Software Product Description

PRODUCT NAME: HP C for OpenVMS

SPD 25.38.35

DESCRIPTION

This document addresses HP C Version 6.5A for OpenVMS Alpha, HP C Version 6.4 for OpenVMS VAX, and HP C Version 7.1 for OpenVMS Integrity Servers (I64). The Alpha V6.5A release is a documentation only release.

HP C (formerly Compaq C) is a standard conforming implementation of the C programming language with HP extensions. The HP C compiler runs under the OpenVMS VAX, Alpha, and I64 Operating Systems and generates optimized and position-independent code.

HP C is a native-mode language product, and is integrated into the Common Language Environments. All OpenVMS system services are available to programs written in HP C. HP C programs can invoke, as functions, modules written in other languages.

HP C supports Record Management Services (RMS) for sequential file organizations and associated access methods. HP C also supports stream file-access methods common among many C implementations.

HP C provides extensive standard-conformance checking, as well as many optional code-quality and portability diagnostics, and supports the lint-like features of the HP Source Code Analyzer. The HP Source Code Analyzer allows the programmer to check for consistent function usage throughout a program environment. HP C also generates complete debug and traceback records for use with OpenVMS Debug. Debug allows the C programmer to set breakpoints, examine and modify the contents of user variables, and selectively halt or continue program execution.

HP C on OpenVMS (Alpha and I64, not VAX) provides IEEE floating-point support as defined by, and in conformance with, the IEEE 754 Standard.

Features

- Limited support for installing more than one version of HP C on the same node, and allowing users to select which version to use on a per-process basis (not on OpenVMS I64, which uses PCSI-based kits).
- Separate modes of compilation to support each of six C dialects:
  - — A strict ANSI89 mode that compiles according to the original ANSI C standard (ANSI/ISO/IEC 9899:1990).
  - — For OpenVMS Alpha and OpenVMS I64, a strict C99 mode that compiles nearly in accordance with the 1999 version of the C standard (ANSI/ISO/IEC 9899:1999), except that the support is not complete and has not been fully verified against conformance suites. This mode may be useful as a preview of what will be considered conforming source code under the new standard, but should not be relied upon for production use until a future release of both HP C and the HP C Run-Time Library for OpenVMS containing complete C99 support. For OpenVMS VAX, this mode is not supported, and is treated as a synonym for relaxed ANSI mode.
  - — A relaxed ANSI mode that compiles according to the latest standard supported by the compiler, but also accepts those HP extensions that do not directly conflict with the semantics of standard C.
  - — A VAX C mode that supports VAX C extensions
  - — A common mode that supports many common usage C constructs as implemented on UNIX systems including Tru64 UNIX (also called "K&R" C or "pcc" mode)
  - — A Microsoft compatibility mode that interprets source programs according to certain language rules followed by the C compiler provided with the Microsoft Visual C++ compiler product.

In addition, just the features specified by Addendum 1 to the ISO C standard adopted by ISO in November of 1994 (digraphs and the __STDC_VERSION__ predefined macro) can be added to each of these dialects except for VAX C mode.

- Data types for numeric, nonnumeric, and systems programming:
  - — C99 Universal Character Names (UCNs) are accepted in identifiers, string literals, and character constants (and their wide variations) (Not OpenVMS VAX).
  - — HP C supports 8, 16, and 32-bit signed and unsigned integers. HP C OpenVMS Alpha and OpenVMS I64 also supports 64-bit signed and unsigned integers.
  - — HP C supports an 8-bit _Bool data type for C99.
  - — HP C supports 32-bit float and 64-bit double floating-point data types. The VAX floating-point formats include D-float and G-float and are user selectable.
  - — HP C OpenVMS Alpha and I64 also supports IEEE floating-point formats in 32-bit single, 64-bit double, and 128-bit quad-precision double-extended representations. The C language type "long double" normally is represented in 128-bit quad precision IEEE format on these platforms, although there is a compile-time option that allows the user to specify that it should use the same representation as type "double" (which is the format used on OpenVMS VAX).
  - — C99 constants for specific values of Infinity and NaN are supported when using/float=ieee (Not OpenVMS VAX).
  - — HP C OpenVMS Alpha and OpenVMS I64 supports the C99 _Complex keyword for specifying three types that represent values in the complex plane, based on Cartesian coordinates of type float, double, or long double, respectively, except that D_float representation is not supported for _Complex types. Run-time library support for C99 mathematical functions operating on these types is available in OpenVMS Alpha V7.3-1 and subsequent versions.
  - — HP C supports passing numeric constants by reference in function calls.
  - — HP C supports the multibyte and wide-character types and features of XPG4, with the locale support available in OpenVMS V6.4 and subsequent versions.
  - — HP C OpenVMS Alpha and OpenVMS I64, on OpenVMS Version 7.0 and later, supports user-controlled features to specify the use of 64-bit pointers that allow applications to exploit the increased address space capabilities of the Alpha and I64 architectures and the OpenVMS Alpha Version 7.0 services. These features include command-line qualifiers, #pragma directives, and run-time library specifications that allow the programmer to allocate and access data at run time that is to be beyond the range of addressing afforded by 32-bit pointers. By default, programs compiled by earlier versions of the compiler or on earlier versions of OpenVMS continue to behave as before, strictly within 32-bit address space. Explicit use of the new compiler features allow such programs to be extended to exploit the extended address space with minimal changes to the source code.

- Storage allocation using:
  - — Reserved words (globalref, globaldef, and globalvalue) for sharing data among program modules
  - — Reserved words (readonly, noshare, and psect name specification) for control of data attributes and data placement
  - — Reserved words (_align and _unaligned) for specifying the alignment boundaries of data objects
  - — Pragmas to control extern models and structure member alignment and base structure alignment
- Option for running only the preprocessor phase of compilation
- Option for generating include-file dependency information to aid in construction of files for the HP Module Management System
- Pragmas to control compiler options
- The C99_Pragma operator, which effectively allows pragma directives to be produced by macro expansion (not OpenVMS VAX).
- Compilation options allowing a choice between fast turnaround and optimization across compilation units
- Option to generate a file of prototype-style function declarations suitable for use in a header file from the function definitions (both prototype-style and old-style) contained in a source file.
- Enhanced diagnostic message controls with the command-line qualifier /WARNINGS, including the following features:
  - — specify whether a message is issued only once per compilation, or at each occurrence
  - — specify severity of any message with a default severity of information or warning
  - — control optional messages using a single numeric "importance level"
  - — control optional messages using functional groups
- Compiler-generated listing file including optional:
  - — Annotations that provide information about certain optimizations that were performed or not performed (Alpha and I64 only)
  - — Source Code
  - — Include-file contents
  - — Machine code
  - — Macro expansion
  - — Compilation statistics
  - — Symbol table with attributes of source program identifiers
  - — Symbol cross reference, showing for each symbol the source lines where it is defined or used, annotated with type of use
- Built-in functions allow access to a subset of VAX, Alpha, and I64 machine instructions. HP C OpenVMS Alpha inline-assembly code is also supported giving access to all Alpha machine-code instructions and PAL calls.
- Integration into the OpenVMS Common Language Environments:
  - — Generation of complete debug and traceback records for Debug support
  - — Conformance to the Calling Standard
  - — Access to the Common Run-Time Library for general purpose routines and support of multi-language environments
  - — Access to the data management facilities of OpenVMS Record Management Services (RMS) by direct calls to the Common Run-Time Library
  - — Support for providing error diagnostics to the HP Language-Sensitive Editor and cross-reference information for the HP Source Code Analyzer
  - — Support for Common Data Dictionary (CDD)
  - — HP C OpenVMS support for interaction with routines executing in translated mode. On OpenVMS Alpha, native Alpha images can link against and interoperate with images translated from OpenVMS VAX. On OpenVMS I64, native I64 images can link against and interoperate with images translated from OpenVMS Alpha (including Alpha images translated from OpenVMS VAX).
- Extensive global and local optimizations of generated code for increased performance under OpenVMS
- Extensive control over optimization behavior
- Interface to the curses screen-manipulation package
- Installation kit cooperates with HP C++.

Compatibility with Other C Implementations

HP C is a conforming hosted implementation of ANSI X3.159-1989 Programming Language C (ISO/IEC 9899:1990[1994]). Its VAXC, common C, and Microsoft C compatibility modes provide many features to ease porting from other environments, though they do not provide 100% emulation of every feature of a particular version of the compilers used in those environments. In addition, the relaxed ANSI mode accepts all features from the currently-supported standard (C99 for OpenVMS Alpha and OpenVMS I64, C89 for OpenVMS VAX) and also accepts a number of features present in those special dialects that do not conflict with the standard, as well as features from the GNU C compiler (gcc) that are sometimes used in Open Source applications and

header files on the Linux platform (e.g. the __typeof__ operator).

While many programs written in C for other compilers can be successfully recompiled under HP C, some incompatibilities among implementations exist.

Run-Time Library for C Applications

With the exception of OpenVMS VAX Operating Systems prior to V6.1, the complete HP C Run-Time Library that is needed for use with HP C is distributed with the OpenVMS Operating Systems. The HP C Run-Time Library provides routines to perform input/output, character and string handling, mathematical computations, memory allocation, and emulation of selected UNIX[R] features. These routines are provided both in shared image and object module library form.

Run-time Library Redistribution

The HP C kit may include run-time library components in either shareable image or object library form. HP grants the user a nonexclusive royalty-free worldwide right to reproduce and distribute these Run-Time Libraries ("the RTLs") provided that the user:

- distributes the RTLs only in conjunction with and as a part of the user's software application product, which is designed to operate in the OpenVMS environment;
- does not use HP's name, logo, or trademarks to market the user's software application product;
- includes HP's copyright notice for HP C on one of the following:
  - — the user's product disk label
  - — each copy of the application
  - — the title or copyright page of the documentation for the software application product
- agrees to indemnify, hold harmless, and defend HP from and against any claims or lawsuits, including attorney's fees, that arise or result from the use or distribution of the software application product. Except as expressly provided herein, HP grants no implied or express license under any of its patents, copyrights, trade secrets, trademarks, or any license or other proprietary interests and rights.

For OpenVMS Alpha systems, the only RTL component that may be redistributed is DECC$CRTL.OLB. Refer to the HP C V6.5 for OpenVMS Alpha Release Notes for instructions on redistributing this RTL component. For OpenVMS VAX systems, the only RTL components that may be redistributed are DECC$CRTL.OLB and AACRT060.A. Refer to the HP C V6.4 for OpenVMS VAX Release Notes for instructions on redistributing these RTL components.

HARDWARE REQUIREMENTS

Processors Supported:

Any Alpha system capable of running the OpenVMS Alpha Operating System Version 6.2 to 7.3-2 or any VAX capable of running the OpenVMS Operating System V5.5-2 to 7.3. OpenVMS I64 supports the following Integrity Servers:

— HP Integrity server rx2600 (2 sockets) - all speeds

— HP Integrity server rx1600 (2 sockets) - all speeds

— HP Integrity server rx4640 (4 sockets) - all speeds

Note: A socket is a receptacle for microprocessor modules. A single microprocessor module may contain one or more CPUs.

Refer to the OpenVMS Operating System's Software Product Description (SPD 82.35.xx) for details.

The following table shows disk space requirements for installation of HP C for OpenVMS. These numbers reflect choosing all of the default installation options. Separate entries are shown for also installing the optional document sets in postscript, text, and html formats.

Disk Space Requirements (Block Cluster Size = 1):

	HP C OpenVMS VAX	HP C OpenVMS Alpha
For installation (without docs):	100,000 blks (50MB)	150,000 blks (75MB)
For installation (with docs):	180,000 blks (90MB)	250,000 blks (125MB)
For permanent use (without docs):	80,000 blks (40MB)	100,000 blks (50MB)
For permanent use (with docs):	120,000 blks (60MB)	160,000 blks (80MB)

These counts refer to the disk space required on the system disk. The sizes are approximate; actual sizes may vary depending on the user's system environment, configuration, and software options.

Memory Requirements for DECwindows Support:

The minimum supported memory for this application running in a standalone DECwindows environment with both the client and server executing on that same system is 8 Mbytes.

OPTIONAL HARDWARE

On VAX systems, only D_, F_, and G_Floating floating-point data types can be used in programs written in HP C, which does not support the H_Floating type. (HP C on Alpha and I64 systems supports IEEE floating point types in addition to these VAX types). Floating-point-intensive applications should be run on configurations with the appropriate hardware support for the floating-point data types being used. For OpenVMS I64

in particular, note that only the IEEE format has hardware support; the VAX format floating-point types on OpenVMS I64systems are implemented in software and incur significant software run-time emulation overhead. Floating-point code that is performance-critical should always use the IEEE format on OpenVMS I64. Consult the base operating system Software Product Description (SPD) for the appropriate floating-point accelerator or other floating-point hardware appropriate for your configuration.

SOFTWARE REQUIREMENTS

- OpenVMS VAX Operating System, Version 5.5-2 to Version 7.3
- OpenVMS Alpha Operating System Version 6.2 to Version 7.3-2
- OpenVMS I64 Operating System V8.2

SOFTWARE LICENSING

A software license is required in order to use HP C software. For VAX and Alpha platforms, HP C is offered with Concurrent Use, Personal Use and Traditional 'capacity' licenses. For I64, it is offered with Concurrent Use licenses. Version update licenses are not available for the I64 platform. Rights to use future revisions of HP C are available only through a Support Agreement or through a new license purchase. For more information about OpenVMS license terms and policies, contact your local HP sales office, or reference the Software Licensing site at: <http://licensing.hp.com/swl/view.slm?page=index>

LICENSE MANAGEMENT FACILITY SUPPORT:

These layered products support the OpenVMS License Management Facility.

License units for Alpha and VAX HP C are allocated on a Capacity Use, Personal and Concurrent Use basis. License units for I64 HP C are allocated on Concurrent Use basis.

Each Personal Use license allows one identified individual to use the layered product. Each Concurrent Use license allows any one individual at a time to use the layered product.

For more information on the License Management Facility, refer to the OpenVMS Operating System Software Product Description or the License Management Facility manual of the OpenVMS Operating System documentation set. For more information about HP's licensing terms and policies, contact your local HP office.

CLUSTER ENVIRONMENT

This layered product is fully supported when installed on any valid and licensed OpenVMS Cluster* configuration without restrictions. The HARDWARE REQUIREMENTS section of this product's Software Product Description detail any special hardware required by this product.

* OpenVMS Cluster configurations are fully described in the OpenVMS Cluster Software Product Description (SPD 29.78.xx) and include CI, Ethernet, and Mixed Interconnect configurations.

OPENVMS TAILORING CLASSES

The following OpenVMS classes are required for full functionality of this layered product:

- OpenVMS Required Save Set
- Programming Support
- Utilities

For more information on OpenVMS classes and tailoring, refer to the OpenVMS Operating System Software Product Description (SPD 82.35.xx)

OPTIONAL SOFTWARE

- HP DECset Release 12.5 for OpenVMS Alpha Systems or HP DECset Release 12.5 for OpenVMS VAX Systems, or DECset for OpenVMS I64 12.6 which includes:
  - — Language-Sensitive Editor/Source Code Analyzer (LSE/SCA) for OpenVMS Systems
  - — DIGITAL Test Manager (DTM) for OpenVMS Systems
  - — Performance and Coverage Analyzer (PCA) for OpenVMS Systems
  - — Code Management System (CMS) for OpenVMS Systems
  - — Module Management System (MMS) for OpenVMS Systems

For more information on HP DECset Release 12.6 for OpenVMS Alpha, OpenVMS I64 Systems, refer to the Software Product Description (SPD 42.29.xx).

For more information on HP DECset Release 12.5 for OpenVMS VAX Systems, refer to the Software Product Description (SPD 27.07.xx)

- DEC CDD/Repository Version 5.3 for OpenVMS VAX and OpenVMS Alpha.

GROWTH CONSIDERATIONS

The minimum hardware and software requirements for any future version of this product may be different from the requirements for the current version.

DISTRIBUTION MEDIA

HP C OpenVMS VAX ONLY:

HP C for OpenVMS VAX is available on the OpenVMS VAX Software Layered Products Library Package (QA–5G88A–H8). The library package includes media and documentation on CD–ROM. Documentation kits containing only the HP C for OpenVMS VAX product are available separately.

HP C OpenVMS Alpha ONLY:

HP C for OpenVMS Alpha is available on the OpenVMS Alpha Software Layered Products Library Package (QA–03XAA–H8). The library package includes media and documentation on CD–ROM.

HP C OpenVMS I64 ONLY:

HP C for OpenVMS I64 is available on the Layered Products media within the Operating Environment package. The Layered Products media includes the product binaries and on-line documentation. An optional hardcopy documentation kit is also offered.

SOFTWARE WARRANTY

This software is provided by HP with a 90 day conformance warranty in accordance with the HP warranty terms applicable to the license purchase.

ORDERING INFORMATION

When purchasing HP C both a license and media must be ordered. The license deliverable provides the LMF PAK required to run the HP C software. The VMS Operating System or Operating Environment (license and media) is a prerequisite to running HP C.

HP C for OpenVMS VAX ONLY:

Software Licenses:
- Personal Use : QL–015AA–**
- Concurrent Use : QL–015AA–**
- Traditional/Capacity Use: QL–015A*–**

Software Media/Documentation: QA–015AA–**
Software Documentation (Hard Copy): QA–015AA–GZ

HP C for OpenVMS Alpha ONLY:

Software Licenses:
- Personal Use : QL–015AA–**
- Concurrent Use : QL–015AA–**
- Traditional/Capacity Use: QL–MU7A*–**

Software Media/Documentation: QA–MU7AA–H8
Software Documentation (Hard Copy): QA–MU7AA–GZ

HP C for OpenVMS I64 ONLY:

Software Licenses:
- Concurrent Use: BA348AC

Software Media:
- Foundation Operating Media, BA322AA or
- Enterprise Operating Media, BA323AA or
- Mission Critical Media, BA324AA

Software Documentation (Hard Copy): BA348MN

An example of a new order for HP C:

Concurrent Use License - BA348AC
Binaries: Operating Environment Media - BA32*A
Hardcopy Documentation Kit (Optional) BA348MN

For more information on the Operating Environments, please see the HP Operating Environments for OpenVMS I64 SPD: 82.34.**

* Denotes variant fields. For additional information on available licenses, services, and media, refer to the appropriate price book.

The ordering information is valid at time of release. Please contact your local HP office for the most up-to-date information.

SOFTWARE PRODUCT SERVICES

A variety of service options are available from HP. For more information, contact your local HP account representative or distributor. Information is also available on www.hp.com/hps/software.

TRADEMARK INFORMATION