OpenMP 4.0 and Beyond

Tuesday, November 19, 2013

Bronis R. de Supinski
Chair, OpenMP Language Committee
OpenMP 4.0 ratified July 2013

- End of a long road? A brief stop along the way…
- Addresses several major open issues for OpenMP
- Did not break existing code (unnecessarily?)
- Includes 106 passed tickets
  - Focused on major tickets initially
  - Builds on two comment drafts ("RC1" and "RC2")
  - Many small tickets after RC2, a few large ones
- Already starting work on OpenMP 4.1 and 5.0
Overview of major 4.0 additions

- Device constructs
- SIMD constructs
- Cancellation
- Task dependences and task groups
- Thread affinity control
- User-defined reductions
- Initial support for Fortran 2003
- Support for array sections (including in C and C++)
- Sequentially consistent atomics
- Display of initial OpenMP internal control variables
Plan for OpenMP specifications

- OpenMP Examples: A separate document
- OpenMP 4.1
  - Clarifications and errata to existing specification
  - Refinements and minor extensions
  - Do not break existing code
  - Minimal implementation burden beyond 4.0
  - Time frame is TBD but targeting ≤ two years
- OpenMP 5.0
  - Address several major open issues for OpenMP
    - Expect less significant advance than 4.0 from 3.1/3.0
  - Do not break existing code unnecessarily
  - Time frame is TBD
OpenMP 4.1 will include many refinements to recent additions

- Many clarifications and minor enhancements
  - SIMD extensions
  - Reductions for C/C++ arrays and templates
  - Runtime routines to support cancelation
- Initial support for memory affinity
- Interoperability with Pthreads
- Tasking and stand-alone reductions
- Some new features are also being considered
  - Support for DOACROSS loops
  - Unroll, block and tile
Refinements to device constructs are the most significant 4.1 plans

- Refinements of combined clauses
  - Addition of even more combined constructs
  - Specifying overlapping clauses on combined constructs
- Asynchronous work queues
- Unstructured data movement
- Link clause/linkable support
- Multiple device types
- Deep copy/map/serialization for map
- Update for map even if present
- Providing device-specific environment variables
OpenMP 4.0 includes initial support for Fortran 2003

- Added to list of base language versions

- Have a list of unsupported Fortran 2003 features
  - List initially included 24 items (some big, some small)
  - List has been reduced to 14 items
  - List in specification reflects approximate OpenMP 4.1 priority
  - Priorities determined by importance and difficulty

- Plan: Reduce list to provide full support in 4.1
  - Many small changes throughout; Support:
    - Procedure pointers
    - Renaming operators on the USE statement
    - ASSOCIATE construct
    - VOLATILE attribute
    - Structure constructors
  - Will support Fortran 2003 object-oriented features next
    - The biggest issue
    - Considering concurrent reexamination of C++ support
More significant topics are being considered for OpenMP 5.0

- More tasking advances (support for event loops)
- General error model
- Continued improvements to device support
- Performance and debugging tools support
- Interoperability and composability
- Locality and affinity
- Transactional memory
- Additional looping constructs and refinements
- Help us shape the future of OpenMP
  - Attend IWOMP, become a cOMPunity member
  - Lobby your institution to join the OpenMP ARB