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MESSAGE HANDLING TOOLKIT AND IRIS SOFTWARE PRODUCT. OPTION ANALYSIS STUDY FOR
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Defence Research Establishment Valcartier

**MESSAGE HANDLING TOOLKIT
AND
IRIS SOFTWARE PRODUCT**

**OPTION ANALYSIS STUDY
FOR
MCOIN III AND AFCCIS**

Presented to:

**Director General, DREV
2459 Boulevard Pie XI North
Val-Bélair, Québec
G3J 1X5**

Attention: Mr. Jean-Claude Labbé (Scientific Authority)



April 1998

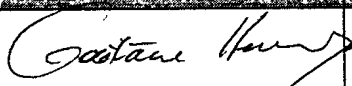


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PREFACE

This document contains the results of an option analysis study involving the Message Handling Toolkit (MHT) application and the IRIS software product¹. The aim of this study was: (a) to investigate the costs of transferring the MHT application from a Sun Solaris platform to a PC Windows NT platform, of extending its functionality, and of using it to meet the message handling needs of the Maritime Command Operational Information (MCOIN III) system and of the Air Force Command and Control System (AFCCIS); (b) to evaluate the costs and investigate the possibility of using IRIS to meet the needs of MCOIN III and AFCCIS in terms of message handling capability; and (c) to evaluate the risks and other technical aspects related to the adoption of one solution or the other. It is important to note that CGI, the contractor involved in that study, has no interest or whatever in the MHT software. For that reason, the results of the study were not biased to promote one of the evaluated products. All the results appearing in this document were approved by the DREV Scientific Authority who can attest of their authenticity. Comments or requests concerning this document should be submitted to:

Jean-Claude Labbé
 Defence Research Establishment Valcartier
 jean-claude.labbe@drev.dnd.ca

| <i>THIS ISSUE</i> | <i>NAME</i> | <i>SIGNATURE</i> | <i>DATE</i> |
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| SUBMITTED BY | <i>HARVEY, Gaétane</i> |  | <i>29/04/98</i> |
| | <i>DUCHESNE, Michel</i> |  | <i>29/04/98</i> |
| REVIEWED/ APPROVED BY | <i>LABBE, Jean-Claude</i> |  | <i>29/04/98</i> |

¹ For a complete description of these software tools, the reader is asked to consult the references listed in Section 2.2

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1. INTRODUCTION

1.1 Scope of Study

From its participation in the NATO Data Fusion Demonstrator (DFD) project over the last five years, DREV gained a great deal of experience with military message handling. In the same period of time, the Information System Technology section at DREV actively participated in the definition and capture of requirements for future Command and Control Information Systems (CCIS). It appears from this requirement definition activity that the handling of structured messages such as ADatP-3, USMTF and OTH T Gold is of major importance for the three Canadian Force (CF) environments (Air Force, Army and Navy). In parallel, research and development (R&D) activities that often involve the development of prototypes to experiment with concepts and technologies also require the use of structured military messages.

It was then important to reuse the effort invested in the DFD project and to propose related activities that could first help or provide support to R&D activities and second guide decision-makers in their choice for a message handling capability. To that end, the following activities were completed:

- the reuse of components developed within the NATO DFD project and the extend of its message handling capabilities to provide a set of tools called the Message Handling Toolkit (MHT) for the manipulation of ADatP-3 and USMTF messages; and
- the evaluation of the IRIS software product based on a set of criteria defined from the knowledge of military message handling capabilities and from CCIS requirements common to the three CF environments (the results of the study provided the concerned or interested people with an understanding of the IRIS message handling system, an indication on its strengths and weaknesses, and an appreciation of how the product can meet their requirements).

The aim of the present study is to pursue the work already done with the IRIS product and the MHT based on the following perspectives:

- investigate the integration of the MHT in MCOIN III and AFCCIS, particularly the costs related to the transfer of the MHT on a PC Windows NT platform and the addition of new functions such as the support of the OTH T Gold message rules;
- evaluate the costs and investigate the integration of the IRIS software product in the MCOIN III and AFCCIS developments; and
- evaluate the risks and other technical aspects related to the adoption of the MHT or of the IRIS product.

1.2 The Message Handling Toolkit (MHT) Application

The MHT was developed at DREV between January and September 1997. The application is issued from work performed for the NATO DFD to support military message handling. The main purpose of the MHT application is to provide a set of tools enabling a user to manipulate ADatP-3 and USMTF messages. Structured messages like ADatP-3 and USMTF offer many advantages to the military users. One of these advantages is that structured formats ensure that messages contents can be correctly understood and interpreted by the different users. For that reason, structured messages become the way to exchange information between different military entities, mainly during national and international tactical military exercises or operations.

On the other hand, it can be very tedious to write such messages if the user is not assisted by appropriate tools. The formats are not easy to remember and the writing of messages is very difficult. To prepare a single message, the user must often navigate through several manuals to get the complete picture of its format.

The MHT provides facilities to enable users to create their own national formats or to use standard NATO ADatP-3 or USMTF formats by using a graphical interface tool. It includes the required functionality to correctly prepare formatted messages and to automatically validate them if the corresponding formats have been previously created using the Message Format Editor. The MHT is a stand-alone application, but it can be integrated with other client applications by using the MHT application library. The application library contains a set of functions allowing developers to access the contents of messages created with the MHT and to integrate them into their own operational databases. The MHT is currently available on a Sun Solaris platform.

1.3 The IRIS Software Product

IRIS is a product developed by Systematic Software Engineering, a Danish software and systems house formed in 1985. The head office and the main technology centre are based in Denmark. Other marketing and support offices are located in other countries such as the United Kingdom, the United States and Germany. The company is developing command, control and communications systems since its creation, but is particularly competent in electronic messaging capabilities based on ADatP-3 formatted messages.

IRIS currently contains two major components: the Message Handling and Formatting System (IRIS/MFS) and the Message Definition System (IRIS/DEF). A third component, the Information Modelling Tool (IRIS/IMT), is presently under development.

IRIS/MFS is a tool for message drafters. It provides facilities and features to enable message preparation, processing and validation. By using IRIS/MFS, the user can edit messages in free-text mode or in assisted mode, release messages for distribution, update an operational database and generate messages automatically from an operational database. IRIS/MFS includes word processor features (cut and paste, copy, etc.), message validation processes at different levels, context-sensitive help and security features, such as audit trails, passwords, operator roles, etc. In addition to the graphical tool used for message drafting and validation, IRIS/MFS provides application libraries enabling developers to incorporate its functionality into their own applications.

IRIS/DEF is a tool for message format drafters. It enables the user to specify and build message format rules such as ADatP-3, USMTF and OTH T Gold. These message rules can then be distributed to the IRIS/MFS operational users. IRIS/DEF uses a NATO ADatP-3 message format database that can be directly imported as a basic database. New message format definitions can also be added to meet national or other specific requirements.

IRIS/IMT is a tool that provides the capability to generate data models directly from either IRIS/DEF or IRIS/MFS. The data model generated with IRIS/IMT represents a message text format in a graphical form. It is then possible to map the representation of the message format with the contents of a relational database. As a consequence, the use of IRIS/IMT facilitates specifications for operational database updating and retrieval operations.

Both the IRIS/MFS and the IRIS/DEF packages are COTS products available on a wide range of computers. The list of IRIS platforms appears in Annex A. A price list of these products appears in Annex B. Some information concerning the future IRIS/IMT capability appear in Annex C.

1.4 Document Overview

- Chapter 2 lists the documents used or referred to during the study.
- Chapter 3 presents an option analysis in terms of costs on the use of the MHT or IRIS in MCOIN III and AFCCIS.
- Chapter 4 includes a brief conclusion on the study.
- Chapter 5 presents the list of acronyms and abbreviations used in this document.

2. REFERENCED DOCUMENTS

2.1 Government Documents

The following government documents should be consulted to facilitate understanding of the study.

- Over-The-Horizon Targeting Gold, Operational Specification, OS-OTG (Rev B), October 1994 , Unclassified
- NATO Message Text Formatting System (FORMETS), ADatP-3 Part I., Change 3, System Concept and Description, October 1993, Unclassified
- NATO Message Text Formatting System (FORMETS), ADatP-3 Part II, Change 9.0, Catalogue of Standard Message Text Formats, February 1995, Unclassified
- NATO Message Text Formatting System (FORMETS), ADatP-3 Part III, Change 9.0, Catalogue of Standard Set Formats, February 1995, Unclassified
- NATO Message Text Formatting System (FORMETS), ADatP-3 Part IV, Change 9.0, Catalogue of Standard Field Formats, February 1995, Unclassified
- Air Force Command and Control Information System (AFCCIS), Statement of Operational Requirements, 3136-1-AFCCIS (SSO ~~Reqs~~ ^{Requirements}), August 1996, Unclassified
- United States Message Transfer Format (USMTF) Systems Standards, AFP 102, Unclassified

2.2 Non-Government Documents

The following non-government documents should be consulted to facilitate understanding of the study.

- IRIS/MFS for Windows NT, User's Manual, Release 2.0, February 1997, Unclassified
- IRIS/MFS Application Libraries, Programmer's Guide, Release 2.0, March 1997, Unclassified
- IRIS/DEF, User's Manual, Release 2.0.0, December 1996, Unclassified
- IRIS/DEF, Administrator's Guide, Release 2.0.0, December 1996, Unclassified
- IRIS, Evaluation Report, Version 1.0, December 1997, Unclassified
- Using the Message Handling Toolkit, Users' Guide, Version 1.0, November 1997, Unclassified
- Message Handling Toolkit, Software Design Document, Version 1.0, November 1997, Unclassified
- Message Handling Toolkit, Application Programming Interface, Version 1.0, November 1997, Unclassified
- Message Handling Toolkit, Models and Data Dictionary, Version 1.0, November 1997, Unclassified

- Message Handling Toolkit, Project Manual and Development Plan, Version 2.0, April 1997, Unclassified
- A Flexible Message Handling Toolkit, DREV TM-9740, December 1997, Unclassified

3. OPTION ANALYSIS

This section includes the evaluation in terms of capabilities and costs of the different options that could be of interest for providing the Canadian Forces, particularly the Navy and the Air Force, with a message handling capability. The following aspects are evaluated:

- the transfer of the MHT application on a PC Windows NT platform, the addition of some required capabilities, particularly the inclusion of the OTH T Gold rules, and the investigation of its use by MCOIN III and AFCCIS;
- the use of the IRIS product as a message handling capability by MCOIN III and AFCCIS; and
- the evaluation of the risks and of other technical aspects related to the adoption of the MHT or IRIS.

3.1 MHT PC Application for MCOIN III and AFCCIS

3.1.1 Foreword

The MHT is currently running on a Sun Solaris platform. One activity of the present study is to evaluate the costs related to the transfer of the MHT software on a PC Windows NT platform and to add a certain number of features and required capabilities. The two interested parties in the use of the MHT on a PC platform are the MCOIN III system and the AFCCIS. For the purpose of the evaluation, the costs are distributed as follows:

- the costs related to the acquisition of software required to transfer the MHT on a PC;
- the costs related to the conversion, integration, tests and installation procedure of the application in the new environment;
- the costs related to the addition of certain features or capabilities to fulfil the needs of MCOIN III (ex. support of OTH T Gold formats and multi-user processing); and
- the costs related to the number of software licences that must be acquired to enable users to run the application.

3.1.2 Current MHT Environment

The MHT application was developed under the Sun Solaris environment. The support software and their versions are listed in Table 1 below. To transfer the MHT on a PC platform, the database, the interface design tool and the Rogue Wave library for such an environment must be acquired. In addition, a C++ development environment, such as C++ Builder or Visual C++ must be available to recompile the application. The GNU parsing tools Flex and Bison are licensed free of charge under the General Public Licence from the Free Software Foundation.

| Software | Used Product |
|------------------|---|
| Operating System | Sun Solaris 2.5 |
| Compiler | SPARCompiler C++ 4.1 (incl. Rogue Wave) |
| Database | ObjectStore 5.0 |
| Interface | Ilog Views 2.3 |
| Parsing Tools | GNU flex 2.4.7 and GNU bison 1.22 |
| Make Utility | GNU make 3.74 |

Table 1 – Current MHT support software

3.1.3 Cost Estimates

3.1.3.1 Software Acquisition

The first step for transferring the MHT on a PC Windows NT platform is to buy the required software products for that platform and to recompile the whole application in the new environment. More specifically, it is necessary to buy the PC development software for the ObjectStore database and for the ILOG interface. A C++ library used for the development of the API must be acquired as well. Table 2 provides detailed information concerning the software acquisition costs. The corresponding quotations are provided in Annex B.

| Companies | Products | Costs (US\$) |
|--|--|---|
| ILOG Contact: Graig Schumpert (Phone: 703-351-9005) | ILOG Views Development Licence Win 95, NT | \$6,500. |
| | Annual Maintenance (15%) | \$ 975. |
| OBJECT DESIGN Contact: Brian Murphy (Phone: 781-674-5116) | ObjectStore DB Development Licence Win 95, NT - 1 client | \$3,050. |
| | Annual Maintenance (15%) | \$ 457. |
| ROGUE WAVE | Tools.h++ 7.0.7 Support | \$ 495. \$ 195. |
| | C++ Development Environment | Approx. \$ 400. |
| TOTAL | | \$12,072. (US\$) or \$16,800 (Can\$) |

Table 2 - Support software costs for the PC Windows NT platform

3.1.3.2 Integration, Development and Documentation

This section provides an evaluation of the effort and costs related to the integration, support and documentation activities. A description of each activity is presented hereafter:

Integration

This activity consists of:

- importing the MHT software from the Sun environment to the targeted PC Windows NT platform;
- review the “makefiles” used in the Sun environment and modify them accordingly to the new environment; and
- recompile and test the whole application into the new environment.

Development

The current version of MHT (on the Sun platform) could be enhanced to include the following functionality:

- *Support the OTH T Gold formatting rules (required capability for the Navy).* For the Navy, the MHT is useless if it does not allow users to create and manipulate OTH T Gold message formats. To support these rules, it is then required to modify the MHT message parser and the interfaces as well. The modifications could be done on the Sun platform before the translation on the PC platform. This would allow to have the same functionality on both platforms and would not necessarily imply additional effort during the conversion process. The particularities of the OTH T Gold rules compared to those of the ADatP-3 or USMTF rules are listed in Annex D.
- *Support multi-users (recommended capability).* The transaction mechanisms implemented into the MHT are not appropriate to support multi-users access to the database. For example, it does not prevent a user to access a message in editing mode when someone else is already editing it. The transaction mechanisms must then be modified to control the multi-user accesses.
- *Support the parsing of conditions (desirable capability).* Specific conditions can be attached to each message format. An example of such a condition is: <the value of Field 1 in Set 5 must be greater than the value of Field 5 in Set 2>. Other conditions are more complex and require having additional knowledge for being verified. For example, a condition can be: <the value of Field 1 in Set 5 must be below Battalion level>. To verify such a condition, it is necessary to have access to a database containing knowledge on the unit hierarchical levels. It is then impossible within a standard message handling tool to verify this type of conditions which are dependent of the context itself and not only of the message formatting rules. The MHT provides the functionality for specifying the conditions attached to a message format, but the message parser itself does not check that the conditions are verified (these conditions could be integrated in each external application depending on the used formats). Integrating the checking of conditions (independent of any external knowledge) into the MHT would require significant efforts since the parser must recognize the syntax of the conditions and this is not an easy process to realize.
- *Reporting capabilities (desirable capability).* This feature refers to the possibility of creating different reports within the MHT and to be able to print them.

Documentation

This activity consists of updating the users' guide of the MHT application.

Table 3 provides an estimate of the effort and costs related to the integration, development and documentation activities described above. This evaluation assumes that the persons involved in the following activities will be the ones that have participated to the development of the MHT application. Otherwise, additional efforts (approximately one month) should be considered for the new person(s) to become familiar with the existing application.

| Activities | Effort (p/d) | Approx. Costs (Can\$) |
|---|---------------------|------------------------------|
| INTEGRATION | | |
| <input type="checkbox"/> Import programs from Sun to PC platform | 2 | \$1,100. |
| <input type="checkbox"/> Update the Sun "makefile" environment in the new PC environment | 3 | \$1,650. |
| <input type="checkbox"/> Compile and test the whole application | 15 | \$8,250. |
| TOTAL for the Integration | 20 | \$11,000. |
| DEVELOPMENT | | |
| <input type="checkbox"/> Support of OTH T Gold rules (parser and interfaces) ² | 60 | \$33,000. |
| <input type="checkbox"/> Multi-users access | 10 | \$5,500. |
| <input type="checkbox"/> Conditions checking | 40 | \$22,000. |
| <input type="checkbox"/> Reporting capabilities | 10 | \$5,500. |
| TOTAL for the Development | 120 | \$66,000. |
| DOCUMENTATION | | |
| <input type="checkbox"/> Updating of the User Guide and online help | 5 | \$2,750. |
| TOTAL | 145 | \$79,500. (Can\$) |

Table 3 - Estimate of costs for the integration, development and documentation effort

The two following subsections (3.1.3.3 and 3.1.3.4) consider two database options (ObjectStore and Oracle) for the MHT application. The MHT is currently developed with ObjectStore, but the possibility of migrating to the Oracle environment is also considered in the evaluation of options since the Oracle RDBMS is widely used within the Canadian Defence organizations.

3.1.3.3 ObjectStore Runtime Licences

A number of client and server licences for the ObjectStore DBMS must be acquired to run the MHT application as it is now. Concerning the use of ILOG Views, DREV has already acquired an unlimited runtime licence allowing to deploy the MHT application within the Canadian National Defense without any extra cost. The Table 4 configuration (number of servers and clients) has been provided to the ObjectStore furnisher and includes quotations he provided.

² The development effort estimated for supporting the rules does not include the population of the database itself with all the existing OTH T Gold formats.

| Target Systems | Number of Servers | Number of Clients | Procurement Timeframe | Costs (US\$) ³ |
|----------------------------|-------------------|-------------------|-----------------------|--|
| MCOIN III | 1 server NT | 100 clients NT | July 98 - Mar 99 | \$4,950. (1 Server) \$63,525. (100 Clients) (include 23% discount) |
| | 2 servers NT | 400 clients NT | Mar 99 - Mar 00 | \$9,900. (2 Servers) \$254,100. (400 Clients) (include 23% discount) |
| TOTAL For MCOIN III | | | | \$332,475. (US\$) or \$465,000 (Can\$) |
| AFCCIS | 2 servers Sun | 25 clients NT | Mar 98- Mar 99 | \$14,500. (2 Servers) \$16,912. (25 Clients) (include 18% discount) |
| | 25 servers NT | 100 clients NT | Mar 99 - Aug 00 | \$101,475. (25 Servers) (include 18% discount) \$63,525. (100 Clients) (include 23% discount) |
| TOTAL for AFCCIS | | | | \$196,412. (US\$) or \$265,000. (Can\$) |

Table 4 - Costs for ObjecStore runtime licences

The ObjecStore price policy is the following:

- a discount of 18% is allowed when the purchased quantity (in a same command order) is 25 or more
- a discount of 23% is allowed when the purchased quantity (in a same command order) is 75 or more

The quotations provided by ObjecStore are included in Annex B. It represents the costs calculated according to their standard sale models. According to the vendor, additional discounts are possible, at least 35% (see special instructions on the quotation form). These discounts are discussed on a case by case basis and are the result of negotiations between the vendor and the buyer.

3.1.3.4 Using Oracle RDBMS Instead of ObjecStore DBMS

Another option that was investigated concerning the MHT application is the possibility of replacing the ObjecStore database by the Oracle RDBMS. This option was considered since Oracle is largely used within the National Defence and most probably at no additional costs. This option implies the complete redesign of the message format database (model, documentation, physical database) and to modify the whole MHT application for replacing all database accesses. A software tool supplied by the Rogue Wave Software company has been identified to facilitate the development of object-oriented applications using

³ An additional annual cost of 15% (of total price) must be considered for software maintenance.

relational databases. This tool called “DBTools.h++” (see Annex E) could greatly simplify the database manipulation by providing a high level access, independent of any database systems. The use of this tool (see involved prices in Table 5) would allow to reuse most of the MHT C++ code and avoid rewriting of the main parser application.

| Company | Products | Costs (US\$) |
|----------------|--|--|
| ROGUE WAVE | DBTools.h++ 2.2.1 (NT) Support | \$ 795. \$ 395. |
| ROGUE WAVE | Oracle Access Library for DBTools.h++ 2.2.1 (NT) Support | \$ 695 \$ 295. |
| TOTAL | | \$2,180. (US\$) or \$3,052. (Can\$) |

Table 5 - Software costs related to the use of DBTools.h++ for accessing the Oracle DB

In addition to the software acquisition costs, it is necessary to add development effort including the following activities:

- build a new data model and physical database and update the documentation;
- modify the whole MHT application; and
- modify the “makefile” environment.

The cost estimates provided in Table 6 are a gross approximation of the effort required to redesign the MHT application using the Oracle RDBMS. The use of any other relational DBMS, such as Sybase, would most probably involve the same level of effort. This effort is not easy to evaluate since it would require a deeper knowledge of the “DBTools.h++” itself and a review of all the MHT programming code to modify.

| Activities | Effort (p/d) | Approx. Costs (Can\$) |
|--|---------------------|------------------------------|
| <input type="checkbox"/> Redesign the database | 45 | \$24,750. |
| <input type="checkbox"/> Modify the whole MHT application | 80 | \$44,000. |
| <input type="checkbox"/> Modify the “makefile” environment | 15 | \$8,250. |
| TOTAL | 140 | \$77,000. (Can\$) |

Table 6 – Costs of development effort when using an Oracle RDBMS

3.1.4 Summary of Costs related to the MHT

The summary of the costs involved by the different approaches for using the MHT in MCOIN III and in AFCCIS appears in Table 7 below. The costs include the development effort related to the conversion of the MHT application from a Sun platform to a PC Windows NT platform, plus the software and runtime licences required depending if either Option 1 (ObjectStore) or Option 2 (Oracle) is selected. The implementation timeframe is estimated to about 4 to 6 months from the starting date if Option 1 is chosen and to about 8 to 10 months if Option 2 is selected.

| Target Systems | Costs related to the conversion of MHT on PC Windows NT | Additional costs related to either Option 1 or Option 2 | |
|---------------------|---|---|-----------------------|
| | | - Option 1 - (ObjectStore) | - Option 2 - (Oracle) |
| MCOIN III | \$96,300. (Can\$) | \$465,000. (Can\$) | \$80,052. (Can\$) |
| AFCCIS | | \$265,000. (Can\$) | |
| Implementation Time | 4-6 months | (only costs related to runtime licences, no additional effort) | 8-10 months |

Table 7 – Summary of costs when using the MHT approach

3.2 Use of IRIS by MCOIN III and AFCCIS

3.2.1 Foreword

IRIS is also a product that is considered by the Canadian National Defence as a possible message handling capability in future command and control information systems. A qualitative evaluation of the software product has been realized last December (see IRIS, Evaluation Report, Version 1.0, December 1997). This evaluation provides the concerned or interested people with an indication on the strengths and weaknesses of the product and with an appreciation of how it can meet their requirements. Furthermore, it should be noted that IRIS has announced last January that additional features would be implemented (see Annex C). These new features will change the evaluation of some criteria in the IRIS evaluation report.

In order to guide the decision-makers in their choice for a message handling capability, the current study includes an estimate of the costs related to the number of software licences that must be acquired to enable users to run the IRIS major components: the Message Formatting System (IRIS/MFS) and the Message Definition System (IRIS/DEF). IRIS/IMT is not considered since it should not be available before the end of calendar year 1998.

3.2.2 Cost Estimates

3.2.2.1 Runtime Licences

Table 8 presents the cost estimates for the acquisition of the IRIS products. The costs are based on the IRIS price list provided by Systematic. This price list could be modified since IRIS is now integrating new features in its list of products (see Annex B). IRIS presently offers three main products:

- IRIS/DEF or the Message Format Editor
Only one copy could be acquired for each the Navy and the Air Force systems. Each site would be responsible to provide the required formats to all other client applications.
- IRIS/MFS or the Message Editor
This application is the main message handling tool. Runtime licences must be purchased for all clients that need to run the application.
- IRIS/Application Libraries
Only one copy should be acquired for each the Navy and the Air Force systems. This library is used by developers needing to access IRIS tools and features through their own applications.

The resulting cost estimates in Table 8 should not be considered as fix since it would probably be possible to negotiate discounts at ordering time . The costs vary also according to the quantity of licences purchased in a same period of time.

| Target Systems | IRIS Products | Number of licences | Costs (Can\$) ⁴ |
|-------------------------|-------------------------------------|--|--|
| MCOIN III | IRIS/DEF (Message Format Editor) | 1 licence for 1 single-user (Unix platform) | \$34,500. ⁵ |
| | Application Libraries (APL) | 1 licence for NT platform | \$28,635. |
| | IRIS/MFS (Message Editor) | 500 clients NT | \$690,000. |
| | IRIS/MFS (Message Editor) | 3 servers NT | \$2,646. |
| TOTAL MCOIN III | | | \$755,781. (Can\$) |
| AFCCIS | IRIS/DEF (Message Format Editor) | 1 licence for 1 single-user (Unix platform) | \$34,500. [\$17,250.] |
| | Application Libraries (APL) | 1 licence for NT platform | \$28,635. [\$14,318.] |
| | IRIS/MFS (Message Editor) | 125 clients NT | \$172,500. [\$110,250.] |
| | IRIS/MFS (Message Editor) | 2 servers Sun + 25 servers NT | \$37,260. ⁶ [\$23,814.] |
| TOTAL for AFCCIS | | | \$272,895. (Can\$) [\$165,632.] |

Table 8 - Costs for the IRIS runtime licences (see Notes below)

⁴ An additional annual cost of 15% (of total price) must be added for software maintenance.

⁵ IRIS/DEF requires an Oracle runtime licence that is not supplied with the product.

⁶ The first 25 IRIS/MFS clients NT licences would cost approximately \$34,500. (Can\$).

The use of IRIS/MFS Lite, which allows editing of formatted messages on a file basis without any transmission mechanism, should also be considered because of its less expensive licence costs. Nevertheless, cost estimates for this particular option are not part of this document.

- Notes:**
- (1) The client and server licences are sold at the same price.
 - (2) There are two different quotations for AFCCIS, the one in squared brackets ([]) is lower if by any chance MCOIN III buys the first 500 licences at full price.
 - (3) IRIS/DEF is used to define new message formats or to modify existing ones. As MCOIN III and AFCCIS operate independently, it would be preferable that each entity get its own licence to handle message formats. The second licence can be purchased at half price. This is also the case for the acquisition of the application libraries.

3.2.3 Summary of Costs Related to IRIS

In the scenario presented above, the full deployment of the IRIS products in the Navy MCOIN III would cost about \$755,781. (Can\$) while for AFCCIS it would cost about \$272,895. (Can\$), if the licences are bought independently (at a different time). These prices could vary for either MCOIN III or AFCCIS depending on which will first order the products and if more than 500 licences are bought at the same time. In the example of Table 8, if MCOIN III buys a full deployment licence, AFCCIS will get its full deployment licence at the reduced price of \$165,632. (Can\$)

3.3 MHT and IRIS Initial Setting and Training

3.3.1 Foreword

This section provides additional information related to the implementation of either the MHT application or the IRIS product. These information concern:

- the costs and recommendations related to the installation and initial configuration of the MHT and IRIS software;
- the costs related to the population of a minimal Message Format Database for both the MCOIN III and the AFCCIS systems;
- the costs related to the training of users and developers to gain an adequate knowledge of the MHT, the IRIS applications, and the software libraries (this last category applies to developers only).

3.3.2 Cost Estimates

3.3.2.1 Installation and Initial Configuration

(a) The IRIS software product

IRIS requires the installation of two separate software tools, IRIS/DEF and IRIS/MFS.

IRIS/DEF is implemented on top of the Oracle RDBMS and the database must first be installed before installing IRIS/DEF. IRIS/DEF is available on Unix platforms and its installation must be done by a person having a good knowledge of the Unix environment. After the installation procedure, several configuration parameters such as user accounts, access rights, user groups, etc. need to be set up by the IRIS/DEF system administrator. It is recommended that the person responsible for the IRIS system administration participates in the training session given by Systematic Software (see Section 3.3.2.3).

IRIS/MFS was installed at DREV on a Windows NT platform and the procedure was quite easy. Nevertheless, it is highly recommended that the software be installed by a person already familiar with Windows NT and such installation procedures, since many configuration parameters must be set correctly to make the application running. Any machine running IRIS/MFS needs to have Windows 95 or Windows NT with a working TCP/IP network protocol. In addition, on the Windows NT machine running the server, an IPX/SPX transport driver must be installed. An IRIS/MFS server can be installed on a PC machine in less than two hours if the person responsible for the installation has experience with such procedures.

In addition to the installation procedure, several configuration parameters such as roles, users, privileges, classification labels, etc. must be set up before starting using IRIS/MFS. These parameters are under the responsibility of a system administrator and are configured by using the IRIS/MFS Administration Tool.

The following information concerning the time required to install IRIS/DEF and IRIS/MFS has been provided by the IRIS software support firm in Ottawa (ref. Don Gilbert, Intelligence Detection Systems, 613-230-0203):

- The installation of an IRIS/DEF application requires approximately 1 day per IRIS/DEF system. This assumes that the installer has sufficient UNIX and ORACLE experience to resolve most of the installation issues.
- The installation of the IRIS/MFS system requires 1 day per server. This does not include the installation times for the clients. The client installation time depends on the method used.

There are two factors which affect the installation of the client software: (a) the operating system used (UNIX vs. NT) and (b) the location of the client software.

Operating System factors

The two considerations for installation of the client software are whether the client is Windows-based or UNIX-based. The UNIX-based product allows remote installation of the software from a central location. If the environment is Windows NT, as it is the case for AFCCIS and MCOIN III, the software must physically be installed or configured on each workstation.

Location of the client software

There are two possible methods for installing clients. The first method (and also the preferred one) is to install the files on the server and share these files over the network. The only configuration issue is that the user environment is setup on each client machine. There is no software installation required.

If the clients can be remotely configured it should take 1 day to configure the baseline client software and test the configuration. The time required to distribute the configuration files to each client must be added. The technician responsible for the installation must physically go to the workstation to configure the software on the machine. This task is estimated to about 15 minutes per workstation.

The second method for installing the software includes the installation and the configuration of the client software on each individual workstation. This task should require approximately .5 day per client (UNIX or Windows NT).

(b) The MHT application

As it exists for now, the MHT is a much simpler application than IRIS. It is a tool used to draft message formats and messages but it does not support the concept of mailbox and does not control the access rights

to messages through user accounts or roles as it is for IRIS. The application does not require configuring any specific parameters. After its installation, it could be ready for use by any user possessing a runtime licence. The MHT application includes the Message Editor, the Message Format Editor and the Message Validation Tool. These are three different applications that are launched from a higher application called MHT.

The installation and configuration efforts required to install the whole MHT application on a Windows NT platform could be limited to the time required to build an installation procedure using an appropriate tool such as Install Shield and the time required to burn the application on CD-ROM (multiple copies). Each user could then proceed to the installation of the MHT on his own computer by himself.

The effort estimated in Table 9 hereafter do not include any effort required to install the underlying database either ObjectStore or Oracle. It is assumed that the system administrator can proceed to the configuration of each IRIS client workstation, only the baseline configuration is taken into account in the following cost evaluation.

| Activities | IRIS | | | | MHT | |
|--|--------------|------------------|--------------|-----------------|--------------------|-----------------|
| | AFCCIS | | MCOIN III | | AFCCIS & MCOIN III | |
| | Effort (p/d) | Cost (Can\$) | Effort (p/d) | Cost (Can\$) | Effort (p/d) | Costs (Can\$) |
| IMPLEMENTATION | | | | | | |
| • Installation (IRIS/DEF) | 1 | \$650. | 1 | \$650. | | |
| • Installation 3 servers (IRIS/MFS) | | | 3 | \$1,950. | | |
| • Installation 27 servers (IRIS/MFS) | 27 | \$17,550. | | | | |
| • Baseline set-up and configuration (IRIS/MFS) | 1 | \$650. | 1 | \$650. | | |
| • Installation MHT | | | | | 7 | \$2,750. |
| • Initial set-up and configuration MHT | | | | | 3 | \$2,750. |
| TOTAL | 29 | \$18,850. | 5 | \$3,250. | 10 | \$5,500. |

Table 9 - Installation costs for IRIS and MHT

3.3.2.2 Initial Message Format Database

The editing and validation of ADatP-3, USMTF or OTH T Gold messages is possible only if the corresponding formatting rules (message formats) exist in the database. A Central Electronic Message Catalog (CEMC), including formatting rules for all NATO ADatP-3 message formats, is maintained by a NATO Agency. From this CECM, a Baseline message formats database containing all message formats "ready for operational use" can be generated to create Mission Files used within the IRIS/MFS. The ADatP-3 Message Format Database can be obtained for free by the Canadian Government from the NATO Agency responsible for it. Then, by using IRIS, all these ADatP-3 message formats are available and do not need to be recreated.

The MHT application does not provide an initial Message Format Database. The user must create all the needed formats by using the Message Format Editor. Another solution that could be conceivable is to obtain the NATO ADatP-3 message formats database and to map its contents with the MHT Message Formats Database. The technical feasibility and the effort for this operation need to be evaluated by comparing the structures of the databases. The current estimates provided in this section concern the creation of an initial database from scratch. The import of existing formats cannot be evaluated for now.

The AFCCIS and MCOIN III systems have estimated that the following message formats that would be required:

- 30 OTH T Gold message formats
- 10 ADatP-3 message formats
- 10 USMTF message formats

The effort required to create these message formats is dependent of the size of each specific message format, some are very simple while others are much more complex and contain many sets and fields (ex. Air Tasking Order). Also, as the database is populated with new sets and fields that can be reused within new message formats, the time required to create them is decreased significantly. In other words, the effort required to populate a message format database decreases as the database is augmented with new fields, new sets and new formats. Table 10 provides a gross estimate of the effort required for populating an initial Message Format Database containing about fifty message formats by using the MHT Message Format Editor. This estimate is based on the time taken to populate one standard message format of medium size by using the Message Format Editor. The estimate provided hereafter could vary from more or less 30 % depending of the content and size of the identified message formats. It was estimated that an average of about one day per format although the first formats could take three to four days to create while the last ones could take only few hours.

| Message Format | Total Effort (d) | Costs (Can\$) |
|---|-------------------------|--------------------------|
| <input type="checkbox"/> OTH T Gold (30 msg) | 30 | \$16,500. |
| <input type="checkbox"/> ADatP-3 (10 msg) | 10 | \$5,500. |
| <input type="checkbox"/> USMTF (10 msg) | 10 | \$5,500. |
| TOTAL | 50 days | \$27,500. (Can\$) |

Table 10 - Initial message format database population

3.3.2.3 Training

This section contains information related to costs for training users and developers in order to adequately understand the MHT and IRIS applications and their software libraries. IRIS courses are held on a regular basis at the Systematic offices in United Kingdom, courses can also be provided on-sites. Table 11 includes both price policies. The prices for on-site courses given by Systematic includes traveling expenses. A combination of several courses would probably decrease the total costs. Not all the courses need to be dispensed to all users and developers. The following list provides some indications to which category of person the courses are addressed:

Introduction to ADatP-3 and IRIS/MFS

This course is addressed to users that create or edit ADatP-3, USMTF, OTH T Gold messages and also to the person responsible for the system configuration and parameters.

Use of IRIS/DEF

This course is addressed to a restricted group of users that are responsible for creating and handling message formats.

Use of IRIS/DEF Management Module

This course is addressed to the IRIS/DEF system administrator

IRIS/MFS Application Libraries

This course is addressed to application developers.

IRIS AQL and MSL

This course is addressed to application developers and system administrators. AQL and MSL are the script languages used to retrieve information or update operational databases. The training on AQL and MSL could be modified as the new IRIS tool called IRIS/IMT is used to map information between message formats and operational database models.

MHT Message Format Editor

This course is addressed to a restricted group of users that are responsible for creating and handling message formats.

MHT Message Editor

This course is addressed to users that create or edit ADatP-3, USMTF, OTH T Gold messages.

MHT Validation Tool

This course is addressed to users that manipulate ADatP-3, USMTF, OTH T Gold messages.

MHT Application Programming Interface

This course is addressed to application developers.

| Activities | No. of Days | No. of Delegates | Approx. Costs (Can\$) |
|--|--------------------|-------------------------|------------------------------|
| IRIS TRAINING (On-Site Courses) | | | |
| <input type="checkbox"/> Introduction to ADatP-3 and IRIS/MFS | 2 | 8 | \$10,120. |
| <input type="checkbox"/> IRIS/DEF | 4 | 6 | \$17,940. |
| <input type="checkbox"/> IRIS/DEF Management Module | 4 | 6 | \$13,340. |
| <input type="checkbox"/> IRIS/MFS Application Libraries | 3 | 6 | \$16,560. |
| <input type="checkbox"/> IRIS AQL and MSL | 3 | 8 | \$16,560. |
| TOTAL for on-site courses for about 6 to 8 participants (including travel expenses) | | | \$74,520. |
| IRIS TRAINING (Scheduled Courses) | | | |
| <input type="checkbox"/> Introduction to ADatP-3 and IRIS/MFS | 2 | 1 | \$1,725. |
| <input type="checkbox"/> IRIS/DEF | 4 | 1 | \$3,450. |
| <input type="checkbox"/> IRIS/DEF Management Module | 4 | 1 | \$3,450. |
| <input type="checkbox"/> IRIS/MFS Application Libraries | 3 | 1 | \$2,588. |
| <input type="checkbox"/> IRIS AQL and MSL | 3 | 1 | \$2,588. |
| TOTAL for scheduled courses for 1 person (excluding travel expenses) | | | \$13, 801. |
| MHT TRAINING | | | |
| <input type="checkbox"/> Preparation for a training session (including course material) | 5 | (max. per session) - | \$2,750. |
| <input type="checkbox"/> Message Format Editor | 2 | 10-15 | \$1,100. |
| <input type="checkbox"/> Message Editor | 2 | 10-15 | \$1,100. |
| <input type="checkbox"/> Message Validation Tool | 1 | 10-15 | \$ 550. |
| <input type="checkbox"/> Application Programming Interface | 2 | 10-15 | \$1,100. |
| TOTAL for preparation and on-site courses for about 10 participants (excluding travel expenses) | | | \$6,600. |

Table 11 – Training Costs

3.3.3 Summary of Costs Related to Initial Setting and Training

Table 12 below presents an overview of costs related to the initial setting of IRIS and MHT, and to train users and developers for these tools. These costs are summarized in three categories: installation and initial configuration, initial Message Format Database, and training.

| Activities | | Costs (Can\$) | |
|--|------------|---|-----------|
| | | IRIS | MHT |
| Installation and Initial Configuration | | \$22,050. | \$5,500 |
| Initial Message Format Database (see Table 10) | OTH T Gold | 0 | \$16,500. |
| | AdatP-3 | 0 | \$5,500. |
| | USMTF | 0 | \$5,500. |
| Training | | \$74,000. (on site) and \$13,801. (scheduled) | \$6,600. |

Table 12 – Summary of costs for initial setting and training

Notes:

1. The creation of an initial Message Format Database with IRIS is not required for ADatP-3 formats, they are provided for free.
2. The training costs for IRIS held on-site apply for about 6 to 8 participants; travel expenses are included.
3. The training costs for IRIS scheduled course apply for 1 participant only; travel expenses are excluded.
4. The training costs for the MHT do not include travel expenses; the number of participants would be preferably between 10 to 15.

3.4 Other Issues

This section highlights two important issues that must be taken into consideration in the present study: the message/information exchange capability and the software support and maintenance service.

3.4.1 Message/Information Exchange Capability

The possibility of exchanging information with external applications is essential when using message handling tools. IRIS/MFS provides both ways of interfacing with external applications. One way is by using the IRIS Application Libraries while the second way provides facilities for direct access to external systems via scripts or programs that are activated at specific time. This data exchange mechanism can, for example, be used to allow the automatic generation of messages from information held in operational databases and inversely operational databases can be updated automatically from specific incoming messages. The way that IRIS/MFS handles the data exchange mechanism is by mapping message text format and database information. A new tool called IMT improves these mapping operations, in particular for mappings involving databases where the current AQL/MSL tool is not considered powerful enough. The use of IRIS/IMT to allow message/information exchange with external applications requires the procurement of a developer module to generate modules and construct mappings and runtime licences to run the written mappings on the actual data (e.g., messages and operational databases). Table 13 below presents the costs related to the acquisition of the IRIS/IMT tool.

| Target Systems | IRIS Product | Number of licences | Costs (Can\$) |
|-----------------------|-----------------------------|---------------------------|----------------------|
| MCOIN III | IRIS/IMT (Modeling Tool) | 500 runtime licences NT | \$64,020. |
| AFCCIS | IRIS/IMT (Modeling Tool) | 125 runtime licences NT | \$16,005. |

Table 13 - Costs for IRIS Modeling Tool

The MHT does not allow such automatic updating and retrieval operations. The way to exchange information created with the MHT is through the MHT Application Programming Interface (API). Client applications must be programmed accordingly to include explicit calls to API methods. The MHT API allows client applications to get information contained in ADatP-3 and USMTF messages created with the MHT Message Editor allowing then updating of the operational databases. There is no functionality allowing the reverse operation that is the generation of ADatP-3, USMTF or OTH T Gold messages from the information contained in an operational database. The effort required to implement the reverse operation capability will be evaluated in another study where the MHT and IRIS capabilities will be faced to the AFCCIS requirements.

3.4.2 Software Support and Maintenance Service

One of the important issues that must be considered in the present study is the support and maintenance service that is offered to users over the lifecycle of the product. IRIS is developed and maintained by Systematic, a software engineering company producing complete and ready-to-use systems and providing periodic upgrade and support to users. Table 14 presents the annual maintenance costs related to the acquisition of the IRIS product.

On the other hand, the MHT has been developed by CGI, a consulting services company, under a DREV contract. CGI does not systematically continue to upgrade and maintain the MHT application. The way that the National Defence can deal with CGI or any other external firms for maintaining and supporting MHT is through outsourcing services. There exist several variants to this type of contract, one is to fix annually a global price for support and maintenance and another to proceed with an estimate based on change requests. The pros and cons, as well as the different parameters of using outsourcing services, must be discussed between both parties to ensure that the maintenance and support services expected for the MHT are well provided during the complete lifecycle. The benefit of using the MHT compared to those of using a COTS product such IRIS should be clearly demonstrated.

| Target Systems | IRIS Products | Maintenance Costs (15%) |
|-----------------------|--|--------------------------------|
| MCOIN III | IRIS/DEF (Message Format Editor) | \$5,175. |
| | Application Libraries (APL) | \$4,301. |
| | IRIS/MFS (Message Editor) | \$96,030. |
| | IRIS/IMT (Modeling Tool) | \$9,603. |
| | TOTAL for Navy MCOIN III per year | \$115,109. (Can\$) |
| AFCCIS | IRIS/DEF (Message Format Editor) | \$5,175. |
| | Application Libraries (APL) | \$4,301. |
| | IRIS/MFS (Message Editor) | \$24,007. |
| | IRIS/IMT (Modeling Tool) | \$2,400. |
| | TOTAL for AFCCIS per year | \$35,883. (Can\$) |

Table 14 – Support and Maintenance costs for IRIS

3.5 Summary of All Costs

The previous sections have detailed the various costs involved if MCOIN III and AFCCIS choose either the MHT or IRIS as their message handling capability. These costs are summarized in two tables. Table 15 lists all costs related to the adoption of the MHT and Table 16 those related to the adoption of IRIS.

| | Conversion On PC Windows NT and addings (Tables 2 +3) | PC ⁷ Option 1 (Object Store) (Table 4) | PC Option 2 (Oracle) (Tables 5+6) | Installation (Table 9) | Message Formats (Table 10) | Training (Table 11) |
|---------------------|---|---|--------------------------------------|------------------------|-------------------------------------|----------------------------|
| MCOIN III | \$96,300. | \$465,000 | \$80,052. | \$5,500. | \$27,500. | \$6,600. For 10-15 persons |
| AFCCIS | | \$265,000 | | | | |
| Implementation Time | 4-6 months (to be done in parallel) | 0 | 8-10 months (to be done in parallel) | 0.5 month | 2.5 months (to be done in parallel) | N/A |

Table 15 – Summary of costs (Can\$) related to the MHT

| | Licences ⁸ (Table 8) | Intallation (Table 9) | Message Formats | Training (Table 11) | IRIS/IMT Product (Table 13) | Maintenance ⁹ (Table 14) |
|-----------------------------------|---------------------------------|---|----------------------------|---|-----------------------------|-------------------------------------|
| MCOIN III | \$755,781. | \$18,850. | Probably already available | \$74,250. On-site for 6 to 8 persons or | \$64,020. | \$115,109. annual |
| AFCCIS | \$272,895. | \$3,250. | | \$13,801. for 1 person at company site | \$16,005. | \$35,883. annual |
| Implementation Time ¹⁰ | N/A | 1.0 month for AFCCIS and 0.25 month for MCOIN III | N/A | N/A | N/A | N/A |

Table 16 – Summary of costs (Can\$) related to IRIS

⁷ Costs could be lower after negotiation.

⁸ Costs could be lower after negotiation and procurement of more than 500 copies.

⁹ Note that there is no maintenance column for the MHT (not yet a COTS product).

¹⁰ Installation time is different for AFCCIS than MCOIN III due to the number of servers and their sites.

4. CONCLUSION

An analysis of the estimated costs contained in Tables 15 and 16 clearly shows that the MHT/Oracle option is by far the less expensive (\$220,353.00 plus the costs for implementing a certain number of required features) to cover the full deployment of MCOIN III and AFCCIS. The MHT/ObjectStore option is more expensive (\$859,300.00) but will be shorter to implement. On the other hand, the IRIS option is definitely the most expensive one (\$1,134,575.00), but in returns offers more capabilities. The costs for training and maintenance, which are not included in the above mentioned figures, are not negligible and should be taken into account by the decision makers.

The MHT and IRIS are two message handling system including different sets of capabilities. Although both systems include the functions to prepare message formats, edit messages and validate their contents, IRIS has a much wider scope and surely offers much more than what will be required to fulfil the MCOIN III and AFCCIS requirements. At the request of the AFCCIS project a study is being completed to evaluate the MHT and IRIS capabilities versus the project requirements. The results of this study should certainly clarify the last assumption.

IRIS is a well supported COTS product. This fact gives IRIS a significant advantage on the MHT which unfortunately is not yet commercialized. Nevertheless, there are plans to commercialize the MHT capabilities as part of a U.K. product called BEASST (Battlespace Event Analysis and Simulation Support Tool) which should be available by the beginning of 1999. This fact should certainly be taken into consideration, since Canada will receive royalty out of this new product.

It is also planned to port the MHT software on an unexpensive PC environment and to add a communication layer to allow reception and sending of messages. Although this PC version might not be supported as a COTS product, it could certainly be of great value as message handling capability for research activities and experimental CCIS developments.

5. ACRONYMS AND DEFINITIONS

| | |
|------------|--|
| ADatP-3 | Allied Data Publication 3 |
| AFCCIS | Air Force Command and Control Information System |
| API | Application Programming Interface |
| CCIS | Command & Control Information System |
| CEMC | Central Electronic Message Catalogue |
| CF | Canadian Forces |
| DB | Database |
| DBMS | Database Management System |
| DFD | Data Fusion Demonstrator |
| DREV | Defence Research Establishment Valcartier |
| IRIS/DEF | IRIS Definition System |
| IRIS/IMT | IRIS Information Modeling Tool |
| IRIS/MFS | IRIS Message Formatting System |
| MCOIN | Maritime Command Operational Information |
| MHT | Message Handling Toolkit |
| MTF | Message Text Format |
| MTFID | Message Text Format Identifier |
| OTH T Gold | Over-The-Horizon Targeting Gold |
| R&D | Research and Development |
| RDBMS | Relational Database Management System |
| USMTF | United States Message Text Format |

ANNEX A

IRIS Platforms

IRIS/MFS Platforms

- SCO-ODT
- SUN/OS 4.1.x
- Solaris 2.x/Intel
- Solaris 2.x
- IBM AIX 3.2
- IBM AIX 4.1
- HP-UX
- Digital Unix/Alpha
- Windows 3.1x
- Windows 95/NT

IRIS/DEF Platforms

- SCO-ODT
- Solaris 2.x
- HP-UX

ANNEX B

COTS Products – Price List

ILOG Quotation



To: Gaetane Harvey
CGI

Phone: (418) 844-4675
Fax: (418) 844-4538

Fr: Craig Schumpert
ILOG Inc.
2525 Wilson Blvd.
Arlington, VA 22201

Phone: (703) 351-9005
Fax: (703) 351-7775

Quote # 970220
Date: 2/20/98

| Items | Product | Qty | Unit Price | Cost |
|-------|---|-----|------------|-------------|
| | ILOG License | 1 | \$6,500 | \$6,500.00 |
| 1 | ILOG Views Development License - Win 95, NT | 1 | \$975 | \$975.00 |
| 2 | Annual Maintenance / Technical Support | 1 | \$10,000 | \$10,000.00 |
| 3 | ILOG Views Development License - HP UX | 1 | \$1,500 | \$1,500.00 |
| 4 | Annual Maintenance / Technical Support | | | |
| | | | Total | \$18,975.00 |

Terms and Conditions

- * Price Quotation is valid for 30 days.
- * Terms are Net 30 days.
- * Prices are FOB Mountain View, California
- * All prices are in US Dollars
- * Acceptance of Shrinkwrap Software License for each ILOG software product purchased.
- * Maintenance includes hotline support, email, and minor upgrades.
- * Annual maintenance fee is 15% per development license list price.
- * All UNIX Development licenses are floating except for ILOG Server which is priced per CPU.

ILOG C++ Software Components, Training, Maintenance, Consulting

| | |
|---|----------|
| Build interactive graphic-intensive and portable interfaces | VIEWS |
| Develop distributed applications | BACKER |
| Build real-time groupware applications | SERVER |
| Connect RDBMSs to C++ applications | DB LINK |
| Monitor data in a real-time environment | RULES |
| Solve resource management problems with constraint processing | SOLVER |
| Solve scheduling applications | SCHEDULE |

Object Design, Inc. Order Supplement

25 Mall Road Burlington, MA 01803
 TEL: (781) 674-5000
 Fax: (781) 674-5461

Brian Murphy 781-674-5116

Bill-to Address:
 CGI-DREV

Agreement #: Shrink Wrap

**Please reference Agreement# on customer P.O.*

Quote Date: 20-Feb-98

Ship-to Address:
 CGI-DREV

Contact Name: Accounts Payable
 Telephone:
 Fax:
 Terms: NET 30

Contact Name: Gaetane Harvey
 Telephone:
 Fax:
 EMAIL:

Taxable? Y N (Circle one)
 (Attach tax exempt certificate)

Sales Agent: Brian Murphy

Territory: I-NE

County:

Sales Admin.: Caroline B.

Quote Exp. Date: 20-Mar-98

Customer PO #:

| PRODUCT NUMBER | PRODUCT DESCRIPTION | QTY | UNIT PRICE | EXTENDED PRICE |
|---------------------------|---|----------|-------------------|--------------------------------|
| SW-OS-NT9-NSS DISCOUNT | On-line Runtime Server/NT Volume Discount of 18% | 30 1 | \$1,950.00 18% | \$148,500.00 (\$26,700.00) |
| SW-OS-NT9-RTC DISCOUNT | ObjectStore Runtime Client/NT Volume Discount of 23% | 625 1 | \$825.00 23% | \$515,625.00 (\$118,593.75) |
| SW-OS-NT9-DVC | Development Client/NT | 1 | \$3,050.00 | \$3,050.00 |
| SW-OS-HPU-DVC | Development Client/HP | 1 | \$4,950.00 | \$4,950.00 |
| MN-ST | Hotlines & Updates for 1 Year | 1 | \$120,982.50 | \$120,982.50 |
| | | | | \$647,813.75 |

Special Instructions: Software Maintenance is priced at 15% of List Price. Participation in the Systems Integrator program will allow for discounts to be increased an additional 35% based on these volumes, which is a very common practice among our US Government Contractors. Additionally, a site license would be most cost effective and provide the government the most flexibility with respect to number of licenses and platforms for deploying the application. If this is of interest, Object Design can provide further details when the need arises.

Object Design and the Customer agree that the products listed above are provided by Object Design to the Customer subject to the terms and conditions of the above-referenced Agreement.

Customer Acceptance
 Signature _____
 Name _____
 Title _____
 Date _____

Object Design Acceptance
 Signature _____
 Name Kevin F. Colliton
 Title Director of Sales Operations
 Date _____

SYSTEMATIC

software engineering limited

The Coliseum

Riverside Way - Camberley

Surrey GU15 3YL - UK

Tel: 01276 675533 - Int: 44 1276 675533

Fax: 01276 675544 - Int: 44 1276 675544

e-mail: ssel@systematic.co.uk

Mr Vaughn Brennan,
IDS Inc.,
66 Slater Street, Suite 600,
Ottawa, Ontario,
Canada. K1P 5H1,

12 February 1998

Ref: SSEL/96144/PPS/297

Dear Vaughn,

QUOTATION

This quotation covers the provision of IRIS products and product maintenance for the IRIS Message Formatting System (IRIS/MFS), IRIS/MPS Application Libraries and the IRIS Definition System required by IDS Inc., for sale to the Defence Research Establishment Valcartier (DREV). The maintenance for these products will be for a period of year from the 1st day of the month following delivery by IDS Inc. Thereafter maintenance will be due for renewal on the anniversary of that date.

This quote is valid until 30th June 1998.

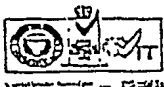
| Product Description | Unit Price (Can\$) | Qty | Total (Can\$) |
|---|--------------------|-----|---------------------|
| IRIS/MFS Servers x 30 with the following IRIS/MFS Clients: | 1,380.00 | 500 | 690,000.00 |
| IRIS/MFS Client Run-time Licences x 500 | 882.00 | 125 | 110,250.00 |
| IRIS/MFS Client Run-time Licences x 125 | 192.06 | 625 | 120,037.50 |
| Annual Maintenance for above IRIS/MFS licences | 128.04 | 625 | 80,025.00 |
| IRIS/MFS Information Modelling Tool (IMT) Run-time Licences (Option) | 19.21 | 625 | 12,006.25 |
| Annual Maintenance for IRIS/MFS IMT Run-time Licences (Option) | | | |
| IRIS/MFS Application Libraries (1 st licence) | 28,635.00 | 1 | 28,635.00 |
| Annual Maintenance for IRIS/MFS Application Libraries (1 st licence) | 4,301.00 | 1 | 4,301.00 |
| IRIS/MFS Application Libraries (2 nd licence) | 14,318.00 | 1 | 14,318.00 |
| Annual Maintenance for IRIS/MFS Application Libraries (2 nd licence) | 4,301.00 | 1 | 4,301.00 |
| IRIS/DEF Multi-user Licence | 103,040.00 | 2 | 206,080.00 |
| Annual Maintenance for IRIS/DEF Multi-user Licence | 15,456.00 | 2 | 30,912.00 |
| IRIS/DEF Management Module (Option) | 34,500.00 | 2 | 69,000.00 |
| Annual Maintenance for IRIS/DEF Management Module (Option) | 5,175.00 | 2 | 10,350.00 |
| Total Price (Can\$): | | | 1,380,215.75 |

These prices are subject to Systematic's terms and conditions overleaf.

For and on behalf of

SYSTEMATIC
software engineering

Tom Patterson
A. D. Patterson
Managing Director




Registered Office
27 Edon Square
Reading - Berkshire RG1 4DP

Registered
in England and Wales
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No.: 591 8535 06



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A form is available to customize the order form display.

Prices are per developer per platform. Unless otherwise noted, support price includes product updates, and telephone customer support for one year.

Products are source code unless otherwise noted. Software is available on CD, 3 1/2" disks, or via the Internet. Other media may be available upon request. Products are shipped with online documentation; printed manuals are available at additional cost. Products that require Tools.h++ must be compiled with Tools.h++ source code.



| Database Products | | | | | | |
|---|---------------|----------------|---------|----------|--------------|---|
| Product | Platform | Type | Version | Item No. | Price (US\$) | Notes |
| DBTools.h++ Core Library Requires purchase of at least one access library. Requires Tools.h++ 7.0.7 or greater. | Unix | Software | 2.2.1 | 31101 | \$1295 | |
| | | Support | | 31301 | \$495 | |
| | OS/2 | Software | 2.1.1 | 32101 | \$795 | |
| | | Support | | 32301 | \$395 | |
| | Windows | Software | 2.2.1 | 34101 | \$795 | 3.1/NT/95 |
| | | Support | | 34301 | \$395 | |
| | Full Platform | Software | 2.2.1 | 35101 | \$2090 | includes all platforms, licensed to a single developer. |
| | | | Support | | 35301 | \$890 |
| | | Printed Manual | | | 36601 | \$50 |
| | Product | Platform | Type | Version | Item No. | Price (US\$) |
| Oracle Access Library for DBTools.h++ Requires DBTools.h++ Core Library. | Unix | Software | 2.2.1 | 31102 | \$1195 | |
| | | Support | | 31302 | \$395 | |
| | OS/2 | Software | 2.1.1 | 32102 | \$695 | |
| | | Support | | 32302 | \$295 | |
| | Windows | Software | 2.2.1 | 34102 | \$695 | 3.1/NT/95 |
| | | Support | | 34302 | \$295 | |
| | Full Platform | Software | 2.2.1 | 35102 | \$1890 | includes all platforms, licensed to a single developer. |
| | | | Support | | 35302 | \$690 |
| | | Printed Manual | | | 36602 | \$25 |
| | Product | Platform | Type | Version | Item No. | Price (US\$) |
| Sybase DB-Library Access Library for DBTools.h++ | Unix | Software | 2.2.1 | 31103 | \$1195 | |
| | | Support | | 31303 | \$395 | |
| | OS/2 | Software | 2.1.1 | 32103 | \$695 | |
| | | Support | | 32303 | \$295 | |
| | Windows | Software | 2.2.1 | 34103 | \$695 | 3.1/NT/95 |
| | | Support | | | | |

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SOFTWARE

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If you are outside of our North American pricing area, please use our international price list.

Customized display, including:
 Product Lines: Foundation
 Platforms: Unix, OS/2, Windows, Full Platform,
 Languages: C++, Java

Prices are per developer per platform.
 Unless otherwise noted, support price includes product updates, and telephone customer support for one year.

Products are source code unless otherwise noted. Software is available on CD, 3 1/2" disks, or via the Internet. Other media may be available upon request. Products are shipped with online documentation; printed manuals are available at additional cost. Products that require Tools.h++ must be compiled with Tools.h++ source code.



| Foundation Products | | | | | | |
|---|---------------|----------------|---------|----------|--------------|--|
| Product | Platform | Type | Version | Item No. | Price (US\$) | Notes |
| <u>Tools.h++</u> | Unix | Software | 7.0.7 | 21101 | \$495 | 3.1/NT/95 includes all platforms, licensed to a single developer. |
| | | Support | | 21301 | \$195 | |
| | OS/2 | Software | 7.0.3 | 22101 | \$495 | |
| | | Support | | 22301 | \$195 | |
| | Windows | Software | 7.0.7 | 24101 | \$495 | |
| | | Support | | 24301 | \$195 | |
| | Full Platform | Software | 7.0.7 | 25101 | \$990 | |
| | | | | 25301 | \$390 | |
| | | Printed Manual | | 26601 | \$45 | |
| | Product | Platform | Type | Version | Item No. | |
| <u>Tools.h++ Professional</u> Includes Tools.h++ | Unix | Software | Unknown | 21112 | \$1195 | includes all platforms, licensed to a single developer. |
| | | Support | | 21312 | \$395 | |
| | Windows | Software | Unknown | 24112 | \$1195 | |
| | | Support | | 24312 | \$395 | |
| | Full Platform | Software | Unknown | 25112 | \$2030 | |
| | | | | 25312 | \$670 | |
| | | Printed Manual | | 26612 | \$75 | |
| Product | Platform | Type | Version | Item No. | Price (US\$) | Notes |
| | Unix | Software | 1.2.2 | 21103 | \$295 | |
| | | Support | | 21303 | \$195 | |

ANNEX C

Extended IRIS Capabilities

Messenger

THE IRIS NEWSLETTER

JANUARY 1998

It has been another year of exciting progress, with further product improvements and the introduction of our new Information Modelling Tool. We now have many more customers and new IRIS distributors - so a warm welcome to them all.

Messenger's lead article is a comprehensive review of the new modelling tool, followed by a sneak preview of the new features and functionality you can expect in version 2.1 of IRIS/MFS, due out in the next couple of months.

So, along with the usual selection of technical reviews, customer profiles, events and training information, issue three of *Messenger* has something for everybody!

Tony Patterson,
Managing Director, Systematic U.K.

CONTENTS

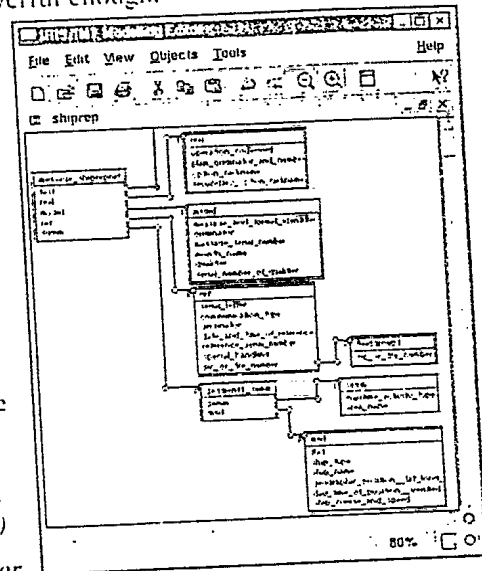
- Information Modelling Tool
- IRIS/MFS v 2.1
- Mission File Management
- IRIS/MFS v 2.1 cont.
- US Activities
- New Message Formats
- IRIS Down Under
- IMT cont.
- FOCSLE Case Study
- IRIS User Group
- Training Course Schedule
- Events
- The Web Site
- The Distributors

IRIS IMT

The Information Modelling Tool (IMT) is a new product in the IRIS/AMH range which addresses a request for improved mapping capabilities, in particular mappings involving databases, where the current AQL/MSL tool is not considered powerful enough.

The IMT uses a data abstraction that hides the actual format of the data element involved in these mappings. This makes it possible when writing mappings to shift the focus from the actual data formats to the information to be mapped. The IMT presents the data models in a graphical format and the mappings between the data models as textual descriptions. The IMT includes facilities to automatically generate data models of databases and MTFs. The IMT can also be used in the development of Information Exchange Requirements (IERs), where it is used to prepare an unambiguous data model of the IER. (continued in centre pages)

The IMT Modelling Editor

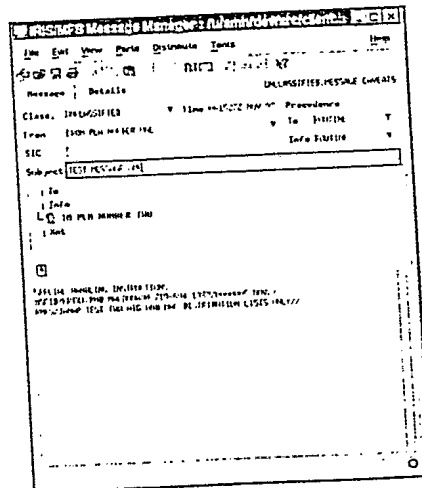


IRIS/MFS V 2.1

As announced at the IUG in Venice, and taking into account the customer feedback, this version of IRIS/MFS will focus on improving not just the editor capabilities, but also the Repository/Message Manager areas. A number of customers have requested enhancements and many of these are now under development. Features included in IRIS/MFS version 2.1 are:

- Re-designed Message Manager
- Re-designed Address Book
- Extended Generic Envelope
- Extended Admin Tool
- Chop-chain Functionality

The New Message Manager

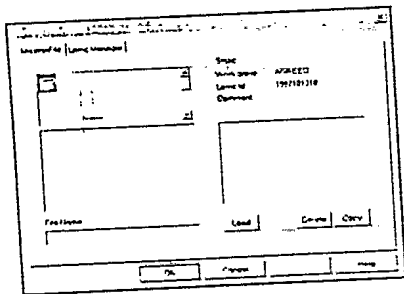


SYSTEMATIC
SOFTWARE ENGINEERING

MISSION FILE MANAGEMENT

The mission file part of both IRIS/DEF and IRIS/MFS needed to be extended to incorporate the changes for handling ADFORM and VMF messages. As this work was necessary the opportunity was taken to re-write this area of software to improve quality and increase speed (speed of generation of mission files in IRIS/DEF and speed of loading mission files into IRIS/MFS).

The improved capability enables the production of mission files from both the working and the baseline table spaces in IRIS/DEF making it possible to test MTF definitions before being baselined, i.e. shortening the turnaround time from defining the MTF to testing it in IRIS/MFS. Old mission files can of course be imported into IRIS/MFS 2.1 - and it is also possible to generate 'old style' mission files in order to support existing installations.



Mission File/LEMC Manager

In addition to the changes above, we have added a GUI for managing the mission files, i.e. for browsing the contents of a mission file and for loading mission files into IRIS/MFS. Another new feature is the ability to activate and deactivate individual message definitions among those already loaded into IRIS/MFS - making it possible to retain a subset of a mission file.

IRIS/MFS V 2.1

- Re-designed Message Manager with support for the extended Generic Envelope, including working of native formats such as ACPI27, JANAP128, EMAIL, STANAG 4406, DD173 etc.

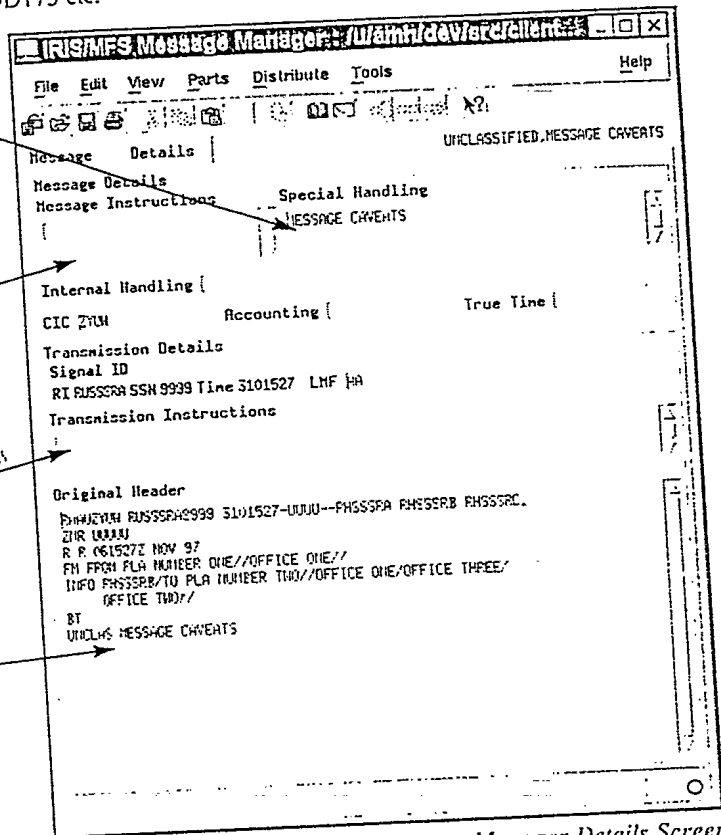
- Extended Generic Envelope with built-in support for ACPI27, JANAP128, EMAIL and DD173 formats. Interfaces to follow include ACPI26, MAPI and STANAG 4406 (X/Open API) support.

Special Handling
ACPI27,
JANAP 128,
Format Line 4

Operating Signals
ACPI27,
JANAP 128,
Format Line 5

Operating Signals
ACPI27,
JANAP 128,
Format Line 4

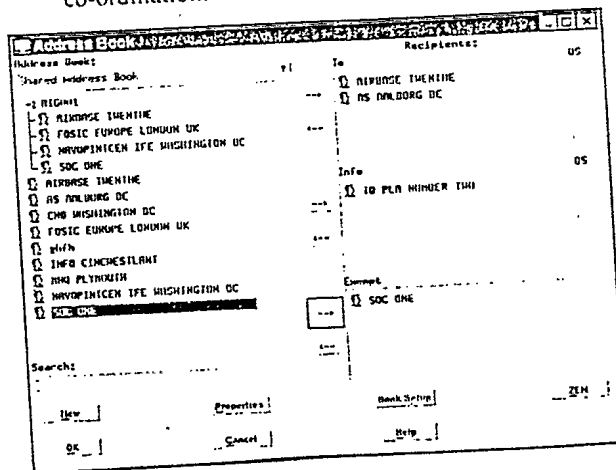
Header
Free Text



New Message Manager Details Screen

- Chop-chain Functionality, making it possible to perform sequential co-ordination as well as the existing parallel co-ordination. The co-ordination mechanism is also enhanced making it possible to see the status of a message out for co-ordination.

- Extended Admin Tool for activating/de-activating individual formats/interfaces as well as defining interface-specific configuration information.



Re-designed Address Book

- RI/PLA addresses, including Office Symbols, EMAIL addresses
- Address groups
- Search on addresses
- Personal/role-based/shared address books

New IRIS/MFS Address Book

U.S. Activities

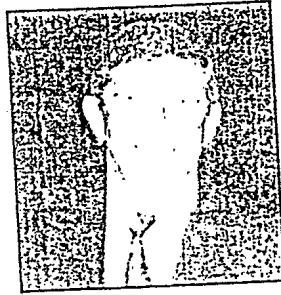
Systematic's efforts to introduce IRIS in the USA have been very well received by potential DoD customers. As well as introducing IRIS to US customers, we have also been active in obtaining the necessary certifications required by major DoD programs.

DII COE Compliance

Principally we have made major strides in the areas of the Defense Information Infrastructure Common Operating Environment (DII COE), a "plug and play" environment where products must qualify and conform to a set of technical rules. These rules allow systems to be modular enabling easy integration. The US Air Force and the US Joint Staff are sponsoring IRIS through this process.

Mil Standard 6040 Compliance

Military Standard 6040 is the set of rules (or standards) that need to be met in order that products be "allowed" to process United States Message Text Formats (USMTF). Last July, IRIS underwent Mil Standard 6040 (USMTF) compliance testing at Ft.



Richard Muirragui
Executive Vice President

Huachuca, Arizona. As a result of these tests, we are now conformant to the USMTF '97 baseline for Windows NT, Solaris 2.5.1 and HP-UX 10. Our software is also ready for USMTF '98 Joint Interoperability testing in the early part of 1998.

Other Efforts

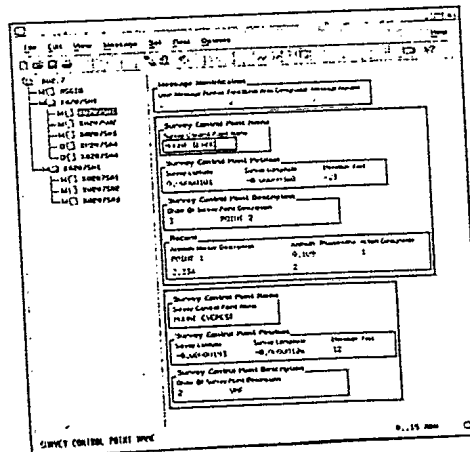
Lockheed-Martin Federal Systems is integrating the IRIS/MFS Body Editor into a Defense Message System User Agent for a Proof-of-Concept to be shown in early January 1998. DISA is also evaluating IRIS/DEF as the possible solution for configuration management administration of US baselines.

New Message Formats - ADFORM & VMF

Two new formats have been added to the range of formats handled by IRIS - ADFORM (Australian Defence Formatted Messages) and VMF (Variable Message Formats). The Australian ADFORM standard, is derived from USMTF, but contains significantly different ways of specifying field definitions and conditions on a message. ADFORM is primarily used in Australia and New Zealand with an allied subset being a true subset of USMTFs.

The US VMF standard continues to be developed and the message catalogue is expanding. IRIS/MFS is capable of handling VMFs by working on them in the IRIS Body Editor in the same way it would a USMTF or ADFORM message. VMF messages are bit-oriented not character based as USMTFs and ADFORM messages and

therefore not man-readable. However, the structure of the messages is not entirely different from USMTFs or ADFORM messages and for that reason IRIS is able to handle VMFs. We will continue to monitor the VMF standard as it develops and implement necessary changes as they emerge.

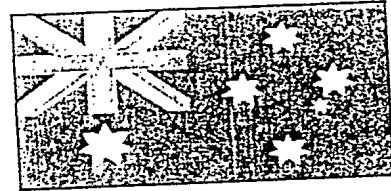


VMF Message in IRIS/MFS Body Editor

IRIS Down Under

After a short period of evaluation, during which IRIS was compared with competing Australian software products, IRIS was selected for integration into phase 3.1 of the Australian Army Command Support System (AUSTACSS). Systematic were contracted to supply the IRIS software on the understanding that the changes necessary to handle ADFORMs were incorporated.

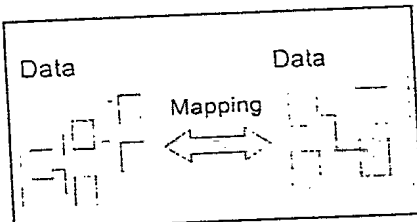
The modified IRIS software was delivered to CelsiusTech Australia at the end of October 1997 and is now being integrated into AUSTACSS. However, Systematic have not only provided the facility to prepare and validate ADFORM messages, but have also modified the IRIS Definition System such that it can be used to modify existing and generate new message types. IRIS/DEF can be used to manage the ADFORM standard in the same way that NATO uses IRIS/DEF to manage the ADFORM standard.



Systematic have now signed an agreement with the Computat Research Pty Limited for the sole distributorship for the IRIS product in Australia and New Zealand. Computat is an Australian based company with a subsidiary in the UK. The Computat Messaging System has already been integrated with IRIS for two major UK Ministry of Defence projects. Many IRIS opportunities have also been identified in Australia and New Zealand. Systematic welcome the agreement with Computat and look forward to a long and rewarding association.

DATA PRESENTATION

The main principle behind the IMT is to build a data abstraction, hiding the actual formats of the elements involved in the mappings. The data abstractions are called *data models* and are presented in the IMT in a graphical format. The mapping is a textual description of how the data in one data model is mapped to the data in the other data model.



Data Models and the associated mapping between them

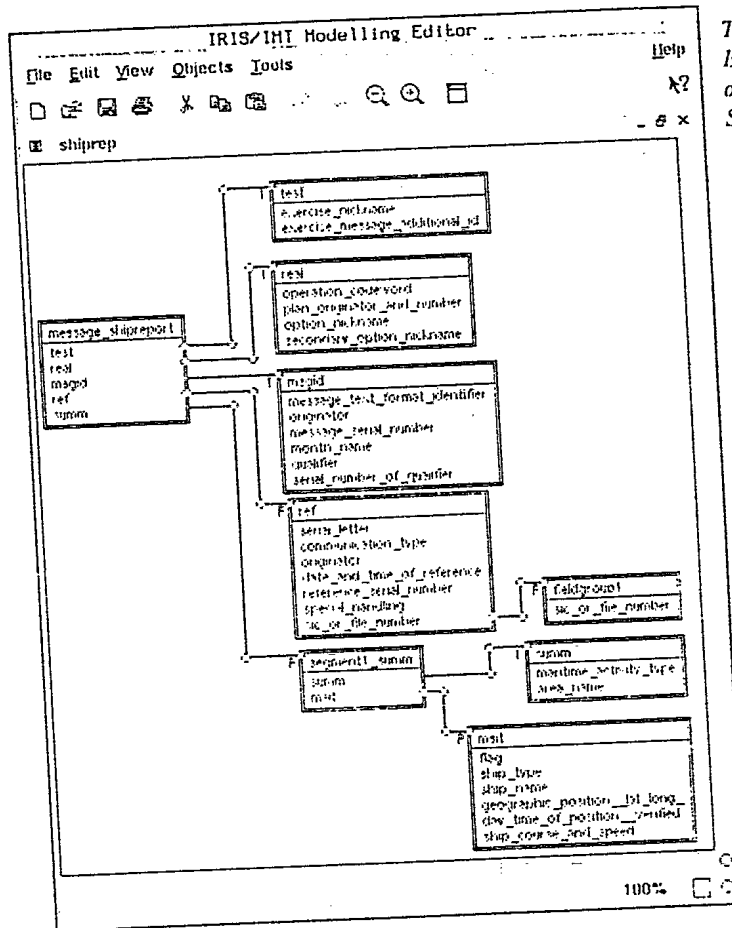
Consider the example of moving data between an MTF and a database. This is a task of deciding how the information should be *mapped* and is independent of how the information is *represented*, i.e. it is not significant whether the information is stored in a formatted message or in a formatted database. The IMT provides the abstraction, making it possible to focus on how the information is mapped, without having to worry about the syntax of ADatP-3 or the details of a relational database. The IMT views all information as data models and allows the same advanced operations on a data model of an MTF as on a data model of a database.

The fact that the IMT is working on models means that the IMT can be extended to be used on virtually any information base, as long as it can, within reason, be seen as a data model. This means that the IMT will be able to support not just relational databases, but also a range of message formats (USMTF, VMF, ADatP-3, ADFORM, EDIFACT etc.) as well as interfaces to other applications, e.g. spreadsheets, graphical information systems and proprietary applications.

Data Modelling Using the IMT

Models are presented graphically in the IMT. For example, the model of a SHIPREPORT, which is a MTF included in the IRIS demo message set, is illustrated below.

The basic structure of this model is a tree, similar to the one used in the IRIS/MFS Body Editor, making it easier for current IRIS/MFS users to read the MTF models in the IMT.

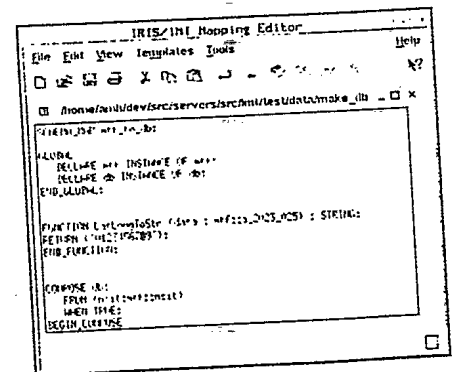


The IMT Modelling Editor with a Model of an MTF SHIPREPORT

Data Mapping Using the IMT

Mappings are written in EXPRESS-MX, a language built on top of the EXPRESS language, which has been specifically designed for mapping between data models. Mappings are presented in a textual form. The IMT contains functionality to indicate which parts of the models are covered by a mapping. For example, a mapping extracting data from a database into a MTF, it is useful to have indicated which parts of the MTF are actually filled in, and likewise which parts of the database are read.

The IMT will also check for consistency in mappings. Reports are



The IMT Mapping Editor

generated for potential problems, for instance, if non-mandatory data is assigned to mandatory data.

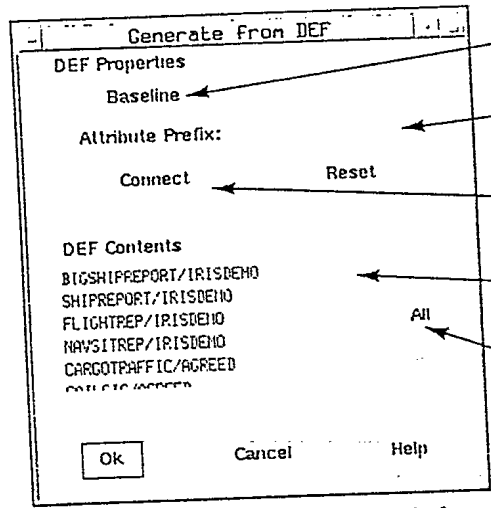
Modelling Tool

Automatic Generation of Data Models

The IMT includes the ability to automatically generate data models of MTFs and relational databases. MTF models can be automatically generated from either IRIS/MFS or IRIS/DEF and in order to generate an MTF model in the IMT the user needs to first select the MTFs to be included in the model.

The illustration below shows the IMT window for selecting an MTF from IRIS/DEF for which a MTF model is required. MTFs are selected from the 'DEF contents' list and the model is automatically generated by pressing the OK button.

The IMT has similar pop up windows for generating models from IRIS/MFS and models of databases.



Use Baseline
 Prefix for Attribute Names
 Reset
 Read List of MTFs
 List of MTFs
 Select all MTFs

Pop-up Window to Generate Models from IRIS/DEF

Summary of Interfaces Supported

The IMT will automatically build a data model representing an MTF from the MTF definition stored in either IRIS/DEF or IRIS/MFS. Also, the IMT will automatically build a data model of a relational database (see list of databases supported below).

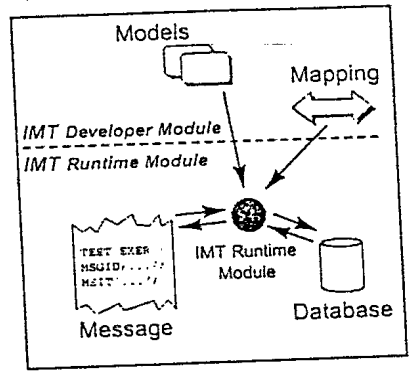
The IMT makes it possible to map between any combination of one or more of these supported interfaces, e.g. between two databases, or between two versions of an ADatP-3 definition, or from USMTF to VMF, USMTF to ADatP-3 etc.

| | Oracle | Sybase | ODBC | USMTF/ADatP-3 | VMF |
|---------------|--------|--------|------|---------------|-----|
| Solaris 2.5 | ✓ | ✓ | 1) | ✓ | ✓ |
| HP-UX 10 | ✓ | 2) | 1) | ✓ | ✓ |
| Windows 95/NT | 2) | 2) | ✓ | ✓ | ✓ |
| AIX 4.x | 2) | 2) | 1) | ✓ | ✓ |
| OSF/1 | 2) | 2) | 1) | ✓ | ✓ |
| SCO 5 | 2) | 2) | 1) | ✓ | ✓ |

1) Note, that ODBC on the UNIX platforms will require an ODBC driver and has therefore not been planned.
 2) Can be made available on request. Other databases can also be supported on request, including DB2 and Informix.

ARCHITECTURE

The IMT consists of two parts, a developer module and a runtime module. The developer module is used to generate models and construct mappings, whilst the runtime module is used to run the written mappings on the actual data, e.g. messages and operational databases.



PERFORMANCE

The IMT has been designed with performance in mind and will be significantly faster than a current AQL solution. This is for a number of reasons:

- Validation of a message is the same, i.e. done by the MTF server, however this is now a part of the IMT and therefore no extra executable program needs to be called.
- The IMT runtime is a single executable program running the entire mapping, thus minimising the overhead of starting applications.
- The IMT has been optimised for speed, making the mappings as fast as possible.

ANNEX D


Specifications on the OTH T Gold Formatting Rules


Major syntactical differences between the OTH T Gold (OTG) formatting rules and the ADatP-3 or USMTF formatting rules:

- The <Message Text Format Identifier> field included in the set MSGID is located at position number 2 instead of position number 1 as it is in ADatP-3 rules.
- An OTG message always starts with a MSGID set and finishes with an ENDAT set.
- A set name has 3 to 5 letters while a set name for ADatP-3 or USMTF has 3 to 8 letters.
- The only free-text sets are RMKS and NARR and they may be used only where specifically permitted in the format.
- An empty field must not have an hyphen character “-“ in it.
- In specific situations, mandatory fields and field markers may be omitted. Such mandatory fields have a “no data” mention in the set specification.
- The hyphen character is used only as an internal field delimiter in field 2 of the “CTC” set and may not be used anywhere else.
- The RMKS set may be used at any location in a message instead of appearing only at the end of the message as it is the case for ADatP-3 rules.
- There may be checksums at the end of a field or a sub-field.
- The instructions for each field will indicate whether checksums are required or permitted (e.g. 020230Z7, 7 represents the checksum of the preceding characters).
- Special handling instructions may be included in the security classification set.
- The maximum length for a message is one hundred (100) lines of sixty-nine (69) characters each.
- The ordering of sets within a segment may not be fixed if expressly stated in the message format.

ANNEX E

Specifications on the DBTools.h++

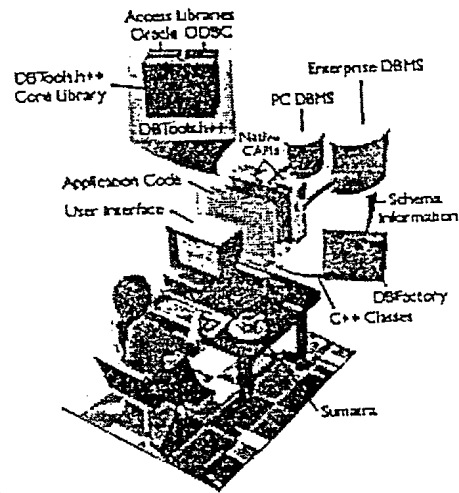
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DBTools.h++

Functional Overview of DBTools.h++

Native connectivity, database portability, a rich set of C++ foundation classes: the tools you need to maximize your productivity, simplify deployment of your application, and satisfy your users. Whether you're designing a simple application, or the most demanding OLTP application, applying DBTools.h++ will boost the productivity of your development effort. Here's what DBTools.h++ delivers:



C++ Foundation Classes

DBTools.h++ is not just a C++ wrapper. It's a complete library of foundation classes to support your C++ database application development efforts. DBTools.h++ builds on the data structures in Rogue Wave's industry-leading foundation class library, Tools.h++, by adding powerful classes for database manipulation with familiar names such as Database, Table, and Cursor. Using the associations between objects and DBTools.h++ enables you to develop applications with object-oriented C++ components rather than by using database vendors' procedural C APIs. Public methods in DBTools.h++ avoid the use of pointers, thereby simplifying memory management, and making your code cleaner, easier to read, and less error-prone.

Bridging The Object-Oriented And RDBMS Worlds

DBTools.h++ bridges the gap between object-oriented development and the relational database paradigm. DBTools.h++ is an object-oriented encapsulation of SQL 92 that supports critical SQL extensions, including Stored Procedures.

Database-Independent Application Development

DBTools.h++ is a two-layer library that delivers database and platform independence. DBTools.h++ source code is identical regardless of the database or platform you choose. The DBTools.h++ core library hosts the public programming interface. Database-specific access libraries deliver native implementations of the core library classes in Oracle, Sybase, Informix, and Ingres databases, with general database connectivity. Deploy an application against different databases simply by defining a new back-end database -- DBTools.h++ automatically links in the new access library at runtime. Your application code doesn't change.

The Performance You Want

Performance is critical to your database applications, and at Rogue Wave we're keenly aware of a host of performance issues. Even if you measure your data in terabytes and your transactions in millions per day, DBTools.h++ delivers a proven solution. It provides a robust set of classes that take advantage of database features that boost application-level and transaction-level performance for

More detail on DBTools.h++

your C++ applications.

Asynchronous Database Access

Using asynchronous database access, DBTools.h++ delivers dramatic application-level performance improvements by continuing to process applications without requiring a response from the database for a previous transaction. Without asynchronous access, the application must block and wait for a response whenever it makes a call to the database.

Multithreading

When supported by your database and compiler, multithreading allows you to maximize your utilization of server resources. DBTools.h++ enforces internal locking to maintain its own internal integrity.

Dynamic SQL

Dynamic SQL streamlines processing of large data sets, allowing both client-side and server-side optimization of transactions. You can bind variables to any SQL statement that is used repeatedly. Recurring execution of statements is done without the overhead of rebinding and reparsing the SQL statement.

The Reliability You Need

DBTools.h++ can easily perform all your error handling -- even exceptions. Your program won't crash because it missed handling an error in the course of communicating with the database. You determine how errors are resolved: individually as they occur, all at once after a series of operations, or any other way you want.

Flexibility To Use Database-Specific Features

If you need to trade database portability for access to special features offered by one database, DBTools.h++ still supports you. You can interleave proprietary C calls to a database client library with DBTools.h++ code. Moreover, you can easily define classes that encapsulate extensions to ANSI SQL and make them available globally.

[Main DBTools.h++ page](#)

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