INTEL® DPC++ COMPATIBILITY TOOL

AGENDA

- What is Intel® DPC++ Compatibility Tool?
- Migration Flow
  - One File Migration
  - vecAdd Example
  - Migration of Larger Code Bases
- Advanced Options

INTEL® DPC++ COMPATIBILITY TOOL(BETA)
MINIMIZES CODE MIGRATION TIME

- Intel® oneAPI Base Toolkit component
- Assists developers migrating code written in CUDA* to DPC++, generating **human readable** code wherever possible
- Inline comments are provided to help developers complete their code
- Windows* and Linux*, IDE integration support

https://software.intel.com/en-us/get-started-with-intel-dpcpp-compatibility-tool

BEFORE YOU BEGIN

Setup the environment

Linux: *source /Path/to/dpcpp-ct/latest/env/vars.sh*

or

source /opt/intel/inteloneapi/setvars.sh

Windows: *Drive:\Path\to\dpcpp-ct\latest\env\vars.bat*

or

C:\Program Files (x86)\inteloneapi\setvars.bat

Command Line Syntax

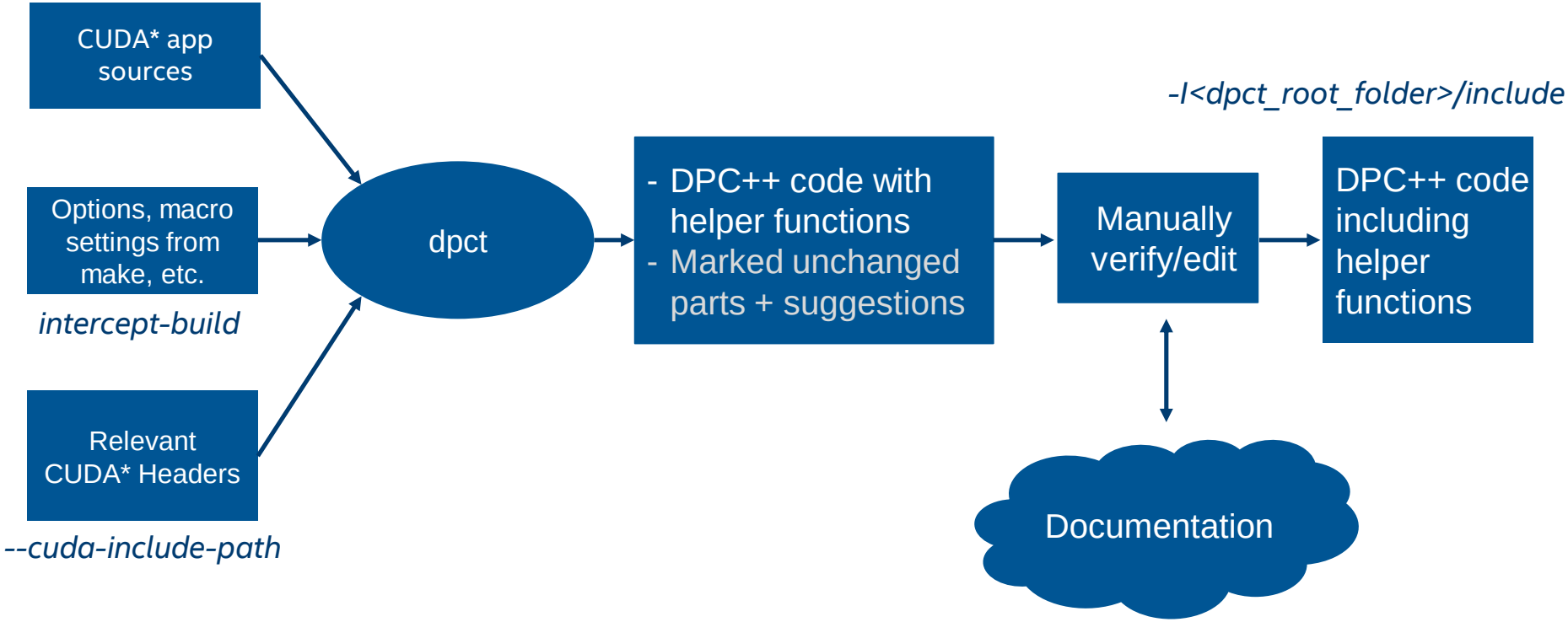
dpct [options] [<source0>... <sourceN>]

Built-in Usage Information

dpct --help

dpct -- -help

USAGE WORKFLOW



https://software.intel.com/en-us/get-started-with-intel-dpcpp-compatibility-tool-diagnostics-reference

WHAT IS NOT MIGRATED?

Tool highlights issues with migration via warnings and code comments

- grep for *DPCT10*

Warnings format:

```
/path/to/file.hpp:26:1: warning: DPCT10XX:0: text of the warning.
// source code line for which warning was generated
^
```

Check documentation for detailed explanation and suggestions to fix

https://software.intel.com/en-us/get-started-with-intel-dpcpp-compatibility-tool-diagnostics-reference

SIMPLE ONE FILE MIGRATION

dpct vectorAdd.cu

- Requires certain CUDA* header files. Default files location:
  - */usr/local/cuda/include*
  - */usr/local/cuda-x.y/include*
- Supported versions: 8.0, 9.0, 9.1, 9.2, 10.0, 10.1
- Migrates CUDA* code *vectorAdd.cu* to DPC++ code *dpct_output/vectoradd.dp.cpp*

dpct --cuda-include-path=<path/to/cuda/include> vectorAdd.cu

dpct --extra-arg="-std=c++11" code_wtih_c++11.cu

```
#include <cuda.h>

#define VECTOR_SIZE 4
__global__ void VectorAddKernel (float *A, float *B, float *C)
{
  A[threadIdx.x] = threadIdx.x + 1.0f;
  B[threadIdx.x] = threadIdx.x + 1.0f;
  C[threadIdx.x] = A[threadIdx.x] + B[threadIdx.x];
}

int main()
{



  float *d_A, *d_B, *d_C;
  cudaMalloc(&d_A, VECTOR_SIZE*sizeof(float));
  cudaMalloc(&d_B, VECTOR_SIZE*sizeof(float));
  cudaMalloc(&d_C, VECTOR_SIZE*sizeof(float));



  VectorAddKernel<<<1, VECTOR_SIZE>>>(d_A, d_B, d_C);



  float Result[VECTOR_SIZE] = { };
  cudaMemcpy(Result, d_C,VECTOR_SIZE*sizeof(float),cudaMemcpyDeviceToHost);

  cudaFree(d_A);
  cudaFree(d_B);
  cudaFree(d_C);
}
```

Header files

Kernel

Mem alloc

Kernel call

Mem copy

Mem free

```
#include <CL/sycl.hpp>
#include <dpct/dpct.hpp>
#define VECTOR_SIZE 4
void VectorAddKernel (float *A, float *B, float *C, sycl::nd_item<3> item_ct1)
{
  A[item_ct1.get_local_id(2)] = item_ct1.get_local_id(2) + 1.0f;
  B[item_ct1.get_local_id(2)] = item_ct1.get_local_id(2) + 1.0f;
  C[item_ct1.get_local_id(2)] = A[item_ct1.get_local_id(2)] + B[item_ct1.get_local_id(2)];
}

int main()
{
  dpct::device_ext &dev_ct1 = dpct::get_current_device();
  sycl::queue &q_ct1 = dev_ct1.default_queue();

  float *d_A, *d_B, *d_C;
  d_A = sycl::malloc_device<float>(VECTOR_SIZE, q_ct1);
  d_B = sycl::malloc_device<float>(VECTOR_SIZE, q_ct1);
  d_C = sycl::malloc_device<float>(VECTOR_SIZE, q_ct1);

  q_ct1.submit([&](sycl::handler &cgh){
    cgh.parallel_for(sycl::nd_range(sycl::range(1, 1, VECTOR_SIZE),
      sycl::range(1, 1, VECTOR_SIZE)), [=](sycl::nd_item<3> item_ct1) {
      VectorAddKernel(d_A, d_B, d_C, item_ct1);
    });
  });

  float Result[VECTOR_SIZE] = { };
  q_ct1.memcpy(Result, d_C, VECTOR_SIZE * sizeof(float)).wait();

  sycl::free(d_A, q_ct1);
  sycl::free(d_B, q_ct1);
  sycl::free(d_C, q_ct1);
}
```

MIGRATION OF LARGER CODE BASES

1. Create a compilation database file

   intercept-build make

2. Migrate your source to DPC++

   dpct -p compile_commands.json -in-root=$PROJ_DIR -out-root=dpcpp_out *.cu

3. Verify the source for correctness and fix not migrated parts

https://software.intel.com/en-us/intel-dpcpp-compatibility-tool-user-guide-usage-workflow-overview

ADVANCED OPTIONS

--enable-ctad

- Use a C++17 class template argument deduction (CTAD) in generated code

  Default: off

```
dpct::get_default_queue_wait().submit([&](sycl::handler &cgh) {
  cgh.parallel_for(sycl::nd_range<3>(sycl::range<3>(1, 1, 1) *
                                     sycl::range<3>(1, 1, VECTOR_SIZE),
                                     sycl::range<3>(1, 1, VECTOR_SIZE)),
                   [=](sycl::nd_item<3> item_ct1) {
                     VectorAddKernel(d_A, d_B, d_C, item_ct1);
                   });
});
```

default

```
dpct::get_default_queue_wait().submit([&](sycl::handler &cgh) {
  cgh.parallel_for(
      sycl::nd_range(sycl::range(1, 1, 1) * sycl::range(1, 1, VECTOR_SIZE),
                     sycl::range(1, 1, VECTOR_SIZE)),
      [=](sycl::nd_item<3> item_ct1) {
        VectorAddKernel(d_A, d_B, d_C, item_ct1);
      });
});
```

--enable-ctad

https://github.com/intel/llvm/tree/sycl/sycl/doc/extensions/deduction_guides

ADVANCED OPTIONS

--sycl-named-lambda

- Generates kernels with the kernel name

  Default: off

```
dpct::get_default_queue_wait().submit([&](sycl::handler &cgh) {
  cgh.parallel_for(sycl::nd_range<3>(sycl::range<3>(1, 1, 1) *
                                     sycl::range<3>(1, 1, VECTOR_SIZE),
                                     sycl::range<3>(1, 1, VECTOR_SIZE)),
                   [=](sycl::nd_item<3> item_ct1) {
                    VectorAddKernel(d_A, d_B, d_C, item_ct1);
                   });
});
```

default

```
dpct::get_default_queue_wait().submit([&](sycl::handler &cgh) {
  cgh.parallel_for<dpct_kernel_name<class VectorAddKernel_5218d9>>(
      sycl::nd_range<3>(sycl::range<3>(1, 1, 1) *
                        sycl::range<3>(1, 1, VECTOR_SIZE),
                        sycl::range<3>(1, 1, VECTOR_SIZE)),
      [=](sycl::nd_item<3> item_ct1) {
       VectorAddKernel(d_A, d_B, d_C, item_ct1);
      });
});
```

--sycl-named-lambda

https://github.com/intel/llvm/tree/sycl/sycl/doc/extensions/UnnamedKernelLambda

ADVANCED OPTIONS

--no-cl-namespace-inline

- Do not use cl namespace (cl::) inlining

  Default: off

```
d_A = (float *)sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                   dpct::get_current_device(),
                                   dpct::get_default_context());
d_B = (float *)sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                   dpct::get_current_device(),
                                   dpct::get_default_context());
d_C = (float *)sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                   dpct::get_current_device(),
                                   dpct::get_default_context());
```

default

```
d_A = (float *)cl::sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                       dpct::get_current_device(),
                                       dpct::get_default_context());
d_B = (float *)cl::sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                       dpct::get_current_device(),
                                       dpct::get_default_context());
d_C = (float *)cl::sycl::malloc_device(VECTOR_SIZE * sizeof(float),
                                       dpct::get_current_device(),
                                       dpct::get_default_context());
```

--no-cl-namespace-inline

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Q&A