



Let's shape a new
era of mobility. Together.

Let's move #LikeABosch

Bosch IP TechDay 2024

ME-IC/PRM-IP | March 14th, 2024



Bosch IP TechDay 2024

Introduction Session

1. Bosch ME in the role of a Tier3

An independent IP supplier



3. Bosch IP Portfolio

Innovative solution for communication, vision and sensor/actuator control



5. TechDay 2024

Agenda & Partners

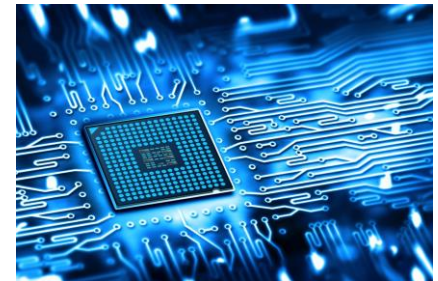
2. Motivation for Automotive IPs

Benefits of standardization, time to market and cost reduction



4. CAN, GTM & Vision IPs

.. a first glance



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Bosch – Role of a Tier3

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Our company in figures

In 2023*



91.6

billion euros
sales revenue



4.6

billion euros EBIT
from operations



427,600

Bosch associates
worldwide at year-end
(approx.)



470

subsidiaries and regional
companies (approx.) in
more than 60 countries

* preliminary figures

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Bosch Mobility Solutions



Mobility Solutions



61%



56.3bn



233,000



Industrial Technology

8%

7.5bn

34,000



Energy and Building Technology

8%

7.6bn

34,000



Consumer Goods

22%

19.9bn

83,000

in 2023

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Mobility Electronics – home of Tier3 IP business

Divisions and subsidiaries

EM	Electrified Motion Low and high voltage electrified solutions	ETAS	ETAS GmbH Solutions and services for the realization of software-defined vehicles
MA	Mobility Aftermarket Vehicle operation services for mobility lifecycle businesses, wiper systems	EB	Bosch eBike Systems Systems solutions for e-bikes – from drive units, rechargeable batteries, ABS to connected displays
ME	Mobility Electronics Electronic control units, semiconductors, sensors and IP	2WP	Two-Wheeler and Powersports Mobility solutions for two-wheeler and powersports manufacturers
PS	Power Solutions Internal combustion engine, fuel cell technology, thermal management	BEG	Bosch Engineering Group* Engineering services for customized mobility solutions
VM	Vehicle Motion: Steering, braking and occupant safety systems, vehicle dynamics sensors, act-by-wire, vehicle motion, software	MS	Mobility Engineering Solutions** Software engineering and services; system integration
XC	Cross-Domain Computing Solutions Modern E/E architectures, assisted & automated driving, software and services, cockpit solutions		

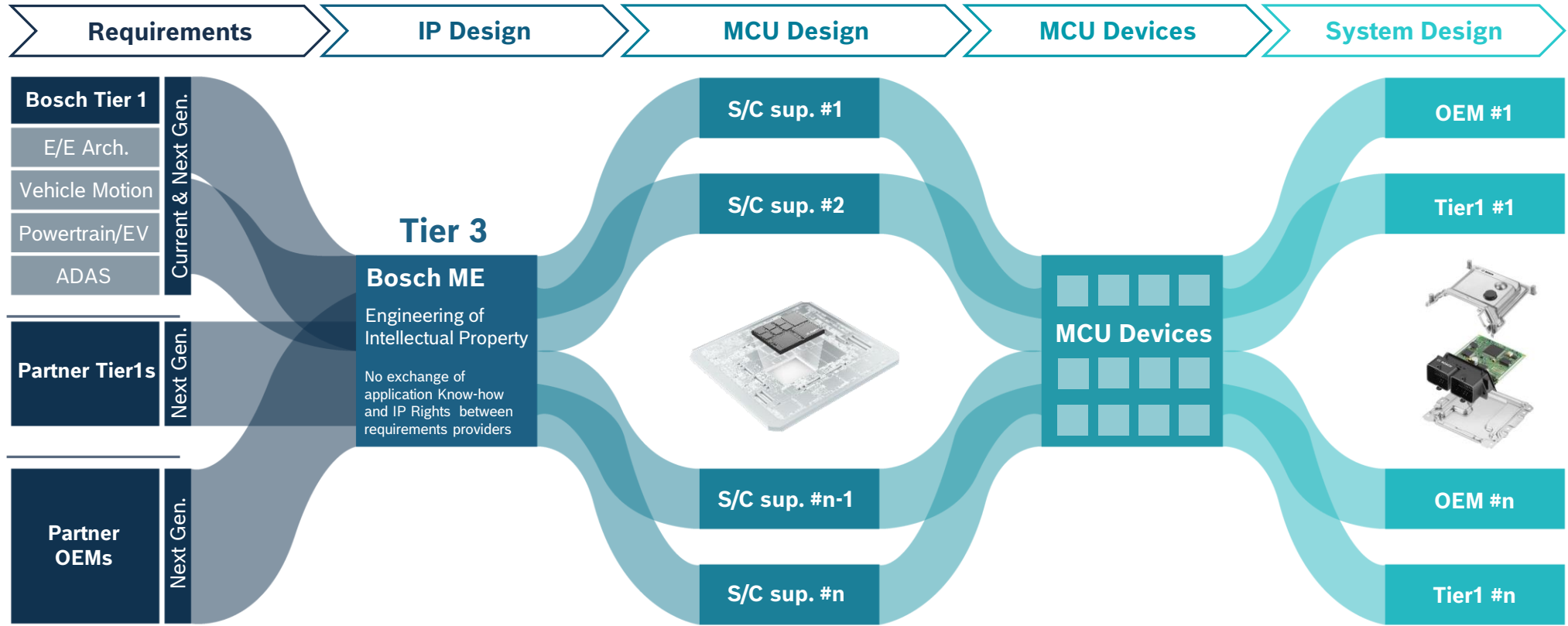
* incl. Commercial Vehicles and Off-Road, and ITK Engineering GmbH
** part of Bosch Global Software Technologies

Regions

AM	Americas
CN	China
EA	East Asia
EU	Europe
IN	India

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Role of Bosch ME in the automotive IP world



Protection by contract and/or NDA

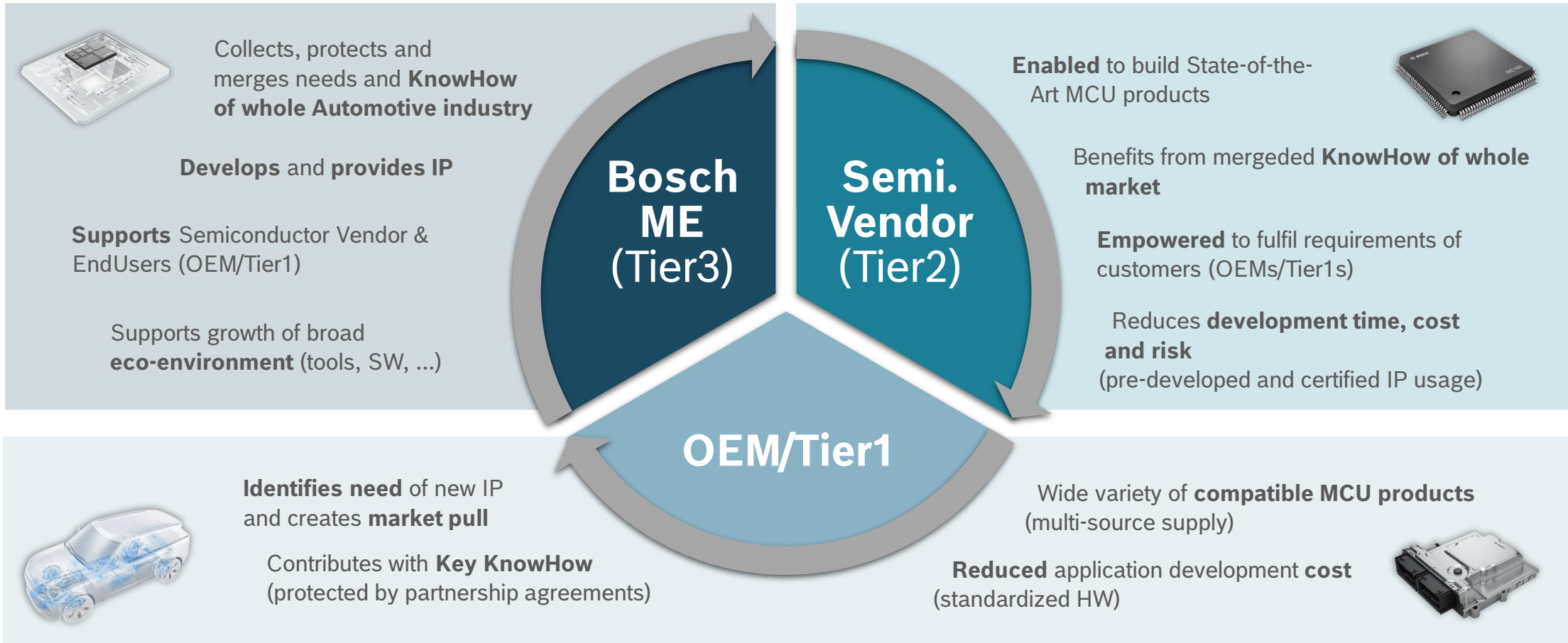
Bosch ME distributes right of the requirements provider to S/C suppliers

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Automotive IPs Motivation

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Benefits & Motivation



3

Bosch IP Portfolio

I/O Processing IP

GTM IP Gen 4

... realtime oriented I/O co-processor
(aka "Timer")

- A scalable timer solution for ...
 - digital input data processing (e.g. sensor data)
 - digital output data generation (e.g. PWMs for actor control)
- Integrated multi-threaded RISC cores for real-time oriented control loops
- Generic architecture to address multiple domains
 - Powertrain (combustion & electric)
 - Chassis and Body applications
 - Inverter, PFC,
 - ...

Communication IPs

CAN IPs


- **X_CAN IP ... CAN XL**
 - Triple-protocol support:
 - Classical CAN, CAN FD and **CAN XL (new)**
 - Active DMA support
 - Bitrates up to 20 Mbit/s
 - Payload up to 2048 byte
- **M_CAN IP**
 - Dual-protocol support:
 - Classical CAN and CAN FD
 - Bitrate up to 8 Mbit/s
 - Payload up to 64 bytes

CAN protocol licensing

- CAN FD (light) protocol license
- CAN XL protocol license

Next generation CAN IPs

... in development

- **XS_CAN IP ... nextGen CAN XL**
 - Small gate count
 - Triple-protocol support:
 - Classical CAN, CAN FD and **CAN XL (new)**
 - Bitrates up to 20 Mbit/s
 - Payload up to 2048 byte
 - CAN FD Light Commander up to 8 Mbit/s
- **FDLR_CAN IP** 
 - CAN FD Light Responder IP
 - For Responder Nodes, MCU less
 - Bitrate up to 8 Mbit/s
 - Payload up to 64 bytes

Hardware Accelerator IPs

Computer Vision IP Gen 2

... comprehensive set of computer vision processing elements

- Optical Flow
 - Optical flow field estimation
 - Native 12MPix input image resolution support
 - Camera's ego-motion estimation
- Stereo Disparity module
- Classifier Engine
- Structure from Motion Detection

Data Flow Architecture IP

... flexible and highly efficient hardware accelerator

- Advanced mathematic algorithms
- Offloading computing intensive functions from μ C cores
- High flexibility due to dynamic re-configurability

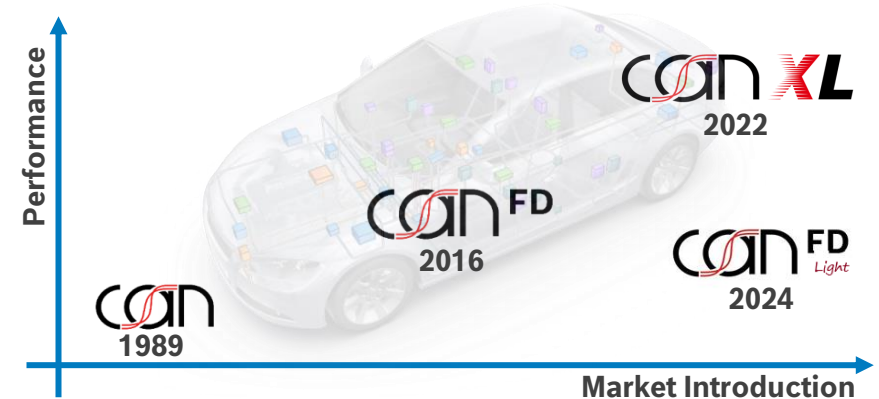
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CAN, GTM & Vision IPs ... a first glance

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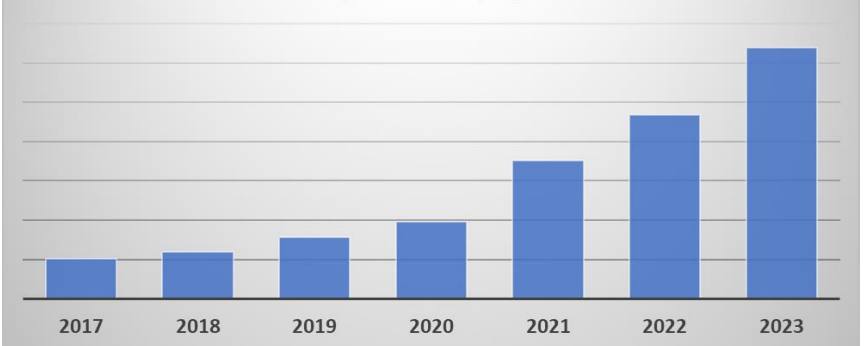
CAN Technology

- Established as **Industry Standard** @ CiA & ISO
 - Bosch driving standardization – **chairman and editor** of protocol specification
- Based on close collaboration with **OEMs, Tier1s and Tier2s**
- Widely supported with parts (Controllers, Transceiver, Tooling)
 - >> **1 bn new CAN FD controllers per year**
- Business based on Protocol License as well as IP modules
 - Protocols: CAN Classic, CAN FD, CAN XL, CAN FD light, ...
 - IP Modules: M_CAN, X_CAN, XS_CAN, FDLR_CAN, ...
- Latest developments include:
 - CAN XL** with up to 20 Mbit/s incl. QoS, Ethernet Tunneling, cost optimized, security, ...
 - CAN FD light** focused on low cost networks, re-use and robustness

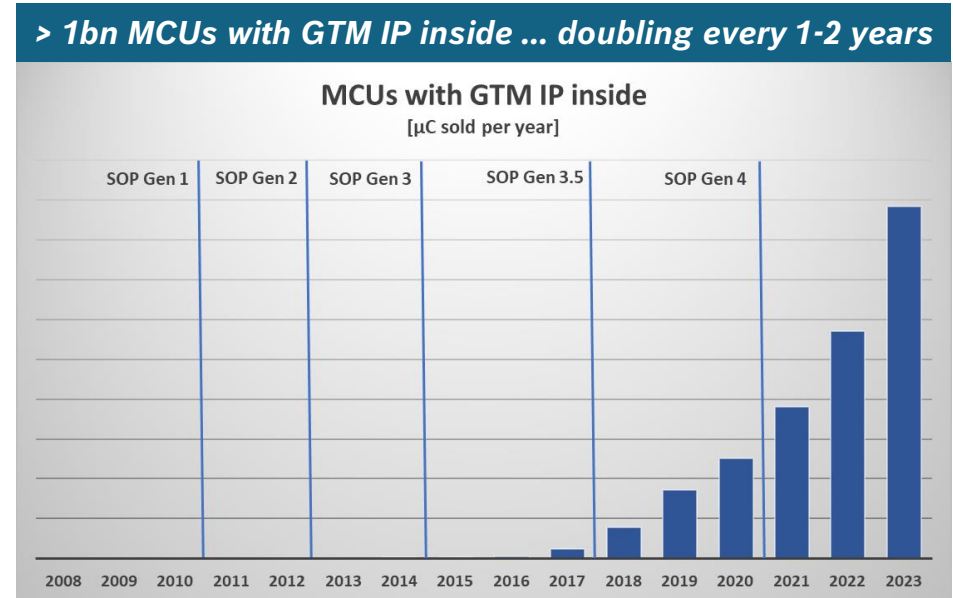


>> 1bn new devices per year with CAN FD inside

Devices with CAN FD inside
[parts sold per year]



- Standardization as driver for IP development
 - 2008 – **proprietary solutions only** (“Timer”)
 - Low-level I/O **software development cost** identified as major pain-point in **second/multi-source strategy**
 - Engine Control Units (ECUs) as **driver for standardization**
 - Quickly spread into all application classes with **sensor/actuator interaction** (body, chassis, EV, ...)
 - Benefit for whole automotive industry by reduction of application development cost
 - Growing **eco-environment** (tools, compilers, ...) and **partnership network** (OEMs/Tier1s)
 - **De-facto standard** for automotive μ Cs



μ Cs with GTM IP inside:

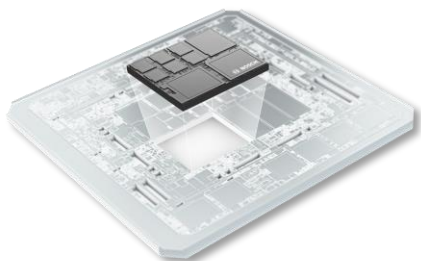
The long path to ramp-up – up to 5 years from IP SOP to μ C ramp-up

- Automotive development cycle
 - The **long path** from IP SOP to μ C/Car **ramp-up**

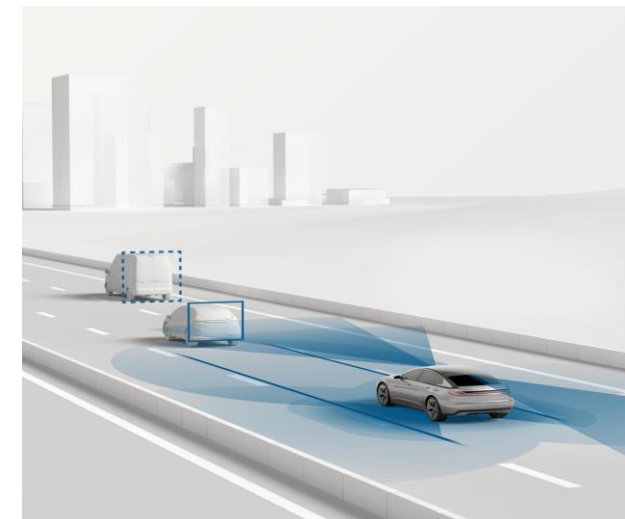
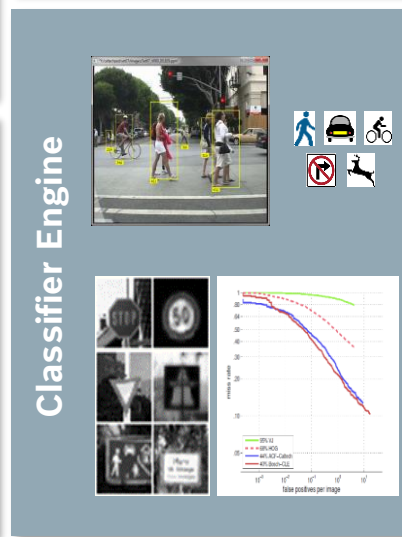
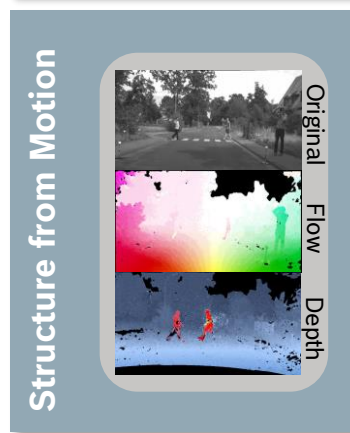
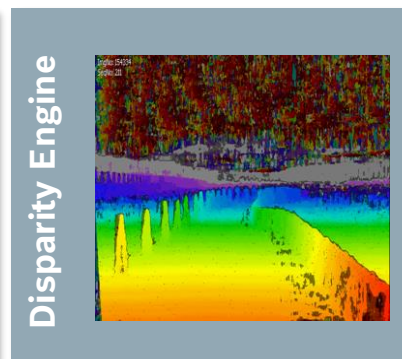
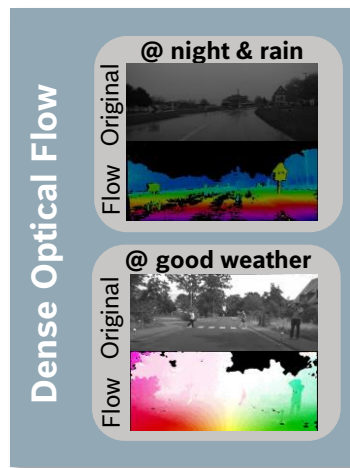


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Computer Vision IPs for ADAS/AI HW Acceleration



- Very high **HD resolution**(12Mpixel) support
- Best in class pre-processing for applications like:
 - **object tracking**
 - **time to collision estimation**
 - **online calibration of stereo cameras**
 - ...
- Extremely **high dynamic range** support (150 dB)
- **Optimized in power and in throughput**
- Excellent **power and die size performance ratio**
- Robust estimation for Automotive use-cases
- ASIL-D capable



- **Field proven** set of IPs
- Running in **millions of cars** everyday
- Vision IP Gen 1 **on the road since 2019**
- **Vision IP Gen 2** available by end of 2024
 - Eval. version available by mid 2024



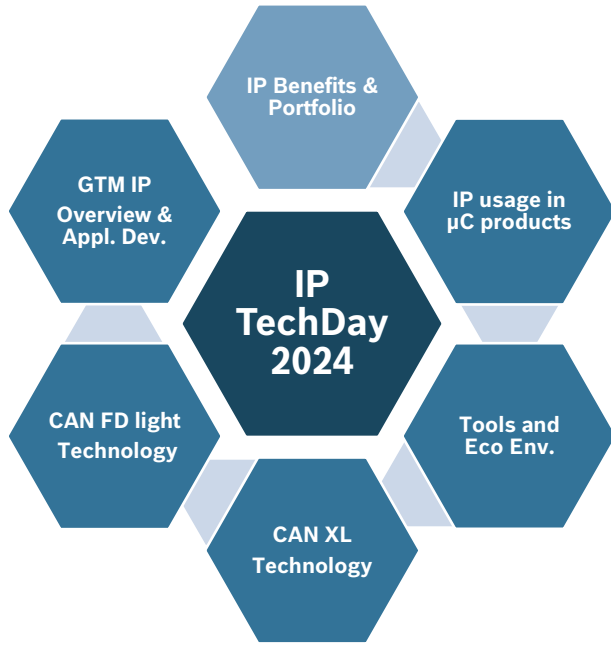
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**TEXAS
INSTRUMENTS**



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COSEDA
Technologies

TASKING



LAUTERBACH
DEVELOPMENT TOOLS

