Code 378(479.22)(066)

CHALLENGES OF CRITICAL INFORMATION MANAGEMENT TECHNOLOGY

Tinatin Mshvidobadze

Gori State University(Georgia)

Abstract

In this paper, we will review and analyze the challenges, and offer some directions for some of the subjects of research, so as to help marshal the creative energies of the corresponding segments of the research community for faster solutions to the challenges.

An important class of new and existing applications requires cooperating entities to share and exchange information seamlessly in real-time, while meeting stringent requirements for quality of service (QoS) and heterogeneity. This paper describes how the recently adopted OMG DDS standard, and the Open Splice DDS implementation of this standard, support the data distribution and management challenges posed by next-generation distributed systems, and systems of systems.

Introduction

Information management technology is technology for managing information, having evolved from file management, information retrieval and database management technologies to encompass customer relationship management, supply chain management, enterprise resource planning, data and application integration, multimedia processing, data mining, and Web personalization and recommendation, among others. Two of the most worthy and pressing areas of research and development in information management today are the taming of information explosion and options overload, and support for ubiquitous computing environments.

Recent trends in net-centric systems motivate the development of mission-critical information management capabilities that ensure the right information is delivered to the right place at the right time to satisfy quality of service (QoS) requirements in heterogeneous environments.

To support these mission-critical information management capabilities in net-centric systems, the Object Management Group (OMG) has adopted the Data Distribution Service (DDS) specification [1], which is a standard for QoS-enabled data-centric publish/subscribe (pub/sub) communication that enables net-centric mission and business-critical information management systems to share information in real time by utilizing QoS-driven publish/subscribe patterns.

This paper describes why Open Splice DDS is an important distributed software technology for mission critical net-centric systems because it supports (1) relational and object oriented modeling of the information shared by, and distributed within, the system (2) location independence, via anonymous publish/subscribe protocols that enable communication between collocated or remote publishers and subscribers, (3) scalability, by supporting large numbers of topics, data readers, and data writers and platform portability and (4) interoperability, via standard interfaces and transport protocols.

Mission-Critical Information Management in Next-Generation Net-Centric Pub/Sub Systems

DDS applications send and receive data within a domain. Domains can be divided into partitions that allow the separation and protection of different data flows. Although DDS entities can belong to different domains, only participants within the same domain can communicate, which helps isolate and optimize communication within communities that share common interests. This approach isolates domain participants across layers, which enables effective use of resources and helps enforce security and confidentiality policies. DDS provides a strongly typed global data space within each domain in which applications produce and

consume dynamically changing portions of a shared information model. DDS's information model capabilities are similar to those of relational databases, except that DDS's global data space is completely distributed, QoS-aware, and allows anonymous and asynchronous sharing of a common information model. By allowing data to flow where and when needed, DDS's global data space enables the sharing of mission-critical information and situational awareness needed to implement net-centric mission-critical information management systems[2].

Publishers and subscribers. In net-centric mission-critical information management systems, publishers and subscribers correspond to a range of do-main participants, such as embedded devices, air traffic control radars, visualization consoles, and online stock feeds, as well as planning and simulation services in operations centers. DDS applications use data writers to publish data values to the global data space of a do-main and data readers to receive data.

Configuring QoS policies allows publishers and subscribers to (1) define the local behavior of their interface with DDS, such as the number of historical data samples they require and the maximum update-rate at which they want to receive data, and (2) how DDS should provide global data availability with respect to reliability, urgency, importance, and durability of the distributed data. Since topics themselves can be annotated with QoS policies that drive the global data-avalaibity, publishers and subscribers can use these pre-defined QoS policies as consistent defaults allowing them to concentrate purely on the local-behavior driving policies.

Subscriptions and matching. A subscription is an operation that associates a subscriber to its matching publishers, as shown in the center of Figure 1.

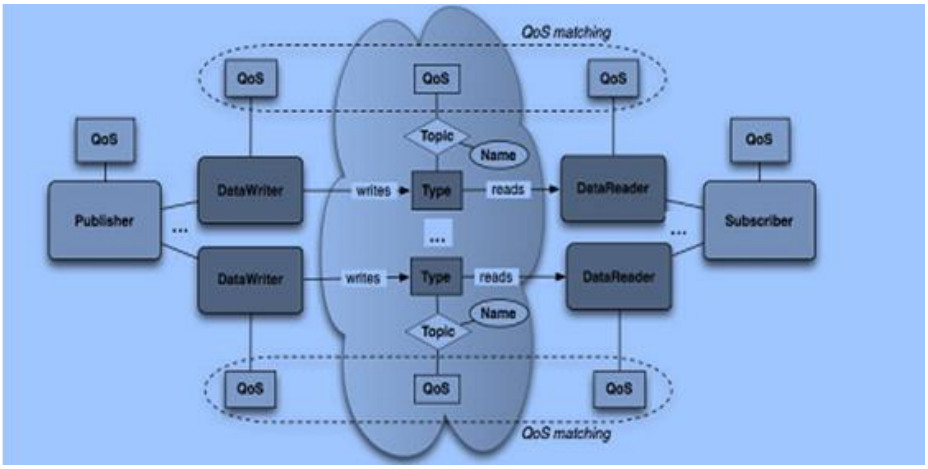

Figure 1 – DDS Publisher/Writer Sub-scriber/Reader and Subscription/QoS Matching.

In addition to the topic-based subscriptions described above, DDS also supports content-based subscription, in which a subset of the standard Structured Query Language (SQL) is used to specify subscription filters. In DDS a matching subscription must match the following two types of topic's properties: (1) its features such as its type, name, key, and content, and (2) its QoS policies.

The matching process for QoS uses a requested/offered (RxO) model, where the requested QoS must be less than or equal to the offered QoS. For example, subscribers requesting reliable data delivery cannot communicate with publishers that only distribute data using best effort delivery[3].

Open Splice DDS use cases. Open Splice DDS was one of the most influential technologies contributing to the definition of the DDS standard, due in large part to its heritage of success during the past two decades in a range of mission-critical distributed systems. In particular, OpenSplice DDS has been deployed in several different application domains, such as defense, aero-space, transportation, etc. For example, the TACTI-COS combat management system [4] developed by THALES Naval Netherlands builds atop Open Splice DDS [5], which

allows TACTICOS to achieve very high scalability, from small ships to aircraft carrier grade, as well as high performance, availability, and determinism even under temporary overload conditions. TACTICOS is currently in use in over15 Navies worldwide serving more than 26 ships-classes ranging from small patrol boats up to large frigates.

From a standardization perspective, DDS continues to evolve to meet new operational and technical challenges of net-centric mission-critical information management systems. The OMG is currently pursuing the following three types of extensions for DDS:

• The first involves adding new platform-specific models that fully leverage programming language ;

• The second extension deals with extensible topics that enable incremental system updates by ensuring that changes in the data model do not break interoperability;

• The third set of extensions focus on network data representation and the syntax used to define topics. For example, upcoming versions of the DDS standard will likely allow the definition of topics using XML, as well as the use of XML or JSON as the network data representation. DDS security has not yet been standardized.

Conclusion

In this paper, we reviewed and analyzed the two major challenges facing the information management technology today, namely, the in formation and options overload problems, and support for ubiquitous environments. As the pace of advances in research to meet these challenges is lagging behind the p ace of the problems becoming ever more intractable and the spread of ubiquitous environments, I am hopeful that researchers working on various relevant subjects will find practical solutions faster.

OpenSplice DDS is standards-based QoS-enabled data-centric pub/sub middleware that provides a feature rich data-centric real-time platform to support the needs of current and planned net-centric mission-critical information management systems. Its powerful set of QoS policies—together with its scalable architecture —makes it an effective and mature choice for solving the data distribution and information management problems net-centric systems.

We should work toward a universal linked information system, in which generality and portability are more important than fancy graphics techniques and complex extra facilities.

References:

1.OMG, “Data Distribution Service for Real-Time Systems Specification,” www.omg.org/docs/formal/04-12-02.pdf

2.Ming Xiong, Jeff Parsons, James Edmondson, Hieu Nguyen, and Douglas C. Schmidt, “Evaluating Technologies for Mission-critical Information Management in Net-Centric Systems,” Proceedings of the Defense Transformation and Net-Centric Systems conference, April 9-13, 2007, Orlando, Florida.

3.Bertrand Meyer, Object Oriented Software Construction – 2nd Edition, Prentice Hall, 2001.

4 THALES, “TACTICOS Combat Management System, Exploiting the Full DDS Potential,” www.omg.org/docs/dds/06-12-06.pdf.

5. Open Splice DDS, www.prismtech.com/openplice-dds.