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Trilinos Software Engineering Status and Future Issues

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Trilinos Software Engineering Overview: Current Status

- Separation of "Stable" Code vs. "Experimental" Code
  - "Primary Stable" code vs. "Secondary Stable" Code
  - "Experimental "code
- Maintaining stability of "Stable" development code and tests
  - "Primary Stable" Code: pre-checkin testing (on "primary platform")
  - "Secondary Stable" Code: nightly tested
- Maintaining portability
  - Nightly testing on a variety of "secondary platforms"
- Testing infrastructure
  - CTest: Local and pre-checkin testing, drives CI and nightly testing
  - CDash: Displays test results
- Automated testing:
  - Trilinos framework nightly testing (Linux, Mac, Windows) => CDash
  - APP Trilinos Integration testing (Xyce, Charon, Alegra, SIERRA)
- Customer application Integration:
  - Daily integration testing with upgrades to Trilinos releases: Charon, Xyce, Alegra
  - Almost Continuous Integration: SIERRA

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Trilinos "Stable" vs "Experimental" Code: Defined

- "Stable" Code and Tests:
  - "Meets one or more of the following criteria:
    - Represents an important capability being used by an existing, or
    - Represents a new capability that the authors are willing to stand behind
    - Does not mean it is being targeted for the next release
  - Expected to be kept working at all times on the primary development platform
  - Developed and maintained to be highly portable
  - Maintained at the high quality as defined by modern SE principles
- "Experimental" Code and Tests:
  - By definition, all remaining code that is not "Stable" code.
  - Represents fundamental research and may be developed with informal low-quality software practices.
  - Any code that has a direct and mandatory dependency on any "Experimental" code must also be considered to be "Experimental" code.
  - Developers should try to avoid depending on other "Experimental" code because it is likely to be unstable and break frequently.
  - "Experimental" code should be protected behind ifdefs with macros that must be defined in order to be built.

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Trilinos "Primary Stable" vs "Secondary Stable" Code

- Sub-categorizations of "stable" code:
  - "Primary Stable" code is "Stable" code that only depends on:
    - C, and C++ compilers
    - Fortran 77 compiler (optional)
    - BLAS and LAPACK
    - MPI
  - "Secondary Stable" code
    - Has additional dependencies such as:
      - SWIG/Python (i.e. PyTrilinos)
      - Fortran 2003+ (i.e. ForTrilinos)
      - External direct sparse solvers like UMFPACK, SuperLU, etc. (i.e. Amesos adapters)
    - Or, could be considered "Primary Stable" Code but is excluded from pre-checkin testing
      - Didasko
      - NewPackage
      - ...
- "Stable" code in one package can only depend on "Stable" code in other packages.
- "Stable" code should by default only build "Primary Stable" code.
- Enabling "Secondary Stable" code should require extra configure-time options.

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Stable (Primary and Secondary) and Experimental Code

- Primary Stable Code and Tests:
  – All affected code should be built and tested *before* a checkin
  – CATEGORY in cmake/Trilinos[Packages,TPLs].cmake set to "PS"
  – Required TPL dependencies on BLAS, LAPACK, and MPI (or less)
  – Configured with:

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

- Secondary Stable Code and Tests:
  – Represents an important (released) capability but has extra TPL dependencies
  – *Note* be enabled for pre-checkin testing
  – Tested by central framework resources (nightly integration testing)
  – CATEGORY in cmake/Trilinos[Packages,TPLs].cmake set to "SS"
  – Requires explicitly enabling "Stable" optional TPL dependencies
  – Configured with:

```
-D Trilinos_ENABLE_ALL_PACKAGES:BOOL=ON \
-D Trilinos_ENABLE_SECONDARY_STABLE_CODE=ON \
-D Trilinos_ENABLE_TESTS:BOOL=ON
```

- Tertiary Stable Code and Tests? (Right now just TPLs)
- Experimental Code:
  – CATEGORY in cmake/Trilinos[Packages,TPLs].cmake set to "EX"
  – Requires explicit enabling
  – Tested by individual package teams (but posts results to main CDash dashboard)

Trilinos Software Engineering: Issues

- Partitioning of the test suite and testing efforts
- Improving stability of “Stable” code => checkin-test.py script
- CMake sub-package architecture
- Official Trilinos developers toolset
- Automated Installation testing
- Regulated backward comparability
- Streamlined and robustify release process
- Other areas of needed improvement and progress

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Partitioning of the Trilinos Test Suite

- "Unit" tests (i.e. TDD tests)
  - Make Trilinos packages better independently tested
  - Goal: Minimize need to enable and test down-stream packages
- "Basic integration" tests (i.e. pre-checkin tests)
  - "Unit tests" + some basic integration tests with all optional packages
  - Required on pre-checkin testing of Primary Stable Code
  - Protects basic functionality and other developers
- "Regression" tests (i.e. basic "nightly" tests)
  - "Basic integration" tests + some heavier tests
  - Runs on all available nightly platforms
  - Protects key correctness functionality
- "Performance" tests (See Teuchos performance tests)
  - Specifically designed to protect serial performance
  - Strong tests with hard time limits (adapted to specific platforms)
  - Runs on specific platforms without any other machine loads
- "Scalability" tests
  - Specifically designed to protect parallel scalability performance
  - Utilize targeted timers around problematic computations
- "User-like" tests (i.e. installation and backward compatibility tests)
  - Subset of "Basic Integration" tests

Need to add a CATEGORIES argument to the PACKAGE_ADD_TEST(…) function and an input cache variable Trilinos_TEST_CATEGORIES

Improving Stability of "Stable" code: Motivation

- Support deep stacks of vertically integrated Trilinos packages with production APPs
- Support tighter coupling and co-development with production APPs
  - SIERRA toolkit packages (STK_Mesh, STK_IO, ...)
  - Replace SIERRA framework code with Trilinos code (Teuchos::ParameterList, ...)
  - Many many others …
- Support more frequent, safer, higher quality, lower risk releases of Trilinos
- Improve overall development productivity and software quality

See:

Trilinos/doc/DevGuide/TrilinosSoftwareEngineeringImprovements/*.tex

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"Stable" Code: 100% Passing Test Policy

- All "Stable" code should have 100% passing tests 100% of the time on the primary development platforms as the norm instead of the exception.

- Achieving 100% passing tests on auxiliary development platforms is also a priority but is done in a secondary development loop.

- A failing test on any testing platform should be addressed and be made to pass or be disabled using the following algorithm:
  - Fix the test in the strongest way possible
  - Or, loosen the "strength" of test to get it pass on that specific platform (i.e. by loosing a platform-specific tolerance)
  - Or, disable the test and submit a new item to the sprint or product backlog (e.g. Bugzilla bug report) so that it can be prioritized and fixed later
  - Or, remove the test and all of the associated code related to it

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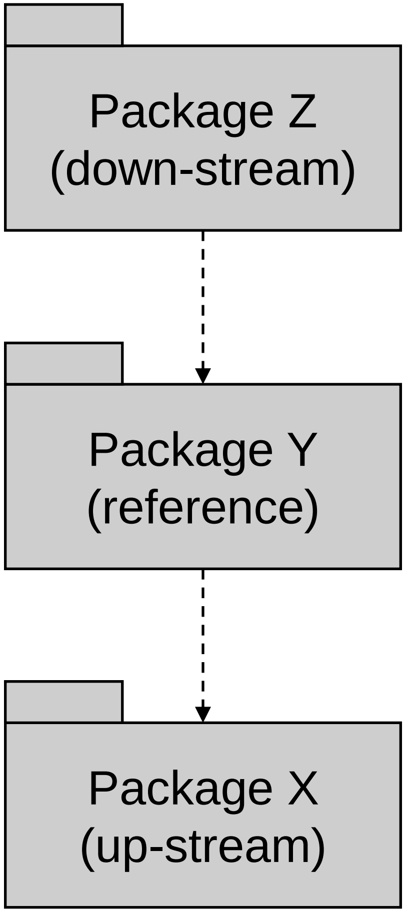
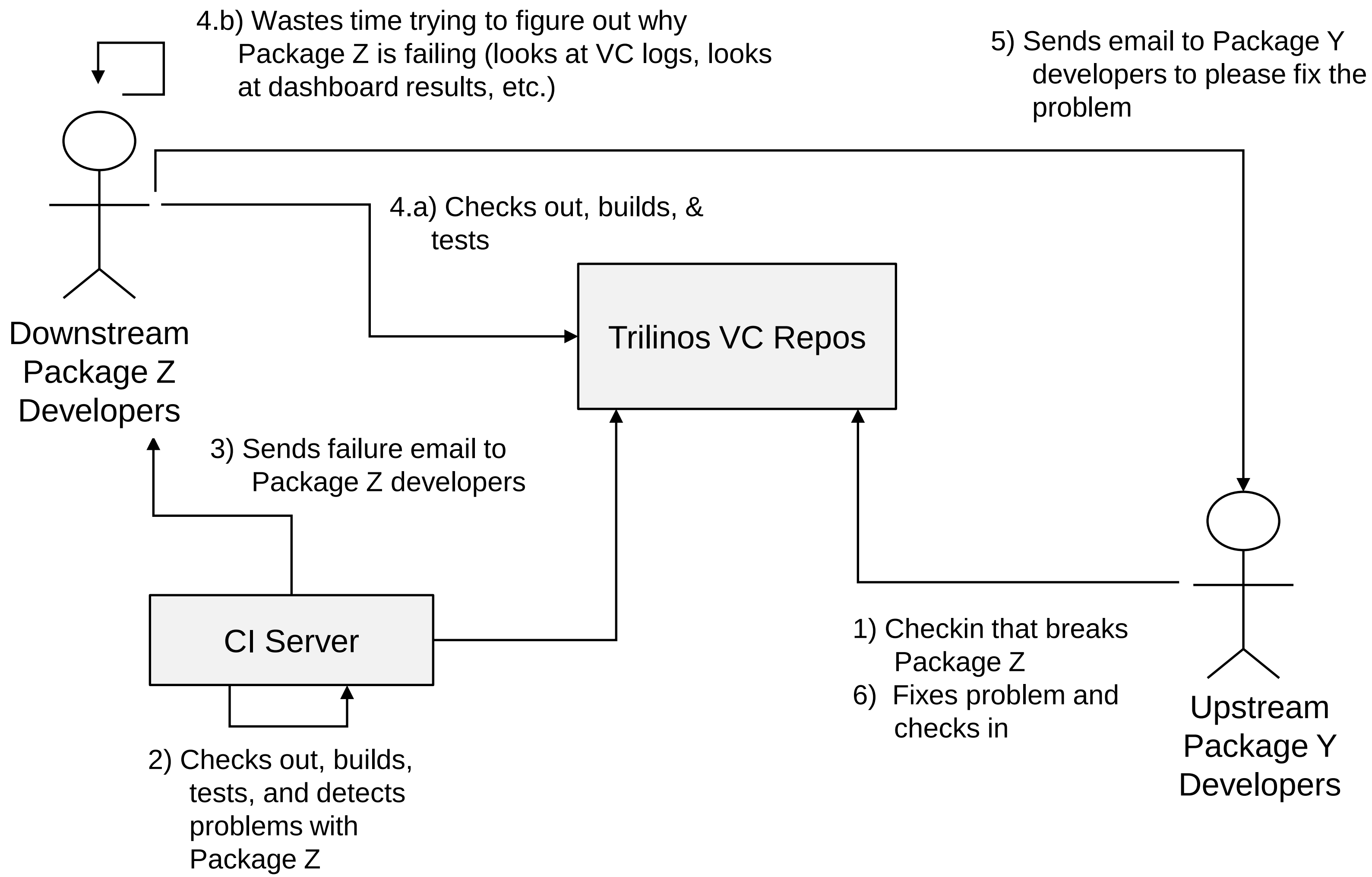
Motivations for a 100% Passing Test Policy for "Stable" Code



Why is 100% passing tests important?

- Package Y (reference package):
  - "Broken Window" Phenomenon
    - => One broken test begets others
  - Zero (0) is singularly different that 1 or X failing tests
    - => People take notice of "all passed" vs "failed"
  - 'M' failing tests is not much different that 'N' failing tests
  - 100% passing tests is a clear measure of the code health
  - 100% passing test suite is unbiased criteria for code checkins
  - 100% passing test suite is an unbiased measure for if any code has been broken after a checkin
  - Code coverage less meaningful when there are failing tests
- Package X (up-stream package being used by Package Y)
  - 100% passing test suite for Package Z provides a clear means to determine if changes in Package X break anything.
- Package Z (down-stream package that uses Package Y)
  - 100% passing test suite for Package Y gives Package Z developers confidence that they can depend on and trust the code in Package Y.
- Bottom Line:
  - 100% passing test suites help to build trust between developers
  - 100% passing test suites help to avoid unnecessary communication
  - 100% passing test suites help to avoid synchronization points

Waste Created By Lack of Sufficient Pre-Checkin Testing



- 90% of these problems can be avoided with sufficient pre-checkin testing!
- Catching the problem before checking in saves everyone wasted time!

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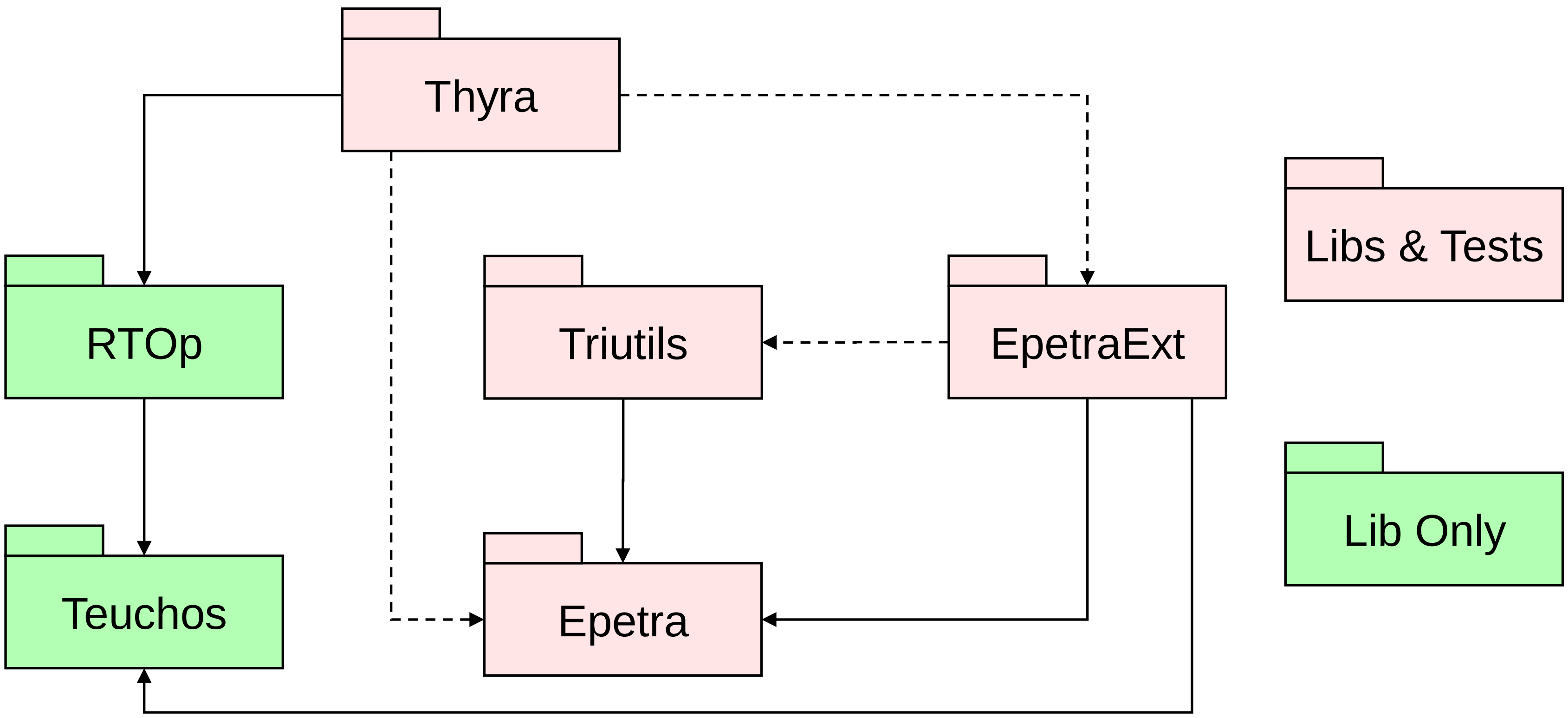
Automatic Dependency Handling for Pre-Checkin Testing

```
$ ./do-configure \
    -D Trilinos_ENABLE_ALL_PACKAGES:BOOL=OFF \
    -D Trilinos_ENABLE_Epetra:BOOL=ON \
    -D Trilinos_ENABLE_ALL_FORWARD_DEP_PACAKGES:BOOL=ON \
    -D Trilinos_ENABLE_TESTS:BOOL=ON
```



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Pre-Checkin Testing: The checkin-test.py script

Python script that performs safe pre-checkin testing:

$ cd SOME_BASE_DIR

$ mkdir CHECKIN; cd CHECKIN

$ $TRILINOS_HOME/cmake/python/checkin-test.py –do-all

- Automatically figures out what Trilinos packages have been changes
- Automatically enables all downstream packages
- Configures, builds and runs tests
  - Built-in Configurations:
    - MPI_DEBUG (Optimized compiler options, checked STL, etc.) (Do at least this build!)
    - SERIAL_RELEASE (varies other configure options)
  - Only enables Primary Stable Code!
  - Strong warning options (warnings as errors is a problem)
- Sends emails after each build case is finished
- Sends final email if it is okay to commit or not
- Can automatically do the commit at the end (Recommended)
- Fully customizable (enabled packages, build cases, etc.)
- Documentation: checkin-test.py --help

checkin-test.py: Example Driver Script

Script I used on my machine (checkin-test-<mymachine>.sh):

```
#!/bin/bash
EXTRA_ARGS=$@
echo "-DBUILD_SHARED_LIBS:BOOL=ON" > COMMON.config
echo "-DTrilinos_ENABLE_Sundance:BOOL=OFF" > SERIAL_RELEASE.config

/home/rabartl/PROJECTS/Trilinos.base/Trilinos/cmake/python/checkin-test.py \
--make-options="-j4" \
--ctest-options="-j4" \
--ctest-time-out=180 \
--commit-msg-header-file=checkin_message \
$EXTRA_ARGS
```

Run as (after symbolically linking into CHECKIN directory):

```
$ ./checkin-test-<mymachine>.sh –do-all –commit
```

Example driver scripts (I symbolically link these):

```
sampleScripts/checkin-test-cygwin-rabartl.sh
sampleScripts/checkin-test-<mymachine>.sh
sampleScripts/checkin-test-scicolan-rabartl.sh
…
```

checkin-test.py: Recommended Workflow

A) Fill out the checkin checklist message in a temporary text file ‘checkin_message’

B) Do local git commits (once we switch to git)

C) Run the checkin-test.py script:

$ ./checkin-test-mymachine.sh –do-all –commit

D) Go do something useful (e.g. **go home**, check email, review a paper, work on a paper, talk with someone, ..)

D) Check your email later to see what happens

Consequences:

- Documents a bullet-proof process for configuring, building, and testing Trilinos
- Does the VC commands to do a safe global checkin (ease git transition)
- Enjoy fewer bad checkins
- Spend less time driving the checkin process

checkin-test.py: Log files

Directory Structure for auto-generated log files

```
CHECKIN/
    checkin-test.out
    update.out
    MPI_DEBUG/
        do-configure.out
        make.out
        ctest.out
    SERIAL_RELEASE/
        …
```

See log files while configure, build, or test is being run:

```
$ tail –f MPI_DEBUG/make.out
```

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checkin-test.py: Cost of Pre-Checkin Testing (Average Case)

A) Enabling just ML and tests/examples in downstream packages

Enabled packages (libraries) (29/52): Teuchos, RTOp, Kokkos, Epetra, Zoltan, Shards, Triutils, Tpetra, EpetraExt, Thyra, Isorropia, AztecOO, Galeri, Amesos, Pamgen, Ifpack, ML, Belos, Stratimikos, Meros, FEI, Anasazi, , Sacado, Intrepid, NOX, Moertel, Rythmos, MOOCHO, Sundance

Enabled packages (tests/examples) (10/52): ML, Belos, Stratimikos, Meros, FEI, NOX, Moertel, Rythmos, MOOCHO, Sundance

<fast-machine>, shared libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	24.2	3.9	438
SERIAL_RELEASE	18.1	1.1	426

<fast-machine>, shared libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	0.7	4.0	438
SERIAL_RELEASE	0.4	1.2	426

<average-machine>, shared libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	59.0	6.5	434
SERIAL_RELEASE*	30.4	1.3	350

<average-machine>, shared libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	1.4	6.6	434
SERIAL_RELEASE*	0.7	1.3	350

- **With shared libraries, rebuilds can be very fast!**
- **Use a fast machine to checkin from!**

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* Sundance disabled on <average-machine> for serial build (see bug ???)

checkin-test.py: Cost of Pre-Checkin Testing (Worst Case)

B) Enabling Teuchos and tests/examples in downstream packages

Enabled packages (libraries) (34/52): Teuchos, RTOp, Kokkos, Epetra, Zoltan, Shards, GlobiPack, Triutils, Tpetra, EpetraExt, Thyra, OptiPack, Isorropia, AztecOO, Galeri, Amesos, Pamgen, Ifpack, Komplex, ML, Belos, Stratimikos, Meros, FEI, Anasazi, RBGen, Sacado, Intrepid, NOX, Moertel, Rythmos, MOOCHO, Sundance, CTrilinos

Enabled packages (tests/examples) (22/52): Teuchos, OptiPack, Isorropia, AztecOO, Galeri, Amesos, Ifpack, Komplex, ML, Belos, Stratimikos, Meros, FEI, Anasazi, RBGen, Sacado, Intrepid, NOX, Moertel, Rythmos, MOOCHO, Sundance

<fast-machine>, shared libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	48.0	8.34	1140
SERIAL_RELEASE	37.3	1.9	1147

<fast-machine>, shared libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	1.1	8.1	1140
SERIAL_RELEASE	1.2	2.1	1147

<average-machine>, shared libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	103.0	12.0	1136
SERIAL_RELEASE*	63.5	2.5	1071

<average-machine>, shared libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	2.3	12.0	1136
SERIAL_RELEASE*	1.49	2.5	1071

* Sundance disabled on <average-machine> (see bug ???)

checkin-test.py: Shared Libraries vs. Static Libraries

B) Enabling Teuchos and tests/examples in downstream packages

Enabled packages (libraries) (34/52): Teuchos, RTOp, Kokkos, Epetra, Zoltan, Shards, GlobiPack, Triutils, Tpetra, EpetraExt, Thyra, OptiPack, Isorropia, AztecOO, Galeri, Amesos, Pamgen, Ifpack, Komplex, ML, Belos, Stratimikos, Meros, FEI, Anasazi, RBGen, Sacado, Intrepid, NOX, Moertel, Rythmos, MOOCHO, Sundance, CTrilinos

Enabled packages (tests/examples) (22/52): Teuchos, OptiPack, Isorropia, AztecOO, Galeri, Amesos, Ifpack, Komplex, ML, Belos, Stratimikos, Meros, FEI, Anasazi, RBGen, Sacado, Intrepid, NOX, Moertel, Rythmos, MOOCHO, Sundance

<average-machine>, shared libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	103.0	12.0	1136
SERIAL_RELEASE*	63.5	2.5	1071

<average-machine>, shared libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	2.3	12.0	1136
SERIAL_RELEASE*	1.49	2.5	1071

<average-machine>, static libs, from scratch

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	115.3	10.7	1136
SERIAL_RELEASE*	72.4	2.7	1071

<average-machine>, static libs, rebuilid

Build Type	Build (min)	Test (min)	#tests
MPI_DEBUG	18.9	10.4	1136
SERIAL_RELEASE*	6.6	2.4	1071

- **Rebuilds with shared libs can be *much* faster that with static libs!**

* Sundance disabled on <average-machine> for serial build (see bug ???)

Speeding up Pre-Checkin Testing: Current Approaches

- 100% safe approaches:
  - Checkin from a fast workstation no mater where you develop (easy with git)
  - Keep private development and checkin builds separate
  - Enabled shared libraries (-DBUILD_SHARED_LIBS:BOOL=ON)
  - Keep the CHECKIN builds up to date (could use crontab or just manually)

- Less than 100% safe approaches (from better to worst):
  - Do only MPI_DEBUG build (--without-serial-release)
  - Disallow enabling all packages (--enable-all-packages=off)
    - Example: Disables enabling all packages when cmake/TrilinosPackages.cmake changes
  - Disable forward packages (--no-enable-fwd-packages)
    - Example: Only tests in the package have changed
    - Example: Good unit tests and minimal changes
  - Disabling specific downstream packages (--disable-packages=P1,…)
    - Example: Disabling Sundance when testing Tpetra
  - Enabling only specific packages (--enable-packages=P1,…)
    - Example: Only test a few packages

      --enable-all-packages=off --enable-packages=Tpetra,Belos,Anasazi

Improving Pre-Checkin Testing: Future Approaches

- Speeding up pre-checkin testing:
  - Move to explicit template instantiation
  - Forward declarations
  - Use pImpl idiom (faster rebuilds)
  - Remove standard C++ headers out of Package_ConfigDefs.hpp
  - Trim down number of “Basic Integration” test executables
  - More unit tests, faster more minimal basic integration tests
  - Move to a sub-package architecture in the CMake build system

- Improving consistency of pre-checkin testing:
  - Standardize versions of GCC, MPI, BLAS, LAPACK etc. …

    => Official Trilinos Developers Toolset

- Improving the portability testing of pre-checkin testing:
  - Strong warnings and warnings as errors
    - Requires standard versions of GCC and MPI!

      => Official Trilinos Developers Toolset

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Possible improvements to the checkin-test.py script

- Convert from CVS to git (to be done very soon)
- Allow for extra user-defined build cases:

    -- extra-builds=BUILD1,BUILD2,…,BUILDN

    - Motivation: Allows enabling Secondary Stable and Experimental Code, enabling extra TPLs, etc.
    - Example: Test Secondary Stable Code and TPLs

        $ echo "-DTPL_ENABLE_SCOTCH:BOOL=ON" >> WITH_SCOTCH.config

        $ ./checkin-test-mymachine.sh --extra-builds=WITH_SCOTCH –do-all

- Add more unit testing

Pre-Checkin Testing: Summary

- Using this script will improve the stability of Trilinos for everyone involved!
- Bad reasons to do a sloppy checkin:
  - "I want to integrate my code frequently"

    => Good motivation but not as important good testing

    => Checking in once a day is usually sufficient
  - "I need to get this revision to a collaborator ASAP"

    => Just have them pull directly from your local git repository
  - "In am doing porting work and can't afford a complete test on the machine"

    => Pull local commits back to your git local working directory your workstation and commit from there
  - "I am in a good point to checkpoint my changes"

    => Do a local git commit
  - "I want to backup my work with history"

    => Use git to publish to a "backup" repository on a different machine
  - "I want to checkin to feel a sense of completion"

    => Mental problem, seek help
- **Please read ''checkin-test.py –help" and give this a try!**
- **Please ask questions, give feedback!**

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CMake Sub-Package Architecture: Motivation

Existing package dependency logic can enable many more packages than is needed for pre-checkin testing

Example: Enable Tpetra

$ checkin-test.py --enable-packages=Tpetra –configure

- Enabled packages (libraries) (28/52): Teuchos, RTOp, Kokkos, Epetra, Zoltan, Shards, Triutils, Tpetra, EpetraExt, Thyra, Isorropia, AztecOO, Galeri, Amesos, Pamgen, Ifpack, ML, Belos, Stratimikos, Meros, Anasazi, RBGen, Sacado, Intrepid, NOX, Rythmos, MOOCHO, Sundance

- Enabled packages (tests/examples) (10/52): Tpetra, Belos, Stratimikos, Meros, Anasazi, RBGen, NOX, Rythmos, MOOCHO, Sundance

=> Problem: Stratimikos, Meros, Rythmos, MOOCHO, and Sundance don't execute one line of Tpetra code!

- General Problem: Current CMake build system does not respect the existing package partitioning

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Software Engineering Theory about Packaging

Package Cohesion OO Principles:

- REP (Release-Reuse Equivalency Principle): The granule of reuse is the granule of release.
- CCP (Common Closure Principle): The classes in a package should be closed together against the same kinds of changes. A change that affects a closed package affects all the classes in that package and no other packages.
- CRP (Common Reuse Principle): The classes in a package are used together. If you reuse one of the classes in a package, you reuse them all.

Package Coupling OO Principles:

- ADP (Acyclic Dependencies Principle): Allow no cycles in the package dependency graph.
- SDP (Stable Dependencies Principle): Depend in the direction of stability.
- SAP (Stable Abstractions Principle): A package should be as abstract as it is stable.

Problem: Many Trilinos packages violate the SE packaging principles most importantly the CRP

Source: Martin, Robert C. *Agile Software Development (Principles, Patterns, and Practices)*. Prentice Hall, 2003

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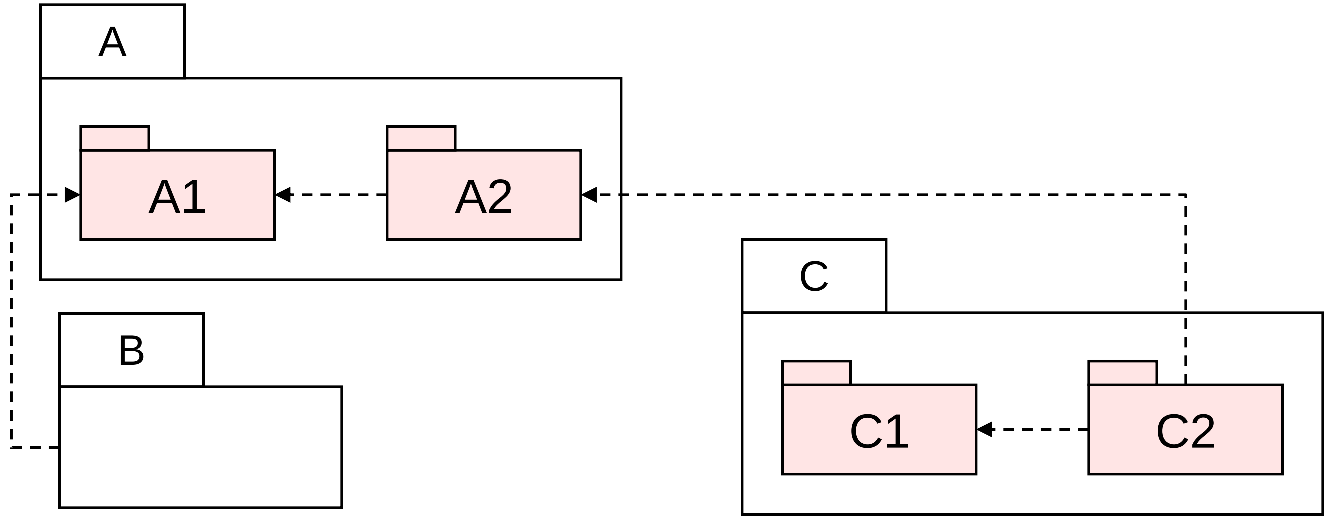
CMake Sub-Package Architecture: The Idea



- Partitioning of Trilinos Code:
  - Trilinos packages: More natural feature/social/user packages
  - Trilinos sub-packages: Rigours SE packages (hidden from user)
- Speeds up pre-checkin rebuilds and testing
- Provided greater control over feature selection
- Helps to minimize superficial entangling dependencies
- Minimizes the number of top-level packages
- Hides complexity form the user
- However, some software engineering packages will still be needed due to dependency issues
- Once we have git we can reorganize for this!

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Official Trilinos Developers Toolset: Idea and Motivation

- Idea: Define a suite of standard build and other tools along with simple global install script
- Candidate list of software:
  - GCC 4.X.Y (Fortran or no Fortran?)
  - Gold ??? (fast linking)
  - Open MPI ???
  - CMake 2.8.X
  - Git ???, eg ???
  - CLAPACK ???
  - Boost ???
  - Doxygen ???
  - Dot ???

- Motivation:
  - Reduce variability in development and testing for different developers
    - Turn on strong warnings and warnings as errors
  - Simplify setup of new Trilinos development machines
  - Allow more code to be elevated to Primary Stable Code (e.g. boost)

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Official Trilinos Developers Toolset: Install scripts

Provide global install script:

$ Install-trilinos-toolset.py –do-all –install-dir=/home/trilinos/install

- Checks out tarballs from Trilinos3PL CVS repository
- Installs all software in single bin, lib, and include directories
- Uses separate install scripts like install-cmake,py, install-git.py etc.
- Would only support basic Linux (perhaps Unix) and Mac computers (not Windows)

ToDo:

- Decide what software should be included
- Decide on versions of all the software packages
- Refactor existing install-git.py and install-cmake.py to enable faster development of simple install steps
- Get software and write basic install scripts and global install script
- Beta users to work out bugs
- Deploy across all Trilinos developers
- Turn on warnings as errors!
- Enjoy more a stable development environment!

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Automated Installation Testing

- Idea:
  - BUILD_DIR_1: Build and install Trilinos headers and libraries

    $ do-configure –D CMAKE_INSTALL_PREFIX:PATH=<INSTALLPATH> …
  - BUILD_DIR_2: Configure tests/examples against installed headers/libs

    $ do-configure –D TRILINOS_ENABLE_TESTS:BOOL=ON \
    -D TRILINOS_USE_INSTALLED_LIBS_BASE:PATH=<INSTALLPATH> …

Details:

- Would be handled automatically by the Trilinos CMake macro wappers
- Would not require any changes in Trilinos packages
- Would read from installed export makefiles to get compiler options, list of link libraries, etc.
- Select subset of tests (only user-like tests not all unit tests)

Consequences:

- Automatic testing of installation process!
- Foundation for backward compatibility

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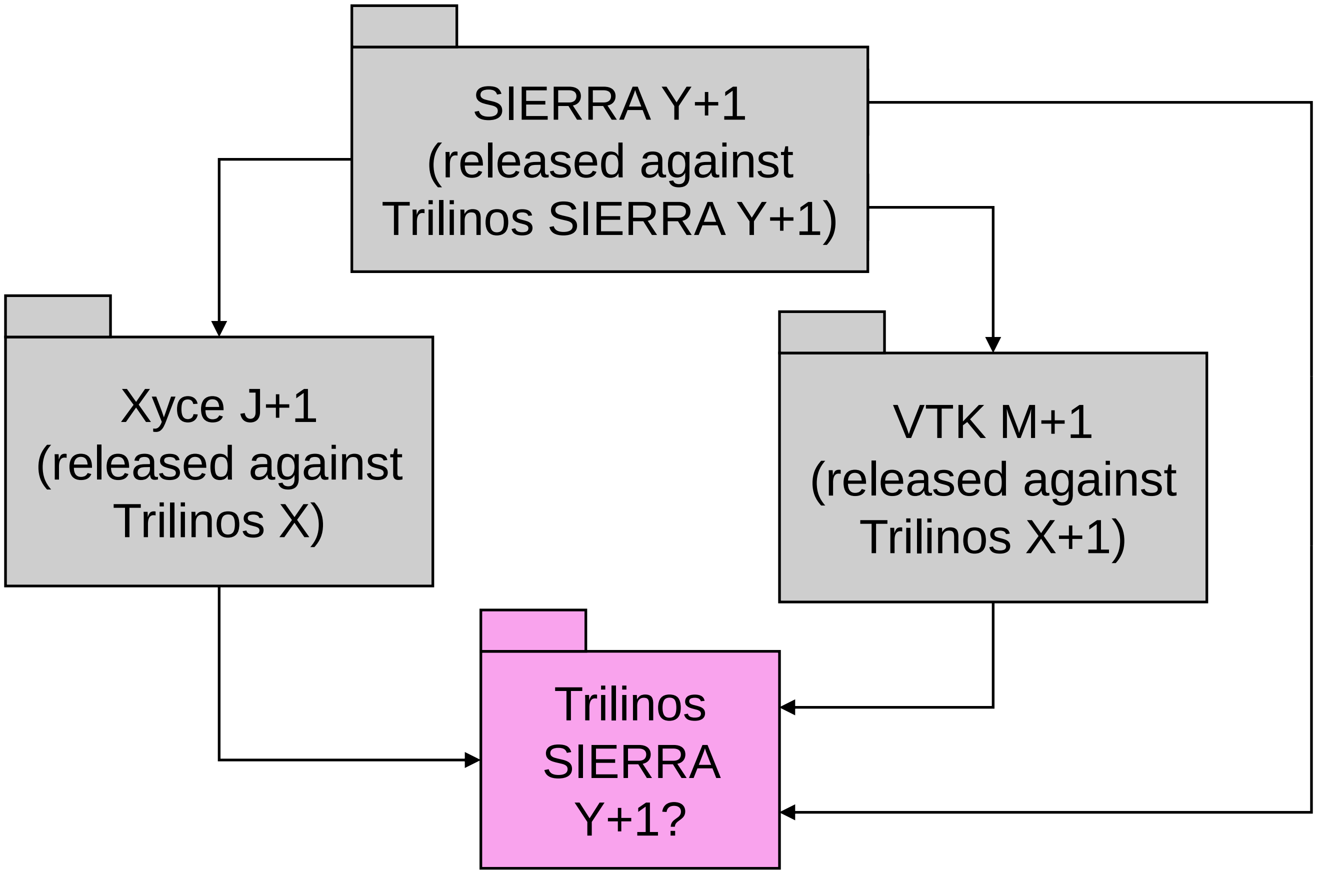
Backward Compatibility Considerations

- Backward compatibility is critical for:
  - Safe upgrades of Trilinos releases
  - Composability and compatibility of different software collections

Example of the Need for Backward Compatibility



Multiple releases of Trilinos presents a possible problem with complex applications

Solution:

=> Provide perfect backward compatibility of Trilinos X through Trilinos SIERRA Y+1

Backward Compatibility Considerations

- Backward compatibility is critical for:
  - Safe upgrades of Trilinos releases
  - Composability and compatibility of different software collections
- Maintaining backward compatibility for all time has downsides:
  - Testing/proving backward compatibility is expensive and costly
  - Encourages not changing (refactoring) existing interfaces etc.
    - => Leads to software “entropy” which kills a software product
- A compromise: Regulated backward compatibility (Tentative)
  - Maintain a window of perfect backward compatibility over major version numbers (e.g. 1-2 years)
  - Provide “Deprecated” compiler warnings
    - Example: GCC’s __deprecated__ attribute enabled with –DTrilinos_SHOW_DEPRCATED_WARNINGS:BOOL=ON
  - Provide strong automated testing of Trilinos backward compatibility
  - Drop backward compatibility between major version numbers

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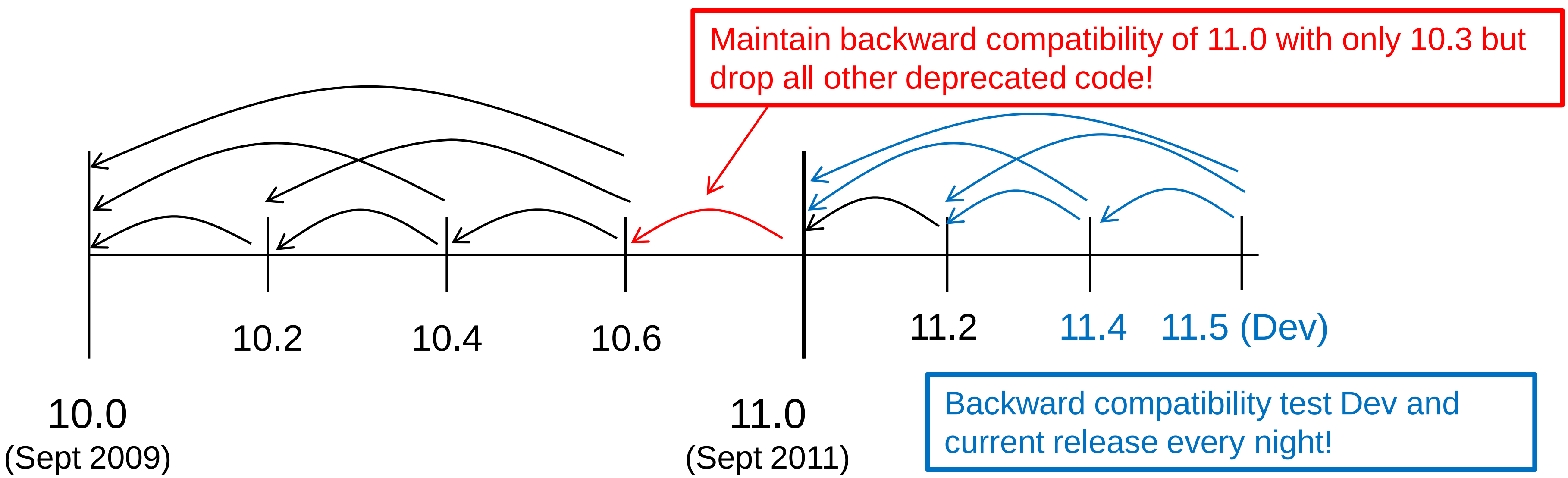
Regulated Backward Compatibility and Version Numbering?

- Proposal: Trilinos Version Numbering X.Y.Z:
  - X: Defines backward compatibility
  - Y: Major release number in backward compatible set
    - Idea: Even numbers = release, odd numbers = dev (CMake, SIERRA)
      - Makes logic with Trilinos_version.h easier
  - Z: Minor releases off the release branch X.Y
- Backward comparability between releases X.Y and X.Z where Z > Y
  - Example: Trilinos10.6 is backward compatible with 10.0 through 10.4
  - Example: Trilinos 11.X is <u>not</u> compatible with Trilinos 10.Y



Example: Major Trilinos versions change every 2 years with 2 releases per year

Streamline and Robustify Release Process

Stay tuned for later discussion

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Other Areas of Needed Improvement and Progress

- Code coverage (see TrilinosCMakeQuickstart.txt)
  - $ ./do-configure -DTrilinos_ENABLE_COVERAGE_TESTING:BOOL=ON
  - $ make dashboard
- Memory checking (see TrilinosCMakeQuickstart.txt)
  - $ env CTEST_DO_MEMORY_TESTING=TRUE make dashboard
  - Need a trimmer test suite to allow valgrind to run
- Namespace safety
  - Don't pollute the global namespace, no 'using namespace ANTHYING'
- Strong warnings and warnings as errors
  - Need a standard version of GCC and MPI first (Official Trilinos Toolset)
- Code reviews (arguments and evidence seems clear)
- Unit testing (see Todd's talk)
  - Reduces need to test downstream packages
- Doxygen documentation (Need automated testing of some type)
- Improving exception safety (basic guarantee, strong guarantee, and no-fail guarantee and memory leaks)
- Globing source and header files (SIERRA packages only)

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Trilinos Software Engineering: Issues

- Partitioning of the test suite and testing efforts
- Improving stability of “Stable” code => checkin-test.py script
- CMake sub-package architecture
- Official Trilinos developers toolset
- Automated Installation testing
- Regulated backward comparability
- Streamlined and robustify release process
- Other areas of needed improvement and progress