

# I.MX RT1170 的特性 及其在汽车仪表盘上的应用

I.MX RT1170: Highlight features and application in automotive digital cluster

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## Agenda

- Overview
- Key Features for Multimedia Applications
- Solutions for Digital Cluster

# i.MX RT1170: Overview

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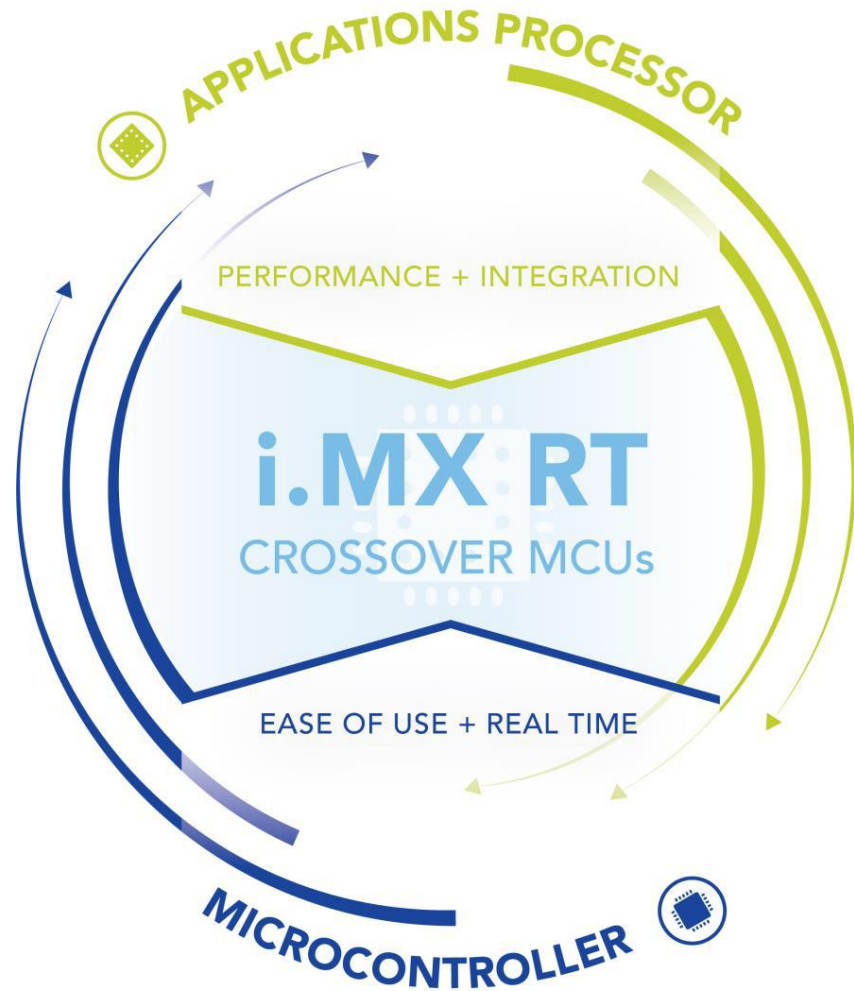


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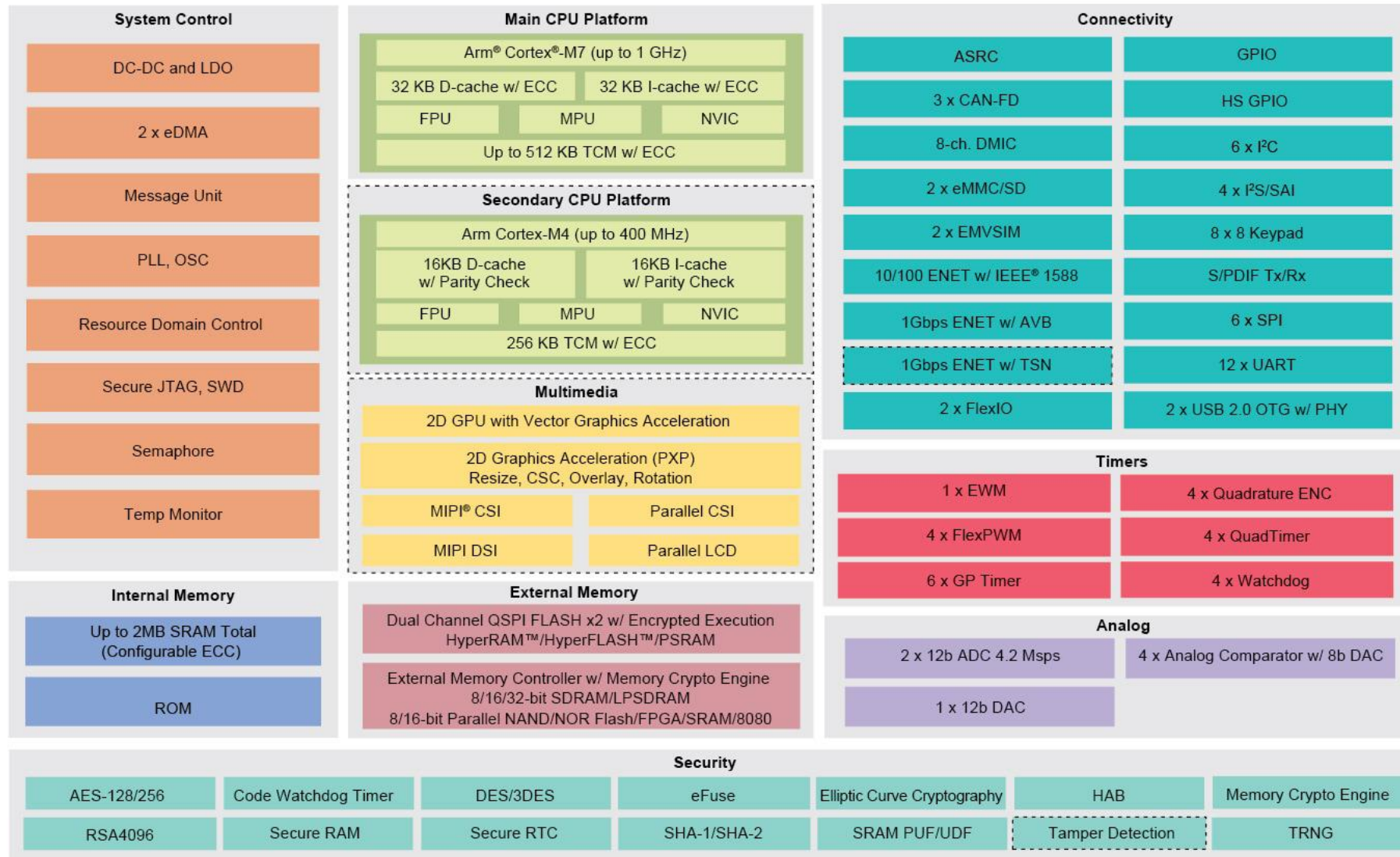
High  
Performance


Advanced  
Security

Rich Feature  
Set

Low power

# I.MX RT1170 BLOCK DIAGRAM



 Available on certain products within the family

## I.MX RT1170 SERIES

	i.MX RT1171	i.MX RT1172	i.MX RT1173	i.MX RT1175	i.MX RT1176
Cortex-M7	1GHz / 800MHz*	1GHz / 800MHz*	800MHz	1GHz / 800MHz*	1GHz / 800MHz*
Cortex-M4	-	-	400MHz**	400MHz**	400MHz**
MIPI CSI / DSI	-	Y	Y	-	Y
OpenVG 1.1 (2DGPU)	-	Y	Y	-	Y
CSI / LCDIF / PXP	-	Y	Y	-	Y
Ethernet	Y	Y	Y	Y	Y
TSN	-	-	-	-	Y
Tamper Protection	-	-	Y	-	-
HAB / AES / DES	Y	Y	Y	Y	Y
Package	289 MAPBGA	289 MAPBGA	289 MAPBGA	289 MAPBGA	289 MAPBGA
Qualification / *Temperature (Tj)	Commercial / 0 C to 95 C Industrial / -40 C to 105 C *Automotive / -40 to 125 C	Commercial / 0 C to 95 C Industrial / -40 C to 105 C Automotive / -40 to 125 C	Industrial / -40 C to 105 C	Commercial / 0 C to 95 C Industrial / -40 C to 105 C Automotive / -40 to 125 C	Commercial / 0 C to 95 C Industrial / -40 C to 105 C Automotive / -40 to 125 C
Part Numbers	<b>MIMXRT1171AVM8A (Auto)</b> MIMXRT1171DVMAA MIMXRT1171CVM8A	<b>MIMXRT1172AVM8A (Auto)</b> MIMXRT1172DVMAA MIMXRT1172CVM8A	- - MIMXRT1173CVM8A	<b>MIMXRT1175AVM8A (Auto)</b> MIMXRT1175DVMAA MIMXRT1175CVM8A	<b>MIMXRT1176AVM8A (Auto)</b> MIMXRT1176DVMAA MIMXRT1176CVM8A

\* Second speed listed is for Automotive/Industrial. First speed listed is speed for consumer qual.

\*\* For Automotive, 400MHz@105C / 240MHz@125C.

• Two new part numbers are added: **i.MX RT117F/i.MX RT117H**.

• **Automotive Temperature/Performance Conditions**

- 800MHz @ 125C requires external PMIC (PF5020) to meet DCDC (The application note will be ready later)
- 600MHz @ 125C w/ internal DCDC @1.0V
- 800MHz @ 105C w/ internal DCDC @1.1V

• Internal DCDC module reduces complexity of external power supply and simplifies power sequencing. It is suitable for applications up to 105C, but when Tj is increased to 125C, the core platform power consumption may exceed its capacity.

# MIMXRT1170-EVK DEVELOP PLATFORM

**Part Numbers:** MIMXRT1170-EVK  
**Display (5.5''):** RK055HDMIPI4M

## Processor

- NXP Semiconductors **MIMXRT1176DVMAA**
- **1GHz Arm® Cortex®-M7**
- **400 MHz Arm® Cortex®-M4 cores**

## Memory

- 512Mbit SDRAM memory
- 512 Mbit Octal Flash
- 128 Mbit QSPI Flash
- 2 Gbit Raw NAND Flash
- 64 Mbit LPSPI Flash
- TF socket for SD card

## Graphics

- MIPI LCD connector
- MIPI Camera Sensor connector

## Audio

- Audio Codec
- 4-pole Audio Headphone Jack
- External speaker connection
- Microphone(Analog & Digital)
- SPDIF Connector

## Connectivity

- 2x Micro USB OTG connectors
- Ethernet (10/100/1000M) connector
- Ethernet (10/100M) connector
- M.2 connector
- CAN Transceivers
- ARDUINO interface
- FRDM Motor control interface
- SIM card slot

## Debug

- JTAG connector
- On-board DAP-Link debugger

## Sensor

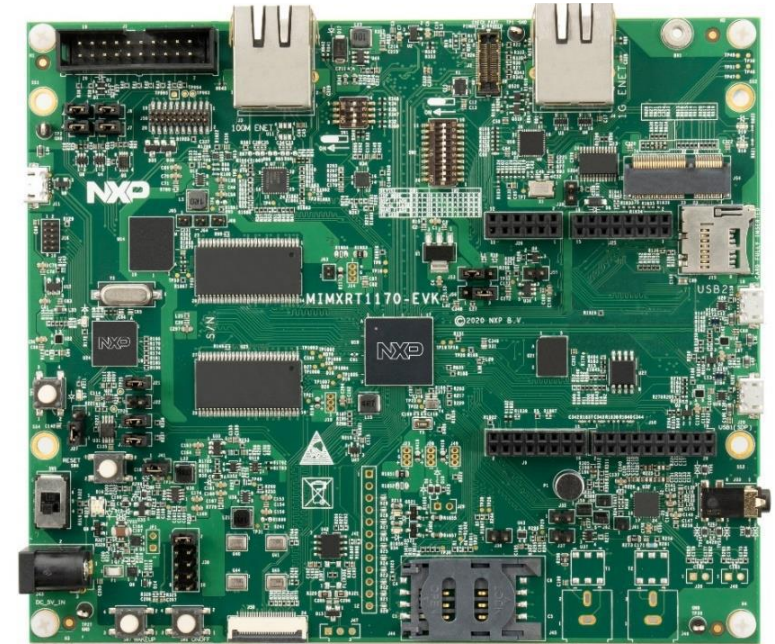
- 6-Axis Ecompass (3-Axis Mag, 3-Axis Accel) sensor FXOS8700CQ

## Tools & OS Support

- MCUXpresso Software & Tools, including MCUXpresso SDK with Amazon FreeRTOS™
- IAR Embedded Workbench® IDE
- Keil® IDE

## Others

- All-in-one board design
- 6-layer through hole PCB



## I.MX RT1170 SW DEVELOPMENT ENVIRONMENT



### MCUXpresso IDE

- Edit
- Compile
- Debug
- Optimize



### MCUXpresso Config Tools

Online and desktop tool suite for system configuration and optimization



### MCUXpresso SDK

- Runtime software including: drivers, middleware, RTOS, demos, and so on
- Supporting tools:
  - MCUXpresso IDE
  - IAR®, ARM® Keil®, GCC w/ Cmake
  - PE Micro and SEGGER probe support

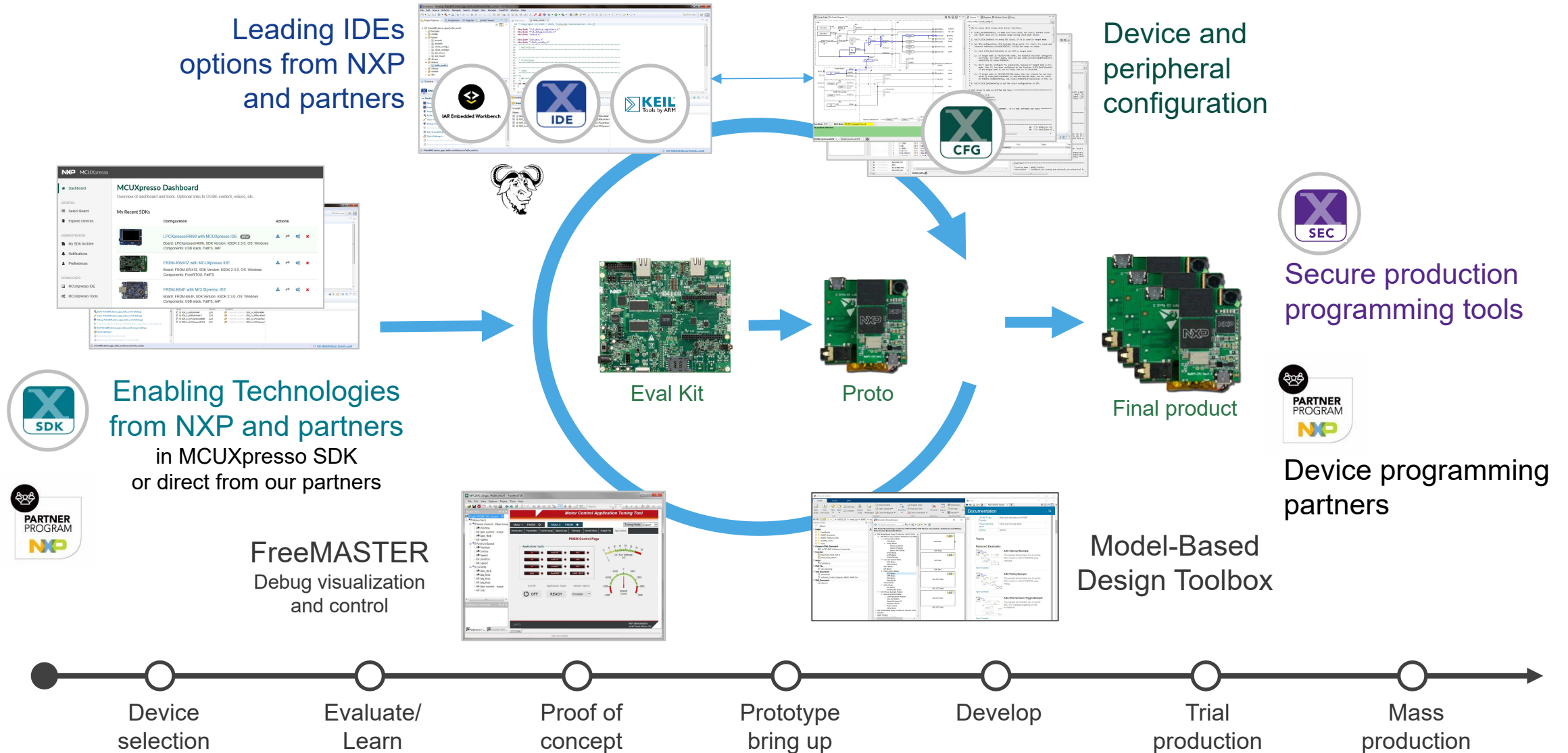


### MCUXpresso Secure Provisioning Tool

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



# STREAMLINED MCUXPRESSO DEVELOPMENT FLOW FOR I.MX RT11XX CROSSOVER MCUS



# i.MX RT1170: Key Features for Multimedia Applications

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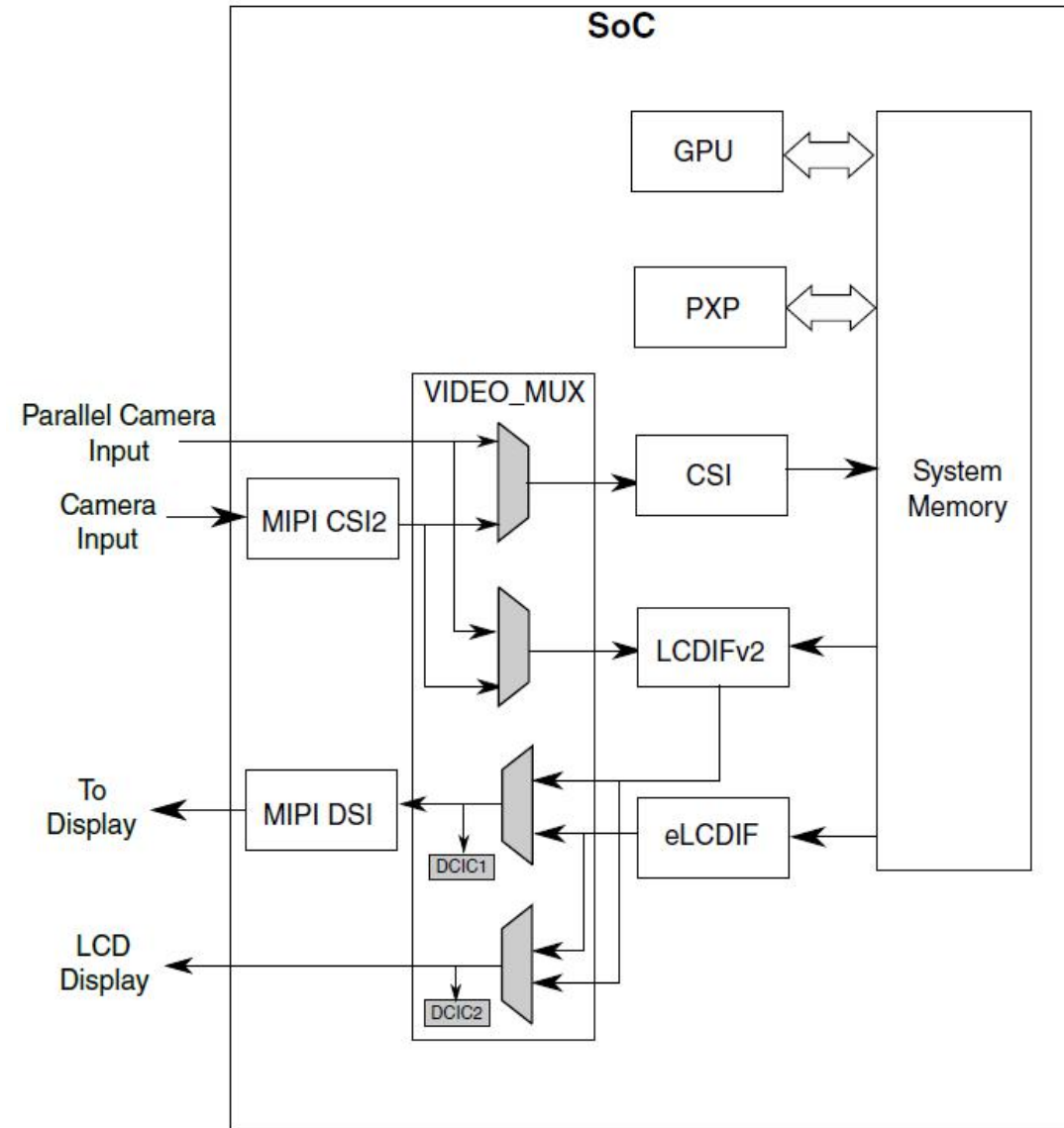
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# Multimedia

# I.MX RT1170 DISPLAY AND CAMERA



## I.MX RT1170 CMOS Sensor Interface and Display Interface

### CMOS Sensor Interface

- Two CSI Interfaces
  - 1x Parallel CSI Interface
  - 1x MIPI-CSI 2-lane Interface
- Data bus
  - Up to 24-bit
  - Also support 8-bit, 10-bit, 16-bit
- Variety of data formats
  - YUV 4:2:2/4:4:4
  - RGB 16/24 bpp
  - CCIR656
  - Other: as generic data, including compressed streams
- Frame resolution
  - Essentially unlimited (up to 65535 x 65535 pixels)
- Input rate
  - 75 MPixel/s peak

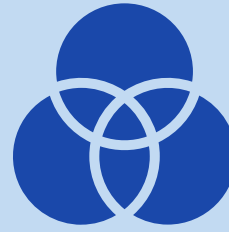
### Display Interface

- Two Display Interfaces
  - 1x Parallel RGB Interface
  - 1x MIPI-DSI 2-lane Interface
- Display Data Bus
  - Up to 24-bit
  - Also support 8-bit/16-bit/18-bit
- Display Resolution
  - Support up to WXGA@60fps with rich UI & application
  - Typical pixel rate: 27~74.25 MP/sec
- Other Features
  - 8-bit to 24-bit color lookup table
  - Fully programmable Panel Interface Generator



## 2D GPU







- **OpenVG Core**
  - Up to 500MHz
- **Support OpenVG 1.1 API**
  - Sophisticated 2D graphical applications.
  - Target applications: GUI, game, low-level graphics device interface, map, and so on
- **Vector Graphics Functions**
  - Clip, fill, filtering, change transparency, and so on



## PXP

- **PXP is High-efficiency graphics 2D and image processing engine:**
  - Flexible image composition options (alpha, color key, Porter-Duff blending)
  - Color space conversion
  - Single-pass processing for Resize, Overlay and Rotation (90°, 180°, 270°)
  - Support data pipeline mode with LCDIF for DRAM bandwidth saving

# GRAPHICS MIDDLEWARE OVERVIEW

PROVIDER / PRODUCT	TYPE	BUSINESS MODEL	UI DEVELOPMENT TOOL	RTOS REQUIRED	OPTIMIZATION
	Free	Free pre-compiled libraries via NXP MCUXpresso SDK (source code license available from SEGGER)	AppWizard	Optional (any)	-
	Free	Open source	GUI Guider by NXP	Optional (any)	PXP, VGLite
 GUI Solutions by TARA Systems	Premium	Developer seats, volume-based product line license	Embedded Wizard Studio	Optional (any)	PXP, VGLite
	Premium	Developer seats, volume-based product line license	Storyboard Designer	Optional (any)	PXP, VGLite
	Free	Free via NXP MCUXpresso SDK (for supported devices)	Azure RTOS GUIX Studio	Azure RTOS ThreadX	-
 The Qt Company	Premium	Developer seats, volume-based product line license	Qt Design Studio, Qt Creator	Optional (any)	PXP, VGLite

# GRAPHICS MIDDLEWARE SUPPORT MATERIAL

- Segger – EmWin

- [MCU Tech Minute | Tips & Tricks for GUI development with emWin and AppWizard](#)
- SEGGER emWin Forum: <https://forum.segger.com/index.php/Board/12-emWin-related/>
- Technical Support: <https://www.segger.com/support/technical-support/>

- LVGL

- Documentation: <https://docs.lvgl.io/v7/en/html/get-started/quick-overview.html>
- Forum: <https://forum.lvgl.io/>
- LVGL Academy: <https://lvgl.academy/>

- Embedded Wizard

- Knowledge Base: <https://doc.embedded-wizard.de/>
- Master Class Video Library: <https://www.embedded-wizard.de/master-class-mondays>
- Community: <https://ask.embedded-wizard.de/>
- Training Options: <https://www.embedded-wizard.de/services/training>

- Crank

- Help Center: [support.cranksoftware.com/hc/en-us](https://support.cranksoftware.com/hc/en-us)
- Videos: [www.cranksoftware.com/learn/video-library](https://www.cranksoftware.com/learn/video-library)
- Advanced Training Webinars: [www.cranksoftware.com/learn/webinars#aut-webinars](https://www.cranksoftware.com/learn/webinars#aut-webinars)

- Microsoft Azure

- Professional support plans available from Microsoft: <https://azure.microsoft.com/en-us/support/options/>
- Documentation: <https://docs.microsoft.com/en-us/azure/rtos/guix/>
- Microsoft Q/A for Azure IoT: [docs.microsoft.com/en-us/answers/products/azure?product=iot](https://docs.microsoft.com/en-us/answers/products/azure?product=iot)
- IoT Tech Community: [aka.ms/iottechcommunity](https://aka.ms/iottechcommunity)

- Qt

- Videos: <https://resources.qt.io/nxp>
- Collateral: <https://www.qt.io/microcontrollers-nxp>
- Training: <https://resources.qt.io/nxpteam>, <https://resources.qt.io/qt-mcus>





# Connectivity

## CONNECTIVITY HIGHLIGHTS

GPIO

I2C

SPI

UART

USB

CAN

Ethernet

EMV\_SIM

Keypad

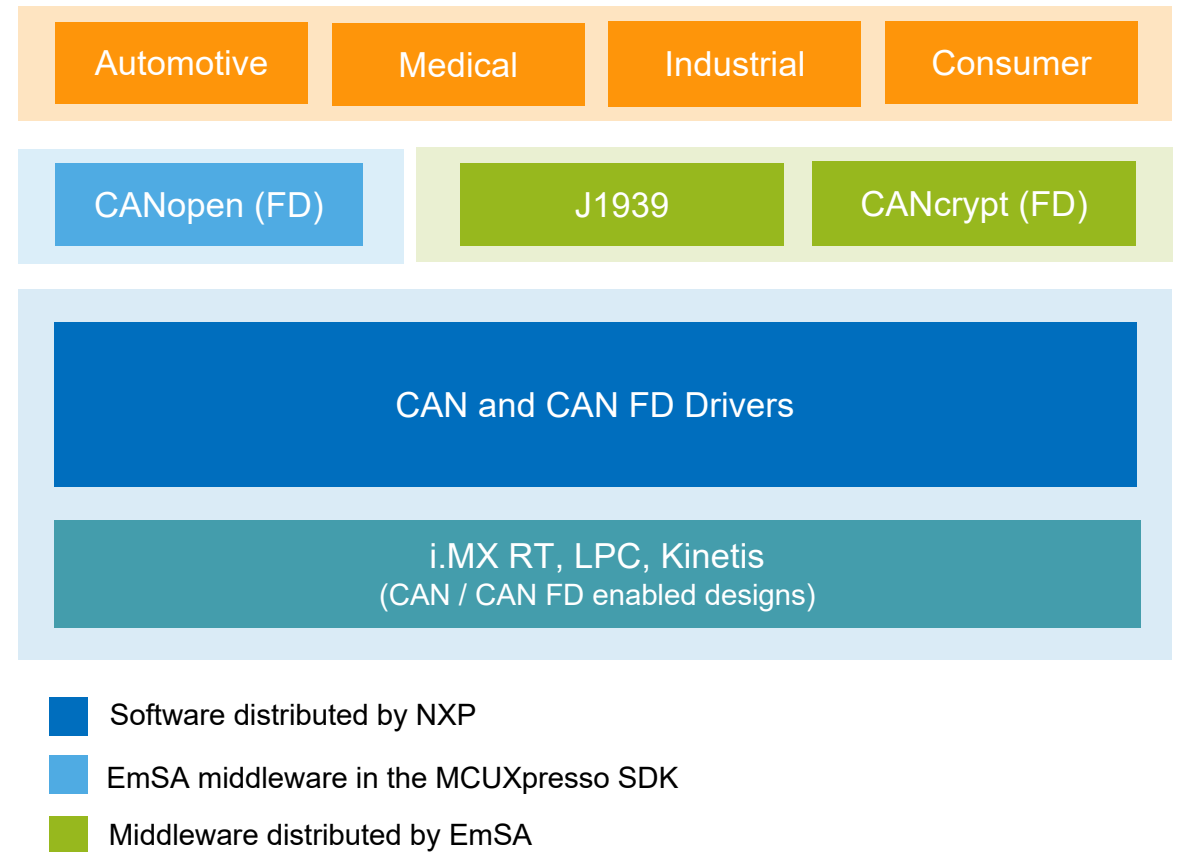
eDMA

WIFI

Bluetooth

## CAN (FD) SOFTWARE FOR NXP MCUS

- NXP provides CAN and CAN FD drivers through the i.MX RT117x MCUXpresso SDK
- Long-time NXP partner EmSA provides middleware for CAN-based higher-layer protocols
- Evaluation versions integrated in MCUXpresso SDK
  - CANopen FD
- Also available from EmSA
  - CANopen
  - J1939
  - CANcrypt and CANcrypt FD



## MICROCANOPEN (FD) MIDDLEWARE

- MicroCANOpen Plus is a small-footprint, commercial-grade CANOpen and CANOpen FD stack with advanced features
- Memory footprint: 7K - 14K bytes (for CANOpen Slaves)
- Passes official CANOpen conformance test
- Fully integrated libraries based on MicroCANOpen Plus v7.0 is available in the MCUXpresso SDK for i.MX RT1170
- Examples to help you get started with your CAN or CAN FD application
  1. CANOpen Generic I/O example (CiA 401)
  2. CANOpen Manager example
  3. CANOpen FD Generic I/O example (CiA 401)
  4. CANOpen FD Manager example
- For more information visit [www.canopenstore.com/pip/microcanopen-plus.html](http://www.canopenstore.com/pip/microcanopen-plus.html)

## i.MX RT1170 AVB/TSN FEATURES (HW/SW)

- TSN Endpoint, and AVB Endpoint (Audio) modules available
- Stack and example applications are free for use with NXP MCUs, and compatible with the MCUXpresso SDK
  - Direct links to download GenAVB/TSN packages are available [here](#)\*
  - Stack provided as object code; FreeRTOS-based examples available as source code

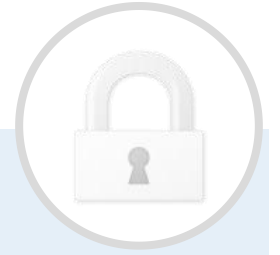
Standard	Description
802.1Qav	Forwarding and Queuing Enhancements (AVB) including Credit Based Shaping
802.1Qbv	Time-aware shaping (per-queue based)
802.1Qbu, 802.3BR	Frame pre-emption
802.1Qat	Stream Reservation Protocol (SRP)
802.1Qcc	SRP Enhancements and Performance Improvements
802.1AS-2020	Timing and synchronization in bridged LAN (gPTP) Includes 802.1AS-rev enhancements (redundant GM clocks, GM failover)

\*TSN software will be available for selection in the SDK Builder in a future release (January 2022)



# Security

# i.MX RT1170 SECURITY



## Crypto Engine

- CAAM
  - AES-128/256, DES/3DES, RSA up to 4096, ECC up to 1024, SHA up to 512 bit
- IEE
  - AES 128/256
- OTFAD
  - AES-128bit

## Random Number Generation

- NIST-Compliant Pseudo Random Number Generator

## Tamper Protection

- Up to 10 tamper pins, active/passive
- Temperature / Voltage / Frequency monitor

## Supply Chain Integrity

- 256-bit manufacture protection key

## Secure Debug

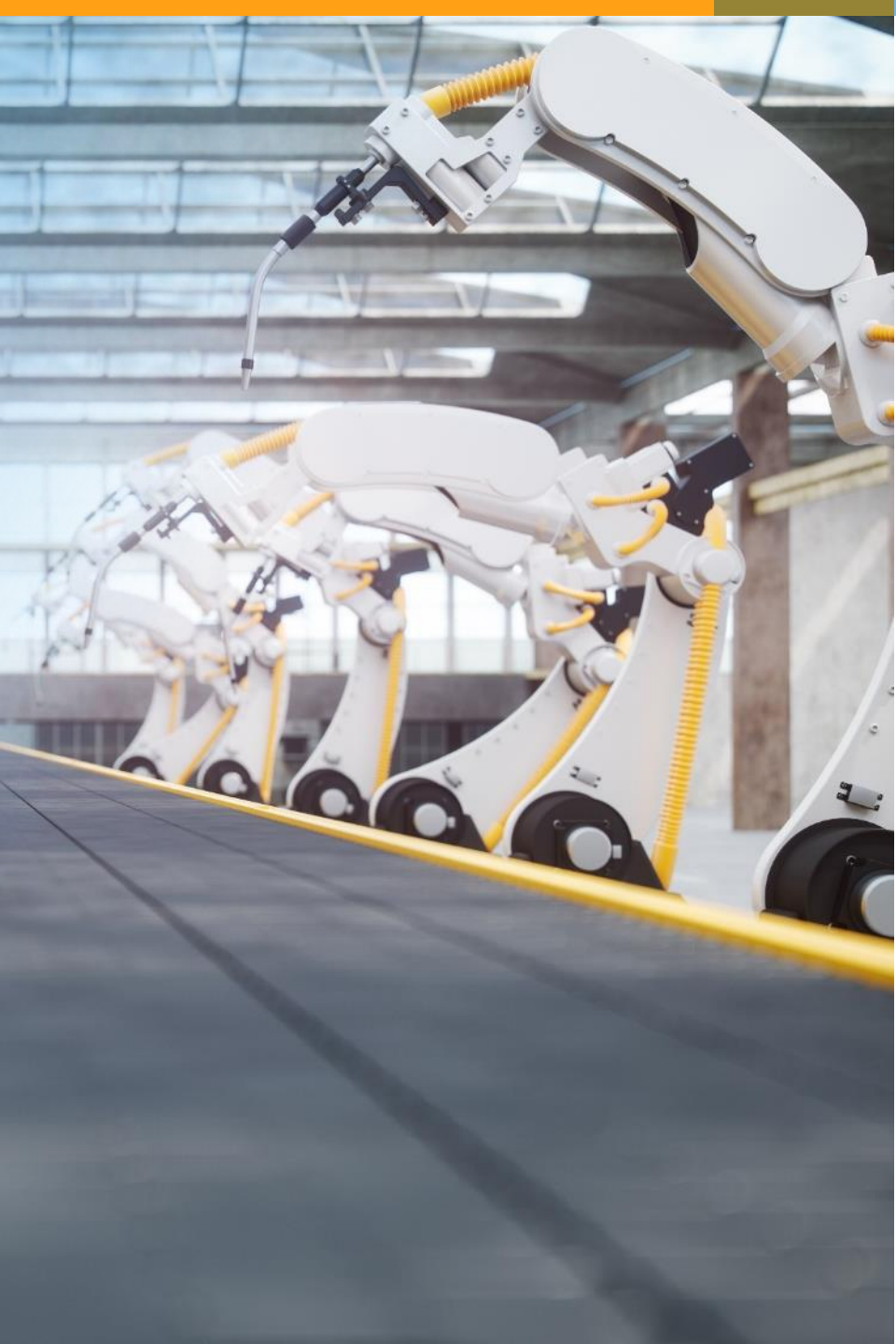
- 128-bit protection key

## On-chip OTP

- Up to 8K bit OTP fuse, 5x 256-bit user keys
- Flexible permission control, including read-protect, write-protect and program-protect

## Key Protection

- UDF module for key scrambling
- PUF key for chip unique secrets



# AI / ML



## EIQ™ TOOLKITS - MACHINE LEARNING LIBRARIES AND DEVELOPMENT TOOLS

- Glow,
- TensorFlow™ Lite
- Arm CMSIS-NN
- DeepViewRT™

Deploying open-source inference engines

- Complimentary tools from NXP, with no separate SDK or release to download:
- Integrated in MCUXpresso SDK

Integrating into MCUXpresso SDK

- Demos
- Documentation
- Technical training: lectures, hands-on, video

Supporting materials for ease of use



# Safety

## I.MX RT1170 SAFETY FEATURES

- Safety-related components:
  - Arm Cortex-M cores x2 (M7 & M4)
  - ECC M7 TCM, Cache, OCRAM
  - ECC M4 TCM
  - 30ns interrupt latency
  - Watchdog Modules x4
  - External Watchdogs
  - Domain Partitioning
  - DCIC display integrity check
  - Ext. ECC SLC NAND FLASH, SDRAM

# i.MX RT1170: Solutions for Digital Cluster

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## I.MX RT1170 TARGET APPLICATIONS FOR AUTO

In-vehicle HMI

Entry level 2D  
digital cluster

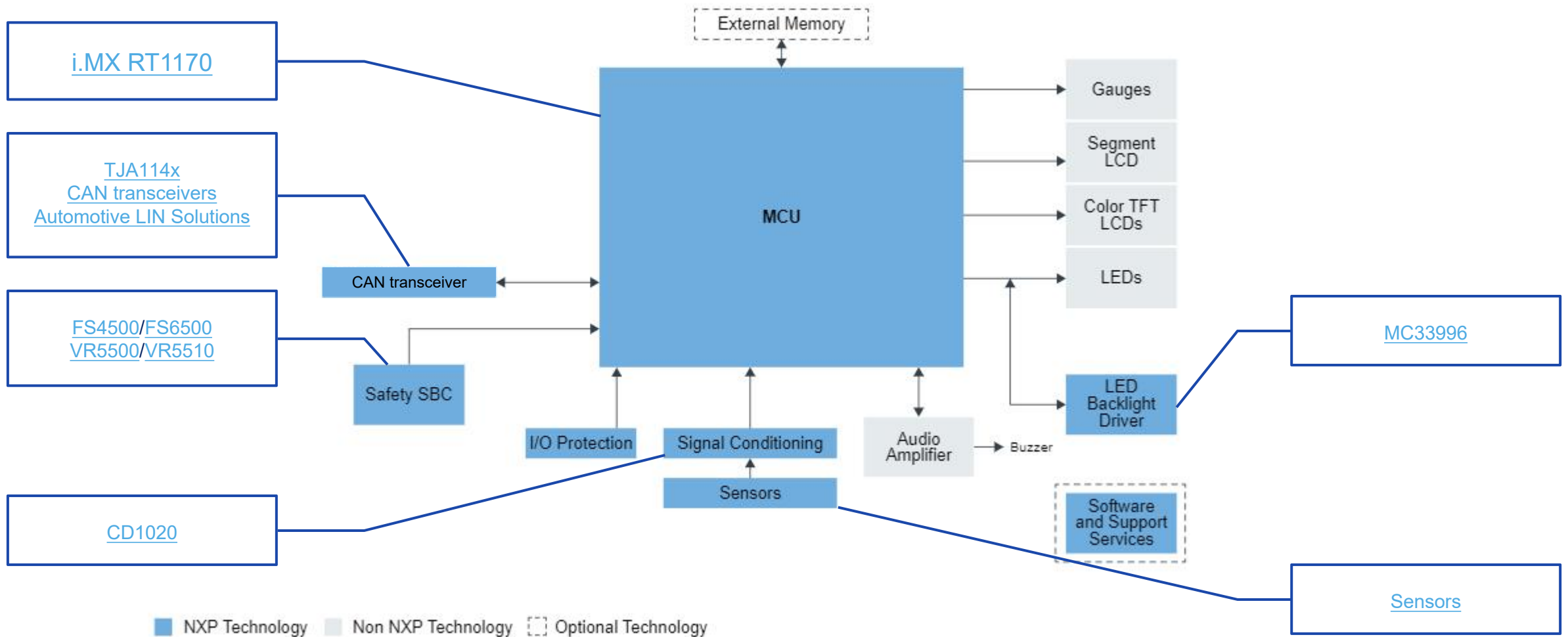
Entry level  
DMS

HUD

Voice  
command

...

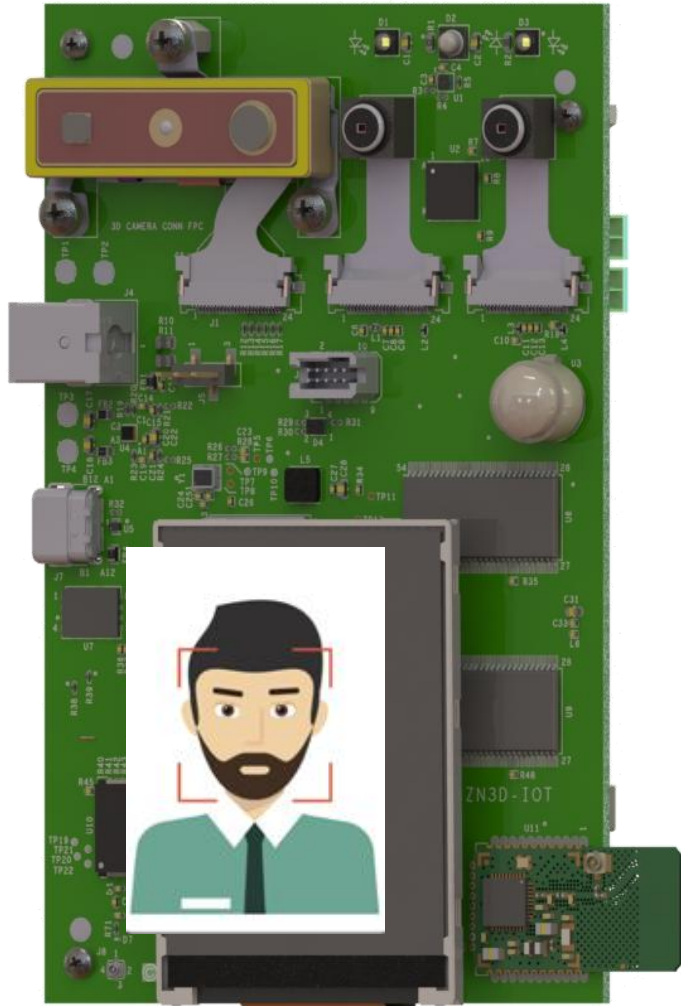
# I.MX RT1170 TARGET APPLICATION – 2D INSTRUMENT CLUSTER / HMI



You may watch the demo in:

- [e-Car cluster demo 1](#)
- [e-Car cluster demo 2](#)

# I.MX RT117H/F-BASED VISION + VOICE SOLUTION



## Components:

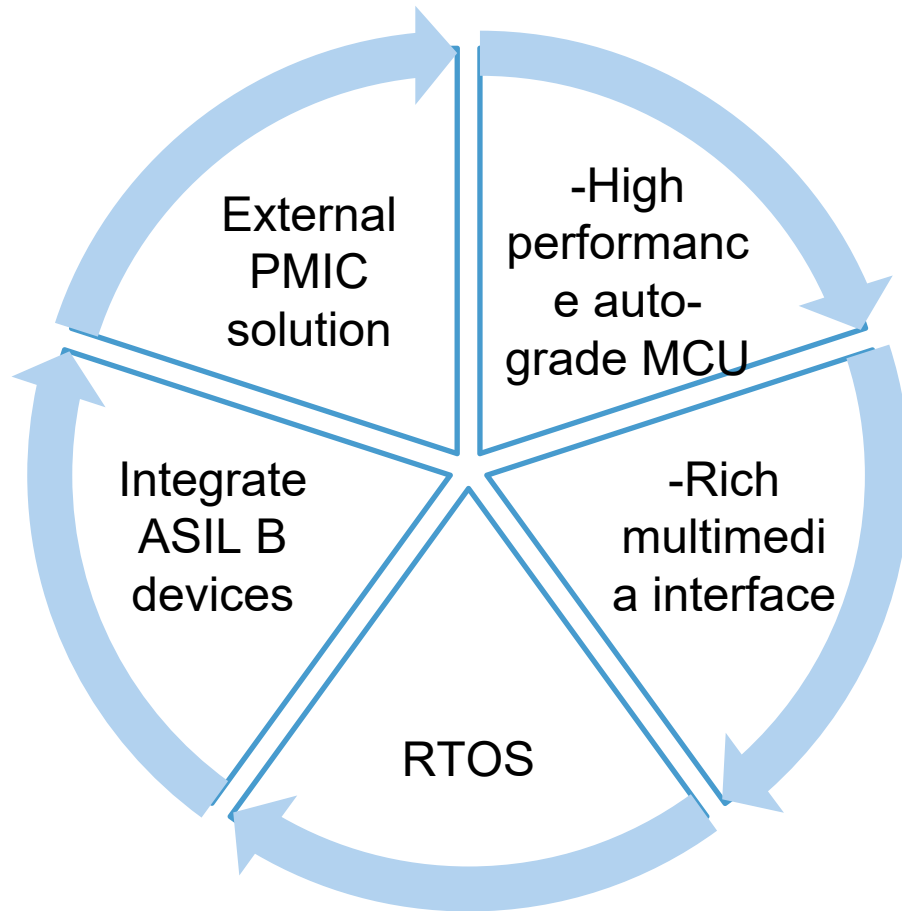
- MCU
- Vision Input
- Voice Input
- Display Output
- Wireless Connectivity

## Use cases:

- Smart lock
- Voice control
- Smart touchless HMI

## I.MX RT1170 AUTO DEVELOPMENT PLATFORM (ADP)

i.MX RT1170 Auto Development Platform (ADP) targets to offer a solid foundation to enable HUD, small cluster, HMI, entry-level DMS, and voice command designs.



- Prove the performance of i.MX RT1170 in automotive applications
- Provide a baseline design as a starting point for customers' automotive applications.

# Coming Soon



## RESOURCES

- More device info at [nxp.com/imxrt1170](https://nxp.com/imxrt1170)
- Available Graphics SW, support, and training can be found on [here](#)
- Graphics-specific Training and Documentation
  - [i.MX RT1170 Crossover MCUs | Embedded Graphics Software Options](#) Video Training
  - [AN13075: i.MX RT1170 Heterogeneous Graphics Pipeline](#)
  - [AN12940: Use Case of RT1170 LCD Display System based on MIPI DSI](#)
- MCUXpresso SDK and other SW tools can be found [here](#)



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