My container is running stable since a year,

is that good?

Timo Pagel

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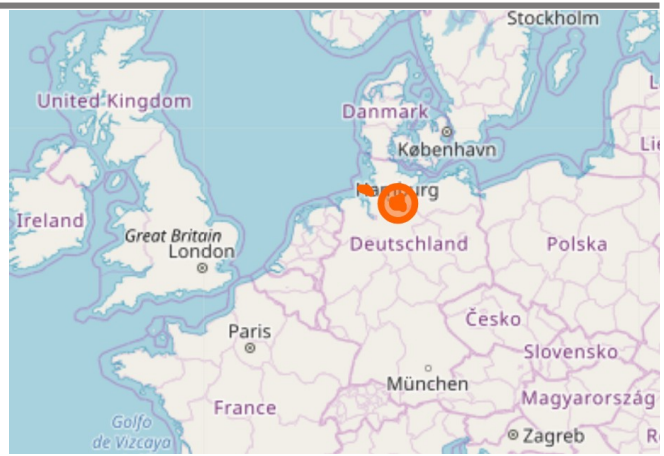
11.05.2019, Kiel

About Me

- DevSecOps Consultant, Hamburg
- Lecturer for *Security in Web Applications* at University of Applied Sciences Kiel/Wedel
- Open Source / Open Knowledge Enthusiast
  - DevSecOps Maturity Model
  - Full University Module Security in Web App.
  - OWASP Software Assurance Maturity Model



Agenda

- Introduction
- Attack Surface Reduction
- Scanning for Known Vulnerabilties
- Fast Patching
- Conclusion

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Patch Management in 2009

My server is running stable since a year

```
$ uptime
12:52:27 up 463 days, [...]
```

My container is running stable since a year

Conclusions?

My container is running stable since a year

Conclusions?

→ Container has not been rebuild since a year

My container is running stable since a year

Conclusions?

→ Container has not been rebuild since a year

→ No patches

→ Host has not been restarted since a year

→ No patches (at least for docker), no kernel updates

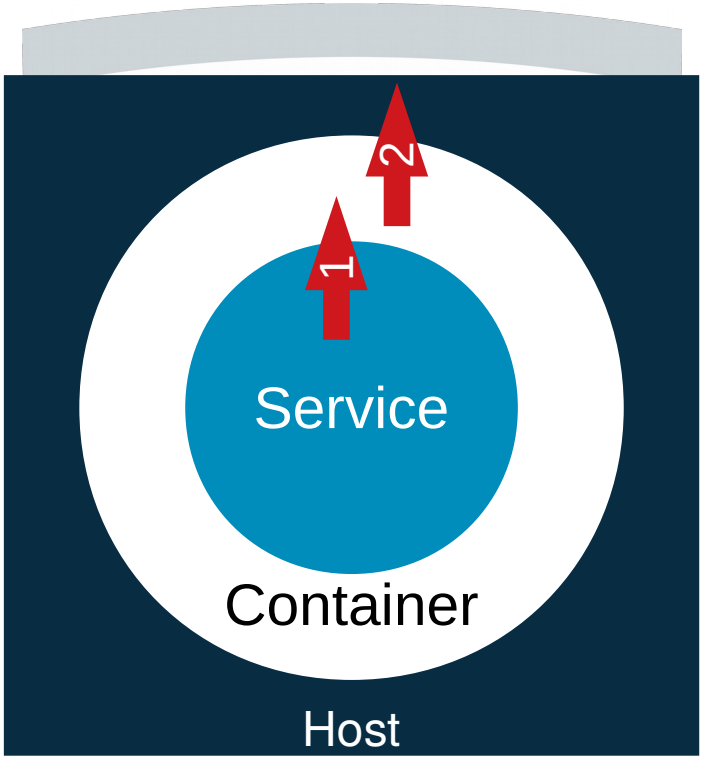
Vulnerabilities

Shellshock, 2014

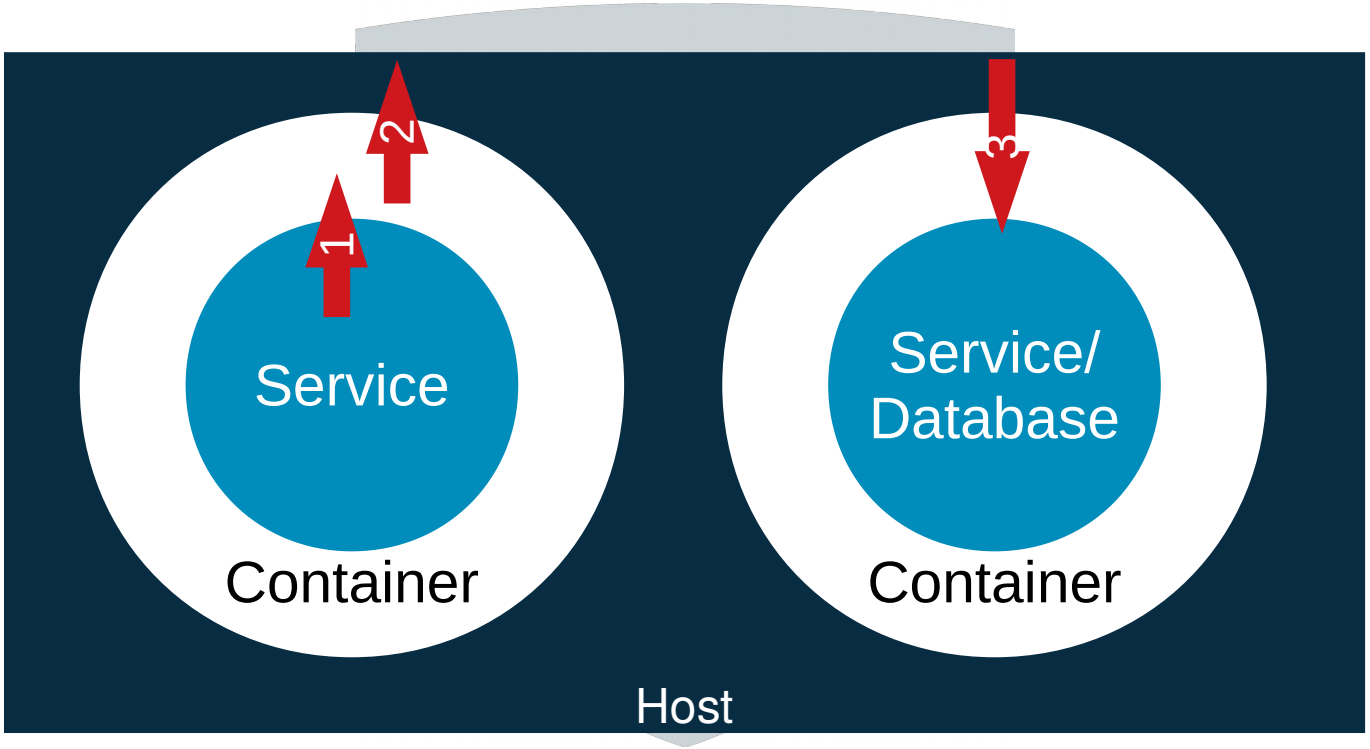
→ privilege escalation

→ run arbitrary commands

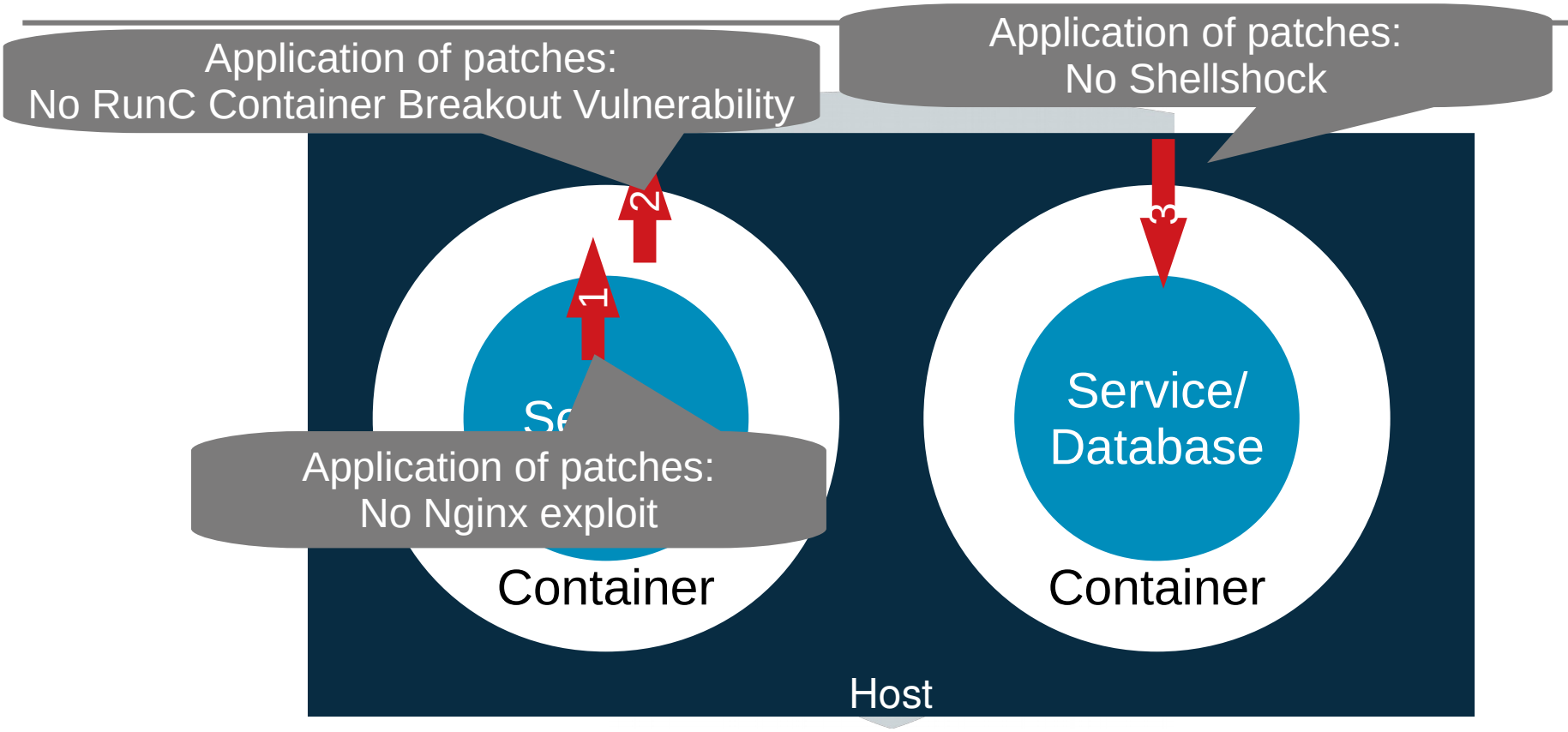
Container Breakout



Container Breakout and more



Container Breakout and Patches



Strategies

- Attack surface reduction
- Scan for vulnerablities
- Fast patching

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Attack Surface Reduction

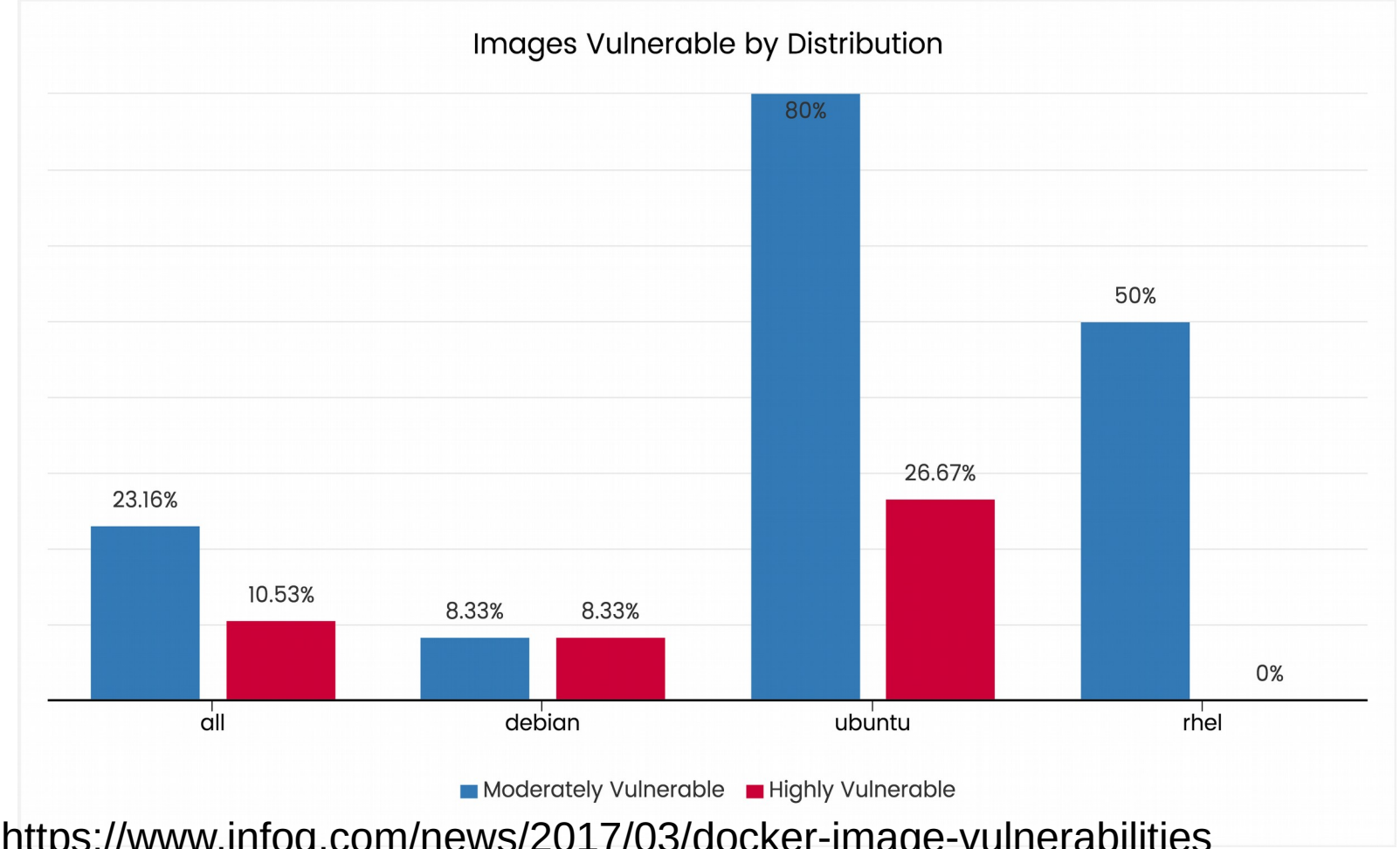
- Careful selection of distribution

Distribution Selection

- Vulnerabilities
- Speed of providing patches
- Size
- Maintainability
- Stability

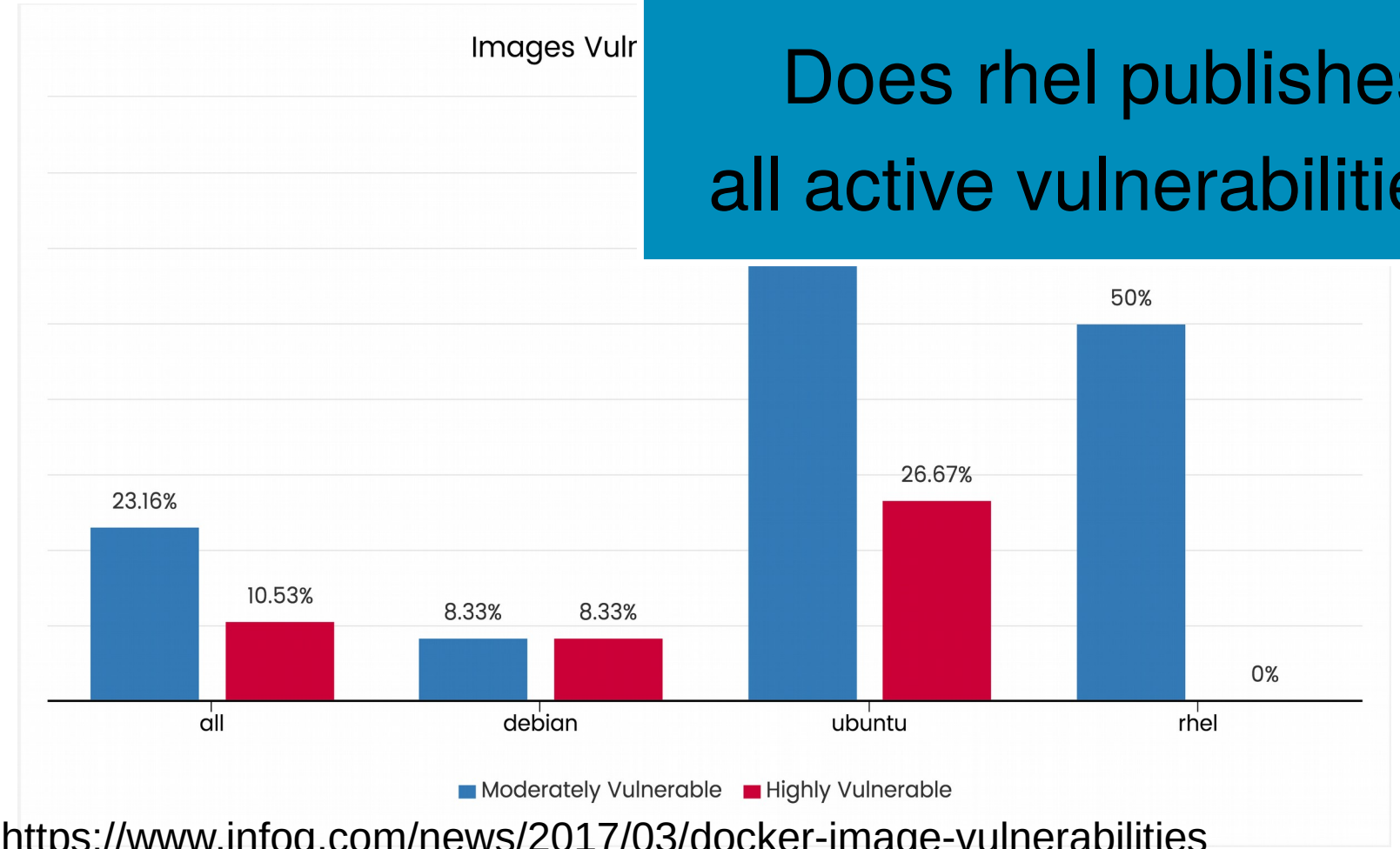
research done with Hendrik Halkow

Image Vulnerable by Distribution



Source: https://www.infoq.com/news/2017/03/docker-image-vulnerabilities

Image Vulnerable by Distribution



Source: https://www.infoq.com/news/2017/03/docker-image-vulnerabilities

OS Selection

- Image size:
  - Alpine: 2.6 MB
  - CentOS: 71.9 MB
  - Debian: 18.3 MB
  - Red Hat Enterprise Linux: 30.8 MB
  - Ubuntu: 31.0 MB

OS Selection

- Image size:
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  - Debian: 18.3 MB
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Does a small image size implies less vulnerabilities?

Maintainability

- Custom *glibc* and *bash* in Alpine

  → Usage of additional *pkg-glibc* in Alpine

  → Not compatible with most Java versions

glibc provides API to the kernel, e.g. *open*, *read*, *write*, *malloc*, …

A manually added Java compatible *glibc* needs to be added

Distroless

Copy only needed files to production images

→ No shell in container

Distroless

- Advantages:
  - Less vulnerable files
- Disadvantages:
  - Requires knowledge
  - For development purpose: original distribution

Hint:

- Scan the original image

  → Results in a lot of false positves

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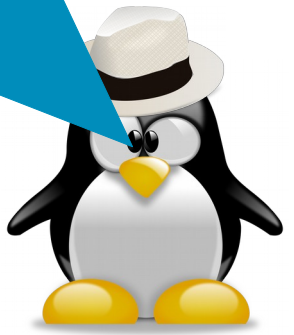
Whom of you is scanning images for known vulnerabilities?



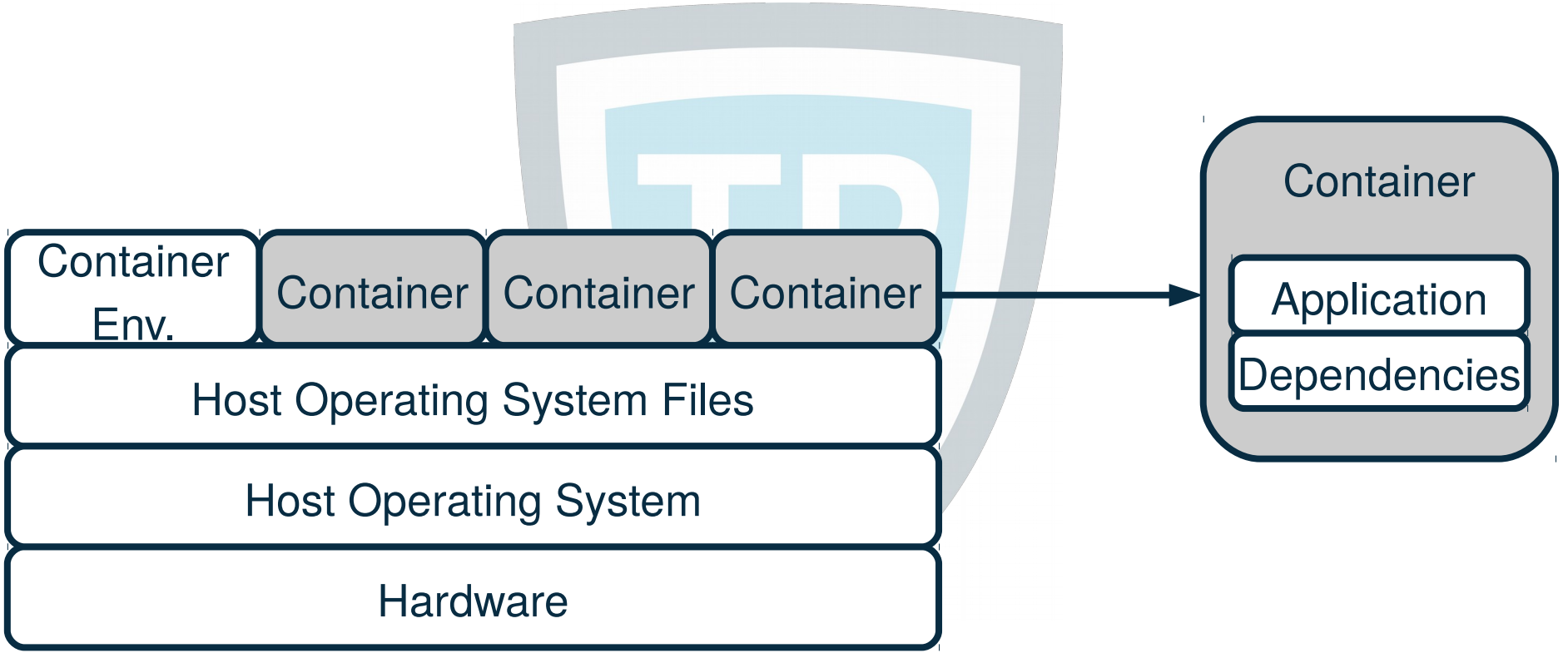
Scanning for Known Vulnerabilties

- What?
- How?
- When?
- Who?

Detection of Components with Known Vulnerabilties

- What?
  - Application
  - Virtualized Operating System (e.g. Container)
  - Operating System
- How?
- When?
- Who?

Docker


Container
Env.
Container
Container
Container
Host Operating System Files
Host Operating System
Hardware
Container
Application
Dependencies

Scanning for Known Vulnerabilties

- What?
- How?
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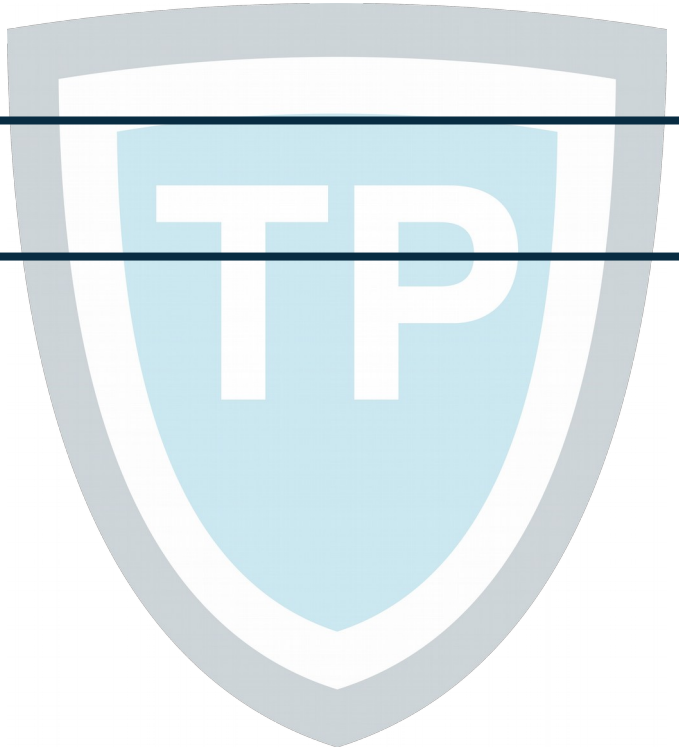


Scan for Vulnerable **Application** Dependencies

- Commercial Tools
  - Blackduck, Artifactory, FOSSA, Whitesource, ...
- Open Source Tools
  - OWASP Dependency Check, NPM, ...

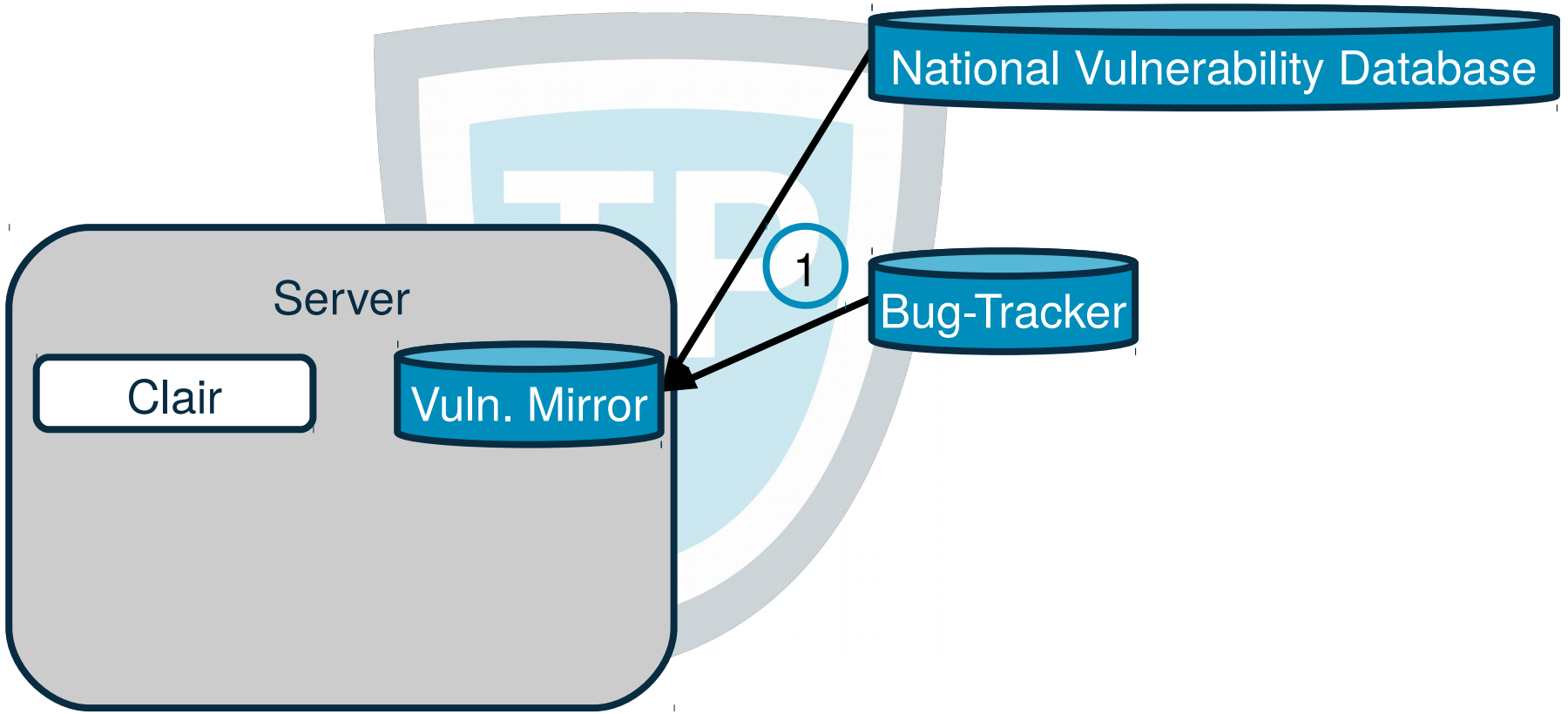
Scan for Vulnerable **Image/Container** Dep.

- Commercial Tools
  - Anchore, Artifactory, Blackduck, hub.docker.com, Tenable.io® Container Security, ...
- Open Source Tools
  - Anchore, CoreOS Clair, OpenSCAP, ...

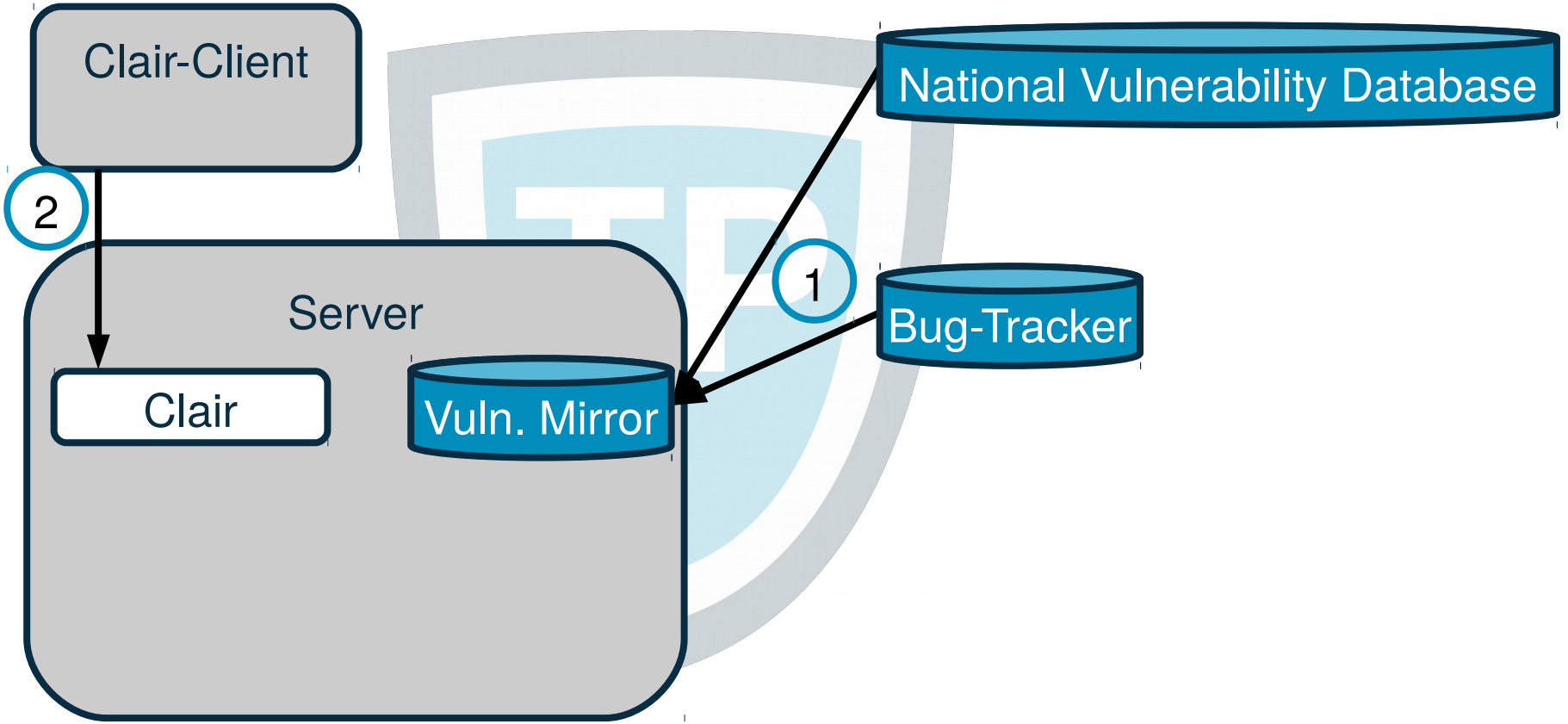
Approaches

- Identification of dependencies incl. version
  - Package managers (App/OS)
  - Fingerprinting (Hash-Sums) of artifacts
  - Pattern recognision
- Vulnerability sources
  - National Vulnerability Database
  - Feeds (e.g. bug tracker)

Approach on Example of Clair



Approach on Example of Clair



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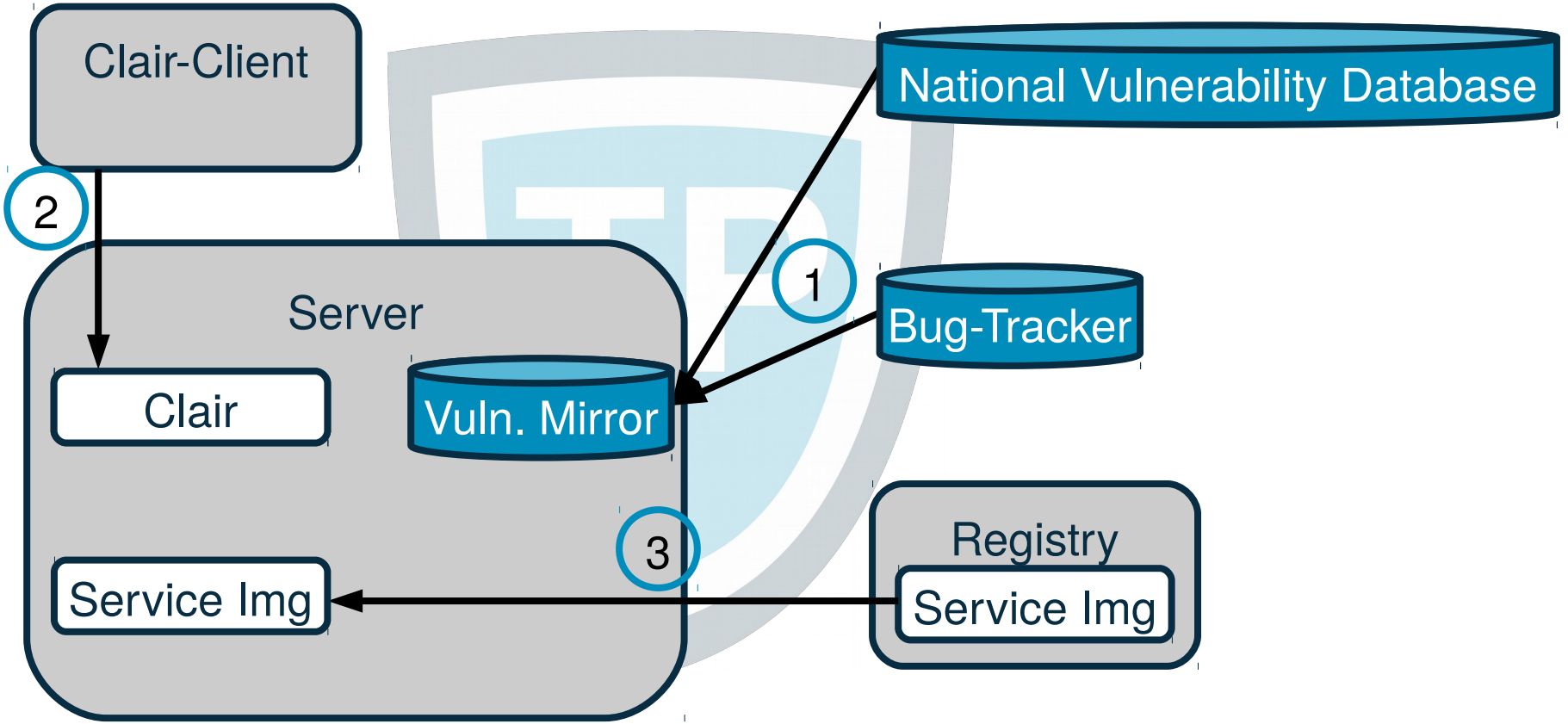
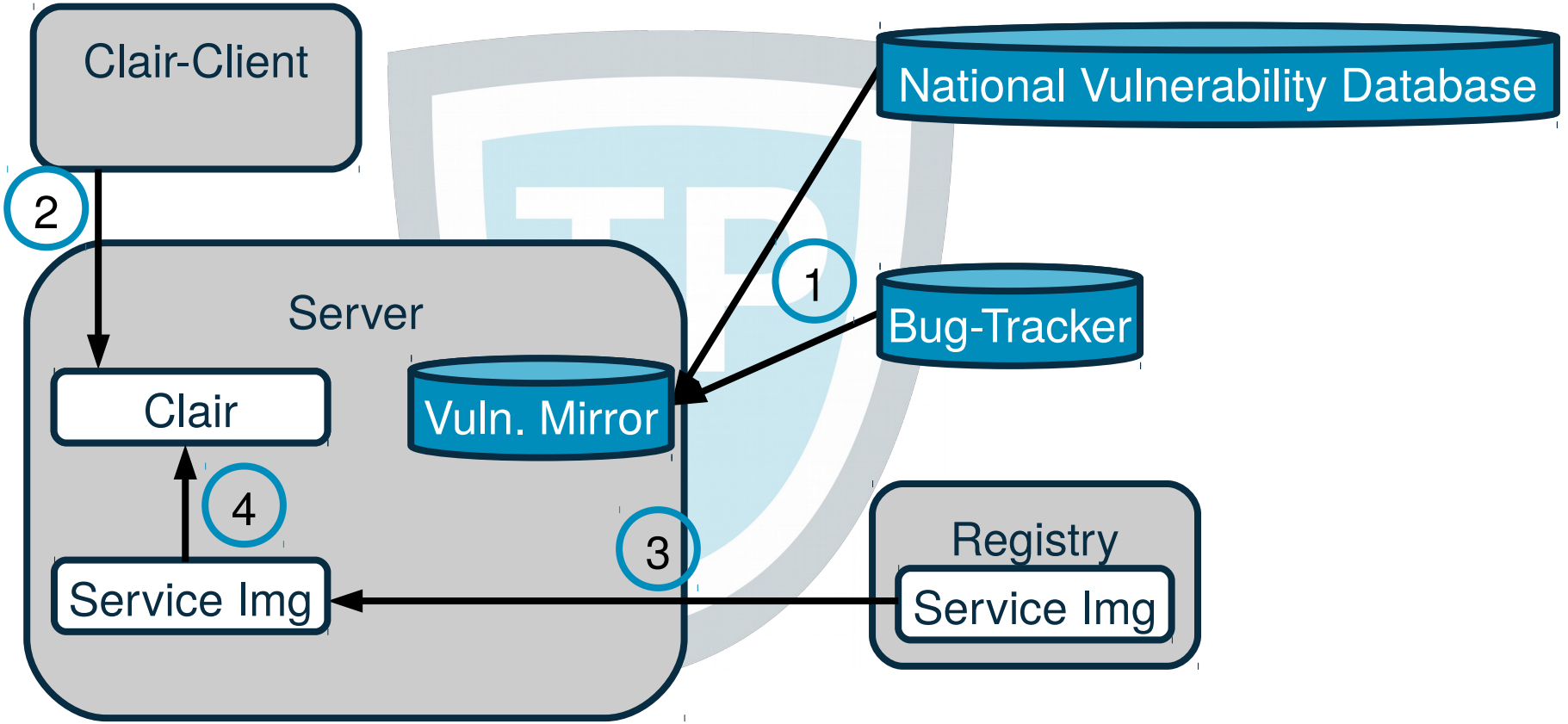
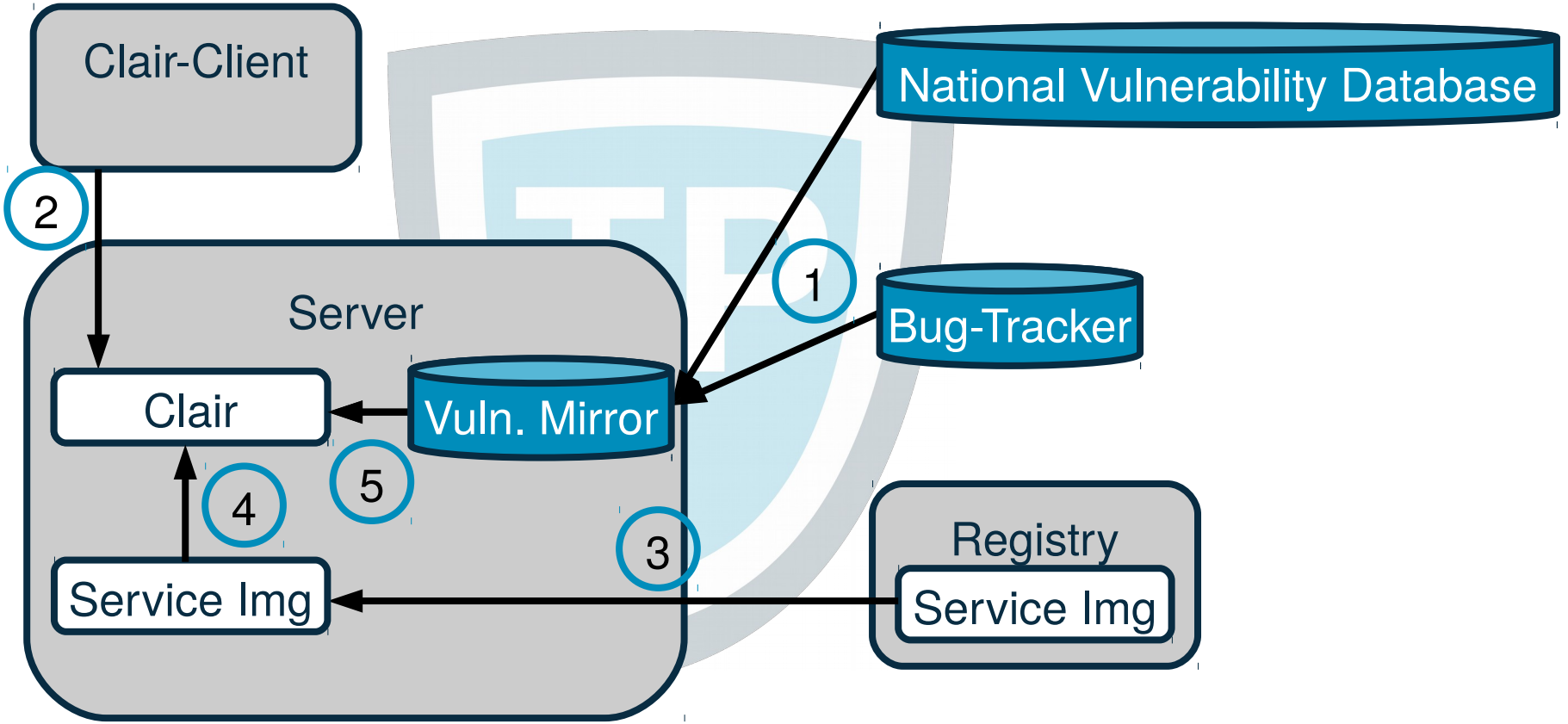


Approach on Example of Clair



Approach on Example of Clair



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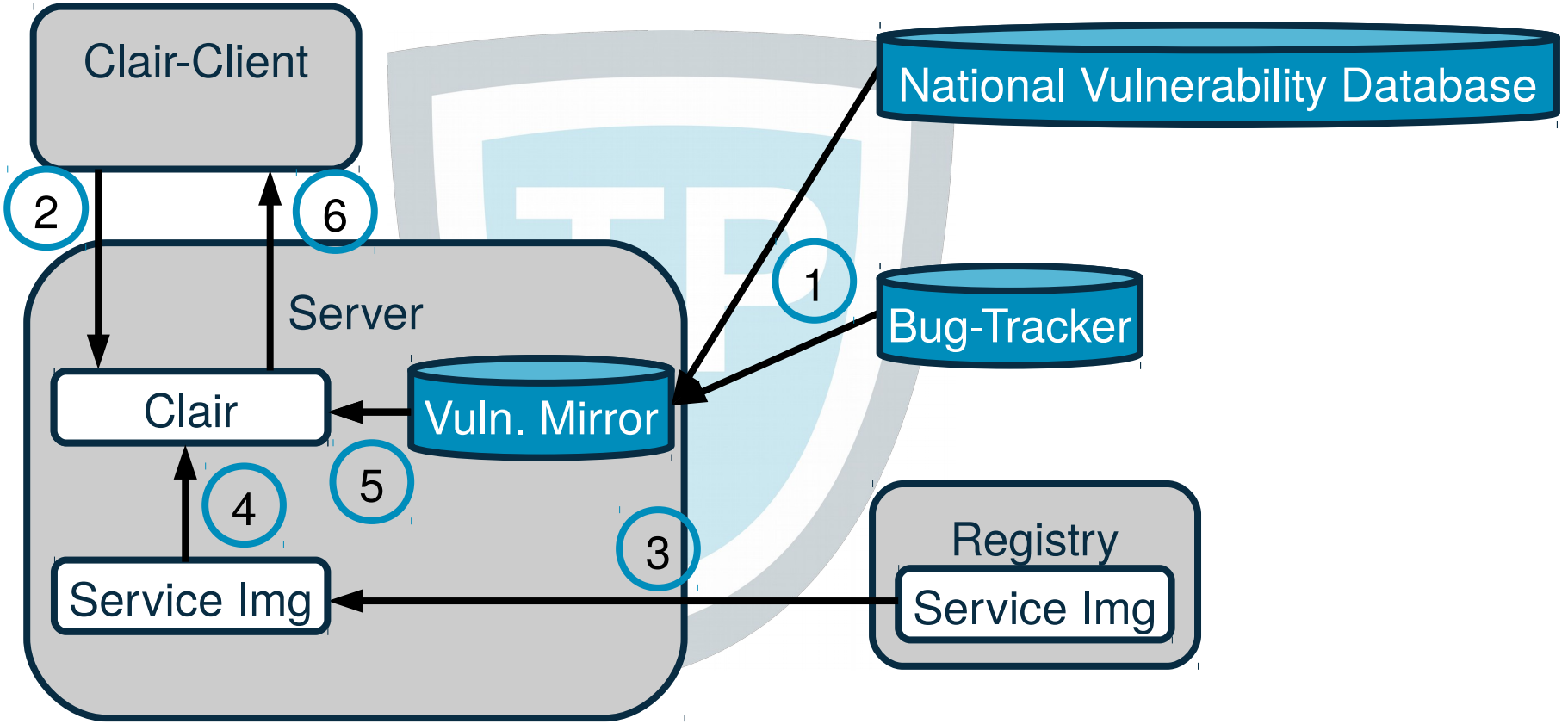


Quality Gates: Thresholds

- Only *n* vulnerabilities
- Only *n* vulnerabilities with criticality *High*
- Dev and ops do not decremt thresholds!

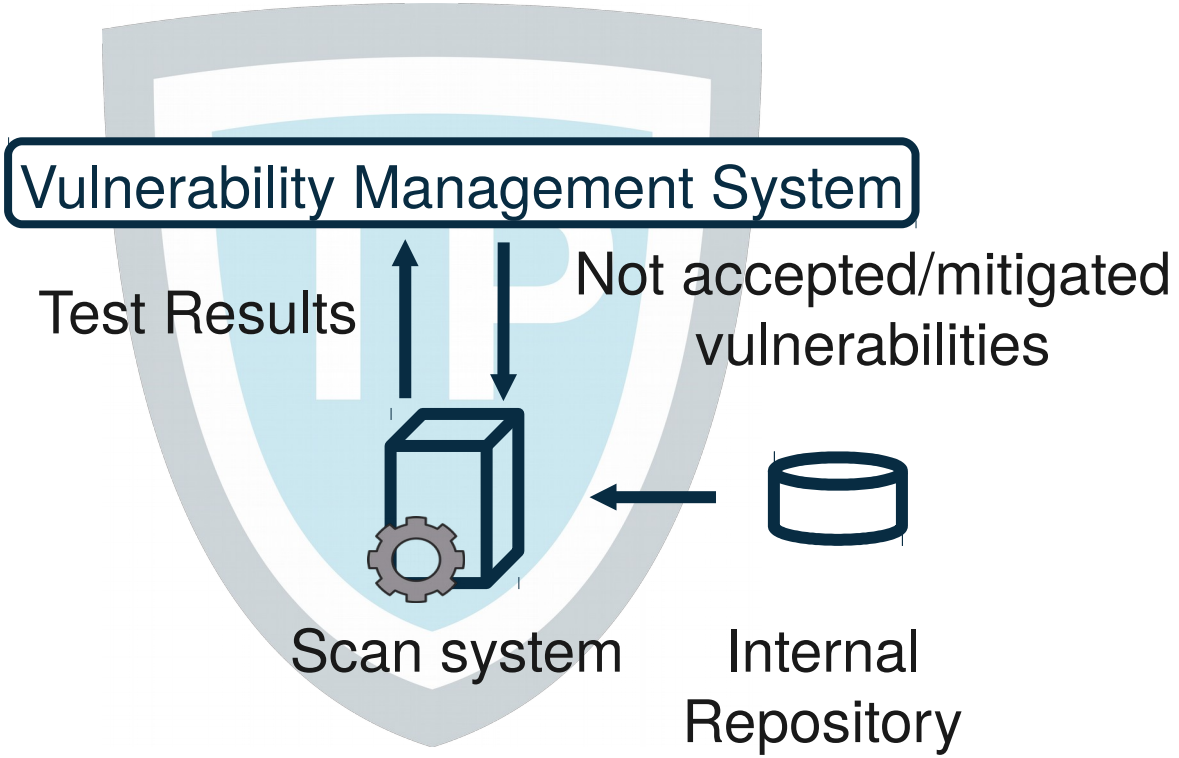
Quality Gates in Regulated Organisations

- Vulnerabilites with ciriticality greater than medium:
  MUST be handeld
- Vulnerabilities with ciriticality low and medium:

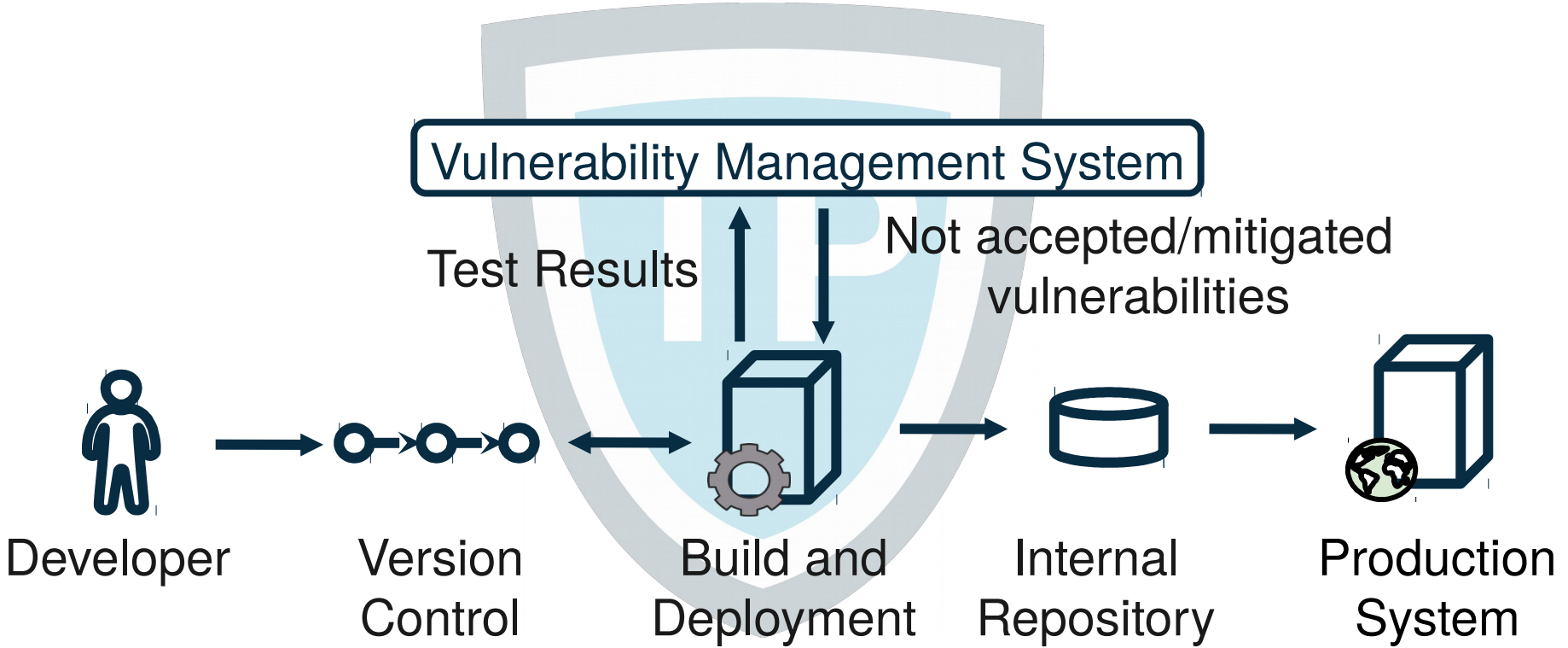
  SHOULD be handeled

  → Not part of automatic quality gate

Scan System


Vulnerability Management System
Test Results
Not accepted/mitigated vulnerabilities
Scan system
Internal Repository

Continuous Integration: Image Scanning



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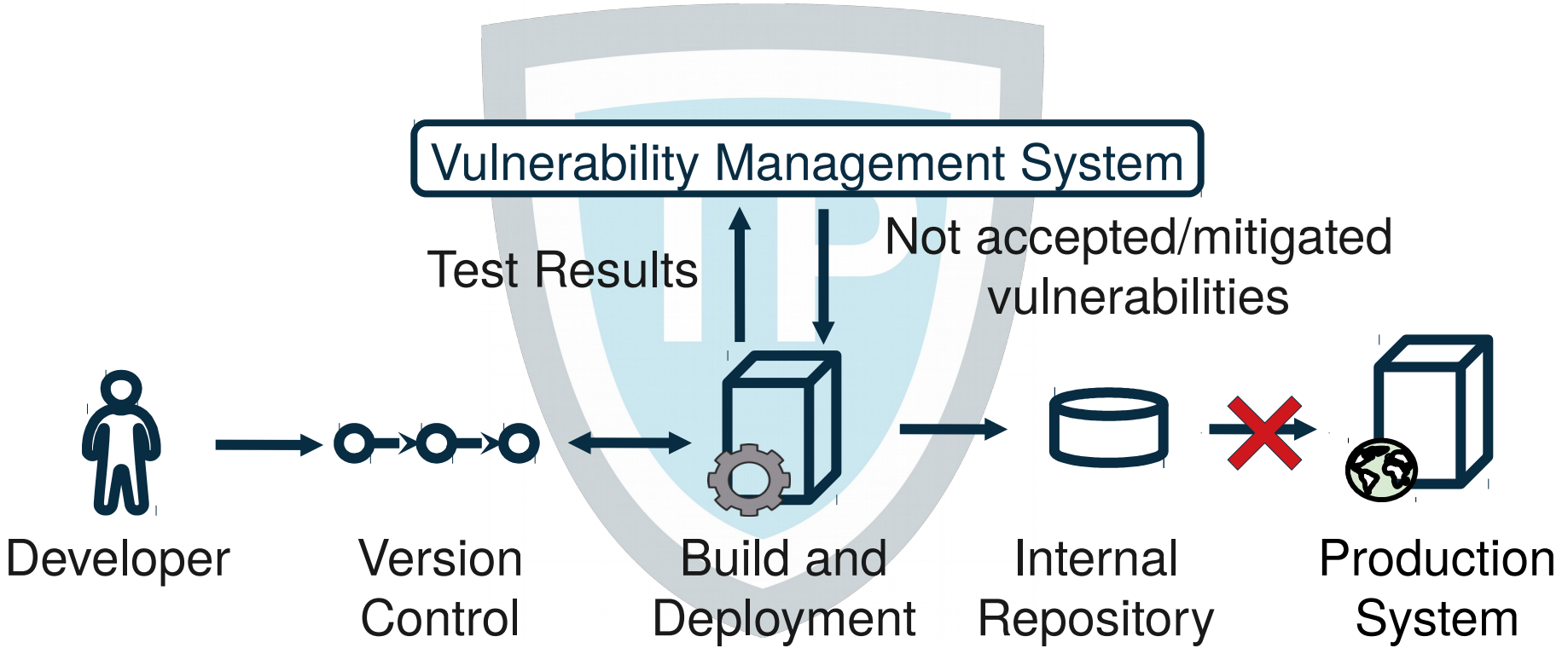

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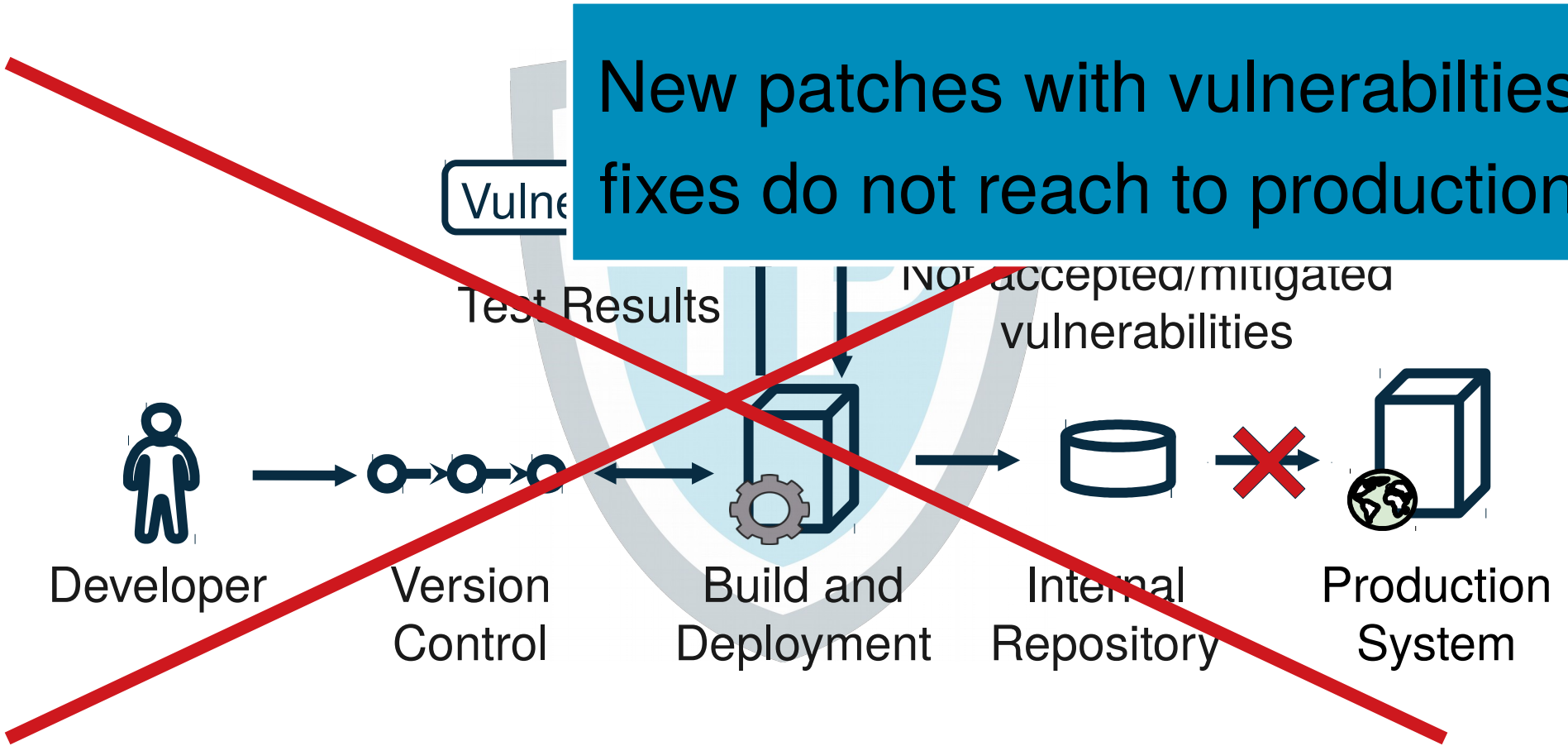
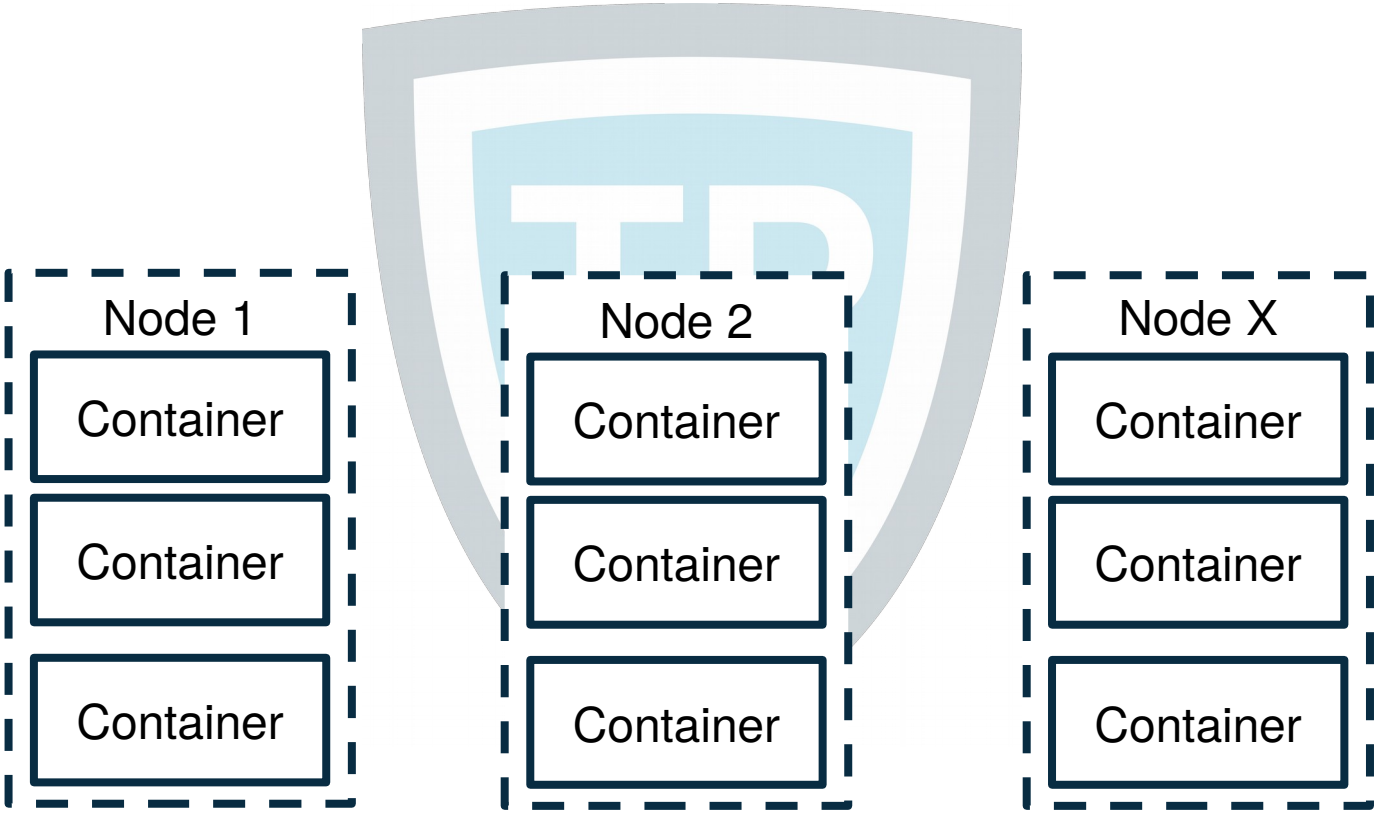


Process to Scan Images



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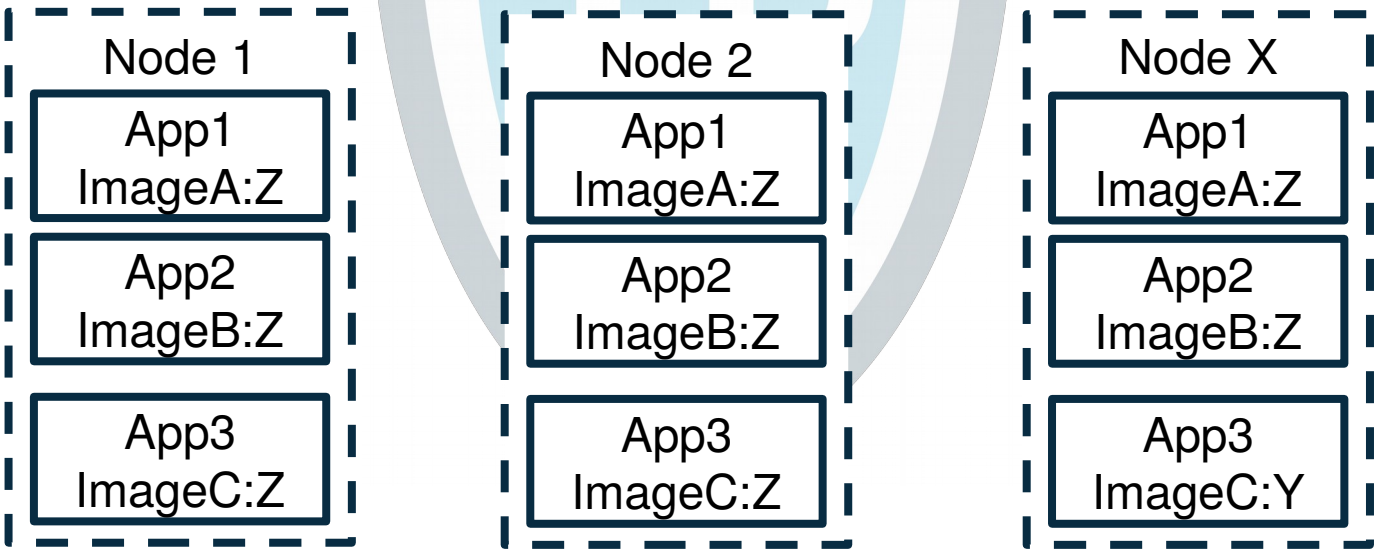

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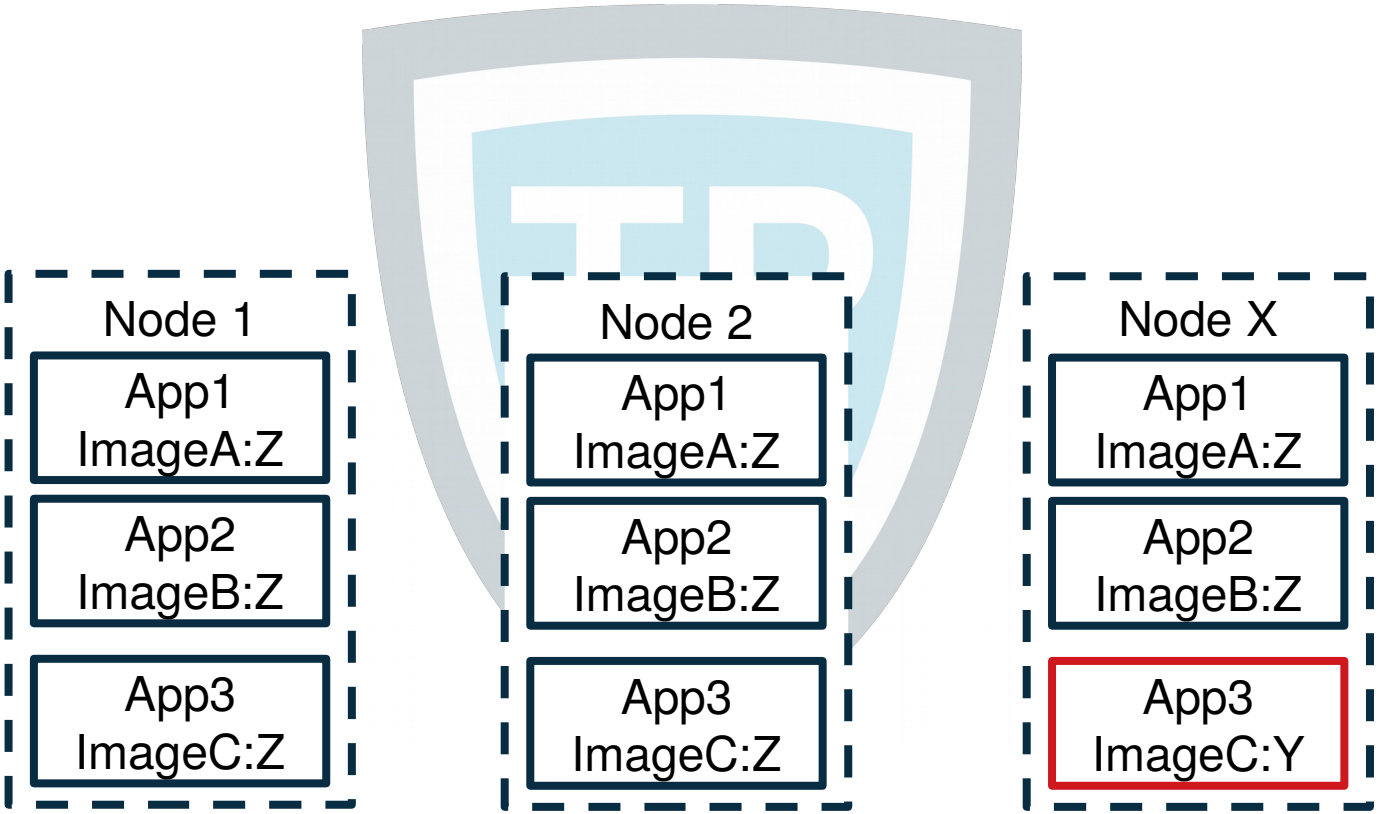

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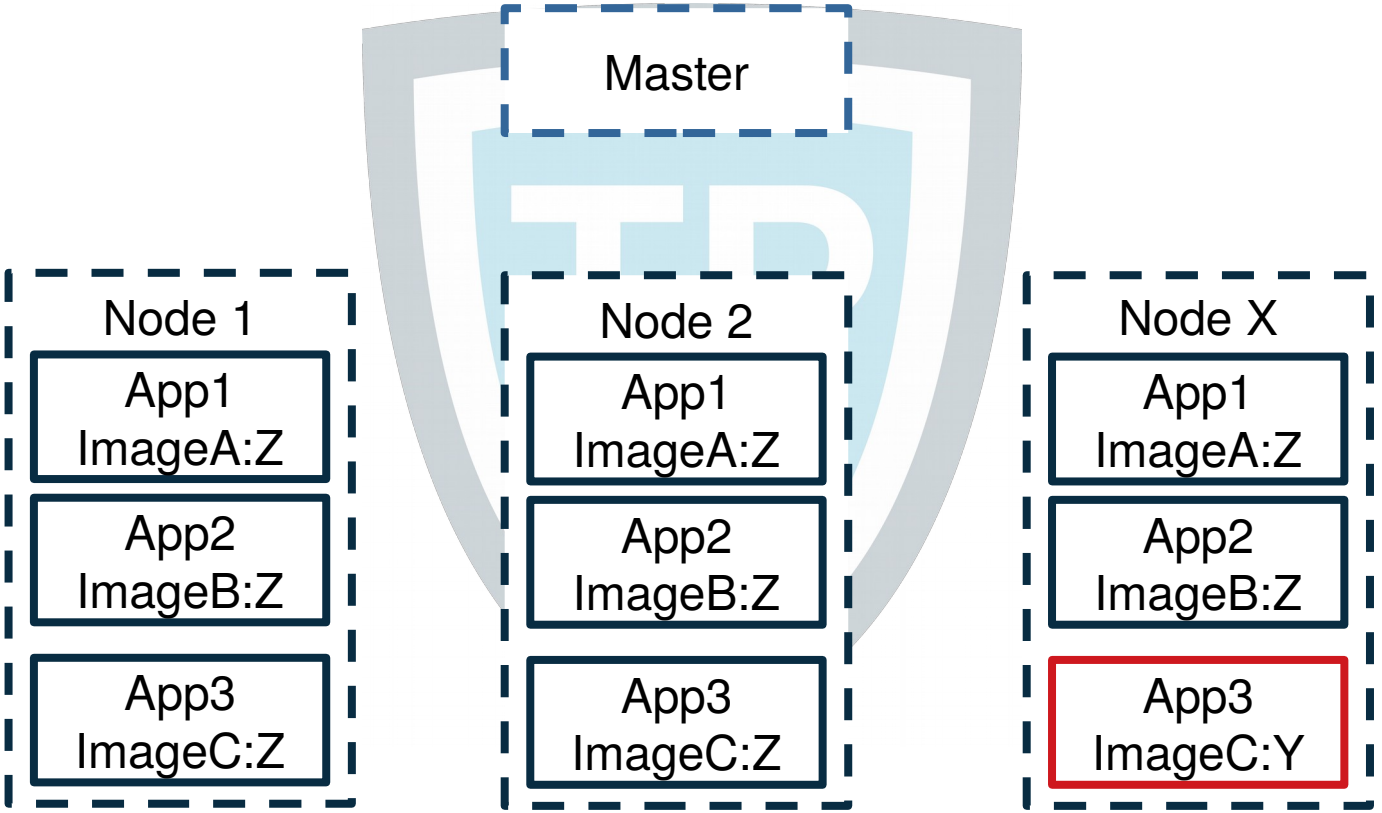
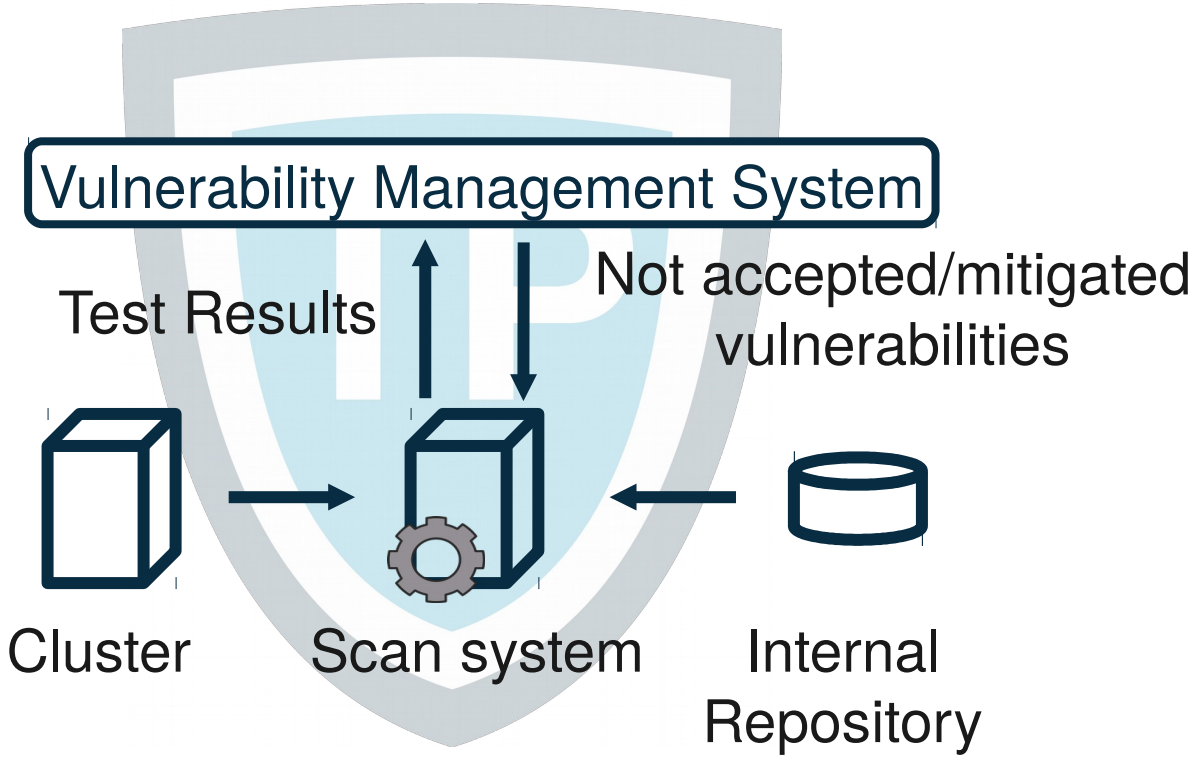


Scan System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Test Results
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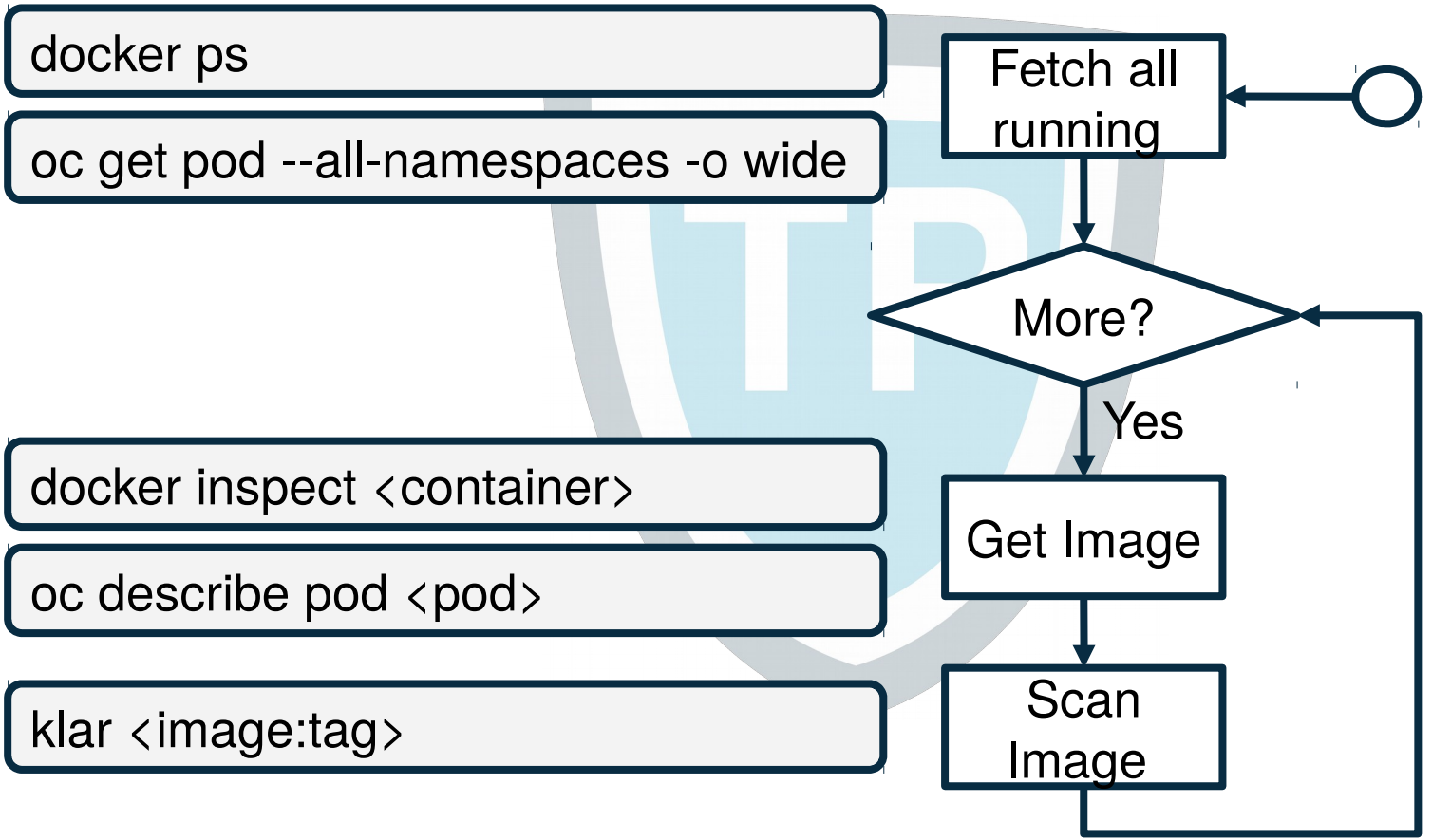
Cluster
Scan system
Internal Repository

Process to Scan Images



Praxis Tipp

- Original images (e.g. nginx) often copy compiled version

  → No package manager

  → No dependencies (Open Source)

  → No Vulnerabilities

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  → No package manager

  → No dependencies (Open Source)

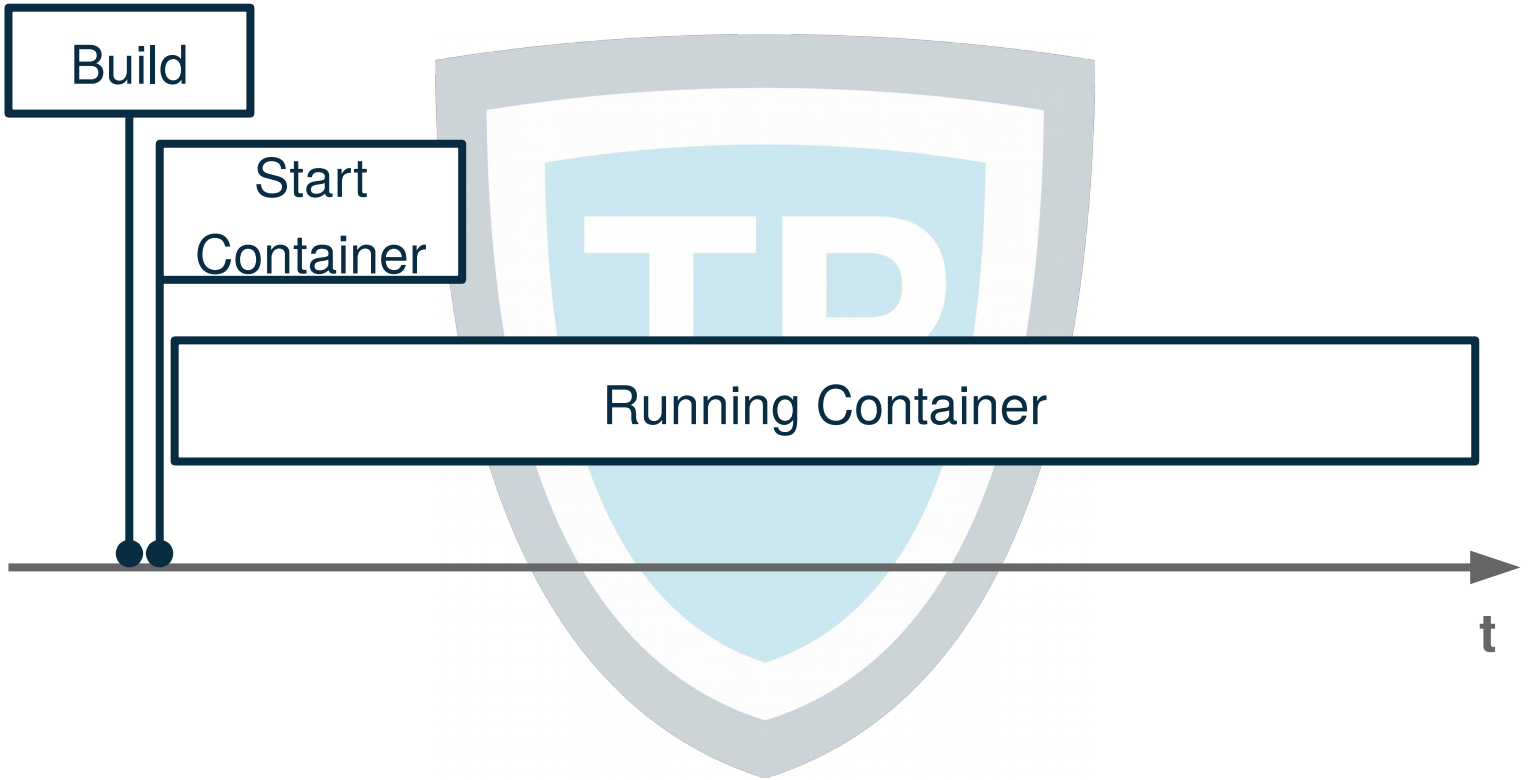
  → No Vulnerabilities

  → Meta package (same version)

Scanning for Known Vulnerabilties

- What?
- How?
- When?
- Who?

Simplified Vulnerability Lifecycle



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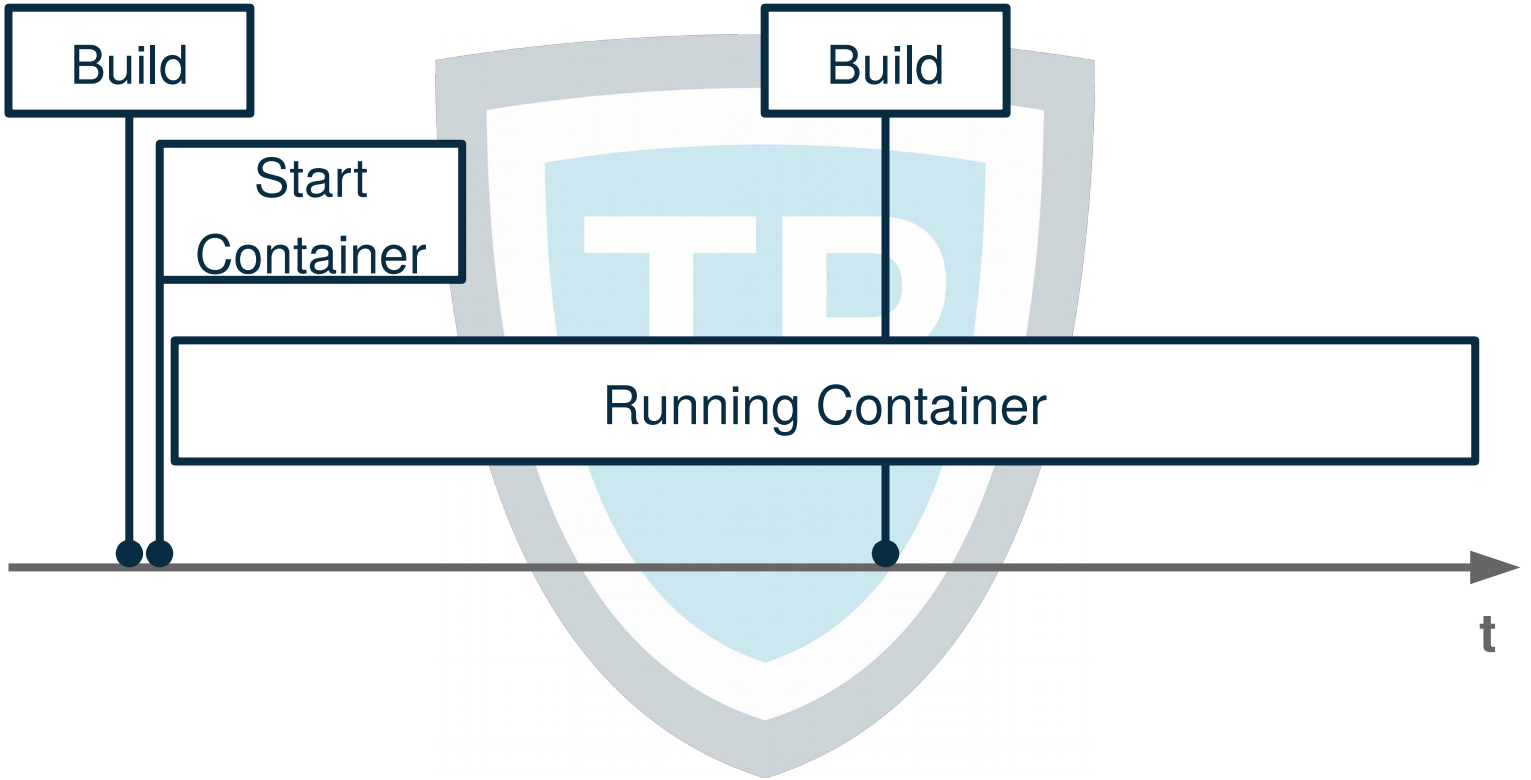

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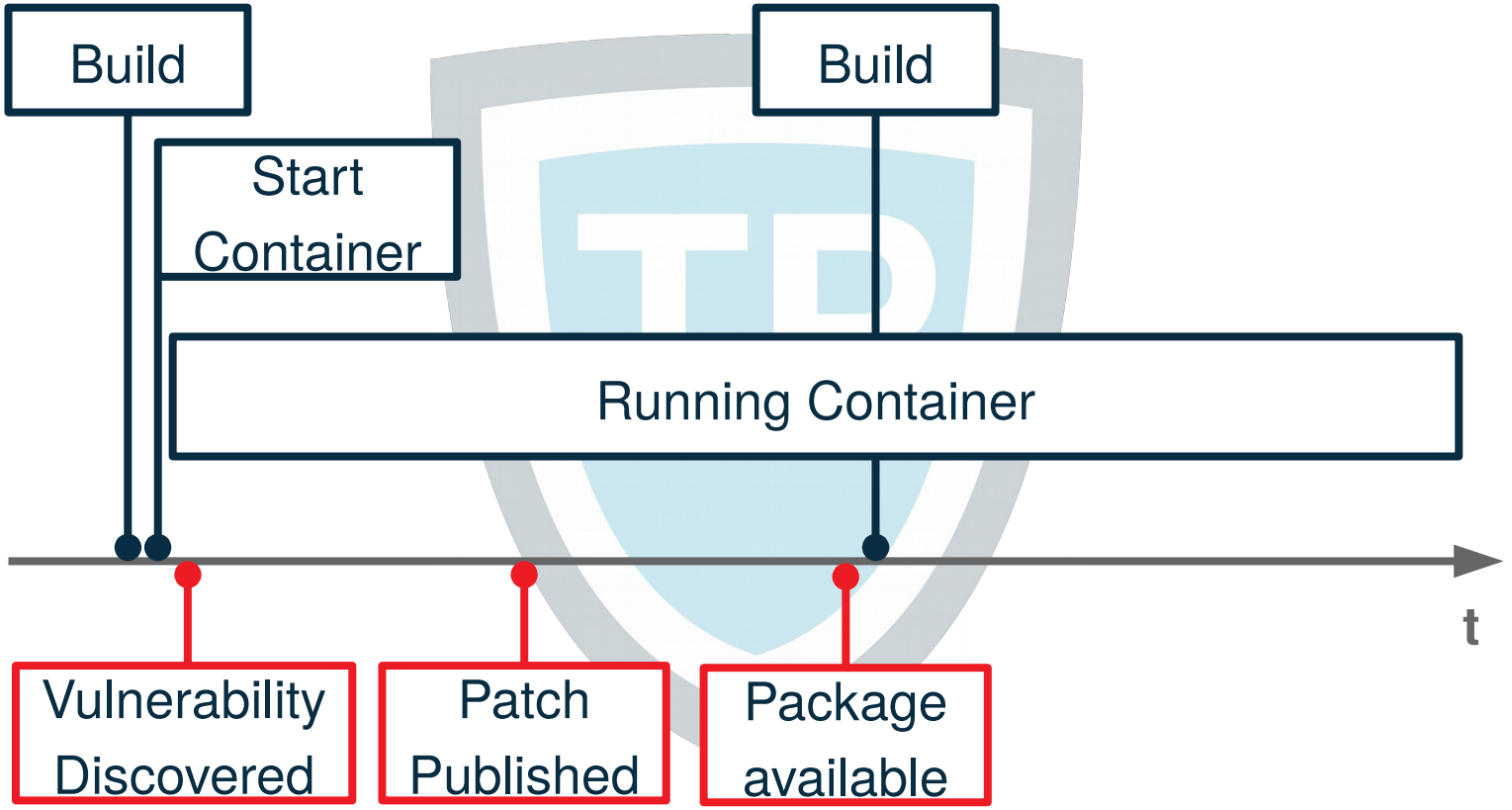

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- What?
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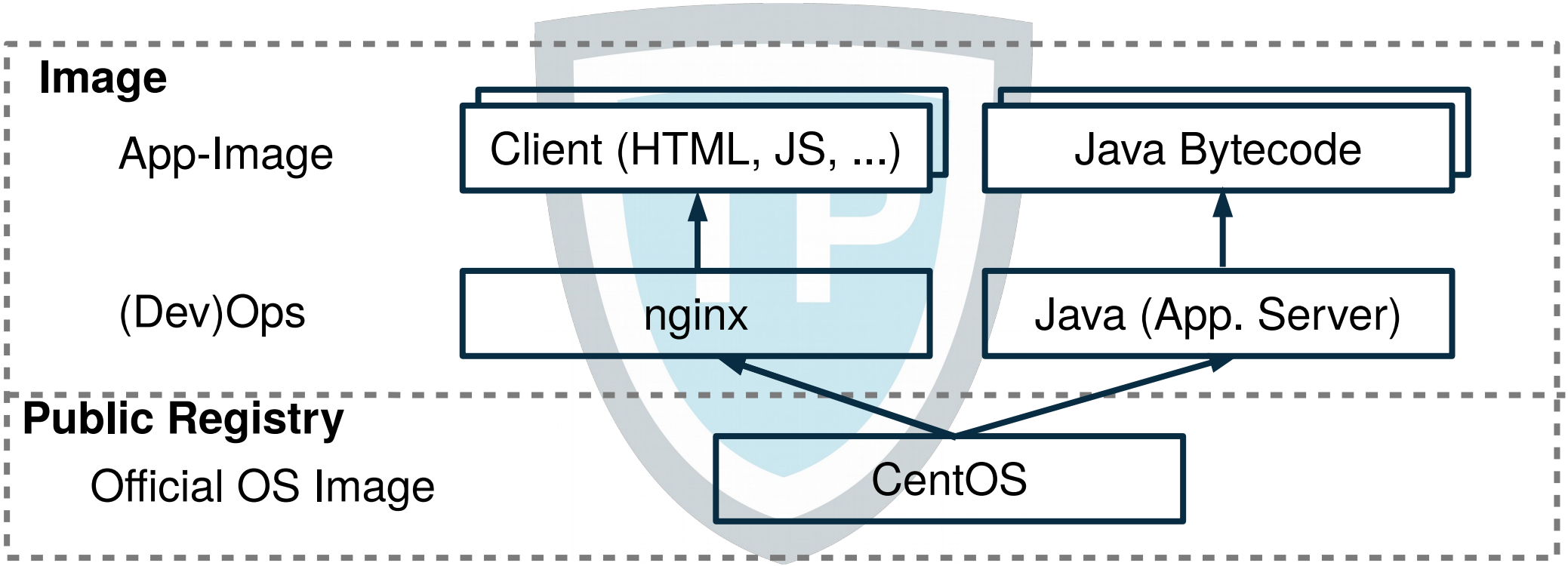
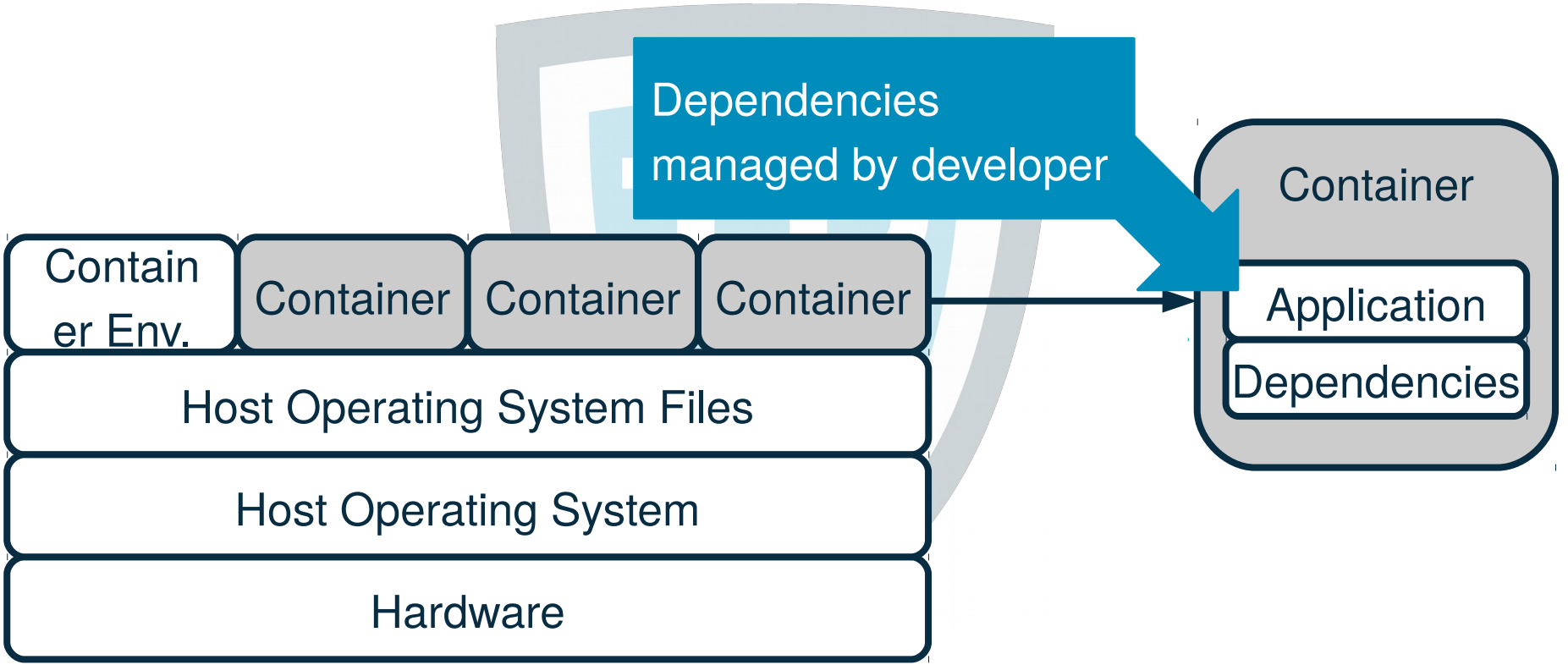
Image Inheritance Tree



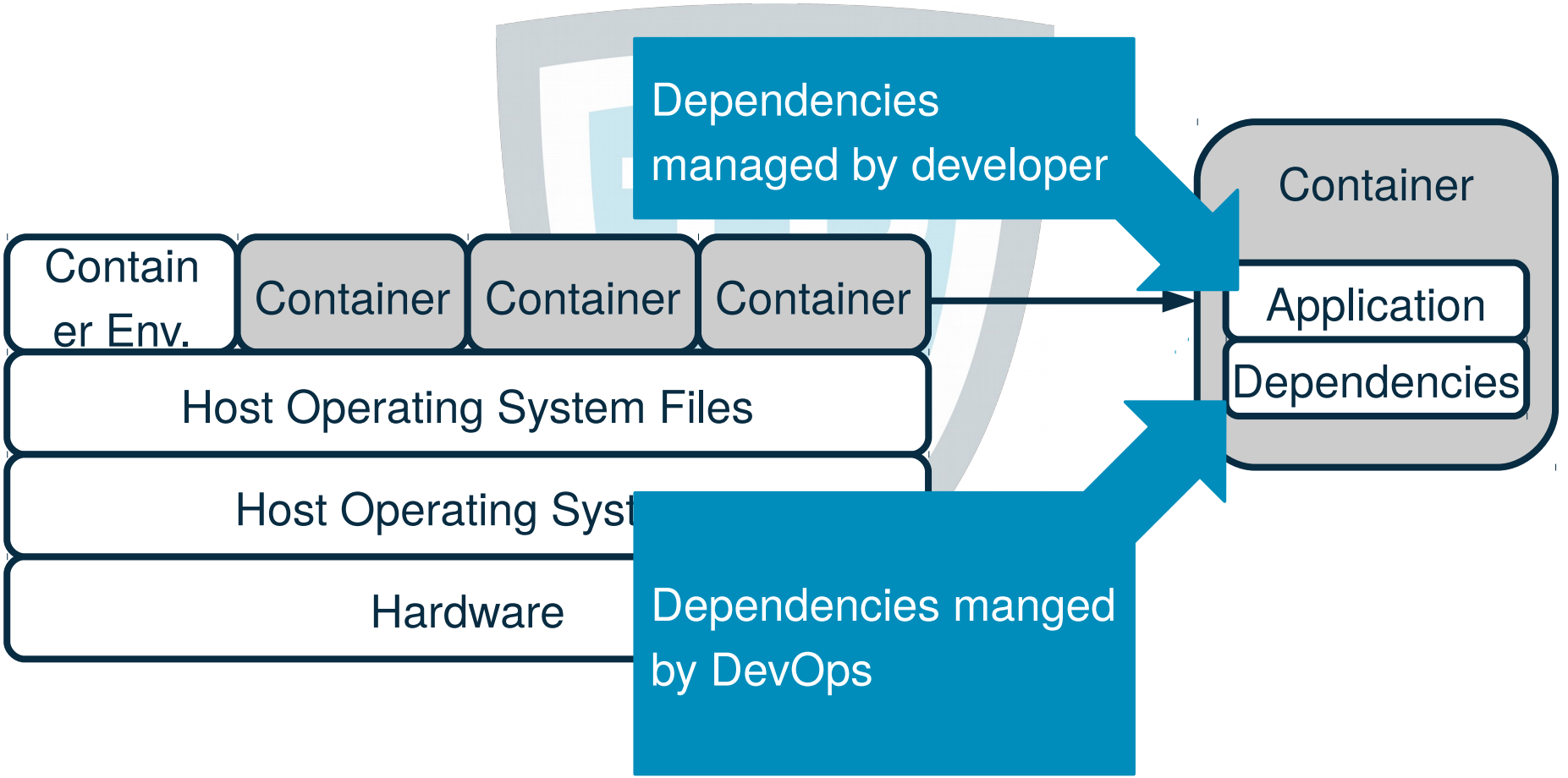
Simplified RACI Matrix

Role	Responsible	Accountable	Consulted	Informed
DevOps-Manager		X		
DevOps-Team	X			
CTO (No Patch)			X	
Customers / Projects				X

Patch-Responsiblities



Patch-Responsiblities



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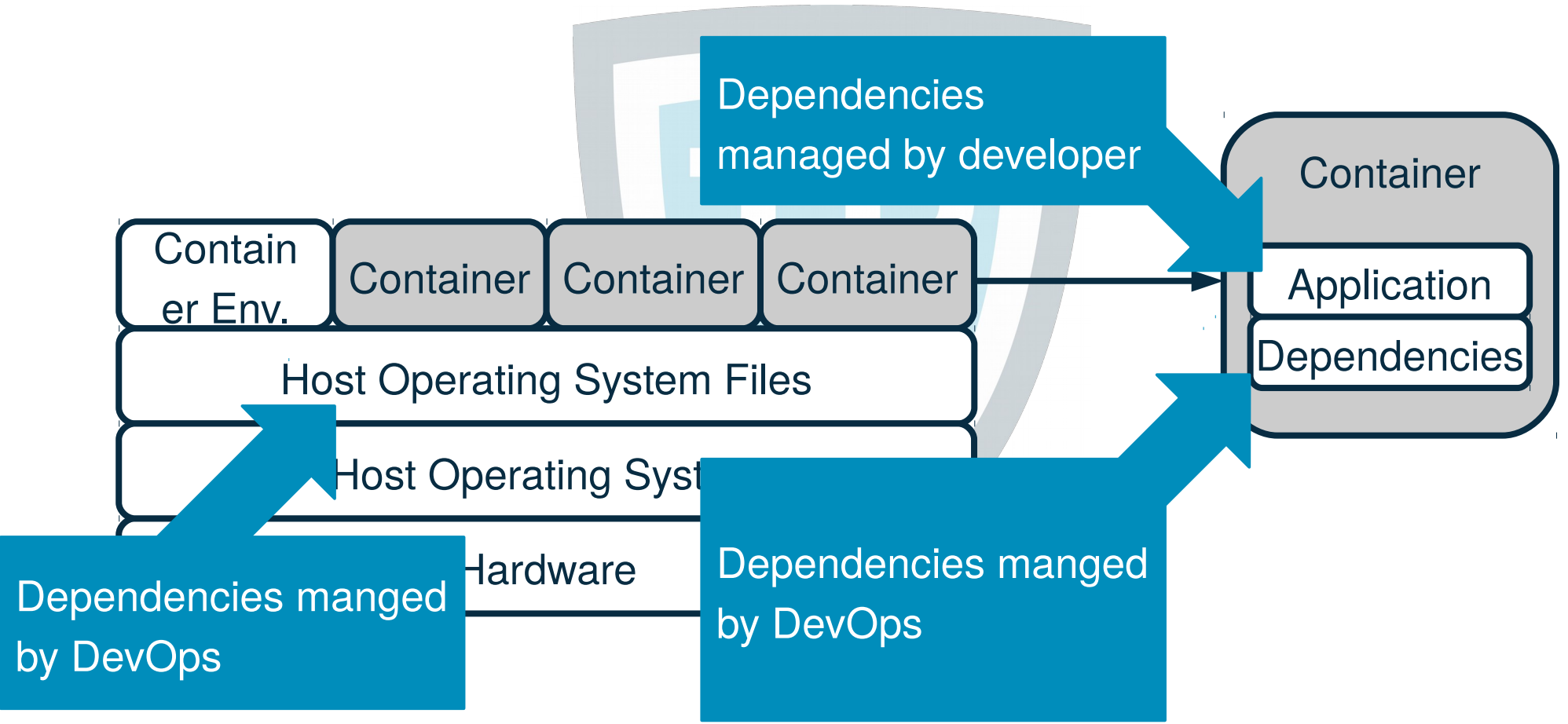

Responding to a Vulnerability

- Transfer
- Avoid
- Mitigate, or
- Accept the risk

Responding to a Vulnerability

- Transfer
- Avoid
- Mitigate, or
- Accept the risk (e.g. temporarily)

Scenario: Critical Vulnerability in *glibc*

What will you do?

- Fix it by yourself (do you have C/C++ developers?)
- Decommission system
- Transfer risk
- Accept (wait for patch in distribution)

Example Denial of Service

CVE-2017-8804

debian

Name	CVE-2017-8804
Description	The xdr_bytes and xdr_string functions in the GNU C Library (aka glibc or libc6) 2.25 mishandle failures of buffer deserialization, which allows remote attackers to cause a denial of service (virtual memory allocation, or memory consumption if an overcommit setting is not used) via a crafted UDP packet to port 111, a related issue to CVE-2017-8779.
Source	CVE (at NVD; CERT, LWN, oss-sec, fulldisc, bugtraq, EDB, Metasploit, Red Hat, Ubuntu, Gentoo, SuSE, Mageia, GitHub code/issues, web search, more)
NVD severity	high (attack range: remote)
Debian Bugs	862086

Example CVE-2015-0235

CVE-2015-0235

Name	CVE-2015-0235
Description	Heap-based buffer overflow in the __nss_hostname_digits_dots function in glibc 2.2, and other 2.x versions before 2.18, allows context-dependent attackers to execute arbitrary code via vectors related to the (1) gethostbyname or (2) gethostbyname2 function, aka "GHOST."
Source	CVE (at NVD; CERT, LWN, oss-sec, fulldisc, bugtraq, EDB, Metasploit, Red Hat, Ubuntu, Gentoo, SUSE bugzilla/CVE, Mageia, GitHub code/issues, web search, more)
References	DLA-139-1, DSA-3142-1
NVD severity	high (attack range: remote)
Debian Bugs	776391

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Periodical Patch Management with Containers

Nightly/Weekly:

- Pull external images
- Perform upgrade/update
- Build project images
- Test images (e.g. A/B-Testing)
- Destroy and start containers

Pitfalls

- Image caching during build (no change → old version)
- CentOS: *yum update --security*

Fail Secure?

https://bugs.centos.org/view.php?id=3578

CentOS Bug Tracker

Activities

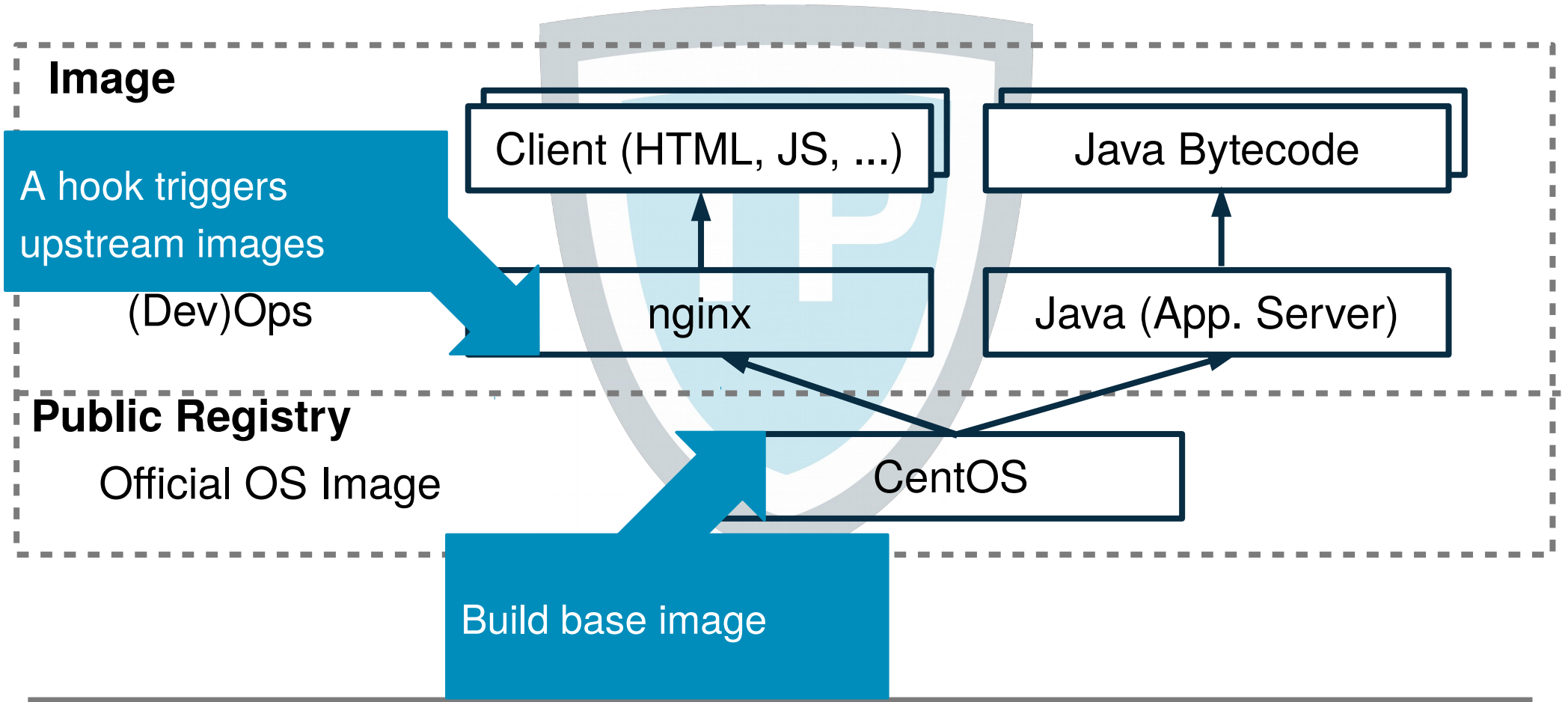
kbsingh@karan.org

2009-04-26 14:36

administrator ~0009256

we dont support yum security in any of the centos repos at the moment

Image Updates



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Pro/Con

Nightly build+deploy

- Good for external images
- High testing requirement
- Continuous Delivery required

Scanning

- Not blind
- High effort in analysing vulnerabilities

→ Time consuming

Conclusion

- Patching is not easy
- Detection of vulnerabilities in running containers
- Quality gates are important and a centralized vulnerability mangement (system)

Questions?

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Trainings	When	Where
Docker Security Workshop	30.08.2019	Hamburg
DevSecOps Workshop	09.09.2019	Hamburg
Sicherheit in Webanwendungen	16.09.2019	Hamburg

Backup