



## NVIDIA JETSON NANO BRINGING AI TO MILLIONS OF NEW DEVICES AT THE EDGE

The AI revolution is transforming industries, and NVIDIA is playing a major role in its adoption. NVIDIA GPUs enable data centers to stream consumer search services, like voice assistants, to millions of people. NVIDIA DRIVE™ AGX solutions power self-driving cars that are safer and more capable year after year. And the NVIDIA Jetson™ platform makes it possible to deploy AI to systems at the edge, serving multiple industries ranging from smart cities to robotics.

With more engagement comes the desire to bring AI to more products that are smaller, more energy efficient, and more affordable. But many companies have been constrained by the challenges of size, power, and AI compute density—until now.

### KEY FEATURES

#### Jetson Nano Module

- > 128-core NVIDIA Maxwell™ GPU
- > Quad-core ARM® A57 CPU
- > 4 GB 64-bit LPDDR4
- > 10/100/1000BASE-T Ethernet

#### Power Options

- > Micro-USB 5V 2A
- > DC power adapter 5V 4A

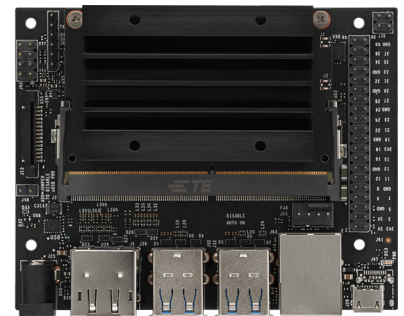
#### I/O

- > USB 3.0 Type A
- > USB 2.0 Micro-B

- > HDMI/DisplayPort
- > M.2 Key E
- > Gigabit Ethernet
- > GPIOs, I<sup>2</sup>C, I<sup>2</sup>S, SPI, UART
- > MIPI-CSI camera connector
- > Fan connector
- > PoE connector

#### Kit Contents

- > NVIDIA Jetson Nano module and carrier board
- > Quick Start Guide and Support Guide



## A Small Breakthrough in AI

With the introduction of Jetson Nano™, NVIDIA enables the development of millions of new AI devices that power efficient in a small form-factor. This is a small AI computer that comes as a developer kit at \$99 and a production-ready module at \$129. It can process data from high-resolution sensors, process multiple sensors simultaneously, and run multiple neural networks per sensor. This makes an entire world of new embedded applications possible, including entry-level NVRs, home robots, and intelligent gateways with full analytics capabilities.

The power of AI, born of supercomputers, is now available to the mass embedded market—only with Jetson Nano.

It all starts with a production-ready, small form-factor (69x45mm) System on Module (SOM) from NVIDIA. It comes with a 128-core NVIDIA Maxwell™ GPU, a quad-core ARM A57 processing system, a video encoder and decoder, and 4 GB LPDDR4 and 16 GB eMMC memory. It also features a host of interfaces and IOs, including high-speed IO for CSI, PCIe, Gigabit Ethernet, and USB3, video interfaces such as HDMI and DisplayPort, and standard IO for I2C, I2S, SPI, and GPIO.

Jetson Nano is designed to reduce overall development time and bring products to market faster by reducing the time spent in hardware design, test, and verification of a complex, robust, power-efficient AI system. The design comes complete with power management, clocking, memory, and fully accessible IOs. Developers can easily connect their sensors and IO and start developing the application-specific parts of the system. With both boot and program flash, Jetson Nano lets developers simply and regularly update their algorithms during development, and even after the system is deployed.



### JETSON NANO LOW COST AI COMPUTER MODULE

#### Heterogeneous CPU Complex

Quad Core A57 with 2 MB L2 for multi-threaded operation  
1.43 Ghz

#### Computer Vision Engines

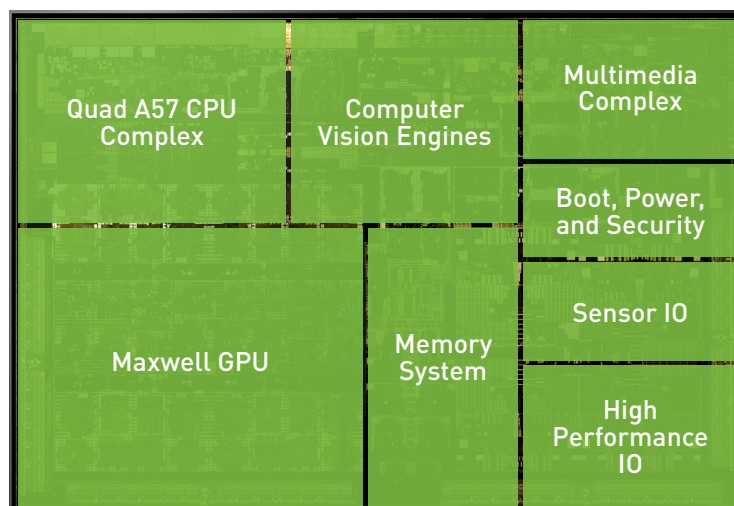
ISP  
Video Image Compositor

#### Maxwell Tensor Core GPU

128 CUDA Tensor Cores  
472 GFLOPS (FP16)

#### Memory

4 GB 64-Bit LPDDR4  
Bandwidth 25.6 GB/s  
16 GB eMMC



#### Multimedia Engines

Encoder 4k, 4x1080p, 8x720p up to 120 fps  
Decoder 4k60, 2x4k, 8x1080p, 16x720p, up to 240fps  
JPEG encode & decode 600 MP/s  
H.264, H.265, VP9, VP8, VC-1, MPEG-2  
HDMI, DP and eDP Display support

#### Boot, Power, and Security

Boot and power management  
ARM TrustZone Secure

#### Industry Standard IO

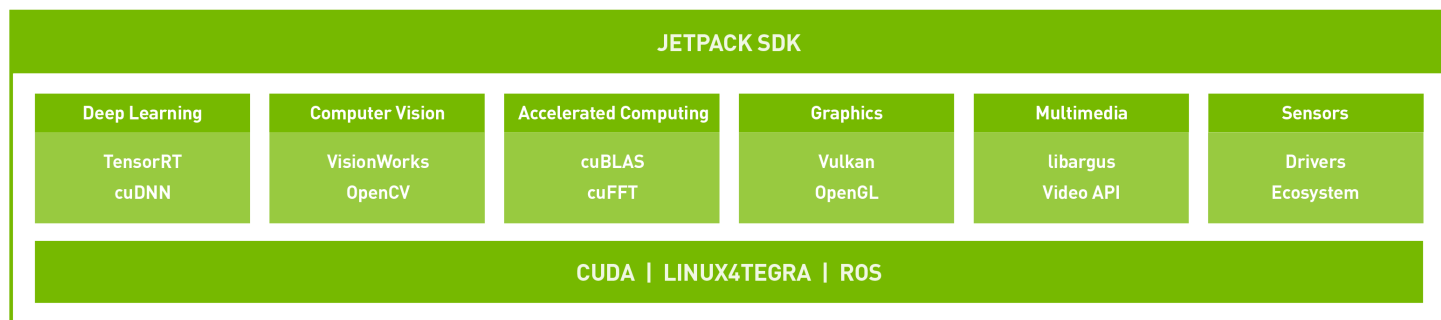
GPIO, I<sup>2</sup>C, I<sup>2</sup>S, SDIO, SPI, UART  
Support up to 12 CSI @1.5 Gbps

#### Industry-Standard High-Speed IO

PCIe Gen2 rootport x1 | x2 | x4  
RGMII Ethernet  
USB 3.0 and 2.0  
USB 3.0 Gen2 Host and Device

## JETPACK SOFTWARE

Jetson Nano is supported by NVIDIA JetPack, which includes a board support package (BSP), Linux OS, NVIDIA CUDA®, cuDNN, and TensorRT™ software libraries for deep learning, computer vision, GPU computing, multimedia processing, and much more. The JetPack SDK scales across the entire Jetson family and is fully compatible with NVIDIA's world-leading AI platform for training and deploying AI software. This helps developers get a head start, quickly getting a system up and running, and focusing on differentiating their products with their application code and unique capabilities.



JetPack comes with the suite of NVIDIA Nsight™ productivity utilities that enables developers to build, debug, profile, and develop world-class, cutting-edge software that uses the latest visual computing hardware from NVIDIA. These Nsight tools include Nsight Systems, a system-wide performance analysis tool designed to visualize an application's algorithms, identify the largest opportunities to optimize, and tune to scale efficiently across multiple CPUs and GPUs. Plus, they include Nsight Graphics, a standalone application for the debugging, profiling, and analysis of graphics applications.

Jetson Nano supports a number of deep learning networks, including ResNet-50, SSD Mobilnet-V2, enet, Tiny YOLO V3, Posenet, VGG-19, Super Resolution, Unet, and others. These models are used for classification, object detection, segmentation, pose estimation, predictive maintenance, image processing, and more. Plus, Jetson Nano supports frameworks like Caffe, TensorFlow, PyTorch, Darknet, MXNet, and Keras.

All of these are supported on JetPack, designed to help reduce the overall development cost and accelerate bringing products to market. This saves developers time and companies money, and delivers the performance needed to run modern AI workloads at a previously unattainable size, power, and cost.

## SOM FEATURES

Module Feature	Tech Spec
GPU	128-core Maxwell 472 GFLOPs (FP16) @ 921 MHz
CPU	4-core ARM A57 @ 1.43 GHz
Memory	4 GB 64-bit LPDDR4 @ 1600 MHz, 25.6 GB/s
Storage	16 GB eMMC
Video Encode	4K @ 30   4x 1080p @ 30   9x 720p @ 30 (H.264/H.265)

Video Decode	4K @ 60   2x 4K @ 30   8x 1080p @ 30   16x 720p @ 30   [H.264/H.265]
Camera	12 (3x4 or 4x2) MIPI CSI-2 DPHY 1.1 lanes (1.5 Gbps)
Display	HDMI 2.0 or DP1.2   eDP 1.4   DSI (1 x2) 2 simultaneous
UPHY	1 x1/2/4 PCIE, 1x USB 3.0, 3x USB 2.0
IO	1x SDIO / 2x SPI / 6x I2C / 2x I2S / GPIOs
Mechanical	69 mm x 45 mm, 260-pin edge connector

## JETPACK SOFTWARE FEATURES

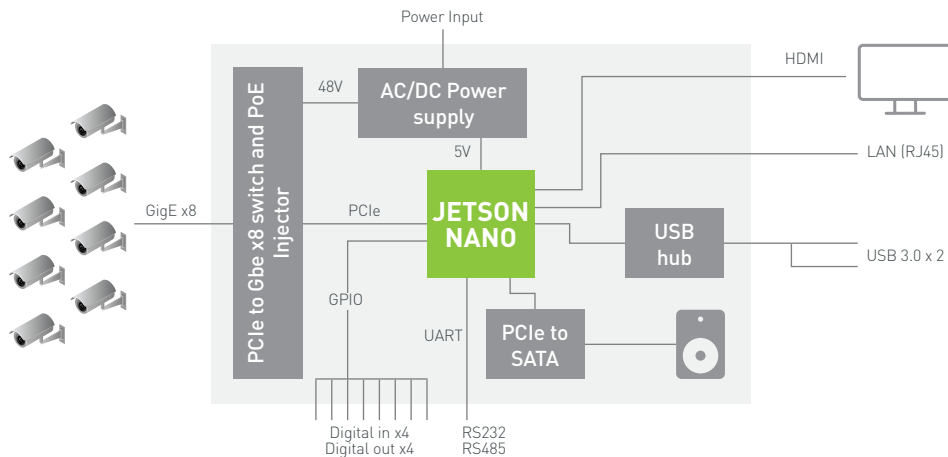
Software Features	Description
Linux OS	This open-source software operating system runs from the desktop to the cloud to all your Internet-connected things.
NVIDIA CUDA	This is a parallel-computing platform and programming model developed by NVIDIA for general computing on graphical processing units (GPUs). It includes specific libraries like cuBLAS for dense linear algebra and cuFFT for Fast Fourier Transforms.
TensorRT and cuDNN	This platform for high-performance deep learning inference includes a deep learning inference optimizer and runtime that delivers low latency and high throughput for deep learning inference applications. TensorRT-based applications perform up to 40X faster than CPU-only platforms during inference. With TensorRT, you can optimize neural network models trained in all major frameworks, calibrate for lower precision with high accuracy, and deploy to hyperscale data centers, embedded, or automotive platforms.
VisionWorks and OpenCV	This is a software development package for computer vision (CV) and image processing. NVIDIA VisionWorks™ implements and extends the Khronos OpenVX standard and is optimized for CUDA-capable GPUs and SOCs, enabling developers to realize CV applications on a scalable and flexible platform.
Libargus Video API	Libargus is an API for acquiring images and associated metadata from a camera that provides an efficient and simple integration into applications and larger frameworks. Libargus delivers images with EGLStreams that are directly supported by other system components such as OpenGL and CUDA and require no buffer copies during operation.
Nsight Systems	This system-wide performance analysis tool is designed to visualize an application's algorithms, help you identify the largest opportunities to optimize, and tune to scale efficiently across any quantity or size of CPUs and GPUs.
Nsight Graphics	This is a standalone application for the debugging, profiling, and analysis of graphics applications.
Nsight Compute	Use this interactive kernel profiler for CUDA applications for detailed performance metrics and API debugging through a user interface and command line tool. Its baseline feature also lets users compare results within the tool.

## APPLICATION EXAMPLES

We list several example application architectures based on Jetson Nano. These applications all have a need for:

- > one or more high resolution sensor
- > multiple sensors and
- > multiple neural networks per sensor

## JETSON NANO AI-ENABLED NVR



8-channel 1080p AI NVR

8 x 10/100 ports with PoE, type 1 class 3

8 channels 1080p 30 fps deep learning

500 MPS decoding @ H.264/H.265

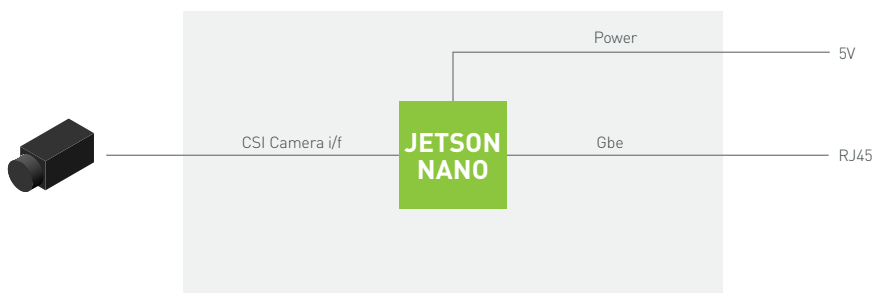
250 MPS encoding @ H.264/H.265

JetPack and DeepStream SDK support

Under 150 W (incl. PoE)

\*hard drive cost not included

## JETSON NANO AI-ENABLED SMART CAMERA



1 4k CSI camera supporting 30 fps

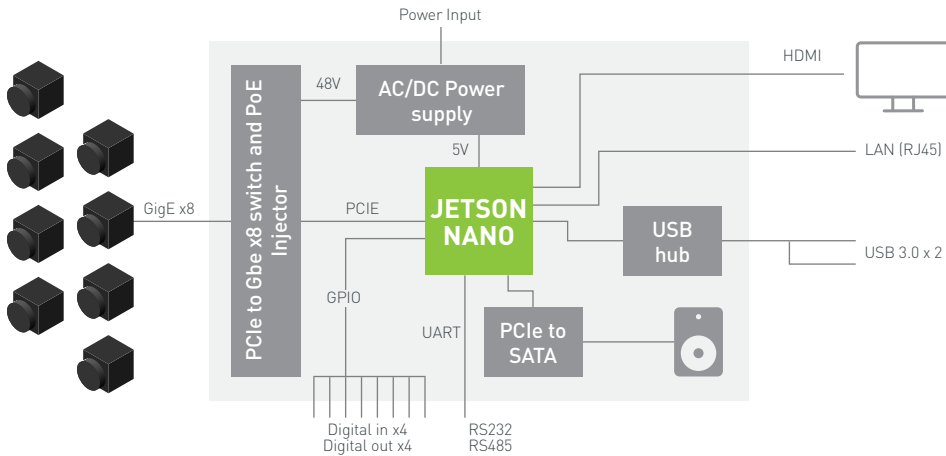
1 channel processing 30 fps deep learning

250 MPS encoding @ H.264/H.265

Gbe connectivity

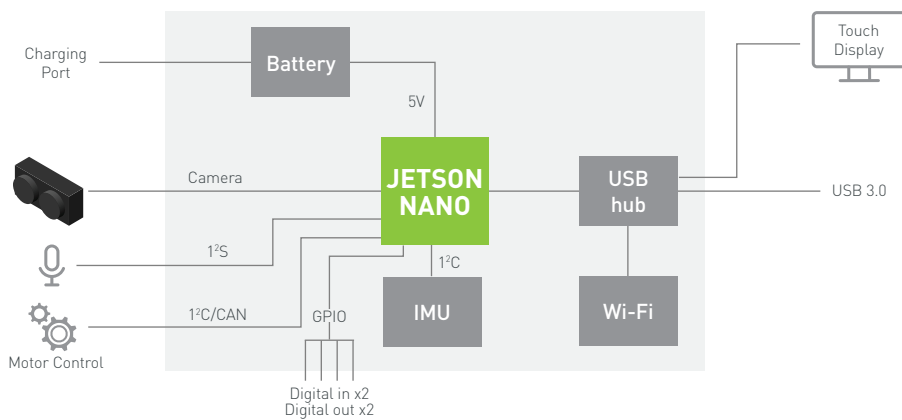
JetPack and DeepStream SDK support

## JETSON NANO AI-ENABLED INDUSTRIAL MACHINE VISION SYSTEM



- 8 x 10/100 ports with PoE, type 1 class 3
- 8 channels of 1080p 30 fps deep learning
- 500 MPS decoding @ H.264/H.265
- 250 MPS encoding @ H.264/H.265
- JetPack and DeepStream SDK support

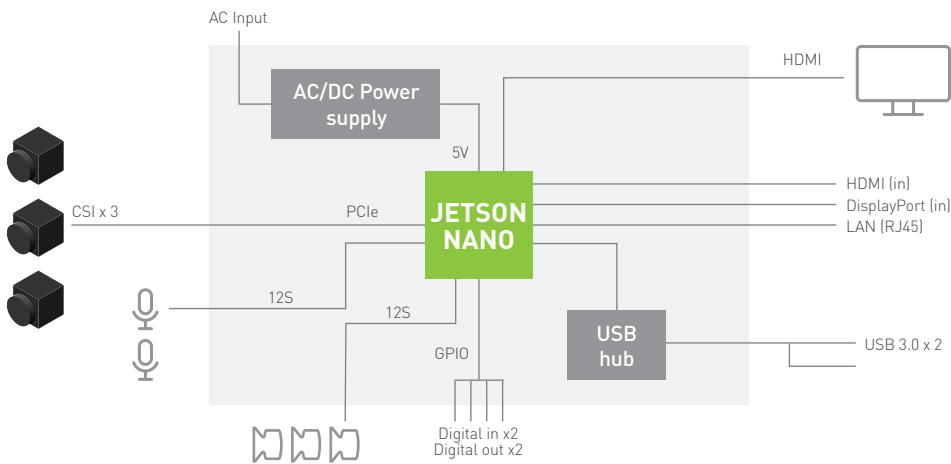
## JETSON NANO AI-ENABLED CONSUMER ROBOT



- 1 1080p camera supporting 30 fps
- 1 channel processing 30 fps deep Learning
- 500 MPS decoding @ H.264/H.265
- Wi-fi connectivity
- Peripherals: motor control, IMU, display (UI), and audio
- JetPack and DeepStream SDK support

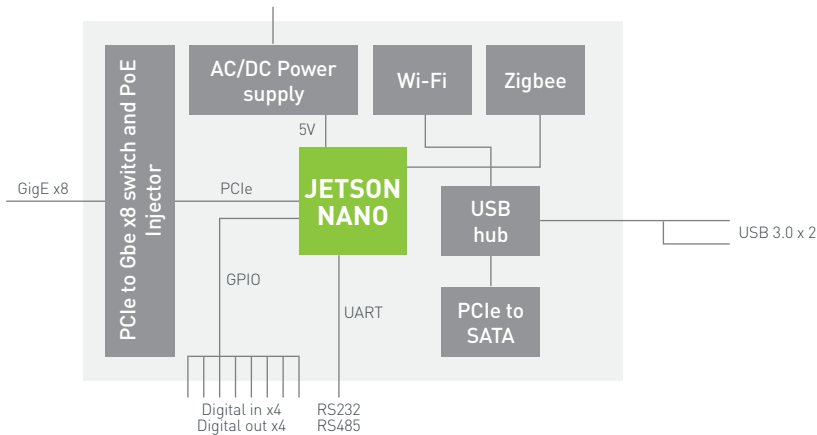
## JETSON NANO AI-ENABLED VIDEO CONFERENCING

### LOW-COST SINGLE-CAMERA SYSTEM



- 1x 1080 CSI 60 fps camera
- Single-channel deep learning
- 500 MPS decoding @ H.264/H.265
- 250 MPS encoding @ H.264/H.265
- JetPack and DeepStream SDK support
- Support for HDMI and DP video input
- Audio in/out and transmission

## JETSON NANO AI ENABLED IOT GATEWAY



- 8 x 10/100 ports with PoE, type 1 class 3
- USB hub to connect Wi-Fi, Zigbee, and RFID wireless chipsets
- JetPack and DeepStream SDK support
- Standard RS232 and RS485
- 4 x GPIO ports