Lawrence Livermore National Laboratory

LMT
Lustre Monitoring Tools

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LMT Mission

- Collect and display real-time and historical information about Lustre filesystem activity.

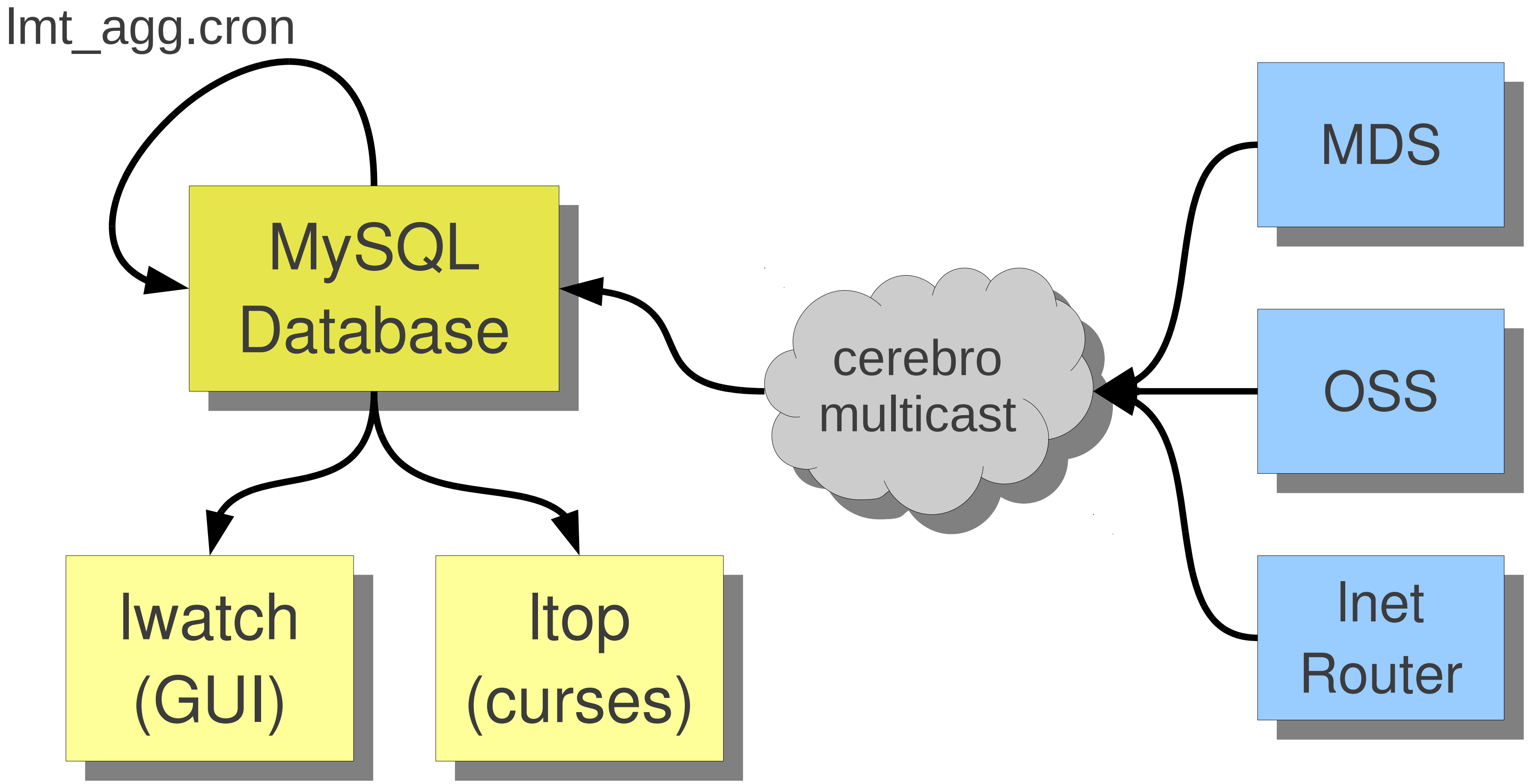
LMT History

- LMT Version 1
  - In-house python prototype
- LMT Version 2
  - Rewrite of LMT in C, Java, Perl, Sh
  - Cerebro for data collection
  - Incorporated MySQL for logging data, proved very useful [Uselton 2009 CUG]
  - ltop text utility
  - lwatch GUI in Java
- LMT Version 3
  - Major improvments by Jim Garlick

Cerebro overview

- Cluster monitoring daemon, tools and libraries
- Inspired by ganglia
- Uses multicast
- Dynamic module interface (plugins) for adding “metrics”
  - /usr/lib/cerebro
- Current metrics:
  - cerebro_metric_lmt_mdt
  - cerebro_metric_lmt_ost
  - cerebro_metric_lmt_router
  - cerebro_metric_lmt_osc

LMT 2 architecture



Problems in LMT version 2

- Lustre config must be expressed in an odd language, then pre-loaded into MySQL.
- Nothing functions until both MySQL and cerebro are up.
- Poor error handling and logging make debug difficult.
- There are two overlapping config files in odd locations.
- The cerebro module code is prototype quality and brittle.

Improved in Version 3

- Lustre config is automatically determined on the fly.
- ltop now functions as soon as cerebro is up.
- MySQL is actually optional now.
- Error handling and logging are rewritten/improved.
- Cerebro module code has been refactored/rewritten.
- There is a single new config file: /etc/lmt/lmt.conf
- More data is collected/shown in ltop

LUA-based lmt.conf

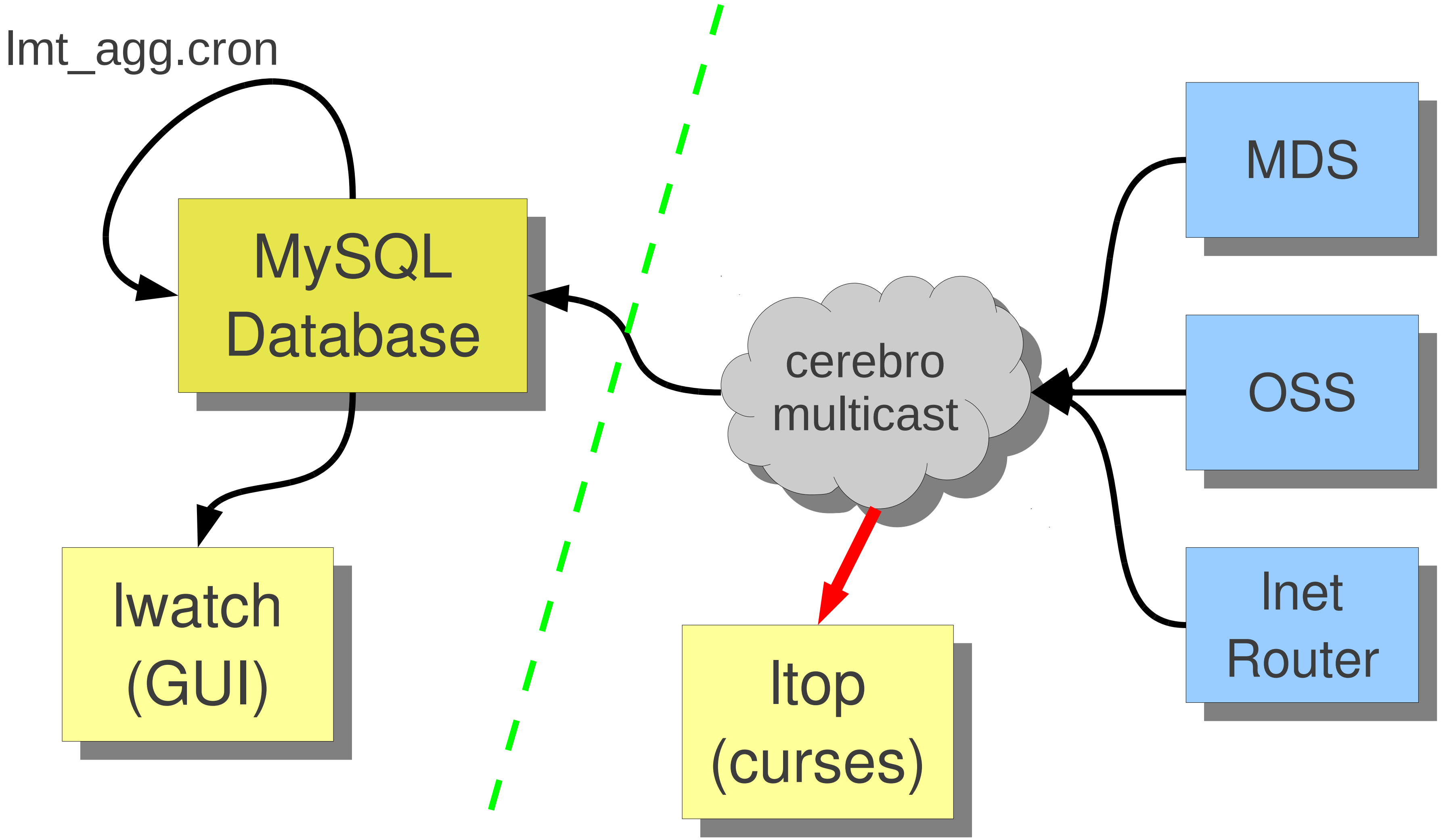
```
lmt_cbr_debug = 0
lmt_proto_debug = 0
lmt_db_debug = 0
lmt_db_host = nil
lmt_db_port = 0
lmt_db_rouser = "lwatchclient"
lmt_db_ropasswd = nil
lmt_db_rwuser = "lwatchadmin"

f = io.open("/etc/lmt/rwpasswd")
if (f) then
   lmt_db_rwpasswd = f:read("*all")
   f:close()
else
   lmt_db_rwpasswd = nil
end
```

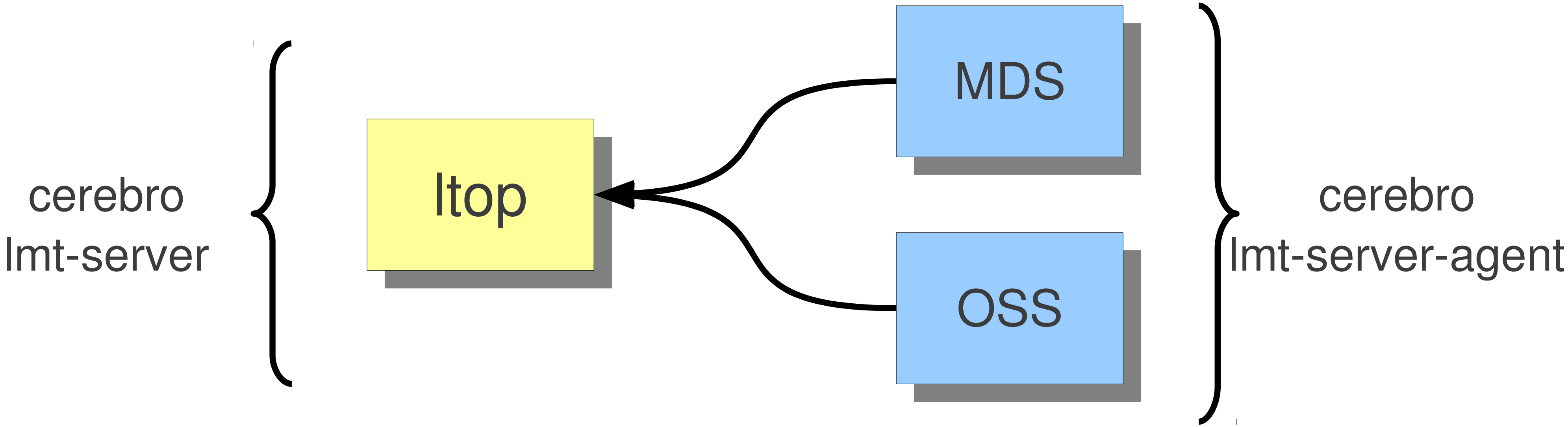
Unchanged in Version 3

- The architecture is the same (except ltop).
- The database schema is unchanged.
- The lwatch/lstat java clients are unchanged (moved to separate lmt-gui package).
- Cron aggregation scripts that convert high → low-res
- MySQL sample data still exist (kludge!).

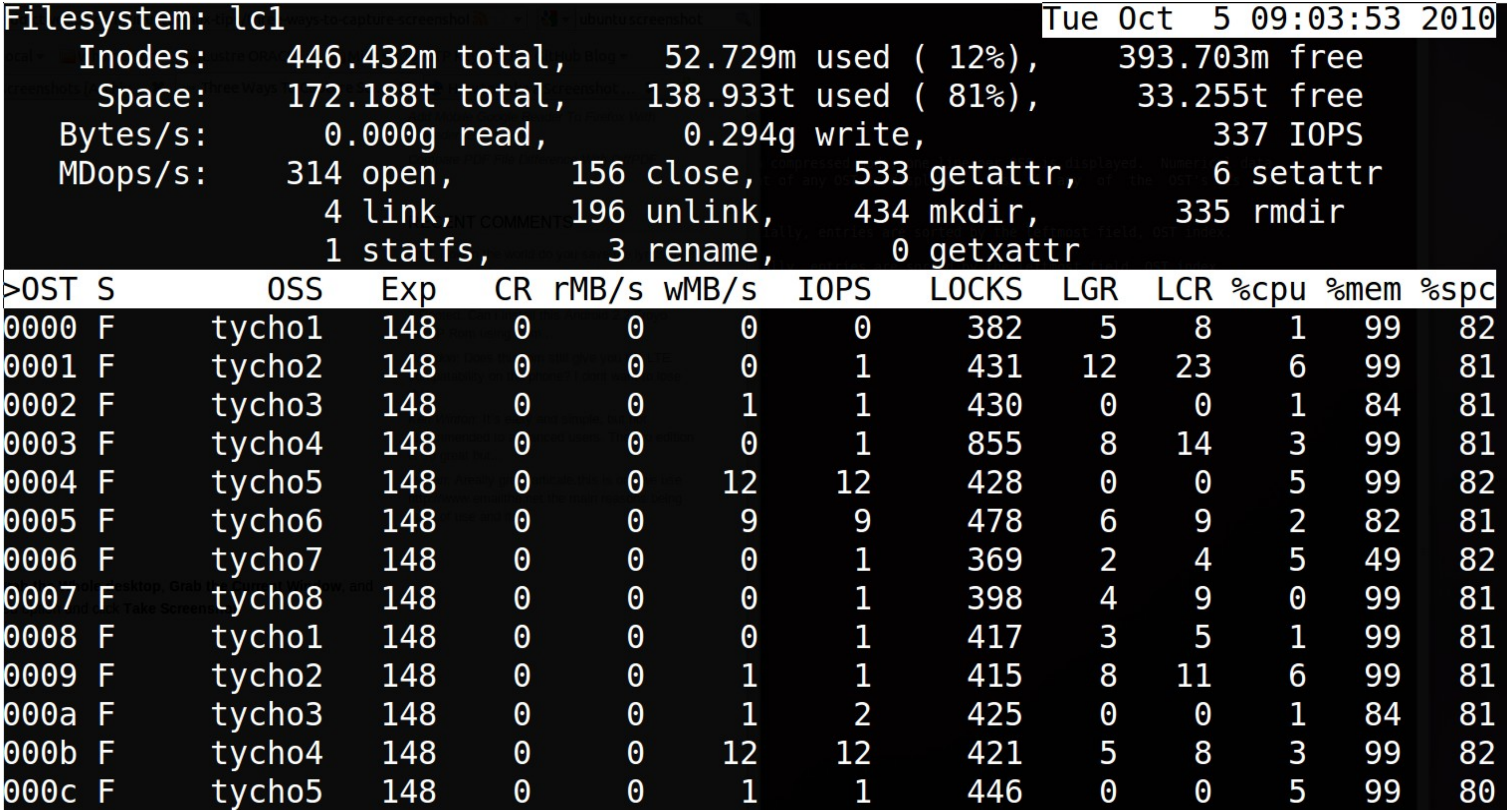
LMT 3 architecture



Simple setup for ltop

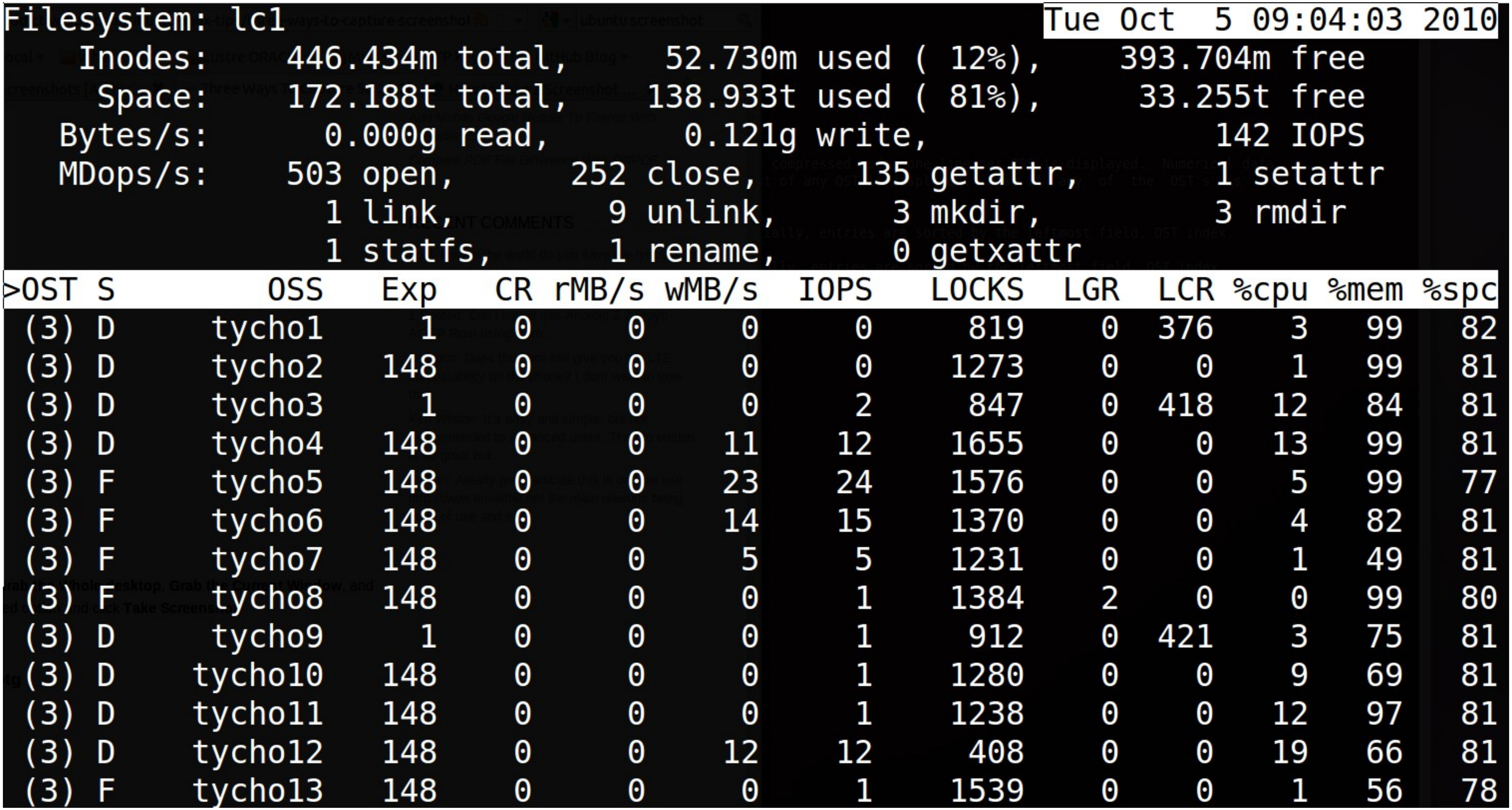


ltop screenshot



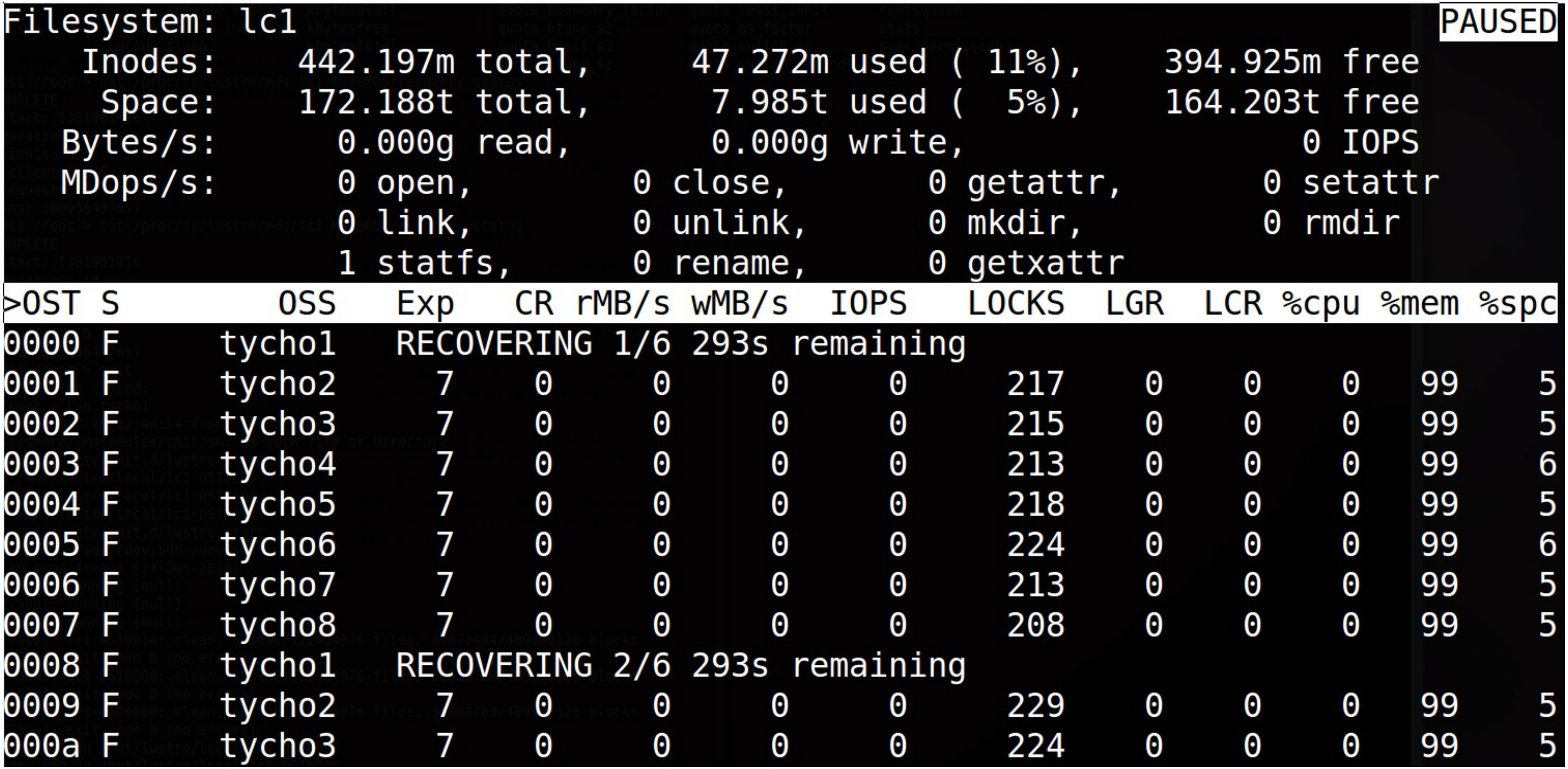
```
Filesystem: lc1                                        Tue Oct  5 09:03:53 2010
    Inodes: 446.432m total,     52.729m used ( 12%),    393.703m free
     Space: 172.188t total,    138.933t used ( 81%),     33.255t free
   Bytes/s:   0.000g read,       0.294g write,               337 IOPS
   MDops/s:   314 open,        156 close,    533 getattr,       6 setattr
                4 link,        196 unlink,   434 mkdir,       335 rmdir
                1 statfs,        3 rename,     0 getxattr
>OST S        OSS   Exp   CR rMB/s wMB/s  IOPS   LOCKS  LGR  LCR %cpu %mem %spc
0000 F     tycho1   148    0     0     0     0     382    5    8    1   99   82
0001 F     tycho2   148    0     0     0     1     431   12   23    6   99   81
0002 F     tycho3   148    0     0     1     1     430    0    0    1   84   81
0003 F     tycho4   148    0     0     0     1     855    8   14    3   99   81
0004 F     tycho5   148    0     0    12    12     428    0    0    5   99   82
0005 F     tycho6   148    0     0     9     9     478    6    9    2   82   81
0006 F     tycho7   148    0     0     0     1     369    2    4    5   49   82
0007 F     tycho8   148    0     0     0     1     398    4    9    0   99   81
0008 F     tycho1   148    0     0     0     1     417    3    5    1   99   81
0009 F     tycho2   148    0     0     1     1     415    8   11    6   99   81
000a F     tycho3   148    0     0     1     2     425    0    0    1   84   81
000b F     tycho4   148    0     0    12    12     421    5    8    3   99   82
000c F     tycho5   148    0     0     1     1     446    0    0    5   99   80
```

ltop ost “compressed” view



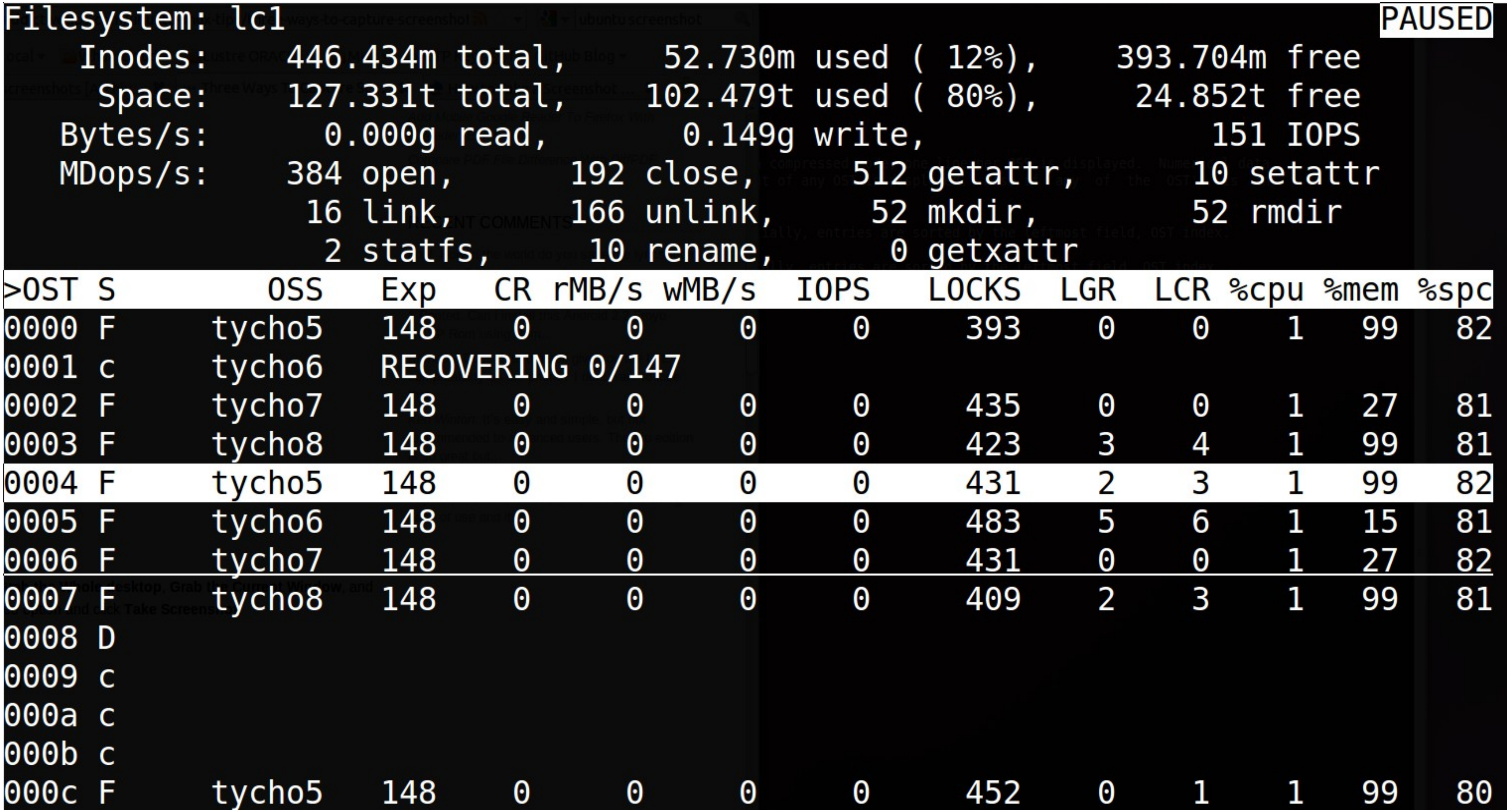
```
Filesystem: lc1                                            Tue Oct  5 09:04:03 2010
    Inodes:  446.434m total,    52.730m used ( 12%),    393.704m free
     Space:  172.188t total,   138.933t used ( 81%),     33.255t free
   Bytes/s:    0.000g read,      0.121g write,              142 IOPS
   MDops/s:  503 open,      252 close,  135 getattr,        1 setattr
               1 link,        9 unlink,     3 mkdir,        3 rmdir
               1 statfs,      1 rename,     0 getxattr
>OST S         OSS   Exp   CR rMB/s wMB/s  IOPS   LOCKS  LGR  LCR %cpu %mem %spc
 (3) D     tycho1     1    0     0     0     0     819    0  376    3   99   82
 (3) D     tycho2   148    0     0     0     0    1273    0    0    1   99   81
 (3) D     tycho3     1    0     0     0     2     847    0  418   12   84   81
 (3) D     tycho4   148    0     0    11    12    1655    0    0   13   99   81
 (3) F     tycho5   148    0     0    23    24    1576    0    0    5   99   77
 (3) F     tycho6   148    0     0    14    15    1370    0    0    4   82   81
 (3) F     tycho7   148    0     0     5     5    1231    0    0    1   49   81
 (3) F     tycho8   148    0     0     0     1    1384    2    0    0   99   80
 (3) D     tycho9     1    0     0     0     1     912    0  421    3   75   81
 (3) D    tycho10   148    0     0     0     1    1280    0    0    9   69   81
 (3) D    tycho11   148    0     0     0     1    1238    0    0   12   97   81
 (3) D    tycho12   148    0     0    12    12     408    0    0   19   66   81
 (3) F    tycho13   148    0     0     0     1    1539    0    0    1   56   78
```

ltop recovery example



```
Filesystem: lc1                                                                PAUSED
    Inodes:    442.197m total,     47.272m used ( 11%),    394.925m free
     Space:    172.188t total,      7.985t used (  5%),    164.203t free
   Bytes/s:      0.000g read,       0.000g write,                 0 IOPS
   MDops/s:      0 open,        0 close,       0 getattr,       0 setattr
                 0 link,        0 unlink,      0 mkdir,         0 rmdir
                 1 statfs,      0 rename,      0 getxattr
>OST S        OSS    Exp    CR rMB/s wMB/s   IOPS    LOCKS   LGR   LCR %cpu %mem %spc
0000 F     tycho1    RECOVERING 1/6 293s remaining
0001 F     tycho2      7     0     0     0      0      217     0     0    0   99    5
0002 F     tycho3      7     0     0     0      0      215     0     0    0   99    5
0003 F     tycho4      7     0     0     0      0      213     0     0    0   99    6
0004 F     tycho5      7     0     0     0      0      218     0     0    0   99    5
0005 F     tycho6      7     0     0     0      0      224     0     0    0   99    6
0006 F     tycho7      7     0     0     0      0      213     0     0    0   99    5
0007 F     tycho8      7     0     0     0      0      208     0     0    0   99    5
0008 F     tycho1    RECOVERING 2/6 293s remaining
0009 F     tycho2      7     0     0     0      0      229     0     0    0   99    5
000a F     tycho3      7     0     0     0      0      224     0     0    0   99    5
```

ltop screenshot



```
Filesystem: lc1                                                        PAUSED
    Inodes: 446.434m total,    52.730m used ( 12%),    393.704m free
     Space: 127.331t total,   102.479t used ( 80%),     24.852t free
   Bytes/s:   0.000g read,      0.149g write,               151 IOPS
   MDops/s:     384 open,        192 close,   512 getattr,   10 setattr
                 16 link,        166 unlink,    52 mkdir,     52 rmdir
                  2 statfs,       10 rename,     0 getxattr
>OST S        OSS    Exp    CR rMB/s wMB/s  IOPS   LOCKS  LGR  LCR %cpu %mem %spc
0000 F     tycho5    148     0     0     0     0     393    0    0    1   99   82
0001 c     tycho6    RECOVERING 0/147
0002 F     tycho7    148     0     0     0     0     435    0    0    1   27   81
0003 F     tycho8    148     0     0     0     0     423    3    4    1   99   81
0004 F     tycho5    148     0     0     0     0     431    2    3    1   99   82
0005 F     tycho6    148     0     0     0     0     483    5    6    1   15   81
0006 F     tycho7    148     0     0     0     0     431    0    0    1   27   82
0007 F     tycho8    148     0     0     0     0     409    2    3    1   99   81
0008 D
0009 c
000a c
000b c
000c F     tycho5    148     0     0     0     0     452    0    1    1   99   80
```

Get LMT

- LMT Code
  - https://github.com/chaos/lmt
  - https://github.com/chaos/lmt-gui
- LMT Wiki
  - https://github.com/chaos/lmt/wiki
- Cerebro Code
  - https://github.com/chaos/cerebro