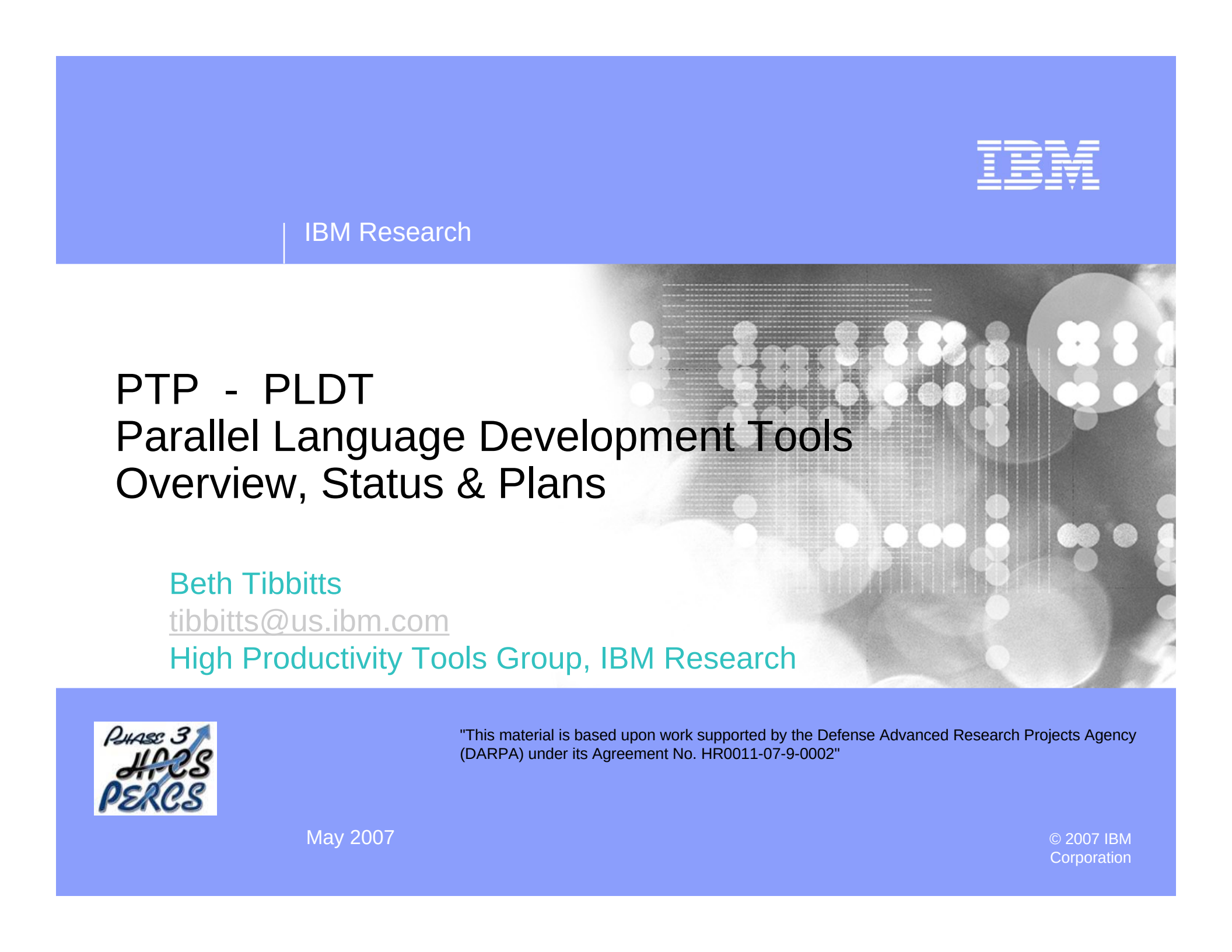

IBM Research

PTP - PLDT
Parallel Language Development Tools
Overview, Status & Plans

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May 2007

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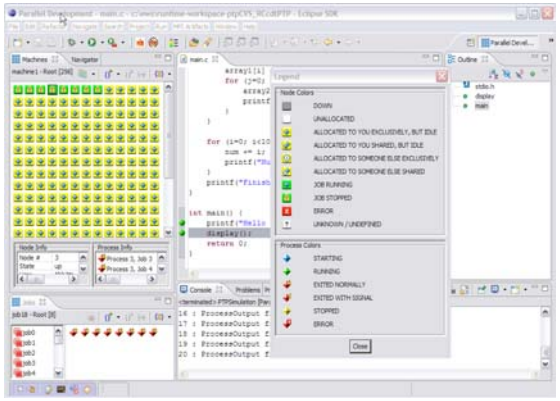
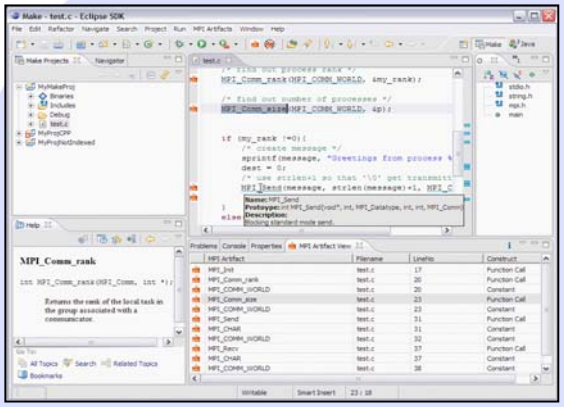
Eclipse PTP: Parallel Tools Platform

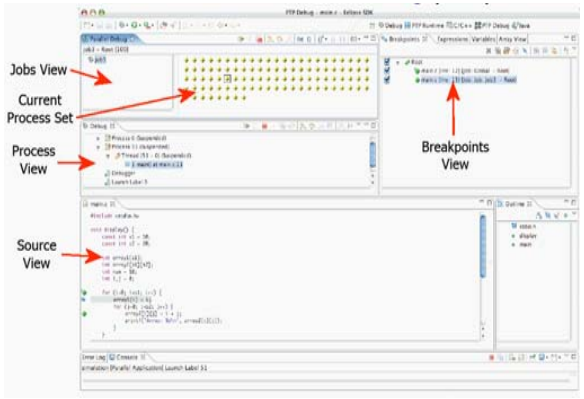
http://eclipse.org/ptp

Parallel Runtime





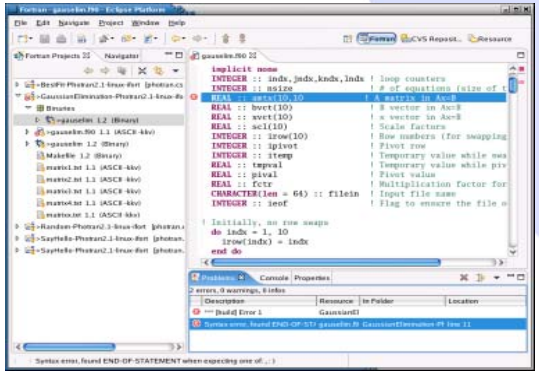
Parallel Language Dev. Tools (PLDT)



Parallel Debugger

eclipse

Fortran Tools



Performance Tools *: based on TuningFork:
http://www.alphaworks.ibm.com/tech/tuningfork

IBM Contributions

Based on
C/C++ Development Tools: CDT
http://eclipse.org/cdt

* Not yet publicly available on eclipse.org

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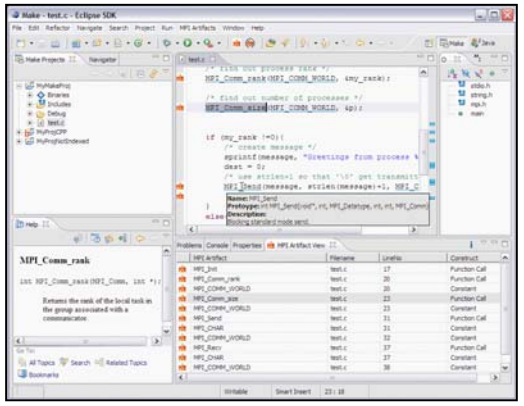
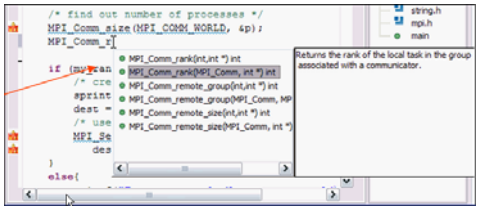
PTP / Parallel Language Development Tools PLDT - overview





- Tools to assist developers in developing parallel codes
- Assistance tools: Identify MPI/OpenMP/LAPI “artifacts”, help (hover, content assist, etc.)
- Static Analysis tools: OpenMP concurrency analysis, MPI barrier analysis to detect deadlocks
- Status: above ported to CDT 4.0, in cvs, “PTP/PLDT 2.0”
- Plans/Ideas:
  - Code templates, artifact view filtering, “New MPI Project” wizards
  - detection of common errors
  - refactoring for parallelism
  - Similar tools for Fortran (dependent on Fortran parser with CDT-like AST)
- What other tools would be helpful?
  - Multi-core tools? What?

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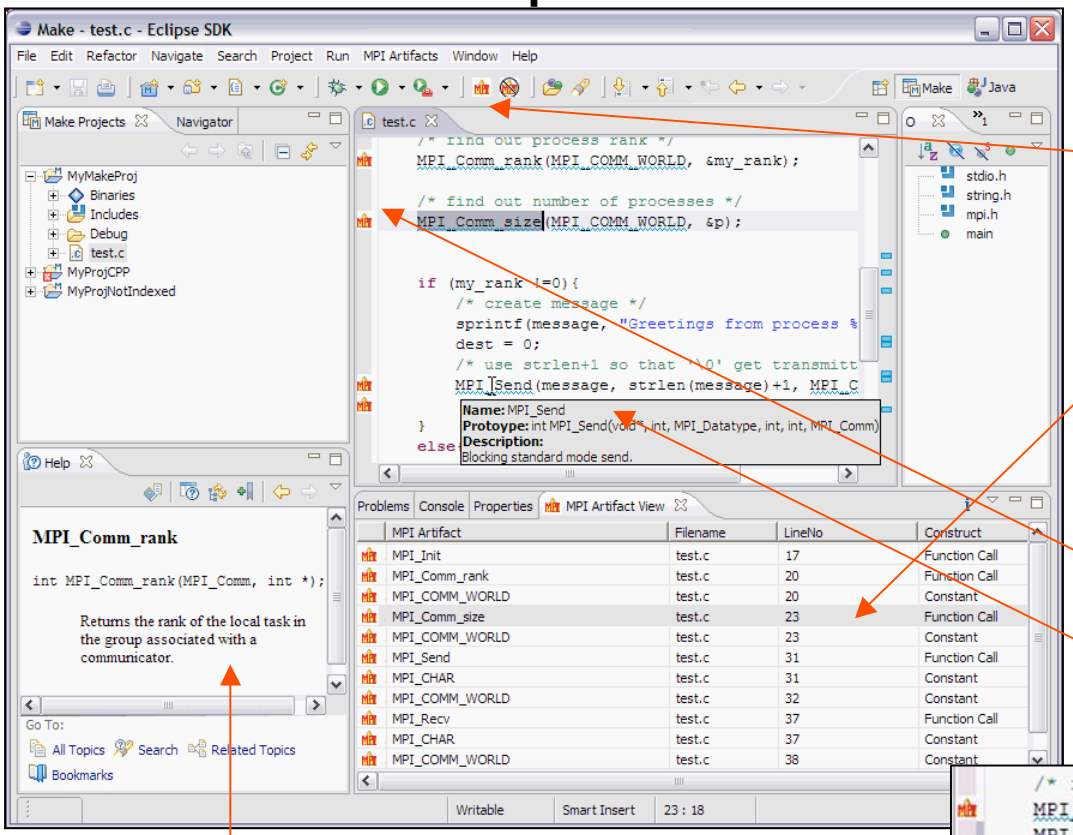
Parallel Language Development Tools: PTP MPI Development Tools

Based on the CDT (C/C++ Development Toolkit),



Actions to find MPI Artifacts via Static analysis

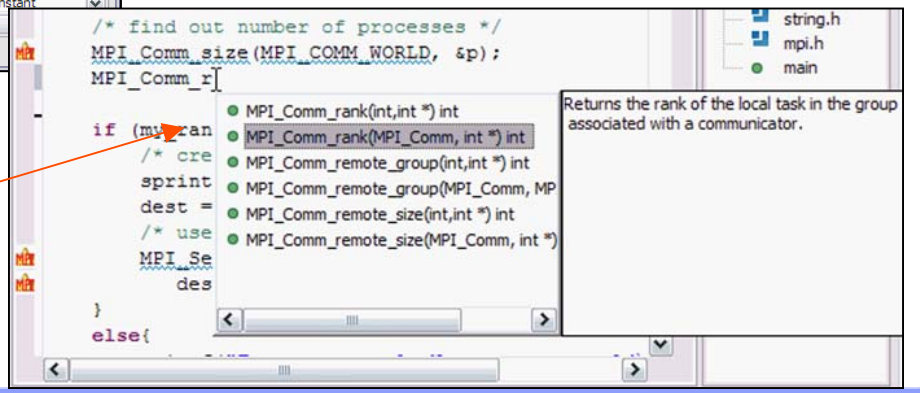
MPI Artifacts found by analysis

Source Markers for Navigation & ID

Mouse hover help And content assist

Context Sensitive Help (F1) provides API info

Content Assist Ctrl-space Suggests completions



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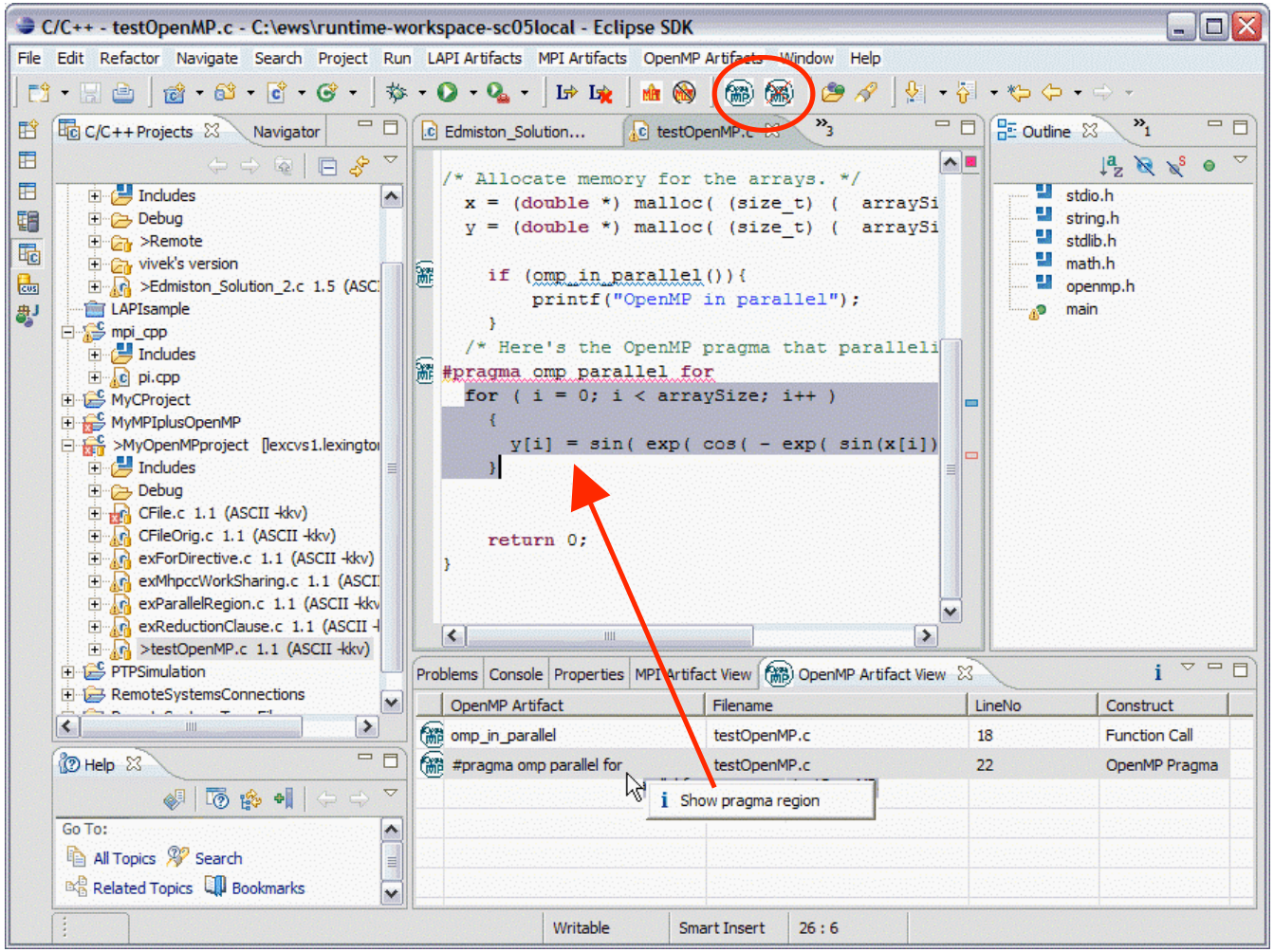
Tools

OpenMP - Simple, Portable, Scalable SMP Programming An API for multi-platform shared-memory parallel programming in C/C++ and Fortran.

- Identify constructs
- List OpenMP constructs
- Link to source code

Analysis

- Identify scope of #pragma
- Identify common problems
- Concurrency analysis



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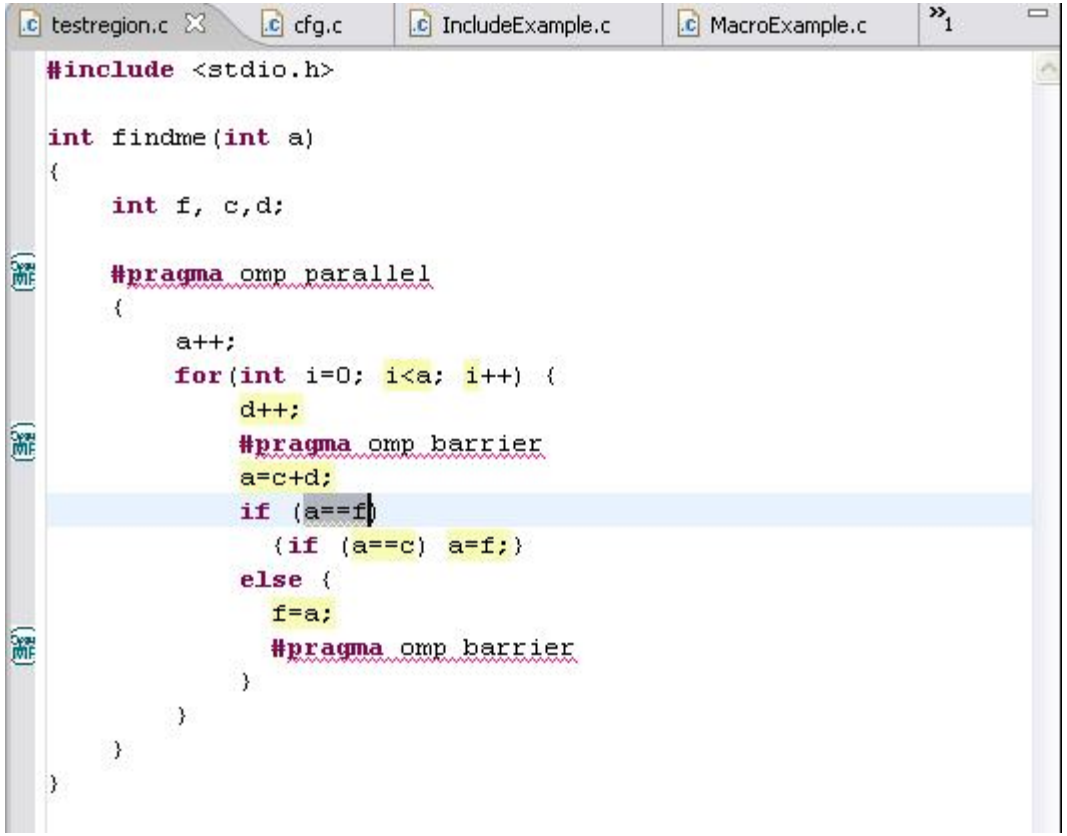
OpenMP Concurrency Analysis



- Analysis of which statements could execute in parallel (based on concurrency analysis of Yuan Lin)

Possible future extension:

- Analysis to develop strategy for parallelizing

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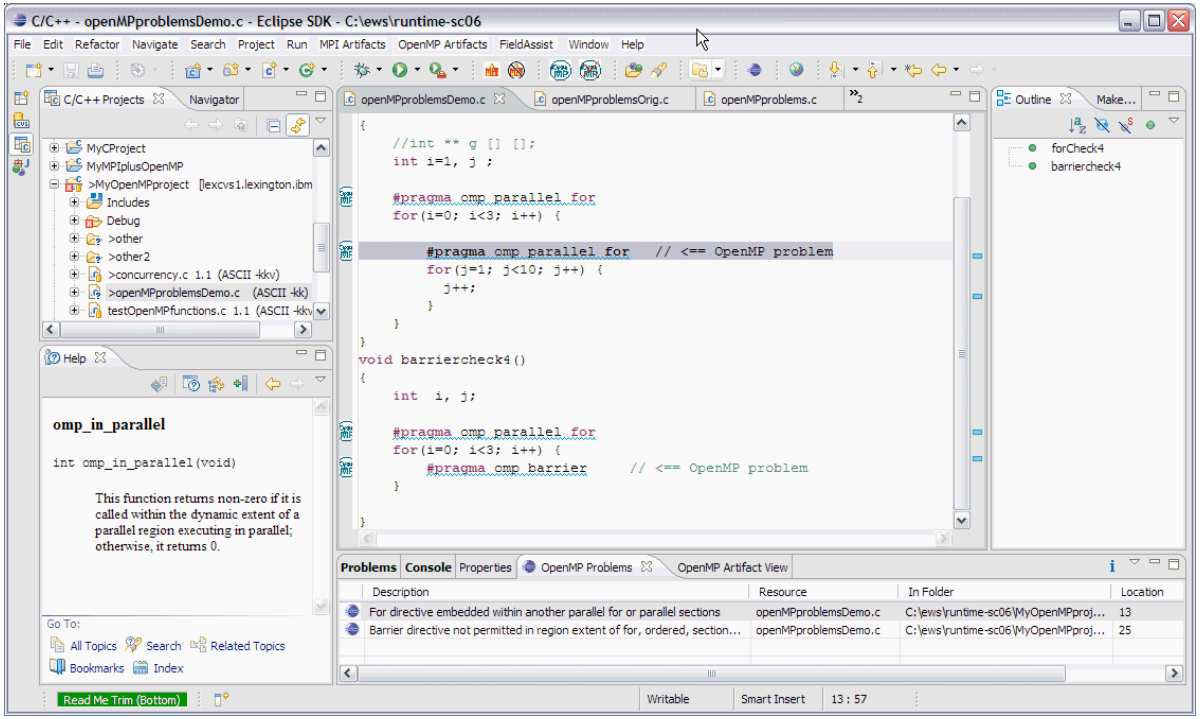
OpenMP problems



Types of problems targeted for analysis include:

- Parallel directive dynamically inside another parallel, establishes single thread context
- For directive embedded within critical, ordered, or master extents
- For directive embedded within another parallel for or parallel sections
- For directive embedded within another for, sections, or single directive
- Barrier directive not permitted in region extent of for, ordered, sections, single, master, and critical
- Master directive not permitted in dynamic extent of for, sections, or single directives
- Ordered directive not permitted in dynamic extent of critical region

Along with the analysis for finding OpenMP artifacts, common problems are also located, and shown in the OpenMP Problems view.
Like the OpenMP Artifacts view, the OpenMP Problems view can be used to navigate to the source code line by double-clicking on the line in the problems view.

While these are along the lines of what compilers would probably also find, they are a hint of future features to find less obvious problems.

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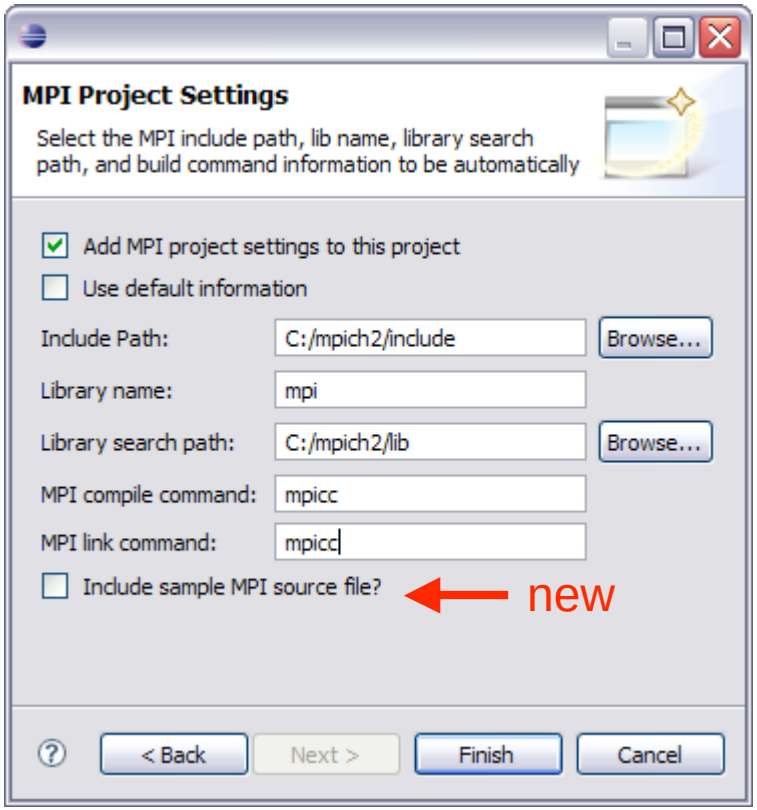
New MPI Project Wizard

- Simplifies creation of new (managed make) MPI projects
- Would it be more useful as a “New MPI Project” wizard instead of an added page to “New C Project” wizard?
- And “New OpenMP Project” etc?



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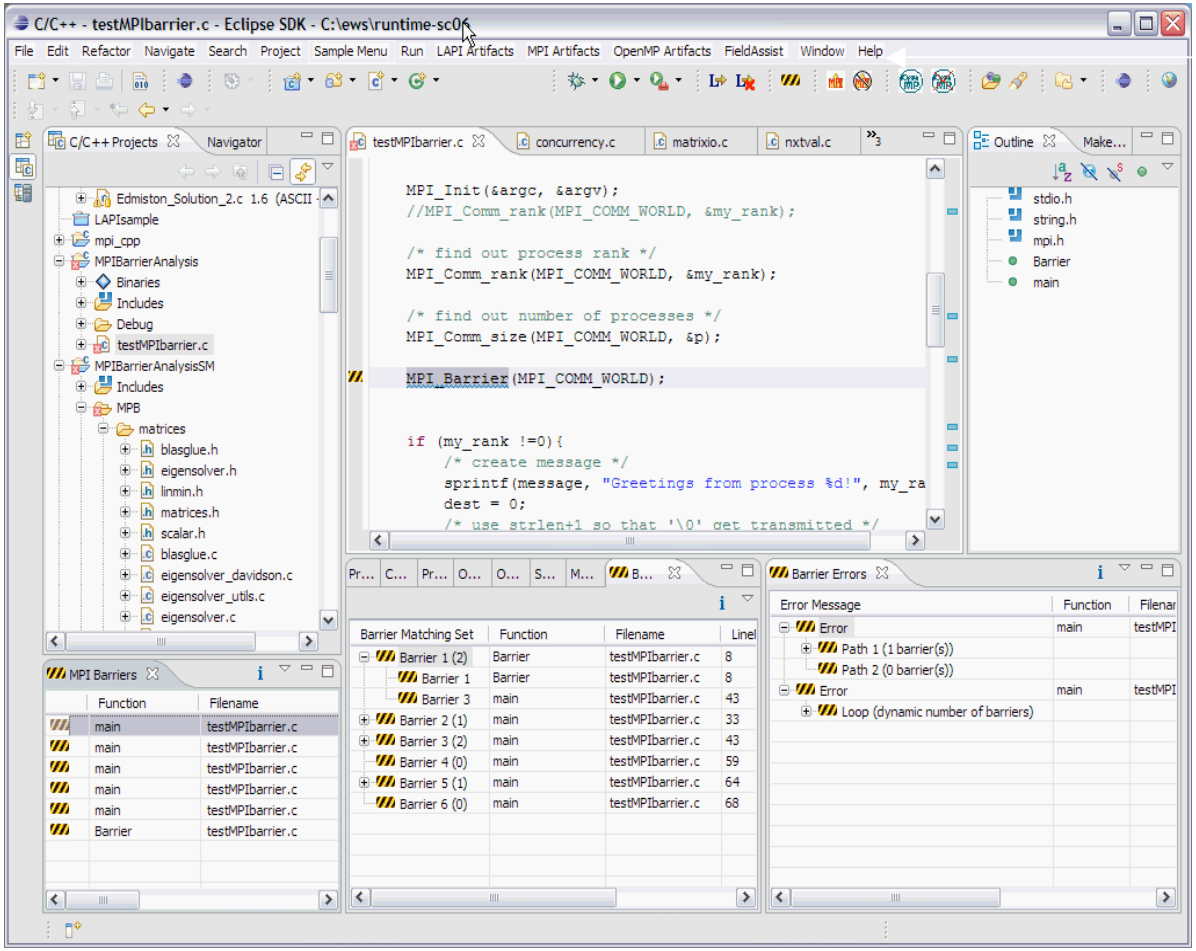
Parallel Language Development Tools:
MPI Barrier Verification Tool



Action to run Barrier Verifier

Verify barrier synchronization in C/MPI programs

- Synchronization errors lead to deadlocks and stalls.
- Programmers may have to spend hours trying to find the source of a deadlock
- Static verification tools help to eliminate errors before the program is executed

Contact: Evelyn Duesterwald, Yuan Zhang

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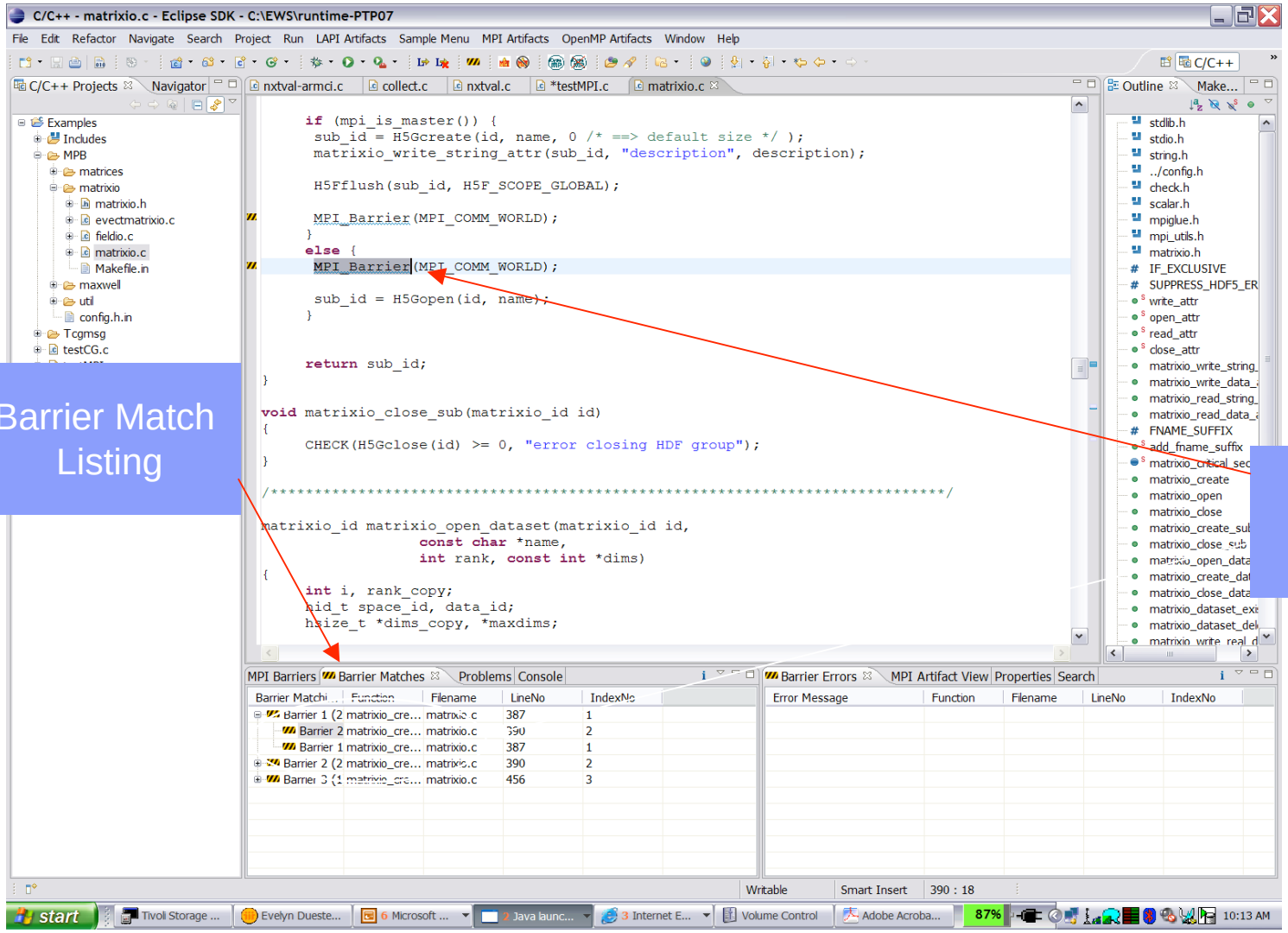
MPI Barrier Verification Tool

Program Verified



Barrier Match Listing

Show Barrier Matching Set

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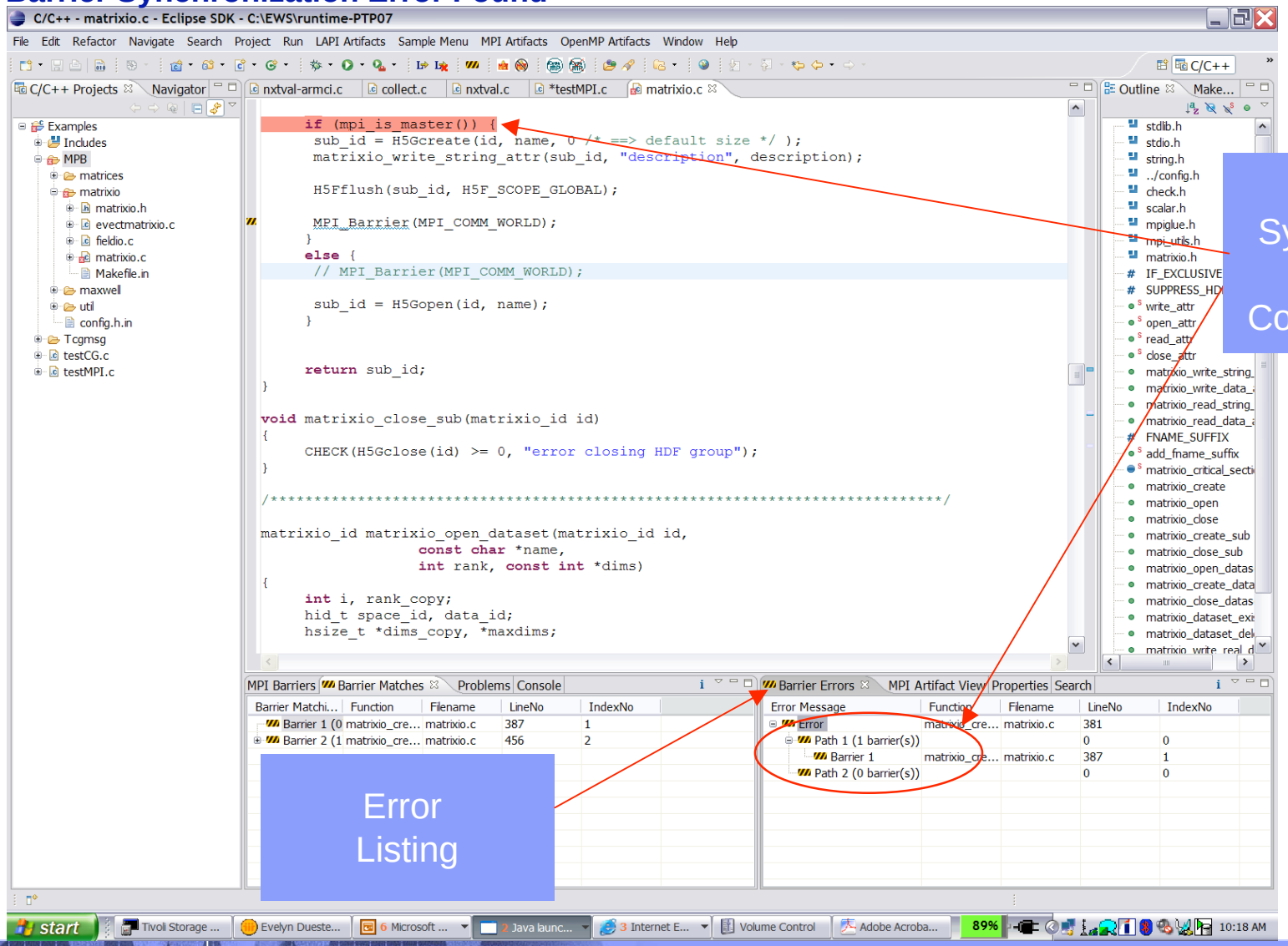
MPI Barrier Verification Tool

Barrier Synchronization Error Found



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