Ambarella

CV25S
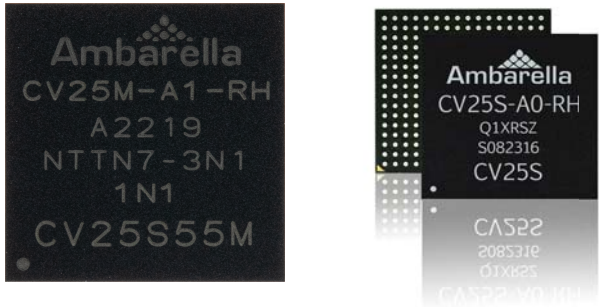# Computer Vision SoC for IP Cameras

Overview

Ambarella's CV25S SoC combines state-of-the-art computer vision technology with image processing in a single, low-power design. Fabricated using advanced 10 nm process technology, CV25S achieves an industry-leading combination of low-power and high-performance in both human and computer vision applications.

Meeting the demands of the next generation of intelligent IP cameras, CV25S's CVflow® architecture provides deep neural network (DNN) computer vision processing and 5MP video encoding, enabling a multitude of computer vision applications on the edge. Efficiently encoding in both AVC and HEVC video formats, CV25S minimizes cloud storage costs by streaming high-resolution video at low bit rates.

To further enhance its computer vision capabilities, CV25S uses a next-generation image signal processor (ISP) to deliver outstanding imaging in low-light conditions, while its high dynamic range (HDR) processing extracts maximum image detail in high-contrast scenes.

CV25S includes a suite of advanced security features to implement advanced on-device physical security, including OTP, secure boot, TrustZone®, and I/O virtualization. A complete set of CVTools is provided to help customers to easily port their own neural networks onto the CV25S SoC.

The CV25S chip targets IP camera designs

Key Features

Flexible Low-Power Platform
- CVflow® computer vision engine
- 64-bit quad-core Arm® Cortex®-A53 CPU up to 1 GHz
- Linux kernel version 4.14 or later (64-bit)
- Linux SDK for standards-based development
- OTP, secure boot, TrustZone, IO virtualization
- Industry-leading image sensors support
- 10 nm low-power CMOS process

CVflow Computer Vision Engine
- CNN / DNN inference acceleration for detection, classification, and more
- CNN toolkit for easy porting with Caffe, TensorFlow, and ONNX
- Tools for high- and low-level algorithm development
- Open SDK

Advanced Image Processing
- Up to 400 MPixels input rate
- Multi-exposure line-interleaved HDR
- Superior low-light processing
- 3D motion-compensated temporal filtering (MCTF)
- Hardware dewarping engine
- Electronic image stablilization (EIS)
- Up to three independent sensor inputs

High-Efficiency Video Encoding
- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 5MP30 video performance
- Multiple CBR and VBR bit rate control modes
- Smart H.264 and H.265 encoder algorithms

Block Diagram

The diagram below illustrates a design based on the Ambarella CV25S device.
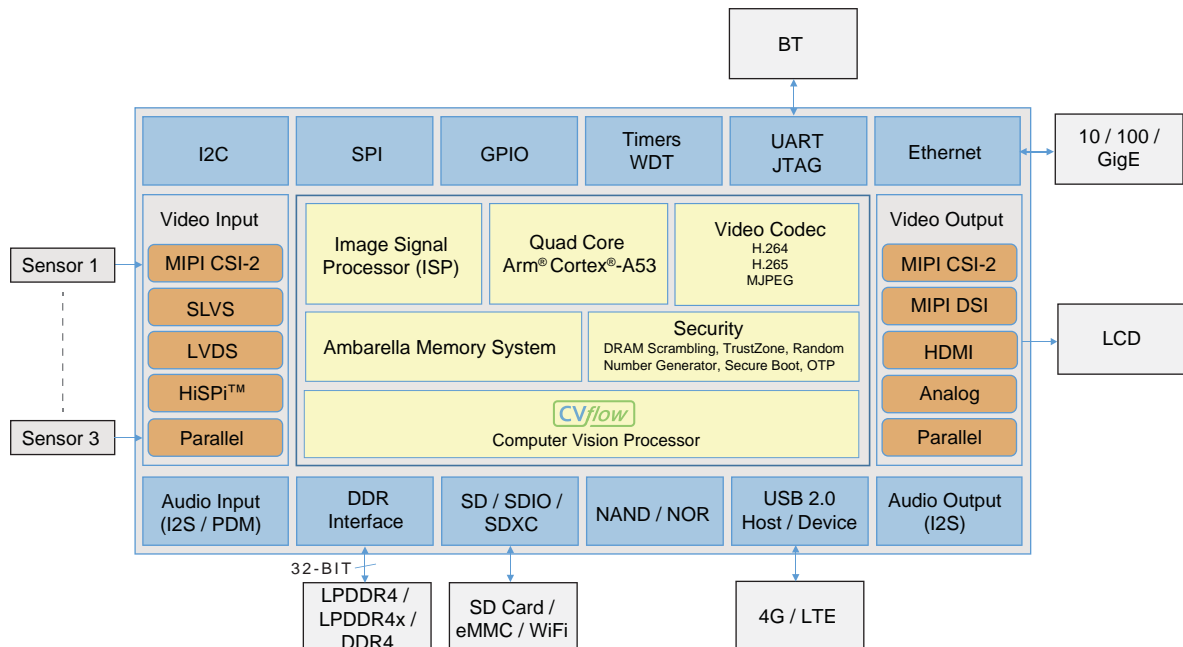
General Specifications

Processor Cores
- Quad-core Arm® Cortex®-A53 up to 1 GHz
- 32KB / 32KB I/D and 1 MB L2 cache
- NEON™ SIMD and FPU acceleration
- OTP, secure boot, TrustZone®, IO virtualization
- AES / 3DES / SHA-1 / MD5 crypto acceleration
- Ambarella image signal processor and video codec

Sensor and Video I/O
- Single, dual, or triple sensor inputs with independent ISP configuration
- Sub-LVDS / MIPI CSI-2 / SLVS / HiSPi™ input
- 16-bit parallel LVCMOS
- BT.601 / 656 video in and 16-bit BT.601 out
- HDMI® 2.0 including PHY with CEC support
- PAL / NTSC composite SD video out
- 4-lane MIPI DSI / CSI-2 and FPD (VESA / JEIDA) out

Sensor Processing
- 400 MPixel/s maximum pixel rate
- Lens shading correction
- Multi-exposure HDR (line-interleaved sensors)
- WDR with local tone mapping

Image Processing
- 3D motion-compensated temporal filtering (MCTF)
- 3-axis electronic image stabilization (EIS)
- Adjustable AE / AWB / AF
- 180º and 360º fisheye lens distortion correction
- High quality polyphase scalers
- Digital PTZ and virtual cameras
- OSD engine, overlays, privacy mask
- Crop, mirror, flip, 90º / 270º rotation
- DC-iris and P-iris
- Defect pixel correction
- Geometric lens distortion correction
- Chromatic aberration correction
- Gamma compensation and color enhancement
- Backlight compensation

Intelligent Video Analytics
- CVflow vision processor for CNN / DNN edge analytics
- People counting and tracking
- Face detection and recognition
- Human / pet / vehicle classification
- Object classification, recognition, and more
- License plate recognition

Video Encoding
- H.265 MP L5.1, H.264 MP/HP L5.1 and MJPEG
- 5MP30 maximum encoding performance
- Up to 8 simultaneous stream encodes
- Flexible GOP configuration with I, P, and B frames
- Temporal scalable video codec (SVC-T) with 4 layers
- Dynamic region of interest (ROI)
- Multiple CBR and VBR rate control modules

Memory Interfaces
- LPDDR4 / LPDDR4x / DDR4 up to 1.6 GHz, 32-bit data bus
- Three SD controllers: SD / SDIO / SDXC
- Boot from SPI or parallel SLC NAND with BCH, SPI NOR, USB, or eMMC

Peripheral Interfaces
- 10 / 100 / 1000 ethernet with RMII / RGMII
- One USB 2.0 port configurable as host / device
- Audio interface including I2S and DMIC
- Multiple SSI / SPI, I2C, and UART
- Multiple GPIO ports, PWM, IR, ADC
- Watchdog timer, multiple general purpose timers, JTAG

Physical
- 10 nm low-power CMOS
- Operating temperature -25ºC to +85ºC
- FBGA package with 361 balls, 13x13 mm, 0.65 mm pitch

CV25S IP Camera Development Platform
The CV25S IP camera development platform contains the necessary tools, software, hardware, and documentation to develop an IP camera utilizing the powerful CVflow processor while supporting development of customized features.

Evaluation Kit (EVK)
- CV25S main board with connectors for sensor / lens board and peripherals
- Sensor board: Sony, ON Semi, Omnivision, Panasonic, and others
- Datasheet, BOM, schematics, and layout
- IP camera reference application with C and C++ source code

Software Development Kit (SDK)
- Linux 4.14 + 64-bit kernel with patches, drivers, tools, and application source code
- CNN CVflow tools for easy porting with Caffe, TensorFlow, and ONNX
- Latest Linaro GCC Toolchain for 64-bit Arm Cortex-A53
- Royalty-free libraries for ISP, 3A, dewarp, and codecs
- Image tuning and manufacturing calibration tools
- Detailed documentation with programmer's guide and application notes

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