Intel® Atom™ Processor Based Platform Technologies

Intelligent Systems Group
Intel Corporation

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- Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM). Functionality, performance or other benefits will vary depending on hardware and software confi gurations. Software applications may not be compatible with all operating systems. Consult your PC manufacturer. For more information, visit http://www.intel.com/go/virtualization.
- Intel® 64 architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel 64 architecture. Processors will not operate (including 32-bit operation) without an Intel® 64 architecture-enabled BIOS. Performance will vary depending on your hardware and software configurations. See www.intel.com/info/em64t for more information including details on which processors support Intel 64 architecture or consult with your system vendor for more information.
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Terminology

- Intel® Hyper-Threading Technology (Intel® HT Technology) - Intel's implementation of simultaneous multithreading (SMT), which provides two logical cores.

- Intel® dual-core technology – Two physical cores or two single core processors in one processor package.

- Intel® multi-core technology – More than two physical cores in one processor package.

- Intel® Virtualization Technology (Intel® VT) - Eases software migration, improves real-time performance, and enhances security.

- Intel® 64 architecture - Improves performance by allowing systems to address more than 4 GB of both virtual and physical memory.

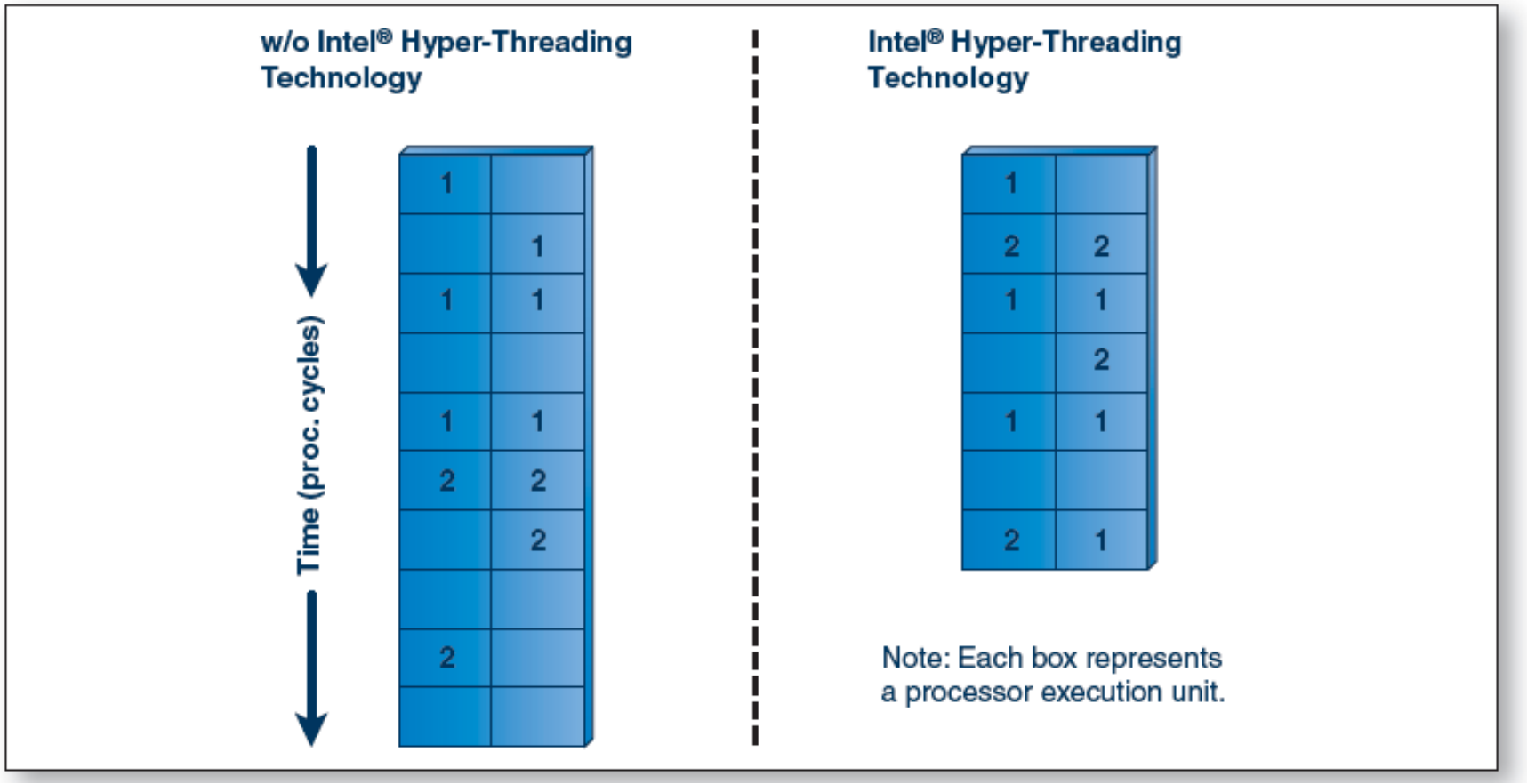
Intel® Hyper-Threading Technology Processor Resource Policies

Intel® Hyper-Threading Technology (Intel® HT Technology) - Processor allows multiple threads to issue instructions on each clock cycle, providing high performance-per watt efficiency.

Policy	Processor Execution Resources
Shared	L1 and L2 cache, execution engine, branch predictors, control logic, and system bus.
Partitioned	Registers, Advanced Programmable Interrupt Controller, timestamp Counter, instruction reorder buffer, load/store buffer, queues.
Replicated	Architecture states, instruction pointers, renaming logic, ITLB, return stack.

Intel® Hyper-threading Technology Processor Resource Utilization

2-wide execution engine



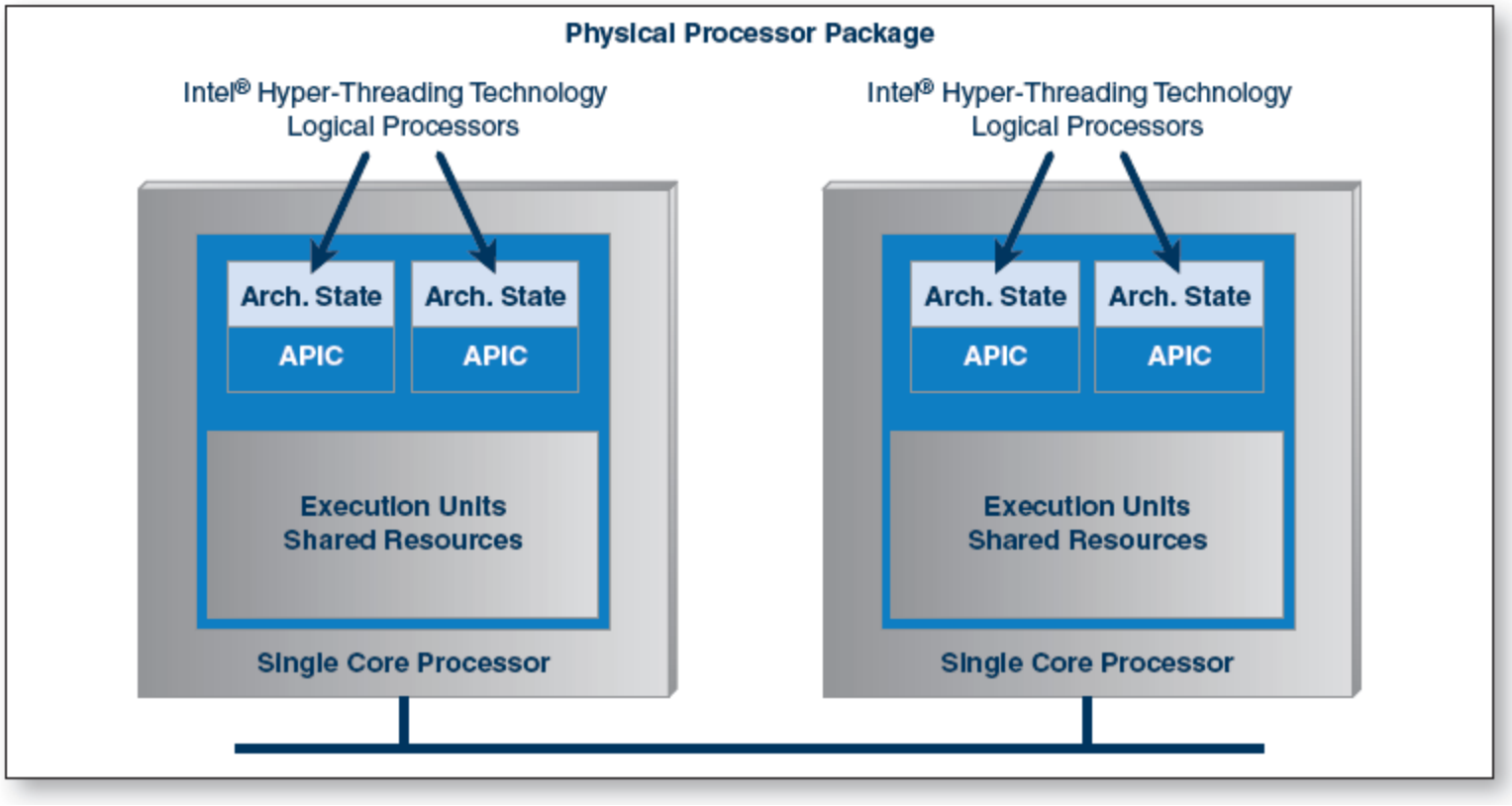
Higher instruction throughput, greater performance* and enhanced energy efficiency

*Performance results are based on certain tests measured on specific computer systems. Any difference in system hardware, software or configuration will affect actual performance. For more information go to http://www.intel.com/performance.

Intel® Dual-Core Technology

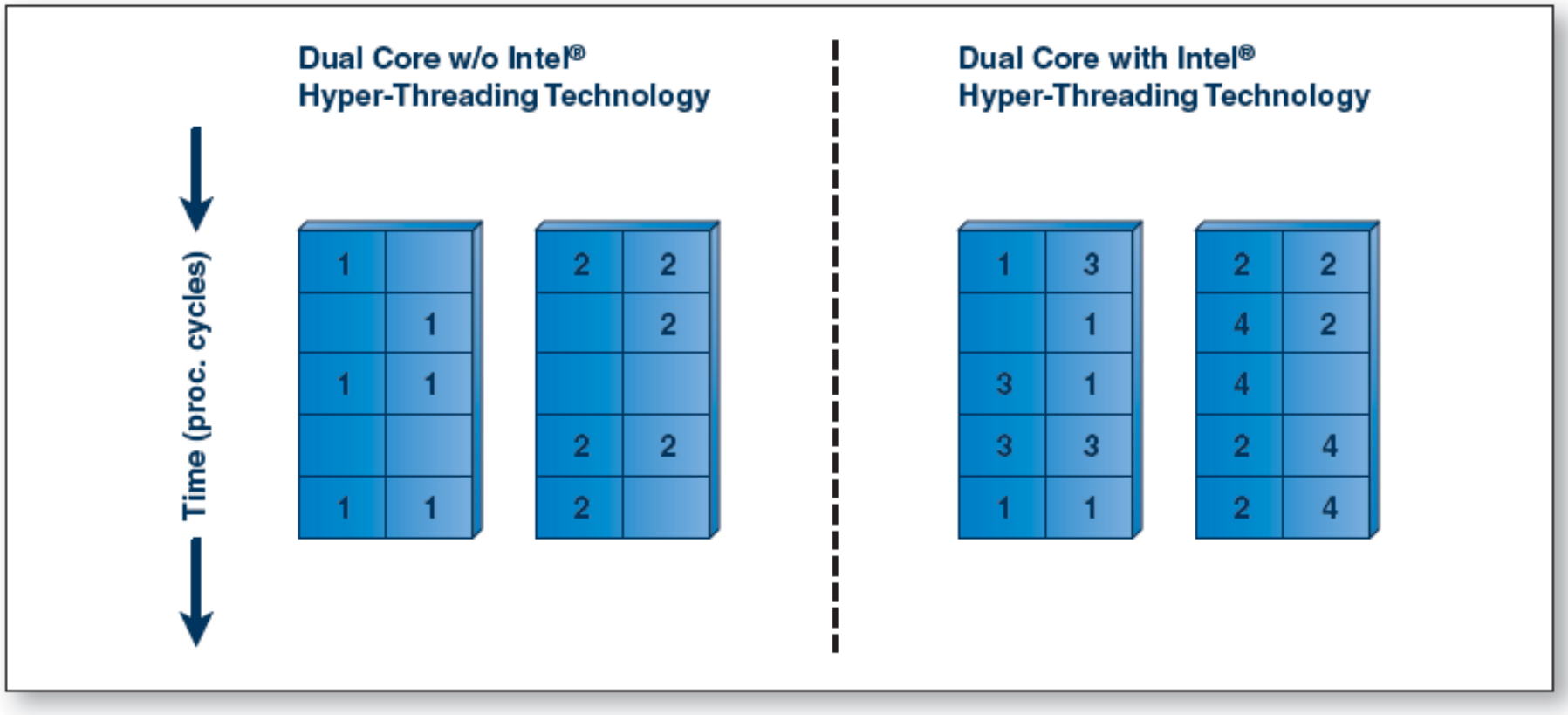
Intel® dual-core technology - Provides dual independent execution cores and pipelines contained within one packaged processor assembly and delivers full parallel execution of two software threads, enabling higher levels of performance.

Dual-Core Processor with Intel® Hyper-threading Technology



Four hardware threads

Dual-Core Processor Resource Utilization



Four threads execute simultaneously

Intel® Virtualization Technology

Operating systems and applications are partitioned to run within virtual machines (VMs) managed by the virtual machine manager (VMM).

The VMM manages the assignment and access between the VMs and platform resources.

There are several use cases for partitioning, such as:

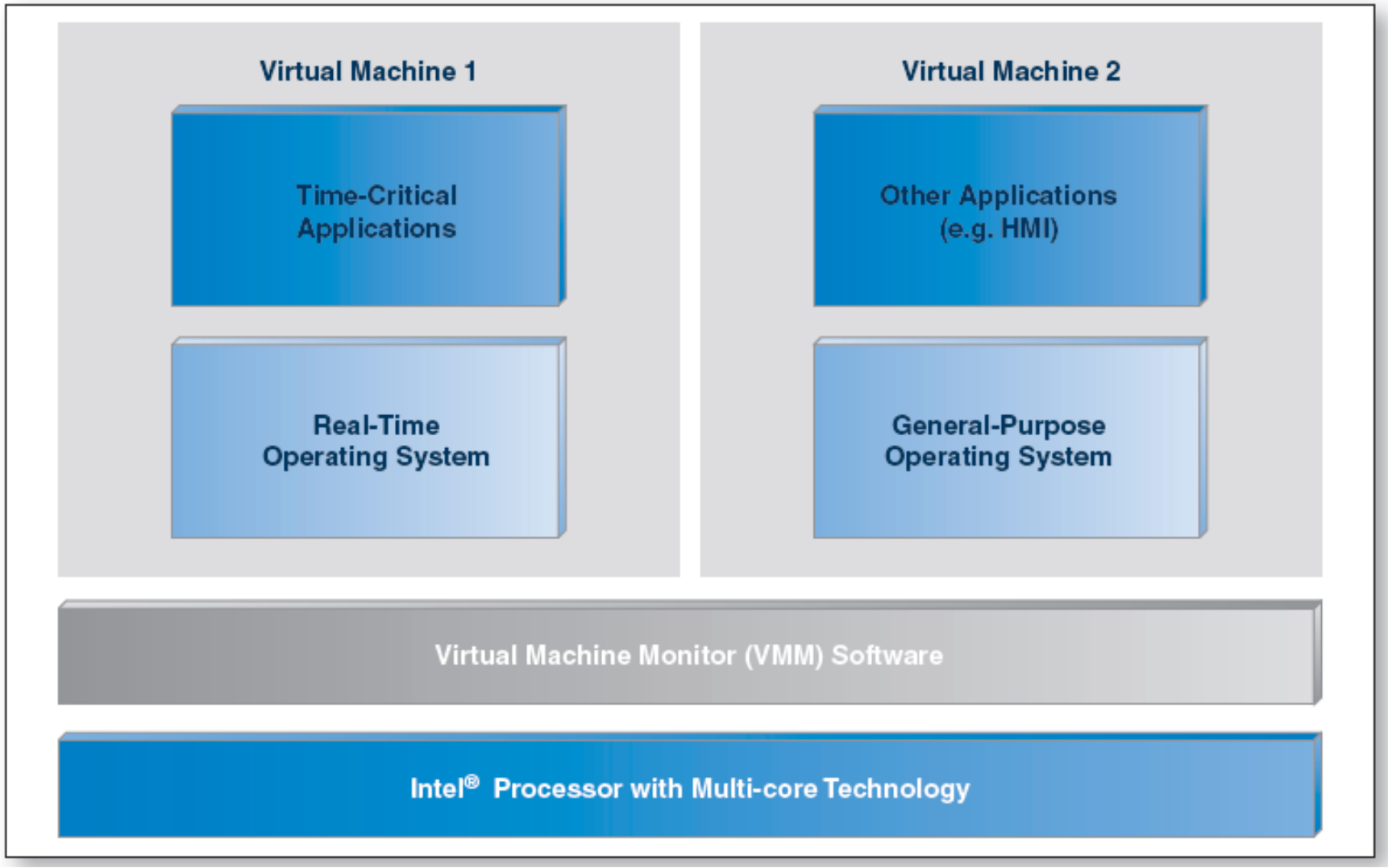
- System leveraging the additional processing power of multi-core enabled hardware by replicating the applications and operating systems across multiple cores.
- System Consolidation.
- OS co-location, which provides the ability for real-time and general purpose operating systems to run simultaneously.

Intel® Virtualization Technology Capabilities and Benefits

Capabilities	Benefits
Isolates applications in secure partitions	Increases system reliability and stability.
Runs RTOS on a dedicated processor core.	Eases software migration and consolidation.
Performs virtualization tasks in hardware.	Improves real-time performance**.
	Decreases loop jitter, increases determinism.
	Decreases VMM load on the processor.
	Reduces VM-to-VM switching time.

**Performance results are based on certain tests measured on specific computer systems. Any difference in system hardware, software or configuration will affect actual performance. For more information go to http://www.intel.com/performance.

Embedded Virtualization OS Co-location Example



Intel® 64 Architecture

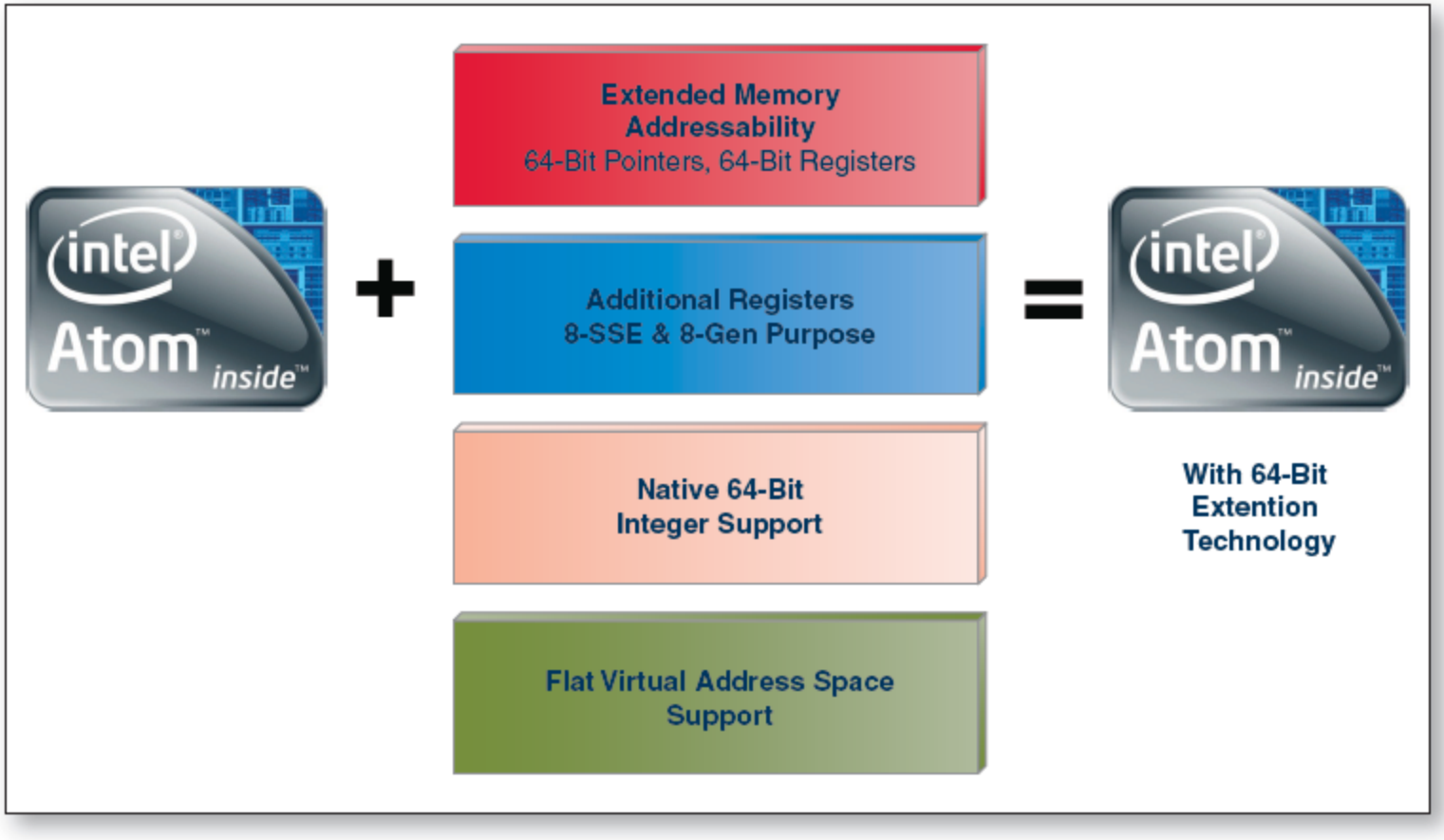
Intel® 64 architecture is an enhancement to Intel® IA-32 architecture.

It delivers 64-bit computing when combined with supporting software.

With Intel 64, software developers can theoretically address up to one terabyte of physical memory†.

† The maximum physical address space for a given platform is much lower.

Intel® Atom™ Processor with Intel® 64 Architecture Ingredients



64-bit Extension Technology

Supported Modes

Intel® 64 Mode

Legacy Mode

- 32-bit OS
- 32-bit apps
- 32-bit drivers

Compatibility Mode

- 64-bit OS
- 32-bit apps
- 64-bit drivers
- 4 GB address space
- GPRs are 32-bit

64-Bit Mode

- 64-bit OS
- 64-bit apps
- 64-bit drivers
- 64-bit flat virtual address space
- GPRs are 64-bit

CPU can switch between each Intel 64 mode on a code-segment by code-segment basis

- Allows 32/16-bit applications to run under 64-bit O/S w/o recompile
- Re-certification of the application may be required

Porting Applications to Intel® 64 Architecture

Programming Considerations
Software development and testing tools for the 64-bit operating system.
The availability of 64-bit compliant third-party libraries supported by the operating system and required by your application.
The conversion of the size of stored data so that data size changes that occur when moving from 32-bit to 64-bit are handled, such as data saved to disk.
Any code that assumes it knows the size or precision of pointer, handle, integer, or other common types, such as size_t, will need to be thoroughly examined. GUI or text display routines, hash algorithms, integer to floating-point conversions, load and save routines, and so on are vulnerable to such code assumptions and may fail catastrophically if the code makes such assumptions. In many cases, the 64-bit compiler can help find such issues.
Porting a 32-bit application to 64 bits can increase the data size in memory, as well as on disk. This can result in performance issues such as increased I/O and storage requirements, increased cache misses, and cache layout issues. These issues must be addressed to prevent performance degradation when the application runs on the 64-bit operating system. Optimize the software for 64-bit performance.

Efficient Programming for the Intel® 64 Architecture

Programming Considerations
Use the 32-bit versions of instructions in 64-bit mode to reduce code size unless the 64-bit version is necessary to access 64-bit data or additional registers.
When needed to reduce register pressure, use the 8 extra general purpose registers and 8 extra XMM registers for floating-point.
Prefer 64-bit by 64-bit integer multiplies that produce 64-bit results over multiplies that produce 128-bit results.
Sign extend to 64-bits instead of sign extending to 32 bits, even when the destination will be used as a 32-bit value.
Use the 64-bit versions of multiply for 32-bit integer multiplies that require a 64-bit result.
Use the 64-bit versions of add for 64-bit adds.
Use 32-bit versions of CVTSI2SS and CVTSI2SD when possible.

References

Resources for Intel® 64 Architecture Programming

- The Intel Press book titled *Programming with Intel® Extended Memory 64 Technology: Migrating Software for Optimal 64-bit Performance (Binstock,* 2006) is a good reference to use for in-depth details of porting 32-bit software to Intel 64.
- The Intel® 64 and IA-32 architectures Software Developer's Manuals
- The Intel Press book titled *The Software Optimization Cookbook; Second Edition (Gerber, Bik, Smith, Tian, 2006) includes comprehensive information* for optimizing software for Intel 64 architecture, formerly known as Intel Extended Memory 64 Technology.
- Community support also exists at the *Intel 64-bit Programming Forum at* http://software.intel.com/en-us/forums/64-bit-programming/.