Bounded Asynchrony and Nested Parallelism for Scalable Graph Processing

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**Standard Template Adaptive Parallel Library (STAPL)**

- A framework for developing parallel C++ code
- A library of C++ components with interfaces similar to the (sequential) C++ Standard Template Library (STL)
- Open source: http://gitlab.com/parasol-lab/stapl

**Project Goals**

- **Ease of use**: shared object programming model provides consistent interface across shared or distributed memory systems
- **Efficiency**: Application building blocks based on C++ STL constructs and extended, automatically tuned for parallel execution
- **Portability**: ARM runtime system hides machine specific details and provides an efficient, uniform communication interface.

**Bounded Asynchrony**

- **k-level-asynchronous Paradigm (KLA):**
  - Generalization of level-synchronous and asynchronous
  - Level synchronous: BSP-style iterative computation, global synchronizations
  - Asynchronous: point-to-point dependencies, possible redundant work
- **KLA**: traversing up to \( k \) hops before synchronizing

**Approximation Through Asynchrony**

- **Idea**: Only redo work if new distance is sufficiently better
- **First approach with breadth-first search (LCPC'16)**
  - Allow vertex distance to contain some error
  - Configurable parameter for tolerance \( \epsilon \)
  - Propagate new distance if \( (d - \epsilon)/d \geq \tau \)

**Future work**

- Identify set of graph properties, algorithm properties and architecture that enable a performance benefit with KLA
- Dynamic (streaming) graph computations
- Heterogeneous graph processing using accelerators

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