Migrating to Intel® Architecture

Intelligent Systems Group
Intel Corporation
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Intel® High Definition Audio (Intel® HD Audio) requires a system with an appropriate Intel chipset and a motherboard with an appropriate codec and the necessary drivers installed. System sound quality will vary depending on actual implementation, controller, codec, drivers and speakers. For more information about Intel HD audio, refer to http://www.intel.com/.

I2C* is a two-wire communications bus/protocol developed by Philips. SMBus is a subset of the I2C bus/protocol and was developed by Intel. Implementations of the I2C bus/protocol may require licenses from various entities, including Philips Electronics N.V. and North American Philips Corporation.

Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain computer system software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

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Part one
1. Port the code to the target operating system
2. Execute the code correctly on one Intel® architecture core
3. Optimize the code for performance on one Intel architecture core

Part two
4. Apply multi-core software design updates
5. Optimize the software design for multi-core Intel architecture

Steps 4 and 5 are optional
## Architecture Differences ARM* vs. Intel® Architecture

<table>
<thead>
<tr>
<th></th>
<th>ARM* and Intel® architecture instructions are very different. For some instructions there is no one to one (ARM to Intel architecture) equivalent. Refer to Intel® 64 and IA-32 Architectures Software Developer Manuals</th>
</tr>
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</table>
| **Instructions** | **Alignment**
* Pointer alignment, e.g. 1 byte aligned on x86, type dependent on ARM, e.g. 4-byte integer must be 4 byte aligned.
* Structure size and alignment. E.g. a `struct` with 3 characters on x86 is 3 bytes; it is 4 bytes on ARM. Intel architecture instructions vary in size and therefore do not require alignment. |
| **Vector Oriented Instructions** | ARM uses Vector Floating Point (VFP) instructions, Advance SIMD (NEON), DSP Enhanced Instructions. Intel architecture uses Intel® Streaming SIMD Extensions (Intel® SSE). |
| **Signed vs. unsigned char** | char is signed on x86 and unsigned on ARM. CHAR_MIN and CHAR_MAX have different values on x86/ARM. gcc compiler can force all char types to be signed: -fsigned-char |
| **Calling Conventions Specified by ABI** | Arguments are passed in registers and on the stack for ARM.
* For Intel architecture, arguments are passed on the stack. |
| **Byte order (Endianness)** | ARM is bi-endian; Intel architecture is little-endian |
| **Bit Fields** | ARM is bit ordered depending on endian selection.
* Intel architecture is “normal bit ordered” aka “up bit ordered” |

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## Architecture Differences PowerPC* vs. Intel® Architecture

<table>
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<tr>
<th>Instructions</th>
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<tbody>
<tr>
<td>Alignment</td>
<td>PowerPC instructions are all 4 bytes in size and must be aligned on 4 byte boundaries. Intel architecture instructions vary in size and therefore do not require alignment. On PowerPC a bool is 4 bytes. On Intel architecture, a bool is 1 byte. Make the code portable by changing the PowerPC boolean data to an unsigned 32-bit integer.</td>
</tr>
<tr>
<td>Vector Oriented</td>
<td>PowerPC uses Altivec* instructions. Intel architecture uses Intel® Streaming SIMD Extensions (Intel® SSE)</td>
</tr>
<tr>
<td>Instructions</td>
<td></td>
</tr>
<tr>
<td>Divide-by-zero</td>
<td>For Integer divide-by-zero, PowerPC simply returns zero. On Intel architecture, executing this operation is fatal.</td>
</tr>
<tr>
<td>Calling Conventions</td>
<td>Arguments are passed in registers for PowerPC. For Intel architecture, arguments are passed on the stack. Intel architecture has fewer registers than PowerPC and therefore local variables may be stored on the stack as well.</td>
</tr>
<tr>
<td>Specified by ABI</td>
<td></td>
</tr>
<tr>
<td>Byte order</td>
<td>PowerPC is bi-endian (primarily configured as big-endian), Intel architecture is little-endian</td>
</tr>
<tr>
<td>(Endianness)</td>
<td></td>
</tr>
<tr>
<td>Bit Fields</td>
<td>PowerPC is “down bit ordered”. Intel architecture is “normal bit ordered” aka “up bit ordered”</td>
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**Intel® Academic Community**

**Traditional BIOS vs. Boot Loader**

**BIOS**
- Open Box Designs
- (Requires Flexibility)

- Standard OS compatibility
- Feature richness
- Open to many use cases
- Multiple boot paths
- Extra services and support

**Boot Loader**
- Closed Box Designs
- (Static Hardware Configurations)

- Custom OS & applications
- Basic Intel® architecture initialization
- Quick and small
- Single use case
- Limited boot options
- No frills
- Royalty free
- No hand-holding

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**Break Away with Intel® Atom™ Processors: Chapter 5**
Example foo.c
#include <stdio.h>
int a = 0x12345678;
int main()
{
    char *ap = (char *) &a;
    printf("%2x %x\n", *ap, a);
    return 0;
}

Different results on BE and LE machines!

Endian neutral code is portable
Software Development Tools
# Intel® Software Development Products

| Windows*          | Intel® C++ Compiler for Windows*  
|                   | Intel® Integrated Performance Primitives (Intel® IPP) Library  
|                   | Intel® VTune™ Performance Analyzer  
|                   | Intel® Parallel Studio  
|                   | Intel® Threading Building Blocks  
| Linux*            | Intel® Embedded Software Development Tool Suite  
|                   | Intel® Application Software Development Tool Suite  
| RTOS              | Intel® C++ Compiler Professional Edition for QNX* Neutrino* RTOS  

## “Application Suite“
- For ISVs and Moblin Community – tune Moblin* applications for more performance and extend battery life of Intel® Atom™ processor powered devices
  

## “Embedded Suite“
- For OEM/ODMs (+ their key ISVs) and OSVs – use a complete tools solution with a sophisticated JTAG debug solution for embedded system and application software design
  
Highly optimized multimedia functions
- Images & video
- Communication & signal processing
- Data processing

Fully utilizing
- Intel® Wireless MMX™ technology
- Intel® Streaming SIMD Extensions 2, Intel® Streaming SIMD Extensions 3
- Multi-core / HT technology

Rapid application development
Cross-platform compatibility & code re-use

Outstanding performance

Use Intel® Integrated Performance Primitives libraries to concentrate on new features rather than optimizing application performance

Intel® Integrated Performance Primitives (Intel® IPP) Library

Optimized for Intel® Atom™ Processor
Architecture Migration Tools
N.A. Software* Vector Oriented Code Conversion Tools bring three tools to market for Linux* and Wind River* VxWorks* operating systems, which will reduce the Digital Signal Processing (DSP) software conversion effort:

- Vector Signal Image Processing Library (VSIPL)
- Altivec.h include file for Intel® architecture
- Altivec* assembler to Intel® compiler assembler

Downloads available from Intel® Embedded Design Center (Intel® EDC):

- N.A. Software Conversion Tool download (Altivec SIMD Macros Translator)
- N.A. Software Conversion Tools
- AltiVec/SSE Migration Guide
- Tools For Moving AltiVec DSP Applications to Intel® Processors - Presentation
- Tools for Moving Altivec DSP Application to Intel Processors – Audio Enable Presentation

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Static Code Analysis Tool with Porting and Endian Checkers

Static code analysis tool for code development
• Includes productivity tool for porting and endianness analysis for migrating to Intel® architecture

Porting analysis driven checkers:
• For example: warn on tx/rx, arrays, Endian Vulnerability, Concurrency Analysis, casting, bit-field, assembly

AVAILABLE NOW!
Available in Klocwork Insight* 9.2 and Insight Pro 2.2

New C/C++ Multicore, multiprocessor design checkers:

Multicore and Endianenss White Paper:
http://www.klocwork.com/resources/endian-deadlock-multicorechallenges

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## References

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<tr>
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<tr>
<td>Intel® Software Network</td>
<td><a href="http://software.intel.com">http://software.intel.com</a></td>
</tr>
<tr>
<td>N.A. Software* Conversion tools</td>
<td><a href="http://www.nasoftware.co.uk/home/index.php/products/conversion-tools">http://www.nasoftware.co.uk/home/index.php/products/conversion-tools</a></td>
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