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Running head: GJXDM Documents and Small Law Enforcement Agencies

GJXDM Documents and Small Law Enforcement Agencies

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Abstract

The purpose of this paper is to demonstrate that while the Global Justice XML Data Model (GJXDM) is a complete and effective solution for criminal justice agencies it is complex to implement and difficult for smaller law enforcement agencies to put into practice. The paper presents the current implementation steps for a new GJXDM document and describes the process of implementing an existing GJXDM document. The paper also presents a tool for agencies to start using and processing GJXDM documents. Also offered within the paper is a design for a central repository for increasing GJXDM information sharing and dissemination of GJXDM software artifacts.

Acknowledgement

I would like to first acknowledge my wife for the continued support during this project. I could not have completed the project without her help and encouragement. I would also like to thank my kids for being so understanding when I had to do my homework. I would like to thank my co-workers for their input into the GJXDM standard and material provided from attending related workshops. I would also like to thank Dr. Doug Hart for his input into the process and feedback on the project's progress. Further I want to acknowledge my friends that provided input and review of the project for accuracy and thoroughness.

Table of Contents

Abstract 2

Acknowledgement 6

Chapter 1 - Introduction 10

Project Need 11

Project Scope 11

Chapter 2 - Review of Literature and Research 13

Literature and Research Overview 13

Research Methodologies 14

Project Literature and Research 14

Project Summary of known's and unknowns 15

Project Contributions 16

Chapter 3 – GJXDM Implementation Process, Tools and Techniques 17

Current GJXDM Implementation Process 17

Conformance 19

Existing Tools 19

Chapter 4 – Software Reuse Approaches 21

Software Reuse Techniques 22

Benefits 23

Disadvantages 23

Chapter 5 –GJXDM Message Sharing Tool 24

GJXDM Project Introduction 24

GJXDM Project Summary 24

Technical Summary 25
GJXDM Project Requirements 25
GJXDM Project Design 26
Database Design 26
Project Development 28
Project Web Service 29
Project Installation 32
Project Testing 33
IEPD Implementation Process 34
GJXDM Technical Project Findings 35
Chapter 6 – Software Reuse Technical Prototype 37
Project Introduction 37
Technical Summary 37
Prototype Design 37
Prototype Use Cases 38
Use Case Text 39
Prototype Database Design 43
Prototype Development 43
Chapter 7 - Findings and Analysis 45
GJXDM Findings and Analysis 45
Software Reuse Findings and Analysis 46
Chapter 8 - Conclusions 48
Project Summary 48
Project Expectations 48

What could have been done different 49

Conclusion 50

Addendum 52

How to Publish and Consume a PLSQL Procedure as a Web Service 52

Figures 71

Tables 71

Project Time Table 72

References 73

Annotated Bibliography 76

Glossary 86

Abbreviations 89

Chapter 1 - Introduction

With the recent events of increased terrorism and catastrophic hurricanes justice communities are making large strides to correct information sharing imperfections. As a result the U.S. Department of Justice (DOJ) Office of Justice Programs and the Global Justice Information Sharing Initiative (Global) have sponsored the Global Justice XML Data Model (GJXDM) reuse and standardization program. GJXDM is a standard available for criminal justice information to be exchanged between law enforcement, public safety agencies, prosecutors, public defenders, and the judicial branch. The purpose of GJXDM is to provide a standard for all agencies to use instead of having each agency create their own format. Further GJXDM allows for reuse in multiple applications. (GJXDM, n.d.)

While the GJXDM standard has become useful for justice agencies to all work towards there is still a void for these agencies to easily incorporate this standard into their processes. (Wagner, 2007) One challenge for the smaller law enforcement agencies is that they do not have information technology groups or the necessary staff and knowledge to implement the GJXDM standard. As a result the smaller law enforcement agencies have a difficult time trying to understand the extensive GJXDM standards and knowing which XML tags to use. One solution being proposed within this paper is for the justice community to create a software reuse tool that allows smaller law enforcement agencies to share information using GJXDM. This software reuse tool would be a central location to be able to share artifacts that will allow all justice agencies to capitalize on the GJXDM data sharing standard. The benefits of software reuse include but are not limited to a reduction in time to market, a shorter development time, a decrease in risk, a smaller amount of duplication, and lower maintenance costs. (Kremer, n.d.) However there are a number of obstacles that must be overcome to be successful with software reuse. For example, one challenge is getting designers and developers to reuse something that

already exists. A second challenge is to provide a central location where designers and developers can easily check if an object already exists and is available for reuse. Without overcoming this challenge users will not have the ability to perform reuse. (Ye et al., 2000)

This paper will demonstrate that the GJXDM standard is difficult to implement for smaller law enforcement agencies due to the complexity of the implementation process, complexity of existing tools and lack of law enforcement resources. It will then demonstrate that by creating software for reuse and a simplified process, smaller law enforcement agencies can implement data sharing using GJXDM.

Project Need

The need for this project is to create a simplified process for utilizing a GJXDM standard information exchange document. The project will provide a tool for smaller law enforcement agencies to more easily implement XML document sharing, find existing GJXDM standard exchange documents and increase reuse within the justice community. The final result will demonstrate that the GJXMD standard can be taken to the next step of software reuse and made available for smaller law enforcement agencies to implement and reuse.

Project Scope

The implementation of a reuse program solution is not an easy task. It requires management commitment, hardware resources, training and more specifically a solution that makes reuse available and easy to perform. The scope of this project is to demonstrate that with the emergence of web services and XML standards, software reuse can allow smaller law enforcement agencies to share information using the GJXDM standard. The project will evaluate existing data sharing efforts in small law enforcement agencies and in the end provide a tool that will allow small law enforcement agencies to share GJXDM documents and to store GJXDM artifacts including documentation, XML style sheets, and schemas. The project will be designed

and developed using an Oracle database for XML document storage and processing, Java will be used for a software reuse web application and the artifacts will be stored in a MySQL database. The XML document processing tool will be available for law enforcement to install and start sharing XML documents and the software reuse tool will be a prototype, easy to use and available to existing law enforcement agencies to use for knowledge sharing. The project will be complete when a GJXDM document can be accepted by an external system and sent to designated parties via e-mail to notify people of an event. In addition the software reuse application will be complete when users have the ability upload and download software reuse artifacts. During the project an implementation process will be documented for small law enforcement agencies to follow. The process will define how to implement a GJXDM standard for agencies. The next step beyond the scope of this project is to expand the functionality of the central repository and to create a tool to communicate its value and application to the different levels of Law Enforcement. (Hsieh, M. and Tempero, E., 2006)

Chapter 2 - Review of Literature and Research

Literature and Research Overview

Recently the GJXDM standard and its success have been expanded to a broader range than just the justice community. This new range of information sharing and standard is called National Information Exchange Model (NIEM). (National Information Exchange Model, 2007) NIEM is an inter-agency information sharing program to help agencies seamlessly share data at the different levels of government including the Federal, State and local levels. NIEM is used to fill the gap between different systems and the barriers to sharing data across different agencies. (Roberts, 2007) One scenario where information sharing across agencies is required would be a situation similar to the New Orleans levy failing or a dam that collapses. In this situation it is helpful for law enforcement agencies to be able to communicate with local hospitals and share data of possible arrivals due to near drowning or injuries. It would also be useful to know if federal units, naval ships or personnel, are close by to support first responders. In the same manner it would be useful information to law enforcement to know if all the people arriving at the hospital start to show signs of skin irritation and vomiting or other indications that terrorism may be involved. This is only one of many possible scenarios that data sharing across different agencies becomes critical and can save lives. (Roberts, 2007)

One success story of information sharing is a result of the amber alert. The Amber Alert has rescued more than 230 children nationwide as a result of cross agencies data sharing. (Roberts, 2007)

The GJXDM standard is considered a part or subset of the NIEM standard and is specific to justice agencies. The GJXDM standard is an extensive standard that supports numerous justice communities' business rules and needs. The data model consists of over 2700 components. Along with this flexibility and all encompassing approach comes complexity. One

common comment of GJXDM efforts is that the GJXDM standard is not easy to understand and takes considerable amount of time to implement. Agencies such as Wisconsin or Kansas have described the process of a GJXDM standard data sharing project as “non-trivial” or complicated. (State of Wisconsin, 2007)(State of Kansas, 2006)

Research Methodologies

There are three areas of research to complete this project. First a literature review will be performed to identify the existing GJXDM tools available to smaller law enforcement agencies and previous GJXDM implementation efforts. These tools and past experiences will be compared to small law enforcement agencies existing resources and will conclude whether a small law enforcement agency can indeed implement a data sharing program with the tools available. The second research effort will be to research the different types of software reuse approaches and this will add value to the project approach. The result of the reuse approach research will determine the design used for the project. The third type of research will be to implement a GJXDM Information Exchange Document and identify areas of reuse that will improve the implementation effort. The third research and the first research will provide the conclusion of whether smaller agencies can indeed implement a GJXDM solution or if a simplified process and tool is required. This type of research is known as constructive research. (Constructive Research, 2007)

Project Literature and Research

According to a 2004 report from the National Institute of Justice states that 90 percent of all law enforcement agencies in the United States have less than 50 sworn officers. (National Institute of Justice, 2004) Small law enforcement agencies do not have the large technical staff that is necessary to implement large IT project. According to a 2006 final report by North Carolina it states that a survey was provided to over 600 law enforcement agencies and that of

those local agencies that did respond reported that they were not using XML at all. (North Carolina, 2006) Therefore what options are available to them? One solution available to smaller law enforcement is to work with a vendor or external company to help implement data sharing needs. (Miller, 2005) This can vary in cost and can be expensive in some cases.

Another option is to hire an independent developer to analyze and implement a data sharing program that supports GJXDM standards.

Partnering with other state or neighboring counties to implement new technologies is another approach. (Romesburg, 2005) There are also a number of different grants that small and rural law enforcement agencies can use to help meet their needs. (National Institute of Justice, 2004)

Project Summary of known's and unknowns

It is known that the GJXDM is an effective standard that has created reuse between justice agencies. GJXDM provides a guideline for agencies to follow when creating information exchange documents. To date more than 50 GJXDM projects have implemented the GJXDM standard. (US Department of Justice – Office of Justice Programs, 2004)

It is known that the GJXDM standard has been implemented by justice agencies and has grown into a larger standard called the National Information Exchange Model (NIEM).

It is unknown whether an artifact repository for reuse exists. The GJXDM frequently asked questions describes a GJXDM data registry that would store GJXDM artifacts to be reused and accessed. However the information on the data registry and any efforts are not clearly document or stated.

Currently there is a central repository for accessing existing Information Exchange Package Documentation (IEPD) however there does not seem to be a location to access additional tools that will further help developers implement GJXDM standards.

Project Contributions

The project has contributed by providing a tool that agencies can use to start sharing GJXDM amber alert messages. Further the design used for the amber alert can also be used for additional GJXDM documents. The software reuse tool can be used for sharing documents and software artifacts that will decrease GJXDM project implementations and increase quality.

The project has identified the following areas for improvement to the GJXDM implementation and reuse.

1. Each agency that supports GJXDM growth seems to have separate website with the similar information as well as different information. It would useful if a uniform or central location of information was created.
2. The schema generation tool provided by Georgia tech while useful introduces the opportunity of sharing schemas and having a repository of schemas. (GJXDM Schema Subset Generation Tool, 2005)
3. Expand the existing repository for finding standard GJXDM schemas and documentation, http://it.ojp.gov/iepd/, to include more tools for developers including Java classes, xslt's used for transformation, and approaches taken.
4. There needs to be more tools for developers to be able to implement information data exchanges using GJXDM. The XML document processing presented in this project can be one of such tools for developers.

Chapter 3 – GJXDM Implementation Process, Tools and Techniques

Current GJXDM Implementation Process

The GJXDM Users Guide describes the implementation process through the use of an Information Exchange Package (IEP) and related documentation. An IEP is a XML schema document that is used to share information across domains. An example of an IEP is a field interview. The IEP for a field interview includes all the information used to share information between law enforcement agencies in the form of an XML schema. An IEPD is a specification for a data exchange and describes a particular exchange of information. (NIEM IEPD Tiger Team, n.d.)

To create a new exchange document or IEP there are five steps that need to be followed:

1. Project Inception
2. Domain Modeling
3. Domain to GJXDM mapping
4. Schema Building
5. Packaging. (SEARCH, The National Consortium for Justice Information and Statistics. 2005)

Project Inception

When compared to many of the development methodologies of software development the project inception would be considered the vision or requirements specification stage. During this step the vision of the IEP needs to be defined. The GJXDM user guide suggests that those involved refer to the JEIM Reference Model at this stage to review common information exchanges between agencies. Also during this stage the exchange requirements are defined. The GJXDM user guide suggests using the JEIM Modeling tool and that this task be completed by a certified JEIM modeler and facilitator. Next is to define a process to follow along with a

schedule. The final task completed during this step is to create a workgroup. It is suggested that the workgroup include business subject-matter experts, GJXDM Experts, and a knowledgeable facilitator. As part of the workgroup construction the project also needs to define the tools that the group will need to complete the project.

Domain Modeling

This step could be considered the design stage within a software development life cycle. During this step the goal is to perform the domain modeling of the information exchange document. Also during this step the workgroup needs to reach agreement on what the document should include and how it should be structured. There a number of different modeling techniques one can use when performing this step however it is suggested by the GJXDM Users Guide that the approach be one that can be viewed by a large group of users and not require custom software licenses. Some types of modeling available include spreadsheet modeling and informal graphical modeling.

Domain to GJXDM mapping

This step is the development of the GJXDM schema. The goal of this step is to map the identified data elements or classes to types or elements within the GJXDM schema. The GJXDM user's guide suggests performing this step within a provided worksheet. The worksheet includes columns that allow one to map the items identified in the Domain modeling step to the GJXDM Schema. The user's guide also suggests the use of a tool provided by NCSC called Wayfarer, http://www.ncsconline.org/d_tech/gjxdm/, which allows users to search the GJXDM model.

Schema Building

The forth step in the process is the Schema Building process, also known as the construction phase of the traditional software development cycle. During this process the agency will create the required schemas necessary to deliver the information exchange document.

Packaging

Once an IEP and IEPD have been created they are then submitted to the IEPD Clearinghouse via http://it.ojp.gov/iepd/. After the IEPD has been accepted it, it can be accessed from other agencies to access and use.

Conformance

The GJXDM is a reference model and is not strict standard used in its entirety. In order for agencies to have the same understanding of GJXDM messages common guidelines must be defined. The following rules must be followed to remain in conformance with the GJXDM standard:

1. Subset schemas must validate against the GJXDM reference schema. Schemas that are conformant must import and reference the GJXDM Schema namespace or a correct GJXDM Schema Subset. (US Department of Justice – Office of Justice Programs, n.d.)
2. If a component already exists within the GJXDM use it and do not create duplicate items. (US Department of Justice – Office of Justice Programs, n.d.)
3. Use the GJXDM components as they are defined and do not use them for other purposes. (US Department of Justice – Office of Justice Programs, n.d.)
4. Use the Apply XML Schema extension rules as defined and consistently. (US Department of Justice – Office of Justice Programs, n.d.)

Existing Tools

There are some existing tools to help agencies execute GJXDM projects and documents. These tools revolve around schema generation and validation and a repository of IEPDs.

Georgia Tech Research Institute has created a website for users to access for XML tools. This website can be accessed from http://justicexml.gtri.gatech.edu/gtri_xml_tools.html and on it are the following tools: Schema Subset Generation tool, XML validation tool and scripts to strip documentation. The National Center for State Courts has also developed a tool called Global JXDM Wayfarer to help developers navigate and generate schema subsets.

In terms of existing tools and a central repository available for software reuse there is a web site that allows users to query existing IEPDs and download the related schemas used for data sharing. This website can be accessed at http://it.ojp.gov/iepd/. Agencies can query the repository for the type of information exchange being implemented. When an agency finds the related IEPD they will download the documentation and extract the file. Within the IEPD will be the related schemas and documentation.

Chapter 4 – Software Reuse Approaches

Software reuse has been a part of the software development effort since the inception of software engineering. (McIlroy , 1969) Software reuse is the process of creating software from existing software instead of creating it from scratch. (Krueger , 1992) Software reuse can simply be the copy and paste of existing code from one program to another or be the reuse of a complete system. Table 1 below lists the different levels of software reuse:

Level of Reuse	Description
Single Line of Code	This level of software reuse involves copying lines of code from a previous program and applying it to a new program.
Procedures and Functions	Procedures and Functions – At this level of reuse a software program is able to utilize existing procedures or functions by including them in the program and calling them.
Modules	The module level may include the reuse of a screen or software module to meet the need for new software developed.
Components	This level of reuse includes applying existing software elements that are capable of communicating with other system elements.
Packages	Package reuse involves being able to apply or reuse a software package that may include a number of functions, procedures or additional components.
Subsystems	This might be the reuse of a subsystem, a part of a larger system.
Entire Programs	The use of existing software programs and applying them to the new software being developed.

Table 1. Levels of Software Reuse. (Anderson, 2004)

Software reuse is not only limited to programs or code for software reuse it can also include documentation. GJXDM is a good example of reuse through IEPDs. Additional documentation reuse may include architecture designs, database designs, security procedures, requirements documents, testing documents, failover solutions, back-up and recovery procedures, and many more.

Software Reuse Techniques

Charles Krueger states in his Software Reuse paper that while there are many different types of technologies for software reuse they all share four common elements: Abstraction, Selection, Specialization and Integration.

Abstraction

Mr. Kruger defines abstraction as the techniques of helping developers to find artifacts that are available for reuse. Without abstraction developers would be spending a large amount of time trying to find objects to use. Further if developers are not easily able to find the required artifact the software reuse tool will not be used.

Selection

Selection is the process of a developer selecting an artifact for reuse once it has been identified. There needs to be a means or function that allows the user to select the artifact and take ownership of it for reuse.

Specialization

Specialization is the step in software reuse after the developer has selected an artifact it is configured to meet the need. A good example is copying existing code and making changes to the code to run within the new environment. Mr. Kruger defines this as specialization.

Integration

Integration is the final step that is performed and during this stage the developer combines the selected artifacts into a complete system. This is the construction of the system.

Benefits

The following are benefits to software reuse:

Increased Efficiency – Less time spend during design and coding (Anderson ,2004)

Better Standards – Through software reuse the application or systems end with the same structure, naming techniques including look and feel. (Anderson , 2004)

Increased Dependability – Software that already exists and is being used is more dependable than new software. (Sommerville, 2004)

Reduces project risk - The idea that software that already exists and is being used is more likely to work than new software and therefore provides lower risk through reuse. (Sommerville, 2004)

Quicker time to market – By reusing software that already exists often times the time it takes to develop the system is faster to production. (Sommerville, 2004)

Disadvantages

The following are disadvantages of software reuse:

Mismatch – the reuse may not match the need exactly and some additional modifications may be needed. (Galorath, n.d.)

Wasted Time – Developers spend more time trying to find an artifact for reuse rather than creating the artifact from scratch. (Krueger, 1992)

In order for software reuse to be successful there needs to be standard documentation for software artifacts. (Leveson, and Weiss, 2004)

Chapter 5 –GJXDM Message Sharing Tool

GJXDM Project Introduction

The purpose of the GJXDM message sharing tool is to provide a tool to law enforcement agencies that they can install and start accepting XML documents and increase information sharing. The project will present an approach to processing XML documents, apply a GJXDM document as an implementation and allow for additional GJXDM documents to be added for further information sharing.

GJXDM Project Summary

As noted earlier the GJXDM and use of IEPDs is a form of reuse that standardizes the sharing of justice information. The standards that have been created allow agencies to share information easier by reusing the same elements within XML schemas and sharing schemas or subsets of the GJXDM. While there are a number of tools available to create schemas there do not appear to be any locations where developers can access in order to abstract knowledge that might help with the implementation of GJXDM. For the purposes of this paper the project implements an IEPD for an Amber Alert, a message sent by law enforcement to alert other agencies that there might have been child abduction, to further understand the IEPD implementation process. The implementation of a new GJXDM document is much more involved than implementing an existing document such as an Amber Alert and the steps for GJXDM document creation have been defined above in the current GJXDM implementation process. The project will define the requirements for the project, provide a database design for GJXDM document processing, provide Oracle database packages that can be used for document processing, provide the steps taken to publish a web service that allows for messages to be delivered, describe an approach to testing the web service and document process, explain the process to install the GJXDM document tool, and finally define the steps to implement such an

IEPD.

Technical Summary

The implementation of the project IEPD was performed using an Oracle database, a PL* SQL database package, Toad by Quest, Java, and the Data Object Model (DOM) parser. At a high level the parsing mechanism for this project allows one to map external XML elements to database tables and columns. After the data is parsed into staging tables it can be loaded into a database via the mapping using a database package or formatted and sent as a notification to designated parties.

GJXDM Project Requirements

The following list the GJXDM project requirements:

1. An authorized user shall be able to create a GJXDM document.
   1.1. An authorized user shall be able to define the XML tags for a GJXDM document.
   1.2. An authorized use shall be able to define the PL*SQL procedure for document processing.
2. The GJXDM system shall accept a GJXDM document via a web service.
   2.1. The GJXDM system shall accept a GJXDM Amber Alert message.
      2.1.1. An authorized user shall be able to receive an Amber Alert Message via e-mail.
      2.1.2. An authorized user shall be able to add an e-mail address for a person to receive an Amber Alert.
      2.1.3. An authorized user shall be able to update an e-mail address for a person.
      2.1.4. An authorized user shall be able to delete an e-mail address for a person.
3. The GJXDM system shall store the original GJXDM document.

GJXDM Project Design

The implementation of an IEPD involves processing XML documents. Therefore the project includes a technique to processing XML documents that smaller agencies can use to start accepting XML documents.

There are a number of different techniques to processing XML documents. The technique used for this project includes using Oracle database tables, the Oracle's XML Developer's Kit (XDK), and the DOM parser.

The processing of an XML document is depicted in Figure 1. First the XML Document

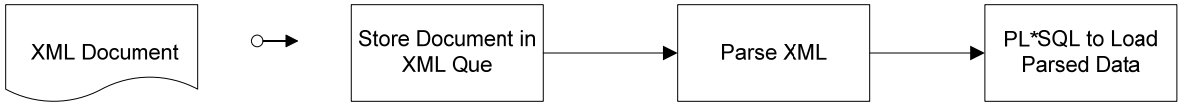


Figure 1. XML Document Flow.

Document is delivered to the system. The delivering of the XML can be in the form of FTP, a web service or manually uploaded to the system. Once the document is received it is stored in an Oracle database table which serves as a document queue. The XML document will then be parsed. During the parsing of the document the XML tags and values are stored into an Oracle database table where they are finally extracted and stored or communicated using a PL*SQL packages and stored procedures. For the Amber alert message the PL*SQL procedure will format and send the amber alert to the e-mail addresses stored in the table CONTACT_EMAILS, see database design below.

Database Design

The goal of the database design created was to create a flexible solution that will allow future documents to be included. As a result the database design allows new documents to be created and for a user to define attributes of each document. Table 2 below provides a

description of each of the project tables and defines how they are use.

Table Name	Description
CONTACT_EMAILS	This table is used for communicating Amber Alert messages. The table stores the e-mail addresses of people that will be notified of an Amber alert.
XML_DOCS	This table is the XML document queue and is used for XML document processing. When a GJXDM document is received the document is first stored here.
XML_DOCUMENT_ CATEGORY_CODES	This table stores the different GJXDM documents that can be processed. When setting up a new GJXDM document it will be stored here.
XML_STATUS_COD ES	This table defines the different types of statuses a document can have and is used for processing documents.
XML_TAG_NAMES	This table is where GJXDM documents are defined. One the document is defined this table is used for parsing and processing documents.
XML_TAG_VALUES	Once a GJXDM document is parsed it stores the parsed values and tags in this table.

Table 2. Table Definitions.

The complete database design for this project is shown in Figure 2 and was created using Quest's TOAD product.

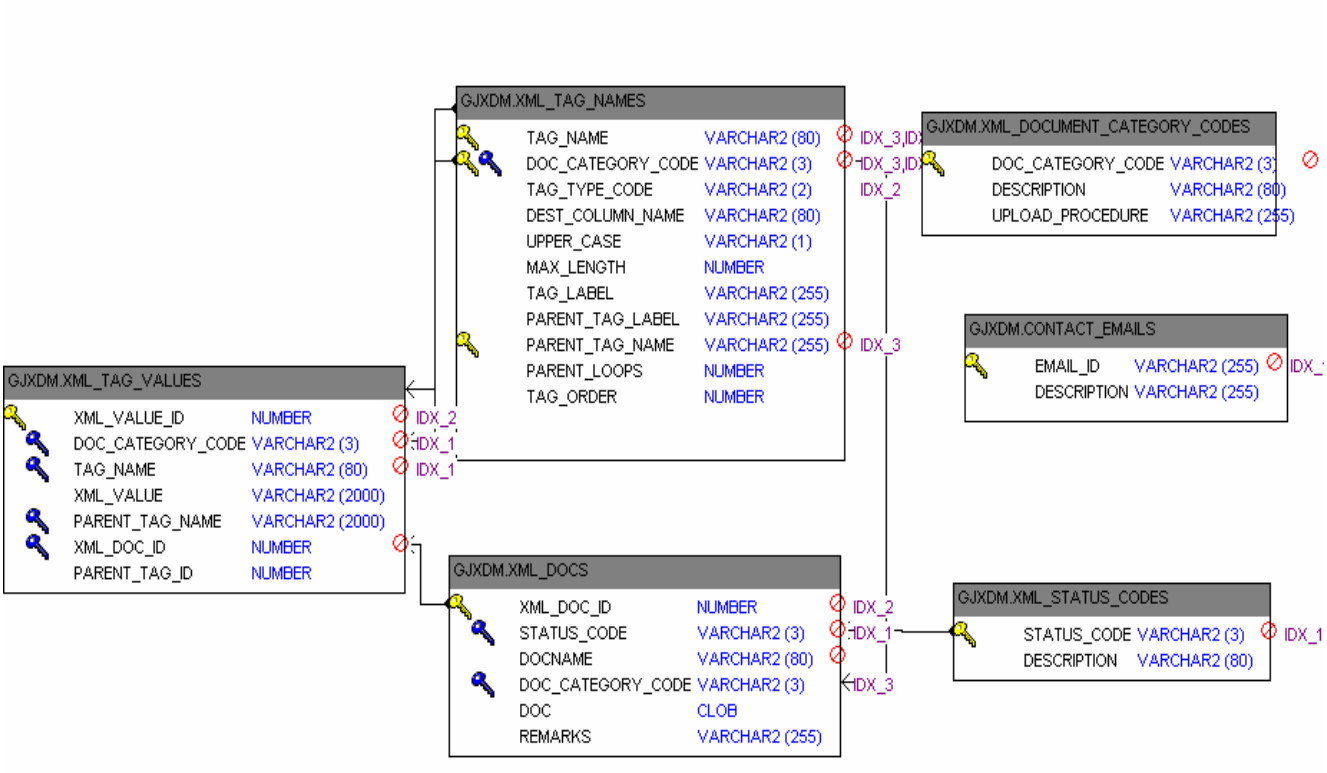


Figure 2. XML Document Processing Database Design

The following describes the table relationships between one another:

A XML_DOCS record can have one and only one status related to it.

A XML_DOCS record can have one and only one document category

A XML_DOCS record can have one or more XML_TAG_NAMES.

A XML_TAG_NAMES record can have one or more XML_TAG_VALUES.

Project Development

The development of this project was performed using TOAD's PL*SQL Editor and SQL PLUS. The project required two database packages be created, XML_TOOLS and SENDMAIL.

The XML_TOOLS package was created to process XML documents, including the amber alert. Within this package includes a procedure that uses the XML_DOM parser to parse the XML document and insert it into XML_TAG_VLAUES. To use the XML_DOM parser the

Java and the XDK must be installed within the database.

The SENDMAIL package includes a wrapper for a Java Class that is stored within the database. The development was based on a document from Oracle's Metalink website, document id 120994.1. The implementation uses 2 jar files, activation.jar and mail.jar, that are required to be loaded into the Oracle 9i database. The activation.jar is provided as a part of the JavaBean Activation Framework and the mail.jar is included as a part of Sun's javamail API 1.2. The activation.jar must be version 1.0.2 and the mail.jar must be version 1.2 in order for them to load correctly within the database.

Once the jar files have been loaded into the database a PL*SQL procedure called SENDMAIL acts as a wrapper to the java class within the database and can be called from PL*SQL or invoked from a web service.

Project Web Service

For the project it was decided to publish a web service to accept amber alert messages. The reason for using a web service is the ease of publishing a web service, high accessibility to external systems and low maintenance. For the project the deployment of the web service was to an Oracle Application Server, or OC4J container, using Oracle's JDeveloper tool version 9.0.4.2.

To deploy a web service the document 214876.1 from Oracle's Metalink website was used as a guide. The approach applied includes publishing an Oracle stored procedure as a web service and therefore allowing external systems to post to it and deliver Amber Alert messages through it. The following steps were taken to create a web service for an Oracle stored procedure, see Addendum A for steps with screen prints:

A. Create a PLSQL procedure within the Oracle database.

B. Create the Web Service using JDeveloper 9.0.4

1. Start JDeveloper
2. Create a database connection:
    i. Select File | New to open the New Gallery dialog box. Expand the General category and select connection as shown below. Double click the Database connection. This starts the Database Connection Wizard.
3. Enter a Connection Name and Type and click Next.
4. Enter Username, Password, check the Deploy Password checkbox and click next.
5. Enter the Database Information and click next.
6. Test the Database Connection and click Finish.

C. Create a New Application Server Connection.

Select File | New to open the New Gallery dialog box. Expand the General category and select connection as shown below. Double click the Application Server Connection. This starts the Application Server Connection Wizard.

1. Specify the Connection Name and Connection Type. Note that for an Application Server Deployment of the web service the connection type needs to be Oracle 9i Application Server – Remote DCM. For this project the standalone connection was used.

2. Specify the Application Server Administrator Username, Password, check the Deploy Password checkbox and click next.
3. In a remote deployment only specify the Enterprise Manager Hostname, Port Oracle Home Directory and click next.
4. Test the Application Server connection and click finish. One might received a message that the connection was refused for the standalone connection but it is okay to continue to the next step.

D. Create a new Workspace called GJXDM.

Select File | New to open the New Gallery dialog box. Select Workspace and click Ok.

1. Create a new Workspace called GJXDM and click ok.
2. Create a new Project called GJXDMWS and click ok.

E. Create a new PL/SQL Web Service and click ok.

Right click on the project, and select New.

In the General Gallery, select "Web Services → PL/SQL Web Services"

Press OK to start the PLSQL Web Service Publishing Wizard.

1. Specify the Database Connection, Select the GJXDM database connection. Select the XML_TOOLS package and designate the Web Service name GJXDMAmberAlertWS.
2. Select the program unit to publish, AMBER_ALERT_WS, and click next.
3. Define or confirm the file locations and press Finish. Note: The Web Service Endpoint is the URL address used to invoke the web service. Also when the finish button is pressed the WSDL and web.xml files are created.

4. (Optional) Create a Java class to test the generated stub. Right click on the project node and select Generate Sample Java Client.

F. Test the Web Service

1. Start the web service by right clicking on the project and select run GJXDMWS.jpr. In the bottom window the url to access the web service will appear.
2. Access the URL test page. Enter http://localhost:8988/GJXDM-GJXDMWS-context-root/GJXDMAmberAlertWS in the url to access the webservice.

The web service is now available to receive requests.

Project Installation

Installation Prerequisites

To utilize this GJXDM Amber Alert processing tool one must be using an Oracle database and the database must have Java and the XML developers Kit installed. For the development and installation of this project Oracle Database version 9.0.4 was used.

Installation Steps

The following are the installation steps to install and use the GJXDM Amber Alert messages, these steps and the web service steps above need to be performed for a complete installation:

1. Unzip the supplied zip file to a new folder called GJXDMTool.
2. Modify the ProjectScript.alt script and replace names to the target database and the password for the sys user.
3. Copy the activation.jar and mail.jar files to a location accessible from a SQL Plus session.
4. Log into the target database as the sys user as sysdba.

5. Configure the SENDMAIL package by defining a SMPT server that will send e-mail. This can be done by opening the SENDMAIL.pkb file and replacing the <SMPTSERVER> text with the SMPT e-mail server name or IP being used.
6. Run the ProjectScript.alt script against the target database and enter the tablespace names when prompted.
7. Enter the email addresses into the CONTACT_EMAILS table.

This project will ultimately be implemented and made available to small law enforcement agencies by a company that focuses on smaller agencies and provides Software as a Service (SaaS) to local law enforcement agencies.

Project Testing

To test the end to end deliver of the amber alert one needs to modify the java client that was created during the web service deployment. The java client needs to be modified to pass a sample amber alert to the web service within the main method. The following is a subset amber alert message that can be used:

```
<amber-doc:AmberAlertDocument>
  <amber:AmberAlert>
     <amber:AmberAlertID><j:ID>AA123.1</j:ID></amber:AmberAlertID>
     <amber:AmberAlertTransmissionDate>2004-11-15</amber:AmberAlertTransmissionDate>
   </amber:AmberAlert>
</amber-doc:AmberAlertDocument>
```

To run the java client right click on the java client class within JDeveloper and select run embedded<java class name>.stub.java. Within the message window towards the bottom left a message should appear stating the Process exited with exit code of 0. As a result of executing

this class the amber alert message should appear in the inbox of the e-mail stored in the CONTACT_EMAILS table.

IEPD Implementation Process

While there are different IEPDs for different business processes the implementation of them share certain characteristics. At the time of this paper a singe IEPD implementation framework or process could not be found. Therefore the following section describes the implementation process used for this project.

Once an IEPD has been selected for implementation and it has been decided that the incoming message is to be stored in a database, the first step one is to perform is a mapping of the XML Schema to the destination database tables and columns. The results of this mapping will serve three purposes. First the mapping will provide the developer with an understanding of where things are to be stored, second it will provide documentation for the interface or information exchange and third it will be useful for testing the interface.

The second step is to configure or develop the information exchange to allow the message to be transferred into or sent from the database. For this project the implementation was to accept an Amber Alert message from an external system. The XML parser used for the project was the XML DOM parser. By loading a XML document, parsing the document into staging tables, and loading the XML data into the mapping columns the final result is an XML document or Amber Alert being populated into a database where users can be alerted of the message. If there is no location within the database to store the alert information one can simply deliver the message from the staging tables and send the alert from them. The later delivery approach was taken for this project however the message can be loaded into database tables if an application has alerts or messaging capabilities.

The third step is to determine the method of transfer. With the emergence of web

services agencies can easily exchange information that does not require file clean up and is relatively easy to create. Another solution is to provide an FTP site that allows information or documents to be posted for information transfer. The FTP approach is not as elegant as web services because it requires addition file management and clean up. A third approach is manual file transfer of information via external media or via an application interface that allows users to manually upload the data into or extract information from a database. While there are additional methods of file transfer and communication they are not discussed within this paper. For this project a web service was deployed to receive amber alert messages.

GJXDM Technical Project Findings

The GJXDM project was successful by providing a tool for small law enforcement agencies to install and start using. The level of effort to implement a GJXDM amber alert can be performed by small law enforcement agencies that are currently utilizing XML and have a tool for accepting XML documents for processing. However for law enforcement agencies that lack the knowledge or tools for processing XML documents the implementation can be more involved. The GJXDM project created here can be used as a starting point for law enforcement agencies. The tools provided allow law enforcement agencies to add additional XML documents for processing and further extension.

The current delivery of the GJXDM Amber Alert is limited to e-mail addresses. A web interface can be created in the future to allow users to register their e-mail to receive amber alerts. Also additional functionality and delivery of the messages can possibly be expanded some day to include additional information systems to register web service information which would allow for the message received from this system to be passed on to other systems or technologies.

During the project it was identified that one area in particular where technology can be

used for amber alert messages and that is the Global Positioning Systems (GPS) in automobiles. It would be ideal to have all automobiles that have the GPS available receive an amber alert message using the GJXDM Amber alert. This would expand the information sharing to those people that were closest to the incident at the time it occurred.

Chapter 6 – Software Reuse Technical Prototype

Project Introduction

The next step to creating GJXDM reusable software artifacts is having a place where agencies and developers can access the software components. The Software Reuse Technical Prototype is meant to be a tool that will allows users to upload, download and search for GJXDM software artifacts to decrease the time it takes to implement a GJXDM document and increase quality.

Technical Summary

The technical prototype for this paper includes a software repository for categorizing and storing GJXDM artifacts for developers to help with GJXDM implementation. The goal for the project is to create a design that can be used for future development and to provide a level of reuse from single lines of code to different packages.

The project also includes an application prototype using an Apache Tomcat listener, a MySQL database and a Java program that utilizes a thick and thin client. The thick client uses java swing for its implementation and the thin client uses JSP, servlets and struts for its implementation. A number of design patterns were used during the development of the Java application. The Model, View Controller (MVC), Factory and DAO design patterns in particular make the application more portable and flexible to meet future business needs. The design of the database was constructed using a simple ERD and the design of the java application includes class diagrams. To demonstrate the workflow of the java application a number of use cases were created.

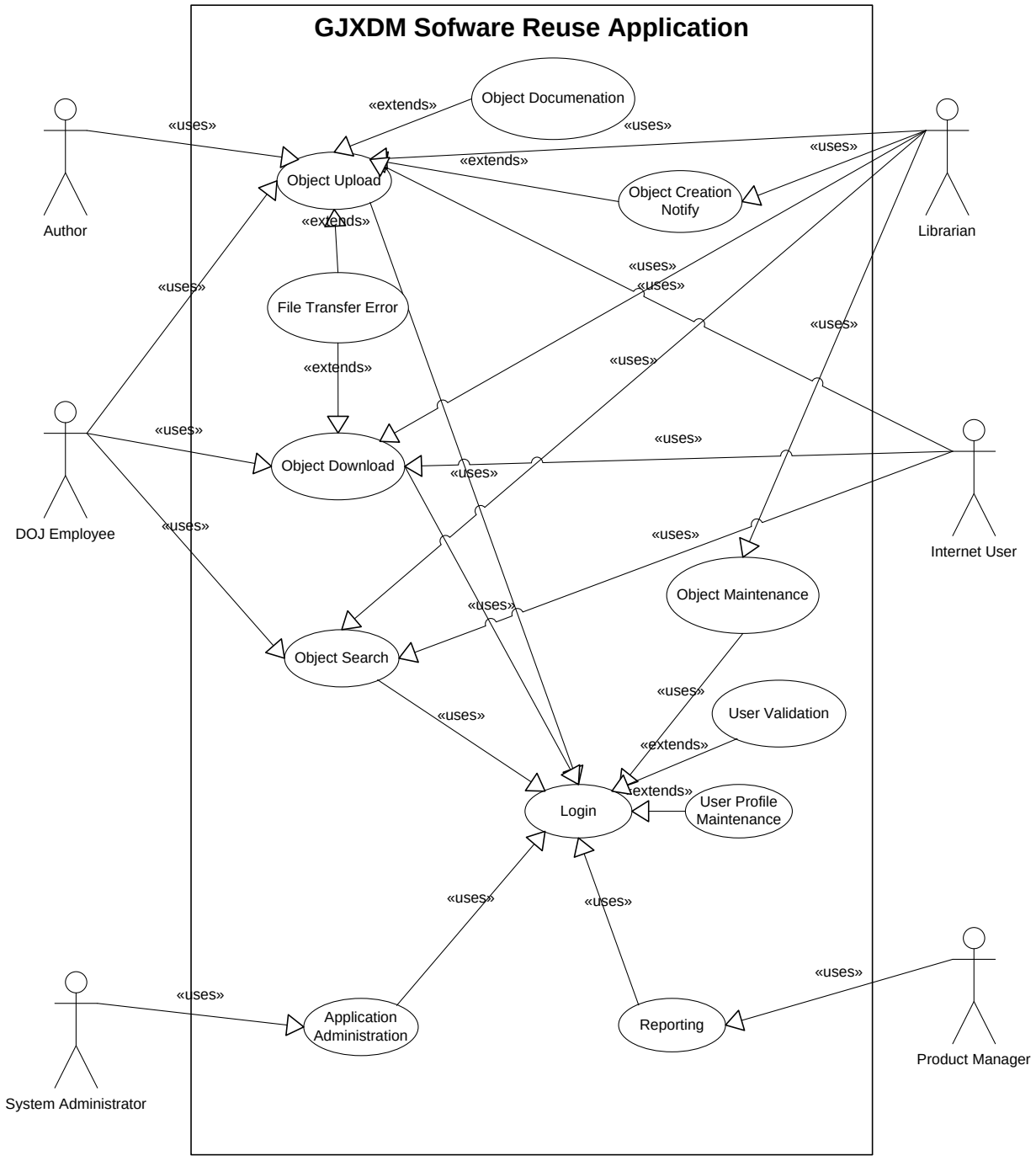
Prototype Design

The software reuse prototype allows for the following functions:

1. User Login.

2. User Profile Maintenance.
3. GJXDM Artifact Upload.
4. GJXDM Artifact Download

Prototype Use Cases



Use Case Text

Object Upload

Primary Actor: Internet User and DOJ User

Stakeholders and Interest:
Internet User: Wants easy-to-use access to GJXDM documentation and software artifacts that will help expedite GJXDM project schedules and to shorten time to market.

DOJ: Want a way to provide GJXDM knowledge and components to the IT market and increase data sharing among the justice agencies.

Author: Wants to Author a new IT component that will be used by others and help society.

Preconditions: Website is accessible for access via the internet.

Success Guaranteed (post conditions): The Object is uploaded to the GJXDM Software Reuse database.

Main Success Scenario:

1. The user accesses the GJXDM Software Reuse application via a URL.
2. The GJXDM Software Reuse application prompts the user for a user name and password.
3. The user enters their username and password.
4. The GJXDM Software Reuse application performs a user validation check and then displays the main screen.
5. The user chooses to upload an object.
6. The application prompts the user for the object for upload, the type of object and documentation.
7. The user selects a file to upload, selects the type of object, enters a description of the object and chooses to perform upload.

8. The GJXDM Software Reuse application provides an initial status for the object, adds the object to the database, executes an Object Creation Notification to the librarian and notifies the user that the object has been added successfully.
9. The user acknowledges the success message and is returned to the GJXDM Software Reuse main screen.

Extensions (Alternate Flows):

4a. Invalid username and password

1. The GJXDM Software Reuse application notifies the user that an invalid username and password were entered.
2. The GJXDM Software Reuse application prompts the user for username and password.

8a. Upload unsuccessful

1. The GJXDM Software Reuse application notifies the user that the file was not uploaded and provides a message related to the issue.
2. The user acknowledges the unsuccessful message and is returned to the upload screen where the user can correct the problem and try again.

Special Requirements:

- Virus Scans will be executed on files at the time of upload.
- File size limit of 4 gigabytes.

Technology and Data Variation List: None

Frequency of Occurrence: Approximately 1 per 7 days.

Object Download

Main Success Scenario -

The Object Download is the process of downloading a HTML file, design diagram, Java Application, or other binary object that will be used for reuse in a GJXDM software project. The internet user or DOJ user will access the GJXDM Software Reuse Application via a URL on an intranet or the internet. The GJXDM Software Reuse application will prompt the user to enter a username and password. The user enters their username and password. The GJXDM Software Reuse application performs a user validation check and then displays the main screen. The user chooses to download an object. The application prompts the user for the object id or name. The user enters the object id or name and chooses to perform the download. The GJXDM Software Reuse application notifies the user that the object has been downloaded successfully. The user acknowledges the success message and is returned to the GJXDM Software Reuse main screen.

Alternate Scenario – Object not found

The application will notify the user that the object being requested was not in the database.

Alternate Scenario – File Transfer Error

The application will notify the user in the event that something occurs during the transfer of the file.

User Profile Maintenance

The User Profile Maintenance is the process of maintaining information about users of the application. Prior to logging into the application a user must have a User Profile. The internet user or DOJ user will access the GJXDM Software Reuse Application via a URL on an intranet or the internet. The GJXDM Software Reuse application will prompt the user to enter a

username and password. The user enters their username and password. The GJXDM Software Reuse application performs a User Validation check and then displays the main screen. The user chooses profile maintenance. The application will prompt the user for changes to a profile which include a new e-mail address, a name change, a mailing address change, password, phone number and username. (The username must be unique to the application and the user will have the option to have the application generate a unique user name for them.) The user will enter the new profile information and will choose "update" to execute the process. The application will prompt the user with a successful message once the action is complete. The user will acknowledge the success message. The GJXDM Software Reuse application will display the main screen.

Prototype Database Design

The database design of the application includes two tables: REUSEABLE_OBJ and USER_PROFILE.

The REUSEABLE_OBJ table is used to store GJXDM objects and provide description for each of the objects. This table is crucial to allowing software artifacts to be stored and categorized correctly to allow for easy abstraction and reuse. Within this table is a blob field which allows for the storing of large data objects to be stored in a binary format.

The USER_PROFILE table is used to record different information about users including contact information.

Prototype Development

The development of the application was performed using Eclipse as the IDE and Apache Tomcat was used for the http listener.

Thick Client

The thick client application supports the MVC design pattern and includes the following

features:

- Object management – create, update, and delete of a GJXDM software artifact.
- My Profile – create, update and delete of a user profile.
- Chat – A chat feature to communicate with Q&A type of support and receive notifications when new objects are created.

Thin Client

The thin client application currently supports the following functionality:

- Web Access – The users can access the application via a URL.
- Object Creation – users can create new objects via the web.
- Object Download – Users can download existing objects.
- Profile Update – Users can update their profile via the web.

The following features would be beneficial to add:

- User Registration Process – allows for users to register via the web and e-mail for validation.
- Object Search – This is necessary for the software abstraction to occur. The object search engine needs to be developed to allows easy abstraction of artifacts.

Chapter 7 - Findings and Analysis

GJXDM Findings and Analysis

The GJXDM implementation project identified that the implementation of a GJXDM IEPD, such as an amber alert, is achievable for agencies that have in house knowledge of XML and GJXDM processing. However for smaller agencies to be expected to create new reusable GJXDM documents and IEPDs themselves are not likely and involve a considerable amount of work.

The following items list the findings of the project:

1. There is a lot of information on GJXDM and it can be difficult to know where to start.
2. The GJXDM standard is large and complex.
3. GJXDM allows for flexibility and growth.
4. There does not appear to be a central reuse repository for sharing GJXDM artifacts.
5. There are limited tools available for implementing GJXDM documents.
6. GJXDM document exchanges do not normally include the complete data model and normally only use a subset.
7. Knowledge of XML and existing XML tools is useful for succeeding.
8. Of the agencies that have implemented GJXDM IEPDs they are all of medium to large size agencies.

The following are some areas where software reuse would be beneficial for processing GJXDM XML messages:

1. A developers how to guide with the specifics the steps to implement an IEPD.
2. Common tag parsers. A number of systems have phone number and address stored in separate fields for reporting. A common software component to share between

developers would be useful and could share time.

3. A tool to translate external codes from codes used within the application. Often times code tables are used within applications to provide drop downs or suggested values. When an external message is being brought into the database a translation of the known codes and the external codes are needed for the application to store the incoming data.
4. A tool to define how to deploy web services within the Oracle Application Server environment.
5. For GJXDM messages that are to be stored in a database the suggested implementation process needs to start with mapping the GJXDM subset schema to the database. This is useful for not only development efforts but also for testing and validation that the data loaded correctly.
6. To be truly successful the data sharing needs to be made available to small law enforcement agencies. One solution may be to have the government fund a GJXDM implementation team to help implement data sharing among the local and smaller agencies.

Software Reuse Findings and Analysis

The software reuse project validated that while implementing a repository for software reuse there would be value to developers to have a location to perform queries and pull information. The following items resulted in the project:

1. A central repository would be helpful to help manage the GJXDM information.
2. Software reuse projects are complex and the scope of this project was more than expected.
3. A central repository for GJXDM artifacts would be helpful for developers and users

to share data.

4. A software reuse project is complex and needs to be easy to use in order to be successful
5. In order for the software reuse repository to be successful the justice community needs to support it and know how to access it.
6. Software reuse projects require commitment from decision makers.

Chapter 8 - Conclusions

Project Summary

The first part of the project involved performing a literature review of the GJXDM standard and previous GJXDM projects. In addition to the literature review the project also included two additional areas: implementing a GJXDM compliant XML document and making GJXDM artifacts available from a software reuse repository.

The implementation of the GJXDM complaint XML document involved implementing an Amber Alert IEPD and processing the document within an Oracle database. The key efforts involved with this portion of the project involved database design, XML parsing, database package development and web service deployment.

The implementation of the software reuse repository involved creating a java base application that allows users to share GJXDM artifacts. The project was meant to deliver a prototype and high level design that can be later added onto or implemented. The design included identifying and documenting the use cases needed for a GJXDM software reuse repository. The prototype involved creating a thick and thin java client that interacts with a MySQL database.

During the implementation of the GJXDM compliant document a number of artifacts were created and documented. These artifacts can be stored within the GJXDM software repository for future GJXDM software projects to utilize to increase quality and decrease implementation time.

Project Expectations

The project did meet its original expectations by identifying a need for additional tools for smaller law enforcement agencies. The project also identified that a large number of the smaller law enforcement agencies are not performing GJXDM data sharing at this time. The

project was successful in providing a tool for law enforcement agencies to start using and sharing amber alert information.

The project identified that through a software reuse repository and better access to GJXDM artifacts data sharing can be increased and more effective.

What could have been done different

There are four things that could have been done differently. The XML document processing could have been designed using alternative approaches, the web application could have been performed using a different database, the search capabilities could be more robust and the design for the software reuse application can be expanded.

First the processing of XML documents could have been performed differently. The design presented here utilized the XML DOM parser due to its flexibility and capability of managing XML documents. The SAX parser could have been used as an alternative approach. Further the parsing of the XML document could have been performed outside of the database as opposed to within the database. By processing the documents within the database everything is within the database and therefore is easy to manage or implement for those agencies familiar with Oracle databases and familiar with stored procedures or PL*SQL..

Second the GJXDM software reuse application could have been implemented using another database, such as Oracle, by using a different driver. With Oracle additional search tools such as Intermedia additional capabilities may have been available for greater abstraction.

As mentioned earlier the design patterns used include the Factory, MVC, and DAO. By using these design patterns the application can be configured to support additional or future technologies as new business requirements are identified. The separation of the different layers (Model, View, and Controller) reduces the coupling between them and therefore allow for more flexibility and growth for the application. It also reduces regression testing efforts due to the

lower coupling.

Third the application search capabilities could have been increased more. Currently the application only allows abstraction for a user by knowing an object id or name. This area of the application needs to be expanded to include searching by the different database fields. There are a number of different approaches that can be taken including XQUERY, XML/SQL, or JXQL. These different approaches need to be analyzed and it needs to be determined the best approach to take for this area of the application.

Finally the software reuse application design could have been expanded to include more code tables for better reporting and data integrity. The application's object types could have been populated from external sources such as a file on the files system or the database. Currently this field is a static array that requires a recompile of the application to add new values. Further the database design could be more robust to include the different levels of reuse for each software artifact. By providing the level of reuse it would help with the abstraction process and allow users to define the level they are looking.

Conclusion

Through the literature review the project did identify that of the law enforcement agencies within the United States 90 percent consist of 50 sworn officers or less. (National Institute of Justice, 2004) The results of the literature review also found that within the small and rural law enforcement agencies a large number of them are not currently using XML in any way. It was also identified that the GJXDM standard contains a large number of elements and it can be complex to implement. Further it is noted that of the projects that have implemented the GJXDM standard and listed at http://it.ojp.gov/topic.jsp?topic_id=107 there does not appear to be an instance where a small law enforcement agency, with less than 50 sworn officers, has implemented the GJXDM standard and if one does exist it is the exception.

In order for information sharing to be effective the GJXDM standard needs to be available to the small law enforcement agencies. Currently it is not very likely that for smaller law enforcement agencies to create a new GJXDM schema subset for XML document sharing without external help from other resources. The smaller law enforcement agencies are not currently utilizing GJXDM, with a large number not using XML at all.

It is possible that through software reuse and software artifact sharing small law enforcement agencies can implement GJXDM documents and data sharing. The project performed within this effort has shown that with proper documentation and software design small law enforcement agencies can implement GJXDM data sharing. The project has in addition provided an approach to processing XML documents for justice agencies to consider when starting a XML document related project. Further the project has identified that the GJXDM data sharing standard can be more effective by providing a software reuse repository for small law enforcement agencies and developers to access to increase data sharing and decrease the time and effort for implementing. The software reuse repository created for this project demonstrates that software artifacts can be created and reused.

With the creation of the GJXDM standard information sharing has become more effective and useful for justice agencies. If agencies across the U.S. could all share data within the same format and manner the country would be a safer place. Also when incidents do occur agencies can be more responsive by identifying the types of services needed and provide those services in a shorter time frame.

Addendum

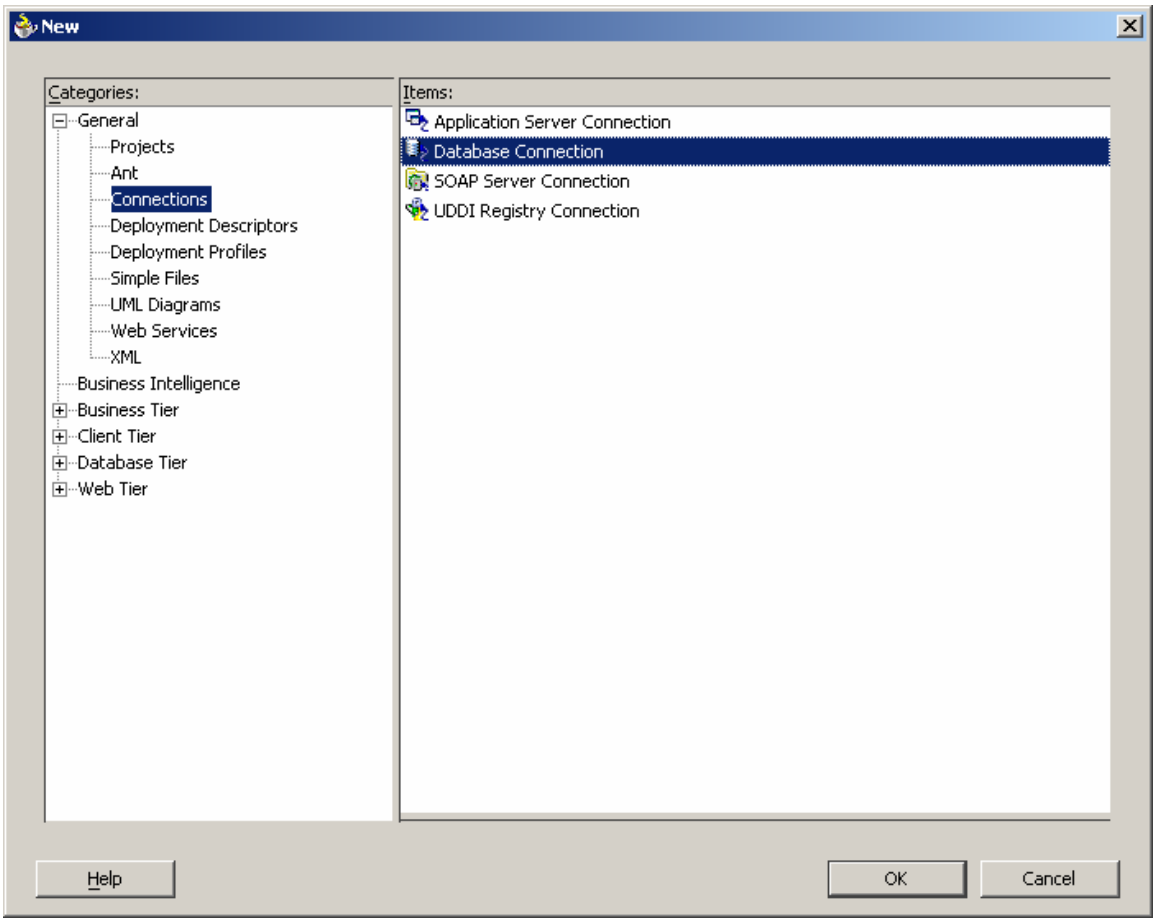
How to Publish and Consume a PLSQL Procedure as a Web Service

A. Create a PLSQL procedure within the Oracle database.

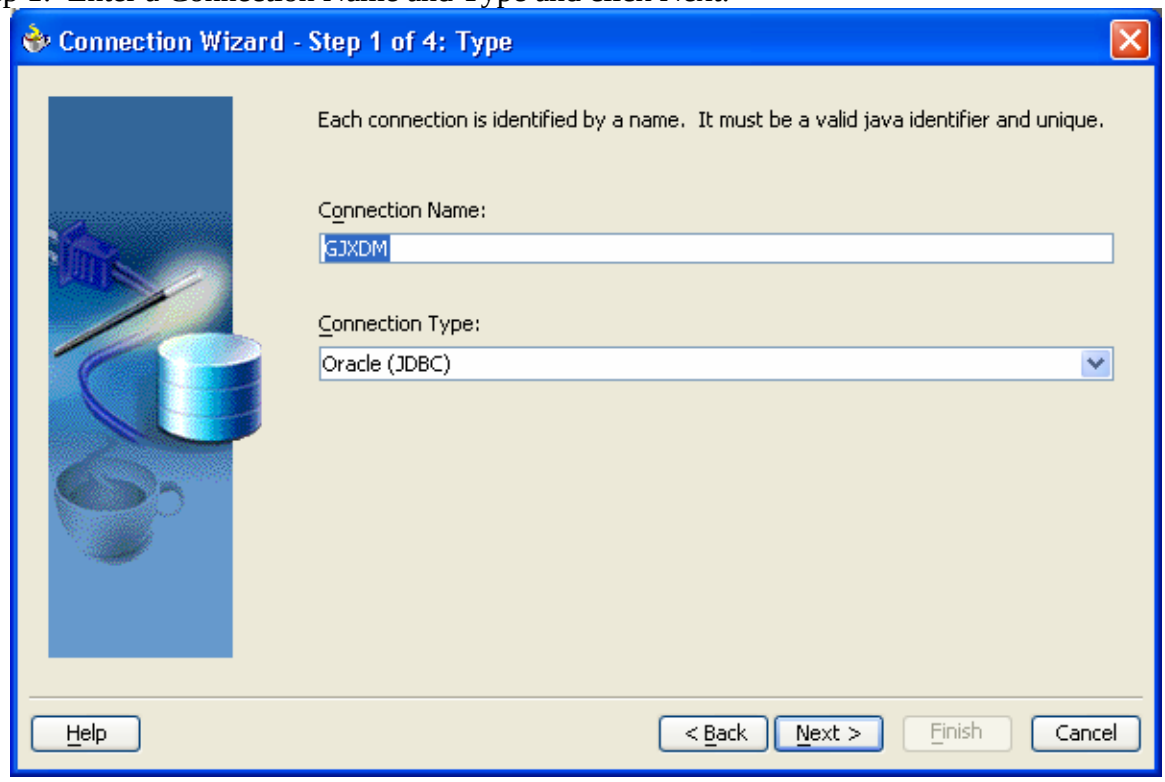
B. Create the Web Service using JDeveloper 9.0.4

1. Start JDeveloper
2. Create a database connection:

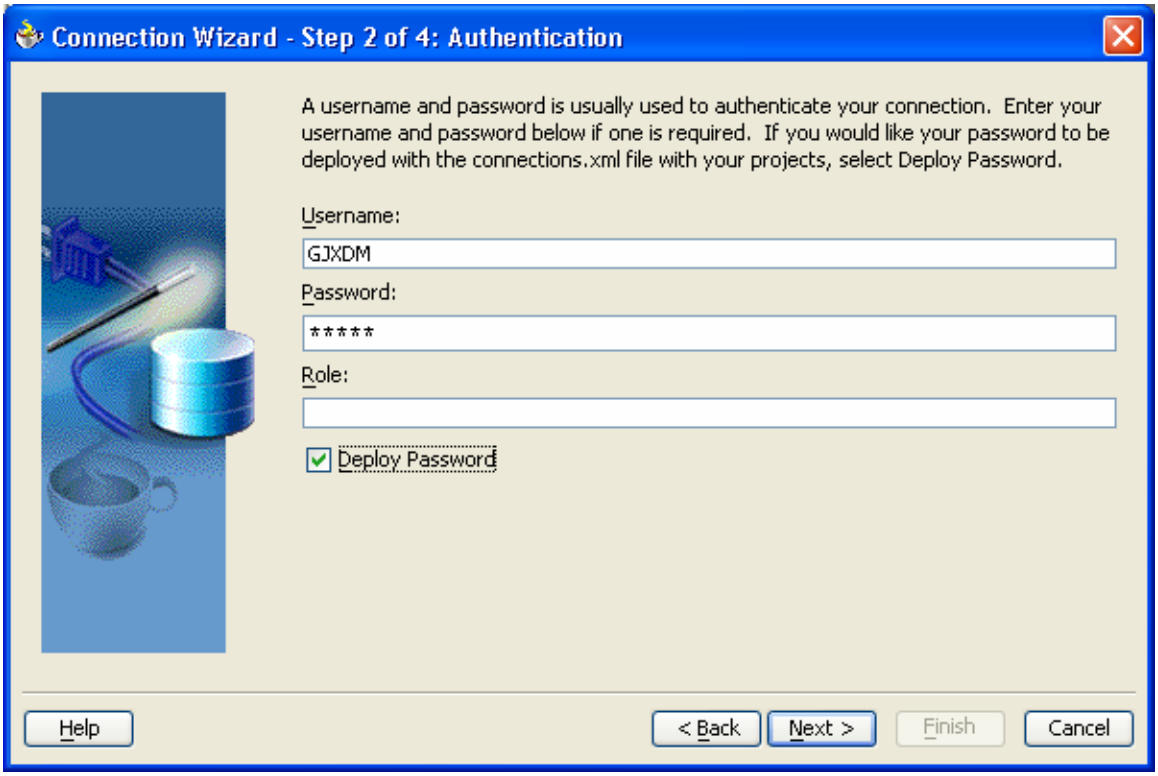
   Select File | New to open the New Gallery dialog box. Expand the General category and select connection as shown below. Double click the Database connection. This starts the Database Connection Wizard.



Step 1: Enter a Connection Name and Type and click Next.

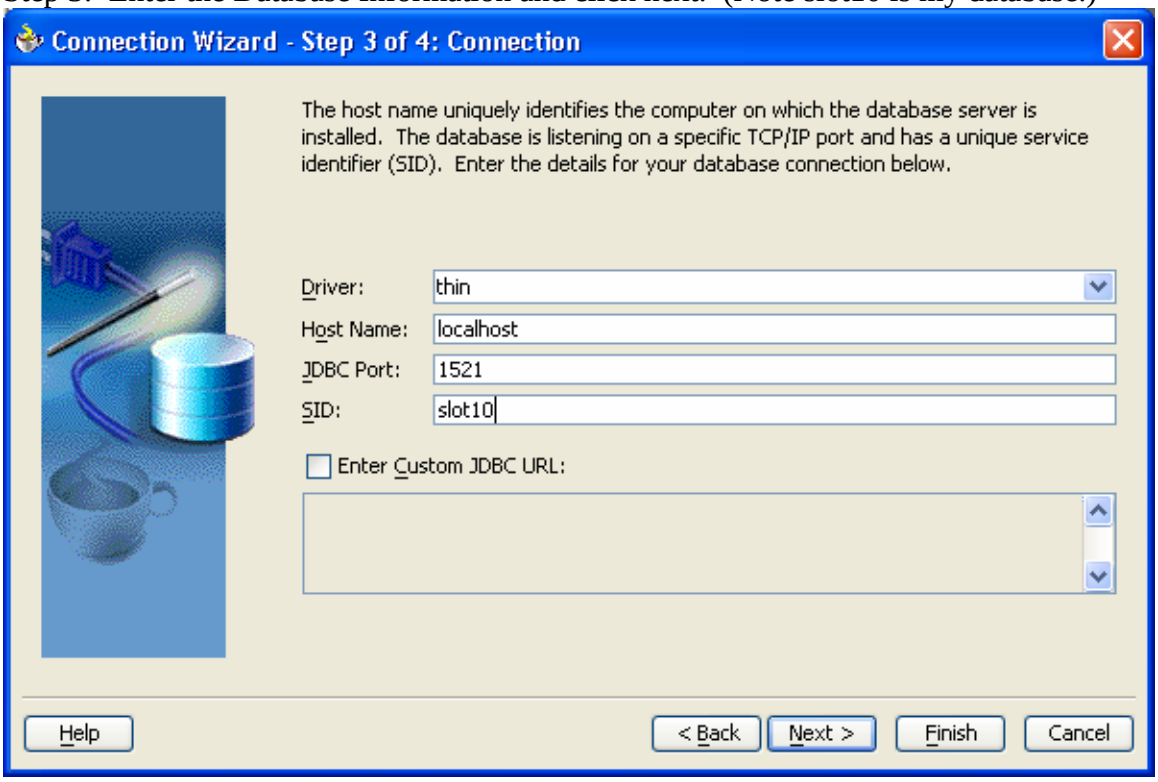


Step 2: Enter Username, Password, check the Deploy Password checkbox and click next.

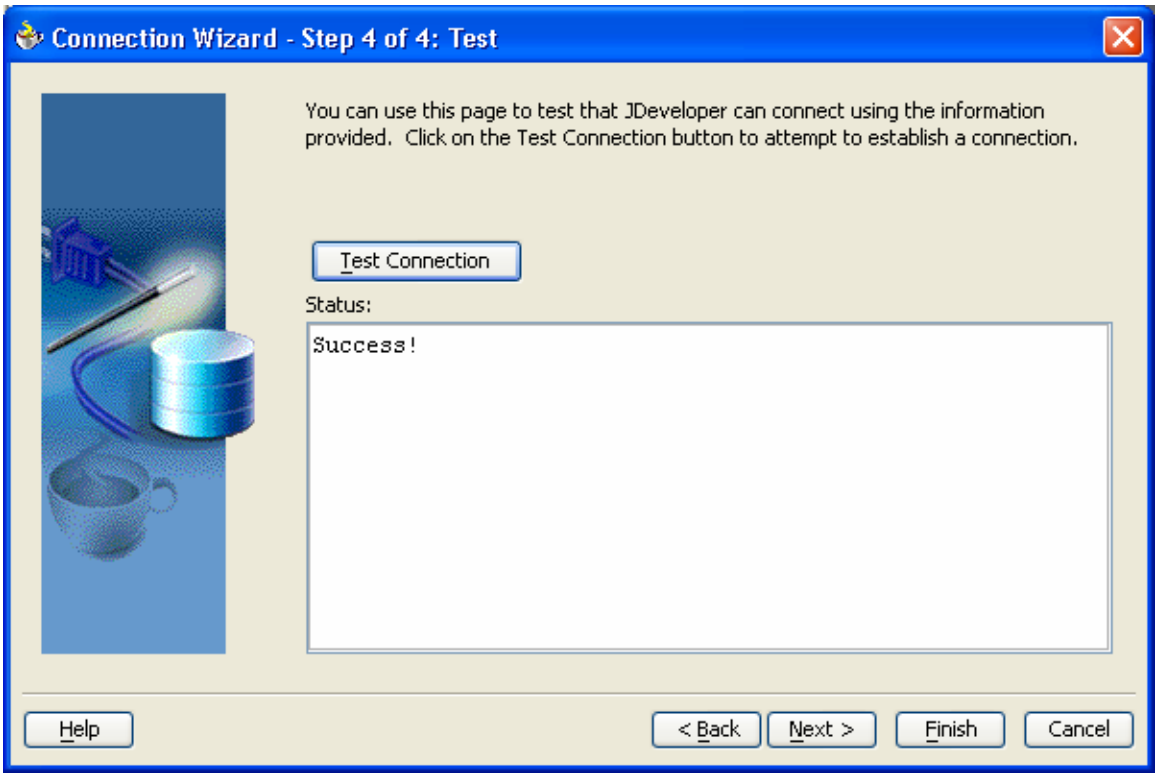


Note: The password should be deployed with the web service.

Step 3: Enter the Database Information and click next. (Note slot10 is my database.)

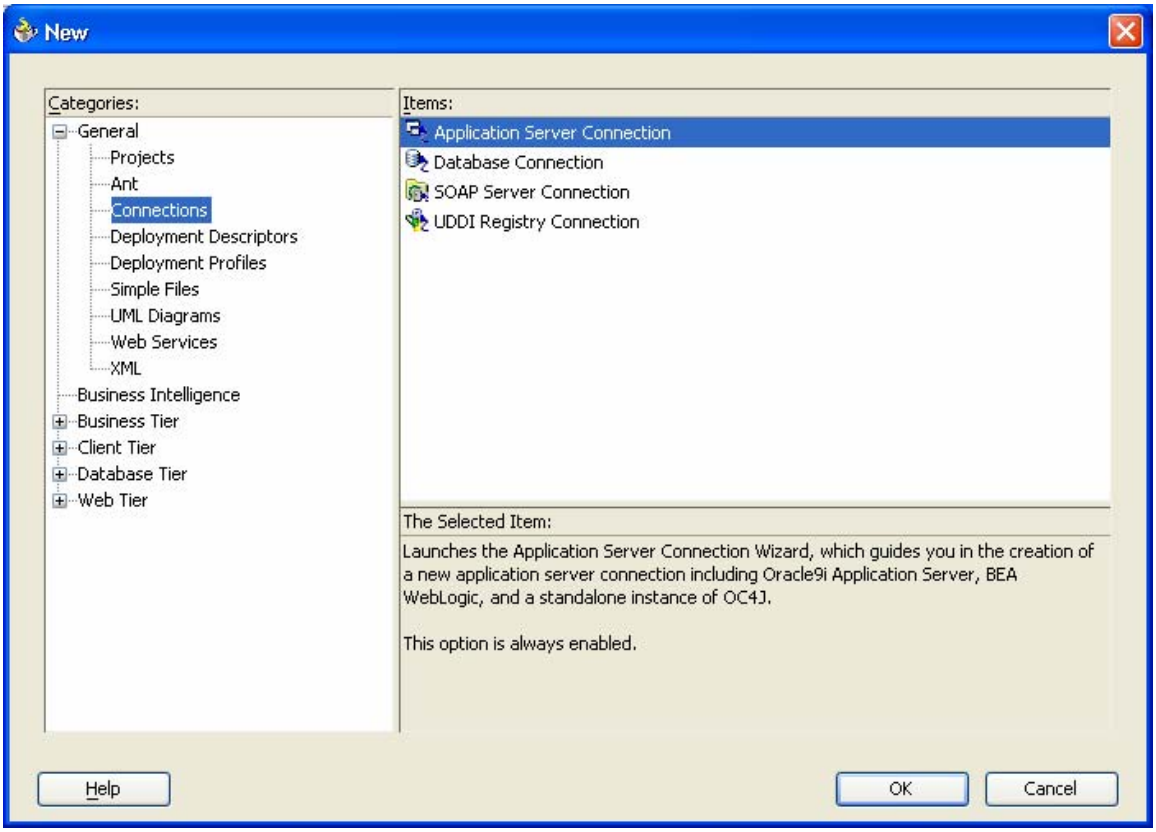


Step 4: Test the Database Connection and click Finish.

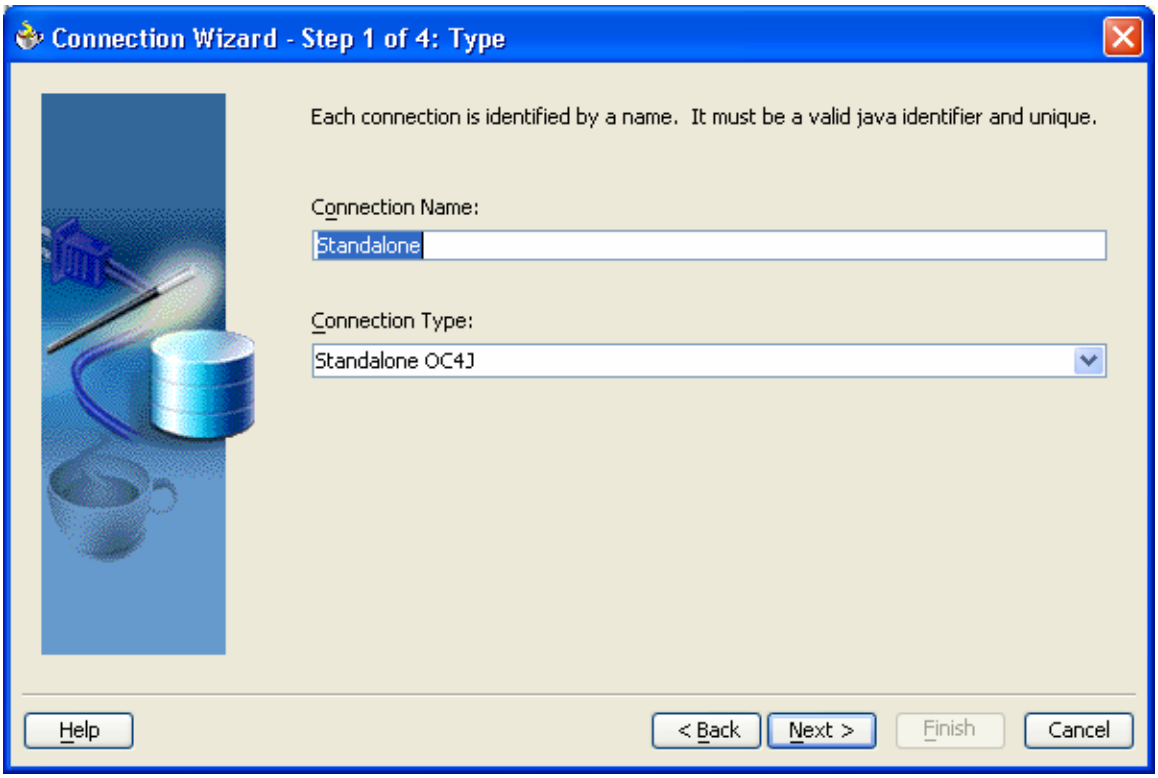

Connection Wizard - Step 4 of 4: Test
You can use this page to test that JDeveloper can connect using the information provided. Click on the Test Connection button to attempt to establish a connection.
Test Connection
Status:
Success!
Help
< Back
Next >
Finish
Cancel

C. Create a New Application Server Connection.

Select File | New to open the New Gallery dialog box. Expand the General category and select connection as shown below. Double click the Application Server Connection. This starts the Application Server Connection Wizard.

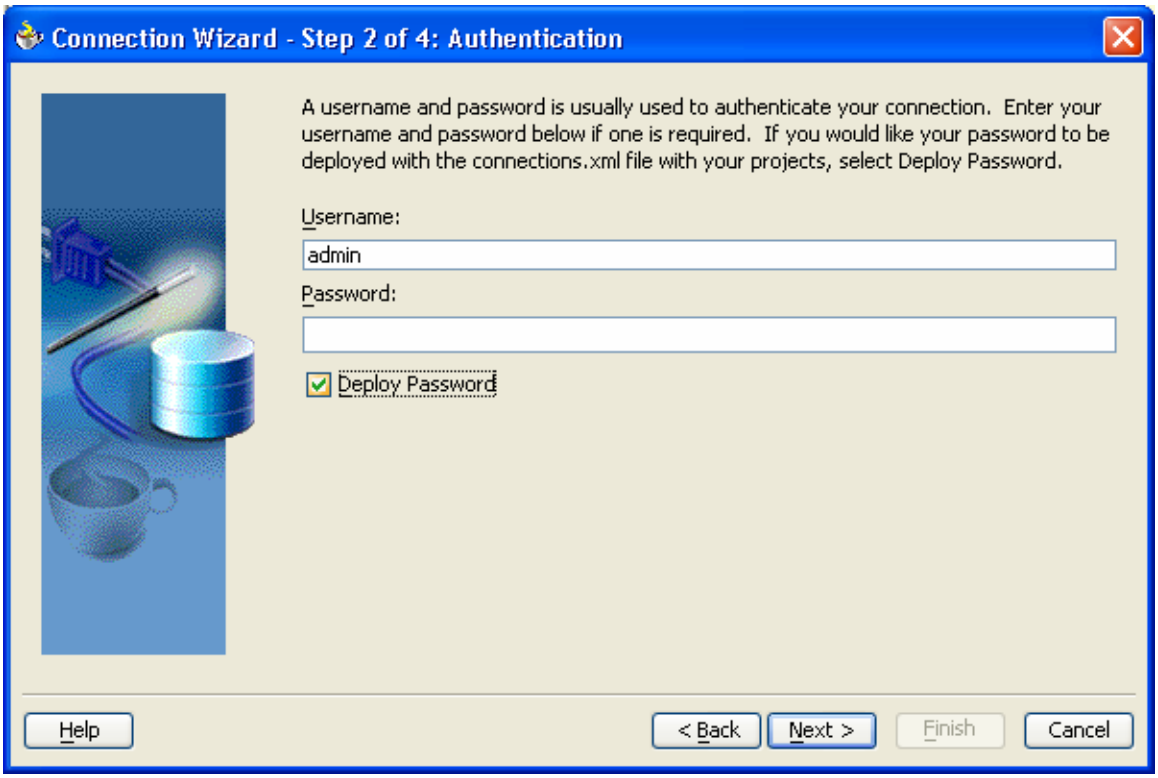


Step 1: Specify the Connection Name and Connection Type



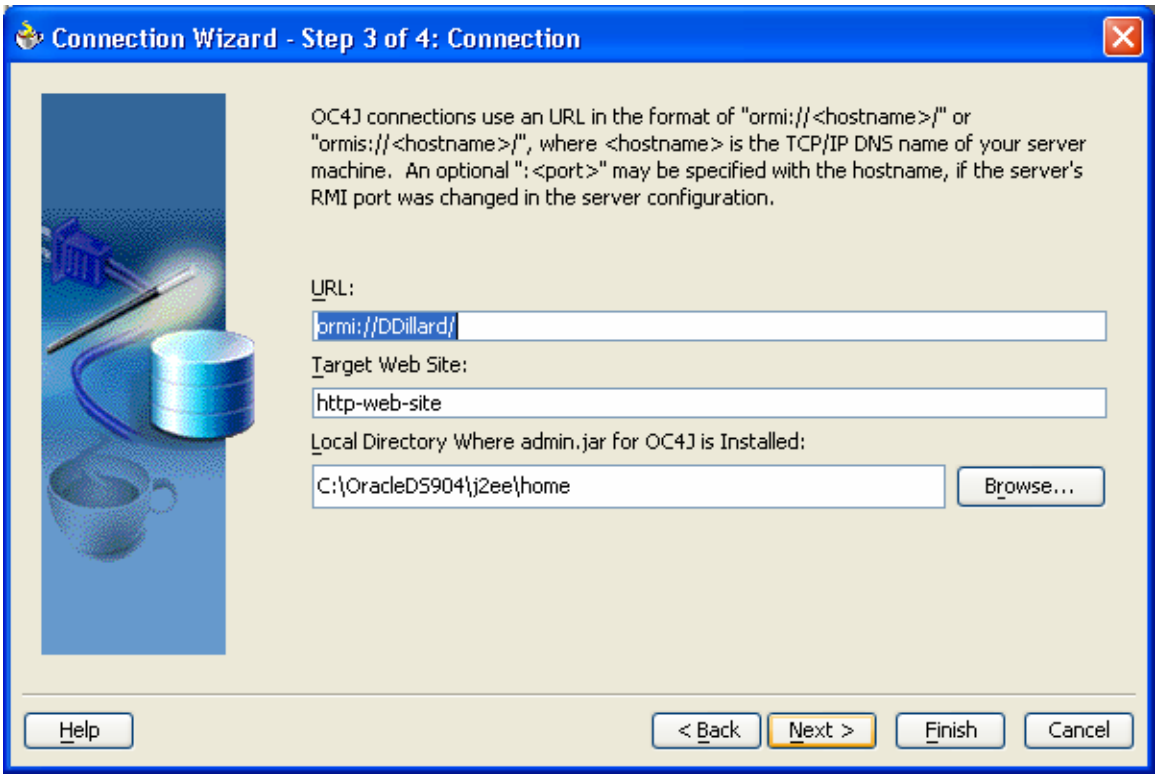
Note that for an Application Server Deployment of the web service the connection type needs to be Oracle 9i Application Server – Remote DCM. For this project the standalone connection was used.

Step 2: Specify the Application Server Administrator Username,Password, check the Deploy Password checkbox and click next.

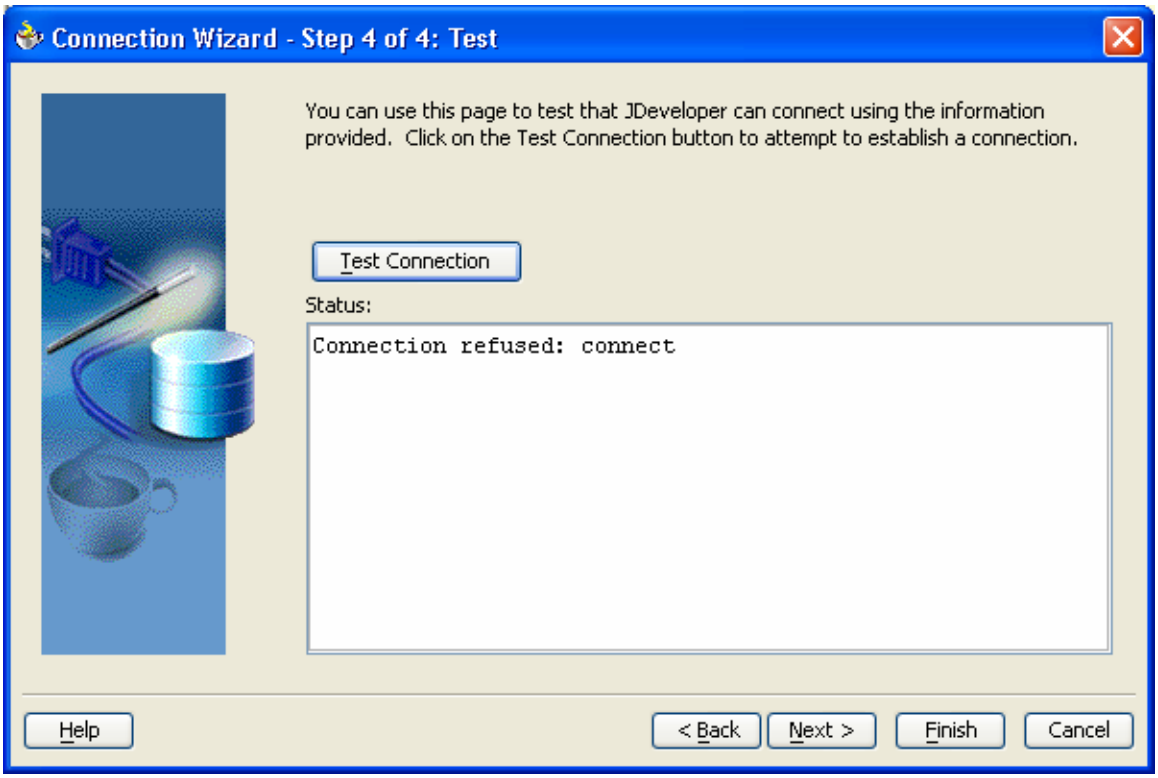


Note: The password should be deployed with the web service.

Step 3: Specify the Enterprise Manager Hostname, Port Oracle Home Directory and click next.



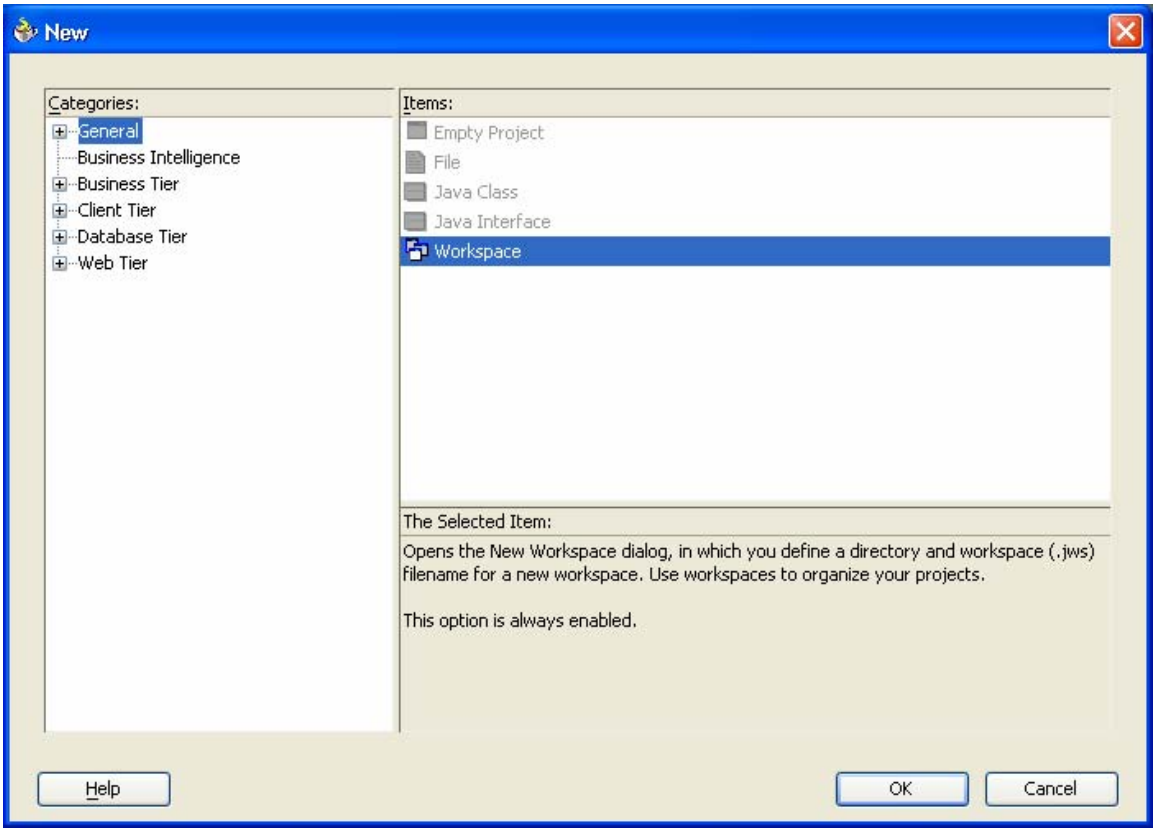
Step 4: Test the Application Server connection and click finish.



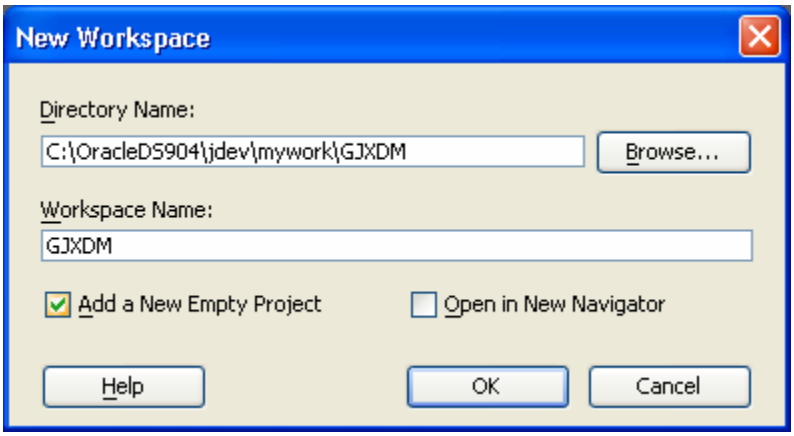
Note: One might received the above message for the standalone connection but it is okay to proceed to the next step.

D. Create a new Workspace called GJXDM.

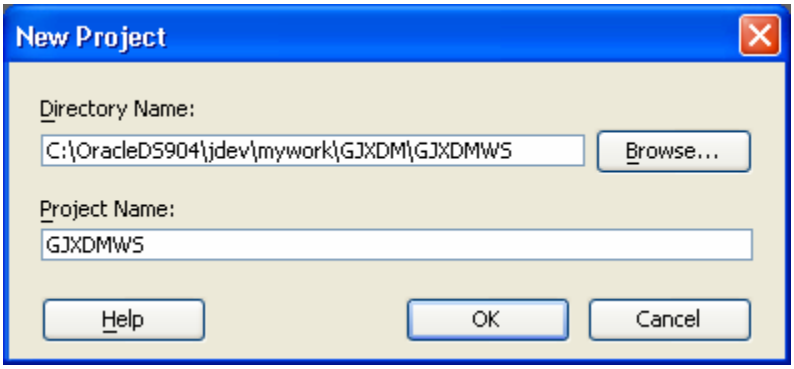
Select File | New to open the New Gallery dialog box. Select Workspace and click Ok.



Step 1: Create a new Workspace called GJXDM and click ok.



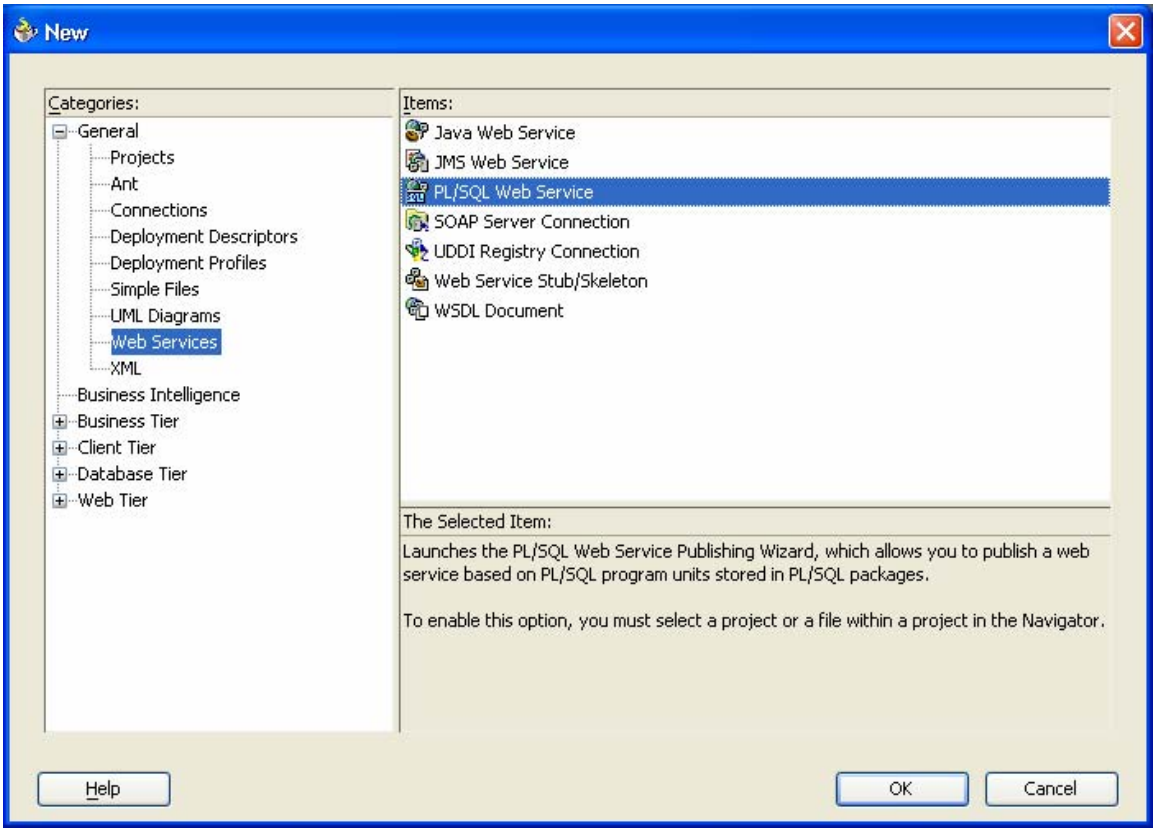
Step 2: Create a new Project called GJXDMWS and click ok.



E. Create a new PL/SQL Web Service and click ok.

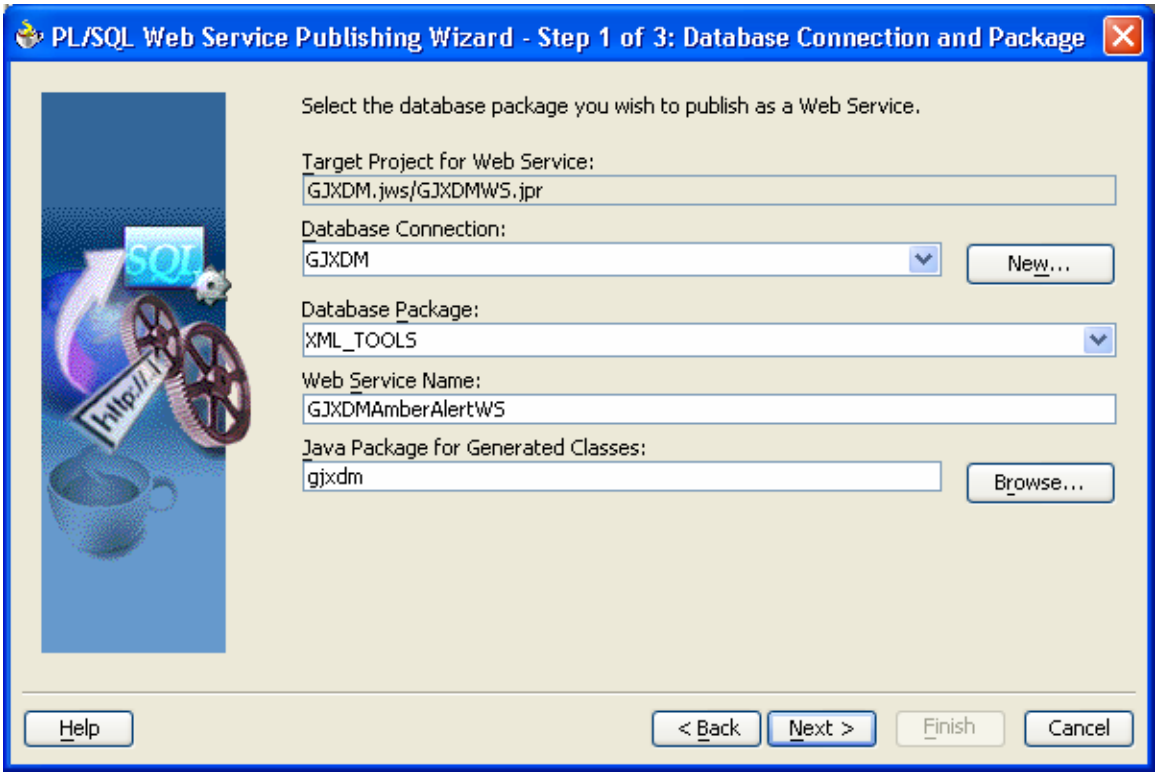
Right click on the project, and select New.

In the General Gallery, select “Web Services → PL/SQL Web Services”

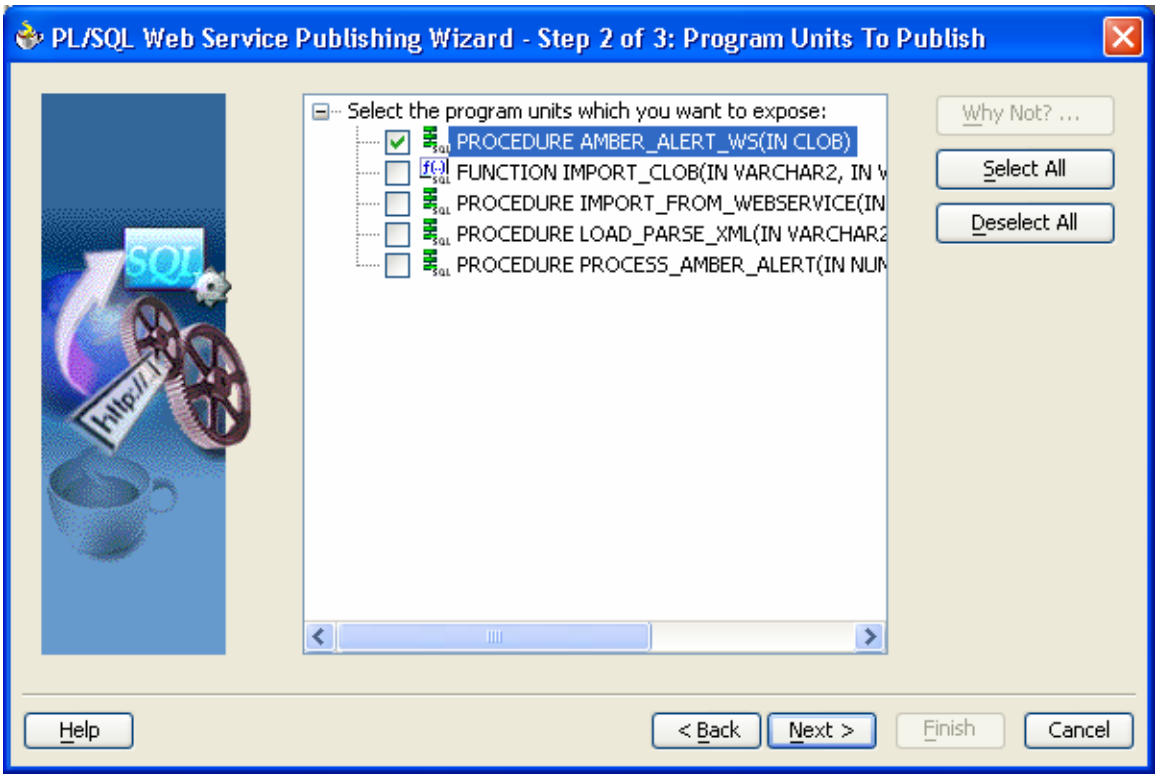


Press OK to start the PLSQL Web Service Publishing Wizard.

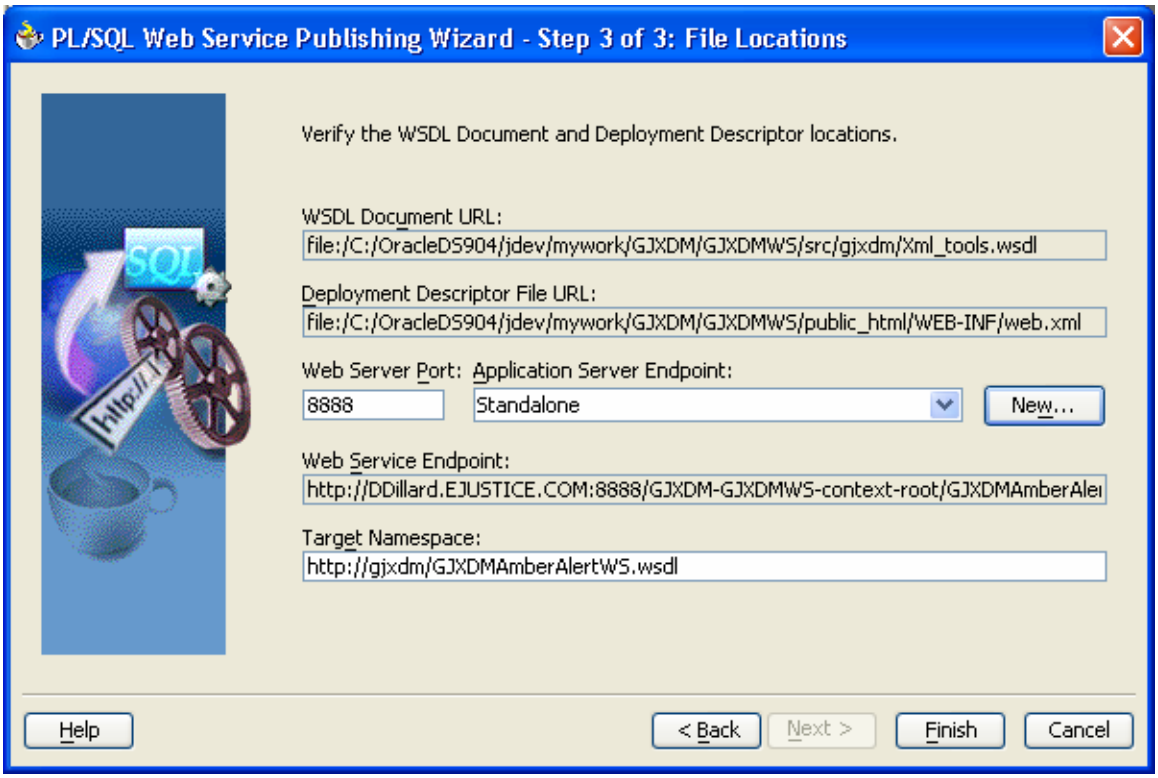
Step 1: Specify the Database Connection, Select the GJXDM database connection. Select the XML_TOOLS package and designate the Web Service name GJXDMAmberAlertWS.



Step 2: Select the Program Unit(s) to Publish and click next.



Step 3: File Locations

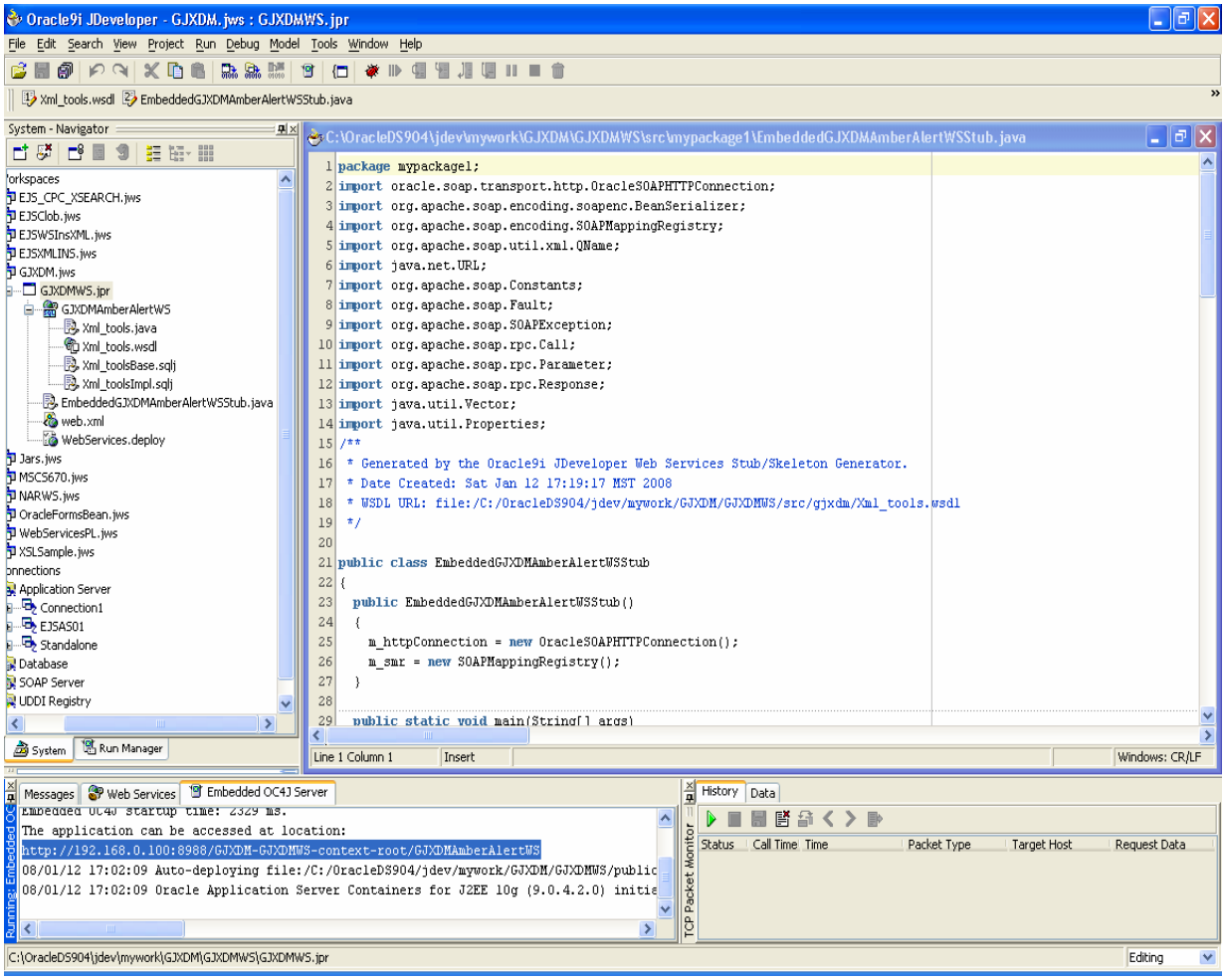


Note: The Web Service Endpoint is the URL address used to invoke the web service. Also when the finish button is pressed the WSDL and web.xml files are created.

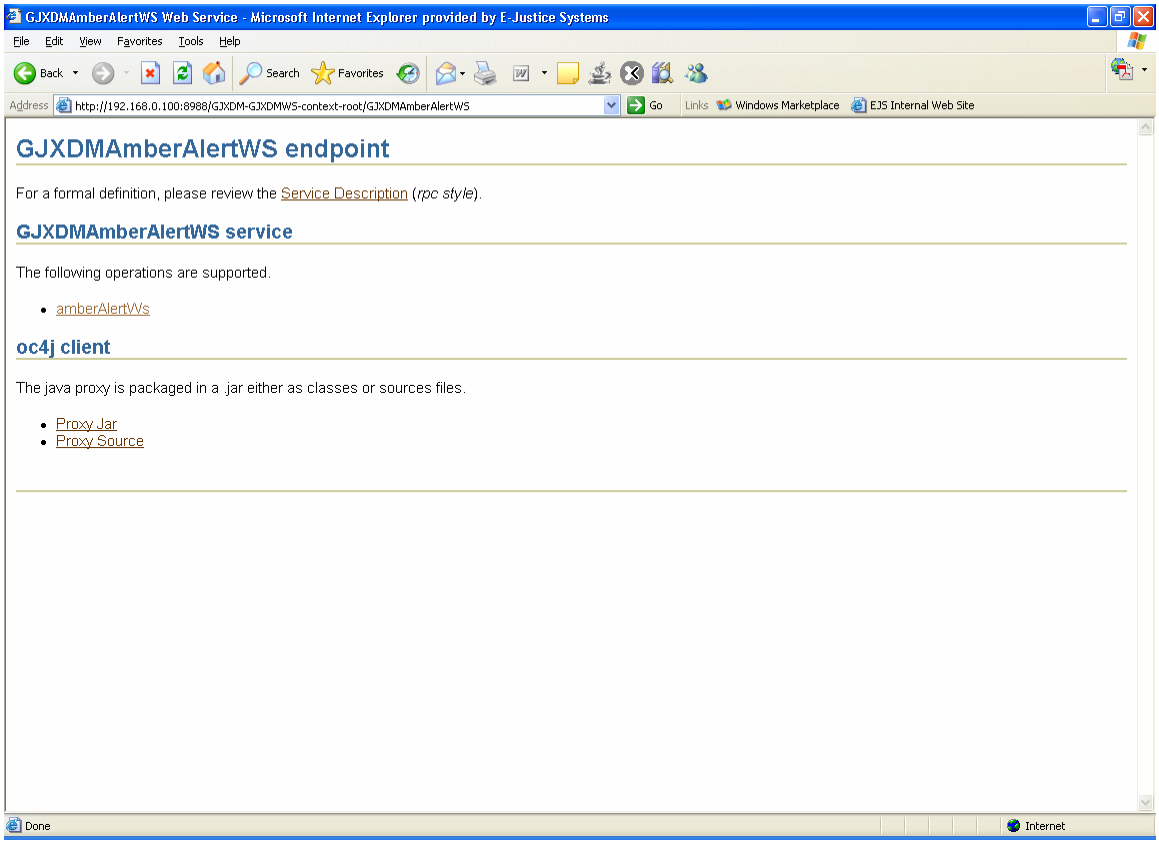
Optional Step 4: Create a Java class to test the generated stub. Right click on the project node and select Generate Sample Java Client.

F. Test the Web Service

Step 1: Start the web service by right clicking on the project and select run GJXDMWS.jpr. In the bottom window the url to access the web service will appear.



Step 2: Access the URL test page. Enter http://192.168.0.100:8988/GJXDM-GJXDMWS-context-root/GJXDMAmberAlertWS in the url to access the webservice.



The web service is now available to receive requests.

Figures

Figure 1. XML Document Flow. 26

Figure 2. XML Document Processing Database Design 28

Tables

Table 1. Levels of Software Reuse. (Anderson, 2004) 21

Table 2. Table Definitions. 27

Project Time Table

The following table is a list of the high level tasks and completion dates for the professional project.

Task Description	**Start Date**	**End Date**	**Status**
Literature Review	10/1/2007	10/31/2007	Complete
Research Global Justice XML Data Model (GJXDM)	10/1/2007	10/15/2007	Complete
Research Reuse Approaches	10/15/2007	10/31/2007	Complete
Write Introduction	10/15/2007	11/1/2007	Complete
Write GJXDM and Software Reuse Literature Review Chapter	11/1/2007	11/15/2007	Complete
Technical Design/Development creation and documentation Chapter	11/15/2007	12/31/2007	Complete
Create Findings and Analysis Chapter	1/1/2008	1/15/2008	Complete
Create Conclusion Chapter	1/16/2008	2/3/2008	Complete
Include back matter	2/3/2008	2/15/2008	Working
Complete Thesis		2/24/2008	Planned

References

Ambler, S (2005). Types of Reuse in Information Technology. Retrieved 10:33, September 23, 2007, from http://www.ambysoft.com/essays/typesOfReuse.html

Anderson, Kennith. (2004). Software Methods and Tools. Chapter 10 Software Reuse. Retrieved December 1, 2007, from http://www.cs.colorado.edu/~kena/classes/3308/f04/lectures/lecture10.pdf.

Constructive research. (2007, May 21). In *Wikipedia, The Free Encyclopedia*. Retrieved 14:23, October 18, 2007, from http://en.wikipedia.org/w/index.php?title=Constructive_research&oldid=132426439

Frakes, W. and Terry, C. (1996). Software reuse: metrics and models. *ACM Comput. Surv.* 28, 2 (Jun. 1996), 415-435. DOI= http://doi.acm.org/10.1145/234528.234531

Galorath, Dan. (n.d.) Software Reuse and Commercial Off-the-*S*helf Software. Retrieved December 1, 2007 from http://www.compaid.com/caiinternet/ezine/galorath-reuse.pdf

GJXDM. (n.d.) Global Justice XML Data Model (Global JXDM). Retreived 13:00. September 29, 2007, from http://www.it.ojp.gov/topic.jsp?topic_id=43

GJXDM Schema Subset Generation Tool. (2005) Georgia Tech Research Institute. Retrieved 1018/2007 from http://gjxdmtools.gtri.gatech.edu/ssgt/SSGT-Search.do;jsessionid=EEFFF7C258DB4FAA3D215A22C493DA97

Hsieh, M. and Tempero, E. (2006). Supporting software reuse by the individual programmer. In *Proceedings of the 29th Australasian Computer Science Conference - Volume 48* (Hobart, Australia, January 16 - 19, 2006). V. Estivill-Castro and G. Dobbie, Eds. ACM International Conference Proceeding Series, vol. 171. Australian Computer Society, Darlinghurst, Australia, 25-33.

Kremer, Rob. (n.d.) Software Reuse. University of Calgary. Retrieved September 30, 2007, 11:19:19, from http://sern.ucalgary.ca/courses/cpsc/451/F00/reuse/reuse.html

Krueger, C. W. 1992. Software reuse. *ACM Comput. Surv.* 24, 2 (Jun. 1992), 131-183. DOI= http://doi.acm.org/10.1145/130844.130856

Leveson, N. G. and Weiss, K. A. 2004. Making embedded software reuse practical and safe. In *Proceedings of the 12th ACM SIGSOFT Twelfth international Symposium on Foundations of Software Engineering* (Newport Beach, CA, USA, October 31 - November 06, 2004). SIGSOFT '04/FSE-12. ACM, New York, NY, 171-178. DOI= http://doi.acm.org/10.1145/1029894.1029897

McIlroy, M. D. (1969), Mass produced software components, *in* P. Naur & B. Randell, eds, Proceedings of NATO Software Engineering Conference', Vol. 1, NATO Science

Committee, pp. 138–150. Presented at the NATO conference on software engineering, Garmisch, Germany, 7-11 October, 1968.

Miller, Christa. (2005) Law Enforcement Technology. How law enforcement agencies are implementing GJXDM. Retrieved December 8, 2007 from http://www.crossflo.com/downloads/Law%20Enforcement%20Technology%205-05.pdf

National Information Sharing Standards Knowledge Base and Help Desk. Retrieved October 16th, 2007 from http://it.ojp.gov/NISS/helpdesk/

National Institure of Justice. (2004) Law Enforcement Technology—Are Small and Rural Agencies Equipped and Trained? Retrieved January 20, 2008 from http://www.ncjrs.gov/pdffiles1/nij/204609.pdf.

National Information Exchange Model. (2007). What is NIEM? Retrieved November 18, 2007 from http://www.niem.gov/whatIsNiem.php

NIEM IEPD Tiger Team. (n.d.) Requirements for a National Information Exchange Model (NIEM) Information Exchange Package Documentation (IEPD) Specification. Retrieved December 8, 2007 from http://www.niem.gov/files/NIEM_IEPD_Requirements_v2_1.pdf.

North Carolina. (2006). Final Report. NGA Center for Best Practices 2006 GJXDM Policy Academy. Retrieved December 8, 2007 from http://www.nga.org/Files/pdf/07GJXDMNC.PDF.

Roberts, David. (2007). National Information Exchange Mode (NIEM)l. Executive Introduction. Retrieved December 5, 2007 from http://www.icjia.state.il.us/iijis/public/pdf/2007Summit/IIJIS%20Summit-NIEM%20Presentation.pdf

Romesburg, William. (2005) Law Enforcement TECH GUIDE FOR Small and Rural Police Agencies. Retrieved December 18, 2007 from http://www.cops.usdoj.gov/files/ric/CDROMs/Tribal/law/LETechGuideSmallRural.pdf

Sargent, R. G. 1986. The use of graphical models in model validation. In *Proceedings of the 18th Conference on Winter Simulation* (Washington, D.C., United States, December 08 - 10, 1986). J. R. Wilson, J. O. Henriksen, and S. D. Roberts, Eds. WSC '86. ACM, New York, NY, 237-241. DOI= http://doi.acm.org/10.1145/318242.318312

Sutcliffe, Alistair (2002). The Domain Theory: Patterns for Knowledge and Software Reuse. (pp. 5-6). Retrieved 15:31:24, from http://books.google.com/books?id=lo566pOk-IgC&pg=PA5&lpg=PA5&dq=henry+ford+software+reuse&source=web&ots=4LeKLvFlbH&sig=uNVjjHxN4LAxtAIiFkLzvF9k7IM

SEARCH, the National Consortium for Justice Information and Statistics. (June, 2005). Building Exchange Content Using the Global Justice XML Data Model: A User Guide

for Practitioners and Developers. Retrieved 11/10/07 from http://www.it.ojp.gov/documents/GJXDMUserGuide.pdf

Sall, Kennith. (n.d.) How the US Federal Government is using XML: One Year Later. Retrieved December 16, 2007 from http://www.idealliance.org/proceedings/xml04/papers/150/How-US-Govt-Using-XML-1YL.html#S8.3.2

Sommerville, Ian. (2004). Software Engineering, 7th edition, Chapter 18. Retrieved December 1, 2007 from http://www.comp.lancs.ac.uk/computing/resources/IanS/SE7/Presentations/PDF/ch18.pdf

State of Kansas. (2006). FINAL REPORT ON 2005 NGA GRANT AWARD For the KANSAS GJXDM IMPLEMENTATION PROJECT. Retrieved December 7, 2007 from http://www.nga.org/Files/pdf/0606GJXDM_KS.PDF.

State of Wisconsin. (2007). Final Report on Cascading Disclosure Control Language: Protecting Privacy in Information-Sharing Initiatives Retrieved December 7, 2007 from http://www.nga.org/Files/pdf/0702TAGRANTREPORTWI.PDF.

US Department of Justice – Office of Justice Programs. (2004) Global Justice XML Data Model (Global JXDM). Retreived 13:00. September 29, 2007, from http://www.it.ojp.gov/topic.jsp?topic_id=43

US Department of Justice – Office of Justice Programs. (n.d.) Global JXDM Implementation Guidelines. Retrieved December 16, 2007 from http://it.ojp.gov/topic.jsp?topic_id=138.

Wagner, Winfield. (2007, May). Eliminating the Information Exchange Bottleneck. Retreived 20:47, September 20, 2007, from http://www.officer.com/print/Law-Enforcement-Technology/Eliminating-The-Information-Exchange-Bottleneck/1$36951

Ye, Y., Fischer, G., and Reeves, B. (2000). Integrating active information delivery and reuse repository systems. In Proceedings of the 8th ACM SIGSOFT international Symposium on Foundations of Software Engineering: Twenty-First Century Applications (San Diego, California, United States, November 06 - 10, 2000). D. S. Rosenblum, Ed. SIGSOFT '00/FSE-8. ACM Press, New York, NY, 60-68. DOI= http://doi.acm.org/10.1145/355045.355053

Annotated Bibliography

Ambler, S., Nalbone, J., and Vizdos, M. (2005). Types of Reuse in Information Technology. Retrieved 10:33, September 23, 2007, from http://www.ambysoft.com/essays/typesOfReuse.html

This is a short description of the different reuse approaches by Scott Ambler, John Nalbone, and Michael Vizdos. The description includes a Figure that shows the different approaches of reuse and correlates each of the approaches with the level of difficulty to and the potential benefit. The code reuse approach is the easiest to implement but also has the lowest reuse benefit while the architected reuse is the most difficult but also can provide the most benefit.

GJXDM. (n.d.) Global Justice XML Data Model (Global JXDM). Retreived 13:00. September 29, 2007, from http://www.it.ojp.gov/topic.jsp?topic_id=43

This website is the Global Justice XML Data Model site provided by the US Department of Justice. The website defines what GJXDM consists of, the agencies that support GJXDM, describes the purpose of the standard, tools for GJXDM schemas, FAQs and provides information on agencies that are currently utilizing GJXDM.

Wagner, Winfield. (2007, May). Eliminating the Information Exchange Bottleneck. Retreived 20:47, September 20, 2007, from http://www.officer.com/print/Law-Enforcement-Technology/Eliminating-The-Information-Exchange-Bottleneck/1$36951

An interesting article written by Winfield Wagner and provides a good description of an Information Exchange Package Documentation (IEPD). He defines an IEPD as "…a specific information exchange and provides a structured set of information to completely define the

information being exchanged, the business rules being enforced and the required GJXDM schema sets." He then describes six steps of an IEPD's life cycle and the past successes with IEPDs. The article provides a good process approach to information exchange projects for departments.

Miller, Christa. (2005). How law enforcement agencies are implementing GJXDM. Retrieved on October 6, 2007, from http://www.officer.com/print/Law-Enforcement-Technology/How-law-enforcement-agencies-are-implementing-GJXDM-/1$25170

This article written by Christa Miller and accessible via officer.com provides a clear example of how information sharing among agencies can directly result in being more effective and efficient. The article provides good examples of how agencies are putting the GJXDM standard to work and includes an option for smaller agencies. It also includes an example of how small law enforcement agencies are working towards GJXDM.

Neil, Kurlander. (2005) Tearing down the stovepipes. Retrieved on October 6, 2007, from http://govtsecurity.com/mag/tearing_down_stovepipes/

This article written by Neil Kurlander describes the different data sharing initiatives within the justice community. One particular area of interest within this article is the bullets that list the barriers to sharing data. "Sharing of information about individuals or groups involved in criminal activities is very limited. In fact, a survey conducted by the Major Cities Chiefs Association revealed several problems:

Lack of communication and information sharing — specifically, lack of a centralized analysis and dissemination function, either at the state or federal level, lack of intelligence from federal agencies, and state statutory requirements that present hurdles to sharing information.

Technology issues — specifically, lack of equipment to facilitate a national intelligence data system, lack of interconnectibility of law enforcement and other databases (e.g. immigration services), limited fiscal resources, lack of technological infrastructure throughout the state, and lack of uniformity among computer systems.

Lack of intelligence standards and policies — specifically, lack of common standards for collection, retention, and dissemination of intelligence data; a need for increased local training on legal standards for collection, storage, and purging of data; access to classified data; and lack of standards for determining when to disseminate intelligence to federal agencies.

Lack of intelligence analysis — specifically, lack of compatible analytical software and lack of analytical support, personnel, equipment, and training.

Poor working relationships — specifically, unwillingness of law enforcement agencies to provide information due to parochial interests and a culture within the federal system that does not foster sharing of information or trust between agencies.

(Source: National Criminal Sharing Plan — Oct 2003 — Office of Justice Programs — U.S. Dept. of Justice — GLOBAL Justice Information Sharing Initiative)"

Office of Justice Programs. (2005) Justice Information Sharing Initiatives. Retrieved on October 6, 2007, from http://www.it.ojp.gov/documents/Infoshare_102004_PlusAcronymGlossary.pdf

This 23 page document describes the different information sharing initiatives and components. Things to note is that the document organizes and defines each of the Global Justice Information

Sharing Initiatives, existing information sharing networks, regional information sharing, and other key programs.

Miller, Christa. (2005) Justice XML: What is it, and what does it mean for your agency? Retrieved October 6, 2007, from http://www.officer.com/publication/article.jsp?pubId=1&id=25154

This article was written by Crista Mille and provides a good description of what GJXDM means, why to use it, the benefits, challenges, and how to get involved. The author describes how GJXDM is not just for larger agencies and smaller agencies can get involved. Further it is stated that to become compliant is not expensive to create a web service to communicate with as long as the software is a relational database that can utilize XML for sharing data.

State of Kansas. (2006) FINAL REPORT ON 2005 NGA GRANT AWARD For the KANSAS GJXDM IMPLEMENTATION PROJECT. Retrieved October 7, 2007, from http://www.nga.org/Files/pdf/0606GJXDM_KS.PDF

This three page document provides feedback from the State of Kansas on recent GJXDM efforts and lessons learned. The document presents 7 different questions in which the State provides a response to reflect the project outcomes. Question 3 is "What lessons did you learn about using GJXDM? What worked/what didn't? ", and the response is that GJXDM is not straight forward. The state's response to this question describes that there is effort in both data and process to include business rules.

Georgia Tech Research Institute. (2004) GJXDM Query Options. Retrieved October 14, 2007, from http://justicexml.gtri.gatech.edu/JXDM-query-options-v31.pdf

This is a 40 page document identifies that while GJXDM is a useful standard an additional standard is needed to query GJXDM information. Within the document are different types of query capabilities that might be used. The final conclusion of the research is that as of 2004 there was not a standard query language that can be recommended. However it was identified that a template and a query language have different roles within the information exchange efforts.

The following are a few of the different query language solutions described:

One query solution described is XQuery and some of its limitations as of the writing of this paper. The paper provides information on different vendor solutions to overcome some of the XQuery short falls however these approaches are vendor specific or has additional license costs that make them unavailable to smaller law enforcement agencies.

Another approach described is a query language called SQL/XML as a possible query solution. This solution involves creating a mapping from the XML tables to XML documents. One of the drawbacks to this solution is that it is not available in older database versions and that it requires detailed knowledge of the information source.

A powerful suggestion is called JXQL which was developed by the Georgia Tech Research Institute. This solution overcomes a number of challenges that the other approaches have and that is that it allows for a query to be performed against a different number of data sources that can be mapped to GJXDM. The shortfall of the JXQL approach is that it is not very well known and the design was very preliminary and the details were never completed. JXQL is also only available within the justice community.

Justice Information Sharing and the Courts: Courts Implementing the GJXDM. Retreived 10/18/2007 from http://www.ncsconline.org/d_tech/gjxdm/ctc9/articles/bunis.pdf

This is a 9 page document that describes how four different courts are using the GJXDM standard and the implementation process for the GJXDM projects. For the purposes of this project this paper did not really apply. However it did provide good examples of how GJXDM is helping courts save money and reduce data entry errors by using the standard. It also included some instances where web services are being used for the document delivery.

National Information Sharing Standards Knowledge Base and Help Desk. Retrieved 10/16/2007 from http://it.ojp.gov/NISS/helpdesk/.

This is an interactive web site and knowledge base that allows users to find answers to common questions. This was useful for finding answers to questions about XML Spy.

Organizations Utilizing the Global JXDM. (n.d.) Retrieved 10/16/2007 from http://it.ojp.gov/topic.jsp?topic_id=107

This website provides a list of the different agencies that are undergoing or have implemented GJXDM standard data sharing projects. The list of projects includes a description of the project, the related dates, money aspects and people to contact.

Building Exchange Content Using the Global Justice XML Data Model: A User Guide for Practitioners and Developers. (June, 2005) SEARCH Developed in partnership with SEARCH, The National Consortium for Justice Information and Statistics U.S. Department of Justice Office of Justice Programs Bureau of Justice Assistance.

This 170 page document is a guide to users and developers. The document was prepared with the support of the Bureau of Justice Assistance (BJA), Office of Justice Programs, U.S. Department

of Justice in collaboration with SEARCH, The National Consortium for Justice Information and Statistics. It provides an in-depth description of the GJXDM history, development, structure, object model, use cases, and tools available. The data model was developed using object-oriented concepts including inheritance. This document was valuable in understanding the document creation process and how IEPD's are created.

GJXDM Schema Subset Generation Tool. (2005) Georgia Tech Research Institute. Retrieved 1018/2007 from http://gjxdmtools.gtri.gatech.edu/ssgt/SSGT-Search.do;jsessionid=EEFFF7C258DB4FAA3D215A22C493DA97

This web site has been provided by the Georgia Tech Research Institute and allows agencies to generate subset schemas from the GJXDM. This is a useful tool for agencies to be able to create subsets since it is recommended to use a subset of the GJXDM and not the entire database model.

Hsieh, M. and Tempero, E. (2006). Supporting software reuse by the individual programmer. In *Proceedings of the 29th Australasian Computer Science Conference - Volume 48* (Hobart, Australia, January 16 - 19, 2006). V. Estivill-Castro and G. Dobbie, Eds. ACM International Conference Proceeding Series, vol. 171. Australian Computer Society, Darlinghurst, Australia, 25-33.

This 9 page document describes an approach to software reuse at the individual programmer level as opposed to most research previously performed. The paper describes how to implement a case-based reasoning approach for retrieval. The paper describes the first step in retrieval being the most important and this is called case representation. There are two common structures for case representation flat or hierarchical. The flat structure for retrieval is performed by querying the attributes of the source case with the attributes related to the stored cases. Next the paper described case indexing, retrieval and nearest neighborhood retrieval (NNR).

GJXDM Information Exchange Package Documentation Guidelines. (March, 2005). Published by the GJXDM XML Structure Task Force. Retrieved 11/10/2007 from http://www.it.ojp.gov/process_links.jsp?link_id=4581

This 8 page document presents the guidelines for using an Information Exchange Package Documentation artifact and describes the business need for it. It identifies the development artifacts that can be created during the IEPD process and may be useful for the type of items stored in a software repository.

Search Group, Incorporated. (2002). JIEM© Reference Model. Version 1.0.1. Retrieved 11/11/07 from http://www.search.org/files/pdf/JRM1.0.1.pdf

This 108 page document describes the Justice Information Exchange Model. The document states that the JIEM is made up of four areas: A conceptual framework for data exchange within the justice arena, a method for analyzing current information exchanges and how to improved them through re-engineering, a modeling tool to help agencies implement the model, and a set of common information exchanges to common agencies.

Sargent, R. G. 1986. The use of graphical models in model validation. In *Proceedings of the 18th Conference on Winter Simulation* (Washington, D.C., United States, December 08 - 10, 1986). J. R. Wilson, J. O. Henriksen, and S. D. Roberts, Eds. WSC '86. ACM, New York, NY, 237-241. DOI= http://doi.acm.org/10.1145/318242.318312

This five page document describes how graphical models can be used for model validation. As a part of the IEP documentation creation domain modeling is discussed as one of the steps.

U.S. Department of Justice – Office of Justice Programs. National Information Sharing Standards Knowledge Base and Help Desk. Retrieved November 18, 2007 from http://gjxdm.custhelp.com/cgi-bin/gjxdm.cfg/php/enduser/popup_adp.php?p_sid=Id4Vx2Ri&p_lva=&p_li=&p_faqid=225&p_created=1153343553&p_sp=cF9zcmNoPSZwX3NvcnRfYnk9JnBfZ3JpZHNvcnQ9JnBfcm93X2NudD0yMTkmcF9wcm9kcz0mcF9jYXRzPSZwX3B2PSZwX2N2PSZwX3NlYXJjaF90eXBlPWFuc3dlcnMuc2VhcmNoX25sJnBfcGFnZT0x

This webpage defines the differences between the National Information Exchange Model (NIEM) and Global Justice Information Exchange Data Model (GJXDM). The GJXDM was created first to address justice information sharing and the NIEM model was created with the GJXDM as a subset of it. NIEM not only includes the justice agencies and also covers intelligence and emergency and disaster management.

Georgia Tech Research Institute. (2004) Rules for Schema Subsets. Retrieved November 18, 2007 from http://justicexml.gtri.gatech.edu/rules_for_schema_subsets.html

This website describes the rules that developers need to consider when performing a transformation on a GJXDM schema. It also states that subset schemas are to be used to validate documents rather than the full GJXDM schema due to performance issues that may result.

Romesburg, William. (2005) Law Enforcement TECH GUIDE FOR Small and Rural Police Agencies. Retrieved December 18, 2007 from http://www.cops.usdoj.gov/files/ric/CDROMs/Tribal/law/LETechGuideSmallRural.pdf

This 94 page guide is a tool for small and rural law enforcement agencies to help provide strategies and planning techniques necessary for successful IT project implementations. I found it very useful by the statistics it provides. It states that there are almost 13,000 local police agencies in the U.S. and more than 11,000 or 89.5% have less than 50 officers. It also state that statistics show that local and rural law enforcement are the last to implement new technologies.

Glossary

Data Access Object – A design pattern using in object oriented programming that separates the database interactions from the application and therefore allows for new database communications to be added without impacting the other areas of the application.

XML Schema – A document that describes the structure, data relationships and data formats of an XML document.

Web Service – A way to allows external systems to communicate and share XML documents.

Index

C

Chapter 1 - Introduction 7

Chapter 2 - Review of Literature and Research.....10

Chapter 3 – GJXDM Implementation Process, Tools and Techniques 14

Chapter 4 – Software Reuse Approaches 17

Chapter 5 –GJXDM Message Sharing Tool.....20

Chapter 6 - Findings and Analysis.....39

Chapter 7- Conclusions 42

Conclusion.....44

Current GJXDM Implementation Process.....14

- Conformance.....16
- Domain Modeling.....14
- Domain to GJXDM mapping.....14
- Existing Tools.....17
- Packaging.....14
- Project Inception.....14
- Schema Building.....14

D

Definition of Terms 10

Domain Modeling.....15

Domain to GJXDM mapping.....15

G

GJXDM Findings and Analysis.....39

GJXDM Project Introduction 20

L

Literature and Research Overview 10

P

Project Contributions.....13

- Areas for Improvement.....13

Project Expectations 42

Project Inception.....14

Project Literature and Research.....12

Project Need Statement 7

Project Scope.....9

Project Summary 42

Project Summary of known’s and unknowns 12

R

Research Methodologies.....11

S

Schema Building 16

Software Reuse Approaches

- Benefits.....19

Disadvantages.....20

Software Reuse Techniques.....18

Software Reuse Findings and Analysis 41

T

Thesis Statement.....7

W

What could have been done different 43

Abbreviations

DAO – Data Access Object

DOJ – Department of Justice

DOM – Data Object Model

ERD – Entity Relationship Diagram

GJXDM – Global Justice XML Data Model

GPS – Global Positioning System

IEP – Information Exchange Package

IEPD – Information Exchange Package Documentation

IT – Information Technology

JEIM – Justice Information Exchange Model

MVC – Model, View and Controller

NIEM – National Information Exchange Model

SaaS – Software as a service

URL – Uniform Resource Locator

XDK – Oracle's XML Developer's Kit