intel ®

Maximize
Application Performance
on Intel® architectures

intel inside
ITANIUM²

intel inside
XEON™

intel inside
pentium® 4
H T

intel inside
centrino™
MOBILE
TECHNOLOGY

Intel® Compilers
Intel® Performance Libraries
Intel® Threading Tools
Intel® VTune™ Analyzers
Intel® Cluster Tools
Intel® Software College

Intel®
**software
development**
products

Contents

Performance + Compatibility + Support

Intel® Software Development Products

Maximize application performance

Intel® Software Development Products allow you to take full advantage of the power of Intel® processors to develop highly optimized applications with superior performance. From compilers that ensure faster code execution, to libraries that provide optimized algorithms, to performance analysis and profiling tools that enable developers to remove bottlenecks and increase code efficiency, Intel® software tools provide a full suite of options designed to help you deliver applications with outstanding performance.

Accelerate developer productivity and time to market

Intel software tools are easy to use, allowing you to get better quality code faster. The compilers are designed to incorporate more functionality in fewer steps. The libraries provide a wide selection of pre-optimized functions (so you don't have to write them yourself). Profiling and performance analysis tools accelerate the process of testing and tuning your application. All of these lead to shorter development cycles and faster time to market.

Cross platform development

Intel Software Development Products offer common user interfaces, functionality, and APIs to provide an environment that allows for easy porting across platforms. From servers to cell phones, this cross platform functionality empowers you to repurpose applications, giving you a head start for entering new markets. Intel Software Development Products provide ever-expanding support for the features of Intel's latest processors, including the Pentium® M processor component of Intel® Centrino™ mobile technology§, Intel® Itanium® 2 processor, Intel® Xeon™ processor, and Intel XScale® technology.

Compatibility

Intel tools are compatible with the leading development environments available today, including Microsoft Visual Studio*, Microsoft Visual Studio .NET, Borland C++ Builder*, and popular Linux* development tools. We have software tools for multithreaded applications and for clustered applications on distributed systems.

Support and Training

To ensure that you get the most out of the Intel software tools, we offer world-class technical support and a variety of training opportunities (Web-based or classroom). Additionally, we provide a rich library of technical resources — white papers, case studies, and documentation to provide even more hints, tips and tricks on maximizing your use of the tools.
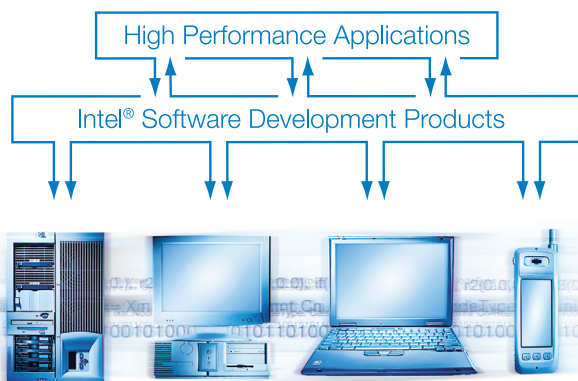
Performance + Compatibility + Support

If you care about making your software perform at its maximum, we invite you to learn more by visiting our Web site, or contacting any reseller worldwide!

Build

Compile

Tune and Debug

Intel® C++ Compiler
For Windows*
Version 8
C++

Intel® Fortran Compiler
For Linux*
Version 8
Fortran

VTune Performance Analyzer
Windows Server* 2003, 2000, XP, Linux*
Version 2
VTune Analyzers

Intel® Cluster Tools
For Linux*
Version 1
Cluster Tools

Intel® Threading Tools
Version 2
Intel Threading Tools

Intel® Math Kernel Library
For Linux*
Version 6
Math Kernel Library

Intel® Integrated Performance Primitives
For Windows*
Version 4
Intel® IPP Library

Intel® Compilers Overview

Overview

Intel® compilers help software run at top speed. They are compatible with the tools developers use. The compilers plug into popular development environments to support the way developers work and feature source and binary compatibility with popular compilers. Every compiler includes Intel® Premier Support that comes directly from Intel and offers updates, technical support and expertise for the Intel® architecture.

Intel compilers are available in seven packages:

- Intel® C++ Compiler for Windows* (includes Intel C++ Compiler for Microsoft eMbedded Visual C++*)
- Intel C++ Compiler for Linux*
- Intel® Visual Fortran Compiler, Standard Edition, for Windows
- Intel Visual Fortran Compiler, Professional Edition, for Windows
- Intel® Fortran Compiler for Linux
- Intel C++ Compiler for Platform Builder for Windows CE .NET (for OEMs and system integrators)
- Intel® C++ Software Development Tool Suite for Palm OS*, Symbian OS*, Nucleus* OS and OS independent systems

Customer Benefits

- Performance — Advanced optimization features deliver outstanding performance for applications running on the latest Intel products, including the Intel® Pentium® 4, Intel® Itanium® 2, and Intel® Xeon™ processors, the Mobile Intel Pentium Processors - M, as well as Intel® Centrino™ mobile technology§ and Intel® Personal Internet Client Architecture (Intel® PCA).

  Intel compilers also provide threaded application development and optimization through support of the OpenMP* 2.0 standard, auto-vectorization and auto-parallelism features.

- Compatibility — The Intel C++ Compiler for Windows is source- and object-code compatible with Microsoft Visual C++* 6.0 and .NET native-code compilers. The Intel C++ and Fortran compilers plug into the Microsoft Visual Studio* environment, which preserves your development environment investment. The Intel Compiler for Windows CE .NET (available with Intel C++ Compiler for Windows) plugs into the Microsoft eMbedded Visual C++ environment. Intel C++ compilers follow ANSI C/C++ and ISO C/C++ standards. The Intel C++ Compiler for Linux is source- and object-code compatible with GNU C 3.2 and supports the C++ ABI.

- Support — Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

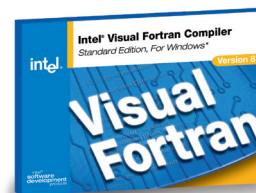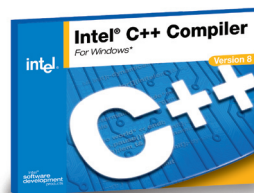## Optimize Your Application for Your Needs

- **Available for Windows* and Linux***
- **Special optimizations** for systems using Intel® Personal Internet Client Architecture (Intel® PCA), IA-32 and Intel® Itanium® 2 processors
- **Advanced optimization features** provide great performance for your applications
- **Compatible** with development tools most programmers already use
- **Intel® C++ Compiler for Windows** features binary compatibility with Microsoft Visual C++* .NET
- **Intel® C++ Compiler for Linux** features binary compatibility with GCC 3.2
- **Intel® Fortran Compiler** offers substantial source compatibility with Compaq Visual Fortran*
- **Intel® Premier Support** keeps you current with the latest compiler updates
- **Fully-functional trial versions** available

§ Wireless connectivity requires additional software, services or external hardware that may need to be purchased separately. Availability of public wireless access points is limited. System performance, battery life and functionality will vary depending on your specific hardware and software.

Technology Highlight:
Code-Coverage and Test-Prioritization Tools

Every Intel compiler for systems based on IA-32 and Itanium 2 processors includes the Code-Coverage Tool and the Test-Prioritization Tool.

Code-Coverage Tool

When it is time to test software quality, developers should use the Code-Coverage Tool. It makes it easy to see which parts of an application have been tested and which have not. The tool paints a picture of code-use by displaying color-coded, annotated HTML pages that provide summary information and simplified navigation through most- and least-covered modules and functions. The Code-Coverage Tool provides:

- Performance: Use of the Code-Coverage Tool can improve development efficiency, improve quality, and increase application performance

- Flexible Analysis: The Code-Coverage Tool only analyzes what you want to analyze, from individual modules to entire applications

- Improved Testing: Developers can view overall code coverage as well as specific module source coverage, which speeds up testing and improves software quality by showing how much code the test suites have actually exercised

- Inclusion with Intel Compilers: The Code-Coverage and Test-Prioritization Tools are included with Intel Compilers – there is nothing extra to buy.
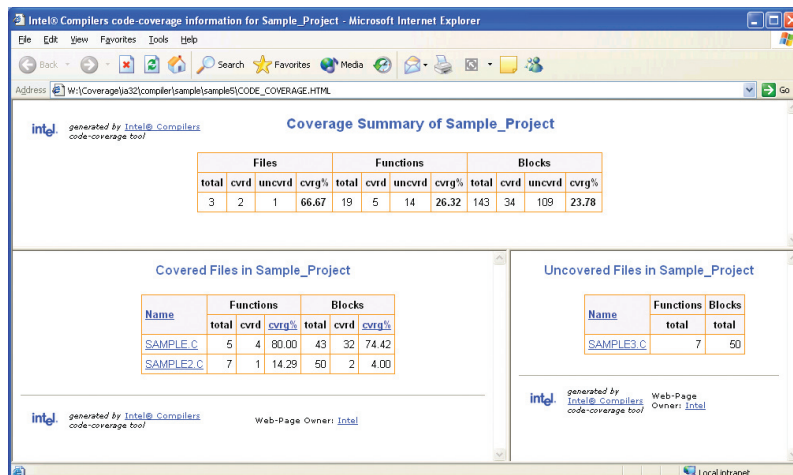
Test-Prioritization Tool

The Test-Prioritization Tool helps developers make sure that quality, function and performance tests stay current and 'on-target' as changes are made to application software. It provides software developers with the capability to quickly and easily select and prioritize application tests as application profiles change. When used with large test-suites, the tool can locate the smallest subset of tests that offer the broadest coverage. This can speed testing turn-around time, improve quality and developer productivity, and lead to high-performing applications that get delivered to market more quickly.

The time-savings and quality-assurance that can come from using this tool can be especially valuable in pressure-packed 'bug-fix' situations where testing is an important milestone in shipping software. The Test-Prioritization Tool provides:

- Performance: The Test-Prioritization Tool helps developers keep their functional and performance tests current as application profiles change.

- Test-Suite Change Tracking: When applications change, the Test-Prioritization Tool automatically suggests tests that are probably affected, helping developers keep test suites current as applications change.

- More Efficient Testing: Developers can use the tool to find the smallest subset of tests for a given test scenario. This can speed up testing by limiting the number of tests done and helping developers pick the fastest-running tests. You can also limit the amount of code that is tested.

- Faster Testing: Developers can also find the set of tests that provide a specified level or degree of coverage. You can further refine the set to select tests that run in a minimum amount of time. This is also useful in 'bug-fix' situations.

- Inclusion with Intel Compilers: The Code-Coverage and Test-Prioritization Tools are included with Intel Compilers –- there is nothing extra to buy.

Top-level Code-Coverage Summary of a Sample Report

Using the Test-Prioritization Tool is a simple 3-step process

Step 1

Compile with prof_genx

Keep the static profile information .spi for coverage analysis

Instrumented Executables

app.exe

Step 2.1

app.exe — Run Instrumented Executables on Test_1

Merge Dynamic Profile Information on .dyn profiles

Test_1.dpi

...

Step 2.n

app.exe — Run Instrumented Executables on Test_n

Merge Dynamic Profile Information on .dyn profiles

Test_n.dpi

Step 3

Run Test Prioritizer

Intel Compiler Features

All of the Intel compilers feature a set of optimizations that help deliver application performance. These features include support for Streaming SIMD Extensions 2 (SSE2) on IA-32 processors, software pipelining in the Itanium 2 processor, and support for Intel XScale® microarchitecture. Intel compilers support multi-threaded code development through auto-vectorization, auto-parallelism and OpenMP programming.

Excellent Floating-Point Instruction Throughput

Intel C++ Compiler on IA-32 processors uses the stack to efficiently execute floating-point instructions. Application performance gains come from overlapping instructions that can put their calculation results in any stack register. On Itanium 2 processors, the compiler takes advantage of directly addressable floating-point registers that enable pipelined floating-point loops and a reduced number of load and store operations as compared to conventional architectures, so applications can run at higher execution speeds. The compiler

for Intel PCA processors provides highly-optimized floating-point emulation libraries to enable development or migration of applications that take advantage of floating-point calculations (single and double precision).

Data Prefetching

Data prefetching is an effective technique to improve memory access latency on IA-32 and Itanium 2 processors. Data prefetching inserts prefetch instructions for selected data references at specific points in the program, so referenced data items are moved as close to the processor as possible (put in cache memory) before data items are actually used. This can provide significant performance improvement for applications that are more compute-intensive. Benefits include:

- Automatic data prefetching
- Data prefetching coordination with other optimizations (for example, software pipelining)
- Code portability so developers don't need to manage this aspect of application performance in source code to write processor-specific instructions

Profile-Guided Optimization process flow

```
┌─────────────────┐
│    Step One      │
│  Compile with    │
│      PGO         │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Instrumented   │
│   Executable     │
│  ┌──────────┐    │
│  │ foo.exe  │    │
│  └──────────┘    │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│    Step Two      │
│ Run instrumented │
│ application to   │
│ produce Dynamic  │
│ Information Files │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│    Dynamic       │
│  Information     │
│  Summary File    │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Step Three     │
│ Feedback Compile │
│   with PGO       │
└─────────────────┘
         │
         ▼
    ╭─────────────╮
    │ Profile-Guided│
    │ Application  │
    ╰─────────────╯
```
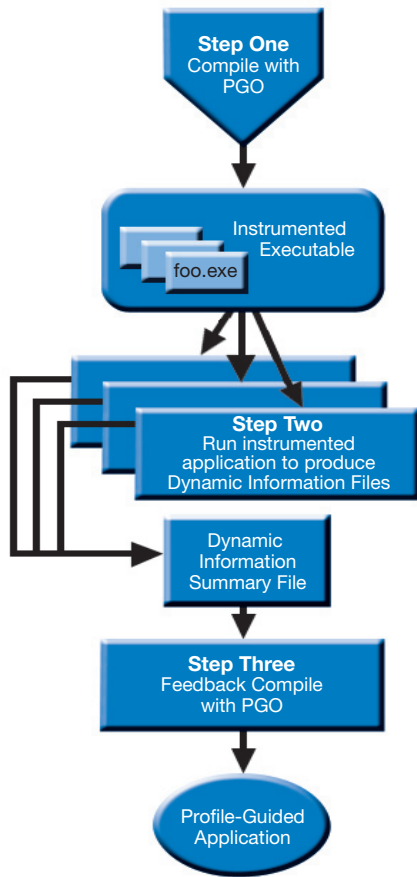
On IA-32 processors, the compiler can work with the Processor Dispatch capability to automatically detect if the application is running on a Pentium 4 processor or an earlier Pentium processor. Pentium 4 processors offer hardware-assisted data prefetching which generally produces better performance, but even here, Processor Dispatch remains under the control of the application developer.

Interprocedural Optimization (IPO)
IPO automatically creates faster code through in-lining, where function calls are replaced with real function code. It is featured on all Intel compilers and can dramatically improve application performance in programs that contain many small- or medium-sized functions that are used frequently, especially programs that contain calls within loops.

Profile-Guided Optimization (PGO)
The PGO compilation process enables the Intel C++ Compiler to take better advantage of the processor architecture, more effectively use instruction paging and cache memory, and make better branch predictions. It improves application performance by reducing instruction-cache thrashing, reorganizing code layout, shrinking code size and reducing branch mispredictions. Note: PGO does not apply to Intel C++ Compiler for Microsoft eMbedded Visual C++.

Multi-Threading Support (OpenMP*, Auto-Parallel)
OpenMP is an industry standard for portable multi-threaded application development, and is effective at fine grain (loop level) and large grain (function level) threading. Intel C++ compilers for IA-32 and Itanium 2 processors support OpenMP API version 2.0 and transform code for shared memory parallel programming.

Intel Compilers for IA-32 Processors
IA-32 compilers support Streaming SIMD Extensions 2 (SSE2) that distinguish the Intel NetBurst® microarchitecture introduced with the Pentium 4 processor. SSE2 goes beyond the initial, performance-oriented support for multimedia or graphical components of applications and includes improved performance for floating-point and double-precision computational needs. The new instructions are supported in a number of ways including inline ASM, compiler intrinsics, class libraries, the vectorizer, and the Intel® Performance Libraries. The compilers for IA-32 processors also support the new instructions on the Pentium 4 processor with Streaming SIMD Extensions 3. The compilers continue to support performance features such as Intel® MMX™ technology, not only on IA-32 processors but also in the Intel C++ Compiler for Intel PCA processors. They support development of highly-optimized multimedia applications using Intel Wireless MMX technology at three levels: Intel Wireless MMX assembler support, intrinsic support, and through a vectorizer option switch.

Automatic Vectorizer

Intel compilers for IA-32 processors provide a vectorizer that automatically parallelizes code to maximize underlying processor capabilities. Vectorizer examples demonstrate how to increase the speed of application execution. New features include support for advanced, dynamic data alignment strategies, including loop peeling to generate aligned loads and loop unrolling to match the pre-fetch of a full cache line.

Processor Dispatch

Intel compilers for IA-32 processors offer developers the option, called Processor Dispatch, to build applications for a specific generation of Intel processor. Dispatch now allows for multiple specific targets, each of which takes advantage of the underlying hardware to deliver application performance. With processor dispatch, developers can build applications for the latest Intel processor — the Pentium 4 processor — while at the same time maintaining the ability for the executable to run on all previous IA-32 processors. Developers can use the latest processor performance features while still delivering high performance on older Intel architecture systems — all in one code base and one executable.

Intel Compilers for the Intel® Itanium® 2 Processor

Intel compilers offer several features that support Itanium 2 processors and improve application performance. Features include predication, branch prediction, software pipelining, speculation, and high-performance floating-point optimizations.

Predication

Other architectures implement conditional execution through branch instructions. The Itanium 2 processor microarchitecture implements conditional execution with predicated instructions, and Intel compilers take specific advantage of it. Predication enables the complete removal of branches from program sequences, an important optimization. This results in larger basic blocks and eliminates associated mispredict penalties, both of which contribute to improved application performance. Since fewer branches exist after predication, dynamic instruction fetching is more efficient because there are fewer possibilities for control flow changes.

Improved Branch Prediction

Intel compilers for Itanium 2 processors support improved branch prediction, a feature that allows the processor to determine the most likely code path after a branch instruction, and, based on the prediction, the processor fetches and begins executing instructions on the selected code path. A mispredicted branch causes a delay in execution because the results of instructions executed along the wrong path must be discarded and the correct path must be fetched and executed. The Itanium 2 microarchitecture enables Intel compilers to communicate branch information to the processor, thus reducing the number of branch mispredictions. It also enables the compiled code to manage the processor hardware using runtime information. These two features complement predication and provide many performance benefits: applications with fewer branch mispredictions run faster, the performance cost from any remaining mispredicted branches is reduced, and applications have fewer cache misses. To ensure that the application is correct in most cases, Intel compilers for Itanium 2 microarchitecture use a recovery-code process that is executed as needed.

Software Pipelining

Intel compilers for Itanium 2 processors use software pipelining to reduce the number of clock cycles necessary to process a loop. The software pipelining feature attempts to overlap loop iterations by dividing each into stages, with several instructions in each iteration stage. Because software pipelining permits multiple loop iterations without unrolling the loop, it enables one-cycle, whole-loop computations in Itanium 2-based applications. Not all loops may benefit from software pipelining; it helps to boost application performance by significantly reducing code expansion, path length and branch mispredictions.

Speculation

The speculation feature allows developers using Intel compilers to improve performance by doing some operations (for example, costly load instructions) out of sequence before they are needed. To ensure that the code is correct in most cases, the compiler executes recovery code as needed. Recovery code ensures correct execution of all affected operations if the original conjecture or speculation was false.

Intel® C++ Compilers for Windows*

The Intel C++ Compiler for Windows provides plug-in compatibility with Microsoft Visual Studio .NET. It is source and object compatible with Microsoft Visual C++ 6.0, and is substantially native source- and object-code compatible with Visual C++ .NET. Standards supported include ANSI C/C++, ISO C/C++, and OpenMP 2.0 C/C++ (except WorkQueue). The Intel C++ Compiler for Windows includes a compiler for IA-32 processors, a separate compiler for Itanium 2 processors, a cross-compiler that runs on systems using IA-32 processors for generating code for systems using Itanium 2 processors, and a fourth compiler used for creating applications that run on Intel PCA processors using Windows CE .NET. This one product provides developers with all the compiler technology they need to build applications that span from hand-held devices, such as mobile phone and PDAs, to the server-based components of a complete solution.

The Intel C++ Compiler for eMbedded Visual C++ empowers application developers to build applications optimized for Intel PCA processors using Intel XScale microarchitecture. The compiler includes support for Microsoft-specific intrinsic functions and provides direct access to hardware, including register and coprocessor access, using a high-level abstraction (no need to drop down to assembly code).

Intel C++ Compiler for eMbedded Visual C++ is part of Intel C++ Compiler 8.0 for Windows, which is designed for application developers. The compiler plugs into eMbedded Visual C++ and is used to create applications that run on devices using Windows CE .NET. This package also includes compilers for IA-32 and Itanium 2 processors. The compiler for Windows CE .NET is also available in a package called Intel C++ Compiler for Platform Builder for Windows CE .NET. This package is designed for system integrators and OEMs and includes a variety of tools that are useful for hardware system debugging and optimization.

Intel C++ Compilers for Linux*

The Intel C++ Compiler for Linux is compatible with GNU C/C++ (GCC) 3.2 and the C++ ABI, enabling developers to use familiar tools such as Emacs, make and more. The compiler provides threaded application development and optimization through support of the OpenMP 2.0 standard and auto-parallelism feature. The Intel C++ Compiler for Linux enables access to floating-point instructions which result in application performance gains. Interprocedural optimization (IPO) can dramatically improve application performance in programs that contain many frequently-used small- or medium-sized functions, especially programs that contain calls within loops.

Intel® Visual Fortran Compilers

The Intel Visual Fortran Compiler for Windows combines Compaq Visual Fortran* language features and Intel code generation and optimization technology to deliver the next generation Fortran for Intel architecture. It features over 250 Compaq Visual Fortran and Intel Fortran commands and synonyms to make it easy to use, plugs into Microsoft Visual Studio and includes support direct from Intel. The compiler is fully-featured Fortran 95 compliant with advanced optimizations to make Fortran applications run fast on IA-32 and Itanium 2 processors. It is available in Standard and Professional Editions. The Professional Edition includes everything that is in the Standard Edition and also includes the IMSL* Fortran 5 Library.

Intel® Fortran Compilers for Linux

The Intel Fortran Compiler for Linux supports development on Linux systems by using familiar tools such as Emacs, make and more and provides mixed language support for Fortran and C. It adheres to the latest ISO Fortran 95 standards. The compiler provides threaded application development and optimization through support of the OpenMP 2.0 standard, auto-vectorization and auto-parallelism features. The product includes specific compilers for Pentium, Itanium 2, and IA-32 processors and the Pentium 4 processor with Streaming SIMD Extensions 3.

For More Information…
http://www.intel.com/software/products/compilers

Intel® C++ Compiler
for Windows*

Overview

Intel® compilers help software run at top speed and feature compatibility with the tools that developers use. Intel® C++ Compiler for Windows* plugs into Microsoft Visual Studio* .NET 2002 and 2003, supporting the way most developers work. The Intel compilers for IA-32 and Intel® Itanium® are source- and binary-compatible with Microsoft Visual C++* native-code compilers.

Intel C++ Compiler for Windows also includes the Intel® C++ Compiler for eMbedded Visual C++* — the compiler for delivering outstanding application performance on wireless and multimedia applications running on Intel® Personal Internet Client Architecture (Intel® PCA) using Windows CE .NET. The compiler is compatible with the eMbedded Visual C++ development environment, making it easy to create highly optimized phone and handheld (PDA) applications. All Intel compilers come with one year of support, including new versions and updates.

Features and Benefits

- **Interprocedure optimization** (IPO) creates faster code through inlining, replacing multiple function calls with actual function codes and performing absolute rather than relative addressing wherever possible
- **Highly-optimized, floating-point emulation** allows development of performance-sensitive applications that use floating-point operations
- **Intrinsic functions accessed from the C++ level** make it easy to use Single Instruction Multiple Data (SIMD) technology from the C++ application level
- **Multi-threaded application support** for OpenMP* and auto-parallelization yields faster execution
- **Support for ANSI C/C++ and ISO C/C++** standards that you already know
- **Intel® Debugger** saves you effort
- **Fully-functional trial version** is available

SPEC* Performance Estimates on IA-32 and Windows*

SPEC Performance Estimates: Higher (Larger) is Better

SPECint 2000 Performance Estimates	-02	Base
Intel® C++ Compiler	1072	1279
Leading Compiler	1010	1047

SPECfp 2000 Performance Estimates	-02	Base
Intel C++ Compiler	997	1261
Leading Compiler	820	956
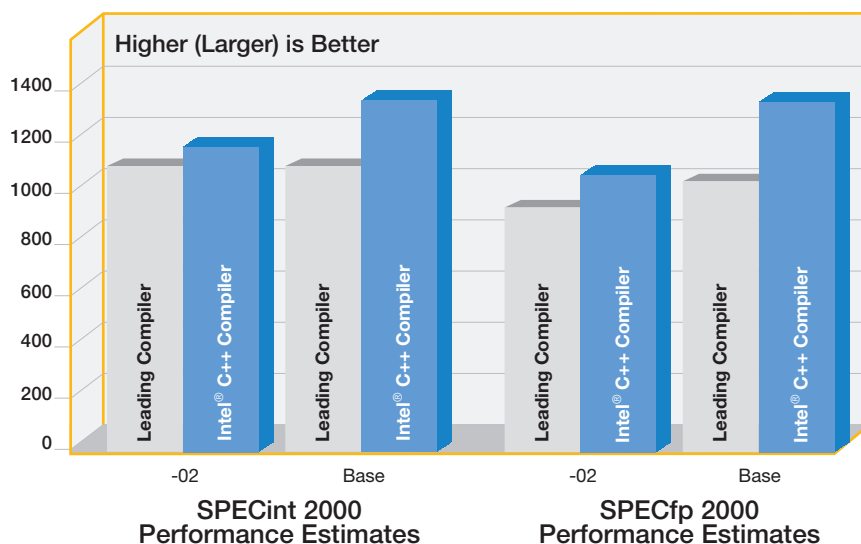
Configuration: Intel® C++ Compiler 8.0 for Windows*, Intel® Pentium® 4 processor 3.2 GHz (512 KB L2 cache, 256 MB memory), Windows XP Professional MP Kernel (Build 2600)

SPEC* performance estimates on Intel® C++ Compiler 8.0 for Windows* against a leading compiler, with SPECint 2000 and SPECfp 2000 Components. **Higher is better.**
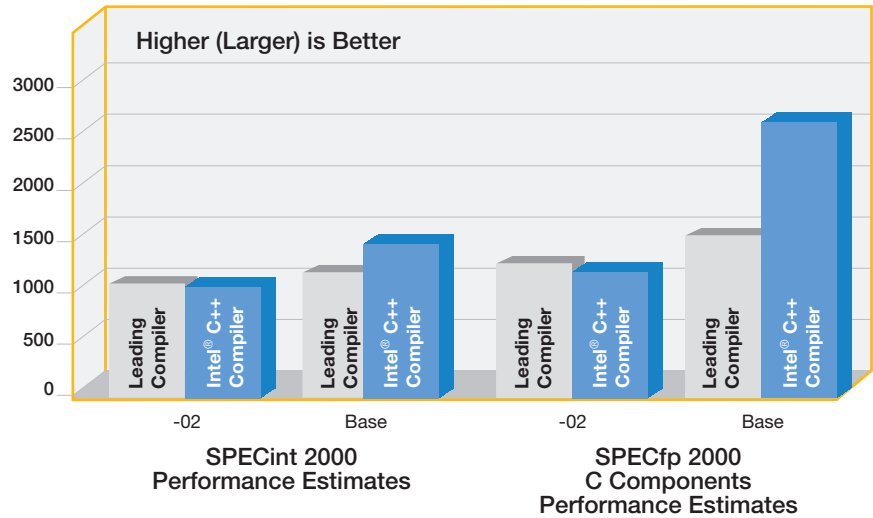
Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

SPEC* Performance Estimates on Intel® Itanium® 2 Processor and Windows*

**SPEC Performance Estimates
Higher (Larger) is Better**

SPECint 2000 Performance Estimates		
	-02	Base
Intel® C++ Compiler 8.0	873	1233
Leading Compiler	888	918

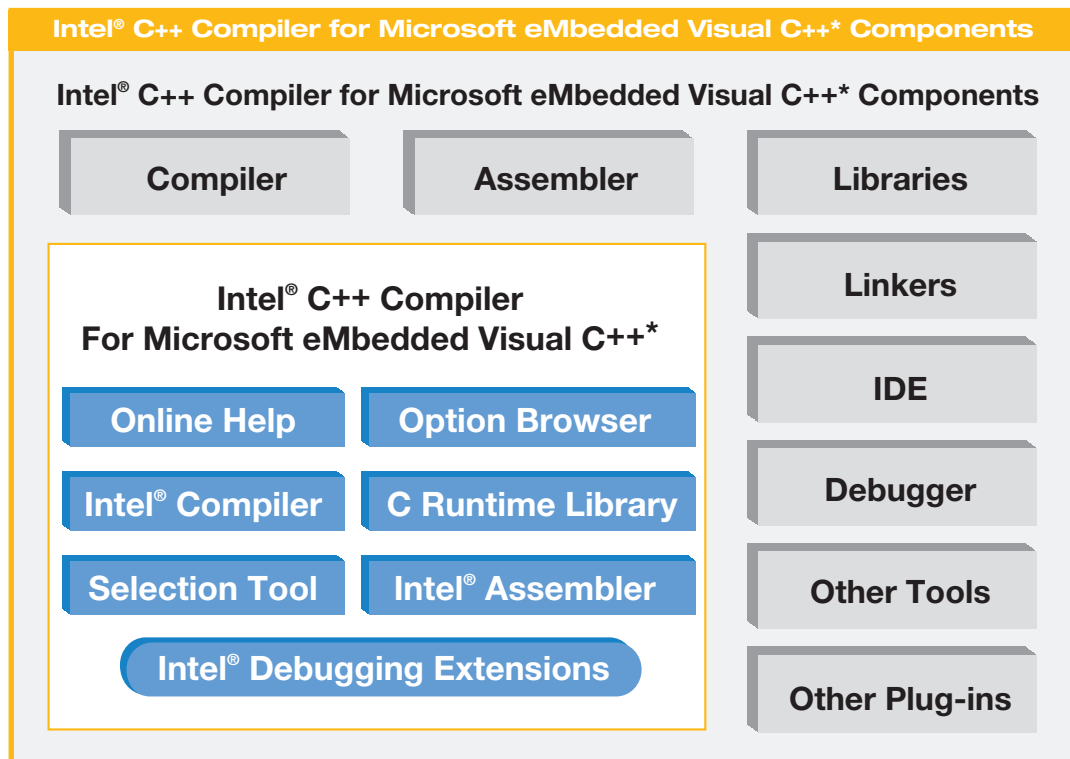| SPECfp 2000 C Components Performance Estimates		
	-02	Base
Intel C++ Compiler 8.0	923	2451
Leading Compiler	1012	1340

Higher (Larger) is Better

Configuration: Intel® C++ Compiler 8.0 for Windows*, against a leading compiler,
with SPECint 2000, Intel® Itanium® 2 processor 1.5 GHz (6 MB L3 cache,
12 GB memory, HP Everest), Windows XP Professional MP
Kernel (Build 2600)

SPEC* performance estimates on Intel® C++ Compiler 8.0 for Windows* against a leading compiler, with SPECint 2000, with SPECint 2000 and SPECfp 2000 C Components. **Higher is better.**

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

What's New in the Intel C++ Compiler for Windows

- Intel C++ Compiler 8.0 for Windows includes compilers and tools for Intel® Personal Internet Client Architecture (Intel® PCA), IA-32 and Itanium processors – compilers that span hand-held computing devices and mobile phones, to compute-intensive and IT-based servers.

- New Processor Support: The IA-32 compiler provides optimization support for the latest Intel processors, including the Intel® Pentium® 4 processor with Streaming SIMD Extensions 3, a new generation of IA-32 processors.

The compiler for Intel PCA processors supports the Intel® PXA27x processor which features Intel® Wireless MMX™ technology.

- The Intel C++ Compiler is source and object compatible with Microsoft Visual C++ 6.0 (and higher), and is substantially source and object native-code compatible with Microsoft Visual C++ .NET. The compiler also plugs into the Microsoft Visual Studio development environment for IA-32.

- Advanced optimizations including full support for Streaming SIMD Extensions (IA-32 processors), Wireless MMX™ Technology (Intel PCA processors), interprocedural optimization, profile guided optimization, data prefetching, automatic vectorizer, auto-parallelization, and more.

Intel® C++ Compiler for Microsoft eMbedded Visual C++* Components

Intel® C++ Compiler for Microsoft eMbedded Visual C++* Components

Compiler	Assembler	Libraries

**Intel® C++ Compiler
For Microsoft eMbedded Visual C++***

Online Help	Option Browser
Intel® Compiler	C Runtime Library
Selection Tool	Intel® Assembler

Intel® Debugging Extensions

- Linkers
- IDE
- Debugger
- Other Tools
- Other Plug-ins

- Optimization support for the latest Intel processors.
- Compatibility with Windows* CE .NET: The Intel compiler plugs into the Microsoft eMbedded Visual C++* development tools, preserving your investment in building applications for Windows CE.
- Code-Coverage Tool that visually presents how much application code is actually used when applied against specified workloads. Use this tool in a variety of ways to improve development efficiency, reduce defects, and increase application performance.

- Test-Prioritization Tool lets you select and prioritize application tests as the profile of applications change. With knowledge gained from using the Code-Coverage Tool, developers can use the Test-Prioritization Tool to target and maintain efficient testing procedures.
- Improved integration with Microsoft Visual Studio .NET 2002 and 2003. Intel C++ Compiler for Intel PCA processors plugs into eMbedded Visual C++ to preserve the way developers work in building applications for hand-held computing and mobile phones that use Windows CE .NET.

PERFORMANCE
Advanced Optimization for Windows Applications

The Intel C++ Compiler for Windows provides advanced optimization features that deliver outstanding performance for applications running on the latest Intel processors, including the Intel® Pentium® 4 processor supporting Hyper-Threading Technology[1], Intel® Xeon™, Pentium M processor—a component of Intel® Centrino™ mobile technology,[2] and Intel® Itanium® 2 processors. Intel compilers also provide threaded application development and optimization through support of the OpenMP* 2.0 standard and auto-parallelism feature.

Intel C++ Compiler for eMbedded Visual C++ is hosted on IA-32 processor-based systems running Windows and produces code targeted for Intel PCA processors running Windows CE .NET. The compiler includes many of the same optimizations available with other Intel compilers, including interprocedural optimization and a highly optimized vectorizer. It also offers optimization tools that are unique to Intel PCA processors, such as highly-optimized floating-point emulation, support for intrinsics, support for Intel® Wireless MMX™ technology and debugging tools specifically designed for Intel PCA processors.

COMPATIBILITY
Works with Visual Studio

The Intel C++ Compiler is source and object native-code compatible with Microsoft Visual C++ 6.0 and .NET and plugs into the Microsoft Visual Studio environment. The compiler follows ANSI C/C++ and ISO C/C++ standards. The Intel C++ Compiler for Intel PCA processors plugs into Microsoft eMbedded Visual C++. Both compilers preserve your development investment.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

For IA-32 and Intel Itanium processor system requirements visit: www.intel.com/software/products/compilers

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[1] Hyper-Threading technology requires a computer system with an Intel® Pentium® 4 processor supporting HT Technology and a Hyper-Threading Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on which processors support HT Technology.
[2] Wireless connectivity requires additional software, services or external hardware that may need to be purchased separately. Availability of public wireless access points is limited. System performance, battery life and functionality will vary depending on your specific hardware and software.

Intel® C++ Compiler
for Linux*

Overview

Intel® compilers help software run at top speed. The compiler provides a variety of optimization options to increase application performance, including interprocedural optimization, profile guided optimization, data prefetching and pre-compiled headers to speed compile time. There are also features to enhance performance of threaded applications, such as support for OpenMP* 2.0, auto-parallelization and auto-vectorization.

In addition, Intel® C++ Compiler for Linux* features source and binary compatibility with GCC 3.2 and compatibility with widely used Linux development utilities to support the way developers work. New tools packaged with the compiler include the Code-Coverage Tool and the Test-Prioritization Tool, both of which can help improve application quality. Every compiler includes one year of support that comes directly from Intel, including updates, technical support and expertise about the Intel architecture.

Features and Benefits

- **Source- and object-code-compatibility with GNU C** enables you to recompile existing software with the Intel® C++ Compiler to increase application performance
- **Compatible with Linux* –** widely-used utilities such as make, Emacs and gdb save you time and effort
- **Interprocedure optimization (IPO)** creates faster code through inlining, replacing multiple function calls with actual function codes and performing absolute rather than relative addressing wherever possible
- **Highly-optimized, floating-point emulation** allows development of performance-sensitive applications that use floating-point operations
- **Intrinsic functions** accessed from the C++ level make it easy to use Single Instruction Multiple Data (SIMD) technology from the C++ application level
- **Multi-threaded application support** for OpenMP* and auto-parallelization is available
- **Intel® Debugger** support saves you effort
- **Fully-functional trial version** is available

SPEC* Performance Estimates on IA-32 and Linux*

SPEC Performance Estimates: Higher is Better

SPECint 2000 Performance Estimates		
	-02	Aggressive
Intel® C++ Compiler 8.0	1060	1267
GCC	846	852
Other Vendor	758	804

SPECfp 2000 C Components Performance Estimates		
	-02	Aggressive
Intel C++ Compiler 8.0	853	1096
GCC	709	716
Other Vendor	869	940

SPECint 2000 Performance Estimates

SPECfp 2000 C Components Performance Estimates
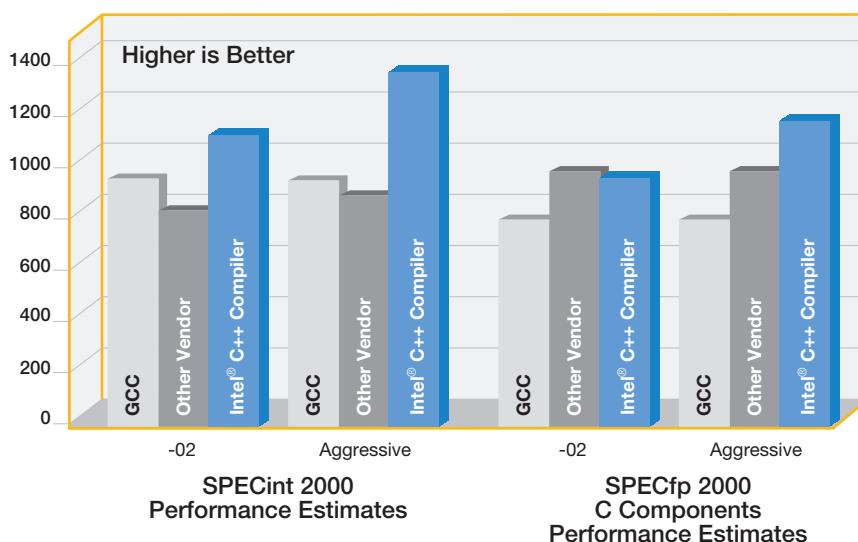
Configuration: Intel® C++ Compiler 8.0 for Linux*, GCC 3.3.2, PGI WS 5.1, Intel® Pentium® 4 processor 3.2 GHz (512 KB L2 cache, 256 MB memory), Linux 2.4 kernel

SPEC* performance estimates on Intel® C++ Compiler 8.0 for Linux* against GCC 3.3.2 and other vendor (PGI* WS 5.1), with SPECint 2000 and SPECfp 2000 C Components. **Higher is better.**

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

## What's New in the Intel C++ Compiler for Linux

- Intel C++ Compiler 8.0 for Linux delivers improved performance on IA-32 and Intel Itanium® 2 processor-based systems. It has a precompiled headers feature that speeds compile time.

- It is now binary compatible with GCC 3.2. This means developers can link code compiled with Intel C++ Compiler 8.0 for Linux with code compiled with GCC 3.2 to create applications. The compiler is compliant with the C++ ABI standard, and it includes additional language features for building the Linux kernel with minor modifications.

- New Processor Support: The compiler provides optimization support for Intel processors, including the Intel® Pentium® 4 processor with Streaming SIMD Extensions 3, a new generation of IA-32 processors, and enhanced support for Itanium 2 processors.

- Code-Coverage Tool that visually presents how much application code is actually used when applied. against

MySQL* on IA-32 and Linux*

Time Comparison: Time in Seconds
Lower is Better

	Set Query	
	-02	Aggressive
Intel® C++ Compiler	377.64	368.68
GCC 3.3.2	653.68	585.29

	Test Select	
	-02	Aggressive
Intel C++ Compiler	343.45	341.45
GCC 3.3.2	418.79	418.47
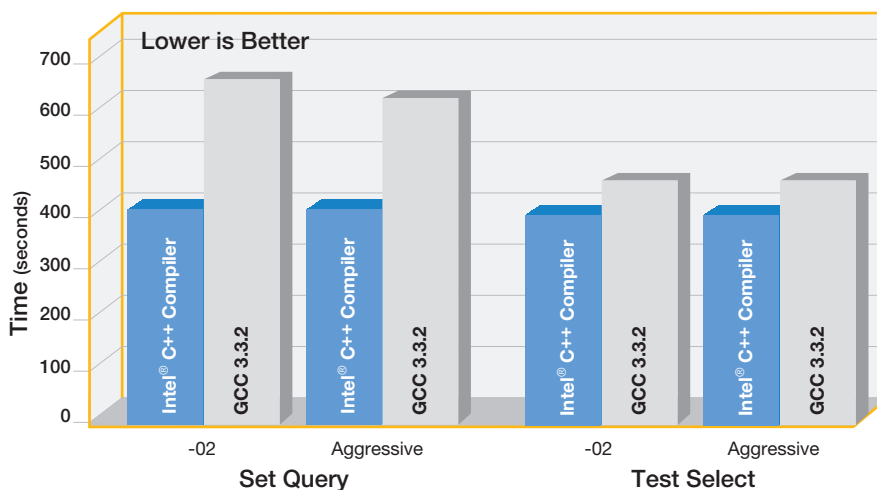
Configuration: MySQL 4.1.1 (no query cache, uses RAM disk), Intel® C++ Compiler 8.0 for Linux*, glibc 2.3.2, GCC 3.3.2, SuSE* 8.2, Intel® Pentium® 4 processor 2.8 GHz (256 MB RAM, 512 KB cache)

Results of performance comparison between Intel C++ Compiler 8.0 for Linux and GCC 3.3.2 running on MySQL* Server 4.1.1. **Lower is better.** Testing supervised by MySQL AB.

specified workloads. Use this tool in a variety of ways to improve development efficiency, reduce defects, and increase application performance.

- Test-Prioritization Tool lets you select and prioritize application tests as the profile of applications changes. With knowledge gained from using the Code-Coverage Tool, developers can use the Test-Prioritization Tool to target and maintain efficient testing procedures.

- Multiplatform: Intel C++ Compilers are packaged and licensed with compilers for both IA-32 and Itanium 2 processors.
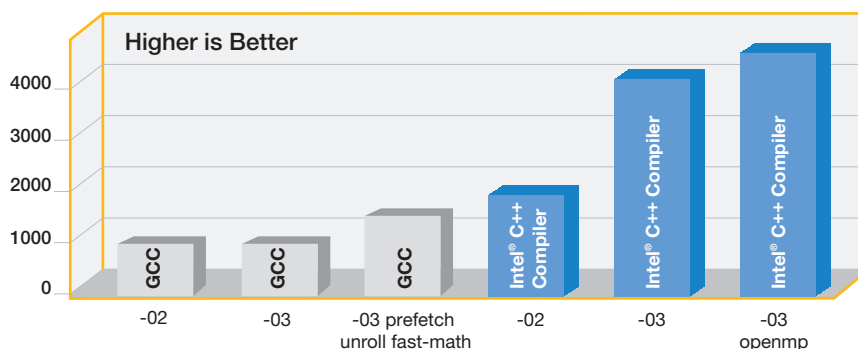
PERFORMANCE
Advanced Optimization

The Intel C++ Compiler for Linux provides advanced optimization features for applications running on the latest Intel processors, including the Intel® Pentium® 4 processor supporting Hyper-Threading Technology[1], Intel® Xeon™, Intel Pentium M — a component of Intel® Centrino™ mobile technology[2], and Intel Itanium 2 processors. Enhancements to existing optimization features continue into this release and include interprocedural optimization, profile guided optimization, data prefetching, highly efficient floating-point optimization, automatic vectorization, auto-parallelization and more. Intel compilers also provide threaded application development and optimization through support of the OpenMP 2.0 standard and auto-parallelism feature.

STREAM* on Intel® Itanium® 2 Processor for Linux*

Stream Rate
Higher is Better

Compiler and Option	Rate (mb/s)
GCC -02	702.17
GCC -03	702.17
GCC -03 prefetch unroll fast-math	1045.79
Intel® C++ Compiler -02	1260.31
Intel C++ Compiler -03	3780.92
Intel C++ Compiler -03 openmp	4096.00

Configuration: Intel® C++ Compiler 8.0 for Linux*, GCC 3.2.3 20030502 (Red Hat Linux* 3.2.3-20), 1.5 GHz Intel Itanium® 2 processor, Red Hat Advanced Server* 2.1

STREAM* test results showing performance comparison between Intel® C++ Compiler 8.0 for Linux* and the GCC 3.2.3 Compiler. **Higher is better.**

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

[1] Hyper-Threading technology requires a computer system with an Intel® Pentium® 4 processor supporting HT Technology and a Hyper-Threading Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on which processors support HT Technology.
[2] Wireless connectivity requires additional software, services or external hardware that may need to be purchased separately. Availability of public wireless access points is limited. System performance, battery life and functionality will vary depending on your specific hardware and software.

COMPATIBILITY
Works with GCC

The Intel C++ Compiler 8.0 for Linux is source and object code compatible with GNU C (GCC 3.2) which means developers can mix code compiled by the Intel compiler with code compiled by GCC 3.2. This can be useful in cases where developers do not have access to source but do have access to binaries. Developers can also continue to use familiar Linux development utilities with Intel C++ Compiler for Linux, preserving the investment and knowledge they have in building applications for Linux.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

For IA-32 and Intel Itanium processor system requirements visit: www.intel.com/software/products/compilers

Intel® Fortran Compiler
for Linux*

Overview

Intel® compilers help software run at top speed. They also feature compatibility and plug into popular development environments, supporting the way developers work, and feature source and binary compatibility with popular compilers. Every compiler includes support that comes directly from Intel, including updates, technical support and expertise about Intel® architecture. Intel® Fortran Compiler for Linux* is compatible with leading development environments and adheres to the latest ISO Fortran 95 standard. Intel Fortran Compiler for Linux provides a variety of optimization options to increase application performance, including interprocedural optimization, profile guided optimization and data prefetching. It includes features to enhance performance of threaded applications, such as support for OpenMP* 2.0, auto-parallelization and auto-vectorization.

Intel Fortran Compiler for Linux is the next generation Fortran compiler for IA-32 and Intel® Itanium® 2 processors. It is an ISO Fortran 95 compiler that combines the Compaq Visual Fortran* (CVF) language features with the code-generation and optimization features of Intel compiler technology. It features over 250 commands that are common to Intel Fortran and CVF to support the way developers work, preserve investment code bases, and support commonly used Linux development tools. New tools packaged with the compiler include the Code-Coverage and Test-Prioritization Tools, both of which can be used to improve application quality. Every compiler includes one year of support that comes directly from Intel, including updates, technical support and expertise about the Intel architecture.

Features and Benefits

- **Compatible with Linux* utilities.** Widely-used utilities such as make, Emacs and gdb
- **Highly-optimized, floating-point emulation** allows development of performance-sensitive applications that use floating-point operations
- **Interprocedure optimization (IPO)** can dramatically improve application performance in programs that contain many frequently used small- or medium-sized functions, especially for programs that contain calls within loops
- **Profile-Guided Optimization (PGO)** reduces instruction-cache thrashing and reorganizes code layout, shrinks code size and reduces branch mispredictions to improve application performance
- **Full Support for Streaming SIMD Extensions 3 (SSE3)** is provided for the Intel® Pentium® 4 processor with Streaming SIMD Extensions 3. The compiler provides support for architectural features of Intel processors
- **Multi-threaded** application support for OpenMP* and auto-parallelism is available
- **Intel® Debugger** saves you effort
- **Fully-functional trial version** is available

STREAM* on Intel® Itanium® 2 and Linux

STREAM Test Results
Higher (Faster) is Better

Compiler & Option	Rate (MB/s)
g77 -02	702.17
g77 -03 prefetch unroll fast-math	1,003.10
Intel Fortran -02	1,257.16
Intel Fortran -03	3,780.92
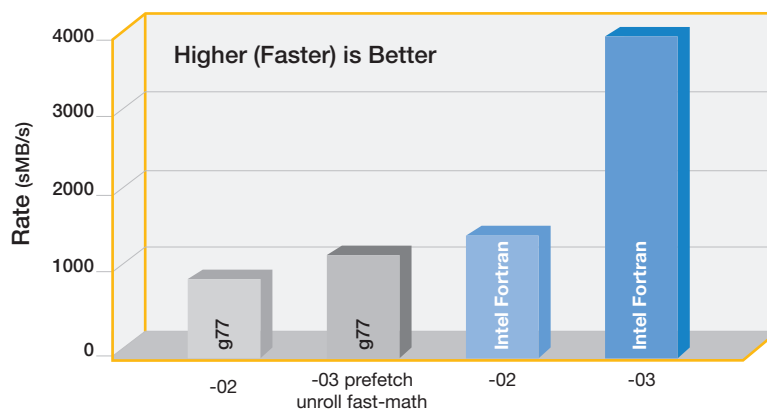
Configuration: Intel® Fortran Compiler 8.0 for Linux, g77 version 3.2.3 20030502 (Red Hat Linux 3.2.3-20), 1.5 GHz Itanium 2 processor system, Red Hat AS 2.1

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, go to www.intel.com/software/products

Polyhedron* on IA-32 and Linux*

**Polyhedron Tests
Lower (Faster) is Better**

F77 Test Geomean	
Intel® Fortran 8.0	**6.27**
Intel Fortran 7.1	**6.86**
Other Linux Fortran	9.97

F90 Test Geomean	
Intel Fortran 8.0	**10.62**
Intel Fortran 7.1	**12.19**
Other Linux Fortran	20.40

Configuration: Intel® Fortran Compiler 8.0 for Linux*, Intel Fortran Compiler 7.1 for Linux, PGI HPF* 3.2.4, Intel® Pentium® 4, 1.8 GHz, 256 MB; Red Hat 9* (kernel 2.4.20-6, glibc 2.3.2-5)

Results of performance comparisons between Intel® Fortran Compiler 8.0 for Linux*, Intel® Fortran Compiler 7.1 for Linux, and PGI HPF* 3.2.4 Linux Fortran Compiler. **Lower (Faster) is better.** Performance tests done by Polyhedron* on Polyhedron configurations. This information is published on their web site at www.polyhedron.com and is reproduced here with permission.
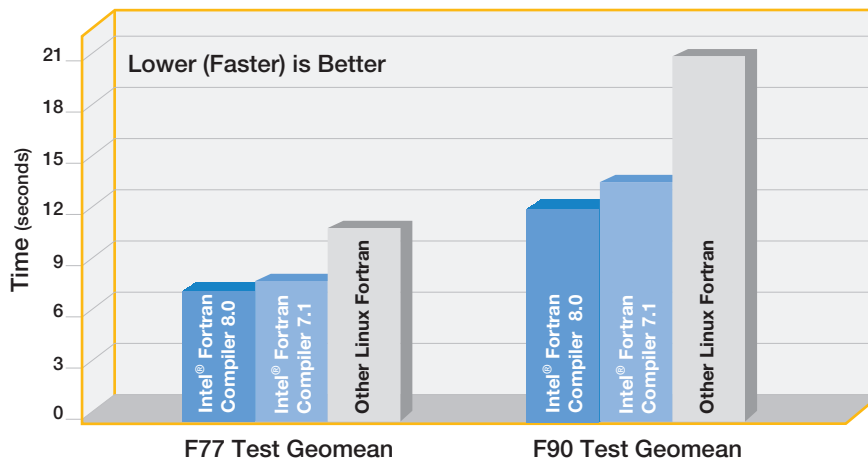
Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel Products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products go to www.intel.com/software/products

What's New in the Intel Fortran Compiler for Linux

- Compaq Visual Fortran front-end, Intel Fortran back-end: Combines the CVF front-end Fortran language features with the Intel Fortran back-end code-generator and optimizer to bring the next-generation Fortran compiler to developers working on IA-32 or Itanium 2 processors using Linux. Intel Visual Fortran Compiler 8.0 for Windows* brings similar capabilities to Windows-based developers. (Windows and Linux compilers are packaged and sold separately).

- Commands: Over 250 commands and synonyms common to both Intel Fortran and CVF are provided to support users of earlier CVF or Intel Fortran compiler users.

- New Processor Support: The IA-32 compiler provides optimization support for the latest Intel processors, including the Intel® Pentium® 4 processor with Streaming SIMD Extensions 3, a new generation of IA-32 processors.

- Advanced optimizations including full support for Streaming SIMD Extensions (IA-32 processors), interprocedural optimization, profile guided optimization, data prefetching, automatic vectorizer, auto-parallelization and more.

- Code-Coverage Tool: Presents how much application code is actually used when applied against specified workloads. Used in a variety of ways to improve development efficiency, reduce defects, and increase application performance.

- Test-Prioritization Tool: Select and prioritize application tests as application profiles change. With knowledge gained, developers can use the Test-Prioritization Tool to target and maintain efficient testing procedures.

PERFORMANCE
Optimize Your Applications

The Intel Fortran Compiler for Linux is designed to take advantage of the performance features of Intel architecture. Advanced optimization features can be used by developers to deliver even more performance. Intel Fortran provides support for threaded application development and optimization through support of OpenMP 2.0 and the auto-parallelization and auto-vectorization options.

COMPATIBILITY
Next Generation Fortran

Compaq Visual Fortran compiler front-end language features have been combined with the Intel back-end code-generation and optimization features to form Intel Fortran Compiler 8.0 for Linux. The compiler works with widely-used Linux command-line development tools preserving the way most Linux developers work and the investment in the way Fortran applications are built.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to

REQUIREMENTS
Hardware and Software

For IA-32 and Intel Itanium processor system requirements visit: www.intel.com/software/products/compilers

Intel® Visual Fortran Compiler
Standard and Professional Editions for Windows*

Overview

Intel® Visual Fortran Compiler for Windows* marks a milestone for Fortran developers. It combines Compaq Visual Fortran* language features with Intel code-generation and optimization technologies to deliver outstanding application performance. It is source- and command-line compatible with Compaq Visual Fortran, includes many industry extensions and integrates into Microsoft Visual Studio* .NET. Intel Visual Fortran Compiler 8.0 for Windows is available in Standard and Professional editions. The Professional Edition features the IMSL* Fortran Library 5.0 from Visual Numerics, Inc. It offers advanced optimizations to make applications run fast on IA-32 and Intel® Itanium® 2 processors and includes support from Intel.

What's New in the Intel Visual Fortran Compiler for Windows

Intel Corporation announces Intel Visual Fortran Compiler 8.0 for Windows. This release delivers enhanced support for the features of the latest processors from Intel, enhanced Compaq Visual Fortran compatibility, and new tools for application testing. Intel compilers deliver outstanding application performance, are compatible with methods and tools widely used to develop software, and include support directly from Intel.

Features and Benefits

- **Compatibility with Compaq Visual Fortran*** makes it easier to move and preserves your investment in software development
- **Integrates into Microsoft Visual Studio* .NET environment** to preserve your investment in how you develop your application software
- **Standard and Professional Editions** offer the choice of using IMSL* Fortran Library 5.0
- **Advanced optimization features** include interprocedural optimization and profile-guided optimization that improve application performance
- **Multi-threaded application support** for OpenMP* and auto-parallelization is included
- **Code-Coverage and Test-Prioritization Tools** are included to speed QA testing
- **Intel® Debugger** saves you effort
- **Fully-functional evaluation version** is available

Polyhedron* on IA-32 and Windows*

Polyhedron Tests
Lower (Faster) is Better

F77 Test Geomean	
Intel® Visual Fortran Compiler 8.0	6.13
Intel Fortran 7.1 Compiler	6.53
Compaq Visual Fortran* 6.6	7.83

F90 Test Geomean	
Intel Visual Fortran Compiler 8.0	10.82
Intel Fortran Compiler 7.1	13.43
Compaq Visual Fortran 6.6	13.32
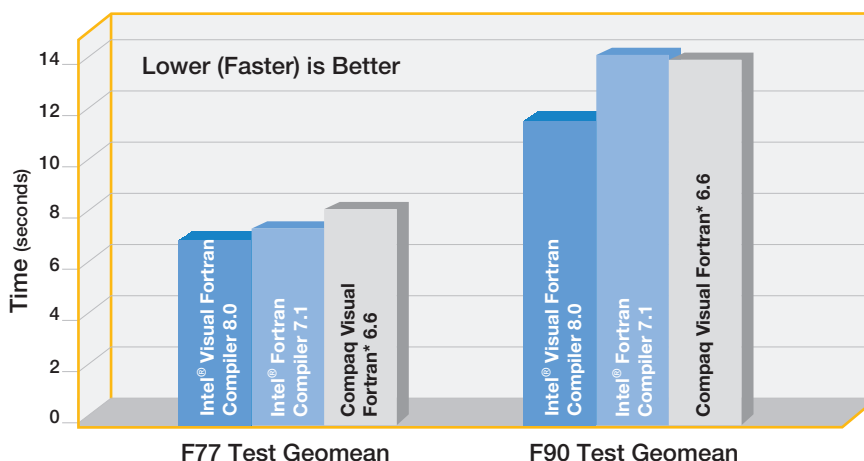
Configuration: Intel® Visual Fortran Compiler 8.0 for Windows*, Intel® Fortran Compiler 7.1, Compaq Visual Fortran* 6.6, Intel® Pentium® 4 (1.8 GHz, 256 MB), Windows 2000

Results of performance comparisons between Intel Visual Fortran Compiler 8.0 for Linux*, Intel Fortran Compiler 7.1 and Compaq Visual Fortran 6.6. **Lower is better.** Performance tests done by Polyhedron on Polyhedron configurations. This information is published on their web site at www.polyhedron.com and is reproduced here with permission.

New Features:

- Compaq Front-end, Intel Back-end: Combines the Compaq Visual Fortran language features with the Intel Visual Fortran code generator and optimizer to offer potential performance improvements to Fortran applications running on IA-32 or Itanium 2 processors using Windows.

- Two Editions: The Standard Edition includes the CVF compatibility features, extensive commands and test tools. The Professional Edition includes all these components plus the IMSL Fortran Library.

- Commands: Over 250 commands and synonyms are built in to support users of earlier Intel Fortran compilers or Compaq Visual Fortran.

- Multiplatform: Intel Visual Fortran Compiler 8.0 for Windows includes compilers for both IA-32 and Itanium 2 processors. The Professional Edition includes IMSL Fortran 5.0 Libraries for both as well.

- Code-Coverage and Test-Prioritization Tools: All Intel compilers now include these new tools to help developers during the testing phase of application development. The Code-Coverage Tool makes it easy to see which parts of an application have been tested and which haven't. The Test-Prioritization Tool helps developers make sure that quality, function and performance tests stay current and 'on-target' as changes are made to application software.

PERFORMANCE
Optimize Your Applications

The Intel Visual Fortran Compiler is designed to take advantage of the performance features of the Intel architecture, for both IA-32 and Itanium 2 processors. The compilers include advanced optimization features that make it easy for developers to deliver improved performance as applications are run on systems using the latest Intel processors, including the Intel® Pentium® 4 with Hyper-Threading Technology[1] and Itanium 2 processors. Intel Visual Fortran also provides support for threaded application development and optimization through support of OpenMP 2.0 and the auto-parallelism feature. Developers using Compaq Visual Fortran will be pleased to see the Professional Edition, which includes the latest release of the IMSL Fortran 5.0 Library from Visual Numerics, Inc. with support from Intel. IMSL provides high-performance computing software for developers of sophisticated numerical analysis applications.

COMPATIBILITY
Compaq Visual Fortran Front-end, Intel Back-end: Next Generation Fortran

Next-Generation Fortran Compaq Visual Fortran compiler front-end language features are combined with the Intel Visual Fortran back-end code-generation and optimization features to form Intel Visual Fortran 8.0 for Windows. Over 250 commands and synonyms make it easy for Compaq Visual Fortran and Intel Visual Fortran developers to use the compiler. The compiler integrates into the Microsoft Visual Studio .NET environment, offering developers the leading integrated development environment (IDE) for Windows-based Fortran development.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

For IA-32 and Intel® Itanium® processor system requirements visit: www.intel.com/software/products/compilers

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[1] Hyper-Threading technology requires a computer system with an Intel® Pentium® 4 processor supporting HT Technology and a Hyper-Threading Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on which processors support HT Technology.

Intel® C++ Software Development Tool Suite
for Palm OS*, Symbian OS*, Nucleus* OS, and OS-Independent Systems

Overview
Intel® Compilers help software run at top speed. They are compatible with the tools that most developers use. The compilers plug into popular developer environments, and feature source and binary compatibility with popular compilers. All Intel Compilers come with one year of support, including new versions and updates.

What's New in Intel C++ Software Development Tool Suite for Palm OS, Symbian OS, Nucleus OS, and OS-Independent Systems
Some of the new features available in the Intel® C++ Software Development Tool Suite for Palm OS*, Symbian OS*, Nucleus* OS, and OS-independent systems include:

- **Full tools support of the new Intel® PXA27x processor with Intel® Wireless MMX™ technology** on three levels provides outstanding performance on multimedia applications on handheld devices. Because the Intel PXA27x processor with Intel Wireless MMX technology performs Single Instruction Multiple Data (SIMD) calculations, the throughput on data calculation (for example, multiple 8-bit pixel operation or 16-bit audio data) is more efficient compared to standard methods.

- **Assembler support includes a complete set of Intel Wireless MMX instructions,** that can improve performance of multimedia applications.

- **Intrinsic functions** can be accessed from the C++ level, making it easy to use SIMD technology from the C++ application level.

Product Features
The Intel® C++ Software Development Tool Suite provides both an optimizing compiler and a set of sophisticated, high-level language debuggers.

Compiler System
- **Full support of Intel® Personal Internet Client Architecture (Intel® PCA) processors** based on Intel XScale® technology provides outstanding performance for system and application software. The Intel® C++ Compiler implements various optimization techniques including scheduling for optimized instruction pipelining and "double load and store."

- **Inter-procedure optimization (IPO)** creates faster code through inlining, replacing multiple function calls with actual function codes, and performing absolute rather than relative addressing wherever possible.

- **Highly-optimized, floating-point emulation library functions** allow development of performance-sensitive applications that use floating-point operations.

Features and Benefits
Optimizing compiler system offers:
- **Full support of Intel® Personal Internet Client Architecture (Intel® PCA) processors based on Intel XScale® technology** provides outstanding performance for system and application software.

- **Inter-procedure optimization (IPO)** creates faster code through inlining, replacing multiple function calls with actual function codes, and performing absolute rather than relative addressing wherever possible.

- **Highly-optimized, floating-point emulation library functions** allow development of performance-sensitive applications that use floating-point operations.

- **Intel® Wireless MMX™ technology** supports development of highly optimized multimedia applications at three levels: assembler support, intrinsic support, and vectorizer option switch.

High-level language debuggers offer:
- **The complete debugger solution** offered within the Intel® C++ Software Development Tool Suite contains a Simulator-Debugger, JTAG Debugger and ROM Monitor Debugger.

- **All debuggers use the same graphical user interface (GUI)** providing the same look and feel, making it easy to use all debuggers intuitively.

- **Full support of all levels of system and application code** is provided through full transparency of the debugged system, from low-level peripheral register access up to first-class, high-level language C++ debugging with full OS awareness. Developers can easily download and burn boot code and OS images into on-board, flash memory devices.

- **Assembler support** includes a complete set of Intel Wireless MMX instructions, improving performance of multimedia applications.

- **Intrinsic functions** can be accessed from the C++ level, making it easy to use SIMD technology from the C++ application level.

- **Vectorizer support** enables the compiler to analyze C++ source code for sequences that can be optimized using parallel computation techniques for multimedia applications, thereby dramatically improving total solution performance without changing source code.

- **The compiler system supports the ARM* EABI binary format and object model,** which enable customers to integrate the Intel® C++ Software Development Tool Suite into existing ARM*-compatible tools environments.

- **16-bit (thumb mode) support** is included and facilitates development of small memory footprint applications.

- **PACE* Native Object Compiler** support enables Palm OS v5.x application developers to create application routines that take advantage of Intel XScale microarchitecture. The Palm OS v5.x provides the capability to execute application code that was developed for the Motorola 68000* architecture on devices with Intel XScale technology by using 68000 emulation. To accelerate parts of an application, the PACE Native Object method allows developers to link native Intel XScale code sequences or functions to existing 68000 application code. This feature provides a performance boost, since time-critical routines can be directly executed on Intel XScale microarchitecture without any emulation tools involved.

- **Integration into Metrowerks CodeWarrior* Integrated Development Environment (IDE)** is provided to accelerate the compilation cycle.

Debuggers

- **The complete debugger solution** offered within the Intel® C++ Software Development Tool Suite contains a Simulator Debugger, JTAG Debugger, and ROM Monitor Debugger. The JTAG Debugger and ROM Monitor provide full OS awareness for the Palm OS, Symbian OS, and Nucleus OS. The debuggers can be used for OS-independent boot and start-up code as well. With this Intel Tool Suite, developers get a sophisticated debugger product line for all phases of software development.

- **All debuggers use the same graphical user interface (GUI)** providing the same look and feel, making it easy to use all debuggers intuitively. Once developers feel comfortable with one tool, the handling of all other versions is easy. This saves time.

The Debugger Graphical User Interface (GUI)
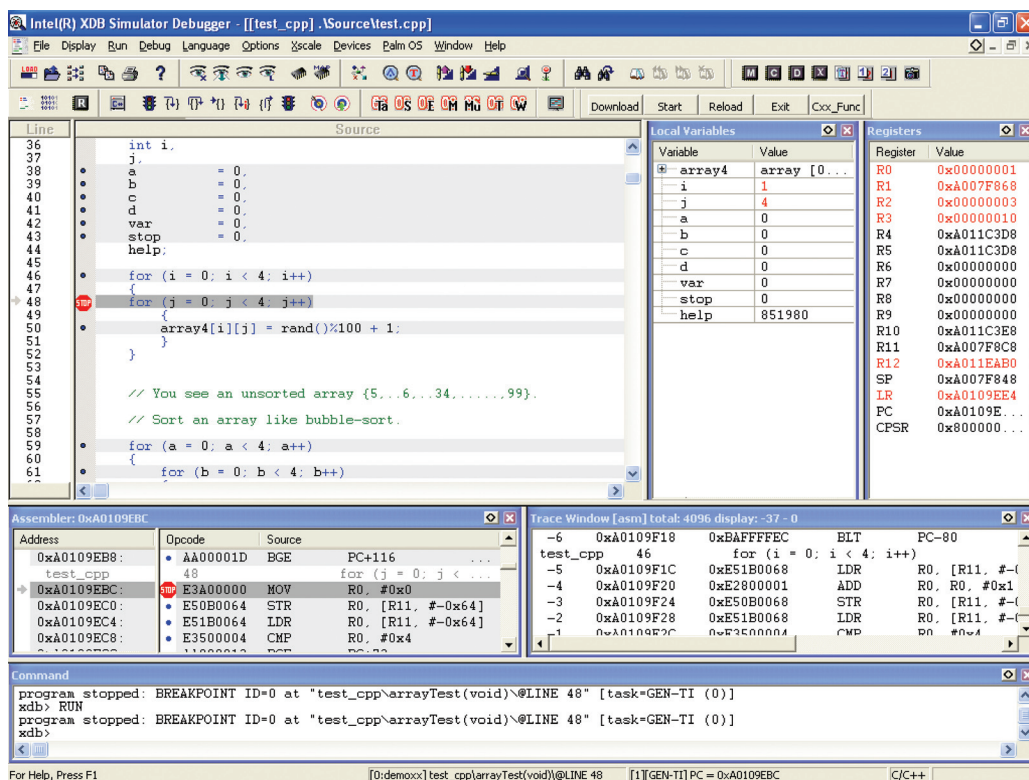
The debugger GUI shows OS awareness features of the Palm OS* v5.x. The Local Variables window (middle top) shows the local variables valid in that particular program scope.

- **Full support of all levels of system and application code** is provided through full transparency of the debugged system, from low-level peripheral register access up to first-class, high-level language C++ debugging with full OS awareness. Debugging of multitasking and multithreaded applications is made easy. From the early stages of OS-independent code development and debugging, the JTAG debugger provides full access to on-board flash memory programming. Developers can easily download and burn boot code and OS images into on-board, flash memory devices.

- **Full Intel PCA processor support** provides an in-depth view into Intel PCA processor programming.

- **Intel Wireless MMX technology support** allows display of Intel Wireless MMX registers and enables modifications with a mouse click and without the need to rebuild the entire application.

- **Execution trace support** enhances understanding of the flow of an executed program, and the browser window fully supports the execution trace mechanism of Intel PCA processors.

- **Coprocessor and peripheral register support** provide access to all peripheral and coprocessor registers. The debuggers display and allow modification of register contents through the bit-field editor, which is supported by complete documentation of all registers and flags. This capability is very useful for low-level driver development, because no rebuild is required to change and validate peripheral register values during testing.

- **Page table viewer** allows calculation efforts required to turn virtual addresses into physical addresses to be bypassed by making the addressing mechanism inside the processor transparent to software developers.

- **Local variable window** displays local and actual application code variables within the scope of the actual code executed, making it easy to verify valid variables within code segments.

- **Script language support** allows developers to create most complex debug scenarios by using XDB's powerful script language. Create a test-bed and run debugging "overnight" while logging all results into a log file.

- **Flash support** enables developers to burn flash memory using XDB JTAG Debugger. Use this tool to easily download and burn OS images.

Intel® Wireless MMX™ Instructions – Registers Window

Register	Value	Comment
WR0	0x0000000000000000	64 Bit Register 0
WR1	0x0000000000000000	64 Bit Register 1
WR2	0x0000000000000000	64 Bit Register 2
WR3	0x0000000000000000	64 Bit Register 3
WR4	0x0000000000000000	64 Bit Register 4
WR5	0x0000000000000000	64 Bit Register 5
WR6	0x0000000000000000	64 Bit Register 6
WR7	0x0000000000000000	64 Bit Register 7
WR8	0x0000000000000000	64 Bit Register 8
WR9	0x0000000000000000	64 Bit Register 9
WR10	0x0000000000000000	64 Bit Register 10
WR11	0x0000000000000000	64 Bit Register 11
WR12	0x0000000000000000	64 Bit Register 12
WR13	0x0000000000000000	64 Bit Register 13
WR14	0x0000000000000000	64 Bit Register 14
WR15	0x0000000000000000	64 Bit Register 15
WCID	0x69051010	32 bit Register,WCID
WCON	0x00000000	32 bit Register,WCON
WCSSF	0x00000000	32 bit Register,WCSSF Saturation SIMD Flags
WCASF	0x00000000	32 bit Register,WCASF Arithmetic SIMD Flags
WCGR0	0x00000000	32 bit Register,WCGR0 General Purpose Register 0
WCGR1	0x00000000	32 bit Register,WCGR1 General Purpose Register 1
WCGR2	0x00000000	32 bit Register,WCGR2 General Purpose Register 2
WCGR3	0x00000000	32 bit Register,WCGR3 General Purpose Register 3

Intel processors with wireless MMX technology include this technology as part of the processor code, similar to the media engine in the Intel® Pentium with MMX processor. All registers of the multimedia engine can be displayed to help you understand and optimize software that fully utilizes this technology.

**Bit Field Editor Allows Modification of Peripheral
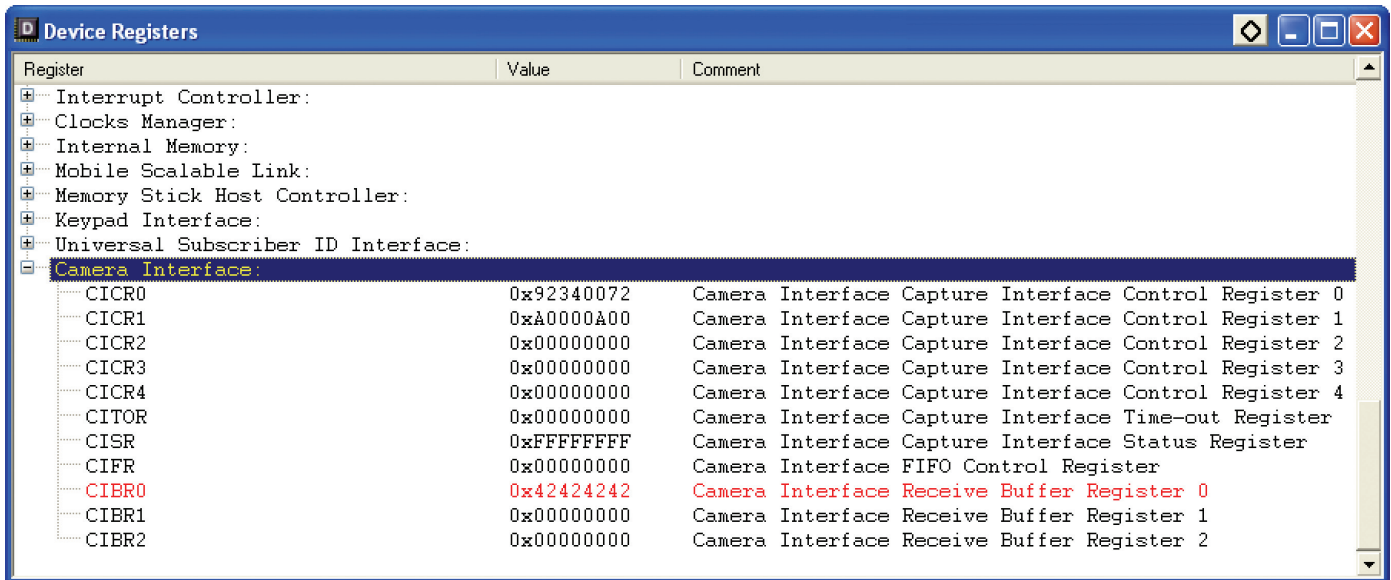Device or Coprocessor Registers**
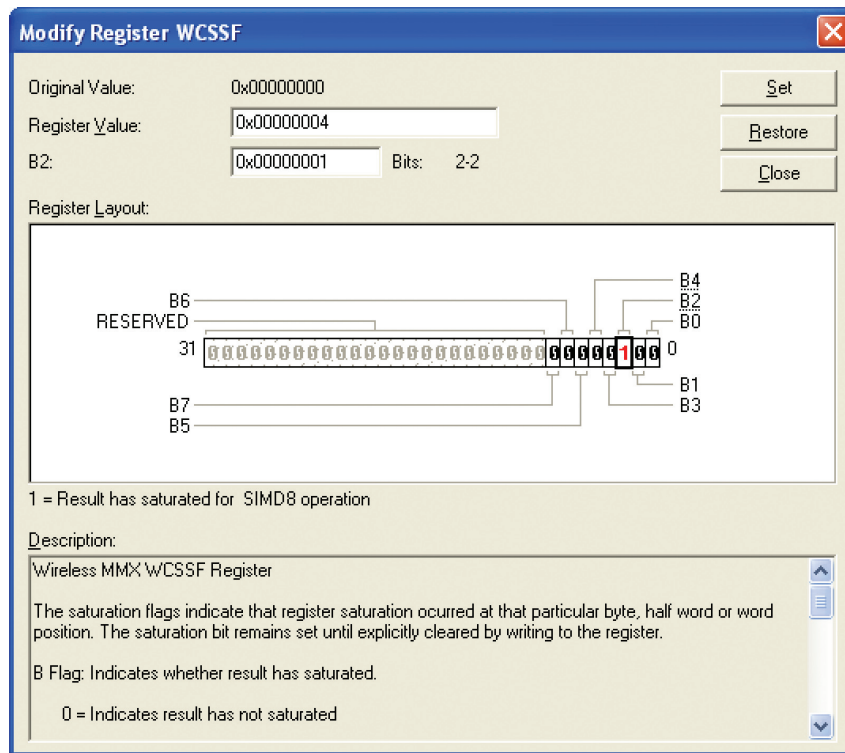
A double-click displays either data or an Intel® Wireless MMX™ technology
configuration register.

- **XDB Simulator Debugger** provides an XDB instruction set simulator and debugger. The XDB instruction set simulator runs on PC platforms and simulates Intel XScale technology, devices, and peripherals. The XDB debugger runs on top of the simulator, allowing low-level register debugging as well as high-level C++ application debugging. One of the key features of the XDB Simulator Debugger is the simulation of on-chip devices (such as an LCD display, UARTs, DMAs, OS timer, and an interrupt controller) within Intel PCA processors. With only a mouse click within the XDB Simulator Debugger, developers can access, inspect, validate, and modify all peripheral registers used in configuring on-chip devices. Furthermore, developers can inspect internal registers within the Intel XScale microarchitecture. Viewing these registers can be extremely helpful in determining the internal status of a peripheral device—information that cannot be viewed on real silicon. An application can be written for an operating system (OS) on the XDB Simulator Debugger. Developers can download the OS image (Palm OS, Symbian OS, or Windows* CE) and run smaller applications within the simulator environment.

- **JTAG interface devices are supported** to provide non-intrusive debugging. OEMs who integrate OS layers with their hardware devices need non-intrusive debugging tools that allow developers to inspect hardware without adding extra software solutions to a target system. JTAG provides a common method used for on-chip-level debugging. Once the debugger (on the host PC side) connects to the silicon through an appropriate JTAG device, developers

Device Registers Window

This window displays the device registers of the Intel® PXA27x processor. Details regarding the Camera Interface registers can be inspected and modified easily by using the bit field editor.

can access registers and ensure that hardware runs properly. In this state, debugging becomes possible without the aid of any loaded software clients. Supported JTAG interface products include those offered by Macraigor and EPI.

- **OS awareness plug-ins** allow developers to debug code with insight into OS behavior. Deeply ingrained into the design philosophy of Intel debuggers is flexibility in integrating new features. Such new feature integration is achieved through plug-ins. One of these features, called OS awareness, takes into account the behavior of an operating system when debugging a multitasking application. A new menu entry—the OS—enhances the look and feel of the debugger. With the aid of this plug-in, developers can easily inspect task lists, thread lists, chunk lists, pipes, mailboxes, and so on. The kernel of the OS maintains this information. The debugger can view and

modify this information at any time, independent of the executed user application software. If the debug infrastructure of the OS supports it, developers can set complex, task-specific breakpoints. Such breakpoints allow program execution to stop only when code executes inside of a specific task. Designers can use OS awareness plug-ins in conjunction with a JTAG debugger or a ROM monitor-based debugger, whereby communication occurs through TCP/IP, USB, or serial ports. The OS awareness plug-ins can be applied for all listed debugger variants, even on the Simulator Debugger. The plug-ins are available for Palm OS, Symbian OS and Nucleus OS.

PERFORMANCE
Advanced Optimization

Advanced optimization features deliver outstanding performance for system software and applications running on the latest Intel PCA processors, including the Intel PXA27x processors with Intel Wireless MMX technology.

COMPATIBILITY
Tools Compatibility Preserves Development Investment

The Intel C++ Software Development Tool Suite for Palm OS, Symbian OS, Nucleus OS, and OS-Independent Systems is source and object native-code compatible with the ARM EABI binary format and object model and plugs into the Metrowerks CodeWarrior Integrated Development Environment (IDE), which preserves your development investment. The compiler follows ANSI C/C++ and ISO C/C++ standards. The Intel C++ Software Development Tool Suite is recommended for optimized system code and application development based on Intel PCA processors (Intel® PXA25x, PXA26x, PXA27x, and PXA800F) and Palm OS v5.x, Symbian OS v6.x, v7.x (debugger support only) and Nucleus OS v1.13.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

For Palm and Symbian operating systems and OS-independent system requirements visit: www.intel.com/software/products/compilers

Intel® C++ Compiler
for Platform Builder for Windows* CE .NET

Overview

Intel® C++ Compiler for Platform Builder for Windows* CE .NET provides system integrators and OEMs with compilers and tools to help them develop hardware devices based on Intel® Personal Internet Client Architecture (Intel® PCA) processors. The compiler and selected tools are available to application developers as part of the Intel C++ compiler for Windows product.

Intel C++ Compiler plugs into Platform Builder for Windows CE .NET and enables PDA, handheld device, and cellular phone solutions. The compiler includes an optimizing compiler and a set of Intel® Debugging Extensions that support Intel XScale® microarchitecture.

Intel C++ Compiler for Platform Builder for Windows CE .NET includes:

- Compilers for IA-32 and Intel® Itanium® processors and Intel XScale microarchitecture
- Assembler
- Runtime libraries
- Help files
- Documentation

Intel compilers help software run at top speed. They support the way developers work because they are compatible with popular development environments. Every compiler includes support that comes directly from Intel, including updates, technical support and expertise about the Intel® architecture.
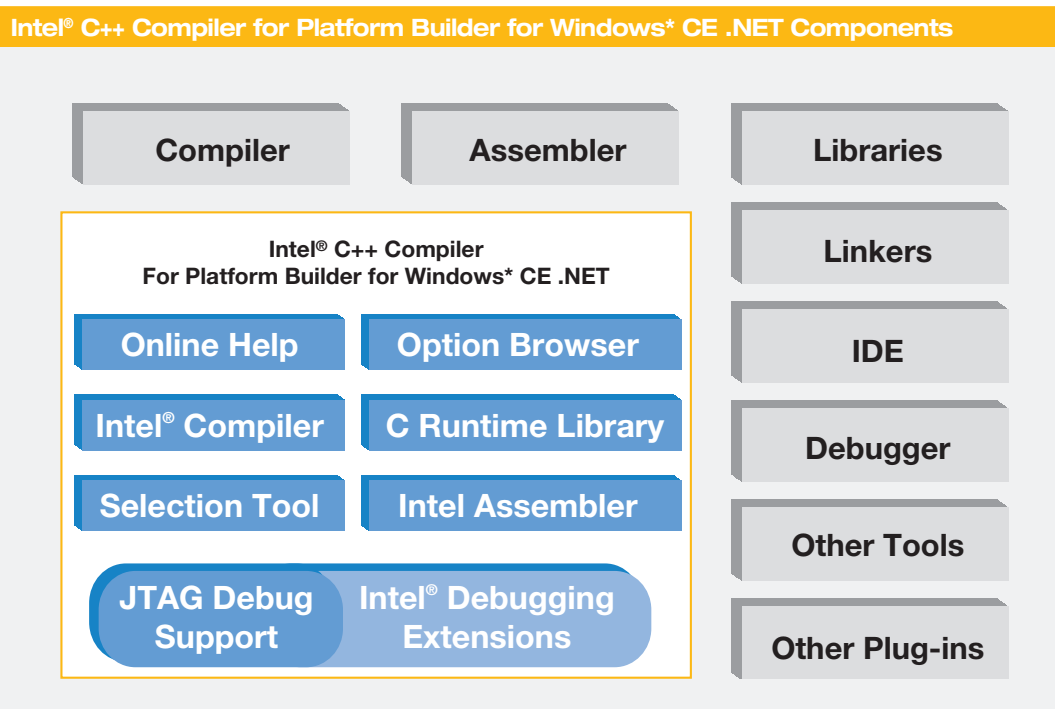
What's New in the Intel C++ Compiler for Platform Builder for Windows CE .NET

- Enables operating system kernel development for devices running on Intel Personal Internet Client Architecture (Intel PCA) processors using Windows CE .NET.

- Disassembler that provides full inspection of Intel XScale technology mnemonic code instructions generated by the compiler. The Intel Debugging Extensions communicate using transmission control protocol, Internet protocol (TCP/IP) or Joint Test Action Group (JTAG) connection (JTAG hardware required).

- Robust set of compiler tools for original equipment manufacturers (OEMs) to help create system software as well as application software for devices on Windows CE .NET.

- Optimization support for the latest Intel PCA processors.

- Microsoft-specific intrinsic functions provide direct hardware access from C++ source level, including register and coprocessor access — no need to drop down to assembly code.

- Highly-optimized floating-point emulation libraries to help enable applications using floating-point calculations.

Features and Benefits

- **Compatibility with Microsoft Tools** preserves your investment in building applications for Windows* CE – the Intel® C++ Compiler plugs into the Platform Builder for Windows CE .NET development tools; the compiler also can be installed and plugged into the Microsoft eMbedded Visual C++* development environment

- **Interprocedure optimization (IPO)** creates faster code through inlining, replacing multiple function calls with actual function codes and performing absolute rather than relative addressing wherever possible

- **Highly-optimized, floating-point emulation** allows development of performance-sensitive applications that use floating-point operations

- **Intrinsic functions accessed from the C++ level** make it easy to use Single Instruction Multiple Data (SIMD) technology from the C++ application level

- **Assembler** supports a complete set of Intel® Wireless MMX™ instructions

- **Vectorizer** supports multimedia applications that can dramatically improve your total solution performance

- **Intel® Debugger** saves effort

- **Fully-functional trial version** is available

Intel® C++ Compiler for Platform Builder for Windows* CE .NET Components

Compiler	Assembler	Libraries

**Intel® C++ Compiler
For Platform Builder for Windows* CE .NET**

Online Help	Option Browser
Intel® Compiler	C Runtime Library
Selection Tool	Intel Assembler
JTAG Debug Support	Intel® Debugging Extensions

Linkers

IDE

Debugger

Other Tools

Other Plug-ins

- Compatibility with Windows CE .NET — compiler plugs into the Platform Builder for Windows CE .NET or Microsoft eMbedded Visual C++ development environment.
- Visual C++ thumb mode support preserves the investment developers may have in 16-bit, small-memory applications.
- Intel Wireless MMX technology support speeds development of highly-optimized, multimedia applications using Intel Wireless MMX technology at three levels: Intel Wireless MMX assembler support, intrinsic support and vectorizer support.
- Interprocedural optimization creates faster code through inlining.

PERFORMANCE
Advanced Optimization

Intel C++ Compiler for Platform Builder for Windows CE .NET is highly optimized to support the Intel XScale technology and provides outstanding software code execution speed. This product includes the Intel Debugging Extensions and turns Microsoft Platform Builder* into a kernel debugger, enabling hardware and system-level developers to monitor and debug start-up code and low-level software routines. Intel C++ Compiler implements various optimization techniques including scheduling for optimized instruction pipelining; support for double load and store (a feature of Intel XScale technology); interprocedural optimization, which keeps variables used across functions in registers for faster access, and more.

COMPATIBILITY
Works with Windows Development Environments

Intel C++ Compiler solution plugs into the Platform Builder for Windows CE .NET (4.1, 4.2), supporting CE 3.0 for system software development and eMbedded Visual C++ for application development. Developers can use Intel C++ Compiler to create applications for Windows CE .NET (4.1, 4.2), Windows CE 3.0, Pocket PC* 2002, Smartphone* 2002 and Windows Mobile* 2003 software for Pocket PC. Intel C++ Compiler also can be used in place of the Microsoft compiler to produce application software for Intel XScale technology. Intel C++ Compiler includes Microsoft-specific intrinsic functions, which provide direct access from the C++ level, including register and coprocessor access, using a high-level of abstraction that reduces the need to drop down to assembly code.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

For IA-32 and Intel Itanium processor system requirements visit: www.intel.com/software/products/compilers

Intel® Performance Libraries

Intel® Integrated Performance Primitives (Intel® IPP)

Overview
Intel® Performance Libraries offer pre-built library functions optimized for Intel processors, enabling developers to focus on building value-add functionality.

Intel® Integrated Performance Primitives (Intel® IPP) is a cross-platform software library that allows users to write optimized applications that maximize performance on Intel processors. Intel IPP includes functionality for signal and image processing, cryptography, text strings and vector manipulation, matrix math, as well as more sophisticated primitives for construction of audio, video and speech codecs.

What's New in the Intel Integrated Performance Primitives 4.0
Intel IPP brings together support for Intel® Pentium®, Intel® Itanium®, Intel® Xeon™, and Intel® Personal Internet Client Architecture (Intel® PCA) processors into a single package. With a common API across the range of architectures, developers receive platform compatibility, reduced development costs, and ease of application porting. Unique features of each architecture are supported. Intel PCA support represents a subset of the functions for Pentium and Itanium processors.

For Pentium, Itanium, and Intel Xeon processors, Intel IPP 4.0 introduces two new function domains for cryptography and text string support as well as function expansion for audio, video, speech coding, and speech recognition – plus improved small footprint support. Intel IPP is available for Windows* and Linux* operating systems (32- and 64-bit support). For Intel PCA
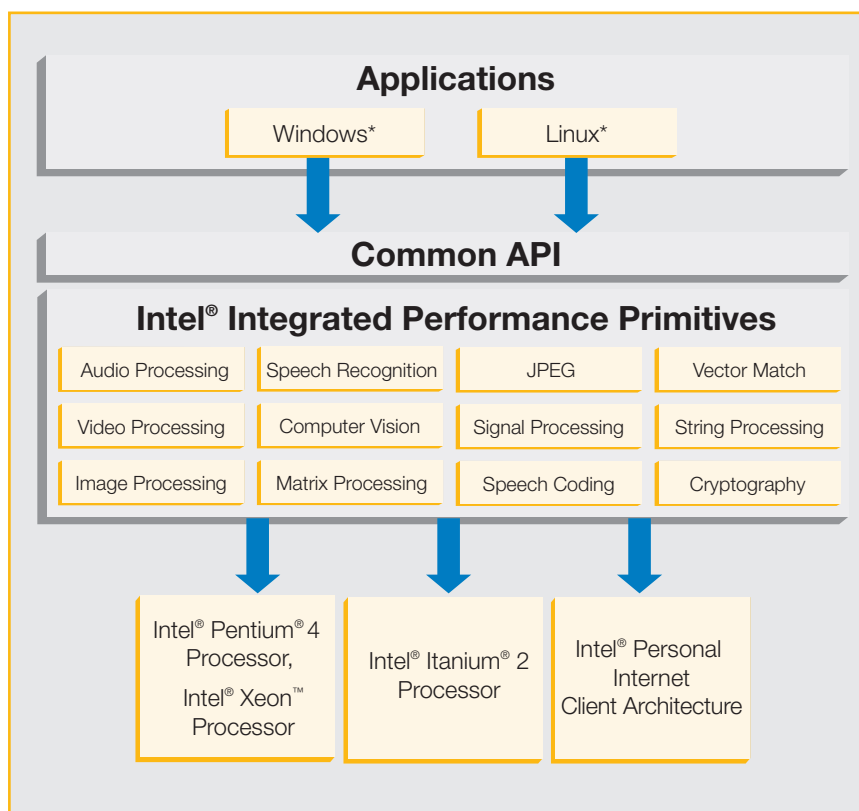
Features and Benefits
- **Programming interface** increases software performance on Intel's latest microprocessors, providing time-to-market advantages and reduced development costs. Developers access advanced processor features without having to write processor-specific code
- **Optimized** for Intel® Itanium® 2, Intel® Xeon™, and Intel® Pentium® processors, and Intel® Personal Internet Client Architecture (Intel® PCA) processors based on Intel XScale® technology. Developers achieve compatibility with a common application programming interface (API) across the range of architectures, multimedia application
- **Threaded application support,** implemented as a thread-safe library for Pentium and Itanium processor-based environments, means applications can be threaded with the assurance that Intel® IPP functions are safe for use in a threaded environment
- **Encoder-decoder** samples accelerate development of applications, components, and codecs. MPEG, H.263, Imaging, MP3, and G.723 are just a few of the areas with aids to build applications faster, making the most of Intel IPP functionality
- **Trial version** is available

Intel® Integrated Performance Primitives Application Domains
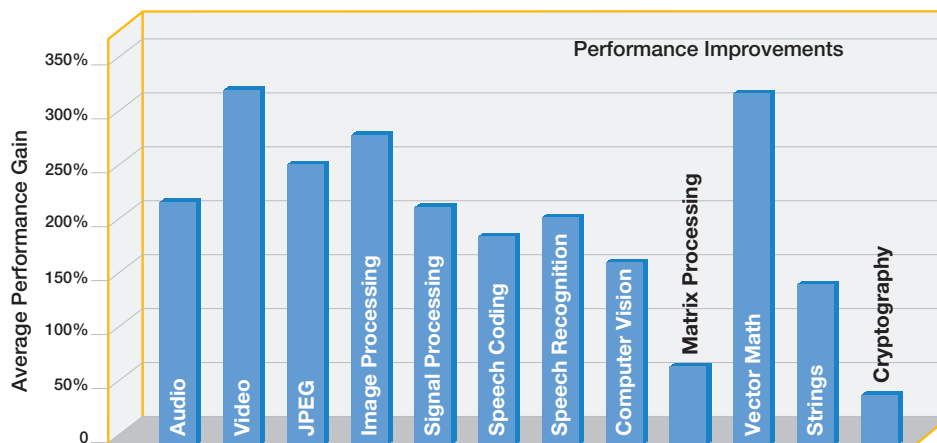
All code running on a PC with an Intel® Pentium® 4 processor with HT Technology, 3.0 GHz, 512 MB using Windows* XP. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, see www.intel.com

Performance Improvements of Intel® Integrated Performance Primitives as Compared to Optimized C Code

29

Applications

| Windows* | Linux* |

Common API

Intel® Integrated Performance Primitives

Audio Processing	Speech Recognition	JPEG	Vector Match
Video Processing	Computer Vision	Signal Processing	String Processing
Image Processing	Matrix Processing	Speech Coding	Cryptography

| Intel® Pentium® 4 Processor, Intel® Xeon™ Processor | Intel® Itanium® 2 Processor | Intel® Personal Internet Client Architecture |

processors, Intel IPP introduces support for Intel® Wireless MMX™ technology.

An extensive variety of encoder-decoder samples has been implemented using Intel IPP functions to help demonstrate the use of Intel IPP and accelerate development of your application, components, and codecs. This sample code is provided under the terms and conditions outlined in the license agreement found with the main Intel IPP 4.0 beta installation package.

PERFORMANCE
Creates Highly Optimized Applications Running on Intel Processors

Intel IPP is a cross-platform software library that provides a programming interface allowing users to write highly optimized applications to maximize performance on Intel processors, while providing time-to-market advantages. Users can access advanced processor features without writing processor-specific code.

COMPATIBILITY
Covers a Range of Intel Architectures with One Application Program Interface

Intel IPP is optimized for Itanium 2, Pentium, Intel Xeon processors, and Intel Personal Internet Client Architecture (Intel PCA) processors based on Intel XScale technology. With a single application programming interface (API) across the range

of architectures, multimedia application developers achieve compatibility and reduce development costs.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information. You must register for support to gain access to the Cryptography library and sample code.

REQUIREMENTS
Hardware and Software

Refer to Intel® Software Development Products Web site for details on system requirements for Intel® Performance Primitives at www.intel.com/software/products/perflib

Intel® Math Kernel Library (Intel® MKL)

Overview

The Intel® Math Kernel Library (Intel® MKL) is a set of highly optimized, thread-safe, mathematical functions for engineering, scientific and financial applications requiring high performance on Intel® platforms.

The functional areas of the library include:

- Linear Algebra (BLAS, LAPACK and DSS)
- Discrete Fourier Transforms (DFT)
- PARDISO Direct Sparse Solver
- Vector Math Library (VML)
- Vector Statistical Library (VSL) random number generators

Linear Algebra (BLAS, LAPACK and DSS)

Intel MKL provides linear algebra functionality with LAPACK (solvers and eigensolvers), plus BLAS levels 1, 2, and 3 offering vector-vector, vector-matrix, and matrix-matrix operations needed for complex mathematical software. Intel MKL also includes a Direct Sparse Solver for solving linear algebra equations. Intel MKL can provide significant performance improvements over alternative linear algebra packages.

Features and Benefits

- **Outstanding Performance on Intel® Platforms**
  - Highly optimized for Intel® Itanium® 2, Intel® Xeon™, and Intel® Pentium® 4 processors
  - Automatic runtime processor detection executes processor-specific optimized code
- **Excellent Scaling on Multiprocessors**
  Extensively threaded, Intel MKL enables you to obtain greater performance on multiprocessors with no additional work
- **Royalty Free**
  Redistribute unlimited copies of the run-time libraries with your software
- **Intel® Premier Support**
  Purchase includes one year of Intel® Premier Support and all product updates (including major version releases) during that term

DGEMM Performance[1]

This chart shows the near linear scaling of Intel MKL in billions of floating point operations per second (GFLOPS). Tests performed on 4-way 1.5 GHz Intel® Itanium® 2 processor with 6 MB L3 cache and 16GB RAM running Red Hat Linux* Advanced Server 2.1
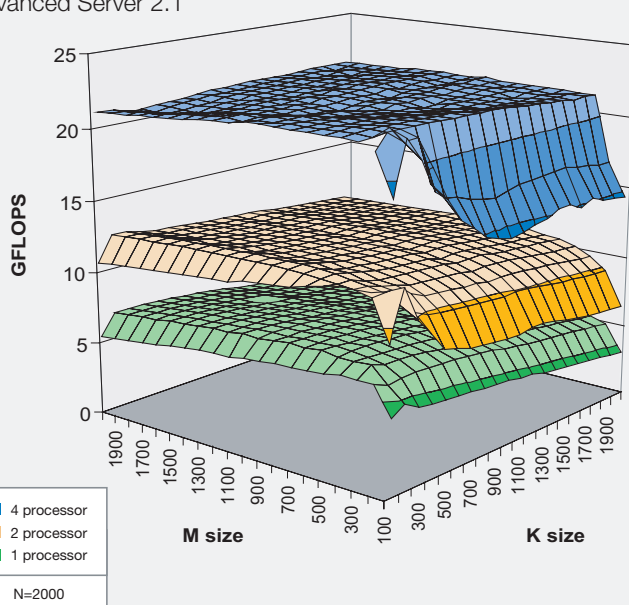
Legend:
- 4 processor
- 2 processor
- 1 processor

N=2000

Discrete Fourier Transforms (DFTs)

The Discrete Fourier Transform (DFT) functionality within Intel MKL provides multi-dimensional routines (1D up to 7D), with mixed radix support (transform lengths other than powers of 2). The DFTs have been optimized particularly to minimize the cache evictions that naturally arise from powers-of-two radix algorithms and are multi-threaded for additional performance on multiprocessor computers.

PARDISO Direct Sparse Solver

Intel MKL has adopted the PARDISO (Parallel Direct Solver) solver from the University of Basel. PARDISO is a thread-safe, high-performance, memory-efficient and easy-to-use software library for solving large, sparse, symmetric and asymmetric linear systems of equations. In addition to the PARDISO interface, Intel MKL also provides a simpler, more modern interface (DSS).

Vector Math Library (VML)

The Vector Math Library (VML) includes a set of optimized implementations of computationally intensive core mathematical functions, including:

- Trigonometric (e.g. Sin, Cos)
- Hyperbolic (e.g. Sinh, Tanh)
- Power (e.g. Sqrt, Cbrt)
- Error (Erf, Erfc)
- Exponential (Exp)
- Logarithmic (Ln, Log10)
- Other (Inv, Div)

VML vector functions provide substantial performance advantages over scalar implementations.

Vector Statistical Library (VSL)

The Vector Statistical Library (VSL) is a collection of **random number generators** for a number of probability distributions, including both discrete and continuous distributions. Applications that might significantly improve performance with VSL include simulation algorithms commonly used in physics, chemistry, medical and financial analysis software including both discrete and continuous distributions.

Performance Improvements BLAS and DFT

Intel MKL 7.0 has significant performance improvements over Intel MKL 6.1, especially on small matrices and data sets.

Performance Improvements[1] since Intel® MKL 6.1.1

Intel® Itanium® 2	Intel®Xeon™and Intel® Pentium® 4
Basic Linear Algebra Subprograms (BLAS) DGEMM	
150-200% on small matrix sizes (40x40 or smaller)	5-50% on small sizes of M dimension (up to 200 elements)
Discrete Fourier Transforms (DFT)	
Up to 100% on the 1D DFT for small to medium vector sizes (256 elements or smaller)	Up to 100% on the 1D DFT for small to medium vector sizes (256 elements or smaller)

PERFORMANCE
Highly Optimized

Intel MKL utilizes **automatic runtime processor detection** to execute code that has been specifically optimized for Intel® Itanium® 2, Intel® Xeon™ and Intel® Pentium® 4 processors.

COMPATIBILITY
Windows* and Linux* Support

The Intel Math Kernel Library for Windows* is compatible with Windows 2003 Server, Windows XP, and for the Itanium processor family, the Microsoft Platform Software Development Kit.

Supported Linux Platforms for Intel MKL[§]

Recommended Linux* Platforms	Intel®Xeon™and Intel® Pentium® 4 Processor-based Systems	Intel® Itanium® Processor-based Systems
Red Hat* Linux* 9.0	X	
Red Hat EL* 2.1	X	X
Red Hat EL 3.0	X	X
SuSE* Linux* 8.2	X	
SuSE Linux Enterprise Server 8	X	X

[§] MPICH version 1.2.5.10 is required for ScaLAPACK in Intel Cluster MKL; visit http://www.myri.com/scs/#downloads.

SUPPORT
Intel® Premier Support Included

Every purchase of the Intel Math Kernel Library includes one year of Intel® Premier Support and all product updates (including major version releases) during that term.

For more information, please refer to the Intel Math Kernel Library Web site at: www.intel.com/software/products/mkl

Intel® Cluster Math Kernel Library (Intel® Cluster MKL)

Overview

The Intel® Cluster Math Kernel Library (Intel® Cluster MKL) contains all the highly optimized, thread-safe, mathematical functions of Intel® Math Kernel Library plus ScaLAPACK (Scalable LAPACK) for Linux* clusters.

The functional areas of the library include:

- ScaLAPACK (Scalable LAPACK) for Linux
- Linear Algebra (BLAS, LAPACK and DSS)
- Discrete Fourier Transforms (DFT)
- PARDISO Direct Sparse Solver
- Vector Math Library (VML)
- Vector Statistical Library (VSL) random number generators

ScaLAPACK

Intel Cluster MKL includes ScaLAPACK (Scalable LAPACK) routines for Linux that utilize the highly optimized BLAS and LAPACK routines also available in Intel Cluster MKL. This compiled, ready-to-use library will enable you to get outstanding performance on Intel® Itanium® 2, Intel® Xeon™ and Intel® Pentium® 4 processor-based, distributed memory, and multiprocessor systems.

Features and Benefits

- **Outstanding Performance on Intel® Platforms**
  - Highly optimized for Intel® Itanium® 2, Intel® Xeon™, and Intel® Pentium® 4 processors
  - Automatic runtime processor detection executes processor-specific optimized code
- **Excellent Scaling on Multiprocessors**
  Extensively threaded, Intel® Cluster MKL enables you to obtain greater performance on multiprocessors with no additional work
- **Royalty Free**
  Redistribute unlimited copies of the run-time libraries with your software
- **Intel® Premier Support**
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ScaLAPACK

Software Library for Linear Algebra Computations on Distributed Memory Computers

Image courtesy of Innovative Computing Laboratory http://icl.cs.utk.edu

Linear Algebra (BLAS, LAPACK and DSS)

Intel Cluster MKL provides linear algebra functionality with LAPACK (solvers and eigensovers), plus BLAS levels 1, 2, and 3 offering vector-vector, vector-matrix, and matrix-matrix operations needed for complex mathematical software. Intel Cluster MKL also includes a Direct Sparse Solver for solving linear algebra equations. Intel Cluster MKL can provide significant performance improvements over alternative linear algebra packages.

Discrete Fourier Transforms (DFTs)

The Discrete Fourier Transform (DFT) functionality within Intel Cluster MKL provides multi-dimensional routines (1D up to 7D), with mixed radix support (transform lengths other than powers of 2). The DFTs have been optimized particularly to minimize the cache evictions that naturally arise from powers-of-two radix algorithms and are multi-threaded for additional performance on multiprocessor computers.

PARDISO Direct Sparse Solver

Intel Cluster MKL has adopted the PARDISO (Parallel Direct Solver) solver from the University of Basel. PARDISO is a thread-safe, high-performance, memory-efficient and easy-to-use software library for solving large, sparse, symmetric and asymmetric linear systems of equations. In addition to the PARDISO interface, Intel Cluster MKL also provides a simpler, more modern interface (DSS).

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The Vector Math Library (VML) includes a set of optimized implementations of computationally intensive core mathematical functions, including:

- Trigonometric (e.g. Sin, Cos)
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- Error (Erf, Erfc)
- Exponential (Exp)
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- Other (Inv, Div)

VML vector functions provide substantial performance advantages over scalar implementations.

Vector Statistical Library (VSL)

The Vector Statistical Library (VSL) is a collection of **random number generators** for a number of probability distributions, including both discrete and continuous distributions. Applications that might significantly improve performance with VSL include simulation algorithms commonly used in physics, chemistry, and medical and financial analysis software including both discrete and continuous distributions.

Supported Linux Platforms for Intel Cluster MKL[1]

Recommended Linux* Platforms	Intel®Xeon™and Intel® Pentium® 4 Processor-based Systems	Intel® Itanium® Processor-based Systems[2]
Red Hat* Linux* 9.0	X	
Red Hat EL* 2.1	X	X
Red Hat EL 3.0	X	X
SuSE* Linux* 8.2	X	
SuSE Linux Enterprise Server 8	X	X

[1] MPICH version 1.2.5..10 is required for ScaLAPACK in Intel Cluster MKL; visit to http://www.myri.com/scs/#downloads.

[2] Kernel 2.4.9-18 SMP or later is required for Intel® Itanium® processor-based systems.

Performance Improvements BLAS and DFT

Intel Cluster MKL 7.0 has significant performance improvements over Intel MKL 6.1, especially on small matrices and data sets.

Performance Improvements[§] since Intel® MKL 6.1.1

Intel® Itanium® 2	Intel®Xeon™and Intel® Pentium® 4
Basic Linear Algebra Subprograms (BLAS) DGEMM	
150-200% on small matrix sizes (40x40 or smaller)	5-50% on small sizes of M dimension (up to 200 elements)
Discrete Fourier Transforms (DFT)	
Up to 100% on the 1D DFT for small to medium vector sizes (256 elements or smaller)	Up to 100% on the 1D DFT for small to medium vector sizes (256 elements or smaller)

PERFORMANCE
Highly Optimized

Intel Cluster MKL utilizes **automatic runtime processor detection** to execute code that has been specifically optimized for Itanium 2, Intel Xeon and Pentium 4 processors.

COMPATIBILITY
Linux Support

The Intel Cluster Math Kernel Library runs on Intel® architecture-based workstations, servers and personal computers running Linux*.

The Intel Cluster MKL is compatible with Intel® Fortran, Intel C++ compilers and GNU compilers on Red Hat Linux* 7.2, for Pentium 4, Xeon and Itanium processor-based systems.

SUPPORT
Intel® Premier Support Included

Every purchase of the Intel Cluster Math Kernel Library includes one year of Intel® Premier Support and all product updates (including major version releases) during that term.

For more information, please refer to the Intel Cluster Math Kernel Library Web site at:
www.intel.com/software/products/clustermkl

[§] Performance tests and ratings are measured using specific computer systems and/or components and reflect the appropriate performance of Intel products as measured by those tests. Any difference in system design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit http://www.intel.com/software/products/.

Intel® VTune™ Performance Analyzer

Overview

Intel® VTune™ analyzers help locate and remove software performance bottlenecks by collecting, analyzing, and displaying system-wide data down to the source level.

Key features include sampling capability, call graph capability, counter monitor, and an enhanced Intel® Tuning Assistant. Intel VTune Performance Analyzer provides both a graphical and a command line interface on Windows* platforms; optional Visual Studio* .NET integration; and remote support for IA-32 and Intel Itanium® processor-based Linux* applications as well as sampling on Intel® PXA250, PXA255, PXA26x, and PXA27x processor-based applications.

What's New in the Intel VTune Performance Analyzer 7.1

Intel VTune Performance Analyzer offers a sampling-over-time view, which allows users to understand how software performance characteristics change over time. Calibration of events in event-based sampling can now be enabled or disabled on a per-event basis. The VTune Performance Analyzer provides support for up to 64 processors. With this latest version, .tb3 and .tb5 files can now be imported.

Call graph can now profile applications on remote Intel Itanium processor-based systems running Linux.
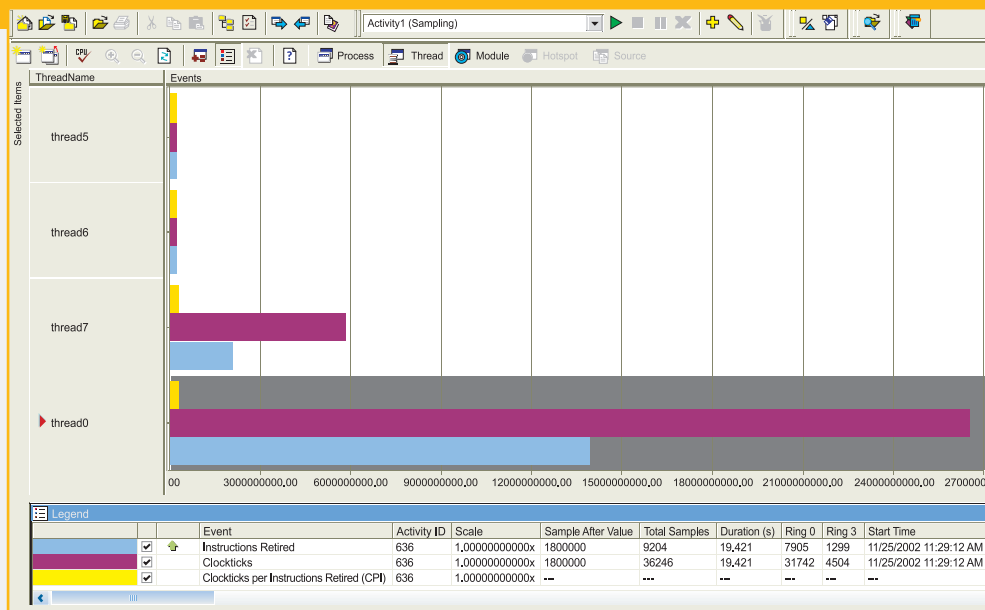
Intel Tuning Assistant has extensive tuning knowledge that allows it to suggest optimization techniques. It has been enhanced with tuning advice for software running on the Intel® Pentium® 4 processor with Streaming SIMD Extensions 3.

Features and Benefits

- **Sampling** provides developers with the most accurate representation of their software's actual performance, with negligible overhead
- **Call graph profiling** provides developers with a pictorial view of program flow to quickly identify critical functions and call sequences
- **Counter monitor** allows developers to track system activity during runtime which helps identify system level performance issues
- **Remote agents for Linux*** provide the ability to collect performance data on a remote Linux system while maintaining the Windows* GUI ease of use for data analysis and interpretation
- **Intel® Tuning Assistant** automatically suggests code improvements based on an extensive knowledge base, increasing productivity
- **Visual Studio* .NET integration** provides the ability to use VTune Performance Analyzer within Visual Studio .NET IDE, improving ease of use and productivity
- **Windows* command line capability** provides power and flexibility to collect sampling data independent of the VTune analyzer GUI, and allowing developers to automate sampling
- **Trial version** is available

Sampling

Sampling provides an accurate representation of software performance with negligible overhead.

		Event	Activity ID	Scale	Sample After Value	Total Samples	Duration (s)	Ring 0	Ring 3	Start Time
✔	✦	Instructions Retired	636	1.00000000000x	1800000	9204	19.421	7905	1299	11/25/2002 11:29:12 AM
✔		Clockticks	636	1.00000000000x	1800000	36246	19.421	31742	4504	11/25/2002 11:29:12 AM
✔		Clockticks per Instructions Retired (CPI)	636	1.00000000000x	--	--	--	--	--	
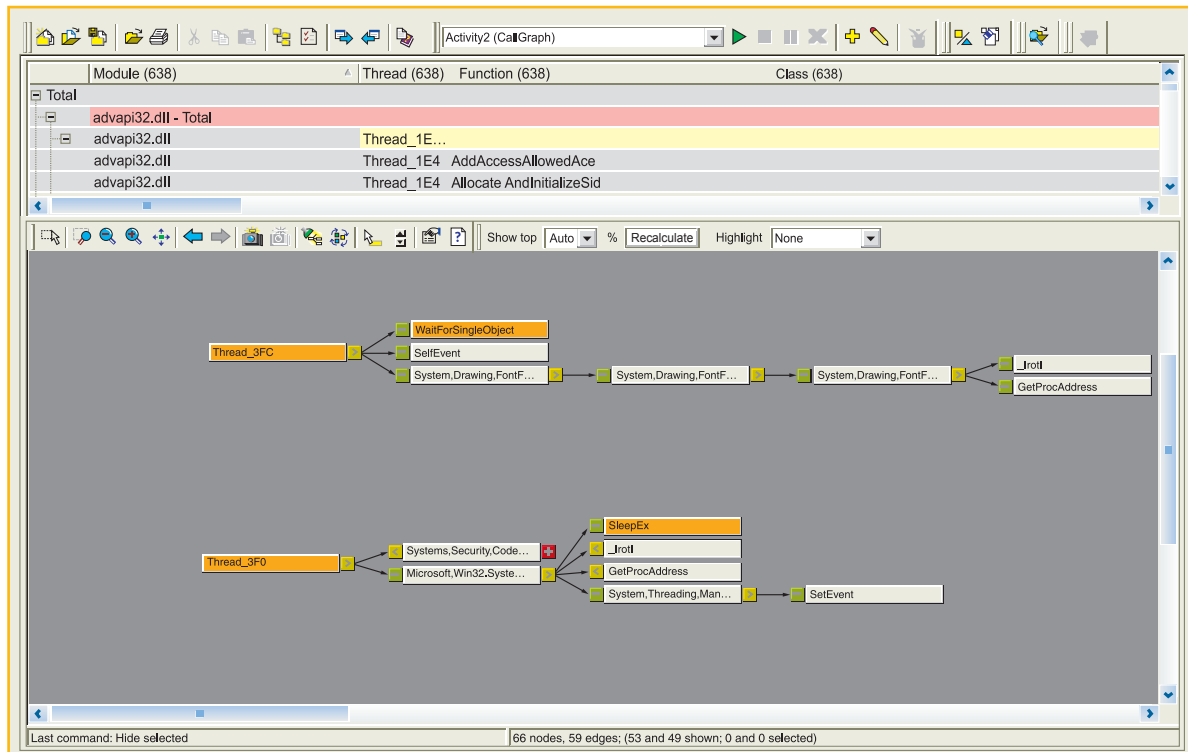
Call Graph

Call graph profiling quickly identifies critical functions and call sequences.

Java* and .NET support has been improved. Remote Java profiling on IA-32 systems on Linux is now available. This includes sampling in addition to call graph profiling for Java classes only. Java applet profiling when Microsoft-Jview* serves as the underlying JVM* is now supported. Mixed mode call graph of Java calls and native module calls is supported on Windows operating systems running on Itanium and Itanium 2 processor-based systems. For .NET the VTune analyzer can profile

managed C++ applications, including mixed DLLs. Both the Java and .NET wizards are now better tailored to different profiling scenarios such as profiling an application that is launched outside of the VTune analyzer.

You can now remotely profile software running on Intel® PXA250, PXA255, PXA26x, and PXA27x processors using the VTune Performance Analyzer GUI.

Counter Monitor

Activity1 (Multiple Collectors)

Drill Down to Correlated Sampling Data View (Alt+F12)   tor Logged data for \\BNSHAH-P4HT

Project Navigator
- VT Project4
  - Activity1 (Multiple C
    - Mon Jun 17 11:06:4
      - Sampling Resu
        - Run1
          - Instruc
          - Clockti
        - Counter Monito

Counter Values (scaled): 100.00, 90.00, 80.00, 70.00, 60.00, 50.00, 40.00, 30.00, 20.00, 10.00, 0.00

Time (Milliseconds): 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000

Legend

Counter Name	Graph Scale	Average	Min	Max	Std. Dev.
Redirector : Network Errors/sec	1.0	0.000	0.000	0.000	0.000
Memory : Available Bytes	0.0000001	103867736.000	101646336.000	106909696.000	2725991.250
System : Processor Queue Length	10.0	3.667	3.000	4.000	0.577
System : Context Switches/sec	0.1	483.733	337.000	756.198	236.196
Processor (_Total) : % Privileged Time	1.0	18.809	9.375	27.682	9.166
Processor (_Total) : % Processor Time	1.0	90.625	71.875	100.000	16.238

Output

General

06/17/2002 11:06:43<localhost> [Run 1] The Sampling Collector is collecting samples based on the following event[s]: Instructions Retired, Clockticks.
06/17/2002 11:06:44 The Counter Monitor collector is collecting data.
06/17/2002 11:06:47<localhost> [Run 1] Sampling data was successfully collected.
06/17/2002 11:06:48 The Counter Monitor collector has successfully finished collecting data.

The Counter monitor tracks system activity during runtime to determine if reduced available memory or file I/O performance issues slow down applications.

PERFORMANCE
Drill Down Through Your Code

Intel VTune Performance Analyzer offers insight into the performance of your software at the system, application, and microarchitecture-level through a wide range of profiling mechanisms and a rich set of views. Use the VTune analyzer to maximize the performance of your software on Intel architecture.

COMPATIBILITY
Works with the Tools You Know and Like

VTune Performance Analyzer can help optimize your software whether you program in Fortran, C#, C/C++, Delphi*, or Java. The analyzer supports Microsoft Visual Studio.NET, Intel® C/C++ and Fortran compilers, Compaq Visual Fortran*, Java, Borland Compilers (Delphi, C++ Builder*), and IBM Visual Age*. Linux support is provided through a remote agent.

Intel® Tuning Assistant
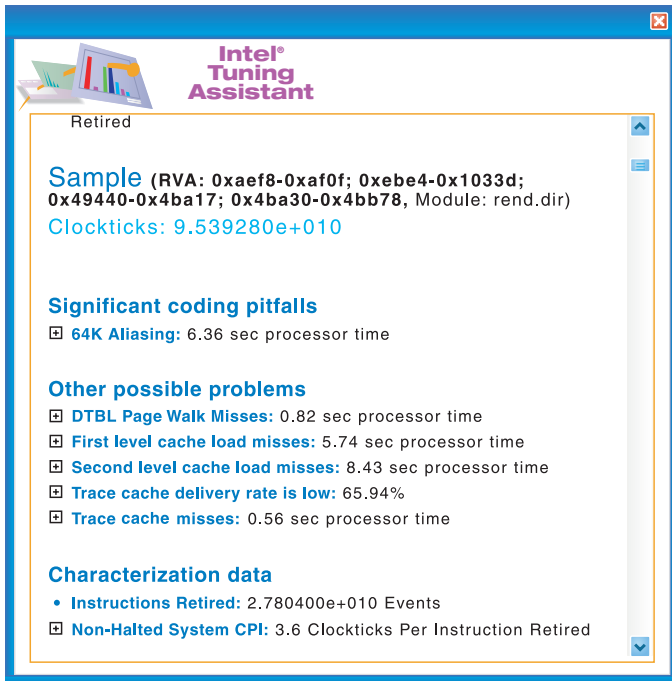
Intel® Tuning Assistant automatically suggests code improvements based on an extensive knowledge base, thereby increasing developer productivity.

Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software

Refer to Intel Software Development Products Web site for details on system requirements for VTune Performance Analyzer at www.intel.com/software/products/vtune

Intel® VTune™ Performance Analyzer
for Linux*

Overview

Intel® VTune™ analyzers help locate and remove software performance bottlenecks by collecting, analyzing, and displaying system-wide performance data down to the source level.

VTune Performance Analyzer for Linux* does this through advanced profiling technologies. Key highlights include a fully native Linux command line interface with support for Intel Itanium® and IA-32 processor-based applications, as well as Java* applications executed on IA-32 processor-based Linux systems.

What's New in the Intel VTune Performance Analyzer 2.0 for Linux

The VTune Analyzer for Linux provides event-based sampling and call graph output on the flow of control of Linux applications on Itanium as well as IA-32 processors. Source view is now available, allowing developers to drill down to the source code level.

The new call graph viewer provides graphical capability for viewing call graph results. The viewer is a plug-in that installs on and works with VTune Performance Analyzer 2.0 for Linux.

Support for several new Linux distributions including their default versions of kernel, glibc, libstdc++, and glib, has been added to VTune Performance Analyzer 2.0 for Linux. The new Itanium

Features and Benefits

- **Platform flexibility —** The latest Intel processors are supported including Intel® Itanium® 2, Pentium® 4 processors; Pentium M processor, a component of Intel® Centrino™ mobile technology§; and Intel® Xeon™ processors

- **This fully Linux*-based solution** eliminates the need for a VTune™ analyzer graphical user interface on a second, networked Windows* system, as required with VTune Performance Analyzer 7.0 and its Linux remote agents

- **Event-based, system-wide sampling** provides developers with the most accurate representation of their software's actual performance, with negligible overhead

- **Call graph profiling** offers a graphical high-level, algorithmic view of program execution based on instrumentation of binary executable files that produce function calling sequence data

- **Command line capability** allows developers the flexibility to collect sampling and call graph data through a choice of scripting languages including PERL*

Sampling Results on Linux* Screen

Sampling results help identify potential performance bottlenecks and hotspots.

```
VTune Performance Analyzer for Linux*
Copyright (C) 2000-2002 Intel Corporation. All rights reserved.
Event Summary
Clockticks
694 = Samples collected due to this event
2392790 = Sample after value used during collection
1660596260 = Total events (samples*SAV)
Process View (all values in decimal)

Process
Event        PID       Events%   Samples  Events       Process Path
-----------------------------------------------------------------------
Pid 0x0      0000                                       vmlinux
Clockticks             14.70%    102      244064580
gkrellm      18477
Clockticks             10.95%    76       181852040    /usr/local/bin/gkrellm
kdeinit      18394
[ ... ]
Clockticks             0.14%     1        2392790      /opt/sag/exx/v611/bin/paulad
kwrapper     18551
Clockticks             0.14%     1        2392790      /opt/sag/exx/v611/bin/rpcss
ntd          11495
Clockticks             0.14%     1        2392790      /opt/sag/exx/v611/bin/ntd
```

A high number of events in a particular process denotes high usage, which in turn indicates potential performance bottlenecks.

processor distribution supports Red Hat Linux* versions WS 2.1 and ES 2.1. Also, a newly supported distribution for IA-32 processor-based Linux applications has been added: SuSE Linux* 9.0 (see the product release notes for the most up-to-date list of supported operating systems).

VTune Analyzer Driver Kit allows you to compile the VTune analyzer driver for your custom kernel environment for the supported distributions. The kit includes open source driver sources, install scripts, documentation, and binaries for supported kernels. For more information see www.intel.com/software/products/opensource/vdk

Java* application profiling on supported distributions for IA-32 processor-based Linux applications has been added. Sampling and call graph profiling options can now be enabled for Java applications. Java Virtual Machines* (JVMs) from BEA, IBM, and Sun are supported.

The new *Getting Started* tutorial teaches the basic concepts and functionality of the VTune Performance Analyzer for Linux. It can export sampling data files for viewing to another VTune Analyzer system as well as to a VTune Analyzer 7.1 system.

PERFORMANCE
Expose Bottlenecks and Hotspots
VTune Performance Analyzer for Linux offers you a view into the Linux application, exposing bottlenecks and hotspots in the code, allowing you to easily pinpoint areas in the code that can be improved. Your Linux application can gain outstanding performance, providing a competitive advantage.

COMPATIBILITY
Supports Intel® Architecture-Compatible Processors
VTune Performance Analyzer for Linux supports the latest Intel processors including IA-32-based and Itanium-based systems as well as multiple Linux distributions and kernels. The tool includes the VTune Performance Analyzer Driver Kit that allows you to compile the VTune analyzer driver for your custom kernel environment for the supported distributions.

SUPPORT
Intel® Premier Support
Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

REQUIREMENTS
Hardware and Software
Refer to Intel Software Development Products Web site for details on system requirements for VTune Performance Analyzer at www.intel.com/software/products/vtune

§ Wireless connectivity requires additional software, services or external hardware that may need to be purchased separately. Availability of public wireless access points is limited. System performance, battery life and functionality will vary depending on your specific hardware and software.

Intel® Thread Checker
for Windows*

Overview

Intel® Threading Tools make it easier to create multithreaded applications that take advantage of the performance benefits of Hyper-Threading Technology included in Intel® Pentium® and Intel® Xeon™ processor-based computer systems. Hyper-Threading Technology[1] from Intel enables the processor to execute two threads (parts of a software program) in parallel — so your software can run more efficiently.

Intel Threading Tools include Intel® Thread Checker, to locate threading errors, and Thread Profiler to identify thread performance issues.

Intel Thread Checker automatically locates bugs in threaded software that might otherwise go undetected. It eliminates this guesswork and pinpoints the location of errors to help quickly analyze and correct them.

Intel Thread Checker graphically displays and groups errors by context for easy review. It can identify six levels of threading issues, from errors and warnings to informative comments. In addition, it classifies each issue it finds for easy prioritization: errors, warnings, cautions, informational and remarks. Sort errors by severity to highlight the most important issues first. Sorting by file lets you focus on bugs you own. Once you find the bugs, easily drill down to the root causes with several graphical tools.

Thread Profiler monitors your application's execution to detect threading performance issues, including thread overhead and synchronization impact. Thread Profiler provides graphical displays to help analyze and correct threading bottlenecks for Win32* or OpenMP* threaded software.

Features and Benefits

- **Automatic Error Detection** saves time to create enough tests to catch the common, uncommon, and intermittent threading bugs
- **Detection of race conditions, thread deadlocks, and thread stalls** saves execution time by finding even subtle parallel programming issues
- **Bug Isolation** shows exactly which variables are causing the bug, where variables get used by the threads, where variables are declared, and the call stack to offending lines of code
- **Compatibility with Win32* APIs for Threads, C runtime library functions, and OpenMP* —** Uses familiar Win32 API and C runtime library function plus all OpenMP pragmas and clauses
- **Choose any of several Microsoft compilers** to build your software for analysis
- **Intel® Fortran and Intel® C++ Compilers —** Displays additional details and the actual variable names, even when using pointers, if you build your software with an Intel compiler and the /Qtcheck command-line option
- **Trial version** is available

Intel® Thread Checker Results Window

Diagnostics List
Displays specific information about every issue identified by Intel Thread Checker. Each entry includes an error description — with one-click diagnostic help — a color-coded severity estimate, and a source code line number. Double-clicking an entry in the diagnostics list shows source code locations where the error occurred.

Source Code View
Displays the line of source code where errors occur. The Stack Trace tab graphically displays the code path(s) taken by threads to arrive at the code error.
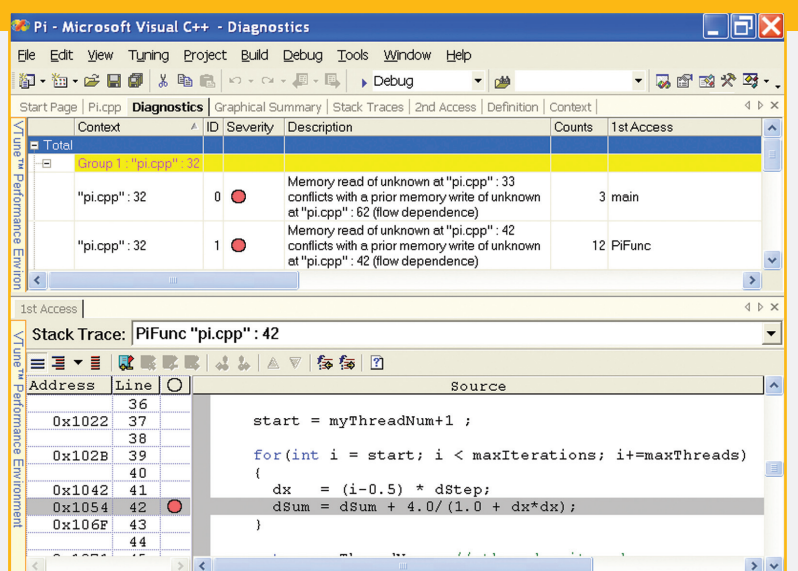
Thread Profiler Timeline View

Displays information from critical path analysis that impacts execution time of Win32 threaded software. The timeline view displays synchronization constructs that lengthen execution time. You can drill down to source where relevant synchronization objects are signaled. Color coding by category helps you locate and prioritize performance issues.

In this example, the objective is to minimize Impact Time (red) and maximize Cruise Time (green) with a resulting shortened execution time.
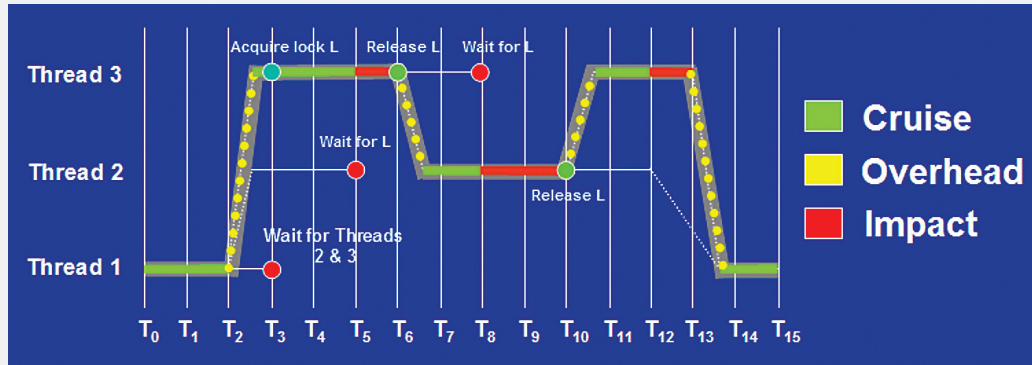
What's New in Intel® Thread Checker 2.0 for Windows*

- Integration with Microsoft Visual Studio* .NET means you can run Intel Thread Checker and view results in the Microsoft Visual Studio .NET development environment
- With the choice of more compilers to build your software, you can select the compiler to build your software for analysis: Intel® C++ Compiler 7.0 or higher; Intel® Fortran Compiler 7.0 or higher; Microsoft Visual C++* .NET 2002, 2003 Editions; and Microsoft Visual C++ 6.0
- Provides one-click help for diagnostics to show possible causes and solution; when using the diagnostic view, just right-click for diagnostic help
- Supports user-defined synchronization primitives, if you do not use Win32 or OpenMP libraries
- Now supports thread-count dependent OpenMP APIs and nested OpenMP parallel regions

PERFORMANCE
Get Insight into Threading Glitches
Intel Thread Checker helps you find and fix threading errors in Win32 and OpenMP threaded software, letting you tune your threaded software for better performance.

COMPATIBILITY
Works Within Visual Studio*
Use Intel Thread Checker within the Microsoft Visual Studio .NET development environment. Intel Thread Checker is compatible with the Win32 APIs for Threads, the C runtime library functions, and OpenMP pragmas and clauses. It is integrated with the VTune™ Performance Analyzer.

SUPPORT
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REQUIREMENTS
Hardware and Software
For IA-32 and Intel® Itanium processor system requirements visit: **www.intel.com/software/products/threading**

[1] Hyper-Threading technology requires a computer system with an Intel® Pentium® 4 processor supporting HT Technology and a Hyper-Threading Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on which processors support HT Technology.

Intel® Trace Analyzer[1]

Overview

Intel® Cluster Tools assist developers and managers of distributed systems in getting the best application performance.

Intel® Trace Analyzer[1] provides a convenient way to graphically analyze the runtime event traces of Intel® Trace Collector,[1] allowing developers to quickly focus on the desired level of detail. Intel Trace Analyzer provides several graphical displays for visualizing application runtime behavior. The timeline and parallelism display shows per-process application activities and message passing along a time axis. Source code location is available with the required compiler support.

Statistical displays help developers visualize the analysis of program execution and communication operations. Most displays are available in global and per-process variants. The timeline view can be zoomed and scrolled. Statistics can be restricted to arbitrary portions of the timeline display.
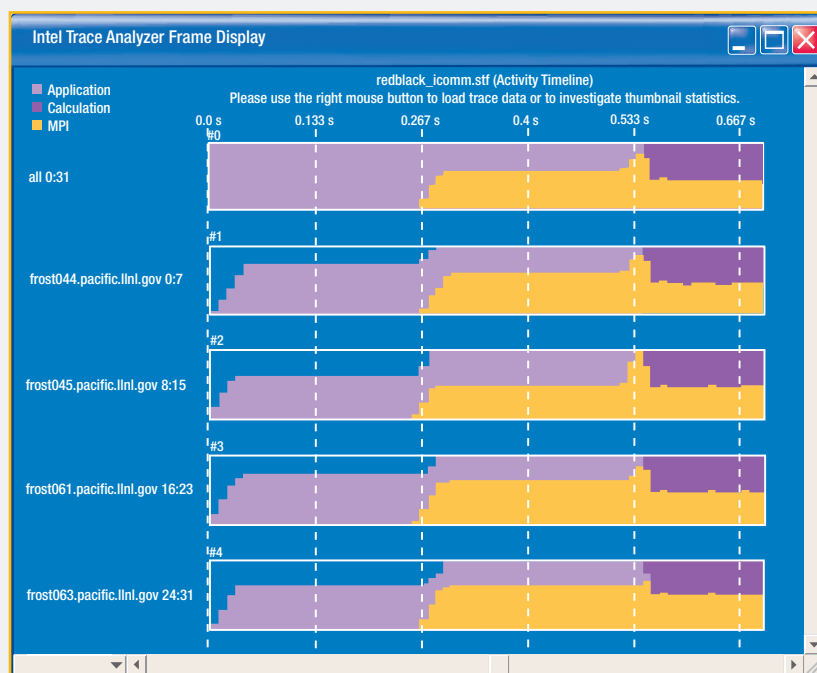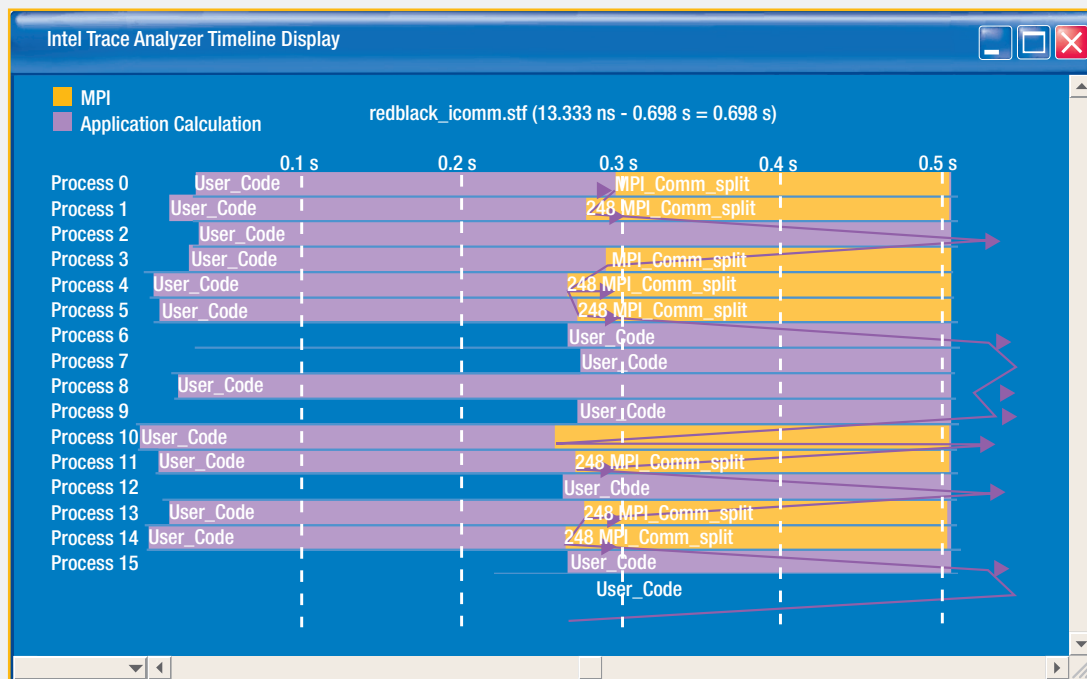
Graphically Analyze Runtime Event Traces

- Ease of use — Provides a convenient way to graphically analyze runtime event traces produced by MPI and other applications, enabling developers to quickly focus on the desired level of detail to find performance hotspots and bottlenecks

- Hierarchical displays — Addresses display scalability, allowing developers to navigate through the trace data at different levels of abstraction (cluster, node, and process)

- Variety of graphical displays — Provides important aspects of the application runtime behavior in detailed and aggregate views

- Timeline views and parallelism display — Displays application activities, source code locations of events, and message-passing along a time axis, allowing developers to visualize the concurrent behavior of parallel applications, and to calculate statistics on demand for specific time intervals and processes

- Communication statistics — Provides communication metrics for an arbitrary time interval and message-length distribution

- Execution statistics — Displays subroutine execution metrics for an arbitrary time interval and shows call-tree comparisons between different program runs

Features and Benefits

- **Display application activities** and message-passing along a time axis to help visualize concurrent behavior of parallel applications

- **Focus on the desired level of detail** to identify performance hotspots and bottlenecks

- **View a hierarchical display** to address display scalability

- **Execution Statistics** help analyze subroutine performance and graphical displays

- **Communication metrics and graphical displays** help identify communication patterns, parameters, performance and communication hotspots

Frame Display of Application Trace File Data

Intel Trace Analyzer Timeline Display

MPI
Application Calculation

redblack_icomm.stf (13.333 ns - 0.698 s = 0.698 s)

	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s
Process 0	User_Code		MPI_Comm_split		
Process 1	User_Code		248 MPI_Comm_split		
Process 2	User_Code				
Process 3	User_Code		MPI_Comm_split		
Process 4	User_Code		248 MPI_Comm_split		
Process 5	User_Code		248 MPI_Comm_split		
Process 6			User_Code		
Process 7			User Code		
Process 8	User_Code				
Process 9			User Code		
Process 10	User_Code				
Process 11	User_Code		248 MPI_Comm_split		
Process 12			User_Code		
Process 13	User_Code		248 MPI_Comm_split		
Process 14	User_Code		248 MPI_Comm_split		
Process 15			User_Code		
			User_Code		

Graphical User Interface Provides Display Variants

Most displays are available in global and per-process variants. Statistics can be restricted to arbitrary parts of the trace. Multiple traces produced by the same application can be compared to assess optimizations. With a fast, graphical user interface, developers can easily control displays and statistics on large data sets by using:

- Object point-and-zoom for enhanced detail
- Context-sensitive sub-menus
- Coupled displays with automatic updates of statistics recomputation

PERFORMANCE
Optimized Analysis and Display

Intel Trace Analyzer provides optimized analysis and display capabilities with fast graphical rendering for complex profiling data.

COMPATIBILITY
Standard X-Windows* Displays

Intel Trace Analyzer uses standard X-Windows* displays, allowing it to work on local Linux* workstations as well as on remote UNIX* or Windows* systems running an X-server.

SUPPORT
Intel® Premier Support

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support and all product updates during that time. Intel Premier Support gives you online access to technical notes, application notes, and documentation. Install the product, and then register to get support and product update information.

Hardware Requirements
- Intel® Pentium® 4, Intel® Xeon™, or newer processor
- 512 MB RAM
- 1 GB disk space
  or
- Intel® Itanium® 2 processor
- 1 GB RAM
- 1 GB disk space

Software Requirements

Supports IA-32 based systems with Linux* and Itanium architecture-based systems with Linux or HP-UX*

[1] Intel® Trace Analyzer, formerly marketed as Vampir. Intel® Trace Collector, formerly marketed as Vampirtrace.

Intel® Trace Collector[1]

Overview

Intel® Cluster Tools assist developers and managers of distributed systems in getting the best application performance.

Intel® Trace Collector[1] brings the advantages of event-based tracing to applications in a low-overhead tracing library. It supports MPI, Java*, and multi-threaded processes with and without MPI. The tool is completely thread safe, allowing tracing of multi-threaded MPI applications. Automatic function profiling is also now supported on all platforms when the GNU Compiler Collection is used to compile C or Fortran source code. Intel® Trace Analyzer[1] and Intel Trace Collector support IA-32 and Intel® Itanium® architectures with Linux* (MPICH). Intel Trace Collector supports the LAM MPI implementation on IA-32 architectures and HP-UX* (HP-MPI) and SGI Altix* (SGI-MPI) systems on Itanium 2 microarchitectures. Intel Trace Analyzer displays the data produced by Intel Trace Collector.

Graphically Analyze Runtime Event Traces

- Event-based tracing tool — Successful use of Intel Trace Collector for MPI performance analysis demonstrates the advantages of event-based tracing compared to exclusively statistical approaches. The timeline display helps developers visualize the concurrent behavior of parallel applications. Statistics can be calculated on demand for given time intervals and specific processes. The tool also brings the advantages of event-based tracing to non-MPI applications such as Java processes and multi-threaded processes without MPI. Java function profiling is possible without recompiling the Java classes. In addition, the traditional Virtual Terminal Application Programming Interface (VT API) is also available to instrument Java source code.

- Ease of use — Intel Trace Collector works as an add-on to existing MPI implementations. In most cases, using the tool requires relinking with the Intel Trace Collector library. If application-defined events must be recorded, a recompile may be necessary. The low-overhead instrumentation limits the perturbation of the application execution, assuring that the runtime behavior remains fundamentally unaltered. Experience shows that lessons learned from studying the traces of a run with Intel Trace Collector invariably lead to improved performance of non-instrumented runs.

- Structured trace file format — Intel Trace Collector introduces a new file format for trace data: the *Structured Trace Format* (STF). This file format was designed from the ground up for scalability and compact data representation. Files can be written in parallel, thus generating trace files faster, and allows random access to portions of a trace, making it suitable for analysis of traces too large for Intel Trace Analyzer.

Features and Benefits

- **Profiling library** records distributed, event-based trace data
- **Low-overhead** and compact data representation provides structured trace file format (STF)
- **Completely thread safe** to allow tracing of multi-threaded Message Passing Interface (MPI) applications
- **Easy-to-use** Application Program Interface (API)
- **Low intrusion instrumentation** for MPI, Java*, or multi-threaded applications
- **Complements Intel's offerings** designed for developing high-performance software including compilers, libraries, and VTune™ Performance Analyzers
- **Automatic function profiling** supported on all platforms when the GNU Compiler Collection is used to compile C or Fortran source code
- **Global Array programming model** allows tracing and performance analysis of applications

Graphical View of Structured Trace Format (STF) Data Collection
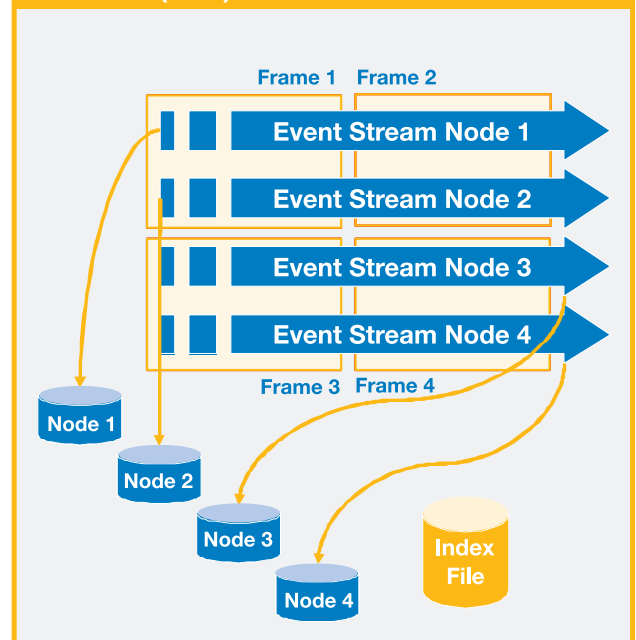
- Scalability and memory handling — Reduction of large memory consumption, often associated with event-based tracing, is addressed by the filtering and memory-handling capabilities of Intel Trace Collector. For deep function call stacks, folding avoids superfluous details by logging the first call to a system function and then hiding all internal functions below this call. Trace data is cached in memory to reduce runtime overhead, but can be written to a cache file in the background without blocking the application. Counters can be used to monitor Intel Trace Collector's memory handling. If that still interferes with the application or simply produces unneeded data, Intel Trace Collector can be used in a purely statistical mode. In this mode, statistics regarding function calls, messages, and collective operations are calculated by Intel Trace Collector at runtime and stored without event data. Intel Trace Analyzer can display these statistics instantaneously without having to load any trace data.

- Completely thread safe — Intel Trace Collector allows tracing of multi-threaded MPI applications. The tool brings the advantages of event-based tracing to non-MPI applications by supporting Java processes and multi-threaded processes without MPI. Java function profiling is possible without recompiling the Java classes. In addition, the traditional VT API is available to instrument Java source code. Automatic function profiling is supported on all platforms when the GNU Compiler Collection is used to compile C or Fortran source code.

PERFORMANCE
Processor and Data Scalability
Intel Trace Collector easily scales up to several hundred processors due to a hierarchical approach to addressing data scalability.

COMPATIBILITY
Diverse Hardware and Software Support
Intel Trace Collector supports IA-32 and Itanium architectures with Linux. MPI implementations such as MPICH, LAM MPI, ScaMPI, and Myrinet* MPI are supported on IA-32 architectures. On Itanium architectures, MPICH, HP-UX (HP-MPI), and SGI Altix (SGI-MPI) systems are supported. Automatic function profiling is supported on all platforms when the GNU Compiler Collection is used to compile C or Fortran source code.

SUPPORT
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Hardware Requirements
- Intel® Pentium® 4, Intel® Xeon™, or newer processor
- 512 MB RAM
- 1 GB disk space
  or
- Intel® Itanium® 2 processor
- 1 GB RAM
- 1 GB disk space

Software Requirements

Supports IA-32 and Itanium architecture-based systems with Linux*. MPI implementations such as MPICH, LAM MPI, ScaMPI, and Myrinet* MPI are supported on IA-32 architectures. On Itanium architecture-based systems, MPICH, HP-UX*, and SGI Altix* systems are supported.

Note: Intel Trace Collector Parallel Performance Analysis Library is a machine (cluster) bound license. This means for every machine (cluster), you need a separate license. Licensing of Intel Trace Collector[1] Parallel Performance Analysis Libraries restricts the maximum number of MPI processes used in a parallel program to no more than the total number of processors used, regardless of the number of MPI processes executed per processor.

[1] Intel® Trace Analyzer, formerly marketed as Vampir. Intel® Trace Collector, formerly marketed as Vampirtrace.

Intel® Software College
World-class training on Intel® software and technologies

Develop and Expand Your Skills

Intel® Software College is the training source on leading-edge software development technologies. Our comprehensive courses cover a broad range of topics about Intel® processors, tools, technologies and platforms.

- Learn how to optimize software performance on Intel® architecture
- Learn to use the Intel tools and to take advantage of the advanced features of the latest Intel microprocessors

With flexible training options, you can choose how you want to learn — we offer instructor-led, web-based, or customized training to meet your needs. All instructor-led courses are delivered by Intel experts and combine presentation and hands-on lab exercises. Web-based training courses provide you with the flexibility to learn when you want to and at your own pace.

Training sessions are offered worldwide.

We Can Help You

Intel expert trainers help you capitalize on today's technology trends to deliver compelling new products to your customers.

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Intel® Software College Courses

Instructor-led courses:

- **High Performance Computing: Application Tuning for Clusters** *(Separate classes available for Intel® Xeon™ processor-based platforms and Intel Itanium® 2-based platforms)*
Hands-on training in parallel computation models, parallel programming, and tuning for single-node and cluster performance

- **High Performance Computing: Cluster Setup, from Building to Benchmarking** *(Separate classes available for Intel® Xeon™ processor-based platforms and Intel Itanium® 2-based platforms)*
Lecture with hands-on training in cluster system design, hardware and software installation, cluster system management, benchmarking and cluster tuning for maximum performance

- **Tuning for the Intel® Itanium® 2 Microarchitecture**
Build expertise in 64-bit application development and optimization through lecture and hands-on labs

- **Thread Programming and Hyper-Threading Technology[1]**
Gain hands-on experience with the most efficient techniques for developing well-optimized threaded applications for Hyper-Threading Technology and multi-processors

Online courses:

- **Enhancing Performance with the Intel® Compiler**
Get started using the Intel® compilers, and learn how to use the major optimization options of the Intel compilers

- **Building Mobile Apps for Intermittent Connections**
Explore how to build a mobile application that continues to operate when a network connection becomes unavailable

- **The Intel® Performance Tuning Methodology**
Learn Intel preferred Performance Tuning Methodology covering performance measurement, analysis, and optimization

[1] Hyper-Threading technology requires a computer system with an Intel® Pentium® 4 processor supporting HT Technology and a Hyper-Threading Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on which processors support HT Technology.

Intel® **software** college

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Support Services

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- Submit or review issues through the Web site
- Notification of product updates
- Online user discussion forums with Intel® Experts
- Evaluation software download center access

Every purchase of an Intel® Software Development Product includes a year of support services, which provides access to Intel® Premier Support, and all upgrades during that time. Our highly-trained, experienced support staff is dedicated to helping you receive the maximum possible benefits from your Intel tools product purchase.

Interactive support is provided through our Intel Premier Support Web site, which is accessible at **www.intel.com/software/products**. You can submit or review issues through this Web page.

After registering on the Intel Premier Support Web site, you will be presented with new information on postings and a variety of options. You can download software upgrades, access product FAQs and errata, or review the status of your issues. Registered members will receive e-mail notifications of product updates. Your communications with the Intel Premier Support team are protected by 128-bit encryption, and maintained online so that you can review them at your convenience.

In addition to Intel Premier Support, you can also find a rich and well-managed repository of product information at our support site. This information includes getting-started tips, known product issues, product errata, license information, and more.

User forums are an easy way to connect with other developers using Intel Software Development Products. These online discussion forums allow you to collaborate with other users on a variety of development topics. Intel experts will also participate to ensure accurate, timely responses to questions raised.

Before you decide to purchase, you can try Intel Software Development Products and superior support services. We encourage you to visit our evaluation center at **www.intel.com/software/products/eval** where you can download an evaluation copy for most of the products.

Intel® Developer Services

Intel® Developer Services is the place for software developers to go for content, resources and opportunities designed to accelerate the development and deployment of their solutions, applications and tools. Find free online training, content and support.

Whether you need to kick-start your next project or solve an issue mid-development, Intel Developer Services is your one-stop resource. Through **www.intel.com/IDS** you can access white papers, case studies, code samples and more.

Log on to **www.intel.com/IDS** and discover the benefits of your free membership today.

Service Options

- Join our community forums to connect with peers and Intel® technical marketing engineers; share tips and ask questions on subjects such as Extensible Firmware Interface, VTune™ Performance Analyzer, or C++ Compilers
- Apply to take advantage of opportunities to gain high-level exposure for your company or product by sharing your original content with our developer community
- Get the training you need to help win new business with Intel solutions, and keep up-to-date with fast-changing technologies through our online trainings and e-tutorials

Early Access Program

The Intel Developer Services Early Access Program is the comprehensive resource for developers of next-generation software solutions that run best on the latest Intel microprocessors. Members get early access to computer systems, software tools, training, customer support, co-marketing opportunities, as well as, original equipment manufacturer (OEM) discounts.

Early Access Program members have access to the latest platform technology, helping their companies gain a performance edge and stay on top of increasing customer demands. Benefits of the program include use of development platforms configured with the latest tools, including many of the Intel Software Development Products listed in this brochure.

It's about utilizing the power of Intel processors, coding with the latest development tools, and gaining a market edge. Members of the Early Access Program are eligible to take advantage of business development and cooperative marketing opportunities including listings in the Intel Developer Solutions Catalog and possible joint appearances at industry events.

For more information on the Early Access Program go to: **www.intel.com/IDS/eap**

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Intel® Solution Services

- **Advanced Data Center Practice**
  Intel® Solution Services create strategies to integrate and manage the many complex components within a data center. Our architectural advice helps balance stringent requirements for scalability, availability, security, and manageability while reducing total cost of ownership (TCO) and maximizing return on investment.
- **Application Platform Practice**
  We help enhance performance of software applications and high-performance computing solutions by taking advantage of the latest Intel® technology.
- **Architecture Planning Practice**
  We offer collaborative, enterprise-wide planning, capitalizing on Intel expertise in IT and e-Business.
- **e-Commerce Applications and Solutions Practice**
  We help implement the latest e-Business applications and optimize IT infrastructures, maximizing resources, ensuring high availability, and reducing TCO.
- **Migration Practice**
  We improve system performance and lower TCO by helping companies migrate to an open, scalable Intel® architecture-based platform. Our expertise includes migration of custom code, application and database servers, migration between non-Intel to Intel architecture, and migration to next-generation Intel architecture.
- **Server Consolidation Practice**
  We consolidate existing infrastructures and set up new utility-computing infrastructures to help maximize resource usage, ensure high levels of availability, lower TCO, and increase manageability.
- **Web Services Practice**
  We create Web services solutions that help meet business and IT requirements, while reducing risk and maximizing IT investment.

Intel® Solution Services, a worldwide professional services organization, helps enterprise companies capitalize on the value of Intel® architecture through consulting that's focused on architecture transitions.

Intel Solution Services is backed by the largest manufacturer of processors in the world and one of the world's largest e-Business corporations. Intel Solution Services designs cost-effective, leading-edge solutions. We help deliver superior business results through expertise in Intel architecture, next-generation technologies, and relationships with key industry alliances.

Our consultants provide significant experience in:

- Technology initiatives, including .NET, J2EE*, XML and mobility architecture
- Enterprise resource planning, customer relationship management, and supply chain management
- Industry-leading Web and application servers, as well as database servers, including Oracle and Microsoft SQL Server
- Operating systems running on Intel architecture, including Windows*, Linux*, UNIX, and HP-UX*
- Load testing tools, such as Mercury Interactive LoadRunner* and WinRunner*
- Intel® software development tools, such as Intel® VTune™ Performance Analyzer, Intel® Compilers, Intel® Performance Libraries, Intel® Thread Checker and Intel® Cluster Tools

For More Information

Our Web Site:
www.intel.com/internetservices/intelsolutionservices

E-mail Us:
solution-services-questions@intel.com

Toll Free in the U.S.: 866-268-9812

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Technical Topics and Resources

Technical Topics

Numerous technical topics and resources for Intel® Software Development Products are available for developers on the Intel Web site. There are white papers, technical discussions, and case studies for all of the tools and architectural discussions of Intel processors.

User Community for Developers

Get expert advice from the developer community. Intel technical marketing engineers also participate to provide answers and stay aware of your concerns and issues. Start today. Anyone can read messages, but posting a question or a response is a privilege limited to registered members. Access the User Community through the Intel® Software Development Products Web site.

More Information

More information and resources for developers are available from Intel Developer Services. Intel Developer Services is a comprehensive Web-based resource that provides software and Internet developers with technical information, tools, and services to accelerate the development of Intel processor-based solutions. Look for "micro-sites" with focus areas on:

- Porting and optimizing applications for Intel processors
- Software technologies and operating systems
- Programs for early access to systems running the next generation Intel processors

Search the Intel Developer Services database at www.intel.com/IDS for a wide variety of technical topics.

White Papers

Here is a partial listing of white papers on Intel Software Development Products.

Intel® Compilers

- Efficient Exploitation of Parallelism on Pentium® III and Pentium® 4 Processor-Based Systems
- Intel: Creating Tools to Make OpenMP* the Standard for Threading Application Software
- Optimizing Applications with the Intel® C++ and Fortran Compilers for Windows* and Linux*

Intel® VTune™ Performance Analyzer

- Advantages of VTune™ Performance Analyzer over other Profilers
- Advanced Call Graph Profiling Techniques

Listings on the Web Site Include:

- **Getting started guides**— learn the basic steps necessary to get up and running on any tool
- **Case studies** – learn how our customers use the software tools to benefit their product development and overall business
- **White papers** – read in-depth analyses of Intel software tools and how they can enhance product development
- **Optimization techniques using the tools** – learn how to improve performance of your applications by accessing the advanced architecture of the latest Intel® processors
- **How to take advantage of parallelism on Intel processors** – get an overview of parallelization and vectorization methods
- **How to tune .NET applications** – learn how to analyze standalone .NET applications and .NET Web services and applications
- **Application development notes** – learn how to tune products to take advantage of features in all of the latest Intel processors
- **Game development applications** – learn how to performance-tune a game application during development with VTune™ Performance Analyzer
- **Tuning server applications** – learn how to identify performance issues in your server applications

For these topics and many more, visit: www.intel.com/software/products

Intel® Performance Libraries

- Intel® Integrated Performance Primitives (Intel® IPP) —Performance Tips and Tricks
- Boosting Application Performance using Intel® Performance Libraries

Intel® Threading Tools

- Threading Methodology: Principles and Practices

Case Studies

The following is a sampling of case studies on Intel Software Product Development products.

Intel® Compilers

**Enhancing Open Source Performance on Linux*,
a Persistent Systems case study —** Persistent Systems used the Intel® C++ Compiler for Linux to optimize the performance of the open-source Linux enterprise database MySQL* to take advantage of the latest features of the Itanium® 2 and Pentium 4 processors.

Helping HPC Applications Unravel the Universe's Origins, a Swinburne University Center for Astrophysics and Supercomputing case study — Swinburne University Center for Astrophysics in Australia wanted to substantially improve the data analysis performance of applications running on their HPC superclusters – well beyond the huge processing capabilities of the hardware. Swinburne's team used the Intel® Fortran Compiler to deliver application performance improvements of 24% to 31%.

**Boosting Performance of Oracle* Database,
an Oracle case study —** Oracle9*i* database customers expect unbreakable software that won't "go down," is secure, and provides integrated business information available anytime, anywhere. Oracle used the Intel® C++ Compiler for Linux* and the Intel C++ Compiler for Windows to ensure that Oracle9*i* database software delivered the best performance possible on Intel processor-based platforms.

**A Shortcut to Success,
an ImageCom case study —** ImageCom, Inc. needed the ability to transcode digital video content for H.263 output at a faster rate than it came in from the source — or face the high risk of dropping content. Intel Integrated Performance Primitives and the Intel C++ Compiler provided the solution.

Intel Performance Libraries

**Speeding up Face Recognition,
a Cognitec case study —** Cognitec utilized Intel® IPP to greatly increase the performance of their biometric facial recognition application. By integrating Intel IPP with their FaceVACs application, Cognitec achieved up to a 10x increase in the number of facial comparisons delivered by a system, relative to the pre-Intel IPP baseline.

**Delivering Real-Time 3D Video Compositing,
a RadTIME case study —** RadTIME's goal was to develop a tool that allowed artists to merge media files, graphics, 3D objects, filtering, and animation with equal flexibility and control. Their design strategy was to fully utilize the Intel Integrated Performance Primitives for much of the 2D math image processing functions and thus to provide as close to real time playback of animation and video as possible. Intel IPP delivered.

**Boosting Performance in Life-Enhancing Designs,
an Abaqus case study —** Abaqus Inc., a maker of medical devices for which safety is of critical importance, had a need to simulate the physical response of structures and solid bodies to load, temperature, contact, impact, and other environmental conditions. Intel® Math Kernel Library and VTune™ Performance Analyzer offered Abaqus engineers a path to a compelling solution on Intel® architecture for these simulation requirements.

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