

3PAR StoreServ存储空间回收测试 - Windows UNMAP

存储配置 孙清雷 2019-05-19 发表

组网及说明

测试使用3PAR StoreServ 7200, 3PAR OS 3.2.2MU4

配置步骤

主机操作系统为WSS2012R2。从win2012/win2012R2支持T10 UNMAP SCSI协议，文件系统删除数据后，主机操作系统会自动对存储卷的已占用空间进行UNMAP操作。



存储端StoreServ 7200, 3PAR OS 3.2.2 MU6。

存储系统的可用数据块为2477个(GiB)。

showcpg -sdg, 查看CPG模板的配置信息。CPG“SunQingleiTestCPG”为RAID1, 步进为2 data。

showspace -cpg CPG名称, 查看按照CPG的空间使用情况。由于CPG“SunQingleiTestCPG”不包含存储卷, 故Usr - Total, Snp - Total, Adm -Total均为0。

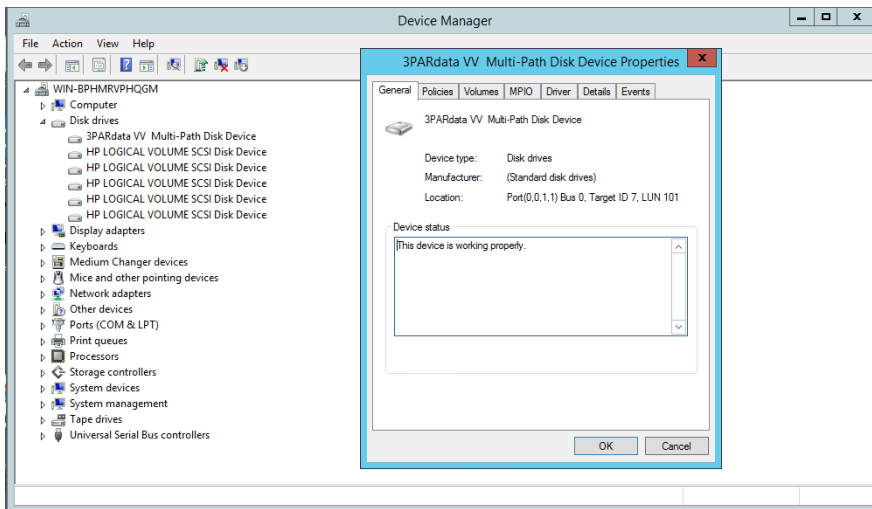
EstFree - RawFree, 是指存储系统可按照该CPG模板进行配置的总空间, 2535424MiB (2476GiB), 与上述存储系统的可用数据块容量相符。

EstFree - LDFree, 是指RawFree空间按照CPG的RAID级别设置之后的可用空间, $2535424\text{MiB} \div 2 = 1267712\text{MiB}$ (1238GiB)。

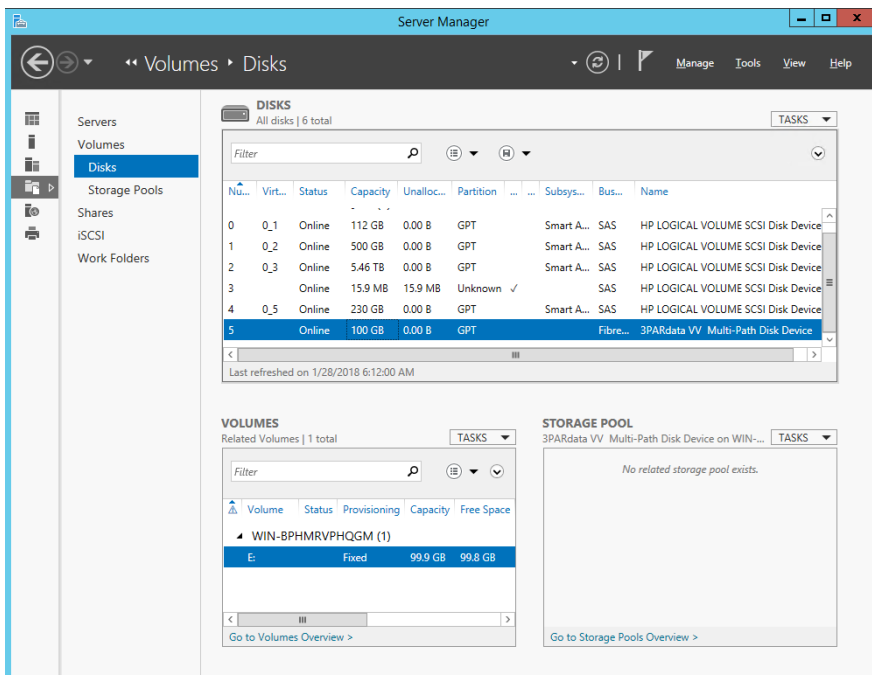
```
3par7200c cli% showversion
Release version 3.2.2 (MU6)
Patches: Pkg

Component Name      Version
CLI Server           3.2.2 (MU6)
CLI Client           3.2.2
System Manager       3.2.2 (MU6)
Kernel               3.2.2 (MU6)
TPD Kernel Code     3.2.2 (MU6)
3par7200c cli% showcpg -sdg SunQingleiTestCPG
3par7200c cli% showcpg -sdg SunQingleiTestCPG
------(MB)-----
Id Name      Warn Limit  Grow Args
2 SunQingleiTestCPG  -  - 32768 -t r1 -ha mag -ssz 2 -p -devtype FC -rpm 10
3par7200c cli% showspace -cpg SunQingleiTestCPG
------(MB)-----
CPG ---EstFree--- --UsrFree-- --Snp--- --Adm--- --Capacity Efficiency-
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2535424 1267712 0 0 0 0 0 0 0 0
3par7200c cli%
3par7200c cli% showpdc
----- Normal Chunklets ----- --- Spare Chunklets ---
Used --- Unused ----- Used --- Unused ---
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 169 0 308 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 165 0 312 0 0 0 0 0 69 0 0
3 0:3:0 FC normal 546 172 0 306 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 164 0 314 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 173 0 305 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 165 0 313 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 172 0 306 0 0 0 0 0 68 0 0
8 0:8:0 FC normal 546 165 0 313 0 0 0 0 0 68 0 0
-----
8 total 4368 1345 0 2477 0 0 0 0 0 546 0 0
3par7200c cli%
```

此时, 存储空间分布示意如下



文件与存储服务，将对应的磁盘5初始化、格式化合分区。



写入文件系统之后，TPVV的总占用空间Tot_Rsvd为9472MiB (9.25GiB)，Usr - Used为65MiB，略有增加。

对于CPG，裸容量消耗为(2535424-2443264)MiB÷1024=90GiB，LD容量消耗为(1267712-1221632)MiB÷1024=45GiB，无变化。

CPG总占用空间为(9216+23552+8192)MiB÷1024=40GiB，总量无变化，但CPG Usr - Total由1024MiB (1GiB)增长为9216MiB (9GiB)，CPG Snap - Total空间为31744MiB (31GiB)降至23552MiB (23GiB)，CPG的各组成部分发生变化。

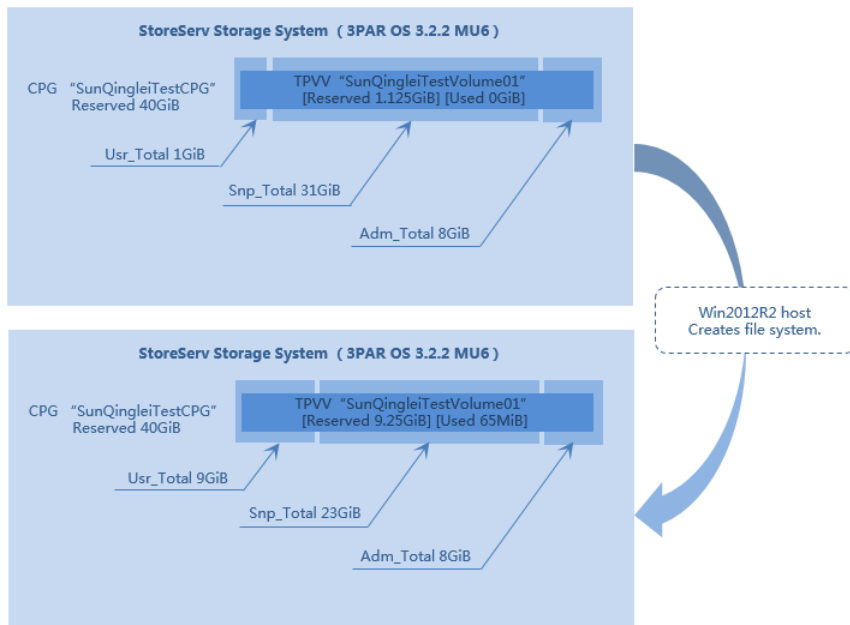
存储系统已使用的数据块数量仍为88个(GiB)。

```

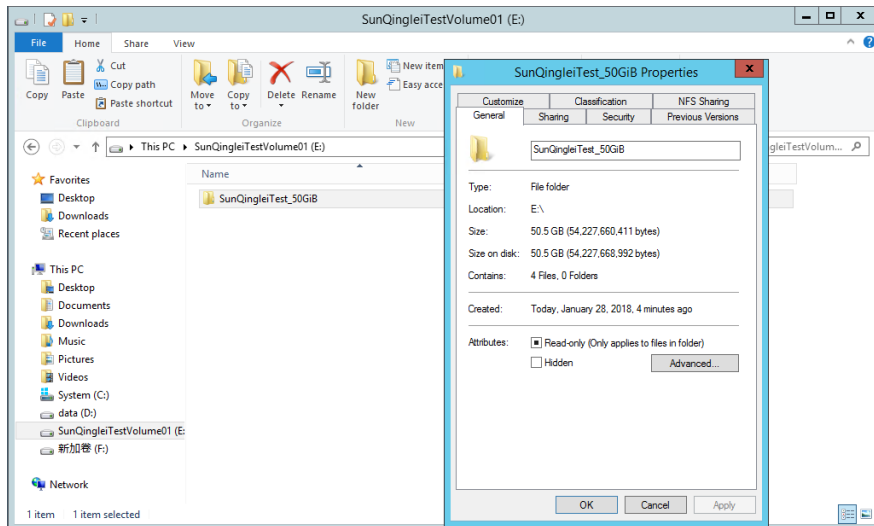
3par7200c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
Id Name          Prov Type Rsvd Used Rsvd Used Wrm Lim Rsvd Used Wrm Lim Tot_Rsvd VSize Capacity Efficiency
-----
10141 SunQingleiTestVolume01 tppv base 256 3 512 0 0 0 0 8704 65 0 1 0 9472 102400 1506.9
-----
1 total
256 3 512 0 0 0 0 8704 65 9472 102400 1506.9
3par7200c cli%
3par7200c cli% showspace -cpg SunQingleiTestCPG
CPG -----EstFree-----Usr-----Snp-----Adm-----Capacity Efficiency
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2443264 1221632 9216 9216 23552 1024 0192 384 4439.1
3par7200c cli%
3par7200c cli% showwpd -c
----- Normal Chunklets ----- Spare Chunklets -----
- Used - - - - - Unused - - - - - Used - - - - - Unused - - - - -
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 170 0 298 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 177 0 309 0 0 0 0 0 69 0 0
3 0:3:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 176 0 302 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 193 0 295 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 176 0 302 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
8 0:8:0 FC normal 546 174 0 304 0 0 0 0 0 68 0 0
8 total
4368 1433 0 2389 0 0 0 0 0 546 0 0
3par7200c cli%

```

此过程，存储空间变化示意如下



向TPVV的磁盘分区中拷入50.5GiB左右的测试数据。



拷入测试数据之后，TPVV的总占用空间Tot_Rsvd为56064MiB (54.75GiB)，Usr - Used为51782MiB (≈ 50.56GiB)，与文件系统层面数据量相符。

对于CPG，裸容量消耗为(2535424-2377728)MiB÷1024=154GiB，增加了64GiB。LD容量消耗为(1267712-1188864)MiB÷1024=77GiB，增加了32GiB。

CPG总占用空间为(55808+9728+8192)MiB÷1024=72GiB，增加32GiB，CPG Usr - Total由9216MiB (9GiB)增长为55808MiB (54.5GiB)，CPG Snp - Total空间为23552MiB (23GiB)降至9728MiB (9.5GiB)，CPG的各组成部分发生变化。

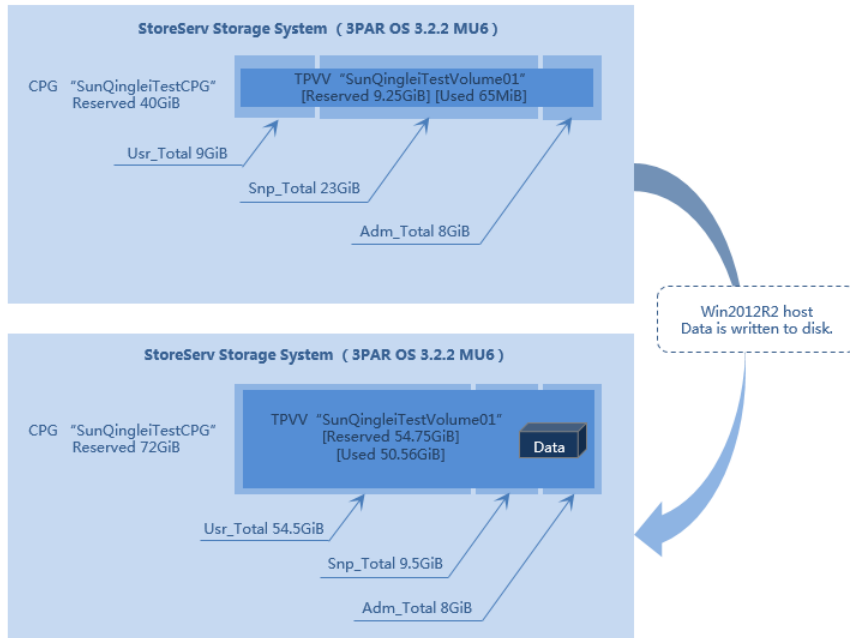
存储系统已使用的数据块数量为152。

```

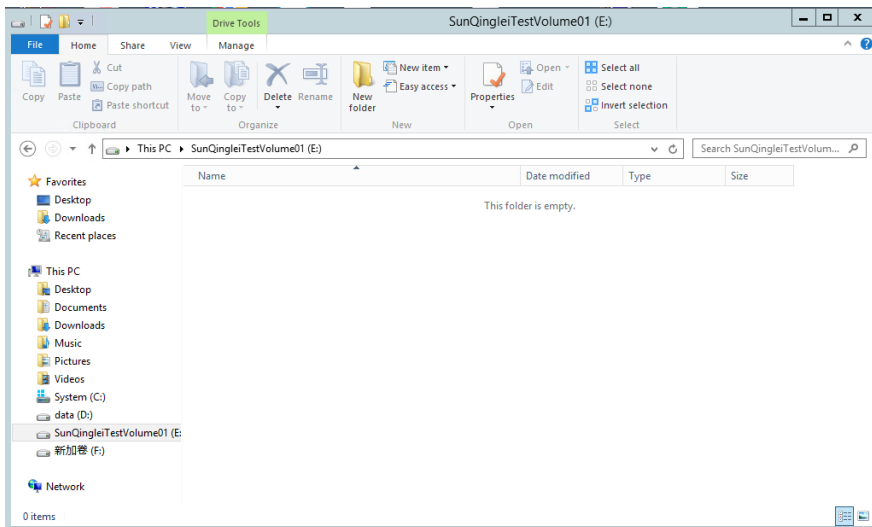
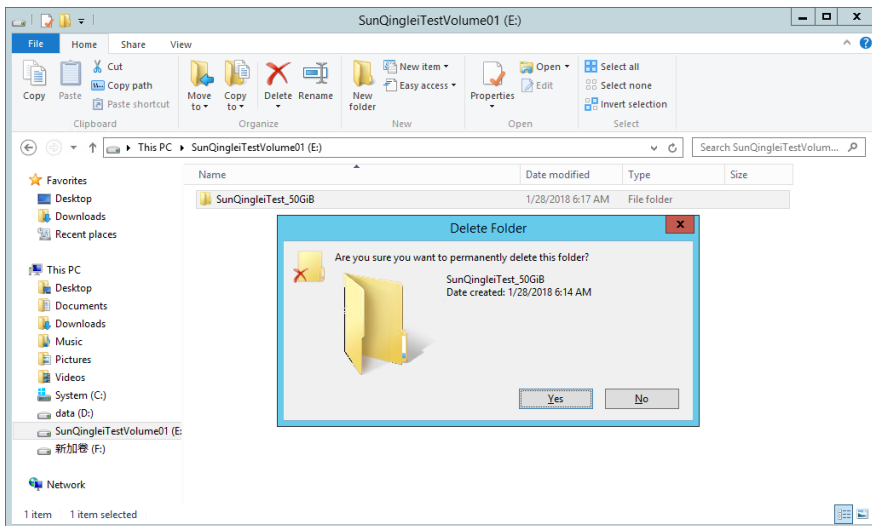
3par720c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
Id Name          Prov Type Rsvd Used Rsvd Used Wrn Lim Rsvd Used Wrn Lim Tot Rsvd VSize  Capacity Efficiency
10141 SunQingleiTestVolume01 tppv base 256 34 512 0 0.0 0 0 55296 51782 50.6 0 0 56064 102400 2.0
1 total
3par720c cli%
3par720c cli% showspace -cpg SunQingleiTestCPG
-----Adm-----Snp-----Usr-----
CPG ---EstFree-----
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2377728 1188864 55808 55808 9728 1024 8192 384 5.9
3par720c cli%
3par720c cli% showpdc -c
----- Normal Chunklets ----- Spare Chunklets -----
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 187 0 288 0 0 0 0 68 0 0
2 0:2:0 FC normal 546 185 0 292 0 0 0 0 68 0 0
3 0:3:0 FC normal 546 192 0 286 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 184 0 294 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 191 0 287 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 184 0 294 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 192 0 286 0 0 0 0 68 0 0
8 0:8:0 FC normal 546 182 0 296 0 0 0 0 68 0 0
8 total
4368 1497 0 2325 0 0 0 0 0 546 0 0
3par720c cli%

```

此过程，存储空间变化示意如下



文件系统层面，彻底删除磁盘分区中的数据。



删除数据之后，TPVV的总占用空间Tot_Rsvd为56064MiB (54.75GiB)，保持不变。Usr - Used会逐渐减少。

CPG总占用空间为(55808+9728+8192)MiB÷1024=72GiB，保持不变。CPG Usr - Total、CPG Snp - Total等均保持不变。

```

3par7200c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
(MB) (MB) (% VSize) (MB) (% VSize) (MB) (MB) Capacity Efficiency
Id Name Prov Type Rsvd Used Rsvd Used Wrn Lim Rsvd Used Wrn Lim Tot Rsvd VSize Compaction Dedup
10141 SunQingleiTestVolume01 tppv base 256 34 512 0 0.0 0 0 55296 39414 38.5 0 0 56064 102400 2.6 --
-----
1 total 256 34 512 0 55296 39414 56064 102400 2.6 --
3par7200c cli%
3par7200c cli% showspace -cpg SunQingleiTestCPG
-----Adm-----Snp-----Usr-----
(MB) (MB) (% VSize) (MB) (% VSize) (MB) (MB) Capacity Efficiency
Cpg ---EstFree-----Usr-----Snp-----Adm-----
Name RawFree LDFree Total Used Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2377720 1188864 55808 95808 9728 1024 8192 384 2645.8 --
3par7200c cli%
3par7200c cli% showwpd -c
-----Normal Chunklets ----- Spare Chunklets ----
Used ----- Unused -----
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 197 0 290 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
3 0:3:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 191 0 287 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
8 0:0:0 FC normal 546 192 0 296 0 0 0 0 0 68 0 0
-----
8 total 4368 1497 0 2325 0 0 0 0 0 546 0 0
3par7200c cli%

```

TPVV的Usr - Used会减少至80MiB，与文件系统层面删除数据的情况相符，可视为主机操作系统对存储卷已完成UNMAP操作，而总占用空间Tot_Rsvd为56064MiB (54.75GiB)，保持不变，即存储卷占用的空间还未回退至CPG之中。

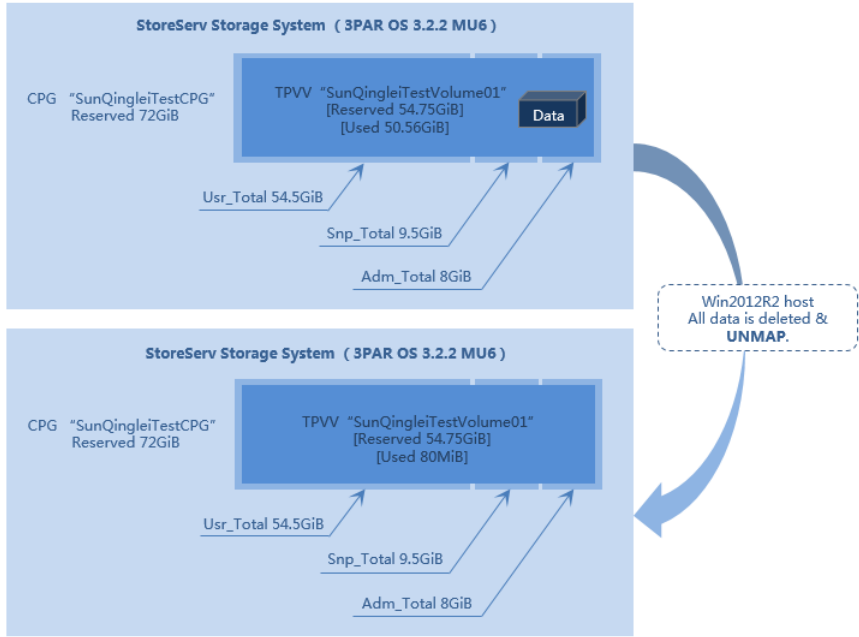
CPG总占用空间为(55808+9728+8192)MiB÷1024=72GiB，保持不变。CPG Usr - Total、CPG Snp - Total等均保持不变。

```

3par7200c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
(MB) (MB) (% VSize) (MB) (% VSize) (MB) (MB) Capacity Efficiency
Id Name Prov Type Rsvd Used Rsvd Used Wrn Lim Rsvd Used Wrn Lim Tot Rsvd VSize Compaction Dedup
10141 SunQingleiTestVolume01 tppv base 256 34 512 0 0.0 0 0 55296 80 0.1 0 0 56064 102400 891.5 --
-----
1 total 256 34 512 0 55296 80 56064 102400 891.5 --
3par7200c cli%
3par7200c cli% showspace -cpg SunQingleiTestCPG
-----Adm-----Snp-----Usr-----
(MB) (MB) (% VSize) (MB) (% VSize) (MB) (MB) Capacity Efficiency
Cpg ---EstFree-----Usr-----Snp-----Adm-----
Name RawFree LDFree Total Used Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2377720 1188864 55808 95808 9728 1024 8192 384 2645.8 --
3par7200c cli%
3par7200c cli% showwpd -c
-----Normal Chunklets ----- Spare Chunklets ----
Used ----- Unused -----
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 197 0 290 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 185 0 292 0 0 0 0 0 69 0 0
3 0:3:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 191 0 287 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
8 0:0:0 FC normal 546 192 0 296 0 0 0 0 0 68 0 0
-----
8 total 4368 1497 0 2325 0 0 0 0 0 546 0 0
3par7200c cli%

```

此过程，存储空间变化示意图如下



测试环境中2个小时后，TPVV的总占用空间Tot_Rsvd会减少至9088MiB (8.875GiB)，存储卷退回(54.75-8.875)=45.875GiB空间至CPG。

存储卷仍占用8GiB左右空间是正常情况，存储卷不会完全释放所有空间，会为每个控制器节点保留4GiB左右的空间。

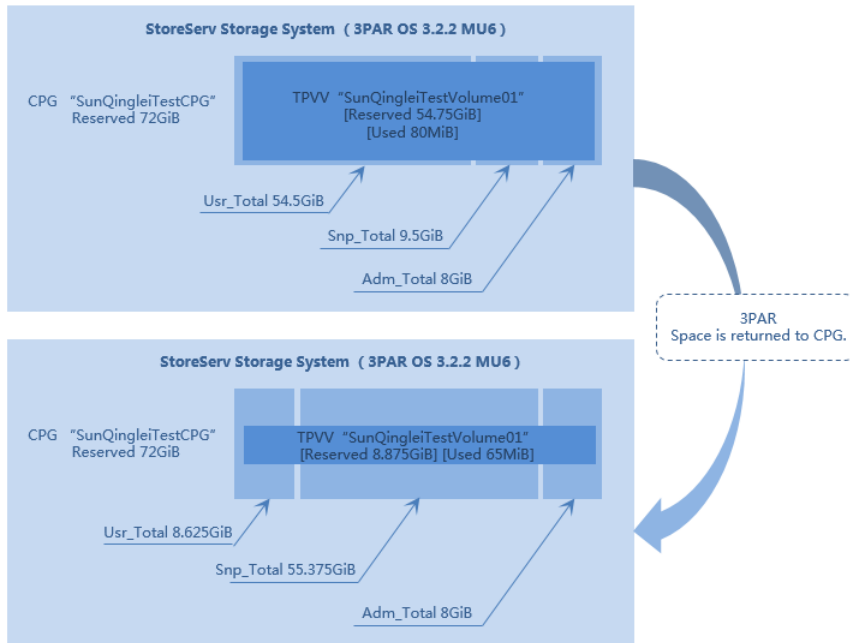
对于CPG，CPG总占用空间为(8832+56704+8192)MiB÷1024=72GiB，保持不变，而CPG Usr - Total由55808MiB减少至8832MiB (8.625GiB)，CPG Snp - Total空间为9728MiB (9.5GiB)增长至56704MiB (55.375GiB)，增长了45.875GiB，即存储卷退回至CPG的空间容量。CPG Snp - Total的部分容量可通过compactcpg，进一步释放回存储系统的可用存储块。

```

3par7200c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
Id Name          Prov Type Rsvd Used Rsvd Used Wrn Lim Rsvd Used Wrn Lim Tot_Rsvd VSize  Capacity Efficiency-
10141 SunQingleiTestVolume01 tppv base 256 34 512 0 0 0 0 8320 65 0 1 0 0 9088 102400 1034.5
-----
1 total
256 34 512 0 8320 65 9088 102400 1034.5
3par7200c cli%
3par7200c cli% showspace -cpg SunQingleiTestCPG
-----
CPG ---EstFree-----Usr-----Snp-----Adm-----Capacity Efficiency-
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 2377720 1188804 8832 8832 56704 1024 8192 384 3064.8
3par7200c cli%
3par7200c cli% showpdc -c
----- Normal Chunklets ----- Spare Chunklets ----
----- Used ----- Unused ----- Used ----- Unused -----
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 187 0 290 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 185 0 292 0 0 0 0 0 69 0 0
3 0:3:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 191 0 287 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 184 0 294 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 192 0 286 0 0 0 0 0 68 0 0
8 0:0:0 FC normal 546 182 0 296 0 0 0 0 0 68 0 0
-----
8 total
4368 1497 0 2325 0 0 0 0 0 546 0 0
3par7200c cli%

```

此过程，存储空间变化示意图如下



注，由于测试环境有变化，故存储系统的可用数据块不恒定，不参考绝对值，仅参考每次操作前后的变化量。

在compactcpg之前，存储系统的可用数据块为1253个(GiB)。

```

3par7200c cli% showvv -s SunQingleiTestVolume01
-----Adm-----Snp-----Usr-----
Id Name          Prov Type Rsvd Used Rsvd Used Wrn Lim Rsvd Used Wrn Lim Tot_Rsvd VSize  Capacity Efficiency-
10141 SunQingleiTestVolume01 tppv base 256 34 512 0 0 0 0 8320 65 0 1 0 0 9088 102400 1034.7
-----
1 total
256 34 512 0 8320 65 9088 102400 1034.7
3par7200c cli%
3par7200c cli% showspace -cpg SunQingleiTestCPG
-----
CPG ---EstFree-----Usr-----Snp-----Adm-----Capacity Efficiency-
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 1280000 640000 8832 8832 56704 1024 8192 384 3063.3
3par7200c cli%
3par7200c cli% showpdc -c
----- Normal Chunklets ----- Spare Chunklets ----
----- Used ----- Unused ----- Used ----- Unused -----
Id CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 321 0 156 0 0 0 0 0 69 0 0
2 0:2:0 FC normal 546 319 0 158 0 0 0 0 0 69 0 0
3 0:3:0 FC normal 546 326 0 152 0 0 0 0 0 68 0 0
4 0:4:0 FC normal 546 318 0 160 0 0 0 0 0 68 0 0
5 0:5:0 FC normal 546 325 0 153 0 0 0 0 0 68 0 0
6 0:6:0 FC normal 546 318 0 160 0 0 0 0 0 68 0 0
7 0:7:0 FC normal 546 326 0 152 0 0 0 0 0 68 0 0
8 0:0:0 FC normal 546 316 0 162 0 0 0 0 0 68 0 0
-----
8 total
4368 2569 0 1253 0 0 0 0 0 546 0 0
3par7200c cli%

```

对CPG进行compactcpg。

随着compactcpg开始，不断地有数据块变为uninit状态，会经重新初始化之后变为可用数据块。


```

2018-01-29 08:25:18 CST Started region move of 128MB from (tp-2-sd-0.1:20160MB) to (tp-2-sd-0.1:128MB)
2018-01-29 08:25:18 CST Started region move of 128MB from (tp-2-sd-0.1:28288MB) to (tp-2-sd-0.1:11024MB)
2018-01-29 08:25:18 CST Started region move of 128MB from (tp-2-sd-0.0:26624MB) to (tp-2-sd-0.0:128MB)
2018-01-29 08:25:18 CST Started region move of 128MB from (tp-2-sd-0.0:29328MB) to (tp-2-sd-0.0:1024MB)
2018-01-29 08:25:25 CST Started region move of 256MB from (tp-2-sd-0.1:27904MB) to (tp-2-sd-0.1:1152MB)
2018-01-29 08:25:25 CST Started region move of 256MB from (tp-2-sd-0.1:27648MB) to (tp-2-sd-0.1:11408MB)
2018-01-29 08:25:43 CST Started region move of 256MB from (tp-2-sd-0.1:27392MB) to (tp-2-sd-0.1:1168MB)
2018-01-29 08:25:43 CST Started region move of 256MB from (tp-2-sd-0.1:27136MB) to (tp-2-sd-0.1:11920MB)
2018-01-29 08:26:01 CST Started region move of 256MB from (tp-2-sd-0.1:26880MB) to (tp-2-sd-0.1:12176MB)
2018-01-29 08:26:01 CST Started region move of 256MB from (tp-2-sd-0.1:26624MB) to (tp-2-sd-0.1:12432MB)
2018-01-29 08:26:20 CST Started region move of 256MB from (tp-2-sd-0.1:26368MB) to (tp-2-sd-0.1:12688MB)
2018-01-29 08:26:20 CST Started region move of 256MB from (tp-2-sd-0.1:26112MB) to (tp-2-sd-0.1:12944MB)
2018-01-29 08:26:40 CST Started region move of 256MB from (tp-2-sd-0.1:25856MB) to (tp-2-sd-0.1:13200MB)
2018-01-29 08:26:40 CST Started region move of 256MB from (tp-2-sd-0.1:25600MB) to (tp-2-sd-0.1:13456MB)
2018-01-29 08:27:02 CST Started region move of 256MB from (tp-2-sd-0.1:25344MB) to (tp-2-sd-0.1:13712MB)
2018-01-29 08:27:02 CST Started region move of 256MB from (tp-2-sd-0.1:25088MB) to (tp-2-sd-0.1:13968MB)
2018-01-29 08:27:21 CST Started region move of 256MB from (tp-2-sd-0.1:24832MB) to (tp-2-sd-0.1:14224MB)
2018-01-29 08:27:21 CST Started region move of 256MB from (tp-2-sd-0.1:24576MB) to (tp-2-sd-0.1:14480MB)
2018-01-29 08:27:39 CST Started region move of 128MB from (tp-2-sd-0.1:24448MB) to (tp-2-sd-0.1:14736MB)
2018-01-29 08:27:39 CST Started region move of 128MB from (tp-2-sd-0.1:24296MB) to (tp-2-sd-0.1:14992MB)
2018-01-29 08:27:48 CST Started region move of 128MB from (tp-2-sd-0.1:24192MB) to (tp-2-sd-0.1:14992MB)
2018-01-29 08:27:48 CST Started region move of 128MB from (tp-2-sd-0.1:24064MB) to (tp-2-sd-0.1:15120MB)
2018-01-29 08:27:58 CST Started region move of 128MB from (tp-2-sd-0.1:23936MB) to (tp-2-sd-0.1:15248MB)
2018-01-29 08:27:58 CST Started region move of 128MB from (tp-2-sd-0.1:23808MB) to (tp-2-sd-0.1:15376MB)
2018-01-29 08:28:07 CST Started region move of 128MB from (tp-2-sd-0.1:23680MB) to (tp-2-sd-0.1:15504MB)
2018-01-29 08:28:07 CST Started region move of 128MB from (tp-2-sd-0.1:23552MB) to (tp-2-sd-0.1:15632MB)
2018-01-29 08:28:16 CST Started region move of 128MB from (tp-2-sd-0.1:23424MB) to (tp-2-sd-0.1:15760MB)
2018-01-29 08:28:16 CST Started region move of 128MB from (tp-2-sd-0.1:23296MB) to (tp-2-sd-0.1:15888MB)
2018-01-29 08:28:25 CST Started region move of 128MB from (tp-2-sd-0.1:23168MB) to (tp-2-sd-0.1:16016MB)
2018-01-29 08:28:25 CST Started region move of 128MB from (tp-2-sd-0.1:23040MB) to (tp-2-sd-0.1:16144MB)
2018-01-29 08:28:35 CST Started region move of 128MB from (tp-2-sd-0.1:22912MB) to (tp-2-sd-0.1:16272MB)
2018-01-29 08:28:35 CST Started region move of 128MB from (tp-2-sd-0.1:22784MB) to (tp-2-sd-0.1:16400MB)
2018-01-29 08:28:45 CST Started region move of 128MB from (tp-2-sd-0.1:22656MB) to (tp-2-sd-0.1:16528MB)
2018-01-29 08:28:45 CST Started region move of 128MB from (tp-2-sd-0.1:22528MB) to (tp-2-sd-0.1:16656MB)
2018-01-29 08:28:54 CST Started region move of 128MB from (tp-2-sd-0.1:22400MB) to (tp-2-sd-0.1:16784MB)
2018-01-29 08:28:54 CST Started region move of 128MB from (tp-2-sd-0.1:22272MB) to (tp-2-sd-0.1:16912MB)
2018-01-29 08:29:04 CST Started region move of 128MB from (tp-2-sd-0.1:22144MB) to (tp-2-sd-0.1:17040MB)
2018-01-29 08:29:04 CST Started region move of 128MB from (tp-2-sd-0.1:22016MB) to (tp-2-sd-0.1:17168MB)
2018-01-29 08:29:12 CST Started region move of 128MB from (tp-2-sd-0.1:21888MB) to (tp-2-sd-0.1:17296MB)
2018-01-29 08:29:13 CST Started region move of 128MB from (tp-2-sd-0.1:21760MB) to (tp-2-sd-0.1:17424MB)
2018-01-29 08:29:22 CST Started region move of 128MB from (tp-2-sd-0.1:21632MB) to (tp-2-sd-0.1:17552MB)
2018-01-29 08:29:22 CST Started region move of 128MB from (tp-2-sd-0.1:21504MB) to (tp-2-sd-0.1:17680MB)
2018-01-29 08:29:31 CST Started region move of 128MB from (tp-2-sd-0.1:21376MB) to (tp-2-sd-0.1:17808MB)
2018-01-29 08:29:31 CST Started region move of 128MB from (tp-2-sd-0.1:21248MB) to (tp-2-sd-0.1:17936MB)
2018-01-29 08:29:41 CST Started region move of 128MB from (tp-2-sd-0.1:21120MB) to (tp-2-sd-0.1:18064MB)
2018-01-29 08:29:41 CST Started region move of 128MB from (tp-2-sd-0.1:20992MB) to (tp-2-sd-0.1:18192MB)
2018-01-29 08:29:50 CST Started region move of 128MB from (tp-2-sd-0.1:20864MB) to (tp-2-sd-0.1:18320MB)
2018-01-29 08:29:50 CST Started region move of 128MB from (tp-2-sd-0.1:20736MB) to (tp-2-sd-0.1:18448MB)
2018-01-29 08:29:55 CST Started region move of 128MB from (tp-2-sd-0.1:20608MB) to (tp-2-sd-0.1:18576MB)
2018-01-29 08:29:58 CST Waiting to switch regions to their new locations.
2018-01-29 08:29:58 CST Truncated LD tp-2-sd-0.1 from 28672MB to 26624MB. Reclaimed 2048MB.
2018-01-29 08:29:58 CST Truncated LD tp-2-sd-0.0 from 28672MB to 18432MB. Reclaimed 10240MB.
2018-01-29 08:29:58 CST Completed region moves. Moved 49 regions for a total of 8064 MB in 4 minutes and 40 seconds.
spar7280c cli%

```

```

spar7280c cli% showpd -c
----- Normal Chunklets ----- Spare Chunklets ----
Used          Unused          Used          Unused
ld CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 314 0 159 5 0 0 0 0 69 0 0 0
2 0:2:0 FC normal 546 316 0 160 1 0 0 0 0 69 0 0 0
3 0:3:0 FC normal 546 319 0 154 5 0 0 0 0 68 0 0 0
4 0:4:0 FC normal 546 315 0 162 1 0 0 0 0 68 0 0 0
5 0:5:0 FC normal 546 318 0 155 5 0 0 0 0 68 0 0 0
6 0:6:0 FC normal 546 315 0 162 1 0 0 0 0 68 0 0 0
7 0:7:0 FC normal 546 319 0 154 5 0 0 0 0 68 0 0 0
8 0:8:0 FC normal 546 313 0 164 1 0 0 0 0 68 0 0 0
8 total 4368 2529 0 1269 24 0 0 0 0 0 546 0 0 0
spar7280c cli%

```

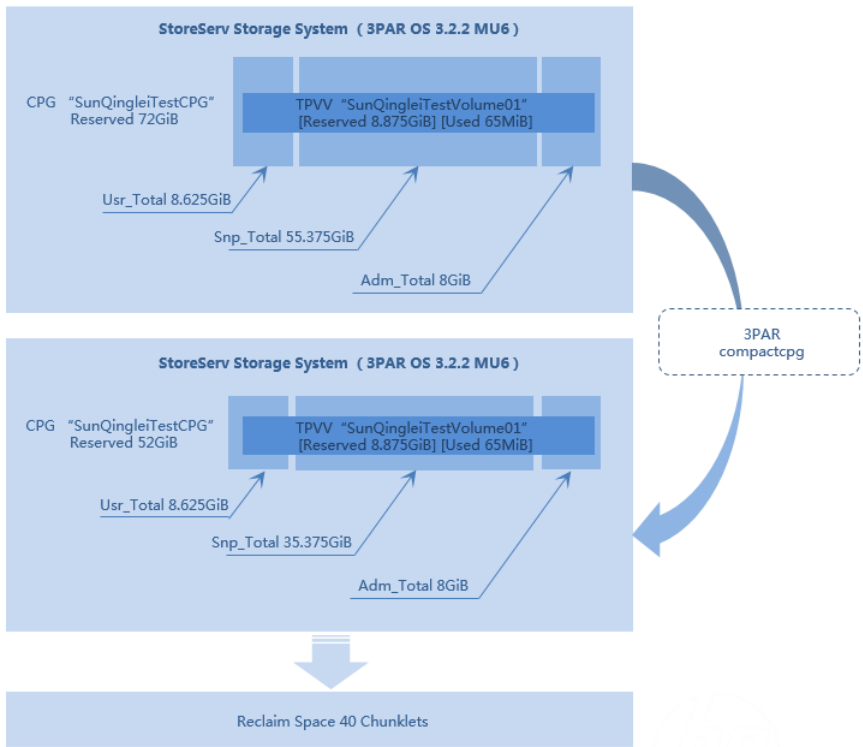
完成compactcpgr之后，CPG总占用空间为(8832+36224+8192)MiB÷1024=52GiB，减少了20GiB，与compactcpgr释放的LD空间相符。其中，CPG Usr - Total为8832MiB (8.625GiB)，保持不变。CPG Sna p - Total空间由56704MiB (55.375GiB)减少至36224MiB (35.375GiB)。存储系统的可用数据块由1253个(GiB)增至1293个(GiB)，增加了40个(GiB)，与CPG的步进相符。

```

spar7280c cli% showspace -cpg SunQingleiTestCPG
CPG --EstFree----Usr----Snp----Adm----Capacity Efficiency
Name RawFree LDFree Total Used Total Used Total Used Compaction Dedup
SunQingleiTestCPG 1329600 660488 8832 8832 36224 1024 8192 384 3065.3
spar7280c cli%
spar7280c cli% showpd -c
----- Normal Chunklets ----- Spare Chunklets ----
Used          Unused          Used          Unused
ld CagePos Type State Total OK Fail Free Uninit Unavail Fail OK Fail Free Uninit Fail
1 0:1:0 FC normal 546 314 0 163 0 0 0 0 0 69 0 0 0
2 0:2:0 FC normal 546 316 0 161 0 0 0 0 0 69 0 0 0
3 0:3:0 FC normal 546 319 0 159 0 0 0 0 0 68 0 0 0
4 0:4:0 FC normal 546 315 0 163 0 0 0 0 0 68 0 0 0
5 0:5:0 FC normal 546 318 0 160 0 0 0 0 0 68 0 0 0
6 0:6:0 FC normal 546 315 0 163 0 0 0 0 0 68 0 0 0
7 0:7:0 FC normal 546 319 0 159 0 0 0 0 0 68 0 0 0
8 0:8:0 FC normal 546 313 0 165 0 0 0 0 0 68 0 0 0
8 total 4368 2529 0 1293 0 0 0 0 0 0 546 0 0 0
spar7280c cli%

```

此过程，存储空间变化示意如下



END.

