



使用**Trident Protect** 保護數據

NetApp public and hybrid cloud solutions

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使用Trident Protect 保護數據

使用Trident Protect 為 OpenShift 容器平台中的容器應用程式提供資料保護

參考文件的此部分提供了使用Trident保護建立容器應用程式的快照和備份的詳細資訊。NetApp Trident Protect 提供進階應用程式資料管理功能，可增強由NetApp ONTAP儲存系統和NetApp Trident CSI 儲存設定器支援的有狀態 Kubernetes 應用程式的功能和可用性。Trident Protect 會建立應用程式快照和備份，這意味著不僅建立持久磁碟區中的應用程式資料的快照和備份，還可以建立應用程式元資料的快照和備份。Trident Protect 建立的快照和備份可以儲存在以下任何物件儲存中，並在稍後從中還原。

- AWS S3
- Azure Blob 儲存
- Google 雲端儲存
- Ontap S3
- 儲存網格
- 任何其他 S3 相容存儲

Trident Protect 使用基於角色的存取控制 (RBAC) 的 Kubernetes 模型。預設情況下，Trident Protect 提供一個名為 trident-protect 的單一系統命名空間及其關聯的預設服務帳戶。如果您的組織擁有許多使用者或特定的安全需求，您可以使用Trident Protect 的 RBAC 功能來更精細地控制對資源和命名空間的存取。

有關Trident Protect 中的 RBAC 的更多信息，請參閱["Trident保護文檔"](#)



叢集管理員可以存取預設的 trident-protect 命名空間中的資源，也可以存取所有其他命名空間中的資源。使用者無法在 trident-protect 命名空間中建立應用程式資料管理自訂資源 (CR)，如快照和備份 CR。作為最佳實踐，使用者需要在應用程式命名空間中建立這些 CR。

可依照文件中提供的說明安裝Trident Protect["這裡"](#)本節將展示使用Trident Protect 對容器應用程式進行資料保護和復原應用程式的工作流程。1.快照建立（按需、按計畫）2.從快照恢復（恢復到相同和不同的命名空間）3.備份創建4.從備份還原

在為應用程式建立快照和備份之前，必須在Trident Protect 中配置物件儲存來儲存快照和備份。這是使用儲存桶 CR 完成的。只有管理員可以建立儲存桶 CR 並對其進行配置。在Trident Protect 中，儲存桶 CR 稱為 AppVault。AppVault 物件是儲存桶的聲明性 Kubernetes 工作流程表示。AppVault CR 包含儲存桶在保護作業（例如備份、快照、復原作業和SnapMirror複製）中所使用的必要配置。

在此範例中，我們將展示如何使用ONTAP S3 作為物件儲存。以下是為ONTAP S3 建立 AppVault CR 的工作流程：1.在ONTAP叢集中的 SVM 中建立 S3 物件儲存伺服器。2.在物件儲存伺服器中建立一個儲存桶。3.在 SVM 中建立 S3 使用者。將存取密鑰和密鑰保存在安全的地方。4.在 OpenShift 中，建立一個金鑰來儲存ONTAP S3 憑證。5.為ONTAP S3 建立 AppVault 對象

為ONTAP S3 設定Trident保護 AppVault

使用ONTAP S3 作為 AppVault 設定Trident Protect 的範例 yaml 檔案

```
# alias tp='tridentctl-protect'

appvault-secret.yaml

apiVersion: v1
stringData:
  accessKeyID: "<access key id created for a user to access ONTAP S3 bucket>"
  secretAccessKey: "corresponding Secret Access Key"
#data:
# base 64 encoded values
# accessKeyID: <base64 access key id created for a user to access ONTAP S3 bucket>
# secretAccessKey: <base 64 Secret Access Key>
kind: Secret
metadata:
  name: appvault-secret
  namespace: trident-protect
type: Opaque

appvault.yaml

apiVersion: protect.trident.netapp.io/v1
kind: AppVault
metadata:
  name: ontap-s3-appvault
  namespace: trident-protect
spec:
  providerConfig:
    azure:
      accountName: ""
```

```

    bucketName: ""
    endpoint: ""
  gcp:
    bucketName: ""
    projectID: ""
  s3:
    bucketName: <bucket-name for storing the snapshots and backups>
    endpoint: <endpoint IP for S3>
    secure: "false"
    skipCertValidation: "true"
  providerCredentials:
    accessKeyID:
      valueFromSecret:
        key: accessKeyID
        name: appvault-secret
    secretAccessKey:
      valueFromSecret:
        key: secretAccessKey
        name: appvault-secret
  providerType: OntapS3

# oc create -f appvault-secret.yaml -n trident-protect
# oc create -f appvault.yaml -n trident-protect

```

```

[root@localhost openshift-benchmark]#
[root@localhost openshift-benchmark]# tp get appvault -n trident-protect
+-----+-----+-----+-----+-----+
|      NAME      | PROVIDER |  STATE  | AGE  | ERROR |
+-----+-----+-----+-----+-----+
| ontap-s3-appvault | OntapS3  | Available | 2d2h |      |
+-----+-----+-----+-----+-----+
[root@localhost openshift-benchmark]# █

```

用於安裝 **postgresql** 應用程式的範例 **yaml** 檔案

```

postgres.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: postgres
spec:
  replicas: 1
  selector:
    matchLabels:
      app: postgres
  template:

```

```

metadata:
  labels:
    app: postgres
spec:
  containers:
  - name: postgres
    image: postgres:14
    env:
      - name: POSTGRES_USER
        #value: "myuser"
        value: "admin"
      - name: POSTGRES_PASSWORD
        #value: "mypassword"
        value: "adminpass"
      - name: POSTGRES_DB
        value: "mydb"
      - name: PGDATA
        value: "/var/lib/postgresql/data/pgdata"
    ports:
      - containerPort: 5432
    volumeMounts:
      - name: postgres-storage
        mountPath: /var/lib/postgresql/data
  volumes:
  - name: postgres-storage
    persistentVolumeClaim:
      claimName: postgres-pvc
---
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: postgres-pvc
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 5Gi
---
apiVersion: v1
kind: Service
metadata:
  name: postgres
spec:
  selector:
    app: postgres

```

```
ports:
- protocol: TCP
  port: 5432
  targetPort: 5432
type: ClusterIP
```

Now create the Trident protect application CR for the postgres app. Include the objects in the namespace postgres and create it in the postgres namespace.

```
# tp create app postgres-app --namespaces postgres -n postgres
```

```
[root@localhost RedHat]# tp get app -n postgres
+-----+-----+-----+-----+
|      NAME      | NAMESPACES | STATE | AGE |
+-----+-----+-----+-----+
| postgres-app   | postgres   | Ready | 24s |
+-----+-----+-----+-----+
[root@localhost RedHat]#
```

建立快照

建立按需快照

```
# tp create snapshot postgres-snap1 --app postgres-app --appvault
ontap-s3-appvault -n postgres
Snapshot "postgres-snap1" created.
```

```
[root@localhost RedHat]# tp get snapshot -n postgres
+-----+-----+-----+-----+-----+
| NAME | APP REF | STATE | AGE | ERROR |
+-----+-----+-----+-----+-----+
| postgres-snap1 | postgres-app | Completed | 19s | |
+-----+-----+-----+-----+-----+
[root@localhost RedHat]#
```

```
[root@localhost DataProtection]# oc get all,pvc,volumesnapshot -n postgres
apps.openshift.io/v1 DeploymentConfig is deprecated in v4.14+, unavailable in v4.10000+
kubevirt.io/v1 VirtualMachineInstancePresets is now deprecated and will be removed in v2.
NAME                                READY  STATUS   RESTARTS   AGE
pod/postgres-cd9d6ccb-jfx49         1/1    Running  0           3h47m

NAME                                TYPE             CLUSTER-IP      EXTERNAL-IP      PORT(S)          AGE
service/postgres                    ClusterIP         172.30.132.112  <none>            5432/TCP          3h47m

NAME                                READY  UP-TO-DATE   AVAILABLE   AGE
deployment.apps/postgres            1/1    1             1           3h47m

NAME                                DESIRED   CURRENT   READY   AGE
replicaset.apps/postgres-cd9d6ccb  1         1         1       3h47m

NAME                                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
persistentvolumeclaim/data-postgres-postgresql-0  Bound    pvc-9f89514e-3f2c-41ad-b7a3-792cea503f00  8Gi        RWO             sc-zon         4h40m
ea-nas <unset>                                     3h47m
persistentvolumeclaim/postgres-pvc              Bound    pvc-951a9910-9edb-48ae-898a-1aed9aa25dc3  5Gi        RWO             sc-zon         3h47m
ea-nas <unset>                                     3h47m

NAME                                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
persistentvolumeclaim/postgres-pvc              Bound    pvc-951a9910-9edb-48ae-898a-1aed9aa25dc3  5Gi        RWO             sc-zon         3h47m
ea-nas <unset>                                     3h47m

NAME                                READYTO
USE  SOURCEPVC                                SOURCE_SNAPSHOT_CONTENT  RESTORE_SIZE  SNAPSHOTCLASS  SNAPSHOTCONTENT
CREATIONTIME  AGE
volumesnapshot.snapshot.storage.k8s.io/snapshot-2e94d04c-c8ea-446a-8d47-64b0bee67107-pvc-951a9910-9edb-48ae-898a-1aed9aa25dc3  true
postgres-pvc  13m  13m  53676Ki  trident-snapshotclass  snapcontent-796ea7f8-59a0-493e-bbd8-3a
e76fe9036c
volumesnapshot.snapshot.storage.k8s.io/snapshot-2e94d04c-c8ea-446a-8d47-64b0bee67107-pvc-9f89514e-3f2c-41ad-b7a3-792cea503f00  true
data-postgres-postgresql-0  13m  13m  368Ki  trident-snapshotclass  snapcontent-86a464d4-ffd8-4279-9cf7-88
88a097c001
```

建立計畫 使用以下命令，將每天 15:33 建立快照，並保留兩個快照和備份。

```
# tp create schedule schedule1 --app postgres-app --appvault ontap-s3-
appvault --backup-retention 2 --snapshot-retention 2 --granularity
Daily --hour 15 --minute 33 --data-mover Restic -n postgres
Schedule "schedule1" created.
```



```
[root@localhost DataProtection]# tp get schedule -n postgres
```

NAME	APP	SCHEDULE	ENABLED	STATE	AGE	ERROR
schedule1	postgres-app	Daily:hour=15,min=33	true		17s	

```
[root@localhost DataProtection]#
```

使用 **yaml** 建立計劃

```
# tp create schedule schedule2 --app postgres-app --appvault ontap-s3-  
appvault --backup-retention 2 --snapshot-retention 2 --granularity  
Daily --hour 15 --minute 33 --data-mover Restic -n postgres --dry-run >  
hourly-snapshotschedule.yaml
```

```
cat hourly-snapshotschedule.yaml
```

```
apiVersion: protect.trident.netapp.io/v1  
kind: Schedule  
metadata:  
  creationTimestamp: null  
  name: schedule2  
  namespace: postgres  
spec:  
  appVaultRef: ontap-s3-appvault  
  applicationRef: postgres-app  
  backupRetention: "2"  
  dataMover: Restic  
  dayOfMonth: ""  
  dayOfWeek: ""  
  enabled: true  
  granularity: Hourly  
  #hour: "15"  
  minute: "33"  
  recurrenceRule: ""  
  snapshotRetention: "2"  
status: {}
```

```
[root@localhost DataProtection]# tp get schedule -n postgres
```

NAME	APP	SCHEDULE	ENABLED	STATE	AGE	ERROR
schedule1	postgres-app	Daily:hour=15,min=33	true		8d7h	
schedule2	postgres-app	Hourly:min=33	true		8d7h	

```
[root@localhost DataProtection]#
```

您可以看到按照此計劃建立的快照。

```
[root@localhost DataProtection]# tp get snap -n postgres
```

NAME	APP REF	STATE	AGE	ERROR
hourly-3f1ee-20250214183300	postgres-app	Completed	19s	
postgres-snap1	postgres-app	Completed	1h25m	

```
[root@localhost DataProtection]#
```

也創建了磁碟區快照。

```
[root@localhost DataProtection]# oc get volumesnapshots -n postgres
```

NAME	CREATIONTIME	AGE	READYTOUSE	SOURCEPVC
snapshot-2e94d04c-c8ea-446a-8d47-64b0bee67107	-pvc-951a9910-9edb-48ae-898a-1aed9aa25dc3	114m	true	postgres-pvc
snapshot-2e94d04c-c8ea-446a-8d47-64b0bee67107	-pvc-9f89514e-3f2c-41ad-b7a3-792cea503f00	114m	true	data-postgres-postgresql-0
snapshot-ce75a274-ecb2-48c9-a0a5-94c10f8e6cb1	-pvc-951a9910-9edb-48ae-898a-1aed9aa25dc3	30m	true	postgres-pvc
snapshot-ce75a274-ecb2-48c9-a0a5-94c10f8e6cb1	-pvc-9f89514e-3f2c-41ad-b7a3-792cea503f00	30m	true	data-postgres-postgresql-0

刪除應用程式以模擬應用程式遺失

```
# oc delete deployment/postgres -n postgres
# oc get pod,pvc -n postgres
No resources found in postgres namespace.
```

從快照還原到相同命名空間

```
# tp create sir postgres-sir --snapshot postgres/hourly-3flee-20250214183300 -n postgres
SnapshotInplaceRestore "postgres-sir" created.
```

```
[root@localhost DataProtection]# tp get sir -n postgres
```

NAME	APPVAULT	STATE	AGE	ERROR
postgres-sir	ontap-s3-appvault	Completed	2m39s	

應用程式及其 PVC 恢復到同一個命名空間。

```
[root@localhost DataProtection]# oc get pods,pvc -n postgres
```

NAME	READY	STATUS	RESTARTS	AGE
pod/postgres-cd9d6ccb-x85tg	1/1	Running	0	98s

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE
persistentvolumeclaim/data-postgres-postgresql-0	Bound	pvc-b2cd67fd-fe4d-49b1-9e06-a53bf7be575e	8Gi	RWO	sc-zonea-nas	<unset>	105s
persistentvolumeclaim/postgres-pvc	Bound	pvc-2d549395-0cc6-4529-b2b9-7361bfb14fa8	5Gi	RWO	sc-zonea-nas	<unset>	105s

```
[root@localhost DataProtection]#
```

從快照還原到不同的命名空間

```
# tp create snapshotrestore postgres-restore --snapshot postgres/hourly-3flee-20250214183300 --namespace-mapping postgres:postgres-restore -n postgres-restore
SnapshotRestore "postgres-restore" created.
```

```
[root@localhost DataProtection]# tp get snapshotrestore -n postgres-restore
```

NAME	APPVAULT	STATE	AGE	ERROR
postgres-restore	ontap-s3-appvault	Completed	1m15s	

您可以看到應用程式已還原到新的命名空間。

```
[root@localhost DataProtection]#
[root@localhost DataProtection]# oc get pods,pvc -n postgres-restore
```

NAME	READY	STATUS	RESTARTS	AGE
pod/postgres-cd9d6ccb-pfxw9	1/1	Running	0	8d

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS
persistentvolumeclaim/data-postgres-postgresql-0	Bound	pvc-3dff4e42-828d-49f9-84e9-4daf75479292	8Gi	RWO	sc-zonea-nas
persistentvolumeclaim/postgres-pvc	Bound	pvc-f57321b2-f21f-4eb7-8f86-4a17f915318b	5Gi	RWO	sc-zonea-nas

```
[root@localhost DataProtection]#
```

建立備份

建立按需備份

```
# tp create backup postgres-backup1 --app postgres-app --appvault
ontap-s3-appvault -n postgres
Backup "postgres-backup1" created.
```

```
[root@localhost DataProtection]# tp get backup -n postgres
```

NAME	APP REF	STATE	AGE	ERROR
backup1	postgres-app	Completed	5d12h	
daily-feac1-20250222153300	postgres-app	Completed	1d10h	
daily-feac1-20250223153300	postgres-app	Completed	10h36m	
hourly-3f1ee-20250224003300	postgres-app	Completed	1h36m	
hourly-3f1ee-20250224013300	postgres-app	Completed	36m27s	
postgres-backup1	postgres-app	Completed	6m19s	

建立備份計畫

上面列表中的每日和每小時備份是根據先前設定的計劃建立的。

```
# tp create schedule schedule1 --app postgres-app --appvault ontap-s3-
appvault --backup-retention 2 --snapshot-retention 2 --granularity
Daily --hour 15 --minute 33 --data-mover Restic -n postgres
Schedule "schedule1" created.
```

```
[root@localhost DataProtection]# tp get schedule -n postgres
```

NAME	APP	SCHEDULE	ENABLED	STATE	AGE	ERROR
schedule1	postgres-app	Daily:hour=15,min=33	true		9d8h	
schedule2	postgres-app	Hourly:min=33	true		9d8h	

刪除應用程式和 PVC 以模擬資料遺失。

```
[root@localhost DataProtection]# oc get pods -n postgres
NAME                                READY   STATUS    RESTARTS   AGE
postgres-cd9d6ccb-dftkt            1/1     Running   0           11s
[root@localhost DataProtection]# oc get deployment -n postgres
NAME    READY   UP-TO-DATE   AVAILABLE   AGE
postgres 1/1      1             1           20s
[root@localhost DataProtection]# oc delete deployment/postgres -n postgres
deployment.apps "postgres" deleted
[root@localhost DataProtection]# oc get pods -n postgres
No resources found in postgres namespace.
[root@localhost DataProtection]# oc get pvc -n postgres
NAME                                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTE
SCLASS   AGE
data-postgres-postgresql-0          Bound     pvc-b2cd67fd-fe4d-49b1-9e06-a53bf7be575e  8Gi        RWO             sc-zonea-nas   <unset>
postgres-pvc                        Bound     pvc-2d549395-0cc6-4529-b2b9-7361bfb14fa8  5Gi        RWO             sc-zonea-nas   <unset>
[root@localhost DataProtection]# oc delete pvc/data-postgres-postgresql-0 -n postgres
persistentvolumeclaim "data-postgres-postgresql-0" deleted
[root@localhost DataProtection]# oc delete pvc/postgres-pvc -n postgres
persistentvolumeclaim "postgres-pvc" deleted
[root@localhost DataProtection]# oc get pvc -n postgres
No resources found in postgres namespace.
[root@localhost DataProtection]#
```

恢復到相同的命名空間 #tp create bir postgres-bir --backup postgres/hourly-3f1ee-20250224023300 -n postgres BackupInplaceRestore "postgres-bir" created。

```
[root@localhost DataProtection]# tp get bir -n postgres
+-----+-----+-----+-----+-----+
| NAME | APPVAULT | STATE | AGE | ERROR |
+-----+-----+-----+-----+-----+
| postgres-bir | ontap-s3-appvault | Completed | 2m19s | |
+-----+-----+-----+-----+-----+
```

應用程式和 PVC 在同一個命名空間中恢復。

```
[root@localhost DataProtection]# oc get pods -n postgres
NAME                                READY   STATUS    RESTARTS   AGE
postgres-cd9d6ccb-t857w            1/1     Running   0           10m
[root@localhost DataProtection]# oc get pvc -n postgres
NAME                                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUTE
SCLASS   AGE
data-postgres-postgresql-0          Bound     pvc-0a849c19-16fe-466f-9733-85e82a8b1677  8Gi        RWO             sc-zonea-nas   <unset>
postgres-pvc                        Bound     pvc-ded304ea-02d4-4225-b606-63007666ad66  5Gi        RWO             sc-zonea-nas   <unset>
```

恢復到不同的命名空間 建立一個新的命名空間。從備份還原到新的命名空間。

```

[root@localhost DataProtection]# oc create ns postgres-restore-from-backup
namespace/postgres-restore-from-backup created
[root@localhost DataProtection]# tp create backuprestore postgres-restore-from-backup --backup postgres/postgres-backup1 --namespace-map
ping postgres:postgres-restore-from-backup -n postgres-restore-from-backup
BackupRestore "postgres-restore-from-backup" created.
[root@localhost DataProtection]# oc get backuprestore -n postgres-restore-from-backup
NAME                                STATE      ERROR      AGE
postgres-restore-from-backup        Running    37s
[root@localhost DataProtection]# oc get backuprestore -n postgres-restore-from-backup
NAME                                STATE      ERROR      AGE
postgres-restore-from-backup        Running    56s
[root@localhost DataProtection]# oc get backuprestore -n postgres-restore-from-backup
NAME                                STATE      ERROR      AGE
postgres-restore-from-backup        Completed  2m52s
[root@localhost DataProtection]# oc get pods -n postgres-restore-from-backup
NAME                                READY      STATUS      RESTARTS      AGE
postgres-cd9d6ccb-p659p            1/1        Running    0              2m9s
[root@localhost DataProtection]# oc get pvc -n postgres-restore-from-backup
NAME                                STATUS      VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   VOLUMEATTRIBUT
ESCLASS   AGE
data-postgres-postgresql-0          Bound      pvc-36df7399-95da-4c67-a621-af9434015bdb    8Gi        RWO              sc-zonea-nas   <unset>
2m18s
postgres-pvc                        Bound      pvc-633de3aa-a4f9-4f3b-93cc-e91afbd4fe02    5Gi        RWO              sc-zonea-nas   <unset>
2m18s
[root@localhost DataProtection]#

```

Activate Windows
 Go to Settings to activate Windows.

若要將應用程式複製或遷移到不同的叢集（執行跨叢集克隆），請在來源叢集上建立備份，然後將備份還原到不同的叢集。確保目標叢集上安裝了Trident保護。

在來源叢集上，執行下圖所示的步驟：

```
[root@localhost DataProtection]# tp create backup postgres-backup-cluster1 --app postgres-app --appvault ontap-s3-appvault -n postgres
Backup "postgres-backup-cluster1" created.
[root@localhost DataProtection]# tp get backup -n postgres
```

NAME	APP REF	STATE	AGE	ERROR
backup1	postgres-app	Completed	5d14h	
daily-feac1-20250222153300	postgres-app	Completed	1d12h	
daily-feac1-20250223153300	postgres-app	Completed	12h18m	
hourly-3f1ee-20250224023300	postgres-app	Completed	1h18m	
hourly-3f1ee-20250224033300	postgres-app	Completed	18m26s	
postgres-backup-cluster1	postgres-app	Running	35s	
postgres-backup1	postgres-app	Completed	1h48m	

```
[root@localhost DataProtection]# tp get backup -n postgres
```

NAME	APP REF	STATE	AGE	ERROR
backup1	postgres-app	Completed	5d14h	
daily-feac1-20250222153300	postgres-app	Completed	1d12h	
daily-feac1-20250223153300	postgres-app	Completed	12h19m	
hourly-3f1ee-20250224023300	postgres-app	Completed	1h19m	
hourly-3f1ee-20250224033300	postgres-app	Completed	19m41s	
postgres-backup-cluster1	postgres-app	Completed	1m50s	
postgres-backup1	postgres-app	Completed	1h49m	

Activate Windows
Go to Settings to activate Windows.

從來源叢集，將上下文切換到目標叢集。然後，確保可以從目標叢集上下文存取 AppVault，並從目標叢集取得 AppVault 內容。

```
[root@localhost DataProtection]# kubectl config use-context default/api-bm-cluster5-min-ocpv-sddc-netapp-com:6443/kube:admin
Switched to context "default/api-bm-cluster5-min-ocpv-sddc-netapp-com:6443/kube:admin".
[root@localhost DataProtection]# tp get appvault -n trident-protect
```

NAME	PROVIDER	STATE	AGE	ERROR
ontap-s3-appvault	OntapS3	Available	3d6h	

```
[root@localhost DataProtection]# tp get appvaultcontent ontap-s3-appvault --show-resources backup --show-paths
```

CLUSTER	APP PATH	TYPE	NAME	TIMESTAMP
ocp-cluster11	bbox	backup	bboxbackup1	2025-01-17 15:57:49 (UTC)
ocp-cluster11	postgres-app	backup	backup1	2025-02-18 13:31:50 (UTC)
ocp-cluster11	postgres-app	backup	daily-feac1-20250222153300	2025-02-22 15:34:44 (UTC)
ocp-cluster11	postgres-app	backup	daily-feac1-20250223153300	2025-02-23 15:34:42 (UTC)
ocp-cluster11	postgres-app	backup	hourly-3f1ee-20250224033300	2025-02-24 03:34:44 (UTC)
ocp-cluster11	postgres-app	backup	hourly-3f1ee-20250224033300	2025-02-24 04:34:47 (UTC)
ocp-cluster11	postgres-app	backup	postgres-backup-cluster1	2025-02-24 03:52:36 (UTC)

使用清單中的備份路徑並建立備份還原 CR 對象，如下面的命令所示。

```
# tp create backuprestore backup-restore-cluster2 --namespace-mapping
postgres:postgres --appvault ontap-s3-appvault --path postgres-
app_4d798ed5-cfa8-49ff-a5b6-c5e2d89aeb89/backups/postgres-backup-
cluster1_ec0ed3f3-5500-4e72-afa8-117a04a0b1c3 -n postgres
BackupRestore "backup-restore-cluster2" created.
```

```
[root@localhost DataProtection]# tp get backuprestore -n postgres
```

NAME	APPVAULT	STATE	AGE	ERROR
backup-restore-cluster2	ontap-s3-appvault	Completed	12m41s	

現在您可以看到應用程式 pod 和 PVC 已在目標叢集中建立。

```
[root@localhost DataProtection]# oc get pods -n postgres
```

NAME	READY	STATUS	RESTARTS	AGE
postgres-cd9d6ccb-2lvcq	1/1	Running	0	13m

```
[root@localhost DataProtection]# oc get pvc -n postgres
```

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS	VOLUMEATTRIBUT
data-postgres-postgresql-0	Bound	pvc-872a5182-601b-4848-b410-fef368337d07	8Gi	RWO	sc-zoneb-san	<unset>
postgres-pvc	Bound	pvc-caf9fa71-76a8-4645-9bb5-2ed72e72948b	5Gi	RWO	sc-zoneb-san	<unset>

使用Trident Protect 保護 Red Hat OpenShift 虛擬化中的虛擬機

使用快照和備份保護 OpenShift 虛擬化中的虛擬機器。此程序包括使用ONTAP S3 物件儲存建立 AppVault、配置Trident Protect 以擷取 VM 資料（包括 Kubernetes 資源物件、持久磁碟區和內部影像），並在必要時還原資料。

OpenShift 虛擬化環境中的虛擬機器是在 OpenShift 容器平台的工作節點中執行的容器化應用程式。保護虛擬機器元資料以及虛擬機器的持久性磁碟非常重要，以便在它們遺失或損壞時可以還原它們。

OpenShift 虛擬化虛擬機器的持久性磁碟可以透過使用整合到 OpenShift 叢集的ONTAP儲存進行支援["Trident犯罪現場調查"](#)。在本節中我們使用["Trident保護"](#)建立虛擬機器（包括其資料磁碟區）的快照和備份到ONTAP物件儲存。

然後，我們在需要時從快照或備份中還原。

Trident Protect 支援 OpenShift 叢集上的應用程式和虛擬機器的快照、備份、復原和災難復原。對於 OpenShift 虛擬化虛擬機，可以使用Trident Protect 保護的資料包括與虛擬機器關聯的 Kubernetes 資源物件、持久磁碟區和內部影像。

以下是本節範例所使用的各個元件的版本

- ["OpenShift 叢集 4.17"](#)

- "透過 Red Hat 提供的 OpenShift Virtualization Operator 安裝 OpenShift Virtualization"
- "Trident25.02"
- "Trident保護 25.02"
- "ONTAP 9.16"

為物件儲存建立 **App Vault**

建立 AppVault

在為應用程式或虛擬機器建立快照和備份之前，必須在Trident Protect 中配置物件儲存來儲存快照和備份。這是使用儲存桶 CR 完成的。只有管理員可以建立儲存桶 CR 並對其進行配置。在Trident Protect 中，儲存桶 CR 稱為 AppVault。AppVault 物件是儲存桶的聲明性 Kubernetes 工作流程表示。AppVault CR 包含儲存桶在保護作業（例如備份、快照、復原作業和SnapMirror複製）中所使用的必要配置。

在此範例中，我們將展示如何使用ONTAP S3 作為物件儲存。以下是為ONTAP S3 建立 AppVault CR 的工作流程：1.在ONTAP叢集中的 SVM 中建立 S3 物件儲存伺服器。2.在物件儲存伺服器中建立一個儲存桶。3.在 SVM 中建立 S3 使用者。將存取密鑰和密鑰保存在安全的地方。4.在 OpenShift 中，建立一個金鑰來儲存ONTAP S3 憑證。5.為ONTAP S3 建立 AppVault 對象

為ONTAP S3 設定Trident保護 AppVault

```
# alias tp='tridentctl-protect'

# cat appvault-secret.yaml
apiVersion: v1
stringData:
  accessKeyID: "<access key of S3>"
  secretAccessKey: "<secret access key of S3>"
# you can also provide base 64 encoded values instead of string values
#data:
# base 64 encoded values
#  accessKeyID: < base 64 encoded access key>
#  secretAccessKey: <base 64 encoded secretAccess key>
kind: Secret
metadata:
  name: appvault-secret
  namespace: trident-protect
type: Opaque

# cat appvault.yaml
apiVersion: protect.trident.netapp.io/v1
kind: AppVault
metadata:
  name: ontap-s3-appvault
  namespace: trident-protect
spec:
  providerConfig:
    azure:
      accountName: ""
      bucketName: ""
      endpoint: ""
    gcp:
      bucketName: ""
      projectID: ""
```

```

s3:
  bucketName: trident-protect
  endpoint: <lif for S3 access>
  secure: "false"
  skipCertValidation: "true"
providerCredentials:
  accessKeyID:
    valueFromSecret:
      key: accessKeyID
      name: appvault-secret
  secretAccessKey:
    valueFromSecret:
      key: secretAccessKey
      name: appvault-secret
providerType: OntapS3

# oc create -f appvault-secret.yaml -n trident-protect
# oc create -f appvault.yaml -n trident-protect

```

```

[root@localhost VM-DataProtection]# tp get appvault
+-----+-----+-----+-----+-----+-----+
| NAME          | PROVIDER | STATE   | ERROR | MESSAGE | AGE   |
+-----+-----+-----+-----+-----+-----+
| ontap-s3-appvault | OntapS3  | Available |      |         | 8d17h |
+-----+-----+-----+-----+-----+-----+
[root@localhost VM-DataProtection]#

```

在 **OpenShift Virtualization** 中建立 VM

在 OpenShift Virtualization 中建立 VM

以下螢幕截圖顯示了使用模板從控制台建立 VM（命名空間 demo 中的 demo-fedora）。根磁碟會自動選擇預設儲存類別，因此，請驗證預設儲存類別是否設定得當。在此設定中，預設儲存類別是 **sc-zonea-san**。確保在建立附加磁碟時選擇儲存類別 **sc-zonea-san** 並選取「應用最佳化儲存設定」複選框。這會將存取模式設為 RWX，將磁碟區模式設為封鎖。



Trident支援 SAN（iSCSI、NVMe/TCP 和 FC）區塊磁碟區模式下的 RWX 存取模式。（這是NAS的預設存取模式）。如果您稍後需要對虛擬機器進行即時遷移，則需要 RWX 存取模式。

StorageClasses

Name ▾ Search by name... /

Name ↑	Provisioner ↑
 sc-zonea-san - Default	csi.trident.netapp.io
 thin-csi	csi.vsphere.vmware.com

Catalog

VirtualMachines

Templates

InstanceTypes

Preferences

Bootable volumes

MigrationPolicies

Checkups

Migration >

Networking >

Storage ▾

PersistentVolumes

Project: demo ▾

VirtualMachines



No VirtualMachines found

Click Create VirtualMachine to create your first VirtualMachine or view the [catalog](#) tab to c

Create VirtualMachine ▾

From InstanceType

From template

With YAML



Fedora VM

fedora-server-small

×

▼ Template info

Operating system

Fedora VM

Workload type

Server (default)

Description

Template for Fedora Linux 39 VM or newer. A PVC with the Fedora disk image must be

▼ Storage ?

☐ Boot from CD ?

Disk source * ?

Template default ▼

Disk size *

-

30

+

GiB ▼

Quick create VirtualMachine

VirtualMachine name *

demo-fedora

Project

demo

Public SSH key

Not configured 

☒ Start this VirtualMachine after creation

Quick create VirtualMachine

Customize VirtualMachine

Activate Windows

Go to Settings to activate Windows.

Cancel

Catalog

Customize and create VirtualMachine

YAML

YAML

Template: Fedora VM

Overview

YAML

Scheduling

Environment

Network interfaces

Disks

Scripts

Metadata

Add disk ▼

Empty disk (blank)

Create a disk with no contents.

/

☐ Mount Windows drivers disk

Use existing

Ephemeral disk (Container image)

Any changes are lost upon reboot

Volume

Add a volume already available on the cluster.

Volume snapshot

Add a snapshot available on the cluster to the VirtualMachine.

☒ Clone volume

Clone a volume available on the cluster and add it to the VirtualMachine.

Create VirtualMachine

Cancel

Drive

Interface

Storage class

Disk	virtio	-	⋮
Disk	virtio	-	⋮

Activate Windows

Go to Settings to activate Windows

19

Add disk



disk1

Disk size *



30



GiB



Type

Disk



Hot plug is enabled only for "Disk" and "Lun" types

Interface *

VirtIO



Hot plug is enabled only for "SCSI" interface

StorageClass

SC sc-zonea-san



☒ Apply optimized StorageProfile settings

Optimized values Access mode: ReadWriteMany, Volume mode: Block.

Save

Cancel

Project: demo

Overview YAML Scheduling Environment Network interfaces **Disks** Scripts Metadata

Add disk

Filter Search by name... ☐ Mount Windows drivers disk

Name	Source	Size	Drive	Interface	Storage class
cloudinitdisk	Other	-	Disk	virtio	-
disk1	Other	30 GiB	Disk	virtio	sc-zonea-san
rootdisk	PVC (auto import)	30 GiB	Disk	virtio	-

bootable

☒ Start this VirtualMachine after creation

Create VirtualMachine Cancel

Activate Windows
Go to Settings to activate V

```
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo
NAME                                     AGE      STATUS   READY
virtualmachine.kubevirt.io/demo-fedora  2m54s   Running  True

NAME                                     READY   STATUS   RESTARTS   AGE
pod/virt-launcher-demo-fedora-69cts     1/1     Running  0          110s

NAME                                     STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS
persistentvolumeclaim/demo-fedora        Bound    pvc-406d9d57-4a5e-4123-93c1-13070b7b0140  30Gi       RWX            sc-zonea-san
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87 Bound    pvc-311f2f81-1d25-4a9a-b0cb-836b4e702f04  30Gi       RWX            sc-zonea-san
[root@localhost VM-DataProtection]#
```

創建應用程式

創建應用程式

為虛擬機器建立一個 **Trident** 保護應用程式

在範例中，demo 命名空間有一個 VM，並且在建立應用程式時包含了該命名空間的所有資源。

```
# alias tp='tridentctl-protect'
# tp create app demo-vm --namespaces demo -n demo --dry-run > app.yaml

# cat app.yaml
apiVersion: protect.trident.netapp.io/v1
kind: Application
metadata:
  creationTimestamp: null
  name: demo-vm
  namespace: demo
spec:
  includedNamespaces:
  - namespace: demo
# oc create -f app.yaml -n demo
```

```
[root@localhost VM-DataProtection]# tp get app -n demo
+-----+-----+-----+-----+
| NAME   | NAMESPACES | STATE | AGE |
+-----+-----+-----+-----+
| demo-vm | demo       | Ready | 45s |
+-----+-----+-----+-----+
[root@localhost VM-DataProtection]# █
```

透過建立備份來保護應用程式

建立備份

建立按需備份

為先前建立的應用程式（demo-vm）建立一個備份，其中包括 demo 命名空間中的所有資源。提供將儲存備份的 appvault 名稱。

```
# tp create backup demo-vm-backup-on-demand --app demo-vm --appvault  
ontap-s3-appvault -n demo  
Backup "demo-vm-backup-on-demand" created.
```

```
[root@localhost VM-DataProtection]# tp get backup -n demo
```

NAME	APP	RECLAIM POLICY	STATE	ERROR	AGE
demo-vm-backup-on-demand	demo-vm	Retain	Completed		12m53s

```
[root@localhost VM-DataProtection]#
```

按計畫建立備份

建立備份計劃，指定要保留的備份粒度和數量。

```
# tp create schedule backup-schedule1 --app demo-vm --appvault ontap-
s3-appvault --granularity Hourly --minute 45 --backup-retention 1 -n
demo --dry-run>backup-schedule-demo-vm.yaml
schedule.protect.trident.netapp.io/backup-schedule1 created

#cat backup-schedule-demo-vm.yaml
apiVersion: protect.trident.netapp.io/v1
kind: Schedule
metadata:
  creationTimestamp: null
  name: backup-schedule1
  namespace: demo
spec:
  appVaultRef: ontap-s3-appvault
  applicationRef: demo-vm
  backupRetention: "1"
  dayOfMonth: ""
  dayOfWeek: ""
  enabled: true
  granularity: Hourly
  hour: ""
  minute: "45"
  recurrenceRule: ""
  snapshotRetention: "0"
status: {}
# oc create -f backup-schedule-demo-vm.yaml -n demo
```

```
[root@localhost VM-DataProtection]# tp get schedule -n demo
```

NAME	APP	SCHEDULE	ENABLED	STATE	ERROR	AGE
backup-schedule1	demo-vm	Hourly:min=45	true			9s

```
[root@localhost VM-DataProtection]# tp get backups -n demo
```

NAME	APP	RECLAIM POLICY	STATE	ERROR	AGE
demo-vm-backup-on-demand	demo-vm	Retain	Completed		44m4s
hourly-4c094-20250312144500	demo-vm	Retain	Completed		20m34s

```
[root@localhost VM-DataProtection]#
```


將虛擬機器還原到相同的命名空間

在範例中，備份 demo-vm-backup-on-demand 包含 fedora VM 的 demo-app 備份。

首先，刪除虛擬機，並確保 PVC、pod 和虛擬機物件從命名空間「demo」中刪除

```
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo
NAME                                     AGE   STATUS   READY
virtualmachine.kubevirt.io/demo-fedora  59m   Running  True

NAME                                     READY   STATUS   RESTARTS   AGE
pod/virt-launcher-demo-fedora-69cts     1/1     Running  0          58m

NAME                                     STATUS   VOLUME                                     CAPACITY
CLASS  VOLUMEATTRIBUTESCLASS  AGE
persistentvolumeclaim/demo-fedora        Bound   pvc-406d9d57-4a5e-4123-93c1-13070b7b0140  30Gi
a-san  <unset>                59m
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87  Bound   pvc-311f2f81-1d25-4a9a-b0cb-836b4e702f04  30Gi
a-san  <unset>                59m
[root@localhost VM-DataProtection]#
[root@localhost VM-DataProtection]# oc delete vm demo-fedora -n demo
virtualmachine.kubevirt.io "demo-fedora" deleted
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo
No resources found in demo namespace.
[root@localhost VM-DataProtection]#
```

Activate
Go to Settings

現在，建立一個就地備份還原物件。

```
# tp create bir demo-fedora-restore --backup demo/demo-vm-backup-on-demand -n demo --dry-run>vm-demo-bir.yaml

# cat vm-demo-bir.yaml
apiVersion: protect.trident.netapp.io/v1
kind: BackupInplaceRestore
metadata:
  annotations:
    protect.trident.netapp.io/max-parallel-restore-jobs: "25"
  creationTimestamp: null
  name: demo-fedora-restore
  namespace: demo
spec:
  appArchivePath: demo-vm_cc8adc7a-0c28-460b-a32f-0a7b3d353e13/backups/demo-vm-backup-on-demand_f6af3513-9739-480e-88c7-4cca45808a80
  appVaultRef: ontap-s3-appvault
  resourceFilter: {}
status:
  postRestoreExecHooksRunResults: null
  state: ""

# oc create -f vm-demo-bir.yaml -n demo
backupinplacerestore.protect.trident.netapp.io/demo-fedora-restore
created
```

```
[root@localhost VM-DataProtection]# tp get bir -n demo
```

NAME	APPVAULT	STATE	ERROR	AGE
demo-fedora-restore	ontap-s3-appvault	Completed		28m17s

```
[root@localhost VM-DataProtection]#
```

驗證虛擬機器、Pod 和 PVC 是否已恢復

```
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-fedora	116s	Running	True

NAME	READY	STATUS	RESTARTS	AGE
pod/virt-launcher-demo-fedora-9kfxh	1/1	Running	0	116s

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS
persistentvolumeclaim/demo-fedora	Bound	pvc-6f69a62c-285c-4980-b0dd-6c85baccf346	30Gi	RWX	sc-zonea-san
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87	Bound	pvc-81d82d82-7aca-40fc-8f8f-6e99246e63f8	30Gi	RWX	sc-zonea-san

```
[root@localhost VM-DataProtection]#
```

將虛擬機器還原到不同的命名空間

首先建立一個要將應用程式還原到的新命名空間，在本例中為 demo2。然後建立備份還原對象

```
# tp create br demo2-fedora-restore --backup demo/hourly-4c094-20250312154500 --namespace-mapping demo:demo2 -n demo2 --dry-run>vm-demo2-br.yaml

# cat vm-demo2-br.yaml
apiVersion: protect.trident.netapp.io/v1
kind: BackupRestore
metadata:
  annotations:
    protect.trident.netapp.io/max-parallel-restore-jobs: "25"
  creationTimestamp: null
  name: demo2-fedora-restore
  namespace: demo2
spec:
  appArchivePath: demo-vm_cc8adc7a-0c28-460b-a32f-0a7b3d353e13/backups/hourly-4c094-20250312154500_aaa14543-a3fa-41f1-a04c-44b1664d0f81
  appVaultRef: ontap-s3-appvault
  namespaceMapping:
    - destination: demo2
      source: demo
  resourceFilter: {}
status:
  conditions: null
  postRestoreExecHooksRunResults: null
  state: ""
# oc create -f vm-demo2-br.yaml -n demo2
```

```
[root@localhost VM-DataProtection]# tp get br -n demo2
```

NAME	APPVAULT	STATE	ERROR	AGE
demo2-fedora-restore	ontap-s3-appvault	Completed		38m52s

驗證是否在新命名空間 demo2 中建立了 VM、pod 和 pvc。

```
[root@localhost VM-DataProtection]#
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo2
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-fedora	5m8s	Running	True

NAME	READY	STATUS	RESTARTS	AGE
pod/virt-launcher-demo-fedora-c7xc6	1/1	Running	0	5m7s

NAME	STATUS	VOLUME	CAPACITY	ACCESS MODES	STORAGECLASS
persistentvolumeclaim/demo-fedora	Bound	pvc-4d278ae2-76cc-46f1-bbf8-071ae75e4a82	30Gi	RWX	sc-zonea-san
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87	Bound	pvc-9b96d09c-7226-4ffc-829b-2cee88e7a117	30Gi	RWX	sc-zonea-san

```
[root@localhost VM-DataProtection]#
```

使用快照保護應用程式

建立快照

建立按需快照 為應用程式建立快照並指定需要儲存它的 appvault。

```
# tp create snapshot demo-vm-snapshot-ondemand --app demo-vm --appvault
ontap-s3-appvault -n demo --dry-run
# cat demo-vm-snapshot-on-demand.yaml
apiVersion: protect.trident.netapp.io/v1
kind: Snapshot
metadata:
  creationTimestamp: null
  name: demo-vm-snapshot-ondemand
  namespace: demo
spec:
  appVaultRef: ontap-s3-appvault
  applicationRef: demo-vm
  completionTimeout: 0s
  volumeSnapshotsCreatedTimeout: 0s
  volumeSnapshotsReadyToUseTimeout: 0s
status:
  conditions: null
  postSnapshotExecHooksRunResults: null
  preSnapshotExecHooksRunResults: null
  state: ""

# oc create -f demo-vm-snapshot-on-demand.yaml
snapshot.protect.trident.netapp.io/demo-vm-snapshot-ondemand created
```

```
[root@localhost VM-DataProtection]#
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo2
NAME                AGE      STATUS    READY
virtualmachine.kubevirt.io/demo-fedora  5m8s    Running   True

NAME                READY    STATUS    RESTARTS   AGE
pod/virt-launcher-demo-fedora-c7xc6     1/1      Running   0           5m7s

NAME                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS
persistentvolumeclaim/demo-fedora        Bound     pvc-4d278ae2-76cc-46f1-bbf8-071ae75e4a82   30Gi       RWX             sc-zonea-san
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87  Bound     pvc-9b96d09c-7226-4ffc-829b-2cee88e7a117   30Gi       RWX             sc-zonea-san
[root@localhost VM-DataProtection]#
```

為快照建立計劃 為快照建立計劃。指定粒度和要保留的快照數量。

```
# tp create Schedule snapshot-schedule1 --app demo-vm --appvault ontap-
s3-appvault --granularity Hourly --minute 50 --snapshot-retention 1 -n
demo --dry-run>snapshot-schedule-demo-vm.yaml

# cat snapshot-schedule-demo-vm.yaml
apiVersion: protect.trident.netapp.io/v1
kind: Schedule
metadata:
  creationTimestamp: null
  name: snapshot-schedule1
  namespace: demo
spec:
  appVaultRef: ontap-s3-appvault
  applicationRef: demo-vm
  backupRetention: "0"
  dayOfMonth: ""
  dayOfWeek: ""
  enabled: true
  granularity: Hourly
  hour: ""
  minute: "50"
  recurrenceRule: ""
  snapshotRetention: "1"
status: {}

# oc create -f snapshot-schedule-demo-vm.yaml
schedule.protect.trident.netapp.io/snapshot-schedule1 created
```

```
[root@localhost VM-DataProtection]# tp get schedule -n demo
```

NAME	APP	SCHEDULE	ENABLED	STATE	ERROR	AGE
backup-schedule1	demo-vm	Hourly:min=45	true			5d23h
snapshot-schedule1	demo-vm	Hourly:min=50	true			12s

```
[root@localhost VM-DataProtection]#
```

```
[root@localhost VM-DataProtection]# tp get snapshots -n demo
```

NAME	APP	RECLAIM POLICY	STATE	ERROR	AGE
backup-39b67e1c-f875-4045-93df-78634bae9dfb	demo-vm	Delete	Completed		6m29s
demo-vm-snapshot-ondemand	demo-vm	Delete	Completed		21m30s
hourly-51839-20250318135000	demo-vm	Delete	Completed		1m29s

```
[root@localhost VM-DataProtection]#
```

從快照還原

將虛擬機器從快照還原到同一個命名空間 從 demo2 命名空間中刪除虛擬機器 demo-fedora。

```
[root@localhost RedHat]# oc get vm,pvc -n demo
NAME                                     AGE   STATUS   READY
virtualmachine.kubevirt.io/demo-fedora  28h   Running  True

NAME                                     STATUS   VOLUME
ORAGECLASS  VOLUMEATTRIBUTESCLASS  AGE
persistentvolumeclaim/demo-fedora          Bound    pvc-e0d5f79d-dff9-450d-be0e-90ab6880b7af
-zonea-san  <unset>          28h
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87  Bound    pvc-e6f7890a-70c7-4538-9035-5e2e9379511d
-zonea-san  <unset>          28h
[root@localhost RedHat]# oc delete virtualmachine.kubevirt.io/demo-fedora -n demo
virtualmachine.kubevirt.io "demo-fedora" deleted
[root@localhost RedHat]#
```

從虛擬機器的快照建立快照就地還原物件。

```
# tp create sir demo-fedora-restore-from-snapshot --snapshot demo/demo-
vm-snapshot-ondemand -n demo --dry-run>vm-demo-sir.yaml

# cat vm-demo-sir.yaml
apiVersion: protect.trident.netapp.io/v1
kind: SnapshotInplaceRestore
metadata:
  creationTimestamp: null
  name: demo-fedora-restore-from-snapshot
  namespace: demo
spec:
  appArchivePath: demo-vm_cc8adc7a-0c28-460b-a32f-
0a7b3d353e13/snapshots/20250318132959_demo-vm-snapshot-
ondemand_e3025972-30c0-4940-828a-47c276d7b034
  appVaultRef: ontap-s3-appvault
  resourceFilter: {}
status:
  conditions: null
  postRestoreExecHooksRunResults: null
  state: ""

# oc create -f vm-demo-sir.yaml
snapshotinplacerestore.protect.trident.netapp.io/demo-fedora-restore-
from-snapshot created
```

```
[root@localhost VM-DataProtection]# tp get sir -n demo
```

NAME	APPVAULT	STATE	ERROR	AGE
demo-fedora-restore-from-snapshot	ontap-s3-appvault	Completed		58m17s

```
[root@localhost VM-DataProtection]#
```

驗證虛擬機器及其 PVC 是否在 demo 命名空間中建立。

```
[root@localhost RedHat]# oc get vm,pvc -n demo
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-fedora	5m17s	Running	True

NAME	STATUS	VOLUME
persistentvolumeclaim/demo-fedora	Bound	pvc-e2f418b0-1b97-40fc-9cb8-943b370d85bc
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87	Bound	pvc-db085154-079f-45ad-9e62-9656e913d01c

```
[root@localhost RedHat]#
```

將虛擬機器從快照還原到不同的命名空間

刪除先前從備份中還原的 demo2 命名空間中的虛擬機器。

```
[root@localhost VM-DataProtection]# oc get vm,pods,pvc -n demo2
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-centos	3m12s	Running	True
virtualmachine.kubevirt.io/demo-fedora	3m11s	Running	True

NAME	READY	STATUS	RESTARTS	AGE
pod/virt-launcher-demo-centos-w77rr	1/1	Running	0	3m11s
pod/virt-launcher-demo-fedora-wwdtc	1/1	Running	0	3m11s

NAME	STORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE	STATUS	VOLUME	CAPACITY	ACCESS MODES
persistentvolumeclaim/demo-centos	sc-zonea-san	<unset>	3m26s	Bound	pvc-7aafd5e2-d4cf-4af6-a259-c68e016ec6cd	30Gi	RWX
persistentvolumeclaim/demo-fedora	sc-zonea-san	<unset>	3m25s	Bound	pvc-c1f8145a-56ea-42c5-abb4-6457b6853e1c	30Gi	RWX
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34	sc-zonea-san	<unset>	3m20s	Bound	pvc-e82b6d98-6762-4473-9bb8-7e98efcb7987	30Gi	RWX
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87	sc-zonea-san	<unset>	3m16s	Bound	pvc-ee13cfbc-2921-4129-a214-a0f6b10335cd	30Gi	RWX

```
[root@localhost VM-DataProtection]# oc delete virtualmachine.kubevirt.io/demo-fedora -n demo2
```

```
virtualmachine.kubevirt.io "demo-fedora" deleted
```

從快照建立快照還原物件並提供命名空間映射。


```
# tp create sr demo2-fedora-restore-from-snapshot --snapshot demo/demo-vm-snapshot-ondemand --namespace-mapping demo:demo2 -n demo2 --dry-run>vm-demo2-sr.yaml

# cat vm-demo2-sr.yaml
apiVersion: protect.trident.netapp.io/v1
kind: SnapshotRestore
metadata:
  creationTimestamp: null
  name: demo2-fedora-restore-from-snapshot
  namespace: demo2
spec:
  appArchivePath: demo-vm_cc8adc7a-0c28-460b-a32f-0a7b3d353e13/snapshots/20250318132959_demo-vm-snapshot-ondemand_e3025972-30c0-4940-828a-47c276d7b034
  appVaultRef: ontap-s3-appvault
  namespaceMapping:
  - destination: demo2
    source: demo
  resourceFilter: {}
status:
  postRestoreExecHooksRunResults: null
  state: ""

# oc create -f vm-demo2-sr.yaml
snapshotrestore.protect.trident.netapp.io/demo2-fedora-restore-from-snapshot created
```

```
[root@localhost VM-DataProtection]# tp get sr -n demo2
```

NAME	APPVAULT	STATE	ERROR	AGE
demo2-fedora-restore-from-snapshot	ontap-s3-appvault	Completed		15m22s

驗證虛擬機器及其 PVC 是否在新的命名空間 demo2 中復原。

```
[root@localhost RedHat]# oc get vm,pvc -n demo2
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-fedora	29h	Running	True

NAME	ORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE	STATUS	VOLUME
persistentvolumeclaim/demo-fedora				Bound	pvc-35dcd9b2-4fca-486c-af9e-596bc5b4dc15
-zonea-san	<unset>		29h		
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87				Bound	pvc-575a3111-382f-4933-a778-0089fa1ea2af
-zonea-san	<unset>		29h		

```
[root@localhost RedHat]#
```


選擇命名空間中的特定虛擬機器來建立快照/備份和還原

在前面的例子中，我們在命名空間內有一個虛擬機器。透過將整個命名空間包含在備份中，可以擷取與該虛擬機器相關的所有資源。在下面的範例中，我們將另一個 VM 新增到同一個命名空間，並使用標籤選擇器為這個新 VM 建立一個應用程式。

在 **demo** 命名空間中建立一個新的虛擬機器（**demo-centos vm**）

```
[root@localhost VM-DataProtection]# oc get vm,pod,pvc -n demo
NAME                                     AGE      STATUS    READY
virtualmachine.kubevirt.io/demo-centos  2m47s    Running   True
virtualmachine.kubevirt.io/demo-fedora   81m      Running   True

NAME                                     READY    STATUS    RESTARTS   AGE
pod/virt-launcher-demo-centos-2nq6g     1/1      Running   0           113s
pod/virt-launcher-demo-fedora-9kfxh     1/1      Running   0           81m

NAME                                     STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS
persistentvolumeclaim/demo-centos        Bound     pvc-ed0f492b-0109-471d-b395-9077ae5f1fa7  30Gi       RWX             sc-zonea-san
persistentvolumeclaim/demo-fedora        Bound     pvc-6f69a62c-285c-4980-b0dd-6c85baccf346  30Gi       RWX             sc-zonea-san
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34  Bound     pvc-3c01142a-4344-4293-ae67-7d3925c56211  30Gi       RWX             sc-zonea-san
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87      Bound     pvc-81d82d82-7aca-40fc-8f8f-6e99246e63f8  30Gi       RWX             sc-zonea-san
[root@localhost VM-DataProtection]#
```

標記 **demo-centos vm** 及其相關資源

```
[root@localhost VM-DataProtection]# oc label vm demo-centos category=protect-demo-centos -n demo
virtualmachine.kubevirt.io/demo-centos labeled
[root@localhost VM-DataProtection]# oc label pvc demo-centos category=protect-demo-centos -n demo
persistentvolumeclaim/demo-centos labeled
[root@localhost VM-DataProtection]# oc label pvc dv-demo-centos-lavender-tortoise-34 category=protect-demo-centos -n demo
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34 labeled
[root@localhost VM-DataProtection]#
```

驗證 **demo-centos vm** 和 **pvcs** 是否已取得標籤

```
[root@localhost VM-DataProtection]# oc get vm --show-labels -n demo
NAME                                     AGE      STATUS    READY    LABELS
demo-centos 6m31s Running True    app-demo-centos,category=protect-demo-centos,kubevirt.io/dynamic-credentials-support=true,vm.kubevirt.io/template.namespace=openshift,vm.kubevirt.io/template.revision=1,vm.kubevirt.io/template.version=v0.31.1,vm.kubevirt.io/template=centos-stream9-server-small
demo-fedora 85m Running True    app-demo-fedora,vm.kubevirt.io/template.namespace=openshift,vm.kubevirt.io/template.revision=1,vm.kubevirt.io/template.version=v0.31.1,vm.kubevirt.io/template=fedora-server-small
[root@localhost VM-DataProtection]#
```

```
[root@localhost VM-DataProtection]# oc get pvc --show-labels -n demo
NAME                                     STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS    VOLUMEATTRIBUTESCLASS    AGE      LABELS
demo-centos Bound     pvc-ed0f492b-0109-471d-b395-9077ae5f1fa7  30Gi       RWX             sc-zonea-san    <unset>                  7m41s    app.kubernetes.io/component=storage,app.kubernetes.io/managed-by=cdi-controller,app.kubernetes.io/part-of=hyperconverged-cluster,app.kubernetes.io/version=4.17.5,app=containerized-data-importer,category=protect-demo-centos,instancetype.kubevirt.io/default-instancetype=ul.medium,instancetype.kubevirt.io/default-preference=centos.stream9,kubevirt.io/created-by=a6a7b49c-669a-4e21-aa78-20743671b284
demo-fedora Bound     pvc-6f69a62c-285c-4980-b0dd-6c85baccf346  30Gi       RWX             sc-zonea-san    <unset>                  86m      app.kubernetes.io/component=storage,app.kubernetes.io/managed-by=cdi-controller,app.kubernetes.io/part-of=hyperconverged-cluster,app.kubernetes.io/version=4.17.5,app=containerized-data-importer,instancetype.kubevirt.io/default-instancetype=ul.medium,instancetype.kubevirt.io/default-preference=fedora,kubevirt.io/created-by=7d5184e9-22f8-4456-9afe-3d1904c430f9
dv-demo-centos-lavender-tortoise-34 Bound     pvc-3c01142a-4344-4293-ae67-7d3925c56211  30Gi       RWX             sc-zonea-san    <unset>                  7m41s    app.kubernetes.io/component=storage,app.kubernetes.io/managed-by=cdi-controller,app.kubernetes.io/part-of=hyperconverged-cluster,app.kubernetes.io/version=4.17.5,app=containerized-data-importer,category=protect-demo-centos,kubevirt.io/created-by=a6a7b49c-669a-4e21-aa78-20743671b284
dv-demo-fedora-fuchsia-shrew-87 Bound     pvc-81d82d82-7aca-40fc-8f8f-6e99246e63f8  30Gi       RWX             sc-zonea-san    <unset>                  86m      app.kubernetes.io/component=storage,app.kubernetes.io/managed-by=cdi-controller,app.kubernetes.io/part-of=hyperconverged-cluster,app.kubernetes.io/version=4.17.5,app=containerized-data-importer,kubevirt.io/created-by=7d5184e9-22f8-4456-9afe-3d1904c430f9
[root@localhost VM-DataProtection]#
```

使用標籤選擇器僅為特定虛擬機器（**demo-centos**）建立應用程式

```
# tp create app demo-centos-app --namespaces 'demo(category=protect-
demo-centos)' -n demo --dry-run>demo-centos-app.yaml

# cat demo-centos-app.yaml

apiVersion: protect.trident.netapp.io/v1
kind: Application
metadata:
  creationTimestamp: null
  name: demo-centos-app
  namespace: demo
spec:
  includedNamespaces:
  - labelSelector:
      matchLabels:
        category: protect-demo-centos
        namespace: demo
status:
  conditions: null

# oc create -f demo-centos-app.yaml -n demo
application.protect.trident.netapp.io/demo-centos-app created
```

```
[root@localhost VM-DataProtection]# tp get app -n demo
```

NAME	NAMESPACES	STATE	AGE
demo-centos-app	demo	Ready	56s
demo-vm	demo	Ready	4h6m

按需和按計劃建立備份和快照的方法與前面所示的相同。由於用於建立快照或備份的 trident-protect 應用程式僅包含來自命名空間的特定 VM，因此從它們還原只會還原特定的 VM。下面顯示了一個備份/復原作業的範例。

使用其對應的應用程式建立命名空間中特定虛擬機器的備份

在前面的步驟中，使用標籤選擇器建立了一個應用程式，以僅包含演示命名空間中的 centos vm。為此應用程式建立備份（在本例中為按需備份）。

```
# tp create backup demo-centos-backup-on-demand --app demo-centos-app
--appvault ontap-s3-appvault -n demo
Backup "demo-centos-backup-on-demand" created.
```

NAME	APP	RECLAIM POLICY	STATE	ERROR	AGE
demo-centos-backup-on-demand	demo-centos-app	Retain	Completed		13m22s
demo-vm-backup-on-demand	demo-vm	Retain	Completed		4h19m
hourly-4c094-20250312174500	demo-vm	Retain	Completed		56m17s

將特定的 **VM** 還原到同一個命名空間 使用對應的應用程式建立了特定的 VM (centos) 的備份。如果從此建立了備份就地恢復或備份恢復，則僅還原此特定的 VM。刪除 Centos VM。

```
[root@localhost RedHat]# oc get vm,pvc -n demo
NAME                                     AGE      STATUS    READY
virtualmachine.kubevirt.io/demo-centos  4m27s    Running   True
virtualmachine.kubevirt.io/demo-fedora   4m27s    Running   True

NAME                                     STATUS    VOLUME
persistentvolumeclaim/demo-centos        Bound     pvc-e8faeaf8-fc0c-4d92-96de-c83a335a7a17
  sc-zonea-san    <unset>          4m33s
persistentvolumeclaim/demo-fedora        Bound     pvc-e2f418b0-1b97-40fc-9cb8-943b370d85bc
  sc-zonea-san    <unset>          4m33s
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34  Bound     pvc-66eb7996-1420-4513-a67c-2824f08534da
  sc-zonea-san    <unset>          4m33s
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87      Bound     pvc-db085154-079f-45ad-9e62-9656e913d01c
  sc-zonea-san    <unset>          4m32s

[root@localhost RedHat]# oc delete virtualmachine.kubevirt.io/demo-centos -n demo
virtualmachine.kubevirt.io "demo-centos" deleted
[root@localhost RedHat]# oc get vm,pvc -n demo
NAME                                     AGE      STATUS    READY
virtualmachine.kubevirt.io/demo-fedora   5m17s    Running   True

NAME                                     STATUS    VOLUME
persistentvolumeclaim/demo-fedora        Bound     pvc-e2f418b0-1b97-40fc-9cb8-943b370d85bc
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87      Bound     pvc-db085154-079f-45ad-9e62-9656e913d01c
[root@localhost RedHat]#
```

從 demo-centos-backup-on-demand 建立備份就地還原並驗證 centos VM 是否已重新建立。

```
#tp create bir demo-centos-restore --backup demo/demo-centos-backup-on-demand -n demo
BackupInplaceRestore "demo-centos-restore" created.
```

```
[root@localhost RedHat]# tp get bir -n demo
```

NAME	APPVAULT	STATE	ERROR	AGE
demo-centos-restore	ontap-s3-appvault	Completed		57m9s
demo-fedora-restore	ontap-s3-appvault	Completed		7d5h


```
[root@localhost RedHat]# oc get vm,pvc -n demo
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-centos	29m	Running	True
virtualmachine.kubevirt.io/demo-fedora	85m	Running	True

NAME	STORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE	STATUS	VOLUME
persistentvolumeclaim/demo-centos	sc-zonea-san	<unset>	29m	Bound	pvc-82954bf7-4a7e-4e0c-9a04-4fa152e1b0ef
persistentvolumeclaim/demo-fedora	sc-zonea-san	<unset>	85m	Bound	pvc-e2f418b0-1b97-40fc-9cb8-943b370d85bc
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34	sc-zonea-san	<unset>	29m	Bound	pvc-2a8d4eb5-ed6d-4408-b85d-e218e9a5d4b0
persistentvolumeclaim/dv-demo-fedora-fuchsia-shrew-87	sc-zonea-san	<unset>	85m	Bound	pvc-db085154-079f-45ad-9e62-9656e913d01c

```
[root@localhost RedHat]#
```

將特定的 **VM** 還原到不同的命名空間 從 demo-centos-backup-on-demand 建立到不同命名空間 (demo3) 的備份恢復，並驗證 centos VM 是否已重新建立。

```
# tp create br demo2-centos-restore --backup demo/demo-centos-backup-on-demand --namespace-mapping demo:demo3 -n demo3
BackupRestore "demo2-centos-restore" created.
```

```
[root@localhost RedHat]#
[root@localhost RedHat]# tp get br -n demo3
```

NAME	APPVAULT	STATE	ERROR	AGE
demo2-centos-restore	ontap-s3-appvault	Completed		52m57s

```
[root@localhost RedHat]#
```

```
[root@localhost RedHat]#
[root@localhost RedHat]# oc get vm,pvc -n demo3
```

NAME	AGE	STATUS	READY
virtualmachine.kubevirt.io/demo-centos	19m	Running	True

NAME	STORAGECLASS	VOLUMEATTRIBUTESCLASS	AGE	STATUS	VOLUME
persistentvolumeclaim/demo-centos	sc-zonea-san	<unset>	19m	Bound	pvc-0a14e38f-07de-4e09-8f88-14a9a8bb45c2
persistentvolumeclaim/dv-demo-centos-lavender-tortoise-34	sc-zonea-san	<unset>	19m	Bound	pvc-d4f9cf2f-264c-4d02-94bf-0db28b427acc

```
[root@localhost RedHat]#
```

影片示範

以下影片示範如何使用快照保護虛擬機

[保護虛擬機](#)

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