

Integration is hard,
Integration tests even more so

@bmuskalla

A GUIDE TO
INTEGRATION BY PARTS:

GIVEN A PROBLEM OF THE FORM:

$$\int f(x)g(x)dx = ?$$

CHOOSE VARIABLES u AND v SUCH THAT:

$$u = f(x)$$
$$dv = g(x)dx$$

NOW THE ORIGINAL EXPRESSION BECOMES:

$$\int u dv = ?$$

WHICH DEFINITELY LOOKS EASIER.

ANYWAY, I GOTTA RUN.

BUT GOOD LUCK!

Task List

Find: All Activate...

- All Mine [Product Development]
 - 16: stack overflow error in working set switcher
 - 12: create a new button for the submission tool
 - 1: implement the connector for new product
 - 2: design a new viewer for the milestones
 - 5: implement a new search algorithm for the viewer
 - 5: implement a new search algorithm for the viewer
- Bug 5, P3 [Product Development]
 - Scheduled: Thursday
 - Elapsed: 00:00
 - Comment by Tom: Have you considered using Lucene indexing...
- 20: update the support policy page
- Personal
 - drop off the car for an oil change









↔ Integration Landscape

View your organization's integration landscape to get an overview of artifact types flowing between your repositories via integrations.

[← Back to Collections](#)

Landscape List

[+ New Integration](#)

Filter

[Reset Filter](#)

Display Settings

Show All Models

Show All Artifact Types

[Reset Layout](#)

▶ Repository

▶ Model



Request



Request

Feature





Atlassian JIRA



IBM Doors



Tricentis Tosca



Atlassian JIRA

API






IBM Doors

API






Tricentis Tosca

API

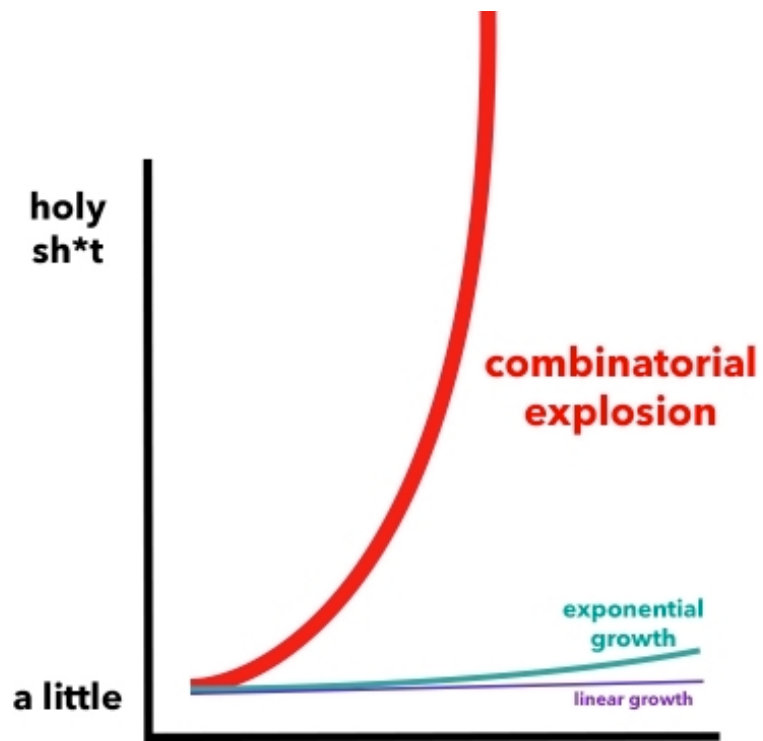
	Atlassian JIRA	<ul style="list-style-type: none">- Issue*- Sub-Task*
	IBM Doors	<ul style="list-style-type: none">- Object
	Tricentis Tosca	<ul style="list-style-type: none">- Defect*- Requirement- Test Case*- ...

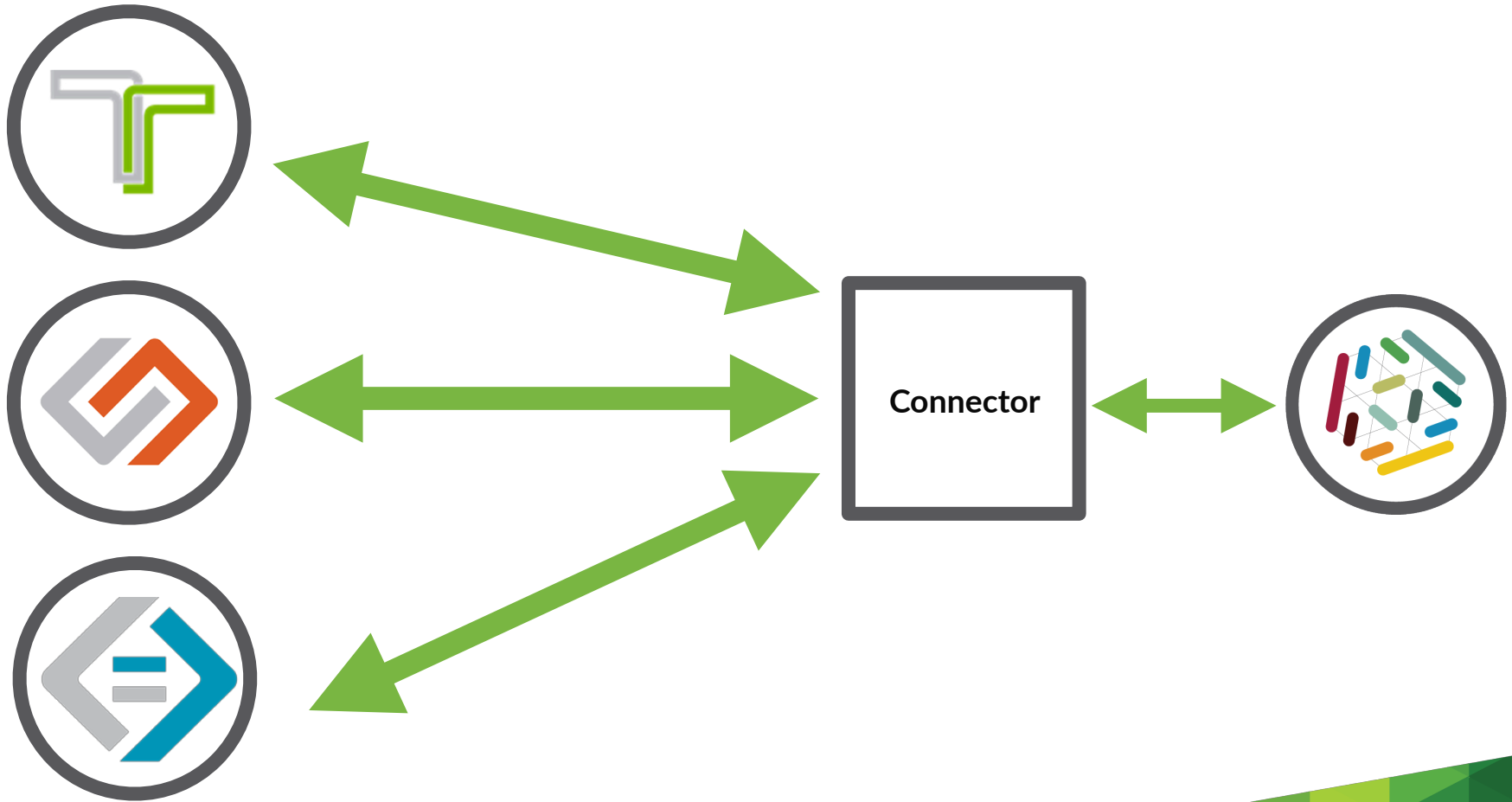
* I'm a different API

	Atlassian JIRA	<ul style="list-style-type: none"> - Issue - Sub-Task <p>6.4</p>	<ul style="list-style-type: none"> - Issue - Sub-Task <p>7.0</p>	<ul style="list-style-type: none"> - Issue - Sub-Task <p>SaaS</p>	<p>24 more...</p>
	IBM Doors	<ul style="list-style-type: none"> - Object <p>9.1</p>	<ul style="list-style-type: none"> - Object <p>9.2</p>	<ul style="list-style-type: none"> - Object <p>9.3</p>	<p>21 more...</p>
	Tricentis Tosca	<ul style="list-style-type: none"> - Defect - Requirement - Test Case - ... <p>8.2.2</p>	<ul style="list-style-type: none"> - Defect - Requirement - Test Case - ... 	<ul style="list-style-type: none"> - Defect - Requirement - Test Case - ... <p>11.3</p>	<p>.. 16 more..</p>

Curse of Dimensionality

- Product use cases
- Repository Version
- Artifact Type (Defect, Requirement, ...)
- Global repository settings (Streams enabled, ...)
- Markup languages (Confluence, HTML, Markdown, ...)
- Authentication methods (Credentials, Tokens, SSO, ...)

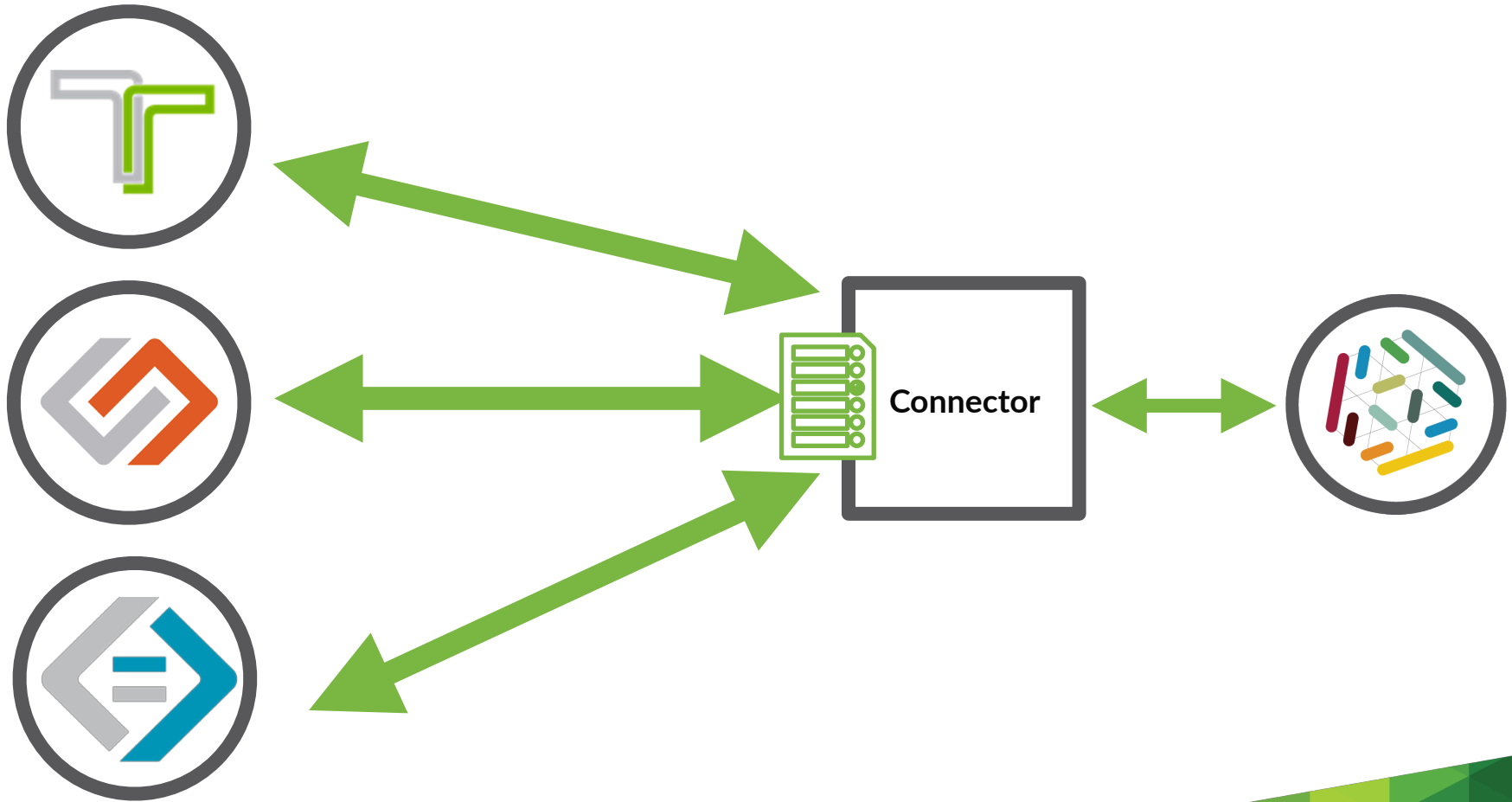




Consumer Driven Contract



- 7 Connector client can create, retrieve, update and delete an artifact
- 7.1 Connector client can create an artifact
- 7.2 Connector client can retrieve an artifact
- 7.3 Connector client can update an existing artifact
 - 7.3.1 Connector client can update an artifact and report success
 - 7.3.2 Connector client can update more than one attribute in a single operation
 - 7.3.3 Connector client receives error when attempting to update an artifact that does not or no longer exists
 - 7.3.4 Connector client receives meaningful feedback when the artifact update operation fails



TCK [tiː-siː-keɪ]

A **Technology Compatibility Kit (TCK)** is a suite of tests that at least nominally checks a particular alleged implementation of a Java Specification Request (JSR) for compliance.

TCK [tiː-siː-keɪ]

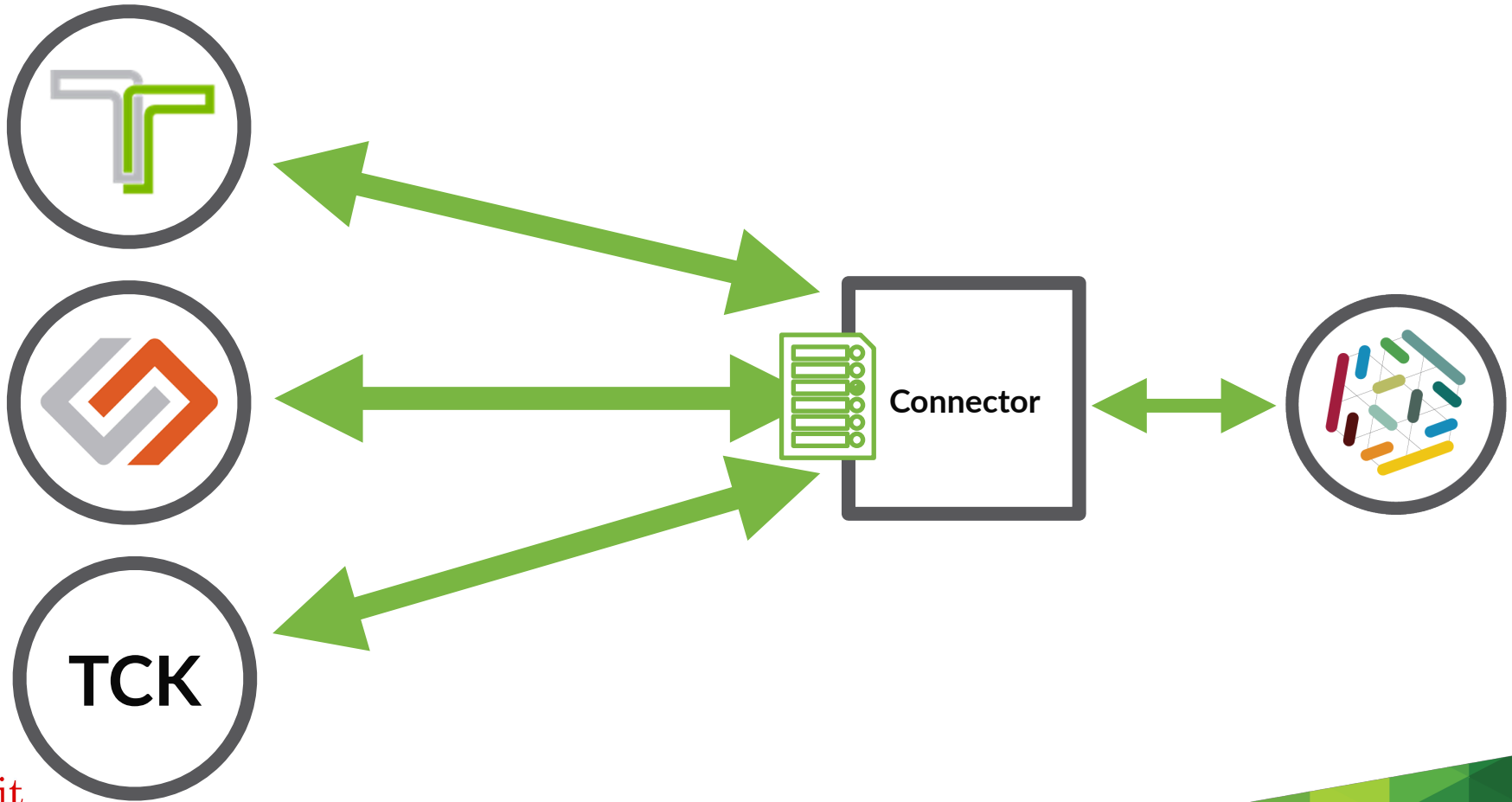
A **Technology Compatibility Kit (TCK)** is a suite of tests that at least nominally checks a particular alleged implementation of a ~~Java Specification Request (JSR)~~ for compliance.

Connector

TCK [tiː-siː-keɪ]

A **Technology Compatibility Kit (TCK)** is a suite of tests that ~~at least nominally~~ checks a particular alleged implementation of a ~~Java Specification Request (JSR)~~ for compliance.

Connector





```
package com.tasktop.connector.github.issues;

public class ClDemoTest extends ConnectorTestCase {

    @Test
    public void canCreateArtifact() {
        // actual test
    }

    public ClDemoTest(Fixture fixture) {
        super(fixture);
    }

}
```

```
package com.tasktop.connector

public class CldemoTest extends AbstractConnectorTest {

    @Test
    public void canCreateArtifact() {
        // actual test
    }

    public CldemoTest(Fixture fixture) {
        super(fixture);
    }
}
```

Runs: 2/2

Errors: 0

Failures: 0

- com.tasktop.connector.github.issues.CldemoTest [Runner: JUnit 4] (1.075 s)
 - Github.com - Issue (1.075 s)
 - canCreateArtifact[Github.com - Issue] (1.075 s)
 - Github Enterprise 2.3.1 - Issue (1.075 s)
 - canCreateArtifact[Github Enterprise 2.3.1 - Issue] (1.075 s)

```
package com.tasktop.connector.github.issues;

public class ClDemoTest extends ConnectorTest {

    @Test
    public void canCreateArtifact() {
        // actual test
    }

    public ClDemoTest(Fixture fixture) {
        super(fixture);
    }

}
```

- ▼ com.tasktop.connector.hp.alm.ClDemoTest [Runner: JUnit 4] (36.148 s)
 - ▶ HP ALM 14.x SaaS with Ping Federate Limited - Defect (36.143 s)
 - ▶ HP ALM 14.x SaaS with Ping Federate Limited - Requirement (37.757 s)
 - ▶ HP ALM 14.x SaaS with Ping Federate Limited - Test Set Folder (36.141 s)
 - ▶ HP ALM 14.x SaaS with Ping Federate Limited - Release (36.142 s)
 - ▶ HP ALM 14.x SaaS with Ping Federate Limited - Release Cycle (36.140 s)
 - ▶ HP ALM 11.52 Limited - Lenient Comments - Requirement (2.192 s)
 - ▶ HP ALM 11.52 Limited - Lenient Comments - Test Instance (0.002 s)
 - ▶ HP ALM 11.52 Limited - Lenient Comments - Test Run (0.002 s)
 - ▶ HP ALM 11.52 Limited - Lenient Comments - Release (0.003 s)
 - ▶ HP ALM 11.52 Limited - Lenient Comments - Release Cycle (2.192 s)
 - ▶ HP ALM 11.00 Limited - Defect (2.192 s)
 - ▶ HP ALM 11.00 Limited - Requirement (0.003 s)
 - ▶ HP ALM 11.00 Limited - Test Run (2.192 s)
 - ▶ HP ALM 11.00 Limited - Release (2.192 s)
 - ▶ HP ALM 11.00 Limited - Release Cycle (2.192 s)
 - ▶ HP ALM 11.52 Limited - Strict Comments - Defect (2.192 s)
 - ▶ HP ALM 11.52 Limited - Strict Comments - Test Configuration (2.192 s)
 - ▶ HP ALM 11.52 Limited - Strict Comments - Release (2.192 s)
 - ▶ HP ALM 11.52 Limited - Strict Comments - Release Cycle (0.001 s)
 - ▶ HP ALM 12.01 Limited - Requirement (0.003 s)
 - ▶ HP ALM 12.01 Limited - Test Set Folder (0.004 s)
 - ▶ HP ALM 12.01 Limited - Test Run (2.192 s)
 - ▶ HP ALM 12.01 Limited - Test (2.192 s)
 - ▶ HP ALM 12.01 Limited - Release (2.192 s)
 - ▶ HP ALM 12.01 Limited - Release Cycle (0.004 s)
 - ▶ HP ALM 12.60 Limited - Defect (38.340 s)
 - ▶ HP ALM 12.60 Limited - Requirement (36.143 s)
 - ▶ HP ALM 12.60 Limited - Test Set (38.340 s)
 - ▶ HP ALM 12.60 Limited - Release (38.339 s)
 - ▶ HP ALM 12.60 Limited - Release Cycle (36.148 s)

Testing against 58 tools
in > 350 versions

471.000 TCK tests
per day



```
@Test
@Validates(value = "7.1.1")
public void createArtifactWithSummary() {
    Artifact artifact = fixture().createArtifact();

    artifact.setSummary("some string");
    fixture().updateArtifact(artifact);

    assertThat(artifact.getSummary()).isEqualTo("some string");
}
```

```
@Test
@Validates(value = "7.1.1")
public void createArtifactWithSummary() {
    Artifact artifact = fixture().createArtifact();


    artifact.setSummary("some string");
    fixture().updateArtifact(artifact);

    assertThat(artifact.getSummary(), is("some string"));
}
```

CON-14330

some string

[✎ Edit](#) [💬 Comment](#) [Assign](#) [To Do](#) [Accepted](#) [Workflow ▾](#)

Type:	 Story	Status:	TO TRIAGE
Priority:	Not Set		(View workflow)
Affects Version/s:	None	Resolution:	Unresolved
Component/s:	Git	Fix Version/s:	None
Labels:	None		

One @Test to catch them all

```

@Test
@Validates(value = "7.1.2")
public void createArtifactWithSummary() {
    Artifact artifact = fixture().createArtifact();

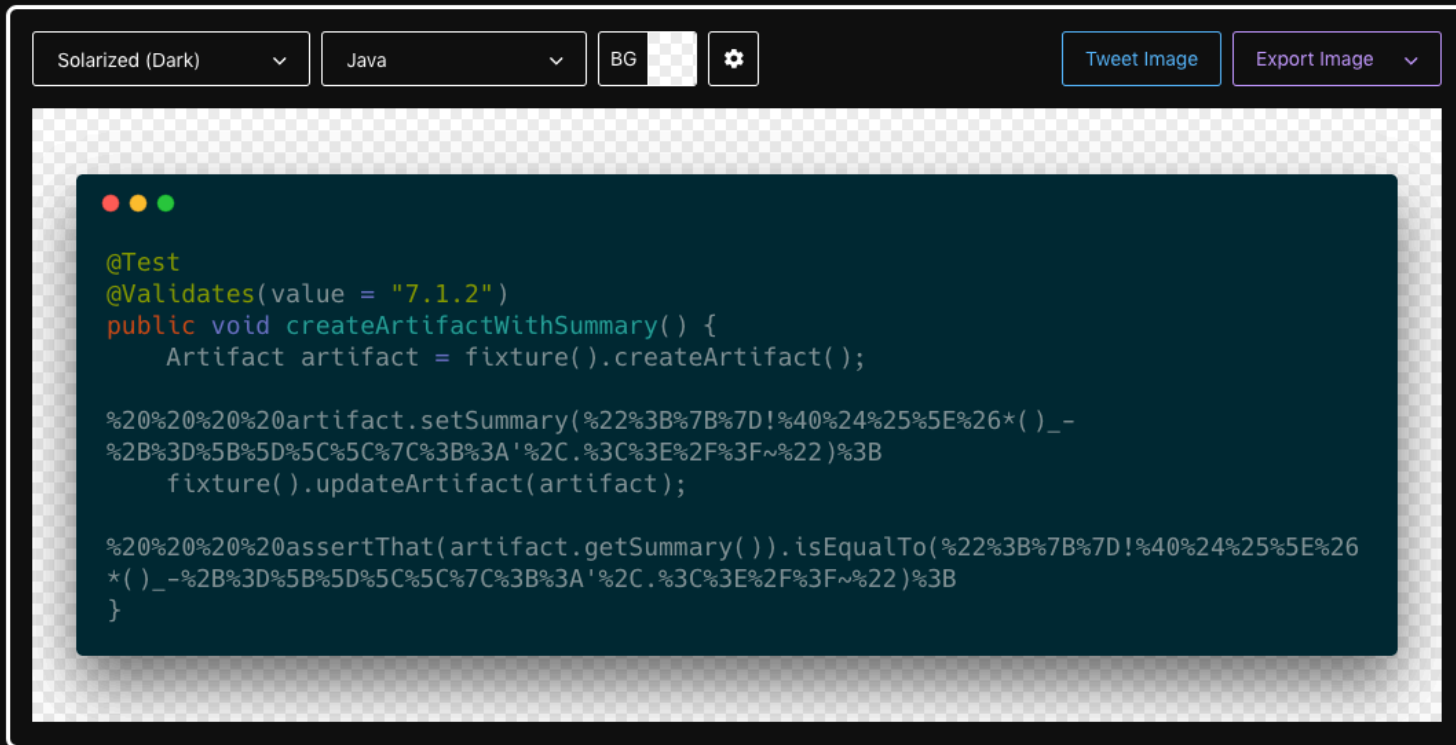
    artifact.setSummary(";{}!@$%^&*()_-=+[]|;:'.<>/?~");
    fixture().updateArtifact(artifact);


    assertThat(artifact.getSummary()).isEqualTo(";{}!@$%^&*()_-=+[]|;:'.<>/?~");
}

```

carbon

Create and share beautiful images of your source code.
Start typing or drop a file into the text area to get started.



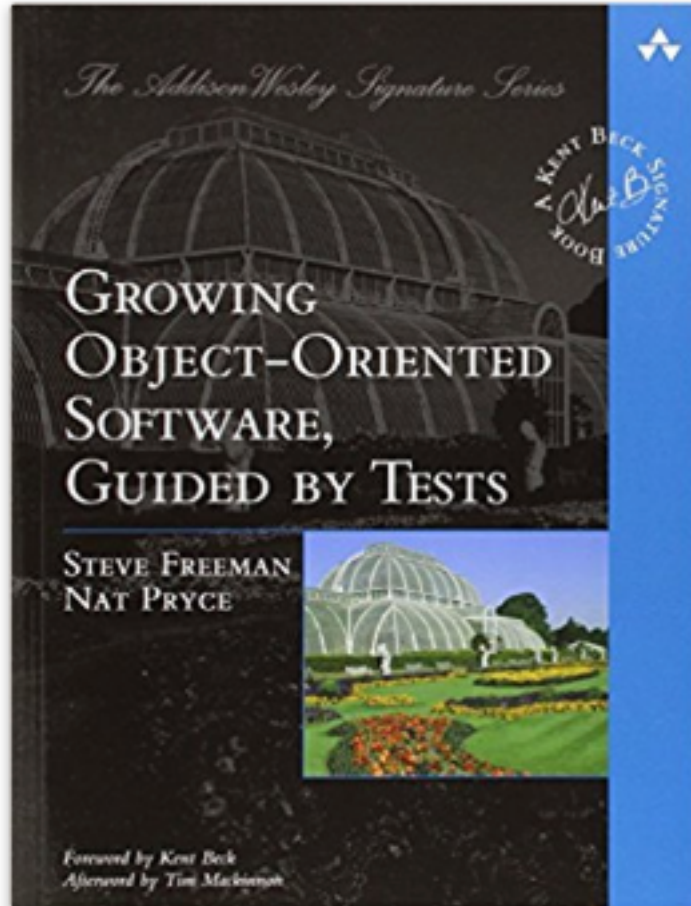
Solarized (Dark) ▾ Java ▾ BG  ⚙️

Tweet Image Export Image ▾

```
@Test
@Validates(value = "7.1.2")
public void createArtifactWithSummary() {
    Artifact artifact = fixture().createArtifact();

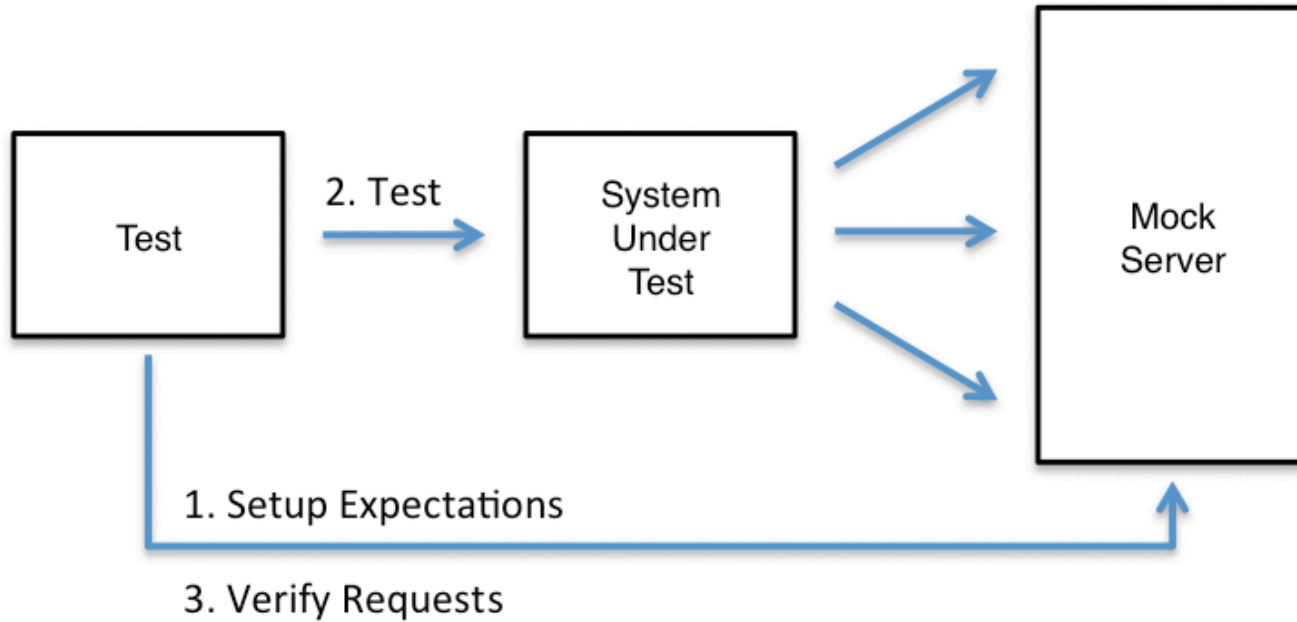
    artifact.setSummary("%20%20%20%20artifact.setSummary(%22%3B%7B%7D!%40%24%25%5E%26*( )_-%2B%3D%5B%5D%5C%5C%7C%3B%3A'%2C.%3C%3E%2F%3F~%22)%3B
    fixture().updateArtifact(artifact);

    %20%20%20%20assertThat(artifact.getSummary()).isEqualTo(%22%3B%7B%7D!%40%24%25%5E%26
    *( )_-%2B%3D%5B%5D%5C%5C%7C%3B%3A'%2C.%3C%3E%2F%3F~%22)%3B
}
```

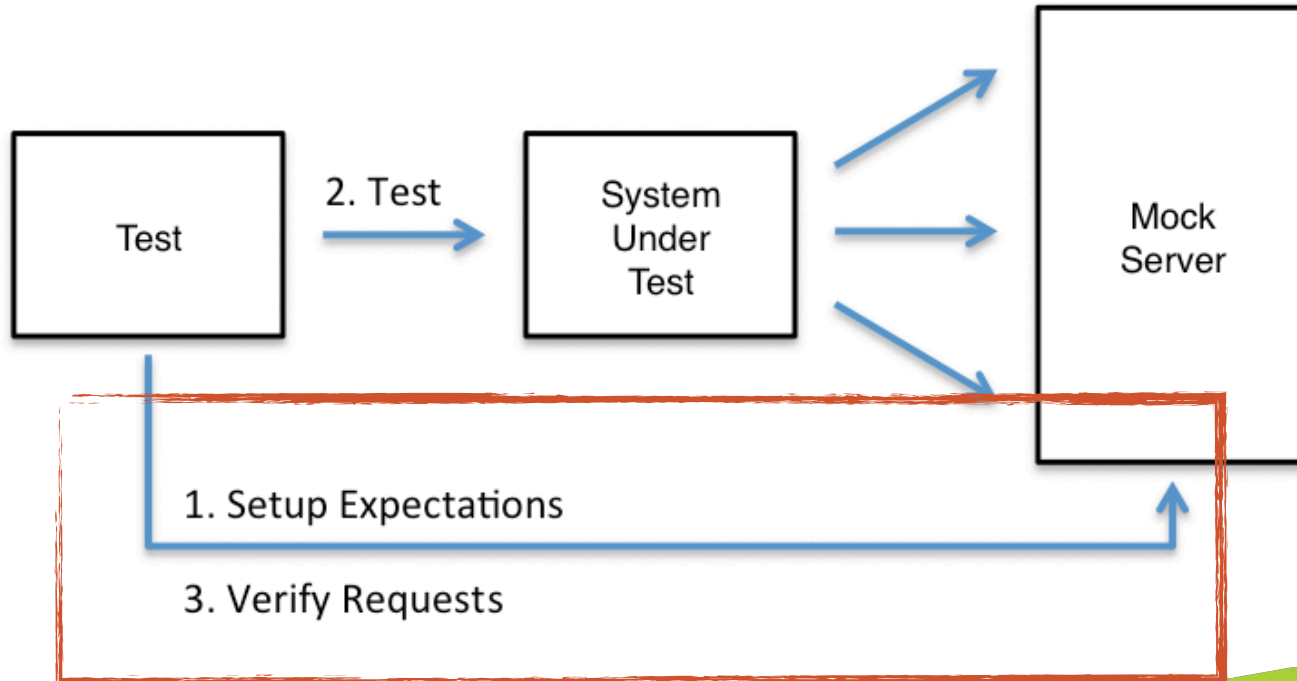


To Mock or Not To Mock

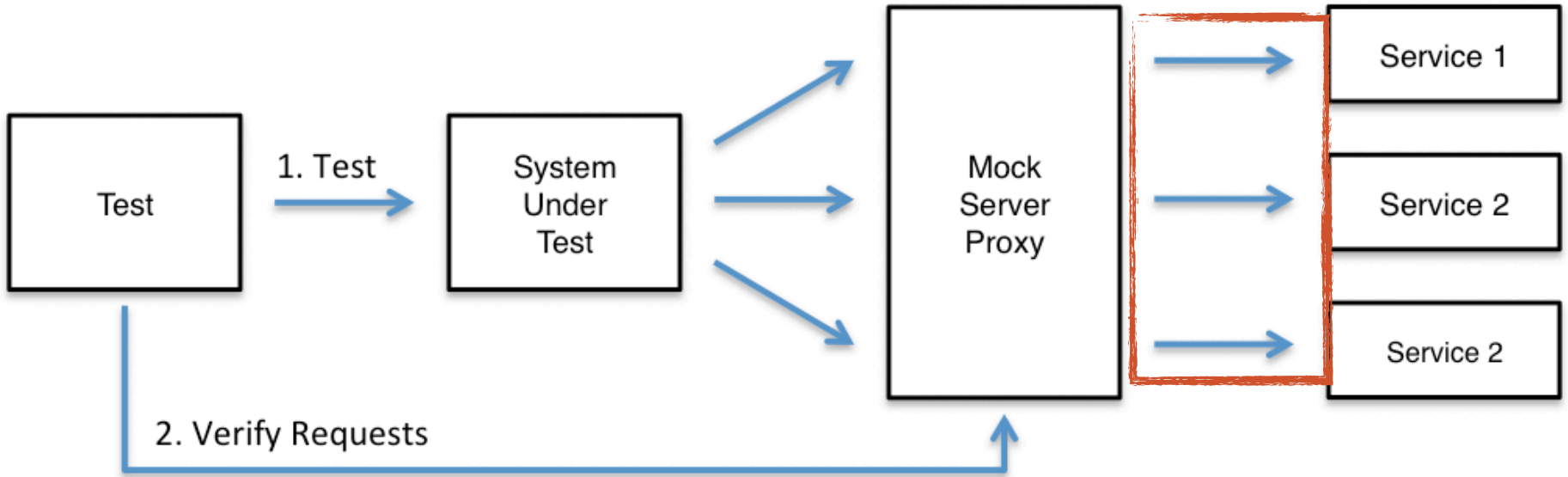
Mocking



Mocking




Mocking with Web Proxy




Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
Against Proxy Mock Server					

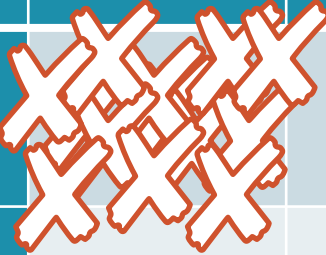
Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
Against Proxy Mock Server					






Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
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Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
Against Proxy Mock Server					

Integration Tests



















	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
Against Proxy Mock Server					

Integration Tests




















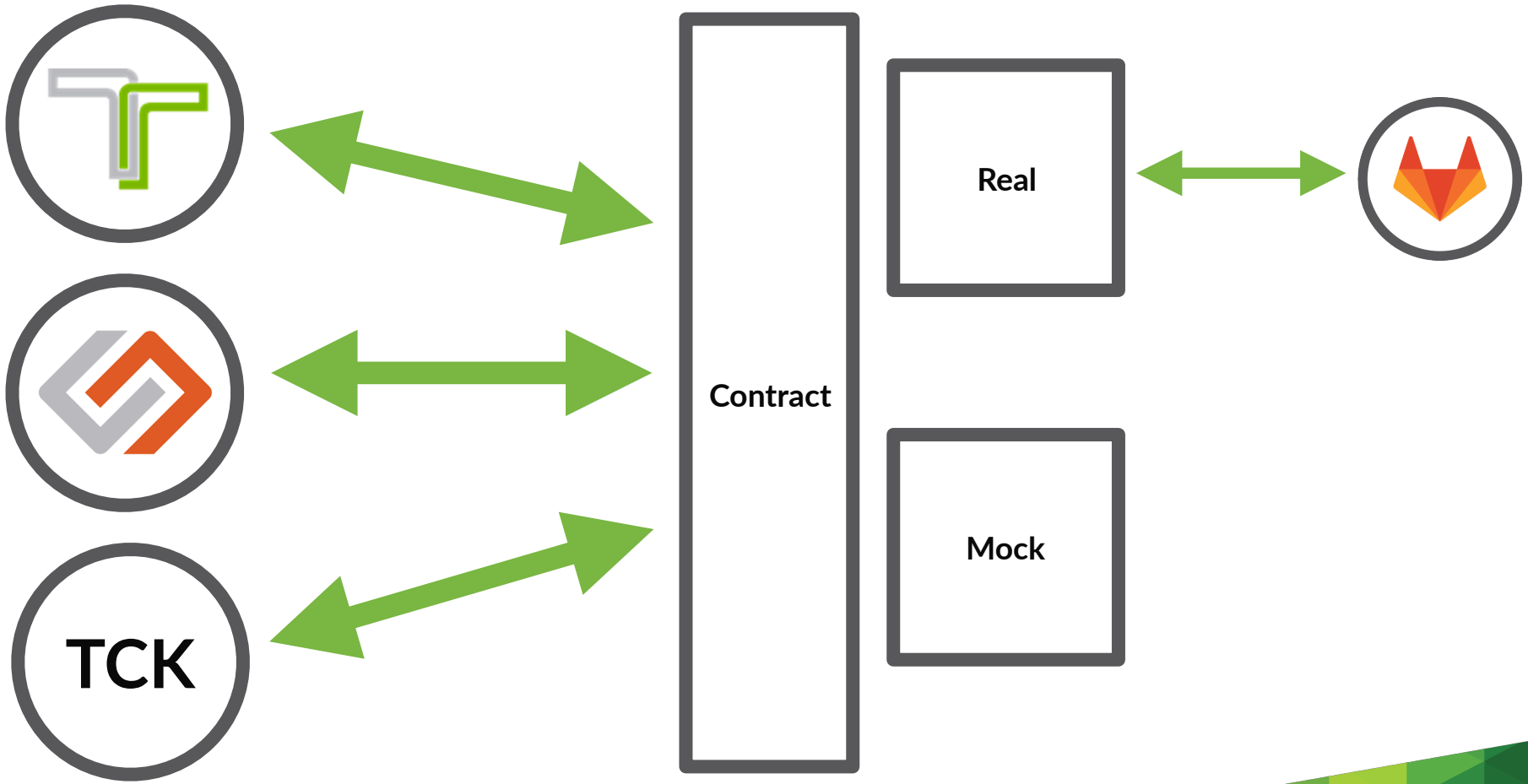
	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
Using real server					
Against Custom Mock server					
Against Proxy Mock Server					

Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
 Using real server					
 Against Custom Mock server					
 Against Proxy Mock Server					

Integration Tests

	Duration	Comprehensive	Catches API Changes	API Independence	Maintenance
					
					
					



Duration

Measure

- CPU
- Lock Contention

Measure

- CPU
- Lock Contention
- Network median/max
- Domain events

Test Duration & Metrics

HTTP endpoints, aggregated (JIRA OnDemand)

Show 10 entries

Search:

# of requests	Method	Request	min (ms)	median (ms)	max (ms)	avg (ms)	total (s)
3342	GET	/rest/api/2/issue/[0-9]?expand=editmeta,schema,names	49	435	1,160	444	1,485
1569	DELETE	/rest/api/2/issue/[0-9]	46	630	1,710	630	989
1545	POST	/rest/api/2/issue	257	582	1,809	631	976
846	POST	/rest/api/2/issue/[0-9]/worklog	159	301	796	312	264
659	PUT	/rest/api/2/issue/[0-9]	57	432	1,135	444	292
651	GET	/rest/api/2/issue/[0-9]/remotelink	61	104	286	107	69
593	GET	/rest/api/2/issue/[0-9]/watchers	64	115	433	118	70
560	GET	/rest/api/2/project/TCKII	64	119	449	122	68
474	GET	/rest/api/latest/serverInfo	0	2	990	66	31
396	POST	/rest/api/2/issueLink	63	167	450	171	67

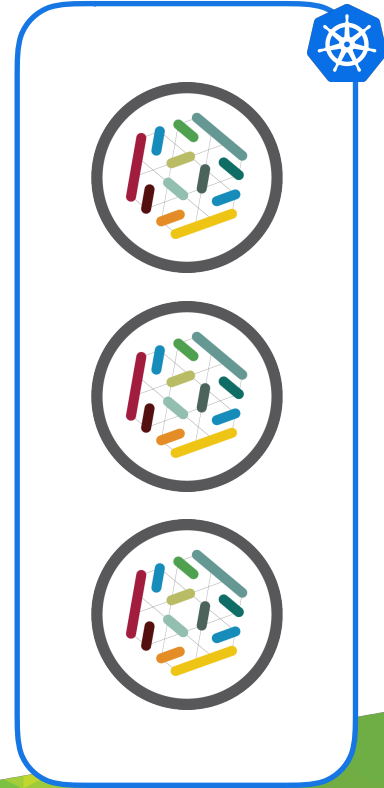
Showing 1 to 10 of 2,390 entries

Previous 1 2 3 4 5 ... 239 Next

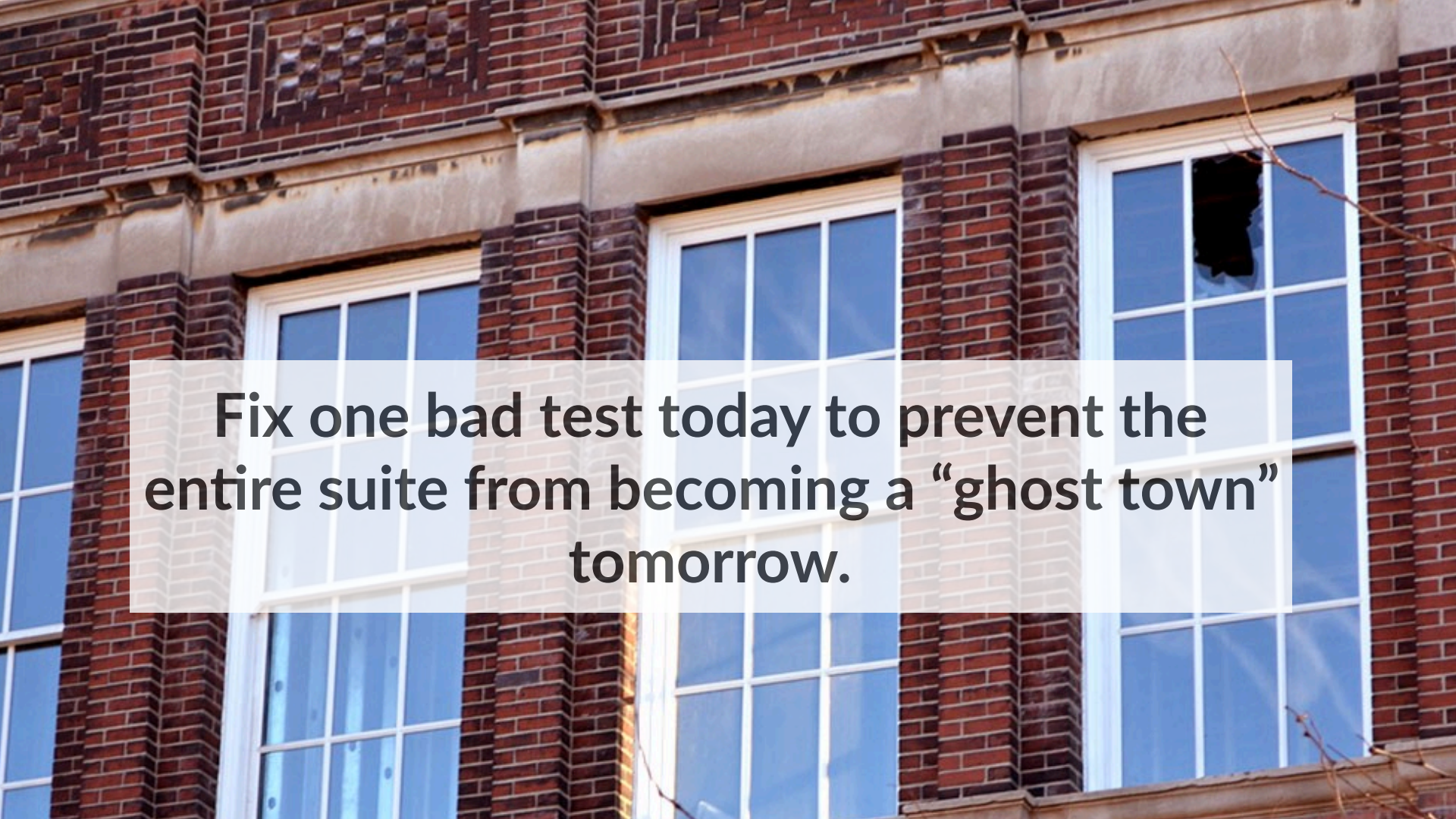
Lessons learned: Sharding



Lessons learned: Sharding



Flakiness

A photograph of a brick building facade with several multi-paned windows. The windows are set in a light-colored stone or concrete frame. The brickwork is dark red. One window on the right has a significant portion of its glass missing, revealing a dark interior. A thin, bare branch is visible in the upper right corner. A semi-transparent white text box is overlaid in the center of the image.

Fix one bad test today to prevent the entire suite from becoming a “ghost town” tomorrow.


Failed

`com.tasktop.internal.artifacts.tck.tests.epic51.US_51_RetrieveUpdateMultiSelectAttributesTest.optionsAreInExpectedOrderForFieldsInArtifactSchema[CA Agile Central On Demand 2.0 - Portfolio Item Theme, ACs=51.1.8]`

Failing for the past 2 builds (Since  #2535)

Took 11 ms.

 [add description](#)

 Failed 2 times in the last 30 runs. Flakiness: 3%, Stability: 93%

Test Stability Plugin: <https://wiki.jenkins.io/display/JENKINS/Test+stability+plugi>

Flaky Test != Flaky Test

Flaky Test != Flaky Test

Bad test?

Flaky connection?

Server-side race conditions?

Flaky Test != Flaky Test

Bad test?

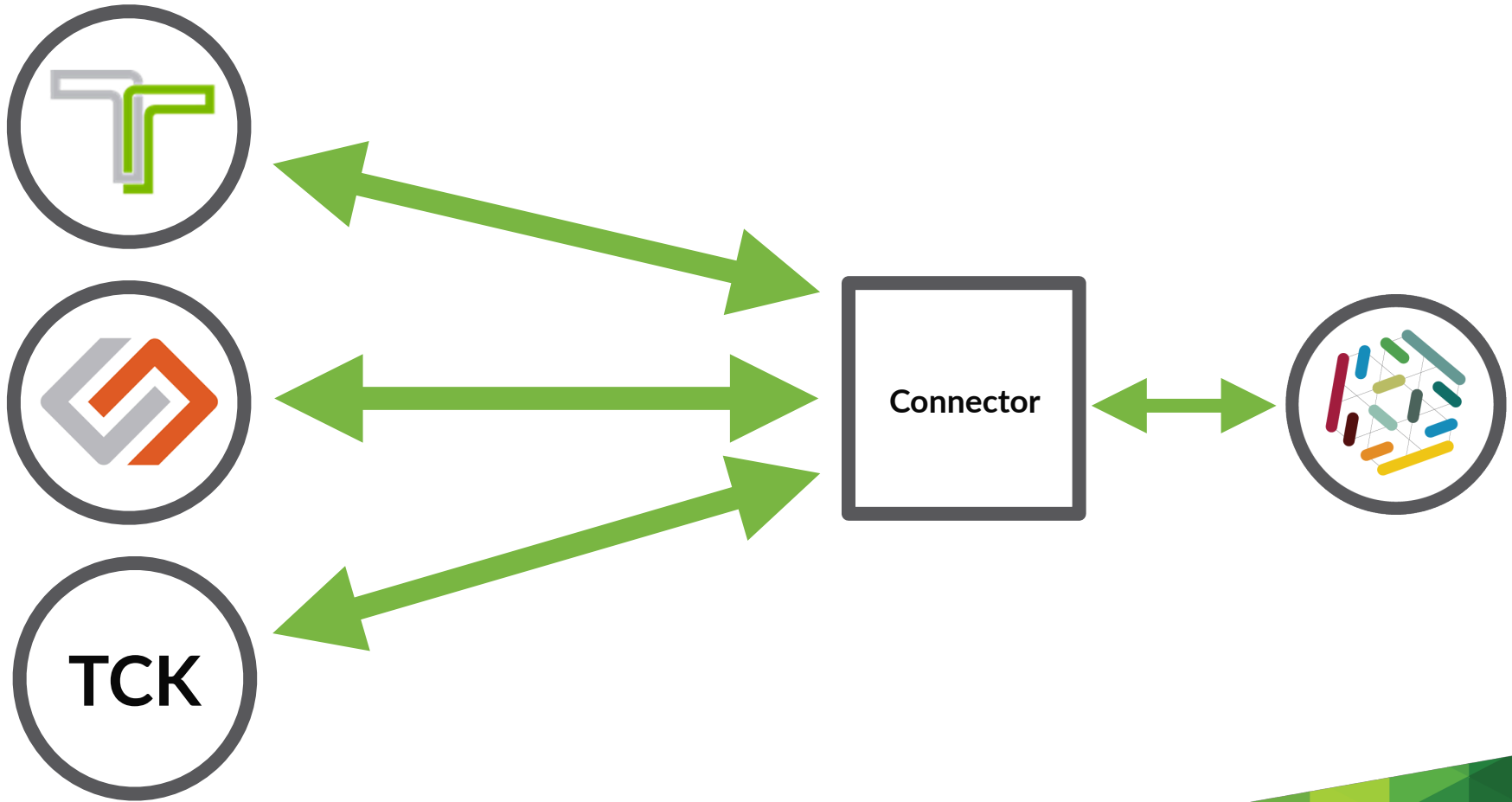
Flaky connection?

Server-side race conditions?

Glitch in the matrix?

Flaky Test \neq Flaky Test

Flaky Test $==$ Real Problem



Flaky Test \neq Flaky Test

Flaky Test $==$ Real Problem

Test behaviour $==$ Production







Help me test like Google

Life of a TE
Life of an SET
Interviews with Googlers
and more

James Whittaker · Jason Arbon · Jeff Carollo

Quarantine vs Data Gathering

Retry strategies

Common Network IO errors (Broken pipe, Paket Loss, ...)	
Known Transport Exceptions (e.g. HTTP 509: Bandwidth Limit exceeded)	
Test timed out	
Assertion Errors/Unknown Cause	

Retry approaches

- JUnit4: easy to implement
 - Or use `@Retry` kevinmost/junit-retry-rule
 - Per Test
- JUnit5 has built-in support: `@RepeatedTest`
 - Per Test? Github #1558
- Maven Surefire/Failsafe
 - `test.rerunFailingTestsCount` (JUnit4 only today)
 - JUnit5 support in discussion
 - Global

“What the **** just happened” Logger

WT*JH Logger

- Capturing by default
- Custom appender using evicting queue
- Triggered by test failure
- Capture server logs if possible as well
 - `container.followOutput(Slf4jLogConsumer);`

Lessons learned

Treat flaky tests like red tests

**Measure your tests, not only your
product**

Be pragmatic; if you want to test the interaction with a 3rd party system, test the interaction with the 3rd party system

Bitte geben Sie uns jetzt Ihr Feedback!

Integration ist schwer, Integrationstests
umso mehr

Benjamin Muskalla

@bmuskalla



Nächste Vorträge in diesem Raum

15:45 Java 9 ist tot, lang lebe Java 11, *Falk Sippach, Steffen Schäfer*

16:45 Ein Plädoyer für Empathie gegenüber Fachexpert*innen, *Michael Plöd*







1:08 PM **Benjamin Muskalla** joined #cl-demo along with jarvis-bot.

1:10 PM **Benjamin Muskalla** @jarvis-bot Does JIRA support attachments?

1:08 PM **Benjamin Muskalla** joined #cl-demo along with jarvis-bot.

1:10 PM **Benjamin Muskalla** @jarvis-bot Does JIRA support attachments?

1:10 PM **jarvis-bot** APP

Atlassian Jira (REST) (SDK) 19.1 - Attachments are supported

Limitations include:

Change detection - Connector cannot detect that an artifact has changed when one or more of its attachments have changed

- * Extra HTTP requests are required per search result to detect attachment changes.

We chose to avoid this performance hit

- * Affects types: [Test Execution (Zephyr)]

Impersonation - Connector cannot impersonate another user to create an attachment

- * By design, Zephyr does not support setting the creator when uploading an attachment

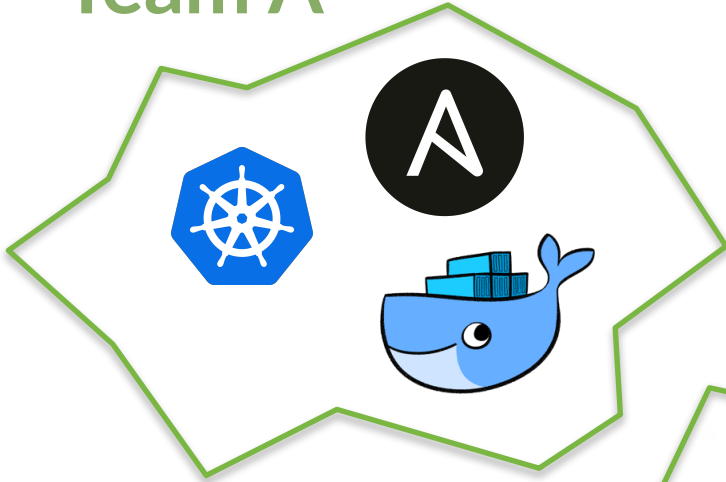
- * Affects types: [Test Execution (Zephyr)]

Impersonation - Connector cannot create an attachment with a specified author

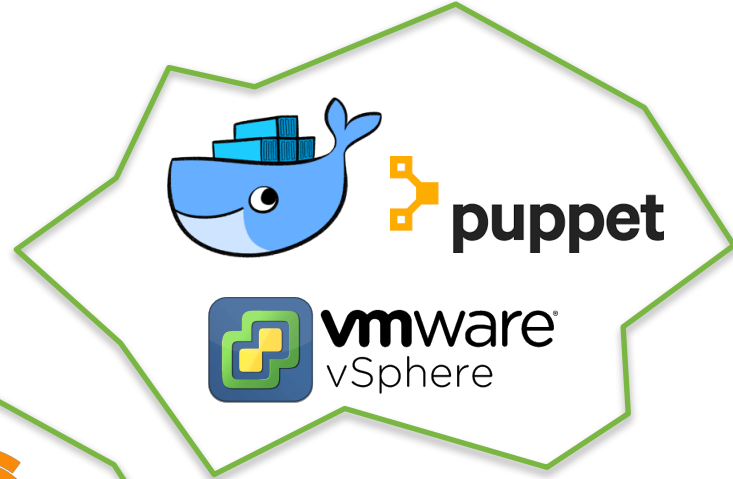
[Show more](#)

Infrastructure

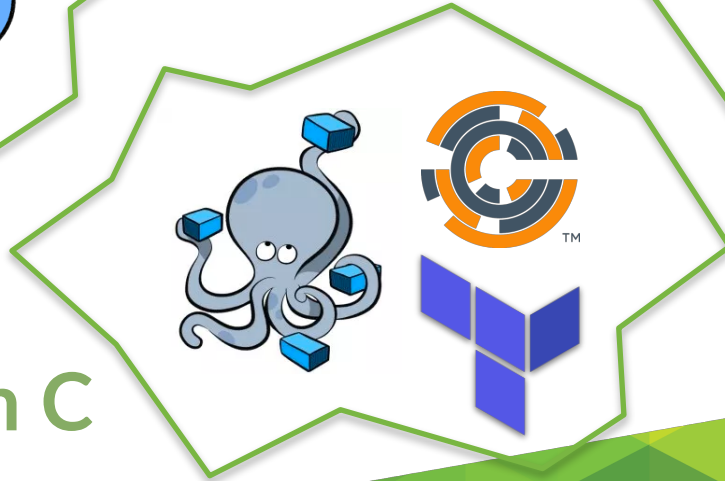
Team A



Team B



Team C



Test Isolation

- Switching default timezone
- Erroneous Authentication attempts

Isolation (cont'd)

- Legacy single-threaded servers

Throttle Concurrent Builds

Throttle this project alone

Throttle this project alone

Throttle this project as part of one or more categories

Throttle this project as part of one or more categories

Maximum Total Concurrent Builds

0

Maximum Concurrent Builds Per Node

0

Throttle Concurrent Builds Plugin: <https://wiki.jenkins.io/display/JENKINS/>

© Tasktop 2019
[Throttle+Concurrent+Builds+Plugin](#)



```
RuleChain.outerRule(new TestTimeRule()  
    .around(new RunInIsolationRule())  
    .around(new FailEarlyRule())  
    .around(new RetryRule())  
    .around(new TimeoutWithThreadDump())  
    .around(new FixtureCleanupRule())  
    .around(new FlakyTestRule())  
    .around(new TraceLoggingRule()));
```