B11 The Impact of Multicore CPUs and Graphics Processing Units (GPUs) on Digital Forensics Tool Design

Golden G. Richard III, PhD, Department of Computer Science, University of New Orleans, New Orleans, LA 70148*

After attending this presentation, attendees will understand the role that multicore CPUs and Graphics Processing Units (GPUs) can play in substantially increasing the performance of tools that process digital evidence. The motivation for "massively threaded" tool designs that support both multicore CPUs and GPUs will be discussed and both the possibilities and limitations of this approach to speeding up digital forensics processing will be covered.

This presentation will impact the forensic community by exposing mechanisms for substantially increasing the performance of digital forensics tools on commodity hardware, with little or no additional hardware expenses, albeit with increased effort on the part of tool developers. This work is important because higher performance tools are critical to deal with the increasing size of investigative targets.

Since the size and complexity of digital forensics targets continues to grow, with commodity disk sizes now exceeding 1TB, it is crucial that tool developers increase the performance of tools that process digital evidence. This is important both to ensure that cases can be processed rapidly to provide timely results and to avoid aggravating the persistent problem of case backlogs. Good tool design plays an important role in rapid evidence processing, but single-threaded designs that process evidence using only a single CPU cannot be scaled up to deal with ever- increasing target sizes. Therefore, alternative mechanisms must be considered, including more effective use of available computing resources, such as multicore CPUs and high-performance Graphics Processing Units (GPUs). Modern CPUs now commonly use multiple compute cores with lowered clock speeds (e.g., the Intel Core2Duo) in favor of single-core designs with high clock speeds (e.g., the Pentium 4 series and earlier). There has also been a major architectural shift in GPU designs, with modern GPUs providing hundreds of (relatively) general purpose processors instead of very specialized graphics processors. Since most current-generation tools are single threaded, they are generally unable to take advantage of the compute resources offered by multicore CPUs and GPUs. The transition to simple multithreading in tools to fully utilize multicore CPUs is a first (and easier) step in the right direction. But in this presentation it will be argued that new massively threaded digital forensics tool designs are needed and the role that GPUs can play should be carefully considered. Modern GPUs are essentially "supercomputers on a card" and with careful programming can yield very significant performance improvements for a variety of problems. But the associated programming issues are non-trivial and care must be exercised in dividing work between the host CPU and GPUs for maximal performance gains.

Results of some recent efforts to port critical digital forensics operations to GPUs and multicore CPUs to increase tool performance will be presented. The focus will be on file carving, with performance results comparing single-threaded designs, simple multithreading on multicore CPUs, and GPU implementations presented.

Digital Forensics, Graphics Processing Units, High Performance Computing

 ** Presenting Author*