OpenCL API 1.2 Reference Card - Page 1

OpenCL (Open Computing Language) is a multi-vendor open standard for general-purpose parallel programming of heterogeneous systems that include CPUs, GPUs, and other processors. OpenCL provides a uniform programming environment for software developers to write efficient, portable code for high-performance compute servers, desktop computer systems, and handheld devices.

[n.n.n] refers to the section in the OpenCL Specification.
[n.n.n] refers to the section in the OpenCL Extension Specification
Text shown in purple is as per the OpenCL Extension Specification.

Specifications are available at www.khronos.org/opencl.

The OpenCL Runtime

Command Queues [5.1]

cl_command_queue **clCreateCommandQueue** (
cl_context *context*, cl_device_id *device*,
cl_command_queue_properties *properties*,
cl_int **errcode_ret*)

properties: CL_QUEUE_PROFILING_ENABLE,
CL_QUEUE_OUT_OF_ORDER_EXEC_MODE_ENABLE

cl_int **clRetainCommandQueue** (
cl_command_queue *command_queue*)

cl_int **clReleaseCommandQueue** (
cl_command_queue *command_queue*)

cl_int **clGetCommandQueueInfo** (
cl_command_queue *command_queue*,
cl_command_queue_info *param_name*,
size_t *param_value_size*,
void **param_value*,
size_t **param_value_size_ret*)

param_name: CL_QUEUE_CONTEXT,
CL_QUEUE_DEVICE,
CL_QUEUE_REFERENCE_COUNT,
CL_QUEUE_PROPERTIES

The OpenCL Platform Layer

The OpenCL platform layer implements platform-specific features that allow applications to query OpenCL devices, device configuration information, and to create OpenCL contexts using one or more devices.

Querying Platform Info and Devices [4.1, 4.2]

cl_int **clGetPlatformIDs** (cl_uint *num_entries*,
cl_platform_id **platforms*, cl_uint **num_platforms*)

cl_int **clGetPlatformInfo** (cl_platform_id *platform*,
cl_platform_info *param_name*,
size_t *param_value_size*, void **param_value*,
size_t **param_value_size_ret*)

param_name: CL_PLATFORM_{PROFILE, VERSION},
CL_PLATFORM_{NAME, VENDOR, EXTENSIONS}

cl_int **clGetDeviceIDs** (cl_platform_id *platform*,
cl_device_type *device_type*, cl_uint *num_entries*,
cl_device_id **devices*, cl_uint **num_devices*)

device_type: CL_DEVICE_TYPE_{ACCELERATOR, ALL, CPU},
CL_DEVICE_TYPE_{CUSTOM, DEFAULT, GPU}

cl_int **clGetDeviceInfo** (cl_device_id *device*,
cl_device_info *param_name*, size_t *param_value_size*,
void **param_value*, size_t **param_value_size_ret*)

param_name:
CL_DEVICE_{NAME, VENDOR, PROFILE, TYPE},
CL_DEVICE_NATIVE_VECTOR_WIDTH_{CHAR, INT},
CL_DEVICE_NATIVE_VECTOR_WIDTH_{LONG, SHORT},
CL_DEVICE_NATIVE_VECTOR_WIDTH_{DOUBLE, HALF},
CL_DEVICE_NATIVE_VECTOR_WIDTH_FLOAT,
CL_DEVICE_PREFERRED_VECTOR_WIDTH_{CHAR, INT},
CL_DEVICE_PREFERRED_VECTOR_WIDTH_{LONG, SHORT},
CL_DEVICE_PREFERRED_VECTOR_WIDTH_{DOUBLE, HALF},
CL_DEVICE_PREFERRED_VECTOR_WIDTH_FLOAT,
CL_DEVICE_PREFERRED_INTEROP_USER_SYNC,
CL_DEVICE_ADDRESS_BITS, CL_DEVICE_AVAILABLE,
CL_DEVICE_BUILT_IN_KERNELS,
CL_DEVICE_COMPILER_AVAILABLE,
CL_DEVICE_{DOUBLE, HALF, SINGLE}_FP_CONFIG,
CL_DEVICE_ENDIAN_LITTLE, CL_DEVICE_EXTENSIONS,
CL_DEVICE_ERROR_CORRECTION_SUPPORT,
CL_DEVICE_EXECUTION_CAPABILITIES,
CL_DEVICE_GLOBAL_MEM_CACHE_{SIZE, TYPE},
CL_DEVICE_GLOBAL_MEM_{CACHELINE_SIZE, SIZE},
CL_DEVICE_HOST_UNIFIED_MEMORY,
CL_DEVICE_IMAGE_MAX_{ARRAY, BUFFER}_SIZE,
CL_DEVICE_IMAGE_SUPPORT,
CL_DEVICE_IMAGE2D_MAX_{WIDTH, HEIGHT},
CL_DEVICE_IMAGE3D_MAX_{WIDTH, HEIGHT, DEPTH},
CL_DEVICE_LOCAL_MEM_{TYPE, SIZE},
CL_DEVICE_MAX_{READ, WRITE}_IMAGE_ARGS,
CL_DEVICE_MAX_CLOCK_FREQUENCY,
CL_DEVICE_MAX_COMPUTE_UNITS,
CL_DEVICE_MAX_CONSTANT_{ARGS,BUFFER_SIZE},
CL_DEVICE_MAX_{MEM_ALLOC, PARAMETER}_SIZE,
CL_DEVICE_MAX_SAMPLERS,
CL_DEVICE_MAX_WORK_GROUP_SIZE,
CL_DEVICE_MAX_WORK_ITEM_{DIMENSIONS, SIZES},
CL_DEVICE_MEM_BASE_ADDR_ALIGN,
CL_DEVICE_OPENCL_C_VERSION, CL_DEVICE_PARENT_DEVICE,
CL_DEVICE_PARTITION_AFFINITY_DOMAIN,
CL_DEVICE_PARTITION_MAX_SUB_DEVICES,
CL_DEVICE_PARTITION_{PROPERTIES, TYPE},
CL_DEVICE_PLATFORM, CL_DEVICE_PRINTF_BUFFER_SIZE,
CL_DEVICE_PROFILING_TIMER_RESOLUTION,
CL_DEVICE_QUEUE_PROPERTIES,
CL_DEVICE_REFERENCE_COUNT,
CL_DEVICE_VENDOR_ID, CL_{DEVICE, DRIVER}_VERSION

Partitioning a Device [4.3]

cl_int **clCreateSubDevices** (cl_device_id *in_device*,
const cl_device_partition_property **properties*,
cl_uint *num_devices*, cl_device_id **out_devices*,
cl_uint **num_devices_ret*)

properties: CL_DEVICE_PARTITION_EQUALLY,
CL_DEVICE_PARTITION_BY_{COUNTS, AFFINITY_DOMAIN}
(Affinity domains may be:
CL_DEVICE_AFFINITY_DOMAIN_NUMA,
CL_DEVICE_AFFINITY_DOMAIN_{L4, L3, L2, L1}_CACHE,
CL_DEVICE_AFFINITY_DOMAIN_NEXT_PARTITIONABLE)

cl_int **clRetainDevice** (cl_device_id *device*)

cl_int **clReleaseDevice** (cl_device_id *device*)

Contexts [4.4]

cl_context **clCreateContext** (
const cl_context_properties **properties*,
cl_uint *num_devices*, const cl_device_id **devices*,
void (CL_CALLBACK**pfn_notify*)
(const char **errinfo*, const void **private_info*,
size_t *cb*, void **user_data*),
void **user_data*, cl_int **errcode_ret*)

properties: NULL or CL_CONTEXT_PLATFORM,
CL_CONTEXT_INTEROP_USER_SYNC,
CL_CONTEXT_{D3D10, D3D11}_DEVICE_KHR,
CL_CONTEXT_ADAPTER_{D3D9, D3D9EX, DXVA}_KHR,
CL_GL_CONTEXT_KHR, CL_CGL_SHAREGROUP_KHR,
CL_{EGL, GLX}_DISPLAY_KHR, CL_WGL_HDC_KHR

cl_context **clCreateContextFromType** (
const cl_context_properties **properties*,
cl_device_type *device_type*,
void (CL_CALLBACK **pfn_notify*)
(const char **errinfo*, const void **private_info*,
size_t *cb*, void **user_data*),
void **user_data*, cl_int **errcode_ret*)

properties: See **clCreateContext**

cl_int **clRetainContext** (cl_context *context*)

cl_int **clReleaseContext** (cl_context *context*)

cl_int **clGetContextInfo** (cl_context *context*,
cl_context_info *param_name*, size_t *param_value_size*,
void **param_value*, size_t **param_value_size_ret*)

param_name: CL_CONTEXT_REFERENCE_COUNT,
CL_CONTEXT_{DEVICES, NUM_DEVICES, PROPERTIES},
CL_CONTEXT_D3D10_PREFER_SHARED_RESOURCES_KHR,
CL_CONTEXT_D3D11_PREFER_SHARED_RESOURCES_KHR

Get CL Extension Function Pointers [9.2]

void* **clGetExtensionFunctionAddressForPlatform** (
cl_platform_id *platform*, const char **funcname*)

Buffer Objects

Elements of a buffer object are stored sequentially and accessed using a pointer by a kernel executing on a device. Data is stored in the same format as it is accessed by the kernel.

Create Buffer Objects [5.2.1]

cl_mem **clCreateBuffer** (cl_context *context*,
cl_mem_flags *flags*, size_t *size*, void **host_ptr*,
cl_int **errcode_ret*)

flags: CL_MEM_READ_WRITE,
CL_MEM_{WRITE, READ}_ONLY,
CL_MEM_HOST_NO_ACCESS,
CL_MEM_HOST_{READ, WRITE}_ONLY,
CL_MEM_{USE, ALLOC, COPY}_HOST_PTR

cl_mem **clCreateSubBuffer** (cl_mem *buffer*,
cl_mem_flags *flags*,
cl_buffer_create_type *buffer_create_type*,
const void **buffer_create_info*, cl_int **errcode_ret*)

flags: same as for **clCreateBuffer**

buffer_create_type: CL_BUFFER_CREATE_TYPE_REGION

Read, Write, Copy Buffer Objects [5.2.2]

cl_int **clEnqueueReadBuffer** (
cl_command_queue *command_queue*, cl_mem *buffer*,
cl_bool *blocking_read*, size_t *offset*, size_t *size*,
void **ptr*, cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueReadBufferRect** (
cl_command_queue *command_queue*, cl_mem *buffer*,
cl_bool *blocking_read*, const size_t **buffer_origin*,
const size_t **host_origin*, const size_t **region*,
size_t *buffer_row_pitch*, size_t *buffer_slice_pitch*,
size_t *host_row_pitch*, size_t *host_slice_pitch*,
void **ptr*, cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueWriteBuffer** (
cl_command_queue *command_queue*, cl_mem *buffer*,
cl_bool *blocking_write*, size_t *offset*, size_t *size*,
const void **ptr*, cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueWriteBufferRect** (
cl_command_queue *command_queue*,
cl_mem *buffer*, cl_bool *blocking_write*,
const size_t **buffer_origin*, const size_t **host_origin*,
const size_t **region*, size_t *buffer_row_pitch*,
size_t *buffer_slice_pitch*, size_t *host_row_pitch*,
size_t *host_slice_pitch*, const void **ptr*,
cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueFillBuffer** (
cl_command_queue *command_queue*,
cl_mem *buffer*, const void **pattern*,
size_t *pattern_size*, size_t *offset*, size_t *size*,
cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueCopyBuffer** (
cl_command_queue *command_queue*,
cl_mem *src_buffer*, cl_mem *dst_buffer*,
size_t *src_offset*, size_t *dst_offset*, size_t *size*,
cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

cl_int **clEnqueueCopyBufferRect** (
cl_command_queue *command_queue*,
cl_mem *src_buffer*, cl_mem *dst_buffer*,
const size_t **src_origin*, const size_t **dst_origin*,
const size_t **region*, size_t *src_row_pitch*,
size_t *src_slice_pitch*, size_t *dst_row_pitch*,
size_t *dst_slice_pitch*, cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

Map Buffer Objects [5.2.3]

void * **clEnqueueMapBuffer** (
cl_command_queue *command_queue*, cl_mem *buffer*,
cl_bool *blocking_map*, cl_map_flags *map_flags*,
size_t *offset*, size_t *size*, cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*,
cl_int **errcode_ret*)

map_flags: CL_MAP_{READ, WRITE},
CL_MAP_WRITE_INVALIDATE_REGION

Memory Objects [5.4.1, 5.4.2]

cl_int **clRetainMemObject** (cl_mem *memobj*)

cl_int **clReleaseMemObject** (cl_mem *memobj*)

cl_int **clSetMemObjectDestructorCallback** (
cl_mem *memobj*, void (CL_CALLBACK **pfn_notify*)
(cl_mem *memobj*, void **user_data*),
void **user_data*)

cl_int **clEnqueueUnmapMemObject** (
cl_command_queue *command_queue*,
cl_mem *memobj*, void **mapped_ptr*,
cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

Migrate Memory Objects [5.4.4]

cl_int **clEnqueueMigrateMemObjects** (
cl_command_queue *command_queue*,
cl_uint *num_mem_objects*,
const cl_mem **mem_objects*,
cl_mem_migration_flags *flags*,
cl_uint *num_events_in_wait_list*,
const cl_event **event_wait_list*, cl_event **event*)

flags: CL_MIGRATE_MEM_OBJECT_HOST,
CL_MIGRATE_MEM_OBJECT_CONTENT_UNDEFINED

Query Memory Object [5.4.5]

cl_int **clGetMemObjectInfo** (cl_mem *memobj*,
cl_mem_info *param_name*, size_t *param_value_size*,
void **param_value*, size_t **param_value_size_ret*)

param_name: CL_MEM_{TYPE, FLAGS, SIZE, HOST_PTR},
CL_MEM_{MAP, REFERENCE}_COUNT, CL_MEM_OFFSET,
CL_MEM_CONTEXT, CL_MEM_ASSOCIATED_MEMOBJECT,
CL_MEM_{D3D10, D3D11}_RESOURCE_KHR,
CL_MEM_DX9_MEDIA_ADAPTER_TYPE_KHR,
CL_MEM_DX9_MEDIA_SURFACE_INFO_KHR

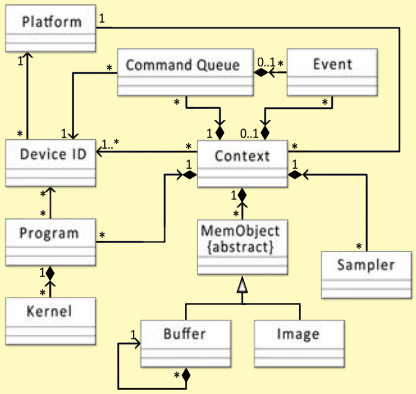
OpenCL Class Diagram [2.1]

The figure below describes the OpenCL specification as a class diagram using the Unified Modeling Language[1] (UML) notation. The diagram shows both nodes and edges which are classes and their relationships. As a simplification it shows only classes, and no attributes or operations.

Annotations

Relationships	
abstract classes	{abstract}
aggregations	♦
inheritance	△
relationship navigability	^

Cardinality	
many	*
one and only one	1
optionally one	0..1
one or more	1..*



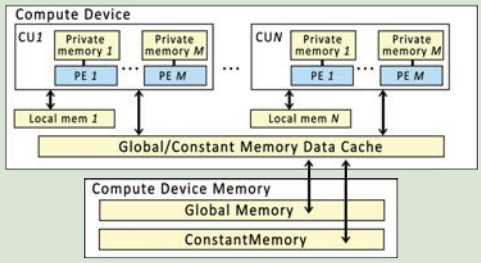
[1] Unified Modeling Language (http://www.uml.org/) is a trademark of Object Management Group (OMG).

OpenCL Device Architecture Diagram [3.3]

The table below shows memory regions with allocation and memory access capabilities.

	Global	Constant	Local	Private
Host	Dynamic allocation Read/Write access	Dynamic allocation Read/Write access	Dynamic allocation No access	No allocation No access
Kernel	No allocation Read/Write access	Static allocation Read-only access	Static allocation Read/Write access	Static allocation Read/Write access

This conceptual OpenCL device architecture diagram shows processing elements (PE), compute units (CU), and devices. The host is not shown.



Program Objects

Create Program Objects [5.6.1]

cl_program **clCreateProgramWithSource** (
cl_context *context*, cl_uint *count*, const char **_strings_,
const size_t *_lengths_, cl_int *_errcode_ret_)

cl_program **clCreateProgramWithBinary** (
cl_context *context*, cl_uint *num_devices*,
const cl_device_id *_device_list_, const size_t *_lengths_,
const unsigned char **_binaries_, cl_int *_binary_status_,
cl_int *_errcode_ret_)

cl_program **clCreateProgramWithBuiltInKernels** (
cl_context *context*, cl_uint *num_devices*,
const cl_device_id *_device_list_,
const char *_kernel_names_, cl_int *_errcode_ret_)

cl_int **clRetainProgram** (cl_program *program*)

cl_int **clReleaseProgram** (cl_program *program*)

Building Program Executables [5.6.2]

cl_int **clBuildProgram** (cl_program *program*,
cl_uint *num_devices*, const cl_device_id *_device_list_,
const char *_options_, void (CL_CALLBACK*_pfn_notify_)
(cl_program *program*, void *_user_data_),
void *_user_data_)

Separate Compilation and Linking [5.6.3]

cl_int **clCompileProgram** (cl_program *program*,
cl_uint *num_devices*, const cl_device_id *_device_list_,
const char *_options_, cl_uint *num_input_headers*,
const cl_program *_input_headers_,
const char **_header_include_names_,
void (CL_CALLBACK*_pfn_notify_)
(cl_program *program*, void *_user_data_),
void *_user_data_)

cl_program **clLinkProgram** (cl_context *context*,
cl_uint *num_devices*, const cl_device_id *_device_list_,
const char *_options_, cl_uint *num_input_programs*,
const cl_program *_input_programs_,
void (CL_CALLBACK*_pfn_notify_)
(cl_program *program*, void *_user_data_),
void *_user_data_, cl_int *_errcode_ret_)

Unload the OpenCL Compiler [5.6.6]

cl_int **clUnloadPlatformCompiler** (
cl_platform_id *platform*)

Query Program Objects [5.6.7]

cl_int **clGetProgramInfo** (cl_program *program*,
cl_program_info *param_name*, size_t *param_value_size*,
void *_param_value_, size_t *_param_value_size_ret_)

param_name: CL_PROGRAM_REFERENCE_COUNT,
CL_PROGRAM_{CONTEXT, NUM_DEVICES, DEVICES},
CL_PROGRAM_{SOURCE, BINARY_SIZES, BINARIES},
CL_PROGRAM_{NUM_KERNELS, KERNEL_NAMES}

cl_int **clGetProgramBuildInfo** (
cl_program *program*, cl_device_id *device*,
cl_program_build_info *param_name*,
size_t *param_value_size*, void *_param_value_,
size_t *_param_value_size_ret_)

param_name: CL_PROGRAM_BINARY_TYPE,
CL_PROGRAM_BUILD_{STATUS, OPTIONS, LOG}

Compiler Options [5.6.4]

Preprocessor: *(-D processed in order listed in **clBuildProgram** or **clCompileProgram**)*
-D *name* -D *name=definition* -I dir

Math intrinsics:
-cl-single-precision-constant -cl-denorms-are-zero
-cl-fp32-correctly-rounded-divide-sqrt

Optimization options:
-cl-opt-disable -cl-mad-enable
-cl-no-signed-zeros -cl-finite-math-only
-cl-unsafe-math-optimizations -cl-fast-relaxed-math

Warning request/suppress:
-w -Werror

Control OpenCL C language version:
-cl-std=CL1.1 // OpenCL 1.1 specification.
-cl-std=CL1.2 // OpenCL 1.2 specification.

Query kernel argument information:
-cl-kernel-arg-info

Linker Options [5.6.5]

Library linking options:
-create-library
-enable-link-options

Program linking options:
-cl-denorms-are-zeroes
-cl-no-signed-zeroes
-cl-unsafe-math-optimizations
-cl-finite-math-only
-cl-fast-relaxed-math

Kernel and Event Objects

Create Kernel Objects [5.7.1]

cl_kernel **clCreateKernel** (cl_program *program*,
const char *_kernel_name_, cl_int *_errcode_ret_)

cl_int **clCreateKernelsInProgram** (cl_program *program*,
cl_uint *num_kernels*, cl_kernel *_kernels_,
cl_uint *_num_kernels_ret_)

cl_int **clRetainKernel** (cl_kernel *kernel*)

cl_int **clReleaseKernel** (cl_kernel *kernel*)

Kernel Arguments and Queries [5.7.2, 5.7.3]

cl_int **clSetKernelArg** (cl_kernel *kernel*, cl_uint *arg_index*,
size_t *arg_size*, const void *_arg_value_)

cl_int **clGetKernelInfo** (cl_kernel *kernel*,
cl_kernel_info *param_name*, size_t *param_value_size*,
void *_param_value_, size_t *_param_value_size_ret_)

param_name: CL_KERNEL_FUNCTION_NAME,
CL_KERNEL_NUM_ARGS, CL_KERNEL_REFERENCE_COUNT,
CL_KERNEL_{ATTRIBUTES, CONTEXT, PROGRAM}

cl_int **clGetKernelWorkGroupInfo** (
cl_kernel *kernel*, cl_device_id *device*,
cl_kernel_work_group_info *param_name*,
size_t *param_value_size*, void *_param_value_,
size_t *_param_value_size_ret_)

param_name: CL_KERNEL_GLOBAL_WORK_SIZE,
CL_KERNEL_[COMPILE_]WORK_GROUP_SIZE,
CL_KERNEL_{LOCAL, PRIVATE}_MEM_SIZE,
CL_KERNEL_PREFERRED_WORK_GROUP_SIZE_MULTIPLE

cl_int **clGetKernelArgInfo** (cl_kernel *kernel*,
cl_uint *arg_indx*, cl_kernel_arg_info *param_name*,
size_t *param_value_size*, void *_param_value_,
size_t *_param_value_size_ret_)

param_name:
CL_KERNEL_ARG_{ACCESS, ADDRESS, TYPE}_QUALIFIER,
CL_KERNEL_ARG_NAME, CL_KERNEL_ARG_TYPE_NAME

Execute Kernels [5.8]

cl_int **clEnqueueNDRangeKernel** (
cl_command_queue *command_queue*,
cl_kernel *kernel*, cl_uint *work_dim*,
const size_t *_global_work_offset_,
const size_t *_global_work_size_,
const size_t *_local_work_size_,
cl_uint *num_events_in_wait_list*,
const cl_event *_event_wait_list_, cl_event *_event_)

cl_int **clEnqueueTask** (
cl_command_queue *command_queue*,
cl_kernel *kernel*, cl_uint *num_events_in_wait_list*,
const cl_event *_event_wait_list_, cl_event *_event_)

cl_int **clEnqueueNativeKernel** (cl_command_queue
command_queue, void (*_user_func_)(void *),
void *_args_, size_t _cb_args_, cl_uint *num_mem_objects*,
const cl_mem *_mem_list_, const void **_args_mem_loc_,
cl_uint *num_events_in_wait_list*,
const cl_event *_event_wait_list_, cl_event *_event_)

Event Objects [5.9]

cl_event **clCreateUserEvent** (cl_context *context*,
cl_int *_errcode_ret_)

cl_int **clSetUserEventStatus** (cl_event *event*,
cl_int *execution_status*)

cl_int **clWaitForEvents** (cl_uint *num_events*,
const cl_event *_event_list_)

cl_int **clGetEventInfo** (cl_event *event*,
cl_event_info *param_name*, size_t *param_value_size*,
void *_param_value_, size_t *_param_value_size_ret_)

param_name: CL_EVENT_COMMAND_{QUEUE, TYPE},
CL_EVENT_{CONTEXT, REFERENCE_COUNT},
CL_EVENT_COMMAND_EXECUTION_STATUS

cl_int **clSetEventCallback** (cl_event *event*,
cl_int *command_exec_callback_type*,
void (CL_CALLBACK *_pfn_event_notify_)
(cl_event *event*, cl_int *event_command_exec_status*,
void *_user_data_),
void *_user_data_)

cl_int **clRetainEvent** (cl_event *event*)

cl_int **clReleaseEvent** (cl_event *event*)

Markers, Barriers, and Waiting for Events [5.10]

cl_int **clEnqueueMarkerWithWaitList** (
cl_command_queue *command_queue*,
cl_uint *num_events_in_wait_list*,
const cl_event *_event_wait_list_, cl_event *_event_)

cl_int **clEnqueueBarrierWithWaitList** (
cl_command_queue *command_queue*,
cl_uint *num_events_in_wait_list*,
const cl_event *_event_wait_list_, cl_event *_event_)

Profiling Operations [5.12]

cl_int **clGetEventProfilingInfo** (cl_event *event*,
cl_profiling_info *param_name*,
size_t *param_value_size*, void *_param_value_,
size_t *_param_value_size_ret_)

param_name: CL_PROFILING_COMMAND_QUEUED,
CL_PROFILING_COMMAND_{SUBMIT, START, END}

Flush and Finish [5.13]

cl_int **clFlush** (cl_command_queue *command_queue*)

cl_int **clFinish** (cl_command_queue *command_queue*)

Supported Data Types

The optional double scalar and vector types are supported if CL_DEVICE_DOUBLE_FP_CONFIG is not zero.

Built-in Scalar Data Types [6.1.1]

OpenCL Type	API Type	Description
bool	--	true (1) or false (0)
char	cl_char	8-bit signed
unsigned char, uchar	cl_uchar	8-bit unsigned
short	cl_short	16-bit signed
unsigned short, ushort	cl_ushort	16-bit unsigned
int	cl_int	32-bit signed
unsigned int, uint	cl_uint	32-bit unsigned
long	cl_long	64-bit signed
unsigned long, ulong	cl_ulong	64-bit unsigned
float	cl_float	32-bit float
double OPTIONAL	cl_double	64-bit. IEEE 754
half	cl_half	16-bit float (storage only)
size_t	--	32- or 64-bit unsigned integer
ptrdiff_t	--	32- or 64-bit signed integer
intptr_t	--	32- or 64-bit signed integer
uintptr_t	--	32- or 64-bit unsigned integer
void	void	void

Built-in Vector Data Types [6.1.2]

OpenCL Type	API Type	Description
char*n*	cl_char*n*	8-bit signed
uchar*n*	cl_uchar*n*	8-bit unsigned
short*n*	cl_short*n*	16-bit signed
ushort*n*	cl_ushort*n*	16-bit unsigned
int*n*	cl_int*n*	32-bit signed
uint*n*	cl_uint*n*	32-bit unsigned
long*n*	cl_long*n*	64-bit signed
ulong*n*	cl_ulong*n*	64-bit unsigned
float*n*	cl_float*n*	32-bit float
double*n* OPTIONAL	cl_double*n*	64-bit float

Other Built-in Data Types [6.1.3]

The optional types listed here other than event_t are only defined if CL_DEVICE_IMAGE_SUPPORT is CL_TRUE.

OpenCL Type	Description
image2d_t OPTIONAL	2D image handle
image3d_t OPTIONAL	3D image handle
image2d_array_t OPTIONAL	2D image array
image1d_t OPTIONAL	1D image handle
image1d_buffer_t OPTIONAL	1D image buffer
image1d_array_t OPTIONAL	1D image array
sampler_t OPTIONAL	sampler handle
event_t	event handle

Reserved Data Types [6.1.4]

OpenCL Type	Description
bool*n*	boolean vector
half*n*	16-bit, vector
quad, quad*n*	128-bit float, vector
complex half, complex half*n* imaginary half, imaginary half*n*	16-bit complex, vector
complex float, complex float*n* imaginary float, imaginary float*n*	32-bit complex, vector
complex double, complex double*n* imaginary double, imaginary double*n*	64-bit complex, vector
complex quad, complex quad*n* imaginary quad, imaginary quad*n*	128-bit complex, vector
float*n*x*m*	*n***m* matrix of 32-bit floats
double*n*x*m*	*n***m* matrix of 64-bit floats

Vector Component Addressing [6.1.7]

Vector Components

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
float2 v;	v.x, v.s0	v.y, v.s1														
float3 v;	v.x, v.s0	v.y, v.s1	v.z, v.s2													
float4 v;	v.x, v.s0	v.y, v.s1	v.z, v.s2	v.w, v.s3												
float8 v;	v.s0	v.s1	v.s2	v.s3	v.s4	v.s5	v.s6	v.s7								
float16 v;	v.s0	v.s1	v.s2	v.s3	v.s4	v.s5	v.s6	v.s7	v.s8	v.s9	v.sa, v.sA	v.sb, v.sB	v.sc, v.sC	v.sd, v.sD	v.se, v.sE	v.sf, v.sF

Vector Addressing Equivalences

Numeric indices are preceded by the letter s or S, e.g.: s1. Swizzling, duplication, and nesting are allowed, e.g.: v.yx, v.xx, v.lo.x

	v.lo	v.hi	v.odd	v.even
float2	v.x, v.s0	v.y, v.s1	v.y, v.s1	v.x, v.s0
float3 *	v.s01, v.xy	v.s23, v.zw	v.s13, v.yw	v.s02, v.xz
float4	v.s01, v.xy	v.s23, v.zw	v.s13, v.yw	v.s02, v.xz

	v.lo	v.hi	v.odd	v.even
float8	v.s0123	v.s4567	v.s1357	v.s0246
float16	v.s01234567	v.s89abcdef	v.s13579bdf	v.s02468ace

*When using .lo or .hi with a 3-component vector, the .w component is undefined.

Operators and Qualifiers

Operators [6.3]

These operators behave similarly as in C99 except that operands may include vector types when possible:

```
+   -   *   %   /   --  ++  ==  !=  &
~   ^   >   <   >=  <=  |   !   &&  ||
?:  >>  <<  =   ,   op=  sizeof
```

Address Space Qualifiers [6.5]

__global, global __local, local
__constant, constant __private, private

Function Qualifiers [6.7]

__kernel, kernel
__attribute__((vec_type_hint(*type*))) *//type defaults to int*
__attribute__((work_group_size_hint(*X*, *Y*, *Z*)))
__attribute__((reqd_work_group_size(*X*, *Y*, *Z*)))

Specify Type Attributes [6.11.1]

Use to specify special attributes of enum, struct and union types.

__attribute__((aligned(*n*)))
__attribute__((aligned))
__attribute__((packed))
__attribute__((endian(host)))
__attribute__((endian(device)))
__attribute__((endian))

Math Constants [6.12.2] [9.5.2]

The values of the following symbolic constants are type float, accurate within the precision of a single precision floating-point number.

MAXFLOAT	Value of maximum non-infinite single-precision floating-point number.
HUGE_VALF	Positive float expression, evaluates to +infinity.
HUGE_VAL	Positive double expression, evals. to +infinity. OPTIONAL

INFINITY	Constant float expression, positive or unsigned infinity.
NAN	Constant float expression, quiet NaN.

When double is supported, macros ending in _F are available in type double by removing _F from the macro name, and in type half when the half extension is enabled by replacing _F with _H.

M_E_F	Value of e
M_LOG2E_F	Value of $\log_2 e$
M_LOG10E_F	Value of $\log_{10} e$
M_LN2_F	Value of $\log_e 2$
M_LN10_F	Value of $\log_e 10$
M_PI_F	Value of π
M_PI_2_F	Value of π / 2
M_PI_4_F	Value of π / 4
M_1_PI_F	Value of 1 / π
M_2_PI_F	Value of 2 / π
M_2_SQRTPI_F	Value of 2 / √π
M_SQRT2_F	Value of √2
M_SQRT1_2_F	Value of 1 / √2

Integer Built-in Functions [6.12.3]

T is type char, char*n*, uchar, uchar*n*, short, short*n*, ushort, ushort*n*, int, int*n*, uint, uint*n*, long, long*n*, ulong, or ulong*n*, where *n* is 2, 3, 4, 8, or 16. ***Tu*** is the unsigned version of ***T***. ***Tsc*** is the scalar version of ***T***.

Tu **abs** (*T x*)	| *x* |
Tu **abs_diff** (*T x*, *T y*)	| *x* – *y* | without modulo overflow
T **add_sat** (*T x*, *T y*)	*x* + *y* and saturates the result
T **hadd** (*T x*, *T y*)	(*x* + *y*) >> 1 without mod. overflow
T **rhadd** (*T x*, *T y*)	(*x* + *y* + 1) >> 1
T **clamp** (*T x*, *T min*, *T max*) *T* **clamp** (*T x*, *Tsc min*, *Tsc max*)	min(max(*x*, *minval*), *maxval*)
T **clz** (*T x*)	number of leading 0-bits in *x*
T **mad_hi** (*T a*, *T b*, *T c*)	mul_hi(*a*, *b*) + *c*
T **mad_sat** (*T a*, *T b*, *T c*)	*a* * *b* + *c* and saturates the result
T **max** (*T x*, *T y*) *T* **max** (*T x*, *Tsc y*)	*y* if *x* < *y*, otherwise it returns *x*
T **min** (*T x*, *T y*)	*y* if *y* < *x*, otherwise it returns *x*
T **min** (*T x*, *Tsc y*)	*y* if *y* < *x*, otherwise it returns *x*
T **mul_hi** (*T x*, *T y*)	high half of the product of *x* and *y*
T **rotate** (*T v*, *T i*)	result[*indx*] = *v*[*indx*] << *i*[*indx*]
T **sub_sat** (*T x*, *T y*)	*x* - *y* and saturates the result
T **popcount** (*T x*)	Number of non-zero bits in *x*

*For **upsample**, return type is scalar when the parameters are scalar.*

short[*n*] **upsample** (char[*n*] *hi*, uchar[*n*] *lo*)	result[*i*]= ((short)*hi*[*i*]<< 8) | *lo*[*i*]
ushort[*n*] **upsample** (uchar[*n*] *hi*, uchar[*n*] *lo*)	result[*i*]=((ushort)*hi*[*i*]<< 8) | *lo*[*i*]
int[*n*] **upsample** (short[*n*] *hi*, ushort[*n*] *lo*)	result[*i*]=((int)*hi*[*i*]<< 16) | *lo*[*i*]
uint[*n*] **upsample** (ushort[*n*] *hi*, ushort[*n*] *lo*)	result[*i*]=((uint)*hi*[*i*]<< 16) | *lo*[*i*]
long[*n*] **upsample** (int[*n*] *hi*, uint[*n*] *lo*)	result[*i*]=((long)*hi*[*i*]<< 32) | *lo*[*i*]
ulong[*n*] **upsample** (uint[*n*] *hi*, uint[*n*] *lo*)	result[*i*]=((ulong)*hi*[*i*]<< 32) | *lo*[*i*]

The following fast integer functions optimize the performance of kernels. In these functions, ***T*** is type int, uint, int*n* or int*n*,where *n* is 2, 3, 4, 8, or 16.

T **mad24** (*T x*, *T y*, *T z*)	Multiply 24-bit integer values *x*, *y*, add 32-bit int. result to 32-bit int. *z*
T **mul24** (*T x*, *T y*)	Multiply 24-bit integer values *x* and *y*

Preprocessor Directives & Macros [6.10]

#pragma OPENCL FP_CONTRACT *on-off-switch*
on-off-switch: ON, OFF, DEFAULT

#pragma OPENCL EXTENSION *extensionname* : *behavior*

#pragma OPENCL EXTENSION **all** : *behavior*

__FILE__	Current source file
__func__	Current function name

__LINE__	Integer line number
__OPENCL_VERSION__	Integer version number, e.g: 120
__CL_VERSION_1_0	Substitutes integer 100 for 1.0
__CL_VERSION_1_1	Substitutes integer 110 for 1.1
__CL_VERSION_1_2	Substitutes integer 120 for 1.2
__OPENCL_C_VERSION__	Sub. integer for OpenCL C version.
__ENDIAN_LITTLE__	1 if device is little endian
__IMAGE_SUPPORT__	1 if images are supported

__FAST_RELAXED_MATH__	1 if –cl-fast-relaxed-math optimization option is specified
FP_FAST_FMA	Defined if double **fma** is fast
FP_FAST_FMAF	Defined if float **fma** is fast
FP_FAST_FMA_HALF	Defined if half **fma** is fast
__kernel_exec(X, *typen*)	Same as: __kernel __attribute__((work_group_size_hint(*X*, 1, 1))) __attribute__((vec_type_hint(*typen*)))

Math Built-in Functions [6.12.2] [9.5.2]

Ts is type float, optionally double, or half if the half extension is enabled. ***Tn*** is the vector form of ***Ts***, where *n* is 2, 3, 4, 8, or 16. ***T*** is ***Ts*** and ***Tn***. ***Q*** is qualifier __global, __local, or __private. **HN** indicates that half and native variants are available using only the float or float*n* types by prepending "half_" or "native_" to the function name. Prototypes shown in brown text are available in half_ and native_ forms only using the float or float*n* types.

T **acos** (*T*)		Arc cosine
T **acosh** (*T*)		Inverse hyperbolic cosine
T **acospi** (*T x*)		acos (*x*) / π
T **asin** (*T*)		Arc sine
T **asinh** (*T*)		Inverse hyperbolic sine
T **asinpi** (*T x*)		asin (*x*) / π
T **atan** (*T y_over_x*)		Arc tangent
T **atan2** (*T y*, *T x*)		Arc tangent of *y* / *x*
T **atanh** (*T*)		Hyperbolic arc tangent
T **atanpi** (*T x*)		atan (*x*) / π
T **atan2pi** (*T x*, *T y*)		atan2 (*y*, *x*) / π
T **cbrt** (*T*)		Cube root
T **ceil** (*T*)		Round to integer toward + infinity
T **copysign** (*T x*, *T y*)		*x* with sign changed to sign of *y*
T **cos** (*T*)	HN	Cosine
T **cosh** (*T*)		Hyperbolic cosine
T **cospi** (*T x*)		cos (π *x*)
T **half_divide** (*T x*, *T y*) *T* **native_divide** (*T x*, *T y*)		*x* / *y* (*T* may only be float or float*n*)
T **erfc** (*T*)		Complementary error function
T **erf** (*T*)		Calculates error function of *T*
T **exp** (*T x*)	HN	Exponential base e
T **exp2** (*T*)	HN	Exponential base 2
T **exp10** (*T*)	HN	Exponential base 10
T **expm1** (*T x*)		e^x -1.0
T **fabs** (*T*)		Absolute value
T **fdim** (*T x*, *T y*)		Positive difference between *x* and *y*
T **floor** (*T*)		Round to integer toward - infinity
T **fma** (*T a*, *T b*, *T c*)		Multiply and add, then round
T **fmax** (*T x*, *T y*) *Tn* **fmax** (*Tn x*, *Ts y*)		Return *y* if *x* < *y*, otherwise it returns *x*
T **fmin** (*T x*, *T y*) *Tn* **fmin** (*Tn x*, *Ts y*)		Return *y* if *y* < *x*, otherwise it returns *x*
T **fmod** (*T x*, *T y*)		Modulus. Returns *x* – *y* * trunc (*x*/*y*)
T **fract** (*T x*, *Q T* **iptr*)		Fractional value in *x*
Ts **frexp** (*T x*, *Q* int **exp*) *Tn* **frexp** (*T x*, *Q* int*n* **exp*)		Extract mantissa and exponent
T **hypot** (*T x*, *T y*)		Square root of $x^2 + y^2$
int[*n*] **ilogb** (*T x*)		Return exponent as an integer value
Ts **ldexp** (*T x*, int *n*) *Tn* **ldexp** (*T x*, int*n* *n*)		*x* * 2^n
T **lgamma** (*T x*) *Ts* **lgamma_r** (*T x*, *Q* int **signp*) *Tn* **lgamma_r** (*T x*, *Q* int*n* **signp*)		Log gamma function
T **log** (*T*)	HN	Natural logarithm
T **log2** (*T*)	HN	Base 2 logarithm
T **log10** (*T*)	HN	Base 10 logarithm
T **log1p** (*T x*)		ln (1.0 + *x*)
T **logb** (*T x*)		Exponent of *x*
T **mad** (*T a*, *T b*, *T c*)		Approximates *a* * *b* + *c*
T **maxmag** (*T x*, *T y*)		Maximum magnitude of *x* and *y*
T **minmag** (*T x*, *T y*)		Minimum magnitude of *x* and *y*
T **modf** (*T x*, *Q T* **iptr*)		Decompose floating-point number
float[*n*] **nan** (uint[*n*] *nancode*) half[*n*] **nan** (ushort[*n*] *nancode*) double[*n*] **nan** (ulong[*n*] *nancode*)		Quiet NaN (Return is scalar when *nancode* is scalar)
T **nextafter** (*T x*, *T y*)		Next representable floating-point value after *x* in the direction of *y*
T **pow** (*T x*, *T y*)		Compute *x* to the power of *y*
Ts **pown** (*T x*, int *y*) *Tn* **pown** (*T x*, int*n* *y*)		Compute x^y, where *y* is an integer
T **powr** (*T x*, *T y*)	HN	Compute x^y, where *x* is >= 0
T **half_recip** (*T x*) *T* **native_recip** (*T x*)		1 / *x* (*T* may only be float or float*n*)
T **remainder** (*T x*, *T y*)		Floating point remainder
Ts **remquo** (*T x*, *T y*, *Q* int **quo*) *Tn* **remquo** (*T x*, *T y*, *Q* int*n* **quo*)		Remainder and quotient
T **rint** (*T*)		Round to nearest even integer
Ts **rootn** (*T x*, int *y*) *Tn* **rootn** (*T x*, int*n* *y*)		Compute *x* to the power of 1/*y*
T **round** (*T x*)		Integral value nearest to *x* rounding
T **rsqrt** (*T*)	HN	Inverse square root
T **sin** (*T*)	HN	Sine
T **sincos** (*T x*, *Q T* **cosval*)		Sine and cosine of *x*
T **sinh** (*T*)		Hyperbolic sine
T **sinpi** (*T x*)		sin (π *x*)
T **sqrt** (*T*)	HN	Square root
T **tan** (*T*)	HN	Tangent
T **tanh** (*T*)		Hyperbolic tangent
T **tanpi** (*T x*)		tan (π *x*)
T **tgamma** (*T*)		Gamma function
T **trunc** (*T*)		Round to integer toward zero

Geometric Built-in Functions [6.12.5] [9.5.4]

Ts is scalar type float, optionally double, or half if the half extension is enabled. ***T*** is ***Ts*** and the 2-, 3-, or 4-component vector forms of ***Ts***.

float{3,4} **cross** (float{3,4} *p0*, float{3,4} *p1*) double{3,4} **cross** (double{3,4} *p0*, double{3,4} *p1*) half{3,4} **cross** (half{3,4} *p0*, half{3,4} *p1*)	Cross product
Ts **distance** (*T p0*, *T p1*)	Vector distance
Ts **dot** (*T p0*, *T p1*)	Dot product
Ts **length** (*T p*)	Vector length
T **normalize** (*T p*)	Normal vector length 1
float **fast_distance** (float *p0*, float *p1*) float **fast_distance** (float*n* *p0*, float*n* *p1*)	Vector distance
float **fast_length** (float *p*) float **fast_length** (float*n* *p*)	Vector length
float **fast_normalize** (float *p*) float*n* **fast_normalize** (float*n* *p*)	Normal vector length 1

Vector Data Load/Store [6.12.7] [9.5.6]

T is type char, uchar, short, ushort, int, uint, long, ulong, or float, optionally double, or half if the half extension is enabled. ***Tn*** refers to the vector form of type ***T***, where *n* is 2, 3, 4, 8, or 16. ***Q*** is an Address Space Qualifier listed in 6.5 unless otherwise noted. When red, ***Q*** cannot be __constant. ***R*** defaults to the current rounding mode, or is one of the Rounding Modes listed in 6.2.3.2.

Tn **vload*n*** (size_t *offset*, const *Q T* **p*)	Read vector data from address (*p* + (*offset* * *n*))
void **vstore*n*** (*Tn data*, size_t *offset*, ***Q*** *T* **p*)	Write vector data to address (*p* + (*offset* * *n*)
float **vload_half** (size_t *offset*, const *Q* half **p*)	Read a half from address (*p* + *offset*)
float*n* **vload_half*n*** (size_t *offset*, const *Q* half **p*)	Read a half*n* from address (*p* + (*offset* * *n*))
void **vstore_half** (float *data*, size_t *offset*, ***Q*** half **p*) void **vstore_half**_*R* (float *data*, size_t *offset*, ***Q*** half **p*) void **vstore_half** (double *data*, size_t *offset*, ***Q*** half **p*)	Write a half to address (*p* + *offset*)
void **vstore_half**_*R* (double *data*, size_t *offset*, ***Q*** half **p*)	Write a half to address (*p* + *offset*)
void **vstore_half*n*** (float*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstore_half*n***_*R* (float*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstore_half*n*** (double*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstore_half*n***_*R* (double*n* *data*, size_t *offset*, ***Q*** half **p*)	Write a half vector to address (*p* + (*offset* * *n*))
float*n* **vloada_half*n*** (size_t *offset*, const *Q* half **p*)	Read half vector data from (*p* + (*offset* * *n*)). For half3, read from (*p* + (*offset* * 4)).
void **vstorea_half*n*** (float*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstorea_half*n***_*R* (float*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstorea_half*n*** (double*n* *data*, size_t *offset*, ***Q*** half **p*) void **vstorea_half*n***_*R* (double*n* *data*, size_t *offset*, ***Q*** half **p*)	Write half vector data to (*p* + (*offset* * *n*)). For half3, write to (*p* + (*offset* * 4)).

Async Copies and Prefetch Functions [6.12.10] [9.5.7]

T is type char, char*n*, uchar, uchar*n*, short, short*n*, ushort, ushort*n*, int, int*n*, uint, uint*n*, long, long*n*, ulong, ulong*n*, float, float*n*, optionally double or double*n*, or half or half*n* if the half extension is enabled.

event_t **async_work_group_copy** (__local *T* **dst*, const __global *T* **src*, size_t *num_gentypes*, event_t *event*) event_t **async_work_group_copy** (__global *T* **dst*, const __local *T* **src*, size_t *num_gentypes*, event_t *event*)	Copies *num_gentypes T* elements from *src* to *dst*
event_t **async_work_group_strided_copy** (__local *T* **dst*, const __global *T* **src*, size_t *num_gentypes*, size_t *src_stride*, event_t *event*) event_t **async_work_group_strided_copy** (__global *T* **dst*, const __local *T* **src*, size_t *num_gentypes*, size_t *dst_stride*, event_t *event*)	Copies *num_gentypes T* elements from *src* to *dst*
void **wait_group_events** (int *num_events*, event_t **event_list*)	Wait for events that identify the **async_work_group_copy** operations to complete
void **prefetch** (const __global *T* **p*, size_t *num_gentypes*)	Prefetch *num_gentypes* * sizeof(*T*) bytes into the global cache

Work-Item Built-in Functions [6.12.1]

These functions query the number of dimensions, the global and local work size specified to **clEnqueueNDRangeKernel**, and the global and local identifier of each work-item when this kernel is executed on a device. *D* is the dimension index.

uint **get_work_dim** ()	Number of dimensions in use
size_t **get_global_size** (uint *D*)	Number of global work-items
size_t **get_global_id** (uint *D*)	Global work-item ID value
size_t **get_local_size** (uint *D*)	Number of local work-items
size_t **get_local_id** (uint *D*)	Local work-item ID
size_t **get_num_groups** (uint *D*)	Number of work-groups
size_t **get_group_id** (uint *D*)	Returns the work-group ID
size_t **get_global_offset** (uint *D*)	Returns global offset

Common Built-in Functions [6.12.4] [9.5.3]

These functions operate component-wise and use round to nearest even rounding mode. ***Ts*** is type float, optionally double, or half if the half extension is enabled. ***Tn*** is the vector form of ***Ts***, where *n* is 2, 3, 4, 8, or 16. ***T*** is ***Ts*** and ***Tn***.

T **clamp** (*T x*, *T min*, *T max*) *Tn* **clamp** (*Tn x*, *Ts min*, *Ts max*)	Clamp *x* to range given by *min*, *max*
T **degrees** (*T radians*)	*radians* to degrees
T **max** (*T x*, *T y*) *Tn* **max** (*Tn x*, *Ts y*)	Max of *x* and *y*
T **min** (*T x*, *T y*) *Tn* **min** (*Tn x*, *Ts y*)	Min of *x* and *y*
T **mix** (*T x*, *T y*, *T a*) *Tn* **mix** (*Tn x*, *Tn y*, *Ts a*)	Linear blend of *x* and *y*
T **radians** (*T degrees*)	*degrees* to radians
T **step** (*T edge*, *T x*) *Tn* **step** (*Ts edge*, *Tn x*)	0.0 if *x* < *edge*, else 1.0
T **smoothstep** (*T edge0*, *T edge1*, *T x*) *T* **smoothstep** (*Ts edge0*, *Ts edge1*, *T x*)	Step and interpolate
T **sign** (*T x*)	Sign of *x*

Relational Built-in Functions [6.12.6]

These functions can be used with built-in scalar or vector types as arguments and return a scalar or vector integer result. ***T*** is type float, floatn, char, charn, uchar, ucharn, short, shortn, ushort, ushortn, int, intn, uint, uintn, long, longn, ulong, ulongn, or optionally double or doublen. ***Ti*** is type char, charn, short, shortn, int, intn, long, or longn. ***Tu*** is type uchar, ucharn, ushort, ushortn, uint, uintn, ulong, or ulongn. *n* is 2, 3, 4, 8, or 16. Optional extension enables half and halfn types.

int **isequal** (float *x*, float *y*) int*n* **isequal** (float*n* *x*, float*n* *y*) int **isequal** (double *x*, double *y*) long*n* **isequal** (double*n* *x*, double*n* *y*) int **isequal** (half *x*, half *y*) short*n* **isequal** (half*n* *x*, half*n* *y*)	Compare of *x* == *y*
int **isnotequal** (float *x*, float *y*) int*n* **isnotequal** (float*n* *x*, float*n* *y*) int **isnotequal** (double *x*, double *y*) long*n* **isnotequal** (double*n* *x*, double*n* *y*) int **isnotequal** (half *x*, half *y*) short*n* **isnotequal** (half*n* *x*, half*n* *y*)	Compare of *x* != *y*
int **isgreater** (float *x*, float *y*) int*n* **isgreater** (float*n* *x*, float*n* *y*) int **isgreater** (double *x*, double *y*) long*n* **isgreater** (double*n* *x*, double*n* *y*) int **isgreater** (half *x*, half *y*) short*n* **isgreater** (half*n* *x*, half*n* *y*)	Compare of *x* > *y*
int **isgreaterequal** (float *x*, float *y*) int*n* **isgreaterequal** (float*n* *x*, float*n* *y*) int **isgreaterequal** (double *x*, double *y*) long*n* **isgreaterequal** (double*n* *x*, double*n* *y*) int **isgreaterequal** (half *x*, half *y*) short*n* **isgreaterequal** (half*n* *x*, half*n* *y*)	Compare of *x* >= *y*
int **isless** (float *x*, float *y*) int*n* **isless** (float*n* *x*, float*n* *y*) int **isless** (double *x*, double *y*) long*n* **isless** (double*n* *x*, double*n* *y*) int **isless** (half *x*, half *y*) short*n* **isless** (half*n* *x*, half*n* *y*)	Compare of *x* < *y*
int **islessequal** (float *x*, float *y*) int*n* **islessequal** (float*n* *x*, float*n* *y*) int **islessequal** (double *x*, double *y*) long*n* **islessequal** (double*n* *x*, double*n* *y*) int **islessequal** (half *x*, half *y*) short*n* **islessequal** (half*n* *x*, half*n* *y*)	Compare of *x* <= *y*
int **islessgreater** (float *x*, float *y*) int*n* **islessgreater** (float*n* *x*, float*n* *y*) int **islessgreater** (double *x*, double *y*) long*n* **islessgreater** (double*n* *x*, double*n* *y*) int **islessgreater** (half *x*, half *y*) short*n* **islessgreater** (half*n* *x*, half*n* *y*)	Compare of (*x* < *y*) || (*x* > *y*)
int **isfinite** (float) int*n* **isfinite** (float*n*) int **isfinite** (double) long*n* **isfinite** (double*n*) int **isfinite** (half) short*n* **isfinite** (half*n*)	Test for finite value
int **isinf** (float) int*n* **isinf** (float*n*) int **isinf** (double) long*n* **isinf** (double*n*) int **isinf** (half) short*n* **isinf** (half*n*)	Test for + or – infinity
int **isnan** (float) int*n* **isnan** (float*n*) int **isnan** (double) long*n* **isnan** (double*n*) int **isnan** (half) short*n* **isnan** (half*n*)	Test for a NaN
int **isnormal** (float) int*n* **isnormal** (float*n*) int **isnormal** (double)	Test for a normal value
long*n* **isnormal** (double*n*) int **isnormal** (half) short*n* **isnormal** (half*n*)	Test for a normal value
int **isordered** (float *x*, float *y*) int*n* **isordered** (float*n* *x*, float*n* *y*) int **isordered** (double *x*, double *y*) long*n* **isordered** (double*n* *x*, double*n* *y*) int **isordered** (half *x*, half *y*) short*n* **isordered** (half*n* *x*, half*n* *y*)	Test if arguments are ordered
int **isunordered** (float *x*, float *y*) int*n* **isunordered** (float*n* *x*, float*n* *y*) int **isunordered** (double *x*, double *y*) long*n* **isunordered** (double*n* *x*, double*n* *y*) int **isunordered** (half *x*, half *y*) short*n* **isunordered** (half*n* *x*, half*n* *y*)	Test if arguments are unordered
int **signbit** (float) int*n* **signbit** (float*n*) int **signbit** (double) long*n* **signbit** (double*n*) int **signbit** (half) short*n* **signbit** (half*n*)	Test for sign bit
int **any** (*Ti x*)	1 if MSB in component of *x* is set; else 0
int **all** (*Ti x*)	1 if MSB in all components of *x* are set; else 0
T **bitselect** (*T a*, *T b*, *T c*) half **bitselect** (half *a*, half *b*, half *c*) half*n* **bitselect** (half*n* *a*, half*n* *b*, half*n* *c*)	Each bit of result is corresponding bit of *a* if corresponding bit of *c* is 0
T **select** (*T a*, *T b*, *Ti c*) *T* **select** (*T a*, *T b*, *Tu c*) half*n* **select** (half*n* *a*, half*n* *b*, short*n* *c*) half **select** (half *a*, half *b*, short *c*) half*n* **select** (half*n* *a*, half*n* *b*, ushort*n* *c*) half **select** (half *a*, half *b*, ushort *c*)	For each component of a vector type, result[*i*] = if MSB of *c*[*i*] is set ? *b*[*i*] : *a*[*i*] For scalar type, result = *c* ? *b* : *a*

Miscellaneous Vector Functions [6.12.12]

Tm and ***Tn*** are type charn, ucharn, shortn, ushortn, intn, uintn, longn, ulongn, floatn, optionally doublen, or halfn if the half extension is enabled, where *n* is 2,4,8, or 16 except in **vec_step** it may also be 3. ***TUn*** is ucharn, ushortn, uintn, or ulongn.

int **vec_step** (*Tn a*) int **vec_step** (*typename*)	Takes a built-in scalar or vector data type argument, returns an integer showing number of elements in the scalar or vector. Returns 1 for scalar, 4 for 3-component vector, else number of elements in the specified type.
Tn **shuffle** (*Tm x*, *TUn mask*) *Tn* **shuffle2** (*Tm x*, *Tm y*, *TUn mask*)	Construct permutation of elements from one or two input vectors, return a vector with same element type as input and length that is the same as the shuffle mask.

Atomic Functions [6.12.11] [9.3]

These functions functions provide atomic operations on 32-bit signed and unsigned integers and single precision floating-point to locations in __global or __local memory. ***T*** is type int or unsigned int. ***T*** may also be type float for **atomic_xchg**, and type long or ulong for extended 64-bit atomic functions. ***Q*** is volatile __global or volatile __local.

T **atomic_add** (*Q T *p*, *T val*)	Read, add, and store
T **atomic_sub** (*Q T *p*, *T val*)	Read, subtract, and store
T **atomic_xchg** (*Q T *p*, *T val*)	Read, swap, and store
T **atomic_inc** (*Q T *p*)	Read, increment, and store
T **atomic_dec** (*Q T *p*)	Read, decrement, and store
T **atomic_cmpxchg** (*Q T *p*, *T cmp*, *T val*)	Read, store (**p* ==*cmp*) ? *val* : **p*
T **atomic_min** (*Q T *p*, *T val*)	Read, store min(**p*, *val*)
T **atomic_max** (*Q T *p*, *T val*)	Read, store max(**p*, *val*)
T **atomic_and** (*Q T *p*, *T val*)	Read, store (**p* & *val*)
T **atomic_or** (*Q T *p*, *T val*)	Read, store (**p* | *val*)
T **atomic_xor** (*Q T *p*, *T val*)	Read, store (**p* ^ *val*)

Optional extensions enable forms of these functions using the atom_ prefix that implement atomic operations on 64-bit signed and unsigned integers. To use any of these forms, include the following in the OpenCL program source:

#pragma OPENCL EXTENSION *extension-name* : enable

Use cl_khr_int64_base_atomics for *extension-name* to enable 64-bit versions of the following functions:

atom_add atom_sub atom_inc
atom_dec atom_xchg atom_cmpxchg

Use cl_khr_int64_extended_atomics for *extension-name* to enable 64-bit versions of the following functions:

atom_min atom_max atom_and
atom_or atom_xor

Conversions and Type Casting Examples [6.2]

T a = (*T*)*b*; // *Scalar to scalar, or scalar to vector*
T a = convert_*T*(*b*); *T a* = convert_*T*_*R*(*b*);
T a = as_*T*(*b*); *T a* = convert_*T*_sat_*R*(*b*);

R can be one of the following rounding modes:

_rte	to nearest even	_rtp	toward + infinity
_rtz	toward zero	_rtn	toward - infinity

Synchronization and Explicit Memory Fence Functions [6.12.8, 6.12.9]

flags argument is the memory address space, set to a combination of CLK_LOCAL_MEM_FENCE and CLK_GLOBAL_MEM_FENCE. Explicit memory fence functions provide ordering between memory operations of a work-item.

void **barrier** (cl_mem_fence_flags *flags*)	Work-items in a work-group must execute this before any can continue
void **mem_fence** (cl_mem_fence_flags *flags*)	Orders loads and stores of a work-item executing a kernel
void **read_mem_fence** (cl_mem_fence_flags *flags*)	Orders memory loads
void **write_mem_fence** (cl_mem_fence_flags *flags*)	Orders memory stores

printf Function [6.12.13]

Writes output to an implementation-defined stream.

int **printf** (constant char * restrict *format*, ...)

printf output synchronization

When the event associated with a particular kernel invocation completes, the output of applicable printf() calls is flushed to the implementation-defined output stream.

printf format string

The format string follows C99 conventions and supports an optional vector specifier:

%[*flags*][*width*][.*precision*][*vector*][*length*]*conversion*

Examples:

The following examples show the use of the vector specifier in the **printf** format string.

```
float4  f = (float4)(1.0f, 2.0f, 3.0f, 4.0f);
printf("f4 = %2.2v4f\n", f);
```

Output: f4 = 1.00,2.00,3.00,4.00

```
uchar4 uc = (uchar4)(0xFA, 0xFB, 0xFC, 0xFD);
printf("uc = %#v4x\n", uc);
```

Output: uc = 0xfa,0xfb,0xfc,0xfd

```
uint2 ui = (uint2)(0x12345678, 0x87654321);
printf("unsigned short value = (%#v2hx)\n", ui);
```

Output: unsigned short value = (0x5678,0x4321)

OpenCL Image Processing: Following is a subset of the OpenCL specification that pertains to image processing and graphics.

Image Objects

Create Image Objects [5.3.1]

cl_mem **clCreateImage** (cl_context *context*,
cl_mem_flags *flags*,
const cl_image_format *image_format,
const cl_image_desc *image_desc,
void *host_ptr, cl_int *errcode_ret)

flags:
CL_MEM_READ_WRITE,
CL_MEM_{WRITE, READ}_ONLY,
CL_MEM_HOST_{WRITE, READ}_ONLY,
CL_MEM_HOST_NO_ACCESS,
CL_MEM_{USE, ALLOC, COPY}_HOST_PTR

Query List of Supported Image Formats [5.3.2]

cl_int **clGetSupportedImageFormats** (
cl_context *context*, cl_mem_flags *flags*,
cl_mem_object_type *image_type*,
cl_uint *num_entries*, cl_image_format *image_formats*,
cl_uint *num_image_formats*)

flags: See **clCreateImage**

image_type: CL_MEM_OBJECT_IMAGE{1D, 2D, 3D},
CL_MEM_OBJECT_IMAGE1D_BUFFER,
CL_MEM_OBJECT_IMAGE{1D, 2D}_ARRAY

Read, Write, Copy Image Objects [5.3.3]

cl_int **clEnqueueReadImage** (
cl_command_queue *command_queue*,
cl_mem *image*, cl_bool *blocking_read*,
const size_t *origin, const size_t *region,
size_t *row_pitch*, size_t *slice_pitch*, void *ptr,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueWriteImage** (
cl_command_queue *command_queue*,
cl_mem *image*, cl_bool *blocking_write*,
const size_t *origin, const size_t *region,
size_t *input_row_pitch*, size_t *input_slice_pitch*,
const void *ptr, cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueFillImage** (
cl_command_queue *command_queue*,
cl_mem *image*, const void *fill_color*,
const size_t *origin, const size_t *region,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list,
cl_event *event)

cl_int **clEnqueueCopyImage** (
cl_command_queue *command_queue*,
cl_mem *src_image*, cl_mem *dst_image*,
const size_t *src_origin, const size_t *dst_origin,
const size_t *region, cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

Copy Between Image, Buffer Objects [5.3.4]

cl_int **clEnqueueCopyImageToBuffer** (
cl_command_queue *command_queue*,
cl_mem *src_image*, cl_mem *dst_buffer*,
const size_t *src_origin, const size_t *region,
size_t *dst_offset*, cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueCopyBufferToImage** (
cl_command_queue *command_queue*,
cl_mem *src_buffer*, cl_mem *dst_image*,
size_t *src_offset*,
const size_t *dst_origin, const size_t *region,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

Map and Unmap Image Objects [5.3.5]

void * **clEnqueueMapImage** (
cl_command_queue *command_queue*, cl_mem *image*,
cl_bool *blocking_map*, cl_map_flags *map_flags*,
const size_t *origin, const size_t *region,
size_t *image_row_pitch*, size_t *image_slice_pitch*,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event,
cl_int *errcode_ret)

Also see **clGetMemObjectInfo** [5.4.5]

Query Image Objects [5.3.6]

cl_int **clGetImageInfo** (cl_mem *image*,
cl_image_info *param_name*, size_t *param_value_size*,
void *param_value*, size_t *param_value_size_ret*)

param_name: CL_IMAGE_{ARRAY, ELEMENT}_SIZE,
CL_IMAGE_{ROW, SLICE}_PITCH,
CL_IMAGE_{FORMAT, BUFFER, HEIGHT, WIDTH, DEPTH},
CL_IMAGE_NUM_{SAMPLES, MIP_LEVELS},
CL_IMAGE_DX9_MEDIA_PLANE_KHR,
CL_IMAGE_{D3D10, D3D11}_SUBRESOURCE_KHR

Image Formats [5.3.1.1, 9.5]

Supported image formats: image_channel_order with image_channel_data_type.

Built-in support: [Table 5.8]

CL_RGBA: CL_HALF_FLOAT, CL_FLOAT, CL_UNORM_INT{8,16}, CL_SIGNED_INT{8,16,32}, CL_UNSIGNED_INT{8,16,32}
CL_BGRA: CL_UNORM_INT8

Optional support: [Table 5.6]

CL_R, CL_A: CL_HALF_FLOAT, CL_FLOAT, CL_UNORM_INT{8,16}, CL_SIGNED_INT{8,16,32}, CL_UNSIGNED_INT{8,16,32}, CL_SNORM_INT{8,16}
CL_INTENSITY: CL_HALF_FLOAT, CL_FLOAT, CL_UNORM_INT{8,16}, CL_SNORM_INT{8|16}
CL_LUMINANCE: CL_UNORM_INT{8,16}, CL_HALF_FLOAT, CL_FLOAT, CL_SNORM_INT{8,16}
CL_RG, CL_RA: CL_HALF_FLOAT, CL_FLOAT, CL_UNORM_INT{8,16}, CL_SIGNED_INT{8,16, 32}, CL_UNSIGNED_INT{8,16,32}, CL_SNORM_INT{8,16}
CL_RGB: CL_UNORM_SHORT_{555,565}, CL_UNORM_INT_101010
CL_ARGB: CL_UNORM_INT8, CL_SIGNED_INT8, CL_UNSIGNED_INT8, CL_SNORM_INT8
CL_BGRA: CL_{SIGNED, UNSIGNED}_INT8, CL_SNORM_INT8

Image Read and Write Built-in Functions

[6.12.14] [9.4, 9.5.8]

The built-in functions defined in this section can only be used with image memory objects created with **clCreateImage**. *sampler* specifies the addressing and filtering mode to use. To enable the **read_imageh** and **write_imageh** forms, enable the extension cl_khr_fp16. To enable the type image3d_t in functions **write_image{f, i, ui, h},** enable the extension cl_khr_3d_image_writes.

Read and write functions for 1D images

Read an element from a 1D image, or write a color value to a location in a 1D image.

float4 **read_imagef** (image1d_t *image*, sampler_t *sampler*, {int, float} *coord*)
float4 **read_imagef** (image1d_t *image*, int *coord*)
float4 **read_imagef** (image1d_array_t *image*, sampler_t *sampler*, {int2, float4} *coord*)
float4 **read_imagef** (image1d_array_t *image*, int2 *coord*)
float4 **read_imagef** (image1d_buffer_t *image*, int *coord*)

int4 **read_imagei** (image1d_t *image*, sampler_t *sampler*, {int, float} *coord*)
int4 **read_imagei** (image1d_t *image*, int *coord*)
int4 **read_imagei** (image1d_array_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
int4 **read_imagei** (image1d_array_t *image*, int2 *coord*)
int4 **read_imagei** (image1d_buffer_t *image*, int *coord*)

uint4 **read_imageui** (image1d_t *image*, sampler_t *sampler*, {int, float} *coord*)
uint4 **read_imageui** (image1d_t *image*, int *coord*)
uint4 **read_imageui** (image1d_array_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
uint4 **read_imageui** (image1d_array_t *image*, int2 *coord*)
uint4 **read_imageui** (image1d_buffer_t *image*, int *coord*)

half4 **read_imageh** (image1d_t *image*, sampler_t *sampler*, {int, float} *coord*)
half4 **read_imageh** (image1d_t *image*, int *coord*)
half4 **read_imageh** (image1d_array_t *image*, sampler_t *sampler*, {int2, float4} *coord*)
half4 **read_imageh** (image1d_array_t *image*, int2 *coord*)
half4 **read_imageh** (image1d_buffer_t *image*, int *coord*)

void **write_imagef** (image1d_t *image*, int *coord*, float4 *color*)
void **write_imagef** (image1d_array_t *image*, int2 *coord*, float4 *color*)
void **write_imagef** (image1d_buffer_t *image*, int *coord*, float4 *color*)

Read and write functions for 1D images (continued)

void **write_imagei** (image1d_t *image*, int *coord*, int4 *color*)
void **write_imagei** (image1d_array_t *image*, int2 *coord*, int4 *color*)
void **write_imagei** (image1d_buffer_t *image*, int *coord*, int4 *color*)

void **write_imageh** (image1d_t *image*, int *coord*, half4 *color*)
void **write_imageh** (image1d_array_t *image*, int2 *coord*, half4 *color*)
void **write_imageh** (image1d_buffer_t *image*, int *coord*, half4 *color*)

void **write_imageui** (image1d_t *image*, int *coord*, uint4 *color*)
void **write_imageui** (image1d_array_t *image*, int2 *coord*, uint4 *color*)
void **write_imageui** (image1d_buffer_t *image*, int *coord*, uint4 *color*)

Read and write functions for 2D images

Read an element from a 2D image, or write a color value to a location in a 2D image.

float4 **read_imagef** (image2d_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
float4 **read_imagef** (image2d_t *image*, int2 *coord*)
float4 **read_imagef** (image2d_array_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
float4 **read_imagef** (image2d_array_t *image*, int4 *coord*)

int4 **read_imagei** (image2d_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
int4 **read_imagei** (image2d_t *image*, int2 *coord*)
int4 **read_imagei** (image2d_array_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
int4 **read_imagei** (image2d_array_t *image*, int4 *coord*)

uint4 **read_imageui** (image2d_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
uint4 **read_imageui** (image2d_t *image*, int2 *coord*)
uint4 **read_imageui** (image2d_array_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
uint4 **read_imageui** (image2d_array_t *image*, int4 *coord*)

half4 **read_imageh** (image2d_t *image*, sampler_t *sampler*, {int2, float2} *coord*)
half4 **read_imageh** (image2d_t *image*, int2 *coord*)
half4 **read_imageh** (image2d_array_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
half4 **read_imageh** (image2d_array_t *image*, int4 *coord*)

Read and write functions for 2D images (continued)

void **write_imagef** (image2d_t *image*, int2 *coord*, float4 *color*)
void **write_imagef** (image2d_array_t *image*, int4 *coord*, float4 *color*)

void **write_imagei** (image2d_t *image*, int2 *coord*, int4 *color*)
void **write_imagei** (image2d_array_t *image*, int4 *coord*, int4 *color*)

void **write_imageui** (image2d_t *image*, int2 *coord*, uint4 *color*)
void **write_imageui** (image2d_array_t *image*, int4 *coord*, uint4 *color*)

void **write_imageh** (image2d_t *image*, int2 *coord*, half4 *color*)
void **write_imageh** (image2d_array_t *image*, int4 *coord*, half4 *color*)

Read and write functions for 3D images

Read an element from a 3D image, or write a color value to a location in a 3D image.

float4 **read_imagef** (image3d_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
float4 **read_imagef** (image3d_t *image*, int4 *coord*)
int4 **read_imagei** (image3d_t *image*, sampler_t *sampler*, {int4, float4} *coord)*
int4 **read_imagei** (image3d_t *image*, int4 *coord*)
uint4 **read_imageui** (image3d_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
uint4 **read_imageui** (image3d_t *image*, int4 *coord*)
half4 **read_imageh** (image3d_t *image*, sampler_t *sampler*, {int4, float4} *coord*)
half4 **read_imageh** (image3d_t *image*, int4 *coord*)

Use this pragma to enable writes to type image3d_t:
#pragma OPENCL EXTENSION cl_khr_3d_image_writes : enable

void **write_imagef** (image3d_t *image*, int4 *coord*, float4 *color*)
void **write_imagei** (image3d_t *image*, int4 *coord*, int4 *color*)
void **write_imageui** (image3d_t *image*, int4 *coord*, uint4 *color*)
void **write_imageh** (image3d_t *image*, int4 *coord*, half4 *color*)

Access Qualifiers [6.6]

Apply to 2D and 3D image types to declare if the image memory object is being read or written by a kernel.

__read_only, read_only
__write_only, write_only

OpenCL Image Processing (continued): Following is a subset of the OpenCL specification that pertains to image processing and graphics.

Sampler Objects [5.5]

cl_sampler **clCreateSampler** (
cl_context *context*, cl_bool *normalized_coords*,
cl_addressing_mode *addressing_mode*,
cl_filter_mode *filter_mode*, cl_int *errcode_ret)

addressing_mode: CL_ADDRESS_[MIRRORED_]REPEAT, CL_ADDRESS_CLAMP[_TO_EDGE], CL_ADDRESS_NONE
filter_mode: CL_FILTER_{NEAREST, LINEAR}

cl_int **clRetainSampler** (cl_sampler *sampler*)

cl_int **clReleaseSampler** (cl_sampler *sampler*)

cl_int **clGetSamplerInfo** (cl_sampler *sampler*,
cl_sampler_info *param_name*,
size_t *param_value_size*, void *param_value,
size_t *param_value_size_ret)

param_name: CL_SAMPLER_REFERENCE_COUNT, CL_SAMPLER_{CONTEXT, FILTER_MODE}, CL_SAMPLER_ADDRESSING_MODE, CL_SAMPLER_NORMALIZED_COORDS

Sampler Declaration Fields [6.12.14.1]

The sampler can be passed as an argument to the kernel using **clSetKernelArg**, or can be declared in the outermost scope of kernel functions, or it can be a constant variable of type sampler_t declared in the program source.

const sampler_t <sampler-name> =
<normalized-mode> | <address-mode> | <filter-mode>

normalized-mode:
CLK_NORMALIZED_COORDS_{TRUE, FALSE}

address-mode:
CLK_ADDRESS_{REPEAT, CLAMP, NONE},
CLK_ADDRESS_{CLAMP_TO_EDGE, MIRRORED_REPEAT}

filter-mode: CLK_FILTER_NEAREST, CLK_FILTER_LINEAR

Direct3D 10 Sharing [9.9]

Provide interoperability between OpenCL and Direct3D 10. If supported, cl_khr_d3d10_sharing will be present in CL_PLATFORM_EXTENSIONS or CL_DEVICE_EXTENSIONS.

cl_int **clGetDeviceIDsFromD3D10KHR** (
cl_platform_id *platform*,
cl_d3d10_device_source_khr *d3d_device_source*,
void *d3d_object,
cl_d3d10_device_set_khr *d3d_device_set*,
cl_uint *num_entries*, cl_device_id *devices,
cl_uint *num_devices)

d3d_device_source:
CL_D3D10_{DEVICE, DXGI_ADAPTER}_KHR

d3d_device_set:
CL_{ALL, PREFERRED}_DEVICES_FOR_D3D10_KHR

cl_mem **clCreateFromD3D10BufferKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D10Buffer *resource, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

cl_mem **clCreateFromD3D10Texture2DKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D10Texture2D *resource, UINT *subresource*,
cl_int *errcode_ret)

flags: See **clCreateFromD3D10BufferKHR**

cl_mem **clCreateFromD3D10Texture3DKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D10Texture3D *resource, UINT *subresource*,
cl_int *errcode_ret)

flags: See **clCreateFromD3D10BufferKHR**

cl_int **clEnqueueAcquireD3D10ObjectsKHR** (
cl_ command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueReleaseD3D10ObjectsKHR** (
cl_ command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

Direct3D 11 Sharing [9.11]

Provide interoperability between OpenCL and Direct3D 11. If supported, cl_khr_d3d11_sharing will be present in CL_PLATFORM_EXTENSIONS or CL_DEVICE_EXTENSIONS.

cl_mem **clCreateFromD3D11Texture2DKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D11Texture2D *resource,
UINT *subresource*, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

Image Query Functions [6.12.14.5]

Query image width, height, and depth in pixels

int **get_image_width** (image{1,2,3}d_t *image*)
int **get_image_width** (image1d_buffer_t *image*)
int **get_image_width** (image{1,2}d_array_t *image*)

int **get_image_height** (image{2,3}d_t *image*)
int **get_image_height** (image2d_array_t *image*)

int **get_image_depth** (image3d_t *image*)

Query image array size

size_t **get_image_array_size** (image1d_array_t *image*)
size_t **get_image_array_size** (image2d_array_t *image*)

Query image dimensions

int2 **get_image_dim** (image2d_t *image*)
int2 **get_image_dim** (image2d_array_t *image*)
int4 **get_image_dim** (image3d_t *image*)

Query image Channel data type and order

int **get_image_channel_data_type** (image{1,2,3}d_t *image*)
int **get_image_channel_data_type** (image1d_buffer_t *image*)
int **get_image_channel_data_type** (image{1,2}d_array_t *image*)

int **get_image_channel_order** (image{1,2,3}d_t *image*)
int **get_image_channel_order** (image1d_buffer_t *image*)
int **get_image_channel_order** (image{1,2}d_array_t *image*)

OpenGL Sharing

Functions available if cl_khr_gl_sharing or cl_apple_gl_sharing is supported. Creating OpenCL memory objects from OpenGL objects using **clCreateFromGLBuffer**, **clCreateFromGLTexture**, and **clCreateFromGLRenderbuffer** ensure the OpenGL object will not be deleted while the corresponding OpenCL memory object exists.

CL Buffer Objects > GL Buffer Objects [9.7.2]

cl_mem **clCreateFromGLBuffer** (cl_context *context*,
cl_mem_flags *flags*, GLuint *bufobj*, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

CL Image Objects > GL Textures [9.7.3]

cl_mem **clCreateFromGLTexture** (cl_context *context*,
cl_mem_flags *flags*, GLenum *texture_target*,
GLint *miplevel*, GLuint *texture*, cl_int *errcode_ret)

flags: See **clCreateFromGLBuffer**

texture_target: GL_TEXTURE_{1D, 2D}[_ARRAY], GL_TEXTURE_{3D, BUFFER, RECTANGLE}, GL_TEXTURE_CUBE_MAP_POSITIVE_{X, Y, Z}, GL_TEXTURE_CUBE_MAP_NEGATIVE_{X, Y, Z}

CL Image Objects > GL Renderbuffers [9.7.4]

cl_mem **clCreateFromGLRenderbuffer** (
cl_context *context*, cl_mem_flags *flags*,
GLuint *renderbuffer*, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

Query Information [9.7.5]

cl_int **clGetGLObjectInfo** (cl_mem *memobj*,
cl_gl_object_type *gl_object_type,
GLuint *gl_object_name)

*gl_object_type returns:
CL_GL_OBJECT_TEXTURE_BUFFER,
CL_GL_OBJECT_TEXTURE{1D, 2D, 3D},
CL_GL_OBJECT_TEXTURE{1D, 2D}_ARRAY,
CL_GL_OBJECT_{BUFFER, RENDERBUFFER}

cl_int **clGetGLTextureInfo** (cl_mem *memobj*,
cl_gl_texture_info *param_name*,
size_t *param_value_size*, void *param_value,
size_t *param_value_size_ret)

param_name:
CL_GL_{TEXTURE_TARGET, MIPMAP_LEVEL}

Share Objects [9.7.6]

cl_int **clEnqueueAcquireGLObjects** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueReleaseGLObjects** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

CL Event Objects > GL Sync Objects [9.8.2]

cl_event **clCreateEventFromGLsyncKHR** (
cl_context *context*, GLsync *sync*, cl_int *errcode_ret)

CL Context > GL Context, Sharegroup [9.6.5]

cl_int **clGetGLContextInfoKHR** (
const cl_context_properties *properties,
cl_gl_context_info *param_name*, size_t *param_value_size*,
void *param_value, size_t *param_value_size_ret)

param_name: CL_DEVICES_FOR_GL_CONTEXT_KHR, CL_CURRENT_DEVICE_FOR_GL_CONTEXT_KHR

DX9 Media Surface Sharing [9.10]

These functions allow applications to use media surfaces as OpenCL memory objects. If this extension in supported, cl_khr_dx9_media_sharing will be present in CL_PLATFORM_EXTENSIONS or CL_DEVICE_EXTENSIONS.

cl_int **clGetDeviceIDsFromDX9MediaAdapterKHR** (
cl_platform_id *platform*, cl_uint *num_media_adapters*,
cl_dx9_media_adapter_type_khr *media_adapters_type*,
void *media_adapters,
cl_dx9_mem_adapter_set_khr *media_adapter_set*,
cl_uint *num_entries*, cl_device_id *devices,
cl_int *num_devices)

media_adapter_type: CL_ADAPTER_{D3D9, D3D9EX, DXVA}_KHR
media_adapter_set: CL_ALL_DEVICES_FOR_DXP_MEDIA_ADAPTER_KHR, CL_PREFERRED_DEVICES_FOR_DX9_MEDIA_ADAPTER_KHR

cl_mem **clCreateFromDX9MediaSurfaceKHR** (
cl_context *context*, cl_mem_flags *flags*,
cl_dx9_media_adapter_type_khr *adapter_type*,
void *surface_info*, cl_uint *plane*, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE
adapter_type: CL_ADAPTER_{D3D9, D3D9EX, DXVA}_KHR

cl_int **clEnqueueAcquireDX9MediaSurfacesKHR** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueReleaseDX9MediaSurfacesKHR** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clGetDeviceIDsFromD3D11KHR** (
cl_platform_id *platform*,
cl_d3d11_device_source_khr *d3d_device_source*,
void *d3d_object,
cl_d3d11_device_set_khr *d3d_device_set*,
cl_uint *num_entries*, cl_device_id *devices,
cl_uint *num_devices)

d3d_device_source: CL_D3D11_DEVICE_KHR, CL_D3D11_DXGI_ADAPTER_KHR
d3d_device_set: CL_PREFERRED_DEVICES_FOR_D3D11_KHR, CL_ALL_DEVICES_FOR_D3D11_KHR

cl_mem **clCreateFromD3D11BufferKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D11Buffer *resource, cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

cl_mem **clCreateFromD3D11Texture3DKHR** (
cl_context *context*, cl_mem_flags *flags*,
ID3D11Texture3D *resource, UINT *subresource*,
cl_int *errcode_ret)

flags: CL_MEM_{READ, WRITE}_ONLY, CL_MEM_READ_WRITE

cl_int **clEnqueueAcquireD3D11ObjectsKHR** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

cl_int **clEnqueueReleaseD3D11ObjectsKHR** (
cl_command_queue *command_queue*,
cl_uint *num_objects*, const cl_mem *mem_objects,
cl_uint *num_events_in_wait_list*,
const cl_event *event_wait_list, cl_event *event)

OpenCL Reference Card Index

The following index shows each item included on this card along with the page on which it is described. The color of the row in the table below is the color of the box to which you should refer.

KHRONOS GROUP

The Khronos Group is an industry consortium creating open standards for the authoring and acceleration of parallel computing, graphics and dynamic media on a wide variety of platforms and devices. See www.khronos.org to learn more about the Khronos Group.