Running Banner ERP on Kubernetes
Technical Deep Dive

Gabriel Tocci

SIG Introduction

Industry Commitment
SIG was established in 1987 serving higher education with IT initiatives that enhance services for students, faculty, staff and alumni.

Ellucian® Partner
SIG is one of the largest privately held higher education consulting firms in the U.S., and we have been a long-standing partner with Ellucian for many years.

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Powered by more than 100 professionals, with an average tenure of 9.5 years, SIG can provide consulting continuity to keep your goals on task.

Agility to Respond
SIG provides a full lifecycle of services from strategy through managed services, and our ability to move quickly is what we do best. We can respond to uncertainty with flexibility as new opportunities arise.

STRATA INFORMATION GROUP

More than
100
People

More than
34
Years Serving
Higher Education

Presenter

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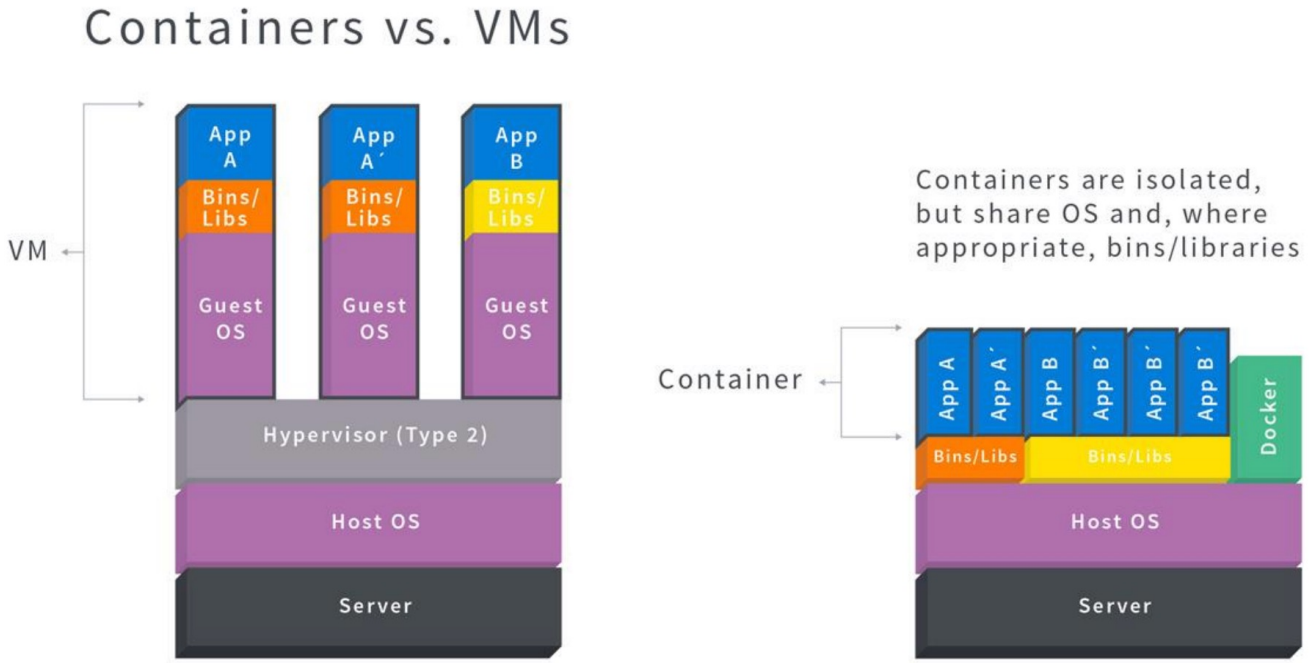
What is Kubernetes (k8s)
How it can help you

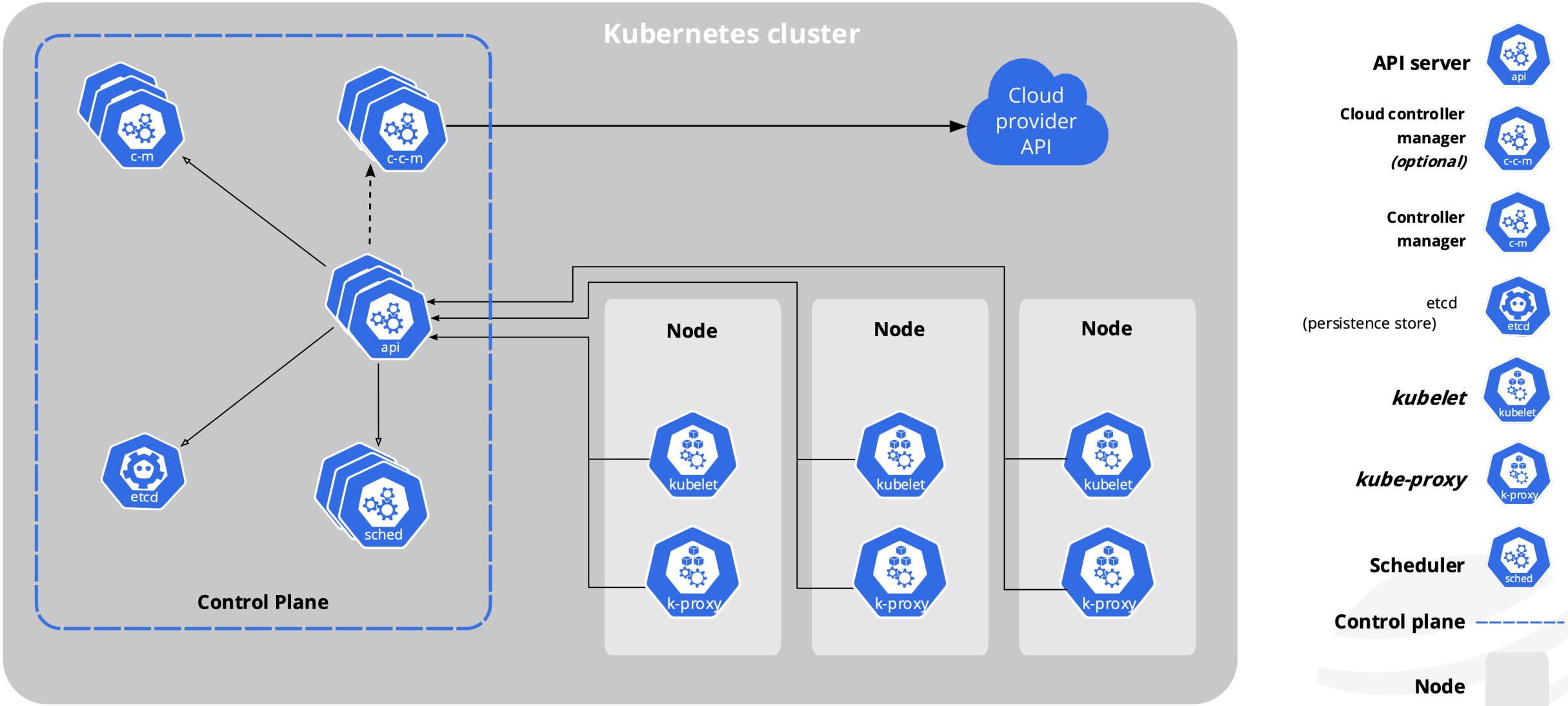
Container Orchestration

- Containerization
  - Docker
  - Other Options; Containerd
- Why Containerization
  - Increased Efficiency
    - Compute Resources
    - IT Operations (devops)
      - Automation
      - Codification (gitops)



Container Orchestration

- NOT Required for Containerization
- Orchestration
  - Kubernetes: Google -> CNCF
  - Other Options: AWS ECS, Swarm
  - Cloud Managed K8s
    - EKS, AKS, GKE, OKE
    - Managed VMs
    - Managed Storage Volumes
    - Managed Load Balancers
    - Managed Image Repos
    - Managed Git Repos
    - Managed DNS
- OnPrem
  - Kubeadm
  - Gitlab
- Distributions
  - Rancher, Mesos, Openshift, etc


Kubernetes cluster
c-m
c-c-m
Cloud provider API
api
etcd
sched
Control Plane
Node
kubelet
k-proxy
Node
kubelet
k-proxy
Node
kubelet
k-proxy
API server
api
Cloud controller manager (optional)
c-c-m
Controller manager
c-m
etcd (persistence store)
etcd
kubelet
kubelet
kube-proxy
k-proxy
Scheduler
sched
Control plane
Node

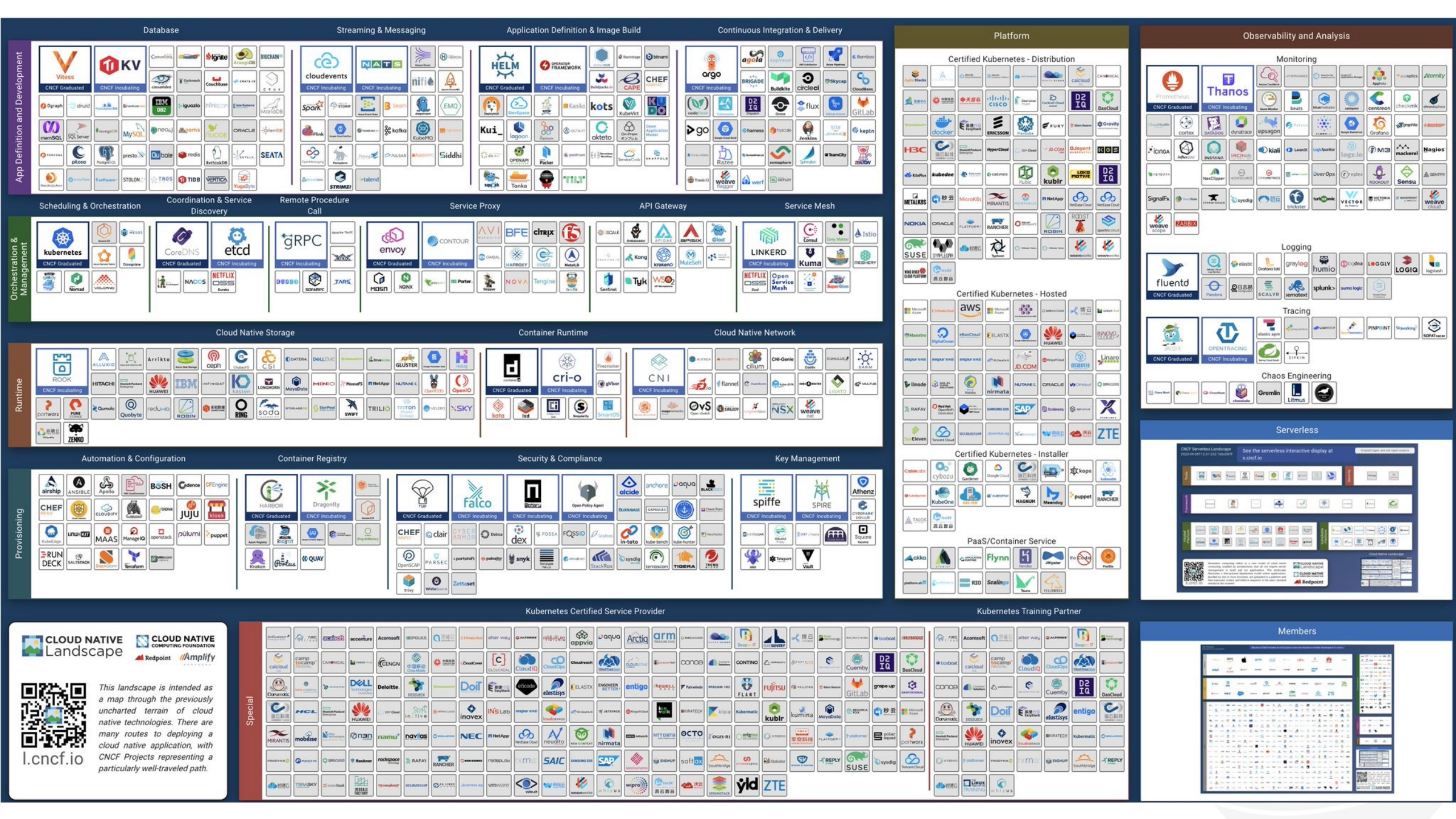
Orchestration Platform

NEEDS

- Node Management
  - Add / Remove Nodes
- Application Deployment
  - Pulls images from repository and run them
- Ingress / Cluster Networking
- Security
  - Role Based Access Control
  - Secrets Management
- Container Access
  - Bash, logs

WANTS

- Package Management: Helm
- Resource Monitoring: Prometheus
- Stateful Sets and Persistent Volumes
- Daemon Sets
- Cron Jobs


App Definition and Development
Database
Streaming & Messaging
Application Definition & Image Build
Continuous Integration & Delivery
Orchestration & Management
Scheduling & Orchestration
Coordination & Service Discovery
Remote Procedure Call
Service Proxy
API Gateway
Service Mesh
Runtime
Cloud Native Storage
Container Runtime
Cloud Native Network
Provisioning
Automation & Configuration
Container Registry
Security & Compliance
Key Management
Platform
Certified Kubernetes - Distribution
Certified Kubernetes - Hosted
Certified Kubernetes - Installer
PaaS/Container Service
Observability and Analysis
Monitoring
Logging
Tracing
Chaos Engineering
Serverless
Kubernetes Certified Service Provider
Special
Kubernetes Training Partner
Members
CLOUD NATIVE Landscape
CLOUD NATIVE COMPUTING FOUNDATION
Redpoint
Amplify
l.cncf.io
This landscape is intended as a map through the previously uncharted terrain of cloud native technologies. There are many routes to deploying a cloud native application, with CNCF Projects representing a particularly well-traveled path.

Lets take a closer look

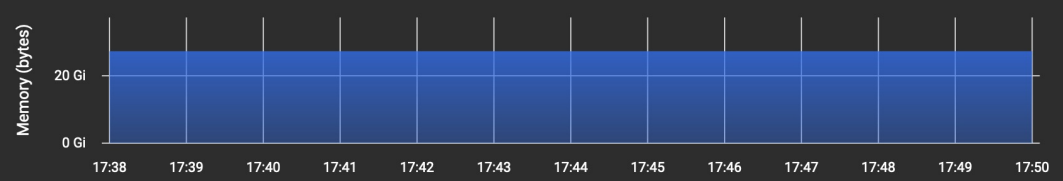
kubernetes | All namespaces | Search

Workloads > Deployments

- Workloads
  - Cron Jobs
  - Daemon Sets
  - Deployments
  - Jobs
  - Pods
  - Replica Sets
  - Replication Controllers
  - Stateful Sets
- Service
  - Ingresses
  - Services
- Config and Storage
  - Config Maps
  - Persistent Volume Claims
  - Secrets
  - Storage Classes
- Cluster
  - Cluster Role Bindings
  - Cluster Roles
  - Namespaces
  - Network Policies
  - Nodes
  - Persistent Volumes
  - Role Bindings
  - Roles
  - Service Accounts

CPU Usage

Memory Usage



Deployments

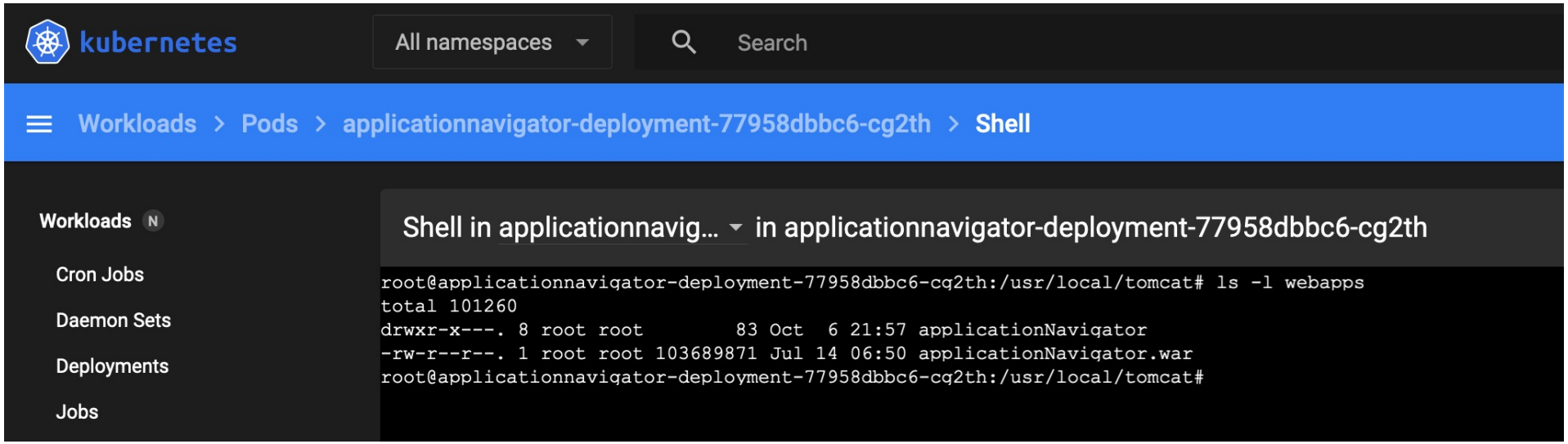
Filter

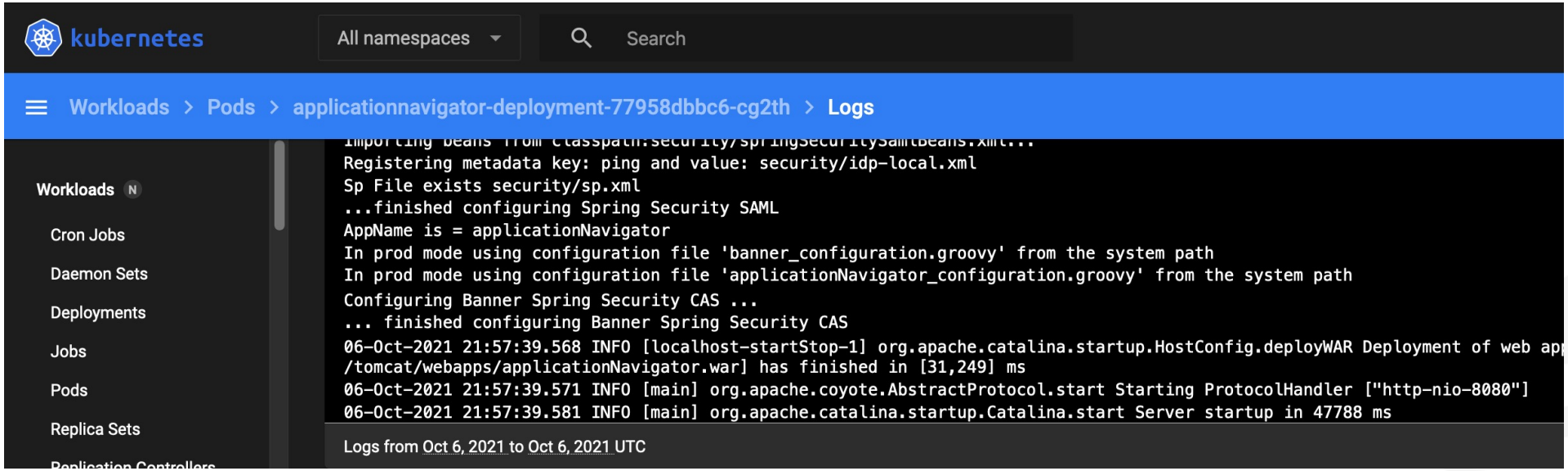
Name	Namespace	Images	Labels	Pods	Created
applicationnavigator-deployment	applicationnavigator	us-ashburn-1.ocir.io/idcqwczj5hir/applicationnavigator:3.3.1	app: applicationnavigator	1 / 1	a month ago
banner-mobileserver-deployment	banner-mobileserver	us-ashburn-1.ocir.io/idcqwczj5hir/banner-mobileserver:5.4.0	app: banner-mobileserver	1 / 1	17 days ago
banneraccessmgmt-deployment	banneraccessmgmt	us-ashburn-1.ocir.io/idcqwczj5hir/banneraccessmgmt:9.3.18.0.3-banint	app: banneraccessmgmt	1 / 1	a month ago
banneradmin-deployment	banneradmin	us-ashburn-1.ocir.io/idcqwczj5hir/banneradmin:9.3.25.0.7-banint	app: banneradmin	1 / 1	a month ago
banportals-deployment	banportals	us-ashburn-1.ocir.io/idcqwczj5hir/banportals:test	app: banportals	1 / 1	a month ago
coredns	kube-system	iad.ocir.io/axoxdievda5j/oke-public-coredns@sha256:14cad471dfe66fb9f9230e1f6df9f454ef7f27b30aaf8d54d67f683870466491	k8s-app: kube-dns, kubernetes.io/name: CoreDNS	3 / 3	a month ago
dashboard-metrics-scraper	kubernetes-dashboard	kubernetesui/metrics-scraper:v1.0.6	k8s-app: dashboard-metrics-scraper	1 / 1	a month ago
degreeworks-deployment	degreeworks	us-ashburn-1.ocir.io/idcqwczj5hir/degreeworks:5.0.5	app: degreeworks-admin	0 / 0	20 days ago
documentmanagementapi-deployment	documentmanagementapi	us-ashburn-1.ocir.io/idcqwczj5hir/documentmanagementapi:9.1.1.1	app: documentmanagementapi	1 / 1	21 days ago
employeeselfservice-deployment	employeeselfservice	us-ashburn-1.ocir.io/idcqwczj5hir/employeeselfservice:9.11	app: employeeselfservice	1 / 1	a month ago

1 – 10 of 25

```
$ kubectl get deployments -A
```

NAMESPACE	NAME	READY	UP-TO-DATE	AVAILABLE	AGE
applicationnavigator	applicationnavigator-deployment	1/1	1	1	33d
banner-mobileserver	banner-mobileserver-deployment	1/1	1	1	17d
banneraccessmgmt	banneraccessmgmt-deployment	1/1	1	1	33d
banneradmin	banneradmin-deployment	1/1	1	1	33d
banportals	banportals-deployment	1/1	1	1	33d
degreeworks	degreeworks-deployment	0/0	0	0	20d
documentmanagementapi	documentmanagementapi-deployment	1/1	1	1	21d
employeeselfservice	employeeselfservice-deployment	1/1	1	1	33d
ethosapimanagementcenter	ethosapimanagementcenter-deployment	1/1	1	1	25d
haproxy-controller	haproxy-ingress	1/1	1	1	34d
haproxy-controller	ingress-default-backend	1/1	1	1	34d
integrationapi	integrationapi-deployment	1/1	1	1	26d
kube-system	coredns	3/3	3	3	34d
kube-system	kube-dns-autoscaler	1/1	1	1	34d
kube-system	kube-state-metrics	1/1	1	1	9d
kube-system	metrics-server	1/1	1	1	33d
kubernetes-dashboard	dashboard-metrics-scraper	1/1	1	1	33d
kubernetes-dashboard	kubernetes-dashboard	1/1	1	1	33d
lynx	lynx-deployment	1/1	1	1	17d
pci	pci-deployment	1/1	1	1	21d
ssb	ssb-deployment	1/1	1	1	33d
ssomanager	ssomanager-deployment	2/2	2	2	33d
studentadvisorssb	studentadvisorssb-deployment	1/1	1	1	33d
studentapi	studentapi-deployment	1/1	1	1	25d
touchnet	touchnet-deployment	1/1	1	1	21d


kubernetes
All namespaces
Search
Workloads > Pods > applicationnavigator-deployment-77958dbbc6-cg2th > Shell
Workloads N
Cron Jobs
Daemon Sets
Deployments
Jobs
Shell in applicationnavig... in applicationnavigator-deployment-77958dbbc6-cg2th
root@applicationnavigator-deployment-77958dbbc6-cg2th:/usr/local/tomcat# ls -l webapps
total 101260
drwxr-x---. 8 root root   83 Oct 6 21:57 applicationNavigator
-rw-r--r--. 1 root root 103689871 Jul 14 06:50 applicationNavigator.war
root@applicationnavigator-deployment-77958dbbc6-cg2th:/usr/local/tomcat#


kubernetes
All namespaces
Search
Workloads > Pods > applicationnavigator-deployment-77958dbbc6-cg2th > Logs
Workloads N
Cron Jobs
Daemon Sets
Deployments
Jobs
Pods
Replica Sets
Registering metadata key: ping and value: security/idp-local.xml
Sp File exists security/sp.xml
...finished configuring Spring Security SAML
AppName is = applicationNavigator
In prod mode using configuration file 'banner_configuration.groovy' from the system path
In prod mode using configuration file 'applicationNavigator_configuration.groovy' from the system path
Configuring Banner Spring Security CAS ...
... finished configuring Banner Spring Security CAS
06-Oct-2021 21:57:39.568 INFO [localhost-startStop-1] org.apache.catalina.startup.HostConfig.deployWAR Deployment of web ap
/tomcat/webapps/applicationNavigator.war] has finished in [31,249] ms
06-Oct-2021 21:57:39.571 INFO [main] org.apache.coyote.AbstractProtocol.start Starting ProtocolHandler ["http-nio-8080"]
06-Oct-2021 21:57:39.581 INFO [main] org.apache.catalina.startup.Catalina.start Server startup in 47788 ms
Logs from Oct 6, 2021 to Oct 6, 2021 UTC

```
$ kubectl exec --stdin --tty applicationnavigator-
df94cb47-r2gkq -- /bin/bash

$ kubectl logs applicationnavigator-df94cb47-r2gkq

$ scale -n applicationnavigator deployment
applicationnavigator-deployment --replicas=3

$ kubectl apply -f .
```

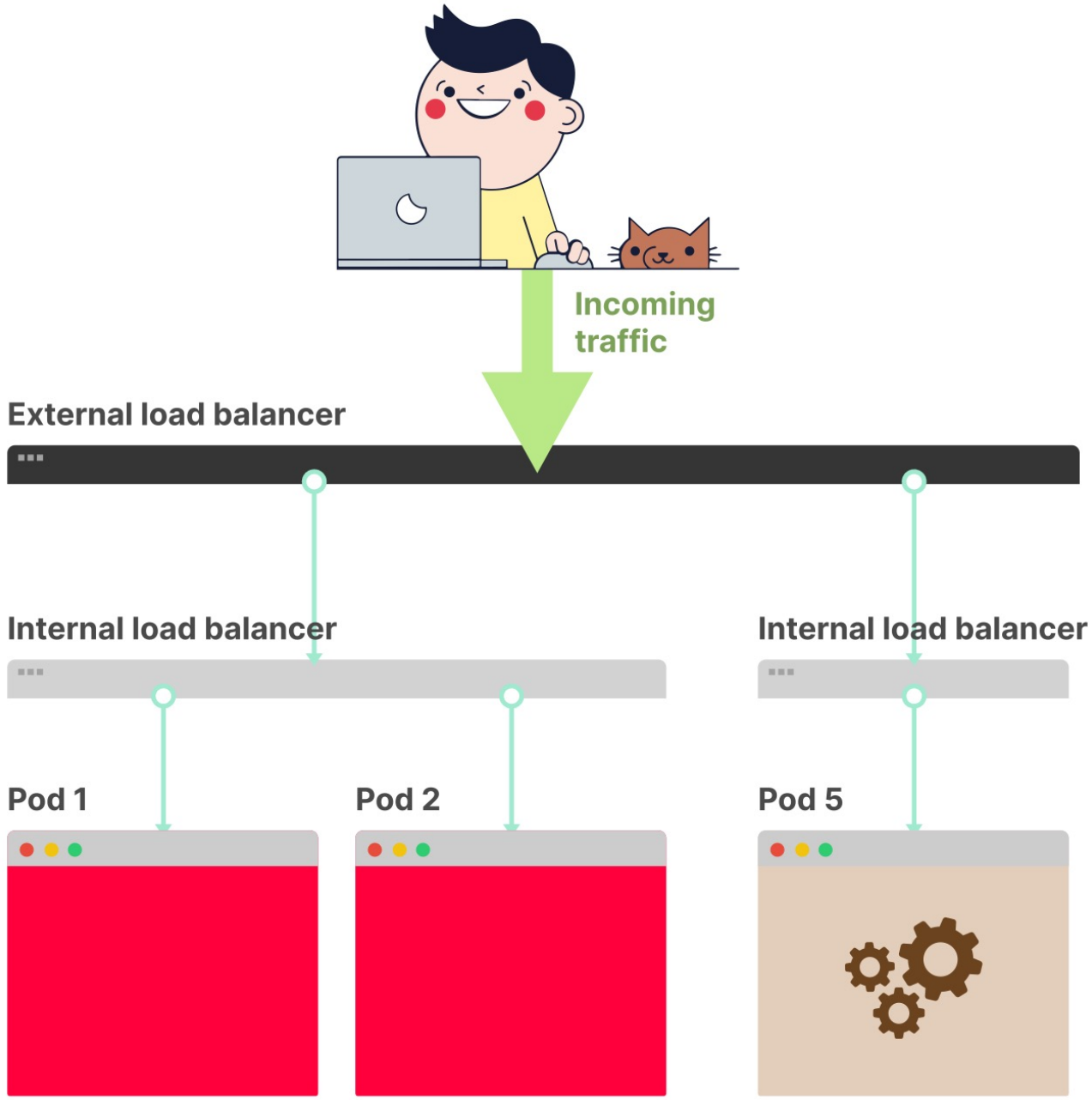
```yaml
---
apiVersion: apps/v1
kind: Deployment
metadata:
  namespace: ssomanager
  name: ssomanager-deployment
  labels:
    app: ssomanager
spec:
  replicas: 2
  selector:
    matchLabels:
      app: ssomanager
  template:
    metadata:
      labels:
        app: ssomanager
    spec:
      imagePullSecrets:
      - name: my-registry-token
      containers:
      - name: ssomanager
        image: us-east-1.cloud.com/my-tenant/ssomanager:8.5.1-PROD
        ports:
        - containerPort: 8080
        resources:
          limits:
            memory: "500M"
            cpu: "2"
          requests:
            memory: "100M"
            cpu: ".25"
        env:
        - name: K8S_JDBC_CONNECTION_STRING
          value: prod-db1.school.edu:1521/PROD
        - name: K8S_INTEGMGR_PW
          valueFrom:
            secretKeyRef:
              name: db-passwords
              key: integmgr-pw

```

HAPROXY INGRESS

- Reliable, Fast, Efficient
  - HTTP Errors Returned – Neither HAProxy nor NGINX Inc. produced any errors. Envoy, however, produced 19 503 errors; NGINX produced 17 502 errors and 8 504 errors; while Traefik produced 1342 502 errors. [1]
- Highly Configurable [2]
  - Route Rules
  - Security
  - Layer 7
- Known Quantity
  - Application Persistence
  - IP Source Affinity
- cluster.school.edu:1024/metrics

[1] https://www.globenewswire.com/news-release/2020/09/01/2086982/0/en/HAProxy-Kubernetes-Ingress-Controller-Twice-as-Fast-with-Lowest-CPU-vs-Four-Competitors.html

[2] https://haproxy-ingress.github.io/docs/configuration/keys/

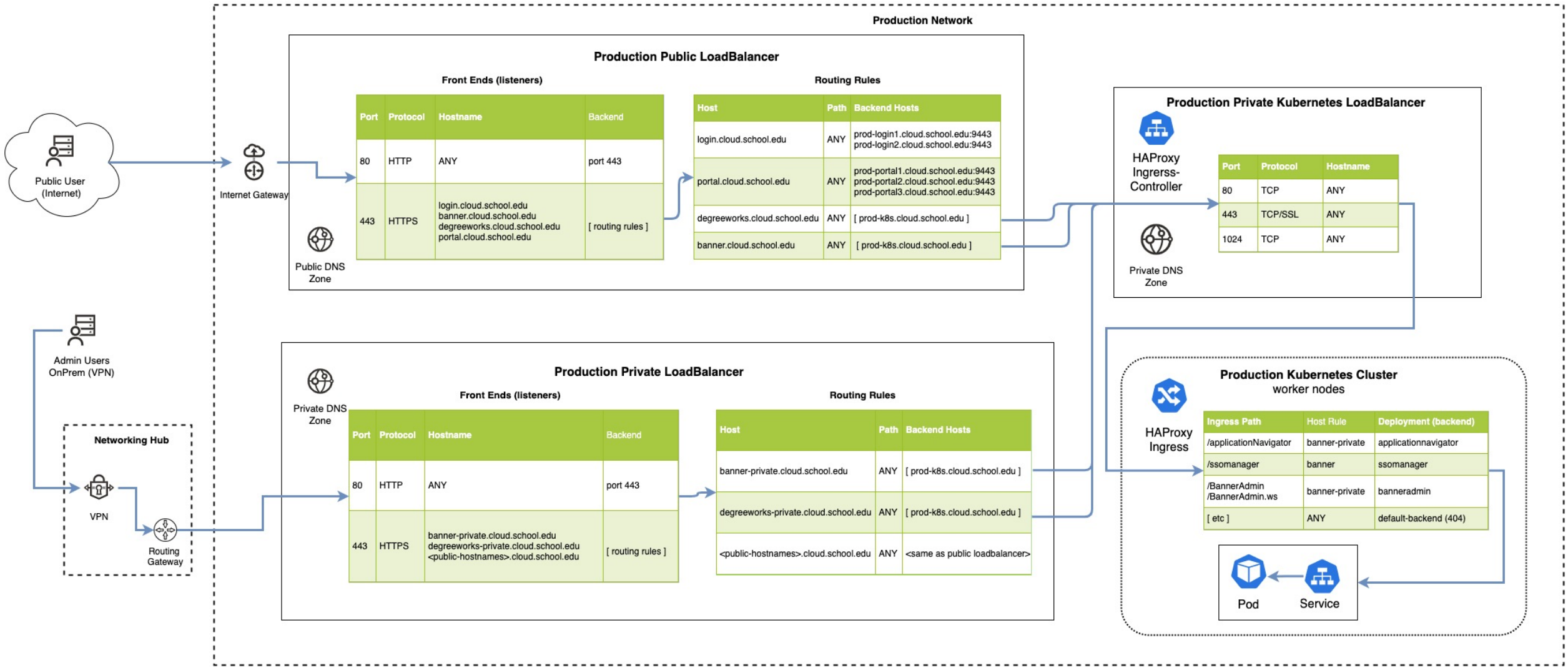


Ingress-controller (frontend)

```yaml
---
apiVersion: v1
kind: Service
metadata:
  labels:
    run: haproxy-ingress
  name: haproxy-ingress
  namespace: haproxy-controller
  annotations:
    service.beta.kubernetes.io/load-balancer-internal: "true"
    service.beta.kubernetes.io/load-balancer-ssl-ports: "443"
    service.beta.kubernetes.io/load-balancer-tls-secret: ssl-cert-star-school-edu-2020
spec:
  selector:
    run: haproxy-ingress
  type: LoadBalancer
  ports:
  - name: https
    port: 443
    protocol: TCP
    targetPort: 443
  - name: stat
    port: 1024
    protocol: TCP
    targetPort: 1024

```

Ingress-service (backend)

```yaml
---
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  namespace: ssomanager
  name: ssomanager-ingress
spec:
  rules:
    - host: banner.cloud.school.edu
      http:
        paths:
        - path: /ssomanager
          pathType: Prefix
          backend:
            service:
              name: ssomanager-service
              port:
                number: 8080

```



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ESM Deployment Integration

Deployment job deploy step - custom scripts

You can create custom pre- and post-deploy step scripts that apply to all deployments of an application or specific to the deployment of the application to a particular App Server.

The deployment job deploy step initially looks for pre- and post-deployment customization scripts in an App Server specific sub-directory of the deployment custom scripts directory.

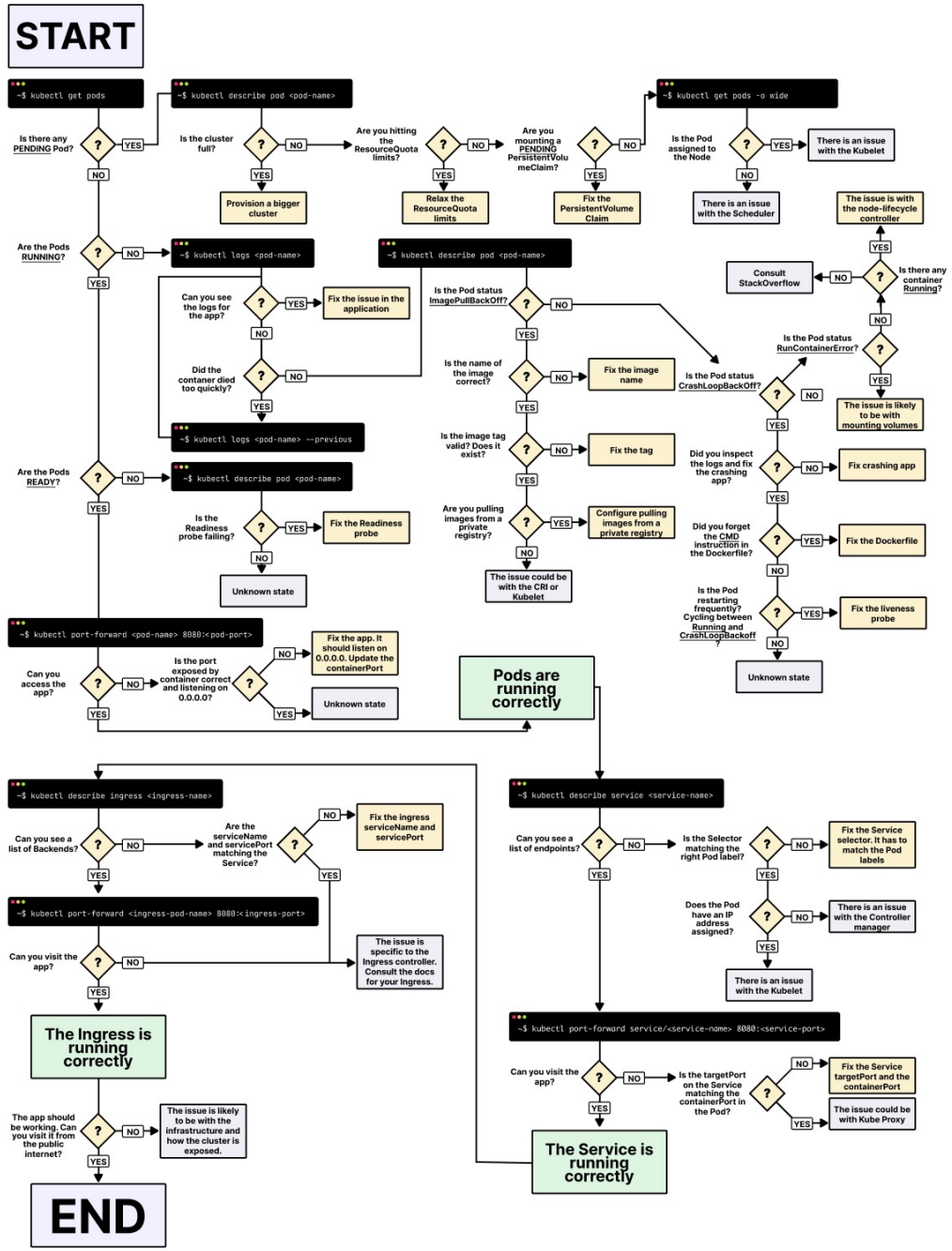
Ban9WarFileStagingPath/deployScripts/*AppName*/*AppServer*

```
echo CURRENT_DIR: $CURRENT_DIR
echo STAGINGPATH: $STAGINGPATH
echo STAGE_SUBDIR: $STAGE_SUBDIR
echo APP_SRVR_NAME: $APP_SRVR_NAME
echo TARGET_DIR: $TARGET_DIR
echo APP_NAME: $APP_NAME
echo SRC_WAR: $SRC_WAR
echo SRC_DIR: $SRC_DIR
```

Deployment Options

- Rebuild Image
  - `Docker build`
  - `Docker push`
  - `kubectl rollout restart deployment $APP_NAME`
- Stage Artifacts
  - `aws s3 cp $SRC_WAR docker-bucket/$APP_NAME/`
  - `kubectl rollout restart deployment $APP_NAME`

Ref: Ellucian_Solution_Manager_1.x_User_Guide_x.pdf



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Ref: https://learnk8s.io/troubleshooting-deployments

Getting Started

Precondition: Containerized Banner Application(s)

- Provision Subnets / Networking / Firewall
- Provision the Cluster
- Add Nodes
- Configure Kubectl
- Deploy kubernetes-dashboard
- Deploy Ingress Controller
- Deploy sample tomcat application
  - Service, Deployment, Ingress
- Deploy Banner application
- ESM Integration
- Automation

Cluster Design

- PROD
- PPRD
- DEVL (other)

Container ENV vars

- Secrets
- ConfigMap
- Deployment

Tagging Strategies

- 9.18
- 9.18-PROD
- PROD
- Latest
    - imagePullPolicy: Always

Contact

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THANK YOU

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