

# MySQL性能诊断与实践

洪斌

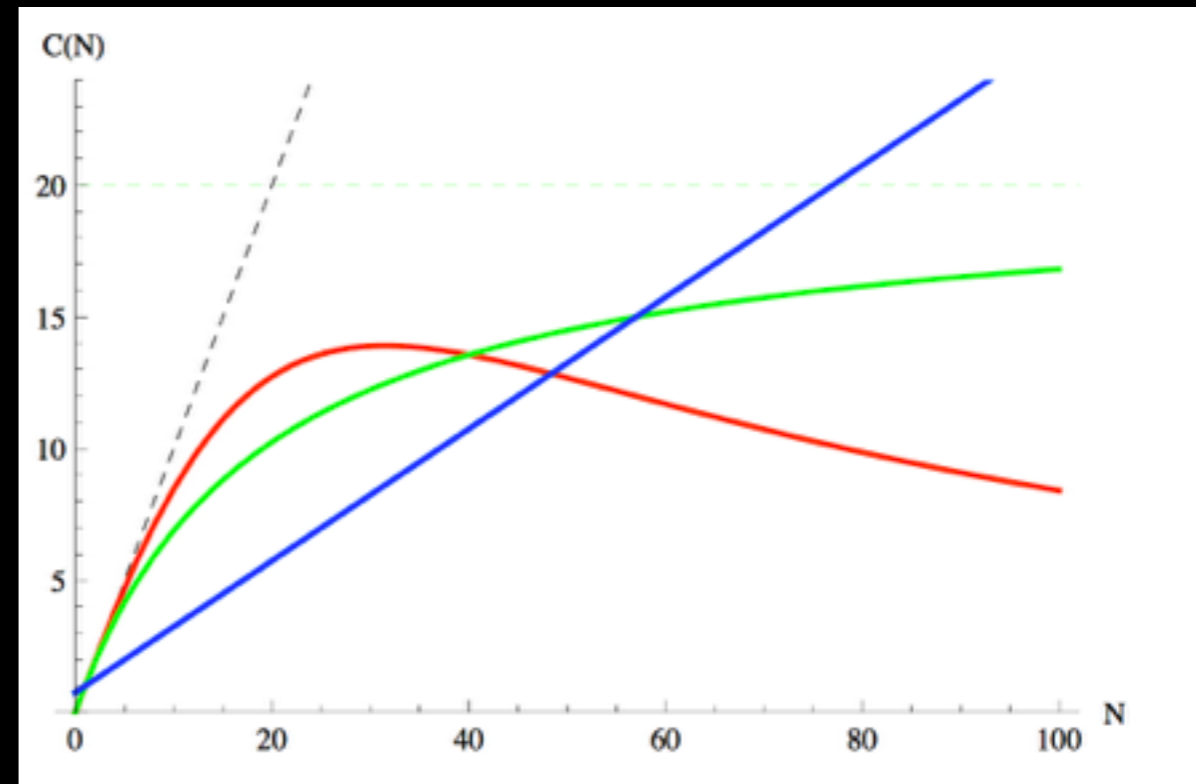


# 大纲

- 了解有关性能诊断的方法
- 介绍一些观测工具用法
- 分享两个案例

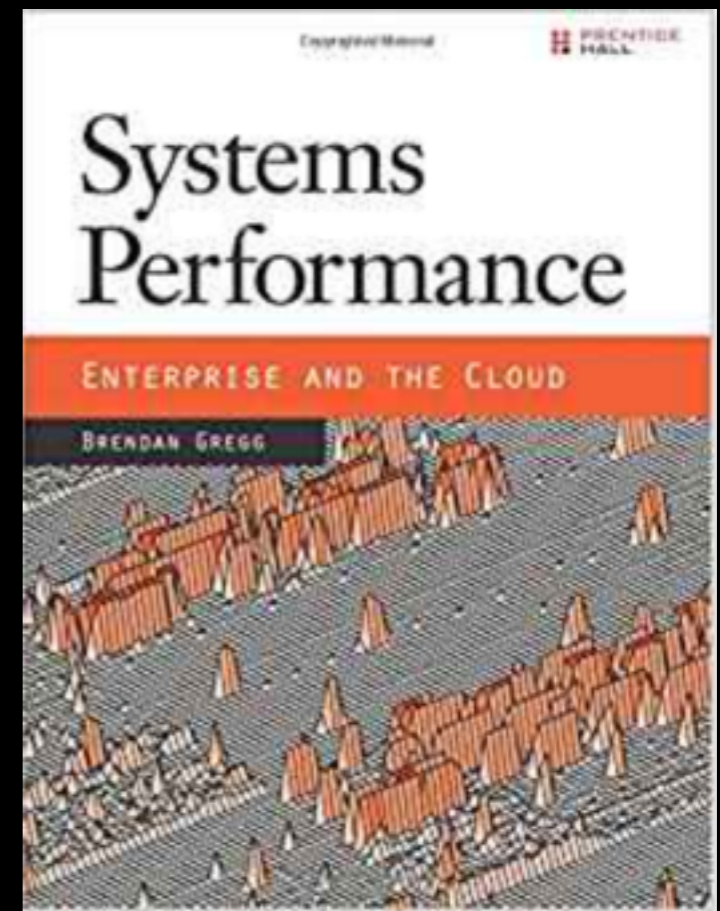
# 几个定律

- Little's Law (queueing theory)
- Amdahl's Law (1967)
- Universal Scalability Law (1993)

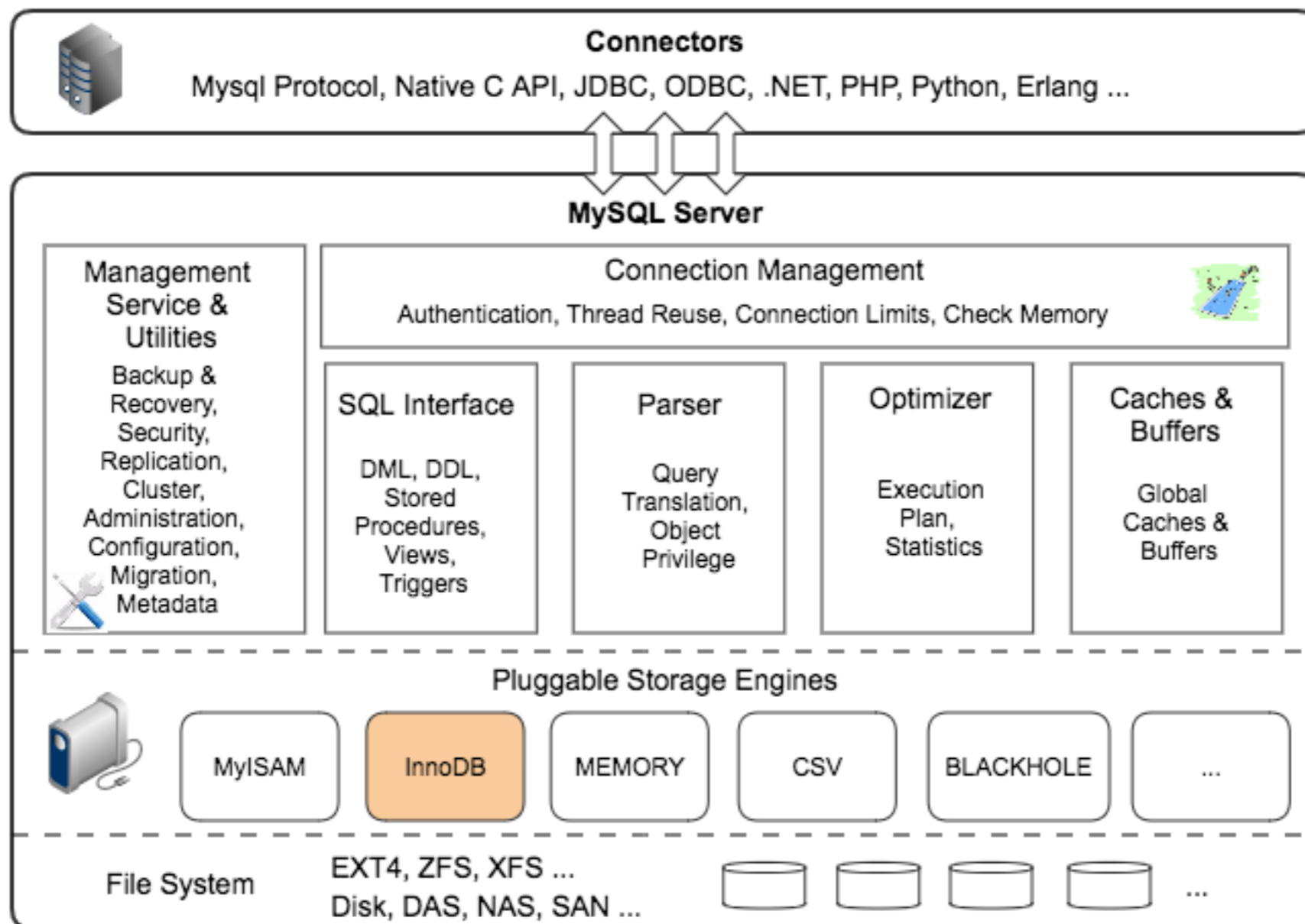


# 通用方法

- USE(Utilization Saturation and Errors)
- 火焰图on-cpu & off-cpu
- 观测工具很重要
- 基线对比



# MySQL体系结构



# 快速诊断

- `top` 判断主机负载情况
- `dmesg | tail` 是否存在oom-killer 或tcp drop等错误信息
- `vmstat 1` 检查r、free、si、so、us、sy、id、wa、st列
- `mpstat -P ALL 1` 检查CPU使用率是否均衡
- `pidstat 1` 检查进程的CPU使用率，多核利用情况
- `iostat -xz 1` 检查r/s, w/s, rkB/s, wkB/s, await, avgqu-sz, %util
- `free -m` 检查内存使用情况
- `sar -n DEV 1` 检查网络吞吐量
- `sar -n TCP,ETCP 1` 检查tcp连接情况active/s, passive/s, retrans/s

# MySQL诊断工具

- error log & slow log & general log
- MySQL SHOW [SESSION|GLOBAL] STATUS
- SHOW PROCESSLIST
- InnoDB 存储引擎状态 SHOW ENGINE INNODB STATUS
- Explain 查看执行计划
- performance schema

# 诊断步骤

1. 检查系统全局资源负载
2. 检查MySQL错误日志
3. 检查MySQL在做什么
4. 检查InnoDB事务情况
5. 检查MySQL复制状态

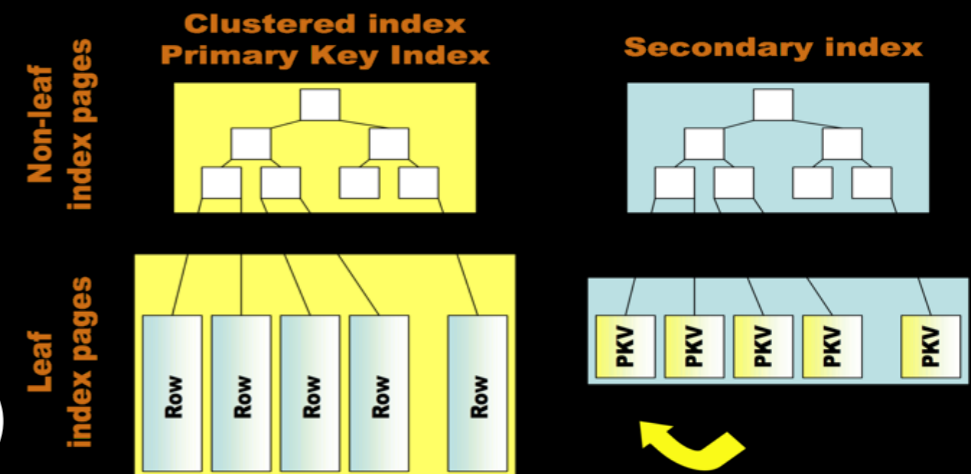


# InnoDB

- InnoDB表必须有主键或唯一索引

```
SELECT t.table_schema, t.table_name FROM information_schema.tables t
LEFT JOIN information_schema.table_constraints c
ON (t.table_schema = c.table_schema AND t.table_name = c.table_name AND c.constraint_type IN ('PRIMARY KEY','UNIQUE'))
WHERE t.table_schema NOT IN ('mysql','information_schema','performance_schema') AND t.engine = 'InnoDB' AND
c.table_name IS NULL;
```

- 主键应使用较小数据类型且有序
- 避免大事务(运行时间长或变更记录多)

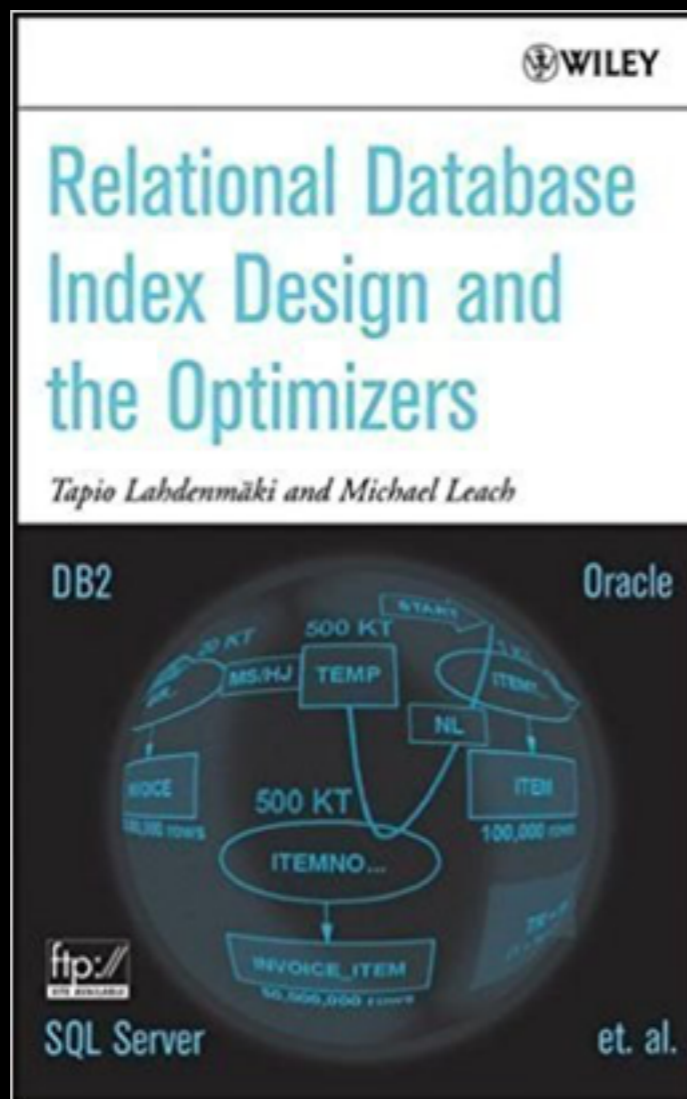


```
SELECT a.requesting_trx_id '被阻塞事务ID', b.trx_mysql_thread_id '被阻塞线程ID', TIMESTAMPDIF(SECOND, b.trx_wait_started, NOW())
'被阻塞秒数', b.trx_query '被阻塞的语句', a.blocking_trx_id '阻塞事务ID', c.trx_mysql_thread_id '阻塞线程ID', d.INFO '阻塞事务信息' FROM
information_schema.INNODB_LOCK_WAITS a
INNER JOIN information_schema.INNODB_TRX b ON a.requesting_trx_id=b.trx_id
INNER JOIN information_schema.INNODB_TRX c ON a.blocking_trx_id=c.trx_id
INNER JOIN information_schema.PROCESSLIST d ON c.trx_mysql_thread_id=d.ID ;
```

# 重要参数

- max\_connection
- innodb\_buffer\_pool\_size
- Innodb\_flush\_neighbors
- Innodb\_io\_capacity
- Innodb\_log\_file\_size
- innodb\_thread\_concurrency

# SQL优化

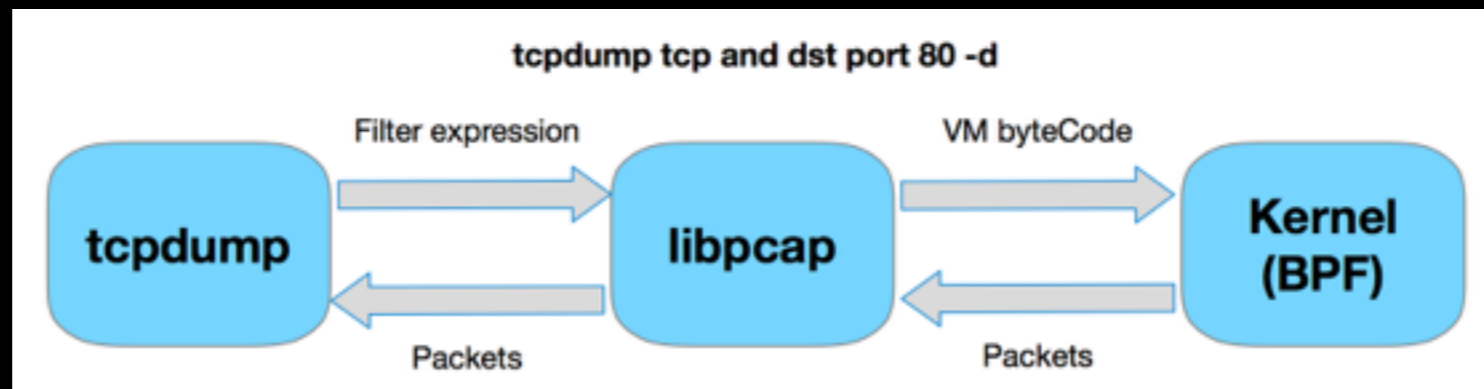


# Note

- 优化的核心就是“少做事”
- 切勿盲目追求最优配置模板
- 避免过早优化

# BPF是什么

- BPF = Berkeley Packet Filter
- The Berkeley Packet Filter (BPF) provides a raw interface to data link layers, permitting raw link-layer packets to be sent and received.



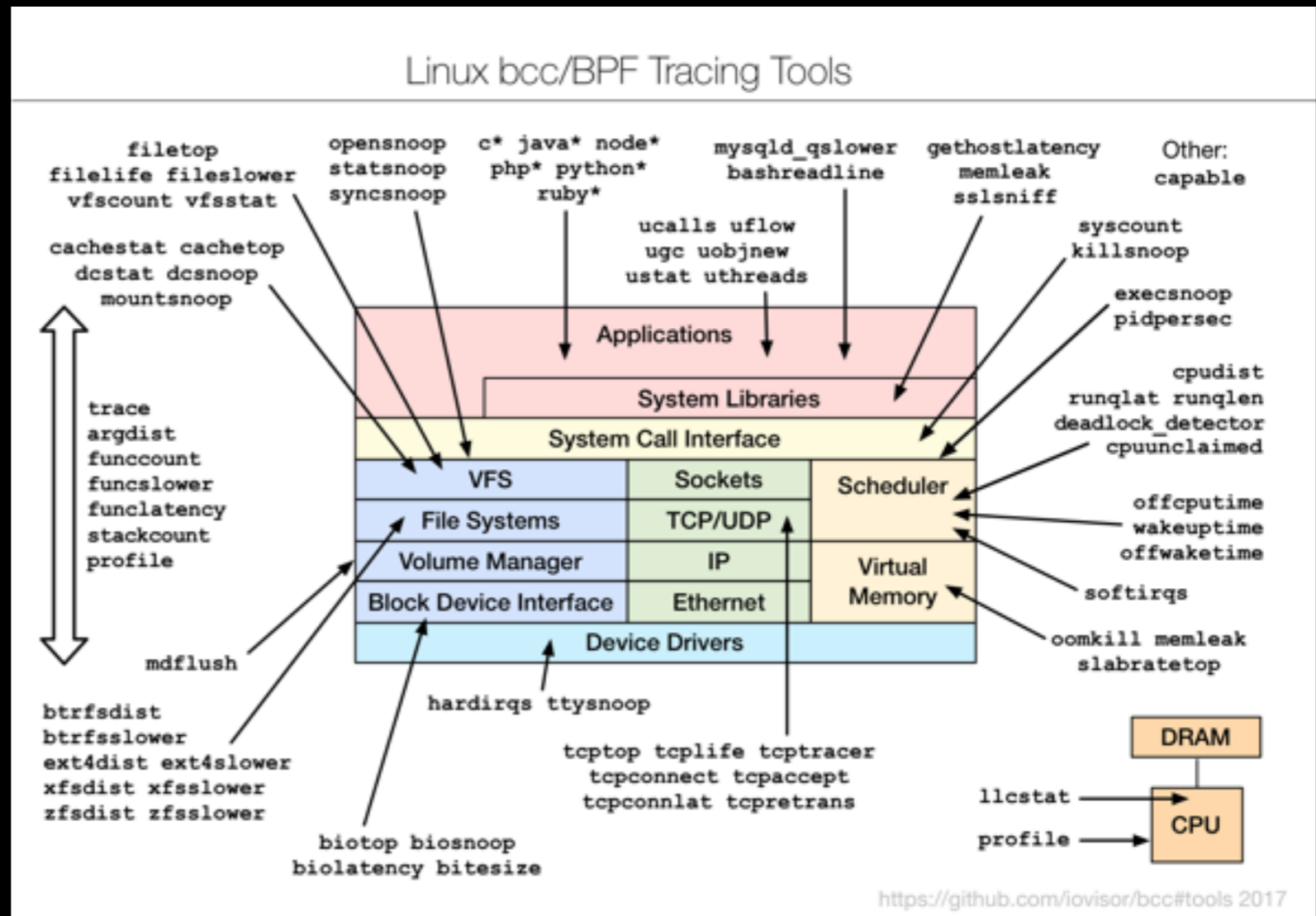
- Since version 3.18, the Linux kernel includes an extended BPF virtual machine, termed extended BPF (eBPF). It can be used for non-networking purposes

# 前提条件

- Linux kernel 4.4+ (推荐 4.9+ )
- 安装Bcc <https://github.com/iovisor/bcc/blob/master/INSTALL.md>
- MySQL 编译 `-DENABLE_DTRACE=1` & 安装 `systemtap-sdt-devel`

# Bcc 工具箱

1. execsnoop
2. opensnoop
3. ext4slower
4. biolateness
5. biosnoop
6. cachestat
7. tcpconnect
8. tcpaccept
9. tcpretrans
10. gethostlatency
11. runlat
12. profile



# Query延迟分布

```
//Only select
root@R820-08:/usr/share/bcc/tools# ./dbstat -p `pidof mysqld` -u -- mysql
Tracing database queries for pids 4754 slower than 0 ms...
^C[11:20:53]
  query latency (us) : count      distribution
    0 -> 1           : 0          |
    2 -> 3           : 0          |
    4 -> 7           : 0          |
    8 -> 15          : 0          |
   16 -> 31          : 0          |
   32 -> 63          : 0          |
   64 -> 127         : 400308    |*****|
  128 -> 255         : 148021    |*****|
  256 -> 511         : 261       |
  512 -> 1023        : 3         |
 1024 -> 2047        : 0         |
 2048 -> 4095        : 1         |
 4096 -> 8191        : 3         |
 8192 -> 16383       : 9         |
```

```
// Select and update
root@R820-08:/usr/share/bcc/tools# ./dbstat -p `pidof mysqld` -u -- mysql
Tracing database queries for pids 4754 slower than 0 ms...
^C[11:20:33]
  query latency (us) : count      distribution
    0 -> 1           : 0          |
    2 -> 3           : 0          |
    4 -> 7           : 0          |
    8 -> 15          : 0          |
   16 -> 31          : 0          |
   32 -> 63          : 0          |
   64 -> 127         : 9198       |*****|
  128 -> 255         : 25826      |*****|
  256 -> 511         : 17629      |*****|
  512 -> 1023        : 14568      |*****|
 1024 -> 2047        : 12533      |*****|
 2048 -> 4095        : 9840       |*****|
 4096 -> 8191        : 4031       |*****|
 8192 -> 16383       : 463        |
16384 -> 32767       : 33         |
32768 -> 65535       : 20         |
65536 -> 131071     : 20         |
```



# 慢Query抓取

```
// Select and update
root@R820-08:/usr/share/bcc/tools# ./dbslower -p `pidof mysqld` -m 5 -- mysql
Tracing database queries for pids 4754 slower than 5 ms...
TIME(s)          PID           MS QUERY
0.956044         4754          5.358 UPDATE sbtest1 SET k=k+1 WHERE id=514
0.956199         4754          5.837 UPDATE sbtest1 SET k=k+1 WHERE id=505
0.956876         4754          5.257 UPDATE sbtest1 SET k=k+1 WHERE id=503
0.955977         4754          6.656 UPDATE sbtest1 SET k=k+1 WHERE id=503
0.956287         4754          6.801 UPDATE sbtest1 SET k=k+1 WHERE id=503
0.955870         4754          7.554 UPDATE sbtest1 SET k=k+1 WHERE id=498
0.956329         4754          7.121 UPDATE sbtest1 SET k=k+1 WHERE id=497
...
```

# VFS 延迟分析

```
// Select and update
root@R730-117:/usr/share/bcc/tools# ./ext4dist 2 1
Tracing ext4 operation latency... Hit Ctrl-C to end.

21:39:52:

operation = read
      usecs          : count    distribution
      0 -> 1         : 0      |
      2 -> 3         : 3      |
      4 -> 7         : 19596  |*****|
      8 -> 15        : 32887  |*****|
      16 -> 31       : 2649   |*      |
      32 -> 63       : 303    |
      64 -> 127      : 48     |
      128 -> 255     : 15     |
      256 -> 511     : 3      |
--
operation = write
      usecs          : count    distribution
      0 -> 1         : 0      |
      2 -> 3         : 2      |
      4 -> 7         : 507    |
      8 -> 15        : 22123  |*****|
      16 -> 31       : 10444  |*****|
      32 -> 63       : 2073   |*      |
      64 -> 127      : 590    |
      128 -> 255     : 174    |
      256 -> 511     : 240    |
```

```
--
operation = fsync
      usecs          : count    distribution
      0 -> 1         : 166    |
      2 -> 3         : 291    |
      4 -> 7         : 446    |*      |
      8 -> 15        : 22     |
      16 -> 31       : 3      |
      32 -> 63       : 1      |
      64 -> 127      : 2847   |*****|
      128 -> 255     : 7164   |*****|
      256 -> 511     : 4292   |*****|
      512 -> 1023    : 882    |**     |
```

# Ext4 延迟分析

```
//Insert data
```

```
root@R820-08:/usr/share/bcc/tools# ./ext4slower 1
```

```
Tracing ext4 operations slower than 1 ms
```

TIME	COMM	PID	T	BYTES	OFF_KB	LAT(ms)	FILENAME
21:59:40	mysqld	4754	S	0	0	3.56	ib_logfile1
21:59:40	mysqld	4754	S	0	0	8.42	sbtest1.ibd
21:59:41	mysqld	4754	S	0	0	3.83	ib_logfile1
21:59:41	mysqld	4754	S	0	0	8.35	sbtest1.ibd
21:59:42	mysqld	4754	S	0	0	8.50	sbtest1.ibd
21:59:42	mysqld	4754	S	0	0	3.53	ib_logfile1
21:59:42	mysqld	4754	S	0	0	8.34	sbtest1.ibd
21:59:43	mysqld	4754	S	0	0	2.69	ib_logfile1
21:59:43	mysqld	4754	S	0	0	8.41	sbtest1.ibd
21:59:44	mysqld	4754	S	0	0	8.37	sbtest1.ibd
21:59:44	mysqld	4754	S	0	0	4.13	ib_logfile1
21:59:44	mysqld	4754	S	0	0	8.38	sbtest1.ibd
21:59:45	mysqld	4754	S	0	0	8.52	sbtest1.ibd

```
root@R820-08:/usr/share/bcc/tools# ./ext4slower 10
```

```
Tracing ext4 operations slower than 10 ms
```

TIME	COMM	PID	T	BYTES	OFF_KB	LAT(ms)	FILENAME
22:03:14	dd	42639	W	1073741824	0	873.20	test1.img
22:03:15	mysqld	4754	W	1048576	1024	16.48	ibdata1
22:03:15	mysqld	4754	W	507904	2048	13.98	ibdata1
22:03:15	mysqld	4754	W	1048576	1302528	15.10	sbtest1.ibd
22:03:15	mysqld	4754	S	0	0	110.94	ibdata1
22:03:16	mysqld	4754	W	1048576	1306624	22.35	sbtest1.ibd

# 块设备延迟分析

```
//Select and update
root@R730-117:/usr/share/bcc/tools# ./biolateny -D 2
Tracing block device I/O... Hit Ctrl-C to end.

disk = 'sdb'

```

usecs	: count	distribution
0 -> 1	: 0	
2 -> 3	: 0	
4 -> 7	: 0	
8 -> 15	: 0	
16 -> 31	: 0	
32 -> 63	: 4694	*****
64 -> 127	: 3399	*****
128 -> 255	: 2211	*****
256 -> 511	: 2250	*****
512 -> 1023	: 642	**
1024 -> 2047	: 0	
2048 -> 4095	: 0	

```
root@R730-117:/usr/share/bcc/tools# ./biolateny -D 2
Tracing block device I/O... Hit Ctrl-C to end.

disk = 'sdb'

```

usecs	: count	distribution
0 -> 1	: 0	
2 -> 3	: 0	
4 -> 7	: 0	
8 -> 15	: 0	
16 -> 31	: 0	
32 -> 63	: 0	
64 -> 127	: 0	
128 -> 255	: 0	
256 -> 511	: 2	*****
512 -> 1023	: 0	
1024 -> 2047	: 0	
2048 -> 4095	: 3	*****

# MySQL文件IO压力分析

```
root@R820-08:/usr/share/bcc/tools# ./filetop -p `pidof mysqld` -C 5
Tracing... Output every 5 secs. Hit Ctrl-C to end

22:26:30 loadavg: 7.50 5.28 4.87 18/1925 44235

TID   COMM      READS  WRITES R_Kb   W_Kb   T FILE
39956 mysqld    0      115   0     462    R ib_logfile1
40075 mysqld    0      107   0     424    R ib_logfile1
39900 mysqld    0     1220   0     137    R R820-08.log
38046 mysqld    0     1263   0     142    R R820-08.log
39085 mysqld    0      101   0     332    R ib_logfile1
38957 mysqld    0      114   0     425    R ib_logfile1
39959 mysqld    0       1     0       2    R ibmPAQIO
4780  mysqld    0       4     0      28    R ib_logfile1
40266 mysqld    0      107   0     361    R ib_logfile1
39984 mysqld    0      111   0     414    R ib_logfile1
39991 mysqld    0     1211   0     136    R R820-08.log
37224 mysqld    0      104   0     449    R ib_logfile1
40259 mysqld    0      109   0     340    R ib_logfile1
39958 mysqld    0      107   0     342    R ib_logfile1
39969 mysqld    0     1214   0     137    R R820-08.log
39966 mysqld    0     1275   0     144    R R820-08.log
39937 mysqld    0     1227   0     138    R R820-08.log
```

# 临时表文件生命周期观测

```
root@R820-08:/usr/share/bcc/tools# ./filelife
```

TIME	PID	COMM	AGE(s)	FILE
22:17:01	43687	cron	0.00	tmpfgHF5vY
22:22:21	39170	mysqld	5.30	#sql1292_59a1f_0.frm

# 短连接分析

```
root@R820-08:/usr/share/bcc/tools# ./tcplife
```

PID	COMM	LADDR	LPORT	RADDR	RPORT	TX_KB	RX_KB	MS
44245	sysbench	127.0.0.1	35038	127.0.0.1	3306	16	699	312.05
44245	sysbench	127.0.0.1	35036	127.0.0.1	3306	17	736	312.20
44245	sysbench	127.0.0.1	35034	127.0.0.1	3306	15	662	312.41
44245	sysbench	127.0.0.1	35032	127.0.0.1	3306	14	638	312.45
44245	sysbench	127.0.0.1	35026	127.0.0.1	3306	14	626	313.17
44245	sysbench	127.0.0.1	35028	127.0.0.1	3306	12	552	313.18
44245	sysbench	127.0.0.1	35022	127.0.0.1	3306	17	736	313.66
44245	sysbench	127.0.0.1	35018	127.0.0.1	3306	13	589	313.86
44245	sysbench	127.0.0.1	35016	127.0.0.1	3306	13	589	314.00
44245	sysbench	127.0.0.1	35014	127.0.0.1	3306	14	626	314.11
44245	sysbench	127.0.0.1	35012	127.0.0.1	3306	17	761	314.15
44245	sysbench	127.0.0.1	35010	127.0.0.1	3306	17	736	314.60
44245	sysbench	127.0.0.1	35008	127.0.0.1	3306	15	663	314.66
44245	sysbench	127.0.0.1	35004	127.0.0.1	3306	16	699	314.74
44245	sysbench	127.0.0.1	35002	127.0.0.1	3306	15	663	315.05
44245	sysbench	127.0.0.1	35000	127.0.0.1	3306	15	699	315.09

```
13:08:05.737768 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1221 > dsl-usr-cust-110.inetarena.com.www : 342:342(0) ack 1449 win 31856 <nop
,nop.timestamp 1247771 114849487> (DF)
13:08:07.467571 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1221: . 1449:2897(1448) ack 342 win 31856
<nop,nop.timestamp 114849637 1247771> (DF)
13:08:07.707634 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1221: . 2897:4345(1448) ack 342 win 31856
<nop,nop.timestamp 114849637 1247771> (DF)
13:08:07.707922 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1221 > dsl-usr-cust-110.inetarena.com.www : 342:342(0) ack 4345 win 31856 <nop
,nop.timestamp 1247968 114849637> (DF)
13:08:08.057941 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1045 > ns.de.ibm.net.domain: 8928* PTR? 110.107.102.209.in-addr.arpa. (46)
13:08:08.747598 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1221: P 4345:5793(1448) ack 342 win 31856
<nop,nop.timestamp 114849813 1247968> (DF)
13:08:08.847870 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1221: FP 5793:6297(504) ack 342 win 31856
<nop,nop.timestamp 114849813 1247968> (DF)
13:08:08.848063 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1221 > dsl-usr-cust-110.inetarena.com.www : 342:342(0) ack 6298 win 31856 <nop
,nop.timestamp 1248082 114849813> (DF)
13:08:08.907566 ppp0 < ns.de.ibm.net.domain > slip139-92-26-177.ist.tr.ibm.net.1045: 8928* 3/1/1 PTR dsl-usr-cust-110.inetarena.com.. P
TR Fingerless.or (199)
13:08:09.151742 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1221 > dsl-usr-cust-110.inetarena.com.www: F 342:342(0) ack 6298 win 31856 <nop
,nop.timestamp 1248112 114849813> (DF)
13:08:10.137603 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1221: . 6298:6298(0) ack 343 win 31856 <no
p,nop.timestamp 114849967 1248112> (DF)
13:09:01.904210 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www: S 920197285:920197285(0) win 32120 <
ss 1460,sackOK.timestamp 1253395 0,nop.vscale 0> (DF)
13:09:03.097569 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: S 122227738:122227738(0) ack 92019
7286 win 32120 <ss 1460,sackOK.timestamp 114855252 1253395,nop.vscale 0> (DF)
13:09:03.098197 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www : 1:1(0) ack 1 win 32120 <nop,nop.ti
imestamp 1253507 114855252> (DF)
13:09:03.102171 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www: P 1:322(321) ack 1 win 32120 <nop,no
p.timestamp 1253507 114855252> (DF)
13:09:04.147613 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: . 1:1(0) ack 322 win 31856 <nop,nop.
timestamp 114855369 1253507> (DF)
13:09:04.507608 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: . 1:1449(1448) ack 322 win 31856 <no
p,nop.timestamp 114855369 1253507> (DF)
13:09:04.507934 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www : 322:322(0) ack 1449 win 31856 <nop
,nop.timestamp 1253648 114855369> (DF)
13:09:06.627604 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: . 1449:2897(1448) ack 322 win 31856
<nop,nop.timestamp 114855491 1253648> (DF)
13:09:06.857649 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: . 2897:4345(1448) ack 322 win 31856
<nop,nop.timestamp 114855491 1253648> (DF)
13:09:06.857918 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www : 322:322(0) ack 4345 win 31856 <nop
,nop.timestamp 1253783 114855491> (DF)
13:09:06.907557 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: FP 4345:5792(1447) ack 322 win 31856
<nop,nop.timestamp 114855627 1253783> (DF)
13:09:06.907887 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www : 322:322(0) ack 5793 win 31856 <nop
,nop.timestamp 1253888 114855627> (DF)
13:09:07.401205 ppp0 > slip139-92-26-177.ist.tr.ibm.net.1222 > dsl-usr-cust-110.inetarena.com.www: F 322:322(0) ack 5793 win 31856 <nop
,nop.timestamp 1253937 114855627> (DF)
13:09:08.317623 ppp0 < dsl-usr-cust-110.inetarena.com.www > slip139-92-26-177.ist.tr.ibm.net.1222: . 5793:5793(0) ack 323 win 31856 <no
p,nop.timestamp 114855780 1253937> (DF)
```

# 案例1

开发：MySQL数据库怎么时快时慢，什么原因？

- 什么类型的请求慢，查询？写入？个别？全部？
- 利用USE方法检查系统资源
- 检查MySQL 线程状态和存储引擎状态



# 案例2

xtrabackup不是热备么，怎么还会堵住业务

```
mysql> show processlist;
+-----+-----+-----+-----+-----+-----+-----+-----+
| Id | User      | Host                | db  | Command | Time | State                                | Info                                |
+-----+-----+-----+-----+-----+-----+-----+-----+
| 31 | root      | localhost           | NULL | Query    | 0    | starting                             | show processlist                  |
| 32 | msandbox | localhost:62019     | test | Query    | 19   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=676 |
| 33 | msandbox | localhost:62020     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=2177 |
| 34 | msandbox | localhost:62026     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=1074 |
| 35 | msandbox | localhost:62024     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=1716 |
| 36 | msandbox | localhost:62027     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=2129 |
| 37 | msandbox | localhost:62023     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=2971 |
| 38 | msandbox | localhost:62022     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=2370 |
| 39 | msandbox | localhost:62028     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=3830 |
| 40 | msandbox | localhost:62025     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=3648 |
| 41 | msandbox | localhost:62021     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=308 |
| 42 | msandbox | localhost:62029     | test | Query    | 10   | Waiting for global read lock        | UPDATE sbtest1 SET k=k+1 WHERE id=524 |
+-----+-----+-----+-----+-----+-----+-----+-----+
12 rows in set (0.00 sec)
```

```
thread_list=$(gdb -p $1 -q -batch -ex 'info threads'|awk '/mysqld/{print $1}'|grep -v '*'|sort -nk1)
for i in $thread_list; do
  echo ">>>>> thread $i <<<<<<"
  grl=`gdb -p $1 -q -batch -ex "thread $i" -ex 'p do_command::thd->thread_id' -ex 'p do_command::thd->global_read_lock'|grep -B3 GRL_ACQUIRED_AND_BLOCKS_COMMIT`
  if [[ $grl =~ 'GRL_ACQUIRED_AND_BLOCKS_COMMIT' ]]; then
    echo "$grl" ; break
  fi
done
```

PHPCON 官网: [www.phpconchina.com](http://www.phpconchina.com)

全部 PPT 下载: <https://github.com/ThinkDevelopers/PHPConChina>

官方QQ群: 34449228、135615537

官方公众号: ThinkInLAMP

