2008-7721P

CMake Trilinos?

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Trilinos User Group Meeting, October 21, 2008

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Outline

- What is CMake?
- User advantages in switching Trilinos to CMake
- Configuring, building, and installing Trilinos with CMake on Unix systems
- Native Microsoft Windows support
  - Self-extracting installer for Trilinos
  - Visual C++ project files and Windows CMake GUI

Overview of CMake

- CMake = “Cross-platform Make”
- CMake:
  - Build system primarily for C/C++ code
  - Front-ends to configure a software package
    - Command-line, Scripts, CURSES, GUIs
  - Back-ends that build code
    - Unix Makefiles, MS Visual C++ Projects, Eclipse Projects, ...
  - Packaging and installing
    - Tar/gzip, Windows self-extracting installers, PackageMaker, RPM, ...
- Platforms and usage:
  - Platforms:
    - Unix/Linux, MAC OSX, MS Windows, AIX, IRIX, ...
  - Internal Sandia use:
    - VTK/Titan, ParaView, ThreatView, ...
  - External use:
    - KDE, MySql, MiKTeX, (and many many more) ..

CMake is a full featured mature build system!

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User advantages in switching Trilinos to CMake?

- Provide native support for MS Windows
  - Visual C++ projects
  - GUI binary installers
- Better user feedback for configuration errors
- Better support for shared libraries on many platforms
- More packaging and installation options
- Easier configuration for complex package dependencies

Current Status of Trilinos/CMake

- Our detailed evaluation of CMake for Trilinos is finished:
  - Roscoe A. Bartlett, Daniel Dunlavy, Guillen Esteban, and Tim Shead. *Trilinos CMake Evaluation.* SAND2008-xxxx, October 2008
    - http://www.cs.sandia.gov/~rabartl/publications.html
- We have a nearly complete CMake build system design in Trilinos Dev
- Current CMake enabled packages:
  - Teuchos, RTOp, Epetra, Triutils, EpetraExt, Thyra, RBGen
- Trilinos community close to making a decision to move to CMake?

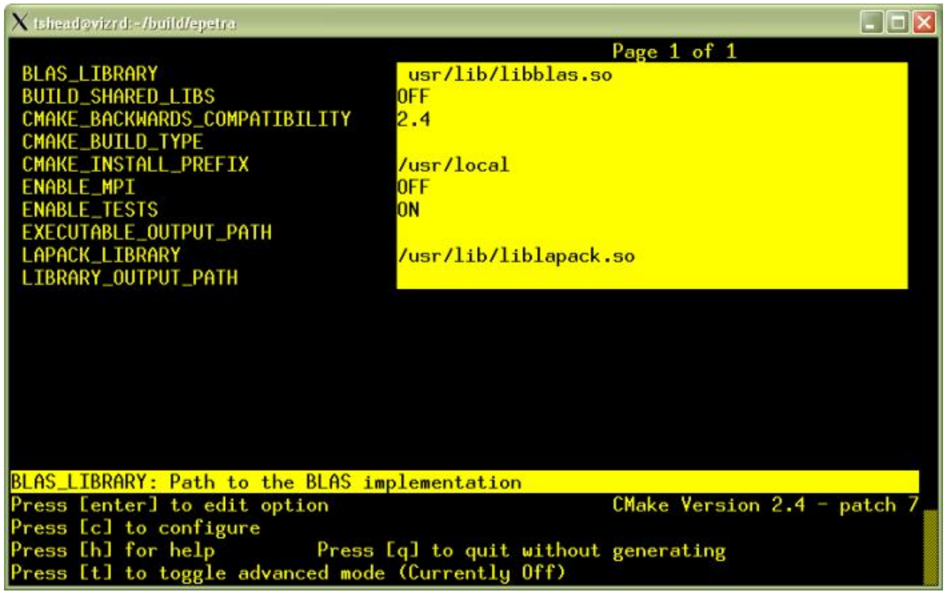
Configuring Trilinos with CMake on Unix/Linux

- CMake interactive mode: [Not Recommended]

```
$ cmake -i $TRILINOS_HOME
```

- CCMake (CURSES):

```
$ ccmake $TRILINOS_HOME
```



```
                                                       Page 1 of 1
BLAS_LIBRARY                        usr/lib/libblas.so
BUILD_SHARED_LIBS                  OFF
CMAKE_BACKWARDS_COMPATIBILITY      2.4
CMAKE_BUILD_TYPE
CMAKE_INSTALL_PREFIX               /usr/local
ENABLE_MPI                         OFF
ENABLE_TESTS                       ON
EXECUTABLE_OUTPUT_PATH
LAPACK_LIBRARY                     /usr/lib/liblapack.so
LIBRARY_OUTPUT_PATH




BLAS_LIBRARY: Path to the BLAS implementation
Press [enter] to edit option                           CMake Version 2.4 - patch 7
Press [c] to configure
Press [h] for help          Press [q] to quit without generating
Press [t] to toggle advanced mode (Currently Off)
```

- CMake script files:

```
$ cmake -S script_file \
  $TRILINOS_HOME
```

- CMake command-line options: [Recommended]

```
$ cmake -D Trilinos_ENABLE_ALL_PACKAGES:BOOL=ON \
 -D Trilinos_ENABLE_TESTS:BOOL=ON ... $TRILINOS_HOME
```

Creating a Configuration Script for CMake

```
#!/bin/sh
EXTRA_ARGS=$@
cmake \
  -D CMAKE_CXX_FLAGS:STRING="-g -O0 -ansi -pedantic -Wall" \
  -D DART_TESTING_TIMEOUT:STRING=600 \
  -D Trilinos_ENABLE_NOX:BOOL=ON \
  -D Trilinos_ENABLE_ALL_OPTIONAL_PACKAGES:BOOL=ON \
  -D Trilinos_ENABLE_EXAMPLES:BOOL=ON \
  -D Trilinos_ENABLE_TESTS:BOOL=ON \
  ... \
  $EXTRA_ARGS \
  ../../../Trilinos
```

```
$ ./do-configure –D VEROBSE_CONFIGURE:BOOL=ON
$ make –j4
$ ctest
$ make install
```

See example scripts:

Trilinos/sampleScripts/*cmake

Special Configuration Modes for Trilinos

- Configuring Trilinos to build all packages with all tests and examples:

```
-D Trilinos_ENABLE_ALL_PACKAGES:BOOL=ON
-D Trilinos_ENABLE_TESTS:BOOL=ON
-D Trilinos_ENABLE_EXAMPLES:BOOL=ON
```

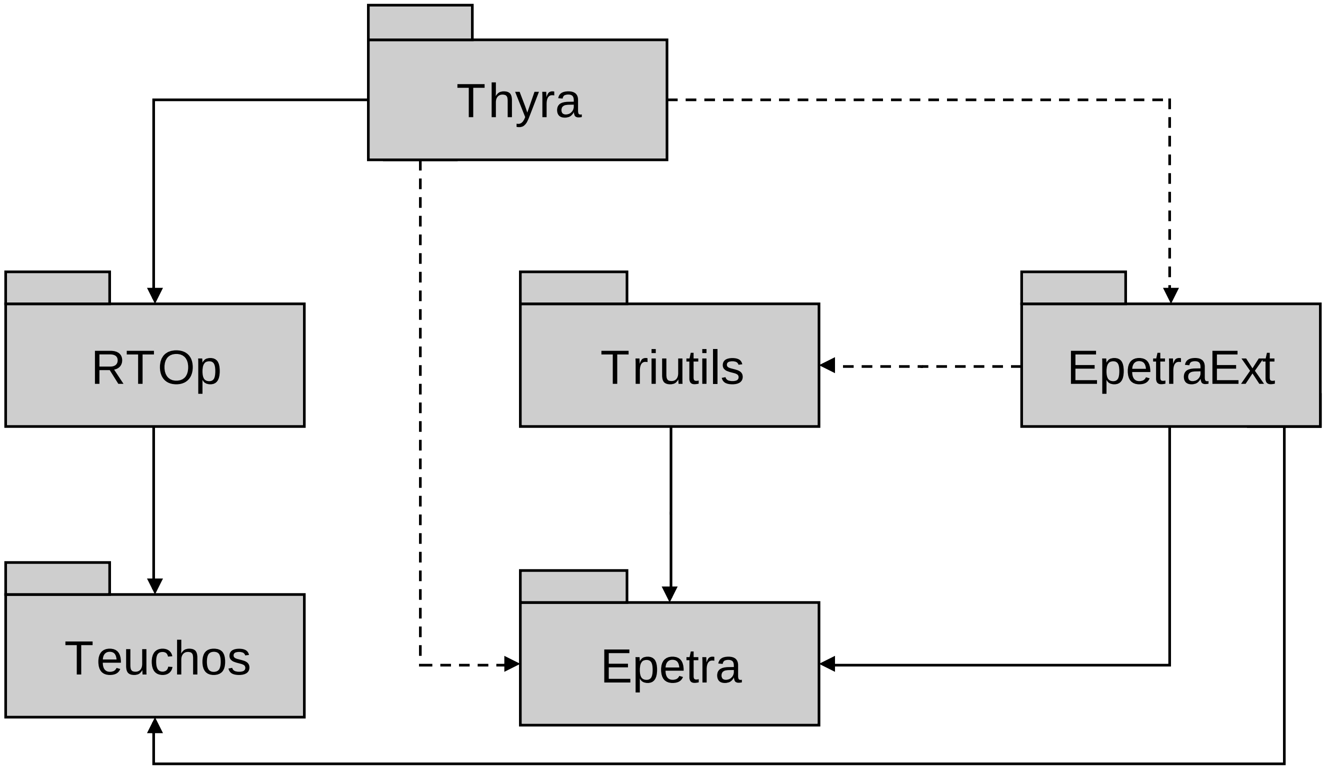
- Configuring a package(s) along with all of the packages it can use

```
-D Trilinos_ENABLE_Stratimikos:BOOL=ON
-D Trilinos_ENABLE_ALL_OPTIONAL_PACKAGES:BOOL=ON
-D Trilinos_ENABLE_TESTS:BOOL=ON
-D Trilinos_ENABLE_EXAMPLES:BOOL=ON
```

- Configuring Trilinos to disable a package(s) and all packages it depends on:

```
-D Trilinos_ENABLE_Stratimikos:BOOL=ON
-D Trilinos_ENABLE_Amesos:BOOL=OFF
```

Example: Enabling a Package and All Optional Packages



Required Dependence ⟶

Optional Dependence - - - ▸

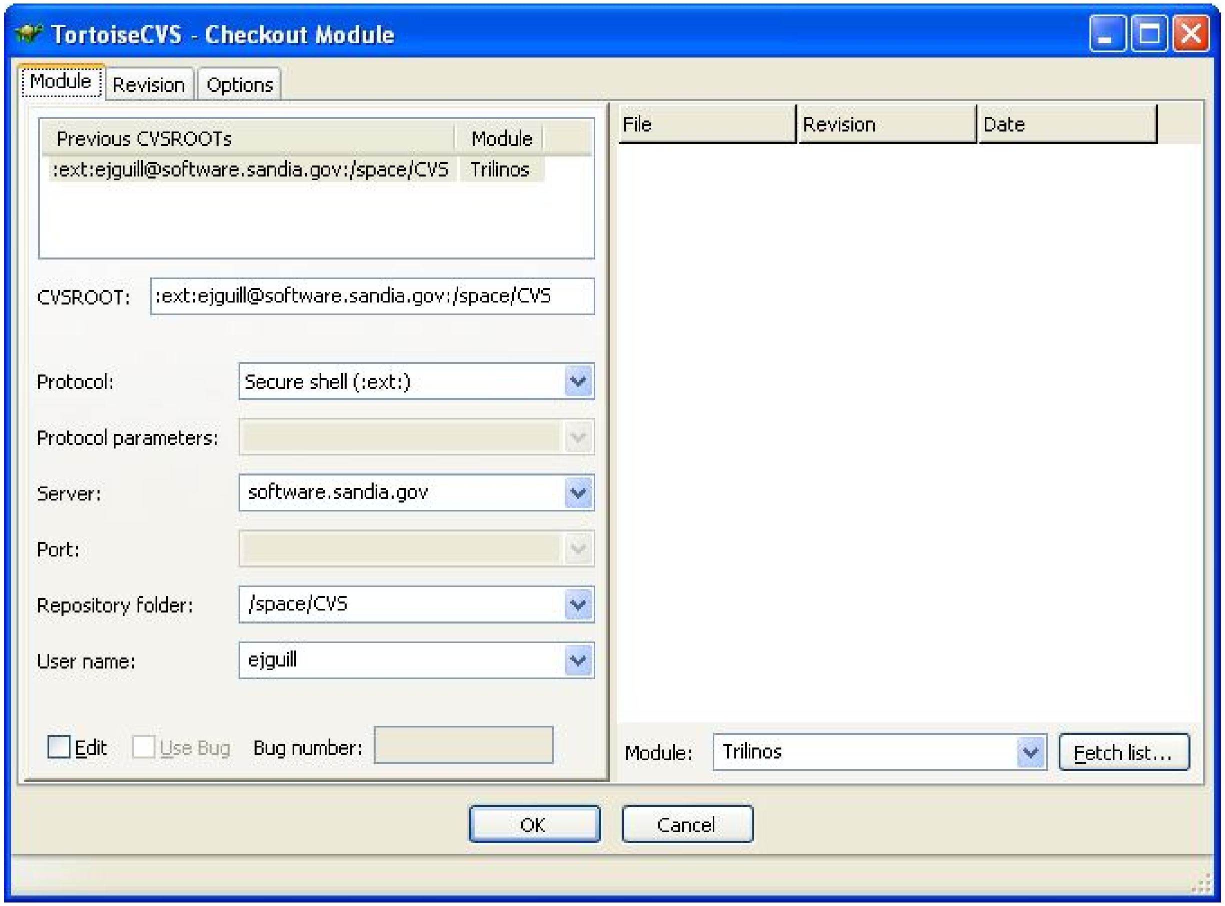
Example: Enabling a Package and All Optional Packages

```
$ ./do-configure -DTrilinos_ENABLE_ALL_PACKAGES:BOOL=OFF \
    -DTrilinos_ENABLE_Thyra:BOOL=ON \
    -DTrilinos_ENABLE_ALL_OPTIONAL_PACKAGES:BOOL=ON
```

```
Configuring Trilinos build directory

...

Enabling all optional packages for current set of enabled packages ...

-- Setting Trilinos_ENABLE_EpetraExt=ON because Trilinos_ENABLE_Thyra=ON
-- Setting Trilinos_ENABLE_Epetra=ON because Trilinos_ENABLE_Thyra=ON
-- Setting Trilinos_ENABLE_Triutils=ON because Trilinos_ENABLE_EpetraExt=ON

Enabling all remaining required packages for the current set of enabled packages ...

-- Setting Trilinos_ENABLE_RTOp=ON because Trilinos_ENABLE_Thyra=ON
-- Setting Trilinos_ENABLE_Teuchos=ON because Trilinos_ENABLE_Thyra=ON

Enabling all optional intra-package enables that can be if both sets of packages are enabled ...

-- Setting EpetraExt_ENABLE_Triutils=ON since Trilinos_ENABLE_EpetraExt=ON AND Trilinos_ENABLE_Triutils=ON
-- Setting Thyra_ENABLE_EpetraExt=ON since Trilinos_ENABLE_Thyra=ON AND Trilinos_ENABLE_EpetraExt=ON
-- Setting Thyra_ENABLE_Epetra=ON since Trilinos_ENABLE_Thyra=ON AND Trilinos_ENABLE_Epetra=ON

Final set of enabled packages:  Teuchos RTOp Epetra Triutils EpetraExt Thyra 6
```

DEMO

Checkout Trilinos From CVS



Previous CVSROOTs	Module
:ext:ejguill@software.sandia.gov:/space/CVS	Trilinos

CVSROOT: :ext:ejguill@software.sandia.gov:/space/CVS

Protocol: Secure shell (:ext:)

Protocol parameters:

Server: software.sandia.gov

Port:

Repository folder: /space/CVS

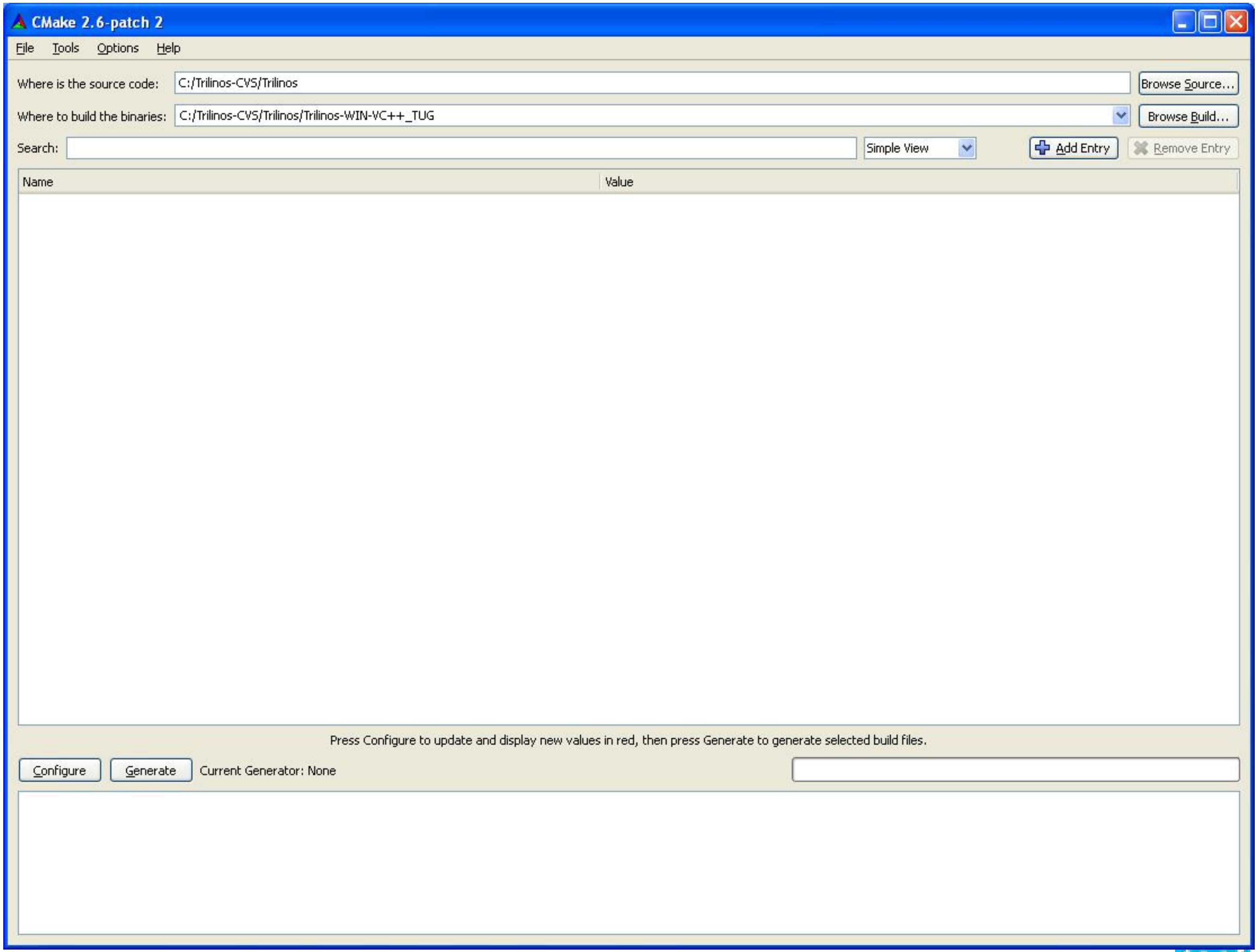
User name: ejguill

□ Edit □ Use Bug Bug number:

File	Revision	Date

Module: Trilinos

Open The CMake GUI



Where is the source code: C:/Trilinos-CVS/Trilinos

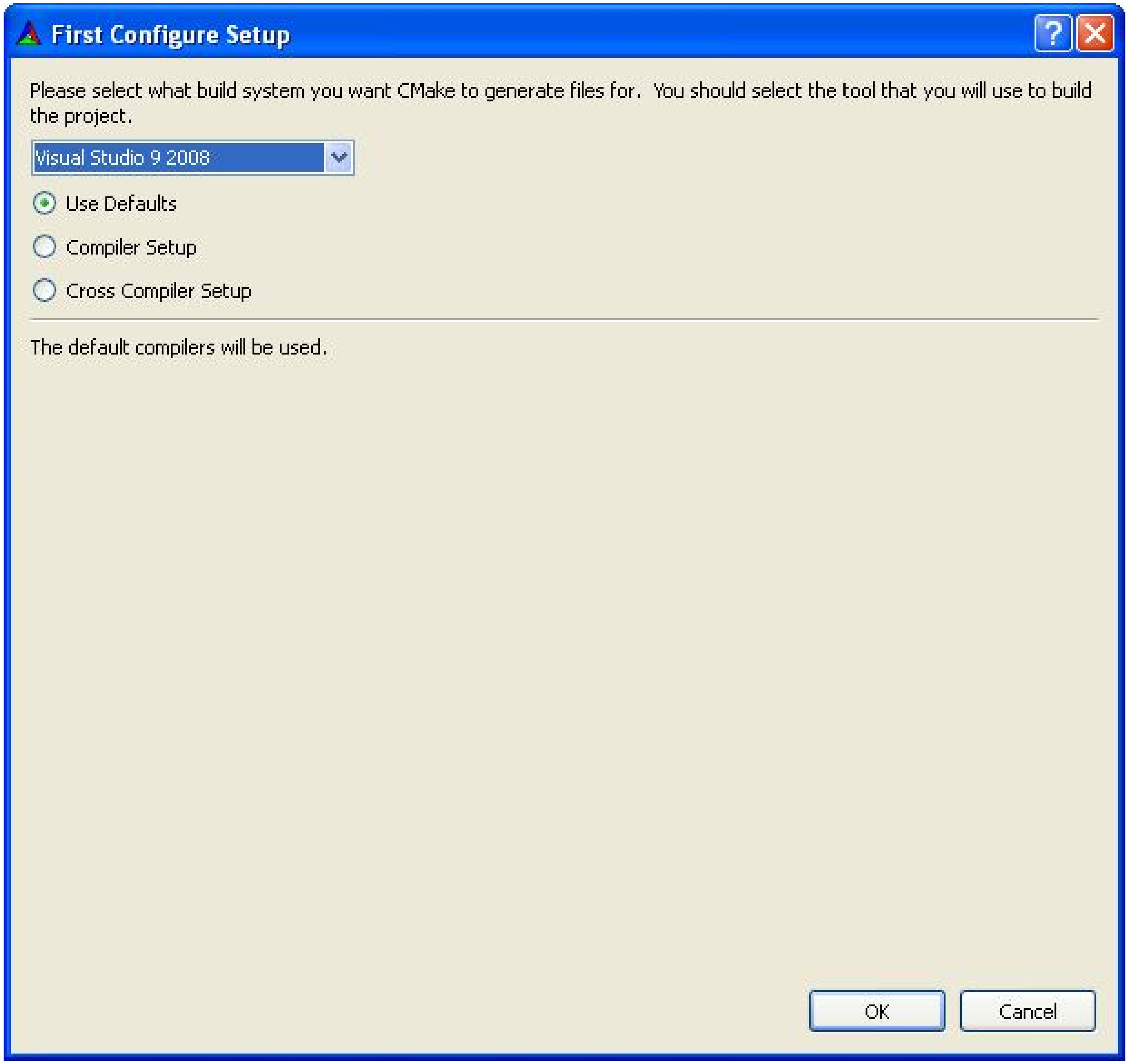
Where to build the binaries: C:/Trilinos-CVS/Trilinos/Trilinos-WIN-VC++_TUG

Search:

Press Configure to update and display new values in red, then press Generate to generate selected build files.

Current Generator: None

Define The Generator



Please select what build system you want CMake to generate files for. You should select the tool that you will use to build the project.

Visual Studio 9 2008

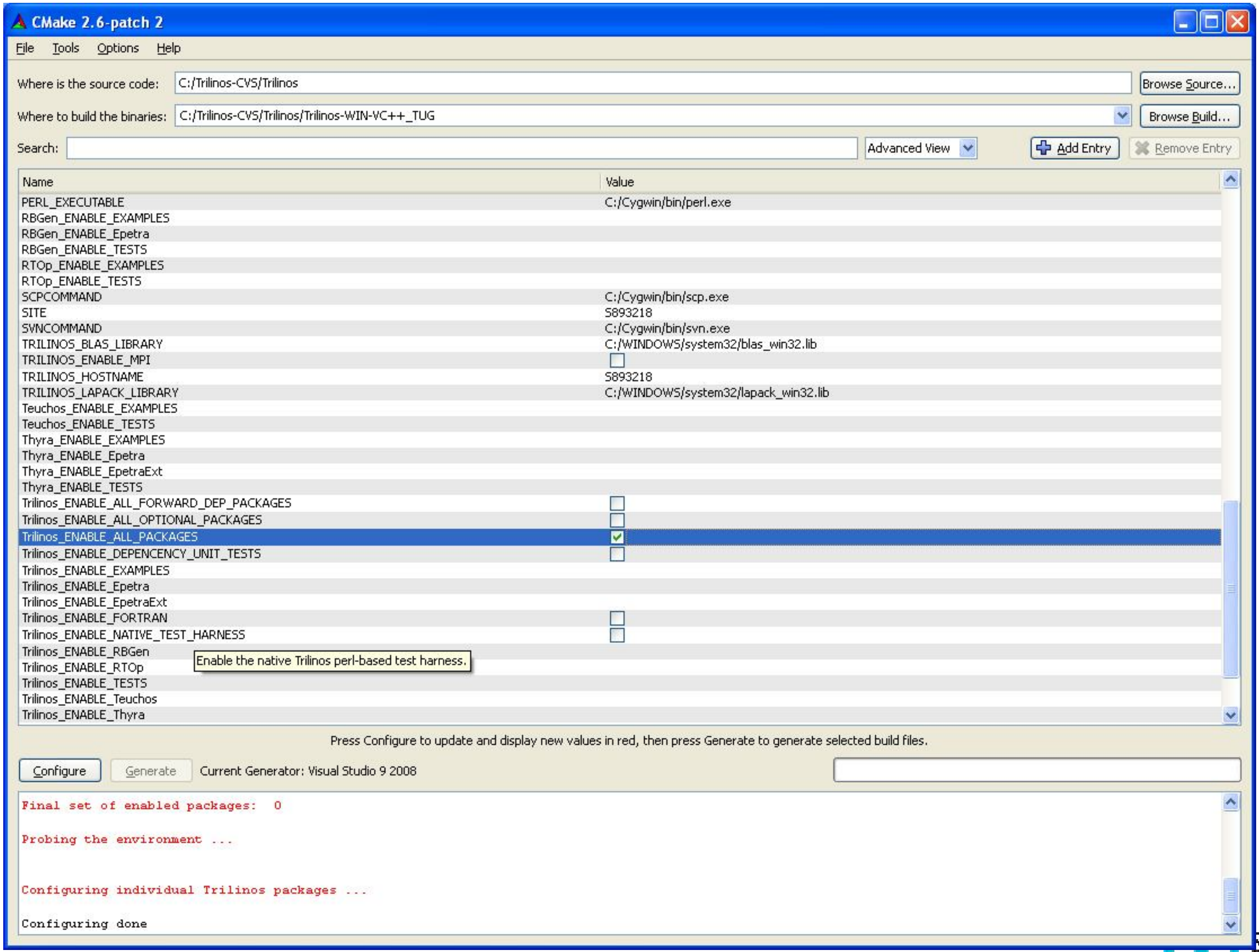
● Use Defaults

○ Compiler Setup

○ Cross Compiler Setup

The default compilers will be used.

Configure



Where is the source code: C:/Trilinos-CVS/Trilinos

Where to build the binaries: C:/Trilinos-CVS/Trilinos/Trilinos-WIN-VC++_TUG

Search:

Name	Value
PERL_EXECUTABLE	C:/Cygwin/bin/perl.exe
RBGen_ENABLE_EXAMPLES	
RBGen_ENABLE_Epetra	
RBGen_ENABLE_TESTS	
RTOp_ENABLE_EXAMPLES	
RTOp_ENABLE_TESTS	
SCPCOMMAND	C:/Cygwin/bin/scp.exe
SITE	S893218
SVNCOMMAND	C:/Cygwin/bin/svn.exe
TRILINOS_BLAS_LIBRARY	C:/WINDOWS/system32/blas_win32.lib
TRILINOS_ENABLE_MPI	□
TRILINOS_HOSTNAME	S893218
TRILINOS_LAPACK_LIBRARY	C:/WINDOWS/system32/lapack_win32.lib
Teuchos_ENABLE_EXAMPLES	
Teuchos_ENABLE_TESTS	
Thyra_ENABLE_EXAMPLES	
Thyra_ENABLE_Epetra	
Thyra_ENABLE_EpetraExt	
Thyra_ENABLE_TESTS	
Trilinos_ENABLE_ALL_FORWARD_DEP_PACKAGES	□
Trilinos_ENABLE_ALL_OPTIONAL_PACKAGES	□
Trilinos_ENABLE_ALL_PACKAGES	☑
Trilinos_ENABLE_DEPENCENCY_UNIT_TESTS	□
Trilinos_ENABLE_EXAMPLES	
Trilinos_ENABLE_Epetra	
Trilinos_ENABLE_EpetraExt	
Trilinos_ENABLE_FORTRAN	□
Trilinos_ENABLE_NATIVE_TEST_HARNESS	□
Trilinos_ENABLE_RBGen	
Trilinos_ENABLE_RTOp	
Trilinos_ENABLE_TESTS	
Trilinos_ENABLE_Teuchos	
Trilinos_ENABLE_Thyra	

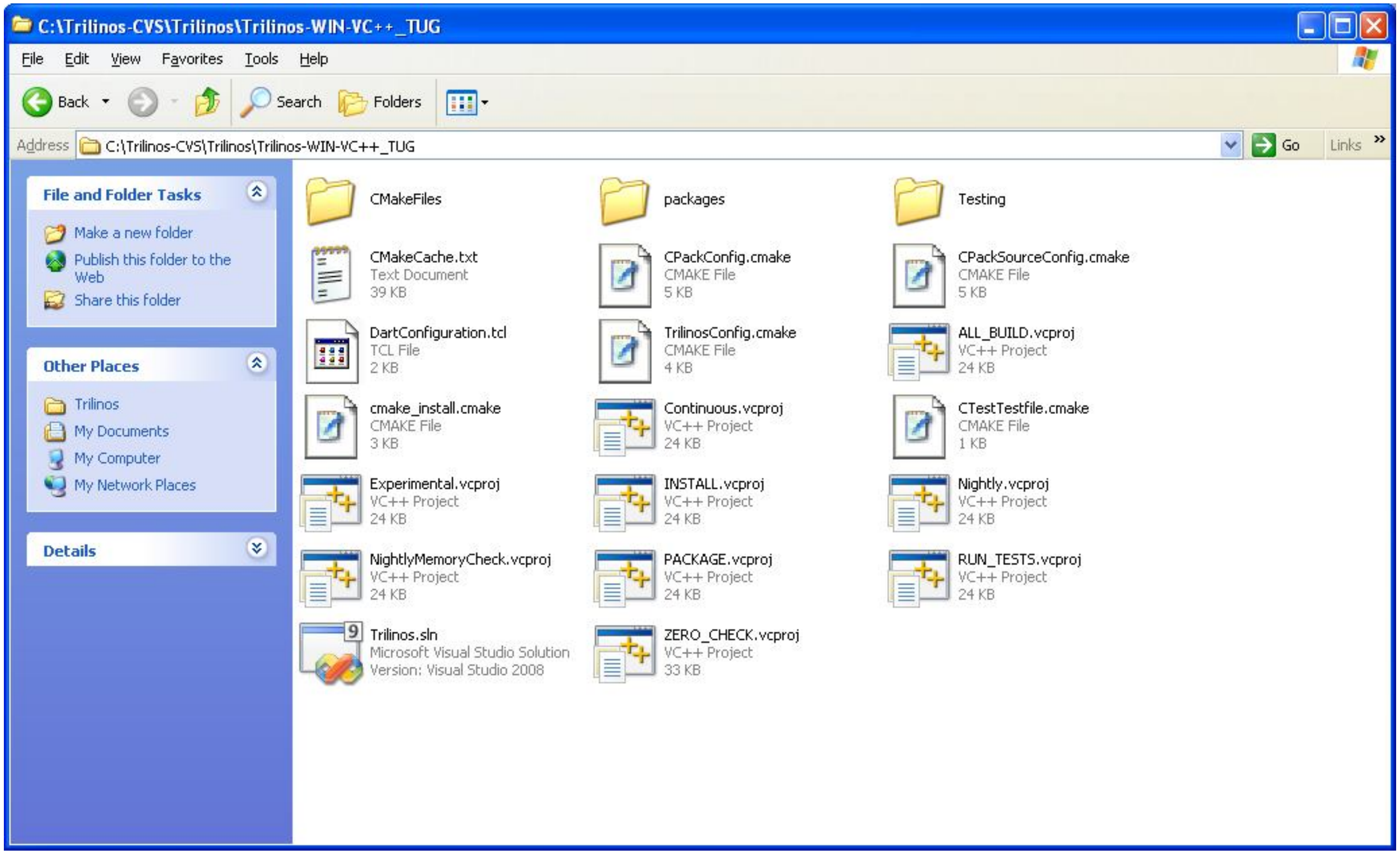
Enable the native Trilinos perl-based test harness.

Press Configure to update and display new values in red, then press Generate to generate selected build files.

Current Generator: Visual Studio 9 2008

```
Final set of enabled packages:  0

Probing the environment ...


Configuring individual Trilinos packages ...

Configuring done
```

Generated VC++ Project Files



CMakeFiles

packages

Testing

CMakeCache.txt
Text Document
39 KB

CPackConfig.cmake
CMAKE File
5 KB

CPackSourceConfig.cmake
CMAKE File
5 KB

DartConfiguration.tcl
TCL File
2 KB

TrilinosConfig.cmake
CMAKE File
4 KB

ALL_BUILD.vcproj
VC++ Project
24 KB

cmake_install.cmake
CMAKE File
3 KB

Continuous.vcproj
VC++ Project
24 KB

CTestTestfile.cmake
CMAKE File
1 KB

Experimental.vcproj
VC++ Project
24 KB

INSTALL.vcproj
VC++ Project
24 KB

Nightly.vcproj
VC++ Project
24 KB

NightlyMemoryCheck.vcproj
VC++ Project
24 KB

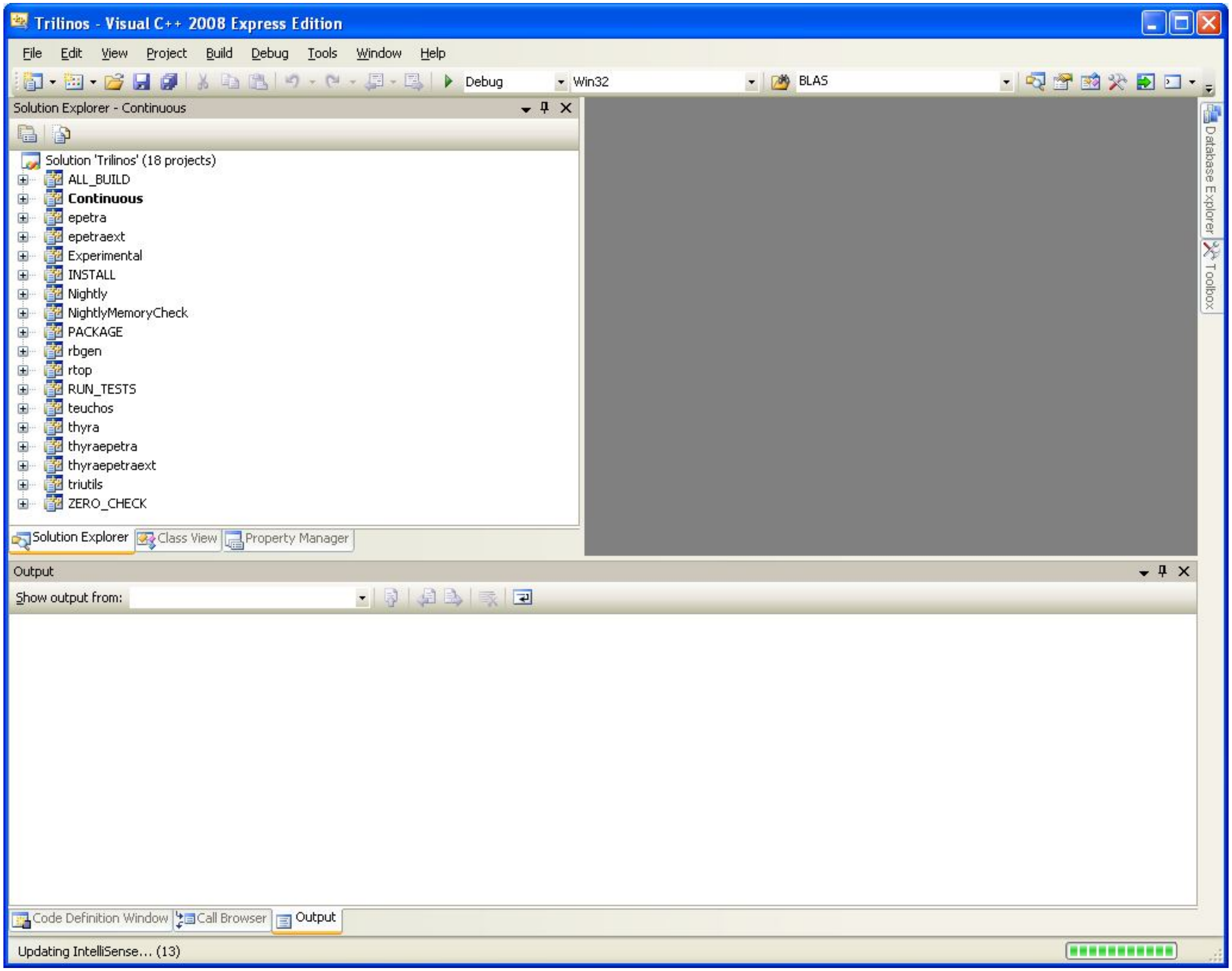
PACKAGE.vcproj
VC++ Project
24 KB

RUN_TESTS.vcproj
VC++ Project
24 KB

Trilinos.sln
Microsoft Visual Studio Solution
Version: Visual Studio 2008

ZERO_CHECK.vcproj
VC++ Project
33 KB

Visual C++ Solution

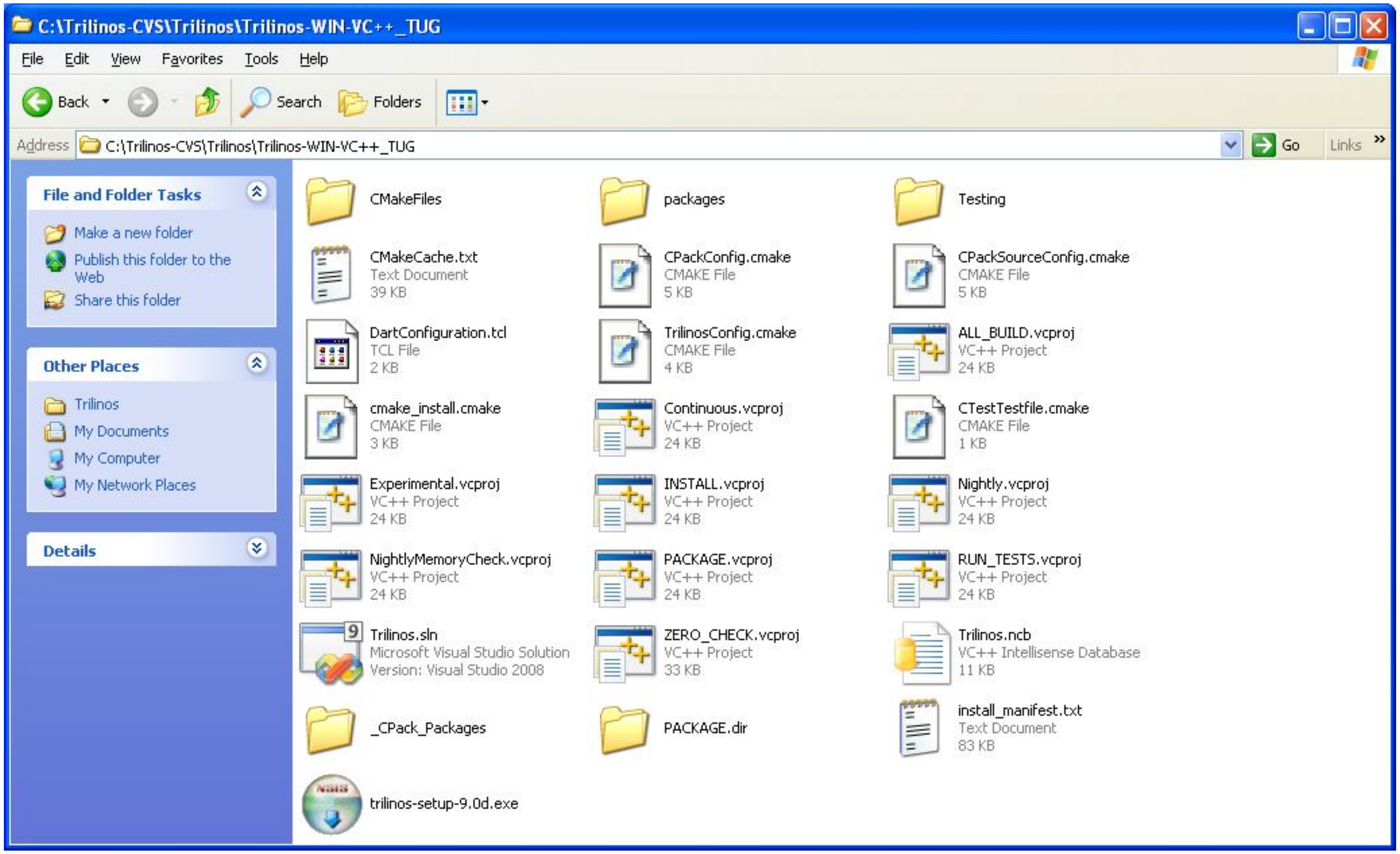


Solution 'Trilinos' (18 projects)

- ALL_BUILD
- **Continuous**
- epetra
- epetraext
- Experimental
- INSTALL
- Nightly
- NightlyMemoryCheck
- PACKAGE
- rbgen
- rtop
- RUN_TESTS
- teuchos
- thyra
- thyraepetra
- thyraepetraext
- triutils
- ZERO_CHECK

Updating IntelliSense... (13)

Binary Installer



C:\Trilinos-CVS\Trilinos\Trilinos-WIN-VC++_TUG

CMakeFiles

packages

Testing

CMakeCache.txt
Text Document
39 KB

CPackConfig.cmake
CMAKE File
5 KB

CPackSourceConfig.cmake
CMAKE File
5 KB

DartConfiguration.tcl
TCL File
2 KB

TrilinosConfig.cmake
CMAKE File
4 KB

ALL_BUILD.vcproj
VC++ Project
24 KB

cmake_install.cmake
CMAKE File
3 KB

Continuous.vcproj
VC++ Project
24 KB

CTestTestfile.cmake
CMAKE File
1 KB

Experimental.vcproj
VC++ Project
24 KB

INSTALL.vcproj
VC++ Project
24 KB

Nightly.vcproj
VC++ Project
24 KB

NightlyMemoryCheck.vcproj
VC++ Project
24 KB

PACKAGE.vcproj
VC++ Project
24 KB

RUN_TESTS.vcproj
VC++ Project
24 KB

Trilinos.sln
Microsoft Visual Studio Solution
Version: Visual Studio 2008

ZERO_CHECK.vcproj
VC++ Project
33 KB

Trilinos.ncb
VC++ Intellisense Database
11 KB

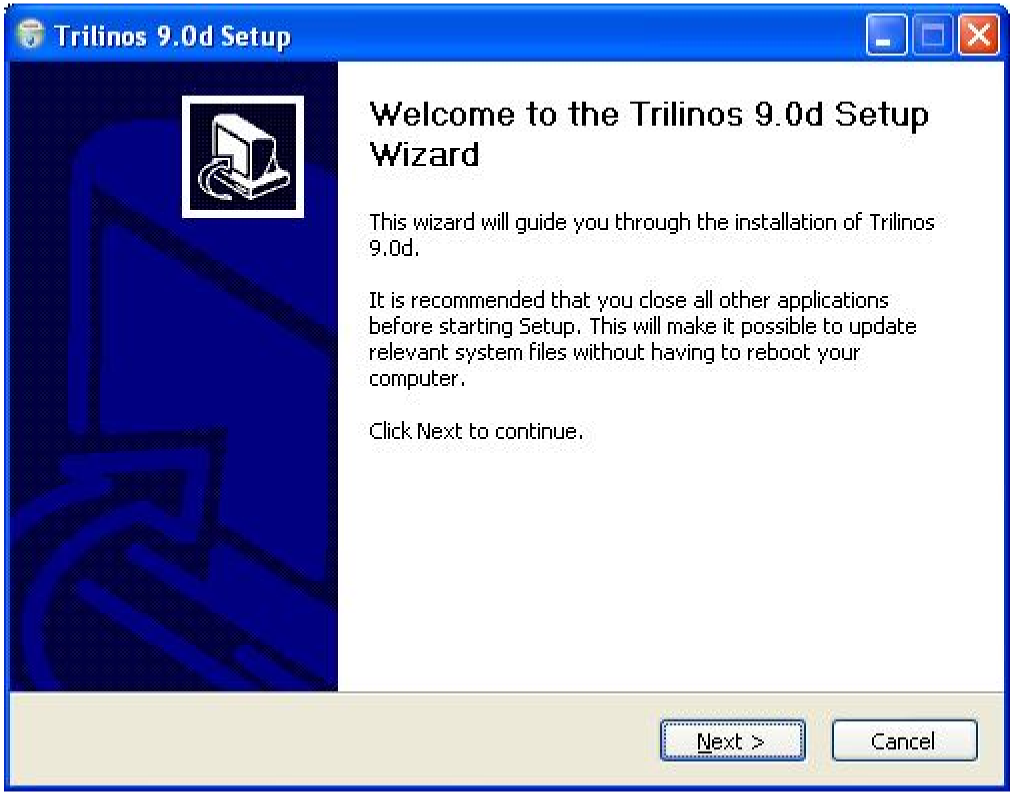
_CPack_Packages

PACKAGE.dir

install_manifest.txt
Text Document
83 KB

trilinos-setup-9.0d.exe

Installing Trilinos



Trilinos 9.0d Setup

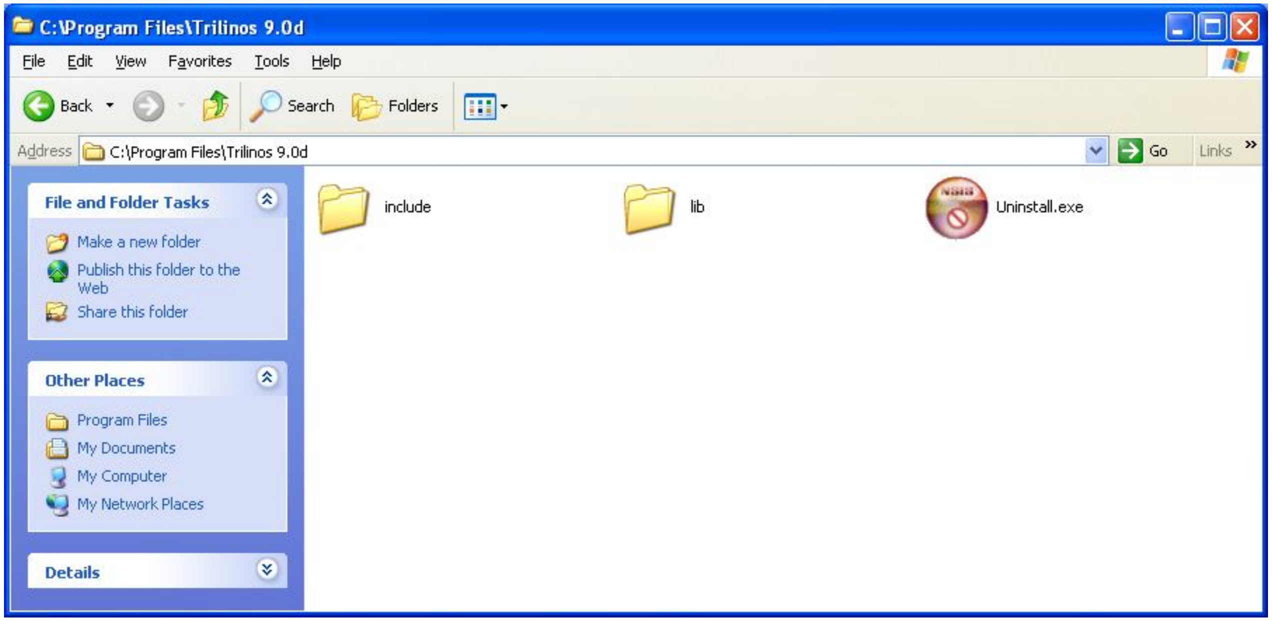
Welcome to the Trilinos 9.0d Setup Wizard

This wizard will guide you through the installation of Trilinos 9.0d.

It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.

Click Next to continue.

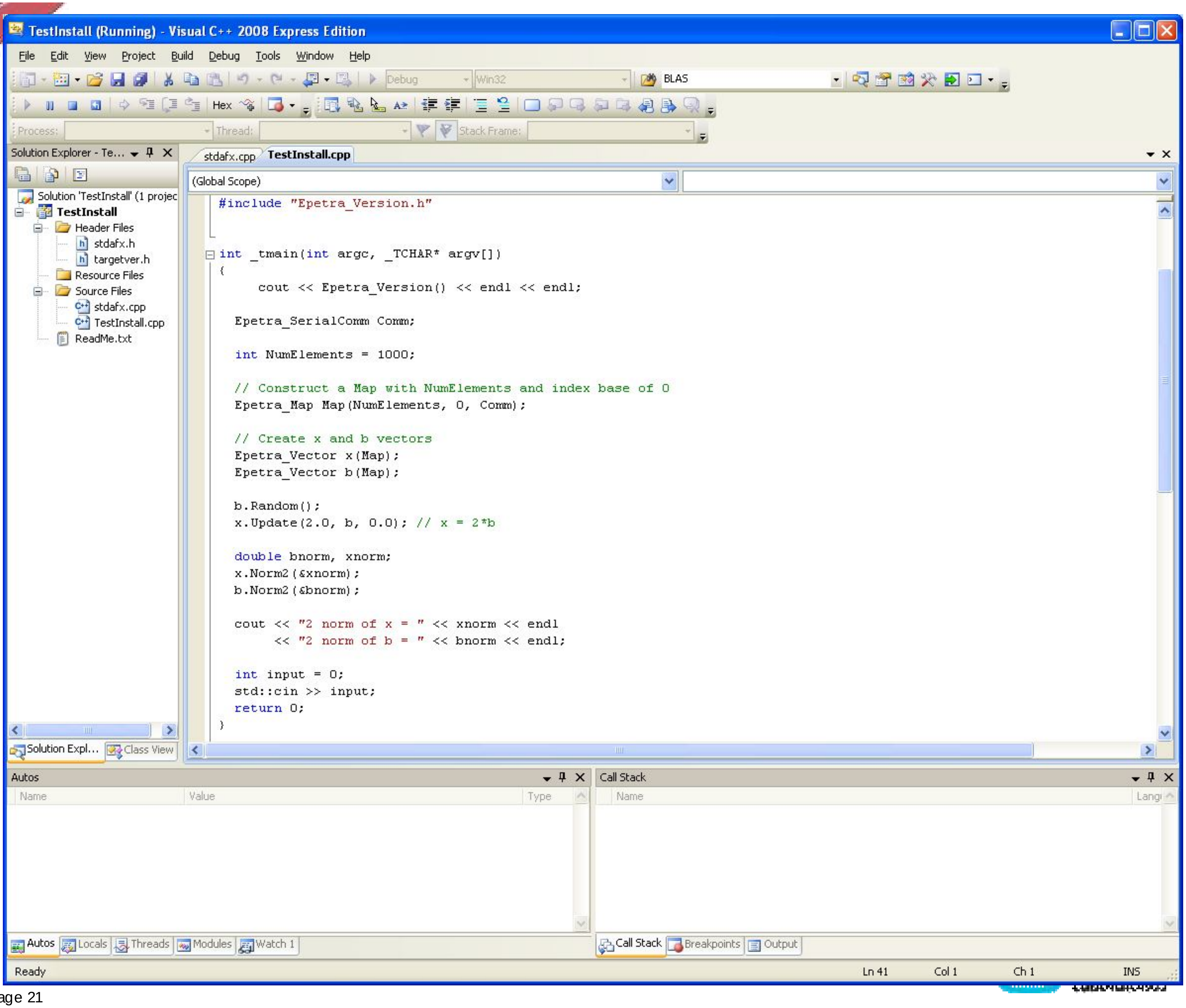
Installed Files



include

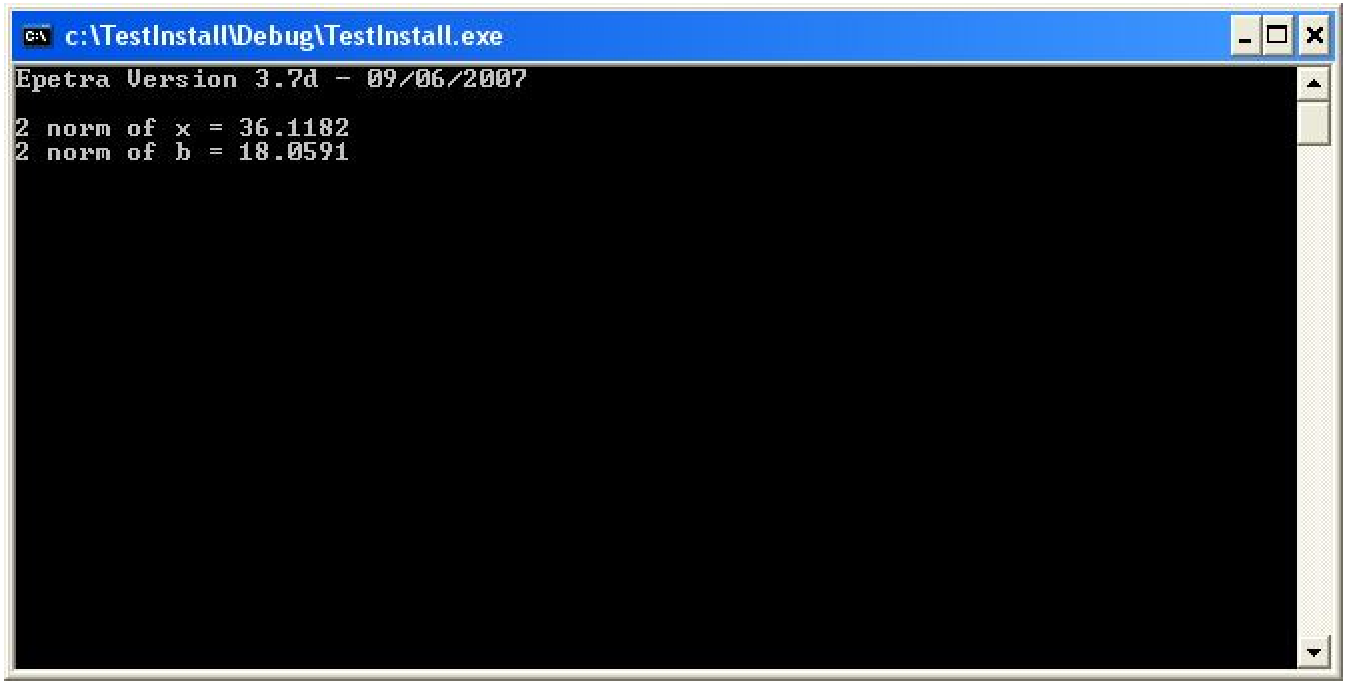
lib

Uninstall.exe



```
#include "Epetra_Version.h"


int _tmain(int argc, _TCHAR* argv[])
{
     cout << Epetra_Version() << endl << endl;

  Epetra_SerialComm Comm;

  int NumElements = 1000;

  // Construct a Map with NumElements and index base of 0
  Epetra_Map Map(NumElements, 0, Comm);

  // Create x and b vectors
  Epetra_Vector x(Map);
  Epetra_Vector b(Map);

  b.Random();
  x.Update(2.0, b, 0.0); // x = 2*b

  double bnorm, xnorm;
  x.Norm2(&xnorm);
  b.Norm2(&bnorm);

  cout << "2 norm of x = " << xnorm << endl
       << "2 norm of b = " << bnorm << endl;

  int input = 0;
  std::cin >> input;
  return 0;
}
```

Executing The Epetra Example From VC++



```
Epetra Version 3.7d - 09/06/2007

2 norm of x = 36.1182
2 norm of b = 18.0591
```

Future for CMake Trilinos?

- Trilinos to start switching over to CMake immediately?

- Provide prototype versions of CMake build sytem in Trilinos 9.0.x minor releases?

- Options for next major Trilinos release (March 2009?)

  - A) Maintain full Autotools build system and only provide partial support for CMake build system? (Already done)

  - B) Full support for CMake build system for all released Trilinos packages and maintain basic Autotools build system for library install only? (Most likely)

  - C) Full support for CMake build system for all released Trilinos packages and drop Autotools support? (Least likely)

What does the Trilinos user community think about these options?