Project Report: Self-Healing Infrastructure with Prometheus, Alertmanager & Ansible

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1. Introduction

High availability and reliability are critical requirements in modern IT systems. Even minor service downtime can impact user experience and business operations. To address this challenge, we implemented a **Self-Healing Infrastructure** that automatically detects service failures and recovers them using monitoring, alerting, and automation tools.

This project demonstrates how **Prometheus + Alertmanager + Ansible** can work together to monitor a service, trigger alerts, and perform automated remediation (self-healing) without human intervention.

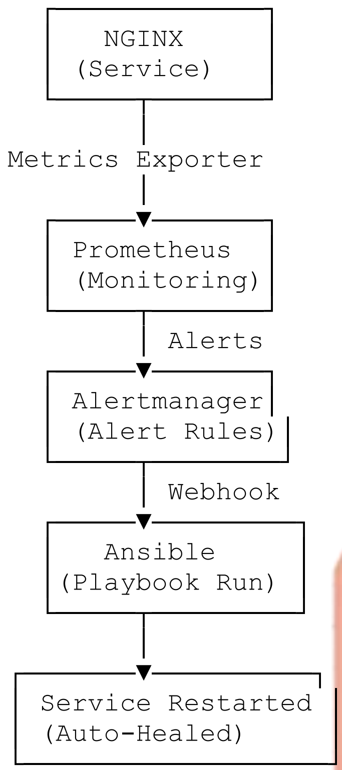
2. Objective

- Continuously monitor services and infrastructure health.
- Automatically detect failures such as service downtime or high CPU usage.
- Trigger alerts when thresholds are breached.
- Execute automated remediation steps (restart service/system) using Ansible.
- Reduce manual intervention and improve uptime.

3. Tools & Technologies

- **Prometheus** → Metrics collection & monitoring.
- **Alertmanager** → Handles alerts and triggers actions.
- **Ansible** → Executes playbooks for automated remediation.
- **Shell Scripting** → Simple automation for service control.
- **Ubuntu VM / Docker** → Environment setup.
- **Sample Service: NGINX** → Used as the monitored service.

4. System Architecture



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5. Implementation Steps

Step 1: Deploy Sample Service

- Installed **NGINX** on Ubuntu/Docker as the monitored service.

```
sudo apt update
sudo apt install nginx -y
```

Step 2: Prometheus Setup

- Installed Prometheus and configured it to scrape NGINX metrics.
- Example **prometheus.yml** config:

```
scrape_configs:
  - job_name: 'nginx'
    static_configs:
      - targets: ['localhost:9100']
```

Step 3: Define Alert Rules

- Example rule: Trigger alert if NGINX goes down.

```
groups:
- name: nginx-rules
  rules:
  - alert: NginxDown
    expr: up{job="nginx"} == 0
    for: 30s
    labels:
      severity: critical
    annotations:
      description: "NGINX service is down"
```

Step 4: Alertmanager Setup

- Configured Alertmanager with **webhook receiver** to call Ansible.
- **alertmanager.yml** snippet:

```
receivers:
- name: 'ansible-webhook'
  webhook_configs:
    - url: 'http://localhost:5001/alert'
```

Step 5: Ansible Playbook

- Playbook to restart NGINX automatically:

```
- name: Auto-heal NGINX Service
  hosts: localhost
  become: yes
  tasks:
    - name: Restart NGINX
      service:
        name: nginx
        state: restarted
```

Step 6: Integration

- Alertmanager webhook triggers a small Flask app or script that executes the Ansible playbook.
- Example webhook handler (Python):

```
from flask import Flask, request
import os
app = Flask(__name__)

@app.route('/alert', methods=['POST'])
def alert():
    os.system("ansible-playbook restart_nginx.yml")
    return "Executed", 200

if __name__ == '__main__':
    app.run(port=5001)
```

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6. Deliverables

✓ **Prometheus Configuration File** (`prometheus.yml`)
✓ **Alertmanager Config** (`alertmanager.yml`)
✓ **Ansible Playbook** (`restart_nginx.yml`)
✓ **Webhook Handler Script** (Python/Flask)
✓ **Demo Evidence**: Logs & screenshots showing:

- Service failure detected.
- Alert triggered.
- Ansible playbook executed.
- Service restarted automatically.

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7. Demo Workflow (Logs Example)

```
[Prometheus] ALERT: NGINX service is down
[Alertmanager] Triggered webhook → /alert
[Webhook] Received alert, running playbook...
[Ansible] TASK [Restart NGINX] ok
[System] NGINX restarted successfully!
```

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8. Conclusion

This project successfully demonstrates the implementation of **self-healing infrastructure** using Prometheus, Alertmanager, and Ansible. The system can detect service downtime, trigger alerts, and automatically restart the service without manual intervention.

By extending this setup, organizations can implement **auto-remediation** for multiple services, integrate advanced playbooks, and enhance resilience in production systems.
