

Discover the analytics capabilities of TI's NEW Arm®-based AM62x processors

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Discover the analytics capabilities of TI's NEW Arm®-based AM62x processors

Today's Presenters:

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EdgeAI Software
Product Manager

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Product Marketing
Engineer

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AI Development
Engineer

Note: This slide deck is modified to make it offline usage

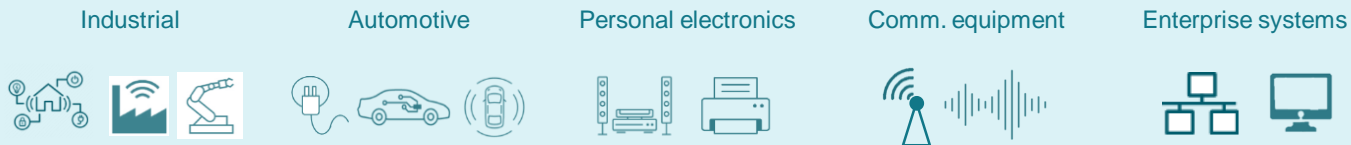
Agenda

- AM62x Introduction
- TI Analytics
 - TI Processor Portfolio
- Enabling Edge AI on AM62x
 - Edge-AI Solution
 - Edge-AI Packages
 - Analytic Models & Performance
- Arm Developer Ecosystem
- How to start Development Now!
- Relevant Training Content

AM62x

TI Processors **Business Unit**

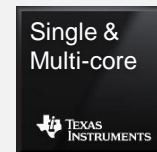
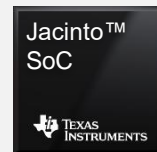
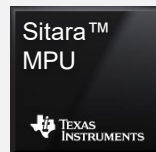
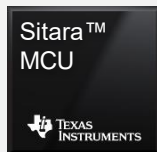
Key markets



Products

Arm®-based MCUs & Processors

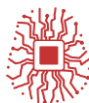
Digital Signal Processors



Investment vectors



Integrated precision sensing & control: Lower system costs with the industry's best-integrated analog



Edge AI & edge computing: Enable decision making & machine learning at the edge



Energy efficiency: Maximize energy efficiency with advanced processing & control capabilities



Functional safety & security: Design robust products with integrated features for functional safety & security

011100
100010
001111

Networking: Real-time networking with high-speed communication switches and network packet accelerators



Unified software development kit: Develop with ease, flexibility and scalability

AM62x Family | Values & Differentiations

Low cost MPU for Analytics!

Better Power Efficiency

No heatsink, fan or lid
 $P_{Active} < 2W$

5-year battery life
 $P_{LP} \sim 5mW$

*4 Low-Power Modes

Protect your privacy

Protect your design's Integrity

Anti-cloning / IP Protection

Security Acc Crypto

Ease-of-use EdgeAI

Facial/Gesture Recognition on ARM

Analytics + Vision Algorithm

MIPI-CSI Camera

Advanced Display Feature

Dual Display Interface

RGB LVDS

Full HD 2K

Open GL3.x

DDR4/LPDDR4 w/ECC

3D GPU

DPI OLDI/LVDS DSS

Revolutionizing Your Next Gen!

Available now on TI.com

<https://www.ti.com/product/AM623>

<https://www.ti.com/product/AM625>

Starting at \$6!

Leading cost-effective System Solution

Rich on-chip resources

Simplified Power Solution

EMAC x2

UART x9

CANFD x3

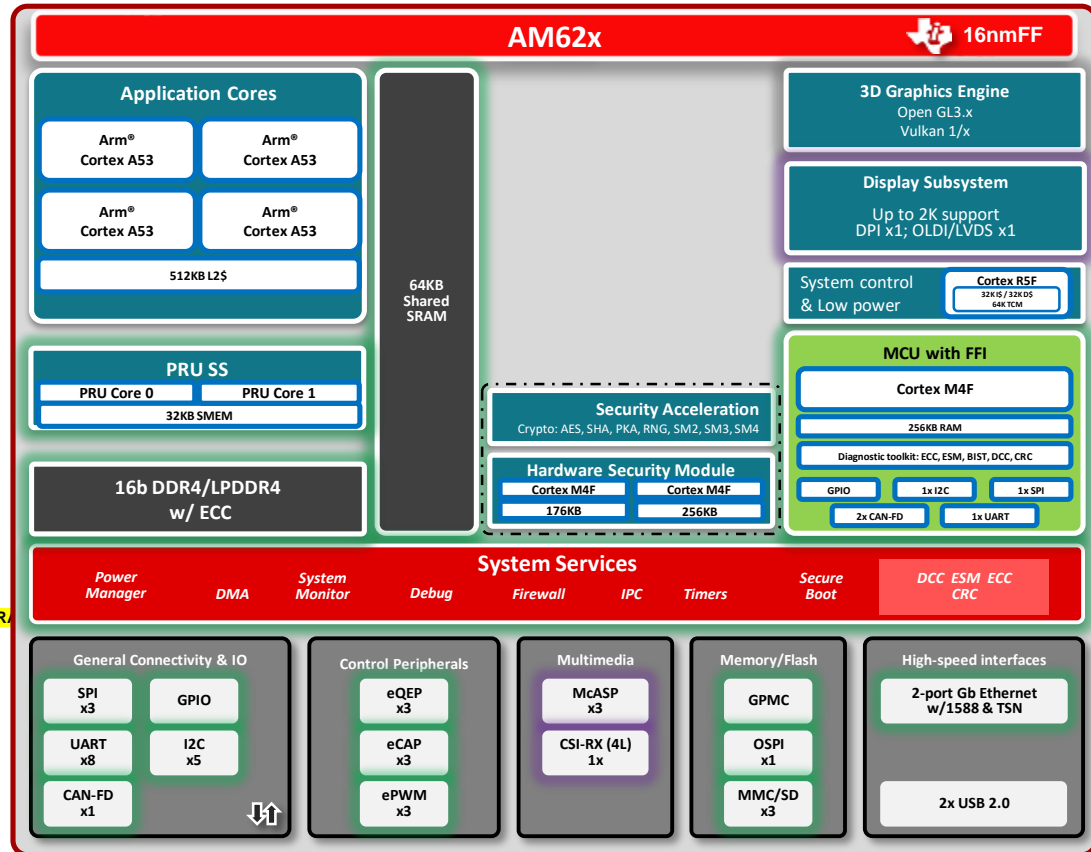
Power Supply

Reducing the power rails

AM62x Cortex[®]-A53 based processors

Available now on TI.com

- **Compute Processing Power**
 - 1-4x Cortex-A53 up to 1.4GHz (up to 16.8K DMIPS), total 512KB L2
 - 1x Cortex-R5 up to 400MHz (System controller & Power management), 64KB TCM
 - PRU SS (Dual core) with 32KB SMEM
 - **3D GPU (8 GFLOPS)**
- **Capture, Viewing, Analytics**
 - 1x CSI-2 RX (4L) @2.5Gbps camera interface
 - **Display subsystem: 1x DPI, 1x OLDI/LVDS with CRC check**
- **Memory IO**
 - 1x 16-bit LP/DDR4-1600, up to 3.2GB/s, inline ECC
 - 1x Octal-SPI with execution-in-place support, 3x MMC/SD, 1x GPMC (16-bit data)
- **Automotive IO**
 - 3x CAN-FD (2x in MCU subsystem)
- **High Speed IO**
 - 2x USB2.0
 - 2-port Gb Ethernet switch (AVB & TSN)
- **Safety & Security**
 - ASIL-B / SIL-2 capable
 - 1x Cortex-M4F (400MHz) MCUSS with FFI, dedicated peripherals & 256KB SRAM
 - Diagnostic toolkit (entire SoC), voltage, temp, clock, ECC monitors & error signaling
 - SHE 1.1/EVITA-Full HSM, Secure boot, Crypto
 - **HSM has dedicated 2x Cortex-M4F running at 400MHz with total of 432KB of SRAM**
- **Power**
 - Typical usecase <2W @125dC Tj
 - Advanced low power stand-by and suspend states
- **Package**
 - 13x13 mm, 0.5mm ball pitch, VCA technology for low cost PCB routing rules
 - 17x17 mm, 0.8mm ball pitch



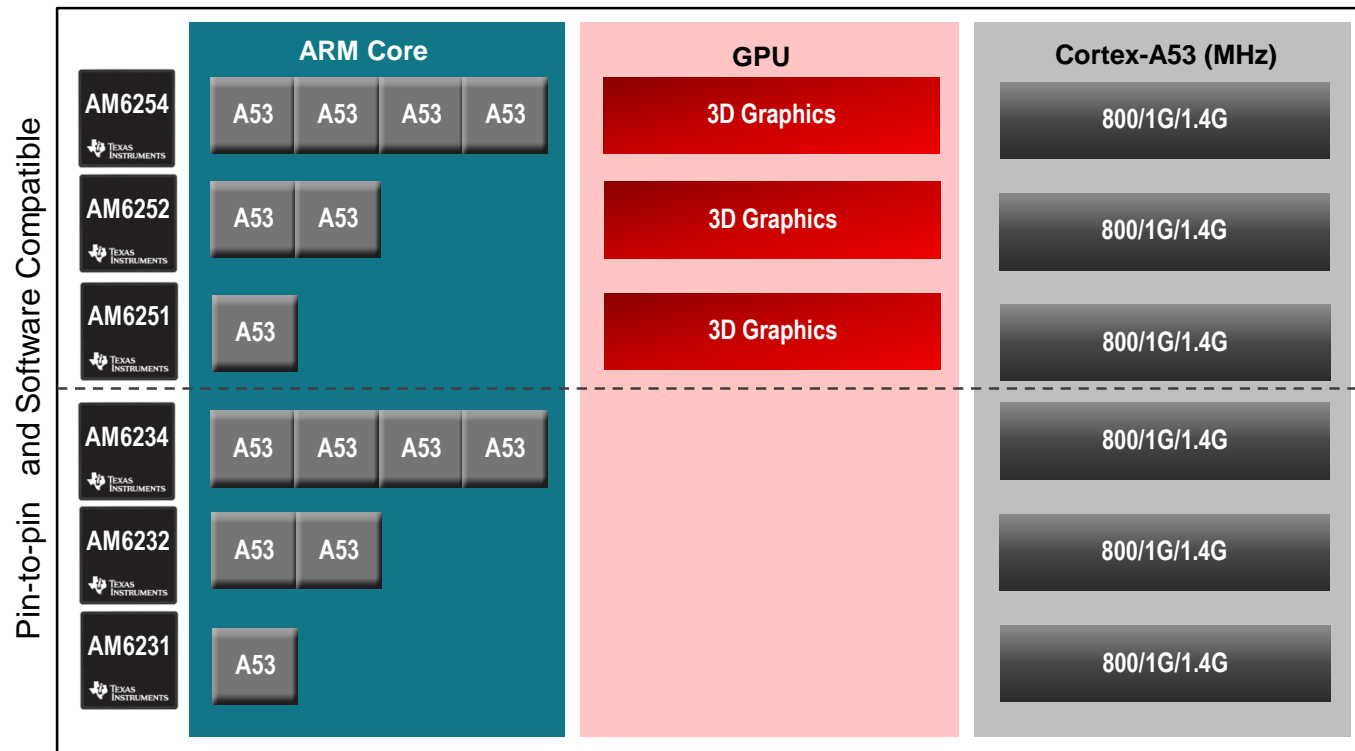
Re-use & tested on AM64x

Re-use & tested on TDA4x

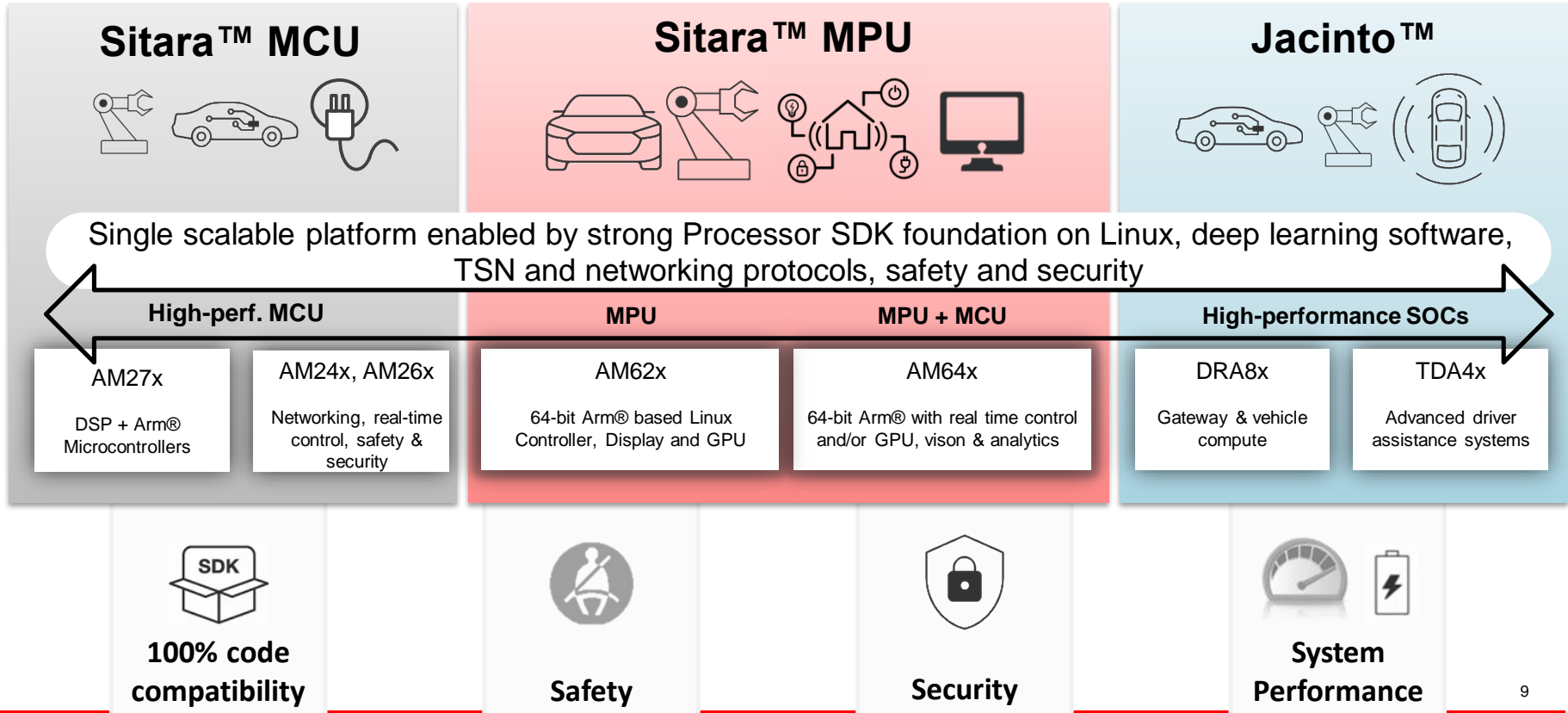
TDA4x IPs downsized

AM62x Family | Multiple pin-to-pin compatible devices

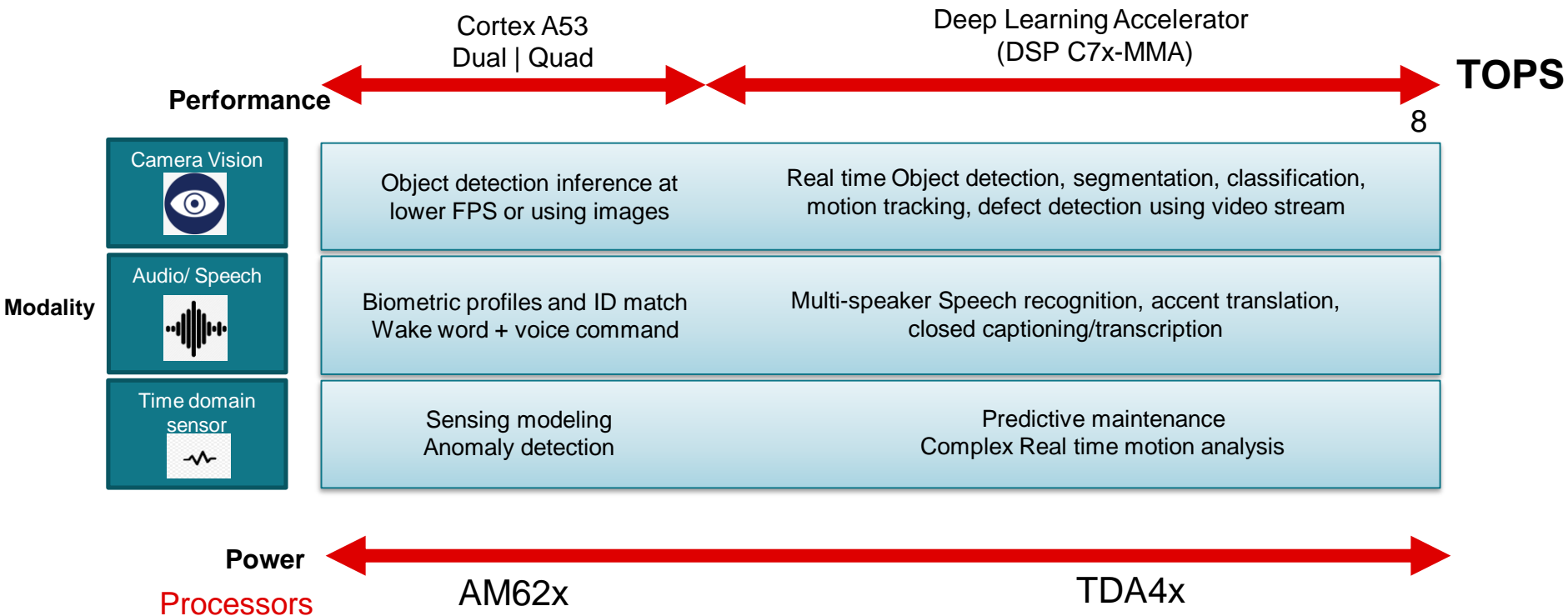
- Scalability to 1, 2, and 4 cores
- Extensive low power modes
- Secure Boot w/ HSM
- Dual display: 2K resolution (1080p60)
- ASIL-B / SIL-2 FS Compliant options available
- Available in 105°C/125°C.
- Packages: 13x13mm 0.5mm VCA, 17x17mm 0.8mm



TI Processors



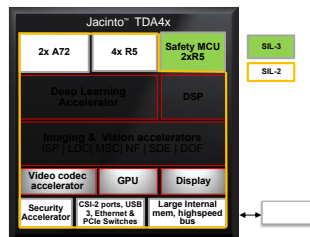
TI EdgeAI Enabled Processor Devices



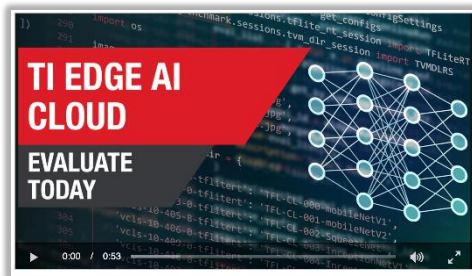
Note: Quad core A53 Tflite performance is provided in [Sitara™ AM64x /AM243x BenchmarksCortex-R5 Memory Access Latency](#)

AI with TI | Explore, Learn and Build

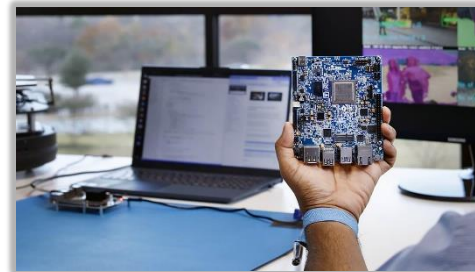
Explore processors



Learn with Free Cloud Tools

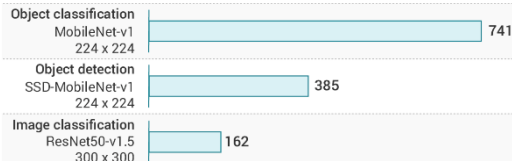


Build with reference designs



Energy efficient AI architecture

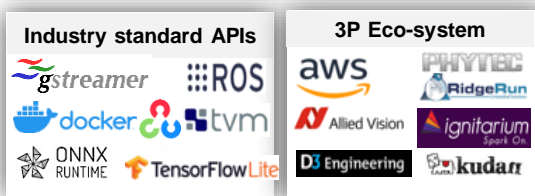
MLPerf inference benchmarks



Get started for free

- **TI Model Zoo:** Extensive AI models for most common problems
- **TI Edge AI Cloud :**
 - Evaluate TI's Models
 - Benchmark your models

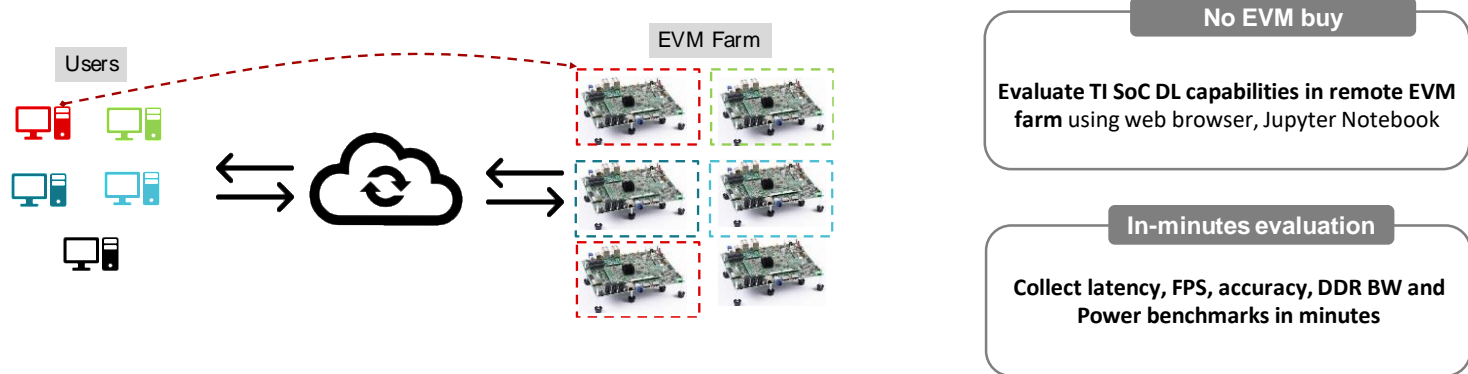
Fast Development Cycle



ti.com/edgeai

TI Edge AI Cloud for faster AI evaluation and development

Free on-line service, enable deep learning evaluation in minutes



 TensorFlow Lite

 ONNX
RUNTIME

 tvm

- < 1 min to explore & compare performance : Model Selection tool
- < 5 min to experience SW & evaluate HW : TI Model Zoo examples
- < 30 min to evaluate custom models : Custom model examples
- 1 hr+ to benchmark performance : TI Model Zoo examples

Available now at www.ti.com/edgeai

AM62x Enabling Edge AI at Low cost & low power

Explore Analytics with AM62x

**Gesture
Recognition**

Touchless Gesture Control



**Face
Recognition**

Touchless Access Control



**Face
Recognition**

**User Authentication
Face Detection**



**People
Detection**

Driver Monitoring



**Object
Detection**

EV Charging

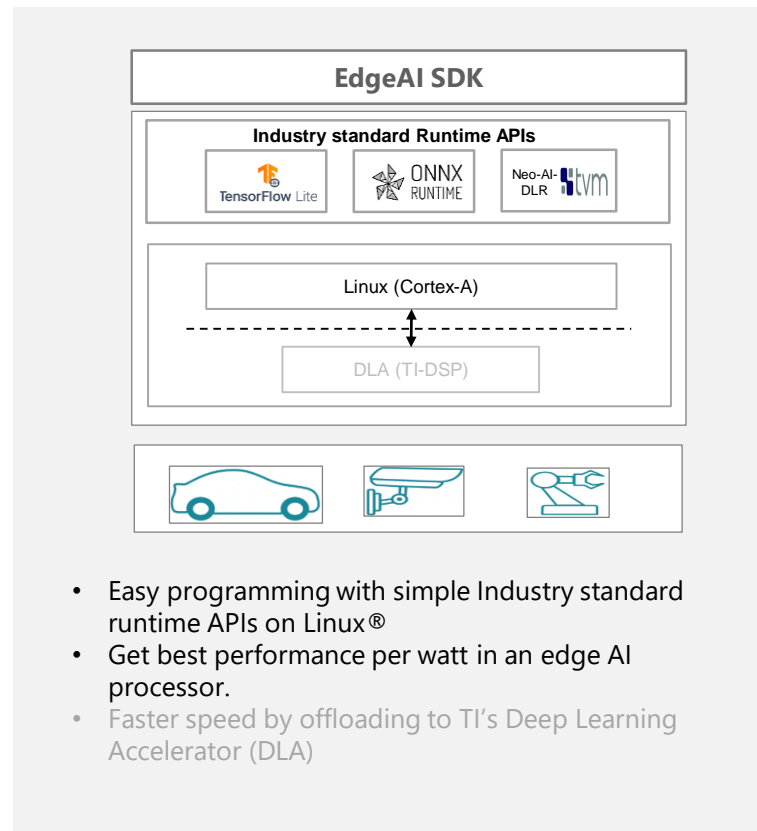
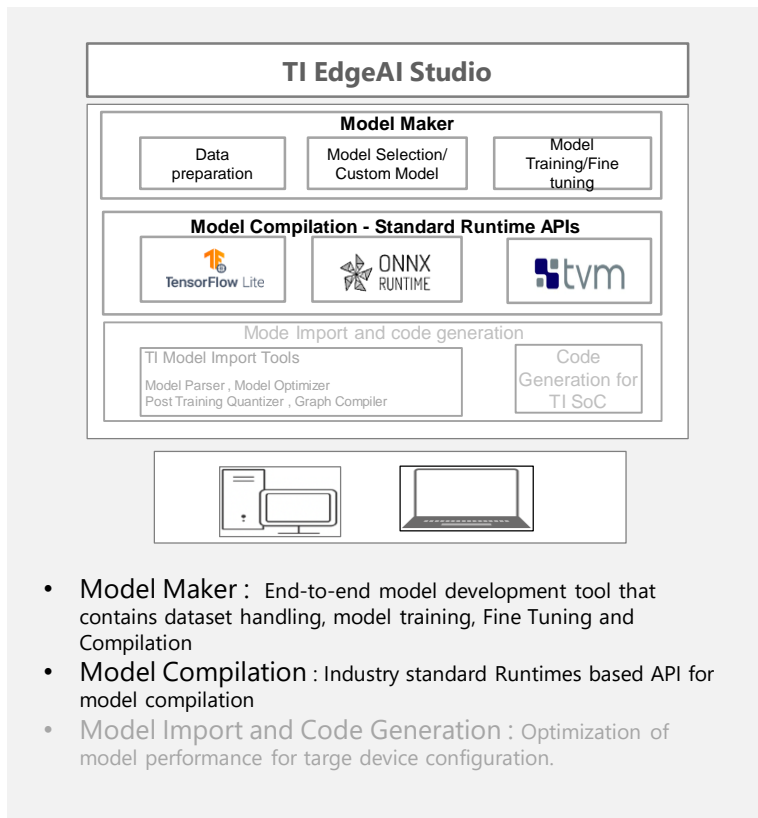


**People
Detection**

Video Doorbell



Edge-AI Solution for Sitara MPU and Jacinto Processors



EdgeAI Packages in AM62x

Package Name	Version	Python API	C++ API	Delegate/Offload
Tensorflow Lite	2.8	Yes	Yes	xnnpack armnn
ONNX Runtime	1.7	Yes	Yes	CPU Execution Provider

- Latest version of Processor SDK can be found here
 - <https://www.ti.com/tool/PROCESSOR-SDK-AM62X>
 - Processor SDK Linux for AM62X - 08.03.00
- Support for on-the-board development of python and C++ application to enable quick deployment of models and debugging
 - Native compilation of C++ application on Target (EVM/SK Board)
- Support for cross compilation of C++ application on Host PC (Ubuntu18.04) for production deployment.

Edge AI TIDL Tools and Examples

- TI hosts github repository with few examples for vision CNN models
- Can be easily benchmarked on TI EVM & Starter Kit boards such as SK-AM62

The screenshot shows a GitHub README page for 'EdgeAI TIDL Tools and Examples'. It includes a title, a description of the repository's purpose, a workflow diagram, and a table of supported hardware.

EdgeAI TIDL Tools and Examples

This repository contains examples developed for Deep learning runtime (DLRT) offering provided by TI's EdgeAI solutions. This repository also contains tools that can help in deploying AI applications on TI's EdgeAI solutions quickly to achieve most optimal performance.

DNN development and deployment work flow

```
graph LR
    subgraph Select
        B[Bring your own Model]
        M[Model zoo Model Selection Tool]
    end
    subgraph TrainRefine
        T[Training and Quantization tools]
    end
    subgraph Evaluate
        EC[Edge AI Cloud]
        EB[Edge AI Benchmark]
    end
    subgraph Deploy
        SDK[SDK]
        subgraph HW
            P[Python/C++]
            T[TEGRA]
            O[TYNED]
            TIDL[TIDL-RT (OpenVA)]
            ARM[ARM MPU (Cortex-A*)]
            MMA[G7x + MMA]
        end
        TIDL --- MMA
    end
    Select --> TrainRefine
    TrainRefine --> Evaluate
    Evaluate --> Deploy
```

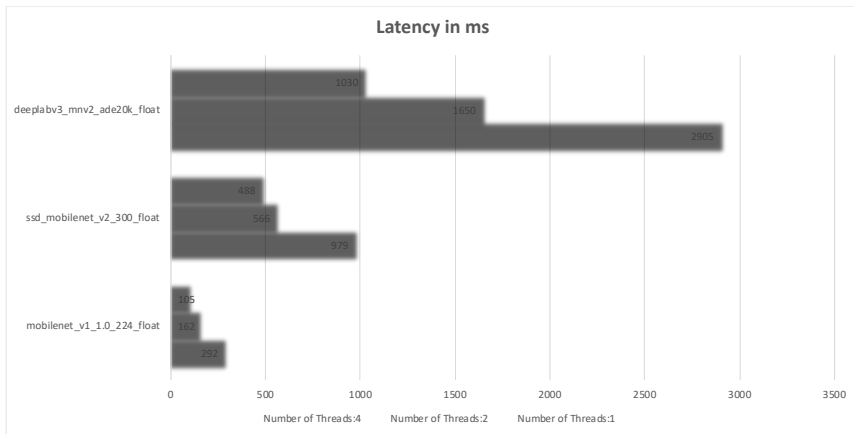
SDK	
Python/C++	
TEGRA	TYNED
TIDL-RT (OpenVA)	
ARM MPU (Cortex-A*)	
G7x + MMA	
TIDL	

- [EdgeAI TIDL Tools and Examples](#)
 - [Introduction](#)
 - [Setup](#)
 - [Advanced Setup Options](#)
 - [Python Examples](#)
 - [C++ Examples](#)
 - [Validated Examples](#)
 - [Jupyter Notebooks](#)
 - [Versioning](#)
 - [Notes](#)
 - [License](#)

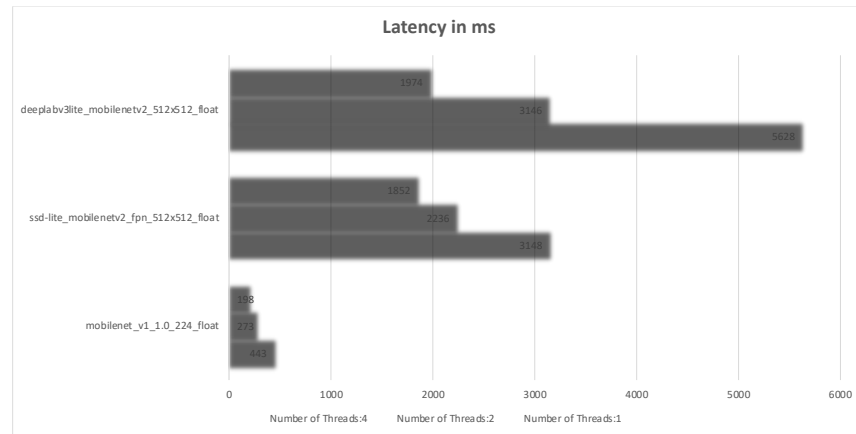
<https://github.com/TexasInstruments/edgeai-tidl-tools>

AI Models Performance Benchmarks on AM62x

TensorFlow Lite Performance With Default Delegate (XNNPack)

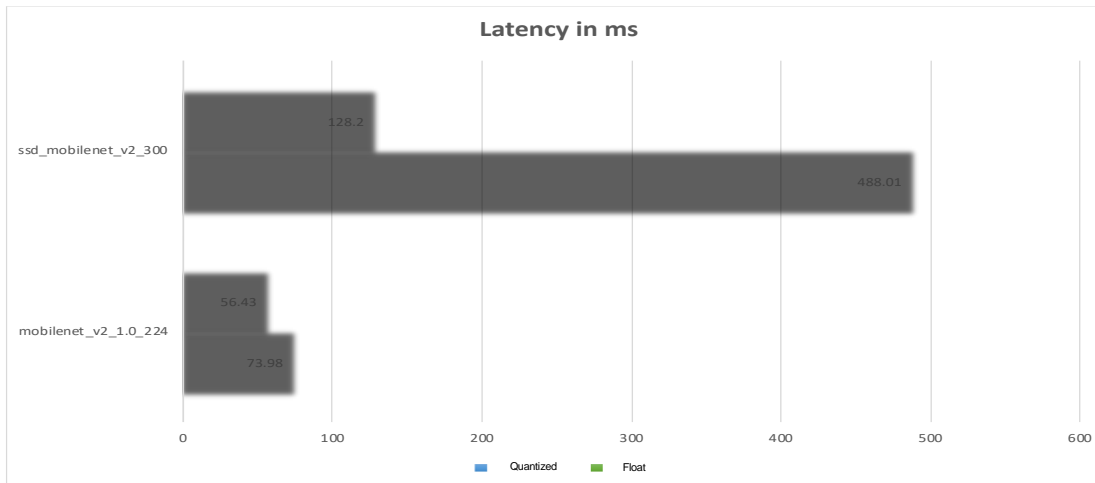


ONNXRuntime Performance With Default Execution Provider (CPU)



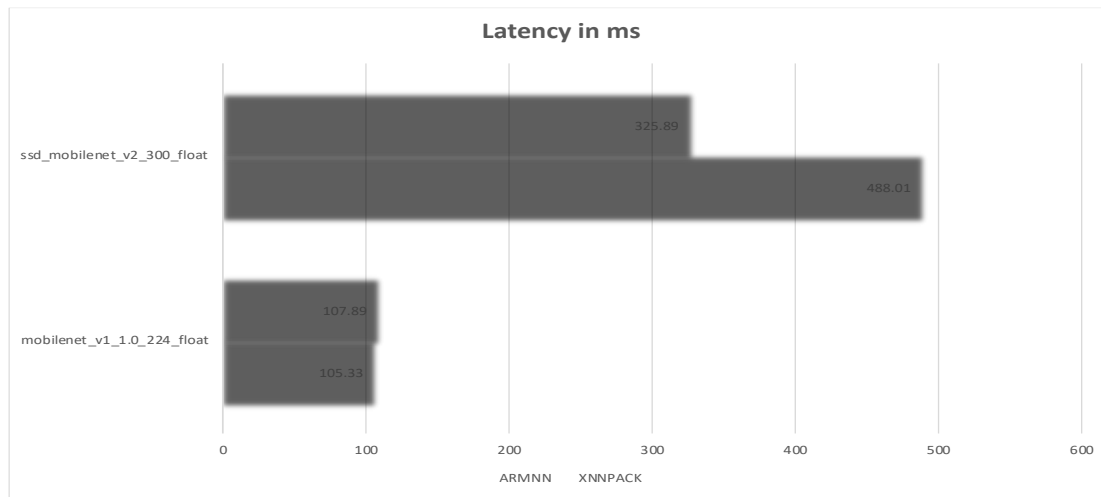
AI Models Performance Benchmarks on AM62x

TensorFlow Lite Performance Comparison with Quantized Models
(With 4 threads)



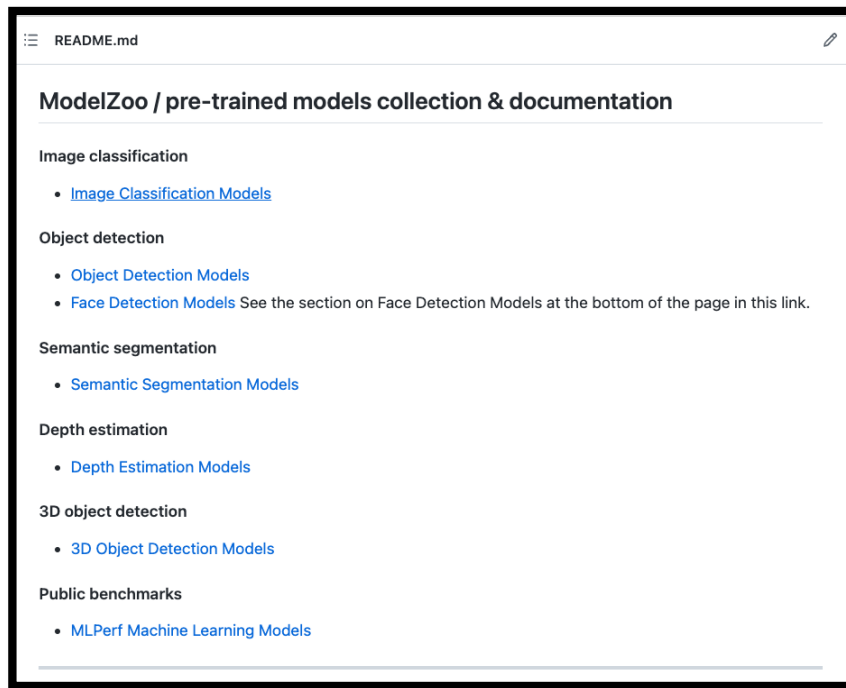
AI Models Performance Benchmarks on AM62x

TensorFlow Lite Performance Comparison with ARMNN Delegate
(With 4 threads)



TI's Edge-AI Model-Zoo

- TI Hosts 100+ CNN models (Camera Input) which can be deployed across TI SoCs. We are planning to add other sensor input (Time series inputs like Audio/Accelerometer etc) as well in the future.
- <https://github.com/TexasInstruments/edgeai-modelzoo>
- List of models Validated on [AM62](#)



Ecosystem of Developers



Developer Ecosystem

The screenshot shows the AM625 developer ecosystem website. At the top, there are navigation tabs: Product details, Technical documentation, Design & development, Ordering & quality, and Support & training. Below this, there are sections for supported products and hardware, application software and framework, and code examples or demos. The main content area is titled "AM62x Design Gallery (01.00.00.00)" and features three featured projects:

- TEXAS INSTRUMENTS:** "Secure access to the building is granted" - Gesture controlled HMI. Description: "This design shows integration of mmWave radar and camera sensor with AM62 to control a building access HMI with face detection and gestures to unlock a PIN controlled entry." Status: "Coming Soon at Embedded World 2022!!"
- MULTICORE-WARE:** "Face recognition for building access". Description: "Ready to evaluate and deployable solution for entry access control systems in Building Automation, Retail, Smart Appliances. Highly customized to effectively utilizes the AM62 hardware to accurately detect & recognize faces in challenging conditions/environments." Link: "Learn more"
- PLUHERAI:** "Video doorbell with deep learning". Description: "Highly accurate people detection AI solution by PlumerAI running on AM62 Processor. The solution is optimized for battery powered products and shows scalable performance that can operate in low lighting and at various distances and backgrounds." Link: "Learn more"

[AM62x Design & Development](#)

[AM62x Design Gallery](#)

Clickable slides on training.ti.com



[phyCORE-AM62x](#)
[byteDEVKIT-AM62x](#)
[AM625x System On Module](#)

Face Recognition on AM62x

From : MultiCoreWare Inc

Availability : Product is available

Features:

Face Detection
Face Recognition
Face Matcher
ARM A53 (1-4 Cores)

Applications:

Touchless Access Authentication
User Heuristics
Characteristics based Trigger

Brief:

Ready to evaluate and Deployable solution for **entry access control** systems in Building Automation, Retail, Smart Appliances. Highly customized to effectively utilizes the AM62 hardware to accurately detect & recognize faces in challenging conditions/environments.

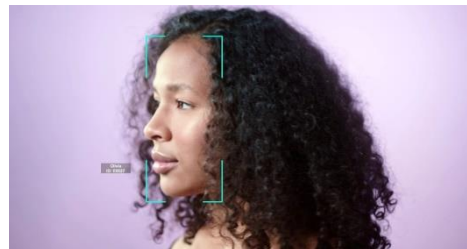
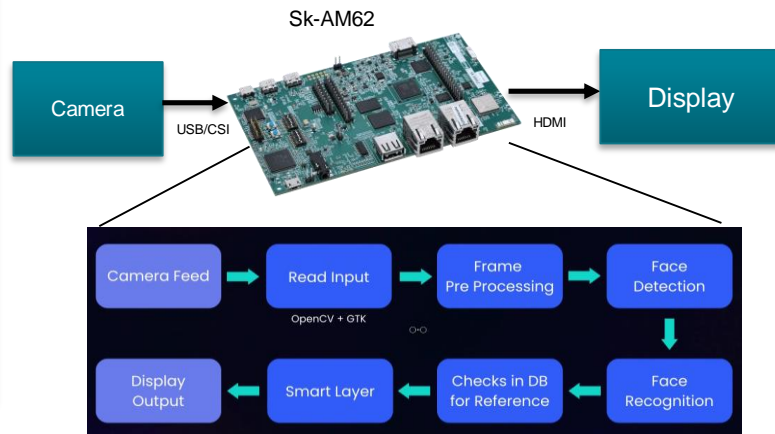
Product Specifications:

- Minimum Resolution for Face Detection - 640 x 480 px
- Minimum face crop size for Face Recognition - 50 x 50 pixels @ 720p
- Minimum Luminance (Lux) - >150
- Sensor Support - RGB
- Occlusion - <30%
- Input Format Image - JPG, PNG, BMP, GIF
- Input Format Video - MP4, AVI, MPG
- Viewing Angle PAN - + / - 45 DEGREES
- Viewing Angle TILT - + / - 30 DEGREES

More details:

[MCW-3P-FACEREC](#)

Using SK-AM62 Board



People Detection on AM62x

From : **Plumerai Ltd.**

Availability : **Product is available**

Features:

- Detects each person in view, even if partially occluded
- Tracks people and assigns up to 20 unique IDs.
- Indoor, outdoor, NIR lighting.
- Trained with 32 million labeled images.
- Extensively validated on diverse people and settings.

Brief:

Production-ready people detection solution that runs at high frame rates on a single Arm Cortex-A53 CPU.

Applications:

- Occupancy management
- HVAC control
- Lighting control
- IOT applications
- Security cameras
- Video doorbells
- Video conferencing cameras

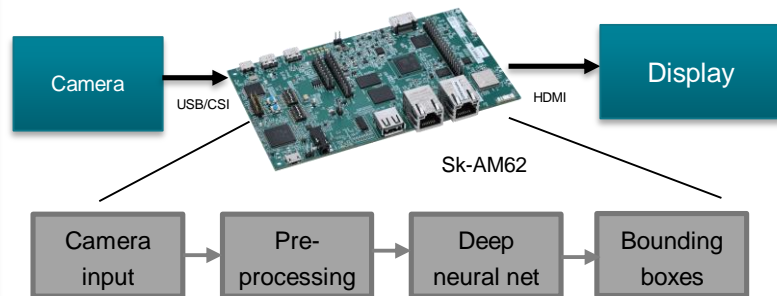
Product Specifications:

- Input:
 - QVGA to 4K video stream.
 - Color, greyscale, NIR input.
 - Standard and wide-angle lenses
- Output:
 - Bounding box coordinates with unique ID
- Sitara AM62x benchmark:
 - Arm Cortex-A53 @ 1.2 GHz
 - Latency: 40.3 ms (single core)
 - Binary size: 2.4 MiB total

More details:

[PLMR-3P-PEODET](#)

Using SK-AM62 Board



How to start with AM62x

Get started with AM62x today!

Product Pages:

- [AM623](#)
- [AM625](#)

Application Examples:

- [AM62x Design Gallery](#)

Hardware:

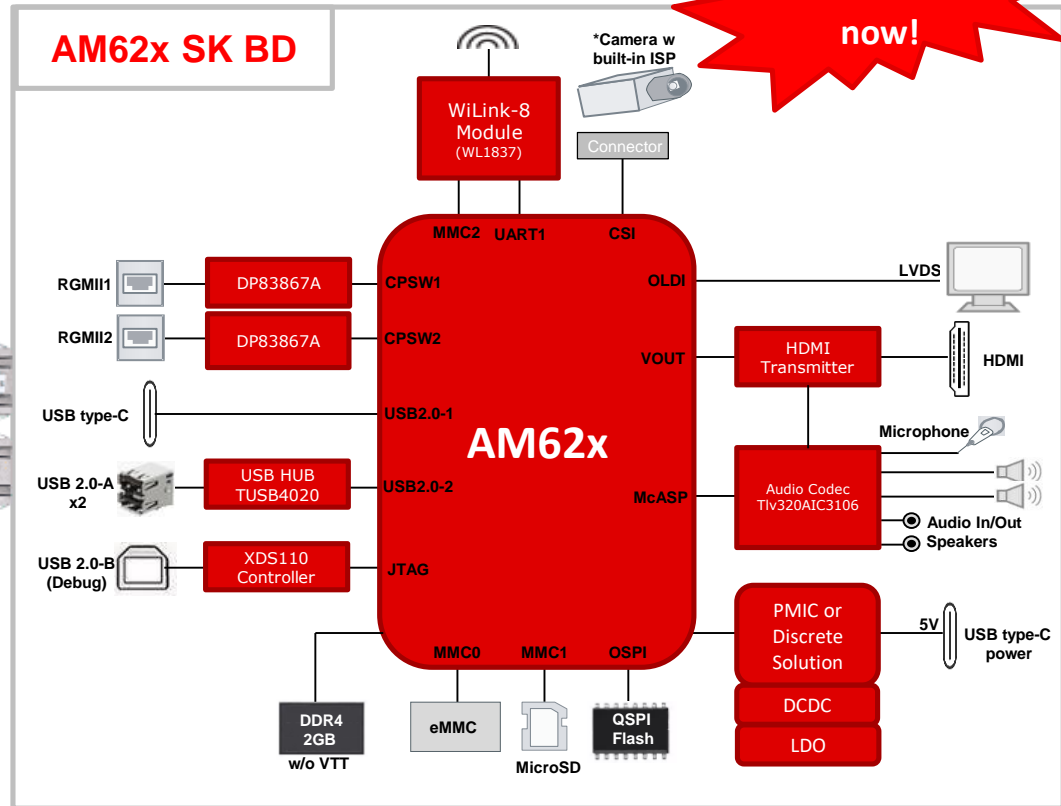
- [SK AM62 EVM](#)

Software :

- [SDK](#)
- [AM62x Dev Portal](#)
- [TI Edge AI](#)

Support:

- [E2E forums](#)



Available on ti.com now!

Clickable slides on training.ti.com

*Camera module is not provided onboard

Questions



Relevant Training Content

Applications:

- [Smart building access with touchless control](#)
- [NPU: Revolutionizing your HMI design with TI's New AM62x processor family](#)
- [Build a smart EV charging station with Vehicle-to-Grid \(V2G\) communication](#)

Development Fundamentals:

- [Program an Edge AI "Hello World" Application Using Free Online Tools](#)
- [Demystifying Embedded Deep Learning Deployment](#)
- [Edge AI Goes Mainstream In Industrial Applications](#)

Ecosystem:

- [Scalability with a third-party ecosystem](#)

Training Series :

- [Process This: A Monthly Webinar Series](#)



Clickable slides on
training.ti.com