Docker cluster systems (Swarm, Kubernetes,…)

DOCKER CLUSTERING

Agenda

- Why clustering
- Problems of clustering
- Available products
- Components of Docker cluster systems
  - Persistence
  - Networking
  - Configuration
- Docker Swarm Setup
- The „Ingress“ network

Why clustering

- High availability
- Scalability
- “Scale out” instead of “scale up”
- Simplifying the maintenance of cluster nodes (updating, replacement, hardware maintenance,…)

Problems of clustering

- Networking
  - Load balancing
  - On which IP/hostname is a service reachable?
  - Where are my depandant services reachable
- Scaling
  - How is the load balanced on all available instances
  - When should a service scale up or down?
- Configuration
- Secrets
- Persistence: where's the data?
  - NFS
  - vSphere Volumes
  - SAN storage

  (we talk about cloud solutions later)

Available products

- Kubernetes
  - OpenShift (based on Kubernetes)
- DC/OS (Mesosphere)
- Docker Swarm
- Rancher
- Nomad
- Mantl
- …

Components – Persistence

- There are plenty of plugins available:
  - Azure File Storage
  - NFS
  - GCE Volumes
  - GlusterFS
  - SAN systems (NetApp, Nimble, Virtuozzo)
  - VMWare vSphere Storage
- Most of them are trying to solve the problem that a container may run on any host so the data has to be available on any host!
- A few are also able to control concurrent R/W access by multiple containers (e.g. GlusterFS, VMWare)

Components – Persistence

- Which persistence driver you want to use depends on your environment
- Is very fast access required (databases, caches,…)?
- Do multiple instances have to share the same data (file storages like NextCloud)?
- Is there any infrastructure available (cloud native like AWS, Azure, GCE, on promise like SAN systems or a NFS server)?
- How fast do you have to setup the cluster?
  (the setup of a NFS is much easier than a GlusterFS cluster)

Components – Networking

- Port publishing (on which cluster-node is an application reachable?)
  - Ingress network in Docker Swarm
- Communication between containers across multiple container hosts
  - Overlay networks in Docker Swarm
- Isolation of applications against each other
  (multiple applications may need the same services but would interfere with each other)
  - Stacks and Services in Docker Swarm
- Service Discovery (method to access other services in an application)
  - Realized with DNS in Docker Swarm

Components – Configuration

- Mounting configuration files into container
- Securing sensible data like credentials, API keys, …
- Share configuration files across multiple containers and hosts
- Docker Swarm has special CMDlets for storing secrets (*docker secret*) and configuration files/values (*docker config*)

Components - Scaling

- Dynamically scale services up and down
- *Optionally: scale services when load is getting higher or lower (Kubernetes)*
- Docker Swarm is able to start new containers on demand (*docker service scale helloworld=5*) but it does not detect if the load is getting worse so this is up to you

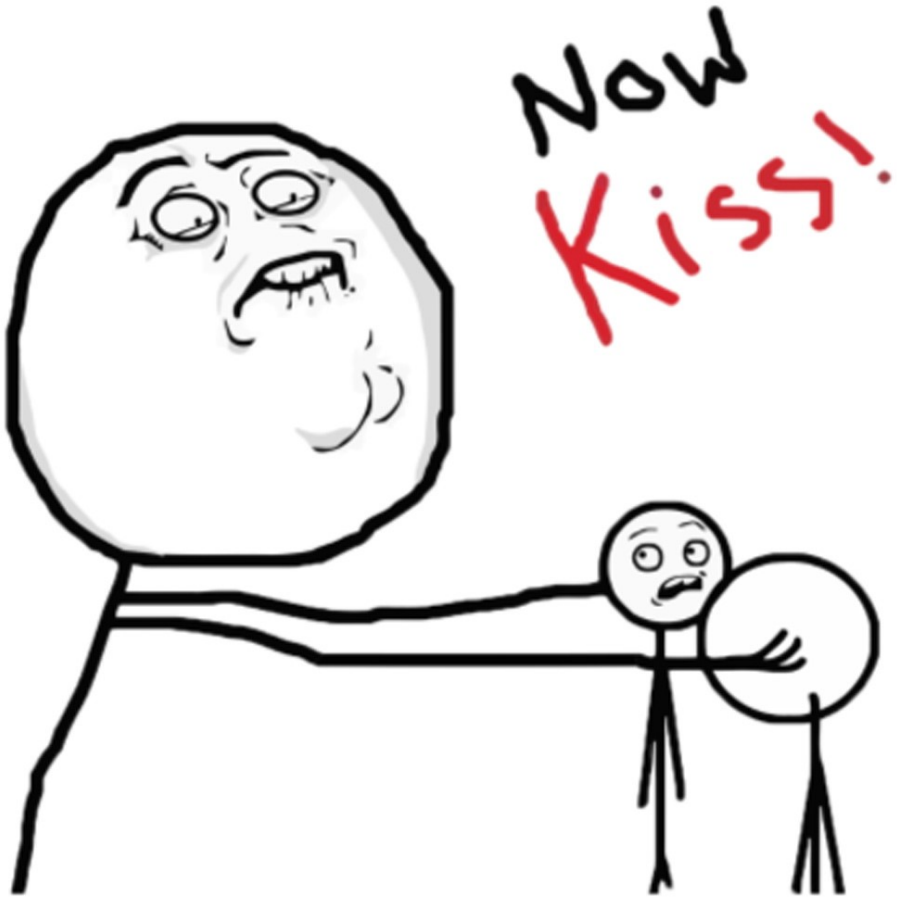
Docker Swarm concepts

- Based on Raft (consensus protocol, will be discussed later)
- Nodes are manager or worker
- Managers are taking actively part in the Raft consensus
- One manager is the leader, the others are in stand-by and are forwarding requests to the master
- Interactions (like starting a service) are only possible with a master node

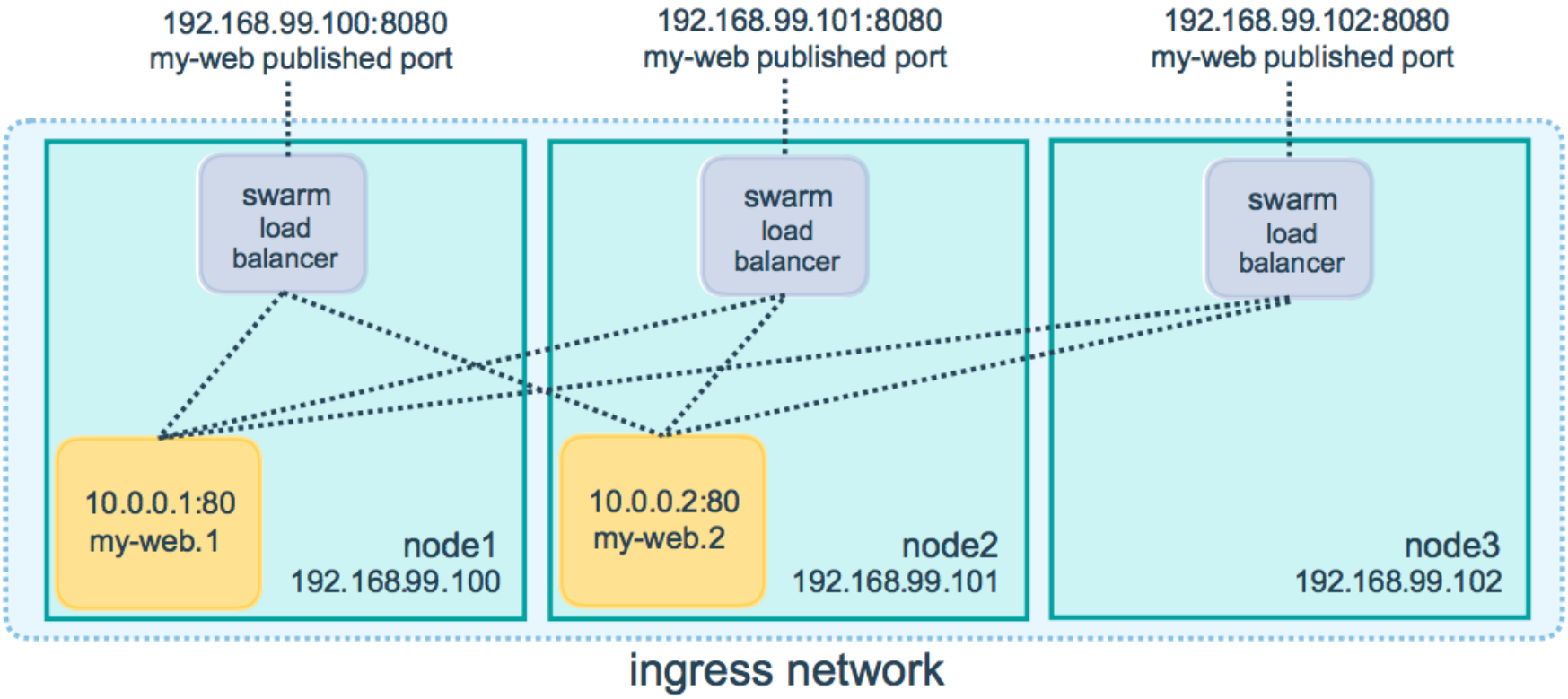
Docker Swarm – Setup

- To create a new Docker Swarm you need at least 2 nodes (for high availability 4 nodes)
- On machine 1 (let‘s call it *master*) you’re initializing the swarm by running *docker swarm init –advertise-addr <MASTER IP>*
- To get a join token you’ve to run on the *master docker swarm join-token worker*. As result Docker should print the complete command to join a worker node
- On machine 2 (let’s call it *worker*) you executed the printed command (e.g. *docker swarm join –token SWMTKN-1-49nj1cmql0jkz5s954yi3oex3nedyz0fb0xx14ie39trti4wxv-8vxv8rssmk743ojnwacrr2e7c <MASTER IP:PORT>*
- A join token may be used multiple times but it has a lifetime so you will have to generate new ones from time to time

Docker Swarm – Routing Mesh



Docker Swarm – Routing mesh

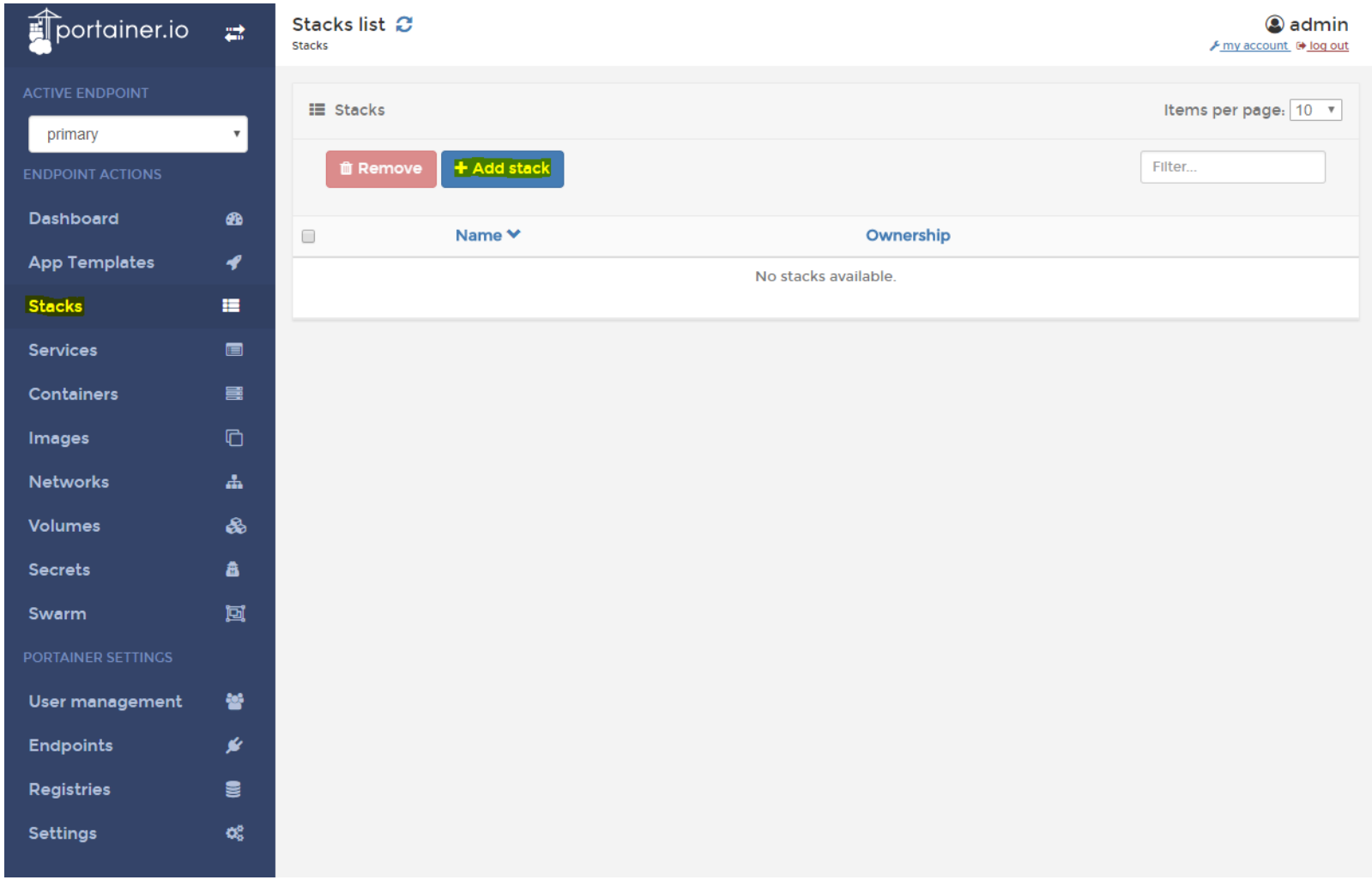


Source: https://docs.docker.com/engine/swarm/ingress/

Docker Swarm – Accessing services

- Like with any local Docker container a Swarm Container publishes a port – ports which should be available from outside the swarm are published through the so called “Ingress” network
- A port published by the ingress network is available at every node (even on worker nodes)
- Communication between services is always possible (if they’re in the same network)
- To resolve other services Docker Swarm uses internal DNS entries for every service, all calls are balanced over all available instances of a specific service (load balancing)

Docker Swarm – Deployment



Docker Swarm – Deployment

```
1    version: '3'
2
3    services:
4      web:
5        image: 127.0.0.1:5000/stackdemo
6        build: .
7        ports:
8          - "8000:8000"
9      redis:
10       image: redis:alpine
11
12
```