

Kubernetes pro dinosaury

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Linux Days 2025

<https://tomasek.cz/ld25>



Představení

Administrátor & Vývojář v CESNET, z.s.p.o. --- 21 let

- eduroam, eduID, CESNET IdM + PKI

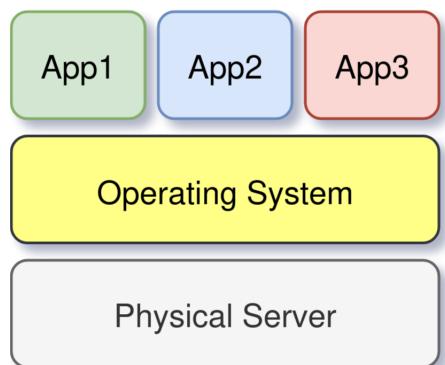
Platform Engineer v 3Key Company, s.r.o. --- od 11/2022

3Key Company vyvíjí platformu CZERTAINLY:

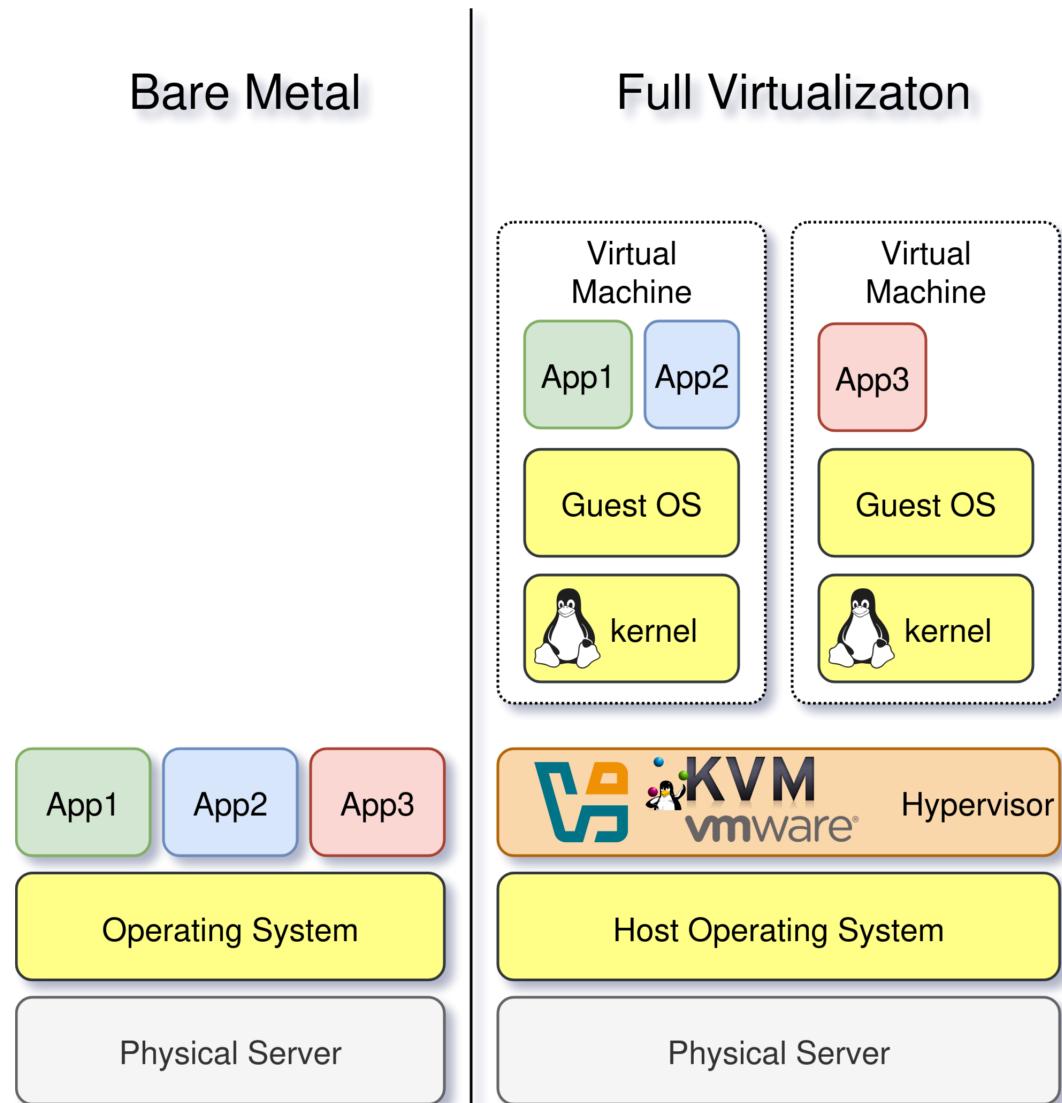
- Životní cyklus Digitálních Certifikátů
- Digitální podpisy dle eIDAS
- Open Source & Cloud Native

Vývoj sdílení prostředků

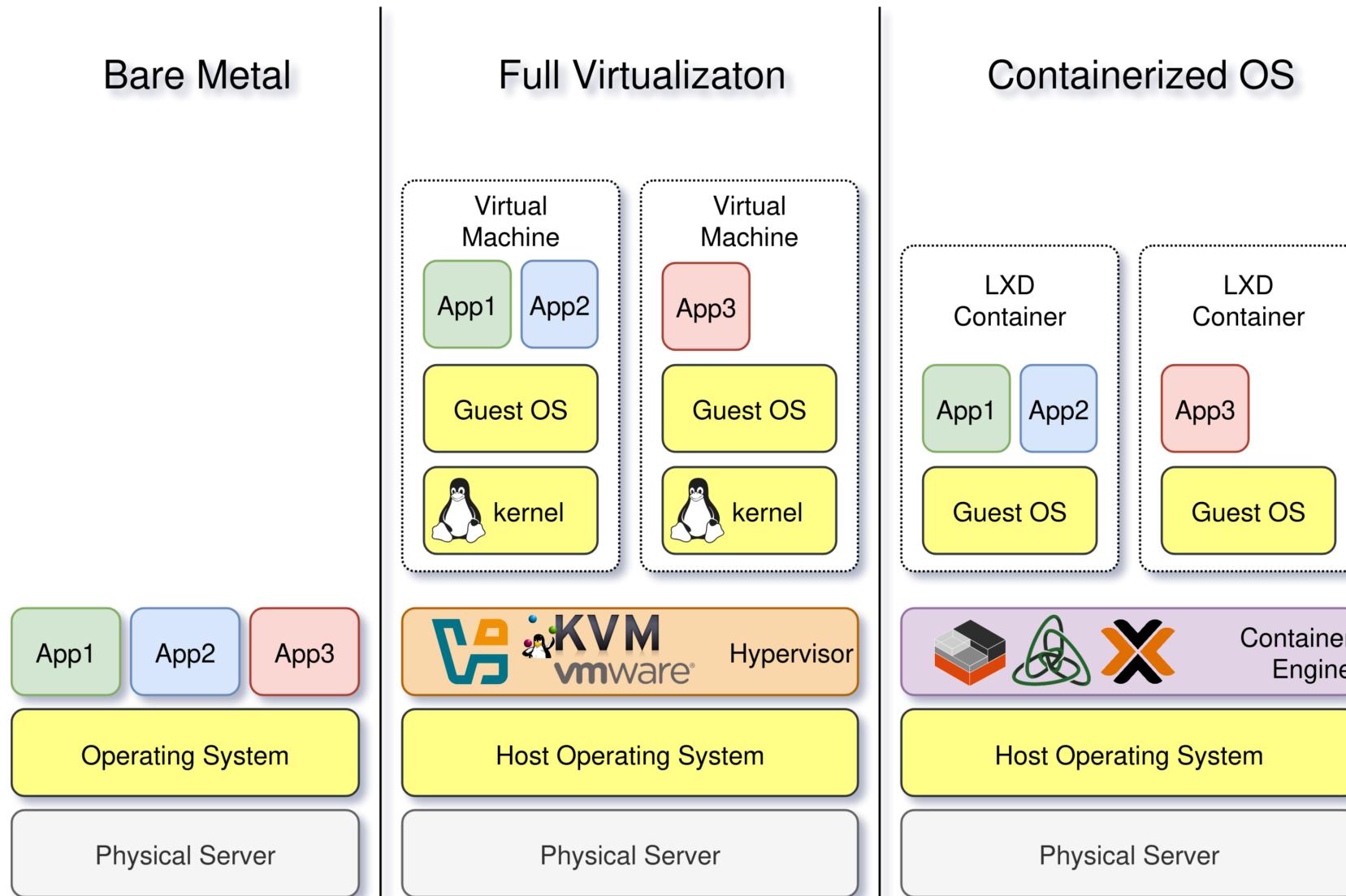
Bare Metal



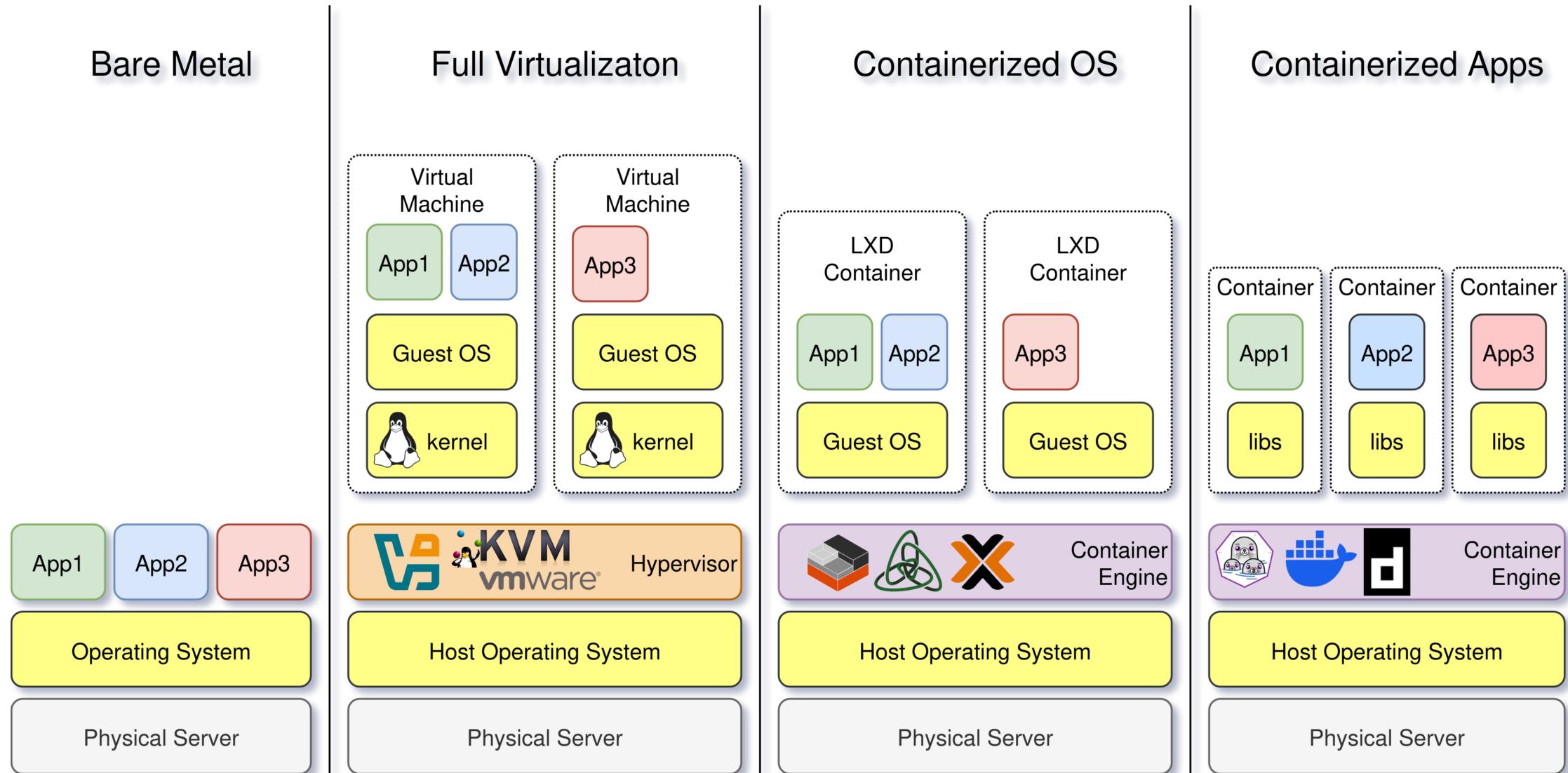
Vývoj sdílení prostředků



Vývoj sdílení prostředků



Vývoj sdílení prostředků



Proč se zajímat o Kontejnery?

Obsahuje

- aplikaci
- aktuální verzi aplikace
- závislosti = knihovny

Neobsahuje

- data
- konfiguraci
- kernel
- init systém
- ssh server, ...

Kontejnery obsahují jen aplikaci

```
$ podman exec -it semik-nginx bash
root@7904f80d7a00:/# ps aux
USER          PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root            1  0.0  0.0  14608  9096 ?        Ss 14:57  0:00 nginx: master process nginx -g daemon off;
www-data         2  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         3  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         4  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         5  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         6  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         7  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         8  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data         9  0.0  0.0  14980 3588 ?        S 14:57  0:00 nginx: worker process
www-data        10  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        11  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        12  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        13  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        14  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        15  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        16  0.0  0.0  14980 3588 ?       S 14:57  0:00 nginx: worker process
www-data        17  0.0  0.0  14980 3524 ?       S 14:57  0:00 nginx: worker process
root@7904f80d7a00:/# exit
```

A proč se zajímat o Kubernetes?

- Nejrozšířenější orchestrátor kontejnerů
- Cloud Provideři
 - Amazon EKS (Elastic Kubernetes Service)
 - Google Kubernetes Engine (GKE)
 - Azure Kubernetes Service (AKS)
- On-Premise
 - OpenShift (RedHat)
 - RKE2 + Rancher (SUSE)
 - K3s (Lightweight Kubernetes)
- **Dokumentace** = předpis pro nasazení instalace aplikace

Znalosti potřebné pro Kubernetes

 Sítové koncepty

 Základy Linuxu

 Kontejnery

 Základy YAML

 ~~Základy verzovacích systémů~~

Následující struktura přednášky

- kontainer od samého začátku
- kontainer s nginx serverem
- kontainer s počítadlem návštěv
- nasazení do Kubernetes

LinuxDays 2025

4. a 5. října 2025, Praha

FIT ČVUT, Praha Dejvice

Návštěvníků od spuštění této stránky:

88888

Základní Debian kontainer - základ FS

```
$ sudo debootstrap --variant=minbase --arch=amd64 stable ./debian-rootfs http://deb.debian.org/debian/  
[sudo] password for semik:  
I: Target architecture can be executed  
I: Retrieving InRelease  
I: Checking Release signature  
I: Valid Release signature (key id 41587F7DB8C774BCCF131416762F67A0B2C39DE4)  
I: Retrieving Packages  
I: Validating Packages  
I: Resolving dependencies of required packages...  
I: Resolving dependencies of base packages...  
I: Checking component main on http://deb.debian.org/debian...  
I: Retrieving apt 3.0.3  
I: Validating apt 3.0.3  
I: Retrieving base-files 13.8+deb13u1  
...  
I: Configuring libc-bin...  
I: Unpacking the base system...  
I: Base system installed successfully.  
  
$ sudo tar -C ./debian-rootfs -czf debian-rootfs.tar.gz .  
$ ls -lh debian-rootfs.tar.gz  
-rw-r--r-- 1 semik semik 91M Sep 21 11:59 debian-rootfs.tar.gz
```

Základní Debian kontainer - Dockerfile

```
FROM scratch
ADD debian-rootfs.tar.gz /
CMD ["/bin/bash"]
```

Základní Debian kontainer - build

```
$ podman build -t semik-debian .
STEP 1/3: FROM scratch
STEP 2/3: ADD debian-rootfs.tar.gz /
--> 88a23cbc621
STEP 3/3: CMD ["/bin/bash"]
COMMIT semik-debian
--> 23e9c8d7323
Successfully tagged localhost/semik-debian:latest
23e9c8d7323dd1073c4dae198d259e39e93b4e09189ccc8f7aa359a8258f8e58
$ podman images | head -2
REPOSITORY          TAG      IMAGE ID      CREATED        SIZE
localhost/semik-debian  latest  23e9c8d7323d  11 seconds ago  307 MB
$ podman run -it --rm semik-debian
root@e51b231698ee:/# ps aux
USER      PID %CPU %MEM      VSZ      RSS TTY      STAT START      TIME COMMAND
root          1  0.0  0.0    4332     3868 pts/0      Ss   10:19      0:00 /bin/bash
root          2  0.0  0.0    6396     3864 pts/0      R+   10:19      0:00 ps aux
root@e51b231698ee:/# exit
$
```

Přidání NGINX webserveru

```
FROM semik-debian

RUN apt-get update
RUN apt-get install -y nginx

CMD ["nginx", "-g", "daemon off;"]
```

Přidání NGINX webserveru - build

```
$ podman build -t semik-nginx .
STEP 1/4: FROM semik-debian
STEP 2/4: RUN apt-get update
Hit:1 http://deb.debian.org/debian stable InRelease
...
--> 3e4e199c320
STEP 3/4: RUN apt-get install -y nginx
Reading package lists...
Building dependency tree...
...
--> 838947b502a
STEP 4/4: CMD ["nginx", "-g", "daemon off;"]
COMMIT semik-nginx
--> f8e6d41355a
Successfully tagged localhost/semik-nginx:latest
f8e6d41355a8987e18f83bbe88a615a89825561efd9a563bea0609e0cfbcbdeb
```

Přidání NGINX webserveru - velikosti

```
$ podman images | head -2
REPOSITORY          TAG      IMAGE ID      CREATED        SIZE
localhost/semik-nginx    latest  f8e6d41355a8  10 minutes ago  487 MB

$ podman history semik-nginx:latest
ID            CREATED      CREATED BY                  SIZE      COMMENT
838947b502a0  7 min ago   /bin/sh -c #(nop) CMD ["nginx", "-g", "daem...  0 B      FROM 838947b502a0
<missing>     7 min ago   /bin/sh -c apt-get install -y nginx           51.4 MB   FROM 3e4e199c3200
3e4e199c3200  7 min ago   /bin/sh -c apt-get update                   129 MB   FROM localhost/semik-debian
.....
8a93158a2a68  3 hours ago  /bin/sh -c #(nop) CMD ["/bin/bash"]       0 B      FROM 8a93158a2a68
<missing>     3 hours ago  /bin/sh -c #(nop) ADD file:9964643c2b482ae...  307 MB
```

Přidání NGINX webserveru - optimalizace #1

```
FROM semik-debian

RUN apt-get update
RUN apt-get install -y nginx
RUN apt-get clean

CMD ["nginx", "-g", "daemon off;"]
```

Přidání NGINX webserveru - optimalizace #1

```
$ podman images | head -2
REPOSITORY          TAG      IMAGE ID      CREATED        SIZE
localhost/semik-nginx  latest   63f05057b311  19 seconds ago  487 MB

$ podman history semik-nginx:latest
ID            CREATED      CREATED BY              SIZE        COMMENT
84ab1cf88f95  7 seconds ago /bin/sh -c #(nop) CMD ["nginx", "-g", "daem...  0 B        FROM 84ab1cf88f95
<missing>     8 seconds ago /bin/sh -c apt-get clean                           78.8 kB    FROM 838947b502a0
838947b502a0  20 minutes ago /bin/sh -c apt-get install -y nginx                51.4 MB    FROM 3e4e199c3200
3e4e199c3200  20 minutes ago /bin/sh -c apt-get update                         129 MB     FROM localhost/semik-debian
8a93158a2a68  4 hours ago   /bin/sh -c #(nop) CMD ["/bin/bash"]                  0 B        FROM 8a93158a2a68
<missing>     4 hours ago   /bin/sh -c #(nop) ADD file:9964643c2b482ae...
```

Přidání NGINX webserveru - optimalizace #2

```
FROM semik-debian
```

```
#RUN apt-get update
#RUN apt-get install -y nginx
#RUN apt-get clean
RUN apt-get update && apt-get install -y nginx && apt-get clean

CMD ["nginx", "-g", "daemon off;"]
```

```
$ podman images | head -2
REPOSITORY          TAG      IMAGE ID      CREATED       SIZE
localhost/semik-nginx  latest  0498ab51a846  About a minute ago  346 MB

$ podman history semik-nginx:latest
ID      CREATED      CREATED BY      SIZE      COMMENT
b5b0bce5767a  About a minute ago /bin/sh -c #(nop) CMD ["nginx", "-g", "dae...  0 B      FROM b5b0bce5767a
<missing>  About a minute ago /bin/sh -c apt-get update && apt-get insta...  38.8 MB    FROM localhost/semik-debian
8a93158a2a68  4 hours ago   /bin/sh -c #(nop) CMD ["/bin/bash"]  0 B      FROM 8a93158a2a68
<missing>  4 hours ago   /bin/sh -c #(nop) ADD file:9964643c2b482ae...  307 MB
```

Otestování NGINX image

```
$ podman run --rm -d --name semik-nginx -p 8080:80 semik-nginx  
6246a4ca7d0e1e73b1bd9c3800a46ee98bcfb1d5c76a838bd9491c3d6ca67564  
$
```

```
$ podman ps  
CONTAINER ID  IMAGE          COMMAND           ...  PORTS          NAMES  
6246a4ca7d0e  localhost/semik-nginx:latest  nginx -g daemon o...  ...  0.0.0.0:8080->80/tcp  semik-nginx  
$
```

```
$ curl http://localhost:8080  
<!DOCTYPE html>  
<html>  
<head>  
<title>Welcome to nginx!</title>  
...
```

Zobrazení správné stránky

```
$ podman run --rm -d --name semik-nginx -p 8080:80 \
-v $(pwd)/index.html:/var/www/html/index.nginx-debian.html:ro \
semik-nginx
190e9adb47b71216c1e4729da78933f8cb9c0c3c4ecae5ad7bdb83b8578be5e7
```

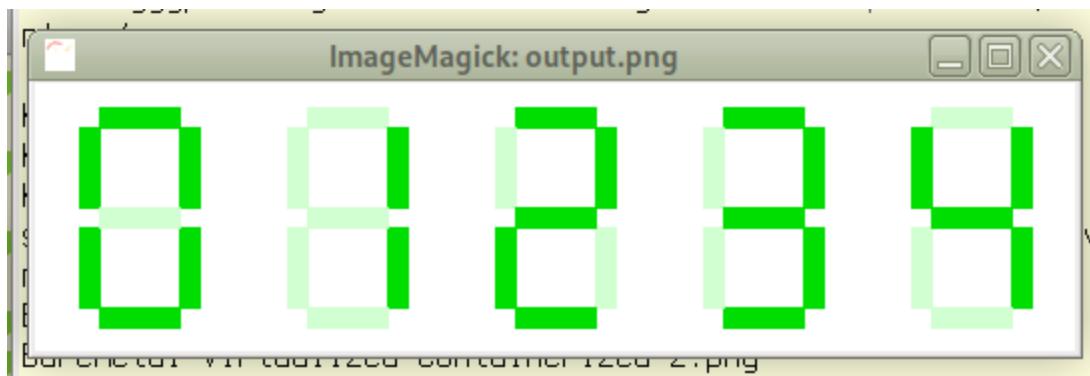
```
$ curl http://localhost:8080
<!DOCTYPE html>
<html><head><title>Vítejte na LinuxDays!</title></head>
<body style="text-align:center;">
<h1>LinuxDays 2025</h1>
<h2>4. a 5. října 2025, Praha</h2>
<h3>FIT ČVUT, Praha Dejvice</h3>
</body></html>
```

```
$ podman stop semik-nginx
semik-nginx
$
```

Vytvoření počítadla návštěv

skript pro generování obrázků (bash + imagemagick)

```
./cgi-bin/7segment.sh -w 10 \
    -c '#00DD00' -o '#d2ffd2' \
    -b white 01234 output.png ; display output.png
```



Vytvoření počítadla návštěv - soubory

```
.  
├── alive.txt  
├── cgi-bin  
│   ├── 7segment.sh  
│   └── counter.sh  
└── data  
    └── counter  
└── Dockerfile  
└── entrypoint.sh
```

`./data` - datový adresář pro počítadlo návštěv (mimo image)

`./cgi-bin/counter.sh` - skript počítadla návštěv

Vytvoření počítadla návštěv - Dockerfile

```
FROM semik-debian

# Install busybox, bash, and any image dependencies (e.g., imagemagick, png tools, etc)
RUN apt-get update && apt-get install -y bash busybox imagemagick && apt-get clean

# Copy entrypoint script
COPY entrypoint.sh /

# Copy scripts
COPY cgi-bin/ /app/cgi-bin/
COPY alive.txt /app/

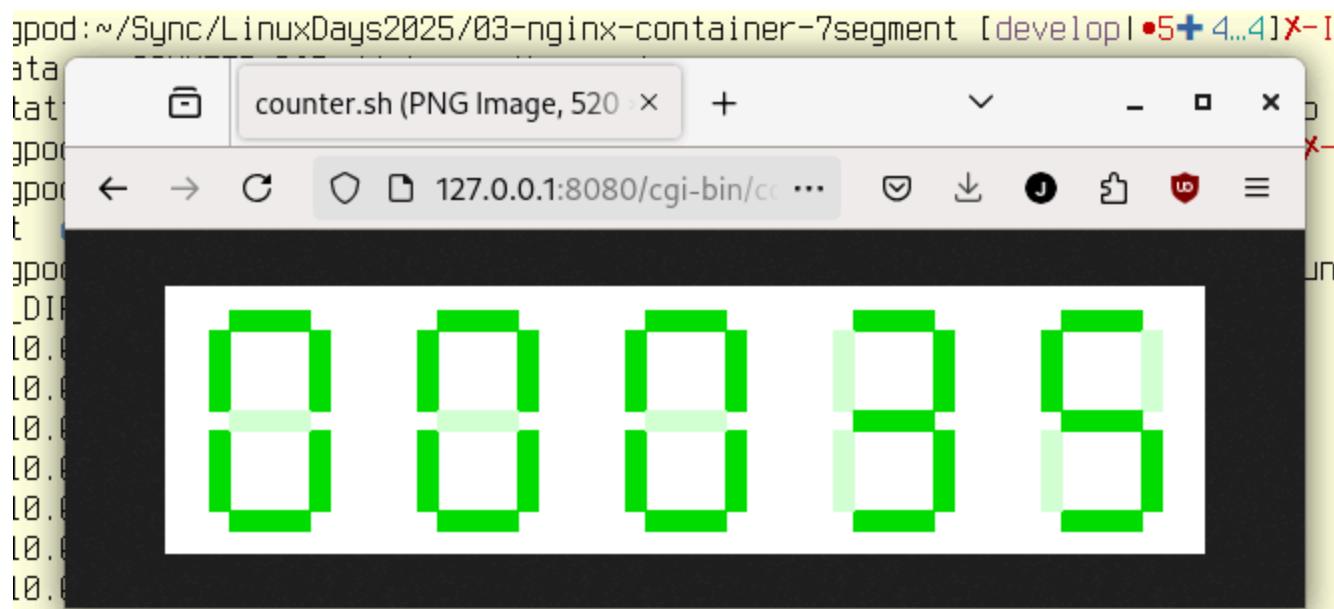
# Make CGI executable
RUN chmod +x /app/cgi-bin/*.sh /entrypoint.sh

# Start busybox httpd with CGI enabled
EXPOSE 8080

# CMD ["busybox", "httpd", "-vv", "-f", "-p", "8080", "-h", "/app"]
# busybox httpd ignores TERM signal, so we need a wrapper script to handle shutdown faster
CMD [ "/entrypoint.sh" ]
```

Vytvoření počítadla návštěv - test

```
$ podman run --rm --name semik-counter \
-p 8080:8080 \
-v $(pwd)/data:/data -e COUNTER_DIR=/data semik-counter
[::ffff:10.0.2.100]:48136: url:/cgi-bin/counter.sh
[::ffff:10.0.2.100]:48142: url:/cgi-bin/counter.sh
[::ffff:10.0.2.100]:48150: url:/cgi-bin/counter.sh
[::ffff:10.0.2.100]:48158: url:/cgi-bin/counter.sh
```



Takhle ne! :)

- před-připravené image
- hub.docker.com
 - oficiální verze od autorů software
 - uživatelské verze
 - <https://docs.docker.com/docker-hub/usage/>
- bitnami

```
$ podman images | grep library\/nginx\\|semik/ld25-nginx
localhost/semik/ld25-nginx      latest          0f252a932576  5 days ago   346 MB
docker.io/library/nginx         latest          203ad09fc156  7 weeks ago  197 MB
```

YAML Ain't Markup Language

- čitelnost nejen strojem, ale i člověkem
- struktura a hierarchie dat je řešena odsazením (**mezerami**, ne tabulátory)
- neomezené úrovně vnořování
- nahrazuje *složité* JSON konfigurace
 - XML si pamatují už jen 
- používá se k definici objektů v Kubernetes

Základní struktura YAML

```
jmeno: "Ukázka struktury YAML"
verze: 1.0
cesky: true
cislo: 42
pole:
  - polozka1
  - polozka2
hash:
  klic1: hodnota1
  klic2: "hodnota 2"
dataTakJakJsou: |
  Toto je text
  ve kterém budou zachovány
  nové řádky.
dataVJednomRadku: >
  Toto je text
  který bude interpretován jako
  jediný řádek.
```

Příklad YAML manifestu pro Kubernetes

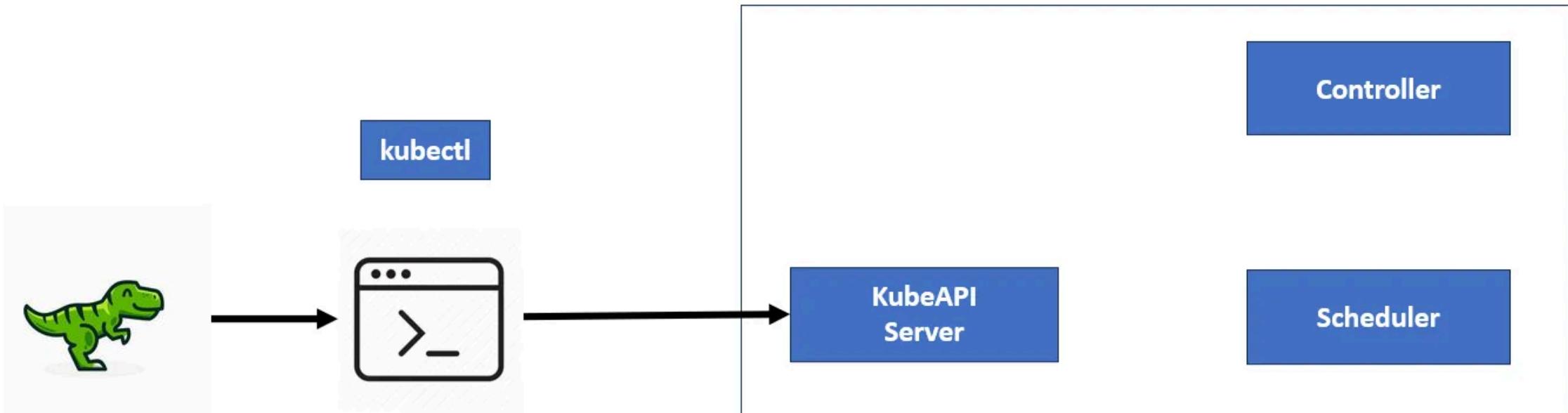
```
apiVersion: v1
kind: Pod
metadata:
  name: nginx-static
spec:
  containers:
    - image: docker.io/semik75/ld25-nginx:latest
      name: nginx-static
      ports:
        - containerPort: 8080
      volumeMounts:
        - name: config
          mountPath: /var/www/html/index.html
          subPath: index.html
  volumes:
    - name: config
      configMap:
        name: nginx-static
```

Nahrání obrazů kontenerů do Artifact Registry

```
$ podman login docker.io
Username: semik75
Password:
Login Succeeded!
$ podman tag semik-nginx semik75/ld25-nginx:latest
$ podman tag semik-counter semik75/ld25-counter:latest
$
$ podman push semik75/ld25-nginx:latest
Getting image source signatures
Copying blob 8cd8bb154730 done
Copying blob e91d164cdb11 done
Copying config 0f252a9325 done
Writing manifest to image destination
Storing signatures
$
$ podman push semik75/ld25-counter:latest
Getting image source signatures
Copying blob 3c2da93b9307 done
...
Copying blob 469a5aa7e0e2 skipped: already exists
Copying config 917795cd2e done
Writing manifest to image destination
Storing signatures
$
```

kubectl - Kubernetes CLI

```
$ export KUBECONFIG=${HOME}/Sync/config/kube-config-lab10
$ kubectl config set-context --current --namespace linuxdays2025
Context "default" modified.
$ kubectl get pods
NAME                      READY   STATUS    RESTARTS   AGE
cgi-counter-7dd7c9998f-7pl6n 1/1     Running   0          16h
cgi-counter-7dd7c9998f-bslbc 1/1     Running   0          16h
cgi-counter-7dd7c9998f-xm95g 1/1     Running   0          16h
nginx-static-d7cb778c4-hmkxv 1/1     Running   0          16h
#
```



kubectl - config

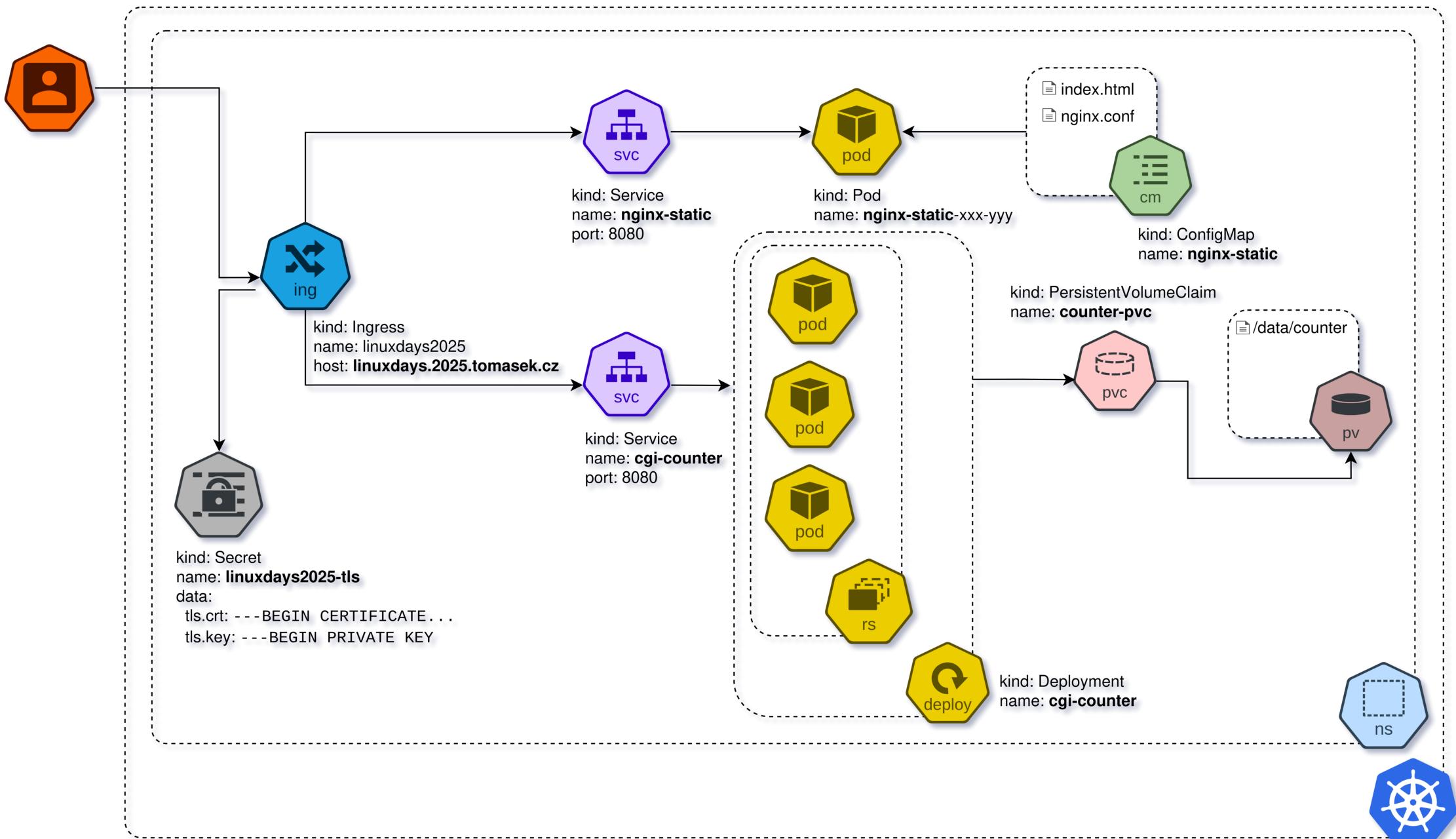
```
$ cat $KUBECONFIG
apiVersion: v1
clusters:
- cluster:
    certificate-authority-data: LS0tLS1CR...
    server: https://46.62.xxx.yyy:6443
    name: default
contexts:
- context:
    cluster: default
    namespace: linuxdays2025
    user: default
    name: default
current-context: default
kind: Config
preferences: {}
users:
- name: default
  user:
    client-certificate-data: LS0tLS1CR...
    client-key-data: LS0tLS1CR...
```

První nasazení do Kubernetes

```
$ kubectl run nginx-static --image=docker.io/semik75/ld25-nginx:latest \
--restart=Never --port=8080
pod/nginx-static created
$ kubectl get pods -o wide
NAME           READY   STATUS    RESTARTS   AGE     IP          NODE
nginx-static   1/1     Running   0          5s      10.42.0.65   lab10
```

```
$ kubectl port-forward nginx-static 8080:80 &
Forwarding from 127.0.0.1:8080 -> 80
Forwarding from [::1]:8080 -> 80
[1] 2474495
```

```
$ curl http://localhost:8080
Handling connection for 8080
<html><head>
<title>Welcome to nginx!</title>
...
```



ConfigMap #1 - declarative

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: nginx-static
data:
  index.html: |
    ...
    <h1>LinuxDays 2025</h1>
    ...
    <p>Návštěvníků od spuštění této stránky:</p>
    ...
    </body></html>
  nginx.conf: |
    error_log /dev/stdout info;
    events {
      worker_connections 1024;
    }
    http {
      access_log      /dev/stdout;

      server {
        listen        8080;
        server_name   localhost;
    ...
}
```

ConfigMap #2 - imperative

```
$ kubectl create configmap nginx-static \
  --from-file=index.html=/path/to/index.html \
  --from-file=nginx.conf=/path/to/nginx.conf           #
```

```
$ kubectl create configmap nginx-static \
  --from-file=index.html=/path/to/index.html \
  --from-file=nginx.conf=/path/to/nginx.conf --dry-run=client -o yaml > nginx-configmap.yaml
```

Secret

```
apiVersion: v1
kind: Secret
metadata:
  name: linuxdays2025-tls
data:
  tls.crt: LS0t...
  tls.key: LS0t...
```

```
$ kubectl create secret generic linuxdays2025-tls \
--from-file=tls.crt=/path/to/tls.crt \
--from-file=tls.key=/path/to/tls.key
```

ConfigMap vs Secret

- konfigurační soubory
 - etcd (nešifrovaně)
 - prostý text
 - RBAC
- hesla, tokeny, certifikáty
 - etcd (volitelné šifrování)
 - base64
 - striktnější RBAC

PersistentVolumeClaim

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: counter-pvc
spec:
  accessModes:
    - ReadWriteOnce
  # storageClassName: local-path
  resources:
    requests:
      storage: 1Mi
```

PersistentVolume (PV) vs PersistentVolumeClaim (PVC)

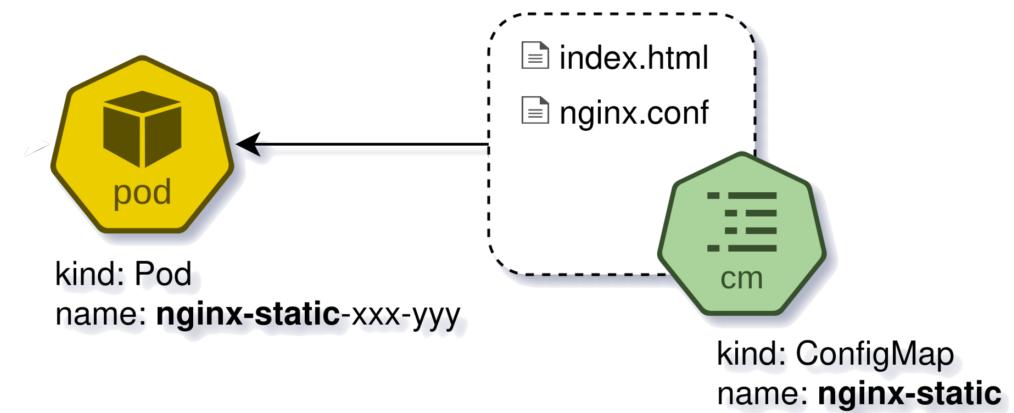
- abstrakce úložiště
- žije nezávisle na PODech
- různé typy úložišť (NFS, iSCSI, cloudové služby, lokální disky, ...)
- recyklace podle politiky
 - Retain
 - Recycle
 - Delete
- žádost úložiště
- dynamické přidělení
- přístupové režimy
 - ReadWriteOnce
 - ReadOnlyMany
 - ReadWriteMany

POD vs ~~ReplicaSet~~ vs Deployment

- nejmenší spusitelná jednotka
 - obsahuje jeden nebo více kontejnerů
 - dočasný - "smrtelný" objekt
 - závislý na Node umírá s ním
 - nevhodný pro přímé nasazení
- vyšší abstrakce nad PODy
 - má na starosti aby požadovaný počet replik PODů
 - standartní způsob nasazení v produkci

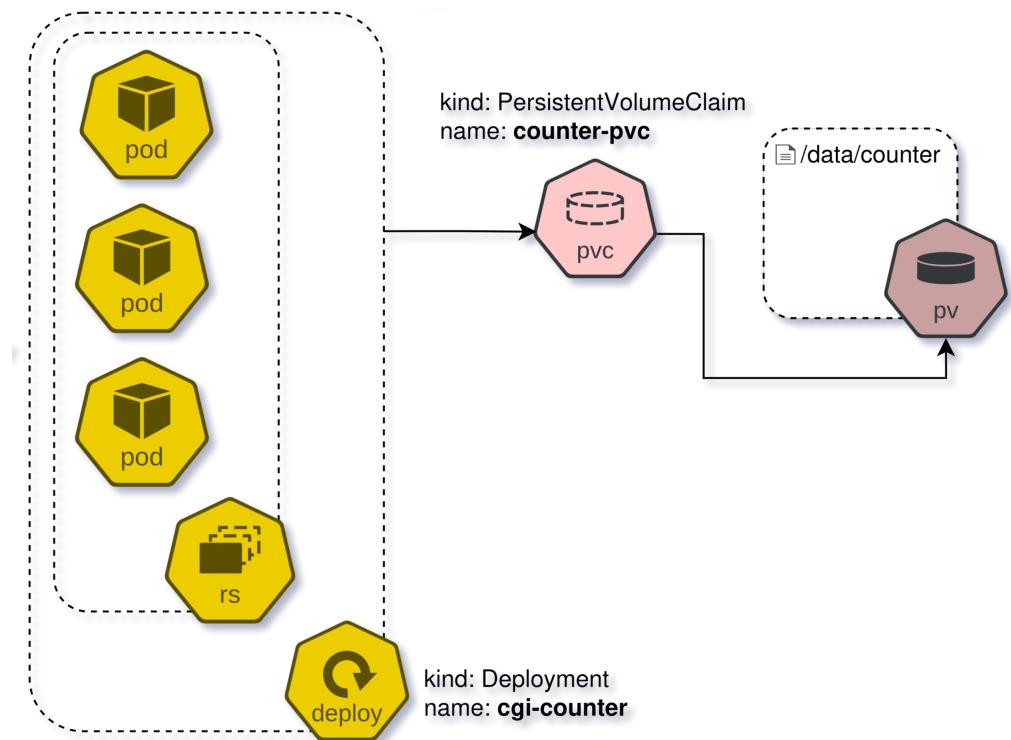
Deployment nginx

```
apiVersion: apps/v1
kind: Pod
metadata:
  name: nginx-static-xxx-yyy
  labels:
    app: nginx-static
spec:
  containers:
    - name: nginx
      image: docker.io/semik75/ld25-nginx:latest
      imagePullPolicy: Always
      ports:
        - containerPort: 8080
      volumeMounts:
        - name: config
          mountPath: /var/www/html/index.html
          subPath: index.html
        - name: config
          mountPath: /etc/nginx/nginx.conf
          subPath: nginx.conf
      volumes:
        - name: config
          configMap:
            name: nginx-static
```



Deployment counter

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: cgi-counter
spec:
  replicas: 3
  selector:
    matchLabels:
      app: cgi-counter
  template:
    metadata:
      labels:
        app: cgi-counter
    spec:
      containers:
        - name: cgi-counter
          image: docker.io/semik75/ld25-counter:latest
          imagePullPolicy: Always
          ports:
            - containerPort: 8080
          env:
            - name: COUNTER_DIR
              value: /data
          volumeMounts:
            - name: data
              mountPath: /data
      volumes:
        - name: data
          persistentVolumeClaim:
            claimName: counter-pvc
```

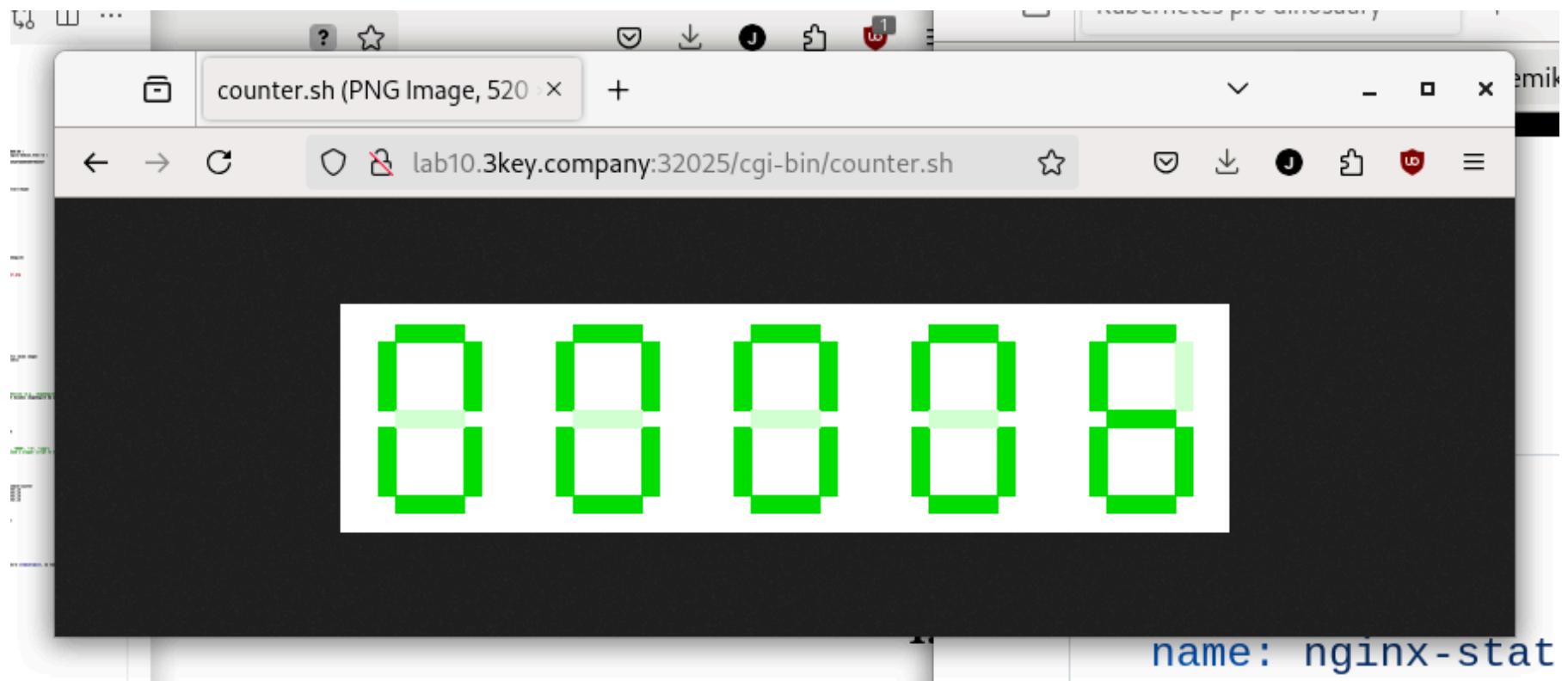


Service

```
apiVersion: v1
kind: Service
metadata:
  name: nginx-static
spec:
  type: ClusterIP
  selector:
    app: nginx-static
  ports:
    - protocol: TCP
      port: 8080
      targetPort: 8080
```

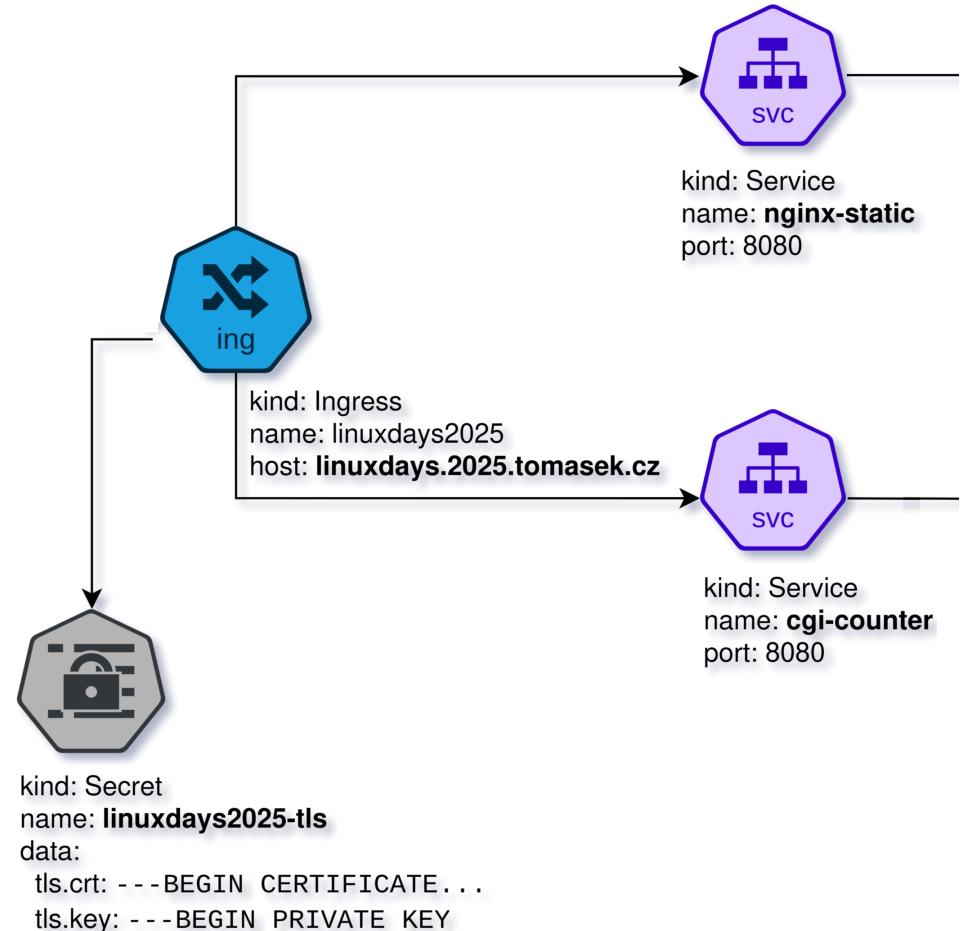
```
apiVersion: v1
kind: Service
metadata:
  name: cgi-counter
spec:
  type: NodePort
  selector:
    app: cgi-counter
  ports:
    - protocol: TCP
      port: 8080
      targetPort: 8080
      nodePort: 32025
```

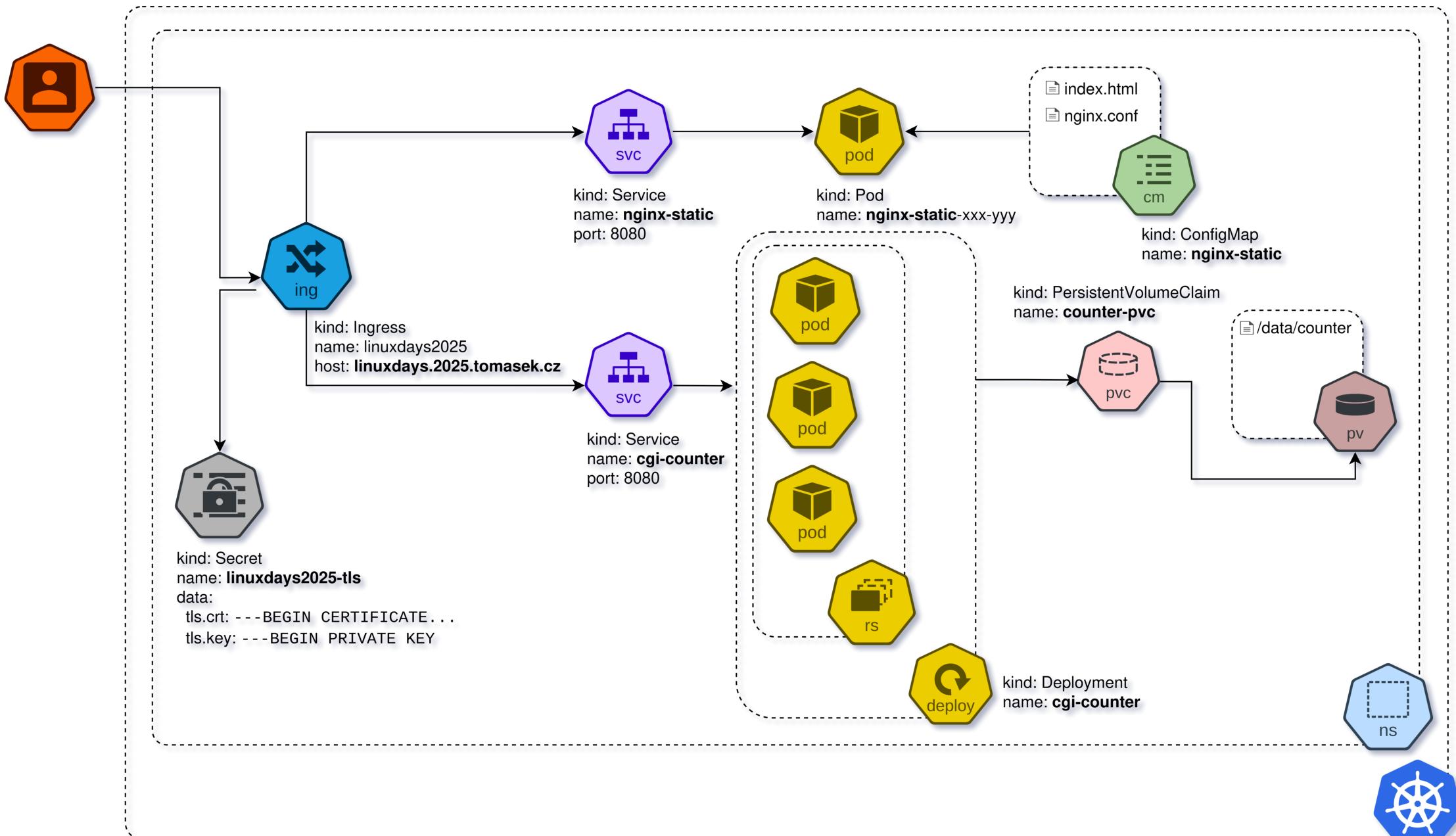
Service - type: NodePort



Ingress

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: linuxdays2025
  annotations:
    kubernetes.io/ingress.class: "nginx"
    cert-manager.io/cluster-issuer: "letsencrypt-prod"
spec:
  tls:
  - hosts:
    - linuxdays2025.tomasek.cz
    secretName: linuxdays2025-tls
  rules:
  - host: linuxdays2025.tomasek.cz
    http:
      paths:
      - path: /
        pathType: Prefix
        backend:
          service:
            name: nginx-static
            port:
              number: 8080
      - path: /cgi-bin/counter.sh
        pathType: ImplementationSpecific
        backend:
          service:
            name: cgi-counter
            port:
              number: 8080
```





Nasazení všech objektů

```
$ ls -1
counter-pvc.yaml
counter-deployment.yaml
counter-service.yaml
linuxdays2025-ingress.yaml
nginx-configmap.yaml
nginx-deployment.yaml
nginx-service.yaml
```

```
$ for i in *.yaml ; do kubectl apply -f "$i" ; done
deployment.apps/cgi-counter created
persistentvolumeclaim/counter-pvc created
service/cgi-counter created
ingress.networking.k8s.io/linuxdays2025 created
ingress.networking.k8s.io/linuxdays2025-alive created
configmap/nginx-static created
deployment.apps/nginx-static created
service/nginx-static created
```

Zobrazení nasazených objektů

```
$ kubectl get all,configmap,pvc,ingress
NAME                           READY   STATUS    RESTARTS   AGE
pod/cgi-counter-7dd7c9998f-7pl6n  1/1     Running   0          3m43s
pod/cgi-counter-7dd7c9998f-bslbc  1/1     Running   0          3m43s
pod/cgi-counter-7dd7c9998f-xm95g  1/1     Running   0          3m43s
pod/nginx-static-d7cb778c4-hmkxv  1/1     Running   0          3m41s

NAME           TYPE        CLUSTER-IP      EXTERNAL-IP      PORT(S)        AGE
service/cgi-counter  NodePort    10.43.5.65    <none>          8080:32025/TCP  3m43s
service/nginx-static ClusterIP  10.43.49.102  <none>          8080/TCP       3m41s

NAME                           READY   UP-TO-DATE  AVAILABLE   AGE
deployment.apps/cgi-counter  3/3     3           3           3m44s
deployment.apps/nginx-static  1/1     1           1           3m42s

NAME                           DESIRED  CURRENT  READY   AGE
replicaset.apps/cgi-counter-7dd7c9998f  3        3        3       3m44s
replicaset.apps/nginx-static-d7cb778c4  1        1        1       3m42s

NAME          DATA   AGE
configmap/kube-root-ca.crt  1      5d
configmap/nginx-static      2      3m42s

NAME           TYPE        DATA   AGE
secret/linuxdays2025-tls  kubernetes.io/tls  2      4d10h

NAME                           STATUS    VOLUME                                     CAPACITY  ACCESS MODES  STORAGECLASS
persistentvolumeclaim/counter-pvc  Bound    pvc-1a02c453...                            1Mi       RWO          local-path

NAME           CLASS  HOSTS          ADDRESS          PORTS        AGE
ingress/linuxdays2025  nginx  linuxdays2025.tomasek.cz  46.62.206.246  80, 443  3m43s
```

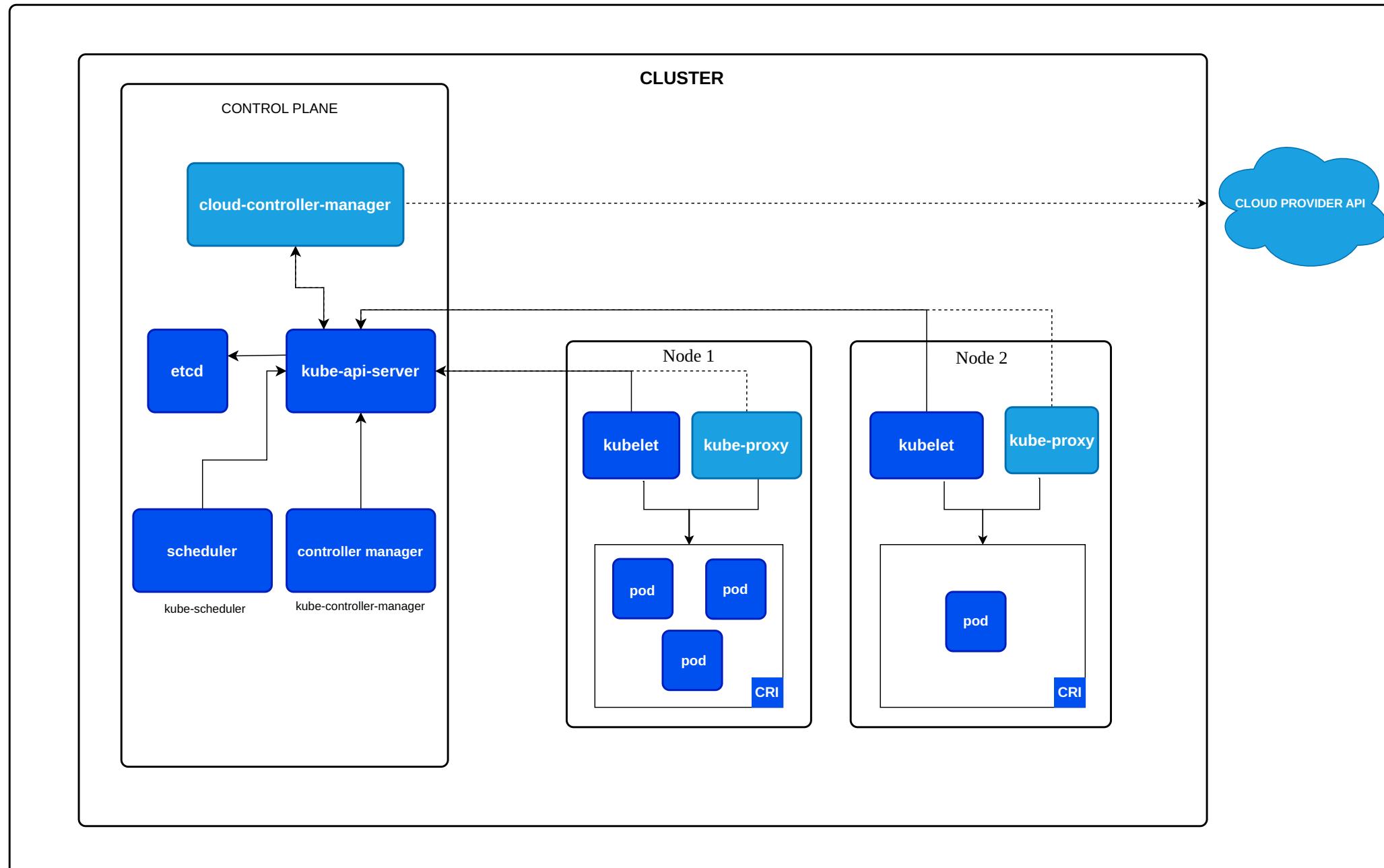
Detailed view of deployment.apps/cgi-counter

```
$ kubectl describe deployment.apps/cgi-counter
Name:                  cgi-counter
Namespace:             linuxdays2025
CreationTimestamp:     Thu, 02 Oct 2025 19:26:20 +0200
Replicas:              3 desired | 3 updated | 3 total | 3 available | 0 unavailable
StrategyType:          RollingUpdate
RollingUpdateStrategy: 25% max unavailable, 25% max surge
Pod Template:
  Containers:
    cgi-counter:
      Image:      docker.io/semik75/ld25-counter:latest
      Port:       8080/TCP
      Environment:
        COUNTER_DIR: /data
      Mounts:
        /data from data (rw)
  Volumes:
    data:
      Type:      PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
      ClaimName: counter-pvc
      ReadOnly:   false
  Conditions:
    NewReplicaSet: cgi-counter-7dd7c9998f (3/3 replicas created)
  Events:
    Type  Reason          Age    From           Message
    ----  -----          ----  --  -----
    Normal ScalingReplicaSet 9m8s  deployment-controller  Scaled up replica set cgi-counter-7dd7c9998f from 0 to 3
```

Interaktivní shell v kontejneru

```
$ kubectl exec cgi-counter-7dd7c9998f-7pl6n -it -- bash  
root@cgi-counter-7dd7c9998f-7pl6n:/# cd /data/  
root@cgi-counter-7dd7c9998f-7pl6n:/data# cat counter  
00004
```

```
$ kubectl -n kube-system exec pod/etcd-lab10 -it -- sh  
error: Internal error occurred: Internal error occurred: error executing command  
in container: failed to exec in container: failed to start exec  
"128c5ae737916eb778b82feadb6b6cd66c545c83d0b3f667a2e02492a4166c4c": OCI runtime  
exec failed: exec failed: unable to start container process: exec: "sh": executable  
file not found in $PATH
```



Logging

- každý kontejner má svůj stdout/stderr
- logy jsou dočasné - žijí s PODem
- `kubectl logs <pod-name> [-c <container-name>] [--previous]`
- logovací agenti (Filebeat+Logstash, ...) sbírají logy a odesílají je do centrálního úložiště
- formáty: text, JSON
- centrální úložiště: Elasticsearch, ...

```
$ kubectl logs nginx-static-d7cb778c4-hmkxv --tail 5
10.42.0.106 - - [02/Oct/2025:22:31:50 +0000] "GET / HTTP/1.1" 200 506 "-" "-"
2025/10/02 22:32:50 [info] 7#7: *6 client 10.42.0.106 closed keepalive connection
10.42.0.106 - - [03/Oct/2025:10:26:50 +0000] "GET / HTTP/1.1" 304 0 "-" "Mozilla/5.0 (X11; Linux x86_64; rv:128.0) Gecko/20100101 Firefox/128.0"
10.42.0.106 - - [03/Oct/2025:10:26:53 +0000] "GET / HTTP/1.1" 304 0 "-" "Mozilla/5.0 (X11; Linux x86_64; rv:128.0) Gecko/20100101 Firefox/128.0"
10.42.0.106 - - [03/Oct/2025:10:26:54 +0000] "GET / HTTP/1.1" 304 0 "-" "Mozilla/5.0 (X11; Linux x86_64; rv:128.0) Gecko/20100101 Firefox/128.0"
```

Jak zjistit, že něco negunguje?

```
$ kubectl -A get events
NAMESPACE LAST SEEN          TYPE    REASON   OBJECT                                     MESSAGE
ejbcace   38m (x1232 over 14d) Normal  Started  Pod/ejbc... Started container ejbca-community-helm
ejbcace   3m59s (x1234 over 14d) Normal  Killing   Pod/ejbc... Container ejbca-community-helm failed startup probe, will be restarted
ejbcace   3m29s (x1234 over 14d) Normal  Pulled   Pod/ejbc... Container image "keyfactor/ejbc...:8.2.0.1" already present on machine
ejbcace   3m29s (x1234 over 14d) Normal  Created  Pod/ejbc... Created container: ejbca-community-helm
ejbcace   1s (x617097 over 14d)  Warning  Unhealthy Pod/ejbc... Startup probe failed: dial tcp 10.42.0.119:8443: connect: connection refused
$ 
$ kubectl -n ejbcace get pods
NAME                      READY   STATUS    RESTARTS   AGE
ejbca-community-helm-76fc567d4d-nkfqd  0/1     Running  1816 (9m17s ago)  32d
```

A proč nefunguje?

```
$ kubectl -n ejbcace logs pod/ejbc... --tail 5
2025-10-03 10:41:37,572+0000 INFO [org.apache.commons.beanutils.FluentPropertyBeanIntrospector] (main) Error when creating ...
2025-10-03 10:41:38,000+0000 ERROR [org.ejbc... ui.cli.jdbc.JdbcTool] (main) FATAL: password authentication failed for user "ejbcace"
2025-10-03 10:41:38,000+0000 INFO [org.ejbc... ui.cli.jdbc.JdbcTool] (main) Done.
2025-10-03 10:41:38,030+0000 INFO [/start.sh] (process:1) Waiting for database 'jdbc:postgresql://.../ejbcace' to become available.
```

Co dělat, když se něco nestartuje?

```
$ kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
qes-ingress-9589b89b5-rmngv      2/2     Running   1 (143m ago) 144m
signserver-66d7bbb74f-hw5bv       0/6     Pending   0          50s

$ kubectl describe pod signserver-66d7bbb74f-hw5bv
Events:
Type      Reason           Age     From                  Message
----      -----           --      --                   -----
Warning   FailedScheduling  25s    gke.io/opt-util-sched 0/8 nodes are available: 8 Insufficient cpu,
                                         8 Insufficient memory.
                                         preemption: 0/8 nodes are available: 8
                                         No preemption victims found for incoming pod.
Normal    TriggeredScaleUp  23s    cluster-autoscaler  Pod triggered scale-up: [{https://www.googleapis.com...}]
```

Jak dál?

- Kurz: [Certified Kubernetes Administrator \(CKA\) with Practice Tests](#) od Mumshad Mannambeth na [Udemy](#)
- Vlastní Kubernetes:
 - [minikube](#) - ve virtuálu
 - [RKE2](#) - na fyzickém HW nebo VM
 - [CERTAINLY Appliance](#), viz [přednáška na LinuxDays 2023](#)
- Cloudové Kubernetes
 - [OpenShift](#) - [na 30d znova a znova](#)
- [Helm](#) - package manager pro Kubernetes
- <https://github.com/semik/LinuxDays2026>

Otázky?

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<https://tomasek.cz/l25>

<https://github.com/semik/LinuxDays2025>

<https://linuxdays2025.tomasek.cz/>