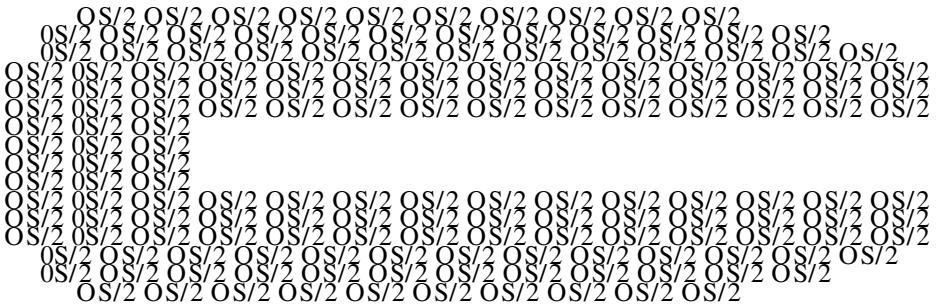

IBM OS/2 Compiler News

January 1992

From the editor

We live in interesting times. IBM, as we all know, is making its own contribution to the tone of the times by introducing its powerful new, user-oriented operating system - OS/2 2.0[1]

This is only part of the whole story. Having produced this operating system - perhaps the most comprehensive operating system yet designed for the personal computer - we have to provide the means to design new, powerful 32-bit applications, and the means to migrate existing 16-bit applications to the 32-bit environment. Then, at last, we'll be able to take advantage of the full power of our 80386 and 80486-based machines.

This is where we come in - the developers of the application development tools for OS/2 2.0 - and this is what this newsletter is about - the application development tools themselves.

Our purpose is to inform you about, and whet your appetite for, the refreshingly new, comprehensive set of tools that we've developed. It's also meant to underline our commitment to providing you, the application developer, with nothing less than the best of everything for OS/2 2.0.

IBM C Set/2 Version 1.0

IBM C SET/2 VERSION 1.0 - ™ is IBM's 32-bit SAA™ C Compiler. It generates code for IBM OS/2 V2.0 and is designed to maximize the performance of applications using this new operating environment by fully exploiting the speed and power of 80386 and 80486-based computers. It comes complete with run-time libraries and a fully interactive, full function, source-level PM debugger.

[1] ™ OS/2 is a registered trademark of IBM Corporation

The 32-bit C Compiler

By providing you with high performance code optimization the IBM 32-bit C compiler gives you the opportunity to produce some of the highest performing OS/2-based applications possible.

- *In the C Set/2 32-bit C compiler IBM has focussed intensely on code optimization.*
- *IBM uses its register-linkage convention, OPTLINK, to improve performance, by using registers to pass parameters.*
- *We have also included a number of other performance-enhancing features, such as:*
  - *improved memory management*
  - *inlining of selected library functions*
  - *memory file I/O support*
  - *fast floating point optimizations.*

During the compile operation, you can view error messages on three levels, as well as LINT-like warning messages grouped in subsets that can be turned on and off, such as:

- *Variables not explicitly initialized*
- *Non-portable code*
- *Appearance of goto statements*
- *Unused external variables*
- *Possible truncation during an assignment*
- *Generate preprocessor warning messages*
- *Not-used parameters*
- *Enum message*
- *Preprocessor trace messages*
- *Name mapping*

Standards

IBM's conformance to industry standards helps you grow by providing you with a standardized growth path:

- *ANSI C X3.159-1989 and ISO/IEC 9899 C conformance*
- *SAA C CPI Level 2 conformance (excluding Record I/O)*
- *PM ™ SAA/CUA™ conforming debugger interface.*

The IBM C Set/2 compiler implements the C element of the SAA Common Programming Interface (CPI) in the 32-bit OS/2 environment. For applications written to the SAA C CPI standard, you can readily export source code to and from the other SAA environments. The IBM C/370 and IBM SAA C/400 compilers, for example, implement the SAA C CPI standard on the System/370™ (and System/390™) and AS/400 ™ platforms respectively, as does the C compiler that comes with the AIX™ Version 3 RISC System/6000™. How do we ensure that your previous or current development tools are still viable?

- *We provide 32/16-bit run-time coexistence and linkage conventions. You can call 16-bit interfaces, such as existing 16-bit libraries or API's and make 16-bit call-backs to 32-bit code.*
- *We tailored the compiler for 80386 and 80486 processor technologies.*
- *We support extensive (standard) IBM run-time libraries to ensure consistency and continuity.*
- *We offer in C Set/2 comprehensive migration support from IBM C/2 V1.1 and Microsoft C [2] 6.0-based applications.*

[2] ™ Registered trademark of Microsoft Corporation

Run-Time Libraries

When you use C Set/2's 32-bit compiler with IBM WorkFrame/2™ - something we highly recommend - you can select your runtime libraries using WorkFrame's menu-driven compile options; you can "mix and match" libraries depending on the executable files you're trying to create and you can use:

- *Static and dynamic C run-time libraries*
- *Fully reentrant multitasking and single tasking C run-time libraries*
- *Dynamic Link Libraries (DLL's)*
- *Subsystem development libraries*

Because the C Set/2 compiler gives you such extensive run-time library support, you can select the best execution environment for your OS/2-based applications. Not only does the IBM 32-bit C compiler let you use this considerable range of 32-bit run-time libraries, but you can also call 16-bit interfaces (for example, existing 16-bit libraries or API's) and link all of these run-time libraries to your program either statically or dynamically.

So you can still use the high quality run-time libraries that you've developed over many projects when you use C Set/2's 32-bit C compiler.

In addition to the standard run-time libraries, C Set/2 offers libraries designed to help you migrate 16-bit C programs to the 32-bit C platform, as well as libraries for developing subsystems with no run-time environment.

Table 1: Compiler and Library Features

- Multithread support for the C run-time libraries
- Multitasking support for creating multiple processes
- Static or dynamic linking of the run-time libraries
- Fully reentrant libraries
- Ability to create user dynamic link libraries
- Subsystem development capabilities
- Exploitation of 32-bit processor features
- Ability to call 16-bit code from C Set/2 32-bit code
- Memory files for temporary storage
- Support of NaN, Infinity, and the 80-bit long double type as defined by Institute of Electrical and Electronics Engineers (IEEE)
- Support of the double-byte character set (DBCS)
- Compiler options specified on the command line or in an environment variable
- Language level compiler options to simplify migration from the IBM C/2 and Microsoft C Version 6.0 products or to enforce SAA or ANSI standards.

The 32-bit PM Debugger

Complementing the IBM 32-bit C compiler is the IBM PM debugger, which features a graphical "point-and-shoot" Presentation Manager user interface. By making the debugger easy to use at the level of your mouse/keyboard and display, we have taken a major step towards decreasing the pain of your debugging.

Because debuggers are, by definition, user productivity tools, we have designed our PM debugger with advanced design features such as:

- *Source Level Debug: You can follow the execution of a program in the compiler source view to quickly identify and correct errors in the code. You get a direct view into the execution of the program to help you identify errors earlier and correct them faster, by:*
  - *stopping a program at user-selected breakpoints, to monitor its progress and to find and correct program errors*
  - *adding, saving or deleting breakpoints or conditional breakpoints*
  - *displaying and changing variables at breakpoints*
  - *controlling execution of multiple threads individually*

- *evaluating expressions in the program.*
- *monitoring variables, storage, expressions, stacks, and queues*
- *giving you multiple views of the program, including source and disassembly code.*

- *Step Mode Debug: "Step" and "Go" give you control to bypass previously debugged code and focus on problem areas.*
- *Presentation Manager (PM) Application Debug Support: Synchronous and asynchronous modes give you two ways to debug PM applications. You can manage the application windows concurrently with the debugger windows.*

Table 2: Debugger Features

- Multiple program views, including source, disassembly, and source and disassembly mixed
- Simple and complex breakpoint capabilities
- Monitor windows for local, global, and automatic variables
- Pointer and indirect referencing
- Hierarchical structure display, including nested structures
- Display of monitored variables in context
- Ability to monitor storage and the call stack
- Display of processor and math coprocessor registers
- Support of DBCS

Problem Determination Aids

In addition to the debugger, C Set/2 provides a number of problem determination aids:

- *Debug memory management functions*
- *Detection of possible programming errors using the* /Kn *(LINT-like) diagnostic compiler options as shown above.*
- *C source code listings. These listings include assembler listing code, expanded macros, and the layout of structures, and show what code the compiler has generated from your program*
- *Precise diagnostic messages to aid problem analysis.*

On-line Documentation

Online documentation adds a new dimension to the compiler. It uses the Information Presentation Facility (IPF), which lets you view the information and "link" to additional information by selecting highlighted text - a technique known as "hypertext". You can also search the online document for occurrences of specific words or phrases. These IPF features let you get to information really quickly without affecting your workflow or your concentration.

Online Help

C Set/2 offers you two kinds of online help:

1. *An online reference that contains information about declarations and definitions, preprocessor directives, include files, compiler options and messages, and library functions. You can access this reference through the* view *command. If you use the Enhanced Editor, you can get help for a particular item by placing the cursor on the word and pressing <Ctrl-H>.*
2. *Contextual and overview help for the debugger. You can get help for the various functions offered by C Set/2. debugger and how to use them, by accessing the debugger help from any debugger window by clicking on an item or from the* **Help** *pull-down.*

Online C Set/2 Publications

C Set/2 provides online publications in two different formats:

- **Information Presentation Facility (IPF) Books**

  IPF is the online help mechanism provided by the OS/2 operating system. The Online Reference (DDE4HELP.INF) is a summary of help for language constructs, library functions, and compiler options and messages. You can access the Online Reference from the command line. The system searches the Online Reference's table of contents and index, and if the item exists, opens the book at the panel about that item.

  For example, typing

  ```
  view DDE4HELP.INF operator precedence
  ```

  opens the book at the panel about "operator precedence".

  The other, simpler, way is to use context-sensitive help via the Enhanced Editor. This editor uses a number of macros that enable it to provide context-sensitive help using the Online Reference. To obtain help for a keyword or construct, simply place the cursor on the problematic word and press Ctrl-H. This opens the Online Reference at the panel for that construct.

- **BookManager™ Books**

  BookManager READ/2 is an OS/2 product that allows you to read online documentation. BookManager features hypertext capabilities which allow you to link between related topics and search documents for keywords to quickly get at the information you need. The following publications are included with the C Set/2 in BookManager READ/2 format:

  - *IBM C Set/2 User's Guide (S10G-4444)*
  - *IBM C Set/2 Migration Guide (S10G-4445)*
  - *SAA CPI Reference - Level 2 (SC09-1308)*

Hardcopy C Set/2 Publications

The publications below are provided with C Set/2.

- *SAA CPI C Reference - Level 2 (SC09-1308), presents the SAA definition of the C programming language.*
- *IBM C Set/2 Migration Guide (S10G-4445), describes how to migrate IBM C/2 Version 1.1 and Microsoft C Version 6.0 programs to C Set/2 and contains a list of migration functions that the C Set/2 compiler supports.*
- *IBM C Set/2 Debugger Tutorial (S10G-4447), provides a tutorial for the C Set/2 debugger.*
- *IBM C Set/2 and WorkFrame/2: An Integrated Development Environment (S10G-4449), explains how to use the C Set/2 compiler and debugger in the WorkFrame/2 environment, and provides a tutorial.*
- *IBM C Set/2 Installation Card (S10G-4443), describes the installation procedure.*
- *IBM C Set/2 Reference Summary (S10G-4446), summarizes the C Set/2 language syntax, keywords, library functions, and compiler options.*

- *IBM C Set/2 License Information (S10G-4442), provides a summary of the features and warranty information.*

In addition, we recommend the following to those of you who are considering moving your C code from one platform to another:

- *Portability Guide for IBM C (SC09-1405), describes how to move code from one platform to another, and how to write portable code. The second release of this document will include information on C Set/2.*

The C Set/2 Installation Program

You can install C Set/2 with the interactive installation program included on the C Set/2 diskettes. You'll find this very easy to do. Using the graphical interface, the installation program lets you choose the options you want to install and where you want to install them.

Online help is provided throughout the program to help you with the installation.

You can also use the installation program to reinstall or add new options later.

IBM OS/2 2.0 Developer's Toolkit

The OS/2 2.0 Developer's Toolkit contains a wide variety of language-independent build and productivity tools. You must use the Toolkit along with C Set/2 primarily because it contains the system linker that the compiler uses (LINK386), as well as the system header files, the import libraries, and the NMAKE utility that increase the capabilities of the compiler.

The Toolkit includes headers and library files for defining OS/2 2.0 API calls, tools for building programs, API reference information, sample programs to demonstrate the coding of API's and a Kernel Debugger.

Table 3: Toolkit Features - Build Tools

- **NMAKE**:
  NMAKE is a utility that can save time by automating the process of updating project files. NMAKE compares the modification dates for one set of files, the target files, to those of another set of files, the dependent files. If you have changed the dependent files more recently than the target files, NMAKE executes a specified series of commands.

  You typically use NMAKE by specifying a project's executable files as target files and the project's source files as the dependent files. If you have changed any of the source files since the executable file was created, NMAKE can issue a command to assemble or compile the changed source files and link them into the executable file.
- **MKMSGF**:
  MKMSGF converts an error, help, prompt or general text information file to a binary format for display at runtime.
- **MSGBIND**:
  MSGBIND binds the message file as a data segment to the application's executable file. The MKMSGF and MSGBIND utilities help you isolate message text to support, for example, translation of text.
- **EXEHDR**:
  EXEHDR is a utility which allows you to display or change fields in the header of an EXE file.
- **MARKEXE**:
  MARKEXE marks .EXE files to indicate whether (a) they can handle long file names and (b) they are window-compatible.
- **IMPLIB**:
  IMPLIB is a utility that creates an import library. Import libraries are used to resolve an application's external references to subroutines in dynamic link libraries.
- **PACK**:
  PACK compresses a file or group of files into a single file optimizing disk space and I/O performance on install.
- **LINK386**:
  LINK386 produces 32-bit .EXE files.

Table 4: Toolkit Features - Libraries

- **OS2286.LIB**:
  Library against which system calls for 16-bit programs are resolved.
- **OS2386.LIB**:
  Library against which system calls for 32-bit programs are resolved.
- **OS2STUB**:
  Module included with an OS/2 program. At runtime, it alerts a DOS user that the program is an OS/2 program (and therefore won't run on DOS).

Table 5: Toolkit Features - 32-bit PM Resource Tools

- **DLGEDIT**:
  DLGEDIT is a PM resource editor which lets you create and modify dialog boxes for use with other PM programs.
- **FONTEDIT**:
  FONTEDIT is a PM resource editor which lets you create and modify fonts for use with other PM programs.
- **ICONEDIT**:
  ICONEDIT is a PM resource editor which lets you create and modify icons, bit maps and pointers for use with other PM programs.
- **Information Presentation Facility Compiler (IPFC)**
  creates .HLP files for panels or viewable .INF files for documents from tagged text files.
- **32-bit Resource Compiler (RC)**
  creates a binary file from Resource Editor (DLGBOX, FONTEDIT, ICONEDIT) output, making the resources available to the application.
- **System Object Model Precompiler (SOMC)**
  creates input to source programs that make available existing classes, and creates new classes, of objects. Bindings for C source programs are in the Toolkit.

Table 6: Toolkit Features - Headers

- **OS2H**:
  OS2H - directory containing ANSI conforming header files that define the OS/2 API's for C.
- **OS2INC**:
  OS2INC - directory containing include files that define the OS/2 API's for ASSEMBLER.

Table 7: Toolkit Features - Debug Support

- **Kernel Debugger**:
  Included in the Toolkit to assist with Ring 0 debugging. The Kernel Debugger is a set of files and utilities that you install separately from the tools and samples in the Toolkit.

Table 8: Toolkit Features - Information & Samples

- **On-line (IPF) Information and Samples**:
  On-line information and sample programs help you exploit the OS/2 2.0 API's in application programs. You can get additional guidance in the use of API's, along with references to the sample programs, in the Programming Guide, the Application Design Guide and the SOM Reference; all available in the OS/2 2.0 Technical Library (see below). Printed versions of the on-line API reference information are also in the Technical Library.

Toolkit Publications

The publications below provide information about the OS/2 2.0 operating system and the IBM OS/2 2.0 Developer's Toolkit. You can buy them either individually or as the **IBM OS/2 2.0 Technical Library**.

Hardcopy OS/2 2.0 Developer's Toolkit Publications

- *Getting Started (S10G-6199), presents an overview of the OS/2 2.0 Developer's Toolkit features and how to use them.*
- *Application Design Guide (S10G-6260), describes how to use the OS/2 2.0 Developer's Toolkit to develop applications.*
- *Programming Guide (S10G-6261), provides information on how to use the various features of the OS/2 2.0 Developer's Toolkit.*
- *Information Presentation Facility Guide and Reference (S10G-6262), describes how to create online help files for Presentation Manager.*
- *System Object Model Guide and Reference (S10G-6309), describes the object model used by the operating system.*
- *Control Program Programming Reference (S10G-6263), describes how to write control programs.*
- *Presentation Manager Programming Reference Volume 1 (S10G-6264), presents the OS/2 functions.*
- *Presentation Manager Programming Reference Volume 2 (S10G-6265), details the OS/2 function calls.*
- *Presentation Manager Programming Reference Volume 3 (S10G-6272), describes window processing, messages, and other OS/2 features.*
- *Physical Device Driver Reference (S10G-6266), describes how to create and use physical device drivers.*
- *Virtual Device Driver Reference (S10G-6310), describes how to create and use virtual device drivers.*
- *Presentation Manager Driver Reference (S10G-6267), provides information on developing drivers for devices operating in an OS/2 environment.*
- *Procedures Language 2/REXX User's Guide (S10G-6269), is an introduction to REXX.*
- *Procedures Language 2/REXX Reference (S10G-6268), provides a summary of the REXX features and APIs.*
- *SAA Common User Access Guide to User Interface Design (SC34-4289), provides information on CUA.*
- *SAA Common User Access Advanced User Interface Design Guide provides advanced information on CUA design guidelines and tools.*

IBM WorkFrame/2 Version 1.0

The PM-based WorkFrame/2 is complementary to C Set/2, giving you an open, highly configurable, project-oriented, language-independent development environment. You can easily customize the WorkFrame/2 interface to create a personalized environment by integrating your own choice of existing or new 16-bit and 32-bit OS/2 tools as well as DOS and Windows tools.

WorkFrame/2 organizes your workplace by grouping your files into logical units called

projects. These can consist of both base and composite projects, the latter which, in turn can be formed by combining a hierarchy of base and/or composite projects. Each of your projects can thus consist of source, object and resource files, as well as targets such as .EXE or .DLL files.

WorkFrame/2 achieves this level of workplace organization by:

- *setting up projects to consist of source, object and resource files and targets such as .EXE or .DLL, etc.*
- *combining base projects to form composite projects.*
- *associating each project with your choice of unique compiler/debugger/maker/linker combination - known as a language profile.*
- *creating an Action Log to document all your actions and their respective return codes, for every project that you initiate through WorkFrame/2.*

You will find that if you use WorkFrame/2 as the integration medium for your development tools, you will almost certainly increase the productivity of these tools.

Because WorkFrame/2 lets you seamlessly plug in different or multiple Edit/Compile/Debug tool components, you can choose whatever mix you like. In IBM's case, the edit component, the applet **Enhanced Editor***, must be installed if you want to use the above Online Help facility (note that the default editor in OS/2, 2.0, is* **E***). The Compile/Debug component is, of course, IBM C Set/2.*

WorkFrame/2 contains tools such as:

- **MAKEDEP** *- a Make File Creation Utility - which creates the MAKE file with which NMAKE (a build tool contained in the OS/2 2.0 Developer's Toolkit) works. This utility consists of a graphical interface and a language-independent DLL which interfaces to a DLL provided with the compiler.*
- **LIB** *- contains both graphical and command-line utilities which let you maintain object libraries. It can be used to:*
  - *Create a library*
  - *Add objects to a library*
  - *Unload objects to any directory*
  - *Change the characteristics of a library*
  - *Generate listing files of different levels of detail*
  - *Display the details of object modules*
  - *Delete objects from a library.*

C Set/2 provides compiler options dialogs that you can use from the WorkFrame/2 environment, and includes a number of directories containing sample projects that demonstrate the capabilities of the WorkFrame/2 and C Set/2 combination; HELLO2, GREP, MAHJONGG, PMLINES and TOUCH. A tutorial guide is also included to help you use C Set/2 in the WorkFrame/2 context.

C Set/2 comes with a number of files that allow you to integrate it into WorkFrame/2. Among these are (a) the C Set/2 language profile, which is used to associate WorkFrame/2 projects with C Set/2, and (b) the compiler options DLL, which presents C Set/2 options through a graphical interface.

If you install WorkFrame/2 at the same time as (actually before) you install C Set/2, the C Set/2 installation program creates project and control (.PRJ) files for the above samples under the WorkFrame/2 home directory. The language profile and options DLL are also copied to the WorkFrame/2 directory.

The many tools in the OS/2 2.0 Developer's Toolkit, shown above, also integrate fully into WorkFrame/2.

Packaging

You can buy the above tools - IBM C Set/2, IBM OS/2 2.0 Developer's Toolkit and IBM WorkFrame/2 - either individually or combined in the "convenience kit" **IBM C Developer's WorkSet/2**, *better known as "The WorkSet" - a complete C application development environment.*

Or, if you have your own compiler/debugger you may want to buy the OS/2 2.0 Developer's Toolkit and WorkFrame/2 in the other convenience kit format - the **IBM OS/2 2.0 Developer's Workbench**, *commonly known as "The Workbench".*

Hardware, Software, and Operating System Requirements

C Set/2 requires a system unit with a 32-bit processor (Intel 80386, 80386SX, or 80486) running the OS/2 2.0 operating system.

The IBM OS/2 2.0 Developer's Toolkit is a C Set/2 prerequisite, primarily because it contains the system linker that the compiler uses (LINK386), as well as the system header files, the import libraries, and the NMAKE utility that increase the capabilities of the compiler.

To effectively use the compiler and debugger, you need a minimum of 8M bytes of RAM. A full installation of the C Set/2 files requires about 10M bytes of disk space, broken down in the following manner:

Compiler and libraries	*4M*
Debugger	*3M*
Online information	*2.2M*
WorkFrame/2 support	*0.8M*

If you do not have an 80486 processor, an 80387 math coprocessor is recommended, because it will greatly increase the speed of floating point operations.

Product Summary

Product	Order No. - 3.5"	Order No. - 5.25"	General Availability
IBM C Set/2 V1.0	10G2996	10G3293	4/7/92
IBM WorkFrame/2 V1.0	10G2994	10G3292	3/31/92
IBM OS/2 2.0 Developer's Toolkit	10G3355	10G4335	3/31/92
IBM C Developer's WorkSet/2	10G2995	10G3363	4/7/92
IBM OS/2 2.0 Developer's Workbench	10G4333	10G4334	3/31/92

This newsletter was produced by the C Set/2 Planning department of the IBM Canada Toronto Lab. For further information on any of the products mentioned, please contact your local IBM office, or an authorised IBM Business Partner.

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