Freescale VISION solution

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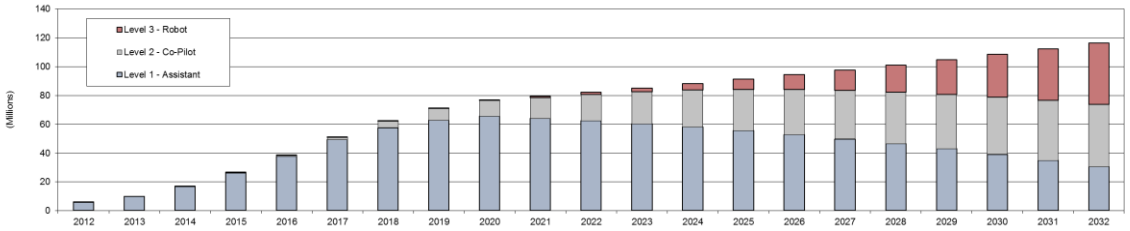
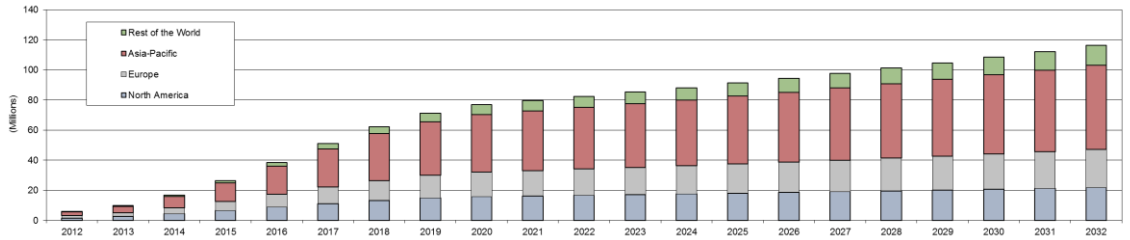
The Market Outlook

The Market – Freescale & Analyst view

Autonomous Vehicle OEM Shipments by Type, World Market, Forecast: 2012 to 2032

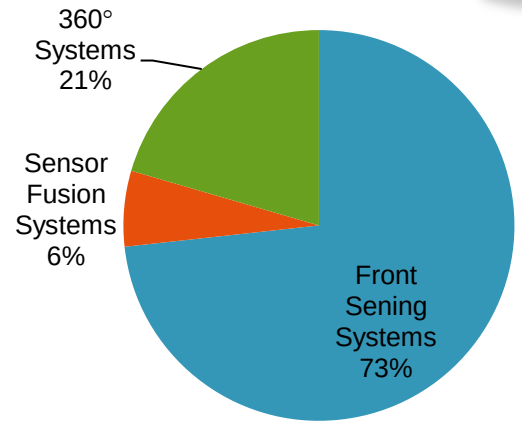


Autonomous Vehicle OEM Shipments by Region, World Market, Forecast: 2012 to 2032



Original graphs from ABI research

2022 SAM



Study elaborated by FSL on market research data

Headline Requirements:

	Front Sensing	360° Sensing	Sensor Fusion
Safe Architecture	ASIL B (min) Quad Cores @ ≥800MHz	ASIL B (min) Quad Cores @ ≥ 800MHz	ASIL D Quad Cores @ ≥1000MHz + 2nd SOC
Sensor Proc	Massively Parallel image processor for detection	Massively Parallel image processor for detection	N/A
HMI	2D GFx for debug & HMI	3D GFX for HD display	N/A
Connectivity	PCIe, MIPI-CSI2	PCIe, ENET, MIPI-CSI2	FD-CAN, FlexRay, ENET

ADAS Market Trends

Comfort while Driving

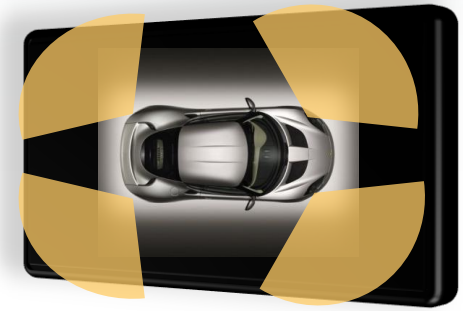
Keeping the Car on the Road

- Camera and radar
- Cognition algorithms to extract features / classify objects
- No display necessary
- Functional safety applied to longitudinal motion

Safe Driving

360° Surround

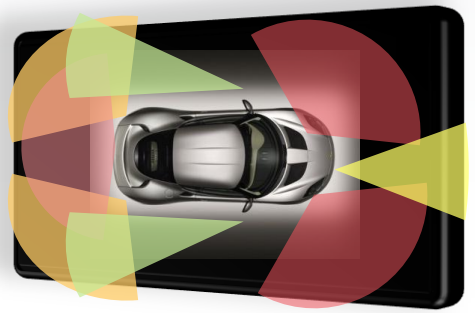
- Rear/Side camera, sat. Radar, Usonic
- 3D image techniques and data fusion
- 2.5D and 3D with high quality
- Greater safety as lateral movements are controlled



Self Driving

Managing Co-driving

- Large data-object handling
- 3D environmental modeling allowing self-navigation
- Ego motion
- Greatest safety – longitudinal and lateral motion prediction
- Integration of feature extraction



Evolution of Advanced Driver Assistance Systems

Collision Mitigation
Passive Systems

Collision Avoidance
Reactive Systems

Collision Prediction
Predictive and Warning

Semi-Autonomous
Predictive Actuators

A simplified Taxonomy for ADAS

Today

- Sensor
- Driver active
- Fail Safe

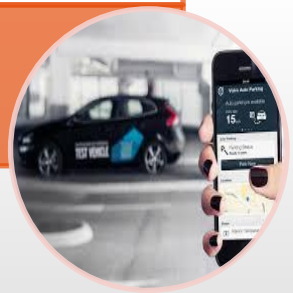
Assist

- ACC
- LDW
- BSD
- Head Light
- TSR

By 2020

- Sensor Fusion & maps
- Co-Pilot
- Dependable & reliable

Automate



- Park Assist
- EBA
- Highway platoons
- ACC with Steer

By 2030

- Sensors & Maps & V2X
- Driverless
- Fail operational

Autonomous

- Commercial autonomous vehicles (drones-big vehicle)
- Driverless public transport
- ACC with Steer

Vision Challenges

Power Consumption

- Power/Performance ratio
- BOM costs (board, heat sinks etc)
- Infotainment products reused

Miniaturization

- Physical application space
- BOM cost reduction
- Safety adds vehicle weight

Functional Safety

- Infotainment products reused
- Safety v availability
- General lack of expertise in the market

Software Investment

- Future reuse of algorithms
- Independency from hardware
- Flexibility to adapt as strategies evolve

Freescale Value

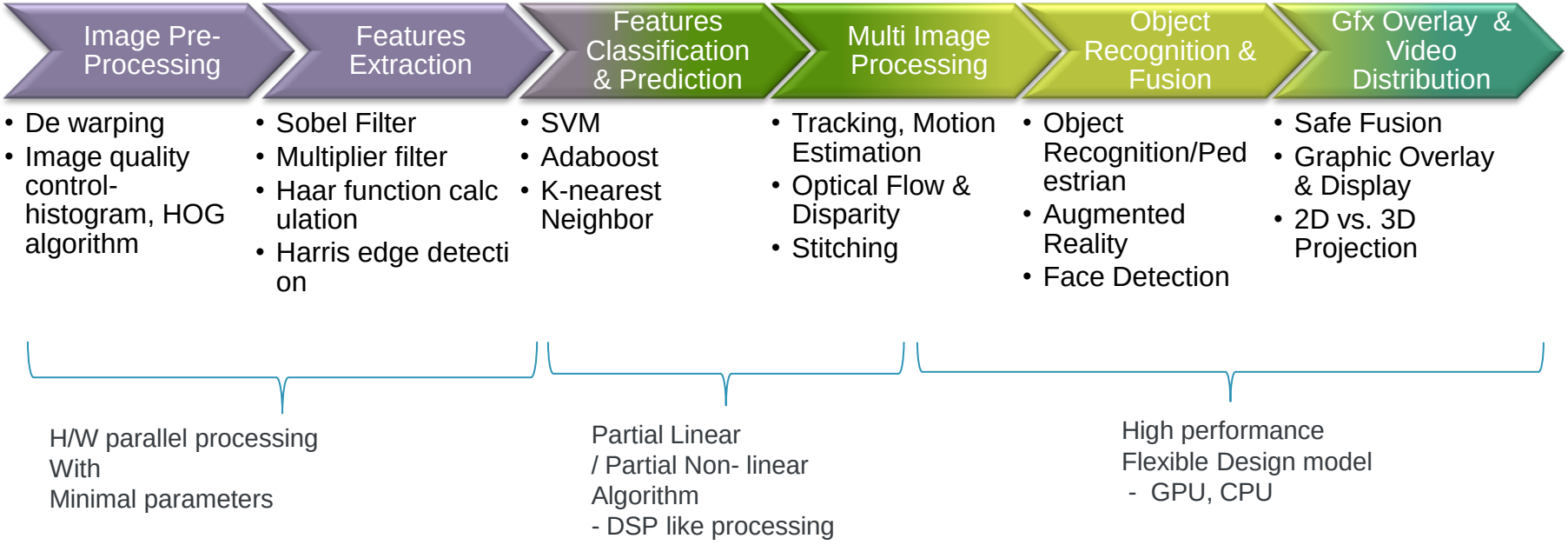
•Industry leading performance per mWatt
•Designed for Vision

•RCP packaging
•ISP integration
•DRAM integration

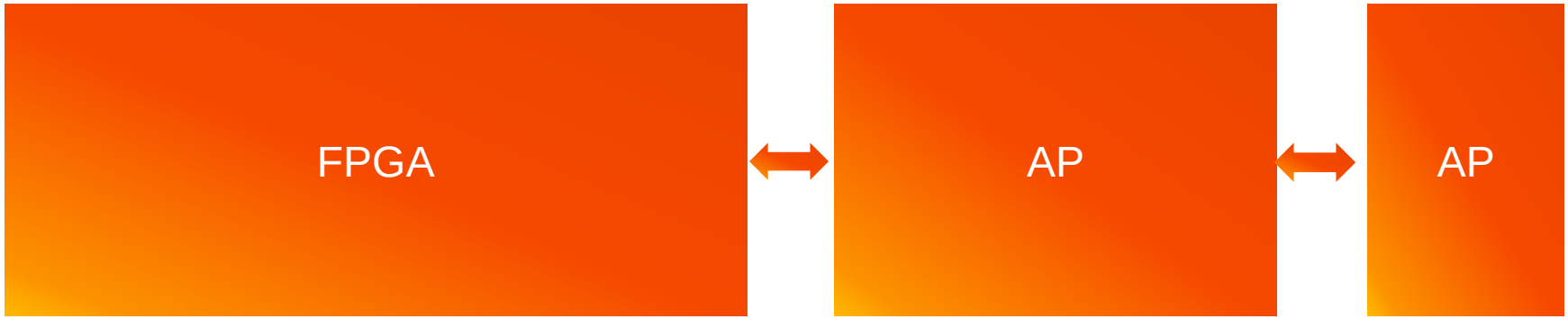
•Safety Process
•Safety IP
•Multi Core

•OpenCL
•Software Partners
•Product family

Image processing process



Existing System configuration- FPGA



Consideration point

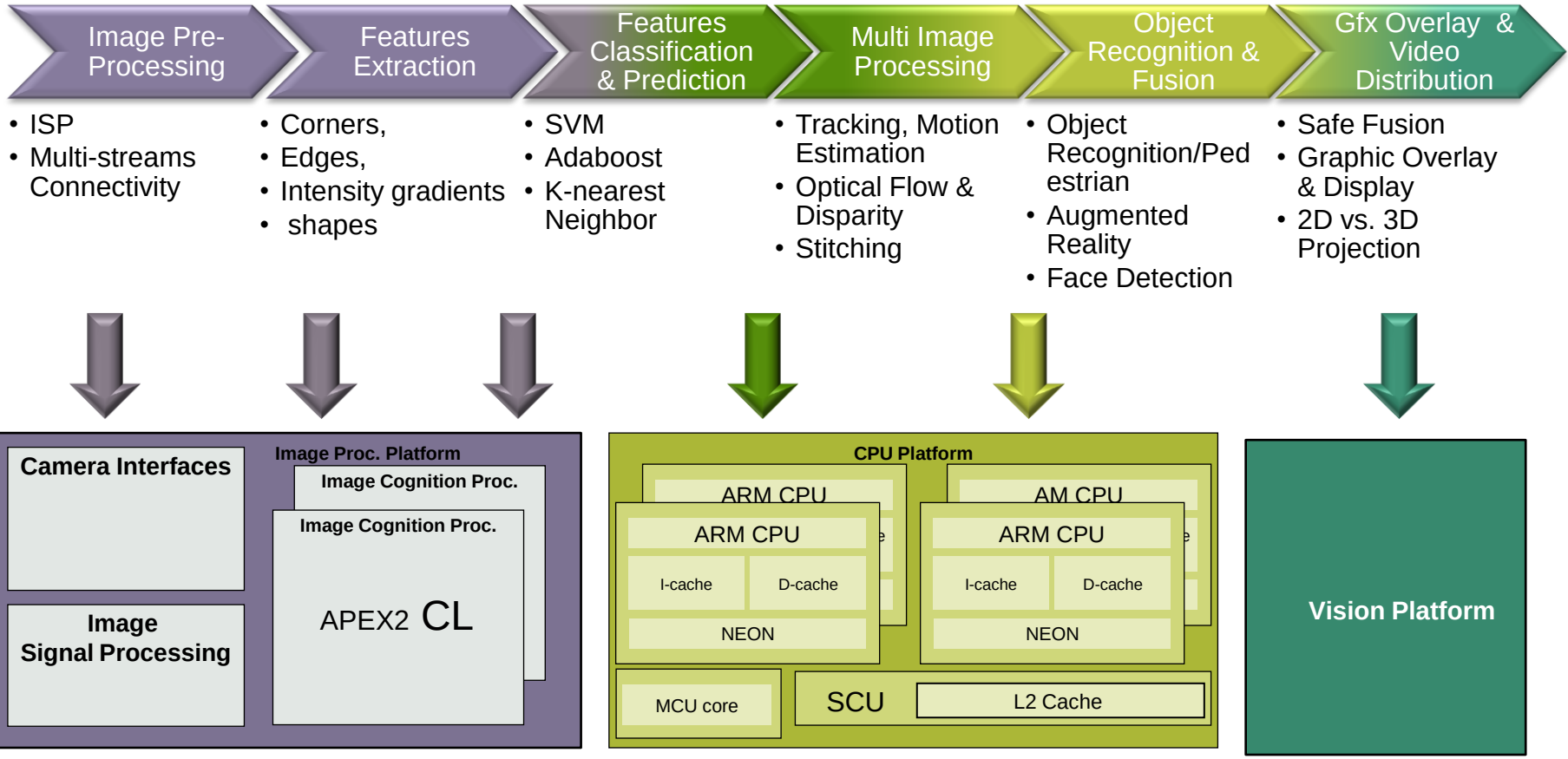
- Development cost
- Power consumption
- Reliability
- Memory system integration

Existing System configuration- DSP

Consideration point

- Development cost
- Fusion algorithm development
- Reliability
- Competition with FPU/ NEON in ARM

Machine Vision Processing ⇒ Freescale proposal

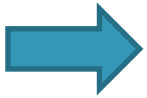


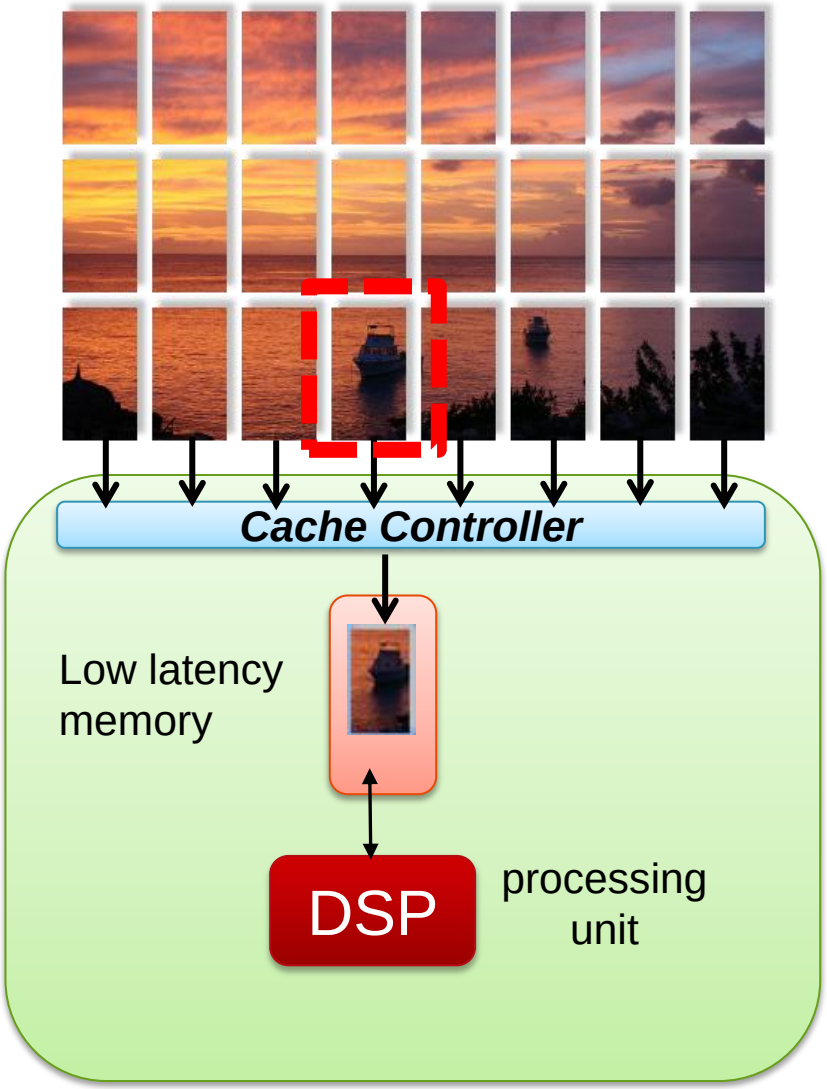
High BW Operations
Scalable MIMD Local Memory
Soft ISP

Scalable RISC – Data Fusion
SIMD Co-Processor - Neon
Memory Hierarchy and coherency

Vector Graphic
Video Codec
Smart Diplay

DSP: Vision Accelerator Architecture





- Image is processed block by block
- Image blocks are processed sequentially

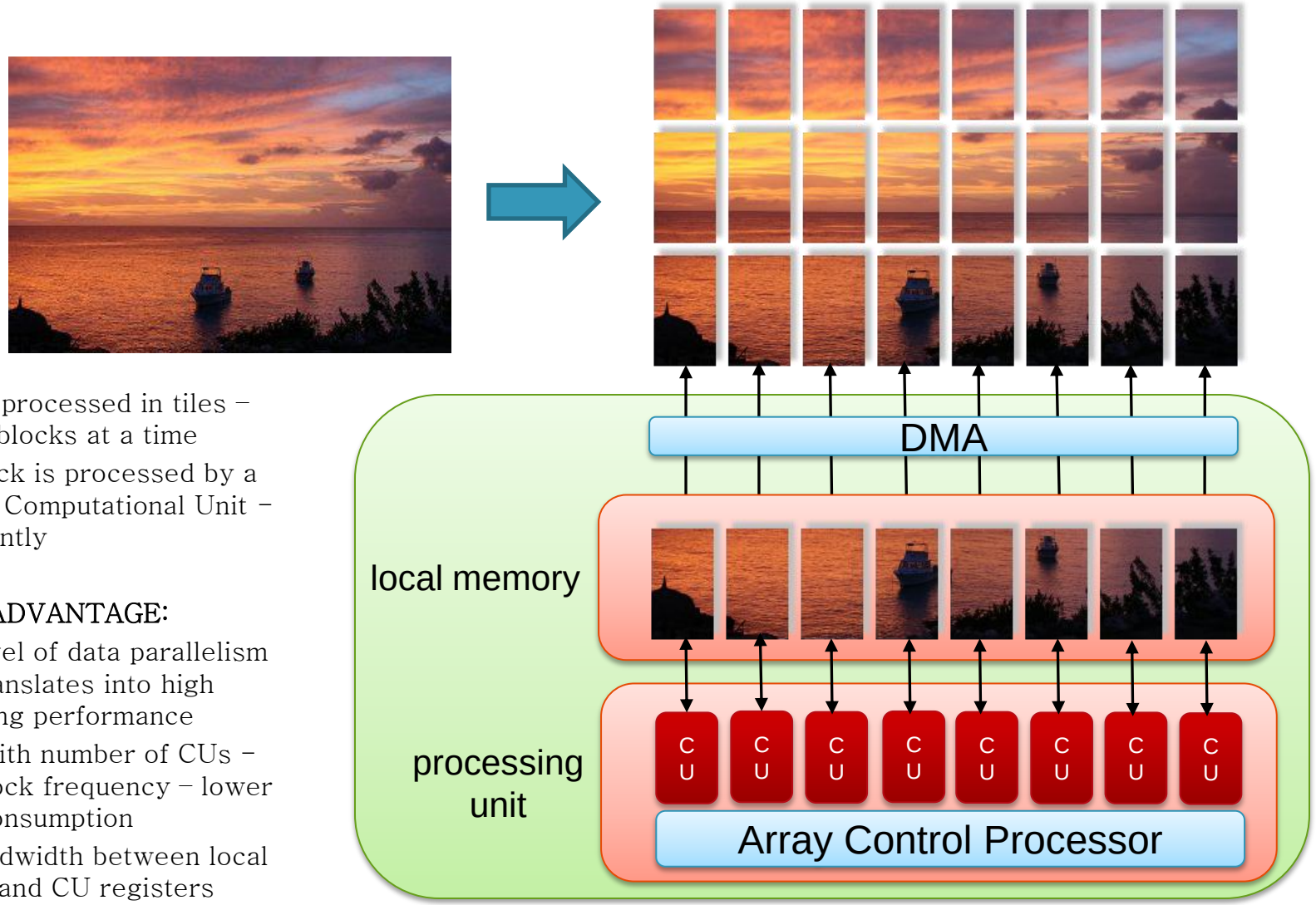
ADVANTAGE:

- Simplicity – within well known programming paradigm

DISADVANTAGE:

- Low level of parallelism
  - Instruction level parallelism only
- Sequential operations forces a low utilization data locality
- *Scales mostly with clock frequency which leads to high system power consumption.*

APEX: Vision Accelerator Architecture

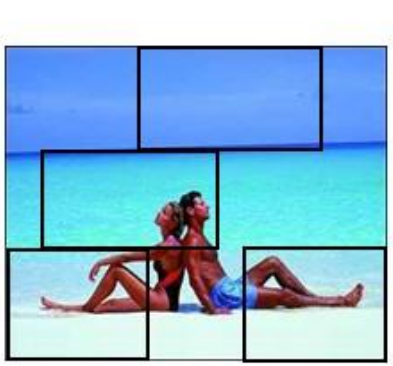


- Image is processed in tiles – multiple blocks at a time
- Each block is processed by a different Computational Unit – concurrently

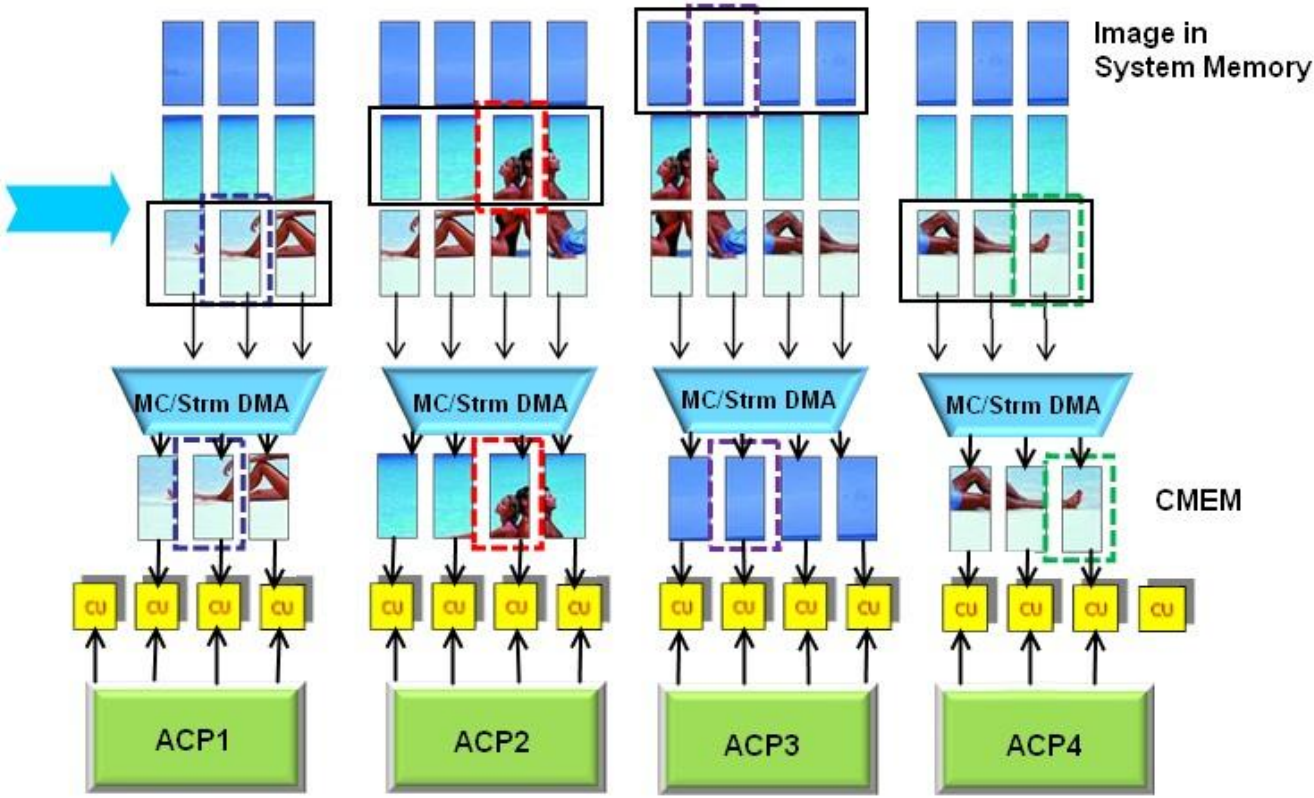
ADVANTAGE:

- High Level of data parallelism which translates into high processing performance
- Scales with number of CUs – lower clock frequency – lower power consumption
- High bandwidth between local memory and CU registers

APEX-2 - SIMD and Scalar Multi-Core



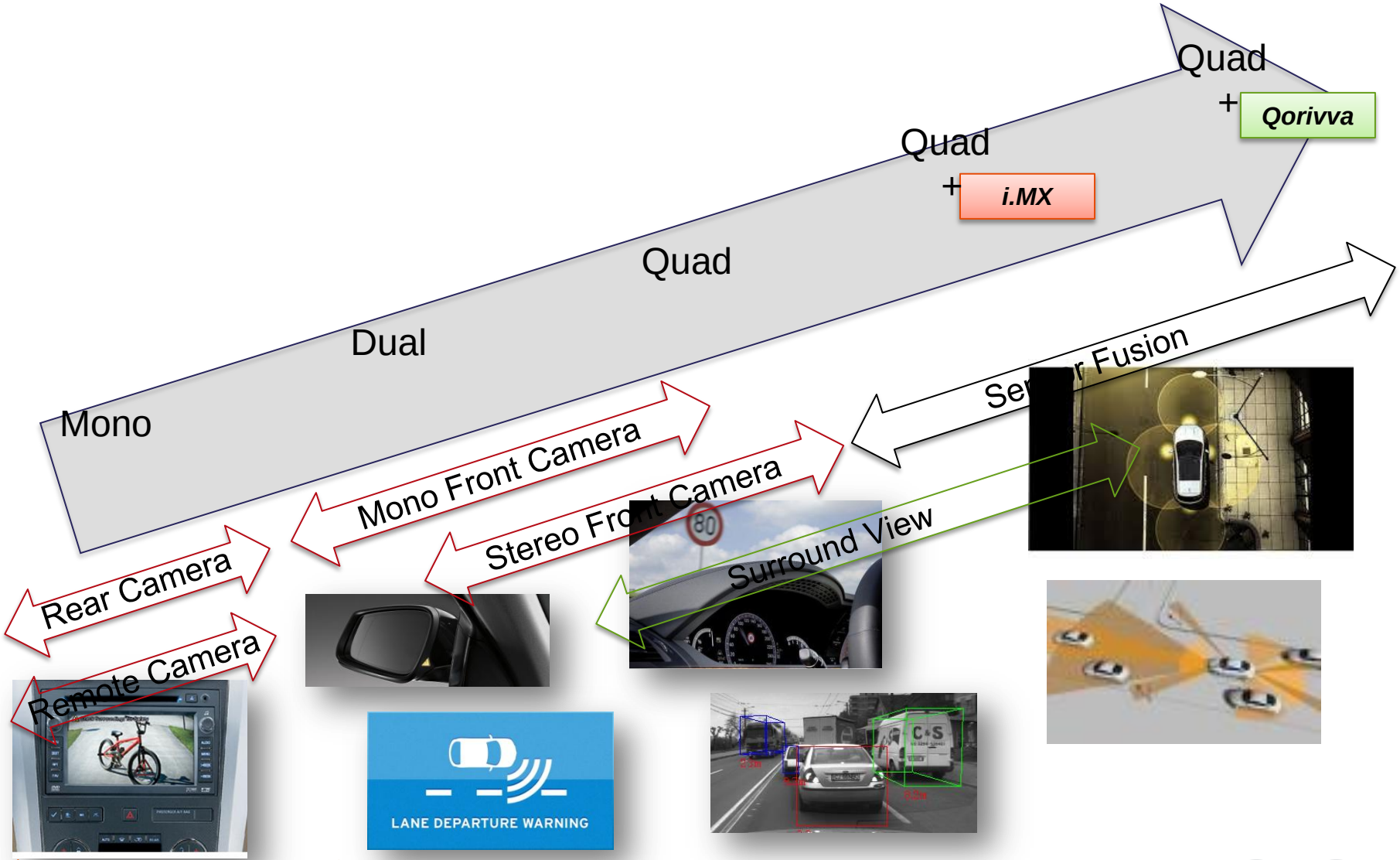
Region of Interests operated on by different ACPs



ADVANTAGE:

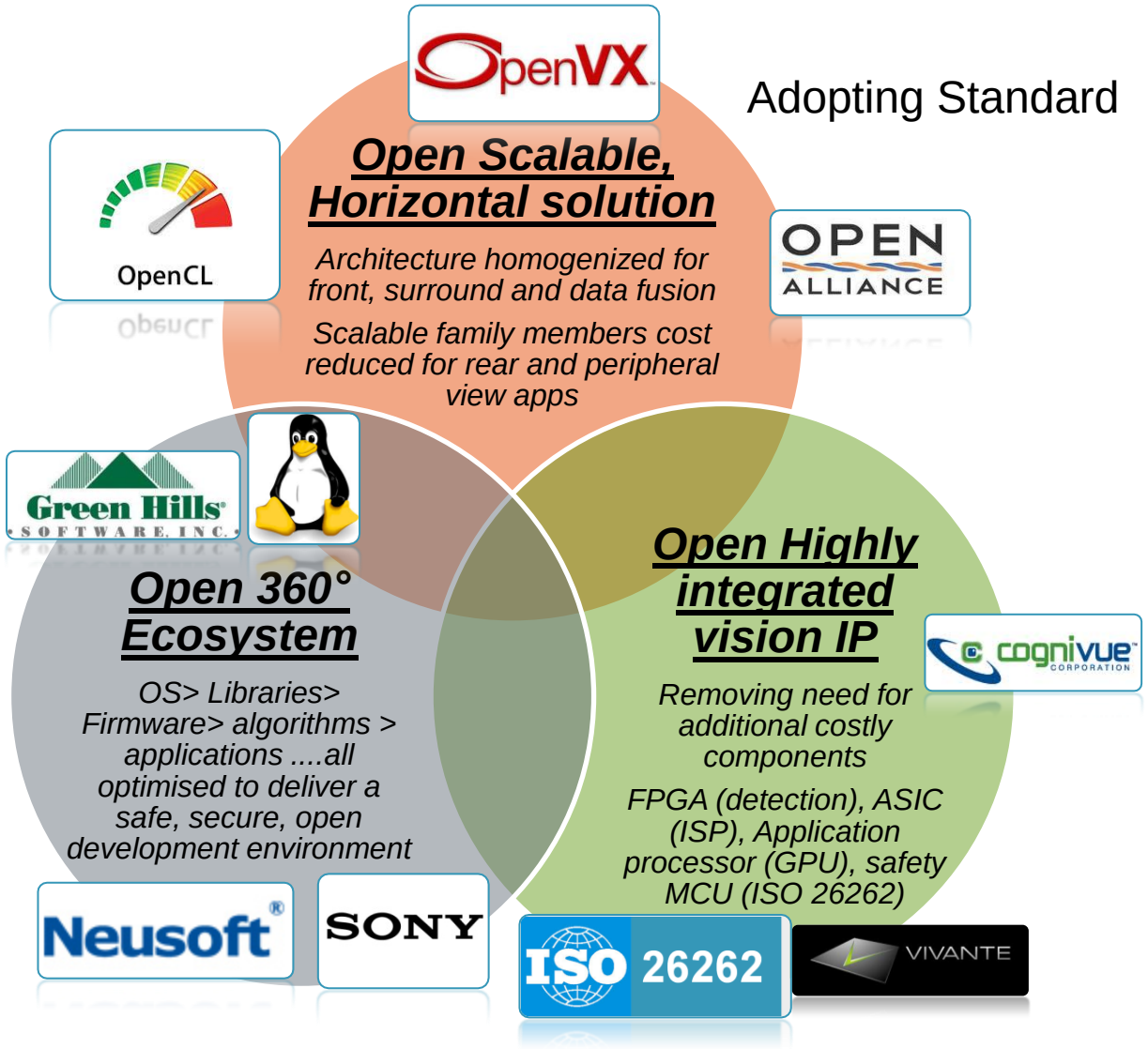
- Each core has a vector and a scalar unit to implement non-data parallelizable processes within the pipeline
- Can run multiple tasks on different portion of the image – concurrently.
- Vector instructions can now execute at different addresses.
- C/C++ complier with extensions for vector operations.

Vision Scalable Solution



Freescale– *Open* Vision Architecture

Breaking the Vertical Paradigm: 'democratization of ADAS'

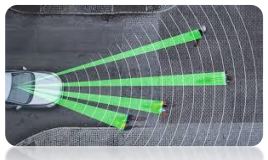


- ***Paving the way to long term goal of semi autonomous autos***

- *Reuse*
- *Scalable*
- *Tools and SW*
- *Open development environment*

Safety and the race to the autonomous car

By 2016 NCAP demands:
- Lane Keep Assist
- Pedestrian Detection
- Emergency Braking



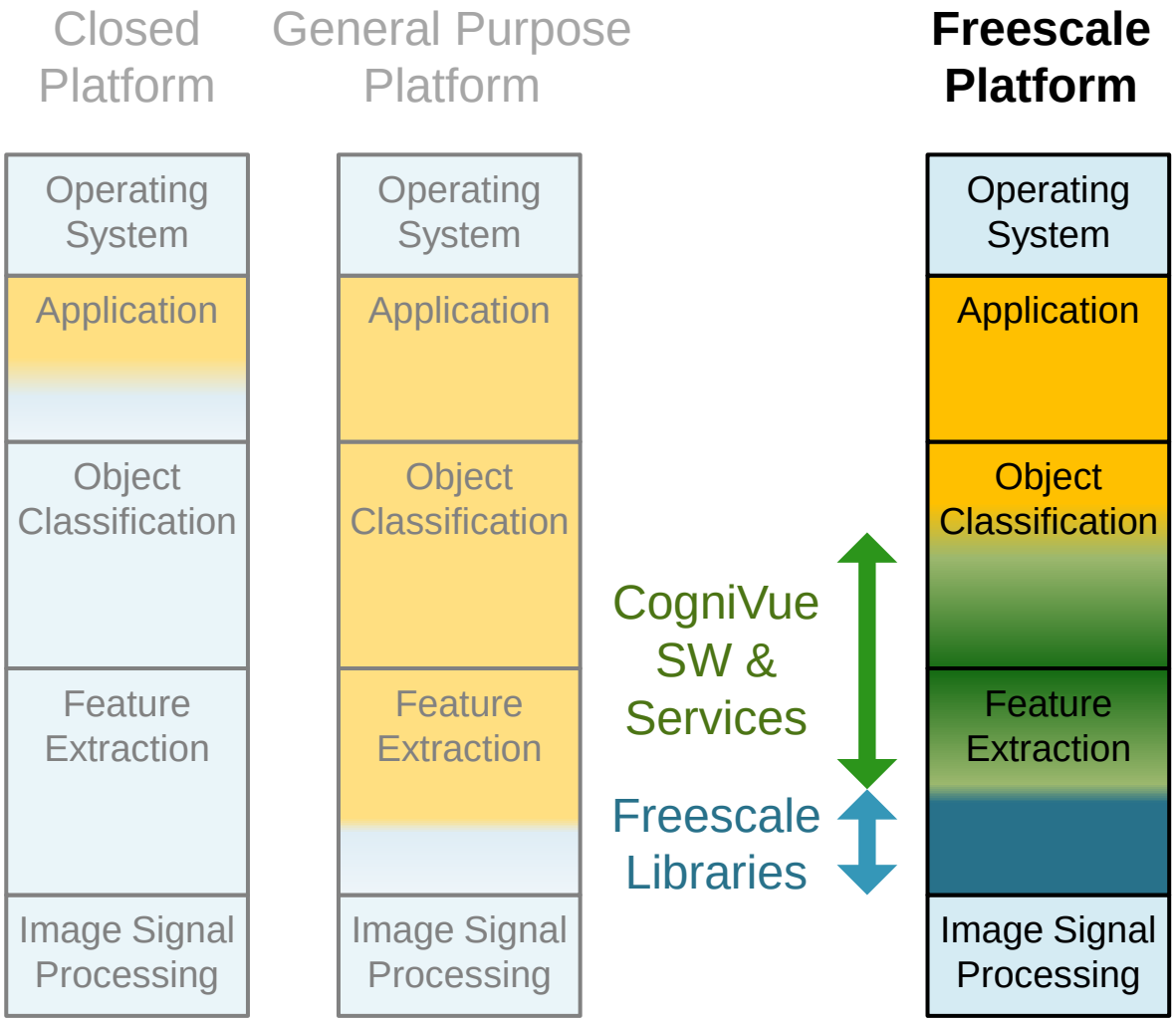
By 2020 OEM "friendly race"
Who will get first to deliver an affordable semi-autonomous vehicle?

Driver Responsible

Shared Responsability

Freescale re-invent Safety:
1. Shift Focus to Availability (not only HW Lock-Step)
2. Balance between HW & SW mechanisms
3. Complements the SW OS non-interference message

Freescale Business Model for Vision ADAS



- Open platform allows differentiation
- Medium initial invest
- Medium time-to-market
- Optimized value creation

Tier1 IP

3rd Party IP

Freescale vision solution SDK Architecture