



# Supporting Dependability for Infineon's Automotive MCUs with Model Based Design

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**MATLAB EXPO**

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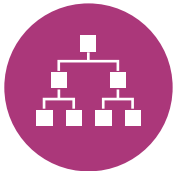
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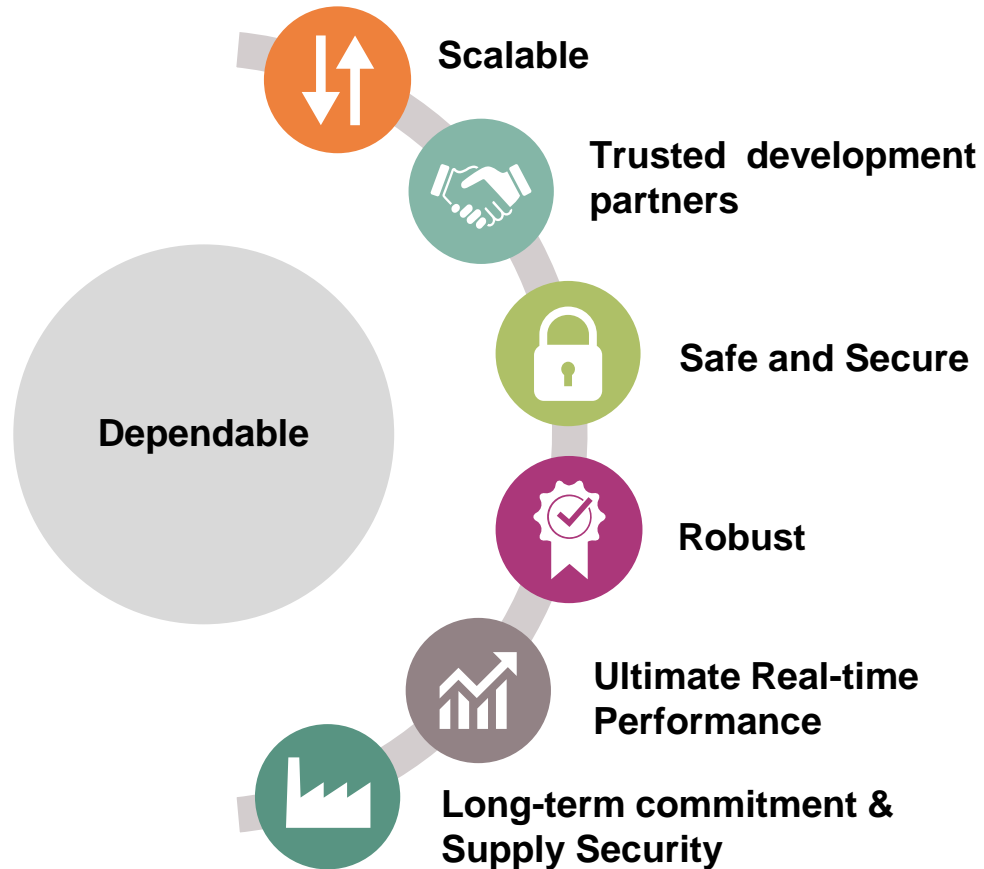
## The start of a new era...

**Automotive** market is facing two simultaneous, fast paced, paradigm shifts:

- › **E/E architecture innovation has brought new requirements to microcontrollers**
  - › More ASIL-D performance
  - › Increased security & connectivity
  - › New SW development methods
  
- › **Trend toward Electrification further accelerates**
  - › Emissions legislations towards Zero Emission
  - › Major OEM with clear focus on Battery Electric Vehicle
  - › Strong reduction of hybrid vehicles expected
  - › Development of next generation of Engine & Transmission questionable



# AURIX™ “Dependability”: More than a technical feature but a holistic value proposition



- > **Best in class AURIX™ family concept** further improved and continued with the AURIX TC4x family
- > Dependability is **more than a set of technical features** and system properties
- > Robustness of an architecture has a strong **influence in product and engineering quality**
- > Constant **innovation in safety and security technologies** is important for highly dependable MCU families
- > **Technical and commercial scalability** is a key advantage in dynamic markets

**More than 1 Billion TriCore™ shipped since 1999**

# Autonomous driving functions require highly available systems which require dependable electronics



**High Availability** | Ensure high availability beyond critical operations; a safe and secure system, that operates in all conditions

**Fail-Operational** | Mitigate potentially hazardous effects by ensuring critical operations in the event of a failure

**Fail-Safe** | in the event of a failure, system enters safe state

Automation



Lower levels (ADAS, <L2)



Higher levels (AD, =L3)



Higher levels (AD, ≥L4+)

Failure



Vehicle enters safe mode



Vehicle continues safety critical tasks



High availability in all conditions for extended time

System



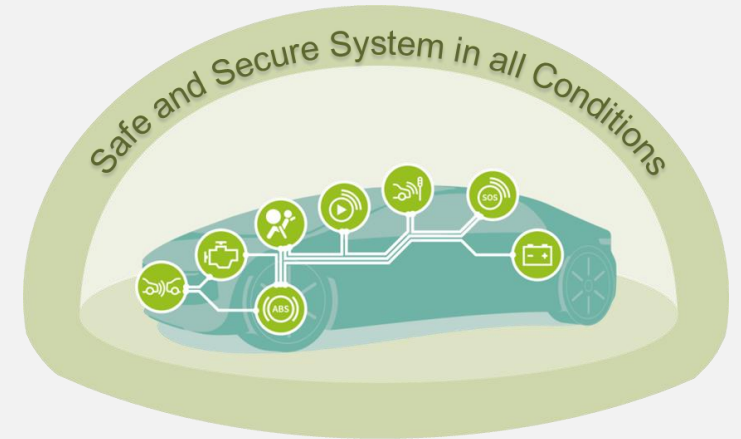
Reliable, robust, safe, secure



**Fail safe** + available



**Fail operational** + highly available



# AURIX™ TC4x defines the next controller standard for safe & secure ECUs with strong networking capabilities



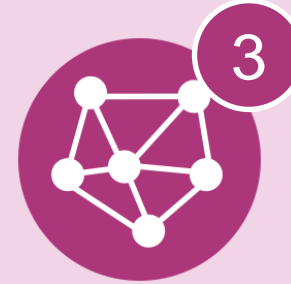
## Higher Performance

- **New 500MHz TriCore™ 1.8**
- **PPU:** Private scalar core + **wide vector unit** with up to 48 GOPS
- SPU3: High-performance **radar processing sub-system**
- A/D Converter sub-system **with integrated DSPs**
- **Data Routing Engine** for CAN – Ethernet - Mem communication



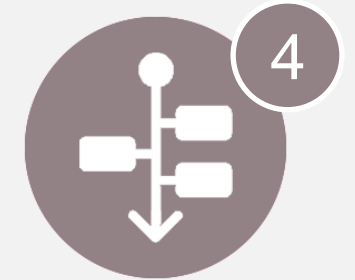
## Safety and Security

- AURIX™ meets ISO26262-2018 **ASIL D safety** standard
- **CSRM:** high-performance security module with private CPU, memories and crypto accelerators
- **CSS:** Distributed crypto and hash engines for secure CAN/Ethernet communication
- Security according to **ISO 21434** standard planned



## Freedom From Interference

- **Hardware isolation** at core and peripheral level
- TriCore™ 1.8 with **up to eight VMs per core and Hypervisor**
- Ultra-fast **context switching**
- **Enhanced memory protection** for cores and virtual machines
- **Fine-granular access protection** to peripherals
- **Isolated DMA protection**



## Rich connectivity

- Up to 2x **5GBit Ethernet** incl. Bridge
- **Accelerated MACsec support** by HW accelerator in CSS and application SW driver
- **4x10/100MBit Ethernet** supporting 10Base-T1S standard
- Up to 2x 8Gbit/s **PCIe 3.0** 1x lane
- Up to 20x CAN-FD
- **CAN-XL**

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# Heterogeneous AURIX™ TC4x supports Requirements for Electric- and Autonomous Vehicle



PPU is a compute subsystem that extends the classical MCU compute performance for approaches like AI, model predictive control and advanced signal processing

## eMobility / xEV



On-board Charger and DC-DC converter

Traction inverter

Battery management system

## Autonomous driving / ADAS



Trajectory Planning & Control

Radar

Sensor Fusion / Processing

## Integration Platform & connectivity



Infrastructure controller for V2V/V2X

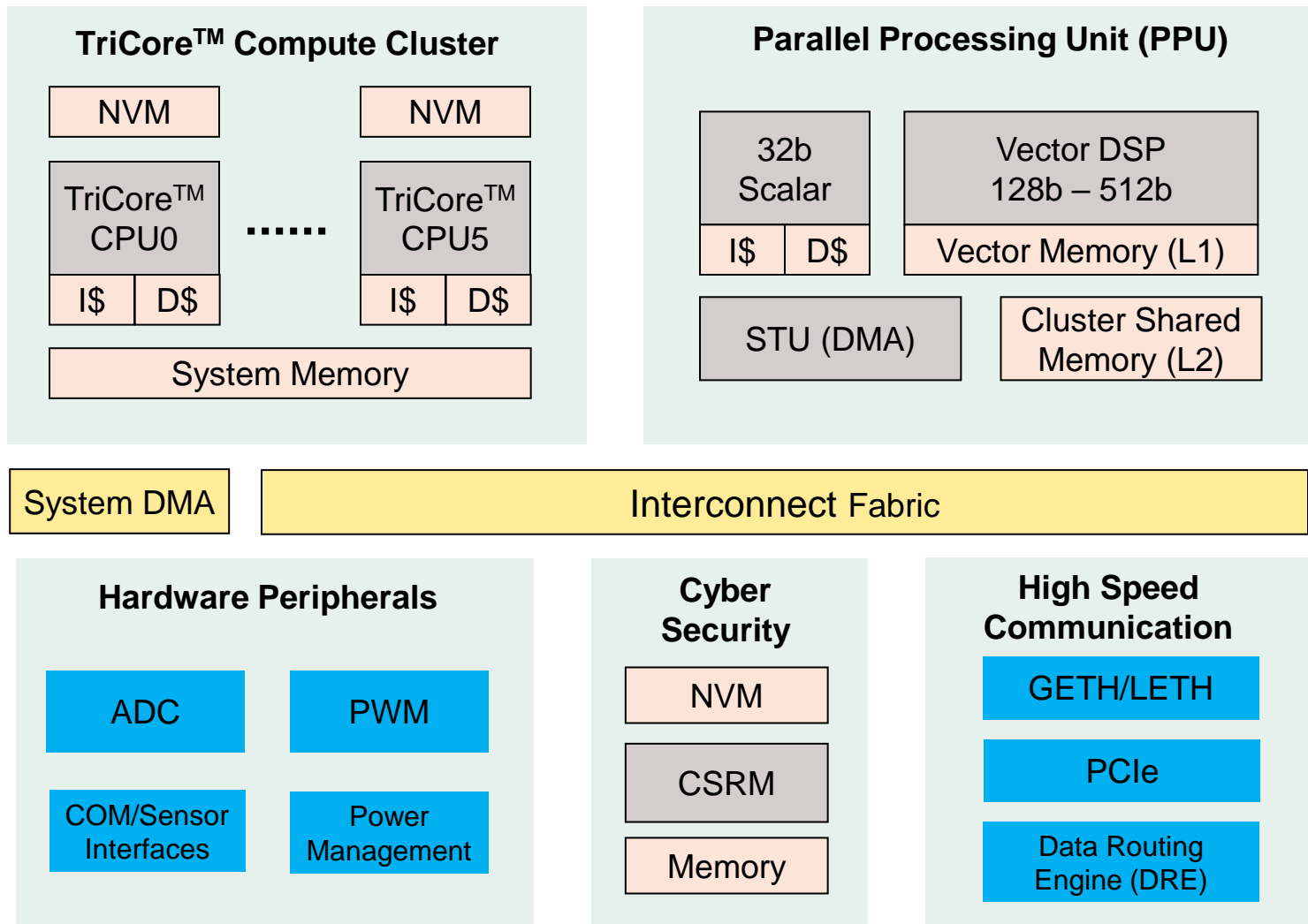
Communication gateway

Domain/Zone controller

# AURIX TC4x is a heterogenous Compute Architecture



*The homogeneous TriCore™ Compute Cluster from AURIX™ TC3xx is enhanced by PPU*

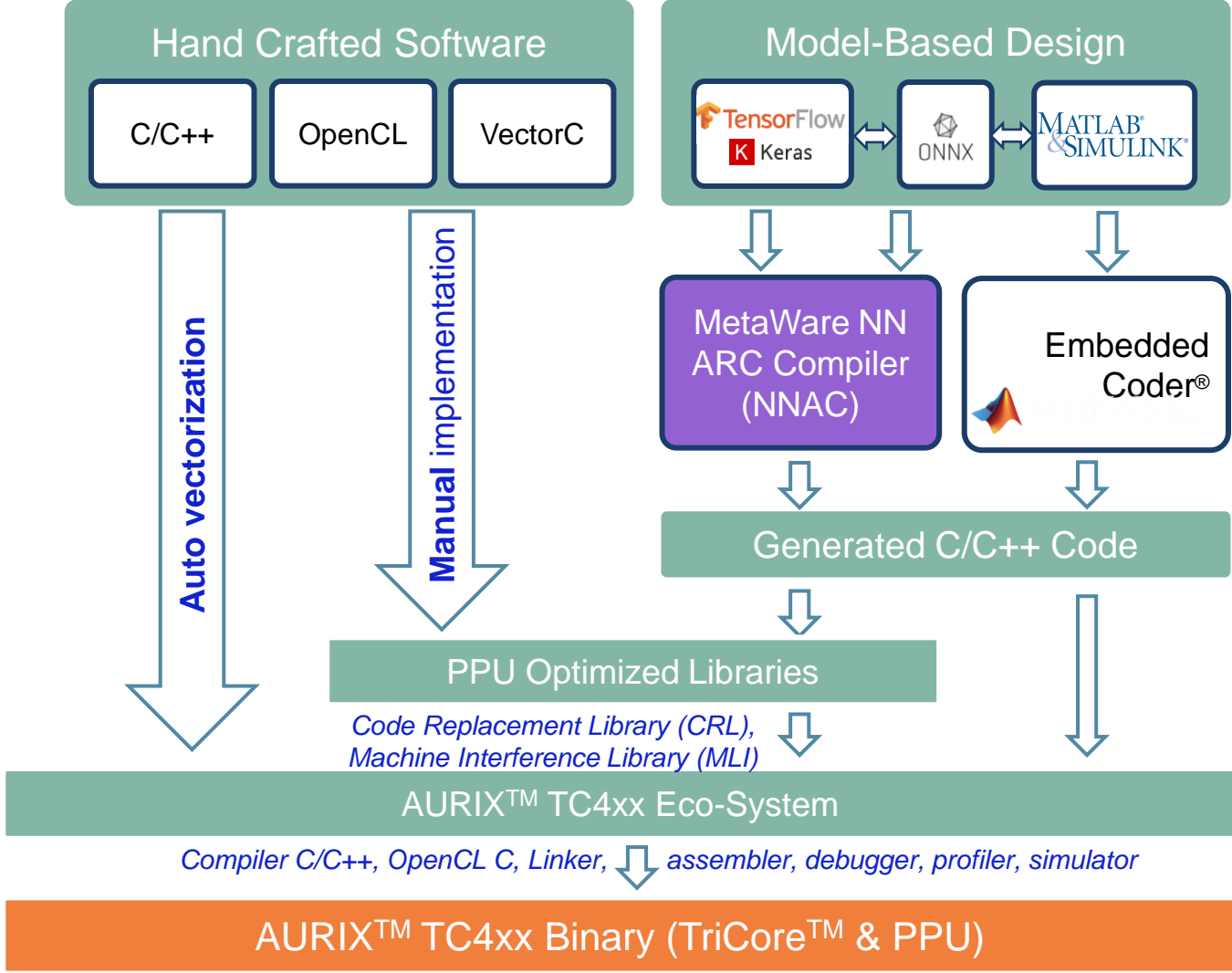


The classical C/C++ programming model has to be enhanced by a parallel compute programming model



Model-Based Design using AURIX™ TC4x HSPs utilizes the advantages of the heterogeneous compute architecture for system engineers

# Model-Based Design Support for AURIX™ TC4xx



## Development Workflow

- > Heterogenous compute architecture of AURIX™ TC4xx is covered by an automatic multi-core code generation using SoC Blockset and Embedded Coder
- > Parallel programming model of PPU is supported by specific libraries
- > Embedded AI workflow is currently supported by the NN SDK from the Synopsys ARC<sup>(R)</sup> MetaWare Toolkit for AURIX<sup>(TM)</sup> TC4x

■ MetaWare Toolkit for AURIX TC4x Tool/Library

# A rich Software and Tool partner ecosystem exists for AURIX™

## Embedded Software Solutions

Autosar BSW, Security, Safety, Connectivity, Hypervisor, Middleware, General Purpose RTOS, Libraries, Graphics, OTA



## Hardware and Software Development Tools

Compiler toolchains  
 Debugger and test tools  
 Software automation  
 Timing and program analysis  
 Simulation and modelling  
 Virtual prototyping  
 Data measurement  
 Rapid prototyping  
 Verification and rule checker  
 Flash programmer



## Training and Services

Software and hardware coaching  
 Flash programming services  
 Engineering services and training



## Free Tools

Compiler and debugger toolchains  
 Configuration and pin mapper  
 Flash programmer

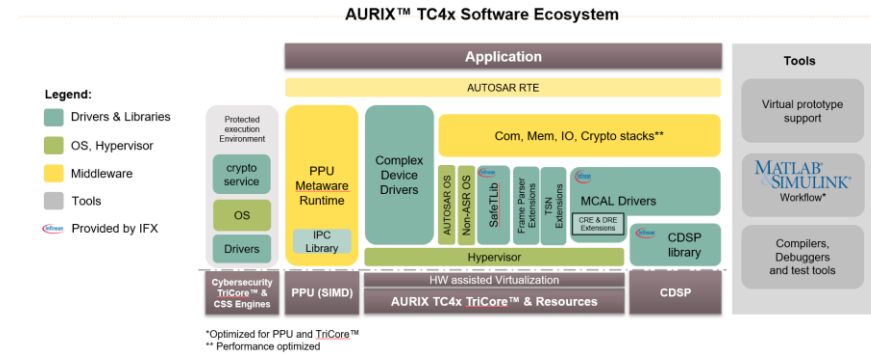
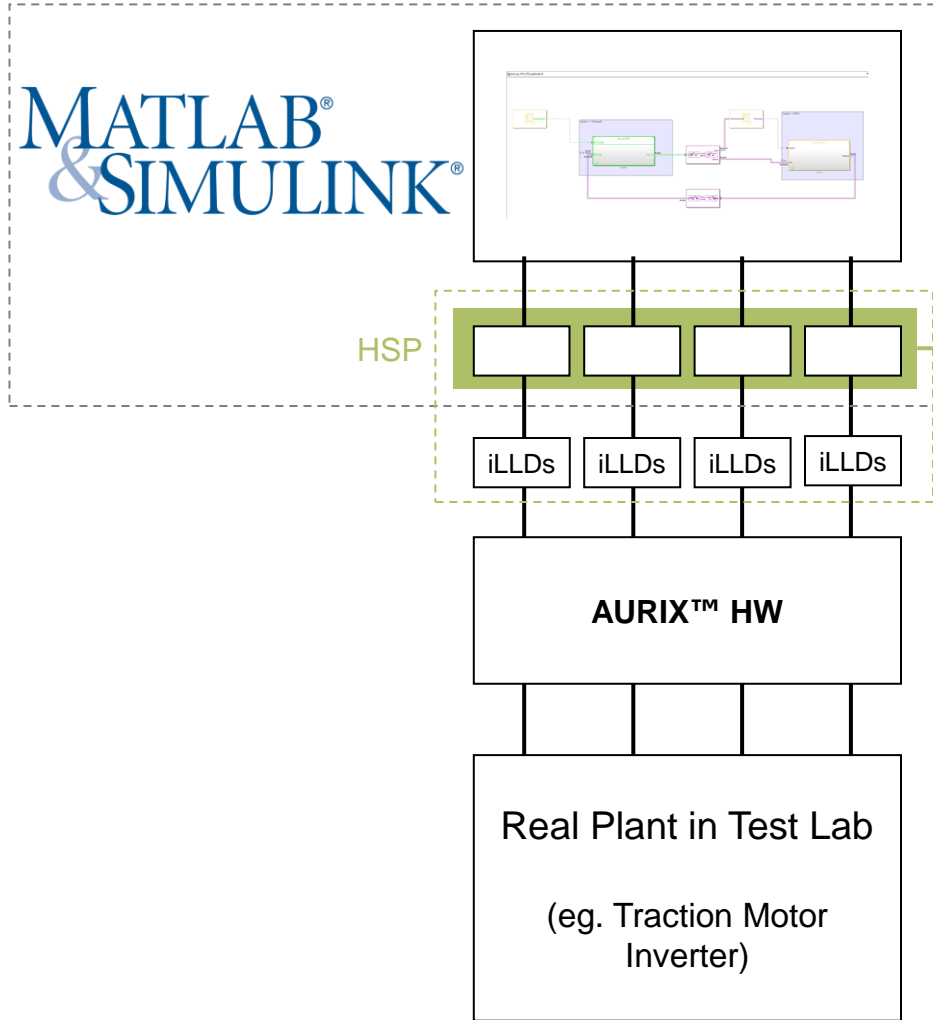


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# TC4x HSP simplifies System Development: First version of the HSP supporting fast prototyping is available



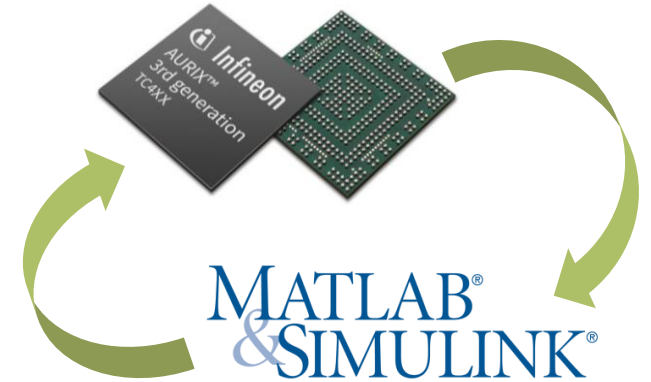
## AURIX™ TC4x Hardware Support Package

- TC4x HSP is available !
- Provides realistic simulation capability
- Translates Simulink models to executable code
- Already optimized for specific processor = TriCore™, PPU
- Automatically connects to peripherals
  - **Fast evaluation of application model on HW**
  - **Accessible through SIMULINK block libraries**
  - **Does not require deep knowledge of HW/iLLD**

# Strategic Engagement: Infineon – MathWorks

## Engagement

- › Infineon and MathWorks have partnered to develop Simulink® support for Infineon's latest AURIX™ TC4x microcontrollers
- › AURIX TC4x is now integrated into Model-Based Design, enabling automotive engineers to accelerate the development of electric vehicle and driver-assistance functions



## Benefits

- › Engineers using Model-Based Design with MATLAB® and Simulink® can accelerate embedded-system development and verification by 30 to 40% over traditional approaches
- › Validate use cases, automatically generate embedded software, and test algorithms - even before silicon is available
- › Utilize the full capabilities of the AURIX TC4x without deep embedded expertise

**This is the latest engagement in an ongoing series of strategic collaborations between Infineon and MathWorks**

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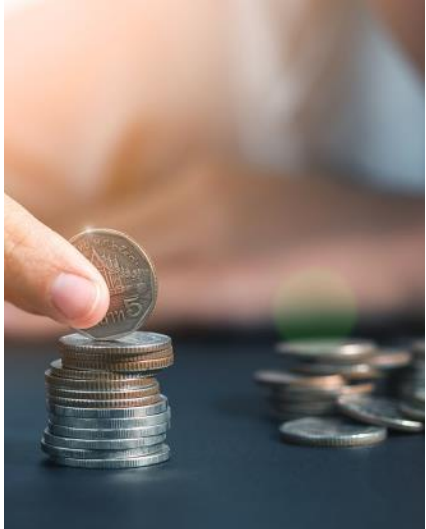
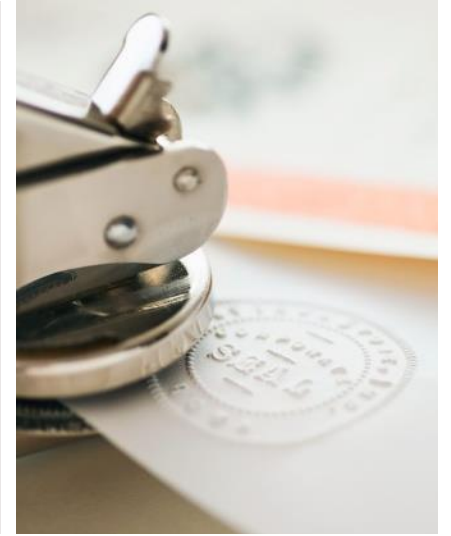


# Supporting Dependability for Infineon's Automotive MCUs with Model Based Design



- › Automotive market is facing two simultaneous, fast paced, paradigm shifts
  - › E/E Architecture
  - › Electrification

- › Infineon's AURIX™ TC4x is here to address these paradigm shifts
- › The SW eco-system is prepared for AURIX™ TC4x



- › Infineon and MathWorks have a strategic partnership to provide MBD solutions for Infineon Automotive Microcontrollers

Visit us at  
[www.mathworks.com/aurix](http://www.mathworks.com/aurix)

- › System design challenge need Model-Based Design
- › The AURIX™ TC4x HSP are available and growing in features



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Thank you



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