



Cray Compiling Environment 8.1 Release Overview and Installation Guide

S-5212-81

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Part I: Release Overview

Introduction [1]

This document provides an overview of the Cray Compiling Environment 8.1 release for the Cray XE and Cray XK systems.

This document does **not** describe hardware, software, installation of related products, or products that Cray does not provide.

1.1 Emphasis for the Cray Compiling Environment 8.1 Release

The *Cray Compiling Environment* release provides the following key enhancements:

- New features as specified by the 2008 Fortran standard. This compiler conforms to the Fortran 2008 standard (ISO/IEC 1539-1:2010).
- Enhanced support for accelerators on Cray Systems, including complete support for the *OpenACC Application Programming Interface, Version 1.0*.
- Performance improvements for Cray XE and Cray XK systems
- Support for the AMD Abu Dhabi CPU
- Support for the Intel Sandy Bridge CPU
- Support for the NVIDIA Kepler GPU

1.2 Cray Compiling Environment 8.1 Release Package Description

The Cray Compiling Environment 8.1 consists of:

- Cray Fortran Compiler, version 8.1
- Cray C and C++ Compiler, version 8.1
- CrayLibs (libraries and utilities), version 8.1
- CrayDoc software suite and the documentation, described in [Chapter 4, Documentation on page 17](#)

All software is installed by means of scripts and RPM Package Manager (RPM) files. For more detail about Cray Compiling Environment 8.1 release package, refer to [Chapter 5, Release Package on page 21](#).

Software Enhancements [2]

This chapter describes the software enhancements provided with the Cray Compiling Environment 8.1 release.

2.1 Performance Enhancements

- Optimization has been improved for targets supporting AVX, especially for kernels using mixed width data types.
- Address computations have been improved to make better use of native hardware capabilities.
- The detection, enforcement, and use of aligned memory operations has been significantly optimized for better application performance.
- Performance of EXP libraries for 64-bit data types on Interlagos CPUs has been improved.
- Additional intrinsics where arguments can be determined are now evaluated at compile time.
- Performance of some reduction operations has been greatly improved by exploiting more instruction level parallelism.
- Autothreading (`-hautothread`) at thread level 3 (`-O thread3` or `-h thread3`) is enhanced to parallelize some small loops with potential cross iteration dependence.
- Performance of adjacent reads has been improved by reducing the number of calls to the Fortran IO library.
- Portions of the optimizer have been redesigned for improved support of applications requiring bit reproducibility when changing the number of MPI ranks and OpenMP threads. `-hflex_mp=conservative` is now much more likely to result in application bit reproducibility, with a minimal impact on performance and `-hflex_mp=intolerant` has considerably improved performance for some applications, without a loss of bit reproducibility.
- The OpenACC `cache` directive and the `cache_nt` clause of the `loop_info` directive are now supported for NVIDIA accelerator targets, allowing the user to tune cache usage on the accelerator.

- Additional UPC and Fortran coarray shared data structures are now automatically grouped into block transfers, yielding improved data transfer speeds.
- Improvement to conflict detection for writes to UPC shared data, or to Fortran coarrays, allows applications to achieve faster message rates for the common case of no write conflicts.

2.2 Fortran Standard Compliance

The Cray Fortran compiler supports ISO/IEC 1539-1:2010, the Fortran 2008 standard.

2.2.1 Extensions to the Fortran Standard

- The maximum rank is equal to 31 - arrays can have up to 31 dimensions. The standard requires a maximum rank of 15.

2.3 OpenMP API Specification

Cray Compiling Environment 8.1 supports *OpenMP Application Program Interface, Version 3.1*. All OpenMP library procedures and directives, except for limitations in a few directive clauses, are supported.

This release adds support for the following feature, not described by the API specification:

- `omp_set_wait_policy()`

A new Cray-specific OpenMP interface, `cray_omp_set_wait_policy`, introduces the ability to change the OpenMP wait policy dynamically during a program's execution. This routine allows dynamic modification of the `wait-policy-var` internal control variable (ICV) value, which corresponds to the `OMP_WAIT_POLICY` environment variable.

2.4 ISO C++ Standard (2003)

The Cray C++ compiler accepts the C++ language as defined by the ISO/IEC 14882:2003 standard, except for exported templates. C++ supports the ISO 2003 Standard Template Library (STL) headers but abrogates support for pre-standard template headers that have the `.h` extension.

Note: C++ codes that use the pre-standard template headers must be updated to the ISO C++ standard.

The `-h gnu` option enables the compiler to recognize a subset of the GCC version 4.4.4 extensions to C listed in the GCC C language extensions table. The default is `-h nognu`. For descriptions of the GCC C language extensions, see <http://gcc.gnu.org/onlinedocs>.

2.5 Accelerator Support

2.5.1 OpenACC Directives

This release supports the *OpenACC Application Programming Interface, Version 1.0* specification developed by PGI, Cray Inc., and NVIDIA, with support from CAPS enterprise. Refer to the OpenACC home page at <http://www.openacc-standard.org/>. Under the Downloads link, select the *OpenACC 1.0 Specification*.

See the `intro_openacc(7)` man page for the most current information regarding this implementation of OpenACC.

2.5.2 Fortran Ininsics

Certain Fortran intrinsic routines will run on the accelerator if they are encountered within an accelerated region. Support for the intrinsics `MAXLOC`, `MINLOC`, `MAXVAL`, and `MINVAL` was added in this release. The main limitation is that argument `DIM` must not be specified.

2.5.3 Module Support

To compile an application that includes accelerator directives, ensure that `PrgEnv-cray` module is loaded and that it includes CCE 8.1. Then, either load the `craype-accel-nvidia20` module for Fermi support or the `craype-accel-nvidia35` module for Kepler support.

Use either the `ftn` or `cc` command to compile.

2.5.4 OpenMP Accelerator Directives Deprecated

The OpenMP accelerator directives are currently being discussed in the OpenMP Language Committee and the specification is currently in a state of flux. The OpenMP accelerator directives, as currently implemented, are deprecated and will be removed in a future CCE release. Please use the OpenACC accelerator directives instead.

2.6 Compiler Command Line Changes

The following command line changes apply to CCE 8.1

- The compiler supports a more aggressive floating point and complex arithmetic optimization level, adding the `-h fp4` option.
- `-h [no]keep_frame_pointer` command line option prevents call stack frame from being optimized out of a function so CrayPat sampling is able to trace call stack back to entry point.
- The `-h mpin` option enables or disables an optimization that converts blocking MPI send and receive operations to their non-blocking counterparts paired with a wait operation, and schedules these operations to overlap communication and computation. The default is `-hmpi0`.
- Interprocedural analysis (IPA) level 5 enables cloning directives. Previously they were enabled at IPA level 4.
- The `-h acc_model=option[:option] . . .` explicitly controls execution and memory model utilized by the accelerator support system. The option arguments identify the type of behavior desired. There are three option sets, only one member of a set may be used at a time; however, all three sets may be used together.

Fortran Only

- The `-hcaf` option to recognize coarray syntax is on by default. A new predefined macro `_CRAY_COARRAY` defined when `-hcaf` is in effect.
- The command line option `-r i` intersperses loop optimization messages within the loopmark listing.
- The `-eD` option enables all debugging options.
- New command line option `-eb` causes the compiler to issue a warning message rather than an error message for procedure call with `TARGET`, `VOLATILE`, `ASYNCHRONOUS` dummy arguments without an explicit interface definition.
- `-S` no longer requires or accepts the specification of an output file. The options `-eS` and `-S` now have the same effect. No changes were made to `-eS`. This change makes the Cray Fortran `-S` option consistent with other compilers.

C Only

- The `-h bounds` option provides checking of UPC shared array accesses to ensure that they are within acceptable boundaries. The `-h nobounds` option disables these checks.

2.7 New Environment Variables

- `NO_STOP_MESSAGE`

If set, and if the `STOP [stop_code]` statement in the Fortran code does **not** specify the optional *stop_code*, then `STOP` messages are not produced when this statement is executed.

2.8 New Compiler Directives

- The general `prefetch` directive instructs the compiler to generate explicit `prefetch` instructions which load data from memory into cache prior to read or write access. See the `prefetch(7)` man page.

Compatibilities and Differences [3]

This chapter describes compatibility issues and functionality changes to be aware of when upgrading from earlier releases of this software.

- The `-hcaf` option to recognize coarray syntax is on by default. In previous releases, the default was `-hnocaf`.
- OpenMP accelerator directives, as currently implemented, are deprecated and will be removed in a future CCE release.
- Some system headers were removed from `upc.h`, including `stdlib.h` which includes `sys/types.h`. Do not rely on `upc.h` to include other system headers. If your code requires `sys/types.h`, Include `stdint.h` if you were not previously doing so.

This chapter describes the documentation that supports the Cray Compiling Environment 8.1 release.

4.1 Accessing Product Documentation

With each software release, Cray provides books and man pages, and in some cases, third-party documentation. These documents are provided in the following ways:

- | | |
|---------------------------|--|
| CrayPort | CrayPort is the external Cray website for registered users that offers documentation for each product. CrayPort has portal pages for each product that contains links to all of the documents that are associated to that product. CrayPort enables you to quickly access and search Cray books, man pages, and in some cases, third-party documentation. You access CrayPort by using the following URL:

http://crayport.cray.com |
| CrayDoc | CrayDoc is the Cray documentation delivery system. CrayDoc enables you to quickly access and search Cray books, man pages, and in some cases, third-party documentation. Access the HTML and PDF documentation via CrayDoc at the following locations. <ul style="list-style-type: none">• The local network location defined by your system administrator• The CrayDoc public website: http://docs.cray.com |
| Man pages | Man pages are textual help files available from the command line on Cray machines. To access man pages, enter the man command followed by the name of the man page. For more information about man pages, see the man(1) man page by entering:

<code>% man man</code> |
| Third-party documentation | Third-party documentation that is not provided through CrayPort or CrayDoc is included with the third-party product. |

4.2 Cray-developed Books Provided with This Release

The books provided with this release are listed in [Table 1](#), which also indicates whether each book was updated. Books are provided in HTML and PDF formats.

Table 1. Books Provided with This Release

Book Title	Number	Updated
<i>Cray Compiling Environment Release Overview and Installation Guide</i> (this document)	S-5212-81	Yes
<i>Cray C and C++ Reference Manual</i>	S-2179-81	Yes
<i>Cray Fortran Reference Manual</i>	S-3901-81	Yes

4.3 Additional Documentation Resources

[Table 2](#) lists additional resources for obtaining documentation not included with this release package.

Table 2. Additional Documentation Resources

Product	Documentation Source
Example:	
GNU compilers	Documentation for the GNU C and Fortran compilers is available at http://gcc.gnu.org/onlinedocs/
glibc	glibc documentation is available at http://gcc.gnu.org/onlinedocs
GLIB	GLIB documentation is available at http://developer.gnome.org/glib/stable
RPM	RPM documentation is available at http://www.rpm.org

4.4 Changes to Man Pages

4.4.1 New Cray Man Pages

These man pages are new with this release:

- `prefetch(7)`: A general directive which instructs the compiler to generate explicit `prefetch` instructions.
- `OpenACC.EXAMPLES(7)`: Example OpenACC codes.
- `execute_command_line(3i)`: Runs a shell command.

4.4.2 Changed Cray Man Pages

The following Cray man pages were changed with this release:

- `craycc(1)`
- `crayCC(1)`
- `crayftn(1)`
- `amo(3i)`
- `intro_intrin(3i)`
- `intro_quad_precision(3i)`
- `num_images(3i)`
- `this_image(3i)`
- `intro_directives(7)`
- `intro_openacc(7)`
- `intro_openmp_acc(7)`
- `intro_pgas(7)`

4.5 Other Related Documents Available

The following publications contain additional information that may be helpful in setting up your Cray Compiling Environment 8.1 environment; they are not provided with this release but are supplied with other products purchased from Cray:

- *Cray Application Developer's Environment Installation Guide*
- *Cray Application Developer's Environment User's Guide*
- *Managing System Software for Cray XE and Cray XK Systems*

5.1 Hardware and Software Requirements

The CCE 8.1.0 release is supported on Cray XE systems that run the Cray Linux Environment (CLE) operating system, version 3.1 and later, and on Cray XK systems that run the CLE operating system, version 4.0.UP01 and later. The Cray Compiling Environment 8.1 release requires the following supporting asynchronous software products:

- Cray Compiler Drivers (xt-asyncpe) 5.12 or later
- GNU Compiler Collection (GCC) 4.4.4 must be installed, but must NOT be the default GCC
- PMI 3.0.0 or later
- Cray Scientific Libraries (LibSci) 11.0.00 or later
- FlexNet License Manager 11.10.0 or later is recommended (available in Third Party Products 5.24 package)

The Cray Compiling Environment 8.1 release requires minimum versions of the following products, if these products are used:

- Cray Portable Extensible Toolkit for Scientific Computation (PETSc) 3.1.05 or later
- hdf5-netcdf 1.8 (HDF5 1.85 and netcdf 4.1.1)
- MPT 5.2.3 or later
- ACML 4.4.0 or later. To use ACML 5.0, GCC 4.6.1 must be installed.
- Cray Performance Measurement and Analysis Tools 5.3.0
- Cray Performance Measurement and Analysis Tools 6.0.0 is required for Reveal

5.2 Contents of the Release Package

The release package includes:

- Cray Fortran Compiler, version 8.1
- Cray C and C++ Compiler, version 8.1
- CrayLibs (libraries and utilities), version 8.1
- CrayDoc software suite and the documentation, described in [Chapter 4, Documentation on page 17](#)

5.3 Licensing

The Cray Compiling Environment 8.1 is licensed under a software license agreement which is specific to the Cray Compiling Environment software. Upgrades to this product are provided only when a software support agreement for this Cray software is in place.

The software license agreement is enforced by FlexNet license manager software. [Table 3](#) shows the licensing scope for Cray Compiling Environment 8.1. A new license key is required for initially installing Cray Compiling Environment software and when upgrading from a previous release to a new major release (8.1). For information on installing the FlexNet Server Software, see [Appendix A, Installing and Managing FlexNet on page 37](#).

To request new FlexNet license manager keys for Cray Compiling Environment, contact license_keys@cray.com.

Table 3. Licensing Scope for Programming Environment Products

License for Product	Host Platform	Concurrent Users
Cray Compiling Environment 8.1	Cray XE and Cray XK systems	Unlimited or 5

For more information about contractual licensing and pricing, contact your Cray sales representative, or send e-mail to crayinfo@cray.com.

5.4 Third-party License Notices

The Cray Compiling Environment 8.1 release includes the following third-party software pursuant to the following third-party license notices.

5.4.1 LLVM

```
=====
LLVM Release License
=====
```

```
University of Illinois/NCSA
Open Source License
```

```
Copyright (c) 2003-2008 University of Illinois at Urbana-Champaign.
All rights reserved.
```

```
Developed by:
```

```
    LLVM Team
```

```
    University of Illinois at Urbana-Champaign
```

```
    http://llvm.org
```

```
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```
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ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF
CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION
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```

5.4.2 `tcmalloc` (google-perftools)

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5.4.3 AMD LibM 3.0.1

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5.4.4 AMD ACML-MV 4.4.1

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Part II: Installation

Installing Cray Compiling Environment 8.1 [6]

Cray Compiling Environment 8.1 is distributed on DVD. It is also available as one or more downloadable files. The instructions in this chapter assume you are working with a DVD. If you are working with either a single `iso` file or a `tar` file composed of individual `rpm` files, adjust the instructions accordingly.

Cray Compiling Environment 8.1 is installed on the shared root. You must have root permissions in order to install this software.

Use these `rpm` files:

- `cce-8.1.0-N.x86_64.rpm` or later

Additionally, Cray Compiling Environment 8.1 requires that the following asynchronous products be installed on your system:

- Cray Scientific Libraries (LibSci) 11.0.00 or later
- Cray Compiler Drivers (xt-asyncpe) 5.12 or later
- GNU Compiler Collection (GCC) 4.4.4

6.1 Installing the RPM Files

Procedure 1. Installing the RPM files

1. Log on to the SMW as `root`.

```
% ssh root@smw
```

2. Load and mount the distribution media, if necessary.

```
smw:~# mount /dev/cdrom /media/cdrom
```

3. Create a temporary directory on the boot node for the installation files, if one does not already exist.

```
smw:~# ssh boot mkdir /tmp/install.cce
```

4. Copy the installation files from the distribution media to the boot node.

```
smw:~# scp -pr /media/cdrom/cce-version.x86_64.rpm \  
boot:/tmp/install.cce
```

5. (Optional) If you need to install asynchronous products, copy these files as needed.

```
smw:~# scp -pr /media/cdrom/xt-gcc-version.x86_64.rpm \
/media/cdrom/xt-asyncpe-version.i386.rpm \
/media/cdrom/xt-libsci-version.x86_64.rpm \
/media/cdrom/cray-mpt-version.x86_64.rpm \
boot:/tmp/install.cce
```

6. Unmount and remove the distribution media.

```
smw:~# umount /media/cdrom
```

7. Log into the boot node as root.

```
smw:~# ssh root@boot
```

8. Change to your temporary directory.

```
boot001:~# cd /tmp/install.cce
```

9. Create a target directory on the shared root and copy the installation files from your temporary directory to the shared root.

```
boot001:/tmp/install.cce # mkdir -p /rr/current/software/install.cce
boot001:/tmp/install.cce # cp -p cce-version.x86_64.rpm \
/rr/current/software/install.cce
```

10. (Optional) If you are installing asynchronous products, copy these files as needed.

```
boot001:/tmp/install.cce # cp -p xt-gcc-version.x86_64.rpm \
xt-asyncpe-version.i386.rpm \
xt-libsci-version.x86_64.rpm \
cray-mpt-version.x86_64.rpm \
/rr/current/software/install.cce
```

11. Open an xtopview session.

```
boot001:/tmp/install.cce # xtopview
```

12. Change to the temporary directory you created on the shared root.

```
default:/# cd /software/install.cce
```

13. Use the rpm command to install the files.

Note: When running rpm from within xtopview, the rpm utility issues a warning that it cannot find /rr/current. This warning may safely be ignored.

Install CCE:

```
default:/software/install.cce # rpm -ivh cce-8.1.0-version.x86_64.rpm
```

Set newly installed CCE to be default:

```
YarcData-logo_a-cray-compan.gifdefault:/software/install.cce #
/opt/cray/admin-pe/set_default_files/set_default_cce_8.1.0
```

(Optional) If installing asynchronous products, use these commands as needed:

```
default:/software/install.cce # rpm -ivh xt-gcc-version.x86_64.rpm
default:/software/install.cce # rpm -ivh xt-asyncpe-version.i386.rpm
default:/software/install.cce # rpm -iv xt-libsci-version.x86_64.rpm
```

Set newly installed *product* to be default:

```
default:/software/install.cce #
/opt/cray/admin-pe/set_default_files/set_default_product_version
```

14. Exit from the xtopview session:

```
default:/software/install.cce # exit
```

15. Log out of the boot node:

```
boot001:/tmp/install.cce # exit
logout
Connection to boot closed.
smw:~#
```

16. Log out of the SMW.

```
smw:~# exit
logout
%
```

6.2 Installing the License Key

To activate your software license, you must insert the FlexNet software license key information provided by Cray into a FlexNet license file on your system. The FlexNet license file contains data that is used to determine whether a licensed software product is allowed to run.

The license file contains the following information:

- Your FlexNet software license key for your Cray product
- Initial installation instructions
- Update instructions
- License manager utilities
- Technical Support information

Cray recommends that you name your license file `/opt/cray/cce/cce.lic`. These instructions assume that the FlexNet license manager is already running, that your license file is located in the directory `/opt/cray/cce`, and that the file is named `cce.lic`.

If you do not have FlexNet license manager already installed on your network, go to [Appendix A, Installing and Managing FlexNet on page 37](#).

Procedure 2. Adding a new key to a license file

1. Log in to your license server as `admin` or `root`.

2. Locate your existing license file, if any.

```
# ls /opt/cray/cce
```

If the directory does not exist, make it.

```
# mkdir -p /opt/cray/cce
```

3. In `/opt/cray/cce`, create the plain text file `cce.lic`. Copy your FlexNet license key you received from Cray (typically in an email message) to `cce.lic`.

4. Set the file access permissions to 644.

```
# chmod 644 /opt/cray/cce/cce.lic
```

5. Update your FlexNet license server to use the new key. Verify that the license server is running.

```
# lmstat
```

If the server is not running, go to [Appendix A, Installing and Managing FlexNet on page 37](#).

Assuming the server is running, reread the license file.

```
# lmreread
```

Your license is now ready to use.

6.3 Changing the Default Programming Environment

The installation of the `cade-prgen` RPM creates a section in the `/etc/bash.bashrc.local` and `/etc/csh.cshrc.local` scripts called the **PE-set-up** block. The user should not modify this block.

To change the default PE, and add more PE user defaults, the site administrator may add appropriate instructions by editing the `/etc/*rc.local` files within the **SITE-set-up** block **only**. Also refer to *Managing System Software for Cray XE and Cray XK Systems*, Section 5.7.

Cray Linux Environment (CLE) 4.0 release modifies the default programming environment in CLE 4.0 as follows:

- The programming environment requires that a default CPU target be specified in the `SITE-set-up` block of the `/etc/*rc.local` files.
- The CLE 4.0 and 4.1 environments support only network target `gemin1`.
- The module, `xt-mpich2`, is no longer loaded as part of the default `PrgEnv-*` product list. This is to accommodate site preferences for `xt-shmem` or `xt-mpich2` as the site default.

6.3.1 Configuring the `/etc/*rc.local` Files on a Cray Linux Environment (CLE) System

The network type is set correctly by the operating system installation and does not need to be reset.

The default link type is static.

Note: On CLE 4.0.UP01, the default programming environment (PE) is `PrgEnv-pgi`, unless set differently in the `SITE-set-up` block of the `/etc/*rc.local` files.

On CLE 4.0.UP02 and later, the default programming environment (PE) is `PrgEnv-cray`, unless set differently in the `SITE-set-up` block of the `/etc/*rc.local` files.

On the Cray XE system, the following configuration loads the `xt-mpich2` module and ensures that code is generated for a `mc12` target.

```
##BEGIN SITE-set-up ADD SITE DEFAULTS HERE
# Site specific set up in this section.
module load xt-mpich2
module load craype-mc12
##END SITE-set-up
```

If you want to change the default PE settings to `PrgEnv-cray`, `SHMEM`, CPU target `xyz`, and dynamic linking, add the following to the `SITE-set-up` block in `bash.bashrc.local` and `cmsh.cshrc.local`:

```
##BEGIN SITE-set-up ADD SITE DEFAULTS HERE
# Site specific set up in this section.
if ( ! ${?PELOCAL_PRGENV} ) then
  module unload PrgEnv-pgi
  module load PrgEnv-cray
  setenv PELOCAL_PRGENV true
  set -r PELOCAL_PRGENV=$PELOCAL_PRGENV
endif
module load xt-shmem
module load craype-xyz
setenv XTPE_LINK_TYPE dynamic
# OR: export XTPE_LINK_TYPE=dynamic
##END SITE-set-up
```

The instructions in the `SITE-set-up` block are not altered by operating system installations. The `SITE-set-up` block is evaluated after the `PE-set-up` block, so make sure new instructions do not conflict with the ones in the `PE-set-up` block.

6.3.2 Configuring the `/etc/*rc.local` Files on a Standalone Linux System with `cade-prgenv-4.0.*`

The installation of the `cade-prgenv` RPM adds the following line to the `*rc.local` files.

```
module use /opt/cray/xt-asyncpe/default/modulefiles;export
XTOS_VERSION=4.0.version
```

The `XTOS_VERSION` is updated with each `cade-prgenv-4.0.*` update.

Administrators may add additional settings **after** this line.

The default link type is `static`.

A CPU target must be defined. The choice of processor module depends on which system the user intends to use as a runtime system for the application they build. The default network type is `gemin` in a 4.0.* programming environment.

Systems that are used for cross compiling for several different processor targets might set the default processor type to `interlagos`. Users on these systems will choose to target a processor and will explicitly load a processor module choice which will override the default.

To set the default programming environment to `PrgEnv-cray`, `link=dynamic`, `SHMEM`, and `cpu=mc12`, add the following lines to `/etc/bash.bashrc.local` and `/etc/csh.cshrc.local`:

```
module use /opt/cray/xt-asyncpe/default/modulefiles
module load PrgEnv-cray
module load craype-mc12
module load xt-shmem
setenv XTPE_LINK_TYPE dynamic
# OR: export XTPE_LINK_TYPE=dynamic
```

6.4 Using Cray Compiling Environment 8.1

After the Cray Compiling Environment 8.1 rpm files are installed and the license is activated, users can load the `PrgEnv-cray` module .

The Cray compilers are invoked by using the `ftn` or `cc` commands.

Because of the multiple compiling environments potentially available on Cray XE systems, the `ftn(1)`, `cc(1)`, and `CC(1)` man pages provide basic introductions to the compiler environment. For information about the Cray compiler command-line options, see the `crayftn(1)`, `craycc(1)`, and `crayCC(1)` man pages.

For more detailed information about the Cray compiler options, directives, pragmas, and optimizations, see *Cray Fortran Reference Manual* and *Cray C and C++ Reference Manual*.

The Cray Compiling Environment 8.1 compilers produce code that can be executed on 64-bit AMD Opteron processors. The valid compilation targets are `barcelona`, `shanghai`, `istanbul`, `mc8`, `mc12`, `interlagos`, `interlagos-cu`, `abudhabi`, `abudhabi-cu`, and `sandybridge`.

The targeting modules (`craype-mc8`, or `craype-interlagos`, for example) set `target_system`. If the `target_system` is set during compilation of any source file, the same `target_system` must also be specified during linking and loading. For example, if users are compiling code for use on eight-core (`mc8`) or twelve-core (`mc12`) systems, they must load the `craype-mc8`, or `craype-mc12` module and use the same module at link and load time.

6.4.1 Compiling and Linking an Application which Contains Accelerator Directives

To compile an application which uses the accelerator directives, ensure that `PrgEnv-cray` module is loaded. Load the appropriate `target_system` module corresponding to the host processor (`craype-interlagos`, for example). The `target_system` modules ensure that corresponding targeted libraries will be linked.

Then, either load the `craype-accel-nvidia20` module for Fermi support or the `craype-accel-nvidia35` module for Kepler support.

Use either the `ftn` or `cc` command to compile.

Installing and Managing FlexNet [A]

The Cray Compiling Environment requires FlexNet license manager.

If you do not already have this software installed on your system, download these packages provided in the Cray Compiling Environment 8.1 package:

- `cray-flexnet-installation-instructions.txt`
- `cray-flexnet-daemon-11.10.0-1.0000.3631.4.1.gem.x86_64.rpm`
- `cray-flexnet-manager-11.10.0-1.0000.3631.4.1.gem.x86_64.rpm`
- `cray-flexnet-publisher-switch-11.10.0-1.0000.3631.4.1.gem.x86_64.rpm`
- `cray-flexnet-utils-11.10.0-1.0000.3631.4.1.gem.x86_64.rpm`

Note: You do not need new licenses for CCE or PerfTools when upgrading the FlexNet Server Software only.

Refer to section 5.3 to determine when new licenses are needed. Follow the instructions in the `cray-flexnet-installation-instructions.txt` file.

A.1 License Management Utilities and Files

Use the following commands to administer the license manager software:

<code>lmdown</code>	Shut down the licensing daemons
<code>lmgrd</code>	Invoke the licensing daemon
<code>lmhostid</code>	Display the host ID of a system
<code>lmremove</code>	Return a license to the license pool
<code>lmreread</code>	Update license daemons with new license data
<code>lmstat</code>	Report current status of the license daemon
<code>lmver</code>	Display the FlexNet version being used

Note: These commands are actually arguments passed to `lmutil`. If any do not exist on your license server, you can create them by making a symbolic link to `lmutil`. For example:

```
ln -s lmutil <command name>
```

A.2 Combining License Files

If you are using three-server redundancy, you must use separate license files with different TCP/IP ports for the licensed software products from each vendor. (Licensed software products from the same vendor can share license files.)

If you are using a single server, you can combine license files. To do so, edit all license files that have matching `SERVER` lines (the port number does not have to match) into one file, and delete the extra `SERVER` lines. Place all `DAEMON` lines after the `SERVER` line.

A.3 Resolving Problems

If you are having problems with your license key, check your installation first. Then examine the log file:

- Verify that the license file is `/opt/cray/cce/cce.lic`. If this is not the location or name of your license file, each user must have `CRAYLMD_LICENSE_FILE` set to the path and name that you are using.
- Verify that the license file has a `FEATURE` line for the product you are trying to use.
- Use the `ps` command and the `lmstat` utility to verify that the servers specified in your license file are running.

When you examine the log file, look for the following messages:

- `Inconsistent encryption code for <name>` — The information encoded in the encryption code for the specified feature, server, or daemon is inconsistent with the information provided in the license file. Recheck the associated `FEATURE`, `SERVER`, or `DAEMON` line in your license file.
- `license daemon: execl failed` — The `lmgrd` path specified on the `DAEMON` line in the license file is not valid. Verify that the license file contains the correct path.
- `Retrying socket bind` — Either the TCP port number is already in use by another process, two `lmgrd` daemons were started with license files that specify the same TCP port, or the port is waiting to timeout after a recently executed `lmgrd` command. This message typically appears when you stop and then immediately try to restart `lmgrd`. In this case, wait a few minutes, to allow TCP time to relinquish the port.

If this fails to correct the problem, check the `SERVER` line in the license file. If another process needs the specified port, edit the license file to specify a different port. If no port is specified, the default port is 27000.