Paradyn Parallel Performance Tools

Installation Guide

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1 OVERVIEW

The Paradyn Parallel Performance Tools are available for research use free of charge. This Guide describes how to obtain, configure, and install the binary version of Paradyn. A source code distribution is also available.

The Paradyn installation process is similar for all supported UNIX and UNIX-like operating systems, and is described in Section 2. The installation process for Windows NT is described in Section 3. Currently, the installation process for Windows NT is similar to that for UNIX, so you may wish to read Section 2 before reading Section 3.

Paradyn supports cycle-accurate virtual timers on x86 Linux systems when used with a kernel that includes the hrtime patch. See Section 4 in order to obtain and install this patch.

Paradyn supports the IBM PMAPI performance library. This allows us to access the hardware cycle timers on IBM machines. See Section 5 for information on obtaining and installing the necessary support libraries.

1.1 Supported platforms

The Paradyn user interface can run on any of the systems listed in Figure 1, which are also the same workstations and parallel computers on which Paradyn can monitor programs. Paradyn can also monitor application programs running on heterogeneous combinations of these platforms.

System Identifier	Description
sparc-sun-solaris2.7	Sun Solaris operating system version 7, running on SPARC processors.
sparc-sun-solaris2.8	Sun Solaris operating system version 8, running on SPARC processors.
i386-unknown-linux2.2	Linux operating system with kernel version 2.2, running on x86 processors.
i386-unknown-linux2.4	Linux operating system with kernel version 2.4, running on x86 processors.
i386-unknown-nt4.0	Microsoft Windows NT operating system version 4.0, running on x86 processors.
i386-unknown-w2k	Microsoft Windows 2000 operating system on x86 processors.
rs6000-ibm-aix4.3[a]	IBM AIX operating system version 4.3.3 or greater, running on RS6000 processors.

Figure 1: Platforms on which Paradyn's user interface can run

a. Power3-based AIX systems will only function properly if APAR IY03550 has been applied. This is detailed in the AIX installation notes, below.

Paradyn supports monitoring MPI applications on IBM AIX, Solaris, and Linux platforms.

2 INSTALLING PARADYN FOR UNIX

This section describes the steps that should be followed to install the binary distribution of Paradyn on a UNIX system. The steps are: prepare a Paradyn directory and obtain the desired files (Section 2.1), process the installation archive files (Section 2.2), install Tcl/Tk if necessary (Section 2.3), and set environment variables and executables search path (Section 2.4).

2.1 Prepare a Paradyn directory and obtain the distribution archive

It is recommended that you install Paradyn and its associated files into its own directory. If you have any previous versions of Paradyn installed, you may wish to create a new directory for this release to avoid confusion between the installations. After creating an installation directory, the next step is to download the version(s) of Paradyn that match your system.

You can obtain the Paradyn binary distribution from the Paradyn web site at `www.paradyn.org`, or by anonymous ftp from `grilled.cs.wisc.edu`, in the `paradyn` directory. This directory contains `README` and `LICENSE` files, as well as the archive files containing the Paradyn binaries named according to their platform. The archive files are `tar` archives, compressed using the `gzip` utility.[1] (E.g., `solaris_sparc_3.3.tar.gz` is the Paradyn 3.3 binary distribution for SPARC Solaris, archived by `tar` and then compressed with `gzip`.) The archives also contain several Paradyn test applications and the headers needed to build or interface your own tools to various Paradyn libraries.

The ftp directory contains several subdirectories. The `doc` directory contains gzip'd tar archives of the Paradyn manuals (including the ***Paradyn User's Guide*** and this document) in both PostScript and PDF formats[2]. The `etc` directory contains additional software Paradyn may require which may not be installed on your system. The `src` directory contains a gzip'd tar archive of the source code and Makefiles for building Paradyn. (For further information on the source code organization and contents, please refer to the ***Paradyn Developer's Guide***).

For example, to download the SPARC Solaris version of Paradyn and the entire set of Paradyn manuals in PDF format using ftp, the session might appear as follows:

```
% ftp grilled.cs.wisc.edu
Name: anonymous
331 Guest login ok, send your complete e-mail address as password.
ftp> binary
200 Type set to I.
ftp> cd paradyn
ftp> get solaris_sparc_3.3.tar.gz
ftp> cd doc
ftp> get PDF_manuals.tar.gz
ftp> quit
```

1. The `tar` utility is available on most UNIX systems. The `gzip` utility is available from the many web sites that distribute GNU sources. Windows NT users may obtain `tar` and `gzip` implementations as part of the Cygwin package, available at www.cygnus.com/cygwin.
2. PDF documents are designed for on-line reference and require the Acrobat reader (available for free for many platforms from Adobe at www.adobe.com), or a similar viewer that supports PDF such as a recent version of GhostView (*gv*).

2.2 Process distribution archive

Once you have obtained the appropriate archive for your platform (e.g., `sparc_solaris_3.3.tar.gz`) and any documents you desire (e.g., `users_guide.tar.gz`), you need to *unzip* and *untar* these files to extract Paradyn's executables, libraries, and other suport files. First, make sure you are in your installation directory. Then, perform commands similar to the following to unzip and untar the archives:

```
% gunzip -c sparc_solaris_3.3.tar.gz | tar xvf -
% gunzip -c PDF_manuals.tar.gz | tar xvf -
```

After executing these commands, your Paradyn installation directory should look similar to the one in Figure 2. (DyninstAPI components are indicated with italics in the figure.) Notice that the subdirectories *bin/sparc-sun-solaris2.7*, *lib/sparc-sun-solaris2.7*, *doc, include*, etc., have been created automatically by the `tar` command. A complete description of all the Paradyn files is given in Figure 3.

2.3 Install Tcl/Tk

The user interface of Paradyn is implemented using the Tcl and Tk packages, currently maintained by Scriptics Corporation. On all platforms, Paradyn needs to find several files from Tcl and Tk version 8.3.0 (8.3.3 for Windows) or later (within the 8.3.x line) in order to run. Furthermore, the executables included in the Paradyn binary distribution are built to use the Tcl and Tk libraries as shared objects.

The installation of Tcl/Tk for use with Paradyn involves two steps. The first step, discussed in this section, is to obtain the necessary files if you don't already have Tcl/Tk installed. The second step is to set environment variables which tell Paradyn where Tcl and Tk are installed, and is discussed in Section 2.4.

If you already have appropriate versions of Tcl/Tk installed on your system, then you simply need to determine where the packages were installed. (If you can't find the files, your system administrator should be able to tell you where they are located.) You are now ready to continue with the Paradyn installation and can skip to the next section.

You can obtain a binary Tcl/Tk distribution from `http://tcl.activestate.com`, and source distribution from `http://www.sourceforge.net`. If you do this, ensure that you build the Tcl and Tk libraries as shared objects and note where they are installed.

2.4 Set environment variables

To operate, Paradyn requires the following environment variables to be defined:

- `PARADYN_ROOT` - the directory containing the *paradyn.rc* configuration file
- `PLATFORM` – indicating the hardware/software platform (see Figure 5 for a list of current valid `PLATFORM` values)
- `PARADYN_LIB` - the full path to the Paradyn runtime dynamic instrumentation library

In addition, you must add the location of the Paradyn executables to your `PATH` environment variable, and the location of the Tcl and Tk shared object files to your `LD_LIBRARY_PATH`.

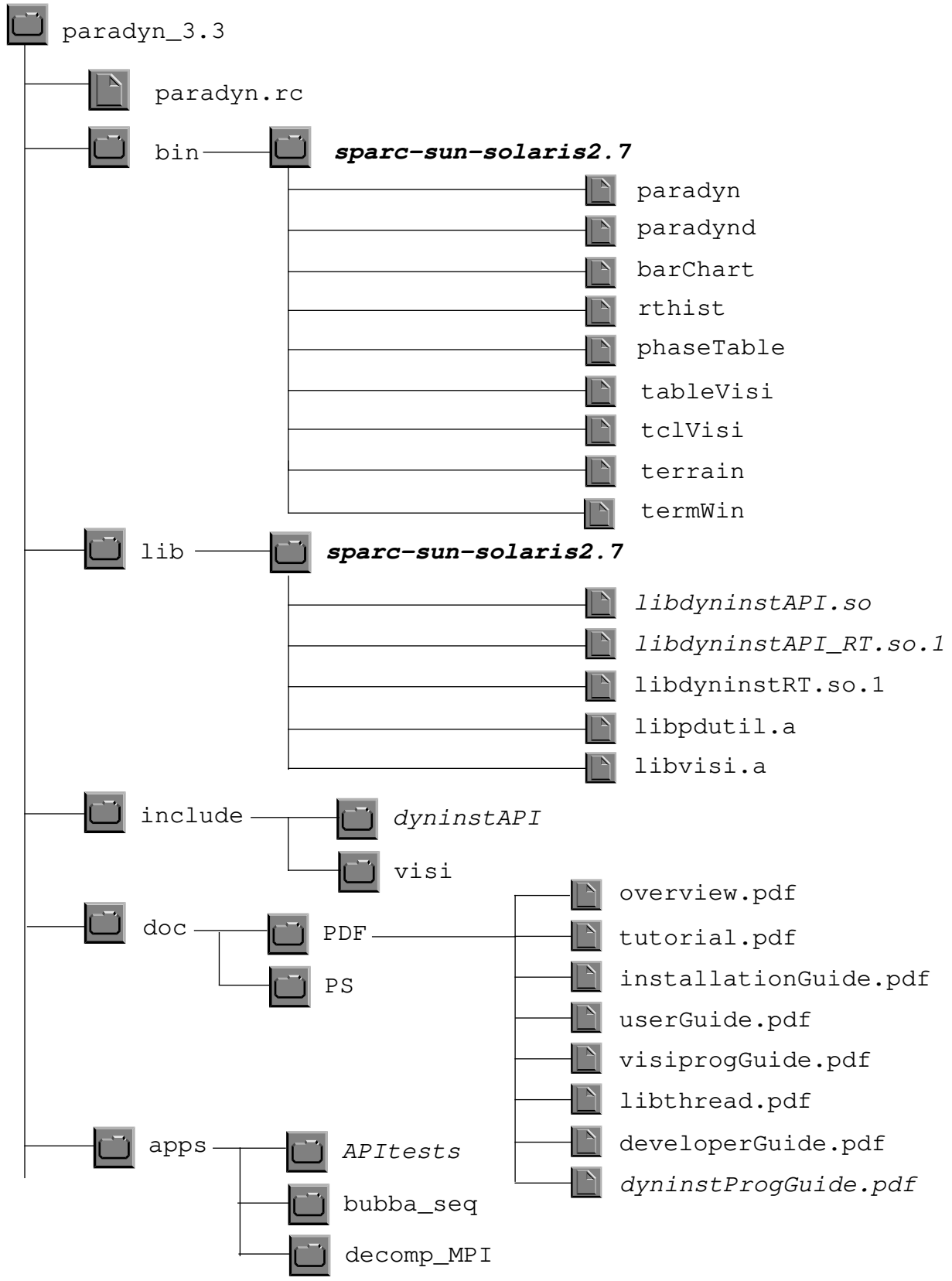

Figure 2: Paradyn directory structure (SPARC Solaris binary distribution example)

File	Description
`paradyn.rc`	Paradyn configuration file containing default definitions for performance metrics and visualizations.
`paradyn` `paradyn.exe`	Paradyn's user interface (or "*front-end*").
`paradynd` `paradynd.exe`	Paradyn's daemon: runs on every host or node where Paradyn is monitoring application processes.
`barChart` `barchart.exe`	*BarChart* visualizer.
`phaseTable` `phaseTable.exe`	*PhaseTable* visualizer.
`rthist` `rthist.exe`	*Runtime Histogram* visualizer.
`tableVisi` `tableVisi.exe`	*Statistics Table* visualizer.
`terrain`	*3D Terrain* visualizer. (*Not yet available on Windows NT*)
`libdyninstRT.so.1` `libdyninstRT.dll`	Paradyn's dynamically loaded run-time dynamic instrumentation library.

`libvisi.a`
`libvisi.lib`
`include/visi/*.h`
`tclVisi`
`tclVisi.exe`
	Library API and include files used to build Visis which interface with Paradyn, and a Tcl interface to allow use of Paradyn performance data in Tcl applications. For more information, refer to the ***VisiLib Programmer's Guide***.

`libdyninstAPI.so`
`libdyninstAPI.dll`
`libdyninstAPI_RT.so.1`
`libdyninstAPI_RT.dll`
`dyninstAPI/*.h`
	DyninstAPI libraries and include files distributed with Paradyn, but not needed when using Paradyn. For more information, refer to the ***DyninstAPI Programmer's Guide***.

`APItests`	DyninstAPI test programs (for all current platforms).
`bubba/bubba_pd`	Sample sequential application (for all current platforms).
`decomp/ssTwod`	Sample MPI application.

Figure 3: Files included in Paradyn binary distribution

Tcl/Tk generally can locate its initialization files from directories specified when it is built and installated: if this isn't the case, you may also need to define two additional environment variables, `TCL_LIBRARY` and `TK_LIBRARY` which specify the correct locations for the required initialization files (e.g., *init.tcl, tk.tcl*).

Figure 4 shows example commands to set the necessary environment variables as described

above. You may wish to add these commands to your shell configuration file (e.g., *.cshrc* if you are using *csh*) so the environment variables are set correctly each time you log on.

Operation: Script commands:

1. Setting `PARADYN_ROOT`, `PLATFORM` & `PARADYN_LIB` environment variables:

csh, tcsh:
```
setenv PARADYN_ROOT ~/paradyn
setenv PLATFORM sparc-sun-solaris2.7
setenv PARADYN_LIB $PARADYN_ROOT/lib/$PLATFORM/libdyninstRT.so.1
```

sh, bash, ksh:
```
PARADYN_ROOT=$HOME/paradyn
PLATFORM=sparc-sun-solaris2.7
PARADYN_LIB=$PARADYN_ROOT/lib/$PLATFORM/libdyninstRT.so.1
export PARADYN_ROOT PLATFORM PARADYN_LIB
```

2. Adding `paradyn` executables to your search path:

csh, tcsh:
```
set path=(~/paradyn/bin/sparc-sun-solaris2.7 $path)
```

sh, bash, ksh:
```
PATH=$HOME/paradyn/bin/sparc-sun-solaris2.7:$PATH
export PATH
```

3. Updating LD_LIBRARY_PATH to point to directory containing libtcl8.3.so and libtk8.3.so.

- For this example, the directory ~/tcl8.3.0/lib contains the tcl and tk libraries. This directory will be dependent on one's system configuration.

csh, tcsh:
```
setenv LD_LIBRARY_PATH ~/tcl8.3.0/lib:$LD_LIBRARY_PATH
```

sh, bash, ksh:
```
LD_LIBRARY_PATH=~/tcl8.3.0/lib:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH
```

Figure 4: Examples of shell and environment variable operations for common UNIX shells

System Identifier	Set PLATFORM variable to:
sparc-sun-solaris2.7	sparc-sun-solaris2.7
sparc-sun-solaris2.8	sparc-sun-solaris2.7
i386-unknown-linux2.2	i386-unknown-linux2.2
i386-unknown-linux2.4	i386-unknown-linux2.2
i386-unknown-nt4.0	i386-unknown-nt4.0
i386-unknown-w2k	i386-unknown-nt4.0
rs6000-ibm-aix4.3	rs6000-ibm-aix4.2

Figure 5: Platform variable for each system identifier

3 INSTALLING PARADYN FOR WINDOWS NT

Currently, the process for installing Paradyn on Windows NT is similar to that used on a UNIX system. (A Windows installer program is planned for a future release.) However, there are some significant differences which are detailed in this section.

Because the installation process is modelled after the UNIX installation process, several of the steps require you to issue commands rather than interact with the Windows GUI shell. A command prompt is accessible from the Start menu by selecting the "Command Prompt" item under the "Programs" submenu. Alternatively, you may wish to use a "UNIX on Windows" package such as Cygwin (`http://www.cygnus.com/cygwin`) to obtain a more UNIX-like command shell and set of utilities.

3.1 Prepare a Paradyn folder and obtain the distribution archive

As stated above, it is desirable to install each release of Paradyn into its own directory ("folder" in Windows parlance). Create a folder for Paradyn using the graphical shell, or by issuing an appropriate `mkdir` command from a command shell.

The process for obtaining the Paradyn binary distribution is the same for UNIX and Windows NT. See Section 2.1 for details on obtaining the distribution archive.

3.2 Process distribution archive

Like the UNIX binary distribution, the Paradyn binary distribution for Windows NT is a gzip'd tar archive. To extract the files in the archive, you must have access to an implementation of tar and gzip for Windows NT. One source for these utilities is the Cygwin package, available at (`http://www.cygnus.com/cygwin`).

To extract the Paradyn files from the archive, issue the following commands at a command prompt (we assume that the archive file is located in the Paradyn installation folder, and that that folder is named "`d:\Paradyn3.2`"):

```
d:
cd \Paradyn3.2
gunzip nt_x86_3.2.tar.gz
tar -xvf nt_x86_3.2.tar
```

The resulting directory tree structure will be similar to that shown in Figure 2.

3.3 Install Tcl/Tk

As on all UNIX platforms, Paradyn on Windows NT uses Tcl/Tk to implement its user interface. Because there is an installer program for Tcl/Tk on Windows, we suggest that you install Tcl/Tk by downloading the "official" Tcl/Tk binary distribution from `http://tcl.activestate.com`. (Note where you installed Tcl/Tk in case you need to know the location of its initialization files to set the `TCL_LIBRARY` and `TK_LIBRARY` environment variables).

3.4 Set environment variables

In general, the same environment variables needed to run Paradyn on a UNIX system are needed to run Paradyn under Windows NT. Since Windows NT uses the `PATH` environment variable to find dynamic link libraries, the `LD_LIBRARY_PATH` variable need not be defined.

Unlike the UNIX method of setting environment variables in a command shell initialization file (like *.cshrc*), you may set environment variables for Windows NT using the System control panel, accessible via the Settings item in the Start menu. In this control panel, select the Environment tabbed page. To update an existing variable (e.g., for updating the `PATH` variable), select the variable in the "User Variables" section of the dialog, update the value in the Value field, and click the Set button to apply your change. To add a new variable (e.g., for the `PARADYN_ROOT` variable), select *any* variable in the "User Variables" section of the dialog, change both the name and value of the variable in the Variable and Value fields, and click the Set button.

Note that changes made in to the environment are not visible to programs that are already running, so if you have a Command Prompt running when you add the Paradyn variables, they will not be set in the existing Command Prompt shell. They will be available, however, for Command Prompt shells created after the environment variable modifications are complete.

4 USING THE LINUX HRTIME KERNEL PATCH

Paradyn supports cycle-accurate virtual timers on x86 Linux systems when used with a kernel that includes the **hrtime** patch. This patch adds very low overhead access to high-resolution process virtual time and, optionally, high-resolution virtualized user and system time. In this section, we assume that the reader knows how to obtain, configure, and build a Linux kernel. If not, please see the Kernel-HOWTO file from the Linux Documentation Project, available at http://www.linux.org/docs. Also, users of Red Hat Linux (version 6.2) who do not wish to recompile their kernels may obtain kernel RPMS with hrtime support from http://www.paradyn.org/libhrtime.

The first step in compiling a kernel with high-resolution timer support is to obtain the hrtime patch distribution and the kernel sources on which the patch will be applied. Download the latest patch distribution from http://www.paradyn.org/libhrtime.

Next, apply the patch to the kernel source. For the purpose of this example, assume the patch will be applied to the sources for kernel version 2.2.17 in /usr/src/linux-2.2.17. Be sure that the symbolic link /usr/src/linux is pointing to the desired kernel source tree, in this case /usr/src/linux-2.2.17.

After the kernel source has been patched, configure the kernel, making sure to enable the following options:

- Prompt for development and/or incomplete code/drivers (`CONFIG_EXPERIMENTAL`)
- High-resolution process virtual time support (NEW) (`CONFIG_HRTIME`)
- High-resolution process utime/stime support (NEW) (`CONFIG_HRUSTIME`)

Finally, build and install the patched kernel. Paradyn will use the high-resolution timers whenever the system is booted into this patched kernel.

For more information on the hrtime kernel patch and **libhrtime** (a library interface to the functionality enabled by the hrtime patch), see http://www.paradyn.org/libhrtime.

5 AIX INSTALLATION NOTES

Paradyn uses a section of the target program's data space for its instrumentation. On the Power3 processor, and any other processor which has split data and instruction caches, changes made using ptrace() to a data space will not necessarily be executed correctly. This behavior causes Paradyn to appear to hang with the message "installing default inst..." before dying. To correct this problem, apply APAR IY03550 -- DBX CANNOT SET BREAK POINTS IN DATA SECTION.

Paradyn supports the IBM PMAPI performance library, available from *http://www.alphaworks.ibm.com/tech/pmapi*. To build Paradyn with PMAPI support, first download and install PMAPI from IBM. Then edit the top level make.config file in the Paradyn build directory and uncomment the USES_PERF_LIBRARY definition. The default Paradyn distribution does not include support for the PMAPI library.

6 COMMON INSTALLATION ERRORS

Figure 6 is a list of common installation errors, with a description of the error and its possible cause which may help you in case you have problems during the installation process. If you have any problem that does not appear on this list or if you have any comments, please send us a detailed message to `paradyn@cs.wisc.edu`.

Error	Description	Possible solution
paradyn: Command not found.	Cannot find or execute the `paradyn` executable.	Check the value of the `PATH` variable. The `paradyn` executable is not in your command search path.
tcl_init() failed.	Cannot start paradyn.	Tcl checks several locations to locate its initialization files, such as init.tcl - depending on your Tcl/Tk installation, you may need to define environment variables `TCL_LIBRARY` and `TK_LIBRARY`, pointing to the correct locations. Also, make sure that you have the required versions of Tcl and Tk installed. For more information, see Section 2.3. On UNIX systems, make sure you have the `DISPLAY` variable set, and that you have permission to use the X display (see the `xhost` man page for details).
paradyn: Exec format error. Wrong Architecture.	Cannot start paradyn.	You are perhaps trying to start Paradyn using the executables for a different architecture. Check that you have the binaries to match your platform.
paradyn: cannot create daemon process.	Cannot start paradynd.	`paradynd` may not be on your command search path or you may be using a `paradynd` executable for a different platform.
`PARADYN_LIB` has not been defined for process	Cannot access runtime instrumentation library `libdyninstRT`.	The `PARADYN_LIB` environment variable should contain the full path name of the library. The file must also be readable.
The dynamic library `oncrpc.dll` could not be found on the path.	Cannot start paradynd.	When running on Windows NT, the RPC library `oncrpc.dll` should be installed and locatable on the environment `PATH`.
visi processes not available.	There are no visi processes defined in Paradyn.	Check the value of `PARADYN_ROOT` and make sure that it is the directory containing the file `paradyn.rc`.

Figure 6: Common installation errors