

# FIWARE Docker Container Service (FDCS) Introduction

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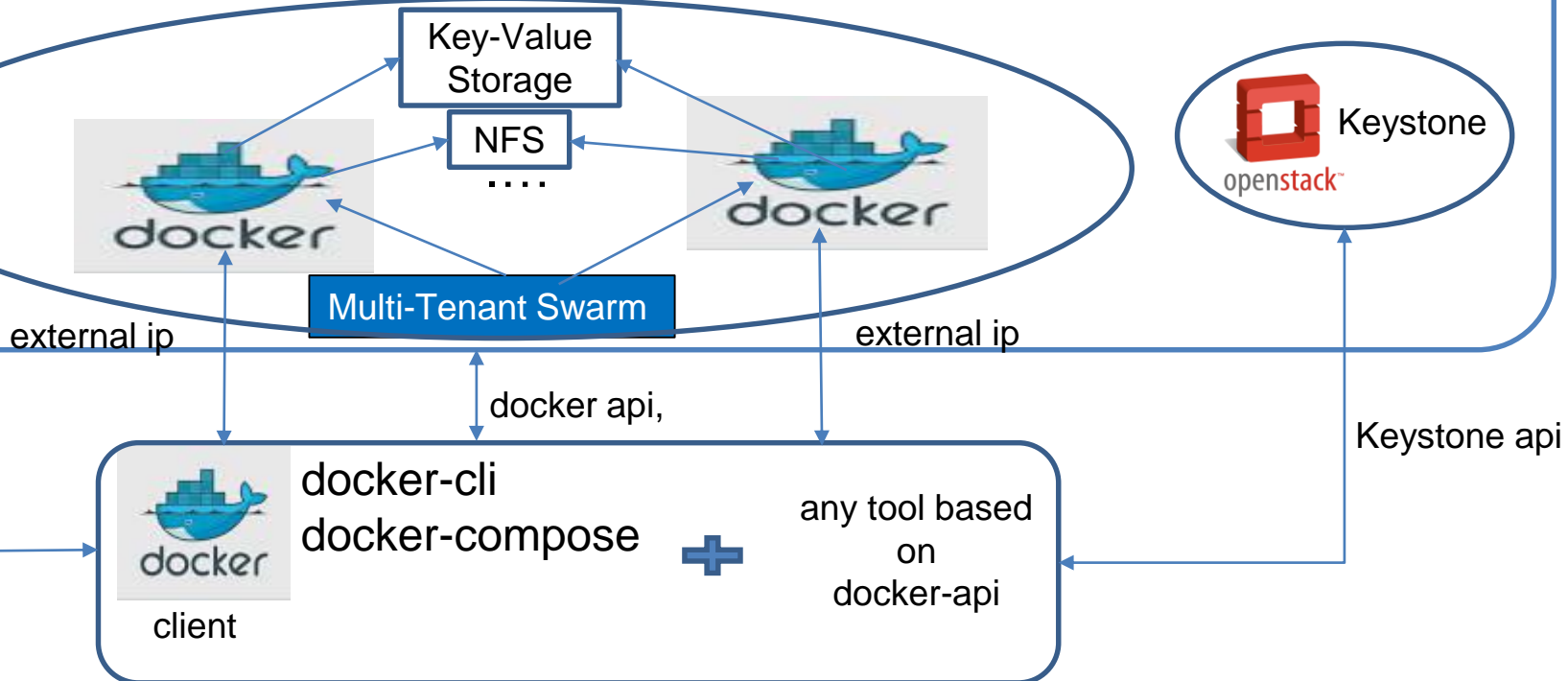
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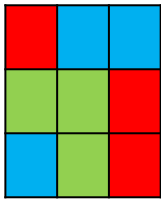
# Docker Container Service (FDCS)

 **FIWARE Lab** Docker Container Service

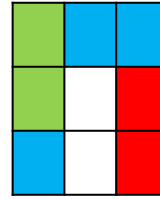


# Container

## Multi-Tenant Isolation and Multi-Tenant Name Scoping



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Multi-Tenant Swarm

Tenant 1

Tenant 2

Tenant 3

# Multi-Tenant Isolation

## each tenant only sees its own containers

### Tenant 1: create, run, and view container

```
nagin@rcc-hrl-kvg-558:~$ set_docker_conf.bash
nagin@rcc-hrl-kvg-558:~$ docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
nagin@rcc-hrl-kvg-558:~$ docker run --name tenant1-loop1 -d ubuntu /bin/sh -c "while true; do echo Hello world; sleep 1; done"
ecf86463aa68132e3739eaaa7d695637f851dbd37f4579312b515ce73f391458
nagin@rcc-hrl-kvg-558:~$ docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
ecf86463aa68        ubuntu             "/bin/sh -c 'while tr"   9 seconds ago      Up 8 seconds                docker-host-1/tenant1-loop1
```

### Tenant 2: create, run and view containers

```
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 run --name tenant2-loop1 -d ubuntu /bin/sh -c "while true; do echo Hello world; sleep 1; done"
bd6464c1922a17098ff155e5881bde56440d192fa5d03d4bbaa0802ecebee53c
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
bd6464c1922a        ubuntu             "/bin/sh -c 'while tr"   16 seconds ago     Up 14 seconds                docker-host-1/tenant2-loop1
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 run --name tenant2-loop2 -d ubuntu /bin/sh -c "while true; do echo Hello world; sleep 1; done"
f5d2baf43168b51e20de5f32224205695c452b1501e844066eb57ed6cdfa7e32
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
f5d2baf43168        ubuntu             "/bin/sh -c 'while tr"   3 seconds ago      Up 2 seconds                docker-host-1/tenant2-loop2
bd6464c1922a        ubuntu             "/bin/sh -c 'while tr"   2 minutes ago      Up About a minute           docker-host-1/tenant2-loop1
```

### Tenant 1: only see's its containers

```
nagin@rcc-hrl-kvg-558:~$ docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
ecf86463aa68        ubuntu             "/bin/sh -c 'while tr"   12 minutes ago     Up 12 minutes                docker-host-1/tenant1-loop1
```

# Multi-Tenant Isolation

each tenant can only manage its own containers

Tenant 1: remove's its containers

```
nagin@rcc-hrl-kvg-558:~$ docker rm -f tenant1-loop1
tenant1-loop1
```

```
nagin@rcc-hrl-kvg-558:~$ docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED          STATUS          PORTS          NAMES
nagin@rcc-hrl-kvg-558:~$
```

Tenant 1: not allowed to remove container created by tenant 2

```
nagin@rcc-hrl-kvg-558:~$ docker rm -f tenant2-loop1
Error response from daemon: Not Authorized!
Error: failed to remove containers: [tenant2-loop1]
nagin@rcc-hrl-kvg-558:~$ docker rm -f bd6464c1922a
Error response from daemon: Not Authorized!
Error: failed to remove containers: [bd6464c1922a]
```

Tenant 1 and Tenant 2 view after rm attempts

```
nagin@rcc-hrl-kvg-558:~$ docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED          STATUS          PORTS          NAMES
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED          STATUS          PORTS          NAMES
f5d2baf43168   ubuntu                              "/bin/sh -c 'while tr"  20 minutes ago   Up 20 minutes   Up 20 minutes   docker-host-1/tenant2-loop2
bd6464c1922a   ubuntu                              "/bin/sh -c 'while tr"  22 minutes ago   Up 22 minutes   Up 22 minutes   docker-host-1/tenant2-loop1
nagin@rcc-hrl-kvg-558:~$
```

# Multi-Tenant Name Scoping

## tenant containers with same name

Tenant 1: creates, runs, and views a named container

```
nagin@rcc-hrl-kvg-558:~$ docker run -d --name same-name-loop ubuntu /bin/sh -c "while true; do echo Hello world; sleep 1; done"
0ac41c0cc89b3739b597450322883039deaf6e11a3b92f68c8074f78faeacc32
nagin@rcc-hrl-kvg-558:~$ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
0ac41c0cc89b	ubuntu	"/bin/sh -c 'while tr"	28 seconds ago	Up 27 seconds		docker-host-1/same-name-loop

Tenant 2: uses same container

```
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 run --name same-name-loop -d ubuntu /bin/sh -c "while true; do echo Hello world; sleep 1; done"
7ff157b833a18c58c1348e970f523d1159965048dad5b2125f34d5c210fce62e
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
7ff157b833a1	ubuntu	"/bin/sh -c 'while tr"	16 seconds ago	Up 14 seconds		docker-host-1/same-name-loop
f5d2baf43168	ubuntu	"/bin/sh -c 'while tr"	26 minutes ago	Up 26 minutes		docker-host-1/tenant2-loop2
bd6464c1922a	ubuntu	"/bin/sh -c 'while tr"	28 minutes ago	Up 28 minutes		docker-host-1/tenant2-loop1

# Tenant members share resources

docker-user-2 and docker-user-3 are both members of docker-tenant-2

```
nagin@rcc-hrl-kvg-558:~$ set_docker_conf.bash -d ~/FCS/members/docker-user-3 -u docker-user-3 -t docker-tenant-2
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-3 ps
CONTAINER ID   IMAGE     COMMAND                  CREATED          STATUS          PORTS          NAMES
7ff157b833a1   ubuntu   "/bin/sh -c 'while tr"  25 minutes ago  Up 25 minutes  docker-host-1/same-name-loop
f5d2baf43168   ubuntu   "/bin/sh -c 'while tr"  52 minutes ago  Up 52 minutes  docker-host-1/tenant2-loop2
bd464c1922a    ubuntu   "/bin/sh -c 'while tr"  54 minutes ago  Up 54 minutes  docker-host-1/tenant2-loop1
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 ps
CONTAINER ID   IMAGE     COMMAND                  CREATED          STATUS          PORTS          NAMES
7ff157b833a1   ubuntu   "/bin/sh -c 'while tr"  26 minutes ago  Up 26 minutes  docker-host-1/same-name-loop
f5d2baf43168   ubuntu   "/bin/sh -c 'while tr"  53 minutes ago  Up 52 minutes  docker-host-1/tenant2-loop2
bd464c1922a    ubuntu   "/bin/sh -c 'while tr"  54 minutes ago  Up 54 minutes  docker-host-1/tenant2-loop1
```

## Tenant members remove tenant 2 containers

```
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-2 rm -f tenant2-loop1
tenant2-loop1
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-3 rm -f tenant2-loop2
tenant2-loop2
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-3 ps
CONTAINER ID   IMAGE     COMMAND                  CREATED          STATUS          PORTS          NAMES
7ff157b833a1   ubuntu   "/bin/sh -c 'while tr"  33 minutes ago  Up 33 minutes  docker-host-1/same-name-loop
```

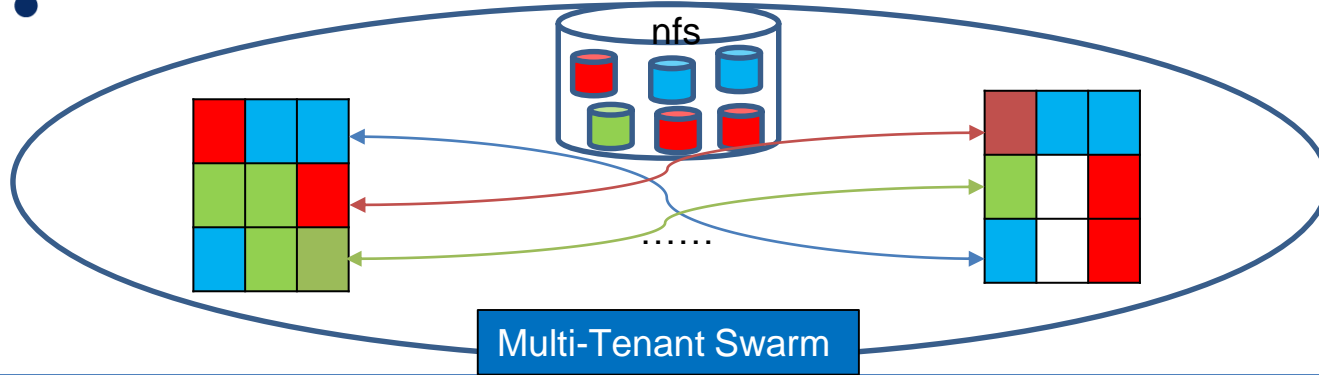
## Tenant member attaches to running containers

```
nagin@rcc-hrl-kvg-558:~$ docker --config ~/FCS/members/docker-user-3 attach same-name-loop
Hello world
Hello world
Hello world
Hello world
Hello world
^Cnagin@rcc-hrl-kvg-558:~$
```

# User defined overlay networks and nfs volumes

## Multi-Tenant Isolation and Multi-Tenant Name Scoping

 **FIWARE Lab** Docker Container Service



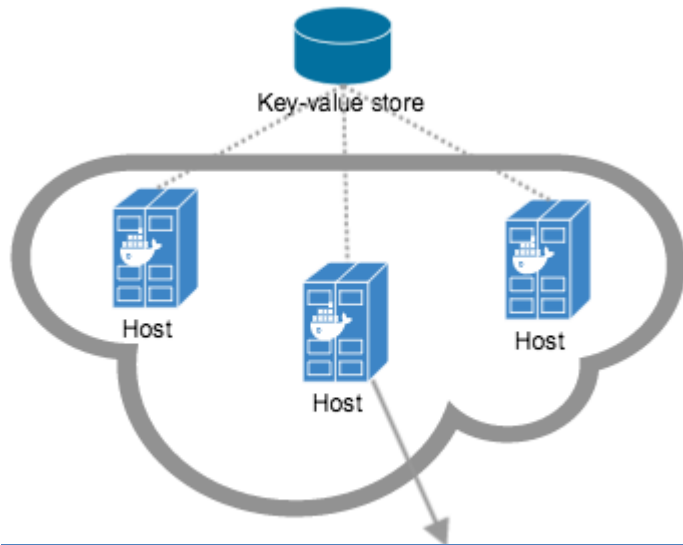
Tenant 1

Tenant 2

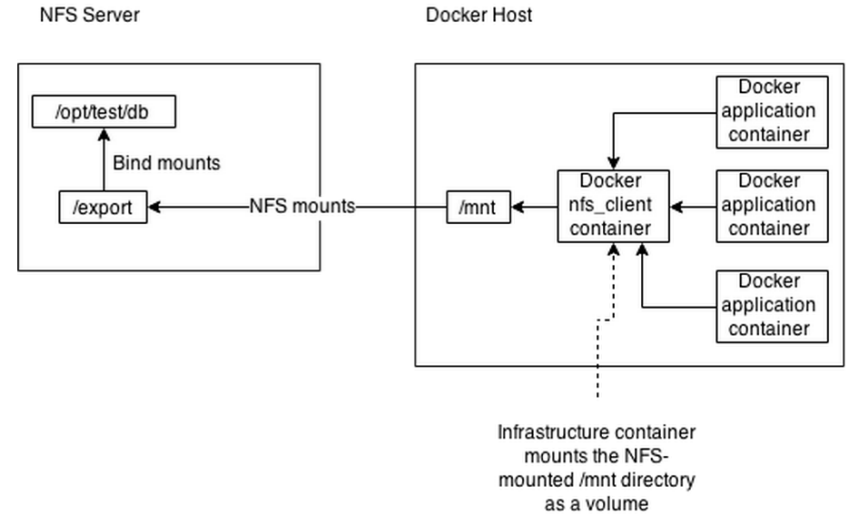
Tenant 3



# User defined overlay networks and nfs volumes



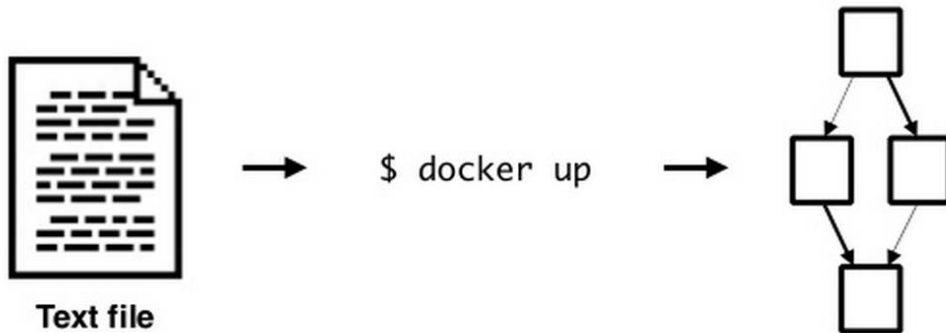
```
> Docker network create -d overlay isolated_nw
```



```
> docker volume create -d nfs myvolume --name myvol
```

Docker-compose version 2  
User defined networks and volume support

## Docker Compose: Get an app running in one command.



# docker-compose.yml: orion + mongodb v1: links and volume\_from

mongodata:

image: mongo:3.2

volumes:

- /data/db

command: /bin/echo "Data-only for mongo"

mongo:

image: mongo:3.2

**volumes\_from:**

- mongodata

command: --nojournal

orion:

image: fiware/orion

**links:**

- mongo

ports:

- "1026"

command: -dbhost mongo

## v2: user defined overlay networks and NFS volumes

```
version: '2'
networks:
  front:
    driver: "overlay"
volumes:
  mongodata:
#   external: true
    driver: "nfs"
services:
  mongo:
    image: mongo:3.2
    command: --nojournal
    networks:
      - front
    volumes:
      - mongodata:/data/db
  orion:
    image: fiware/orion
    ports:
      - "1026"
    networks:
      - front
    command: -dbhost mongo
```

Use docker compose to bring up service

```
/orion$ docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
--------------	-------	---------	---------	--------	-------	-------

```
/orion$ docker volume ls
```

DRIVER	VOLUME NAME
--------	-------------

```
/orion$ docker network ls
```

NETWORK ID	NAME	DRIVER
------------	------	--------

```
/orion$ docker-compose up -d
```

```
Creating network "orion_front" with driver "overlay"
```

```
Creating volume "orion_mongodata" with nfs driver
```

```
Creating orion_orion_1
```

```
Creating orion_mongo_1
```

## Service up and running on cluster

```
~/orion$ docker-compose ps
```

Name	Command	State	Ports
orion_mongo_1	/entrypoint.sh --nojournal	Up	27017/tcp
orion_orion_1	/usr/bin/contextBroker -fg ...	Up	130.206.119.32:32768->1026/tcp

```
:~/orion$ docker ps
```

CONTAINER ID	IMAGE	STATUS	NAMES
40e14092eddf	fiware/orion	Up 8 minutes	docker-host-3/orion_orion_1
59a647da904e	mongo:3.2	Up 8 minutes	docker-host-2/orion_mongo_1

## User defined volume and overlay network created

```
/orion$ docker volume ls
```

DRIVER	VOLUME NAME
nfs	orion_mongodata
nfs	orion_mongodata

```
/orion$ docker network ls
```

NETWORK ID	NAME	DRIVER
1b651ad80f4b	orion_front	overlay

```

/orion$ docker network inspect orion_front
[
  {
    "Name": "orion_front",
    "Id":
"1b651ad80f4b9567626faba94accdf74aa77217d91258105525d56a2d5907426",
    "Scope": "global",
    "Driver": "overlay",
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.0.0/24",
          "Gateway": "10.0.0.1/24"
        }
      ]
    }
  },
  "Containers": {
    "c67fbd499135cf20aa301a5e9c9b8611330a64cf1ac5315ca47fde5b5a4ecf50": {
      "Name": "orion_orion_1",
      "EndpointID":
"4d5111cb9303e61bf28f3a5209e788d2e33c9d3f1a5c29ebdfc8e8a1503ddc9e",
      "MacAddress": "02:42:0a:00:00:02",
      "IPv4Address": "10.0.0.2/24",
      "IPv6Address": ""
    },
    "cba077da484f4b5f9ff6b47721810e7660dce5979ed84636573626f28d97d533": {
      "Name": "orion_mongo_1",
      "EndpointID":
"fde05d125ba6971218eff9b5092877f7c6e47b8baaa67d156be83957b43baeab",
      "MacAddress": "02:42:0a:00:00:03",
      "IPv4Address": "10.0.0.3/24",
      "IPv6Address": ""
    }
  },
  "Options": {}
}
]

```



```
/orion$ port=$(docker-compose port orion 1026)
```

```
/orion$ curl $port/v2/entities
```

```
[]
```

```
/orion$ curl ${port}/v2/entities -s -S --header 'Content-Type: application/json' -X POST -d @- <<EOF
```

```
{  
  "id": "Room2",  
  "type": "Room",  
  "temperature": {  
    "value": 23,  
    "type": "Number"  
  },  
  "pressure": {  
    "value": 720,  
    "type": "Number"  
  }  
}
```

```
EOF
```

```
/orion$ curl $port/v2/entities
```

```
[{"id":"Room2","type":"Room","pressure":{"type":"Number"  
,"value":720,"metadata":{}},"temperature":{"type":"Number"  
,"value":23,"metadata":{}}}]
```

## Bring down the application

```
~/orion$ docker-compose down
Stopping orion_mongo_1 ... done
Stopping orion_orion_1 ... done
Removing orion_mongo_1 ... done
Removing orion_orion_1 ... done
Removing network orion_front
```

```
~/orion$ docker network ls
```

NETWORK ID	NAME	DRIVER
------------	------	--------

```
~/orion$ docker volume ls
```

DRIVER	VOLUME NAME
--------	-------------

nfs	orion_mongodata
-----	-----------------

nfs	orion_mongodata
-----	-----------------

Bring the app up again

```
~/orion$ docker-compose up -d
Creating network "orion_front" with driver "overlay"
Creating volume "orion_mongodata" with nfs driver
Creating orion_orion_1
Creating orion_mongo_1
docker-user-1 @rcc-hrl-kvg-558:~/orion$ docker network ls
NETWORK ID          NAME           DRIVER
d92818b2e5c0       orion_front   overlay
~/orion$ port=$(docker-compose port orion 1026)
```

```
~/orion$ curl $port/v2/entities
```

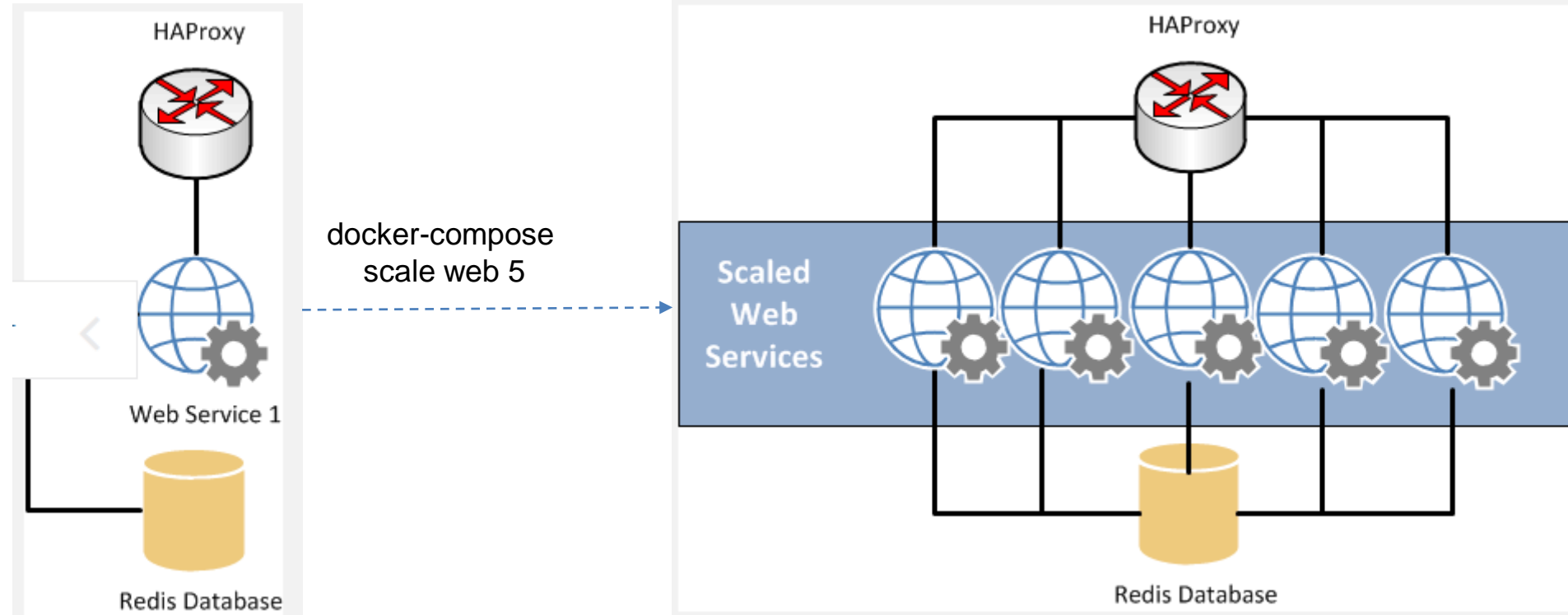
```
[{"id":"Room2","type":"Room","pressure":{"type":"Number","value":720.000000},"temperature":{"type":"Number"
```

FIWARE Docker Container Service (FDCS)  
online documentation

- readthedocs: <http://fiware-docker-container-service.readthedocs.org/en/latest/>
- FIWARE catalogue: <http://catalogue.fiware.org/enablers/docker/>



# Docker-compose: Scale web app



docker-compose.yml:

```
web:
  image: nginx/dockercomposedemo_web:v2
  volumes:
    - /code
  links:
    - redis
  expose:
    - "5000"
redis:
  image: redis
lb:
  image: tutum/haproxy
  links:
    - web
  ports:
    - "80"
  environment:
    - BACKEND_PORT=5000
    - BALANCE=roundrobin
```

## docker-compose: bring up and access web app

```
nagin@rcc-hrl-kvg-558:~/work/src/github.com/vegasbrianc/docker-compose-demo$ docker-compose up -d
Creating dockercomposedemo_redis_1
Creating dockercomposedemo_web_1
Creating dockercomposedemo_lb_1
nagin@rcc-hrl-kvg-558:~/work/src/github.com/vegasbrianc/docker-compose-demo$ docker-compose ps
```

Name	Command	State	Ports
dockercomposedemo_lb_1	python /haproxy/main.py	Up	1936/tcp, 443/tcp, 130.206.126.17:32793->80/tcp
dockercomposedemo_redis_1	/entrypoint.sh redis-server	Up	6379/tcp
dockercomposedemo_web_1	/bin/sh -c python app.py	Up	5000/tcp

```
nagin@rcc-hrl-kvg-558:~/work/src/github.com/vegasbrianc/docker-compose-demo$ curl 130.206.126.17:32793
hosted by: 07c39cb7ce71, hits: 1
nagin@rcc-hrl-kvg-558:~/work/src/github.com/vegasbrianc/docker-compose-demo$ docker inspect dockercomposedemo_web_1 | grep Id
  "Id": "07c39cb7ce71c073169505209db0434ae158d9b25092780b54b81f2d2409247c",
  "DeviceId": "663",
```

## docker-compose: bring up and access web app

```
docker-compose-demo$ dispatcher.bash -j 5 -i "curl" 130.206.126.17:32793
```

```
Using 5 parallel threads
REPETITIONS 5
> curl 130.206.126.17:32793
> curl 130.206.126.17:32793
> curl 130.206.126.17:32793
> curl 130.206.126.17:32793
> curl 130.206.126.17:32793

hosted by: 07c39cb7ce71, hits: 2

hosted by: 07c39cb7ce71, hits: 3

hosted by: 07c39cb7ce71, hits: 4

hosted by: 07c39cb7ce71, hits: 5

hosted by: 07c39cb7ce71, hits: 6
It takes 5274 ms to complete these tasks...
```



# docker-compose: bring up and access web app

```
/docker-compose-demo$ docker-compose scale web=5
```

```
/docker-compose-demo$ docker rm -f dockercomposedemo_lb_1
```

```
/docker-compose-demo$ docker-compose up -d
```

```
dockercomposedemo_redis_1 is up-to-date  
dockercomposedemo_web_5 is up-to-date  
dockercomposedemo_web_4 is up-to-date  
dockercomposedemo_web_3 is up-to-date  
dockercomposedemo_web_2 is up-to-date  
dockercomposedemo_web_1 is up-to-date  
Creating dockercomposedemo_lb_1
```

```
/docker-compose-demo$ docker-compose ps
```

Name	Command	State	Ports
dockercomposedemo_lb_1	python /haproxy/main.py	Up	1936/tcp, 443/tcp, 130.206.126.17:32794->80/tcp
dockercomposedemo_redis_1	/entrypoint.sh redis-server	Up	6379/tcp
dockercomposedemo_web_1	/bin/sh -c python app.py	Up	5000/tcp
dockercomposedemo_web_2	/bin/sh -c python app.py	Up	5000/tcp
dockercomposedemo_web_3	/bin/sh -c python app.py	Up	5000/tcp
dockercomposedemo_web_4	/bin/sh -c python app.py	Up	5000/tcp
dockercomposedemo_web_5	/bin/sh -c python app.py	Up	5000/tcp

## docker-compose: bring up and access web app

```
/docker-compose-demo$ dispatcher.bash -j 5 -i "curl" 130.206.126.17:32794
```

```
Using 5 parallel threads
REPETITIONS 5
> curl 130.206.126.17:32794
> curl 130.206.126.17:32794
> curl 130.206.126.17:32794
> curl 130.206.126.17:32794
> curl 130.206.126.17:32794

hosted by: 6b8698b092a9, hits: 10

hosted by: a920ae8dc75f, hits: 10

hosted by: 07c39cb7ce71, hits: 8

hosted by: 435352f0639e, hits: 8

hosted by: 72d21c73a29d, hits: 11
It takes 2017 ms to complete these tasks...
```

# Limitations

- Not allowed to reference docker host file system with `-volume <host>:<container>`
  - common means of configuring a container or doing backups
- Currently only experimental service running on FIWARE Lab (not for public)