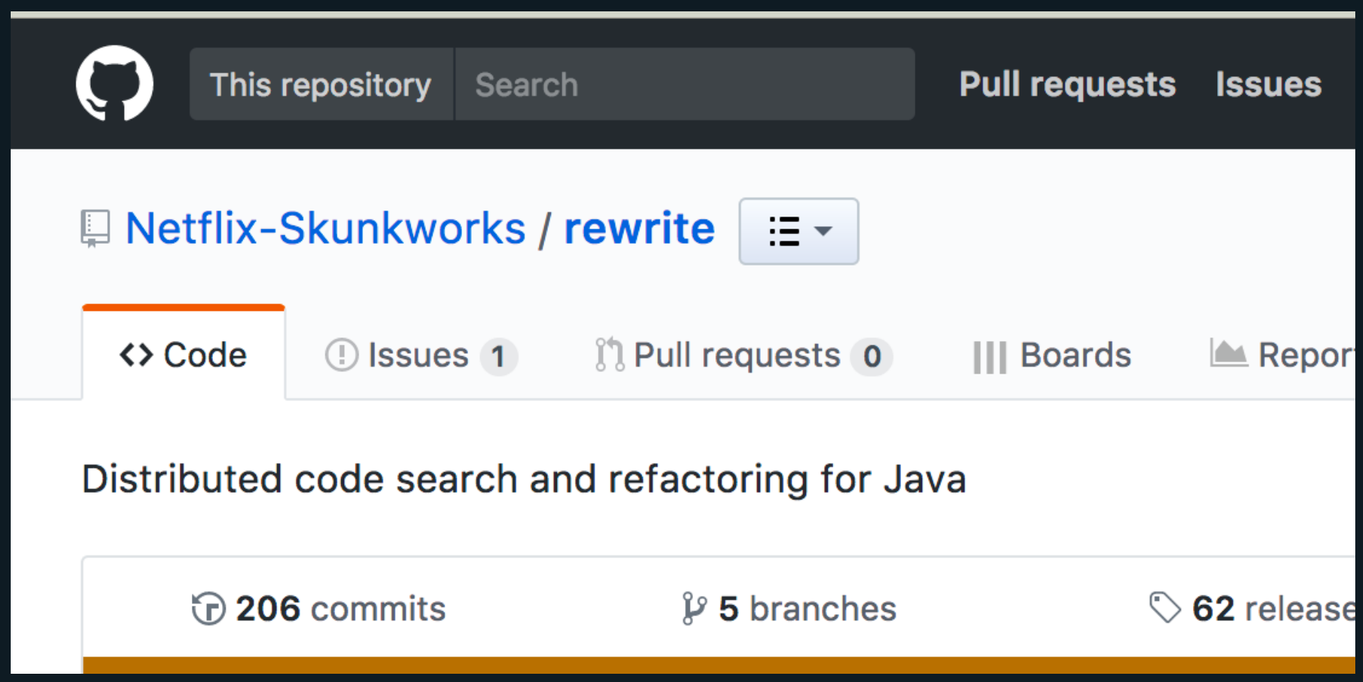
Distributed Refactoring with Rewrite.

Jon Schneider
@jon_k_schneider

github.com/jkschneider/springone-distributed-monorepo

Part 1: Rewrite is a programmatic refactoring tool.



Suppose we have a simple class A.

```
import com.google.common.base.Objects;

public class A {
    void foo() {
        Objects.firstNonNull(null, 1);
    }
}
```

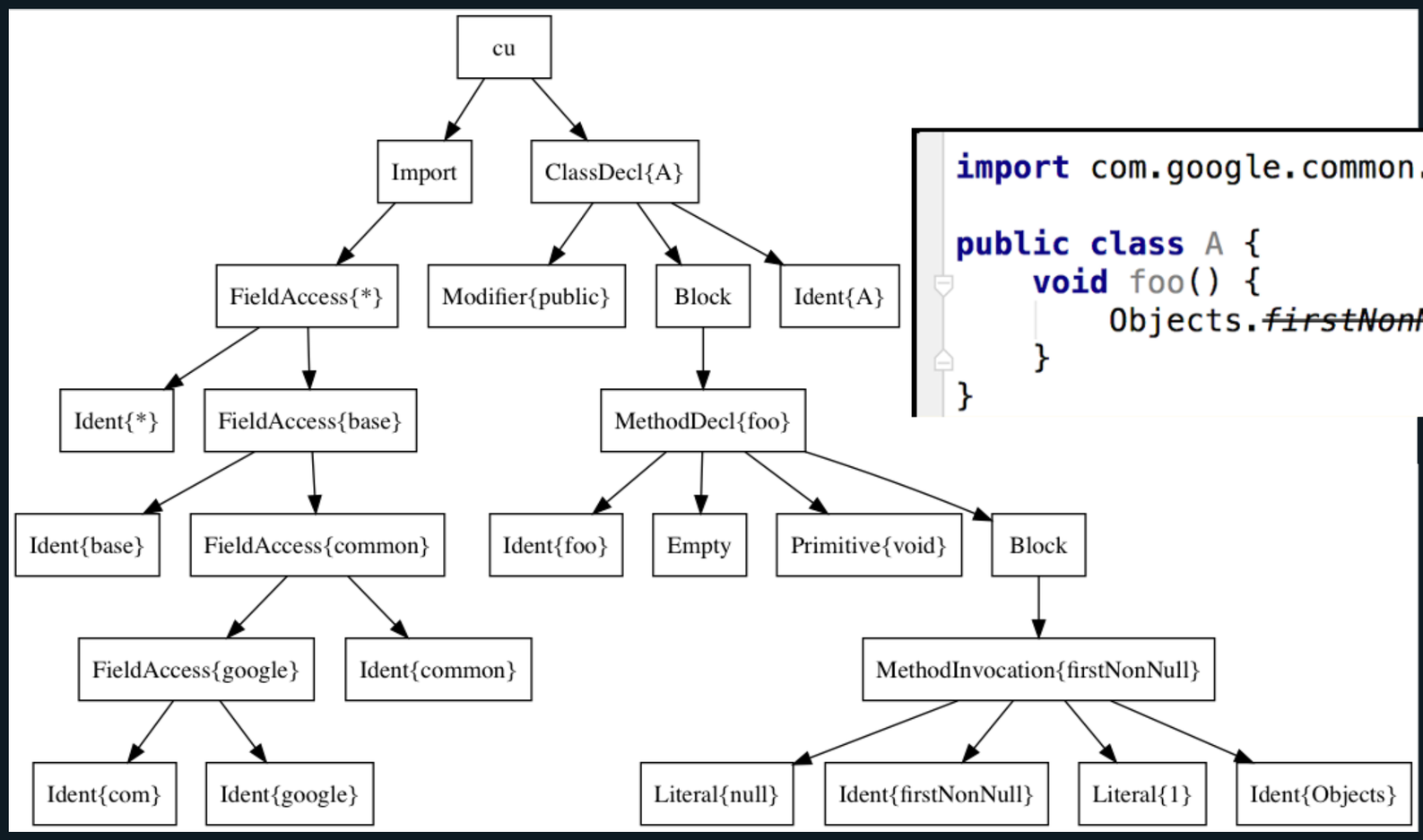
Raw source code + classpath = Rewrite AST.

```
String javaSource = /* Read A.java */;
List<Path> classpath = /* A list including Guava */;

Tr.CompilationUnit cu = new OracleJdkParser(classpath)
        .parse(javaSource);

assert(cu.firstClass().getSimpleName().equals("A"));
```

The Rewrite AST covers the whole Java language.




```java
import com.google.common.base.Objects;

public class A {
    void foo() {
        Objects.firstNonNull(null, 1);
    }
}
```

Rewrite's AST is special.

1. Serializable
2. Acyclic
3. Type-attributed

Rewrite's AST preserves formatting.

```java
public class A {
    public void foo() {
        List<String> l = Arrays.asList( ...a: "",
                "a",
                    "b",
                        "c"
        );
    }
}
```

```java
List<String> l = Arrays.asList("",
        "a",
            "b",
                "c"
)
```

```
Tr.CompilationUnit cu = new OracleJdkParser().parse(aSource);
        assertThat(cu.print()).isEqualTo(aSource);
```

```
cu.firstClass().methods().get(0) // first method
  .getBody().getStatements() // method contents
  .forEach(t -> System.out.println(t.printTrimmed()));
```

We can find method calls and fields from the AST.

```java
public class A {
    public void foo() {
        List<String> l = Arrays.asList(
                ...a: "a",
                "b",
                "c"
        );
    }
}
```

```
Tr.CompilationUnit cu = new OracleJdkParser().parse(aSource);
assertThat(cu.findMethodCalls("java.util.Arrays asList(..)")).hasSize(1);
assertThat(cu.firstClass().findFields("java.util.Arrays")).isEmpty();
```

We can find types from the AST.

```java
public class A {
    public void foo() {
        List<String> l = Arrays.asList(
                ...a: "a",
                "b",
                "c"
        );
    }
}
```

```
assertThat(cu.hasType("java.util.Arrays")).isTrue();
assertThat(cu.hasType(Arrays.class)).isTrue();

assertThat(cu.findType(Arrays.class))
  .hasSize(1).hasOnlyElementsOfType(Tr.Ident.class);
```

Suppose we have a class referring to a deprecated Guava method.

```java
import com.google.common.base.Objects;
import com.google.common.util.concurrent.MoreExecutors;

public class B {
    void foo() {
        Objects.firstNonNull(
                null,
                "hi"
        );

        MoreExecutors.sameThreadExecutor();
    }
}
```

We can refactor both deprecated references.

```
Tr.CompilationUnit cu = new OracleJdkParser().parse(bSource);
Refactor refactor = cu.refactor();

refactor.changeMethodTargetToStatic(
  cu.findMethodCalls("com.google..Objects firstNonNull(..)"),
  "com.google.common.base.MoreObjects"
);

refactor.changeMethodName(
  cu.findMethodCalls("com.google..MoreExecutors sameThreadExecutor()"),
  "directExecutor"
);
```

The fixed code emitted from Refactor can be used to overwrite the original source.

```
1    import com.google.common.base.MoreObjects;
2    import com.google.common.util.concurrent.MoreExecutors;
3
4    public class B {
5        void foo() {
6            MoreObjects.firstNonNull(
7                    null,
8                    "hi"
9            );
10
11           MoreExecutors.directExecutor();
12       }
13   }
```

```
// emits a string containing the fixed code, style preserved
refactor.fix().print();
```

Or we can emit a diff that can be used with `git apply`

```
// emits a String containing the diff
refactor.diff();
```

```
diff --git a/B.java b/B.java
index cf08ec7..14f2241 100644
--- a/B.java
+++ b/B.java
@@ -1,15 +1,15 @@

-import com.google.common.base.Objects;
+import com.google.common.base.MoreObjects;
 import com.google.common.util.concurrent.MoreExecutors;

 public class B {
     void foo() {
-        Objects.firstNonNull(
+        MoreObjects.firstNonNull(
                 null,
                 "hi"
         );

-        MoreExecutors.sameThreadExecutor();
+        MoreExecutors.directExecutor();
     }
 }
```

refactor-guava contains all the rules for our Guava transformation.

```
refactor.changeMethodTargetToStatic(
        cu.findMethodCalls( signature: "com.google.common.base.Objects firstNonNull(..)"),
        toClass: "com.google.common.base.MoreObjects"
);

refactor.changeMethodTargetToStatic(
        cu.findMethodCalls( signature: "com.google.common.collect.Iterators emptyIterator(..)"),
        toClass: "java.util.Collections"
);

refactor.changeMethodName(
        cu.findMethodCalls( signature: "com.google.common.util.concurrent.MoreExecutors sameThreadEx
        toName: "directExecutor"
);

refactor.changeMethodName(
        cu.findMethodCalls( signature: "com.google.common.util.concurrent.Futures get(java.util.con
        toName: "getChecked"
);

refactor.changeMethodName(
        cu.findMethodCalls( signature: "com.google.common.util.concurrent.Futures transform(com.goo
```

Just annotate a static method to define a refactor rule.

```
@AutoRewrite(value = "reactor-mono-flatmap",
             description = "change flatMap to flatMapMany")
public static void migrateMonoFlatMap(Refactor refactor) {
  // a compilation unit for the source file we are refactoring
  Tr.CompilationUnit cu = refactor.getOriginal();

  refactor.changeMethodName(
    cu.findMethodCalls("reactor..Mono flatMap(..)"),
    "flatMapMany");
}
```

Part 2: Using BigQuery to find all Guava code in Github

Identify all Java sources from BigQuery's Github copy.

```
SELECT *
FROM [bigquery-public-data:github_repos.files]
WHERE RIGHT(path, 5) = '.java'
```


In options, save the results of this query to: `myproject:spinnakersummit.java_files`.

You will have to allow large results as well. This is a fairly cheap query (336 GB).

Move Java source file contents to our dataset.

```
SELECT *
FROM [bigquery-public-data:github_repos.contents]
WHERE id IN (
  SELECT id
  FROM [myproject:spinnakersummit.java_files]
)
```

Note: This will eat into your $300 credits.
It cost me ~$6 (1.94 TB).

Cut down the sources to just those that refer to Guava packages.

Getting cheaper now...

```
SELECT repo_name, path, content
FROM [myproject:spinnakersummit.java_file_contents] contents
INNER JOIN [myproject:spinnakersummit.java_files] files
  ON files.id = contents.id
WHERE content CONTAINS 'import com.google.common'
```


Notice we are going to join just enough data from `spinnakersummit.java_files` and `spinnakersummit:java_file_contents` in order to be able to construct our PRs.

Save the result to `myproject:spinnakersummit.java_file_contents_guava`.

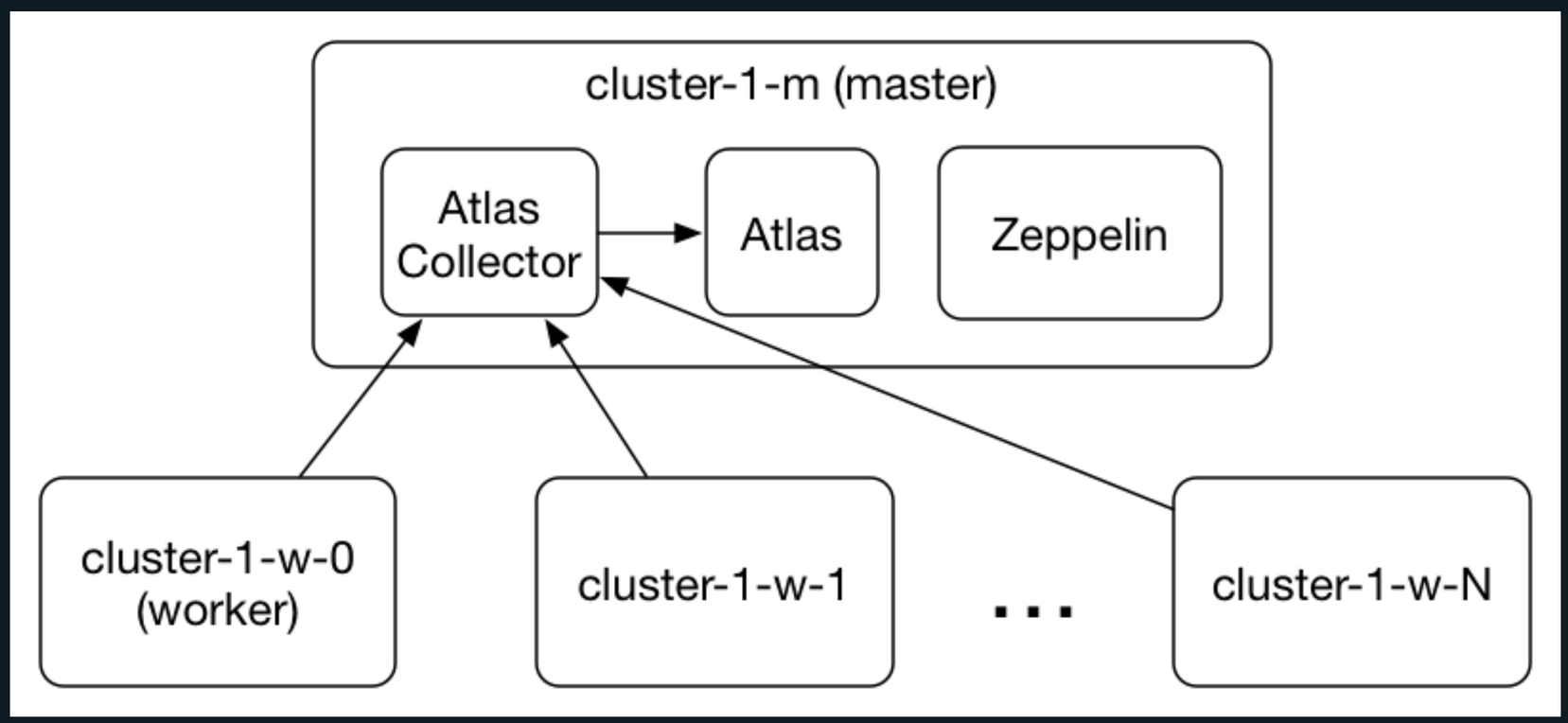
Through Step 3, we have cut down the size of the initial BigQuery public dataset from 1.94 TB to around 25 GB. Much more manageable!

We now have the dataset to run our refactoring rule on.

1. 2.6 million Java source files.
2. 47,565 Github repositories.

Part 3: Employing our refactoring rule at scale on Google Cloud Dataproc.

Create a Spark/Zeppelin cluster on Google Cloud Dataproc.



Monitoring our Spark workers with Atlas and micrometer

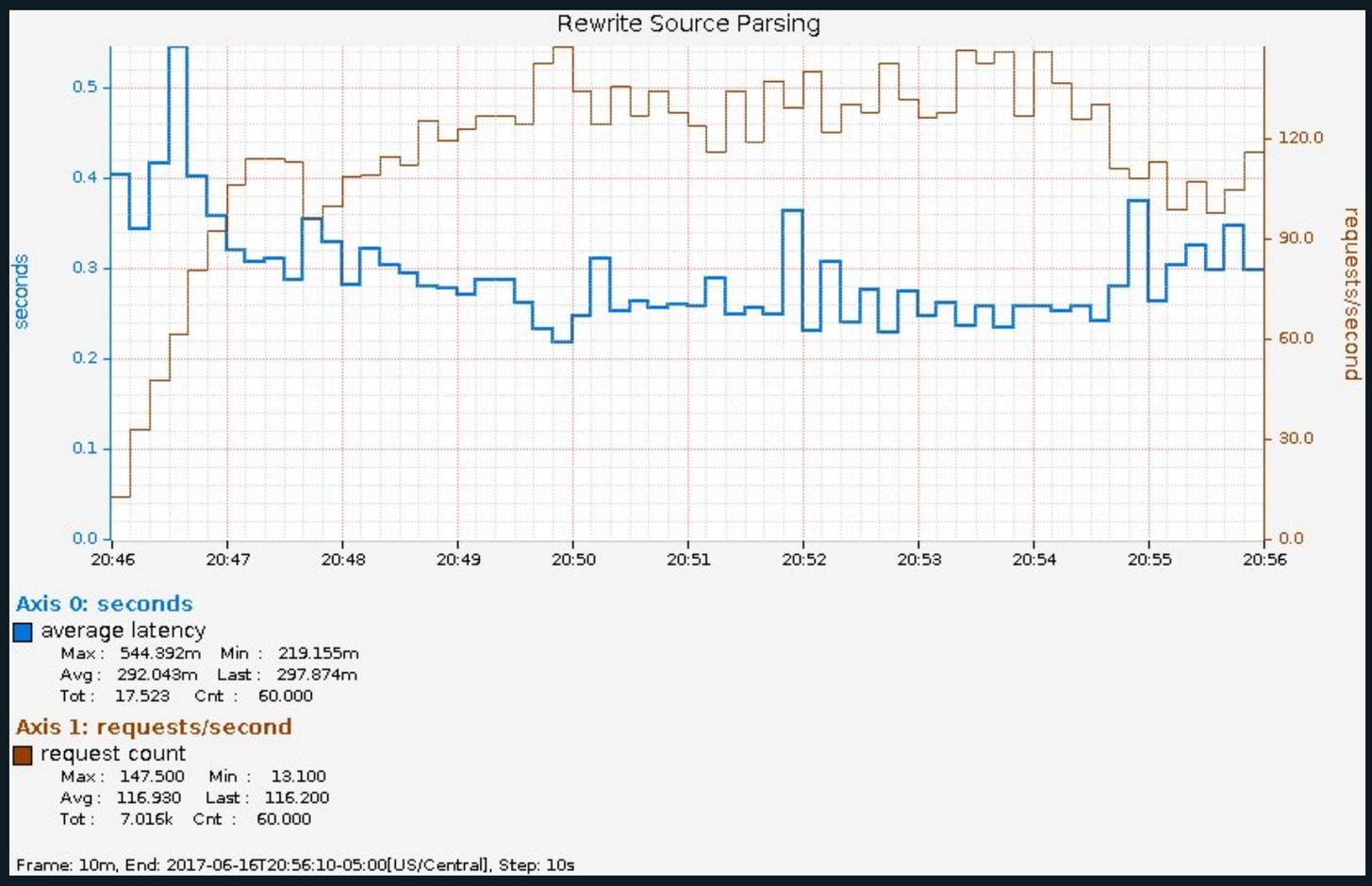
```
@RestController
class TimerController {
  @Autowired MeterRegistry registry;

  @PostMapping("/api/timer/{name}/{timeNanos}")
  public void time(@PathVariable String name, @PathVariable Long timeNanos) {
    registry.timer(name).record(timeNanos, TimeUnit.NANOSECONDS);
  }
}
```

We'll write the job in a Zeppelin notebook.

1. Select sources from BigQuery
2. Map over all the rows, parsing and running the refactor rule.
3. Export our results back to BigQuery.

Measuring our initial pass.



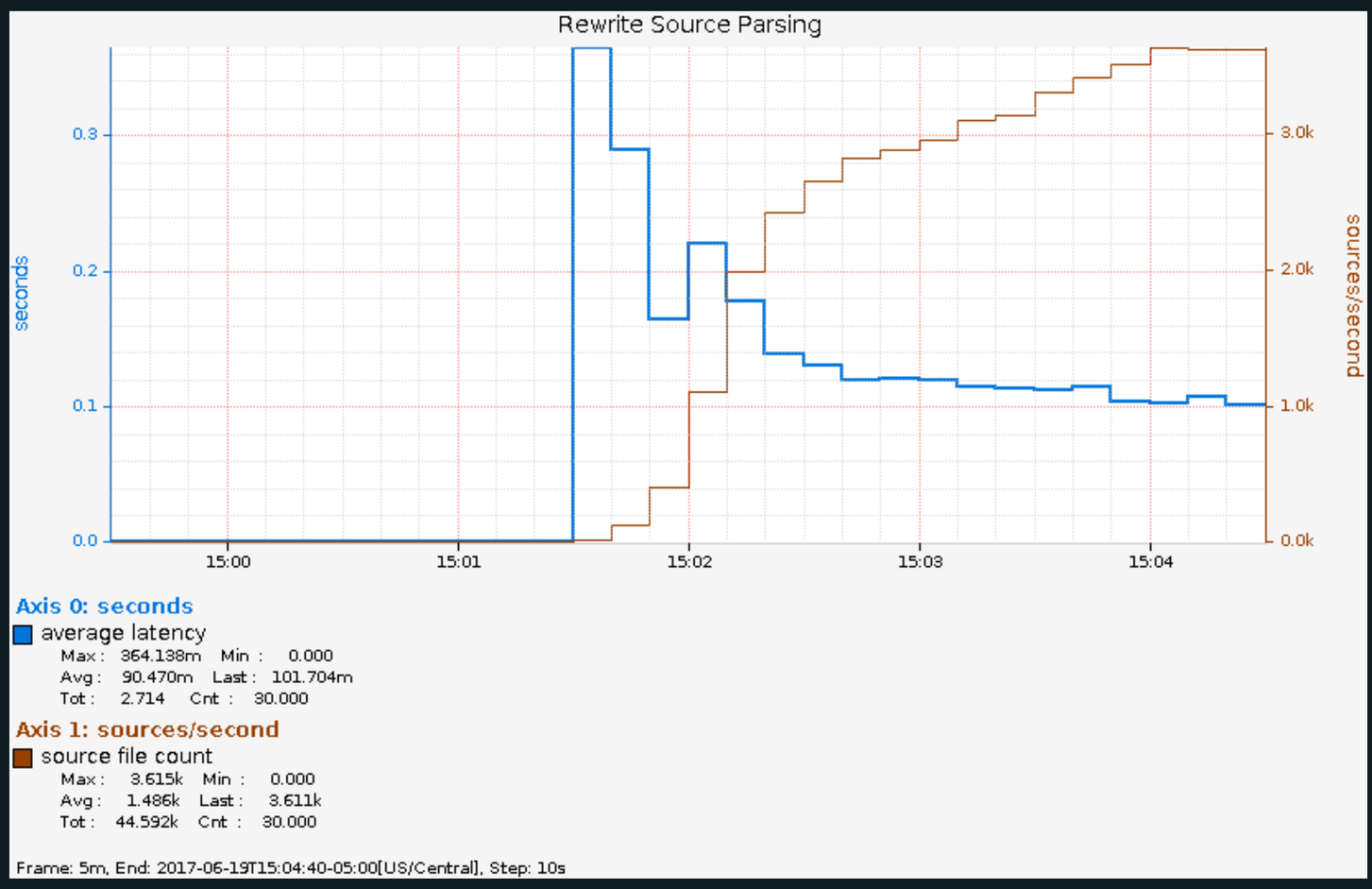
Measuring how big our cluster needs to be.

1. Rewrite averages 0.12s per Java source file
2. Rate of 6.25 sources per core / second
3. With 128 preemptible VMs, we've got:
   512 cores * 6.25 sources / core / second

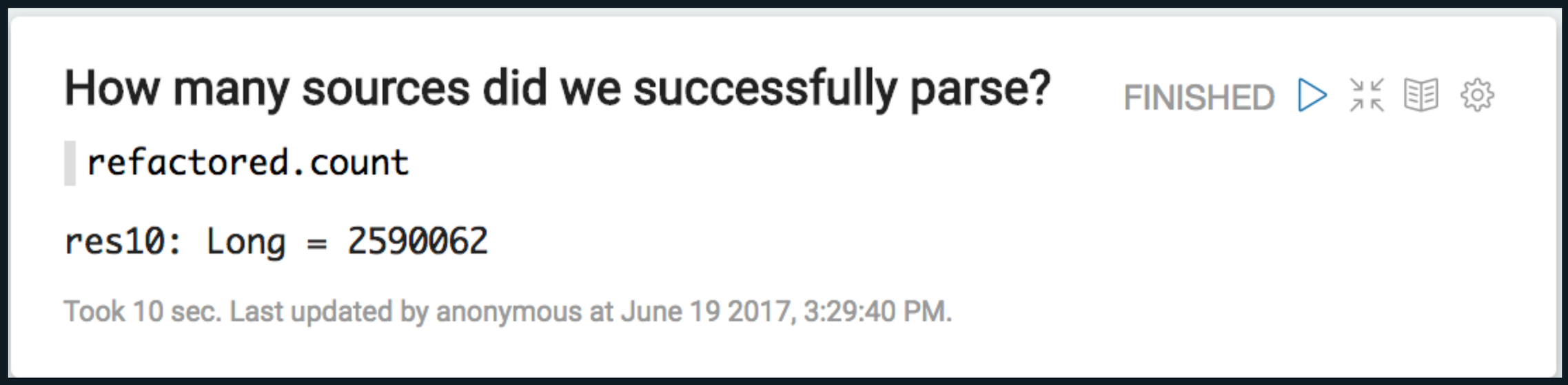
3,200 sources / second = ~13 minutes total

We hope...

After scaling up the cluster with a bunch of cheap VMs.



Some source files are too badly formed to parse.



2,590,062/2,687,984 Java sources = 96.4%.

We found a healthy number of issues.

— 4,860 of 47,565 projects with problems
— 10.2% of projects with Guava references use deprecated API
— 42,794 source files with problems
— 70,641 lines of code affected

```
%sql
select issue, count(1) as total
from issues
group by issue
order by total
```

FINISHED

issue	total
Futures.get	291
TypeToken.isAssignableFrom	429
Futures.withFallback	445
Futures.transform	609
FutureFallback	724
OutputSupplier	1,157
MapConstraints	2,146
InputSupplier	2,681
Objects.firstNonNull	2,783
MoreExecutors.sameThreadExecutor	5,044
Iterators.emptyIterator	7,334
Objects.toStringHelper	23,155

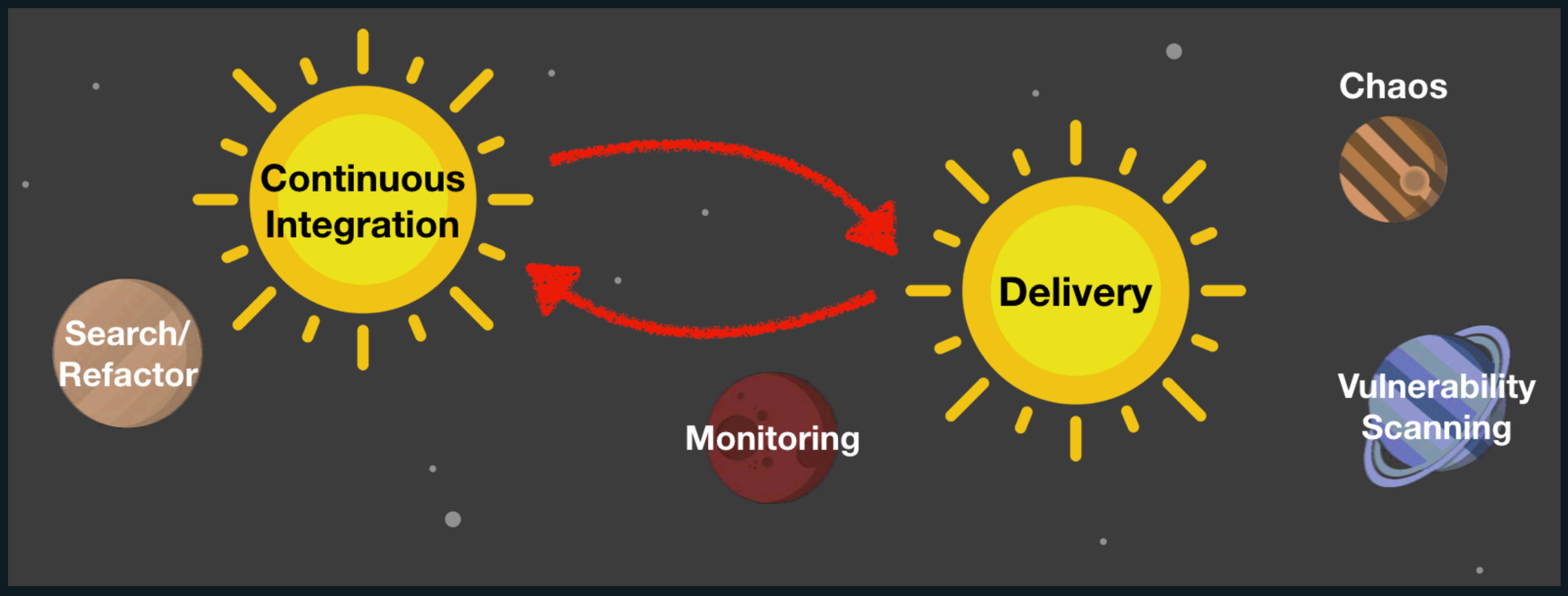
Epilogue: Issuing PRs for all the patches

Generate a single patch file per repo.

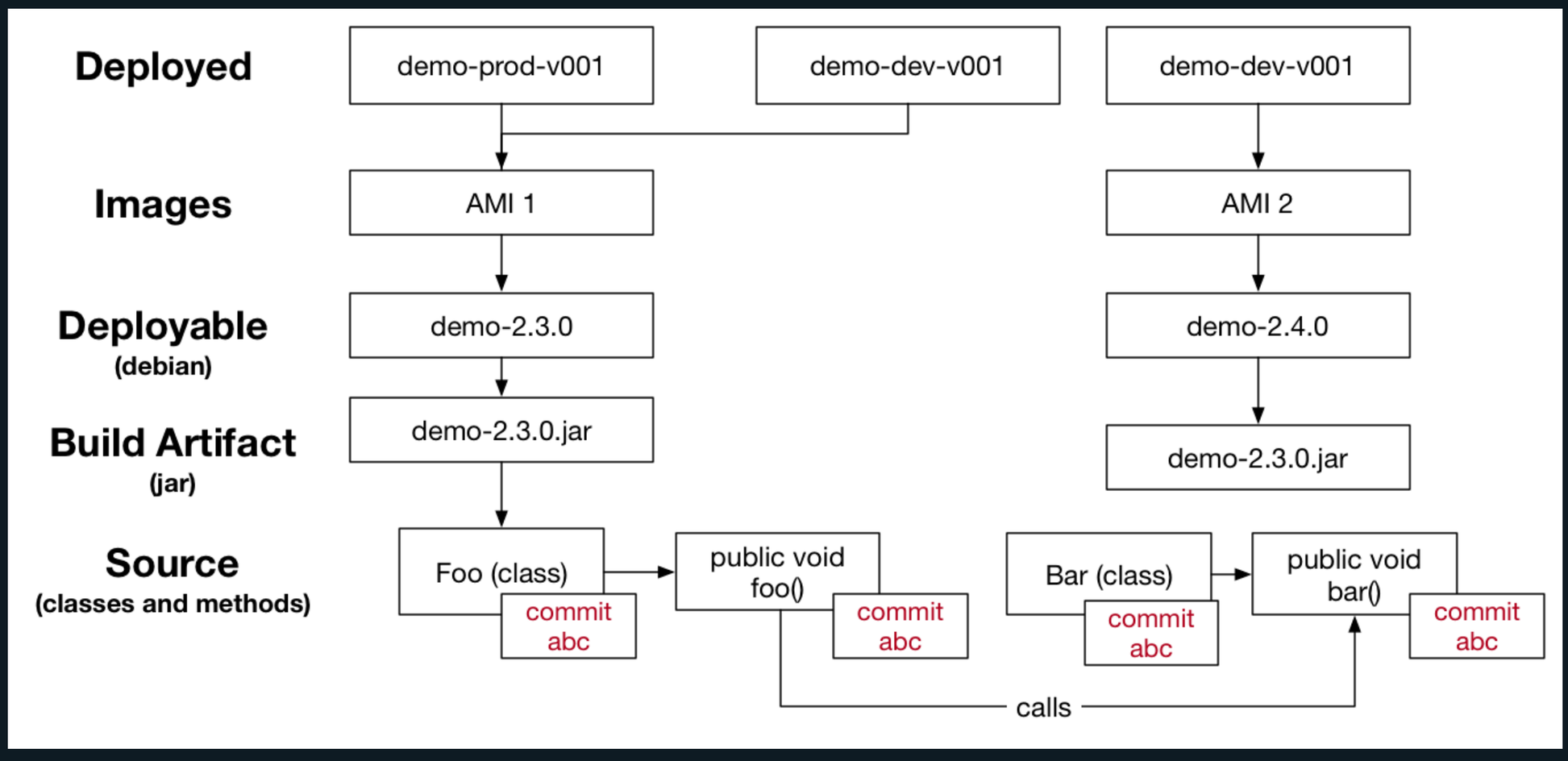
```
SELECT repo, GROUP_CONCAT_UNQUOTED(diff, '\n\n') as patch
FROM [cf-sandbox-jschneider:spinnakersummit.diffs]
GROUP BY repo
```

Part 2: A stateful CD solution like Spinnaker is key to this in practice.

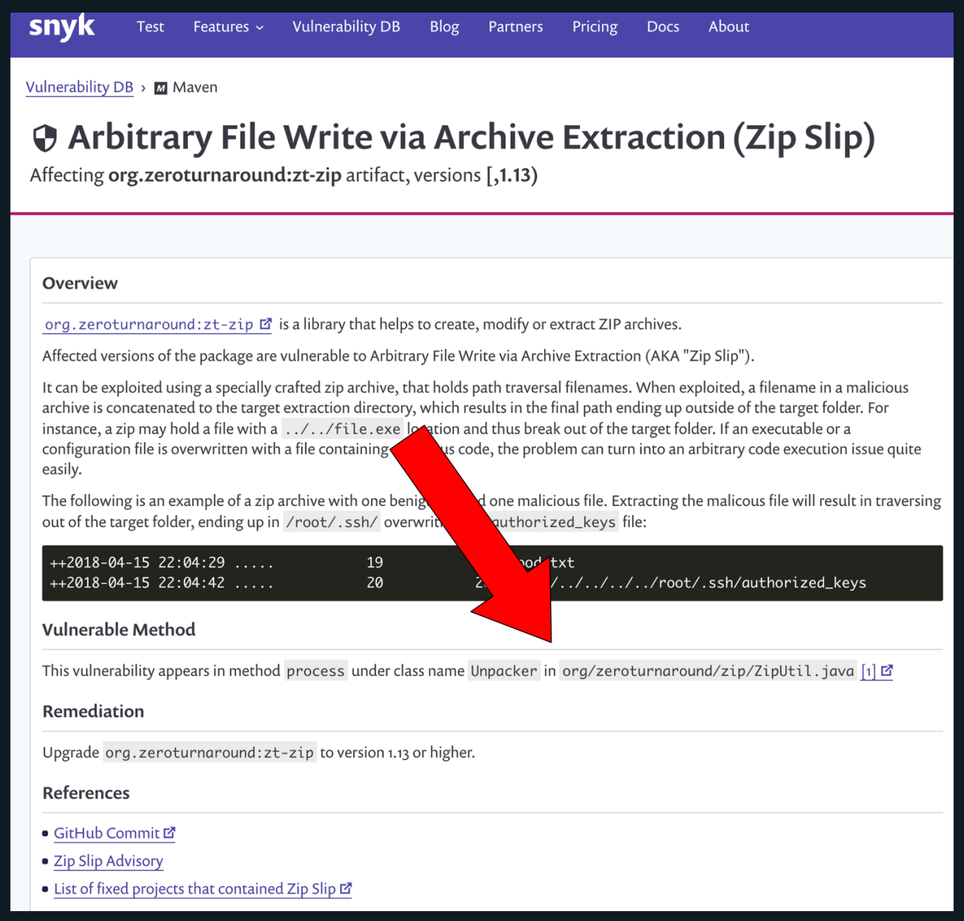
CI and CD have distinct orbits.



Maintain a property graph of assets.



Increasingly, method level vulnerabilities are available.



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Arbitrary File Write via Archive Extraction (Zip Slip)

Affecting **org.zeroturnaround:zt-zip** artifact, versions **[,1.13)**

Overview

org.zeroturnaround:zt-zip is a library that helps to create, modify or extract ZIP archives.

Affected versions of the package are vulnerable to Arbitrary File Write via Archive Extraction (AKA "Zip Slip").

It can be exploited using a specially crafted zip archive, that holds path traversal filenames. When exploited, a filename in a malicious archive is concatenated to the target extraction directory, which results in the final path ending up outside of the target folder. For instance, a zip may hold a file with a `../../file.exe` location and thus break out of the target folder. If an executable or a configuration file is overwritten with a file containing malicious code, the problem can turn into an arbitrary code execution issue quite easily.

The following is an example of a zip archive with one benign file and one malicious file. Extracting the malicous file will result in traversing out of the target folder, ending up in `/root/.ssh/` overwriting the `authorized_keys` file:

```
++2018-04-15 22:04:29 .....           19           19  good.txt
++2018-04-15 22:04:42 .....           20           20  ../../../../../root/.ssh/authorized_keys
```

Vulnerable Method

This vulnerability appears in method `process` under class name `Unpacker` in `org/zeroturnaround/zip/ZipUtil.java` [1]

Remediation

Upgrade `org.zeroturnaround:zt-zip` to version 1.13 or higher.

References

- GitHub Commit
- Zip Slip Advisory
- List of fixed projects that contained Zip Slip

Thanks for attending!