Gaining Actionable Cross-Project Build Insights

From Experience to Implementation

Gradle

DPE Summit 2024

DPE SUMMIT

Who we are

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Develocity Co-Founder

Agenda

Data-informed Development

Use cases

Collection and Revelation of Build Data

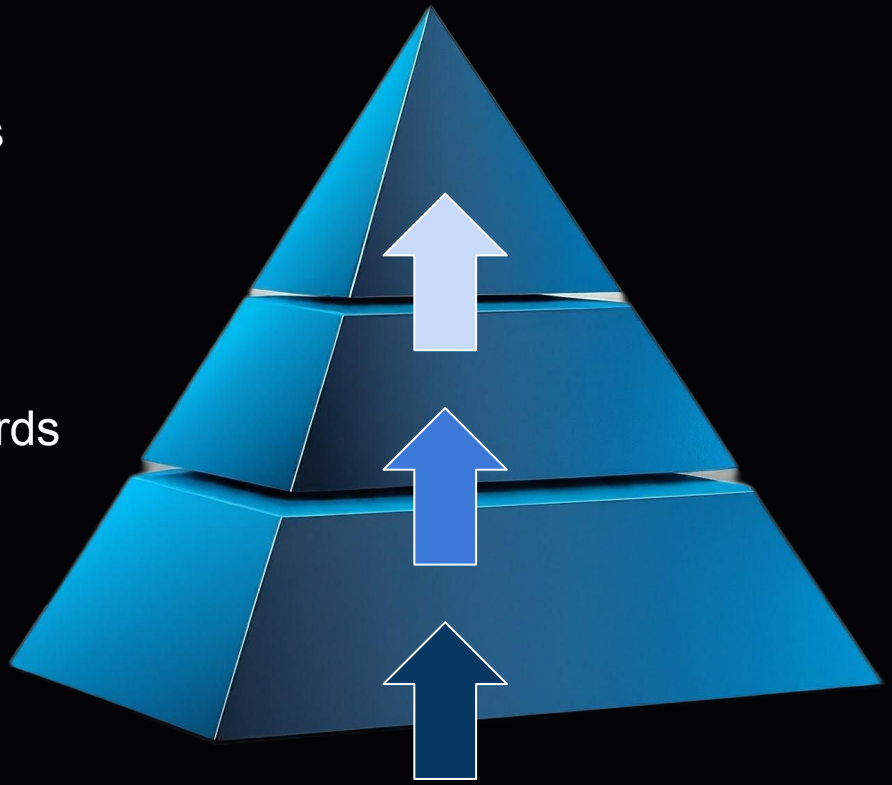
A journey

Data Informed Development

Knowledge
- Actionable Insights
- Reports

Information
- Metrics
- Charts & Dashboards

Data
- Query-able
- Raw

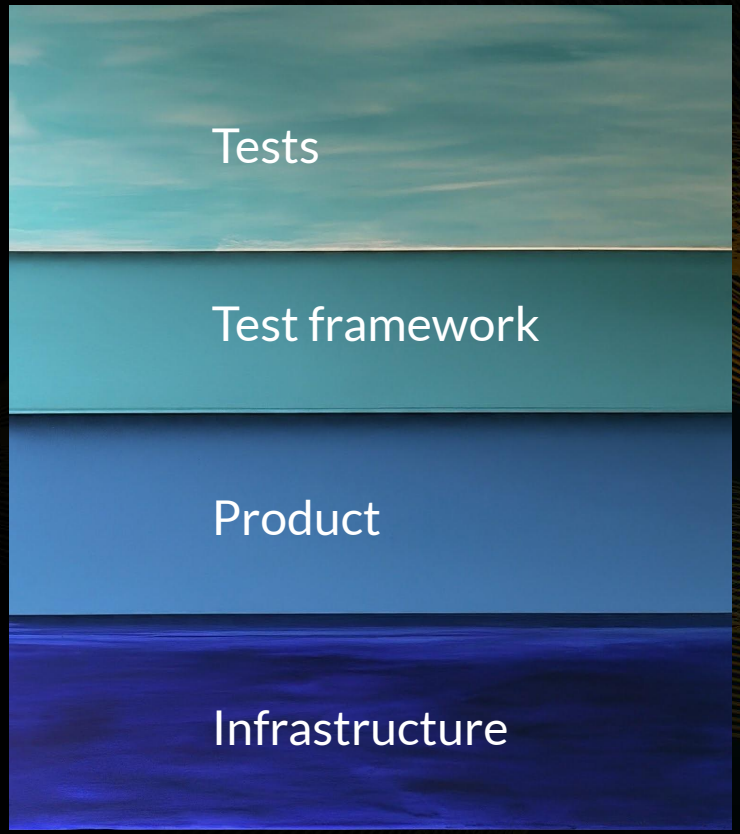


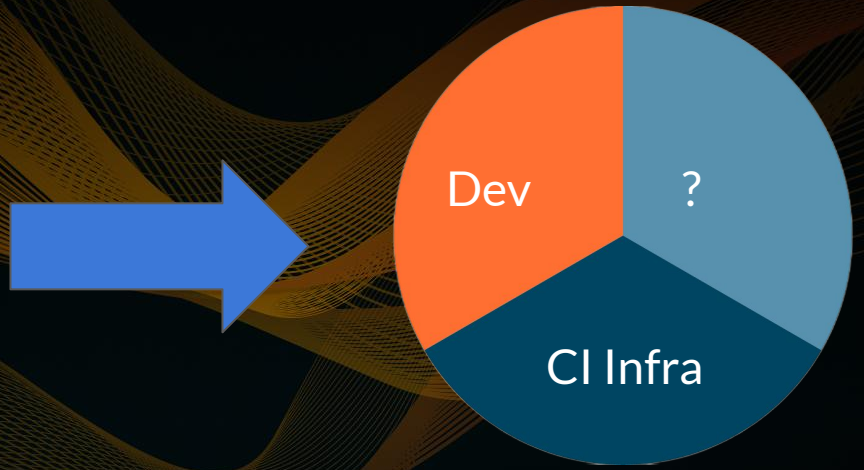
CI Failures

What to focus on?

Why does it fail?

Who gets to fix it?





Knowledge

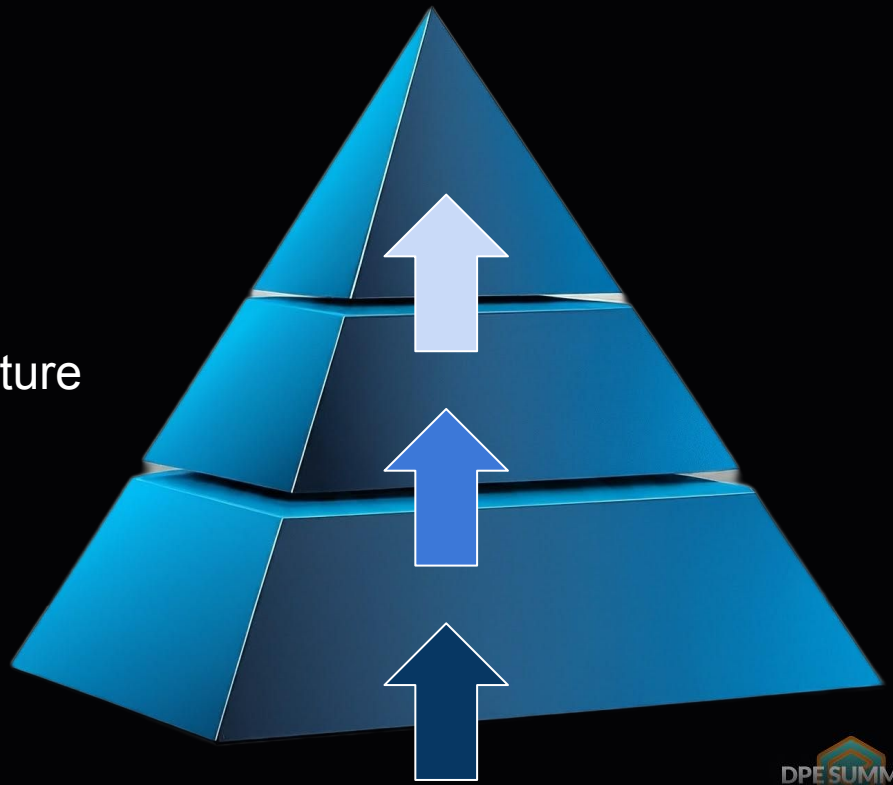
- What to fix, by which team

Information on Flaky Tests

- Test / Framework / Product / Infrastructure

Data:

- Test results



Faster machines
What could possibly go wrong?

Because... humans

1. Long queues in CI
2. Double the speed of the CI machines
3. CI queues disappear
4. Wait 2 weeks
5. Get even longer CI queues
6. …
7. ???

Knowledge

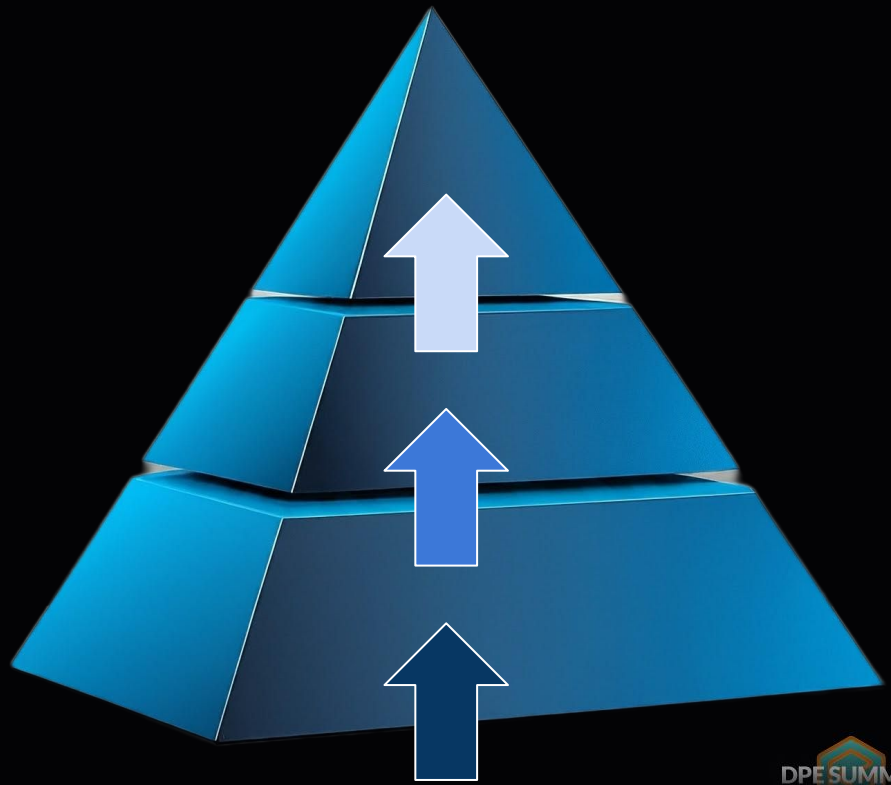
- Developers run their builds in CI because it’s faster

Information

- More CI builds
- Fewer local builds

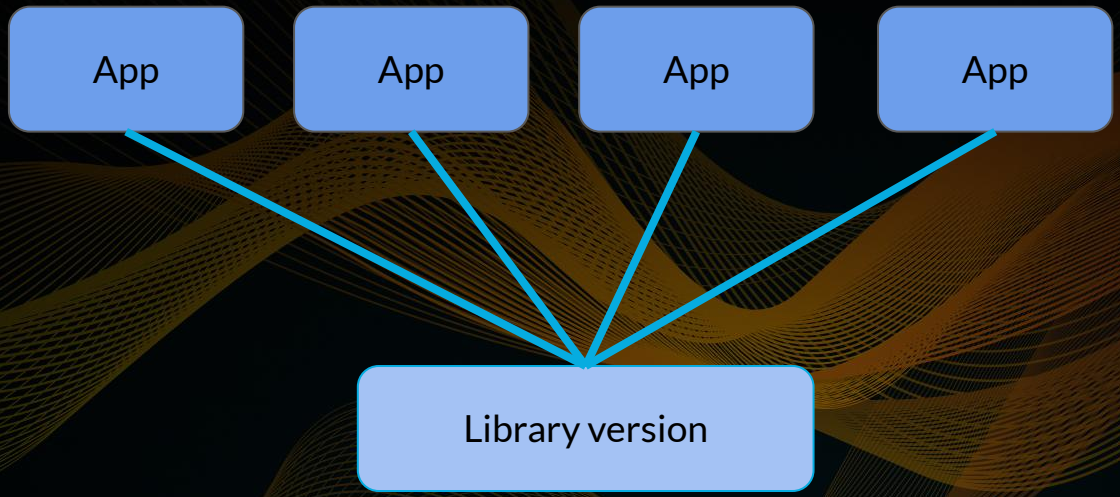
Data:

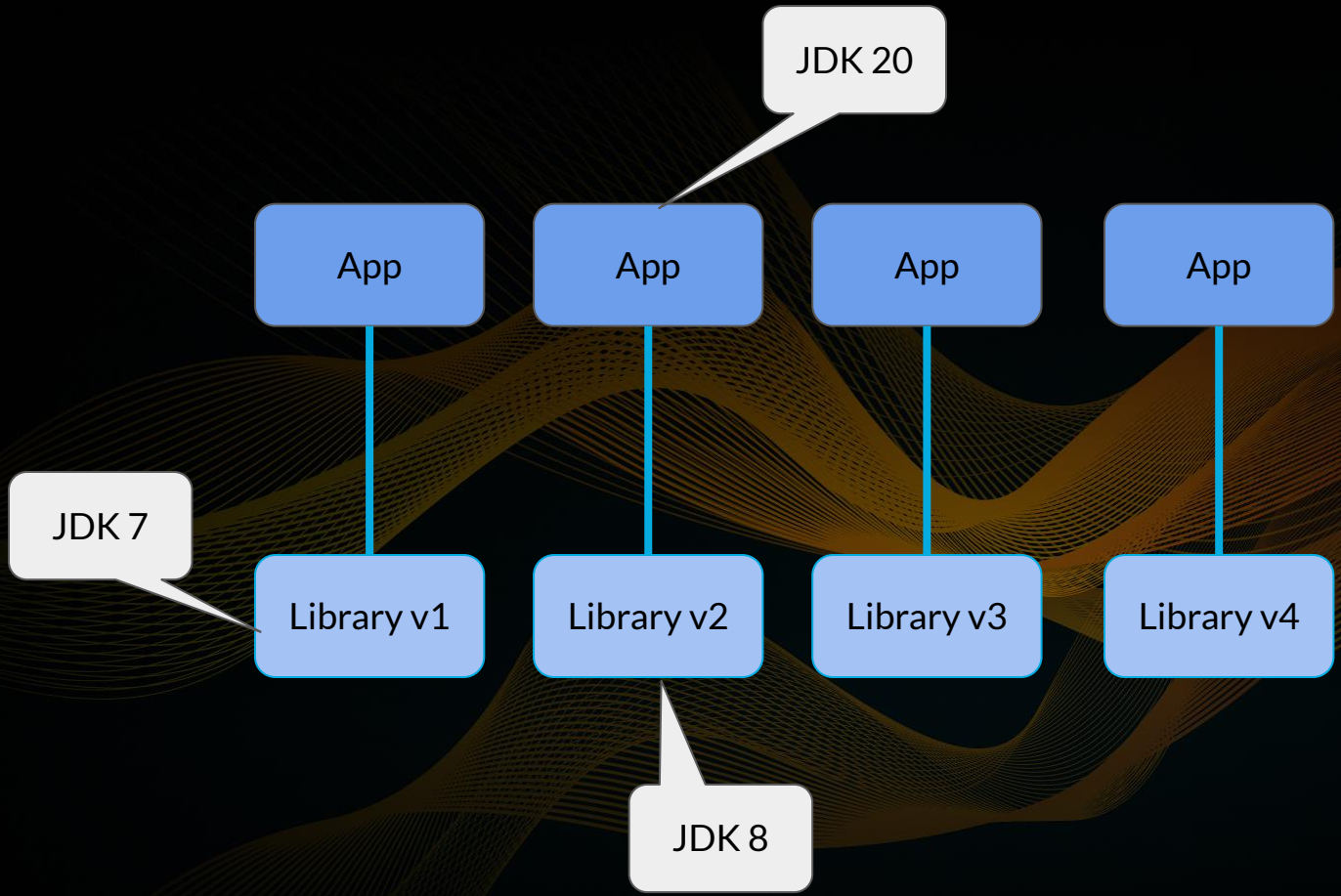
- CI builds
- Local builds

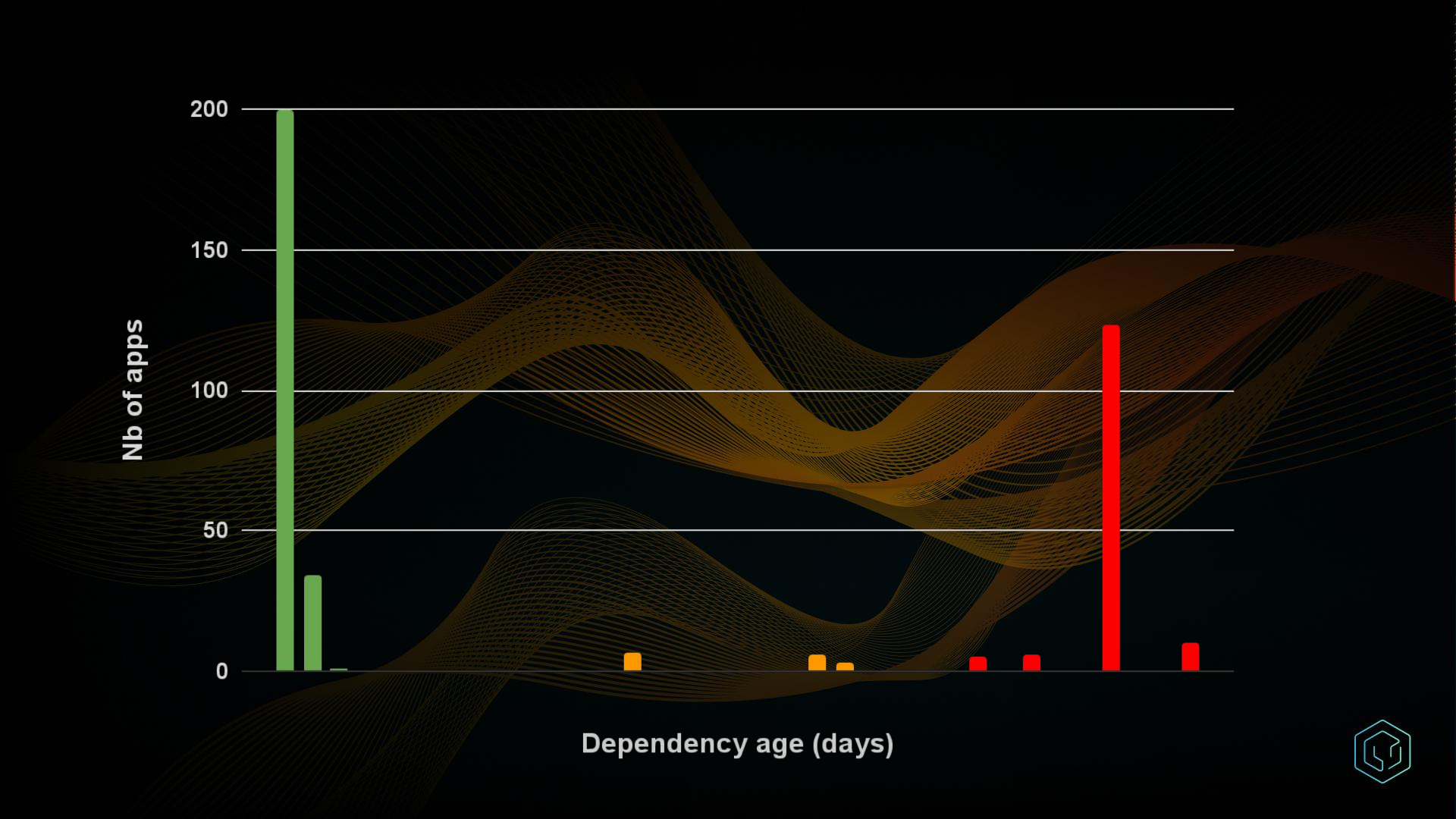


Large Migrations

Are we there yet?


App
App
App
App
Library version


JDK 20
App
App
App
App
JDK 7
Library v1
Library v2
Library v3
Library v4
JDK 8


200
150
100
50
0
Nb of apps
Dependency age (days)

Knowledge

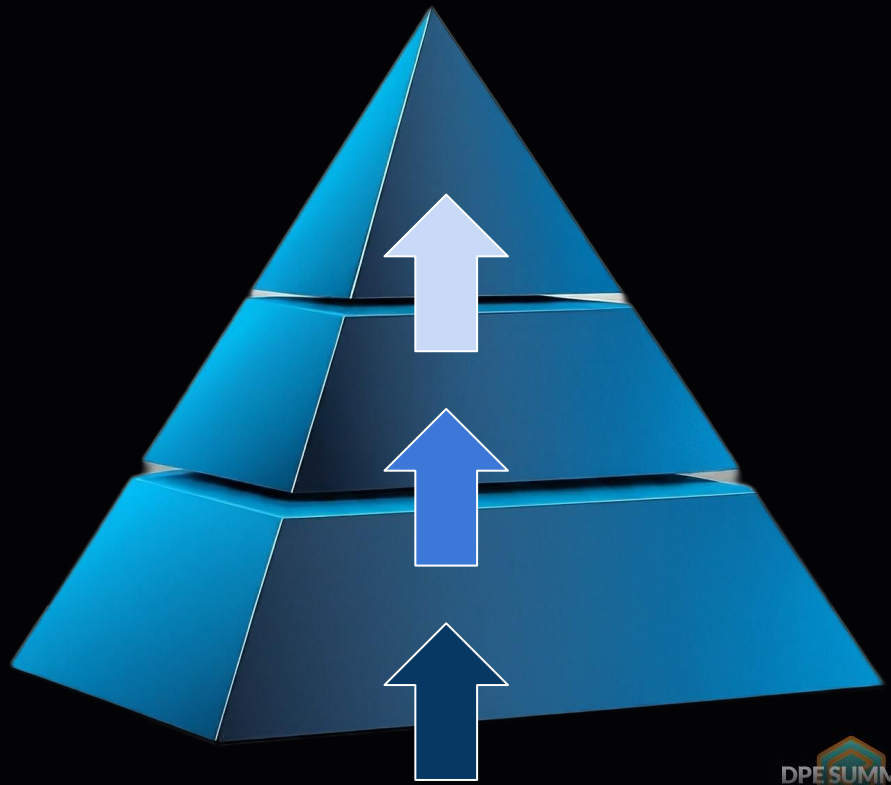
- Which dependency to update
- Where to update the Build Platform

Information

- All apps, all dependencies
- All apps, all Toolchain elements

Data:

- Source code
- Build configurations
- Build logs
- SBOM



Many repos to optimize

Navigating the Build jungle

2 repos x **30 minutes** x 1000 builds/day

=

2K repos x **3 minutes** x 10 builds/day

Toolchain Observability

Across all projects

Agenda

Data-informed Development
Use cases

Collection and Revelation of Build Data
A journey

Comprehensive build data is the foundation for developer toolchain observability

Develocity build plugins eavesdrop what happens while the build is running

```
plugins {
    id("com.gradle.develocity") version "3.18.1"
}

develocity {
    server = "https://develocity.company.net"
}
```

```
./gradlew build --init-script develocity-init.gradle
```

Build progress is tracked in the form of fine-grained build events

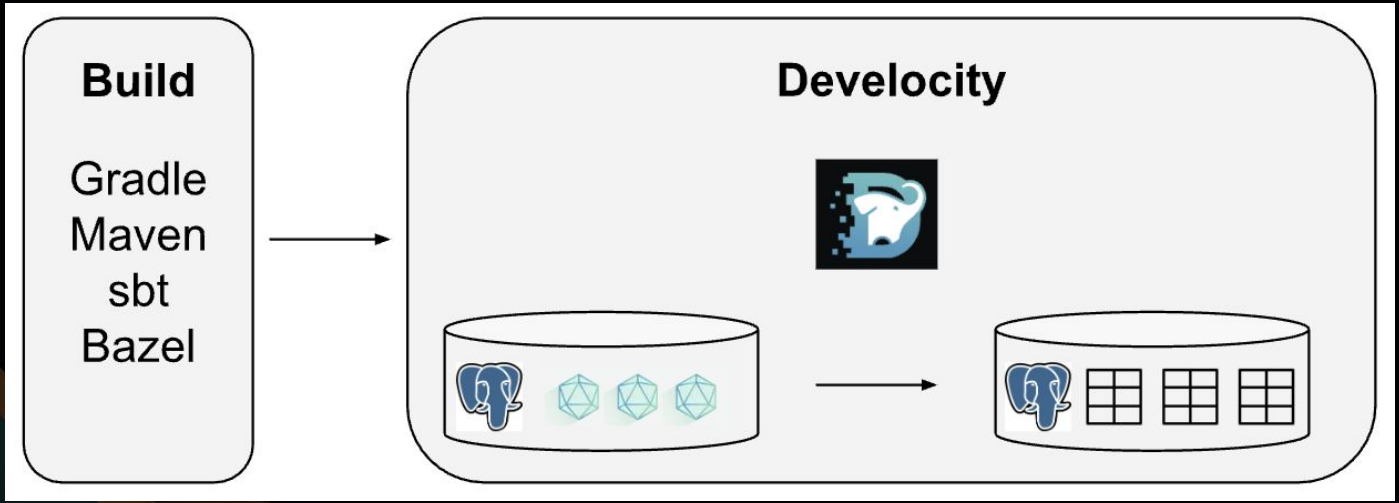
```
public class TaskStarted_1_4 extends TaskStarted_1_3 {

    public final String buildPath;

    public TaskStarted_1_4(long id, String path, String className,
        @Nullable Long thread, String buildPath,
    ) {
        super(id, path, className, thread);
        this.buildPath = buildPath;
    }

    ...
}
```

Build events are uploaded to the Develocity server and persisted as a blob in S3-compatible storage



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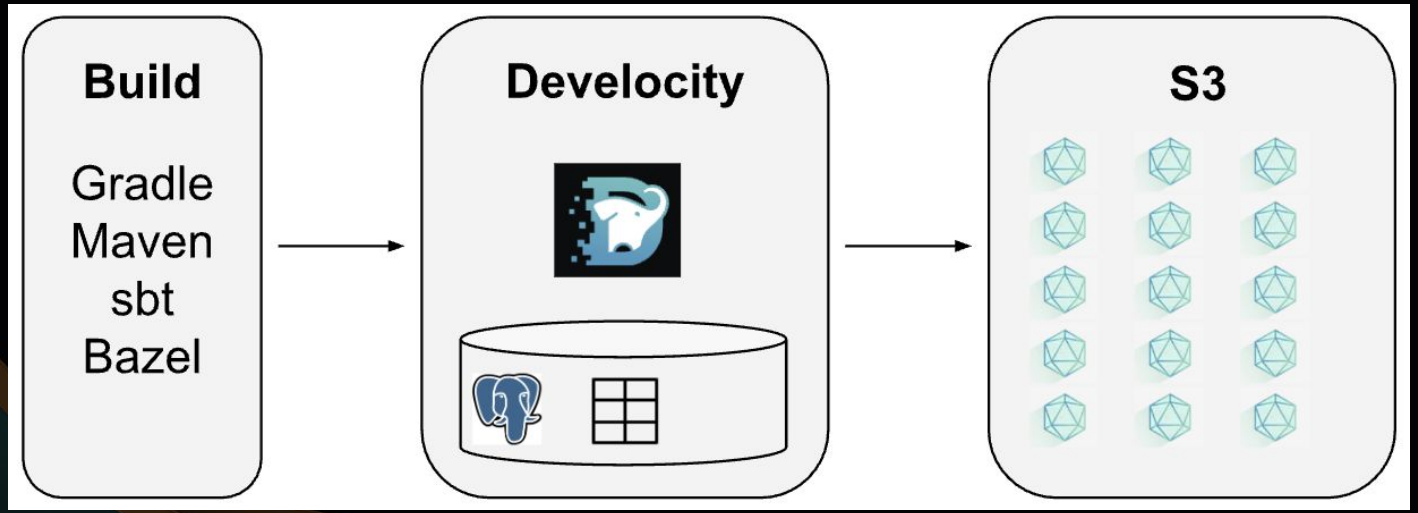
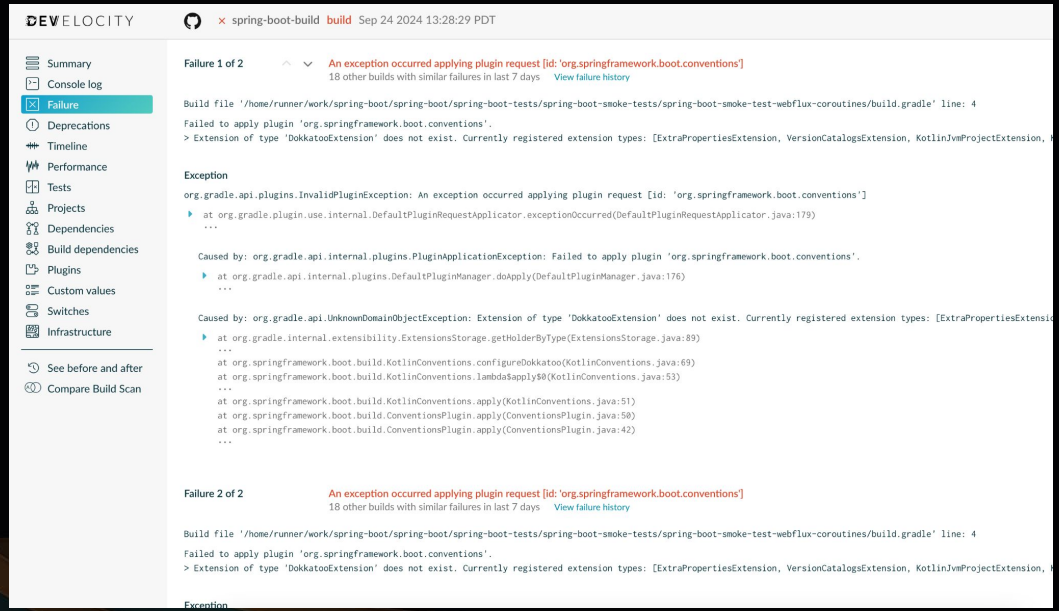


A single build is visualized as a Build Scan by on-demand converting the build events into a Frontend build model



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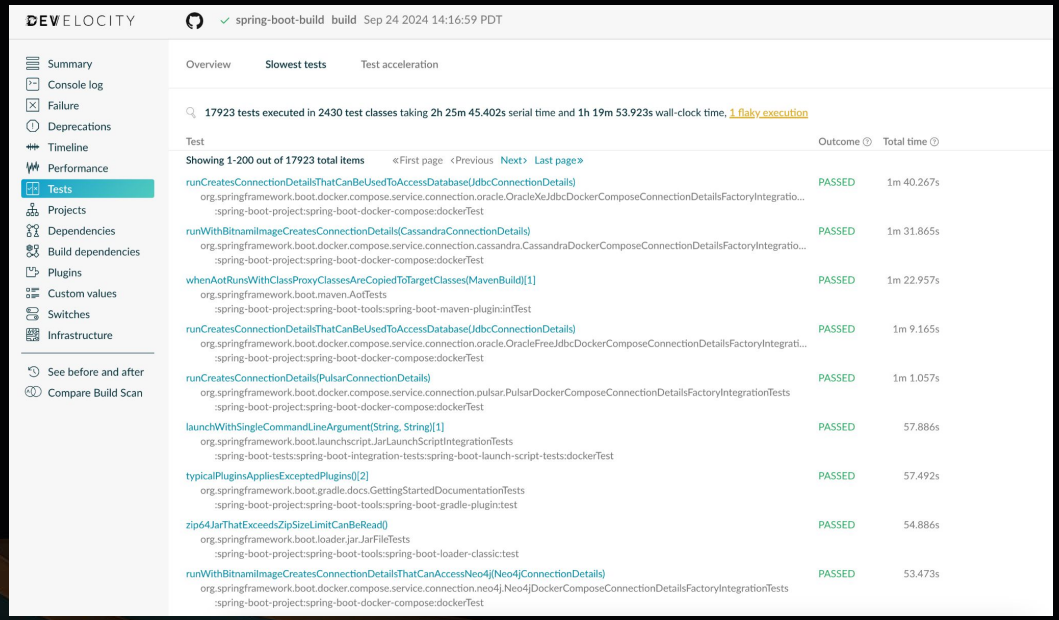

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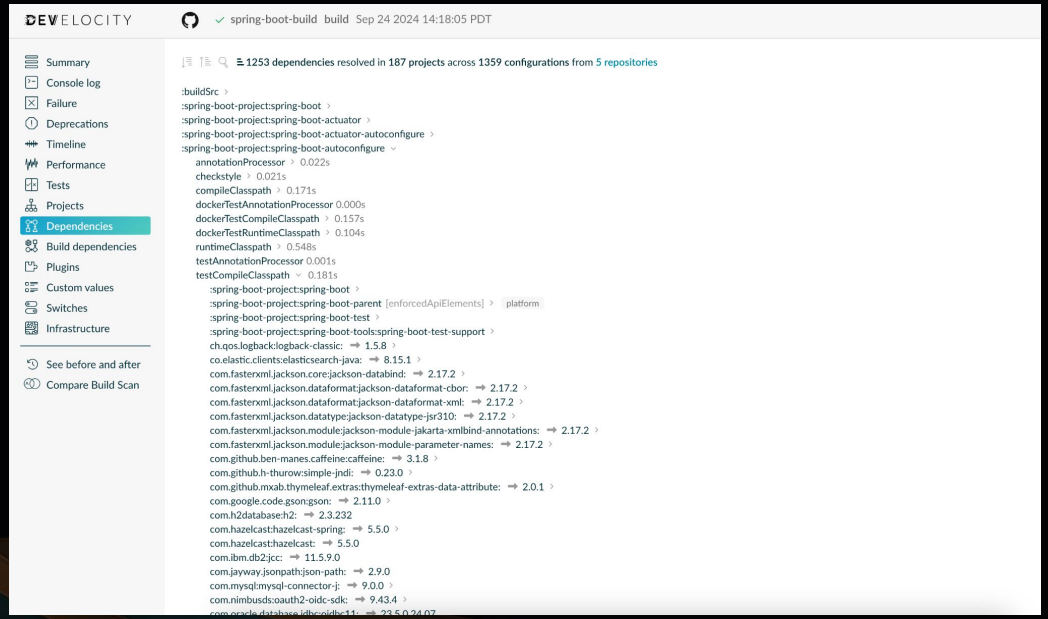
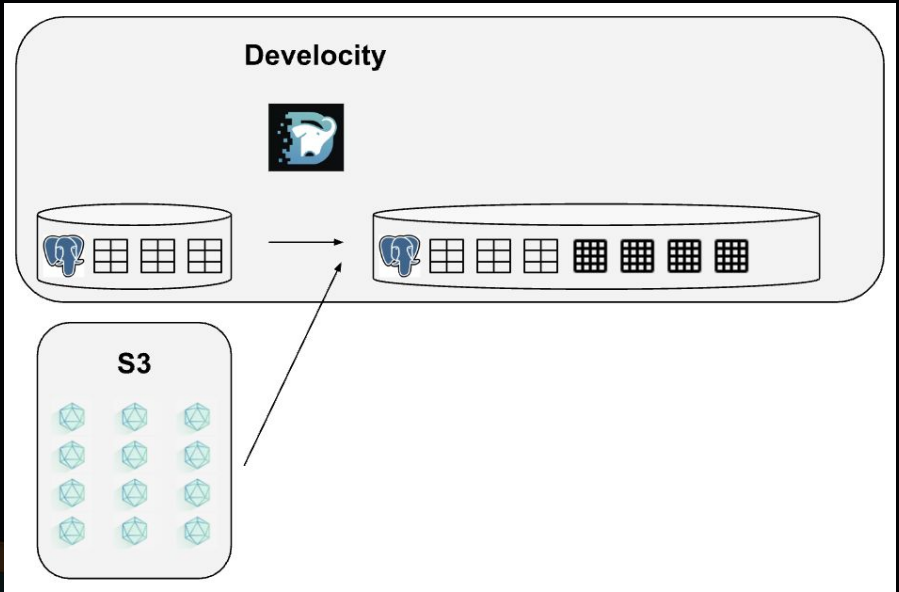


Highly specialized Develocity cross-build dashboards are backed by projection tables in the DB



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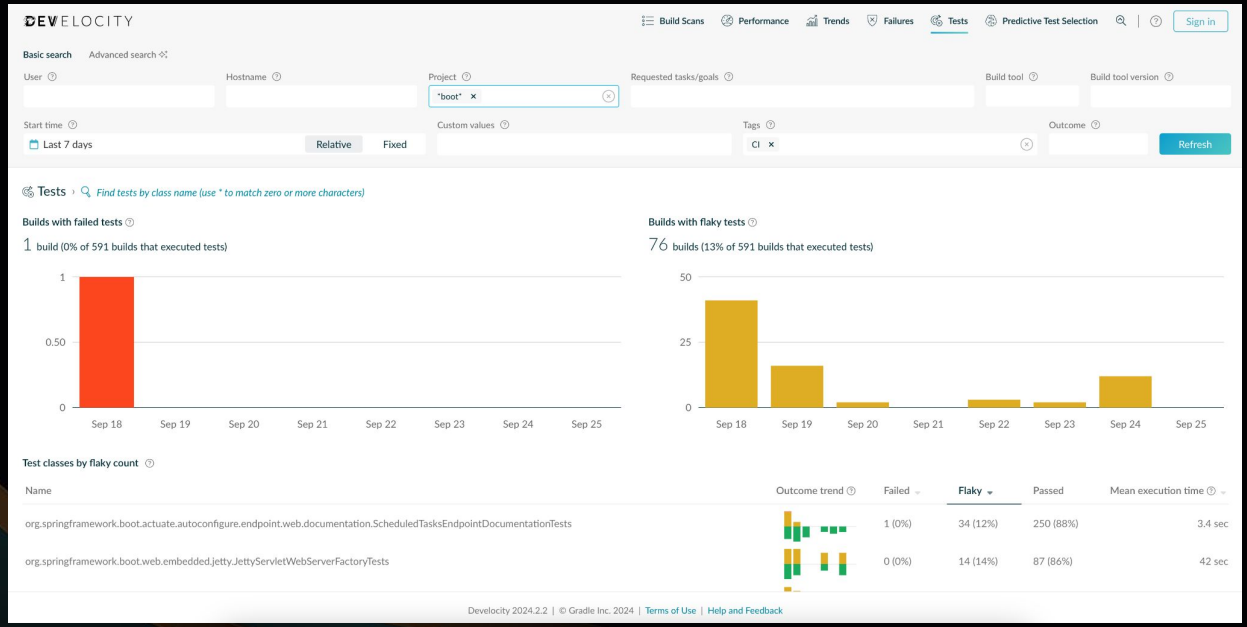

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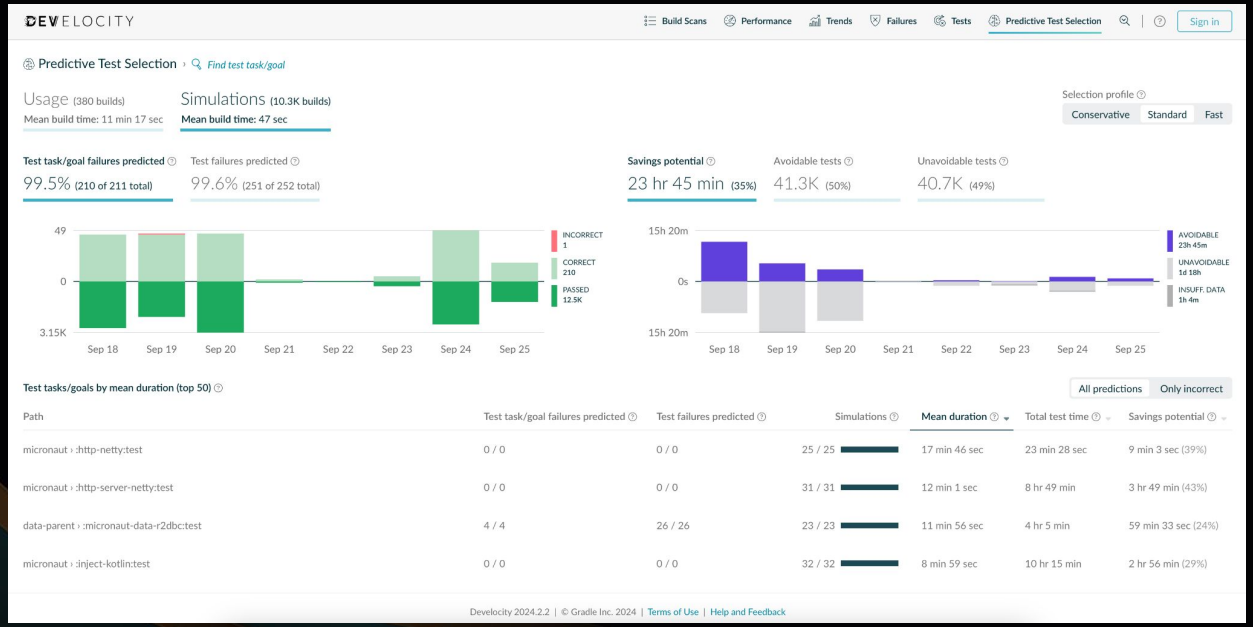

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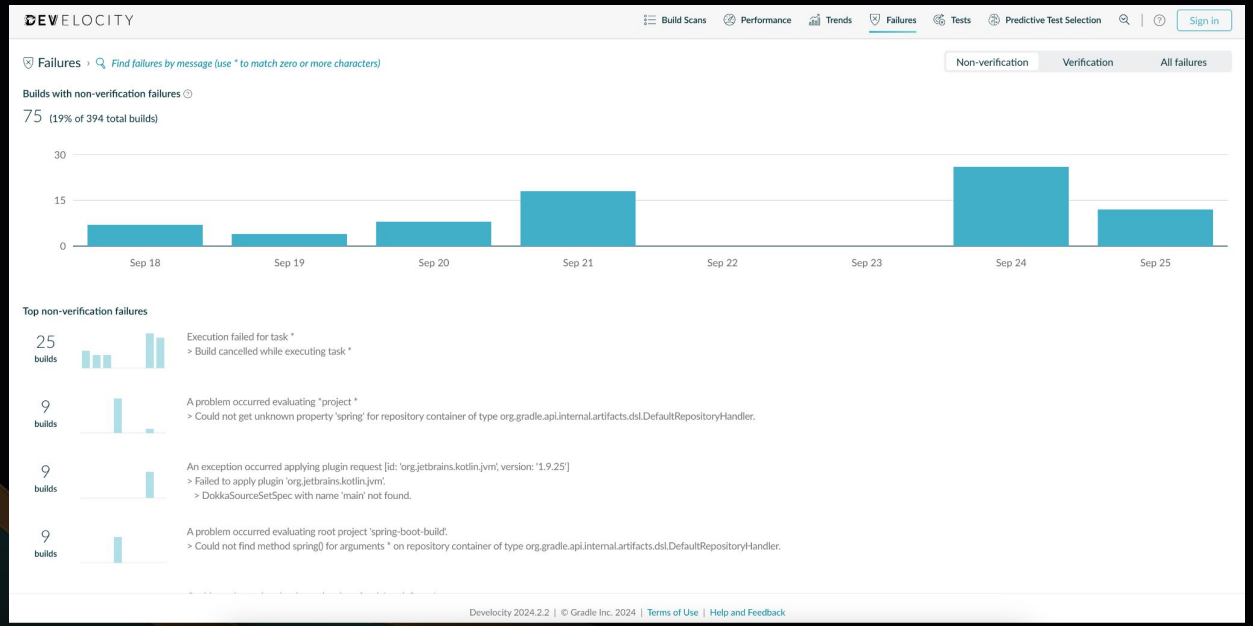


More questions can be asked about the build data than can be provided with built-in dashboards

The fine-grained build events can be consumed via API in their raw format

/build-export/v2/build/dcetsxpvueltk/events


```
id: dcetsxpvueltk
event: Build
data:
{"toolType":"maven","agentVersion":"1.22.1","toolVersion":"3.9.9","buildId":"dcetsx
pvueltk","timestamp":1727267831018}

id: 0
event: BuildEvent
data:
{"timestamp":1727267724835,"type":{"majorVersion":1,"minorVersion":0,"eventType":"M
vnBuildStarted"},"data":{}}

id: 1
event: BuildEvent
data:
{"timestamp":1727267724835,"type":{"majorVersion":1,"minorVersion":0,"eventType":"M
vnHardware"},"data":{"numProcessors":8}}
```

The build data can be consumed via API as higher-level build models that provide specific views on the data

/api/builds/uywcwqs7bhhqc/gradle-attributes


```
{
    "id": "uywcwqs7bhhqc",
    "buildStartTime": 1727268163248,
    "buildDuration": 27285,
    "gradleVersion": "8.10.2",
    "pluginVersion": "3.18.2-rc-1",
    "rootProjectName": "dv",
    "requestedTasks": [
        ":lib-common:verify"
    ],
    "hasFailed": false,
    "tags": [
        "CI",
        "base_release",
        "Linux",
        "Release"],
    ...
```

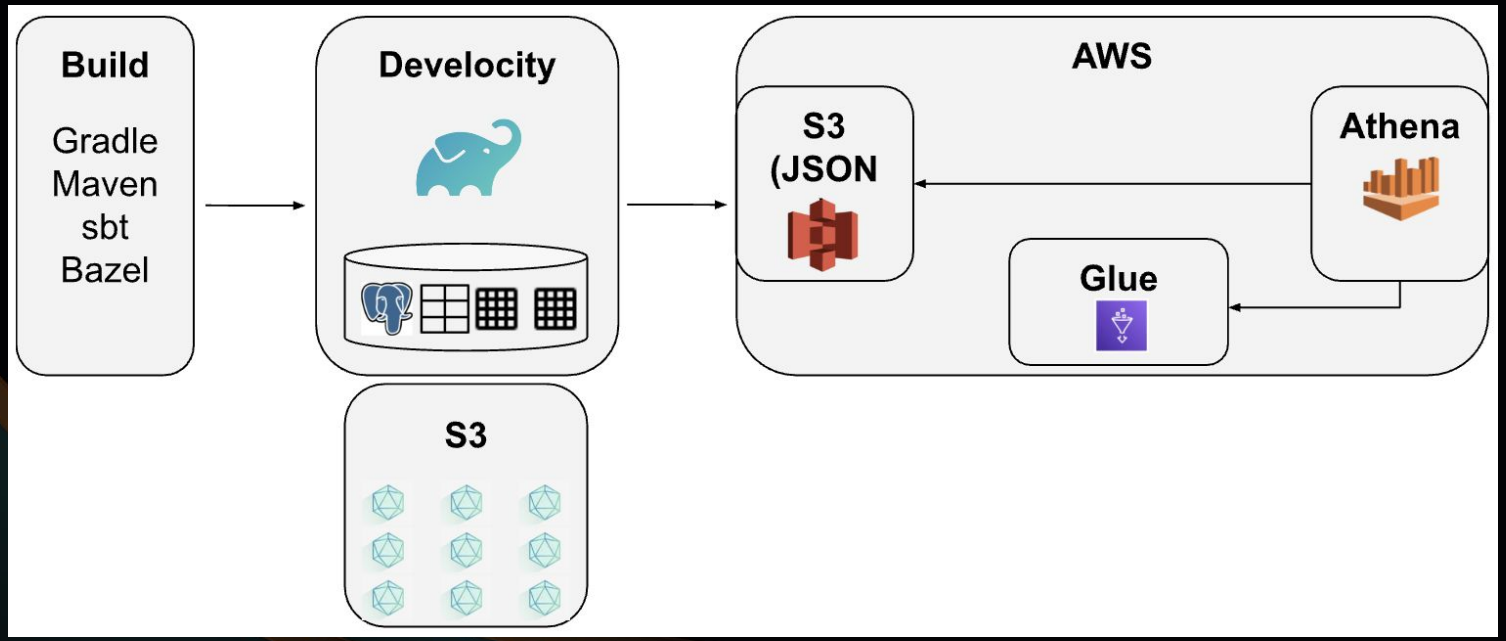
```
    "buildOptions": {
        "buildCacheEnabled": true,
        "configurationCacheEnabled": false,
        "configurationOnDemandEnabled": true,
        "continuousBuildEnabled": false,
        "continueOnFailureEnabled": true,
        "daemonEnabled": true,
        "dryRunEnabled": false,
        "excludedTasks": [],
        "fileSystemWatchingEnabled": true,
        "isolatedProjectsEnabled": false,
        "maxNumberOfGradleWorkers": 4,
        "offlineModeEnabled": false,
        "parallelProjectExecutionEnabled": true,
        "refreshDependenciesEnabled": false,
        "rerunTasksEnabled": false
    },
```

The build data can be consumed via API as higher-level build models that provide specific views on the data

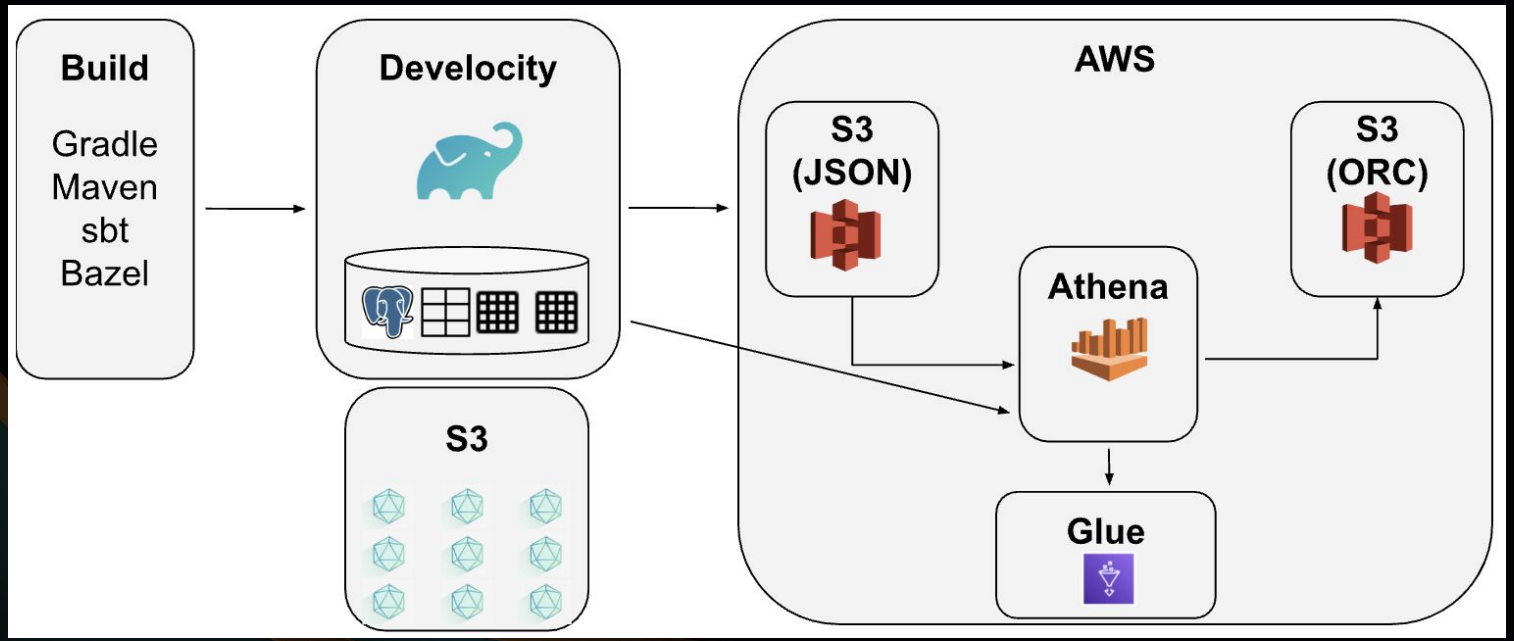
- General attributes of each build
- Multi-module/project structure
- Build cache performance characteristics
- Network activity
- Resource usage
- Applied plugins
- etc.

Customers must be able to instantly ask their own questions about the build data

Build models can be queried via big query services available from common cloud providers



Build models can be queried via big query services available from common cloud providers

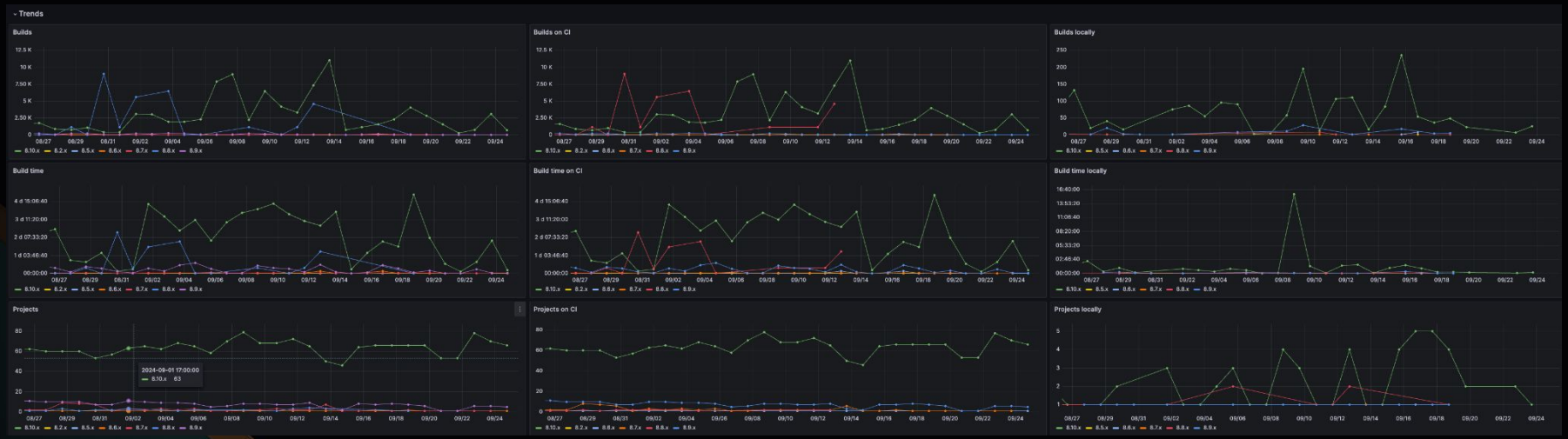


Build models can be queried via big query services available from common cloud providers

- Using ORC to store build data is faster to query and requires less disk space
- Storing multiple builds per ORC file avoids AWS S3 rate limits
- Using tables to mimic materialized views avoids slow UNNEST queries

Pre-built Grafana dashboards can be connected to big query services to gain actionable build insights across projects

Pre-built Grafana dashboards can be connected to big query services to gain actionable build insights across projects



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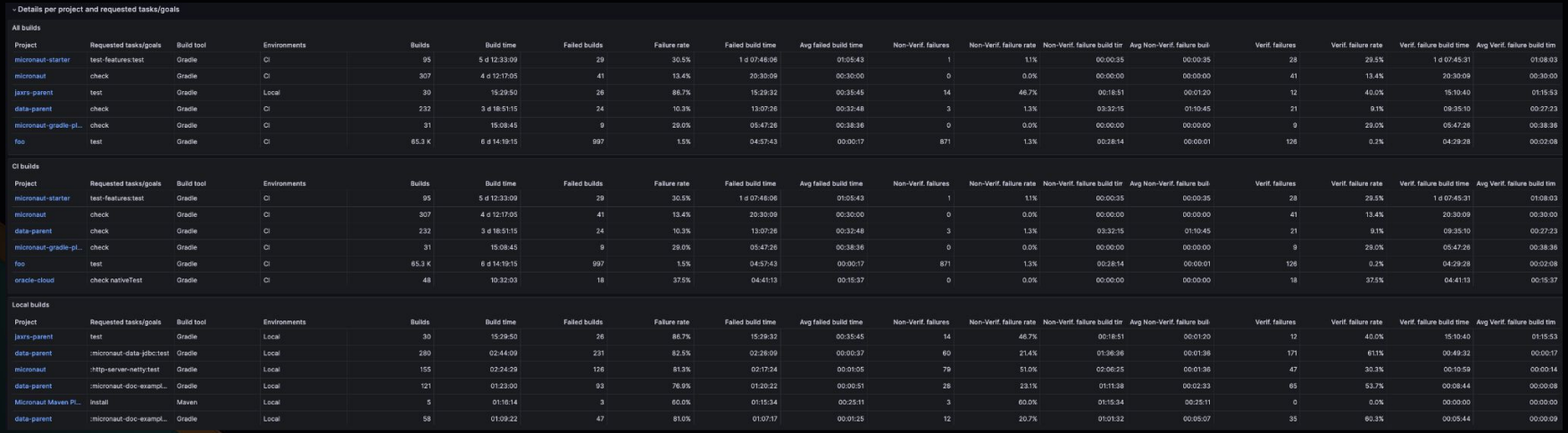


Details per project and requested tasks/goals

All builds

Project	Requested tasks/goals	Build tool	Environments	Builds	Build time	Failed builds	Failure rate	Failed build time	Avg failed build time	Non-Verif. failures	Non-Verif. failure rate	Non-Verif. failure build tim	Avg Non-Verif. failure buil	Verif. failures	Verif. failure rate	Verif. failure build time	Avg Verif. failure build tim
micronaut-starter	test-features:test	Gradle	CI	95	5 d 12:33:09	29	30.5%	1 d 07:46:06	01:05:43	1	1.1%	00:00:35	00:00:35	28	29.5%	1 d 07:45:31	01:08:03
micronaut	check	Gradle	CI	307	4 d 12:17:05	41	13.4%	20:30:09	00:30:00	0	0.0%	00:00:00	00:00:00	41	13.4%	20:30:09	00:30:00
jaxrs-parent	test	Gradle	Local	30	15:29:50	26	86.7%	15:29:32	00:35:45	14	46.7%	00:18:51	00:01:20	12	40.0%	15:10:40	01:15:53
data-parent	check	Gradle	CI	232	3 d 18:51:15	24	10.3%	13:07:26	00:32:48	3	1.3%	03:32:15	01:10:45	21	9.1%	09:35:10	00:27:23
micronaut-gradle-pl...	check	Gradle	CI	31	15:08:45	9	29.0%	05:47:26	00:38:36	0	0.0%	00:00:00	00:00:00	9	29.0%	05:47:26	00:38:36
foo	test	Gradle	CI	65.3 K	6 d 14:19:15	997	1.5%	04:57:43	00:00:17	871	1.3%	00:28:14	00:00:01	126	0.2%	04:29:28	00:02:08

CI builds

Project	Requested tasks/goals	Build tool	Environments	Builds	Build time	Failed builds	Failure rate	Failed build time	Avg failed build time	Non-Verif. failures	Non-Verif. failure rate	Non-Verif. failure build tim	Avg Non-Verif. failure buil	Verif. failures	Verif. failure rate	Verif. failure build time	Avg Verif. failure build tim
micronaut-starter	test-features:test	Gradle	CI	95	5 d 12:33:09	29	30.5%	1 d 07:46:06	01:05:43	1	1.1%	00:00:35	00:00:35	28	29.5%	1 d 07:45:31	01:08:03
micronaut	check	Gradle	CI	307	4 d 12:17:05	41	13.4%	20:30:09	00:30:00	0	0.0%	00:00:00	00:00:00	41	13.4%	20:30:09	00:30:00
data-parent	check	Gradle	CI	232	3 d 18:51:15	24	10.3%	13:07:26	00:32:48	3	1.3%	03:32:15	01:10:45	21	9.1%	09:35:10	00:27:23
micronaut-gradle-pl...	check	Gradle	CI	31	15:08:45	9	29.0%	05:47:26	00:38:36	0	0.0%	00:00:00	00:00:00	9	29.0%	05:47:26	00:38:36
foo	test	Gradle	CI	65.3 K	6 d 14:19:15	997	1.5%	04:57:43	00:00:17	871	1.3%	00:28:14	00:00:01	126	0.2%	04:29:28	00:02:08
oracle-cloud	check nativeTest	Gradle	CI	48	10:32:03	18	37.5%	04:41:13	00:15:37	0	0.0%	00:00:00	00:00:00	18	37.5%	04:41:13	00:15:37

Local builds

Project	Requested tasks/goals	Build tool	Environments	Builds	Build time	Failed builds	Failure rate	Failed build time	Avg failed build time	Non-Verif. failures	Non-Verif. failure rate	Non-Verif. failure build tim	Avg Non-Verif. failure buil	Verif. failures	Verif. failure rate	Verif. failure build time	Avg Verif. failure build tim
jaxrs-parent	test	Gradle	Local	30	15:29:50	26	86.7%	15:29:32	00:35:45	14	46.7%	00:18:51	00:01:20	12	40.0%	15:10:40	01:15:53
data-parent	:micronaut-data-jdbc:test	Gradle	Local	280	02:44:09	231	82.5%	02:28:09	00:00:37	60	21.4%	01:36:36	00:01:36	171	61.1%	00:49:32	00:00:17
micronaut	:http-server-netty:test	Gradle	Local	155	02:24:29	126	81.3%	02:17:24	00:01:05	79	51.0%	02:06:25	00:01:36	47	30.3%	00:10:59	00:00:14
data-parent	:micronaut-doc-exampl...	Gradle	Local	121	01:23:00	93	76.9%	01:20:22	00:00:51	28	23.1%	01:11:38	00:02:33	65	53.7%	00:08:44	00:00:08
Micronaut Maven Pl...	install	Maven	Local	5	01:16:14	3	60.0%	01:15:34	00:25:11	3	60.0%	01:15:34	00:25:11	0	0.0%	00:00:00	00:00:00
data-parent	:micronaut-doc-exampl...	Gradle	Local	58	01:09:22	47	81.0%	01:07:17	00:01:25	12	20.7%	01:01:32	00:05:07	35	60.3%	00:05:44	00:00:09

Pre-built Grafana dashboards can be connected to big query services to gain actionable build insights across projects

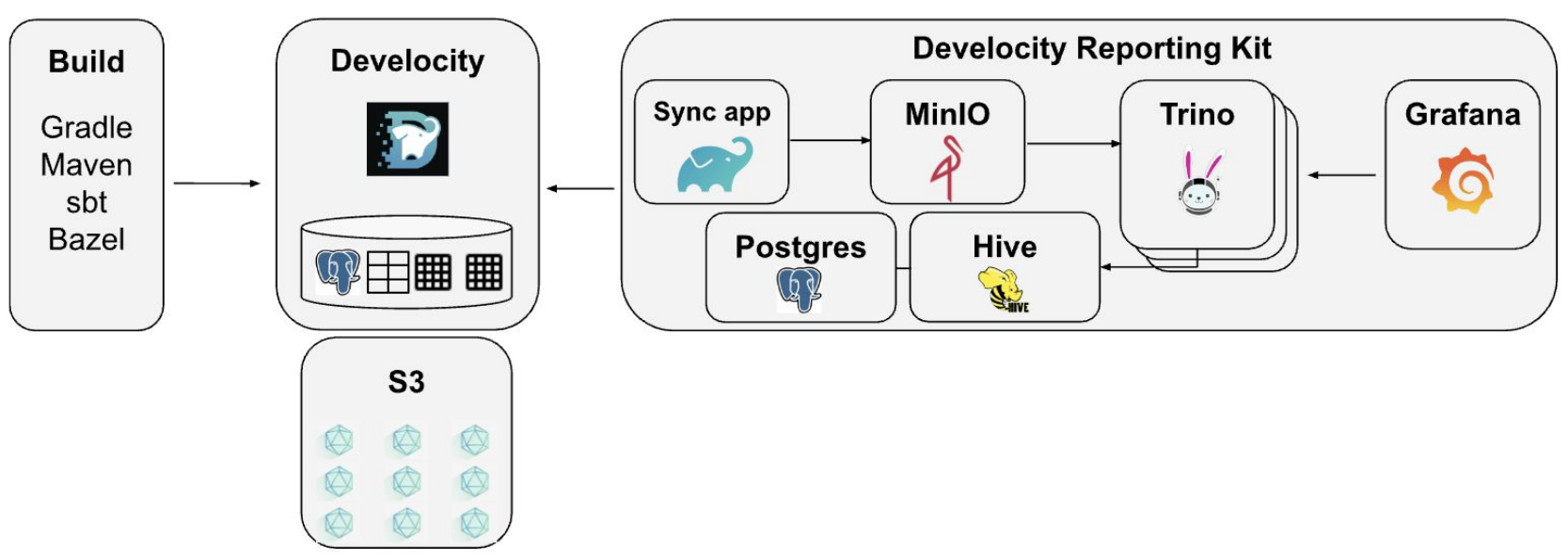
- Build volume
- Environment
- Build Failures
- Build Deprecations
- Plugins
- Networking
- Parallelization and resource usage
- Build Caching
- Settings

More build models and pre-built dashboards coming with every Develocity release.

Alerts can be implemented via Grafana Alerting or by combining different cloud provider services

- Example:
  - Event Bridge Scheduler
  - Lambda function
  - Simple notification service (SNS)

All-in-one reporting kit can be used to fetch, store, query, and visualize build data



Customers may prefer different reporting outputs to surface the build insights

Reports combining explanations and numeric results are another way to surface actionable build insights

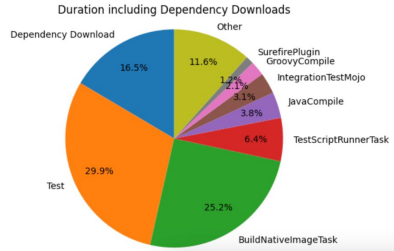
Analysis of Executed Maven Goals and Gradle Tasks

- duration: The cumulated build wall clock time of just running this goal.
- frequency: How many build projects run this goal or task as part of their build execution.
- Frequency Percentage: The percent of build projects running this goal or task as part of their build execution.
- Goal Duration Percentage: The duration of this goal relative to the total time of running goals. They will add up to 100%.
- Total Duration Percentage: The duration of this goal relative to the cumulated overall build time (which for example includes dependency download time). They will not add up to 100%.

All those variables are relative to the context in which they are evaluate. When a goal is solely executed on CI, this goal has a higher duration percentage in the CITotal context than in the Total context.

Goals with more than 1% total duration for Total

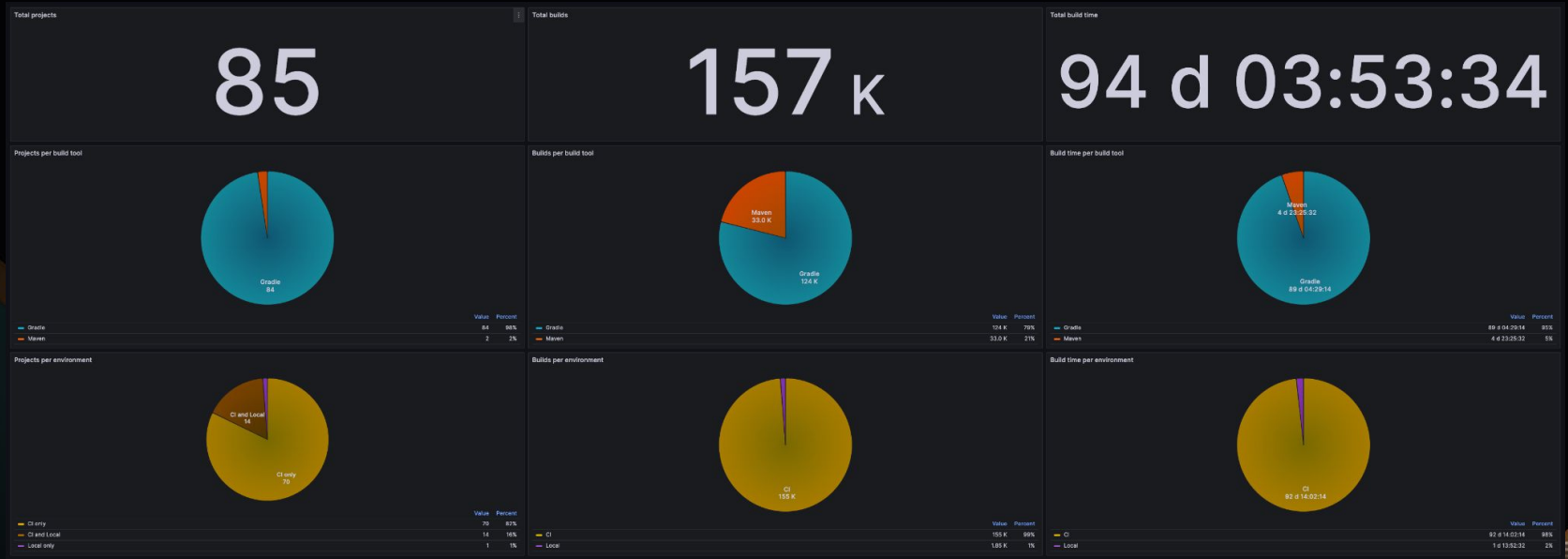
Type	Duration	Frequency	Build Cache Savings	Frequency Percentage	Build Cache Savings Percentage	Goal Duration Percentage	Total Duration Percentage
org.gradle.api.tasks.testing.Test	36,038	349	13,647	3.66%	37.87%	35.85%	29.93%
org.graalvm.buildtools.gradle.tasks.BuildNativeImageTask	30,334	113	0	1.18%	0.00%	30.18%	25.19%
io.micronaut.guides.tasks.TestScriptRunnerTask	7,714	21	9,003	0.22%	116.72%	7.67%	6.41%
org.gradle.api.tasks.compile.JavaCompile	4,625	726	9,921	7.60%	214.51%	4.60%	3.84%
org.apache.maven.plugins.invoker.IntegrationTestMojo	3,788	3	0	0.03%	0.00%	3.77%	3.15%
org.gradle.api.tasks.compile.GroovyCompile	2,575	328	2,037	3.44%	79.11%	2.56%	2.14%
org.apache.maven.plugin.surefire.SurefirePlugin	1,433	14	0	0.15%	0.02%	1.43%	1.19%
Other	14,012	nan	7,333	nan%	52.34%	13.94%	11.64%



Use cases

Inactive project causing high CI build queues

NPM & Python build insights coming in 2025

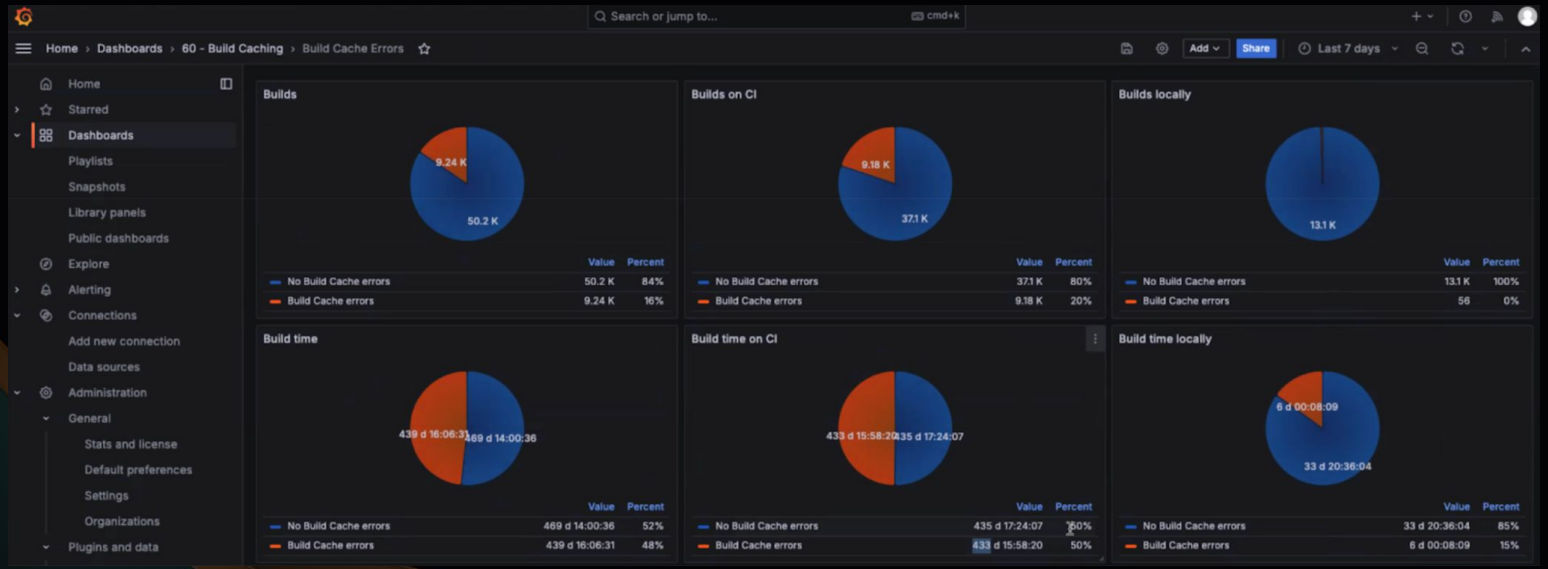


High dependency download rate overloading the infrastructure

High dependency download rate overloading the infrastructure

Ephemeral build slow-down mitigation coming in 2025

Network instabilities causing half the build volume to run without build caching



Network instabilities causing half the build volume to run without build caching

JDK usages not in compliance with company policies

CI builds

Version	Projects	Builds
Oracle Java HotSpot 17.0.12	74	30.0 K
Eclipse OpenJDK 17.0.12	77	122 K
Oracle Java HotSpot 21.0.4	72	2.12 K
GraalVM OpenJDK 17.0.9	3	459
Eclipse OpenJDK 21.0.4	1	161
Amazon OpenJDK 17.0.12	1	46

Local builds

Version	Projects	Builds
Homebrew OpenJDK 21.0.2	2	11
Homebrew OpenJDK 17.0.12	1	21
Oracle Java HotSpot 21	1	7
GraalVM OpenJDK 17.0.4	2	14
GraalVM OpenJDK 22.0.2	1	2
Amazon OpenJDK 17.0.7	1	3

Develocity provides comprehensive build data and enables instant build data exploration to improve the developer toolchain

VISIT US

Want to learn more about Develocity, or want to work on Develocity?

Visit us at the booth in the lounge!

THANKS

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