Intel® System Studio 2014 Overview
What you will learn from this slide deck

• High level overview of each component for Intel® System Studio, along with how they address these development environments

  System & Application code running Linux*, Android* & Tizen™

• Please see subsequent slide decks for in-depth technical training
System Software Developer Challenges

- Meeting release schedule
- System reliability
- Power efficiency & application performance

If you could improve one thing about your embedded design activities, what would it be?

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product quality</td>
<td>792</td>
<td>4.69</td>
</tr>
<tr>
<td>Device/system performance/reliability</td>
<td>793</td>
<td>4.67</td>
</tr>
<tr>
<td>Time-to-market</td>
<td>786</td>
<td>3.99</td>
</tr>
<tr>
<td>Engineering productivity</td>
<td>781</td>
<td>3.96</td>
</tr>
<tr>
<td>Product cost</td>
<td>792</td>
<td>3.96</td>
</tr>
<tr>
<td>Development cost</td>
<td>791</td>
<td>3.68</td>
</tr>
<tr>
<td>Design reuse</td>
<td>787</td>
<td>3.71</td>
</tr>
<tr>
<td>Device form factor</td>
<td>759</td>
<td>3.68</td>
</tr>
<tr>
<td>Power requirements</td>
<td>789</td>
<td>3.59</td>
</tr>
<tr>
<td>Third-party services</td>
<td>753</td>
<td>2.92</td>
</tr>
</tbody>
</table>

UBM Electronics - 2012 Embedded Market Survey

Intel® System Studio 2014
Deep System Insights for Embedded and Mobile Developers

Accelerate Time To Market
Speed-up development and testing with deep hardware and software insights

Strengthen System Reliability
Enhance code stability using in-depth system wide debuggers and analyzers

Boost Power Efficiency and Performance
Boost system power efficiency and performance using system-wide analyzers, compilers and libraries
Intel® System Studio 2014
What is it?

Integrated software tool suite that provides deep system-wide insights to help:
- Accelerate Time-to-Market
- Strengthen System Reliability
- Boost power Efficiency and Performance

DEBUGGERS
- System
- Application

ANALYZERS
- Power & Performance
- Memory & Threading

COMPILER & LIBRARIES
- C/C++ Compiler
- Signal, media, Data & Math Processing

JTAG Interface¹

System & Application code running Linux*, Android* & Tizen™

Embedded or Mobile

1 Optional

Copyright® 2013, Intel Corporation. All rights reserved. *Other brands and names are the property of their respective owners.
Intel® System Studio 2014

- Get your IVI system up and running in less time
- Top reliability & performance drives optimal user experiences

Differentiate Tizen™ Automotive IVI Systems Today.
Intel® System Studio 2014 allows for advanced power, system, and JIT profiling. The tools provide deep system-wide insights to speed TTM power-optimized, high performance, and reliable Android* Intel® Architecture-based devices.
Intel® System Studio 2014
Deep System Insights for Embedded and Mobile Developers

More Platforms

Host OS Support
Windows* & Linux*

Target OS Support

More Usability

• Enhanced Eclipse* & Wind River Workbench* integration
• Cross-development
• Enhanced system-wide debug (JTAG for Intel® Core™-based platforms)

More Verticals

• Automotive - Tizen* IVI
• Embedded Android*
## Support for Latest Intel Processors & SoCs

<table>
<thead>
<tr>
<th></th>
<th>Intel® Quark SoC X1000</th>
<th>Intel® Atom™ Processors</th>
<th>Haswell microarchitecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel® JTAG Debugger† - System Debug¹</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Enhanced GDB* Debugger - Application Debug</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intel® Inspector - Memory &amp; Threading Analysis</td>
<td>--</td>
<td>✓</td>
<td>Memory &amp; Thread Analysis</td>
</tr>
<tr>
<td>Intel® VTune™ Amplifier †† - Power &amp; Performance</td>
<td>--</td>
<td>✓</td>
<td>Hardware Events</td>
</tr>
<tr>
<td>Intel® Graphics Performance Analyzers</td>
<td>--</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Intel® C++ Compiler</td>
<td>✓</td>
<td>✓</td>
<td>SSSE3, SSE, AVX, AVX2, FMA3</td>
</tr>
<tr>
<td>Intel® MKL library</td>
<td>--</td>
<td>--</td>
<td>SSE, AVX, AVX2, FMA3</td>
</tr>
<tr>
<td>Intel® IPP library</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

¹ Hardware platform debug for new processors added as new processors ship

† Hardware events for new processors added as new processors ship

†† Optional

Copyright © 2013, Intel Corporation. All rights reserved. *Other brands and names are the property of their respective owners.
# Integrated & Comprehensive Development Suite

<table>
<thead>
<tr>
<th>Accelerate Time To Market</th>
<th>Strengthen System Reliability</th>
<th>Boost Power Efficiency and Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® JTAG Debugger 2014&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>GDB* Debugger 7.5</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>SVEN Technology 1.0</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® VTune™ Amplifier 2014 for Systems</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® Graphics Performance Analyzers (Android*)</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® Inspector 2014 for Systems</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® C++ Compiler 14.0</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® Integrated Performance Primitives 8.1</td>
</tr>
<tr>
<td><img src="1" alt="Checkmark" /></td>
<td><img src="1" alt="Checkmark" /></td>
<td>Intel® Math Kernel Library 11.1</td>
</tr>
</tbody>
</table>

Deep system-level insights into power, reliability and performance which help accelerate time to market of Intel Architecture-based embedded and mobile systems

<sup>1 Optional</sup>
<table>
<thead>
<tr>
<th>Phase</th>
<th>Component</th>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify, Debug &amp; Flash</td>
<td>Intel® JTAG Debugger 20141</td>
<td>In-depth system and application debug</td>
<td>• In-depth debug insight into CPU, SoC and chipset for fast issue resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Leave trace instrumentation in production code for fast system-wide issue resolution</td>
</tr>
<tr>
<td></td>
<td>GDB* Debugger</td>
<td></td>
<td>• Detailed application debug and trace for fast issue resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Data race detection in parallel software</td>
</tr>
<tr>
<td></td>
<td>Intel® Inspector 2014 for Systems</td>
<td></td>
<td>• Increased productivity and code quality, and lowers cost, finds memory, threading, and security defects before they happen</td>
</tr>
<tr>
<td>Tune</td>
<td>Intel® VTune™ Amplifier 2014 for Systems</td>
<td>In-depth software analysis and tuning</td>
<td>• Fast in-depth analysis of SoC behavior</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Remove guesswork, saves time, makes it easier to optimize for power efficiency and find performance optimization opportunities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• In-depth analysis on resource limited targets</td>
</tr>
<tr>
<td></td>
<td>Intel® Graphics Performance Analyzers</td>
<td>In-depth GPU analysis for Android*</td>
<td>• Optimize user experience of IA-based Android* devices</td>
</tr>
<tr>
<td>Build</td>
<td>Intel® C++ Compiler 14</td>
<td>Compiler and performance libraries</td>
<td>• Boost system performance for IA-based embedded designs and achieve scalability benefits of multicore and forward scale to many-core</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cross platform development and integration into Eclipse for ease-of-use</td>
</tr>
<tr>
<td></td>
<td>Intel® Integrated Performance Primitives 8.1</td>
<td>A set of high-performance software building blocks for signal, media, and data processing</td>
<td>• Speed up development &amp; performance with key software building blocks for signal, data, and media processing</td>
</tr>
<tr>
<td></td>
<td>Intel® Math Kernel Library 11.1</td>
<td></td>
<td>• GCC* compatibility</td>
</tr>
</tbody>
</table>

Enhance power efficiency, system reliability, and boost performance with Intel® System Studio 2014
## Intel® System Studio 2014 –
### What’s New?

<table>
<thead>
<tr>
<th>Broader host and target OS coverage</th>
<th>New Intel® Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>• New Tizen™ IVI, Embedded Android*</td>
<td>• New Intel® Quark SoC X1000-based platforms</td>
</tr>
<tr>
<td>• New Yocto Project* 1.5; Wind River* Linux 6</td>
<td>• New support for Intel® Atom™ processor E3xxx &amp; C2xxx series</td>
</tr>
<tr>
<td>• New Windows* host development for Linux*-based targets</td>
<td>• New support for 4th generation Intel® Core™ processor</td>
</tr>
</tbody>
</table>

### Enhanced Eclipse* integration & cross-build

- Automated Eclipse* IDE Integration on Linux* and Windows* hosts
- Enhanced cross-build sysroot support and Wind River* Workbench integration
- OpenEmbedded* 3rd party toolchain layer recipes

### New features across all key components

- Intel® C++ Compiler and libraries generated code compatible with Wind River Simics*
- Intel® JTAG Debugger 2014 – New support for Intel® Core™, Intel® Xeon™ & Intel® Quark processors; Agent based UEFI debug
- GNU* GDB - Branch Trace Store (btrace) for Intel® Atom™ or 4th generation Intel® Core™ Processors
- Intel® VTune™ Amplifier 2014 for Systems - Adds system-wide event-based sampling of uncore and SoC memory bandwidth

- Intel® C++ Compiler 2014 – Optimizations for the latest Intel® processor generation
- Intel® Integrated Performance Primitives 8.1 - Adds new signal processing features for LTE, and optimizations for the latest Intel® processor generation
- Intel® Math Kernel Library 11.1 - Optimizations for the latest Intel® processor generation
- Intel® Graphics Performance Analyzers – Supports GPU optimization for Android*
Ease of Development

Intel® System Studio+ integrates into Eclipse* CDT to help ease cross-platform development.
Intel® System Studio 2014 Wind River Linux* and Workbench*

- Build, analyze, debug and optimize Wind River Linux-based systems with Intel® System Studio
- Seamless integration of Intel® C++ Compiler and libraries into Wind River build environment
Where is my system ...

Spending Time?

- Focus tuning on functions taking time
- See call stacks
- See time on source

Wasting Time?

- See cache misses on your source
- See functions sorted by # of cache misses

Waiting Too Long?

- See locks by wait time
- Red/Green for CPU utilization during wait

Waking-up Too Often?

- See wakeup causes on your source
- See CPU frequencies per core

Advanced profiling for power efficiency and scalable multicore performance

- Linux & Windows host to Linux targets cross sampling
- Low overhead
- No special recompiles
Intel® VTune™ Amplifier for Systems
Cross-platform Power & Performance Analysis

Remote Data Collection

Power and Performance Analysis
- Collects data on target device
- Analyze results on host system

Flexible data collection, configuration, and control

Low overhead sampling
No hardware instrumentation required
View results in source or assembly

Cross platform sampling of processor & SoC-wide events
Intel® VTune™ Amplifier 2014 for Systems
Power & Performance profiling for Android* based devices

Intel® Energy Profiler
Find issues that affect power and energy consumption

Performance Profiler
Find performance bottlenecks

Java* JIT Profiler
Find performance issues in Java stack

Detect and help fix issues across all layers of the IA platform
Intel® Energy Profiler
Analyzes Platform-Wide Power Consumption

- Displays processes for events and causes that wake-up the processor
- Correlates CPU, SoC components, and Linux/Android Wakelocks activities
- Analyzes effects of the interaction of different IP blocks with the SoC
- Comprehensive analysis coverage
  - Sleep State Analysis (C-state, S-State, D-State)
  - Frequency Analysis (P-State)
  - Analysis of User Wakelocks, Kernel Wakelocks, S0ix, D0ix states, and S3 (suspend-to-RAM) tracing
- Powerful filtering

Uniquely identify cause of wake-ups & provide timer call stacks
Analysis of Intel processor blocks that are not in the core
- Memory bandwidth for Intel® Core™ Processor
- Memory bandwidth and QPI bandwidth for Intel® Xeon™ Processor
- Cache Box support for both client and server parts
SoC = Heterogeneous Multicore
Multiple architectures
- Several different specialized processors
- Common memory bus
- Data exchange between multiple processors

Orchestra of Devices
- Specialized micro-engines for data encode / decode
- Multitude of I/O devices
- Advanced power management
- Common memory & data bus system

Access and visibility to SoC execution units
Intel® VTune™ Amplifier 2014 for Systems
Performance Analyzer

More Profiling Data

- SoC wide analysis Memory band with, wake-ups & frequency
- Statistical call counts
- Hardware events + stacks
  Lower overhead, Higher resolution
  Finds hot spots in small functions
- Intel® Atom™, SoC events
- Haswell events
  Updates as new processors ship

Easier To Use

Remote data collection
Source view for inlined code
(For Intel® and GCC* compilers)
Java tuning
Results map to the Java source
Task annotation API
Label and visualize tasks
User defined metrics
Create meaningful metrics from events
Programmable hot keys
Start and stop collection easily
More/better advanced profiles
(e.g., Bandwidth)

Activity in CPU

Easy to use, wealth of data, powerful analysis
Intel® VTune™ Amplifier for Systems
JIT Performance Profiler – Boosts Performance

- JIT APIs to profile run time generated code
- Analyzes multiple regions, results map to the Java* source
- Drill-down to Java source code
- Source View for Java tuning and Inlined Code
- Fast hardware sampling (with optional stacks)
- Profiles cache misses and bandwidth
- Powerful filtering to quickly identify cause of performance issues in Java stack

Advanced Java* Dalvik profiling to boost performance
Intel® System Analyzer

- Real-time system-level performance analysis for Intel-based Android devices
- Immediate experiments and overwrites enable developers to isolate CPU and GPU performance problems
- Metrics for CPU, GPU, API, memory, network, power, etc.

Drag ‘n Drop Metrics
Real-time Experiments
Heap Growth Analysis

Diagnose heap growth. Get a list of memory allocations not freed in an interval set with the GUI or an API.

Improved Error Suppression

Preduce Suppressions Remove False Errors Safely

```
Suppression = {
    Name = "Example";
    Type = { uninitialized_memory_access }
    Stacks = {
        mod=a.out, func=update_x;
        func=main;
    }
```

More precise, easy to edit, team shareable. Choose which stack frame to suppress. Eliminate the false, not the real errors.

Debugger Breakpoints

Diagnose the problem. Break into the debugger just before the error occurs. Examine the variables and threads.

Pause/Resume Collection

Speed-up analysis by limiting its scope. Turn on analysis only during the execution of the suspected problem.

Supports remote data collection on embedded Linux* OSs

Diagnose errors with less effort
Intel® JTAG Debugger 2014 Accelerate system bring up and validation

Key Features

- **New**: JTAG debug for Intel® Core™, Xeon® & Quark SoC-based platforms
- **New**: Agent based UEFI debug
- JTAG system debug with event tracing (SVEN)
- Bitfield editor with full register description
- EFI/UEFI Firmware, bootloader debug, Linux* OS awareness
- Flashing and peripheral register support
- Access to page translation and descriptor tables
- Dynamically loaded kernel module debug
- LBR On-Chip instruction trace support, SMP run control support
Intel® JTAG Debugger 2014
Page Translation Table Insight into Memory Configuration

- Identify why memory access failed
- Complete register description & manipulation
- Instant and simple resolution & translation between virtual and physical address space

Fast issue tracking
- Bitfield Editor
- Edit registers
- Full register description

Memory address translation

Take control of memory configuration issues and memory leaks
Intel® JTAG Debugger & GDB* System Debug and Validation

WHICH CODE, DID WHAT, AND WHEN?

Kernel & user mode
- Platform stability and start-up
- Firmware & bootloader
- Flash write & repair
- Operating system & driver
- Application debug
Where did things start to go wrong?

- Intel® Atom™ and 4th Gen. Intel® Core™ Processor supports Last Branch Record (LBR)
- Set breakpoint in OS signal event handler
- Unroll execution flow leading up to stack overflow or segmentation fault
- Follow execution backwards to where it deviated from expectation
- Re-run to that point and analyze memory accesses

Unroll past execution flow for fast issue resolution
System Visible Event Nexus (SVEN) 1.0

What is it?

**Detailed SoC & CPU System View**
- Multiple cores (IA, DSP, other)
- User and kernel code

**Ultra-low Overhead Sampling**
- Can remain in production builds
- Around 1/10 of a microsecond
- Well defined event structure

**A ultra-fast trace recorder for SoC and CPU events**

- Visualize, Analyze and Debug system event traces
  - Command line interface
  - Graphical user interface

**Instrumented Software Modules of Systems & Devices**

- User
- Device
- Kernel

**JTAG Device**
- Event tracing with JTAG
- Smart breakpoints
  - Interrupt execution on key events

Ultra-fast software event tracing recorder for fast issue resolution
SVEN - A Stethoscope for your System System & SoC trace through JTAG

Trace Visualization
- Advanced navigation, search & filter
- Graphical and textual event display
- User controlled trace line grouping

Smart Event Triggers
- Live JTAG system debug with event tracing
- Smart breakpoints that interrupt execution on trace event calls
- Set smart breakpoints for in-depth analysis
  For example:
  - Break on any event from the USB driver
  - Break on any Debug String that starts with "ERROR"
  - Break if register X is accessed
  - Break if register X bits [7-9] have value 0b101

Enhance system stability through powerful JTAG & event tracing
Application Debug with Enhanced GDB* Debugger Optimized for Intel Architecture

• Plug into existing Eclipse* IDE for increased productivity
• Debug issues where symptoms are not visible immediately
• Remote debug with branch trace and data race detection
• GDB with pre-build binaries for Yocto Project* and WR Linux* targets

Fast and focused debugging of data races & sporadic occurring errors
High Performance

- Generate faster code using Intel® AVX and Intel® AVX2 instructions
- Intel® Cilk™ Plus: Tasking and vectorization

=> Shortest possible execution times help develop low-power applications

Standards and cross-build support

- Enhanced cross-build sysroot integration into Eclipse® CDT & Wind River® Workbench
  - Windows host to Linux target
  - Linux host to Linux target
- OpenEmbedded® 3rd party toolchain layer recipes
- Excellent C99 & C++0x support

Cross platform. High performance. GNU compatibility.

Optimization Notice

Please refer to the applicable product literature and Reference Manual for more information regarding the specific instruction sets covered by this notice.

Copyright © 2013, Intel Corporation. All rights reserved. *Other brands and names are the property of their respective owners.
Intel® Cilk™ Plus Simplifies Parallelism

<table>
<thead>
<tr>
<th>What</th>
<th>Language extensions to simplify task &amp; data parallelism</th>
</tr>
</thead>
</table>
| Features | • 3 simple keywords & array notations for parallelism  
  • Support for task and data parallelism  
  • Semantics similar to serial code |
| Why | • Simple way to parallelize your code & enhance performance  
  • Sequentially consistent, low overhead, powerful solution  
  • Supports C/C++ |
Intel® Integrated Performance Primitives

Optimized for Performance & Power Efficiency

- Highly tuned LTE (MMSE MIMO) routines for communications
- Highly optimized using SSSE3, SSE, and AVX, AVX2 instruction sets
- Performance beyond what an optimized compiler produces alone

Intel Engineered & Future Proofed to Shorten Development Time

- Ready-to-use
- Fully optimized for current and past processors
- Save development, debug, and maintenance time
- Code once now, receive future optimizations later

Wide Range of Cross Platform & OS Functionality

- Thousands of highly optimized signal, data and media functions
- Broad embedded Linux OS target support
- Supports Intel® Quark, Intel® Atom™, Core™, and Xeon® processors

Performance building blocks to boost Embedded and Mobile system performance

Signal Processing (1D)

Filters

- FFT
- FIR
- Threshold
- Convolution
- Median

Statistics

- Mean
- StdDev
- NormDiff
- Sum
- MinMax

Image & Frame Processing (2D)

Transforms

- FFT
- Resize
- Rotate
- Mirror
- Warp/Shear

Filters

- Convolution
- Morphology
- Threshold
- Histogram

Computer Vision

- Canny
- Optical Flow
- Segmentation
- Haar Classifiers
- Hough Transform

Color Conversion

- RGB/BGR
- YUV/YCbCr
- 420, 422, 444

Statistics

- Mean
- StdDev
- NormDiff
- Sum
- MinMax
Intel® Integrated Performance Primitives
Performance Boost from Intel® AVX

Intel® Integrated Performance Primitives (Intel® IPP) 7.1
ippiSqrt_32f Performance Comparison

Significant performance boost by utilizing Intel® SSE3 and AVX

Array Length

Cycles Per Element (CpE)

Optimization Notice: Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice. Notice revision #20110804
Intel® Math Kernel Library (Intel® MKL)

- Highly optimized threaded math routines
- Optimizations using Intel® AVX and the new Intel® Advanced Vector Extensions 2 (Intel® AVX2)
- Use Intel® MKL on embedded Linux* targets in communications, medical, industrial, and other segments
- Use Intel MKL with Intel® C++ Compiler and GCC*

#1 used math library in the world

Source: Evans Data 2011-2013 WW Developer Surveys
Intel® Math Kernel Library

Performance Boost for Fast Fourier Transform (FFT)
Summary/Call to Action

Intel® System Studio 2014 provides deep system-level insights into power, reliability and performance to help accelerate time to market of Intel Architecture-based embedded and mobile systems

For more information, to evaluate, or purchase: http://intel.ly/system-studio

Useful links

- Premier Support: https://premier.intel.com
- Email: intelsystemstudio@intel.com
Flash Memory Tool

- Broad flash type support - NOR and NAND
- Flash binary and hex files
- Mechanism to recover corrupted flash - Intel® Atom™ Processor CE5300
- Backup flash contents into binary file on host
- Erase/unlock/lock blocks
- Ideal for fast BIOS update

Updating key system software stack components, made easy