THE CLOUD AT CENGN

MOH AHMED, NATHALIE GUTHRIE

JANUARY 16TH, 2020
STUDENT SIGN IN

STUDENT-HR@CENGN.CA
CENGN’s Mission

CENGN drives technology innovation and industry growth through our test bed, technical expertise, talent development, and partner ecosystem.
CENGN
CREATING THE NEXT GENERATION NETWORK
Agenda

• About Me
• Cloud Computing Overview
• Application Evolution
• Microservices and Containers
• Kubernetes Overview
• Service Mesh Demo
• Open Source Communities
• Past Student Engineering Projects
• About CENGN
About Me

• Graduated from Carleton University
• Worked with containers for a couple of years
• Joined CENGN a year and a half ago
  – Cloud Infrastructure Engineer
  – Facility Management & Site Reliability
  – Co-op Hiring Manager & Mentor
• Certified Kubernetes Administrator (CKA)
Cloud Technologies
Cloud Computing

- Cloud computing is an Internet-based delivery of on-demand and flexible computing resources.
- Enables access to a shared pool of computing resources that can be rapidly provisioned.
- Cloud resources are virtualized resources in data centers whose physical location can be anywhere in the world.
Benefits of Cloud Computing
Cloud Deployment Models

- Hybrid Cloud
- Public Cloud
- Private Cloud
- Traditional Infrastructure
Legacy Applications

Traditional

- Application
- Host OS
- Hardware
Current Applications

Virtual Machines

Traditional
Current Applications

Virtual Machines

- KVM
- VMware ESXi
- VirtualBox

Application
Guest OS
Hypervisor
Host OS
Hardware

Type 1 Hypervisor
Type 2 Hypervisor

Traditional

Virtual Machines

Host OS
Hypervisor
Hardware

Application
Guest OS
Hypervisor
Hardware
Next-Generation Applications

- Traditional
- Virtual Machines
- Containers
  - Application 1
  - Base OS 1
  - Container Engine
  - Host OS
  - Hardware
  - Application 2
  - Base OS 2
Microservice Architecture

Monolithic Architecture

- Customer service
- Product service
- Cart service

Single Instance

Microservice Architecture

- UI Microservice
- Customer Microservice
- Product Microservice
- Cart Microservice
Containers Overview

- Scalable and modular
- Lightweight and quick
- Convenient and portable
  - “Build once, run anywhere”
- Deployment consistency
- Accessible
  - Open Container Initiative
Kubernetes Overview

- “Governor”, “helmsman”, “captain”, “pilot”
- Founded by Google engineers in mid-2014
  - Inspired by Project Borg, an internal Google Project
- Google donated it to CNCF 2015
- Powerful container orchestration platform
  - Automated rollouts and rollbacks
  - Self-healing
  - Horizontal scaling
  - Much more
Kubernetes Overview
Providing Value

- Some of this is invisible to the end user
- Upgrades are easier to roll out or roll back if needed
- High Availability on all our infrastructure services
- Distributed runtimes and distributed storage
Providing Value

• Some of this is invisible to the end user
• Upgrades are easier to roll out or roll back if needed
• High Availability on all our infrastructure services
• Distributed runtimes and distributed storage
Providing Value

- Some of this is invisible to the end user
- Upgrades are easier to roll out or roll back if needed
- High Availability on all our infrastructure services
- Distributed runtimes and distributed storage
Providing Value

- Some of this is invisible to the end user
- Upgrades are easier to roll out or roll back if needed
- High Availability on all our infrastructure services
- Distributed runtimes and distributed storage
Providing Value

• Some of this is invisible to the end user
• Upgrades are easier to roll out or roll back if needed
• High Availability on all our infrastructure services
• Distributed runtimes and distributed storage
DEMO
Service Mesh Demo
Application Overview
<table>
<thead>
<tr>
<th>Application</th>
<th>Applications</th>
<th>Overview</th>
<th>Graph</th>
<th>Workloads</th>
<th>Services</th>
<th>Istio Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>cengn-summit</td>
<td>0</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cert-manager</td>
<td>3</td>
<td>✓ 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>che</td>
<td>1</td>
<td>✓ 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>datadog</td>
<td>1</td>
<td>✓ 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>default</td>
<td>0</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>guacamole</td>
<td>0</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ingress-nginx</td>
<td>2</td>
<td>✓ 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>isovalet</td>
<td>2</td>
<td>✓ 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>istio-demos</td>
<td>4</td>
<td>✓ 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>istio-system</td>
<td>12</td>
<td>✓ 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>monitoring</td>
<td>5</td>
<td>✓ 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>netbox</td>
<td>1</td>
<td>✓ 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>netbox-community</td>
<td>2</td>
<td>✓ 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>niro</td>
<td>1</td>
<td>✓ 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rook-ceph</td>
<td>11</td>
<td>✓ 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seafile</td>
<td>4</td>
<td>✓ 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>apiVersion</td>
<td>networking.istio.io/v1alpha3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kind</td>
<td>VirtualService</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>metadata</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>productpage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>spec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hosts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- ratings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>http</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- route</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- destination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>host</td>
<td>ratings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>apiVersion</th>
<th>networking.istio.io/v1alpha3</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind</td>
<td>VirtualService</td>
</tr>
<tr>
<td>metadata</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>ratings</td>
</tr>
<tr>
<td>spec</td>
<td></td>
</tr>
<tr>
<td>hosts</td>
<td></td>
</tr>
<tr>
<td>- ratings</td>
<td></td>
</tr>
<tr>
<td>http</td>
<td></td>
</tr>
<tr>
<td>- route</td>
<td></td>
</tr>
<tr>
<td>- destination</td>
<td></td>
</tr>
<tr>
<td>host</td>
<td>ratings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>apiVersion</th>
<th>networking.istio.io/v1alpha3</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind</td>
<td>VirtualService</td>
</tr>
<tr>
<td>metadata</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>details</td>
</tr>
<tr>
<td>spec</td>
<td></td>
</tr>
<tr>
<td>hosts</td>
<td></td>
</tr>
<tr>
<td>- details</td>
<td></td>
</tr>
<tr>
<td>http</td>
<td></td>
</tr>
<tr>
<td>- route</td>
<td></td>
</tr>
<tr>
<td>- destination</td>
<td></td>
</tr>
<tr>
<td>host</td>
<td>details</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>apiVersion</th>
<th>networking.istio.io/v1alpha3</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind</td>
<td>VirtualService</td>
</tr>
<tr>
<td>metadata</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>reviews</td>
</tr>
<tr>
<td>spec</td>
<td></td>
</tr>
<tr>
<td>hosts</td>
<td></td>
</tr>
<tr>
<td>- reviews</td>
<td></td>
</tr>
<tr>
<td>http</td>
<td></td>
</tr>
<tr>
<td>- route</td>
<td></td>
</tr>
<tr>
<td>- destination</td>
<td></td>
</tr>
<tr>
<td>host</td>
<td>reviews</td>
</tr>
</tbody>
</table>
Traffic Manipulation

apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: reviews
spec:
  hosts:
    - reviews
  http:
    - route:
      destination:
        host: reviews
        subset: v1

apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: reviews
spec:
  hosts:
    - reviews
  http:
    - route:
      destination:
        host: reviews
        subset: v1
        weight: 50
      destination:
        host: reviews
        subset: v3
        weight: 50
COMMUNITY CONTRIBUTIONS
Open Source

- Anyone can download and install the things discussed today
- Different ways to contribute:
  - Use the projects
  - File bugs or feature requests
  - Code solutions
  - Attend meetups or other community events
Linux Foundation

- Builds ecosystems around open source projects
- Community of businesses, organizations, individuals
  - CENGN is an associate member
- Hosts many projects
  - Linux Kernel
  - Networking, Deep Learning, Security, Cloud & Containers
Cloud Native Computing Foundation

- The CNCF is the Linux Foundation’s biggest sub-project
- “Sustaining and Integrating Open Source Technologies”
- Highly distributed applications that work together and generalize containers
Service Mesh Technologies

- kubernetes
- CNI
- Istio
- cilium
- envoy
CNCF Landscape
CENGN is a KCSP!
Network Core Validation
Dedicated Student Platform

- 4-node cluster
- Isolated behind OPNsense firewall
- 256 vCPUs, 1 TB RAM, 3.5 TB Storage
- 20Gig interconnections
System Automation

CHQ

CBY

SERVERS

CMT

MRS

NETWORKING DEVICES

DMTF

REDFISH API

PARAMIKO

SSH

EXTRACT LAYER

PyNetbox

netbox

EXPORT LAYER
Recap

- Evolution of applications throughout the years
- Microservices architecture and containers
- Demo application with out-of-the-box observability and traffic manipulation
- Open source initiatives like The Linux Foundation and CNCF’s ecosystem
- Kubernetes, the unofficial standard in container orchestration
- Lots of student project revolving around these technologies
Training
Solving Problems
Contributing
Having Fun
About Me

• Nathalie Guthrie
• Director, Human Resources
• Joined 2 years, 9 months, 26 days ago
• Why I love CENGN
  – Mission Driven
  – Continuous Development
  – Rewarding Impact
  – Inclusive Environment
CENGN Internship Program

- Approximately 40 students complete CENGN terms (47 in fiscal ‘20)
- 70% of internships are technical (Cloud Infrastructure, Customer Solutions, Cloud Research, Project Management)
- Available Business Internships in Marketing, Human Resources, and Accounting
- 97% Success Rate
  - 17% hired at CENGN
  - 45% returned to school
  - 35% working in industry
CENGN Bootcamp

• CENGN Academy’s Cloud Networking Boot Camp is a rapid dive into the essential concepts and hands-on skills required to work successfully in a cloud systems environment.

• Modules focus on Linux, containerization with Docker & Kubernetes, networking and finally cloud computing with OpenStack.

• Participants perform multiple system-level configurations, and learn how to install/manage applications using a variety of methods.
THANK YOU
Kubernetes Building Blocks
The Building Blocks

Namespace 1
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container

Namespace 2
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container

Namespace 3
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container
All of this is running on a server somewhere
It could be a bare-metal node or a virtual machine
There are master nodes and worker nodes
  – Masters: handle control-plane workload
  – Workers: handle all other workloads
Containers

- Lightweight Linux environment
- Immutable
- Provided by a "Container Runtime Engine"
  - Platform for building, pushing, and running containers
Nodes
Containers
Pods

- One or more strongly-related containers
- The base unit in Kubernetes
- Containers inside a pod run on the same machine and share the IP, port space
- Pods are disposable, IP addresses recycled
Containers
Pods
Services

• Route to the pod instance
• Gets its own stable IP address
• Routing traffic to the pods by matching labels

Labels
• Arbitrary metadata attached to a Kubernetes resource – such as a pod

Selectors
• Queries objects based on their label
Pods
Services

Pod

Service

Pod

Seafile

Service

Pod

netbox
Deployments

- Control the pods
- Configure, scale, and update applications
- Ensures the current state is consistent with the desired state
Services

Pod

Pod

Service

Service

Pod

Pod

Seafile

netbox
Deployments
Deployments
Deployments
Secrets

- Allows the storage of sensitive information
  - Credentials
  - Tokens
  - Certificates
- Safer and more flexible than having it be stored within a pod
- User and system created
Deployments
Secrets

- Secret
- Deployment
- Service
- Pod

- Seafile
- netbox
Namespaces

- Enables isolation and segregation of resources
- Better organization
- Increased security
- A few default ones:
  - default
  - kube-system
  - kube-public
Secrets
Namespaces
The Building Blocks

Namespace 1
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container

Namespace 2
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container

Namespace 3
- Secret
- Deployment
- Service
- Pod
  - Container
  - Container