VkCore® SC

FEATURES AND BENEFITS

- VkCore SC is a safety critical driver based on the Vulkan® SC 1.0 API, designed and developed from the ground up for high performance, resource constrained devices, and safety critical certification (including RTCA DO-178C / EUROCAE ED-12C Level A, ISO 26262 ASIL D and IEC 61508 SIL3)

- Combines graphics and compute capabilities in a single API

- Ideal for multi-core applications - supports multicore partitions, hypervisor, and Guest OS configurations

- Includes HyperCore™ GPU virtualization manager

- Thinner, wider driver than OpenGL® for increased control enabling performance and flexibility

- Reduced CPU overhead

- Contains no open source and no 3rd party software

- Supports RTOS, including Wind River® VxWorks®, SYSGO® PikeOS™, QNX® OS, Green Hills® INTEGRITY®, DDC-I Deos™, Lynx Software Technologies LynxOS®, Automotive Grade Linux and configurable for proprietary RTOS and bare metal

- Supports plug-in drivers for video decode and encode, DecodeCore® and EncodeCore®

- Supports compositing using the vk_khr_display extension

- Supports VkCoreGL® SC1 (OpenGL SC 1.0.1), VkCoreGL® SC2 (OpenGL SC 2.0) and GPU safety monitor (TrueCore™) libraries

- Supports plug-in validation layer to help with development

- Available with CertCore™ 178 (Avionics DO-178C / ED-12C Level A, C and D) and CertCore™ 26262/61508 safety certification packages

INTRODUCTION

CoreAVI's VkCore SC is a safety critical driver based on the Vulkan SC 1.0 safety critical API from The Khronos Group to address safety critical graphics and compute requirements for multiple markets and applications including automotive, avionics, industrial and transportation platforms. Vulkan provides a new approach to graphics rendering, providing the application control over such features as memory and error management (refer to Figure 1). While Vulkan is a ground-up redesign of a graphics API for GPU acceleration, legacy applications are supported through OpenGL SC 1.0.1 and OpenGL SC 2.0 libraries running on top of Vulkan enabling applications to take advantage of both OpenGL and Vulkan simultaneously. This enables performance improvements and adds differentiated features to existing applications.

Hardware video encode and decode acceleration engines are supported with plug-in drivers to encode framebuffers as well as decode a video stream into a texture. Together these drivers enable video distribution, recording, and playback. CoreAVI also provides a built-in API to simplify capturing video data directly into textures to minimize latency. To ease initialization of any graphics/video hardware external to a GPU, CoreAVI includes a mechanism to perform initialization after basic GPU initialization and before the GPU is driving its display outputs.

Safety certification concerns such as detecting Hazardously Misleading Information and GPU over-utilization are also addressed with CoreAVI's TrueCore™ GPU software safety monitor application. For automotive and industrial applications, CertCore™ Safety Packages are available to support ISO 26262 ASIL D and IEC 61508 SIL3 that include Safety Manual, Failure Modes, Effects and Diagnostic Analysis (FMEDA) information. For avionics applications, safety certification kits are available to support DAL A, C and D. An optional validation layer is also available to check parameter inputs to the VkCore SC API for use during development and debug.

VkCore SC, and related drivers and libraries, are typically delivered as Off-The Shelf (OTS) standard products with customization services available.
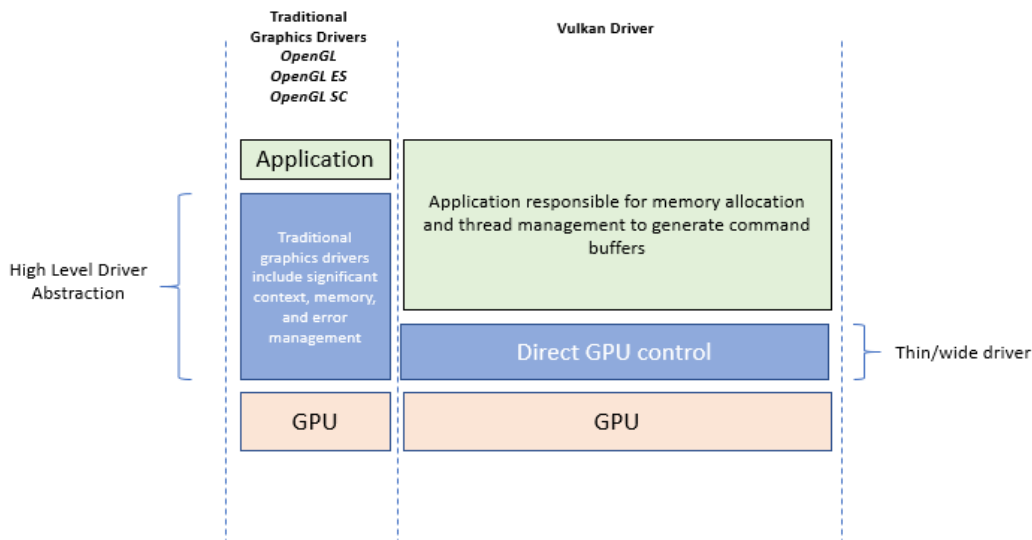

Figure 1: Vulkan Explicit GPU Control

INCLUDED FEATURES

VkCore SC is provided with a variety of features detailed below (see Figure 2).

Shader Programming

GPU shader programming and graphics compute is supported by an offline GLSL compiler which compiles the shader source programs into Vulkan pipeline objects used at runtime. Supported shaders include Vertex, Fragment, and Geometry.

Display Controller Driver

VkCore SC also includes an integrated display controller driver which enables the configuration of the display controller ports and other display controller function settings. A means to define a fully custom video mode by defining resolution and timing details is also provided. In addition, there is a mechanism to display a "splash screen" once the display controller is initialized.

GPU Virtualization Manager

VkCore SC includes a GPU virtualization manager to enable multiple graphics rendering partitions to drive single, or multiple, GPU(s). Specifically, VkCore SC supports a Multi-Threaded Multi Partition (MTMP) architecture providing support for single-threaded or multi-threaded applications in the same or different address spaces as well as sharing of a single GPU by applications residing in different Guest OSs .
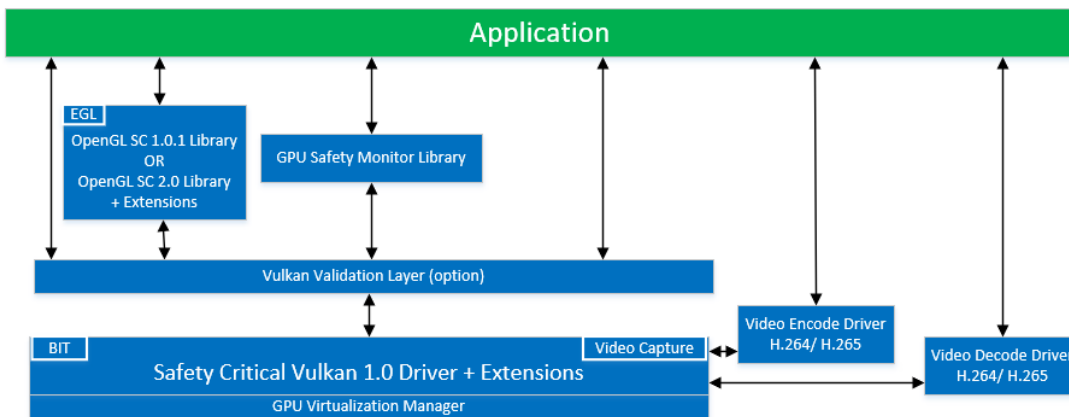

Figure 2: Vulkan Graphics and Compute

Security

Security features of VkCore SC complement the GPU Virtualization Manager enablement by adding full boundary protection on memory assigned to each partition such that each partition only has access to their assigned resources through the utilization of virtual memory management hardware as supported on the target GPU hardware.

Security provides a high level of Information Assurance (IA) for systems managing confidential and classified information alongside unclassified data rendering to one or more displays through a GPU.

Support for Mixed Criticality Safety Levels

The combination of VkCore SC and TrueCore enables a CoreAVI monitor to detect GPU overutilization and to address the concern with graphics or compute applications with different levels of safety sharing a non-pre-emptive GPU. This means that with appropriate system design, applications can fully utilize GPU hardware acceleration of both graphics and compute capabilities in a system with mixed criticality requirements and meet safety requirements/goals.

Video Capture Support

VkCore SC includes CoreAVI's DecodeCore™ to enable low latency video capture from an external source. DecodeCore includes a mechanism to interface with external Direct Memory Access (DMA) engine(s) to directly transfer video data directly into the GPU memory to provide a low latency video capture solution. The captured video is encapsulated inside a VkImage object and is treated as a read-only texture from the GPU's point of view. Contact CoreAVI for an Interface Requirements document describing requirements for the DMA engine and associated driver software for the video capture hardware.

Built-In-Test

VkCore SC contains a common API to run included Built-In-Tests (BIT) for the GPU. The BIT tests cover basic GPU functionality. All BIT can be run as Initiated BIT (IBIT) and those that can be run as continuous BIT (CBIT) are identified.

Sample Software

There is sample software demonstrating the use of the CoreAVI video capture assist API and custom hardware initialization sequencing with GPU initialization, providing a reference for your custom video hardware driver.

Extensions

Supported extensions include VK_KHR_surface, VK_KHR_swapchain, VK_KHR_display and VK_KHR_maintenance1.

SUPPORTED GRAPHICS PROCESSORS

VkCore SC supports an extensive range of discrete GPUs and SoCs from multiple vendors including AMD's Embedded Radeon™ E9171 GPU, NXP's i.MX 8 SoC featuring dual Vivante GC7000XSVX GPUs, Arm-based SoCs incorporating the Mali-G78AE GPU and the Intel 11th Generation CPU i7-1185GREC-RT and i71186GREC-RT (formerly Tiger Lake). CoreAVI provides temperature screened versions of the AMD GPU and Intel i7-1186GREC-RT for applications required to operate across extreme thermal ranges. CoreAVI's R&D and certification teams are continuously evaluating all GPUs and SoCs available on the market and continue to add new device support to its growing list of supported platforms.

SUPPORTED CONFIGURATION

VkCore SC is available for the generic Power Architecture, Arm or x86 instruction set architectures supporting 64-bit operation and hardware floating point in a Symmetric Multi-Processing environment, and is built using the RTOS vendor qualified compiler.

CERTIFICATION DATA

CoreAVI provides complete DO-178C/ED-12C certification data packages called CertCore 178, which support the use of VkCore SC graphics drivers in any FAA DO-178C / EASA ED-12C avionics safety certification. CertCore 178 can be licensed for DAL A, C or D and used to meet program requirements while managing costs. The DAL D evidence kit is ideal for programs with requirements to show safety certifiability.

For automotive and industrial applications, CoreAVI also provides CertCore 26262/61508 to support automotive and industrial certifiable designs.

USER INTEGRATION MANUAL (SAFETY MANUAL)

In addition to a User Manual and Porting Guide, a User Integration Manual is also available to describe usage, assumptions and issues to put VkCore SC into context. The User Integration Manual describes requirements to be considered by the application developer, such as:

- Potential safety requirement fulfilled by VkCore SC

- How VkCore SC must be configured and integrated

- Any post-integration testing of VkCore SC

- Any known safety impacting issues with VkCore SC

Requirements Transfer

VkCore SC is developed as a Safety Element out of Context (SEooC)/Compliant Item. This is an industry standard approach to developing safety elements where the end application is unknown. CoreAVI has made assumptions based on market data that are captured within the Safety Manual. CoreAVI is willing to discuss acceptance of new customer safety requirements for future designs. Please contact CoreAVI Sales for further information.

Availability of Safety Documentation

The following table lists the safety documentation for the library:

DELIVERABLE	CONTENTS	AVAILABILITY	DELIVERY
Safety Manual	Documents usage, assumptions, issues, etc. of SEooC to put the SEooC into a safety context (application)	NDA Material	TBD

Support

CoreAVI provides integration, performance optimization, and design consulting services.

External Product Audits

CoreAVI works with industry accredited independent authorities for assessment and certification of products.