MySQL

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MySQL 5.7 Performance: Scalability & Benchmarks

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Are you Dimitri?.. ;-)

- Yes, it's me :-)
- Hello from Paris! ;-)
- Passionated by Systems and Databases Performance
- Previous 15 years @Sun Benchmark Center
- Started working on MySQL Performance since v3.23
- But during all that time just for “fun” only ;-)
- Since 2011 “officially” @MySQL Performance full time now
- http://dimitrik.free.fr/blog / @dimitrik_fr

Agenda

- Overview of MySQL Performance
- Performance improvements in MySQL 5.7 & Benchmark results
- Pending issues..
- Q & A
- As well may be not exactly in the proposed order ;-)

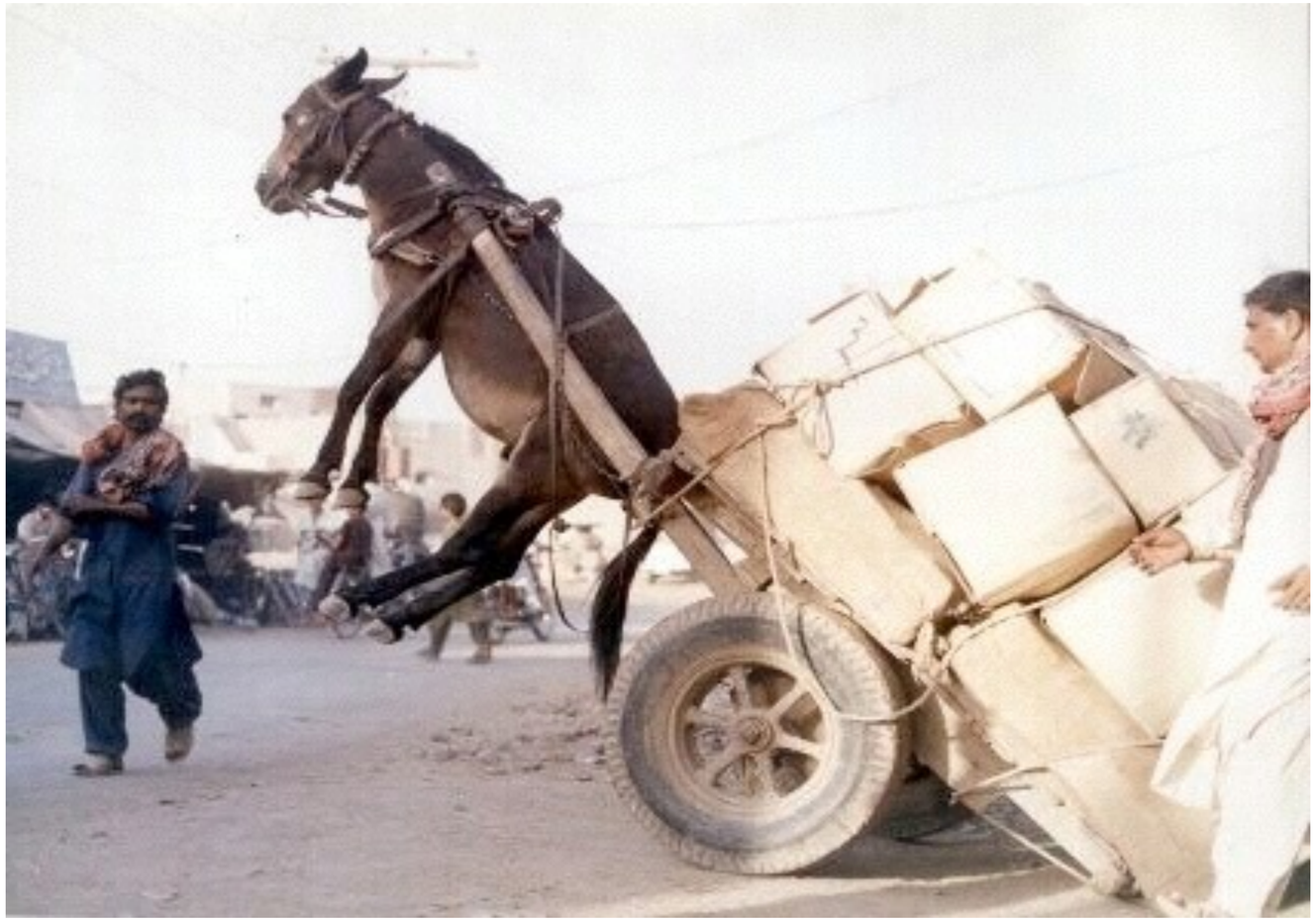
Why Benchmarking MySQL ?...

Why benchmarking MySQL?..

- Any solution may look “good enough”...

Why benchmarking MySQL?..

- Until it did not reach its limit..



Why benchmarking MySQL?..

- And even improved solution may not resist to increasing load..

Why benchmarking MySQL?..

- And reach a similar limit..

Why benchmarking MySQL?..

- A good benchmark testing may help you to understand ahead the resistance of your solution to incoming potential problems ;-)

Why benchmarking MySQL?..

- But keep it in mind:
  - Even a very powerful solution but leaved in wrong hands may still be easily broken!... :-)

The Main MySQL Performance Best Practice #1 is... ???..

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USE YOUR BRAIN !!!... ;-)

The Main MySQL Performance Best Practice #1 is... ???..

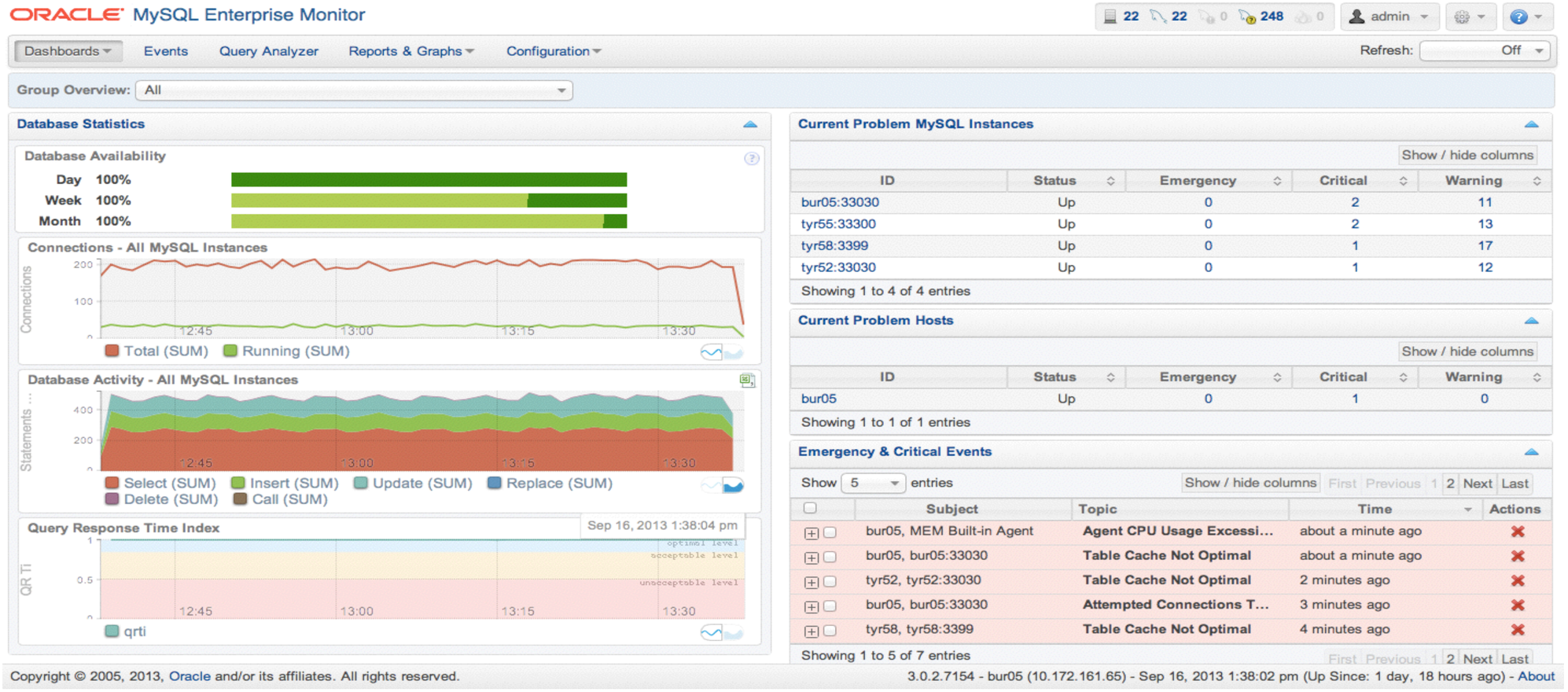
USE YOUR BRAIN !!!... ;-)

Monitoring is THE MUST !

even don’t start to test anything without monitoring.. ;-)

MySQL Enterprise Monitor

- Fantastic tool!
  - Did you already try it?.. Did you see it live?..



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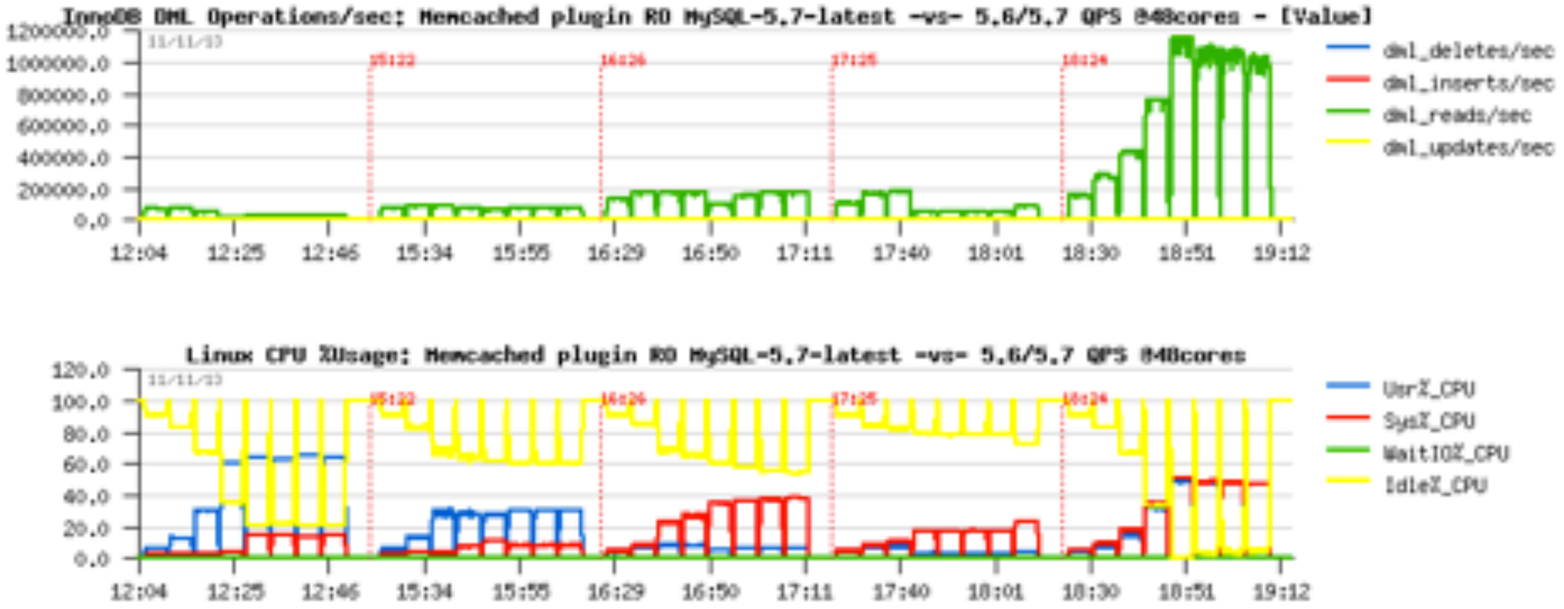
Other Monitoring Tools

- Cacti, Zabbix, Nagios, Solarwinds, etc…..
- *dim_STAT*
  - well, I'm using this one, sorry ;-)
  - all graphs within presentation were made with it
  - details are in the end of presentation..



A Word about Monitoring…

- **always** validate the impact of your Monitoring on your Production ;-)
- taking 1sec measurements is fine, except :
  - if it's eating 100% CPU time on one or more CPU cores..
  - reducing your network traffic / latency..
  - eats your RAM, etc.
- avoid to be too much intrusive on MySQL/InnoDB internals..
  - you may easily create an additional overhead
  - as well you may add artificial locks on your workflow
    - ex: in 5.6 run in loop "show processlist", etc..
- well, think about what you're doing (#1 best practice once again ;-))

Benchmarking & Tuning

- there is no Benchmarking without Tuning ;-)
- as there is no Tuning without Benchmarking ;-)
- depending on the MySQL version :
  - some things you “may tune”
  - some things you “may just accept” ;-)
  - (e.g. you need 5.6 to have binlog group commit, etc.)
- so, you need to have a clear idea about :
  - which situation you can always solve by tuning, so no worry..
  - which situation you may only avoid, so have to consider and take care about..
  - don’t be creating artificial limitations (e.g. if 32GB REDO is allowed - use it!)
  - be sure what is really important for you!

The following materials are about…

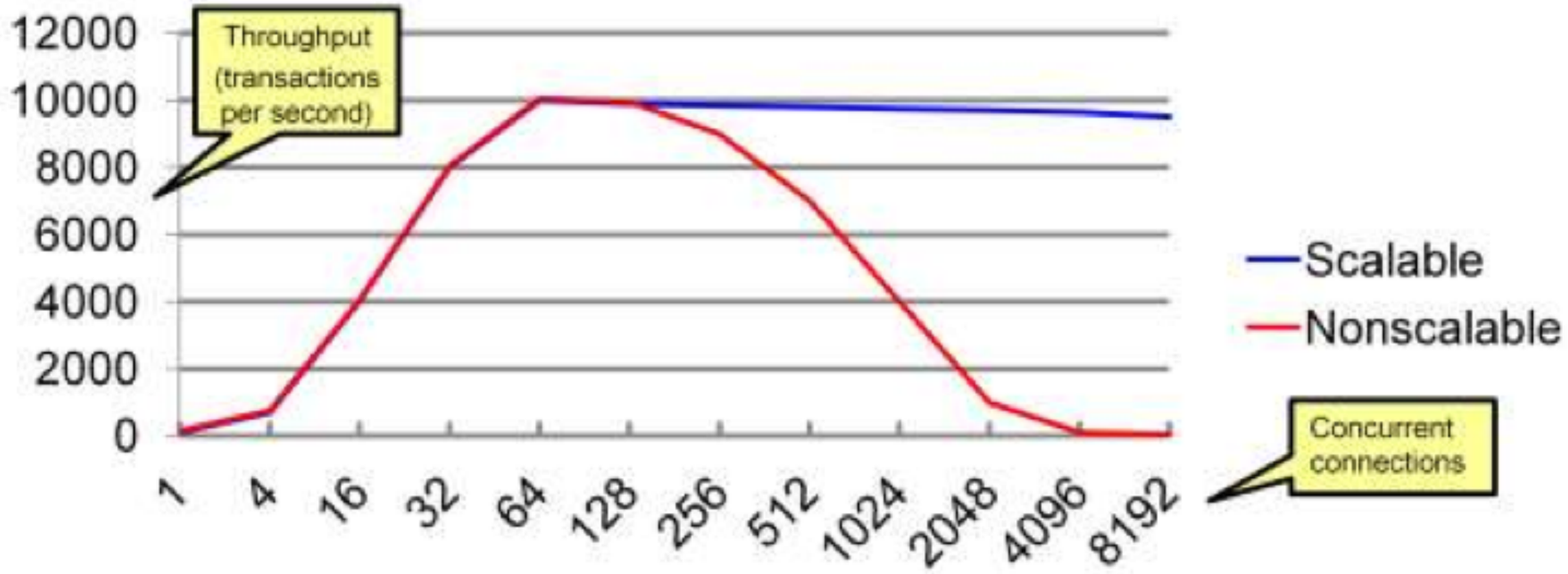
- Single MySQL Instance Performance & Scalability
  - single HW host
  - no replication
  - just to understand how far MySQL Server may scale..
  - what are the limits
  - what to care about ahead
  - which situations are absolutely to avoid..

Why Scalability ?..

- CPU Speed : no more "free lunches" ;-)
  - will x2 times faster CPU increase your performance by x2 ?..
- CPU cores : more and more over year-to-year..
  - Intel 2CPU : 8cores-HT
  - Intel 2CPU : 12cores-HT
  - Intel 2CPU : 16cores-HT
  - Intel 2CPU : 20cores-HT
  - Intel 2CPU : 36cores-HT (2015)
  - …
- Scalability In Few Words :
  - your software is able to deliver a **higher** throughput if more HW resources are available..
  - (then, scaling it well or not is another story ;-))

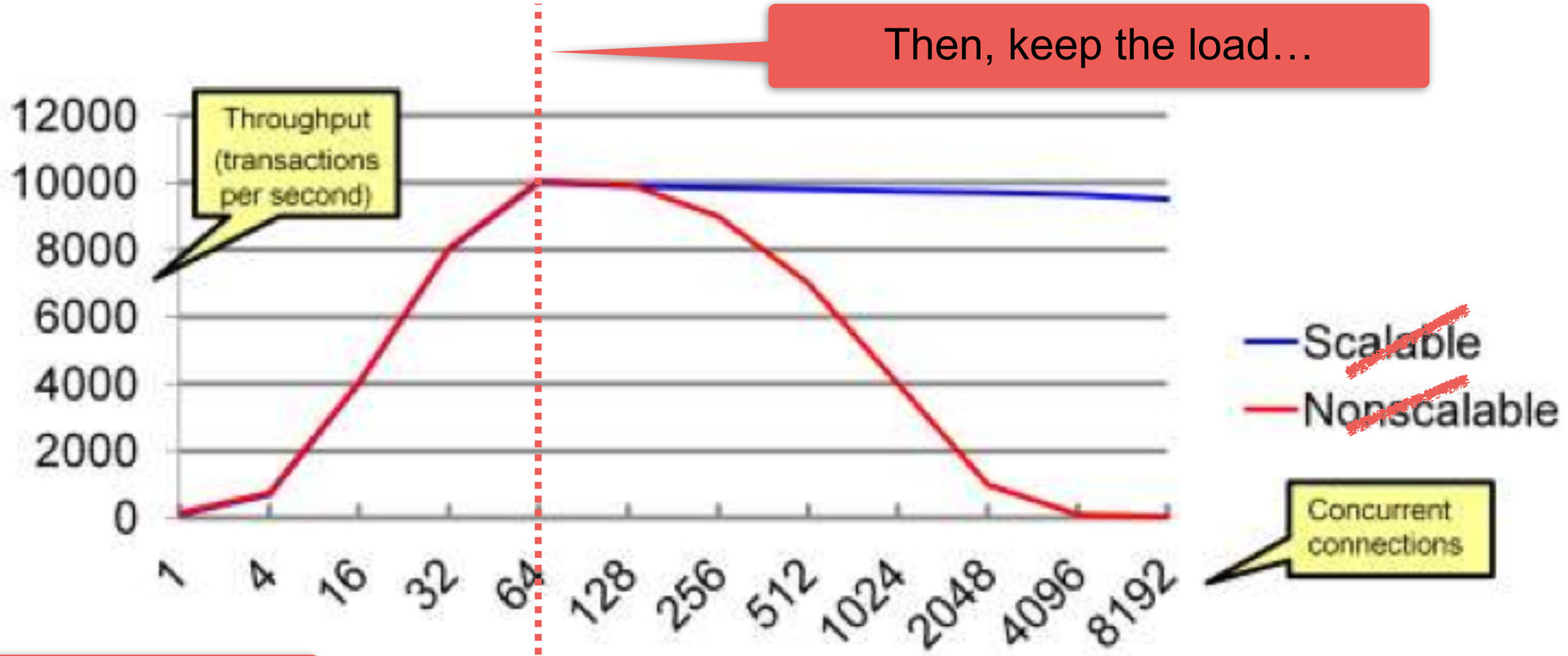
A B-shit Slide…

- Odd interpretation of Scalability…



A B-shit Slide… (2)

- Odd interpretation of Scalability…

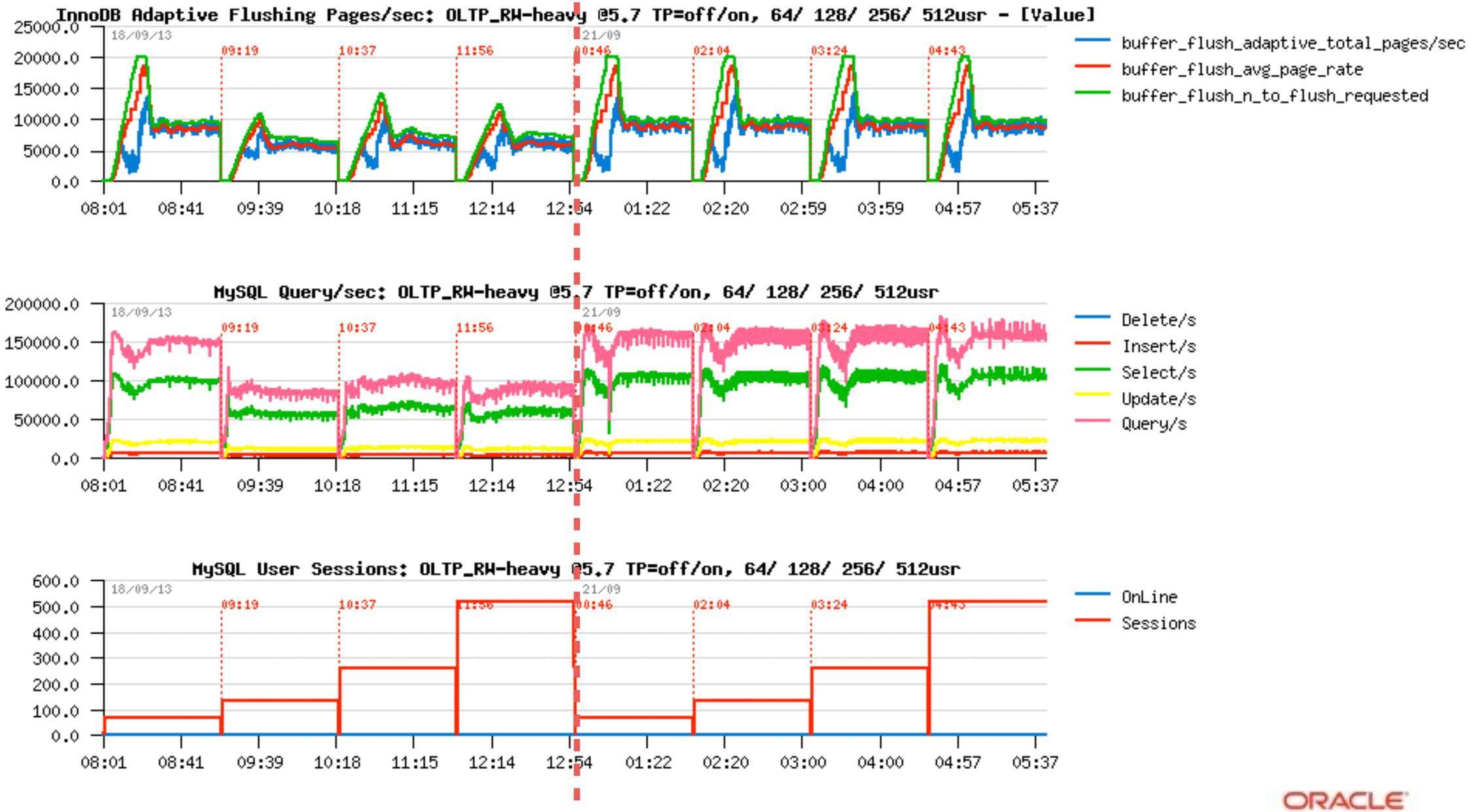


Both are scaling up to 64 connections,
but only one is able to keep a higher load..

MySQL on High Load

- Once you've reached your Max TPS on your system :
  - try to understand first what is limiting you? (I/O, CPU, Network, MySQL internals?)
  - the next goal then: to avoid a TPS "regression" on a higher load
- How to keep your Max TPS on a higher load too?
  - the dumb rule : avoid to have a higher load! ;-)
  - seriously :
    - usually all you need is to find a way to do not let you workload concurrency out-pass the levels your reaching on the TPS Max, that's all..
    - InnoDB thread concurrency helps here (yet more improved in MySQL 5.7)
    - InnoDB spin wait delay tuning helps to lower mutexes / rw-locks waits impact
    - ThreadPool
  - **NOTE : there is no "magic" for response time :**
    - if your Max TPS you're reaching on N users
    - and able to keep the same Max TPS on N x2 users (or x3, x4, etc.)
    - your response time may only grow! (and be x2 times bigger (or x3, or x4, etc.))

Thread Pool in old MySQL 5.7 @Heavy OLTP_RW

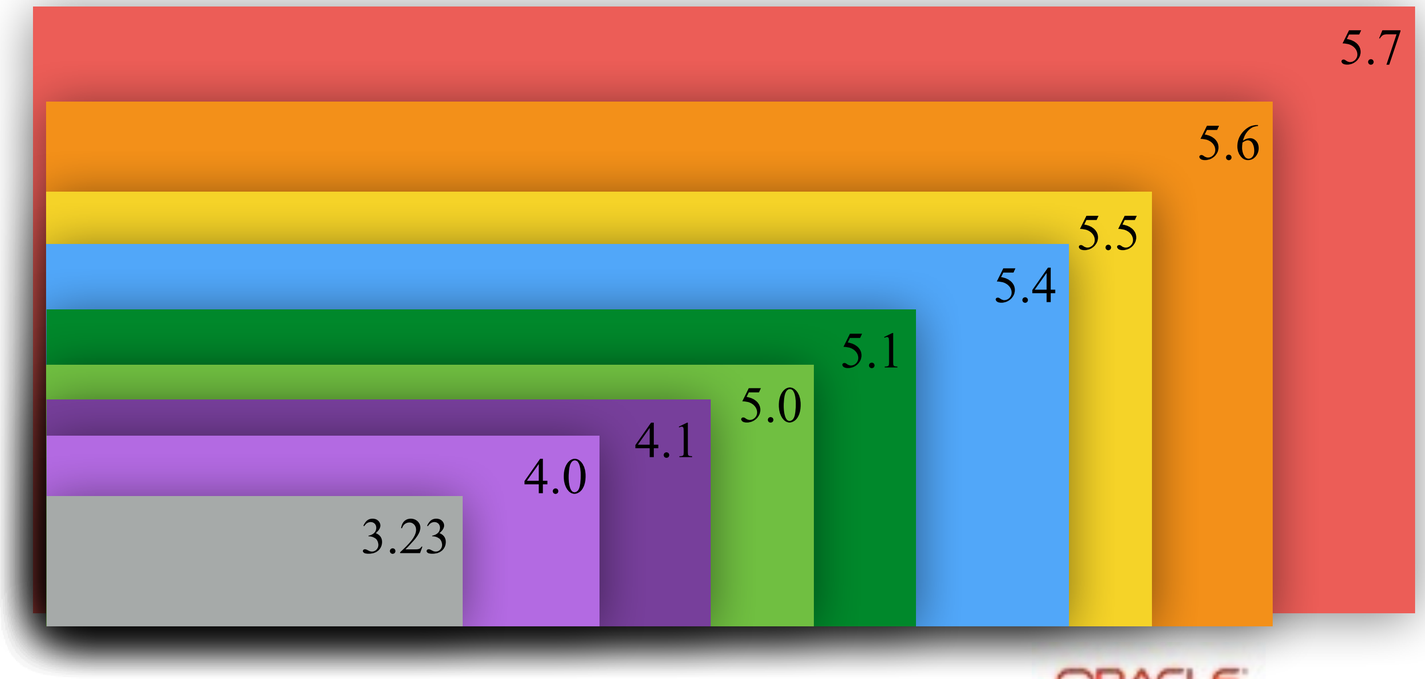


MySQL & CPU Usage

- CPU chips progress:
  - CPU = 1 CPU (1 vcpu)
  - CPU = N cores (N vcpu)
  - CPU = N cores, M core threads (NxP vcpu)
  - …
- How many **really** parallel tasks your CPU is able to execute??
  - as many as how many vcpu are **really** able to run in parallel!
  - **for ex. you have 32cores-HT :**
    - only 32 concurrent MySQL threads may be executed on the same time
    - is HT helping? - **yes**
    - is HT makes 32cores be equal to 64cores? - **no**
    - if my system is reporting to have CPU 50% busy on my MySQL workload, does it mean I have a 50% marge in CPU usage? — **NO!..** ;-)
    - my workload is pure CPU bound, I'm reaching N TPS on 64 users and I'm claiming I'm getting x5 higher (Nx5) TPS on 512 users! — well, you're lying somewhere ;-))

MySQL Performance Evolution

- From version-to-version :
  - 3.23 => 4.0 => 4.1 => 5.0 => 5.1 => 5.4 => 5.5 => 5.6 => 5.7 …
  - more features => longer code path.. (see: “What is new in MySQL 5.7” by Geir this AM)
  - MySQL/InnoDB code is very sensible to CPU cache(s)..
  - single user / low load => going slower..
- Looking back :
  - Drizzle !
  - do you know Drizzle ?
  - do you use Drizzle ?
  - do you run your production on ?



MySQL Performance Evolution

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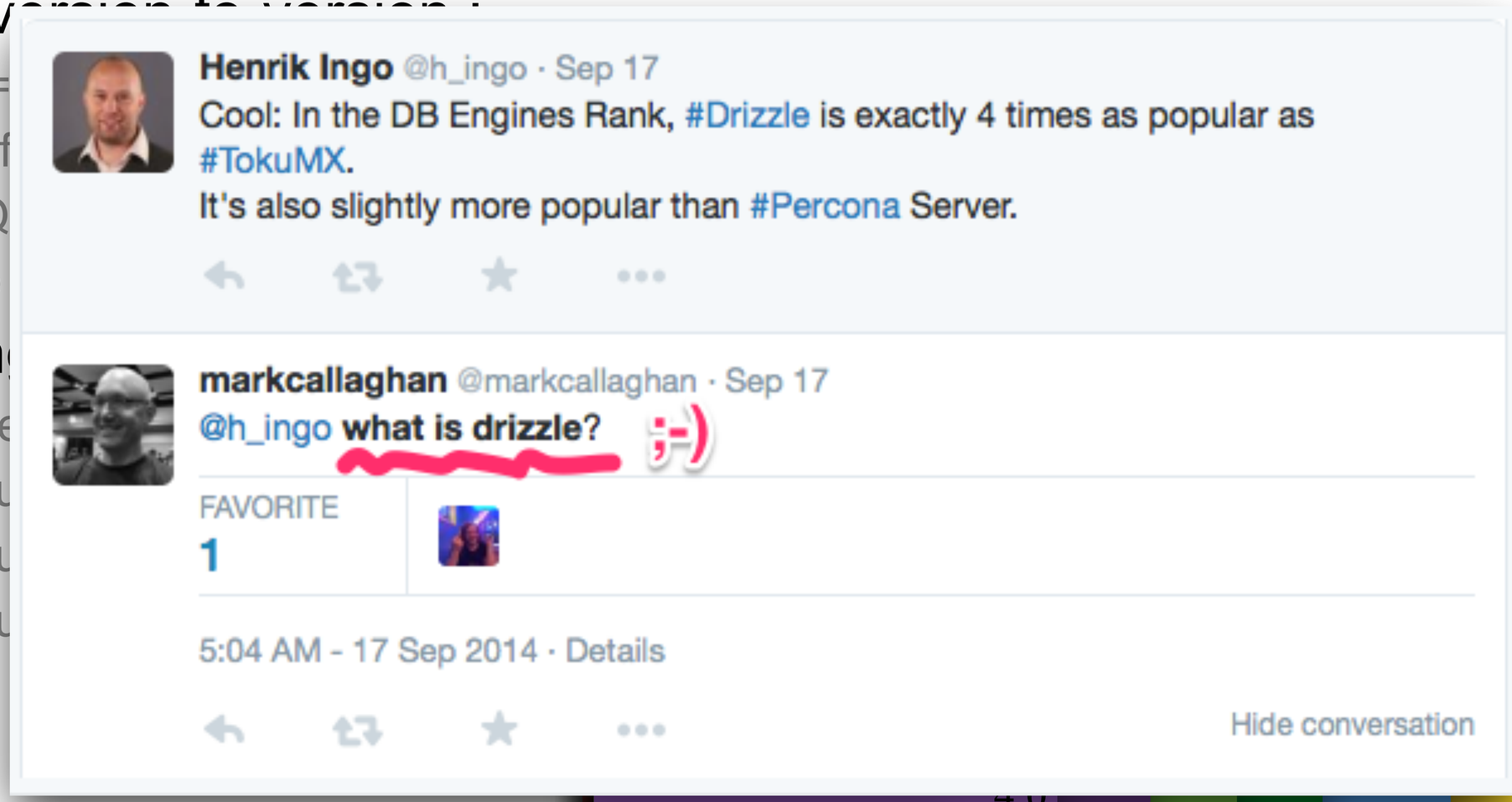


Performance Investigation Efforts (relative)

- report a problem..
- point on the source of the problem..
- suggest what should be fixed..
- suggest **how** it shoud be fixed…
- **implement** the final fix…

Test Workload

- Before to jump into something complex...
  - Be sure first you're comfortable with “basic” operations!
  - Single table? Many tables?
  - Short queries? Long queries?
- Remember: any complex load in fact is just a mix of simple operations..
  - So, try to split problems..
  - Start from as simple as possible..
  - And then increase complexity progressively..
- NB : **any** test case is important !!!
  - Consider the case rather reject it with “I’m sure you’re doing something wrong..” ;-))

“Generic” Test Workloads @MySQL

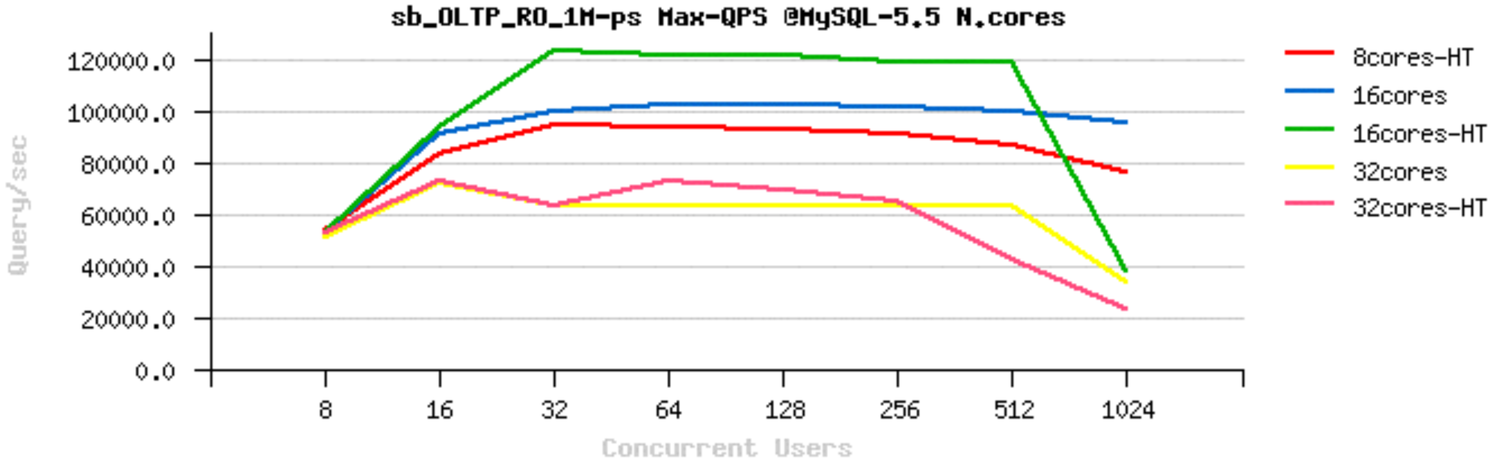
- Sysbench
  - OLTP, RO/RW, N-tables, lots test workload load options, deadlocks
- DBT2 / TPCC-like
  - OLTP, RW, very complex, growing db, no options, deadlocks
  - In fact using mostly only 2 tables! (thanks Performance Schema ;-))
- dbSTRESS
  - OLTP, RO/RW, several tables, one most hot, configurable, no deadlocks
- iiBench
  - pure INSERT (time series) + SELECT
- LinkBench (Facebook)
  - OLTP, RW, very intensive, IO-hungry..
- DBT3
  - DWH, RO, complex heavy query, loved by Optimizer Team ;-)

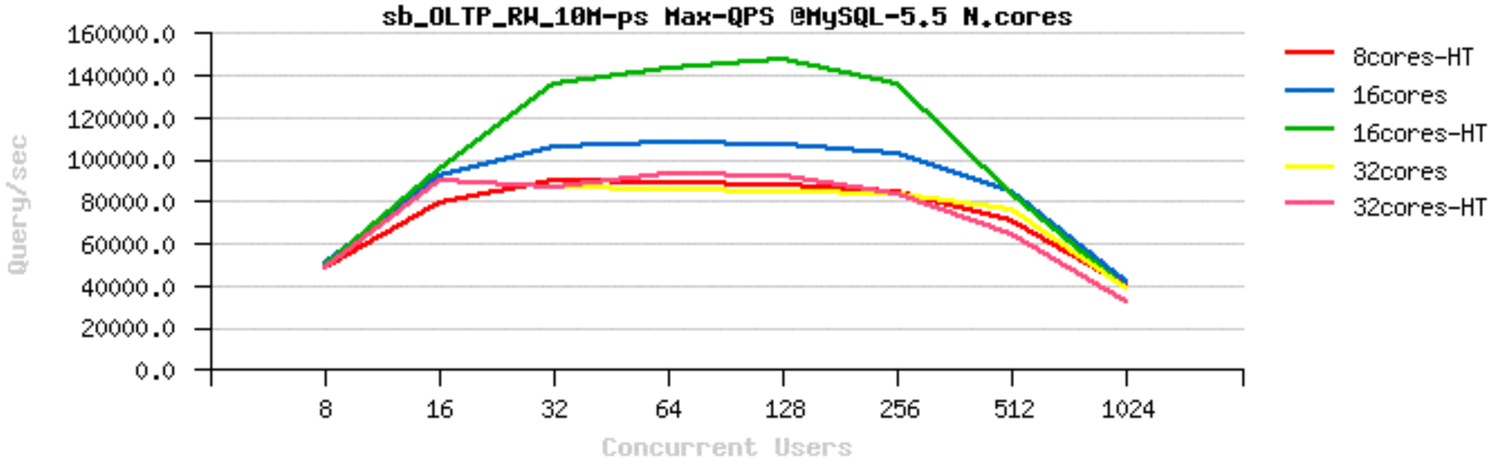
Analyzing Workloads: RO -vs- RW

- Read-Only (RO) :
  - Nothing more simple when comparing DB Engines, HW configs, etc..
  - RO In-Memory : data set fit in memory / BP / cache
  - RO IO-bound : data set out-passing a given memory / BP / cache
- Read+Write (RW) :
  - I/O is **ALWAYS** present ! - storage performance matters a lot !
  - may be considered as always IO-bound ;-)
  - RW In-Memory : same as RO, data set fit in memory, but :
    - small data set => small writes
    - big dataset => big writes ;-)
  - RW IO-bound : data set out-passing a memory
    - means there will be (a lot of?) reads !
- NOTE : Random Read (RR) operation is the main IO-bound killer !!!

From where we're coming with MySQL 5.7 ?..

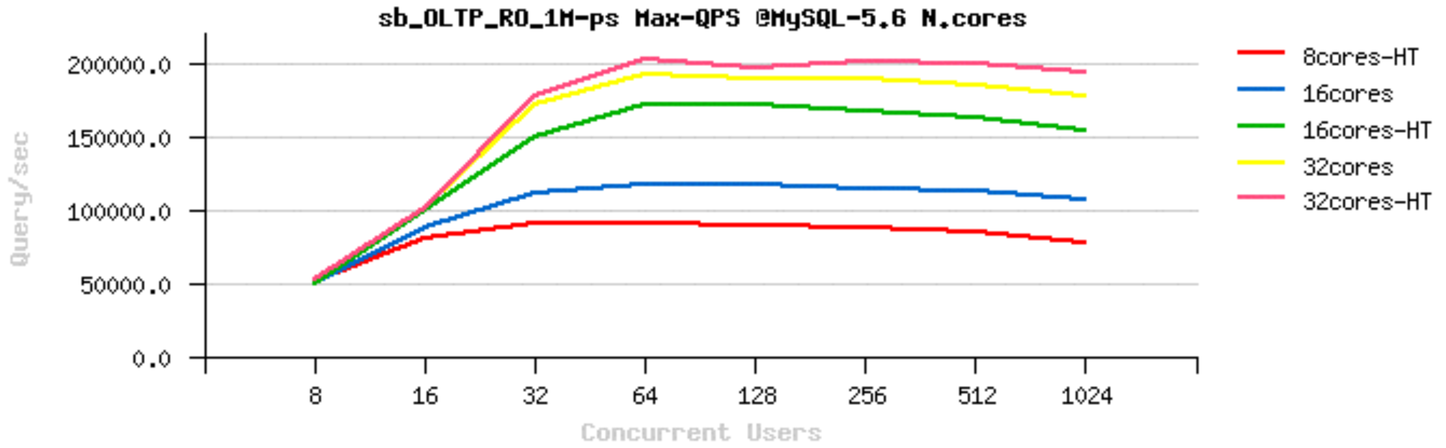
- MySQL 5.5 : RO & RW
  - QPS Max on 16cores
  - worse on 32cores
  - Note: RW out-pass RO!

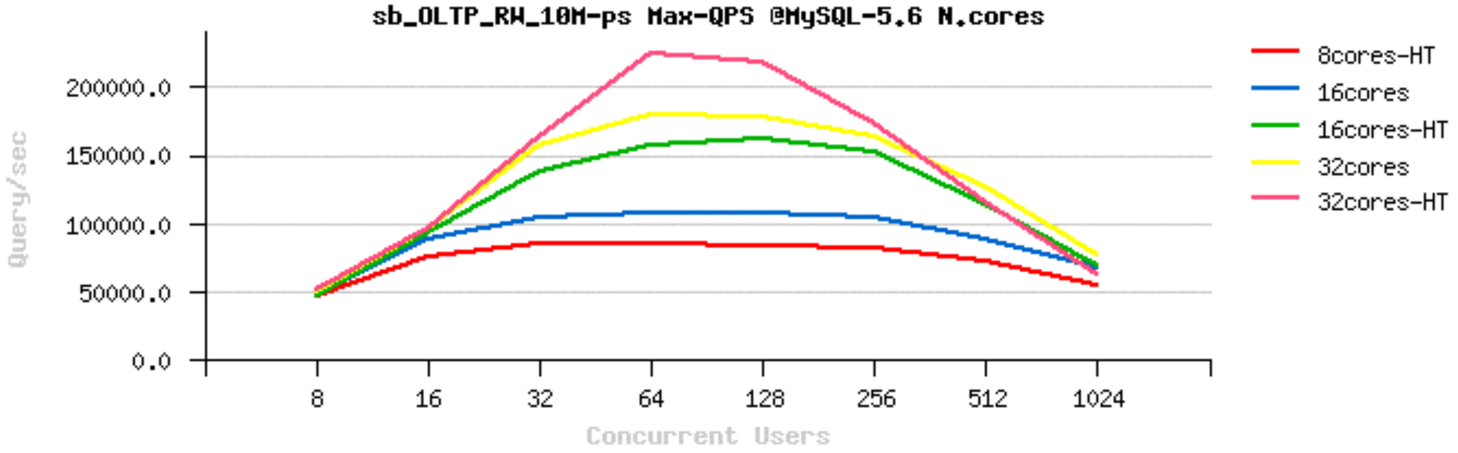




From where we're coming with MySQL 5.7 ?..

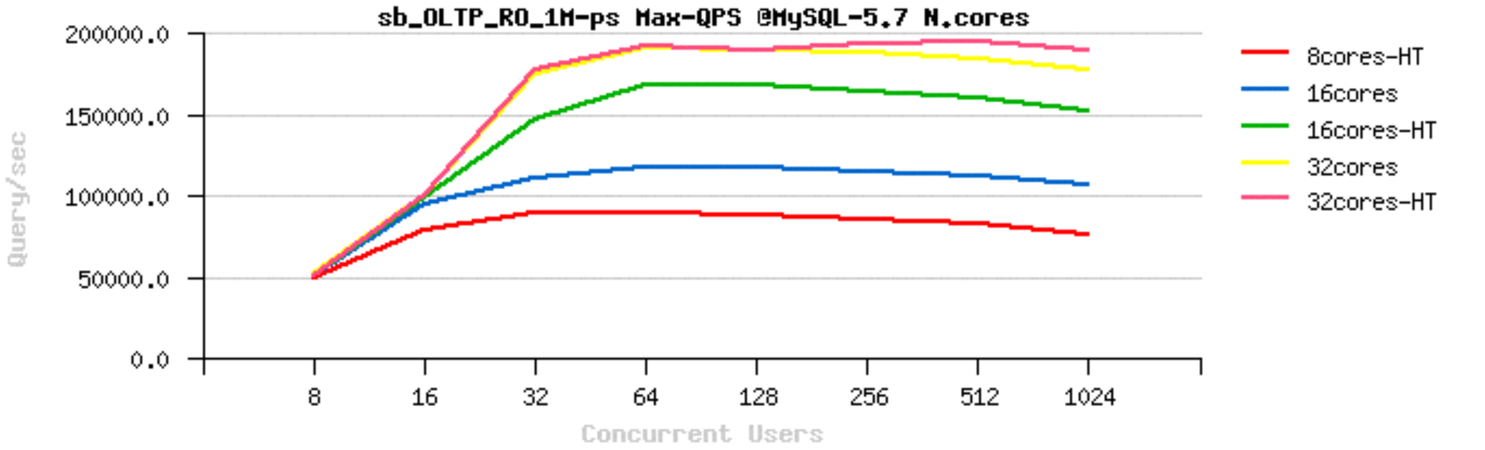
- MySQL 5.6 : RO & RW
  - not lower on 32cores!! ;-)
  - RW out-pass RO !!..??

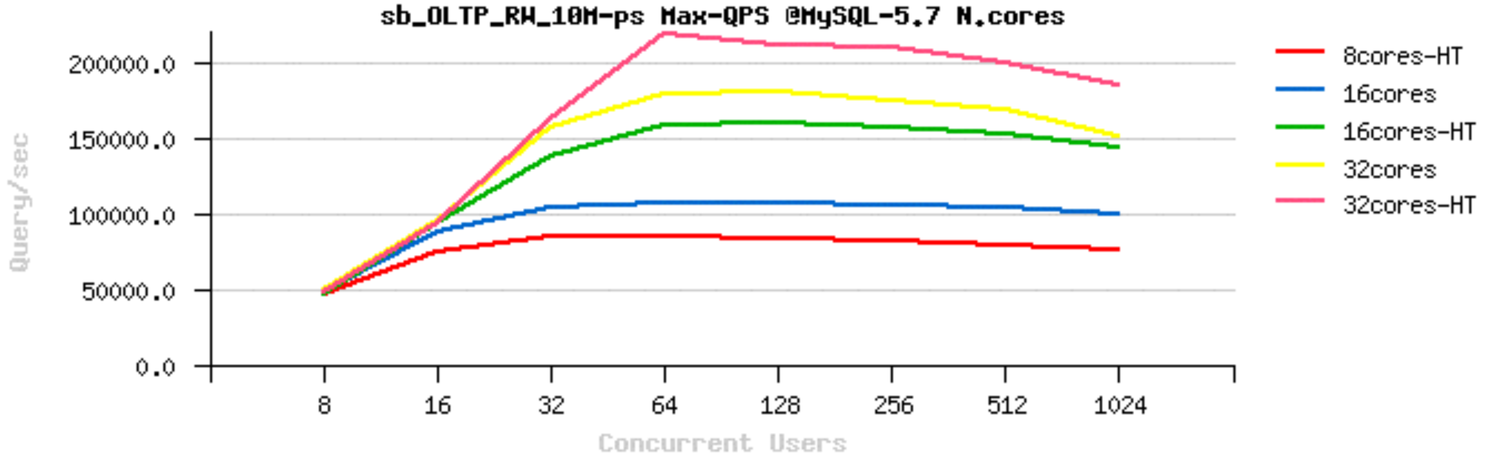




From where we're coming with MySQL 5.7 ?..

- MySQL 5.7.1 : RO & RW
  - more stable than 5.6
  - **RW** out-pass RO !!..





Read-Only Scalability @MySQL / InnoDB

- Depends on a workload..
  - sometimes the limit is only within your memcpy() rate ;-)
- But really started to scale only since MySQL 5.7
  - due improved TRX list management, MDL, THR_lock, etc..
  - scaling up to 64 CPU cores for sure, reported on more cores too..
  - Note : remind my “scalability” notes ;-))
  - Note : code path is growing with new features! (small HW may regress)
- IO-bound :
  - could be limited by storage (if you’re not using a fast flash)
  - or by internal contentions (InnoDB file_sys mutex)
- Limitations
  - there are still some limitations “by design” (block lock, file_sys, etc..)
  - all in TODO to be fixed, but some are needing a deep redesign

RO related starter configuration settings

- my.conf :

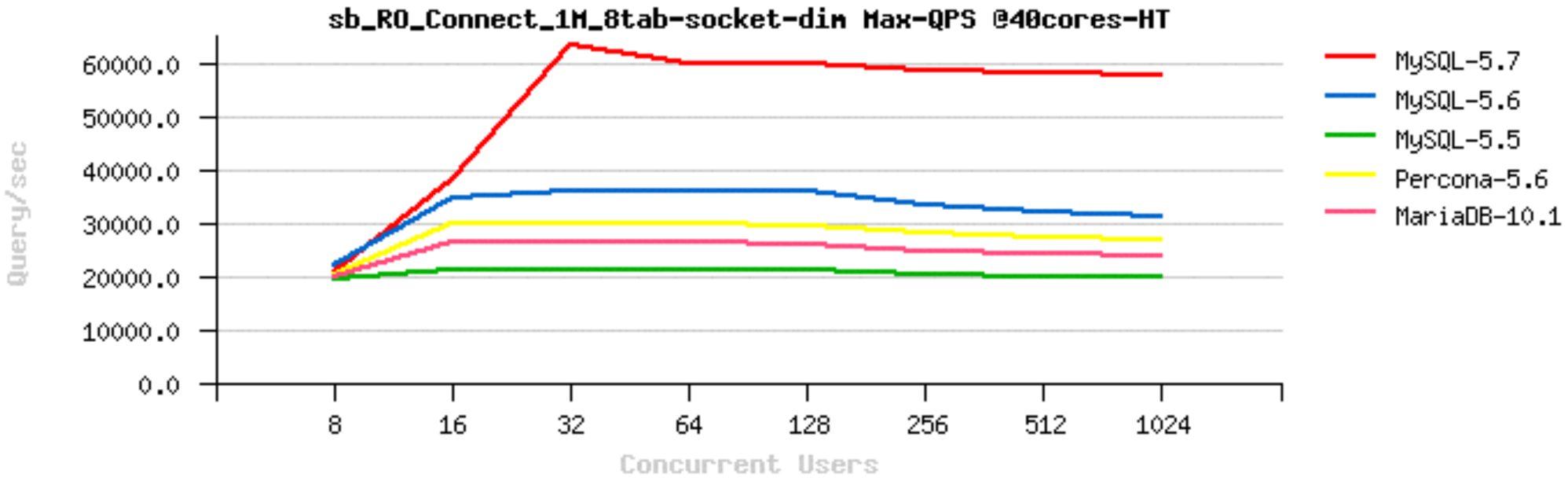
```
join_buffer_size=32K
sort_buffer_size=32K

table_open_cache = 8000
table_open_cache_instances = 16
query_cache_type = 0

innodb_buffer_pool_size= 64000M (2/3 RAM ?)
innodb_buffer_pool_instances = 32
innodb_thread_concurrency = 0 / 32 / 64
innodb_spin_wait_delay= 6 / 48 / 96

innodb_stats_persistent = 1
innodb_adaptive_hash_index= 0 / 1
innodb_monitor_enable = '%'
```

Sysbench OLTP_RO Workloads

- Available Test Workloads :
  - **Point-Select** : a row read by PK id (most aggressive workload, extremely fast queries)
  - **Simple-Ranges** : read N rows via PK range (hot on memcpy() and hash)
  - **Order-Ranges** : as Simple-Ranges, but ordered by non-indexed column (hot on the same)
  - **SUM-Ranges** : read SUM value from N rows in PK range (hot on the same)
  - **Distinct-Ranges** : as Order-Ranges, but DISTINCT values from non-indexed column (extremely hot on in-memory temp tables create/drop)..
  - **RO_Connect** : a single Point-Select with re-connect
- OLTP_RO :
  - composed of :
    - x10 Point-Selects
    - x1 Simple-Range, N=100
    - x1 Order-Range, N=100
    - x1 SUM-Range, N=100
    - x1 Distinct-Range, N=100

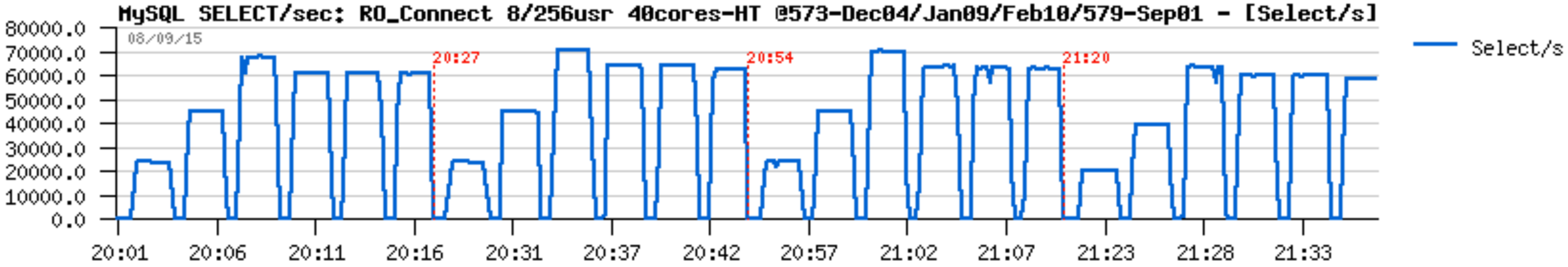
Entry Ticket : RO_Connect

- Many web apps cannot use persistent connections
  - connect => Query(s) => disconnect



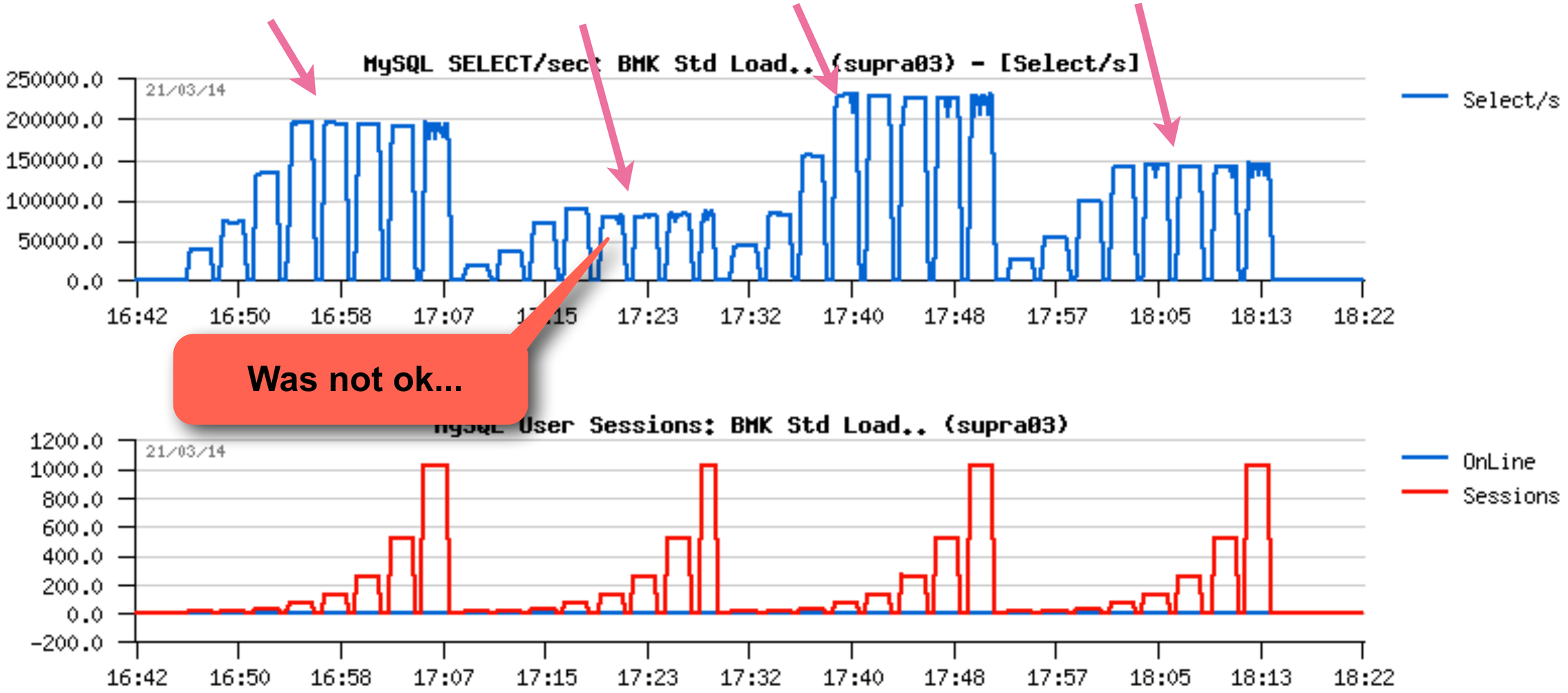
Entry Ticket : RO_Connect in 5.7

- Many web apps cannot use persistent connections
  - connect => Query(s) => disconnect
  - there was even 70K Connect/sec, but new features over 2 years..
  - on newer HW : over 100K Connect/sec
  - 5.8 expectations : to do much more than this ;-)



Sysbench OLTP_RO Workloads @MySQL 5.7 - Apr.2014

- Simple ranges, Distinct ranges, SUM ranges, Ordered ranges



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RO_Dranges : “kernel” contention

- Sysbench RO Distinct Ranges - Apr.2014
  - 40cores-HT server
- Profiler:

```
  80.52%  [kernel]                        [k] _spin_lock
   7.36%  [kernel]                        [k] native_write_msr_safe
   2.08%  [kernel]                        [k] smp_invalidate_interrupt
   0.82%
   0.76%
   0.69%
   0.53%
   ...
```

```
  73.13%   mysqld  [kernel.kallsyms]                                  [k] _spin_lock
           |
           --- _spin_lock
               |
               |--99.96%-- flush_tlb_others_ipi
               |           native_flush_tlb_others
               |           flush_tlb_mm
               |           zap_page_range
               |           sys_madvise
               |           system_call_fastpath
               |           madvise
               |           |
               |           |--2.73%-- 0x7f03db1e1818
             ...
```

But who is the killer ?...

RO_Dranges : “kernel” contention

- Sysbench RO Distinct Ranges - Apr.2014
  - 40cores-HT server
- And the killer is... - **jemalloc** !!! ;-)
  - Distinct Selects workload is extremely hot on malloc (HEAP)
    - in fact any SELECT involving HEAP temp tables will be in the same case..
    - ex: small results via group by, order by, etc..
  - jemalloc has a smart memory free stuff...
  - trigger OS via madvise()..
  - disabling this jemalloc feature resolving the problem ;-)

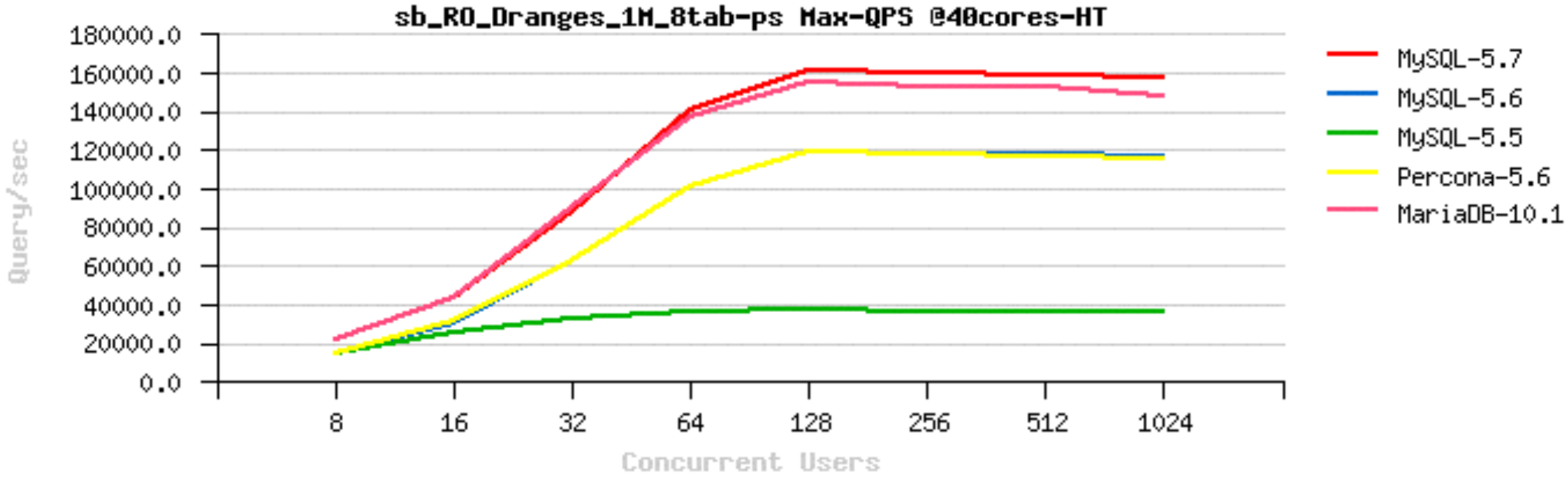
```
LD_PRELOAD=/apps/lib/libjemalloc.so  ; export LD_PRELOAD
MALLOC_CONF=lg_dirty_mult:-1         ; export MALLOC_CONF
```

RO_Dranges : “hot” hash

- Sysbench RO Distinct Ranges - 2015
  - 40cores-HT (32/12cores-HT as well)
  - my_hash_sort_simple() takes over 20% CPU time..
- A long story short :
  - on DISTINCT optimizer is doing INSERT into a Memory table with unique hash index
  - (same the processing of the GROUP BY as well)
  - however, Memory table (HEAP engine) is calling 4 times the my_hash_sort_simple() function per INSERT..
  - fixed in 5.7 : 20% more performance ;-)

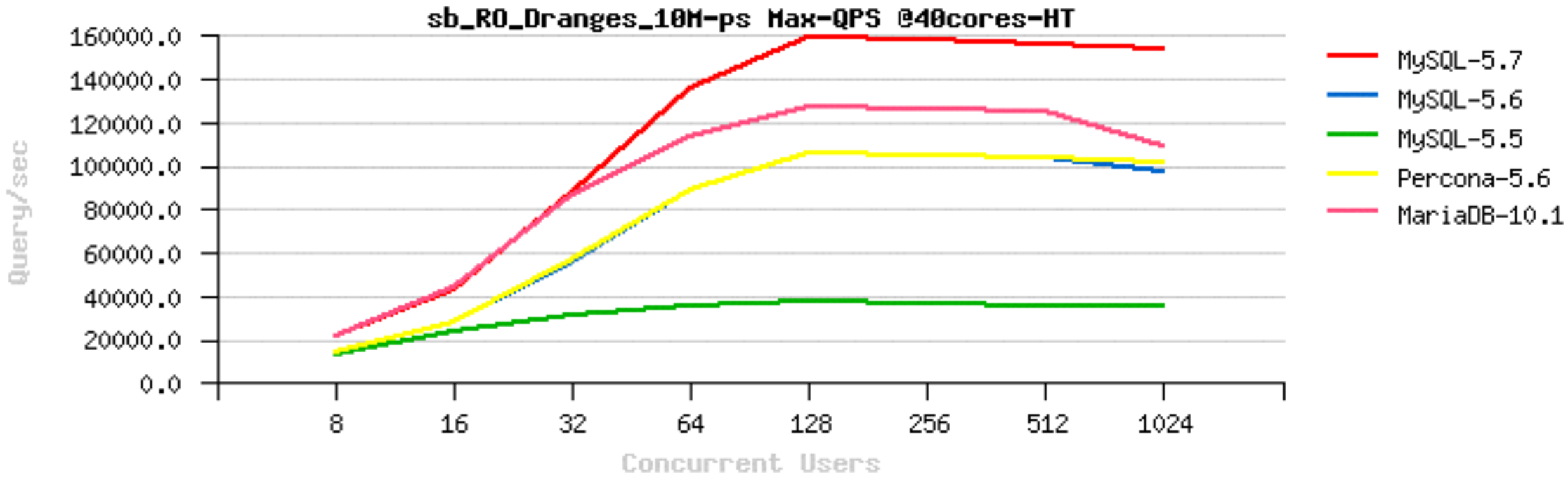
RO_Dranges : 8-tables

- Sysbench RO Distinct Ranges 1Mx8-tables - Sep.2015
  - 40cores-HT



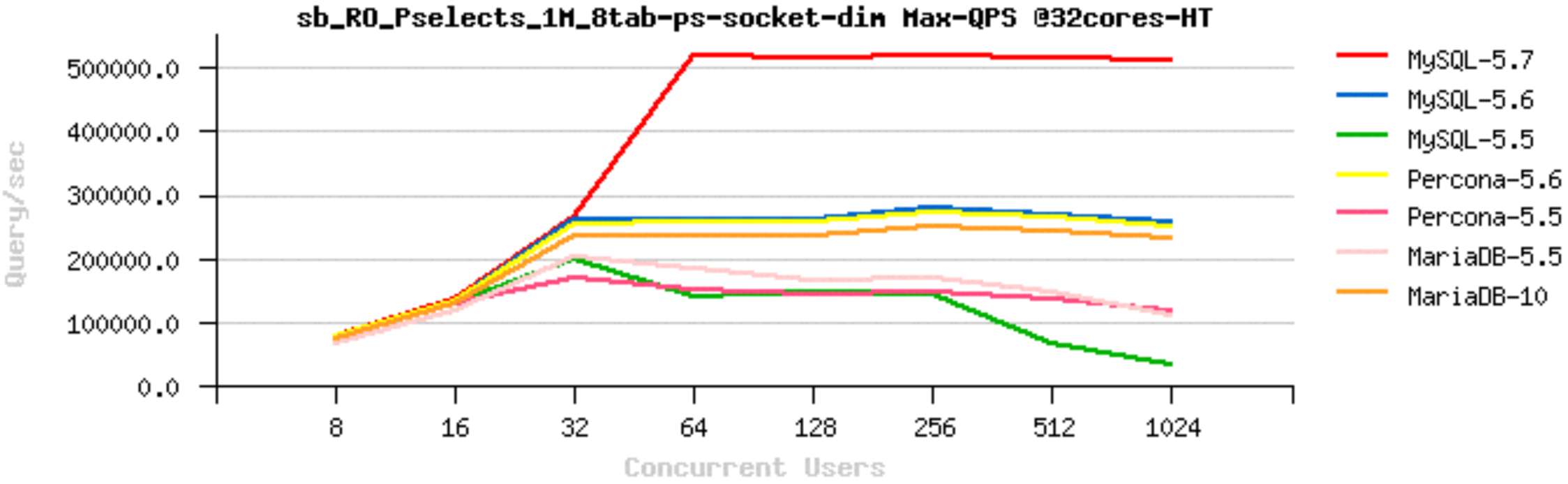
RO_Dranges : 1-table

- Sysbench RO Distinct Ranges 10M - Sep.2015
  - 40cores-HT



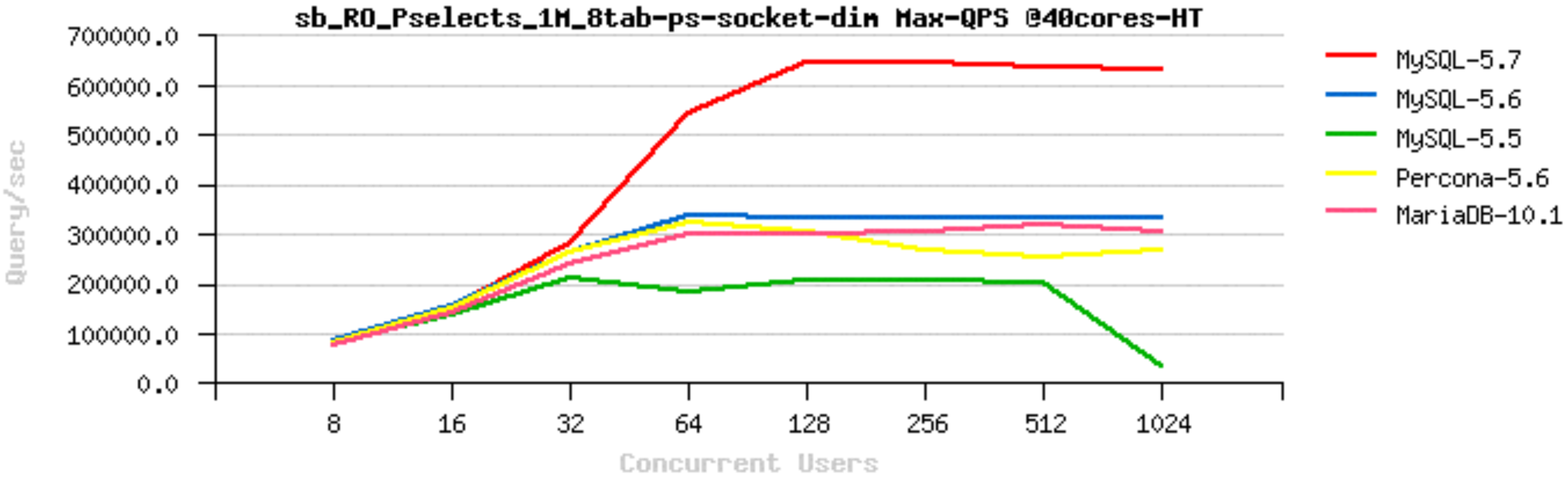
RO In-Memory @MySQL 5.7

- **500K QPS** Sysbench Point-Selects 8-tab, 32cores-HT :



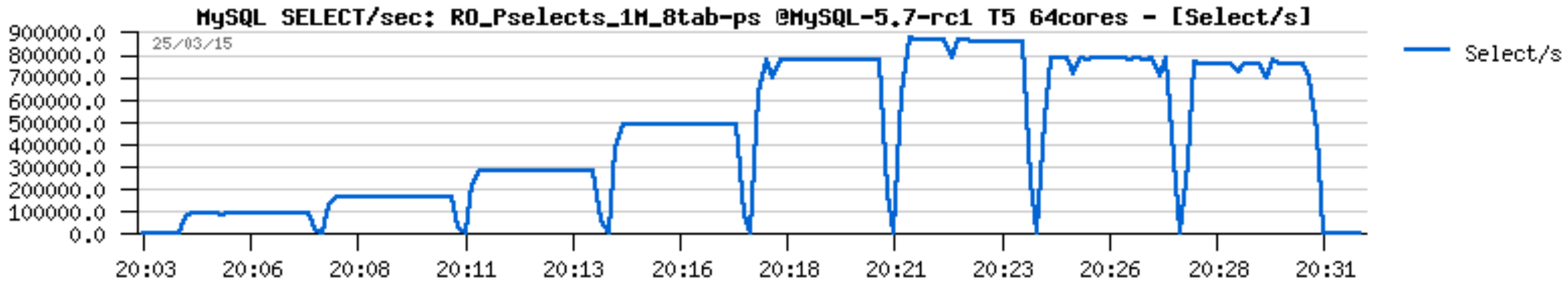
RO In-Memory @MySQL 5.7

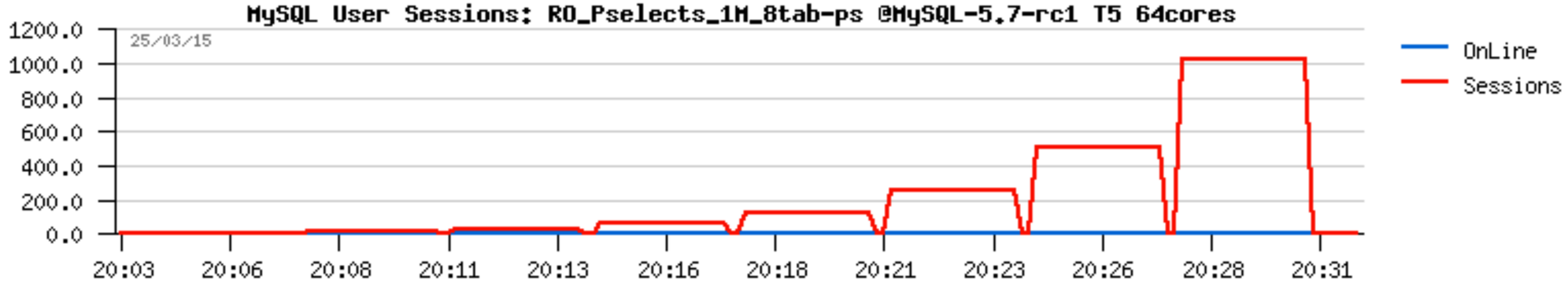
- **645K QPS** Sysbench Point-Selects 8-tab, 40cores-HT :



RO In-Memory @MySQL 5.7 - Apr.2015

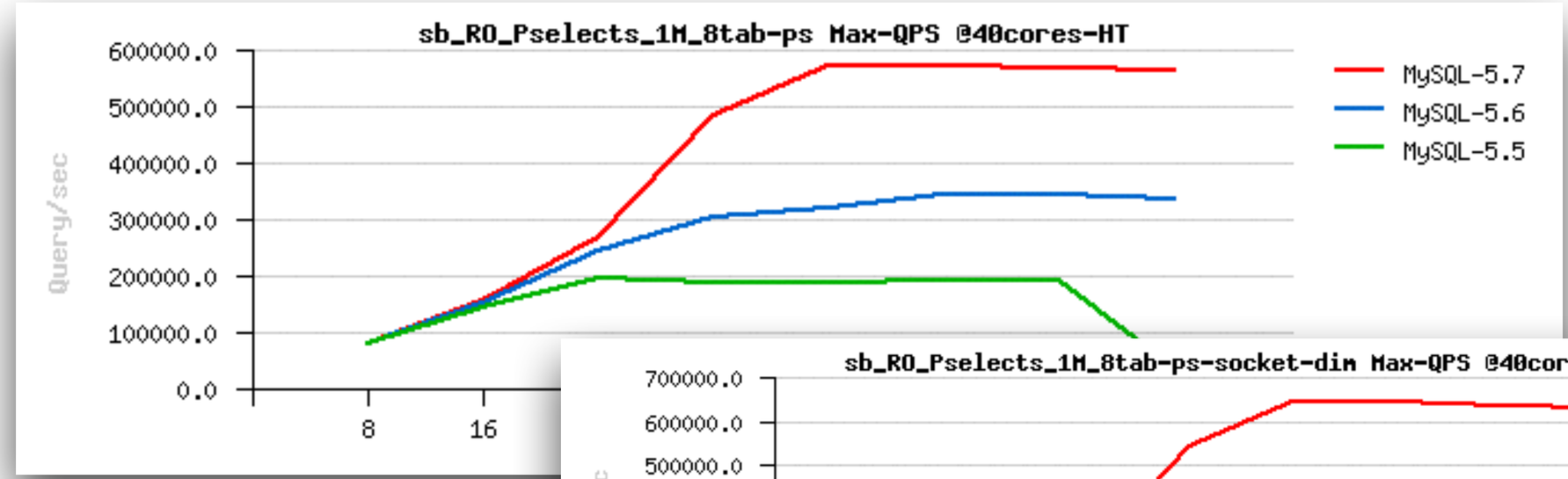
- **Around 900K QPS** Sysbench Point-Selects 8-tab, 64cores SPARC T5 :
  - Just a probe test with zero efforts ;-)

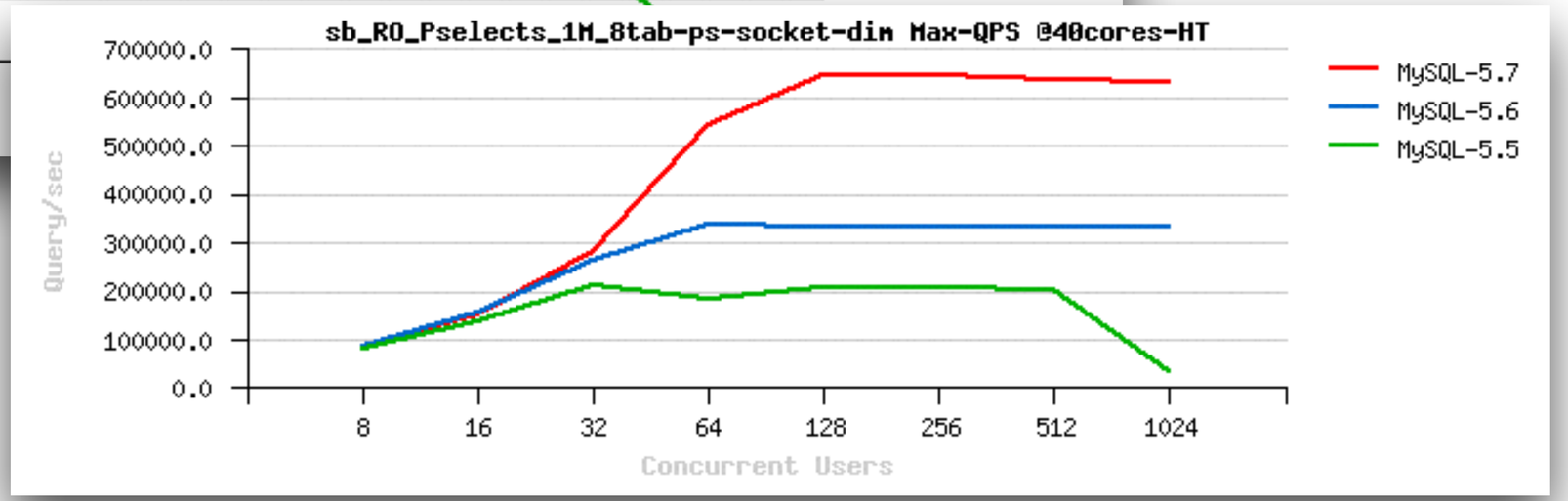




Few words about RO scalability

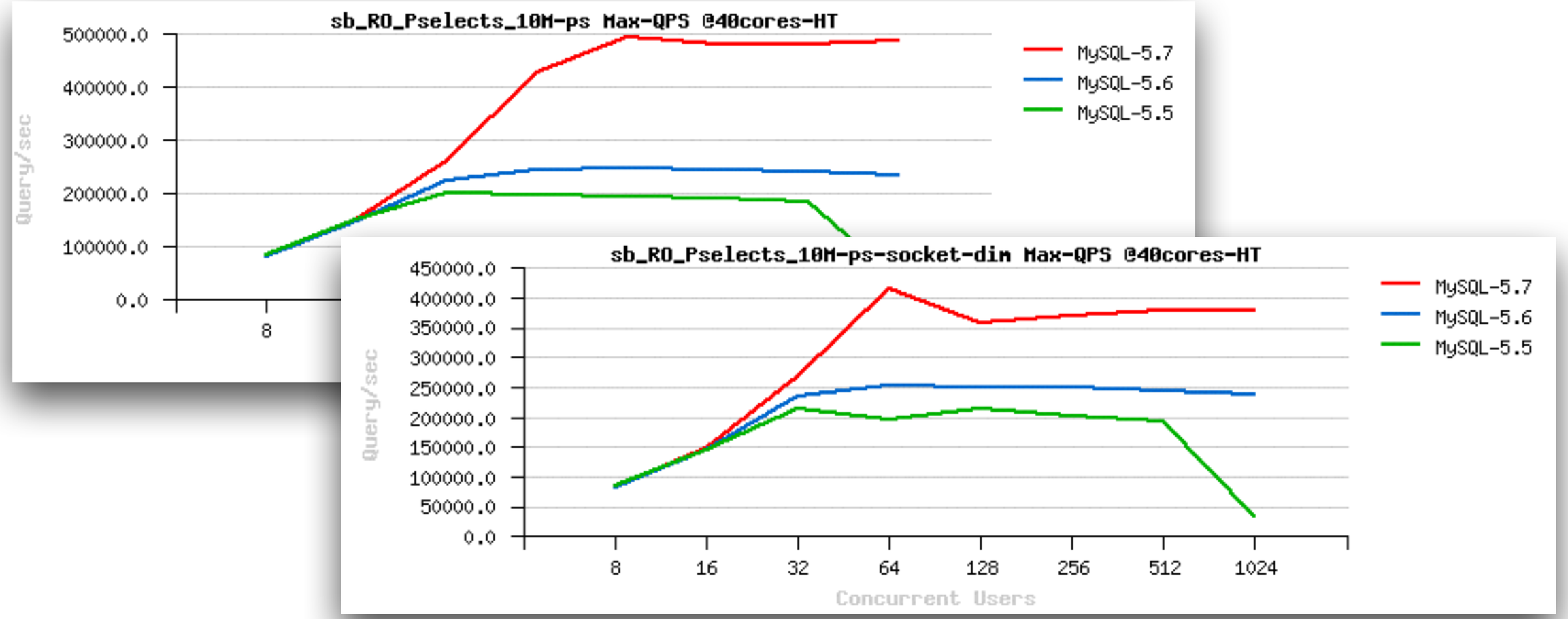
- OLTP_RO Point-selects **8**-tables, the same 40cores host
  - IP socket & sysbench 0.4.13 -vs- UNIX socket & sysbench 0.4.8 :





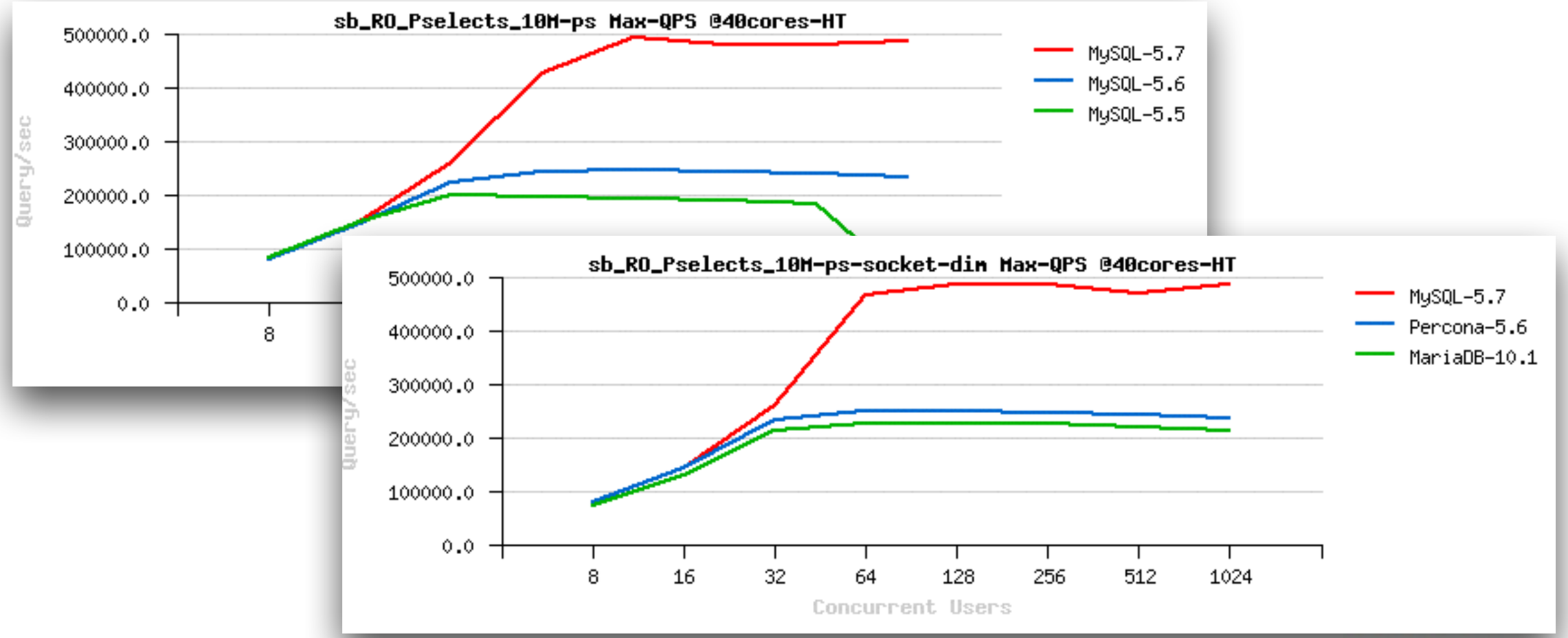
Few words about RO scalability (bis) - Oct.2014

- OLTP_RO Point-selects **1**-table, the same 40cores host
  - IP socket & sysbench 0.4.13 -vs- UNIX socket & sysbench 0.4.8 :



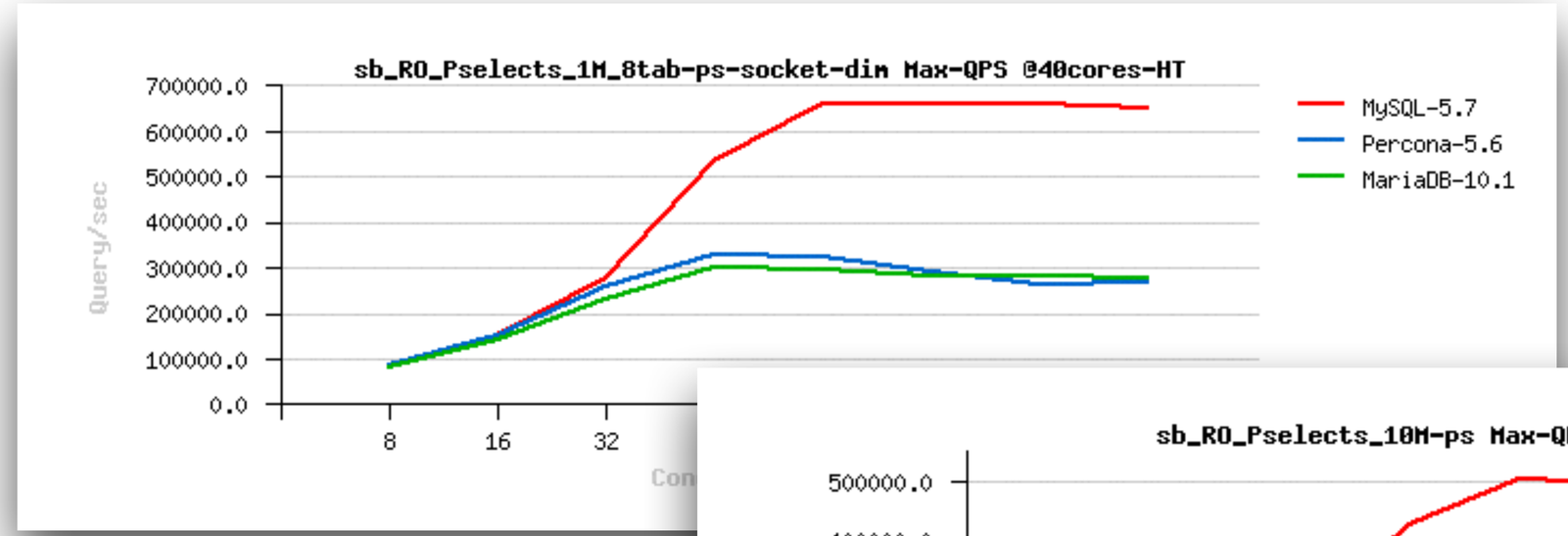
Few words about RO scalability (bis) - Apr.2015

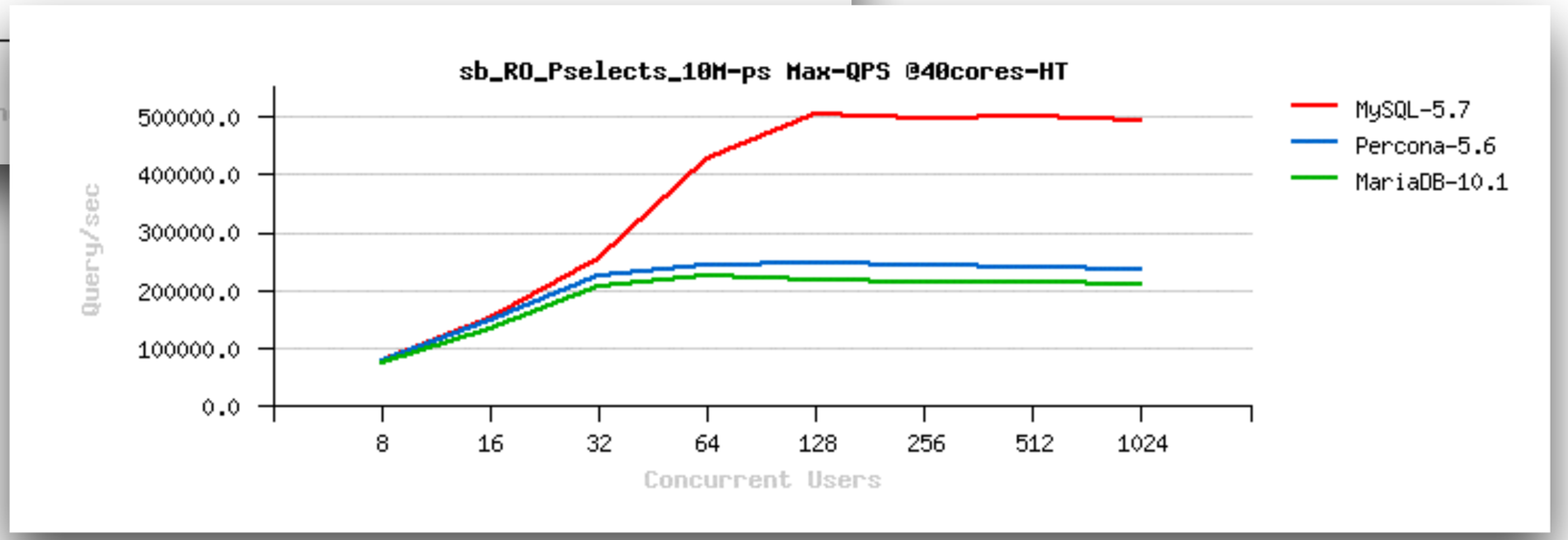
- OLTP_RO Point-selects **1**-table, the same 40cores host
  - IP socket & sysbench 0.4.13 -vs- UNIX socket & sysbench 0.4.8 :



Few words about RO scalability (bis2) - Apr.2015

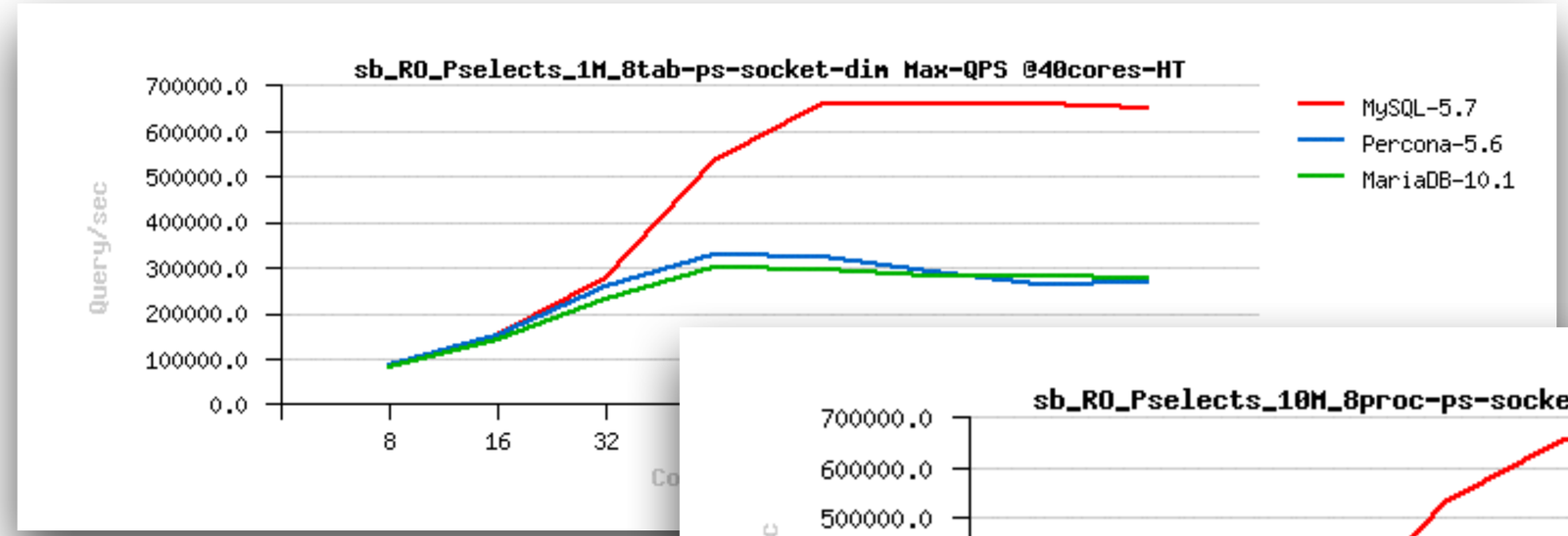
- OLTP_RO Point-selects **8**-tables -vs- **1**-table, the same 40cores host
  - Note : running 8 sysbench processes on 8-tables



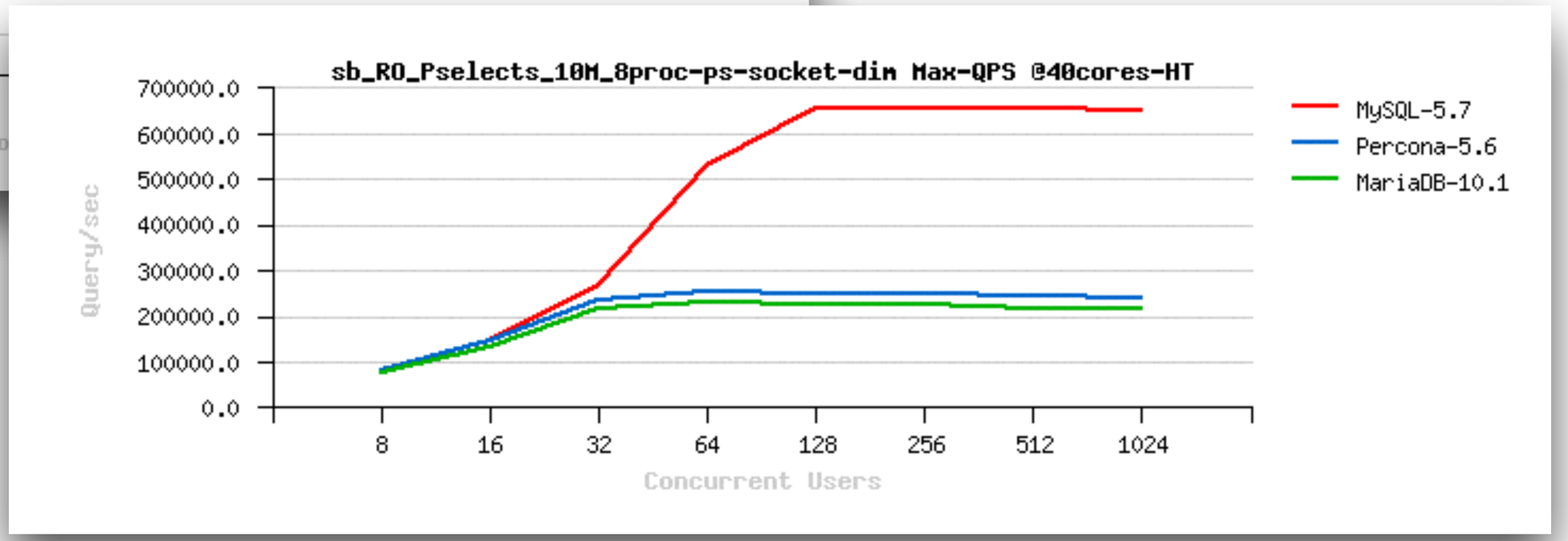


Few words about RO scalability (bis2) - Apr.2015

- OLTP_RO Point-selects **8**-tables -vs- **1**-table, the same 40cores host
  - Note : running now 8 sysbench processes on 1-table test too

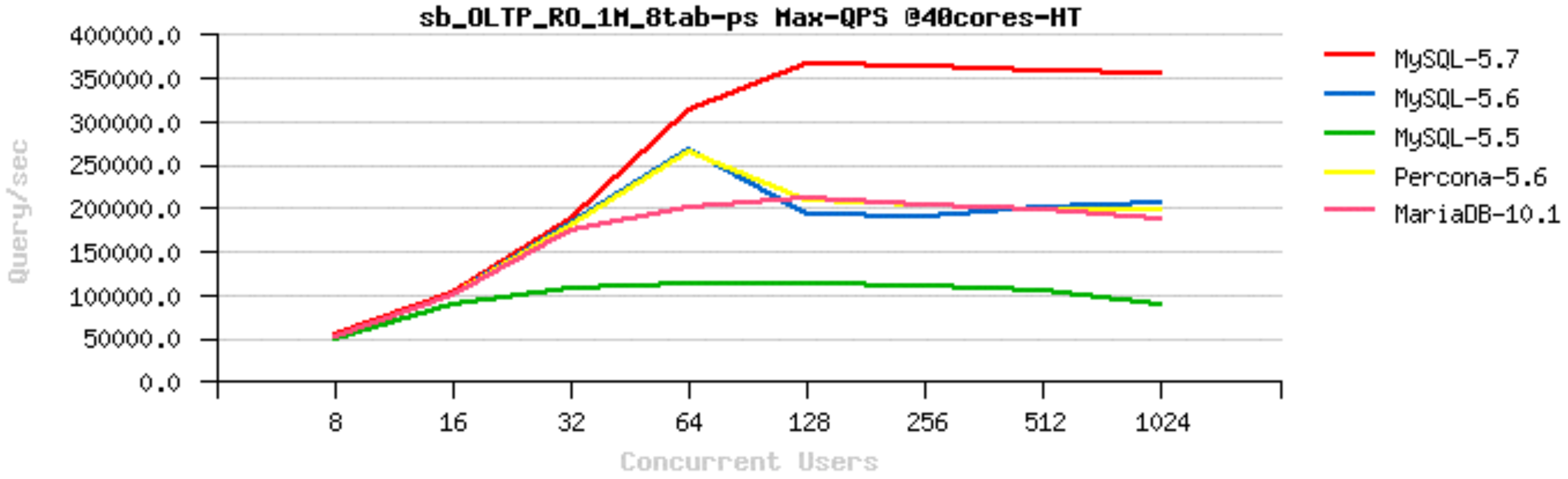


TODO: fix Sysbench ;-)



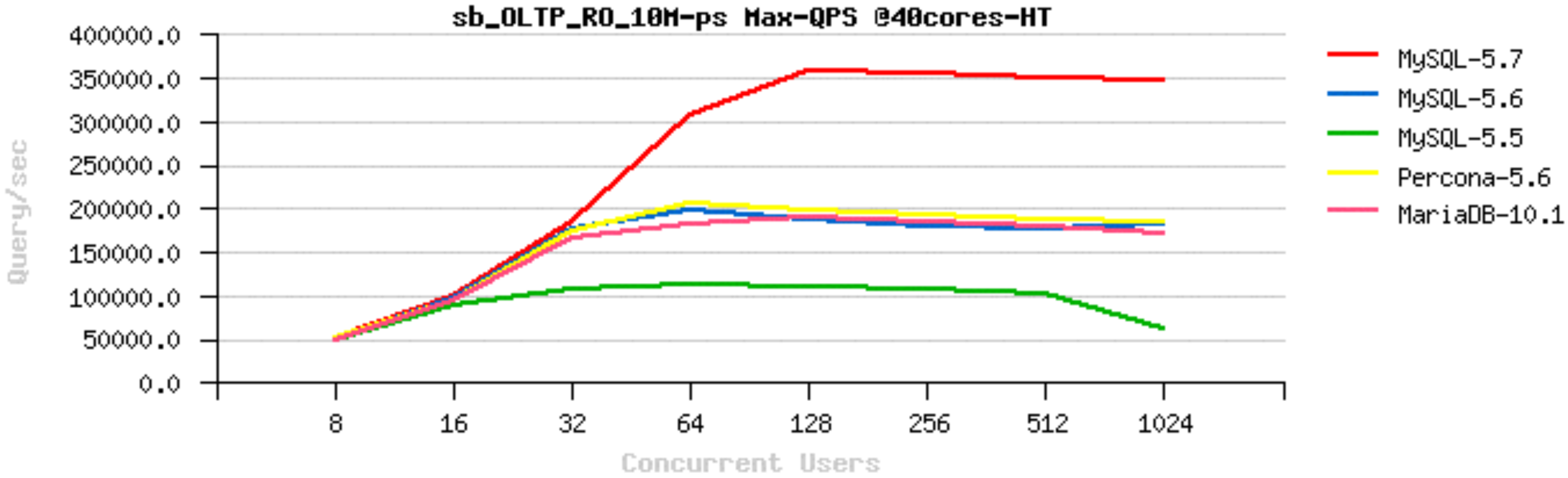
OLTP_RO : 8-tables

- Sysbench OLTP_RO 1Mx8-tables
  - 40cores-HT



OLTP_RO : 1-table

- Sysbench OLTP_RO 10M
  - 40cores-HT

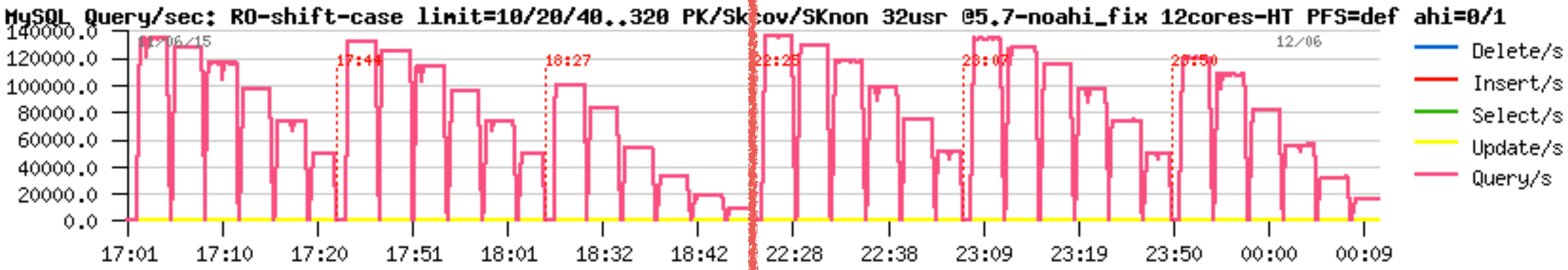


RO Pending Issues…

- InnoDB Adaptive Hash Index (AHI)
  - implemented with a global RW-lock
  - InnoDB RW-locks are not scaling by design (CPU cache syncs)
  - using table partitions helps to split indexes
  - using AHI partitions (5.7) helps to split RW-locks (coop. with Percona)
  - yet far from fixed..
  - 5.8 : AHI re-write / re-design

RO Pending Issues…

- PK vs Sec.IDX lookups
  - AHI helps
  - using covering indexes helps
  - reading less rows per query helps too.. (in ex: 10/20/40.. 320 rows)
  - PK Cov.IDX Sec.IDX PK Cov.IDX Sec.IDX



AHI=off AHI=on

RO Pending Issues…

- InnoDB Block Lock
  - seen when the same pages are accessed concurrently..
  - how to see : “show mutex” is back ;-)
  - workarounds :
    - avoid such an access pattern, don’t do this ;-)
    - use a smart query cache (like ProxySQL), or row cache (memcached, etc.)..
  - expected to be fixed in 5.8 : page re-design
    - but nothing yet promised.. ;-)

Read+Write (RW) Workloads Scalability @MySQL 5.7

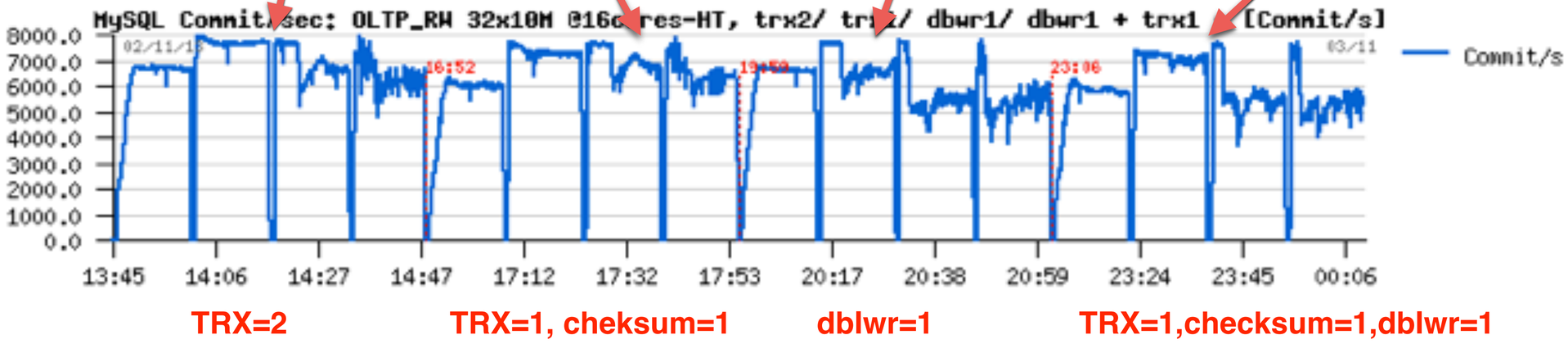
- Huge progress is already here too!
  - improved index locking
  - reduced lock_sys mutex contention
  - parallel flushing + improved flushing design
  - much better observability of internals
  - etc..
- However, not yet as good as Read-Only..
  - Performance continues to increase with more CPU cores
  - But on move from 16 to 32cores-HT you may gain only 50% better
  - Better performance on a faster storage as well
  - But cannot yet use a full power of fast flash for today..
  - Work in progress ;-)
  - Internal contentions & Design limitations are the main issues here..
  - still many things are in pipe & prototype..

Read+Write Performance @MySQL / InnoDB

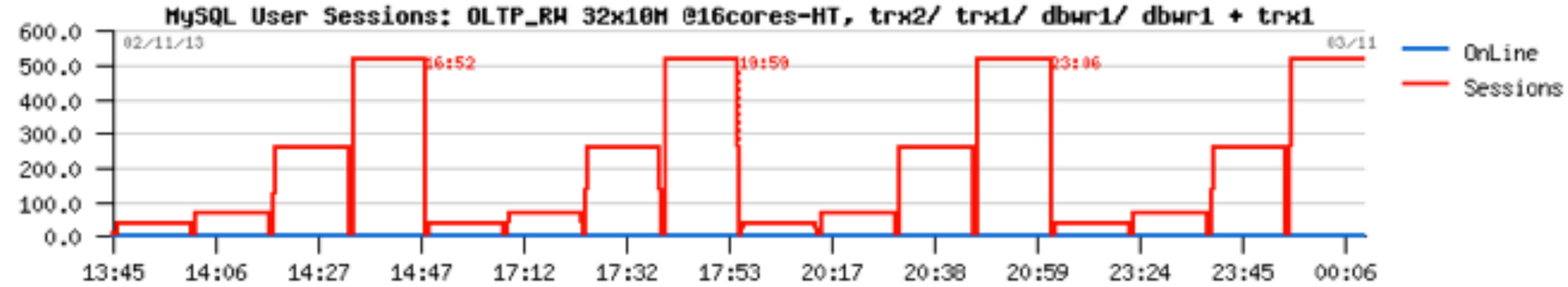
- Transactional processing
  - your CPU-bound transactional processing defines your Max possible TPS
  - with a bigger volume / more IO / etc. => Max TPS will not increase ;-)
- Data Safety
  - binlog : overhead + bottleneck (be sure you have binlog group commit)
  - InnoDB checksums : overhead (reasonable since crc32 is used)
  - innodb_flush_log_at_trx_commit = 1 : overhead + bottleneck
  - InnoDB double write buffer : **KILLER** ! overhead + huge bottleneck..
    - need a fix / re-design / etc. in urgency ;-)
    - Fusion-io atomic writes is one of (**true** support in MySQL 5.7)
    - Using EXT4 with data journal is another one
    - but a true re-design is still preferable ;-)

Impact of “safety” options..

- OLTP_RW 32x10M-tables @Percona-5.6
  - test cases: trx=2 | trx=1 + chksum=1 | dblwr=1 | trx=1 + chksum=1 + dblwr=1



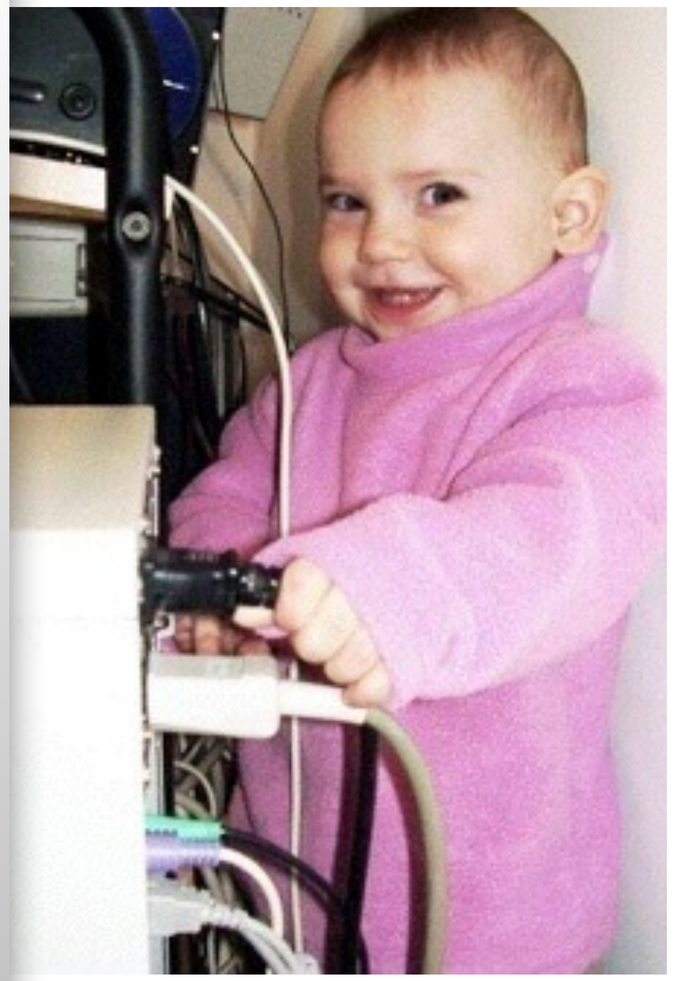
TRX=2 TRX=1, cheksum=1 dblwr=1 TRX=1,checksum=1,dblwr=1



RW related starter configuration settings

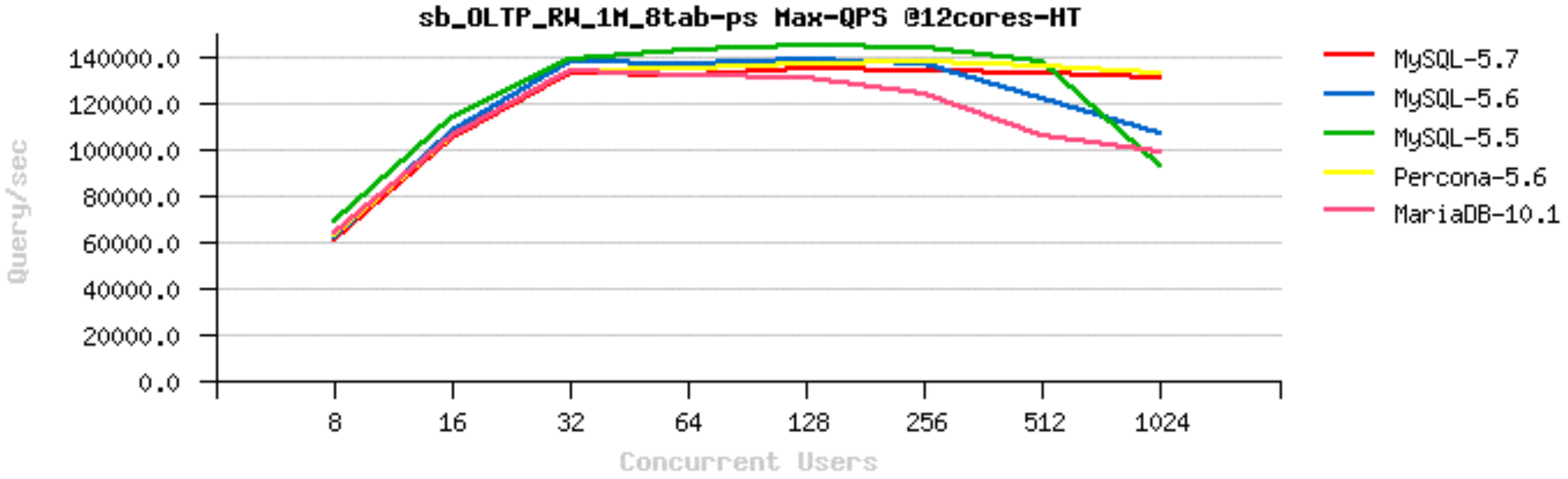
- my.conf :

```
innodb_file_per_table
innodb_log_file_size=1024M
innodb_log_files_in_group=3 / 12 / ...
innodb_checksum_algorithm= none / crc32
innodb_doublewrite= 0 / 1
innodb_flush_log_at_trx_commit= 2 / 1
innodb_flush_method=O_DIRECT
innodb_use_native_aio=1
innodb_adaptive_hash_index=0

innodb_adaptive_flushing = 1
innodb_flush_neighbors = 0
innodb_read_io_threads = 16
innodb_write_io_threads = 16
innodb_io_capacity=15000
innodb_max_dirty_pages_pct=90
innodb_max_dirty_pages_pct_lwm=10
innodb_lru_scan_depth=4000
innodb_page_cleaners=4

innodb_purge_threads=4
innodb_max_purge_lag_delay=30000000
innodb_max_purge_lag= 0 / 1000000

binlog ??
```



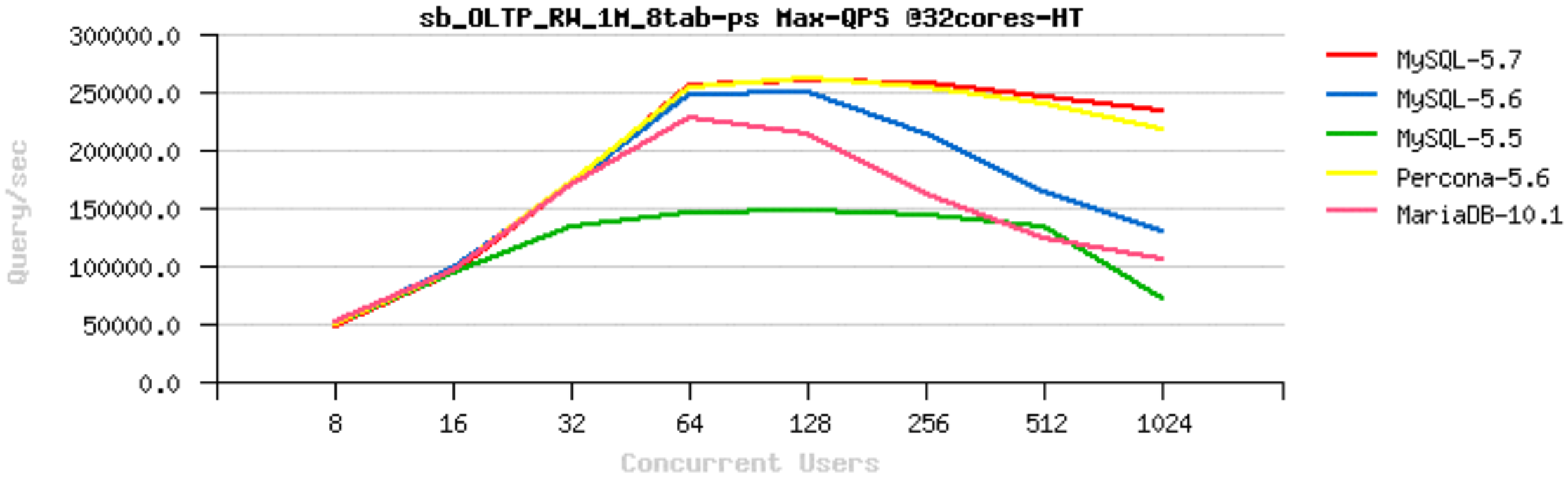
OLTP_RW : 8-tables

- Sysbench OLTP_RW 1Mx8-tables
  - 12cores-HT
  - and the winner is: MySQL 5.5 !! ;-))



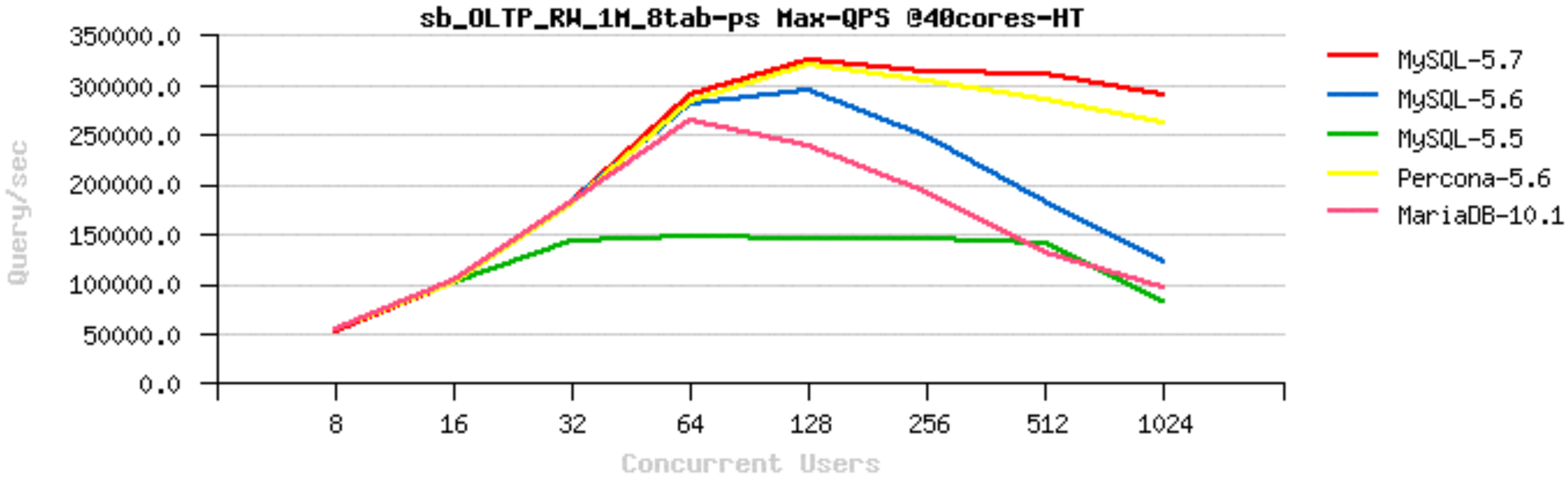
OLTP_RW : 8-tables

- Sysbench OLTP_RW 1Mx8-tables
  - 32cores-HT
  - and the winner is: rather MySQL 5.7 !! ;-))



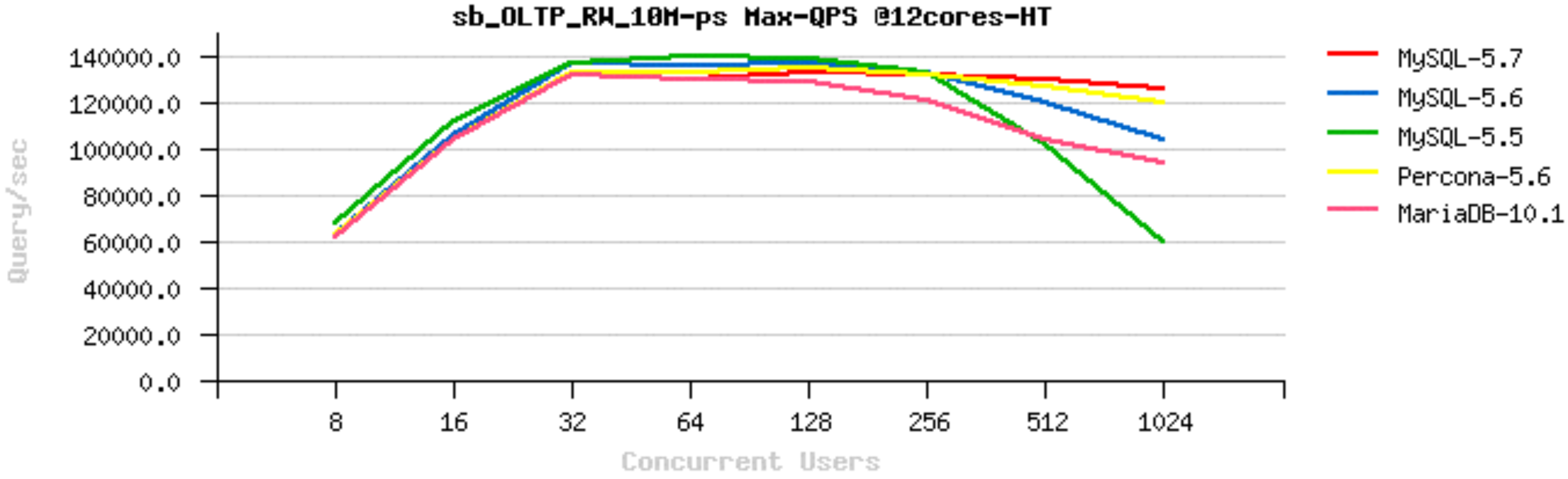
OLTP_RW : 8-tables

- Sysbench OLTP_RW 1Mx8-tables
  - 40cores-HT
  - and the winner is: rather MySQL 5.7 !! ;-))



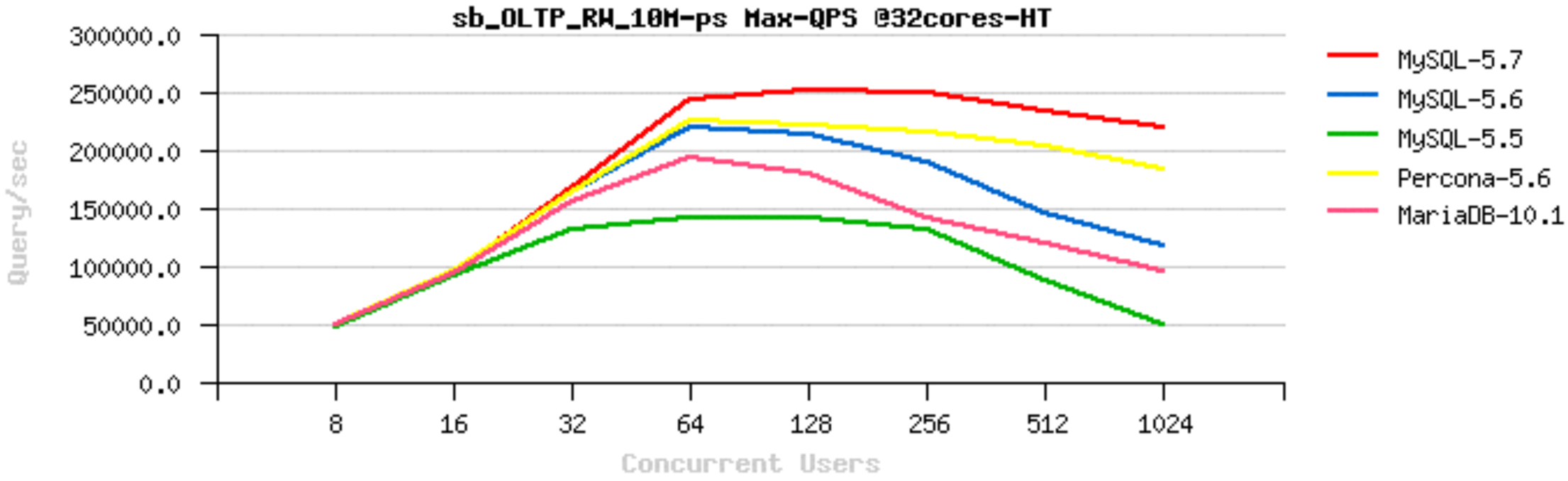
OLTP_RW : 1-table

- Sysbench OLTP_RW 10M
  - 12cores-HT
  - and the winner is: again MySQL 5.5 !! ;-))



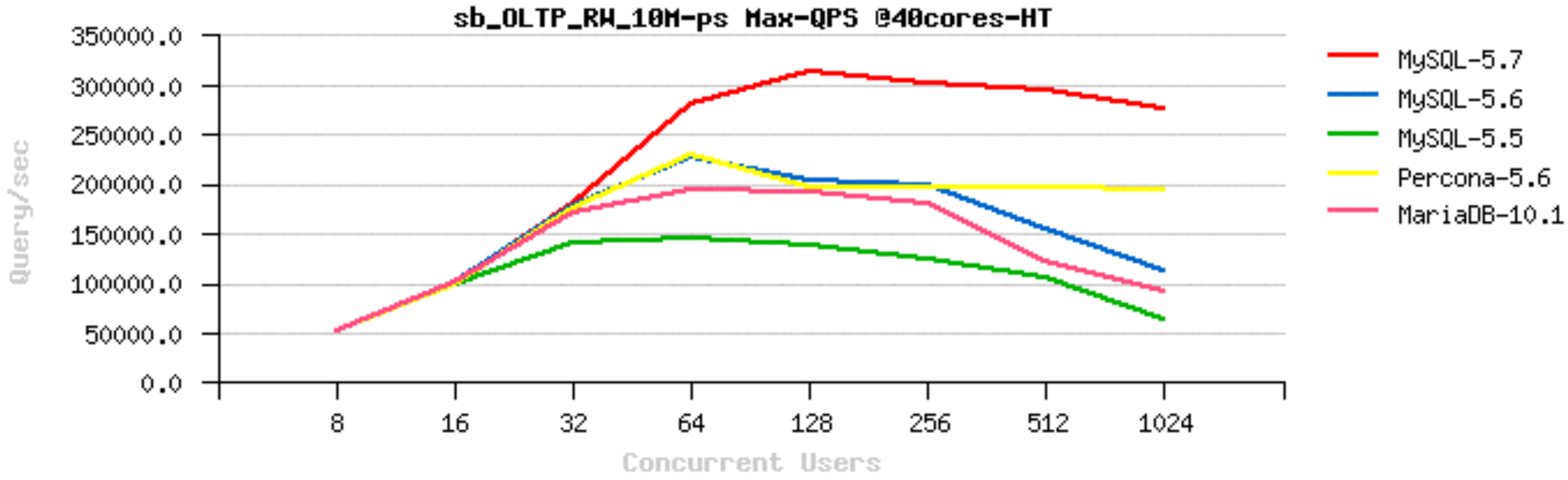
OLTP_RW : 1-table

- Sysbench OLTP_RW 10M
  - 32cores-HT
  - and the winner is: far MySQL 5.7 !! ;-))



OLTP_RW : 1-table

- Sysbench OLTP_RW 10M
  - 40cores-HT
  - and the winner is: far MySQL 5.7 !! ;-))



RW Scalability Limits and Problems

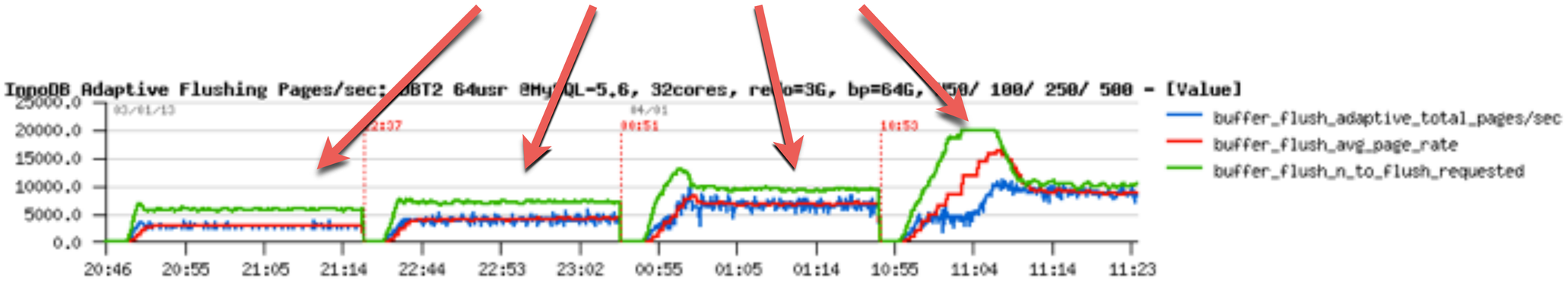
- Show-stoppers :
  - REDO log (log_sys contention) : need a re-design..
  - DBLWR Buffer (not IO, but its internal locking) : need a full re-write..
  - fil_sys mutex is limiting I/O operations rate..
- Pending problems :
  - InnoDB Purge may be lagging : need UNDO & co. re-design..
    - workaround : tune max lag to not let History Length growing by write throttling
    - 5.7 : allocated UNDO space can be truncated !! (free your disk space)
  - huge impact of writes on reads
  - IO layers are needing yet more instrumentation / observability
  - AIO needs more control / tunable(s)
  - AHI re-design
  - go yet more far with Adaptive Flushing
  - etc. etc. etc…

RW IO-bound

- Still data In-Memory, but much bigger volume :
  - more pages to flush for the **same** TPS rate
- Data bigger or much bigger than Memory / cache / BP :
  - the amount of free pages becomes short very quickly..
  - and instead of mostly IO writes only you’re starting to have IO reads too
  - these reads usually mostly random reads
  - if your storage is slow - reads will simply kill your TPS ;-)
  - if your storage can follow - once you’re hitting fil_sys mutex you’re done
  - as well LRU flushing may become very heavy..
- NOTE:
  - on Linux : using **AIO + O_DIRECT** seems to be the most optimal for RW IO-bound
  - but always check yourself ;-)

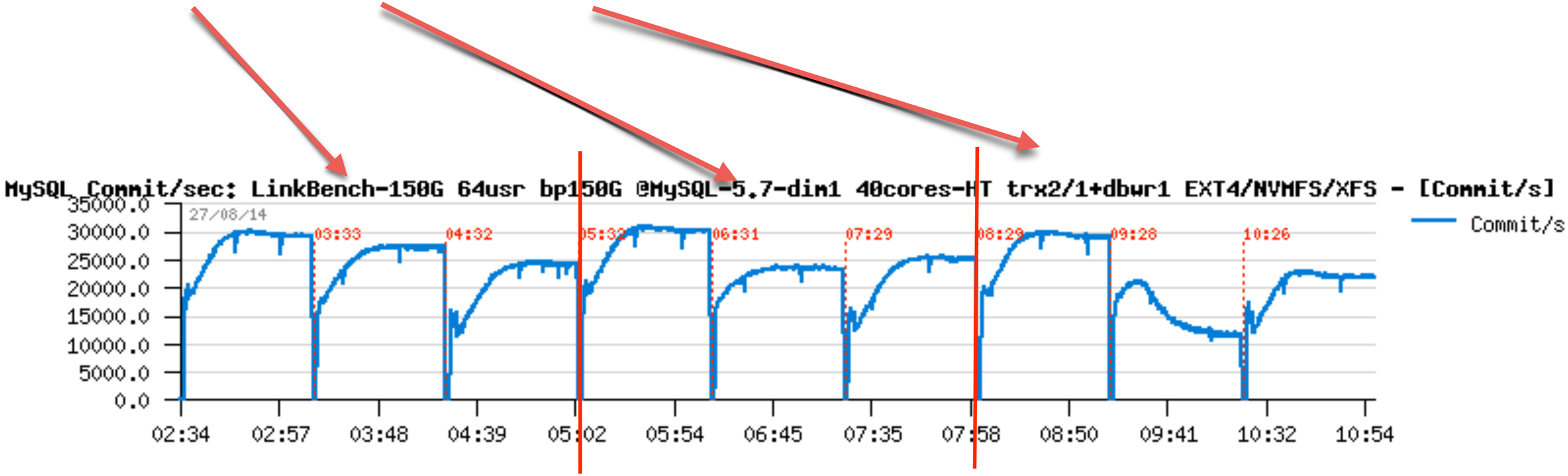
RW IO-bound “In-Memory”

- Impact of the database size
  - with a growing db size the TPS rate may be only the same or worse ;-)
  - and required Flushing rate may only increase..
- ex.: DBT2 workload :
  - 64 users, db volume: 50W, 100W, 250W, 500W



RW IO-Bound : Test your Filesystem before to deploy

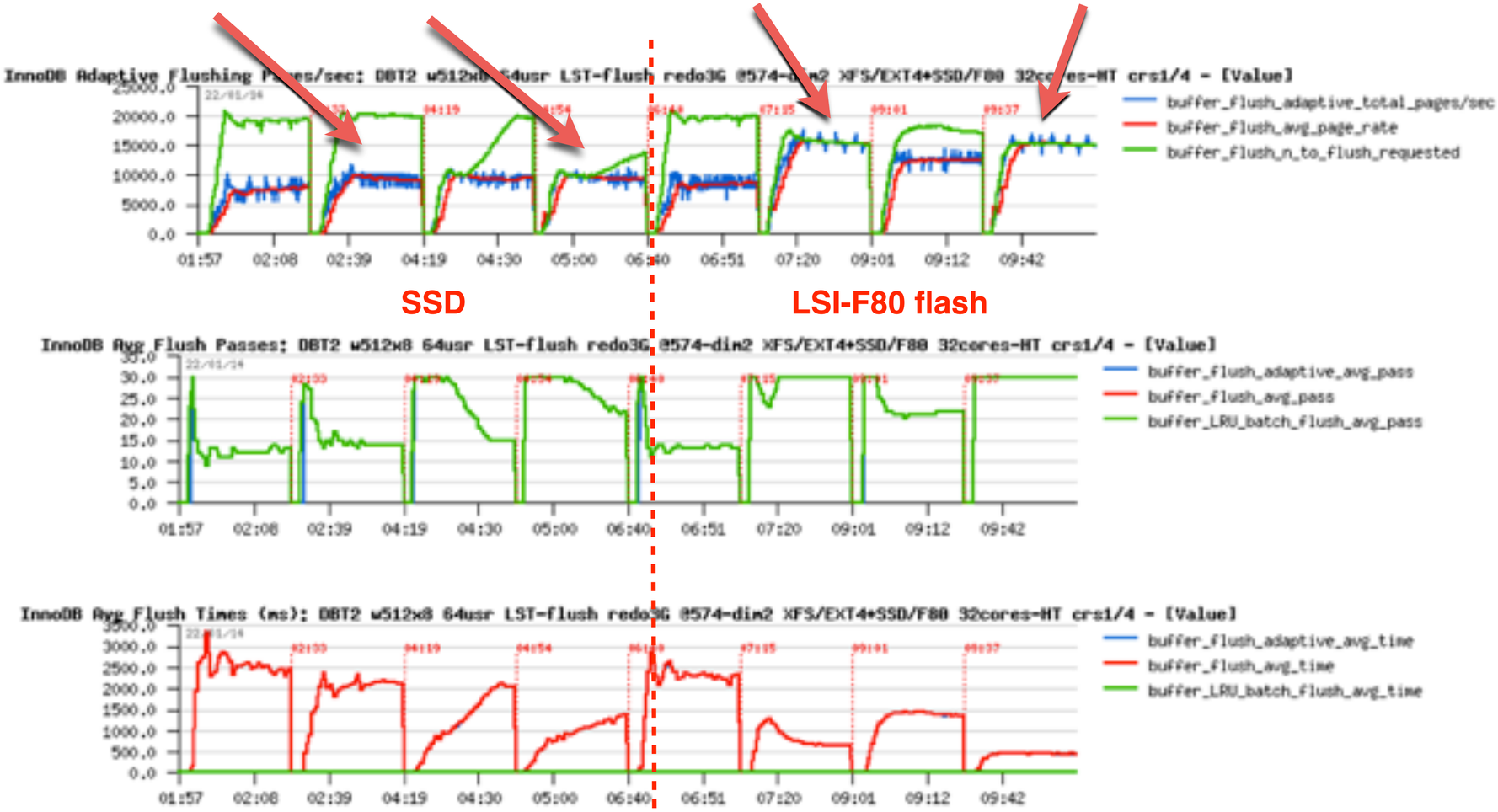
- LinkBench 150G workload
  - test cases : “safety” options on 64usr, Fusion-io
  - EXT4 -vs- NVMFS -vs- XFS



EXT4 NVMFS XFS

RW IO-Bound : Consider a fast storage

- InnoDB Flushing in MySQL 5.7 & storage:
  - DBT2 512Wx8, 64usr, each test first with 1 then with 4 cleaners
  - XFS@SSD | EXT4@SSD | XFS@LSI-F80 | EXT4@LSI-F80



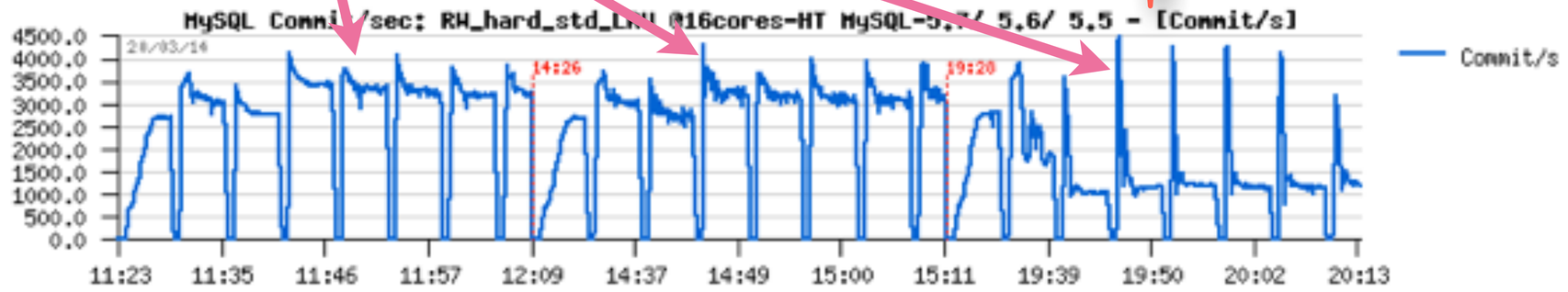
RW IO-bound “Out-of-Memory”

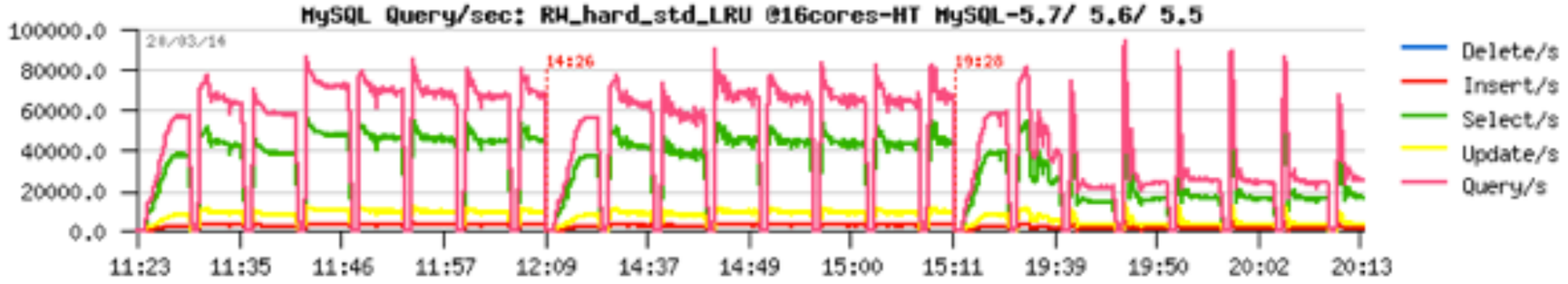
- The “entry” limit here is storage performance
  - as you’ll have a lot of IO reads..
- Once storage is no more an issue :
  - you may hit internal contentions (ex. InnoDB file_sys mutex)
  - or other engine design limitations..
  - sometimes a more optimal config settings may help..
  - but sometimes not ;-)

RW LRU-bound : 5.5 is out of the game..

- Sysbench OLTP_RW 10M x32-tables
  - Users: 8, 16, 32 .. 1024
  - MySQL : 5.7 / 5.6 / 5.5

Please, upgrade me to 5.6 !!!



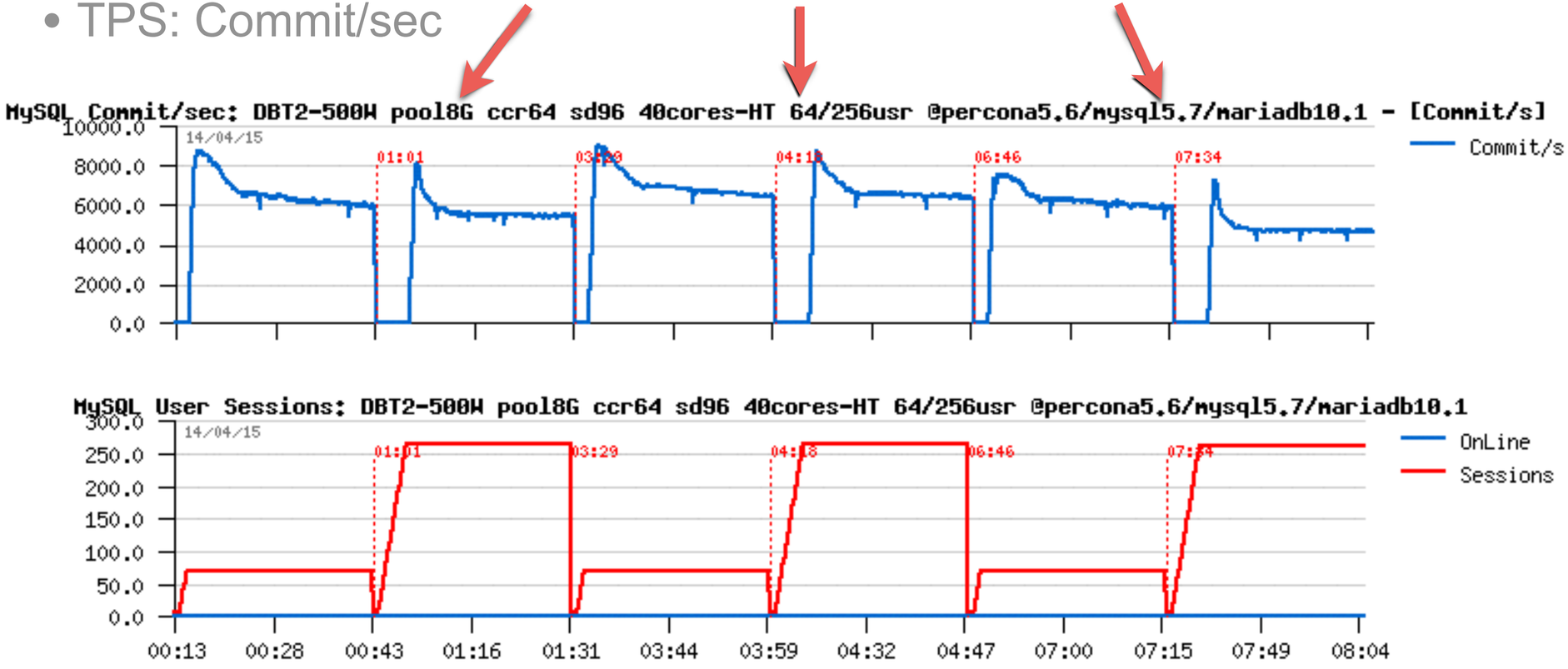


Analyzing DBT2-500W Workload @40cores-HT

- Mostly IO-bound (~100G database)
  - so, storage layer: Fusion-io flash, EXT4
- Test cases :
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - concurrent user sessions: 64, 256
  - Buffer Pool size: 8G (LRU-bound) / 96G (Flushing-bound)
  - LRU depth = 4000
  - IO capacity = 15000
  - IO_DIRECT_NO_FSYNC + native AIO
  - REDO log size = 3 x 1GB
  - InnoDB thread concurrency = 0 / 64
  - InnoDB spin wait delay = 6 / 96
  - …

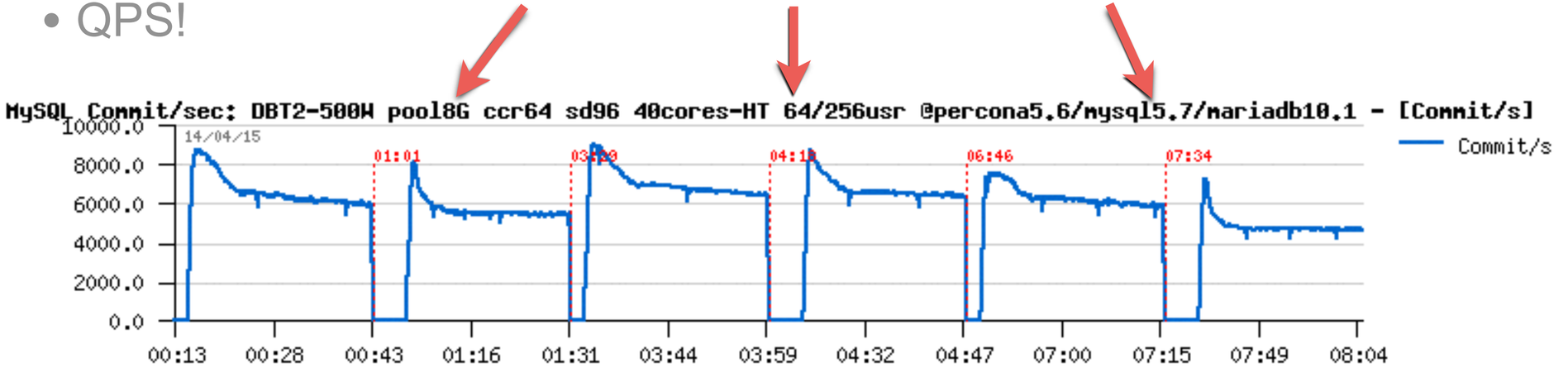
DBT2-500W Workload @40cores-HT

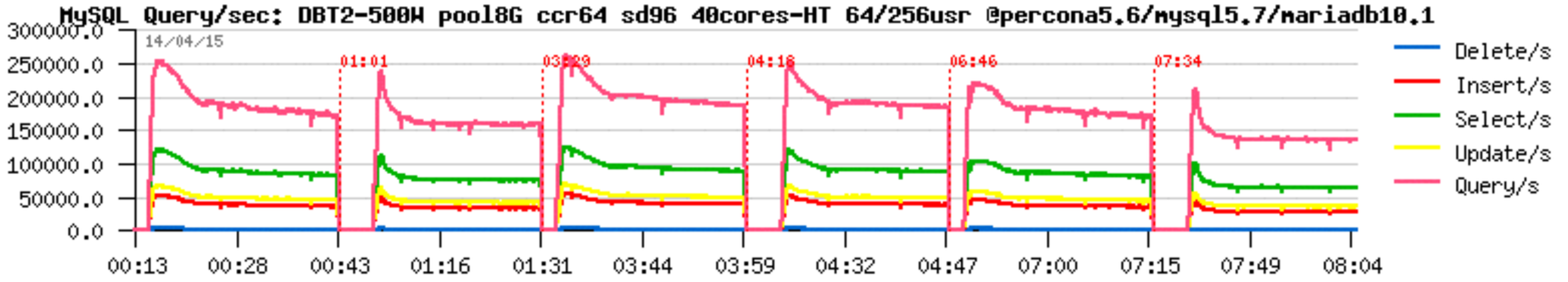
- LRU-bound (BP=8G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - TPS: Commit/sec



DBT2-500W Workload @40cores-HT

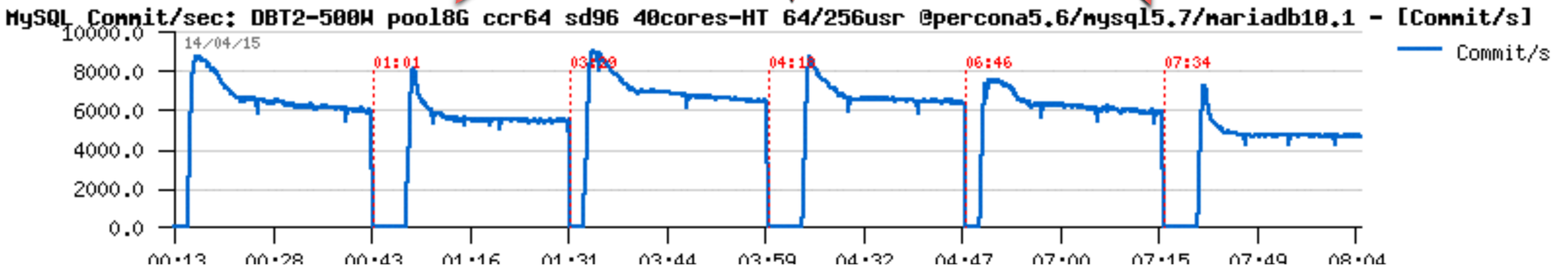
- LRU-bound (BP=8G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - QPS!

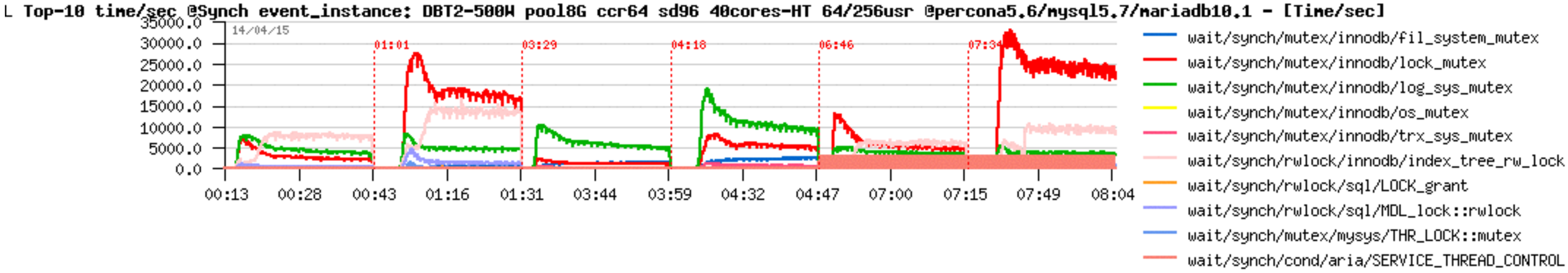




DBT2-500W Workload @40cores-HT

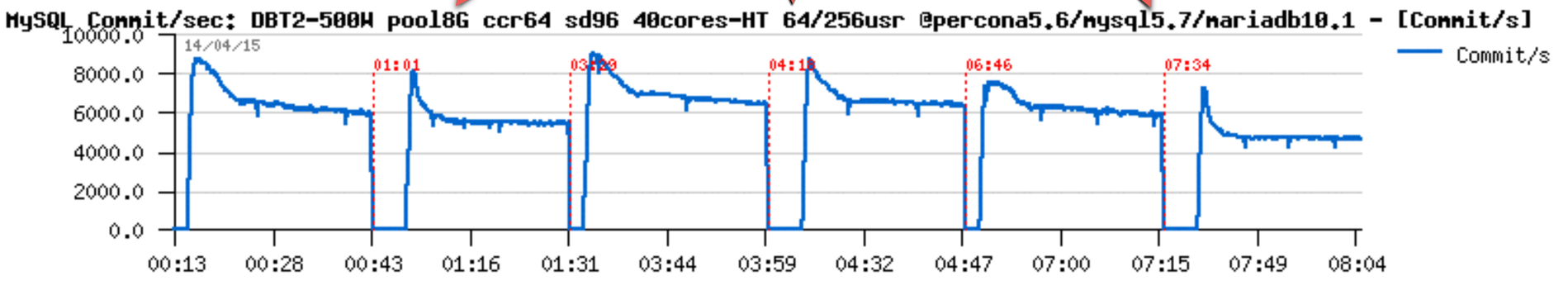
- LRU-bound (BP=8G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - Lock waits: index lock impact…

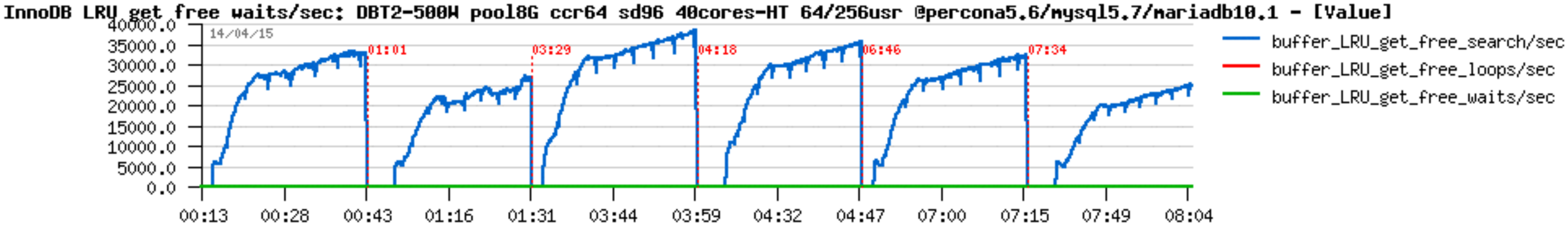




DBT2-500W Workload @40cores-HT

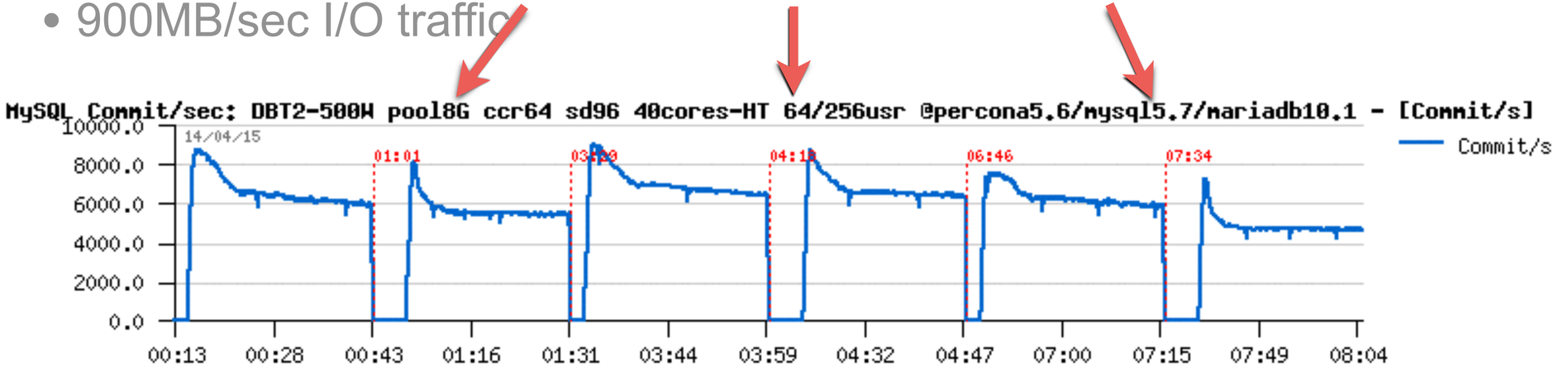
- LRU-bound (BP=8G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - up to 40K page reads/sec rate

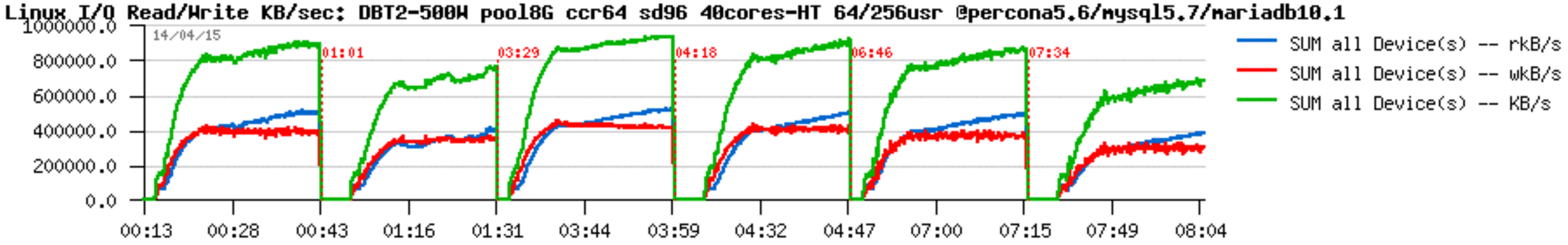




DBT2-500W Workload @40cores-HT

- LRU-bound (BP=8G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - 900MB/sec I/O traffic





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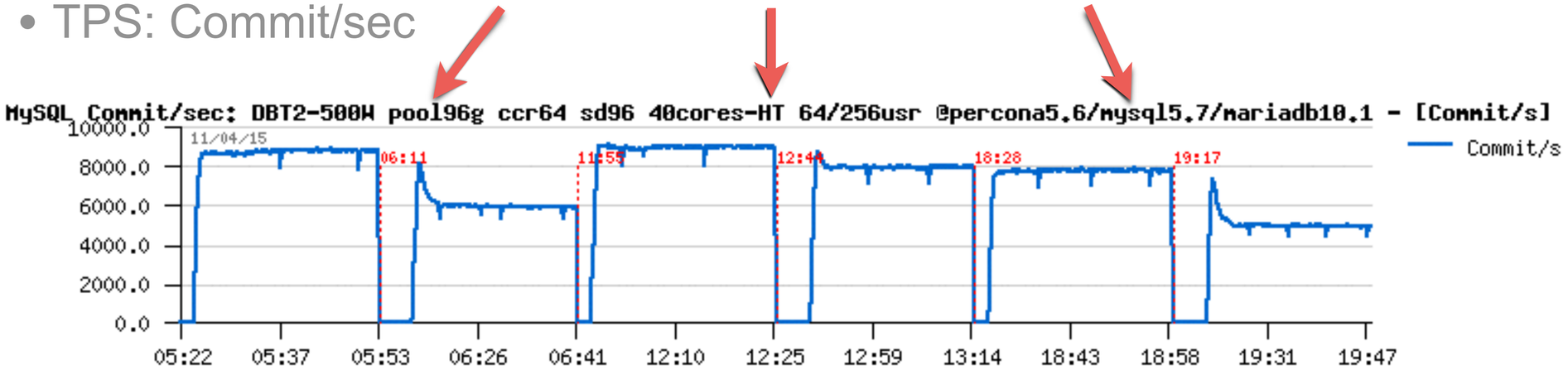
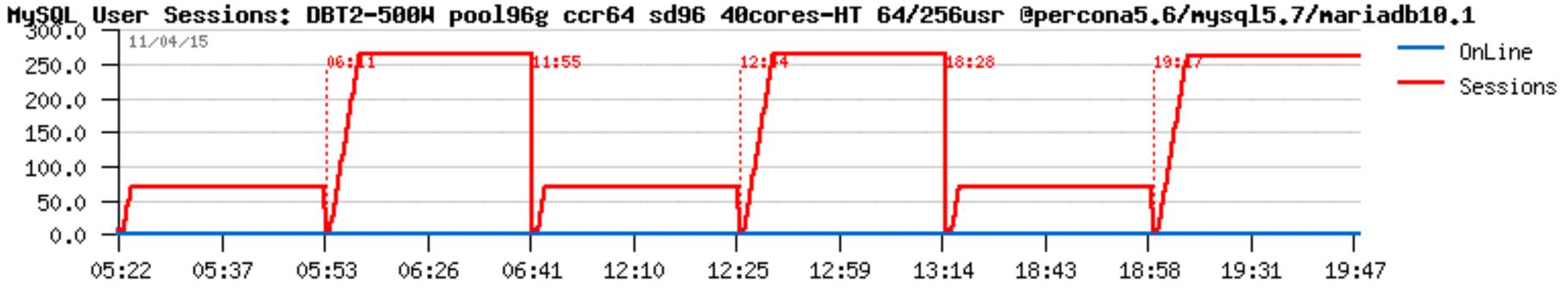
DBT2-500W Workload @40cores-HT

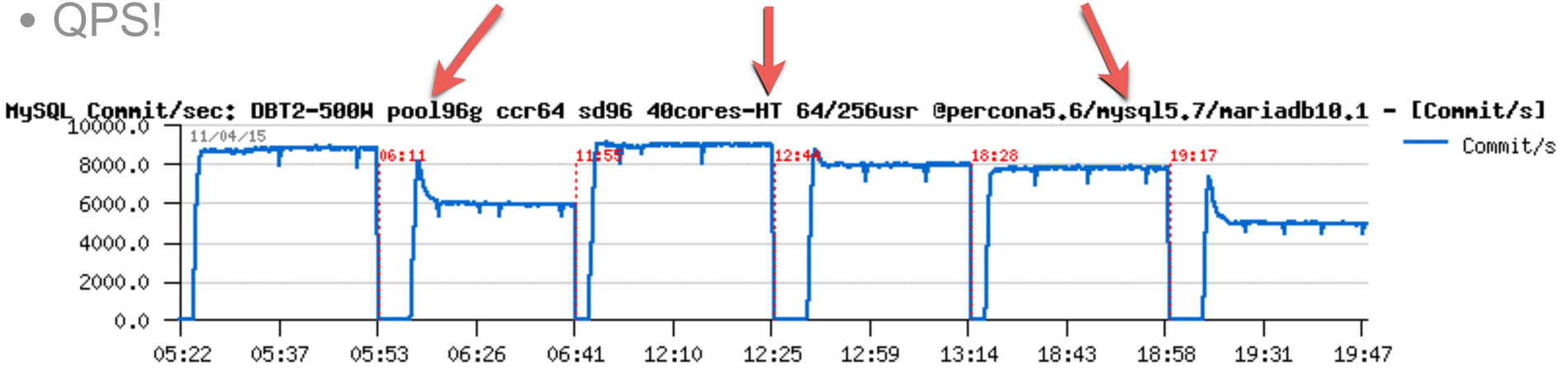
- Flushing-bound (BP=96G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - TPS: Commit/sec

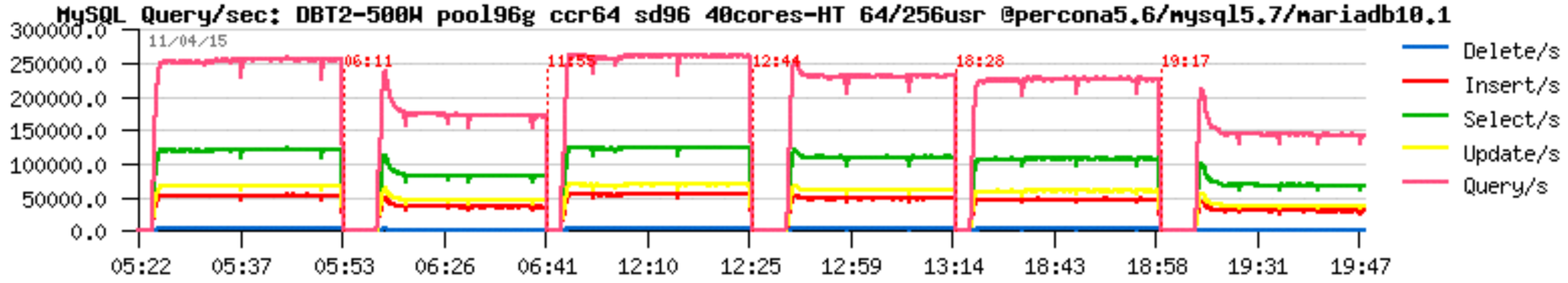




DBT2-500W Workload @40cores-HT

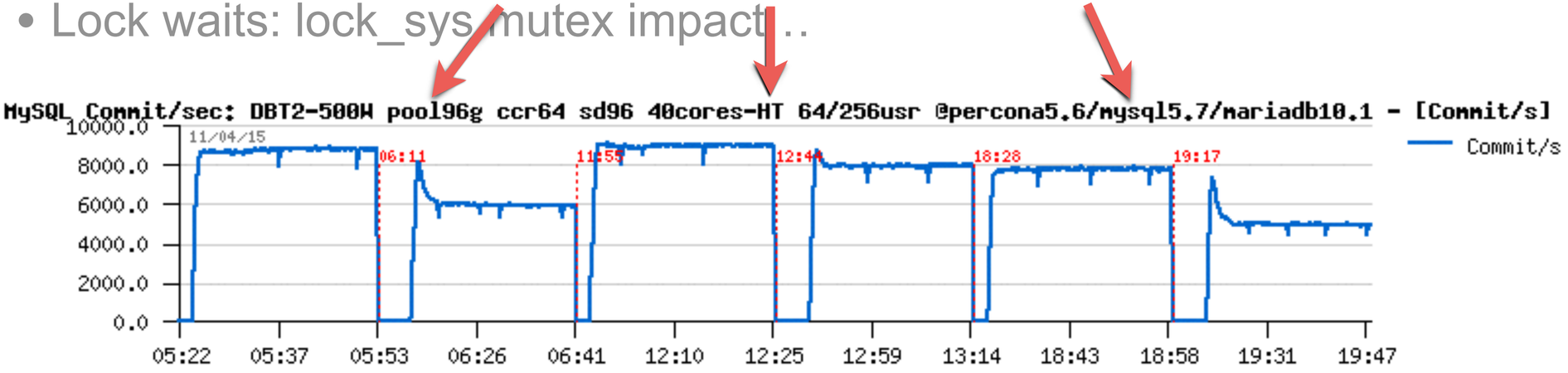
- Flushing-bound (BP=96G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - QPS!

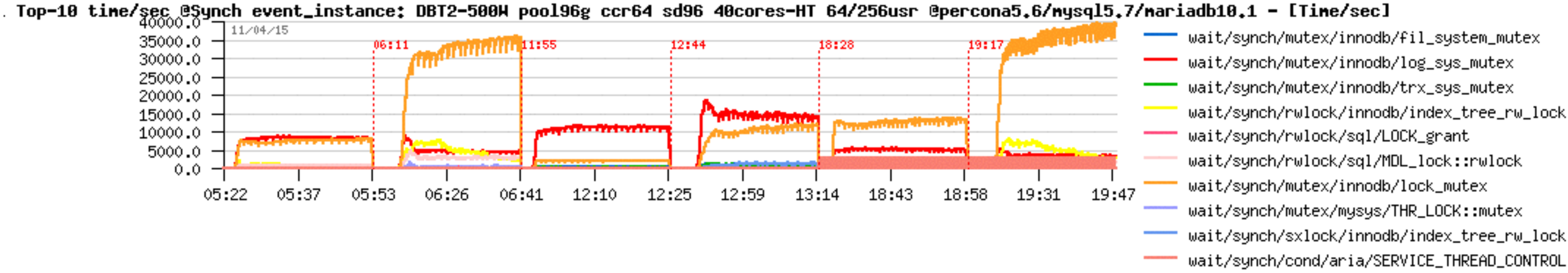




DBT2-500W Workload @40cores-HT

- Flushing-bound (BP=96G): Final Results
  - engines: Percona Server 5.6 / MySQL 5.7 / MariaDB 10.1
  - Lock waits: lock_sys mutex impact ..





So, work continues..
stay tuned... ;-)

Come to see us at OpenWorld-2015 in SF, 25-30/Oct. !!!

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Few words about dim_STAT (if you're asking ;-))

- All graphs are built with dim_STAT (http://dimitrik.free.fr)
  - All System load stats (CPU, I/O, Network, RAM, Processes,...)
  - Manly for Solaris & Linux, but any other UNIX too :-)
  - Add-Ons for Oracle, MySQL, PostgreSQL, Java, etc.
  - MySQL Add-Ons:
    - mysqlSTAT : all available data from "show status"
    - mysqlLOAD : compact data, multi-host monitoring oriented
    - mysqlWAITS : top wait events from Performance SCHEMA
    - InnodbSTAT : most important data from "show innodb status"
    - innodbMUTEX : monitoring InnoDB mutex waits
    - innodbMETRICS : all counters from the METRICS table
  - And any other you want to add! :-)

THANK YOU !!!

- All details about presented materials you may find on:
  - http://dimitrik.free.fr - dim_STAT, dbSTRESS, Benchmark Reports, etc.
  - http://dimitrik.free.fr/blog - Articles about MySQL Performance, etc.