

# INTRODUCTION TO LAYERSCAPE ATUO & BLUEBOX 3.0 FOR HIGH PERFORMANCE COMPUTING

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SECURE CONNECTIONS  
FOR A SMARTER WORLD

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## **AGENDA**

Introduction

Automotive Layerscape

BlueBox 3.0 & SDK

LX2160A/BlueBox 3.0 Typical Use Case

Summary

# ONE CAR, DIFFERENT MISSIONS & TECHNOLOGY EVOLUTIONS

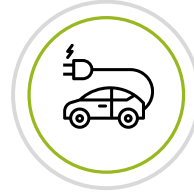


## THE AUTO-DRIVING CAR

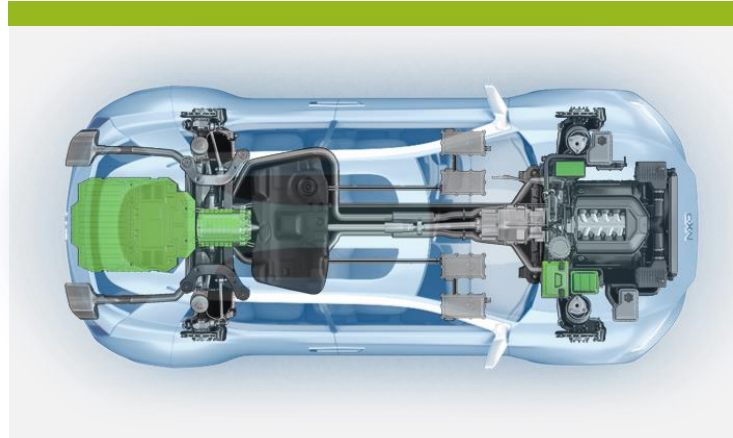


**Be conscious, decide, learn**

Mega sensing + processing  
New infrastructures



## THE ELECTRIC VEHICLE



**Transport at top efficiency**

New infrastructures  
Battery technology



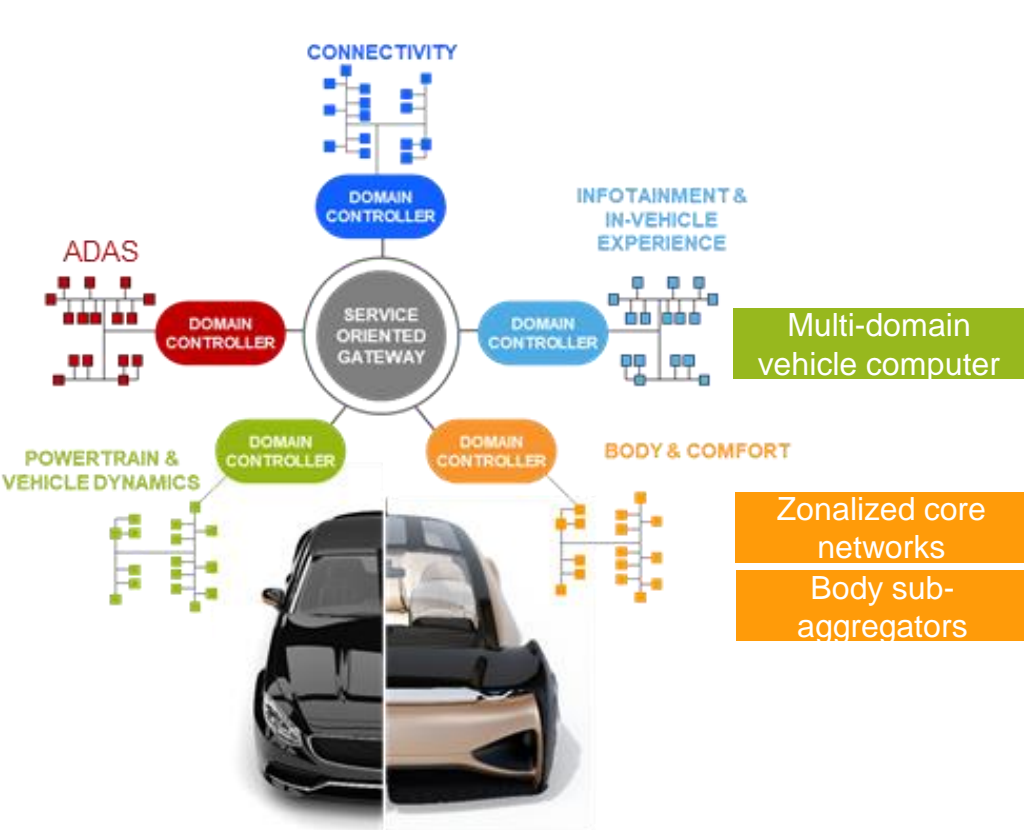
## THE SERVICE-ORIENTED CAR



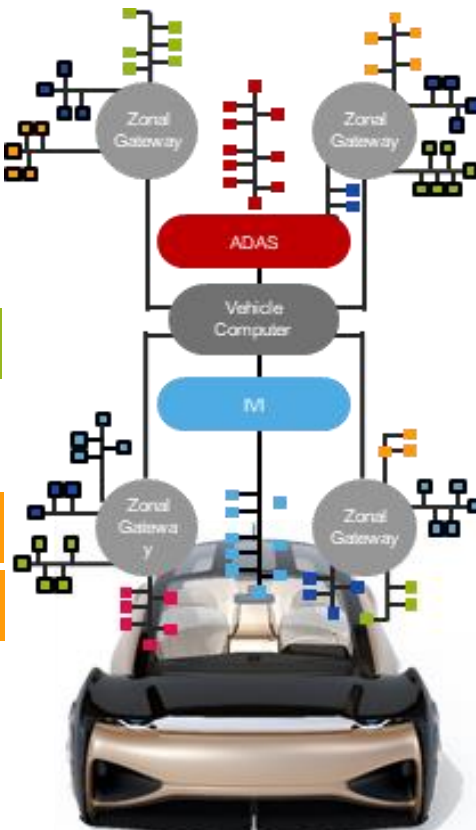
**Update, customize, reconfigure**

Hardware virtualization  
Safe hyper-connectivity

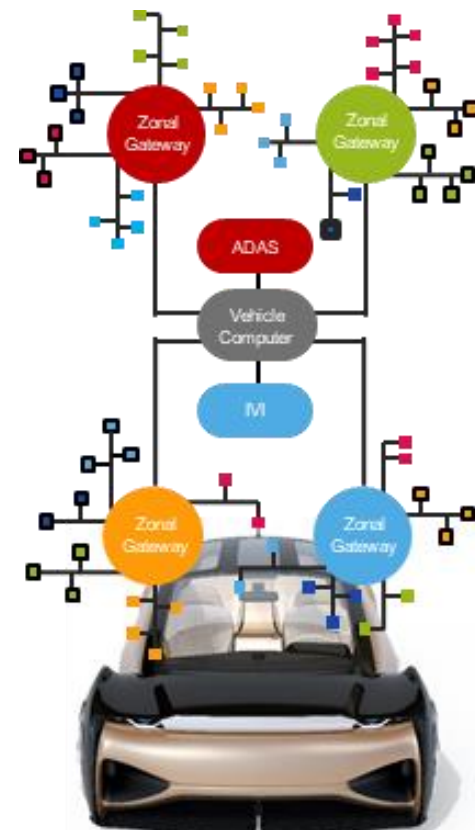
# EVOLUTIONARY PATH: TWO WAVES, ON LOGICAL AND PHYSICAL PATHS



**MY22 - Domain EE**  
Logical: domain  
Physical: dedicated networks



**MY26 - Hybrid Zonal EE**  
Logical: multi-domain  
Physical: zonal + dedicated networks



**MY30 - Zonal EE**  
Logical: virtualized domain  
Physical: zonal networks

## LAYERSCAPE MARKETS AND TECHNOLOGIES

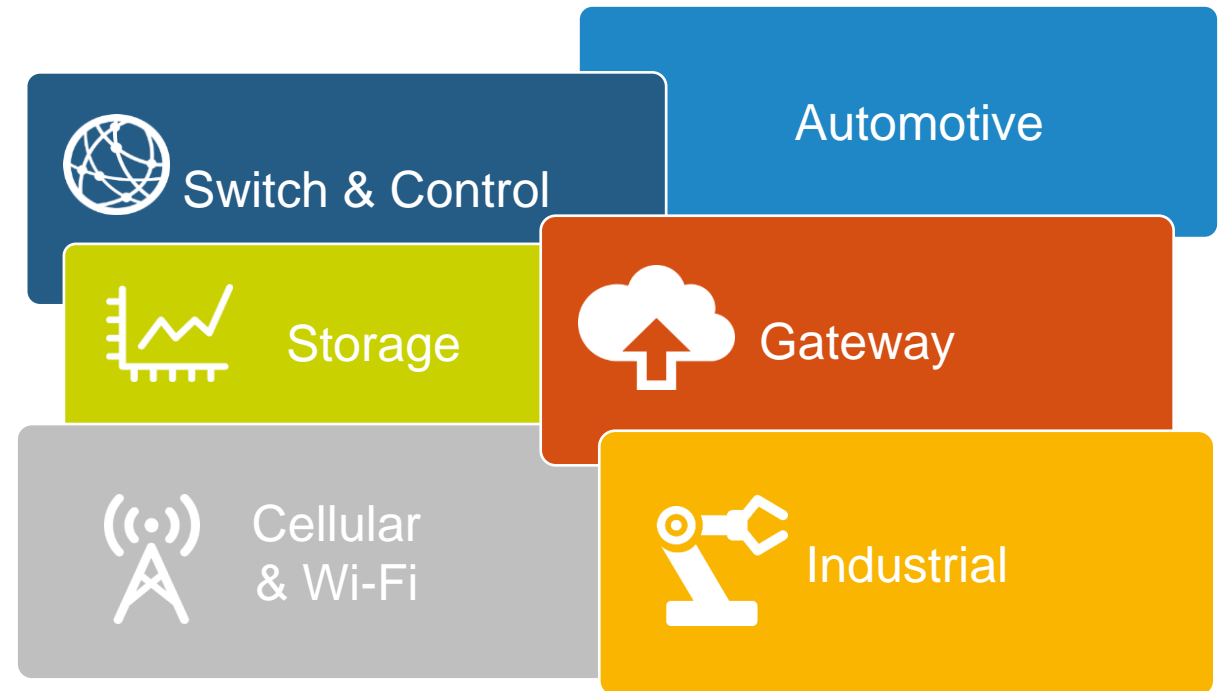
Enabling Secure Infrastructure  
with Cost- and Power-Efficient Solutions  
and Unique Expertise

Virtualization

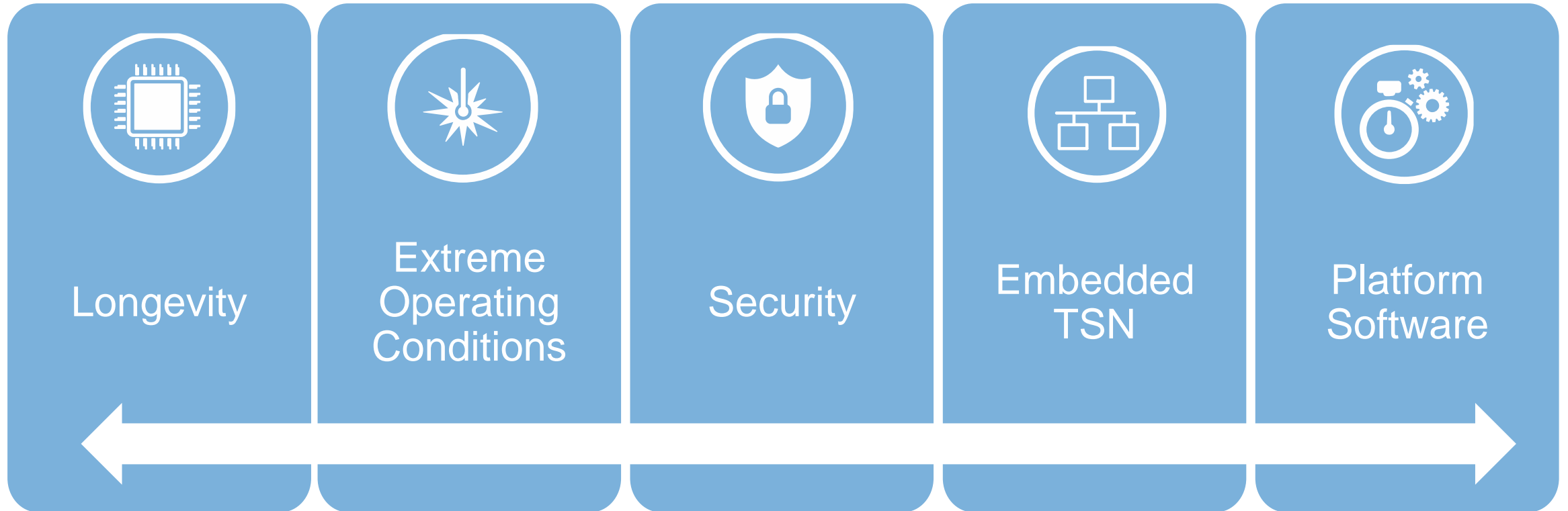
Security (Trust & Protocol Acceleration)

Software Solutions and Services

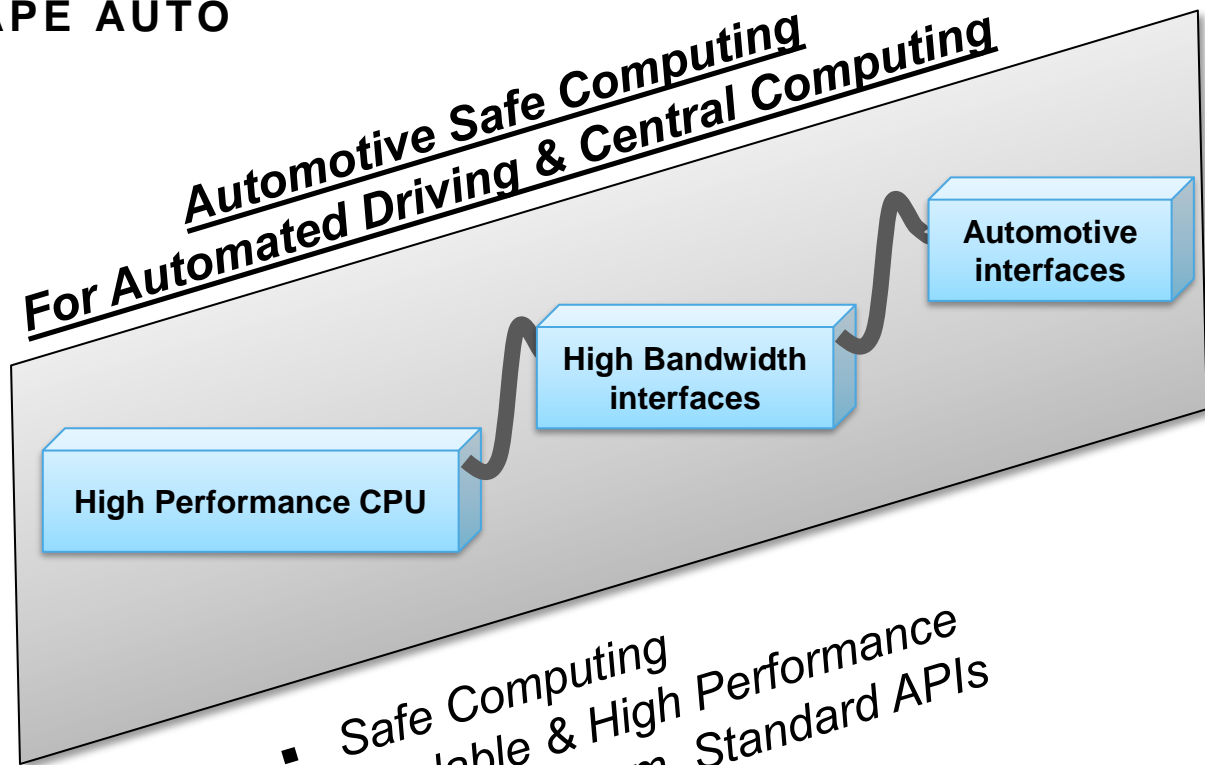
## Targeted Solution Segments



## WHY NXP IS A KEY PARTNER



# WHAT IS LAYERSCAPE AUTO



- Safe Computing
- Scalable & High Performance
- Open Platform, Standard APIs



Central and Zonal Computing

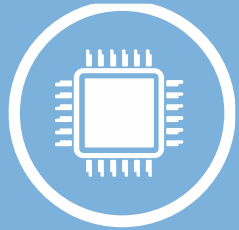
Fusion and Path Planning

Telematics

Gateway

Sensor Data Intelligent Storage

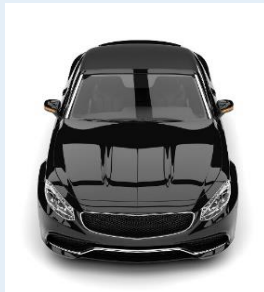
## SUPPLY LONGEVITY & AUTOMOTIVE QUALIFICATION



Longevity

### NXP Automotive & Industrial Application Processors

- 10 and 15-year supply longevity options
- Formal program with products listed at [www.nxp.com/productlongevity](http://www.nxp.com/productlongevity)



Automotive & Industrial applications require product longevity

- Long product lifecycles
- Special product certification required



### Automotive qualification

- All LayerScape Automotive SoCs are AEC Q100 Grade 3 qualified (105 Tj max)
- LS1043A has an AEC Q100 Grade 2 version (125 Tj max)
- All LayerScape Automotive SoCs are part of the 15 year product longevity program

### Safety

Features	Collateral
<ul style="list-style-type: none"><li>• ZD-like approach to reduce risk of DPPM or Life failures</li><li>• Expected Operating Life fail rate &lt;10 FIT</li><li>• Mission Profile: 10 years always on, 90C Tj-effective</li><li>• TMU, MBIST, ECC</li></ul>	<ul style="list-style-type: none"><li>• Safety reference Manual</li><li>• FMEDA</li><li>• Safety for mil/aero DO-254</li></ul>

LAYERSCAPE SERIES: SCALABILITY AND FLEXIBILITY  
LEVERAGE ONE DESIGN INTO DIVERSE PRODUCT PORTFOLIO

Automotive  
Qualified

Scalable series of 64-bit ARM-based SoC Families

LS1012A 1x A53	LS1021A 2x A72	LS1024A 2x A9	LS1028A 2x A72	LS1023A 2x A53	LS1026A 2x A72	LS1043A 4x A53	LS1046A 4x A72	LS1048A 4x A53	LS1088A 8x A53	LS2084A 8x A72	LS2088A 8x A72	LX2162A 16x A72	LX2160A 16x A72
LS1012A	LS1021A	LS1024A	LS1028A	LS1023A	LS1026A	LS1043A	LS1046A	LS1048A	LS1088A	LS2084A	LS2088A	LX2162A	LX2160A
64-bit Arm 2Gbps Packet 1Gbps Crypto	32-bit Arm 2Gbps Pkt 1Gbps Crypto	32-bit Arm 2Gbps Pkt 2Gbps Crypto	64-bit Arm 5Gbps Crypto Integrated GPU	64-bit Arm 10Gbps Pkt 5Gbps Crypto	64-bit Arm 20Gbps Pkt 10Gbps Crypto	64-bit Arm 10Gbps Pkt 5Gbps Crypto	64-bit Arm 20Gbps Pkt 10Gbps Crypto	64-bit Arm 20Gbps Pkt 10Gbps Crypto	64-bit Arm 20Gbps Pkt 10Gbps Crypto	64-bit Arm 40G Pkt 20G Crypto	64-bit Arm 40G Pkt 20G Crypto	64-bit Arm 88G Pkt 50G Crypto	64-bit Arm 100G Pkt 50G Crypto

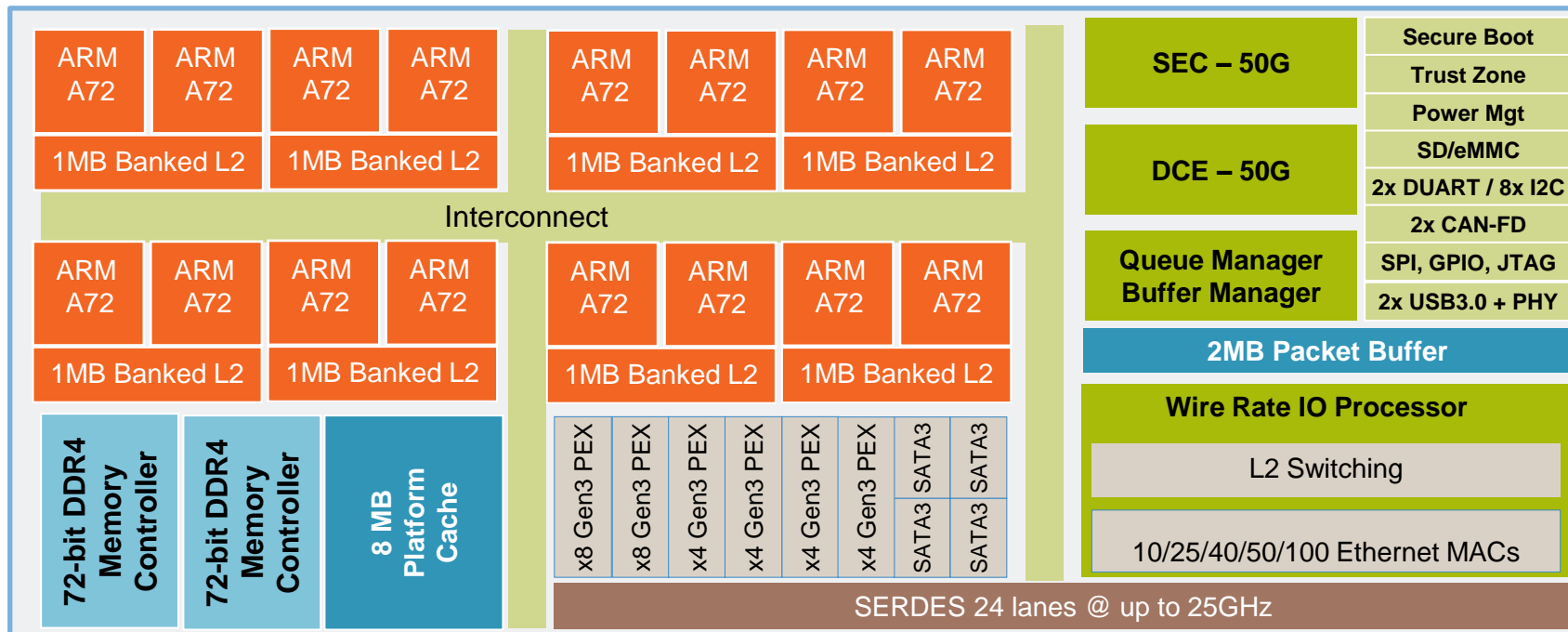
Pin-to-pin Compatible

Pin-to-pin  
Compatible

Software Compatible

# LX2160A

Automotive  
Qualified



Auto Qualified Parts: Now

## Auto quality

- AEC Q100 Grade 3 (105 Tj)
- 15 years product longevity
- Profile: 10 years, 90C Tj-effective

## Performance

- ARM A72 x 16 @ up to 2.2 GHz
- 2x72b (including ECC) DDR4 up to 3.2GT/s
- High Speed IO
- Multiple PCIe Gen3 controllers
- Multiple Ethernet MACs (up to 100G)

## Functional Safety

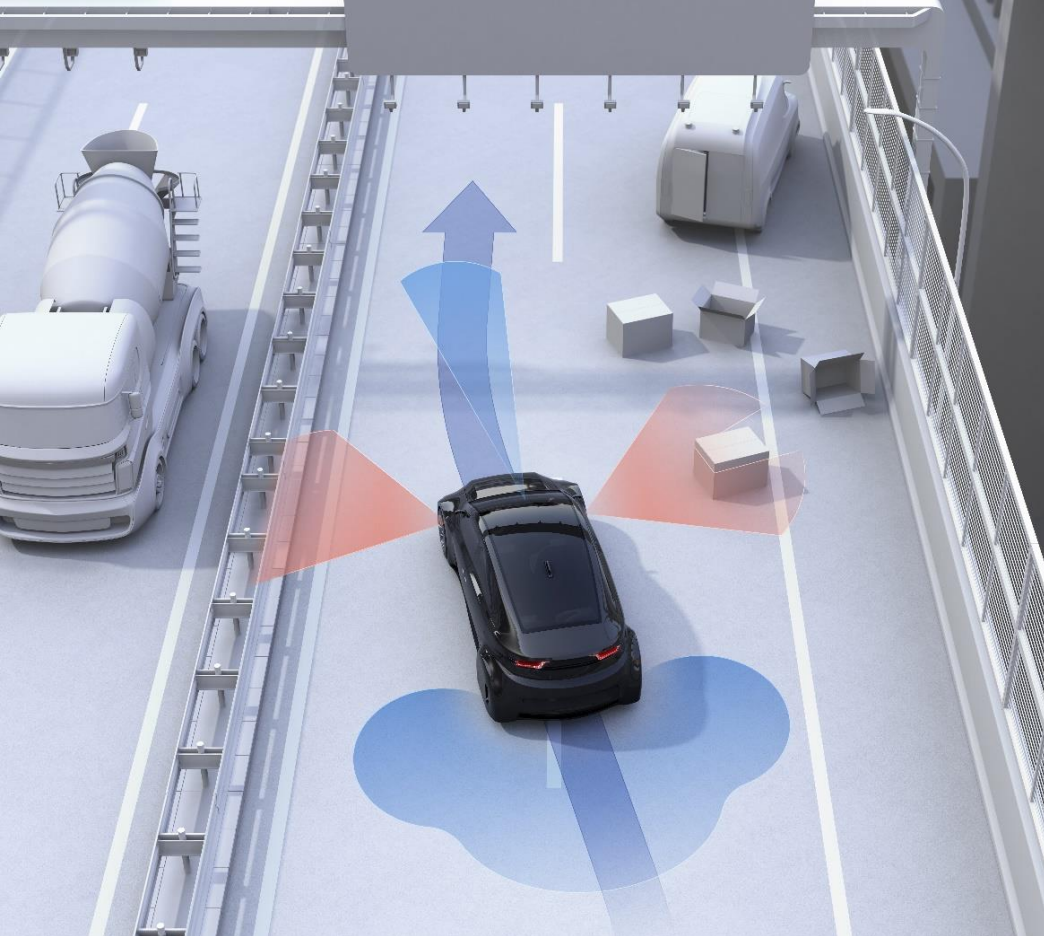
- QM(B)
- Safety Manual, FMEDA
- ECC protected memories
- Fault localization, containment and recovery
- Excellent support for virtualization, containerization

## Process & Package

- 40x40mm, Lidded FCBGA, 1mm pitch (1517 pins)

## Security

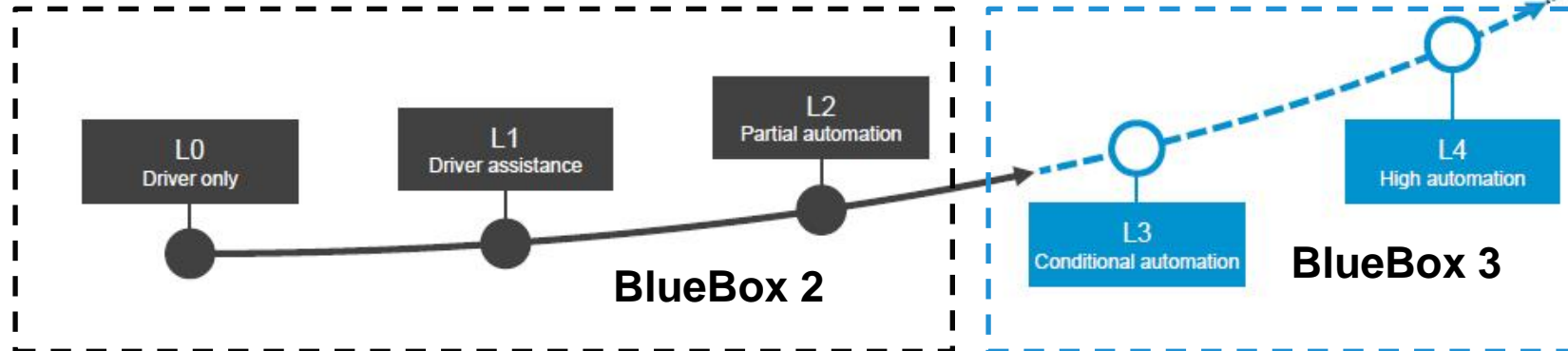
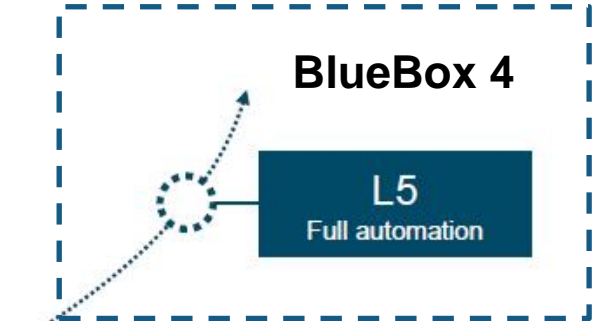
- 50Gbps Crypto Acceleration
- MACSEC, IPsec, SSL
- Trust Architecture
  - Secure Boot
  - Secure Debug
  - Secure Storage
  - Tamper Detection
  - HW Enforced Partitioning
  - ARM Trust Zone



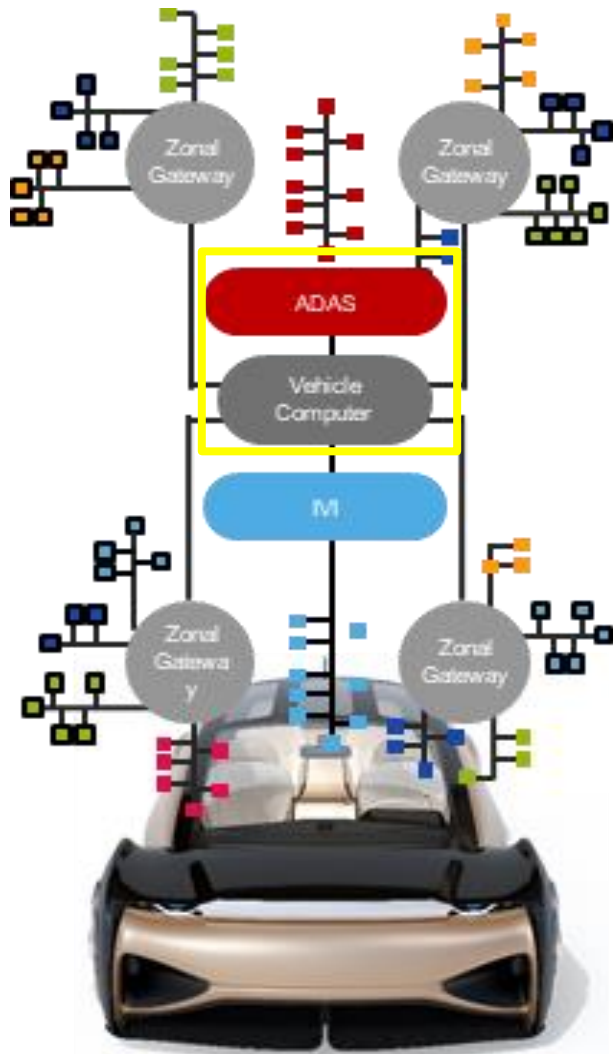
A development platform for Automotive High Performance Compute applications such as Automated Drive and Central Computing with functional safety, AI acceleration and automotive interfaces based on existing Silicon



# TARGET APPLICATIONS



## TARGET APPLICATIONS



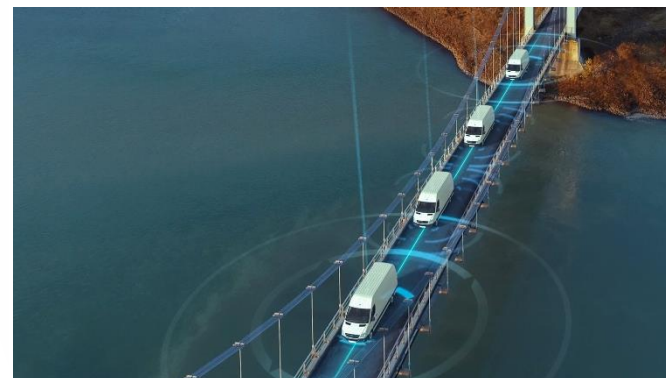
### HIGH PERFORMANCE COMPUTE

Intelligent Networking Solution  
Sensor Data Intelligent Recorder  
Telematics  
Mobility as a Service



### ADAS

Active Safety  
Parking Assistance  
Driving Assistance



### AD

Traffic Jam Pilot  
Valet Parking  
Highway Pilot  
Autonomous Trucking

# BLUEBOX 3.0 FUNCTIONAL SAFETY

## FLEXIBLE SAFETY

Support ASIL-B and  
ASIL-D decomposition

ASIL Level based on the  
performance & safety need

Primary and fallback configuration

Comprehensive safety collaterals

## SAFETY COMPUTE

S32G high performance ASIL-D

Flexible ASIL-B/D Lockstep A53

Triple Lockstep M7

ASIL-D SOC foundation

## SYSTEM LEVEL SAFETY

BlueBox 3.0 safety concept

System level safety concept

Safety enablement

Safety demonstrator

System level safety concept with flexibility from QM, ASIL B to ASIL D



# TRUE EMBEDDED SYSTEM SOLUTION

## TRUE EMBEDDED

Auto qualified SOCs and PMICs

## FLEXIBLE ARCHITECTURE

Supporting multiple configuration  
with expansion options

## SOFTWARE ENABLEMENT

BlueBox 3.0 SDK with efficient neural  
network support with Kalray MPPA

High performance Arm® cores

Automotive interfaces

Small form factor

Multi system configuration

Expansion via PCIe and Ethernet

Integration and support of Kalray  
framework

Full perception & planning prototype

Safety enablement

Tailored for Automotive Safe Compute with flexibility to allow  
customers to develop and prototype various AD and EE architectures use cases and software



## ENHANCE PERFORMANCE WITH BLUEBOX 3.0

### LX2160A

16 High performance  
Arm® A72 cores

Outstanding performance

Multiple PCIe / Ethernet

Auto qualified

### S32G274

High performance  
gateway & safety computing

Gateway with auto interfaces

Lockstep CPUs

ASIL-D safety

### KALRAY COOLIDGE

High performance NN &  
Math accelerator

Optimized NN Engine

Up to 160 CPU Cores\*

High Performance / Power

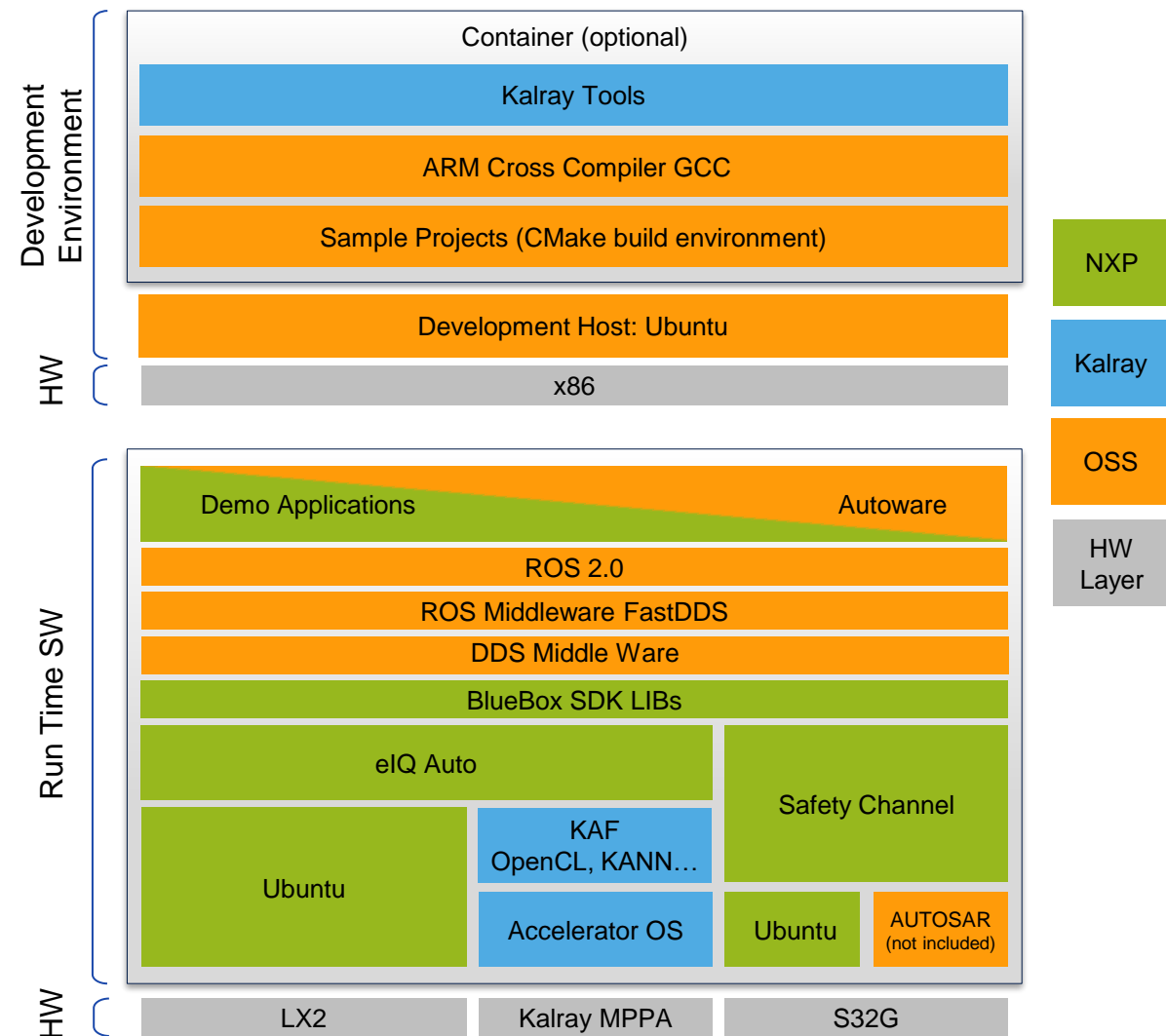
Outstanding overall performance for all Automotive Safe & High-Performance Compute workloads



\* Based on Kalray Coolidge V2

# BLUEBOX SOFTWARE DEVELOPMENT KIT (BLUEBOX SDK)

- Comprehensive software development environment
  - Consistent Linux based development
  - CMake based build system
  - Integrated offline tools
- Integrated High Performance AI/ML and compute accelerator support
  - eIQ Auto, Kalray MPPA
- Support for highly efficient communication
  - FastDDS on PCIe
- Prototyping and application boilerplates
  - ROS 2, Autoware.Auto
- Automotive software grade
  - Key software components targeting Automotive SPICE



**TYPICAL BLUEBOX SDK USE CASE**

Surround sensing

Processing, object detection

Scene interpretation

Decision making

Visualisation

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**NXP**

**TYPICAL BLUEBOX SDK USE CASE**

Surround sensing

Processing, object detection

Scene interpretation

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Visualisation

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**NXP**

**TYPICAL BLUEBOX SDK USE CASE**

The diagram illustrates the workflow of the Bluebox SDK in a vehicle's perception system. A car is shown on a road, with various sensor beams (Surround sensing) and processing areas (Processing, object detection) highlighted. The diagram also shows a pedestrian crossing the road, with labels for Scene interpretation, Decision making, and Visualisation.

- Surround sensing:** Represented by blue lines and dots indicating the car's field of view.
- Processing, object detection:** Indicated by a blue oval around the pedestrian, showing the system's ability to detect and track objects.
- Scene interpretation:** A label pointing to the overall environment, indicating the system's understanding of the scene.
- Decision making:** A label pointing to the system's ability to make decisions based on the interpreted scene.
- Visualisation:** A label pointing to the car's internal processing and the resulting visual output.

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**TYPICAL BLUEBOX SDK USE CASE**

The diagram illustrates the workflow of the Bluebox SDK in a vehicle's perception system:

- Surround sensing:** Represented by blue sensor beams emanating from the car, detecting the environment.
- Processing, object detection:** The area where the sensed data is processed to identify objects, such as the pedestrian on the crosswalk.
- Scene interpretation:** The process of understanding the context of the scene, such as recognizing a pedestrian crossing.
- Decision making:** The final step where the system decides on the appropriate action based on the interpreted scene.
- Visualisation:** The output of the system, showing the detected objects and the processed scene.

**PUBLIC**

**NXP**

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**NXP**

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**TYPICAL BLUEBOX SDK USE CASE**

Surround sensing

Processing, object detection

Scene interpretation

Decision making

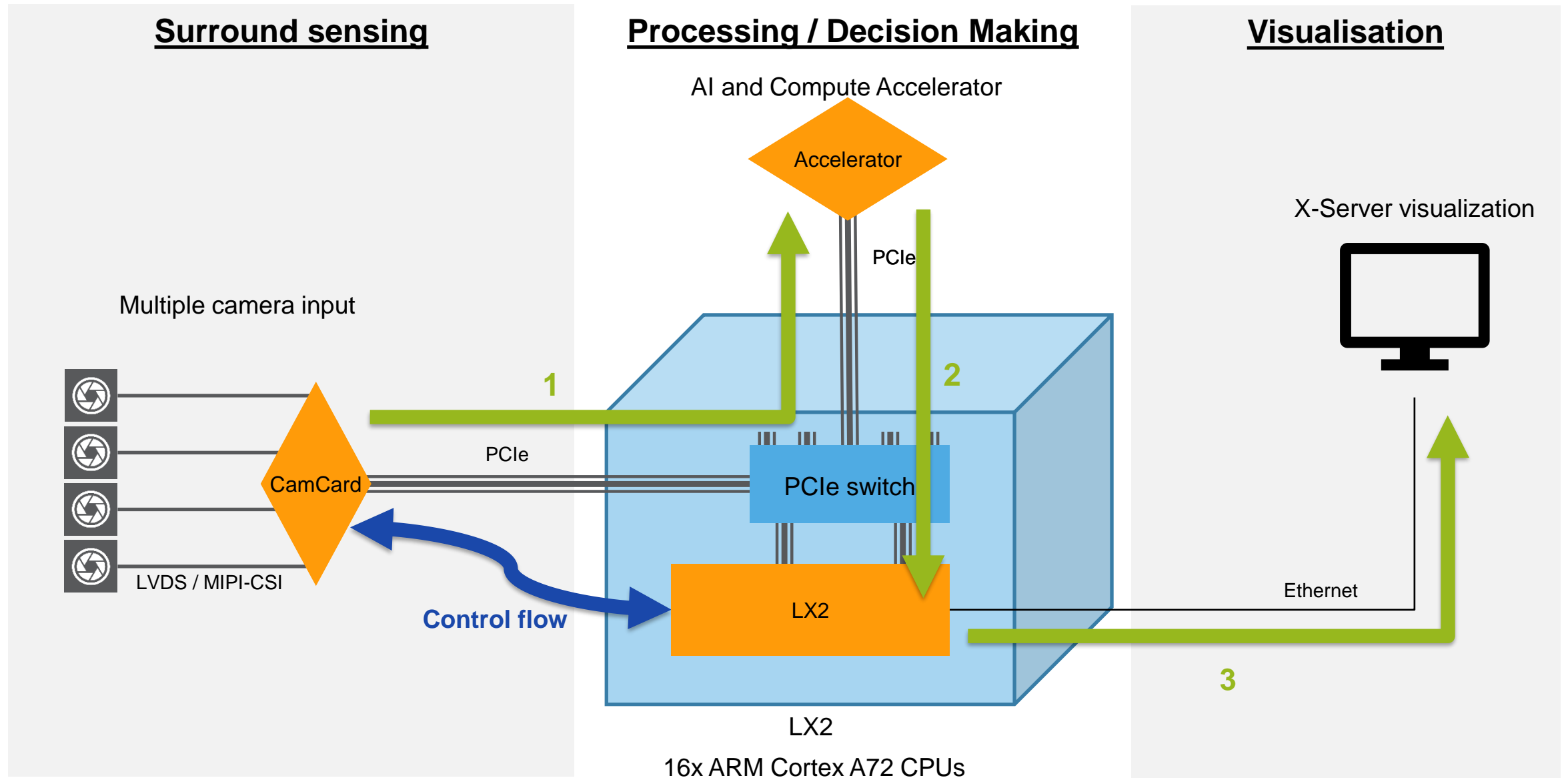
Visualisation

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17

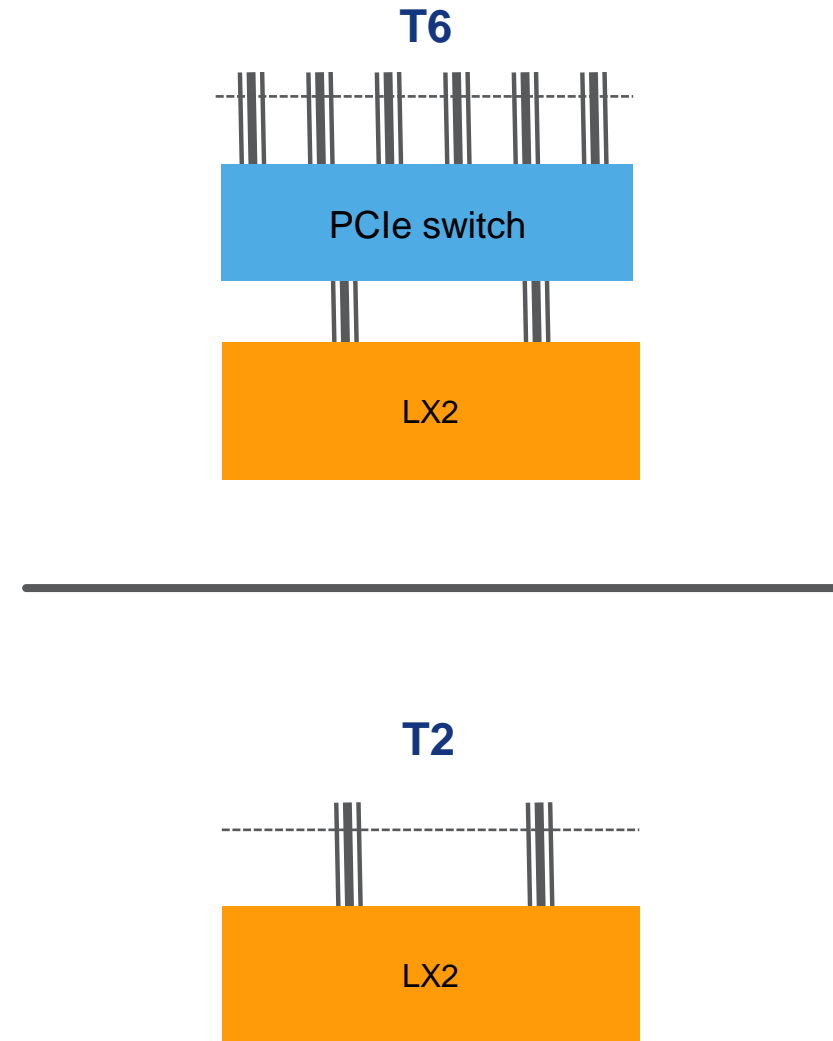
**NXP**

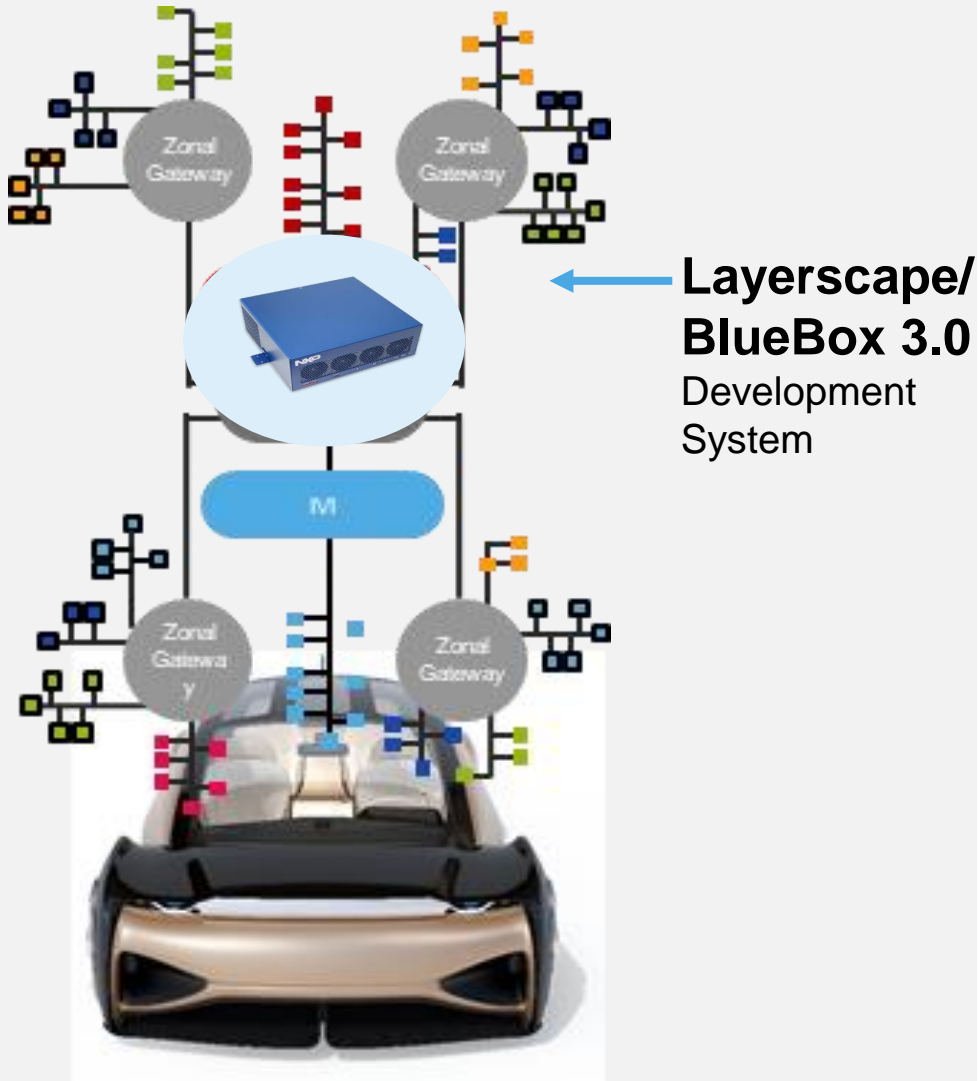
## TYPICAL BLUEBOX SDK USE CASE (T6 CHASSIS)



## LX2 CPU

- Multi-purpose CPU
  - Post-processing
  - Data interpretation
  - Decision making
- All processes runs from LX2
  - CamCard API for image input
  - Compute acceleration via OpenCL for MPPA
  - eIQ Auto API for AI processing
- T6 Chassis has PCIe switch
  - PCIe P2P traffic through switch without LX overhead
- T2 Chassis doesn't have PCIe switch
  - PCIe P2P traffic routed through the two LX2 PCIe connections





**PHYSICAL RESTRUCTURE | ZONES**

**ENABLING USER-DEFINED CAR**

## NXP LAYERSCAPE/BLUEBOX 3.0

Automotive High Performance Compute (AHPC) development platform, built with Layerscape Automotive



Protect your customers  
**Safety**



Embedded architecture  
**Flexible and easy prototyping**



Increase the speed of development  
**Increased performance**





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