

UB0100 AI & CV Compute Engine

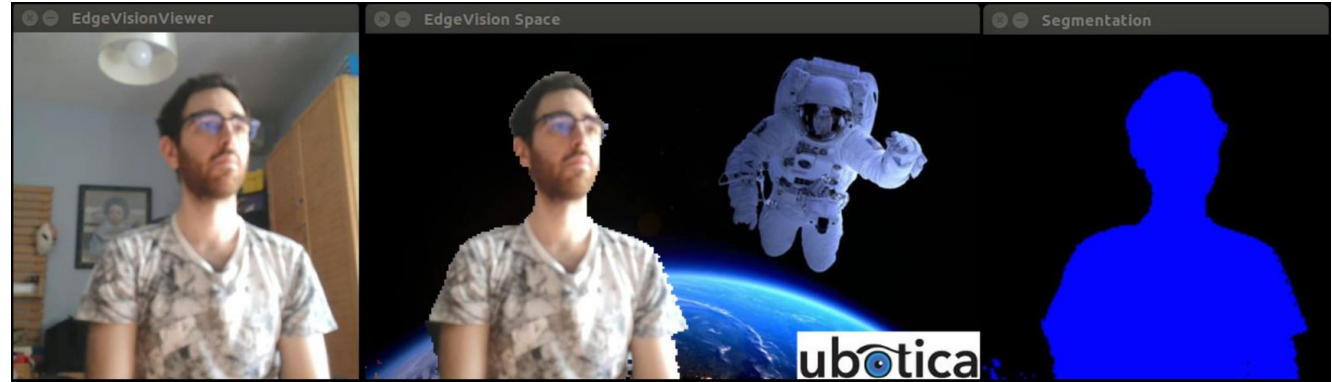
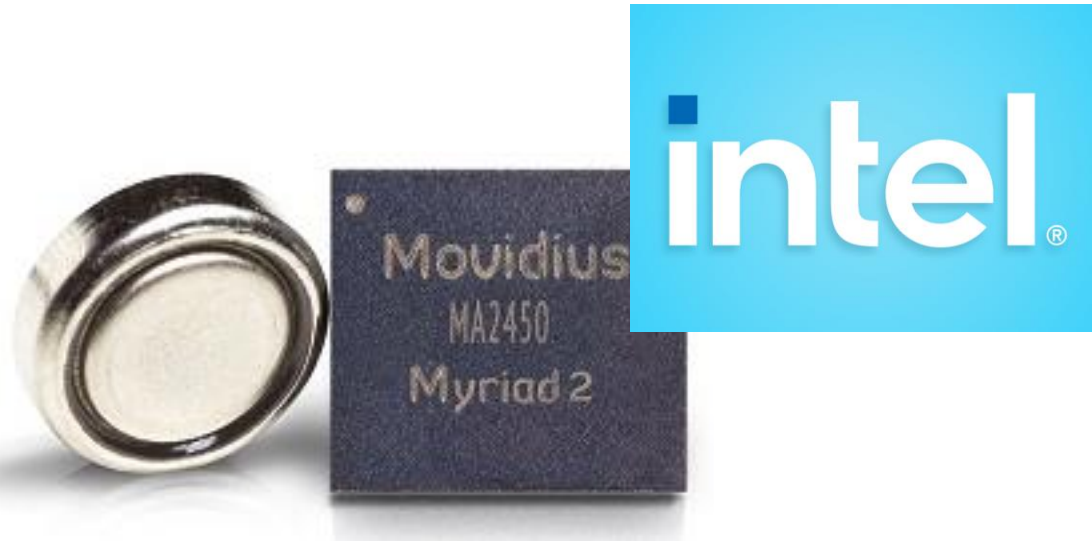
Aubrey Dunne

VP Engineering, Ubotica Technologies

ADCSS, October 22nd 2020

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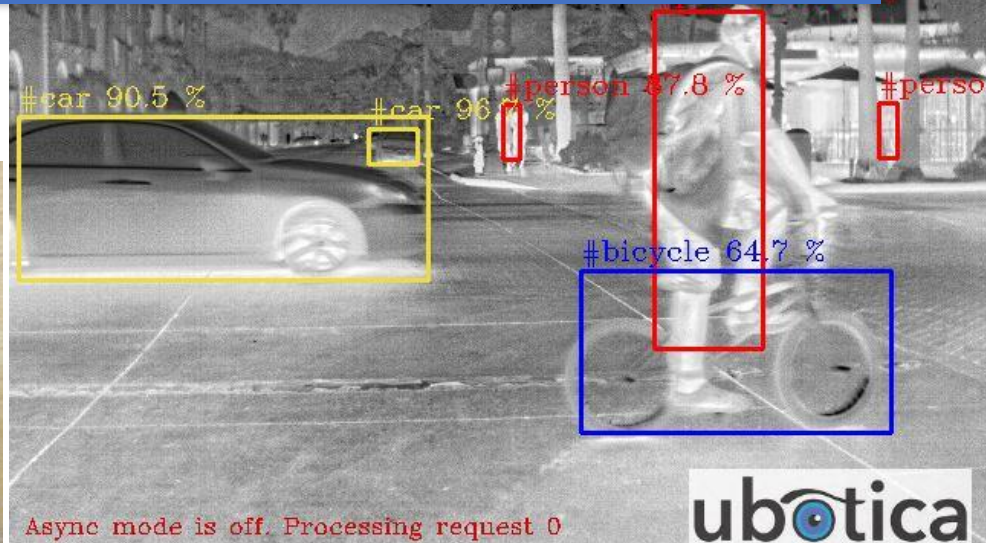
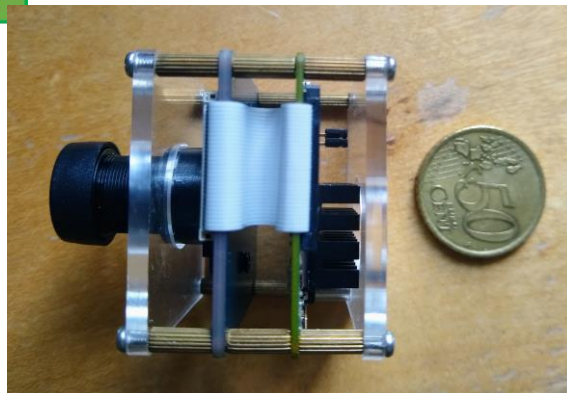
Providing AI Solutions for
Edge Based
Computer Vision Applications

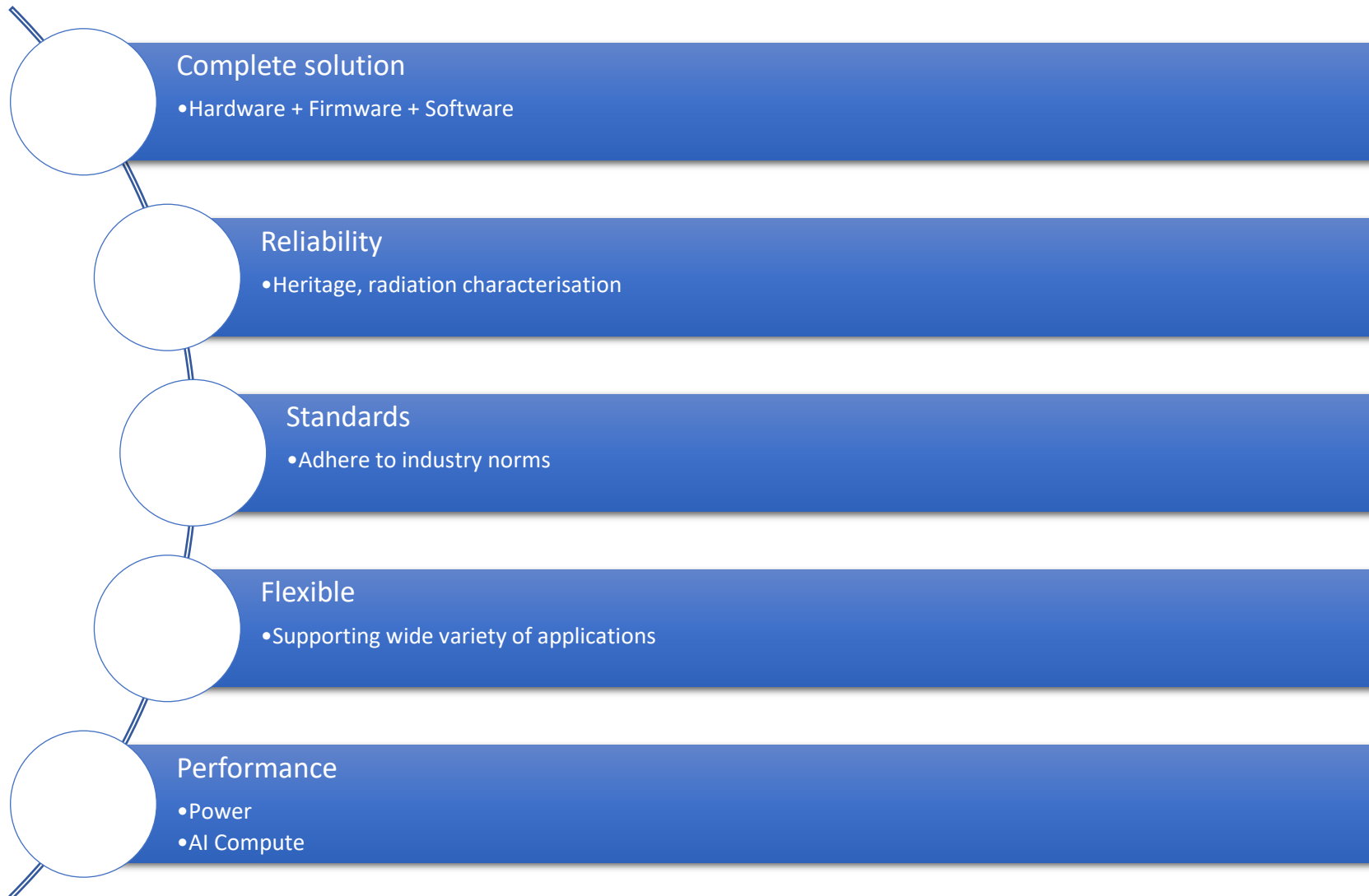


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Inference time: 50.863 ms
CNN parsing time: 17.952 ms
OpenCV rendering time: 0.000 ms
Program FPS: 1.000000
  
```

Providing AI solutions for edge based Computer Vision applications

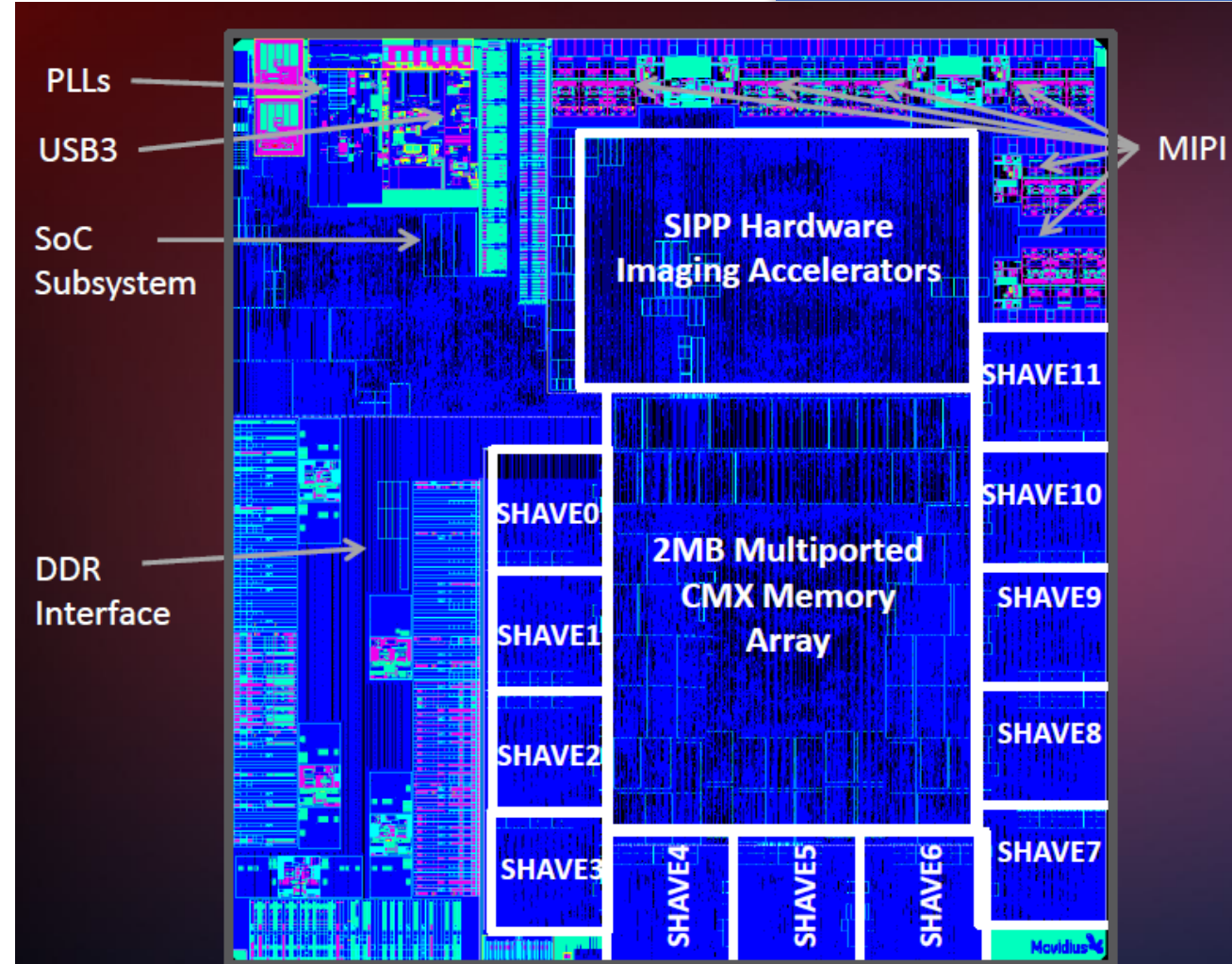




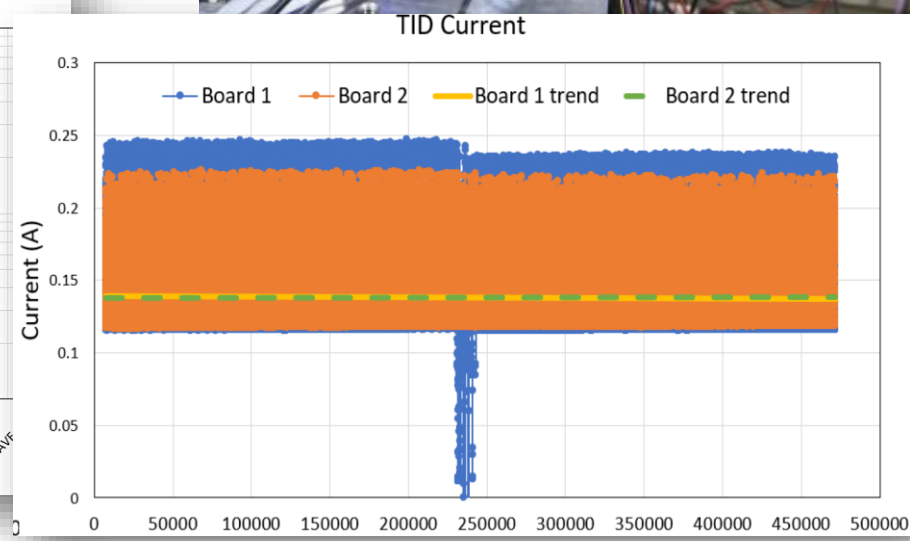
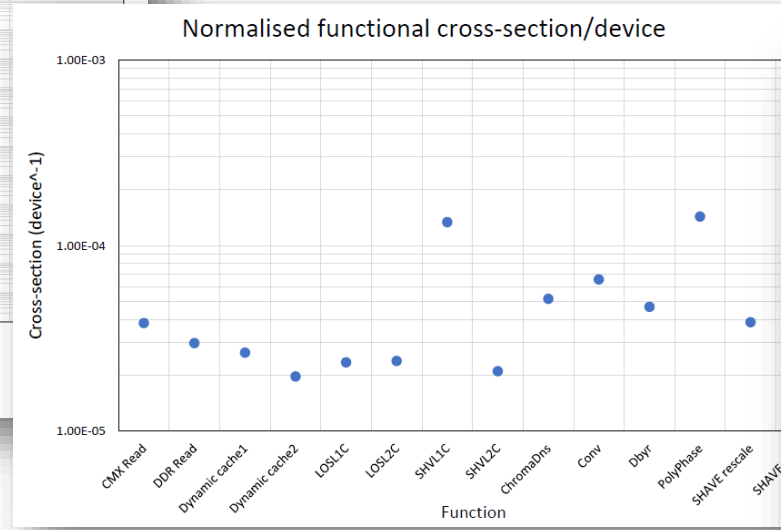
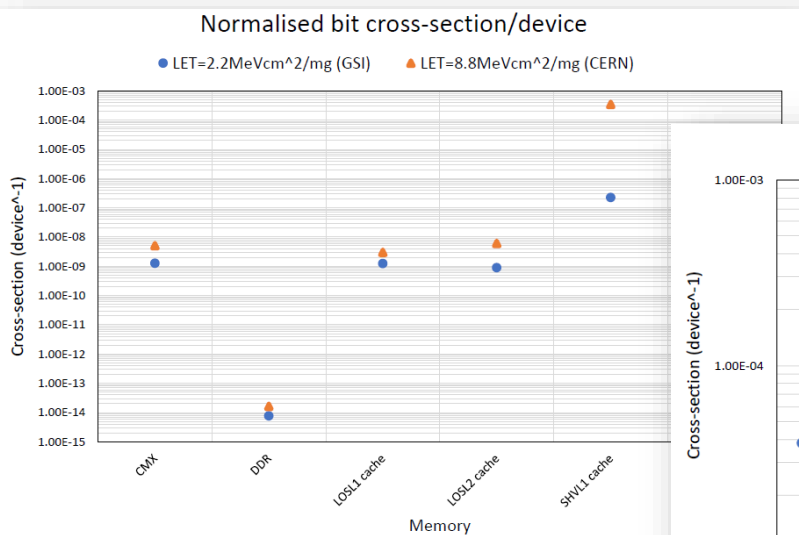
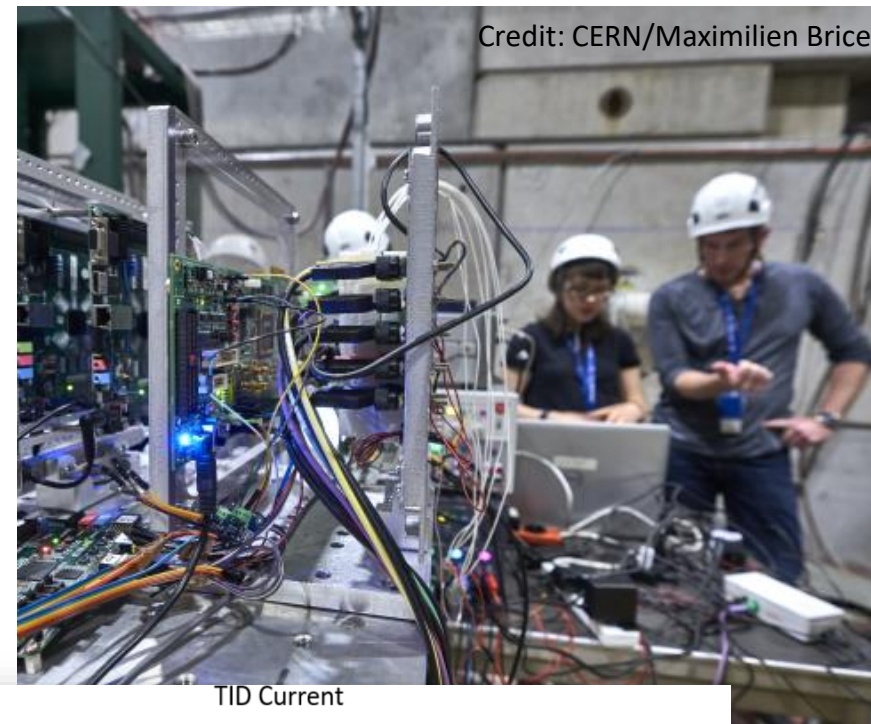
- Software reconfigurable hardware–software platform
- Intel Myriad 2 AI and CV engine
 - 2 LEONs
 - 12 VLIW SHAVE vector cores
 - >1 TOPS compute
 - Stacked DDR
- 1W nominal power envelope

9.5mm x 8mm

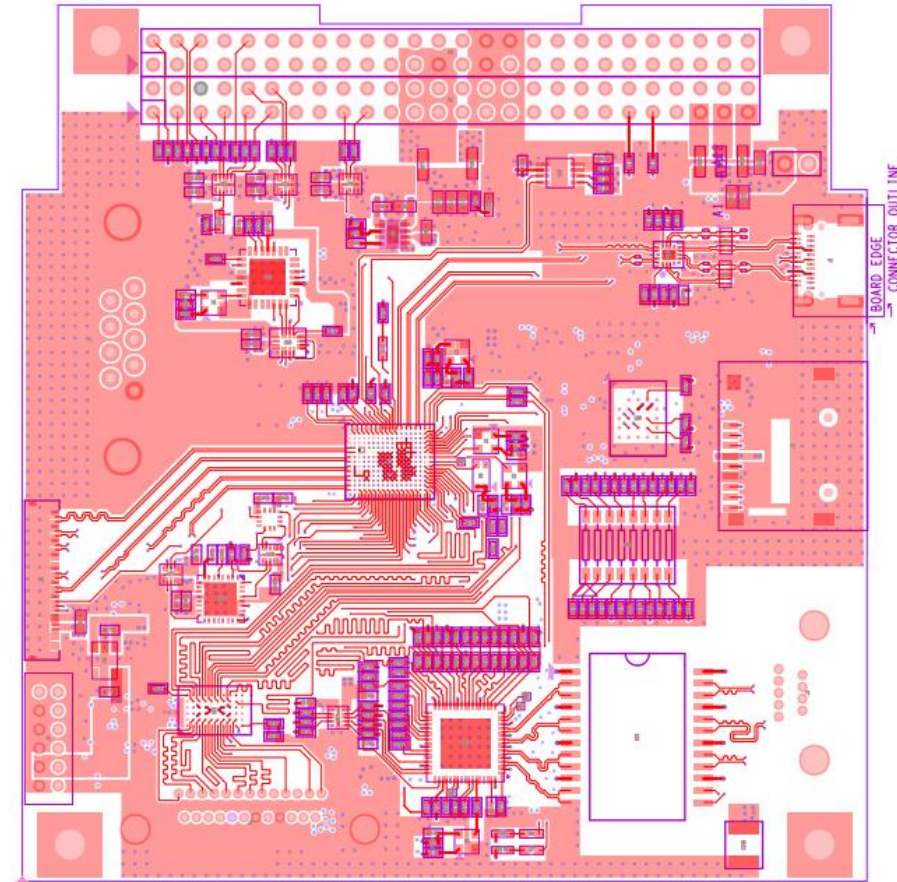
Power ↔ Performance

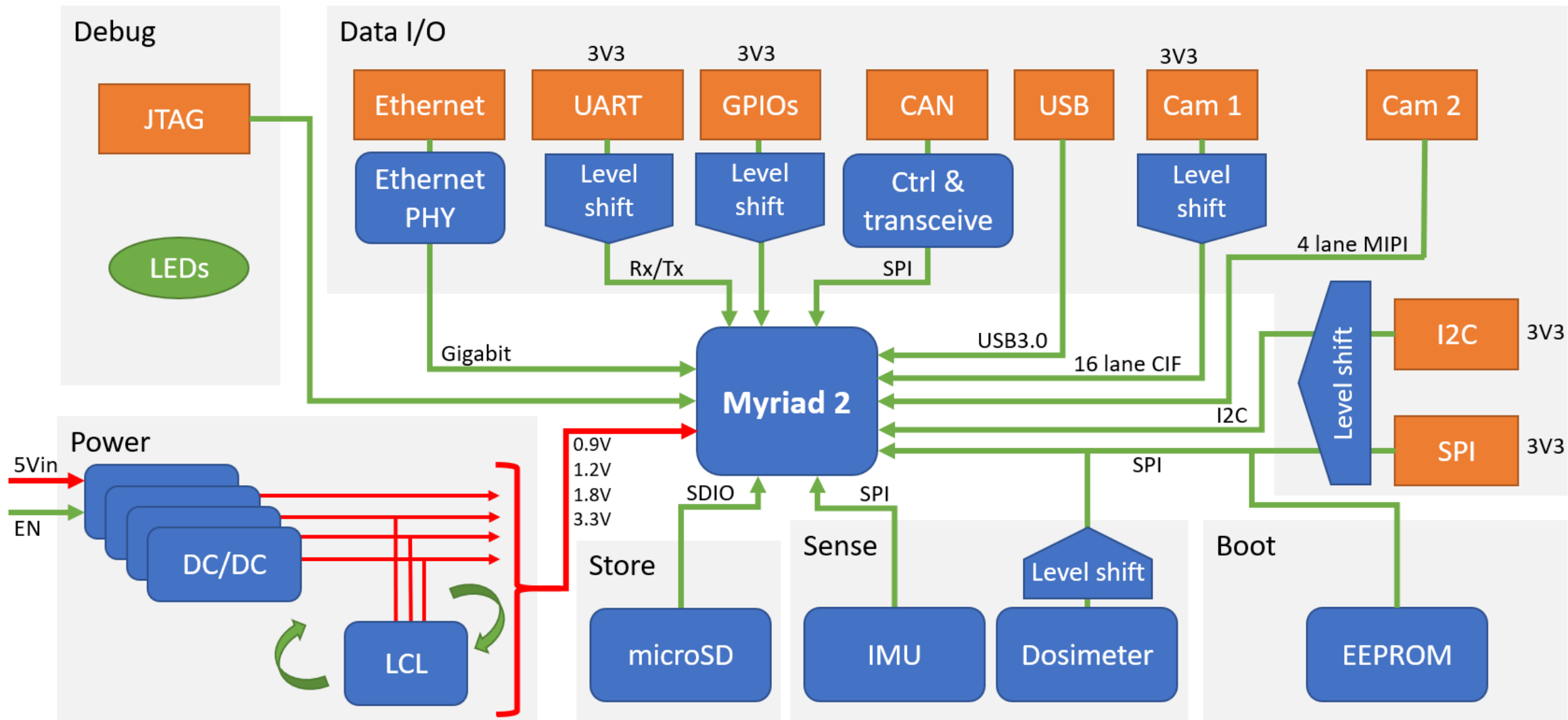


- COTS device
- Radiation characterisation
 - SEL, SEU, TID
- No critical sensitivity observed

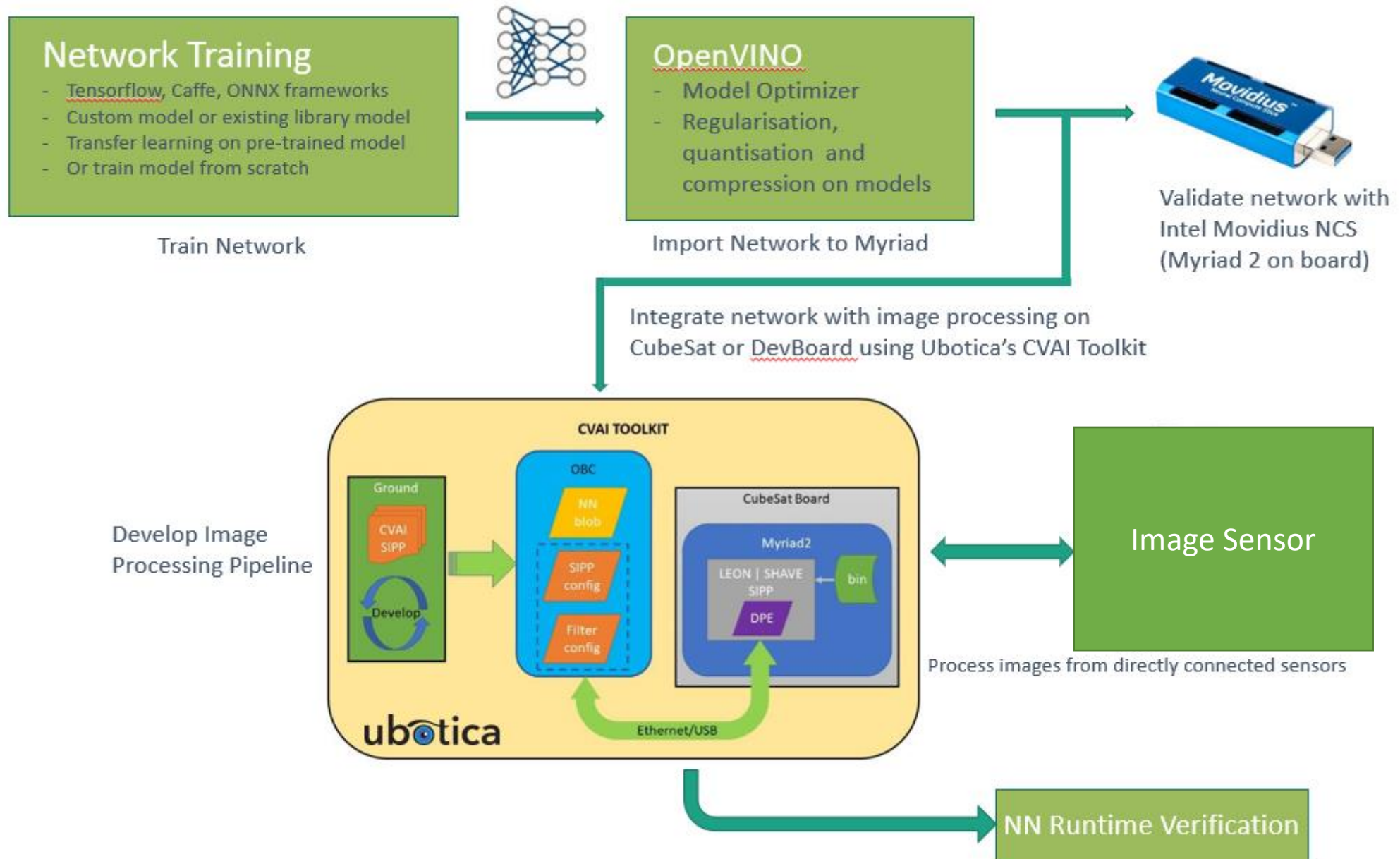


- Ubotica UB0100 AI & CV compute engine
 - Space design, parts heritage
 - Integrated latch-up protection
 - PC104 form factor (IoD spec.)
 - Gigabit Ethernet or USB2.0/3.0
 - Client – server paradigm
 - CAN for optional control
 - Peripheral sensors

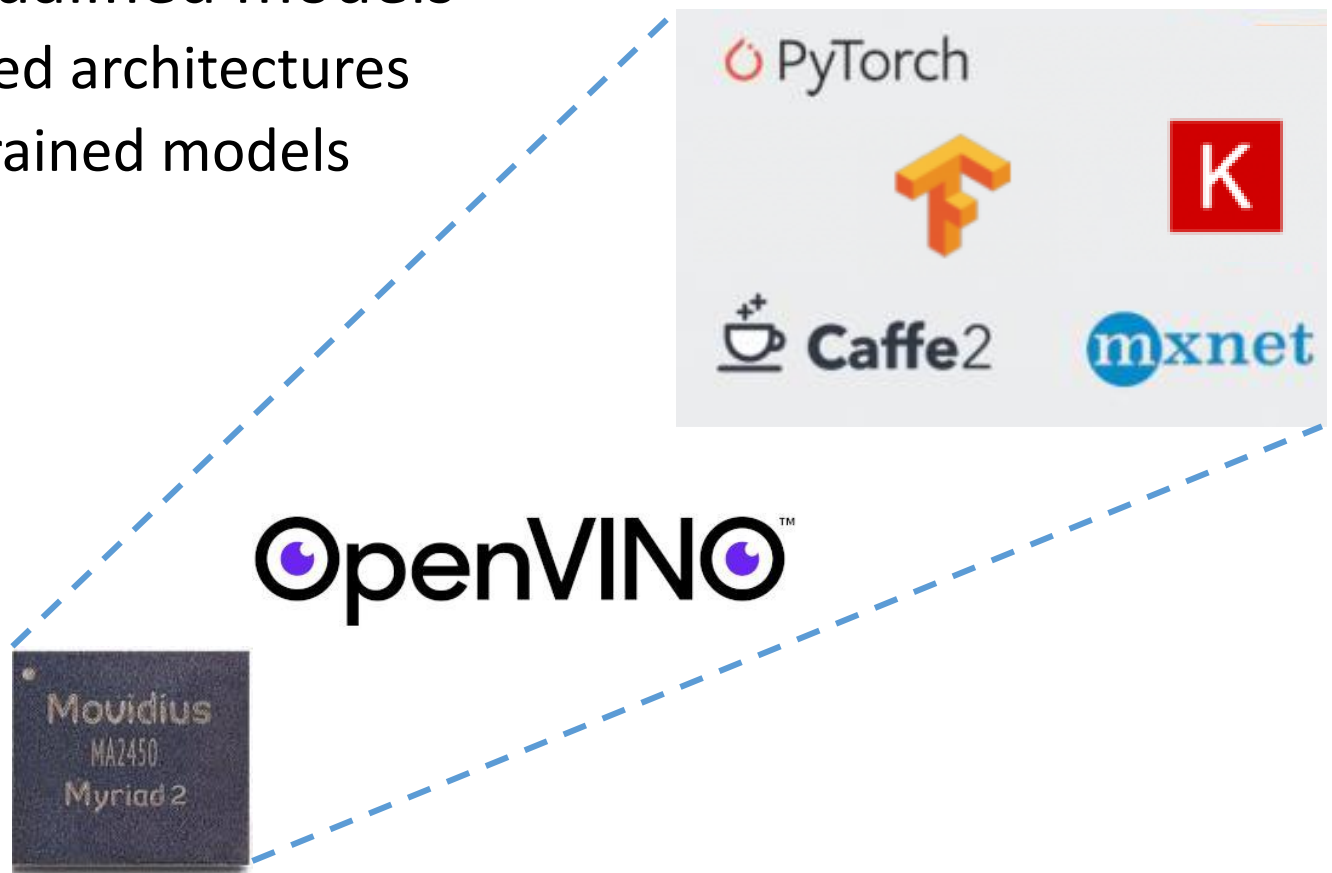




- Expose maximum functionality
 - Without the burden of embedded development
- Focus on deploying *solutions*
- Efficient embedded CV and ISP kernels
 - HW filters for common ISP functions
 - Library of optimised ISP and CV SW kernels executing in parallel on SHAVE vector processors
- *Image pre-processing* → *inference*



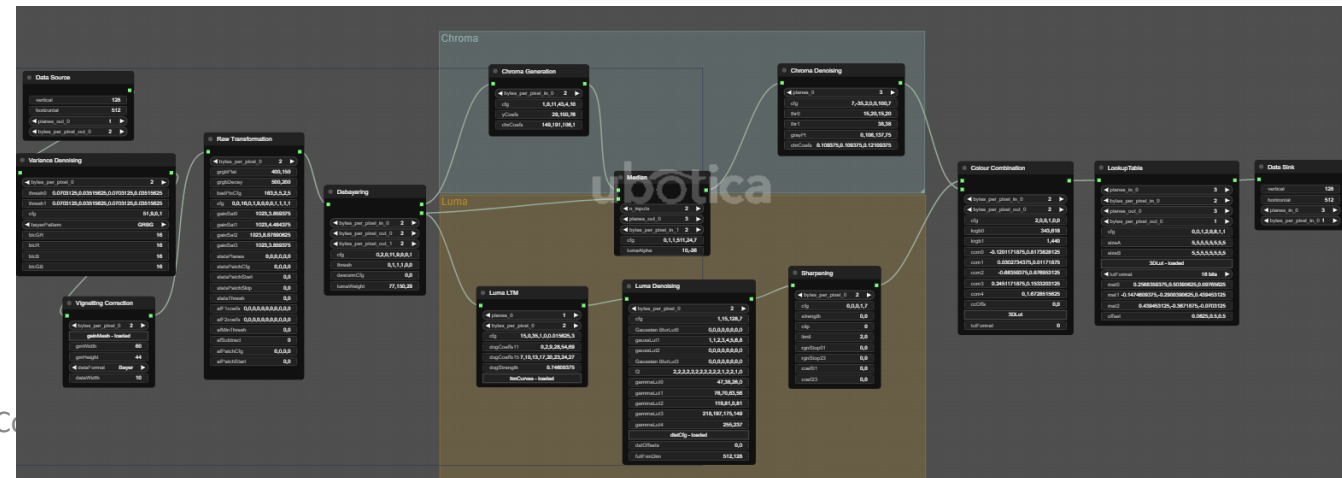
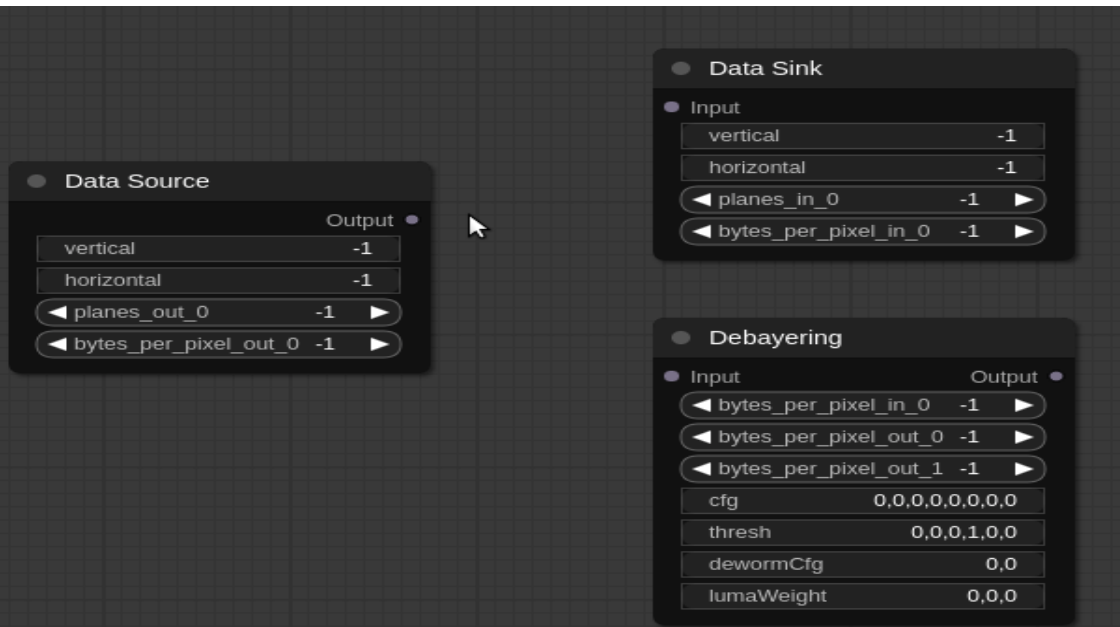
- Broad NN framework support
 - OpenVINO for model conversion and compilation
- Intel’s qualified models
 - Verified architectures
 - Pre-trained models



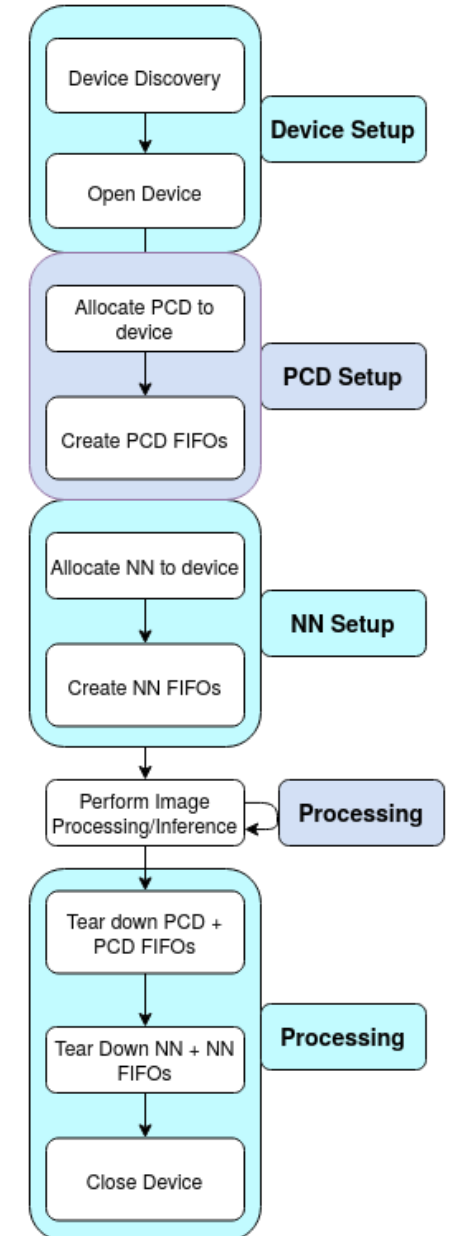
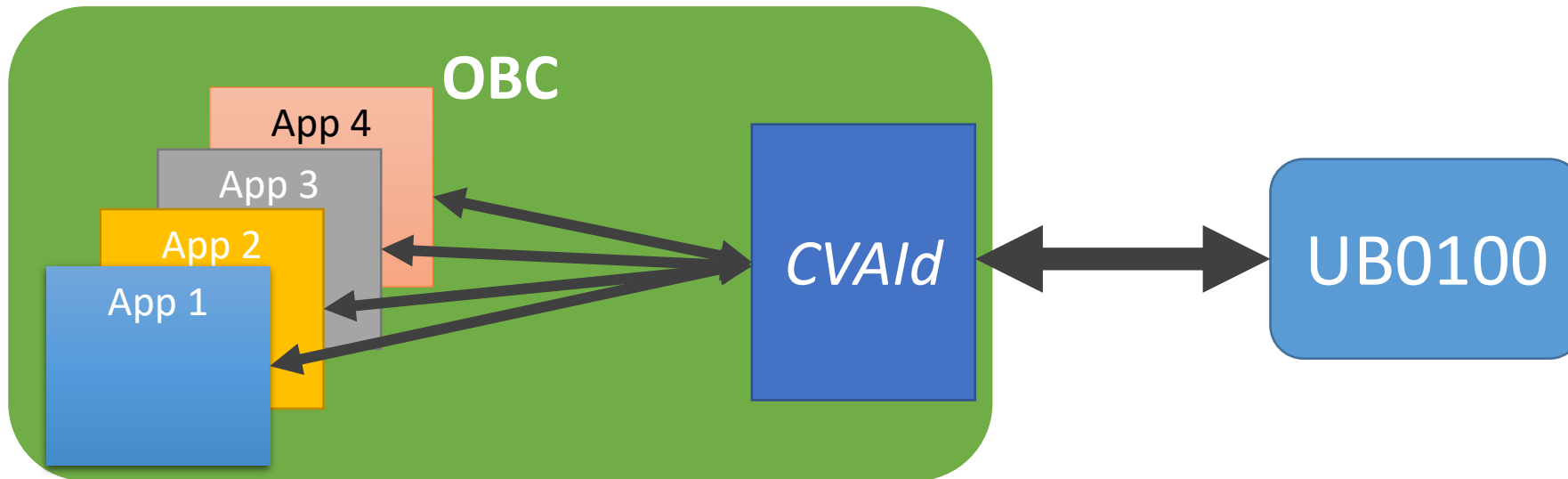
Network
Action recognition encode-decode
ResNet18v2
EfficientNet-b0
EfficientNet-b4
MobileNetv2
TDNN
AlexNet
Googlenet-v2
Inception-resnet-v2
ResNet-101
ResNet-50
Squeezenet1.1
VGG16
Googlenet-v1
Googlenet-v4
ResNet-152
TinyYOLO
VGG17

- Unlocks CV hardware blocks for solution dev.
- Drag-and-drop pipeline development tool
- Runtime reconfigurable
 - No firmware re-compilation required
 - No interruption to embedded application

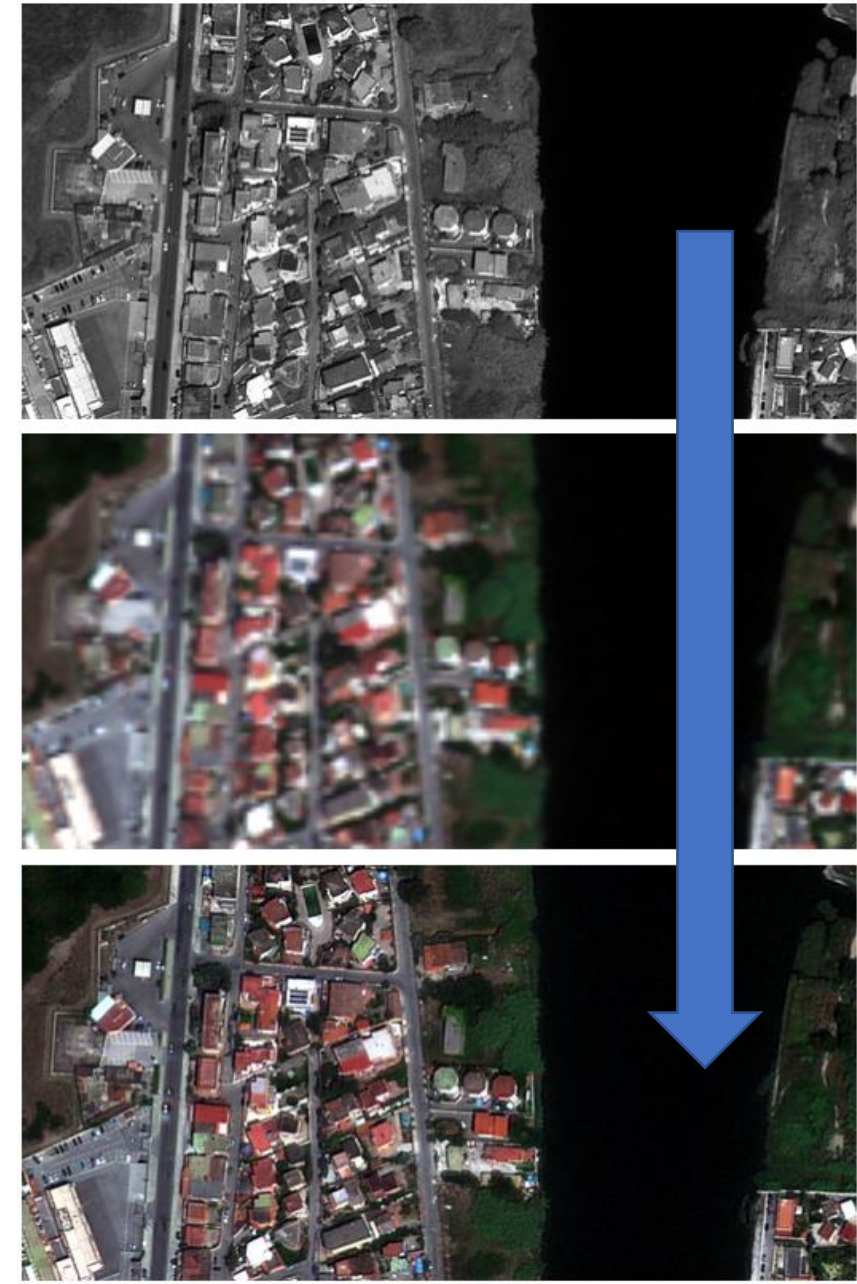
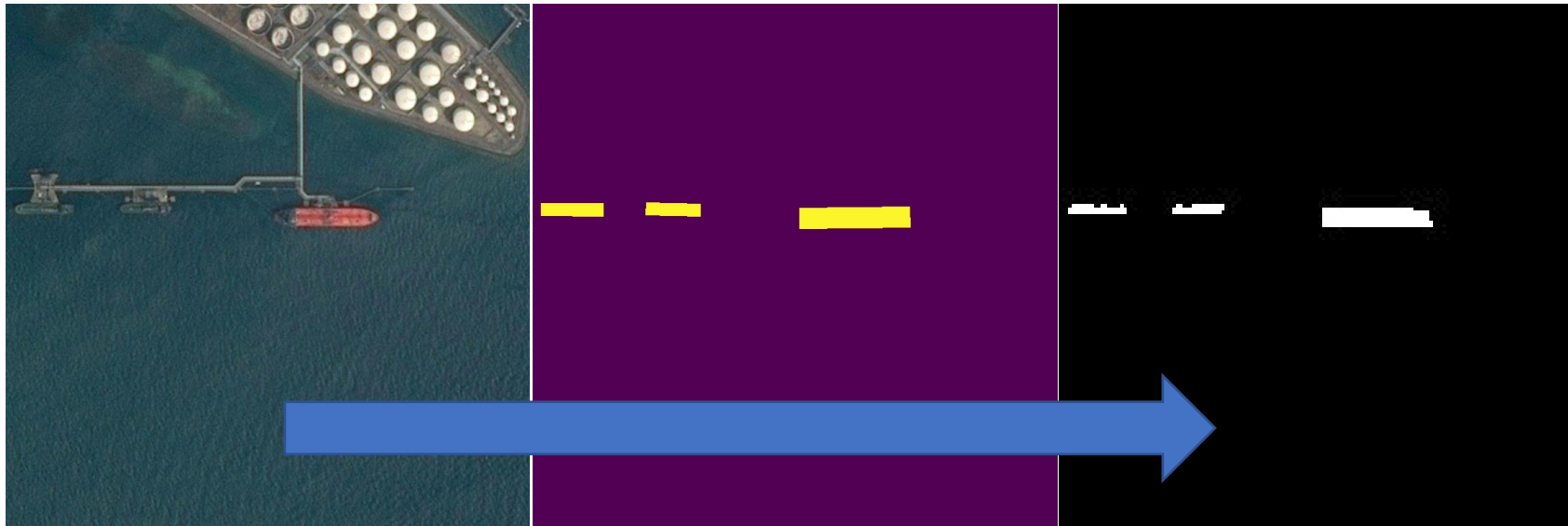
Hardware	Software
Variance Denoising	Add
Vignetting Correction	Subtract
Raw Transformation	Bilateral
Debayering	Bitwise operations
Luma LTM	Box filter
Luma Denoising	Census filter
Sharpening	Convolutions
Chrome Generation	Data type conversions
Median	Separable convolutions
Chroma Denoising	Colour type conversions
Colour Combination	Morphology operations
Lookup Table	Blur
Edge Detection	Homography
Convolution	Laplacian
Harris Corner	Min Max
Resize	Downsample
	...



- C++ API for application development
 - Housekeeping functions
- *CVAId* version that operates as a background service
 - Multiple applications running concurrently

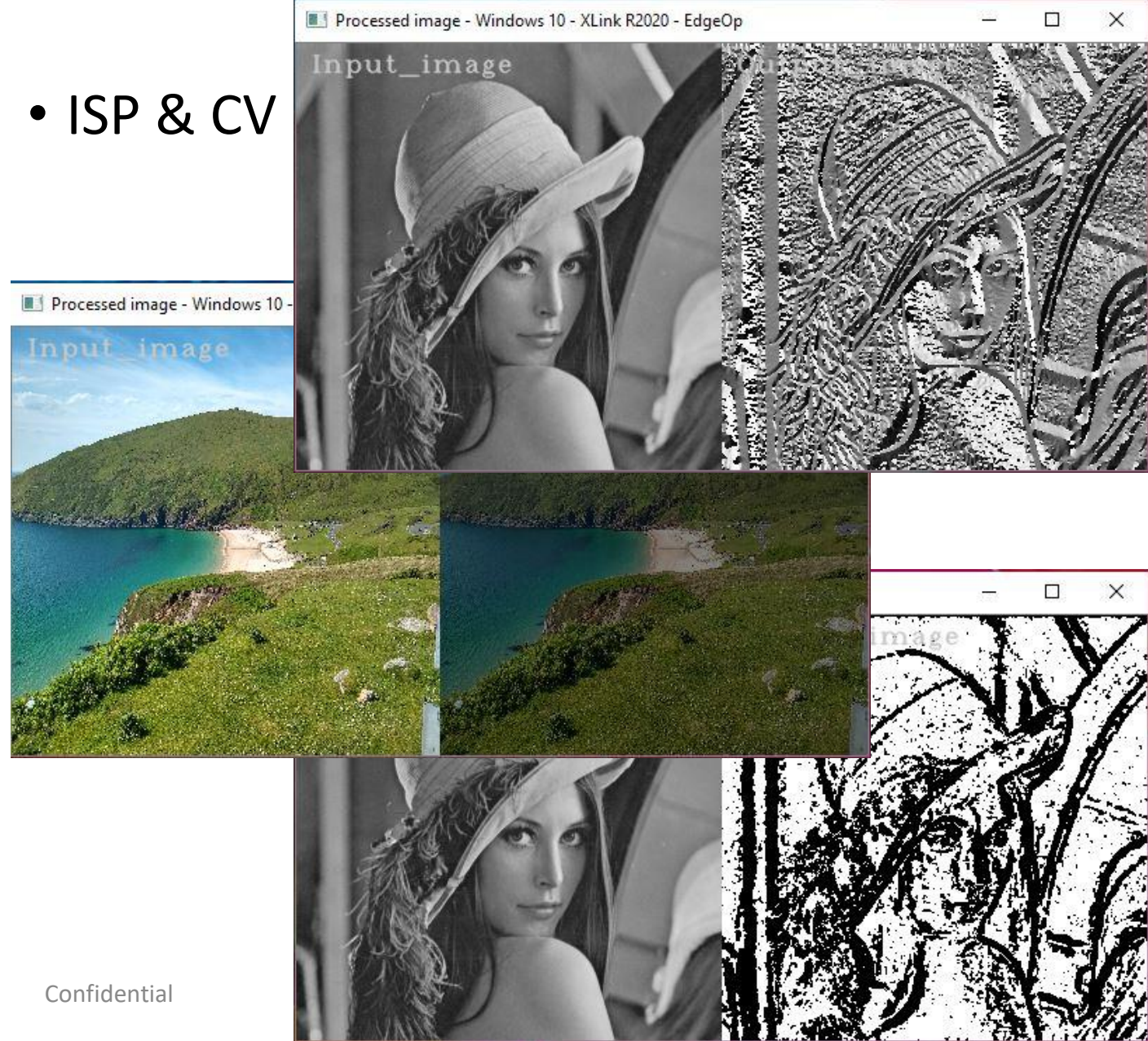


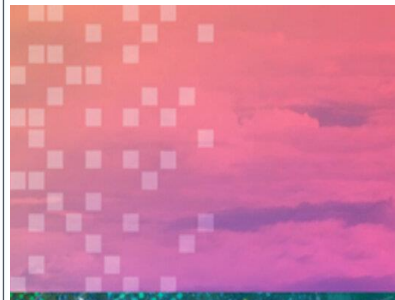
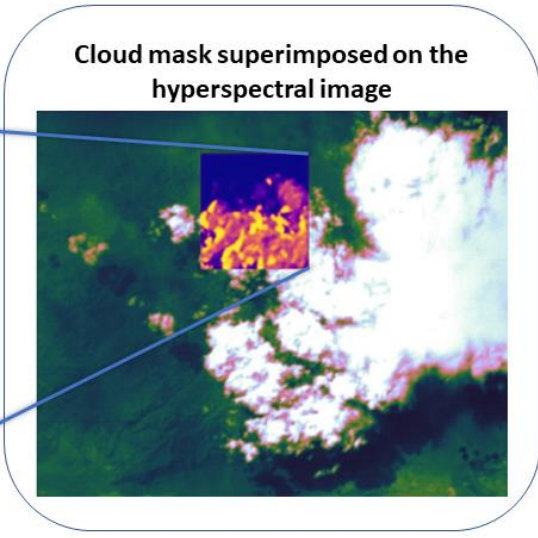
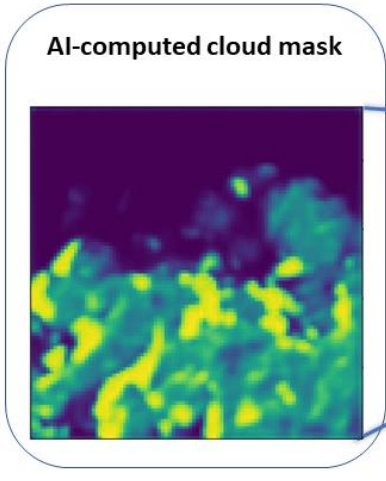
- Focus on EO
 - Ship detection
 - Pan-sharpening
 - Flare detection
 - Vehicle detection





- ISP & CV





mantis

Φ -sat-1

Φ -sat-2



- Enable users to develop and deploy AI & CV CubeSat applications
 - Utilise **hardware blocks** of Myriad 2 for efficient CV
 - **Reconfigurable** Image Signal Processing pipeline and **updatable** networks
 - Perform optimised **AI inference** with image pre-processing
 - **Runtime** interaction over Ethernet and USB

EM and FM variants

Thank You!

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