



VSI BLISS X1.14-141 for OpenVMS x86-64 Systems

Release Notes

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This document contains information about version X1.14-141 of the BLISS compilers for OpenVMS x86-64.

1. OpenVMS X86-64 BLISS Bugfixes, Features, and Differences

This chapter describes the bugfixes in this release of OpenVMS x86-64 BLISS, new features, and the differences between the BLISS compilers on OpenVMS I64 and OpenVMS Alpha.

The list of corrections since the last release is found in Chapter 2.

1.1. The Family of BLISS Compilers

BLISS-32EN and BLISS-64EN are native compilers running on, and generating code for OpenVMS for Alpha systems.

BLISS-32IN and BLISS-64IN are native compilers running on, and generating code for OpenVMS for I64 systems.

BLISS-32XN and BLISS-64XN are native compilers running on, and generating code for OpenVMS for x86-64 systems.

The BLISS-32xx compilers do operations 32 bits wide (i.e. BLISS values are longwords). The default width is 32 bits. In this document, they are collectively referred to as "the 32-bit compilers."

The BLISS-64xx compilers do operations 64 bits wide (i.e. BLISS values are quadwords). The default width is 64 bits. In this document, they are collectively referred to as "the 64-bit compilers."

The compilers are invoked as follows:

Compiler	Command
BLISS-32EN	BLISS/A32 or BLISS (On OpenVMS Alpha systems)
BLISS-64EN	BLISS/A64
BLISS-32IN	BLISS/I32 or BLISS (On OpenVMS I64 systems)
BLISS-64IN	BLISS/I64
BLISS-32XN	BLISS/X32 or BLISS (On OpenVMS x86-64 systems)
BLISS-64XN	BLISS/X64

1.2. File Extensions and Output Locations

The default filetype for object files is .OBJ.

The default output filetype for library files is .L32 for BLISS-32EN, BLISS-32IN, and BLISS-32XN; and .L64 for BLISS-64EN, BLISS-64IN, and BLISS-64XN.

Library files are NOT compatible between dialects.

The search list for BLISS-32EN is:

For source code:	.B32E, .B32, .BLI
For require files:	.R32E, .R32, .REQ

For library files:	.L32E, .L32, .LIB
--------------------	-------------------

The search list for BLISS-64EN is:

For source code:	.B64E, .B64, .BLI
For require files:	.R64E, .R64, .REQ
For library files:	.L64E, .L64, .LIB

The search list for BLISS-32IN is:

For source code:	.B32I, .B32, .BLI
For require files:	.R32I, .R32, .REQ
For library files:	.L32I, .L32, .LIB

The search list for BLISS-64IN is:

For source code:	.B64I, .B64, .BLI
For require files:	.R64I, .R64, .REQ
For library files:	.L64I, .L64, .LIB

The search list for BLISS-32XN is:

For source code:	.B32X, .B32, .BLI
For require files:	.R32X, .R32, .REQ
For library files:	.L32X, .L32, .LIB

The search list for BLISS-64XN is:

For source code:	.B64X, .B64, .BLI
For require files:	.R64X, .R64, .REQ
For library files:	.L64X, .L64, .LIB

The location of the output files depends on where in the command line the output qualifier was found.

If an output file qualifier, such as **/OBJECT**, **/LIST** or **/LIBRARY**, is used after an input file specification and does not include an output file specification, the output file specification defaults to the device, directory, and file name of the immediately preceding input file.

Thus:

```
BLISS [FOO]BAR/OBJ      -- Puts BAR.OBJ in directory FOO
BLISS /OBJ [FOO]BAR    -- Puts BAR.OBJ in default directory
BLISS [FOO]BAR/OBJ=[]  -- Puts BAR.OBJ in default directory
```

1.3. BLISS Differences Between VAX BLISS-32 and Alpha BLISS

1.3.1. VAX Hardware Registers

1.3.1.1. AP Register

The parameter-passing mechanism is different on Alpha, and there is no equivalent to the AP register.

References to AP which are used to access the parameter list can be replaced by **COMMON BLISS** linkage functions such as **ACTUALPARAMETER** and **ACTUALCOUNT**. The **COMMON BLISS** function **ARGPTR** is supported on Alpha (but requires the compiler to "fake" an argument block, and so impacts performance adversely, particularly for the 32-bit compilers). **ARGPTR** returns a pointer to a VAX-format argument list (i.e. starting with a count, and structured as a vector). Vector elements are **BLISS** values, 32 bits long in the 32-bit compilers and 64 bits long in the 64-bit compilers.

It is important to note that this means:

- The values in the **ARGPTR** vector are copies of the actuals, not the actuals themselves;
- There is no easy way for 32-bit code to look at the upper 32 bits of an actual parameter.

One common VAX idiom is **CALLG(.AP, ...)**, which passes a routine's own input parameter list on to another routine. For fixed-length parameter lists, this is easy for users to imitate in **COMMON BLISS**, but for variable-length ones it is not. To support this idiom in Alpha BLISS, we provide an assembly routine **BLI\$CALLG** on Alpha and Itanium but replaced with the standard **LIB\$CALLG** on x86-64.

BLI\$CALLG takes two arguments: the first is a pointer to the in-memory argument list built by the **ARGPTR** built-in, and the second is the address of a routine to call. **BLI\$CALLG** is designed to handle a valid argument list. If anything else is passed to it, there will be unpredictable results.

We anticipate that users will replace **CALLG(.AP, .RTN)** by **BLI\$CALLG(ARGPTR(), .RTN)**.

Because the compiler has to "home" register arguments for **ARGPTR**, it will be more efficient to use normal calls than to use **BLI\$CALLG(ARGPTR(), ...)**. This contrasts with **CALLG(.AP, ...)**, which is more efficient than a normal call.

Use of the AP as a scratch register holding a local variable is not portable, but the larger number of registers offered on the Alpha will allow another register to be used in its place.

The name "AP" is not recognized by the compilers, and will cause an error.

1.3.1.2. FP Register

The Alpha calling standards do not directly support dynamic condition handling, so constructs of the type **.FP = handler** are invalid.

COMMON BLISS has the **ENABLE** mechanism to establish static condition handlers.

The Alpha BLISS compilers provide two new built-ins named **ESTABLISH** and **REVERT**. Their semantics parallel the VAX idiom of assignments to the location pointed to by the FP register.

- **ESTABLISH(rtn)**

Establishes RTN as the current handler. It has no value.

- **REVERT()**

Disestablishes any established handler routine. It also has no value.

These built-ins cannot be used in the same routine as **ENABLE**. No enable vector is passed to a handler that is established using **ESTABLISH**.

When a routine which has established a handler returns, that handler is disestablished automatically.

Programs which inspect the frame will have to be re-written, as the frame layout has changed for Alpha.

Because all references to the VAX FP must be changed, use of the name "FP" in a **BUILTIN** declaration is an error. Access to the Alpha FP may be achieved by use of register 29, the Alpha frame pointer. However, this is almost certain to cause a register conflict and prevent the generation of code; we recommend that all manipulation of the real FP take place in Alpha assembler.

1.3.1.3. SP Register

Because all references to the VAX SP must be changed, use of the name "SP" in a **BUILTIN** declaration is an error. Access to the Alpha SP may be achieved by use of register 30, the Alpha stack pointer. However, this is almost certain to cause a register conflict and prevent the generation of code; we recommend that all manipulation of the real SP take place in Alpha assembler.

1.3.1.4. PC Register

Use of the name "PC" is an error, as there is no equivalent to the VAX PC on Alpha.

1.3.2. QUAD Allocation Unit

The 64-bit compilers recognize **QUAD** as specifying a data-segment of eight bytes (64 bits), in the same way that **LONG** is recognized as specifying 32 bits. **QUAD** is not recognized by the 32-bit compilers, as the 32-bit version of the BLISS language provides no method for manipulating data-segments larger than 32 bits in size.

QUAD may be used in the 64-bit compilers wherever **BYTE**, **WORD**, and **LONG** may be used in BLISS-32.

The default size for data-segments in the 64-bit compilers is **LONG** or **QUAD**, depending on the presence or absence of the compile-time switch **/ASSUME=LONG_DEFAULT** or **/ASSUME=SIGNED_LONG**.

1.3.3. Attributes

1.3.3.1. ALIGN Attribute

The **ALIGN** attribute is allowed on **EXTERNAL**, **BIND**, and **GLOBAL BIND** declarations in addition to the **OWN**, **GLOBAL**, **LOCAL** and **STACKLOCAL** declarations on which BLISS-32 allows it. In the Alpha compilers, in addition to telling the compiler on what boundaries to allocate data, it tells the compiler what assumptions it can make regarding the alignment of data that the compiler does not allocate in this compilation unit.

1.3.3.2. ALIAS Attribute

The **ALIAS** attribute indicates that a variable may be changed by routine calls and indirect assignments. **ALIAS** may be used on any of the following declarations: **EXTERNAL**, **GLOBAL**, **OWN**, **FORWARD**, **MAP**, **BIND**, **GLOBAL BIND**, **LOCAL**, **STACKLOCAL**.

The BLISS language assumes that named storage segments will in general be changed only by using the name of the variable. Also, BLISS expects that two different named pointer variables do not point to the same block of storage.

If it is necessary to have more than one pointer to the same named variable or block of storage, these pointers should be declared with the **ALIAS** attribute.

Any variable passed using an OpenVMS item-list must be treated as **ALIAS**.

The Alpha BLISS compilers automatically mark as **ALIAS** any variable whose address is used in a context other than fetch or store. These are the variables that got the "consider **VOLATILE**" diagnostic when **/CHECK=ADDRESS_TAKEN** was used. This diagnostic now reads: "assuming **ALIAS**".

In most cases, Alpha-only BLISS source code can rely on the automatic **ALIAS** analysis by the Alpha BLISS compiler. Since VAX BLISS-32 does not do this, code that is common between Alpha and VAX needs to use explicit **ALIAS** attributes. This requires VAX BLISS V4.7; older versions do not support the **ALIAS** attribute.

1.3.3.3. VOLATILE Attribute

The **VOLATILE** attribute is stronger in Alpha BLISS than in VAX BLISS. On VAX, **VOLATILE** means that the variable can change at any time. On Alpha, it has the following properties:

- Always causes one memory access for long/quad read/write and byte/word reads
- Strict source ordering (no reordering of reads, for example)
- Proper size (for long/quad)
- Only supported for aligned accesses
- Yields byte granularity

As a result, **VOLATILE** is sufficient for I/O registers.

This may require source code changes in existing Alpha BLISS programs. Specifically, writing to an unaligned 16-bit (word) field in a **VOLATILE** structure causes an unrecoverable alignment (**ROPRAND**) fault.

The compiler has added a diagnostic to issue a warning for unaligned **VOLATILE** references:

```
%BLS32-W-UNAVOLACC, volatile access appears unaligned, but must be aligned at run-time
```

BLISS users should modify their code to completely eliminate all **UNAVOLACC** warnings.

What **MUST** Be Done to ensure correct operation:

1. Any references to **VOLATILE** unaligned 16-bit words must be changed to eliminate unrecoverable faults.
2. All uses of structures that contain 16-bit words should be examined to ensure that either:
 - a. The 16-bit field is aligned, or
 - b. The structure is not accessed using **REF VOLATILE**

What **SHOULD** be done to get good performance:

1. Unaligned access of other types are recoverable but take extra time. In almost all cases, it is desirable to change the **VOLATILE** attribute to **ALIAS** to avoid unnecessary alignment faults.

1.3.4. Linkages

1.3.4.1. CALL linkage

The **CALL** linkage is the standard linkage on Alpha. See the OpenVMS Calling Standard for details.

Routines compiled with a 32-bit compiler can call routines compiled with a 64-bit compiler and vice versa. Parameters are truncated when shortened, and sign-extended when lengthened.

By default, **CALL** linkages pass an argument count. This can be overridden using the **NOCOUNT** linkage option described below.

Though the arguments are passed in quadwords, the 32-bit compilers can only "see" the lower 32 bits.

1.3.4.2. JSB Linkage

The OpenVMS compilers have a JSB linkage type. Routines declared with the JSB linkage type are frameless routines, i.e. they do not modify the FP register.

1.3.4.3. Global Registers

Routines with linkages with **GLOBAL REGISTERS** which did not declare those registers as **EXTERNAL REGISTERS** follow the BLISS-32 rules:

- If the global register is not declared at all, its value will be preserved;
- If the register is specifically declared (e.g. as a **GLOBAL** register), the value of the register will be preserved and a new, nested lifetime started for the register.

1.3.4.4. INTERRUPT and EXCEPTION Linkages

The OpenVMS compilers have **INTERRUPT** and **EXCEPTION** linkage types. See the System Reference Manual for details. Routines with these linkages cannot be called from BLISS.

1.3.4.5. COUNT and NOCOUNT Linkage Attributes

The linkage attributes **COUNT** and **NOCOUNT** allow the user to specify whether the argument count should be passed from the caller to the callee. These attributes are legal only for the **CALL** linkage type. The default is **COUNT**. The default can be controlled on a module-wide basis by using either the command line qualifier **/[NO]COUNT** or the module head switch **[NO]COUNT**. As usual, a switch setting given in a module head overrides the command line qualifier. The linkage functions **ACTUALCOUNT**, **ACTUALPARAMETER**, **NULLPARAMETER**, and **ARGPTR** may not be used in routines whose linkages are **NOCOUNT**.

1.3.5. Machine Specific Features

1.3.5.1. Alpha Registers

Alpha integer registers are available, using the same syntax used on the VAX for access to VAX registers. Alpha floating registers are not available.

Many of the registers are not available for use by user code, as they are reserved for special uses. A register conflict message will be issued when a user request for a particular register cannot be satisfied.

1.3.5.2. PALcode Built-in Functions

The following **PALcode** instructions are available as built-in functions in the OpenVMS compilers.

BPT	INSQHIL	REMQHIL	BUGCHK	MTPR_ASTSR	MFPR_MCES
CHME	INSQTIL	REMQTIL	IMB	MTPR_FEN	MFPR_SSP

CHMK	INSQUEL	REMQUEL	PROBER	MTPR_PRBR	MFPR_WHAMI
CHMS	INSQHIQ	REMQHIQ	PROBEW	MTPR_SIRR	MFPR_PTBR
CHMU	INSQTIQ	REMQTIQ	RD_PS	MTPR_TBIAP	MFPR_SISR
HALT	INSQUEQ	REMQUEQ	SWASTEN	MTPR_IPIR	MFPR_IPL
	INSQUEL_D	REMQUEL_D	WR_PS_SW	MTPR_MCES	MFPR_PCBB
	INSQUEQ_D	REMQUEQ_D	CFLUSH	MTPR_TBIS	MFPR_SCBB
	INSQHILR	REMQHILR	DRAINA	MTPR_SSP	MFPR_TBCHK
	INSQHIQR	REMQHIQR	LDQP	MTPR_ASTEN	MFPR_ESP
	INSQTILR	REMQTILR	STQP	MTPR_IPL	MFPR_USP
	INSQTIQR	REMQTIQR	SWPCTX	MTPR_SCBB	MFPR_FEN
			GENTRAP	MTPR_TBIA	MFPR_PRBR
			RSCC	MTPR_ESP	MFPR_ASTEN
			READ_UNQ	MTPR_USP	MFPR_ASTSR
			WRITE_UNQ	MTPR_VPTB	MFPR_VPTB
				MTPR_TBISD	
				MTPR_TBISI	
				MTPR_DATFX	
				MTPR_ASN	
				MTPR_PERFMON	

The following **PALcode** instructions are available as built-in functions in the other compilers:

BPT IMB HALT GENTRAP

Refer to the SRM for information regarding inputs and outputs. Please note that all of above names are preceded by a **PAL_** to distinguish them from similar VAX built-ins.

CALL_PAL is a generic **PALcode** built-in. The first parameter, which must be a compile-time constant expression, is the function field of the **CALL_PAL** instruction. The remaining parameters are the inputs to the **CALL_PAL** instruction.

1.3.5.3. New Built-in Functions for Atomic Operations

The following new built-in functions allow atomic updating of memory:

ADD_ATOMIC_LONG, ADD_ATOMIC_QUAD, AND_ATOMIC_LONG,
AND_ATOMIC_QUAD, OR_ATOMIC_LONG, OR_ATOMIC_QUAD

The operations have the form:

```
<op>_ATOMIC_<size>( ptr, expr
    [ , retry_count ]           ! Optional input
    [; old_value    ] )         ! Optional output
```

```
Value:           1            Operation succeeded
                 0            Operation failed
```

<op> is one of AND, ADD, OR
<size> is one of LONG or QUAD

The operation is addition (or ANDing or ORing) of the expression **EXPR** to the data-segment pointed to by **PTR** within a load-locked/store-conditional code sequence. The operation will be tried **RETRY_COUNT** times. If the operation cannot be performed successfully in the specified number of trials, the built-in's value is zero.

PTR must be a naturally-aligned address.

The optional output parameter **OLD_VALUE** is set to the previous value of the data-segment pointed to by **PTR**.

For the 32-bit compilers, the **EXPR** parameter will be sign-extended and the **OLD_VALUE** parameter will be truncated for the **QUAD** operations.

1.3.5.4. Compatible Built-in Functions for Atomic Operations

TESTBITSSI, **TESTBITCCI**, **TESTBITSS**, **TESTBITSC**, **TESTBITCS**, **TESTBITCC** and **ADAWI** have been implemented in an upward-compatible manner.

The **TESTBITxx** built-ins are AST-atomic. This is a weaker form of atomicity than the **TESTBITxxI** built-ins have. The operations have the form:

```
TESTBITxxx( field
            [ , retry_count ]      ! Optional input
            [; success-flag ] )    ! Optional output

Value:      1      Bit was set (TESTBITSSI) or clear (TESTBITCCI)
            0      Otherwise
```

BLISS-32's **ADAWI** returns the contents of the PSL. Since the PSL doesn't exist on Alpha, the return value of **ADAWI** is a simulated partial VAX PSL, where only the condition codes are significant.

```
ADAWI( address, addend)
```

```
Value:      PSL 0:3 (Simulated partial VAX PSL)
```

1.3.5.5. New Shift Built-in Functions

Built-in functions for shifts in a known direction have been added. They are only valid for shift amounts in the range **0..%BPVAL-1**.

```
result = SLL(value, amount)      Shift left logical
result = SRL(value, amount)      Shift right logical
result = SRA(value, amount)      Shift right arithmetic
```

1.3.5.6. Other Machine-specific Built-in Functions

Other machine specific built-in functions are:

- **ROT**(value, shift) – rotates value by shift bits, returning the rotated value.
- **TRAPB**() – generates the **TRAPB** instruction.
- **RPCC**() – generates the **RPCC** instruction.
- **WRITE_MBX**(dest-address, value-to-store) – generates the **STQ_C** instruction required for writing to mailboxes. See the section "Mailbox Posting" in the I/O Architecture chapter of the SRM for details. This function returns 1 for success and 0 for failure.
- **UMULH**, **CMPBGE**, **ZAP**, and **ZAPNOT** – **UMULH**, **CMPBGE**, **ZAP** and **ZAPNOT** each have two input parameters and have a value. They correspond to the Alpha instructions with the same names.
- **CMP_STORE_LONG** and **CMP_STORE_QUAD** – **CMP_STORE_LONG**(addr, comparand, value, destination) and **CMP_STORE_QUAD**(addr, comparand, value, destination) do the following

interlocked operations: compare the longword or quadword at addr with comparand, and if they are equal, store value at destination. They return an indicator of success (1) or failure (0).

1.4. BLISS Differences Between Alpha BLISS and Itanium BLISS

This section describes those Alpha BLISS features that are not supported by OpenVMS I64 BLISS.

1.4.1. Machine Specific Built-ins

The following Alpha BLISS machine-specific built-ins are not supported:

RPCC	ZAP
TRAPB	ZAPNOT
DRAINT	CMP_STORE_LONG
WRITE_MBX	CMP_STORE_QUAD
CMPBGE	

CMP_STORE_LONG and **CMP_STORE_QUAD** are replaced by **CMP_SWAP_LONG** and **CMP_SWAP_QUAD**.

1.4.2. Itanium Registers

The following Itanium registers are not supported for naming in **REGISTER**, **GLOBAL REGISTER**, **EXTERNAL REGISTER** or as parameters to **LINKAGE** declarations.

R0	zero register
R1	global pointer
R2	volatile and GEM scratch register
R12	stack pointer
R13	thread pointer
R14-R16	volatile and GEM scratch registers
R17-R18	volatile scratch registers

1.4.3. PALcode Built-in Functions

The following Alpha BLISS **PALcode** built-ins are not supported:

CALL_PAL	PAL_MFPR_PCBB	PAL_MTPR_SIRR
PAL_BPT	PAL_MFPR_PRBR	PAL_MTPR_SSP
PAL_BUGCHK	PAL_MFPR_PTBR	PAL_MTPR_TBIA
PAL_CFLUSH	PAL_MFPR_SCBB	PAL_MTPR_TBIAP
PAL_CHME	PAL_MFPR_SISR	PAL_MTPR_TBIS
PAL_CHMK	PAL_MFPR_SSP	PAL_MTPR_TBISD
PAL_CHMS	PAL_MFPR_TBCHK	PAL_MTPR_TBISI
PAL_CHMU	PAL_MFPR_USP	PAL_MTPR_USP
PAL_DRAINA	PAL_MFPR_VPTB	PAL_MTPR_VPTB
PAL_HALT	PAL_MFPR_WHAMI	PAL_PROBER
PAL_GENTRAP	PAL_MTPR_ASTEN	PAL_PROBEW
PAL_IMB	PAL_MTPR_ASTSR	PAL_RD_PS
PAL_LDQP	PAL_MTPR_DATFX	PAL_READ_UNQ

PAL_MFPR_ASN	PAL_MTPR_ESP	PAL_RSCC
PAL_MFPR_ASTEN	PAL_MTPR_FEN	PAL_STQP
PAL_MFPR_ASTSR	PAL_MTPR_IPIR	PAL_SWPCTX
PAL_MFPR_ESP	PAL_MTPR_IPL	PAL_SWASTEN
PAL_MFPR_FEN	PAL_MTPR_MCES	PAL_WRITE_UNQ
PAL_MFPR_IPL	PAL_MTPR_PRBR	PAL_WR_PS_SW
PAL_MFPR_MCES	PAL_MTPR_SCBB	PAL_MTPR_PERFMON

Macros are provided in **STARLET.REQ** for **PALCALL** built-ins. The privileged **CALL_PALs** call exec routines and the unprivileged **CALL_PALs** execute system services.

1.4.4. INTERRUPT and EXCEPTION Linkages

The Alpha **INTERRUPT** and **EXCEPTION** linkages are not supported.

1.4.5. "BUILTIN Rn"

The ability to specify an Itanium register name to the **BUILTIN** keyword is not supported.

1.4.6. Built-ins

1.4.6.1. Common BLISS Built-ins

The following existing Common BLISS built-ins are supported:

ABS	CH\$FIND_NOT_CH	CH\$WCHAR
ACTUALCOUNT	CH\$FIND_SUB	CH\$WCHAR_A
ACTUALPARAMETER	CH\$GEQ	MAX
ARGPTR	CH\$GTR	MAXA
BARRIER	CH\$LEQ	MAXU
CH\$ALLOCATION	CH\$LSS	MIN
CH\$A_RCHAR	CH\$MOVE	MINA
CH\$A_WCHAR	CH\$NEQ	MINU
CH\$COMPARE	CH\$PLUS	NULLPARAMETER
CH\$COPY	CH\$PTR	REF
CH\$DIFF	CH\$RCHAR	SETUNWIND
CH\$EQL	CH\$RCHAR_A	SIGN
CH\$FAIL	CH\$SIZE	SIGNAL
CH\$FILL	CH\$TRANSLATE	SIGNAL_STOP
CH\$FIND_CH	CH\$TRANSTABLE	

1.4.6.1.1. RETURNADDRESS Built-in

A new built-in function **RETURNADDRESS** returns the PC of the caller's caller.

This built-in takes no arguments and the format is:

```
RETURNADDRESS ()
```

1.4.6.2. Machine-specific Built-ins

The following Alpha BLISS machine-specific built-ins are supported:

```
BARRIER
ESTABLISH
REVERT
```

ROT
 SLL
 SRA
 SRL
 UMULH

ADAWI

ADD_ATOMIC_LONG AND_ATOMIC_LONG OR_ATOMIC_LONG
 ADD_ATOMIC_QUAD AND_ATOMIC_QUAD OR_ATOMIC_QUAD

The **XXX_ATOMIC_XXX** built-ins no longer support the optional retry-count input argument.

TESTBITSSI TESTBITCC TESTBITCS
 TESTBITCCI TESTBITSS TESTBITSC

The **TESTBITxx** instructions no longer support the optional retry-count input argument or the optional success-flag output argument.

ADDD DIVD MULD SUBD CMPD
 ADDF DIVF MULF SUBF CMPF
 ADDG DIVG MULG SUBG CMPG
 ADDS DIVS MULS SUBS CMPS
 ADDT DIVT MULT SUBT CMPT

CVTDF CVTFD CVTGD CVTSF CVTTD
 CVTDG CVTFG CVTGF CVTSI CVTTG
 CVTDI CVTFI CVTGI CVTSL CVTTI
 CVTDL CVTFL CVTGL CVTSQ CVTTL
 CVTDQ CVTFQ CVTGQ CVTST CVTTQ
 CVTDT CVTFS CVTGT CVTTS

CVTID CVTLD CVTQD
 CVTIF CVTLF CVTQF
 CVTIG CVTLG CVTQG
 CVTIS CVTLS CVTQS
 CVTIT CVTLT CVTQT

CVTRDL CVTRDQ
 CVTRFL CVTRFQ
 CVTRGL CVTRGQ
 CVTRSL CVTRSQ
 CVRTL CVRTQ

1.4.6.3. New Machine-specific Built-ins

A number of new built-ins have been added that provide access to single Itanium instructions which may be used by the operating system.

1.4.6.3.1. Built-ins for Single Instructions

Each name capitalized below is a new built-in function which may be specified. The lower-case name in parenthesis is the actual IA64 instruction executed. The arguments to these instructions (and therefore their associated BLISS built-in names) are detailed in the "Intel IA-64 Architecture Software Developer's Manual".

BREAK (break) LOADRS (loadrs) RUM (rum) HINT (hint)

BREAK2	(break)*	PROBER	(probe.r)	SRLZD	(srlz.d)
FC	(fc)	PROBEW	(probe.w)	SRLZI	(srlz.i)
FLUSHRS	(flushrs)	PCTE	(ptc.e)	SSM	(ssm)
FWB	(fwb)	PCTG	(ptc.g)	SUM	(sum)
INVALAT	(invala)	PCTGA	(ptc.ga)	SYNCI	(sync.i)
ITCD	(itc.d)	PTCL	(ptc.l)	TAK	(tak)
ITCI	(itc.i)	PTRD	(ptr.d)	THASH	(thash)
ITRD	(itr.d)	PTRI	(ptr.i)	TPA	(tpa)
ITRI	(itr.i)	RSM	(rsm)	TTAG	(ttag)

*The **BREAK2** built-in requires two parameters. The first parameter, which must be a compiletime literal, specifies the 21-bit immediate value of the **BREAK** instruction. The second parameter, may be any expression whose value is moved into I64 general register R17 just prior prior to executing the **BREAK** instruction.

1.4.6.3.2. Access to Processor Registers

The OpenVMS I64 BLISS compiler provides built-in functions for access to read and write the many and varied processor registers in the Itanium implementations. They are:

```
GETREG  SETREG  GETREGIND  SETREGIND
```

These built-ins execute the mov.i instruction which is detailed in the "Intel IA-64 Architecture Software Developer's Manual".

The two **GET** built-ins return the value of the register specified.

To specify the register a specially encoded integer constant is used which is defined in an Intel C header file. See Appendix A for the contents of this file.

1.4.6.4. PALcode Built-ins

The following Alpha BLISS **PALcode** built-ins are supported:

```
PAL_INSQHIL      PAL_REMQHIL
PAL_INSQHILR     PAL_REMQHILR
PAL_INSQHIQ      PAL_REMQHIQ
PAL_INSQHIQR     PAL_REMQHIQR
PAL_INSQTIL      PAL_REMQTIL
PAL_INSQTILR     PAL_REMQTILR
PAL_INSQTIQ      PAL_REMQTIQ
PAL_INSQTIQR     PAL_REMQTIQR
PAL_INSQUEL      PAL_REMQUEL
PAL_INSQUEL_D    PAL_REMQUEL_D
PAL_INSQUEQ      PAL_REMQUEQ
PAL_INSQUEQ_D    PAL_REMQUEQ_D
```

The 24 queue-manipulation **PALcalls** are implemented by BLISS as a call to a OpenVMS-provided **SYS\$PAL_XXXX** run-time routine.

1.4.7. BLI\$CALLG

The VAX idiom **CALLG(.AP, ...)** was replaced by an assembly routine **BLI\$CALLG(ARGPTR(), .RTN)** for OpenVMS Alpha BLISS. This routine as defined for OpenVMS ALpha BLISS will be re-written for the Itanium architecture and supported for OpenVMS I64 BLISS.

1.4.8. Itanium Registers

The Itanium general registers which may be named in **REGISTER**, **GLOBAL REGISTER**, **EXTERNAL REGISTER** and as parameters to **LINKAGE** declarations are as follows:

- R3-R11
- R19-R31

In addition, 8 parameter registers will be able to be named for parameters in **LINKAGE** declarations only. They are: R32-R39.

There is no support for accessing the Itanium general registers R40-R127.

Naming of any of the Itanium Floating Point, Predicate, Branch and Application registers via the **REGISTER**, **GLOBAL REGISTER**, **EXTERNAL REGISTER** and **LINKAGE** declarations is not supported.

A register conflict message is issued when a user request for a particular register cannot be satisfied.

1.4.9. ALPHA_REGISTER_MAPPING switch

A new module level switch **ALPHA_REGISTER_MAPPING** is being provided for OpenVMS I64 BLISS.

This switch may be specified either in the **MODULE** declaration or a **SWITCHES** declaration. Use of this switch will cause a re-mapping of Alpha register numbers to Itanium register numbers as described below.

Any register number specified as part of a **REGISTER**, **GLOBAL REGISTER**, **EXTERNAL REGISTER** or as parameters to **GLOBAL**, **PRESERVE**, **NOPRESERVE** or **NOT USED** in linkage declarations in the range of 0-31 will be remapped according to the **IMACRO** mapping table as follows:

0 =	GEM_TS_REG_K_R8	16 =	GEM_TS_REG_K_R14
1 =	GEM_TS_REG_K_R9	17 =	GEM_TS_REG_K_R15
2 =	GEM_TS_REG_K_R28	18 =	GEM_TS_REG_K_R16
3 =	GEM_TS_REG_K_R3	19 =	GEM_TS_REG_K_R17
4 =	GEM_TS_REG_K_R4	20 =	GEM_TS_REG_K_R18
5 =	GEM_TS_REG_K_R5	21 =	GEM_TS_REG_K_R19
6 =	GEM_TS_REG_K_R6	22 =	GEM_TS_REG_K_R22
7 =	GEM_TS_REG_K_R7	23 =	GEM_TS_REG_K_R23
8 =	GEM_TS_REG_K_R26	24 =	GEM_TS_REG_K_R24
9 =	GEM_TS_REG_K_R27	25 =	GEM_TS_REG_K_R25
10 =	GEM_TS_REG_K_R10	26 =	GEM_TS_REG_K_R0
11 =	GEM_TS_REG_K_R11	27 =	GEM_TS_REG_K_R0
12 =	GEM_TS_REG_K_R30	28 =	GEM_TS_REG_K_R0
13 =	GEM_TS_REG_K_R31	29 =	GEM_TS_REG_K_R29
14 =	GEM_TS_REG_K_R20	30 =	GEM_TS_REG_K_R12
15 =	GEM_TS_REG_K_R21	31 =	GEM_TS_REG_K_R0

The mappings for register numbers:

16-20

26-28

30-31

Translate into registers which are considered invalid specifications for OpenVMS I64 BLISS (see sections 2.3.3 and 2.4.3 in the OpenVMS I64 BLISS specification). Declarations including any these registers when **ALPHA_REGISTER_MAPPING** is specified generate an error such as:

```
r30 = 30
.....^
Alpha register 30 cannot be declared, invalid mapping to IPF register 12 at
line number 9 in file ddd:[xxx]TESTALPHAREGMAP.BLI
```

Notice that the source line names register number 30 but the error text indicates register 12 is the problem. It is the translated register for 30, register 12, which is illegal to specify.

1.4.9.1. ALPHA_REGISTER_MAPPING and Linkage Declarations

There is a special set of mappings for Alpha registers R16-R21 if those registers are specified as linkage I/O parameters.

For linkage I/O parameters ONLY the mappings for R16-R21 are as follows:

```
16 = GEM_TS_REG_K_R32      19 = GEM_TS_REG_K_R35
17 = GEM_TS_REG_K_R33      20 = GEM_TS_REG_K_R36
18 = GEM_TS_REG_K_R34      21 = GEM_TS_REG_K_R37
```

1.4.9.1.1. ALPHA_REGISTER_MAPPING and "NOTUSED"

When **ALPHA_REGISTER_MAPPING** is specified, any Alpha register that maps to an Itanium scratch register and is specified as **NOTUSED** in a linkage declaration will be placed in the **PRESERVE** set.

This will cause the register to be saved on entry to the routine declaring it **NOTUSED** and restored on exit.

1.4.10. /ANNOTATIONS Qualifier

The OpenVMS I64 BLISS compiler will support a new compilation qualifier **/ANNOTATIONS**. This qualifier provides information in the source listing regarding optimizations compiler is making (or not) during compilation.

The qualifier accepts a number of keywords which reflect the different listing annotations available. They are:

ALL	
NONE	
CODE	Used for annotations of machine code listing. Only NOP instructions are currently annotated.
DETAIL	Provides greater detail, used in conjunction with other keywords.

The remaining keywords reflect GEM optimizations:

```
INLINING
LOOP_TRANSFORMS
LOOP_UNROLLING
PREFETCHING
```

```

SHRINKWRAPPING
SOFTWARE_PIPELINING
TAIL_CALLS
TAIL_RECURSION
LINKAGES

```

All keywords with the exception of ALL and NONE are negatable. The qualifier itself is also negatable. By default it is not present in the command line.

If the **/ANNOTATIONS** qualifier is specified without any parameters the default is ALL.

1.4.11. /ALPHA_REGISTER_MAPPING Qualifier

The OpenVMS I64 BLISS compiler supports a new compilation qualifier to enable **ALPHA_REGISTER_MAPPING** without having to modify the source.

This is a positional qualifier.

Specifying this qualifier on the compilation line for a module is equivalent to setting the **ALPHA_REGISTER_MAPPING** switch in the module header.

1.4.12. /ALPHA_REGISTER_MAPPING Informationals

For OpenVMS I64 BLISS new informational messages have been added to show the usage of the **ALPHA_REGISTER_MAPPING** feature.

If the switch **ALPHA_REGISTER_MAPPING** is specified in the module header or as an argument to the **SWITCHES** declaration the following will be displayed:

```

MODULE SIMPLE (MAIN=TEST, ALPHA_REGISTER_MAPPING)=
.....^
%BLS64-I-TEXT, Alpha Register Mapping enabled

```

If the switch **NOALPHA_REGISTER_MAPPING** is specified in the module header or as an argument to the **SWITCH** declaration the following will be displayed:

```

MODULE SIMPLE (MAIN=TEST, NOALPHA_REGISTER_MAPPING)=
.....^
%BLS64-I-TEXT, Alpha Register Mapping disabled

```

1.4.13. ADD, AND, Built-in Functions for Atomic Operations

The **ADD_ATOMIC_XXXX**, **AND_ATOMIC_XXXX** and **OR_ATOMIC_XXXX** built-in functions for atomic updating of memory are supported by OpenVMS I64 BLISS.

Because the Itanium instructions to support these built-ins will wait until the operation succeeds the optional retry-count input parameter has been eliminated. These built-ins now have the form:

```

<op>_ATOMIC_<size>(ptr, expr
                    [;old_value] ) !Optional output

```

```

Value:    1 Operation succeeded
          0 Operation failed

```

<op> is one of AND, ADD OR

<size> is one of LONG or QUAD

The operation is addition (or ANDing or ORing) of the expression EXPR to the data-segment pointed to by PTR in an atomic fashion.

PTR must be a naturally-aligned address.

The optional output parameter **OLD_VALUE** is set to the previous value of the data-segment pointed to by PTR.

Any attempt to use the OpenVMS Alpha BLISS optional **retry_count** results in a syntax error.

1.4.14. TESTBITxxI and TESTBITxx Built-in Functions for Atomic Operations

The **TESTBITxxI** and **TESTBITxx** built-in functions for atomic operations are supported by OpenVMS I64 BLISS.

Because the Itanium instruction to support these built-ins will wait until the operation succeeds the optional input parameter **retry_count** and the optional output parameter **success_flag** have been eliminated.

These built-ins now have the form:

```
TESTBITxxx( field )
```

Any attempt to use the OpenVMS Alpha BLISS optional **retry_count** or **success_flag** arguments results in a syntax error.

1.4.15. Granularity of Byte, Longword and Quadword Writes

OpenVMS I64 BLISS will support the **/GRANULARITY=keyword** qualifier, the switch **DEFAULT_GRANULARITY=n**, and the data attribute **GRANULARITY(n)** as described below.

Users can control the granularity of stores and fetches by using the command line qualifier **/GRANULARITY=keyword**, the switch **DEFAULT_GRANULARITY=n**, and the data attribute **GRANULARITY(n)**.

The keyword in the command line qualifier must be either **BYTE**, **LONGWORD**, or **QUADWORD**. The parameter **n** must be either 0(byte), 2(longword) or 3(quadword).

When these are used together, the data attribute has the highest priority. The switch, when used in a **SWITCHES** declaration, sets the granularity of data declared after it within the same scope. The switch may also be used in the module header. The command line qualifier has the lowest priority.

1.4.16. Shift Built-in Functions

The Alpha built-in functions for shifts in a known direction are supported for OpenVMS I64 BLISS.

They are only valid for shift amounts in the range **0..%BPVAL-1**.

1.4.17. Compare and Swap Built-in Functions

OpenVMS I64 provides support for the following new compare and swap built-in functions:

- `CMP_SWAP_LONG(addr, comparand, value)`
- `CMP_SWAP_QUAD(addr, comparand, value)`

These functions do the following interlocked operations: compare the longword or quadword at `addr` with `comparand`, and if they are equal, store `value` at `addr`. They return an indicator of success (1) or failure (0).

Note

These new built-in functions are provided for OpenVMS Alpha BLISS as well.

1.4.18. I64-specific Multimedia Instructions

There are no plans to support access to the I64-specific multimedia-type instructions.

1.4.19. Linkages

1.4.19.1. CALL Linkage

The `CALL` linkage, as described below for OpenVMS Alpha Bliss, is supported by OpenVMS I64 BLISS.

Routines compiled with a 32-bit compiler can call routines compiled with a 64-bit compiler and vice versa. Parameters are truncated when shortened, and sign-extended when lengthened.

By default, `CALL` linkages pass an argument count. This can be overridden using the `NOCOUNT` linkage option.

Though the arguments are passed in quadwords, the 32-bit compilers can only "see" the lower 32 bits.

1.4.19.2. JSB Linkage

The OpenVMS I64 BLISS compilers have a JSB linkage type. Routines declared with the JSB linkage will fit in with the JSB rules as defined by the OpenVMS Calling Standard.

1.4.20. /[NO]TIE Qualifier

This qualifier is supported for OpenVMS I64.

TIE is used to enable the compiled code to be used in combination with translated images, either because the code might call into a translated image or might be called from a translated image.

In particular, TIE

1. Causes the inclusion of procedure signature information in the compiled program. This may increase the size and possibly also the number of relocations processed during linking and image activation, but does not otherwise affect performance.
2. Causes calls to procedure values (sometimes called indirect or computed calls) to be compiled using a service routine (`OTS$CALL_PROC`); this routine determines whether the target procedure is native `IPF` code or in a translated image and proceeds accordingly.

`/NOTIE` is the default.

1.4.21. `/ENVIRONMENT=([NO]FP)` and `ENVIRONMENT([NO]FP)`

The `/ENVIRONMENT=([NO]FP)` qualifier and the `ENVIRONMENT([NO]FP)` switch were provided for OpenVMS Alpha BLISS to cause the compiler to disable the use of floating point registers for certain integer division operations.

For OpenVMS I64 BLISS, the `/ENVIRONMENT=NOFP` command qualifier or `ENVIRONMENT(NOFP)` switch does not totally disable floating point due to the architectural features of I64. Instead, source code is still restricted to not have floating point operations, but the generated code for certain operations (in particular, integer multiplication and division and the constructs that imply them) are restricted to use a small subset of the floating point registers. Specifically, if this option is specified, the compiler is restricted to using f6-f11, and will set the `ELF EF_IA_64_REDUCEFP` option described in the Intel Itanium Processor-specific Application Binary Interface, section 4.1.1.6.

The `/ENVIRONMENT=FP` command qualifier and `ENVIRONMENT(FP)` switch are unaffected.

1.4.22. Floating Point Support

1.4.22.1. Floating Point Built-in Functions

BLISS does not have a high level of support for floating-point numbers. The extent of the support involves the ability to create floating-point literals, and there are machine-specific built-ins for floating-point arithmetic and conversion operations.

None of the floating point built-in functions detect overflow, so they do not return a value.

1.4.22.2. Floating Point Literals

The floating point literals supported by OpenVMS I64 BLISS is the same set supported by OpenVMS Alpha BLISS: `%E`, `%D`, `%G`, `%S` and `%T`.

1.4.22.3. Floating Point Registers

Direct use of the I64 floating-point registers is not supported.

1.4.22.4. Calling Non-BLISS Routines with Floating Point Parameters

It is possible to call standard non-BLISS routines that expect floating-point parameters passed by value, and that return a floating-point or complex value.

The standard functions `%FFLOAT`, `%DFLOAT`, `%GFLOAT`, `%SFLOAT` and `%TFLOAT` are supported by OpenVMS I64 BLISS.

1.4.23. New and Expanded Lexicals

BLISS will add new compiler-state lexicals to support the OpenVMS I64 compilers: `BLISS32I` and `BLISS64I`.

- BLISS will add new compiler-state lexicals to support the OpenVMS I64 compilers: `BLISS32I` and `BLISS64I`.

`%BLISS(BLISS32)` is true for all 32-bit BLISS compilers.

%BLISS(BLISS32V) is true only for VAX BLISS (BLISS-32).

%BLISS(BLISS32E) is true for all 32-bit Alpha compilers.

%BLISS(BLISS64E) is true for all 64-bit Alpha compilers.

%BLISS(BLISS32I) is true for all 32-bit I64 compilers.

%BLISS(BLISS64I) is true for all 64-bit I64 compilers.

- The lexicals **%BLISS32I** and **%BLISS64I** have been added. Their behavior matches that of the new parameters to **%BLISS**.
- Support for the I64 architecture as a keyword to the **%HOST** and **%TARGET** lexicals has been added for OpenVMS I64 BLISS.

1.4.24. OpenVMS I64 BLISS Support for IPF Short Data Sections

The OpenVMS Calling Standard requires that all global data objects with a size of 8 bytes or smaller be allocated in short data sections.

Short data sections can be addressed with an efficient code sequence that involves adding a 22-bit literal to the contents of the GP base register. This code sequence limits the combined size of all the short data sections. A linker error will occur if the total amount of data allocated to short data sections exceeds a size of 2^{22} bytes.

Compilers on Itanium can use GP relative addressing when accessing short globals and short externals.

OpenVMS I64 BLISS has a new **PSECT** attribute, **GP_RELATIVE**, and a new **PSECT** attribute, **SHORT**, to support allocating short data sections.

Specifying the **GP_RELATIVE** keyword as a **PSECT** attribute causes that **PSECT** to be labeled as containing short data so that the linker will allocate the PSECT close to the GP base address.

The syntax of the **SHORT** attribute is as follows:

```
"SHORT" "(" psect-name ")"
```

The following rules apply to the **SHORT** attribute:

1. If the psect-name in a **SHORT** attribute is not yet declared then its appearance in a **SHORT** attribute constitutes a declaration. The attributes of the **PSECT** containing the **SHORT** attribute become the attributes of the **PSECT** named in the **SHORT** attribute, except that the **PSECT** name declared in the **SHORT** attribute does not have the **SHORT** attribute and the **PSECT** name declared in the **SHORT** attribute does have the **GP_RELATIVE** attribute.
2. If the psect-name in a **SHORT** attribute has been previously declared then its attributes are not changed. A warning message is generated if the **PSECT** named in a **SHORT** attribute does not have the **GP_RELATIVE** attribute.
3. If a data object with storage class **OWN**, **GLOBAL** or **PLIT** has a size of 8 or fewer bytes and the data object is specified to be allocated to a **PSECT** that includes the **SHORT** attribute, then that object is allocated to the **PSECT** named in the **SHORT** attribute. Note that this is a one-step process that is not recursive. If a short data object has its allocation **PSECT** renamed by the **SHORT** attribute, then the **SHORT** attribute of the renamed **PSECT** is not considered for any further renaming.

4. Data objects with sizes larger than 8 bytes ignore the **SHORT** attribute.
5. Data objects in the **CODE**, **INITIAL** and **LINKAGE** storage classes ignore the **SHORT** attribute, regardless of their size.
6. For the purposes of **PSECT** renaming by means of the **SHORT** attribute, the size of a **PLIT** object does not include the size of the count word that precedes the **PLIT** data.

Example:

PSECT

```
NODEFAULT = $GLOBAL_SHORT$
  (READ, WRITE, NOEXECUTE, NOSHARE, NOPIC, CONCATENATE, LOCAL, ALIGN(3),
   GP_RELATIVE),
```

```
! The above declaration of $GLOBAL_SHORT$ is not needed.  If the above
! declaration were deleted then the SHORT($GLOBAL_SHORT$) attribute in
! the following declaration would implicitly make an identical
! declaration of $GLOBAL_SHORT$.
```

```
GLOBAL = $GLOBAL$
  (READ, WRITE, NOEXECUTE, NOSHARE, NOPIC, CONCATENATE, LOCAL, ALIGN(3),
   SHORT($GLOBAL_SHORT$)),
```

```
NODEFAULT = MY_GLOBAL
  (READ, WRITE, NOEXECUTE, SHARE, NOPIC, CONCATENATE, LOCAL, ALIGN(3)),
```

```
PLIT = $PLIT$
  (READ, NOWRITE, NOEXECUTE, SHARE, NOPIC, CONCATENATE, GLOBAL, ALIGN(3),
   SHORT($PLIT_SHORT$));
```

GLOBAL

```
  X1,                ! allocated in $GLOBAL_SHORT$
  Y1 : VECTOR[2, LONG], ! allocated in $GLOBAL_SHORT$
  Z1 : VECTOR[3, LONG], ! allocated in $GLOBAL$
  A1 : PSECT(MY_GLOBAL), ! allocated in MY_GLOBAL
  B1 : VECTOR[3, LONG] PSECT(MY_GLOBAL), ! allocated in MY_GLOBAL
  C1 : VECTOR[3, LONG]
        PSECT($GLOBAL_SHORT$); ! allocated in $GLOBAL_SHORT$
```

PSECT GLOBAL = MY_GLOBAL;

```
! use MY_GLOBAL as default for both noshort/short
```

GLOBAL

```
  X2,                ! allocated in MY_GLOBAL
  Y2 : VECTOR[2, LONG], ! allocated in MY_GLOBAL
  Z2 : VECTOR[3, LONG], ! allocated in MY_GLOBAL
  A2 : PSECT($GLOBAL$), ! allocated in $GLOBAL_SHORT$
  B2 : VECTOR[3, LONG] PSECT($GLOBAL$); ! allocated in $GLOBAL$;
```

```
! Note that the allocations of A1, X2 and Y2 violate the calling
! standard rules.  These variables cannot be shared with other
! languages, such as C or C++.
```

PSECT GLOBAL = \$GLOBAL\$;

```
! back to using $GLOBAL$/ $GLOBAL_SHORT$ as default noshort/short
```

```

GLOBAL BIND
    P1 = UPLIT("abcdefghi"),           ! allocated in $PLIT$
    P2 = PLIT("abcdefgh"),            ! allocated in $PLIT_SHORT$
    P3 = PSECT(GLOBAL) PLIT("AB"),    ! allocated in $GLOBAL_SHORT$
    p4 = PSECT($PLIT_SHORT$)
        PLIT("abcdefghijklmnop"),      ! allocated in $PLIT_SHORT$
    P5 = PSECT(MY_GLOBAL) PLIT("AB"); ! allocated in MY_GLOBAL

! Note that the allocations of A1, X2, Y2 and P5 violate the calling
! standard rules. These variables cannot be shared with other
! languages, such as C or C++. They can be shared with modules
! written in BLISS and MACRO.

```

Note

Openvms I64 BLISS does not support using **GP_RELATIVE** addressing mode on **EXTERNAL** variable references. However, the usual **GENERAL** addressing mode used by **EXTERNAL** variables will correctly reference a **GP_RELATIVE** section. There are no plans to add an **ADDRESSING_MODE(GP_RELATIVE)** attribute to BLISS.

1.5. BLISS Differences Between Itanium BLISS and x86-64 BLISS

This section describes those BLISS features that will not be supported by OpenVMS x86-64 BLISS.

1.5.1. Floating Point Register Names

The Alpha/Itanium floating point register names are not supported for naming in **REGISTER**, **GLOBAL REGISTER**, **EXTERNAL REGISTER** or as parameters to **LINKAGE** declarations.

1.5.2. RETURNADDRESS Built-in with BLISS-32

The **RETURNADDRESS** built-in function returns the PC of the caller's caller.

The linker on OpenVMS x86-64 will place code in 64-bit address space by default. BLISS-32 will only return the bottom 32-bits of the PC of the caller's caller. There is no ability to obtain the full 64-bit return address from BLISS-32.

1.5.3. BLI\$CALLG Removed

The VAX idiom **CALLG(.AP, ...)** was replaced by an assembly routine **BLI\$CALLG(ARGPTR(), .RTN)** for OpenVMS Alpha and OpenVMS I64.

The **BLI\$CALLG** routine that was present on OpenVMS Alpha and OpenVMS I64 has been obsoleted for OpenVMS x86-64. Programs should just use the **LIB\$CALLG** Run-Time Library function which performs the identical function.

1.5.4. ALPHA_REGISTER_MAPPING SWITCH and Qualifier

The module level switch **ALPHA_REGISTER_MAPPING** as well as the **ALPHA_REGISTER_MAPPING** DCL qualifier are essentially ignored. All

1.5.5. Unsupported and Ignored DCL Qualifiers

The **/ANNOTATIONS** qualifier which provides information about optimizations applied to the program on Alpha and I64 is ignored on x86-64.

The **/GRANULARITY** qualifier is ignored for x86-64. The x86 architecture is a byte-granular architecture and the code generator will automatically adjust as needed for better performance.

The **/MACHINE_CODE** qualifier is ignored on x86-64. Use **ANALYZE/OBJECT/DISASSEMBLE** as an alternative. We will provide an improved machine code listing in a future release.

The **/TIE** qualifier is ignored for x86-64 since there is no binary translator available on OpenVMS x86-64.

1.5.6. Built-ins Supported from OpenVMS Alpha and OpenVMS I64 Systems

1.5.6.1. SETREG and GETREG Built-ins

The OpenVMS I64 BLISS compiler provided built-in functions (**GETREG**, **SETREG**, **GETREGIND**, **SETREGIND**) for access to read and write the many and varied processor registers. The built-ins are support on OpenVMS x86-64 for a limited number of x86-64 general registers and processor registers. See **STARLET.REQ (X86REG\$** prefixed symbols) for the short list of registers.

1.5.6.2. Built-ins from OpenVMS I64

A small number of built-ins that were added for OpenVMS I64 BLISS are supported with OpenVMS x86-64 BLISS.

BREAK
BREAK2

1.5.6.3. Built-ins from OpenVMS Alpha

The following built-ins from OpenVMS ALpha BLISS are supported with OpenVMS x86-64 BLISS.

BARRIER
ESTABLISH
REVERT

ROT
SLL
SRA
SRL
UMULH

ADAWI

ADD_ATOMIC_LONG AND_ATOMIC_LONG OR_ATOMIC_LONG
ADD_ATOMIC_QUAD AND_ATOMIC_QUAD OR_ATOMIC_QUAD

CMP_SWAP_LONG CMP_SWAP_QUAD

TESTBITSSI TESTBITCC TESTBITCS
TESTBITCCI TESTBITSS TESTBITSC

ADDD	DIVD	MULD	SUBD	CMPD
ADDF	DIVF	MULF	SUBF	CMPF
ADDG	DIVG	MULG	SUBG	CMPG
ADDS	DIVS	MULS	SUBS	CMP S
ADDT	DIVT	MULT	SUBT	CMP T
CVTDF	CVTFD	CVTGD	CVTSF	CVTTD
CVTDG	CVTFG	CVTGF	CVTSI	CVTTG
CVTDI	CVTFI	CVTGI	CVTSL	CVTTI
CVTDL	CVTFL	CVTGL	CVTSQ	CVTTL
CVTDQ	CVTFQ	CVTGQ	CVTST	CVTTQ
CVTDT	CVTFS	CVTGT		CVTTS
CVTID	CVTLD	CVTQD		
CVTIF	CVTLF	CVTQF		
CVTIG	CVTLG	CVTQG		
CVTIS	CVTLS	CVTQS		
CVTIT	CVTLT	CVTQT		
CVTRDL	CVTRDQ			
CVTRFL	CVTRFQ			
CVTRGL	CVTRGQ			
CVTRSL	CVTRSQ			
CVRTL	CVRTQ			
PAL_INSQHIL		PAL_REMQHIL		
PAL_INSQHILR		PAL_REMQHILR		
PAL_INSQHIQ		PAL_REMQHIQ		
PAL_INSQHIQR		PAL_REMQHIQR		
PAL_INSQTIL		PAL_REMQTIL		
PAL_INSQTILR		PAL_REMQTILR		
PAL_INSQTIQ		PAL_REMQTIQ		
PAL_INSQTIQR		PAL_REMQTIQR		
PAL_INSQUEL		PAL_REMQUEL		
PAL_INSQUEL_D		PAL_REMQUEL_D		
PAL_INSQUEQ		PAL_REMQUEQ		
PAL_INSQUEQ_D		PAL_REMQUEQ_D		

The **TESTBITxx** instructions do not support the optional retry-count input argument or the optional success-flag output argument from Alpha.

The **xxx_ATOMIC_xxx** do not support the optional retry-count input argument from Alpha. These built-ins now have the form:

```
<op>_ATOMIC_<size>(ptr, expr
                    [;old_value] ) !Optional output
```

```
Value:  1 Operation succeeded
        0 Operation failed
```

```
<op> is one of AND, ADD OR
<size> is one of LONG or QUAD
```

The operation is addition (or ANDing or ORing) of the expression **EXPR** to the data-segment pointed to by **PTR** in an atomic fashion.

PTR must be a naturally-aligned address.

The optional output parameter **OLD_VALUE** is set to the previous value of the data-segment pointed to by **PTR**.

Any attempt to use the OpenVMS Alpha BLISS optional **retry_count** will result in a syntax error.

The **CMP_SWAP** built-ins have the form:

```
CMP_SWAP_<op>(addr, comparand, value)
```

These functions do the following interlocked operations: compare the longword or quadword at **addr** with **comparand**, and if they are equal, store **value** at **addr**. They return an indicator of success (1) or failure (0).

1.5.7. New and Expanded Lexicals

BLISS will add new compiler-state lexicals to support the OpenVMS x86-64 compilers: **BLISS32X** and **BLISS64X**.

- **%BLISS** will now recognize **BLISS32E**, **BLISS64E**, **BLISS32V**, **BLISS32I**, **BLISS64I**, **BLISS32X**, and **BLISS64X**.

%BLISS(BLISS32) is true for all 32-bit BLISS compilers.

%BLISS(BLISS32V) is true only for VAX BLISS (BLISS-32).

%BLISS(BLISS32E) is true for all 32-bit Alpha compilers.

%BLISS(BLISS64E) is true for all 64-bit Alpha compilers.

%BLISS(BLISS32I) is true for all 32-bit I64 compilers.

%BLISS(BLISS64I) is true for all 64-bit I64 compilers.

%BLISS(BLISS32X) is true for all 32-bit x86-64 compilers.

%BLISS(BLISS64X) is true for all 64-bit x86-64 compilers.

- The lexicals **%BLISS32X** and **%BLISS64X** have been added. Their behavior will parallel that of the new parameters to **%BLISS**.
- Support for the **x86_64** (also **x86**) architecture as a keyword to the **%HOST** and **%TARGET** lexicals has been added for OpenVMS x86-64 BLISS.

1.6. Floating Point Support

1.6.1. Floating Point Built-in Functions

BLISS does not have a high level of support for floating-point numbers. The extent of the support involves the ability to create floating-point literals, and there are machine-specific built-ins for floating-point arithmetic and conversion operations.

1.6.2. Floating Point Literals

The floating point literals supported by OpenVMS x86-64 BLISS is the same set supported by OpenVMS Alpha and OpenVMS I64 BLISS: **%E**, **%D**, **%G**, **%S** and **%T**.

1.6.3. Floating Point Registers

Direct use of the x86-64 floating-point registers is not supported.

1.6.4. Calling Non-BLISS Routines with Floating Point Parameters

It is possible to call standard non-BLISS routines that expect floating-point parameters passed by value, and that return a floating-point or complex value.

The standard functions `%FFLOAT`, `%DFLOAT`, `%GFLOAT`, `%SFLOAT` and `%TFLOAT` will be supported by OpenVMS x86-64 BLISS.

1.7. Documentation

Documentation available for OpenVMS x64-64 BLISS consists of the following:

- VAX BLISS-32 Language Reference Manual (SYS\$HELP:BLISSREFMANUAL.PDF)
- VAX BLISS-32 Language User Manual (SYS\$HELP:BLISSUSERMANUAL.PDF)
- These release notes.

We are considering a future update/addendum to the manual to incorporate all the information from these release notes.

1.8. Debugging

All programs that will be used with a debugger should be compiled with the `/NOOPTIMIZE/DEBUG` qualifiers. Debugging optimized code is very difficult. Compilation with normal (full) optimization will have these noticeable effects:

- Stepping by line will generally seem to bounce around due to the effects of code scheduling. The general drift will definitely be forward, but experience indicates that the effect will be very close to stepping by instruction.
- Variables that are "split" so that they are allocated in more than one location during different parts of their lifetimes are not described at all.

Neither of these problems will occur in modules compiled `/NOOPTIMIZE`.

Debugging on OpenVMS x86-64 is currently limited due to missing support in the LLVM backend for BLISS-specific `DWARF` records. We are working on this and expect future versions of BLISS to be improved.

1.9. Building the STARLET and LIB .L32 and .L64 libraries

The `STARLET` and `LIB` precompiled header files are shipped as part of the OpenVMS x86-64 kit. If you need to rebuild them yourself, below are the commands required to do so:

```
$bliss/x32/terminal=noerrors/lib=sys$common:[syslib]starlet.l32 sys
$library:starlet.req
$bliss/x32/terminal=noerrors/lib=sys$common:[syslib]lib.l32      sys
$library:starlet.req+sys$library:lib.req
```

```
$bliss/x64/terminal=noerrors/lib=sys$common:[syslib]starlet.l64 sys
$library:starlet.r64
$bliss/x64/terminal=noerrors/Assume=NoQuad_Literal -
    /lib=sys$common:[syslib]lib.l64 sys
$library:starlet.r64+sys$library:lib.r64
```

You will need to be logged into an account with system privileges to successfully write the files to SYS\$COMMON:[SYSLIB]

2. Maintenance Corrections for OpenVMS x86-64 BLISS

The following bugs have been fixed since the V1.13-136 release.

1. Initializing a bitvector would incorrectly overwrite adjacent variables. The following example incorrectly writes 32-bits to variable A which is only 8-bits big:

```
global b;
    local a : initial(.b) bitvector[8];
```

2. A field-selected store with size of zero would incorrectly write into the destination. This example incorrectly writes the bottom byte of 'data':

```
own data : initial(-1);

    routine write(dptra, offset, s) : novalue =
        begin (.dptra)<.offset,.s,0> = 0; end;

    write(data,0,0);
```

3. The alignment of **EXTERNAL LITERALS** was incorrectly computed and the optimizer would incorrectly believe that different literals were the same value.
4. The **WEAK** attribute did not work with **EXTERNAL ROUTINE**. It would generate a non-WEAK reference instead.
5. **LOCAL** variables in nested scopes in a routine would get incorrect debug information and sometimes cause a compiler assertion.
6. The compiler would get a **G2L** assertion if a routine and variable had the same name.
7. The **ACTUALCOUNT** builtin would sometimes return the wrong number of arguments when the optimizer was enabled.
8. The compiler would generate incorrect calling sequences when calling a routine inside the same module with different number of arguments.
9. The optimizer would perform a "tail-call" optimization where it would replace the final "callq" instruction with a "jmp" instruction. This transformation is not allowed by the OpenVMS Calling Standard and results in the exception handling stack-walking code to return prematurely.
10. Overlay PSECTs would be generated with extra padding at the end and be the wrong size.
11. The compiler would ACCVIO if **/DEBUG** was used with some **LINKAGE** declarations that references Alpha registers.

12. Improved code for various VAX floating builtins. The prior compiler would sometimes convert the VAX floating to **IEEE** floating then immediately convert it back to VAX floating.
13. The compiler now uses 64-bit heap for much of the optimizer and code-generator. This allows much larger programs to be compiled.

3. Known Bugs and Deficiencies

This chapter describes known bugs and deficiencies in the x86-64 BLISS compiler.

1. Due to a design flaw in structure definitions, compiler errors can occur when the first occurrence of a structure formal is within a conditional branch.

Example:

```
STRUCTURE BAD [I, P, S] = [%UPVAL]
                        (IF .I THEN BAD ELSE BAD + .BAD<16, 16>) <P, S>;
```

BLISS semantics guarantee that a structure actual-parameter is evaluated only once. This is implemented by treating the first occurrence of a structure formal as if it were a **BIND** declaration. The other occurrences of the structure formal are then treated as if they were uses of the "imaginary" bind-name. This choice of implementation fails when the first occurrence of the structure formal is in conditional flow. The problem can be avoided by ensuring that the first occurrence of each formal is outside of conditional flow. The example structure should be written as:

```
STRUCTURE GOOD [I, P, S] = [%UPVAL]
                        (GOOD; IF .I THEN GOOD ELSE GOOD
                        + .GOOD<16, 16>) <P, S>;
```

Note that the "structure-name" is the zeroth structure formal parameter. The formals "I", "P", and "S" are already outside of conditional flow, so they are processed correctly. This change will cause the compiler to use slightly more memory, but the resulting code will be correct. There also should be no reduction in optimization.

No problem will occur when the conditional flow is constant folded at compile time, or when there is no conditional flow in the structure body.