Policies and Patterns for High-Performance, Real-Time Object Request Brokers

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Abstract

Middleware is becoming increasingly important for building flexible communication systems that reduce software development cycle time and effort. Unfortunately, conventional middleware implementations of CORBA have historically lacked the efficiency, predictability, and scalability required by real-time systems. A decade of intensive R&D on design techniques and optimization principle patterns has recently converged, however, to yield high-performance and real-time middleware that can meet end-to-end Quality of Service (QoS) requirements for real-time systems.

This tutorial outlines recent advances in real-time middleware, focusing on the policies and patterns in Real-time CORBA. Real-time CORBA defines a standard set of interfaces and capabilities to manage CPU, network, and memory resources predictably and efficiently end-to-end. This tutorial will illustrate via real world examples the key features and policies in the Real-time CORBA programming model. It will also describe the patterns that can be applied in ORB architectures to minimize priority inversion and non-determinism, associate client requests with servants in constant time, and implement standard and custom middleware protocols using small memory footprints.

The patterns and optimizations covered in the tutorial are based on TAO, which is a widely used open-source real-time ORB that supports end-to-end QoS guarantees over a range of networks and embedded system interconnects. TAO is currently deployed at Boeing, Lockheed, Lucent, Motorola, Nokia, Nortel, Raytheon, SAIC, and Siemens, where it is used for real-time avionics, simulations, and telecommunications systems. Source code, documentation, and technical papers on TAO are available at www.cs.wustl.edu/~schmidt/TAO.html.

Douglas Schmidt is an Associate Professor in the Electrical and Computer Engineering Department at the University of California, Irvine. Previously, he was Director of the Center for Distributed Object Computing and an Associate Professor of Department of Computer Science and the Department of Radiology at Washington University in St. Louis, Missouri, USA. His research focuses on design patterns, implementation, and experimental analysis of object-oriented frameworks that facilitate the development of high-performance, real-time distributed object computing systems on parallel processing platforms running over high-speed networks and embedded system interconnects.
Dr. Schmidt is an internationally recognized expert on distributed object computing and has published widely in top IEEE, ACM, IFIP, and USENIX technical conferences and journals on topics ranging from high-performance communication software systems and parallel processing for high-speed networking protocols to real-time distributed object computing with CORBA and object-oriented design patterns.