Performance Summary

Chapel version 1.19

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Overview

- Generally speaking, performance has improved with 1.19

- Previous slides have shown performance improvements
  - … due to communication optimizations
  - … due to compiler and module optimizations
  - … due to runtime optimizations

- These slides contain overall 1.19 performance results and trends
  - Shows comparisons across releases

Outline

- Single Locale Performance Trends
- Multi-locale Performance Trends
- Scalability Trends
- Priorities and Next Steps

Single Locale Performance

Single Locale Performance

- No major single locale performance changes
  - No known regressions
  - Some improvements from making cstdlib atomics the default
  - Performance efforts are focused on multi-locale and scalability improvements

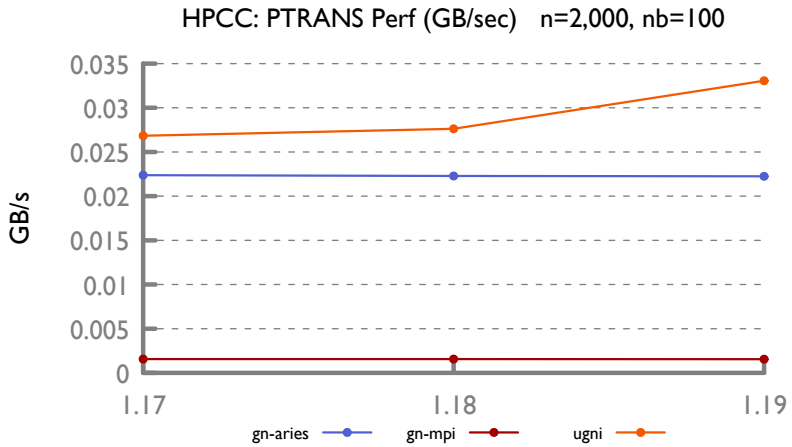
Multi-locale Performance Trends

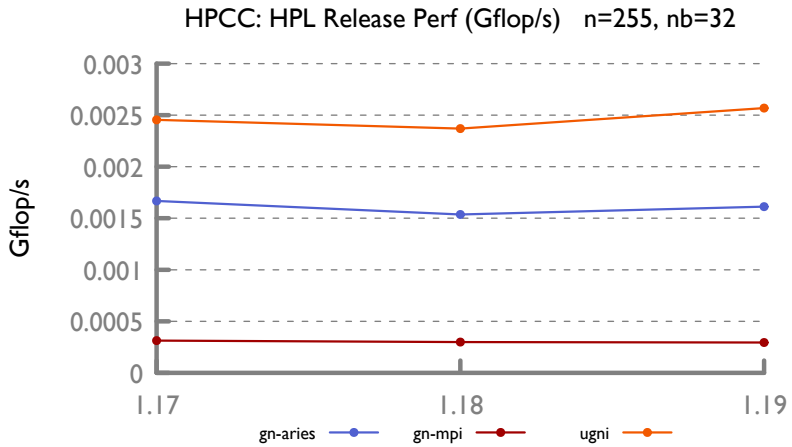
Multi-locale Performance Configuration

- Hardware: 16 nodes of a Cray XC
  - 28-core, 128GB RAM
    - (2) 14-core “Broadwell” 2.6 GHz
- Software:
  - CLE 6
  - GCC 8.2.0
  - Chapel 1.17.1, 1.18.0, 1.19.0

Multi-Locale Performance

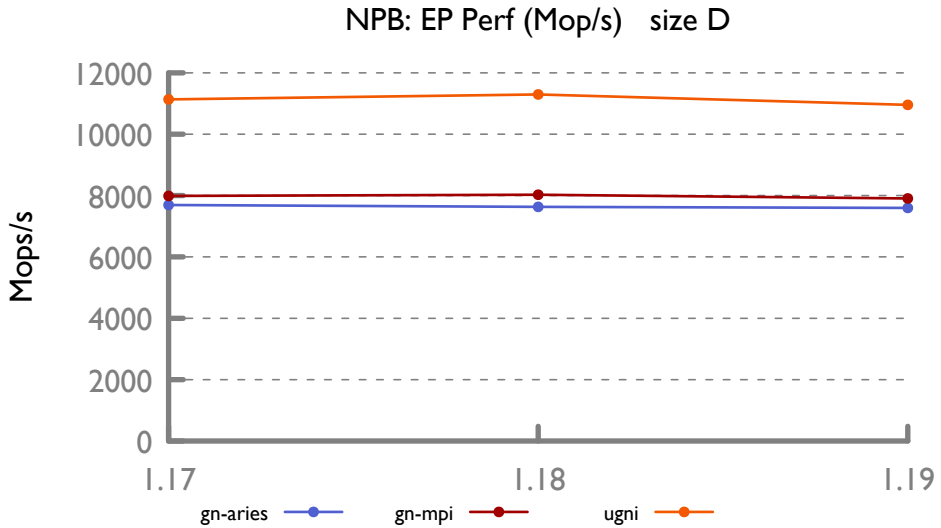
- Modest multi-locale performance improvements





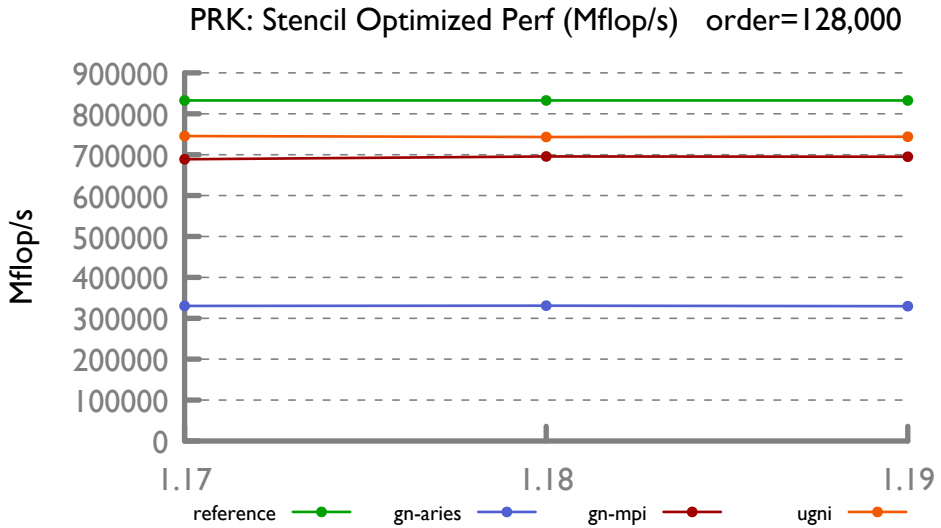
Multi-Locale Performance

- Minor regression for NAS Parallel Benchmarks: EP
  - Has been resolved on master, but not in 1.19 release
    - Regression was minor, not a critical benchmark for us



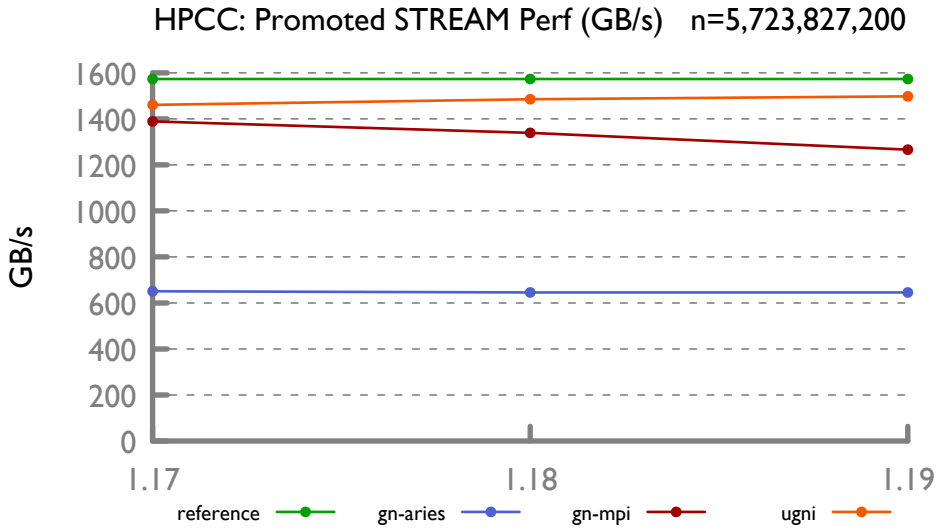
Multi-Locale Performance

- Discovered PRK-stencil is not on par with reference as previously reported
  - Missed setting OpenMP affinity flags for reference version
    - Remaining gap due to imperfect Chapel task-affinity between trials



Multi-Locale Performance

- Regression for Promoted Stream under GASNet with MPI conduit
  - Not an important configuration, but discovered promoted version has comm
    - Surprising, communication not expected for any stream variants



Scalability Trends

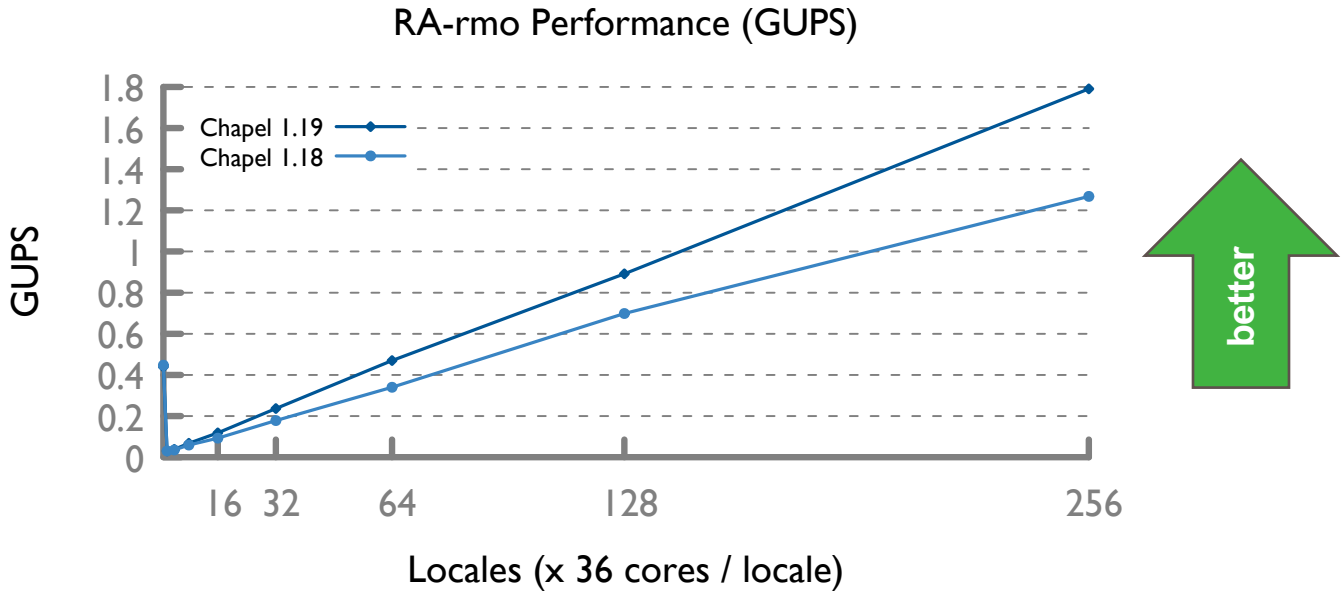
Scalability Configurations

- 256 Node Configuration:
  - 36-core, 128GB RAM
    - (2) 18-core “Broadwell” 2.1 GHz
  - CLE 7.0 UPO0
    - GCC 8.2.0, cray-mpich/cray-shmem 7.7.7.1, Chapel 1.18.0/1.19.0

- 1024 Node Configuration (Edison):
  - 24-core (48 HT), 64 GB RAM
    - (2) 12-core "Ivy Bridge" 2.4 GHz processors
  - CLE 6.0 UP07
    - GCC 8.2.0, Chapel 1.18.0/1.19.0

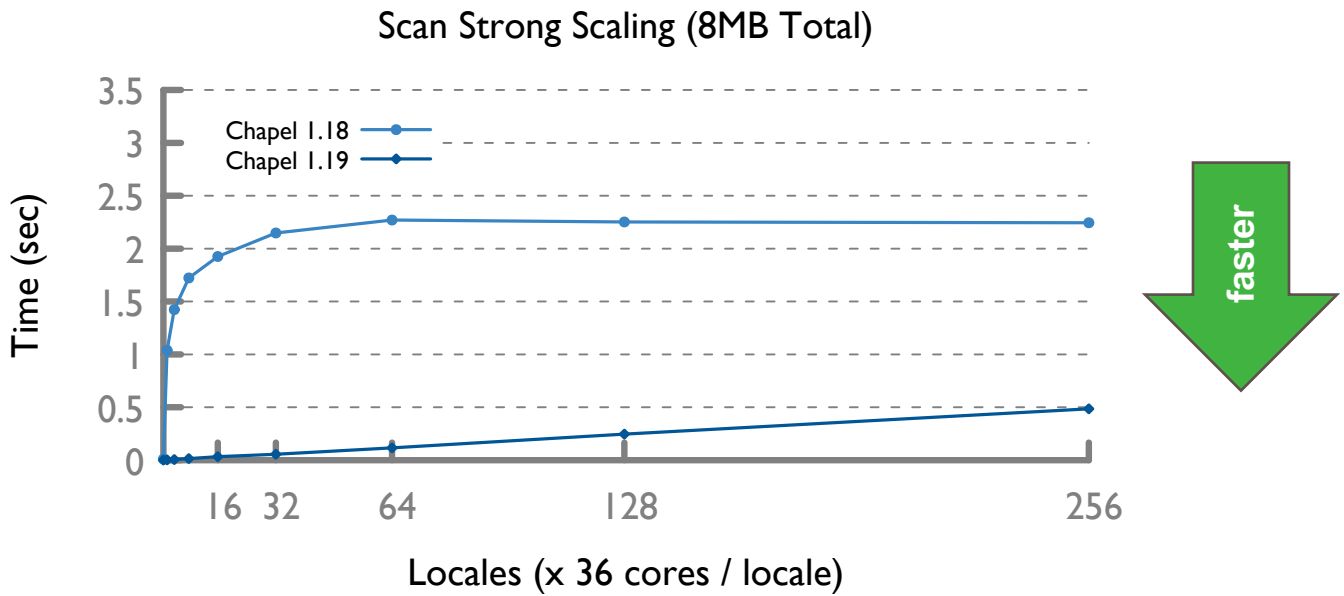
Scalability

- Significant scalability improvements
  - 45% improvement for RA using remote-memory-operations



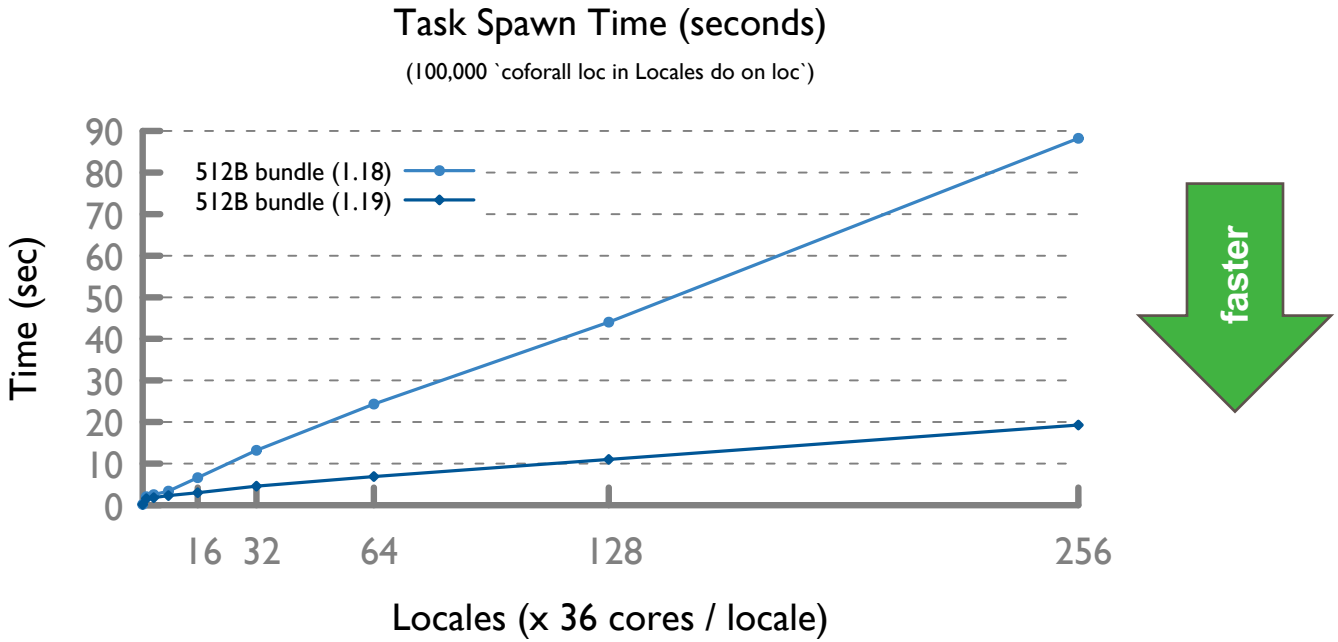
Scalability

- Significant scalability improvements
  - Scans over block distributed arrays scale



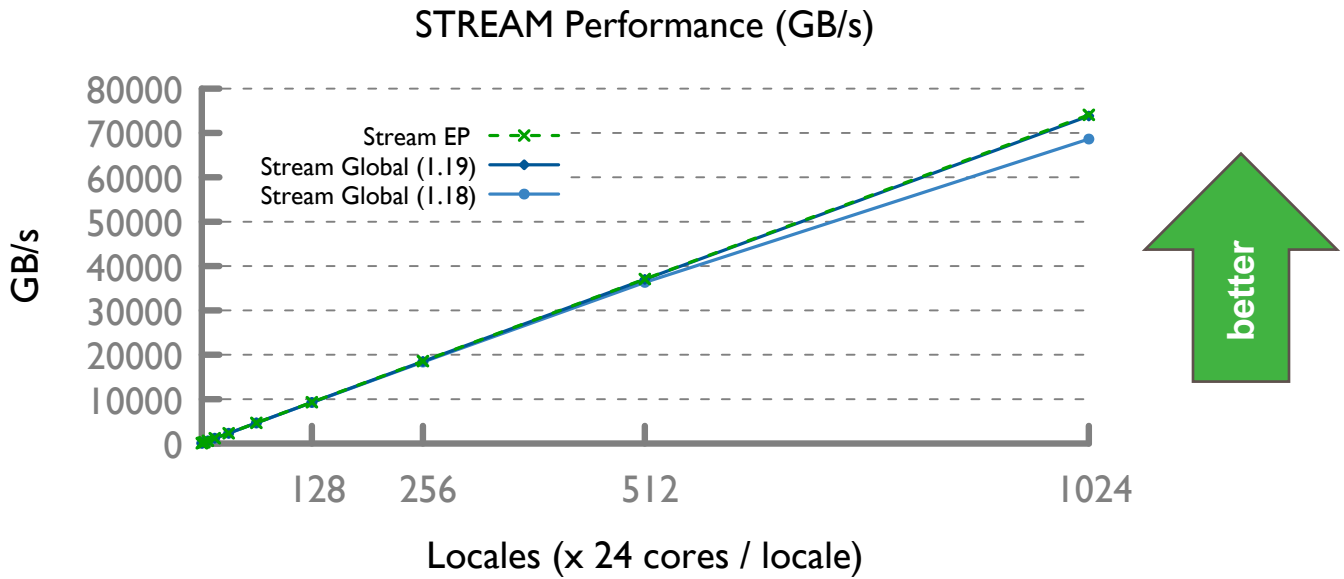
Scalability

- Significant scalability improvements
  - 4.5x improvement for typical remote task spawns



Scalability

- Significant scalability improvements
  - 8% speedup for Stream Global at 1,024 nodes (~25,000 cores)



Performance Priorities and Next Steps

Performance Priorities and Next Steps

- Continue with Bale-driven optimizations
  - Enable unordered compiler optimization by default
  - Flesh out unordered operation API
  - Port and tune additional Bale applications
  - Start on aggregation library and performance experiments
- Locality oriented improvements
  - Optimize slicing
  - Optimize communication for distributed fields in records/classes
  - Improve bulk transfer for distributed arrays
- Tune comm=ofi performance

Performance Priorities and Next Steps

- Switch to llvm backend by default
  - Provides more consistent and controllable performance
  - Will likely have vectorization improvements
- Eliminate communication for promoted Stream
- Implement a task-resetting policy
- Eliminate remaining memory leaks
- Improve compilation speed

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