

Additional Progress and Status

Chapel Team, Cray Inc.

Chapel version 1.9

April 17th, 2014 (released) / May 2014 (documented)



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Launcher Improvements

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Add slurm-srun Launcher

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Background: Chapel was missing a flexible Slurm launcher

- existing Slurm launcher was for GASnet over InfiniBand only
- Slurm is becoming an increasingly popular WLM in general
- Cray has been developing a native Slurm implementation
 - new Chapel Slurm launcher was required to run jobs on machines using it

This Effort: add a slurm-srun launcher

- based on the existing slurm_gasnetrun_ibv launcher
- updated with more options to match pbs-aprun and aprun launchers
- should work on Slurm systems regardless of network or comm layer

Impact:

- able to successfully run programs using slurm-srun launcher
 - tested on XC30 for programs using gasnet comm layer
 - 1.9 implementation did not work with the ugni comm layer (fixed for 1.9.0.1)
- supports most of the same features as pbs-aprun and aprun launchers
 - cpu binding for affinity is not supported (can be supplied as slurm env var)



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“Native” slurm isn’t real term. It is more of the term that Cray is using for its slurm launcher since the initial efforts towards a slurm launcher was slurm over alps. Note that this launcher also works for Slurm outside of Cray systems

Initially, the slurm-srun launcher was put together close to the 1.9 release and had some bugs in it. These bugs led to suboptimal performance and didn’t work with the UGNI comm layer. These issues have since been fixed and will go out with the 1.9.0.1 release (Cray module only).

Add slurm-srun Launcher

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Next Steps: further improvements and merging of launchers

- add ability to bind tasks to CPUs for better affinity
- test launcher on various machines
 - check for compatibility with InfiniBand networks, etc
- try to merge the slurm-srun and slurm-gasnetrun_ibv launchers
- start regular testing of the launcher
 - as resources become available



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The slurm-gasnetrun_ibv uses gasnetrun for infiniband to launch jobs instead of srun. It's not clear yet if we will be able to merge them or if there are cases where srun will not be able to launch jobs over infiniband; or whether maintaining the GASNet launcher will have other benefits.

Improve pbs-aprun Launcher

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Background: pbs-aprun launcher was broken for Moab/Torque

- known bug with Moab/Torque WLM prevented jobs from starting
- for machines running PBSPRO, our launcher still worked

This Effort: update launcher to work around Moab/Torque bug

- add ability to determine the specific WLM being used
- if Moab/Torque is the WLM, then workaround the bug

Impact:

- pbs-aprun launcher works again for Moab/Torque WLM
- pbs-aprun continues to work with PBSPRO WLM



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Moab/Torque recently (since Chapel 1.8) stopped starting jobs that have mppdepth=<numcpus> as part of the resource requirement. This is a known problem and as a workaround we now simply specify the number of nodes and walltime for Moab/Torque jobs and let aprun specify the number of cpus to use.

Previously we didn't differentiate WLMs as well as we could have. PBSPRO was detected, but Moab/Torque got detected as 'unknown' and just had default settings used. The fix updated the launcher so we identify when we are using moab/torque and change our resource request appropriately.

Fixed with r23049 on 04/02/2014



Portability Improvements

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Native atomics for Intel and Cray

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Background:

- Prior to this release atomics were supported for only some compilers:
 - gnu, cray-prgenv-gnu, cray-prgenv-intel
- Fallback uses sync variables and is far more expensive

This Effort:

- Enabled intrinsic atomics for intel and cray-prgenv-cray compilers
 - pgi/cray-prgenv-pgi not an option due to lack of support for atomic intrinsics

Impact:

- Significant performance improvements if using those compilers
 - (we don't in performance testing shown in these slide decks)

Next Steps:

- Implement atomics in terms of C11 constructs



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To clarify, the difference between the 'foo' compiler and the 'cray-prgenv-foo' compiler is that the former refers to running the compiler directly (e.g., fcc) and the latter refers to running the Cray Programming Environment's 'cc' that wraps 'fcc'. These are treated as distinct compiler targets within Chapel to account for any distinct flags or default configurations that the Cray Programming Environment adds.

Third-party Improvements



GASNet:

- Upgraded to version 1.22.0
- Made 'aries' the default conduit for cray-xc platform by default
- Disabled 'pshm' for all non-udp GASNet conduits

GMP:

- Updated to version 6.0.0

hwloc:

- Added a snapshot of 1.7.2 to the release

re2:

- Added a snapshot of 20140111 to the release

Qthreads:

- made various minor improvements to our snapshot of 1.10

dygraphs:

- added a snapshot for generating performance graphs



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Other Portability Improvements



- **Significantly Improved Portability to Mac OS X**
 - used by default by most new hires to the team
 - changes included:
 - back-end compiler portability improvements
 - third-party package portability improvements
 - generated code improvements



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Outreach and Community Engagement

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Presentations



Pacific Northwest Numerical Analysis Seminar (PNWNAS):

- **[The Chapel Parallel Programming Language](#)**
 - 45-minute invited talk
 - October 19th, Seattle WA
 - ~65 attendees: students, faculty, and industry from WA, OR, ID, BC

SC13 Talks:

- **[Hierarchical Locales: Exposing the Node Architecture in Chapel](#)**
 - 20-minute invited talk
 - November 19th, KISTI Booth, Denver CO
 - ~12 attendees
- **[Chapel: An Emerging Parallel Programming Language](#)**
 - 15-minute talk in support of the Emerging Technologies booth
 - November 20th, HPC Impact Theatre, Denver CO
 - ~35 attendees



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SC13 Chapel Activities (Cray-led)

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- **Emerging Technologies Booth presence/participation**
 - poster, handouts, rotating booth-wide slideshow
 - continual stream of visitors for 3-1/2 days
 - some colleagues and collaborators, but at least as many new faces
- **Chapel Lightning Talks 2013 BoF**
 - Cray-delivered overview talk
 - Six talks from community members:
 - MiniMD (Brad)
 - Education (Tim Stitt, University of Notre Dame)
 - Chapel Over MPI-3 (Pavan Balaji, Argonne)
 - Autotuning (Ray Chen, U Maryland)
 - HDFS in Chapel (Michael Ferguson)
 - Futures (Shams Imam, Rice university)



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SC13 Chapel Activities (Community-led)

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Technical Poster: Ray Chen (UMD)

- topic: autotuning and Chapel
- a semi-finalist in the ACM Student Research Competition

HPC Educators Program: David Bunde (Knox), Kyle Burke (Colby)

- topic: use of Chapel in academic courses
- ~30 attendees for first half, ~10 for second
 - (apparently, many non-educators came to hear more about Chapel)



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More Presentations

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SIAM PP14:

- [Chapel Language Features for Hierarchical Tiling and Exascale Architectures](#) [\[audio + slides\]](#)
 - 20-minute minisymposium talk
 - February 19th, Portland OR
 - ~30 SIAM PP14 attendees: DOE, academics, etc.
- [Co-Design Via Proxy Applications: MiniMD in Chapel](#)
 - 20-minute minisymposium talk
 - February 21st, Portland OR
 - ~15 SIAM PP14 attendees, primarily DOE, some academics

SICM² workshop (computational chemistry):

- [Chapel, Life, the Universe](#)
 - 30-minute invited talk
 - March 29th, Manhattan, NY
 - ~45 attendees, 2/3 computational chemists, 1/3 computer science



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Even More Presentations



Northwest C++ Users Group:

- [**Chapel: An Emerging Parallel Programming Language**](#) **[video]**
 - 60-minute invited talk
 - April 16th, Redmond WA
 - ~30 attendees: primarily local mainstream/"big data" professionals



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Notable Talks by non-Cray Personnel



- **SIGCSE 2014 Workshop**

- *Chapel: A Versatile Tool for Teaching Undergraduates Parallel Programming*
 - David Bunde (Knox College) and Kyle Burke (Colby College)
 - March 8th, Atlanta GA

- **CCSC Regional Conference**

- *Using Chapel to Teach Parallel Concepts*
 - David Bunde (Knox College)
 - April 4th, Fulton, MO

(see <http://chapel.cray.com> for links to materials)



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Other presentations in the interim



ETH Zurich: 2-hour seminar

PADAL Workshop (Lugano): 15-minute invited panel talk

(see <http://chapel.cray.com> for links to materials)



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Notable Upcoming Outreach Opportunities

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- **CHI UW: Chapel Implementers and Users Workshop**
 - May, Phoenix AZ
 - <http://chapel.cray.com/CHI UW.html>
- **SC14**
 - Submitted a tutorial proposal
 - November, New Orleans LA
- **Repeat Invitation to speak at Argonne Summer School**
- **DOE ASCR Productivity Workshop**
- **Third Cray blog article ("Why Chapel?")**



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Laundry Lists

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Other Improvements not covered here



- **--minimal-modules compilation mode for developers**
 - avoids the vast majority of internal/standard module contents
 - useful for rapidly testing core language features
- **removed --serial and --serial-forall flags**



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Notable Community Contributions

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Michael Ferguson (LTS):

- Significant LLVM back-end improvements
- Implemented improved operator precedence
- Improved support for `c_ptr / c_ptrTo`
- Improved casts to boolean types
- Propagated `CHPL_*` environment variables to GASNet launcher
- Optional runtime support for thread-local storage using `__thread`
- QIO, GMP bug fixes
- Portability improvements for Debian, Mac

Chris Wailes (Indiana):

- function resolution improvements including partial instantiation

Rafael Larrosa (Malaga):

- Launcher improvements
- GASNet/ibv portability improvement

Brandon Ross (Buffalo):

- string utilities



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Notable Bug Fixes



- Improved const checking on records and fields
- Fixed a bug in string-to-c_string conversions
- Fixed a race condition in task reporting
- bug fix for abs(real) (and support for abs(imag))
- semantic check for tuple size mismatches
- bug fix for timer.clear()
- bug fixes for representation of literals in generated code
- bug fix for usernames containing spaces
- bug fix relating to do...while warnings on local constants



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Language Specification Improvements



- Documented atomic variables
- Documented new assignment signature
- Documented 'noinit'
- Documented expression-less 'serial' statement
- Documented 'ref this' intents
- Clarified casting from numeric types to 'bool'
- Clarified rules related to nil casting and deletion
- Updated operator precedence table to reflect new choices
- Various other improvements and cleanups



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Other Documentation Improvements



- Added a PERFORMANCE file to address FAQs
- Rewrote top-level LICENSE files to clarify third-party terms
- Removed user AGREEMENT to avoid compromising BSD
- Refreshed and reorganized README.tasks
- Noted 'clang' as a CHPL_*_COMPILER option
- Refreshed and reorganized README.tasks
- Improved description of Cray environment variables
- Clarified formatted I/O documentation
- General refresh and improvements to various READMEs



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Correctness Testing Improvements



- Made testing system less Cray-centric
- Moved test result emails to SourceForge mailing lists
- Added numtrials capability
- Added support for nightly testing against --fast



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Performance Testing Improvements

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- pushed performance testing graphs to public web
- automated SVN tracking of nightly performance data
- added verification capability
- added ability to track compiler performance
- implemented an annotation capability for perf. graphs
 - not enabled yet, but can be utilized on a per-user basis
- scripts for release-over-release testing
 - and append nightly results to historical data for instant comparisons
- switched to using `--static` and `--fast` by default
- utility script for splicing .dat files from performance runs



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