

64-bit computing - it's here now!

by Rob Bracken

Intel has been working for some time on a 64-bit successor to the *Pentium* processor. Its code name was *Merced*, but they have now given it the official name of the *Itanium* processor. Don't confuse it with the *Pentium IV* or *Williamette* processor, which is the 32-bit successor to the *Pentium III*. This is a brief look at it, and at the implications for developers.

Intel plan to start producing the *Itanium* processor in the second half of this year. Prototype *Itanium* servers and workstations have been available since the end of last year, and thousands of prototype chips have now been delivered. Many software and hardware vendors – including HP, IBM and Microsoft - have committed to it and a number of initiatives are at an advanced stage of development. The first public demonstrations of *Itanium* are scheduled for September, showing a graphics demo on 64-bit Windows and Apache on 64-bit Linux (more on these later).

Features of the Itanium processor

Itanium is the first processor based on Intel's *A-64* architecture. It includes the following features:

- 64-bit linear address space, allowing it to address 18 billion Gigabytes of RAM (wow!)
- 2.1 GB/s system bus (for use with *Rambus* memory)
- 4MB L3 cache
- 32-bit compatible
- Built-in parallelism through *predication* (I'm not an expert on microcode, and I haven't a clue what it means). New instructions in the IA-64 set allow this to happen, but compilers must be modified to use them (over to you, Borland!).
- 128 integer registers, 128 floating-point registers, 8 branch registers and 64 predicate registers.
- Hardware support for procedure calls, via a *Register Stack Engine* which can manage stack operations in the background.
- Initially will run at 800MHz, but will be able to process up to 20 instructions per clock cycle.

How will it help?

Intel's research shows that only five percent of the existing Internet infrastructure is in place today to address the predicted server needs of the e-Business environment by the year 2005. *Itanium* is designed to address this need. It will – initially – be available in high-end servers and workstations (but – as we all know – today's high-end server is tomorrow's entry-level desktop machine).

It will allow high processing rates in the areas of On Line Transaction Processing, security encoding/decoding (for example - the RSA algorithm lends itself well to *Itanium's* inherent parallelism) and 3D modelling.

Operating Systems – Windows

Microsoft have been working on 64-bit Windows since at least 1998. Windows 2000 is “64-bit ready”, meaning that programs written to the Win64 spec. will run on Windows 2000. A preview release of 64-bit Windows is now available. Some features to note are:

- 64-bit Windows platform is a native 64-bit operating system based on Windows 2000.
- Increased virtual memory space – 4TB user and 4TB kernel.
- 32-bit programs will run in a virtual space in a similar way to 16-bit programs on 32-bit Windows. They will use *thunking* to allow them to make 32-bit calls to the 64-bit system.
- It will *not* run 16-bit programs.
- It will *not* support the ISA expansion bus.
- Pointers have been increased to 64-bits. Integers and long integers default to 32-bits, but 64-bit integers are available.
- The Win64 API is the same as the Win32 API, except that pointers are passed as 64-bits.

Operating Systems – Linux

The *Trillian* project has been underway since May 1999, to produce a Linux port for the IA-64 architecture. Its members include HP, IBM and Intel. 64-bit Linux distributions are available for testing from SuSe, Redhat and TurboLinux. You can also download an *IA64-Linux Developer's Toolkit* from Intel or HP that allows you to develop, test, debug, and run IA-64 Linux based applications on today's IA-32 Linux systems.

How will it affect us?

The main area where we will be affected is when we use pointers and pointer arithmetic. 64-bit Windows and Linux will both use 64-bit pointers, as opposed to the 32-bit pointers in the current versions. This will impact both pointer storage (for example in object definitions) and arithmetic. There is also an important distinction between 64-bit Windows and 64-bit Linux, in that Windows will retain a 32-bit long integer while Linux will use a 64-bit long integer.

Example: if you cast a 32-bit pointer to a 32-bit integer, you can then perform integer arithmetic on it. If, however, you try to cast a 64-bit pointer to a 32-bit integer, either the compiler will generate an error, or the pointer will be truncated.

You will be able to use 64-bit integers, but the default is 32-bits.

O/S	Integers	Long Integers	Pointers
64-bit Linux	32-bit	64-bit	64-bit
64-bit Windows	32-bit	32-bit	64-bit

The most important action you can take is to make sure that your code is 64-bit *clean*. This involves ensuring that your programs will compile on *both* 32-bit *and* 64-bit platforms. For instance, define datatype aliases to use in your code, and use IFDEFs to set them to the appropriate length. There are a number of documents and guides available from Microsoft and the Linux community to help you do this.



More Information:

- <http://developer.intel.com/design/ia-64>
- IA-64 Roadmap (www.intel.com)
- Itanium Processor Microarchitecture Reference (www.intel.com)
- Getting Ready for 64-bit Windows (msdn.microsoft.com)
- <http://www.linuxia64.org>
- <http://www.software.hp.com>

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Our picture shows Rob (right) and friends at DCon.