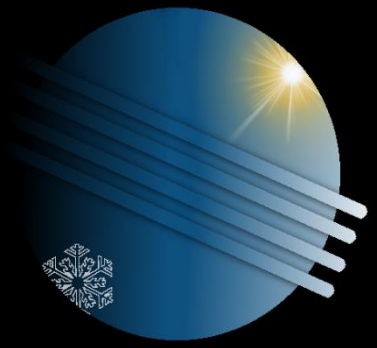

Making Offline Analyses Continuous

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Michael D. Ernst[♦], David Notkin[♦]

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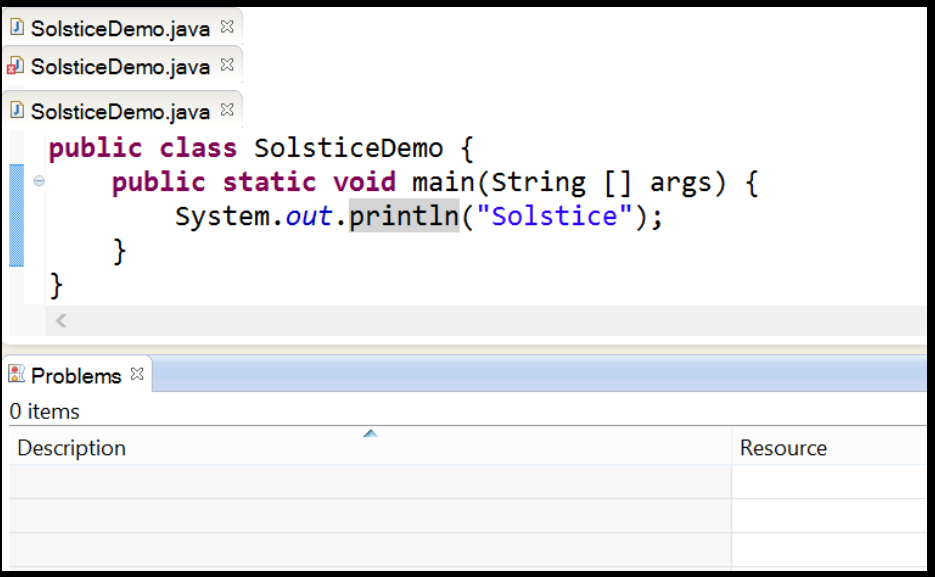
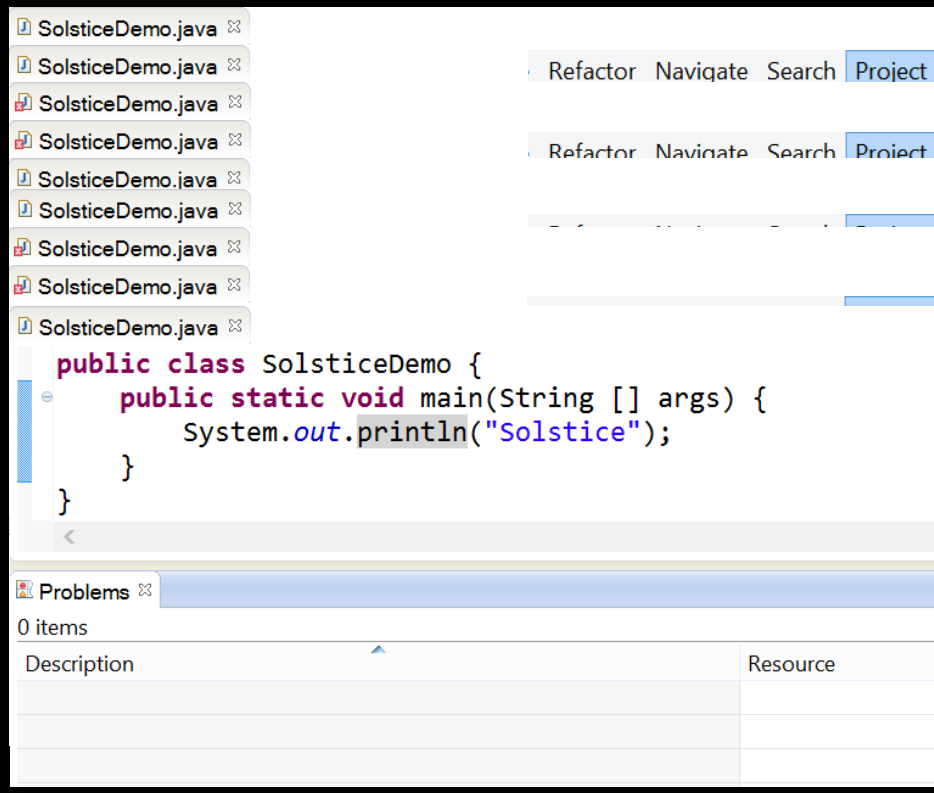
❄ University of Massachusetts, Amherst

Compilation: Continuous vs. Offline Analysis





Continuous Analysis

- Invoked without developer interaction
- Updates the result as input program changes

Offline analysis: invoked by the developer manually

Continuous Analysis Feedback is Good

- Manual invocation interrupts development
- Research: continuous feedback is useful
  [Boehm 1981, Katzan 1969, SaffE 2003]
  - Continuous testing reduces development time 15%
    [SaffE 2003]

Goal: Let's build tons of continuous analyses!

Wait! Building continuous analyses is **hard**

Ways to Build a Continuous Analysis

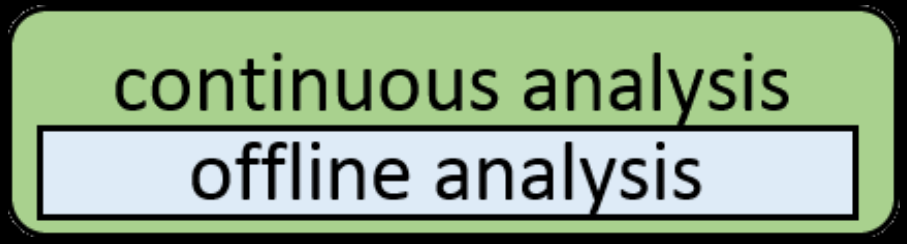
Re-architect an offline analysis:

- Incrementalization [Eclipse compilation]
  - Extremely complex, not possible for some analyses

Wrap an offline analysis:

- Trigger-based analysis [Metrics, FindBugs, Check-style plug-ins]
  - Analysis must be fast
  - Analysis cannot observe buffer-level edits
- Manually-managed copy codebase
  (Quick Fix Scout [MusluBHEN 2012], Crystal [BrunHEN 2011])
  - Implementation is complex and difficult

Our approach:
Making Offline Analyses Continuous



Wrap an offline analysis into an IDE-integrated continuous analysis easily and efficiently

Outline

- Motivation
- Wrapping offline analyses into continuous
- Evaluation and results
- Contributions

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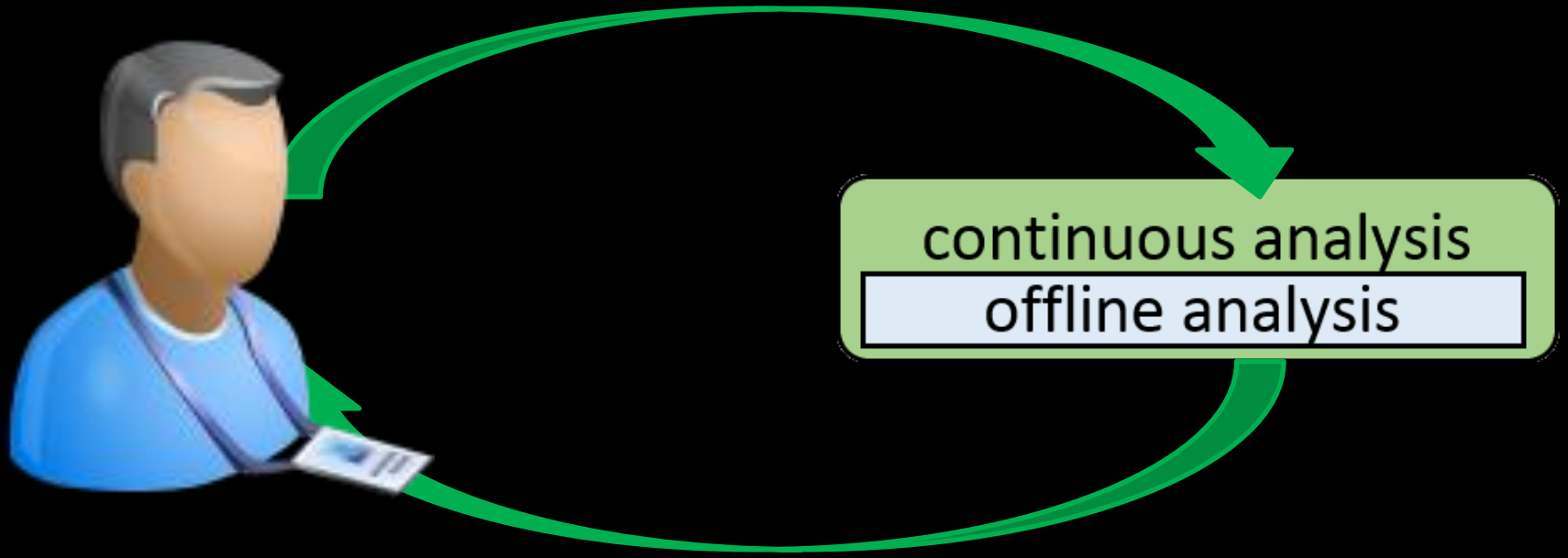
Goal 1: Currency

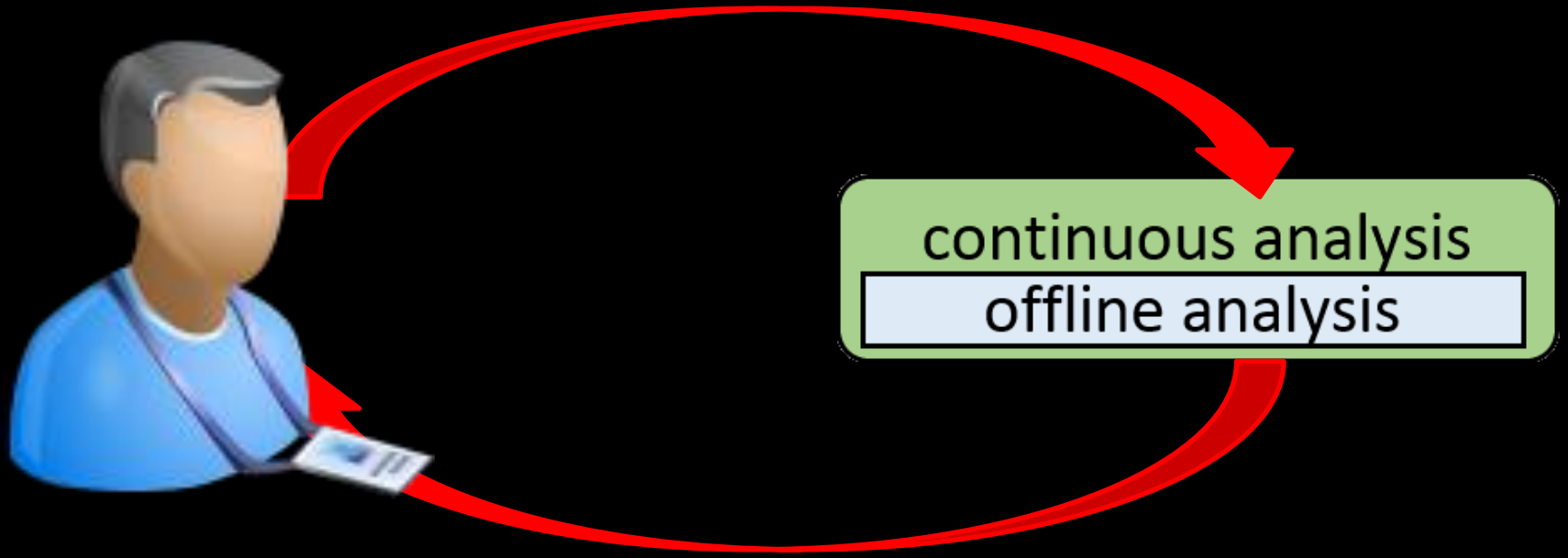
Analysis should have access to most recent code



Most recent analysis results
should be accessible to the developer

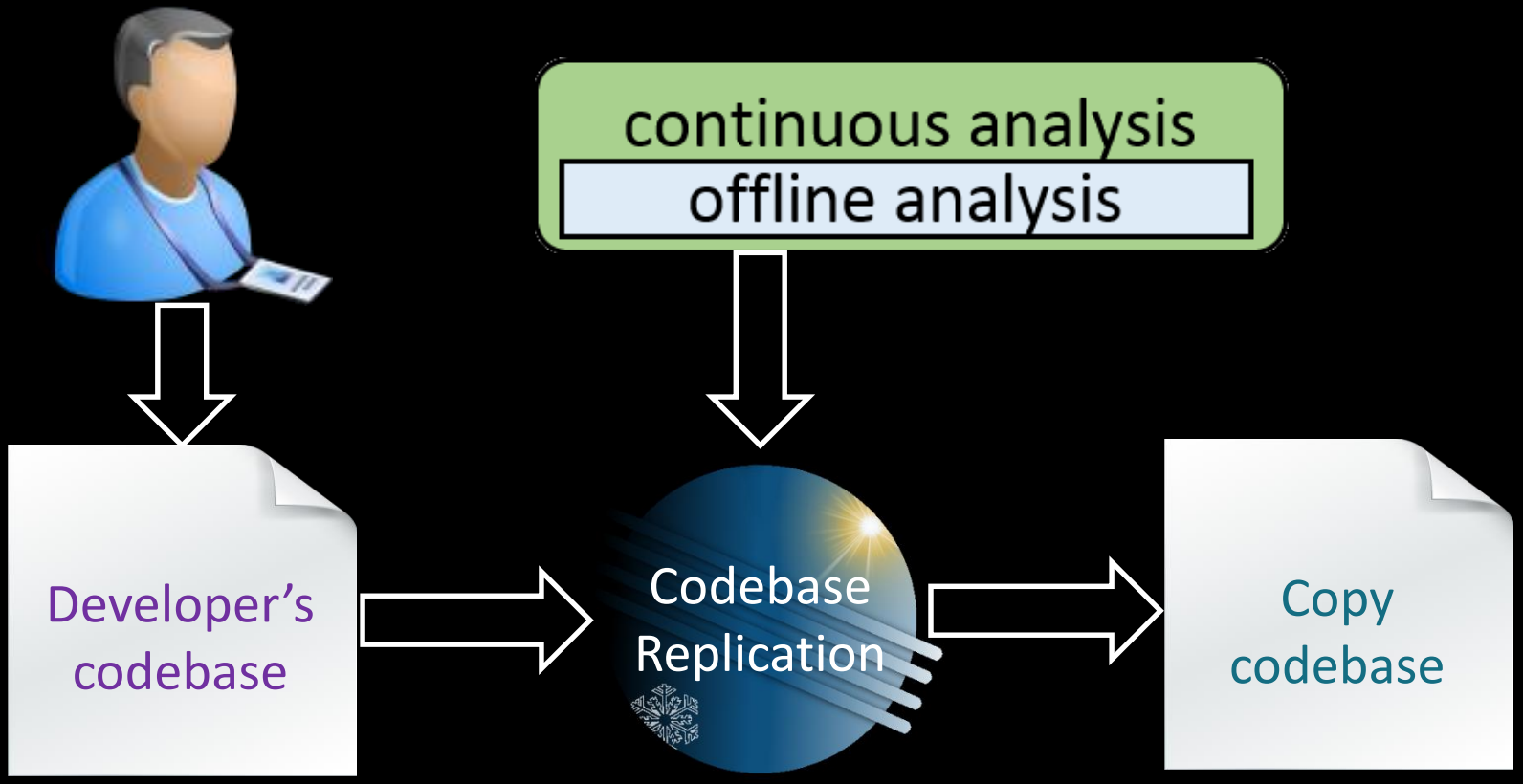
Goal 2: Isolation

Analysis should run on a consistent codebase



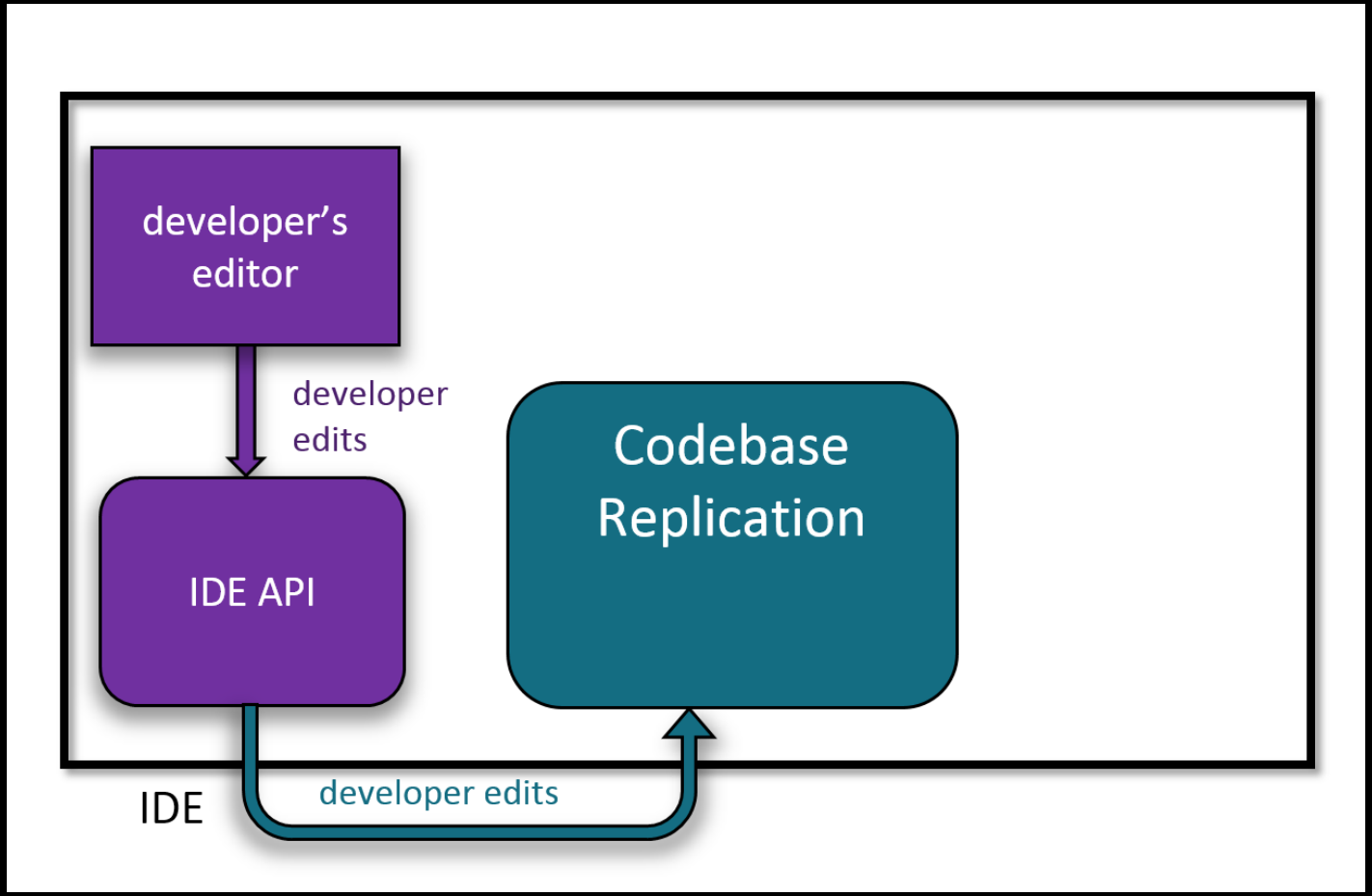
Analysis should not block the developer

Approach: Codebase Replication

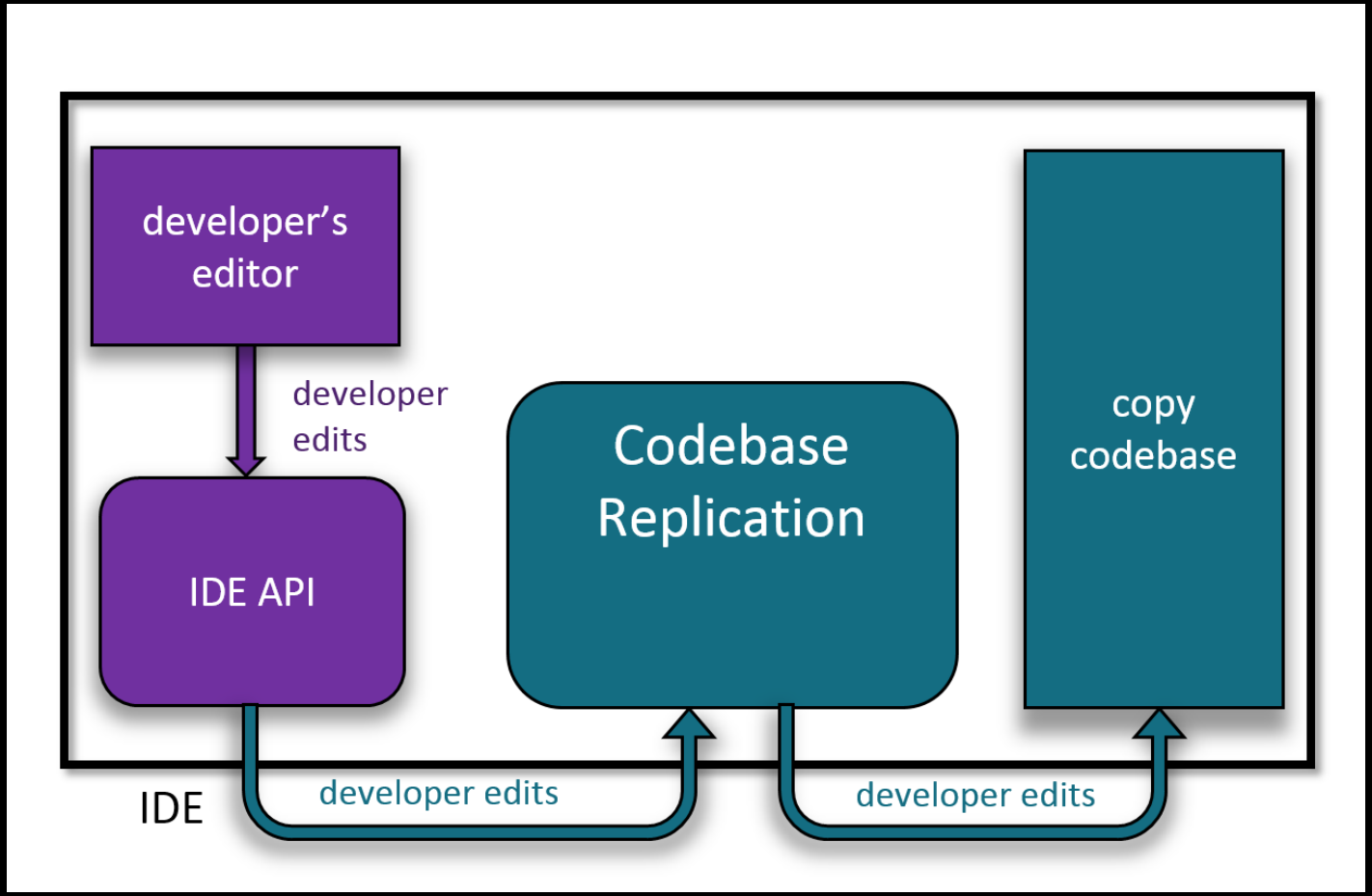


Achieves goals of currency and isolation

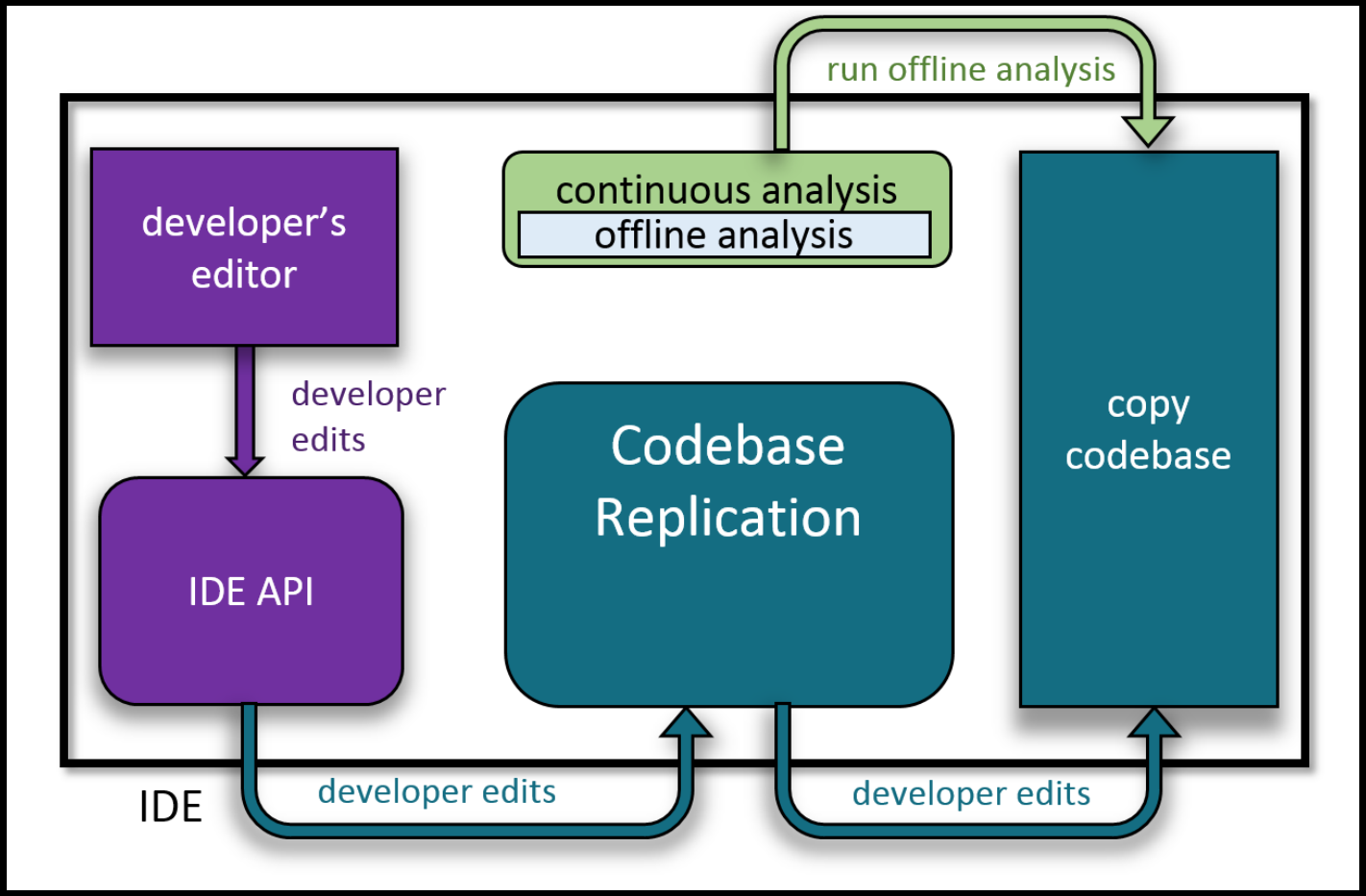
Codebase Replication: Architecture



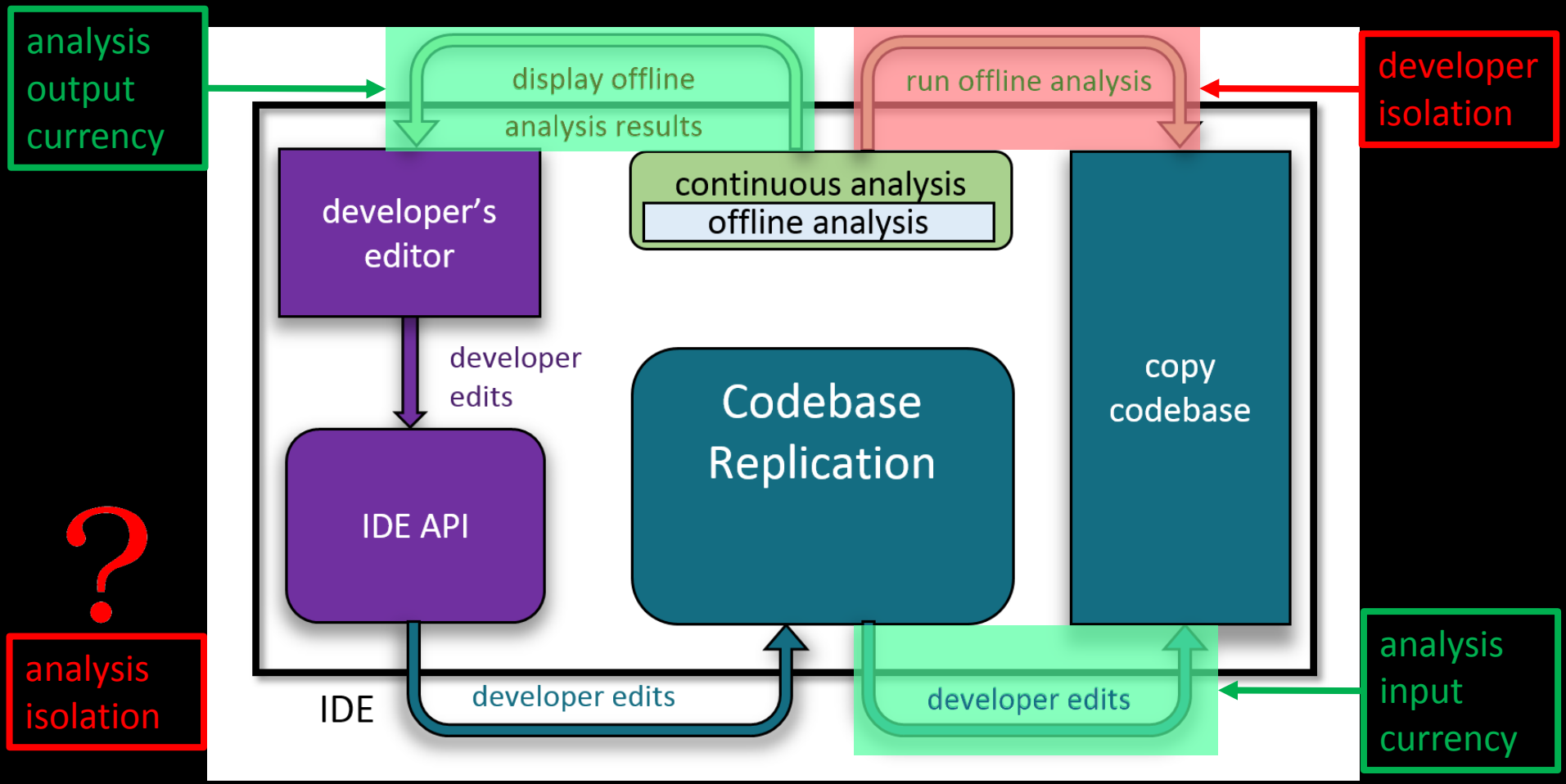
Codebase Replication: Architecture



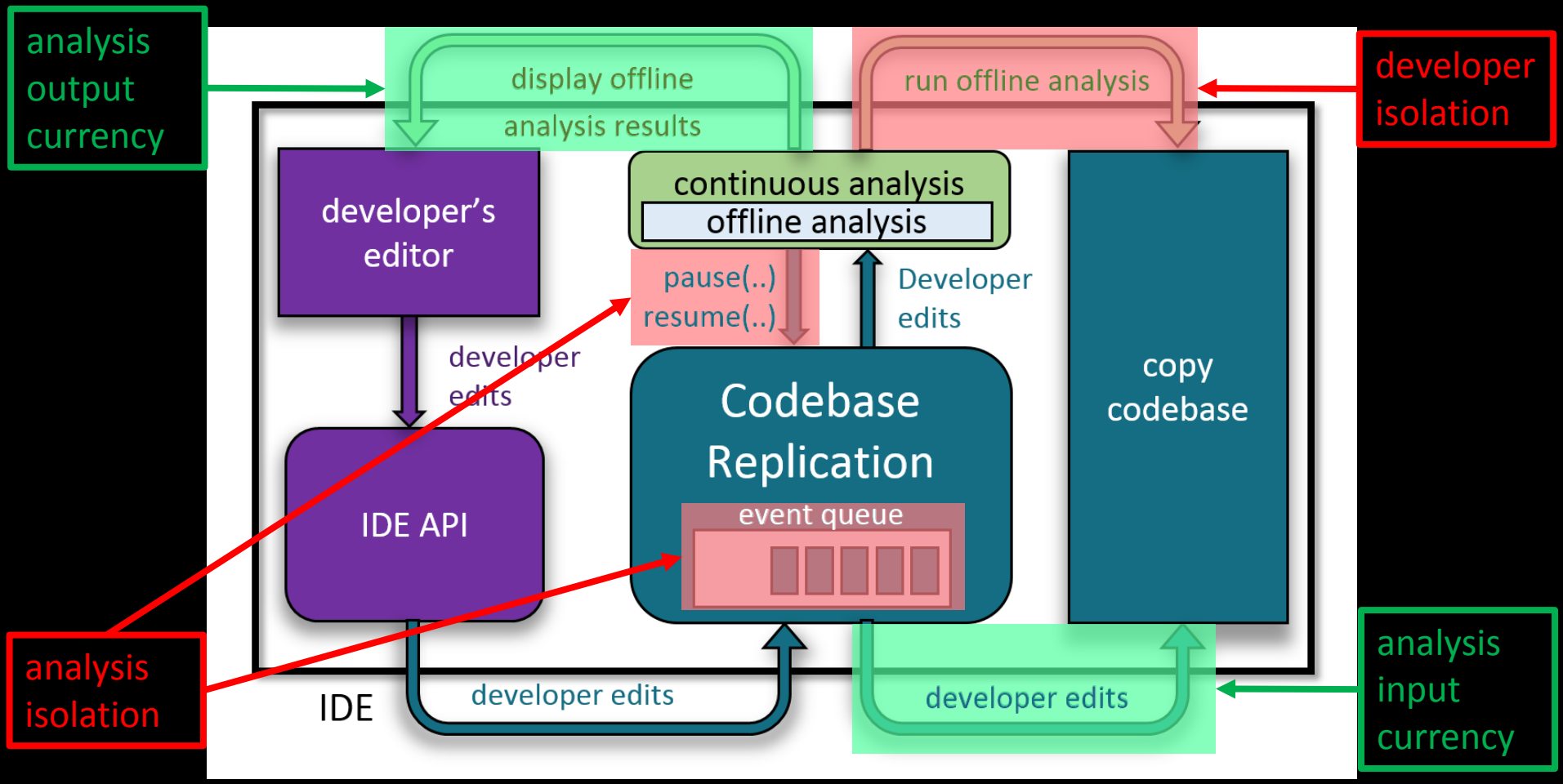
Codebase Replication: Architecture

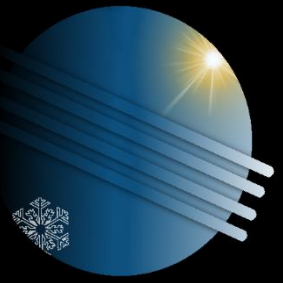


Codebase Replication: Architecture



Codebase Replication: Architecture



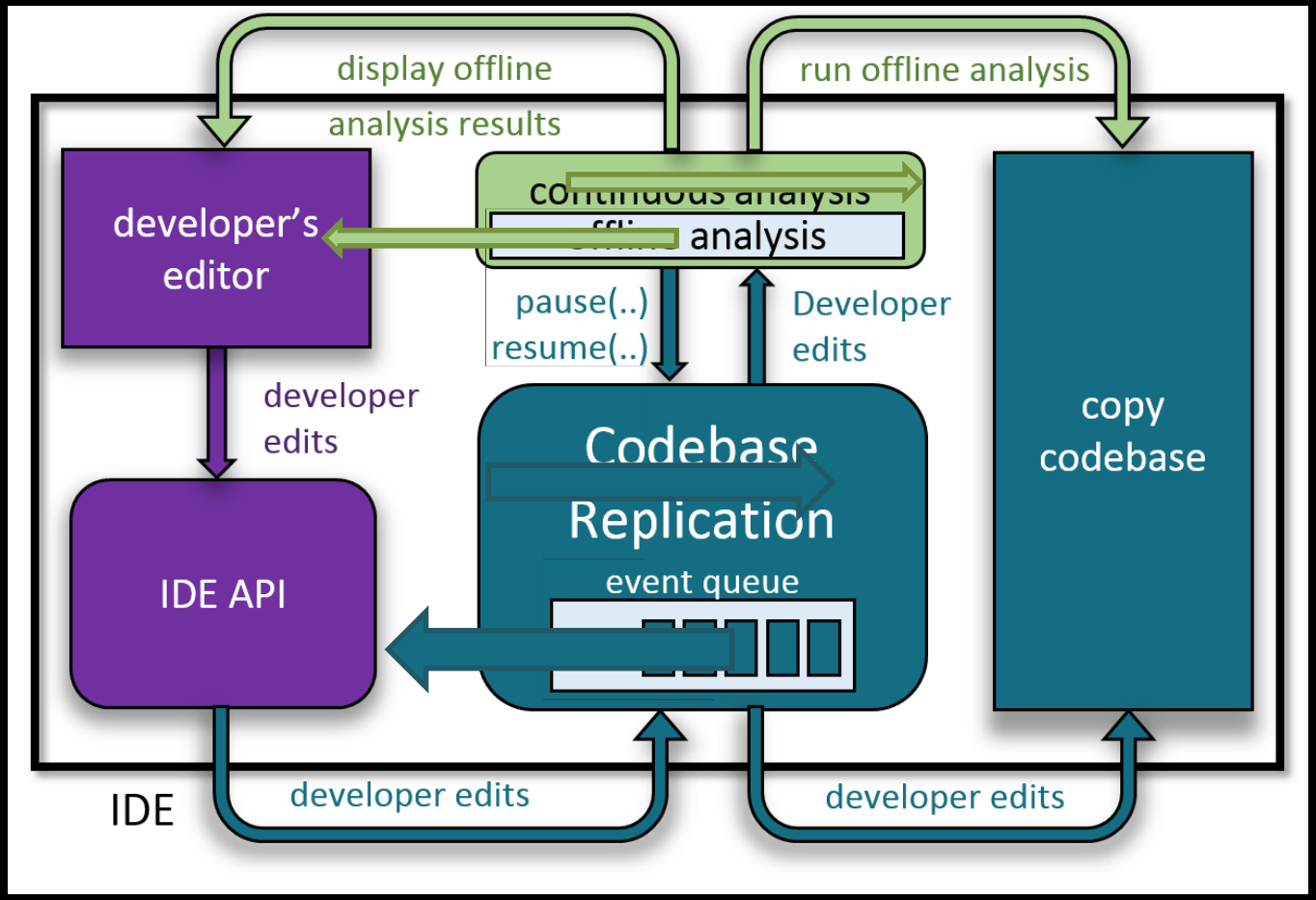


Solstice: Codebase Replication for Eclipse

Eclipse-specific design changes:

- Solstice runs a headless (w/o UI) copy Eclipse
- Copy Eclipse manages the copy workspace
  - One Eclipse is associated with one workspace
- Bidirectional link between two Eclipses

Solstice: Architecture



Developer's Eclipse

Copy (headless) Eclipse

Outline

- Motivation
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Research Questions

Quantitative evaluation: Currency and isolation

- How fast does the analysis get access to changed code?
- How fast does the developer see new analysis results?
- Does the developer notice any IDE slowdown?
- How much is the analysis delayed?

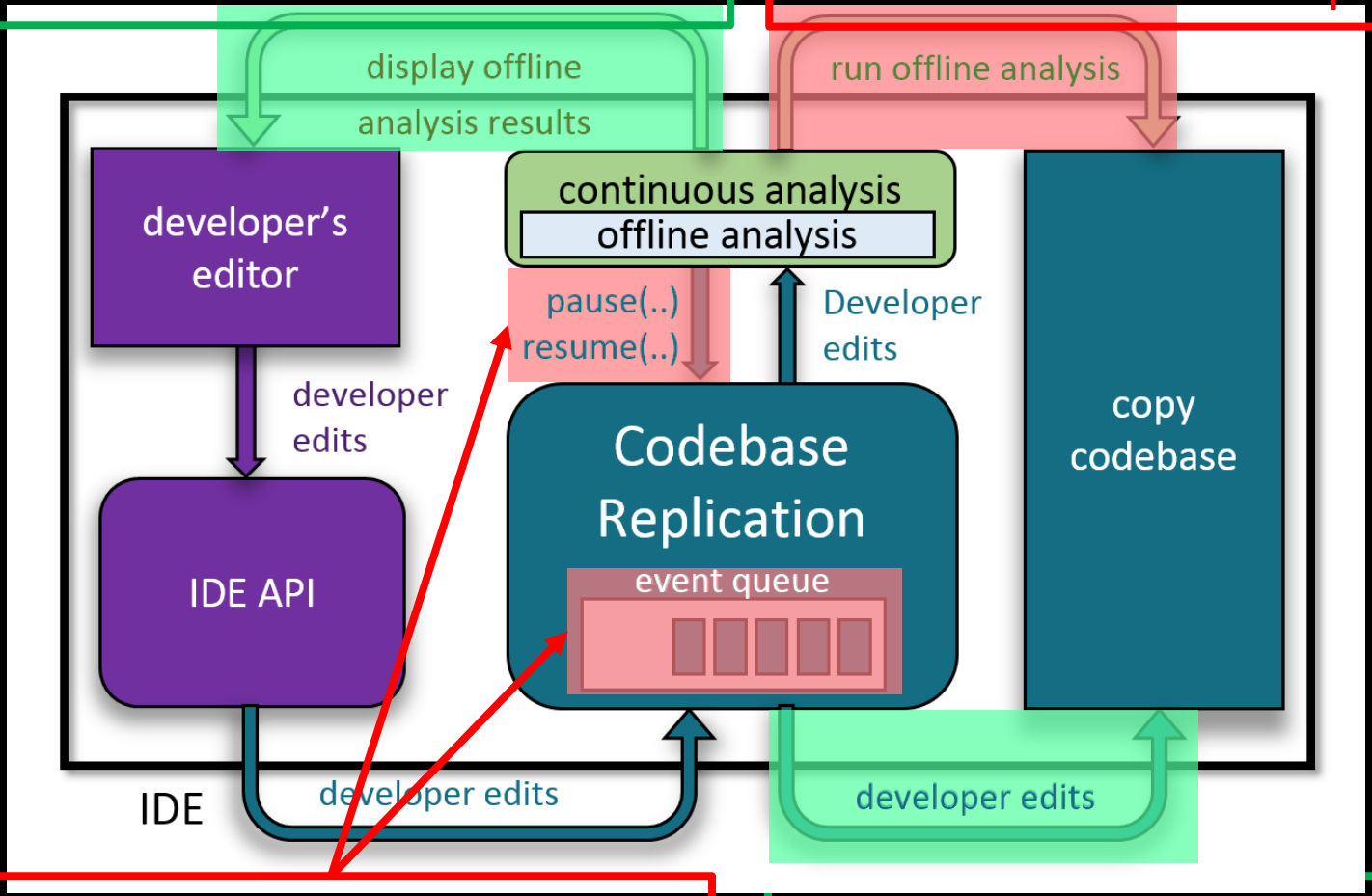
Case study

- How hard is it to implement Solstice analysis wrappers?
- Are Solstice analysis wrappers useful?
  - Preliminary result: yes. Refer to the paper for details.

Efficient Currency & Isolation

Analysis Results Delay
3ms

Overhead on the Developer
Edits: **2.5ms** File ops: **1.5ms**



Penalty on Analysis
70ms

Analysis Input Delay
2.5ms

It is Easy to Implement an Analysis Wrapper

3 analysis wrappers:

- FindBugs
- PMD
- Testing

On average 800 LoC (500 LoC without UI), 18 hours.

Compare to:

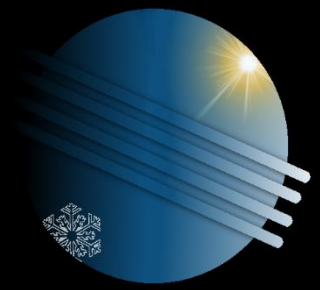
- Eclipse FindBugs plug-in: 16 KLoC
- Quick Fix Scout: 7.4 KLoC
- Eclipse continuous testing plug-in: 3.5 KLoC

Example Analysis Wrapper Implementation

```
@SolsticeServerPreferences(preferencePageID = ContinuousFindBugsPreferencePage.PREFERENCE_ID,
                           storedPreferenceIDs = {SharedOperations.EXECUTABLE_PATH_PREFERENCE_ID})
public class ContinuousFindBugsServer extends SolsticeServerNodeWithLogger
{
    public ContinuousFindBugsServer() {
        super(true);
    }
    private String processAnalysisCompleted(FindbugsAnalysisCompletedMessage message) {
        // Pretty print results
    }
}

public class ContinuousFindBugs extends SCPurePreciseAnalysis
{
    private volatile String findBugsExecutablePath_ = "";
    public ContinuousFindBugs() {
        super(AnalysisGranularity.PROJECT);
    }
    public void preferenceChanged(String preferenceID, String preferenceValue) {
        if (preferenceID.equals(SharedOperations.EXECUTABLE_PATH_PREFERENCE_ID))
            findBugsExecutablePath_ = preferenceValue;
        resumeAnalysis();
    }
    protected @Nullable ClientAnalysisFailedMessage shallRunAnalysis() {
        return projectContainsCompilationErrors(getCurrentProject());
    }
    protected ClientAnalysisMessage runAnalysis() {
        // Run FindBugs & return results.
    }
}
```

□ = Provided by Solstice API



Contributions

- Codebase Replication
  - New approach to implement continuous analyses
  - Analyses get currency and isolation
- Solstice
  - Evaluation: fast and responsive
  - Implement continuous analyses quickly and easily

http://bitbucket.org/kivancmuslu/solstice