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Deploy OpendayLight using Helm charts

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Agenda

- Overview
- Use cases and motivation
- OpendayLight Docker Container
- OpendayLight Helm Charts
- OpendayLight on K8s clusters
- OpendayLight Clustering
- CI Integration and deployment (JJB Templates)
- Future enhancements and use cases
- Improvements
- Discussion

Overview

- Deploy OpendayLight (ODL) as a docker container.
- ODL Container releases are available on Sonatype Nexus 3 (since Silicon SR2 14.2 release).
- Helm charts are created to deploy the ODL container on Kubernetes (K8s) clusters
- Using COE (Cloud Orchestration Engine), Openstack Magnum API.
- CI/CD jobs templates.

Use cases and motivation

- ODL presence on the microservices platform.
- Learnability for new users (containers, microk8s, docker compose, multi-node K8s).
- Deploy ODL in K8S environment which makes the ODL service seamless and available.
- Ease the deployment of the ODL cluster.

ODL Docker container

- Base image is `openjdk:11-jdk-slim` (429 MiB).
- Docker build off existing ODL distribution release artifacts (400 MiB uncompressed) opendaylight-${ODL_VERSION}.tar.gz
- Combined image was ~1 GiB
- jlink is used to remove redundant java modules.
- Final image size ~512 MiB.
- Override default ODL feature (odl-restconf) by passing an ENV variable "FEATURES"

ODL Docker container

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Start an ODL instance (Silicon SR2) with docker:

```
# docker login nexus3.opendaylight.org:10001

# docker pull
nexus3.opendaylight.org:10001/opendaylight/opendaylight:14.2.0

# docker run -d -p 8181:8181 --env
FEATURES=odl-restconf,odl-netconf-topology opendaylight:14.2.0
```

ODL Docker container

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Ports:

TCP	1790	BGP
TCP	2550	CLUSTER
TCP	2830	NETCONF NB
TCP	4189	PCEP
TCP	6633	OPENFLOW
TCP	6640	OVSDB
TCP	6653	OPENFLOW
TCP	6666	NETCONF CALLHOME SERVER
TCP	8101	KARAF SHELL
TCP	8181	RESTCONF
TCP	8185	WEBSOCKETS
TCP	12345	BMP
UDP	4342	LISP

Operationalize ODL in Production

- Containerize ODL provides a consistent runtime environment, but…
- No self-healing if hosting OS partition fills up
- Can’t recover if other processes outside the ODL consumes all physical memory.
- Deterministic hardware failure.
- Non-deterministic hardware failure.
- Running a hybrid environment, ODL on standalone VM and rest of business API in Kubernetes.

ODL Helm Charts

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- Goal is to support stateful ODL deployment on Kubernetes.
- Define a standard set of configurable parameter for ODL.
- Customize using values.yaml or using --set flag.
  - Tunable Java memory options and GC options.
  - Support persistence volume storage class or emptyDir volume.
  - Different version of ODL docker images.
  - Image pull secret.
  - ODL features.
  - Node selector and affinity.
- When using remote persistence volume (e.g. ceph storage class), ODL can recover on failed worker node by kubernetes on different node over same volume.
- Stateful Set, with predictable pod name during scaling.

ODL Helm Charts

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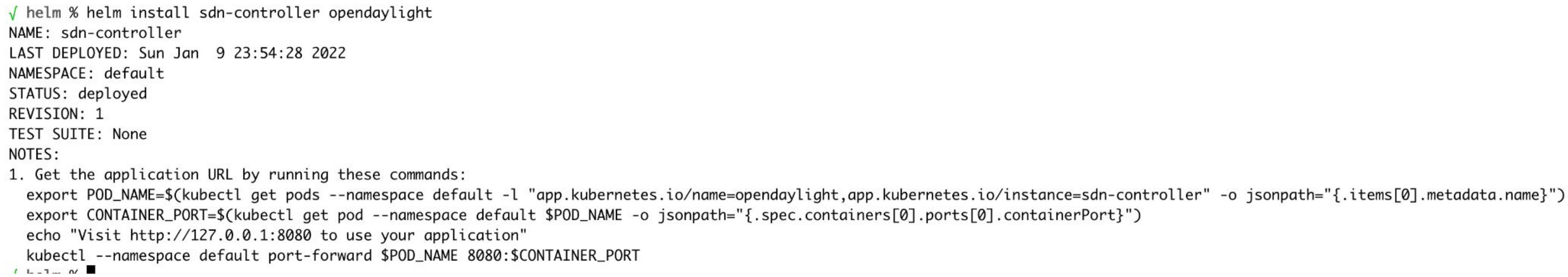
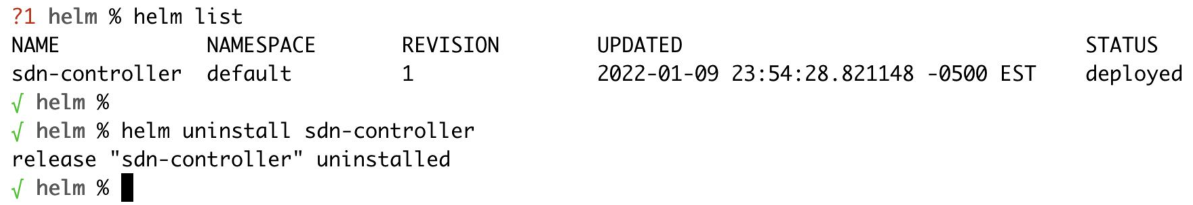
Create single ODL instance



```
√ helm % helm install sdn-controller opendaylight
NAME: sdn-controller
LAST DEPLOYED: Sun Jan  9 23:54:28 2022
NAMESPACE: default
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
1. Get the application URL by running these commands:
  export POD_NAME=$(kubectl get pods --namespace default -l "app.kubernetes.io/name=opendaylight,app.kubernetes.io/instance=sdn-controller" -o jsonpath="{.items[0].metadata.name}")
  export CONTAINER_PORT=$(kubectl get pod --namespace default $POD_NAME -o jsonpath="{.spec.containers[0].ports[0].containerPort}")
  echo "Visit http://127.0.0.1:8080 to use your application"
  kubectl --namespace default port-forward $POD_NAME 8080:$CONTAINER_PORT
√ helm %
```

Uninstall ODL instance



```
?1 helm % helm list
NAME            NAMESPACE       REVISION        UPDATED                                 STATUS
sdn-controller  default         1               2022-01-09 23:54:28.821148 -0500 EST    deployed
√ helm %
√ helm % helm uninstall sdn-controller
release "sdn-controller" uninstalled
√ helm %
```

ODL Clustering

Motivation:

- Deploying ODL in a kubernetes cluster for Higher Availability.
- Ease of deploying a scaled-up ODL cluster by updating replica-count in values.yaml

Opendaylight uses Akka based Clustering between different ODL instances. However setting up a clustering environment in ODL takes manual effort to configure different instances inside a cluster. For details, see here.

Using Helm and Kubernetes, the process is now automated by deploying various ODL instances as pods running inside Kubernetes environment in an Akka based cluster.

This is accomplished by configuring the cluster dynamically on deployment.

› List of nodes is determined using the service FQDN and relying on Kubernetes statefulset to generate consecutive ordinal numbers for each of the replica's created. This list is then passed on to the configure_cluster script to configure each instance during deployment.
› akka.conf is also dynamically updated with the unique 'member-IDs' and 'seed-nodes' based on each of the pods (ODL nodes) unique FQDN
› Each karaf instance is then restarted to take into account this updated configuration.

ODL Clustering

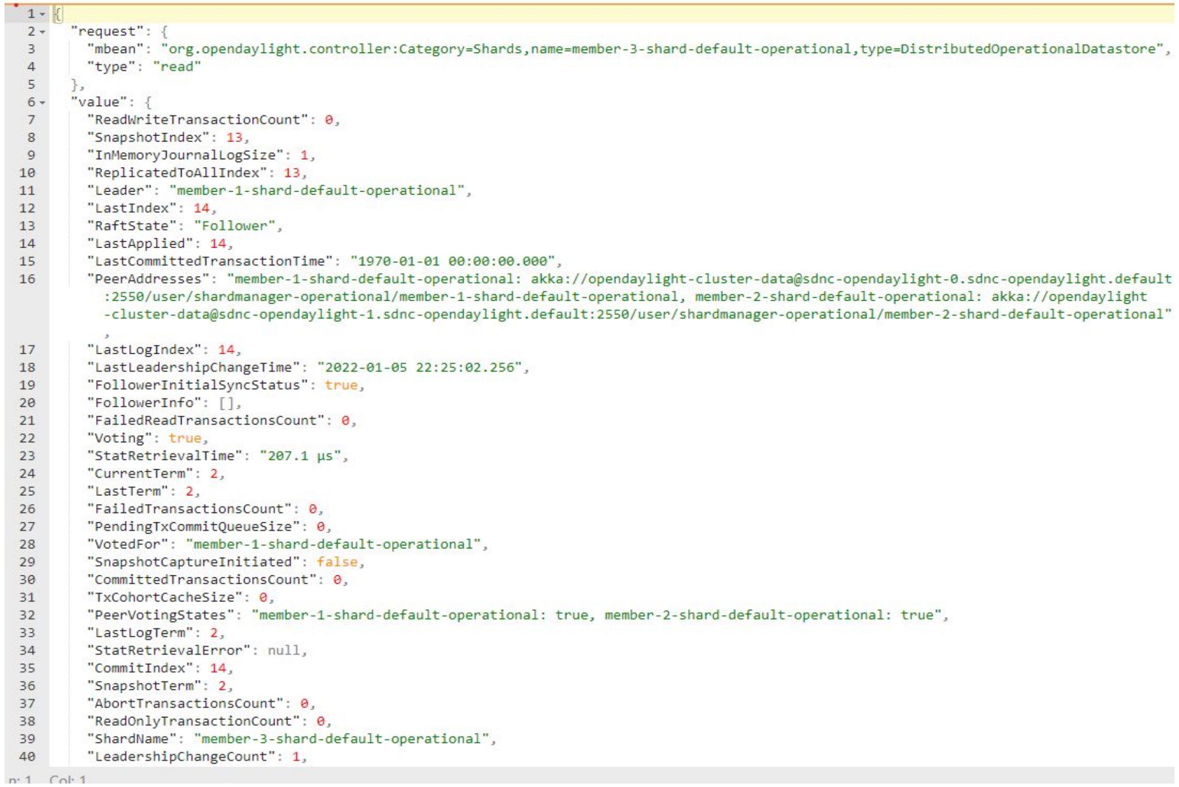
To install ODL-cluster

$ helm install sdnc opendaylight --set **replicaCount**=3 --set **config.isClusterDeployment**=true --set **autoscaling.enabled**=false

```
$ kubectl  get pods
NAME                 READY   STATUS    RESTARTS   AGE
sdnc-opendaylight-1   1/1     Running     0           25m
sdnc-opendaylight-2   1/1     Running     0           25m
sdnc-opendaylight-0   1/1     Running     0           25m
```

To uninstall ODL-cluster

$ helm uninstall sdnc



```
{
  "request": {
    "mbean": "org.opendaylight.controller:Category=Shards,name=member-3-shard-default-operational,type=DistributedOperationalDatastore",
    "type": "read"
  },
  "value": {
    "ReadWriteTransactionCount": 0,
    "SnapshotIndex": 13,
    "InMemoryJournalLogSize": 1,
    "ReplicatedToAllIndex": 13,
    "Leader": "member-1-shard-default-operational",
    "LastIndex": 14,
    "RaftState": "Follower",
    "LastApplied": 14,
    "LastCommittedTransactionTime": "1970-01-01 00:00:00.000",
    "PeerAddresses": "member-1-shard-default-operational: akka://opendaylight-cluster-data@sdnc-opendaylight-0.sdnc-opendaylight.default
      :2550/user/shardmanager-operational/member-1-shard-default-operational, member-2-shard-default-operational: akka://opendaylight
      -cluster-data@sdnc-opendaylight-1.sdnc-opendaylight.default:2550/user/shardmanager-operational/member-2-shard-default-operational"
      ,
    "LastLogIndex": 14,
    "LastLeadershipChangeTime": "2022-01-05 22:25:02.256",
    "FollowerInitialSyncStatus": true,
    "FollowerInfo": [],
    "FailedReadTransactionsCount": 0,
    "Voting": true,
    "StatRetrievalTime": "207.1 µs",
    "CurrentTerm": 2,
    "LastTerm": 2,
    "FailedTransactionsCount": 0,
    "PendingTxCommitQueueSize": 0,
    "VotedFor": "member-1-shard-default-operational",
    "SnapshotCaptureInitiated": false,
    "CommittedTransactionsCount": 0,
    "TxCohortCacheSize": 0,
    "PeerVotingStates": "member-1-shard-default-operational: true, member-2-shard-default-operational: true",
    "LastLogTerm": 2,
    "StatRetrievalError": null,
    "CommitIndex": 14,
    "SnapshotTerm": 2,
    "AbortTransactionsCount": 0,
    "ReadOnlyTransactionCount": 0,
    "ShardName": "member-3-shard-default-operational",
    "LeadershipChangeCount": 1,
```

CI Integration - K8S deploy template and macro

- CI - Jenkins, Nexus3 (Docker and Helm Repo)
- Openstack Magnum API and JJB
- JJB templates are built over the K8s cluster templates
- Released artifacts (Containers and Helm Charts) are available on ODL Nexus 3.
- Job templates are designed with the flexibility to create a K8s cluster setup and pass a custom script from the job definition. The custom script can contain the required test that can be run on the pod running ODL.

CI Jobs - ODL Docker

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ODL Docker Jobs:

Templates: global-jjb/jjb/lf-docker-jobs

- "{project-name}-gerrit-docker-jobs"
- "{project-name}-gerrit-release-jobs"

Jobs: releng/builder/jjb/packaging

- packaging-odl-docker

CI Jobs - ODL Helm Charts

ODL Helm Charts K8S templates and Jobs:

- Template: jjb/packaging/openstack-k8s.yaml
  - {project-name}-k8s-odl-deploy-test (uses K8S cluster templates k8s-1.8.1)
    - lf-k8s-cluster-create-with-template
    - lf-k8s-cluster-deploy
    - lf-k8s-cluster-cleanup
- Jobs: jjb/packaging/
  - "packaging-k8s"
    - Inputs: helm version, master count/type, node count/type, container registry, deploy script.
- Test job:
  - https://jenkins.opendaylight.org/releng/view/packaging/job/packaging-k8s-odl-deploy-test/5/

CI - Scope of improvement

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- Allow configuration script to be passed to the cluster setup to work with different use cases.
- Documentation
- Tox for helm charts
- Migrate the job templates to releng/global-jjb

Future use cases

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- Migrate some CSIT (2node, 3node tests) to work with ODL docker/K8s cluster setup.
- Dynamic scalability of ODL.

Resources

ODL containers and Helm Charts source:

https://git.opendaylight.org/gerrit/integration/packaging

Jenkins CI Jobs (jjb/packaging)

https://git.opendaylight.org/gerrit/releng/builder

Openstack Magnum API

https://docs.openstack.org/magnum/latest/user

ODL Docker/Helm Charts weekly meeting (1:30pm-2:30pm PST)

https://lists.opendaylight.org/g/app-dev/message/977

Questions