IBM OS Full American National Standard COBOL Compiler and Library, Version 4

Program Numbers: 5734-CB2 (Compiler and Library)
5734-LM2 (Library Only)

COBOL Teleprocessing, Advanced Symbolic Debugging, and Object Code Optimization capabilities are available with the IBM Operating System Full American National Standard COBOL Compiler and Library Version 4. Other improvements in function over previous versions are also available.

The Compiler and Library operates under control of the MFT, MVT, and VS1 options of the Operating System.

Operation of the Version 4 Compiler and Library is also available under the control of the Conversational Monitor System (CMS) in the virtual machine environment of Virtual Machine Facility/370 (VM/370).

The Version 4 implementation is compatible with the highest level of American National Standard COBOL, X3.23-1968 (American National Standard COBOL is compatible with, and identical to, the international standard of the language, ISO/R1989-1972 Programming Language COBOL). The Version 4 Compiler contains all the features supported in Versions 1, 2, and 3 of the Compiler.

Some of the added features are implemented through CODASYL and IBM language extensions to American National Standard COBOL. Other features are implemented through new options in control statements.

The Version 4 Compiler, together with the Version 4 Subroutine Library, is available as Program Product 5734-CB2. The Version 4 Subroutine Library provides subroutines which can be link edited with object modules produced by the Version 4 Compiler. In conjunction with the COBOL Library Management facility of the Version 4 Compiler, linkage to these subroutines can also be performed dynamically during problem program execution. Under OS, some or all of these subroutines (except the routine used for intra-region/partition communication, the queue structure description routine, a STOP RUN routine, and a special DISPLAY routine) may be placed in the MVT link pack area or the MFT resident reusable routine area, and shared by all COBOL programs in main storage. If the COBOL Library Management facility is not used, the Version 4 Subroutine Library must also be available at link edit time.

The Version 4 Subroutine Library is also available as a separate Program Product (Program Number 5734-LM2).

The following paragraphs describe the features of the Version 4 Compiler, and identify restricted facilities when the Compiler is used with CMS.

Teleprocessing (TP) Feature [1]

Device independent message processing programs can now be written using COBOL language statements to send and receive message data over a communications network. Such COBOL programs can retrieve messages from input queues and place messages into an output queue.

The actual transmission and reception of messages to and from terminals is performed by a user-written Assembler Language Message Control Program (MCP) that utilizes the OS Telecommunications Access Method (TCAM) macro instructions.

Using the Teleprocessing feature of the Version 4 Compiler, the COBOL programmer can:

- Accept telecommunications messages from input queues and enter telecommunications messages into an output queue for subsequent transmission.
- Dynamically identify at object time the number of and symbolic names of all message queues accessed by the COBOL program.
- Interrogate the MCP to determine the number of messages present in the input queues.
- Send output messages using symbolic destination names, and receive messages from symbolically identified sources.

For test purposes, in both the OS and CMS environments, the user may use sequential data sets (BSAM) to simulate message reception and transmission without modifying either his program logic or his COBOL language statements. This facility is available under CMS.

Other New Features

- ***Symbolic Debugging*** -- gives the user additional execution time information for debugging purposes. This information includes dynamic dumps of selected data areas at user-specified points in the Procedure Division, and a symbolic formatted dump of the problem program at abnormal termination. The dump consists of three parts: an abnormal termination message identifying the COBOL statement number causing the abnormal termination, selected areas from the Task Global Table, and data items from the Data Division. (If the FLOW option is specified, a time sequenced flow trace of executed procedure-names may also be obtained.) A dump similar in content to the abnormal termination dump

[1] This feature is not applicable to CMS.

may be obtained at any time during program execution. Therefore, an end-of-job dump can be obtained by requesting such a dump at a STOP RUN, EXIT PROGRAM, or GOBACK statement.

If the symbolic debugging feature is used, the optional object code optimizer is automatically requested (see description below). The symbolic debugging feature and the batch compile feature are mutually exclusive.

- *Syntax-Checker Feature* -- produces an unconditional or conditional syntax-only compilation. When unconditional syntax checking is requested, the source program is scanned for syntax errors and such error messages are generated, but no object code is produced. When conditional syntax checking is requested, a full compilation is produced if no messages or if only W-level or C-level messages are generated; if one or more E-level or D-level messages are generated, no object code is produced. When object code is not generated, compilation time will be reduced significantly. (A few syntax errors may not be detected when using this option. A list of such errors is available.)

- *Optimized Object code* -- (As compared to code generated by previous American National Standard COBOL Compilers) -- can optionally be generated by the Version 4 Compiler. That is, if the Optimizer is requested, a program compiled with the Version 4 Compiler will usually result in fewer machine instructions than it would contain had it been compiled with a previous version of the Compiler. For COBOL object programs that are not I/O-bound, execution time is reduced.

- *COBOL Library Management Facility* -- allows the user to specify at compile time that some, or all, of the COBOL object time library subroutines are to be shared by all COBOL programs in main storage. Under OS, at initial program loading (IPL) time, the user may cause some or all of the needed COBOL subroutines to be placed into the MVT link pack area (LPA) or MFT resident reusable routine area (RRR). (There are four exceptions: a routine used for intra-region/partition communication, the queue structure description routine, a STOP RUN routine, and a special DISPLAY routine cannot be so placed.) All executing COBOL programs may then access the one copy provided. All those COBOL execution time subroutines which the COBOL program requires, but which are not available in either the LPA or RRR, will be loaded into the same region or partition as the COBOL program itself prior to executing the procedural code. The COBOL library Management facility does not require the dynamic invocation facility (described below).

- *Dynamic Invocation and Release of Subprograms* -- is now possible. At execution time, the COBOL programmer can fetch and load user subprograms dynamically. The main storage assigned to such a subprogram can also be released when the subprogram is no longer needed. This permits the COBOL programmer to control whether the subprogram is to be made available in its initial state or in its last-used state each time it is called. Dynamic invocation requires the COBOL Library Management facility. This facility is not supported under CMS.

- *String Manipulation* -- allows the COBOL programmer to separate contiguous data in a data field into multiple logical subfields, and also to concatenate two or more subfields into a single field. The subfields need not be contiguous.

- *I/O Performance Enhancement* -- for queued sequential data sets, the RECFM subparameter of the DD statement may optionally be specified at object time, permitting the programmer to specify the standard block option (for data sets with recording mode F) or the track overflow option for the data set. (The track overflow option is equivalent to writing an APPLY RECORD-OVERFLOW clause in the source program.) Use of the standard block option (most significantly for direct access devices having the Rotational Positional Sensing feature) results in I/O performance improvement.

Programming Systems

The Version 4 Compiler operates under the control of the MFT, MVT, and VS1 options of the Operating System and under the CMS component of VM/370. Use of the VS1 option requires a release of the Operating System that supports VS1. The Version 4 Subroutine Library is required to execute Version 4 COBOL object programs. Use of the TSO and ASCII features included in the Version 4 Compiler requires a release of the Operating System that supports TSO and ASCII. If ASCII or separately signed numeric data types are to be sorted, COBOL object programs using the Sort feature require the separate Program Product IBM System/360 Sort/Merge, Program Number 5734-SM1. Use of the COBOL Teleprocessing feature requires the TCAM Modification Level 11 at object time.

At execution time, teleprocessing programs produced by the Version 4 Compiler require the minimum configuration as defined for TCAM, the TCAM Modification II release, and an OS Release 20.1 system. The user must supply an Assembler Language Message Control Program (MCP) written using the TCAM macro instructions.

Use of the other features of the Version 4 Compiler requires the same control program options as did previous releases of the compiler.

In a TSO system, the Version 4 Compiler can most conveniently be invoked using the current release of TSO COBOL Prompter (Program Product 5734-CP1). The Symbolic Debugging features of the Version 4 Compiler are available from the TSO terminal when executing in a TSO region. The TSO user can enter symbolic debug control information from the terminal in card image format, and receive symbolic debug display output at the terminal. The Syntax-Checker feature of the Version 4 Compiler is available for use in compiling in a TSO Time Shared region, with error messages sent at the end of compilation to the TSO terminal. Message Processing programs can be tested in a TSO Time Shared region; messages can be sent to and received from the TSO terminal without the TCAM message control program in the system, via the BSAM compatibility feature.

The Version 4 Compiler also operates under the control of the Conversational Monitor System (CMS) in the virtual machine environment of Virtual Machine Facility/370 (VM/370). Under CMS, the Version 4 Compiler can accept and compile any COBOL source program that the Version 4 Compiler can accept and compile under the control of the various options of the Operating System. The object code generated by the Version 4 Compiler under CMS can be executed under the control of the options of the Operating System that are described earlier in this publication, except that the Debug files created under CMS for use by Batch Symbolic Debug cannot be used in an OS environment. The object code generated by the Version 4 Compiler under CMS can also be executed under CMS with the restrictions that are listed in the Program Product publication, ***IBM OS Full American National Standard COBOL Compiler and Library, Version 4, Planning Guide,*** Order No. GC28-6431.

System Configuration

The IBM OS Full American National Standard COBOL compiler main storage requirement of 80K bytes remains the same for Version 4. Under MVT the Compiler requires a region of 80K bytes, instead of the 86K bytes required by previous versions.

Use of the symbolic debugging feature requires an additional data set -- SYSUT5. Either enough direct access storage space must be available to contain this data set, or an additional tape unit assigned to SYSUT5 must be available to contain it. When the feature is used, this data set must be available at both compile time and execution time. The resultant increase in object program execution time varies directly with the number and extent of symbolic dumps provided.

When running under CMS, the Version 4 Compiler requires the minimum CMS configuration (320K of virtual storage).

Under TSO, additional storage is required in the TSO Time Shared regions. Details of TSO requirements can be found in the publication ***IBM System/360 Operating System: Time Sharing Option, Planning for TSO,*** Order No. GC28-6698.

Reference Material

A more detailed description of the Version 4 Compiler and Library can be found in the Program Product publications:

IBM OS Full American National Standard COBOL Compiler and Library, Version 4, Planning Guide, Order No. GC28-6431.

IBM OS Full American National Standard COBOL, Order No. GC28-6396.

Information about planning a teleprocessing Message Control Program may be found in the publications ***IBM System/360 Operating System: TCAM Concepts and Facilities,*** Order No. GC30-2022, and in ***IBM System/360 Operating System: Telecommunications Access Method (TCAM) Programmer's Guide and Reference Manual,*** Order No. GC30-2024.

Compatibility

Object programs produced by the Version 4 Compiler must be executed with the Version 4 Subroutine Library (available with the Version 4 Compiler, and also available as a separate Program Product, Program Number 5734-LM2.)

Programs compiled with previous versions of the IBM Operating System Full American National Standard COBOL Compiler may be recompiled without modification with the Version 4 Compiler, providing that new Version 4 reserved words are not specified as user-defined names.

Object modules produced by Version 3 of the American National Standard COBOL compiler may be combined with Version 4 object modules and link edited with the Version 4 Subroutine Library. However, object modules produced by the Version 3 Compiler cannot use the COBOL Library Management Facility.

Source programs written for the COBOL E and F Compilers must be converted before compiling them on the Version 4 Compiler. The Language Conversion Program described in the publication ***IBM System/360 Conversion Aids: COBOL-to-American National Standard COBOL Language Conversion Program,*** Order No. GC28-6400, facilitates such conversions.

Upward data set compatibility exists between the Version 4 Compiler and the other IBM Operating System COBOL Compilers: previous versions of the Full American National Standard COBOL Compiler, the COBOL E Compiler, and the COBOL F Compiler. That is, data sets created by a program compiled on one of these compilers can be processed by a program compiled on the Version 4 Compiler.

The disk formats of CMS data sets are not compatible with OS; however, the data sets are transferable.

Programming Service Classification: A

The Programming service classification assigned to any licensed program may be changed by IBM in accordance with the terms of the License Agreement for IBM Program Products, normally on six months notice. Some reclassifications may constitute a discontinuance of service.

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