Pattern-Oriented Distributed System Architectures

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Tutorial Overview

Developing software for distributed systems that effectively utilizes concurrency over high-speed, low-speed, and mobile networks is hard; developing high quality reusable distributed systems is even harder. The principles, methods, and skills required to develop reusable software cannot be learned by generalities. Instead, developers must learn through experience how reusable software components and frameworks can be designed, implemented, optimized, validated, maintained, and enhanced by applying good development practices and patterns.

This tutorial describes how to apply patterns and middleware frameworks to alleviate the complexity of developing software for distributed systems. These patterns and framework components have been used successfully by the presenter on production communication software projects at many commercial companies for telecommunication systems, network management for personal communication systems, electronic medical imaging systems, real-time avionics and aerospace systems, distributed interactive simulations, and automated stock trading.

The tutorial illustrates by example how to significantly simplify and enhance the development of communication software that effectively utilizes concurrency and distribution via the use of:

- **Object-oriented design techniques**, such as patterns, layered modularity, and data/control abstraction.
- **Object-oriented language features**, such as abstract classes, inheritance, dynamic binding, and parameterized types.
- **Middleware**, such as object-oriented frameworks for host infrastructure middleware (*e.g.*, JVMs and ACE) and distribution middleware (*e.g.* CORBA and J2EE).
- **Advanced operating system mechanisms**, such as event demultiplexing, multi-threading, multi-processing, synchronization, and dynamic linking.

The tutorial examines patterns and framework solutions abstracted from production systems in domains ranging from telecommunications, avionics, distributed electronic medical imaging systems, web servers, and real-time object request brokers to illustrate the key technical design and implementation issues. The material presented in this tutorial is based in part on the book "Pattern-Oriented Software Architecture: Patterns for Concurrent and Distributed Objects" [1], which is the second volume in the Pattern-Oriented Software Architecture (POSA) series [2].

References

[1] D. C. Schmidt, M. Stal, H. Rohnert, and F. Buschmann, *Pattern-Oriented Software Architecture: Patterns for Concurrent and Networked Objects, Volume 2*. New York: Wiley & Sons, 2000.

[2] F. Buschmann, R. Meunier, H. Rohnert, P. Sommerlad, and M. Stal, *Pattern-Oriented Software Architecture—A System of Patterns*. New York: Wiley & Sons, 1996.