Creating Applications with the IBM® OS/2® Extended Edition Database Manager

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Foreword

The OS/2 Extended Edition is one of IBM's most important undertakings, and I had the privilege of participating in several stages of its development. As a member of the Corporate Programming Staff, I helped define IBM's Systems Application Architecture (SAA). Then, as the Product Manager for the Database Manger, my team was responsible for the planning, design, and development of that component of the Extended Edition. Finally, as Systems Manager, my organization was responsible for all the components of OS/2 Extended Edition Version 1.1 (Database, Communications, and LAN). This set of experiences made it evident to me that the OS/2 Extended Edition Database Manager is a critically important offering in the following ways:

- For customers: It provides the same basic technology and capabilities found in IBM's leadership S/370 database products (DB2 and SQL/DS) at the individual and LAN server levels.
- For IBM: It completes a family of relational products across the breadth of IBM's product line.
- For the industry: It takes an additional step in implementing SQL.

This book is a must for those developing applications that access IBM's OS/2 Extended Edition Database Manager. It goes far beyond the reference books and user guides in the following ways:

- Gives clear explanation of the fundamental issues and trade-offs associated with relational database management systems.
- Explains the rationale behind the design choices and technology in IBM's relational database products and, in particular, the OS/2 Extended Edition Database Manager.
- Includes hints that offer powerful insights into developing the most efficient, best performing applications based on OS/2 Extended Edition Database Manager.

As a result, you can save valuable time gaining the expertise to exploit IBM's database technology on OS/2.

IBM pioneered SQL and relational database technology in 1970. Since then, IBM has continued to make major investments in relational database research. The result is a family

of database products that offers outstanding performance across the entire range of applications, from complex query optimization for decision support to quick updates for transaction oriented environments. For example, the OS/2 Extended Edition Database Manager uses algorithms and technologies found in DB2, but rewritten in C and optimized to the OS/2 environment. In some cases, Database Manager uses even more sophisticated techniques than DB2 made possible by advances in IBM research after DB2's original release (index locking, for example). The members of the IBM Relational Database Family are DB2 (for MVS), SQL/DS (for VM), Database Manager/400 (for OS/400), and OS/2 Extended Edition Database Manager. The Database Manager plays a major role both within OS/2 Extended Edition and within the framework of IBM's Systems Application Architecture. The OS/2 Extended Edition is intended to provide a distributed application platform that has been system tested by IBM; provides consistent user interfaces, publications, administration, configuration and installation; provides a single, reliable contact for education and support; and provides you with the function and performance you require across the full breadth of IBM distributed systems.

I wish you good reading and good luck creating outstanding OS/2 solutions for your customers!

Pat Motola

Manager of Business Development
Metaphor Computer Systems

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Preface

This book is for the individual who wants to design and build database applications for the IBM OS/2 Database Manager. It provides information and recommendations on how the technology in the Database Manager affects your application design. Additionally, examples are given of C language programs that use the Structured Query Language (SQL) and other functions of the Database Manager. The Query Manager is described in terms of how to best use its function to supplement your efforts to create a complete database application.

This book is intended for the reader who is already familiar with the Database Manager, has possibly installed and tried the Query Manager user interface, and is now wondering how to combine all of the Database Manager features into a database application. If you plan on writing database programs, we have assumed that you are familiar with the C programming language. If you plan to use the Query Manager to supplement your database programs, we have assumed that you are familiar with its general operation.

The discussion on Database Manager is divided into four parts. Part 1 provides an overall description of the Database Manager and an overview of the elements used to build Database Manager applications. You should read this part as well as Part 2, "Database Application Design Considerations," before starting to develop your application.

Part 2 discusses how the Database Manager implements the relational model. This part provides hints on designing your database application to take advantage of the Database Manager implementation.

Part 3 guides you through the use of SQL statements and Database Manager function calls in the C language. This combination of SQL and C function calls provides a powerful and flexible medium for developing sophisticated database applications. Programming examples are taken from a set of database programs that are listed in the Appendix.

Besides providing some basic guidelines on use of the Query Manager, Part 4 shows how Query Manager features can be exploited to supplement your C language database programs.

Appendix A lists Database Manager function names according to their functional category. This listing can tell you in a glance what functions you need to perform particular Database Manager functions such as create or connect to a database. Appendix B contains listings of the sample programs described in Part 3. You can use these C language programs as a database application toolkit. They provide useful functions such as listing the

tables, views, and columns defined in a database or importing a file to a table. Other programs contain helpful examples of SQL that you can use directly in your own database applications, such as a program that executes SQL statements entered onscreen.

RELATED PUBLICATIONS

We have not tried to replace the IBM publications. Information in this book, such as the detailed database design considerations, sample programs, and Query Manager application design guidelines, supplements the reference material found in the IBM publications. Where possible, you will be referred to the appropriate IBM manual for reference material.

For writing database programs in C you will need *IBM OS/2 Extended Edition Database Manager Programming Guide and Reference*, which is available separately from IBM as part number 90X7905. This guide contains the command and syntax reference for the Database Services functions. You will also need the IBM C/2 compiler and supporting documentation. Depending on what other features of OS/2 you plan on using, you may require additional software and documentation. For example, if you plan on using the Presentation Manager you will require The IBM OS/2 Toolkit.

For working with the Query Manager you will need *IBM OS/2 Extended Edition User's Guide*, which comes with the OS/2 Extended Edition. This guide contains step-by-step instructions on how to use the Query Manager.

Readers with complicated data management needs should familiarize themselves with the relational model and SQL. The following books are good sources of information on the relational model and SQL: *IBM OS/2 Extended Edition SQL Concepts*, *IBM OS/2 Extended Edition SQL Reference*, IBM part number 90X7907, and *A Guide to the SQL Standard* by C.J. Date (Addison-Wesley, 1987).

If you are struggling with the mass of IBM publications, you might order the *IBM OS/2 Information and Planning Guide*, form number G360-2650. This publication contains product and planning information about both the IBM OS/2 Standard and Extended Editions. Use it as a guide to the other IBM publications on OS/2.

Acknowledgments

This book would not have been possible without the support and expertise of all the people at Addison-Wesley, in particular, Carole McClendon, Joanne Clapp, and Rachel Guichard. We also owe our thanks to Philip Chang for his thorough and thoughtful technical evaluation of the manuscript.

Clearly, the information in this book represents the conglomerate knowledge of many people, especially those IBM people who wrote the OS/2 Database Manager. These are the individuals who created this software and share in the creation of this book. Several of them offered suggestions and provided a perspective that helped form the contents.

We would also like to express our appreciation to the International Business Machines Corporation (IBM) for their assistance. All views expressed in this book are solely the authors' and should not be attributed to IBM or any other IBM employee.

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PART ONE

Introduction to Database Manager Applications

Before beginning to develop your own Database Manager applications, you should be familiar with the functions that Database Manager offers. Part 1 of the book explains those functions.

Chapter 1, "What is the Database Manager?", provides an overview of Database Services and the Query Manager, the two major components of the Database Manager. This overview helps you understand the purpose of these two components and how you can use them to meet your data management needs.

Chapter 2, "What is a Database Application?", defines a database application in terms of the functions available to the Database Manager application developer. Each of the components described in Chapter 1 provides a specialized set of functions to be used in building your application. After reading this chapter, you should have sufficient understanding of the elements of a Database Manager application so that you can begin planning which elements to include in your database application.

CHAPTER ONE

What is the Database Manager?

OVERVIEW

"What is the Database Manager?" is a simple question that requires a lengthy answer. This chapter begins to answer this question by describing the components available in the Database Manager, their relationship to the IBM OS/2 operating system, and how you access these components.

The IBM Database Manager is a full function relational database management system. It includes such features as concurrent data access, data consistency, data protection, and security. As shown in Figure 1-1, your data is presented in simple tables with information structured into rows and columns. The IBM Structured Query Language (SQL) is used to define, enter, and retrieve your data.

STAFF Table

ID	NAME	DEPT	JOB	YEARS	SALARY	COMM
10	Sanders	20	Mgr	7	18357.50	-
20	Pernal	20	Sales	8	18171.25	612.45
30	Marenghi	38	Mgr	5	17506.75	-
40	O'Brien	38	Sales	6	18006.00	846.55
50	Hanes	15	Mgr	10	20659.80	-
60	Quigley	38	Sales	-	16808.30	650.25
70	Rothman	15	Sales	7	16502.83	1152.00
80	James	20	Clerk	-	13504.60	128.20

Figure 1-1 A Relational Table from the IBM SAMPLE Database

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