Evaluating Network Technologies from Prototype to Production
## Toward rapid performance debugging throughout a system's lifecycle

Nathan Hanford (LLNL)

Shaping Future Networks with Simulation

- LLNL is a member of several industry standards groups.
- Running benchmark simulations of future networks prevents performance mishaps in real hardware.
- Participating in open standards advances LLNL's interests.

- The Allreduce operation is critical to the performance of both HPC and AI applications.
- In an Allreduce operation, many cooperating collective processes perform an operation and share the result.

- Example: one benchmark used throughout the HPC system lifecycle:
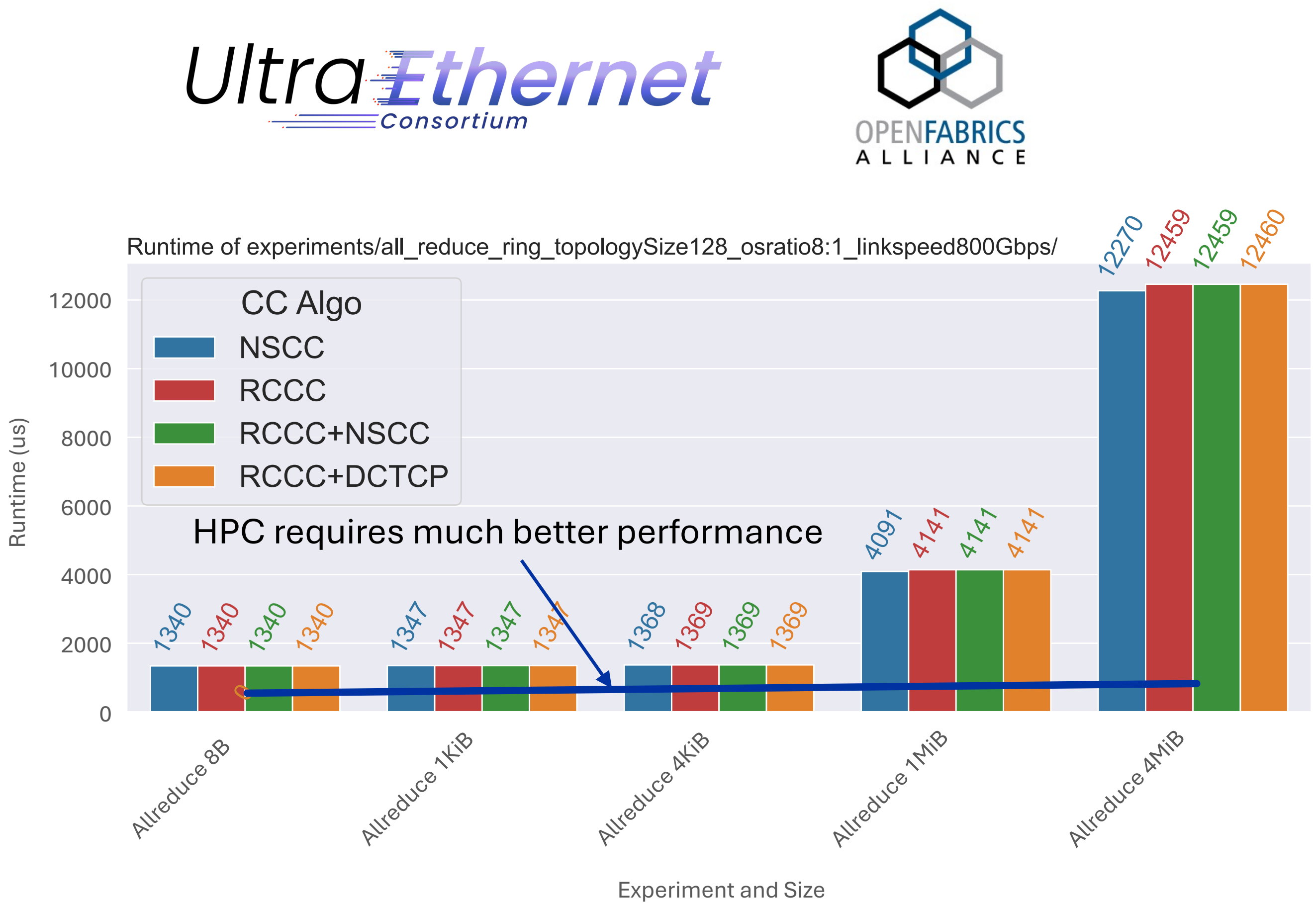
An early Allreduce Transport Simulation Benchmark output from htsim.

Identifying Performance Issues During Acceptance

- Benchmarks help verify a system is within specification.
- When systems are not within specification, LLNL collaborates with vendors to identify and mitigate the performance issues.
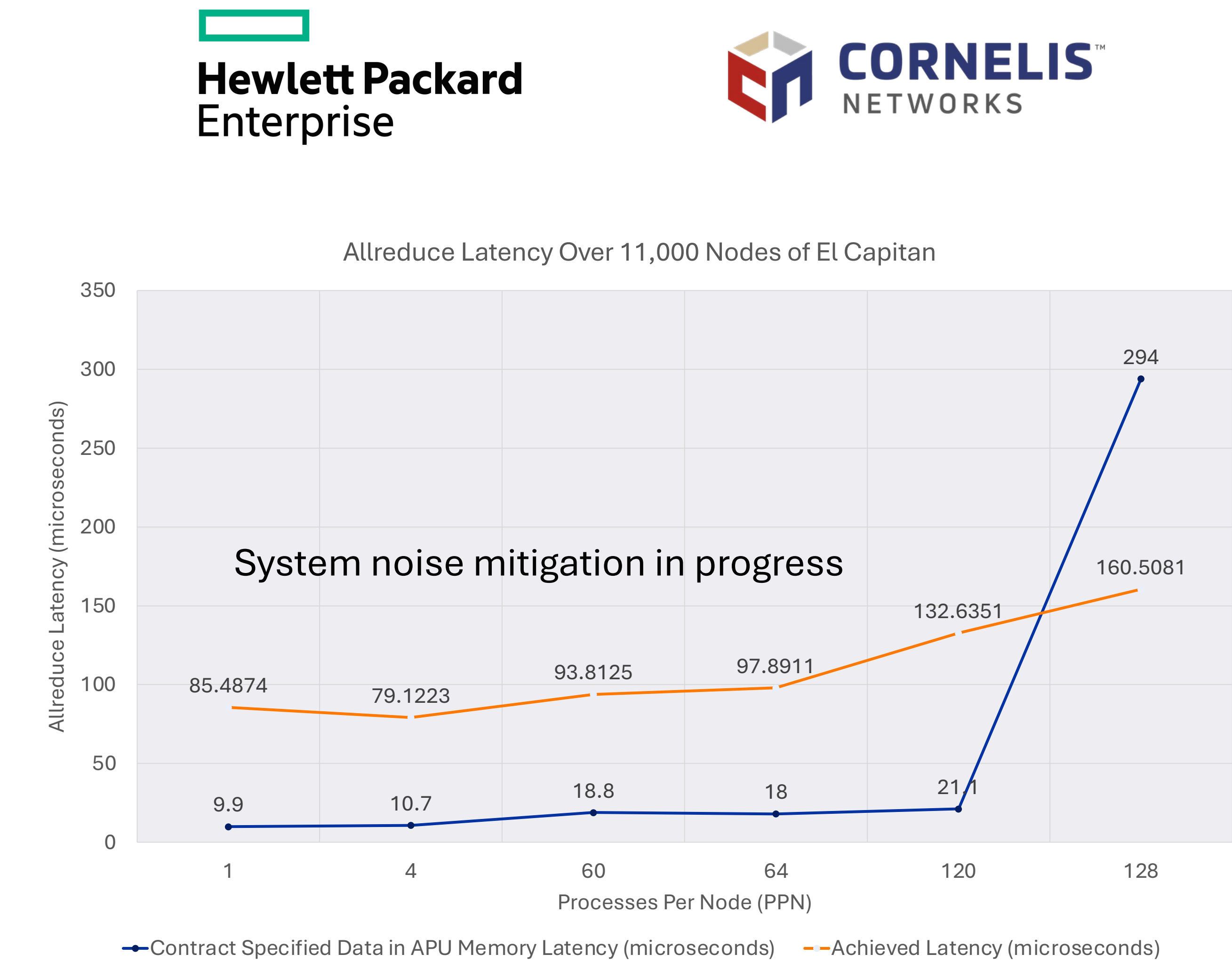

An early Allreduce CORAL2 Acceptance Benchmark showing untuned Allreduce performance degradation. The above performance issue was subsequently addressed with a system noise mitigation strategy in collaboration with the vendor.

- LLNL also contributes to open-source benchmarks, adding features such as buffer validation—making sure that data was accurately delivered.

Continuous Performance Improvement

- Multiple MPIs can help show when performance regressions occur.
- This friendly competition results in the best performance for users.
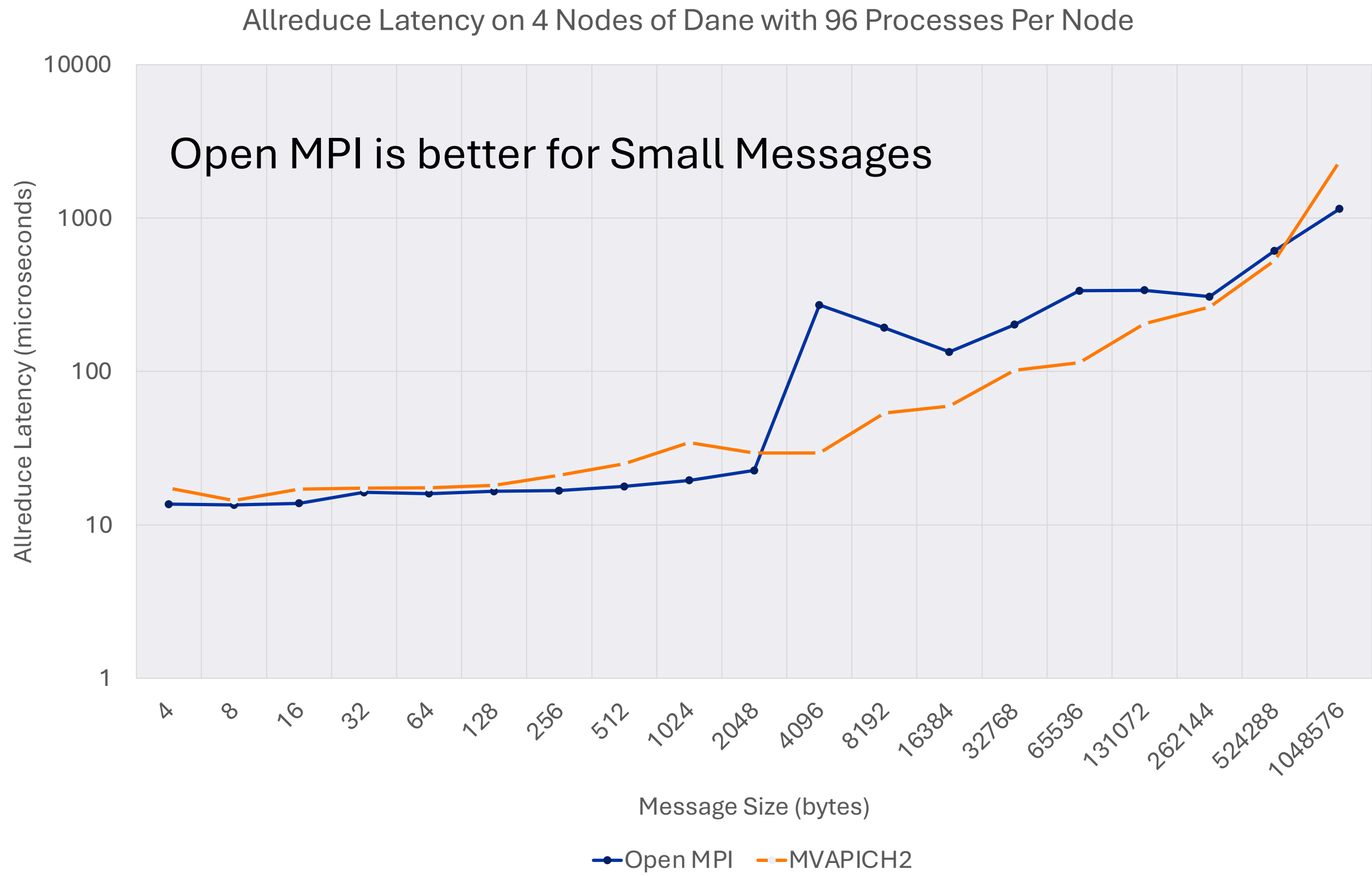
Conclusions and Future Work

- Allreduce is just one micro benchmark of one MPI operation.
- LLNL uses dozens of other benchmarks, proxy applications, and mini-applications to simulate, design, procure, accept, and validate HPC systems.
- As HPC systems become more complex, older benchmark management frameworks struggle to manage parameters and data.
- Benchpark is an emerging LLNL project that leverages Spack to collaboratively manage benchmark builds throughout the lifecycle.
- Automation will shorten the time needed to find performance regressions.