**Summary of Using Spring Boot Actuator, Prometheus, and Grafana**

Spring Boot Actuator is a sub-project of the Spring Boot Framework. It includes a number of additional features that help to monitor and manage the Spring Boot application. Spring Boot Actuator provides several features like health check-up, request traffic, auditing JVM metrics, log information, caching statics, database state etc. It provides HTTP end points to manage and monitor applications on the production environment. Actuator endpoints can display system metrics and application information in JSON format. Metrics can be exported in various formats so that different monitoring tools can retrieve and visualize them. MA5 application, which is built on Spring Boot platform, can utilize this feature for monitoring system health and performance.

Prometheus is an open-source systems monitoring and alerting toolkit, and it collects and stores application metrics as time series data. Application metrics are numeric measurements about health and performance about the application. For example, for a web server it might be request times, for a database it might be number of active connections or number of active queries etc. A Prometheus server can act as a central server that scrapes various application metrics from different web applications. All metrics can be queried by PromQL, the Prometheus query language that retrieves, filters, and aggregates metrics data. Prometheus provides user interface that user can access metrics information and dashboard through a browser. Prometheus also utilizes a push gateway for supporting gathering metrics from short-lived jobs, such as cron jobs that are automatically kicked off at certain scheduled time periods. Prometheus has an alert manager component to handle alerts, which can be sent through notification system, such as emails, so notifications of system performance issues can be sent to system admins.

The architecture diagram of Prometheus:

Diagram

Description automatically generated

The following screens show Prometheus displays application statuses and CPU usage metrics:

Graphical user interface, text, application

Description automatically generated

Graphical user interface

Description automatically generated with medium confidence

Spring Boot Actuator can generate metrics in the format that Prometheus understands under the help of Micrometer Prometheus registry library, so metrics of a web application built by Spring Boot can be monitored by Prometheus. Furthermore, Micrometer library provides API for developers to instrument application source code and generate custom metrics.

Grafana is an open-source analytics platform to query, visualize and alert on application metrics. Grafana pulls metrics from metric database, and it supports many metric databases such as Prometheus, Influxdb, Graphite, and other time series databases. Grafana provides richer and fancier UI and dashboards than Prometheus. But Grafana cannot directly retrieve metrics from Spring Boot actuator, so it needs to use Prometheus as its data source. Multiple visualized metrics can be grouped in a dashboard. The following screen shows a dashboard for various metrics:

A screenshot of a computer

Description automatically generated with medium confidence

Advantages of using Spring Boot Actuator, Prometheus, and Grafana:

1. They are all open-source software and tools, so there is no cost.
2. They become popular in the fast-emerging DevOps software process, so there are strong community supports.
3. Health and performance metrics of multiple web applications can be gathered and visualized in a central place, so that system admins and operational team can easily manage and quickly discover performance issues.
4. Web applications are independent of Prometheus and Grafana, so it means if a web application is down, Prometheus and Grafana are still up and running, and the application “down” status can be quickly captured by Prometheus.