Intel® Itanium® Processor-Specific Optimization

In general, -O3, IPO and/or PGO, and utilizing the Optimization Reports (in the *Fine-Tuning* section) to control aliasing and improve memory utilization, provides the best performance for Intel® Itanium® processor-based systems.

Fine-Tuning

Once you have identified performance hot-spots, you may need to provide the compiler with more information to fine-tune specific functions. The Optimization and Vectorization Reports may show places where loops could not be optimized fully due to pointer aliasing or memory access overlaps, for example. Also, the *Intel® C++ and Fortran Compilers User's Guides* include details on other #pragmas, directives, and intrinsics that can be used to control software-pipelining, unrolling, vectorization, and prefetching for further fine-tuning within your application code.

Parallel Performance

The following options allow the compiler to help you parallelize your application for multi-processor or Hyper-Threading Technology capable systems.

Windows§ Command	Linux§ Command	Comment
/G1	**-tpp1**	Targets optimization for the Itanium processor.
/G2	**-tpp2**	Targets optimization for the Itanium 2 processor. Generated code is also compatible with the Itanium processor. (Default)
/QIPF_fma[-]	**-IPF_fma[-]**	Enables [disables] the combining of floating-point multiplies and add/subtract operations.
/QIPF_fp_speculation*mode*	**-IPF_fp_speculation *mode***	Enables floating-point speculations with one of the following modes: **fast**–Speculate floating-point operations. **off**–Disables speculation of floating-point operations. **safe**–Speculate only when safe. **strict**–This is the same as specifying off.
/Qftz[-]	**-ftz[-]**	Flushes denormal results to zero. The option is turned ON with -O3 by default. This only impacts the application when the main program or dll main is compiled.
/Qivdep_parallel	**-ivdep_parallel**	Indicates there is absolutely no loop-carried memory dependency in the loop where the IVDEP directive is specified.
/QIPF_fltacc[-]	**-IPF_fltacc[-]**	Enables [disables] optimizations that affect floating-point accuracy.
/QIPF_flt_eval_method{0|2}	**-IPF_flt_eval_method0**	Evaluates floating-point operands to the precision indicated by the program.

Windows§ Command	Linux§ Command	Comment
/Qunroll[n]	**-unroll[n]**	Sets the maximum number of times to unroll loops. -unroll0 disables loop unrolling. The default is -unroll, which uses default heuristics.
/Qrestrict[-]	**-[no]restrict**	Enables/disables pointer disambiguation with the restrict qualifier.
	-falias	Assumes aliasing in the program. (C++ Linux only)
	-ffnalias	Assumes aliasing within functions. (C++ Linux only)
/Oa	**-fno-alias**	Assumes no aliasing in program.
/Ow	**-fno-fnalias**	Assumes no aliasing within functions, but assumes aliasing across calls.
/Qalias_args[-]	**-alias_args[-]**	Implies arguments may be aliased [not aliased].
/Qopt_report	**-opt_report**	Generates an optimization report directed to stderr.
/Qopt_report_file*filename*	**-opt_report_file*filename***	Specifies the filename for the optimization report.
/Qopt_report_level*level*	**-opt_report_level*level***	Specifies the verbosity level of the output. Valid arguments are **min** (default), **med**, **max**.
/Qopt_report_phase *name*	**-opt_report_phase *name***	Specifies the compilation name for which reports are generated. The option can be used multiple times in the same compilation to get output from multiple phases. Valid name arguments: **ipo:** Interprocedural Optimizer **hlo:** High Level Optimizer **ilo:** Intermediate Language Scalar Optimizer **ecg:** Code Generator **omp:** OpenMP§ **all:** All phases
/Qopt_report_routine [rtn]	**-opt_report_routine [rtn]**	Specifies a routine **rtn**. Reports from all routines with names that include **rtn** as part of the name are generated. By default, reports for all routines are generated.
/Qopt_report_help	**-opt_report_help**	Displays all possible settings for **-opt_report_phase**. No compilation is performed.

Windows§ Command	Linux§ Command	Comment
/Qopenmp	**-openmp**	Enables the parallelizer to generate multi-threaded code based on the OpenMP§ directives.
/Qopenmp_report{0|1|2}	**-openmp_report{0|1|2}**	Controls the OpenMP parallelizer's diagnostic levels. The default is /Qopenmp_report1.
/Qparallel	**-parallel**	Detects parallel loops capable of being executed safely in parallel and automatically generates multithreaded code for these loops.
/Qpar_report{0|1|2|3}	**-par_report{0|1|2|3}**	Controls the auto-parallelizer's diagnostic levels as follows: **0:** displays no diagnostic information. **1:** indicates loops successfully parallelized (default). **2:** loops successfully and unsuccessfully parallelized. **3:** adds information about any proven or assumed dependencies inhibiting parallelization.
/Qpar_threshold[n]	**-par_threshold[n]**	Sets a threshold for the auto-parallelization of loops based on the probability of profitable execution of the loop in parallel, **n=0** to **100**. Default: **n=75**. This option is used for loops whose computation work volume cannot be determined at compile time. **0:** parallelize loops regardless of computation work volume. **100:** parallelize loops only if profitable parallel execution is almost certain.

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Quick Reference Guide to Optimization with Intel® Compilers

For Intel® Pentium® 4 and Intel® Itanium® Processor Families

A Step-by-Step Approach to Application Tuning with Intel Compilers

Before you begin performance tuning, ensure that your application runs as intended with a base set of options or in debug-mode (-Od and -Zi).

1. Use the Automatic Optimization Options (-O1, -O2, or -O3) and determine which one works best for your application by measuring performance with each.
2. Add in Interprocedural Optimization (IPO) and/or Profile-Guided Optimization (PGO) and again measure performance to determine if your application benefits from either of them.
3. Fine-tune performance with the processor-specific options to target IA-32 or Intel® Itanium® processor systems specifically. This step works best by identifying performance "hot-spots" with the Intel® VTune™ Performance Analyzer so you know which parts of your application need specific tuning. Also, the Intel Compiler's Optimization Reports show where the compiler could use more of your help.
4. Run your applications on multi-processor or Hyper-Threading Technology capable systems using Parallel Performance options.

Maximize
Application Performance
on Intel® architectures

Automatic Optimization Options

Before you begin performance tuning, ensure that your application runs as intended with a base set of options or in debug mode (-Od and-Zi). These are general optimization options that should be at the heart of any application tuning for Intel® Pentium® 4 and Itanium® processors. Try these different options and measure your performance before proceeding to more advanced optimizations.

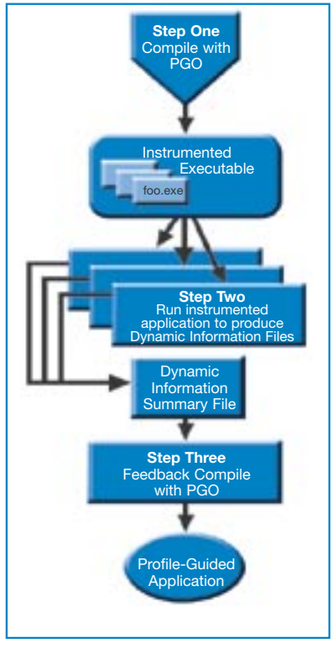
Windows§ Command	Linux§ Command	Comment
/Od (No Optimization)	**-O0**	No optimization. Useful during application development and debugging.
/O1 (Optimize for size)	**-O1**	Omits optimizations that tend to increase object size. Creates the smallest optimized code in most cases. On Linux systems with IA-32 processors only, there is no difference between **-O1** and **-O2**. This option has proven useful in many large server/database applications where memory paging due to larger code size is an issue.
/O2 (Maximize speed)	**-O1** or **-O2**	Default setting. Creates the fastest code in most cases, but may increase code size significantly over **/O1**. On Linux systems with IA-32 processors, **-O1** and **-O2** are equivalent.
/Ox (Maximize optimization)	n/a	Equivalent to **/O2** except that **/Ox** does not imply **/Gy** (function packaging) or **/Gf** (string pooling).
/O3 (High-level optimizations)	**-O3**	Same as **/O2,** plus loop transformations and data prefetching for improved memory usage efficiency. For the full benefit of **/O3** on Intel 32-bit processors, also use the **/Qx{K, W, N, B, P}** or **/Qax{K, W, N, B, P}** options for Pentium III and Pentium 4 processors and subsequent IA-32 processors. This option has proven useful for a broad range of applications, particularly loopy, kernel-based code common in high-performance computing.
/Zi	**-g**	Generates debug information for use with any of the common platform debuggers.

Interprocedural Optimization (IPO) and Profile-Guided Optimization (PGO) Options

IPO controls function-inlining to reduce function call overhead and improve data layout across functions. PGO provides run-time feedback to guide optimization decisions about data and code layout to improve instruction-cache, paging and branch prediction. IPO can increase code size. Be sure to measure your execution performance, compile-time, and code-size tradeoffs with these options. IPO is best used in conjunction with PGO to guide which functions to inline.

Windows§ Command	Linux§ Command	Comment
/Qip	**-ip**	Single file optimization. Allows selective inlining optimization within a single source file.
/Qipo	**-ipo**	Multi-file optimization. Permits inlining and other optimizations among multiple source files.
/Qprof_gen	**-prof_gen**	Instruments a program for profiling.
/Qprof_dir*dir*	**-prof_dir***dir*	Specifies a directory for the profiling output files, *.dyn and *.dpi.
/Qprof_use	**-prof_use**	Enables use of profiling information during optimization.

Profile-Guided Optimization (PGO) Steps



IA-32 Processor-specific Optimization

These options allow you to tune performance specifically for the Intel processor-based systems you are targeting. As with each previous step, measure the performance benefit of each option to guide your decisions. Use the Intel Compilers' Optimization Reports to assist in determining whether you can provide more help to the compiler in the form of anti-aliasing or memory disambiguation information.

IA-32-Specific Optimization Recommendation: Use the -QaxN (-axN on Linux), new in the 8.0 compilers, for best performance across all Intel® Pentium® 4 processors and the Pentium M processor. (You may also want to experiment with -QaxB (-axB) on Pentium M processors.)

Windows§ Command	Linux§ Command	Comment
/Qax{K|W|N|B|P}	**-ax{K|W|N|B|P}**	Automatic Processor Dispatch. Generates specialized code for the indicated processors while also generating generic IA-32 code. You can use more than one code to tune for multiple processors in the same executable. **K** - Intel Pentium III and compatible Intel processors **W** - Intel Pentium 4 and compatible Intel processors **N** - Intel Pentium 4 and compatible Intel processors **B** - Intel Pentium M and compatible Intel processors **P** - Intel Pentium 4 processor with Streaming SIMD Extensions 3 and compatible Intel processors Beginning with Intel Version 8 compilers, **K** and **W** are deprecated and will be removed from future releases. **N** provides additional Pentium 4 processor tuning beyond **W**.
/Qx{K|W|N|B|P}	**-x{K|W|N|B|P}**	Processor-specific Targeting. Generates specialized code for the indicated processor. The executable should only be run on the targeted compatible processors. **K** - Intel Pentium III and compatible Intel processors **W** - Intel Pentium 4 and compatible Intel processors **N** - Intel Pentium 4 and compatible Intel processors **B** - Intel Pentium M and compatible Intel processors **P** - Intel Pentium 4 processor with Streaming SIMD Extensions 3 and compatible Intel processors Beginning with Intel Version 8 compilers, **K** and **W** are deprecated and will be removed from future releases. **N** provides additional Pentium 4 processor tuning beyond **W**. **N**, **B**, and **P** generate a run-time check to determine that the correct compatible Intel processor is used to prevent potential run-time faults that could otherwise occur with **K** and **W**.
/Qprefetch[-]	**-prefetch[-]**	Enables or disables prefetch insertion (requires **-O3**).
/Qfp_port	**-fp_port**	Rounds floating-point results after floating-point operations, so rounding to user-declared precision happens at assignments and type conversions; this has some impact on speed. The default is to keep results of floating-point operations in higher precision. Use this if you are experiencing differences in floating-point precision versus other platforms.
/Qvec_report{0|1|2|3|4|5}	**-vec _report{0|1|2|3|4|5}**	Controls amount of vectorizer diagnostic information as follows: n = **0**: no information n = **1**: indicates vectorized loops (default) n = **2**: indicates vectorized and non-vectorized loops n = **3**: indicates vectorized and non-vectorized loops and prohibits data dependence information n = **4**: indicates non-vectorized loops n = **5**: indicates non-vectorized loops and prohibits data dependence information