OPARI 2
USER MANUAL
1.0.7-rc1 (revision 846)

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Contents

List of Figures

List of Tables

Chapter 1

Opari2

Opari2 is a tool to automatically instrument C, C++ and Fortran source code files in which OpenMP is used. Function calls to a POMP2 API are inserted around OpenMP directives. By implementing this API, detailed measurements regarding the runtime behavior of an OpenMP application can be made. A conforming POMP2 implementation needs to implement all POMP2 functions, see pomp2_lib.h for a list of those.

OpenMP 3.0 introduced tasking to OpenMP. To support this feature the POMP2 adapter needs to do some bookkeeping in regard to specific task IDs. The pomp2_lib.c provided with this package includes the necessary code so it is strongly advised to use it as a basis for writing an adapter to your own tool.

A detailed description of the first Opari version has been published by Mohr et al. in "Design and prototype of a performance tool interface for OpenMP" (Journal of supercomputing, 23, 2002).

1.1 INSTALLATION

Opari2 was developed with Autotools. After downloading and unpacking, change into your build directory and perform the following steps:

1. ./configure

   [--prefix=<*installation directory*>]

   [--with-compiler-suite=<*gcc*|*ibm*|*intel*|*pathscale*|*pgi*|*studio*>]

2. make

3. make install

See the file INSTALL for further information.

1.2 USAGE

To create an instrumented version of an OpenMP application, each file of interest is transformed by the OPARI2 tool. The application is then linked against the POMP2 runtime measurement library and optionally to a special initialization file (see section LINKING (startup initialization only) and SUMMARY for further details).

A call to Opari2 has the following syntax:

```
Usage: opari2 [OPTION] ... infile [outfile]

with following options and parameters:

[--f77|--f90|--c|--c++]  [OPTIONAL] Specifies the programming language
                         of the input source file. This option is only
                         necessary if the automatic language detection
                         based on the input file suffix fails.

[--nosrc]                [OPTIONAL] If specified, OPARI2 does not
                         generate #line constructs, which allow to
                         preserve the original source file and line
                         number information, in the transformation
                         process. This option might be necessary if
                         the OpenMP compiler does not understand #line
                         constructs.  The default is to generate #line
                         constructs.

[--nodecl]               [OPTIONAL] Disables the generation of
                         POMP2_DLISTXXXXX macros. These are used in the
                         parallel directives of the instrumentation to
                         make the region handles shared. By using this
                         option the shared clause is used directly on
                         the parallel directive with the resprective
                         region handles.

[--tpd]                  [OPTIONAL] Adds the clause 'copyin(<pomp_tpd>)'
                         to any parallel construct. This allows to
                         pass data from the creating thread to its
                         children. The variable is declared externally
                         in all files, so it needs to be defined by
                         the pomp library.

[--disable=<constructs>] [OPTIONAL] Disable the instrumentation of
                         manually-annotated POMP regions or the
                         more fine-grained OpenMP constructs such as
                         !$OMP ATOMIC. <constructs> is a comma
                         separated list of the constructs for which
                         the instrumentation should be disabled.
                         Accepted tokens are atomic, critical, master,
                         flush, single, ordered or locks (as well as
                         sync to disable all of them) or regions.

[--task=                 Special treatment for the task directive
      abort|warn|remove] abort:  Stop instrumentation with an error
                                 message when encountering a task
                                 directive.
                         warn:   Resume but print a warning.
                         remove: Remove all task directives.

[--untied=               Special treatment for the untied task attribute.
     abort|keep|no-warn] The default beavior is to remove the untied
```

```
                          attribute, thus making all tasks tied, and print
                          out a warning.
                          abort:   Stop instrumentation with an error
                                   message when encountering a task
                                   directive with the untied attribute.
                          keep:    Do not remove the untied attribute.
                          no-warn: Do not print out a warning.

[--tpd-mangling=          [OPTIONAL] If programming languages are mixed
 gnu|intel|sun|pgi|       (C and Fortran), the <pomp_tpd> needs to use
 ibm|cray]                the Fortran mangled name also in C files.
                          This option specifies to use the mangling
                          scheme of the gnu, intel, sun, pgi or ibm
                          compiler. The default is to use the mangling
                          scheme of the compiler used to build opari2.

[--version]               [OPTIONAL] Prints version information.

[--help]                  [OPTIONAL] Prints this help text.

infile                    Input file name.

[outfile]                 [OPTIONAL] Output file name. If not
                          specified, opari2 uses the name
                           infile.mod.suffix if the input file is
                          called infile.suffix.

Report bugs to <scorep-bugs@groups.tu-dresden.de>.
```

If you run Opari2 on the input file `example.c` it will create two files:

- `example.mod.c` is the instrumented version of `example.c`, i.e. it contains the original code plus calls to the POMP2 API referencing handles to the OpenMP regions identified by Opari2.
- `example.c.opari.inc` contains the OpenMP region handle definitions accompanied with all the relevant data needed by the handles. This compile time context (CTC) information is encoded into a string for maximum portability. For each region, the tuple (region_handle, ctc_string) is passed to an initializing function (POMP2_Assign_handle()). All calls to these initializing functions are gathered in a function named POMP2_Init_reg_XXX_YY, where XXX_YY is unique for each compilation unit.

At some point during the runtime of the instrumented application, the region handles need to be initialized using the information stored in the CTC string. This can be done in one of of two ways:

- during *startup* of the measurement/POMP2 system, or
- during *runtime* when a region handle is accessed for the first time.

We *highly* recommend using the first option as it incurs much less runtime overhead than the second one (no locking, no lookup needed). In this case all POMP2_Init_reg_XXX_YY functions introduced by opari2 need to be called. See LINKING (startup initialization only) for further details. For runtime initialization the ctc string as argument to the relevant POMP2 function calls is provided as an argument.

1.3 CTC string decoding

As mentioned above, we pass ctc strings to different POMP2 functions. These functions need to parse the string in order to process the encoded information. With POMP2_Region_info and ctcString2RegionInfo() the opari2 package provides means of doing this, see pomp2_region_info.h.

The CTC string is a string in the format "length∗key=value∗key=value∗[key=value]∗∗, for example:

∗*82*∗*regionType=parallel*∗*sscl=xmpl*.c:61:61∗escl=xmpl.c:66:66∗hasIf=1∗∗

Mandatory keys are:

- *regionType* Type of the region (here parallel)
- *sscl* First line of the region (usually with full path to file)
- *escl* Last line of the region

Optional keys are

- *hasNumThreads* Set if a numThreads clause is used in the OpenMP directive
- *hasIf* Set if an if clause is used
- *hasOrdered* Set if an ordered clause is used
- *hasReduction* Set if a reduction clause is used
- *hasSchedule* Set if a schedule clause is used
- *hasCollapse* Set if a collapse clause is used

The optional values are set to 0 by default, i.e. the presence of the key denotes the presence of the respective clause.

You can use the function ctcString2RegionInfo() to decode CTC strings. It can be found in pomp2_region_info.c and pomp2_region_info.h, installed under <opari-prefix>/share/opari2/devel.

1.4 LINKING (startup initialization only)

For startup initialization all POMP2_Init_reg_XXX_YY functions that can be found in the object files and libraries of the application are called. This is done by creating an additional compilation unit that contains calls to following POMP2 functions:

- POMP2_Init_region(),
- POMP2_Get_num_regions(), and
- POMP2_Get_opari2_version().

The resulting object file is linked to the application. During startup of the measurement system the only thing to be done is to call POMP2_Init_region() which then calls all POMP2_Init_reg_XXX_YY functions.

In order to create the additional compilation unit (for example `pomp2_init_file.c`) the following command sequence can be used:

```
% `opari2-config --nm` <objs_and_libs> |            \
  `opari2-config --egrep` -i "pomp2_init_reg" | \
  `opari2-config --egrep` " [TN] " |                \
  `opari2-config --awk-cmd` -f                      \
  `opari2-config --awk-script` > pomp2_init_file.c
```

Here, <objs_and_libs> denotes the entire set of object files and libraries that were instrumented by opari2.

Due to portability reasons `nm`, `egrep` and `awk` are not called directly but via the provided `opari2-config` tool.

1.5 POMP user instrumentation

For manual user instrumentation the following pragmas are provided.

C/C++:

```
#pragma pomp inst init
#pragma pomp inst begin(region_name)
#pragma pomp inst altend(region_name)
#pragma pomp inst end(region_name)
```

Fortran:

```
!$POMP INST INIT
!$POMP INST BEGIN(region_name)
!$POMP INST ALTEND(region_name)
!$POMP INST END(region_name)
```

Users can specify code regions, like functions for example, with `INST BEGIN` and `INST END`. If a region contains several exit points like return/break/exit/... all but the last need to be marked with `INST ALTEND` pragmas. The `INST INIT` pragma should be used for initialization in the beginning of main, if no other initialization method is used. See the EXAMPLE section for an example on how to use user instrumentation.

1.6 EXAMPLE

The directory <prefix>/share/opari2/doc/example contains the following files:

```
example.c
example.f
Makefile
```

The Makefile contains all required information for building the instrumented and uninstrumented binaries. It demonstrates the compilation and linking steps as described above.

Additional examples which illustrate the use of user instrumentation can be found in <prefix>/share/opari2/doc/example_user_instrumentation. The folder contains the following files:

```
example_user_instrumentation.c
example_user_instrumentation.f
Makefile
```

1.7 News

1.7.1 LINK STEP

Opari2 uses a new mechanism to link files. The main advantage is, that no opari.rc file is needed anymore. Libraries can now be preinstrumented and parallel builds are supported. To achieve this, the handles for parallel regions are instrumented using a ctc_string.

1.7.2 POMP2

The POMP2 interface is not compatible with the original POMP interface. All functions of the new API begin with POMP2_. The declaration prototypes can be found in pomp2_lib.h.

1.7.3 POMP2_Parallel_fork

The POMP2_Parallel_fork() call has an additional argument to pass the requested number of threads to the POMP2 library. This allows the library to prepare data structures and allocate memory for the threads before they are created. The value passed to the library is determined as follows:

- If a `num_threads` clause is present, the expression inside this clause is evaluated into a local variable `pomp_num_threads`. This variable is afterwards passed in the call to POMP2_Parallel_fork() and in the num_threads clause itself.
- If no num_threads clause is present, omp_get_max_threads() is used to determine the requested value for the next parallel region. This value is stored in `pomp_num_threads` and passed to the POMP2_Parallel_fork() call.

In Fortran, instead of omp_get_max_threads(), a wrapper function pomp_get_max_threads_XXX_X is used. This function is needed to avoid multiple definitions of omp_get_max_threads() since we do not know whether it is defined in the user code or not. Removing all definitions in the user code would require much more Fortran parsing than is done with opari2, since function definitions cannot easily be distinguished from variable definitions.

1.7.4 pomp_tpd

If it is necessary for the POMP2 library to pass information from the master thread to its children, the option `--tpd` can be used. Opari2 uses the copyin clause to pass a threadprivate variable `pomp_tpd` to the newly spawned threads at the beginning of a parallel region. This is a 64 bit integer variable, since Fortran does not allow pointers. However a pointer can be stored in this variable, passed to child threads with the copyin clause (in C/C++ or Fortran) and later on be cast back to a pointer in the pomp library.

To support mixed programming (C/Fortran) the variable name depends on the name mangling of the Fortran compiler. This means, for GNU, Sun, Intel and PGI C compilers the variable is called pomp_tpd_ and for IBM it is called pomp_tpd in C. In Fortran it is of course always called pomp_tpd. The --tpd-mangling option can be used to change this. The variable is declared extern in all program units, so the pomp library contains the actual variable declaration of pomp_tpd as a 64 bit integer.

1.7.5 Tasking construct

In *OpenMP 3.0* the new tasking construct was introduced. All parts of a program are now implicitly executed as tasks and the user gets the possibility of creating tasks that can be scheduled for asynchronous execution. Furthermore these tasks can be interrupted at certain scheduling points and resumed later on (see the OpenMP API 3.0 for more detailed information).

Opari2 instruments functions POMP2_Task_create_begin and POMP2_Task_create_-end to allow the recording of the task creation time. For the task execution time, the functions POMP2_Task_begin and POMP2_Task_end are instrumented in the code. To correctly record a profile or a trace of a program execution these different instances of tasks need to be differentiated. Since OpenMP does not provide Task ids, the performance measurement system needs to create and maintain own task ids. This cannot be done by code instrumentation as done by *Opari2* alone but requires some administration of task ids during runtime. To allow the measurement system to administrate these ids, additional task id parameters (pomp_old_task/pomp_new_task) were added to all functions belonging to OpenMP constructs which are task scheduling points. With this package there is a "dummy" library, which can be used as an adapter to your measurement system. This library contains all the relevant functionality to keep track of the different instances of tasks and it is highly recommended to use it as a template to implement your own adapter for your measurement system.

For more detailed information on this mechanism see:

"How to Reconcile Event-Based Performance Analysis with Tasking in OpenMP"

by Daniel Lorenz, Bernd Mohr, Christian Rössel, Dirk Schmidl, and Felix Wolf

In: Proc. of 6th Int. Workshop of OpenMP (IWOMP), LNCS, vol. 6132, pp. 109121

DOI: 10.1007/978-3-642-13217-9_9

1.8 SUMMARY

The typical usage of OPARI2 consists of the following steps:

1. Call OPARI2 for each input source file

```
% opari2 file1.f90
...
% opari2 fileN.f90
```

2. Compile all modified output files ∗.mod.∗ using the OpenMP compiler
3. Generate the initialization file

```
% `opari2-config --nm` file1.mod.o ... fileN.mod.o | \
  `opari2-config --egrep` -i "pomp2_init_reg" |  \
  `opari2-config --egrep` " [TD] " |                \
  `opari2-config --awk-cmd` -f                      \
  `opari2-config --awk-script` > pomp2_init_file.c
```

4. Link the resulting object files against the pomp2 runtime measurement library.

Appendices

Appendix A

OPARI2 INSTALL

```
For generic installation instructions see below.

Configuration of OPARI2
***********************

Optional Features:
  --disable-FEATURE       do not include FEATURE (same as --enable-FEATURE=no)
  --enable-FEATURE[=ARG]  include FEATURE [ARG=yes]
  --enable-silent-rules   less verbose build output (undo: `make V=1')
  --disable-silent-rules  verbose build output (undo: `make V=0')
  --disable-libtool-lock  avoid locking (might break parallel builds)
  --disable-openmp        do not use OpenMP
  --disable-option-checking      ignore unrecognized --enable/--with options
  --disable-dependency-tracking  speeds up one-time build
  --enable-dependency-tracking   do not reject slow dependency extractors
  --enable-shared[=PKGS]         build shared libraries [default=no]
  --enable-static[=PKGS]         build static libraries [default=yes]
  --enable-fast-install[=PKGS]   optimize for fast installation [default=yes]

Optional Packages:
  --with-PACKAGE[=ARG]    use PACKAGE [ARG=yes]
  --without-PACKAGE       do not use PACKAGE (same as --with-PACKAGE=no)
  --with-platform=(auto,disabled,<platform>)
                          autodetect platform [auto], disabled or select one
                          from: altix, aix, arm, bgl, bgp, bgq, crayxt, linux,
                          solaris, mac, necsx.
  --with-compiler-suite=(gcc|ibm|intel|pathscale|pgi|studio)
                          The compiler suite to build this package with. Needs
                          to be in $PATH [gcc].
  --with-pic              try to use only PIC/non-PIC objects [default=use
                          both]
  --with-gnu-ld           assume the C compiler uses GNU ld [default=no]
  --with-sysroot=DIR      Search for dependent libraries within DIR
                          (or the compiler's sysroot if not specified).

Some influential environment variables:
(note that the _FOR_BUILD variables take precedence, e.g. if you call
opari's configure from a top level configure in a cross-compile
environment that defines CC as well as CC_FOR_BUILD etc.)
  CC_FOR_BUILD
              C compiler command for the frontend build
  CXX_FOR_BUILD
```

```
              C++ compiler command for the frontend build
  F77_FOR_BUILD
              Fortran 77 compiler command for the frontend build
  FC_FOR_BUILD
              Fortran compiler command for the frontend build
  CPPFLAGS_FOR_BUILD
              (Objective) C/C++ preprocessor flags for the frontend build,
              e.g. -I<include dir> if you have headers in a nonstandard
              directory <include dir>
  CFLAGS_FOR_BUILD
              C compiler flags for the frontend build
  CXXFLAGS_FOR_BUILD
              C++ compiler flags for the frontend build
  FFLAGS_FOR_BUILD
              Fortran 77 compiler flags for the frontend build
  FCFLAGS_FOR_BUILD
              Fortran compiler flags for the frontend build
  LDFLAGS_FOR_BUILD
              linker flags for the frontend build, e.g. -L<lib dir> if you
              have libraries in a nonstandard directory <lib dir>
  LIBS_FOR_BUILD
              libraries to pass to the linker for the frontend build, e.g.
              -l<library>
  CC          C compiler command
  CFLAGS      C compiler flags
  LDFLAGS     linker flags, e.g. -L<lib dir> if you have libraries in a
              nonstandard directory <lib dir>
  LIBS        libraries to pass to the linker, e.g. -l<library>
  CPPFLAGS    (Objective) C/C++ preprocessor flags, e.g. -I<include dir> if
              you have headers in a nonstandard directory <include dir>
  CXX         C++ compiler command
  CXXFLAGS    C++ compiler flags
  F77         Fortran 77 compiler command
  FFLAGS      Fortran 77 compiler flags
  FC          Fortran compiler command
  FCFLAGS     Fortran compiler flags
  CPP         C preprocessor
  CXXCPP      C++ preprocessor

Use these variables to override the choices made by 'configure' or to help
it to find libraries and programs with nonstandard names/locations.

Please report bugs to <scorep-bugs@groups.tu-dresden.de>.


Installation Instructions
*************************

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2006, 2007, 2008, 2009 Free Software Foundation, Inc.

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are permitted in any medium without royalty provided the copyright
notice and this notice are preserved.  This file is offered as-is,
without warranty of any kind.

Basic Installation
==================

   Briefly, the shell commands './configure; make; make install' should
configure, build, and install this package.  The following
more-detailed instructions are generic; see the 'README' file for
```

instructions specific to this package. Some packages provide this
'INSTALL' file but do not implement all of the features documented
below. The lack of an optional feature in a given package is not
necessarily a bug. More recommendations for GNU packages can be found
in *note Makefile Conventions: (standards)Makefile Conventions.

   The 'configure' shell script attempts to guess correct values for
various system-dependent variables used during compilation. It uses
those values to create a 'Makefile' in each directory of the package.
It may also create one or more '.h' files containing system-dependent
definitions. Finally, it creates a shell script 'config.status' that
you can run in the future to recreate the current configuration, and a
file 'config.log' containing compiler output (useful mainly for
debugging 'configure').

   It can also use an optional file (typically called 'config.cache'
and enabled with '--cache-file=config.cache' or simply '-C') that saves
the results of its tests to speed up reconfiguring. Caching is
disabled by default to prevent problems with accidental use of stale
cache files.

   If you need to do unusual things to compile the package, please try
to figure out how 'configure' could check whether to do them, and mail
diffs or instructions to the address given in the 'README' so they can
be considered for the next release. If you are using the cache, and at
some point 'config.cache' contains results you don't want to keep, you
may remove or edit it.

   The file 'configure.ac' (or 'configure.in') is used to create
'configure' by a program called 'autoconf'. You need 'configure.ac' if
you want to change it or regenerate 'configure' using a newer version
of 'autoconf'.

   The simplest way to compile this package is:

  1. 'cd' to the directory containing the package's source code and type
     './configure' to configure the package for your system.

     Running 'configure' might take a while. While running, it prints
     some messages telling which features it is checking for.

  2. Type 'make' to compile the package.

  3. Optionally, type 'make check' to run any self-tests that come with
     the package, generally using the just-built uninstalled binaries.

  4. Type 'make install' to install the programs and any data files and
     documentation. When installing into a prefix owned by root, it is
     recommended that the package be configured and built as a regular
     user, and only the 'make install' phase executed with root
     privileges.

  5. Optionally, type 'make installcheck' to repeat any self-tests, but
     this time using the binaries in their final installed location.
     This target does not install anything. Running this target as a
     regular user, particularly if the prior 'make install' required
     root privileges, verifies that the installation completed
     correctly.

  6. You can remove the program binaries and object files from the
     source code directory by typing 'make clean'. To also remove the
     files that 'configure' created (so you can compile the package for

```
     a different kind of computer), type ‘make distclean’.  There is
     also a ‘make maintainer-clean’ target, but that is intended mainly
     for the package’s developers.  If you use it, you may have to get
     all sorts of other programs in order to regenerate files that came
     with the distribution.

  7. Often, you can also type ‘make uninstall’ to remove the installed
     files again.  In practice, not all packages have tested that
     uninstallation works correctly, even though it is required by the
     GNU Coding Standards.

  8. Some packages, particularly those that use Automake, provide ‘make
     distcheck’, which can by used by developers to test that all other
     targets like ‘make install’ and ‘make uninstall’ work correctly.
     This target is generally not run by end users.

Compilers and Options
=====================

   Some systems require unusual options for compilation or linking that
the ‘configure’ script does not know about.  Run ‘./configure --help’
for details on some of the pertinent environment variables.

   You can give ‘configure’ initial values for configuration parameters
by setting variables in the command line or in the environment.  Here
is an example:

     ./configure CC=c99 CFLAGS=-g LIBS=-lposix

   *Note Defining Variables::, for more details.

Compiling For Multiple Architectures
====================================

   You can compile the package for more than one kind of computer at the
same time, by placing the object files for each architecture in their
own directory.  To do this, you can use GNU ‘make’.  ‘cd’ to the
directory where you want the object files and executables to go and run
the ‘configure’ script.  ‘configure’ automatically checks for the
source code in the directory that ‘configure’ is in and in ‘..’.  This
is known as a "VPATH" build.

   With a non-GNU ‘make’, it is safer to compile the package for one
architecture at a time in the source code directory.  After you have
installed the package for one architecture, use ‘make distclean’ before
reconfiguring for another architecture.

   On MacOS X 10.5 and later systems, you can create libraries and
executables that work on multiple system types--known as "fat" or
"universal" binaries--by specifying multiple ‘-arch’ options to the
compiler but only a single ‘-arch’ option to the preprocessor.  Like
this:

     ./configure CC="gcc -arch i386 -arch x86_64 -arch ppc -arch ppc64" \
                 CXX="g++ -arch i386 -arch x86_64 -arch ppc -arch ppc64" \
                 CPP="gcc -E" CXXCPP="g++ -E"

   This is not guaranteed to produce working output in all cases, you
may have to build one architecture at a time and combine the results
using the ‘lipo’ tool if you have problems.

Installation Names
```

==========

By default, 'make install' installs the package's commands under '/usr/local/bin', include files under '/usr/local/include', etc. You can specify an installation prefix other than '/usr/local' by giving 'configure' the option '--prefix=PREFIX', where PREFIX must be an absolute file name.

You can specify separate installation prefixes for architecture-specific files and architecture-independent files. If you pass the option '--exec-prefix=PREFIX' to 'configure', the package uses PREFIX as the prefix for installing programs and libraries. Documentation and other data files still use the regular prefix.

In addition, if you use an unusual directory layout you can give options like '--bindir=DIR' to specify different values for particular kinds of files. Run 'configure --help' for a list of the directories you can set and what kinds of files go in them. In general, the default for these options is expressed in terms of '${prefix}', so that specifying just '--prefix' will affect all of the other directory specifications that were not explicitly provided.

The most portable way to affect installation locations is to pass the correct locations to 'configure'; however, many packages provide one or both of the following shortcuts of passing variable assignments to the 'make install' command line to change installation locations without having to reconfigure or recompile.

The first method involves providing an override variable for each affected directory. For example, 'make install prefix=/alternate/directory' will choose an alternate location for all directory configuration variables that were expressed in terms of '${prefix}'. Any directories that were specified during 'configure', but not in terms of '${prefix}', must each be overridden at install time for the entire installation to be relocated. The approach of makefile variable overrides for each directory variable is required by the GNU Coding Standards, and ideally causes no recompilation. However, some platforms have known limitations with the semantics of shared libraries that end up requiring recompilation when using this method, particularly noticeable in packages that use GNU Libtool.

The second method involves providing the 'DESTDIR' variable. For example, 'make install DESTDIR=/alternate/directory' will prepend '/alternate/directory' before all installation names. The approach of 'DESTDIR' overrides is not required by the GNU Coding Standards, and does not work on platforms that have drive letters. On the other hand, it does better at avoiding recompilation issues, and works well even when some directory options were not specified in terms of '${prefix}' at 'configure' time.

Optional Features
==========

If the package supports it, you can cause programs to be installed with an extra prefix or suffix on their names by giving 'configure' the option '--program-prefix=PREFIX' or '--program-suffix=SUFFIX'.

Some packages pay attention to '--enable-FEATURE' options to 'configure', where FEATURE indicates an optional part of the package. They may also pay attention to '--with-PACKAGE' options, where PACKAGE is something like 'gnu-as' or 'x' (for the X Window System). The 'README' should mention any '--enable-' and '--with-' options that the

```
package recognizes.

   For packages that use the X Window System, `configure' can usually
find the X include and library files automatically, but if it doesn't,
you can use the `configure' options `--x-includes=DIR' and
`--x-libraries=DIR' to specify their locations.

   Some packages offer the ability to configure how verbose the
execution of `make' will be.  For these packages, running `./configure
--enable-silent-rules' sets the default to minimal output, which can be
overridden with `make V=1'; while running `./configure
--disable-silent-rules' sets the default to verbose, which can be
overridden with `make V=0'.

Particular systems
==================

   On HP-UX, the default C compiler is not ANSI C compatible.  If GNU
CC is not installed, it is recommended to use the following options in
order to use an ANSI C compiler:

     ./configure CC="cc -Ae -D_XOPEN_SOURCE=500"

and if that doesn't work, install pre-built binaries of GCC for HP-UX.

   On OSF/1 a.k.a. Tru64, some versions of the default C compiler cannot
parse its `<wchar.h>' header file.  The option `-nodtk' can be used as
a workaround.  If GNU CC is not installed, it is therefore recommended
to try

     ./configure CC="cc"

and if that doesn't work, try

     ./configure CC="cc -nodtk"

   On Solaris, don't put `/usr/ucb' early in your `PATH'.  This
directory contains several dysfunctional programs; working variants of
these programs are available in `/usr/bin'.  So, if you need `/usr/ucb'
in your `PATH', put it _after_ `/usr/bin'.

   On Haiku, software installed for all users goes in `/boot/common',
not `/usr/local'.  It is recommended to use the following options:

     ./configure --prefix=/boot/common

Specifying the System Type
==========================

   There may be some features `configure' cannot figure out
automatically, but needs to determine by the type of machine the package
will run on.  Usually, assuming the package is built to be run on the
_same_ architectures, `configure' can figure that out, but if it prints
a message saying it cannot guess the machine type, give it the
`--build=TYPE' option.  TYPE can either be a short name for the system
type, such as `sun4', or a canonical name which has the form:

     CPU-COMPANY-SYSTEM

where SYSTEM can have one of these forms:

     OS
```

```
     KERNEL-OS

   See the file 'config.sub' for the possible values of each field.  If
'config.sub' isn't included in this package, then this package doesn't
need to know the machine type.

   If you are _building_ compiler tools for cross-compiling, you should
use the option '--target=TYPE' to select the type of system they will
produce code for.

   If you want to _use_ a cross compiler, that generates code for a
platform different from the build platform, you should specify the
"host" platform (i.e., that on which the generated programs will
eventually be run) with '--host=TYPE'.

Sharing Defaults
================

   If you want to set default values for 'configure' scripts to share,
you can create a site shell script called 'config.site' that gives
default values for variables like 'CC', 'cache_file', and 'prefix'.
'configure' looks for 'PREFIX/share/config.site' if it exists, then
'PREFIX/etc/config.site' if it exists.  Or, you can set the
'CONFIG_SITE' environment variable to the location of the site script.
A warning: not all 'configure' scripts look for a site script.

Defining Variables
==================

   Variables not defined in a site shell script can be set in the
environment passed to 'configure'.  However, some packages may run
configure again during the build, and the customized values of these
variables may be lost.  In order to avoid this problem, you should set
them in the 'configure' command line, using 'VAR=value'.  For example:

     ./configure CC=/usr/local2/bin/gcc

causes the specified 'gcc' to be used as the C compiler (unless it is
overridden in the site shell script).

Unfortunately, this technique does not work for 'CONFIG_SHELL' due to
an Autoconf bug.  Until the bug is fixed you can use this workaround:

     CONFIG_SHELL=/bin/bash /bin/bash ./configure CONFIG_SHELL=/bin/bash

'configure' Invocation
======================

   'configure' recognizes the following options to control how it
operates.

'--help'
'-h'
     Print a summary of all of the options to 'configure', and exit.

'--help=short'
'--help=recursive'
     Print a summary of the options unique to this package's
     'configure', and exit.  The 'short' variant lists options used
     only in the top level, while the 'recursive' variant lists options
     also present in any nested packages.
```

```
‘--version’
‘-V’
     Print the version of Autoconf used to generate the ‘configure’
     script, and exit.

‘--cache-file=FILE’
     Enable the cache: use and save the results of the tests in FILE,
     traditionally ‘config.cache’.  FILE defaults to ‘/dev/null’ to
     disable caching.

‘--config-cache’
‘-C’
     Alias for ‘--cache-file=config.cache’.

‘--quiet’
‘--silent’
‘-q’
     Do not print messages saying which checks are being made.  To
     suppress all normal output, redirect it to ‘/dev/null’ (any error
     messages will still be shown).

‘--srcdir=DIR’
     Look for the package’s source code in directory DIR.  Usually
     ‘configure’ can determine that directory automatically.

‘--prefix=DIR’
     Use DIR as the installation prefix.  *note Installation Names::
     for more details, including other options available for fine-tuning
     the installation locations.

‘--no-create’
‘-n’
     Run the configure checks, but stop before creating any output
     files.

‘configure’ also accepts some other, not widely useful, options.  Run
‘configure --help’ for more details.
```

Appendix B

Data Structure Documentation

B.1 POMP2_Region_info Struct Reference

This struct stores all information on an OpenMP region, like the region type or corresponding source lines. The function ctcString2RegionInfo() can be used to fill this struct with data from a ctcString.

`#include <pomp2_region_info.h>`

Data Fields

Required attributes

- POMP2_Region_type mRegionType
- char * mStartFileName
- unsigned mStartLine1
- unsigned mStartLine2
- char * mEndFileName
- unsigned mEndLine1
- unsigned mEndLine2

Currently not provided by opari

- bool mHasCopyIn
- bool mHasCopyPrivate
- bool mHasIf
- bool mHasFirstPrivate
- bool mHasLastPrivate
- bool mHasNoWait
- bool mHasNumThreads
- bool mHasOrdered
- bool mHasReduction
- bool mHasCollapse
- bool mHasUntied
- POMP2_Schedule_type mScheduleType

- char * mUserGroupName

Attributes for specific region types

- unsigned mNumSections
- char * mCriticalName
- char * mUserRegionName

B.1.1 Detailed Description

This struct stores all information on an OpenMP region, like the region type or corresponding source lines. The function ctcString2RegionInfo() can be used to fill this struct with data from a ctcString.

B.1.2 Field Documentation

B.1.2.1 char* POMP2_Region_info::mCriticalName

name of a named critical region

B.1.2.2 char* POMP2_Region_info::mEndFileName

name of the corresponding source file from the closing pragma

B.1.2.3 unsigned POMP2_Region_info::mEndLine1

line number of the first line from the closing pragma

B.1.2.4 unsigned POMP2_Region_info::mEndLine2

line number of the last line from the closing pragma

B.1.2.5 bool POMP2_Region_info::mHasCollapse

true if a collapse clause is present

B.1.2.6 bool POMP2_Region_info::mHasCopyIn

true if a copyin clause is present

B.1.2.7 bool POMP2_Region_info::mHasCopyPrivate

true if a copyprivate clause is present

B.1.2.8 bool POMP2_Region_info::mHasFirstPrivate

true if a firstprivate clause is present

B.1.2.9 bool POMP2_Region_info::mHasIf

true if an if clause is present

B.1.2.10 bool POMP2_Region_info::mHasLastPrivate

true if a lastprivate clause is present

B.1.2.11 bool POMP2_Region_info::mHasNoWait

true if a nowait clause is present

B.1.2.12 bool POMP2_Region_info::mHasNumThreads

true if a numThreads clause is present

B.1.2.13 bool POMP2_Region_info::mHasOrdered

true if an ordered clause is present

B.1.2.14 bool POMP2_Region_info::mHasReduction

true if a reduction clause is present

B.1.2.15 bool POMP2_Region_info::mHasUntied

true if a untied clause was present, even if the task was changed to tied during instrumentation.

B.1.2.16 unsigned POMP2_Region_info::mNumSections

number of sections

B.1.2.17 POMP2_Region_type POMP2_Region_info::mRegionType

type of the OpenMP region

B.1.2.18 POMP2_Schedule_type POMP2_Region_info::mScheduleType

schedule type in the schedule clause

B.1.2.19 char* POMP2_Region_info::mStartFileName

name of the corresponding source file from the opening pragma

B.1.2.20 unsigned POMP2_Region_info::mStartLine1

line number of the first line from the opening pragma

B.1.2.21 unsigned POMP2_Region_info::mStartLine2

line number of the last line from the opening pragma

B.1.2.22 char* POMP2_Region_info::mUserGroupName

user group name

B.1.2.23 char* POMP2_Region_info::mUserRegionName

name of a user defined region

The documentation for this struct was generated from the following file:

- pomp2_region_info.h

Appendix C

File Documentation

C.1 pomp2_lib.h File Reference

This file contains the declarations of all POMP2 functions.

```
#include <stddef.h>
#include <stdint.h>
```

Typedefs

- typedef void * POMP2_Region_handle

Functions

- void POMP2_Assign_handle (POMP2_Region_handle *pomp2_handle, const char ctc_string[])
- void POMP2_Begin (POMP2_Region_handle *pomp2_handle)
- void POMP2_End (POMP2_Region_handle *pomp2_handle)
- void POMP2_Finalize ()
- POMP2_Task_handle POMP2_Get_new_task_handle ()
- void POMP2_Init ()
- void POMP2_Off ()
- void POMP2_On ()

Functions generated by the instrumenter

- size_t POMP2_Get_num_regions ()
- void POMP2_Init_regions ()
- const char * POMP2_Get_opari2_version ()

C.1.1 Detailed Description

This file contains the declarations of all POMP2 functions. alpha

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C.1.2 Typedef Documentation

C.1.2.1 typedef void* POMP2_Region_handle

Handles to identify OpenMP regions.

C.1.3 Function Documentation

C.1.3.1 void POMP2_Assign_handle (POMP2_Region_handle * *pomp2_handle*, const char *ctc_string[]*)

Registers a POMP2 region and returns a region handle.

Parameters

pomp2_handle	Returns the handle for the newly registered region.
ctc_string	A string containing the region data.

C.1.3.2 void POMP2_Begin (POMP2_Region_handle * *pomp2_handle*)

Called at the begin of a user defined POMP2 region.

Parameters

pomp2_handle	The handle of the started region.

C.1.3.3 void POMP2_End (POMP2_Region_handle * *pomp2_handle*)

Called at the begin of a user defined POMP2 region.

Parameters

pomp2_handle	The handle of the started region.

C.1.3.4 void POMP2_Finalize ( )

Finalizes the POMP2 adapter. It is inserted at the #pragma pomp inst end.

C.1.3.5 POMP2_Task_handle POMP2_Get_new_task_handle ( )

Function that returns a new task handle.

Returns

new task handle

C.1.3.6 size_t POMP2_Get_num_regions ( )

Returns the number of instrumented regions.

The instrumenter scans all opari-created include files with nm and greps the POMP2_-INIT_uuid_numRegions() function calls. Here we return the sum of all numRegions.

Returns

number of instrumented regions

C.1.3.7 const char* POMP2_Get_opari2_version ( )

Returns the opari version.

Returns

version string

C.1.3.8 void POMP2_Init ( )

Initializes the POMP2 adapter. It is inserted at the #pragma pomp inst begin.

C.1.3.9 void POMP2_Init_regions ( )

Init all opari-created regions.

The instrumentor scans all opari-created include files with nm and greps the POMP2_-INIT_uuid_numRegions() function calls. The instrumentor then defines these functions by calling all grepped functions.

C.1.3.10 void POMP2_Off ( )

Disables the POMP2 adapter.

C.1.3.11 void POMP2_On ( )

Enables the POMP2 adapter.

C.2 pomp2_region_info.h File Reference

This file contains function declarations and structs which handle informations on OpenMP regions. POMP2_Region_info is used to store these informations. It can be filled with a ctcString by ctcString2RegionInfo().

```
#include <stdbool.h>
```

Data Structures

- struct POMP2_Region_info

  This struct stores all information on an OpenMP region, like the region type or corresponding source lines. The function ctcString2RegionInfo() can be used to fill this struct with data from a ctcString.

Enumerations

- enum POMP2_Region_type
- enum POMP2_Schedule_type

Functions

- void ctcString2RegionInfo (const char ctcString[ ], POMP2_Region_info *regionInfo)
- void freePOMP2RegionInfoMembers (POMP2_Region_info *regionInfo)
- const char * pomp2RegionType2String (POMP2_Region_type regionType)
- const char * pomp2ScheduleType2String (POMP2_Schedule_type scheduleType)

C.2.1 Detailed Description

This file contains function declarations and structs which handle informations on OpenMP regions. POMP2_Region_info is used to store these informations. It can be filled with a ctcString by ctcString2RegionInfo().

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Date

Started Fri Mar 20 16:30:45 2009

C.2.2 Enumeration Type Documentation

C.2.2.1 enum POMP2_Region_type

POMP2_Region_type

C.2.2.2 enum POMP2_Schedule_type

type to store the scheduling type of a for worksharing constuct

C.2.3 Function Documentation

C.2.3.1 void ctcString2RegionInfo (const char *ctcString[]*, POMP2_Region_info * *regionInfo*)

ctcString2RegionInfo() fills the POMP2_Region_info object with data read from the ctcString. If the ctcString does not comply with the specification, the program aborts with exit code 1.

Rationale: ctcString2RegionInfo() is used during initialization of the measurement system. If an error occurs, it is better to abort than to struggle with undefined behaviour or *guessing* the meaning of the broken string.

Note

Can be called from multiple threads concurrently, assuming malloc is thread-safe. ctcString2RegionInfo() will assign memory to the members of *regionInfo*. You are supposed to to release this memory by calling freePOMP2RegionInfoMembers().

Parameters

ctcString	A string in the format "length∗key=value∗[key=value]∗". The length field is parsed but not used by this implementation. Possible values for key are listed in ctcTokenMap. The string must at least contain values for the keys `regionType`, `sscl` and `escl`. Possible values for the key `regionType` are listed in regionTypesMap. The format for `sscl` resp. `escl` values is `"filename:lineNo1:lineNo2"`.
regionInfo	must be a valid object

Postcondition

At least the required attributes (see POMP2_Region_info) are set.
All other members of *regionInfo* are set to 0 resp. false resp. POMP2_No_schedule.
If `regionType=sections` than POMP2_Region_info::mNumSections has a value > 0.
If `regionType=region` than POMP2_Region_info::mUserRegionName has a value != 0.
If `regionType=critical` than POMP2_Region_info::mCriticalName may have a value != 0.

C.2.3.2 void freePOMP2RegionInfoMembers (POMP2_Region_info * *regionInfo*)

Free the memory of the regionInfo members.

Parameters

regionInfo	The regioninfo to be freed.

C.2.3.3 const char* pomp2RegionType2String (POMP2_Region_type *regionType*)

converts regionType into a string

Parameters

regionType	The regionType to be converted.

Returns

string representation of the region type

C.2.3.4 const char* pomp2ScheduleType2String (POMP2_Schedule_type *scheduleType*)

converts scheduleType into a string

Parameters

schedule-Type	The scheduleType to be converted.

Returns

string representation of the scheduleType

Index