

IONA Technologies
March 2004



Transaction Management in Artix

Marc Eeckhout
Senior Sales Engineer
IONA Technologies
Making Software Work Together
marc.eeckhout@iona.com

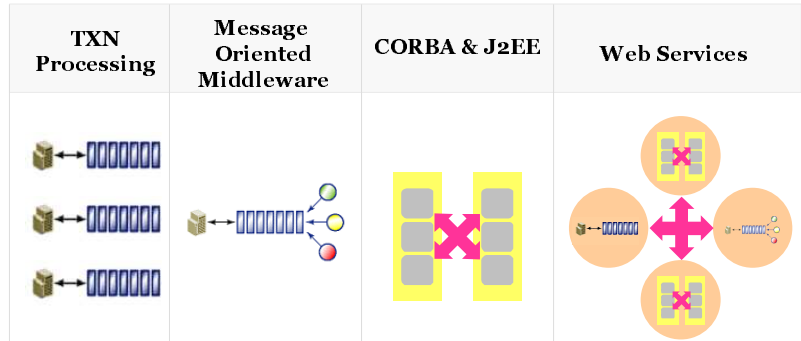
Table of Contents

THE IONA TRANSACTION INFRASTRUCTURE	3
Distributed Transaction Management Review	3
The IONA Transaction Manager	4
Artix and Transactions	5
ARTIX AND TRANSACTIONS IN THE NEAR FUTURE	6
Introduction to WS-CAF	6
Relationship of the specifications	7
USING IONA TRANSACTION MANAGER:	8
CONTACT DETAILS	11

The IONA Transaction Infrastructure

Distributed Transaction Management Review

Most resource managers, for example databases and message queues, provide support for native transactions. However, when an application wants two or more resource managers to be part of the same transaction, a third party must provide the necessary coordination to ensure the ACID properties are guaranteed for the distributed transaction. This is the job of transaction managers that are independent of the individual resource manager.



The application uses the transaction manager to create the transaction. Each resource manager accessed during the transaction becomes a participant in the transaction. When the application completes the transaction, by issuing either a commit or rollback request, the transaction manager communicates with each resource manager.

When there are two or more participants involved in a transaction, the transaction manager uses a two-phase-commit (2PC) protocol to ensure that all participants agree on the final outcome of the transaction despite any failures that may occur. The 2PC protocol works as follows:

Phase 1: Prepare to Commit & Voting

- The transaction manager sends a "prepare to commit" message to each participant. Each participant responds to this message with a vote indicating whether the transaction should be committed or rolled back.
- The transaction manager collects the prepare votes and makes a decision on the outcome of the transaction. If all participants voted to commit the transaction may commit. However, if a least one participant voted to rollback the transaction is rolled back. This completes the first phase.

Phase 2: Commit or Rollback

- In the second phase, the transaction manager sends either commit or rollback messages to each participant. The 2PC protocol guarantees the ACID properties despite any failures that may occur. Usually the transaction manager uses a log to record the progress of the 2PC protocol so that messages can be replayed during recovery.

If there is only one participant in the transaction the transaction manager can use a one-phase-commit (1PC) protocol instead of the 2PC protocol, which can be expensive in terms of the number of messages sent and the data that must be logged. The 1PC protocol essentially delegates the transaction completion to the single resource manager.

The Object Management Group (OMG) has defined a transaction service (OTS) that provides interfaces that:

- Manage the demarcation of transactions (creation and completion)
- Manage the propagation of transaction contexts to the participants of the transaction
- Allow applications to participate in the transaction

The X/Open XA interface provides integration with compliant resource managers such as databases and message queues.

Transaction demarcation is where the application sets the boundaries of the transaction. Typically this is done using the OTS Current interface; invoking the begin() operation at the start of the transaction and either commit() or rollback() at the end of the transaction. An alternative to using the Current interface is to create transactions directly using the TransactionFactory interface and commit or rollback the transactions using the Terminator interface.

Propagation refers to the passing of information related to the transaction to the application objects that are participants in the transaction. When the Current interface is used for transaction demarcation this propagation takes place transparently. Transactions created using the TransactionFactory interface must be propagated by adding an extra parameter to the operation.

Integration with resource managers such as databases is done using the XA interface. Alternatively, an application may use the OTS Resource interface to provide integration with proprietary resource managers.

The OTS interfaces also provide operations for general transaction management. These include:

- Setting timeouts
- Registering resource objects and synchronization objects
- Comparing transactions
- Getting transaction names

The IONA Transaction Manager

IONA's transaction Manager what is used by all IONA products, which has been on the market for seven years, is based on the transaction engine called Encina TP Monitor (now owned by IBM). IONA has the source rights of the Encina transaction engine and is still improving it.

Encina is a tried and tested transaction engine which has a proven track record of scalability and performance in high volume transactional systems. Encina, together with Tuxedo and IBM's CICS, is recognized by users as a reliable transaction engine that is suitable for mission critical systems.

The IONA Transaction Manager is widely used in large scaled deployments all around the world. The customer list includes for example Boeing, OCC and GAD. The last section of this document describes a case study of OCC which use this Transaction Manager as the core component of his architecture.

Artix and Transactions

Artix supports 1PC and 2PC protocols. The 1PC allows developers to make use of the Artix transaction manager without incurring the overhead of the 2PC protocol. By making use of the OTS and XA interfaces an application can be easily extended to support multiple resource managers within a transaction easily.

The Artix transaction manager interfaces, while based upon OTS, are not limited to CORBA or even the IONA transaction manager for OTS. For example:

- WS-Transactions provides the wire protocols for transaction coordination. As one might expect, the implementation of this protocol is non-trivial and requires sophisticated transaction infrastructure. WS-Transaction messages are mapped from WS protocols to the transaction manager.
- MQSeries provides an XA-compliant transaction manager, which can provide the underlying transaction management implementation for the Artix transaction interfaces.

Artix provides a solution for this problem by allowing access to existing TXN management artifacts, including OTS, MQ, and Tuxedo implementations of TXN management systems, through the Artix environment. Transactions can be supported over any transport plug-in.

Artix and Transactions in the near future

Based on IONA's experience with distributed transaction handling we joined several web service standardization bodies to develop a standard for transaction support within web services. The industry had several attempts to propose standards like: WS-transactions and BTP.

The last and most promising standard with the widest industry support is called WS-CAF. IONA is implementing this proposed WS-CAF standard and will complete this implementation in the second half of 2004.

The approach of IONA will give the customer the possibility to use traditional style transaction support like what is already available in Artix but it also makes it possible to the customer to adopt WS-CAF or pieces of the that standard like WS-T(XM) or WS-CF.

Introduction to WS-CAF

The Web Services Composite Application Framework (WS-CAF) is divided into three parts:

- Web Service Context (WS-CTX), a lightweight framework for simple context management
- Web Service Coordination Framework (WS-CF), a sharable mechanism to manage context augmentation and lifecycle, and guarantee message delivery
- Web Services Transaction Management (WS-TXM), comprising three distinct protocols for interoperability across multiple transaction managers and supporting multiple transaction models (two phase commit, long running actions, and business process flows)

The overall aim of the combination of the parts of WS-CAF is to support various transaction processing models and architectures. It is important to realize also that the individual parts of WS-CAF are designed to complement Web services orchestration and choreography technologies such as BPEL ,WSCI and WS-Choreography and work with existing Web services specifications such as WS-Security and WS-Reliability. The parts define incremental layers of functionality that can be implemented and used separately by these and other specifications separately or together.

The emphasis of WS-CAF is to define supporting services required by Web services used in combination. Furthermore, the parts of WS-CAF comprise a stack, starting from WS-CTX, adding WS-CF, and finally WS-TXM to deliver the complete features and functionality required by composite applications.

An implementation of WS-CAF can start with WS-CTX for simple context management, and later add WS-CF for its additional context management features and message delivery guarantees, and finally add WS-TXM for managing a variety of recovery protocols. Similarly, a composite application can use the level of support required, from simple context management through to transactional recovery mechanisms.

Relationship of the specifications

In Figure 1 we can see the relationship between the various specifications and the protocols they support. This shows the hierarchy of transaction protocols currently supported by WS-TXM.

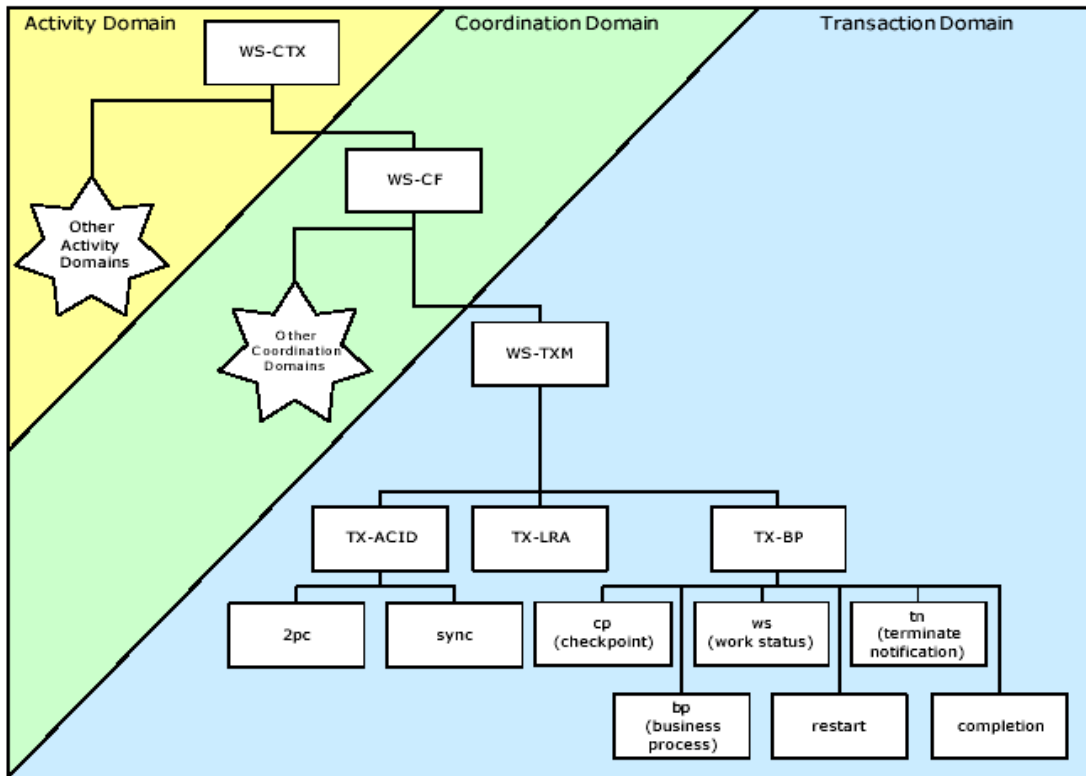


Figure 1, Relationship between specifications and transaction protocols.

WS-CAF concepts are based on the assumption that multiple Web services are often placed into various relationships to accomplish a common purpose and therefore at a minimum need a way to share common context (the Activity Domain), and at a maximum need a way to coordinate results (the Coordination Domain) into a single, potentially long-running larger unit of work with predictable results despite failure conditions (the Transaction Domain).

Web services typically cooperate to perform a shared function, such as multiple related operations on a shared resource such as a database or display, or processing different portions of a purchase order using a predefined sequence, and may require one or more of these domain services depending on the shared function.

Using IONA Transaction Manager:

The Options Clearing Corporation

Headquartered in Chicago, Illinois and founded in 1973, the Options Clearing Corporation (OCC) is the largest clearing organization in the world for options and was the first clearing house to receive an 'AAA' credit rating from Standard & Poor's Corporation. Operating under the jurisdiction of the Securities and Exchange Commission and the Commodity Futures Trading Commission, OCC is jointly owned by the American Stock Exchange, Chicago Board Options Exchange, International Securities Exchange, Pacific Exchange and the Philadelphia Stock Exchange.

OCC provides timely and reliable clearing and settlement services to its Clearing Members and ensures the financial integrity of its shareholder markets for the securities it issues and guarantees. In doing so it manages its costs and performance risks prudently.

OCC innovates products and services that support and encourage trading on shareholder markets and enhance the safety and operating effectiveness of Clearing members and their Customers. The company strives to deliver the highest levels of clearance and settlement services at a reasonable cost. It attempts to efficiently and successfully perform risk management obligations. It continues to provide added value services, promote and influence the growth of the markets served, and aggressively and successfully enter new markets in support of customers.

OCC is implementing a business strategy that allows it to deliver the goals of its mission statement. OCC sees reliable, convenient on-line access as an important step in giving customers what they want.

MEETING THE DEMANDS OF A CHANGING MARKET

Recent rapid and fundamental changes in the industry have created new customer demands for instant access to their financial assets. The systems must be available around the clock, and information provided by the system must be up-to-date and accurate. The technologies involved in building such a system pose a significant challenge. OCC has entered this new market aggressively and successfully in support of its customers.

OCC constantly reviews ways to improve its service to its customer base of clearing members and exchanges. OCC aims to provide customers with the highest levels of clearance and settlement services at a reasonable cost. It has investigated how members need to interact with OCC via Internet or wireless media, and studied how emerging technologies can improve overall business efficiencies.

OCC needed to provide its customers with timely, accurate information about their assets. The system had to provide customers with easy access to information over the Internet and allow them to perform transactions in a secure environment. The underlying IT environment for OCC's clearing system had been in place at OCC since the 1980s and was in need of an overhaul. Other factors influencing the decision to update the system included the changing marketplace resulting in sudden increases in transaction volume, new trading products, and increased customer usage of the Internet.

OCC decided to undertake a project to rewrite and gradually replace its existing clearing system. This massive project, was called ENCORESM, and completed end of 2003. It was the largest development project in OCC's history. ENCORE is a response to the industry's ever increasing efficiency and flexibility requirements. ENCORE increases customer satisfaction by enabling real-time processing capabilities. ENCORE also increases OCC's service flexibility by accommodating growth in options volume and new products, and provides secured Internet accessibility to OCC's customers.

"In order to offer customers a one-stop shop for monitoring and controlling their financial assets, we needed a system that was capable of bridging many disparate systems to obtain and update data. Orbix provided this functionality in an easy, intuitive way based on object-oriented concepts already familiar to many of our developers", says Herr.

BUILDING THE SOLUTION

Thousands of customers are accessing ENCORE for inquiry and transaction activities. The system integrates many existing systems. It communicates with legacy applications and coordinate transactions across multiple systems. With the new system in place, OCC is able to provide its customers with fast, reliable information about their assets.

ENCORE offers an interface that empowers customers, allowing them to perform transactions in a secure and high-performance environment. There are many other tangible business benefits for having adopted the new system: It will be scalable to millions of users so that the anticipated increase in transactions within the options market will be an opportunity for OCC to increase sales and market share. The system also has the potential to be extended to offer new trading products and services to customers.

ENCORE is being built using IONA's Orbix Enterprise Edition, and especially the IONA Transaction Manager. IONA's solution helps reduce development costs and speeds delivery by hiding many of the complexities often faced by developers in the financial industry. The Transaction Manager permits to process secure transactions and to handle heavy workloads.

"Orbix Enterprise Edition has helped OCC overcome many of the technical hurdles needed to enable us to reap the business advantages offered by ENCORE. IONA has provided a standards based enterprise middleware solution to make diverse software components work together in a reliable, dependable and scalable manner", says Herr.

IONA STANDS OUT AMONG COMPETITORS

OCC's choice of IONA for this project came after a meticulous decision process. The decision was based on many factors including IONA's proven success in the financial industry and heavy transaction management, performance, support for industry standards, and the expertise of IONA's Customer Services and Global Services organizations.

"The decision to choose IONA was based on a detailed vendor and technology analysis. More than 20 factors were considered before choosing IONA. The fact that IONA is recognized as a leader in providing solutions to the financial sector had an impact in our decision" says Herr.

"Another influential factor in choosing IONA was OCC's requirement for high performance from its application," says Priyadarshi. IONA's development platform is widely used within the financial industry for high-volume applications that demand high performance. "Our processes involve heavy computation and require high speed. We chose IONA after a complex decision process. We also looked at the strategic direction of IONA as a company. This was done as a risk reduction measure for our technology choice," says Herr.

OCC selected IONA to help meet the requirement of providing customers with timely, accurate information about their assets. IONA has proven experience in providing solutions to the financial sector and offers a complete solution to many of the technical obstacles faced by OCC while implementing the requirements of the new system.

THE FUTURE LOOKS BRIGHT

IONA continues to provide products based on industry standards that help companies solve their most complex integration problems such as inter-process communication within a diverse environment and distributed transaction control. "Consultants from IONA's Global Services and Customer Services organization were also instrumental in helping OCC through its planning and development. IONA will continue to act as contributing partners in the software development process at OCC.

The developers at OCC highly regard IONA as leaders in building scalable, standards based distributed systems", says Herr.

Contact Details

- **IONA France** Multiburo, Immeuble Elysées La Défense, 7C Place du Dôme, 92056 La Défense Cedex, France Phone +33 1 7275 7315 Fax +33 1 7275 7311
- **IONA Technologies PLC** The IONA Building, Shelbourne Road, Dublin 4, Ireland Phone +353 1 637 2000 Fax +353 1 637 2888
- **IONA Technologies Inc.** 200 West Street Waltham, MA 02451 USA Phone +1 781 902 8000 Fax +1 781 902 8001
- **IONA Technologies Japan Ltd** Akasaka Sanchohome, Building 7/F 3-21-16 Akasaka Minato-ku, Tokyo Japan 107-0052 Phone +813 3560 5611 Fax +813 3560 5612

French Office: Jérôme Parel (jerome.parel@iona.com, +33 1 7275 7315, +33 6 1222 9158)

Support support@iona.com

Training training@iona.com

Sales sales@iona.com

FTP [ftp.iona.com](ftp://ftp.iona.com)

WWW www.iona.com

IONA Enterprise Integrator, IONA Mainframe Integrator, Adaptive Runtime Technology, Total Business Integration, IONA SureTrack are Trademarks of IONA Technologies PLC, IONA XMLBus, Orbix, Orbix 2000 Notification, Orbix/E and Orbix End 2 Anywhere are Registered Trademarks of IONA Technologies PLC

While the information in this publication is believed to be accurate, IONA Technologies PLC makes no warranty of any kind to this material including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. IONA shall not be liable for errors contained herein, or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

COPYRIGHT NOTICE. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, photo-copying, recording or otherwise, without prior written consent of IONA Technologies PLC. No third-party intellectual property right liability is assumed with respect to the use of the information contained herein. IONA Technologies PLC assumes no responsibility for errors or omissions contained in this white paper. This publication and features described herein are subject to change without notice.

Copyright © 1999-2003 IONA Technologies PLC. All rights reserved.

All products or services mentioned in this white paper are covered by the trademarks, service marks, or product names as designated