MySQL

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MySQL 8.0-dev 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..
- Progress in MySQL 8.0-dev & Benchmark results..
- Q & A

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
  - where we're in MySQL Dev as of today..

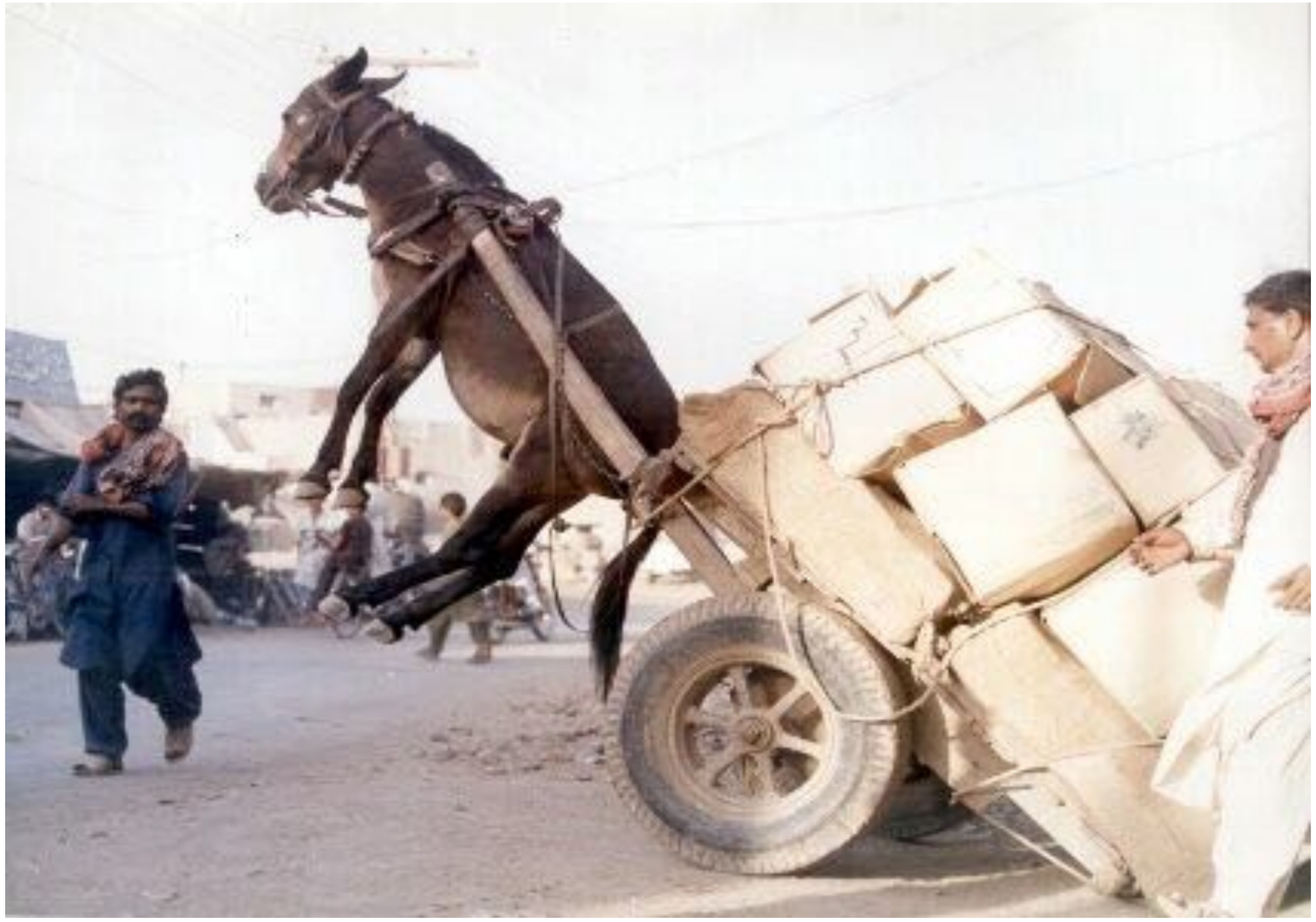
Why MySQL Performance ?...

Why MySQL Performance ?..

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

Why MySQL Performance ?..

- Until it did not reach its limit..



Why MySQL Performance ?..

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

Why MySQL Performance ?..

- And reach a similar limit..

Why MySQL Performance ?..

- Analyzing your workload performance and testing your limits may help you to understand ahead the resistance of your solution to incoming potential problems ;-)

Why MySQL Performance ?..

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

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

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

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

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

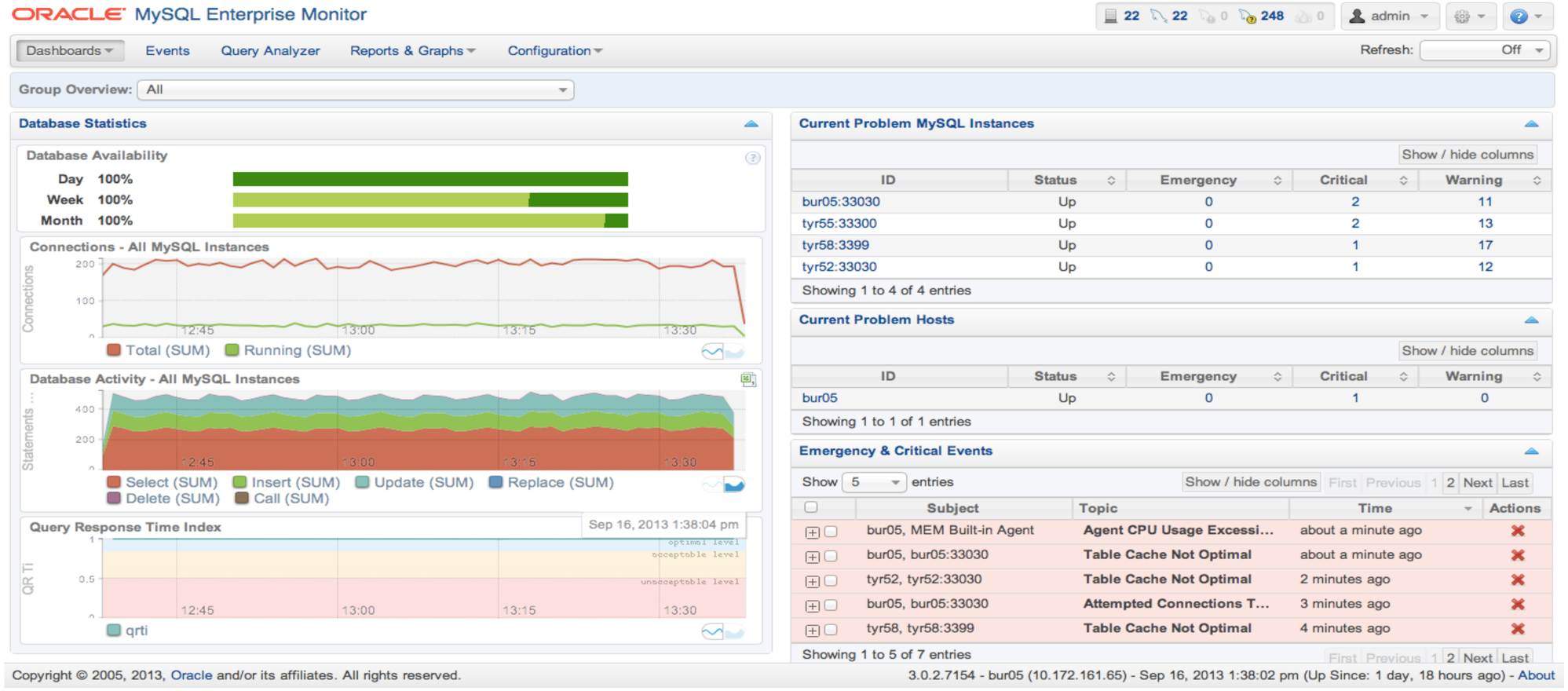
USE YOUR BRAIN !!!... ;-)

#2 - Monitoring is THE MUST !

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

MySQL Enterprise Monitor

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



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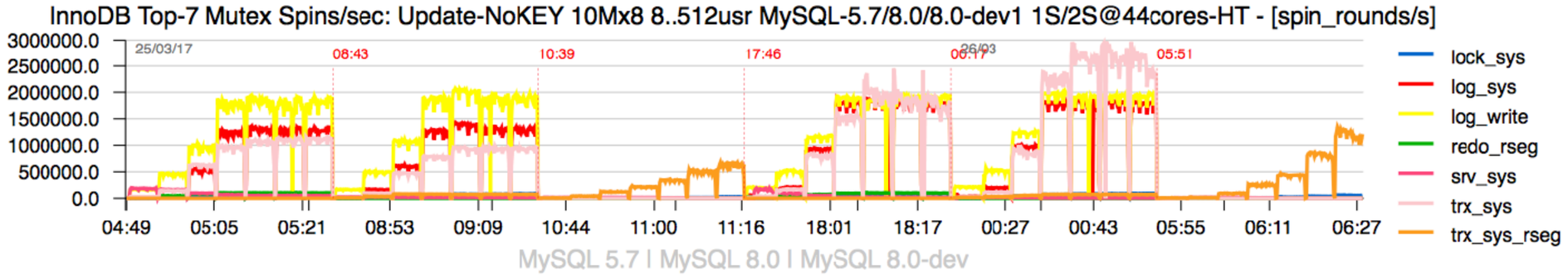
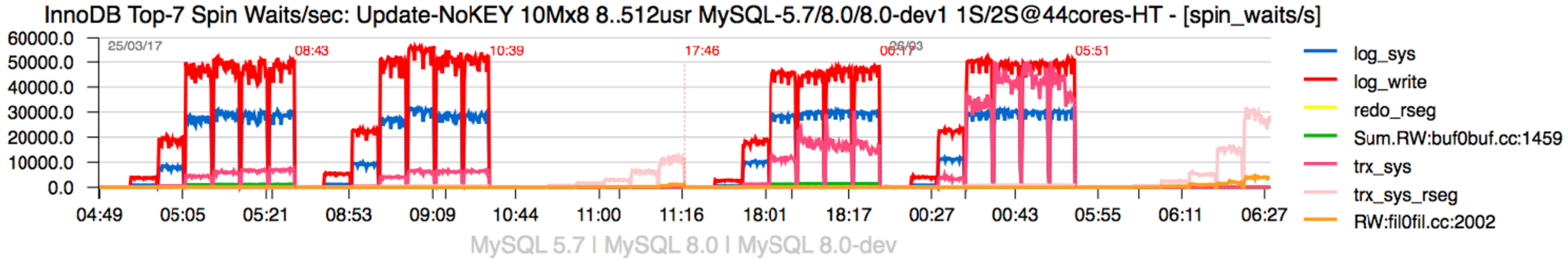
Other Monitoring Tools

- Cacti, Zabbix, Nagios, Solarwinds, VividCortex, PMM, etc…..
- ***dim_STAT***
  - yes, 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…

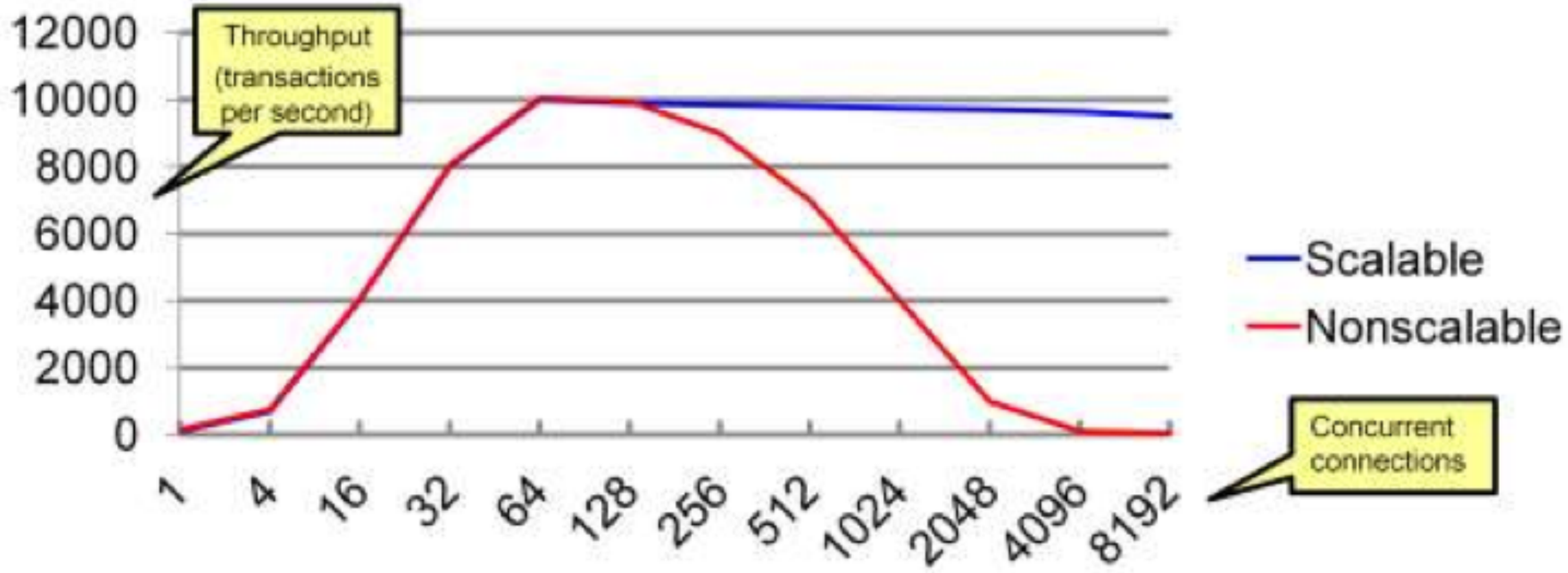
- **always** validate the impact of your Monitoring on your Production ;-)
- taking 1sec measurements is fine, except :
  - if it's eating 100% CPU time on one or more CPU cores..
  - reducing your network traffic / latency..
  - eats your RAM, etc.
- avoid to be too much intrusive on MySQL/InnoDB internals..
  - you may easily create an additional overhead
  - as well you may add artificial locks on your workflow
    - for ex: run in loop "show processlist", etc..
- well, nothing is coming for free, so **think** about what you're doing !
- (#1 best practice once again ;-))

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)
  - Intel 2CPU : 44cores-HT (March 2016)..
  - Intel 2CPU : 56cores-HT (March 2017)..
  - …
- Scalability In Few Words :
  - your software is able to deliver a **higher** throughput if more HW resources are available..
  - (then, scaling well or not is another story ;-))

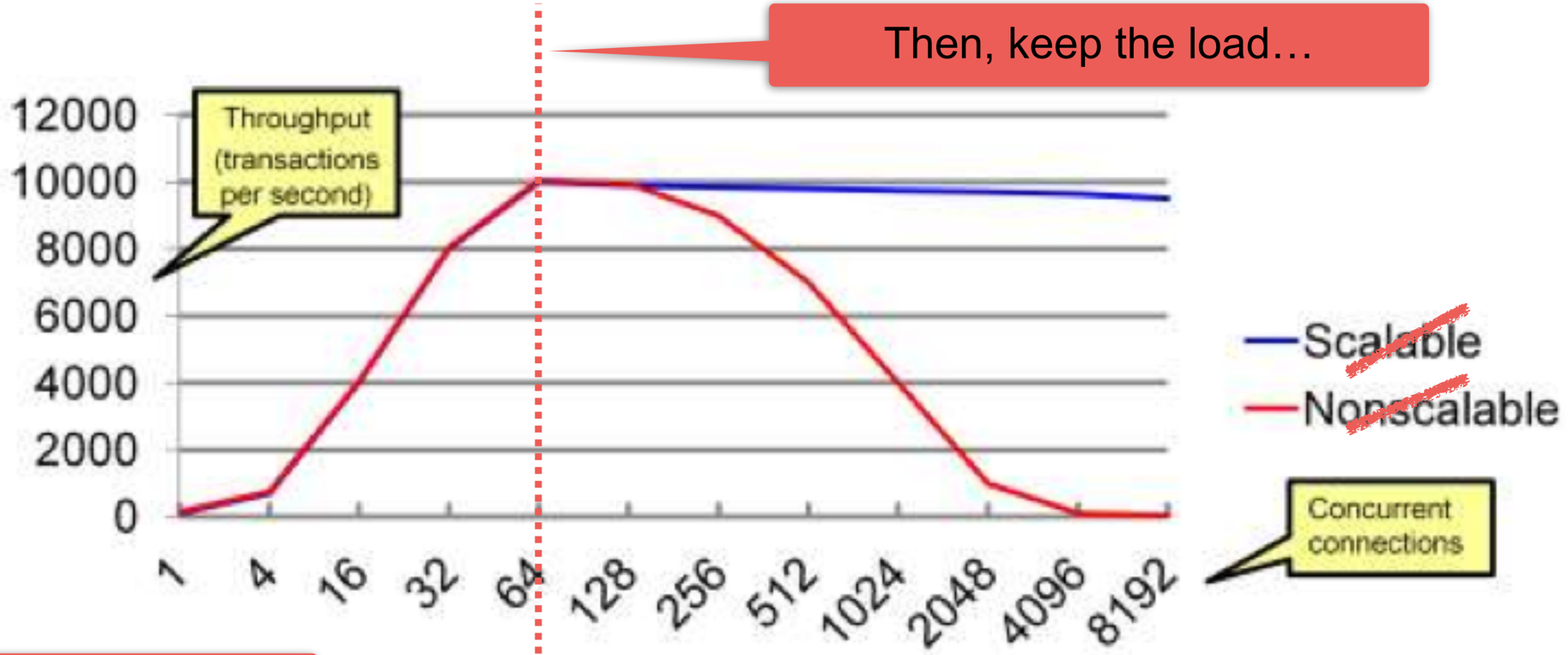
A B-shit Slide…

- 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..

Why Benchmarks ?..

- Production Performance issues ?..
  - the last thing you should do is to validate your tuning tweaks on live production ;-)
  - rather take a time to create a test case to reproduce the problem
  - then test the fix on “dev” (or “benchmark”) server(s)..
- The best Benchmark Workload for you ?
  - the Benchmark reproducing your own production conditions !
  - the collection of your production test cases may quickly become your own Benchmark Suite to validate any tuning or HW changes impact..
- If you don’t have :
  - adopt “standard” / existing benchmark workload
  - test your tuning, your HW, your database Engine
  - try to adapt the workload conditions to be more close to your production
  - etc..
- Don’t arrange feet to boots (BenchMarketing)..

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..” ;-))
  - And even if you were doing something wrong, try to understand its impact..
  - (Best Practice #1 once again ;-))

“Generic” Test Workloads @MySQL

- Sysbench
  - “Entry Ticket” Workloads, looks simple, but still the most complete test kit !
  - OLTP, RO/RW, N-tables, lots test workload load options, deadlocks
- DBT2 / TPCC-like
  - OLTP, RW, pretty complex, growing db, no options, deadlocks
  - in reality using mostly 2 tables only! (thanks Performance Schema ;-))
- dbSTRESS
  - OLTP, RO/RW, several tables, one most hot, configurable, no deadlocks
- iiBench
  - pure INSERT bombarding (like time series) + optionally SELECTs
- LinkBench (Facebook)
  - OLTP, RW, looks intensive and IO-hungry, needs more investigations..
- DBT3
  - DWH, RO, complex heavy queries, loved by Optimizer Team ;-)

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #1 - Read-Only, In-Memory
  - dataset : not too small, not too big - for ex. 10M x 8-tables
  - tuning : just default
  - goals :
    - check the max QPS you can obtain..
    - do you scale with growing load ?..
    - what is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))
- Note :
  - be sure your queries are having a “good” execution plan, no missed indexes, etc..
  - get this all fixed first, otherwise no need to continue ;-)

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #2 - Read-Only, In-Memory
  - dataset : much bigger than in Step #1, but still in-memory.. - for ex. 50M x 8-tables
  - tuning : just default
  - goals :
    - check the max QPS you can obtain.. - and now also vs Step #1
    - do you still scale with growing load ?..
    - what is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #3 - Read-Only, 1/2 In-Memory (going IO-bound)
  - dataset : same as in Step #2, just BP size = 1/2 of dataset size
  - tuning :
    - BP size = 1/2 dataset
    - O_DIRECT_NO_FSYNC (to be sure we don’t read from FS cache)
  - goals :
    - your IO subsystem will be much involved now..
    - check the max QPS you can obtain.. - and now also vs Step #2
    - do you still scale with growing load ?..
    - are you already blocked by IO ?..
    - what else is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #4 - Read-Only, 1/4 In-Memory (going very IO-bound)
  - dataset : same as in Step #2, just BP size = 1/4 of dataset size now
  - tuning :
    - BP size = 1/4 dataset
    - O_DIRECT_NO_FSYNC (to be sure we don’t read from FS cache)
  - goals :
    - your IO subsystem will be yet much more involved now..
    - check the max QPS you can obtain.. - and now also vs Step #2 & #3..
    - do you still scale with growing load ?..
    - are you already blocked by IO ?..
    - what else is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #1-bis - Read+Write, In-Memory
  - dataset : not too small, not too big - for ex. 10M x 8-tables
  - tuning :
    - use big REDO (ex. 32GB), enough BP instances (ex.16), O_DIRECT+AIO, IO capacity..
    - trx_commit=1
  - goals :
    - follow your Checkpoint Age, tune IO capacity / IO capacity max, see your flushing rate/time
    - check the max QPS you can obtain..
    - do you scale with growing load ?.. do you need to limit concurrency ?..
    - what is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))
- Note :
  - be sure your workload is free of “artificial” deadlocks, etc.
  - get this all fixed first, otherwise no need to continue ;-)

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #2-bis - Read+Write, In-Memory
  - dataset : much bigger, but still kept in memory - for ex. 50M x 8-tables
  - tuning :
    - use big REDO (ex. 32GB), enough BP instances (ex.16), O_DIRECT+AIO, IO capacity..
    - trx_commit=1
  - goals :
    - follow your Checkpoint Age, tune IO capacity / IO capacity max, do you need to adjust ?
    - check the max QPS you can obtain..
    - do you still scale with growing load ?.. do you need to limit concurrency ?..
    - what is blocking ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #3-bis - Read+Write, 1/2 In-Memory
  - dataset : same as in #2-bis, BP size= 1/2 dataset
  - tuning :
    - use big REDO (ex. 32GB), enough BP instances (ex.16), O_DIRECT+AIO, IO capacity..
    - trx_commit=1
  - goals :
    - follow your Checkpoint Age, tune IO capacity / IO capacity max, do you need to adjust ?
    - follow your free pages demand rate => you'll probably need to adjust LRU depth..
    - follow your LRU flushing/evict rate/times => need adjust cleaners/ BP instances ?..
    - check the max QPS you can obtain..
    - do you still scale with growing load ?.. do you need to limit concurrency ?..
    - what is blocking ?.. are you already limited by IO ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

Test Plan (by Dimitri) / *if you really want to understand..*

- Step #4-bis - Read+Write, 1/4 In-Memory
  - dataset : same as in #2-bis, BP size= 1/4 dataset
  - tuning :
    - use big REDO (ex. 32GB), enough BP instances (ex.16), O_DIRECT+AIO, IO capacity..
    - trx_commit=1
  - goals :
    - follow your Checkpoint Age, tune IO capacity / IO capacity max, do you need to re-adjust ?
    - follow again your free pages demand rate => you'll probably need to Re-adjust LRU depth..
    - follow your LRU flushing/evict rate/times => need Re-adjust cleaners/ BP instances ?..
    - check the max QPS you can obtain..
    - do you still scale with growing load ?.. do you need to limit concurrency ?..
    - what is blocking ?.. are you already limited by IO ?..
    - anyone doing better than you on the same HW/OS ?..
    - if yes : why ?.. => until this remains unresolved, no reason to go more far ;-))

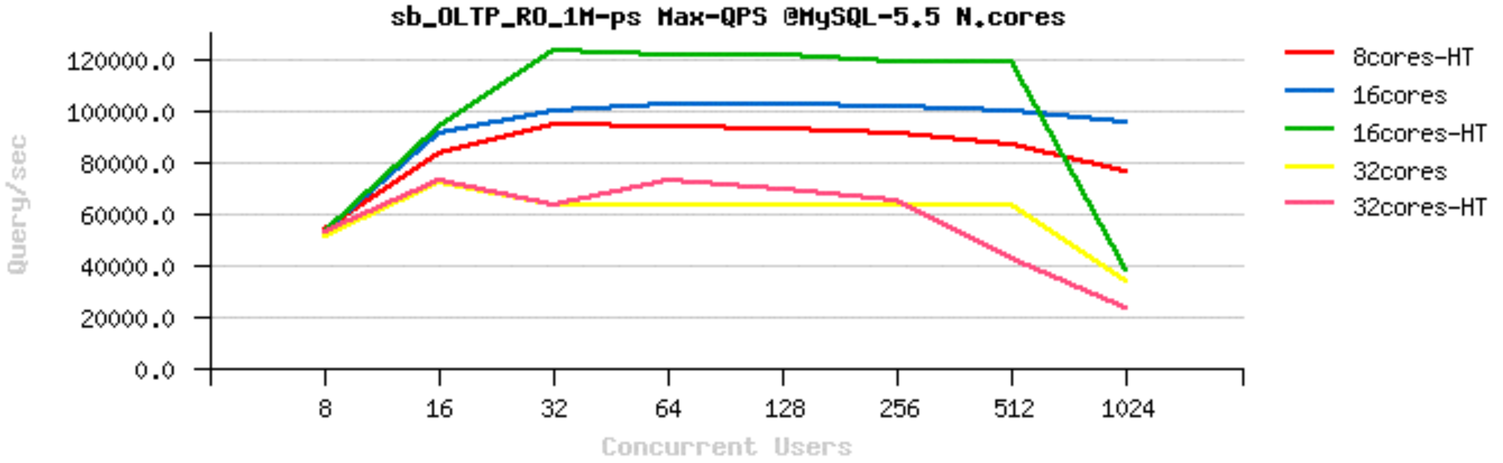
MySQL Performance milestones

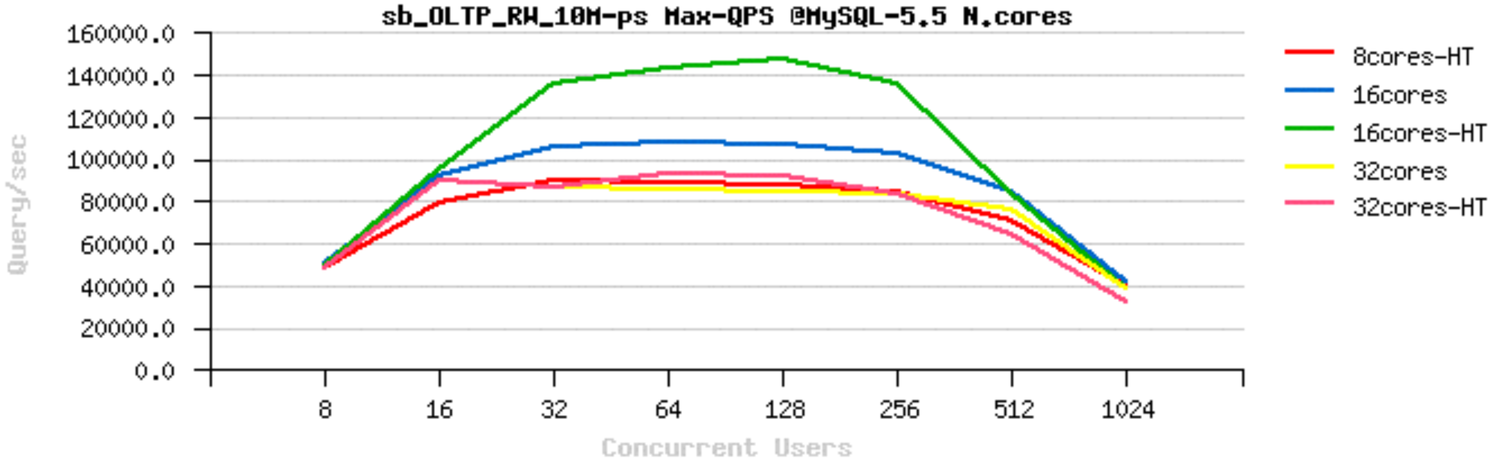
- MySQL 5.5
  - delivered “already known” solutions (except BP instances and few other)..
- MySQL 5.6
  - first fundamental changes (kernel_mutex split, G5 patch, RO transactions, etc..)
- MySQL 5.7
  - finally fully unlocked READs, no more contentions on the “Server” layer, etc..
- MySQL 8.0-dev
  - main focus is on efficiency : do more on the same HW ;-))
  - work in progress..

Why so much attention to RO Performance in MySQL 5.7 ?..

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

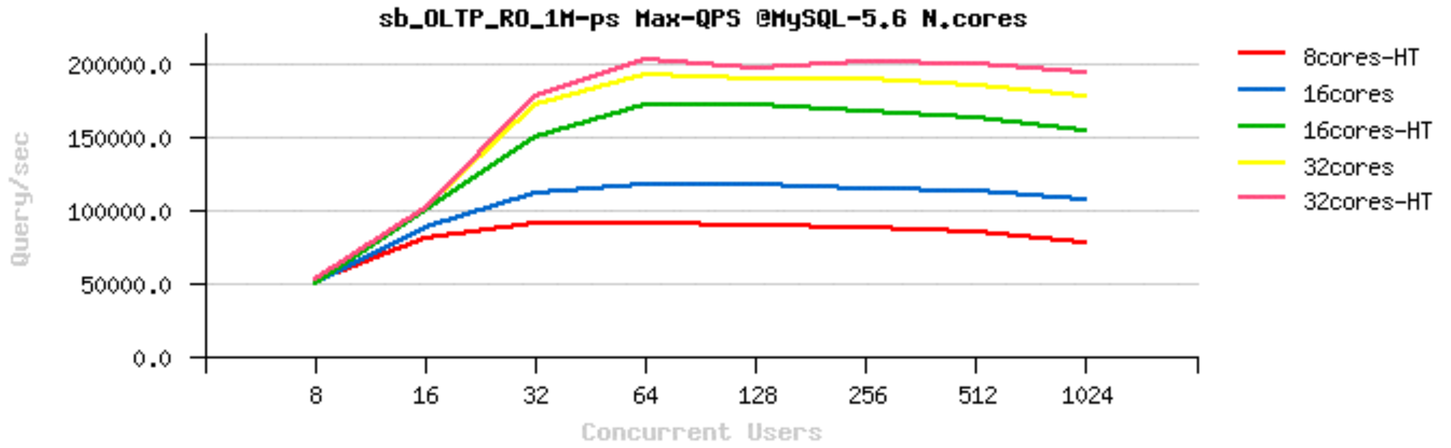
- MySQL 5.5 : RO & RW
  - QPS Max on 16cores
  - worse on 32cores
  - Note: RW out-pass RO!

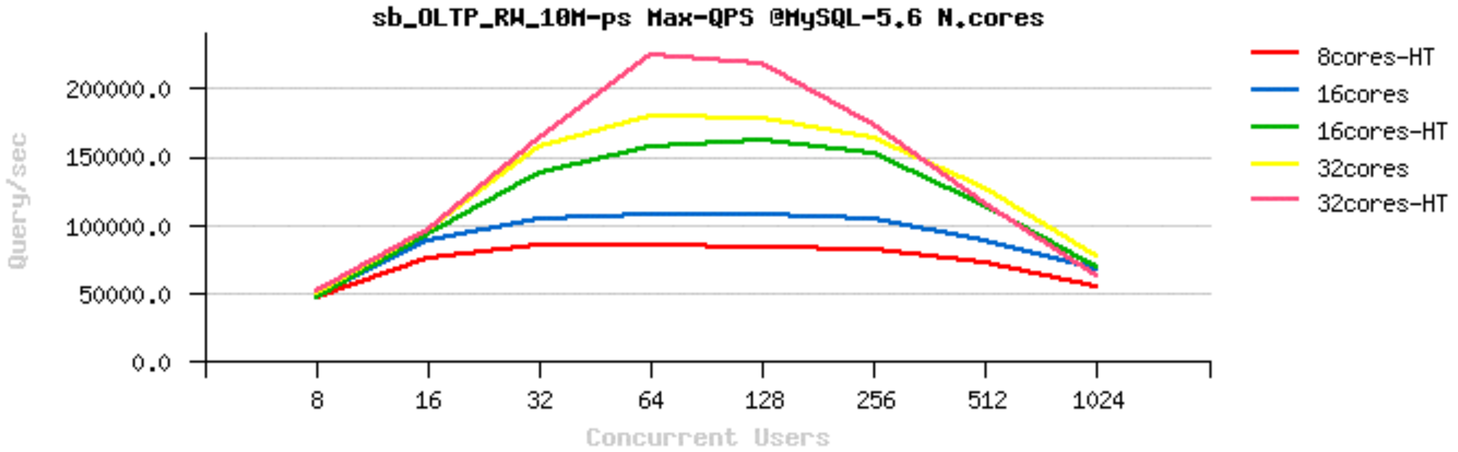




From where we're coming with MySQL 5.7 ?..

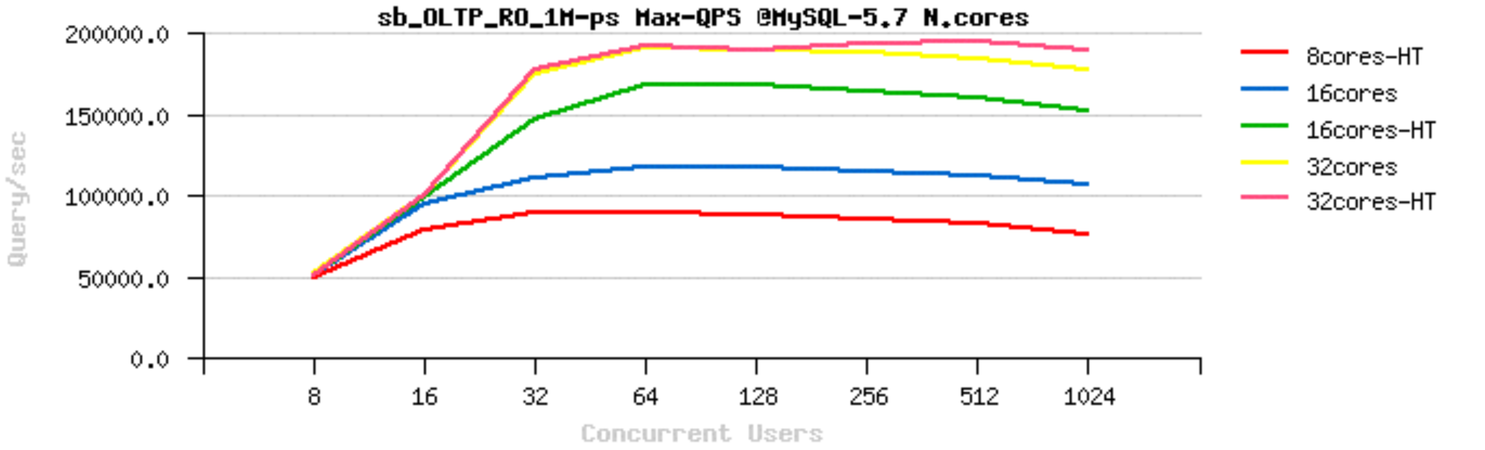
- MySQL 5.6 : RO & RW
  - not lower on 32cores!! ;-)
  - RW out-pass RO !!..??

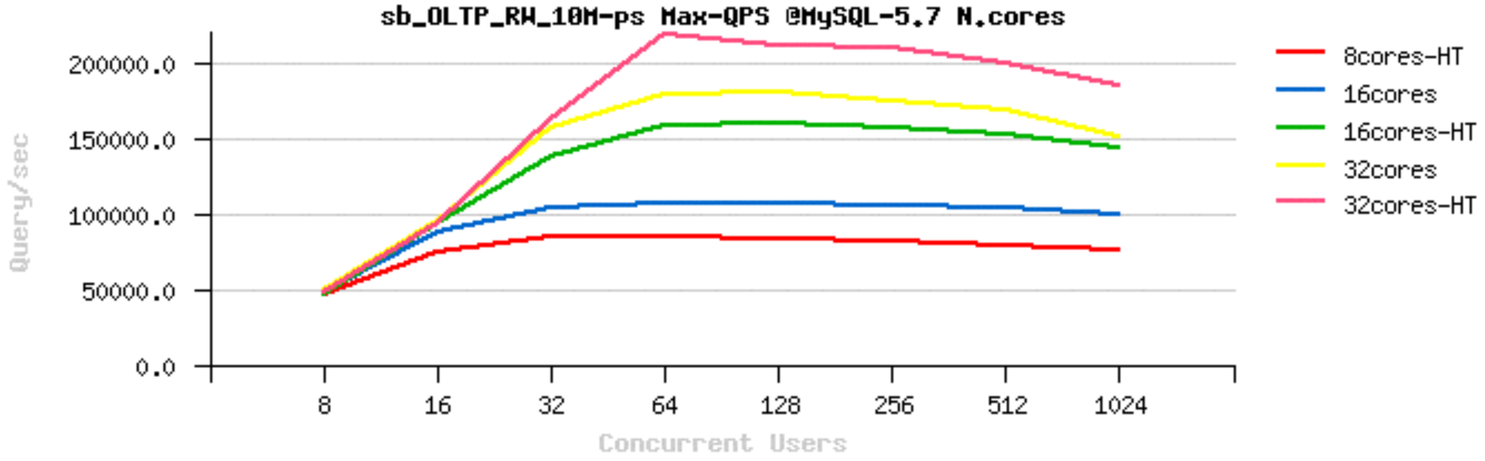




From where we're coming with MySQL 5.7 ?..

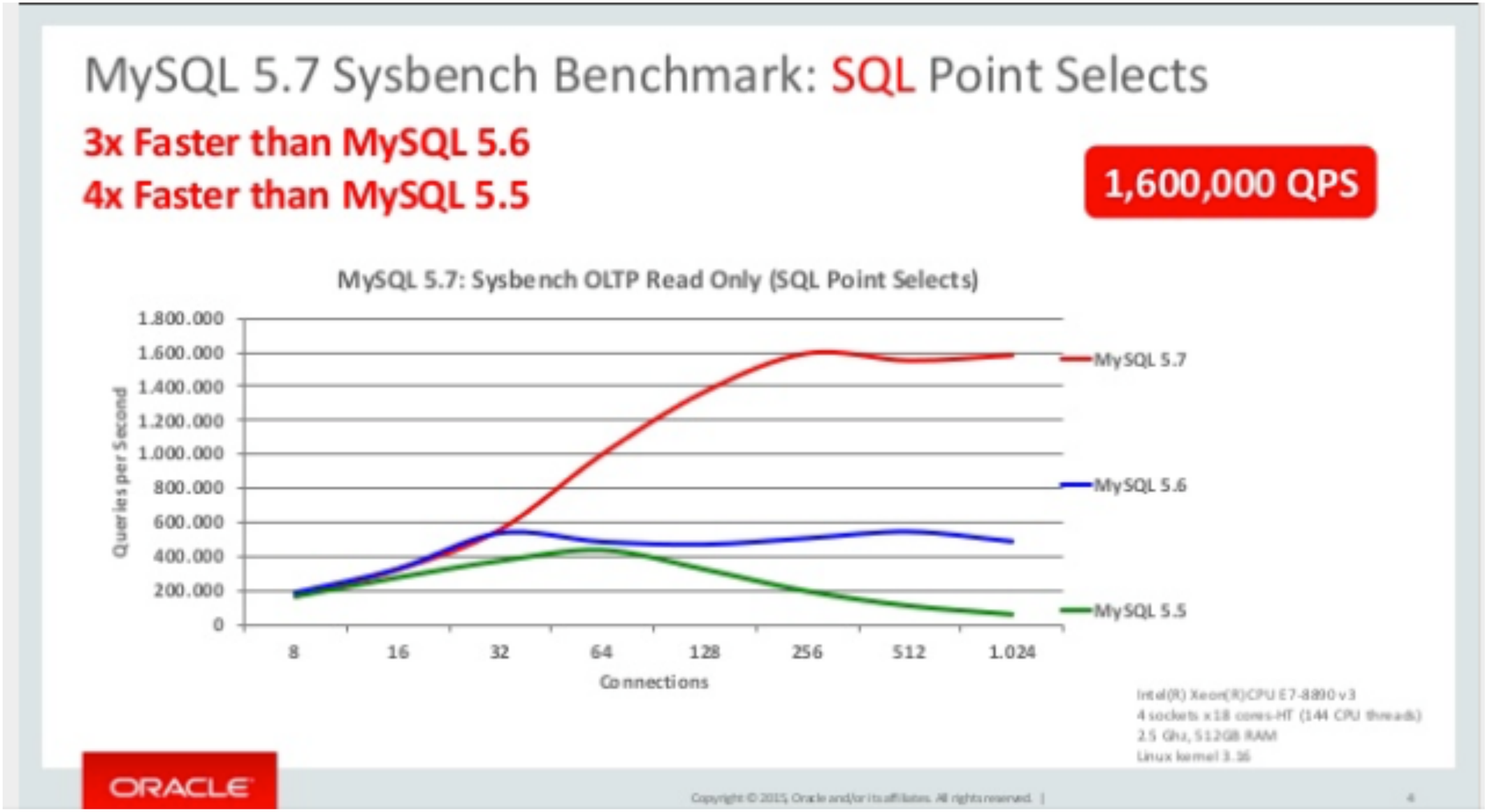
- MySQL 5.7.1 : RO & RW
  - more stable than 5.6
  - **RW** out-pass RO !!..





MySQL 5.7 : 1.6M QPS

- What is behind this number ?..



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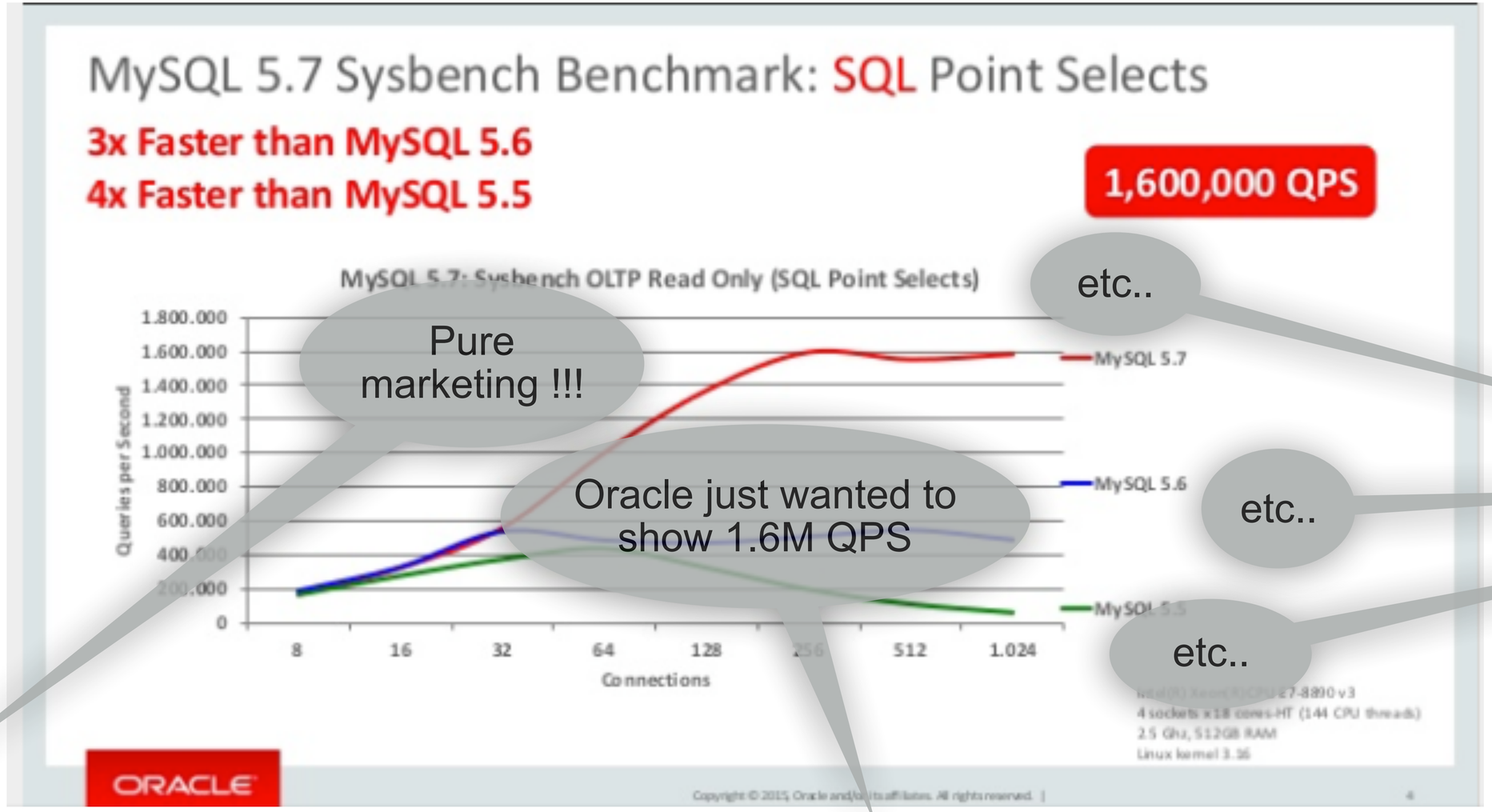
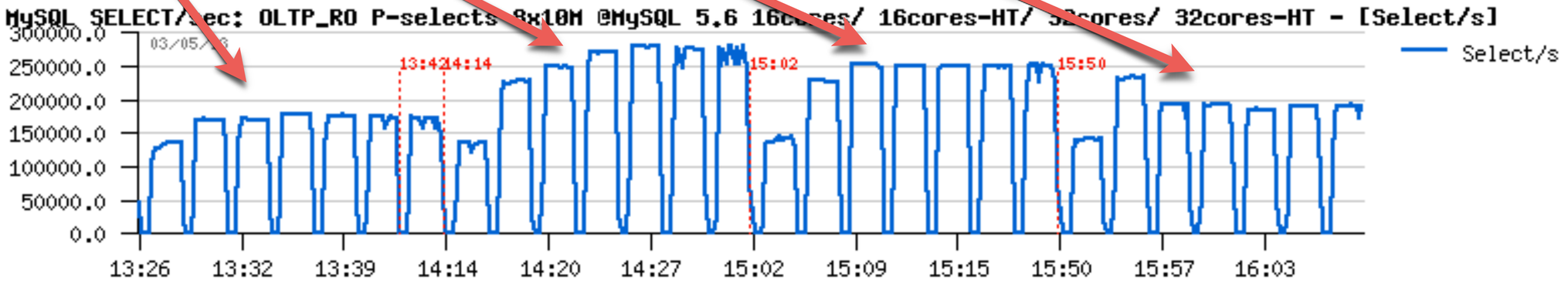
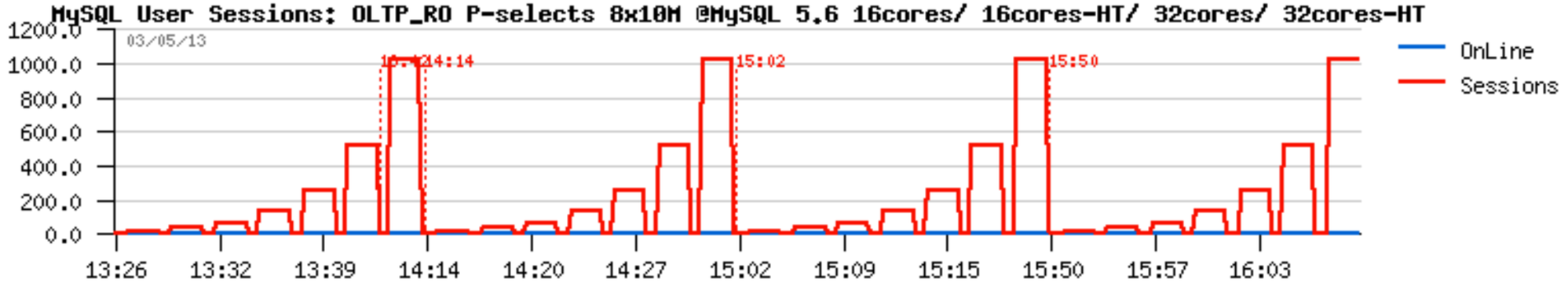


Behind the numbers...

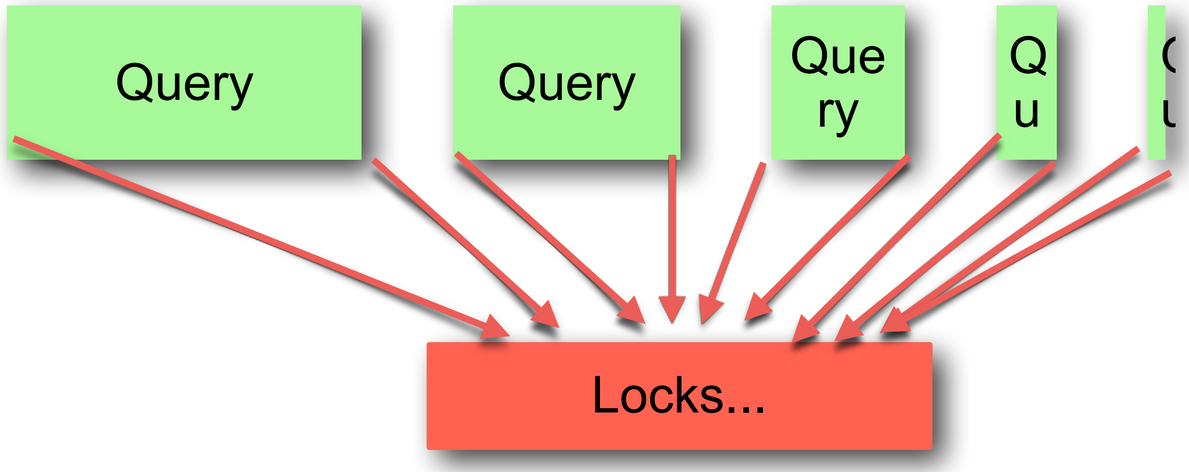
- MySQL 5.6, RO Point-Select Performance
  - 16cores, 16cores-HT, 32cores, 32cores-HT

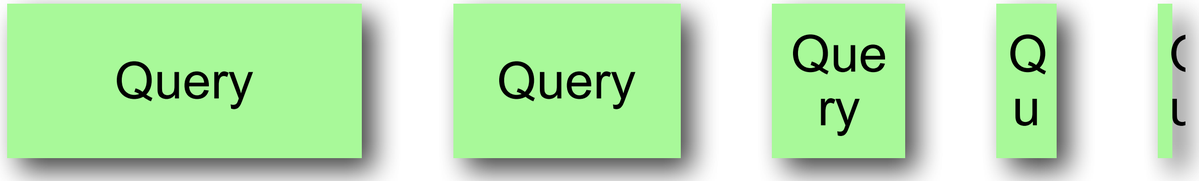




Behind the numbers...

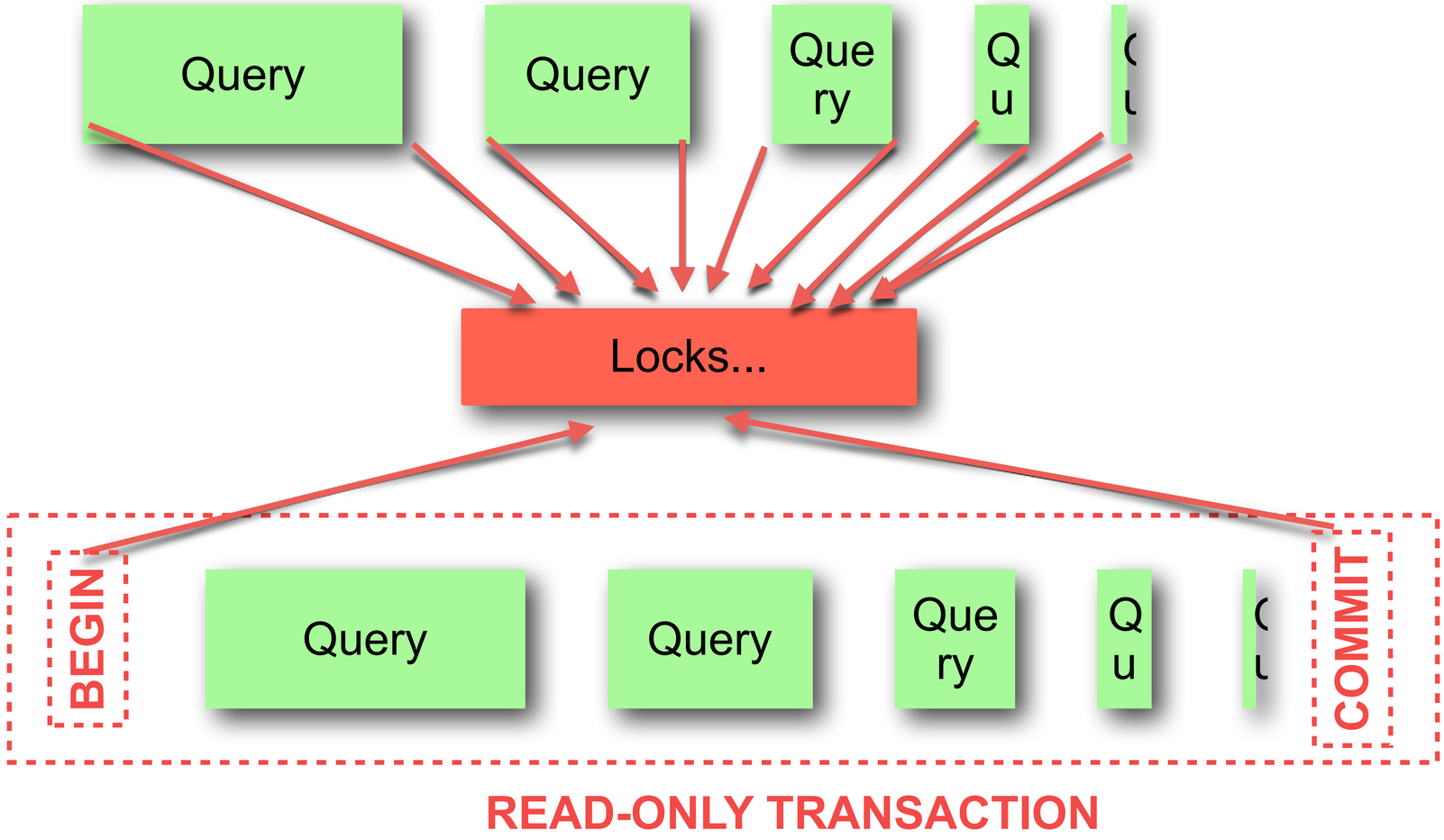
- Why ?..





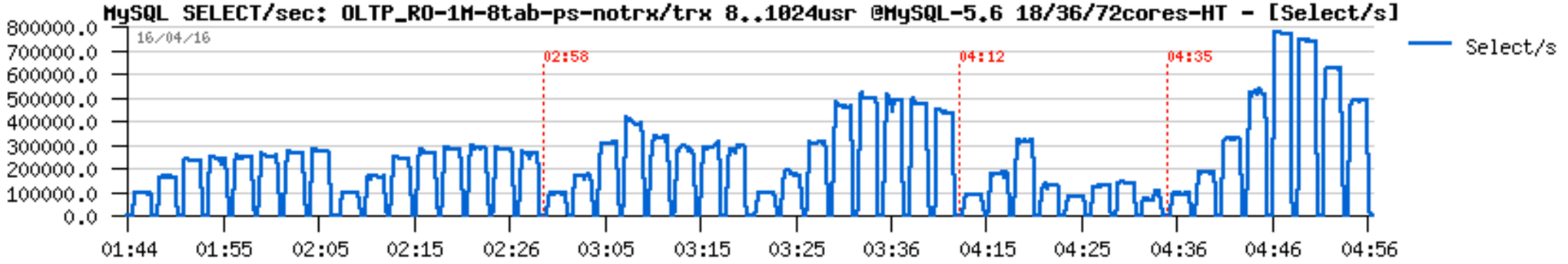
Behind the numbers...

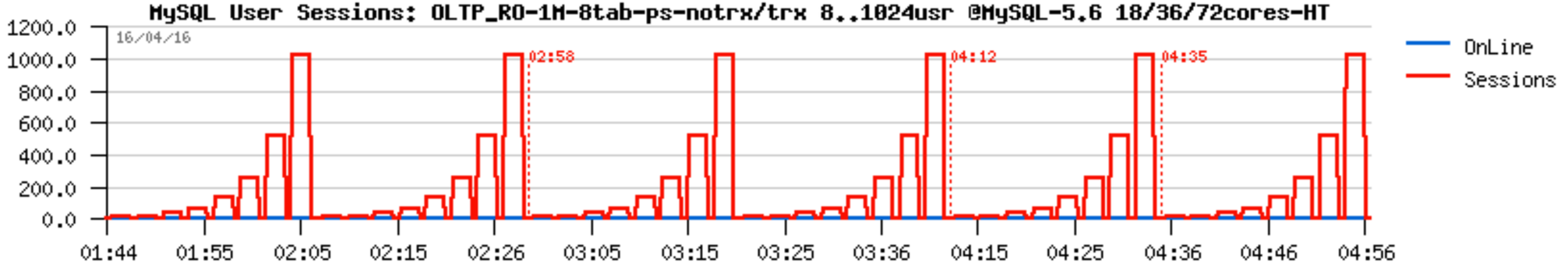
- MySQL 5.6 : Read-Only Transactions "workaround" :



Behind the numbers...

- MySQL 5.6, OLTP_RO-1Mx8-tables, 72cores-HT
  - OLTP_RO : [x14 SELECT Queries]
  - without / with transaction enclosure, 18/36/72cores-HT





Behind the numbers...

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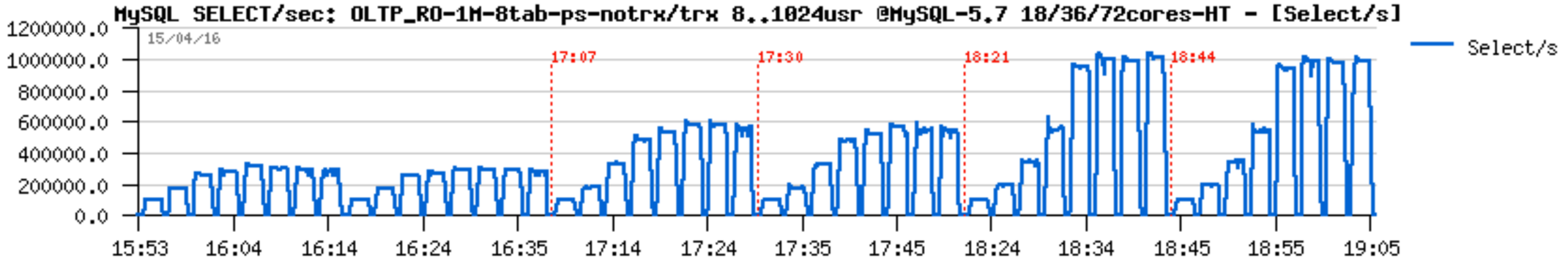
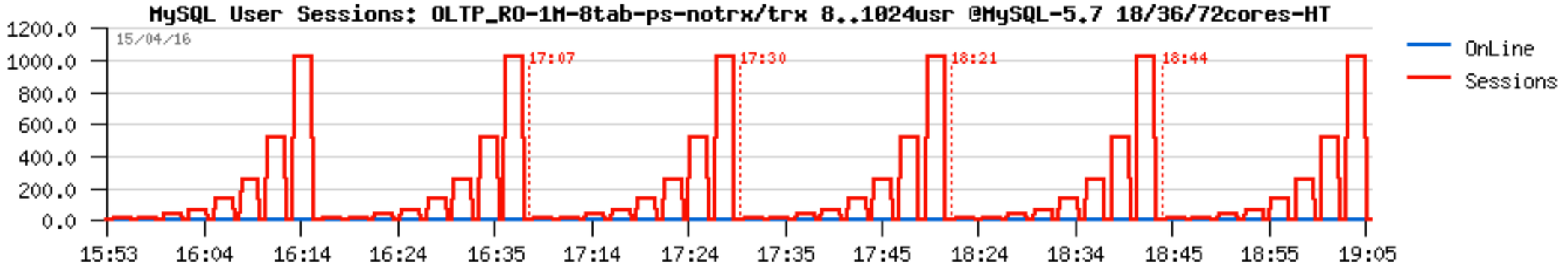


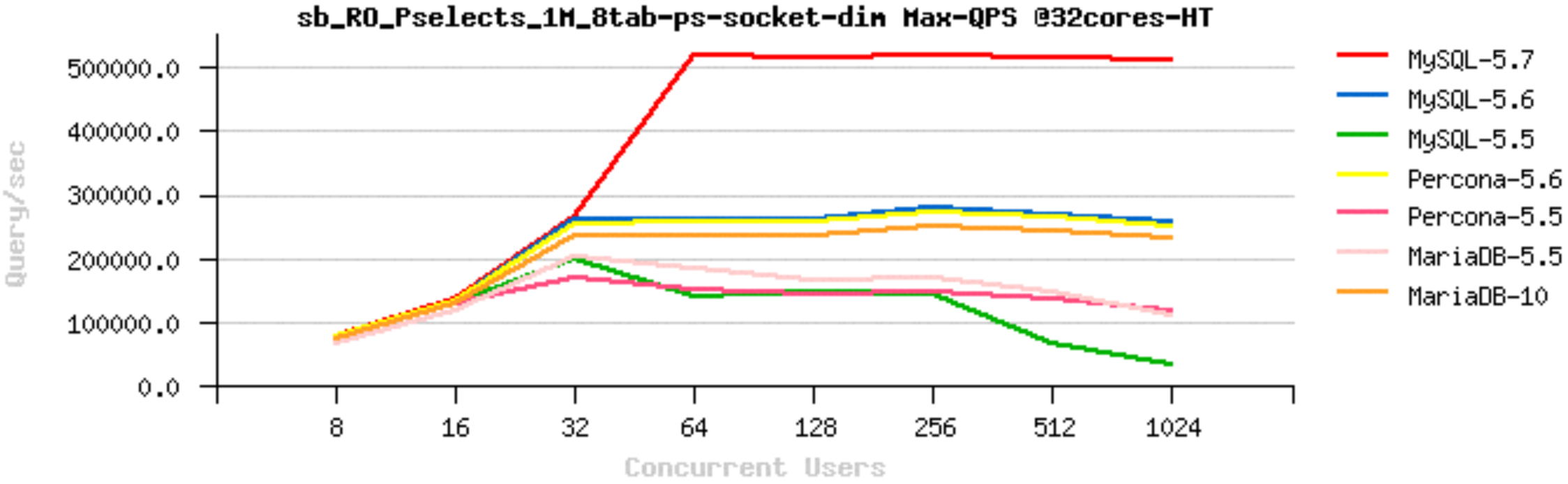


Behind the numbers...

- Up to you to decide what is less or more significant for you..
- If for ex. [x1000(!) Point-Select Queries] in a single transaction is OK
  - as was done by MariaDB to show their 1M QPS result..
  - hm.. and nobody called this BenchMarketing ?..

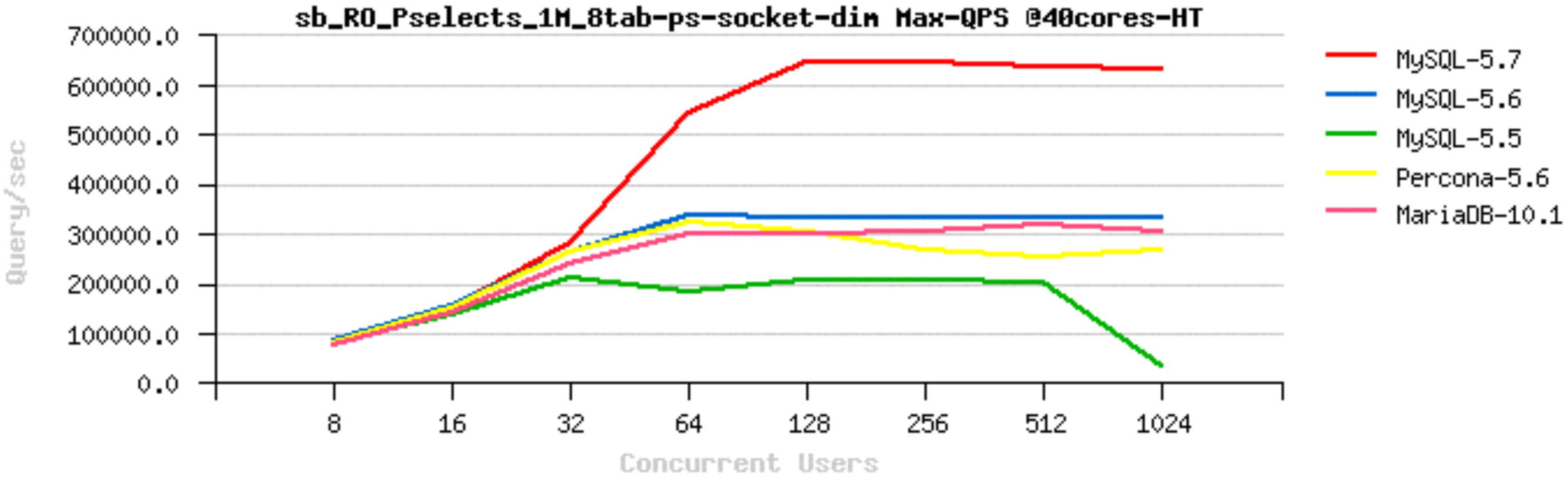
RO In-Memory @MySQL 5.7

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



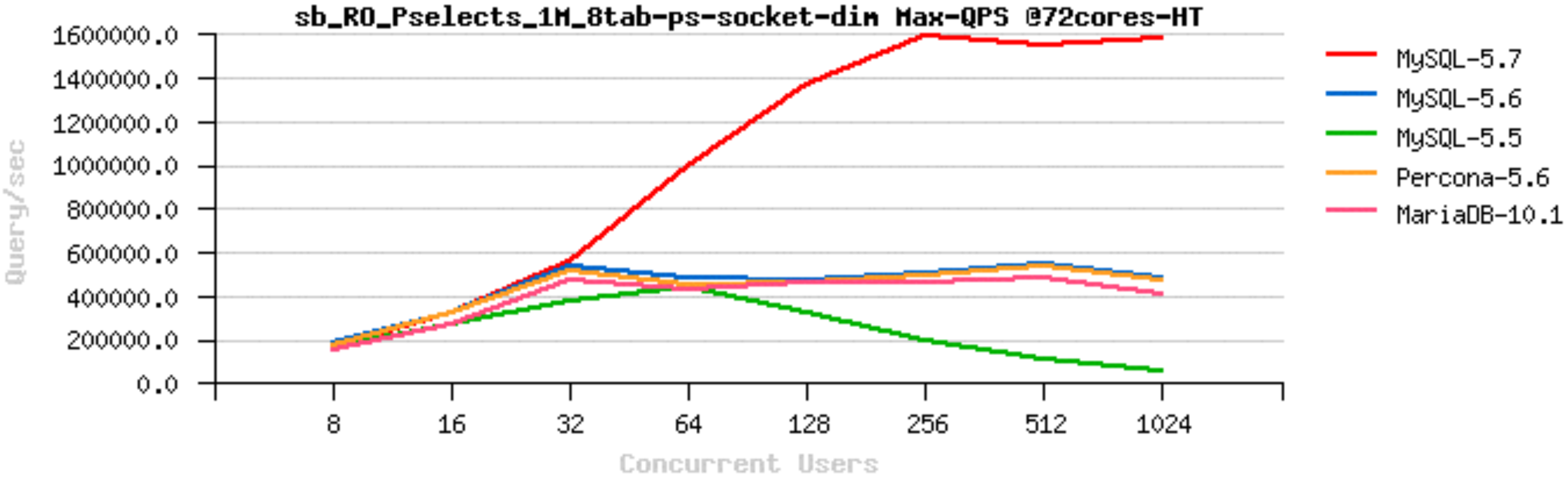
RO In-Memory @MySQL 5.7

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



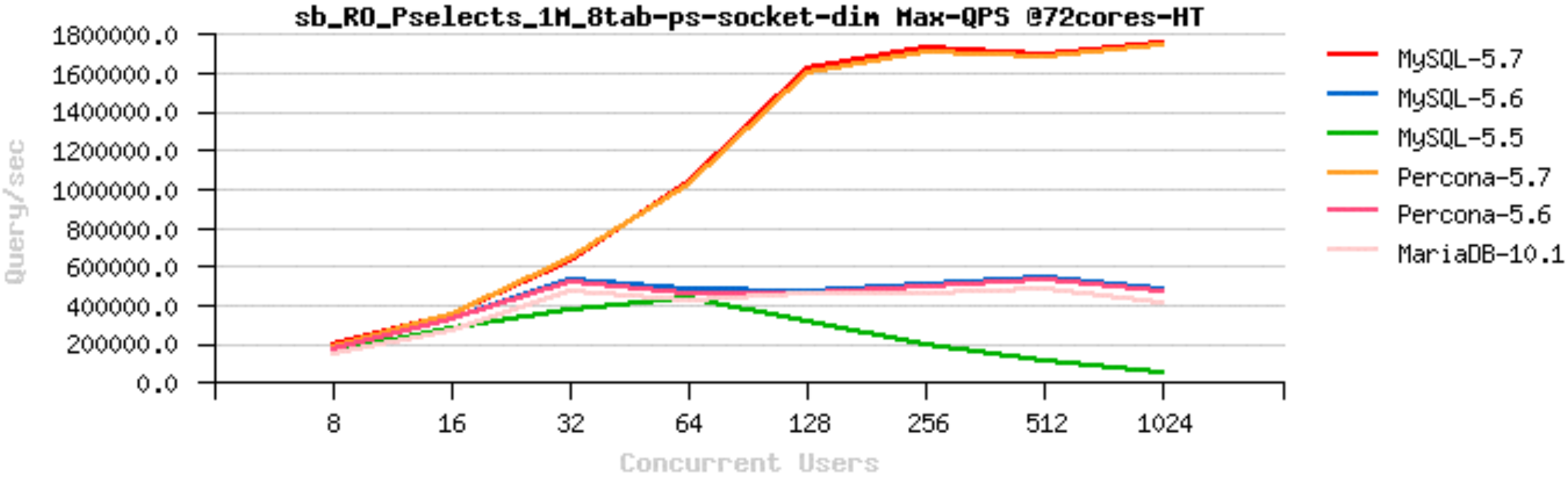
RO Point-Selects @MySQL 5.7 (Oct.2015)

- **1.6M (!!) QPS** Sysbench Point-Selects 8-tab :
  - 72cores-HT



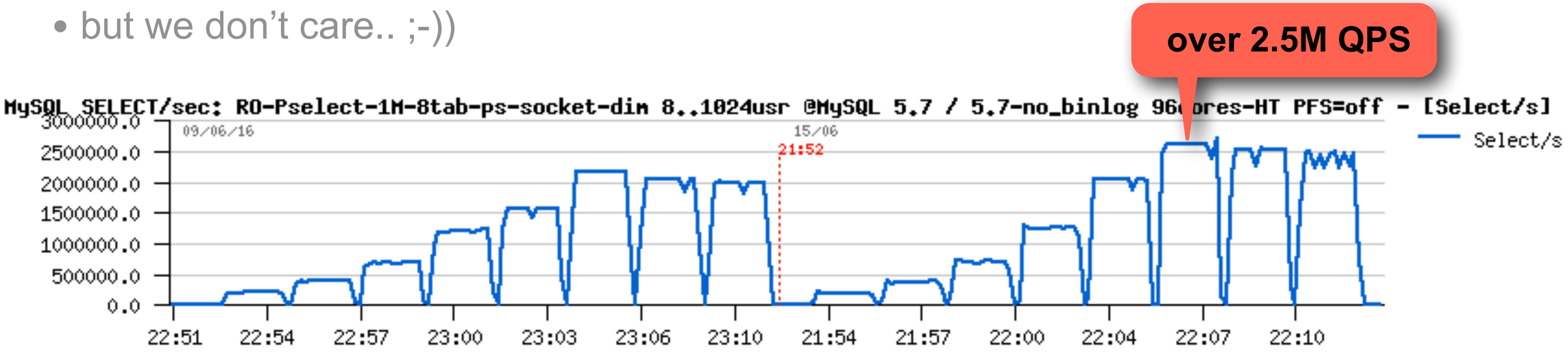
RO Point-Selects @MySQL 5.7 (Apr.2016)

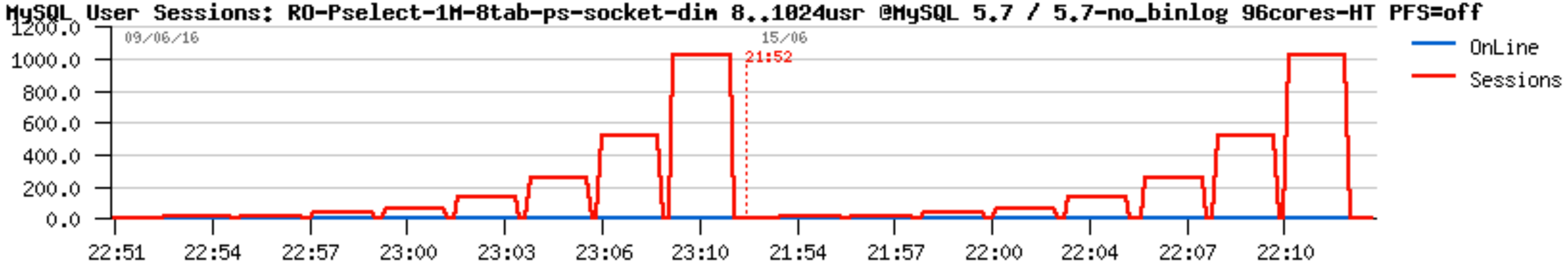
- **1.8M QPS** Sysbench Point-Selects 8-tab, 72cores-HT :
  - or even more, if you really run after numbers.. ;-))



RO Point-Selects @MySQL 5.7 (Jun.2016)

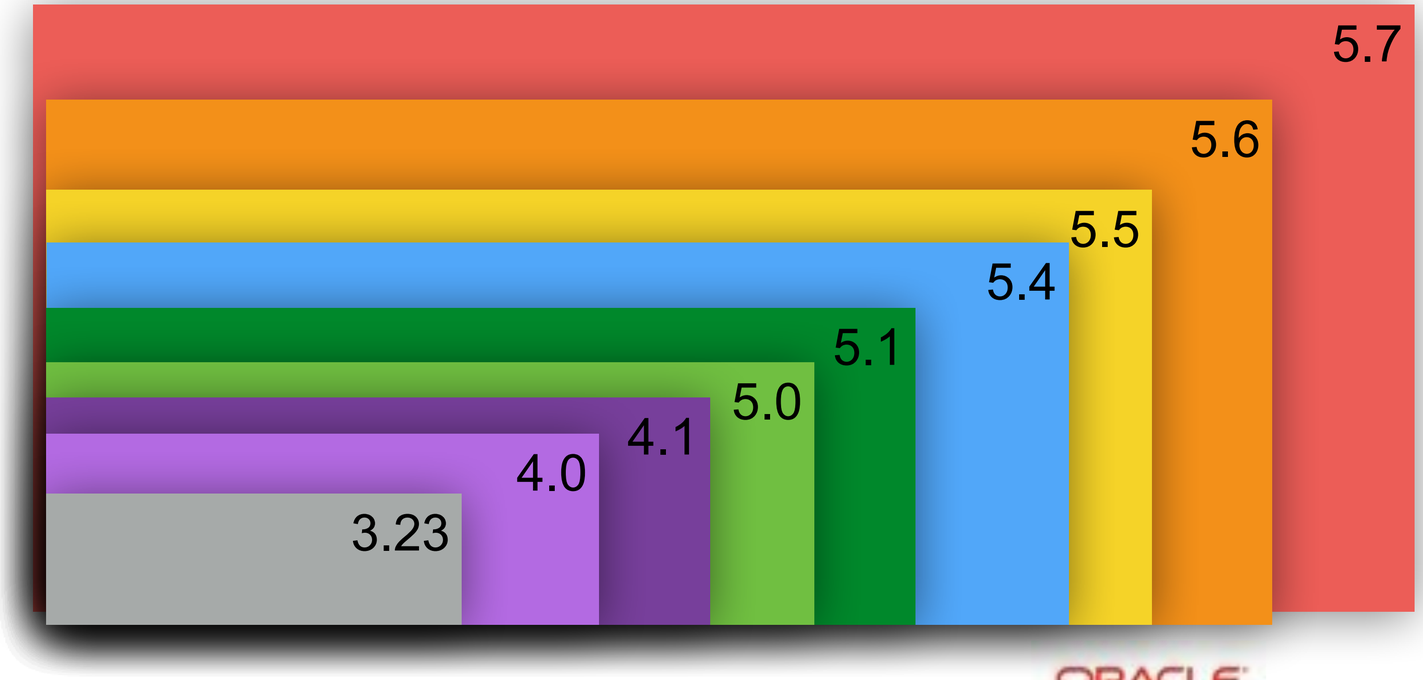
- **2.5M (!!) QPS** Sysbench Point-Selects 8-tab, 96cores-HT :
  - but we don't care.. ;-))





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 every: “What is new in MySQL” by Geir)
  - MySQL/InnoDB code is very sensible to CPU cache(s)..
  - single user / low load => going slower..
- Looking back :
  - Drizzle !
  - “feature less MySQL”..
  - do you know Drizzle ?
  - do you use Drizzle ?
  - do you run your production on ?



MySQL Performance Evolution

- From v
  - 3.23 =
  - more f
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  - single
- Lookin
  - Drizzle
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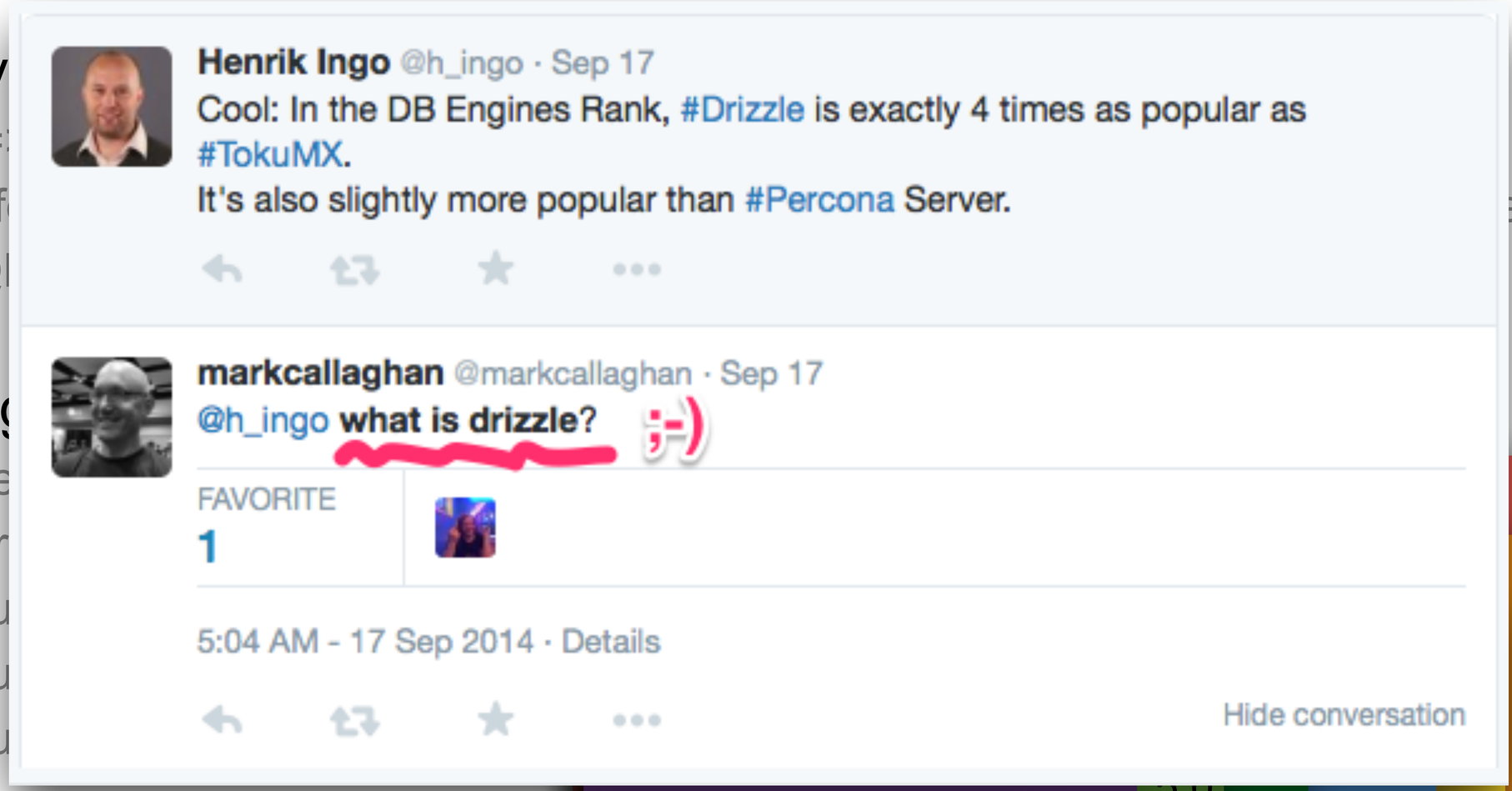
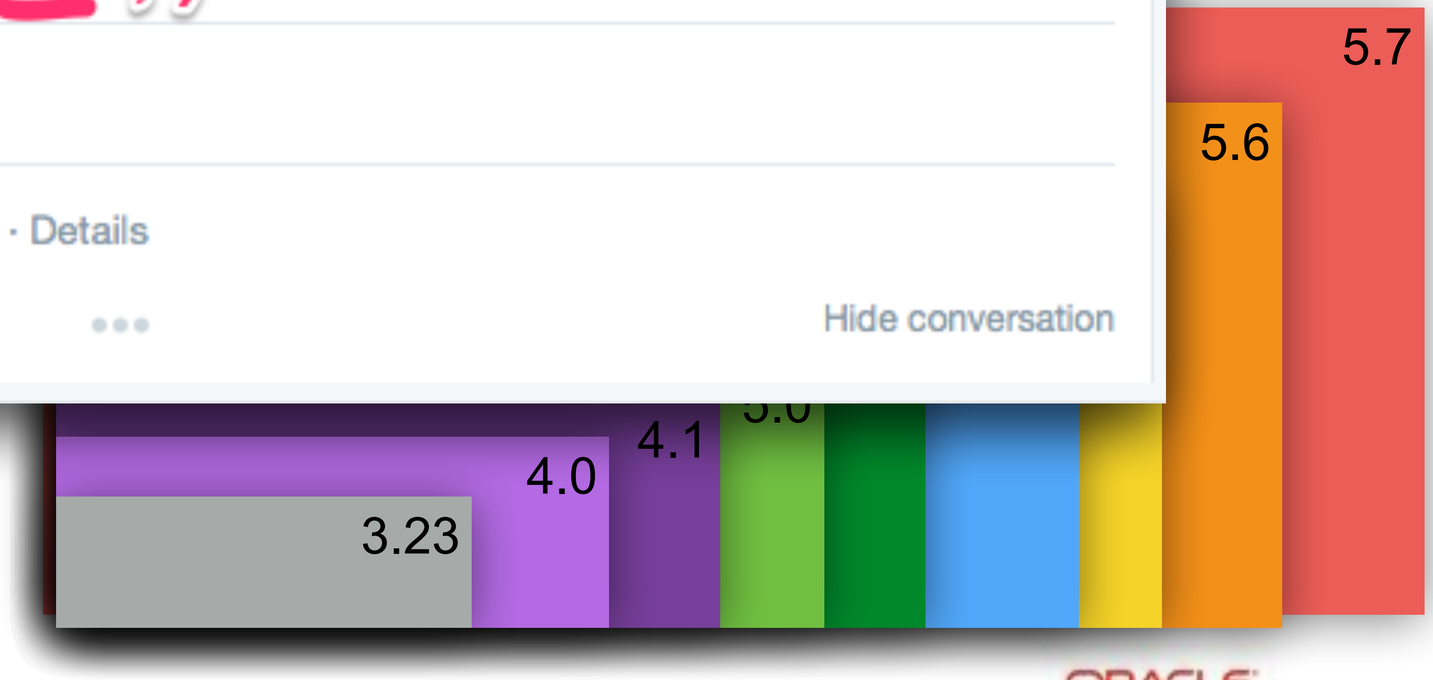
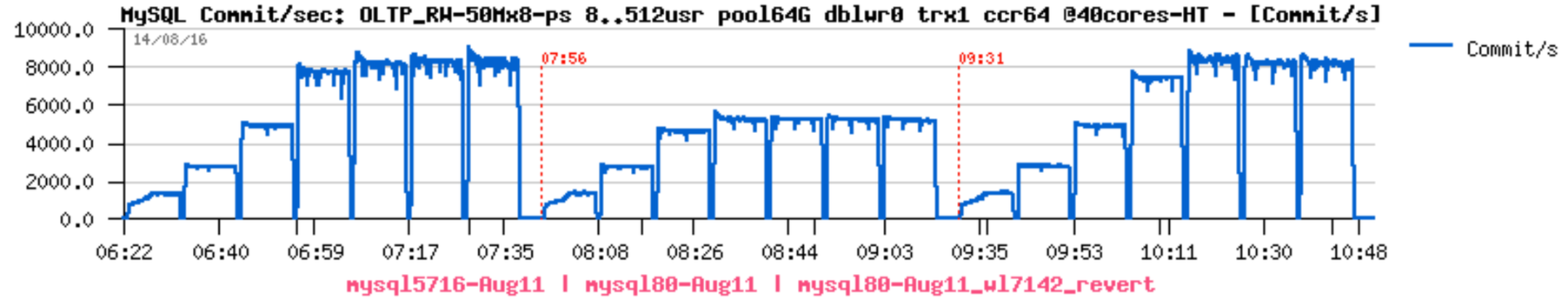
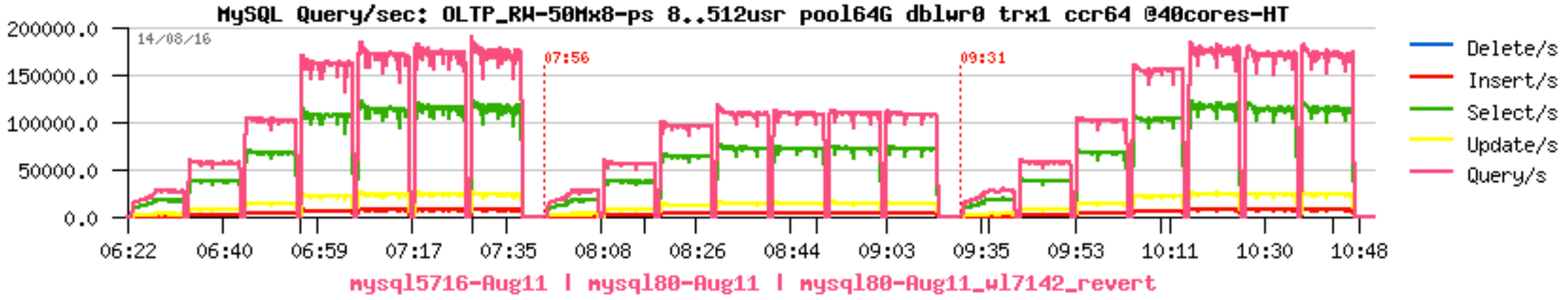




MySQL 8.0 : Why no Performance news until now ?..

- One picture say more than many words ;-)
  - Aug.2016 : revert the changes and re-do the whole work…
  - Team Force : face & fix the problems when they come! (you cannot predict everything)..





Pending issues after MySQL 5.7 GA..

- RO :
  - Block Locks
  - Lookups via Sec.IDX
  - fil_system mutex contention (on every IO)
- RW :
  - Double Write..
  - REDO log related bottlenecks
  - TRX management contentions
  - LOCK management..
  - IO / fil_system
  - RR / RC isolation..
  - UPDATE Performance..
  - INSERT Performance..
  - Purge lagging..
  - …

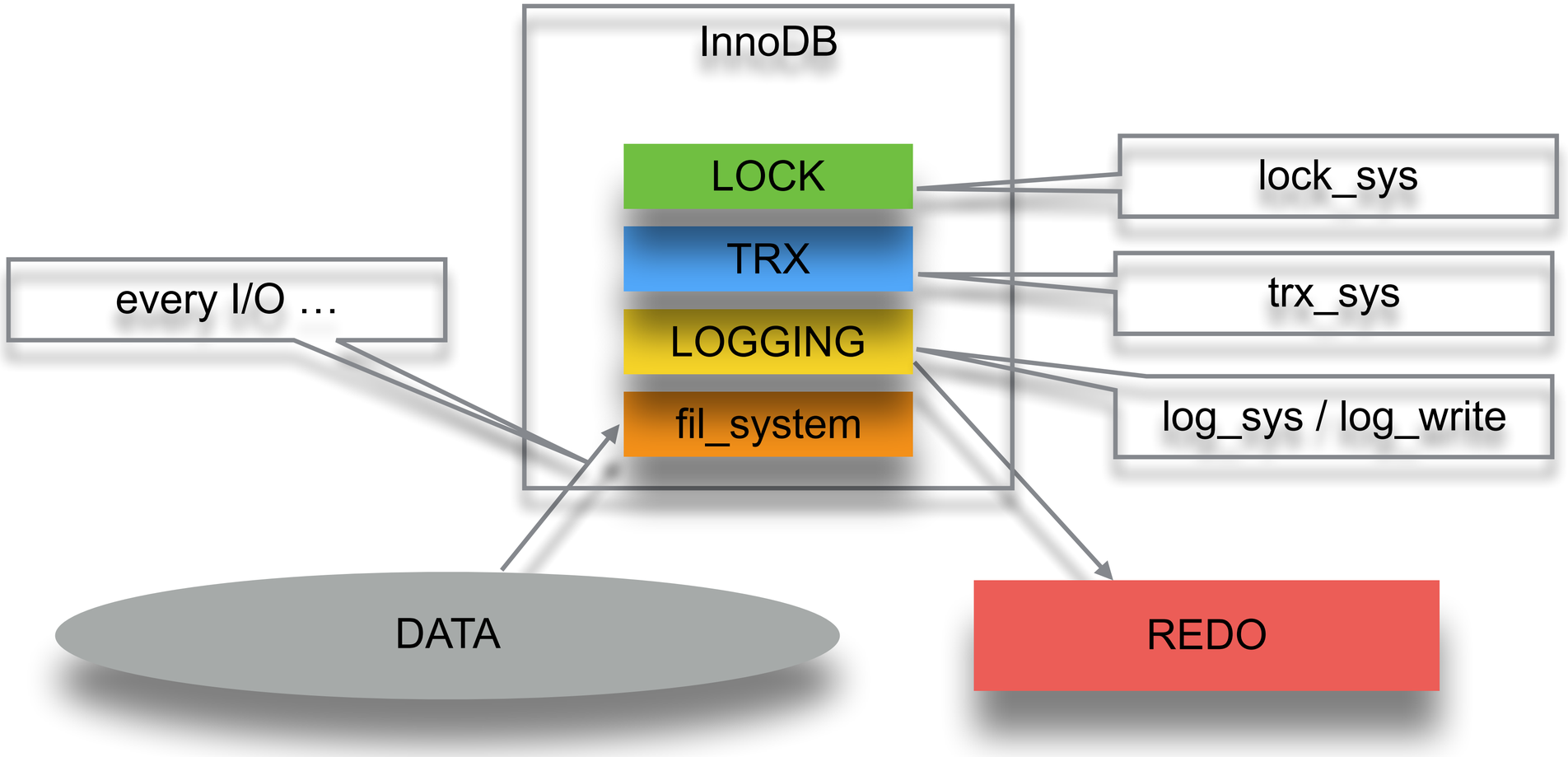
Pending issues after MySQL 5.7 GA..

- RO :
  - Block Locks
  - Lookups via Sec.IDX
  - fil_system mutex contention (on every IO) **<= 8.0-dev**
- RW :
  - Double Write.. **<= 8.0-dev**
  - REDO log related bottlenecks **<= 8.0-dev**
  - TRX management contentions **<= 8.0-dev**
  - LOCK management.. **<= 8.0-dev**
  - IO / fil_system **<= 8.0-dev**
  - RR / RC isolation.. **<= 8.0-dev**
  - UPDATE Performance.. **<= 8.0-dev**
  - INSERT Performance..
  - Purge lagging..
  - …

Few words about Double Write

- Protection from partially written pages..
- Old code is a huge bottleneck itself..
- New code :
  - was ready during winter 2016
  - but not ready on 5.7 GA deadline..
  - means must be validated on 8.0 dev code first..
  - and only then “back-ported” to 5.7 ..
  - but on 8.0 some pre-required changes should be approved before..
  - so, 5.7 still has no new code ;-)
  - expected performance impact : if storage is able to keep x2 higher writes, **then no diff (!)**
  - (double write : writing x2 times more)
- But real fix : get a rid of it ;-)
  - not for soon yet..

MySQL 8.0-dev : New Design for InnoDB Fundamentals..

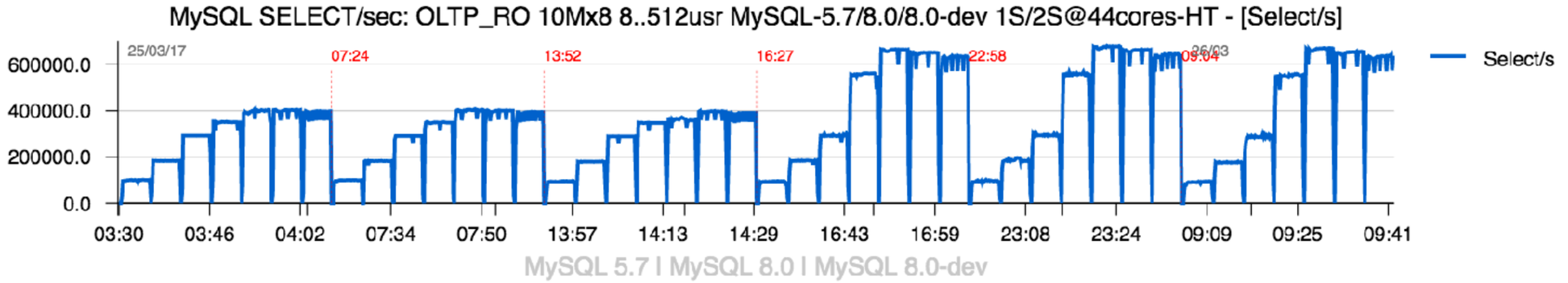


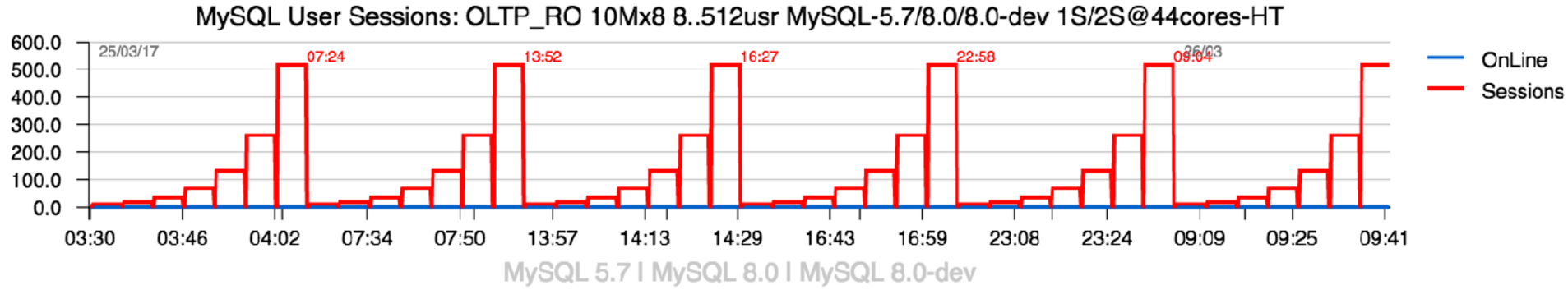
MySQL 8.0-dev Performance : Following “The Test Plan”

- HW :
  - 4S 40cores-HT / 2S 44cores-HT / 4S 96cores-HT (RAM: >= 256G)
    - bug on Linux kernel not allowing to use 96cores fully, so presenting mainly 1S/2S 44cores result
- Workloads :
  - Sysbench RO/ RW/ Update-NoKEY, 10Mx8 / 50Mx8, uniform / pareto
  - DBT2 W1000/ LinkBench-150G/ dbSTRESS-20M (400M)/ iiBench-x16-100M
- Config :
  - BP= 128G/ 64G/ 32G
  - trx_commit=1, concurrency=0, spin delay=6
  - O_DIRECT_NO_FSYNC + AIO, EXT4, flash storage (Seagate, Intel, Samsung)
  - redo 32GB, io capacity max up to 40K
  - RR / RC isolation, VATS
- Load levels:
  - 8, 16, 32, .. 512 concurrent users

Sysbench OLTP_RO 10Mx8-tables

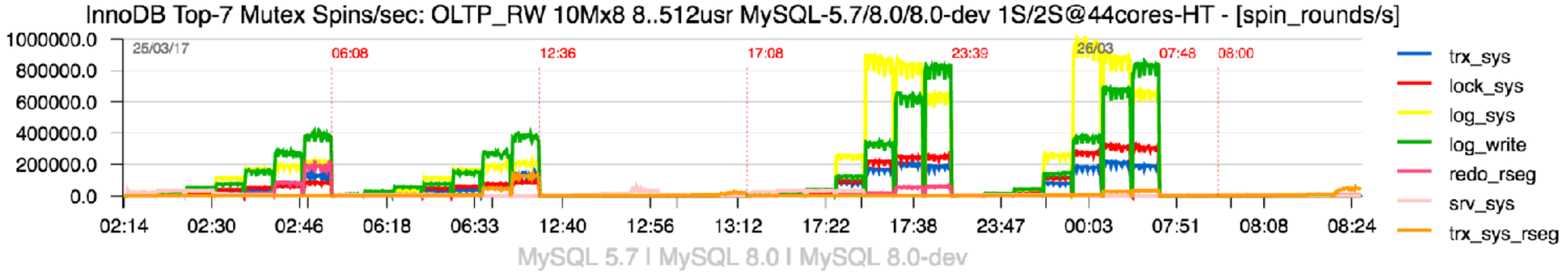
- Observations :
  - same QPS on 5.7 / 8.0-dev, no impact, fine..

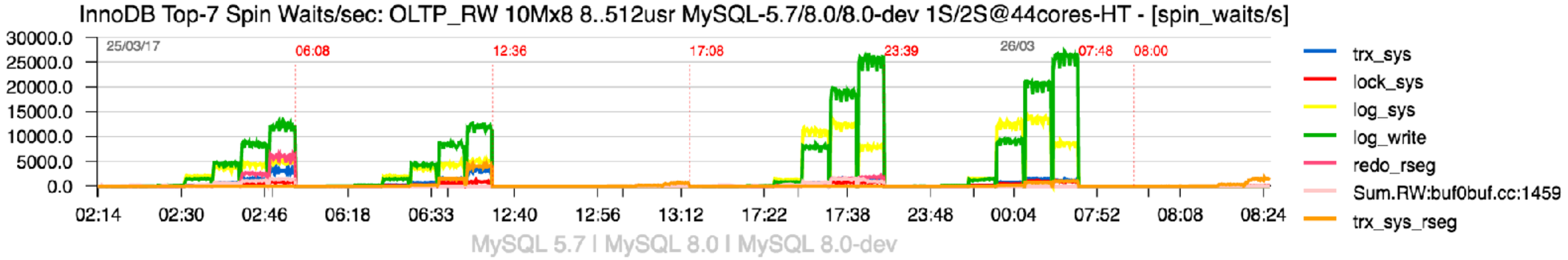




Sysbench OLTP_RW 10Mx8-tables

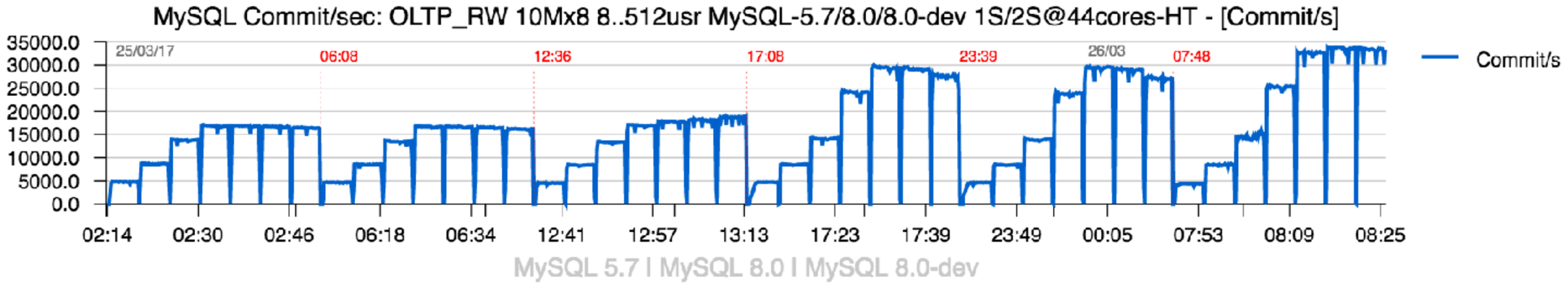
- Observations :
  - 8.0-dev : all hot spin waits are gone..
  - so, what about performance ?..

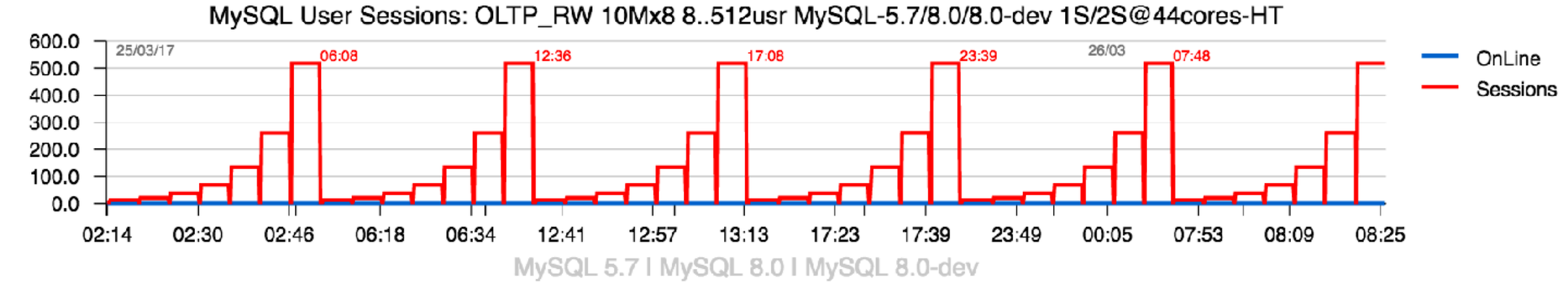




Sysbench OLTP_RW 10Mx8-tables

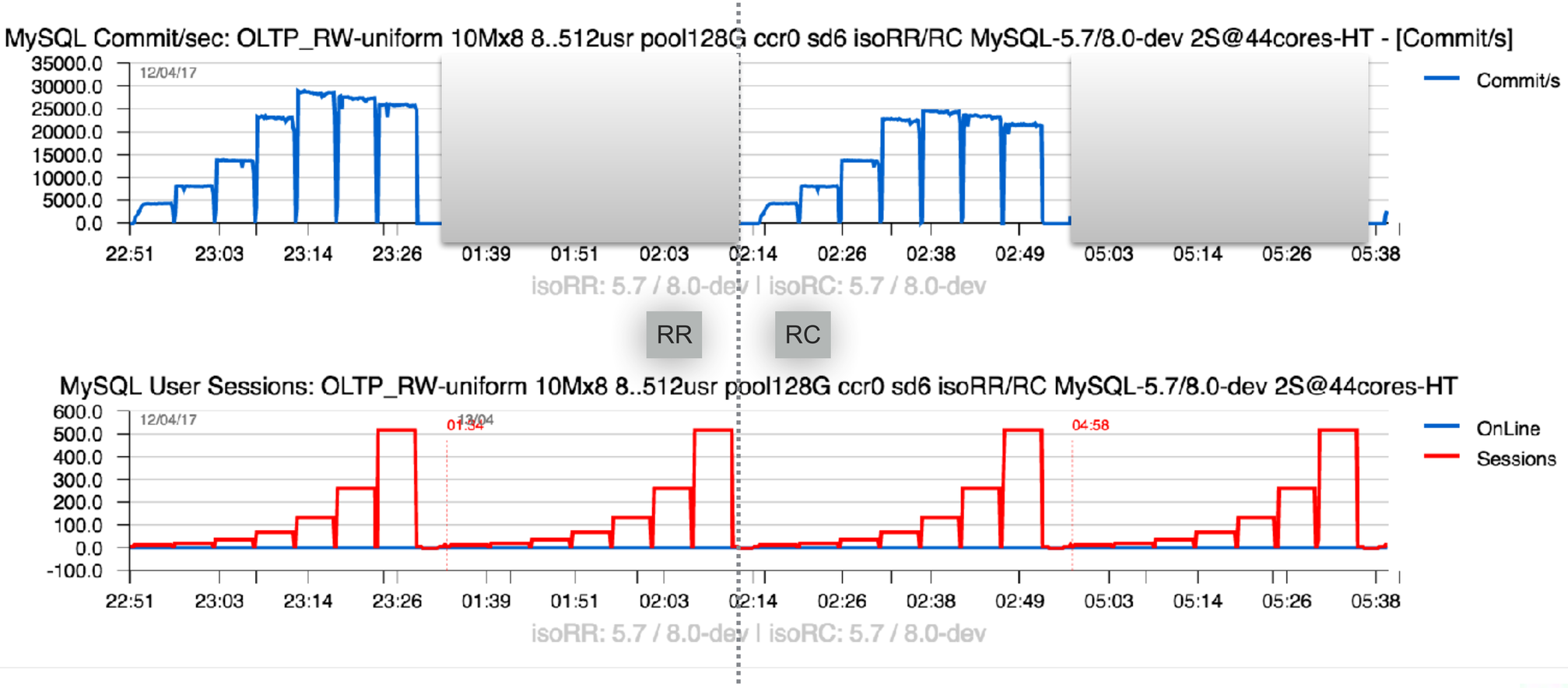
- Observations :
  - 8.0-dev : clear gain, but not more than 10%-15%, why ?..
  - yes, WRITE waits are gone, but mind that READs are dominating in this workload..





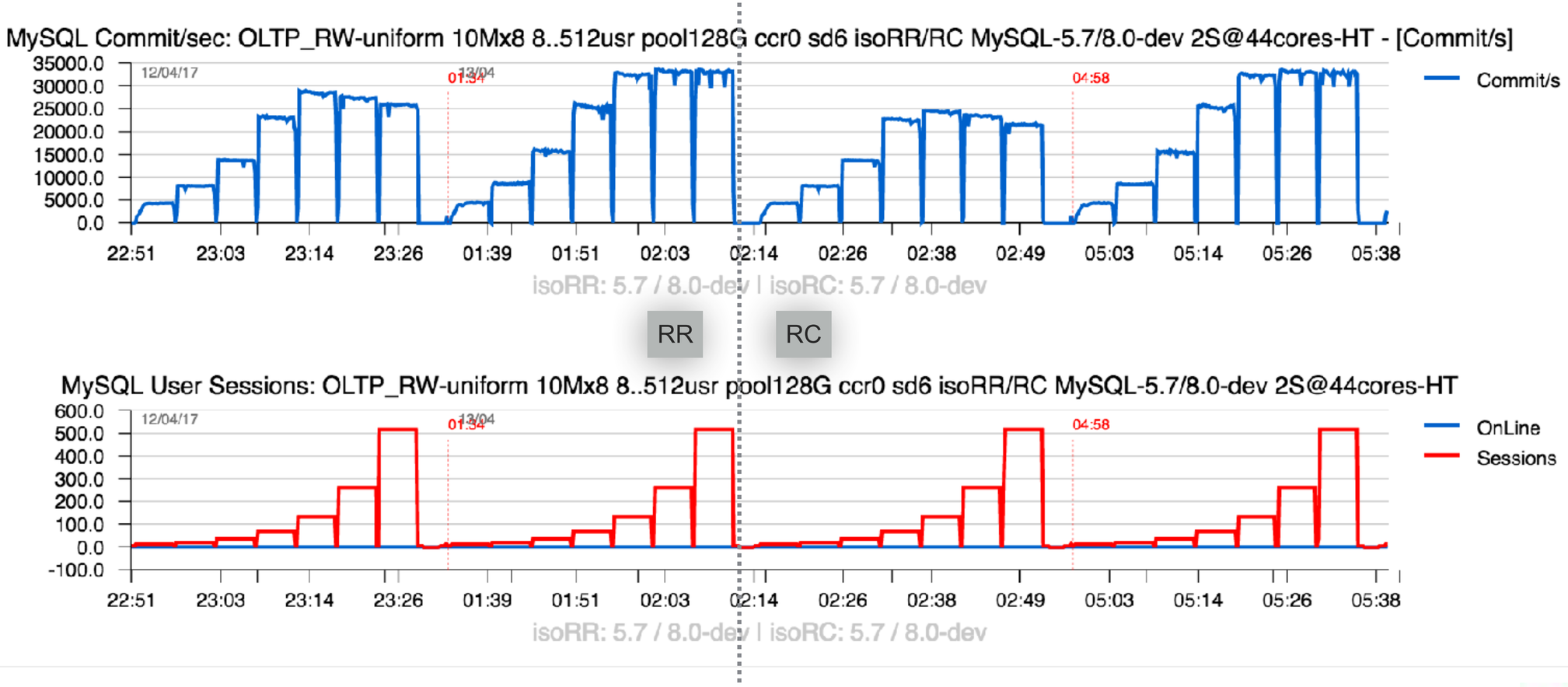
Sysbench OLTP_RW 10Mx8-tables - RR/RC Isolation

- Observations :
  - 5.7 : drop on RR => RC isolation.. (known issue from a very long time, trx_sys cost)..
  - 8.0-dev : … ?



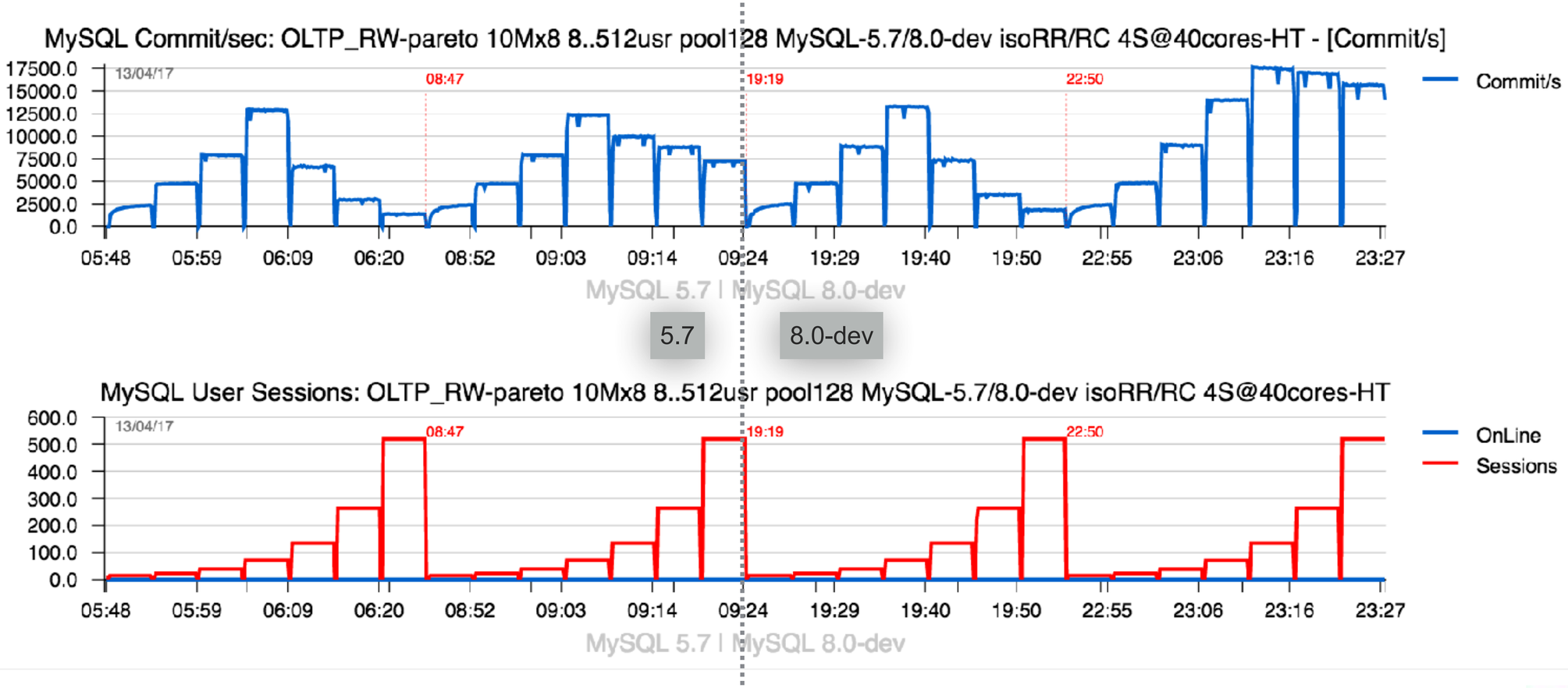
Sysbench OLTP_RW 10Mx8-tables - RR/RC Isolation

- Observations :
  - 5.7 : drop on RR => RC isolation.. (known issue from a very long time, trx_sys cost)..
  - 8.0-dev : same TPS on RR & RC isolation (!!)



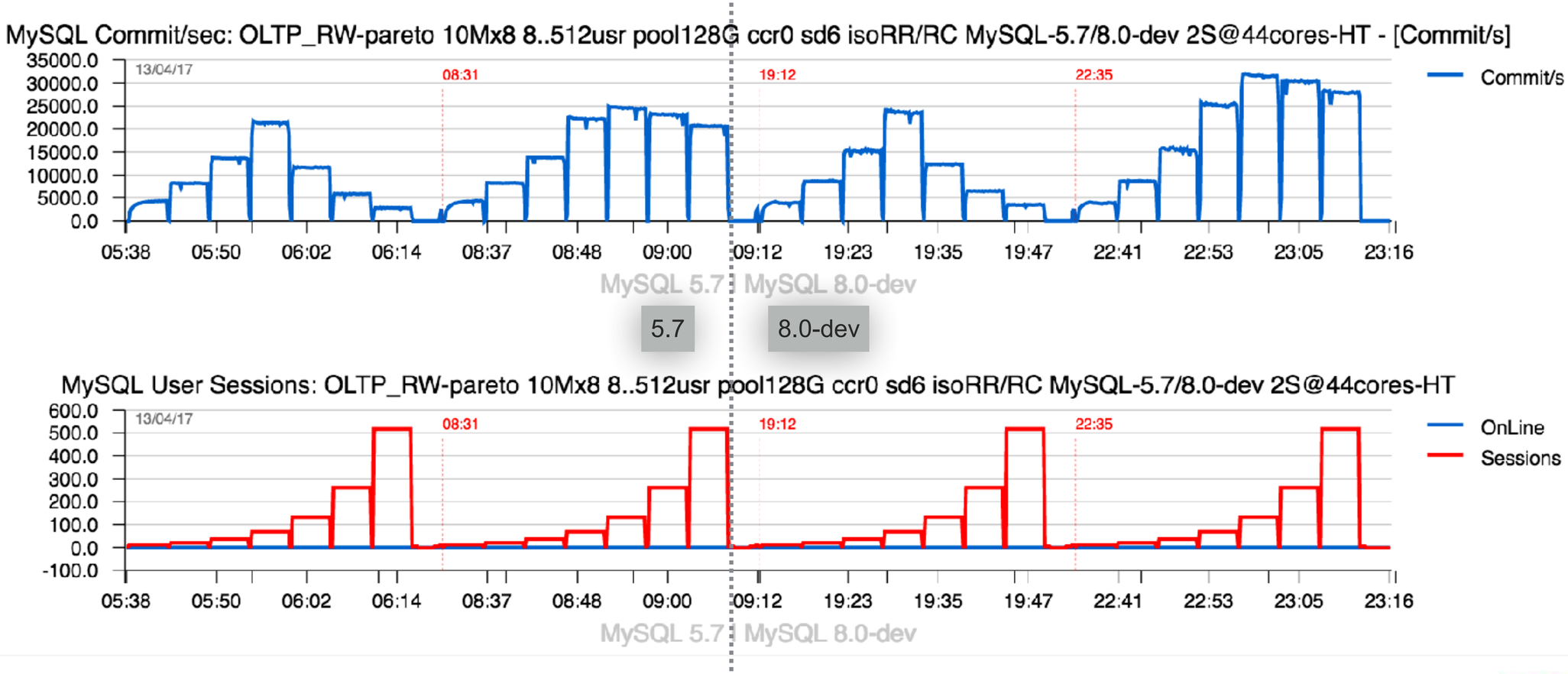
Sysbench OLTP_RW 10Mx8-tables - “pareto” 4S@40cores

- Observations :
  - RR : both Engines loosing TPS on high load due concurrent row access (“pareto")
  - RC : 8.0-dev is doing way better !



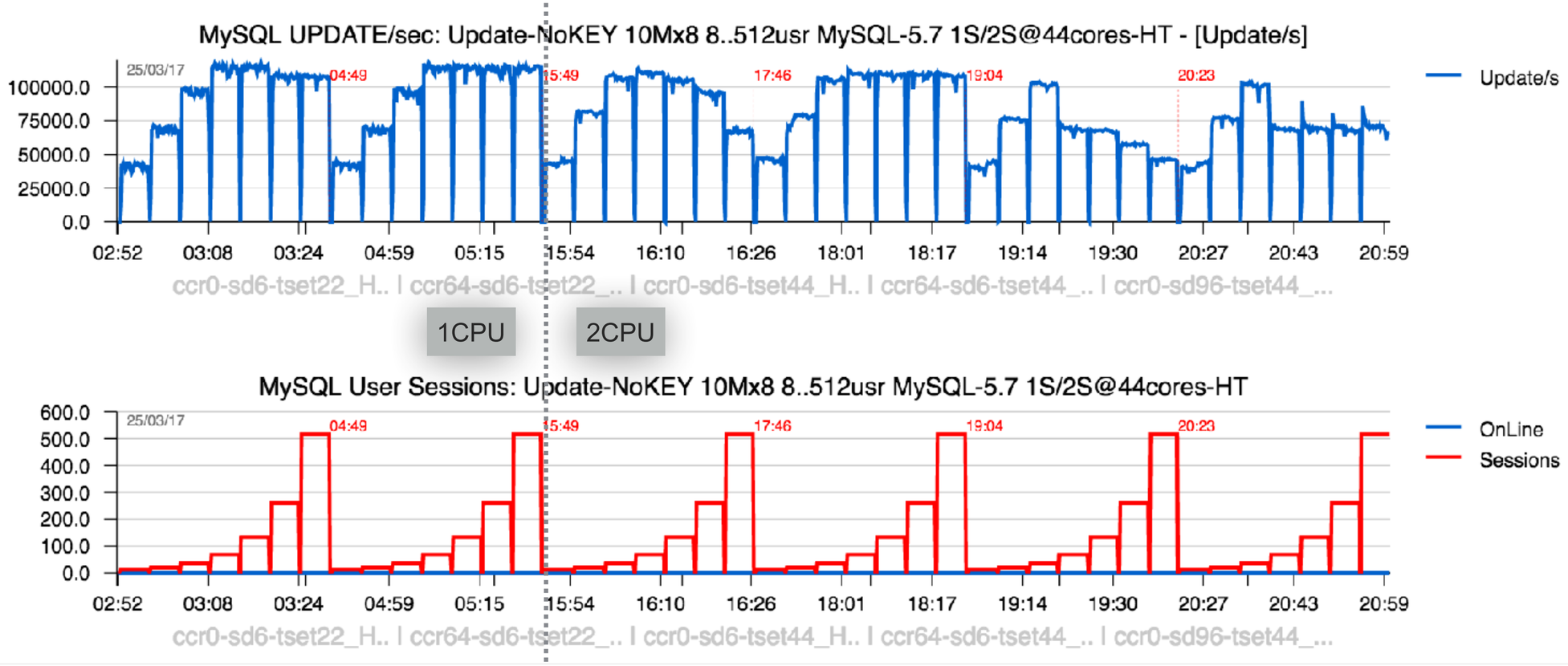
Sysbench OLTP_RW 10Mx8-tables - “pareto” 2S@44cores

- Observations :
  - RR : both Engines loosing TPS on high load due concurrent row access (“pareto")
  - RC : 8.0-dev is doing way better !



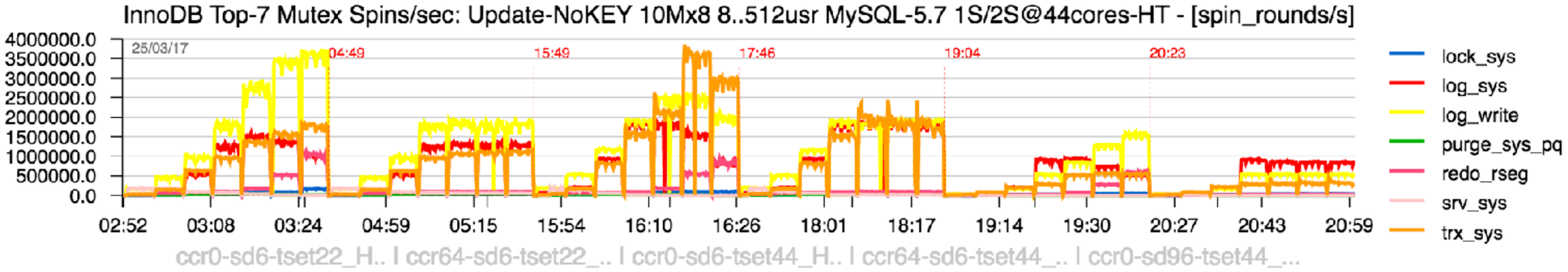
Sysbench Update-NoKEY 10Mx8-tables @MySQL 5.7

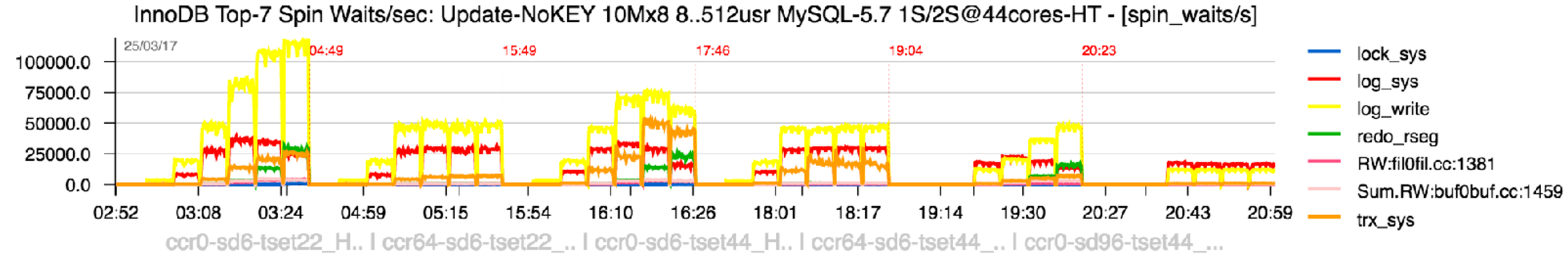
- Observations :
  - MySQL 5.7 : no any gain from 1 CPU socket => 2 CPU sockets.. - why ?..
  - (tuning concurrency=64 helps to avoid drops on high load)



Sysbench Update-NoKEY 10Mx8-tables @MySQL 5.7

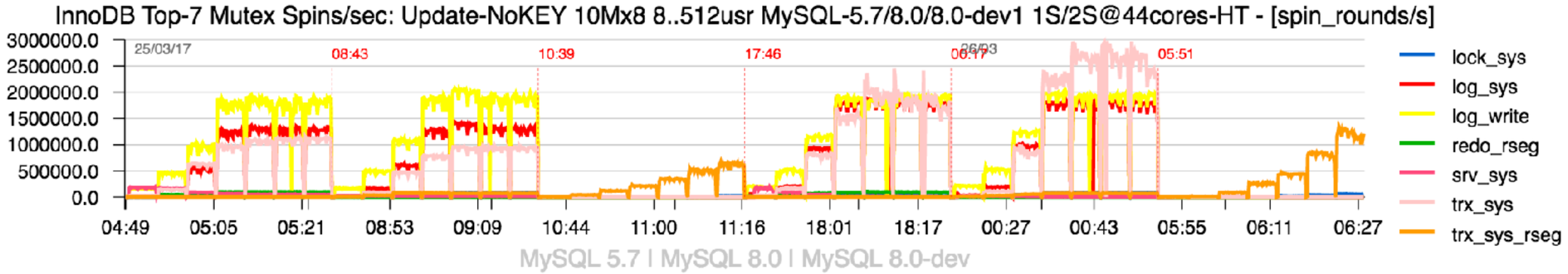
- Observations :
  - MySQL 5.7 : 1 CPU socket => 2 CPU sockets increasing **trx_sys** waits..
  - delaying waits is not a fix (and not helping anymore)..

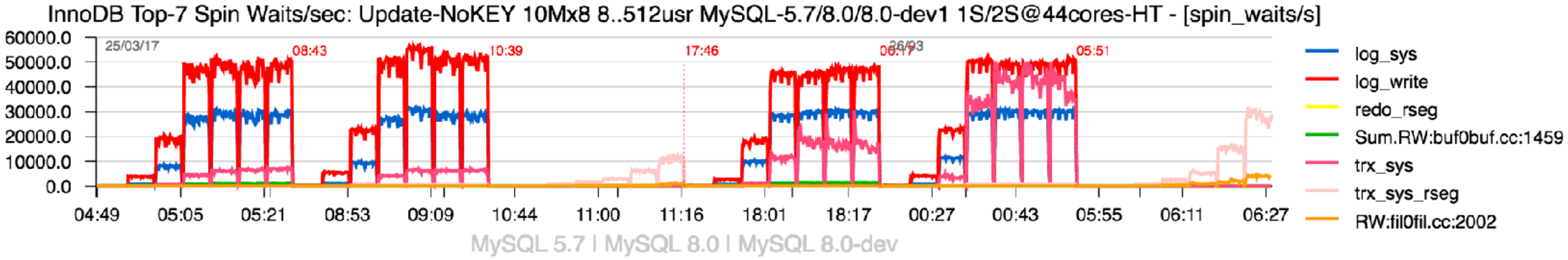




Sysbench Update-NoKEY 10Mx8-tables

- Observations :
  - all hot contentions are gone on 8.0-dev..
  - what about results ?.. ;-))





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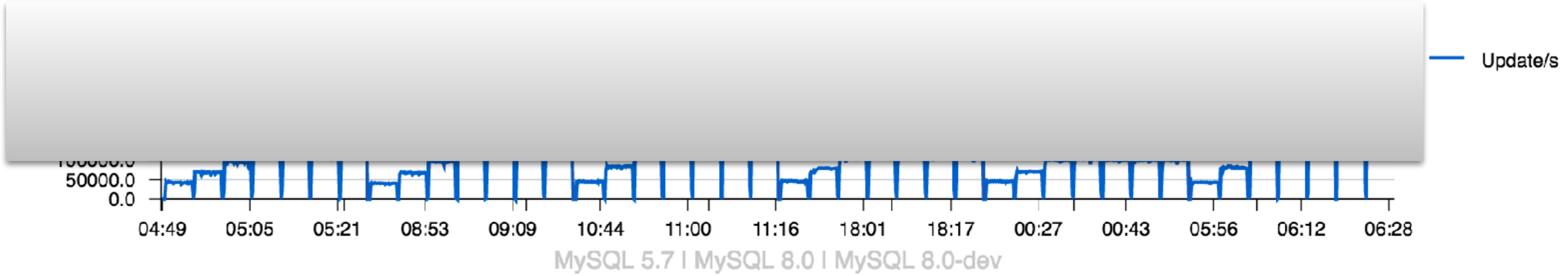

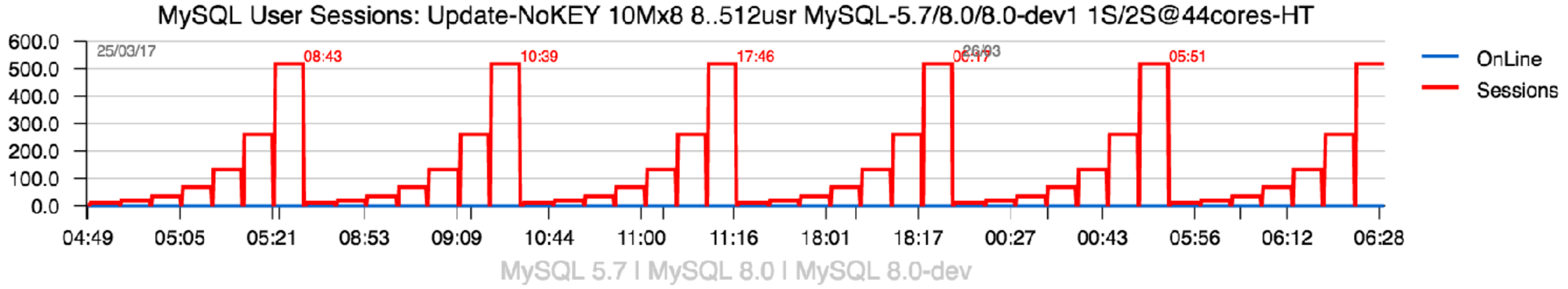

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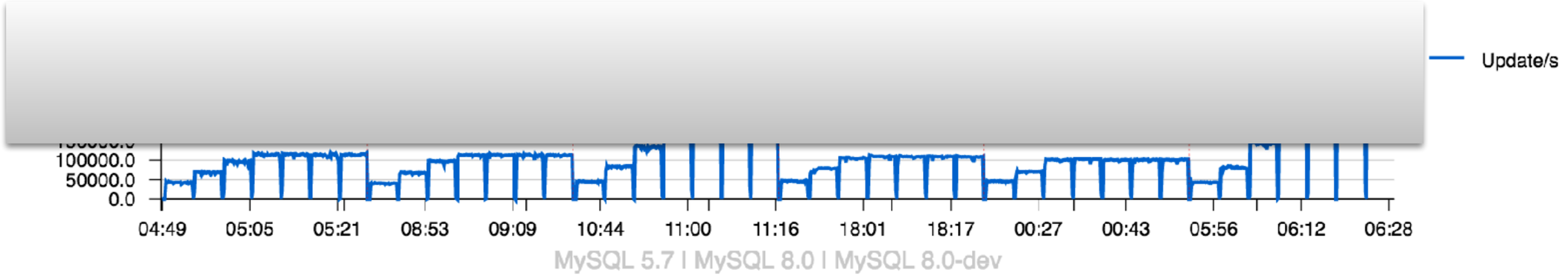

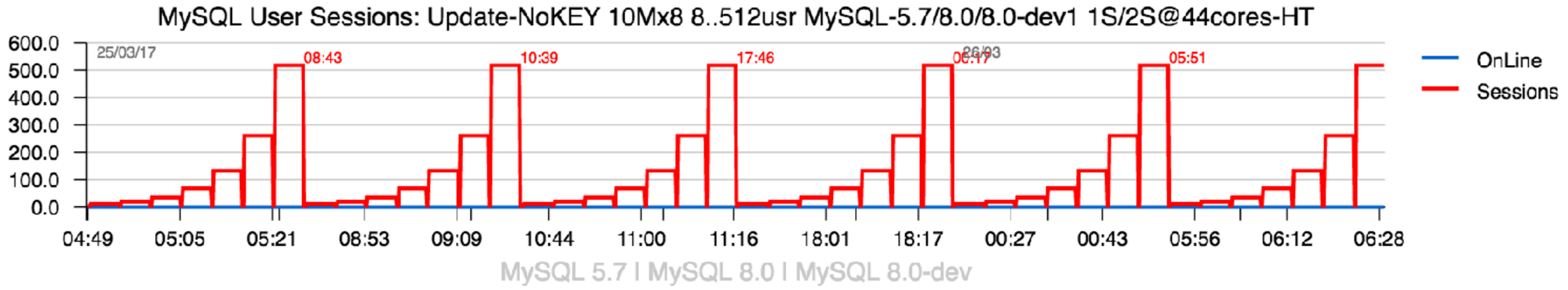

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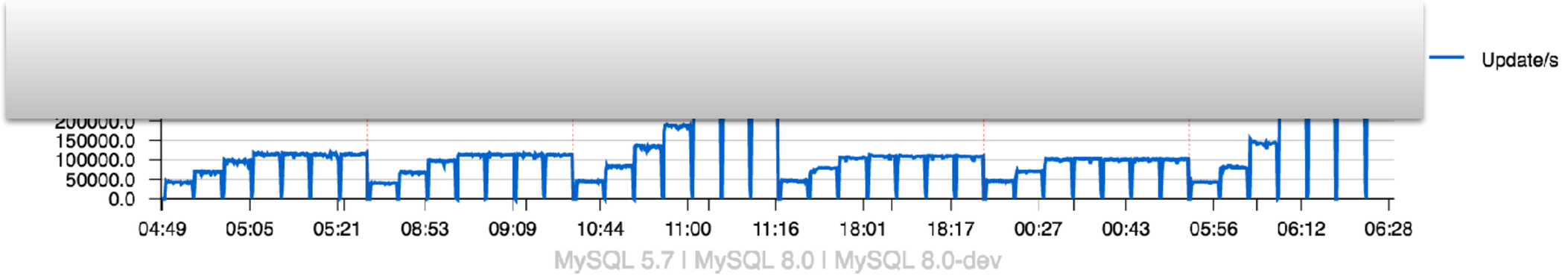

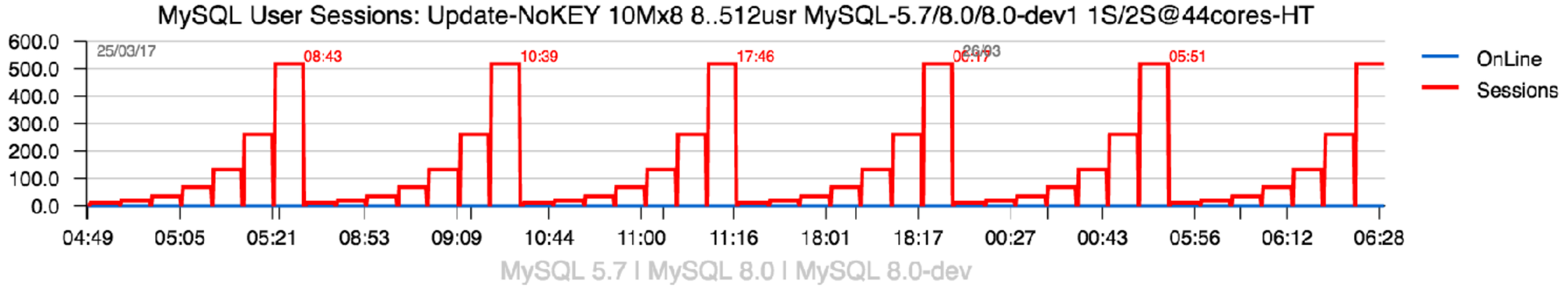

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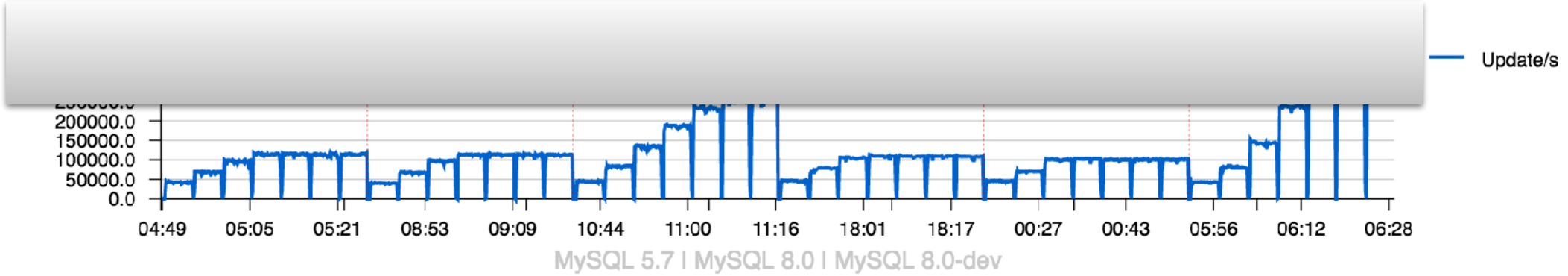
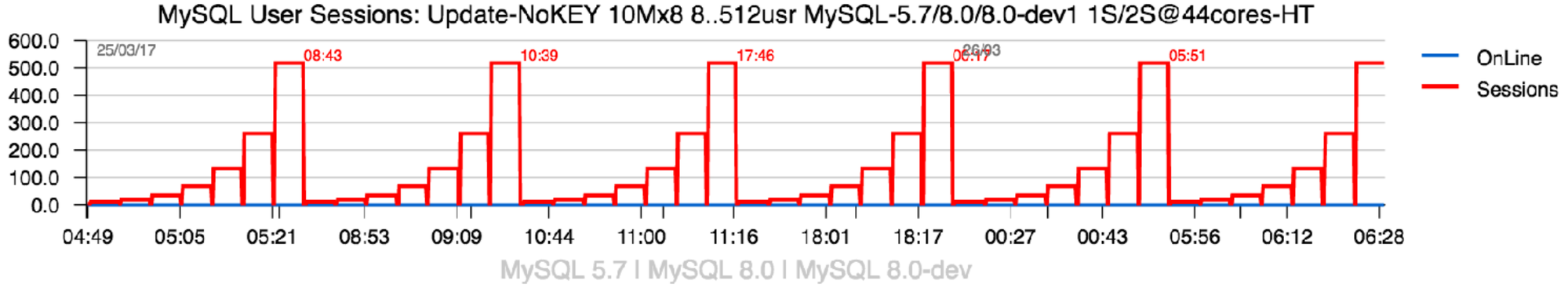
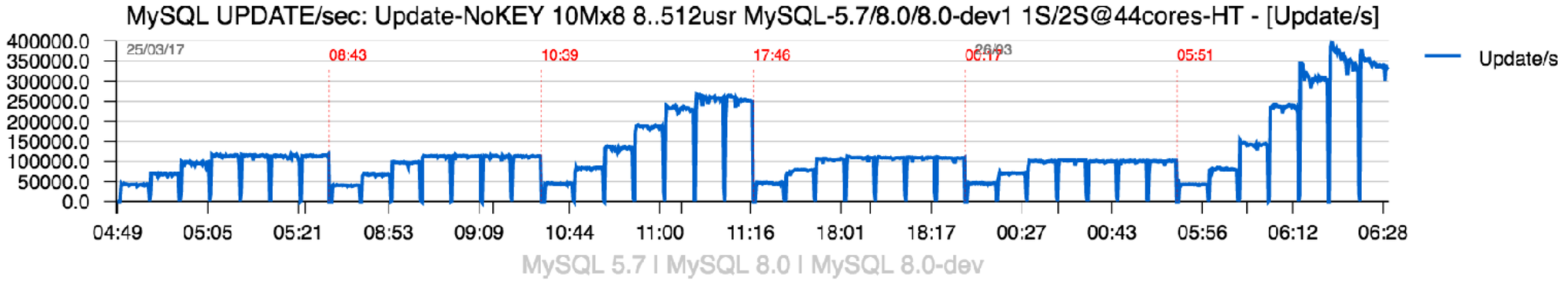
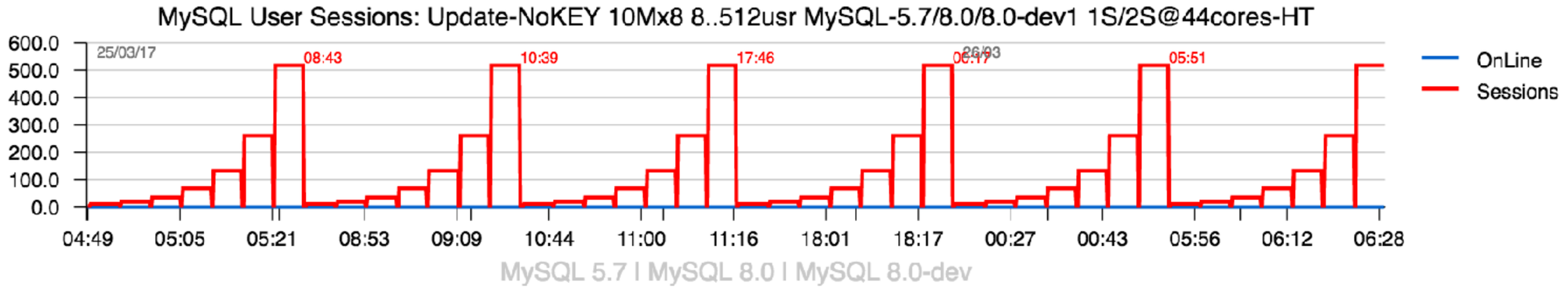




Sysbench Update-NoKEY 10Mx8-tables

- Observations :
  - MySQL 8.0-dev : **x2** times better on 1 CPU socket, **x3** times on 2 CPU !!!
  - NOTE : and even on **8usr** load too !!!



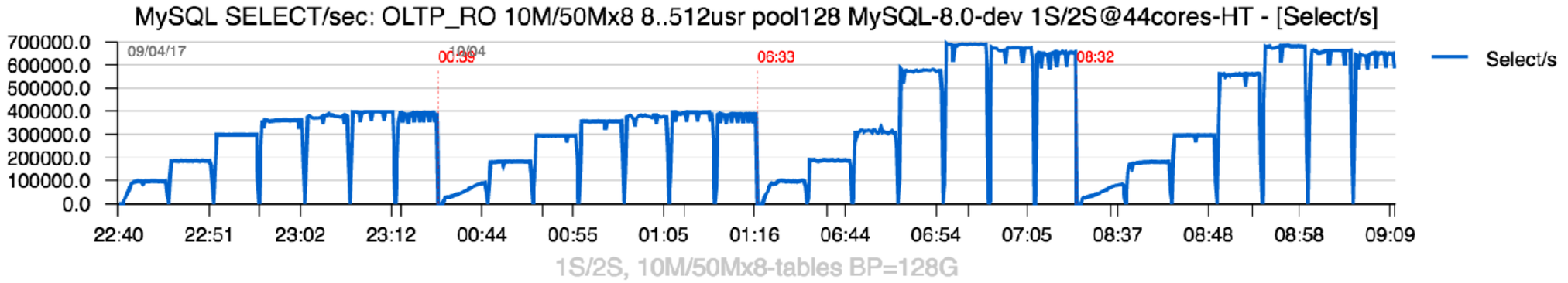


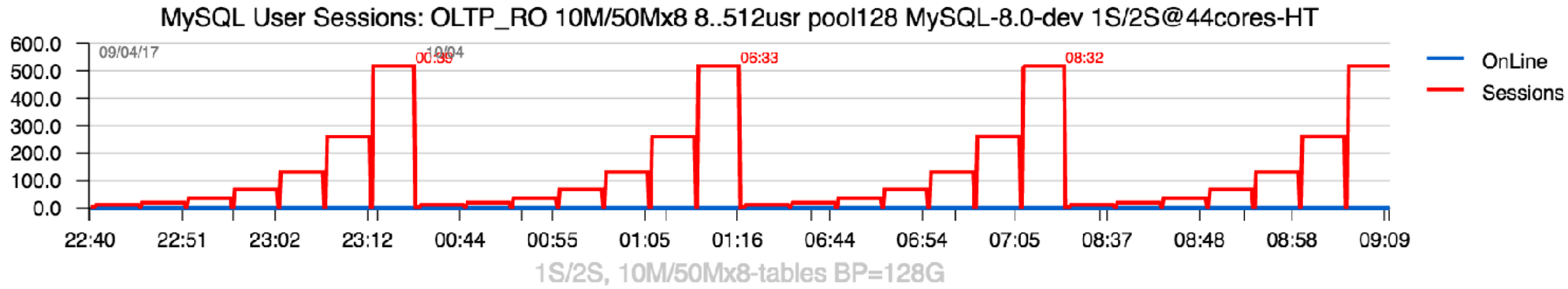
Sysbench Workloads : Data Volume Impact

- Volume :
  - **10Mx8 vs 50Mx8**
- BP :
  - 128GB (all in-memory)
- CPU :
  - 1S (1 CPU socket (22cores-HT))
  - 2S (2 CPU sockets (44cores-HT))
- Access Pattern :
  - UNIFORM (default) vs PARETO
- Workloads :
  - OLTP_RO
  - OLTP_RW
  - Update-NoKEY

Sysbench OLTP_RO : 10Mx8 vs 50Mx8 (BP=128G)

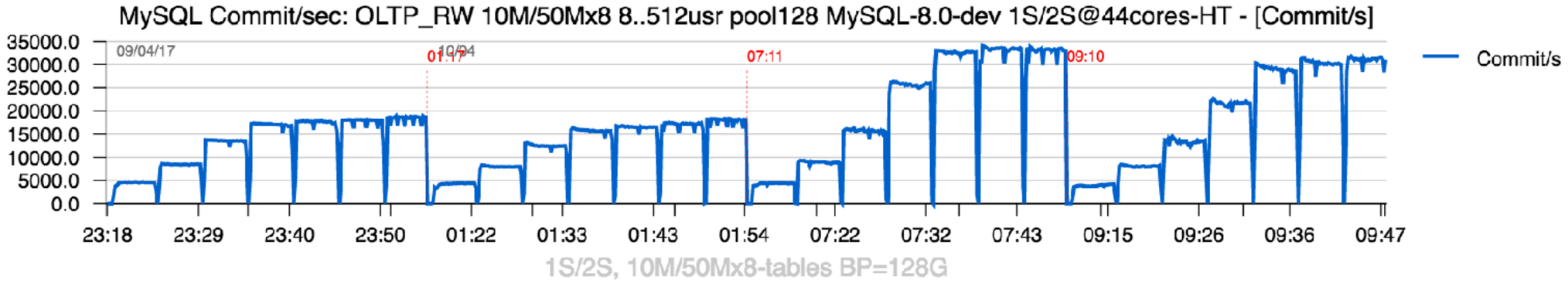
- Observations :
  - Same QPS on 10Mx8 and 50Mx8 data volumes

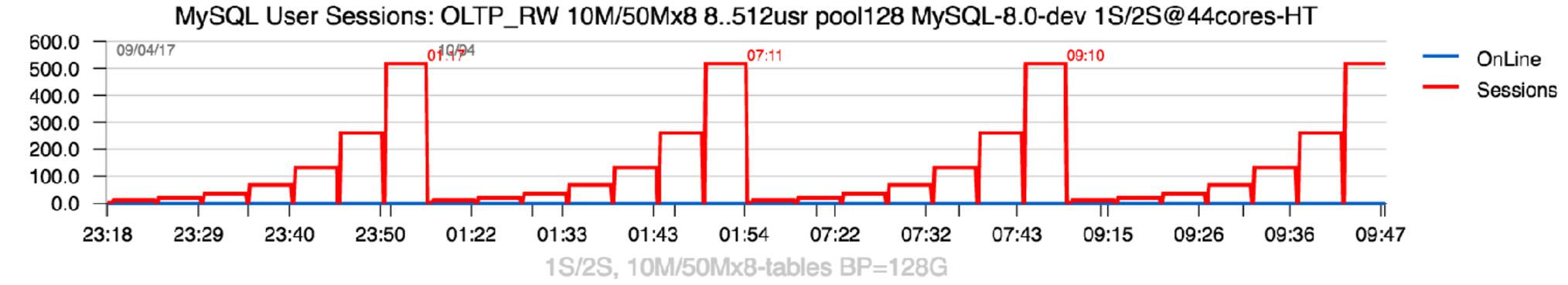




Sysbench OLTP_RW : 10Mx8 vs 50Mx8 (BP=128G)

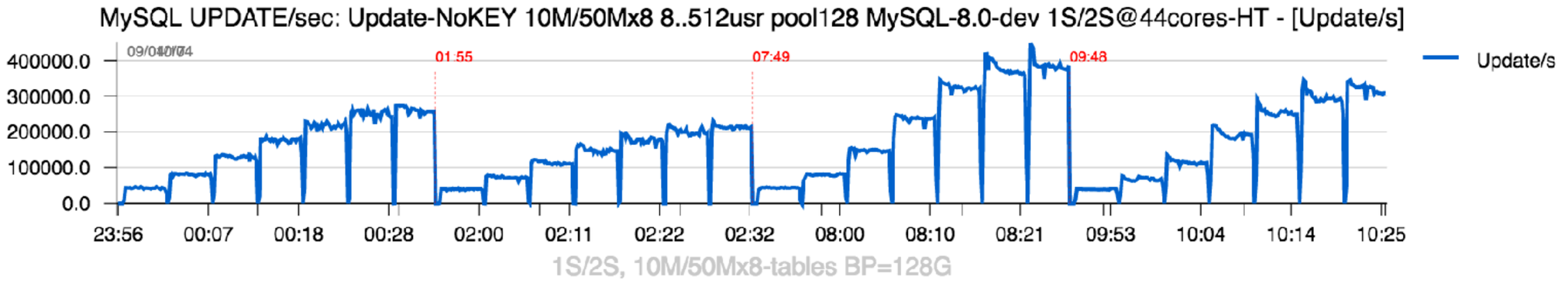
- Observations :
  - similar TPS on 1S
  - but on 2S with 50Mx8 volume TPS level is decreasing..

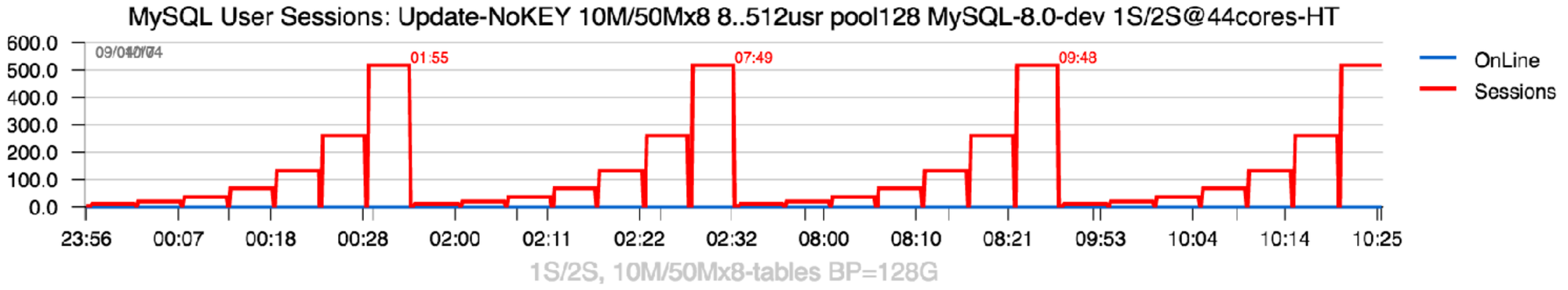




Sysbench Update-NoKEY : 10Mx8 vs 50Mx8 (BP=128G)

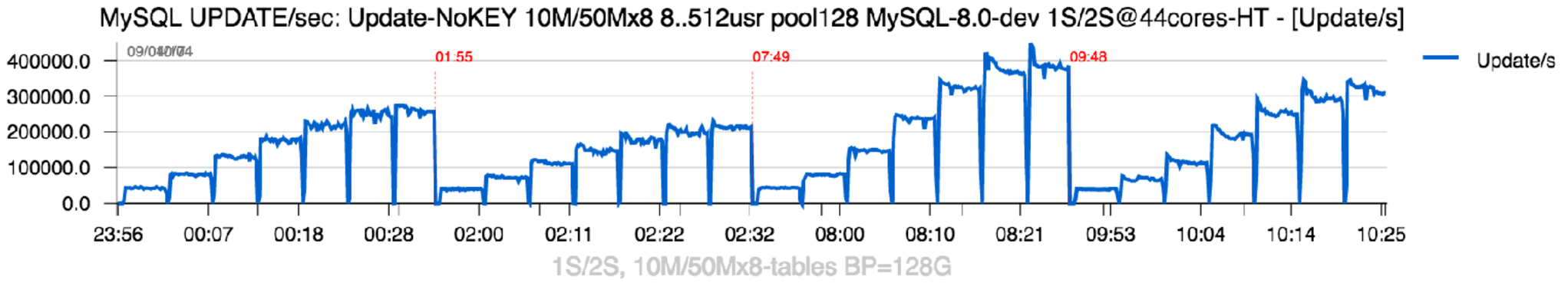
- Observations :
  - all data in-memory, but TPS rate is going lower on 50Mx8 data volume on both 1S & 2S..
  - why ?..

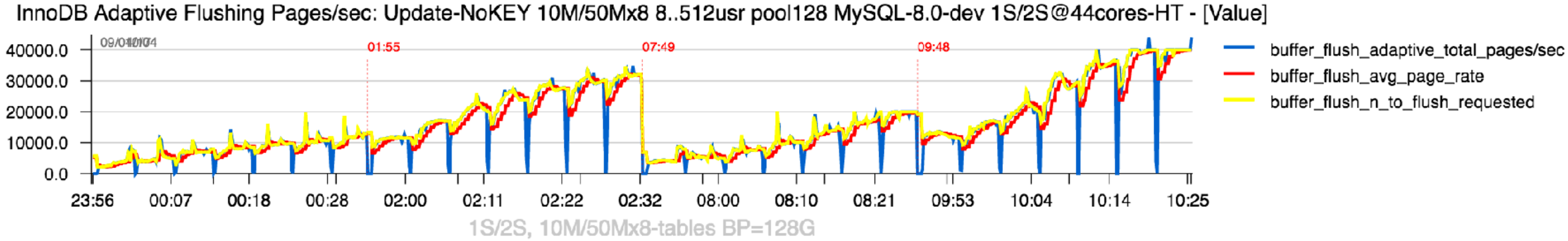




Sysbench Update-NoKEY : 10Mx8 vs 50Mx8 (BP=128G)

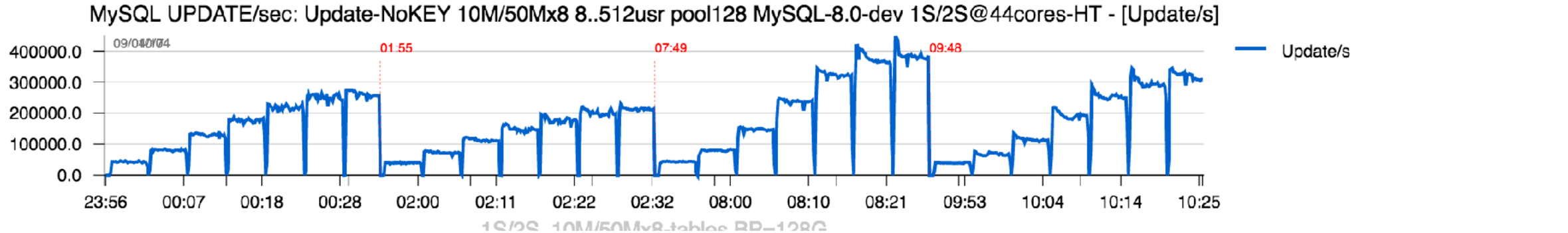
- Observations :
  - all data in-memory, but TPS rate is going lower on 50Mx8 data volume on both 1S & 2S..
  - why ?.. => IO impact..

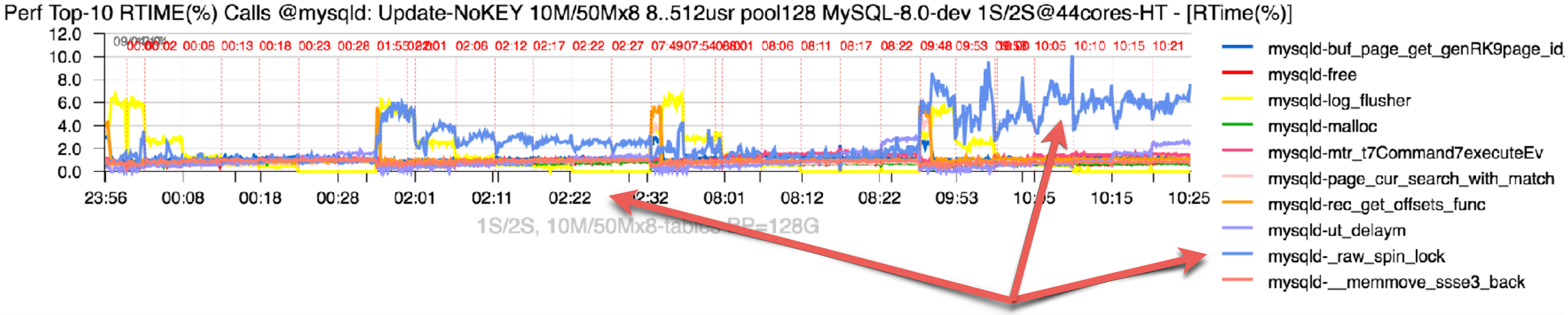




Sysbench Update-NoKEY : 10Mx8 vs 50Mx8 (BP=128G)

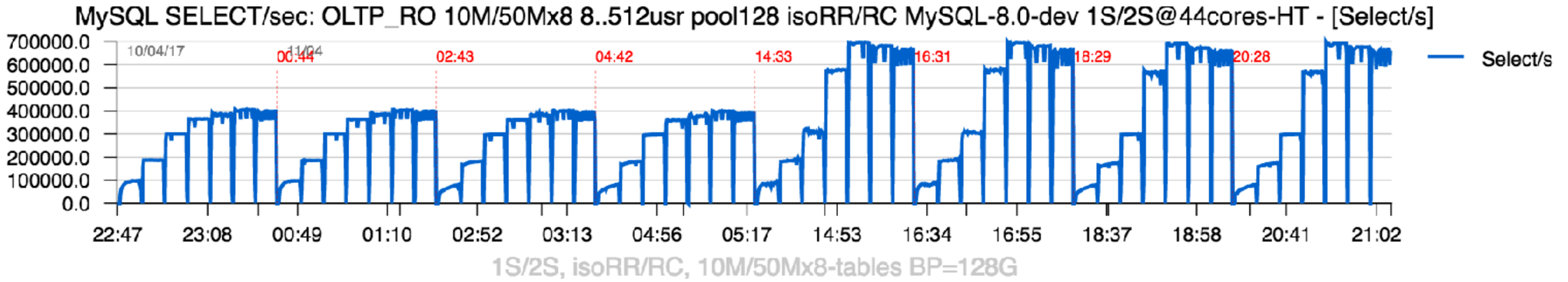
- Observations :
  - all data in-memory, but TPS rate is going lower on 50Mx8 data volume on both 1S & 2S..
  - why impact from background IO writes ???.. => AIO also needs CPU..

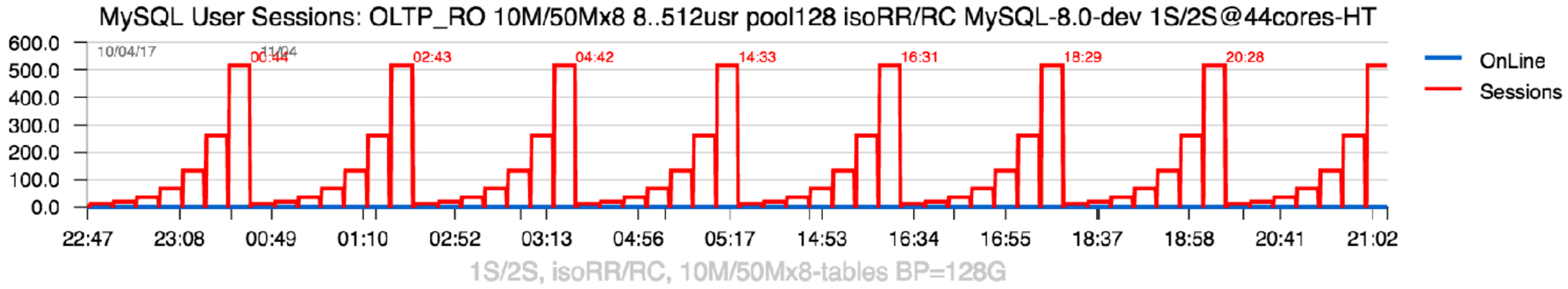




Sysbench OLTP_RO-pareto : 10Mx8 vs 50Mx8 (BP=128G)

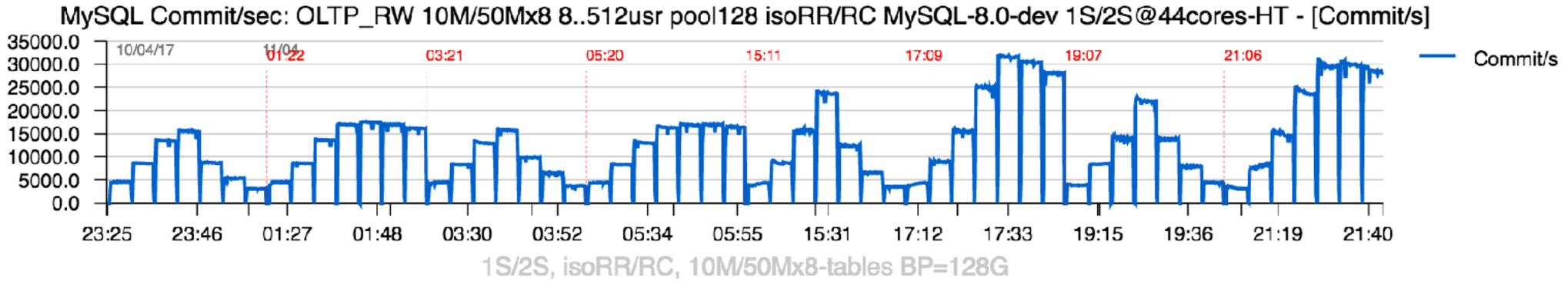
- Observations :
  - Same QPS on 10Mx8 and 50Mx8 data volumes
  - no difference between RR / RC isolation..

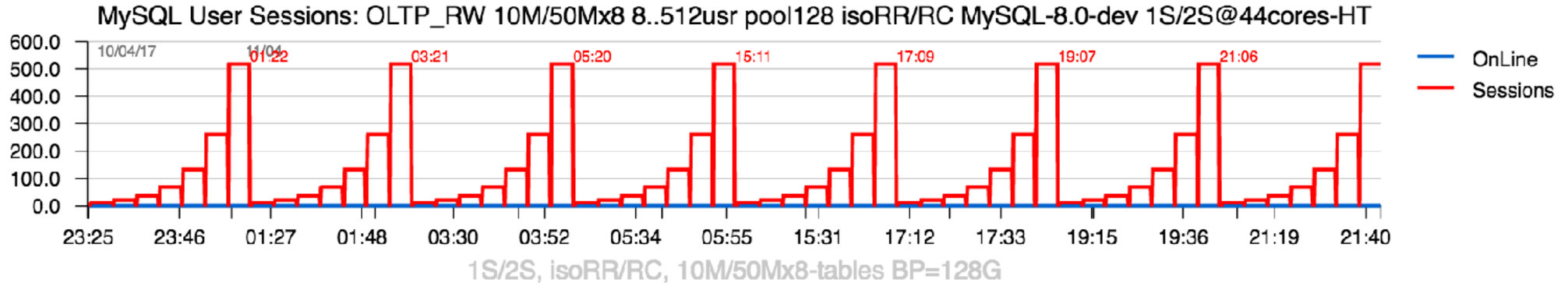




Sysbench OLTP_RW-pareto : 10Mx8 vs 50Mx8 (BP=128G)

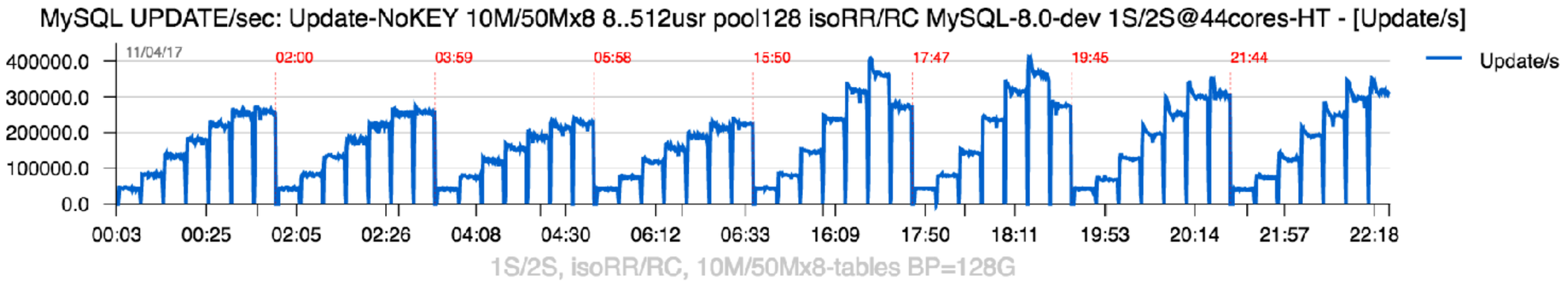
- Observations :
  - indeed, using RC makes a huge difference
  - TPS on 50Mx8 volume is slightly lower than on 10Mx8..

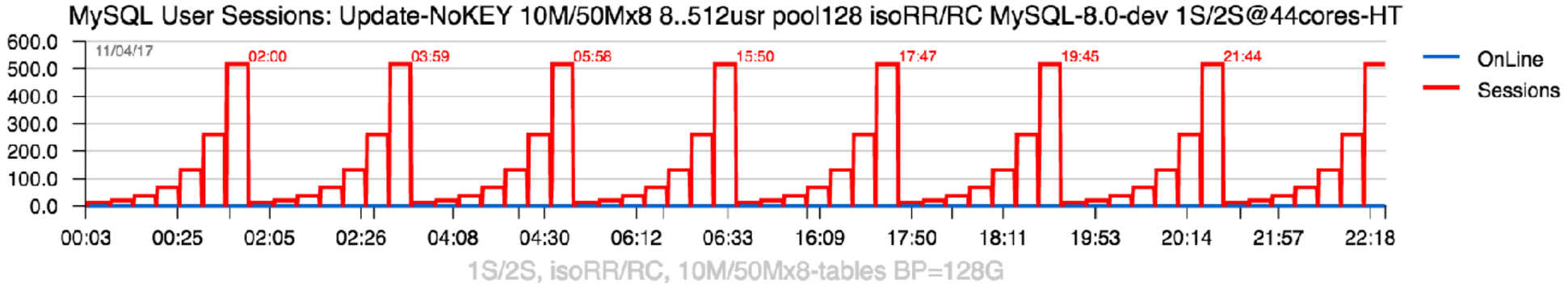




Sysbench Update-NoKEY-pareto : 10Mx8 vs 50Mx8 (BP=128G)

- Observations :
  - similar to UNIFORM, no difference between RR / RC
  - however, on 10Mx8 volume 512usr load hitting row locking contention..



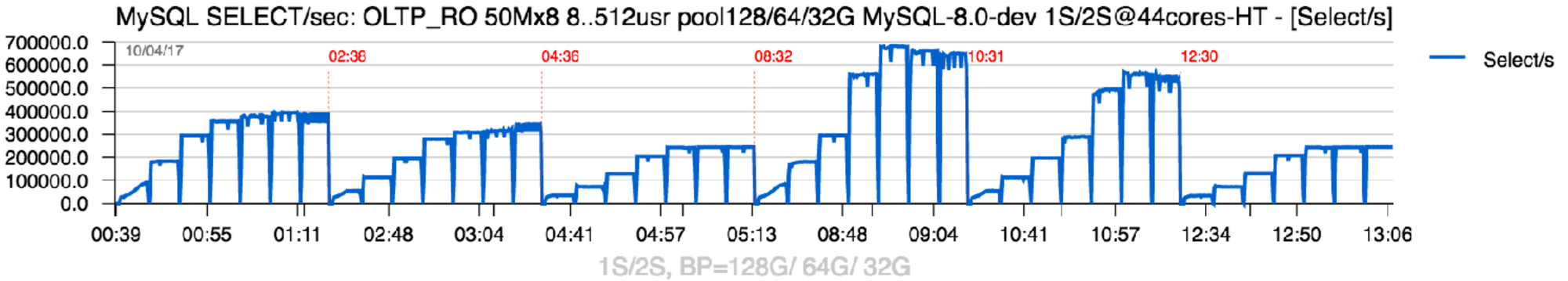


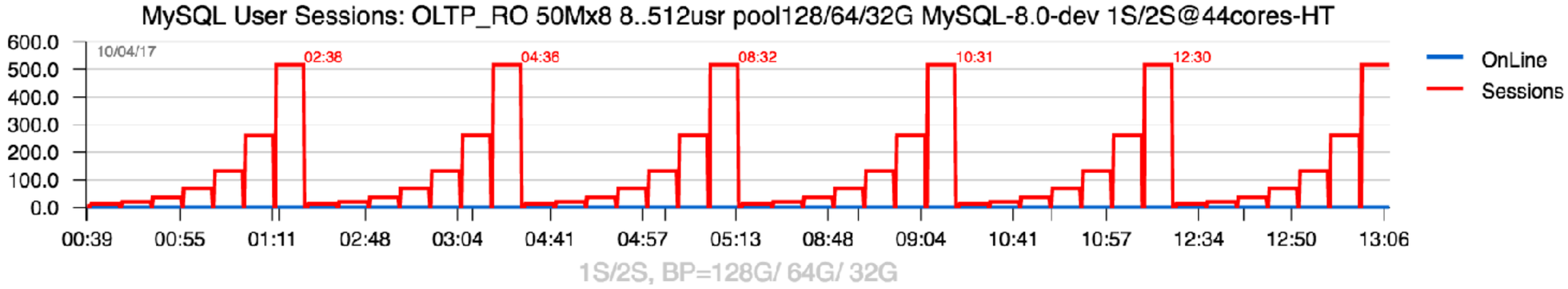
Sysbench Workloads : I/O Impact

- Volume :
  - 50Mx8
- BP :
  - **128GB** (all in-memory)/ **64GB** (1/2 in-memory)/ **32GB** (1/4 in-memory)
- CPU :
  - 1S (1 CPU socket (22cores-HT))
  - 2S (2 CPU sockets (44cores-HT))
- Access Pattern :
  - UNIFORM (default) vs PARETO
- Workloads :
  - OLTP_RO
  - OLTP_RW
  - Update-NoKEY

Sysbench OLTP_RO 50Mx8 : BP=128G/ 64G/ 32G

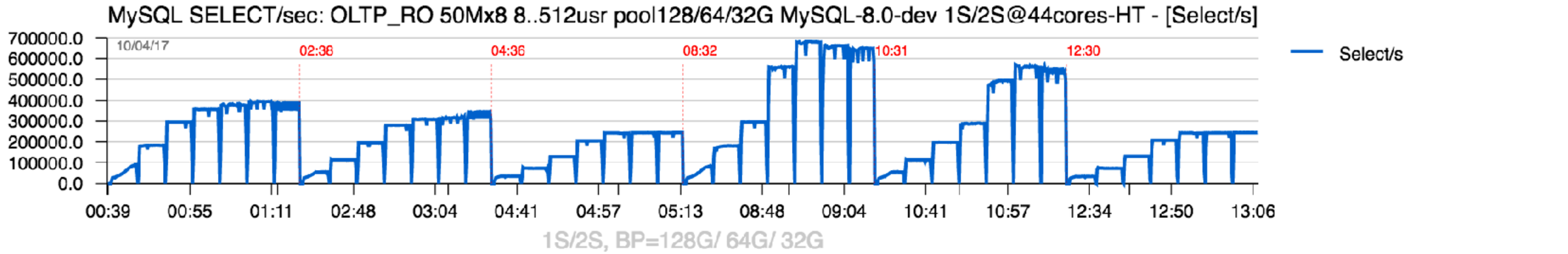
- Observations :
  - Clear I/O impact.. => with 32GB BP size we're testing Storage, and no more MySQL ;-)
  - IO : **3500** MB/sec (!!!) - the max possible for a given NVMe..

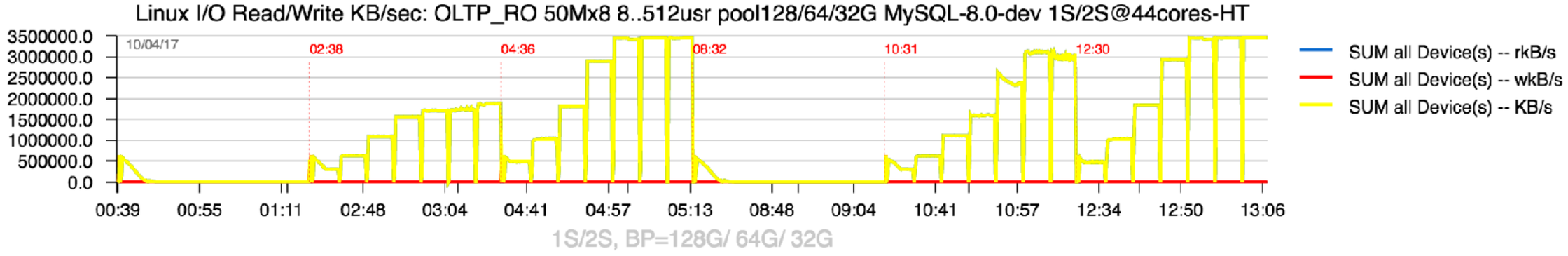




Sysbench OLTP_RO 50Mx8 : BP=128G/ 64G/ 32G

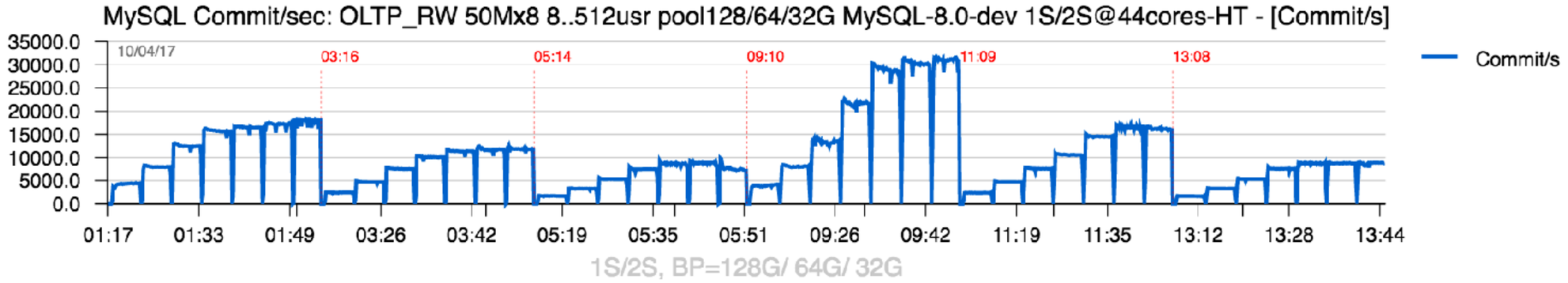
- Observations :
  - Clear I/O impact.. => with 32GB BP size we're testing Storage, and no more MySQL ;-)
  - IO : **3500** MB/sec (!!!) - the max possible for a given NVMe..

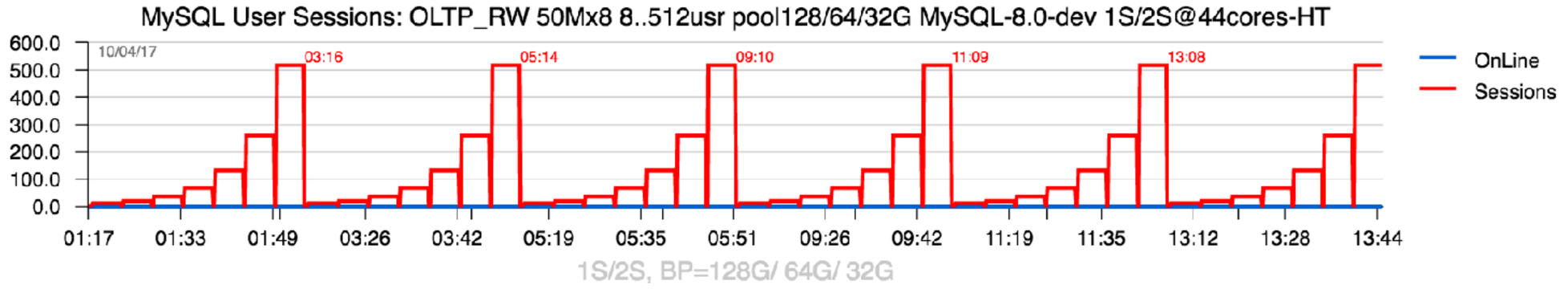




Sysbench OLTP_RW 50Mx8 : BP=128G/ 64G/ 32G

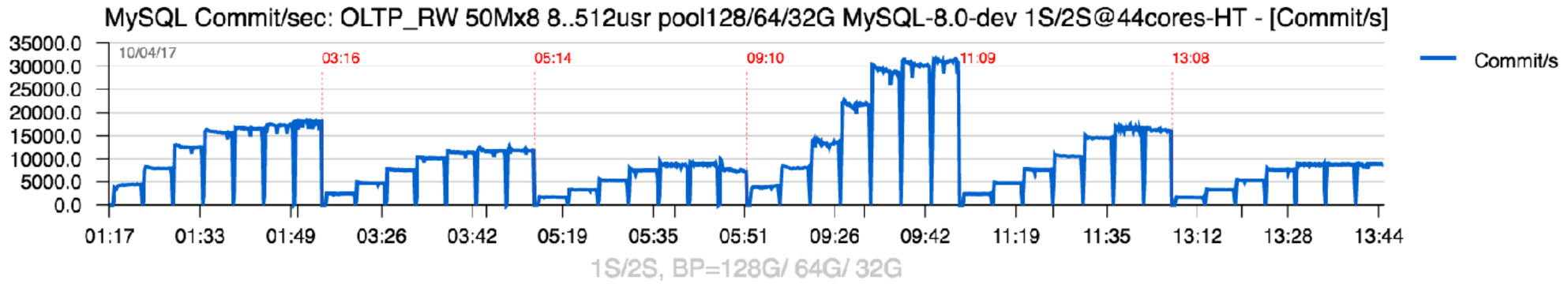
- Observations :
  - Clear I/O impact.. => significant TPS drop from 128G => 64G => 32G BP..
  - IO : **3000** MB/sec - the max possible “mixed” for a given NVMe ?..

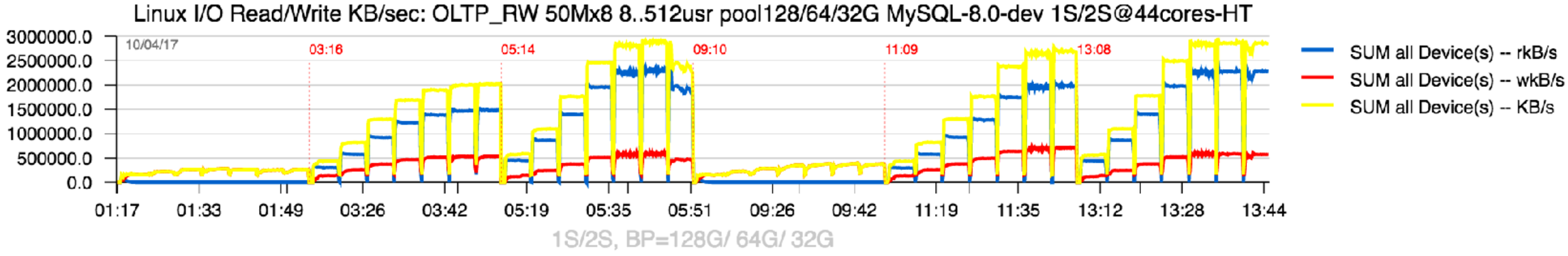




Sysbench OLTP_RW 50Mx8 : BP=128G/ 64G/ 32G

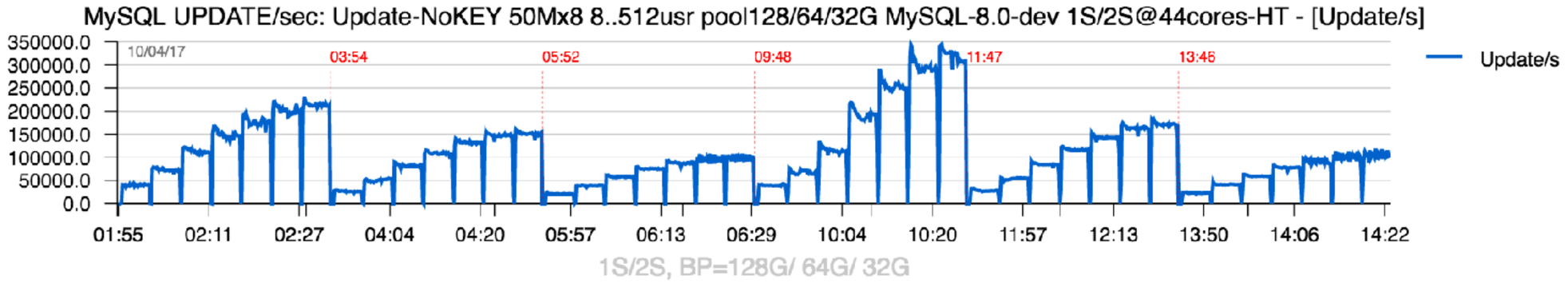
- Observations :
  - Clear I/O impact.. => significant TPS drop from 128G => 64G => 32G BP..
  - IO : **3000** MB/sec - the max possible “mixed” for a given NVMe ?..

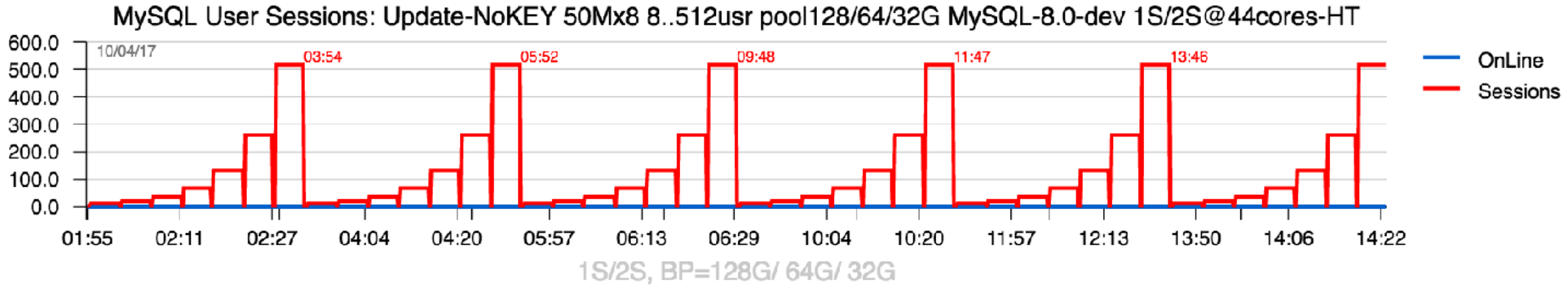




Sysbench Update-NoKEY 50Mx8 : BP=128G/ 64G/ 32G

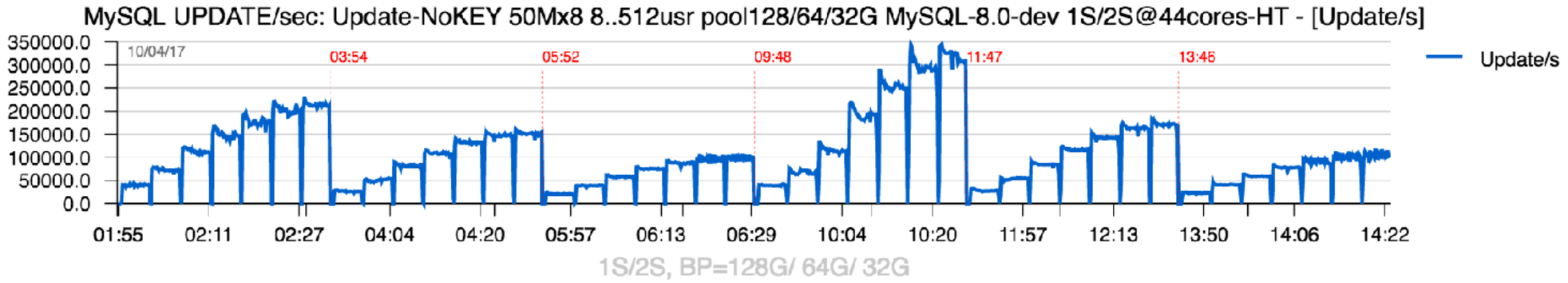
- Observations :
  - Clear I/O impact.. => significant TPS drop from 128G => 64G => 32G BP..
  - 64GB BP : why near no difference between 1S / 2S ?..

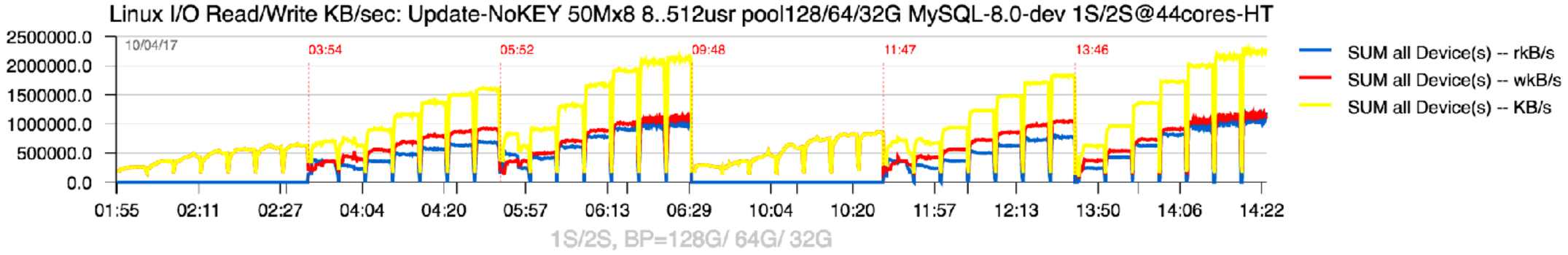




Sysbench Update-NoKEY 50Mx8 : BP=128G/ 64G/ 32G

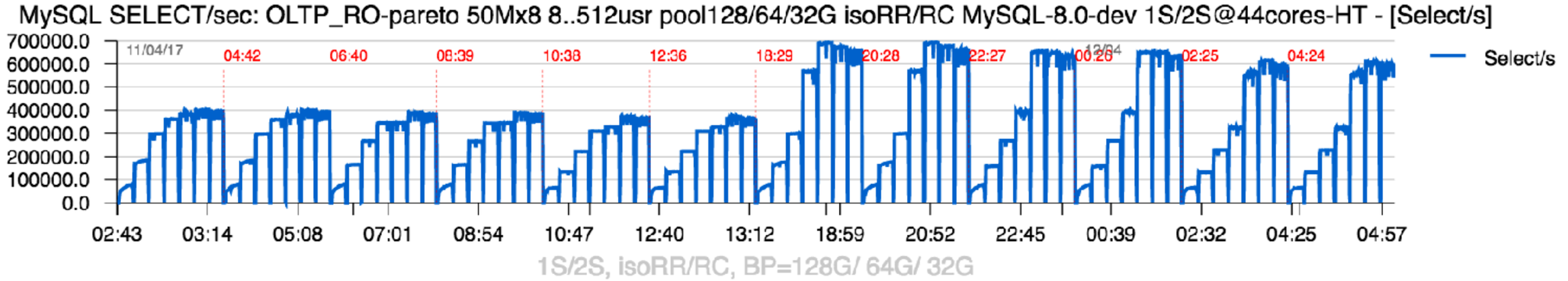
- Observations :
  - Clear I/O impact.. => significant TPS drop from 128G => 64G => 32G BP..
  - IO : **2200** MB/sec - the max possible “50/50 mixed” for a given NVMe ?..

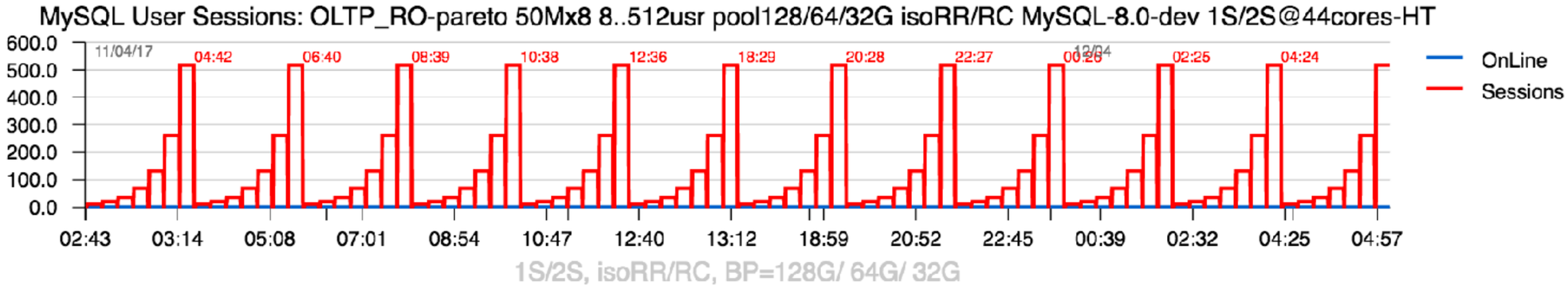




Sysbench OLTP_RO-pareto 50Mx8 : BP=128G/ 64G/ 32G

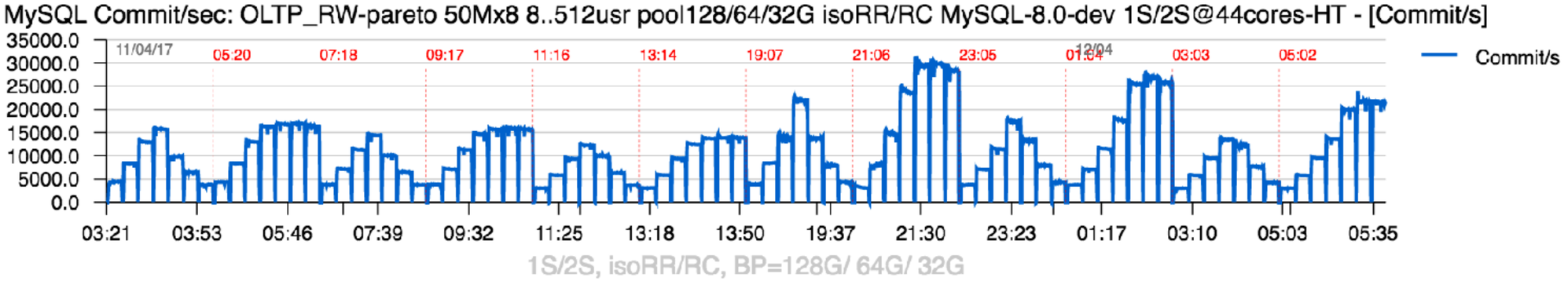
- Observations :
  - Very limited IO impact..
  - no difference between RR / RC isolation

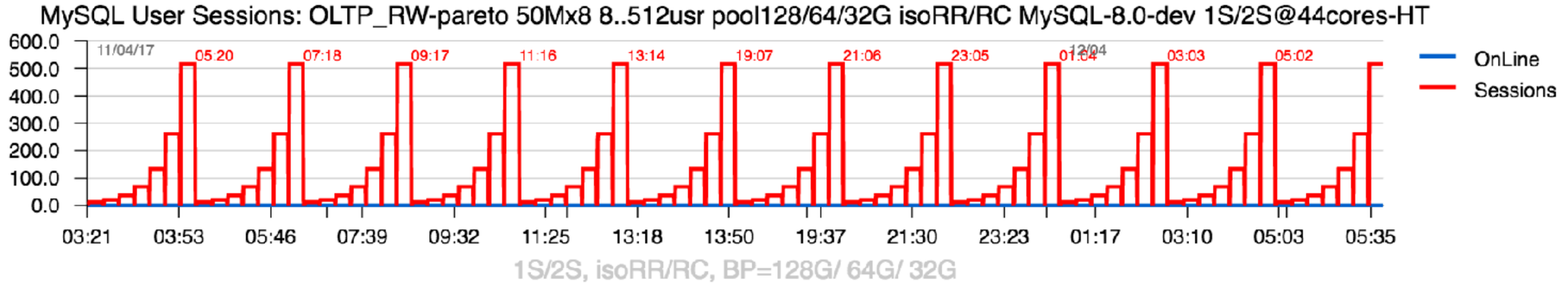




Sysbench OLTP_RW-pareto 50Mx8 : BP=128G/ 64G/ 32G

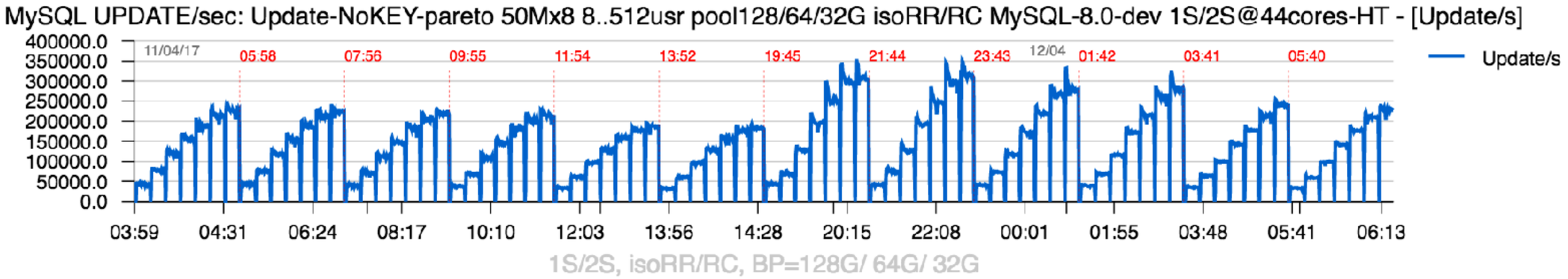
- Observations :
  - IO impact is present, but more than x2 times lower vs UNIFORM..
  - RC isolation is the must ;-)

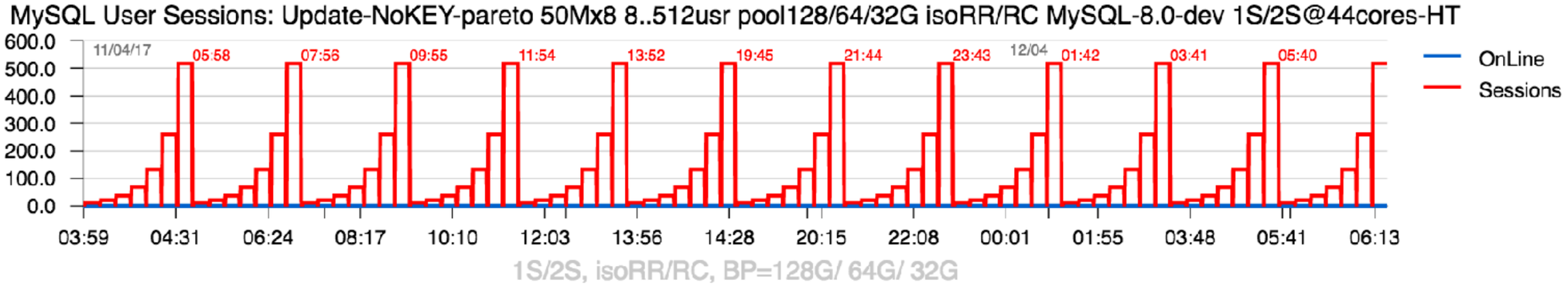




Sysbench Update-NoKEY-pareto 50Mx8 : BP=128G/ 64G/ 32G

- Observations :
  - IO impact is present, but more than x2 times lower vs UNIFORM..
  - why ?.. => significantly less IO reads with PARETO



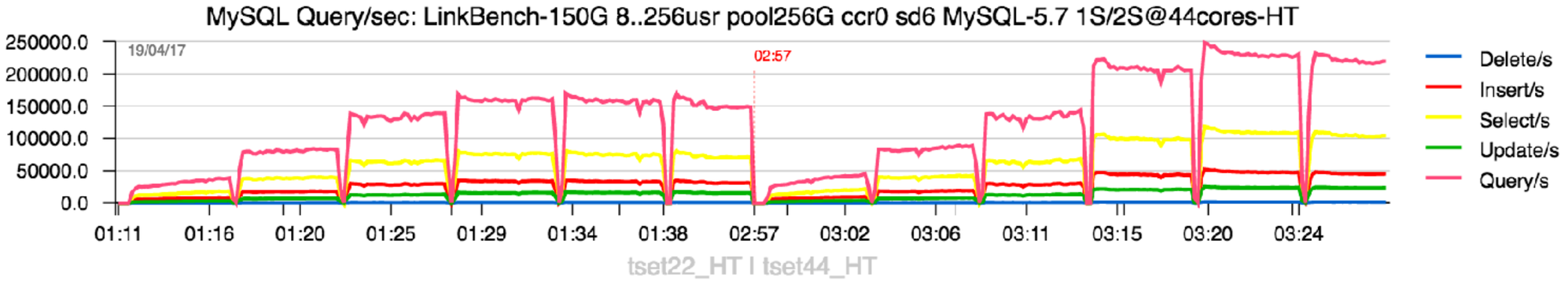


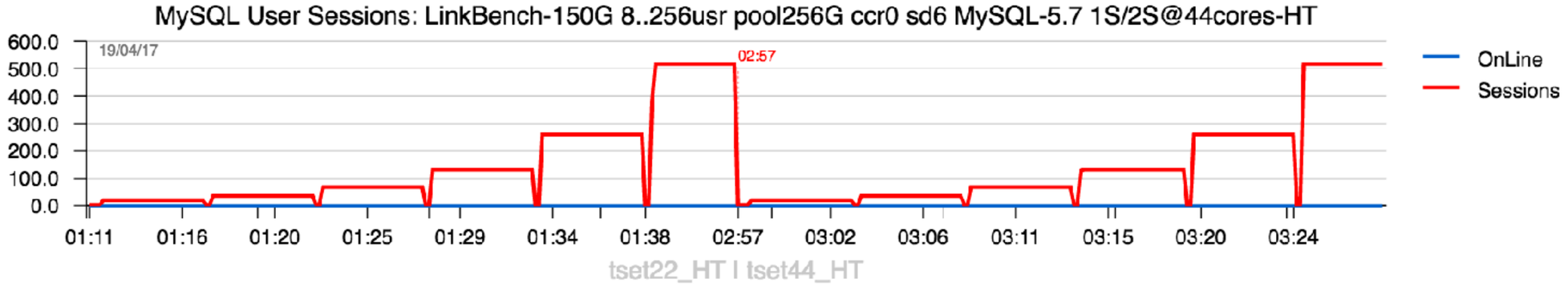
LinkBench

- Volume :
  - 150M (150GB)
- Engine :
  - LinkBench is not working anymore with 8.0
  - so, testing with MySQL 5.7
- Load :
  - 8, 16, .. 512 concurrent users

LinkBench-150G : BP=256GB (in-memory)

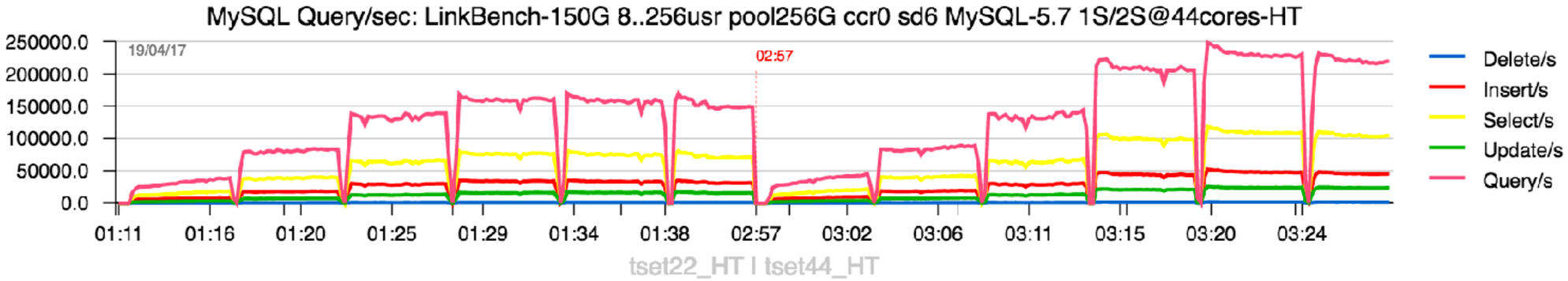
- Observations :
  - 1S => 2S : 50% performance improvement
  - what are the bottlenecks ?..

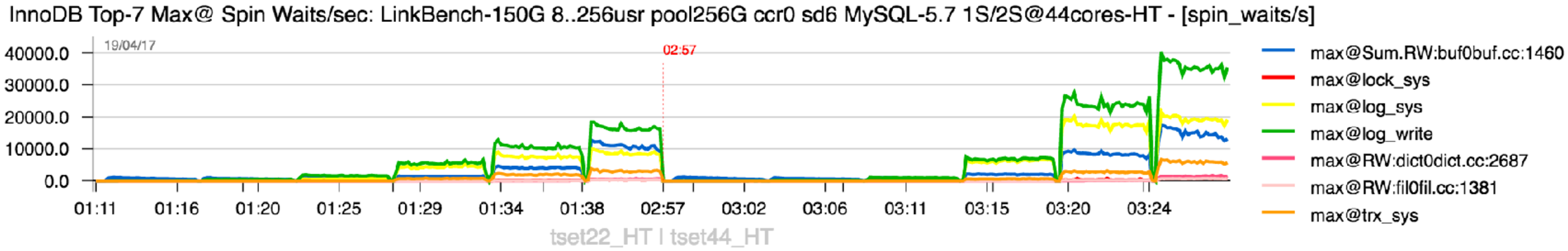




LinkBench-150G : BP=256GB (in-memory)

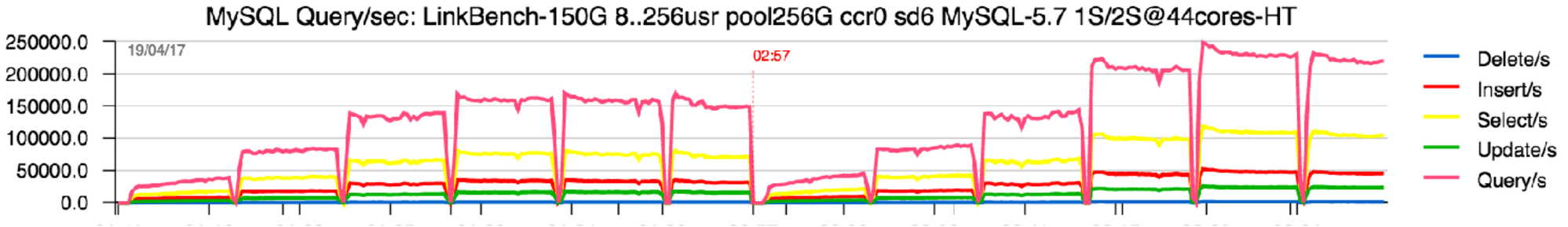
- Observations :
  - 1S => 2S : 50% performance improvement
  - what are the bottlenecks ?.. => 8.0 should fix, but block lock..

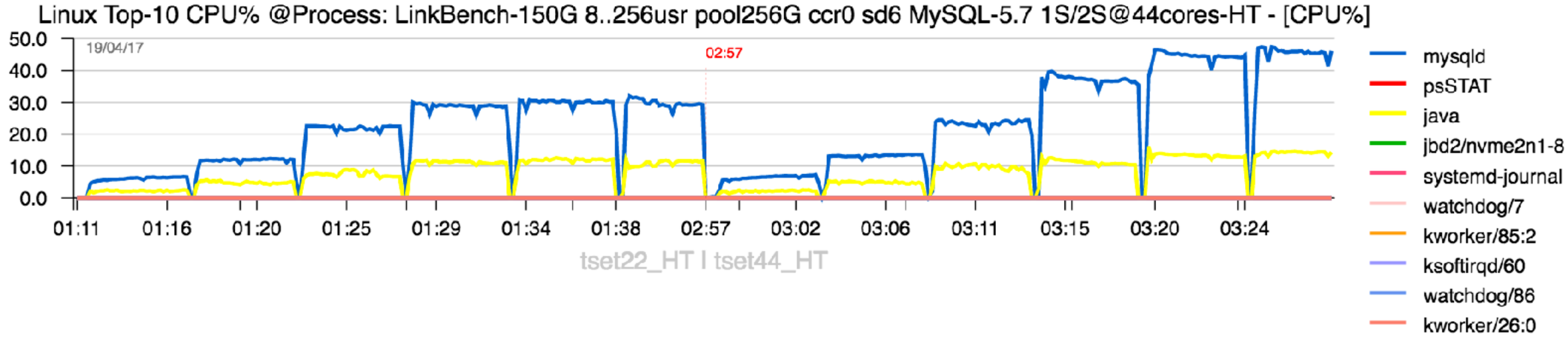




LinkBench-150G : BP=256GB (in-memory)

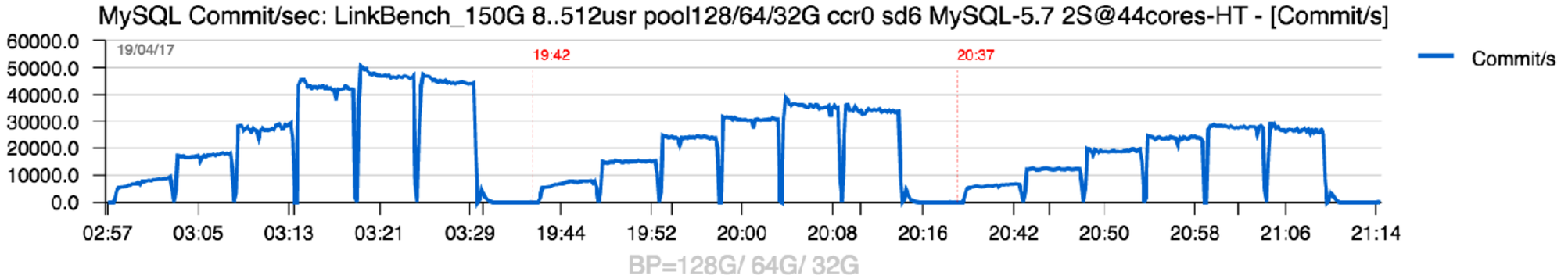
- Observations :
  - 1S => 2S : 50% performance improvement
  - low CPU usage.. => timeout in load generator itself ?..

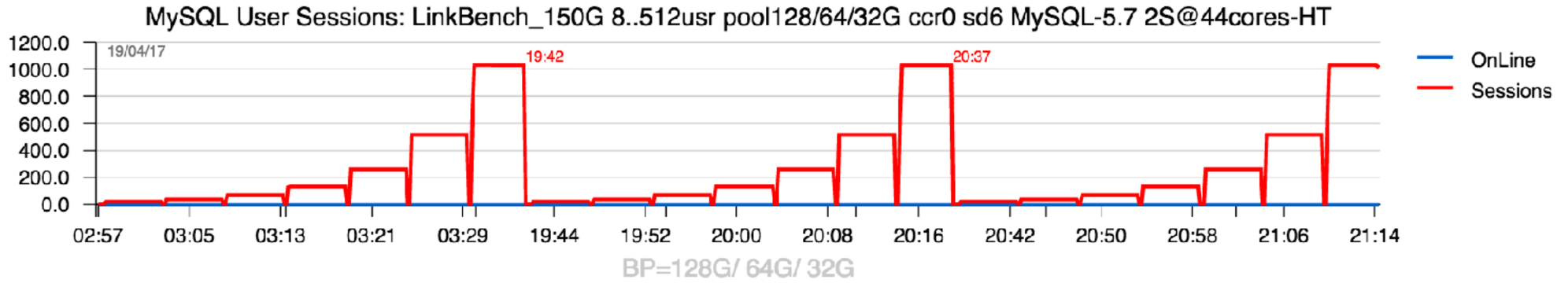




LinkBench-150G : BP=128GB/ 64GB/ 32GB

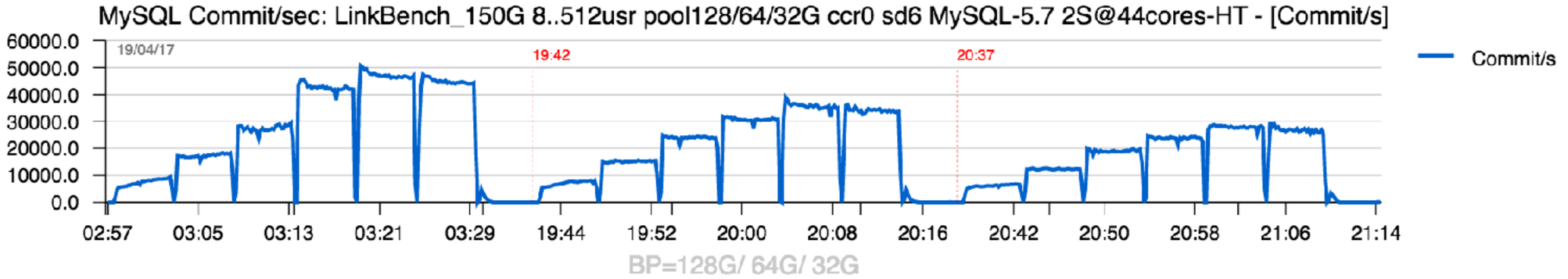
- Observations :
  - IO impact : significant, but much less than UNIFORM..
  - what about contentions ?..

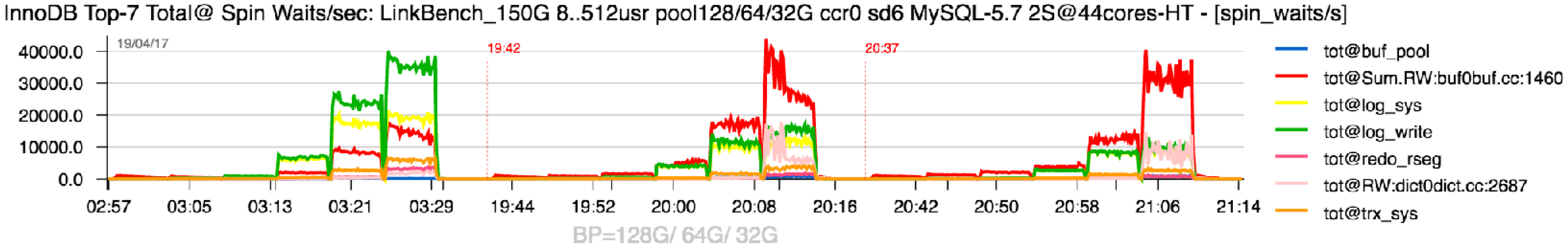




LinkBench-150G : BP=128GB/ 64GB/ 32GB

- Observations :
  - IO impact : significant, but much less than UNIFORM..
  - what about contentions ?.. => **block RW-lock** dominates on IO-bound !!!



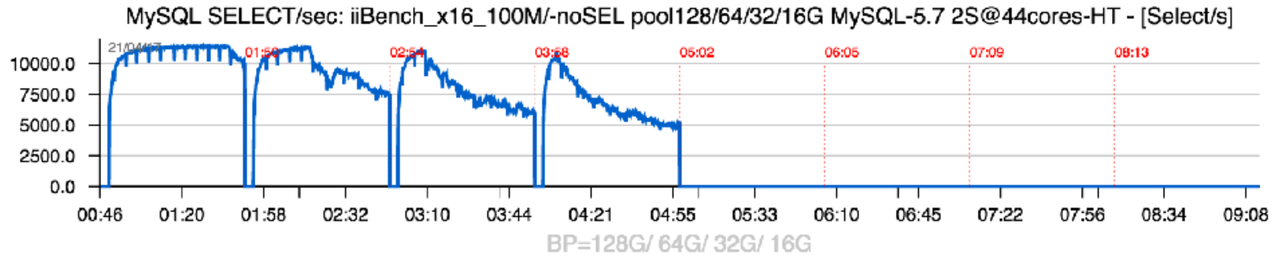


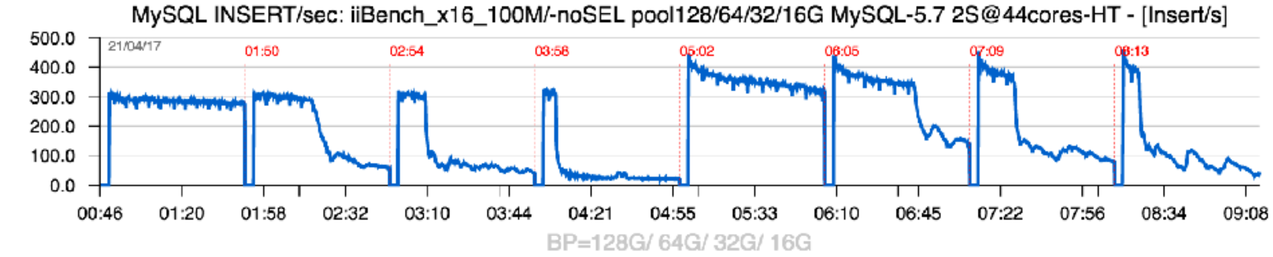
iiBench

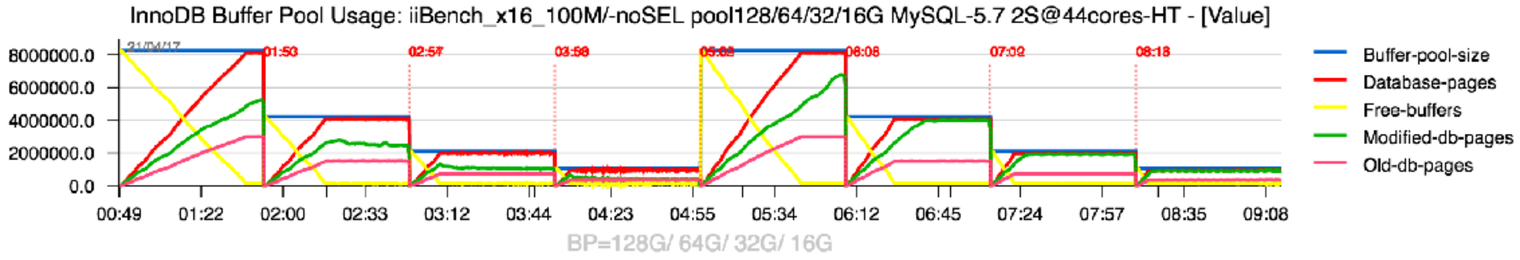
- Test Scenario :
  - x16 parallel iiBench processes running together during 1H
  - each process is using its own table
  - one test with SELECTs, another without..
- Side note :
  - iiBench is written in Python
  - during workload python process is using 60% CPU time itself (mysqld 40%)
  - makes sense to rewrite with sysbench 1.0 ?.. ;-)
- Key point :
  - during INSERT activity, B-Tree index in InnoDB growing quickly
  - as soon as index pages have no more place in BP and re-read from storage, performance is going down..

iiBench 100M x16 : BP= 128G/ 64G/ 32G/ 16G

- Observations :
  - until B-Tree remains in BP => 300K INSERT/sec.. (and if not, QPS drop)

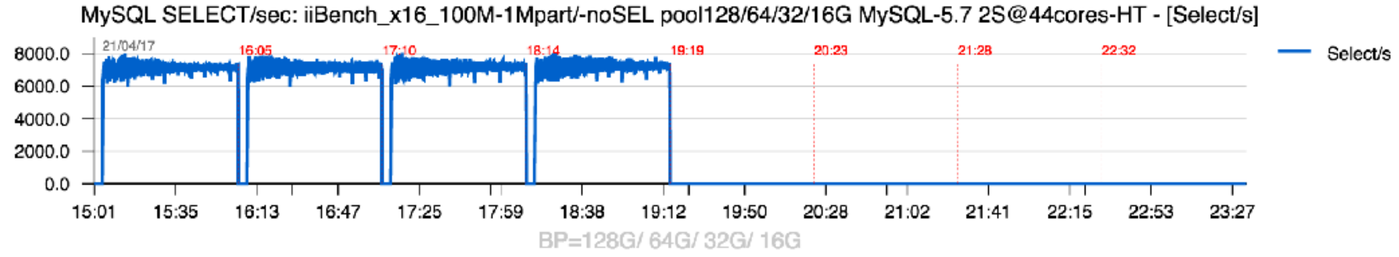


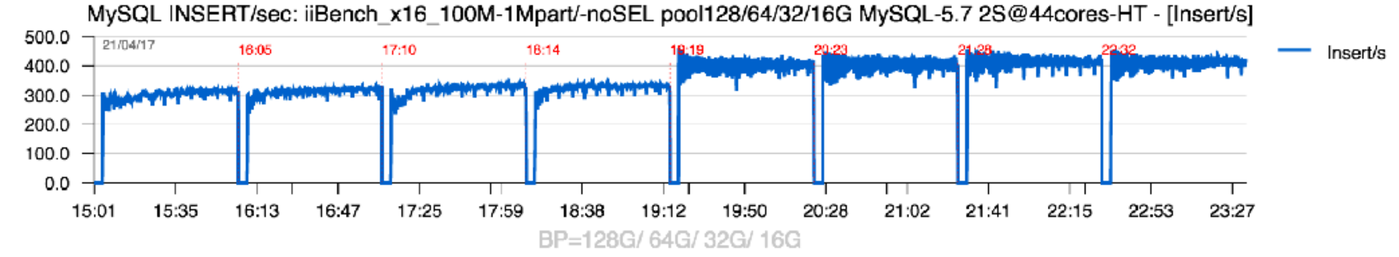


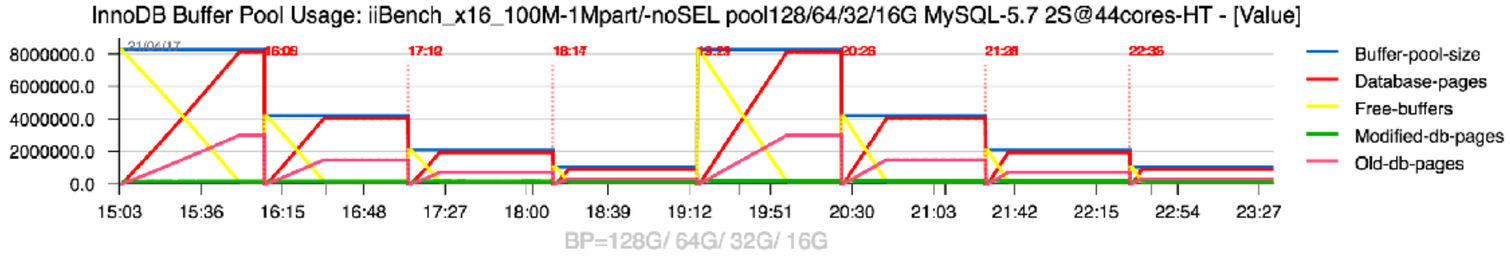


iiBench 100M x16 & 1M-parts : BP= 128G/ 64G/ 32G/ 16G

- Observations :
  - workaround : using partitions for table splits index B-Tree





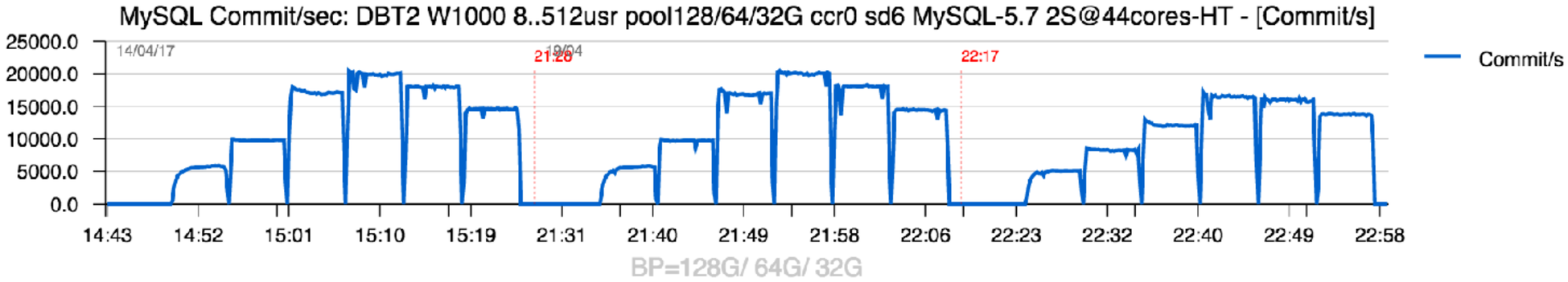


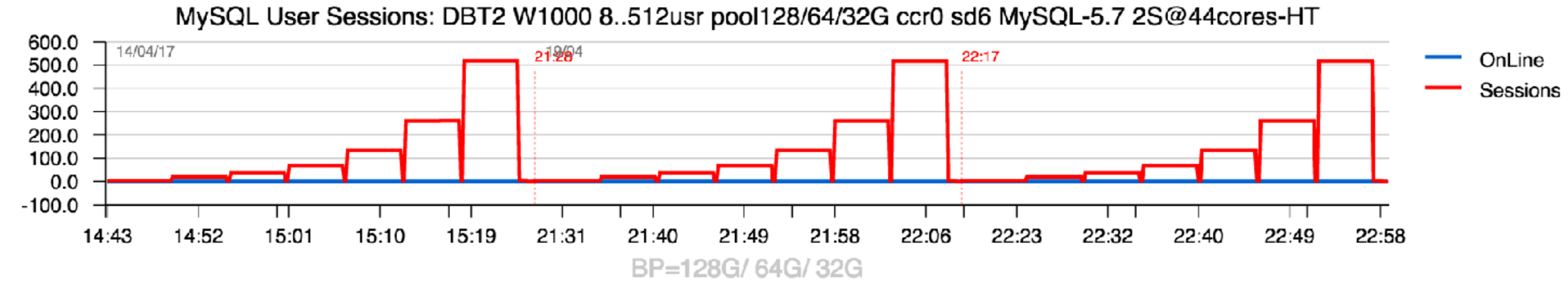
DBT2 (TPC-C)

- Data Volume :
  - 1000W (130G)
- Test Configurations :
  - BP = 128G/ 64G/ 32G
- Load :
  - 8, 16, … 512 concurrent users
- Engine :
  - MySQL 8.0-dev : has an issue on this workload..
  - so, testing with 5.7 to analyze potential gains

DBT2 1000W : BP = 128G/ 64G/ 32G

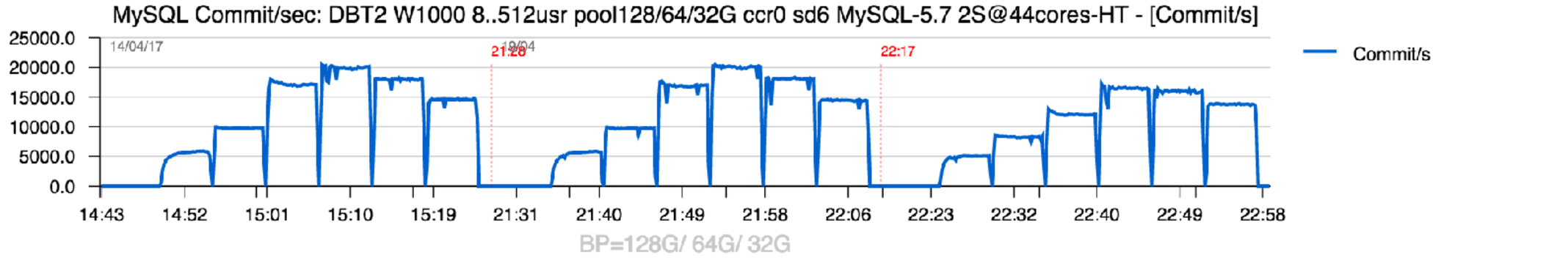
- Observations :
  - I/O impact : really small..
  - what is IO activity on 32GB BP ?..

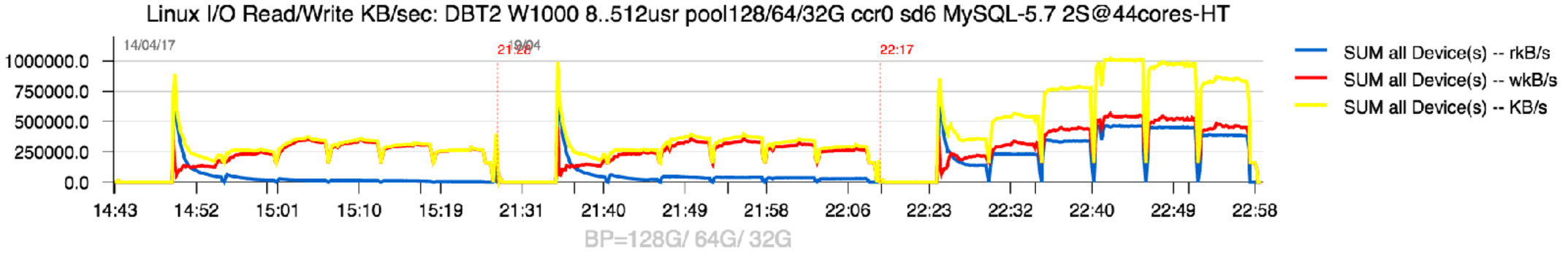




DBT2 1000W : BP = 128G/ 64G/ 32G

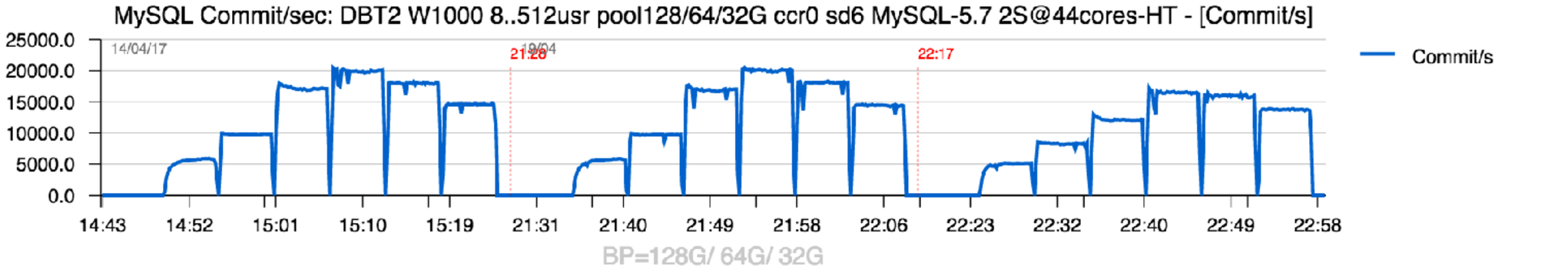
- Observations :
  - I/O impact : really small..
  - what is IO activity on 32GB BP ?.. => 1000 MB/s only (the lowest from all tests)

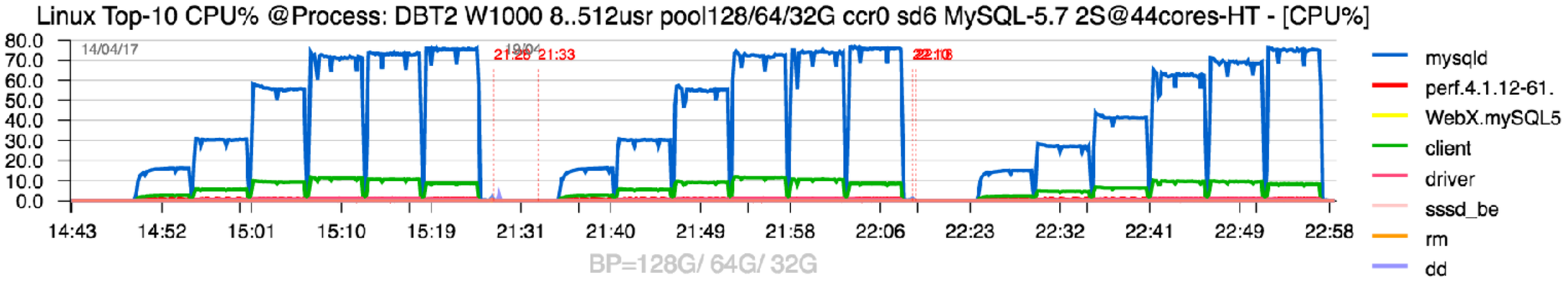




DBT2 1000W : BP = 128G/ 64G/ 32G

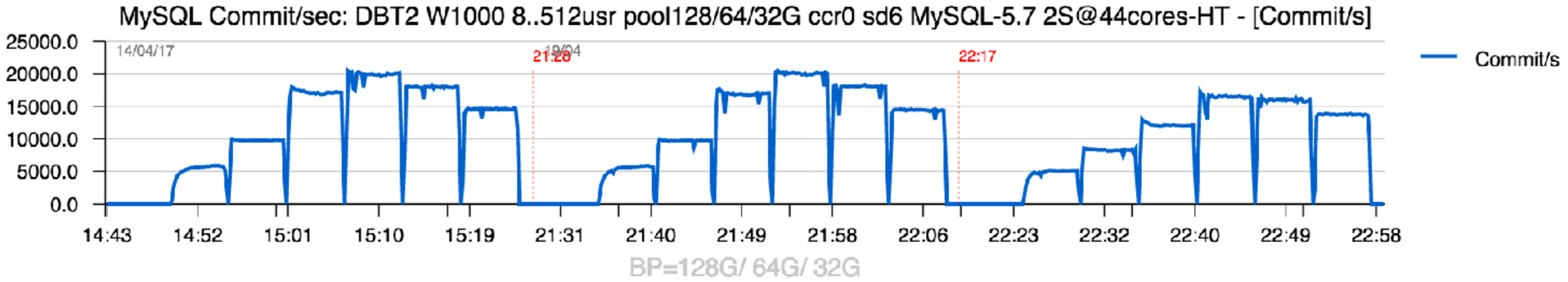
- Observations :
  - mostly CPU-bound => that's why so loved by CPU vendors ;-)
  - what about contentions ?..

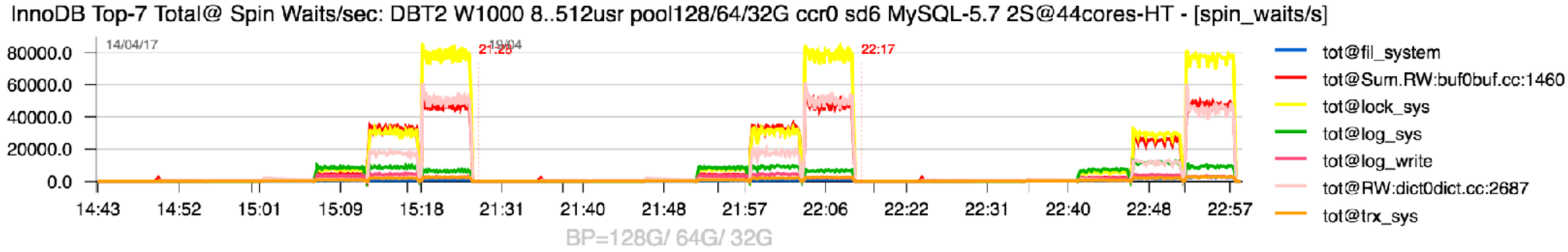




DBT2 1000W : BP = 128G/ 64G/ 32G

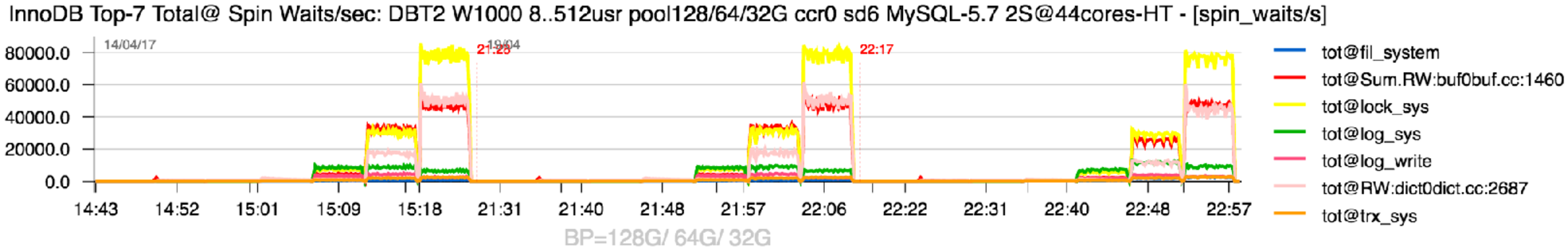
- Observations :
  - mostly CPU-bound => that's why so loved by CPU vendors ;-)
  - what about contentions ?.. => most are expected to gone with 8.0-dev..





DBT2 1000W : BP = 128G/ 64G/ 32G

- Observations :
  - mostly CPU-bound => that's why so loved by CPU vendors ;-)
  - what about contentions ?.. => most are expected to gone with 8.0-dev..
    - log_sys/ log_write/ trx_sys/ lock_sys ..
    - dict RW-lock => expected to gone with New DD
    - block RW-lock => … maybe not for 8.0 …
- Note :
  - maybe better not to use this workload for Storage validations ;-))




MAN
So, work in progress..
stay tuned... ;-)
SUPERMAN

One more thing ;-)

- All graphs are built with dim_STAT (http://dimitrik.free.fr)
  - All System load stats (CPU, I/O, Network, RAM, Processes,...)
  - Manly for Linux, Solaris, OSX (and any other UNIX too :-)
  - Add-Ons for MySQL, Oracle RDBMS, 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! :-)
- Links
  - http://dimitrik.free.fr - dim_STAT, dbSTRESS, Benchmark Reports, etc.
  - http://dimitrik.free.fr/blog - Articles about MySQL Performance, etc.