BLACK SESAME TECHNOLOGIES

Stock Code: 2533.HK

Enabling Intelligent Vehicle with Chip and Solution

Empowering Future Mobility with Chips

Mkt@bst.ai

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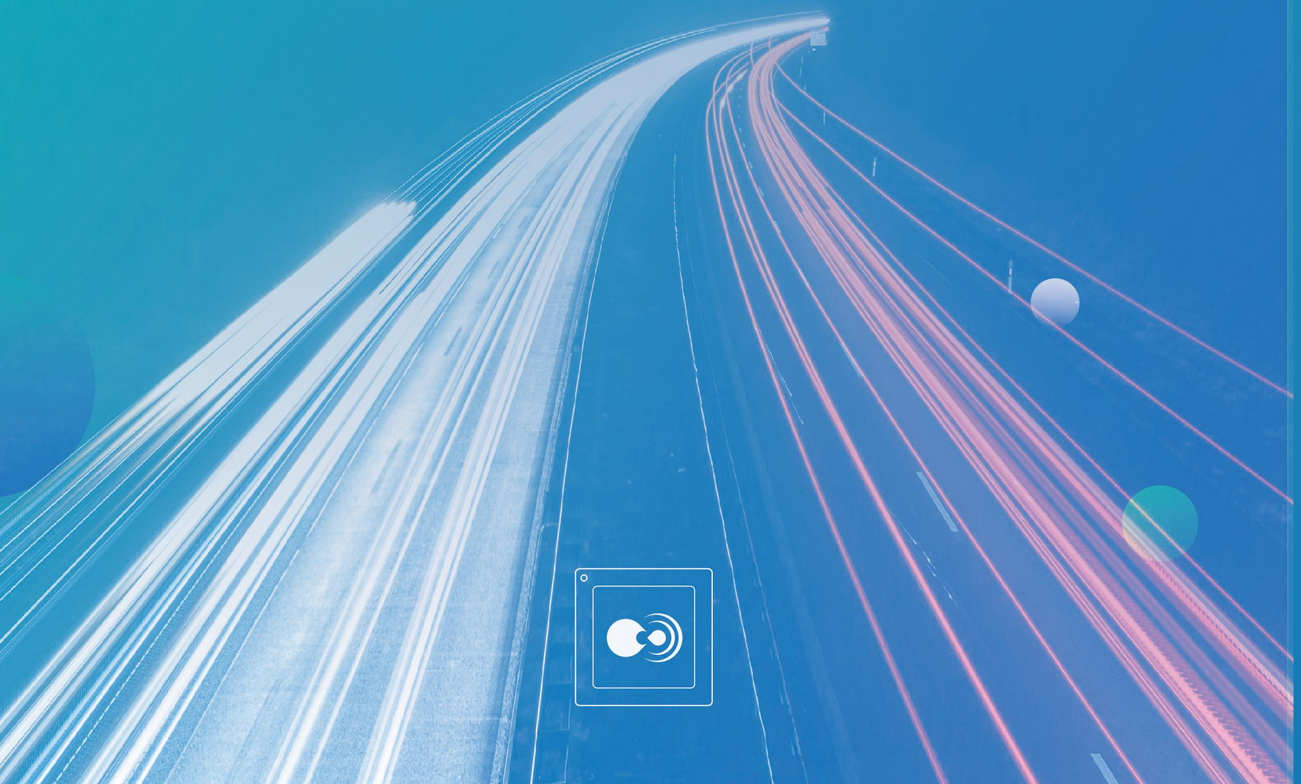
San Jose | Singapore | Hong Kong | Wuhan | Shanghai | Shenzhen | Chengdu | Chongqing | Beijing

Stock Code: 2533.HK

BLACK SESAME TECHNOLOGIES

Black Sesame Technologies

Black Sesame Technologies is a leading provider in automotive-grade computing platform and solutions for smart vehicles. Founded in 2016, Black Sesame Technologies has listed on the main board of the Hong Kong Stock Exchange since 2024, under stock code 2533.HK. The Company started with Huashan Series high-computing power platforms for autonomous driving and released Wudang Series cross-domain platforms in 2023 to address more diverse and sophisticated demands for advanced functionalities in smart vehicles, while also beginning to expand into other applications. Black Sesame Technologies proprietary automotive-grade products and technologies empower smart vehicles with mission-critical capabilities, such as ADAS, smart cockpit, advanced imaging and interconnection. The Company offers full -stack ADAS capabilities to meet broad customer needs through automotive-grade computing platform and solutions, powered by the Company's own IP cores, algorithms and support software.



Having over 1000 employees worldwide, Black Sesame Technologies established R&D and sales centers in the Silicon Valley, Singapore, Hong Kong and mainland China. Our core team consists of talents from top companies like Bosch, OV, Nvidia, Ambarella, Microsoft，Qualcomm, Huawei and ZTE, with averages 15+ years professional experiences.

Black Sesame Technologies has carried out a series of commercial cooperations with industry-leading companies in L2/L3 ADAS solutions and autonomous driving perception systems, including Geely Group, Dongfeng Group, FAW Group, SAIC Motor, JAC Group, Bosch, APTIV, Continental, ecarX, Joynext, LeddarTech & etc. Currently, HuashanA1000 family is in full production and has been adopted by multiple leading OEMs. The mass-produced vehicle models include Geely Galaxy E8, Galaxy Xingyao 8, LYNK & CO 08, LYNK & CO 07, Dongfengen007, Dongfeng er008 & etc. In addition, the Company's algorithms and image processing technologies have been commercially implemented in various fields including commercial vehicles, smart mobility, smart robotics and smart phones.

Company History of Mass Production

2016

Jul. Company founded

2018

Mar. Entered into global strategic cooperation agreement with **Bosch**

2019

Nov. Entered into strategic cooperation agreement with **FAW Group** to accelerate intelligent driving commercialization

2020

Jun. Launched **Huashan A1000** and **Huashan A1000L**

Oct. Launched autonomous driving solutions and V2X solution

2021

Sep. Entered into strategic cooperation with **JAC Motors** to develop vehicle-level autonomous driving chips and visual perception algorithms

2022

Sep. Awarded project with **Utopilot** on L4 AGV and heavy truck models

Dec. Announced joint collaboration with **Dongfeng Motor** to deploy Huashan A1000 SoCs on its first all-electric sedan and SUV models

Reached a commercial vehicle platform-level strategic cooperation with SANY

2023

Apr. Announced **the industry' s first cross-domain computing platform** for intelligent vehicles , **Wudang Series,** achieving four-domain with single chip

May. Announced joint collaboration with **FAW Group** to deploy Huashan A1000L on the **Hongqi models**

Aug. The GEELY – **LYNK & CO 08** with Huashan A1000 start to sell

Iveco Olsson equipped with Huashan A1000 are mass-produced

2024

Mar. **Dongfeng eπ007** with Huashan A1000 started to sell

May. **LYNK&CO 07EM-P** with Huashan A1000 started to sell

Jun. **Dongfeng eπ008** with Huashan A1000 started to sell

Aug. **Officially listed on the main board of the HKEX**

Sep. Signed a technical cooperation framework agreement with Dongfeng Motor to deepen cooperation

Dec. **Launched Huashan A2000 family chips**

2025

Jan. Entered into global strategic cooperation agreement with **Continental**

Feb. Awarded project with **FAW Group** on Huashan A1000

Mar. **Geely Galaxy E8, Galaxy Xingyao 8** with Huashan A1000 started to sell

Apr. **Launched "Safety Intelligent Platform"** based on **Wudang C1200 family chip**

Awarded project with **Dongfeng Motor** on Wudang C1296

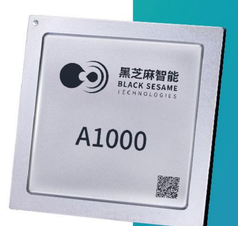
Black Sesame Technologies Huashan A1000 Family

A1000

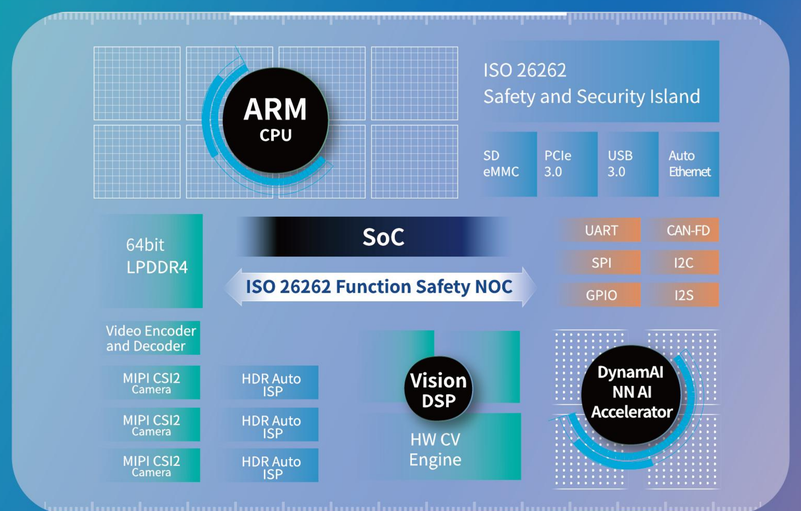
Automotive Grade High Performance AD Chip

Huashan A1000 is a high performance and low power consumption SoC of autonomous driving computing chip, embedded with dedicated high performance image sensing, real-time computer vision and neural network processor. Based on camera sensing and AI computing, the chip provides a tremendous sensor interfaces and supports L2+/L3 autonomous driving solutions.

A1000 is certified with ISO26262 ASIL-B Functional Safety and AEC-Q100 Grade-2 standard.



Architecture



Specification

16nm FFC Automotive Process

8 Cores high-performance ARM Cortex A55 CPU@1.5GHz
- Multi-level caches
- TrustZone

Automotive Grade 64bit LPDDR4

Automotive Grade NeuralIQ ISP Pipeline
- 16 channels HD camera input
- Support 8MP
- 3-exposure HDR, up to 140dB dynamic range
- Offline low-light denoising and LED flash suppression
- Mix of inline and offline processing mode

Computer Vision Processing Hardware Accelerator
- 5 cores high performance vision DSP
- CV Hardware acceleration
- H.264/H.265 video encoder and decoder for 4k video

Package

FCBGA 25mm*25mm, 0.8mm pitch

Operating Conditions

Environment -40°C ~ 105 °C

High Performance, High Energy-efficient DynamAI NN Engine (For multiple channels camera access and high performance computing scenario usage)
- Hybrid precision 4-bit/8-bit MAC Array
- Perform up to 58 TOPS(INT8)
- Overall 80% utilization of convolution layers MAC Array.
- Sparse support for storage and acceleration.
- Int 8/16-bit, floating 16 bit GEMM and Nonlinear functions acceleration.
- Open-source DynamAI NN compiler tools

Function Safety and Information Security
- Verified by ISO26262 ASIL-B and AEC-Q100 Grade-2 standard
- Security MCU with dual-cores lockstep
- Real time security monitoring and inspection
- Embedded safety guard mechanism involving ECC, Parity
- Secure booting
- OTP on chip for Private-key storage and life-cycle management

Rich Peripheral Interfaces
- 1x PCIe Gen3 4L or 2x PCIe Gen3 2L, and can be managed as Root Complex or Endpoint port
- USB3.0 DRD and USB2.0 device
- 10/100/1000Mbps automotive grade Ethernet
- eMMC/SD
- CAN_FD
- UART, SPI, I2C, I2S, GPIO

Device interfaces

Interface	Number	Descriptions
MIPI DPHY	4	Camera data interface, dual or quad line each interface
eMMC/SD	2	8-bit eMMC 5.1 host, 4-bit SD 4.2 host
USB	2	1x USB 3.0 DCD + 1x USB 2.0 device
I2S	2	Audio input/output
UART	4	Debug or sensors
PWM	4	Status and control
SPI	6	Sensors, CAN bridge
CAN-FD	3	Perception status, vehicle information, RADAR sensor
I2C	6	Camera control
Ethernet	2	10M/100M/1Gpbs, TSN and QoS support
PCIe Gen3	2	Configurable to 2x2 or 1x4 modes RC or EP
DDR	2	Support LPDDR4@4000MHz
Display	1	24bit RGB interface

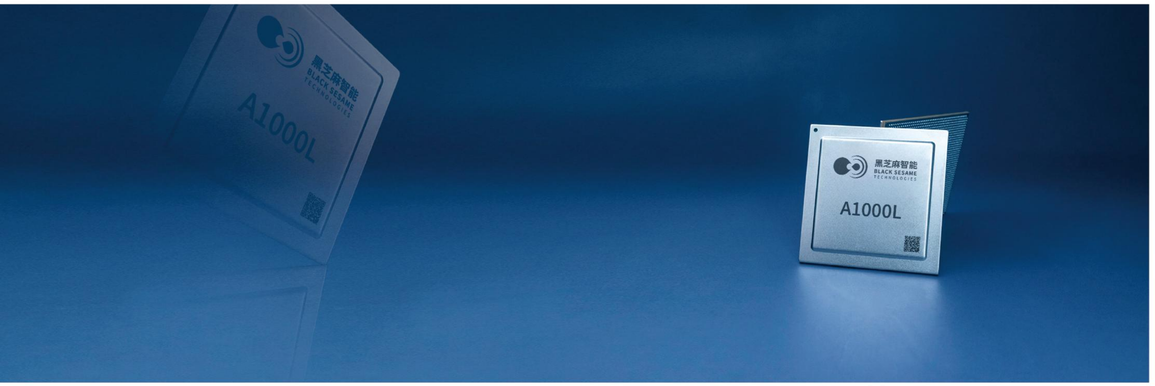
Black Sesame Technologies Huashan A1000 Family

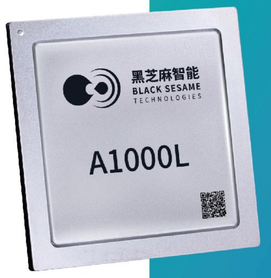
A1000L

Autonomous Driving Chip

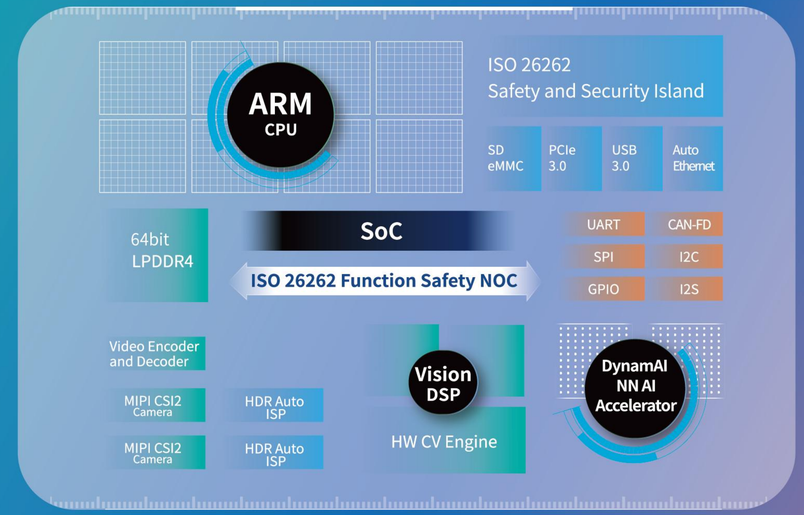
Huashan A1000L is a medium-high performance and low power consumption SoC of autonomous driving perception chip, embedded with dedicated high performance image sensing, real-time computer vision and neural network processor. Based on camera sensing and AI computing, the chip provides a tremendous sensor interfaces and supports L2/L2+ autonomous driving solutions.

A1000L is certified with ISO26262 ASIL-B Functional Safety and AEC-Q100 Grade-2 standard.





Architecture



Specification

16nm FFC Automotive Process
8 Cores High-performance ARM Cortex A55 CPU@1.2GHz
Automotive Grade 64-bit LPDDR4

Automotive Grade NeuralIQ ISP Pipeline
- 8 channels HD camera input
- Support 8MP
- 3-exposure HDR, up to 140dB dynamic range
- Offline low-light denoising and LED flash suppression
- Mix of inline and offline processing mode

Computer Vision Processing Hardware Accelerator
- 3 cores high performance vision DSP
- CV Hardware acceleration
- H.264 video encoder and decoder for 4*720p video

Encapsulation
FCBGA 25mm*25mm, 0.8mm pitch

Working temperature
Environment-40°C ~ 105 °C

High performance、High energy-efficient DynamAI NN Engine
- Hybrid precision 4-bit/8-bit MAC Array
- Perform up to 16 TOPS(INT8)
- Overall 80% utilization of convolution layers MAC Array.
- Sparse support for storage and acceleration.
- Open-source DynamAI NN compiler tools.

Function and Information Safety
- Chip approved by ISO 26262 ASIL-B and AEC-Q100 Grade-2 standard
- Security processor with dual-cores lockstep
- Real time security monitoring and inspection
- Embedded safety guard mechanism involving ECC, Parity
- Secure boot
- OTP on chip for Private-key storage and life-cycle management

Vast Device API
- 4 channels PCIe Gen3 configurable for 1x4 or 2X2 permutations, and can be managed as Root Complex or Endpoint port
- USB3.0 DRD and USB2.0 device
- 10/100/1000Mbps automotive grade Ethernet
- eMMC/SD
- CAN_FD
- UART, SPI, I2C, I2S, GPIO

Device interfaces

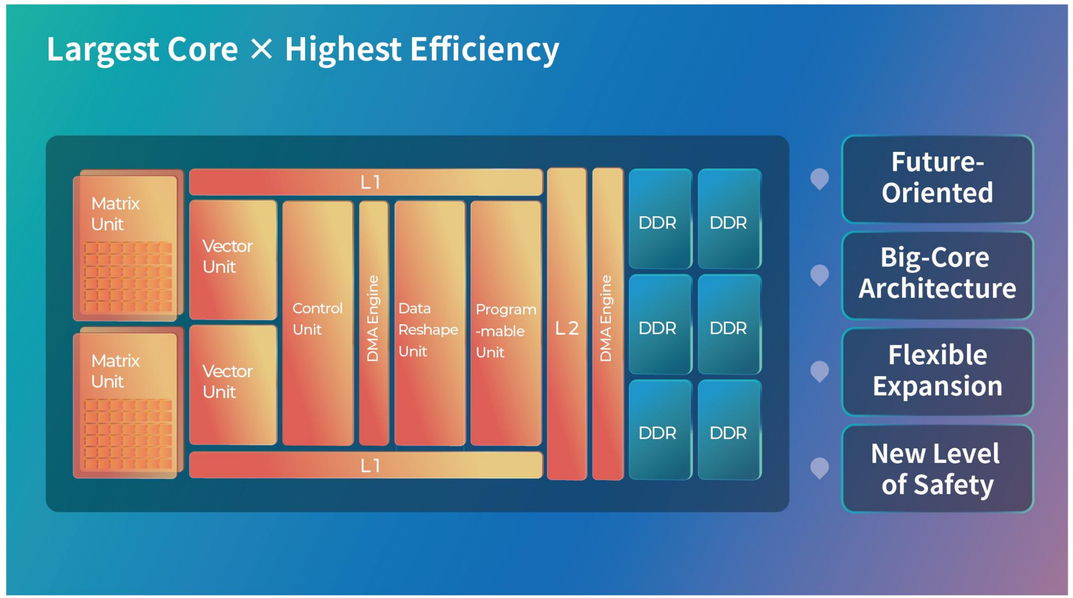
Interface	Number	Descriptions
MIPI DPHY	2	Camera data interface. 4-lane each interface
eMMC/SD	2	8-bit eMMC 5.1 host, 4- bit SD 4.2 host
USB	2	1xUSB 3.0 DRD + 1x USB 2.0 device
I2S	2	Audio input/output
UART	4	Debug or sensors
PWM	4	Status and control
SPI	6	Sensors CAN bridge
CAN-FD	3	Perception status, vehicle information, RADAR sensor
I2C	6	Camera control
Ethernet	2	10M/100M/1Gpbs. TSN and QoS support
PCIe Gen3	2	Configurable to 2x2 or 1x4 modes RC or EP
DDR	2	Support LPDDR4 @3200 MHz
Display	1	24bit RGB interface

Black Sesame Technologies Huashan A2000 Family

A2000

Full-scenario Knowledge-driven AD Chip

Black Sesame Technologies Huashan A2000 Family is a high performance, high efficiency AI SoC chip designed dedicatedly for next-generation AI models. Manufactured with a 7nm process, it features the industry's largest built-in NPU — JIUSHAO, adopted an advanced memory architecture providing powerful acceleration capabilities for the end-to-end and multimodal large model algorithms of next-generation intelligent driving. A2000 supports cache-coherent multi-chip interconnection, which flexibly supports larger-scale models expansion and is readily prepared for the long-term evolution of AI algorithms. A2000 is not only suitable for high-level intelligent driving scenarios but can also be applied to miscellaneous inference scenarios in industrial and consumer fields.

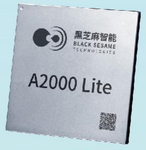


High-performance Chip Platform Dedicated for Next Generation AI Models

Huashan A2000 Family Product Portfolio

A2000 Lite

Urban Autonomous Driving Chip

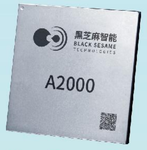


Industry's Extreme Cost-effectiveness

Typical Solution: Vision (+ Single LiDAR)
Performance: Industry flagship chip

A2000

Full-scenario Knowledge-driven AD Chip

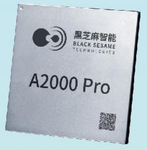


New Generation Computing Platform

Typical Solution: Vision + Multi-LiDARs
Performance: 2x industry flagship chip
CPU: 16*Cortex-A78AE
MCU: 6*Cortex-R52(LS)
Adopted automotive-grade IP
Modular design facilitates flexible expansion

A2000 Pro

High-end Full-scenario Knowledge-driven AD Chip



Chiplet Architecture Flagship Computing Platform

Scenario Solution: Safety and redundancy
Performance: 4x industry flagship chip

Specification

16 Cores High-performance ARM Cortex A78AE Automotive Grade CPU
- 10 times better than pervious generation of performance
- DCLS supported, ASIL-D

High performance ARM Mali G78AE Automotive Grade GPU
- Real-world 3D HMI rendering output fully supported

JIUSHAO NPU customized for the next generation of AI algorithms
- Hybrid precision 4-bit/8-bit/16-bit MAC Array
- Unstructured sparsity hardware acceleration
- Int 4/8/16-bit, floating 8/16-bit and nonlinear functions acceleration
- Hardware acceleration for Transformer
- Hardware acceleration for segmented quantization of weights
- Big core design
- Programmable High-precision nonlinear unit

High Performance Real-time Processing Capability
- Built-in high performance Real-time processing Cortex R52 core

Automotive Grade NeuralIQ ISP Pipeline Enhanced Version
- More than 24 channels HD camera input
- More than 17MP camera input supported
- 4-exposure HDR, up to 150dB dynamic range
- Low-light denoising and LED flicker mitigation
- RGB-IR Supported

Computer Vision Processing Hardware Accelerator
- New generation Q8 vision DSP
- CV hardware acceleration
- H.264/H.265 video encoder and decoder,up to 4x4K@60fps

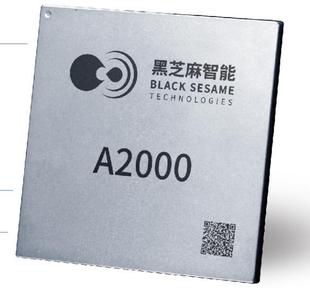
Rich peripherals of Automotive Grade Screen
- Rich peripherals: DSI, eDP
- Support 4K standard screen and pillar-to-pillar screen display
- Mutiple screen output supported

Multi-channel High-speed Ethernet
- 4x10GbE Line speed forwarding capability

Rich Peripheral Interfaces
- Multi channel CAN-FD supported
- USB3.1
- eMMC/SD
- UFS3.1
- UART、SPI、I2C、I3C、I2S、GPIO

7nm Automotive Process

Package
- FCBGA 42.5×42.5mm, 0.8 mm pitch



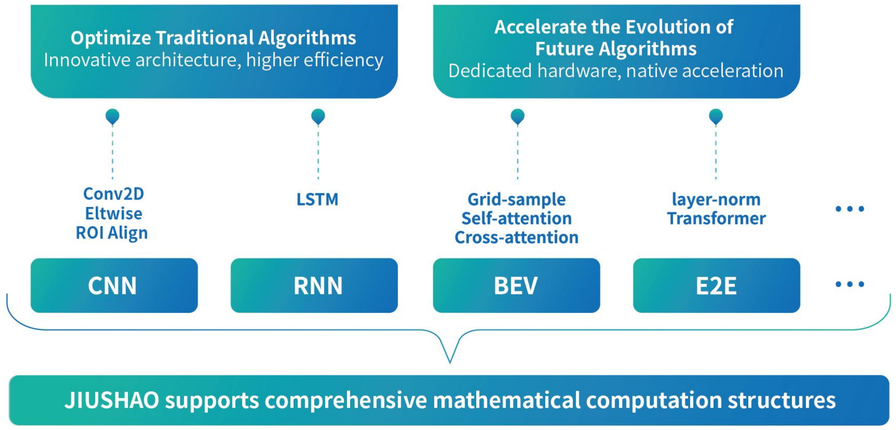
Operating Conditions
- Ambient operating temperature range -40~105°C

Reliability and Functional Safety
- Verified by ISO26262 ASIL-B and AEC-Q100 Grade-2 standard
- Auto-grade CPU, GPU cores
- Real time security monitoring and inspection
- Embedded safety guard mechanism with ECC, Parity checking
- A safety NPU that supports redundancy checking

Information Security
- EVITA-Full and OSCCA
- Secure boot
- OTP on chip for keystorage and life-cycle management
- Multiple dedicated hardware encryption and decryption engines

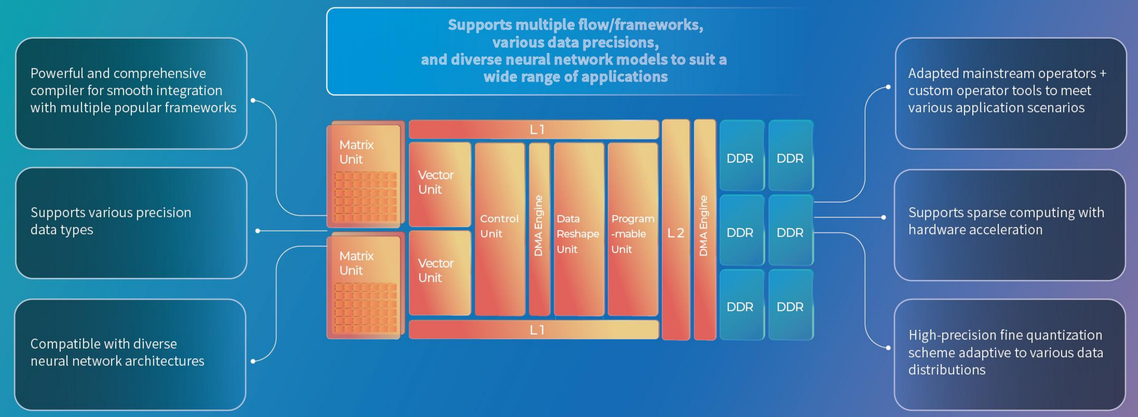
JIUSHAO Architecture

Future-Oriented



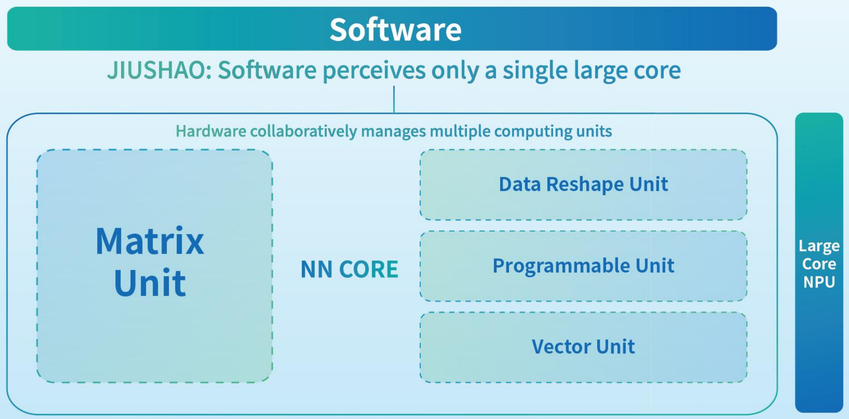
JIUSHAO Architecture

Flexible Expansion



JIUSHAO Architecture

Big-Core Architecture



Advantages

- High actual performance
- Low latency
- High energy efficiency
- Low software development difficulty

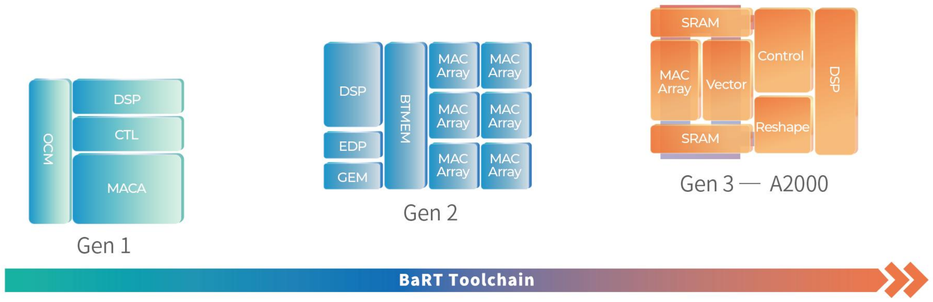
Disadvantages

- High difficulty in chip implementation

JIUSHAO Architecture

New Level of Safety

High reliability based on 3 generations of evolution and mass-production experience



Safety NPU supporting redundancy checks

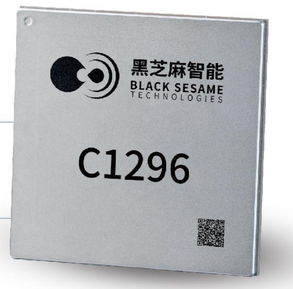
- Symmetric design supporting redundancy check of computation results
- Support for ECC hardware verification
- Built-in high-safety real-time firmware
- Priority preemption with deterministic latency
- MBIST / LBIST
- Comprehensive fault reporting mechanism
- Dedicated safety communication channel

Black Sesame Technologies Wudang C1200 Family

C1296

The Industry's First Computing Chip to Support Multi-domain Fusion

Black Sesame Technologies Wudang C1296 is a high-performance, highly integrated on-board cross-domain computing chip. It is manufactured by 7nm auto-grade process, with built-in high-performance CPU, GPU, DSP and real-time processing capabilities. Its cross-domain architecture combines hard isolation and Hypevisor functions, based on proprietary IP cores: NPU and ISP.It provides a wealth of sensor interfaces, high and low speed body interfaces, various display output interfaces and ten Gigabit Ethernet interfaces, fully supports the cross-domain integration of smart cockpit, smart driving and gateway, and meets the needs of various stages of the evolution of the vehicle electronic and electrical architecture.



Specification

10 Cores High-performance ARM Cortex A78AE Automotive GradeCPU
- 5 times better than previous generation of performance
- DCLS supported, ASIL-D

The First High-performance ARM Automotive Grade GPU Mali G78AE
- 20 times better than previous generation of performance
- DCLS supported, ASIL-D

High Performance, High Energy-efficient DynamAI NN Engine (For multiple channels camera access andhigh performance computing scenario usage)
- Hybrid precision 4-bit/8-bit MAC Array
- Overall 80% utilization of convolution layers MAC Array
- Sparse support for storage and acceleration
- Int 8/16-bit, floating 16 bit GEMM and Nonlinear functions acceleration
- Open-source and familized DynamAI NN compiler tools

High Performance Real-time Processing Capability
- Built-in high performance real-time processing computing power to 32KDMIPS (16DMIPS in DCLS)

Optimized Memory System Architecture
- Cache specifications that match high-performance CPU: 512KB L2 Cache, 2MB L3 Cache/Cluster
- Built-in 12MB super large SRAM space
- Automotive grade 64bit LPDDR5/LPDDR4X

Automotive Grade NeurallQ ISP Pipeline Enhanced Version
- 12 channels HD camera input
- More than 17MP camera input supported
- 3-exposure HDR, up to 140dB dynamic range
- Offline low-light denoising and LED flash suppression
- Support for RGB-IR Sensor added
- Processing 2.4G pixels per second

High performance HIFI5 DSP
- Latest generation Audio DSP
- Built-in NNE to speed up sound processing algorithms

Computer Vision Processing Hardware Accelerator
- 5 cores high performance vision DSP
- CV Hardware acceleration
- H.264/H.265 video encoder and decoder for 4k video

Rich interfaces of Automotive Grade Screen
- Rich interface types: 2xDSI, 2xLVDS, 1xDP/eDP
- Support 4K standard screen and long screen display
- Mutiple screen output supported

Built-in High-speed Switch Acceleration Module
- 2x10 GbE + 2x2.5 GE Line speed forwarding capability
- CAN-ETH high-speed switching capability

Separate PCIe 4.0 High-speed Port
- Support 2x2 Lane and 1x4 Lane configuration
- Without any Ethernet port occupation

Rich Peripheral Interfaces, Fully Compatible with New and Old Auto-grade regulations
- More than 20 CAN-FD supported
- More than 6 LIN interfaces supported
- Support FlesRay interface
- 2xUSB3.1 device
- eMMC/SD
- UFS3.1
- UART、SPI、I2C、I3C、I2S、TDM、GPIO

7nm Automotive Process

Soft and Hard Cross-domain Architecture and System Design
- Hard isolated MPU unit, low-cost implementation of cross-domain typical system solutions
- Combined with VMS, it flexibly meets the requirements of complex cross-domain scenarios

Package
- FCBGA 31*31 mm, 0.8 mm pitch
- Be compatible with C1200 family Pin2Pin

Operating Conditions
- Environment -40℃~105℃

Function Safety and Information Security
- Verified by ISO26262 ASIL-B and AEC-Q100 Grade-2 standard
- CPU, GPU with dual-cores lockstep supported
- Real time security monitoring and inspection
- Embedded safety guard mechanism involving ECC, Parity
- EVITA-Full and OSCCA
- Secure booting
- OTP on chip for Private-keystorage and life-cycle management
- Multiple independent hardware encryption and decryption engines, dedicated hardware acceleration engines for secure communication

Device interfaces

Interface	Number	Descriptions
MIPI CSI2 RX	3	Camera data interface, support CPHY/DPHY
MIPI DSI	2	Display Interface: MIPI Display Serial Interface
eDP/DP	1	Display Interface: embedded DisplayPort/DisplayPort
LVDS	2	Display Interface: Low Voltage Differential Signaling Interface
Ethernet	4	2*10 Gbps+2*2.5 Gbps, TSN and QoS support
OSPI	2	2*XIP capable OSPI interface
SPI	4	Sensor CAN bridge
UART	8	Debug or sensors
I2C	12	Camera control
I3C	6	Upgrade version of I2C, Sensors and IMU
ADC	1	ADC with multi channels
CAN-FD	22	Perception status, vehicle information, RADAR sensor
LIN	8	Vehicle information
FlexRay	6	Vehicle information
I2S	4	Audio input/output
TDM	5	Audio input/output
PWM	20	Status and control
eMMC/SD	2	4-bit/8-bit eMMC5.1 host, 4-bit SD 4.2 host
UFS3.1	1	Support 2 lanes, compliant with 1 lane
DDR	2	Support LPDDR5/4X
USB	2	USB3.1/USB2.0 DRD
PCIE Gen4	1	Support RC or EP Mode, Configurable to 2* 2 lane or 1* 4 lane mode

Black Sesame Technologies Wudang C1200 Family

C1236

The Single Autonomous Driving Chip to Support NOA Driving Function

Black Sesame Technologies Wudang C1236 is a high-performance, highly integrated on-board intelligent driving chip, manufactured by 7nm auto-grade technology. In addition to built-in high-performance CPU, GPU, DSP and real-time processing capabilities, it also integrates a 10-gigabit Ethernet-CAN interface line-speed forwarding module, with proprietary IP cores: NPU and ISP. It provides a wealth of sensor interfaces, high and low speed body interfaces, and 10 Gigabit Ethernet interfaces, etc., which can meet all the computing and data processing requirements of mainstream NOA scenarios through a single SoC.

Specification

8 Cores High-performance ARM Cortex A78AE Automotive GradeCPU
- 4 times better than previous generation of performance
- DCLS supported, ASIL-D

The First High-performance ARM Automotive Grade GPU Mali G78AE
- 10 times better than previous generation of performance
- DCLS supported, ASIL-D

High Performance, High Energy-efficient DynamAI NN Engine (For multiple channels camera access andhigh performance computing scenario usage)
- Hybrid precision 4-bit/8-bit MAC Array
- Overall 80% utilization of convolution layers MAC Array
- Sparse support for storage and acceleration
- Int 8/16-bit, floating 16 bit GEMM and Nonlinear functions acceleration
- Open-source and familized DynamAI NN compiler tools

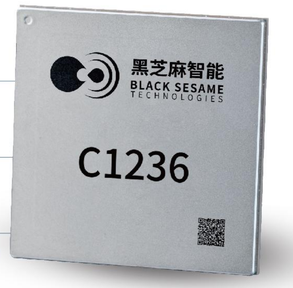
High Performance Real-time Processing Capability
- Built-in high performance real-time processing computing power to 32KDMIPS (16DMIPS in DCLS)

Optimized Memory System Architecture
- Cache specifications that match high-performance CPU: 512KB L2 Cache, 2MB L3 Cache/Cluster
- Built-in 12MB super large SRAM space
- Automotive grade 64bit LPDDR5/LPDDR4X

Automotive Grade NeurallQ ISP Pipeline Enhanced Version
- 12 channels HD camera input
- More than 17MP camera input supported
- 3-exposure HDR, up to 140dB dynamic range
- Offline low-light denoising and LED flash suppression
- Support for RGB-IR Sensor added
- Processing 2.4G pixels per second

ComputerVision Processing Hardware Accelerator
- 5 cores high performance vision DSP
- CV Hardware acceleration
- H.264/H.265 video encoder and decoder for 4k video

Dual screen interface
- 2xDSI
- Support 4K standard screen and long screen display
- Dual screen output supported



Built-in High-speed Switch Acceleration Module
- 2x10 GbE + 2x2.5 GE Line speed forwarding capability
- CAN-ETH high-speed witching capability

Separate PCIe 4.0 High-speed Port
- Support 2x2 Lane and 1x4 Lane configuration
- Without any Ethernet port occupation

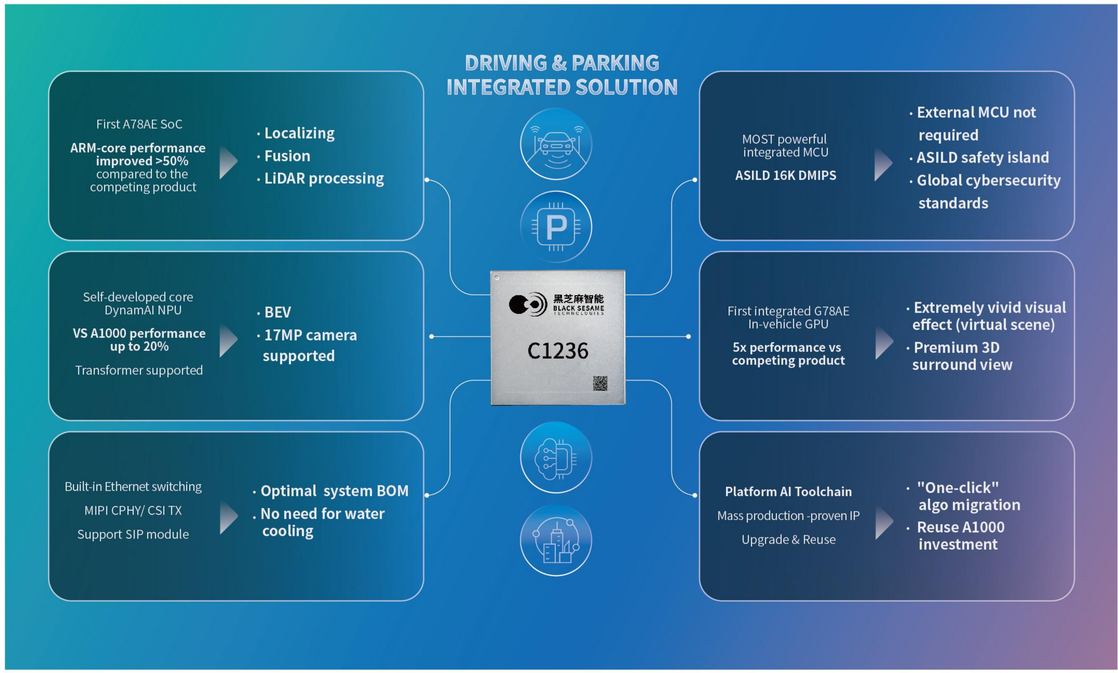
Rich Peripheral Interfaces, Fully Compatible with New and Old Auto-grade regulations
- More than 20 CAN-FD supported
- More than 6 LIN interfaces supported
- Support FlesRay interface
- 1xUSB3.1 device
- eMMC/SD
- UFS3.1
- UART、SPI、I2C、I3C、GPIO

7nm Automotive Process

Package
- FCBGA 31*31 mm, 0.8 mm pitch
- Be compatible with C1200 family Pin2Pin

Operating Conditions
- Environment -40°C~105°C

Function Safety and Information Security
- Verified by IS026262 ASIL-B and AEC-Q100 Grade-2 standard
- CPU, GPU with dual-cores lockstep supported
- Real time security monitoring and inspection
- Embedded safety guard mechanism involving ECC, Parity
- EVITA-Full and OSCCA
- Secure booting
- OTP on chip for Private-keystorage and life-cycle management
- Multiple independent hardware encryption and decryption engines, dedicated hardware acceleration engines for secure communication



Device interfaces

Interface	Number	Descriptions
MIPI CSI2 RX	3	Camera data interface, support CPHY/DPHY
MIPI DSI	2	Display Interface: MIPI Display Serial Interface
Ethernet	4	2*10 Gbps+2*2.5 Gbps, TSN and QoS support
OSPI	2	2*XIP capable OSPI interface
SPI	4	Sensor CAN bridge
UART	8	Debug or sensors
I2C	12	Camera control
I3C	6	Upgrade version of I2C, Sensors and IMU
ADC	1	ADC with multi channels
CAN-FD	22	Perception status, vehicle information, RADAR sensor
LIN	8	Vehicle information
FlexRay	6	Vehicle information
I2S	4	Audio input/output
TDM	5	Audio input/output
PWM	20	Status and control
eMMC/SD	2	4-bit/8-bit eMMC5.1 host, 4-bit SD 4.2 host
UFS3.1	1	Support 2 lanes, compliant with 1 lane
DDR	2	Support LPDDR5/4X
USB	1	USB3.1/USB2.0 DRD
PCIE Gen4	1	Support RC or EP Mode, Configurable to 2* 2 lane or 1* 4 lane mode

Advance Driver Assistant System (ADAS) and Autonomous Driving (AD) Solutions

Overview

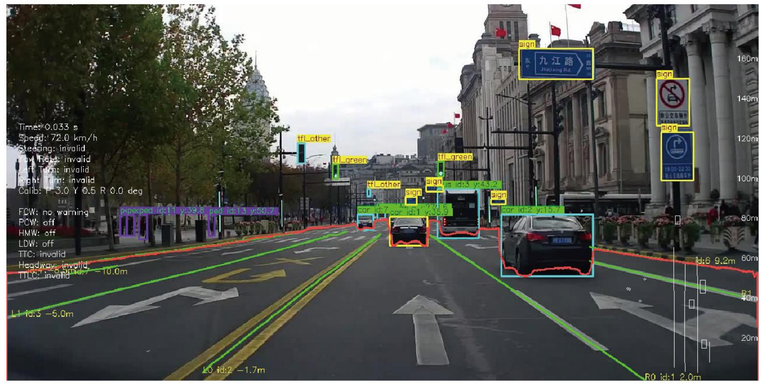
Advance Driver Assistance Systems (ADAS)solution has functionalities and flexibilities with support of both passive and active scenarios:

. L2 class ADAS uses a 1V1R sensor equipped with Huashan A1000L chip.

. L2+ class ADAS uses one Surround-Monocular camera+ four BEV cameras with Huashan A1000L chip. In addition to the embedded GPU on chip, it can achieve APA functions.

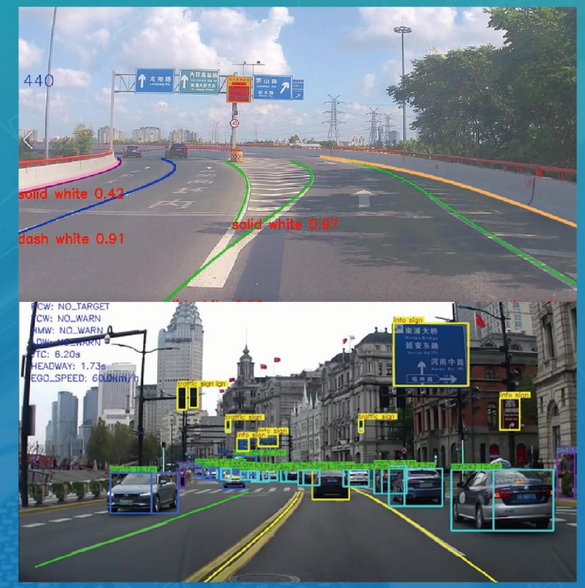
. L3 and above class ADAS can configure a multi-sensors solution to equip Huashan A1000 chips. In addition to the embedded GPU on chip, it can achieve AVP functions.

ADAS Solution for various driving situations



	Speed	Detection distance	Types	Recall	Precision	Support for ADAS / AD
Passenger	200kph	80m	Adult/Children/Bicycle rider	>90%	>95%	PCW/TJA/HWA
Road marking	200kph	120m	Single solid/Single dashed/Double solid/ Double dashed/Roadside	>90%	>96%	LKA/ACC/TJA/HWA
Traffic light	200kph	50m	Direction/Color/Flash	>95%	>98%	TJA/HWA
Vehicle	200kph	200m	Car/Bus/Motorcycle/Van	>98%	>99%	FCW/AEB/TJA/HWA
Traffic sign	200kph	50m	Speed Limit/No U-Turn/Stop/ Do not Enter/No passing	>98%	>99%	TSR /TJA/HWA
Free space	kph	m	Roadside/Vehicle/Passenger			LKA/TJA/HWA

HighWay Pilot (HWP) Traffic Jam Pilot (TJP)



Highway Pilot

Partial automatic longitudinal and lateral vehicle control:

- The entire speed range
- Drivers' supervision (Hands on/off)
- Low speed tracing under no road marking
- Temporary high speed tracing under no road marking
- Auto change lanes when reached the speed limit

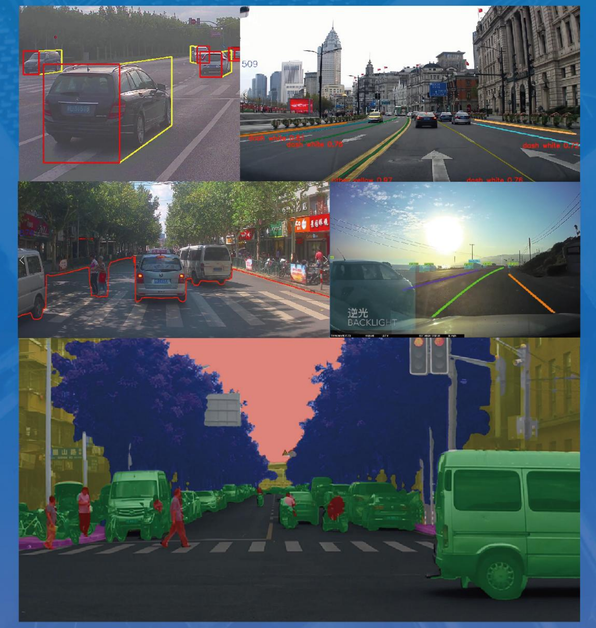
Traffic Jam Pilot

Surrounding environment perception representation:

- Low speed (0~65kph)
- Hands off/Out of sight
- Adaptive vehicle positioning on the road

Autonomous-driving oriented high precision multi-tasks visual perception solution

A single NN is implemented for multi-tasks of 3D objectives detection, road marking recognition and perception of free space, traffic light, traffic signs and road signs.



Objective Detection:

Perception and Recognition of moving objects in images

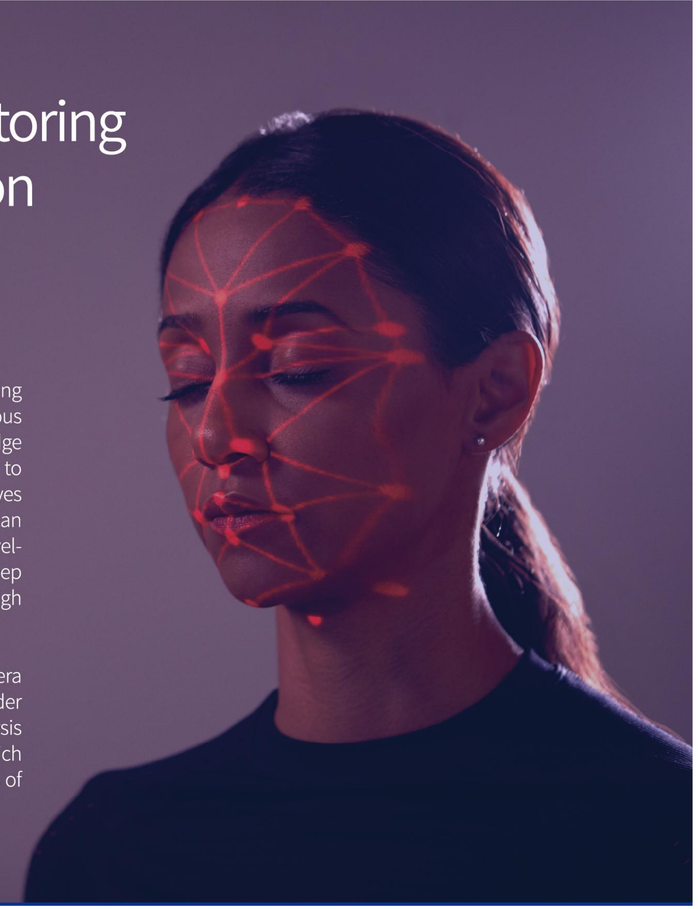
- Low-light, high-light, fuzz weather
- Classifications of more than 24 classes: car, bicycle, motorcycle, passenger, etc.
- Multi-objectives tracing.

Semantic Image Segmentation:

Each pixel in the image is divided into corresponding categories to achieve pixel level classification.

- Target identification and classification
- Fences, road markings, road signs, barricades, traffic lights
- Free space planning

Patronus Driver Monitoring System (DMS) Solution



Overview

Black Sesame Technologies Patronus Driver Monitoring System (DMS) is a configurable solution with tremendous functionalities. The solution combines cutting-edge computer vision technology and neural network (NN) to detect features and postures of the driver's face, head, eyes and mouth. Trained from a specific dataset, the NN can catch the key facial features precisely. With the self-developed 3D face restructuring technique based on deep learning, this solution can identify human face with high stability and accuracy.

This solution is based on a monocular near-infrared camera and stable demarcating technique, with a cost under control. The self-trained NN uses reduction and analysis techniques to be compressed for embedded systems which are resource limited and run efficiently without any loss of performance.

Features

The DMS solution provides various features. It achieves safe driving by real-time monitoring the driver's head and facial features together with external information to provide a prediction of driver's condition.

Facial Recognition

- Face recognition can be detected and tracked within ±90°
- Human face detection
- Class I and II anti-Spoofing living identification

Facial Features

- Open/closed eyes, refractive glasses/sunglasses
- Open/closed mouth and wearing mask
- Wearing hat

Head posture and eye tracking

- Head deflection can be detected within ± 90°
- Turn and bow head
- Sight tracking

Distraction

- Smoking
- Phone calling
- Drinking and eating

Driving Safety

- Drivers' absence
- Fatigue detection
- Distraction detection
- Displace of seat belt detection
- Camera block

Solution Highlights

- Low-cost solution based on a monocular camera
- Advanced 3D face restructuring technique
- Face feature detection under a large-angle deflection
- A 3D head posture estimation under a large-angle deflection
- Specific neural network reduction and compression technology built for the embedded platform

Hardware and Runtime Environment

Hardware

Camera

- Monocular near infrared 940nm camera

Computing platform

- Embedded SoC based on ARM CPU
- Embedded SoC of CPU + NPU

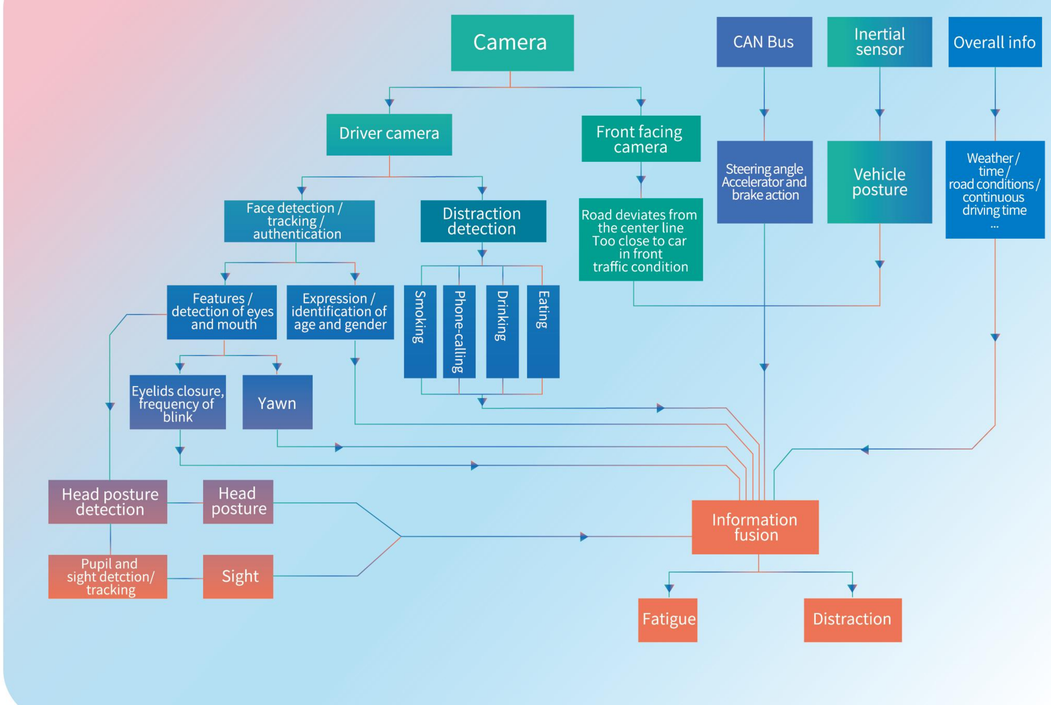
Operating System

- Linux x86/x64
- Android
- QNX

Runtime Environment

- OpenCV 3.4.1 or later version
- g++ 5.4.0 or later version
- CMake 2.8.0 or later version

System Architecture



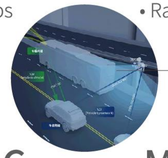
V2X - Edge Computing Solution

Powerful Real-time Computing Chip

- Real-time processing on chip to reduce the requirement of bandwidth for data streaming, ratio of data compression >20x
- Support multi-channels HD video, capturing more details. MEC processor can support up to 10 channels HD visual sensor input and AI analysis.
- Video compression and enc-dec capacity up to 4K@60fps

Efficient and Precise Perception Algorithm

- Vehicle and objective perception: the perception range is 300 meters, vehicle identification accuracy > 90%, and event accuracy > 95%
- License plate perception: 300 meters of the whole license plate perception and tracking
- Radar-Camera fusion: accuracy > 95%

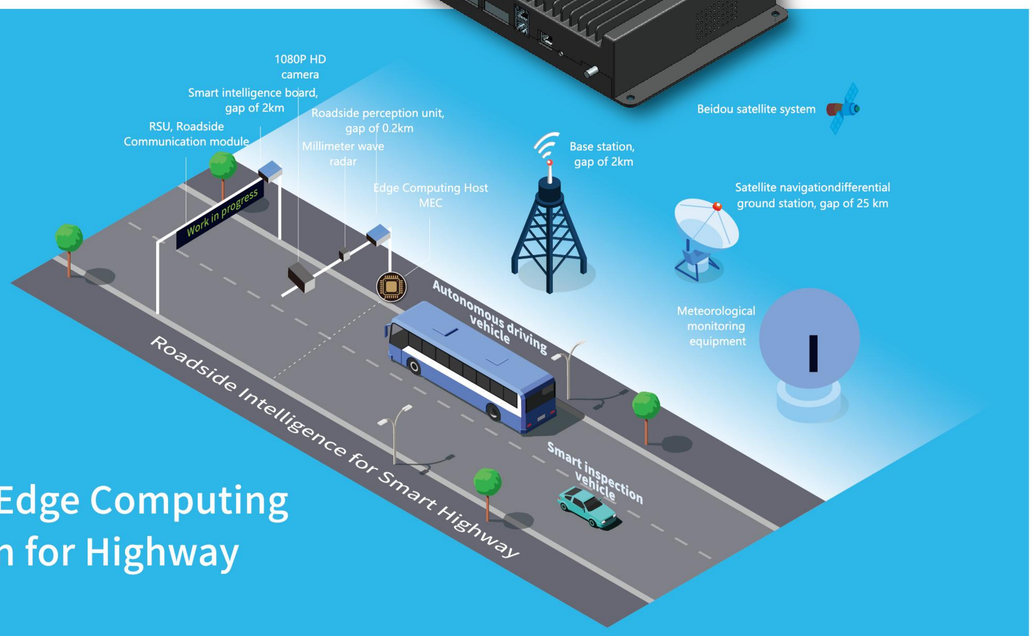


Mobile Edge Computing, MEC

- Performs 58TOPS(INT8) computing power
- Support multi-channel perception data inputs
- Support traffic objectives detection and classification
- Support traffic event detection
- Support multiple types of sensors: camera, millimeter wave radar and Lidar
- Embedded data combination algorithm for multiple sensors
- Seamlessly connect to V2X system
- Industrial design with automotive core IP chip, high durability
- Capable to work under harsh environment, working temperature from -20 to 70°C

Multi-Scenarios Image Processing

- Overcome visual interference of rain, fog and night
- Improved details of imaging for objectives or event capturing
- Self-developed automotive grade ISP



Mobile Edge Computing Solution for Highway

High Precision Vision Localization Solution

The solution integrates Black Sesame cutting-edge technologies in image processing, visual perception and vision localization algorithm. It improves localization precision and stability based on multi-sensor fusion. The whole system is powered by the great computing power of the Huashan series SoC and provides a highly efficient and low-cost localization solution for intelligent driving and driving assistance functions.

Cost-effective

Based on Huashan series SoC, the power consumption is 5W with output frequency from 1 to 100Hz. A configurable localization solution does not rely on HD maps. Without extra cost, allowing to select different low-cost GPS/IMU components.

Multi-scenarios

Provide six degrees of free localization in multi-scenarios, even in complex GPS-signal-free scenarios, such as parking lots, tunnels & etc. Provide centimeter-level absolute and relative localization results without relying on HD maps.

Support multi-platforms, PnP

Equipped with an independent hardware system of standard interface of UART and Ethernet.
Software based on C/C++, applicable for different hardware and software environments, like Black Sesame Technologies Huashan series SoC, Nvidia TX2/Xavier. It supports ROS, Apollo (3.5 or later version). The API is easy to use, with one line of code you can fetch the localization result.

High precision, high reliability

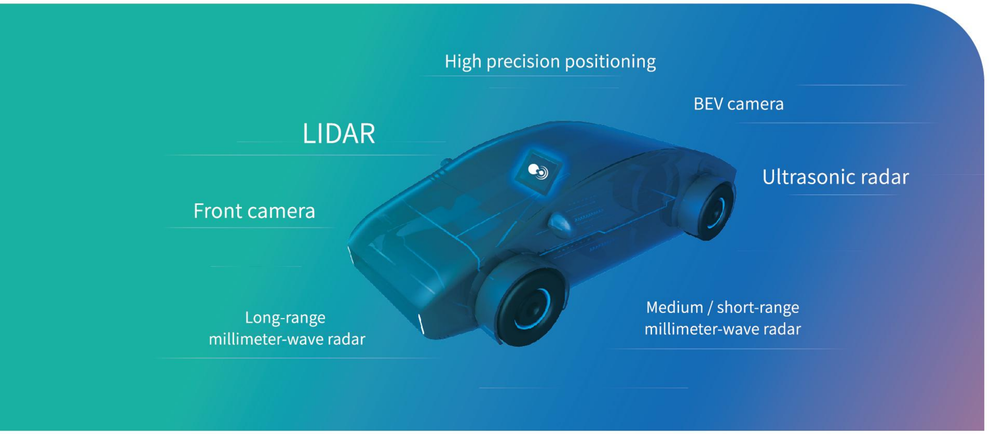
Centimeter-level localization result
Support continuous localization under all scenarios and capable to overcome sophisticated light changes.
Based on multi-sensors fusion technology

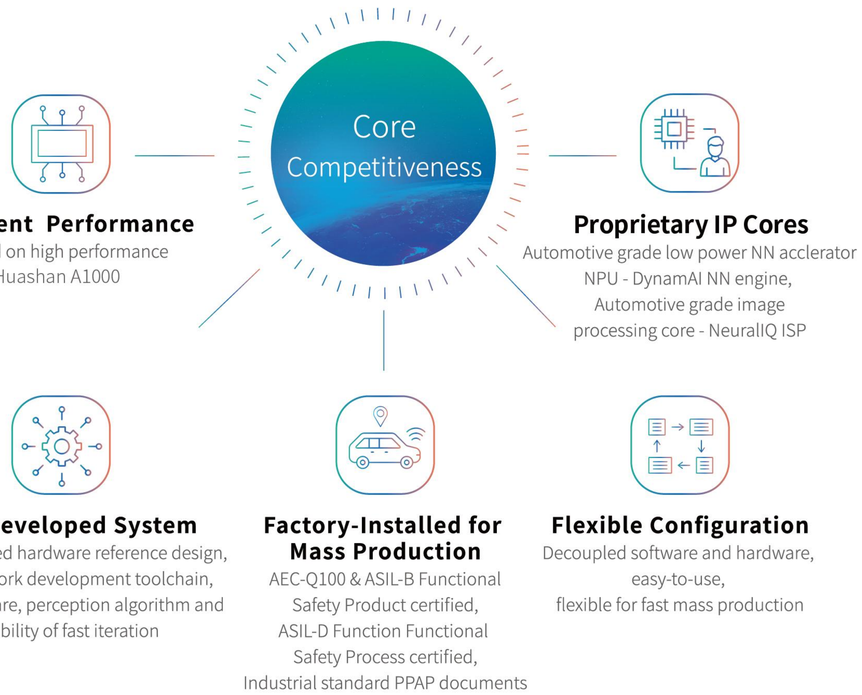
Drive Brain

Based on Mass-Produced High Performance SoC

Drive Brain-a multi-sensor solution for L3 intelligent driving domain control. Based on Black Sesame Technologies Huashan A1000 and cooperated with HD map and a multi-sensors fusion based percep-tion of camera, MWR and Lidar, it realizes high-level autonomous driving domain control functions in factory-installed mass production.

This solution integrates intelligent driving, gateway/domain management and applications like point-to-point navigation driving assistant, HPP/AVP parking, SOA, shadow mode & etc.. With pre-installed ultra-high computing power hardware before mass production, ADAS/ADS systems could be continuously upgraded.





Drive Eye

Clear and Beautiful Vision

Drive Eye - Based on Black Sesame Technologies newest low power consumption platform, it supports applications of 8 million pixels front-facing camera and multiple intelligent cameras in the cockpit. Within products of the same power consumption in mass production, this solution makes full usage of the details of 8MP camera.

Automotive grade self-developed ISP ensures the data from the camera could be tuned perfectly to satisfy Clear Vision needs of intelligent driving algorithm, and also achieves Beautiful Vision of display require-ment in cockpit.

Features

High hardware computing power

Utilization of computation up to 85%

Cost reduction by using 8MP camera

AEB, LKA, APA, OMS, DMS, DVR

Drive Sensing

Mass-Produced Single Chip for Parking and Driving Integrated Solution

Drive Sensing - A mass-produced SINGLE chip solution for integrated parking and driving ADAS function. Black Sesame Technologies' Huashan A1000L/A1000 chip combined with embedded GPU, in-house developed ISP and NPU, and multi-sen-sors fusion of front-facing and BEV camera, front and corner radar and ultrasonic radar, is a single chip for parking and driving integrated solution. This solution provides oncise, eficient and cost effective functions for L2+ driving, APA/AVP, full 3D scene, and multi-channel DVR.

Solution Highlights

Real • Fusion
Based on A1000L/A1000, support domain controller of driving and parking integrated solution.

Full • Function
Embedded CPU, MCU, GPU, ISP, NPU & etc., support functions of full 3D rendering scene display, L2+ front ADAS, and surround view parking.

Low • Cost
Achieve high-low speed fusion and sufficiently reduce solution cost by using a single powerful chip.

High • Efficiency
High utilization of massive NN accelerators, automotive low energy consumption, energy efficiency is up to 5 TOPS/W and satisfies passive heat removal.

Huashan-SOM (System on Module)

The Huashan-SOM series is developed based on the Black Sesame Technologies Huashan A1000 SoC.
Huashan-SOM involves CPU, GPU, NPU, DSP, memory, power management and interface of vast I/O devices.
Taking Huashan-SOM advantages of high reliability and security, customers can agilely develop integrated products for different scenarios.
Huashan-SOM has built-in Linux OS and drivers of devices, friendly for customization.
Huashan-SOM is compliant with AEC-Q100 Grade 2 and ISO 26262 ASIL-B, its Safety Island design is certified by ISO26262 ASIL-D.

Core Computing Board
+
Expansion Board

Advantages of Huashan-SOM

With the Black Sesame Technologies Shanhai development toolchain, clients are able to swiftly develop their products for end customers based on application scenarios, covering automotive, robotics and other edge computing applications.

Huashan-SOM Technical Parameters

No.	Module	Specs
1	CPU	8-core ARM Cortex-A55, Max freq. 1.5GHz
2	Memory	Dual channels 32-bit LPDDR4 memory interface, Max freq. 3200MHz
3	External storage	eMMC/SD
4	NN computation	58TOPS
5	CV computation	5 cores 800MHz DSP + HW
6	Camera	16 channels HD camera input, support 8MP
7	ISP	1.2Gpps high dynamic image processing, dynamic range up to 140dB
8	Ethernet	2*Auto GigE, support TSN and QoS, configurable for MII, RGMII or GMII interface
9	PCIe	4 channels PCIe Gen3, configurable for 1x4 or 2x2, supported RC/EP
10	Device Interface	6*SPI, 4*UART, 2*CAN-FD, 4*I2C, 2*I2S, 2*USB, GPIO
11	Safety	400MHz dual-core Lockstep ARM Cortex-R5, AEC-Q100 G2, ISO 26262 ASIL-B, Safety Island
12	Video encoding	HW H.264/265,4k@60fps
13	Video output	24-bit RGB output in parallel, Max 1080p@60fps
14	Power consumption	< 8W (AI NET)
15	Sensors	GNSS/IMU、Camera、MMW Radar、USR、LiDAR
16	Manufacturing process	16nm FFC Automotive Process

Commercial Vehicle Active Safety System Patronus 2.0

Commercial Vehicle Active Safety System Patronus 2.0 is an aftermarket-mounted integrated solution. This platform can be used in different types of vehicles like commercial vehicles and vans. The main chip of this platform is Black Sesame Technologies self-developed Huashan series SoC with great computing power, low cost and high openness. Relying on the great computing power of the chip, the platform supports massive NN perception, DMS, BSD and all-round algorithms.

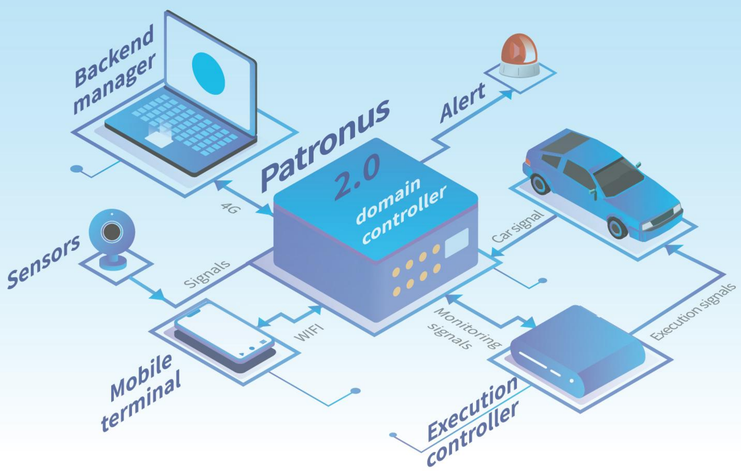
The system involves various interfaces of multi-channels camera, CAN, external storage, gigabit Ethernet, 4G, Wi-Fi, USB, HDMI, SPK, MIC, RS485/232, digital input, which makes the system have higher adaptability for different scenarios.

Based on high reliability, the platform achieves a controllable cost by reasonable materials selection and structure design. The overall solution has outstanding cost performance compared to similar products in the market.

Black Sesame Technologies supports flexible collaboration model. We provide a complete solution of controller + algorithms, chip + reference solution + algorithm solution, and also open to chip + reference solution + algorithm porting tools model.

Patronus 2.0

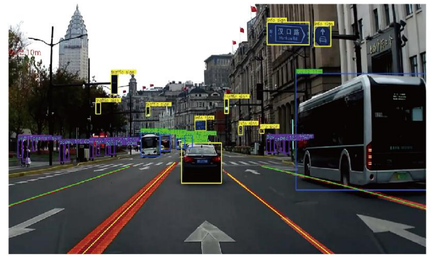
Patronus 2.0 Architecture



Patronus 2.0 Functions

ADAS & Driving Recording

Equipped with a Black Sesame Technologies self-developed neural network model, it has high accuracy, many categories of objective classification, and strong adaptability. With the actuator, it can achieve active safety function, and reduce hardware costs by sharing DVR cameras.



DMS

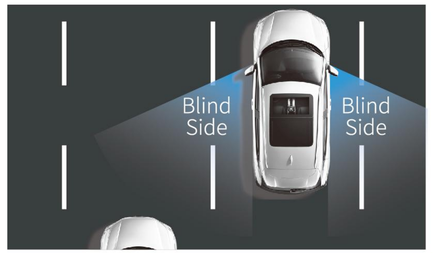
Black Sesame Technologies self-developed algorithm realizes functions like face recognition and monitoring of fatigue, distraction, smoking, phone calling and leaving situations. The algorithm has a low demand for computing power and strong flexibility.

Smoking X Phone calling

Drinking

BSD (Blind Side Detection)

It realizes identification of vehicles, pedestrians and obstacles in the blind area, and is able to recognize objectives quickly and accurately.
With cooperation of the actuator, it can realize active control functions.



Surrounding Viewing & Monitoring

It monitors inside and outside of the cabin for assistance of parking, reversing and in-car monitoring & etc.

Hanhai Autonomous Driving Middleware Platform

Advantages

A full-suite of development toolkits:

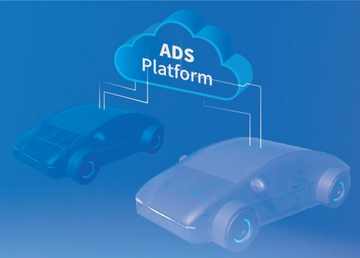
Consisting of development toolkits targeting SoC, MCU and PC, Seamlessly supporting the development of autonomous driving and V2X application scenarios.

Openness:

The key modules of the autonomous driving system and other basic components are packaged into open APIs, allowing users to access and use the processing capabilities of the Huashan series SoCs swiftly and easily.

Swift deployment:

Reducing the development workload of customers and shortening the development cycle of applications from the customer end.
It can also help customers continuously improve the performance of autonomous driving applications.



Broad compatibility:

Compatible with a large variety of vehicle models and third-party autonomous driving systems and thus reducing customers' development and deployment costs.

Hanhai ADSP (Autonomous Driving Solution Platform) Middleware Platform

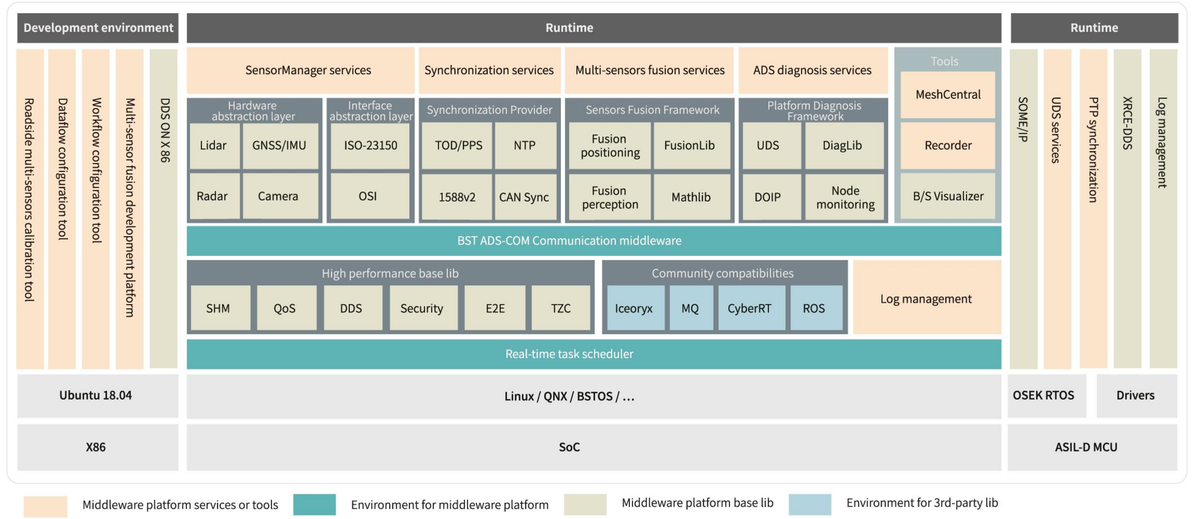
Open & empowered development and deployment of autonomous driving application

Multiple Development Toolkits Supports Multi-scenario Development

Based on Huashan series embedded system development platform, it includes development toolkits like Target (SoC) SDK, X86 (Host) SDK, Target (MCU) SDK, perfectly supporting development of vehicle-side, road-side, other intelligent driving and V2X scenarios.

Fast Deployment of Solutions Agile Development with High Computing Power

With the high performance of Huashan series chips, the key modules of autonomous driving system and other basic software components are packaged into open APIs, allowing users to access and use the processing capabilities of the Huashan series chips quickly and easily. It also assists developers to agilely develop and deploy solutions of autonomous driving.



Specification

ADS-Platform involves Target (SoC) SDK, X86 (Host) SDK, Target (MCU) SDK

Target (SoC) SDK

It provides a runtime environment on the SoC and a compilation environment on the host side, meanwhile implements a real-time task scheduler for heterogeneous computing units. SensorManager, a sensor access and management service, offers high-precision time synchronization, multi-sensor fusion and ADS diagnosis service.

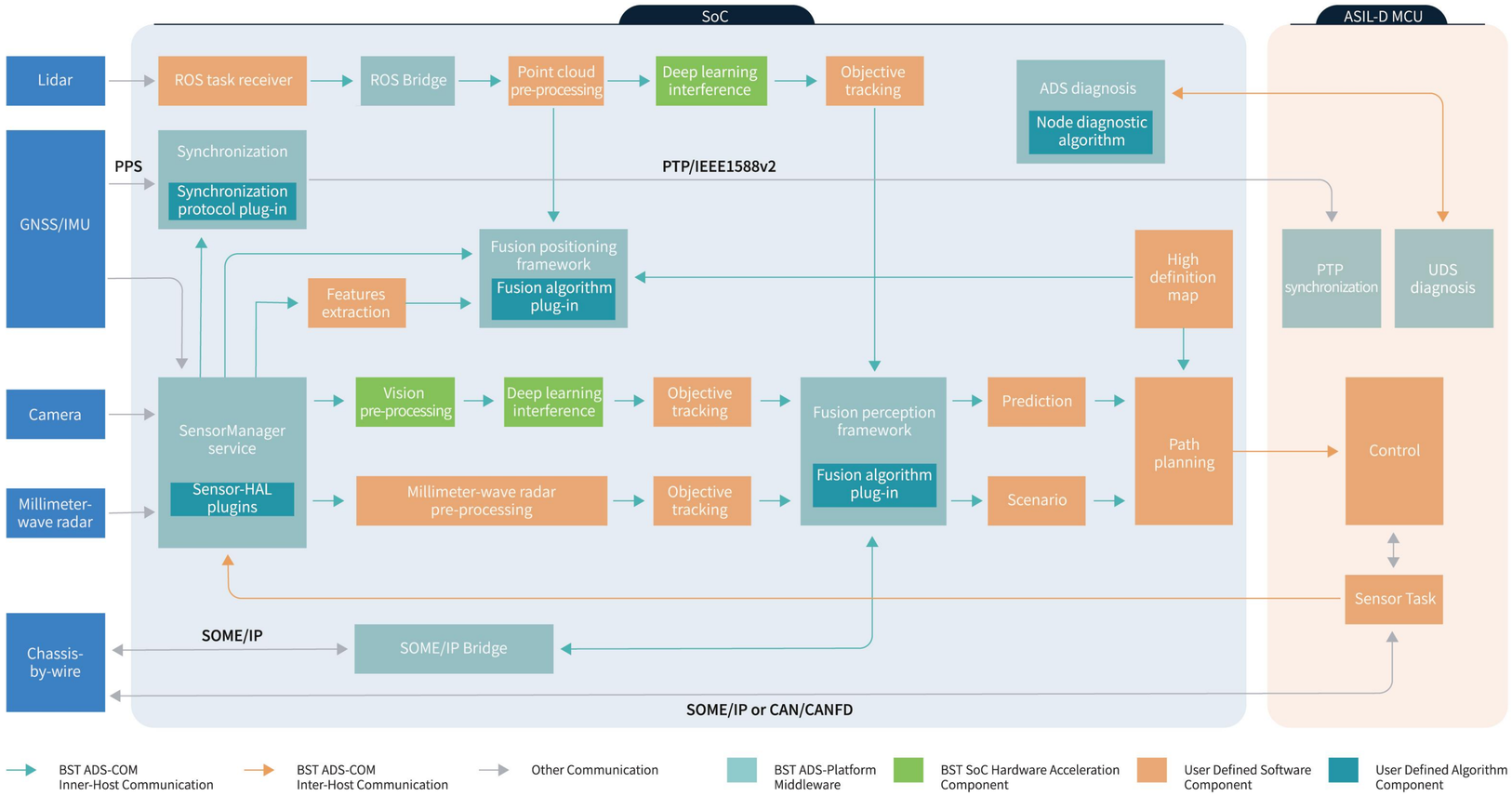
All services and task nodes of BST ADS-Platform communicate based on BST ADS-COM communication middleware, which enables high performance DDS communication within / between processes, heterogeneous computing units and cross-hosts, which is compatible with middleware ecosystems like CyberRT, ROS.

X86 (Host) SDK

It contains multiple tools including a calibration tool of multi-sensors for roadside scenario in V2X, a dataflow configuration tool for recording, replying, visualization and analysis, a workflow configuration tool for tasks scheduling, resource monitoring and visualization and also an integrated development platform for debugging, verification and visualization of multi-sensor fusion algorithm. Meanwhile, X86 SDK provides a DDS environment and customization API, which sufficiently guarantees DDS communication between the customized program and SoC.

Target (MCU) SDK

A MCU computing platform for ASIL-D, which provides MCU SDK for customization, and supports SOME/IP, PTP synchronization (IEEE 1588v2), UDS on CAN diagnosis protocol and log service. In addition, the target SDK also provides XRCE-DDS, the light-weight DDS framework which can be used to communicate with X86 and BST SoC.



EMPOWERING **FUTURE** **MOBILITY** WITH **CHIPS**