i960® Microprocessor CTOOLS Application Development Tools

PRODUCT OVERVIEW

Intel's CTOOLS provides a complete set of application development tools for developing embedded designs, including an advanced optimizing compiler, an assembler, a linker, utilities, and a variety of libraries, including floating-point emulation.

Besides operating with the most popular operating systems, CTOOLS also incorporates industry standards in all areas. CTOOLS conforms to ANSI Standard X3.159-1989 and passes the Plum Hall conformance and Perennial test suites. CTOOLS also conforms to the 80960 Application Binary Interface (ABI), enabling object code interoperability with third-party tools and debuggers. Compatibility with known standards makes new users productive immediately, and ensures access to existing application code.

CTOOLS can be used across all members of the i960® microprocessor family. Command line switches allow the compiler to take advantage of specific architectural features. For instance, in the case of the i960 Cx and Hx processors, the compiler uses advanced code scheduling algorithms to modify instruction sequences, taking advantage of the processor's parallel execution capability. The generated code is highly efficient, assuring maximum performance for your embedded applications.

PROVEN OPTIMIZATION TECHNIQUES

Advanced optimization techniques are incorporated into Intel's CTOOLS compiler to offer customers superior performance while maintaining robust code. The compiler incorporates local, global, program-wide and profile-driven optimizations:

Processor-Independent Optimizations Including:

- Constant expression evaluation
- Constant propagation
- Collapsing of arithmetic and bitwise boolean identities
- Common subexpression elimination
- Register subsumption or register coalescing
- Local variable promotions
- Tail-call elimination
- Procedure inlining
- Branch optimizations
- Dead code elimination
- Loop invariant code motion
- Variable shadowing
- Superblock formation
- Basic block rearrangement

Processor-Dependent Optimizations Including:

- Specialized instruction selection
- An intelligent register manager
- Code scheduling
- Use of on-chip data RAM for spill registers
- Efficient use of complex addressing modes
- Branch prediction
- Generation of leaf procedures
- Memory access coalescing

WHOLE-PROGRAM AND PROFILE-DRIVEN OPTIMIZATIONS

CTOOLS also provides program-level optimizations, which allow optimizations such as function inlining to occur across source files. Changing the optimization level is as simple as changing an argument on the compiler's command line. Restructuring your build environment is no longer needed!

A runtime profile can be used to guide the whole-program optimization decisions. Such profile-driven optimizations combine a global view of the entire program with its typical runtime behavior, to produce highly optimized code.

Collecting a runtime profile is often an expensive procedure. With CTOOLS R5.0, once a runtime profile is collected, it can be used to guide optimizations after days, weeks or even months of changes to your source code. The profile is automatically interpolated to match the structure of your program.

COMPRESSION ASSISTED VIRTUAL EXECUTION (CAVE)

By storing non-critical functions in compressed form, CTOOLS can save valuable memory in your ROM-based application. When invoked, such functions are decompressed onto the runtime stack and executed. Upon function return, the stack space is automatically freed.

DEBUGGING OPTIMIZED CODE

The DWARF 2.0 symbolic debug information format supports expression of the complex relationships between your source program and its highly optimized object code. Debugging features such as breakpoints and displaying a variable's value behave more reliably with DWARF than with existing object file formats such as COFF and b.out, when your code is optimized. Optimized code debugging can often eliminate the expensive step of building an unoptimized version of your application for debugging purposes.

KEY FEATURES

- Improved Code Generation for the i960® RP, Jx and Hx Processor Families
- Easy-to-Use Whole-Program and Profile-Driven Optimizations
- Efficient Memory Use with Runtime Decompression of Compressed Object Code
- Debug of Optimized Code Using the ELF Object File Format with DWARF 2.0 Symbolic Debug Records
- Conformance to the 80960 Tools Consortium's Application Binary Interface (ABI) Enhances Interoperability
- PCI Download and PCI Comm on DOS and Windows 95
- On-Line HTML Hypertext Documentation
- Compatible with GNU/960 R4.6 and CTOOLS960 R4.6
- Conforms to ANSI Standard X3.159-1989 and Passes Plum Hall Conformance and Perennial Tests
- Supports In-Line Assembly Code in C Source
- Includes IEEE-754 Compatible, High-Speed, Accelerated Floating-Point library for Components without On-Chip Floating-Point Instructions
- Supports Windows 95, DOS and Selected UNIX Hosts
- Source Code Supplied
- Annual Support Contracts Available

ASSEMBLER AND LINKER

The assembler processes assembly code produced by the compiler. The CTOOLS toolset offers other valuable utilities such as:

- Debugging aids: object file dumper and mapper
- An archiver to build libraries
- An object file stripper to eliminate debug records from the object module
- A COFF to IEEE-695 object file converter
- A big-endian to little-endian object file converter
- A ROM builder to produce ROMable code

The linker links together separately compiled modules, performing additional optimizations such as replacing calls by branch-and-link sequences. It reads the contents of a configuration file in order to map the application's code and data sections in memory and then link correct run-time libraries for the application. Linkage may be performed in interactive steps until the final link step, at which time all unresolved externals are satisfied.

DEBUGGER AND MONITOR

The gdb960 symbolic debugger and MON960 monitor are included in CTOOLS. The debugger is a full symbolic debugger, and operates with the MON960 monitor to allow setting of breakpoints, single-stepping, variable tracing, and many other capabilities.

LIBRARY SUPPORT

CTOOLS supports three library types:

- i960 architecture-specific high-level libraries
- IEEE-754 compatible accelerated floating-point libraries
- Low-level libraries supporting i960 processor evaluation boards

The CTOOLS linker configuration files hide the complexity of linking the correct libraries. All C libraries have been optimized and generated using the CTOOLS compiler. They are offered in normal code form, in position-independent form for use in applications relocatable at load time, and in big-endian form for applications that use i960 big-endian memory regions.

TECHNICAL SUPPORT

Annual software maintenance contracts are available from Intel. Contracts include free production upgrades, 1-800 technical support, FaxBack, BBS and guaranteed bug turnaround (once they have been identified). Intel also offers a 30-day, money-back guarantee to customers who are not satisfied after purchasing any Intel development tool.

HOST SYSTEMS SUPPORTED:

PC Compatible/DOS, Windows 95, HP9000/HP-UX, IBM RS6000/AIX, Sun-4

PROCESSORS SUPPORTED:

i960® Sx, Kx, Cx, Jx, RP, and Hx Processors

AVAILABILITY:

Now

CONTACT:

Local Distributor, Intel Sales Office or Intel Support at (800) 628-8686.

World Wide: call + 1 (503) 264-7354, 7-5:00, Mon-Wed & Fri; 7-3:00, Thur. All U.S. Pacific time.

WWW: http://www.intel.com

ORDERING INFORMATION:

CTOOLSW95KT	Windows 95 & PC Compatible/DOS — CD-ROM & 3 1/2" diskettes
CTOOLSDOSKT	PC Compatible/DOS — 3 1/2" diskettes & CD-ROM
CTOOLSUNXKT	HP9000/HP-UX — 4mm Sun-4/UNIX & IBM RS/6000/AIX — 8mm & QIC-24

i960® Microprocessor Literature

Title	Literature Order #	FaxBack Document #
PRODUCT INFORMATION		
i960® Processor Product Line Card		2033
i960® Processor Literature List		2115
FaxBack Document List		2068
i960® CA/CF 32-Bit Superscalar Microprocessor InfoGuide		2705
i960® KA/KB 32-Bit Embedded Microprocessor InfoGuide		2716
i960® HA/HD/HT Superscalar Microprocessor InfoGuide		2730
i960® JX Microprocessor/ The Cobra Series InfoGuide		2731
i960® SA/SB 32-Bit Embedded Microprocessors with 16-Bit Burst Data Bus	272233	
Enhanced PC I/O Performance with i960® RP Processor	272740	
DATA SHEETS		
80960HA/HD/HT 32-Bit High-Performance Superscalar Processor	272495	
80960JA/JF Embedded 32-Bit Microprocessor	272504	
80960CA-33,-25,-16 32-Bit High Performance Superscalar Processor	270727	
80960CF-33,-25,-16 32-Bit High Performance Superscalar Processor	272187	
80960KA Embedded 32-Bit Microprocessor	270775	
80960KB Embedded 32-Bit Microprocessor with Integrated Floating-Point Unit	270565	
80960SA Embedded 32-Bit Microprocessor with 16-Bit Burst Data Bus	272206	
80960SB Embedded 32-Bit Microprocessor with 16-Bit Burst Data Bus	272207	
82961KD Printer Coprocessor	272221	
80960 Intelligent I/O Microprocessor	272737	
APPLICATION NOTES/APPLICATION BRIEFS		
i960® Microprocessor Competitive Benchmark Report	272392	2515
Internetworking and the Intel i960® Microprocessor	272601	2359
Imaging and the Intel i960® Microprocessor	272602	2360
AB-42 80960Kx Self-Test	270703	
AP-506 Designing for 80960Cx and 80960Hx Compatibility	272556	
AP-703 DRAM Controller for the 33-MHz i960® CA/CF Microprocessor	272627	
APPLICATION NOTES/APPLICATION BRIEFS (cont'd)		
AP-704 A Simple DRAM Controller for the i960® Cx Processor Using Flexlogic	272628	
AP-706 DRAM Controller for the 40-MHz i960® CA/CF Microprocessor	272655	
AP-712 DRAM Controller for the 33-MHz i960® JA/JF/JD Microprocessor	272674	
i960® RP Processor: A Single Chip Intelligent I/O Subsystem	272238	
TOOLS		
Technical Assistance (tools)		2544
Solutions960® Catalog	270791	
GNU/960 Software Toolset Fact Sheet	272178	
i960® Microprocessor Product Line and Support Tools Fact Sheet	272219	
EP80960CX Evaluation Platform	272505	
i960® Microprocessor Evaluation Platform/Cyclone EP	272508	
Cyclone* Evaluation Platform User's Guide	272577	
i960® SA/SB Processor Evaluation Board Fact Sheet	272033	
QT 960 Evaluation and Prototyping Board Fact Sheet	270743	
EV80960SX Evaluation Board User's Manual	270853	
EP80960CX Evaluation Platform User's Guide	272456	
82596CA High-Performance 32-Bit Local Area Network Coprocessor	290218	
MANUALS/DATABOOKS		
i960® Jx Microprocessor User's Manual	272483	
i960® Cx Microprocessor User's Manual	270710	
i960® KB Microprocessor Programmer's Reference Manual	270567	
i960® SA/SB Microprocessor Reference Manual	270929	
82961KD Printer Coprocessor Reference Manual	272280	
i960® Extended Architecture Programmer's Reference Manual	271191	
i960® Processors and Related Products Databook	272084	
i960® RP Microprocessor User's Manual	272736	

Intel Reference Numbers

World Wide Web Address:	**http://www.intel.com**
FaxBack System:	**1 (800) 525-3019 or (503) 264-6835**
Application Bulletin Board System:	**1 (503) 264-7999**
Intel Literature Center:	**1 (800) 548-4725 7 a.m. to 7 p.m. CST**
Retail PC and Network Products:	**1 (800) 538-3373 or (503) 629-7000 7 a.m. to 7 p.m. PST**
General Information Hotline:	**1 (800) 628-8686 & (916) 356-3104 5 a.m. to 5 p.m. PST**

UNITED STATES
Intel Corporation
2200 Mission College Blvd.
Santa Clara, CA
95052-8119

JAPAN
Intel Japan, K.K.
5-6 Tokodai,
Tsukuba-shi
Ibaraki-ken,
300-26

FRANCE
Intel Corporation
S.A.R.L.
1, Quai De Grenelle,
BP543
75725 Paris Cedex

UNITED KINGDOM
Intel Corporation (U.K.) Ltd.
Pipers Way
Swindon SN3 1RJ
Wiltshire,
England

GERMANY
Intel GmbH
Dornacher Strasse 1
D-85622 Felkirchen
Muenchen

HONG KONG
Intel Semiconductor Ltd.
32/F Two Pacific Place
88 Queensway,
Central

CANADA
Intel Semiconductor
of Canada, Ltd.
190 Attwell Drive,
Suite 500
Rexdale, Ontario M9W 6H8

♻ Printed on Recycled Paper

Order Number 281434-003 Printed in U.S.A./0596/3K/IL KG