Intel® C++ Composer XE and Intel® Xeon Phi™ Coprocessors: Productivity and Performance in Video Conversion

Development Case Study
Intel® C++ Composer XE
Realtime superresolution program

Issues
- Increase the speed of superresolution processing (conversion from standard-definition (SD) to high-definition (HD) video)
- Improve development efficiency for programs that use parallel processing

Solutions
- Intel® C++ Composer XE
- Intel® Xeon® processor E5-2600 product family
- Intel® Xeon Phi™ coprocessor
- Express5800/HR120a-1 x86 server (NEC)
- Realtime superresolution program (NEC)

Benefits
- Greater program development efficiency
- Approximate five-fold increase in processing performance compared to previous system
- Achievement of realtime video conversion
- Reduction of development workload (one-fifth that of GPGPU)

**Empowered by Innovation**

NEC Corporation
Headquarters: 7-1, Shiba 5-chome, Minato-ku, Tokyo
Established: July 17, 1899
Capital: ¥397.2 billion (As of Mar. 31, 2012)
Sales: ¥1,749.2 billion (corporate), ¥3,036.8 billion (consolidated) (Fiscal year ended Mar. 31 2012)
Business activities: IT services, platforms, carrier networks, public infrastructure, and personal solutions
http://jpn.nec.com/

Intel® C++ Composer XE optimizes programs running on Intel® processors.

**Development of Superresolution Program to Run on x86 Server Fitted with Intel® Xeon Phi™ Coprocessor**

Advances in IT have ushered in the new era of big data. In the field of image processing, the growing volume of data brought about by the shift to high-definition demands even faster processing speeds. In broadcasting especially, a growing requirement for presenting legacy content in high-quality format is creating a pressing need for techniques capable of achieving this. To meet this demand, NEC Corporation has been conducting research on superresolution processing that converts video from standard-definition (SD) to high-definition (HD) format. Unfortunately, the huge quantity of data involved makes for long computation times. As Kazuhisa Ishizaka, assistant manager of NEC’s Green Platform Research Laboratories noted, “Existing servers fitted with Intel® Xeon® processors take several hours to convert a single hour of SD video to HD format.”

In response, in September 2012, NEC embarked on the development of a superresolution program to run on its Express5800/HR120a-1 x86 servers fitted with Intel® Xeon Phi™ coprocessors that provide advanced levels of parallel processing performance. The Express5800/HR120a-1 is a 1U rack server designed for the efficient processing of big data. It can incorporate up to two Intel® Xeon® processor E5-2600 product family devices together with up to two Intel® Xeon Phi™ coprocessor boards mounted in PCI slots. As each Intel® Xeon Phi™ coprocessor can incorporate 50 or more cores, each of which is capable of executing four threads, a single server can simultaneously execute a maximum of 520 threads in parallel.

“We set out to achieve realtime video conversion by rewriting the source code of the Intel® Xeon® processor program so that it could run on multiple processors in parallel,” said Mr. Ishizaka.

**Use of Intel® C++ Composer XE for Code Optimization, Including Vectorization**

NEC’s superresolution program calculates the differences between adjacent frames in the input video and identifies these differences as “movements”. The high-resolution images are then generated by superimposing these movements. As the input video frames are resolved down to the sub-pixel level, how
Intel® C++ Composer XE Optimizes Program Code for Running on Intel® Xeon Phi™ Coprocessors

It represents a major reduction in workload (Figure 2).

Improvements Aimed at Enhancing Tuning for Future Application in 4K2K Video Conversion

Having successfully applied parallel processing to achieve realtime superresolution processing, NEC has plans to continue testing with the aim of making further performance improvements.

“Having succeeded in improving development efficiency by adopting common program code for both the Intel® Xeon® processor and Intel® Xeon Phi™ coprocessor, we are looking forward to more highly portable and scalable products from Intel in the future.”

Intel intends to continue supporting NEC’s superresolution technology through product enhancements.

For more information on the Intel® C++ Composer XE, visit: http://www.intel.co.jp/content/www/jp/ja/developer/software-products.html

For a 30 day free trial of Intel® C++ Composer XE, please fill out the application form at the following URL: http://software.intel.com/en-us/intel-software-evaluation-center

Kazuhisa Ishizaka, Ph.D
Assistant Manager
Green Platform Research Laboratories
NEC Corporation

Program Uses Parallel Processing to Achieve Realtime Conversion of Input Video

NEC was able to achieve two things by developing a superresolution program that uses parallel processing. The first was a high-speed realtime processing performance. A server fitted with only Intel® Xeon® processors and running the original source code was able to achieve no more than 6 fps when converting input videos with a frame rate of 30 fps. In contrast, when rewritten and run on the Express5800/HR120a-1 test machine fitted with two Intel® Xeon Phi™ coprocessor SE10P boards, with parallelization, optimization, and tuning, the program was able to perform conversion at the same 30 fps rate as the input video. This represented a five-fold improvement in performance over the previous system (Figure 1).

This realtime performance means that one hour of video, for example, takes only one hour to process. The impact of being able to view the HD images at the same rate as the input video is considerable, allowing broadcasters to complete work the same day, or surveillance camera footage to be used on-the-spot to pick out suspicious individuals.

The second achievement was a reduction in workload. The development project was completed by three engineers in one month. As this is just one-fifth the amount of work required for a similar GPGPU development, it is a major advantage over using a GPGPU, which requires the source code to be rewritten for each processor,” said Mr. Ishizaka.

The availability of “native mode” for the Intel® Xeon Phi™ coprocessor is another feature of note. By using native mode, recompilation is all that is needed to port a program developed on the Intel® Xeon® processor to the Intel® Xeon Phi™ coprocessor. In other words, the same program source code can run on different platforms.

“Having a common program source code is more efficient because tasks such as performance tuning and maintenance only need to be done once. This is a major advantage over using a GPGPU, which requires the source code to be rewritten for each processor,” said Mr. Ishizaka.

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Figure 1. Performance Improvements
(Source: NEC Corporation)

Figure 2. Assessment of High Development Productivity of Intel® Xeon Phi™ Coprocessor
(Source: NEC Corporation)