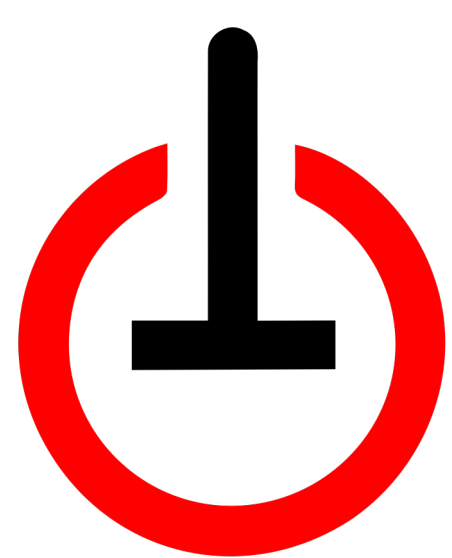




Edge-to-Cloud Threat Detection using a Raspberry Pi Kubernetes Cluster

Mohsin Abbasi, Hafiza Fatima Athar, Maham Anis, Sadia Saeed, Awais Yaseen,
Muhammad Musfir, Abdul Hanan Javaid, Javier de Santiago Soto, Md. Forman Ullah Sajib

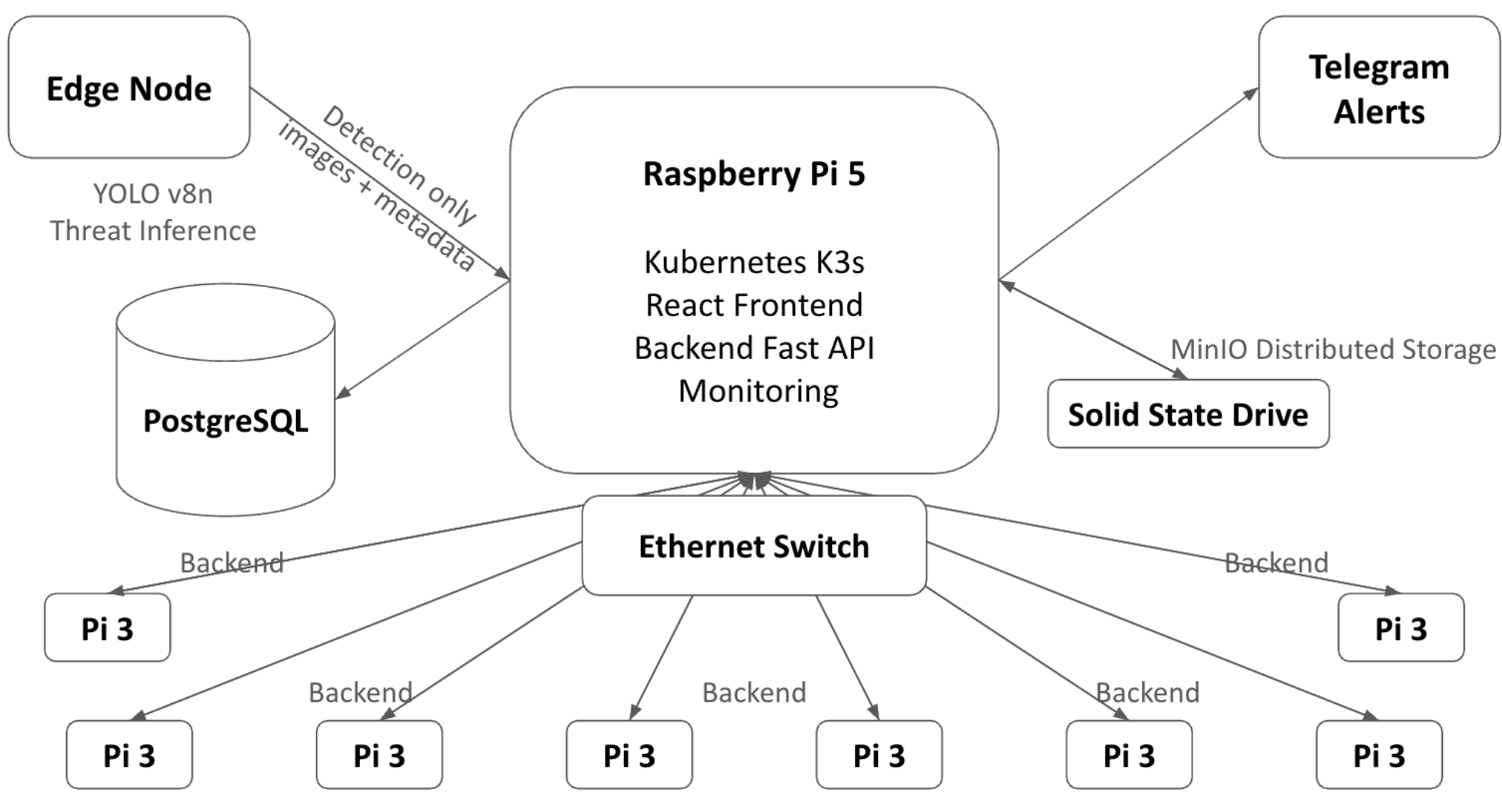
Objectives

Develop a scalable edge-cloud surveillance platform capable of detecting threats in real time while minimizing network bandwidth through edge inference.

- Real-time threat detection
- Edge AI inference
- Distributed cloud backend
- Kubernetes cluster
- Centralized monitoring
- Scalable Raspberry Pi cluster

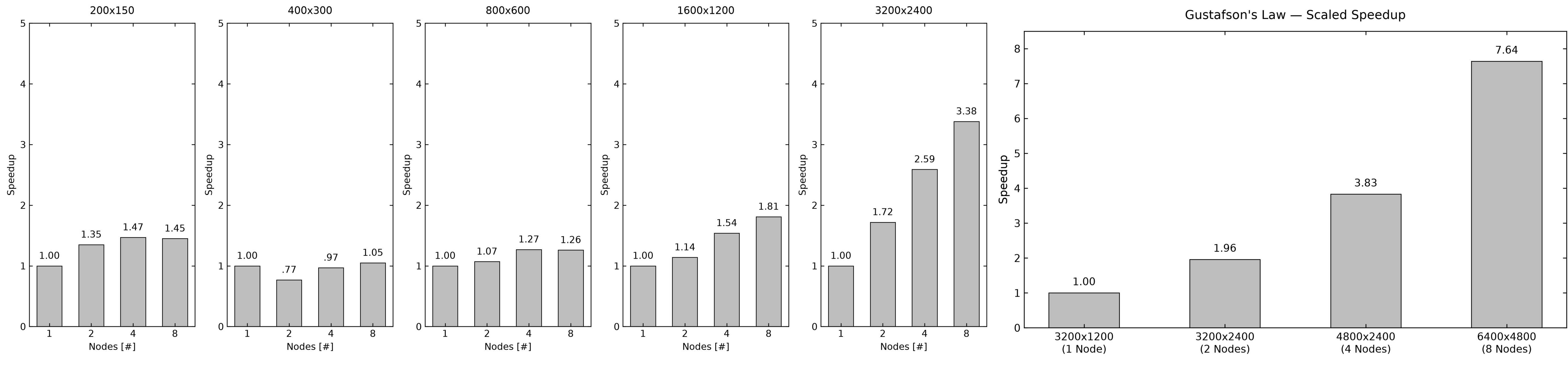


System Architecture



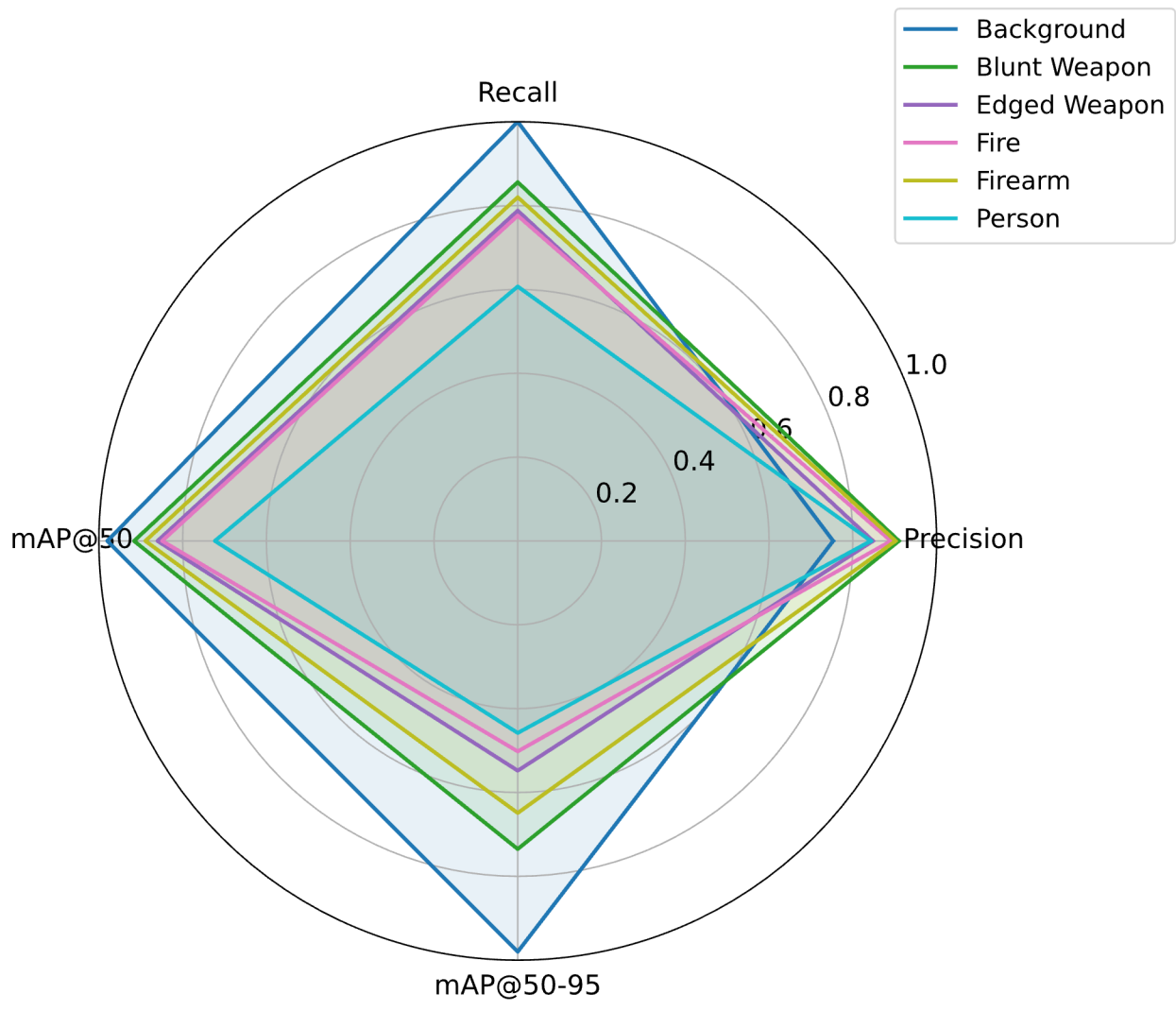
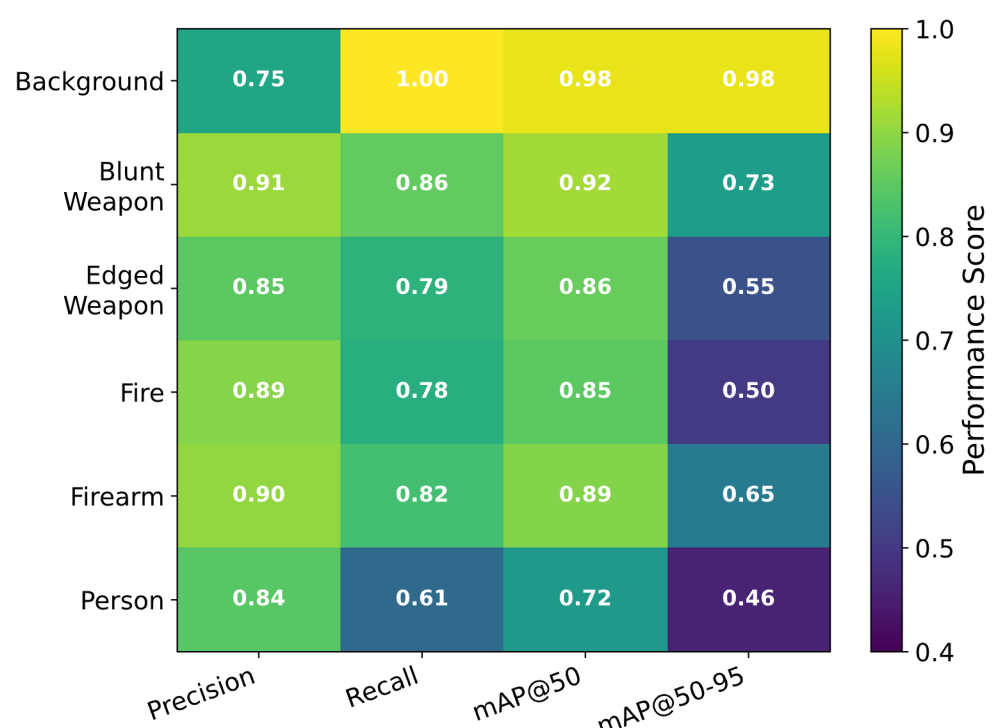
- PXE Boot, 64-bit aarch64 Raspberry PI 3 x 8
- YOLO8n Powered Raspberry PI 4 Edge Node
- High Performance Computing Cluster
- Distributed Storage on Solid State Drive SSD
- Cluster scalability through Kubernetes K3s
- Observability with Prometheus and Grafana
- Notifications and alerts on Telegram

Parallel Computing



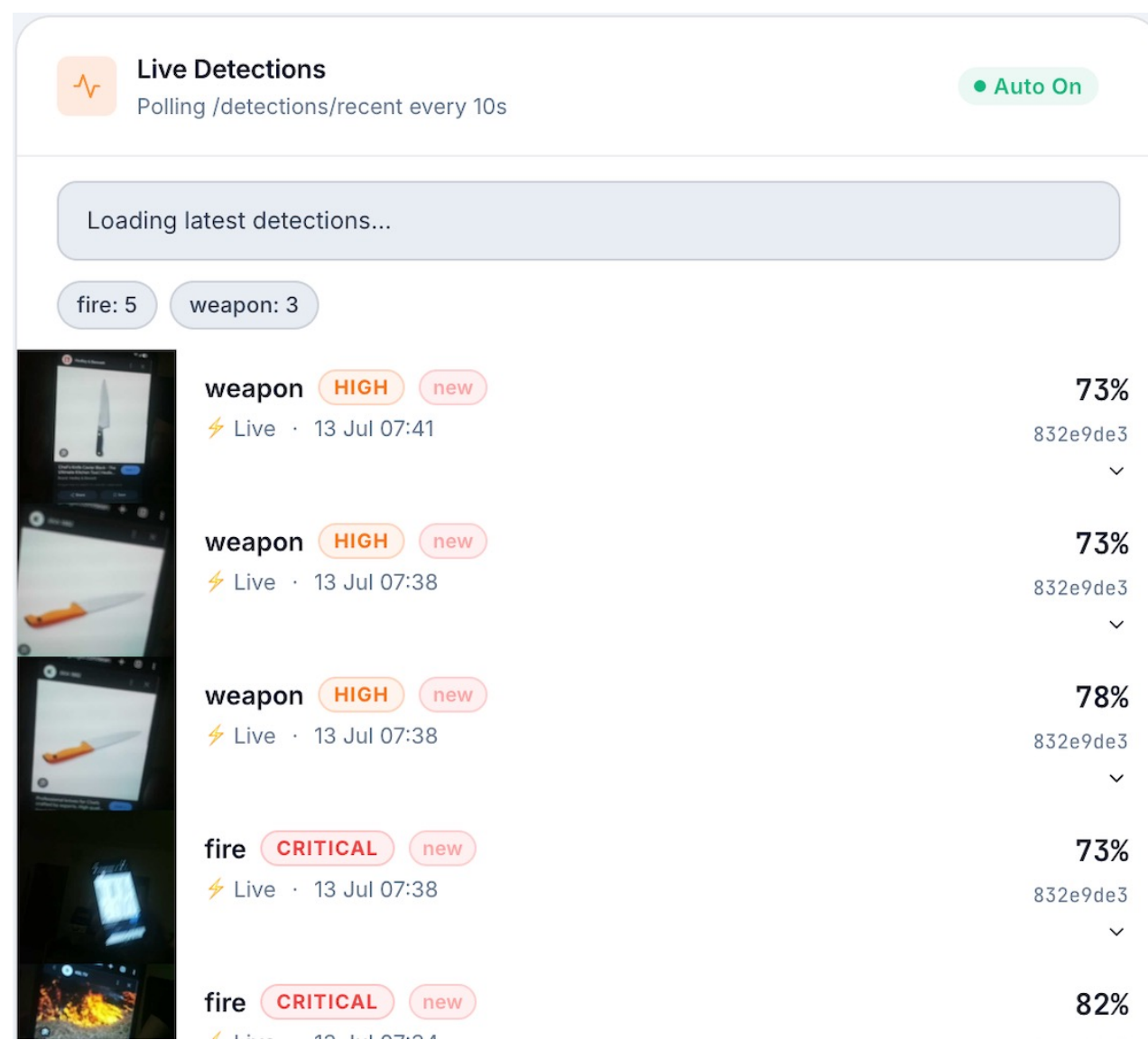
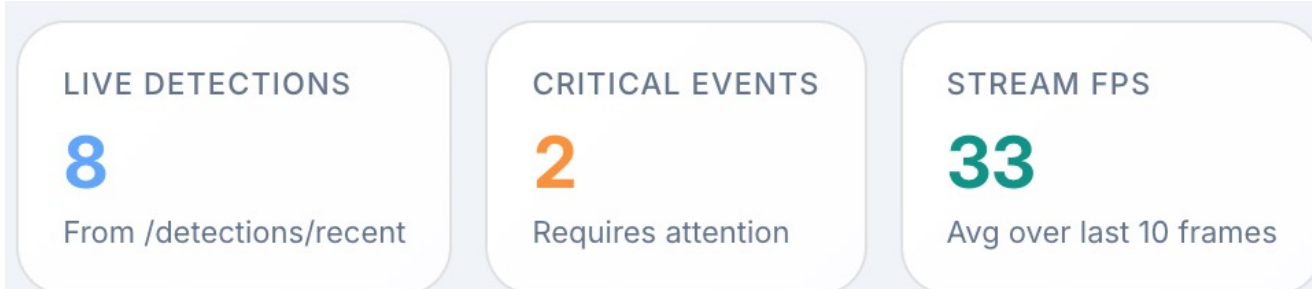
Edge AI Detection

- Hardware-enabled inference
- Sony IMX500 camera
- Trained on 10k images
- 30 fps approximately
- Raspberry Pi 4 Edge computing



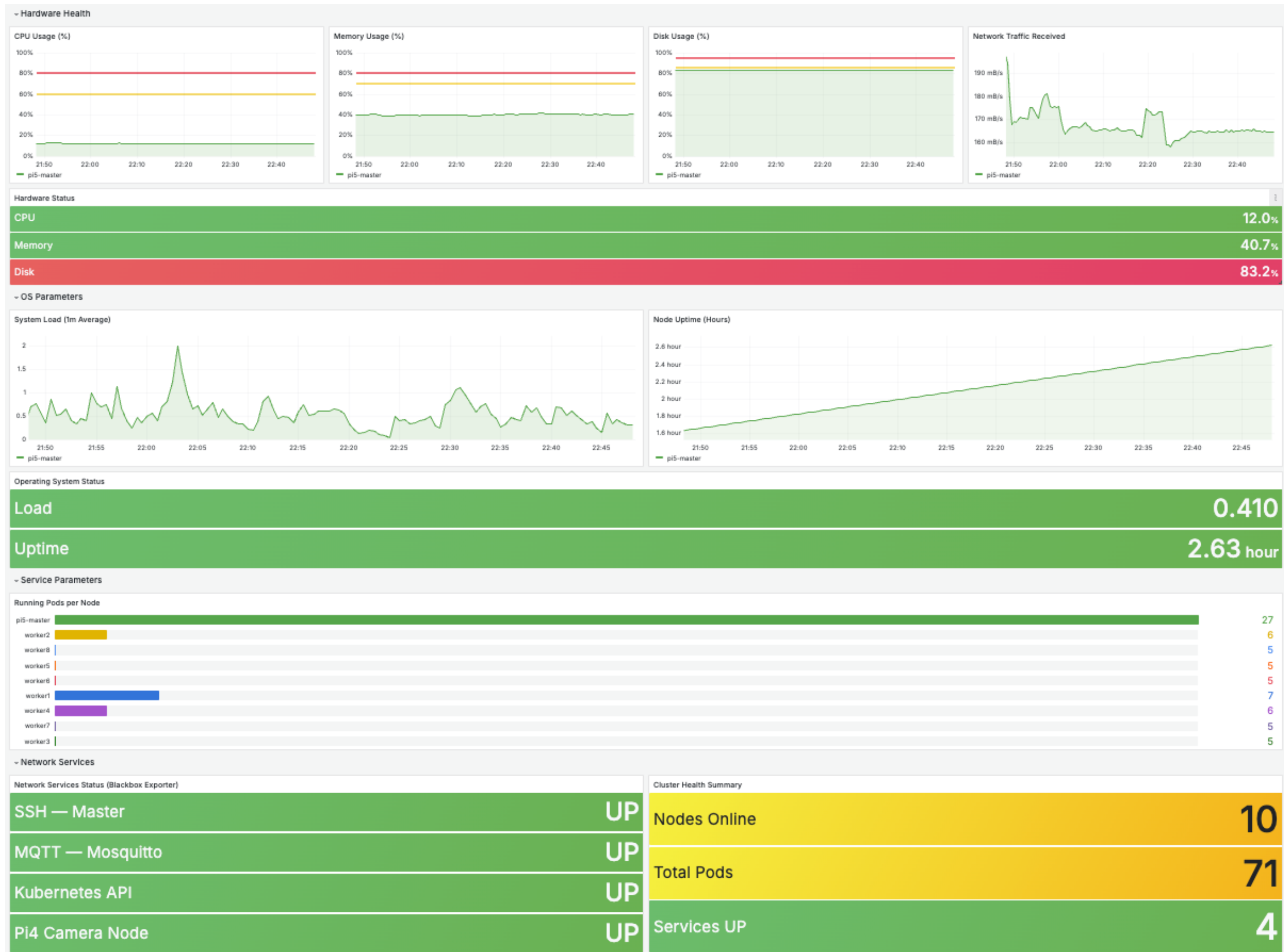
Frontend

- Raspberry PI 5 deployed
- Real time threat results
- User Authentication
- Events filtering
- Linked Grafana UI
- React, HTML, CSS
- API Endpoints Documentation



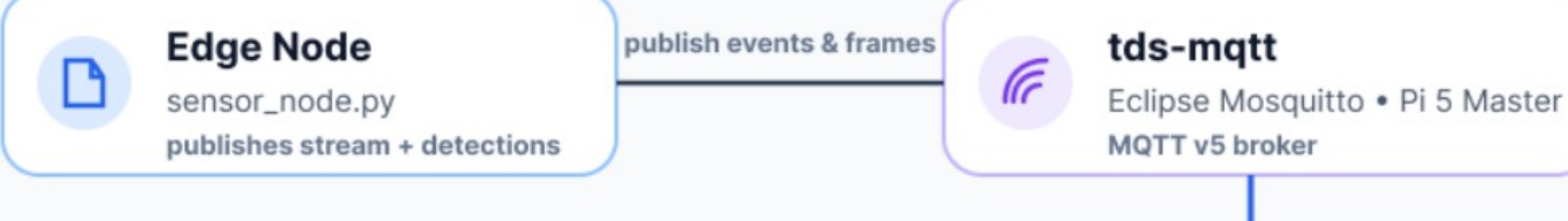
Observability

- Prometheus - CPU, Memory, Disk, Health Status, Uptime metrics
- Grafana - Visualization with various graphs
- Alert Notifications via Telegram

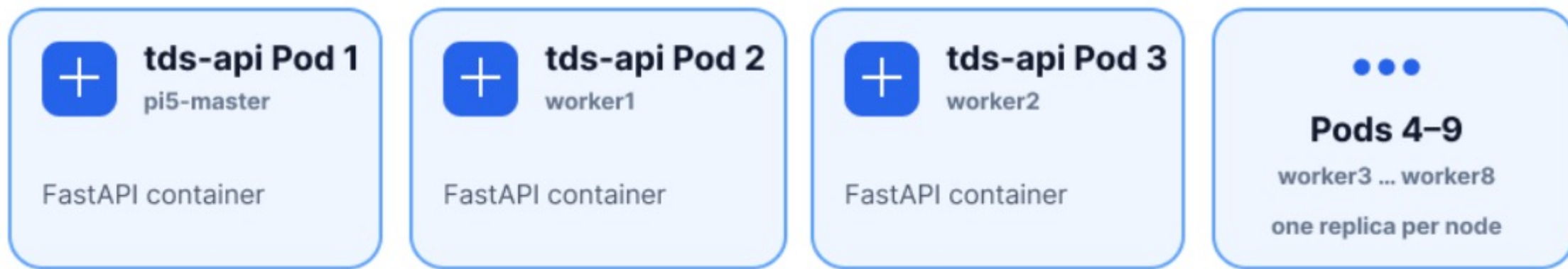


Backend

EVENT INGESTION



FASTAPI DEPLOYMENT · tds-api



SERVICE-REPOSITORY ARCHITECTURE

