



PERCONA



Ferramentas e métodos para análise de performance em MySQL

Sobre mim



Leonardo Bacchi Fernandes

Suporte em banco de dados sênior na Percona

- MySQL
- PostgreSQL
- MongoDB

Expectativas

Essa apresentação não tem como foco:

- Ensinar os detalhes de cada ferramenta
- Explicar o funcionamento interno do MySQL
- Como resolver todos os problemas de performance com uma única solução

Foco da apresentação:

- Entender por onde começar uma análise de performance
- Apresentar ferramentas e comandos que temos à disposição
- Foco nas ferramentas de MySQL
- Exemplos

Agenda:

- Desafios
- Por onde começar uma análise de performance
- Entendendo o servidor
- Saturação de recursos
- Entendendo o banco de dados
- Investigando o MySQL



Troubleshooting

Desafios e como resolvê-los

Desafios

- Muita informação (agulha num palheiro)

Solução

- Entender o problema!
- Análise sistemática

Método

- Qual problema estamos tentando resolver?
 - Perguntas básicas
- Entender a configuração do servidor e do MySQL
 - Recursos e configurações
- Achar a saturação
 - Sistema operacional
 - CPU
 - Memória
 - Disco
 - Rede
 - MySQL (análise direcionada)



Sistema Operacional

Entendendo o servidor – Percona toolkit (pt-summary)

```
# Percona Toolkit System Summary Report #####
    Date | 2023-11-17 15:14:43 UTC (local TZ: UTC +0000)
    Hostname | tp-lab.tp.int.percona.com
    Uptime | 277 days, 2:01, 20 users, load average: 14.73, 13.64, 13.40
    System | Iron_Systems.Inc; CS-PER-1U-A02;
vA02 (Other)
    Service Tag | IS1902-0001
    Platform | Linux
    Release | CentOS Stream release 8
    Kernel | 5.13.12-1.el8.elrepo.x86_64
Architecture | CPU = 64-bit, OS = 64-bit
    Threading | NPTL 2.28
    SELinux | Enforcing
    Virtualized | No virtualization detected
#####
    Processors | physical = 2, cores = 24, virtual = 48, hyperthreading = yes
    Speeds | 1x3000.000, 1x3599.989, 1x3599.995, 2x3599.996, 2x3599.997, 2x3599.998, 1x3599.999,
4x3600.000, 1x3600.003, 1x3600.004, 1x3600.005, 1x3600.006, 1x3600.011, 2x3600.012, 27x3700.000
    Models | 48xIntel(R) Xeon(R) Gold 6136 CPU @ 3.00GHz
```

Entendendo o servidor – Percona toolkit (pt-summary)

```
Caches | 48x25344 KB
# Memory #####
  Total | 376.6G
  Free  | 12.5G
  Used  | physical = 169.7G, swap allocated = 2.0G, swap used = 2.0M, virtual = 169.7G
  Shared | 26.4G
  Buffers | 194.4G
  Caches | 178.5G
  Dirty  | 16040 kB
  UsedRSS | 156.1G
  Swappiness | 1
  DirtyPolicy | 10, 10
[...]
```

```
# Disk Schedulers And Queue Size #####
  dm-0 | 128
  dm-1 | 128
  nvme0n1 | [none] 1023
  sda | [mq-deadline] 256
  sdb | [mq-deadline] 64
[...]
```

```
# Memory mamagement #####
Transparent huge pages are currently disabled on the system.
# The End #####
```

Antes de continuar

```
shell > dmesg -T
```

```
[....]
```

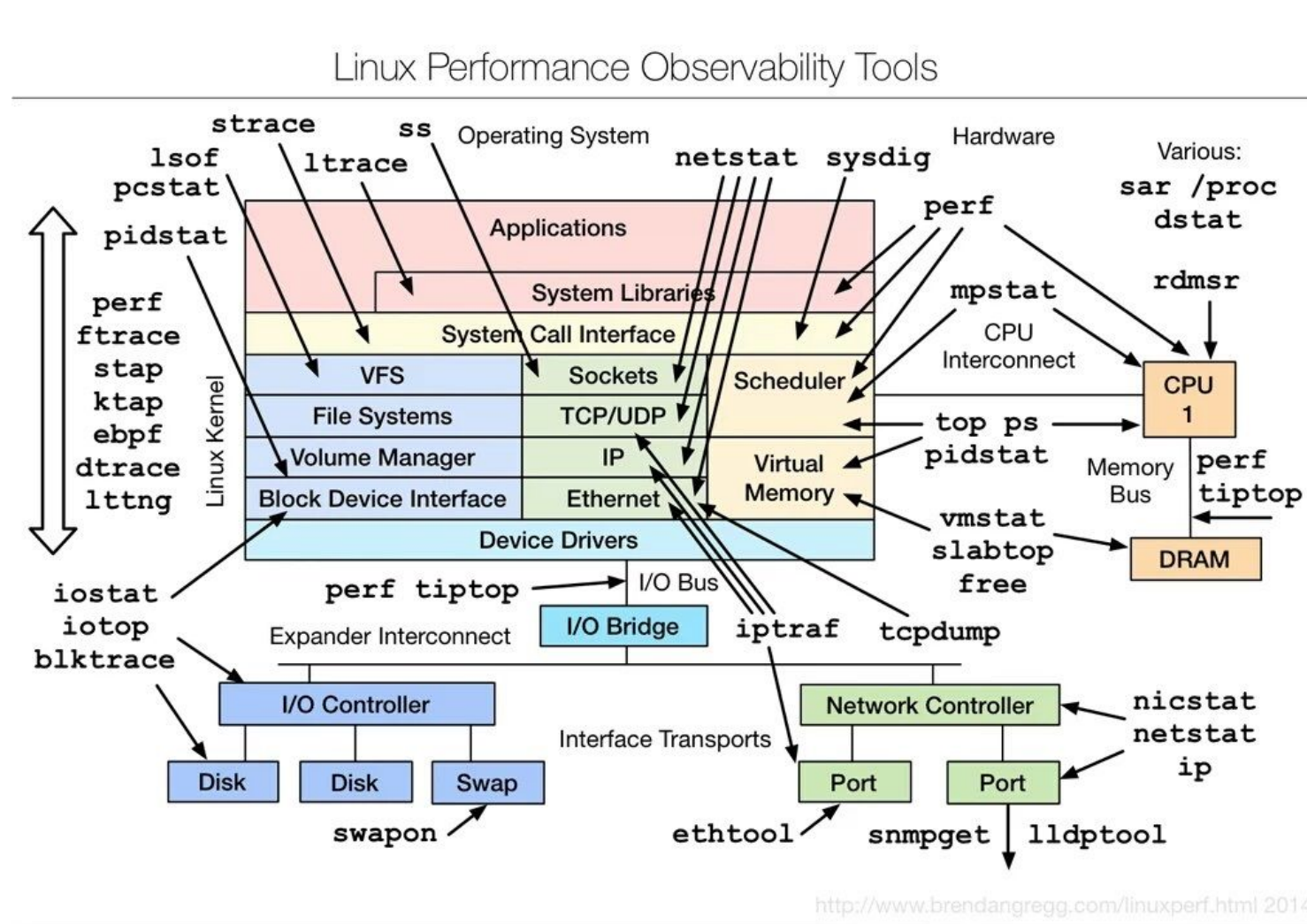
```
[Thu Nov 23 09:02:45 2023] XFS (dm-17): metadata I/O error in  
"xfs_alloc_read_agfl+0x7c/0xc0 [xfs]" at daddr 0x3 len 1 error 74
```

```
[Thu Nov 23 09:02:45 2023] XFS (dm-17): page discard on page 0000000063ba1b5d, inode  
0x84, offset 0.
```

```
[Thu Nov 23 09:02:45 2023] XFS (dm-17): Metadata CRC error detected at  
xfs_agfl_read_verify+0xa5/0xf0 [xfs], xfs_agfl block 0x3
```

```
[Thu Nov 23 09:02:45 2023] XFS (dm-17): Unmount and run xfs_repair
```

Encontrando a saturação



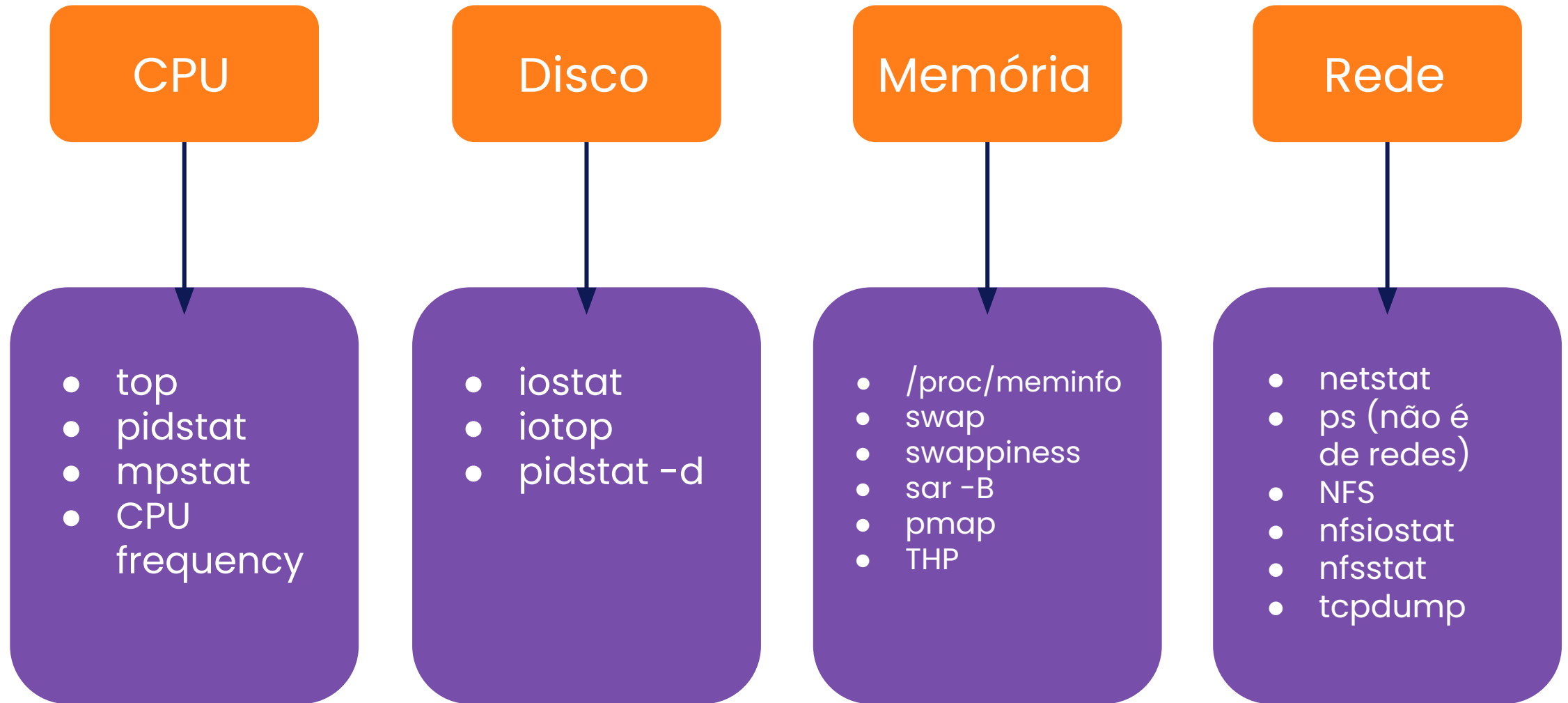
O pt-stalk:

2023_11_16_15_32_05-df	2023_11_16_15_32_05-mpstat	2023_11_16_15_32_05-procvmstat
2023_11_16_15_32_05-disk-space	2023_11_16_15_32_05-mpstat-overall	2023_11_16_15_32_05-ps
2023_11_16_15_32_05-diskstats	2023_11_16_15_32_05-mysqldadmin	2023_11_16_15_32_05-slabinfo
2023_11_16_15_32_05-hostname	2023_11_16_15_32_05-netstat	2023_11_16_15_32_05-slave-status
2023_11_16_15_32_05-innodbstatus1	2023_11_16_15_32_05-netstat_s	2023_11_16_15_32_05-sysctl
2023_11_16_15_32_05-innodbstatus2	2023_11_16_15_32_05-numastat	2023_11_16_15_32_05-top
2023_11_16_15_32_05-interrupts	2023_11_16_15_32_05-opentables1	2023_11_16_15_32_05-transactions
2023_11_16_15_32_05-iostat	2023_11_16_15_32_05-opentables2	2023_11_16_15_32_05-trigger
2023_11_16_15_32_05-iostat-overall	2023_11_16_15_32_05-output	2023_11_16_15_32_05-variables
2023_11_16_15_32_05-lock-waits	2023_11_16_15_32_05-processlist	2023_11_16_15_32_05-vmstat
2023_11_16_15_32_05-meminfo	2023_11_16_15_32_05-procstat	2023_11_16_15_32_05-vmstat-overall

Por onde começar? Vmstat!

procs		memory				swap		io		system		cpu				
r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa	st
6	1	7855772	2738416	1030560	14434456	2	7	2410	3663	2	2	3	2	94	1	0
2	3	7841080	2649620	1030572	14499056	14736	0	14736	12648	14339	18965	4	5	79	12	0
2	1	7831380	2561088	1030628	14582280	9908	0	9912	536708	15789	21347	5	8	74	13	0
3	1	7817288	2460360	1030680	14670372	14180	0	14180	11628	16563	20716	5	7	76	12	0
6	1	7807036	2401968	1030704	14722064	10352	0	10352	10808	11244	14896	4	5	79	12	0
2	0	7788156	2286776	1030732	14815840	18916	0	18916	12008	18277	24335	6	7	76	11	0
5	0	7774144	2153444	1030800	14930096	14092	0	14092	11932	17075	21561	6	8	73	12	0
3	1	7758948	2032568	1030840	15038872	15228	0	15228	10140	17226	21524	6	8	74	12	0
2	2	7742324	1969736	1030852	15070872	16696	0	16696	226732	12879	17663	3	6	81	11	0
2	1	7733772	2916060	1030884	14112948	8624	0	8624	325984	12317	16447	5	10	71	14	0
2	1	7719412	2791012	1030932	14227000	14824	0	14824	10436	17696	21634	7	8	74	12	0
3	1	7703388	2688812	1030980	14300700	16204	0	16204	9828	14894	19540	5	6	78	11	0
2	1	7687968	2594900	1031064	14371124	15528	0	15528	9892	14939	19890	5	6	78	11	0
2	0	7671992	2490496	1031132	14460112	16136	0	16136	10380	16252	21255	6	7	76	11	0
3	1	7652988	2414100	1031204	14522084	19212	0	19212	10260	16720	22323	4	7	78	11	0
2	2	7644948	2349800	1031232	14588544	8048	0	8048	9276	10848	13851	4	5	79	12	0
2	1	7630584	2232148	1031304	14692068	14380	0	14380	9696	16172	20611	6	7	75	12	0
3	1	7613368	2097384	1031320	14807428	17268	0	17268	11644	18684	23692	7	8	73	12	0
3	1	7593860	2023476	1031344	14861360	19492	0	19492	8308	15854	21407	4	6	79	11	0
5	1	7579868	1946236	1031376	14926072	14052	0	14052	8144	14055	18682	5	6	78	11	0
3	1	7566964	1782620	1031460	15076976	12960	0	12960	36660	21848	29820	18	20	50	12	0

Mais detalhes!



Alguns exemplos e o quê estamos procurando – CPU

```
top - 19:40:45 up 23 days, 1:04, 4 users, load average: 1.18, 1.09, 1.12
Tasks: 251 total, 3 running, 248 sleeping, 0 stopped, 0 zombie
%Cpu(s): 9.0 us, 10.5 sy, 0.0 ni, 66.9 id, 11.3 wa, 0.0 hi, 2.3 si, 0.0 st
MiB Mem : 128812.0 total, 2648.4 free, 111039.2 used, 15124.4 buff/cache
MiB Swap: 8192.0 total, 522.8 free, 7669.2 used. 16543.8 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1217314	mysql	20	0	200.5g	107.5g	20088	S	87.5	85.5	556:37.28	mysqld
249	root	0	-20	0	0	0	R	6.2	0.0	2:54.73	kworker+
1291049	root	20	0	8368	3440	2084	S	6.2	0.0	0:00.01	bash
1291259	root	20	0	10616	3968	3360	R	6.2	0.0	0:00.01	top
1	root	20	0	167664	8940	5724	S	0.0	0.0	3:35.30	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.38	kthreadd

Mais detalhes – mpstat

11:45:14 AM	CPU	%usr	%nice	%sys	%iowait	%irq	%soft	%steal	%guest	%gnice	%idle
11:45:15 AM	all	18.71	0.00	2.52	0.55	0.00	0.38	0.00	0.00	0.00	77.84
11:45:15 AM	0	46.46	0.00	4.04	3.03	0.00	4.04	0.00	0.00	0.00	42.42
11:45:15 AM	1	35.71	0.00	4.08	2.04	0.00	0.00	0.00	0.00	0.00	58.16
11:45:15 AM	2	51.52	0.00	3.03	1.01	0.00	0.00	0.00	0.00	0.00	44.44
11:45:15 AM	3	53.00	0.00	2.00	2.00	0.00	1.00	0.00	0.00	0.00	42.00
11:45:15 AM	4	32.00	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	61.00
11:45:15 AM	5	44.44	0.00	3.03	2.02	0.00	0.00	0.00	0.00	0.00	50.51
11:45:15 AM	6	65.66	0.00	17.17	0.00	0.00	1.01	0.00	0.00	0.00	16.16
11:45:15 AM	7	52.53	0.00	3.03	1.01	0.00	1.01	0.00	0.00	0.00	42.42
11:45:15 AM	8	34.69	0.00	3.06	2.04	0.00	1.02	0.00	0.00	0.00	59.18
11:45:15 AM	9	47.96	0.00	5.10	2.04	0.00	1.02	0.00	0.00	0.00	43.88
11:45:15 AM	10	62.89	0.00	1.03	1.03	0.00	1.03	0.00	0.00	0.00	34.02
11:45:15 AM	11	54.55	0.00	2.02	1.01	0.00	1.01	0.00	0.00	0.00	41.41
11:45:15 AM	12	7.92	0.00	3.96	0.00	0.00	0.00	0.00	0.00	0.00	88.12
11:45:15 AM	13	4.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	94.00
11:45:15 AM	14	4.04	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	93.94
11:45:15 AM	15	3.03	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	94.95
11:45:15 AM	16	3.03	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	94.95
11:45:15 AM	17	3.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	93.00
11:45:15 AM	18	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	96.00
11:45:15 AM	19	4.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	93.00
11:45:15 AM	20	4.08	0.00	1.02	0.00	0.00	0.00	0.00	0.00	0.00	94.90
11:45:15 AM	21	5.05	0.00	1.01	1.01	0.00	0.00	0.00	0.00	0.00	92.93
[...]											

Disco – iostat

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	1.36	8.03	1.49	10.87	20.69	100.32	19.58	0.01	0.89	0.22	0.98	0.04	0.05
sdb	0.04	840.30	69.58	2515.21	3156.37	32166.43	27.33	0.07	0.03	0.44	0.01	0.03	6.79
drbd0	0.00	0.00	69.62	3520.52	3156.18	32106.45	19.64	0.09	0.02	0.44	0.02	0.02	8.03
Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	4.00	0.00	15.00	1.00	164.00	4.00	21.00	0.01	0.38	0.40	0.00	0.19	0.30
sdb	0.00	748.00	60.00	2028.00	960.00	23532.00	23.46	0.25	0.12	0.08	0.12	0.03	5.80
drbd0	0.00	0.00	60.00	2885.00	960.00	23660.00	16.72	8.60	2.92	0.08	2.97	0.14	40.50
Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	63.00	3.00	152.00	76.00	860.00	12.08	0.11	0.72	1.00	0.72	0.02	0.30
sdb	0.00	759.00	184.00	2169.00	2944.00	24648.00	23.45	0.54	0.23	0.09	0.24	0.03	7.90
drbd0	0.00	0.00	185.00	3009.00	2960.00	24468.00	17.17	18.49	5.79	0.09	6.14	0.13	41.10

IO per processo – pidstat -d

07:46:41	AM	UID	PID	kB_rd/s	kB_wr/s	kB_ccwr/s	iodelay	Command
07:46:42	AM	0	1368	=1.00	=1.00	-1.00	3	auditd
07:46:42	AM	0	2480669	-1.00	-1.00	-1.00	1	sssd kcm
07:46:42	AM	0	3240123	-1.00	-1.00	-1.00	1	sssd-be
07:46:42	AM	1921	3717915	1627.72	7398.02	0.00	0	mysqld

07:46:42	AM	UID	PID	kB_rd/s	kB_wr/s	kB_ccwr/s	iodelay	Command
07:46:43	AM	0	1368	=1.00	=1.00	-1.00	3	auditd
07:46:43	AM	1921	2482304	0.00	4.00	0.00	0	pidstat
07:46:43	AM	1921	3717915	0.00	4216.00	0.00	0	mysqld

07:46:43	AM	UID	PID	kB_rd/s	kB_wr/s	kB_ccwr/s	iodelay	Command
07:46:44	AM	0	1368	=1.00	=1.00	-1.00	3	auditd
07:46:44	AM	1921	2481653	0.00	4.00	0.00	0	pidstat
07:46:44	AM	1921	3717915	0.00	11228.00	0.00	0	mysqld

Memória – /proc/meminfo:

```
MemTotal:      792068956 kB
MemFree:       2385772 kB
MemAvailable:  72430296 kB
Buffers:              28 kB
Cached:        69941412 kB
[...]
AnonHugePages: 53016576 kB
CmaTotal:              0 kB
```



MySQL

Análise direcionada

Entendendo o banco de dados (pt-mysql-summary)

```
# Report On Port 3306 #####
      User | root@localhost
      Time | 2023-11-29 19:39:59 (UTC)
  Hostname | db-replica
   Version | 8.0.34-26 Percona Server (GPL), Release '26', Revision '0fe62c85'
  Built On | Linux x86_64
   Started | 2023-11-29 06:45 (up 0+12:54:30)
[...]
```

```
# Processlist #####
```

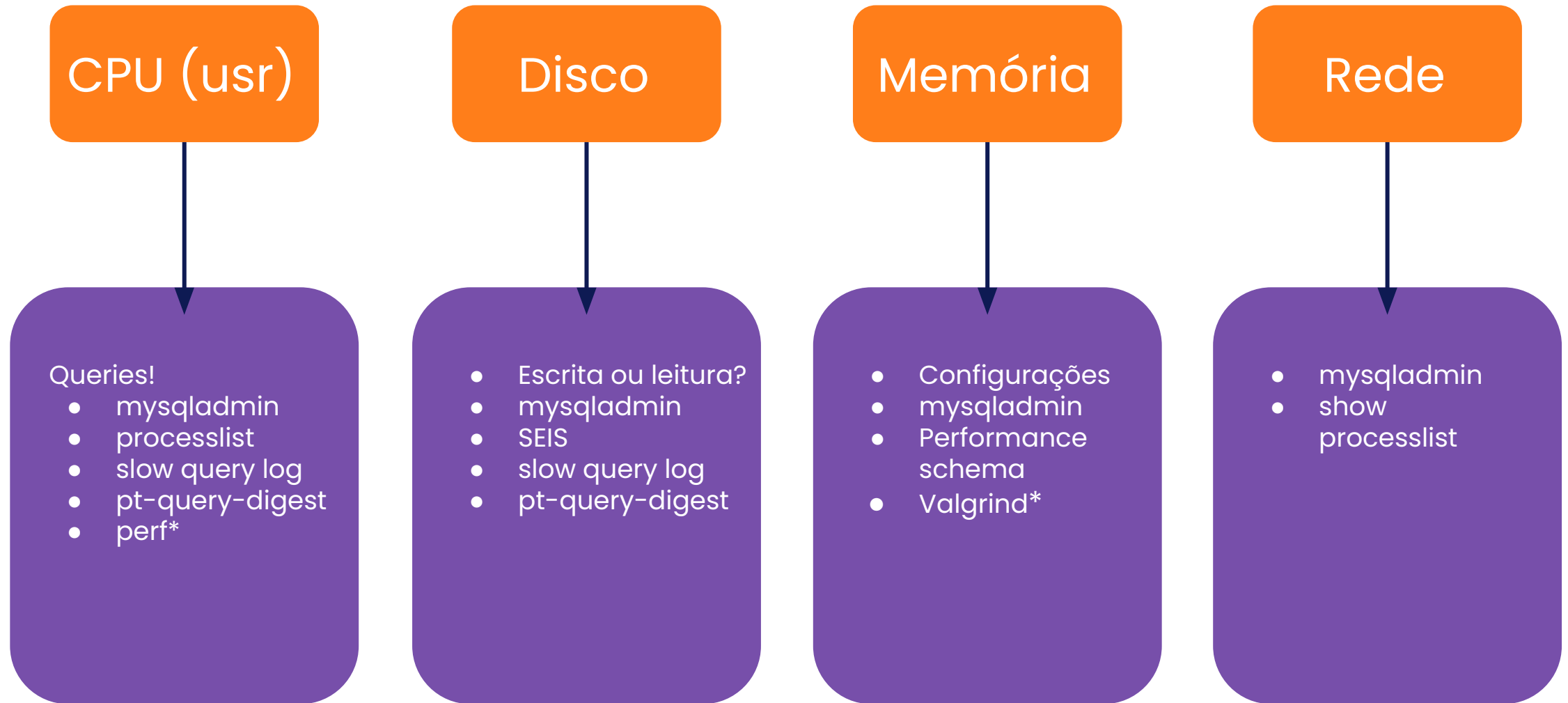
Command	COUNT(*)	Working	SUM(Time)	MAX(Time)
Connect	1	1	45000	45000
Daemon	1	1	45000	45000
Query	10	10	450	200

```
[...]
```

Entendendo o banco de dados (pt-mysql-summary)

```
# InnoDB #####
      Version | 8.0.34-26
    Buffer Pool Size | 184.0G
    Buffer Pool Fill | 50%
    Buffer Pool Dirty | 4%
      File Per Table | ON
      Log File Size | 2 * 8.0G = 16.0G
    Log Buffer Size | 16M
      Flush Method | fsync
    Flush Log At Commit | 1
      Checkpoint Age | 3G
    History List Len | 394
    max_heap_table_size | 16G
      tmp_table_size | 16G
```


Direcionando a nossa análise



CPU (usr)

- Muitas queries
 - mysqladmin
 - Threads_running
 - Queries
- Queries com alto processamento (group by, order by, agregações)
 - mysqladmin
 - Handler_read_*
 - Rows_sorted
- SHOW PROCESSLIST
- Slow query log
- perf*

A ferramenta mysqladmin:

mysqladmin (SHOW GLOBAL STATUS):

Variable_name	Value
Aborted_clients	341
Aborted_connects	58
Aborted_connects_preauth	58
Access_denied_errors	0
Acl_column_grants	0
Acl_database_grants	1
Acl_function_grants	0
Acl_procedure_grants	0
Acl_package_spec_grants	0
[...]	

Usando mysqladmin com pt-mext:

```
shell > pt-mext -r -- cat 2023_11_16_15_32_05-mysqladmin >
2023_11_16_15_32_05-mysqladmin.mext
```

Aborted_clients	341	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Aborted_connects	58	0	0	0	0	0	0	0	0	0	0	0	1	0	13
Aborted_connects_preauth	58	0	0	0	0	0	0	0	0	0	0	0	1	0	13
Access_denied_errors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acl_column_grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acl_database_grants	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acl_function_grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[...]															

CPU – mysqladmin.mext

Threads_running	35	-11	15	40	30	-3	-12	-22
Queries	35257685	30105	474350	410880	401232	36849	37101	34370
Rows_read	9084319798	122884	171800	9783766	803720	152813	192471	733985
Sort_rows	141471818	158818	31381	33813	25874	16861	33254	33474
Innodb_row_lock_time	882360	0	22	726	10	9	0	1

CPU – SHOW PROCESSLIST

```
***** 1. row *****
  Id: 1
  User: system user
  Host:
  db: NULL
  Command: Daemon
  Time: NULL
  State: InnoDB purge coordinator
  Info: NULL
Progress: 0.000
***** 2. row *****
  Id: 2
  User: system user
  Host:
  db: NULL
  Command: Daemon
  Time: NULL
  State: InnoDB purge worker
  Info: NULL
Progress: 0.000

[...]
```

SHOW PROCESSLIST

```
shell > grep -h State *processlist | sort | uniq -c | sort -nr
16374      State:
  987      State: Sending data
  840      State: Opening tables
  296      State: Update
  264      State: Creating sort index
[...]
```

```
shell > grep -h Command *processlist | sort | uniq -c | sort -nr
16392      Command: Sleep
  2214      Command: Query
  1080      Command: Daemon
   112      Command: Connect
    1      Command: Ping
```

```
shell > grep -h "Command: Query" *processlist -A1 | grep Time | sort -nrk2 | head -n 6
Time: 113
Time: 112
Time: 111
Time: 111
Time: 110
Time: 110
```

Disco

- Escrita
 - Tamanho de Redo log
 - mysqladmin
 - Innodb_os_log_written
 - Innodb_checkpoint_age
 - Innodb_data_written
 - Innodb_buffer_pool_pages_flushed
 - Innodb_rows_inserted, _deleted, _updated
 - Innodb_os_log_pending_fsyncs, _writes
 - Innodb_data_pending_fsyncs, _writes
 - Created_tmp_disk_tables
 - Binlog_cache_disk_use
 - SHOW ENGINE INNODB STATUS
 - SHOW PROCESSLIST

Escrita – SHOW ENGINE INNODB STATUS:

```
---TRANSACTION 18548610466, ACTIVE 11 sec
mysql tables in use 1, locked 1
748 lock struct(s), heap size 123000, 71229 row lock(s), undo log entries 70938
MySQL thread id 11, OS thread handle 139794744915520, query id 12673731 Applying batch of
row changes (delete)
[...]
---TRANSACTION 18548487502, ACTIVE (PREPARED) 0 sec committing
mysql tables in use 1, locked 1
1 lock struct(s), heap size 1128, 0 row lock(s), undo log entries 1
MySQL thread id 3605448, OS thread handle 140364097828416, query id 126599638 <IP> <USER>
waiting for handler commit
INSERT IGNORE INTO [redacted]
[...]
Pending normal aio reads: [0, 0, 0, 0] , aio writes: [6, 10, 2, 4] ,
```

Disco

- Leitura
 - mysqladmin
 - Innodb_data_read
 - Innodb_buffer_pool_reads
 - Innodb_buffer_pool_pages_data, _dirty, _free
 - Innodb_data_pending_reads
 - Handler_read_*
 - Handler_read_rnd_next
 - Created_tmp_tables
 - SHOW PROCESSLIST
 - Slow Query Log

Slow Query Log

- Auditoria de query
 - `slow_query_log=1`
 - `long_query_time=0`
 - Percona Server for MySQL
 - `log_slow_rate_limit`
 - `log_slow_rate_type` (session, query)
 - `slow_query_log_use_global_control`
- Relatório
 - `pt-query-digest`

Relatório (pt-query-digest)

```
# 1.8s user time, 20ms system time, 63.80M rss, 390.15G vsz
# Current date: Fri Dec 1 19:21:14 2023
# Hostname: LEONARDOs-MacBook-Pro.local
# Files: slow_13_April.txt
# Overall: 1.54k total, 57 unique, 0.01 QPS, 0.36x concurrency
# Time range: 2023-04-11T00:06:21 to 2023-04-13T12:25:33
# Attribute          total          min          max          avg          95%      stddev      median
# =====
# Exec time          78204s          10s       30837s          51s          63s          788s          17s
# Lock time           2s           19us        189ms          1ms          1ms           8ms          761us
# Rows sent          16.44M           0        3.25M       10.95k       223.14     166.68k           0
# Rows examine        5.07G          179        1.51G        3.38M          9.30M       39.23M      345.04k
# Rows affecte        6.73M           0        1.95M        4.49k       719.66      84.09k       381.65
# Bytes sent          1.02G           0       293.74M      693.62k       38.40k       12.61M           0
# Query size          26.81M          29        2.15M       17.86k       18.47k       92.35k       18.47k
```

Relatório (pt-query-digest)

# Profile							
#	Rank	Query ID	Response time		Calls	R/Call	V/M Item
#	====	=====	=====		=====	=====	=====
#	1	0x61FC30FD48BDB2BD	30974.8336	39.6%	2	15487.4168	30... SELECT UNION tb1 tb2 tb3
#	2	0xBA73B33390C045C8	26380.0881	33.7%	1024	25.7618	17.94 INSERT SELECT table4
#	3	0xD5EFE2CCEF8B7E1E	2746.2674	3.5%	3	915.4225	79... SELECT [redacted]
#	4	0xB7B1F398523D42C9	1934.9007	2.5%	74	26.1473	7.23 SELECT UNION [redacted]
#	5	0xD803B305A2A92E25	1882.2888	2.4%	108	17.4286	4.09 SELECT [redacted]
#	6	0x5B06045903FB685B	1653.3620	2.1%	52	31.7954	2.24 SELECT [redacted]
#	7	0x361D39E89A10AEAD	1570.7166	2.0%	3	523.5722	10... CALL `function`
[...]							

Relatório (pt-query-digest)

```
# Query 1: 0.00 QPS, 0.26x concurrency, ID 0x61FC30FD48BDB2BD at byte 26217073
# This item is included in the report because it matches --limit.
# Scores: V/M = 30425.85
# Time range: 2023-04-11T21:12:17 to 2023-04-13T05:43:57
# Attribute      pct      total      min      max      avg      95%      stddev      median
# =====
# Count          0         2
# Exec time      39    30975s    138s    30837s    15487s    30837s    21708s    15487s
# Lock time      0         4ms      1ms      3ms      2ms      3ms      980us      2ms
# Rows sent      0    10.61k    5.20k    5.41k    5.31k    5.41k    152.03    5.31k
# Rows examine   29    1.52G    12.35M    1.51G    777.92M    1.51G    1.06G    777.92M
# Rows affecte   0         0         0         0         0         0         0         0
# Bytes sent     0    1.00M    501.92k    523.32k    512.62k    523.32k    15.13k    512.62k
# Query size     0    6.18k    3.09k    3.09k    3.09k    3.09k         0    3.09k
[...]
# Tables
#     SHOW TABLE STATUS FROM `database1` LIKE 'table1'\G
#     SHOW CREATE TABLE `database1`.`table1`\G
[...]
<redacted query>
```

Memória

- Configuração básica
 - Innodb_buffer_pool_size
 - Tabelas temporárias:
 - max_heap_size
 - max_tmp_table_size
 - internal_tmp_mem_storage_engine
 - temptable_max_ram
 - temptable_max_mmap
 - temptable_use_mmap
- Instrumentação de memória do Performance Schema
- Valgrind*

Performance Schema

- Dinâmico

```
UPDATE performance_schema.setup_instruments SET ENABLED = 'YES' WHERE  
NAME LIKE 'memory/%';
```

- Restart

```
[mysqld]
```

```
performance-schema-instrument='memory/%=ON'
```


Instrumentação de memória – Performance Schema

```
SELECT * FROM sys.memory_global_by_current_bytes;  
SELECT * FROM sys.memory_by_host_by_current_bytes;  
SELECT * FROM sys.memory_by_thread_by_current_bytes;  
SELECT * FROM sys.memory_by_user_by_current_bytes;  
SELECT * FROM performance_schema.memory_summary_global_by_event_name;
```

Instrumentação de memória – Performance Schema

```
mysql> select event_name, CURRENT_NUMBER_OF_BYTES_USED from
performance_schema.memory_summary_global_by_event_name order by CURRENT_NUMBER_OF_BYTES_USED desc limit
10;
```

event_name	CURRENT_NUMBER_OF_BYTES_USED
memory/innodb/ buf_buf_pool	123884044288
memory/innodb/hash0hash	3301798144
memory/innodb/buf0buf	978383808
memory/sql/THD::main_mem_root	415611096
memory/sql/TABLE	94581184
memory/innodb/ memory	84150712
memory/performance_schema/events_errors_summary_by_host_by_error	43767808
memory/performance_schema/events_errors_summary_by_account_by_error	43767808
memory/performance_schema/events_statements_summary_by_digest	41600000
memory/performance_schema/table_handles	38010880

Redes

- **mysqladmin + Processlist**
 - Bytes_received
 - Queries grandes (DML com Large Objects)
 - Bytes_sent
 - Queries retornando muitos dados
 - Queries retornando Large Objects
 - mysqldump
 - clone



Próximos passos

Como continuar se não encontrar saturação?

- MySQL error log
- innodb_thread_concurrency
- SHOW ENGINE INNODB STATUS (SEIS)
 - Locks
 - Mutexes
 - History List Length
 - Transações de longa duração
 - Pending I/O operations

SEIS – Mutexes

SEMAPHORES

OS WAIT ARRAY INFO: reservation count 74141362449

--Thread 139618702718720 has waited at **btr0sea.ic** line 128 **for 0.00 seconds** the semaphore:

S-lock on RW-latch at 0x5583cc0cfea8 created in file btr0sea.cc line 230

number of readers 6, waiters flag 0, lock_word: 1fffffff

Last time read locked in file btr0sea.ic line 128

Last time write locked in file

/mnt/workspace/percona-xtradb-cluster-5.7-debian-binary/label_exp/min-bionic-x64/percona-xtradb
-cluster-5.7-5.7.26-31.37/storage/innobase/include/btr0sea.ic line 90

[...]

--Thread 139795325380160 has waited at **ha_innodb.cc** line 19920 for **4 seconds** the semaphore:

Mutex at 0x56415cba0e60, Mutex RW_LOCK_LIST created sync0debug.cc:1674, **locked by**

139772063462976

SEIS – Transactions

```
-----  
TRANSACTIONS  
-----
```

```
[...]
```

History list length 151

LIST OF TRANSACTIONS FOR EACH SESSION:

```
[...]
```

---TRANSACTION 4418712625, **ACTIVE 18 sec starting index read**

mysql tables in use 3, locked 3

LOCK WAIT 2 lock struct(s), heap size 1128, 1 row lock(s)

MySQL thread id 70729626, OS thread handle 140637547157248, query id 7996430202

<ip> <database> updating

UPDATE [redacted]

----- **TRX HAS BEEN WAITING 18 SEC FOR THIS LOCK TO BE GRANTED:**

RECORD LOCKS space id 30714 page no 42997 n bits 128 index PRIMARY of table

`<database>`.`<table>` trx id 4418712625 **lock_mode X locks rec but not gap waiting**

Record lock, heap no 19 PHYSICAL RECORD: n_fields 53; compact format; info bits 0

Visão Macro – mysqladmin

- Threads_connected, Threads_running
- Innodb_buffer_pool_reads
- Innodb_data_read
- Handler_read_*
- Innodb_data_written
- Innodb_*.pending*
- Binlog_cache_disk_use

Acesso à arquivos

- Table_open_cache_hits, _misses
 - table_open_cache
- Open_files, _tables, Opened_files, _tables
 - open_files_limit
- Innodb_num_open_files
 - innodb_open_files
- Open_table_definitions, Opened_table_definitions
 - table_definition_cache

Caso exemplo

Opened_tables	1038776101	13310	13812	13228	13356	14060	13468
Table_open_cache_misses	938174187	12718	2417	12135	12767	12222	13479

Original:

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
128838	mysql	20	0	166.9g	131.1g	39524	S	1057	8.7	11457:29	mysqld
128838	mysql	20	0	166.9g	131.2g	39540	S	947.9	8.7	11457:58	mysqld
128838	mysql	20	0	166.9g	131.1g	39540	S	913.5	8.7	11458:27	mysqld

Depois de ajustar open_files_limit, innodb_open_files e table_open_cache:

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
3863380	mysql	20	0	160.4g	126.9g	38952	S	100.0	8.4	6631:06	mysqld
3863380	mysql	20	0	160.4g	126.9g	38952	S	191.9	8.4	6631:12	mysqld
3863380	mysql	20	0	160.4g	126.9g	38952	S	191.0	8.4	6631:18	mysqld

Se tudo mais falhar

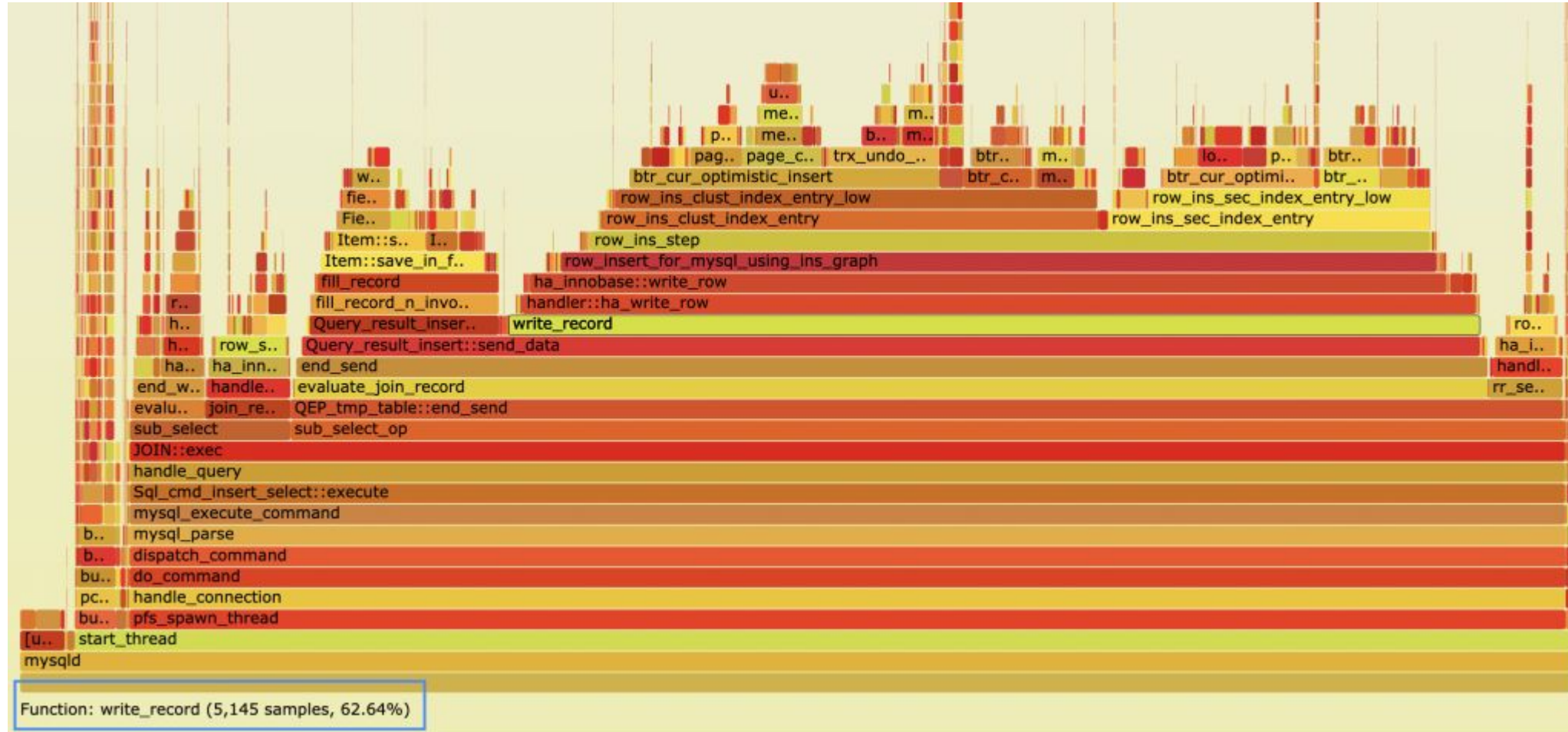
- Perf + Flamegraph
 - <https://github.com/brendangregg/FlameGraph>

```
shell > sudo perf record -a -F 99 -g -p $(pgrep -x mysqld) -- sleep 10
```

```
shell > sudo perf script > perf.script
```

```
shell > ~/src/FlameGraph/stackcollapse-perf.pl perf.script |  
~/src/FlameGraph/flamegraph.pl > flamegraph.svg
```

Se tudo mais falhar



Lentidão vs. não responsivo

- Bugs!
 - pt-pmp
 - Somente o stack trace de cada thread
 - Necessário gdb e debug symbols
 - Core dump
 - gcore

Pt-pmp

```
shell > pt-pmp --pid $(pgrep -x mysqld) --save-samples pt-pmp.log
```

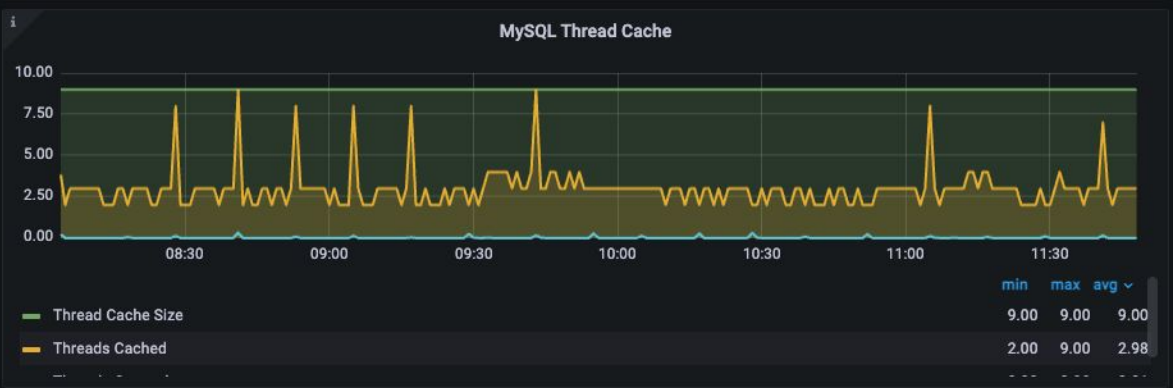
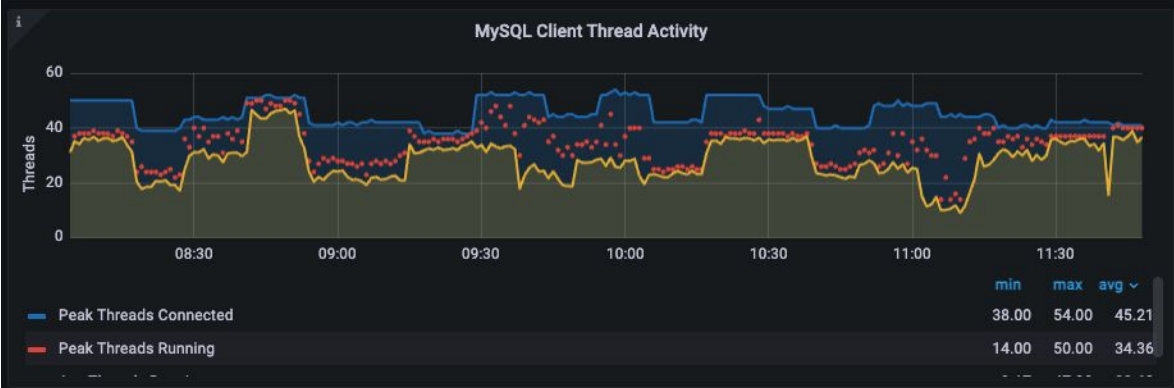
```
17260 __lll_lock_wait(libpthread.so.0),_L_lock_1093(libpthread.so.0),pthread_mutex_lock(libpthread
e.so.0),THD::init,THD::THD,Channel_info::create_thd,Channel_info_tcpip_socket::create_thd,handle_conn
tion,pfs_spawn_thread,start_thread(libpthread.so.0),clone(libc.so.6)
```

```
1175 __lll_lock_wait(libpthread.so.0),_L_lock_1093(libpthread.so.0),pthread_mutex_lock[...]
[...]
```

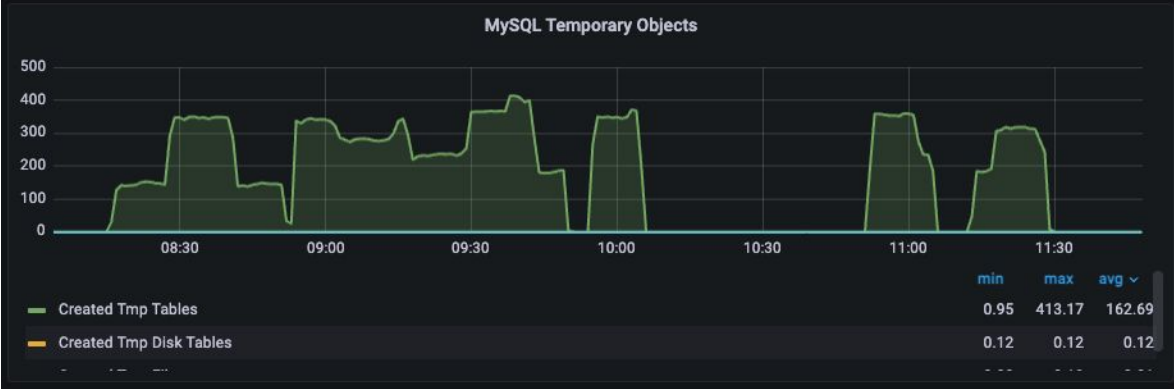
```
1 __lll_lock_wait(libpthread.so.0),_L_lock_1093(libpthread.so.0),pthread_mutex_lock(libpthread
.so.0),System_variable::init,PFS_system_variable_cache::do_materialize_session, table_variables_by_thr
ead::rnd_next,ha_perfschema::rnd_next,handler::ha_rnd_next,filesort,QEP_TAB::sort_table,join_init_rea
d_record,sub_select,JOIN::exec,handle_query,execute_sqlcom_select,mysql_execute_command,mysql_parse,
dispatch_command,do_command,handle_connection,pfs_spawn_thread,start_thread(libpthread.so.0),clone(li
c.so.6)
```

```
1 __lll_lock_wait(libpthread.so.0),_L_lock_1093(libpthread.so.0),pthread_mutex_lock(libpthread
mso.0),cleanup_variables,plugin_thdvar_init,THD::init,THD::cleanup_connection,dispatch_command,do_co
mand,handle_connection,pfs_spawn_thread,start_thread(libpthread.so.0),clone(libc.so.6)
```

PMM



Temporary Objects & Slow Queries



Links úteis

- <https://www.percona.com/software/database-tools/percona-monitoring-and-management>
- <https://pmmdemo.percona.com/graph/>
- <https://docs.percona.com/percona-server/8.0/slow-extended.html>
- <https://docs.percona.com/percona-toolkit/index.html>
- <https://www.percona.com/blog/profiling-software-using-perf-and-flame-graphs/>
- <https://www.percona.com/blog/inspecting-mysql-servers-part-1-the-percona-support-way/>
- <https://www.percona.com/blog/inspecting-mysql-servers-part-2-knowing-the-server/>
- <https://www.percona.com/blog/inspecting-mysql-servers-part-3-what-mysql/>
- <https://www.percona.com/blog/inspecting-mysql-servers-part-4-an-engine-in-motion/>
- <https://www.percona.com/blog/inspecting-mysql-servers-part-5-percona-monitoring-and-management/>



Perguntas?

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Obrigado!

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