Performance Tuning for Intel® Xeon Phi™ Coprocessors

Visualizing Performance Opportunities using Intel® VTune™ Amplifier
Introduction

Can profile host, offload or native coprocessor applications

Host-based profiling may be sufficient to identify vectorization/parallelism/offload candidates

- Call stacks currently available for host only

Start with representative/reasonable workloads!

Use Intel® VTune™ Amplifier XE to gather hot spot data

- Tells what functions account for most of the run time
- Often, this is enough
  - But it does not tell you much about program structure
- Move on to more detailed analyses
Intel® VTune™ Amplifier XE
Tune Applications for Scalable Multicore Performance

Fast, Accurate Performance Profiles
- Hotspot (Statistical call tree)
- Hardware-Event Based Sampling

Thread Profiling
- Visualize thread interactions on timeline
- Balance workloads

Easy set-up
- Pre-defined performance profiles
- Use a normal production build

Compatible
- Microsoft*, GCC*, Intel compilers
- C/C++, Fortran, Assembly, .NET*
- Latest Intel processors and compatible processors

Find Answers Fast
- Filter out extraneous data
- View results tied to source/assembly lines
- Event multiplexing

Windows* or Linux*
- Visual Studio* Integration (Windows)
- Standalone user interface and command line
- 32 and 64-bit

1 IA-32 and Intel® 64 architectures.
Many features work with compatible processors.
Event based sampling requires a genuine Intel Processor.
A Quick Tour Through Intel® VTune™ Amplifier

Setting up a project

- Execution file, command line arguments, working directory
- Search directories (standard binary libraries for Intel MPSS 3)
- Quick tour of advanced setup dialog

Selecting a collector

- Host versus native event collection

Launching a collection

Viewing results, source and assembly
VTune™ Amplifier XE visualizes performance
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Result Components
VTune™ Amplifier XE visualizes performance

![VTune Amplifier XE interface]

<table>
<thead>
<tr>
<th>Function / Call Stack</th>
<th>CPU Time by Utilization</th>
<th>Module</th>
<th>Function (Full)</th>
<th>Source File</th>
</tr>
</thead>
<tbody>
<tr>
<td>multiply3$omp$parallel</td>
<td>11.239s</td>
<td>0x5</td>
<td>multiply3$omp$parallel_for@122</td>
<td>multiply.c</td>
</tr>
<tr>
<td>[OpenMP worker]</td>
<td>2.872s</td>
<td>libomp.so</td>
<td>_kmp_launch_worker(VOID*)</td>
<td>_z_dublin.e</td>
</tr>
<tr>
<td>[OpenMP fork]</td>
<td>0.150s</td>
<td>libomp.so</td>
<td>_kmpc_for_call</td>
<td>kmp_csumpp</td>
</tr>
<tr>
<td>int_arr</td>
<td>0.010s</td>
<td>0x5</td>
<td>init_arr</td>
<td>matrix.c</td>
</tr>
<tr>
<td>init_arr</td>
<td>0.010s</td>
<td>0x5</td>
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</tbody>
</table>

**Grid Pane**
VTune™ Amplifier XE visualizes performance

Grid Pane
Grouping pull-down
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Source View /
Per line localization
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Can also copy small data files onto card, but will need to be recopied after reboot.
Suggest create /tmp/usrname as working directory.
VTune™ Amplifier XE visualizes performance

Assembly View / View / Hot spot Navigation controls
For event collection the coprocessor is treated as a special HW architecture.

```
 optimized Hotspots - Knights Corner Platform

Identify your most time-consuming source code. Unlike Hotspots, Lightweight Hotspots has lower overhead when stack collection is disabled. Reduced overhead makes it possible to set a lower sampling interval than Hotspots (as low as 1ms without stacks), which is useful for locating small functions that are called frequently. This analysis type can also be used to sample all processes on a system. Press F1 for more details. Press F1 for more details.

List of Intel Xeon Phi coprocessor cards: 0

[ ] Analyze user tasks

Details

Events configured for CPU: Intel(R) Xeon(R) E5 processor

NOTE: For analysis purposes, Intel VTune Amplifier XE 2013 may adjust the Sample After values in the table below by a multiplier. The multiplier depends on the value of the Duration time estimate option specified in the Project Properties dialog.

<table>
<thead>
<tr>
<th>Event Name</th>
<th>Sample After</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU_CLK_UNHALTED</td>
<td>10000000</td>
<td></td>
</tr>
<tr>
<td>INSTRUCTIONS_EXECUTED</td>
<td>10000000</td>
<td></td>
</tr>
</tbody>
</table>
```
Project properties provides the means to invoke data collection by target type.
Launch Application serves many uses, from host/offload to native execution.
Search directories have been reorganized to speed symbol resolution during finalization.

Notable coprocessor library paths:
- `/opt/mpss/3.2/sysroots/k1om-mpss-Linux/boot`
- `/opt/mpss/3.2/sysroots/k1om-mpss-Linux/lib64`
- `/opt/intel/composerxe/lib/mic`
- `/opt/intel/composerxe/tbb/lib/mic`
- `/opt/intel/composerxe/mkl/lib/mic`
- `/opt/intel/mpi-rt/4.1.3/mic`
General Exploration runs a set of events to drive top-down analysis.
For more information on Intel® Xeon Phi™ and VTune™ Amplifier XE


Coprocessor Performance Monitoring Unit:

For general information: http://software.intel.com/mic-developer
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