MA060–012–00–00
Doc. ver.: 1.45

TriCore v1.5

C++ COMPILER USER'S GUIDE

TASKING

A publication of

Altium BV

Documentation Department

http://www.tasking.com
http://www.altium.com

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MANUAL PURPOSE AND STRUCTURE

PURPOSE

This manual is aimed at users of the TASKING TriCore C++ Compiler. It assumes that you are conversant with the C and C++ language.

MANUAL STRUCTURE

Related Publications
Conventions Used In This Manual

1. Software Installation
   Describes the installation of the C++ Cross–Compiler for the TriCore family of processors.

2. Overview
   Provides an overview of the TriCore toolchain and gives you some familiarity with the different parts of it and their relationship. A sample session explains how to build an application from your C++ file.

3. Language Implementation
   Concentrates on the approach of the TriCore architecture and describes the language implementation. The C++ language itself is not described in this document.

4. Compiler Use
   Deals with invocation, command line options and pragmas.

5. Compiler Diagnostics
   Describes the exit status and error/warning messages of the C++ compiler.

APPENDICES

A. Flexible License Manager (FLEXlm)
   Contains a description of the Flexible License Manager.

B. Error Messages
   Contains an overview of the error messages.

C. Utitily Programs
Contains a description of the prelinker and the muncher which are delivered with the C++ compiler package.

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RELATED PUBLICATIONS

- The C++ Programming Language (second edition)
  by Bjarne Straustrup (1991, Addison Wesley)
- ISO/IEC 14882:1998 C++ standard [ANSI]
  More information on the standards can be found at
  `http://www.ansi.org`
- The Annotated C++ Reference Manual
  by Margaret A. Ellis and Bjarne Straustrup (1990, Addison Wesley)
- The C Programming Language (second edition)
  by B. Kernighan and D. Ritchie (1988, Prentice Hall)
- ANSI X3.159–1989 standard [ANSI]
- TriCore C Cross–Compiler User's Guide [TASKING, MA060–002–00–00]
- TriCore Cross–Assembler, Linker/Locator, Utilities User's Guide
  [TASKING, MA060–000–00–00]
- TriCore CrossView Pro Debugger User's Guide [TASKING,
  MA06–043–00–00]

CONVENTIONS USED IN THIS MANUAL

The notation used to describe the format of call lines is given below:

{ }	Items shown inside curly braces enclose a list from which you must choose an item.
[ ]	Items shown inside square brackets enclose items that are optional.
|	The vertical bar separates items in a list. It can be read as OR.
italics	Items shown in italic letters mean that you have to substitute the item. If italic items are inside square brackets, they are optional. For example: *filename* means: type the name of your file in place of the word *filename*.
...	An ellipsis indicates that you can repeat the preceding item zero or more times.
`screen font`	Represents input examples and screen output examples.
bold font	Represents a command name, an option or a complete command line which you can enter.

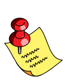
For example

```
command [option]... filename
```

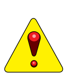
This line could be written in plain English as: execute the command *command* with the optional options *option* and with the file *filename*.

Illustrations

The following illustrations are used in this manual:



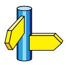
This is a note. It gives you extra information.



This is a warning. Read the information carefully.

 This illustration indicates actions you can perform with the mouse.

 This illustration indicates keyboard input.

 This illustration can be read as “See also”. It contains a reference to another command, option or section.

MANUAL STRUCTURE

CHAPTER

1

SOFTWARE INSTALLATION

TASKING

CHAPTER 1

1.1 INTRODUCTION

This chapter describes how you can install the TASKING C++ Compiler for the TriCore on Windows 95/98/NT/2000, Linux and several UNIX hosts.

1.2 INSTALLATION FOR WINDOWS

Step 1

Start Windows (95/98/NT/2000), if you have not already done so.

Step 2

Insert the CD–ROM into the CD–ROM drive.

If the TASKING Welcome dialog box appears, skip steps 3 and 4.

Step 3

Select the `Start` button and select the `Run...` menu item.

Step 4

On the command line type:

```
d:\setup
```

(substitute the correct drive letter for your CD–ROM drive) and press the **<Return>** or **<Enter>** key or click on the `OK` button.

The TASKING Welcome dialog box appears.

Step 5

Select a product and click on `Install`.

Step 6

Follow the instructions that appear on your screen.

You can find your serial number on the *Certificate of Authenticity* or *Product Update Form*, delivered with the product.

Step 7

License the software product as explained in section 1.5, *Licensing TASKING Products*.

1.2.1 SETTING THE ENVIRONMENT

After you have installed the software, you can set some environment variables to make invocation of the tools easier, when invoking the tools from a Windows Command Prompt. When you are using EDE all settings are configurable from within EDE. A list of all environment variables used by the toolchain is present in the section *nvironment ariables* in the chapter *verview*.

Make sure that your path is set to include all of the e ecutables you have just installed. If you installed the software under `C:\CTRI`, you can include the e ecutable directory `C:\CTRI\BIN` in your search path.

In EDE, select the `Project | Directories...` menu item. Add one or more e ecutable directory paths to the `Executable Files Path` field.

The environment variable TMPDIR can be used to specify a directory where programs can place temporary files. The C++ compiler uses the environment variable CPTRIINC to search for include files. An e ample of setting this variable is given below.

See also the section *nclude Files* in the chapter *ompiler se*.

Example Windows Command Prompt

Enter the following line when you use a Command Prompt window.

```
set CPTRIINC=c:\ctri\include
```

Example Windows 95/98

Add the following line to your `autoexec.bat` file.

```
set CPTRIINC=c:\ctri\include
```

Example Windows NT/2000

1. Open the `System Properties` dialog.

   ou can do this by double–clicking on the `System` icon in the Control Panel `Start | Settings | Control Panel` or right–click on the `My Computer` icon on your desktop and select `Properties`.

2. Select the `Environment` tab.

. In the `Variable` edit field enter:

CPTRIINC

4. In the `Value` edit field enter:

   `c:\ctri\include`

5. Click on the `Set` button, then click `OK`.

1.3 INSTALLATION FOR LINUX

Each product on the CD–ROM is available as an RPM package and as a gzipped tar file. For each product the following files are present:

SW*product–version–RPMrelease*.i386.rpm
SW*product–version*.tar.gz

Both files contain exactly the same information. When your Linux distribution supports RPM packages, you can install the `.rpm` file. Otherwise, you can install the product from the `.tar.gz` file.

1.3.1 RPM INSTALLATION

Step 1

In most situations you have to be ”root” to install RPM packages, so either login as ”root”, or use the **su** command.

Step 2

Insert the CD–ROM into the CD–ROM drive. Mount the CD–ROM on a directory, for example `/cdrom`. See the Linux manual pages about **mount** for details.

Step 3

Go to the directory on which the CD–ROM is mounted:

```
cd /cdrom
```

Step 4

To install or upgrade all products at once, issue the following command:

```
rpm –U SW*.rpm
```

This will install or upgrade all products in the default installation directory `/usr/local`. Every RPM package will create a single directory in the installation directory.

The RPM packages are 'relocatable', so it is possible to select a different installation directory with the **––prefix** option. For instance when you want to install the products in `/opt`, use the following command:

```
rpm –U ––prefix /opt SW*.rpm
```

For Red Hat 6.0 users: The **––prefix** option does not work with RPM version 3.0, included in the Red Hat 6.0 distribution. Please upgrade to RPM verion 3.0.3 or higher, or use the `.tar.gz` file installation described in the next section if you want to install in a non–standard directory.

1.3.2 TAR.GZ INSTALLATION

Step 1

Login as a user.

Be sure you have read, write and execute permissions in the installation directory. Otherwise, login as "root" or use the **su** command.

Step 2

Insert the CD–ROM into the CD–ROM drive. Mount the CD–ROM on a directory, for example `/cdrom`. See the Linux manual pages about **mount** for details.

Step 3

Go to the directory on which the CD–ROM is mounted:

```
cd /cdrom
```

Step 4

To install the products from the `.tar.gz` files in the directory `/usr/local`, issue the following command for each product:

`tar xzf SW`*`product–version`*`.tar.gz –C /usr/local`

Every `.tar.gz` file creates a single directory in the directory where it is extracted.

1.3.3 SETTING THE ENVIRONMENT

After you have installed the software, you can set some environment variables to make invocation of the tools easier. A list of all environment variables used by the toolchain is present in the section *Environment Variables* in the chapter *Overview*.

Make sure that your path is set to include all of the executables you have just installed.

The environment variable TMPDIR can be used to specify a directory where programs can place temporary files.

1.4 INSTALLATION FOR UNIX HOSTS

Step 1

Login as a user.

Be sure you have read, write and execute permissions in the installation directory. Otherwise, login as root or use the **su** command.

Step 2

If you are a first time user decide where you want to install the product (By default it will be installed in `/usr/local`).

Step 3

For CD–ROM install: insert the CD–ROM into the CD–ROM drive. Mount the CD–ROM on a directory, for example `/cdrom`. Be sure to use a ISO 9660 file system with Rock Ridge extensions enabled. See the UNIX manuals page about **mount** for details.

Or:

For tape install: insert the tape into the tape unit and create a directory where the contents of the tape can be copied to. Consider the created directory as a temporary workspace that can be deleted after installation has succeeded. For example:

```
mkdir /tmp/instdir
```

Step 4

For CD–ROM install: go to the directory on which the CD–ROM is mounted:

```
cd /cdrom
```

For tape install: copy the contents of the tape to the temporary workspace using the following commands:

```
cd /tmp/instdir
tar xvf /dev/tape
```

where *tape* is the name of your tape device.

If you have received a tape with more than one product, use the non–rewinding device for installing the products.

Step 5

Run the installation script:

```
sh install
```

and follow the instructions appearing on your screen.

First a question appears about where to install the software. The default answer is **/usr/local**. On certain sites you may want to select another location.

On some hosts the installation script asks if you want to install SW000098, the Flexible License Manager (FLEXlm). If you do not already have FLEXlm on your system, you must install it; otherwise the product will not work on those hosts. See section 1.5, *Licensing TASKING Products*.

If the script detects that the software has been installed before, the following messages appear on the screen:

```
       *** WARNING ***
SWxxxxxx xxxx.xxxx already installed.
Do you want to REINSTALL? [y,n]
```

Answering **n** (no) to this question causes installation to abort and the following message being displayed:

```
=> Installation stopped on user request <=
```

Answering **y** (yes) to this question causes installation to continue. And the final message will be:

```
Installation of SWxxxxxx xxxx.xxxx completed.
```

Step 6

For tape install: remove the temporary installation directory with the following commands:

```
cd /tmp
rm –rf instdir
```

Step 7

If you purchased a protected TASKING product, license the software product as explained in section 1.5, *Licensing TASKING Products*.

Step 8

Logout.

1.4.1 SETTING THE ENVIRONMENT

After you have installed the software, you can set some environment variables to make invocation of the tools easier. A list of all environment variables used by the toolchain is present in the section *Environment Variables* in the chapter *Overview*.

Make sure that your path is set to include all of the executables you have just installed.

The environment variable TMPDIR can be used to specify a directory where programs can place temporary files.

1.5 LICENSING TASKING PRODUCTS

TASKING products are protected with license management software (FLEXlm). To use a TASKING product, you must install the licensing information provided by TASKING for the type of license purchased.

You can run TASKING products with a node–locked license or with a floating license. When you order a TASKING product determine which type of license you need (UNIX products only have a floating license).

Node–locked license (PC only)

This license type locks the software to one specific PC so you can use the product on that particular PC only.

Floating license

This license type manages the use of TASKING product licenses among users at one site. This license type does not lock the software to one specific PC or workstation but it requires a network. The software can then be used on any computer in the network. The license specifies the number of users who can use the software simultaneously. A system allocating floating licenses is called a **license server**. A license manager running on the license server keeps track of the number of users.

See the *Flexible License Manager (FLEXlm)* appendix for detailed information on FLEXlm.

1.5.1 OBTAINING LICENSE INFORMATION

Before you can install a software license you must have a "License Information Form" containing the license information for your software product. If you have not received such a form follow the steps below to obtain one. Otherwise, you can install the license.

Node–locked license (PC only)

1. If you need a node–locked license, you must determine the hostid of the computer where you will be using the product. See section 1.5.7, *How to Determine the Hostid*.

2. When you order a TASKING product, provide the hostid to your local TASKING sales representative. The License Information Form which contains your license key information will be sent to you with the software product.

Floating license

1. If you need a floating license, you must determine the hostid and hostname of the computer where you want to use the license manager. Also decide how many users will be using the product. See section 1.5.7, *How to Determine the Hostid* and section 1.5.8, *How to Determine the Hostname*.

2. When you order a TASKING product, provide the hostid, hostname and number of users to your local TASKING sales representative. The License Information Form which contains your license key information will be sent to you with the software product.

1.5.2 INSTALLING NODE-LOCKED LICENSES

Keep your ”License Information Form” ready. If you do not have such a form read section 1.5.1, *Obtaining License Information*, before continuing.

Step 1

Install the TASKING software product following the installation procedure described in section 1.2, *Installation for Windows*.

Step 2

Create a file called ”`license.dat`” in the `c:\flexlm` directory, using an ASCII editor and insert the license information contained in the ”License Information Form” in this file. This file is called the ”license file”. If the directory `c:\flexlm` does not exist, create the directory.

If you wish to install the license file in a different directory, see section 1.5.6, *Modifying the License File Location*.

If you already have a license file, add the license information to the existing license file. If the license file already contains any SERVER lines, you must use another license file. See section 1.5.6, *Modifying the License File Location*, for additional information.

The software product and license file are now properly installed.

See the *Flexible License Manager (FLEXlm)* appendix for more information on FLEXlm.

1.5.3 INSTALLING FLOATING LICENSES

Keep your "License Information Form" ready. If you do not have such a form read section 1.5.1, *Obtaining License Information*, before continuing.

Step 1

Install the TASKING software product following the installation procedure described earlier in this chapter on the computer or workstation where you will use the software product.

As a result of this installation two additional files for FLEXlm will be present in the `flexlm` subdirectory of the toolchain:

`Tasking`	The Tasking daemon (vendor daemon).
`license.dat`	A template license file.

Step 2

If you already have installed FLEXlm v6.1 or higher for Windows or v2.4 or higher for UNIX (for example as part of another product) you can skip this step and continue with step 3. Otherwise, install SW000098, the Flexible License Manager (FLEXlm), on the license server where you want to use the license manager.

The installation of the license manager on Windows also sets up the license daemon to run automatically whenever a license server reboots. On UNIX you have to perform the steps as described in section 1.5.5, *Setting Up the License Deaemon to Run Automatically*.

It is not recommended to run a license manager on a Windows 95 or Windows 98 machine. Use Windows NT instead (or UNIX).

Step 3

If FLEXlm has already been installed as part of a non–TASKING product you have to make sure that the `bin` directory of the FLEXlm product contains a copy of the **Tasking** daemon (see step 1).

Step 4

Insert the license information contained in the "License Information Form" in the license file, which is being used by the license server. This file is usually called `license.dat`. The default location of the license file is in directory `c:\flexlm` for Windows and in `/usr/local/flexlm/licenses` for UNIX.

If you wish to install the license file in a different directory, see section 1.5.6, *Modifying the License File Location*.

If the license file does not exist, you have to create it using an ASCII editor. You can use the license file `license.dat` from the toolchain's `flexlm` subdirectory as a template.

If you already have a license file, add the license information to the existing license file. If the SERVER lines in the license file are the same as the SERVER lines in the License Information Form, you do not need to add this same information again. If the SERVER lines are not the same, you must use another license file. See section 1.5.6, *Modifying the License File Location*, for additional information.

Step 5

On each PC or workstation where you will use the TASKING software product the location of the license file must be known. If it differs from the default location (`c:\flexlm\license.dat` for Windows, `/usr/local/flexlm/licenses/license.dat` for UNIX), then you must set the environment variable **LM_LICENSE_FILE**. See section 1.5.6, *Modifying the License File Location*, for more information.

Step 6

Now all license infomation is entered, the license manager must be started (see section section 1.5.4). Or, if it is already running you must notify the license manager that the license file has changed by entering the command (located in the flexlm `bin` directory):

```
lmreread
```

On Windows you can also use the graphical FLEXlm Tools (**lmtools**): Start **lmtools** (if you have used the defaults this can be done by selecting `Start | Programs | TASKING FLEXlm | FLEXlm Tools`), fill in the current license file location if this field is empty, click on the `Reread` button and then on `OK`. Another option is to reboot your PC.

The software product and license file are now properly installed.

Where to go from here?

The license manager (daemon) must always be up and running. Read section 1.5.4 on how to start the daemon and read section 1.5.5 for information how to set up the license daemon to run automatically.

If the license manager is running, you can now start using the TASKING product.

See the *Flexible License Manager (FLEXlm)* appendix for detailed information on FLEXlm.

1.5.4 STARTING THE LICENSE DAEMON

The license manager (daemon) must always be up and running. To start the daemon complete the following steps on each license server:

Windows

1. Start the license manager tool by (`Start | Programs | TASKING FLEXlm | FLEXlm License Manager`).
2. In the `Control` tab, click on the `Start` button.
3. Close the program by clicking on the `OK` button.

UNIX

1. Log in as the operating system administrator (usually root).
2. Change to the FLEXlm installation directory (default `/usr/local/flexlm`):

   ```
   cd /usr/local/flexlm
   ```

3. For C shell users, start the license daemon by typing the following:

   ```
   bin/lmgrd -2 -p -c licenses/license.dat >>& \
      /var/tmp/license.log &
   ```

Or, for Bourne shell users, start the license daemon by typing the following:

```
bin/lmgrd -2 -p -c licenses/license.dat >> \
   /var/tmp/license.log 2>&1 &
```

In these two commands, the **–2** and **–p** options restrict the use of the **lmdown** and **lmremove** license administration tools to the license administrator. You omit these options if you want. Refer to the usage of **lmgrd** in the *Flexible License Manager (FLEXlm)* appendix for more information.

1.5.5 SETTING UP THE LICENSE DAEMON TO RUN AUTOMATICALLY

To set up the license daemon so that it runs automatically whenever a license server reboots, follow the instructions below that are approrpiate for your platform. steps on each license server:

Windows

1. Start the license manager tool by (`Start | Programs | TASKING FLEXlm | FLEXlm License Manager`).
2. In the `Setup` tab, enable the `Start Server at Power–Up` check box.
3. Close the program by clicking on the `OK` button. If a question appears, answer `Yes` to save your settings.

UNIX

In performing any of the procedures below, keep in mind the following:

- Before you edit any system file, make a backup copy.

HP–UX

1. Log in as the operating system administrator (usually root).
2. In the directory `/etc/rc.config.d` create a file named `rc.lmgrd` with the following contents. Replace *FLEXLMDIR* by the FLEXlm installation directory (default `/usr/local/flexlm`):

```
#!/sbin/sh
FLEXLMDIR/bin/lmgrd –2 –p –c FLEXLMDIR/licenses/license.dat >> \
    /var/tmp/license.log 2>&1 &
```

After the **–c** option, you have to specify the correct location of the license file.

SunOS4

1. Log in as the operating system administrator (usually root).
2. Append the following lines to the file `/etc/rc.local`. Replace *FLEXLMDIR* by the FLEXlm installation directory (default `/usr/local/flexlm`):

```
FLEXLMDIR/bin/lmgrd –2 –p –c FLEXLMDIR/licenses/license.dat >> \
    /var/tmp/license.log 2>&1 &
```

SunOS5 (Solaris 2)

1. Log in as the operating system administrator (usually root).
2. In the directory `/etc/init.d` create a file named `rc.lmgrd` with the following contents. Replace *FLEXLMDIR* by the FLEXlm installation directory (default `/usr/local/flexlm`):

```
#!/bin/sh
FLEXLMDIR/bin/lmgrd –2 –p –c FLEXLMDIR/licenses/license.dat >> \
    /var/tmp/license.log 2>&1 &
```

3. Make it executable:

```
chmod u+x rc.lmgrd
```

4. Create an ’S’ link in the `/etc/rc3.d` directory to this file and create ’K’ links in the other `/etc/rc?.d` directories:

```
ln /etc/init.d/rc.lmgrd /etc/rc3.d/Snumrc.lmgrd
ln /etc/init.d/rc.lmgrd /etc/rc?.d/Knumrc.lmgrd
```

num must be an approriate sequence number. Refer to you operating system documentation for more information.

1.5.6 MODIFYING THE LICENSE FILE LOCATION

The default location for the license file on Windows is:

```
c:\flexlm\license.dat
```

On UNIX this is:

```
/usr/local/flexlm/licenses/license.dat
```

If you want to use another name or directory for the license file, each user must define the environment variable **LM_LICENSE_FILE**. Do this in `autoexec.bat` (Windows 95/98), from the `Control Panel -> System | Environment` (Windows NT) or in a UNIX login script.

If you have more than one product using the FLEXlm license manager you can specify multiple license files to the **LM_LICENSE_FILE** environment variable by separating each pathname (*lfpath*) with a '**;**' (on UNIX also '**:**'):

Example Windows:

```
set LM_LICENSE_FILE=c:\flexlm\license.dat;c:\license.txt
```

Example UNIX:

```
setenv LM_LICENSE_FILE
/usr/local/flexlm/licenses/license.dat:/myprod/license.txt
```

If the license file is not available on these hosts, you must set **LM_LICENSE_FILE** to *port@host*; where *host* is the host name of the system which runs the FLEXlm license manager and *port* is the TCP/IP port number on which the license manager listens.

To obtain the port number, look in the license file at *host* for a line starting with "SERVER". The fourth field on this line specifies the TCP/IP port number on which the license server listens. For example:

```
setenv LM_LICENSE_FILE 7594@elliot
```

See the *Flexible License Manager (FLEXlm)* appendix for detailed information.

1.5.7 HOW TO DETERMINE THE HOSTID

The hostid depends on the platform of the machine. Please use one of the methods listed below to determine the hostid.

Platform	Tool to retrieve hostid	Example hostid
HP–UX	**lanscan** (use the station address without the leading ’0x’)	0000F0050185
SunOS/Solaris	**hostid**	170a3472
Windows	**tkhostid** (or use **lmhostid**)	0800200055327

Table 1–1: Determine the hostid

If you do not have the program **tkhostid** you can download it from our Web site at: http://www.tasking.com/support/flexlm/tkhostid.zip . It is also on every product CD that includes FLEXlm.

1.5.8 HOW TO DETERMINE THE HOSTNAME

To retrieve the hostname of a machine, use one of the following methods.

Platform	Method
HP–UX	**hostname**
SunOS/Solaris	**hostname**
Windows 95/98	Go to the Control Panel, open ”Network”, click on ”Identification”. Look for ”Computer name”.
Windows NT	Go to the Control Panel, open ”Network”. In the ”Identification” tab look for ”Computer Name”.

Table 1–2: Determine the hostname

CHAPTER

OVERVIEW

2

TASKING

CHAPTER 2

2.1 INTRODUCTION TO C++ COMPILER

This manual provides a functional description of the TriCore C++ Compiler. This manual uses **cptri** (the name of the binary) as a shorthand notation for "TASKING TriCore C++ Compiler". You should be familiar with the C++ language and with the ANSI/ISO C language.

The C++ compiler can be seen as a preprocessor or front end which accepts C++ source files or sources using C++ language features. The output generated by **cptri** is TriCore C, which can be translated with the C compiler **ctri**.

The C++ compiler is part of a complete toolchain. For details about the C compiler see the "TASKING TriCore C Compiler User's Guide".

The C++ compiler is normally invoked via the control program which is part of the toolchain. The control program facilitates the invocation of various components of the toolchain. The control program recognizes several filename extensions. C++ source files (`.cc`, `.cxx`, `.cpp` or `.c` with the **–c++** option) are passed to the C++ compiler. C source files (`.c`) are passed to the compiler. Assembly sources (`.asm` or `.src`) are passed to the assembler. Relocatable object files (`.obj`) and libraries (`.a`) are recognized as linker input files. Files with extension `.out` and `.dsc` are treated as locator input files. Everything else is considered an object file and is passed to the linker. The control program supports options to stop at any stage in the compilation process and has options to produce and retain intermediate files.

The C++ compiler accepts the C++ language of the ISO/IEC 14882:1998 C++ standard, with some minor exceptions documented in the next chapter. It also accepts embedded C++ language extensions.

The C++ compiler does no optimization. Its goal is to produce quickly a complete and clean parsed form of the source program, and to diagnose errors. It does complete error checking, produces clear error messages (including the position of the error within the source line), and avoids cascading of errors. It also tries to avoid seeming overly finicky to a knowledgeable C or C++ programmer.

2.2 DEVELOPMENT STRUCTURE

The next figure explains the relationship between the different parts of the TASKING TriCore toolchain:

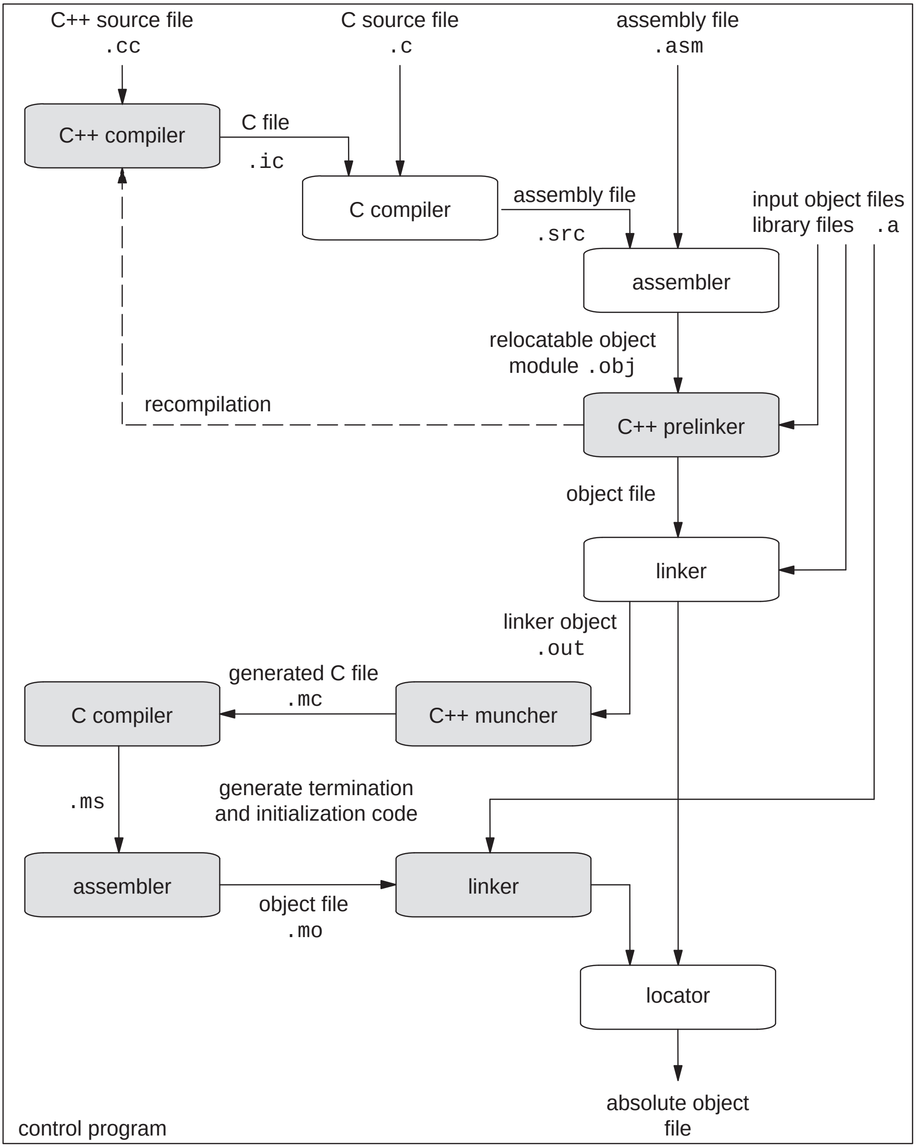


Figure 2–1: Development flow

OVERVIEW

2.2.1 THE PRELINKER PHASE

The C++ compiler provides a complete implementation of an automatic instantiation mechanism. The automatic instantiation mechanism is a ”linker feedback” mechanism. It works by providing additional information in the object file that is used by a ”prelinker” to determine which template entities require instantiation so that the program can be linked successfully. Unlike most aspects of the C++ compiler the automatic instantiation mechanism is, by its nature, dependent on certain operating system and object file format properties. In particular, the prelinker is a separate program that accesses information about the symbols defined in object files.

At the end of each compilation, the C++ compiler determines whether any template entities were referenced in the translation unit. If so, an ”instantiation information” file is created, referred to for convenience as a `.ii` file. If no template entities were referenced in the translation unit, the `.ii` file will not be created and any existing file will be removed. If an error occurs during compilation, the state of the `.ii` file is unchanged.

Once a complete set of object files has been generated, including the appropriate flags, the prelinker is invoked to determine whether any new instantiations are required or if any existing instantiations are no longer required. The command line arguments to the prelinker include a list of input files to be analyzed. The input files are the object files and libraries that constitute the application. The prelinker begins by looking for instantiation information files for each of the object files. If no instantiation information files are present, the prelinker concludes that no further action is required.

If there are instantiation information files, the prelinker reads the current instantiation list from each information file. The instantiation list contains the list of instantiations assigned to a given source file by a previous invocation of the prelinker. The prelinker produces a list of the global symbols that are referenced or defined by each of the input files. The prelinker then simulates a link operation to determine which symbols must be defined for the application to link successfully.

When the link simulation has been completed, the prelinker processes each input file to determine whether any new instantiations should be assigned to the input file or if any existing instantiations should be removed. The prelinker goes through the current instantiation list from the instantiation information file to determine whether any of the existing instantiations are no longer needed. An instantiation may be no longer needed because the template entity is no longer referenced by the program or because a user supplied specialization has been provided. If the instantiation is no longer needed, it is removed from the list (internally; the file will be updated later) and the file is flagged as requiring recompilation.

The prelinker then examines any symbols referenced by the input file. The responsibility for generating an instantiation of a given entity that has not already been defined is assigned to the first file that is capable of generating that instantiation.

Once all of the assignments have been updated, the prelinker once again goes through the list of object files. For each, if the corresponding instantiation information file must be updated, the new file is written. Only source files whose corresponding .ii file has been modified will be recompiled.

At this point each `.ii` file contains the information needed to recompile the source file and a list of instantiations assigned to the source file, in the form of mangled function and static data member names.

If an error occurs during a recompilation, the prelinker exits without updating the remaining information files and without attempting any additional compilations.

If all recompilations complete without error, the prelink process is repeated, since an instantiation can produce the demand for another instantiation. This prelink cycle (finding uninstantiated templates, updating the appropriate `.ii` files, and dispatching recompilations) continues until no further recompilations are required.

When the prelinker is finished, the linker is invoked. Note that simply because the prelinker completes successfully does not assure that the linker will not detect errors. Unresolvable template references and other linker errors will not be diagnosed by the prelinker.

2.2.2 THE MUNCHER PHASE

The C++ muncher implements global initialization and termination code.

The muncher takes the output of the linker as its input file and looks for names beginning with prefixes such as `__sti__` or `__std__`, those being, respectively, initialization and termination routines to be called at run–time. It generates a C program that defines a data structure containing a list of pointers to the initialization and termination routines. This generated program is then compiled and linked in with the executable. The data structure is consulted at run–time by startup code invoked from `_main`, and the routines on the list are invoked at the appropriate times.

2.3 ENVIRONMENT VARIABLES

This section contains an overview of the environment variables used by the TriCore toolchain.

Environment Variable	Description
ASTRIINC	Specifies an alternative path for include files for the assembler.
CTRIINC	Specifies an alternative path for #include files for the C compiler **ctri**.
CTRILIB	Specifies a path to search for library files used by the linker **lktri**.
CCTRIBIN	When this variable is set, the control program, **cctri**, prepends the directory specified by this variable to the names of the tools invoked.
CCTRIOPT	Specifies extra options and/or arguments to each invocation of **cctri**. The control program processes the arguments from this variable before the command line arguments.
CPTRIINC	Specifies an alternative path for #include files for the C++ compiler **cptri**.
LM_LICENSE_FILE	Identifies the location of the license data file. Only needed for hosts that need the FLEXlm license manager.
PATH	Specifies the search path for your executables.
TMPDIR	Specifies an alternative directory where programs can create temporary files.

Table 2–1: Environment variables

2.4 FILE EXTENSIONS

For compatibility with future TASKING Cross–Software the following extensions are suggested:

Source files:

.cc	C++ source file, input for C++ compiler
.cxx	C++ source file, input for C++ compiler
.cpp	C++ source file, input for C++ compiler
.c	C source file, input for C compiler (or for C++ compiler if you use the **–c++** option of the control program)
.asm	hand coded assembly source file, input for the assembler
.dsc	description file, input for linker/locator

Intermediate source files:

.ic	temporary C source file generated by the C++ compiler, input for the C compiler
.src	assembly source file generated by the C compiler, input for the assembler
.pr	output file generated by the object reader, input for the C++ muncher
.mc	C source file generated by the C++ muncher, input for the C compiler
.ms	assembly source file generated by the C compiler, input for the assembler
.mo	relocatable IEEE–695 object file generated by the assembler, input for the linker

Object files:

.obj	relocatable IEEE–695 object file generated by the assembler, input for the linker
.a	object library file
.out	relocatable linker output file

.abs	absolute locator output file, IEEE–695 object file
.hex	absolute Intel Hex output file from the locator
.sre	absolute Motorola S–record output file from the locator

List files:

.lst	assembler list file
.cal	C function call graph file, output from the linker
.lnl	linker map file
.map	locator map file

CHAPTER

3

LANGUAGE IMPLEMENTATION

TASKING

CHAPTER 3

3.1 INTRODUCTION

The TASKING C++ compiler (**cptri**) offers a new approach to high–level language programming for the TriCore family. The C++ compiler accepts the C++ language as defined by the ISO/IEC 14882:1998 standard, with the exceptions listed in section 3.4. It also accepts the language extensions of the C compiler.

This chapter describes the C++ language extensions and some specific features.

3.2 C++ LIBRARY

The TASKING C++ compiler supports the STLport C++ libraries. STLport is a multiplatform ANSI C++ Standard Library implementation. It is a free, open–source product, wich is delivered with the TASKING C++ compiler. The library supports standard templates and I/O streams.

You can find more information and documentation on the STLport library on the following sites:

http://www.stlport.org/doc/index.html
http://www.sgi.com/tech/stl/index.html

Also read the license agreement on:

http://www.stlport.org/doc/license.html

This license agreement is applicable to the C++ library only. All other product components fall under the TASKING license agreement.

3.3 C++ LANGUAGE EXTENSION KEYWORDS

The C++ compiler supports the same language extension keywords as the C compiler. These language extensions are enabled by default (**––embedded**), but you can disable them by specifying the **––no_embedded** command line option. When **–A** is used, the extensions will be disabled.

The following language extensions are supported:

additional data types

In addition to the standard data types, **ctri** supports three additional basic types to perform fixed point arithmetic (`_fract`, `_sfract` and `_accum`). Two additonal basic types were added to the C compiler to support the packed arithmetic instructions (`_packb` and `_packhw`). The intregal type `_bit` is added to support the bit instructions.

_at

You can specify a variable to be at an absolute address.

_atbit

You can specify a variable to be at a bit offset within a `_bitword` or bit–addressable `_sfr` variable.

bit fields

You can use the type modifiers `_sfrbit16` and `_sfrbit32` to control the access of SFR bit fields.

storage types

Apart from a memory category (extern, static, ...) you can specify a storage type in each declaration (`_near`, `_far`, `_a0`, `_a1`, `_a8`, `_a9`).

circular buffers

cptri supports the data type `_circ` as an extended data type.

interrupt functions

You can specify interrupt functions directly through interrupt vectors in the C language (`_interrupt` and `_interrupt_fast` keywords).

intrinsic functions

A number of pre–declared functions can be used to generate inline assembly code at the location of the intrinsic (built–in) function call. This avoids the overhead which is normally used to do parameter passing and context saving before executing the called function.

pragmas

The C++ compiler supports the same pragmas as the C compiler. Pragmas give directions to the code generator of the compiler.

All of the language extensions mentioned above are described in detail in the *C Cross–Compiler User's Guide*.

3.4 C++ DIALECT ACCEPTED

The C++ compiler accepts the C++ language as defined by the ISO/IEC 14882:1998 standard, with the exceptions listed below.

The C++ compiler also has a cfront compatibility mode, which duplicates a number of features and bugs of cfront 2.1 and 3.0.x. Complete compatibility is not guaranteed or intended; the mode is there to allow programmers who have unwittingly used cfront features to continue to compile their existing code. In particular, if a program gets an error when compiled by cfront, the C++ compiler may produce a different error or no error at all.

Command line options are also available to enable and disable anachronisms and strict standard–conformance checking.

3.4.1 NEW LANGUAGE FEATURES ACCEPTED

The following features not in traditional C++ (the C++ language of ”*The Annotated C++ Reference Manual*” by Ellis and Stroustrup (ARM)) but in the standard are implemented:

- The dependent statement of an `if`, `while`, `do–while`, or `for` is considered to be a scope, and the restriction on having such a dependent statement be a declaration is removed.
- The expression tested in an `if`, `while`, `do–while`, or `for`, as the first operand of a ”`?`” operator, or as an operand of the ”`&&`”, ”`:`”, or ”`!`”operators may have a pointer–to–member type or a class type that can be converted to a pointer–to–member type in addition to the scalar cases permitted by the ARM.
- Qualified names are allowed in elaborated type specifiers.
- A global–scope qualifier is allowed in member references of the form `x.::A::B` and `p–>::A::B`.
- The precedence of the third operand of the ”`?`” operator is changed.
- If control reaches the end of the `main()` routine, and `main()` has an integral return type, it is treated as if a `return 0;` statement were executed.

- Pointers to arrays with unknown bounds as parameter types are diagnosed as errors.
- A functional–notation cast of the form `A()` can be used even if `A` is a class without a (nontrivial) constructor. The temporary created gets the same default initialization to zero as a static object of the class type.
- A cast can be used to select one out of a set of overloaded functions when taking the address of a function.
- Template friend declarations and definitions are permitted in class definitions and class template definitions.
- Type template parameters are permitted to have default arguments.
- Function templates may have nontype template parameters.
- A reference to `const volatile` cannot be bound to an rvalue.
- Qualification conversions, such as conversion from `T**` to `T const * const *` are allowed.
- Digraphs are recognized.
- Operator keywords (e.g., `not`, `and`, `bitand`, etc.) are recognized.
- Static data member declarations can be used to declare member constants.
- `wchar_t` is recognized as a keyword and a distinct type.
- `bool` is recognized.
- RTTI (run–time type identification), including `dynamic_cast` and the `typeid` operator, is implemented.
- Declarations in tested conditions (in `if`, `switch`, `for`, and `while` statements) are supported.
- Array `new` and `delete` are implemented.
- New–style casts (`static_cast`, `reinterpret_cast`, and `const_cast`) are implemented.
- Definition of a nested class outside its enclosing class is allowed.
- `mutable` is accepted on non–static data member declarations.
- Namespaces are implemented, including `using` declarations and directives. Access declarations are broadened to match the corresponding `using` declarations.
- Explicit instantiation of templates is implemented.
- The `typename` keyword is recognized.
- `explicit` is accepted to declare non–converting constructors.

- The scope of a variable declared in the `for-init-statement` of a `for` loop is the scope of the loop (not the surrounding scope).
- Member templates are implemented.
- The new specialization syntax (using “`template <>`”) is implemented.
- Cv–qualifiers are retained on rvalues (in particular, on function return values).
- The distinction between trivial and nontrivial constructors has been implemented, as has the distinction between PODs and non–PODs with trivial constructors.
- The linkage specification is treated as part of the function type (affecting function overloading and implicit conversions).
- `extern inline` functions are supported, and the default linkage for `inline` functions is external.
- A typedef name may be used in an explicit destructor call.
- Placement delete is implemented.
- An array allocated via a placement new can be deallocated via delete.
- Covariant return types on overriding virtual functions are supported.
- `enum` types are considered to be non–integral types.
- Partial specialization of class templates is implemented.
- Partial ordering of function templates is implemented.
- Function declarations that match a function template are regarded as independent functions, not as “guiding declarations” that are instances of the template.
- It is possible to overload operators using functions that take `enum` types and no `class` types.
- Explicit specification of function template arguments is supported.
- Unnamed template parameters are supported.
- The new lookup rules for member references of the form `x.A::B` and `p->A::B` are supported.
- The notation `:: template` (and `->template`, etc.) is supported.
- In a reference of the form `f()->g()`, with `g` a static member function, `f()` is evaluated. The ARM specifies that the left operand is not evaluated in such cases.
- `enum` types can contain values larger than can be contained in an `int`.

- Default arguments of function templates and member functions of class templates are instantiated only when the default argument is used in a call.
- String literals and wide string literals have `const` type.
- Class name injection is implemented.
- Argument–dependent (Koenig) lookup of function names is implemented.
- Class and function names declared only in unqualified friend declarations are not visible except for functions found by argument–dependent lookup.
- A `void` expression can be specified on a return statement in a `void` function.
- Function–try–blocks, i.e., try–blocks that are the top–level statements of functions, constructors, or destructors, are implemented.
- Universal character set escapes (e.g., `\uabcd`) are implemented.
- On a call in which the expression to the left of the opening parenthesis has class type, overload resolution looks for conversion functions that can convert the class object to pointer–to–function types, and each such pointed–to ”surrogate function” type is evaluated alongside any other candidate functions.
- Template template parameters are implemented.

3.4.2 NEW LANGUAGE FEATURES NOT ACCEPTED

The following features of the C++ standard are not implemented yet:

- Two–phase name binding in templates, as described in [temp.res] and [temp.dep] of the standard, is not implemented.
- The `export` keyword for templates is not implemented.
- A partial specialization of a class member template cannot be added outside of the class definition.

3.4.3 ANACHRONISMS ACCEPTED

The following anachronisms are accepted when anachronisms are enabled (with **--anachronisms**):

- `overload` is allowed in function declarations. It is accepted and ignored.

- Definitions are not required for static data members that can be initialized using default initialization. The anachronism does not apply to static data members of template classes; they must always be defined.
- The number of elements in an array may be specified in an array `delete` operation. The value is ignored.
- A single `operator++()` and `operator--()` function can be used to overload both prefix and postfix operations.
- The base class name may be omitted in a base class initializer if there is only one immediate base class.
- Assignment to `this` in constructors and destructors is allowed. This is allowed only if anachronisms are enabled and the "assignment to `this`" configuration parameter is enabled.
- A bound function pointer (a pointer to a member function for a given object) can be cast to a pointer to a function.
- A nested class name may be used as a non–nested class name provided no other class of that name has been declared. The anachronism is not applied to template classes.
- A reference to a non–const type may be initialized from a value of a different type. A temporary is created, it is initialized from the (converted) initial value, and the reference is set to the temporary.
- A reference to a non–const class type may be initialized from an rvalue of the class type or a derived class thereof. No (additional) temporary is used.
- A function with old–style parameter declarations is allowed and may participate in function overloading as though it were prototyped. Default argument promotion is not applied to parameter types of such functions when the check for compatibility is done, so that the following declares the overloading of two functions named `f`:

  ```
  int f(int);
  int f(x) char x; { return x; }
  ```

  Note that in C this code is legal but has a different meaning: a tentative declaration of `f` is followed by its definition.

- When **--nonconst_ref_anachronism** is enabled, a reference to a non–const class can be bound to a class rvalue of the same type or a derived type thereof.

```
struct A {
     A(int);
     A operator=(A&);
     A operator+(const A&);
};
main () {
     A b(1);
     b = A(1) + A(2);  // Allowed as anachronism
}
```

3.4.4 EXTENSIONS ACCEPTED IN NORMAL C++ MODE

The following extensions are accepted in all modes (except when strict ANSI violations are diagnosed as errors):

- A `friend` declaration for a class may omit the `class` keyword:

```
class A {
     friend B;  // Should be ”friend class B”
};
```

- Constants of scalar type may be defined within classes:

```
class A {
     const int size = 10;
     int a[size];
};
```

- In the declaration of a class member, a qualified name may be used:

```
struct A {
     int A::f();  // Should be int f();
};
```

- The preprocessing symbol `c_plusplus` is defined in addition to the standard `__cplusplus`.
- A pointer to a constant type can be `delete`d.

- An assignment operator declared in a derived class with a parameter type matching one of its base classes is treated as a default assignment operator, that is, such a declaration blocks the implicit generation of a copy assignment operator. (This is cfront behavior that is known to be relied upon in at least one widely used library.) Here is an example:

  ```
  struct A { };
  struct B : public A {
       B& operator=(A&);
  };
  ```

  By default, as well as in cfront–compatibility mode, there will be no implicit declaration of `B::operator=(const B&)`, whereas in strict–ANSI mode `B::operator=(A&)` is not a copy assignment operator and `B::operator=(const B&)` is implicitly declared.

- Implicit type conversion between a pointer to an `extern ”C”` function and a pointer to an `extern ”C++”` function is permitted. Here's an example:

  ```
  extern ”C” void f(); // f's type has extern ”C” linkage
  void (*pf)()      // pf points to an extern ”C++” function
        = &f;       // error unless implicit conversion is
                    // allowed
  ```

  This extension is allowed in environments where C and C++ functions share the same calling conventions. It is enabled by default; it can also be enabled in cfront–compatibility mode or with option **--implicit_extern_c_type_conversion**. It is disabled in strict–ANSI mode.

- A ”**?**” operator whose second and third operands are string literals or wide string literals can be implicitly converted to ”`char *`” or ”`wchar_t *`”. (Recall that in C++ string literals are `const`. There is a deprecated implicit conversion that allows conversion of a string literal to ”`char *`”, dropping the `const`. That conversion, however, applies only to simple string literals. Allowing it for the result of a ”**?**” operation is an extension.)

  ```
  char *p = x ? ”abc” : ”def”;
  ```

- Except in strict–ANSI mode, default arguments may be specified for function parameters other than those of a top–level function declaration (e.g., they are accepted on `typedef` declarations and on pointer–to–function and pointer–to–member–function declarations).

3.4.5 EXTENSIONS ACCEPTED IN CFRONT 2.1 COMPATIBILITY MODE

The following extensions are accepted in cfront 2.1 compatibility mode in addition to the extensions listed in the 2.1/3.0 section following (i.e., these are things that were corrected in the 3.0 release of cfront):

- The dependent statement of an `if`, `while`, `do–while`, or `for` is not considered to define a scope. The dependent statement may not be a declaration. Any objects constructed within the dependent statement are destroyed at exit from the dependent statement.
- Implicit conversion from integral types to enumeration types is allowed.
- A non–`const` member function may be called for a `const` object. A warning is issued.
- A `const void *` value may be implicitly converted to a `void *` value, e.g., when passed as an argument.
- When, in determining the level of argument match for overloading, a reference parameter is initialized from an argument that requires a non–class standard conversion, the conversion counts as a user–defined conversion.
- When a built–in operator is considered alongside overloaded operators in overload resolution, the match of an operand of a built–in type against the built–in type required by the built–in operator is considered a standard conversion in all cases (e.g., even when the type is exactly right without conversion).
- A reference to a non–`const` type may be initialized from a value that is a `const`–qualified version of the same type, but only if the value is the result of selecting a member from a `const` class object or a pointer to such an object.
- The cfront 2.1 ”transitional model” for nested type support is simulated. In the transitional model a nested type is promoted to the file scope unless a type of the same name already exists at the file scope. It is an error to have two nested classes of the same name that need to be promoted to file scope or to define a type at file scope after the declaration of a nested class of the same name. This ”feature” actually restricts the source language accepted by the compiler. This is necessary because of the effect this feature has on the name mangling of functions that use nested types in their signature. This feature does not apply to template classes.

- A cast to an array type is allowed; it is treated like a cast to a pointer to the array element type. A warning is issued.
- When an array is selected from a class, the type qualifiers on the class object (if any) are not preserved in the selected array. (In the normal mode, any type qualifiers on the object are preserved in the element type of the resultant array.)
- An identifier in a function is allowed to have the same name as a parameter of the function. A warning is issued.
- An expression of type `void` may be supplied on the return statement in a function with a void return type. A warning is issued.
- Cfront has a bug that causes a global identifier to be found when a member of a class or one of its base classes should actually be found. This bug is emulated in cfront compatibility mode. A warning is issued when, because of this feature, a nonstandard lookup is performed. The following conditions must be satisfied for the nonstandard lookup to be performed:
  - A member in a base class must have the same name as an identifier at the global scope. The member may be a function, static data member, or non–static data member. Member type names do not apply because a nested type will be promoted to the global scope by cfront which disallows a later declaration of a type with the same name at the global scope.
  - The declaration of the global scope name must occur between the declaration of the derived class and the declaration of an out–of–line constructor or destructor. The global scope name must be a type name.
  - No other member function definition, even one for an unrelated class, may appear between the destructor and the offending reference. This has the effect that the nonstandard lookup applies to only one class at any given point in time. For example:

```
struct B   {
    void func(const char*);
};
```

```
struct D : public B {
public:
    D();
    void Init(const char* );
};

struct func {
    func( const char* msg);
};

D::D()

void D::Init(const char* t)
{
    //Should call B::func -- calls func::func instead.
    new func(t);
}
```

The global scope name must be present in a base class (`B::func` in this example) for the nonstandard lookup to occur. Even if the derived class were to have a member named func, it is still the presence of `B::func` that determines how the lookup will be performed.

- A parameter of type ”`const void *`” is allowed on operator delete; it is treated as equivalent to ”`void *`”.
- A period (”`.`”) may be used for qualification where ”`::`” should be used. Only ”`::`” may be used as a global qualifier. Except for the global qualifier, the two kinds of qualifier operators may not be mixed in a given name (i.e., you may say `A::B::C` or `A.B.C` but not `A::B.C` or `A.B::C`). A period may not be used in a vacuous destructor reference nor in a qualifier that follows a template reference such as `A<T>::B`.
- Cfront 2.1 does not correctly look up names in friend functions that are inside class definitions. In this example function `f` should refer to the functions and variables (e.g., `f1` and `a1`) from the class declaration. Instead, the global definitions are used.

```
int a1;
int e1;
void f1();
class A {
  int a1;
  void f1();
  friend void f()
  {
    int i1 = a1;  // cfront uses global a1
    f1();  // cfront uses global f1
  }
};
```

Only the innermost class scope is (incorrectly) skipped by cfront as illustrated in the following example.

```
int a1;
int b1;
struct A {
  static int a1;
  class B {
    static int b1;
    friend void f()
    {
      int i1 = a1;  // cfront uses A::a1
      int j1 = b1;  // cfront uses global b1
    }
  };
};
```

- `operator=` may be declared as a nonmember function. (This is flagged as an anachronism by cfront 2.1)
- A type qualifier is allowed (but ignored) on the declaration of a constructor or destructor. For example:

```
class A {
  A() const;  // No error in cfront 2.1 mode
};
```

3.4.6 EXTENSIONS ACCEPTED IN CFRONT 2.1 AND 3.0 COMPATIBILITY MODE

The following extensions are accepted in both cfront 2.1 and cfront 3.0 compatibility mode (i.e., these are features or problems that exist in both cfront 2.1 and 3.0):

- Type qualifiers on the `this` parameter may to be dropped in contexts such as this example:

  ```
  struct A {
    void f() const;
  };
  void (A::*fp)() = &A::f;
  ```

  This is actually a safe operation. A pointer to a `const` function may be put into a pointer to non–`const`, because a call using the pointer is permitted to modify the object and the function pointed to will actually not modify the object. The opposite assignment would not be safe.

- Conversion operators specifying conversion to `void` are allowed.
- A nonstandard friend declaration may introduce a new type. A friend declaration that omits the elaborated type specifier is allowed in default mode, but in cfront mode the declaration is also allowed to introduce a new type name.

  ```
  struct A {
    friend B;
  };
  ```

- The third operand of the `?` operator is a conditional expression instead of an assignment expression as it is in the modern language.
- A reference to a pointer type may be initialized from a pointer value without use of a temporary even when the reference pointer type has additional type qualifiers above those present in the pointer value. For example,

  ```
  int *p;
  const int *&r = p;  // No temporary used
  ```

- A reference may be initialized with a null.
- Because cfront does not check the accessibility of types, access errors for types are issued as warnings instead of errors.

- When matching arguments of an overloaded function, a `const` variable with value zero is not considered to be a null pointer constant. In general, in overload resolution a null pointer constant must be spelled ”`0`” to be considered a null pointer constant (e.g., ’`\0`’ is not considered a null pointer constant).
- Inside the definition of a class type, the qualifier in the declarator for a member declaration is dropped if that qualifier names the class being defined.

```
struct S {
  void S::f();
};
```

- An alternate form of declaring pointer–to–member–function variables is supported, for example:

```
struct A {
  void f(int);
  static void sf(int);
  typedef void A::T3(int);  // nonstd typedef decl
  typedef void T2(int);     // std typedef
};
typedef void A::T(int); // nonstd typedef decl
T* pmf = &A::f;         // nonstd ptr–to–member decl
A::T2* pf = A::sf;      // std ptr to static mem decl
A::T3* pmf2 = &A::f;    // nonstd ptr–to–member decl
```

  where `T` is construed to name a routine type for a non–static member function of class `A` that takes an `int` argument and returns `void`; the use of such types is restricted to nonstandard pointer–to–member declarations. The declarations of `T` and `pmf` in combination are equivalent to a single standard pointer–to–member declaration:

```
void (A::* pmf)(int) = &A::f;
```

  A nonstandard pointer–to–member declaration that appears outside of a class declaration, such as the declaration of `T`, is normally invalid and would cause an error to be issued. However, for declarations that appear within a class declaration, such as `A::T3`, this feature changes the meaning of a valid declaration. cfront version 2.1 accepts declarations, such as `T`, even when `A` is an incomplete type; so this case is also excepted.

- Protected member access checking is not done when the address of a protected member is taken. For example:

```
class B { protected: int i; };
class D : public B { void mf(); };
void D::mf() {
  int B::* pmi1 = &B::i;  // error, OK in cfront mode
  int D::* pmi2 = &D::i;  // OK
}
```

Protected member access checking for other operations (i.e., everything except taking a pointer–to–member address) is done in the normal manner.

- The destructor of a derived class may implicitly call the private destructor of a base class. In default mode this is an error but in cfront mode it is reduced to a warning. For example:

```
class A {
     ~A();
};
class B : public A {
     ~B();
};
B::~B(){}    // Error except in cfront mode
```

- When disambiguation requires deciding whether something is a parameter declaration or an argument expression, the pattern *type–name–or–keyword*`(`*identifier...*`)` is treated as an argument. For example:

```
class A { A(); };
double d;
A x(int(d));
A(x2);
```

By default `int(d)` is interpreted as a parameter declaration (with redundant parentheses), and so `x` is a function; but in cfront–compatibility mode `int(d)` is an argument and `x` is a variable.

The declaration `A(x2);` is also misinterpreted by cfront. It should be interpreted as the declaration of an object named `x2`, but in cfront mode is interpreted as a function style cast of `x2` to the type `A`.

Similarly, the declaration

```
int xyz(int());
```

declares a function named `xzy`, that takes a parameter of type ”function taking no arguments and returning an `int`”. In cfront mode this is interpreted as a declaration of an object that is initialized with the value `int()` (which evaluates to zero).

- A named bit–field may have a size of zero. The declaration is treated as though no name had been declared.
- Plain bit fields (i.e., bit fields declared with a type of `int)` are always unsigned.
- The name given in an elaborated type specifier is permitted to be a `typedef` name that is the synonym for a class name, e.g.,

```
typedef class A T;
class T *pa;                // No error in cfront
mode
```

- No warning is issued on duplicate size and sign specifiers.

```
short short int i;  // No warning in cfront mode
```

- Virtual function table pointer update code is not generated in destructors for base classes of classes without virtual functions, even if the base class virtual functions might be overridden in a further–derived class. For example:

```
struct A {
  virtual void f() {}
  A() {}
  ~A() {}
};
struct B : public A {
  B() {}
  ~B() {f();}         // Should call A::f according to
                      // ARM 12.7
};
struct C : public B {
  void f() {}
} c;
```

In cfront compatibility mode, `B::~B` calls `C::f`.

- An extra comma is allowed after the last argument in an argument list, as for example in

```
f(1, 2, );
```

- A constant pointer–to–member–function may be cast to a pointer–to–function. A warning is issued.

```
struct A {int f();};
main () {
  int (*p)();
  p = (int (*)())A::f;  // Okay, with warning
}
```

- Arguments of class types that allow bitwise copy construction but also have destructors are passed by value (i.e., like C structures), and the destructor is not called on the ”copy”. In normal mode, the class object is copied into a temporary, the address of the temporary is passed as the argument, and the destructor is called on the temporary after the call returns. Note that because the argument is passed differently (by value instead of by address), code like this compiled in cfront mode is not calling–sequence compatible with the same code compiled in normal mode. In practice, this is not much of a problem, since classes that allow bitwise copying usually do not have destructors.
- A union member may be declared to have the type of a class for which you have defined an assignment operator (as long as the class has no constructor or destructor). A warning is issued.
- When an unnamed class appears in a `typedef` declaration, the `typedef` name may appear as the class name in an elaborated type specifier.

```
typedef struct { int i, j; } S;
struct S x;  // No error in cfront mode
```

- Two member functions may be declared with the same parameter types when one is static and the other is non–static with a function qualifier.

```
class A {
  void f(int) const;
  static void f(int);  // No error in cfront mode
};
```

- The scope of a variable declared in the `for–init–statement` is the scope to which the `for` statement belongs.

```
int f(int i) {
  for (int j = 0; j < i; ++j) { /* ... */ }
  return j;           // No error in cfront mode
}
```

- Function types differing only in that one is declared `extern ”C”` and the other `extern ”C++”` can be treated as identical:

LANGUAGE

```
typedef void (*PF)();
extern ”C” typedef void (*PCF)();
void f(PF);
void f(PCF);
```

`PF` and `PCF` are considered identical and `void f(PCF)` is treated as a compatible redeclaration of `f`. (By contrast, in standard C++ PF and `PCF` are different and incompatible types — `PF` is a pointer to an `extern ”C++”` function whereas `PCF` is a pointer to an `extern ”C”` function — and the two declarations of `f` create an overload set.)

- Functions declared `inline` have internal linkage.
- `enum` types are regarded as integral types.
- An uninitialized `const` object of non–POD class type is allowed even if its default constructor is implicitly declared:

```
struct A { virtual void f(); int i; };
const A a;
```

- A function parameter type is allowed to involve a pointer or reference to array of unknown bounds.
- If the user declares an `operator=` function in a class, but not one that can serve as the default `operator=`, and bitwise assignment could be done on the class, a default operator= is not generated; only the user–written `operator=` functions are considered for assignments (and therefore bitwise assignment is not done).
- A member function declaration whose return type is omitted (and thus implicitly `int`) and whose name is found to be that of a type is accepted if it takes no parameters:

```
typedef int I;

struct S {
  I(); // Accepted in Cfront mode (declares ”int S::I()”)
  I(int); // Not accepted
};
```

3.5 NAMESPACE SUPPORT

Namespaces are enabled by default except in the cfront modes. You can use the command–line options **--namespaces** and **--no_namespaces** to enable or disable the features.

Name lookup during template instantiations now does something that approximates the two–phase lookup rule of the standard. When a name is looked up as part of a template instantiation but is not found in the local context of the instantiation, it is looked up in a synthesized instantiation context. The C++ compiler follows the new instantiation lookup rules for namespaces as closely as possible in the absence of a complete implementation of the new template name binding rules. Here is an example:

```
namespace N {
  int g(int);
  int x = 0;
  template <class T> struct A {
    T f(T t) { return g(t); }
    T f() { return x; }
  };
}

namespace M {
  int x = 99;
  double g(double);
  N::A<int> ai;
  int i = ai.f(0);      // N::A<int>::f(int) calls
                        // N::g(int)
  int i2 = ai.f();      // N::A<int>::f() returns
                        // 0 (= N::x)
  N::A<double> ad;
  double d = ad.f(0);   // N::A<double>::f(double)
                        // calls M::g(double)
  double d2 = ad.f();   // N::A<double>::f() also
                        // returns 0 (= N::x)
}
```

The lookup of names in template instantiations does not conform to the rules in the standard in the following respects:

- Although only names from the template definition context are considered for names that are not functions, the lookup is not limited to those names visible at the point at which the template was defined.

- Functions from the context in which the template was referenced are considered for all function calls in the template. Functions from the referencing context should only be visible for dependent function calls.

The lookup rules for overloaded operators are implemented as specified by the standard, which means that the operator functions in the global scope overload with the operator functions declared extern inside a function, instead of being hidden by them. The old operator function lookup rules are used when namespaces are turned off. This means a program can have different behavior, depending on whether it is compiled with namespace support enabled or disabled:

```
struct A { };
A operator+(A, double);
void f() {
  A a1;
  A operator+(A, int);
  a1 + 1.0;   // calls operator+(A, double)
              // with namespaces enabled but
}             // otherwise calls operator+(A, int);
```

3.6 TEMPLATE INSTANTIATION

The C++ language includes the concept of *templates*. A template is a description of a class or function that is a model for a family of related classes or functions.[1] For example, one can write a template for a Stack class, and then use a stack of integers, a stack of floats, and a stack of some user–defined type. In the source, these might be written Stack<int>, Stack<float>, and Stack<X>. From a single source description of the template for a stack, the compiler can create *instantiations* of the template for each of the types required.

The instantiation of a class template is always done as soon as it is needed in a compilation. However, the instantiations of template functions, member functions of template classes, and static data members of template classes (hereafter referred to as template entities) are not necessarily done immediately, for several reasons:

- One would like to end up with only one copy of each instantiated entity across all the object files that make up a program. (This of course applies to entities with external linkage.)
- The language allows one to write a *specialization* of a template entity, i.e., a specific version to be used in place of a version generated from the template for a specific data type. (One could, for example, write a version of Stack<int>, or of just Stack<int>::push, that replaces the template–generated version; often, such a specialization provides a more efficient representation for a particular data type.) Since the compiler cannot know, when compiling a reference to a template entity, if a specialization for that entity will be provided in another compilation, it cannot do the instantiation automatically in any source file that references it.
- The language also dictates that template functions that are not referenced should not be compiled, that, in fact, such functions might contain semantic errors that would prevent them from being compiled. Therefore, a reference to a template class should not automatically instantiate all the member functions of that class.

(It should be noted that certain template entities are always instantiated when used, e.g., inline functions.)

[1] Since templates are descriptions of entities (typically, classes) that are parameterizable according to the types they operate upon, they are sometimes called **parameterized types**.

From these requirements, one can see that if the compiler is responsible for doing all the instantiations automatically, it can only do so on a program–wide basis. That is, the compiler cannot make decisions about instantiation of template entities until it has seen all the source files that make up a complete program.

This C++ compiler provides an instantiation mechanism that does automatic instantiation at link time. For cases where you want more explicit control over instantiation, the C++ compiler also provides instantiation modes and instantiation pragmas, which can be used to exert fine–grained control over the instantiation process.

3.6.1 AUTOMATIC INSTANTIATION

The goal of an automatic instantiation mode is to provide painless instantiation. You should be able to compile source files to object code, then link them and run the resulting program, and never have to worry about how the necessary instantiations get done.

In practice, this is hard for a compiler to do, and different compilers use different automatic instantiation schemes with different strengths and weaknesses:

- AT&T/USL/Novell's *cfront* product saves information about each file it compiles in a special directory called `ptrepository`. It instantiates nothing during normal compilations. At link time, it looks for entities that are referenced but not defined, and whose mangled names indicate that they are template entities. For each such entity, it consults the `ptrepository` information to find the file containing the source for the entity, and it does a compilation of the source to generate an object file containing object code for that entity. This object code for instantiated objects is then combined with the ”normal” object code in the link step.

If you are using *cfront* you must follow a particular coding convention: all templates must be declared in `.h` files, and for each such file there must be a corresponding `.cc` file containing the associated definitions. The compiler is never told about the `.cc` files explicitly; one does not, for example, compile them in the normal way. The link step looks for them when and if it needs them, and does so by taking the `.h` filename and replacing its suffix.[2]

This scheme has the disadvantage that it does a separate compilation for each instantiated function (or, at best, one compilation for all the member functions of one class). Even though the function itself is often quite small, it must be compiled along with the declarations for the types on which the instantiation is based, and those declarations can easily run into many thousands of lines. For large systems, these compilations can take a very long time. The link step tries to be smart about recompiling instantiations only when necessary, but because it keeps no fine–grained dependency information, it is often forced to "recompile the world" for a minor change in a `.h` file. In addition, *cfront* has no way of ensuring that preprocessing symbols are set correctly when it does these instantiation compilations, if preprocessing symbols are set other than on the command line.

- Borland's C++ compiler instantiates everything referenced in a compilation, then uses a special linker to remove duplicate definitions of instantiated functions.

  If you are using Borland's compiler you must make sure that every compilation sees all the source code it needs to instantiate all the template entities referenced in that compilation. That is, one cannot refer to a template entity in a source file if a definition for that entity is not included by that source file. In practice, this means that either all the definition code is put directly in the `.h` files, or that each `.h` file includes an associated `.cc` (actually, `.cpp`) file.

  This scheme is straightforward, and works well for small programs. For large systems, however, it tends to produce very large object files, because each object file must contain object code (and symbolic debugging information) for each template entity it references.

[2] The actual implementation allows for several different suffixes and provides a command–line option to change the suffixes sought.

Our approach is a little different. It requires that, for each instantiation required, there is some (normal, top–level, explicitly–compiled) source file that contains the definition of the template entity, a reference that causes the instantiation, and the declarations of any types required for the instantiation.[3] This requirement can be met in various ways:

- The Borland convention: each `.h` file that declares a template entity also contains either the definition of the entity or includes another file containing the definition.
- Implicit inclusion: when the compiler sees a template declaration in a `.h` file and discovers a need to instantiate that entity, it is given permission to go off looking for an associated definition file having the same base name and a different suffix, and it implicitly includes that file at the end of the compilation. This method allows most programs written using the *cfront* convention to be compiled with our approach. See the section on implicit inclusion.
- The ad hoc approach: you make sure that the files that define template entities also have the definitions of all the available types, and add code or pragmas in those files to request instantiation of the entities there.

Our compiler's automatic instantiation method works as follows:

1. The first time the source files of a program are compiled, no template entities are instantiated. However, the generated object files contain information about things that *could* have been instantiated in each compilation. For any source file that makes use of a template instantiation an associated `.ii` file is created if one does not already exist (e.g., the compilation of `abc.cc` would result in the creation of `abc.ii`).

2. When the object files are linked together, a program called the *prelinker*, **prelktri**, is run. It examines the object files, looking for references and definitions of template entities, and for the added information about entities that could be instantiated.

[3] Isn't this always the case? No. Suppose that file `A` contains a definition of class `X` and a reference to `Stack<X>::push`, and that file `B` contains the definition for the member function `push`. There would be no file containing both the definition of `push` and the definition of `X`.

3. If the prelinker finds a reference to a template entity for which there is no definition anywhere in the set of object files, it looks for a file that indicates that it could instantiate that template entity. When it finds such a file, it assigns the instantiation to it. The set of instantiations assigned to a given file is recorded in the associated instantiation request file (with, by default, a `.ii` suffix).

4. The prelinker then executes the compiler again to recompile each file for which the `.ii` file was changed. The original compilation command–line options (saved in the template information file) are used for the recompilation.

5. When the compiler compiles a file, it reads the `.ii` file for that file and obeys the instantiation requests therein. It produces a new object file containing the requested template entities (and all the other things that were already in the object file).

6. The prelinker repeats steps 3–5 until there are no more instantiations to be adjusted.

7. The object files are linked together.

Once the program has been linked correctly, the `.ii` files contain a complete set of instantiation assignments. From then on, whenever source files are recompiled, the compiler will consult the `.ii` files and do the indicated instantiations as it does the normal compilations. That means that, except in cases where the set of required instantiations changes, the prelink step from then on will find that all the necessary instantiations are present in the object files and no instantiation assignment adjustments need be done. That's true even if the entire program is recompiled.

If you provide a specialization of a template entity somewhere in the program, the specialization will be seen as a definition by the prelinker. Since that definition satisfies whatever references there might be to that entity, the prelinker will see no need to request an instantiation of the entity. If you add a specialization to a program that has previously been compiled, the prelinker will notice that too and remove the assignment of the instantiation from the proper `.ii` file.

The `.ii` files should not, in general, require any manual intervention. One exception: if a definition is changed in such a way that some instantiation no longer compiles (it gets errors), and at the same time a specialization is added in another file, and the first file is being recompiled before the specialization file and is getting errors, the `.ii` file for the file getting the errors must be deleted manually to allow the prelinker to regenerate it.

If you supplied the **–v** option to the control program **cctri**, and the prelinker changes an instantiation assignment, the prelinker will issue messages like:

```
C++ prelinker: A<int>::f() assigned to file test.o
C++ prelinker: executing: cctri –c test.cc
```

The automatic instantiation scheme can coexist with partial explicit control of instantiation by you through the use of pragmas or command–line specification of the instantiation mode. See the following sections.

Instantiations are normally generated as part of the object file of the translation unit in which the instantiations are performed. But when "one instantiation per object" mode is specified, each instantiation is placed in its own object file. One–instantiation–per–object mode is useful when generating libraries that need to include copies of the instances referenced from the library. If each instance is not placed in its own object file, it may be impossible to link the library with another library containing some of the same instances. Without this feature it is necessary to create each individual instantiation object file using the manual instantiation mechanism.

The automatic instantiation mode is enabled by default. It can be turned off by the command–line option **--no_auto_instantiation**. If automatic instantiation is turned off, the extra information about template entities that could be instantiated in a file is not put into the object file.

3.6.2 INSTANTIATION MODES

Normally, when a file is compiled, no template entities are instantiated (except those assigned to the file by automatic instantiation). The overall instantiation mode can, however, be changed by a command line option:

--instantiate none
Do not automatically create instantiations of any template entities. This is the default. It is also the usually appropriate mode when automatic instantiation is done.

--instantiate used
Instantiate those template entities that were used in the compilation. This will include all static data members for which there are template definitions.

––instantiate all

Instantiate all template entities declared or referenced in the compilation unit. For each fully instantiated template class, all of its member functions and static data members will be instantiated whether or not they were used. Non–member template functions will be instantiated even if the only reference was a declaration.

––instantiate local

Similar to **––instantiate used** except that the functions are given internal linkage. This is intended to provide a very simple mechanism for those getting started with templates. The compiler will instantiate the functions that are used in each compilation unit as local functions, and the program will link and run correctly (barring problems due to multiple copies of local static variables.) However, one may end up with many copies of the instantiated functions, so this is not suitable for production use. **––instantiate local** can not be used in conjunction with automatic template instantiation. If automatic instantiation **––instantiate local** option. If automatic instantiation is not enabled by default, use of **––instantiate local** and **––auto_instantiation** is an error.

In the case where the **cctri** command is given a single file to compile and link, e.g.,

```
cctri test.cc
```

the compiler knows that all instantiations will have to be done in the single source file. Therefore, it uses the **––instantiate used** mode and suppresses automatic instantiation.

3.6.3 INSTANTIATION #PRAGMA DIRECTIVES

Instantiation pragmas can be used to control the instantiation of specific template entities or sets of template entities. There are three instantiation pragmas:

- The **instantiate** pragma causes a specified entity to be instantiated.
- The **do_not_instantiate** pragma suppresses the instantiation of a specified entity. It is typically used to suppress the instantiation of an entity for which a specific definition will be supplied.

- The **can_instantiate** pragma indicates that a specified entity can be instantiated in the current compilation, but need not be; it is used in conjunction with automatic instantiation, to indicate potential sites for instantiation if the template entity turns out to be required.

The argument to the instantiation pragma may be:

a template class name	`A<int>`
a template class declaration	`class A<int>`
a member function name	`A<int>::f`
a static data member name	`A<int>::i`
a static data declaration	`int A<int>::i`
a member function declaration	`void A<int>::f(int,char)`
a template function declaration	`char* f(int, float)`

A pragma in which the argument is a template class name (e.g., `A<int>` or `class A<int>`) is equivalent to repeating the pragma for each member function and static data member declared in the class. When instantiating an entire class a given member function or static data member may be excluded using the **do_not_instantiate** pragma. For example,

```
#pragma instantiate A<int>
#pragma do_not_instantiate A<int>::f
```

The template definition of a template entity must be present in the compilation for an instantiation to occur. If an instantiation is explicitly requested by use of the **instantiate** pragma and no template definition is available or a specific definition is provided, an error is issued.

```
template <class T> void f1(T);  // No body provided
template <class T> void g1(T);  // No body provided
```

```
void f1(int) {}  // Specific definition
void main()
{
     int      i;
     double   d;
     f1(i);
     f1(d);
     g1(i);
     g1(d);
}

#pragma instantiate void f1(int)   // error – specific
                                   // definition
#pragma instantiate void g1(int)   // error – no body
                                   // provided
```

`f1(double)` and `g1(double)` will not be instantiated (because no bodies were supplied) but no errors will be produced during the compilation (if no bodies are supplied at link time, a linker error will be produced).

A member function name (e.g., `A<int>::f`) can only be used as a pragma argument if it refers to a single user defined member function (i.e., not an overloaded function). Compiler–generated functions are not considered, so a name may refer to a user defined constructor even if a compiler–generated copy constructor of the same name exists. Overloaded member functions can be instantiated by providing the complete member function declaration, as in

```
#pragma instantiate char* A<int>::f(int, char*)
```

The argument to an instantiation pragma may not be a compiler–generated function, an inline function, or a pure virtual function.

3.6.4 IMPLICIT INCLUSION

When implicit inclusion is enabled, the C++ compiler is given permission to assume that if it needs a definition to instantiate a template entity declared in a `.h` file it can implicitly include the corresponding `.cc` file to get the source code for the definition. For example, if a template entity `ABC::f` is declared in file `xyz.h`, and an instantiation of `ABC::f` is required in a compilation but no definition of `ABC::f` appears in the source code processed by the compilation, the compiler will look to see if a file `xyz.cc` exists, and if so it will process it as if it were included at the end of the main source file.

To find the template definition file for a given template entity the C++ compiler needs to know the full path name of the file in which the template was declared and whether the file was included using the system include syntax (e.g., `#include <file.h>`). This information is not available for preprocessed source containing `#line` directives. Consequently, the C++ compiler will not attempt implicit inclusion for source code containing `#line` directives.

By default, the list of definition–file suffixes tried is `.cc`, `.cpp`, and `.cxx`. If **–c++** is supplied to the control program **cctri**, `.c` is also used as C++ file.

Implicit inclusion works well alongside automatic instantiation, but the two are independent. They can be enabled or disabled independently, and implicit inclusion is still useful when automatic instantiation is not done.

The implicit inclusion mode can be turned on by the command–line option **--implicit_include**.

Implicit inclusions are only performed during the normal compilation of a file, (i.e., not when doing only preprocessing). A common means of investigating certain kinds of problems is to produce a preprocessed source file that can be inspected. When using implicit inclusion it is sometimes desirable for the preprocessed source file to include any implicitly included files. This may be done using the **--no_preproc_only** command line option. This causes the preprocessed output to be generated as part of a normal compilation. When implicit inclusion is being used, the implicitly included files will appear as part of the preprocessed output in the precise location at which they were included in the compilation.

3.7 PREDEFINED MACROS

The C++ compiler defines a number of preprocessing macros. Many of them are only defined under certain circumstances. This section describes the macros that are provided and the circumstances under which they are defined.

All C predefined macros are also defined.

__STDC__ Defined in ANSI C mode and in C++ mode. In C++ mode the value may be redefined. Not defined when embedded C++ is used.

__FILE__ ”current source filename”

__LINE__ current source line number (int type)

__TIME__ ”hh:mm:ss”

__DATE__ ”Mmm dd yyyy”

__cplusplus Defined in C++ mode.

c_plusplus Defined in default C++ mode, but not in strict mode.

__STDC_VERSION__
Defined in ANSI C mode with the value 199409L. The name of this macro, and its value, are specified in Normative Addendum 1 of the ISO C Standard.

__SIGNED_CHARS__
Defined when plain `char` is signed. This is used in the `<limits.h>` header file to get the proper definitions of `CHAR_MAX` and `CHAR_MIN`.

_WCHAR_T Defined in C++ mode when `wchar_t` is a keyword.

_BOOL Defined in C++ mode when `bool` is a keyword.

__ARRAY_OPERATORS
Defined in C++ mode when array `new` and `delete` are enabled.

__EXCEPTIONS
Defined in C++ mode when exception handling is enabled.

__RTTI Defined in C++ mode when RTTI is enabled.

__PLACEMENT_DELETE
Defined in C++ mode when placement delete is enabled.

__NAMESPACES
Defined in C++ mode when namespaces are supported (**--namespaces**).

__TSW_RUNTIME_USES_NAMESPACES
Defined in C++ mode when the configuration flag RUNTIME_USES_NAMESPACES is TRUE. The name of this predefined macro is specified by a configuration flag. __EDG_RUNTIME_USES_NAMESPACES is the default.

__TSW_IMPLICIT_USING_STD
Defined in C++ mode when the configuration flag RUNTIME_USES_NAMESPACES is TRUE and when the standard header files should implicitly do a using–directive on the `std` namespace (**--using_std**).

__TSW_CPP__
Always defined.

__TSW_CPP_VERSION__
Defined to an integral value that represents the version number of the C++ front end. For example, version 2.37 is represented as 237.

__embedded_cplusplus
Defined as 1 in Embedded C++ mode.

3.8 PRECOMPILED HEADERS

It is often desirable to avoid recompiling a set of header files, especially when they introduce many lines of code and the primary source files that `#include` them are relatively small. The C++ compiler provides a mechanism for, in effect, taking a snapshot of the state of the compilation at a particular point and writing it to a disk file before completing the compilation; then, when recompiling the same source file or compiling another file with the same set of header files, it can recognize the "snapshot point", verify that the corresponding precompiled header (PCH) file is reusable, and read it back in. Under the right circumstances, this can produce a dramatic improvement in compilation time; the trade–off is that PCH files can take a lot of disk space.

3.8.1 AUTOMATIC PRECOMPILED HEADER PROCESSING

When **--pch** appears on the command line, automatic precompiled header processing is enabled. This means the C++ compiler will automatically look for a qualifying precompiled header file to read in and/or will create one for use on a subsequent compilation.

The PCH file will contain a snapshot of all the code preceding the "header stop" point. The header stop point is typically the first token in the primary source file that does not belong to a preprocessing directive, but it can also be specified directly by **#pragma hdrstop** (see below) if that comes first. For example:

```
#include "xxx.h"
#include "yyy.h"
int i;
```

The header stop point is `int` (the first non–preprocessor token) and the PCH file will contain a snapshot reflecting the inclusion of `xxx.h` and `yyy.h`. If the first non–preprocessor token or the `#pragma hdrstop` appears within a `#if` block, the header stop point is the outermost enclosing `#if`. To illustrate, heres a more complicated example:

LANGUAGE

```
#include ”xxx.h”
#ifndef YYY_H
#define YYY_H 1
#include ”yyy.h”
#endif
#if TEST
int i;
#endif
```

Here, the first token that does not belong to a preprocessing directive is again `int`, but the header stop point is the start of the `#if` block containing it. The PCH file will reflect the inclusion of `xxx.h` and conditionally the definition of `YYY_H` and inclusion of `yyy.h`; it will not contain the state produced by `#if TEST`.

A PCH file will be produced only if the header stop point and the code preceding it (mainly, the header files themselves) meet certain requirements:

- The header stop point must appear at file scope –– it may not be within an unclosed scope established by a header file. For example, a PCH file will not be created in this case:

  ```
  // xxx.h
  class A {

  // xxx.C
  #include ”xxx.h”
  int i; };
  ```

- The header stop point may not be inside a declaration started within a header file, nor (in C++) may it be part of a declaration list of a linkage specification. For example, in the following case the header stop point is int, but since it is not the start of a new declaration, no PCH file will be created:

  ```
  // yyy.h
  static

  // yyy.C
  #include ”yyy.h”
  int i;
  ```

- Similarly, the header stop point may not be inside a `#if` block or a `#define` started within a header file.

- The processing preceding the header stop must not have produced any errors. (Note: warnings and other diagnostics will not be reproduced when the PCH file is reused.)
- No references to predefined macros `__DATE__` or `__TIME__` may have appeared.
- No use of the `#line` preprocessing directive may have appeared.
- **#pragma no_pch** (see below) must not have appeared.
- The code preceding the header stop point must have introduced a sufficient number of declarations to justify the overhead associated with precompiled headers. The minimum number of declarations required is 1.

When the host system does not support memory mapping, so that everything to be saved in the precompiled header file is assigned to preallocated memory (MS–Windows), two additional restrictions apply:

- The total memory needed at the header stop point cannot exceed the size of the block of preallocated memory.
- No single program entity saved can exceed 16384, the preallocation unit.

When a precompiled header file is produced, it contains, in addition to the snapshot of the compiler state, some information that can be checked to determine under what circumstances it can be reused. This includes:

- The compiler version, including the date and time the compiler was built.
- The current directory (i.e., the directory in which the compilation is occurring).
- The command line options.
- The initial sequence of preprocessing directives from the primary source file, including `#include` directives.
- The date and time of the header files specified in `#include` directives.

This information comprises the PCH prefix. The prefix information of a given source file can be compared to the prefix information of a PCH file to determine whether the latter is applicable to the current compilation.

As an illustration, consider two source files:

```
// a.cc
#include ”xxx.h”
...                   // Start of code
// b.cc
#include ”xxx.h”
...                   // Start of code
```

When `a.cc` is compiled with **--pch**, a precompiled header file named `a.pch` is created. Then, when `b.cc` is compiled (or when `a.cc` is recompiled), the prefix section of `a.pch` is read in for comparison with the current source file. If the command line options are identical, if `xxx.h` has not been modified, and so forth, then, instead of opening `xxx.h` and processing it line by line, the C++ compiler reads in the rest of `a.pch` and thereby establishes the state for the rest of the compilation.

It may be that more than one PCH file is applicable to a given compilation. If so, the largest (i.e., the one representing the most preprocessing directives from the primary source file) is used. For instance, consider a primary source file that begins with

```
#include ”xxx.h”
#include ”yyy.h”
#include ”zzz.h”
```

If there is one PCH file for `xxx.h` and a second for `xxx.h` *and* `yyy.h`, the latter will be selected (assuming both are applicable to the current compilation). Moreover, after the PCH file for the first two headers is read in and the third is compiled, a new PCH file for all three headers may be created.

When a precompiled header file is created, it takes the name of the primary source file, with the suffix replaced by an implementation–specified suffix (`pch` by default). Unless **--pch_dir** is specified (see below), it is created in the directory of the primary source file.

When a precompiled header file is created or used, a message such as

```
”test.cc”: creating precompiled header file ”test.pch”
```

is issued. The user may suppress the message by using the command–line option **--no_pch_messages**.

When the **--pch_verbose** option is used the C++ compiler will display a message for each precompiled header file that is considered that cannot be used giving the reason that it cannot be used.

In automatic mode (i.e., when **--pch** is used) the C++ compiler will deem a precompiled header file obsolete and delete it under the following circumstances:

- if the precompiled header file is based on at least one out–of–date header file but is otherwise applicable for the current compilation; or
- if the precompiled header file has the same base name as the source file being compiled (e.g., `xxx.pch` and `xxx.cc`) but is not applicable for the current compilation (e.g., because of different command–line options).

This handles some common cases; other PCH file clean–up must be dealt with by other means (e.g., by the user).

Support for precompiled header processing is not available when multiple source files are specified in a single compilation: an error will be issued and the compilation aborted if the command line includes a request for precompiled header processing and specifies more than one primary source file.

3.8.2 MANUAL PRECOMPILED HEADER PROCESSING

Command–line option **--create_pch** *file–name* specifies that a precompiled header file of the specified name should be created.

Command–line option **--use_pch** *file–name* specifies that the indicated precompiled header file should be used for this compilation; if it is invalid (i.e., if its prefix does not match the prefix for the current primary source file), a warning will be issued and the PCH file will not be used.

When either of these options is used in conjunction with **--pch_dir**, the indicated file name (which may be a path name) is tacked on to the directory name, unless the file name is an absolute path name.

The **--create_pch**, **--use_pch**, and **--pch** options may not be used together. If more than one of these options is specified, only the last one will apply. Nevertheless, most of the description of automatic PCH processing applies to one or the other of these modes –– header stop points are determined the same way, PCH file applicability is determined the same way, and so forth.

3.8.3 OTHER WAYS TO CONTROL PRECOMPILED HEADERS

There are several ways in which the user can control and/or tune how precompiled headers are created and used.

- **#pragma hdrstop** may be inserted in the primary source file at a point prior to the first token that does not belong to a preprocessing directive. It enables you to specify where the set of header files subject to precompilation ends. For example,

  ```
  #include ”xxx.h”
  #include ”yyy.h”
  #pragma hdrstop
  #include ”zzz.h”
  ```

  Here, the precompiled header file will include processing state for `xxx.h` and `yyy.h` but not `zzz.h`. (This is useful if the user decides that the information added by what follows the **#pragma hdrstop** does not justify the creation of another PCH file.)

- **#pragma no_pch** may be used to suppress precompiled header processing for a given source file.
- Command–line option **--pch_dir** *directory–name* is used to specify the directory in which to search for and/or create a PCH file.

Moreover, when the host system does not support memory mapping and preallocated memory is used instead, then one of the command–line options **--pch**, **--create_pch**, or **--use_pch**, if it appears at all, must be the *first* option on the command line.

3.8.4 PERFORMANCE ISSUES

The relative overhead incurred in writing out and reading back in a precompiled header file is quite small for reasonably large header files.

In general, it does not cost much to write a precompiled header file out even if it does not end up being used, and if it *is* used it almost always produces a significant speedup in compilation. The problem is that the precompiled header files can be quite large (from a minimum of about 250K bytes to several megabytes or more), and so one probably does not want many of them sitting around.

Thus, despite the faster recompilations, precompiled header processing is not likely to be justified for an arbitrary set of files with nonuniform initial sequences of preprocessing directives. Rather, the greatest benefit occurs when a number of source files can share the same PCH file. The more sharing, the less disk space is consumed. With sharing, the disadvantage of large precompiled header files can be minimized, without giving up the advantage of a significant speedup in compilation times.

Consequently, to take full advantage of header file precompilation, users should expect to reorder the `#include` sections of their source files and/or to group `#include` directives within a commonly used header file.

Below is an example of how this can be done. A common idiom is this:

```
#include ”comnfile.h”
#pragma hdrstop
#include ...
```

where `comnfile.h` pulls in, directly and indirectly, a few dozen header files; the `#pragma hdrstop` is inserted to get better sharing with fewer PCH files. The PCH file produced for `comnfile.h` can be a bit over a megabyte in size. Another idiom, used by the source files involved in declaration processing, is this:

```
#include ”comnfile.h”
#include ”decl_hdrs.h”
#pragma hdrstop
#include ...
```

decl_hdrs.h pulls in another dozen header files, and a second, somewhat larger, PCH file is created. In all, the source files of a particular program can share just a few precompiled header files. If disk space were at a premium, you could decide to make comnfile.h pull in *all* the header files used –– then, a single PCH file could be used in building the program.

Different environments and different projects will have different needs, but in general, users should be aware that making the best use of the precompiled header support will require some experimentation and probably some minor changes to source code.

CHAPTER

4

COMPILER USE

TASKING

CHAPTER 4

4.1 INVOCATION

The invocation syntax of the C++ compiler is:

cptri [[*option*]... *file*

When you use a **UNIX** shell (Bourne shell, C–shell), arguments containing special characters (such as '( )' and '?') must be enclosed with **" "** or escaped. The **–?** option (in the C–shell) becomes: **"–?"** or **–\?**.

The C++ compiler accepts a C++ source file name and command line options in random order. A C++ source file must have a `.cc`, `.cxx` or `.cpp` suffix.

Command line options may be specified using either single character option codes (e.g., **–o**), or keyword options (e.g., **––output**). A single character option specification consists of a hyphen '–' followed by one or more option characters (e.g., **–Ab**). If an option requires an argument, the argument may immediately follow the option letter, or may be separated from the option letter by white space. A keyword option specification consists of two hyphens followed by the option keyword (e.g., **––strict**). Keyword options may be abbreviated by specifying as many of the leading characters of the option name as are needed to uniquely identify an option name (for example, the **––wchar_t_keyword** option may be abbreviated as **––wc**). Note that this is not supported by the control program! If an option requires an argument, the argument may be separated from the keyword by white space, or the keyword may be immediately followed by **=***option*. When the second form is used there may not be any white space on either side of the equals sign.

The priority of the options is left–to–right: when two options conflict, the first (most left) one takes effect. The **–D** and **–U** options are not considered conflicting options, so they are processed left–to–right for each source file. You can overrule the default output file name with the **––gen_c_file_name** option.

A summary of the options is given below. The next section describes the options in more detail.

Option	Description
–?	Display invocation syntax
––alternative_tokens **––no_alternative_tokens**	Enable or disable recognition of alternative tokens

Option	Description
––anachronisms **––no_anachronisms**	Enable or disable anachronisms
––arg_dep_lookup **––no_arg_dep_lookup**	Perform argument dependent lookup of unqualified function names
––array_new_and_delete **––no_array_new_and_delete**	Enable or disable support for array new and delete
––auto_instantiation **––no_auto_instantiation** **–T**	Enable or disable automatic instantiation of templates
––base_assign_op_is_default **––no_base_assign_op_is_default**	Enable or disable the anachronism of accepting a copy assignment operator with a base class as a default for the derived class
––bool **––no_bool**	Enable or disable recognition of `bool`
––brief_diagnostics **––no_brief_diagnostics**	Enable or disable a shorter form of diagnostic output
––cfront_2.1 **–b**	Compile C++ compatible with cfront version 2.1
––cfront_3.0	Compile C++ compatible with cfront version 3.0
––class_name_injection **––no_class_name_injection**	Add class name to the scope of the class
––comments **–C**	Keep comments in the preprocessed output
–C*cpu*	Include SFR definition file reg*cpu*.sfr before source
––const_string_literals **––no_const_string_literals**	Make string literals `const`
––create_pch *file*	Create a precompiled header file with the specified name

USAGE

Option	Description
––define_macro *macro*[**(***parm–list***)**][**=***def*] **–D***macro*[**(***parm–list***)**][**=***def*]	Define preprocessor *macro*
––dependencies **–M**	Preprocess only. Emit dependencies for make
––diag_suppress *tag*[**,***tag*]... **––diag_remark** *tag*[**,***tag*]... **––diag_warning** *tag*[**,***tag*]... **––diag_error** *tag*[**,***tag*]...	Override normal error severity
––display_error_number	Display error number in diagnostic messages
––distinct_template_signatures **––no_distinct_template_signatures**	Disallow or allow normal functions as template instantiation
––dollar **–$**	Accept dollar signs in identifiers
––early_tiebreaker	Early handling of tie–breakers in overload resolution
––embedded **––no_embedded**	Enable or disable support for embedded C++ language extension keywords
––embedded_c++	Enable the diagnostics of noncompliance with the ”Embedded C++” subset
––enum_overloading **––no_enum_overloading**	Enable or disable operator functions to overload builtin operators on enum–typed operands
––error_limit *number* **–e***number*	Specify maximum *number* of errors
––error_output *efile*	Send diagnostics to error list file
––exceptions **––no_exceptions** **–x**	Enable or disable support for exception handling
––explicit **––no_explicit**	Enable or disable support for the `explicit` specifier on constructor declarations

Option	Description
––extended_variadic_macros **––no_extended_variadic_macros**	Allow (or disallow) macros with a variable number of arguments and allow the naming of the list
––extern_inline **––no_extern_inline**	Enable or disable inline function with external C++ linkage
–F	Single precision floating point
––force_vtbl	Force definition of virtual function tables
––for_init_diff_warning **––no_for_init_diff_warning**	Enable or disable warning when old–style `for`–scoping is used
––friend_injection **––no_friend_injection**	Control the visibility of friend declarations
––gen_c_file_name *file*	Specify name of generated C output *file*
––guiding_decls **––no_guiding_decls**	Enable or disable recognition of ”guiding declarations” of template functions
––implicit_extern_c_type_conversion **––no_implicit_extern_c_type_conversion**	Enable or disable implicit type conversion between external C and C++ function pointers
––implicit_include **––no_implicit_include** **–B**	Enable or disable implicit inclusion of source files as a method of finding definitions of template entities to be instantiated
––implicit_typename **––no_implicit_typename**	Enable or disable implicit determination, from context, whether a template parameter dependent name is a type or nontype
––incl_suffixes *suffixes*	Set the valid suffixes for include files
––include_directory *dir* **–I***dir*	Look in directory *dir* for include files

Option	Description
––inlining **––no_inlining**	Enable or disable minimal inlining of function calls
––instantiate *mode* **–t** *mode*	Control instantiation of external template entities
––instantiation_dir *dir*	Write instantiation files to *dir*
––late_tiebreaker	Late handling of tie–breakers in overload resolution
––list *lfile* **–L** *lfile*	Generate raw list file *lfile*
––long_lifetime_temps **––short_lifetime_temps**	Select lifetime for temporaries
––long_preserving_rules **––no_long_preserving_rules**	Enable or disable K&R arithmetic conversion rules for longs
––namespaces **––no_namespaces**	Enable or disable the support for namespaces
––new_for_init	New–style `for`–scoping rules
––no_code_gen **–n**	Do syntax checking only
––no_line_commands **–P**	Preprocess only. Remove line control information and comments
––nonconst_ref_anachronism **––no_nonconst_ref_anachronism**	Enable or disable the anachronism of allowing a reference to nonconst to bind to a class rvalue of the right type
––nonstd_qualifier_deduction **––no_nonstd_qualifier_deduction**	Use (or do not use) a non–standard template argument deduction method
––nonstd_using_decl **––no_nonstd_using_decl**	Allow or disallow unqualified name in non–member using declaration
––no_preproc_only	Specify that a full compilation should be done (not just preprocessing)

Option	Description
––no_use_before_set_warnings **–j**	Suppress warnings on local automatic variables that are used before their values are set
––no_warnings **–w**	Suppress all warning messages
––old_for_init	Old–style `for`–scoping rules
––old_line_commands	Put out line control information in the form # *nnn* instead of #line *nnn*
––old_specializations **––no_old_specializations**	Enable or disable old–style template specialization
––old_style_preprocessing	Forces pcc style preprocessing
––one_instantiation_per_object	Create separate instantiation files
––output *file* **–o** *file*	Specify name of preprocess or intermediate output *file*
––pch	Automatically use and/or create a precompiled header file
––pch_dir *dir*	Specify directory *dir* in which to search for and/or create a precompiled header file
––pch_messages **––no_pch_messages**	Enable or disable the display of a message indicating that a precompiled header file was created or used in the current compilation
––pch_verbose	Generate a message when a precompiled header file cannot be used
––pending_instantiations *n*	Maximum number of instantiations for a single template (default 64)
––preinclude *file*	Include *file* at the beginning of the compilation
––preprocess **–E**	Preprocess only. Keep line control information and remove comments
––remarks **–r**	Issue remarks

Option	Description
––remove_unneeded_entities **––no_remove_unneeded_entities**	Enable or disable the removal of unneeded entities from the generated intermediate C file
––rtti **––no_rtti**	Enable or disable support for RTTI (run–time type information)
––signed_chars **–s**	Treat all ’char’ variables as signed
––special_subscript_cost **––no_special_subscript_cost**	Enable or disable a special nonstandard weighting of the conversion to the integral operand of the `[]` operator in overload resolution.
––strict **–A**	Strict ANSI C++. Issue errors on non–ANSI features
––strict_warnings **–a**	Strict ANSI C++. Issue warnings on non–ANSI features
––suppress_typeinfo_vars	Suppress type info variables in generated C
––suppress_vtbl	Suppress definition of virtual function tables
––sys_include *dir*	Look in directory *dir* for system include files
––timing **–#**	Generate compilation timing information
––trace_includes **–H**	Preprocess only. Generate list of included files
––tsw_diagnostics **––no_tsw_diagnostics**	Enable or disable TASKING style diagnostic messages
––typename **––no_typename**	Enable or disable recognition of `typename`
––undefine_macro *macro* **–U***macro*	Remove preprocessor *macro*

Option	Description
––unsigned_chars **–u**	Treat all 'char' variables as unsigned
––use_pch *file*	Use a precompiled header file of the specified name
––using_std **––no_using_std**	Enable or disable implicit use of the `std` namespace when standard header files are included
––variadic_macros **––no_variadic_macros**	Allow (or disallow) macros with a variable number of arguments
––version **–V** **–v**	Display version header only
––warnings_as_errors	Treat warnings as errors
––wchar_t_keyword **––no_wchar_t_keyword**	Enable or disable recognition of `wchar_t` as a keyword
––wrap_diagnostics **––no_wrap_diagnostics**	Enable or disable wrapping of diagnostic messages
––xref *xfile* **–X** *xfile*	Generate cross–reference file *xfile*

Table 4–1: Compiler options (alphabetical)

Description	Option
Include options	
Include SFR definition file reg*cpu*.sfr before source	**–C***cpu*
Look in *dir* for include files	**––include_directory** *dir* **–I***dir*
Look in *dir* for system include files	**––sys_include** *dir*
Set the valid suffixes for include files	**––incl_suffixes** *suffixes*
Include *file* at the beginning of the compilation	**––preinclude** *file*

Description	Option
Preprocess options	
Preprocess only. Keep line control information and remove comments	**––preprocess** **–E**
Preprocess only. Remove line control information and comments	**––no_line_commands** **–P**
Keep comments in the preprocessed output	**––comments** **–C**
Do syntax checking only	**––no_code_gen** **–n**
Specify that a full compilation should be done (not just preprocessing)	**––no_preproc_only**
Put out line control information in the form # *nnn* instead of #line *nnn*	**––old_line_commands**
Forces pcc style preprocessing	**––old_style_preprocessing**
Preprocess only. Emit dependencies for make	**––dependencies** **–M**
Preprocess only. Generate list of included files	**––trace_includes** **–H**
Define preprocessor *macro*	**––define_macro** *macro*[**(***parm–list***)**] [**=***def*] **–D***macro*[**(***parm–list***)**][**=***def*]
Remove preprocessor *macro*	**––undefine_macro** *macro* **–U***macro*
Allow (or disallow) macros with a variable number of arguments	**––variadic_macros** **––no_variadic_macros**
Allow (or disallow) macros with a variable number of arguments and allow the naming of the list	**––extended_variadic_macros** **––no_extended_variadic_macros**
Language control options	
Strict ANSI C++. Issue errors on non–ANSI features	**––strict** **–A**
Strict ANSI C++. Issue warnings on non–ANSI features	**––strict_warnings** **–a**
Single precision floating point	**–F**
Compile C++ compatible with cfront version 2.1	**––cfront_2.1** **–b**
Compile C++ compatible with cfront version 3.0	**––cfront_3.0**

Description	Option
Accept dollar signs in identifiers	**––dollar** **–$**
Treat all 'char' variables as signed	**––signed_chars** **–s**
Treat all 'char' variables as unsigned	**––unsigned_chars** **–u**
Enable or disable K&R arithmetic conversion rules for longs	**––long_preserving_rules** **––no_long_preserving_rules**
Make string literals `const`	**––const_string_literals** **––no_const_string_literals**
Enable or disable support for exception handling	**––exceptions** **––no_exceptions** **–x**
Enable the diagnostics of noncompliance with the "Embedded C++" subset	**––embedded_c++**
Enable or disable support for embedded C++ language extension keywords	**––embedded** **––no_embedded**
Enable or disable operator functions to overload builtin operators on enum–typed operands	**––enum_overloading** **––no_enum_overloading**
Enable or disable support for the `explicit` specifier on constructor declarations	**––explicit** **––no_explicit**
Enable or disable inline function with external C++ linkage	**––extern_inline** **––no_extern_inline**
Enable or disable implicit type conversion between external C and C++ function pointers	**––implicit_extern_c_type_ conversion** **––no_implicit_extern_c_type_conv ersion**
Suppress type info variables in generated C	**––suppress_typeinfo_vars**
Suppress definition of virtual function tables	**––suppress_vtbl**
Force definition of virtual function tables	**––force_vtbl**
Enable or disable anachronisms	**––anachronisms** **––no_anachronisms**

Description	Option
Enable or disable the anachronism of accepting a copy assignment operator with a base class as a default for the derived class	**––base_assign_op_is_default** **––no_base_assign_op_is_default**
Enable or disable the anachronism of allowing a reference to nonconst to bind to a class rvalue of the right type	**––nonconst_ref_anachronism** **––no_nonconst_ref_anachronism**
Use (or do not use) a non–standard template argument deduction method	**––nonstd_qualifier_deduction** **––no_nonstd_qualifier_deduction**
Allow or disallow unqualified name in non–member using declaration	**––nonstd_using_decl** **––no_nonstd_using_decl**
Perform argument dependent lookup of unqualified function names	**––arg_dep_lookup** **––no_arg_dep_lookup**
Add class name to the scope of the class	**––class_name_injection** **––no_class_name_injection**
Control the visibility of friend declarations	**––friend_injection** **––no_friend_injection**
Early or late handling of tie–breakers in overload resolution	**––early_tiebreaker** **––late_tiebreaker**
Enable or disable support for array new and delete	**––array_new_and_delete** **––no_array_new_and_delete**
Enable or disable support for namespaces	**––namespaces** **––no_namespaces**
New–style `for`–scoping rules	**––new_for_init**
Old–style `for`–scoping rules	**––old_for_init**
Enable or disable implicit use of the `std` namespace when standard header files are included	**––using_std** **––no_using_std**
Enable or disable support for RTTI (run–time type information)	**––rtti** **––no_rtti**
Enable or disable recognition of `bool`	**––bool** **––no_bool**
Enable or disable recognition of `typename`	**––typename** **––no_typename**
Enable or disable implicit determination, from context, whether a template parameter dependent name is a type or nontype	**––implicit_typename** **––no_implicit_typename**

Description	Option
Enable or disable a special nonstandard weighting of the conversion to the integral operand of the `[]` operator in overload resolution.	**––special_subscript_cost** **––no_special_subscript_cost**
Enable or disable recognition of `wchar_t` as a keyword	**––wchar_t_keyword** **––no_wchar_t_keyword**
Select lifetime for temporaries	**––long_lifetime_temps** **––short_lifetime_temps**
Enable or disable recognition of alternative tokens	**––alternative_tokens** **––no_alternative_tokens**
Enable or disable minimal inlining of function calls	**––inlining** **––no_inlining**
Enable or disable the removal of unneeded entities from the generated intermediate C file	**––remove_unneeded_entities** **––no_remove_unneeded_entities**
Template instantiation options	
Control instantiation of external template entities	**––instantiate** *mode* **–t** *mode*
Enable or disable automatic instantiation of templates	**––auto_instantiation** **––no_auto_instantiation** **–T**
Create separate instantiation files	**––one_instantiation_per_object**
Write instantiation files to *dir*	**––instantiation_dir** *dir*
Enable or disable implicit inclusion of source files as a method of finding definitions of template entities to be instantiated	**––implicit_include** **––no_implicit_include** **–B**
Maximum number of instantiations for a single template (default 64)	**––pending_instantiations** *n*
Dis–allow or allow normal functions as template instantiation	**––distinct_template_signatures** **––no_distinct_template_signatures**
Enable or disable recognition of ”guiding declarations” of template functions	**––guiding_decls** **––no_guiding_decls**
Enable or disable old–style template specialization	**––old_specializations** **––no_old_specializations**

Description	Option
Precompiled header options	
Automatically use and/or create a precompiled header file	**––pch**
Create a precompiled header file with the specified name	**––create_pch** *file*
Use a precompiled header file of the specified name	**––use_pch** *file*
Specify directory *dir* in which to search for and/or create a precompiled header file	**––pch_dir** *dir*
Enable or disable the display of a message indicating that a precompiled header file was created or used in the current compilation	**––pch_messages** **––no_pch_messages**
Generate a message when a precompiled header file cannot be used	**––pch_verbose**
Output file options	
Specify name of preprocess or intermediate output *file*	**––output** *file* **–o** *file*
Specify name of generated C output *file*	**––gen_c_file_name** *file*
Diagnostic options	
Display invocation syntax	**–?**
Display version header only	**––version** **–V** **–v**
Generate compilation timing information	**––timing** **–#**
Send diagnostics to error list file	**––error_output** *efile*
Generate raw list file *lfile*	**––list** *lfile* **–L** *lfile*
Generate cross–reference file *xfile*	**––xref** *xfile* **–X** *xfile*
Override normal error severity	**––diag_suppress** *tag*[**,***tag*]... **––diag_remark** *tag*[**,***tag*]... **––diag_warning** *tag*[**,***tag*]... **––diag_error** *tag*[**,***tag*]...
Treat warnings as errors	**––warnings_as_errors**

Description	Option
Display error number in diagnostic messages	**––display_error_number**
Specify maximum *number* of errors	**––error_limit** *number* **–e***number*
Issue remarks	**––remarks** **–r**
Suppress all warning messages	**––no_warnings** **–w**
Suppress warnings on local automatic variables that are used before their values are set	**––no_use_before_set_warnings** **–j**
Enable or disable a shorter form of diagnostic output	**––brief_diagnostics** **––no_brief_diagnostics**
Enable or disable TASKING style diagnostic messages	**––tsw_diagnostics** **––no_tsw_diagnostics**
Enable or disable wrapping of diagnostic messages	**––wrap_diagnostics** **––no_wrap_diagnostics**
Enable or disable warning when old–style `for`–scoping is used	**––for_init_diff_warning** **––no_for_init_diff_warning**

Table 4–2: Compiler options (functional)

4.1.1 DETAILED DESCRIPTION OF THE COMPILER OPTIONS

Option letters are listed below. If the same option is used more than once, the first (most left) occurrence is used. The placement of command line options is of no importance except for the **–I** option. Some options also have a ”no_” form. These options are described together.

–?

Option:

–?

Description:

Display an explanation of options at stdout.

Example:

```
cptri  –?
```

--alternative_tokens

Option:

--alternative_tokens
--no_alternative_tokens

Default:

--alternative_tokens

Description:

Enable or disable recognition of alternative tokens. This controls recognition of the digraph tokens in C++, and controls recognition of the operator keywords (e.g., **not**, **and**, **bitand**, etc.).

Example:

To disable operator keywords (e.g., ”not”, ”and”) and digraphs, enter:

```
cptri  --no_alternative_tokens test.cc
```

--anachronisms

Option:

--anachronisms
--no_anachronisms

Default:

--no_anachronisms

Description:

Enable or disable anachronisms.

Example:

```
cptri  --anachronisms test.cc
```

--nonconst_ref_anachronisms,
--cfront_2.1 / **–b** / **--cfront_3.0**
Section *Anachronisms Accepted* in chapter *Language Implementation*.

--arg_dep_lookup

Option:

--arg_dep_lookup
--no_arg_dep_lookup

Default:

--arg_dep_lookup

Description:

Controls whether argument dependent lookup of unqualified function names is performed.

Example:

```
cptri  --no_arg_dep_lookup test.cc
```

--array_new_and_delete

Option:

--array_new_and_delete
--no_array_new_and_delete

Default:

--array_new_and_delete

Description:

Enable or disable support for array new and delete.

Example:

```
cptri  --no_array_new_and_delete test.cc
```

--auto_instantiation / -T

Option:

–T / **--auto_instantiation**
--no_auto_instantiation

Default:

--auto_instantiation

Description:

–T is equivalent to **--auto_instantiation**. Enable or disable automatic instantiation of templates.

Example:

```
cptri  --no_auto_instantiation test.cc
```

--instantiate / **–t**
Section *Template Instantiation* in chapter *Language Implementation*.

--base_assign_op_is_default

Option:

--base_assign_op_is_default
--no_base_assign_op_is_default

Default:

--base_assign_op_is_default (in cfront compatibility mode)

Description:

Enable or disable the anachronism of accepting a copy assignment operator that has an input parameter that is a reference to a base class as a default copy assignment operator for the derived class.

Example:

```
cptri  --base_assign_op_is_default test.cc
```

--bool

Option:

--bool
--no_bool

Default:

--bool

Description:

Enable or disable recognition of the `bool` keyword.

Example:

```
cptri  --no_bool test.cc
```

--brief_diagnostics

Option:

--brief_diagnostics
--no_brief_diagnostics

Default:

--brief_diagnostics

Description:

Enable or disable a mode in which a shorter form of the diagnostic output is used. When enabled, the original source line is not displayed and the error message text is not wrapped when too long to fit on a single line.

Example:

```
cptri  --no_brief_diagnostics test.cc
```

--wrap_diagnostics
Chapter *Compiler Diagnostics* and Appendix *Error Messages*.

-C

Option:

–C*cpu*

Arguments:

The CPU name which identifies your TriCore derivative.

Description:

Use special function register definitions for *cpu*. The filename looked for is "reg*cpu*.sfr" in the same way include files whose names are enclosed in "" are searched. The file is included before compiling the source.

Example:

To specify to the C++ compiler to look for a file named `regtc10gp.sfr`, and to use this file as a special function register definition file, enter:

```
cptri –Ctc10gp test.cc
```

--cfront_version / -b

Option:

–b / **--cfront_2.1**
--cfront_3.0

Default:

Normal C++ mode.

Description:

–b is equivalent to **--cfront_2.1**. **--cfront_2.1** or **--cfront_3.0** enable compilation of C++ with compatibility with cfront version 2.1 or 3.0 respectively. This causes the compiler to accept language constructs that, while not part of the C++ language definition, are accepted by the AT&T C++ Language System (cfront) release 2.1 or 3.0 respectively. These options also enable acceptance of anachronisms.

Example:

To compile C++ compatible with cfront version 3.0, enter:

```
cptri  --cfront_3.0 test.cc
```

--anachronisms
Section *Extensions Accepted in Cfront 2.1 and 3.0 Compatibility Mode* in chapter *Language Implementation*.

--class_name_injection

Option:

--class_name_injection
--no_class_name_injection

Default:

--class_name_injection

Description:

Controls whether the name of a class is injected into the scope of the class (as required by the standard) or is not injected (as was true in earlier versions of the C++ language).

Example:

```
cptri  --no_class_name_injection test.cc
```

--comments / -C

Option:

–C
--comments

Description:

Keep comments in the preprocessed output. This should be specified after either **--preprocess** or **--no_line_commands**; it does not of itself request preprocessing output.

Example:

To do preprocessing only, with comments and with line control information, enter:

```
cptri  –E –C test.cc
```

--preprocess / **–E**, **--no_line_commands** / **–P**

––const_string_literals

Option:

––const_string_literals
––no_const_string_literals

Default:

––const_string_literals

Description:

Control whether C++ string literals and wide string literals are `const` (as required by the standard) or non–`const` (as was true in earlier versions of the C++ language).

Example:

```
cptri  ––no_const_string_literals test.cc
```

--create_pch

Option:

--create_pch *filename*

Arguments:

A filename specifying the precompiled header file to create.

Description:

If other conditions are satisfied (see the *Precompiled Headers* section), create a precompiled header file with the specified name. If **--pch** (automatic PCH mode) or **--use_pch** appears on the command line following this option, its effect is erased.

Example:

To create a precompiled header file with the name `test.pch`, enter:

```
cptri  --create_pch test.pch test.cc
```

--pch, **--use_pch**
Section *Precompiled Headers* in chapter *Language Implementation*.

––define_macro / -D

Option:

–D*macro* [**(***parm–list***)**][**=***def*]
––define_macro *macro* [**(***parm–list***)**][**=***def*]

Arguments:

The macro you want to define and optionally its definition.

Description:

Define *macro* to the preprocessor, as in #define. If *def* is not given ('**=**' is absent), '1' is assumed. Function–style macros can be defined by appending a macro parameter list to *name*. Any number of symbols can be defined. The definition can be tested by the preprocessor with #if, #ifdef and #ifndef, for conditional compilations.

Example:

```
cptri  –DNORAM –DPI=3.1416 test.cc
```

––undefine_macro / **–U**

--dependencies / -M

Option:

–M
--dependencies

Description:

Do preprocessing only. Instead of the normal preprocessing output, generate on the preprocessing output file a list of dependency lines suitable for input to a ’make’ utility.

When implicit inclusion of templates is enabled, the output may indicate false (but safe) dependencies unless **--no_proproc_only** is also used.

When you use the control program you have to use the **–Em** option instead, to obtain the same result.

Examples:

```
cptri  -M test.cc
```

```
test.ic: test.cc
```

--preprocess / **–E**, **--no_line_commands** / **–P**

--diag_*option*

Option:

--diag_suppress *tag*[,*tag*]...
--diag_remark *tag*[,*tag*]...
--diag_warning *tag*[,*tag*]...
--diag_error *tag*[,*tag*]...

Arguments:

A mnemonic error tag or an error number.

Description:

Override the normal error severity of the specified diagnostic messages. The message(s) may be specified using a mnemonic error tag or using an error number. The error tag names and error numbers are listed in the *Error Messages* appendix.

Example:

When you want diagnostic error 20 to be a warning, enter:

```
cptri  --diag_warning 20 test.cc
```

Chapter *Compiler Diagnostics* and Appendix *Error Messages*.

--display_error_number

Option:

--display_error_number

Description:

Display the error message number in any diagnostic messages that are generated. The option may be used to determine the error number to be used when overriding the severity of a diagnostic message. The error numbers are listed in the *Error Messages* appendix.

Normally, diagnostics are written to stderr in the following form:

”*filename*”**, line** *line_num*: *message*

With **--display_error_number** this form will be:

”*filename*”**, line** *line_num*: *severity* **#***err_num*: *message*

or:

”*filename*”**, line** *line_num*: *severity* **#***err_num***–D**: *message*

If the severity may be overridden, the error number will include the suffix **–D** (for discretionary); otherwise no suffix will be present.

Example:

```
cptri  --display_error_number test.cc
```

```
”test.cc”, line 7: error #64–D: declaration does not
        declare anything

  struct ;
  ^
```

Chapter *Compiler Diagnostics* and Appendix *Error Messages*.

--distinct_template_signatures

Option:

--distinct_template_signatures
--no_distinct_template_signatures

Default:

--distinct_template_signatures

Description:

Control whether the signatures for template functions can match those for non–template functions when the functions appear in different compilation units. The default is **--distinct_template_signatures**, under which a normal function cannot be used to satisfy the need for a template instance; e.g., a function ”`void f(int)`” could not be used to satisfy the need for an instantiation of a template ”`void f(T)`” with `T` set to int. **--no_distinct_template_signatures** provides the older language behavior, under which a non–template function can match a template function. Also controls whether function templates may have template parameters that are not used in the function signature of the function template

Example:

```
cptri  --no_distinct_template_signatures test.cc
```

––dollar / -$

Option:

–$
––dollar

Default:

No dollar signs are allowed in identifiers.

Description:

Accept dollar signs in identifiers. Names like `A$VAR` are allowed.

Example:

```
cptri  –$ test.cc
```

--early_tiebreaker / --late_tiebreaker

Option:

--early_tiebreaker
--late_tiebreaker

Default:

--early_tiebreaker

Description:

Select the way that tie–breakers (e.g., cv–qualifier differences) apply in overload resolution. In "early" tie–breaker processing, the tie–breakers are considered at the same time as other measures of the goodness of the match of an argument value and the corresponding parameter type (this is the standard approach). In "late" tie–breaker processing, tie–breakers are ignored during the initial comparison, and considered only if two functions are otherwise equally good on all arguments; the tie–breakers can then be used to choose one function over another.

Example:

```
cptri  --late_tiebreaker test.cc
```

--embedded

Option:

--embedded
--no_embedded

Default:

--embedded

Description:

Enable or disable support for embedded C++ language extension keywords.

Example:

To disable embedded C++ language extension keywords, enter:

```
cptri  --no_embedded test.cc
```

––embedded_c++

Option:

––embedded_c++

Description:

Enable the diagnostics of noncompliance with the “Embedded C++” subset (from which templates, exceptions, namespaces, new–style casts, RTTI, multiple inheritance, virtual base classes, and `mutable` are excluded.

Example:

To enable the diagnostics of noncompliance with the “Embedded C++” subset, enter:

```
cptri  ––embedded_c++ test.cc
```

--enum_overloading

Option:

--enum_overloading
--no_enum_overloading

Default:

--enum_overloading

Description:

Enable or disable support for using operator functions to overload builtin operations on enum–typed operands.

Example:

To disable overloading builtin operations on enum–typed operands, enter:

```
cptri  --no_enum_overloading test.cc
```

––error_limit / -e

Option:

–e*number*
––error_limit *number*

Arguments:

An error limit number.

Default:

––error_limit 100

Description:

Set the error limit to *number*. The C++ compiler will abandon compilation after this number of errors (remarks and warnings are not counted toward the limit). By default, the limit is 100.

Example:

When you want compilation to stop when 10 errors occurred, enter:

```
cptri  –e10 test.cc
```

––error_output

Option:

––error_output *efile*

Arguments:

The name for an error output file.

Description:

Redirect the output that would normally go to stderr (that is, diagnostic messages) to the file *efile*. This option is useful on systems where output redirection of files is not well supported. If used, this option should probably be specified first in the command line, since otherwise any command–line errors for options preceding the **––error_output** would be written to stderr before redirection.

Example:

To write errors to the file `test.err` instead of stderr, enter:

```
cptri ––error_output test.err test.cc
```

––exceptions / -x

Option:

–x / **––exceptions**
––no_exceptions

Default:

––no_exceptions

Description:

Enable or disable support for exception handling. **–x** is equivalent to **––exceptions**.

Example:

```
cptri  --exceptions test.cc
```

--explicit

Option:

--explicit
--no_explicit

Default:

--explicit

Description:

Enable or disable support for the `explicit` specifier on constructor declarations.

Example:

To disable support for the `explicit` specifier on constructor declarations, enter:

```
cptri  --no_explicit test.cc
```

--extended_variadic_macros

Option:

--extended_variadic_macros
--no_extended_variadic_macros

Default:

--no_extended_variadic_macros

Description:

Allow or disallow macros with a variable number of arguments (implies **--variadic_macros**) and alow or disallow the naming of the variable argument list.

Example:

```
cptri  --extended_variadic_macros test.cc
```

--variadic_macros

--extern_inline

Option:

--extern_inline
--no_extern_inline

Default:

--extern_inline

Description:

Enable or disable support for `inline` functions with external linkage in C++. When `inline` functions are allowed to have external linkage (as required by the standard), then `extern` and `inline` are compatible specifiers on a non–member function declaration; the default linkage when `inline` appears alone is external (that is, `inline` means `extern inline` on non–member functions); and an `inline` member function takes on the linkage of its class (which is usually external). However, when `inline` functions have only internal linkage (as specified in the ARM), then `extern` and `inline` are incompatible; the default linkage when inline appears alone is internal (that is, `inline` means `static inline` on non–member functions); and `inline` member functions have internal linkage no matter what the linkage of their class.

Example:

```
cptri  --no_extern_inline test.cc
```

–F

Option:

–F

Description:

–F forces using single precision floating point only, even when `double` or `long double` is used. In fact `double` and `long double` are treated as `float` and default argument promotion from `float` to `double` is suppressed. Every expression is evaluated in single precision. This saves a lot of code and increases the execution speed.

Examples:

To force `double` to be treated as `float`, enter:

```
cptri –F test.cc
```

--for_init_diff_warning

Option:

--for_init_diff_warning
--no_for_init_diff_warning

Default:

--for_init_diff_warning

Description:

Enable or disable a warning that is issued when programs compiled under the new for–init scoping rules would have had different behavior under the old rules. The diagnostic is only put out when the new rules are used.

Example:

```
cptri  --no_for_init_diff_warning test.cc
```

--new_for_init / **--old_for_init**

--force_vtbl

Option:

--force_vtbl

Description:

Force definition of virtual function tables in cases where the heuristic used by the C++ compiler to decide on definition of virtual function tables provides no guidance. See **--suppress_vtbl**.

Example:

```
cptri  --force_vtbl test.cc
```

--suppress_vtbl

--friend_injection

Option:

--friend_injection
--no_friend_injection

Default:

--no_friend_injection

Description:

Controls whether the name of a class or function that is declared only in `friend` declarations is visible when using the normal lookup mechanisms. When `friend` names are injected, they are visible to such lookups. When `friend` names are not injected (as required by the standard), function names are visible only when using argument–dependent lookup, and class names are never visible.

Example:

```
cptri  --friend_injection test.cc
```

--arg_dep_lookup

--gen_c_file_name

Option:

--gen_c_file_name *file*

Arguments:

An output filename.

Default:

Module name with `.ic` suffix.

Description:

This option specifies the file name to be used for the generated C output.

Example:

To specify the file `out.ic` as the output file instead of `test.ic`, enter:

```
cptri --gen_c_file_name out.ic test.cc
```

--guiding_decls

Option:

--guiding_decls
--no_guiding_decls

Default:

--guiding_decls

Description:

Enable or disable recognition of "guiding declarations" of template functions. A guiding declaration is a function declaration that matches an instance of a function template but has no explicit definition (since its definition derives from the function template). For example:

```
template <class T> void f(T) { ... }
void f(int);
```

When regarded as a guiding declaration, `f(int)` is an instance of the template; otherwise, it is an independent function for which a definition must be supplied. If **--no_guiding_decls** is combined with **--old_specializations**, a specialization of a non–member template function is not recognized — it is treated as a definition of an independent function.

Example:

```
cptri  --no_guiding_decls test.cc
```

--old_specializations

--implicit_extern_c_type_conversion

Option:

--implicit_extern_c_type_conversion
--no_implicit_extern_c_type_conversion

Default:

--implicit_extern_c_type_conversion

Description:

Enable or disable an extension to permit implicit type conversion in C++ between a pointer to an `extern "C"` function and a pointer to an `extern "C++"` function. This extension is allowed in environments where C and C++ functions share the same calling conventions.

Example:

```
cptri  --no_implicit_extern_c_type_conversion test.cc
```

--implicit_include / -B

Option:

–B / **--implicit_include**
--no_implicit_include

Default:

--no_implicit_include

Description:

Enable or disable implicit inclusion of source files as a method of finding definitions of template entities to be instantiated. **–B** is equivalent to **--implicit_include**.

Example:

```
cptri  --implicit_include test.cc
```

--instantiate / **–t**
Section *Template Instantiation* in chapter *Language Implementation*.

--implicit_typename

Option:

--implicit_typename
--no_implicit_typename

Default:

--implicit_typename

Description:

Enable or disable implicit determination, from context, whether a template parameter dependent name is a type or nontype.

Example:

```
cptri  --no_implicit_typename test.cc
```

--typename

--incl_suffixes

Option:

--include_suffixes *suffixes*

Arguments:

A colon–separated list of suffixes (e.g., ”`h:hpp::`”).

Description:

Specifies the list of suffixes to be used when searching for an include file whose name was specified without a suffix. If a null suffix is to be allowed, it must be included in the suffix list.

The default suffix list is no extension, `.h` and `.hpp`.

Example:

To allow only the suffixes `.h` and `.hpp` as include file extensions, enter:

```
cptri  --incl_suffixes h:hpp test.cc
```

Section 4.2, *Include Files*.

--include_directory / -I

Option:

–I*directory*
--include_directory *directory*

Arguments:

The name of the directory to search for include file(s).

Description:

Change the algorithm for searching #include files whose names do not have an absolute pathname to look in *directory*.

Example:

```
cptri  –I/proj/include test.cc
```

Section 4.2, *Include Files*.
--sys_include

--inlining

Option:

--inlining
--no_inlining

Default:

--inlining

Description:

Enable or disable minimal inlining of function calls.

Example:

To disable function call inlining, enter:

```
cptri  --no_inlining test.cc
```

––instantiate / -t

Option:

–t*mode*
––instantiate *mode*

Pragma:

instantiate *mode*

Arguments:

The instantiation mode, which can be one of:

none
used
all
local

Default:

–tnone

Description:

Control instantiation of external template entities. External template entities are external (that is, noninline and nonstatic) template functions and template static data members. The instantiation mode determines the template entities for which code should be generated based on the template definition:

none Instantiate no template entities. This is the default.

used Instantiate only the template entities that are used in this compilation.

all Instantiate all template entities whether or not they are used.

local Instantiate only the template entities that are used in this compilation, and force those entities to be local to this compilation.

Example:

To specify to instantiate only the template entities that are used in this compilation, enter:

```
cptri  –tused test.cc
```

--auto_instantiation / –T
Section *Template Instantiation* in chapter *Language Implementation*.

--instantiation_dir

Option:

--instantiation_dir *directory*

Arguments:

The name of the directory to write instantiation files to.

Description:

You can use this option in combination with option **--one_instantiation_per_object** to specify a directory into which the generated object files should be put.

Example:

To create separate instantiation files in directory `/proj/template`, enter:

```
cptri  --one_instantiation_per_object \
       --instantiation_dir /proj/template test.cc
```

Section *Template Instantiation* in chapter *Language Implementation*.
--one_instantiation_per_object

––list / -L

Option:

–L*lfile*
––list *lfile*

Arguments:

The name of the list file.

Description:

Generate raw listing information in the file *lfile*. This information is likely to be used to generate a formatted listing. The raw listing file contains raw source lines, information on transitions into and out of include files, and diagnostics generated by the C++ compiler. Each line of the listing file begins with a key character that identifies the type of line, as follows:

N: a normal line of source; the rest of the line is the text of the line.

X: the expanded form of a normal line of source; the rest of the line is the text of the line. This line appears following the N line, and only if the line contains non–trivial modifications (comments are considered trivial modifications; macro expansions, line splices, and trigraphs are considered non–trivial modifications).

S: a line of source skipped by an #if or the like; the rest of the line is text. Note that the #else, #elif, or #endif that ends a skip is marked with an N.

L: an indication of a change in source position. The line has a format similar to the # line–identifying directive output by cpp, that is to say

L *line_number* "*file–name*" *key*

where *key* is,

1 for entry into an include file;

2 for exit from an include file;

and omitted otherwise.

The first line in the raw listing file is always an L line identifying the primary input file. L lines are also output for #line directives (*key* is omitted). L lines indicate the source position of the following source line in the raw listing file.

R, **W**, **E**, or **C**: an indication of a diagnostic (R for remark, W for warning, E for error, and C for catastrophic error). The line has the form

S "file–name" line_number column–number message–text

where *S* is R, W, E, or C, as explained above. Errors at the end of file indicate the last line of the primary source file and a column number of zero. Command line errors are catastrophes with an empty file name ("") and a line and column number of zero. Internal errors are catastrophes with position information as usual, and message–text beginning with (internal error). When a diagnostic displays a list (e.g., all the contending routines when there is ambiguity on an overloaded call), the initial diagnostic line is followed by one or more lines with the same overall format (code letter, file name, line number, column number, and message text), but in which the code letter is the lower case version of the code letter in the initial line. The source position in such lines is the same as that in the corresponding initial line.

Example:

To write raw listing information to the file `test.lst`, enter:

```
cptri –L test.lst test.cc
```

--long_lifetime_temps / --short_lifetime_temps

Option:

--long_lifetime_temps
--short_lifetime_temps

Default:

--long_lifetime_temps	(cfront)
--short_lifetime_temps	(standard C++)

Description:

Select the lifetime for temporaries: short means to end of full expression; long means to the earliest of end of scope, end of switch clause, or the next label. Short is standard C++, and long is what cfront uses (the cfront compatibility modes select long by default).

Example:

```
cptri  --long_lifetime_temps test.cc
```

--long_preserving_rules

Option:

--long_preserving_rules
--no_long_preserving_rules

Default:

--no_long_preserving_rules

Description:

Enable or disable the K&R usual arithmetic conversion rules with respect to `long`. This means the rules of K&R I, Appendix A, 6.6. The significant difference is in the handling of "`long` *op* `unsigned int`" when `int` and `long` are the same size. The ANSI/ISO rules say the result is `unsigned long`, but K&R I says the result is `long` (`unsigned long` did not exist in K&R I).

The default is the ANSI/ISO rule.

Example:

```
cptri  --long_preserving_rules test.cc
```

--namespaces

Option:

--namespaces
--no_namespaces

Default:

--namespaces

Description:

Enable or disable support for namespaces.

Example:

```
cptri  --no_namespaces test.cc
```

--using_std
Section *Namespace Support* in chapter *Language Implementation*.

--new_for_init / --old_for_init

Option:

--new_for_init
--old_for_init

Default:

--new_for_init

Description:

Control the scope of a declaration in a `for-init-statement`. The old (cfront–compatible) scoping rules mean the declaration is in the scope to which the `for` statement itself belongs; the new (standard–conforming) rules in effect wrap the entire `for` statement in its own implicitly generated scope.

Example:

```
cptri  --old_for_init test.cc
```

--no_code_gen / -n

Option:

–n
--no_code_gen

Description:

Do syntax–checking only. Do not generate a C file.

Example:

```
cptri  --no_code_gen test.cc
```

--no_line_commands / -P

Option:

–P
--no_line_commands

Description:

Do preprocessing only. Write preprocessed text to the preprocessing output file, with comments removed and without line control information. When you use the **–P** option, use the **–o** option to separate the output from the header produced by the compiler.

Examples:

```
cptri  -P -o preout test.cc
```

--comments / **–C**, **--preprocess** / **–E**, **--dependencies** / **–M**

--nonconst_ref_anachronism

Option:

--nonconst_ref_anachronism
--no_nonconst_ref_anachronism

Default:

--nonconst_ref_anachronism

Description:

Enable or disable the anachronism of allowing a reference to nonconst to bind to a class rvalue of the right type. This anachronism is also enabled by the **--anachronisms** option and the cfront–compatibility options.

Example:

```
cptri  --no_nonconst_ref_anachronism test.cc
```

--anachronisms, **--cfront_2.1** / **–b** / **--cfront_3.0**
Section *Anachronisms Accepted* in chapter *Language Implementation*.

--nonstd_qualifier_deduction

Option:

--nonstd_qualifier_deduction
--no_nonstd_qualifier_deduction

Default:

--no_nonstd_qualifier_deduction

Description:

Controls whether nonstandard template argument deduction should be performed in the qualifier portion of a qualified name. With this feature enabled, a template argument for the template parameter `T` can be deduced in contexts like `A<T>::B` or `T::B`. The standard deduction mechanism treats these as nondeduced contexts that use the values of template parameters that were either explicitly specified or deduced elsewhere.

Example:

```
cptri  --nonstd_qualifier_deduction test.cc
```

--nonstd_using_decl

Option:

--nonstd_using_decl
--no_nonstd_using_decl

Default:

--no_nonstd_using_decl

Description:

Controls whether a non–member using declaration that specifies an unqualified name is allowed.

Example:

```
cptri  --nonstd_using_decl test.cc
```

--no_preproc_only

Option:

--no_proproc_only

Description:

May be used in conjunction with the options that normally cause the C++ compiler to do preprocessing only (e.g., **--preprocess**, etc.) to specify that a full compilation should be done (not just preprocessing). When used with the implicit inclusion option, this makes it possible to generate a preprocessed output file that includes any implicitly included files.

Examples:

```
cptri  -E -B --no_preproc_only test.cc
```

--preprocess / **–E**,
--implicit_include / **–B**, **--no_line_commands** / **–P**

--no_use_before_set_warnings / -j

Option:

–j
--no_use_before_set_warnings

Description:

Suppress warnings on local automatic variables that are used before their values are set.

Example:

```
cptri  –j test.cc
```

--no_warnings / –w

--no_warnings / -w

Option:

–w
--no_warnings

Description:

Suppress all warning messages. Error messages are still issued.

Example:

To suppress all warnings, enter:

```
cptri –w test.cc
```

--old_line_commands

Option:

--old_line_commands

Description:

When generating source output, put out #line directives in the form used by the Reiser cpp, that is, # *nnn* instead of #line *nnn*.

Example:

To do preprocessing only, without comments and with old style line control information, enter:

```
cptri  -E --old_line_commands test.cc
```

--preprocess / **-E**, **--no_line_commands** / **-P**

--old_specializations

Option:

--old_specializations
--no_old_specializations

Default:

--old_specializations

Description:

Enable or disable acceptance of old–style template specializations (that is, specializations that do not use the `template<>` syntax).

Example:

```
cptri  --no_old_specializations test.cc
```

--old_style_preprocessing

Option:

--old_style_preprocessing

Description:

Forces pcc style preprocessing when compiling. This may be used when compiling an ANSI C++ program on a system in which the system header files require pcc style preprocessing.

Example:

To force pcc style preprocessing, enter:

```
cptri  -E --old_style_preprocessing test.cc
```

--preprocess / **-E**, **--no_line_commands** / **-P**

--one_instantiation_per_object

Option:

--one_instantiation_per_object

Description:

Put out each template instantiation in this compilation (function or static data member) in a separate object file. The primary object file contains everything else in the compilation, that is, everything that is not an instantiation. Having each instantiation in a separate object file is very useful when creating libraries, because it allows the user of the library to pull in only the instantiations that are needed. That can be essential if two different libraries include some of the same instantiations.

Example:

To create separate instantiation files, enter:

```
cptri  --one_instantiation_per_object test.cc
```

Section *Template Instantiation* in chapter *Language Implementation*.

--output / -o

Option:

–o *file*
--output *file*

Arguments:

An output filename specifying the preprocessing or intermediate language output file.

Default:

No intermediate output file is generated.

Description:

Use *file* as output filename for the preprocessing or intermediate language output file.

Example:

To use the file `my.pre` as the preprocessing output file, enter:

```
cptri  –E –o my.pre test.cc
```

--preprocess / –E, **--no_line_commands / –P**

--pch

Option:

--pch

Description:

Automatically use and/or create a precompiled header file. For details, see the *Precompiled Headers* section in chapter *Language Implementation*. If **--use_pch** or **--create_pch** (manual PCH mode) appears on the command line following this option, its effect is erased.

Example:

```
cptri  --pch test.cc
```

--use_pch, **--create_pch**
Section *Precompiled Headers* in chapter *Language Implementation*.

--pch_dir

Option:

--pch_dir *dir_name*

Arguments:

The name of the directory to search for and/or create a precompiled header file.

Description:

Specify the directory in which to search for and/or create a precompiled header file. This option may be used with automatic PCH mode (**--pch**) or manual PCH mode (**--create_pch** or **--use_pch**).

Example:

To use the directory `/usr/include/pch` to automatically create precompiled header files, enter:

```
cptri --pch_dir /usr/include/pch --pch test.cc
```

--pch, **--use_pch**, **--create_pch**
Section *Precompiled Headers* in chapter *Language Implementation*.

--pch_messages

Option:

--pch_messages
--no_pch_messages

Default:

--pch_messages

Description:

Enable or disable the display of a message indicating that a precompiled header file was created or used in the current compilation.

Example:

```
cptri  --create_pch test.pch --pch_messages test.cc
```

```
"test.cc": creating precompiled header file "test.pch"
```

--pch, **--use_pch**, **--create_pch**
Section *Precompiled Headers* in chapter *Language Implementation*.

--pch_verbose

Option:

--pch_verbose

Description:

In automatic PCH mode, for each precompiled header file that cannot be used for the current compilation, a message is displayed giving the reason that the file cannot be used.

Example:

```
cptri  --pch --pch_verbose test.cc
```

--pch
Section *Precompiled Headers* in chapter *Language Implementation*.

––pending_instantiations

Option:

––pending_instantiations *n*

Arguments:

The maximum number of instantiation for a single template.

Default:

64

Description:

Specifies the maximum number of instantiations of a given template that may be in process of being instantiated at a given time. This is used to detect runaway recursive instantiations. If *n* is zero, there is no limit.

Example:

To specify a maximum of 32 pending instantiations, enter:

```
cptri  ––pending_instantiations 32 test.cc
```

Section *Template Instantiation* in chapter *Language Implementation*.

--preinclude

Option:

--preinclude *filename*

Arguments:

The name of file to include at the beginning of the compilation.

Description:

Include the source code of the indicated file at the beginning of the compilation. This can be used to establish standard macro definitions, etc.

The filename is searched for in the directories on the include search list.

Example:

```
cptri  --preinclude extra.h test.cc
```

Section 4.2, *Include Files*.

--preprocess / -E

Option:

–E
--preprocess

Description:

Do preprocessing only. Write preprocessed text to the preprocessing output file, with comments removed and with line control information. When you use the **–E** option, use the **–o** option to separate the output from the header produced by the compiler.

Example:

```
cptri  –E –o preout test.cc
```

--comments / **–C**,
--dependencies / **–M**,
--no_line_commands / **–P**

––remarks / -r

Option:

–r
––remarks

Description:

Issue remarks, which are diagnostic messages even milder than warnings.

Example:

To enable the display of remarks, enter:

```
cptri –r test.cc
```

--remove_unneeded_entities

Option:

--remove_unneeded_entities
--no_remove_unneeded_entities

Default:

--remove_unneeded_entities

Description:

Enable or disable an optimization to remove unneeded entities from the generated intermediate C file. Something may be referenced but unneeded if it is referenced only by something that is itself unneeded; certain entities, such as global variables and routines defined in the translation unit, are always considered to be needed.

Example:

```
cptri  --no_remove_unneeded_entities test.cc
```

––rtti

Option:

––rtti
––no_rtti

Default:

––no_rtti

Description:

Enable or disable support for RTTI (run–time type information) features: `dynamic_cast`, `typeid`.

Example:

```
cptri  ––rtti test.cc
```

--signed_chars / -s

Option:

–s
--signed_chars

Description:

Treat ’character’ type variables as ’signed character’ variables. When plain char is signed, the macro `__SIGNED_CHARS__` is defined.

Example:

```
cptri  -s test.cc
```

--unsigned_chars / –u

--special_subscript_cost

Option:

--special_subscript_cost
--no_special_subscript_cost

Default:

--no_special_subscript_cost

Description:

Enable or disable a special nonstandard weighting of the conversion to the integral operand of the `[]` operator in overload resolution.

This is a compatibility feature that may be useful with some existing code. The special cost is enabled by default in cfront 3.0 mode. With this feature enabled, the following code compiles without error:

```
struct A {
      A();
      operator int *();
      int operator[](unsigned);
};
void main() {
      A a;
      a[0]; // Ambiguous, but allowed with this option
            // operator[] is chosen
}
```

Example:

`cptri  --special_subscript_cost test.cc`

––strict / -A
––strict_warnings / -a

Option:

–A / **––strict**

–a / **––strict_warnings**

Description:

Enable strict ANSI mode, which provides diagnostic messages when non–ANSI features are used, and disables features that conflict with ANSI C or C++. ANSI violations can be issued as either warnings or errors depending on which command line option is used. The **––strict** options issue errors and the **––strict_warnings** options issue warnings. The error threshold is set so that the requested diagnostics will be listed.

Example:

To enable strict ANSI mode, with error diagnostic messages, enter:

```
cptri  –A test.cc
```

--suppress_typeinfo_vars

Option:

--suppress_typeinfo_vars

Description:

Suppress the generation of type info variables when run–time type info (RTTI) is disabled. By default only type info variables are generated, no other run–time type info. With this option you can also suppress type info varables.

Example:

```
cptri  --suppress_typeinfo_vars test.cc
```

--rtti

––suppress_vtbl

Option:

––suppress_vtbl

Description:

Suppress definition of virtual function tables in cases where the heuristic used by the C++ compiler to decide on definition of virtual function tables provides no guidance. The virtual function table for a class is defined in a compilation if the compilation contains a definition of the first non–inline non–pure virtual function of the class. For classes that contain no such function, the default behavior is to define the virtual function table (but to define it as a local static entity). The **––suppress_vtbl** option suppresses the definition of the virtual function tables for such classes, and the **––force_vtbl** option forces the definition of the virtual function table for such classes. **––force_vtbl** differs from the default behavior in that it does not force the definition to be local.

Example:

```
cptri  --suppress_vtbl test.cc
```

––force_vtbl

--sys_include

Option:

--sys_include *directory*

Arguments:

The name of the system include directory to search for include file(s).

Description:

Change the algorithm for searching system include files whose names do not have an absolute pathname to look in *directory*.

Example:

```
cptri  --sys_include /proj/include test.cc
```

Section 4.2, *Include Files*.
--include_directory

––timing / -#

Option:

–#
––timing

Default:

No timing information is generated.

Description:

Generate compilation timing information. This option causes the compiler to display the amount of CPU time and elapsed time used by each phase of the compilation and a total for the entire compilation.

Example:

```
cptri  –# test.cc

processed 180 lines at 8102 lines/min
```

--trace_includes / -H

Option:

–H
--trace_includes

Description:

Do preprocessing only. Instead of the normal preprocessing output, generate on the preprocessing output file a list of the names of files #included.

Examples:

```
cptri  –H test.cc

iostream.h
string.h
```

--preprocess / **–E**, **--no_line_commands** / **–P**

--tsw_diagnostics

Option:

--tsw_diagnostics
--no_tsw_diagnostics

Default:

--tsw_diagnostics

Description:

Enable or disable a mode in which the error message is given in the TASKING style. So, in the same format as the TASKING C compiler messages.

Example:

```
cptri  --no_tsw_diagnostics test.cc
```

--brief_diagnostics
Chapter *Compiler Diagnostics* and Appendix *Error Messages*.

--typename

Option:

--typename
--no_typename

Default:

--typename

Description:

Enable or disable recognition of the `typename` keyword.

Example:

```
cptri  --no_typename test.cc
```

--implicit_typename

––undefine_macro / -U

Option:

–U*name*
––undefine_macro *name*

Arguments:

The name macro you want to undefine.

Description:

Remove any initial definition of identifier *name* as in #undef, unless it is a predefined ANSI standard macro. ANSI specifies the following predefined symbols to exist, which cannot be removed:

__FILE__	"current source filename"
__LINE__	current source line number (int type)
__TIME__	"hh:mm:ss"
__DATE__	"Mmm dd yyyy"
__STDC__	level of ANSI standard. This macro is set to 1 when the option to disable language extensions (**–A**) is effective. Whenever language extensions are excepted, __STDC__ is set to 0 (zero).
__cplusplus	is defined when compiling a C++ program

When **cptri** is invoked, also the following predefined symbols exist:

c_plusplus	is defined in addition to the standard __cplusplus
__SIGNED_CHARS__	is defined when plain `char` is signed.
_WCHAR_T	is defined when `wchar_t` is a keyword.
_BOOL	is defined when `bool` is a keyword.
__ARRAY_OPERATORS	is defined when array new and delete are enabled.

These symbols can be turned off with the **–U** option.

Example:

```
cptri  –Uc_plusplus test.cc
```

–D / --define_macro

--unsigned_chars / -u

Option:

–u
--unsigned_chars

Description:

Treat 'character' type variables as 'unsigned character' variables.

Example:

```
cptri  -u test.cc
```

--signed_chars / –s

--use_pch

Option:

--use_pch *filename*

Arguments:

The filename to use as a precompiled header file.

Description:

Use a precompiled header file of the specified name as part of the current compilation. If **--pch** (automatic PCH mode) or **--create_pch** appears on the command line following this option, its effect is erased.

Example:

To use the precompiled header file with the name `test.pch`, enter:

```
cptri  --use_pch test.pch test.cc
```

--pch, **--create_pch**
Section *Precompiled Headers* in chapter *Language Implementation*.

--using_std

Option:

--using_std
--no_using_std

Default:

--using_std

Description:

Enable or disable implicit use of the `std` namespace when standard header files are included.

Example:

```
cptri  --using_std test.cc
```

--namespaces
Section *Namespace Support* in chapter *Language Implementation*.

--variadic_macros

Option:

--variadic_macros
--no_variadic_macros

Default:

--no_variadic_macros

Description:

Allow or disallow macros with a variable number of arguments.

Example:

```
cptri  --variadic_macros test.cc
```

--extended_variadic_macros

––version / -V / -v

Option:

–V
–v
––version

Description:

Display version information.

Example:

```
cptri –V
```

```
TriCore C++ compiler vx.y rz  SN00000000–015 (c) year TASKING, Inc.
```

––warnings_as_errors

Option:

––warnings_as_errors

Description:

Treat warning messages as errors. This also affects the return value of the application when only warnings occur. A build process will now stop when warnings occur.

The error messages are listed in Appendix B, *Error Messages*.

Example:

```
cptri  ––warnings_as_errors test.cc
```

--wchar_t_keyword

Option:

--wchar_t_keyword
--no_wchar_t_keyword

Default:

--wchar_t_keyword

Description:

Enable or disable recognition of `wchar_t` as a keyword.

Example:

```
cptri  --no_wchar_t_keyword test.cc
```

--wrap_diagnostics

Option:

--wrap_diagnostics
--no_wrap_diagnostics

Default:

--wrap_diagnostics

Description:

Enable or disable a mode in which the error message text is not wrapped when too long to fit on a single line.

Example:

```
cptri  --no_wrap_diagnostics test.cc
```

--brief_diagnostics
Chapter *Compiler Diagnostics* and Appendix *Error Messages*.

--xref / -X

Option:

–X*xfile*
--xref *xfile*

Arguments:

The name of the cross–reference file.

Description:

Generate cross–reference information in the file *xfile*. For each reference to an identifier in the source program, a line of the form

symbol_id name X file–name line–number column–number

is written, where *X* is

D for definition;

d for declaration (that is, a declaration that is not a definition);

M for modification;

A for address taken;

U for used;

C for changed (but actually meaning used and modified in a single operation, such as an increment);

R for any other kind of reference, or

E for an error in which the kind of reference is indeterminate.

symbol–id is a unique decimal number for the symbol. The fields of the above line are separated by tab characters.

4.2 INCLUDE FILES

You may specify include files in two ways: enclosed in <...> or enclosed in ”...”. When an #include directive is seen, the following algorithm is used to try to open the include file:

1. If the filename is enclosed in ”...”, and it is not an absolute pathname (does not begin with a ’\’ for PC, or a ’/’ for UNIX), the include file is searched for in the directory of the file containing the #include line. For example, in:

   PC:

   ```
   cptri ..\..\source\test.cc
   ```

   UNIX:

   ```
   cptri ../../source/test.cc
   ```

   cptri first searches in the directory `..\..\source` (`../../source` for UNIX) for include files.

   If you compile a source file in the directory where the file is located (**cptri test.cc**), the compiler searches for include files in the current directory.

   This first step is not done for include files enclosed in <...>.

2. Use the directories specified with the **–I** or **--include_directory** option, in a left–to–right order. For example:

   PC:

   ```
   cptri –I..\..\include demo.cc
   ```

   UNIX:

   ```
   cptri –I../../include demo.cc
   ```

3. Check if the environment variable CPTRIINC exists. If it does exist, use the contents as a directory specifier for include files. You can specify more than one directory in the environment variable CPTRIINC by using a separator character. Instead of using **–I** as in the example above, you can specify the same directory using CPTRIINC:

PC:

```
set CPTRIINC=..\..\include
cptri demo.cc
```

UNIX:

if using the Bourne shell (sh)

```
CPTRIINC=../../include
export CPTRIINC
cptri demo.cc
```

or if using the C–shell (csh)

```
setenv CPTRIINC ../../include
cptri demo.cc
```

4. When an include file is not found with the rules mentioned above, the compiler tries the subdirectories `include.cpp` and `include`, one directory higher than the directory containing the **cptri** binary. For example:

   PC:

   cptri.exe is installed in the directory `C:\CTRI\BIN`
   The directories searched for the include file are
   `C:\CTRI\INCLUDE.CPP` and `C:\CTRI\INCLUDE`

   UNIX:

   cptri is installed in the directory `/usr/local/ctri/bin`
   The directories searched for the include file are
   `/usr/local/ctri/include.cpp` and
   `/usr/local/ctri/include`

   The compiler determines run–time which directory the binary is executed from to find this `include` directory.

5. If the include file is still not found, the directories specified in the **––sys_include** option are searched.

   A directory name specified with the **–I** option or in CPTRIINC may or may not be terminated with a directory separator, because **cptri** inserts this separator, if omitted.

When you specify more than one directory to the environment variable CPTRIINC, you have to use one of the following separator characters:

PC:

; **,** *space*

e.g. **`set CPTRIINC=..\..\include;\proj\include`**

UNIX:

: **;** **,** *space*

e.g. **`setenv CPTRIINC ../../include:/proj/include`**

If the include directory is specified as –, e.g., **–I–**, the option indicates the point in the list of **–I** or **--include_directory** options at which the search for file names enclosed in <...> should begin. That is, the search for <...> names should only consider directories named in **–I** or **--include_directory** options following the **–I–**, and the directories of items 3 and 4 above. **–I–** also removes the directory containing the current input file (item 1 above) from the search path for file names enclosed in ”...”.

An include directory specified with the **--sys_include** option is considered a “system” include directory. Warnings are suppressed when processing files found in system include directories.

If the filename has no suffix it will be searched for by appending each of a set of include file suffixes. When searching in a given directory all of the suffixes are tried in that directory before moving on to the next search directory. The default set of suffixes is, no extension, `.h` and `.hpp`. The default can be overridden using the **--incl_suffixes** command line option. A null file suffix cannot be used unless it is present in the suffix list (that is, the C++ compiler will always attempt to add a suffix from the suffix list when the filename has no suffix).

4.3 PRAGMAS

According to ANSI (3.8.6) a preprocessing directive of the form:

```
#pragma pragma-token-list new-line
```

causes the compiler to behave in an implementation–defined manner. The compiler ignores pragmas which are not mentioned in the list below. Pragmas give directions to the code generator of the compiler. Besides the pragmas there are two other possibilities to steer the code generator: command line options and keywords. The compiler acknowledges these three groups using the following rule:

Command line options can be overruled by keywords and pragmas. Keywords can be overruled by pragmas. So the pragma has the highest priority.

This approach makes it possible to set a default optimization level for a source module, which can be overridden temporarily within the source by a pragma.

cptri supports the following pragmas and all pragmas that are described in the *C Cross–Compiler User's Guide*:

instantiate
do_not_instantiate
can_instantiate
These are template instantiation pragmas. They are described in detail in the section *Template Instantiation* in chapter *Language Implementation*.

hdrstop
no_pch
These are precompiled header pragmas. They are described in detail in the section *Precompiled Headers* in chapter *Language Implementation*.

once
When placed at the beginning of a header file, indicates that the file is written in such a way that including it several times has the same effect as including it once. Thus, if the C++ compiler sees **#pragma once** at the start of a header file, it will skip over it if the file is #included again.

A typical idiom is to place an #ifndef guard around the body of the file, with a #define of the guard variable after the #ifndef:

```
#pragma once    // optional
#ifndef FILE_H
#define FILE_H
... body of the header file ...
#endif
```

The **#pragma once** is marked as optional in this example, because the C++ compiler recognizes the #ifndef idiom and does the optimization even in its absence. **#pragma once** is accepted for compatibility with other compilers and to allow the programmer to use other guard–code idioms.

ident This pragma is given in the form:

#pragma ident "*string***"**

or:

#ident "*string***"**

4.4 COMPILER LIMITS

The ANSI C standard [1–2.2.4] defines a number of translation limits, which a C compiler must support to conform to the standard. The standard states that a compiler implementation should be able to translate and execute a program that contains at least one instance of every one of the limits listed below. The C compiler's actual limits are given within parentheses.

Most of the actual compiler limits are determined by the amount of free memory in the host system. In this case a 'D' (Dynamic) is given between parentheses. Some limits are determined by the size of the internal compiler parser stack. These limits are marked with a 'P'. Although the size of this stack is 200, the actual limit can be lower and depends on the structure of the translated program.

- 15 nesting levels of compound statements, iteration control structures and selection control structures (P > 15)
- 8 nesting levels of conditional inclusion (50)
- 12 pointer, array, and function declarators (in any combinations) modifying an arithmetic, a structure, a union, or an incomplete type in a declaration (15)
- 31 nesting levels of parenthesized declarators within a full declarator (P > 31)
- 32 nesting levels of parenthesized expressions within a full expression (P > 32)
- 31 significant characters in an external identifier (full ANSI–C mode),
  120 significant characters in an external identifier (non ANSI–C mode)
- 511 external identifiers in one translation unit (D)
- 127 identifiers with block scope declared in one block (D)
- 1024 macro identifiers simultaneously defined in one translation unit (D)
- 31 parameters in one function declaration (D)
- 31 arguments in one function call (D)
- 31 parameters in one macro definition (D)
- 31 arguments in one macro call (D)
- 509 characters in a logical source line (1500)
- 509 characters in a character string literal or wide string literal (after concatenation) (1500)

- 8 nesting levels for **#include**d files (50)
- 257 case labels for a switch statement, excluding those for any nested switch statements (D)
- 127 members in a single structure or union (D)
- 127 enumeration constants in a single enumeration (D)
- 15 levels of nested structure or union definitions in a single struct–declaration–list (D)

CHAPTER 5

COMPILER DIAGNOSTICS

TASKING

CHAPTER 5

5.1 DIAGNOSTIC MESSAGES

Diagnostic messages have an associated *severity*, as follows:

- Catastrophic errors, also called 'fatal errors', indicate problems of such severity that the compilation cannot continue. For example: command–line errors, internal errors, and missing include files. If multiple source files are being compiled, any source files after the current one will not be compiled.
- Errors indicate violations of the syntax or semantic rules of the C++ language. Compilation continues, but object code is not generated.
- Warnings indicate something valid but questionable. Compilation continues and object code is generated (if no errors are detected).
- Remarks indicate something that is valid and probably intended, but which a careful programmer may want to check. These diagnostics are not issued by default. Compilation continues and object code is generated (if no errors are detected).
- The last class of messages are the internal compiler errors. These errors are caused by failed internal consistency checks and should never occur. However, if such a 'SYSTEM' error appears, please report the occurrence to TASKING, using a Problem Report form. Please include a diskette or tape, containing a small C++ program causing the error.

By default, **--tsw_diagnostics**, diagnostics are written to `stderr` with a form like the following:

```
test.cc
     5:   break;
E  116: a break statement may only be used within a loop or switch
```

With the command line option **--no_tsw_diagnostics** the message appear in the following form:

```
"test.cc", line 5: a break statement may only be used within a loop
          or switch
    break;
    ^
```

Note that the message identifies the file and line involved, and that the source line itself (with position indicated by the `^`) follows the message. If there are several diagnostics in one source line, each diagnostic will have the form above, with the result that the text of the source line will be displayed several times, with an appropriate position each time.

Long messages are wrapped to additional lines when necessary.

A configuration flag controls whether or not the string error: appears, i.e., the C++ compiler can be configured so that the severity string is omitted when the severity is error.

The command line option **--brief_diagnostics** may be used to request a shorter form of the diagnostic output in which the original source line is not displayed and the error message text is not wrapped when too long to fit on a single line.

The command line option **--display_error_number** may be used to request that the error number be included in the diagnostic message. When displayed, the error number also indicates whether the error may have its severity overridden on the command line (with one of the **--diag_***severity* options). If the severity may be overridden, the error number will include the suffix **–D** (for discretionary); otherwise no suffix will be present.

```
"Test_name.cc", line 7: error #64-D: declaration does not
          declare anything
  struct ;
  ^

"Test_name.cc", line 9: error #77: this declaration has no storage
          class or type specifier
  xxxxx;
  ^
```

Because an error is determined to be discretionary based on the error severity associated with a specific context, a given error may be discretionary in some cases and not in others.

For some messages, a list of entities is useful; they are listed following the initial error message:

```
"test.cc", line 4: error: more than one instance of overloaded
          function "f" matches the argument list:
            function "f(int)"
            function "f(float)"
            argument types are: (double)
    f(1.5);
    ^
```

In some cases, some additional context information is provided; specifically, such context information is useful when the C++ compiler issues a diagnostic while doing a template instantiation or while generating a constructor, destructor, or assignment operator function. For example:

```
"test.cc", line 7: error: "A::A()" is inaccessible
  B x;
     ^
          detected during implicit generation of "B::B()" at line 7
```

Without the context information, it is very hard to figure out what the error refers to.

For a list of error messages and error numbers, see Appendix *Error Messages*.

5.2 TERMINATION MESSAGES

cptri writes sign–off messages to `stderr` if errors are detected. For example, one of the following forms of message

`n errors detected in the compilation of "ifile".`

`1 catastrophic error detected in the compilation of "ifile".`

`n errors and 1 catastrophic error detected in the compilation of "ifile".`

is written to indicate the detection of errors in the compilation. No message is written if no errors were detected.

`Error limit reached.`

is written when the count of errors reaches the error limit (see the **–e** option); compilation is then terminated. The message

`Compilation terminated.`

is written at the end of a compilation that was prematurely terminated because of a catastrophic error. The message

`Compilation aborted`

is written at the end of a compilation that was prematurely terminated because of an internal error. Such an error indicates an internal problem in the compiler. If such an internal error appears, please report the occurrence to TASKING, using a Problem Report form. Please include a diskette or tape, containing a small C++ program causing the error.

5.3 RESPONSE TO SIGNALS

The signals `SIGINT` (caused by a user interrupt, like **^C**) and `SIGTERM` (caused by a **kill** command) are trapped by the C++ compiler and cause abnormal termination.

5.4 RETURN VALUES

cptri returns an exit status to the operating system environment for testing.

For example,

in a PC BATCH–file you can examine the exit status of the program executed with ERRORLEVEL:

```
cptri %1.cc
IF ERRORLEVEL 1 GOTO STOP_BATCH
```

In a Bourne shell script, the exit status can be found in the **$?** variable, for example:

```
cptri $*
case $? in
0)         echo ok ;;
2|4)       echo error ;;
esac
```

The exit status of **cptri** indicates the highest severity diagnostic detected and is one of the numbers of the following list:

–1 Abnormal termination
0 Compilation successful, no errors, maybe some remarks
0 There were warnings
2 There were user errors, but terminated normally
4 A catastrophic error, premature ending

When you used the command line option **--warnings_as_errors**, the exit status will be 2 when there were warnings.

APPENDIX

FLEXIBLE LICENSE MANAGER (FLEXlm)

A

TASKING

APPENDIX A

1 INTRODUCTION

This appendix discusses Globetrotter Software's Flexible License Manager and how it is integrated into the TASKING toolchain. It also contains descriptions of the Flexible License Manager license administration tools that are included with the package, the daemon log file and its contents, and the use of daemon options files to customize your use of the TASKING toolchain.

2 LICENSE ADMINISTRATION

2.1 OVERVIEW

The Flexible License Manager (FLEXlm) is a set of utilities that, when incorporated into software such as the TASKING toolchain, provides for managing access to the software.

The following terms are used to describe FLEXlm concepts and software components:

feature — A feature could be any of the following:

- A TASKING software product.
- A software product from another vendor.

license — The right to use a feature. FLEXlm restricts licenses for features by counting the number of licenses for features in use when new requests are made by the application software.

client — A TASKING application program.

daemon — A process that ”serves” clients. Sometimes referred to as a *server*.

vendor daemon — The daemon that dispenses licenses for the requested features. This daemon is built by an application's vendor, and contains the vendor's personal encryption code. **Tasking** is the vendor daemon for the TASKING software.

license daemon
The daemon process that sends client processes to the correct vendor daemon on the correct machine. The same license daemon is used by all applications from all vendors, as this daemon neither performs encryption nor dispenses licenses. The license daemon processes no user requests on its own, but forwards these requests to other daemons (the vendor daemons).

server node A computer system that is running both the license and vendor daemon software. The server node will contain all the dynamic information regarding the usage of all the features.

license file An end–user specific file that contains descriptions of the server nodes that can run the license daemons, the various vendor daemons, and the restrictions for all the licensed features.

The TASKING software is granted permission to run by FLEXlm daemons; the daemons are started when the TASKING toolchain is installed and run continuously thereafter. Information needed by the FLEXlm daemons to perform access management is contained in a license data file that is created during the toolchain installation process. As part of their normal operation, the daemons log their actions in a daemon log file, which can be used to monitor usage of the TASKING toolchain.

The following sections discuss:

- Installation of the FLEXlm daemons to provide for access to the TASKING toolchain.
- Customizing your use of the toolchain through the use of a daemon options file.
- Utilities that are provided to assist you in performing license administration functions.
- The daemon log file and its contents.

For additional information regarding the use of FLEXlm, refer to the chapter *Software Installation*.

2.2 PROVIDING FOR UNINTERRUPTED FLEXLM OPERATION

TASKING products licensed through FLEXlm contain a number of utilities for managing licenses. These utilities are bundled in the form of an extra product under the name SW000098. TASKING products themselves contain two additional files for FLEXlm in a *flexlm* subdirectory:

`Tasking`	The Tasking daemon (vendor daemon).
`license.dat`	A template license file.

If you have already installed FLEXlm (e.g. as part of another product) then it is not needed to install the bundled SW000098. After installing SW000098 on UNIX, the directory `/usr/local/flexlm` will contain two subdirectories, `bin` and `licenses`. After installing SW000098 on Windows the directory `c:\flexlm` will contain the subdirectory `bin`. The exact location may differ if FLEXlm has already been installed as part of a non–TASKING product but in general there will be a directory for executables such as `bin`. That directory must contain a copy of the **Tasking** daemon shipped with every TASKING product. It also contains the files:

`lmgrd`	The FLEXlm daemon (license daemon).
`lm*`	A group of FLEXlm license administration utilities.

Next to it, a license file must be present containing the information of all licenses. This file is usually called `license.dat`. The default location of the license file is in directory `c:\flexlm` for Windows and in `/usr/local/flexlm/licenses` for UNIX. If you did install SW000098 then the `licenses` directory on UNIX will be empty, and on Windows the file `license.dat` will be empty. In that case you can copy the `license.dat` file from the product to the `licenses` directory after filling in the data from your ”License Information Form”.

Be very careful not to overwrite an existing `license.dat` file because it contains valuable data.

Example `license.dat`:

```
SERVER HOSTNAME HOSTID PORT
DAEMON Tasking /usr/local/flexlm/bin/Tasking
FEATURE SW008002–32 Tasking 3.000 EXPDATE NUSERS PASSWORD SERIAL
```

After modifications from a license data sheet (example):

```
SERVER elliot 5100520c 7594
DAEMON Tasking /usr/local/flexlm/bin/Tasking
FEATURE SW008002-32 Tasking 3.000 1-jan-00 4 0B1810310210A6894 "123456"
```

If the `license.dat` file already exists then you should make sure that it contains the DAEMON and FEATURE lines from your license data sheet. An appropriate SERVER line should already be present in that case. You should only add a new SERVER line if no SERVER line is present. The third field of the DAEMON line is the pathname to the **Tasking** daemon and you may change it if necessary.

The default location for the license file on Windows is:

```
c:\flexlm\license.dat
```

On UNIX this is:

```
/usr/local/flexlm/licenses/license.dat
```

If the pathname of the resulting license file differs from this default location then you must set the environment variable **LM_LICENSE_FILE** to the correct pathname. If you have more than one product using the FLEXlm license manager you can specify multiple license files by separating each pathname (*lfpath*) with a '**;**' (on UNIX also '**:**') :

Windows:

set LM_LICENSE_FILE=*lfpath*[**;***lfpath*]...

UNIX:

setenv LM_LICENSE_FILE *lfpath*[**:***lfpath*]...

If you are running the TASKING software on multiple nodes, you have three options for making your license file available on all the machines:

1. Place the license file in a partition which is available (via NFS on Unix systems) to all nodes in the network that need the license file.
2. Copy the license file to all of the nodes where it is needed.
3. Set LM_LICENSE_FILE to "*port@host*", where *host* and *port* come from the SERVER line in the license file.

When the main license daemon **lmgrd** already runs it is sufficient to type the command:

```
lmreread
```

for notifying the daemon that the `license.dat` file has been changed. Otherwise, you must type the command:

```
lmgrd >/usr/tmp/license.log &
```

Both commands reside in the flexlm `bin` directory mentioned before.

2.3 DAEMON OPTIONS FILE

It is possible to customize the use of TASKING software using a daemon options file. This options file allows you to reserve licenses for specified users or groups of users, to restrict access to the TASKING toolchain, and to set software timeouts. The following table lists the keywords that are recognized at the start of a line of a daemon options file.

Keywords	Function
RESERVE	Ensure that TASKING software will always be available to one or more users or on one or more host computer systems.
INCLUDE	Specify a list of users who are allowed exclusive access to the TASKING software.
EXCLUDE	Specify a list of users who are not allowed to use the TASKING software.
GROUP	Specify a group of users for use in the other commands.
TIMEOUT	Allow licenses that are idle for a specified time to be returned to the free pool, for use by someone else.
NOLOG	Causes messages of the specified type to be filtered out of the daemon's log output.

Table A–1: Daemon options file keywords

In order to use the daemon options capability, you must create a daemon options file and list its pathname as the fourth field on the `DAEMON` line for the **Tasking** daemon in the license file. For example, if the daemon options were in file `/usr/local/flexlm/Tasking.opt` (UNIX), then you would modify the license file `DAEMON` line as follows:

```
DAEMON Tasking /usr/local/Tasking /usr/local/flexlm/Tasking.opt
```

A daemon options file consists of lines in the following format:

```
RESERVE     number feature {USER | HOST | DISPLAY | GROUP} name
INCLUDE     feature {USER | HOST | DISPLAY | GROUP} name
EXCLUDE     feature {USER | HOST | DISPLAY | GROUP} name
GROUP       name <list_of_users>
TIMEOUT     feature timeout_in_seconds
NOLOG       {IN | OUT | DENIED | QUEUED}
REPORTLOG   file
```

Lines beginning with the sharp character (#) are ignored, and can be used as comments. For example, the following options file would reserve one copy of feature `SWxxxxxx-xx` for user “pat”, three copies for user “lee”, and one copy for anyone on a computer with the hostname of “terry”; and would cause `QUEUED` messages to be omitted from the log file. In addition, user “joe” and group “pinheads” would not be allowed to use the feature `SWxxxxxx-xx`:

```
GROUP       pinheads moe larry curley
RESERVE 1   SWxxxxxx-xx USER pat
RESERVE 3   SWxxxxxx-xx USER lee
RESERVE 1   SWxxxxxx-xx HOST terry
EXCLUDE     SWxxxxxx-xx USER joe
EXCLUDE     SWxxxxxx-xx GROUP pinheads
NOLOG       QUEUED
```

3 LICENSE ADMINISTRATION TOOLS

The following utilities are provided to facilitate license management by your system administrator. In certain cases, execution access to a utility is restricted to users with root privileges. Complete descriptions of these utilities are provided at the end of this section.

lmcksum

Prints license checksums.

lmdiag (Windows only)

Diagnoses license checkout problems.

lmdown

Gracefully shuts down all license daemons (both **lmgrd** all vendor daemons, such as **Tasking**) on the license server.

lmgrd

The main daemon program for FLEXlm.

lmhostid

Reports the hostid of a system.

lmremove

Removes a single user's license for a specified feature.

lmreread

Causes the license daemon to reread the license file and start any new vendor daemons.

lmstat

Helps you monitor the status of all network licensing activities.

lmswitchr

Switches the report log file.

lmver

Reports the FLEXlm version of a library or binary file.

lmtools *(Windows only)*

This is a graphical Windows version of the license administration tools.

3.1 LMCKSUM

Name

lmcksum – print license checksums

Synopsis

lmcksum [**–c** *license_file*] [**–k**]

Description

The **lmcksum** program will perform a checksum of a license file. This is useful to verify data entry errors at your location. **lmcksum** will print a line–by–line checksum for the file as well as an overall file checksum.

The following fields participate in the checksum:

- hostid on the `SERVER` lines
- daemon name on the `DAEMON` lines
- feature name, version, daemon name, expiration date, # of licenses, encription code, vendor string and hostid on the `FEATURE` lines
- daemon name and encryption code on `FEATURESET` lines

Options

–c *license_file*

Use the specified *license_file*. If no **–c** option is specified, **lmcksum** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmcksum** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

–k

Case–sensitive checksum. If this option is specified, **lmcksum** will compute the checksum using the exact case of the `FEATURE`'s and `FEATURESET`'s encryption code.

3.2 LMDIAG (Windows only)

Name

lmdiag – diagnose license checkout problems

Synopsis

lmdiag [**–c** *license_file*] [**–n**] [*feature*]

Description

lmdiag (Windows only) allows you to diagnose problems when you cannot check out a license.

If no *feature* is specified, **lmdiag** will operate on all features in the license file(s) in your path. **lmdiag** will first print information about the license, then attempt to check out each license. If the checkout succeeds, **lmdiag** will indicate this. If the checkout fails, **lmdiag** will give you the reason for the failure. If the checkout fails because **lmdiag** cannot connect to the license server, then you have the option of running ”extended connection diagnostics”.

These extended diagnostics attempt to connect to each port on the license server node, and can detect if the port number in the license file is incorrect. **lmdiag** will indicate each port number that is listening, and if it is an **lmgrd** process, **lmdiag** will indicate this as well. If **lmdiag** finds the vendor daemon for the feature being tested, then it will indicate the correct port number for the license file to correct the problem.

Parameters

feature Diagnose this feature only.

Options

–c *license_file*

Diagnose the specified *license_file*. If no **–c** option is specified, **lmdiag** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmdiag** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

–n Run in non–interactive mode; **lmdiag** will not prompt for any input in this mode. In this mode, extended connection diagnostics are not available.

3.3 LMDOWN

Name

lmdown – graceful shutdown of all license daemons

Synopsis

lmdown [**–c** *license_file*] [**–q**]

Description

The **lmdown** utility allows for the graceful shutdown of all license daemons (both **lmgrd** and all vendor daemons, such as **Tasking**) on all nodes. You may want to protect the execution of lmdown, since shutting down the servers causes users to lose their licenses. See the **–p** option in Section 3.4, lmgrd.

lmdown sends a message to every license daemon asking it to shut down. The license daemons write out their last messages to the log file, close the file, and exit. All licenses which have been given out by those daemons will be revoked, so that the next time a client program goes to verify his license, it will not be valid.

Options

–c *license_file*
: Use the specified *license_file*. If no **–c** option is specified, **lmdown** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmdown** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

–q
: Quiet mode. If this switch is not specified, **lmdown** asks for confirmation before asking the license daemons to shut down. If this switch is specified, **lmdown** will not ask for confirmation.

lmgrd, lmstat, lmreread

3.4 LMGRD

Name

lmgrd – flexible license manager daemon

Synopsis

lmgrd [**–c** *license_file*] [**–l** *logfile*] [**–2 –p**] [**–t** *timeout*] [**–s** *interval*]

Description

lmgrd is the main daemon program for the FLEXlm distributed license management system. When invoked, it looks for a license file containing all required information about vendors and features. On UNIX systems, it is strongly recommended that **lmgrd** be run as a non–privileged user (not root).

Options

–c *license_file*
: Use the specified *license_file*. If no **–c** option is specified, **lmgrd** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmgrd** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

–l *logfile*
: Specifies the output log file to use. Instead of using the **–l** option you can use output redirection (**>** or **>>**) to specify the name of the output log file.

–2 –p
: Restricts usage of **lmdown**, **lmreread**, and **lmremove** to a FLEXlm administrator who is by default root. If there is a UNIX group called ”lmadmin” then use is restricted to only members of that group. If root is not a member of this group, then root does not have permission to use any of the above utilities.

–t *timeout*
: Specifies the *timeout* interval, in seconds, during which the license daemon must complete its connection to other daemons if operating in multi–server mode. The default value is 10 seconds. A larger value may be desirable if the daemons are being run on busy systems or a very heavily loaded network.

–s *interval* Specifies the log file timestamp *interval*, in minutes. The default is 360 minutes. This means that every six hours **lmgrd** logs the time in the log file.

lmdown, lmstat

3.5 LMHOSTID

Name

lmhostid – report the `hostid` of a system

Synopsis

lmhostid

Description

lmhostid calls the FLEXlm version of `gethostid` and displays the results.

The output of **lmhostid** looks like this:

```
lmhostid – Copyright (C) 1989, 1999 Globetrotter Software, Inc.
The FLEXlm host ID of this machine is ”1200abcd”
```

Options

lmhostid has no command line options.

3.6 LMREMOVE

Name

lmremove – remove specific licenses and return them to license pool

Synopsis

lmremove [**–c** *license_file*] *feature user host* [*display*]

Description

The **lmremove** utility allows the system administrator to remove a single user's license for a specified feature. This could be required in the case where the licensed user was running the software on a node that subsequently crashed. This situation will sometimes cause the license to remain unusable. **lmremove** will allow the license to return to the pool of available licenses.

lmremove will remove all instances of "user" on node "host" on display "display" from usage of "feature". If the optional `-c file` is specified, the indicated file will be used as the license file. Since removing a user's license can be disruptive, execution of **lmremove** is restricted to users with root privileges.

Options

–c *license_file*

Use the specified *license_file.* If no **–c** option is specified, **lmremove** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmremove** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

lmstat

3.7 LMREREAD

Name

lmreread – tells the license daemon to reread the license file

Synopsis

lmreread [**–c** *license_file*]

Description

lmreread allows the system administrator to tell the license daemon to reread the license file. This can be useful if the data in the license file has changed; the new data can be loaded into the license daemon without shutting down and restarting it.

The license administrator may want to protect the execution of **lmreread**. See the **–p** option in Section 3.4, lmgrd for details about securing access to **lmreread**.

lmreread uses the license file from the command line (or the default file, if none specified) only to find the license daemon to send it the command to reread the license file. The license daemon will always reread the file that it loaded from the original path. If you need to change the path to the license file read by the license daemon, then you must shut down the daemon and restart it with that new license file path.

You cannot use **lmreread** if the `SERVER` node names or port numbers have been changed in the license file. In this case, you must shut down the daemon and restart it in order for those changes to take effect.

lmreread does not change any option information specified in an options file. If the new license file specifies a different options file, that information is ignored. If you need to reread the options file, you must shut down (**lmdown**) the daemon and restart it.

Options

–c *license_file*

Use the specified *license_file*. If no **–c** option is specified, **lmreread** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmreread** looks for the file `license.dat` in the default location.

lmdown

3.8 LMSTAT

Name

lmstat – report status on license manager daemons and feature usage

Synopsis

lmstat [**–a**] [**–A**] [**–c** *license_file*] [**–f** [*feature*]]
[**–l** [*regular_expression*]] [**–s** [*server*]] [**–S** [*daemon*]] [**–t** *timeout*]

Description

License administration is simplified by the **lmstat** utility. **lmstat** allows you to instantly monitor the status of all network licensing activities. **lmstat** allows a system administrator to monitor license management operations including:

- Which daemons are running
- Users of individual features
- Users of features served by a specific `DAEMON`

Options

–a Display all information.

–A List all active licenses.

–c *license_file*
Use the specified *license_file*. If no **–c** option is specified, **lmstat** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmstat** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

–f [*feature*] List all users of the specified *feature*(s).

–l [*regular_expression*]
List all users of the features matching the given *regular_expression*.

–s [*server*] Display the status of the specified *server* node(s).

–S [*daemon*] List all users of the specified *daemon*'s features.

–t *timeout* Specifies the amount of time, in seconds, **lmstat** waits to establish contact with the servers. The default value is 10 seconds. A larger value may be desirable if the daemons are being run on busy systems or a very heavily loaded network.

lmgrd

3.9 LMSWITCHR (Windows only)

Name

lmswitchr – switch the report log file

Synopsis

lmswitchr [**–c** *license_file*] *feature new–file*

or:

lmswitchr [**–c** *license_file*] *vendor new–file*

Description

lmswitchr (Windows only) switches the report writer (REPORTLOG) log file. It will also start a new REPORTLOG file if one does not already exist.

Parameters

feature	Any feature this daemon supports.
vendor	The name of the vendor daemon (such as **Tasking**).
new–file	New file path.

Options

–c *license_file*

Use the specified *license_file*. If no **–c** option is specified, **lmswitchr** looks for the environment variable `LM_LICENSE_FILE` in order to find the license file to use. If that environment variable is not set, **lmswitchr** looks for the file `c:\flexlm\license.dat` (Windows), or `/usr/local/flexlm/licenses/license.dat` (UNIX).

3.10 LMVER

Name

lmver – report the FLEXlm version of a library or binary file

Synopsis

lmver *filename*

Description

The **lmver** utility reports the FLEXlm version of a library or binary file.

Alternatively, on UNIX systems, you can use the following commands to get the FLEXlm version of a binary:

strings *file* **| grep Copy**

Parameters

filename	Name of the executable of the product.

3.11 LICENSE ADMINISTRATION TOOLS FOR WINDOWS

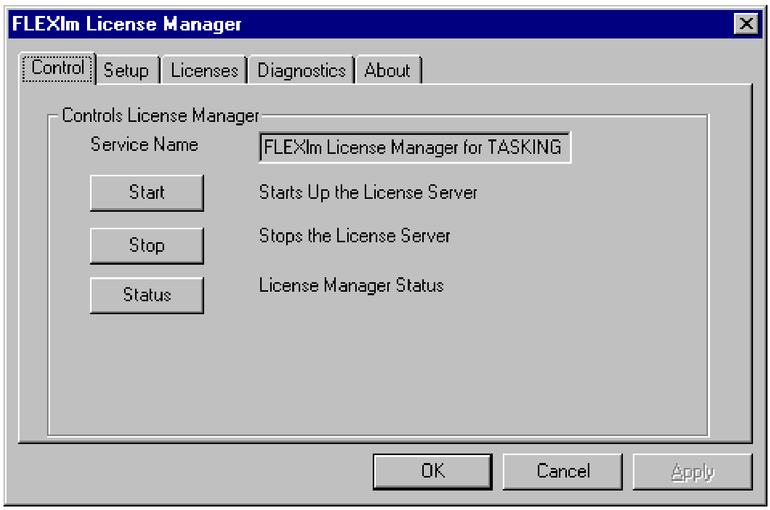
3.11.1 LMTOOLS FOR WINDOWS

For the 32 Bit Windows Platforms, an **lmtools.exe** Windows program is provided. It has the same functionality as listed in the previous sections but is graphically–oriented. Simply run the program (`Start | Programs | TASKING FLEXlm | FLEXlm Tools`) and choose a button for the functionality required. Refer to the previous sections for information about the options of each feature. The command line interface is replaced by pop–up dialogs that can be filled out.The central EDIT field is where the license file path is placed. This will be used for all other functions and replaces the "**–c** *license_file*" argument in the other utilities.

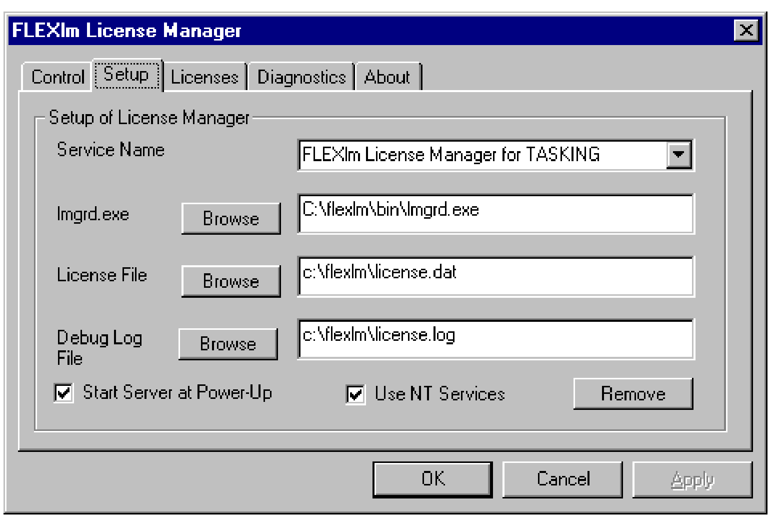
The `HOSTID` button displays the hostid's for the computer on which the program is running. The `TIME` button prints out the system's internal time settings, intended to diagnose any time zone problems. The `TCP Settings` button is intended to fix a bug in the Microsoft TCP protocol stack which has a symptom of very slow connections to computers. After pressing this button, the system will need to be rebooted for the settings to become effective.

3.11.2 FLEXLM LICENSE MANAGER FOR WINDOWS

lmgrd.exe can be run manually or using the graphical Windows tool. You can start this tool from the FLEXlm program folder. Click on `Start | Programs | TASKING FLEXlm | FLEXlm Tools`



From the `Control` tab you can start, stop, and check the status of your license server. Select the `Setup` tab to enter information about your license server.



Select the `Control` tab and click the `Start` button to start your license server. **lmgrd.exe** will be launched as a background application with the license file and debug log file locations passed as parameters.

If you want **lmgrd.exe** to start automatically on NT, select the `Use NT Services` check box and **lmgrd.exe** will be installed as an NT service. Next, select the `Start Server at Power–UP` check box.

The `Licenses` tab provides information about the license file and the `Advanced` tab allows you to perform diagnostics and check versions.

4 THE DAEMON LOG FILE

The FLEXlm daemons all generate log files containing messages in the following format:

mm/dd hh:mm `(DAEMON` *name*`)` *message*

Where:

mm/dd hh:mm	Is the month/day hour:minute that the message was logged.
`DAEMON` *name*	Either "license daemon" or the string from the `DAEMON` line that describes your daemon. In the case where a single copy of the daemon cannot handle all of the requested licenses, an optional "`_`" followed by a number indicates that this message comes from a forked daemon.
message	The text of the message.

The log files can be used to:

- Inform you when it may be necessary to update your application software licensing arrangement.
- Diagnose configuration problems.
- Diagnose daemon software errors.

The messages are grouped below into the above three categories, with each message followed by a brief description of its meaning.

4.1 INFORMATIONAL MESSAGES

Connected to node

This daemon is connected to its peer on node *node*.

CONNECTED, master is name

The license daemons log this message when a quorum is up and everyone has selected a master.

DEMO mode supports only one SERVER host!

An attempt was made to configure a demo version of the software for more than one server host.

DENIED: N feature to user (mm/dd/yy hh:mm)

user was denied access to `N` licenses of *feature*. This message may indicate a need to purchase more licenses.

EXITING DUE TO SIGNAL nnn
EXITING with code nnn

All daemons list the reason that the daemon has exited.

EXPIRED: feature

feature has passed its expiration date.

IN: feature by user (N licenses) (used: d:hh:mm:ss) (mm/dd/yy hh:mm)

user has checked back in `N` licenses of *feature* at *mm/dd/yy hh:mm*.

IN server died: feature by user (number licenses) (used: d:hh:mm:ss) (mm/dd/yy hh:mm)

user has checked in `N` licenses by virtue of the fact that his server died.

License Manager server started

The license daemon was started.

Lost connection to host

A daemon can no longer communicate with its peer on node *host*, which can cause the clients to have to reconnect, or cause the number of daemons to go below the minimum number, in which case clients may start exiting. If the license daemons lose the connection to the master, they will kill all the vendor daemons; vendor daemons will shut themselves down.

Lost quorum

The daemon lost quorum, so will process only connection requests from other daemons.

MASTER SERVER died due to signal nnn

The license daemon received fatal signal *nnn*.

MULTIPLE xxx servers running. Please kill, and restart license daemon

The license daemon has detected that multiple copies of vendor daemon *xxx* are running. The user should kill all *xxx* daemon processes and re–start the license daemon.

OUT: feature by user (N licenses) (mm/dd/yy hh:mm)

user has checked out `N` licenses of *feature* at *mm/dd/yy hh:mm*

Removing clients of children

The top–level daemon logs this message when one of the child daemons dies.

RESERVE feature for HOST name
RESERVE feature for USER name

A license of *feature* is reserved for either user *name* or host *name*.

REStarted xxx (internet port nnn)

Vendor daemon *xxx* was restarted at internet port *nnn*.

Retrying socket bind (address in use)

The license servers try to bind their sockets for approximately 6 minutes if they detect *address in use* errors.

Selected (EXISTING) master node

This license daemon has selected an existing master (node) as the master.

SERVER shutdown requested

A daemon was requested to shut down via a user–generated kill command.

[NEW] Server started for: feature–list

A (possibly new) server was started for the features listed.

Shutting down xxx

The license daemon is shutting down the vendor daemon *xxx*.

SIGCHLD received. Killing child servers

A vendor daemon logs this message when a shutdown was requested by the license daemon.

Started name

The license daemon logs this message whenever it starts a new vendor daemon.

Trying connection to node

The daemon is attempting a connection to *node*.

4.2 CONFIGURATION PROBLEM MESSAGES

hostname: Not a valid server host, exiting

This daemon was run on an invalid hostname.

hostname: Wrong hostid, exiting

The hostid is wrong for *hostname*.

BAD CODE for feature-name

The specified feature name has a bad encryption code.

CANNOT OPEN options file "file"

The options file specified in the license file could not be opened.

Couldn't find a master

The daemons could not agree on a master.

license daemon: lost all connections

This message is logged when all the connections to a server are lost, which often indicates a network problem.

lost lock, exiting
Error closing lock file
Unable to re-open lock file

The vendor daemon has a problem with its lock file, usually because of an attempt to run more than one copy of the daemon on a single node. Locate the other daemon that is running via a **ps** command, and kill it with **kill –9**.

NO DAEMON line for daemon

The license file does not contain a `DAEMON` line for *daemon*.

No "license" service found

The TCP *license* service did not exist in `/etc/services`.

No license data for "feat", feature unsupported

There is no feature line for *feat* in the license file.

No features to serve!

A vendor daemon found no features to serve. This could be caused by bad data in the license file.

UNSUPPORTED FEATURE request: feature by user

The *user* has requested a feature that this vendor daemon does not support. This can happen for a number of reasons: the license file is bad, the feature has expired, or the daemon is accessing the wrong license file.

Unknown host: hostname

The hostname specified on a `SERVER` line in the license file does not exist in the network database (probably `/etc/hosts`).

lm_server: lost all connections

This message is logged when all the connections to a server are lost. This probably indicates a network problem.

NO DAEMON lines, exiting

The license daemon logs this message if there are no `DAEMON` lines in the license file. Since there are no vendor daemons to start, there is nothing to do.

NO DAEMON line for name

A vendor daemon logs this error if it cannot find its own `DAEMON` name in the license file.

4.3 DAEMON SOFTWARE ERROR MESSAGES

accept: message

An error was detected in the `accept` system call.

ATTEMPT TO START VENDOR DAEMON xxx with NO MASTER

A vendor daemon was started with no master selected. This is an internal consistency error in the daemons.

BAD PID message from nnn: pid: xxx (msg)

A top–level vendor daemon received an invalid `PID` message from one of its children (daemon number *xxx*).

BAD SCONNECT message: (message)

An invalid "server connect" message was received.

Cannot create pipes for server communication

The `pipe` call failed.

Can't allocate server table space

A `malloc` error. Check swap space.

Connection to node TIMED OUT

The daemon could not connect to *node*.

Error sending PID to master server

The vendor server could not send its `PID` to the top–level server in the hierarchy.

Illegal connection request to DAEMON

A connection request was made to `DAEMON`, but this vendor daemon is not `DAEMON`.

Illegal server connection request

A connection request came in from another server without a `DAEMON` name.

KILL of child failed, errno = nnn

A daemon could not kill its child.

No internet port number specified

A vendor daemon was started without an internet port.

Not enough descriptors to re-create pipes

The “top–level” daemon detected one of its sub–daemon’s death. In trying to restart the chain of sub–daemons, it was unable to get the file descriptors to set up the pipes to communicate. This is a fatal error, and the daemons must be re–started.

read: error message

An error in a `read` system call was detected.

recycle_control BUT WE DIDN’T HAVE CONTROL

The hierarchy of vendor daemons has become confused over who holds the control token. This is an internal error.

return_reserved: can’t find feature listhead

When a daemon is returning a reservation to the “free reservation” list, it could not find the `listhead` of features.

select: message

An error in a select system call was detected.

Server exiting

The server is exiting. This is normally due to an error.

SHELLO for wrong DAEMON

This vendor daemon was sent a “server hello” message that was destined for a different `DAEMON`.

Unsolicited msg from parent!

Normally, the top–level vendor daemon sends no unsolicited messages. If one arrives, this message is logged. This is a bug.

WARNING: CORRUPTED options list (o–>next == 0)
Options list TERMINATED at bad entry

An internal inconsistency was detected in the daemon’s option list.

5 FLEXLM LICENSE ERRORS

FLEXlm license error, encryption code in license file is inconsistent

Check the contents of the license file using the license data sheet for the product. Correct the license file and run the **lmreread** command. However, do not change the last (fourth) field of a SERVER line in the license file. This cannot have any effect on the error message but changing it will cause other problems.

license file does not support this version

If this is a first time install then follow the procedure for the error message:

```
FLEXlm license error, encryption code in license file is
inconsistent
```

because there may be a typo in the fourth field of a FEATURE line of your license file. In all other cases you need a new license because the current license is for an older version of the product.

Replace the FEATURE line for the old version of the product with a FEATURE line for the new version (it can be found on the new license data sheet). Run the **lmreread** command afterwards. You can have only one version of a feature (previous versions of the product will continue to work).

FLEXlm license error, cannot find license file

Make sure the license file exists. If the pathname printed on the line after the error message is incorrect, correct this by setting the `LM_LICENSE_FILE` environment variable to the full pathname of the license file.

FLEXlm license error, cannot read license file

Every user needs to have read access on the license file and at least execute access on every directory component in the pathname of the license file. Write access is never needed. Read access on directories is recommended.

FLEXlm license error, no such feature exists

Check the license file. There should be a line starting with:

```
FEATURE SWiiiiii–jj
```

where ”iiiiii” is a six digit software code and ”jj” is a two digit host code for identifying a compatible host architecture. During product installations the product code is shown, e.g. SW008002, SW019002. The number in the software code is the same as the number in the product code except that the first number may contain an extra leading zero (it must be six digits long).
The line after the license error message describes the expected feature format and includes the host code.
Correct the license file using the license data sheet for the product and run the **lmreread** command. There is one catch: do not add extra SERVER lines or change existing SERVER lines in the license file.

FLEXlm license error, license server does not support this feature

If the `LM_LICENSE_FILE` variable has been set to the format *number@host* then see first the solution for the message:

```
FLEXlm license error, no such feature exists
```

Run the **lmreread** program to inform the license server about a changed license data file. If **lmreread** succeeds informing the license server but the error message persists, there are basically three possibilities:

1. The license key is incorrect. If this is the case then there must be an error message in the log file of **lmgrd**. Correct the key using the license data sheet for the product. Finally rerun **lmreread**. The log file of **lmgrd** is usually specified to **lmgrd** at startup with the **–l** option or with **>**.

2. Your network has more than one FLEXlm license server daemon and the default license file location for **lmreread** differs from the default assumed by the program. Also, there must be more than one license file. Try one of the following solutions on the same host which produced the error message:

   – type:

     `lmreread –c /usr/local/flexlm/licenses/license.dat`

   – set `LM_LICENSE_FILE` to the license file location and retry the **lmreread** command.

   – use the **lmreread** program supplied with the product SW000098, Flexible License Manager. SW000098 is bundled with all TASKING products.

3. There is a protocol version mismatch between **lmgrd** and the daemon with the name ”Tasking” (the vendor daemon according to FLEXlm terminology) or there is some other internal error. These errors are always written to the log file of **lmgrd**. The solution is to upgrade the **lmgrd** daemon to the one supplied in SW000098, the bundled Flexible License Manager product.

   On the other hand, if **lmreread** complains about not being able to connect to the license server then follow the procedure described in the next section for the error message ”Cannot read license file data from server”. The only difference with the current situation is that not the product but a license management utility shows a connect problem.

FLEXlm license error, Cannot read license file data from server

This indicates that the program could not connect to the license server daemon. This can have a number of causes. If the program did not immediately print the error message but waited for about 30 seconds (this can vary) then probably the license server host is down or unreachable. If the program responded immediately with the error message then check the following if the `LM_LICENSE_FILE` variable has been set to the format *number@host*:

- is the number correct? It should match the fourth field of a SERVER line in the license file on the license server host. Also, the host name on that SERVER line should be the same as the host name set in the `LM_LICENSE_FILE` variable. Correct `LM_LICENSE_FILE` if necessary.

In any case one should verify if the license server daemon is running. Type the following command on the host where the license server daemon (**lmgrd**) is supposed to run.

On SunOS 4.x:

```
ps wwax | grep lmgrd | grep –v grep
```

On HP–UX or SunOS 5.x (Solaris 2.x):

```
ps –ef | grep lmgrd | grep –v grep
```

If the command does not produce any output then the license server daemon is not running. See below for an example how to start **lmgrd**.

Make sure that both license server daemon (**lmgrd**) and the program are using the same license data. All TASKING products use the license file /usr/local/flexlm/licenses/license.dat unless overruled by the environment variable LM_LICENSE_FILE. However, not all existing **lmgrd** daemons may use the same default. In case of doubt, specify the license file pathname with the **–c** option when starting the license server daemon. For example:

```
lmgrd –c /usr/local/flexlm/licenses/license.dat \
      –l /usr/local/flexlm/licenses/license.log &
```

and set the LM_LICENSE_FILE environment variable to the license.dat pathname mentioned with the **–c** option of **lmgrd** before running any license based program (including **lmreread**, **lmstat**, **lmdown**). If **lmgrd** and the program run on different hosts, transparent access to the license file is assumed in the situation described above (e.g. NFS). If this is not the case, make a local copy of the license file (not recommended) or set LM_LICENSE_FILE to the form *number@host*, as described earlier.

If none of the above seems to apply (i.e. **lmgrd** was already running and LM_LICENSE_FILE has been set correctly) then it is very likely that there is a TCP port mismatch. The fourth field of a SERVER line in the license file specifies a TCP port number. That number can be changed without affecting any license. However, it must never be changed while the license server daemon is running. If it has been changed, change it back to the original value. If you do not know the original number anymore, restart the license server daemon after typing the following command on the license server host:

```
kill PID
```

where PID is the process id of **lmgrd**.

6 FREQUENTLY ASKED QUESTIONS (FAQS)

6.1 LICENSE FILE QUESTIONS

I've received FLEXlm license files from 2 different companies. Do I have to combine them?

You don't have to combine license files. Each license file that has any 'counted' lines (the 'number of licenses' field is >0) requires a server. It's perfectly OK to have any number of separate license files, with different **lmgrd** server processes supporting each file. Moreover, since **lmgrd** is a lightweight process, for sites without system administrators, this is often the simplest (and therefore recommended) way to proceed. With v6+ **lmgrd**/**lmdown**/**lmreread**, you can stop/reread/restart a single vendor daemon (of any FLEXlm version). This makes combining licenses more attractive than previously. Also, if the application is v6+, using 'dir/*.lic' for license file management behaves like combining licenses without physically combining them.

When is it recommended to combine license files?

Many system administrators, especially for larger sites, prefer to combine license files to ease administration of FLEXlm licenses. It's purely a matter of preference.

Does FLEXlm handle dates in the year 2000 and beyond?

Yes. The FLEXlm date format uses a 4–digit year. Dates in the 20th century (19xx) can be abbreviated to the last 2 digits of the year (xx), and use of this feature is quite widespread. Dates in the year 2000 and beyond must specify all 4 year digits.

6.2 FLEXLM VERSION

Which FLEXlm versions does TASKING deliver?

For Windows we deliver FLEXlm v6.1 and for UNIX we deliver v2.4.

I have products from several companies at various FLEXlm version levels. Do I have to worry about how these versions work together?

If you're not combining license files from different vendors, the simplest thing to do is make sure you use the tools (especially **lmgrd**) that are shipped by each vendor.

lmgrd will always correctly support older versions of vendor daemons and applications, so it's **always** safe to use the latest version of **lmgrd** and the other FLEXlm utilities. If you've combined license files from 2 vendors, you **must** use the latest version of lmgrd.

If you've received 2 versions of a product from the same vendor, you must use the latest vendor daemon they sent you. An older vendor daemon with a newer client will cause communication errors.

Please ignore letters appended to FLEXlm versions, i.e., v2.4d. The appended letter indicates a patch, and does NOT indicate any compatibility differences. In particular, some elements of FLEXlm didn't require certain patches, so a 2.4 **lmgrd** will work successfully with a 2.4b vendor daemon.

I've received a new copy of a product from a vendor, and it uses a new version of FLEXlm. Is my old license file still valid?

Yes. Older FLEXlm license files are always valid with newer versions of FLEXlm.

6.3 WINDOWS QUESTIONS

What Windows Host Platforms can be used as a server for Floating Licenses?

The system being used as the server (where the FLEXlm License Manager is running) for Floating licenses, must be Windows NT. The FLEXlm License Manager does not run properly with Windows 95/98.

Why do I need to include NWlink IPX/SPX on NT?

This is necessary for either obtaining the Ethernet card address, or to provide connectivity with a Netware License server.

6.4 TASKING QUESTIONS

How will the TASKING licensing/pricing model change with License Management (FLEXlm)?

TASKING will now offer the following types of licenses so you can purchase licenses based upon usage:

License	Description	Pricing
Node Locked	This license can only be used on a specific system. It cannot be moved to another system.	The pricing for this license will be the current product pricing.
Floating	This license requires a network (license server and a TCP/IP (or IPX/SPX) connection between clients and server) and can be used on any host system **(using the same operating system)** in the network.	The pricing for this license will be 50% higher than the node locked license.

How does FLEXlm affect future product ordering?

For all licenses, node locked or floating, you must provide information that is used to create a license key. For node locked licenses we must have the HOST ID. Floating licenses require the HOST ID and HOST NAME. The HOST ID is a unique identification of the machine, which is based upon different hardware depending upon host platform. The HOST NAME is the network name of the machine.

TASKING Logistics CANNOT ship ANY orders that do not include the HOST ID and/or HOST NAME information.

What if I do not know the information needed for the license key?

We have a software utility (**tkhostid.exe**) which will obtain and display the HOST ID so a customer can easily obtain this information. This utility is available from our web site, placed on all product CDs (which support FLEXlm), and from technical support. If you have already installed FLEXlm, you can also use **lmhostid**.

- In the case of a *Node locked license*, it is important that the customer runs this utility on the exact machine he intends to run the TASKING tools on.

- In the case of a *Floating License*, the **tkhostid.exe** (or **lmhostid**) utility should be run on the machine on which the FLEXlm license manager will be installed, e.g. the server. The HOST NAME information can be obtained from within the Windows Control Panel. Select "Network", click on "Identification", look for "Computer name".

How will the "locking" mechanism work?

- For node locked licenses, FLEXlm will first search for an ethernet card. If one exists, it will lock onto the number of the ethernet card. If an ethernet card does not exist, FLEXlm will lock onto the hard disk serial number.
- For floating licenses, the ethernet card number will be used.

What happens if I try to move my node locked license to another system?

The software will not run.

What does linger–time for floating licenses mean?

When the TASKING product starts to run, it will try to obtain a license from the license server. The license server keeps track of the number of licenses already issued, and grants or denies the request. When the software has finished running, the license is kept by the license server for a period of time known as the "linger–time". If the same user requests the TASKING product again within the linger–time, he is granted the license again. If another user requests a license during the linger–time, his request is denied until the linger–time has finished

What is the length of the linger–time for floating licenses?

The length of the linger–time for both the PC and UNIX floating licenses is 5 minutes.

Can the linger–time be changed?

Yes. A customer can change the linger–time to be larger (but not shorter) than the time specified by TASKING.

What happens if my system crashes or I upgrade to a new system?

You will need to contact Technical Support for temporary license keys due to a system crash or to move from one system to another system. You will then need to work with your local sales representative to obtain a permanent new license key.

6.5 USING FLEXLM FOR FLOATING LICENSES

Does FLEXlm work across the internet?

Yes. A server on the internet will serve licenses to anyone else on the internet. This can be limited with the 'INTERNET=' attribute on the FEATURE line, which limits access to a range of internet addresses. You can also use the INCLUDE and EXCLUDE options in the daemon option file to allow (or deny) access to clients running on a range of internet addresses.

Does FLEXlm work with Internet firewalls?

Many firewalls require that port numbers be specified to the firewall. FLEXlm v5 **lmgrd** supports this.

If my client dies, does the server free the license?

Yes, unless the client's whole system crashes. Assuming communications is TCP, the license is automatically freed immediately. If communications are UDP, then the license is freed after the UDP timeout, which is set by each vendor, but defaults to 45 minutes. UDP communications is normally only set by the end–user, so TCP should be assumed. If the whole system crashes, then the license is not freed, and you should use '**lmremove**' to free the license.

What happens when the license server dies?

FLEXlm applications send periodic heartbeats to the server to discover if it has died. What happens when the server dies is then up to the application. Some will simply continue periodically attempting to re–checkout the license when the server comes back up. Some will attempt to re–checkout a license a few times, and then, presumably with some warning, exit. Some GUI applications will present pop–ups to the user periodically letting them know the server is down and needs to be re–started.

How do you tell if a port is already in use?

99.44% of the time, if it's in use, it's because **lmgrd** is already running on the port – or was recently killed, and the port isn't freed yet. Assuming this is not the case, then use '**telnet** *host port*' – if it says *"can't connect"*, it's a free port.

Does FLEXlm require root permissions?

No. There is no part of FLEXlm, **lmgrd**, vendor daemon or application, that requires root permissions. In fact, it is strongly recommended that you do not run the license server (**lmgrd**) as root, since root processes can introduce security risks.
If **lmgrd** must be started from the root user (for example, in a system boot script), we recommend that you use the '**su**' command to run **lmgrd** as a non–privileged user:

```
su username –c"/path/lmgrd –c /path/license.dat \
            –l /path/log"
```

where *username* is a non–privileged user, and *path* is the correct paths to **lmgrd**, `license.dat` and debug log file. You will have to ensure that the vendor daemons listed in */path–to–license/*license.dat have execute permissions for username. The paths to all the vendor daemons in the license file are listed on each DAEMON line.

Is it ok to run lmgrd as 'root' (UNIX only)?

It is not prudent to run any command, particularly a daemon, as root on UNIX, as it may pose a security risk to the Operating System. Therefore, we recommend that **lmgrd** be run as a non–privileged user (not 'root'). If you are starting **lmgrd** from a boot script, we recommend that you use

```
su username –c"umask 022; /path/lmgrd \
            –c /path/license.dat –l /path/log"
```

to run **lmgrd** as a non–privileged user.

Does FLEXlm licensing impose a heavy load on the network?

No, but partly this depends on the application, and end–user's use. A typical checkout request requires 5 messages and responses between client and server, and each message is < 150 bytes.

When a server is not receiving requests, it requires virtually no CPU time. When an application, or **lmstat**, requests the list of current users, this can significantly increase the amount of networking FLEXlm uses, depending on the number of current users. Also, prior to FLEXlm v5, use of 'port@host' can increase network load, since the license file is down–loaded from the server to the client. 'port@host' should be, if possible, limited to small license files (say < 50 features). In v5, 'port@host' actually improves performance.

Does FLEXlm work with NFS?

Yes. FLEXlm has no direct interaction with NFS. FLEXlm uses an NFS–mounted file like any other application.

Does FLEXlm work with ATM, ISDN, Token–Ring, etc.?

In general, these have no impact on FLEXlm. FLEXlm requires TCP/IP or SPX (Novell Netware). So long as TCP/IP works, FLEXlm will work.

Does FLEXlm work with subnets, fully–qualified names, multiple domains, etc.?

Yes, although this behavior was improved in v3.0, and v6.0. When a license server and a client are located in different domains, fully–qualified host names have to be used. A fully–qualified hostname is of the form:

node.domain

where *node* is the local hostname (usually returned by the '**hostname**' command or '**uname –n**') *domain* is the internet domain name, e.g. 'globes.com'.

To ensure success with FLEXlm across domains, do the following:

1. Make the sure the fully–qualified hostname is the name on the SERVER line of the license file.
2. Make sure ALL client nodes, as well as the server node, are able to 'telnet' to that fully–qualified hostname. For example, if the host is locally called 'speedy', and the domain name is 'corp.com', local systems will be able to logon to speedy via 'telnet speedy'. But very often, 'telnet speedy.corp.com' will fail, locally.
   Note that this telnet command will always succeed on hosts in other domains (assuming everything is configured correctly), since the network will resolve speedy.corp.com automatically.
3. Finally, there must be an 'alias' for speedy so it's also known locally as speedy.corp.com. This alias is added to the `/etc/hosts` file, or if NIS/Yellow Pages are being used, then it will have to be added to the NIS database. This requirement goes away in version 3.0 of FLEXlm.

If all components (application, **lmgrd** and vendor daemon) are v6.0 or higher, no aliases are required; the only requirement is that the fully–qualified domain name, or IP–address, is used as a hostname on the SERVER, or as a hostname in LM_LICENSE_FILE port@host, or @host.

Does FLEXlm work with NIS and DNS?

Yes. However, some sites have broken NIS or DNS, which will cause FLEXlm to fail. In v5 of FLEXlm, NIS and DNS can be avoided to solve this problem. In particular, sometimes DNS is configured for a server that's not current available (e.g., a dial–up connection from a PC). Again, if DNS is configured, but the server is not available, FLEXlm will fail.

In addition, some systems, particularly Sun, SGI, HP, require that applications be linked dynamically to support NIS or DNS. If a vendor links statically, this can cause the application to fail at a site that uses NIS or DNS. In these situations, the vendor will have to relink, or recompile with v5 FLEXlm. Vendors are strongly encouraged to use dynamic libraries for libc and networking libraries, since this tends to improve quality in general, as well as making NIS/DNS work.

On PCs, if a checkout seems to take 3 minutes and then fails, this is usually because the system is configured for a dial–up DNS server which is not currently available. The solution here is to turn off DNS.

Finally, hostnames must NOT have periods in the name. These are not legal hostnames, although PCs will allow you to enter them, and they will not work with DNS.

We're using FLEXlm over a wide–area network. What can we do to improve performance?

FLEXlm network traffic should be minimized. With the most common uses of FLEXlm, traffic is negligible. In particular, checkout, checkin and heartbeats use very little networking traffic. There are two items, however, which can send considerably more data and should be avoided or used sparingly:

- '**lmstat –a**' should be used sparingly. '**lmstat –a**' should not be used more than, say, once every 15 minutes, and should be particularly avoided when there's a lot of features, or concurrent users, and therefore a lot of data to transmit; say, more than 20 concurrent users or features.
- Prior to FLEXlm v5, the 'port@host' mode of the LM_LICENSE_FILE environment variable should be avoided, especially when the license file has many features, or there are a lot of license files included in LM_LICENSE_FILE. The license file information is sent via the network, and can place a heavy load. Failures due to 'port@host' will generate the error LM_SERVNOREADLIC (–61).

APPENDIX

ERROR MESSAGES

B

TASKING

APPENDIX B

1 INTRODUCTION

This appendix lists all diagnostic messages, starting with the error number and the error tag name, followed by the message itself. The error number and/or error tag can be used in **--diag_***severity* options to override the normal error severity.

The C++ compiler produces error messages on standard error output. With the **--error_output** option you can redirect the error messages to an error list file.

Normally, diagnostics are written to `stderr` in the following form (TASKING layout):

severity **#***err_num***:** *message*

The *severity* can be one of: **R** (remark), **W** (warning), **E** (error), **F** (fatal error), **S** (internal error).

With **--no_tsw_diagnostics**, diagnostics are written to stderr in the following form:

"*filename***", line** *line_num***:** *message*

With **--display_error_number** this form will be:

"*filename***", line** *line_num***:** *severity* **#***err_num***:** *message*

or:

"*filename***", line** *line_num***:** *severity* **#***err_num***–D:** *message*

Where *severity* can be one of: remark, warning, error, catastrophic error, command–line error or internal error.

If the severity may be overridden, the error number will include the suffix **–D** (for discretionary); otherwise no suffix will be present.

In a raw listing file (**–L** option) diagnostic messages have the following layout, starting with the severity (R: remark, W: warning, E: error, C: catastrophe):

[R|W|E|C] "*filename*" *line_number column_number error_message*

For more detailed information see chapter *Compiler Diagnostics*.

All diagnostic messages are listed below.

2 MESSAGES

0001 last_line_incomplete:
last line of file ends without a newline

0002 last_line_backslash:
last line of file ends with a backslash

0003 include_recursion:
#include file *"xxxx"* includes itself

0004 out_of_memory:
out of memory

0005 source_file_could_not_be_opened:
could not open source file *"xxxx"*

0006 comment_unclosed_at_eof:
comment unclosed at end of file

0007 bad_token:
unrecognized token

0008 unclosed_string:
missing closing quote

0009 nested_comment:
nested comment is not allowed

0010 bad_use_of_sharp:
"#" not expected here

0011 bad_pp_directive_keyword:
unrecognized preprocessing directive

0012 end_of_flush:
parsing restarts here after previous syntax error

0013 exp_file_name:
expected a file name

0014 extra_text_in_pp_directive:
extra text after expected end of preprocessing directive

0016 illegal_source_file_name:
"xxxx" is not a valid source file name

0017 exp_rbracket:
expected a "]"

0018 exp_rparen:
expected a ")"

0019 extra_chars_on_number:
extra text after expected end of number

0020 undefined_identifier:
identifier *"xxxx"* is undefined

0021 useless_type_qualifiers:
type qualifiers are meaningless in this declaration

0022 bad_hex_digit:
invalid hexadecimal number

0023 integer_too_large:
integer constant is too large

0024 bad_octal_digit:
invalid octal digit

0025 zero_length_string:
quoted string should contain at least one character

0026 too_many_characters:
too many characters in character constant

0027 bad_character_value:
character value is out of range

0028 expr_not_constant:
expression must have a constant value

0029 exp_primary_expr:
expected an expression

0030 bad_float_value:
floating constant is out of range

0031 expr_not_integral:
expression must have integral type

0032 expr_not_arithmetic:
expression must have arithmetic type

0033 exp_line_number:
expected a line number

0034 bad_line_number:
invalid line number

0035 error_directive:
#error directive: *xxxx*

0036 missing_pp_if:
the #if for this directive is missing

0037 missing_endif:
the #endif for this directive is missing

0038 pp_else_already_appeared:
directive is not allowed –– an #else has already appeared

0039 divide_by_zero:
division by zero

0040 exp_identifier:
expected an identifier

0041 expr_not_scalar:
expression must have arithmetic or pointer type

0042 incompatible_operands:
operand types are incompatible (”*type*” and ”*type*”)

0044 expr_not_pointer:
expression must have pointer type

0045 cannot_undef_predef_macro:
#undef may not be used on this predefined name

0046 cannot_redef_predef_macro:
this predefined name may not be redefined

0047 bad_macro_redef:
incompatible redefinition of macro *"entity"* (declared at line *xxxx*)

0049 duplicate_macro_param_name:
duplicate macro parameter name

0050 paste_cannot_be_first:
"##" may not be first in a macro definition

0051 paste_cannot_be_last:
"##" may not be last in a macro definition

0052 exp_macro_param:
expected a macro parameter name

0053 exp_colon:
expected a ":"

0054 too_few_macro_args:
too few arguments in macro invocation

0055 too_many_macro_args:
too many arguments in macro invocation

0056 sizeof_function:
operand of sizeof may not be a function

0057 bad_constant_operator:
this operator is not allowed in a constant expression

0058 bad_pp_operator:
this operator is not allowed in a preprocessing expression

0059 bad_constant_function_call:
function call is not allowed in a constant expression

0060 bad_integral_operator:
this operator is not allowed in an integral constant expression

0061 integer_overflow:
integer operation result is out of range

0062 negative_shift_count:
shift count is negative

0063 shift_count_too_large:
shift count is too large

0064 useless_decl:
declaration does not declare anything

0065 exp_semicolon:
expected a ”;”

0066 enum_value_out_of_int_range:
enumeration value is out of ”int” range

0067 exp_rbrace:
expected a ”}”

0068 integer_sign_change:
integer conversion resulted in a change of sign

0069 integer_truncated:
integer conversion resulted in truncation

0070 incomplete_type_not_allowed:
incomplete type is not allowed

0071 sizeof_bit_field:
operand of sizeof may not be a bit field

0075 bad_indirection_operand:
operand of ”*” must be a pointer

0076 empty_macro_argument:
argument to macro is empty

0077 missing_decl_specifiers:
this declaration has no storage class or type specifier

0078 initializer_in_param:
a parameter declaration may not have an initializer

0079 exp_type_specifier:
expected a type specifier

0080 storage_class_not_allowed:
a storage class may not be specified here

0081 mult_storage_classes:
more than one storage class may not be specified

0082 storage_class_not_first:
storage class is not first

0083 dupl_type_qualifier:
type qualifier specified more than once

0084 bad_combination_of_type_specifiers:
invalid combination of type specifiers

0085 bad_param_storage_class:
invalid storage class for a parameter

0086 bad_function_storage_class:
invalid storage class for a function

0087 type_specifier_not_allowed:
a type specifier may not be used here

0088 array_of_function:
array of functions is not allowed

0089 array_of_void:
array of void is not allowed

0090 function_returning_function:
function returning function is not allowed

0091 function_returning_array:
function returning array is not allowed

0092 param_id_list_needs_function_def:
identifier–list parameters may only be used in a function definition

0093 function_type_must_come_from_declarator:
function type may not come from a typedef

0094 array_size_must_be_positive:
the size of an array must be greater than zero

0095 array_size_too_large:
array is too large

0096 empty_translation_unit:
a translation unit must contain at least one declaration

0097 bad_function_return_type:
a function may not return a value of this type

0098 bad_array_element_type:
an array may not have elements of this type

0099 decl_should_be_of_param:
a declaration here must declare a parameter

0100 dupl_param_name:
duplicate parameter name

0101 id_already_declared:
"xxxx" has already been declared in the current scope

0102 nonstd_forward_decl_enum:
forward declaration of enum type is nonstandard

0103 class_too_large:
class is too large

0104 struct_too_large:
struct or union is too large

0105 bad_bit_field_size:
invalid size for bit field

0106 bad_bit_field_type:
invalid type for a bit field

0107 zero_length_bit_field_must_be_unnamed:
zero–length bit field must be unnamed

0108 signed_one_bit_field:
signed bit field of length 1

0109 expr_not_ptr_to_function:
expression must have (pointer–to–) function type

0110 exp_definition_of_tag:
expected either a definition or a tag name

0111 code_is_unreachable:
statement is unreachable

0112 exp_while:
expected ”while”

0114 never_defined:
entity–kind ”entity” was referenced but not defined

0115 continue_must_be_in_loop:
a continue statement may only be used within a loop

0116 break_must_be_in_loop_or_switch:
a break statement may only be used within a loop or switch

0117 no_value_returned_in_non_void_function:
non–void *entity–kind ”entity”* (declared at line *xxxx*) should return a value

0118 value_returned_in_void_function:
a void function may not return a value

0119 cast_to_bad_type:
cast to type ”*type*” is not allowed

0120 bad_return_value_type:
return value type does not match the function type

0121 case_label_must_be_in_switch:
a case label may only be used within a switch

0122 default_label_must_be_in_switch:
a default label may only be used within a switch

0123 case_label_appears_more_than_once:
case label value has already appeared in this switch

0124 default_label_appears_more_than_once:
default label has already appeared in this switch

0125 exp_lparen:
expected a ”(”

0126 expr_not_an_lvalue:
expression must be an lvalue

0127 exp_statement:
expected a statement

0128 loop_not_reachable:
loop is not reachable from preceding code

0129 block_scope_function_must_be_extern:
a block–scope function may only have extern storage class

0130 exp_lbrace:
expected a ”{”

0131 expr_not_ptr_to_class:
expression must have pointer–to–class type

0132 expr_not_ptr_to_struct_or_union:
expression must have pointer–to–struct–or–union type

0133 exp_member_name:
expected a member name

0134 exp_field_name:
expected a field name

0135 not_a_member:
entity–kind "entity" has no member *"xxxx"*

0136 not_a_field:
entity–kind "entity" has no field *"xxxx"*

0137 expr_not_a_modifiable_lvalue:
expression must be a modifiable lvalue

0138 address_of_register_variable:
taking the address of a register variable is not allowed

0139 address_of_bit_field:
taking the address of a bit field is not allowed

0140 too_many_arguments:
too many arguments in function call

0141 all_proto_params_must_be_named:
unnamed prototyped parameters not allowed when body is present

0142 expr_not_pointer_to_object:
expression must have pointer–to–object type

0143 program_too_large:
program too large or complicated to compile

0144 bad_initializer_type:
a value of type *"type"* cannot be used to initialize an entity of type *"type"*

0145 cannot_initialize:

entity–kind "entity" may not be initialized

0146 too_many_initializer_values:

too many initializer values

0147 not_compatible_with_previous_decl:

declaration is incompatible with *entity–kind "entity"* (declared at line *xxxx*)

0148 already_initialized:

entity–kind "entity" has already been initialized

0149 bad_file_scope_storage_class:

a global–scope declaration may not have this storage class

0150 type_cannot_be_param_name:

a type name may not be redeclared as a parameter

0151 typedef_cannot_be_param_name:

a typedef name may not be redeclared as a parameter

0152 non_zero_int_conv_to_pointer:

conversion of nonzero integer to pointer

0153 expr_not_class:

expression must have class type

0154 expr_not_struct_or_union:

expression must have struct or union type

0155 old_fashioned_assignment_operator:

old–fashioned assignment operator

0156 old_fashioned_initializer:

old–fashioned initializer

0157 expr_not_integral_constant:

expression must be an integral constant expression

0158 expr_not_an_lvalue_or_function_designator:

expression must be an lvalue or a function designator

0159 decl_incompatible_with_previous_use:

declaration is incompatible with previous *"entity"* (declared at line *xxxx*)

0160 external_name_clash:

name conflicts with previously used external name *"xxxx"*

0161 unrecognized_pragma:

unrecognized #pragma

0163 cannot_open_temp_file:

could not open temporary file *"xxxx"*

0164 temp_file_dir_name_too_long:

name of directory for temporary files is too long (*"xxxx"*)

0165 too_few_arguments:

too few arguments in function call

0166 bad_float_constant:

invalid floating constant

0167 incompatible_param:

argument of type *"type"* is incompatible with parameter of type *"type"*

0168 function_type_not_allowed:

a function type is not allowed here

0169 exp_declaration:

expected a declaration

0170 pointer_outside_base_object:

pointer points outside of underlying object

0171 bad_cast:

invalid type conversion

0172 linkage_conflict:
external/internal linkage conflict with previous declaration

0173 float_to_integer_conversion:
floating–point value does not fit in required integral type

0174 expr_has_no_effect:
expression has no effect

0175 subscript_out_of_range:
subscript out of range

0177 declared_but_not_referenced:
entity–kind "entity" was declared but never referenced

0178 pcc_address_of_array:
"&" applied to an array has no effect

0179 mod_by_zero:
right operand of "%" is zero

0180 old_style_incompatible_param:
argument is incompatible with formal parameter

0181 printf_arg_mismatch:
argument is incompatible with corresponding format string conversion

0182 empty_include_search_path:
could not open source file *"xxxx"* (no directories in search list)

0183 cast_not_integral:
type of cast must be integral

0184 cast_not_scalar:
type of cast must be arithmetic or pointer

0185 initialization_not_reachable:
dynamic initialization in unreachable code

0186 unsigned_compare_with_zero:
pointless comparison of unsigned integer with zero

0187 assign_where_compare_meant:
use of ”=” where ”==” may have been intended

0188 mixed_enum_type:
enumerated type mixed with another type

0189 file_write_error:
error while writing *xxxx* file

0190 bad_il_file:
invalid intermediate language file

0191 cast_to_qualified_type:
type qualifier is meaningless on cast type

0192 unrecognized_char_escape:
unrecognized character escape sequence

0193 undefined_preproc_id:
zero used for undefined preprocessing identifier

0194 exp_asm_string:
expected an asm string

0195 asm_func_must_be_prototyped:
an asm function must be prototyped

0196 bad_asm_func_ellipsis:
an asm function may not have an ellipsis

0219 file_delete_error:
error while deleting file *”xxxx”*

0220 integer_to_float_conversion:
integral value does not fit in required floating–point type

0221 float_to_float_conversion:
floating–point value does not fit in required floating–point type

0222 bad_float_operation_result:
floating–point operation result is out of range

0223 implicit_func_decl:
function declared implicitly

0224 too_few_printf_args:
the format string requires additional arguments

0225 too_many_printf_args:
the format string ends before this argument

0226 bad_printf_format_string:
invalid format string conversion

0227 macro_recursion:
macro recursion

0228 nonstd_extra_comma:
trailing comma is nonstandard

0229 enum_bit_field_too_small:
bit field cannot contain all values of the enumerated type

0230 nonstd_bit_field_type:
nonstandard type for a bit field

0231 decl_in_prototype_scope:
declaration is not visible outside of function

0232 decl_of_void_ignored:
old–fashioned typedef of ”void” ignored

0233 old_fashioned_field_selection:
left operand is not a struct or union containing this field

0234 old_fashioned_ptr_field_selection:
pointer does not point to struct or union containing this field

0235 var_retained_incomp_type:
variable *”xxxx”* was declared with a never–completed type

0236 boolean_controlling_expr_is_constant:
controlling expression is constant

0237 switch_selector_expr_is_constant:
selector expression is constant

0238 bad_param_specifier:
invalid specifier on a parameter

0239 bad_specifier_outside_class_decl:
invalid specifier outside a class declaration

0240 dupl_decl_specifier:
duplicate specifier in declaration

0241 base_class_not_allowed_for_union:
a union is not allowed to have a base class

0242 access_already_specified:
multiple access control specifiers are not allowed

0243 missing_class_definition:
class or struct definition is missing

0244 name_not_member_of_class_or_base_classes:
qualified name is not a member of class "*type*" or its base classes

0245 member_ref_requires_object:
a nonstatic member reference must be relative to a specific object

0246 nonstatic_member_def_not_allowed:
a nonstatic data member may not be defined outside its class

0247 already_defined:
entity–kind "*entity*" has already been defined

0248 pointer_to_reference:
pointer to reference is not allowed

0249 reference_to_reference:
reference to reference is not allowed

0250 reference_to_void:
reference to void is not allowed

0251 array_of_reference:
array of reference is not allowed

0252 missing_initializer_on_reference:
reference *entity–kind ”entity”* requires an initializer

0253 exp_comma:
expected a ”,”

0254 type_identifier_not_allowed:
type name is not allowed

0255 type_definition_not_allowed:
type definition is not allowed

0256 bad_type_name_redeclaration:
invalid redeclaration of type name *”entity”* (declared at line *xxxx*)

0257 missing_initializer_on_const:
const *entity–kind ”entity”* requires an initializer

0258 this_used_incorrectly:
”this” may only be used inside a nonstatic member function

0259 constant_value_not_known:
constant value is not known

0260 missing_type_specifier:
explicit type is missing (”int” assumed)

0261 missing_access_specifier:
access control not specified (*”xxxx”* by default)

0262 not_a_class_or_struct_name:
not a class or struct name

0263 dupl_base_class_name:
duplicate base class name

0264 bad_base_class:
invalid base class

0265 no_access_to_name:
entity–kind ”entity” is inaccessible

0266 ambiguous_name:
”entity” is ambiguous

0267 old_style_parameter_list:
old–style parameter list (anachronism)

0268 declaration_after_statements:
declaration may not appear after executable statement in block

0269 inaccessible_base_class:
implicit conversion to inaccessible base class *”type”* is not allowed

0274 improperly_terminated_macro_call:
improperly terminated macro invocation

0276 id_must_be_class_or_namespace_name:
name followed by ”::” must be a class or namespace name

0277 bad_friend_decl:
invalid friend declaration

0278 value_returned_in_constructor:
a constructor or destructor may not return a value

0279 bad_destructor_decl:
invalid destructor declaration

0280 class_and_member_name_conflict:
invalid declaration of a member with the same name as its class

0281 global_qualifier_not_allowed:
global–scope qualifier (leading ”::”) is not allowed

0282 name_not_found_in_file_scope:
the global scope has no *”xxxx”*

0283 qualified_name_not_allowed:

qualified name is not allowed

0284 null_reference:

NULL reference is not allowed

0285 brace_initialization_not_allowed:

initialization with "{...}" is not allowed for object of type *"type"*

0286 ambiguous_base_class:

base class *"type"* is ambiguous

0287 ambiguous_derived_class:

derived class *"type"* contains more than one instance of class *"type"*

0288 derived_class_from_virtual_base:

cannot convert pointer to base class *"type"* to pointer to derived class *"type"* –– base class is virtual

0289 no_matching_constructor:

no instance of constructor *"entity"* matches the argument list

0290 ambiguous_copy_constructor:

copy constructor for class *"type"* is ambiguous

0291 no_default_constructor:

no default constructor exists for class *"type"*

0292 not_a_field_or_base_class:

"xxxx" is not a nonstatic data member or base class of class *"type"*

0293 indirect_nonvirtual_base_class_not_allowed:

indirect nonvirtual base class is not allowed

0294 bad_union_field:

invalid union member –– class *"type"* has a disallowed member function

0296 bad_rvalue_array:

invalid use of non–lvalue array

0297 exp_operator:

expected an operator

0298 inherited_member_not_allowed:

inherited member is not allowed

0299 indeterminate_overloaded_function:

cannot determine which instance of *entity–kind "entity"* is intended

0300 bound_function_must_be_called:

a pointer to a bound function may only be used to call the function

0301 duplicate_typedef:

typedef name has already been declared (with same type)

0302 function_redefinition:

entity–kind "entity" has already been defined

0304 no_matching_function:

no instance of *entity–kind "entity"* matches the argument list

0305 type_def_not_allowed_in_func_type_decl:

type definition is not allowed in function return type declaration

0306 default_arg_not_at_end:

default argument not at end of parameter list

0307 default_arg_already_defined:

redefinition of default argument

0308 ambiguous_overloaded_function:

more than one instance of *entity–kind "entity"* matches the argument list:

0309 ambiguous_constructor:

more than one instance of constructor *"entity"* matches the argument list:

0310 bad_default_arg_type:

default argument of type *"type"* is incompatible with parameter of type *"type"*

0311 return_type_cannot_distinguish_functions:

cannot overload functions distinguished by return type alone

0312 no_user_defined_conversion:

no suitable user–defined conversion from *”type”* to *”type”* exists

0313 function_qualifier_not_allowed:

type qualifier is not allowed on this function

0314 virtual_static_not_allowed:

only nonstatic member functions may be virtual

0315 unqual_function_with_qual_object:

the object has type qualifiers that are not compatible with the member function

0316 too_many_virtual_functions:

program too large to compile (too many virtual functions)

0317 bad_return_type_on_virtual_function_override:

return type is not identical to nor covariant with return type *”type”* of overridden virtual function *entity–kind ”entity”*

0318 ambiguous_virtual_function_override:

override of virtual *entity–kind ”entity”* is ambiguous

0319 pure_specifier_on_nonvirtual_function:

pure specifier (”= 0”) allowed only on virtual functions

0320 bad_pure_specifier:

badly–formed pure specifier (only ”= 0” is allowed)

0321 bad_data_member_initialization:

data member initializer is not allowed

0322 abstract_class_object_not_allowed:

object of abstract class type *”type”* is not allowed:

0323 function_returning_abstract_class:

function returning abstract class *”type”* is not allowed:

0324 duplicate_friend_decl:
duplicate friend declaration

0325 inline_and_nonfunction:
inline specifier allowed on function declarations only

0326 inline_not_allowed:
”inline” is not allowed

0327 bad_storage_class_with_inline:
invalid storage class for an inline function

0328 bad_member_storage_class:
invalid storage class for a class member

0329 local_class_function_def_missing:
local class member *entity–kind ”entity”* requires a definition

0330 inaccessible_special_function:
entity–kind ”entity” is inaccessible

0332 missing_const_copy_constructor:
class *”type”* has no copy constructor to copy a const object

0333 definition_of_implicitly_declared_function:
defining an implicitly declared member function is not allowed

0334 no_suitable_copy_constructor:
class *”type”* has no suitable copy constructor

0335 linkage_specifier_not_allowed:
linkage specification is not allowed

0336 bad_linkage_specifier:
unknown external linkage specification

0337 incompatible_linkage_specifier:
linkage specification is incompatible with previous *”entity”* (declared at line *xxxx*)

0338 overloaded_function_linkage:

more than one instance of overloaded function *"entity"* has "C" linkage

0339 ambiguous_default_constructor:

class *"type"* has more than one default constructor

0340 temp_used_for_ref_init:

value copied to temporary, reference to temporary used

0341 nonmember_operator_not_allowed:

"operator*xxxx*" must be a member function

0342 static_member_operator_not_allowed:

operator may not be a static member function

0343 too_many_args_for_conversion:

no arguments allowed on user–defined conversion

0344 too_many_args_for_operator:

too many parameters for this operator function

0345 too_few_args_for_operator:

too few parameters for this operator function

0346 no_params_with_class_type:

nonmember operator requires a parameter with class type

0347 default_arg_expr_not_allowed:

default argument is not allowed

0348 ambiguous_user_defined_conversion:

more than one user–defined conversion from *"type"* to *"type"* applies:

0349 no_matching_operator_function:

no operator *"xxxx"* matches these operands

0350 ambiguous_operator_function:

more than one operator *"xxxx"* matches these operands:

0351 bad_arg_type_for_operator_new:
first parameter of allocation function must be of type ”size_t”

0352 bad_return_type_for_op_new:
allocation function requires ”void *” return type

0353 bad_return_type_for_op_delete:
deallocation function requires ”void” return type

0354 bad_first_arg_type_for_operator_delete:
first parameter of deallocation function must be of type ”void *”

0356 type_must_be_object_type:
type must be an object type

0357 base_class_already_initialized:
base class *”type”* has already been initialized

0358 base_class_init_anachronism:
base class name required –– *”type”* assumed (anachronism)

0359 member_already_initialized:
entity–kind ”entity” has already been initialized

0360 missing_base_class_or_member_name:
name of member or base class is missing

0361 assignment_to_this:
assignment to ”this” (anachronism)

0362 overload_anachronism:
”overload” keyword used (anachronism)

0363 anon_union_member_access:
invalid anonymous union –– nonpublic member is not allowed

0364 anon_union_member_function:
invalid anonymous union –– member function is not allowed

0365 anon_union_storage_class:

anonymous union at global or namespace scope must be declared static

0366 missing_initializer_on_fields:

entity–kind "entity" provides no initializer for:

0367 cannot_initialize_fields:

implicitly generated constructor for class *"type"* cannot initialize:

0368 no_ctor_but_const_or_ref_member:

entity–kind "entity" defines no constructor to initialize the following:

0369 var_with_uninitialized_member:

entity–kind "entity" has an uninitialized const or reference member

0370 var_with_uninitialized_field:

entity–kind "entity" has an uninitialized const field

0371 missing_const_assignment_operator:

class *"type"* has no assignment operator to copy a const object

0372 no_suitable_assignment_operator:

class *"type"* has no suitable assignment operator

0373 ambiguous_assignment_operator:

ambiguous assignment operator for class *"type"*

0375 missing_typedef_name:

declaration requires a typedef name

0377 virtual_not_allowed:

"virtual" is not allowed

0378 static_not_allowed:

"static" is not allowed

0379 bound_function_cast_anachronism:

cast of bound function to normal function pointer (anachronism)

0380 expr_not_ptr_to_member:

expression must have pointer–to–member type

0381 extra_semicolon:

extra ";" ignored

0382 nonstd_const_member:

nonstandard member constant declaration (standard form is a static const integral member)

0384 no_matching_new_function:

no instance of overloaded *"entity"* matches the argument list

0386 no_match_for_addr_of_overloaded_function:

no instance of *entity–kind "entity"* matches the required type

0387 delete_count_anachronism:

delete array size expression used (anachronism)

0388 bad_return_type_for_op_arrow:

"operator–>" for class *"type"* returns invalid type *"type"*

0389 cast_to_abstract_class:

a cast to abstract class *"type"* is not allowed:

0390 bad_use_of_main:

function "main" may not be called or have its address taken

0391 initializer_not_allowed_on_array_new:

a new–initializer may not be specified for an array

0392 member_function_redecl_outside_class:

member function *"entity"* may not be redeclared outside its class

0393 ptr_to_incomplete_class_type_not_allowed:

pointer to incomplete class type is not allowed

0394 ref_to_nested_function_var:

reference to local variable of enclosing function is not allowed

0395 single_arg_postfix_incr_decr_anachronism:

single–argument function used for postfix *"xxxx"* (anachronism)

0397 bad_default_assignment:

implicitly generated assignment operator cannot copy:

0398 nonstd_array_cast:

cast to array type is nonstandard (treated as cast to *"type"*)

0399 class_with_op_new_but_no_op_delete:

entity–kind "entity" has an operator new*xxxx*() but no default operator delete*xxxx*()

0400 class_with_op_delete_but_no_op_new:

entity–kind "entity" has a default operator delete*xxxx*() but no operator new*xxxx*()

0401 base_class_with_nonvirtual_dtor:

destructor for base class *"type"* is not virtual

0403 member_function_redeclaration:

entity–kind "entity" has already been declared

0404 inline_main:

function "main" may not be declared inline

0405 class_and_member_function_name_conflict:

member function with the same name as its class must be a constructor

0406 nested_class_anachronism:

using nested *entity–kind "entity"* (anachronism)

0407 too_many_params_for_destructor:

a destructor may not have parameters

0408 bad_constructor_param:

copy constructor for class *"type"* may not have a parameter of type *"type"*

0409 incomplete_function_return_type:

entity–kind "entity" returns incomplete type *"type"*

0410 protected_access_problem:

protected *entity–kind "entity"* is not accessible through a *"type"* pointer or object

0411 param_not_allowed:

a parameter is not allowed

0412 asm_decl_not_allowed:

an "asm" declaration is not allowed here

0413 no_conversion_function:

no suitable conversion function from *"type"* to *"type"* exists

0414 delete_of_incomplete_class:

delete of pointer to incomplete class

0415 no_constructor_for_conversion:

no suitable constructor exists to convert from *"type"* to *"type"*

0416 ambiguous_constructor_for_conversion:

more than one constructor applies to convert from *"type"* to *"type"*:

0417 ambiguous_conversion_function:

more than one conversion function from *"type"* to *"type"* applies:

0418 ambiguous_conversion_to_builtin:

more than one conversion function from *"type"* to a built–in type applies:

0424 addr_of_constructor_or_destructor:

a constructor or destructor may not have its address taken

0425 dollar_used_in_identifier:

dollar sign ("$") used in identifier

0426 nonconst_ref_init_anachronism:

temporary used for initial value of reference to non–const (anachronism)

0427 qualifier_in_member_declaration:
qualified name is not allowed in member declaration

0428 mixed_enum_type_anachronism:
enumerated type mixed with another type (anachronism)

0429 new_array_size_must_be_nonnegative:
the size of an array in ”new” must be non–negative

0430 return_ref_init_requires_temp:
returning reference to local temporary

0432 enum_not_allowed:
”enum” declaration is not allowed

0433 qualifier_dropped_in_ref_init:
qualifiers dropped in binding reference of type ”*type*” to initializer of type ”*type*”

0434 bad_nonconst_ref_init:
a reference of type ”*type*” (not const–qualified) cannot be initialized with a value of type ”*type*”

0435 delete_of_function_pointer:
a pointer to function may not be deleted

0436 bad_conversion_function_decl:
conversion function must be a nonstatic member function

0437 bad_template_declaration_scope:
template declaration is not allowed here

0438 exp_lt:
expected a ”<”

0439 exp_gt:
expected a ”>”

0440 missing_template_param:
template parameter declaration is missing

0441 missing_template_arg_list:

argument list for *entity–kind "entity"* is missing

0442 too_few_template_args:

too few arguments for *entity–kind "entity"*

0443 too_many_template_args:

too many arguments for *entity–kind "entity"*

0445 not_used_in_template_function_params:

entity–kind "entity" is not used in declaring the parameter types of *entity–kind "entity"*

0446 cfront_multiple_nested_types:

two nested types have the same name: *"entity"* and *"entity"* (declared at line *xxxx*) (cfront compatibility)

0447 cfront_global_defined_after_nested_type:

global *"entity"* was declared after nested *"entity"* (declared at line *xxxx*) (cfront compatibility)

0449 ambiguous_ptr_to_overloaded_function:

more than one instance of *entity–kind "entity"* matches the required type

0450 nonstd_long_long:

the type "long long" is nonstandard

0451 nonstd_friend_decl:

omission of *"xxxx"* is nonstandard

0452 return_type_on_conversion_function:

return type may not be specified on a conversion function

0456 runaway_recursive_instantiation:

excessive recursion at instantiation of *entity–kind "entity"*

0457 bad_template_declaration:

"xxxx" is not a function or static data member

0458 bad_nontype_template_arg:

argument of type *"type"* is incompatible with template parameter of type *"type"*

0459 init_needing_temp_not_allowed:

initialization requiring a temporary or conversion is not allowed

0460 decl_hides_function_parameter:

declaration of *"xxxx"* hides function parameter

0461 nonconst_ref_init_from_rvalue:

initial value of reference to non–const must be an lvalue

0463 template_not_allowed:

"template" is not allowed

0464 not_a_class_template:

"type" is not a class template

0466 function_template_named_main:

"main" is not a valid name for a function template

0467 union_nonunion_mismatch:

invalid reference to *entity–kind "entity"* (union/nonunion mismatch)

0468 local_type_in_template_arg:

a template argument may not reference a local type

0469 tag_kind_incompatible_with_declaration:

tag kind of *xxxx* is incompatible with declaration of *entity–kind "entity"* (declared at line *xxxx*)

0470 name_not_tag_in_file_scope:

the global scope has no tag named *"xxxx"*

0471 not_a_tag_member:

entity–kind "entity" has no tag member named *"xxxx"*

0472 ptr_to_member_typedef:

member function typedef (allowed for cfront compatibility)

0473 bad_use_of_member_function_typedef:

entity–kind "entity" may be used only in pointer–to–member declaration

0475 nonexternal_entity_in_template_arg:

a template argument may not reference a non–external entity

0476 id_must_be_class_or_type_name:

name followed by "::~" must be a class name or a type name

0477 destructor_name_mismatch:

destructor name does not match name of class *"type"*

0478 destructor_type_mismatch:

type used as destructor name does not match type *"type"*

0479 called_function_redeclared_inline:

entity–kind "entity" redeclared "inline" after being called

0481 bad_storage_class_on_template_decl:

invalid storage class for a template declaration

0482 no_access_to_type_cfront_mode:

entity–kind "entity" is an inaccessible type (allowed for cfront compatibility)

0484 invalid_instantiation_argument:

invalid explicit instantiation declaration

0485 not_instantiatable_entity:

entity–kind "entity" is not an entity that can be instantiated

0486 compiler_generated_function_cannot_be_instantiated:

compiler generated *entity–kind "entity"* cannot be explicitly instantiated

0487 inline_function_cannot_be_instantiated:

inline *entity–kind "entity"* cannot be explicitly instantiated

0488 pure_virtual_function_cannot_be_instantiated:

pure virtual *entity–kind "entity"* cannot be explicitly instantiated

0489 instantiation_requested_no_definition_supplied:

entity–kind "entity" cannot be instantiated –– no template definition was supplied

0490 instantiation_requested_and_specialized:

entity–kind "entity" cannot be instantiated –– it has been explicitly specialized

0491 no_constructor:

class *"type"* has no constructor

0493 no_match_for_type_of_overloaded_function:

no instance of *entity–kind "entity"* matches the specified type

0494 nonstd_void_param_list:

declaring a void parameter list with a typedef is nonstandard

0495 cfront_name_lookup_bug:

global *entity–kind "entity"* used instead of *entity–kind "entity"* (cfront compatibility)

0496 redeclaration_of_template_param_name:

template parameter *"xxxx"* may not be redeclared in this scope

0497 decl_hides_template_parameter:

declaration of *"xxxx"* hides template parameter

0498 must_be_prototype_instantiation:

template argument list must match the parameter list

0500 bad_extra_arg_for_postfix_operator:

extra parameter of postfix "operator*xxxx*" must be of type "int"

0501 function_type_required:

an operator name must be declared as a function

0502 operator_name_not_allowed:

operator name is not allowed

0503 bad_scope_for_specialization:

entity–kind "entity" cannot be specialized in the current scope

0504 nonstd_member_function_address:

nonstandard form for taking the address of a member function

0505 too_few_template_params:

too few template parameters –– does not match previous declaration

0506 too_many_template_params:

too many template parameters –– does not match previous declaration

0507 template_operator_delete:

function template for operator delete(void *) is not allowed

0508 class_template_same_name_as_templ_param:

class template and template parameter may not have the same name

0510 unnamed_type_in_template_arg:

a template argument may not reference an unnamed type

0511 enum_type_not_allowed:

enumerated type is not allowed

0512 qualified_reference_type:

type qualifier on a reference type is not allowed

0513 incompatible_assignment_operands:

a value of type ”*type*” cannot be assigned to an entity of type ”*type*”

0514 unsigned_compare_with_negative:

pointless comparison of unsigned integer with a negative constant

0515 converting_to_incomplete_class:

cannot convert to incomplete class ”*type*”

0516 missing_initializer_on_unnamed_const:

const object requires an initializer

0517 unnamed_object_with_uninitialized_field:

object has an uninitialized const or reference member

0518 nonstd_pp_directive:
nonstandard preprocessing directive

0519 unexpected_template_arg_list:
entity–kind "entity" may not have a template argument list

0520 missing_initializer_list:
initialization with "{...}" expected for aggregate object

0521 incompatible_ptr_to_member_selection_operands:
pointer–to–member selection class types are incompatible (*"type"* and *"type"*)

0522 self_friendship:
pointless friend declaration

0523 period_used_as_qualifier:
"." used in place of "::" to form a qualified name (cfront anachronism)

0524 const_function_anachronism:
non–const function called for const object (anachronism)

0525 dependent_stmt_is_declaration:
a dependent statement may not be a declaration

0526 void_param_not_allowed:
a parameter may not have void type

0529 bad_templ_arg_expr_operator:
this operator is not allowed in a template argument expression

0530 missing_handler:
try block requires at least one handler

0531 missing_exception_declaration:
handler requires an exception declaration

0532 masked_by_default_handler:
handler is masked by default handler

0533 masked_by_handler:

handler is potentially masked by previous handler for type *"type"*

0534 local_type_used_in_exception:

use of a local type to specify an exception

0535 redundant_exception_specification_type:

redundant type in exception specification

0536 incompatible_exception_specification:

exception specification is incompatible with that of previous *entity–kind "entity"* (declared at line *xxxx*):

0540 no_exception_support:

support for exception handling is disabled

0541 omitted_exception_specification:

omission of exception specification is incompatible with previous *entity–kind "entity"* (declared at line *xxxx*)

0542 cannot_create_instantiation_request_file:

could not create instantiation request file *"xxxx"*

0543 non_arith_operation_in_templ_arg:

non–arithmetic operation not allowed in nontype template argument

0544 local_type_in_nonlocal_var:

use of a local type to declare a nonlocal variable

0545 local_type_in_function:

use of a local type to declare a function

0546 branch_past_initialization:

transfer of control bypasses initialization of:

0548 branch_into_handler:

transfer of control into an exception handler

0549 used_before_set:

entity–kind "entity" is used before its value is set

0550 set_but_not_used:

entity–kind "entity" was set but never used

0551 bad_scope_for_definition:

entity–kind "entity" cannot be defined in the current scope

0552 exception_specification_not_allowed:

exception specification is not allowed

0553 template_and_instance_linkage_conflict:

external/internal linkage conflict for *entity–kind "entity"* (declared at line *xxxx*)

0554 conversion_function_not_usable:

entity–kind "entity" will not be called for implicit or explicit conversions

0555 tag_kind_incompatible_with_template_parameter:

tag kind of *xxxx* is incompatible with template parameter of type *"type"*

0556 template_operator_new:

function template for operator new(size_t) is not allowed

0558 bad_member_type_in_ptr_to_member:

pointer to member of type *"type"* is not allowed

0559 ellipsis_on_operator_function:

ellipsis is not allowed in operator function parameter list

0560 unimplemented_keyword:

"entity" is reserved for future use as a keyword

0561 cl_invalid_macro_definition:

invalid macro definition:

0562 cl_invalid_macro_undefinition:

invalid macro undefinition:

0563 cl_invalid_preprocessor_output_file:

invalid preprocessor output file

0564 cl_cannot_open_preprocessor_output_file:
cannot open preprocessor output file

0565 cl_il_file_must_be_specified:
IL file name must be specified if input is

0566 cl_invalid_il_output_file:
invalid IL output file

0567 cl_cannot_open_il_output_file:
cannot open IL output file

0568 cl_invalid_C_output_file:
invalid C output file

0569 cl_cannot_open_C_output_file:
cannot open C output file

0570 cl_error_in_debug_option_argument:
error in debug option argument

0571 cl_invalid_option:
invalid option:

0572 cl_back_end_requires_il_file:
back end requires name of IL file

0573 cl_could_not_open_il_file:
could not open IL file

0574 cl_invalid_number:
invalid number:

0575 cl_incorrect_host_id:
incorrect host CPU id

0576 cl_invalid_instantiation_mode:
invalid instantiation mode:

0578 cl_invalid_error_limit:
invalid error limit:

0579 cl_invalid_raw_listing_output_file:
invalid raw–listing output file

0580 cl_cannot_open_raw_listing_output_file:
cannot open raw–listing output file

0581 cl_invalid_xref_output_file:
invalid cross–reference output file

0582 cl_cannot_open_xref_output_file:
cannot open cross–reference output file

0583 cl_invalid_error_output_file:
invalid error output file

0584 cl_cannot_open_error_output_file:
cannot open error output file

0585 cl_vtbl_option_only_in_cplusplus:
virtual function tables can only be suppressed when compiling C++

0586 cl_anachronism_option_only_in_cplusplus:
anachronism option can be used only when compiling C++

0587 cl_instantiation_option_only_in_cplusplus:
instantiation mode option can be used only when compiling C++

0588 cl_auto_instantiation_option_only_in_cplusplus:
automatic instantiation mode can be used only when compiling C++

0589 cl_implicit_inclusion_option_only_in_cplusplus:
implicit template inclusion mode can be used only when compiling C++

0590 cl_exceptions_option_only_in_cplusplus:
exception handling option can be used only when compiling C++

0591 cl_strict_ansi_incompatible_with_pcc:
strict ANSI mode is incompatible with K&R mode

0592 cl_strict_ansi_incompatible_with_cfront:
strict ANSI mode is incompatible with cfront mode

0593 cl_missing_source_file_name:
missing source file name

0594 cl_output_file_incompatible_with_multiple_inputs:
output files may not be specified when compiling several input files

0595 cl_too_many_arguments:
too many arguments on command line

0596 cl_no_output_file_needed:
an output file was specified, but none is needed

0597 cl_il_display_requires_il_file_name:
IL display requires name of IL file

0598 void_template_parameter:
a template parameter may not have void type

0599 too_many_unused_instantiations:
excessive recursive instantiation of *entity–kind ”entity”* due to instantiate–all mode

0600 cl_strict_ansi_incompatible_with_anachronisms:
strict ANSI mode is incompatible with allowing anachronisms

0601 void_throw:
a throw expression may not have void type

0602 cl_tim_local_conflicts_with_auto_instantiation:
local instantiation mode is incompatible with automatic instantiation

0603 abstract_class_param_type:
parameter of abstract class type *”type”* is not allowed:

0604 array_of_abstract_class:
array of abstract class *”type”* is not allowed:

0605 float_template_parameter:

floating–point template parameter is nonstandard

0606 pragma_must_precede_declaration:

this pragma must immediately precede a declaration

0607 pragma_must_precede_statement:

this pragma must immediately precede a statement

0608 pragma_must_precede_decl_or_stmt:

this pragma must immediately precede a declaration or statement

0609 pragma_may_not_be_used_here:

this kind of pragma may not be used here

0611 partial_override:

overloaded virtual function *"entity"* is only partially overridden in *entity–kind "entity"*

0612 specialization_of_called_inline_template_function:

specific definition of inline template function must precede its first use

0613 cl_invalid_error_tag:

invalid error tag:

0614 cl_invalid_error_number:

invalid error number:

0615 param_type_ptr_to_array_of_unknown_bound:

parameter type involves pointer to array of unknown bound

0616 param_type_ref_array_of_unknown_bound:

parameter type involves reference to array of unknown bound

0617 ptr_to_member_cast_to_ptr_to_function:

pointer–to–member–function cast to pointer to function

0618 no_named_fields:

struct or union declares no named members

0619 nonstd_unnamed_field:

nonstandard unnamed field

0620 nonstd_unnamed_member:

nonstandard unnamed member

0622 cl_invalid_pch_output_file:

invalid precompiled header output file

0623 cl_cannot_open_pch_output_file:

cannot open precompiled header output file

0624 not_a_type_name:

"xxxx" is not a type name

0625 cl_cannot_open_pch_input_file:

cannot open precompiled header input file

0626 invalid_pch_file:

precompiled header file *"xxxx"* is either invalid or not generated by this version of the compiler

0627 pch_curr_directory_changed:

precompiled header file *"xxxx"* was not generated in this directory

0628 pch_header_files_have_changed:

header files used to generate precompiled header file *"xxxx"* have changed

0629 pch_cmd_line_option_mismatch:

the command line options do not match those used when precompiled header file *"xxxx"* was created

0630 pch_file_prefix_mismatch:

the initial sequence of preprocessing directives is not compatible with those of precompiled header file *"xxxx"*

0631 unable_to_get_mapped_memory:

unable to obtain mapped memory

0632 using_pch:

”*xxxx*”: using precompiled header file ”*xxxx*”

0633 creating_pch:

”*xxxx*”: creating precompiled header file ”*xxxx*”

0634 memory_mismatch:

memory usage conflict with precompiled header file *”xxxx”*

0635 cl_invalid_pch_size:

invalid PCH memory size

0636 cl_pch_must_be_first:

PCH options must appear first in the command line

0637 out_of_memory_during_pch_allocation:

insufficient memory for PCH memory allocation

0638 cl_pch_incompatible_with_multiple_inputs:

precompiled header files may not be used when compiling several input files

0639 not_enough_preallocated_memory:

insufficient preallocated memory for generation of precompiled header file (*xxxx* bytes required)

0640 program_entity_too_large_for_pch:

very large entity in program prevents generation of precompiled header file

0641 cannot_chdir:

”xxxx” is not a valid directory

0642 cannot_build_temp_file_name:

cannot build temporary file name

0643 restrict_not_allowed:

”restrict” is not allowed

0644 restrict_pointer_to_function:

a pointer or reference to function type may not be qualified by ”restrict”

0645 bad_declspec_modifier:

”xxxx” is an unrecognized __declspec attribute

0646 calling_convention_not_allowed:

a calling convention modifier may not be specified here

0647 conflicting_calling_conventions:

conflicting calling convention modifiers

0648 cl_strict_ansi_incompatible_with_microsoft:

strict ANSI mode is incompatible with Microsoft mode

0649 cl_cfront_incompatible_with_microsoft:

cfront mode is incompatible with Microsoft mode

0650 calling_convention_ignored:

calling convention specified here is ignored

0651 calling_convention_may_not_precede_nested_declarator:

a calling convention may not be followed by a nested declarator

0652 calling_convention_ignored_for_type:

calling convention is ignored for this type

0654 decl_modifiers_incompatible_with_previous_decl:

declaration modifiers are incompatible with previous declaration

0655 decl_modifiers_invalid_for_this_decl:

the modifier *”xxxx”* is not allowed on this declaration

0656 branch_into_try_block:

transfer of control into a try block

0657 incompatible_inline_specifier_on_specific_decl:

inline specification is incompatible with previous *”entity”* (declared at line *xxxx*)

0658 template_missing_closing_brace:
closing brace of template definition not found

0659 cl_wchar_t_option_only_in_cplusplus:
wchar_t keyword option can be used only when compiling C++

0660 bad_pack_alignment:
invalid packing alignment value

0661 exp_int_constant:
expected an integer constant

0662 call_of_pure_virtual:
call of pure virtual function

0663 bad_ident_string:
invalid source file identifier string

0664 template_friend_definition_not_allowed:
a class template cannot be defined in a friend declaration

0665 asm_not_allowed:
"asm" is not allowed

0666 bad_asm_function_def:
"asm" must be used with a function definition

0667 nonstd_asm_function:
"asm" function is nonstandard

0668 nonstd_ellipsis_only_param:
ellipsis with no explicit parameters is nonstandard

0669 nonstd_address_of_ellipsis:
"&..." is nonstandard

0670 bad_address_of_ellipsis:
invalid use of "&..."

0672 const_volatile_ref_init_anachronism:

temporary used for initial value of reference to const volatile (anachronism)

0673 bad_const_volatile_ref_init:

a reference of type *"type"* cannot be initialized with a value of type *"type"*

0674 const_volatile_ref_init_from_rvalue:

initial value of reference to const volatile must be an lvalue

0675 cl_SVR4_C_option_only_in_ansi_C:

SVR4 C compatibility option can be used only when compiling ANSI C

0676 using_out_of_scope_declaration:

using out–of–scope declaration of *entity–kind "entity"* (declared at line *xxxx*)

0677 cl_strict_ansi_incompatible_with_SVR4:

strict ANSI mode is incompatible with SVR4 C mode

0678 cannot_inline_call:

call of *entity–kind "entity"* (declared at line *xxxx*) cannot be inlined

0679 cannot_inline:

entity–kind "entity" cannot be inlined

0680 cl_invalid_pch_directory:

invalid PCH directory:

0681 exp_except_or_finally:

expected __except or __finally

0682 leave_must_be_in_try:

a __leave statement may only be used within a __try

0688 not_found_on_pack_alignment_stack:

"xxxx" not found on pack alignment stack

0689 empty_pack_alignment_stack:

empty pack alignment stack

0690 cl_rtti_option_only_in_cplusplus:

RTTI option can be used only when compiling C++

0691 inaccessible_elided_cctor:

entity-kind "entity", required for copy that was eliminated, is inaccessible

0692 uncallable_elided_cctor:

entity-kind "entity", required for copy that was eliminated, is not callable because reference parameter cannot be bound to rvalue

0693 typeid_needs_typeinfo:

<typeinfo> must be included before typeid is used

0694 cannot_cast_away_const:

xxxx cannot cast away const or other type qualifiers

0695 bad_dynamic_cast_type:

the type in a dynamic_cast must be a pointer or reference to a complete class type, or void *

0696 bad_ptr_dynamic_cast_operand:

the operand of a pointer dynamic_cast must be a pointer to a complete class type

0697 bad_ref_dynamic_cast_operand:

the operand of a reference dynamic_cast must be an lvalue of a complete class type

0698 dynamic_cast_operand_must_be_polymorphic:

the operand of a runtime dynamic_cast must have a polymorphic class type

0699 cl_bool_option_only_in_cplusplus:

bool option can be used only when compiling C++

0701 array_type_not_allowed:

an array type is not allowed here

0702 exp_assign:
expected an ”=”

0703 exp_declarator_in_condition_decl:
expected a declarator in condition declaration

0704 redeclaration_of_condition_decl_name:
”xxxx”, declared in condition, may not be redeclared in this scope

0705 default_template_arg_not_allowed:
default template arguments are not allowed for function templates

0706 exp_comma_or_gt:
expected a ”,” or ”>”

0707 missing_template_param_list:
expected a template parameter list

0708 incr_of_bool_deprecated:
incrementing a bool value is deprecated

0709 bool_type_not_allowed:
bool type is not allowed

0710 base_class_offset_too_large:
offset of base class *”entity”* within class *”entity”* is too large

0711 expr_not_bool:
expression must have bool type (or be convertible to bool)

0712 cl_array_new_and_delete_option_only_in_cplusplus:
array new and delete option can be used only when compiling C++

0713 based_requires_variable_name:
entity-kind ”entity” is not a variable name

0714 based_not_allowed_here:
__based modifier is not allowed here

0715 based_not_followed_by_star:
__based does not precede a pointer operator, __based ignored

0716 based_var_must_be_ptr:

variable in __based modifier must have pointer type

0717 bad_const_cast_type:

the type in a const_cast must be a pointer, reference, or pointer to member to an object type

0718 bad_const_cast:

a const_cast can only adjust type qualifiers; it cannot change the underlying type

0719 mutable_not_allowed:

mutable is not allowed

0720 cannot_change_access:

redeclaration of *entity–kind "entity"* is not allowed to alter its access

0721 nonstd_printf_format_string:

nonstandard format string conversion

0722 probable_inadvertent_lbracket_digraph:

use of alternative token "<:" appears to be unintended

0723 probable_inadvertent_sharp_digraph:

use of alternative token "%:" appears to be unintended

0724 namespace_def_not_allowed:

namespace definition is not allowed

0725 missing_namespace_name:

name must be a namespace name

0726 namespace_alias_def_not_allowed:

namespace alias definition is not allowed

0727 namespace_qualified_name_required:

namespace–qualified name is required

0728 namespace_name_not_allowed:

a namespace name is not allowed

0729 bad_combination_of_dll_attributes:
invalid combination of DLL attributes

0730 sym_not_a_class_template:
entity–kind "entity" is not a class template

0731 array_of_incomplete_type:
array with incomplete element type is nonstandard

0732 allocation_operator_in_namespace:
allocation operator may not be declared in a namespace

0733 deallocation_operator_in_namespace:
deallocation operator may not be declared in a namespace

0734 conflicts_with_using_decl:
entity–kind "entity" conflicts with using–declaration of *entity–kind "entity"*

0735 using_decl_conflicts_with_prev_decl:
using–declaration of *entity–kind "entity"* conflicts with *entity–kind "entity"* (declared at line *xxxx*)

0736 cl_namespaces_option_only_in_cplusplus:
namespaces option can be used only when compiling C++

0737 useless_using_declaration:
using–declaration ignored –– it refers to the current namespace

0738 class_qualified_name_required:
a class–qualified name is required

0741 using_declaration_ignored:
using–declaration of *entity–kind "entity"* ignored

0742 not_an_actual_member:
entity–kind "entity" has no actual member *"xxxx"*

0744 mem_attrib_incompatible:
incompatible memory attributes specified

0745 mem_attrib_ignored:
memory attribute ignored

0746 mem_attrib_may_not_precede_nested_declarator:
memory attribute may not be followed by a nested declarator

0747 dupl_mem_attrib:
memory attribute specified more than once

0748 dupl_calling_convention:
calling convention specified more than once

0749 type_qualifier_not_allowed:
a type qualifier is not allowed

0750 template_instance_already_used:
entity–kind "entity" (declared at line *xxxx*) was used before its template was declared

0751 static_nonstatic_with_same_param_types:
static and nonstatic member functions with same parameter types cannot be overloaded

0752 no_prior_declaration:
no prior declaration of *entity–kind "entity"*

0753 template_id_not_allowed:
a template–id is not allowed

0754 class_qualified_name_not_allowed:
a class–qualified name is not allowed

0755 bad_scope_for_redeclaration:
entity–kind "entity" may not be redeclared in the current scope

0756 qualifier_in_namespace_member_decl:
qualified name is not allowed in namespace member declaration

0757 sym_not_a_type_name:
entity–kind "entity" is not a type name

0758 explicit_instantiation_not_in_namespace_scope:

explicit instantiation is not allowed in the current scope

0759 bad_scope_for_explicit_instantiation:

entity–kind "entity" cannot be explicitly instantiated in the current scope

0760 multiple_explicit_instantiations:

entity–kind "entity" explicitly instantiated more than once

0761 typename_not_in_template:

typename may only be used within a template

0762 cl_special_subscript_cost_option_only_in_cplusplus:

special_subscript_cost option can be used only when compiling C++

0763 cl_typename_option_only_in_cplusplus:

typename option can be used only when compiling C++

0764 cl_implicit_typename_option_only_in_cplusplus:

implicit typename option can be used only when compiling C++

0765 nonstd_character_at_start_of_macro_def:

nonstandard character at start of object–like macro definition

0766 exception_spec_override_incompat:

exception specification for virtual *entity–kind "entity"* is incompatible with that of overridden *entity–kind "entity"*

0767 pointer_conversion_loses_bits:

conversion from pointer to smaller integer

0768 generated_exception_spec_override_incompat:

exception specification for implicitly declared virtual *entity–kind "entity"* is incompatible with that of overridden *entity–kind "entity"*

0769 implicit_call_of_ambiguous_name:

"entity", implicitly called from *entity–kind "entity"*, is ambiguous

0770 cl_explicit_option_only_in_cplusplus:

option ”explicit” can be used only when compiling C++

0771 explicit_not_allowed:

”explicit” is not allowed

0772 conflicts_with_predeclared_type_info:

declaration conflicts with *”xxxx”* (reserved class name)

0773 array_member_initialization:

only ”()” is allowed as initializer for array *entity–kind ”entity”*

0774 virtual_function_template:

”virtual” is not allowed in a function template declaration

0775 anon_union_class_member_template:

invalid anonymous union –– class member template is not allowed

0776 template_depth_mismatch:

template nesting depth does not match the previous declaration of *entity–kind ”entity”*

0777 multiple_template_decls_not_allowed:

this declaration cannot have multiple ”template <...>” clauses

0778 cl_old_for_init_option_only_in_cplusplus:

option to control the for–init scope can be used only when compiling C++

0779 redeclaration_of_for_init_decl_name:

”xxxx”, declared in for–loop initialization, may not be redeclared in this scope

0780 hidden_by_old_for_init:

reference is to *entity–kind ”entity”* (declared at line *xxxx*) –– under old for–init scoping rules it would have been *entity–kind ”entity”* (declared at line *xxxx*)

0781 cl_for_init_diff_warning_option_only_in_cplusplus:

option to control warnings on for–init differences can be used only when compiling C++

0782 unnamed_class_virtual_function_def_missing:

definition of virtual *entity–kind "entity"* is required here

0783 svr4_token_pasting_comment:

empty comment interpreted as token–pasting operator "##"

0784 storage_class_in_friend_decl:

a storage class is not allowed in a friend declaration

0785 templ_param_list_not_allowed:

template parameter list for *"entity"* is not allowed in this declaration

0786 bad_member_template_sym:

entity–kind "entity" is not a valid member class or function template

0787 bad_member_template_decl:

not a valid member class or function template declaration

0788 specialization_follows_param_list:

a template declaration containing a template parameter list may not be followed by an explicit specialization declaration

0789 specialization_of_referenced_template:

explicit specialization of *entity–kind "entity"* must precede the first use of *entity–kind "entity"*

0790 explicit_specialization_not_in_namespace_scope:

explicit specialization is not allowed in the current scope

0791 partial_specialization_not_allowed:

partial specialization of *entity–kind "entity"* is not allowed

0792 entity_cannot_be_specialized:

entity–kind "entity" is not an entity that can be explicitly specialized

0793 specialization_of_referenced_entity:

explicit specialization of *entity–kind "entity"* must precede its first use

0794 template_param_in_elab_type:

template parameter *xxxx* may not be used in an elaborated type specifier

0795 old_specialization_not_allowed:

specializing *entity–kind "entity"* requires "template<>" syntax

0798 cl_old_specializations_option_only_in_cplusplus:

option "old_specializations" can be used only when compiling C++

0799 nonstd_old_specialization:

specializing *entity–kind "entity"* without "template<>" syntax is nonstandard

0800 bad_linkage_for_decl:

this declaration may not have extern "C" linkage

0801 not_a_template_name:

"xxxx" is not a class or function template name in the current scope

0802 nonstd_default_arg_on_function_template_redecl:

specifying a default argument when redeclaring an unreferenced function template is nonstandard

0803 default_arg_on_function_template_not_allowed:

specifying a default argument when redeclaring an already referenced function template is not allowed

0804 pm_derived_class_from_virtual_base:

cannot convert pointer to member of base class *"type"* to pointer to member of derived class *"type"* –– base class is virtual

0805 bad_exception_specification_for_specialization:

exception specification is incompatible with that of *entity–kind "entity"* (declared at line *xxxx*):

0806 omitted_exception_specification_on_specialization:

omission of exception specification is incompatible with *entity–kind "entity"* (declared at line *xxxx*)

0807 unexpected_end_of_default_arg:

unexpected end of default argument expression

0808 default_init_of_reference:

default–initialization of reference is not allowed

0809 uninitialized_field_with_const_member:

uninitialized *entity–kind "entity"* has a const member

0810 uninitialized_base_class_with_const_member:

uninitialized base class *"type"* has a const member

0811 missing_default_constructor_on_const:

const *entity–kind "entity"* requires an initializer –– class *"type"* has no explicitly declared default constructor

0812 missing_default_constructor_on_unnamed_const:

const object requires an initializer –– class *"type"* has no explicitly declared default constructor

0813 cl_impl_extern_c_conv_option_only_in_cplusplus:

option "implicit_extern_c_type_conversion" can be used only when compiling C++

0814 cl_strict_ansi_incompatible_with_long_preserving:

strict ANSI mode is incompatible with long preserving rules

0815 useless_type_qualifier_on_return_type:

type qualifier on return type is meaningless

0816 type_qualifier_on_void_return_type:

in a function definition a type qualifier on a "void" return type is not allowed

0817 static_data_member_not_allowed:

static data member declaration is not allowed in this class

0818 invalid_declaration:

template instantiation resulted in an invalid function declaration

0819 ellipsis_not_allowed:

"..." is not allowed

0820 cl_extern_inline_option_only_in_cplusplus:

option "extern_inline" can be used only when compiling C++

0821 extern_inline_never_defined:

extern inline *entity–kind "entity"* was referenced but not defined

0822 invalid_destructor_name:

invalid destructor name for type *"type"*

0824 ambiguous_destructor:

destructor reference is ambiguous –– both *entity–kind "entity"* and *entity–kind "entity"* could be used

0825 virtual_inline_never_defined:

virtual inline *entity–kind "entity"* was never defined

0826 unreferenced_function_param:

entity–kind "entity" was never referenced

0827 union_already_initialized:

only one member of a union may be specified in a constructor initializer list

0828 no_array_new_and_delete_support:

support for "new[]" and "delete[]" is disabled

0829 double_for_long_double:

"double" used for "long double" in generated C code

0830 no_corresponding_delete:

entity–kind "entity" has no corresponding operator delete*xxxx* (to be called if an exception is thrown during initialization of an allocated object)

0831 useless_placement_delete:

support for placement delete is disabled

0832 no_appropriate_delete:

no appropriate operator delete is visible

0833 ptr_or_ref_to_incomplete_type:

pointer or reference to incomplete type is not allowed

0834 bad_partial_specialization:

invalid partial specialization –– *entity–kind "entity"* is already fully specialized

0835 incompatible_exception_specs:

incompatible exception specifications

0836 returning_ref_to_local_variable:

returning reference to local variable

0837 nonstd_implicit_int:

omission of explicit type is nonstandard ("int" assumed)

0838 ambiguous_partial_spec:

more than one partial specialization matches the template argument list of *entity–kind "entity"*

0840 partial_spec_is_primary_template:

a template argument list is not allowed in a declaration of a primary template

0841 default_not_allowed_on_partial_spec:

partial specializations may not have default template arguments

0842 not_used_in_partial_spec_arg_list:

entity–kind "entity" is not used in template argument list of *entity–kind "entity"*

0843 partial_spec_param_depends_on_templ_param:

the type of partial specialization template parameter *entity–kind "entity"* depends on another template parameter

0844 partial_spec_arg_depends_on_templ_param:

the template argument list of the partial specialization includes a nontype argument whose type depends on a template parameter

0845 partial_spec_after_instantiation:

this partial specialization would have been used to instantiate *entity–kind "entity"*

0846 partial_spec_after_instantiation_ambiguous:

this partial specialization would have been made the instantiation of *entity–kind "entity"* ambiguous

0847 expr_not_integral_or_enum:

expression must have integral or enum type

0848 expr_not_arithmetic_or_enum:

expression must have arithmetic or enum type

0849 expr_not_arithmetic_or_enum_or_pointer:

expression must have arithmetic, enum, or pointer type

0850 cast_not_integral_or_enum:

type of cast must be integral or enum

0851 cast_not_arithmetic_or_enum_or_pointer:

type of cast must be arithmetic, enum, or pointer

0852 expr_not_object_pointer:

expression must be a pointer to a complete object type

0853 member_partial_spec_not_in_class:

a partial specialization of a member class template must be declared in the class of which it is a member

0854 partial_spec_nontype_expr:

a partial specialization nontype argument must be the name of a nontype parameter or a constant

0855 different_return_type_on_virtual_function_override:

return type is not identical to return type *"type"* of overridden virtual function *entity–kind "entity"*

0856 cl_guiding_decls_option_only_in_cplusplus:

option "guiding_decls" can be used only when compiling C++

0857 member_partial_spec_not_in_namespace:

a partial specialization of a class template must be declared in the namespace of which it is a member

0858 pure_virtual_function:

entity–kind "entity" is a pure virtual function

0859 no_overrider_for_pure_virtual_function:

pure virtual *entity–kind "entity"* has no overrider

0860 decl_modifiers_ignored:

__declspec attributes ignored

0861 invalid_char:

invalid character in input line

0862 incomplete_return_type:

function returns incomplete type *"type"*

0863 local_pragma_pack:

effect of this "#pragma pack" directive is local to *entity–kind "entity"*

0864 not_a_template:

xxxx is not a template

0865 friend_partial_specialization:

a friend declaration may not declare a partial specialization

0866 exception_specification_ignored:

exception specification ignored

0867 unexpected_type_for_size_t:

declaration of "size_t" does not match the expected type *"type"*

0868 exp_gt_not_shift_right:

space required between adjacent ">" delimiters of nested template argument lists (">>" is the right shift operator)

0869 bad_multibyte_char_locale:

could not set locale *"xxxx"* to allow processing of multibyte characters

0870 bad_multibyte_char:

invalid multibyte character sequence

0871 bad_type_from_instantiation:

template instantiation resulted in unexpected function type of *”type”* (the meaning of a name may have changed since the template declaration –– the type of the template is *”type”*)

0872 ambiguous_guiding_decl:

ambiguous guiding declaration –– more than one function template *”entity”* matches type *”type”*

0873 non_integral_operation_in_templ_arg:

non–integral operation not allowed in nontype template argument

0874 cl_embedded_cplusplus_option_only_in_cplusplus:

option ”embedded_c++” can be used only when compiling C++

0875 templates_in_embedded_cplusplus:

Embedded C++ does not support templates

0876 exceptions_in_embedded_cplusplus:

Embedded C++ does not support exception handling

0877 namespaces_in_embedded_cplusplus:

Embedded C++ does not support namespaces

0878 rtti_in_embedded_cplusplus:

Embedded C++ does not support run time type information

0879 new_cast_in_embedded_cplusplus:

Embedded C++ does not support the new cast syntax

0880 using_decl_in_embedded_cplusplus:

Embedded C++ does not support using declarations

0881 mutable_in_embedded_cplusplus:

Embedded C++ does not support ”mutable”

0882 multiple_inheritance_in_embedded_cplusplus:

Embedded C++ does not support multiple or virtual inheritance

0883 cl_invalid_microsoft_version:

invalid Microsoft version number

0884 inheritance_kind_already_set:

pointer–to–member representation has already been set for *entity–kind* ”*entity*”

0885 bad_constructor_type:

”*type*” cannot be used to designate constructor for ”*type*”

0886 bad_suffix:

invalid suffix on integral constant

0887 uuidof_requires_uuid_class_type:

operand of __uuiof must have a class type for which __declspec(uuid(”...”)) has been specified

0888 bad_uuid_string:

invalid GUID string in __declspec(uuid(”...”))

0889 cl_vla_option_only_in_C:

option ”vla” can be used only when compiling C

0890 vla_with_unspecified_bound_not_allowed:

variable length array with unspecified bound is not allowed

0891 explicit_template_args_not_allowed:

an explicit template argument list is not allowed on this declaration

0892 variably_modified_type_not_allowed:

an entity with linkage cannot have a variably modified type

0893 vla_is_not_auto

a variable length array cannot have static storage duration

0894 sym_not_a_template:

entity–kind ”*entity*” is not a template

0896 expected_template_arg:

expected a template argument

0897 explicit_template_args_in_expr:

explicit function template argument lists are not supported yet in expression contexts

0898 no_params_with_class_or_enum_type:

nonmember operator requires a parameter with class or enum type

0899 cl_enum_oveloading_option_only_in_cplusplus:

option ”enum_overloading” can be used only when compiling C++

0901 destructor_qualifier_type_mismatch:

qualifier of destructor name ”*type*” does not match type ”*type*”

0902 type_qualifier_ignored:

type qualifier ignored

0903 cl_nonstandard_qualifier_deduction_option_only_in_cplusplus:

option ”nonstd_qualifier_deduction” can be used only when compiling C++

0905 bad_declspec_property:

incorrect property specification; correct form is __declspec(property(get=name1,put=name2))

0906 dupl_get_or_put:

property has already been specified

0907 declspec_property_not_allowed:

__declspec(property) is not allowed on this declaration

0908 no_get_property:

member is declared with __declspec(property), but no ”get” function was specified

0909 get_property_function_missing:

the __declspec(property) ”get” function *”xxxx”* is missing

0910 no_put_property:

member is declared with __declspec(property), but no ”put” function was specified

0911 put_property_function_missing:

the __declspec(property) ”put” function *”xxxx”* is missing

0912 dual_lookup_ambiguous_name:

ambiguous class member reference –– *entity–kind ”entity”* (declared at line *xxxx*) used in preference to *entity–kind ”entity”* (declared at line *xxxx*)

0913 bad_allocate_segname:

missing or invalid segment name in __declspec(allocate(”...”))

0914 declspec_allocate_not_allowed:

__declspec(allocate) is not allowed on this declaration

0915 dupl_allocate_segname:

a segment name has already been specified

0916 pm_virtual_base_from_derived_class:

cannot convert pointer to member of derived class *”type”* to pointer to member of base class *”type”* –– base class is virtual

0917 cl_invalid_instantiation_directory:

invalid directory for instantiation files:

0918 cl_one_instantiation_per_object_option_only_in_cplusplus:

option ”one_instantiation_per_object” can be used only when compiling C++

0919 invalid_output_file:

invalid output file: *”xxxx”*

0920 cannot_open_output_file:

cannot open output file: *”xxxx”*

0921 cl_ii_file_name_incompatible_with_multiple_inputs:

an instantiation information file name may not be specified when compiling several input files

0922 cl_one_instantiation_per_object_incompatible_with_multiple_inputs:

option ”one_instantiation_per_object” may not be used when compiling several input files

0923 cl_ambiguous_option:

more than one command line option matches the abbreviation ”––*xxxx*”:

0925 cv_qualified_function_type:

a type qualifier cannot be applied to a function type

0926 cannot_open_definition_list_file:

cannot open definition list file: *”xxxx”*

0927 cl_late_tiebreaker_option_only_in_cplusplus:

late/early tiebreaker option can be used only when compiling C++

0928 cl_strict_ansi_incompatible_with_tsw_extensions:

strict ANSI mode is incompatible with TASKING Embedded C++ extensions

0929 tsw_embedded_extensions_not_allowed:

TASKING Embedded C++ extensions not allowed

0930 tsw_at_already_used:

_at() can only be used once in a declaration

0931 tsw_atbit_already_used:

_atbit() can only be used once in a declaration

0932 tsw_at_atbit_conflict:

_at() and _atbit() cannot be used in the same declaration

0938 tricore_fast_interrupt_conflict:

_interrupt() and _interrupt_fast() cannot be used in the same declaration

0939 tricore_interrupt_already_used:

_interrupt() can only be used once in a declaration

0940 tricore_interrupt_fast_already_used:

_interrupt_fast() can only be used once in a declaration

0941 tsw_expr_not_integral_or_fractional:

expression must have integral or fractional type

0942 tsw_expr_not_integral_or_enum_or_fractional:
expression must have integral, enum or fractional type

0943 cl_options_after_input_file_not_allowed:
options are not allowed after the input file name

0944 bad_va_start:
incorrect use of va_start

0945 bad_va_arg:
incorrect use of va_arg

0946 bad_va_end:
incorrect use of va_end

0947 cl_pending_instantiations_option_only_in_cplusplus:
pending instantiations option can be used only when compiling C++

0948 cl_invalid_import_directory:
invalid directory for #import files:

0949 cl_import_only_in_microsoft:
an import directory can be specified only in Microsoft mode

0950 ref_not_allowed_in_union:
a member with reference type is not allowed in a union

0951 typedef_not_allowed:
"typedef" may not be specified here

0952 redecl_changes_access:
redeclaration of *entity–kind "entity"* alters its access

0953 qualified_name_required:
a class or namespace qualified name is required

0954 implicit_int_on_main:
return type "int" omitted in declaration of function "main"

0955 invalid_inheritance_kind_for_class:

pointer–to–member representation *"xxxx"* is too restrictive for *entity–kind "entity"*

0956 implicit_return_from_non_void_function:

missing return statement at end of non–void *entity–kind "entity"*

0957 duplicate_using_decl:

duplicate using–declaration of *"entity"* ignored

0958 unsigned_enum_bit_field_with_signed_enumerator:

enum bit–fields are always unsigned, but enum *"type"* includes negative enumerator

0959 cl_class_name_injection_option_only_in_cplusplus:

option "class_name_injection" can be used only when compiling C++

0960 cl_arg_dependent_lookup_option_only_in_cplusplus:

option "arg_dep_lookup" can be used only when compiling C++

0961 cl_friend_injection_option_only_in_cplusplus:

option "friend_injection" can be used only when compiling C++

0962 invalid_name_after_template:

name following "template" must be a member template

0964 local_class_friend_requires_prior_decl:

nonstandard local–class friend declaration –– no prior declaration in the enclosing scope

0965 nonstd_default_arg:

specifying a default argument on this declaration is nonstandard

0966 cl_nonstd_using_decl_option_only_in_cplusplus:

option "nonstd_using_decl" can be used only when compiling C++

0967 bad_return_type_on_main:

return type of function "main" must be "int"

0968 template_parameter_has_class_type:

a template parameter may not have class type

0969 default_arg_on_member_decl:

a default template argument cannot be specified on the declaration of a member of a class template

0970 return_from_ctor_function_try_block_handler:

a return statement is not allowed in a handler of a function try block of a constructor

0971 no_ordinary_and_extended_designators:

ordinary and extended designators cannot be combined in an initializer designation

0972 no_negative_designator_range:

the second subscript must not be smaller than the first

0973 cl_designators_option_only_in_C:

option ”designators” can be used only when compiling C

0974 cl_extended_designators_option_only_in_C:

option ”extended_designators” can be used only when compiling C

0975 extra_bits_ignored:

declared size for bit field is larger than the size of the bit field type; truncated to *xxxx* bits

0976 constructor_type_mismatch:

type used as constructor name does not match type *”type”*

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APPENDIX

C

UTILITY PROGRAMS

TASKING

APPENDIX C

1 INTRODUCTION

This appendix describes the utility programs that are delivered with the C++ compiler. The utility programs help with various link–time issues and are meant to be called from the control program.

When you use a **UNIX** shell (Bourne shell, C–shell), arguments containing special characters (such as '( )' and '?') must be enclosed with **" "** or escaped. The **–?** option (in the C–shell) becomes: **"–?"** or **–\?**.

2 PRELINKER

The prelinker is invoked at link time to manage automatic instantiation of template entities. It is given a complete list of the object files and libraries that are to be linked together. It examines the external names defined and referenced within those files, and finds cases where template entities are referenced but not defined. It then examines information in the object files that describes instantiations that could have been done during compilation, and assigns the needed instantiations to appropriate files. The prelinker then invokes the compiler again to compile those files, which will do the necessary instantiations.

The invocation syntax of the C++ prelinker is:

prelktri [*option*]... *files*

where the *files* list includes all object files and libraries, and the *options* are:

–? Display an explanation of options at `stdout`.

–V Display version information at `stderr`.

–c *c* Use *c* as symbol prefix character instead of the default underscore.

–D Do not assign instantiation to non–local object files. Instantiations may only be assigned to object files in the current directory.

–e Treat warnings as errors. This also affects the return value of the application when only warnings occur. A build process will now stop when warnings occur.

–i Ignore invalid input lines.

–l*xxx* Specify a library (e.g., **–lstd**).

–L Skip system library search.

–L *directory* Specify an additional search path for system libraries.

–m Do not demangle identifier names that are displayed.

–n Update the instantiation list files (`.ii`), but do not recompile the source files.

–N *filename* If a file from a non–local directory needs to be recompiled, do the compilation in the current directory. An updated list of object files and library names is written to the file specified by *filename* so that the driver program can tell that alternate versions of some of the object files should be used.

–q Quiet mode. Turns off verbose mode.

–r Do not stop after the maximum number of iterations. (The instantiation process is iterative: a recompilation may bring up new template entities that need to be instantiated, which requires another recompilation, etc. Some recursive templates can cause iteration that never terminates, because each iteration introduces another new entity that was not previously there. By default, this process is stopped after a certain number of iterations.)

–R *number* Override the number of reserved instantiation information file lines to be used.

–s *number* Specifies whether the prelinker should check for entities that are referenced as both explicit specializations and generated instantiations. If *number* is zero the check is disabled, otherwise the check is enabled.

–S Suppress instantiation flags in the object files.

–T *cpu* Set the target CPU type.

–u Specify that external names do not have an added leading underscore. By default, external names get a leading underscore. With this option you specify that the leading underscore belongs to the external name.

–v Verbose mode.

3 MUNCHER

The muncher implements a lowest–common–denominator method for getting global initialization and termination code executed on systems that have no special support for that.

The muncher accepts the output of the prelinker as its input file and generates a C program that defines a data structure containing a list of pointers to the initialization and termination routines. This generated program is then compiled and linked in with the executable. The data structure is consulted at run–time by startup code invoked from `_main`, and the routines on the list are invoked at the appropriate times.

The invocation syntax of the C++ muncher is:

munchtri [*option*]... [*file*]

where the *file* is an output file generated by the prelinker, and the *options* are:

–? Display an explanation of options at `stdout`.

–V Display version information at `stderr`.

–c *c* Use *c* as symbol prefix character instead of the default underscore

–i *n* Skip first *n* lines of input.

–o *file* Write output to *file*.

–u Specify that external names do not have an added leading underscore. By default, external names get a leading underscore. With this option you specify that the leading underscore belongs to external name.

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