一、背景信息

1、硬件配置

1.1、集群环境说明

主机名	主机IP地址	配置信息	角色
node111	集群网络 172.16.33.111 业务网络 172.16.21.111	**CPU：**E5-2620 v3 @ 2.40GHz x 2 **内存：**128G **硬盘：**240G SSD x 1（系统盘）6T HDD x 12（数据盘） **网络：**万兆 x2	MON、MGR、MDS、OSD
node112	集群网络 172.16.33.112 业务网络 172.16.21.112	**CPU：**E5-2620 v3 @ 2.40GHz x 2 **内存：**128G **硬盘：**240G SSD x 1（系统盘）6T HDD x 12（数据盘） **网络：**万兆 x2	MON、MGR、MDS、OSD
node113	集群网络 172.16.33.113 业务网络 172.16.21.113	**CPU：**E5-2620 v3 @ 2.40GHz x 2 **内存：**128G **硬盘：**240G SSD x 1（系统盘）6T HDD x 12（数据盘） **网络：**万兆 x2	MON、MGR、MDS、OSD

1.2、客户端环境说明

主机名	主机IP地址	配置信息
node40	业务网络 172.16.21.40	**CPU：**E5-2630 v3 @ 2.40GHz x 2 **内存：**32G **硬盘：**240G SSD x 1（系统盘） **网络：**万兆 x1
node41	业务网络 172.16.21.41	**CPU：**E5-2630 v3 @ 2.40GHz x 2 **内存：**32G **硬盘：**240G SSD x 1（系统盘） **网络：**万兆 x1
node42	业务网络 172.16.21.42	**CPU：**E5-2630 v3 @ 2.40GHz x 2 **内存：**32G **硬盘：**240G SSD x 1（系统盘） **网络：**万兆 x1

2、测试版本

V112R002C00SSDSB060

3、测试说明

3.1、测试工具

vdbench50406

4、部署调整

4.1、集群参数

- 调整osd、mds内存限制为4G

```
[root@node111 ~]# cat /etc/ceph/ceph.conf | grep memory
osd_memory_target = 4294967296
mds_cache_memory_limit = 4294967296
```

4.2、文件接口

- 副本池（data）或纠删池（ecpool）pg数调整为1024，均衡该池内所有OSD的pg数
- 客户端选择nfs v4版本挂载

- 三个集群节点各出一个nfs，三个客户端与集群节点一一对应挂载访问

4.3、块接口

- 副本池（rbd）或纠删池（ecrbd）pg数调整为1024，均衡该池内所有OSD的pg数
- 禁用rbd特性（fast-diff、object-map）
  注：当rbd填充完，再次覆盖写时，性能值会出现衰减情况

```
[root@node113 ~]# rbd feature disable rbd/rep-rbd001 fast-diff
[root@node113 ~]# rbd feature disable rbd/rep-rbd001 object-map
[root@node113 ~]# rbd info rbd/rep-rbd001
rbd image 'rep-rbd001':
    size 4TiB in 1048576 objects
    order 22 (4MiB objects)
    block_name_prefix: rbd_data.2f45376b8b4567
    format: 2
    features: layering, exclusive-lock, deep-flatten
    flags:
    create_timestamp: Tue Aug 25 13:57:31 2020
#禁用前
[root@node112 ~]# rbd bench --image=rep-rbd001 --io-type=write --io-threads=1
bench  type write io_size 4096 io_threads 16 bytes 104857600 pattern random
  SEC       OPS   OPS/SEC   BYTES/SEC
    1        66     81.36  333253.30
    2       128     70.48  288679.68
    3       178     64.58  264512.87
    4       251     66.59  272743.77
    5       314     65.88  269860.04
#禁用后
[root@node112 ~]# rbd bench --image=rep-rbd001 --io-type=write --io-threads=1
bench  type write io_size 4096 io_threads 16 bytes 104857600 pattern random
  SEC       OPS   OPS/SEC   BYTES/SEC
    1      1009   1024.18  4195043.98
    2      1824    919.23  3765148.60
    3      2612    875.57  3586344.05
    4      3492    876.80  3591378.11
    5      4163    835.74  3423202.21
```

- 三个集群节点各出一个target（每个target出两个4T的卷），三个客户端与集群节点一一对应挂载访问

4.4、对象接口

- 调整索引池（rgw.index）pg数为128，调整数据池（rgw.data）pg数为1024，均衡该池内所有OSD的pg数
- 每个网关实例下添加如下参数（/etc/ceph/ceph.conf），设置分片数为8（即单个bucket可容纳100万个文件）具体分片数可根据单bucket业务写入数调整

```
rgw_override_bucket_index_max_shards = 8
```

- 三个集群节点，每个节点出两个网关，三个客户端上配置haproxy，指定本身8088端口（127.0.0.1：8088）为前端业务写入入口，后端配置对应六个网关，均衡三个集群节点流量

二、基准测试

1、网络测试

- **客户端节点-->集群节点**

```
[root@node40 ~]# iperf -c 172.16.21.111 -P 0
------------------------------------------------------------
Client connecting to 172.16.21.111, TCP port 5001
TCP window size: 3.54 MByte (default)
------------------------------------------------------------
[  3] local 172.16.21.40 port 38570 connected with 172.16.21.111 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.0 sec  10.9 GBytes  9.40 Gbits/sec
[root@node40 ~]#
```

```
[root@node41 ~]# iperf -c 172.16.21.112 -P 0
------------------------------------------------------------
Client connecting to 172.16.21.112, TCP port 5001
TCP window size: 2.73 MByte (default)
------------------------------------------------------------
[  3] local 172.16.21.41 port 6312 connected with 172.16.21.112 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.0 sec  10.8 GBytes  9.30 Gbits/sec
[root@node41 ~]#
```

```
[root@node42 ~]# iperf -c 172.16.21.113 -P 0
------------------------------------------------------------
Client connecting to 172.16.21.113, TCP port 5001
TCP window size: 1.03 MByte (default)
------------------------------------------------------------
[  3] local 172.16.21.42 port 57520 connected with 172.16.21.113 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.0 sec  10.9 GBytes  9.40 Gbits/sec
```

- **集群节点<-->集群节点**

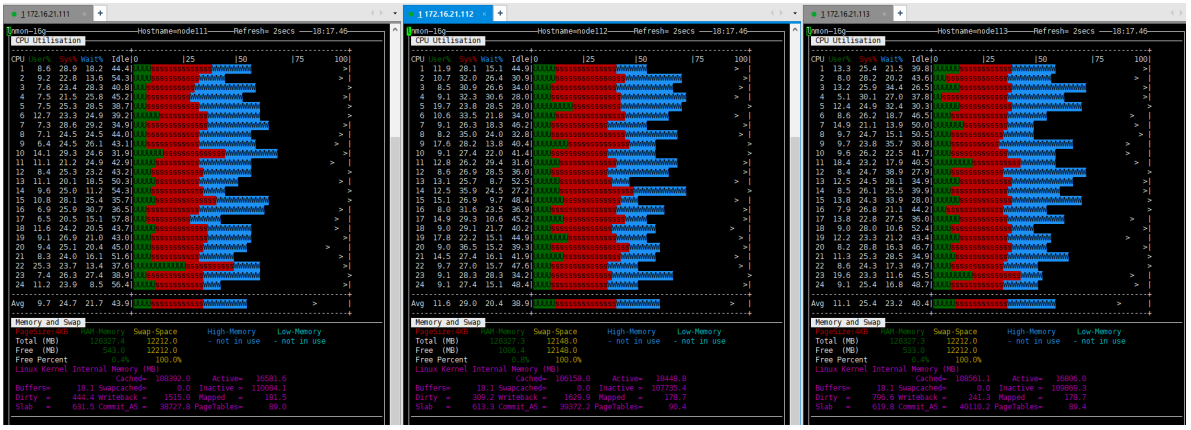
三、性能测试

1、【blustore】副本测试

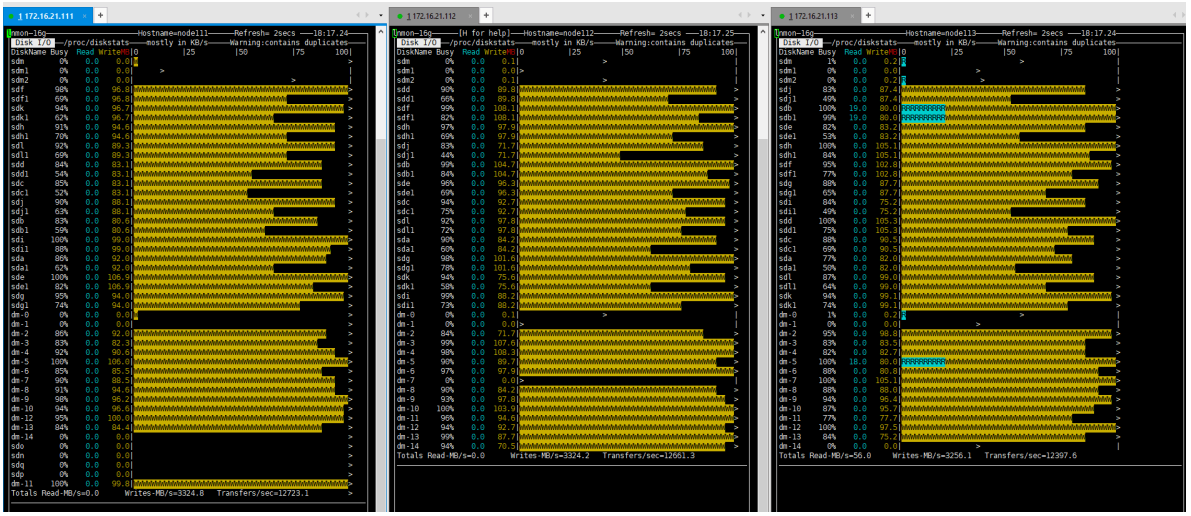
1.1、【文件】1M顺序写

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/replica/largetest01,depth=1,width=10,files=288,size=200m,sha
fwd=format,threads=32,xfersize=1m
fwd=default,operation=write,xfersize=1m,fileio=sequential,fileselect=sequenti
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

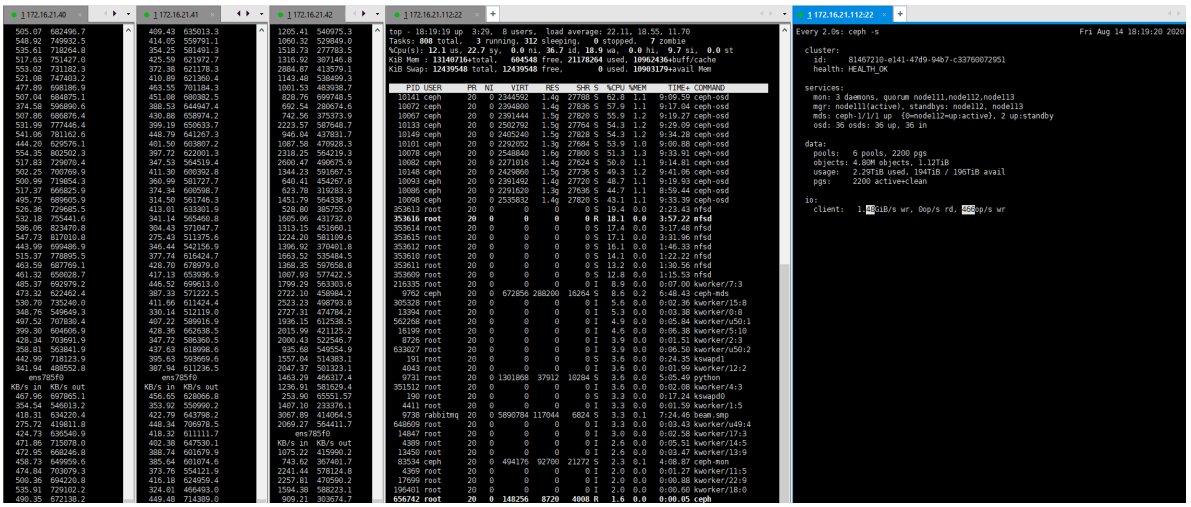
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

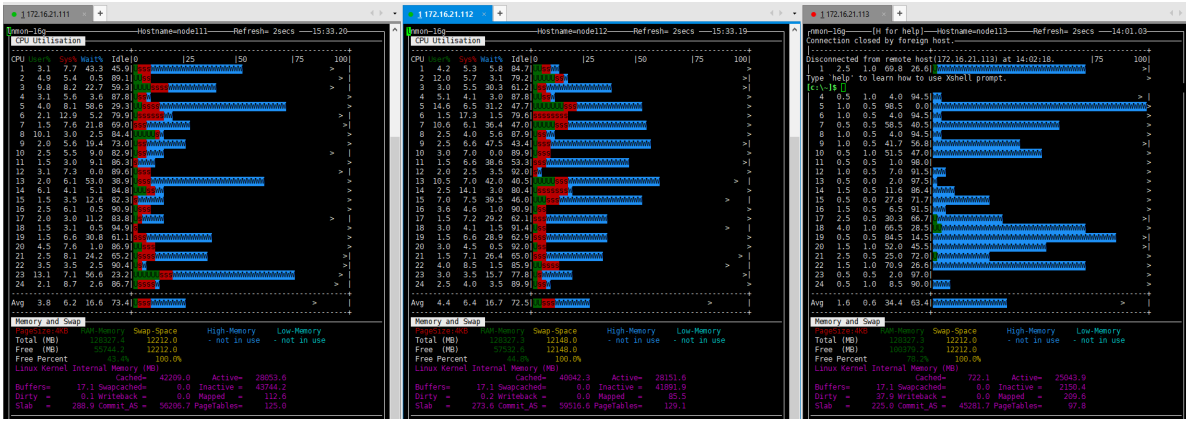
  1M顺序写：（带宽：1612.7MB/s IOPS：1612.7 时延：54.542ms)

```
[root@node40 file-bluestore-replica]# cat 1M-Write/totals.html
<title>Vdbench 1M-write/totals.html</title><pre>
Run totals


Link to Run Definitions:          <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                  <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>18:06:31.002 Starting RD=format_for_rd1</b></i>


Aug 14, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                        rate   resp total  sys   pct   rate   resp   rate   resp  read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
18:15:07.052  avg_2-516 1116.3 66.668   7.7 5.36   0.0    0.0  0.000 1116.3 66.668  0.00  1116 1116.2 1048577   0.0 90.691   0.0  0.000   5.6  16286   5.6 1632.9   5.6 1075.9   0.0  0.000

<a name="_1100439041"></a><i><b>18:15:09.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

18:25:09.047  avg_2-600 1612.7 54.542   8.5 6.18   0.0    0.0  0.000 1612.7 54.542  0.00  1612 1612.7 1048580   0.0  0.000   0.0  0.000   0.0  0.000   8.1 146.72   8.0 788.87   0.0  0.000
```

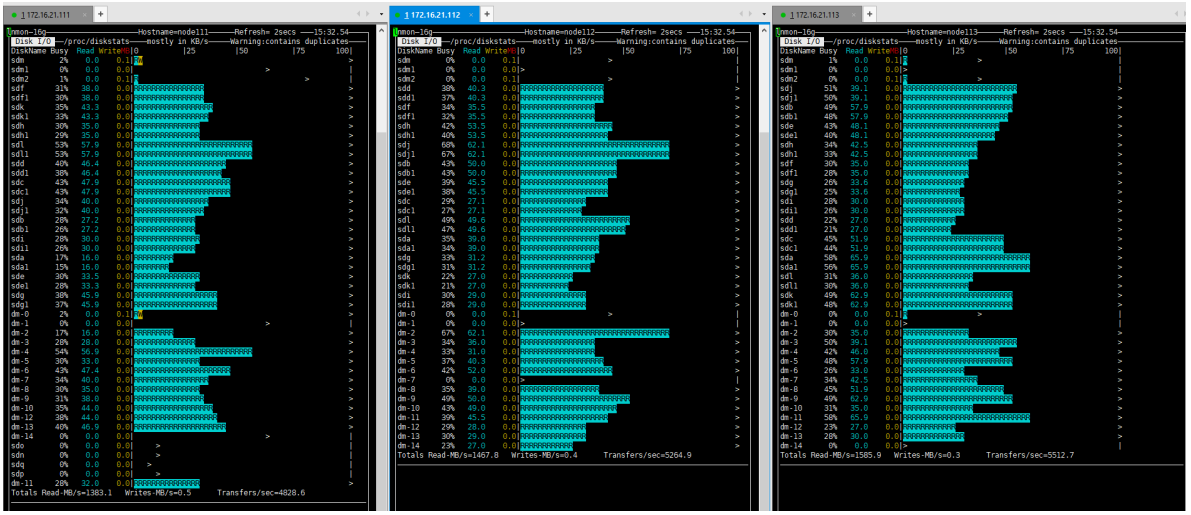
1.2、【文件】1M顺序读

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/replica/largetest02,depth=1,width=10,files=288,size=200m,sha
fwd=format,threads=32,xfersize=1m
fwd=default,operation=read,xfersize=1m,fileio=sequential,fileselect=sequentia
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

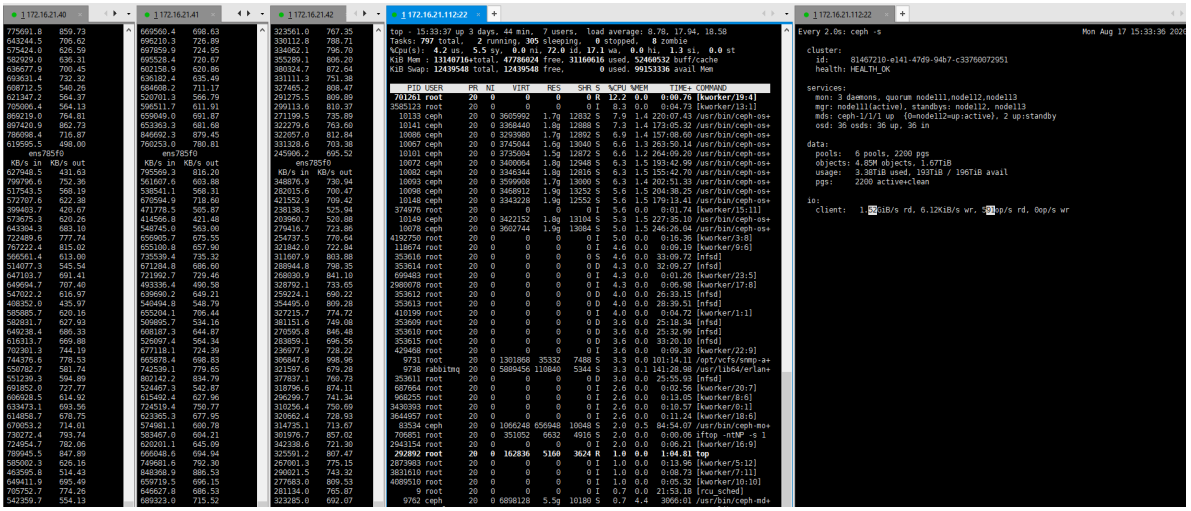
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

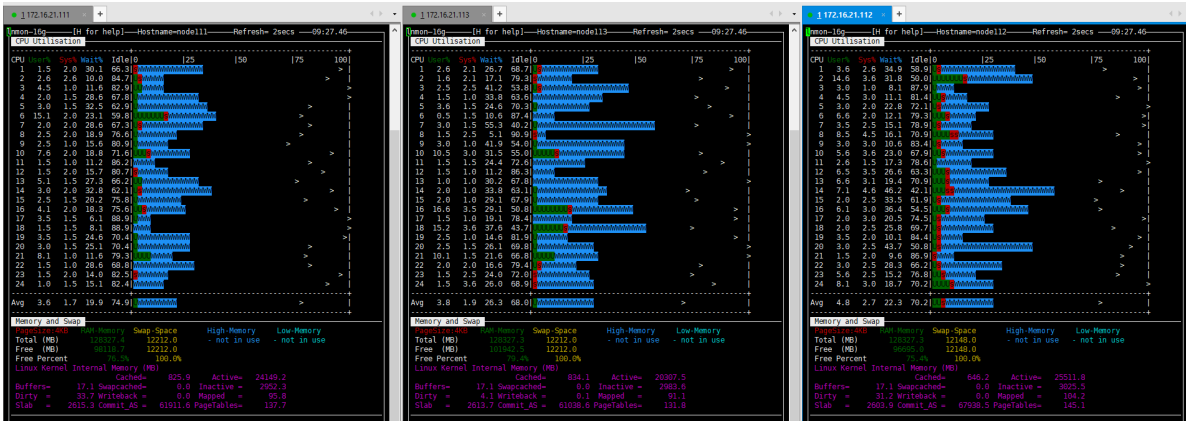
1M顺序读： （带宽：1526.3MB/s IOPS：1526.4 时延：48.080ms)

```
[root@node40 file-bluestore-replica]# cat 1M-read/totals.html
<title>Vdbench 1M-read/totals.html</title><pre>
Run totals


Link to Run Definitions:          <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                  <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>18:33:56.003 Starting RD=format_for_rd1</b></i>


Aug 14, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                        rate    resp total  sys   pct   rate   resp   rate   resp read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
18:41:55.050  avg_2-479 1202.5 64.017   8.5 6.05   0.0    0.0  0.000 1202.5 64.017  0.00  1202 1202.4 1048576    0.0 74.059    0.0  0.000    6.0  14836    6.0 941.13    6.0 963.94    0.0  0.000

<a name="_1100439041"></a><i><b>18:41:57.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

18:51:57.053  avg_2-600 1526.4 48.080   5.4 3.94 100.0 1526.4 48.080    0.0  0.000 1526  0.00 1526.3 1048577    0.0  0.000    0.0  0.000    0.0  0.000    7.7 2280.7    7.6 369.00    0.0  0.000
```

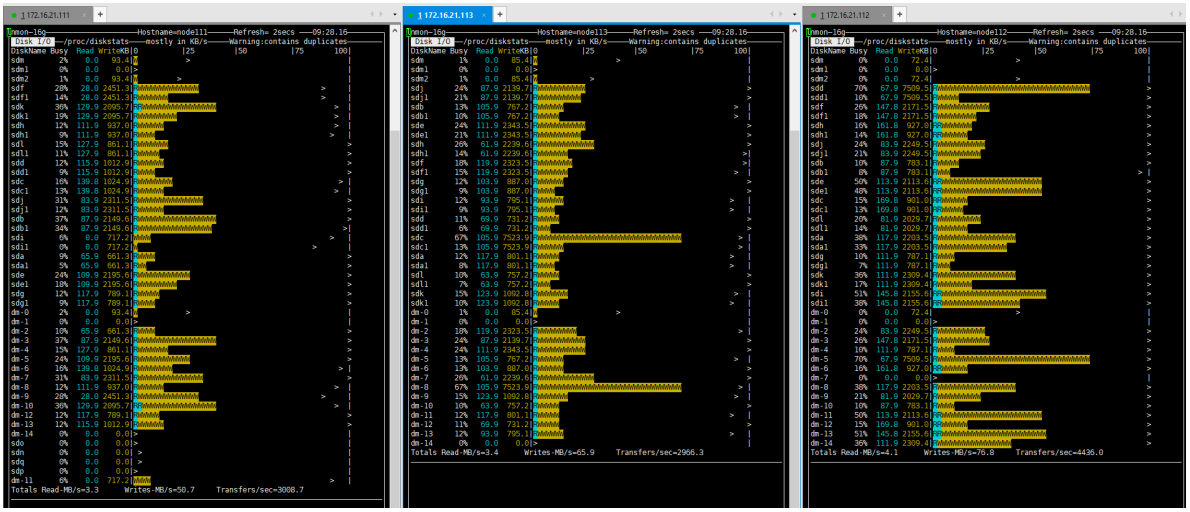
1.3、【文件】4K随机写

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/replica/smalltest01,depth=2,width=120,files=100,size=64k,sha
fwd=format,threads=32,xfersize=4k
fwd=default,operation=write,xfersize=4k,fileio=random,fileselect=random,threa
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

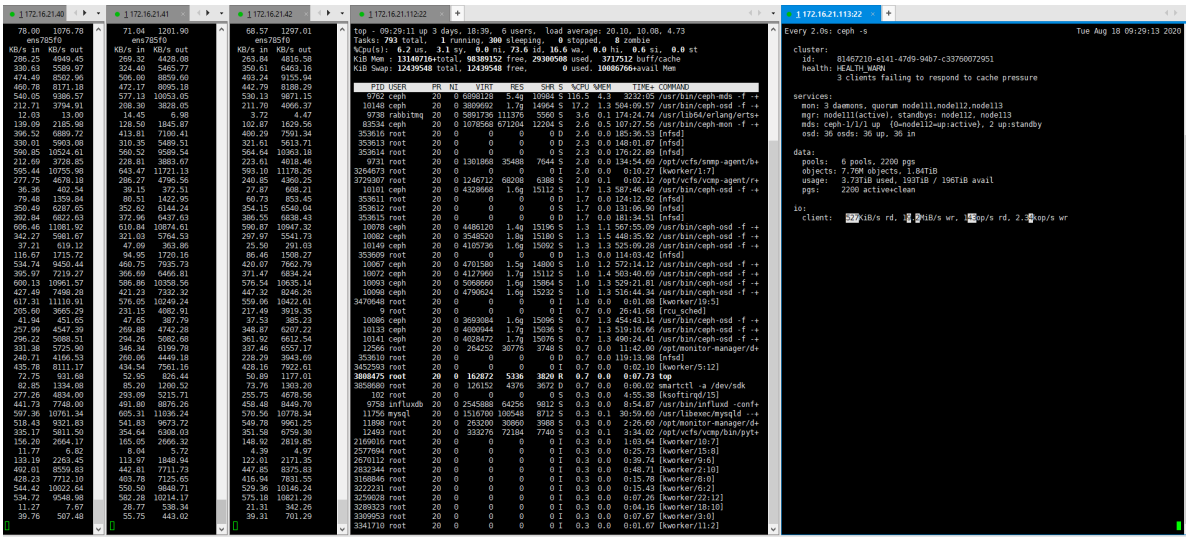
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**

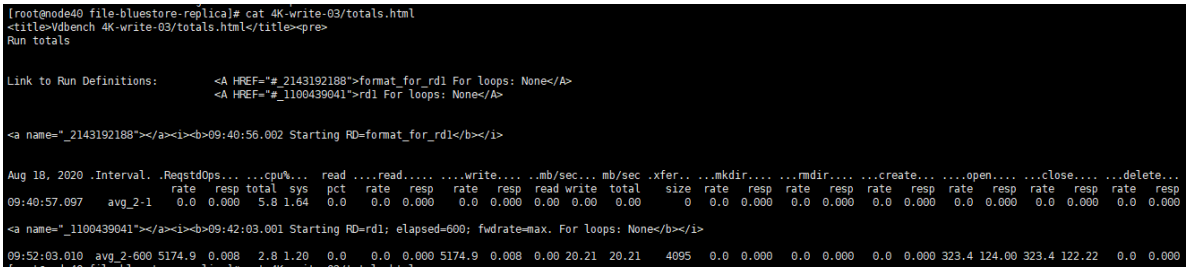


- **客户端网络资源占用**



- **性能测试结果**

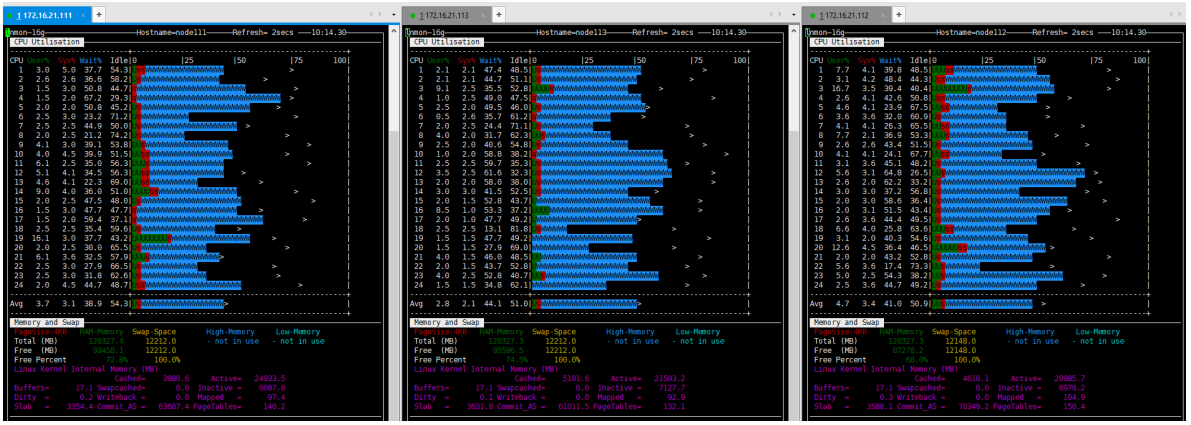
  4K随机写：（带宽：20.21MB/s IOPS：5174.9 时延：0.008ms）



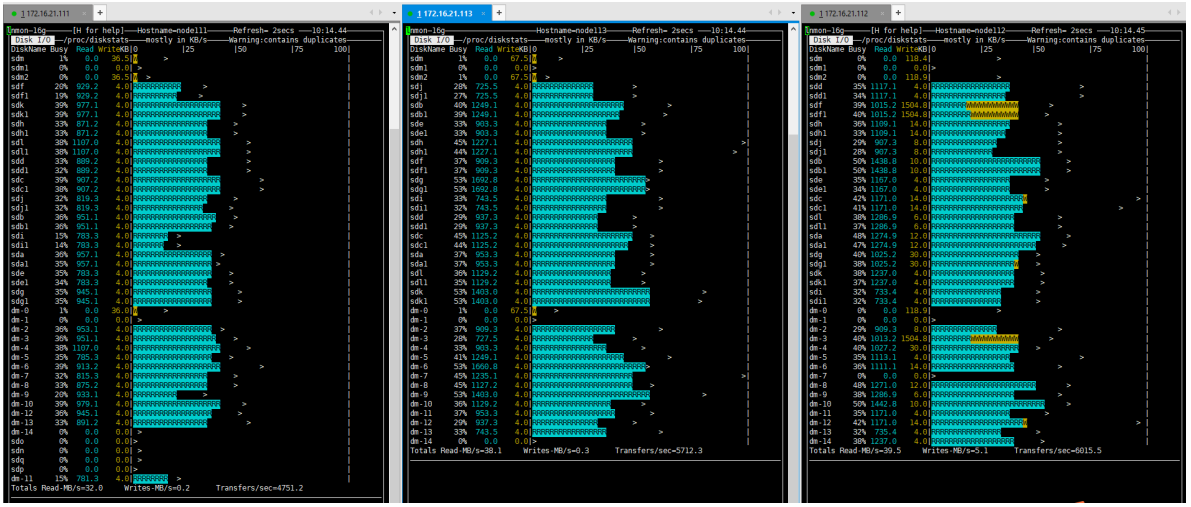
1.4、【文件】4K随机读

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/replica/smalltest02,depth=2,width=120,files=100,size=64k,sha
fwd=format,threads=32,xfersize=4k
fwd=default,operation=read,xfersize=4k,fileio=random,fileselect=random,thread
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

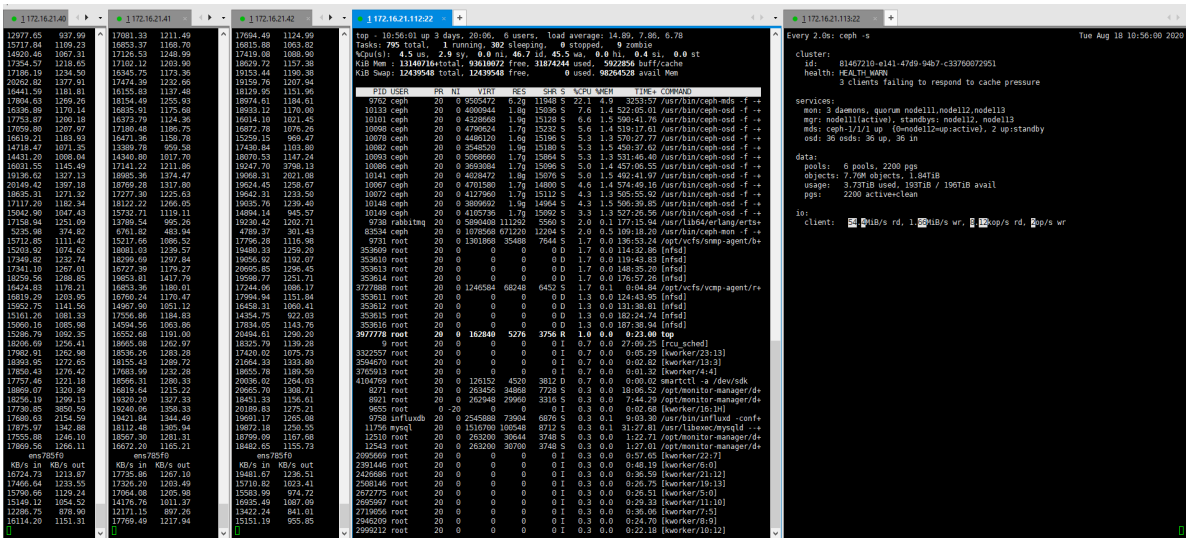
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

  4K随机读：（带宽：42.53MB/s IOPS：10886 时延：6.022ms）

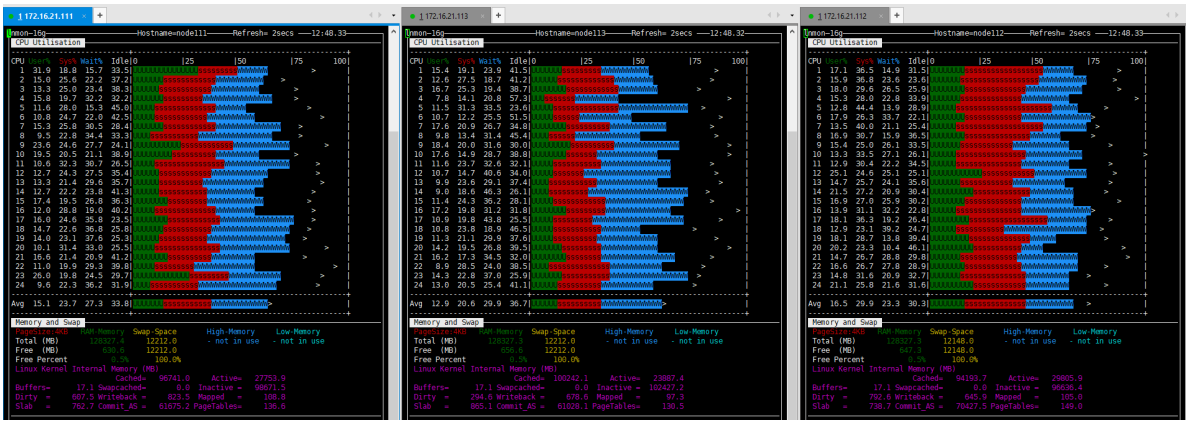
```
[root@node40 file-bluestore-replica]# cat 4K-read-01/totals.html
<title>Vdbench 4K-read-01/totals.html</title><pre>
Run totals


Link to Run Definitions:         <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                 <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>10:12:43.002 Starting RD=format_for_rd1</b></i>


Aug 18, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                        rate   resp total  sys   pct   rate   resp   rate   resp  read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
10:12:44.095     avg_2-1    0.0  0.000   3.3 1.01   0.0    0.0  0.000    0.0  0.000  0.00  0.00   0.00       0   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000

<a name="_1100439041"></a><i><b>10:13:46.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

10:23:46.049  avg_2-600  10886  6.022   3.4 1.72 100.0  10886  6.022    0.0  0.000 42.53  0.00  42.53    4096   0.0  0.000   0.0  0.000   0.0  0.000 680.5 29.528 680.4  6.841   0.0  0.000
```

2、【blustore】纠删测试

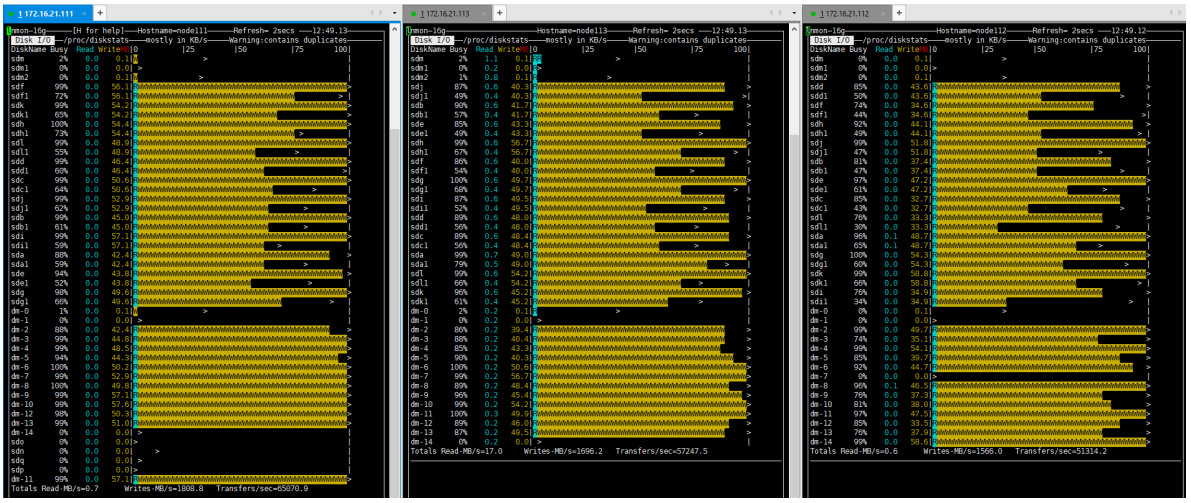
2.1、【文件】1M顺序写

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/ec/largetest01,depth=1,width=10,files=288,size=200m,shared=y
fwd=format,threads=32,xfersize=1m
fwd=default,operation=write,xfersize=1m,fileio=sequential,fileselect=sequenti
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

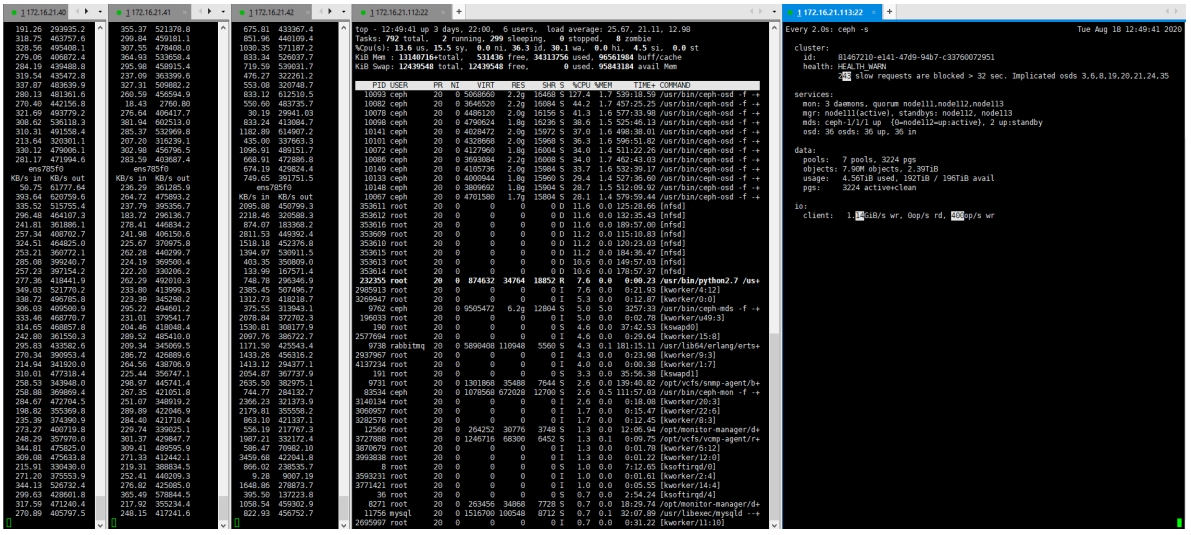
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

1M顺序写： （带宽：1073.2MB/s IOPS：1073.2 时延：81.796ms）

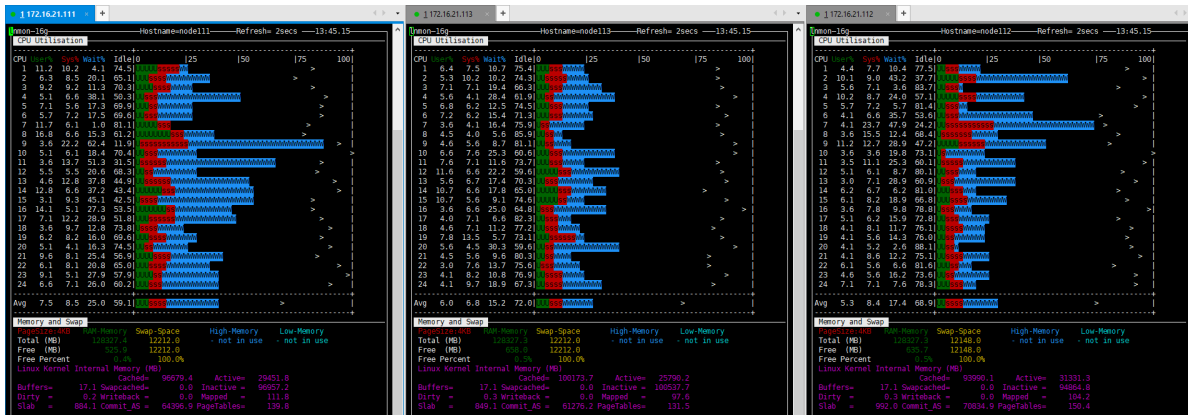
```
[root@node40 file-bluestore-ec]# cat 1M-write/totals.html
<title>Vdbench 1M-write/totals.html</title><pre>
Run totals


Link to Run Definitions:          <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                  <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>12:36:43.003 Starting RD=format_for_rd1</b></i>


Aug 18, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                         rate   resp total  sys   pct   rate   resp   rate   resp read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
12:47:09.058  avg_2-626  920.1 86.395   7.1 5.14   0.0    0.0  0.000  920.1 86.395  0.00 920.1 920.11 1048574   0.0 55.730   0.0  0.000   4.6  19831   4.6 1170.4   4.6 1184.1   0.0  0.000

<a name="_1100439041"></a><i><b>12:47:12.000 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

12:57:12.062  avg_2-600 1073.2 81.796   6.1 4.27   0.0    0.0  0.000 1073.2 81.796  0.00 1073 1073.2 1048580   0.0  0.000   0.0  0.000   0.0  0.000   5.4 197.85   5.3 1228.9   0.0  0.000
```

2.2、【文件】1M顺序读

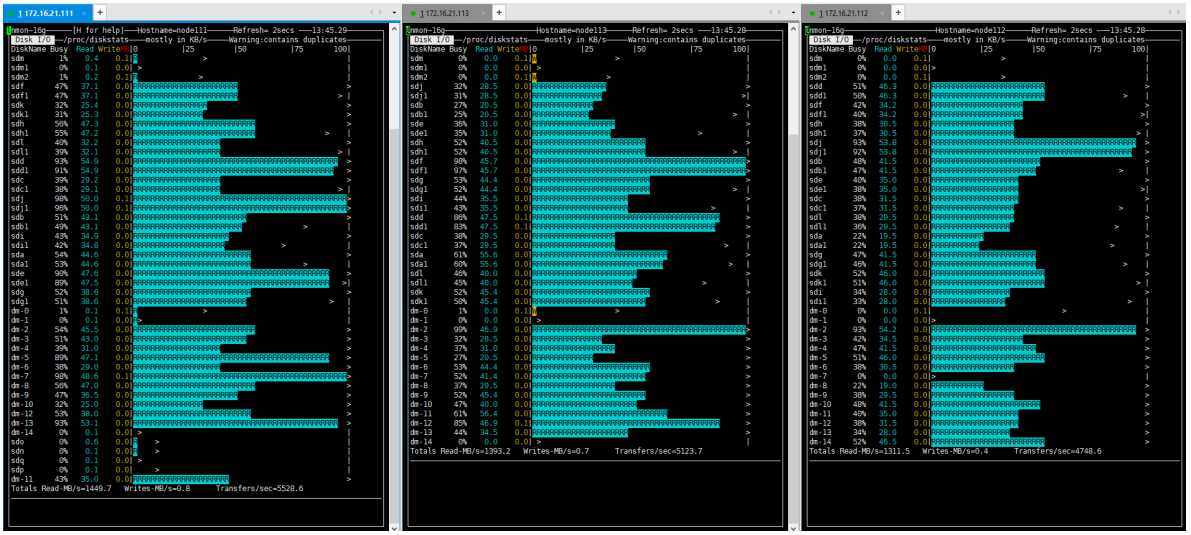
```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/ec/largetest02,depth=1,width=10,files=288,size=200m,shared=y
fwd=format,threads=32,xfersize=1m
```

```
fwd=default,operation=read,xfersize=1m,fileio=sequential,fileselect=sequentia
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

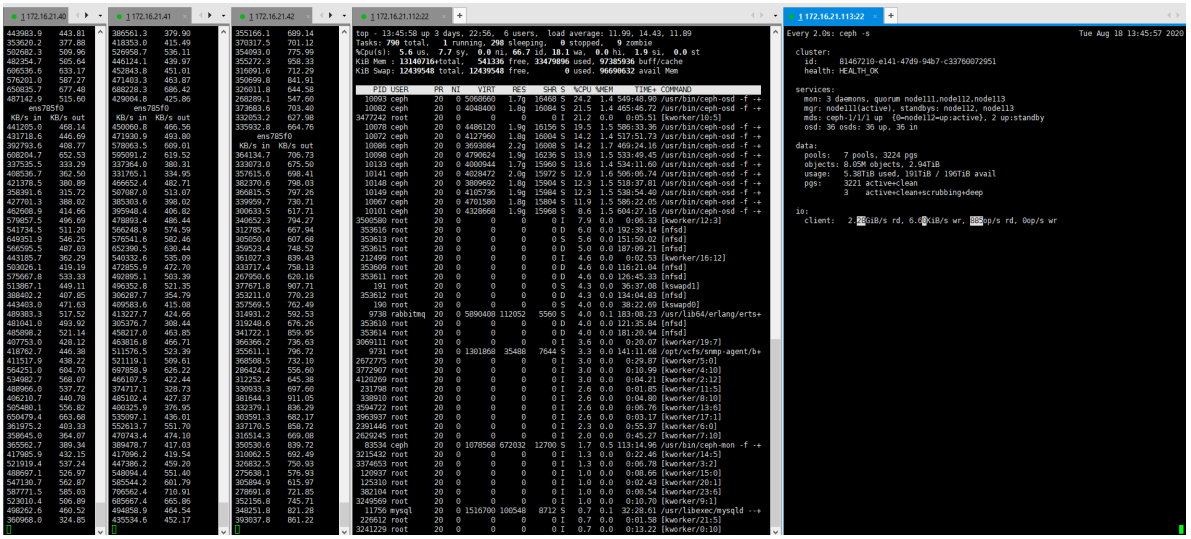
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

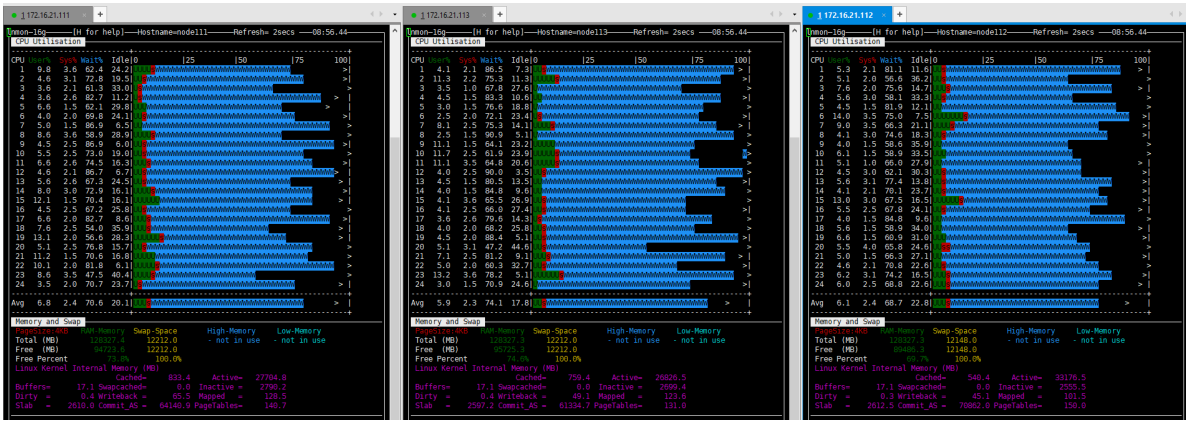
  1M顺序读：（带宽：1218.0MB/s IOPS：1218.1 时延：61.102ms）

```
[root@node40 file-bluestore-ec]# cat 1M-read/totals.html
<title>Vdbench 1M-read/totals.html</title><pre>
Run totals


Link to Run Definitions:        <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>13:31:11.003 Starting RD=format_for_rd1</b></i>


Aug 18, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                         rate   resp total  sys   pct   rate   resp   rate   resp  read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
13:41:37.052  avg_2-626  920.1 86.237   6.3 4.52   0.0    0.0  0.000  920.1 86.237  0.00 920.1 920.12 1048581   0.0 52.052   0.0  0.000   4.6  20149   4.6 1310.6   4.6 1356.5   0.0  0.000

<a name="_1100439041"></a><i><b>13:41:39.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

13:51:39.052  avg_2-600 1218.1 61.102   4.9 3.59 100.0 1218.1 61.102    0.0  0.000  1218  0.00 1218.0 1048578   0.0  0.000   0.0  0.000   0.0  0.000   6.2 2729.7   6.1 403.75   0.0  0.000
[root@node40 file-bluestore-ec]#
```

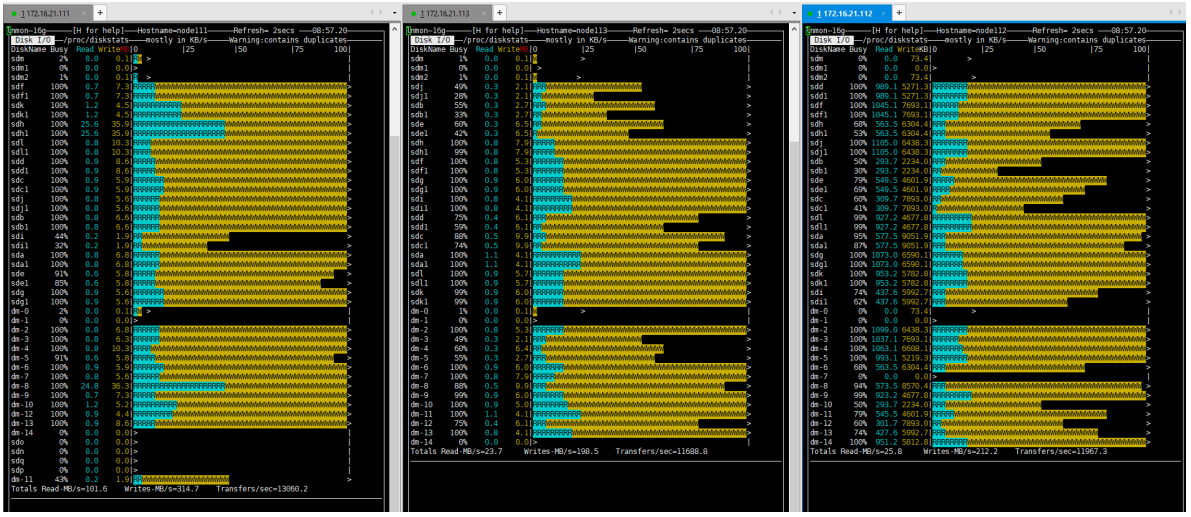
1.3、【文件】4K随机写

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/ec/smalltest01,depth=2,width=120,files=100,size=64k,shared=y
fwd=format,threads=32,xfersize=4k
fwd=default,operation=write,xfersize=4k,fileio=random,fileselect=random,threa
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

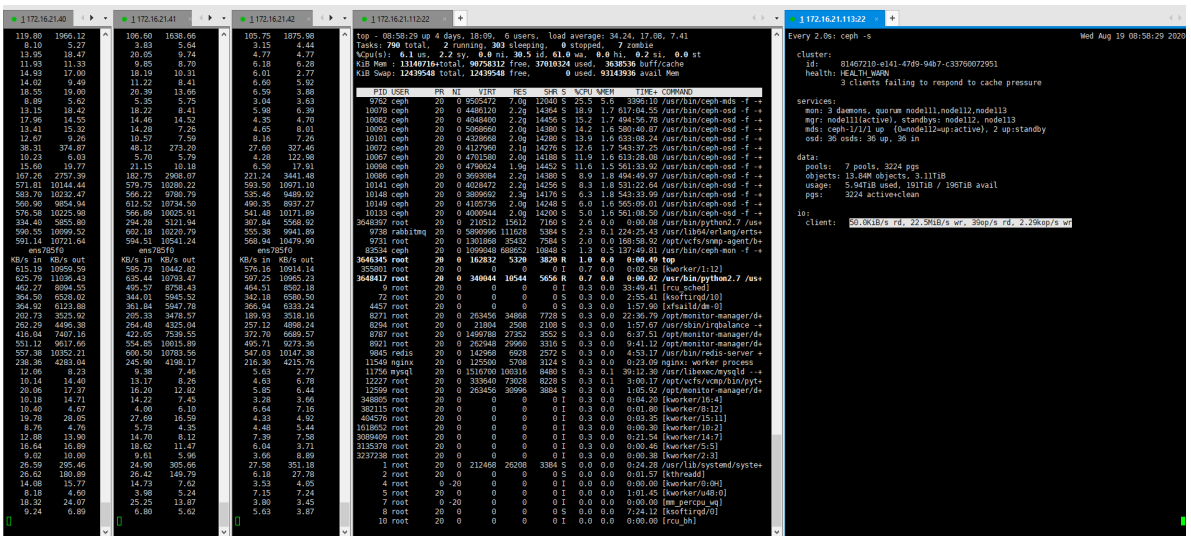
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

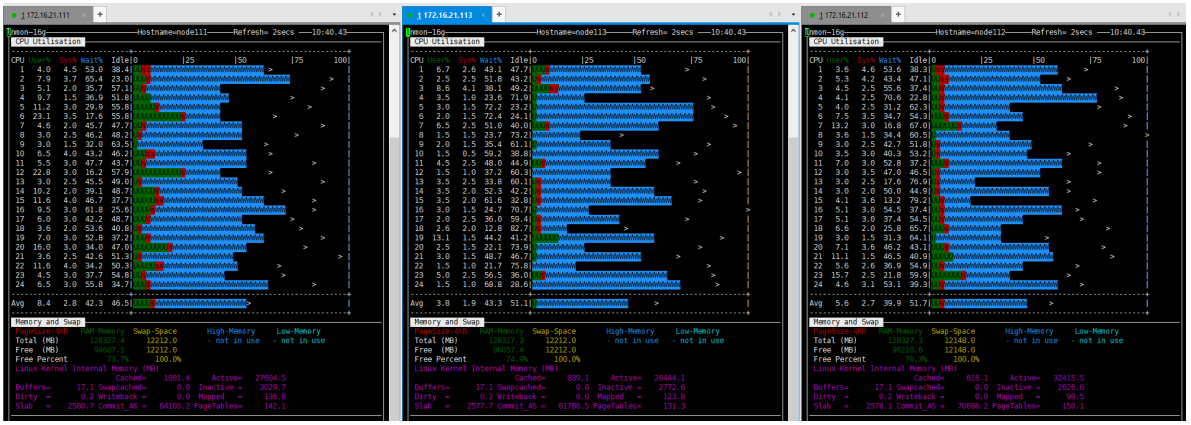
4K随机写： （带宽：19.09MB/s IOPS：4885.8 时延：0.008ms）

```
[root@node40 file-bluestore-ec]# cat 4K-write-01/totals.html
<title>Vdbench 4K-write-01/totals.html</title><pre>
Run totals


Link to Run Definitions:        <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>08:53:57.002 Starting RD=format_for_rd1</b></i>


Aug 19, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                         rate   resp total  sys   pct   rate   resp   rate   resp  read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
08:53:58.085    avg_2-1    0.0  0.000   3.0 1.00   0.0    0.0  0.000    0.0  0.000  0.00  0.00   0.00       0   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000

<a name="_1100439041"></a><i><b>08:55:41.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

09:05:41.051  avg_2-600 4885.8  0.008   2.6 1.16   0.0    0.0  0.000 4885.8  0.008  0.00 19.09  19.09    4095   0.0  0.000   0.0  0.000   0.0  0.000 305.4 132.81 305.3 127.50   0.0  0.000
```

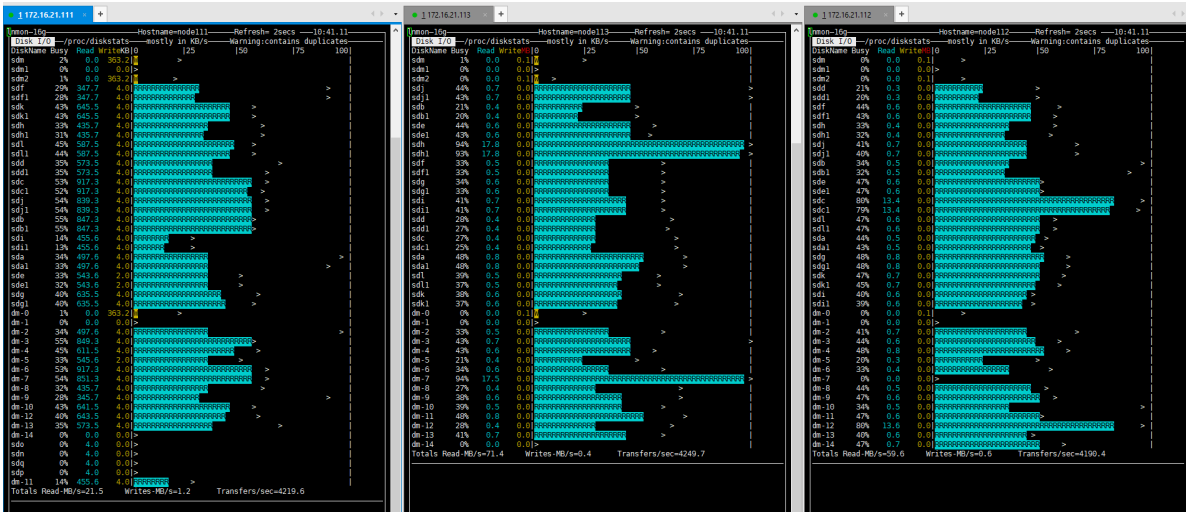
1.4、【文件】4K随机读

```
hd=default,vdbench=/root/vdbench50406,user=root,shell=ssh
hd=hd1,system=node40
hd=hd2,system=node41
hd=hd3,system=node42
fsd=fsd1,anchor=/ec/smalltest02,depth=2,width=120,files=100,size=64k,shared=y
fwd=format,threads=32,xfersize=4k
fwd=default,operation=read,xfersize=4k,fileio=random,fileselect=random,thread
fwd=fwd1,fsd=fsd1,host=hd1
fwd=fwd2,fsd=fsd1,host=hd2
fwd=fwd3,fsd=fsd1,host=hd3
rd=rd1,fwd=fwd*,fwdrate=max,format=restart,elapsed=600,interval=1
```

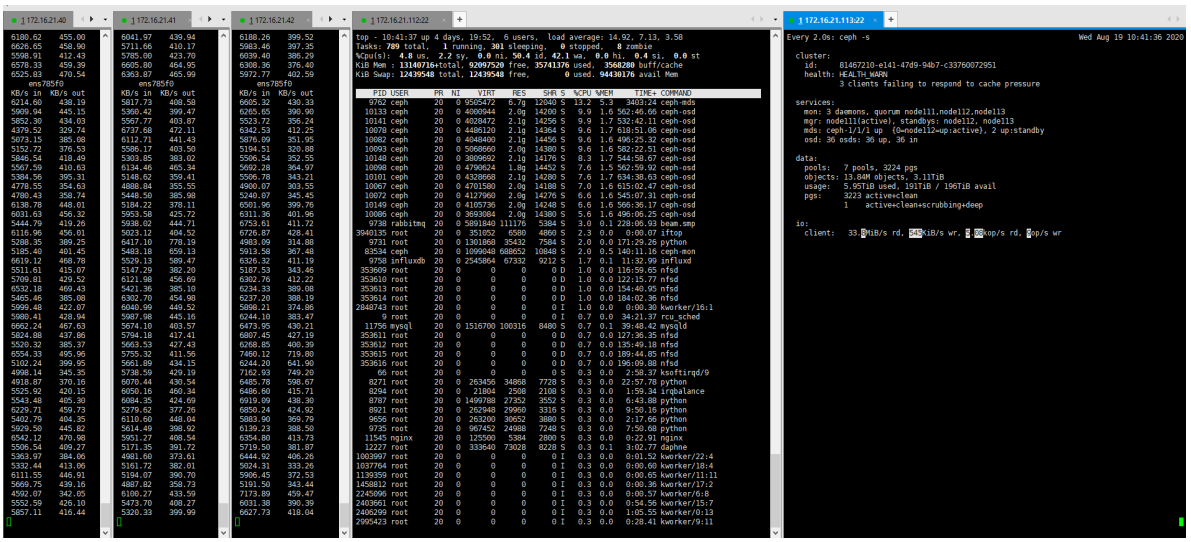
- **集群节点CPU/内存资源占用**



- **集群节点磁盘资源占用**



- **客户端网络资源占用**



- **性能测试结果**

  4K随机读：（带宽：21.07 MB/s IOPS：5393.7 时延：12.153ms）

```
[root@node40 file-bluestore-ec]# cat 4K-read-02/totals.html
<title>Vdbench 4K-read-02/totals.html</title><pre>
Run totals


Link to Run Definitions:        <A HREF="#_2143192188">format_for_rd1 For loops: None</A>
                                <A HREF="#_1100439041">rd1 For loops: None</A>


<a name="_2143192188"></a><i><b>10:37:59.002 Starting RD=format_for_rd1</b></i>


Aug 19, 2020 .Interval. .ReqstdOps... ...cpu%...  read ....read..... ....write.... ..mb/sec... mb/sec .xfer.. ...mkdir.... ...rmdir.... ...create... ....open.... ...close.... ...delete...
                         rate   resp total  sys   pct   rate   resp   rate   resp  read write  total    size  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp  rate   resp
10:38:00.116     avg_2-1    0.0  0.000   2.7  0.98   0.0    0.0  0.000    0.0  0.000  0.00  0.00   0.00       0   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000   0.0  0.000

<a name="_1100439041"></a><i><b>10:39:44.001 Starting RD=rd1; elapsed=600; fwdrate=max. For loops: None</b></i>

10:49:44.050   avg_2-600 5393.7 12.153   2.7 1.34 100.0 5393.7 12.153    0.0  0.000 21.07  0.00  21.07    4096   0.0  0.000   0.0  0.000   0.0  0.000 337.2 60.154 337.1 13.845   0.0  0.000
```

四、测试总结

1、性能测试

1.1、文件接口

存储引擎	存储类型	测试模型	带宽	IOPS	时延
bluestore	副本	【文件】1M顺序写	1612.7MB/s	1612.7	54.542ms
bluestore	副本	【文件】1M顺序读	1526.3MB/s	1526.4	48.080ms
bluestore	副本	【文件】4K随机写	20.21MB/s	5174.9	0.008ms
bluestore	副本	【文件】4K随机读	42.53MB/s	10886	6.022ms
bluestore	纠删	【文件】1M顺序写	1073.2MB/s	1073.2	81.796ms
bluestore	纠删	【文件】1M顺序读	1218.0MB/s	1218.1	61.102ms
bluestore	纠删	【文件】4K随机写	19.09MB/s	4885.8	0.008ms
bluestore	纠删	【文件】4K随机读	21.07 MB/s	5393.7	12.153ms