

# ComputeCore™

## FEATURES & BENEFITS

- SafeAI tools and framework that provides the building blocks to enable accelerated compute and visualization for autonomous systems using the Vulkan® SC API.
- Provides safety critical deterministic inferencing of neural network models for a broad array of compute and AI oriented deployments.
  - Compatible with the interoperable ONNX Network Exchange Format enabling portability between popular Neural Network open-source model training frameworks and the Khronos approved ecosystem
  - Broad array of safety critical accelerated Vulkan SC based inference engines enabling the deployment of desktop-based expression models
- Includes support for linear algebra and signal manipulation algorithms through the exposed BLAS and FFT compute interfaces.
  - Fundamental building blocks for computer vision and neural network deployments
  - Matrix manipulation in addition to image and signal enhancement capabilities
- Supporting a broad range of Machine Learning, Autonomous, Compute and Visualization use cases servicing Automotive ADAS & L4/L5 Autonomy, Medical, Aerospace & Defense, and Industrial Robotics application domains.
- Decoupled from hardware enabling cross platform portability and averting obsolescence overhead with the incumbent applications.
- Enables applications to interact with both native Vulkan SC graphics and compute pipelines resulting in a high-performance parallel processing capability with low latency, low complexity, and easy to maintain visualization and compute solution.
- Commercial Vulkan® build and execution option, facilitating off target (desktop) rapid / low-cost development.
- Provides a safety critical certifiable alternative and facilitates the transition to Vulkan SC based Compute from OpenCL™ /CUDA®.
- Designed from the ground up for real time and safety certification. Contains no open-source components and no 3<sup>rd</sup> party software.
- Available with CertCore™26262/61508 (ISO 26262 Accredited Safety Assessment Certificate) and CertCore™178 (DO-178C / ED12-C Avionics) ASIL D / DAL A safety certification package.

## INTRODUCTION

CoreAVI's ComputeCore™ is a suite of libraries that implement standard industry computational operations facilitating core building blocks for Safe AI, machine learning and autonomous systems using the Vulkan SC API. ComputeCore is offered in conjunction with CoreAVI's VkCore® SC Khronos conformant Vulkan SC graphics and compute foundation layer, allowing applications to benefit from the performance gains and scalable capabilities offered by Vulkan.

Three ComputeCore libraries are available that can be used independently or in conjunction to facilitate foundational computational operations and safe inferencing acceleration in a safety critical deterministic manner enabling the system integrator to focus on unique aspects of their application.

1. The BLAS Library (Basic Linear Algebra Subprograms) offers routines that provide standard building blocks for performing basic vector and matrix operations. Level 1 BLAS perform scalar, vector and vector-vector operations, Level 2 BLAS perform matrix-vector operations, and Level 3 BLAS perform matrix-matrix operations.
2. The FFT Library (Fast Fourier-Transform) supports 1D and 2D FFT algorithms, heavily leveraged for data intense signal and image processing use cases.
3. The NN Library (Neural Network) is based on the Khronos NNEF (Neural Network Exchange Format) specification and is design to import and inference trained networks from external open-source frameworks such as PyTorch, Caffe2, TensorFlow, Theano, MXNet, Chainer, etc. This facilitates the transfer of trained networks from their chosen training framework into a wide variety of Vulkan SC-based accelerated inference engines.

CoreAVI provides a rich complement of example applications and sample algorithms that can be deployed immediately, facilitating ease of integration and migration to Vulkan SC Compute from non-safety critical OpenCL or CUDA, saving development time and money.

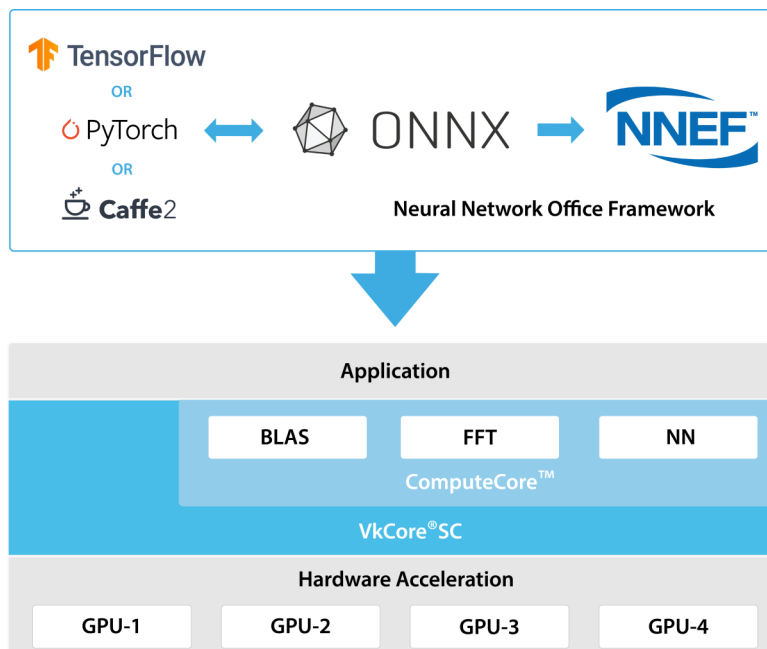


Figure 1: SafeAI Compute & Visualization Suite

## SUPPORT LIBRARIES

ComputeCore provides the following support libraries:

### *Fast Fourier Transform (FFT)*

- Implements common FFT operations on 1D, 2D, ND data
- Supports both real and complex data, as well as forward and inverse operation
- 4 to 10 times faster for 1D operations than the popular FFTW library

### *BLAS (Basic Linear Algebra Subprograms)*

- Implementation of commonly used mathematical operations
- Matrix and vector manipulations including matrix multiplication, transpose and inverse
- Support operations defined at [netlib.org/blas](http://netlib.org/blas)

### *NN (Neural Network)*

- NN Models represented and executed using the Khronos NNEF specification
- Compatible with the ONNX Network Exchange Format enabling portability between popular Neural Network open-source frameworks: PyTorch, Caffe2, TensorFlow, Theano, MXNet, Chainer, etc.
- Conversion from ONNX to NNEF using the Khronos approved ecosystem
- Offline neural network compilation enforcing determinism and lean execution
- Flexible development environment supporting NN Model intermixing between external created and online defined networks.
- Synchronous / Asynchronous NN Model execution in addition to runtime configurable network precision control

*Industry Use Cases*

The following table lists a broad range of Machine Learning, Autonomous, Compute and Visualization use cases servicing Automotive ADAS & L4/L5 Autonomy, Medical, Aerospace & Defense, and Industrial Robotics application domains.

Signal & Image Processing / Filtering	Degraded Vision	Computer Vision	Synthetic Display
Object Detection / Analysis & Tracking	Augmented Vision	Optical Flow Analysis	Neural Network Inferencing
Security Monitoring & Encryption	Object Edge Detection	Image Segmentation	Spatial Domain Image Filtering
Standard Deviation Filtering	Noise Removal	Blurring	Sensor Fusion

Contact [Sales@CoreAVI.com](mailto:Sales@CoreAVI.com) for more information on our SafeAI software suite and ComputeCore.