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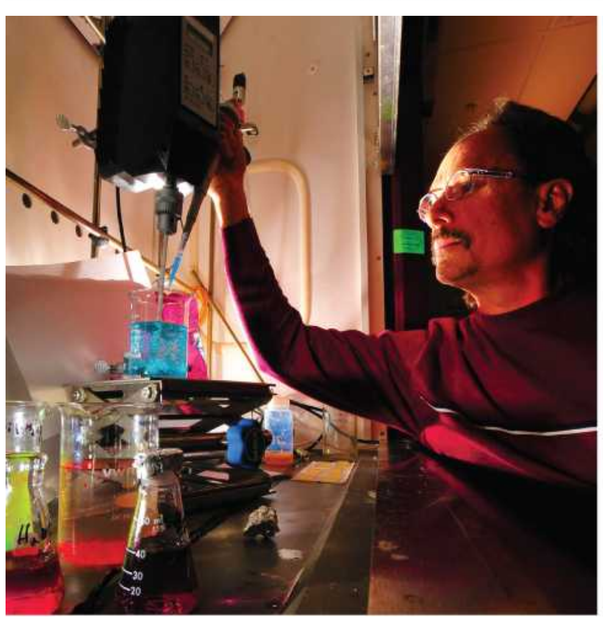


Enhancing Qthreads for ECP Science and Energy Impact

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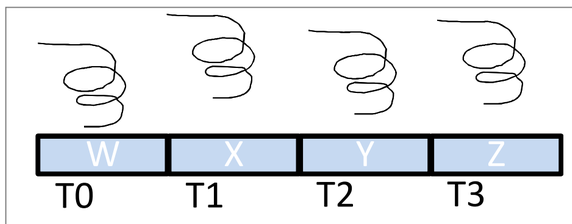
What is Qthreads? Qthreads is a library that provides lightweight multithreading for nimble locality-aware **on-node task parallelism**, exposing this capability through high-level programming models such as the **Kokkos** C++ performance portability library and Cray's **Chapel** language, and via tech transfer to standards like **OpenMP**.

Qthreads at a Glance	
Development	2007 - Present
License	Three-clause BSD
Repository	http://github.com/Qthreads

What enhancements are proposed and what is the impact? The project's objective is to develop techniques that improve **network concurrency** for applications that use multithreading coupled with communication, e.g., **MPI+X**. The impact is more efficient use of network and node resources to deliver better **performance** for ECP applications.

What has the work in year one of the project contributed toward these goals?

- **Understanding use cases** for applications to benefit from better network concurrency, revisiting earlier work on **task parallel over-decomposition** [1,2].
- **Evaluating the performance gap** due to serialization of threads' network accesses to analyze **requirements** for better network concurrency support.
- **Developing Qthreads instrumentation** capabilities to observe related metrics.



Under the proposed design, asynchronous tasks executed by the Qthreads runtime will contribute to a FinePoints partitioned buffer as their computations complete.

What are the "next steps" for the project, and what is the current technical approach that is being pursued?

- **Design, implement, evaluate, and refine** enhanced network concurrency support in the Qthreads runtime.
- **Leverage FinePoints** [3], a recent technology developed under the "Open MPI for Exascale" ECP-ST project that provides a low-overhead mechanism for multithreaded MPI using a novel partitioned communication scheme.

[1] Barrett et al. "Toward an Evolutionary Task Parallel Integrated MPI+X Programming Model." *6th Intl. Workshop on Programming Models and Applications for Multicores and Manycores (PMAM 2015).*
[2] Stark et al. "Early Experiences Co-Scheduling Work and Communication Tasks for Hybrid MPI+X Applications." *Proc. of 2014 Workshop on Exascale MPI (ExaMPI 2014) at Supercomputing 2014 (SC14)*
[3]. Grant et al. "Lightweight threading with MPI using Persistent Communications Semantics". SAND2015-8650C. Sandia National Laboratories, Albuquerque, NM, 2015.

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