

Sunita Chandrasekaran Associate Professor, University of Delaware PDC Summer School, Aug 2023 Slides courtesy AMD Getting Started with OpenMP® Offload Applications on AMD Accelerators

> Presenter: Event: Date:

AMD together we advance_

Agenda

- 1. AMD Open Source Software Stack: Recap
- 2. Building Simple OpenMP® Offload Applications
- B. Hybrid MPI + OpenMP® Offload Applications Support
- 4. Runtime Report for Performance Investigation
- 5. Summary

AMD ROCm[™] Software Stack: Recap

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NDA NOT REQUIRED | AMD PUBLIC USE

OPEN SOFTWARE PLATFORM FOR GPU COMPUTE

ROCm

- Unlocked GPU Power To Accelerate Computational Tasks
- Optimized for HPC and Deep Learning Workloads at Scale
- Open Source Enabling Innovation,
 Differentiation, and
 Collaboration

Derict marks & App SupportMLPERFHPL/HPCGLife ScienceGeo SciencePhysicsOperating Systems Support $RHEL$ $CentOS$ $SLES$ UbuntuCluster DeploymentSingularity $Kubernetes$ $Docker$ $SLURM$ Framework Support $Kokkos/RAJA$ $PPyTorch$ $TensorFlow$ BLAS $RAND$ FFT $MIGraphX$ $MIVisionX$ $PRIM$ BUAS $RAND$ $SPARSE$ $THUST$ $MIOpen$ $RCCL$ Programming Models $OpenMPerAPI$ $OpenIter$ $OpenIter$ $Debuger$ $hipify$ $GPUFort$	Panahmarka & Ann Sunnert	Optimized Training/Inference Models & Applications					
Operating Systems SupportRHELCentOSSLESUbuntuCluster DeploymentSingularityKubernetes®Docker®SLURMFramework SupportKokkos/RAJAPyTochTensorFlowBLASRANDFFTMIGraphXMIVisonXPRIMSOLVERALUTONSPARSETHRUSTMIOpenRCCLProgramming ModelsOpenMP® APOpenL™DebuggerhjfyGPUFort	Benchmarks & App Support	MLPERF	HPL/HPCG	G Life S	cience Ge	o Science	Physics
Cluster DeploymentSingularityKubernetes®Docker®SLURMFramework SupportKokkos/RAJAPyTochTensor-FlowBLASRANDFFTMIGraphXMIVisionXPRIMBLASCOLVERALUTONSPARSETHRUSTMIOTONRCCLProgramming ModelsOpenMP® APIOpencL™HIPAPIHIPAPIGPUFortDevelopment ToolchainCompilerProfilerTracerDebuggerhjufyGPUFort	Operating Systems Support	RHEL (CentOS SL		3	Ubuntu
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Development Toolchain Compiler Profiler Tracer Debugger hipify GPUFort	Programming Models	OpenMP® API		OpenCL™		HIP API	
	Development Toolchain	Compiler P	rofiler	Tracer	Debugger	hipify	GPUFort
Drivers & Runtime GPU Device Drivers and ROCm Run-Time	Drivers & Runtime	GPU Device Drivers and ROCm Run-Time					
Deployment Tools ROCm Validation Suite ROCm Data Center Tool ROCm SMI	Deployment Tools	ROCm Validation Suite ROCm Data Center ROCm SMI				Cm SMI	

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Compilers(1)

ROCmCC and AOMP

- ROCmCC provides support for both HIP and OpenMP®
- AOMP: the AMD OpenMP® research compiler for AMD Instinct[™] accelerators. It is used to prototype new OpenMP® features for ROCmCC

GNU Compilers (GNU Compiler Collection - <u>https://gcc.gnu.org/wiki/Offloading</u>)

- Provide offloading support to AMD GPUs (OpenMP®, OpenACC)
 - GCC 11 supports additionally:
 - AMD GCN MI100 (gfx908) GPUs.
 - GCC 13 (under development) adds support for AMD's Instinct MI200 (gfx90a) GPU series.
 - The devel/omp/gcc-12 (OG12) branch augments the GCC 12 branch with OpenMP and offloading features.

Compilers(2)

- Siemens® Compilers (Sourcery CodeBench Lite C/C++/Fortran)
 - Siemen's free GCC-based compilers
 - Supports all GCC 12 features, enriched by OpenMP® features from GCC's development branch and AMD GCN improvements such as support for offloading debugging.
 - Still under development.
- If you are on an AMD/HPE HPC system, there are additional options Cray Compilers (HPE compilers)
 Provide offloading support to AMD GPUs (OpenMP®, HIP, OpenACC)
- List of OpenMP Compilers & Tools :
 - <u>https://github.com/ROCm-Developer-Tools/aomp</u>
 - <u>https://www.openmp.org/resources/openmp-compilers-tools</u>

Compilers(3)

	Cray			AMD			
Module	ссе			ROCm™			
Language	С	C++	Fortran	С	C++	Fortran	HIP
Compiler	craycc	crayCC	crayftn	amdclang	amdclang++	amdflang	hipcc
				clang clang-cl	clang++	flang	

hipcc: wrapper for amdclang/amdclang++. It also makes sure to call either amdclang or nvcc based on the platform. Useful portability.

In case of porting CUDA codes to HIP, ROCm[™] provides 'HIPification' tools to do the heavy-lifting Please consider using HIPify tools like Hipify-perl or Hipify-clang

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ROCm Library	Note/comment
hipBLAS/rocBLAS	Basic Linear Algebra Subroutines
hipFFT/rocFFT	Fast Fourier Transfer Library
hipSPARSE/rocSPARSE	Sparse BLAS + SPMV
hipSolver/rocSolver	Lapack Library
rocALUTION	Sparse iterative solvers & preconditioners with Geometric & Algebraic MultiGrid
hipThrust/rocThrust	C++ parallel algorithms library
rocPRIM	Low Level Optimized Parallel Primitives
MIOpen	Deep learning Solver Library
hipRAND/rocRAND	Random Number Generator Library
EIGEN – HIP port	C++ template library for linear algebra: matrices, vectors, numerical solvers
RCCL	Communications Primitives Library based on the MPI equivalents

Latest status available at: https://github.com/ROCm-Developer-Tools/HIP

This talk focuses on simple and hybrid (MPI +) OpenMP Offload Application building and running on AMD GPUs