IBM XL C/C++ for AIX, V13.1

IBM

Improve application performance and developer productivity using the latest IBM XL C/C++ compilers for IBM Power Systems

Highlights

IBM® XL C/C++ for AIX®, V13.1:

- Leverages the capabilities of the latest POWER8™ architecture for increased value and reduced costs

- Maximizes application performance through industry leading optimization technology for better system utilization and cost reduction

- Improves developer productivity with partial support of C11, C++11, and OpenMP 4.0 features to simplify programming, shorten the development cycle, and reduce risk

- Eases application migration to Power Systems™ through conformance to the ISO C99 and ISO C++03 standards and a subset of the latest C and C++ standards protecting application investment

- Integrates with Rational® Developer for AIX and Linux, C/C++ Edition, for improved developer productivity and team collaboration, lowering project costs and risks

Leverages the capabilities of the latest POWER8 architecture

XL C/C++ for AIX, V13.1 generates code that leverages the capabilities of the latest POWER8 architecture. New compiler suboptions for architecture and tuning are added to specify code generation for the POWER8 processor architecture. -qarch=pwr8 instructs the compiler to produce code that can fully exploit the POWER8 architecture. -qtune=pwr8 enables optimizations, such as instruction scheduling, that maximize performance on the Power Systems with the POWER8 design and processor, while allowing for binary compatibility with previous POWER® processors.

XL C/C++ for AIX provides built-in functions for direct programmer access to the POWER architecture. Built-in functions enable programmers to use the syntax of C or C++ function calls and C or C++ variables to access

the instruction set of the target POWER architecture for exact control over the generated code. These built-in functions are automatically inserted when the compiler optimizes code and enables the development of highly optimized applications. If preferred, programmers can rely on the compiler to automatically exploit processor features and not write any low-level code. In XL C/C++ for AIX, V13.1, new built-in functions are added to support the following POWER8 features:

- POWER8 vector processing functions
- POWER8 binary-coded decimal functions
- POWER8 cryptography functions
- POWER8 quad-word arithmetic functions
- POWER8 load-and-reserve and store condition instructions
- POWER8 cache and data prefetch control functions
- POWER8 transactional memory functions
- POWER8 prefetch functions

The Mathematical Acceleration Subsystem (MASS) libraries contain frequently used math intrinsic functions that enable improved performance over the corresponding standard system library functions. These highly tuned MASS libraries are enhanced to support the POWER8 technology:

- The vector MASS library contains vector functions that are tuned for the POWER8 architecture. These functions can be used in either 32-bit or 64-bit mode.

- XL C/C++ ships with a single-instruction, multiple-data (SIMD) MASS library tuned specifically for the POWER8 processor.

Maximizes application performance through industry-leading compiler optimization technology

The optimization and hardware exploitation features in IBM XL C/C++ help improve programming productivity. The XL C/C++ compiler generates code that delivers leading-edge performance from existing or new hardware, often with no source code changes.

In XL C/C++ for AIX, V13.1, entity visibility attributes are added to describe whether and how an entity that is defined in one module can be referenced or used in other modules. By using the visibility attributes for entities, you can get the following benefits:

- Decreasing the size of shared libraries
- Reducing the chance of symbol collision
- Allowing more optimization for the compile and link phases
- Improving the efficiency of dynamic linking

XL C/C++ provides faster compile time for large applications. In addition, the use of machine resources is improved by reducing the amount of memory required by the compiler, such as for pointer analysis and alias computation. Header files, which are repeatedly used in applications, are cached within the compiler to speed up overall processing during compile time. The compiler and optimizer use the greater addressability of the 64-bit process space, thereby allowing significantly larger programs to be optimized.

Profile directed feedback (PDF) optimization collects information about an application run with typical input data and then applies transformations to the program based on that information. PDF can ensure that the performance of the application is optimized for its important inputs. Application profile monitoring and profile directed feedback capabilities minimize the need for manual tuning to achieve desirable performance on large, complex applications.

SHOWPDF reports provide profiling information that includes block-counter and call-counter profiling information and cache-miss profiling and value profiling information. SHOWPDF reports identify opportunities to improve code performance thereby simplifying the effort of hand tuning applications.

Improves developer productivity

The compiler simplifies your programming tasks by providing installation enhancements as well as new and enhanced compiler options.

New and enhanced compiler options

In XL C/C++ for AIX, V13.1, the following options are added or updated. For a complete list of all the new and changed options and directives, see the Getting Started guides for the XL Compilers.

- The `-qinfo=mt` suboption notifies you about potential places where synchronization is needed.
- The `-qinfo=unset` suboption detects automatic variables that are used before they are set, and flags them with informational messages at compile time.
- The `-qprefetech=dscr` suboption helps to improve the runtime performance of your applications. You can specify a value for dscr depending on your system architecture.
- The `-qunroll=n` suboption hints to the compiler to unroll loops by a factor of n. If the loop has fewer than n iterations, it is fully unrolled. The compiler may silently limit unrolling to a value lower than n.

Installation enhancements

The compiler now installs to its own location without needing to replace the version that is already installed.

Eases application migration to IBM Power Systems

Make applications portable with the XL compilers, which offer industry compliant programming languages and extensions. XL compilers help programmers easily maintain and run their applications on IBM systems.

IBM XL C/C++ conforms to the following programming language specifications for C/C++: C89, C99, C++ 98, and C++03; and supports a subset of the C11 and C++11 standards.

Augmenting the standardized language levels, the XL C/C++ compiler has implemented C and C++ language extensions to support vector programming and a subset of GNU C and C++ language extensions. In addition, the XL C++ compiler maintains close support of Boost C++ library releases.

C11 and C++11 features

XL C/C++ supports a subset of the C11 and C++11 features. In V13.1, the following C11 and C++11 features are added:

The typedef redeclaration
Using the typedef redeclaration, you can redefine a name that is a previous typedef name in the same scope to refer to the same type. The XL C compiler supports all types, including a variable modified type.

Generic selection
Generic selection provides a mechanism to choose an expression according to a given type name at compile time. A common usage is to define type generic macros.

Defaulted and deleted functions
This feature introduces two new forms of function declarations to define explicitly defaulted functions and deleted functions. For the explicitly defaulted functions, the compiler generates the default implementations, which are more efficient than manually programmed implementations. The compiler disables the deleted functions to avoid calling unwanted functions. You can use the `-qlanglvl=defaultanddelete` option to enable this feature.

Generalized constant expressions
In V13.1, the generalized constant expressions feature extends the set of expressions permitted within constant expressions. The implementation of this feature in XL C/C++ V12.1 was a partial implementation of what is defined in the C++11 standard. In this release, enhancements are made to support user-defined constexpr objects and constexpr pointers or references to constexpr functions and objects. You can use the `-qlanglvl=constexpr` option to enable this feature.

The nullptr keyword
This feature introduces nullptr as a null pointer constant. The nullptr constant can be distinguished from integer 0 for overloaded functions. The constants of 0 and NULL are treated as the integer type for overloaded functions, whereas nullptr can be implicitly converted to only the pointer type, pointer-to-member type, and bool type. You can use the `-qlanglvl=nullptr` option to enable this feature.

Full support of OpenMP 3.1 and partial support of OpenMP 4.0

XL C/C++ provides full support for OpenMP 3.1 so programmers can automate parallel programming and take advantage of multiprocessor systems. Some of the features include finer control of the number of threads used in nested parallelism, full control of where a thread can switch from one task to another task, and more types of atomic operation to better synchronize parallel code.

XL C/C++ for AIX, V13.1 also supports the following OpenMP 4.0 features:

Update and capture clauses enhancements
The update and capture clauses of the atomic construct are extended to support more expression forms.

OMP_DISPLAY_ENV environment variable
You can use the OMP_DISPLAY_ENV environment variable to display the values of the internal control variables (ICVs) associated with the environment variables and the build-specific information about the runtime library.

Integrates with Rational Developer for AIX and Linux

XL C/C++ readily integrates with IBM Rational Developer for AIX and Linux, C/C++ Edition, an eclipse based integrated development environment (IDE) for creating, maintaining and porting of applications to IBM Power Systems. Rational Developer for AIX and Linux improves programmer productivity by providing a rich user interface (UI) to replace older text-based, command-line development tools. This will help accelerate application development and maintenance in the AIX and Linux operating environments.

IBM Rational Team Concert™ (RTC) software is a Jazz-based offering that provides integrated team collaboration through such features as project dashboards, work items, source control, builds and reports. Rational Developer for AIX and Linux ships a client that readily integrates with Rational Team Concert. It improves overall application lifecycle management and the efficiency of the entire development organization. Organizations can also leverage this modern development environment to attract and retain new talent. The familiarity of many new graduates with Eclipse tools can help lower training costs.

Summary

IBM compilers are designed to allow applications to take advantage of virtually all the hardware exploitation features provided by IBM processors including POWER8. By utilizing leading-edge optimization technologies in IBM compilers, organizations can improve their return on investment in hardware assets, while increasing programmer productivity.

Organizations often wait until they upgrade their hardware to upgrade their compilers. However, given that the compilers can deliver significant improvements in application performance and programmer productivity, compilers offer a cost-effective way to get more out of existing technology. By periodically upgrading compilers, programmers can take advantage of new language, usability and optimization features, and stay ahead of competitors on the technology curve.

XL C/C++ for AIX supports integration with the latest IBM Rational Developer for AIX and Linux, C/C++ Edition, a premier Eclipse-based integrated development environment for application development and maintenance; and IBM Rational Team Concert, a Jazz-based application life cycle management software product. These development tools improve programmer productivity and overall team efficiency and help reduce cost and risk, and improve time to value.

For more information

To learn more about the IBM XL C/C++ for AIX compiler, contact your IBM representative, IBM Business Partner, or visit: XL C/C++ for AIX at www.ibm.com/software/products/en/xlcpp-aix.

Get started today by downloading a trial version of the XL C/C++ for AIX compiler at: XL C/C++ for AIX at www.ibm.com/software/products/en/xlcpp-aix.