Running game servers on Kubernetes

Mo Firouz

About me

- My name is Mo(hammad) Firouz!
- Originally Iranian - can speak Farsi with a funny accent.
- Software architect
- Co-founder of Heroic Labs

Heroic Labs

- Nakama, a realtime and social server for games.
- Completely open-source (and free!): https://github.com/heroiclabs/nakama
- Realtime, server-authoritative multiplayer
- Flexible matchmaking system
- Extendable using Lua scripting
- Friends, Clans, Chat + more

Nakama

Things to discuss

1. Intro to Kubernetes
2. System overview
3. Two examples of game servers
    - Nakama server
    - Unity Headless servers

Intro to Kubernetes

System for automating deployment, scaling, and management of ***containerized*** *applications*

- Hardware provisioning - replaces Puppet, Chef and Ansible.
- Supervisor-like responsibilities - healthcheck and uptime
- Log aggregation + metrics + scheduled jobs + (much) more

Intro to Kubernetes

Some rules to follow:

1. Log to stdout and stderr
2. Return non-zero for abnormal exits
3. Add healthcheck endpoint - ideally to `/`
4. Add readiness endpoint - ideally to same as healthcheck
5. Use cmd args and env variables, not config files

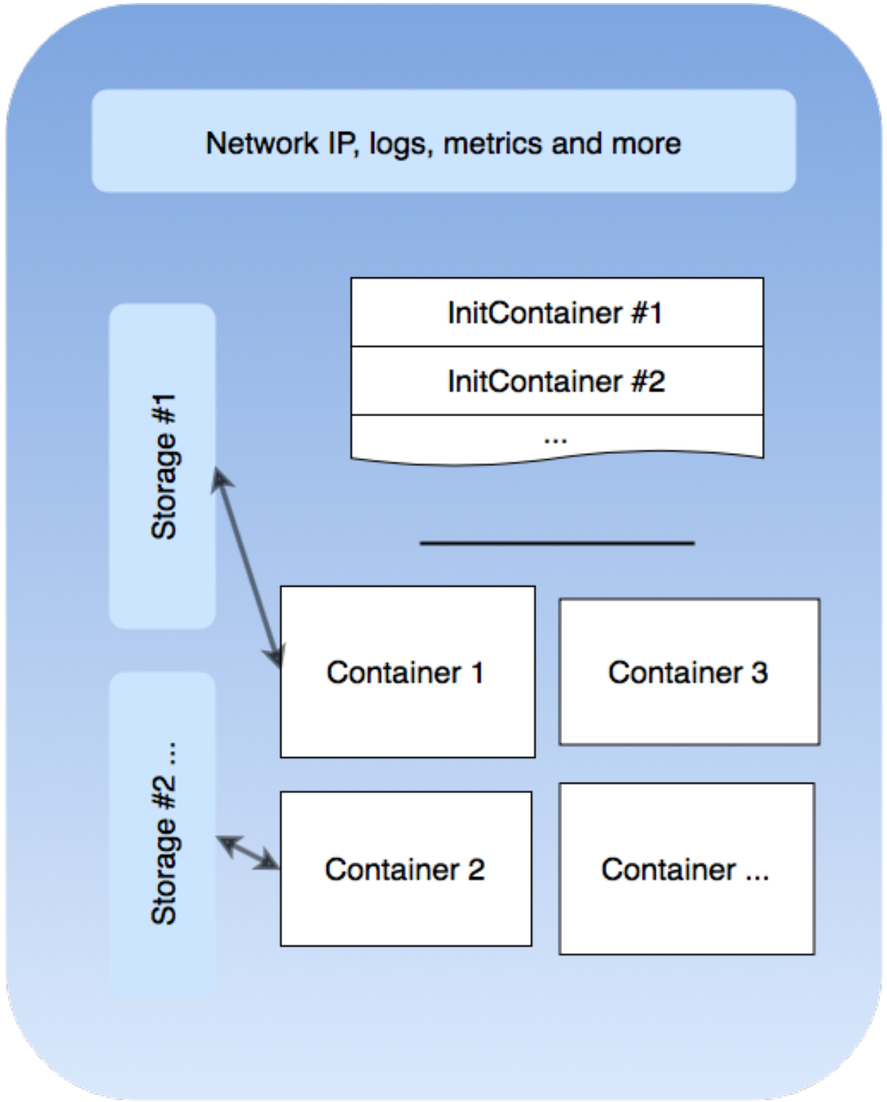
Intro to Kubernetes

Kubernetes components

1. Pod
2. Controllers
3. Service + Ingress
4. Nodes
5. Autoscaling

Pod

- Wrap one or more containers
- Pods are ephemeral
  - can be dynamically created / deleted
- Unique network cluster-IP (but not permanent)
- Storage resource(s)



Pod

```yaml
apiVersion: v1
kind: Pod
metadata:
  labels:
    app: nakama
spec:
  volumes:
  - name: nakama-volume
    emptyDir:
containers:
  - name: nakama
    image: heroiclabs/nakama
    command: "/bin/sh exec nakama"
    ports:
    - containerPort: 7350
      name: api
    volumeMounts:
    - mountPath: /nakama-data
      name: nakama-volume
```

Service

- A way to access pods
- Services have DNS names
  - `controller.namespace.service.cluster.local`
  - `controller.namespace`
- Expose applications internally and externally

Service

- ClusterIP: cluster-internal IP
- NodePort: Expose port (mapping) on the physical node
- LoadBalancer: Cloud provider’s load balancer
- ExternalName: CNAME without any proxying

Service

```yaml
apiVersion: v1
kind: Service
metadata:
  name: nakamaservice
  labels:
    service: nakama
spec:
  selector:
    app: nakama
  type: NodePort
  ports:
  - port: 80
    targetPort: 7350
    name: api
```

Ingress

- Very similar to LoadBalancer service
- Only allowing HTTP(S) traffic into the cluster
- SSL Termination
- Usually configures Cloud Provider traffic

Ingress

```yaml
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: nakamaingress
  labels:
    ingress: nakama
  annotations:
    kubernetes.io/ingress.allow-http: "false"
spec:
  tls:
    - secretName: ingress-cert-secret
  backend:
    serviceName: nakama
    servicePort: 80
```

Controllers

- Replicating homogeneous set of pods
- Ensures healthy pods are running
- Deployment:
  - Manage infrastructure state from current to desired
  - Rolling update
  - Scale up/down pod replicas
  - History and rollback

Controller

- StatefulSet:
  - Very similar to Deployment
  - Sticky pod IDs - sequential gurantueed ordering
  - Disk and Network resources will stay the same across roll outs
- DaemonSets, (Cron)Jobs, and more...

Controller

```yaml
apiVersion: apps/v1beta2
kind: StatefulSet
metadata:
  name: nakamastatefulset
spec:
  serviceName: "nakamaservice" # This must exist before Statefulset is created
  revisionHistoryLimit: 1
  replicas: 2
  podManagementPolicy: OrderedReady # or Parallel
  updateStrategy:
    type: RollingUpdate
  selector:
    matchLabels:
      app: nakama # this must matches below
  template:
    metadata:
      labels:
        app: nakama
    # ...rest of pod template...
```

Nodes

- Assign special pods to special nodes

```
nodeSelector:
  disktype: ssd
```

- Use `affinity` and `anti-affinity` to indicate soft/hard requirement for node attractiveness
- Use `taint` and `tolerations` to repel pods from nodes
- Use both to schedule pods only on nodes with special hardware
- Ensure to use resource `requests` and `limits` for pods to limit noisey neighbour problems.

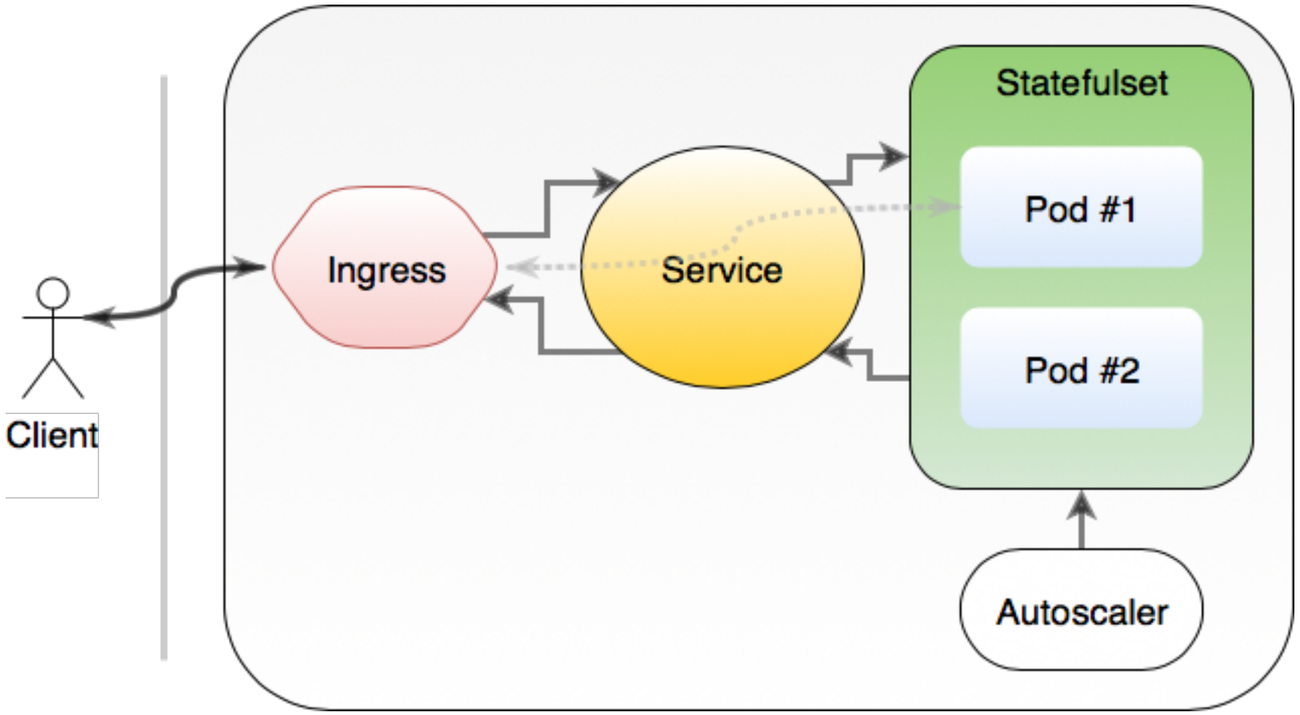
Nodes

```yaml
affinity:
  podAntiAffinity:
    preferredDuringSchedulingIgnoredDuringExecution:
    - weight: 100
      podAffinityTerm:
        topologyKey: kubernetes.io/hostname
        labelSelector:
          matchExpressions:
          - key: app
            operator: In
            values:
            - nakama
```

Autoscaling

```yaml
apiVersion: autoscaling/v2beta1
kind: HorizontalPodAutoscaler
metadata:
  name: nakamascaler
  labels:
    autoscaler: nakama
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: StatefulSet
    name: nakamastatefulset
  minReplicas: 1
  maxReplicas: 10
  metrics:
  - type: Resource
    resource:
      targetAverageUtilization: 50
      name: cpu
```

System overview

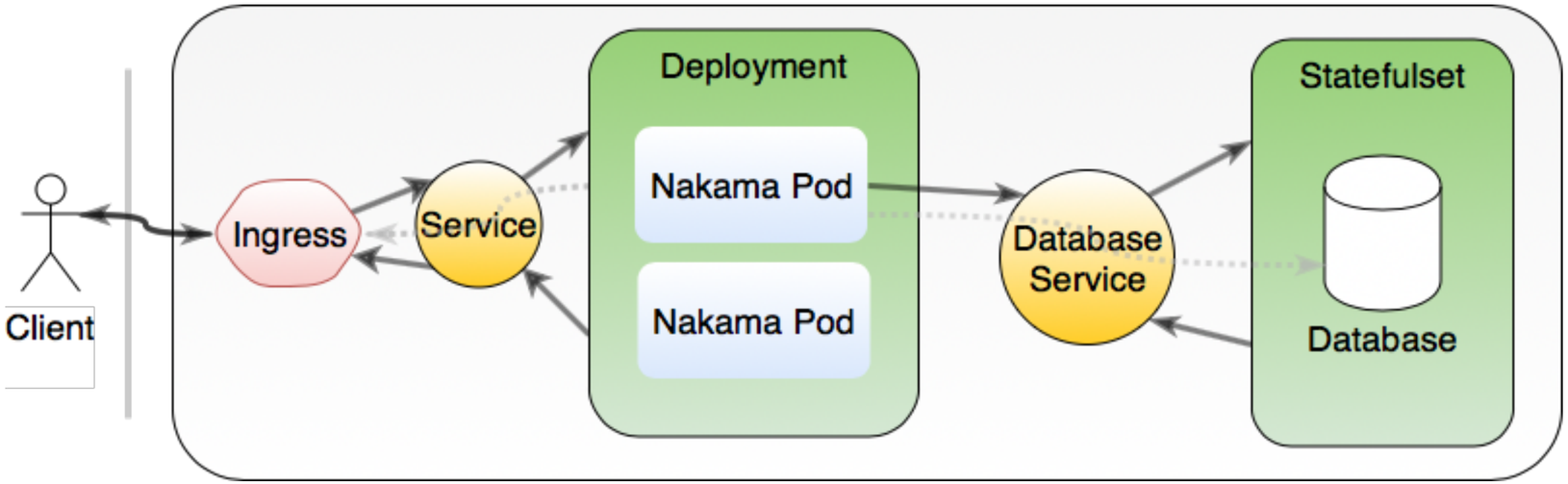


Nakama game server

- Realtime multiplayer
- Server-authoritative multiplayer
- Matchmaking
- Custom code runtime

- Presence system
- Friends, Groups/clans
- Realtime chat, notifications
- User accounts, authentication

Nakama game server



Nakama game server

Pods

Name	Node	Status	Restarts	Age	CPU (cores)	Memory (bytes)
nakama-0	nakama-n1s1--7a45d00d-b0n3	Running	0	10 hours	0.005	64.531 Mi
cockroachdb-1	db-n1s2-a7f0d49a-f90p	Running	0	16 days	0.019	1.016 Gi
cockroachdb-0	db-n1s2-a7f0d49a-8cb2	Running	0	16 days	0.016	973.879 Mi
cockroachdb-2	db-n1s2-a7f0d49a-4ts8	Running	0	16 days	0.017	1,013.605 Mi

Stateful Sets

Name	Labels	Pods	Age	Images
nakama	statefulset: nakama	1 / 1	a month	heroiclabs/nakama:2.0.1
cockroachdb	statefulset: cockroachdb	3 / 3	2 months	cockroachdb/cockroach:v2.0.1

Nakama game server

Ingresses

Name	Endpoints	Age
nakama	35.186.228.0	2 months

Services

Name	Labels	Cluster IP	Internal endpoints	External endpoints	Age
nakama	service: nakama	10.23.250.87	nakama.tgc:7350 TCP nakama.tgc:30570 TCP	-	a month
cockroachdb	service: cockroachdb	None	cockroachdb.tgc:26257 T cockroachdb.tgc:0 TCP cockroachdb.tgc:8080 TC cockroachdb.tgc:0 TCP	-	2 months

Unity headless server

```
/Applications/Unity/Unity.app/Contents/MacOS/Unity -quit -batchmode -nographics \
  -logFile .unity-build.log \
  -projectPath $(pwd)/unity-fastpacedmultiplayer \
  -executeMethod BuildTools.QuickBuildLinux
```

```
public static void QuickBuildLinux()
{
    BuildPlayerOptions opts = new BuildPlayerOptions
    {
        options = BuildOptions.Development & BuildOptions.EnableHeadlessMode,
        locationPathName = "/Users/mo/Desktop/server",
        target = BuildTarget.StandaloneLinux64
    };

    BuildPipeline.BuildPlayer(opts);
}
```

Unity headless server

```yaml
metadata:
  generateName: "unity-"
  labels:
    app: unity-server
spec:
  hostNetwork: true
  containers:
    - image: mofirouz/unity-fastpacedmultiplayer:0.0.1
      name: unity-server
      imagePullPolicy: Always
      command:
      - "/bin/sh"
      - "-ecx"
      - >
        exec ./server -logFile /dev/stdout
      ports:
        - containerPort: 7777
          name: server-api
```

Feel free to send questions;

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Talk available on GitHub:
https://github.com/mofirouz/gameservers-kubernetes