Primera 同步远程复制配置参考指南

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存储产品支持部

——伍雅宁

版本编号：20200701

目录

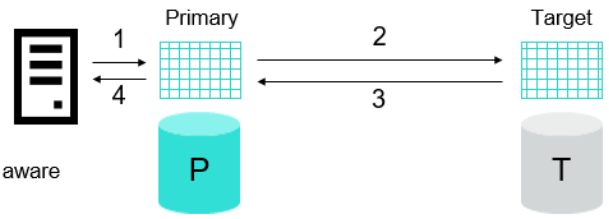
同步远程复制原理和拓扑

主机发送 I/O 到主存储缓存后，主存储会立即把数据同步到目标存储缓存，然后目标存储做完缓存镜像后向主存储确认接收到 I/O 后，最后主存储向主机回复接收到 I/O。

Synchronous mode

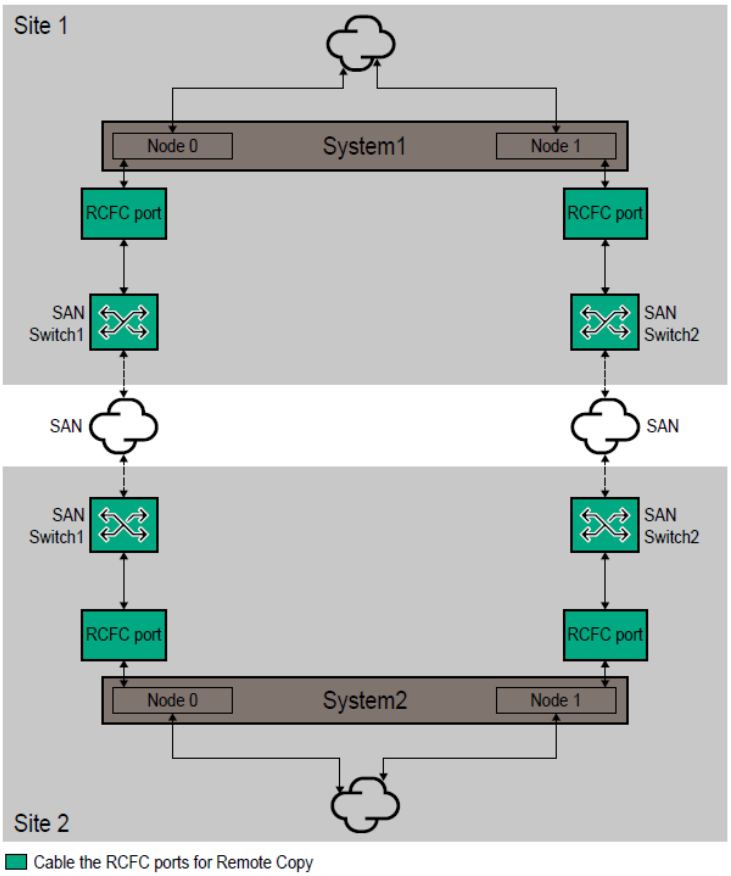
Continuous operation and synchronization

- Real-time Mirror
  - Highest I/O currency
  - Lock-step data consistency
- Space Efficient
  - Thin provisioning/Thin deduped/Compression aware
- Targeted Use
  - Campus-wide business continuity
- Guaranteed Consistency



1 : Host server writes I/O to primary write cache
2 : Primary array writes I/O to secondary write cache
3 : Remote array acknowledges the receipt of the I/O
4 : Host I/O acknowledged to host

本次以 RCFC 作为远程复制链路，把两个节点的远程复制端口连接到不同 SAN 交换机上，主存储和目标存储的的 0:3:4 端口连接到 1 号交换机，主存储和目标存储的 1:3:4 端口连接到 2 号交换机。



远程复制链路配置

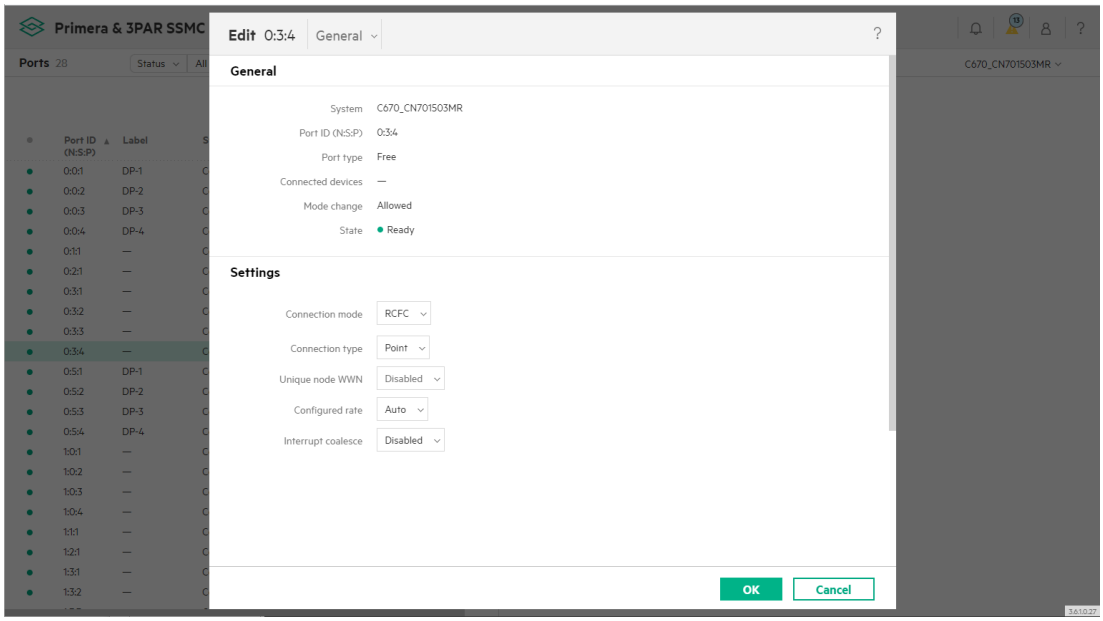
默认情况下存储FC端口模式为Target，也就是主机端口，使用showportdev命令确认当前这些端口没有被使用，然后把主存储和目标存储端口一对一划分WWPN Zone。把端口离线之后配置为RCFC端口，在命令行下需要使用controlport offline和controlport config rcfc进行配置。配置之后端口模式变为Initiator，查看端口参数可见当前IntCoal参数默认为Enabled。IntCoal解释："Interrupt coalescing" (IntCoal) allows the device driver to delay delivery of the interrupt to the kernel by waiting a short while (around 0.2 ms by default) in order to coalesce other interrupts.

```
C630 cli% showport 0:3:4 1:3:4
N:S:P   Mode State ----Node_WWN---- -Port_WWN/HW_Addr- Type Protocol Label Partner FailoverState
0:3:4 target ready 2FF70002AC025C02   20340002AC025C02 free       FC     -   1:3:4          none
1:3:4 target ready 2FF70002AC025C02   21340002AC025C02 free       FC     -   0:3:4          none
------------------------------------------------------------------------------------------------
    2
C630 cli% controlport offline 0:3:4 1:3:4
Are you sure you want to run controlport offline on port 0:3:4?
select q=quit y=yes n=no: y
Are you sure you want to run controlport offline on port 1:3:4?
select q=quit y=yes n=no: y
C630 cli% controlport config rcfc 0:3:4 1:3:4
Are you sure you want to run controlport config rcfc on port 0:3:4 (connection type point)?
select q=quit y=yes n=no: y
Are you sure you want to run controlport config rcfc on port 1:3:4 (connection type point)?
select q=quit y=yes n=no: y
C630 cli% showport 0:3:4 1:3:4
N:S:P      Mode State ----Node_WWN---- -Port_WWN/HW_Addr- Type Protocol Label Partner FailoverState
0:3:4 initiator ready 2FF70002AC025C02   20340002AC025C02 free       FC     -       -             -
1:3:4 initiator ready 2FF70002AC025C02   21340002AC025C02 free       FC     -       -             -
------------------------------------------------------------------------------------------------
    2
C630 cli% showportdev all  0:3:4 1:3:4
Illegal integer argument 0:3:4

C630 cli% showportdev all  0:3:4
   PtId LpID  Hadr ----Node_WWN---- -Port_WWN/HW_Addr- ftrs   svpm   bbct flen   -----vp_WWN----- Name
0xa0600 0x00  0x00 2FF70002AC025C02 20340002AC025C02   0x8800 0x0032 n/a  0x0800 20340002AC025C02 0:3:4
------------------------------------------------------------------------------------------------
     1 total
C630 cli% showportdev all  1:3:4
    PtId LpID  Hadr ----Node_WWN---- -Port_WWN/HW_Addr- ftrs   svpm   bbct flen   -----vp_WWN----- Name
0x140600 0x00  0x00 2FF70002AC025C02 21340002AC025C02   0x8800 0x0032 n/a  0x0800 21340002AC025C02 1:3:4
------------------------------------------------------------------------------------------------
      1 total
C630 cli% showport -par  0:3:4 1:3:4
N:S:P Connmode ConnType CfgRate MaxRate Class2   UniqNodeWwn VCN      IntCoal TMWO     Smart_SAN
0:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled enabled disabled unsupported
1:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled enabled disabled unsupported
------------------------------------------------------------------------------------------------
```

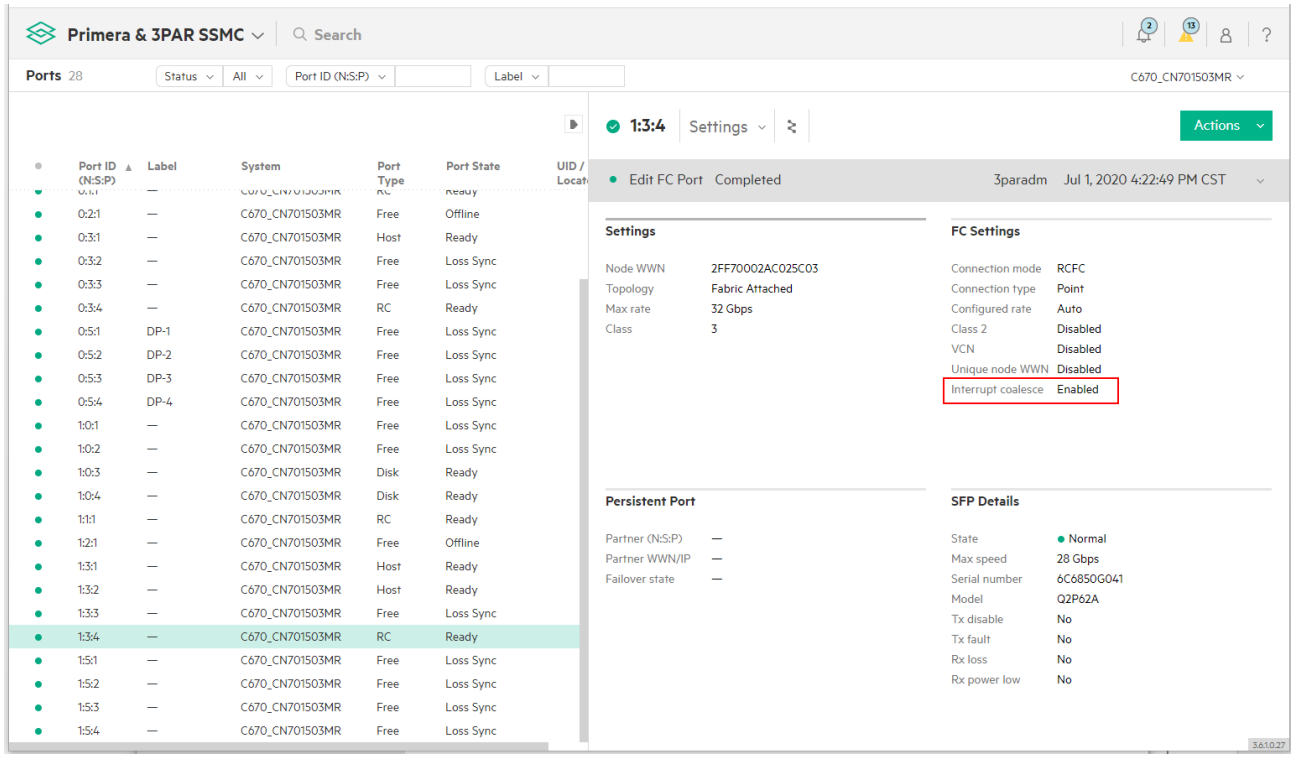
目前 Primera 远程复制手册没有提及这个参数，但参考 3PAR Remote Copy 手册还是建议使用 controlport intcoal disable 禁用这个参数。

```
C630 cli% showport -par 0:3:4 1:3:4
N:S:P Connmode ConnType CfgRate MaxRate Class2   UniqNodeWwn VCN      IntCoal TMWO     Smart_SAN
0:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled enabled disabled unsupported
1:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled enabled disabled unsupported
------------------------------------------------------------------------------------------------
2
C630 cli%  controlport intcoal disable -f 0:3:4
C630 cli% controlport intcoal disable -f 1:3:4
C630 cli% showport -par 0:3:4 1:3:4
N:S:P Connmode ConnType CfgRate MaxRate Class2   UniqNodeWwn VCN      IntCoal  TMWO     Smart_SAN
0:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled disabled disabled unsupported
1:3:4 rcfc     point    auto    32Gbps  disabled disabled    disabled disabled disabled unsupported
------------------------------------------------------------------------------------------------
2
C630 cli%
```

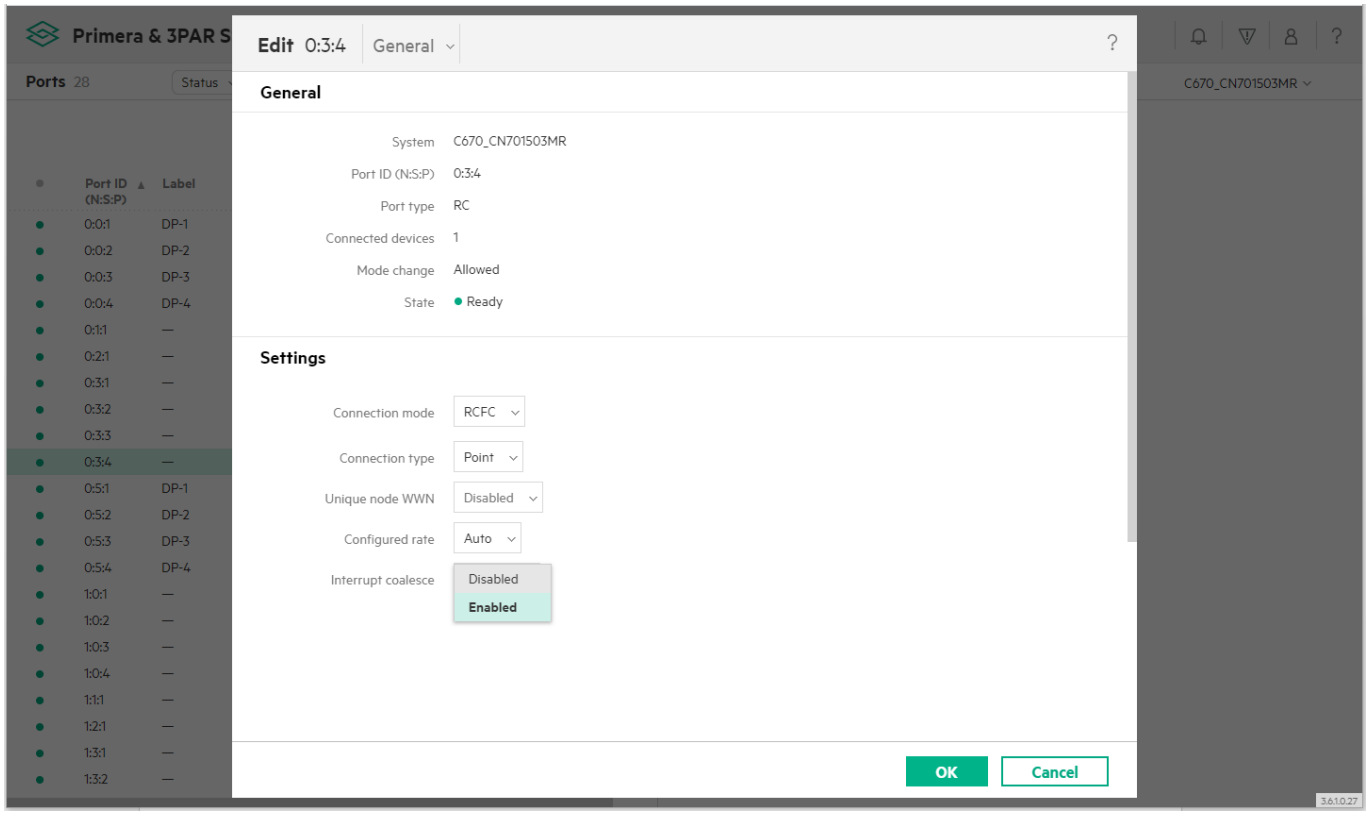
在 SSMC 中也可以选中 FC 端口后点击编辑，把端口连接模式改为 RCFC，然后点击 OK。这里可见在 SSMC 配置 RCFC 端口时 IntCoal 的设置为禁用。



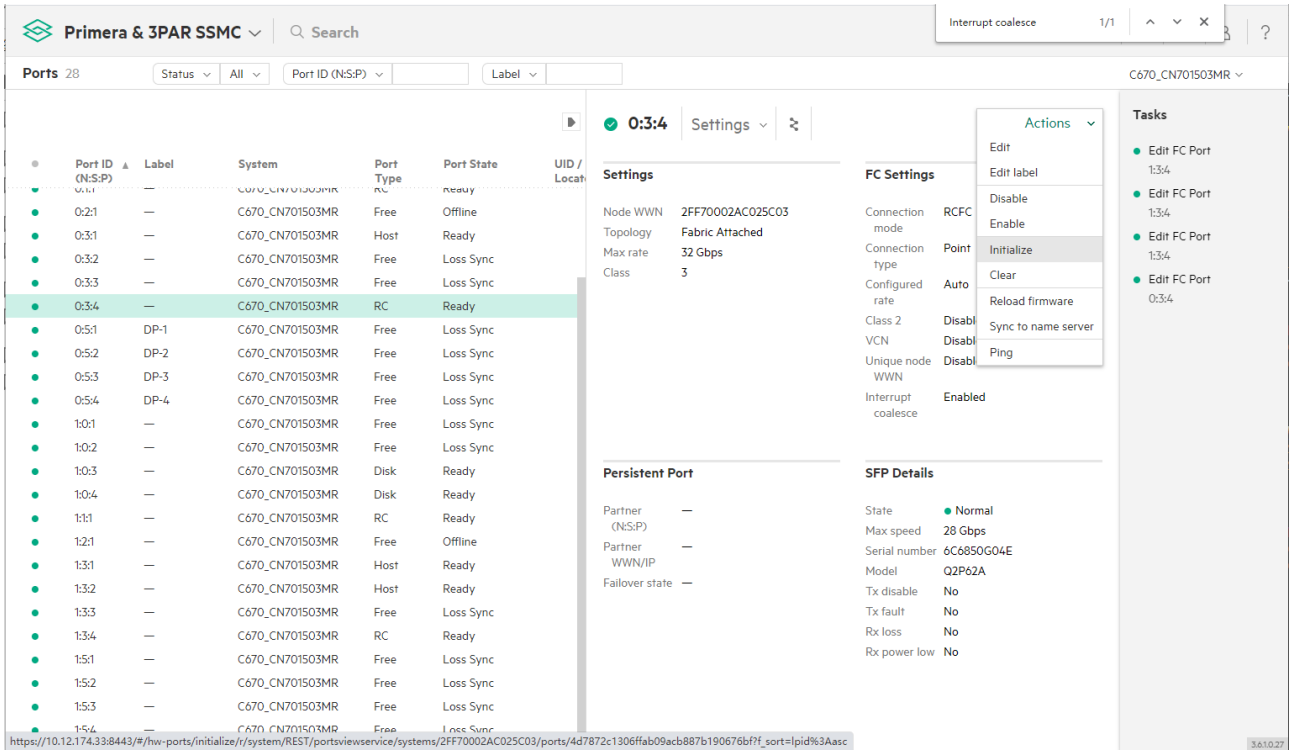
但配置完成之后 IntCoal 参数仍旧是启用状态。



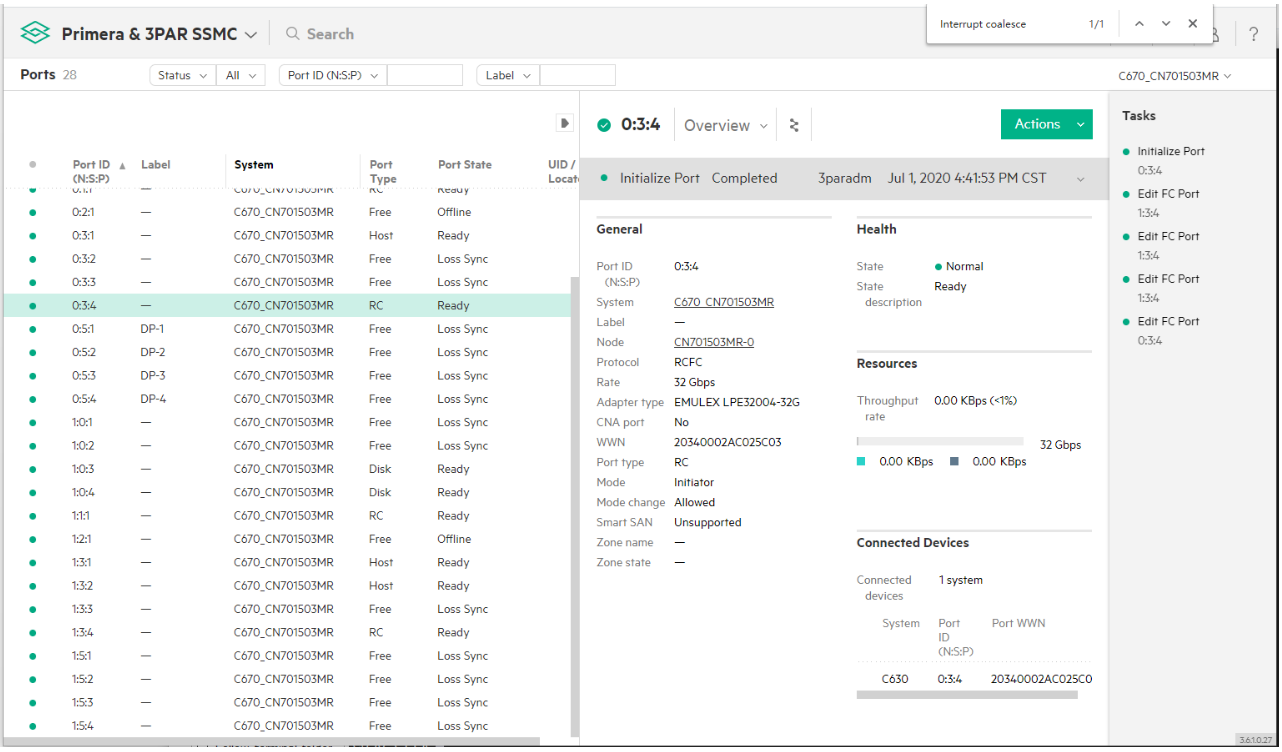
建议编辑端口手动禁用此参数。



把端口配置为 RCFC 之后需要对端口进行初始化。



如果两端 RCFC 端口都初始化完成并且 Zone 配置正确则可以看到对端 RCFC 端口已经 Login。



在命令行下可以使用 showportdev 确认 FC 端口 Login 状态。使用 showrctransport –rcfc 确认 RCFC 端口状态，两端 RCFC 端口都初始化完成并且 Zone 配置正确后 RCFC 端口状态从 New 变为 ready。

```
C630 cli% showport 0:3:4 1:3:4
N:S:P      Mode State ----Node_WWN---- -Port_WWN/HW_Addr- Type Protocol Label Partner FailoverState
0:3:4 initiator ready 2FF70002AC025C02   20340002AC025C02 rcfc       FC     -       -             -
1:3:4 initiator ready 2FF70002AC025C02   21340002AC025C02 rcfc       FC     -       -             -
---------------------------------------------------------------------------------------------------
    2
C630 cli% showportdev all 0:3:4
   PtId LpID  Hadr ----Node_WWN---- -Port_WWN/HW_Addr- ftrs   svpm   bbct   flen   -----vp_WWN----- Name
0xa0600 0x00  0x00 2FF70002AC025C02 20340002AC025C02  0x8800 0x0032 n/a    0x0800 20340002AC025C02 0:3:4
0xa0700 0x04  n/a  2FF70002AC025C03 20340002AC025C03  0x0000 0x0032 0x0000 n/a    20340002AC025C02 -
---------------------------------------------------------------------------------------------------------
      2 total
C630 cli% showportdev all 1:3:4
    PtId LpID  Hadr ----Node_WWN---- -Port_WWN/HW_Addr- ftrs   svpm   bbct   flen   -----vp_WWN----- Name
0x140600 0x00  0x00 2FF70002AC025C02 21340002AC025C02  0x8800 0x0032 n/a    0x0800 21340002AC025C02 1:3:4
0x140700 0x05  n/a  2FF70002AC025C03 21340002AC025C03  0x0000 0x0032 0x0000 n/a    21340002AC025C02 -
----------------------------------------------------------------------------------------------------------
       2 total
C630 cli% showrctransport -rcfc
N:S:P Peer_Node_WWN    Peer_Port_WWN    State
0:3:4 2FF70002AC025C03 20340002AC025C03 new
1:3:4 2FF70002AC025C03 21340002AC025C03 new
C630 cli% controlport rcfc init -f 0:3:4
C630 cli% controlport rcfc init -f 1:3:4
C630 cli% showrctransport -rcfc
N:S:P Peer_Node_WWN    Peer_Port_WWN    State
0:3:4 2FF70002AC025C03 20340002AC025C03 incomplete
1:3:4 2FF70002AC025C03 21340002AC025C03 incomplete
C630 cli% showrctransport -rcfc
N:S:P Peer_Node_WWN    Peer_Port_WWN    State
0:3:4 2FF70002AC025C03 20340002AC025C03 ready
1:3:4 2FF70002AC025C03 21340002AC025C03 incomplete
C630 cli% showrctransport -rcfc
N:S:P Peer_Node_WWN    Peer_Port_WWN    State
0:3:4 2FF70002AC025C03 20340002AC025C03 ready
1:3:4 2FF70002AC025C03 21340002AC025C03 incomplete
C630 cli% showrctransport -rcfc
N:S:P Peer_Node_WWN    Peer_Port_WWN    State
0:3:4 2FF70002AC025C03 20340002AC025C03 ready
1:3:4 2FF70002AC025C03 21340002AC025C03 ready
C630 cli%
```

RCFC 端口配置完成后，使用 checkrclink 命令检查两端连通性和吞吐量，在其中一台存储上使用 checkrclink startserver 本地端口命令，把本地存储作为服务器。这里注意 Local IP Addr 后面的 IPv6 地址，后面要使用到。

```
C670_CN701503MR cli% checkrclink startserver 1:3:4
Starting Server
Test length (secs):       172800
Time now (secs):          1593595001
Min run time (secs):      1593767801
Running link test on:     1:3:4
Local IP Addr:            fe80::2134:2:ac02:5c03
Local Device name:        fcnet2
```

把另外一端作为客户端，使用 checkrclink startclient 本地端口 对端 IPv6 地址开始检测，300 单位是秒。

```
C630 cli% checkrclink startclient 1:3:4 fe80::2134:2:ac02:5c03 300
Running Client Side
Running link test on:  1:3:4
Test length (secs):    300
Destination Addr:      fe80::2134:2:ac02:5c03
Local IP Addr:           fe80::2134:2:ac02:5c02
Local Device name:       fcnet2

------------------------------------------------------------
Measuring link latency
------------------------------------------------------------

Average measured latency: 0.108 ms
Pings Lost:               0 %

------------------------------------------------------------
Starting throughput test, from 1:3:4 -> fe80::2134:2:ac02:5c03
------------------------------------------------------------
------------------------------------------------------------
Client connecting to fe80::2134:2:ac02:5c03%fcnet2, TCP port 5001
TCP window size: 1285 KByte (default)
------------------------------------------------------------
[  5] local fe80::2134:2:ac02:5c02 port 48870 connected with fe80::2134:2:ac02:5c03 port 5001
[  4] local fe80::2134:2:ac02:5c02 port 48864 connected with fe80::2134:2:ac02:5c03 port 5001
[  3] local fe80::2134:2:ac02:5c02 port 48866 connected with fe80::2134:2:ac02:5c03 port 5001
[  6] local fe80::2134:2:ac02:5c02 port 48868 connected with fe80::2134:2:ac02:5c03 port 5001
```

测试完成后会显示当前两套存储通过此链路产生的吞吐量以及是否适合配置远程复制，使用相同方法测试所有端口确认所有端口可以正常配置远程复制。

```
[ ID] Interval       Transfer     Bandwidth
[  5]  0.0-300.0 sec  238319104 KBytes  6507648 Kbits/sec
[  4]  0.0-300.0 sec  238240128 KBytes  6505520 Kbits/sec
[  3]  0.0-300.0 sec  238240768 KBytes  6505549 Kbits/sec
[  6]  0.0-300.0 sec  238298240 KBytes  6507036 Kbits/sec
[SUM]  0.0-300.0 sec  953098240 KBytes  26025559 Kbits/sec

============================================================
TEST SUMMARY from 1:3:4 -> fe80::2134:2:ac02:5c03
Test Started:     Wed Jul  1 17:17:19 CST 2020
Test Finished:    Wed Jul  1 17:22:21 CST 2020
============================================================

Latency:                    0.108 ms
Lost pings:                 0 %
Through-put:              > 26025559 Kbits/second
FC Invalid Words (ne):      0
FC CRC Errors (ne):         0
FC Invalid Words (fe):      0
FC CRC Errors (fe):         0

Link 1:3:4 is SUITABLE for Remote Copy Use

============================================================
```

远程复制目标配置

当前远程复制端口配置完成，使用 startrcopy 启用远程复制功能，在主存储上配置了远程复制目标后，由于目标存储还没有进行配置，所以 Link 状态为 Down。

```
C630 cli% showport -rcfc
N:S:P      Mode State ----Node_WWN---- ----Port_WWN----   Rate
0:3:4 initiator ready 2FF70002AC025C02 20340002AC025C02 32Gbps
1:3:4 initiator ready 2FF70002AC025C02 21340002AC025C02 32Gbps
------------------------------------------------------------
    2
C630 cli% showrcopy

Remote Copy System Information
Status: Started, Normal
C630 cli% creatercopytarget C670_CN701503MR FC 2FF70002AC025C03 0:3:4:20340002AC025C03
C630 cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name            ID Type Status Options          Policy
C670_CN701503MR  3 FC   new    2FF70002AC025C03 mirror_config

Link Information

Target          Node  Address          Status Options
C670_CN701503MR 0:3:4 20340002AC025C03 Down   -
receive         0:3:4 20340002AC025C03 Up     -
C630 cli%
```

在目标存储上配置远程复制目标后，使用 showrcopy 可见 Target 状态为 ready，Link 状态为 Up。

```
C670_CN701503MR cli% showport -rcfc
N:S:P      Mode State ----Node_WWN---- ----Port_WWN----   Rate
0:3:4 initiator ready 2FF70002AC025C03 20340002AC025C03 32Gbps
1:3:4 initiator ready 2FF70002AC025C03 21340002AC025C03 32Gbps
------------------------------------------------------------
    2
C670_CN701503MR cli% creatercopytarget C630 FC 2FF70002AC025C02 0:3:4:20340002AC025C02
C670_CN701503MR cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name ID Type Status Options          Policy
C630  3 FC   ready  2FF70002AC025C02 mirror_config

Link Information

Target  Node  Address          Status Options
C630    0:3:4 20340002AC025C02 Up     -
receive 0:3:4 20340002AC025C02 Up     -
C670_CN701503MR cli%
```

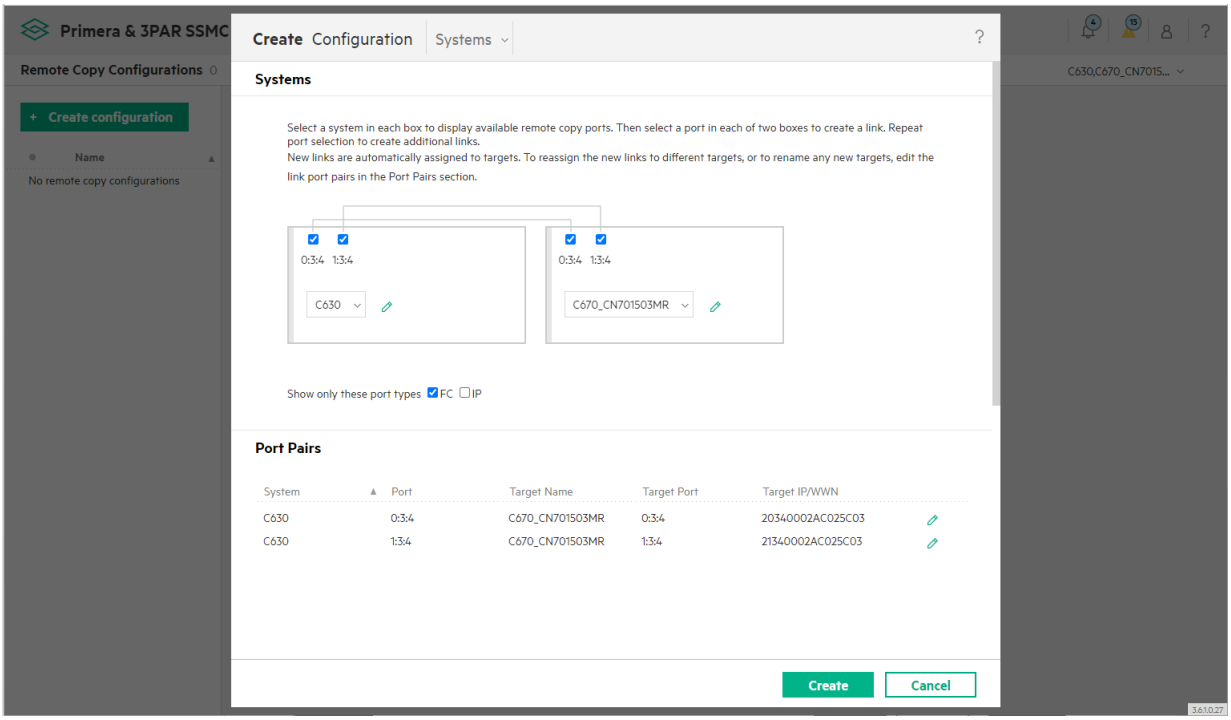
使用 admitrcopylink 把另外一条链路也加入到远程复制目标中。

```
C630 cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name            ID Type Status Options          Policy
C670_CN701503MR  3 FC   ready  2FF70002AC025C03 mirror_config

Link Information

Target          Node  Address          Status Options
C670_CN701503MR 0:3:4 20340002AC025C03 Up     -
receive         0:3:4 20340002AC025C03 Up     -
C630 cli% admitrcopylink C670_CN701503MR 1:3:4:21340002AC025C03
C630 cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name            ID Type Status Options          Policy
C670_CN701503MR  3 FC   ready  2FF70002AC025C03 mirror_config

Link Information

Target          Node  Address          Status Options
C670_CN701503MR 0:3:4 20340002AC025C03 Up     -
C670_CN701503MR 1:3:4 21340002AC025C03 Down   -
receive         0:3:4 20340002AC025C03 Up     -
receive         1:3:4 21340002AC025C03 Up     -
```

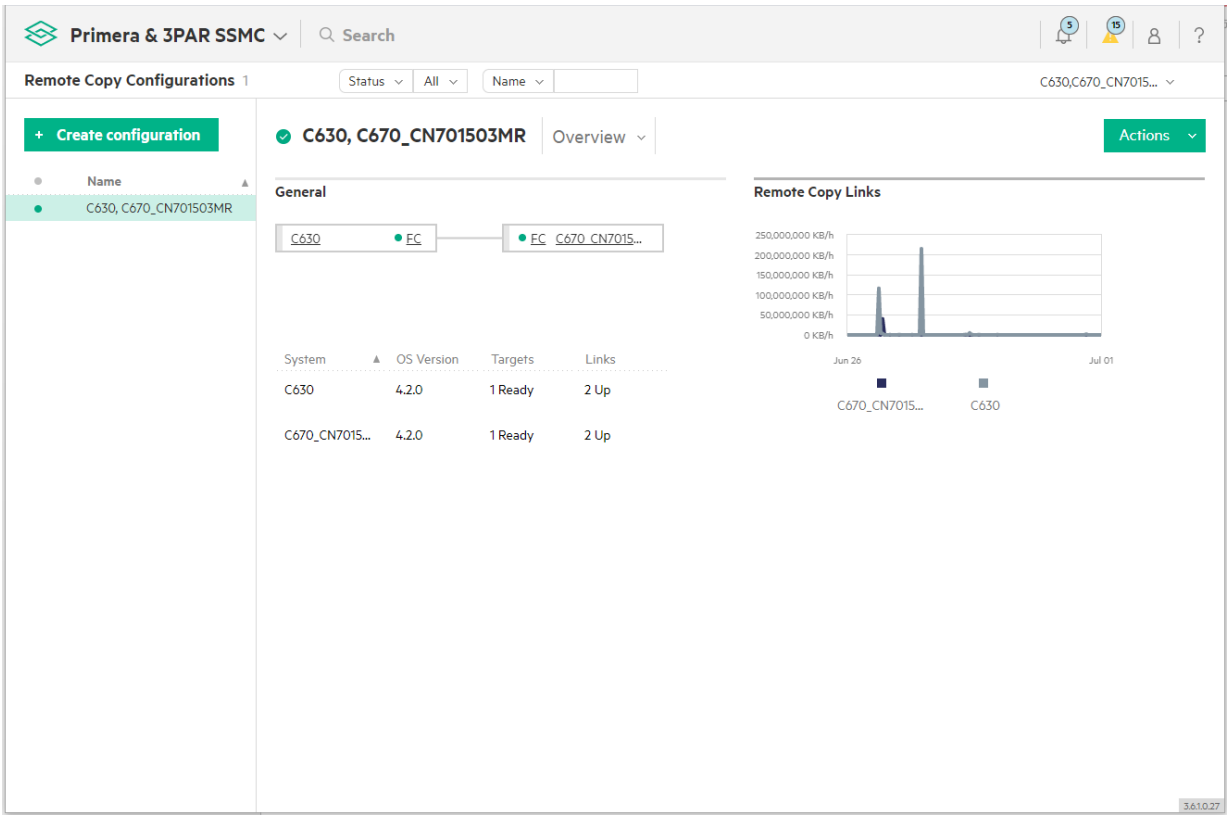
两套存储都做完此操作后所有复制目标和链路状态显示正常。

```
C670_CN701503MR cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name ID Type Status Options          Policy
C630  3 FC   ready  2FF70002AC025C02 mirror_config

Link Information

Target  Node  Address          Status Options
C630    0:3:4 20340002AC025C02 Up     -
receive 0:3:4 20340002AC025C02 Up     -
C670_CN701503MR cli% admitrcopylink C630 1:3:4:21340002AC025C02
C670_CN701503MR cli% showrcopy

Remote Copy System Information
Status: Started, Normal

Target Information

Name ID Type Status Options          Policy
C630  3 FC   ready  2FF70002AC025C02 mirror_config

Link Information

Target  Node  Address          Status Options
C630    0:3:4 20340002AC025C02 Up     -
C630    1:3:4 21340002AC025C02 Up     -
receive 0:3:4 20340002AC025C02 Up     -
receive 1:3:4 21340002AC025C02 Up     -
```

也可以使用 SSMC 配置，选中两套存储后点击 Remote Copy Configurations，点击 Create configuration，左侧选中主存储并勾选端口，右侧选择目标存储并勾选端口，然后点击 Create。



远程复制目标创建完成。



远程复制组配置

可以在主存储上使用 creatercopygroup 命令建立模式为同步的远程复制组，以下为示例：
Creatercopygroup -usr_cpg ForVmware C670_CN701503MR:SSD_r6 -snp_cpg ForVmware C670_CN701503MR:SSD_r6 ForVmware C670_CN701503MR:sync

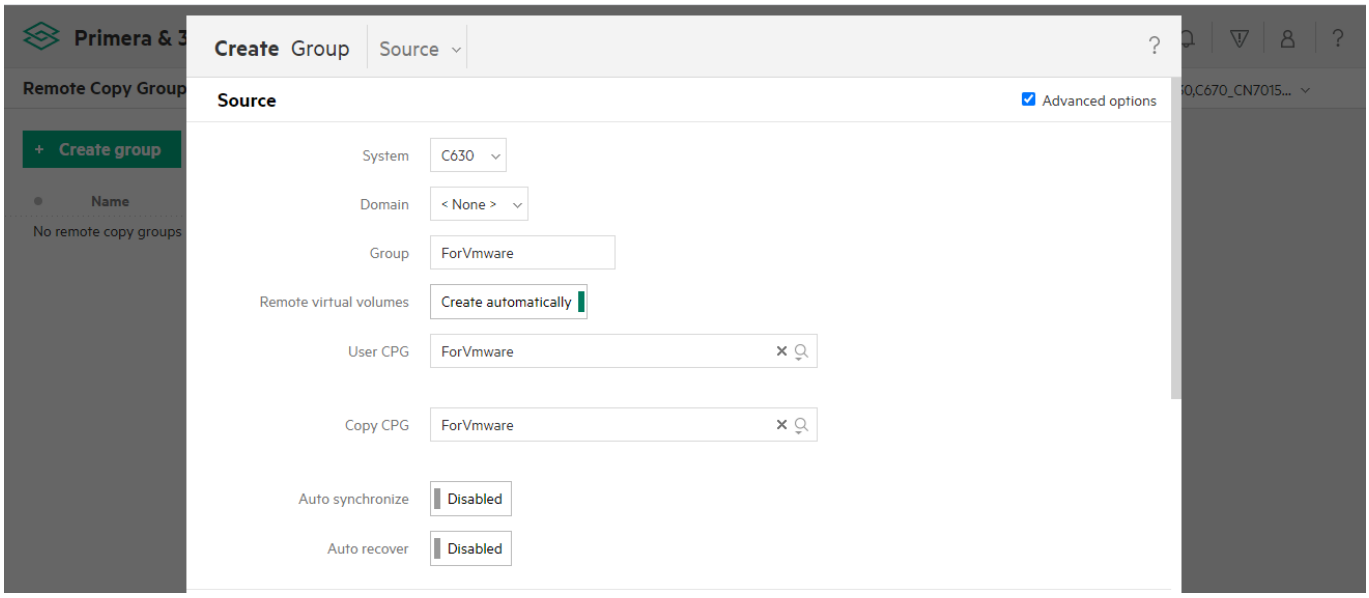
可以使用 admitrcopyvv 命令把卷加入远程复制组，以下为示例：
admitrcopyvv -createvv VMFS5 ForVmware C670_CN701503MR:VMFS5.r （createvv 可以自动创建远程卷）

```
C630 cli% showrcopy groups

Remote Copy System Information
Status: Started, Normal
C630 cli% creatercopygroup  -usr_cpg ForVmware C670_CN701503MR:SSD_r6 -snp_cpg ForVmware C670_CN701503MR:SSD_r6 ForVmware
C670_CN701503MR:sync
C630 cli% showrcopy groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         Target          Status   Role       Mode     Options
ForVmware    C670_CN701503MR New      Primary    Sync
  LocalVV      ID   RemoteVV     ID   SyncStatus    LastSyncTime

C630 cli% admitrcopyvv -createvv VMFS5 ForVmware C670_CN701503MR:VMFS5.r
C630 cli% showrcopy groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         Target          Status   Role       Mode     Options
ForVmware    C670_CN701503MR New      Primary    Sync
  LocalVV      ID   RemoteVV     ID   SyncStatus    LastSyncTime
  VMFS5          23 VMFS5.r       478 New           NA

C630 cli%
```

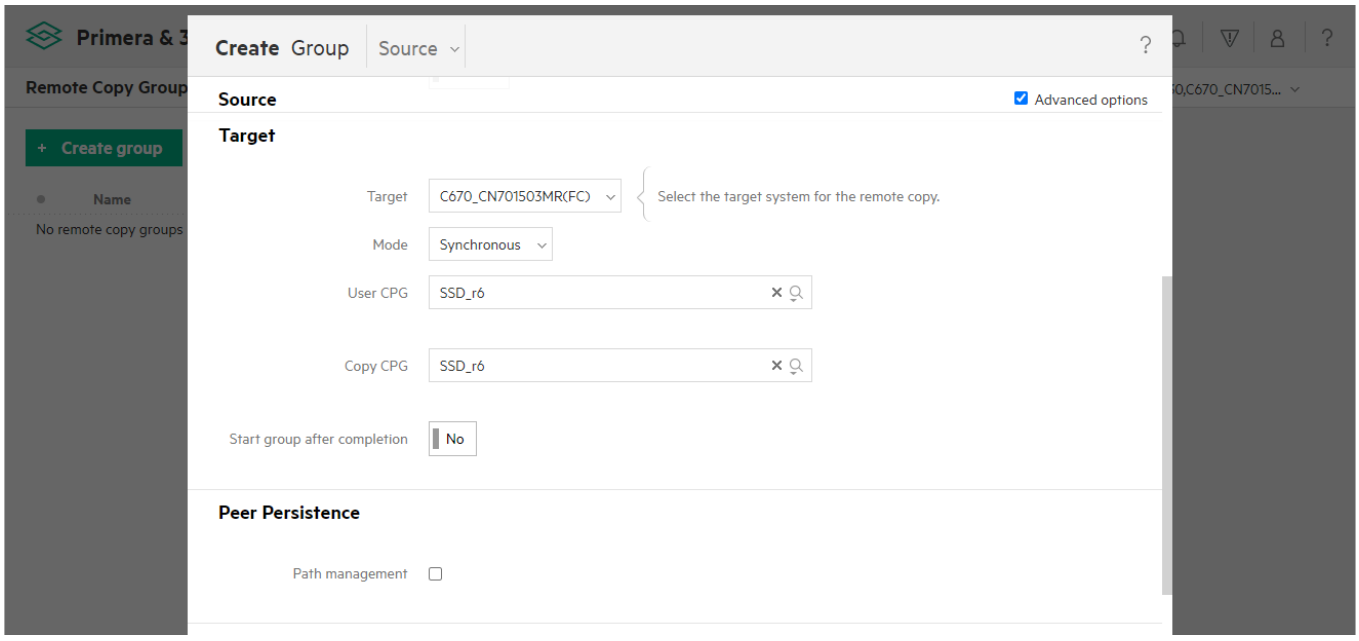
在主存储执行过 admitrcopyvv 命令后，目标存储上也创建了相同 WWID 的远程卷。

```
C670_CN701503MR cli% showvv -rcopy
                                                                                -Rsvd(MiB)- -(MiB)-
 Id Name      Prov Compr Dedup Type CopyOf BsId Rd -Detailed_State- Snp     Usr   VSize RcopyStatus RcopyGroup
  2 .mgmtdata full NA    NA    base ---       2 RW normal             0  524288  524288 none        --
  1 .srdata   full NA    NA    base ---       1 RW normal             0  102400  102400 none        --
  0 admin     full NA    NA    base ---       0 RW normal             0   10240   10240 none        --
478 VMFS5.r   tpvv No    No    base ---     478 RW normal           512     512  102400 secondary   ForVmware.r154626
-------------------------------------------------------------------------------------------------------------------
  4 total                                                           512  637440  739328
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    6 C630       New      Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r       478 VMFS5          23 New           none      none     NA      NA     NA     NA

C670_CN701503MR cli%
```

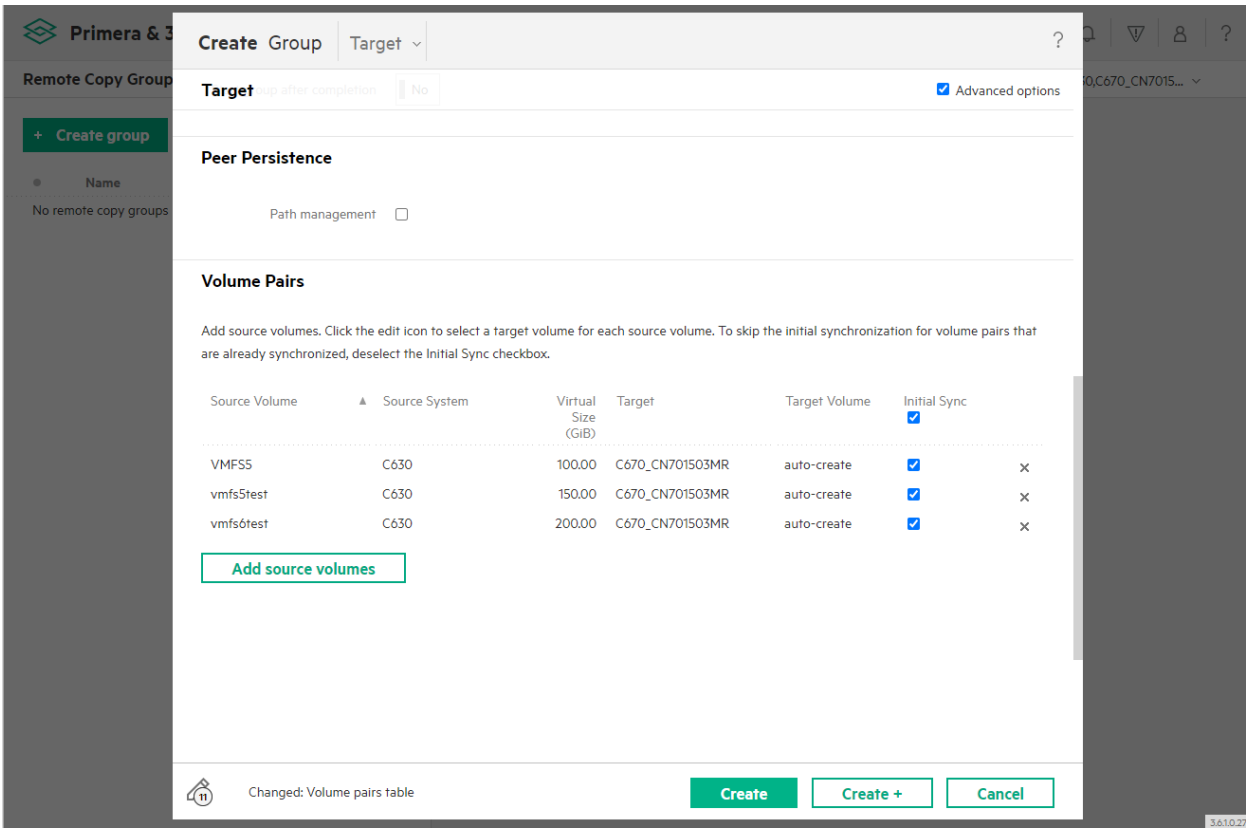
在 SSMC 或使用 creatercopygroup 命令创建远程复制组。选择主存储并给远程复制组命名，选择自动创建远程卷，设置远程复制组的 User CPG 和 Copy CPG，auto synchronize 策略可以让远程复制组在故障转移后自动反向同步，auto recover 可以在远程复制链路恢复后自动启动远程复制组。



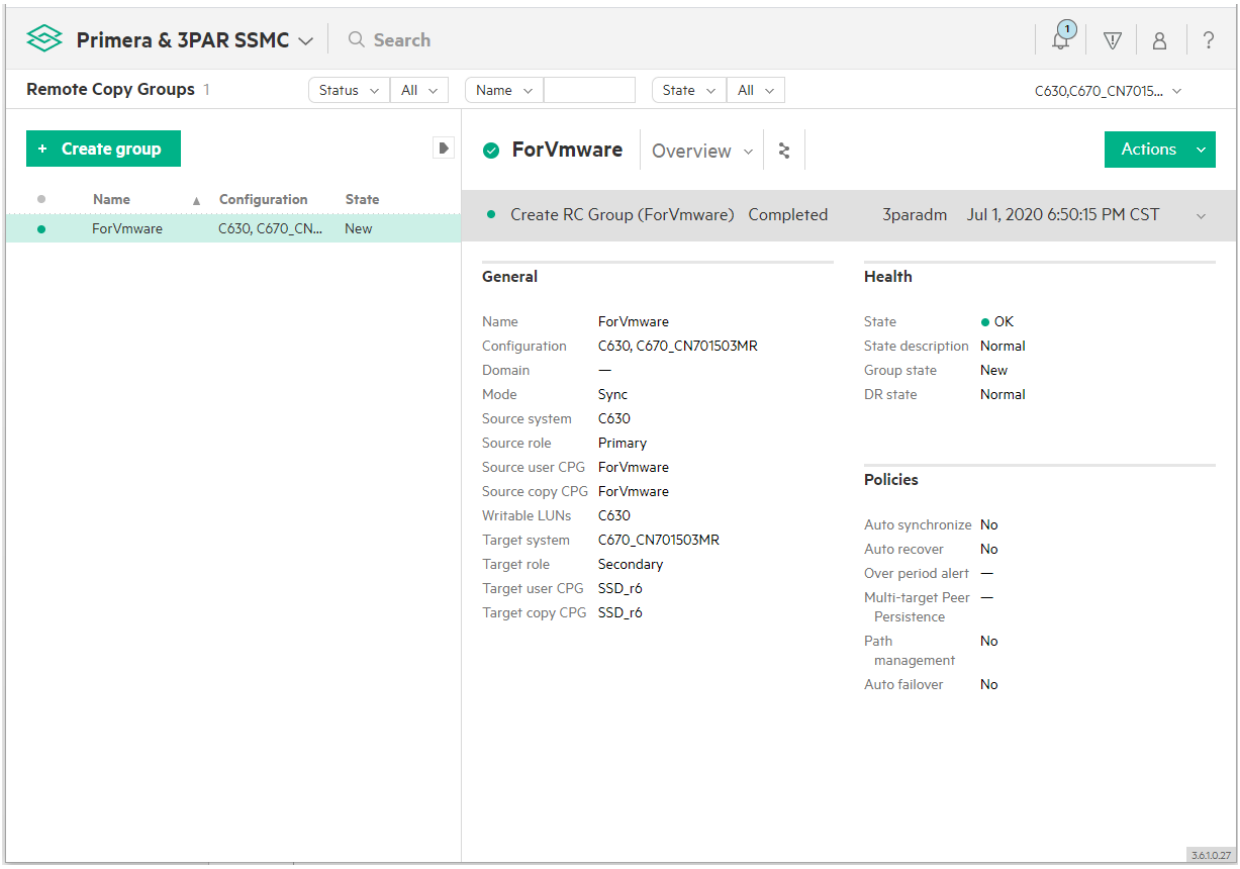
选择复制目标，模式选择同步，选择复制目标的 User CPG 和 Copy CPG，选择是否在创建复制组后自动启动开始同步，本次不配置 Peer Persistence 所以不勾选 Path management。



往复制组添加卷，并点击 Create。



远程复制组创建完成。



远程卷同步原理

使用 showrcopy 命令可以比较直观的看到远程复制组的状态，由于还没有开始同步所以主存储当前同步状态为 New。

```
C630 cli% showvv -s VMFS5
                              ---------Snp---------- ----------Usr---------- ----------Total----------
                              --(MiB)-- -(% VSize)-- ---(MiB)--- -(% VSize)-- ----------(MiB)---------- ---Efficiency---
Id Name  Prov Compr Dedup Type Rsvd Used Used Wrn Lim  Rsvd  Used Used Wrn Lim  Rsvd  Used HostWr  VSize Compact Compress
23 VMFS5 tpvv No    No    base 8064    0  0.0   0   0 72448 62223 60.8   0   0 80512 62223  62222 102400    1.65       --
-------------------------------------------------------------------------------------------------------------------------
 1 total                       8064    0              72448 62223              80512 62223  62222 102400
C630 cli% showrcopy -d groups ForVmware

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR New      Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV    ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5      23 VMFS5.r       479 New           none      none     NA      NA     NA     NA
  vmfs5test  26 vmfs5test.r   480 New           none      none     NA      NA     NA     NA
  vmfs6test  27 vmfs6test.r   481 New           none      none     NA      NA     NA     NA

C630 cli% showvv -d VMFS5
Id Name  Rd Mstr  Prnt Roch Rwch PPrnt SPrnt PBlkRemain -------------VV_WWN------------- -----CreationTime------ Udid
23 VMFS5 RW 1/0/-  ---  ---  ---   ---    --         -- 60002AC0000000000000001700025C02 2020-06-19 20:03:49 CST   23
-------------------------------------------------------------------------------------------------------------------------
 1 total                                               0
C630 cli% showvv -d rcpy*
no vv listed
C630 cli%
```

目标存储当前同步状态也为 New。

```
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    7 C630       New      Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r     479 VMFS5          23 New           none      none     NA      NA     NA     NA
  vmfs5test.r 480 vmfs5test      26 New           none      none     NA      NA     NA     NA
  vmfs6test.r 481 vmfs6test      27 New           none      none     NA      NA     NA     NA

C670_CN701503MR cli% showvv -s VMFS5.r
                              ---------Snp---------- ---------Usr---------- ---------Total---------
                              --(MiB)-- -(% VSize)-- --(MiB)-- -(% VSize)-- ---------(MiB)--------- ---Efficiency---
 Id Name    Prov Compr Dedup Type Rsvd Used Used Wrn Lim Rsvd Used Used Wrn Lim Rsvd Used HostWr  VSize Compact Compress
479 VMFS5.r tpvv No    No    base  512    0  0.0   0   0  512    0  0.0   0   0 1024    0      0 102400    0.00       --
-------------------------------------------------------------------------------------------------------------------------
  1 total                       512    0              512    0              1024    0      0 102400
C670_CN701503MR cli% showvv -d VMFS5.r
 Id Name    Rd Mstr  Prnt Roch Rwch PPrnt SPrnt PBlkRemain -------------VV_WWN------------- -----CreationTime------ Udid
479 VMFS5.r RW 1/0/-  ---  ---  ---   ---    --         -- 60002AC0000000000000001700025C02 2020-07-01 18:54:45 CST  479
-------------------------------------------------------------------------------------------------------------------------
  1 total                                               0
C670_CN701503MR cli% showvv -d rcpy*
no vv listed
C670_CN701503MR cli%
```

在主存储上使用 startrcopygroup 启动复制组，启动会生成任务 ID，使用 showtask -d 可查看任务详情，此时使用 controlport offline 禁用两个 RCFC 端口。

```
C630 cli% startrcopygroup ForVmware
Group ForVmware starts, task ID = 6995 6996 6997
C630 cli% showtask -d 6995
  Id Type            Name      Status Phase     Step -------StartTime------- -FinishTime- -Priority- -User-
6995 remote_copy_sync vmfs6test active   2/3 0/204800 2020-07-01 19:55:49 CST -            n/a        n/a

Detailed status:
2020-07-01 19:55:49 CST Created     task.
2020-07-01 19:55:49 CST Startup     adding full sync of volume vmfs6test in group ForVmware to target C670_CN701503MR to th
e synchronization list.
2020-07-01 19:55:49 CST Started     full sync of volume vmfs6test  (offset 0MB length 204800MB) in group ForVmware to targe
t C670_CN701503MR has started. (sync_vol: none  resync_vol: none.)

C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR Started  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5        23 VMFS5.r       479 Syncing (18%) none      none     NA      NA     NA     NA
  vmfs5test    26 vmfs5test.r   480 Syncing (31%) none      none     NA      NA     NA     NA
  vmfs6test    27 vmfs6test.r   481 Syncing (0%)  none      none     NA      NA     NA     NA

C630 cli% controlport offline -f 0:3:4 1:3:4
```

使用 showalert 可见在两端复制链路心跳超过 5s 后提示远程复制链路宕，在复制链路宕掉 10s 后系统提示远程复制目标宕，

```
Id          : 86
State       : New
Message Code: 0x03a00fa
Time        : 2020-07-01 19:56:35 CST
Severity    : Major
Type        : Component state change
Message     : Remote Copy Link 14(C670_CN701503MR_1_3_4) Failed (Down Due To Send Error Or Missing Heartbeat {0x1})

Id          : 85
State       : New
Message Code: 0x03a00fa
Time        : 2020-07-01 19:56:35 CST
Severity    : Major
Type        : Component state change
Message     : Remote Copy Link 13(C670_CN701503MR_0_3_4) Failed (Down Due To Send Error Or Missing Heartbeat {0x1})

Id          : 87
State       : New
Message Code: 0x03900fa
Time        : 2020-07-01 19:56:45 CST
Severity    : Major
Type        : Component state change
Message     : Remote Copy Target 4(C670_CN701503MR) Failed (All Links To Target Are Down {0x2})

Id          : 88
State       : New
Message Code: 0x00e000a
Time        : 2020-07-01 19:56:45 CST
Severity    : Minor
Type        : Task failed
Message     : Task 6997 (type "remote_copy_sync", name "VMFS5") has failed (could not sync volume). Please see task status
for details.
```

此时在主存储上查看远程复制任务已经失败，由于第一次完整复制没有完成所以同步状态为NotSynced，主存储上此时没有创建任何快照。

```
C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR Stopped  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV    ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5      23 VMFS5.r       479 NotSynced     none      none     NA      NA     NA     NA
  vmfs5test  26 vmfs5test.r   480 NotSynced     none      none     NA      NA     NA     NA
  vmfs6test  27 vmfs6test.r   481 NotSynced     none      none     NA      NA     NA     NA

C630 cli% showvv -d rcpy*
no vv listed
C630 cli% showtask -d 6995
  Id Type             Name      Status Phase Step -------StartTime------- ------FinishTime------- -Priority- -User-
6995 remote_copy_sync vmfs6test failed   ---   --- 2020-07-01 19:55:49 CST 2020-07-01 19:56:45 CST n/a        n/a

Detailed status:
2020-07-01 19:55:49 CST Created     task.
2020-07-01 19:55:49 CST Startup     adding full sync of volume vmfs6test in group ForVmware to target C670_CN701503MR to th
e synchronization list.
2020-07-01 19:55:49 CST Started     full sync of volume vmfs6test  (offset 0MB length 204800MB) in group ForVmware to targe
t C670_CN701503MR has started. (sync_vol: none  resync_vol: none.)
2020-07-01 19:56:45 CST Stopped     This synchronization was stopped by the sysmgr.
2020-07-01 19:56:45 CST Failed      sync of volume vmfs6test(vmfs6test) in ForVmware group to target C670_CN701503MR failed
, volume has status UNSYNC.

C630 cli% showvv -d rcpy*
no vv listed
C630 cli%
```

在目标存储上查看复制组状态也为NotSynced，目标存储上没有创建快照。

```
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    7 C630       Stopped  Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV       ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r      479 VMFS5          23 NotSynced     none      none     NA      NA     NA     NA
  vmfs5test.r  480 vmfs5test      26 NotSynced     none      none     NA      NA     NA     NA
  vmfs6test.r  481 vmfs6test      27 NotSynced     none      none     NA      NA     NA     NA

C670_CN701503MR cli% showvv -d rcpy*
no vv listed
C670_CN701503MR cli% showvv -d rcpy*
no vv listed
C670_CN701503MR cli%
```

在主存储上上启用 RCFC 端口然后启用复制组，此时系统再次生成复制任务，使用 statrcopy 可以在主存储和目标存储上看到复制吞吐量。

```
C630 cli% controlport rst -f 0:3:4 1:3:4
C630 cli% startrcopygroup ForVmware
Group ForVmware starts, task ID = 6999 7000 7001
C630 cli% statrcopy
  20:07:35 07/01/2020                                          -Throughput(KBytes per sec)- -Write Same Zero(KBytes per sec)-
Target          Node  Address          IPC    Total(KBytes)       Current        Average          Current          Average
-------------------------------------------------------------------------------------------------------------------------
C670_CN701503MR 0:3:4 20340002AC025C03 RCs013    1252981.32          0.00           0.00             0.00             0.00
C670_CN701503MR 1:3:4 21340002AC025C03 RCs114    1244917.09          0.00           0.00             0.00             0.00
-------------------------------------------------------------------------------------------------------------------------
C670_CN701503MR                                  2497898.40          0.00           0.00             0.00             0.00

receive         0:3:4 20340002AC025C03 RCr015      76863.95         13.25          13.25             0.00             0.00
receive         1:3:4 21340002AC025C03 RCr116      72534.66         13.01          13.01             0.00             0.00
-------------------------------------------------------------------------------------------------------------------------
Receive                                          149398.60         26.26          26.26             0.00             0.00
Send                                            2497898.40          0.00           0.00             0.00             0.00
-------------------------------------------------------------------------------------------------------------------------
Total                                           2647297.01         26.26          26.26             0.00             0.00
```

```
C670_CN701503MR cli% statrcopy
20:08:51 07/01/2020                                          -Throughput(KBytes per sec)- -Write Same Zero(KBytes per sec)-
Target     Node     Address          IPC    Total(KBytes)       Current        Average          Current          Average
-------------------------------------------------------------------------------------------------------------------------
C630       0:3:4    20340002AC025C02 RCs013    154980.76          0.00           0.00             0.00             0.00
C630       1:3:4    21340002AC025C02 RCs114    150825.73          0.00           0.00             0.00             0.00
-------------------------------------------------------------------------------------------------------------------------
C630                                            305806.48          0.00           0.00             0.00             0.00

receive    0:3:4    20340002AC025C02 RCr015  32617892.53     138838.89      138838.89        100112.82        100112.82
receive    1:3:4    21340002AC025C02 RCr116  32493836.42     138344.49      138344.49        101401.17        101401.17
-------------------------------------------------------------------------------------------------------------------------
Receive                                     65111728.95     277183.38      277183.38        201513.99           201.51
Send                                          305806.48          0.00           0.00             0.00             0.00
-------------------------------------------------------------------------------------------------------------------------
Total                                       65417535.43     277183.38      277183.38        201513.99           201.51
```

在主存储和目标存储上使用 showrocpy -d 确认同步完成。

```
C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name          ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware      7 C670_CN701503MR Started  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV     ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5         23 VMFS5.r       479 Synced        none      none     NA      NA     NA     NA
  vmfs5test     26 vmfs5test.r   480 Synced        none      none     NA      NA     NA     NA
  vmfs6test     27 vmfs6test.r   481 Synced        none      none     NA      NA     NA     NA

C630 cli% showvv -d rcpy*
no vv listed
C630 cli% showtask -d 6999
  Id Type             Name      Status Phase Step -------StartTime------- ------FinishTime------- -Priority- -User-
6999 remote_copy_sync vmfs6test done     ---   --- 2020-07-01 20:07:28 CST 2020-07-01 20:08:03 CST n/a        n/a

Detailed status:
2020-07-01 20:07:28 CST Created     task.
2020-07-01 20:07:28 CST Startup     adding full sync of volume vmfs6test in group ForVmware to target C670_CN701503MR to th
e synchronization list.
2020-07-01 20:07:28 CST Started     full sync of volume vmfs6test  (offset 0MB length 204800MB) in group ForVmware to targe
t C670_CN701503MR has started. (sync_vol: none  resync_vol: none.)
2020-07-01 20:08:03 CST Completed   sync of volume vmfs6test(vmfs6test) in group ForVmware to target C670_CN701503MR has co
mpleted, 262MB of 204800MB transmitted.

C630 cli%
```

再次断开 RCFC 端口并确认远程复制组停止，此时主存储上会创建快照（Resync SS）。所以，根据手册和白皮书介绍，无论是手动停止远程复制组还是 I/O 错误导致远程复制组被终止主存储都会创建快照，然后回复主机继续发送 I/O，主存储创建快照之后，如果之前有 I/O 正在同步到目标存储但最终因为远程复制组被停止而失败，则这些 I/O 会被单独记录到主存储的失败 I/O 列表中，注意远程复制组停止之后的 I/O 不会被记录在失败 I/O 列表中。远程复制组再次启动后，主存储会先送失败 I/O 列表中的数据，然后通过当前数据（据手册和白皮书描述在重新启动远程复制组后主存储也会新建立快照记录最新数据状态，但实际操作中远程复制组启动后并没有看到新的新快照），最新数据状态与旧快照做对比后进行增量复制，把数据同步到目标存储。

```
C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR Started  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV    ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5       23 VMFS5.r       479 Synced        none      none     NA      NA     NA     NA
  vmfs5test   26 vmfs5test.r   480 Synced        none      none     NA      NA     NA     NA
  vmfs6test   27 vmfs6test.r   481 Synced        none      none     NA      NA     NA     NA

C630 cli% controlport offline -f 0:3:4 1:3:4
C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR Stopped  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV    ID   RemoteVV     ID   SyncStatus    Resync_ss   Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5       23 VMFS5.r       479 Stopped       rcpy.7.23.4 none     NA      NA     NA     2020-07-01 20:15:07 CST
  vmfs5test   26 vmfs5test.r   480 Stopped       rcpy.7.26.4 none     NA      NA     NA     2020-07-01 20:15:07 CST
  vmfs6test   27 vmfs6test.r   481 Stopped       rcpy.7.27.4 none     NA      NA     NA     2020-07-01 20:15:07 CST

C630 cli% showvv -d rcpy*
 Id Name         Rd Mstr  Prnt Roch Rwch PPrnt SPrnt PBlkRemain ------------VV_WWN------------ -----CreationTime------ Udi
d
494 rcpy.7.23.4 RO 1/0/-   23  ---  ---   ---    --         -- 60002AC000000000000001EE00025C02 2020-07-01 20:15:07 CST  49
4
495 rcpy.7.26.4 RO 1/0/-   26  ---  ---   ---    --         -- 60002AC000000000000001EF00025C02 2020-07-01 20:15:07 CST  49
5
496 rcpy.7.27.4 RO 1/0/-   27  ---  ---   ---    --         -- 60002AC000000000000001F000025C02 2020-07-01 20:15:07 CST  49
6
--------------------------------------------------------------------------------------------------------------------------
-
```

此时由于没有新数据，目标存储上不会创建快照，但会在远程复制组启动的时候把主存储失败 I/O 列表的数据进行同步。

```
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    7 C630       Stopped  Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r     479 VMFS5          23 Stopped       none      none     NA      NA     NA     2020-07-01 20:15:08 CST
  vmfs5test.r 480 vmfs5test      26 Stopped       none      none     NA      NA     NA     2020-07-01 20:15:08 CST
  vmfs6test.r 481 vmfs6test      27 Stopped       none      none     NA      NA     NA     2020-07-01 20:15:08 CST

C670_CN701503MR cli% showvv -d rcpy*
no vv listed
C670_CN701503MR cli%
```

在主存储卷写入数据后再次启动远程复制组，同步完成前远程复制组再次停止，此时主存储创建新的快照（Resync_ss）并在远程复制组再次启动时与当前最新数据做对比之后把增量数据同步到目标存储，由于复制速度很快下图中快照已经被删除。

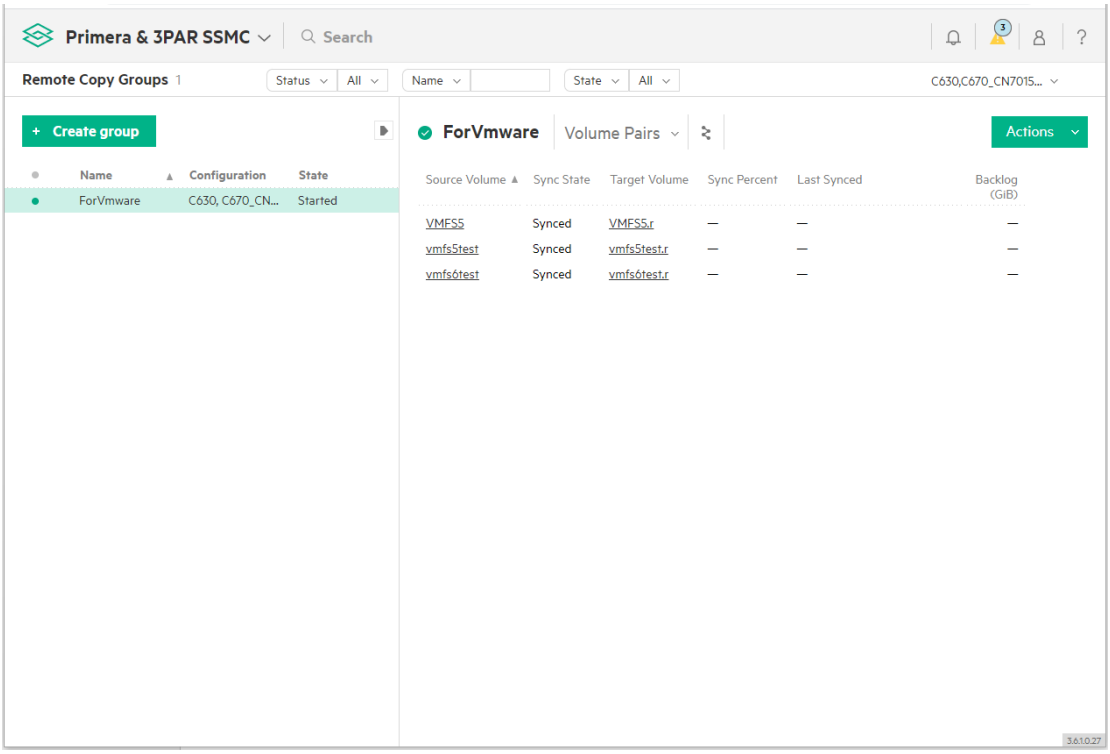
```
C630 cli% startrcopygroup ForVmware
Group ForVmware starts, task ID = 7009 7010 7011
C630 cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name         ID   Target          Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware     7 C670_CN701503MR Started  Primary    Sync     ForVmware    ForVmware    SSD_r6     SSD_r6
  LocalVV    ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5      23 VMFS5.r       479 Synced        none      none     NA      NA     NA     NA
  vmfs5test  26 vmfs5test.r   480 Synced        none      none     NA      NA     NA     NA
  vmfs6test  27 vmfs6test.r   481 Synced        none      none     NA      NA     NA     NA

C630 cli% showvv -d rcpy*
no vv listed
C630 cli%
```

目标存储在主存储启动同步时也会生成快照记录当前数状态，在同步过程中如果出现同步意外终止可以使用此快照回滚到之前数据状态。在同步完成前如果复制组再次停止不会创建新的快照，快照在同步完成后被删除。鉴于同步复制技术在远程复制组停止（主存储）和启动（目标存储）会使用快照技术，一个远程复制组不建议加入太多卷，避免大量卷同时建立快照造成的 I/O 等待导致主机 I/O 超时。

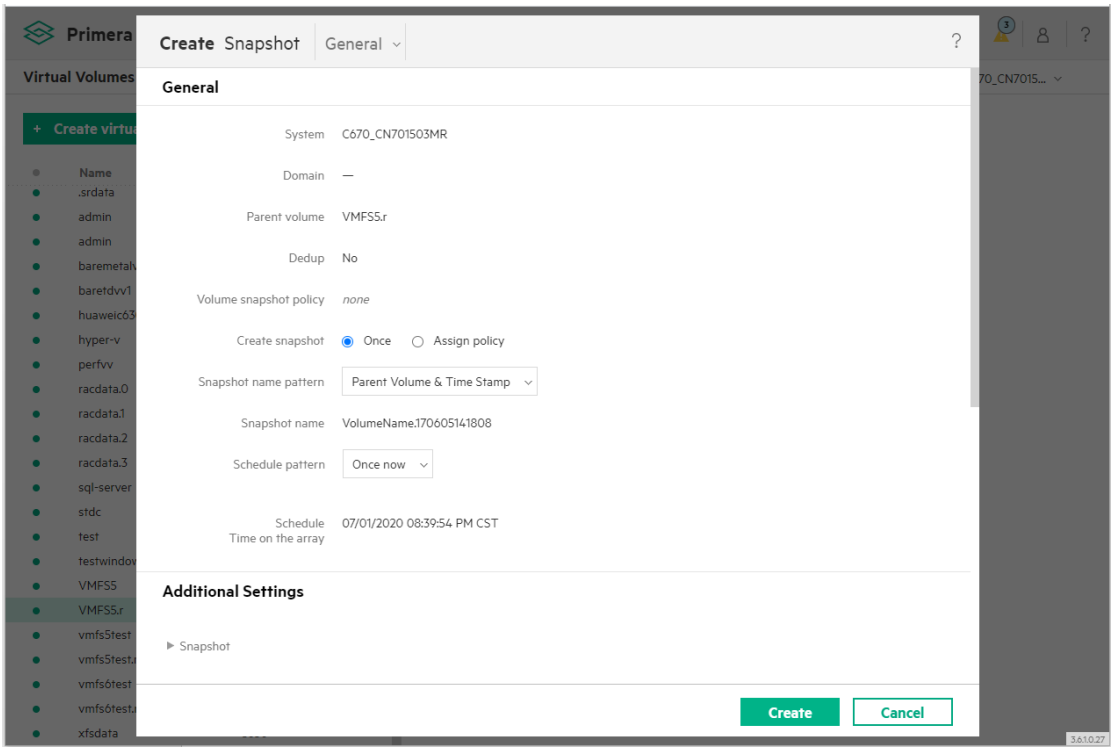
```
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    7 C630       Started  Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss    Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r     479 VMFS5          23 Syncing       rcpy.7.479.4 none     NA      NA     NA     NA
  vmfs5test.r 480 vmfs5test      26 Synced        rcpy.7.480.4 none     NA      NA     NA     NA
  vmfs6test.r 481 vmfs6test      27 Synced        rcpy.7.481.4 none     NA      NA     NA     NA

C670_CN701503MR cli% showvv -d rcpy*
 Id Name          Rd Mstr  Prnt Roch Rwch PPrnt SPrnt PBlkRemain ------------VV_WWN------------ -----CreationTime------ Ud
id
485 rcpy.7.479.4 RO 1/0/-  479  ---  ---   ---    --         -- 60002AC000000000000001E500025C03 2020-07-01 20:29:18 CST  4
85
486 rcpy.7.480.4 RO 1/0/-  480  ---  ---   ---    --         -- 60002AC000000000000001E600025C03 2020-07-01 20:29:18 CST  4
86
487 rcpy.7.481.4 RO 1/0/-  481  ---  ---   ---    --         -- 60002AC000000000000001E700025C03 2020-07-01 20:29:18 CST  4
87
------------------------------------------------------------------------------------------------------------------------
--
  3 total                                                 0

C670_CN701503MR cli% showvv -d rcpy*
no vv listed
C670_CN701503MR cli% showrcopy -d groups

Remote Copy System Information
Status: Started, Normal

Group Information

Name              ID   Target     Status   Role       Mode     LocalUserCpg LocalSnapCpg RmUserCpg  RmSnapCpg  Options
ForVmware.r154626    7 C630       Started  Secondary  Sync     SSD_r6       SSD_r6       ForVmware  ForVmware
  LocalVV      ID   RemoteVV     ID   SyncStatus    Resync_ss Sync_ss  VV_iter R_iter S_iter LastSyncTime
  VMFS5.r     479 VMFS5          23 Synced        none      none     NA      NA     NA     NA
  vmfs5test.r 480 vmfs5test      26 Synced        none      none     NA      NA     NA     NA
  vmfs6test.r 481 vmfs6test      27 Synced        none      none     NA      NA     NA     NA
```

远程复制卷验证

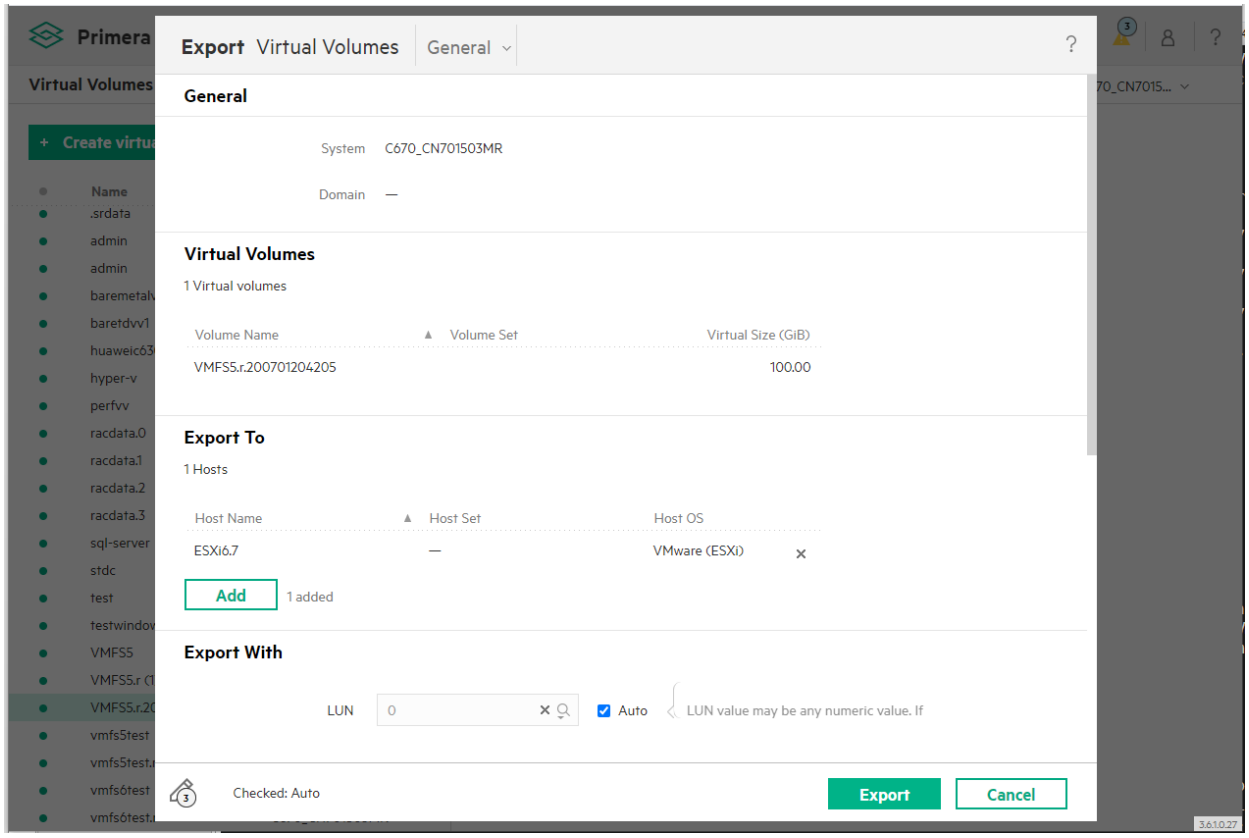
由于远程卷无法直接映射并使用，所以需要对远程卷做快照来进行验证数据有效性。首先确认远程复制组中卷的同步状态是 Synced。如果链路经常存在不稳定情况，可以使用 checkrcopyvv 检查一下远程卷的数据一致性，语法是 checkrcopyvv –v 本地 VV 名称 复制目标：远程卷名称，比如 checkvv –v VMFS5 C630:VMFS5.r。



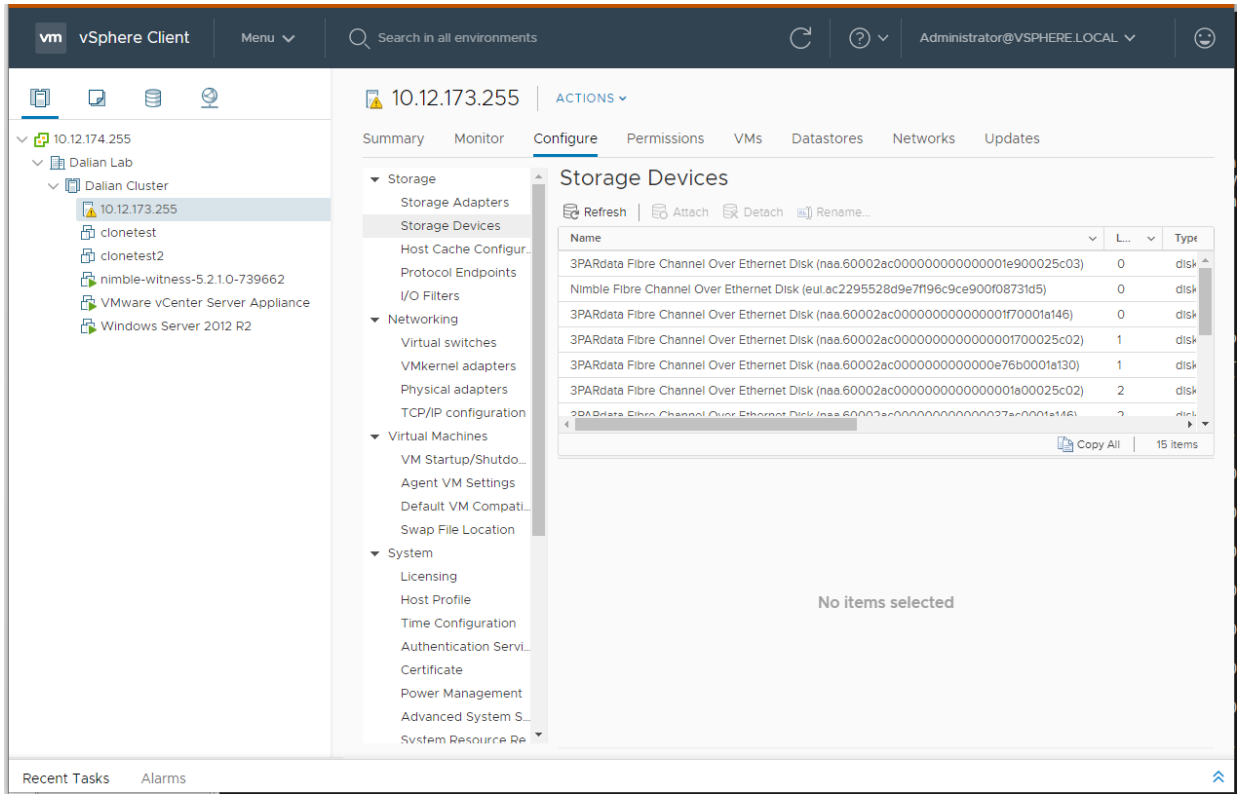
在远程卷上创建快照。



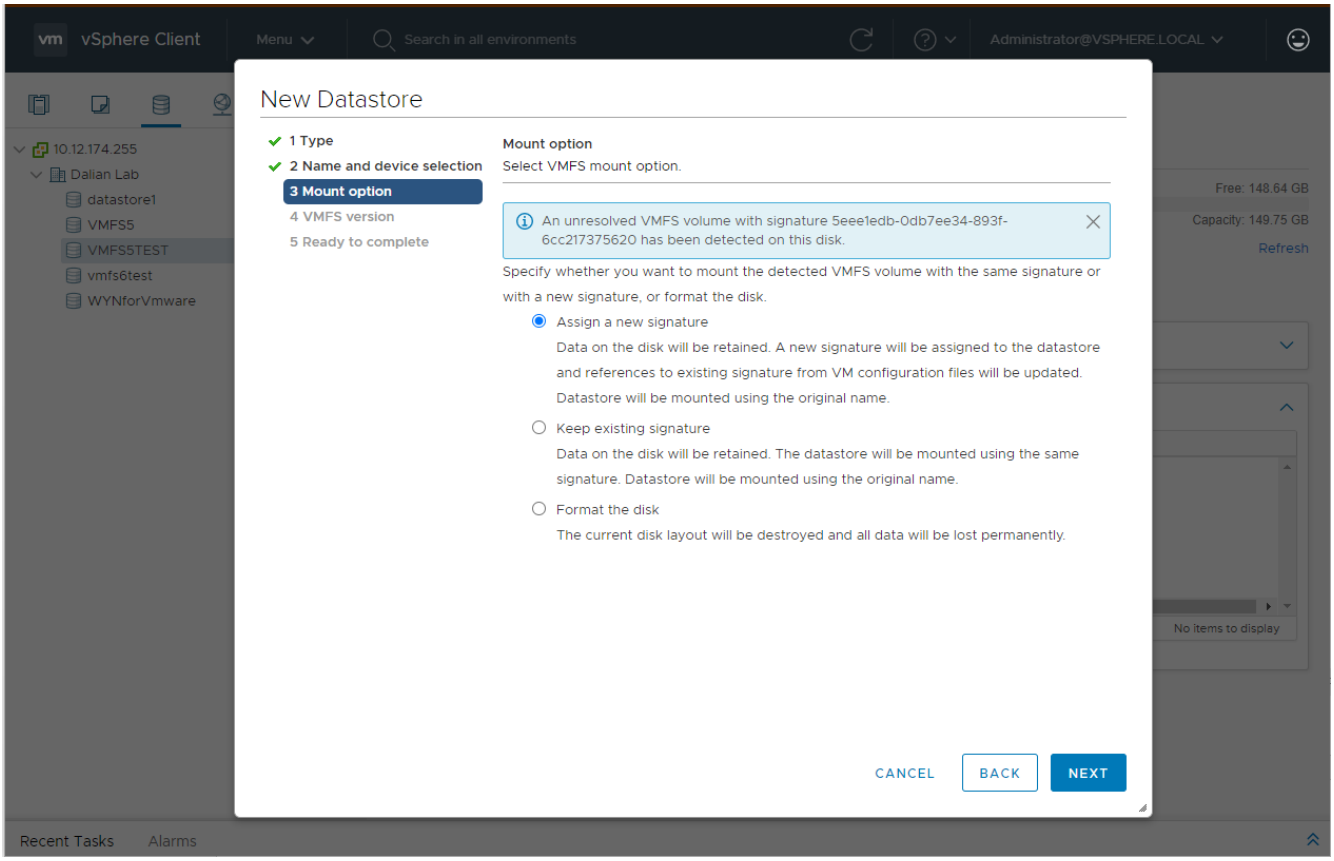
然后映射给主机，此处使用 Vmware ESXi 环境作为测试，其他环境方法类似。



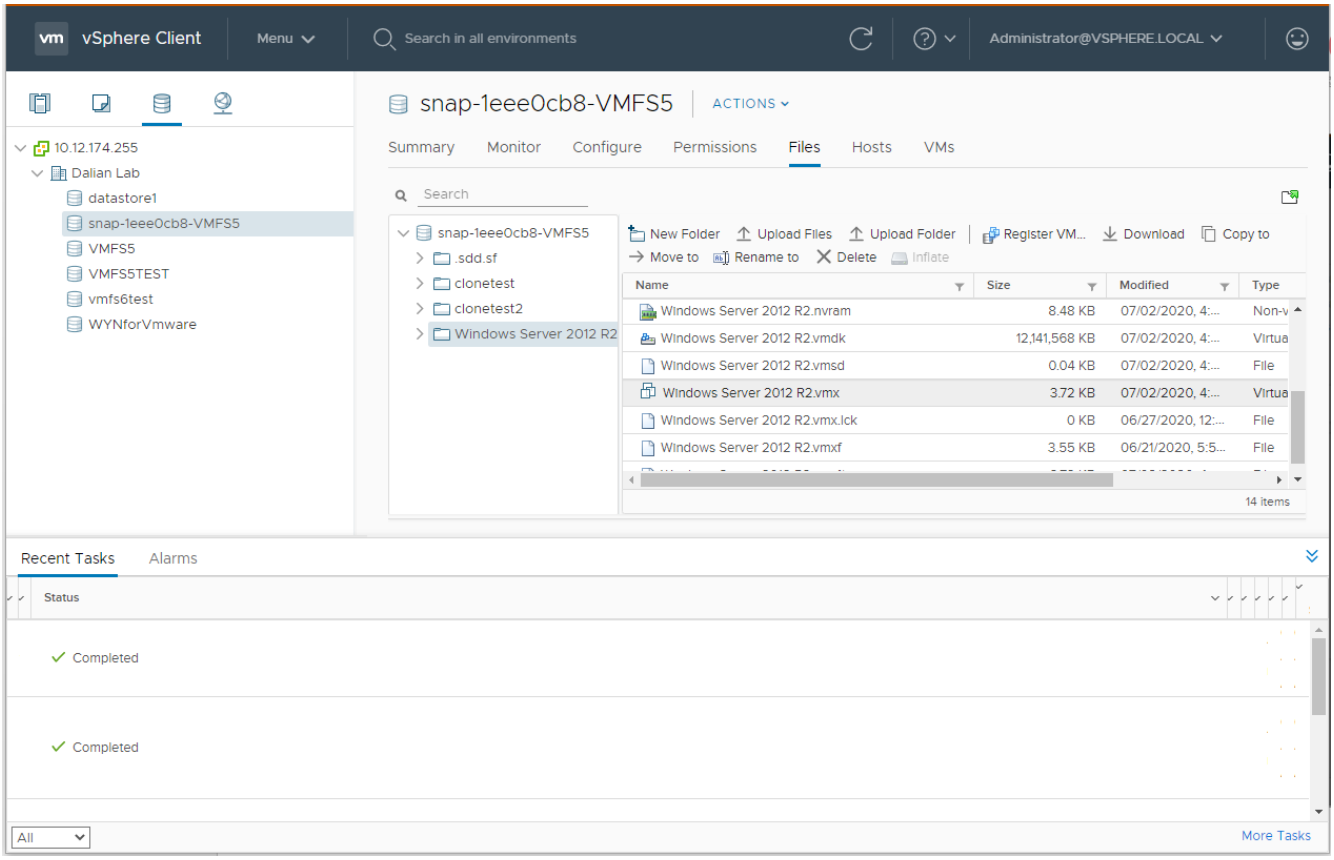
在 Vmware ESXi 主机上确认已经扫描到远程卷的快照。



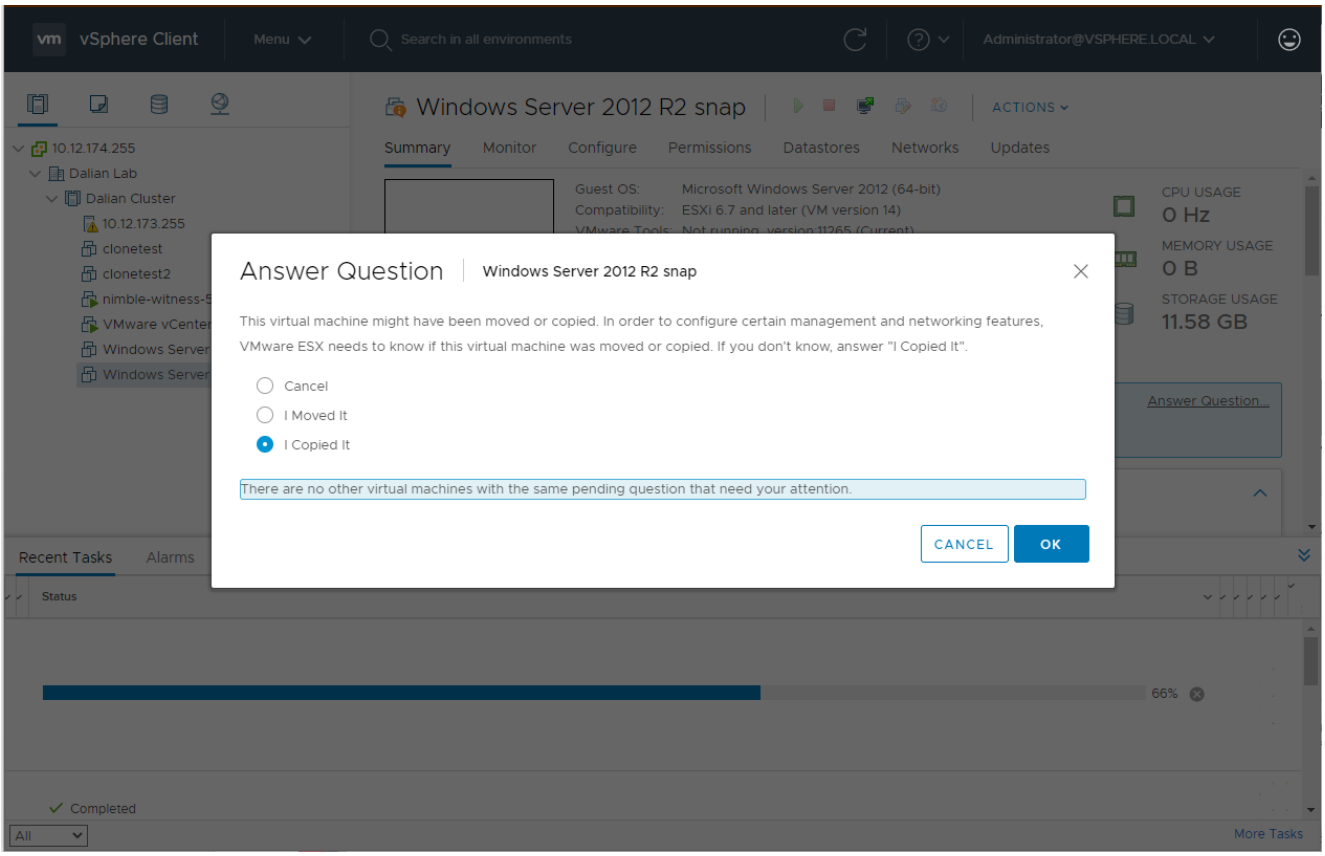
挂载 Datastore，这里注意由于源卷仍旧在使用，所以需要分配一个新的签名。



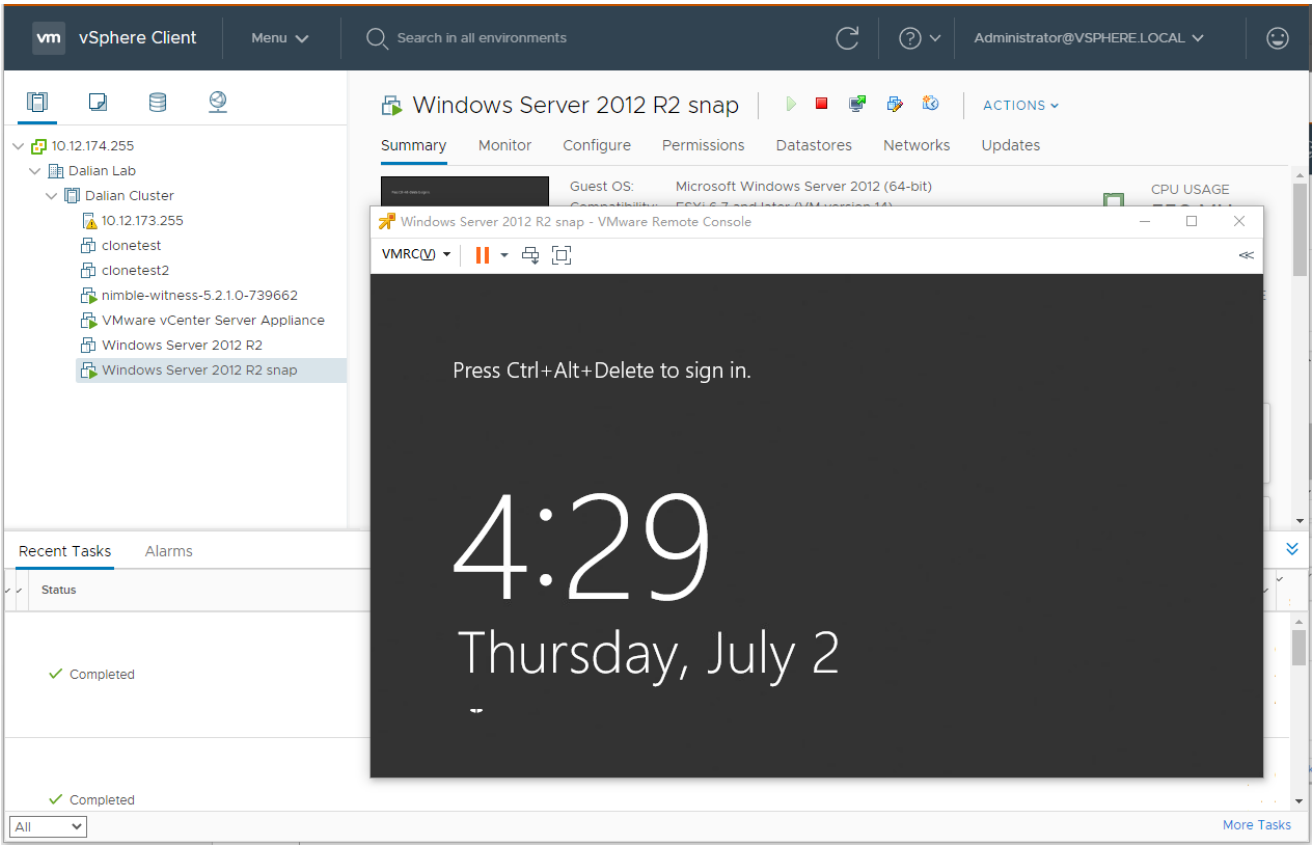
Datastore 挂载完成后可以尝试关闭之前的虚拟机并注册此 Datastore 的虚拟机。



启动虚拟机时需要回答问题，这里选择 I Copied it。

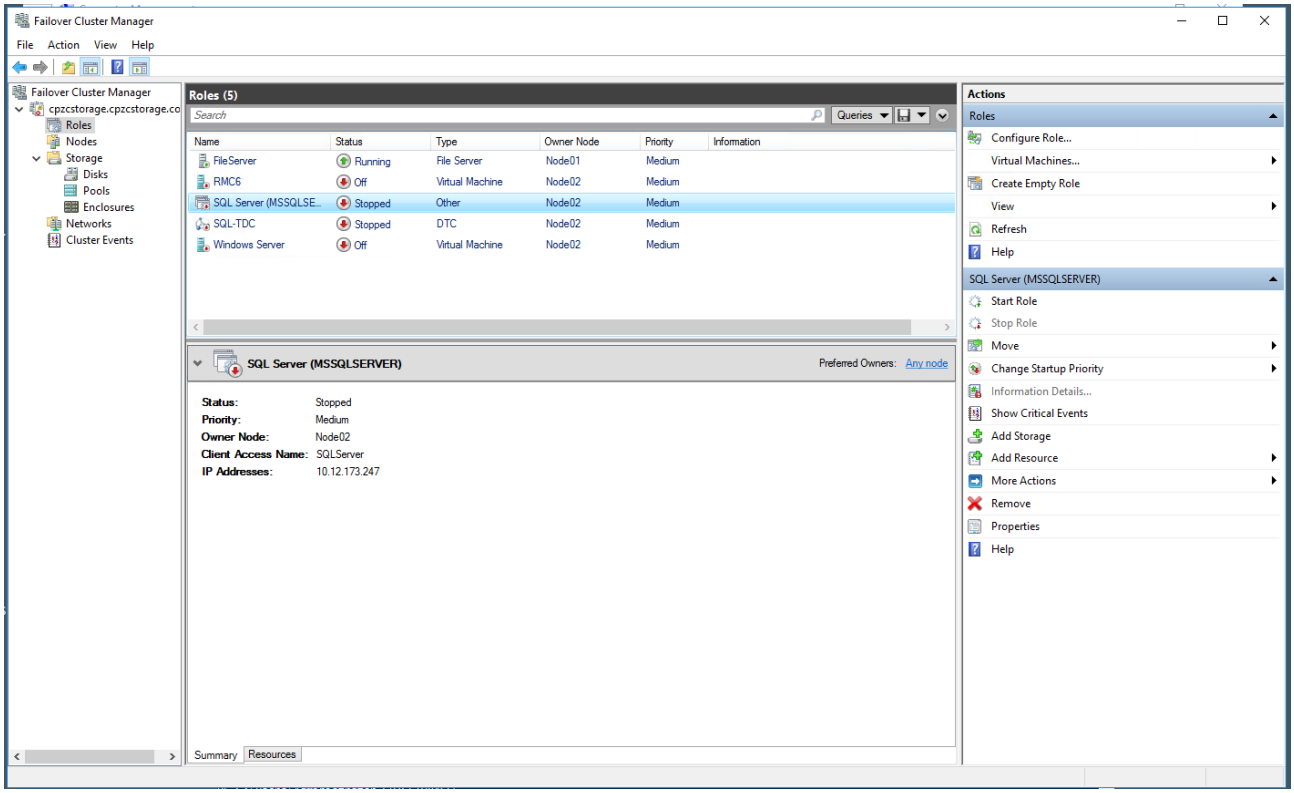


确认虚拟机可以正常启动。

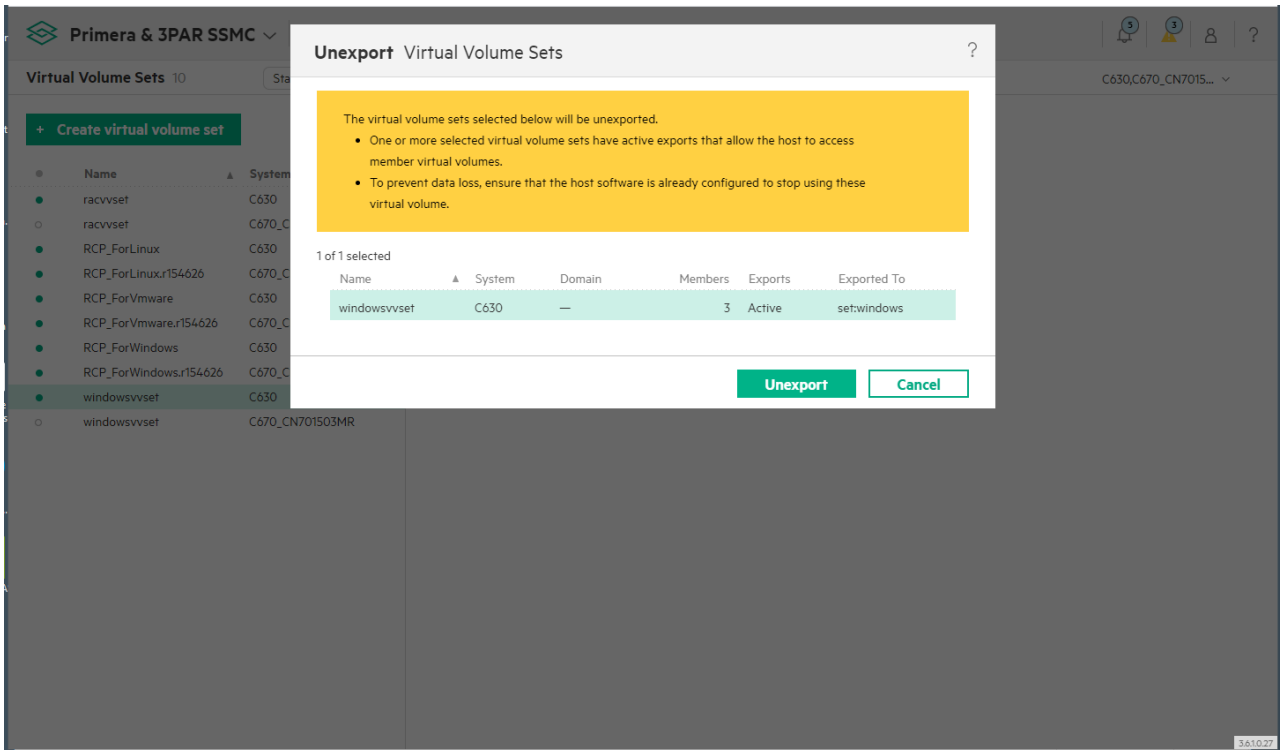


故障转移和恢复

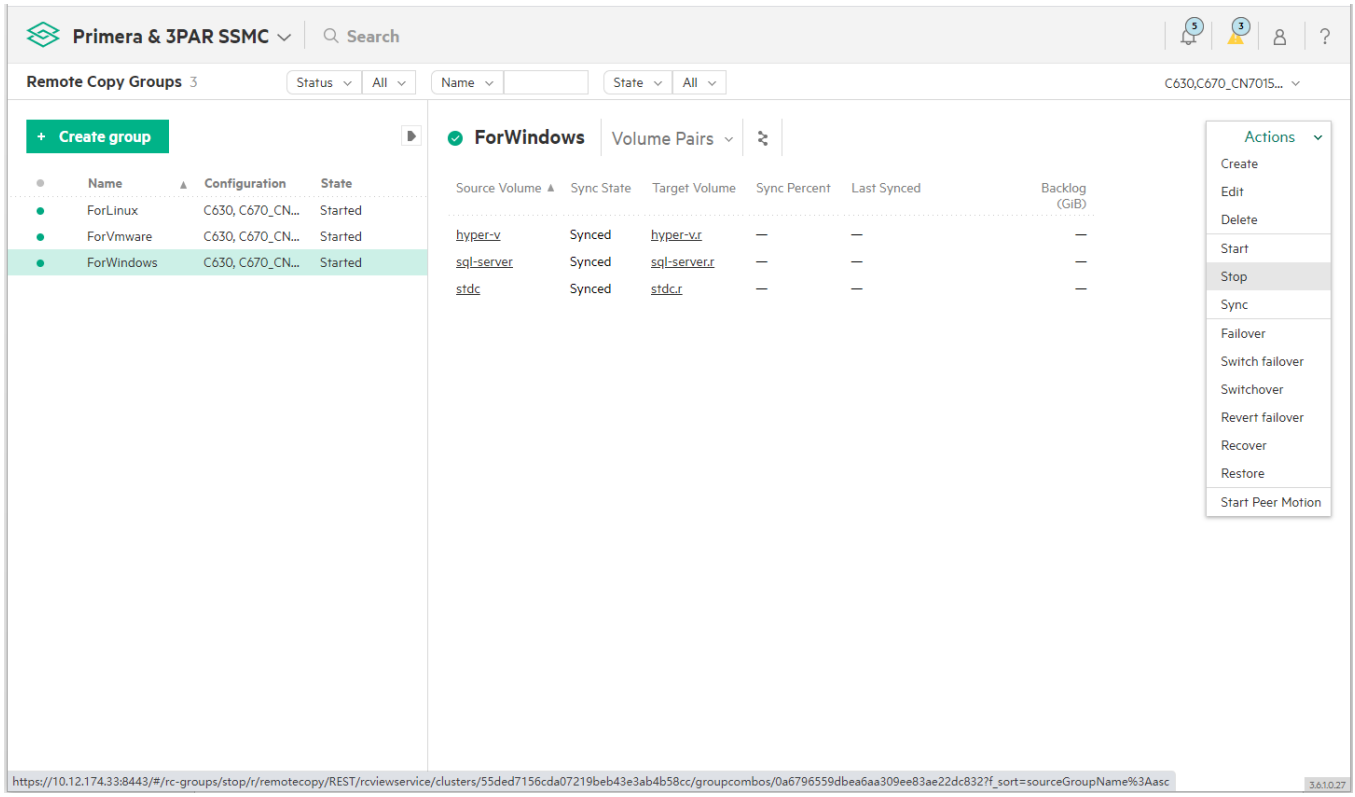
由于并没有配置 Peer Persistent，卷只从主存储中映射，所以即使是同步复制，故障转移也需要先停止业务。



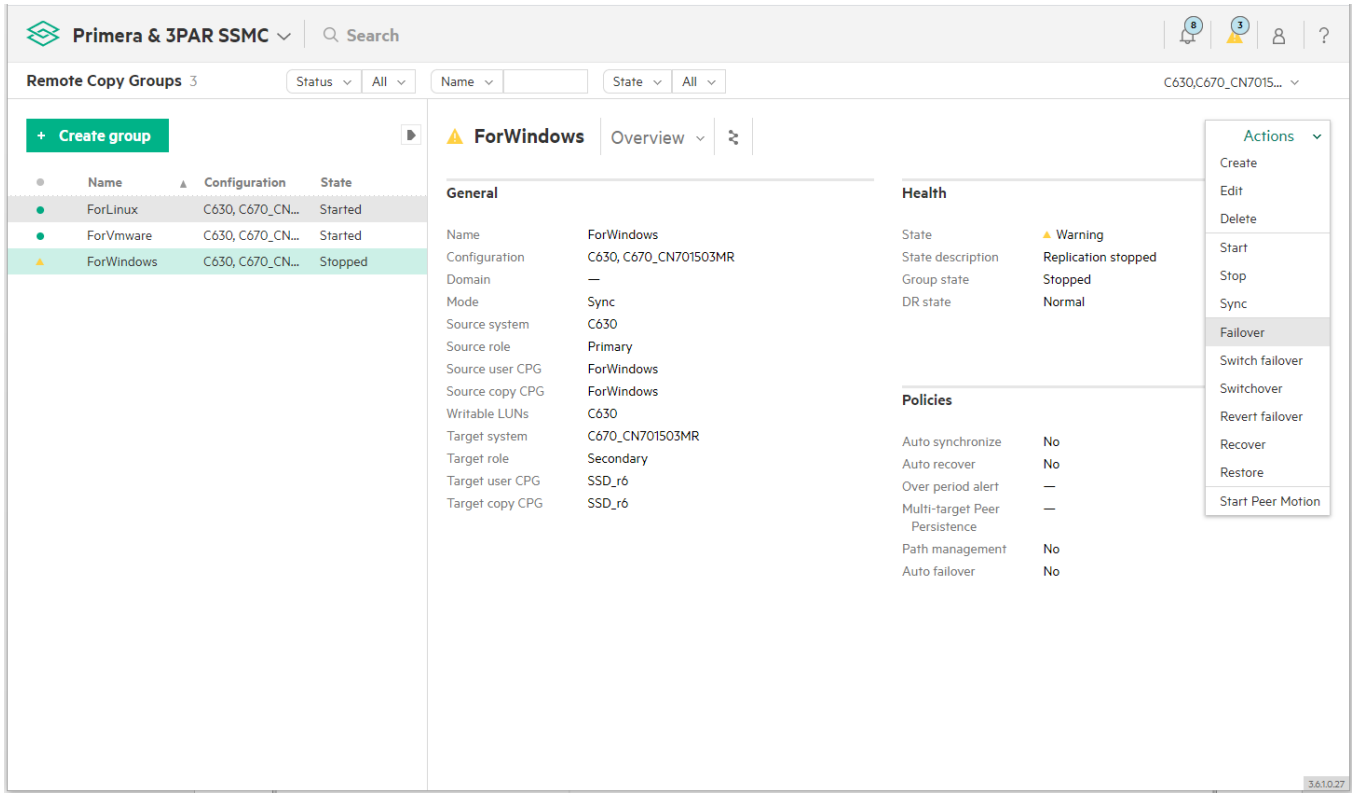
然后取消主存储的卷映射。



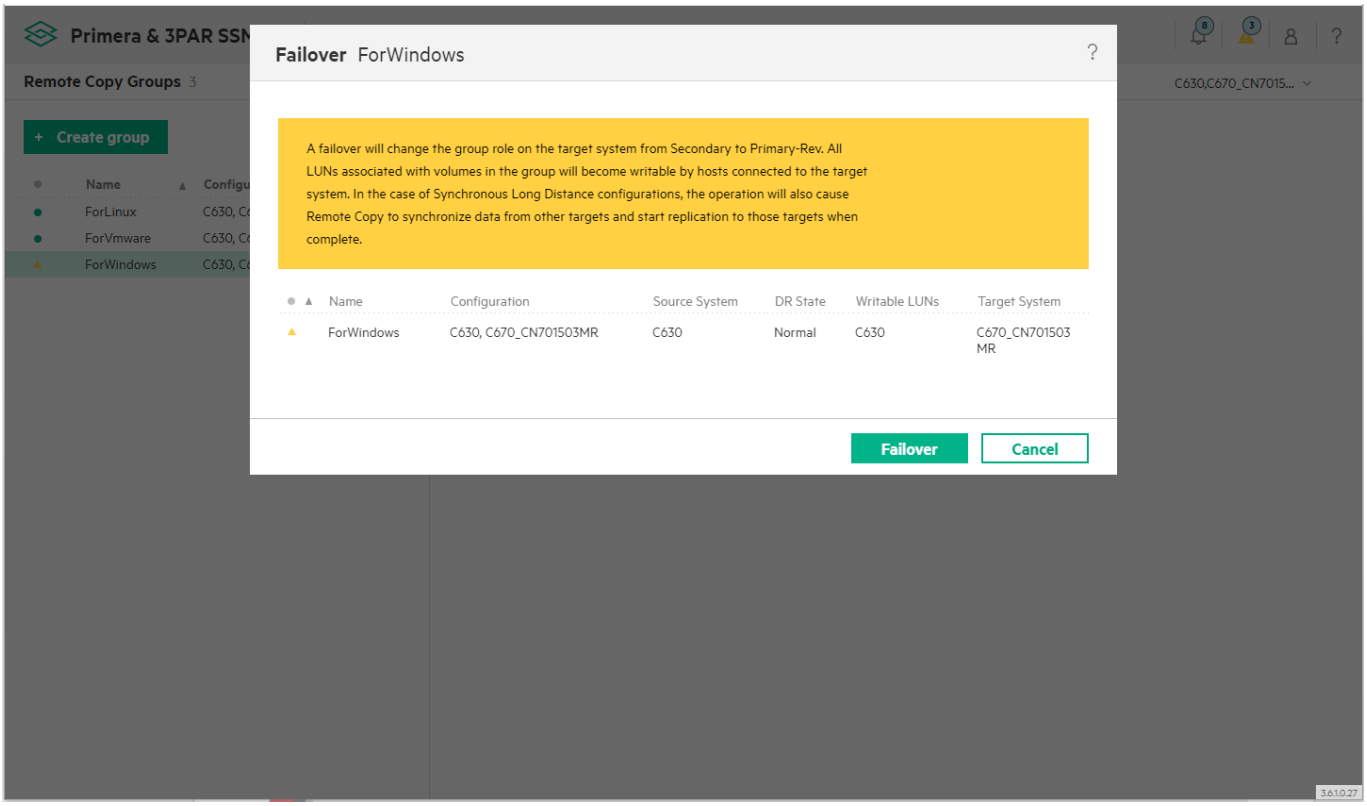
在 SSMC 中确认远程复制组中卷的状态为已同步，然后停止远程复制组。



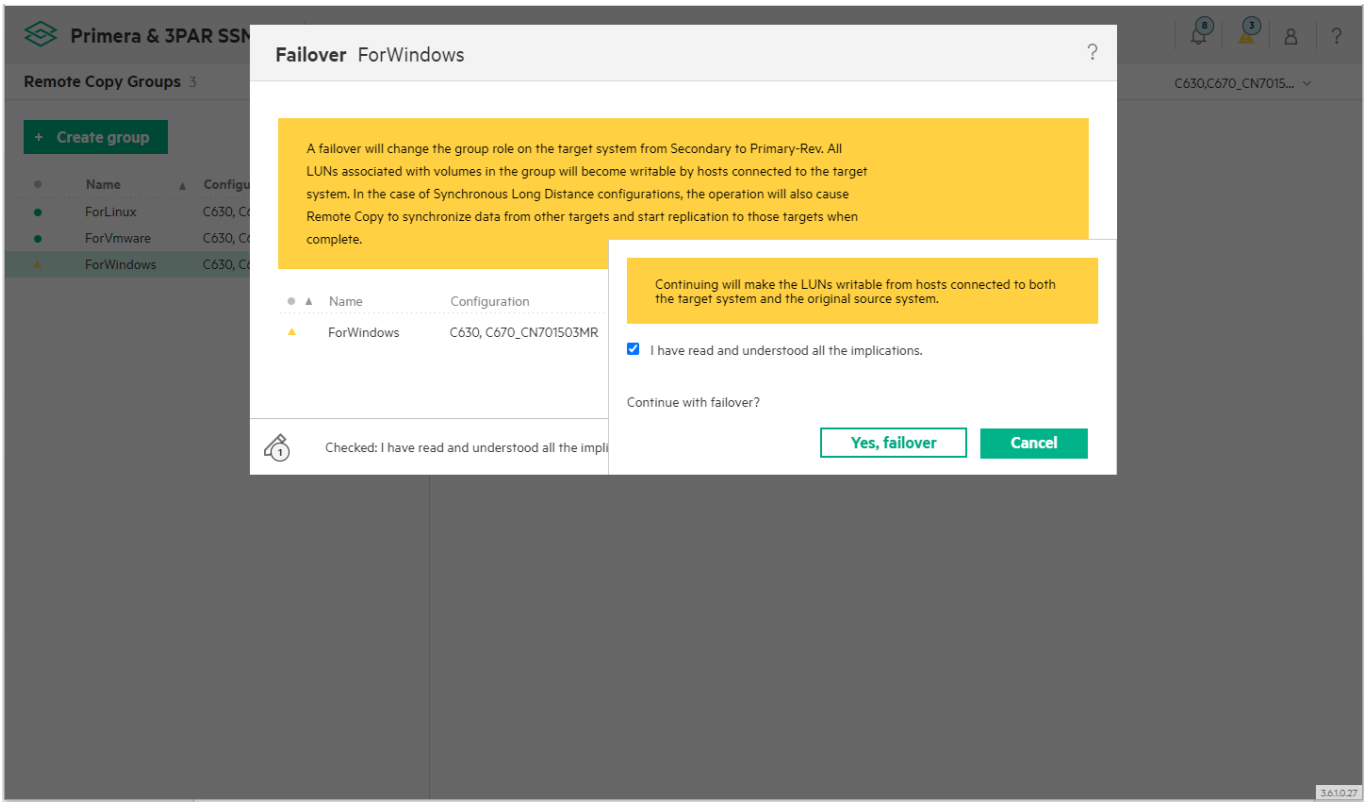
当前主存储角色为 Primary，目标存储角色为 Secondary，点击 Actions-Failover。



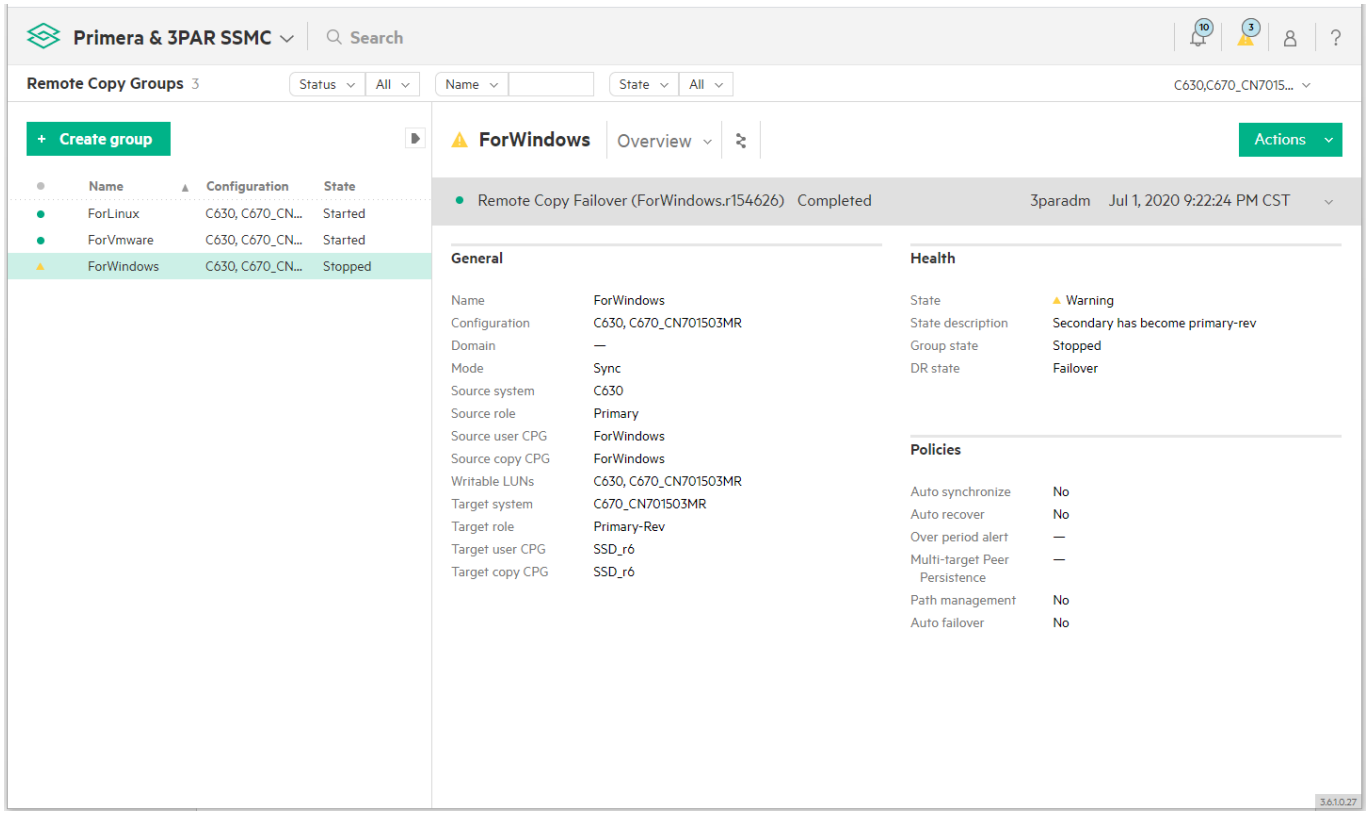
点击 Failover。



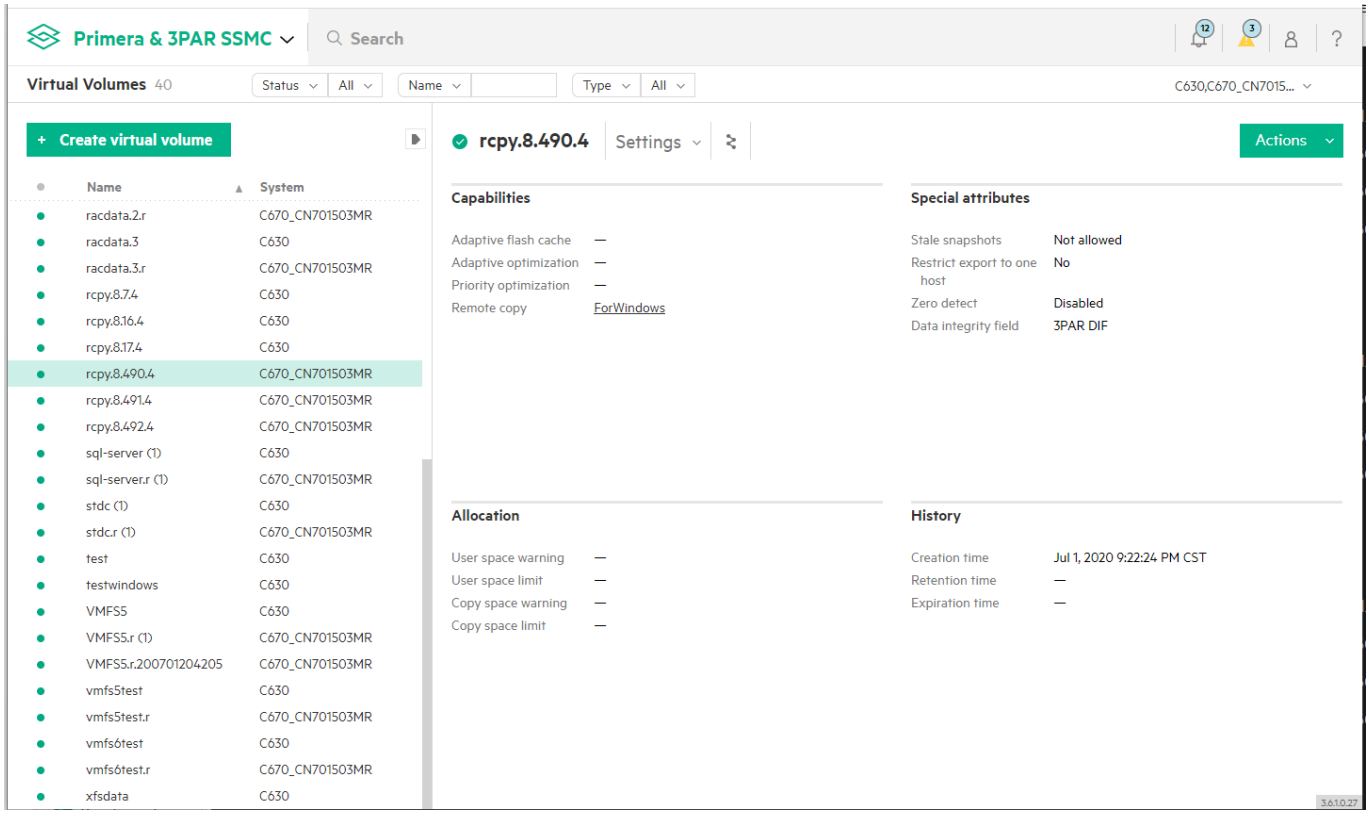
勾选 I have read and understood all the implications，点击 Yes,failover。



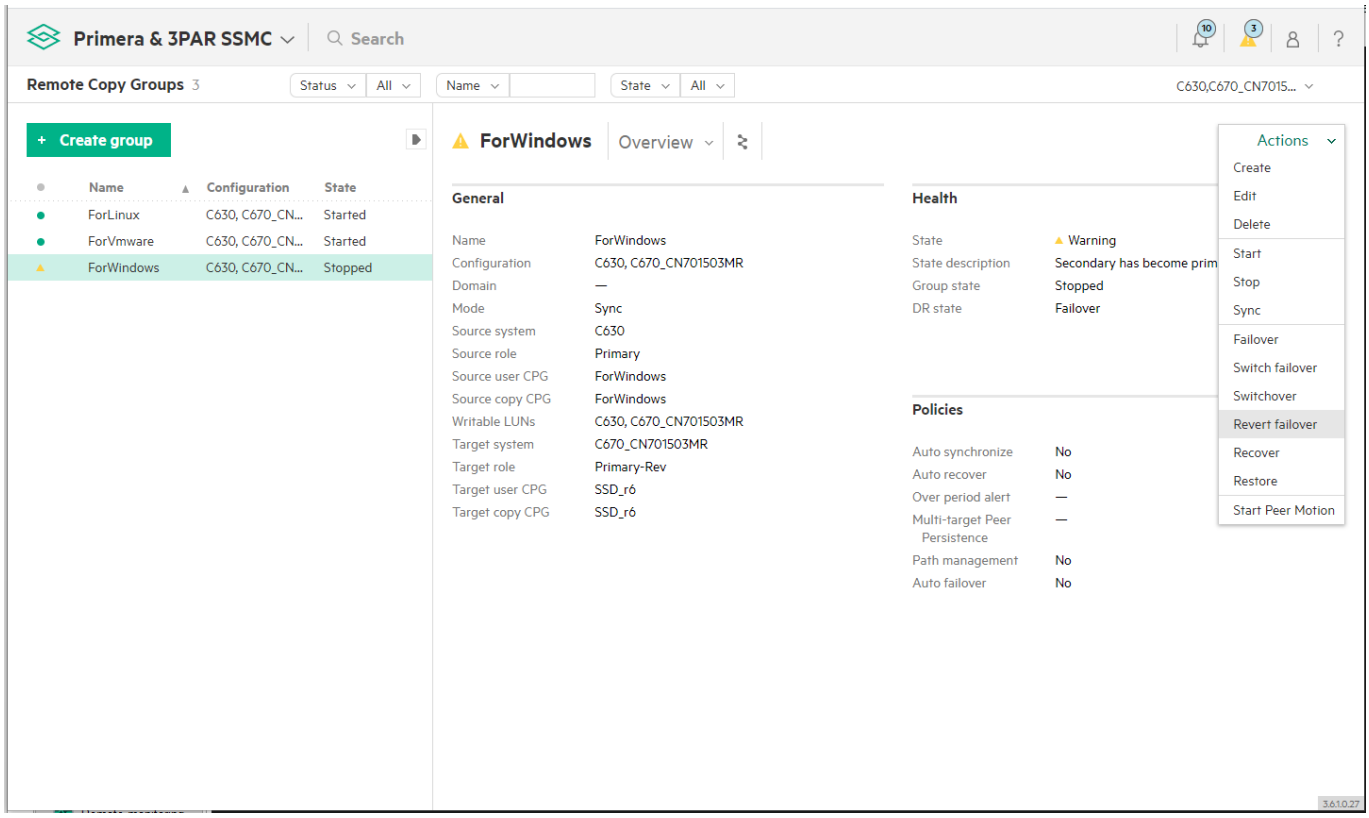
此时主存储角色仍旧为 Primary，目标存储角色为 Primary-Rev，此时两端均可读写。



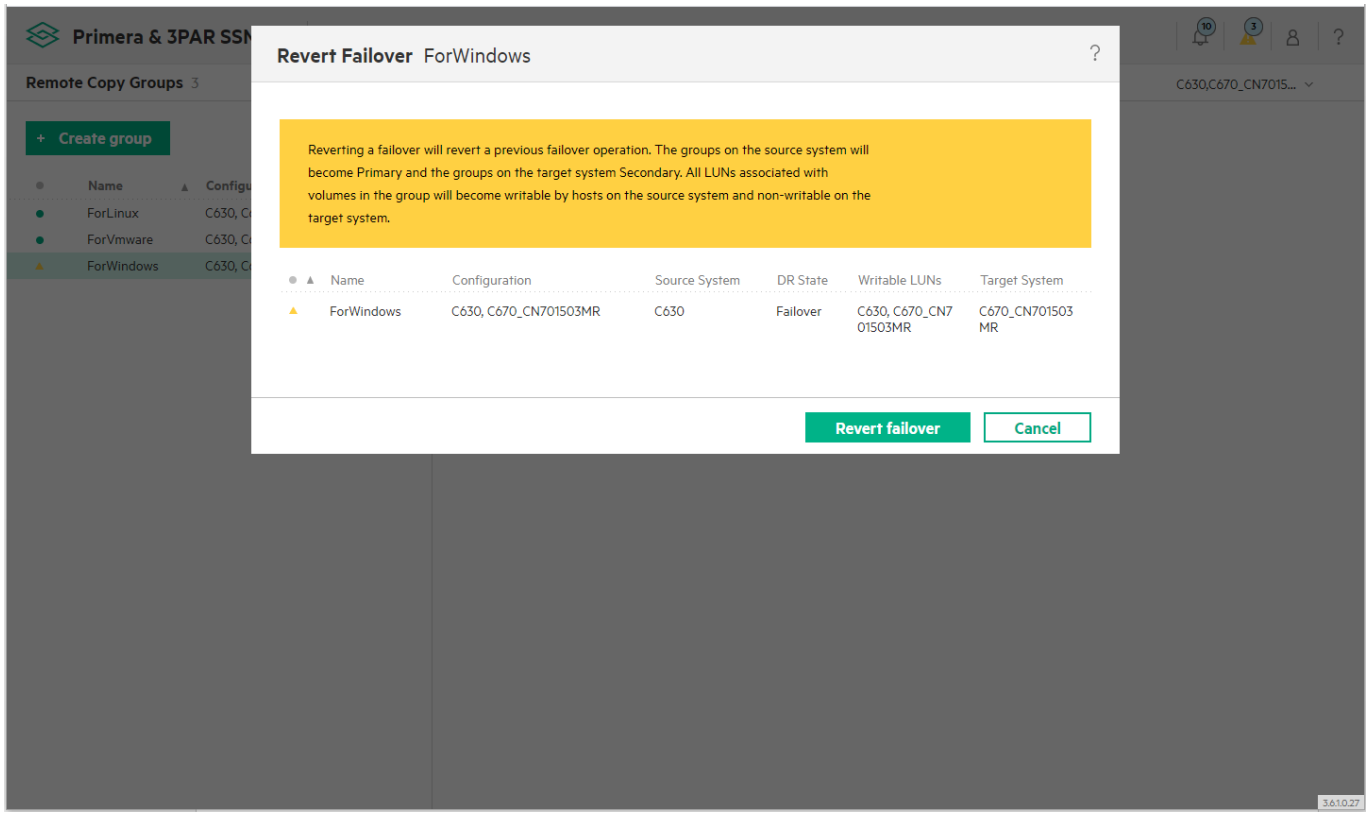
此时除了主存储上在停止远程复制组时创建快照，目标存储在故障转移后也创建了快照。



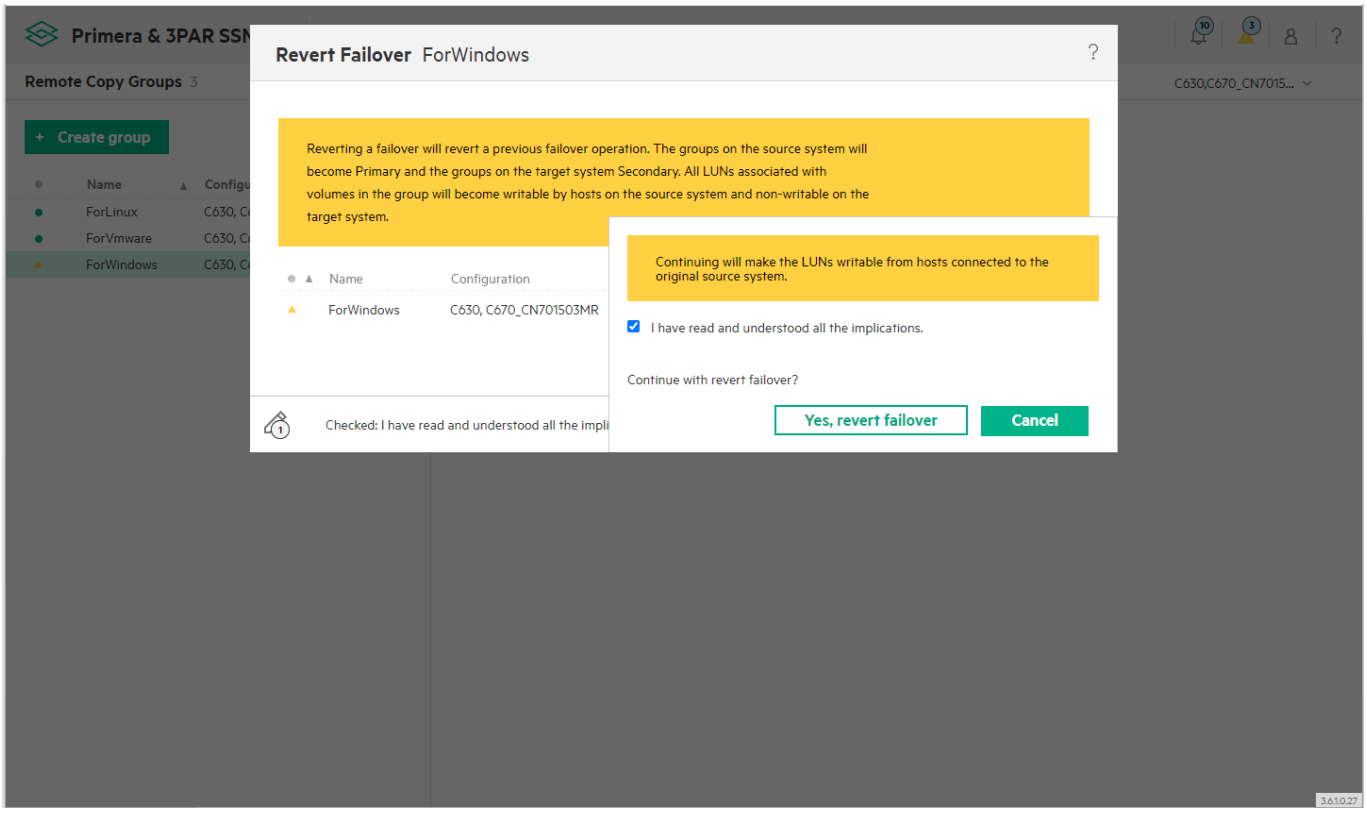
如果此时想回退故障转移前的状态，可以使用 Revert failover。



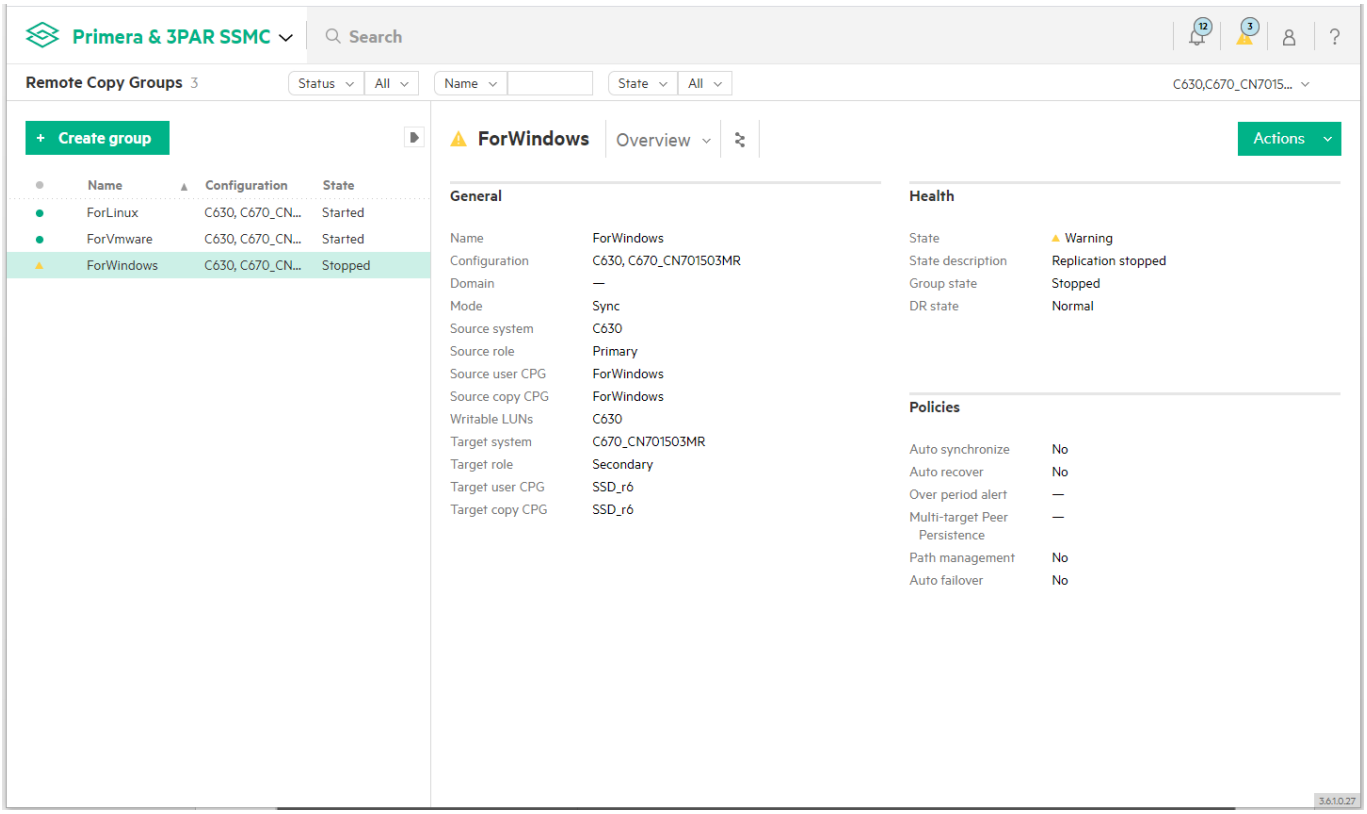
点击 Revert failover。



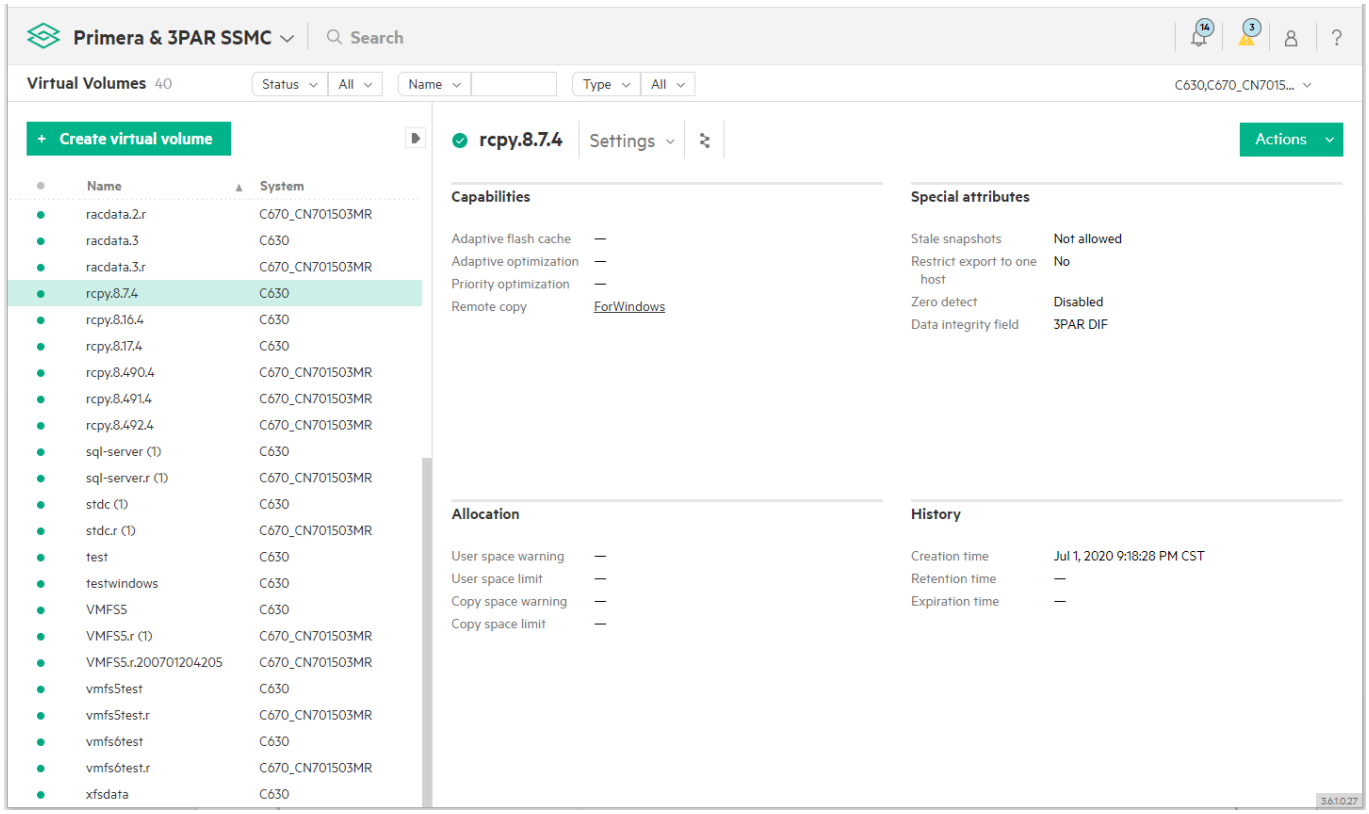
勾选 I have read and understood all the implications，点击 Yes,revert failover。



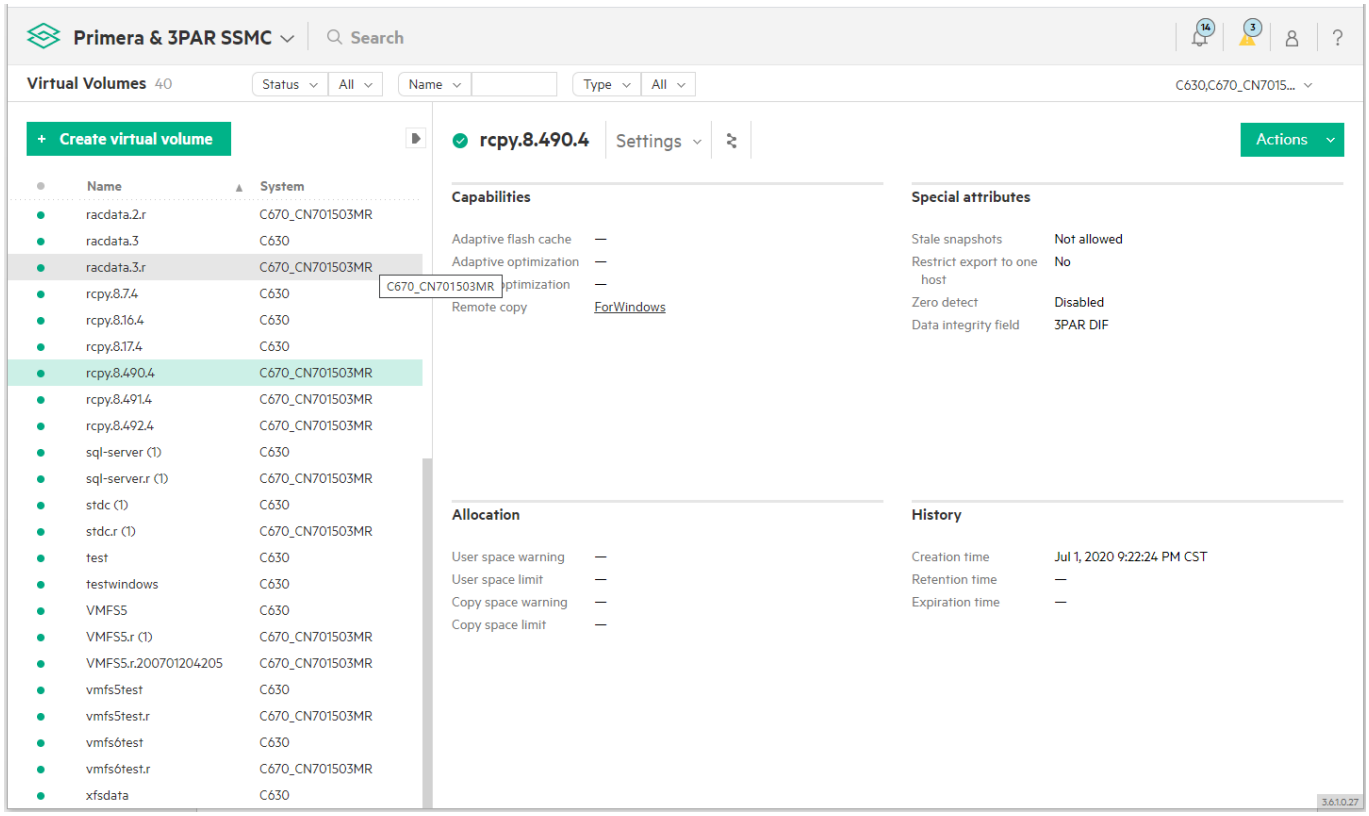
此时主存储角色仍旧为 Primary，目标存储角色为 Secondary。



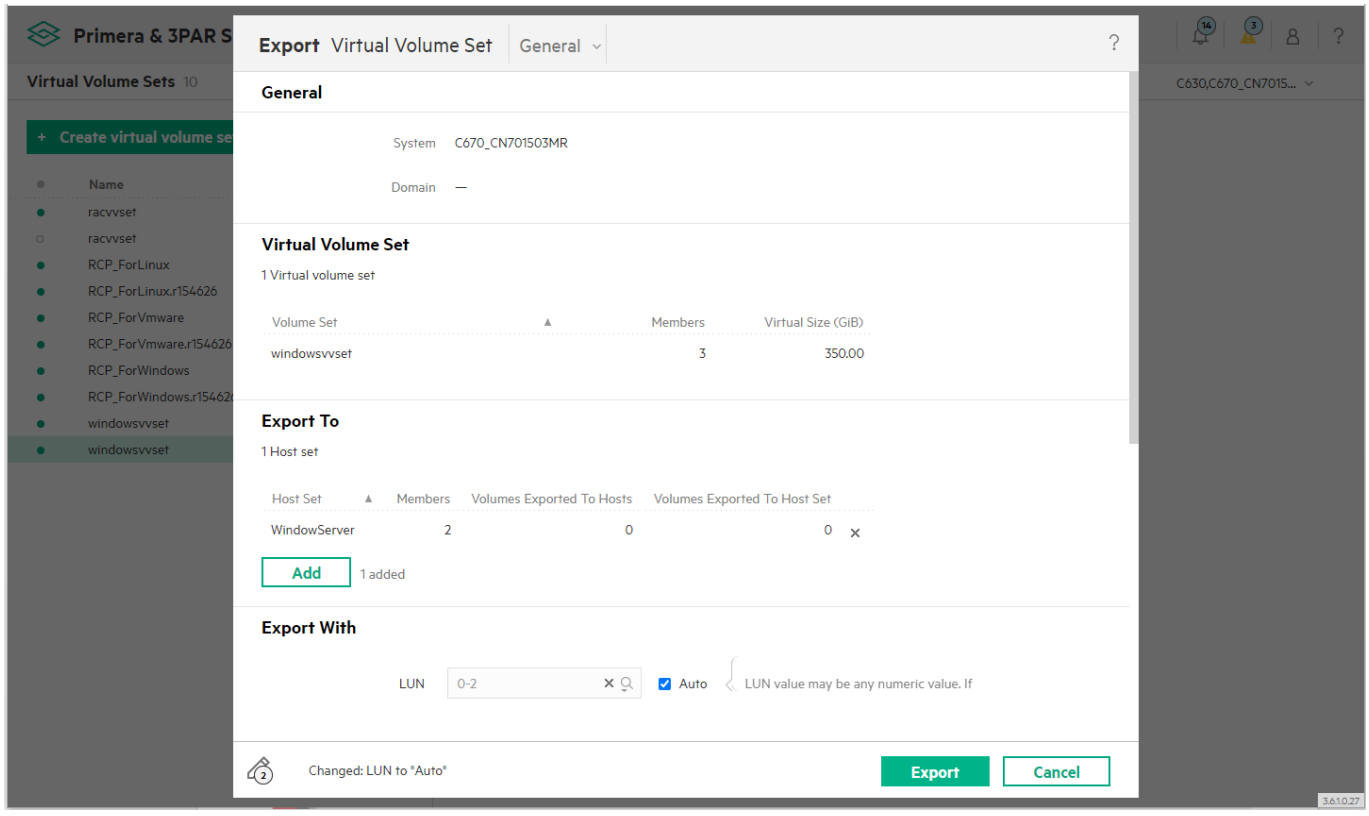
此时由于远程复制组仍旧在停止状态，主存储上保留的快照仍旧是故障转移前停止远程复制组时创建的快照。



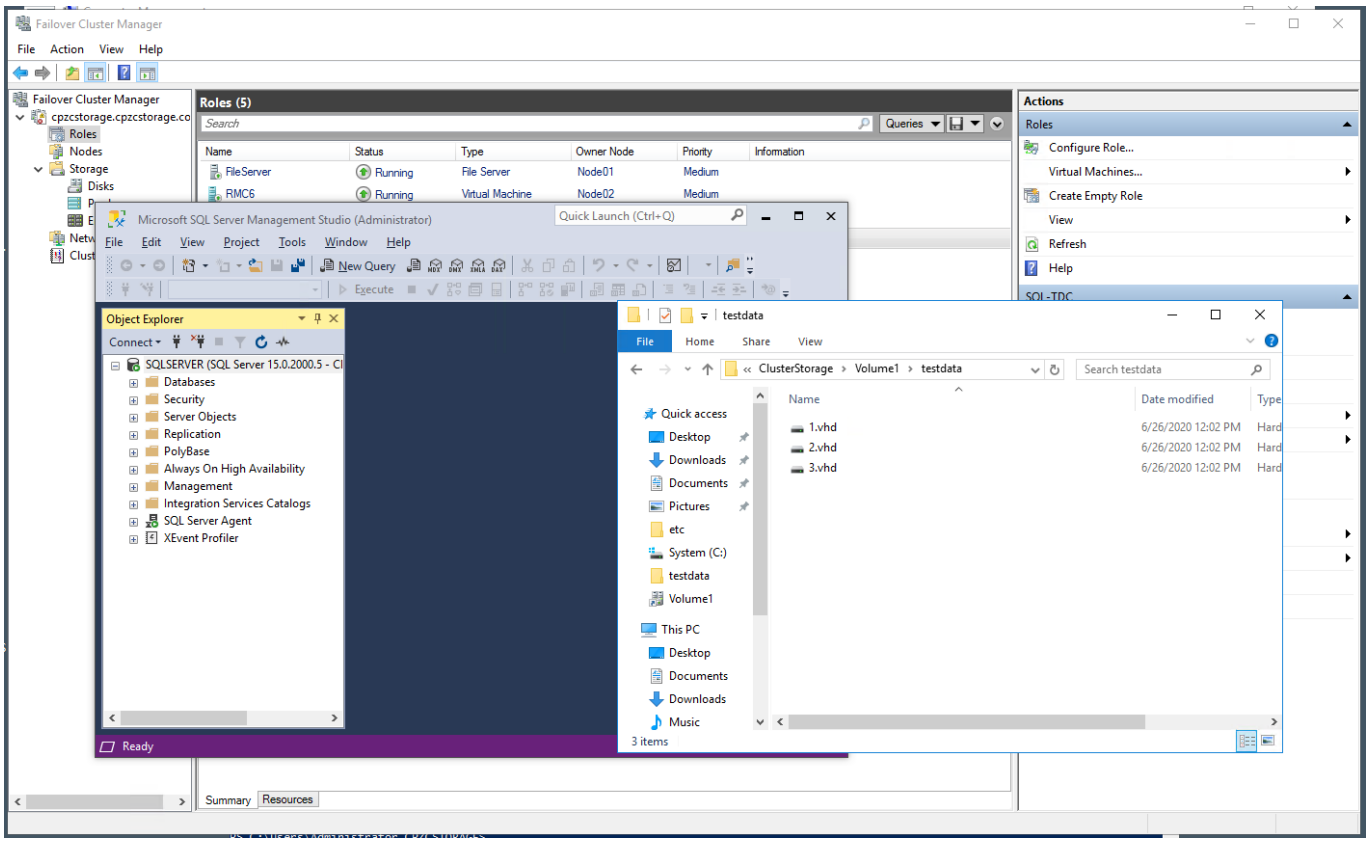
目标存储也仍旧保留故障转移后创建的快照。



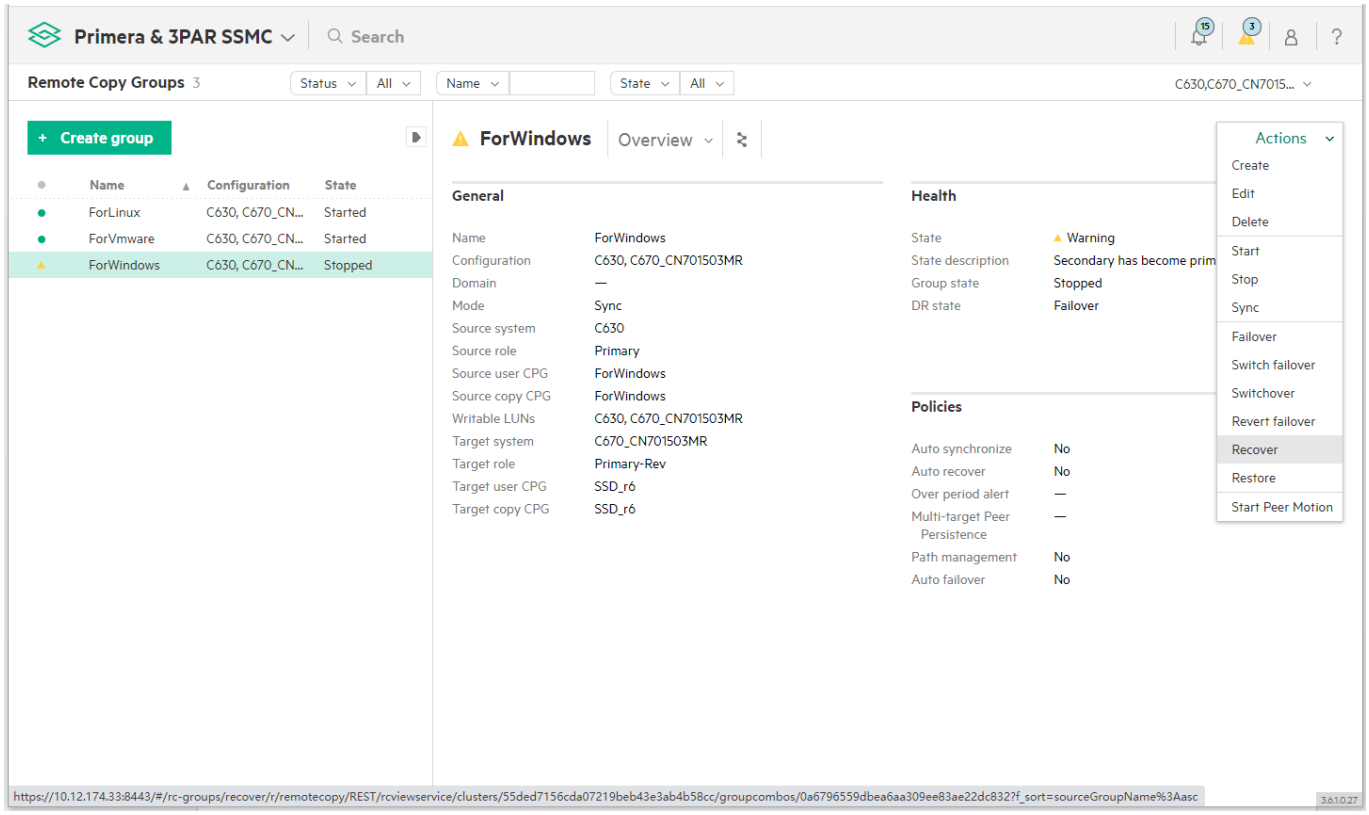
再次故障转移并映射远程卷。



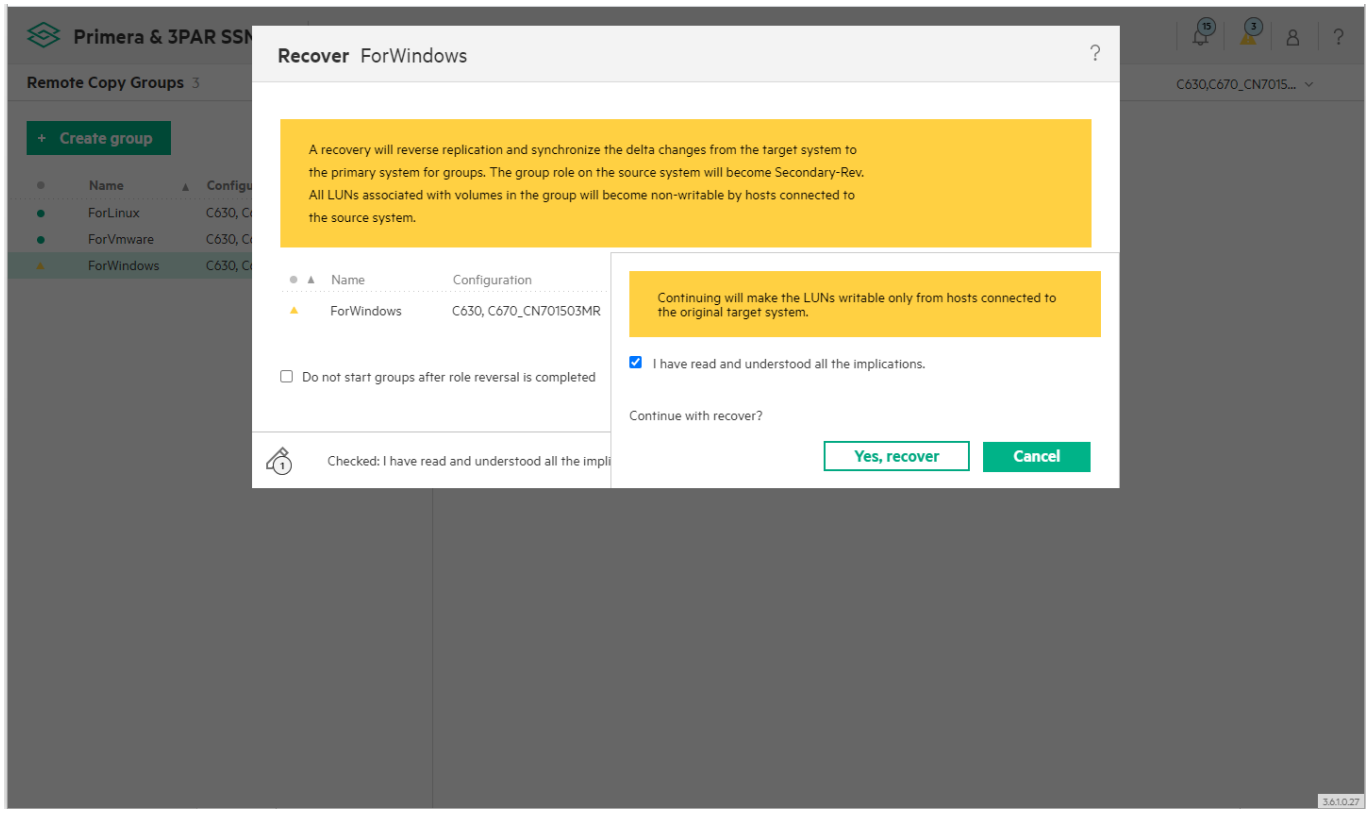
确认主机挂载远程卷可以正常启动应用，然后写入新数据。



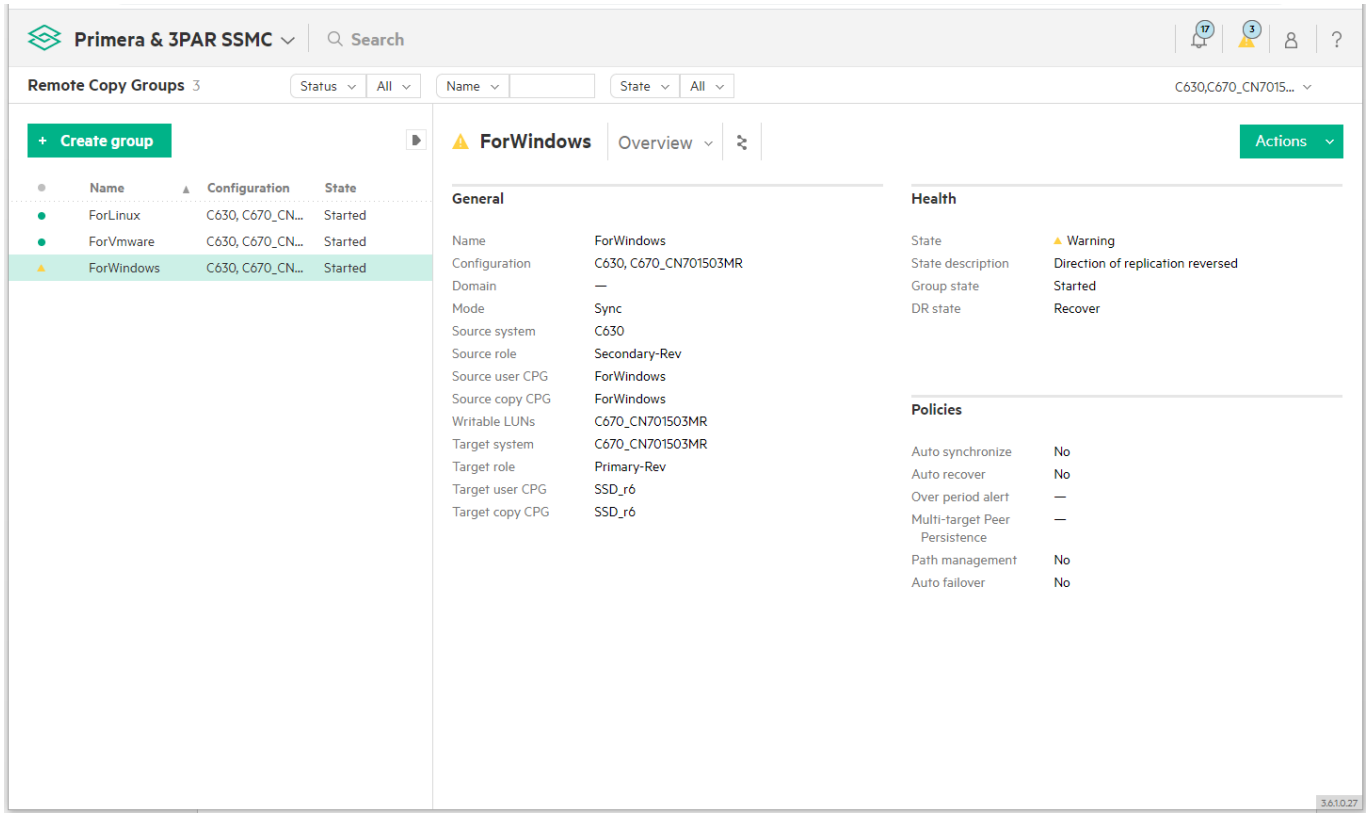
此时使用 Recover 功能反向同步主存储上的卷。



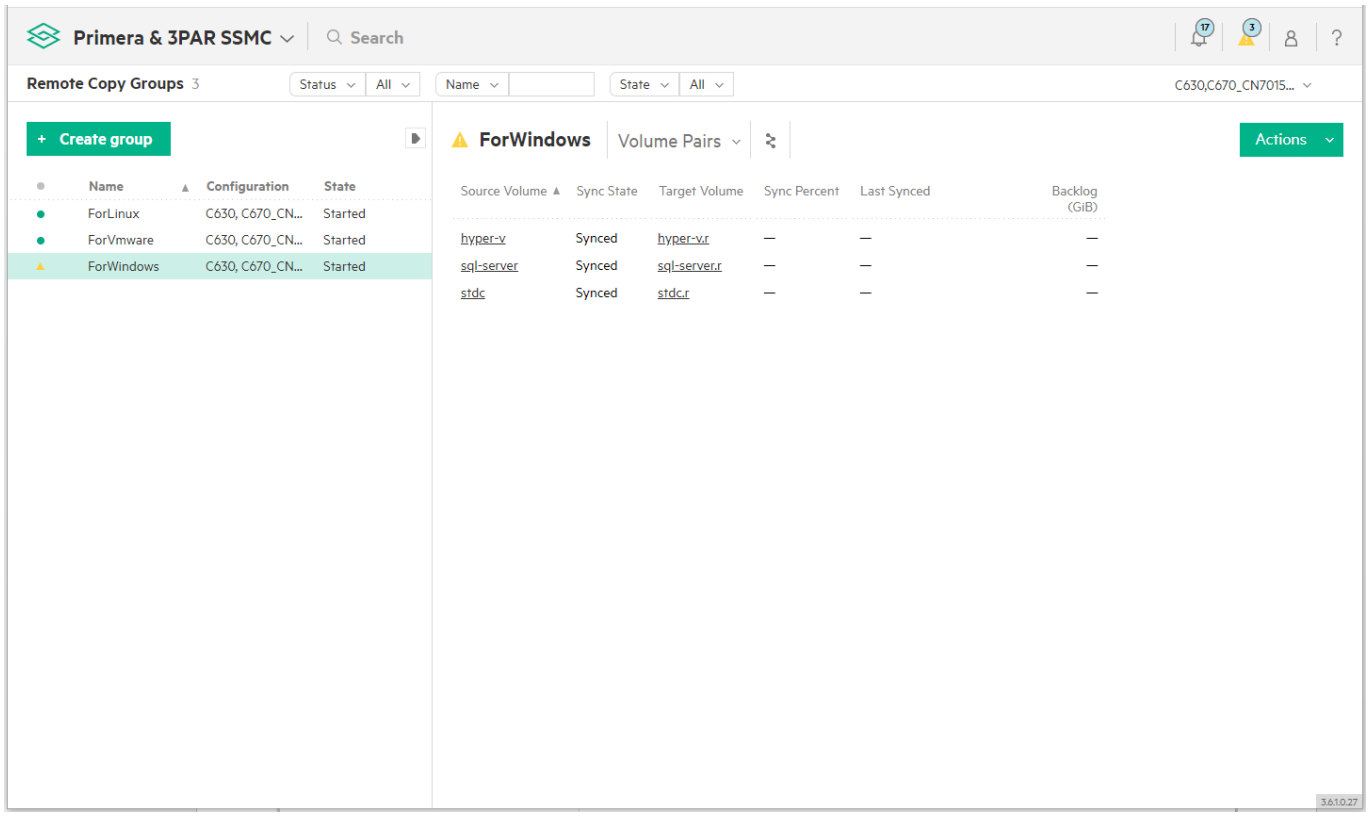
点击 Yes, recover。



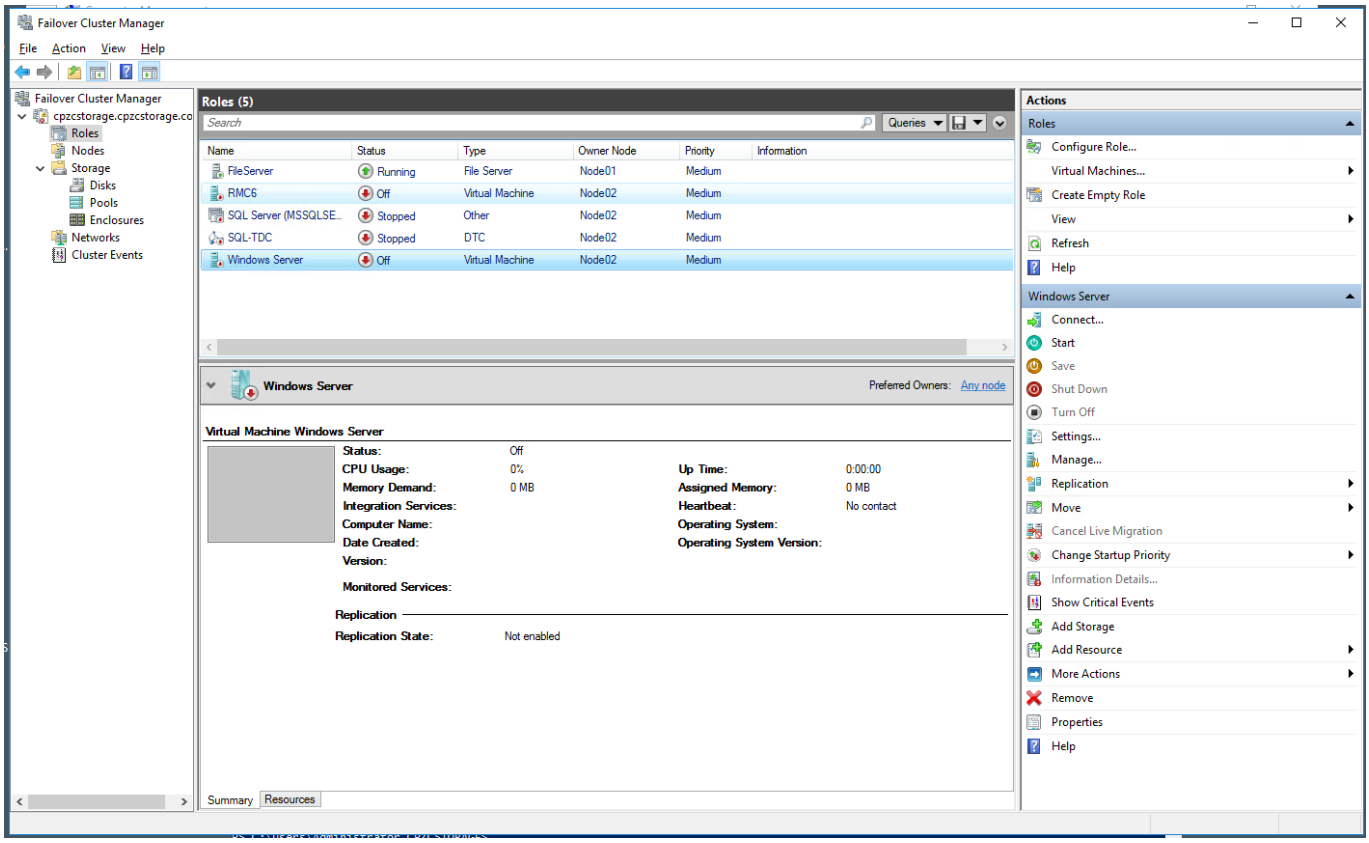
此时主存储角色变为 Secondary-Rev，目标存储角色仍旧为 Primary-Rev。



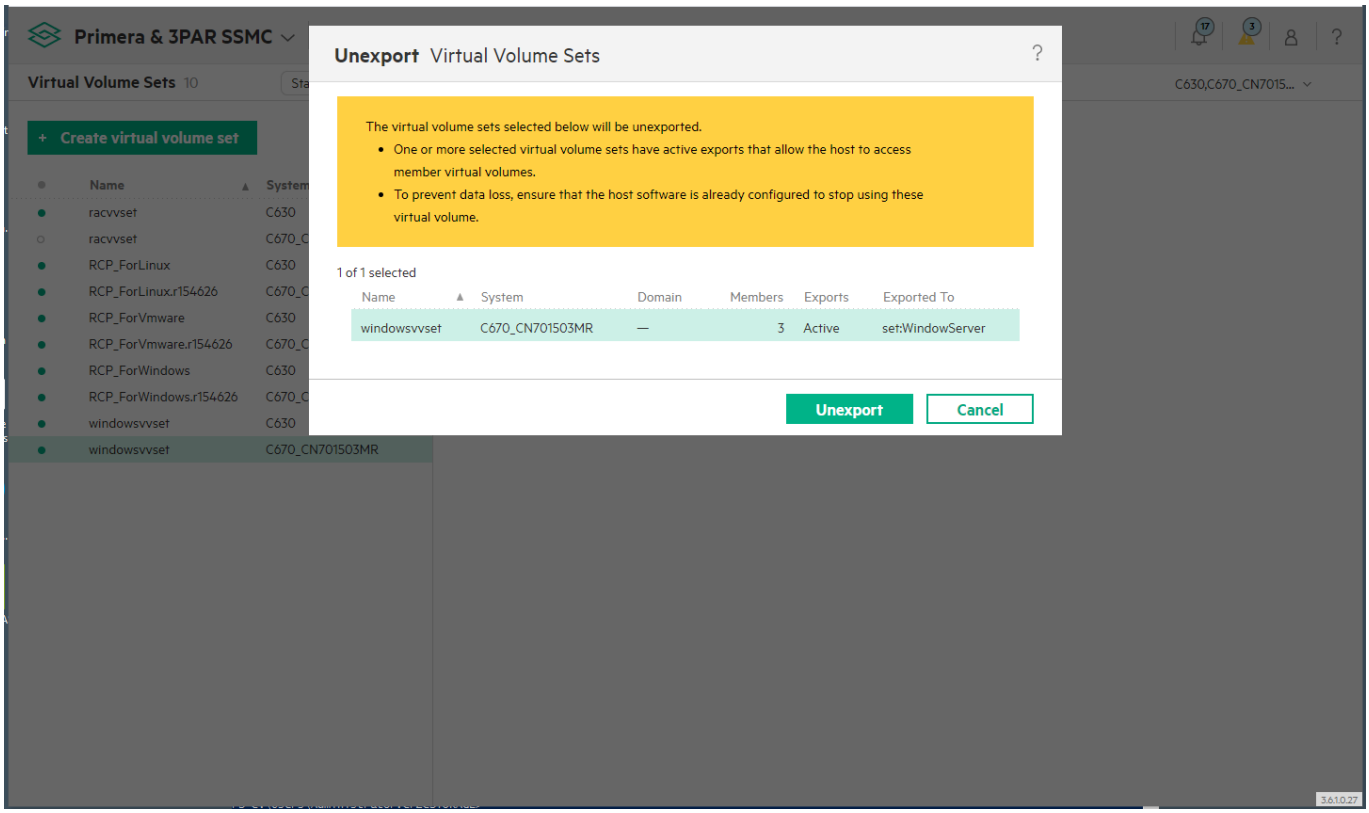
同步完成后两端存储上的快照都被删除。



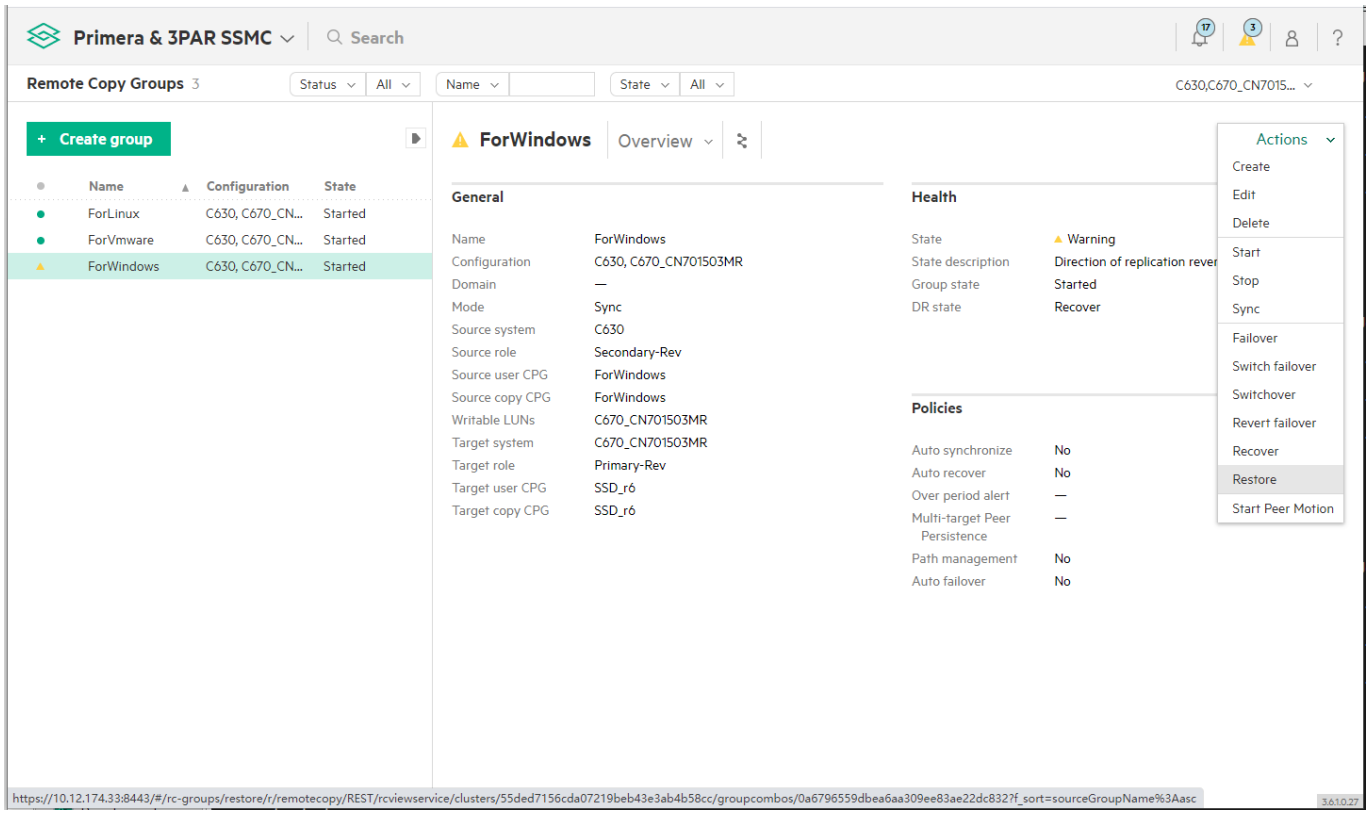
在做 Restore 前停止业务。



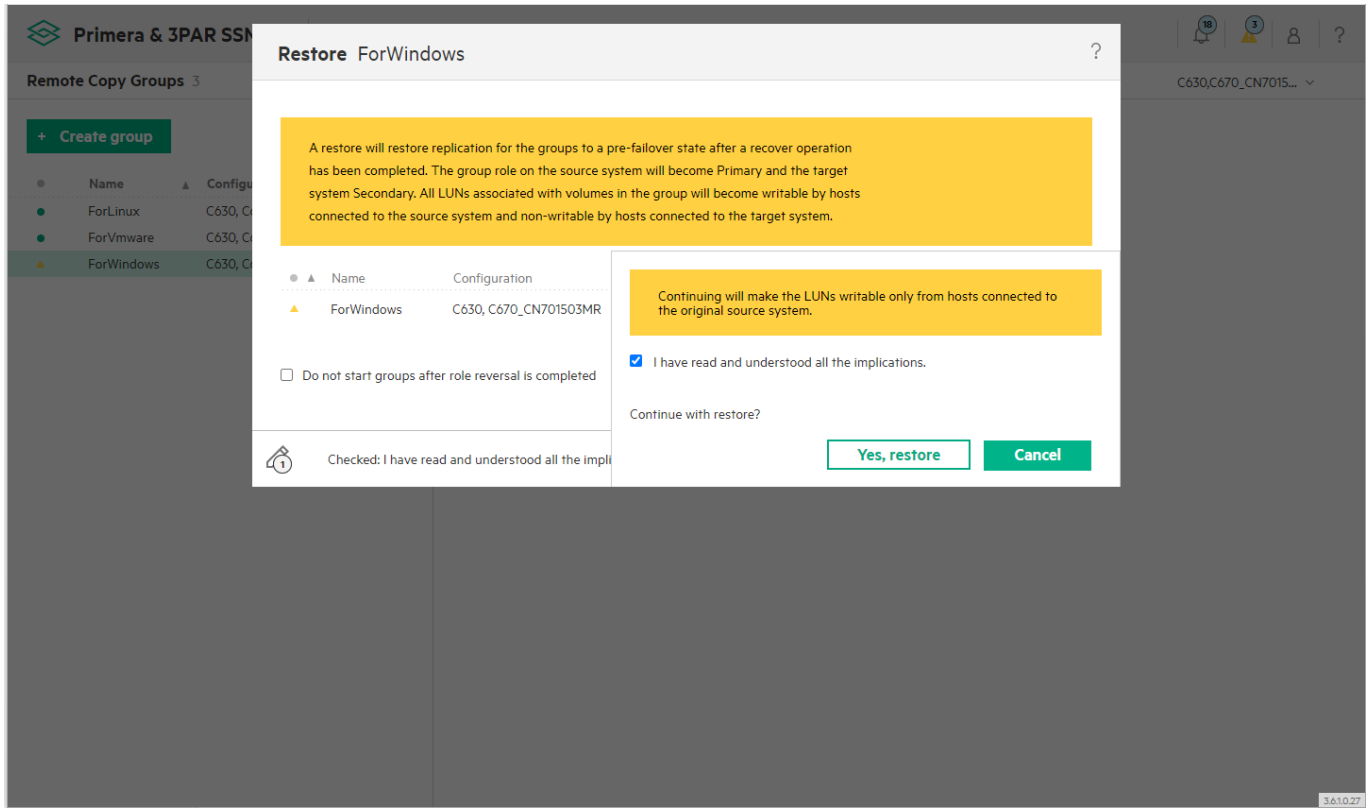
把远程卷取消映射。



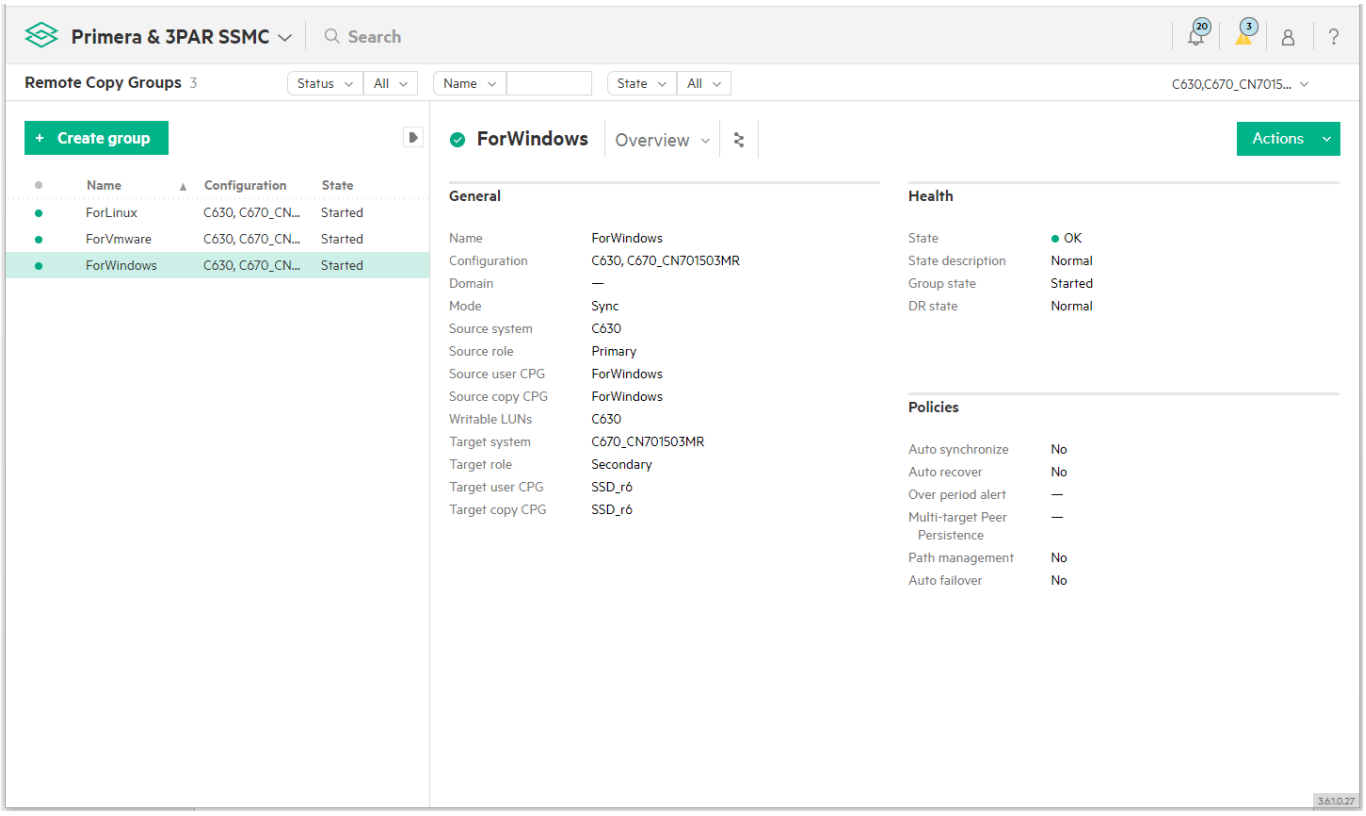
使用 Restore 恢复两端存储原始角色和流向。



点击 Yes, restore。



Restore 完成后主存储恢复 Primary 角色，目标存储仍旧为 Secondary 角色。



此时挂载卷确认业务正常并可以看到新写入的数据。