

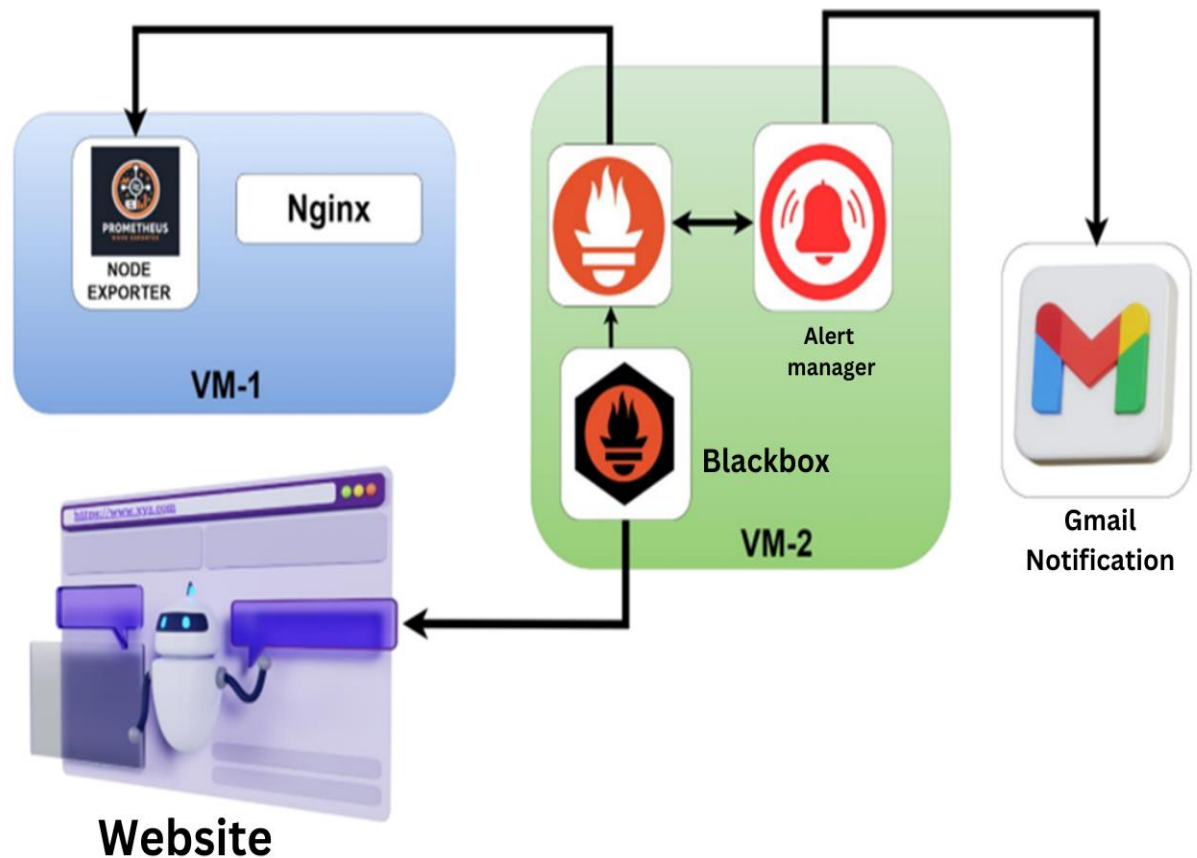
DevOps

Ultimate Monitoring Project

Introduction

In this project, we implemented a comprehensive monitoring solution using Prometheus and various exporters to ensure the reliability and performance of a web application hosted on AWS EC2 instances. This setup includes Node Exporter for hardware and OS metrics, Blackbox Exporter for probing endpoints, and Alertmanager for handling alerts. Gmail integration was also configured to receive notifications for critical alerts.

Architecture



Project Components and Best Practices

Components

1. **EC2 Instances:**
 - **Instance 1:** Hosts the web application, Node Exporter, and Nginx.
 - **Instance 2:** Hosts Prometheus, Blackbox Exporter, and Alertmanager.
2. **Prometheus:** Centralized monitoring tool for collecting and querying metrics.
3. **Node Exporter:** Collects hardware and OS-level metrics from the web server.
4. **Blackbox Exporter:** Probes endpoints to monitor uptime and response time.
5. **Alertmanager:** Manages alerts sent by Prometheus based on defined rules.
6. **Gmail Integration:** Sends email notifications for critical alerts.

Alerts

1. **InstanceDown:** Triggers when an instance is down for more than 1 minute.
2. **WebsiteDown:** Triggers when the website is down for more than 1 minute.
3. **HostOutOfMemory:** Triggers when available memory is less than 25% for more than 5 minutes.
4. **HostOutOfDiskSpace:** Triggers when the root filesystem has less than 50% available space.
5. **HostHighCpuLoad:** Triggers when CPU load is above 80% for more than 5 minutes.
6. **ServiceUnavailable:** Triggers when the node exporter service is unavailable for more than 2 minutes.
7. **HighMemoryUsage:** Triggers when memory usage exceeds 90% for more than 10 minutes.
8. **FileSystemFull:** Triggers when any filesystem has less than 10% available space for more than 5 minutes.

Best Practices

1. Define Clear Objectives and Metrics

- Identify Key Metrics: Determine which metrics are critical for the health and performance of your application and infrastructure (e.g., CPU usage, memory usage, response times, error rates).
- Set Baselines and Thresholds: Establish baseline performance levels and set thresholds for alerts to distinguish between normal and abnormal behavior.

2. Use Multiple Data Sources

- Combine Metrics and Logs: Use both metrics and logs to get a comprehensive view of the system's health.
- Integrate Various Exporters: Use relevant exporters (Node Exporter, Blackbox Exporter, etc.) to collect metrics from different parts of your infrastructure.

3. Implement Robust Alerting

- Define Relevant Alerting Rules: Create alerting rules that cover various failure scenarios and performance degradation.
- Avoid Alert Fatigue: Ensure alerts are actionable and avoid too many false positives. Group related alerts to reduce noise.
- Use Multiple Notification Channels: Configure alerts to be sent via multiple channels (email, SMS, chat tools) to ensure they are noticed.

4. Ensure High Availability and Redundancy

- Deploy Across Multiple Regions: Set up monitoring components in multiple regions to avoid single points of failure.
- Backup and Replicate Data: Regularly back up Prometheus data and configuration files. Use replication to ensure data availability.

5. Optimize Performance and Resource Usage

- Tune Scrape Intervals and Retention Policies: Set appropriate scrape intervals and data retention policies to balance between data granularity and resource usage.

Phase 1: Initial Setup

Provision EC2 Instances:

- Launch two EC2 instances in your preferred region.
- Configure security groups to allow necessary traffic (SSH, HTTP, Prometheus, etc.).

Launch Virtual Machine using AWS EC2

Here is a detailed list of the basic requirements and setup for the EC2 instance i have used for running Jenkins, including the specifics of the instance type, AMI, and security groups.

EC2 Instance Requirements and Setup:

1. Instance Type

- Instance Type: `t2.medium`
- vCPUs: 2
- Memory: 8 GB
- Network Performance: Moderate

2. Amazon Machine Image (AMI)

- AMI: Ubuntu Server 24.04 LTS

3. Security Groups

Security groups act as a virtual firewall for your instance to control inbound and outbound traffic.

Adjust security settings to allow necessary ports:

- Prometheus: 9090
- Alert manager: 9093
- Blackbox Exporter: 9115
- Node Exporter: 9100
- Email transmissions: 587

Phase 2: Install and Configure Node Exporter and Deploy Web application on Instance 1

1. Install Node Exporter:

Wget

```
https://github.com/prometheus/node_exporter/releases/download/v1.8.1/node_exporter-1.8.1.linux-amd64.tar.gz
```

```
tar xvfz node_exporter-1.8.1.linux-amd64.tar.gz
```

```
cd node_exporter-1.8.1.linux-amd64
```

```
./node_exporter &
```

2. Install Nginx:

```
sudo apt update
```

```
sudo apt install nginx
```

3. Deploy Web Application(Java based Application)

Git hub repo- <https://github.com/Shubham-Stunner/BoardGame.git>

Install Java using this command.

```
sudo apt install openjdk-17-jre-headless -y
```

install Maven

```
sudo apt-get install software-properties-common
```

```
sudo apt-add-repository universe
```

```
sudo apt-get update
```

```
sudo apt-get install maven
```

Build the Package

```
maven package
```

Run the Application

```
cd target/
```

```
java -jar database_service_project-0.0.2.jar
```

Application runs on **Port 8080** - <instance_ip>:8080

Phase 3: Install and Configure Prometheus, Blackbox Exporter, and Alertmanager on Instance 2

1. Install Prometheus:

```
wget
https://github.com/prometheus/prometheus/releases/download/v2.52.0/prometheus-2.52.0.linux-amd64.tar.gz
tar xvfz prometheus-2.52.0.linux-amd64.tar.gz
cd prometheus-2.52.0.linux-amd64
./prometheus --config.file=prometheus.yml &
```

2. Install Blackbox Exporter:

```
wget
https://github.com/prometheus/blackbox_exporter/releases/download/v0.25.0/blackbox_exporter-0.25.0.linux-amd64.tar.gz
tar xvfz blackbox_exporter-0.25.0.linux-amd64.tar.gz
cd blackbox_exporter-0.25.0.linux-amd64
./blackbox_exporter &
```

3. Install Alertmanager:

```
wget
https://github.com/prometheus/alertmanager/releases/download/v0.27.0/alertmanager-0.27.0.linux-amd64.tar.gz
tar xvfz alertmanager-0.27.0.linux-amd64.tar.gz
cd alertmanager-0.27.0.linux-amd64
./alertmanager --config.file=alertmanager.yml &
```

Configuration Files

Prometheus Configuration (prometheus.yml)

Go inside the prometheus.yml file and add these configurations.

- **Global Configuration:**

global:

scrape_interval: 15s

evaluation_interval: 15s

- **Alertmanager Configuration:**

alerting:

alertmanagers:

- static_configs:

- targets: ['localhost:9093']

- **Scrape Configuration:**

- **Prometheus:**

scrape_configs:

- job_name: "prometheus"

static_configs:

- targets: ["localhost:9090"]

- **Node Exporter:**

- job_name: "node_exporter"

static_configs:

- targets: ["<instance_ip>:9100"]

o Blackbox Exporter:

```
- job_name: 'blackbox'
metrics_path: /probe
params:
  module: [http_2xx]
static_configs:
  - targets:
    - http://prometheus.io
    - https://prometheus.io
    - http://<instance_ip>:8080/
relabel_configs:
  - source_labels: [__address__]
    target_label: __param_target
  - source_labels: [__param_target]
    target_label: instance
  - target_label: __address__
    replacement:<instance_ip>:9115
```

You should restart your Prometheus after completing all this configuration using this command .

```
pgrep Prometheus
```

You will get some service id . example:- 3445

Kill this service using command:

```
Kill 3445
```


Alert Rules Configuration (alert_rules.yml)

- **Alert Rules Group:** Create a new file inside the prometheus directory named **alert_rules.yml**

groups:

- name: alert_rules

rules:

- alert: InstanceDown

expr: up == 0

for: 1m

labels:

severity: "critical"

annotations:

summary: "Endpoint {{ \$labels.instance }} down"

description: "{{ \$labels.instance }} of job {{ \$labels.job }} has been down for more than 1 minute."

- alert: WebsiteDown

expr: probe_success == 0

for: 1m

labels:

severity: critical

annotations:

description: The website at {{ \$labels.instance }} is down.

summary: Website down

- alert: HostOutOfMemory

expr: node_memory_MemAvailable / node_memory_MemTotal * 100 < 25

for: 5m

labels:

severity: warning

annotations:

summary: "Host out of memory (instance {{ \$labels.instance }})"

description: "Node memory is filling up (< 25% left)\n VALUE = {{ \$value }}\n LABELS: {{ \$labels }}"

- alert: HostOutOfDiskSpace

expr: (node_filesystem_avail{mountpoint="/" * 100) /
node_filesystem_size{mountpoint="/" < 50

for: 1s

labels:

severity: warning

annotations:

summary: "Host out of disk space (instance {{ \$labels.instance }})"

description: "Disk is almost full (< 50% left)\n VALUE = {{ \$value }}\n LABELS: {{ \$labels }}"

- alert: HostHighCpuLoad

expr: (sum by (instance)
(irate(node_cpu{job="node_exporter_metrics",mode="idle"}[5m]))) > 80

for: 5m

labels:

severity: warning

annotations:

summary: "Host high CPU load (instance {{ \$labels.instance }})"

description: "CPU load is > 80%\n VALUE = {{ \$value }}\n LABELS: {{ \$labels }}"

- alert: ServiceUnavailable

expr: up{job="node_exporter"} == 0

```
for: 2m
```

```
labels:
```

```
severity: critical
```

```
annotations:
```

```
summary: "Service Unavailable (instance {{ $labels.instance }})"
```

```
description: "The service {{ $labels.job }} is not available\n VALUE = {{ $value }}\n LABELS: {{ $labels }}"
```

```
- alert: HighMemoryUsage
```

```
expr: (node_memory_Active / node_memory_MemTotal) * 100 > 90
```

```
for: 10m
```

```
labels:
```

```
severity: critical
```

```
annotations:
```

```
summary: "High Memory Usage (instance {{ $labels.instance }})"
```

```
description: "Memory usage is > 90%\n VALUE = {{ $value }}\n LABELS: {{ $labels }}"
```

```
- alert: FileSystemFull
```

```
expr: (node_filesystem_avail / node_filesystem_size) * 100 < 10
```

```
for: 5m
```

```
labels:
```

```
severity: critical
```

```
annotations:
```

```
summary: "File System Almost Full (instance {{ $labels.instance }})"
```

```
description: "File system has < 10% free space\n VALUE = {{ $value }}\n LABELS: {{ $labels }}"
```

Add alert_rules inside **prometheus.yml** - Uncomment the alert_rules.yml .

Create Gmail Authentication Password

To create an application-specific password for Gmail, you'll need to enable two-factor authentication (2FA) on your Google account and then generate an app password. Here are the steps:

1. Enable Two-Factor Authentication (2FA):

- Log in to your Google account and navigate to Google Account Security.
- Under the "Signing in to Google" section, find "2-Step Verification" and click on it.
- Follow the prompts to set up 2FA. You might need to provide your phone number and verify it via a code sent by SMS.

2. Generate an App Password:

- Once 2FA is enabled, go back to the Google Account Security page.
- Search this on your browser :-
<https://myaccount.google.com/apppassowords>
- You might need to sign in again for security reasons.
- On the "App passwords" page, click on the "Select app" dropdown and choose "Other (Custom name)".
- Enter a name for the app password, such as "Prometheus Alertmanager", and click "Generate".
- Google will provide you with a 16-character app password. Make sure to copy this password.

3. Use the App Password in Your Configuration:

- Replace <your-app-password> in your alertmanager.yml configuration with the generated app password.

Alertmanager Configuration (alertmanager.yml)

Routing Configuration: add these in the alertmanager.yml file

route:

 group_by: ['alertname']

 group_wait: 30s

 group_interval: 5m

 repeat_interval: 1h

 receiver: 'email-notifications'

receivers:

- name: 'email-notifications'

 email_configs:

 - to: jaiswaladi246@gmail.com

 from: test@gmail.com

 smarthost: smtp.gmail.com:587

 auth_username: your_email

 auth_identity: your_email

 auth_password: "bdmq omqh vvkz zoqx"

 send_resolved: true

inhibit_rules:

- source_match:

 severity: 'critical'

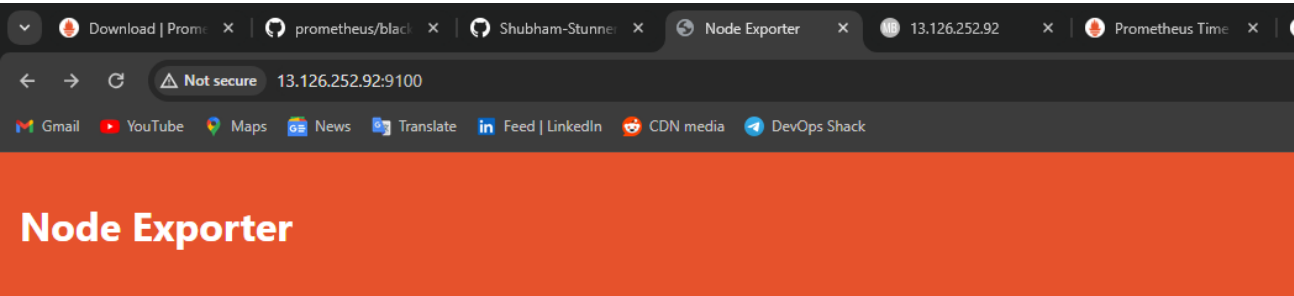
 target_match:

 severity: 'warning'

 equal: ['alertname', 'dev', 'instance']

Results

Node Exporter

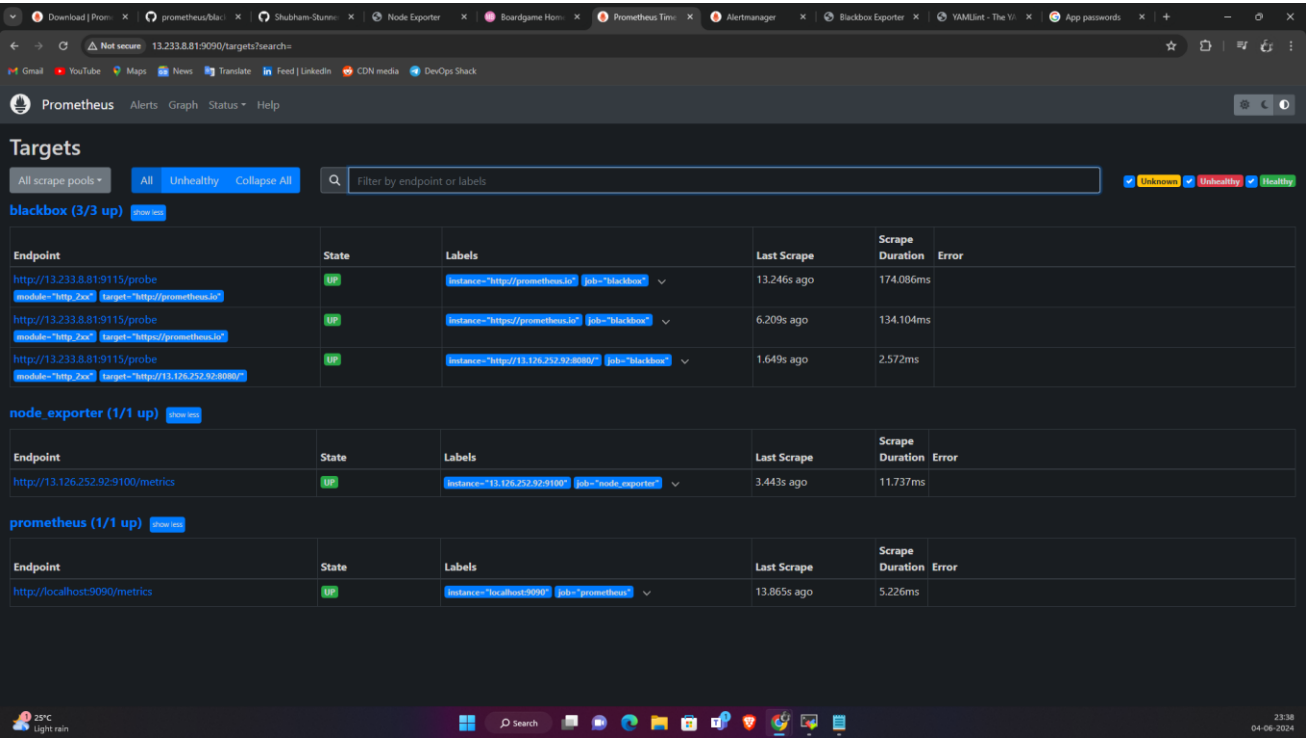


Prometheus Node Exporter

Version: (version=1.8.1, branch=HEAD, revision=400c3979931613db930ea035f39ce7b377cd5b5b)

- [Metrics](#)

Prometheus



Alert manager

Download | Prom...prometheus/blac...Shubham-Stunne...Node Exporter...Boardgame Hom...Prometheus Time...Alertmanager...Black...

← → ↺ 13.233.8.81:9093/#/status

Gmail YouTube Maps News Translate Feed | LinkedIn CDN media DevOps Shack

Alertmanager Alerts Silences Status Settings Help

Status

Uptime: 2024-06-04T18:06:05.221Z

Cluster Status

Name: 01HZJ6VZX4A3AKZ45GPY8MAXHT

Status: ready

Peers:

- Name:** 01HZJ6VZX4A3AKZ45GPY8MAXHT
- Address:** 172.31.34.160:9094

Version Information

Branch: HEAD

BuildDate: 20240228-11:51:20

BuildUser: root@22cd11f671e9

GoVersion: go1.21.7

Revision: 0aa3c2aad14cff039931923ab16b26b7481783b5

Version: 0.27.0

Config

```
global:
  resolve_timeout: 5m
http_config:
  follow_redirects: true
  enable_http2: true
smtp_hello: localhost
smtp_smtpd: true
```

Stop you web application & Node exporter to get an alert on alert manager.

Download | Pr...prometheus/blac...Shubham-Stu...Node Exporter...13.126.252.82...Prometheus Ti...Alertmanager...Blackbox Exp...VMAlert - Thi...App passwords...FIRING:1 Ins...+ -

← → ↺ 13.233.8.81:9090/alerts?search=

Gmail YouTube Maps News Translate Feed | LinkedIn CDN media DevOps Shack

Prometheus Alerts Graph Status Help

🔍 Filter by name or labels

Show annotations

alert.rules.yml > alert.rules

Inactive (0) Pending (11) Firing (2)

InstanceDown (1 active)

```
name: InstanceDown
expr: up == 0
for: 1m
labels:
  severity: critical
annotations:
  description: '{{ $labels.instance }} of job {{ $labels.job }} has been down for more than 1 minute.
  summary: Endpoint {{ $labels.instance }} down
```

Labels	State	Active Since	Value
instance=InstanceDown instance=13.126.252.82:9100 job=node_exporter severity=critical	FIRING	2024-06-04T18:13:26.661690604Z	0

WebsiteDown (1 active)

HostOutOfMemory (0 active)

HostOutOfDiskSpace (0 active)

HostHighCpuLoad (0 active)

ServiceUnavailable (1 active)

HighMemoryUsage (0 active)

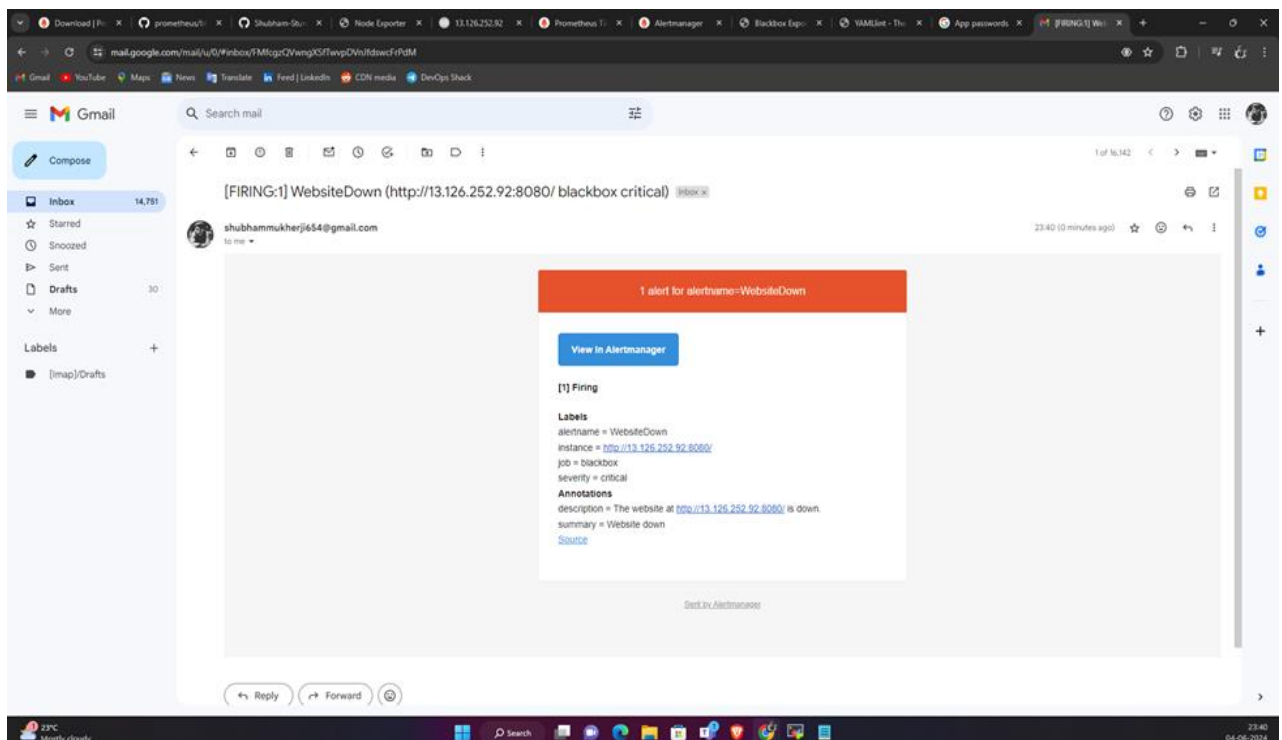
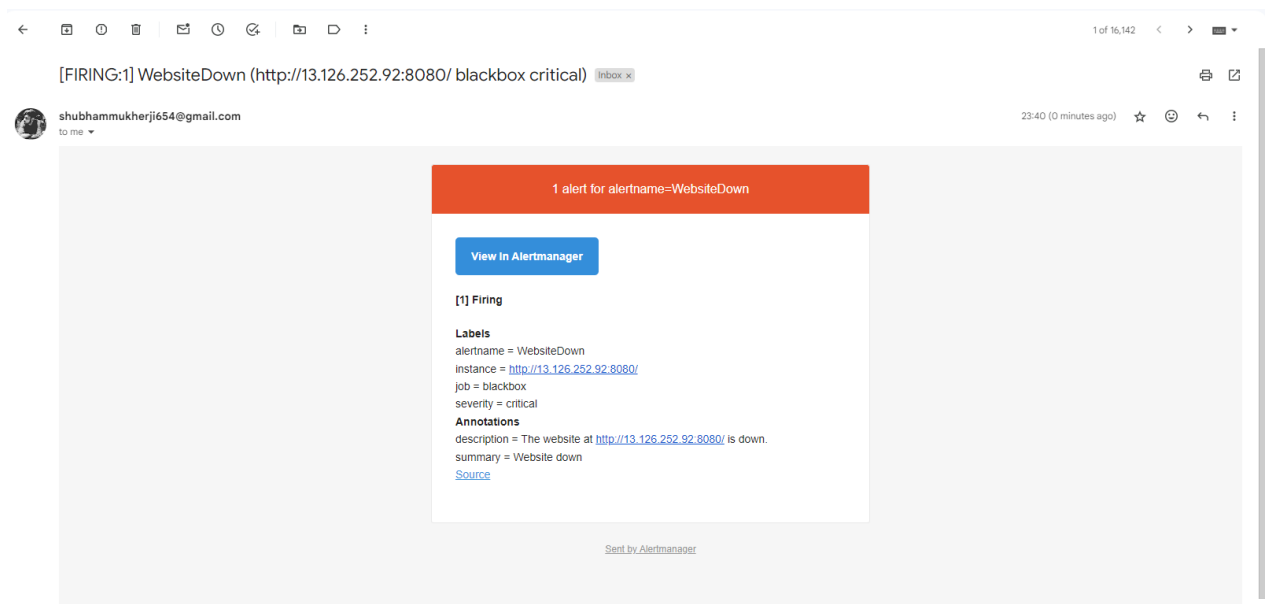
FileSystemFull (0 active)

EUR/USD +0.33%

Search

23:45 04-06-2024

Gmail Notification



Acknowledgement

I would like to extend my heartfelt gratitude to **Aditya Jaiswal** from the YouTube channel "**DevOps Shack**" for his invaluable guidance and insights throughout this project. His tutorials and resources provided a solid foundation for implementing a comprehensive monitoring solution using Prometheus and its ecosystem. The knowledge and best practices shared on his channel greatly contributed to the successful completion of this project. Thank you for your support and dedication to the DevOps community.

Conclusion

In this project, we successfully implemented a robust monitoring solution using Prometheus and its ecosystem to ensure the reliability and performance of a web application hosted on AWS EC2 instances. By utilizing Node Exporter, Blackbox Exporter, and Alertmanager, we achieved a setup capable of collecting detailed metrics, monitoring endpoint availability, and managing alerts effectively.

Key achievements include:

- **Multi-Instance Setup:**
 - Instance 1: Hosts the web application, Node Exporter, and Nginx.
 - Instance 2: Hosts Prometheus, Blackbox Exporter, and Alertmanager.
- **Gmail Integration:** Configured Alertmanager to send email notifications via Gmail for timely alerts on critical issues.

This project highlights the importance of a well-planned monitoring strategy in maintaining the operational excellence of web-based services. Regular updates and adherence to best practices will ensure the monitoring solution remains effective and responsive to new challenges.