

## CASE STUDY

High-Performance Computing  
Life Sciences

# Managing an Ocean of Information



Software

## Lab7 Systems optimizes BioBuilds™ tools for superior performance using Intel® Parallel Studio XE and Intel® C++ Compiler

“Intel® compilers optimize the BioBuilds™ packages for superior performance on the Intel64 architecture, including auto-vectorization and auto-parallelization for additional performance gains on modern, multi-core CPUs.”

—Cheng Lee  
Principal Software Architect  
Lab7 Systems

Finding efficient ways to manage the massive amounts of data generated by new technologies is a key concern for many industries. It's especially challenging in the world of life sciences, where research breakthroughs are based on an ever-expanding ocean of information.

With help from Intel and Intel® Parallel Studio XE, Lab7 Systems is optimizing the open-source BioBuilds™ tool collection to make life easier for bioinformaticians, scientists, and IT teams.

### Open Source Solution

Based in Austin, Texas, Lab7 Systems is a software company working to help reduce the need for hands-on data management of the massive amounts of data generated by new life sciences technologies, and to get the best possible performance from constantly evolving hardware. The company's core commercial product is the Lab7 Enterprise Science Platform™ (ESP™), the first complete sample-to-answer software platform for data-intensive laboratory operations.

Lab7 Systems also curates, maintains, and supports BioBuilds, a collection of open-source bioinformatics tools, pre-built for Linux\* on both x86 and IBM Power Systems\* platforms and for OS X\*. By including all supporting libraries, BioBuilds eliminates the need to maintain and build custom versions of these tools—providing a path out of “dependency hell,” a colloquial term for the frustration of those who have installed software packages with dependencies on specific versions of other software packages. BioBuilds also enables reproducibility by providing a reference point that ensures collaborators are all using the same versions of tools. BioBuilds uses the Conda\* package manager to ensure consistent computing environments across all supported platforms. The standard BioBuilds releases are free to download and use. Lab7 Systems also offers paid options for customers needing additional support and/or custom packages.

### Maximizing Performance

To maximize performance on the Intel64 platform, Lab7 Systems used the tools in Intel Parallel Studio XE. This toolset makes it easier for developers to deliver top C++, Fortran, and Python\* application performance that scales on today's and next-gen processors. It also simplifies the process of creating fast, reliable parallel code.

Lab7 Systems modified its upstream build systems to support use of Intel® compilers instead of GNU Compiler Collection\* (GCC\*). Specifically, Lab7 Systems used the Intel® C++ Compiler to build select binaries in the BioBuilds 2017.05 release—significantly improving their performance compared to their GCC-built counterparts.

The company chose Intel C++ Compiler because of a combination of factors:



## Case Study | Managing an Ocean of Information

- Standard C/C++ language support
- GCC compatibility
- Better optimization for Intel64
- Automatic SIMD vectorization and parallelization for Intel64
- Interprocedural optimization
- Profiler and analysis tools for generating and/or improving parallel code

Types of optimizations included explicit targeting of the SSE4.2 architecture (“-x”); alternative code paths for the AVX, CORE-AVX-I, and CORE-AVX2 architectures (“-ax”); optimizations enabled by the “-O3”; interprocedural optimizations (“-ip” and “-ipo”); and auto-parallelization (“-parallel”).

Lab7 Systems is in the process of benchmarking several applications to quantify the performance gains from building with Intel Parallel Studio XE, which have been significant.

“Intel compilers optimize BioBuilds packages for superior performance on the Intel64 architecture,” explained Cheng Lee, principal software architect at Lab7 Systems, “including auto-vectorization and auto-parallelization for additional performance gains on modern, multi-core CPUs. Additionally, these compilers generate binaries with multiple, auto-dispatched code paths that ensure optimized performance across a range of hardware.”

## Ongoing Support

Another key factor was Intel’s support for Lab7 Systems in this open source project, which included providing both funding and Intel Parallel Studio XE licenses.

In accordance with BioBuilds release policies, Lab7 Systems is making the bioinformatics tools optimized using Intel’s compiler freely available. “This reflects Lab7 Systems’ commitment to supporting open source in bioinformatics and provides users access to pre-built, higher-performance binaries they would normally not have access to,” explained Lee.

In addition, Lab7 Systems provides paid support contracts for users who need additional optimizations for specific Intel64 CPUs, or who would like optimized packages that cannot be included in the public (free) release due to issues such as licensing restrictions.

## Building the Future

Lab7 Systems will continue to use the Intel® compilers to build performance-tuned packages for the 2017.11 release. In addition, Lab7 Systems plans to use other Intel Parallel Studio XE components to further improve the performance of certain applications:

- **Intel® VTune™ Amplifier:** An advanced performance profiler for tuning application performance, scalability, and memory access. Enables accurate profiling of C, C++, Fortran, Python\*, Go\*, assembly, and Java\* or a mix of languages.
- **Intel® Advisor:** A vectorization optimization and threading advisor tool for C, C++, C#, and Fortran applications to optimize vectorization and quickly prototype threading designs.

## Learn More

[Intel® Parallel Studio XE >](#)

[Intel® C++ Compiler >](#)

[BioBuilds >](#)



Intel technologies’ features and benefits depend on system configuration and may require enabled hardware, software, or service activation.

Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer, or learn more at [www.intel.com](http://www.intel.com).

Intel’s compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice. Notice revision #20110804

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information go to [www.intel.com/performance](http://www.intel.com/performance).

Intel does not control or audit the design or implementation of third party benchmark data or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmark data are reported and confirm whether the referenced benchmark data are accurate and reflect performance of systems available for purchase.

This document and the information given are for the convenience of Intel’s customer base and are provided “AS IS” WITH NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. Receipt or possession of this document does not grant any license to any of the intellectual property described, displayed, or contained herein. Intel® products are not intended for use in medical, lifesaving, life-sustaining, critical control, or safety systems, or in nuclear facility applications.

Copyright © 2017 Intel Corporation. All rights reserved. Intel, VTune, and the Intel logo are trademarks of Intel Corporation in the U.S. and/or other countries.

\* Other names and brands may be claimed as the property of others.

Printed in USA

0917/SS

Please Recycle