

DISTRIBUTED SIMULATION MODELING: A COMPARISON OF HLA, CORBA, AND RMI

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ABSTRACT

The execution of distributed simulations has become increasingly important to the Department of Defense (DOD). This paper compares three architectures for supporting distributed computing, HLA, CORBA, and RMI. While the fundamental structure of each is similar, there are differences that can profoundly impact an application developer or the administrator of a distributed simulation exercise.

1 INTRODUCTION

The design and execution of distributed simulation models has become increasingly important to the Department of Defense (DOD). In recent years, the DOD has invested considerable resources in infrastructures for distributed simulation modeling. The current focus is the High Level Architecture (HLA) spearheaded by the Defense Modeling and Simulation Office (DMSO) (US Department of Defense, 1998). The HLA benefits greatly from two earlier DOD efforts: the Distributed Interactive Simulation (DIS) protocol standards, and the Aggregate Level Simulation Protocol (ALSP). There have been several efforts in the commercial sector to enable distributed computing. Two of the most viable recent efforts are the Common Object Request Broker (CORBA), by the Object Management Group (OMG), and Remote Method Invocation (RMI), from Sunsoft's Java Development Kit (JDK).

There are many reasons why DOD has an interest in a common framework for performing distributed simulation. Declining defense budgets have increased the necessity for cost containment. Increased use of simulation for training, acquisition, and analysis promises to substantially reduce costs. A common architecture for distributed simulation enhances interoperability and reuse in various DOD simulation modeling efforts.

Each of these three architectures for distributed computing offers much to the problem of executing a distributed simulation model. Each has a fundamental world view that affects the structure of its architecture.

This paper will compare the features of these three important technologies with particular focus on their impact on distributed simulation. Naturally, it is impossible to cover all aspects of the architectures, so this paper will only touch briefly on the salient features of each, emphasizing those aspects impacting the simulator.

In the following section we will discuss the core elements of distributed architectures. Sections 3 through 5 will touch on the important features of HLA, CORBA, and RMI, respectively, followed by a brief discussion and comparison in Section 6. Section 7 will present conclusions and recommendations.

2 BASIC ELEMENTS OF DISTRIBUTED ARCHITECTURES

We will focus our attention on three of the basic elements of distributed architectures: an object interface language, an object manager, and a naming service. In addition, we will consider issues such as the programming languages supported, the hardware and operating systems, and the network protocols used.

An object interface language is important for supporting distributed applications because they require a more abstract level of communications than ordinary applications. An object must make only minimal assumptions about the implementation of another object's method since that method could involve objects on another machine. In contrast to a class's definitions of methods, an interface is a contract for implementing objects and contains only a list of methods. Interfaces are therefore the ideal vehicle for providing interoperability between distributed objects. HLA and CORBA take a multilingual approach to distributed objects so they define their own separate interface specifications that are distinct from the implementing languages. RMI, on the other hand, is a language specific approach and thus uses the Java language interface for its interface specification. This considerably simplifies many design issues but limits the extent to which RMI can deal with distributed objects in other languages. Using interfaces is a critical factor for implementing

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engineering desires and intentions representation agent cooperation coordination negotiation organization and communication distributed problem solving specification of agent communication languages formalization of ontologies and conversational agents The book highlights new trends and challenges in agent and multi agent research and will be of interest to the research community working in the fields of artificial intelligence collective computational intelligence robotics dialogue systems and in particular agent and multi agent systems technologies and applications *Handbook of Dynamic System Modeling* Paul A. Fishwick, 2007-06-01 The topic of dynamic models tends to be splintered across various disciplines making it difficult to uniformly study the subject Moreover the models have a variety of representations from traditional mathematical notations to diagrammatic and immersive depictions Collecting all of these expressions of dynamic models the *Handbook of Dynamic Sy* **Patient Flow** Randolph Hall, 2013-12-11 This book is dedicated to improving healthcare through reducing delays experienced by patients With an interdisciplinary approach this new edition divided into five sections begins by examining healthcare as an integrated system Chapter 1 provides a hierarchical model of healthcare rising from departments to centers regions and the macro system A new chapter demonstrates how to use simulation to assess the interaction of system components to achieve performance goals and Chapter 3 provides hands on methods for developing process models to identify and remove bottlenecks and for developing facility plans Section 2 addresses crowding and the consequences of delay Two new chapters 4 and 5 focus on delays in emergency departments and Chapter 6 then examines medical outcomes that result from waits for surgeries Section 3 concentrates on management of demand Chapter 7 presents breakthrough strategies that use real time monitoring systems for continuous improvement Chapter 8 looks at the patient appointment system particularly through the approach of advanced access Chapter 9 concentrates on managing waiting lists for surgeries and Chapter 10 examines triage outside of emergency departments with a focus on allied health programs Section 4 offers analytical tools and models to support analysis of patient flows Chapter 11 offers techniques for scheduling staff to match patterns in patient demand Chapter 12 surveys the literature on simulation modeling which is widely used for both healthcare design and process improvement Chapter 13 is new and demonstrates the use of process mapping to represent a complex regional trauma system Chapter 14 provides methods for forecasting demand for healthcare on a region wide basis Chapter 15 presents queueing theory as a method for modeling waits in healthcare and Chapter 16 focuses on rapid delivery of medication in the event of a catastrophic event Section 5 focuses on achieving change Chapter 17 provides a diagnostic for assessing the state of a hospital and using the state assessment to select improvement strategies Chapter 18 demonstrates the importance of optimizing care as patients transition from one care setting to the next Chapter 19 is new and shows how to implement programs that improve patient satisfaction while also improving flow Chapter 20 illustrates how to evaluate the overall portfolio of patient diagnostic groups to guide system changes and Chapter 21 provides project management tools to guide the execution of patient flow projects **Simulation Symposium (SS 2001),**

34th Annual IEEE,2001 Proceedings of an April 2001 symposium addressing traditional discrete event and continuous simulation topics as well as topics in areas of distributed systems network modeling and advances in simulation methodology and practices Material is in sections on simulation based performance analysis network modeling and simulation VLSI circuit simulators simulation languages and environments Web based modeling and simulation parallel and distributed simulation and advances in simulation methodology and practices Some subjects are queue structures for shared memory multiprocessor systems building a Web based federated simulation system with Jini and XML modeling and simulation of active networks performance optimization of throttled time warp simulation and fault identification networks by passive testing Lacks a subject index c Book News Inc

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Discrete-Event Modeling and Simulation Gabriel A. Wainer,Pieter J. Mosterman,2018-09-03 Collecting the work of the foremost scientists in the field Discrete Event Modeling and Simulation Theory and Applications presents the state of the art in modeling discrete event systems using the discrete event system specification DEVS approach It introduces the latest advances recent extensions of formal techniques and real world examples of various applications The book covers many topics that pertain to several layers of the modeling and simulation architecture It discusses DEVS model development support and the interaction of DEVS with other methodologies It describes different forms of simulation supported by DEVS the use of real time DEVS simulation the relationship between DEVS and graph transformation the influence of DEVS variants on simulation performance and interoperability and composability with emphasis on DEVS standardization The text also examines extensions to DEVS new formalisms and abstractions of DEVS models as well as the theory and analysis behind real world system identification and control To support the generation and search of optimal models of a system a framework is developed based on the system entity structure and its transformation to DEVS simulation models In addition the book explores numerous interesting examples that illustrate the use of DEVS to build successful applications including optical network on chip construction building design process control workflow systems and environmental models A one stop resource on advances in DEVS theory applications and methodology this volume offers a sampling of the best research in the area a broad picture of the DEVS landscape and trend setting applications enabled by the DEVS approach It provides the basis for future research discoveries and encourages the development of new applications

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1. Understanding the eBook 1998 Winter Simulation Conference Proceedings
 - The Rise of Digital Reading 1998 Winter Simulation Conference Proceedings
 - Advantages of eBooks Over Traditional Books
2. Identifying 1998 Winter Simulation Conference Proceedings
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an 1998 Winter Simulation Conference Proceedings
 - User-Friendly Interface
4. Exploring eBook Recommendations from 1998 Winter Simulation Conference Proceedings
 - Personalized Recommendations
 - 1998 Winter Simulation Conference Proceedings User Reviews and Ratings
 - 1998 Winter Simulation Conference Proceedings and Bestseller Lists

5. Accessing 1998 Winter Simulation Conference Proceedings Free and Paid eBooks
 - 1998 Winter Simulation Conference Proceedings Public Domain eBooks
 - 1998 Winter Simulation Conference Proceedings eBook Subscription Services
 - 1998 Winter Simulation Conference Proceedings Budget-Friendly Options
6. Navigating 1998 Winter Simulation Conference Proceedings eBook Formats
 - ePub, PDF, MOBI, and More
 - 1998 Winter Simulation Conference Proceedings Compatibility with Devices
 - 1998 Winter Simulation Conference Proceedings Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of 1998 Winter Simulation Conference Proceedings
 - Highlighting and Note-Taking 1998 Winter Simulation Conference Proceedings
 - Interactive Elements 1998 Winter Simulation Conference Proceedings
8. Staying Engaged with 1998 Winter Simulation Conference Proceedings
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers 1998 Winter Simulation Conference Proceedings
9. Balancing eBooks and Physical Books 1998 Winter Simulation Conference Proceedings
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection 1998 Winter Simulation Conference Proceedings
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine 1998 Winter Simulation Conference Proceedings
 - Setting Reading Goals 1998 Winter Simulation Conference Proceedings
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of 1998 Winter Simulation Conference Proceedings
 - Fact-Checking eBook Content of 1998 Winter Simulation Conference Proceedings
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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