

# 1 Hinweise

```
# Zugriff auf ozone cli
ozone fs

# Beispielsyntax
ozone sh <object> <operation> <--Parameter> /Pfad/Zu/Datei
ozone sh bucket create --enforcegdpr=true /demo/bucketencr

# Hilfe zu Befehlen
# Objekte: volume, bucket, key, snapshot
# Operation: delete, create, list, put, info
ozone sh <object> <operation> --help

# Bash Umgebung einer bestimmten Docker Instanz öffnen
docker exec -it <ContainerName> bash
# z.B. docker exec -it docker_ozone-om-1 bash
# z.B. docker exec -it docker_ozone-datanode-2 bash

ozone version
```

## 2 Übungen

### 2.1 Erstellen von Objekten

- Erstellen eines Volume namens demo

```
ozone sh volume create /demo
```

- Liste von Volumes anzeigen lassen

```
ozone sh volume list
```

```
[ {
  "metadata" : { },
  "name" : "s3v",
  "admin" : "hadoop",
  "owner" : "hadoop",
  "quotaInBytes" : -1,
  "quotaInNamespace" : -1,
```

```

"usedNamespace" : 0,
"creationTime" : "2025-02-05T20:57:54.879Z",
"modificationTime" : "2025-02-05T20:57:54.879Z",
"acls" : [ {
  "type" : "USER",
  "name" : "hadoop",
  "aclScope" : "ACCESS",
  "aclList" : [ "ALL" ]
}, {
  "type" : "GROUP",
  "name" : "hadoop",
  "aclScope" : "ACCESS",
  "aclList" : [ "ALL" ]
} ],
"refCount" : 0
}, {
  "metadata" : { },
  "name" : "demo",
  "admin" : "hadoop",
  "owner" : "hadoop",
  "quotaInBytes" : -1,
  "quotaInNamespace" : -1,
  "usedNamespace" : 0,
  "creationTime" : "2025-02-05T21:14:10.675Z",
  "modificationTime" : "2025-02-05T21:14:10.675Z",
  "acls" : [ {
    "type" : "USER",
    "name" : "hadoop",
    "aclScope" : "ACCESS",
    "aclList" : [ "ALL" ]
  }, {
    "type" : "GROUP",
    "name" : "hadoop",
    "aclScope" : "ACCESS",
    "aclList" : [ "ALL" ]
  } ],
  "refCo

```

- Erstellen eines Buckets: `bucket1`

```
ozone sh bucket create /demo/bucket1
```

- Erstellen und hochladen einer Datei in `/demo/bucket1`
- z.B. `hello.text`

```
echo "Hello Ozone" > hello.txt
```

```
ozone sh key put /demo/bucket1/hello.txt hello.txt
```

- Ausgabe der Dateien des Buckets `bucket1`

```
ozone sh key list /demo/bucket1
```

```
[ {  
  "volumeName" : "demo",  
  "bucketName" : "bucket1",  
  "name" : "hello.txt",  
  "dataSize" : 12,  
  "creationTime" : "2025-02-05T21:15:18.852Z",  
  "modificationTime" : "2025-02-05T21:15:20.105Z",  
  "replicationConfig" : {  
    "replicationFactor" : "THREE",  
    "requiredNodes" : 3,  
    "replicationType" : "RATIS"  
  },  
  "metadata" : { },  
  "file"
```

## 2.2 Dateien herunterladen

- Herunterladen der Datei mit dem Operator `get`

```
ozone sh key get /demo/bucket1/hello.txt downloaded.txt
```

```
cat downloaded.txt
```

## 2.3 GDPR Compliant Buckets

- Erstelle ein Bucket `bucketencr` im Volume `demo`, welches Keys nur verschlüsselt abspeichert

```
ozone sh bucket create --enforcegdpr=true /demo/bucketencr
```

- Erstelle in diesem Bucket eine Datei (Key)

```
echo "Verschlüsselte Datei" > encr_file.txt
```

```
ozone sh key put /demo/bucketencr/encr_file.txt encr_file.txt
```

```
ozone sh key list /demo/bucketencr
```

```
[ {  
  "volumeName" : "demo",  
  "bucketName" : "bucketencr",  
  "name" : "encr_file.txt",  
  "dataSize" : 32,  
  "creationTime" : "2025-02-05T21:17:06.946Z",  
  "modificationTime" : "2025-02-05T21:17:08.188Z",  
  "replicationConfig" : {  
    "replicationFactor" : "THREE",  
    "requiredNodes" : 3,  
    "replicationType" : "RATIS"  
  },  
  "metadata" : { },  
  "file" : true  
} ]
```

- Mit dem `info` Operator können Informationen über Objekte wie Buckets, Keys oder Volumes ausgegeben werden

```
ozone sh key info /demo/bucketencr/encr_file.txt
```

```
ozone sh bucket info /demo/bucketencr
```

```
ozone sh volume info /demo
```

- Dabei wird die Stelle gesucht, bei der die GDPR Verschlüsselung im Objekt markiert ist.

```
{  
  "volumeName" : "demo",  
  "bucketName" : "bucketencr",  
  "name" : "encr_file.txt",  
  "dataSize" : 32,  
  "creationTime" : "2025-02-05T21:17:06.946Z",
```

```

"modificationTime" : "2025-02-05T21:17:08.188Z",
"replicationConfig" : {
  "replicationFactor" : "THREE",
  "requiredNodes" : 3,
  "replicationType" : "RATIS"
},
"metadata" : {
  "gdprEnabled" : "true"
},
"ozoneKeyLocations" : [ {
  "containerID" : 2,
  "localID" : 115816896921600002,
  "length" : 32,
  "offset" : 0,
  "keyOffset" : 0
} ],
"file" : true
}

```

```

{
  "metadata" : {
    "gdprEnabled" : "true"
  },
  "volumeName" : "demo",
  "name" : "bucketencr",
  "storageType" : "DISK",
  "versioning" : false,
  "usedBytes" : 96,
  "usedNamespace" : 1,
  "creationTime" : "2025-02-05T21:16:33.756Z",
  "modificationTime" : "2025-02-05T21:16:33.756Z",
  "sourcePathExist" : true,
  "quotaInBytes" : -1,
  "quotaInNamespace" : -1,
  "bucketLayout" : "FILE_SYSTEM_OPTIMIZED",
  "owner" : "hadoop",
  "link" : false
}

```

- Lade die verschlüsselte Datei aus dem Bucket `bucketencr` Datei herunter. Die Datei wird dabei wieder entschlüsselt.

```
ozone sh key get /demo/bucketencr/encr_file.txt downloaded_decr.txt
```

```
cat downloaded_decr.txt
```

## 2.4 Inspektion von Datanodes

- Schaue, dir die Datanodes auf der Command Line an

```
ozone admin datanode list
```

```
Datanode: c404f568-ef38-4fd2-b921-c77e8bc56a84 (/default-  
rack/172.18.0.8/docker_ozone-datanode-2.docker_ozone_default/3 pipelines)  
Operational State: IN_SERVICE  
Health State: HEALTHY  
Related pipelines:  
7d020f25-52ed-4a91-8926-730a0009ede9/RATIS/THREE/RATIS/OPEN/Follower  
4c901574-8279-44a5-b56c-88d1e29b9849/RATIS/THREE/RATIS/OPEN/Leader  
9728179c-561b-4dc8-bd9a-b0be6fbfb84/RATIS/ONE/RATIS/OPEN/Leader
```

```
Datanode: d8a08097-a3ae-49c3-a049-c71f296b8e50 (/default-  
rack/172.18.0.7/docker_ozone-datanode-3.docker_ozone_default/3 pipelines)  
Operational State: IN_SERVICE  
Health State: HEALTHY  
Related pipelines:  
92004a07-bf68-4095-80e6-a90f1cc68b52/RATIS/ONE/RATIS/OPEN/Leader  
7d020f25-52ed-4a91-8926-730a0009ede9/RATIS/THREE/RATIS/OPEN/Leader  
4c901574-8279-44a5-b56c-88d1e29b9849/RATIS/THREE/RATIS/OPEN/Follower
```

```
Datanode: 34c93f7d-78d0-4e71-80a9-6b1cdf4e1a61 (/default-  
rack/172.18.0.2/docker_ozone-datanode-1.docker_ozone_default/3 pipelines)  
Operational State: IN_SERVICE  
Health State: HEALTHY  
Related pipelines:  
7d020f25-52ed-4a91-8926-730a0009ede9/RATIS/THREE/RATIS/OPEN/Follower  
4c901574-8279-44a5-b56c-88d1e29b9849/RATIS/THREE/RATIS/OPEN/Follower  
f329fb2c-2513-4e17-92c6-6077f06ee657/RATIS/ONE/RATIS/OPEN/Leader
```

- Öffne Bash auf der Instanz eines Datanodes
  - Öffne dazu ein neues Terminal und verbinde dich via Bash mit einem Datanode:

```
docker exec -it <Containername> bash  
# z.B. docker exec -it docker_ozone-datanode-2 bash
```

- Oder gehe auf einen Datanode in Docker und wähle "Open in terminal"

- Schau dir unter `/data/hdds` die Blöcken sowie Metadata an
- Finde die physischen Blöcke der verschlüsselten und entschlüsselten Dateien

```
cat /data/hdds.../chunks
cat /data/hdds.../netadata
ls /data/hdds....
```

```
cat /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/1/chunks/115816896921600001.block
# Hello Ozone
cat /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/2/chunks/115816896921600002.block
#G. & z B , ^ y I ) 4
```

```
cat /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/1/metadata/1.container
```

```
!<KeyValueContainerData>
checksum: ee5a395709419205cf13262fcee5047b42e06df7b33f7cb27a6e29bf7e3cfae
chunksPath: /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/1/chunks
containerDBType: RocksDB
containerID: 1
containerType: KeyValueContainer
layOutVersion: 2
maxSize: 5368709120
metadata: {}
metadataPath: /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/1/metadata
originNodeId: c404f568-ef38-4fd2-b921-c77e8bc56a84
originPipelineId: 4c901574-8279-44a5-b56c-88d1e29b9849
schemaVersion: '3'
state: OPEN
```

```
cat /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/2/metadata/2.container
```

```
!<KeyValueContainerData>
checksum: 39c9991301dd4b1fa2e4019772f0765061c81b61befd11985f1d8dd9b5c41447
chunksPath: /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/2/chunks
containerDBType: RocksDB
containerID: 2
containerType: KeyValueContainer
layOutVersion: 2
```

```
maxSize: 5368709120
metadata: {}
metadataPath: /data/hdds/hdds/CID-8308d28b-f974-41d7-a5aa-
ad6bd51384e9/current/containerDir0/2/metadata
originNodeId: c404f568-ef38-4fd2-b921-c77e8bc56a84
originPipelineId: 7d020f25-52ed-4a91-8926-730a0009ede9
schemaVersion: '3'
state: OPEN
```

## 2.5 Ozone Snapshots

- Lade eine Datei in /demo/bucket1

```
echo "Snapshot 1" > snapshot1.txt
```

```
ozone sh key put /demo/bucket1/snapshot1.txt snapshot1.txt
```

- Erstelle einen Snapshot des Buckets /demo/bucket1

```
ozone sh snapshot create /demo/bucket1
```

- Lade eine zweite Datei hoch

```
echo "Snapshot 2" > snapshot2.txt
```

```
ozone sh key put /demo/bucket1/snapshot2.txt snapshot2.txt
```

- Erstelle einen zweiten Snapshot von Bucket in /demo/bucket1

```
ozone sh snapshot create /demo/bucket1
```

- Anzeigen einer Liste aller Snapshots in Bucket /demo/bucket1 mit snapshot + list Operator

```
ozone sh snapshot list /demo/bucket1
```

```
[ {
  "volumeName" : "demo",
  "bucketName" : "bucket1",
```



```

"name" : "s20250205-212329.265",
"creationTime" : 1738790609265,
"snapshotStatus" : "SNAPSHOT_ACTIVE",
"snapshotId" : "dedcdc55-d6fa-483d-a38e-23fb10b0638e",
"snapshotPath" : "demo/bucket1",
"checkpointDir" : "-dedcdc55-d6fa-483d-a38e-23fb10b0638e",
"referencedSize" : 69,
"referencedReplicatedSize" : 69,
"exclusiveSize" : 0,
"exclusiveReplicatedSize" : 0
}, {
  "volumeName" : "demo",
  "bucketName" : "bucket1",
  "name" : "s20250205-212504.358",
  "creationTime" : 1738790704358,
  "snapshotStatus" : "SNAPSHOT_ACTIVE",
  "snapshotId" : "c9f3c324-fa73-40a0-8c76-901fa1dfcd90",
  "snapshotPath" : "demo/bucket1",
  "checkpointDir" : "-c9f3c324-fa73-40a0-8c76-901fa1dfcd90",
  "referencedSize" : 102,
  "referencedReplicatedSize" : 102,
  "exclusiveSize" : 0,
  "exclusiveReplicatedSize" : 0
} ]

```

- Zeige die Unterschiede zwischen zwei Snapshots mit `snapshot diff` an

```
ozone sh snapshot diff /demo/bucket1 <NameSnapshot1> <NameSnapshot2>
```

Difference between snapshot: s20250205-212329.265 and snapshot: s20250205-212504.358

```
+      ./snapshot2.txt
```

- Anzeige der Infos eines Snapshot

```
ozone sh snapshot info /demo/bucket1 s20250205-030511.101
```

```

{
  "volumeName" : "demo",
  "bucketName" : "bucket1",
  "name" : "s20250205-212504.358",
  "creationTime" : 1738790704358,
  "snapshotStatus" : "SNAPSHOT_ACTIVE",

```

```
"snapshotId" : "c9f3c324-fa73-40a0-8c76-901fa1dfcd90",
"snapshotPath" : "demo/bucket1",
"checkpointDir" : "-c9f3c324-fa73-40a0-8c76-901fa1dfcd90",
"referencedSize" : 102,
"referencedReplicatedSize" : 102,
"exclusiveSize" : 0,
"exclusiveReplicatedSize" : 0
}
```

## 2.6 Quota

- Erstelle ein neues volume `demoqu` mit der Einschränkung bezüglich der Namen (Maximum 2)

```
ozone sh volume create --namespace-quota 2 /demoqu
```

- Versuche 3 Buckets in diesem Volume zu erstellen

```
ozone sh bucket create /demoqu/bucket1
ozone sh bucket create /demoqu/bucket2
ozone sh bucket create /demoqu/bucket3
```

- Beim Erstellen wird ein Fehler auftreten, da nur 2 Buckets in diesem Volume erlaubt sind

```
QUOTA_EXCEEDED The namespace quota of Volume:demoqu exceeded:
quotaInNamespace: 2 but namespace consumed: 3.
```

- Kontrolliere die tatsächlich und die erlaubte Anzahl der Namespaces für das Volume

```
ozone sh volume info /demoqu
```

```
{
  "metadata" : { },
  "name" : "demoqu",
  "admin" : "hadoop",
  "owner" : "hadoop",
  "quotaInBytes" : -1,
  "quotaInNamespace" : 2,
  "usedNamespace" : 2,
  "creationTime" : "2025-02-05T21:27:04.509Z",
  "modificationTime" : "2025-02-05T21:27:04.509Z",
```

```

    "acls" : [ {
      "type" : "USER",
      "name" : "hadoop",
      "aclScope" : "ACCESS",
      "aclList" : [ "ALL" ]
    }, {
      "type" : "GROUP",
      "name" : "hadoop",
      "aclScope" : "ACCESS",
      "aclList" : [ "ALL" ]
    } ],
    "refCount" : 0
  }
}

```

- Erhöhe die Anzahl der Buckets im Volume auf 5 mit `setquota`
- Danach kann ein neues Bucket ohne Fehlermeldung erstellt werden

```
bin/ozone sh volume setquota --namespace-quota 10 /demoqu
```

- Versuche jetzt ein drittes Bucket zu erstellen

```
ozone sh bucket create /demoqu/bucket3
```

## 2.7 Ozone Insight

### Use Ozone Insight

- Zeige Komponenten an

```
ozone insight list
```

scm.node-manager	SCM Datanode management related
information.	
scm.replica-manager	SCM closed container replication manager
scm.event-queue	Information about the internal async
event delivery	
scm.protocol.block-location	SCM Block location protocol endpoint
scm.protocol.heartbeat	SCM Datanode protocol endpoint
scm.protocol.container-location	SCM Container location protocol endpoint
scm.protocol.security	SCM Block location protocol endpoint
om.key-manager	OM Key Manager
om.protocol.client	Ozone Manager RPC endpoint

<code>datanode.pipeline</code>	More information about one ratis datanode ring.
<code>datanode.dispatcher</code>	Datanode request dispatcher (after Ratis replication)

- Benutze `ozone insight metrics` um dir Metriken zu verschiedenen Komponenten anzuschauen (z.B. Heartbeat)

```
ozone insight metrics scm.protocol.block-location
```

Metrics for `'scm.protocol.block-location'` (SCM Block location protocol endpoint)

RPC connections

Open connections: 0  
Dropped connections: 0  
Received bytes: 5261  
Sent bytes: 44652

RPC queue

RPC average queue time: 0.0  
RPC call queue length: 0

RPC performance

RPC processing time average: 1.0  
Number of slow calls: 0

Message type counters

Number of AllocateScmBlock calls: 4  
Number of DeleteScmKeyBlocks calls: 0  
Number of GetScmInfo calls: 2  
Number of SortDatanodes calls: 3  
Number of AddScm calls: 0

- Stelle eine Verbindung mit `ozone insight logs` zum Client Protokoll Service her

```
ozone insight logs om.protocol.client
```

- In einem anderen Terminal sollen jetzt Daten an ein beliebiges Bucket gesendet werden.

```
docker exec -it docker_ozone-datanode-2 bash
```

```
ozone sh volume create /demo
```

```
echo "Hello Ozone" > hello.txt
```

```
ozone sh key put /demo/bucket1/hello.txt hello.txt
```

- Im ersten Terminal können jetzt die Ereignisse verfolgt werden

```
[OM] 2025-02-05 21:33:19,367
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol ServiceList request is received
[OM] 2025-02-05 21:33:19,556
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol CreateVolume request is received
[OM] 2025-02-05 21:33:27,346
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol ServiceList request is received
[OM] 2025-02-05 21:33:27,525
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol InfoVolume request is received
[OM] 2025-02-05 21:33:27,539
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol InfoBucket request is received
[OM] 2025-02-05 21:33:27,577
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol CreateKey request is received
[OM] 2025-02-05 21:33:28,818
[DEBUG|org.apache.hadoop.ozone.protocolPB.OzoneManagerProtocolServerSideTranslatorPB|OzoneProtocolMessageDispatcher] OzoneProtocol CommitKey request is received
```