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DOF606 - Gestion du Réseau Overlay avec Docker en mode Swarm

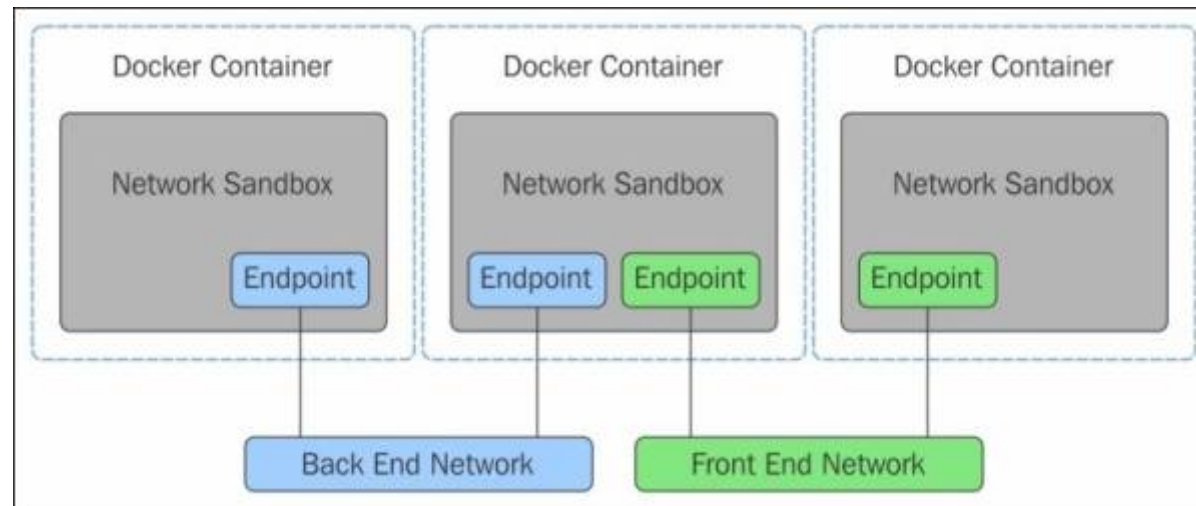
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L'Approche Réseau Docker

L'approche réseau de Docker est **libnetwork** qui implémente le **Container Network Model** (CNM). Dans ce modèle on trouve trois composants :

- Sandbox,
 - contient la configuration réseau du conteneur à savoir, la gestion des interfaces, la table de routage et le DNS,
 - Endpoint,
 - relie un sandbox à un network,
 - Network,
 - un groupe d'endpoints qui communiquent directement.
-



LAB #1 - Gestion du Réseau overlay

En plus des réseaux **bridge**, **host** et **none**, Docker propose deux autres types de réseaux, à savoir **overlay** et **macvlan**. Ce module concerne overlay. Pour plus d'informations concernant le type **macvlan**, consultez le site de la documentation de Docker [ici](#).

Comme son nom indique, un réseau overlay est un réseau qui se positionne au-dessus du réseau des hôtes. Lors de la création d'un réseau overlay, celui-ci n'est disponible par défaut qu'aux services swarm. Par contre il est possible de connecter des conteneurs autonomes au réseau overlay si l'option **-attachable** est spécifiée lors de sa création. Ce type d'utilisation du réseau overlay n'est pas recommandé par Docker qui dit que le support de cette fonctionnalité pourrait être retiré.

Le trafic lié à la gestion des services swarm est crypté par défaut avec l'algorithme AES en mode GCM. Afin de crypter le trafic des données liées aux applications il est possible d'utiliser l'option **-opt encrypted** lors de la création du réseau overlay. Dans ce cas, Docker crée des tunnels IPSEC entre chaque nœud qui utilise le même algorithme que le trafic des services swarm. Il y a donc une dégradation des performances à évaluer avant la mise en production. Dans les deux cas les clefs sont modifiées toutes les 12 heures (voir <https://www.vaultproject.io/docs/internals/rotation.html>)



ATTENTION : Le cryptage des données liées aux applications n'est pas compatible avec Windows™. Lors de la connexion du nœud Windows™ à un réseau overlay crypté, aucune erreur ne sera rapportée. Par contre le nœud



sera incapable de communiquer.

Commencez par re-cr  er un swarm en utilisant les machines virtuelles **manager**, **worker1** et **worker2** :

```
root@debian11:~# ssh -l trainee 10.0.2.62
The authenticity of host '10.0.2.62 (10.0.2.62)' can't be established.
ECDSA key fingerprint is SHA256:sEfHBv9azmK60cjqF/aJgUc9jg56slNaZQdAUcvB0vE.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.0.2.62' (ECDSA) to the list of known hosts.
trainee@10.0.2.62's password: trainee
Linux manager.i2tch.loc 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64
```

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

Last login: Sun Jul 17 08:27:29 2022 from 10.0.2.1

trainee@manager:~\$ su -

Mot de passe : fenestros

root@manager:~#

root@manager:~# docker swarm leave

Node left the swarm.

root@manager:~# docker swarm init --advertise-addr 10.0.2.62

Swarm initialized: current node (tpnlzsk20sfsfafmk2cvefqjc) is now a manager.

To add a worker to this swarm, run the following command:

```
docker swarm join --token SWMTKN-1-23d7n1fk9rvlhty106q9390bfpf9daljjguq3s807le6c5qs-
e0slyqsajvmi7s8t9l9mw48ao 10.0.2.62:2377
```

```
To add a manager to this swarm, run 'docker swarm join-token manager' and follow the instructions.  
root@manager:~# exit  
trainee@manager:~# exit
```

Connectez-vous au **worker1** :

```
root@manager:~# ssh -l trainee 10.0.2.63  
The authenticity of host '10.0.2.63 (10.0.2.63)' can't be established.  
ECDSA key fingerprint is SHA256:sEfHBv9azmK60cjgF/aJgUc9jg56slNaZQdAUcvB0vE.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added '10.0.2.63' (ECDSA) to the list of known hosts.  
trainee@10.0.2.63's password: trainee  
Linux worker1.i2tch.loc 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Sun Mar 21 16:34:26 2021 from 10.0.2.11  
trainee@worker1:~$ su -  
Mot de passe : fenestros  
root@worker1:~#  
  
root@worker1:~# docker swarm leave  
Node left the swarm.  
  
root@worker1:~# docker swarm join --token SWMTKN-1-23d7n1fk9rvlhty106q9390bfpf9daljjguq3s807le6c5qs-  
e0slyqsajvmi7s8t9l9mw48ao 10.0.2.62:2377  
This node joined a swarm as a worker.  
  
root@worker1:~# exit  
déconnexion
```

```
trainee@worker1:~$ exit
déconnexion
Connection to 10.0.2.63 closed.

root@manager:~#
```

Connectez-vous au **worker2** :

```
root@manager:~# ssh -l trainee 10.0.2.64
The authenticity of host '10.0.2.64 (10.0.2.64)' can't be established.
ECDSA key fingerprint is SHA256:sEfHBv9azmK60cjQF/aJgUc9jg56slNaZQdAUcvB0vE.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '10.0.2.64' (ECDSA) to the list of known hosts.
trainee@10.0.2.64's password: trainee
Linux worker2.i2tch.loc 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sun Mar 21 16:18:25 2021 from 10.0.2.11
trainee@worker2:~$ su -
Mot de passe : fenestros
root@worker2:~#

root@worker2:~# docker swarm leave
Node left the swarm.

root@worker2:~# docker swarm join --token SWMTKN-1-23d7n1fkkk9rvlhty106q9390bfpf9daljjguq3s807le6c5qs-
e0slyqsajvmi7s8t9l9mw48ao 10.0.2.62:2377
This node joined a swarm as a worker.
```

```

root@worker2:~# exit
déconnexion

trainee@worker2:~$ exit
déconnexion
Connection to 10.0.2.64 closed.

root@manager:~#

```

Vérifiez l'état du swarm :

```

root@manager:~# docker node ls
ID                                HOSTNAME                STATUS                AVAILABILITY                MANAGER STATUS
ENGINE VERSION
b85hxlidxbr1mh1txdlhrfe4us *    manager.i2tch.loc      Ready                Active                       Leader
19.03.4
4sui75vvdhmet4qvt0zbvzlzl      worker1.i2tch.loc      Ready                Active
19.03.4
lbjtg5o9kw3x6xg7frm07jfufw      worker2.i2tch.loc      Ready                Active
19.03.4
root@manager:~# docker node ls --filter role=manager
ID                                HOSTNAME                STATUS                AVAILABILITY                MANAGER STATUS
ENGINE VERSION
b85hxlidxbr1mh1txdlhrfe4us *    manager.i2tch.loc      Ready                Active                       Leader
19.03.4
root@manager:~# docker node ls --filter role=worker
ID                                HOSTNAME                STATUS                AVAILABILITY                MANAGER STATUS
ENGINE VERSION
4sui75vvdhmet4qvt0zbvzlzl      worker1.i2tch.loc      Ready                Active
19.03.4
lbjtg5o9kw3x6xg7frm07jfufw      worker2.i2tch.loc      Ready                Active
19.03.4

```

Vérifiez la présence du réseau overlay **ingress** ainsi que le réseau ponté **docker_gwbridge** :

```
root@manager:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
4edb7186dcc9	bridge	bridge	local
d4c9b0c9437a	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
r8htcvc8oxmz	ingress	overlay	swarm
de563e30d473	none	null	local



Info : Le réseau **docker_gwbridge** relie le réseau **ingress** à l'adaptateur réseau de l'hôte et par conséquent relie le démon Docker aux autres démons Docker qui participent dans swarm.



Best Practice : Docker recommande l'utilisation de réseaux de type overlay différents pour chaque application ou groupe d'applications.

1.1 - Création d'un Réseau overlay

A partir du Manager, créez un réseau de type overlay appelé **nginx-net** :

```
root@manager:~# docker network create -d overlay nginx-net
j57jhtug4kjxp22aily664lqr
root@manager:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
dde514eea83f	bridge	bridge	local
d4c9b0c9437a	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
r8htcvc8oxmz	ingress	overlay	swarm

j57jhtug4kjsx de563e30d473	nginx-net none	overlay null	swarm local
-------------------------------	-------------------	-----------------	----------------

1.2 - Création d'un Service

Créez un service nginx qui utilise le réseau **nginx-net** :

```
root@manager:~# docker service create --name my-nginx --publish target=80,published=80 --replicas=5 --network
nginx-net nginx
fpydgix3elrc1qum72gvwcb7f
overall progress: 5 out of 5 tasks
1/5: running [=====>]
2/5: running [=====>]
3/5: running [=====>]
4/5: running [=====>]
5/5: running [=====>]
verify: Service converged
```



Info : Le service publie le port 80 qui est visible de l'extérieur. Les conteneurs communiquent entre eux sans ouvrir de ports supplémentaires.

Vérifiez que le service fonctionne avant de poursuivre :

```
root@manager:~# docker service ls
```

ID	NAME	MODE	REPLICAS	IMAGE	PORTS
fpydgix3elrc	my-nginx	replicated	5/5	nginx:latest	*:80->80/tcp

Consultez maintenant les détails du service :

```
root@manager:~# docker service inspect my-nginx
```

```
[
  {
    "ID": "fpydgix3e1rc1qum72gvwcb7f",
    "Version": {
      "Index": 40
    },
    "CreatedAt": "2019-10-28T06:23:29.17883246Z",
    "UpdatedAt": "2019-10-28T06:23:29.183438696Z",
    "Spec": {
      "Name": "my-nginx",
      "Labels": {},
      "TaskTemplate": {
        "ContainerSpec": {
          "Image":
"nginx:latest@sha256:922c815aa4df050d4df476e92daed4231f466acc8ee90e0e774951b0fd7195a4",
          "Init": false,
          "StopGracePeriod": 10000000000,
          "DNSConfig": {},
          "Isolation": "default"
        },
        "Resources": {
          "Limits": {},
          "Reservations": {}
        },
        "RestartPolicy": {
          "Condition": "any",
          "Delay": 5000000000,
          "MaxAttempts": 0
        },
        "Placement": {
          "Platforms": [
            {
              "Architecture": "amd64",
              "OS": "linux"
            }
          ]
        }
      }
    }
  }
]
```

```
    },
    {
      "OS": "linux"
    },
    {
      "Architecture": "arm64",
      "OS": "linux"
    },
    {
      "Architecture": "386",
      "OS": "linux"
    },
    {
      "Architecture": "ppc64le",
      "OS": "linux"
    },
    {
      "Architecture": "s390x",
      "OS": "linux"
    }
  ]
},
"Networks": [
  {
    "Target": "j57jhtug4kjxp22aily664lqr"
  }
],
"ForceUpdate": 0,
"Runtime": "container"
},
"Mode": {
  "Replicated": {
    "Replicas": 5
  }
}
```

```
    },
    "UpdateConfig": {
      "Parallelism": 1,
      "FailureAction": "pause",
      "Monitor": 5000000000,
      "MaxFailureRatio": 0,
      "Order": "stop-first"
    },
    "RollbackConfig": {
      "Parallelism": 1,
      "FailureAction": "pause",
      "Monitor": 5000000000,
      "MaxFailureRatio": 0,
      "Order": "stop-first"
    },
    "EndpointSpec": {
      "Mode": "vip",
      "Ports": [
        {
          "Protocol": "tcp",
          "TargetPort": 80,
          "PublishedPort": 80,
          "PublishMode": "ingress"
        }
      ]
    }
  },
  "Endpoint": {
    "Spec": {
      "Mode": "vip",
      "Ports": [
        {
          "Protocol": "tcp",
          "TargetPort": 80,
```

```
        "PublishedPort": 80,  
        "PublishMode": "ingress"  
    }  
  ],  
  "Ports": [  
    {  
      "Protocol": "tcp",  
      "TargetPort": 80,  
      "PublishedPort": 80,  
      "PublishMode": "ingress"  
    }  
  ],  
  "VirtualIPs": [  
    {  
      "NetworkID": "r8htcvc8oxmzy896xvwvv87k5",  
      "Addr": "10.255.0.5/16"  
    },  
    {  
      "NetworkID": "j57jhtug4kjxp22aily664lqr",  
      "Addr": "10.0.0.2/24"  
    }  
  ]  
}  
]
```



Important : Notez ici les informations concernant les ports et les Endpoints utilisés par le service.

1.3 - Déplacer le Service vers un autre Réseau overlay

Consultez le réseau overlay **nginx-net** sur les trois nœuds :

```
root@manager:~# docker inspect nginx-net
[
  {
    "Name": "nginx-net",
    "Id": "j57jhtug4kjxp22aily664lqr",
    "Created": "2019-10-28T07:23:29.492986337+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.0.0/24",
          "Gateway": "10.0.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "b2e882e530b10f8fd0b2481f851007f864ce1495bc9fdedcf51a475c0fc03aeb": {
        "Name": "my-nginx.2.bo4q3us1f6m0uwxhqgtaulyg5",
```

```
    "EndpointID": "f6f82bcb81ba82191f3988702b0e91f7f5f139c5c88899ad7c95e12ab189e055",
    "MacAddress": "02:42:0a:00:00:04",
    "IPv4Address": "10.0.0.4/24",
    "IPv6Address": ""
  },
  "c0a76b54dad58b0faf80d2f915a10072aa7d726c46036caa3157d22c30dba843": {
    "Name": "my-nginx.4.aqj5vafpqtkc8f4rn4v04x4kn",
    "EndpointID": "813bef65edc4de42d5ec4357013f5b711cd21ce7d1a1c8361c1d989d0d709071",
    "MacAddress": "02:42:0a:00:00:06",
    "IPv4Address": "10.0.0.6/24",
    "IPv6Address": ""
  },
  "lb-nginx-net": {
    "Name": "nginx-net-endpoint",
    "EndpointID": "d087f5fe91481b12ca0b966d01584d143b25c746952bb517441cfad6beba90de",
    "MacAddress": "02:42:0a:00:00:08",
    "IPv4Address": "10.0.0.8/24",
    "IPv6Address": ""
  }
},
"Options": {
  "com.docker.network.driver.overlay.vxlanid_list": "4097"
},
"Labels": {},
"Peers": [
  {
    "Name": "1199cab4a6dd",
    "IP": "10.0.2.62"
  },
  {
    "Name": "69676ae46ab9",
    "IP": "10.0.2.63"
  }
]
```

```
        "Name": "d058d363197d",
        "IP": "10.0.2.64"
    }
]
}
```

```
root@worker1:~# docker inspect nginx-net
```

```
[
  {
    "Name": "nginx-net",
    "Id": "j57jhtug4kjxp22aily664lqr",
    "Created": "2019-10-28T07:23:29.561068917+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.0.0/24",
          "Gateway": "10.0.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
```

```
    "50b205e2ed4ccaaad5adc06c508af235557c89c116c819e367a1d925e9c2b564": {
      "Name": "my-nginx.1.gcz867ezj0y46tsdgoz8j3jz2",
      "EndpointID": "a48a43da98acef2748f42ffa992ba302863ed3c417fa3289cbd3aed0e33e97fa",
      "MacAddress": "02:42:0a:00:00:03",
      "IPv4Address": "10.0.0.3/24",
      "IPv6Address": ""
    },
    "lb-nginx-net": {
      "Name": "nginx-net-endpoint",
      "EndpointID": "54ed15511cdd574cb60d37d39257cbf7b30331b24bb069aadb33b457b2864789",
      "MacAddress": "02:42:0a:00:00:0a",
      "IPv4Address": "10.0.0.10/24",
      "IPv6Address": ""
    }
  },
  "Options": {
    "com.docker.network.driver.overlay.vxlanid_list": "4097"
  },
  "Labels": {},
  "Peers": [
    {
      "Name": "69676ae46ab9",
      "IP": "10.0.2.63"
    },
    {
      "Name": "d058d363197d",
      "IP": "10.0.2.64"
    },
    {
      "Name": "1199cab4a6dd",
      "IP": "10.0.2.62"
    }
  ]
}
```

```
]
```

```
root@worker2:~# docker inspect nginx-net
```

```
[
  {
    "Name": "nginx-net",
    "Id": "j57jhtug4kjxp22aily664lqr",
    "Created": "2019-10-28T07:23:29.562818383+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.0.0/24",
          "Gateway": "10.0.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "31bcb5e553886cd9b3a6b8e70fe0c2bed92fe081bd0def0c94864631a940cbd6": {
        "Name": "my-nginx.5.t3be85jtp2qlhpmvsl4866s5m",
        "EndpointID": "ffa92f5f3bb7fd2665a8be336ef1e4e2d786790852eb152dac1a2c45f18518ba",
        "MacAddress": "02:42:0a:00:00:07",
        "IPv4Address": "10.0.0.7/24",
```

```
    "IPv6Address": ""
  },
  "8e2ce40a6e0d9fb2bc64c264b92164b6ea241a2369d8e6844d00b8952f5729a7": {
    "Name": "my-nginx.3.dma616z2rkbted13zd824fyo2",
    "EndpointID": "99cfb31ce34ccd9b6b15f71c87eddb5f39a84512ec76d215d54bdaaf851d5129",
    "MacAddress": "02:42:0a:00:00:05",
    "IPv4Address": "10.0.0.5/24",
    "IPv6Address": ""
  },
  "lb-nginx-net": {
    "Name": "nginx-net-endpoint",
    "EndpointID": "c0816f6f1e5c046ac1deb8163c5a8cf40765a126bf76b6f10bf1bb708a51dfa1",
    "MacAddress": "02:42:0a:00:00:09",
    "IPv4Address": "10.0.0.9/24",
    "IPv6Address": ""
  }
},
"Options": {
  "com.docker.network.driver.overlay.vxlanid_list": "4097"
},
"Labels": {},
"Peers": [
  {
    "Name": "d058d363197d",
    "IP": "10.0.2.64"
  },
  {
    "Name": "69676ae46ab9",
    "IP": "10.0.2.63"
  },
  {
    "Name": "1199cab4a6dd",
    "IP": "10.0.2.62"
  }
]
```

```
]
}
]
```



Important : Notez que le réseau **nginx-net** a été créé automatiquement sur les deux Workers. Notez aussi le contenu de la section **Peers** qui liste les nœuds ainsi que la section **Containers** qui liste les conteneurs sur chaque nœud qui sont connectés au réseau overlay.

Créez maintenant un deuxième réseau de type overlay, appelé **nginx-net-2** :

```
root@manager:~# docker network create -d overlay nginx-net-2
aez5huut9hd472qmldzf2tsud
```

Déplacez le service **my-nginx** vers le réseau **nginx-net-2** :

```
root@manager:~# docker service update --network-add nginx-net-2 --network-rm nginx-net my-nginx
my-nginx
overall progress: 5 out of 5 tasks
1/5: running [=====>]
2/5: running [=====>]
3/5: running [=====>]
4/5: running [=====>]
5/5: running [=====>]
verify: Service converged
```

Vérifiez que le service fonctionne avant de poursuivre :

```
root@manager:~# docker service ls
```

ID	NAME	MODE	REPLICAS	IMAGE	PORTS
----	------	------	----------	-------	-------

fpydgix3elrc	my-nginx	replicated	5/5	nginx:latest	*:80->80/tcp
--------------	----------	------------	-----	--------------	--------------

Vérifiez qu'aucun conteneur se trouve dans le réseau **nginx-net** :

```
root@manager:~# docker network inspect nginx-net
[
  {
    "Name": "nginx-net",
    "Id": "j57jhtug4kjxp22aily664lqr",
    "Created": "2019-10-28T06:21:18.337578134Z",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.0.0/24",
          "Gateway": "10.0.0.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": null,
    "Options": {
      "com.docker.network.driver.overlay.vxlanid_list": "4097"
    },
  },
]
```

```
    "Labels": null
  }
]
```

Vérifiez maintenant que les conteneurs se trouvent dans le réseau **nginx-net-2** :

```
root@manager:~# docker network inspect nginx-net-2
[
  {
    "Name": "nginx-net-2",
    "Id": "aez5huut9hd472qmldzf2tsud",
    "Created": "2019-10-28T10:09:54.465105557+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.1.0/24",
          "Gateway": "10.0.1.1"
        }
      ]
    },
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "0bf159064e30d5e788a12baca53ee8e9504a2d7300017fb268cb9e90caaea27a": {
```

```
    "Name": "my-nginx.2.81pveqac42zesvuulpbiho7k6",
    "EndpointID": "25c9587e76cfca10d17b10fa967186bc73ca6b444cc2689e43a7243f5d1795b2",
    "MacAddress": "02:42:0a:00:01:05",
    "IPv4Address": "10.0.1.5/24",
    "IPv6Address": ""
  },
  "74e656da8c670fca23270078565af164c4d42415f012ff51ccb02395c6d121e9": {
    "Name": "my-nginx.3.mj1lbsguaaewk61dw7yxxjdlu",
    "EndpointID": "2be3c3e0286d3afb5ba47bbd903151a4d337a45743cb30c46595160223e02fba",
    "MacAddress": "02:42:0a:00:01:07",
    "IPv4Address": "10.0.1.7/24",
    "IPv6Address": ""
  },
  "lb-nginx-net-2": {
    "Name": "nginx-net-2-endpoint",
    "EndpointID": "768a4cc926b5c94a20904e5db500dc62b40a063077a49769ccccc007a6cb61ac",
    "MacAddress": "02:42:0a:00:01:06",
    "IPv4Address": "10.0.1.6/24",
    "IPv6Address": ""
  }
},
"Options": {
  "com.docker.network.driver.overlay.vxlanid_list": "4098"
},
"Labels": {},
"Peers": [
  {
    "Name": "69676ae46ab9",
    "IP": "10.0.2.63"
  },
  {
    "Name": "1199cab4a6dd",
    "IP": "10.0.2.62"
  }
],
```

```
{
  "Name": "d058d363197d",
  "IP": "10.0.2.64"
}
]
```

Supprimez maintenant le service **my-nginx** ainsi que les deux réseaux overlay **nginx-net** et **nginx-net-2** :

```
root@manager:~# docker service rm my-nginx
my-nginx

root@manager:~# docker network rm nginx-net nginx-net-2
nginx-net
nginx-net-2
```

1.4 - DNS container discovery

Le daemon Docker exécute un serveur DNS embarqué à l'adresse 127.0.0.11 qui permet la résolution des noms dans un réseau personnalisé. Si ce serveur est incapable de faire la résolution, il transfère la requête à tout serveur externe défini dans le conteneur.

Pour que le **DNS container discovery** fonctionne, les ports suivants doivent être ouverts sur les nœuds :

- 2377/tcp
- 7946/tcp
- 7946/udp
- 4789/udp

Créez maintenant le réseau de type overlay **test-net** :

```
root@manager:~# docker network create --driver=overlay --attachable test-net
hrs25w4l951kkickhj6262mjpg
```



Important : Notez que le **NETWORK-ID** ici est **hrs25w4l951kkickhj6262mjg**.

Sur le Manager, démarrez un conteneur interactif appelé **alpine1** et qui se connecte au réseau **test-net** :

```
root@manager:~# docker run -it --name alpine1 --network test-net alpine
Unable to find image 'alpine:latest' locally
latest: Pulling from library/alpine
89d9c30c1d48: Pull complete
Digest: sha256:c19173c5ada610a598915111163d28a67368362762534d8a8121ce95cf2bd5a
Status: Downloaded newer image for alpine:latest
/ #
```

Listez les réseaux disponibles sur **Worker1** :

```
root@worker1:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
3fe43b514f9d	bridge	bridge	local
ee22b3e623ca	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
r8htcvc8oxmz	ingress	overlay	swarm
de563e30d473	none	null	local



Important : Notez que le réseau **test-net** n'a pas été créé.

Démarrez maintenant un conteneur **alpine2** sur **Worker1** :

```
root@worker1:~# docker run -dit --name alpine2 --network test-net alpine
```

```
Unable to find image 'alpine:latest' locally
latest: Pulling from library/alpine
89d9c30c1d48: Pull complete
Digest: sha256:c19173c5ada610a5989151111163d28a67368362762534d8a8121ce95cf2bd5a
Status: Downloaded newer image for alpine:latest
5734e84cd460cdd33ce90970d98a96837a0305832a86fc4d86be38aecf51b23b
```

Saisissez la commande **docker network ls** sur **Worker1** :

```
root@worker1:~# docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
3fe43b514f9d        bridge             bridge              local
ee22b3e623ca        docker_gwbridge    bridge              local
f3cb3bc3c581        host               host                local
r8htcvc8oxmz        ingress            overlay             swarm
de563e30d473        none               null                local
hrs25w4l951k        test-net           overlay             swarm
```



Important : Notez que le réseau **test-net**, ayant le même **NETWORK ID**, a été automatiquement créé lors de la création du conteneur **alpine2**.

Listez les réseaux disponibles sur **Worker2** :

```
root@worker2:~# docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
ff7308310f60        bridge             bridge              local
0ce1d8369c29        docker_gwbridge    bridge              local
f3cb3bc3c581        host               host                local
r8htcvc8oxmz        ingress            overlay             swarm
de563e30d473        none               null                local
```



Important : Notez que le réseau **test-net** n'a pas été créé.

Attachez vous au conteneur **alpine2** sur **Worker1** et essayez de contacter le conteneur **alpine1** :

```
root@worker1:~# docker ps -a
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS
ce9097b864dc        alpine             "/bin/sh"          23 minutes ago      Up 23 minutes
alpine2

root@worker1:~# docker attach alpine2
/ #

/ # ping -c 2 alpine1
PING alpine1 (10.0.2.2): 56 data bytes
64 bytes from 10.0.2.2: seq=0 ttl=64 time=1.874 ms
64 bytes from 10.0.2.2: seq=1 ttl=64 time=1.669 ms

--- alpine1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 1.669/1.771/1.874 ms
/ #
```

Retournez dans la VM **Manager** et essayez de contacter le conteneur **alpine2** à partir du conteneur **alpine1** :

```
root@manager:~# docker attach alpine1
/ #

/ # ping -c 2 alpine2
PING alpine2 (10.0.0.4): 56 data bytes
64 bytes from 10.0.0.4: seq=0 ttl=64 time=0.666 ms
```

```
64 bytes from 10.0.0.4: seq=1 ttl=64 time=1.239 ms

--- alpine2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.666/0.952/1.239 ms
/ #
```

Créez ensuite le conteneur **alpine3** sur le **Worker2** essayez de contacter le conteneur **alpine1** :

```
root@worker2:~# docker run -it --rm --name alpine3 --network test-net alpine
Unable to find image 'alpine:latest' locally
latest: Pulling from library/alpine
c9b1b535fdd9: Pull complete
Digest: sha256:ab00606a42621fb68f2ed6ad3c88be54397f981a7b70a79db3d1172b11c4367d
Status: Downloaded newer image for alpine:latest
/ #

/ # ping -c 2 alpine1
PING alpine1 (10.0.2.2): 56 data bytes
64 bytes from 10.0.2.2: seq=0 ttl=64 time=0.642 ms
64 bytes from 10.0.2.2: seq=1 ttl=64 time=1.684 ms

--- alpine1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.642/1.163/1.684 ms
/ # exit
```

Arrêtez maintenant le conteneur **alpine2** sur **Worker1** :

```
root@worker1:~# docker container stop alpine2
alpine2
```

Saisissez la commande **docker network ls** :

```
root@worker1:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
3bb80f391804	bridge	bridge	local
ee22b3e623ca	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
r8htcvc8oxmz	ingress	overlay	swarm
de563e30d473	none	null	local



Important : Notez que le réseau **test-net** a été supprimé.

Supprimez le conteneur **alpine2**:

```
root@worker1:~# docker container rm alpine2
alpine2
```

Arrêtez le conteneur **alpine1** et supprimez le réseau **test-net** sur **Manager** :

```
/ # exit
```

```
root@manager:~# docker container stop alpine1
alpine1
```

```
root@manager:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
a604e7db6f95	bridge	bridge	local
d4c9b0c9437a	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
jxu667wzmj2u	ingress	overlay	swarm
de563e30d473	none	null	local
518l09lcjhsp	test-net	overlay	swarm

```
root@manager:~# docker network rm test-net
test-net
```

2.5 - Création d'un Réseau overlay Personnalisé

Il est possible de créer un réseau overlay personnalisé. Dans ce cas là, il convient de supprimer le réseau ingress déjà existant :

```
root@manager:~# docker network rm ingress
WARNING! Before removing the routing-mesh network, make sure all the nodes in your swarm run the same docker
engine version. Otherwise, removal may not be effective and functionality of newly create ingress networks will
be impaired.
Are you sure you want to continue? [y/N] y
ingress
```

Créez ensuite votre réseau personnalisé :

```
root@manager:~# docker network create --driver overlay --ingress --subnet=10.11.0.0/16 --gateway=10.11.0.2 --opt
com.docker.network.driver.mtu=1200 my-ingress
44ozn3vtg23zkksrvloXuulcl

root@manager:~# docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
24be8a0f0ef5        bridge              bridge              local
d4c9b0c9437a        docker_gwbridge     bridge              local
f3cb3bc3c581        host                host                local
44ozn3vtg23z        my-ingress          overlay             swarm
de563e30d473        none                null                local
```

Créez de nouveau le service **my-nginx** :

```
root@manager:~# docker service create --name my-nginx --publish target=80,published=80 --replicas=5 nginx
gpliozmbi25dx3skn00m6suoz
```

```
overall progress: 5 out of 5 tasks
```

```
1/5: running [=====>]
2/5: running [=====>]
3/5: running [=====>]
4/5: running [=====>]
5/5: running [=====>]
```

```
verify: Service converged
```

```
root@manager:~# docker service ls
```

ID	NAME	MODE	REPLICAS	IMAGE	PORTS
gpliozmbi25d	my-nginx	replicated	5/5	nginx:latest	*:80->80/tcp

```
root@manager:~# docker service ps my-nginx
```

ID	NAME	IMAGE	NODE	DESIRED STATE	CURRENT STATE
ERROR	PORTS				
upmbwmtr76cm	my-nginx.1	nginx:latest	worker1.i2tch.loc	Running	Running about
a minute ago					
qz6p1li7zmef	my-nginx.2	nginx:latest	worker2.i2tch.loc	Running	Running about
a minute ago					
me50mkhd1lyk	my-nginx.3	nginx:latest	manager.i2tch.loc	Running	Running about
a minute ago					
sctjud70ihkl	my-nginx.4	nginx:latest	worker1.i2tch.loc	Running	Running about
a minute ago					
kql9qx3phb73	my-nginx.5	nginx:latest	worker2.i2tch.loc	Running	Running about
a minute ago					

Consultez les informations concernant le service **my-nginx** :

```
root@manager:~# docker service inspect my-nginx
```

```
[
  {
    "ID": "gpliozmbi25dx3skn00m6suoz",
    "Version": {
      "Index": 230
    }
  }
]
```

```

},
"CreatedAt": "2019-10-28T14:49:33.6719228Z",
"UpdatedAt": "2019-10-28T14:49:33.679624758Z",
"Spec": {
  "Name": "my-nginx",
  "Labels": {},
  "TaskTemplate": {
    "ContainerSpec": {
      "Image":
"nginx:latest@sha256:922c815aa4df050d4df476e92daed4231f466acc8ee90e0e774951b0fd7195a4",
      "Init": false,
      "StopGracePeriod": 100000000000,
      "DNSConfig": {},
      "Isolation": "default"
    },
    "Resources": {
      "Limits": {},
      "Reservations": {}
    },
    "RestartPolicy": {
      "Condition": "any",
      "Delay": 50000000000,
      "MaxAttempts": 0
    },
    "Placement": {
      "Platforms": [
        {
          "Architecture": "amd64",
          "OS": "linux"
        },
        {
          "OS": "linux"
        }
      ]
    }
  }
}

```

```
        "Architecture": "arm64",
        "OS": "linux"
    },
    {
        "Architecture": "386",
        "OS": "linux"
    },
    {
        "Architecture": "ppc64le",
        "OS": "linux"
    },
    {
        "Architecture": "s390x",
        "OS": "linux"
    }
]
},
"ForceUpdate": 0,
"Runtime": "container"
},
"Mode": {
    "Replicated": {
        "Replicas": 5
    }
},
"UpdateConfig": {
    "Parallelism": 1,
    "FailureAction": "pause",
    "Monitor": 5000000000,
    "MaxFailureRatio": 0,
    "Order": "stop-first"
},
"RollbackConfig": {
    "Parallelism": 1,
```

```
        "FailureAction": "pause",
        "Monitor": 5000000000,
        "MaxFailureRatio": 0,
        "Order": "stop-first"
    },
    "EndpointSpec": {
        "Mode": "vip",
        "Ports": [
            {
                "Protocol": "tcp",
                "TargetPort": 80,
                "PublishedPort": 80,
                "PublishMode": "ingress"
            }
        ]
    }
},
"Endpoint": {
    "Spec": {
        "Mode": "vip",
        "Ports": [
            {
                "Protocol": "tcp",
                "TargetPort": 80,
                "PublishedPort": 80,
                "PublishMode": "ingress"
            }
        ]
    },
    "Ports": [
        {
            "Protocol": "tcp",
            "TargetPort": 80,
            "PublishedPort": 80,
```

```
        "PublishMode": "ingress"
      },
    ],
    "VirtualIPs": [
      {
        "NetworkID": "44ozn3vtg23zkksrvloXuulcl",
        "Addr": "10.11.0.1/16"
      }
    ]
  }
}
```

Vérifiez maintenant que les conteneurs se trouvent dans le réseau **my-ingress** :

```
root@manager:~# docker inspect my-ingress
[
  {
    "Name": "my-ingress",
    "Id": "l1l1ucu5ufjfwz6e0umtygdqy",
    "Created": "2020-03-10T11:02:38.278429829+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.11.0.0/16",
          "Gateway": "10.11.0.2"
        }
      ]
    },
  },
]
```

```
"Internal": false,
"Attachable": false,
"Ingress": true,
"ConfigFrom": {
  "Network": ""
},
"ConfigOnly": false,
"Containers": {
  "6f0168ff5153b899af31098740de34997b12417ef7c0f3824938edf79b2bca7f": {
    "Name": "my-nginx.3.me50mkhd1lykwz7aj07znloh1",
    "EndpointID": "41531d43496f4723cb62cad1d57c5a088faebe79c430d04a1765022e31d8ae17",
    "MacAddress": "02:42:0a:0b:00:05",
    "IPv4Address": "10.11.0.5/16",
    "IPv6Address": ""
  },
  "my-ingress-sbox": {
    "Name": "my-ingress-endpoint",
    "EndpointID": "0205796eeb005ef77b3ea382fd1e72c312a58fd717b5a79ca6cacc7e090068e6",
    "MacAddress": "02:42:0a:0b:00:0a",
    "IPv4Address": "10.11.0.10/16",
    "IPv6Address": ""
  }
},
"Options": {
  "com.docker.network.driver.mtu": "1200",
  "com.docker.network.driver.overlay.vxlanid_list": "4100"
},
"Labels": {},
"Peers": [
  {
    "Name": "9a00e8bc72fe",
    "IP": "10.0.2.62"
  },
  {
```

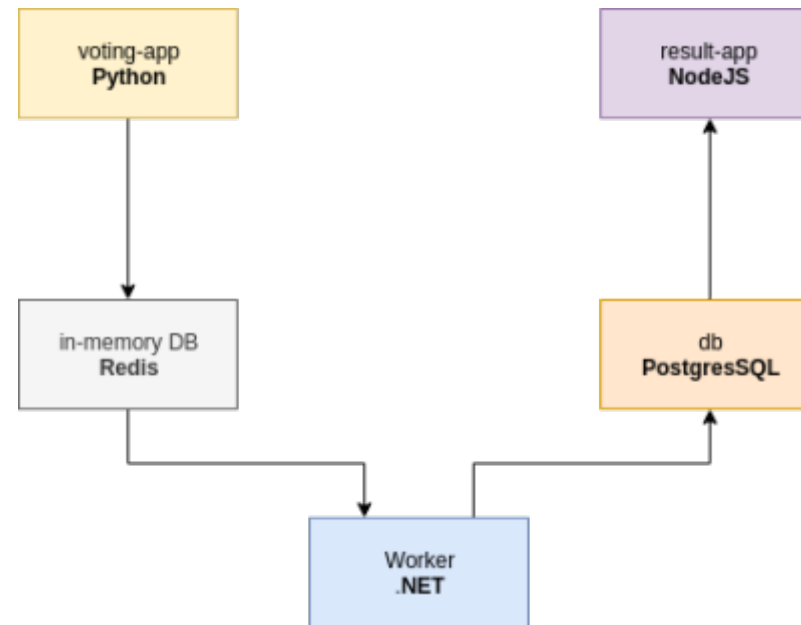
```
    "Name": "3ea669d48ca2",  
    "IP": "10.0.2.64"  
  },  
  {  
    "Name": "f30e39df1704",  
    "IP": "10.0.2.63"  
  }  
]  
}  
]
```

Supprimez maintenant le service **my-nginx** :

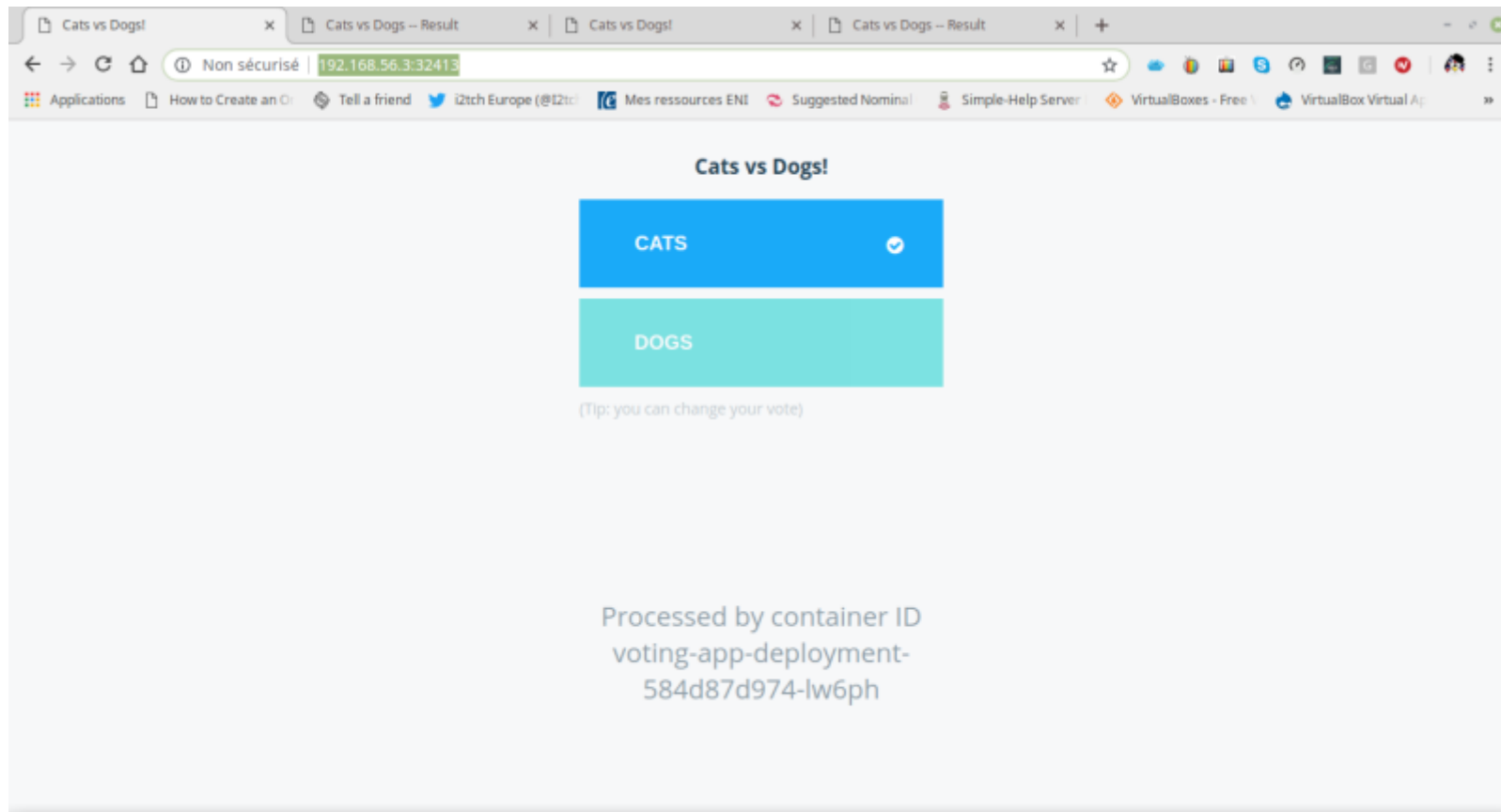
```
root@manager:~# docker service rm my-nginx  
my-nginx
```

LAB #2 - Gestion d'une Architecture de Microservices

Vous allez mettre en place une application simple, appelé **demo-voting-app** et développé par Docker, sous forme de microservices :

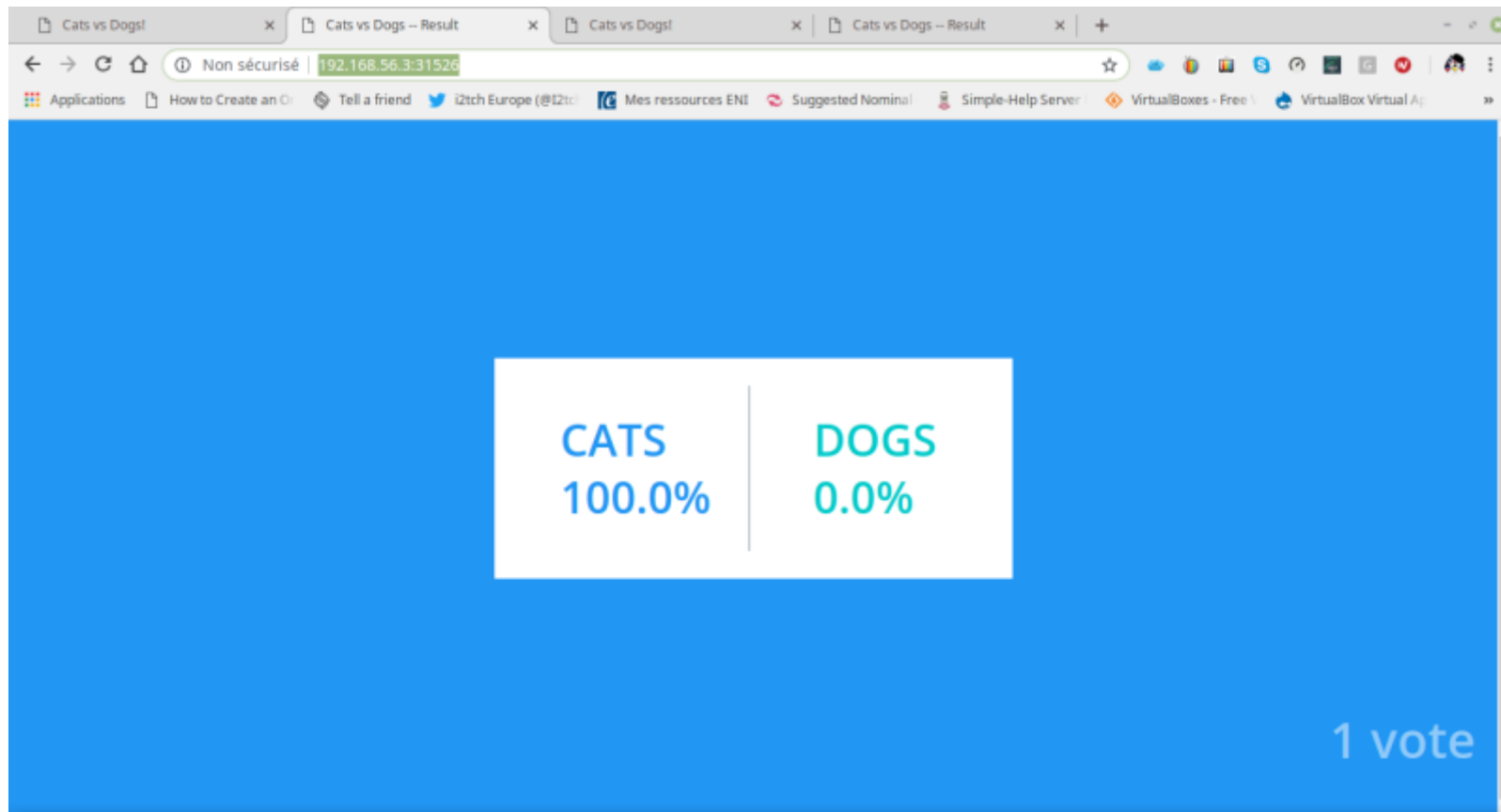


Dans cette application le conteneur **voting-app** permet de voter pour des **chats** ou des **chiens**. Cette application tourne sous Python et fournit une interface HTML :



Lors de la vote, le résultat de celle-ci est stocké dans **Redis** dans une base de données en mémoire. Le résultat est ensuite passé au conteneur **Worker** qui tourne sous .NET et qui met à jour la base de données persistante dans le conteneur **db** qui tourne sous PostgreSQL.

L'application **result-app** qui tourne sous NodeJS lit ensuite la table dans la base de données PostgreSQL et affiche le résultat sous forme HTML :



2.1 - Mise en Place avec Docker Swarm avec des réseaux Overlay

Cette application peut être mise en place sous docker swarm avec avec la commande **docker stack**. Un **stack** est un groupe de services. Premièrement, vérifiez l'état du Swarm :

```
root@manager:~# docker node ls
```

ID	HOSTNAME	STATUS	AVAILABILITY	MANAGER STATUS
ENGINE VERSION				
b85hxlidxbr1mhltxd1hrfe4us *	manager.i2tch.loc	Ready	Active	Leader
19.03.4				

4sui75vvdhmet4qvt0zbvzlzl 19.03.4	worker1.i2tch.loc	Ready	Active
lbjtg5o9kw3x6xg7frm07jfufw 19.03.4	worker2.i2tch.loc	Ready	Active

Créez maintenant le fichier **docker-stack.yml** :

```
root@manager:~# vi docker-stack.yml

root@manager:~# cat docker-stack.yml
version: "3"
services:

  redis:
    image: redis:alpine
    networks:
      - frontend
    deploy:
      replicas: 1
      update_config:
        parallelism: 2
        delay: 10s
      restart_policy:
        condition: on-failure
  db:
    image: postgres:9.4
    environment:
      POSTGRES_USER: "postgres"
      POSTGRES_PASSWORD: "postgres"
    volumes:
      - db-data:/var/lib/postgresql/data
    networks:
      - backend
    deploy:
```

```
    placement:
      constraints: [node.role == manager]
vote:
  image: dockersamples/examplevotingapp_vote:before
  ports:
    - 5000:80
  networks:
    - frontend
  depends_on:
    - redis
  deploy:
    replicas: 2
    update_config:
      parallelism: 2
    restart_policy:
      condition: on-failure
result:
  image: dockersamples/examplevotingapp_result:before
  ports:
    - 5001:80
  networks:
    - backend
  depends_on:
    - db
  deploy:
    replicas: 1
    update_config:
      parallelism: 2
      delay: 10s
    restart_policy:
      condition: on-failure

worker:
  image: dockersamples/examplevotingapp_worker
```

```
networks:
  - frontend
  - backend
depends_on:
  - db
  - redis
deploy:
  mode: replicated
  replicas: 1
  labels: [APP=VOTING]
  restart_policy:
    condition: on-failure
    delay: 10s
    max_attempts: 3
    window: 120s
  placement:
    constraints: [node.role == manager]

visualizer:
  image: dockersamples/visualizer:stable
  ports:
    - "8080:8080"
  stop_grace_period: 1m30s
  volumes:
    - "/var/run/docker.sock:/var/run/docker.sock"
  deploy:
    placement:
      constraints: [node.role == manager]

networks:
  frontend:
  backend:

volumes:
```

db-data:

Dans ce fichier on peut constater 6 services, **redis**, **db**, **vote**, **result**, **worker** et **visualizer**. Les 5 premiers services forment ensemble l'application tandis que le service **visualizer** nous permettra de voir comment l'application a été mise en place.

Dans un premier temps, regardez la clef **deploy** du service **worker** :

```
...
  deploy:
    mode: replicated
    replicas: 1
    labels: [APP=VOTING]
    restart_policy:
      condition: on-failure
      delay: 10s
      max_attempts: 3
      window: 120s
    placement:
      constraints: [node.role == manager]
...
```

La clef **deploy** permet de spécifier des options lors du déploiement du service :

- **mode** - Il existe deux types de services. **Replicated** où on spécifie le nombre d'instances que Docker doit mettre en place sur les hôtes **disponibles** en fonction de la valeur de **replicas** et **Global** qui implique que Docker démarrera une instance du service sur chaque hôte chaque fois qu'un hôte devient disponible.



- **replicas** - spécifie le nombre de replicas
- **restart_policy** spécifie ce qui se passe en cas d'arrêt du service. Dans le cas ci-dessus, docker va essayer de re-démarrer le service **3** fois (**max_attempts**) à des intervalles de **10** secondes (**delay**) en attendant chaque fois **120** secondes (**window**) pour constater si le service s'est effectivement re-démarré,
- **placement** - spécifie où le service doit être démarré.

Déployez maintenant le stack :

```
root@manager:~# docker stack deploy -c docker-stack.yml app
Creating network app_backend
Creating network app_default
Creating network app_frontend
Creating service app_worker
Creating service app_visualizer
Creating service app_redis
Creating service app_db
Creating service app_vote
Creating service app_result
```



Important - Notez que chaque réseau et chaque service a comme préfixe le nom de l'application **app**.

Consultez maintenant l'état du stack :

```
root@manager:~# docker stack ls
NAME                SERVICES    ORCHESTRATOR
app                 6           Swarm
```

Consultez ensuite l'état des services :

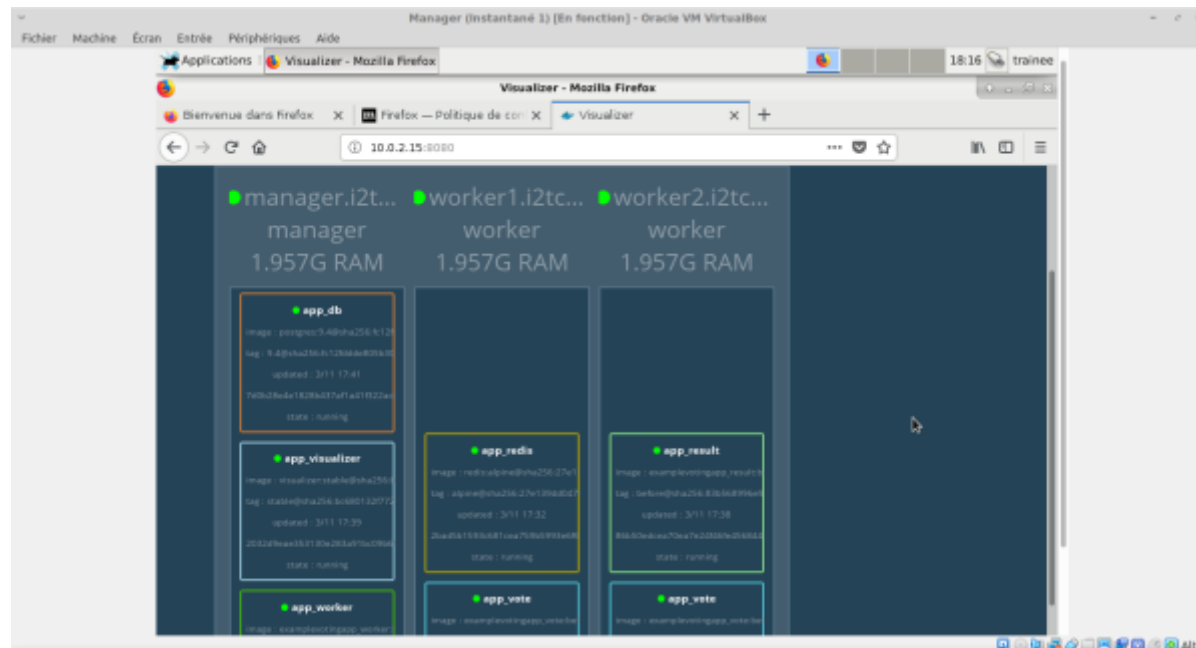
```
root@manager:~# docker service ls
ID                NAME                MODE                REPLICAS            IMAGE
PORTS
d0i4ac4fshw0     app_db              replicated          1/1                  postgres:9.4
funp5kboyip1     app_redis           replicated          1/1                  redis:alpine
dpdkc49oj671     app_result          replicated          1/1
dockersamples/examplevotingapp_result:before *:5001->80/tcp
```

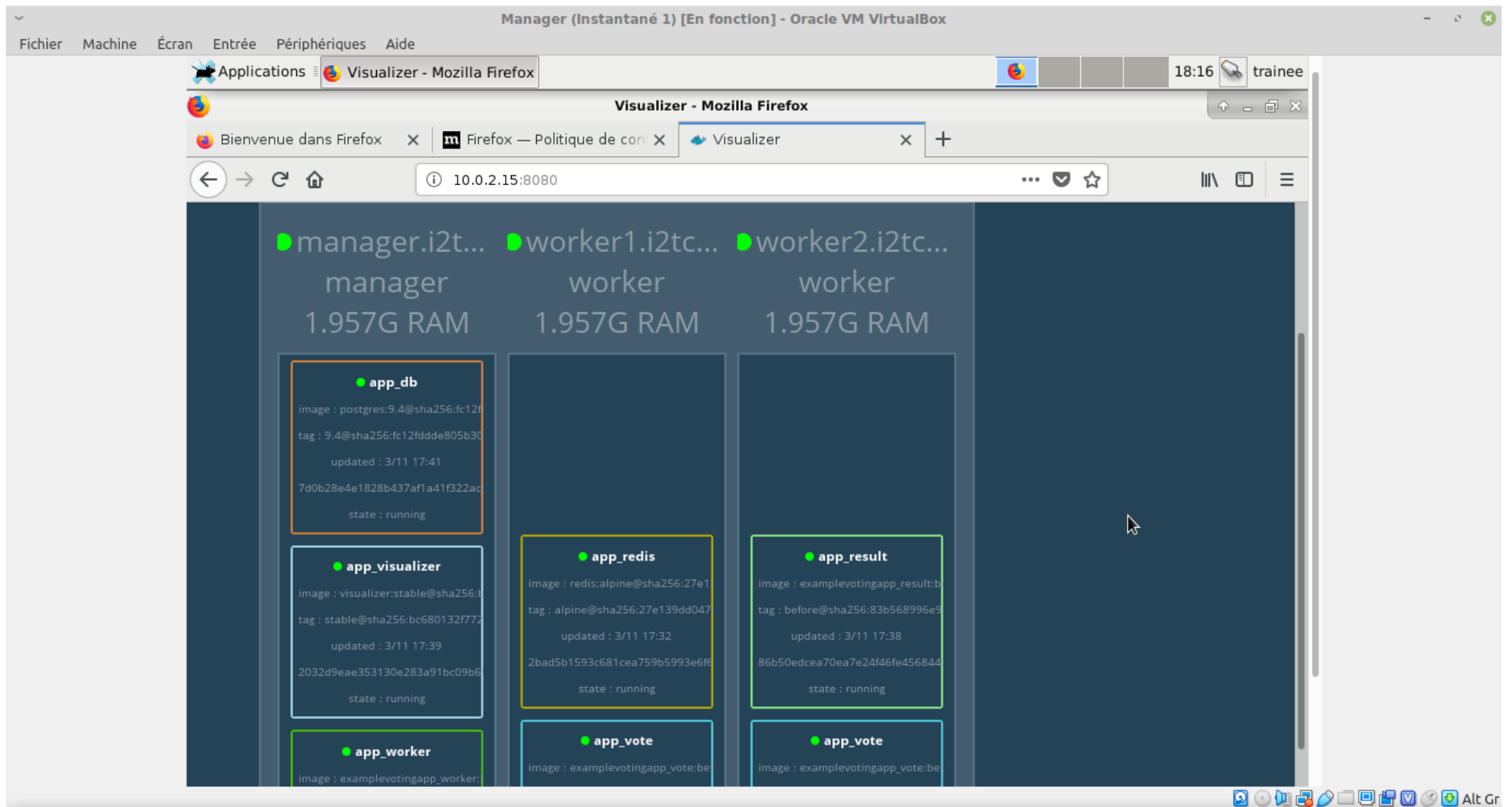
```
vrkahnv38v5mn      app_visualizer      replicated      1/1      dockersamples/visualizer:stable
*:8080->8080/tcp
t4u16cpdrx21       app_vote              replicated      2/2
dockersamples/examplevotingapp_vote:before *:5000->80/tcp
so40eljbcbviy      app_worker            replicated      1/1
dockersamples/examplevotingapp_worker:latest
```



Important : Notez que la configuration du service **visualizer** a exposé le port **8080**. De cette façon, ce service est disponible sur le port 8080 de chaque nœud dans la swarm.

Retournez à la fenêtre d'Apache Guacamole dans le navigateur de **votre** ordinateur. Cliquez sur la connexion **Debian11_10.0.2.46_VNC**. Lancez ensuite un navigateur Internet. Naviguez à l'URL <http://10.0.2.62:8080> et consultez le service **visualizer** :





Comme vous pouvez constater, conformément au fichier **docker-stack.yml**, les trois conteneurs **db**, **worker** et **visualizer** ont été démarrés sur le nœud manager.

Retournez à votre connexion SSH et consultez l'état des réseaux dans les trois nœuds :

```
root@manager:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
sw489bb290zb	app_backend	overlay	swarm
smuxoglyudpo	app_default	overlay	swarm
lfizui95od90	app_frontend	overlay	swarm
24be8a0f0ef5	bridge	bridge	local
d4c9b0c9437a	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
x7l4mk4ldb75	my-ingress	overlay	swarm
de563e30d473	none	null	local



Important : Notez que les trois réseaux créés sont de type **overlay**.

```
root@worker1:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
qhysvpoolsw0	app_frontend	overlay	swarm
f9a69d02de3b	bridge	bridge	local
ee22b3e623ca	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
x7l4mk4ldb75	my-ingress	overlay	swarm
de563e30d473	none	null	local



Important : Notez que seul le réseau **app_frontend** a été créé dans **worker1**.

```
root@worker2:~# docker network ls
```

NETWORK ID	NAME	DRIVER	SCOPE
s4gbgi4ispli	app_backend	overlay	swarm

qhysvpoolsw0	app_frontend	overlay	swarm
0e6c118bf3fd	bridge	bridge	local
0ce1d8369c29	docker_gwbridge	bridge	local
f3cb3bc3c581	host	host	local
x7l4mk4ldb75	my-ingress	overlay	swarm
de563e30d473	none	null	local



Important : Notez que les deux réseaux **app_frontend** et **app_backend** ont été créés dans **worker2**.

Consultez les informations concernant le réseau **app_backend** :

```
root@manager:~# docker inspect app_backend
[
  {
    "Name": "app_backend",
    "Id": "s4gbgi4ispli5wjpgnf4uci2a",
    "Created": "2019-11-03T17:30:56.822222239+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
      "Options": null,
      "Config": [
        {
          "Subnet": "10.0.3.0/24",
          "Gateway": "10.0.3.1"
        }
      ]
    }
  }
],
```

```
"Internal": false,
"Attachable": false,
"Ingress": false,
"ConfigFrom": {
  "Network": ""
},
"ConfigOnly": false,
"Containers": {
  "7d0b28e4e1828b437af1a41f322acb5cf19afc25c42303986dd2c7b4d5aea568": {
    "Name": "app_db.1.s6g6w47k532rvaeoyske8as9i",
    "EndpointID": "c26795c837f6dc736a3f9be34525ae505e9db6381a2144bb62087b3ee6c7ff25",
    "MacAddress": "02:42:0a:00:03:03",
    "IPv4Address": "10.0.3.3/24",
    "IPv6Address": ""
  },
  "ef7227281d297b001bb0f60ac81a0c9926e8fb663a7f43eb201cced632dc5564": {
    "Name": "app_worker.1.38kniuqoelvfyonwdcytlhpqo",
    "EndpointID": "990065eec5062ff159e82bc1e4666fd098d5597439221995af4f01040ab24599",
    "MacAddress": "02:42:0a:00:03:09",
    "IPv4Address": "10.0.3.9/24",
    "IPv6Address": ""
  },
  "lb-app_backend": {
    "Name": "app_backend-endpoint",
    "EndpointID": "913845cbab9a6c3011eaaa87fcc66f10268b5e11554be9f1a20b1078f7b9b8a4",
    "MacAddress": "02:42:0a:00:03:04",
    "IPv4Address": "10.0.3.4/24",
    "IPv6Address": ""
  }
},
"Options": {
  "com.docker.network.driver.overlay.vxlanid_list": "4101"
},
"Labels": {
```

```
    "com.docker.stack.namespace": "app"
  },
  "Peers": [
    {
      "Name": "377986fb7d5a",
      "IP": "10.0.2.62"
    },
    {
      "Name": "5cc4b863da9f",
      "IP": "10.0.2.64"
    }
  ]
}
```



Important : Notez que le réseau est **10.0.3.0/24** et la passerelle **10.0.3.1**.

Consultez les informations concernant le réseau **app_frontend** :

```
root@manager:~# docker inspect app_frontend
[
  {
    "Name": "app_frontend",
    "Id": "qhysvpoolsw0318gsubbvd3rx",
    "Created": "2019-11-03T17:31:27.354293132+01:00",
    "Scope": "swarm",
    "Driver": "overlay",
    "EnableIPv6": false,
    "IPAM": {
      "Driver": "default",
```

```
    "Options": null,
    "Config": [
      {
        "Subnet": "10.0.2.0/24",
        "Gateway": "10.0.2.1"
      }
    ],
    "Internal": false,
    "Attachable": false,
    "Ingress": false,
    "ConfigFrom": {
      "Network": ""
    },
    "ConfigOnly": false,
    "Containers": {
      "ef7227281d297b001bb0f60ac81a0c9926e8fb663a7f43eb201cced632dc5564": {
        "Name": "app_worker.1.38kniuqoelvfyonwdcytlhpqo",
        "EndpointID": "3fad9773920412464b6ae59f8d9ffc5aac2e937b88dc384268591cf7d21fb9",
        "MacAddress": "02:42:0a:00:02:0a",
        "IPv4Address": "10.0.2.10/24",
        "IPv6Address": ""
      },
      "lb-app_frontend": {
        "Name": "app_frontend-endpoint",
        "EndpointID": "343887373c1f92ac08b271ee52dd160089eeed7cad13b7924e438919254b6442",
        "MacAddress": "02:42:0a:00:02:0b",
        "IPv4Address": "10.0.2.11/24",
        "IPv6Address": ""
      }
    },
    "Options": {
      "com.docker.network.driver.overlay.vxlanid_list": "4100"
    },
  },
```

```
  "Labels": {
    "com.docker.stack.namespace": "app"
  },
  "Peers": [
    {
      "Name": "0e21ba1bbfab",
      "IP": "10.0.2.63"
    },
    {
      "Name": "5cc4b863da9f",
      "IP": "10.0.2.64"
    },
    {
      "Name": "377986fb7d5a",
      "IP": "10.0.2.62"
    }
  ]
}
```



Important : Notez que le réseau est **10.0.2.0/24** et la passerelle **10.0.2.1**.

Consultez les informations concernant le réseau **app_default** :

```
root@manager:~# docker inspect app_default
[
  {
    "Name": "app_default",
    "Id": "z62t49w18wl2mrboa92tunrhq",
    "Created": "2019-10-28T17:22:44.724040846+01:00",
```

```
"Scope": "swarm",
"Driver": "overlay",
"EnableIPv6": false,
"IPAM": {
  "Driver": "default",
  "Options": null,
  "Config": [
    {
      "Subnet": "10.0.1.0/24",
      "Gateway": "10.0.1.1"
    }
  ]
},
"Internal": false,
"Attachable": false,
"Ingress": false,
"ConfigFrom": {
  "Network": ""
},
"ConfigOnly": false,
"Containers": {
  "2032d9eae353130e283a91bc09b65b4a84b7e8f5602a466f4ea1bd9c64e964dc": {
    "Name": "app_visualizer.1.nbf78cn5g37dmu0fwrxt7kbrg",
    "EndpointID": "d5274ff057c9d9af0288efb7f9bfed3a5ca1b3e656e265ad343f52c0b1c161f5",
    "MacAddress": "02:42:0a:00:01:03",
    "IPv4Address": "10.0.1.3/24",
    "IPv6Address": ""
  },
  "lb-app_default": {
    "Name": "app_default-endpoint",
    "EndpointID": "6afb8909d94528633e4150054311f645790280b1ab1c686c43e865ba97ec3df9",
    "MacAddress": "02:42:0a:00:01:04",
    "IPv4Address": "10.0.1.4/24",
    "IPv6Address": ""
  }
}
```

```
    }
  },
  "Options": {
    "com.docker.network.driver.overlay.vxlanid_list": "4099"
  },
  "Labels": {
    "com.docker.stack.namespace": "app"
  },
  "Peers": [
    {
      "Name": "377986fb7d5a",
      "IP": "10.0.2.62"
    }
  ]
}
```



Important : Notez que le réseau est **10.0.1.0/24** et la passerelle **10.0.1.1**.

Schématiquement, la mise en place de l'application dans le Swarm est ainsi :



Dernièrement, supprimez le stack :

```
root@manager:~# docker stack ls
NAME          SERVICES    ORCHESTRATOR
app           6           Swarm

root@manager:~# docker stack rm app
Removing service app_db
Removing service app_redis
Removing service app_result
Removing service app_visualizer
```

```
Removing service app_vote
Removing service app_worker
Removing network app_frontend
Removing network app_backend
Removing network app_default

root@manager:~# docker ps -a
CONTAINER ID      IMAGE      COMMAND      CREATED      STATUS
PORTS            NAMES
d02c6115724c     alpine     "/bin/sh"    6 days ago   Exited (0) 6 days ago
alpine1
```