About This Manual

Objectives of This Manual

The CM-5 Connection Machine system, or CM, is a high-performance parallel supercomputer, capable of executing properly written CM Fortran programs at very high speed on large amounts of numeric information.

Getting the best performance out of the CM-5 means being familiar with the CM Fortran programming environment. This includes the CM-5 itself, the CM Fortran compiler, and the tools available on the CM-5 for observing and measuring the performance of a CM Fortran program.

The *CM-5 CM Fortran Performance Guide* is a reference manual on the issues in software, hardware, and program design that affect the performance of a CM Fortran program.

Please Note: The generated code, performance figures, and programming advice presented in this document are based on the version of the CM Fortran compiler available at the time of writing. Future compiler enhancements and/or CM-5 design improvements may make some of this information incorrect or obsolete.

Intended Audience

This manual is intended primarily as a reference source for experienced CM Fortran programmers. Code examples are provided illustrating specific points, but this manual is not a tutorial on CM Fortran program design; rather it is a source of issues you'll want to consider, as well as tools you'll find useful, in analyzing and rewriting your CM Fortran code for better performance.

Revision Information

This manual is a revision of, and supersedes, the *CM-5 CM Fortran Performance Guide*, Version 2.1.

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Organization of This Manual

This manual consists of two parts. The first part describes hardware and software components, and presents some examples of timing and performance analysis of CM Fortran programs.

The second part of this document builds on this information, showing how the design of the CM-5, the structure of the CM Fortran compiler, and the structure of a given CM Fortran program can all affect the observed performance of the program.

The emphasis throughout this document is on presenting the mechanism that one uses to compile and execute a CM Fortran program, rather than giving general statements to the effect of "do this and you'll see a 10 percent performance improvement." (These kinds of statements tend to be difficult to support in general cases.) Understanding the mechanism allows a programmer to tailor the advice given here to meet his or her needs.

Part I The CM Fortran Programming Environment

Chapter 1 The CM-5 System
An overview of the hardware and software of the CM-5.

Chapter 2 The CM Fortran Compiler
An overview of the global execution model, compilation process, and performance-related command-line switches of the CM Fortran compiler.

Chapter 3 CM Fortran Timing and Analysis Tools
A description of the available tools for recording and displaying timing and performance analysis data for your CM Fortran code.

Part II CM Fortran Performance Techniques

Chapter 4 CM Fortran Performance Aspects
A summary of the categories of performance issues in CM Fortran on the CM-5, each of which is discussed in one of the following chapters.

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Chapter 5 Parallel Array Layout
A discussion of the default layout of parallel arrays on the CM, as well as the compiler directives you can use to choose your own parallel array layouts.

Chapter 6 Array Alignment and Aliasing
A description of how to use, and when not to use, the CM Fortran **ALIGN** directive, along with a discussion of array aliasing.

Chapter 7 Parallel Computation
A discussion of parallel computation on the CM-5, including how to time the parallel computation in your code, how to make your program's computation more effective, and what optimizations the CM Fortran compiler provides to improve parallel computation.

Chapter 8 Parallel Communication
A discussion of parallel communication on the CM-5, including the types of communication used, and how to make your program use communication operations more effectively.

Chapter 9 Memory Management
A discussion of memory management on the CM-5, including parallel memory layout, how to handle out-of-memory errors, and how to make your program's use of parallel memory more efficient.

Chapter 10 Miscellaneous Performance Issues
A discussion of miscellaneous issues that affect performance, such as the use of CMSSL optimized communication routines and the nodal and global/local compiler models.

Appendix

Appendix A CMRTS and CM Memory Allocation
A brief description of the CMRTS software layer and the low-level data structures used in parallel array allocation.

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Related Documents

These documents are part of the CM documentation set:

- *Getting Started in CM Fortran*, October 1994
- *CM Fortran Language Reference Manual,* Version 2.2
- *CM Fortran Libraries Reference Manual,* Version 2.2
- *CM Fortran User's Guide*, Version 2.2
- *CM Fortran Programming Guide*, Version 2.2
- *CM-5 Technical Summary*, November 1993

The following documents are available on-line:

- **cmfortran-***version***.releasenotes**, **cmfortran-***version***.bugupdate**
- man pages for the **cmf** command and all CM Fortran intrinsic and library procedures

Notation Conventions

The table below displays the notation conventions observed in this manual.

Convention	Meaning
bold typewriter	UNIX and CM System Software commands, command options, and filenames, when they appear embedded in text. Also programming language elements, such as keywords, operators, and function names, when they appear embedded in text.
italics	Argument names and placeholders in function and command formats.
`typewriter`	Code examples and code fragments.
`%` **bold typewriter** `regular typewriter`	In interactive examples, user input is shown in bold typewriter and system output is shown in regular typewriter font.

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