Security on Azure Kubernetes Services with open-source tools

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About Me

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- Data Scientist @ Unilever Vietnam
- Solution Architect @ Savills Vietnam
- Full-stack Developer @ Pizitech
- Tech Trainer @ Microsoft Student Partners

ASP.NET Core 2+ | Microsoft Azure |

Azure DevOps | Docker | Kubernetes |

Power BI | Excel | MS SQL | Python

Story

- Tèo is a system engineer want to test Kubernetes on Azure
- After 3 days using AKS, he realized that his MySQL database was overload, and bad inserted inside the database.
- He said… “I need to find a way to know what happened on my system. Then protect it with… my small budget”.

Agenda

Duration	Content
5 min	Overview Azure security solutions for Azure Kubernetes Services
25 min	Open-source Web Application Firewall | Layer-7 Load Balancer | HTTPS • Kubernetes NGINX Ingress Controller. • cert-manager: SSL certificate manager on Kubernetes • Demo: Deploy NGINX Ingress Controller and cert-manager • Write YAML config files to activate WAF | L7 LB | HTTPS • Security Test
5 min	Log Management for Azure Kubernetes Services
5 min	Attack alerting to Slack with Azure Logic App

Scope of this presentation

- Azure AKS = managed Kubernetes service by Azure
- Protect AKS cluster from outside – at application layer (L7).

- ~~Identity protection (Azure AD)~~
- ~~Secured networking inside AKS cluster~~
- ~~Backup | Disaster Recovery for AKS cluster~~

Overview Azure security solutions for Azure Kubernetes Services

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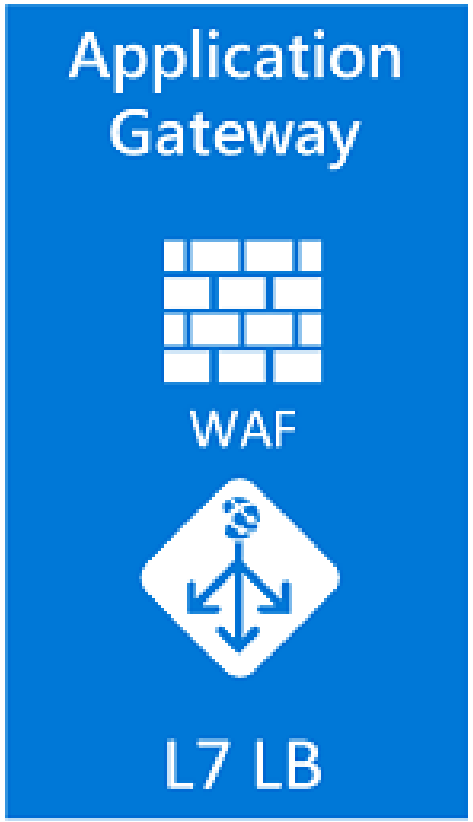
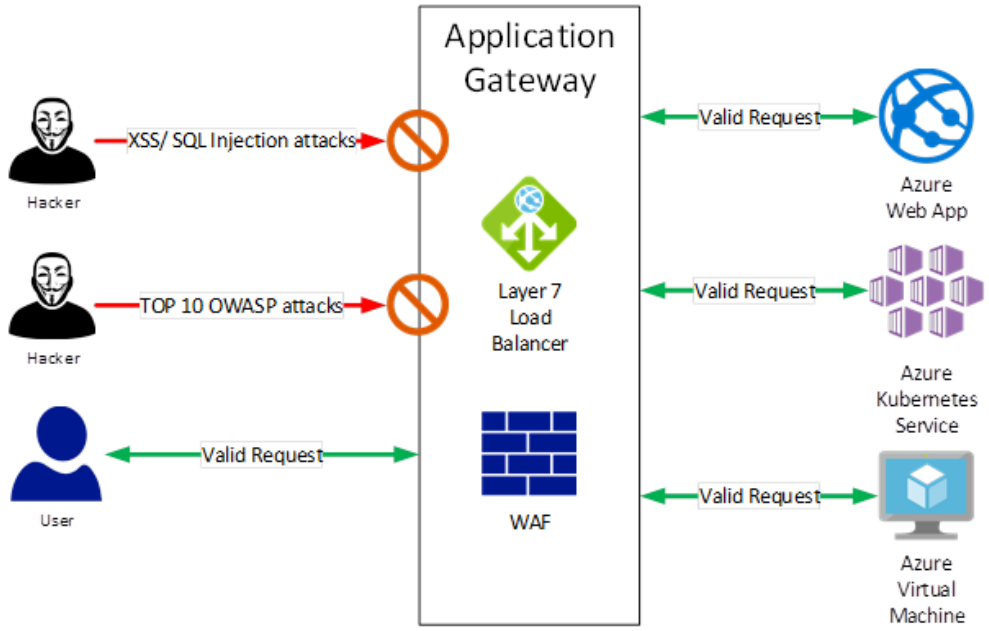
Overview Azure security solutions

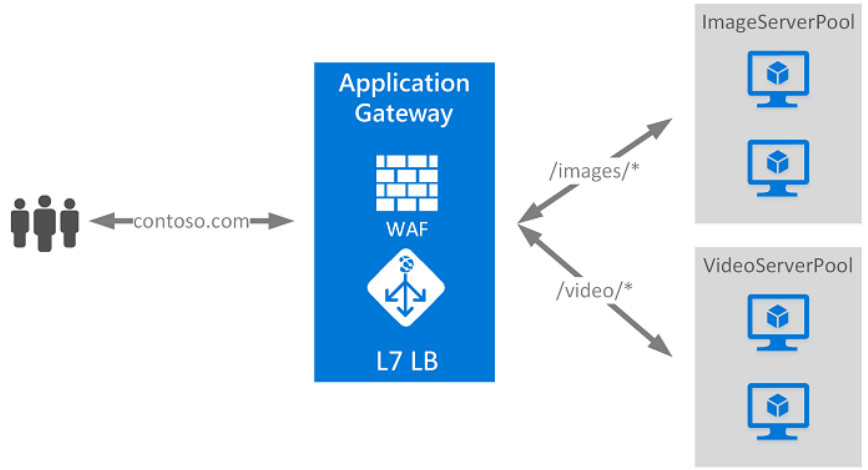
- Azure Application Gateway
- Azure Log Analytics
- Azure Monitor



Azure Application Gateway

- Web Application Firewall:
  - Block malicious traffic
- Layer-7 Load Balancer
  - Route traffic based on URL
- Friendly management dashboard.

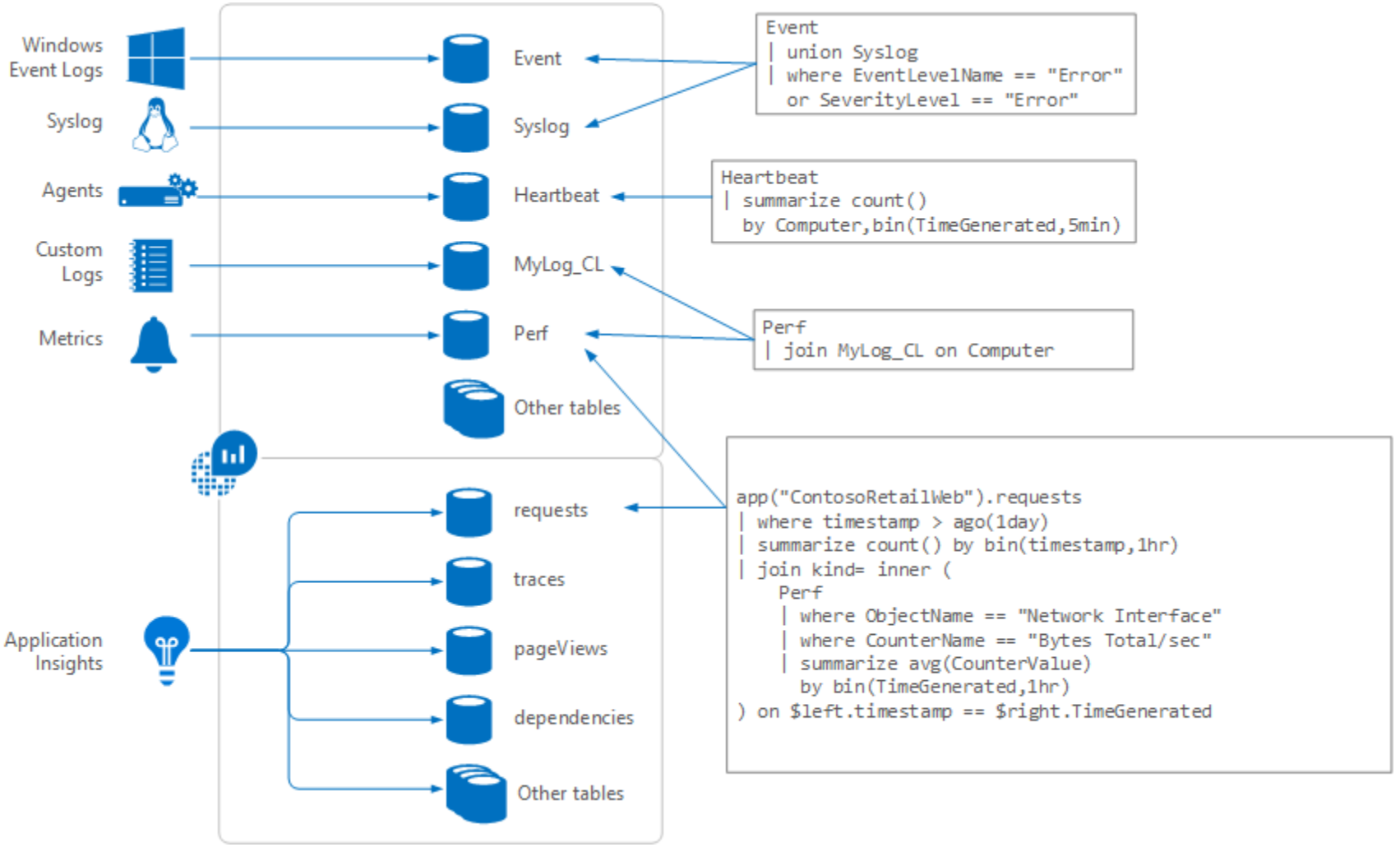




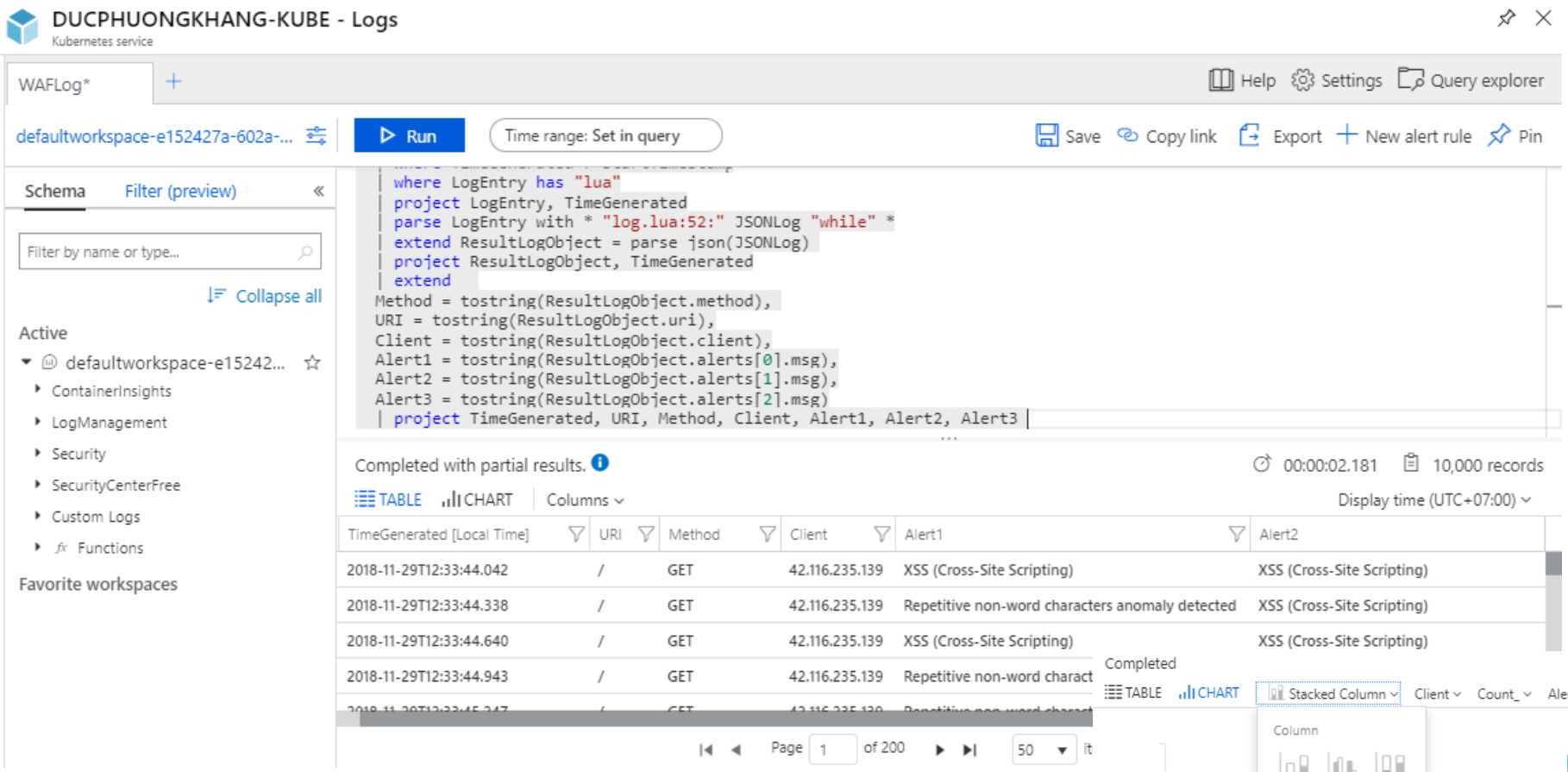
Azure Log Analytics

- Log storage
- Log digestion
- Log visualization
- Log retention

Using Kusto query language

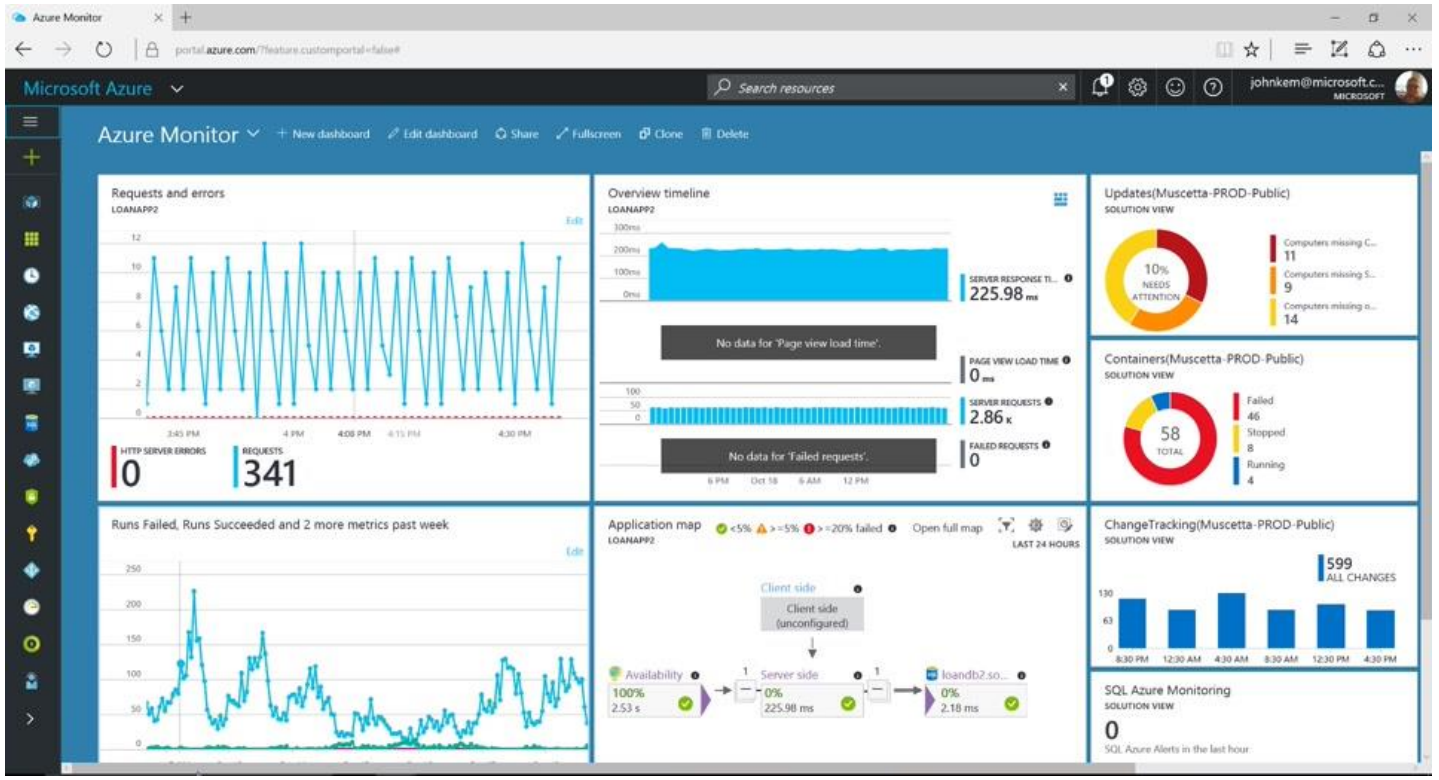


Azure Log Analytics



Azure Monitor

- Log Analytics is a part of Azure Monitor
- Support on monitoring CPU, network, virtual machines,…
- Support alert with rules via email, webhook,…



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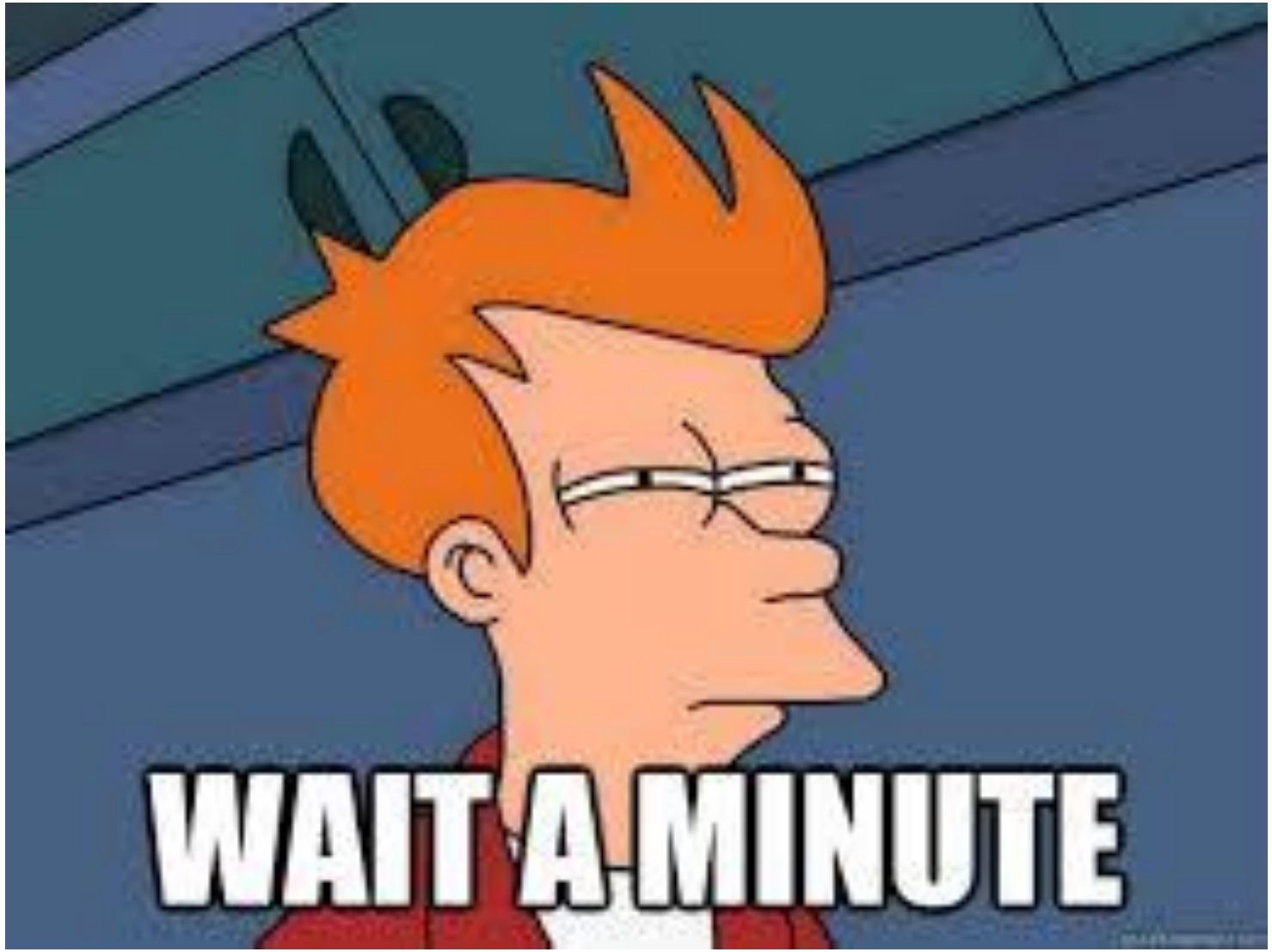

Monthly Cost

Azure Application Gateway	Azure Log Analytics	Azure Monitor
Microsoft: from **$103.018**	Free: 5GB	Standard metrics: FREE
Others (F5, Barracuda): BYOL	Ingestion: **$2.99**/GB	Alert from log: from **$0.5**
	Retention: $0.13/GB	Notification from alert: **$2**

https://azure.microsoft.com/en-us/pricing/details/monitor/

https://azure.microsoft.com/en-us/pricing/details/application-gateway/

Opensource WAF | L7 LB | HTTPS: Kubernetes NGINX Ingress controller

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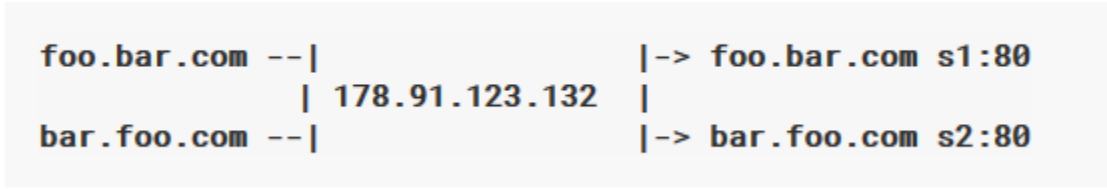
What is Ingress?

- Ingress, added in Kubernetes v1.1, **exposes HTTP and HTTPS routes from outside the cluster to services within the cluster.** Traffic routing is controlled by rules defined on the Ingress resource.
- An Ingress can be configured to **give services externally-reachable URLs, load balance traffic, terminate SSL,** and offer name based virtual hosting
- An Ingress **does not expose arbitrary ports or protocols.** Exposing services other than HTTP and HTTPS to the internet typically uses a service of type Service.Type=NodePort or Service.Type=LoadBalancer



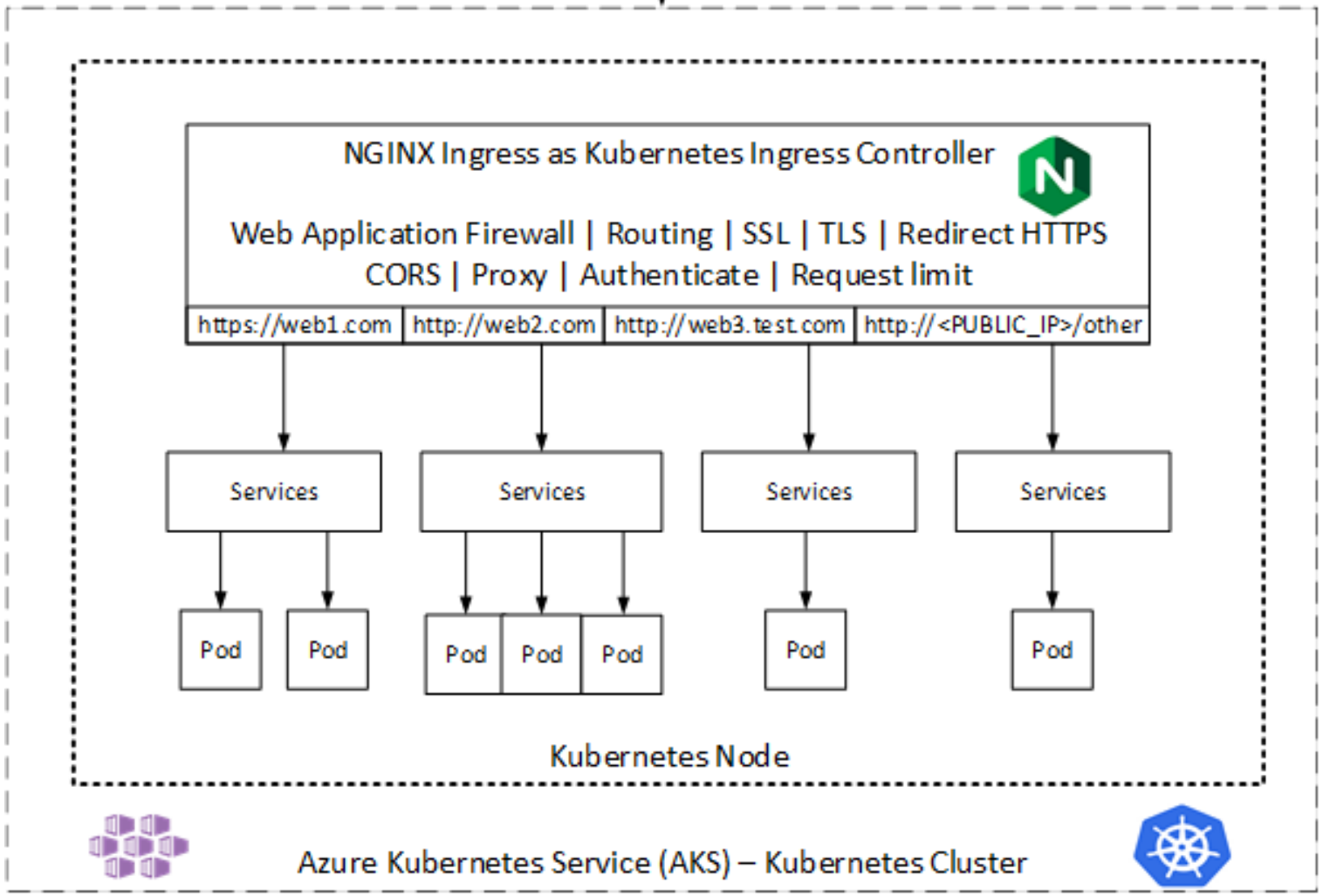

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: name-virtual-host-ingress
spec:
  rules:
  - host: foo.bar.com
    http:
      paths:
      - backend:
          serviceName: service1
          servicePort: 80
  - host: bar.foo.com
    http:
      paths:
      - backend:
          serviceName: service2
          servicePort: 80
```

Ingress Controller

Implementation:

- NGINX Ingress
- HAProxy
- Istio
- Traefik

https://kubernetes.io/docs/concepts/services-networking/ingress-controllers/



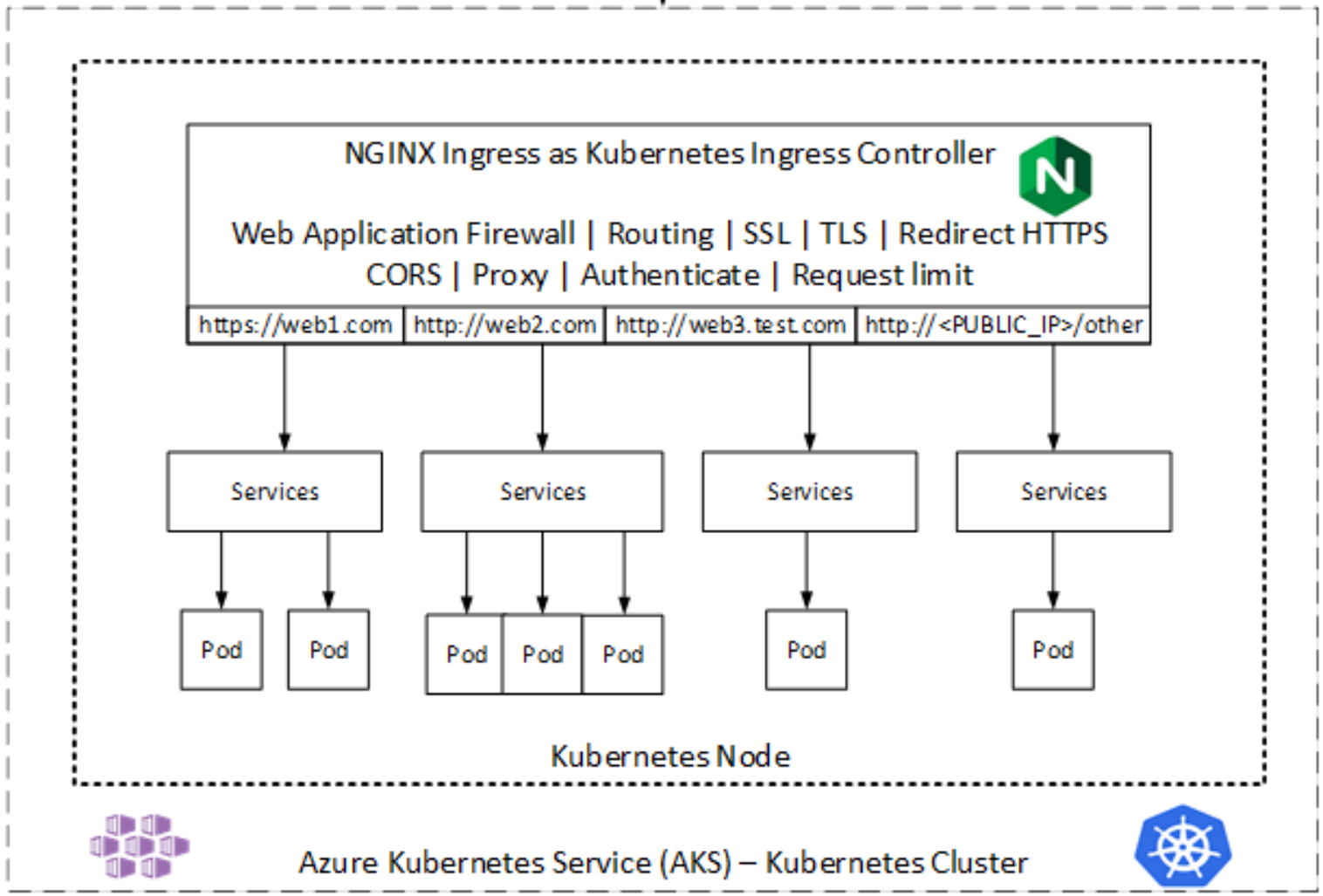
NGINX Ingress Controller

- Opensource project maintained by Kubernetes community based on NGINX Product. Integrate with *Resty WAF (ModSecurity)*.

  https://github.com/kubernetes/ingress-nginx

- Different from NGINX product:

  https://github.com/nginxinc/kubernetes-ingress/blob/master/docs/nginx-ingress-controllers.md



Opensource WAF | L7 LB | HTTPS: cert-manager: SSL certificate manager on Kubernetes

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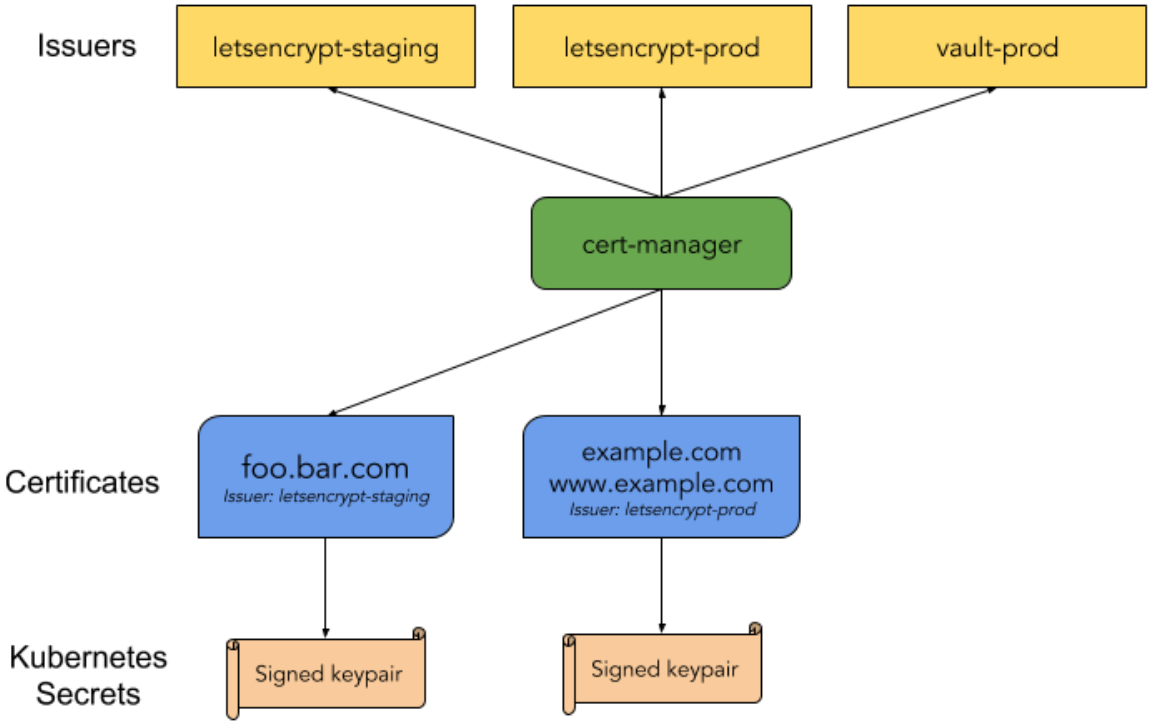
cert-manager

- cert-manager is a Kubernetes **add-on to automate the management and issuance of TLS certificates** from various issuing sources.
- It will ensure **certificates are valid and up to date** periodically, and **attempt to renew certificates** at an appropriate time **before expiry**.



https://github.com/jetstack/cert-manager

Opensource WAF | L7 LB | HTTPS: Deploy NGINX Ingress Controller and cert-manager

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Instruction steps

NGINX Ingress Controller

- Install HELM
- Install NGINX Ingress controller by using HELM
- Assign IP of Ingress to AKS DNS
- Config Ingress controller to record external IP to log file.

cert-manager

- Install cert-manager by using HELM.
- Config SSL Issuer (YAML)
- Config domain name for SSL certificate (YAML)

DEMO

Deploy NGINX Ingress Controller and Cert Manager

Opensource WAF | L7 LB | HTTPS: Write YAML files to activate WAF | L7 LB | HTTPS

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Ingress YAML Annotations

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- Resty WAF
- Force SSL
- SSL Issuer

https://github.com/kubernetes/ingress-nginx/blob/master/docs/user-guide/nginx-configuration/annotations.md

```yaml
annotations:
  kubernetes.io/ingress.class: nginx
  certmanager.k8s.io/cluster-issuer: letsencrypt-prod
  nginx.ingress.kubernetes.io/ssl-redirect: "true" # Force redirect HTTPS
  nginx.ingress.kubernetes.io/rewrite-target: /
  nginx.ingress.kubernetes.io/lua-resty-waf: "active" # Turn on WAF
  nginx.ingress.kubernetes.io/lua-resty-waf-score-threshold: "10"
```

Ingress YAML Specs

- SSL Domain and Secret
- Mapping domain to service

```yaml
spec:
  tls:
  - hosts: # Replace your domains in here
    - shop.thesis.analyticsvn.com
    secretName: tls-secret
  rules:
  - host: shop.thesis.analyticsvn.com # Replace your domain in here
    http:
      paths:
      - path: /
        backend:
          serviceName: dpk-shop # Replace your service name
          servicePort: 80 # Replace your service port
```

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Write Ingress config to activate WAF | HTTPS | L7 LB

Pen-test

Log Management on Azure Kubernetes Service

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Log Management solution

Open source tools

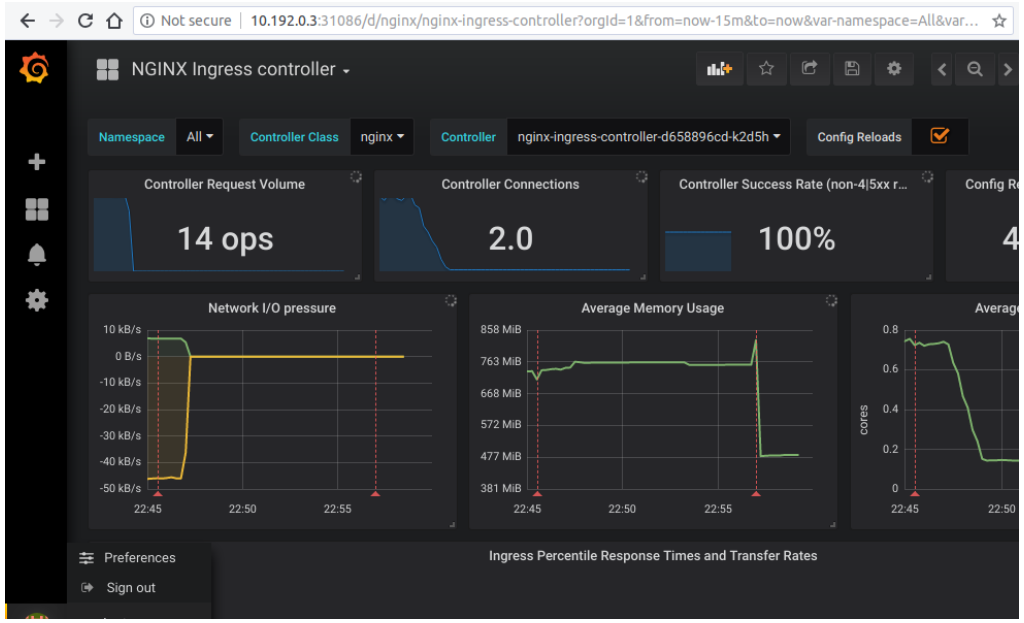
- kubectl logs
- ELK (Elasticsearch, Logstash, Kibana) Stack
- Prometheus + Grafana
- InfluxDB with NGINX Ingress plugin

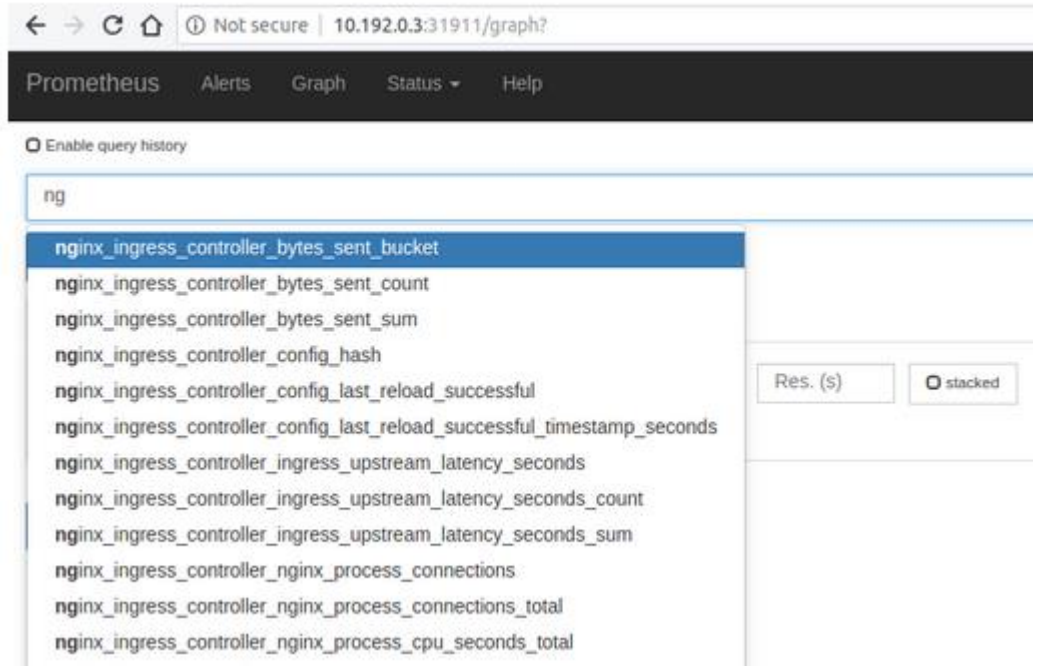
Microsoft Azure services

- Azure Log Analytics from Azure Monitor workspace. (Log collect status: ON – by default)

Prometheus + Grafana

- Official supported by NGINX Ingress controller
- Follow tutorial at: https://kubernetes.github.io/ingress-nginx/user-guide/monitoring/





DEMO

Prometheus + Grafana (UI only | not included installed steps)

Azure Log Analytics (query)

Alert to Slack with Azure Logic App

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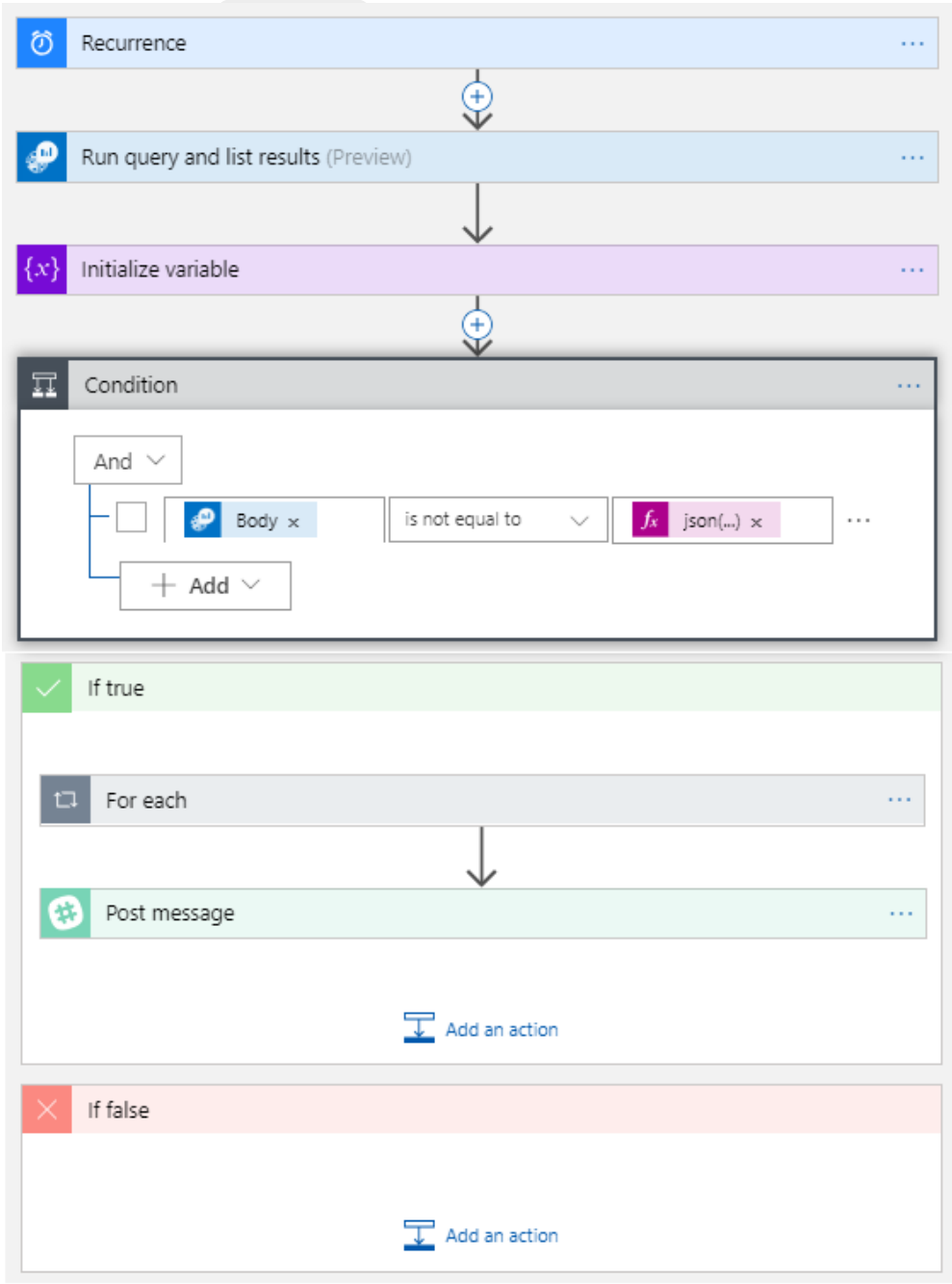
Azure Logic App + Slack

- Azure Logic App: platform for workflow and automation tasks with less-code approach.
- Slack: communication channel
- Logic App scan log in Log Analytics → Alert to Slack if detect attacks.



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DEMO

Azure Logic App and Slack for Attack Alert

(result demo only)

THANK YOU

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Reference

- Deploy-code Github:
- … (will filled in later) …