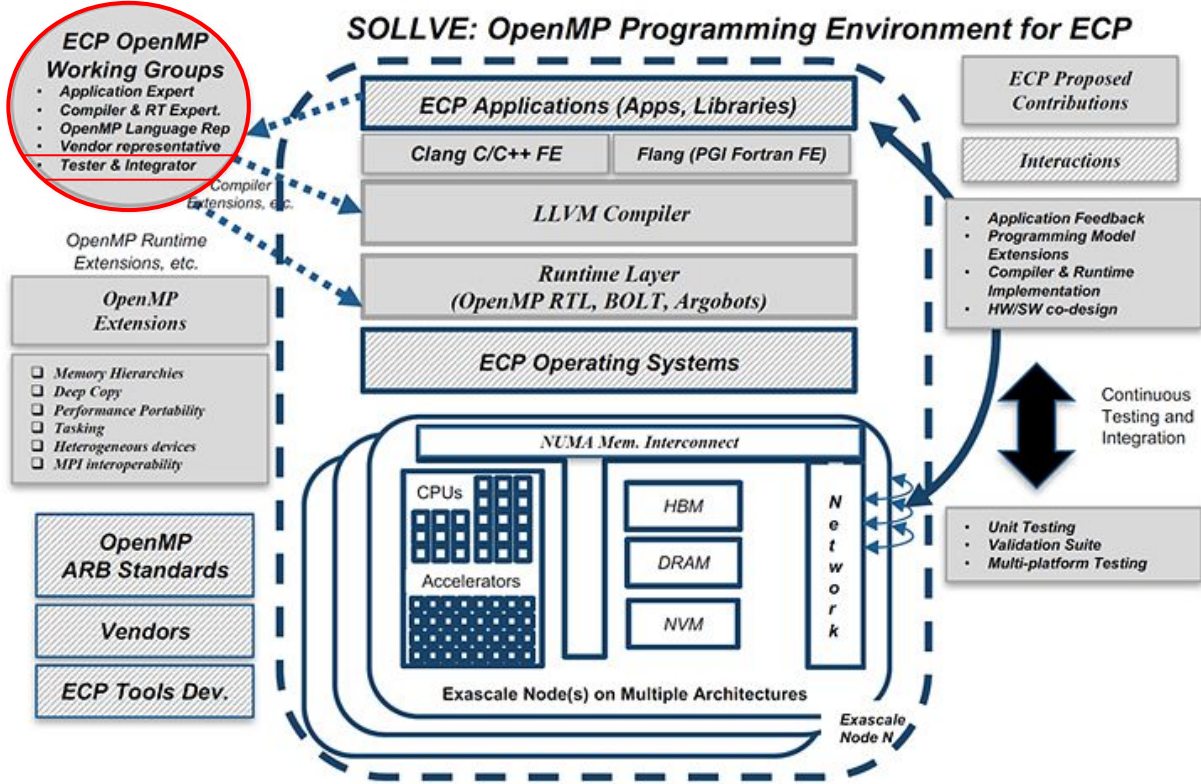


ECP SOLLVE: OpenMP Validation and Verification Testsuite

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Swaroop Pophale, Seyong Lee, David E. Bernholdt



Exascale Computing Project: SOLLVE



SOLLVE V&V Current Team



- Andrew Kallai
- Felipe Cabarcas
- Sunita Chandrasekaran
- Swaroop Pophale
- Seyong Lee
- David E. Bernholdt
- Outside the project Contributors
 - AMD, Siemens
- Former Project Members
 - Nolan Baker, Michael Carr, Nikhil Rao, Jaydon Reap, Kristina Holsapple, Joshua Hoke Davis, Thomas Huber, Jose M. Monsalve

SOLLVE V&V Objectives

- Tests implementations of new features introduced in OpenMP 4.5+
- Checks conformance to the specification
 - Peer reviewed, publicly available
- Highlights ambiguities in the OpenMP specification
- Reports status of implementations on primary ECP target platforms
 - Help application and compiler developers
- Exemplifies the use of the new features in OpenMP
- Abstracts application kernels as tests

Latest OpenMP Specification: 5.2

- Released November 2021
 - Around 27 modifications (new features, deprecated features, behavior changes)
 - Some of these modifications to the specification are implemented in popular compilers
 - GCC provides status here <https://gcc.gnu.org/wiki/openmp>
 - LLVM provides status here <https://clang.llvm.org/docs/OpenMPsupport.html#openmp-5-1-implementation-details>
 - Leads to writing tests from scratch, with no compilers to test with
- 6.0 specification is scheduled to be released on November 2024

OpenMP Validation and Verification (V&V) Testsuite

- Clone the repo https://github.com/SOLLVE/sollve_vv
- Setup your environment (install or 'module load' your compilers)
- Use our make commands to compile and run a single test or the whole suite
 - Running a single test:

```
make CC=clang CXX=clang++ FC=flang-new OMP_VERSION=5.2 SOURCES=test_name all
```

- Running the entire suite

```
make CC=clang CXX=clang++ FC=flang-new OMP_VERSION=5.2 all
```

Tests and Coverage

	Number of Tests			
	C	C++	Fortran	Totals
4.5	116	14	103	233
5.0	180	21	126	318
5.1	89	4	19	108
5.2	15	2	4	20
Total	397	30	252	679

	Approximated coverage of requested features		
	C	C++	Fortran
4.5	100%	100%	100%
5.0	88%	100%	88%
5.1	87%	100%	40%
5.2	84%	100%	19%

- The testsuite not only contains tests for the new features of each specification, but also commonly used combinations by developers
 - We have given priority to requested features over complete coverage

Systems and Compilers Regularly tested

System	Perlmutter	Summit	Frontier	Sunspot
Location	NERSC	ORNL	ORNL	ANL
CPU/GPU type	AMD/Nvidia	IBM/Nvidia	AMD/AMD	Intel/Intel
GNU (gcc/gfortan)	YES	YES	NO	NO
LLVM (clang/flang-new)	YES	YES	YES	NO
AMD ROCM (amdclang/amdflang)	NO	NO	YES	NO
HPE/Cray (cce)	YES	NO	YES	NO
IBM (xlc, xlf)	NO	YES	NO	NO
NVIDIA (nvc, nvfortran)	NO	YES	YES	NO
INTEL (icpx, ifx)	NO	NO	NO	YES

OpenMP | Validation & verification

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RESULTS

These results were last reviewed October 16, 2023

Compilers tested on respective systems:

Summit - CPU: **IBM POWER9**, GPU: **NVIDIA V100** - GNU (13.2.1), LLVM (18.0.0), XLC(16.01), NVHPC (22.11)

Frontier - CPU: **AMD EPYC 7A53**, GPU: **AMD MI250X** - CCE(16.0.6), AMDCLANG (17.0.0), LLVM (18.0.0)

Perlmutter - CPU: **AMD Milan EPYC**, GPU: **NVIDIA A100** - GNU (12.1.1), NVHPC (23.1), CCE (16.0.6), LLVM (18.0.0)

Sunspot - CPU: **Intel Xeon Sapphire**, GPU: **Intel Ponte Vecchio** - INTEL Compiler (17.0.0)

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Compilers

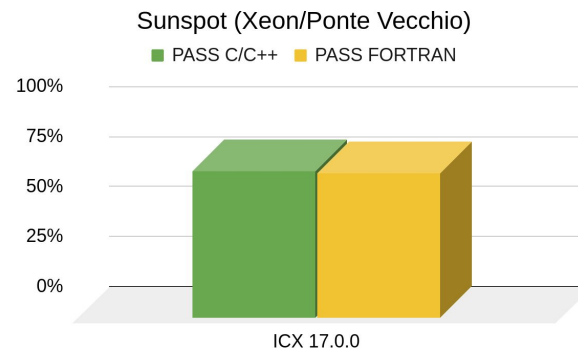
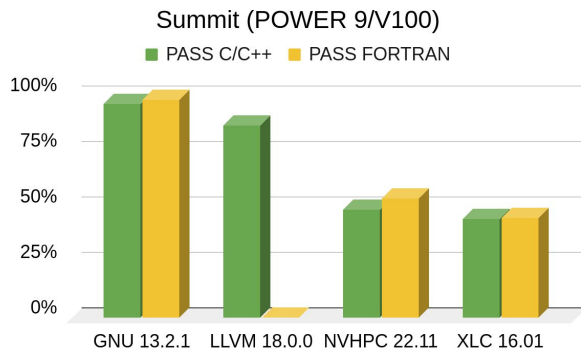
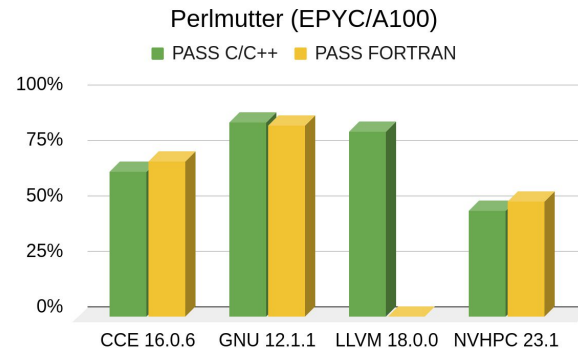
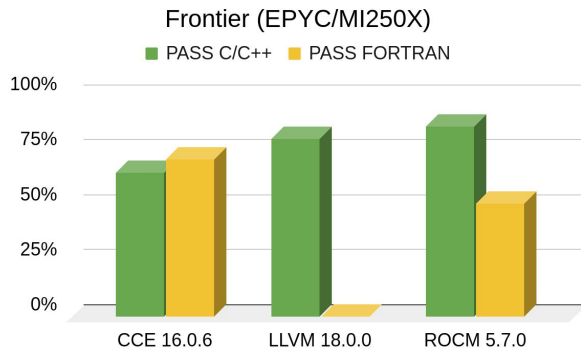
- CC 16.0.6
- ftn Cray Fortran : 16.0.1
- cc 16.0.6

Systems

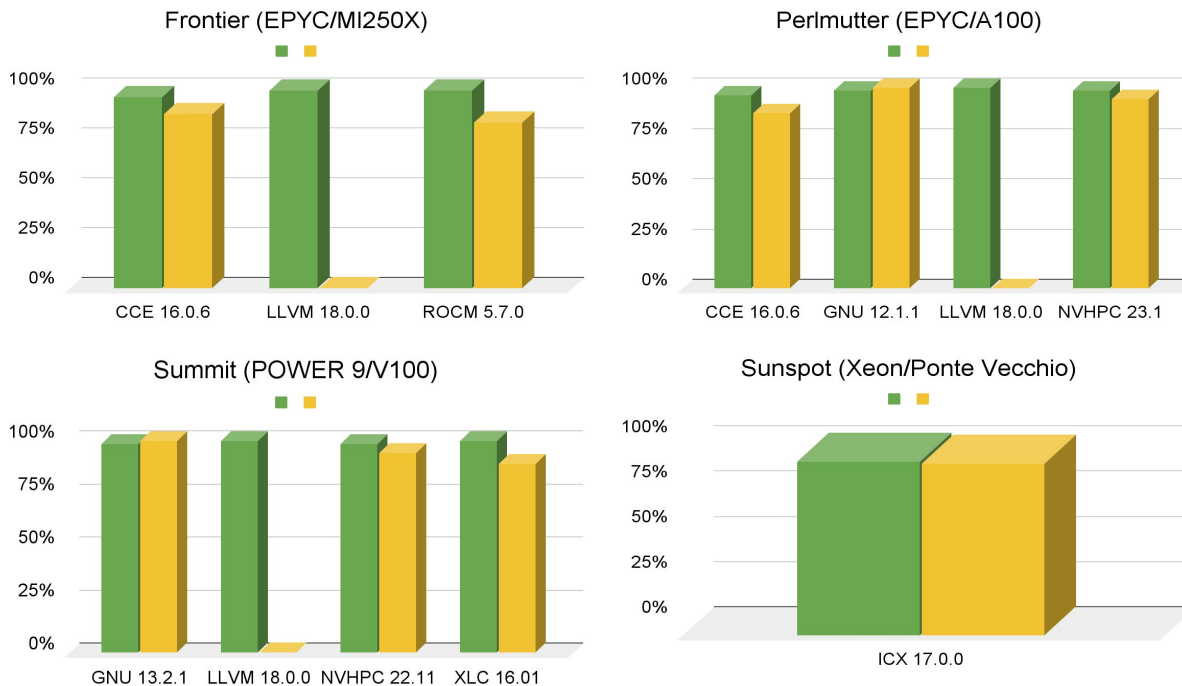
- frontier
- perlmutter
- summit

OpenMP Specification Version

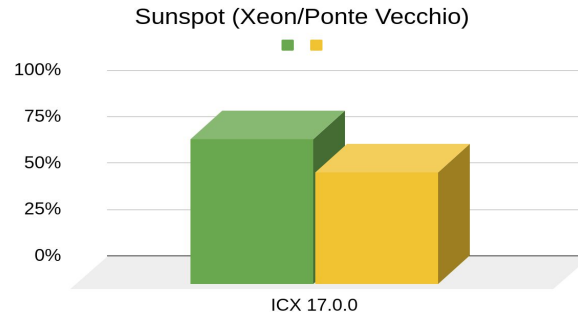
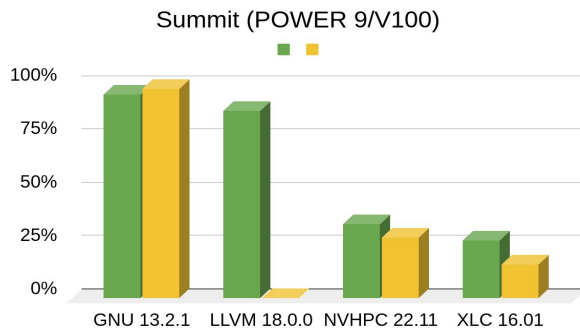
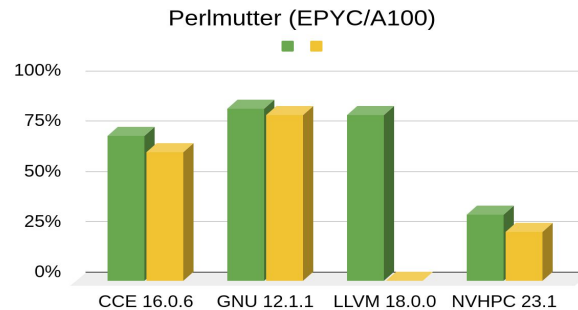
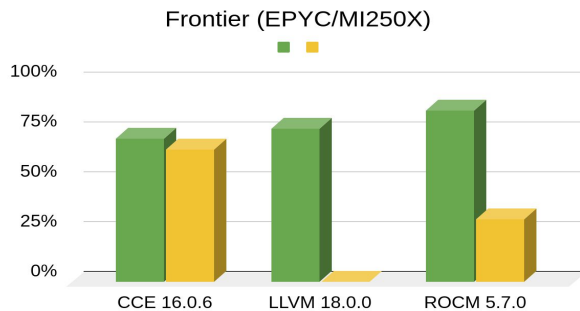
Overall Results



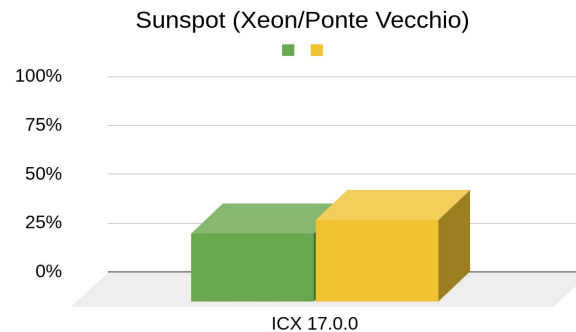
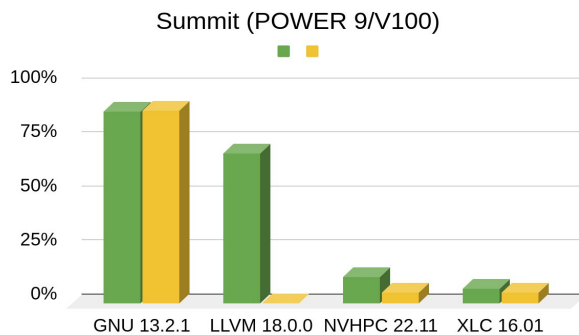
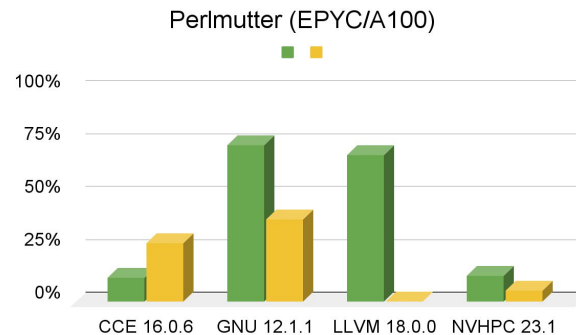
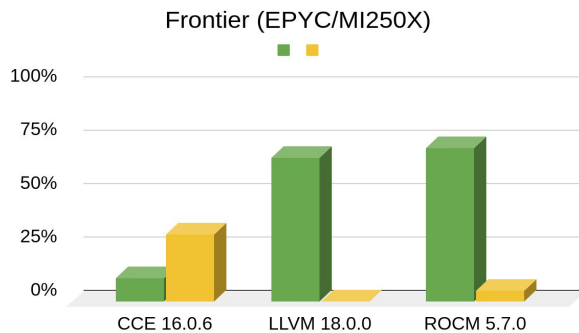
Results OpenMP 4.5



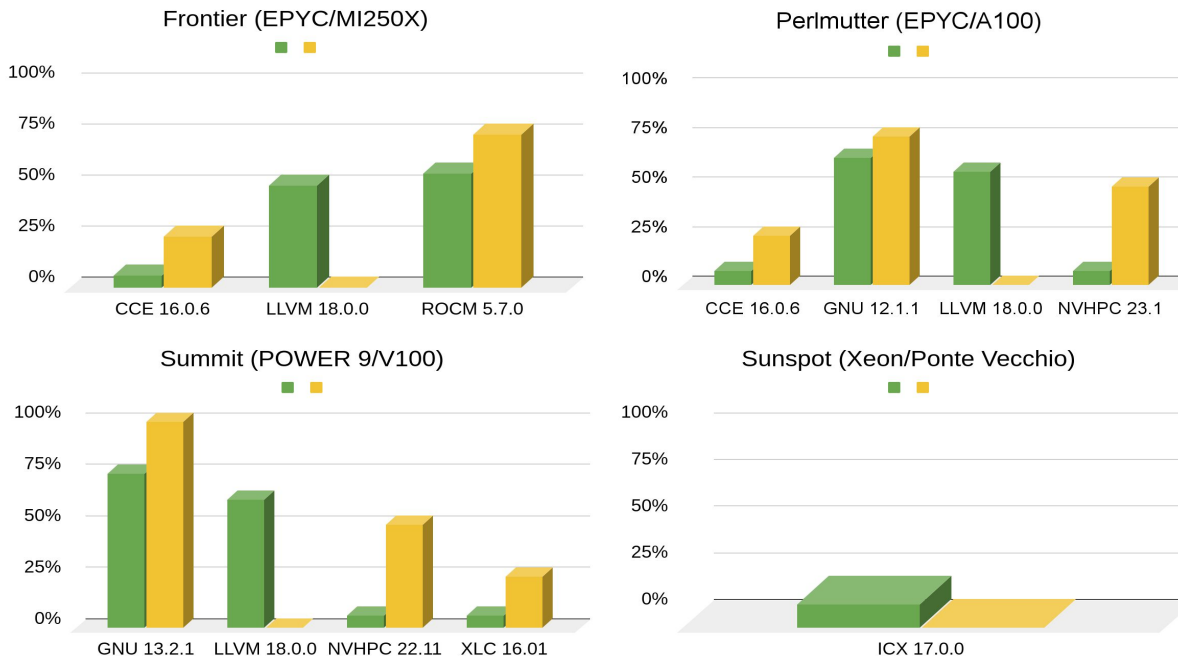
Results OpenMP 5.0



Results OpenMP 5.1



Results OpenMP 5.2



Beyond V&V

- At UD: Aaron Jarmusch, Aaron Liu and Vaidhyathan Ravichandran are
 - Integrating regression and stress testing into the SOLLVE V&V Testsuite
 - Creating a CI infrastructure to test LLVM OpenMP on GPU systems
 - Running SOLLVE V&V, Heckbench and AMD's Smoke
 - Focusing on offloading for AMD and NVIDIA GPU systems
 - <https://gitlab.e4s.io/uo-public/llvm-sollve/-/pipelines>
 - Using a system @ University of Oregon
 - Creating an LNT
 - LLVM Nightly Testing: a set of client and server tools for monitoring the performance of software over its lifecycle
 - <http://lnt.llvm.org/>

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LLVM SOLLVE

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uo-public > LLVM SOLLVE > Pipelines

All 55 Finished Branches Tags

Filter pipelines

Status	Pipeline	Created by	Stages
passed 00:47:09 14 hours ago	Merge branch 'force-build-off' into 'main' #9812 P main → 13d5dc52 Scheduled latest		✓
passed 00:46:49 1 day ago	Merge branch 'force-build-off' into 'main' #9795 P main → 13d5dc52 Scheduled latest		✓
passed 00:47:20 2 days ago	Merge branch 'force-build-off' into 'main' #9787 P main → 13d5dc52 Scheduled latest		✓
passed 00:48:07 2 days ago	Changing the tests that are being run for ... #9785 P gpu-change → 037a3e8b latest		✓
passed 00:54:18 3 days ago	Merge branch 'force-build-off' into 'main' #9779 P main → 13d5dc52 latest		✓
passed 00:46:58 3 days ago	hecbench, sollve vv: checkout specific com... #9763 P main → 92edf5b7 Scheduled		✓

SOLLVE / solve_vv

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master 387 branches 0 tags Go to file Add file Code

seyonglee Add new_test/5.1/atomic/test_atomic_fail_seq_cst.F90 (#766) ... a6a94ab 2 weeks ago 1,477 commits

.github	Update test-request.md	2 months ago
ompvv	Add OMPVV_NUM_TEAMS_HOST for Fortran	5 months ago
sys	Providing option to the user to set time limit using SOLLVE_TIMELIMI...	2 weeks ago
template	Remove shared env macro from target and target data tests (#143)	3 years ago
tests	Add new_test/5.1/atomic/test_atomic_fail_seq_cst.F90 (#766)	2 weeks ago
.gitignore	Update gitignore to correctly ignore recent report online tags, pycac...	2 years ago
LICENSE	Correct LICENSE name (#173)	3 years ago
Makefile	Minor fixes: typos, zero-sized VLA, memory leaks	2 months ago
README.md	Update README.md	2 years ago

README.md

Welcome

Welcome to SOLLVE V&V sub-project!

About

OpenMP Offloading Validation & Verification Suite; Official repository. We have migrated from bitbucket!! For documentation, results, publication and presentations, please check out our website ->

crpl.cis.udel.edu/ompvvsolve/

testing validation openmp verification compilers testing-framework openmp-offloading openmp-target

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