CSCS
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Swiss National Supercomputing Centre

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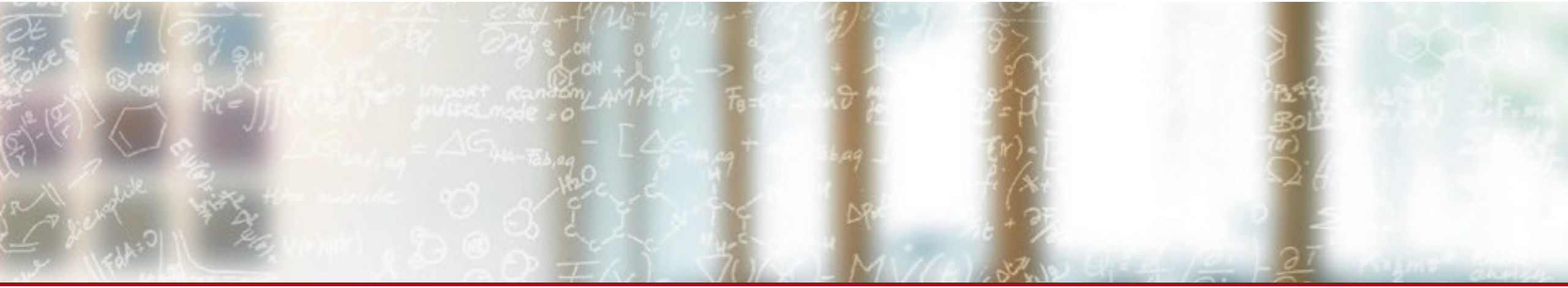


Experimenting With Security Compliance Checking Using ReFrame

Victor Holanda Rusu, Matteo Basso, Chris Gamboni, Fabio Zambrino, and Massimo Benini, CSCS

May 6th, 2025

Computing Horizons: CUG 2025

Implementing DevSecOps in HPC

Because Regular HPC Wasn't Hard Enough

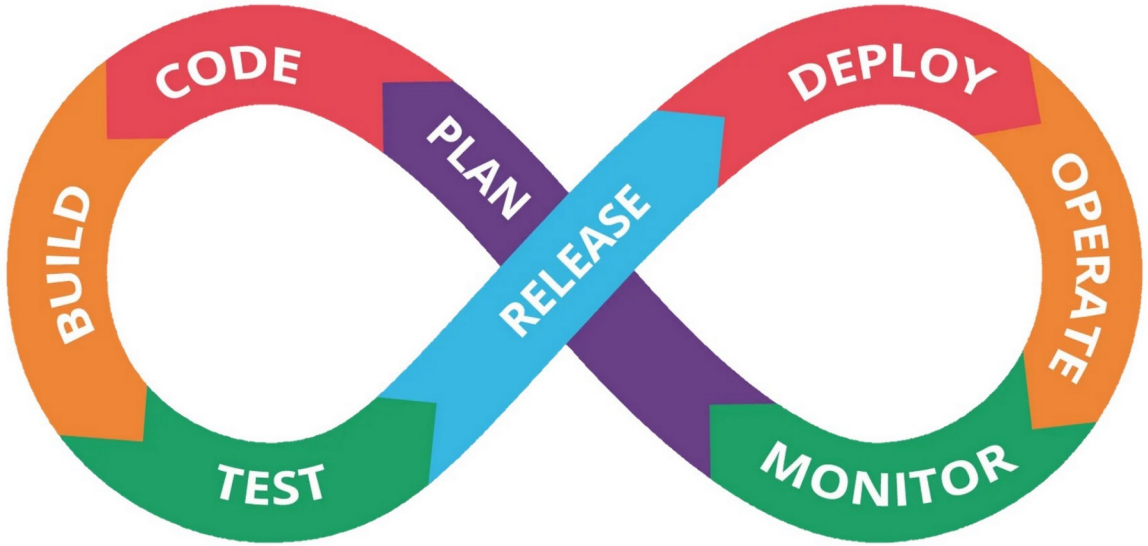
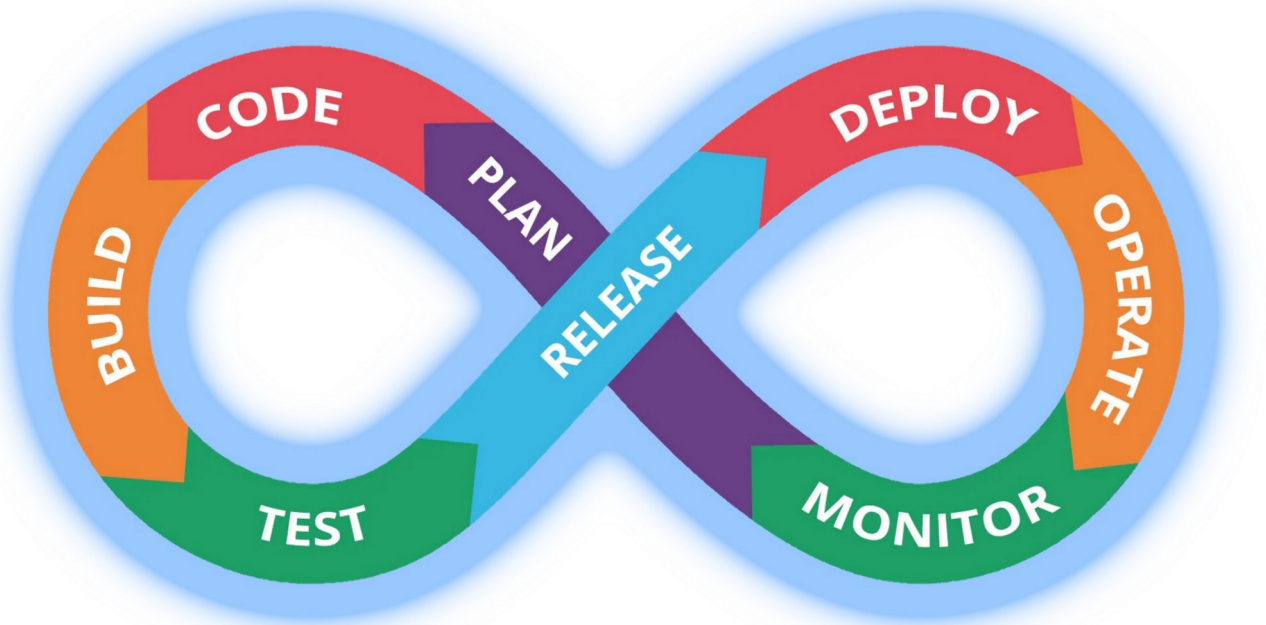


Image from https://mia-platform.eu/blog/devops/

Implementing DevSecOps in HPC

It’s Fine, Everything is Fine

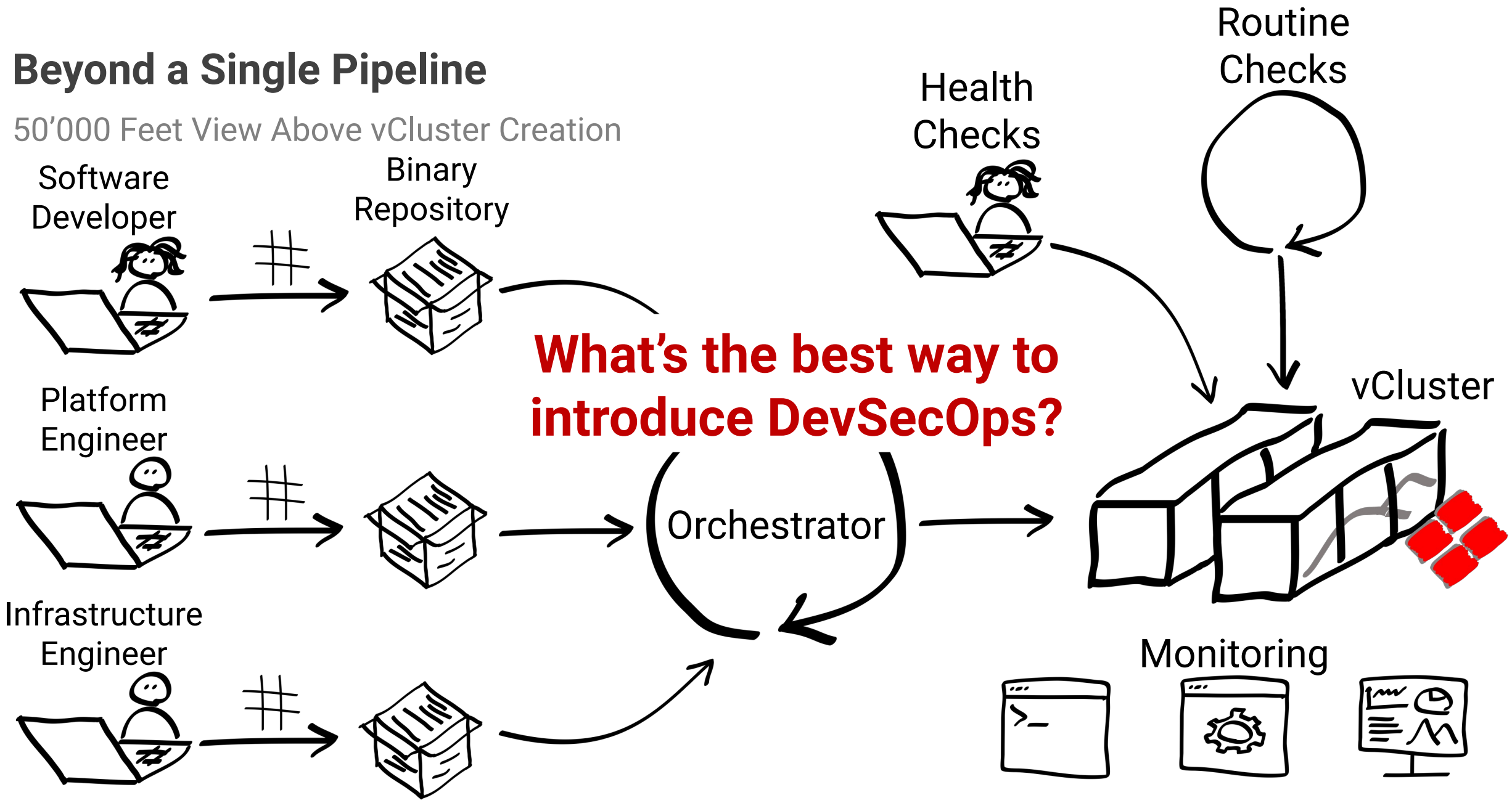


Modified from https://mia-platform.eu/blog/devops/

DevSecOps in HPC: It’s Not Just One Pipeline; It’s a Whole Lot More

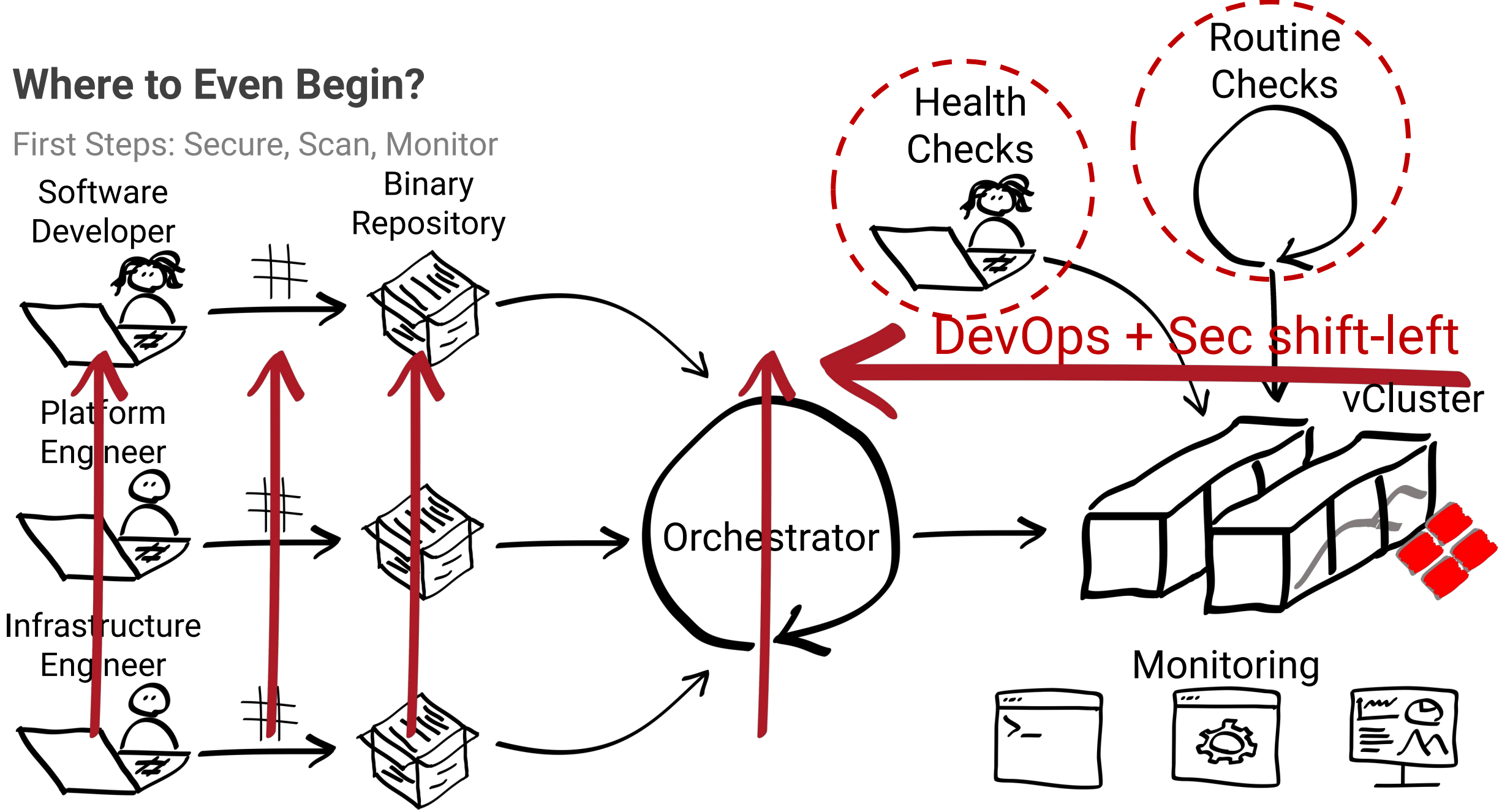
Beyond a Single Pipeline

50’000 Feet View Above vCluster Creation



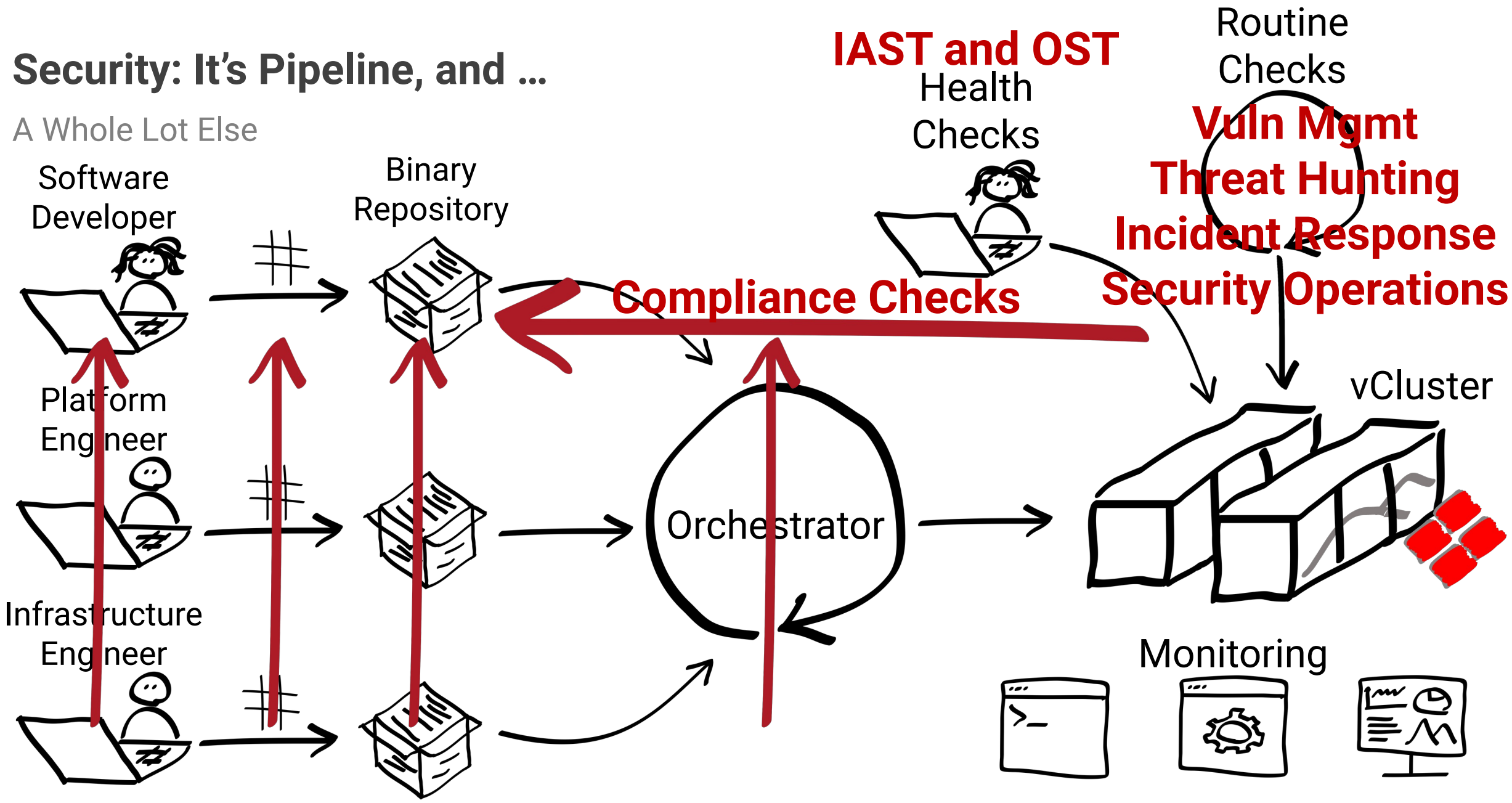
Where to Even Begin?

First Steps: Secure, Scan, Monitor



Security: It's Pipeline, and …

A Whole Lot Else



What Is Security Compliance Testing?

The Art of Checking All the Boxes (And Then Some)

- Viewed as a “Security Theatre” activity by many
- Checks conformity to standards and policies
  - Ensures a system or application adheres to predefined security requirements, e.g., DISA STIGs, ANSSI BP, ISO 27001
- Detects misconfigurations and potential vulnerabilities
- Provides measurable and reportable results
- Is mainly automatable
- Can be used as a baseline to start implementing hardened configurations
- Can be used as Indicators of Compromise

Security Compliance Testing in Practice

Where Theory Meets Reality (and It's Complicated)

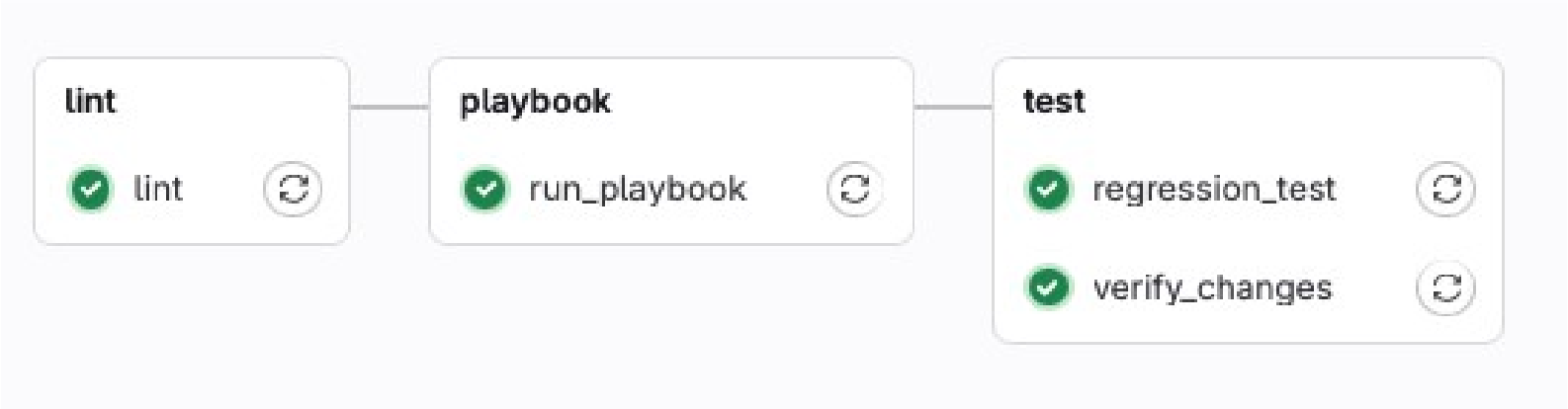
- We use Security-focused tools, vendor provided and difficult to customize
- Our hardening verification is OSCAP* centric
  - OSCAP is the industry standard in security
  - CSCS engineers are not necessarily used to them
- Support for different OSes varies
  - The security team needs to write customization
  - A bunch of additional bash scripts
- Reporting is not integrated with monitoring

*OSCAP stands for Open Security Content Automation Protocol

What a Simple Ansible CI Pipeline Looks Like?

On a Good Day

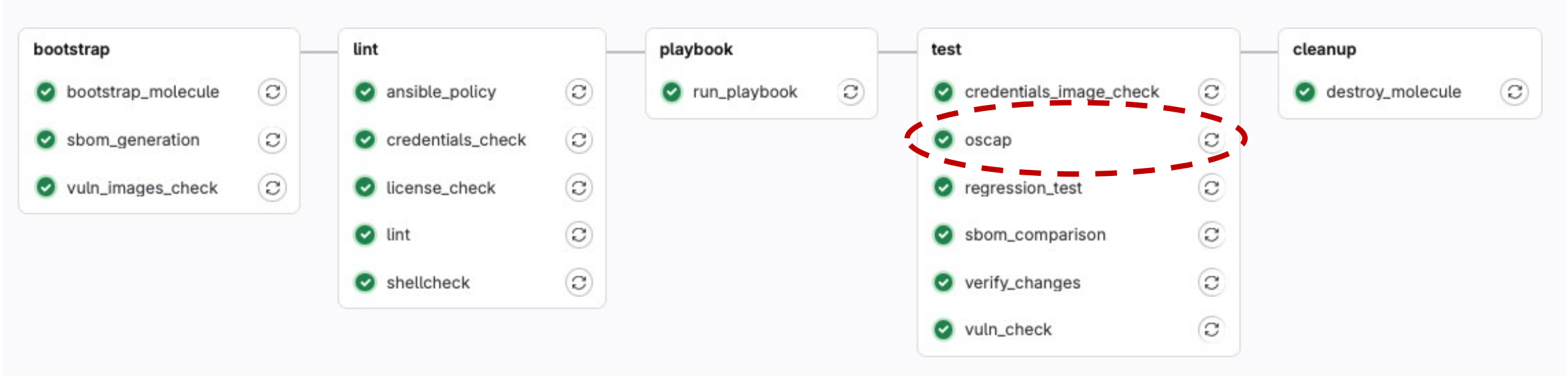
- This is a 4 jobs pipeline



DevSecOps Ansible CI Pipeline

Now with 4x the Complexity (and 5x the YAML)

- This is a 16 jobs pipeline
- Engineer owns the pipeline
- Tools must be configurable – focus on silencing false positives



How does a OSCAP Test Look Like?

Peeking Under the Hood: How OSCAP Writes Tests

```
<Rule id="xccdf_org.ssgproject.content_rule_file_groupowner_etc_passwd">
  <title>Ensure group ownership of /etc/passwd file is root</title>
  <description>
    The /etc/passwd file should be group-owned by root to prevent
    unauthorized users from obtaining sensitive information.
  </description>
  <check system="urn:xccdf:check:system:ocil">
    <check-content-ref href="checks/ocil/file_groupowner_etc_passwd.xml" />
  </check>
  <fix system="urn:xccdf:fix:system:ansible">
    <fix-content-ref name="fix_file_groupowner_etc_passwd_ansible"/>
  </fix>
</Rule>
```

How does a OCIL* Questionnaire Look Like?

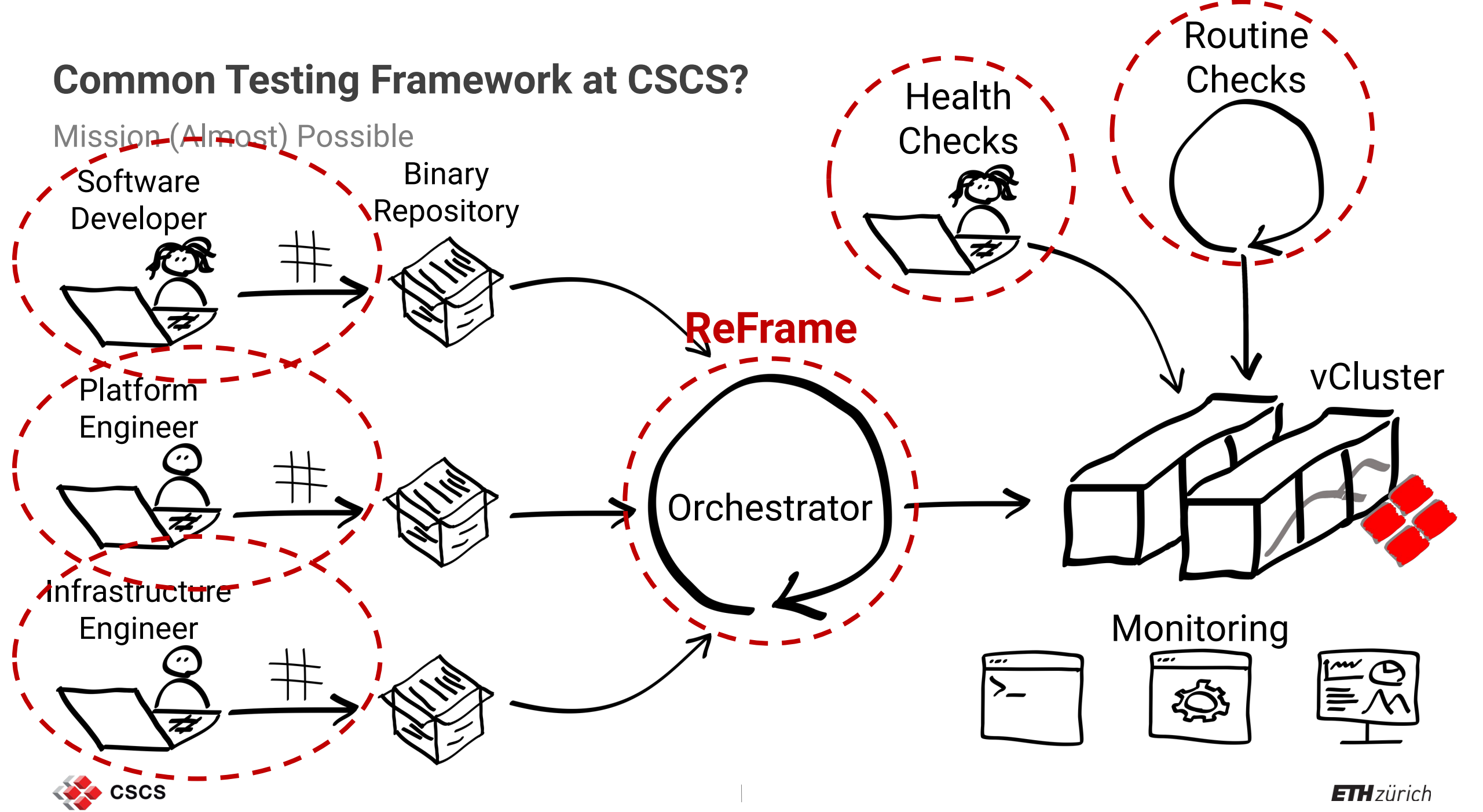
Peeking Into the World of OCIL (Yes, it's XML Again)

```
<ocil:questionnaire id="file_groupowner_etc_passwd_questionnaire">
  <ocil:question id="file_groupowner_etc_passwd_question">
    Is the group owner of the /etc/passwd file set to 'root'?
  </ocil:question>
  <ocil:action id="file_groupowner_etc_passwd_action">
    To verify the group ownership of the /etc/passwd file, run the
following command:
    <ocil:command>stat -c "%G" /etc/passwd</ocil:command>
    The output should be:
    <ocil:command_output>root</ocil:command_output>
    If the group owner is not 'root', this is a finding.
  </ocil:action>
</ocil:questionnaire>
```

*OCIL stands for Open Checklist Interactive Language

Common Testing Framework at CSCS?

Mission (Almost) Possible



ReFrame Tests: When Less Really Is More

An Engineering Perspective

```
@rfm.simple_test
class file_groupowner_etc_passwd_check(seccommon.file_perms_check):
    paths = parameter([{'/etc/passwd' : {'group' : 'root'}}])
```

Security Compliance in ReFrame

Code Hiding in a Sea of Explanations

```
@rfm.simple_test
class file_groupowner_etc_passwd_check(seccommon.file_perms_check):
    paths = parameter([{'/etc/passwd' : {'group' : 'root'}}])
    descr = 'Ensure group ownership of /etc/passwd file is root'
    rationale = variable(str, value='The /etc/passwd file contains …')
    severity = variable(str, value='medium')
    correction = variable(str, value='automated')
    tags |= {'isa-62443-2009', 'cis@sle15', 'iso27001-2013', 'cce@sle15'…}
```

Annotation Required by Compliance

A Real Engineer's ReFrame Test

One Class, All the Things

```
@rfm.simple_test
class file_perms_etc_passwd_check(seccommon.file_perms_check):
    paths = parameter([{'/etc/passwd' : {'group' : 'root'}},
                       {'/etc/passwd' : {'owner' : 'root'}},
                       {'/etc/passwd' : {'perm'  : '0644'}},])
or

@rfm.simple_test
class file_perms_etc_passwd_check(seccommon.file_perms_check):
    paths = parameter([{'/etc/passwd' : {'group' : 'root',
                                         'owner' : 'root',
                                         'perm ' : '0644'}}])
```

Our Achievements

Proof We Were Busy (Mostly)

- Ported ComplianceAsCode project checks into ReFrame
- Focused on DISA STIG, ANSSI-BP-28 enhanced, and CSCS custom standards and policies
- Created a custom OSCAP-like report generator
- We have +1200 security compliance checks
- We support SUSE and RedHat
- Labelled the tests, to support conditional execution
- Integration with our Monitoring

The Results Are In…

Our Very Own OSCAP-ish Report

System Health Check

System: MyInsecureVM

Summary | Check Results | Disclaimer

Security Tests Profile

MyInsecureVM	root	290.2 s	4.7.4	2025-04-21 09:02:04
Hostname	User	Execution Time	Reframe Version	Execution Date

Test Execution Summary

965 100%	0 0.0%	429 44.5%	164 17.0%	372 38.5%
Total	Aborted	Failure	Skipped	Success

The Results Are In...

Our Very Own OSCAP-ish Report

Failure sudo_add_noexec_check

Status
Failure

Description
The sudo NOEXEC tag, when specified, prevents user executed commands from executing other commands, like a shell for example. This should be enabled by making sure that the NOEXEC tag exists in /etc/sudoers configuration file or any sudo configuration snippets in /etc/sudoers.d/.

Rationale
Restricting the capability of sudo allowed commands to execute sub-commands prevents users from running programs with privileges they wouldn't have otherwise.

Tags
anssi

Execution time
1.1 s

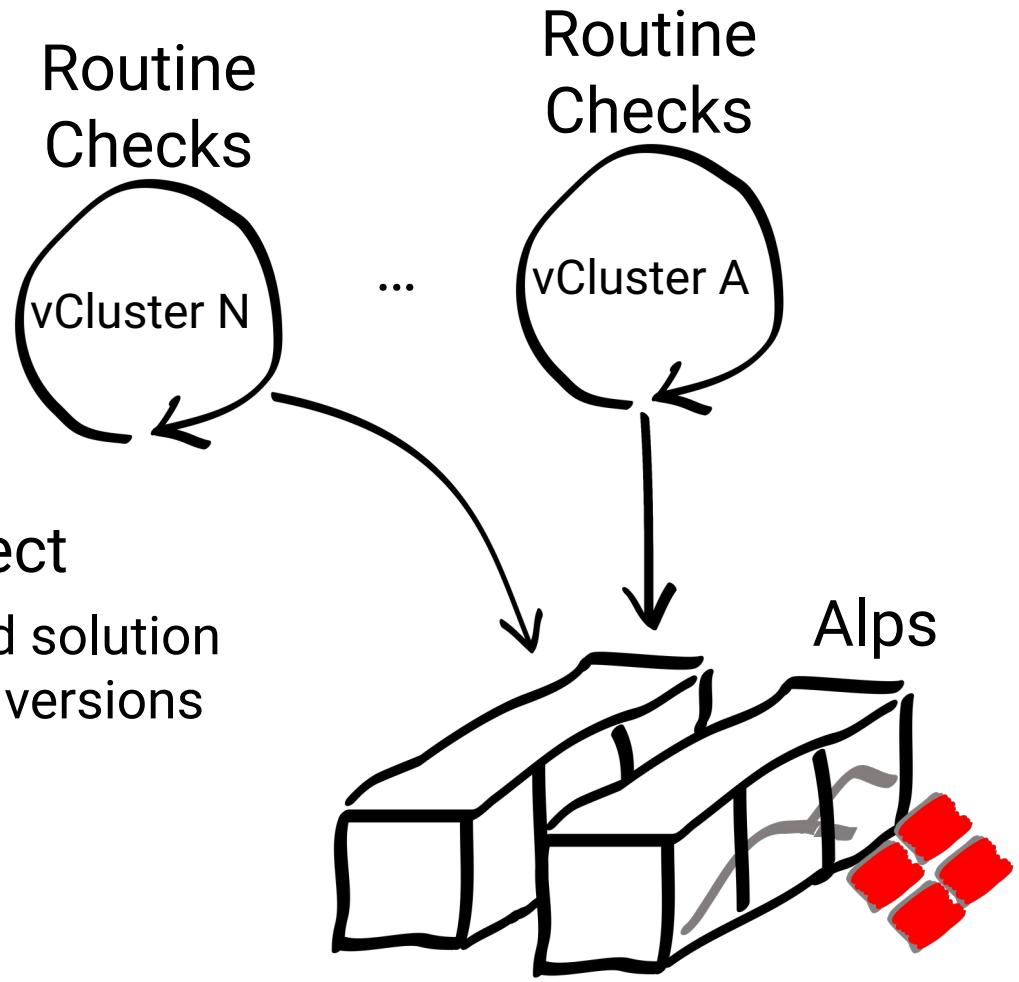
Failed Reason
▾ Display toggle ...

```
sanity error:
Defaults noexec not found in /etc/sudoers
```

Check bash script
▸ Display toggle ...

Work in Progress

Because We Are Not Done Yet

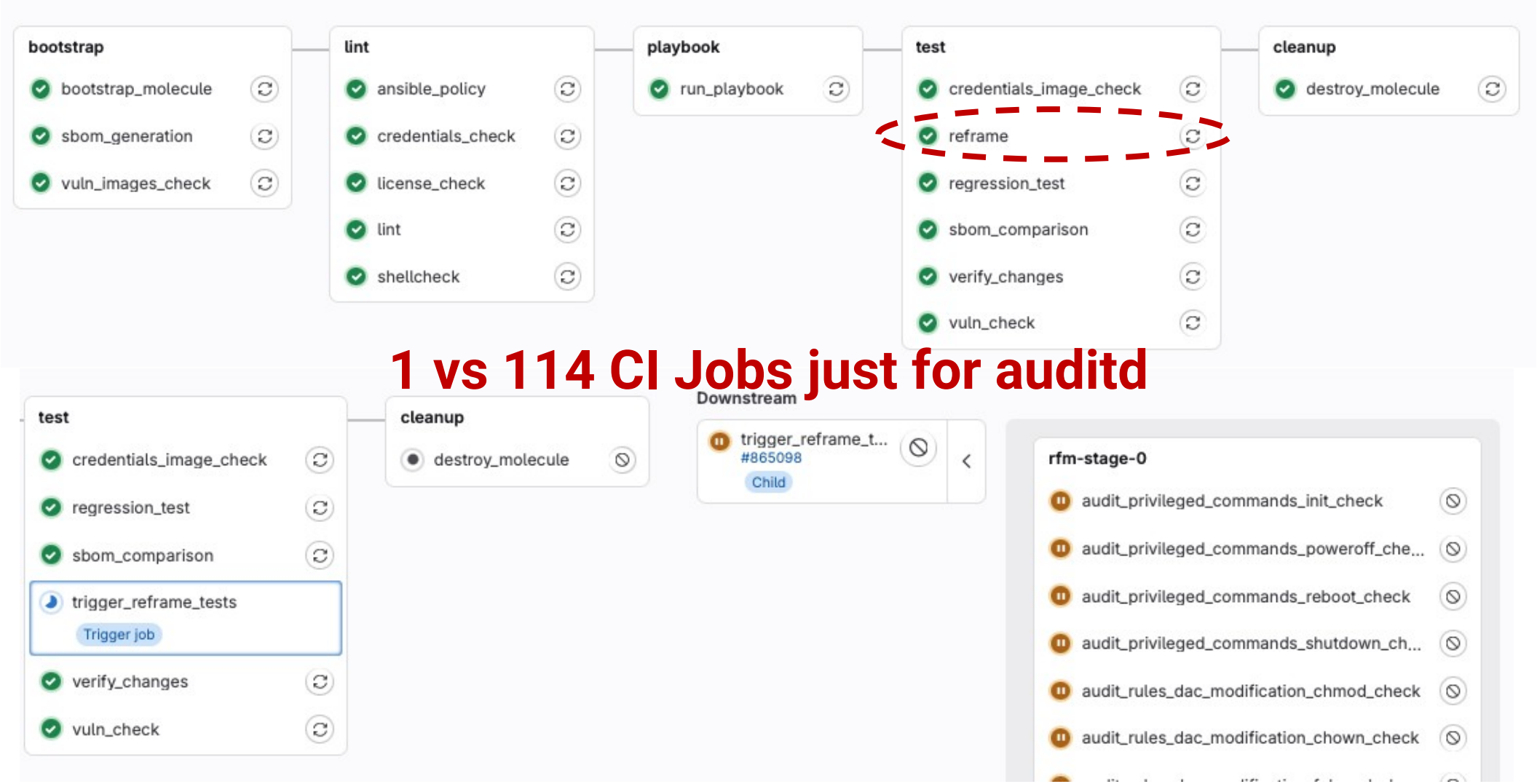


- Single repository of security checks vs per project
  - Monolithic repository (Google Style?) vs decentralized solution
  - Different security profile branches, different software versions

Current blocker for sharing our tests

How Fine Is Too Fine?

Adventures in CI Granularity

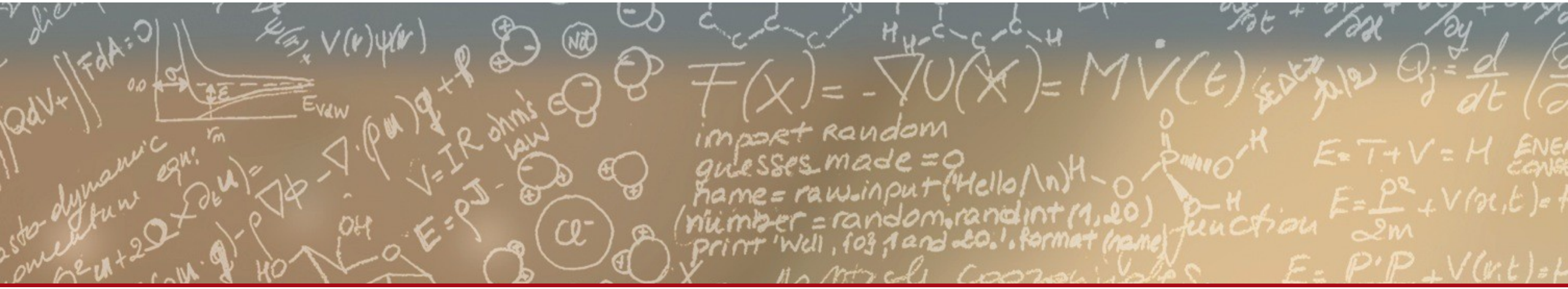


Take Home Message

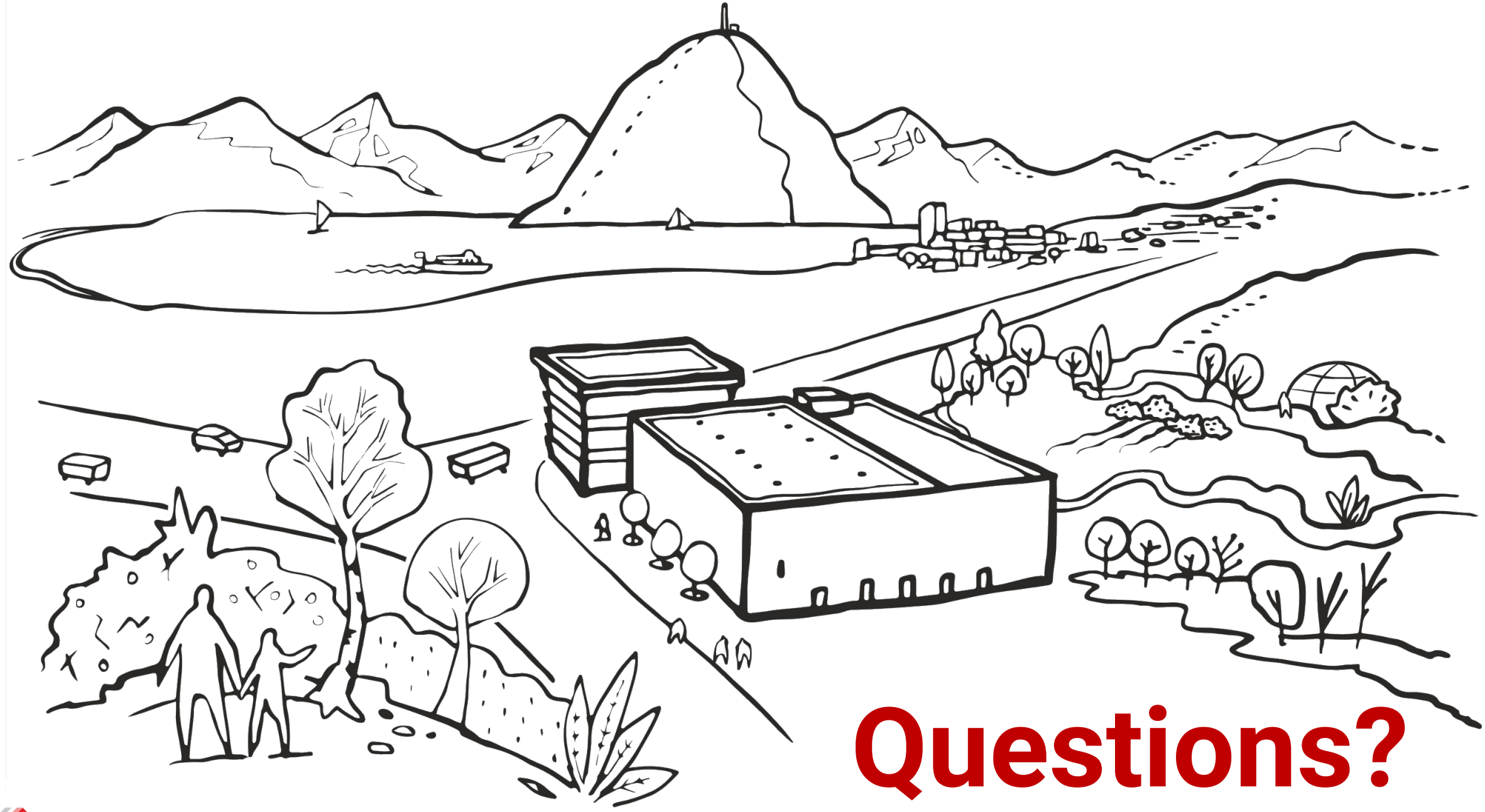
TL;DR Edition

- The Sec part in DevSecOps is very intrusive
  - Empower engineers to own their stack
  - Needs to reusable to avoid discrepancies in the security teams view and the DevSecOps view
- The tools may pose a challenge in DevSecOps adoption/implementation
- We used ReFrame because of its current adoption at CSCS
  - You are encouraged to use your own tool
- We are looking for people interested to work together to maintain these tests

The right tool speaks your team's language, cutting through noise to **focus on security**



Thank you for your attention.



Questions?