Security-Aware Scheduling for Real-Time Parallel Applications on Clusters

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Abstract: An increasing number of real-time parallel applications on clusters, such as aircraft control and medical electronics systems, require high quality of security to assure confidentiality, authenticity, and integrity of information. Conventional scheduling algorithms for clusters have been proposed to achieve high performance of parallel applications without security requirements; however, enhancing security of clusters for parallel applications requiring service flexibility remains an open problem. In this tutorial, we will discuss our current research that focuses on developing and evaluating new scheduling mechanisms and algorithms for applications with timing and security constraints on clusters. In particular, we will first describe an adaptive control framework for quality of security in cluster computing systems. The framework is centered on a model of security-sensitive real-time applications and security overhead model. The overhead model is used to measure security overheads incurred by an array of security services, including encryption, authentication, integrity check, etc. Next, we will describe a dynamic real-time scheduling algorithm, or TAPADS (Task Allocation for Parallel Applications with Deadline and Security constraints), which seamlessly integrates security requirements into real-time scheduling for clusters. To quantitatively evaluate the performance TAPADS, we conducted extensive experiments using real world applications and traces as well as synthetic benchmarks. We will present experimental results to demonstratively show that TAPADS significantly improves system performance in terms of quality of security and schedulability over three existing scheduling algorithms.

Bio: Dr. Xiao Qin is an Assistant Professor in the Department of Computer Science and Software Engineering at Auburn University. He received the B.S. and M.S. degrees in Computer Science from Huazhong University of Science and Technology, China, in 1996 and 1999, respectively. He received the Ph.D. in Computer Science from the University of Nebraska-Lincoln in 2004. Prior to joining Auburn University in 2007, he had been an assistant professor with New Mexico Institute of Mining and Technology (New Mexico Tech) for three years. In 2007, he received an NSF CPA Award (No. CCF-0742187) and an NSF CSR Award (No. CNS-0713895). His research interests include parallel and distributed systems, real-time computing, storage systems, fault tolerance, and performance evaluation. His research is supported by the U.S. National Science Foundation, Auburn University, and Intel Corporation. He had served as a subject area editor of *IEEE Distributed System Online* (2000-2001). He has been on the program committees of various international conferences, including IEEE Cluster, IEEE IPCCC, and ICPP.