



Cray Performance Analysis Tools 5.3 Release Overview and Installation Guide

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Part I: Release Overview

Introduction [1]

This document provides an overview of the 5.3.0 release of CrayPat and Cray Apprentice2 for systems running the Cray Linux Environment (CLE) operating system, including Cray XE and Cray XK systems. This document also provides instructions for installing these products on your system.

1.1 Emphasis for the 5.3 Release

This release provides the following key enhancements:

- Improved support for Cray XK systems with Graphics Processing Unit (GPU) accelerators
- Automatic MPI rank-order analysis and rank-order placement file generation
- Updated entry points for improved tracing of SHMEM, Chapel, and PGAS code
- New Cray Apprentice2 client for Microsoft Windows

Software Enhancements [2]

This chapter outlines the enhancements provided with this release. For a full list of the changes implemented in `pat_build`, the run time library (RTL), and `pat_report`, load the `perftools` module and use the `module help perftools` command.

For compatibility issues and differences that you may encounter when installing or using this release, see [Chapter 3, Compatibilities and Differences on page 13](#).

2.1 Improved Cray XK Support

GPU statistics are now available in full trace mode, in addition to the default run time summary mode. Full trace is enabled by setting the `PAT_RT_SUMMARY` environment variable to 0.

Note: Enabling full trace can produce enormous data files. Users should consider reading the section titled "Controlling Data File Size" in *Using Cray Performance Analysis Tools*.

In addition, new reporting options have been added to improve the understanding of GPU statistics. For more information, see *Using Cray Performance Analysis Tools* or the `pat_report(1)` man page.

2.2 Automatic MPI Rank-Order Analysis

By default, MPI program ranks are placed on compute node cores sequentially in SMP style, as described in the `intro_mpi(3)` man page. You can use the `MPICH_RANK_ORDER_METHOD` environment variable to override this default placement, and in some cases achieve significant improvements in performance.

With this release, the Cray Performance Analysis Tools now provide two ways to help optimize MPI rank order. If you already understand your program's patterns of communications well enough to specify an optimized rank order without further assistance, you can use the `grid_order` utility to manually generate a rank order list that can be used as an input to the `MPICH_RANK_REORDER_METHOD` environment variable.

Alternatively, you can use CrayPat to analyze MPI sent-message data, detect a grid topology, report rank-order optimization information, and automatically generate a recommended rank-order placement file for use with `MPICH_RANK_REORDER_METHOD`.

For more information, see *Using Cray Performance Analysis Tools*.

2.3 Run Time Library Changes

As a result of changes implemented to improve support for Cray XK systems, the following run time environment variables have been added to the run time library.

`PAT_RT_ACCPC`

`PAT_RT_ACCPC_FILE`

`PAT_RT_ACCPC_FILE_GROUP`

`PAT_RT_ACC_FORCE_SYNC`

The following obsolete run time environment variables are removed in this release.

`PAT_RT_TRACE_ARCHIVE`

`PAT_RT_TRACE_LOOPS`

`PAT_RT_DOFORK`

`PAT_RT_OMP_SYNC_TRIES`

For more information about run time environment variables, see the `intro_craypat(1)` man page or *Using Cray Performance Analysis Tools*.

2.4 Online Help

CrayPat includes an extensive online help system, which features many examples and the answers to many frequently asked questions. To access the help system, enter this command:

```
> pat_help
```

The `pat_help` command accepts options. For example, to jump directly into the FAQ, enter this command:

```
> pat_help FAQ
```

Once the help system is launched, navigation is by one-key commands (e.g., `/` to return to the top-level menu) and text menus. It is not necessary to enter entire words to make a selection from a text menu; only the significant letters are required. For example, to select "Building Applications" from the **FAQ** menu, it is sufficient to enter **Buil**.

Help system usage is documented further in the `pat_help(1)` man page.

Likewise, Cray Apprentice2 features an online help system as well as numerous pop-ups and tool-tips that are displayed by hovering the cursor over an area of interest on a chart or graph. To access the online help system, click the **Help** button, or right-click on any report tab and then select **Panel Help** from the pop-up menu.

Feel free to experiment with the Cray Apprentice2 user interface and to left- or right-click on any area that looks like it might be interesting. Because Cray Apprentice2 does not write any data files, you cannot corrupt, truncate, or otherwise damage your original .ap2 data file using Cray Apprentice2.

2.5 Bug Reports Addressed Since the Last Release

The following bug reports are addressed in this release.

```
776439 craypat trace instrumented VASP5.2 aborts if built with pat_build -g lapack
777545 CrayPat issues "Expected but did not find event tag"
771619 IO data is not passed from xf to ap2
774673 No write statistics show in pat_report from perftools 5.2.x
776614 perftools/5.2.3: pat_report -Ompi_rank_order no longer works
778603 The pat_report option, -s filter_input=..., has no effect.
779131 pat_report -d cum_sa,cum_sa% does not work
```


Compatibilities and Differences [3]

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

3.1 Users Must Recompile Applications

Because of changes made in this release, users must recompile and re-instrument applications that were compiled, linked, and instrumented using earlier CrayPat modules.



Caution: Not recompiling and re-instrumenting an application will result in an undefined behavior.

3.2 Data File Compatibility

Data file compatibility is not maintained between versions. Programs instrumented using earlier versions of CrayPat must be recompiled, relinked, and reinstrumented using the current version of CrayPat. Likewise, `.xf` and `.ap2` data files created using earlier versions of CrayPat cannot be read using the release 5.3.0 version of `pat_report`, nor can data files created using release 5.3.0 be read using earlier versions of `pat_report` or Cray Apprentice2.

Note: `.ap2` data files created using earlier versions of `pat_report` can be read using Cray Apprentice2 release 5.3.0, but cannot take advantage of the improved infrastructure and therefore may appear to load slowly.

If you have upgraded to release 5.3.0 from an earlier version of CrayPat, the earlier version likely remains on your system in the `/opt/cray/modulefiles/perftools` directory. (This may vary depending on your site's software administration and default version policies.) To revert to the earlier version, you will need to explicitly unload the newer version and load the earlier version.

For example, assuming the older version is 5.2.0:

```
> module unload perftools
> module load perftools/5.2.0
```

3.3 FlexNet License Server Update Required

Use of Cray performance analysis tools requires a FlexNet license. For information on activating the software license see Activating the FlexNet License Key [Activating the FlexNet License Key on page 23](#).

Because of changes made in this release, sites must obtain and install a new FlexNet license for this product. This product will not work with older versions of the FlexNet license.

This chapter describes the documentation that supports the Performance Tools 5.3.0 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 notes 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 Performance Analysis Tools Release Overview and Installation Guide</i> (this document)	S-2474-53	Yes
<i>Using Cray Performance Analysis Tools</i>	S-2376-53	Yes
<i>CrayDoc Installation and Administration Guide</i>	S-2340-411	No

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
GNU compilers	Documentation for the GNU C and Fortran compilers is available at http://gcc.gnu.org/onlinedocs/
Lustre	Additional Lustre documentation is available at http://wiki.lustre.org/index.php/Lustre_Documentation
PAPI	PAPI documentation is available at http://icl.cs.utk.edu/papi/
RPM	RPM documentation is available at http://www.rpm.org

4.4 New or Changed Cray Man Pages

The following Cray man pages are new or updated with this release:

- `intro_craypat(1)`
- `pat_build(1)`
- `pat_report(1)`
- `pat_help(1)`
- `grid_order(1)`
- `accpc(5)`
- `nwpc(5)`
- `papi_counters(5)`
- `app2(1)`

5.1 Hardware and Software Requirements

The Performance Analysis Tools 5.3.0 release requires the following environment in order to run.

- Cray Linux Environment (CLE) 3.1 or later
- Microsoft Windows 7 (optional: for Cray Apprentice2 only)
- Cray xt-asyncpe 3.2 or later
- System Management Workstation 2.0 or later
- CRMS 2.0 or later
- At least one of the following compilers:

- Cray CCE 8.0 or later

Note: Required for Cray XK systems

- GCC 4.5.x

Note: GCC 4.6.x does not currently support user function tracing in CrayPat

- Intel 12.0 or later
- PGI 10.9 or later

5.2 Contents of the Release Package

The release package includes:

- CrayPat 5.3.0
- Cray Apprentice2 5.3.0
- PAPI 4.2.0
- CUDA 4.0.17 (for Cray XK systems only)
- CUDATOOLS 4.0.17 (for Cray XK systems only)
- CrayDoc software suite and the documentation, described in [Chapter 4, Documentation on page 15](#)
- A printed copy of this release overview

5.3 Licensing

The Cray Performance Measurement and Analysis Tools product uses the software license agreement for Cray software. Upgrades to this product are provided only when a software support agreement for this Cray software product is in place.

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

To request FlexNet license manager keys for Cray Compiling Environment and Cray Performance Measurement and Analysis Tools releases, contact license_keys@cray.com.

Part II: Installation Guide

The Cray Performance Analysis Tools package is distributed on CD-ROM. It is also available as downloadable rpm files. The instructions in this chapter assume that you are working with a CD-ROM.

Note: Cray Inc. no longer provides the DWARF and ELF libraries, which previously were included in the `toolsup` rpm. You can download the latest version of DWARF from <http://reality.sgiweb.org/davea/dwarf.html> and the latest version of ELF from <http://www.mr511.de/software/english.html>.

6.1 Installing the Performance Analysis Tools on Cray Systems

You must have root permissions in order to install this software on Cray systems.

Procedure 1. Installing the Performance Tools 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.perftools
```

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

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

5. Unmount and remove the distribution media.

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

6. Log into the boot node as `root`.

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

7. Change to your temporary directory.

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

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

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

9. Open an xtopview session.

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

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

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

11. (Optional) If you want the versions you are about to install to become the new default versions, set the environment variable.

```
default:/software/install.cpat # export CRAY_INSTALL_DEFAULT=1
```

If you do not set this environment variable, any previously installed default version remains the default version, and your users will need to load a specific module in order to select the newly installed version.

12. 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.

To install the performance analysis tools for use on a Cray system, use these commands:

```
default:/software/install.perftools # rpm -ivh --oldpackage perftools-version.x86_64.rpm
default:/software/install.perftools # rpm -ivh --oldpackage \
perftools-clients-version.x86_64.rpm
```

13. (Optional) After RPM file installation is complete, if you set the CRAY_INSTALL_DEFAULT environment variable earlier, unset it now:

```
default:/software/install.perftools # unset CRAY_INSTALL_DEFAULT
```

14. Exit from the xtopview session:

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

15. Log out of the boot node:

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

16. Log out of the SMW.

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

6.2 Activating the FlexNet License Key

Note: Cray Performance Analysis Tools release 5.3.0 requires a new FlexNet software license key for all installations. Even if you are upgrading from an earlier version of the Cray Performance Analysis Tools, you must obtain and install a new license key.

To activate your software license, 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 determines whether a licensed software product is allowed to run.

The license file contains the following information:

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

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

The FlexNet license manager should already be installed on your system. If it is not, follow the installation instructions in Appendix A, Installing FlexNet, in *Cray Compiling Environment Release Overview and Installation Guide* (S-5212).

Procedure 2. Adding a new key to a license file

1. Login to your license server as admin or superuser.

2. Locate your existing license file, if any.

```
# ls /opt/cray/perftools
```

If the directory does not exist, create it.

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

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

4. Set the file access permissions to 644.

```
# chmod 644 /opt/cray/perftools/perftools.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, follow the installation instructions in Appendix A, Installing FlexNet, in *Cray Compiling Environment Release Overview and Installation Guide* (S-5212).

Assuming the server is running, re-read the license file.

```
# lmread
```

Your license is now ready to use.

6.3 Installing the Cray Performance Analysis Tools on Standalone Linux Systems

The Cray Performance Analysis tools can also be installed on many common Linux desktop systems. Follow the instructions in this section to install the desktop version.

Note: In this release, only Cray Apprentice2 and some selected `pat_report` functions are supported on standalone Linux systems. You are still required to instrument your programs using `pat_build`, execute your programs using `aprun`, and perform the initial conversion of `.xf` data to `.ap2` report files using `pat_report`, on a Cray system.

6.3.1 System Requirements

Note: Because of the high degree of variability in common Linux desktop installations, you may be required to install or update other libraries and utilities in order to address dependencies.

Before installing the desktop version, verify that the following requirements are met.

- You have `root` permissions on the Linux system.
- The Linux system must use at least one 64-bit, x86-based processor (AMD Opteron, Intel Pentium 4, or equivalent).
- The Linux system must have at least 1 GB of RAM. More is preferable.
- The Linux system must have at least 70 GB of total disk space and at least 3 GB of free disk space. More is preferable.
- The Linux system must run SUSE Linux Enterprise Desktop (SLED) 11 or later.

Note: The desktop version of the Cray Performance Analysis Tools may be usable on other Linux systems. However, behavior on other versions of Linux is untested at this time.

- Modules 3.1.6 or later must be installed. If you do not already have Modules installed on your desktop system, you can install it from the file `cray-modules-3.1.6-14.x86_64.rpm`, which is distributed with the Cray XT operating system.
- The `/opt` file system must exist and be mounted in the `root` of the file system.
- The `/tmp` file system must have sufficient space to hold the temporary files created during installation.
- Root must have write permissions into `/opt`.

6.3.2 Installation Procedure

Procedure 3. Installing from a tar file

1. Log on to the Linux system as `root`.
2. Copy the `perftools-clients-<version>.tar` file to a working directory.
3. (Optional) If you want the application you are about to install to become the default version, set the environment variable:

```
$ export CRAY_INSTALL_DEFAULT=1
```

4. Use the `tar` command to extract the distribution file:

```
$ tar -xvf perftools-clients-version.tar
```

5. Change to the installation directory:

```
$ cd perftools-clients-version
```

6. Execute the installation script:

```
$ ./Install
```

The end-user license agreement displays. You must type **Yes** to accept the license agreement in order to continue installation.

7. (Optional) After the installation script completes, if you set the `CRAY_INSTALL_DEFAULT` environment variable earlier, unset it now.
8. Resume normal operations.

6.4 Installing Cray Apprentice2 on Microsoft Windows Systems

This release includes a version of Cray Apprentice2 that can be installed and used on Microsoft Windows systems.

Note: The Windows version works on Windows 7 only. It is not supported on earlier versions of the Microsoft Windows operating system.

To install this version of Cray Apprentice2 on Windows, follow these steps.

Procedure 4. Installing on Microsoft Windows

1. Locate the installer file on your distribution media. The Windows installer file is named `Apprentice2Installer_version.exe`.
2. Copy the installer to the Windows system on which you want to use it.
3. Double-click on the installer file to begin the installation.
4. Follow the on-screen prompts to complete the installation process.

After Cray Apprentice2 is installed on your Windows system, you can launch it either by double-clicking on the Cray Apprentice2 desktop icon, or by double-clicking on an `.ap2` file.

6.5 Using CrayPat and Cray Apprentice2

Assuming your site has the correct licenses, use the `module` command to load the tools.

Man pages are included in the associated Module files and become available only after the Module file is loaded.

6.5.1 Loading Modules

The `module` command can accept a number of arguments. The arguments most commonly used are listed in [Table 3](#).

Table 3. Commonly Used Module Arguments

Argument	Description
<code>list</code>	View the list of modules that are currently loaded
<code>avail</code>	View the list of modules currently available to be loaded
<code>load</code>	Load a module file
<code>swap</code>	Swap a currently loaded module for another module
<code>unload</code>	Unload a currently loaded module file without swapping it for another module
<code>use</code>	Use a different set of module files
<code>help</code>	Release notes and module command usage information

To use the Cray Performance Analysis Tools load the `perftools` module:

```
> module load perftools
```

6.5.2 Using CrayPat and Cray Apprentice2

CrayPat and Cray Apprentice2 are described in *Using Cray Performance Analysis Tools*, as well as in man pages and online help systems. The three essential command line commands are:

`pat_build` Instrument your program for data collection.

`pat_report` After your program has completed execution, post-process the resulting data files for text reports and further analysis.

`app2` [*Cray_system_name*]

Launch the Cray Apprentice2 client to conduct in-depth graphical analysis of the processed data files.

Note: If you are running the Cray Apprentice2 client on a standalone Linux system, also specify the *Cray_system_name* where the `.ap2` files you wish to open reside.

These commands and their options are discussed in the following man pages.

Table 4. CrayPat Man Pages

Man Page	Description
<code>intro_craypat(1)</code>	A quick introduction to CrayPat usage and detailed information about runtime environment variables that affect the kind, quality, and quantity of information captured during program execution
<code>pat_build(1)</code>	Detailed information about preparing your programs for performance analysis experiments
<code>pat_report(1)</code>	Detailed information about the reports that can be generated from performance analysis data after it has been captured
<code>app2(1)</code>	A quick introduction to the Cray Apprentice2 graphical data analysis tool

CrayPat also includes `pat_help(1)`, an extensive online help system and tutorial that includes many practical examples of CrayPat usage as well as the answers to many frequently asked questions.

The most common cause of confusion when getting started with CrayPat is losing track of where you are in the Cray system. For example, some commands can be run on either service or compute nodes, while others return valid results only when run on compute nodes. To further complicate matters, some commands can be run only on specific types of nodes, and then only if launched from a mount-point on a Lustre file system and launched using the correct utility.

If a CrayPat or PAPI command does not seem to return the expected results, always verify that you have the correct modules loaded for the system you are using and that you are running the command from the correct location in the file system.