PaRSEC is a generic framework for architecture aware scheduling and management of micro-tasks on distributed many-core heterogeneous architectures. Applications we consider can be expressed as a Direct Acyclic Graph of tasks with labeled edges designating data dependencies. DAGs are represented in a compact problem-size independent format that can be queried on-demand to discover data dependencies in a totally distributed fashion. PaRSEC assigns computation threads to the cores, overlaps communications and computations and uses a dynamic, fully-distributed scheduler based on architectural features such as NUMA nodes and algorithmic features such as data reuse.

**FEATURES**
- Supports Distributed Heterogeneous Platforms
- Sustained Performance
- NUMA & Cache Aware Scheduling
- State-of-the-art Algorithms
- Capacity Level Scalability
- Performance Portability
- Implicit Communication
- Communication Overlapping

**APPLICABILITY DOMAINS**

**NWChem** (Execution of ICSD_T2_8i)

**Sparse Direct Solver PaSTiX**

**Dense Linear Algebra** (192 GPU Cluster)

PaRSEC TOOLCHAIN

- Write high-level DSLs (Tensor contraction, Block Sparse, Trees, ...)
- Annotate loop nests using language extensions
- APIs give information to the run-time such as:
  - data distribution (across nodes)
  - data organization
  - data serialization functions
  - object construction/destruction

Efficient Data Flow Representation

Input serial codes are converted automatically by the PaRSEC compiler into the task Dataflow representation which can also be edited by the programmer. The Dataflow compiler generates the stubs that, along with the Data distribution provided by the programmer via Domain Specific Extensions, the Application code & Codelets, the Runtime and relevant libraries are linked by the system compiler to generate the executable that will run on a heterogeneous distributed memory supercomputer.

**PaRSEC TOOLCHAIN**

- Domain Science (Chemical, Nuclear Physics, ...)
- High-level DSLs
- Sequential Source Code
- Dynamic Task Discovery
- Data Distribution
- Scheduling Hints
- Application Code & Codelets
- Runtime
- Relevant Libraries
- PaRSEC

PaRSEC uses a symbolic, problem size independent representation to express the Directed Acyclic Graph (DAG) of the Dataflow of a program. As a result, at runtime, successors and predecessors of any given task can be evaluated independently, without exploring portions of the DAG pertaining to tasks localized on other nodes. Furthermore, the whole DAG is never unfolded, and only the set of locally active tasks resides in the memory at any given time.