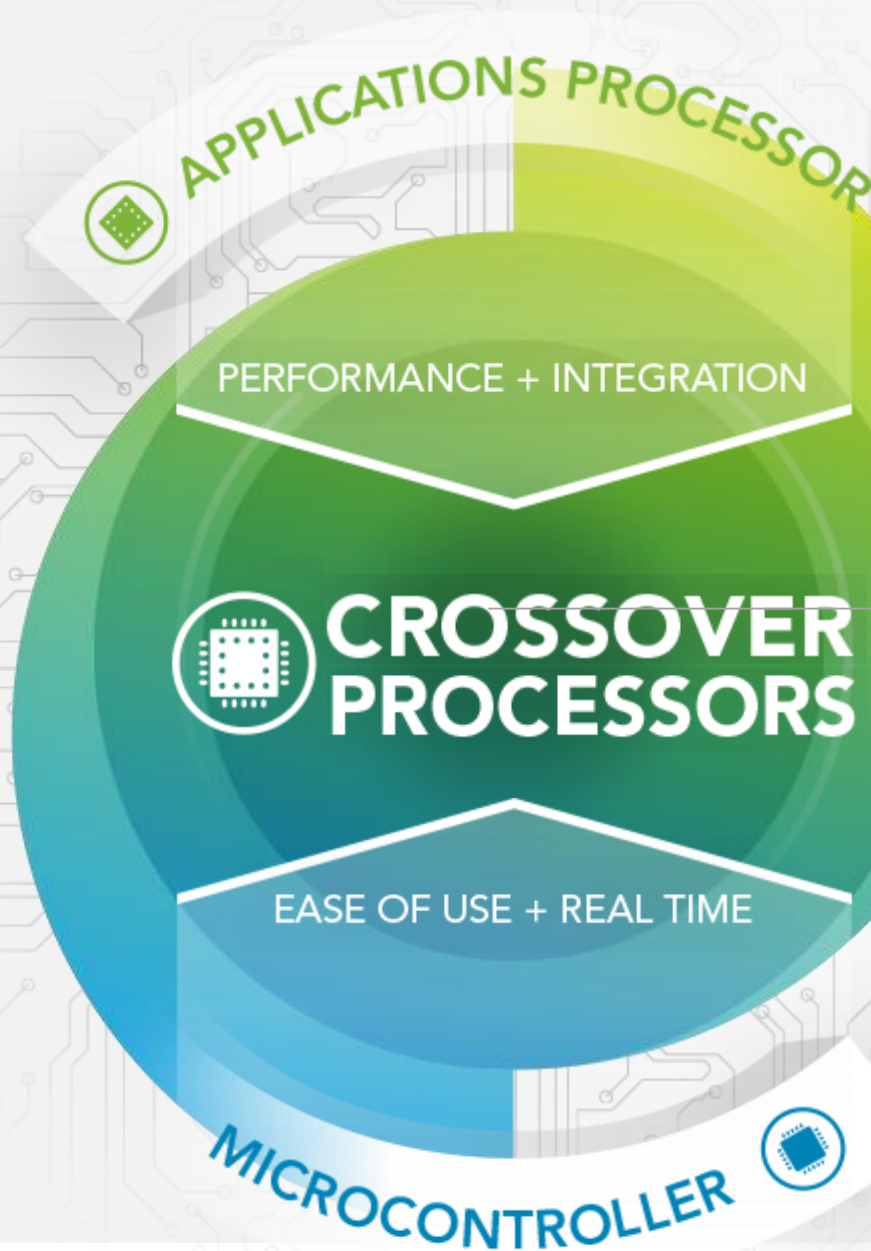
MCUXpresso

RTOS

KINETIS & LPC
MCUs



Best Of Both Worlds



i.MX RT CROSSOVER MCUs

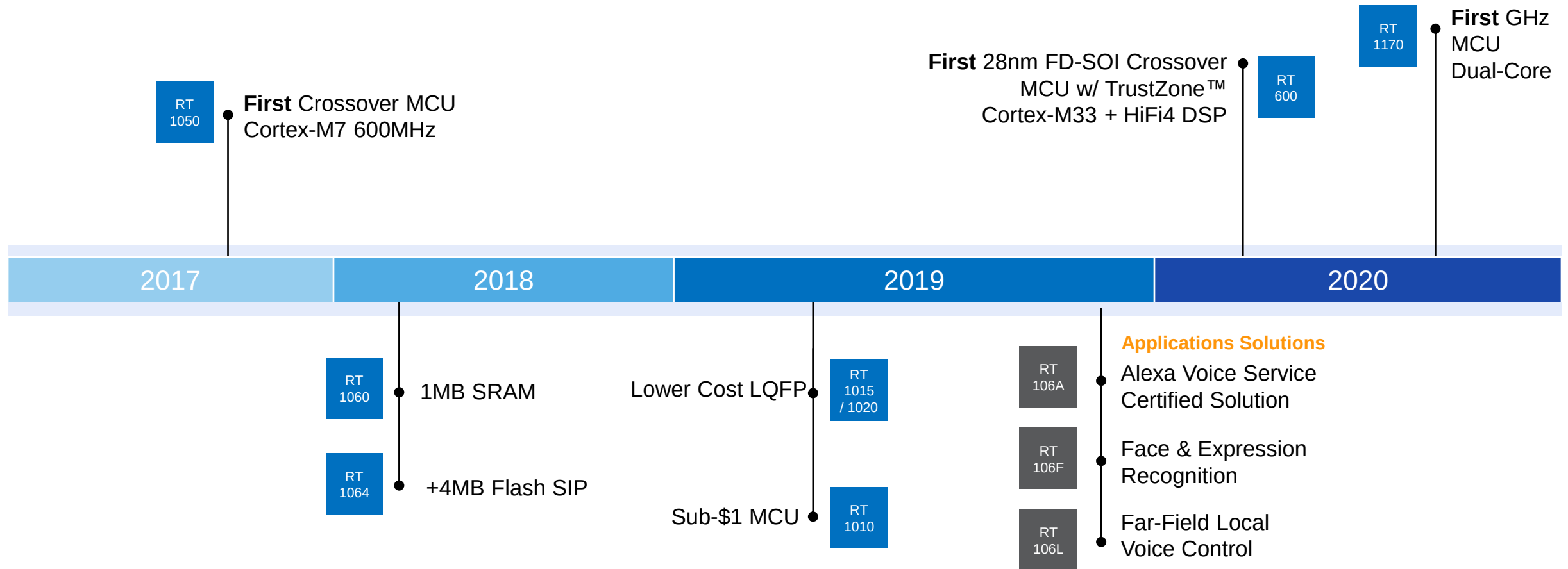
- Arm® Cortex® -M cores
- Up to 1 GHz performance
- High integration
- Deterministic instructions
- Short latency
- Easy to use tools
- RTOS support



MCUXpresso

RTOS

i.MX RT CROSSOVER MCUS – A HISTORY OF “FIRSTS”



i.MX RT SERIES KEY HIGHLIGHTS



High Performance Real-time Processing

- Cortex-M7 up to 1GHz (RT11xx)
(50% faster than current existing M7 products)
- Cortex-M33 up to 275MHz with Trust Zone (RT6xx/5xx)
- Up to 600MHz DSP and other co-processor accelerators (RT6xx/5xx)
- Up to 5MB On Chip SRAM



High Level of Integration

- High Security enabled by AES-256, HAB and On-the-fly QSPI Flash Decryption
- 2D graphics acceleration engine with Parallel & MIPI DSI/CSI
- LCD display controller up to WXGA (1366x768)
- Digital microphone and I2S interfaces for multichannel, high performance audio and voice
- Up to 3x Ethernet and 3x CANFD



Low BOM Cost

- Competitive Pricing
- Fully integrated PMIC with DC-DC
- Low cost packages enabling 4 layer (BGA) & 2 layer (LQFP) PCB design
- Quad/Octal Serial and SDRAM interface



Easy to Use

- MCU customers can leveraging their current toolchain (MCUXpresso, IAR, Keil)
- Rapid and easy prototyping and development with NXP FreeRTOS, SDK, ARM mbed and the global ARM ecosystem
- Single voltage input simplifies power circuit design
- Scalability to LPC, Kinetis & i.MX products

i.MX RT SERIES TARGET APPLICATIONS

Voice & Audio

High-end, consumer audio devices, including specialty equipment such as:

- Home Audio
- Professional microphone
- Guitar pedals
- Audio Tuners



Consumer & Healthcare

- Wearables
- Smart appliances
- Cameras & LCDs
- Mobile patient care, e.g. infusion pump or respirator
- Blood pressure monitor
- Activity & wellness monitor
- Exercise equipment with display



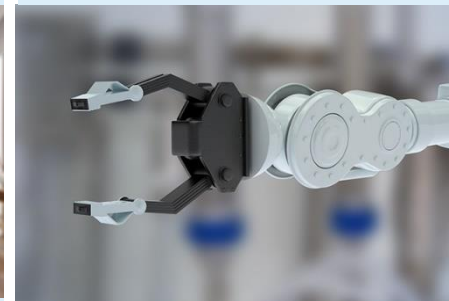
Home & Building Automation

- HVAC climate control
- Security
- Lighting control panels
- IoT gateways
- Smoke Detectors
- Thermostats



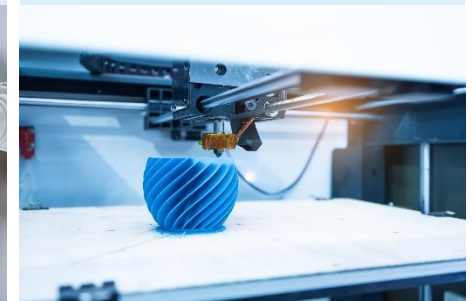
Industrial Computing

- EBS
- PLCs
- Factory automation
- Test and measurement
- HMI control assembly line robotics
- QR Readers
- Barcode Scanners

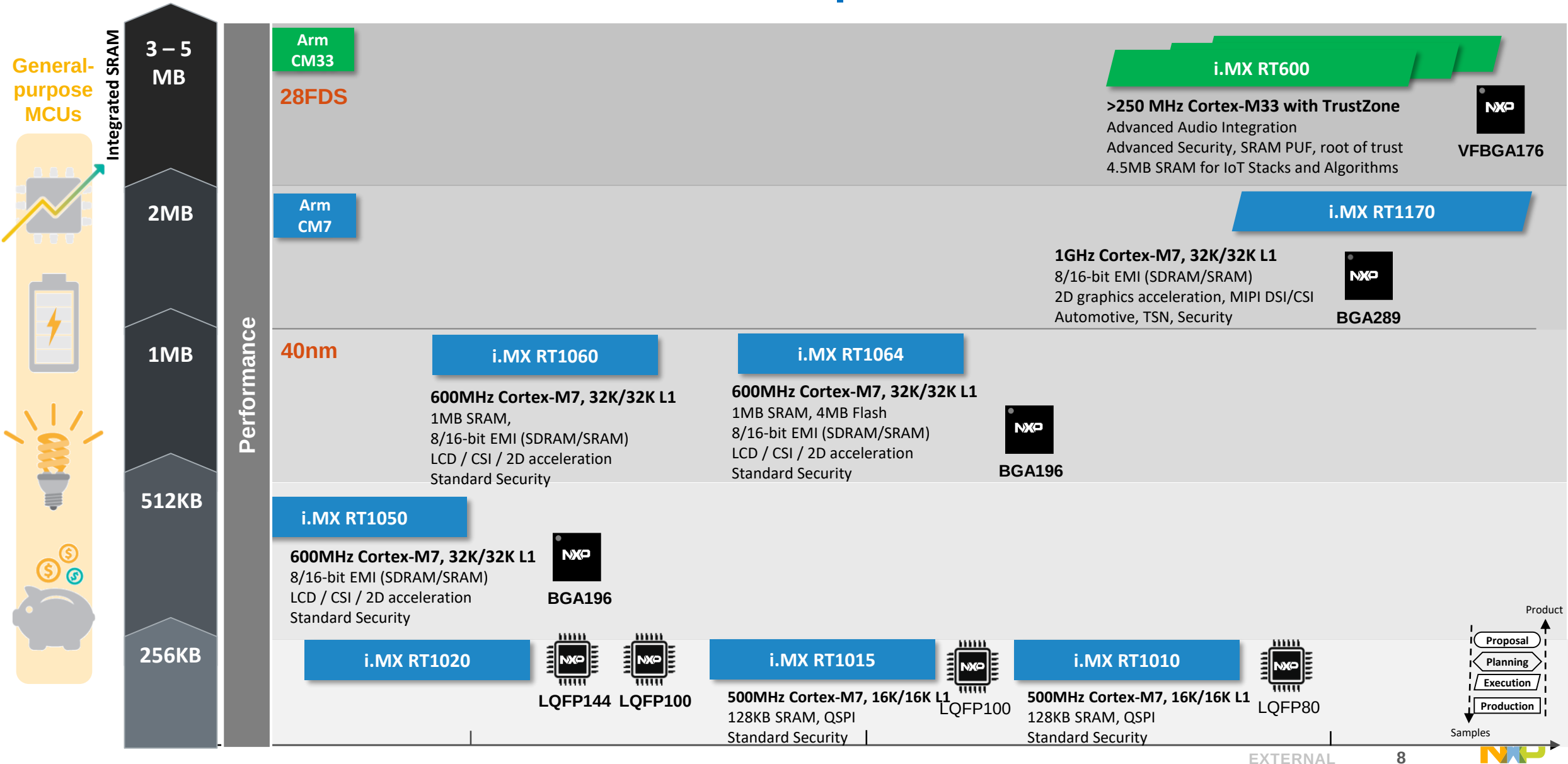


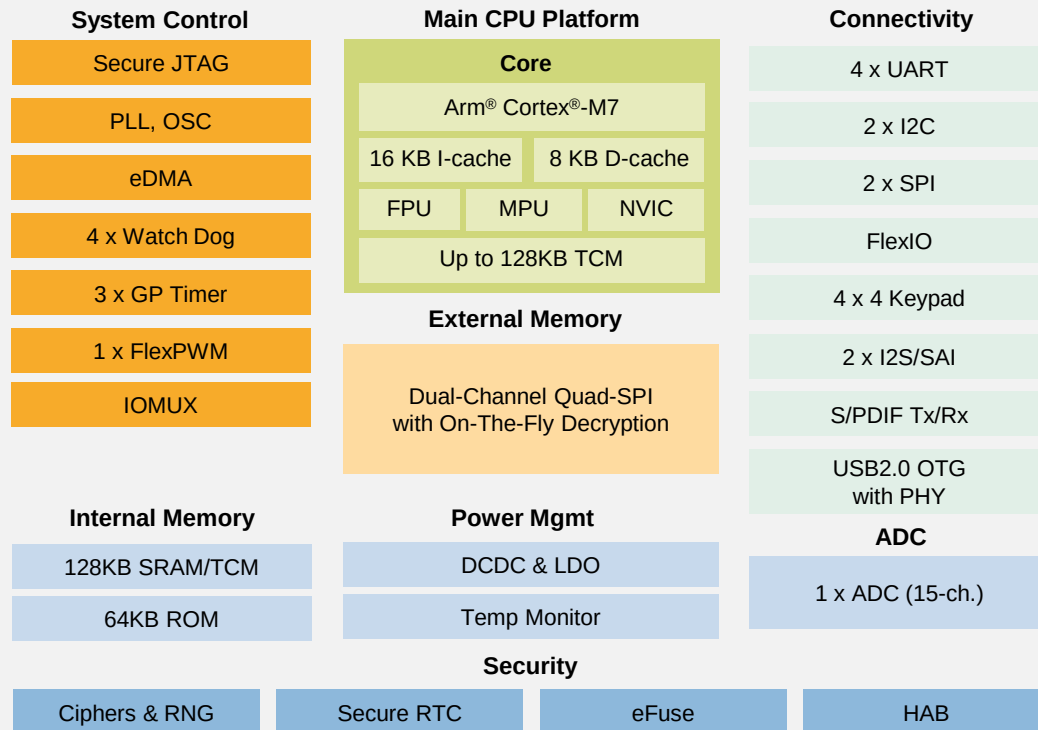
Motor Control & Power Conversion

- 3D printers
- Thermal printers
- Unmanned autonomous vehicles
- Robotic vacuum cleaners
- Drones



i.MX SERIES MCU PORTFOLIO | HIGH PERFORMANCE





NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE i.MX RT1010: BLOCK DIAGRAM

High Performance and Integration

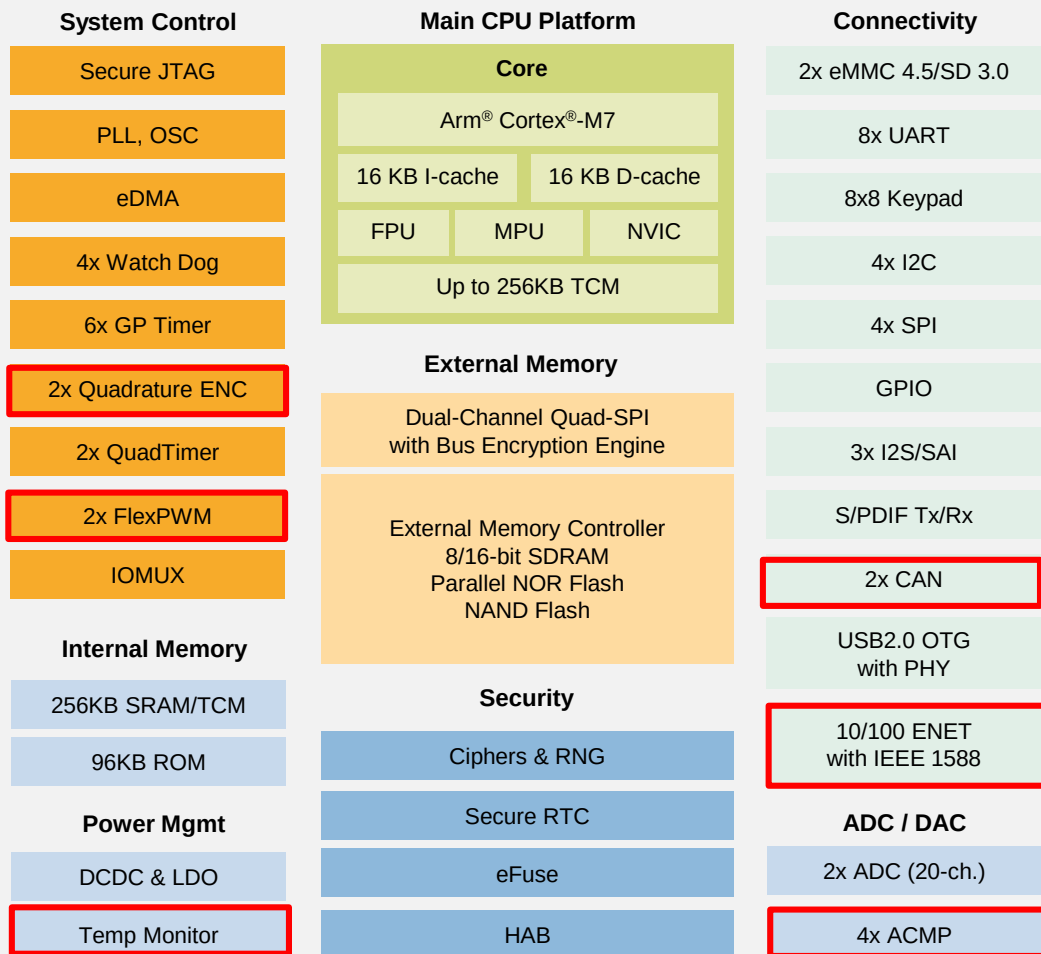
- Cortex-M7 up to 500MHz with 16KB/8KB I/D cache
- High Speed USB with PHY
- Security (On-The-Fly FlexSPI decryption)
- Rich Audio features

Low cost and easy to develop

- LQFP Packages enable low cost 2-layer PCB design
- Integrated power management module reduces complexity of external power supply
- FreeRTOS with SDK
- MCUXpresso / Keil / IAR

Specifications

- Package: 80LQFP, 12x12, 0.5p
- Temp / Qual: -40 to 105°C (Tj) Industrial
0 to 95°C (Tj) Consumer



NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE i.MX RT1020: BLOCK DIAGRAM

High Performance and Integration

- Cortex-M7 up to 500MHz with 16KB/16KB I/D cache
- High Speed USB with PHY
- Multi PWM for dual motor control
- Security (On-The-Fly FlexSPI decryption)
- Rich Audio features

Security

- TRNG&PRNG(NIST SP 800-90 Certified)
- 128-AES cryptography
- Bus Encryption Engine: Protect QSPI Flash Content

Specifications

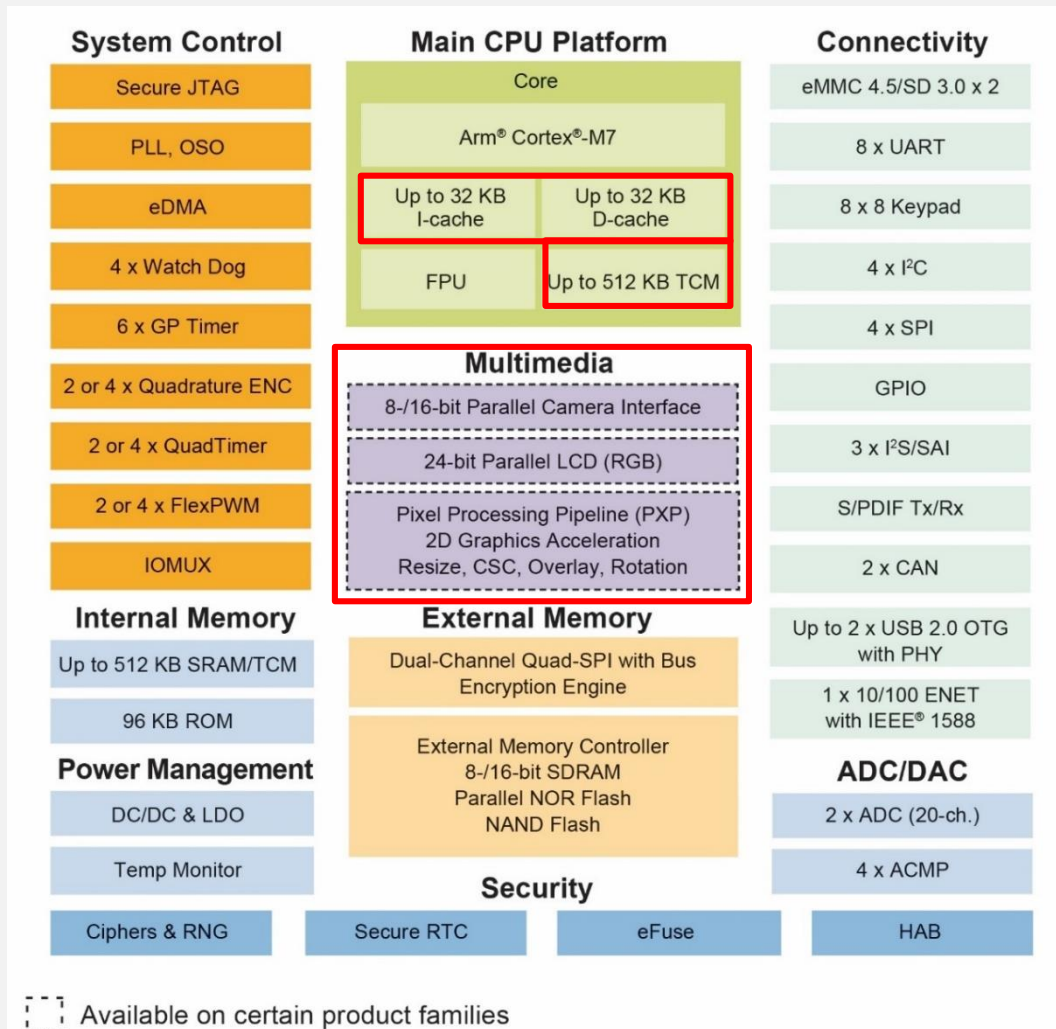
- Package: 144LQFP, 10x10, 0.5p
100LQFP, 14x14, 0.5p
- Temp / Qual: -40 to 105°C (Tj) Industrial
0 to 95°C (Tj) Consumer

Low cost and easy to develop

- LQFP Packages enable low cost 2-layer PCB design
- Integrated power management module reduces complexity of external power supply
- FreeRTOS with SDK
- MCUXpresso / Keil / IAR

NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE

i.MX RT1050: BLOCK DIAGRAM



High Performance Real Time system

- Cortex-M7 up to 600MHz , 50% faster than any other existing M7 products
- 20ns interrupt latency, a TRUE Real time processor
- 512KB SRAM, configurable to 512KB TCM

Rich Peripheral

- Motor Control: Flex PWM X 4, Quad Timer X 4, ENC X 4
- 2x USB, 2x SDIO, 2x CAN, 1x ENET with 1588, 8xUART, 4x SPI, 4x I2C
- 8/16-bit CSI interface and 8/16/24-bit LCD interface
- Quad-SPI interface, with Bus Encryption Engine
- Audio interface: 3x SAI/ SPDIF RX & TX/ 1x ESAI

Security

- TRNG&PRNG(NIST SP 800-90 Certified)
- 128-AES cryptography
- Bus Encryption Engine: Protect QSPI Flash Content

Specifications

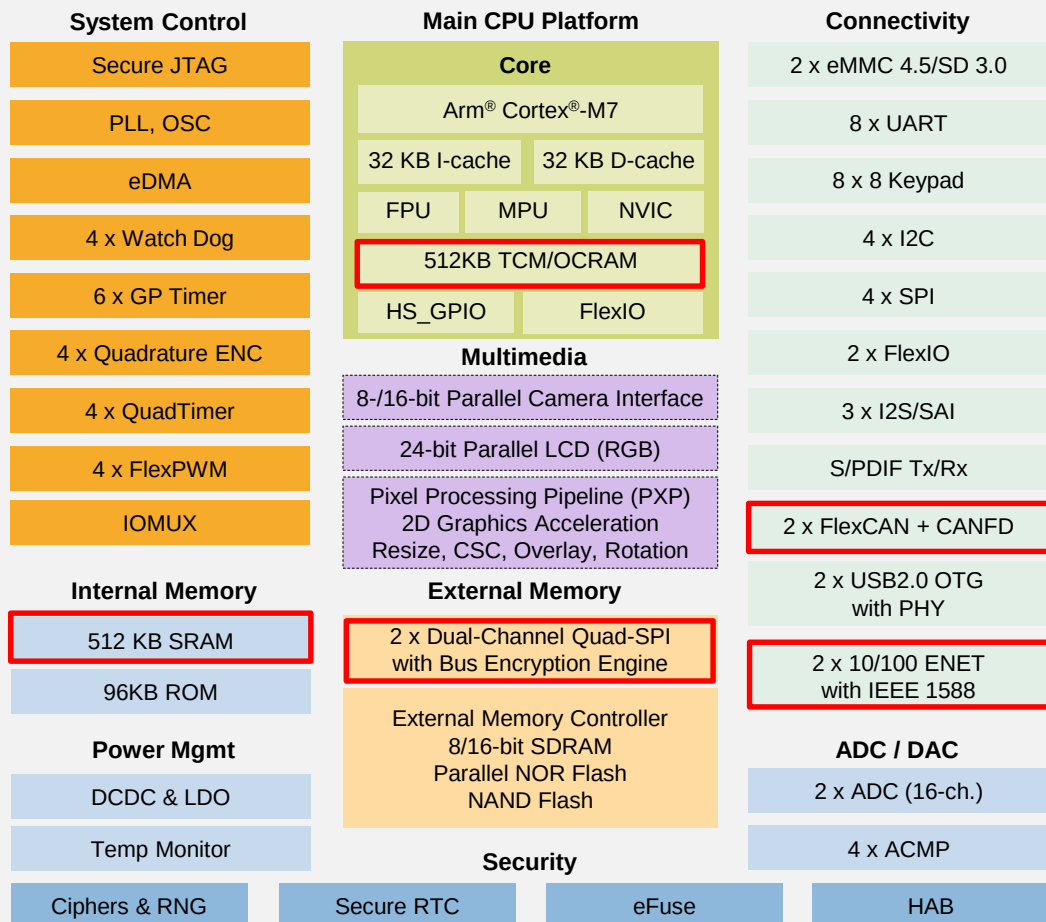
- Package: MAPBGA196 | 10x10mm², 0.65mm pitch (130 GPIOs)
MAPBGA196 | 12x12mm², 0.8mm pitch
- Temp / Qual: -40 to 105°C (Tj) Industrial / 0 to 95°C (Tj) Consumer

Ease of Use

- FreeRTOS with SDK, IAR, Keil
- MCUXpresso
- Comprehensive ecosystem

Low BOM Cost

- Fully integrated PMIC with DC-DC
- QSPI and SDRAM interface



 Available on certain product families

NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE i.MX RT1060: BLOCK DIAGRAM

High Performance Real Time system

- Cortex-M7 up to 600MHz , 50% faster than any other existing M7 products
- 20ns interrupt latency, a TRUE Real time processor
- 512KB SRAM + 512KB TCM/OCRAM

Rich Peripheral

- Motor Control: Flex PWM X 4, Quad Timer X 4, ENC X 4
- 2x USB, 2x SDIO, 2x CAN + 1x CANFD, 2x ENET with 1588, 8xUART, 4x SPI, 4x I2C
- 8/16-bit CSI interface and 8/16/24-bit LCD interface
- 2x Qual-SPI interface, with Bus Encryption Engine
- Audio interface: 3x SAI/ SPDIF RX & TX/ 1x ESAI

Security

- TRNG&PRNG(NIST SP 800-90 Certified)
- 128-AES cryptography
- Bus Encryption Engine: Protect QSPI Flash Content

Specifications

- Package: MAPBGA196 | 10x10mm², 0.65mm pitch (130 GPIOs)
MAPBGA196 | 12x12mm², 0.8mm pitch
- Temp / Qual: -40 to 105°C (Tj) Industrial / 0 to 95°C (Tj) Consumer

Ease of Use

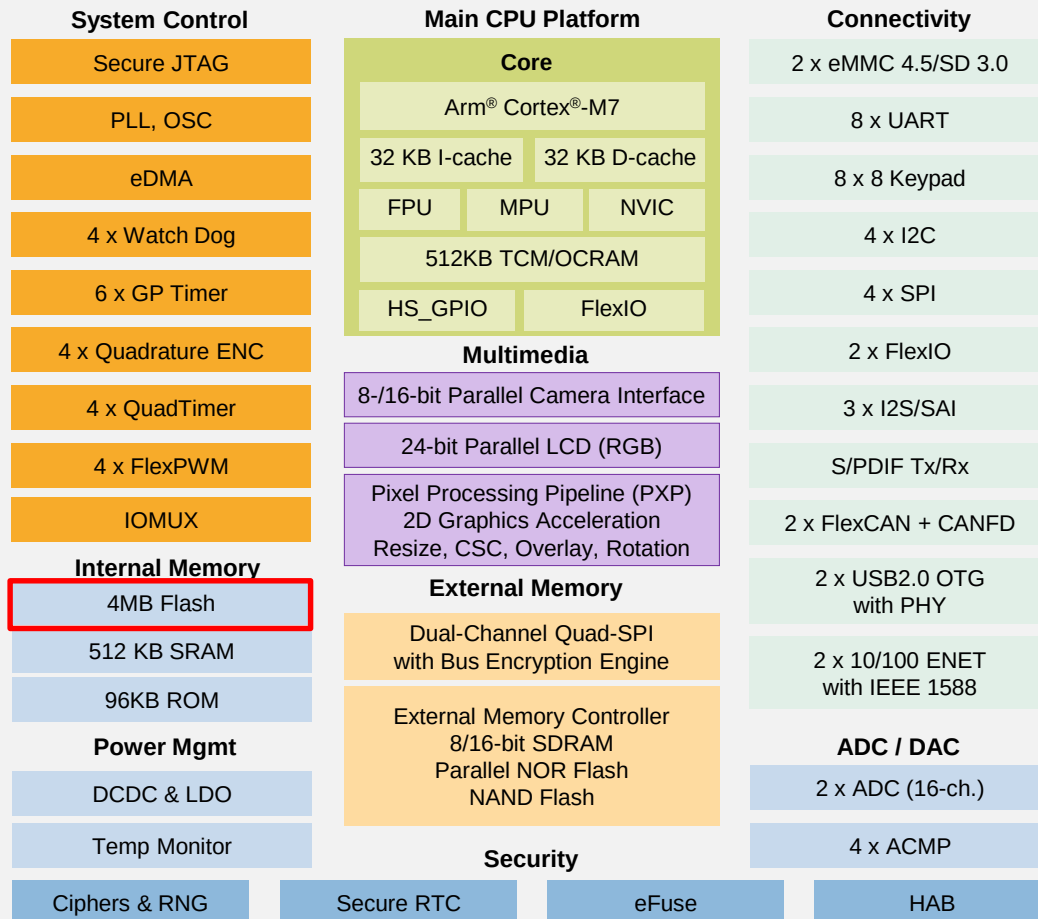
- MCUXpresso with SDK, IAR, Keil
- FreeRTOS
- Comprehensive ecosystem

Low BOM Cost

- Fully integrated PMIC with DC-DC
- QSPi and SDRAM interface

NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE

i.MX RT1064: BLOCK DIAGRAM



 Available on certain product families

High Performance Real Time system

- Cortex-M7 up to 600MHz , 50% faster than any other existing M7 products
- 20ns interrupt latency, a TRUE Real time processor
- 512KB SRAM + 512KB TCM/OCRAM
- 4MB Flash

Rich Peripheral

- Motor Control: Flex PWM X 4, Quad Timer X 4, ENC X 4
- 2x USB, 2x SDIO, 2x CAN + 1x CANFD, 2x ENET with 1588, 8xUART, 4x SPI, 4x I2C
- 8/16-bit CSI interface and 8/16/24-bit LCD interface
- 2x Qual-SPI interface, with Bus Encryption Engine
- Audio interface: 3x SAI/ SPDIF RX & TX/ 1x ESAI

Security

- TRNG&PRNG(NIST SP 800-90 Certified)
- 128-AES cryptography
- Bus Encryption Engine: Protect QSPI Flash Content

Specifications

- Package: MAPBGA196 | 10x10mm², 0.65mm pitch (130 GPIOs)
MAPBGA196 | 12x12mm², 0.8mm pitch
- Temp / Qual: -40 to 105°C (Tj) Industrial / 0 to 95°C (Tj) Consumer

Ease of Use

- MCUXpresso with SDK, IAR, Keil
- FreeRTOS
- Comprehensive ecosystem

Low BOM Cost

- Fully integrated PMIC with DC-DC
- QSPi and SDRAM interface

NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE

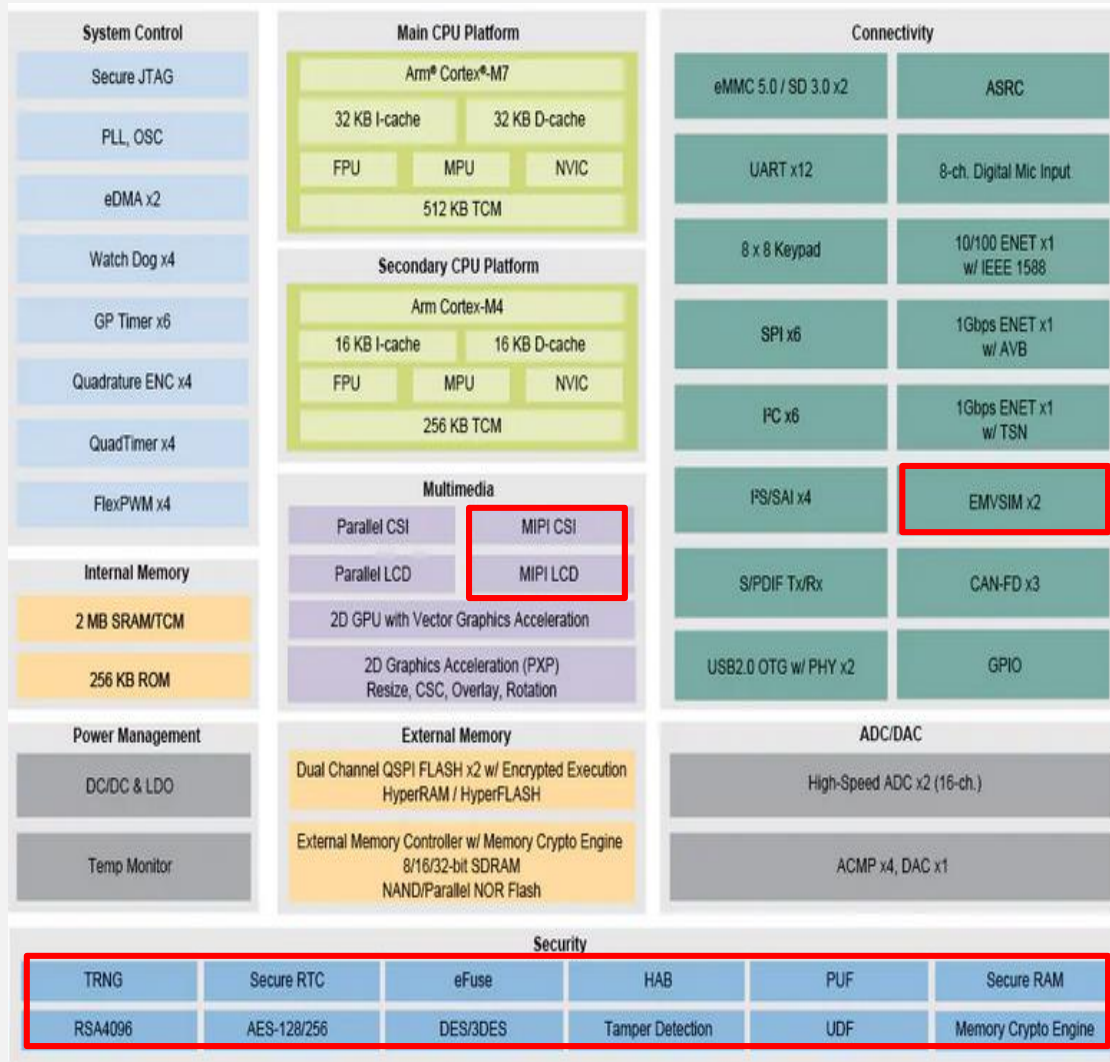
i.MX RT1170: BLOCK DIAGRAM

► Specifications

- **Process:** SEC 28FD-SOI
- **Core Voltage:** 1.0V
- **Package:** MAPBGA289, 14x14mm, 0.8mm pitch
- **Temperature:** -40C to 125C (Tj)

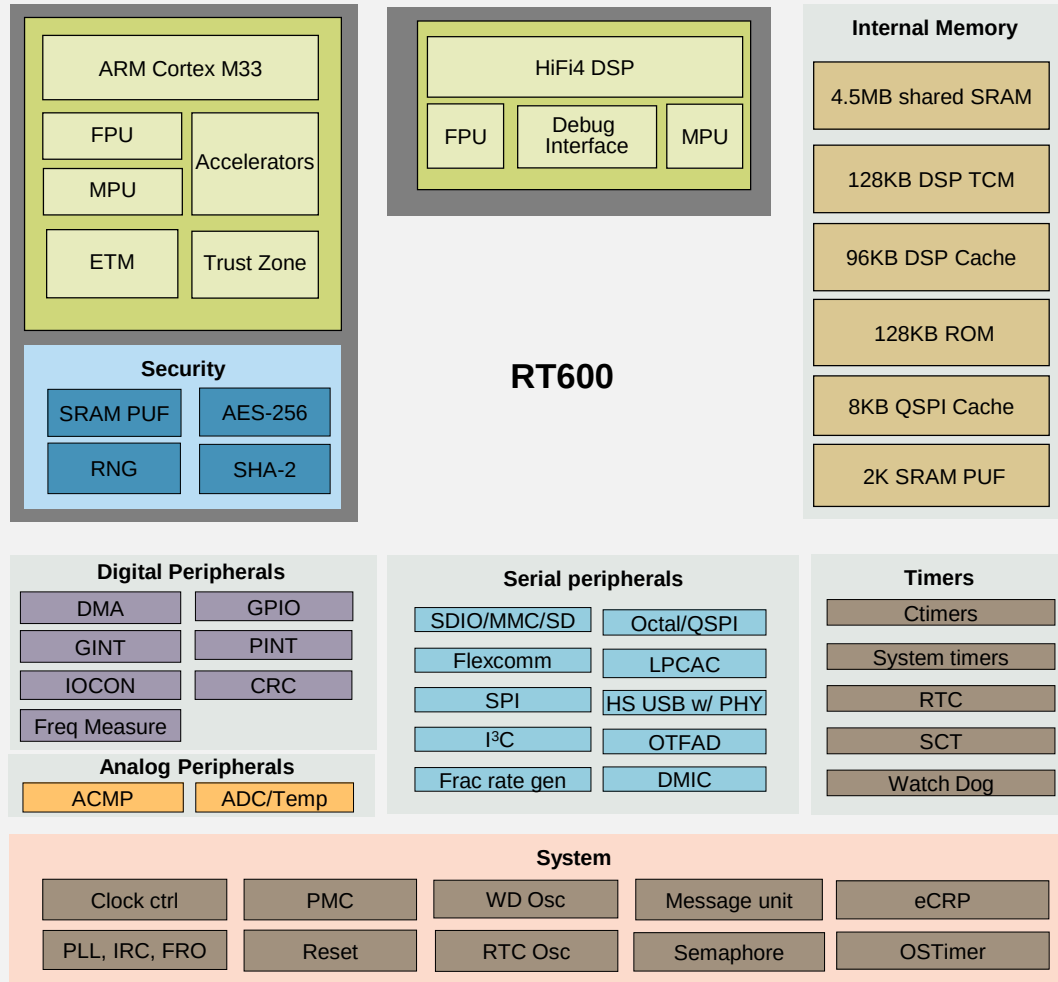
► Key Features and Advantages

- ARM [Cortex-M7](#) processor, [1 GHz](#), 32KB/32KB L1 Cache, 512KB TCM
- ARM Cortex-M4 processor, 400MHz, 16KB/16KB L1 Cache, 256KB TCM
- [2MB on-chip SRAM](#) (including TCM for CPU core)
- Parallel LCD Display up to [WXGA \(1280x800\)](#)
- 8/16-bit Parallel Camera Sensor Interface
- 2-lane [MIPI CSI](#) and 2-lane [MIPI DSI](#)
- 2D Graphics Acceleration & OpenVG Acceleration
- 8/16/32-bit [SDRAM](#) controller up to 200MHz
- 8/16-bit Parallel NOR FLASH / NAND FLASH / PSRAM
- 2x QSPI NOR FLASH / HyperRAM / HyperFLASH Interface
- 2x eMMC 5.0/SD 3.0/SDIO Port
- 2x USB 2.0 OTG, HS/FS, Device or Host with PHY
- Audio: 4x I2S/SAI, 1x S/PDIF Tx/Rx, [ASRC](#), [digital microphone input](#)
- 3x ENET: 10/100 ENET w/ IEEE 1588 + [1Gbps ENET w/ AVB](#) + [1Gbps ENET w/ TSN](#)
- 2x 12-bit ADC, [2Msamples/s](#), up to 20 input channels total
- 4x Analog comparator, 1x DAC
- [Full PMU Integration](#), DCDC+LDOs
- Secure Boot, TRNG, RSA4096, Tamper Detection, Secure Key Storage



NXP 32-BIT ARM BASED MCUS – HIGH PERFORMANCE

i.MX RT600: BLOCK DIAGRAM



Core Platform

- Up to 275MHz Cortex-M33
 - TrustZone, MPU, FPU, SIMD
- 600MHz Hifi4 DSP
- Coprocessors
 - DSP Accelerator
 - Crypto Engine

Memory

- 4.5 MB SRAM
- 128KB DSP TCM
- 96KB DSP Cache (32kl 64kD)

Timers

- 5 x 32b Timers
- SCTimer/PWM
- Multi-Rate Timer
- 2 x Windowed Watchdog Timer
- RTC
- Micro Timer

Interfaces

- USB High-speed (H/D) w/ on-chip HS PHY
- USB Full-speed (H/D), Crystal-less
- 2 x SDIO, 1 supports HS400
- 1 x High-Speed SPI up to 50MHz
- 8 x Flexcomms support up to 8x SPI, 8x I2C, 8x UART, 4x I²S channels (total 8 instances)
- I3C Master and Slave
- 8ch DMICs

Security

- SRAM PUF
- AES256
- SHA-2
- RNG

Analog

- ACMP
- ADC
- 1MHz LP Osc
- 16MHz IRC
- 48/60MHz IRC
- 32KHz RTC Osc
- PLLs

Power Supply

- 1.71V-3.6V

Package

- 9x9 BGA, 0.5mm pitch

i.MX RT EVK TABLE

EVK	i.MX RT1010	i.MX RT1015	i.MX RT1020	i.MX RT1050	i.MX RT1060	i.MX RT1064
Processor	- MIMXRT1011DAE5A 500 MHz Arm® Cortex®-M7 core 80 LQFP	- MIMXRT1015DAF5A 500 MHz Arm® Cortex®-M7 core 100 LQFP	- MIMXRT1021DAG5A 500 MHz Arm® Cortex®-M7 core 144 LQFP	- MIMXRT1052DVL6B 600 MHz Arm® Cortex®-M7 core 196 MAPBGA	- MIMXRT1062DVL6A 600 MHz Arm® Cortex®-M7 core 196 MAPBGA	- MIMXRT1064DVL6A 600 MHz Arm® Cortex®-M7 core 196 MAPBGA
Memory	128 Mb QSPI Flash	128 Mb QSPI Flash	256 Mb SDRAM memory 64 Mb QSPI Flash - TF socket for SD card	256 Mb SDRAM memory 512 Mb Hyper Flash 64 Mb QSPI Flash - TF socket for SD card	256 Mb SDRAM memory 512 Mb Hyper Flash 64 Mb QSPI Flash - TF socket for SD card	256 Mb SDRAM memory 512 Mb Hyper Flash 64 Mb QSPI Flash - TF socket for SD card
Display	N/A	N/A	N/A	- Parallel LCD connector - Camera connector	- Parallel LCD connector - Camera Sensor Module	- Parallel LCD connector - Camera Sensor Module
Audio	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone - SPDIF connector	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone - SPDIF connector	- Audio codec 4-pole audio headphone jack - External speaker connection - Microphone - SPDIF connector
Connectivity	- Micro USB OTG connector - Arduino® interface	- Micro USB OTG connector - Arduino® interface	- Micro USB host connector - Micro USB OTG connector - Ethernet (10/100T) connector - CAN transceivers - Arduino® interface	- Micro USB host connector - Micro USB OTG connector - Ethernet (10/100T) connector - CAN transceivers - Arduino® interface	- Micro USB host connector - Micro USB OTG connector - Ethernet (10/100T) connector - CAN transceivers - Arduino® interface	- Micro USB host connector - Micro USB OTG connector - Ethernet (10/100T) connector - CAN transceivers - Arduino® interface
Debug	- JTAG connector - Onboard DAP-link debugger	- JTAG connector - Onboard DAP-link debugger	- JTAG connector - Onboard DAP-link debugger	- JTAG connector - Onboard DAP-link debugger	- JTAG connector - Onboard DAP-link debugger	- JTAG connector - Onboard DAP-link debugger
Sensor	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ
Part Number	MIMXRT1010-EVK	MIMXRT1015-EVK	MIMXRT1020-EVK	IMXRT1050-EVKB	MIMXRT1060-EVK	MIMXRT1064-EVK
Display / Camera	N/A	N/A	N/A	RK043FN02H-CT 4.3"	RK043FN02H-CT 4.3"	RK043FN02H-CT 4.3"



EASE-OF-USE & PRODUCT ENABLEMENT



MCUXpresso

Software and Tools

UNIFIED SUITE OF
TOOLS FOR EASY
DEVELOPMENT
WITH NXP MCUs



MCUXpresso Software and Tools

for General Purpose MCUs and Crossover processors



MCUXpresso IDE

Edit, compile, debug and optimize in an intuitive and powerful IDE



MCUXpresso SDK

Runtime software including peripheral drivers, middleware, RTOS, demos and more



MCUXpresso Config Tools

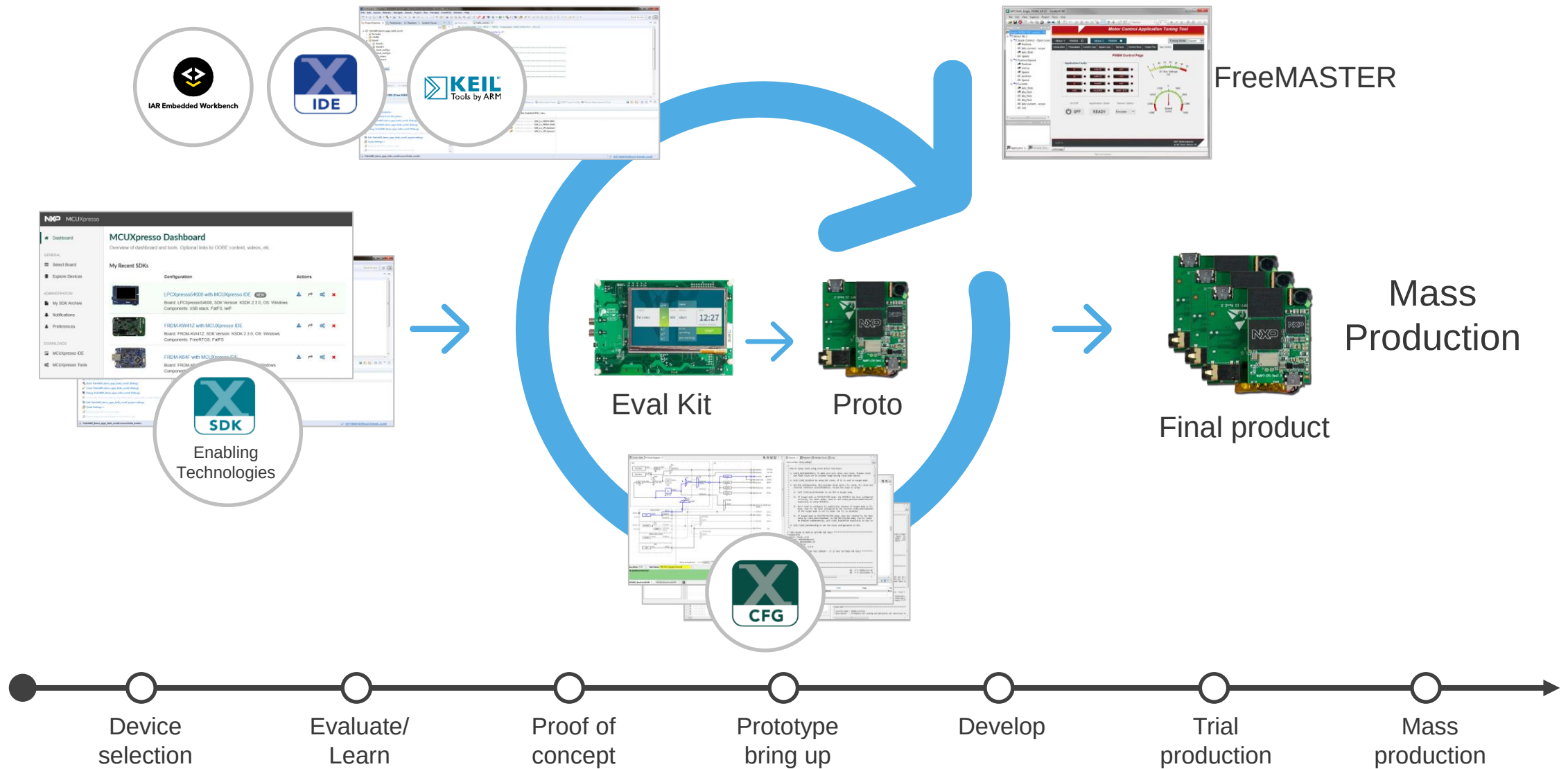
Online and desktop tool suite for system configuration and optimization



MCUXpresso Secure Provisioning Tool

Graphical and command line tool for securely provisioning and programming MCUs with secure boot

STREAMLINED MCUXPRESSO DEVELOPMENT FLOW





NXP MCU BASED SOLUTIONS FOR MACHINE LEARNING AT THE EDGE

• *VOICE AND VISION*



SECURE CONNECTIONS
FOR A SMARTER WORLD

NXP IoT Solutions – Purpose

VISION

Simplifying complex IoT integration challenges; focused on voice, vision and anomaly detection

MISSION

Enabling OEMs to focus on their application differentiation and get their products to market faster

VALUE

Proving & Productizing relevant and optimized integrated solutions for our customers

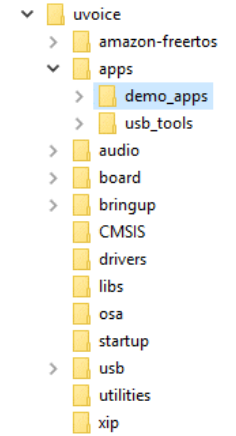
PRODUCTION GRADE, CERTIFIED IOT ML EDGE COMPUTE SOLUTIONS

- Implemented with best in class silicon, software and IP from NXP and 3rd parties
- Near production ready hardware
 - Cost and form factor optimized
- Pre-integrated production ready software, fully tested & certified
- NXP provides a single point of contact for support, licensing and procurement
- Use case dependent solutions:
 - Turnkey – for well defined use cases
 - Customizable – can be modified, tuned and trained for specific use cases

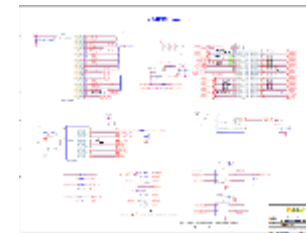
OOB HW/SW



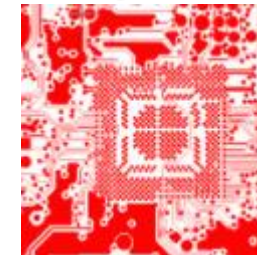
Software Source



Schematics



Layouts



Certifications



BOMs

U1	MIMXRT1052DVL6B	1. MXRT1050 Cross Processor
U3	W9812G6B-BI	128Mbit SDRAM 3V 166MHz
U4	IS26K12565-DABLI0	256Mb Hyperflash 3V 100MHz FL
U5	A7101CHTK2	Secure IoT/Authentication Conn
U6	LBEE5K1DX-883	IC WIFI BT/BLE B/G/N 3-4.8V LGA
U7	MKW21Z12VHT4	KINETIS L 32-BIT MCU CORTX-M
U8,U9	NX3L2267GM,115	IC ANALOG SWITCH SPDT 10XQFN
U10	XCL214B333DR	DC/DC CONVERTER 3.3V 5W

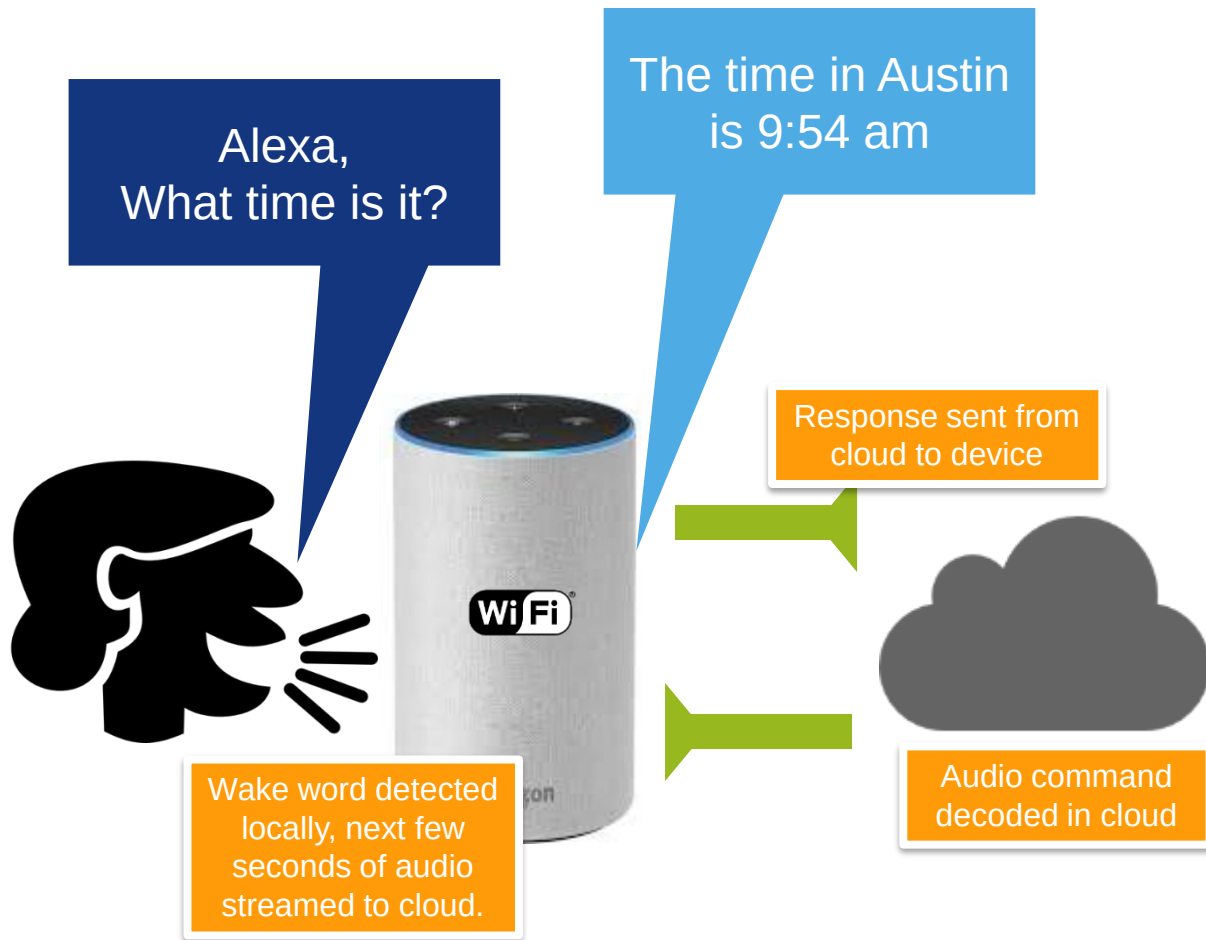
Documentation





VOICE ASSISTANTS CLOUD VS. LOCAL

Cloud Based Voice Control



Local Voice Control





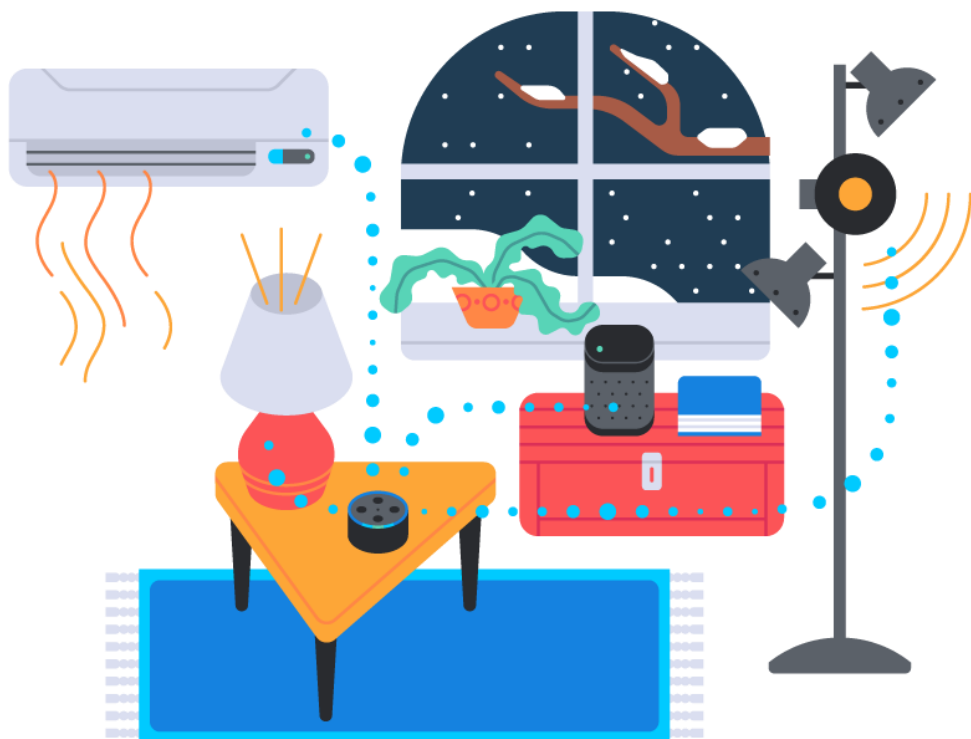
i.MXRT106A FOR ALEXA BUILT-IN



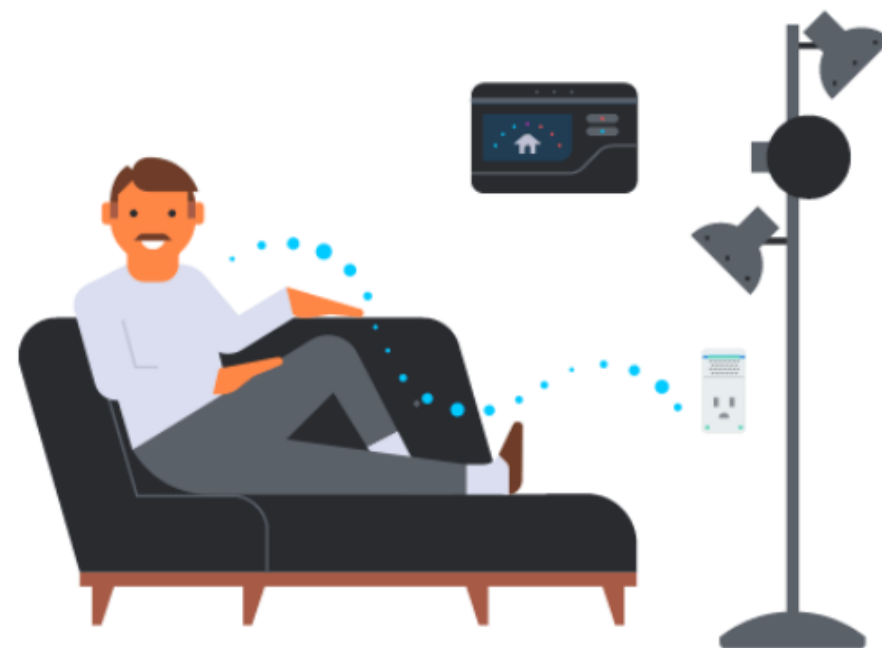
“ALEXA BUILT-IN” VS. “WORKS WITH ALEXA”



- Devices that can be controlled by commands spoken into other devices with Alexa built-in



- Echo speakers and other products with microphone arrays built-in to receive Alexa commands, to control this, or other devices





Far-Field

- Arm Cortex-M7 MCU based Alexa built-in solution
 - i.MX RT106A – 600 MHz, 1 MB SRAM
- Lowers Alexa built-in cost up to 50% by offloading compute & memory intensive workloads to cloud
 - Eliminates SDRAM, eMMC Flash, PMIC, 6+ layer board
- Reduces frequency, size and cost of OTA updates by leveraging an Amazon managed cloud based service
- Familiar MCU platform for IoT developers
 - No Linux & MPU learning curve for RTOS developers
- i.MX RT106A MCU bundles all AVS Integration for AWS IoT Core software (<\$4*)
 - Includes machine learning audio front end (AFE) for far-field voice
- NXP's AVS qualified turnkey solution shortens time-to-market
 - Full reference design, source code, schematics, BOM & layout
 - Go from concept to launch in less than 6 months

VOICE ASSISTANT IMPLEMENTATION OPTIONS: MCU VS. MPU

	MPU (Application Processor)	MCU (Embedded Processor)
Applications	Smart phones & tablets, Smart screens, Routers/gateways, Robo-cleaners, etc.	Switches, Appliances, Power tools, Toys, etc.
Graphics	Complex UI	None, or basic bit mapped
Operating System	Linux, Android, iOS, Windows, ...	FreeRTOS, MicroC/OS, Mbed OS, ...
Virtual Memory Support	Memory Management Unit	No
Storage	Giga Bytes (NAND Flash)	Mega Bytes (NOR Flash – often on chip)
Memory	Giga Bytes (SDRAM)	Mega Byte (SRAM – usually all on chip)
CPU example	Arm Cortex-A	ARM Cortex-M
Number of cores	1, 2, 4, 8, ...	1 (or 2)
NXP Example Family	i.MX 8M	i.MX RT1060

	AVS Integration for AWS IoT Core (MCU)	Full AVS C++ SDK (MPU)
Ideal for:	Smart switches, plugs, fans, appliances, thermostats, smoke detectors	Wireless speakers, sound bars, smart TVs, STBs
Platform	i.MX RT106A (Arm Cortex-M7 @ 600 MHz)	i.MX 8M (Quad Arm Cortex-A53 @ 1.5 GHz)
RAM	1 MB On-chip SRAM	1 GB LPDDR4
Flash	32 MB Hyper-Flash	8 GB eMMC
Protocol / OS	MQTT / FreeRTOS	HTTP/2 / Linux
Voice (Alexa Built-in)	✓	✓
Dialogs, Alerts, Skills, Routines	✓	✓
Alexa Announce & Messaging	✓	✓
Alexa Calling	Coming soon	✓
Music	Amazon Music (Optional) – @64 kbps Opus Mono	Amazon Music, Pandora, iHeartRadio, TuneIn, Spotify
Multi Room Music	N/A	✓
Surround sound	N/A	3D audio: Dolby Atmos, DTS:X
Speakers	Speech optimized	Music optimized
NXP Differentiation	Turnkey, single MCU, no DSP, distribution channel	Single MPU, no DSP, 3D audio, distribution
Availability	Now (NXP solution)	Now (Reference design)

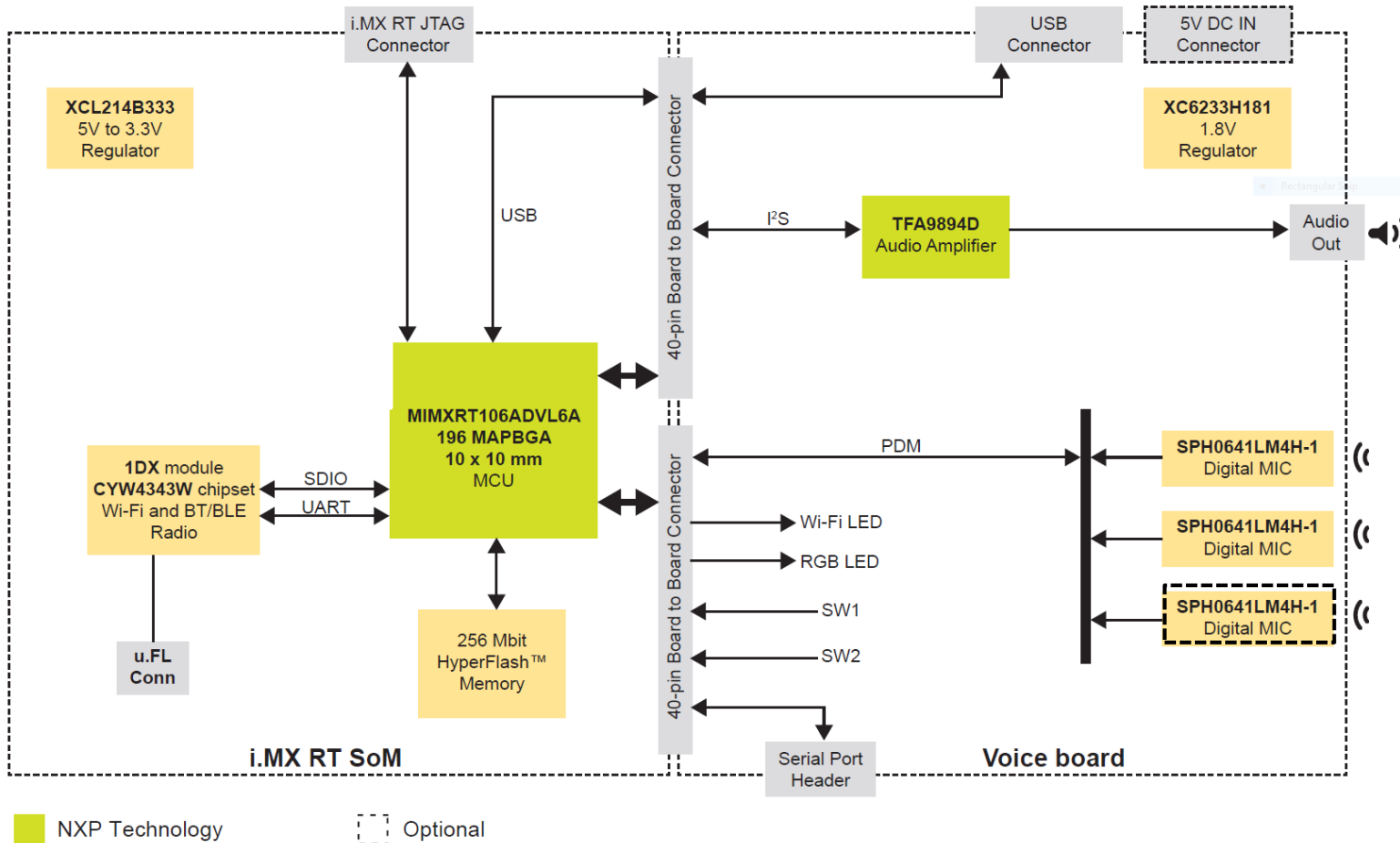
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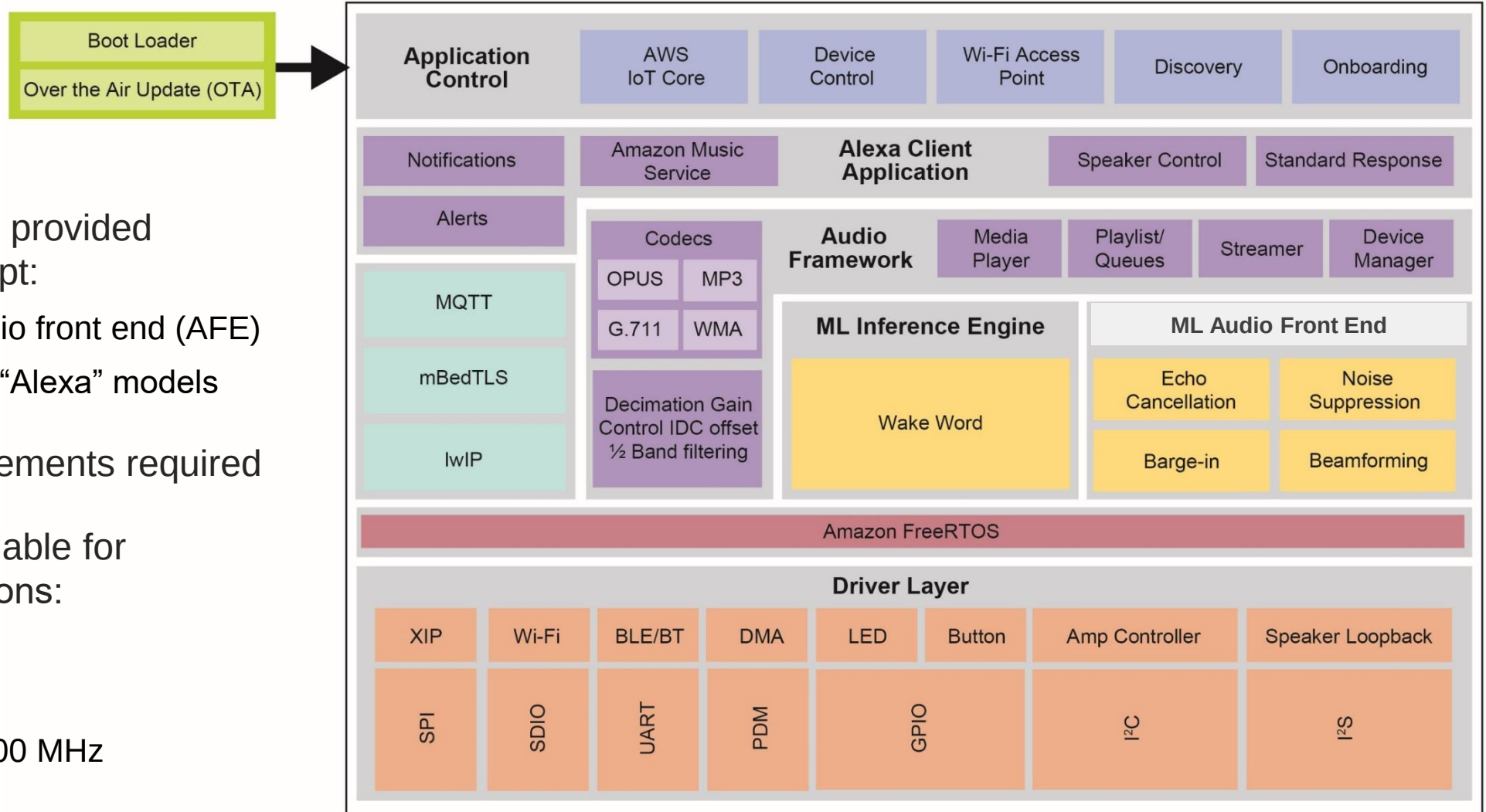
i.MX RT106A REFERENCE DESIGN BLOCK DIAGRAM



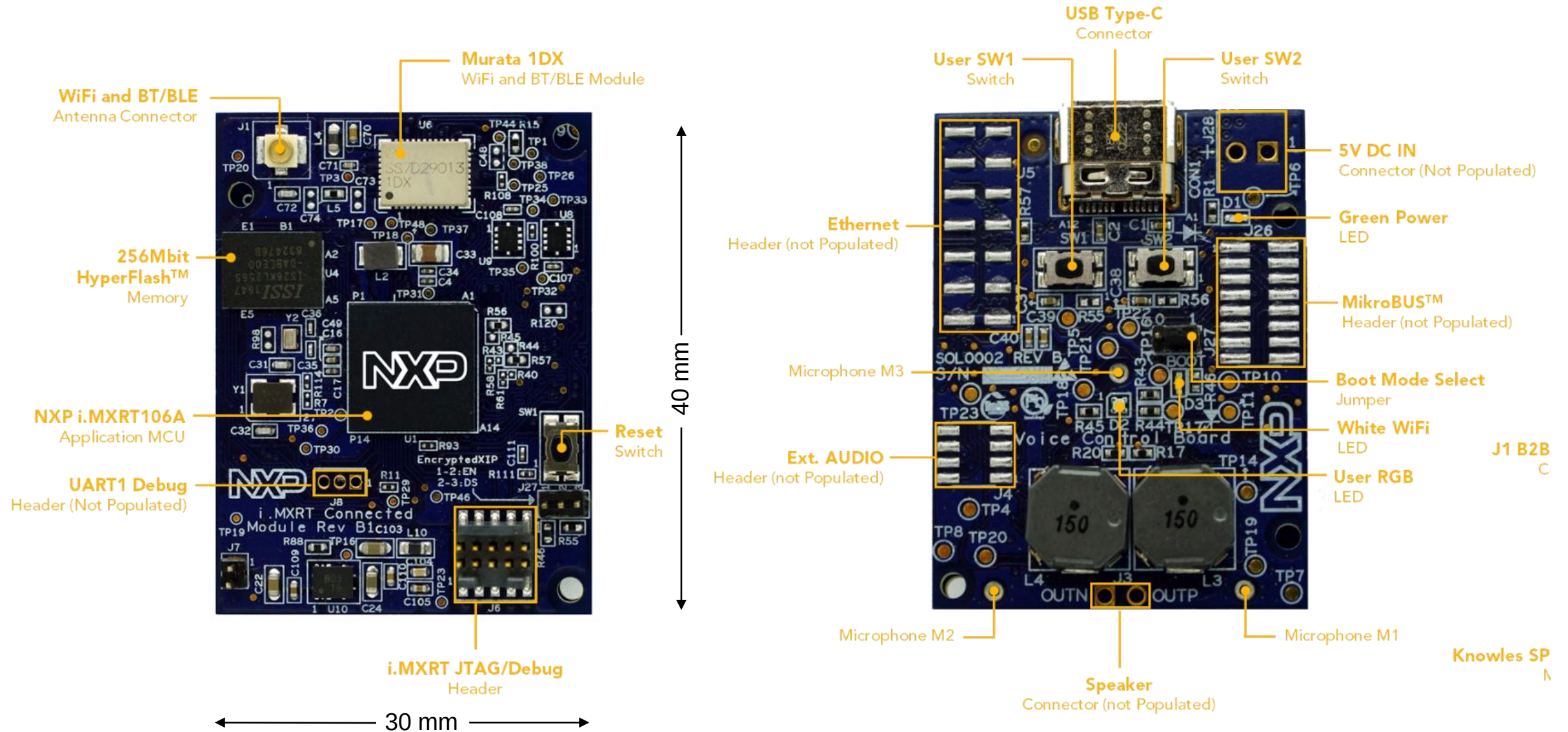
- i.MX RT106A orderable and shipping now
- Evaluation & development kit (SLN-ALEXA-IOT) available Dec (\$149)

i.MX RT106A ALEXA SOLUTION – SOFTWARE

- Turnkey SW solution provided as source code except:
 - Machine learning audio front end (AFE)
 - Wake word engine & “Alexa” models
- No third party engagements required
- MCU resources available for developer’s applications:
 - RAM: 70% used
 - 300 kB available
 - CPU: 60% used @ 600 MHz
 - 180° far-field (2 mics)
 - No optimization



i.MX RT106A DEVELOPMENT KIT (SLN-ALEXA-IOT) \$149



- Any device that can add Alexa to a room, removing an Echo speaker from countertop or wall
- Smart Home
 - Smart light switches, shade and fan controls, smart plugs and outlets
 - Thermostats
 - Alarm panels
 - Set top boxes
 - Home gateways, routers, access points and mesh Wi-Fi systems
 - Smoke & CO detectors
 - Garage door openers
 - Room air conditioners and (de-)humidifiers
- Smart Appliances
 - Major (fridge, oven, washer, dryer, cooktop, vent hood, etc.)
 - Countertop (microwave, coffee maker, food processor, etc.)





- i.MX RT106A – ARM Cortex-M7 MCU @600 MHz
 - Includes ML audio front end for far-field voice
- Four month design cycle!
 - Design kicked off in early February
 - First production run in June
- Launched August 23rd, 2019 – \$99 MSRP
 - On sale now from Amazon.com and Hubble's network of home builder distributors
- More products coming soon
 - More light switches, appliances (microwave oven, etc.), mesh Wi-Fi system, coffee pod holder, ...

FOR MORE INFORMATION...

www.nxp.com/mcu-avs

MCU-based Solution for Alexa Voice Service

Turnkey i.MX RT solution for Alexa Built-in.

Overview Specifications Buy Design Resources Get Help

- Alexa Voice Service**
Qualified by Amazon - runs Amazon FreeRTOS.
- Turnkey Solution**
Easy implementation into any application.
- Low BOM Cost**
Reduced by over 50% compared to MPU designs.
- Compact Design**
Ultra-small form factor boards - 30 x 40 mm.
- Full Software Capabilities**
Far-field, Noise reduction, Echo cancellation.

Overview
PRE-PRODUCTION

NXP's MCU-based solution for Amazon's Alexa Voice Service (AVS) leverages the i.MX RT crossover processor, enabling developers to quickly and easily add Alexa voice assistant capabilities to their products. This ultra-small form-factor, turnkey hardware design comes completely integrated with Amazon qualified software for an out of the box AVS experience.

Buy

SLN-ALEXA-IOT ACTIVE
MCU-based Solution for Alexa Voice Service

Turnkey embedded i.MX RT voice solution for Amazon's Alexa Voice Service.

Kit contains

- i.MX RT Voice Solution
- USB Type-C Y Cable

Distributor

- Schematics, BOM, layout on nxp.com
- Kit comes with download codes
 - Software (source, binaries) & documentation
 - To be included in MCUXpresso SDK (1Q20)
- [Getting Started OOB](#)



i.MXRT106L FOR LOCAL VOICE CONTROL

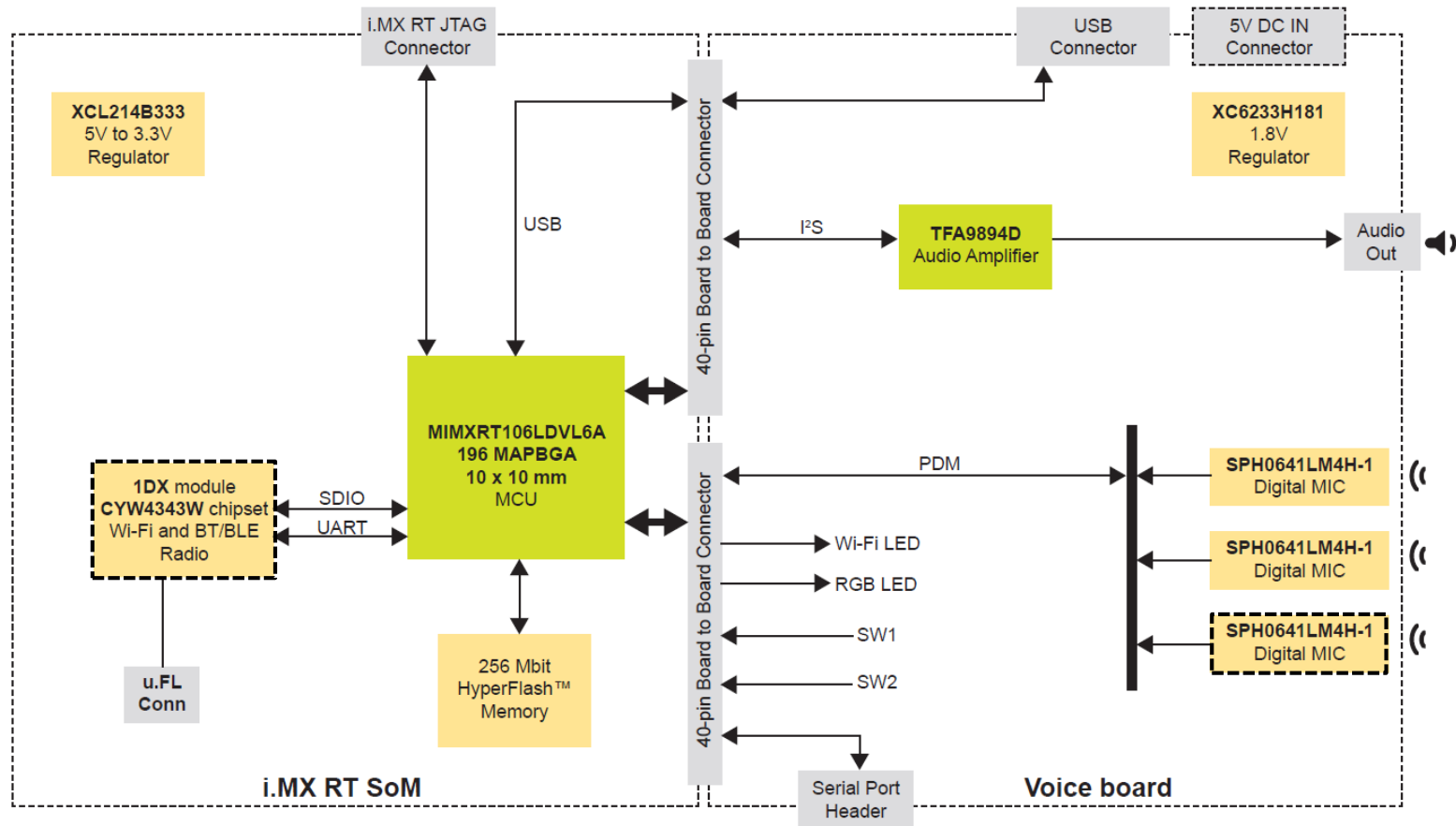
i.MX RT106L – MCU BASED SOLUTION FOR LOCAL VOICE CONTROL



Far-Field

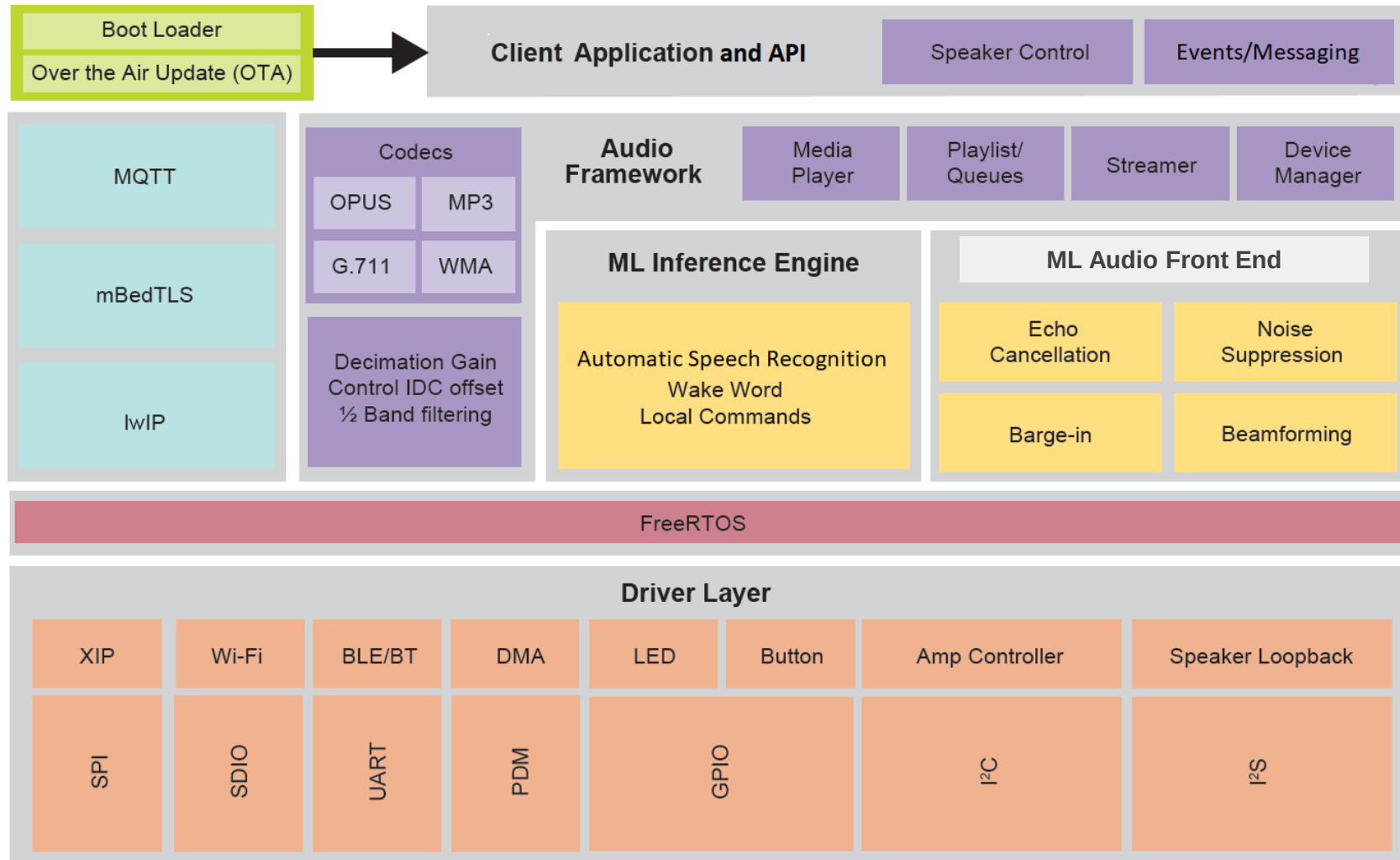
- Arm Cortex-M7 MCU based automatic speech recognition (ASR)
 - i.MX RT106L – 600 MHz, 1 MB SRAM
- MCU lowers BOM cost ~50% compared to MPU implementations
 - Eliminates SDRAM, eMMC Flash, PMIC, 6+ layer board
- Familiar MCU platform for IoT developers
 - No Linux & MPU learning curve for RTOS developers
- i.MX RT106L bundles ASR & ML/AI AFE SW for far-field
 - Local voice eliminates cost, latency & privacy issues of cloud
- NXP's turnkey solution slashes time-to-market
 - Full reference design, software source, schematics, BOM & layout
 - From concept to product launch in 6 months
- Development kits on sale February 25, 2020
 - Contact NXP sales for early access

i.MX RT106L MCU BASED SOLUTION FOR LOCAL VOICE CONTROL – HW



- i.MX RT106L devices orderable and shipping now
- Evaluation & development kit (SLN-LOCAL-IOT) on sale Feb 25, 2020 (\$149)
 - Leverages HW & SW from Alexa solution (i.MX RT106A – SLN-ALEXA-IOT)

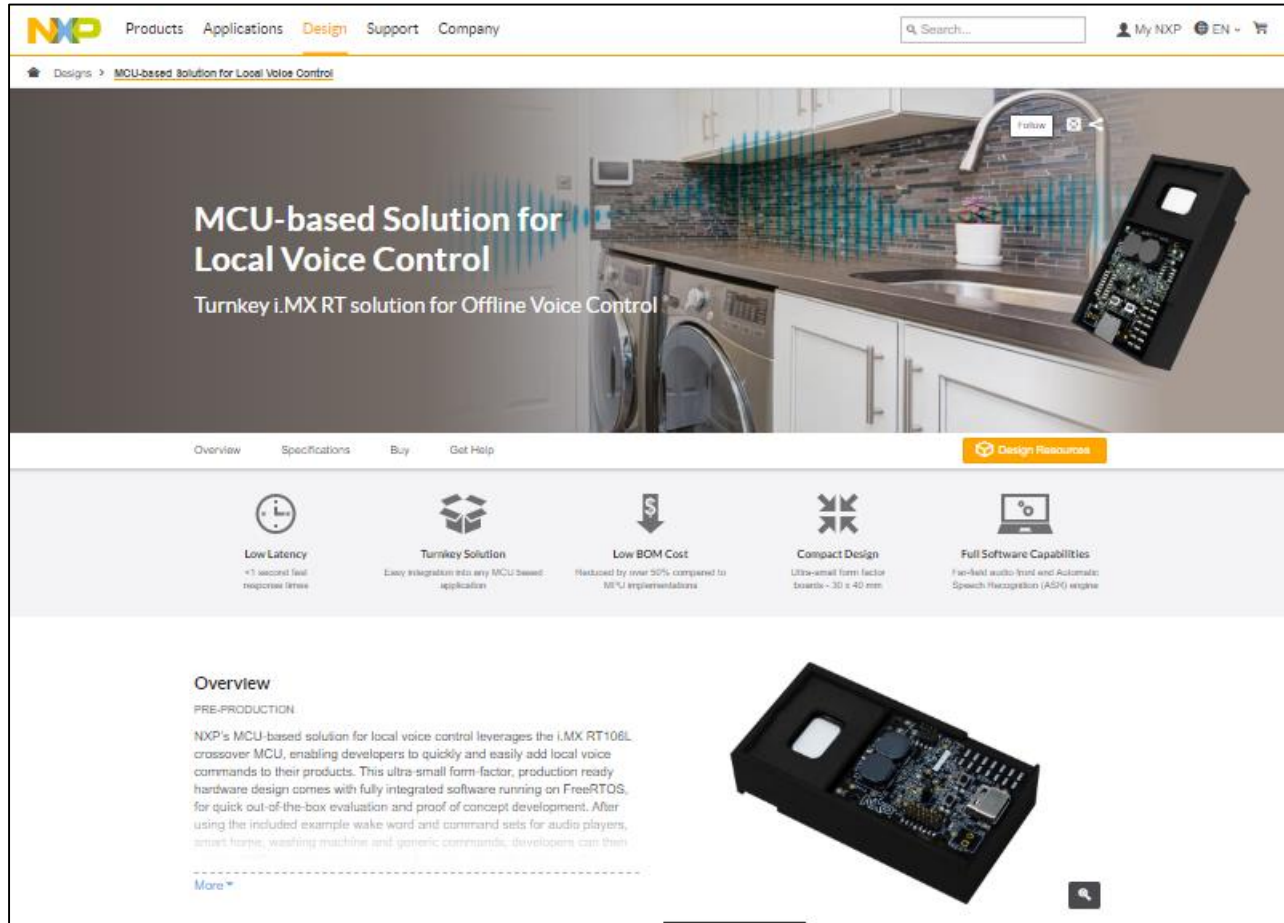
i.MX RT106L MCU BASED SOLUTION FOR LOCAL VOICE CONTROL – SW



- Out of the box kit with example command sets and wake word
 - Details on next slide
- Easy to create models for custom wake word and commands (NRE)
 - Up to 30 unique commands
- MCU resources available for developer's applications:
 - RAM: 30% used
 - 700 kB available
 - CPU: ~65% used @ 528 MHz
 - 180° far-field (2 mics)
 - No optimization

FOR MORE INFORMATION...

www.nxp.com/mcu-local



NXP Products Applications **Design** Support Company

Search...

My NXP EN

Designs > **MCU-based Solution for Local Voice Control**

MCU-based Solution for Local Voice Control

Turnkey i.MX RT solution for Offline Voice Control

Overview Specifications Buy Get Help Design Resources

- Low Latency**
<1 second full response time
- Turnkey Solution**
Easy integration into any MCU based application
- Low BOM Cost**
Reduced by over 90% compared to MCU implementations
- Compact Design**
Ultra-small form factor boards ~ 30 x 40 mm
- Full Software Capabilities**
Field audio front end and Automatic Speech Recognition (ASR) engine

Overview

PRE-PRODUCTION

NXP's MCU-based solution for local voice control leverages the i.MX RT106L crossover MCU, enabling developers to quickly and easily add local voice commands to their products. This ultra-small form-factor, production ready hardware design comes with fully integrated software running on FreeRTOS, for quick out-of-the-box evaluation and proof of concept development. After using the included example wake word and command sets for audio players, smart home, washing machine and generic commands, developers can then

More



SLN-LOCAL-IOT **ACTIVE**

MCU-based Solution for Local Voice Control

Turnkey embedded i.MX RT voice solution for Local Voice Control

Kit contains

- i.MX RT Voice Solution
- USB Type-C Y Cable

Request early access invitation

Distributor

- Schematics, BOM, layout on nxp.com
- Kit comes with software download codes
 - Source, binaries, documentation



i.MX RT106F FOR FACE RECOGNITION

i.MX RT106F – MCU-BASED SOLUTION FOR FACE RECOGNITION

- **MCU-based face & emotion recognition**

- Arm Cortex-M7, 600 MHz, 1 MB SRAM
- Lowers BOM cost ~50% compared to MPU implementations

- **Offline**

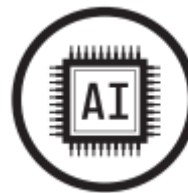
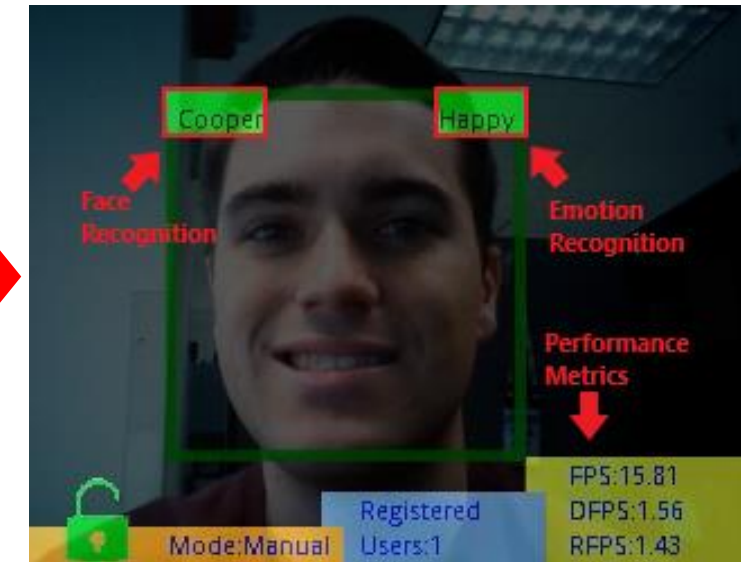
- Eliminates cost, complexity & privacy issues of cloud-based solutions

- **Liveness/anti-spoofing capable**

- Designed for consumer security apps

- **Slashes time-to-market**

- Full reference design, software source, schematics, BOM & layout
- From concept to launch in 3~6 months



EXTERNAL

MCU-based Face Recognition – Example Use Cases

- **Secure Access**

- Use: Replace key, card, BLE/phone with user face
- Example Application: Residential Smart Lock

- **User Authorization**

- Use: Control equipment access levels / authorities by user face
- Example Application: Cooktop, Forklift

- **User Identification**

- Use: Identify and catalog users (by name or anonymously – Friction Free Identification)
- Example Application: Retail loyalty program at POS

- **User Customization**

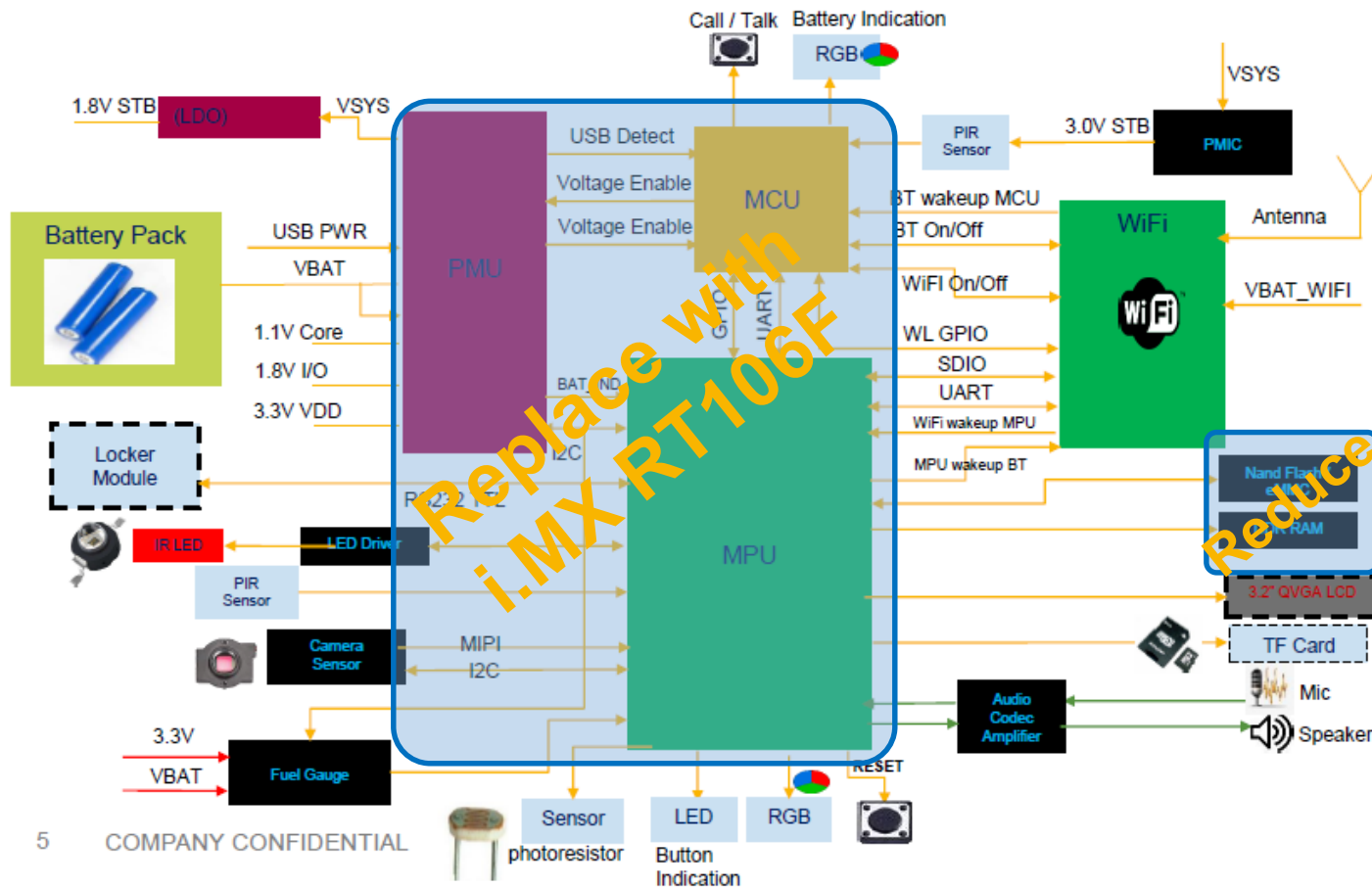
- Use: Customize environmental or equipment controls based on user
- Example Application: Thermostat, Lighting Control



- **Emotion Detection**

- Use: Identify user mood (and react)
- Example Application: Toys, Guest Ratings at POS

Minimize Cost, Power Requirements, and Design Complexity



- **Replace expensive and power hungry “MPU+PMIC+MCU” design with simple MCU-only design**
 - Drastic cost system cost reduction
 - Drastic simplification of design
 - Reduce system power
 - Reduce PCB footprint, improve form factor flexibility
- **Reduce memory subsystem**
 - Replace huge expensive DDR and Flash with low cost SDRAM and QSPI Flash
 - Additional power reduction
 - Further PCB footprint reduction

MPU VS. MCU



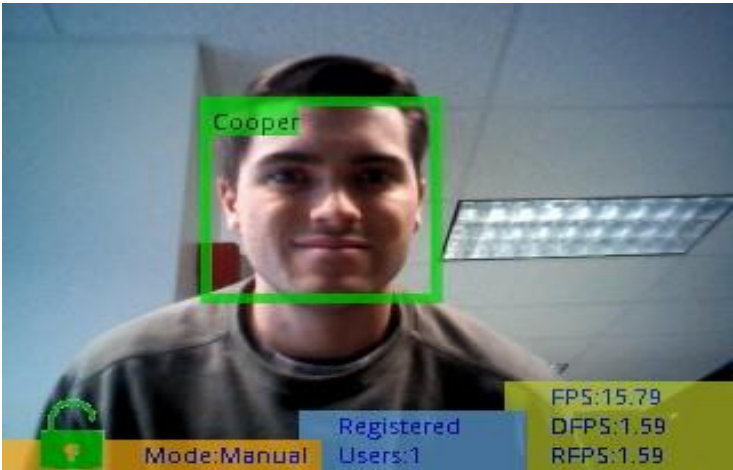
	MPU (Application Processor)	MCU (Embedded Processor)
Applications	Smart phones & tablets, Smart screens, Routers/gateways, Robo-cleaners, etc.	Switches, Appliances, Power tools, Toys, etc.
Graphics	Complex UI	None, or basic bit mapped
Operating System	Linux, Android, iOS, Windows, ...	FreeRTOS, MicroC/OS, Mbed OS, ...
Virtual Memory Support	Memory Management Unit	No
Storage	Giga Bytes (NAND Flash)	Mega Bytes (NOR Flash – often on chip)
Memory	Giga Bytes (SDRAM)	Mega Byte (SRAM – usually all on chip)
CPU	Arm Cortex-A Intel Core i7	Arm Cortex-M Intel 8051
Number of cores	1, 2, 4, 8, ...	1 (or 2)
NXP Example Family	i.MX 8M	i.MX RT1060

CONFIGURING DETECTION RESOLUTION – VGA VS QVGA

VGA
(Face detected at ~1.4m)



QVGA
(Face detected at ~.7m)

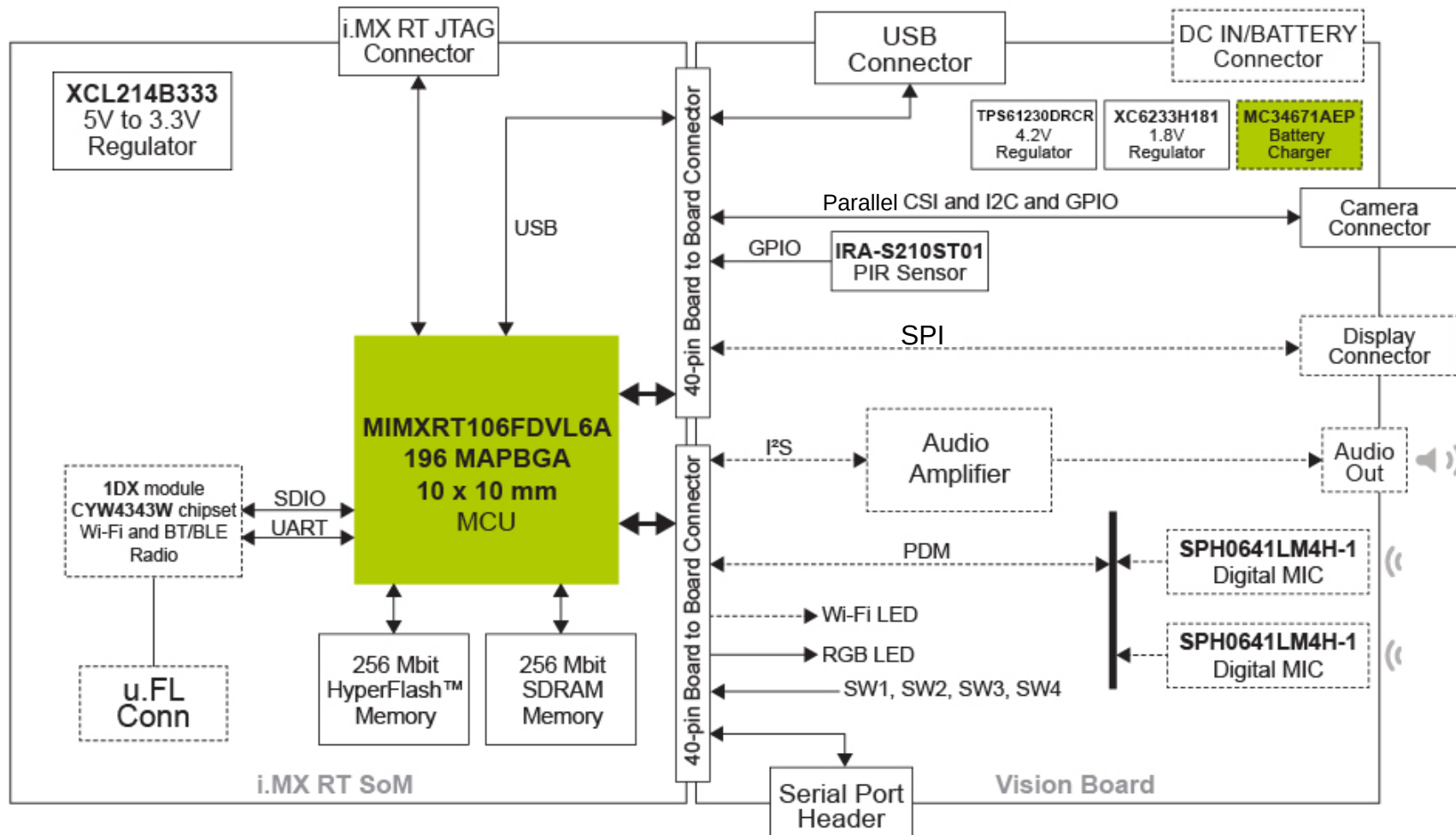


```
COM3 - PuTTY
SHELL>> detection resolution vga
SHELL>> Detection resolution VGA mode selected, reset system
```

Mode	Resolution	Requires SDRAM?	Detection & Recognition Range	Detection Inference Speed
VGA	640x480	Yes	.3m ~1.4m	100ms
QVGA	320x240	No	.3m ~ .7m	80ms

```
COM3 - PuTTY
SHELL>> detection resolution qvga
SHELL>> Detection resolution QVGA mode selected, reset system
```


i.MX RT106F MCU BASED SOLUTION FOR FACE RECOGNITION – HW



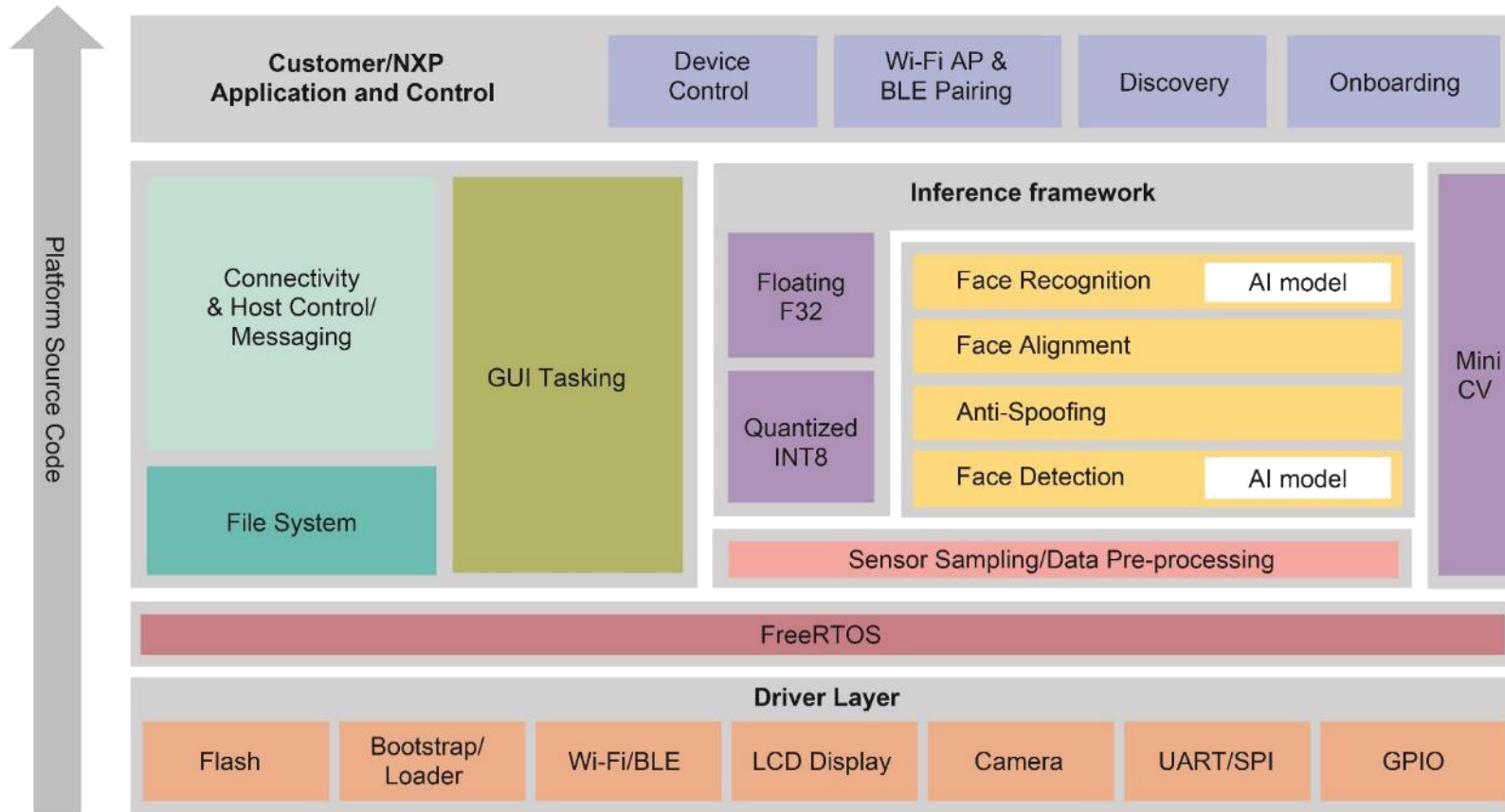
- Dev kit: SLN-VIZN-IOT
 - On sale now
 - \$179.59 (US MSRP)

- i.MX RT106F includes license for all face recognition software
 - <\$4.00 (100k resale)

- More information
 - <http://www.nxp.com/mcu-vision>

Non NXP Technology
 NXP Technology
 Additional Board Features

i.MX RT106F MCU SOLUTION FOR FACE RECOGNITION – SW



- Pre-integrated software minimizes development time
- Out of the box automatic registration & recognition
 - Name not required
- <1 second inference time
 - Scalable, power vs speed
- Register up to 200 faces locally

RT106F BASED VISION SOLUTIONS PLAN



SLN-VIZN-IOT
i.MX RT106F

Single RGB Camera
Local Face Recognition



SLN-VIZNSEC-IOT
i.MX RT106F

Dual RGB+IR Cameras
Secure Local Face Recognition

- Single camera kit officially launched in Q1-20.
- Dual camera kits plan for ready by end of June.
- RT106F samples already accept order.
- We accept alpha customer for dual camera now.



2020
Q1

2020
Q2

2020
Q3

2020
Q4

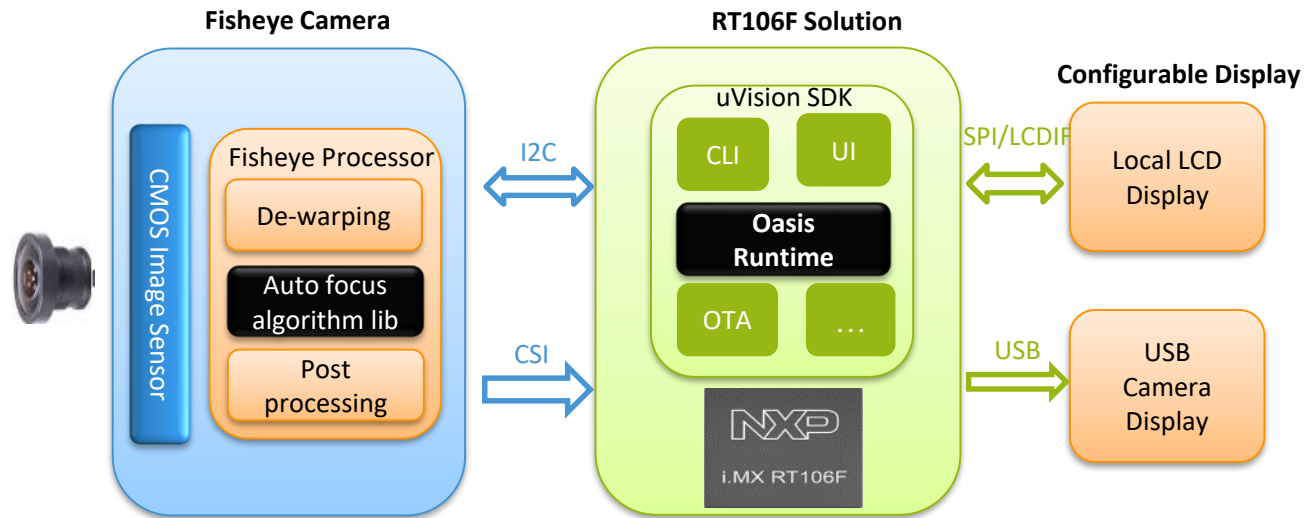
SLN-VIZNSEC-IOT DUAL CAMERA ADAPTER

- **Uses combination IR + RGB camera**
 - Cheaper than 3D time-of-flight solutions
- **Protects against spoofing**
 - Color and grayscale pictures
 - Phone displays
- **Low-light face recognition**
 - Good for nighttime applications
- **Target application**
 - Smart face recognition eLock.
 - Door access control.



SLN-VIZN-IOT - FISHEYE CAMERA APPLICATION

- **180° FOV**
 - Removes need for a display in many cases (no need to align face with camera)
- **Automatically zooms in on faces**



NXP FISHEYE FACIAL RECOGNITION



lgo



NXP | i.MX RT LOCAL

- Offline voice control
- Eliminates cloud connectivity
- Full privacy with low latency
- Turnkey HW & SW solution

COOPER
CARNAHAN

FOR MORE INFORMATION...

<http://www.nxp.com/mcu-vision>

MCU-based Solution for Face Recognition

Overview Specifications Buy Design Resources Get Help

Low Latency
<1 second fast response times

Turnkey Solution
Easy integration into any application

Low BOM Cost
Reduced by over 50% compared to MPU designs

Compact Design
Ultra-small form factor boards - 50 mm x 40 mm

Full Software Capabilities
Image cropping, face detection, face recognition

Overview

NXP's MCU-based machine vision solution leverages the i.MX RT106F crossover MCU enabling developers to quickly and easily add face recognition capabilities to their products. This ultra-small form-factor, production ready hardware design comes with fully integrated software running on FreeRTOS, for quick out-of-the-box implementation. This turnkey solution minimizes time to market, risk, and development effort, enabling OEMs to easily add machine vision to their smart home and smart appliance products without the need for

Easy registration process for face recognition

Buy

SLN-VIZN-IOT
MCU-based Solution for Face Recognition

Turnkey embedded i.MX RT106F for Face Recognition

Kit contains:

- i.MX RT Face Recognition Solution
- USB Type-C Cable

Buy Direct Distributor

Availability?

- **Buy** SLN-VIZN-IOT kits
- **View** getting started pages and videos
- **Download** schematics, BOM, layout
 - Kit comes with software download code
 - Source, binaries, documentation
 - Available in MCUXpresso SDK in 3Q20

EXPANDING NXP'S PORTFOLIO OF i.MX RT MCU TURNKEY IOT SOLUTIONS

- Turnkey ML edge compute solutions on MCUs
 - i.MX RT106L for local voice control
 - i.MX RT106F for face recognition
 - i.MX RT106A for Alexa built-in
- Offline capabilities lower latency & total cost of ownership, while preserving privacy
- Developers of MCU based IoT products will now have access to voice control and face recognition capabilities, avoiding a learning curve of moving to Linux based MPUs
- MCU based designs reduce BOM cost ~50% compared to MPU implementations
- Turnkey solutions reduce development time, speeding time to market

ONLINE SUPPORT THROUGH TIC

What is TIC?

- Online support, comprised of specialized engineers and communities, designed to answer NXP customers' questions
- Serves all customers using web and chat
- Has team of 50+ engineers doing only support
- Specialists, not generalists

Scope of Support?

- Remote, focus on mass market products, not all products
- Engineers work based on written questions
- English and Chinese are standard languages

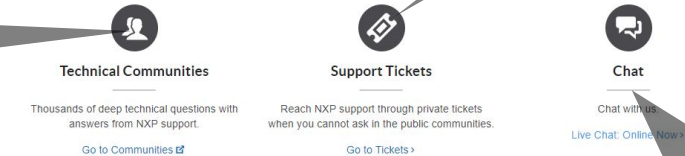
For: Technical Questions
When: **non-confidential technical issues**
Login: Need

How to reach the TIC?

1. **Login to the Online Ticket System** (www.nxp.com/support)



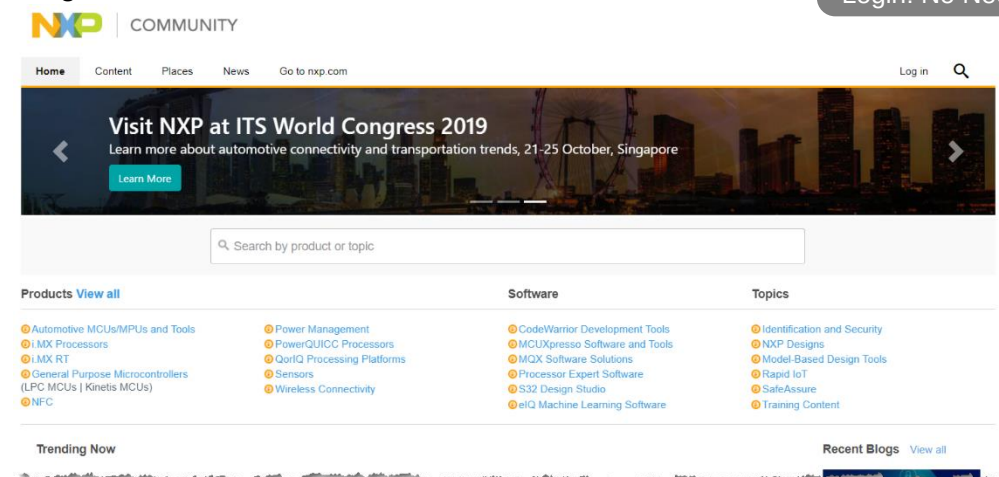
For: Technical Questions
When: **can't be shared publicly**
Login: Need



For: **Generic non-technical** questions
Login: No Need

2. **NXP Community System** (<https://community.nxp.com>)

✓ **Login: Need**



3. **External NXP Community System** (恩智浦中文社区 <http://www.nxp.org/>)

✓ **Login: Need**

✓ **Only support Chinese**

✓ **Support product range: i.MX MPU & i.MX RT & LPC & Kinetis**

Covered Product Families		Support through		Language support	
		Ticket System	Communities	English	Chinese
MPU	i.MX	X	X	X	X
	Digital Networking	X	X	X	
MCU	i.MXRT, Kinetis & FSL Legacy MCU, LPC	X	X	X	X
	Auto 32bit MPC5xxx	X	X	X	
	Auto 16bit (S12)	X	X	X	
	Auto 32bit S32K	X	X	X	X
Misc	Analog & Sensors	X	(X)	X	X
	RF (Power & Small Signal)	X		X	
	NFC (Readers, NTAG, MIFARE)	X	X	X	X
	SIP (Interfaces, Connectivity)	X		X	X
	Security and Authentication (Mass market)	X		X	X



SECURE CONNECTIONS
FOR A SMARTER WORLD