Webinar

# Designing with TI and the New BeagleBone AI 64

Ultra Librarian®

Introduction to BeagleBoard.org

1. Affordable single board computers.
2. Open-Source hardware & software.
3. Focused on education & Industry.
4. Performance ARM & RISC-V SoCs.
5. Expansion through stackable capes.
6. Large community support channels.
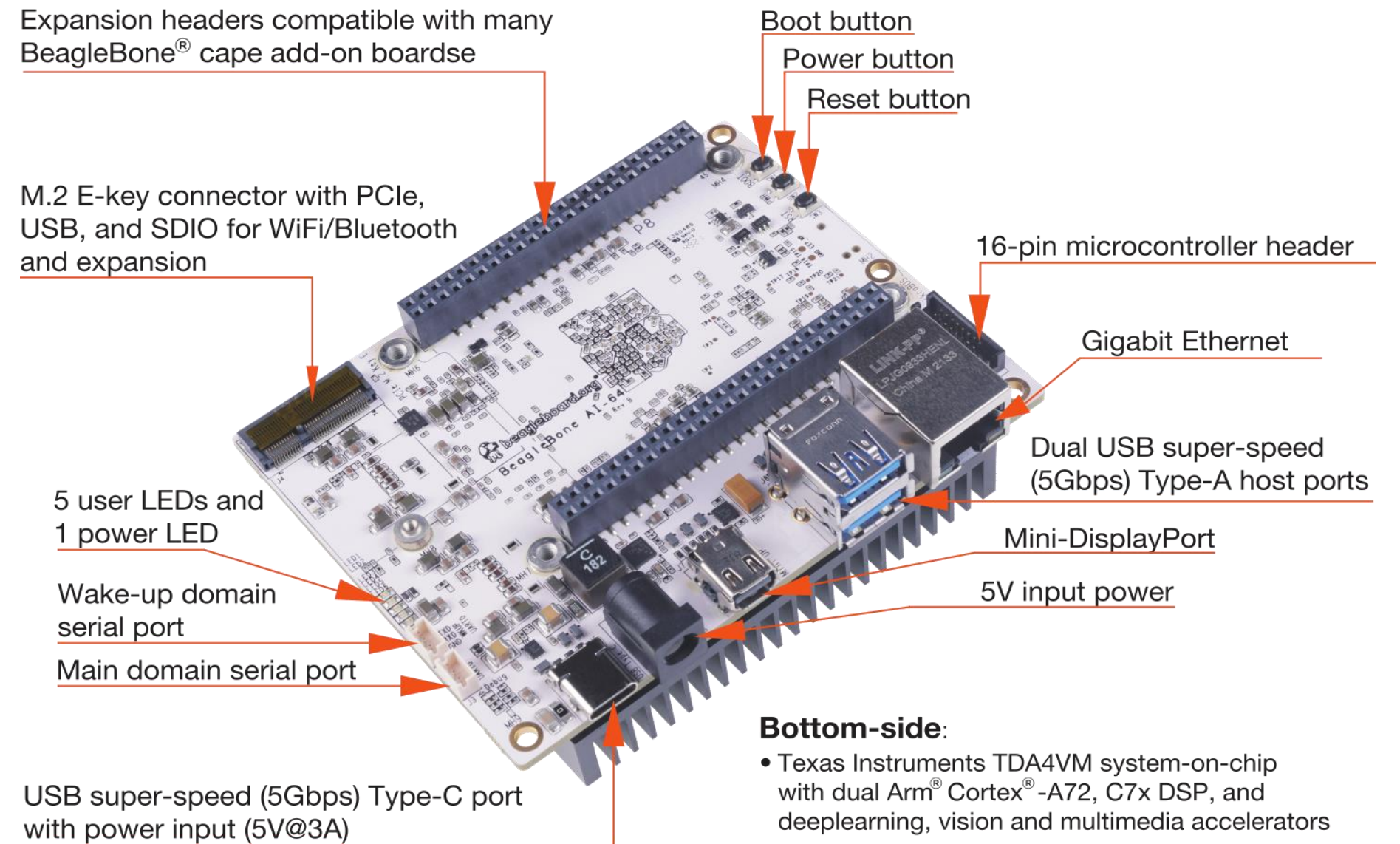7. Huge project database, open for all!

The **BeagleBoard.org Foundation** is a Michigan,USA-based **501(c)(3) non-profit corporation** existing to provide education in and collaboration around the design and use of open-source software and hardware in embedded computing. BeagleBoard.org is the result of an effort by a collection of passionate individuals, including several employees of Texas Instruments, interested in creating powerful, open, and embedded devices. We invite you to participate and become part of BeagleBoard.org, defining its direction. All the designs are fully open source and components are available for anyone to manufacture compatible hardware.
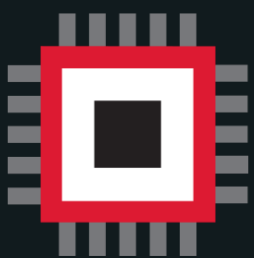
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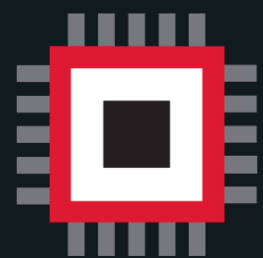
Introduction to BeagleBone AI-64

- Dual A72 @ 1.5GHz
- 6x R5 and 12x PRU
- 3x DSP, MMA (8 TOPs)
- M.2 w/Pcle + USB
- 2x USB3-SS Type-A
- USB3-SS Type-C
- Gigabit Ethernet
- BeagleBone Headers
- Mini-DisplayPort
- 4GB DDR, 16GB flash
- 2x CSI, 1xDSI

BeagleBone® AI-64

Expansion headers compatible with many BeagleBone® cape add-on boardse

Boot button
Power button
Reset button

M.2 E-key connector with PCIe, USB, and SDIO for WiFi/Bluetooth and expansion

16-pin microcontroller header

Gigabit Ethernet

Dual USB super-speed (5Gbps) Type-A host ports

5 user LEDs and 1 power LED

Wake-up domain serial port

Main domain serial port

Mini-DisplayPort

5V input power

USB super-speed (5Gbps) Type-C port with power input (5V@3A)

Bottom-side:
- Texas Instruments TDA4VM system-on-chip with dual Arm® Cortex®-A72, C7x DSP, and deeplearning, vision and multimedia accelerators
- 4GB DDR4 RAM
- 16GB on-board eMMC flash storage
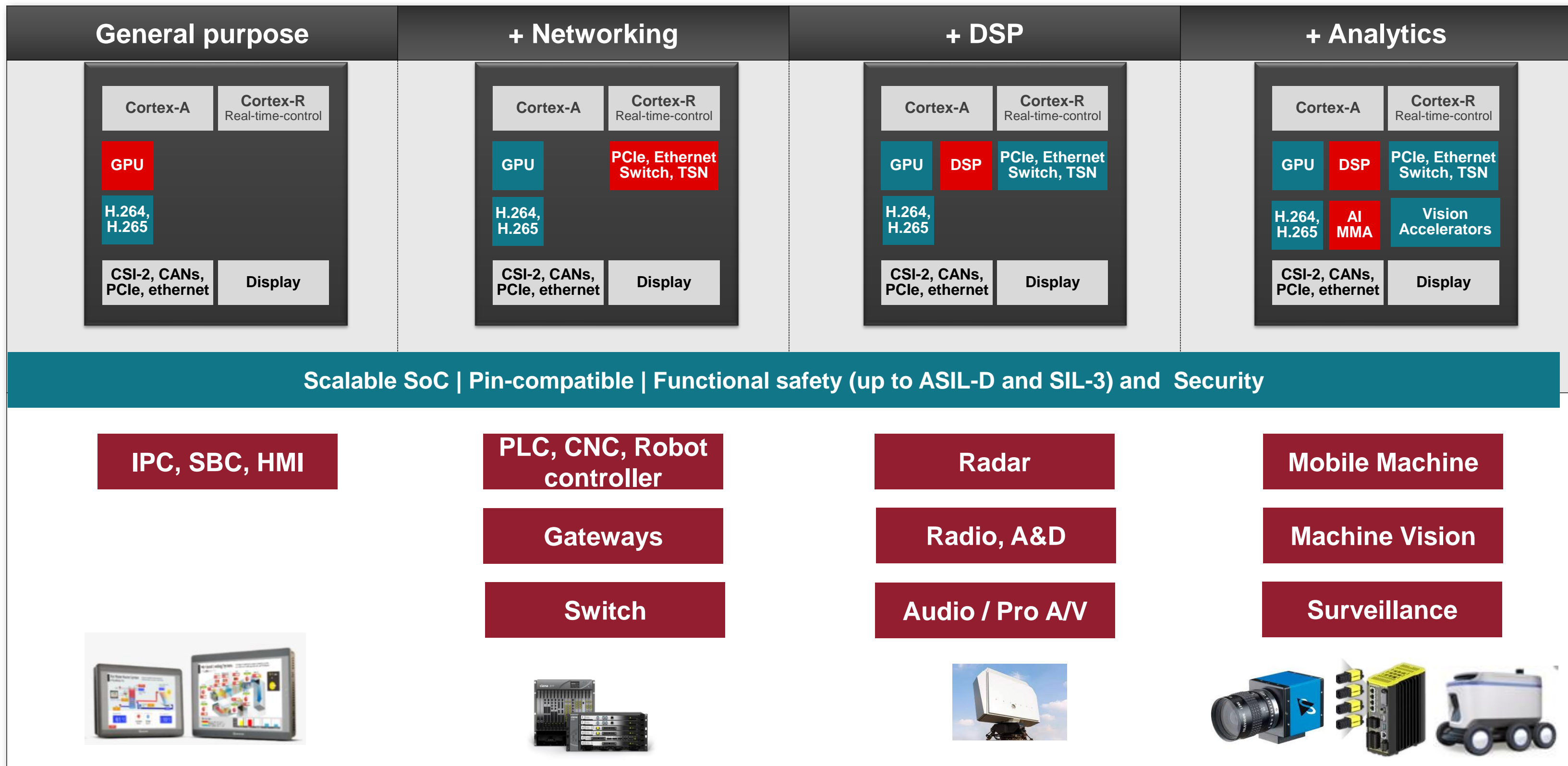- Micro-SD slot
- Dual CSI-2 camera connectors

BeagleBone® AI-64 brings a complete system for developing artificial intelligence (AI) and machine learning solutions with the convenience and expandability of the BeagleBone® platform.

beagleboard.org®

TDA4 scalable processor | Enables broad range of embedded application

Differentiation (red)
Optional (teal)

General purpose	+ Networking	+ DSP	+ Analytics
Cortex-A / Cortex-R Real-time-control	Cortex-A / Cortex-R Real-time-control	Cortex-A / Cortex-R Real-time-control	Cortex-A / Cortex-R Real-time-control
GPU	GPU / PCIe, Ethernet Switch, TSN	GPU / DSP / PCIe, Ethernet Switch, TSN	GPU / DSP / PCIe, Ethernet Switch, TSN
H.264, H.265	H.264, H.265	H.264, H.265	H.264, H.265 / AI MMA / Vision Accelerators
CSI-2, CANs, PCIe, ethernet / Display	CSI-2, CANs, PCIe, ethernet / Display	CSI-2, CANs, PCIe, ethernet / Display	CSI-2, CANs, PCIe, ethernet / Display

Scalable SoC | Pin-compatible | Functional safety (up to ASIL-D and SIL-3) and Security

General purpose	+ Networking	+ DSP	+ Analytics
IPC, SBC, HMI	PLC, CNC, Robot controller	Radar	Mobile Machine
	Gateways	Radio, A&D	Machine Vision
	Switch	Audio / Pro A/V	Surveillance

4

TEXAS INSTRUMENTS

TDA4VM driving innovations for embedded product

High performance, less power

- Dual-core Cortex-A72 @ 2GHz
- 8 TOPS AI, 2x more FPS/TOPS compared to competition
- Vision hardware accelerators, process 8x cameras, 2x 3D cameras
- 2x power efficient compared to competition

Cost efficient, compact design

- Save $30+ with advance integration, enables simpler compact design
- Integrates safety MCU, PCIe switch, Ethernet switch, imaging, vision and AI accelerators in one single SoC

Jacinto™ TDA4x

2x A72	4x R5	Safety MCU 2xR5

Deep Learning Accelerator	DSP

Imaging & Vision accelerators
ISP | LDC| MSC| NF | SDE | DOF

Video codec accelerator	GPU	Display

Security Accelerator	CSI-2 ports, USB 3, Ethernet & PCIe Switches	Large Internal mem, highspeed bus
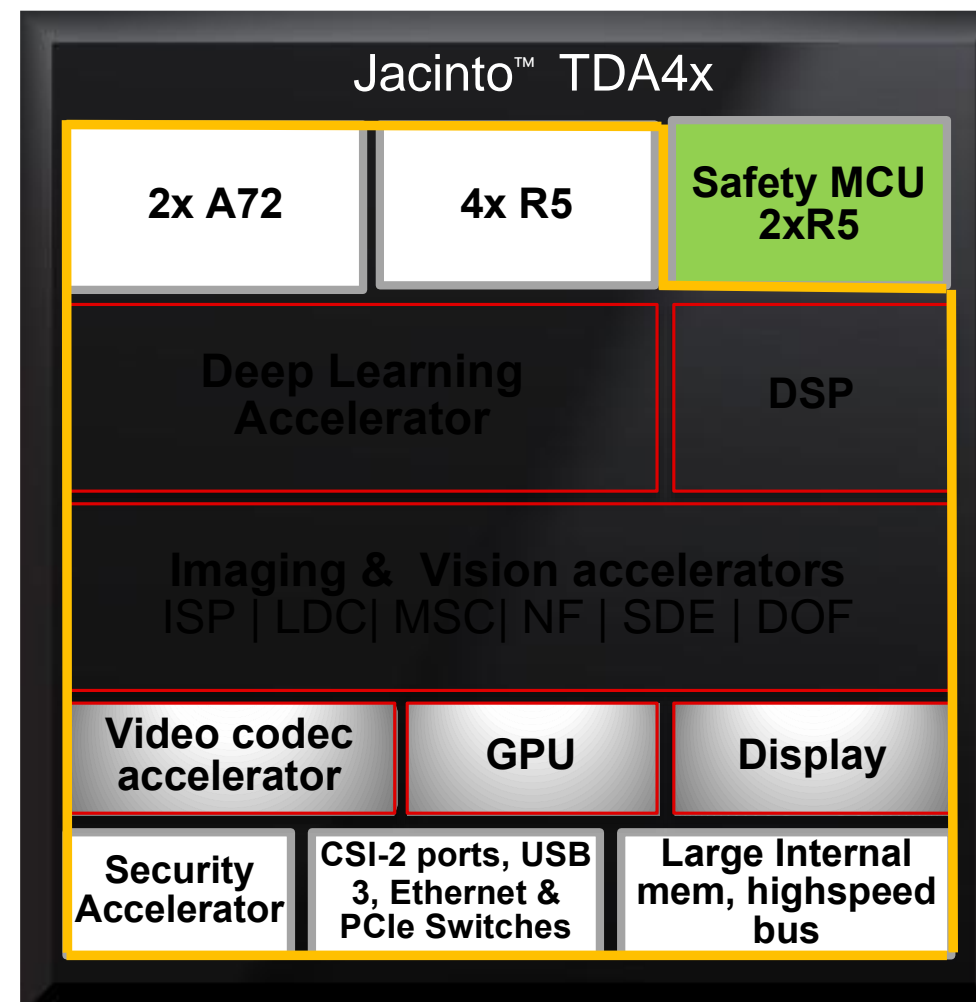
Easy programming, faster TTM[1]

- Hardware agnostic programming. ROS1/ROS2 hardware accelerated nodes
- Linux and QNX SDK, SafeRTOS options
- Extensive AI tools and ecosystem

[1] TTM: Time to market

Functionally safe, and smart

- ASIL-B/SIL-2 complaint vision, AI and sensor fusion, low level drivers from TI
- ASIL-D complaint MCUs, with access to large internal memory

TDA4VM with high-performance processing and advance integration suitable for broad range of applications
2x Cortex-A72 | 8 TOP AI | 100 GFLOPS GPU | 4 displays | 8p Ethernet switch | 4p PCIe switch | USB3
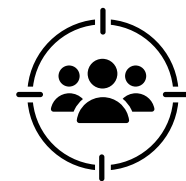
Sigrity Parallel Bus Analysis for LPDDR4 Interface

LPDDR4 Analysis
- Using Controller port on TI Processor (U19)
- Kingston 4GB (1024Mx16x2ch) LPDDR4 (U25)
- Data Lines – Layers 3 & 5
- Address Lines – Layer 12
- PDN for LPDDR4 – Layer top & 9
- Reference (GND) –
  Layer top, 2, 4, 6, 7, 8, 10, 11, 12, 13, BOT
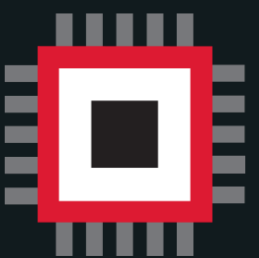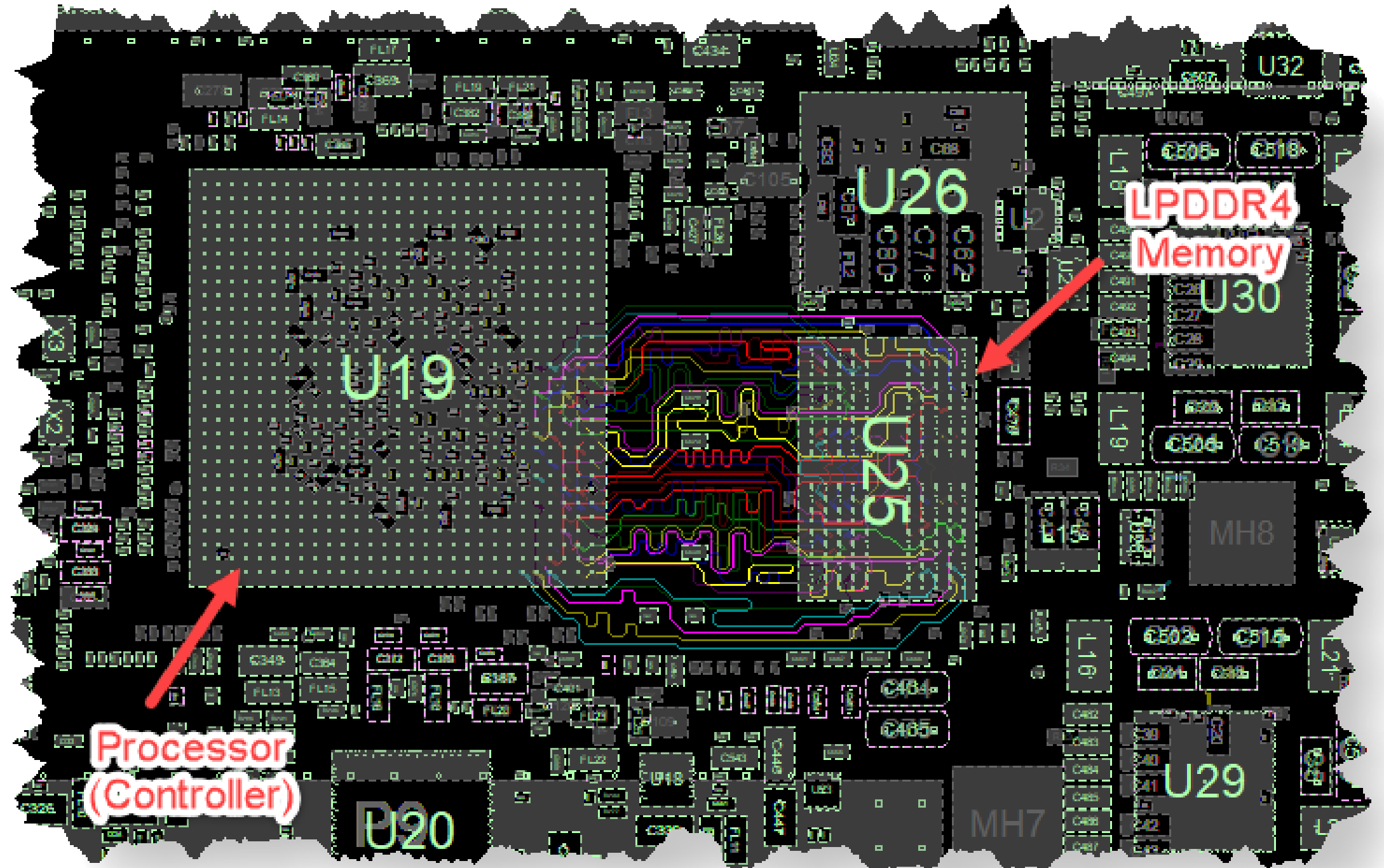
Sigrity PCIe w/ M.2 form factor (SSD card Intfc) Analysis

PCIeM.2 Analysis
- Using PCIeM.2 port on TI Processor (U19)
- SSD M.2 form factor connector (J4)
- Channels on Top layer, 3, & 12
- Reference (GND) – Layer Top, 2, 4, 11, 13
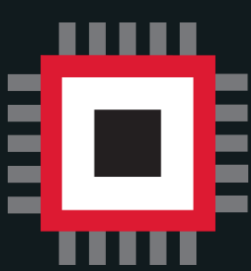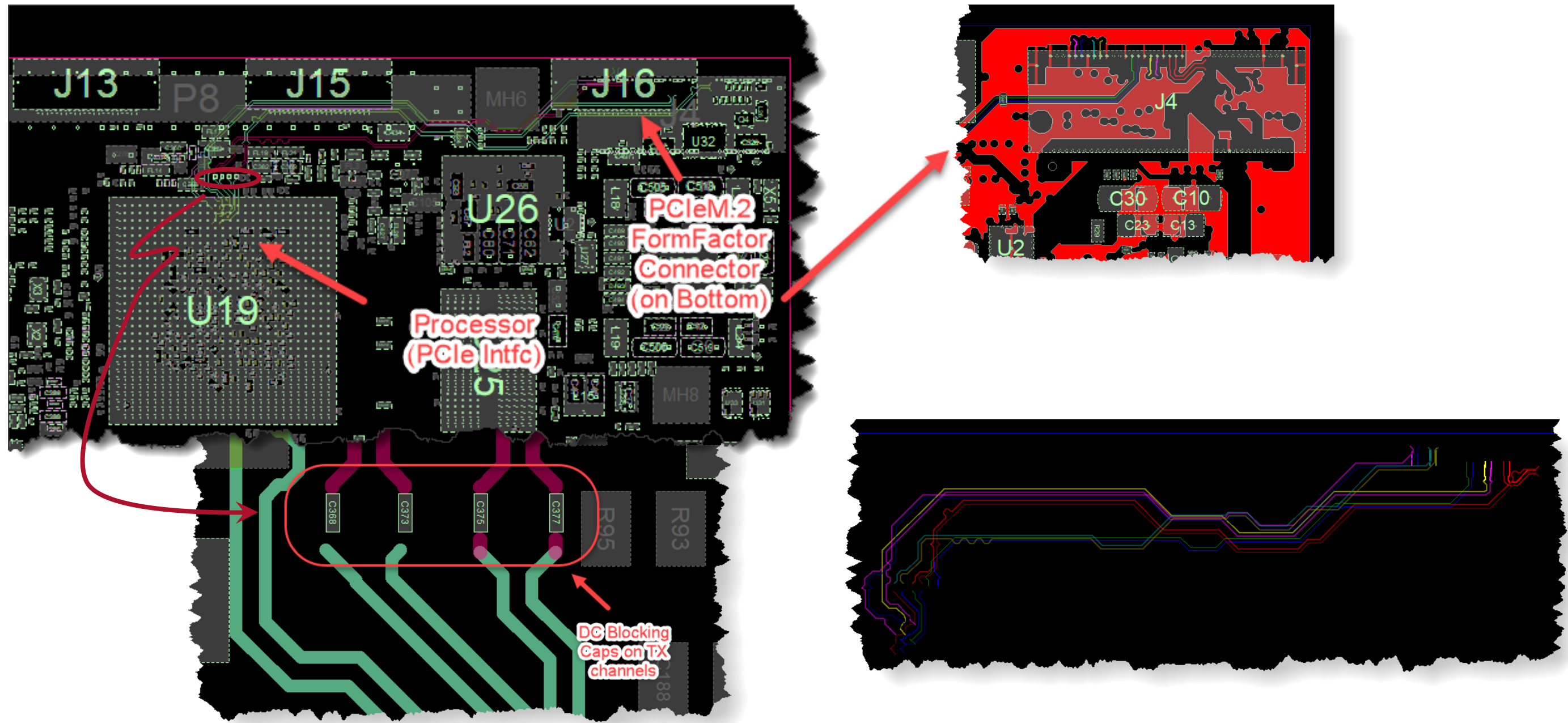
Sigrity IR Drop & Current Density Analysis

VDD_Core (0.8V) IRDrop Analysis
- Using PMIC U29 as source VRM
- Sinks associated with TI Processor U19
- PDN Layer Top, 2, 3, 5, 7, 8, 10, & 12
- Reference (GND) – Essentially All Layers