Pharos: Automated Container Image Security and Compliance Platform

Abstract

Pharos is an open-source platform designed to automate the security scanning, vulnerability management, and compliance reporting of container images in modern DevOps environments. It integrates with CI/CD pipelines, *Kubernetes* clusters, and monitoring tools to provide real-time insights into image security, streamline vulnerability remediation, and helps support regulatory compliance.

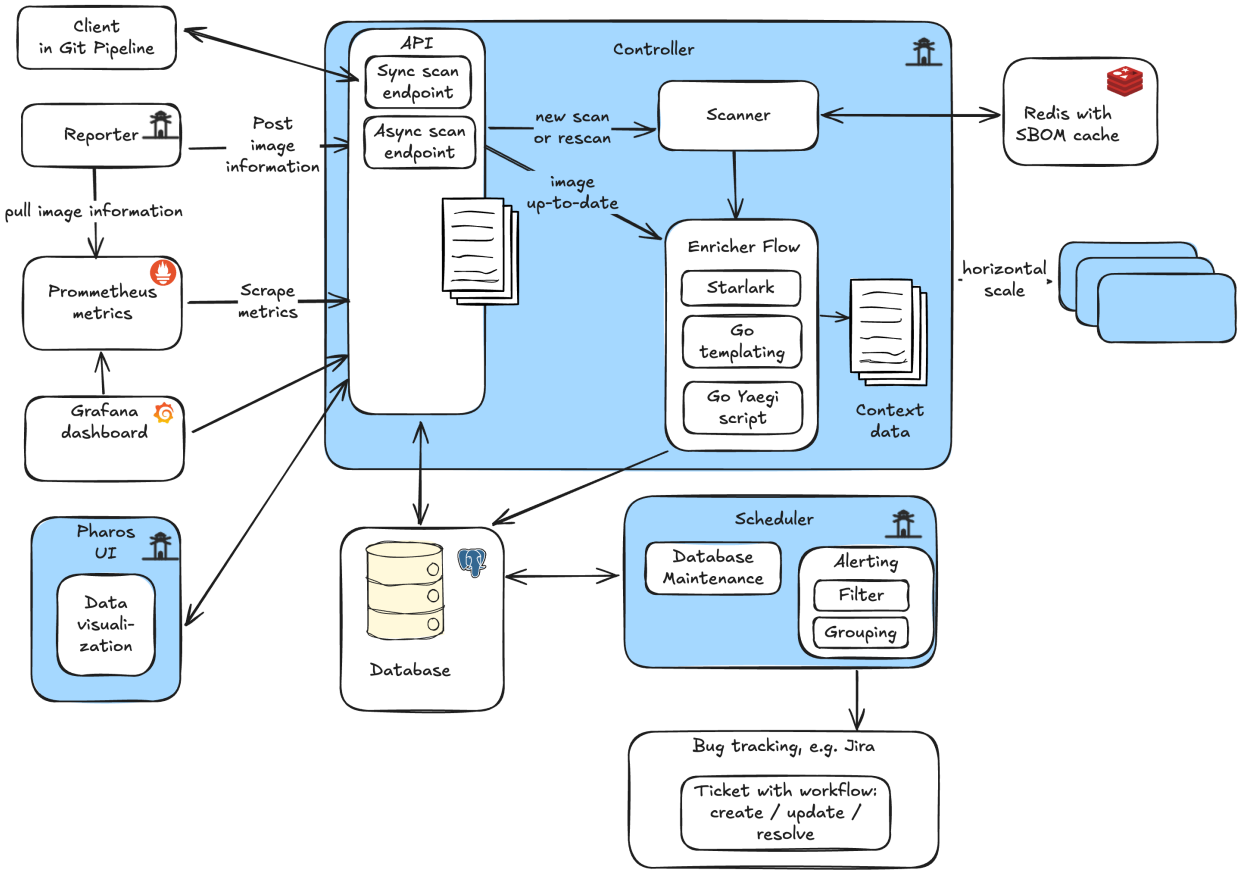
Introduction

Containerization has revolutionized software deployment, but it introduces new security challenges. Vulnerabilities in container images can propagate rapidly across environments. Pharos addresses these challenges by providing a scalable, automated solution for scanning, reporting, and managing container image security.

Architecture Overview

Pharos is built in Go and leverages a modular architecture:

- **Core Components**:
  - Controller handles API,scanning, enrichment,
  - Prometheus reporter, handles submission of images
  - Scheduler handles database maintenance and submission of alerts.
- **Supported Scanners**: Integrates with *Grype* and *Trivy* for vulnerability analysis.
- **Deployment**: Designed to run on *Kubernetes*, with Helm charts for simplified installation and management.
- **Extensibility**: Custom enrichers/mappers, plugin support, and integration with external systems.



Key Features

Open Source

Pharos is open source, new features can be added or bugs addressed by the community.

Automated Image Scanning

All scan requests are processed through the Pharos Controller, which orchestrates vulnerability analysis and compliance checks using *Grype* or *Trivy*.

Queue-Based Processing

Scan requests are queued for scalable, asynchronous task management, ensuring efficient handling of large volumes of images.

Comprehensive REST API

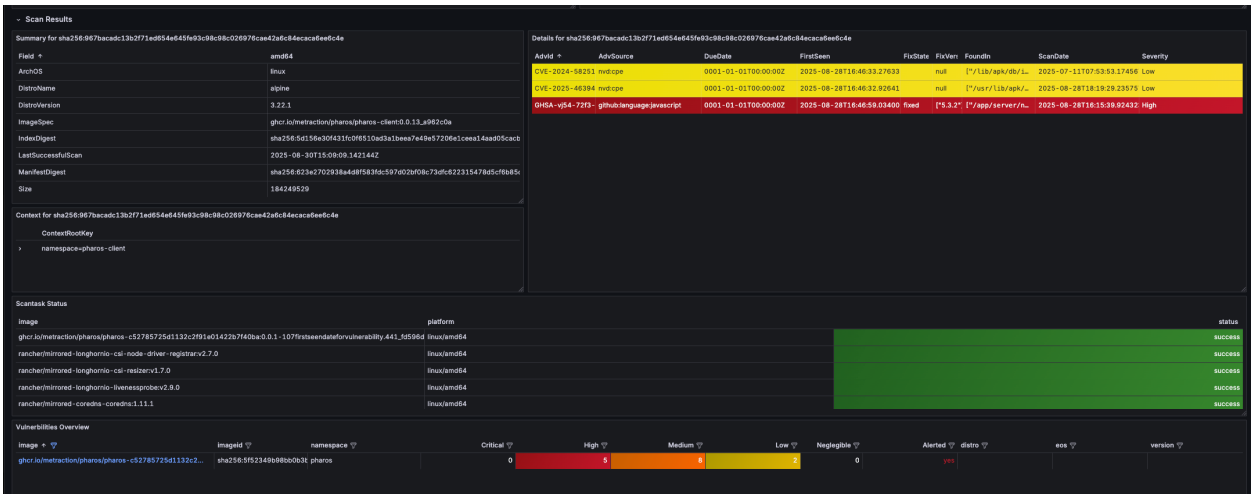
Pharos provides endpoints for submitting scan tasks, retrieving results, and integrating with external systems, enabling seamless automation and integration.

Scalability

The Controller with Scanner and REST API components can be scaled horizontally to meet increasing demands in large environments.

Real-Time Reporting

Prometheus integration enables real-time metrics collection, with Grafana dashboards available for visualization and monitoring.



Extensible Enrichment

Enrichers using Go Templating, Starlark scripts, or Yaegi Go scripting enrich image context.

Example for enrichers usage:

- Calculation of EOS (End-Of-Support) Date
- Setting of owner, to automatically assign tickets to teams or persons
- Setting of CMDB IDs by calling the CMDB's API or using files.
- Waiving of vulnerabilities or images
- Summarize data (see below)

The following example shows how we can summarize vulnerabilites with a simple Starlark script:

```
#!/usr/bin/env star

# Example return summary of findings
def enrich(input):
    data = input.payload
    severity_01_critical = 0
    severity_02_high = 0
    severity_03_medium = 0
    severity_04_low = 0
    severity_05_negligible = 0
    for finding in data.Image.Findings:
        if finding.Severity == "Critical":
            severity_01_critical += 1
        elif finding.Severity == "High":
            severity_02_high += 1
        elif finding.Severity == "Medium":
            severity_03_medium += 1
        elif finding.Severity == "Low":
            severity_04_low += 1
        elif finding.Severity == "Negligible":
            severity_05_negligible += 1
    alerted = False
    if severity_01_critical > 0 or severity_02_high > 0:
        alerted = True # We only create tickets if critical or high severities are found.
    # Return data
    return {
        "Severity01Critical": severity_01_critical,
        "Severity02High": severity_02_high,
        "Severity03Medium": severity_03_medium,
        "Severity04Low": severity_04_low,
        "Severity05Negligible": severity_05_negligible,
        "Alerted": alerted
    }
```

Alerting & Integration

Scan results can trigger alerts via webhooks, including automated *Jira* ticket creation for detected vulnerabilities. *Jiralert* is included as an optional component to simplify ticket management.

- No need for prometheus or alertmanager to fire alerts.
- Simplifies alerting, workflows and ticket creation.

Labels added by the enrichment process are added to the alert.

Example of *Jira* Ticket created with enriched Data from above.

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[FIRING:1] ghcr.io/metraction/pharos/pharos-client:0.0.13_a962c0a in namespace pharos-client has vulnerabilities

Priority	= Medium
namespace	pharos-client
imagespec	ghcr.io/metraction/pharos/pharos-client:0.0.13_a962c0a
imageid	sha256:967bacadc13b2f71ed654e645fe93c98c98c026976cae42a6c84ecaca6ee6c4e
digest	sha256:623e2702938a4d8f583fdc597d02bf08c73dfc622315478d5cf6b85dd054a497

Description
Labels:

Name	Value
Alerted	true
Severity01Critical	0
Severity02High	1
Severity03Medium	0
Severity04Low	2
Severity05Negligible	0
digest	sha256:623e2702938a4d8f583fdc597d02bf08c73dfc622315478d5cf6b85dd054a497
distro	alpine
eos	2027-05-01 00:00:00 +0000 UTC
imageid	sha256:967bacadc13b2f71ed654e645fe93c98c98c026976cae42a6c84ecaca6ee6c4e
imagespec	ghcr.io/metraction/pharos/pharos-client:0.0.13_a962c0a
namespace	pharos-client
platform	linux/amd64
version	3.22.1

Annotations:

Deployment

Examples for helm deployment are included, this also includes optionally the creation of *Jira* tickets via *Jiralert*

Roadmap and future enhancements

- Modern Web UI to manage images, enrichers, create reports and manually waiving images.