MySQL

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MySQL 8.0 Performance: Scalability & Benchmarks

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MySQL Performance Architect @Oracle

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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
- Where we're with MySQL 8.0 & Benchmark results..
  - RO / Skylake / UTF8..
  - RW / new REDO / Resource Groups
  - IO-bound / Optane
  - Sysbench / TPCC-like / dbSTRESS
- Pending issues..
- Q & A

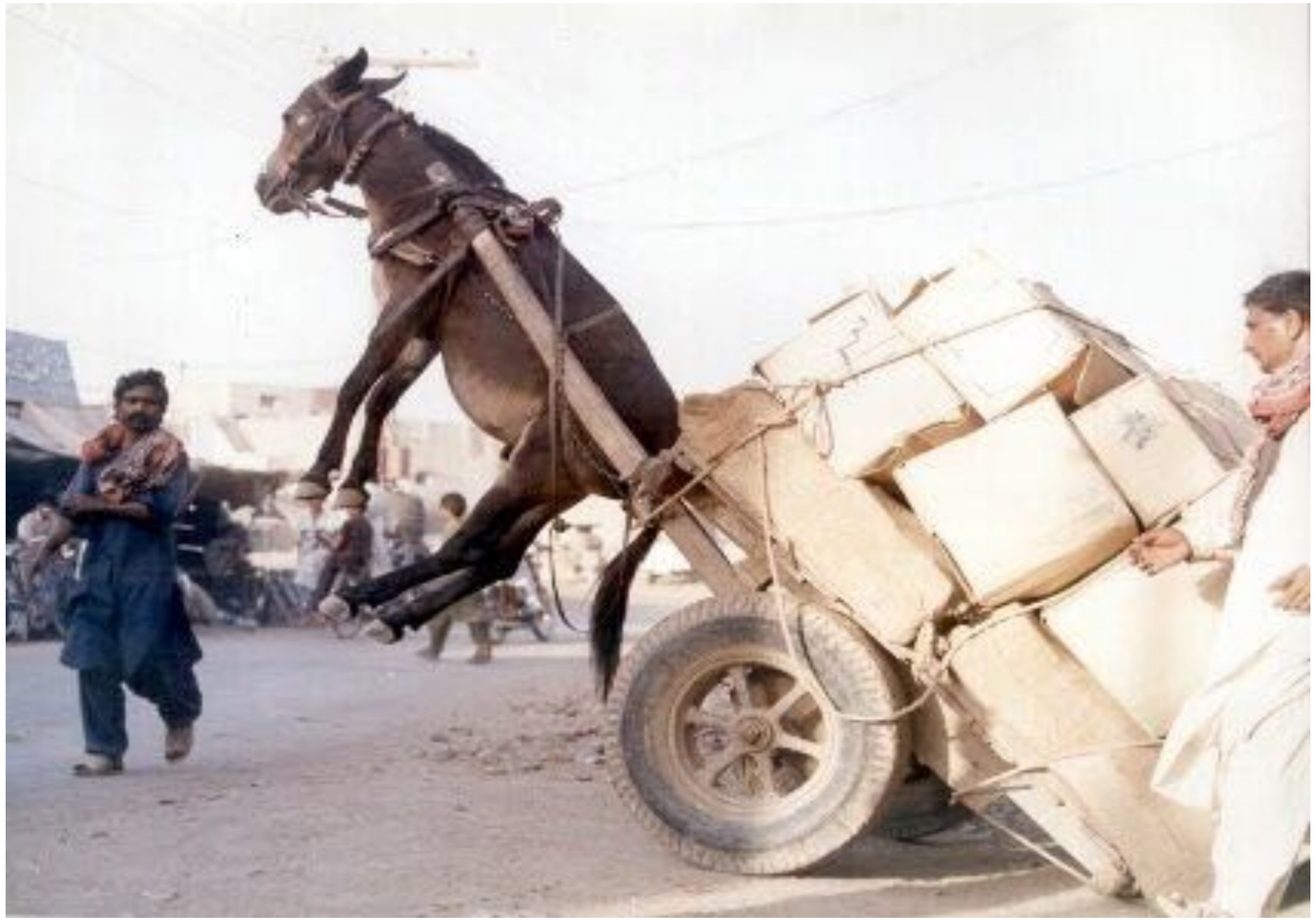
Why MySQL Performance ?...

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 ?..

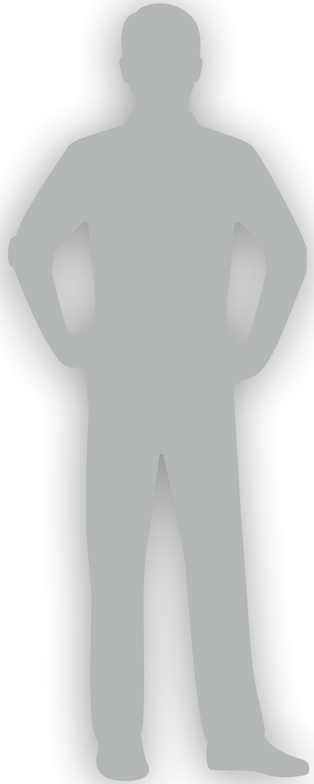
- Analyzing your workload performance and testing your limits may help you to understand ahead the resistance of your solution to incoming potential problems ;-)

Why MySQL Performance ?..

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

Why MySQL Performance ?

Is Performance your priority #1 ?



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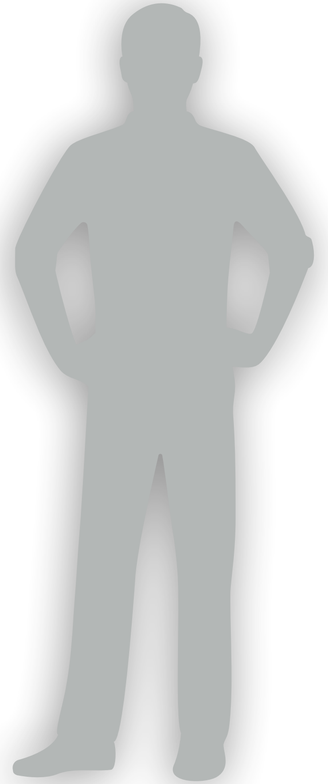

DB Guru

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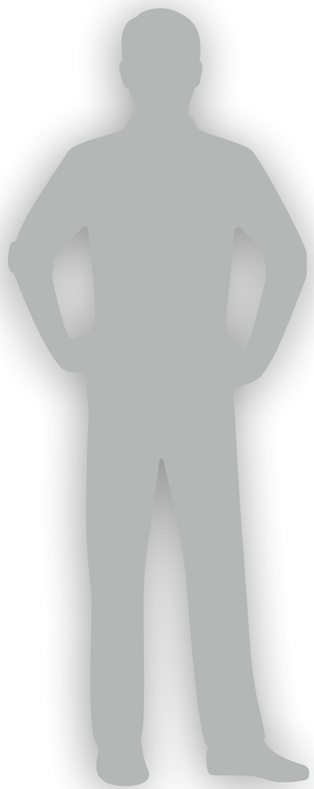
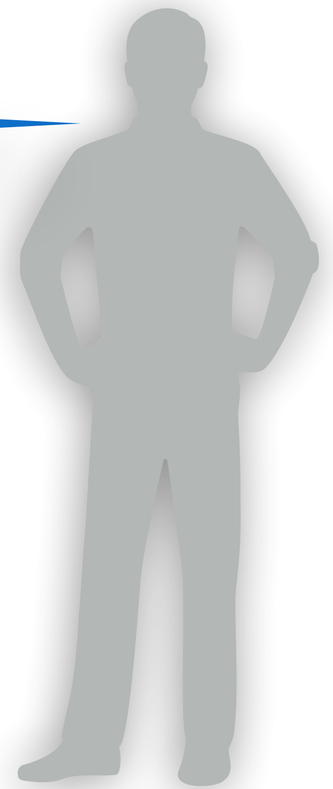
Why MySQL Performance ?



Is Performance your priority #1 ?

NO ! — the priority #1 is deployment flexibility !



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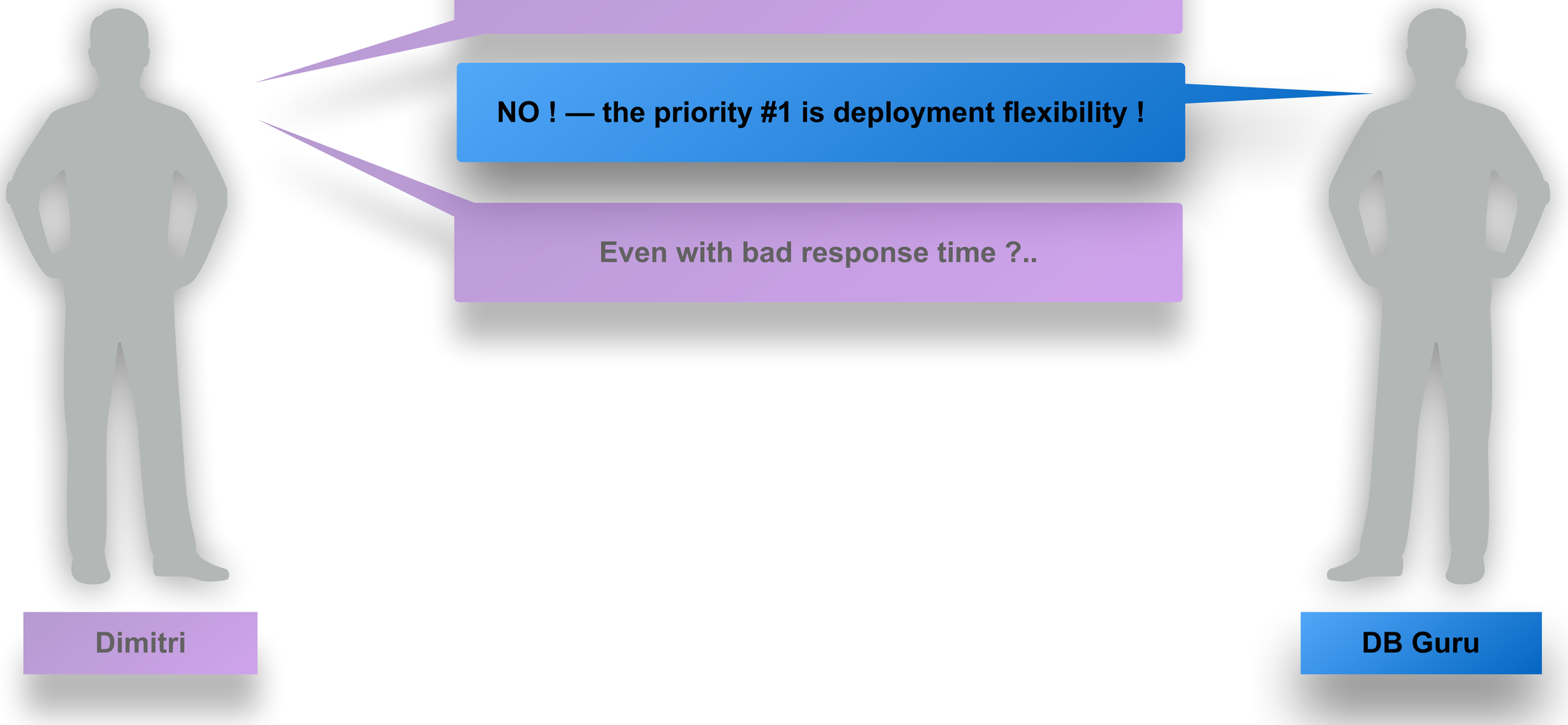
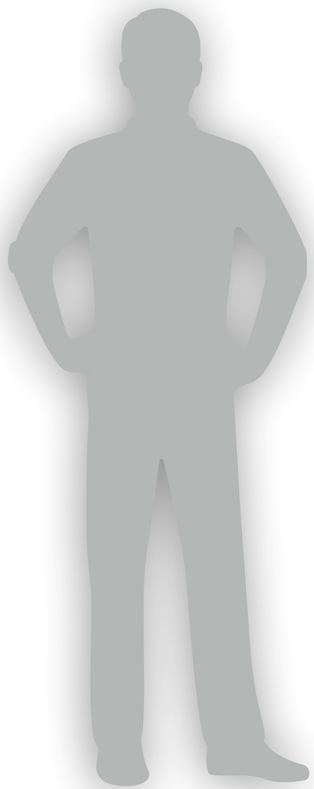


Why MySQL Performance ?



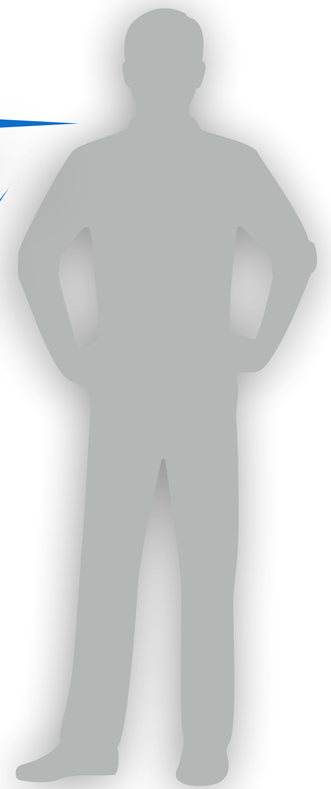
Dimitri

Is Performance your priority #1 ?

NO ! — the priority #1 is deployment flexibility !

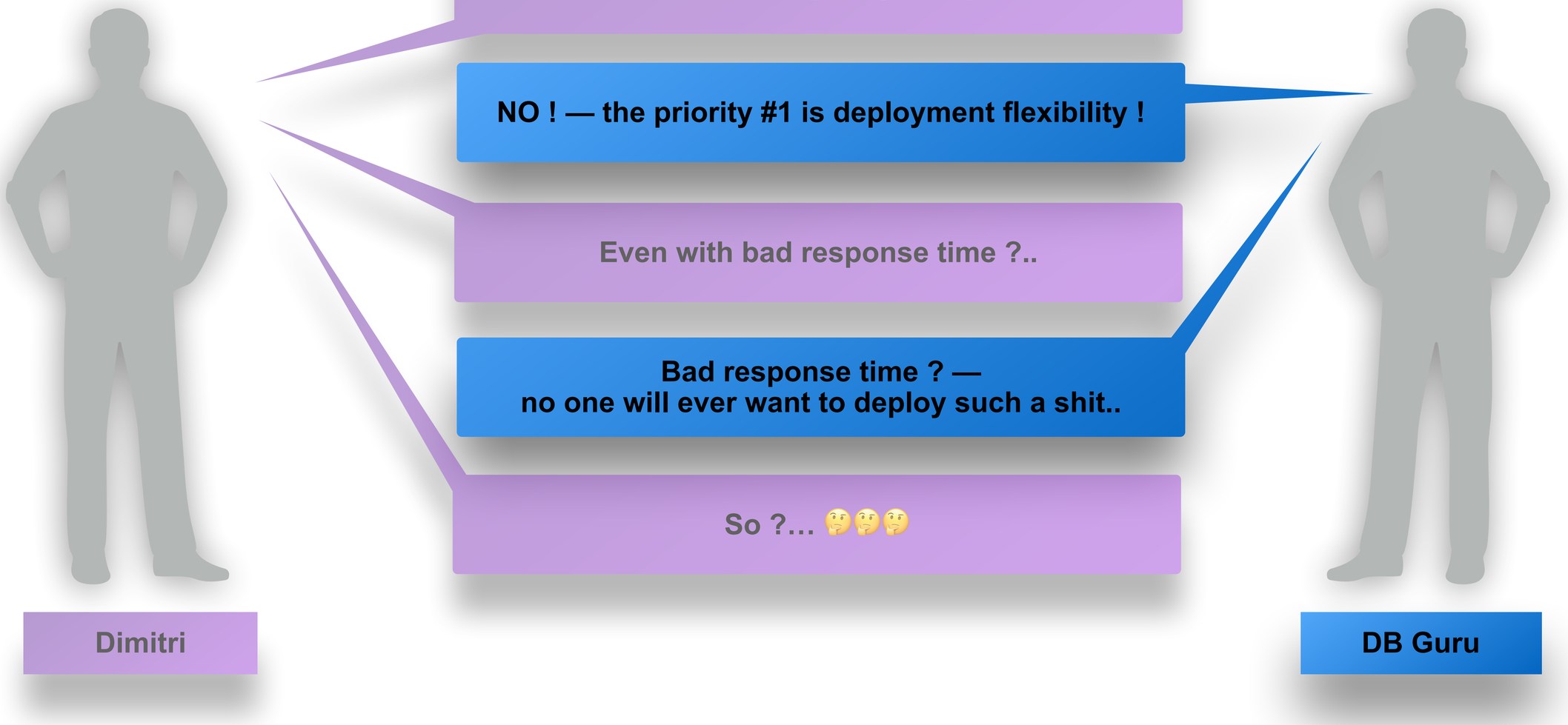
Even with bad response time ?..

Bad response time ? —
no one will ever want to deploy such a shit..



DB Guru

Why MySQL Performance ?



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

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USE YOUR BRAIN !!! ;-)

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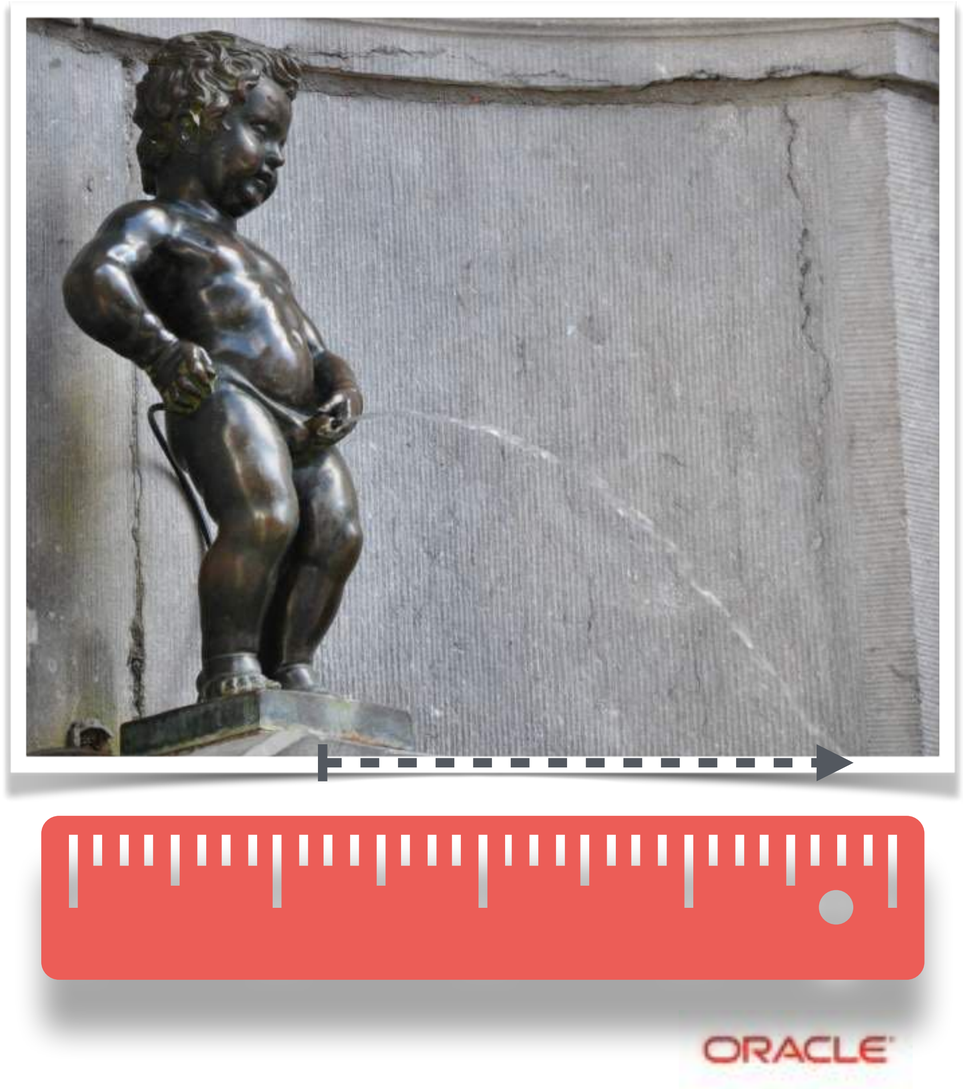
USE YOUR BRAIN !!! ;-)

Common Sources of MySQL Performance Problems..

- “Fixable” ones ;-)
  - DB Schema/ Indexes/ SQL query/ Optimizer plan/ Apps code/ etc. etc..
  - odd tuning/ wrong config setup/
  - e.g. generally can be fixed by => RTFM ! ;-)
- “By design” ones..
  - known ?..
  - workaround ?..
  - can be ever fixed ?..
  - heh…
  - work in progress.. <= and here is where we come ;-))

Why Benchmarks ?

- Common perception of benchmarks is often odd..
  - “not matching real world”…
  - “pure Marketing”..
  - “pure BenchMarketing”..
  - etc. etc. etc..
- well..
  - “it depends..” ©
  - get your own opinion by understanding of the tested workloads !
  - e.g. remind Best Practice #1 ;-))



Benchmarks & MySQL

- Every test workload is pointing to a problem to resolve !
  - evaluate & understand the problem(s)
  - then try to fix it
  - or propose a workaround
  - evaluate & confirm the fix / workaround
  - keep running in QA to discover any potential regression ON TIME !..

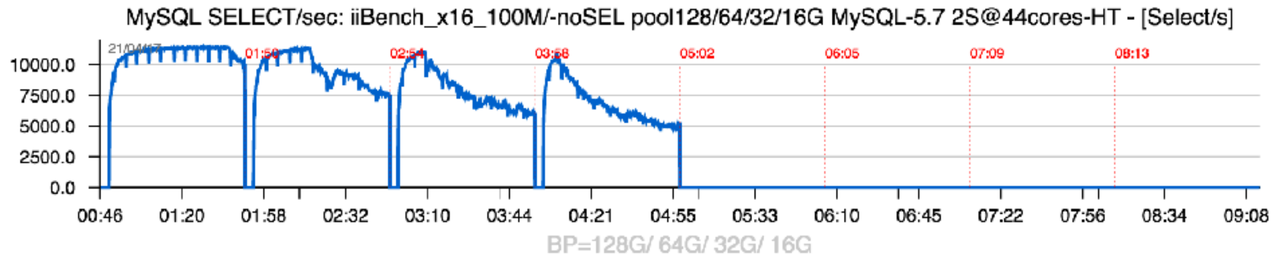
- As well :
  - kind of “reference” of what to expect
  - evaluate any new HW, systems, etc..

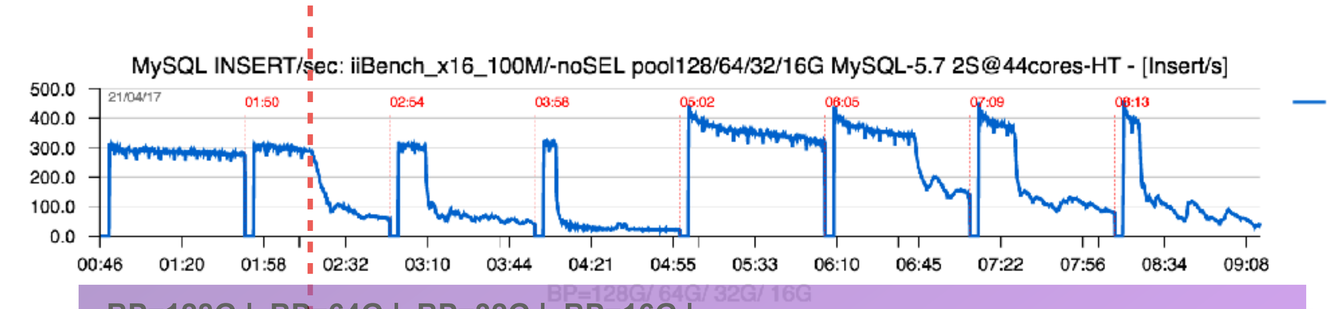
Example: iiBench (INSERT Benchmark)

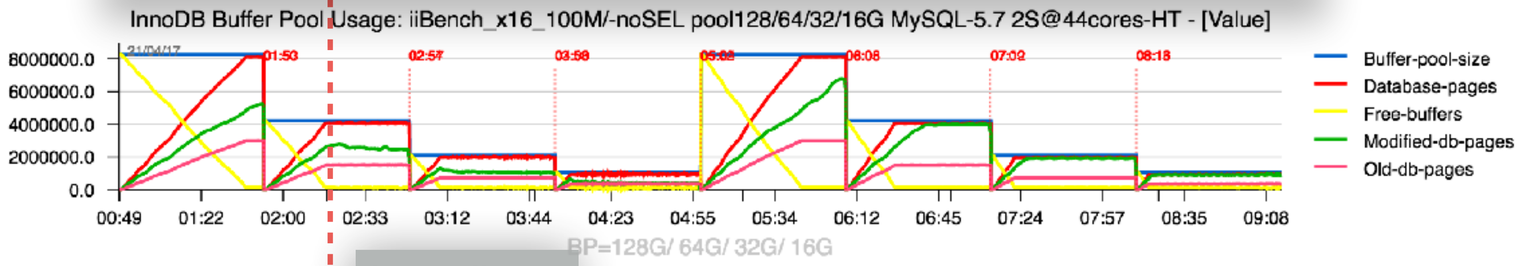
- Main claim :
  - InnoDB is xN times slower vs Write-oriented Engine XXX
  - so, use XXX, as it’s better
- Test Scenario :
  - x16 parallel iiBench processes running together during 1H
  - each process is using its own table
  - one test with SELECTs, another without..
- Key point :
  - during INSERT 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..
  - e.g. “by design” problem ;-))

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

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



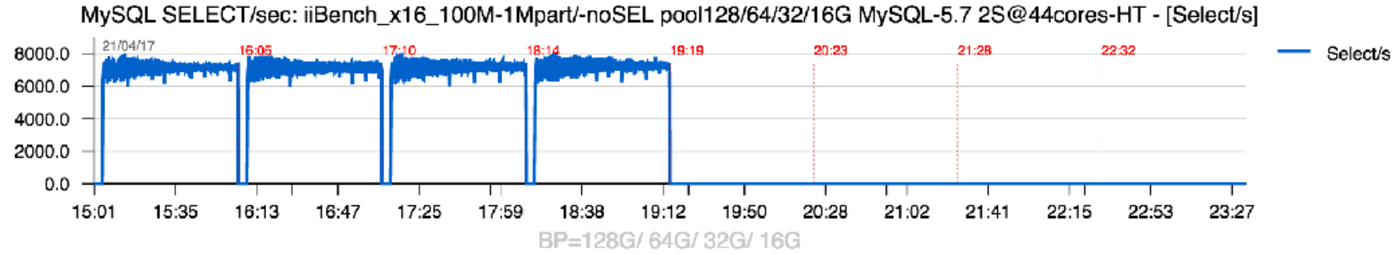


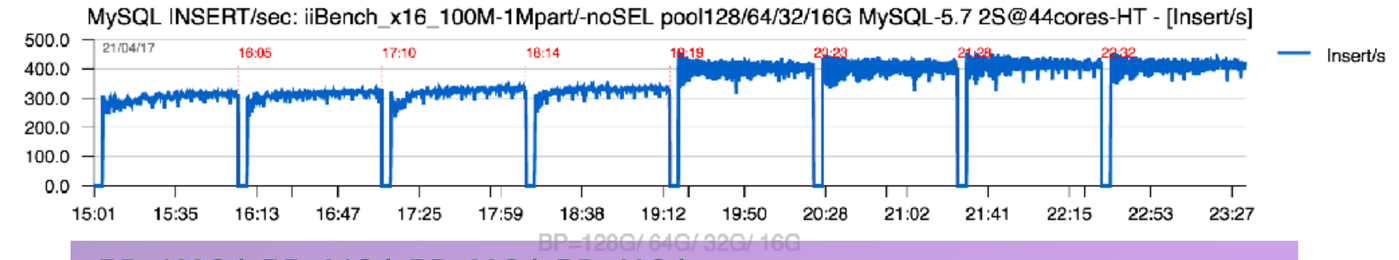


free buffers !!!

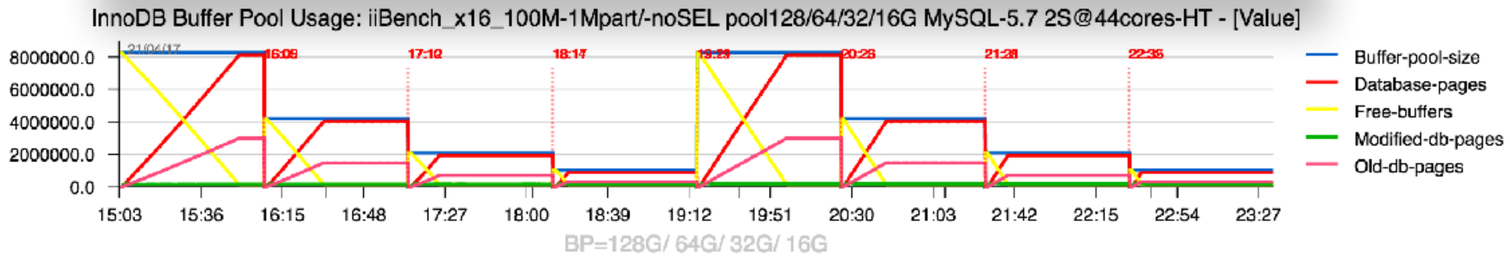
iiBench 100M x16 & 1M-parts : BP= 128G/ 64G/ 32G/ 16G

- Observations :
  - workaround : keep index cached in BP (via table partitions or other)





BP=128G | BP=64G | BP=32G | BP=16G |

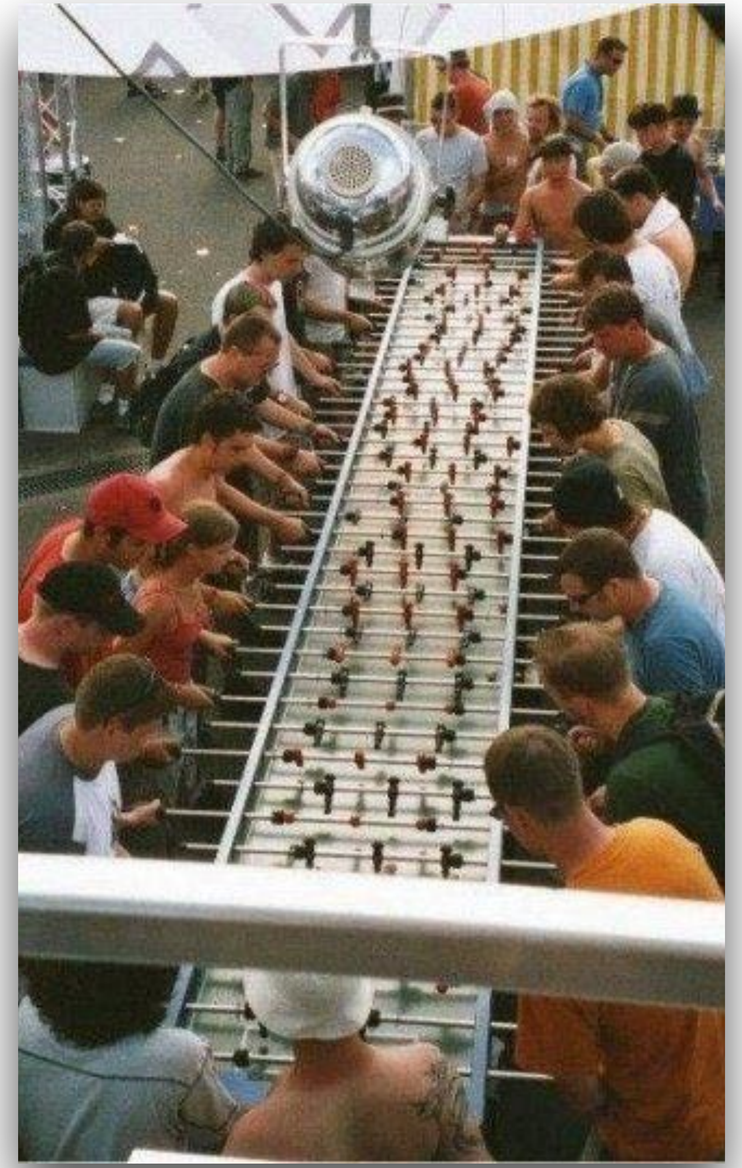


Test Workload

- 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 ;-))

The Best Test Workload

- For You :
  - workload simulating your Production !
  - JMetter (free)
  - LoadRunner ($$)
  - etc.
- otherwise :
  - use “generic” test workloads
  - change / adapt / extend..
  - **share** with us ! ;-))



“Generic” Test Workloads @MySQL

- Sysbench - #1
  - The “Entry Ticket” Workloads - looks simple, but still the most complete test kit !
  - OLTP, RO/RW, points on various RO and RW issues
- DBT2 / TPCC-like
  - OLTP, RW, pretty complex, growing db, no options, deadlocks
- DBT3
  - DWH, RO, complex heavy queries, loved by Optimizer Team ;-)
- dbSTRESS
  - OLTP, RO/RW, several tables, points on RW and Sec.IDX issues
- iiBench
  - pure INSERT bombarding + optionally SELECTs, points on B-Tree issues
- LinkBench (Facebook)
  - OLTP, RW, looks intensive and IO-hungry

Why Sysbench is #1 ?..

- Historically :
  - the most simple to install, to use, most lightweight
  - why entry ticket : covers most important “key workload cases” in MySQL performance

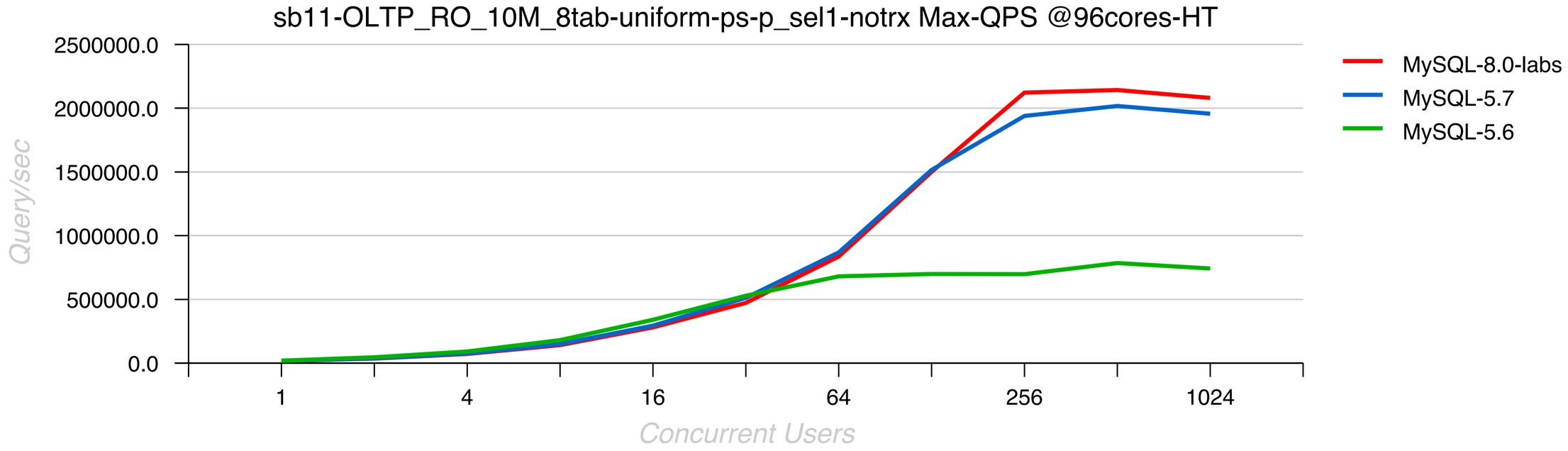
- New Sysbench :
  - https://github.com/akopytov/sysbench
  - have fixed all past issues
  - high flexibility for any test scenario with LUA scripts
  - integrated LUA JIT => high execution speed + lightweight !
  - more various test scenarios are expected to come
  - excellent opportunity to write your own test cases !
  - move and use it now ! ;-)

MySQL Scalability 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..)
  - but : RW workloads are faster than RO ! ;-))
- MySQL 5.7
  - finally fully unlocked Read-Only + no more contentions on the “Server” layer, etc..
  - and (finally) RO is faster than RW ;-))
- MySQL 8.0
  - main focus is on efficiency : do more on the same HW ;-))
  - main target HW : 2CPU Sockets systems
  - RW scalability.. & data security..
  - NOTE : Continuous Release Model !

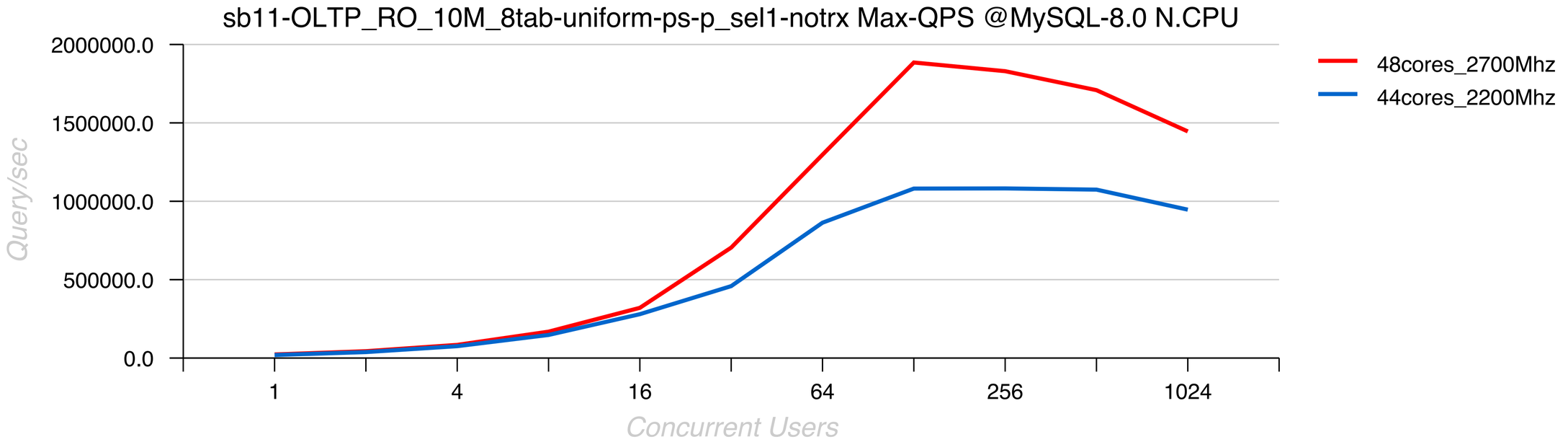
RO Point-Selects @MySQL 8.0-labs (Sep.2017)

- **2.1M (!!) QPS** Sysbench Point-Selects 10Mx8tab :
  - 4CPU Sockets (4S) : 96cores-HT Broadwell v4
  - the main gain : NO regression -vs- 5.7 !! (and I'm serious ;-))



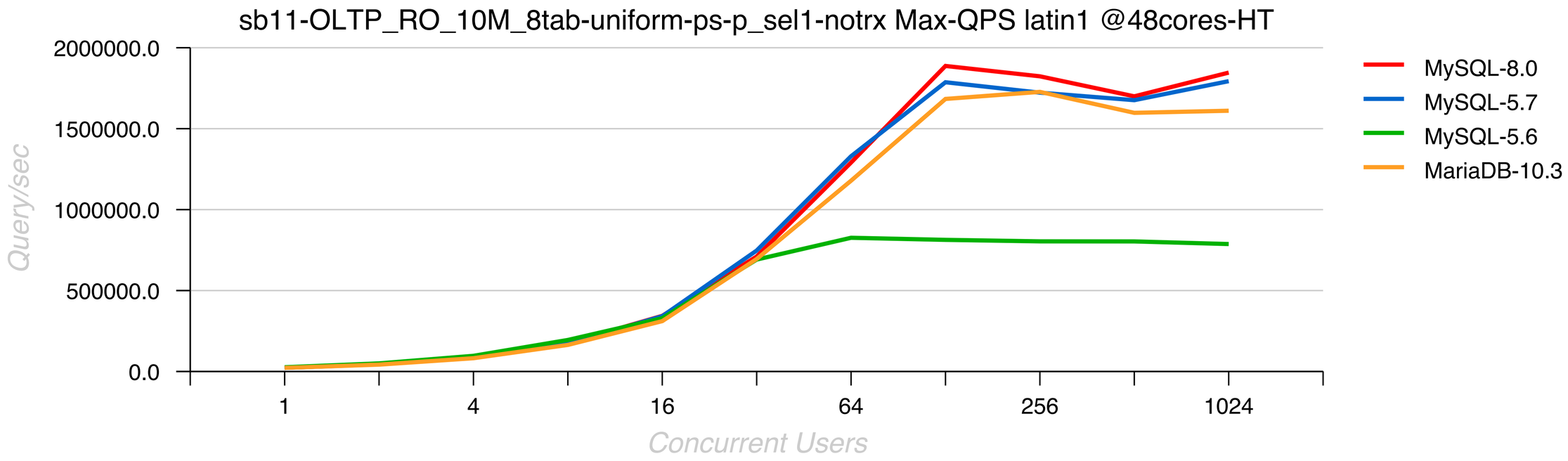
RO Point-Selects @MySQL 8.0 (Dec.2017)

- Sysbench Point-Selects 10Mx8tab @2CPU Sockets
  - 2CPU Sockets Broadwell v4 : 44cores-HT
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - => near **80**% gain in peak QPS !! already 50% on 32usr load !!



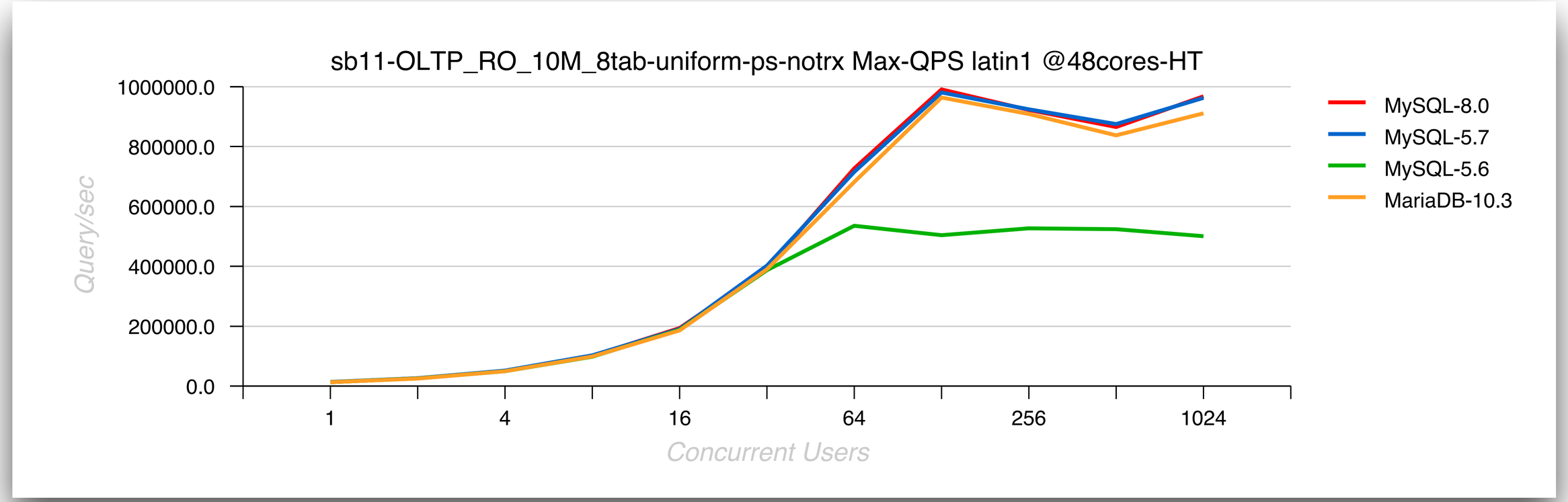
RO Point-Selects @MySQL 8.0 (Apr.2018)

- **1.8M+ (!!) QPS** Sysbench Point-Selects 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - => currently our best results on 2S HW



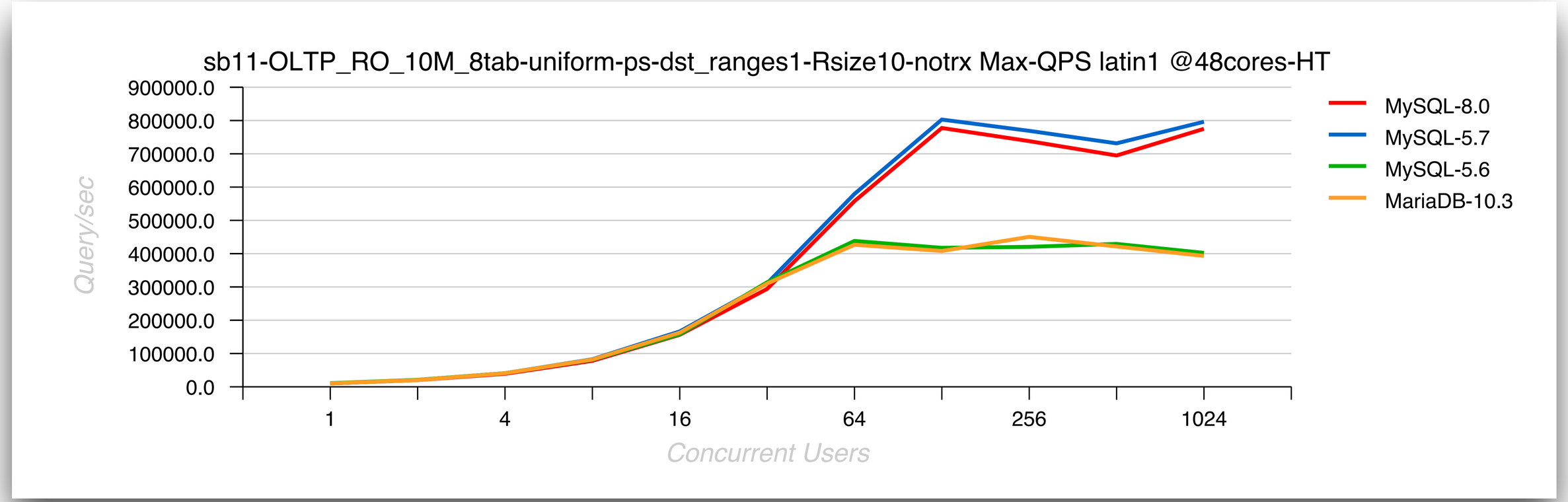
OLTP_RO @MySQL 8.0 (Apr.2018)

- **1M (!!) QPS** Sysbench OLTP_RO 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT



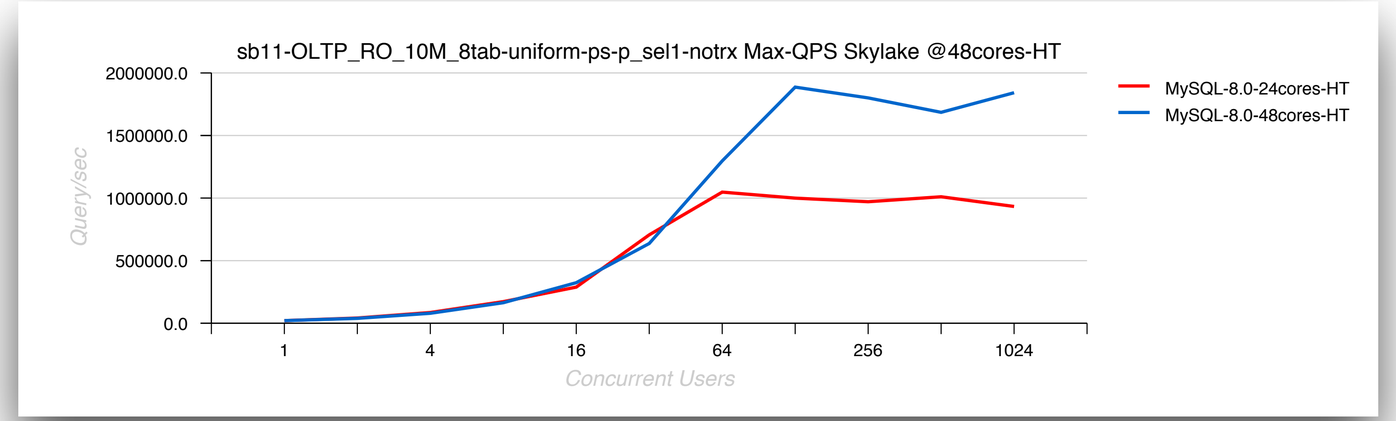
RO Distinct-Ranges @MySQL 8.0 (Apr.2018)

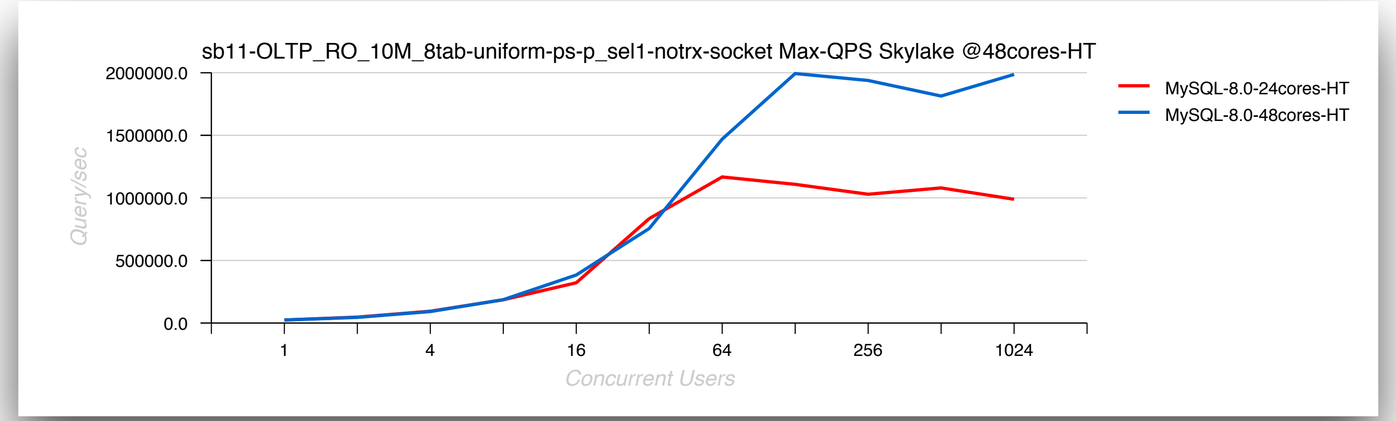
- **790K QPS** Sysbench OLTP_RO 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - => first signs of regression in 8.0..
  - => no comments about MariaDB..



Point-Selects : IP port -vs- UNIX socket

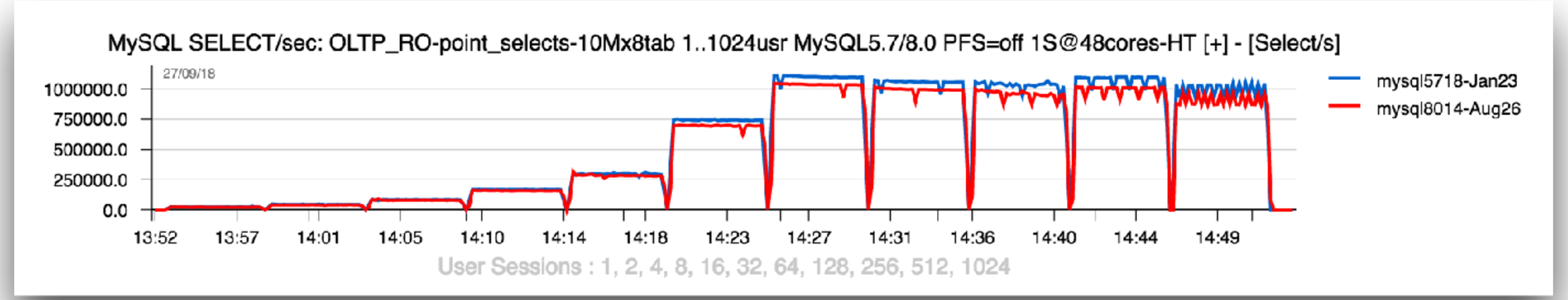
- Skylake 2S, 48cores-HT :
  - up to **19%** difference !
  - HW ? OS kernel ?
  - IP stack ?
  - under investigations…

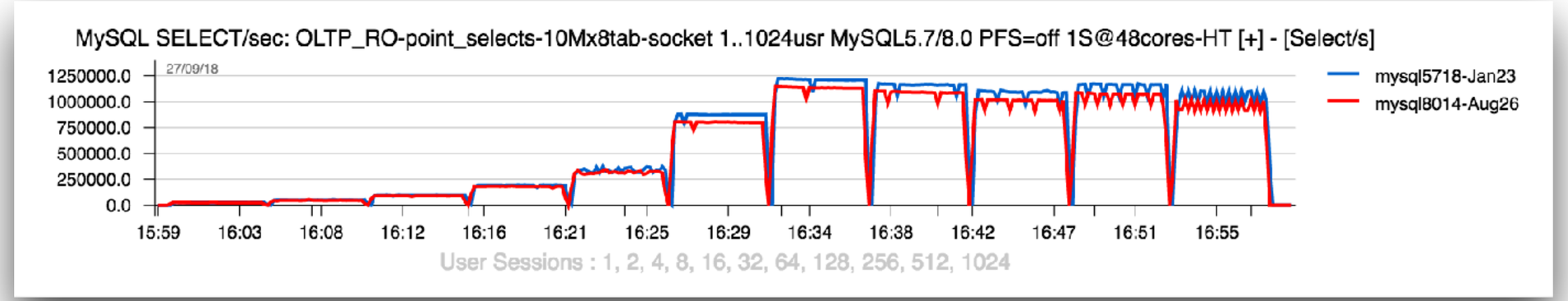




Point-Selects : MySQL 5.7 -vs- 8.0 (Oct.2018)

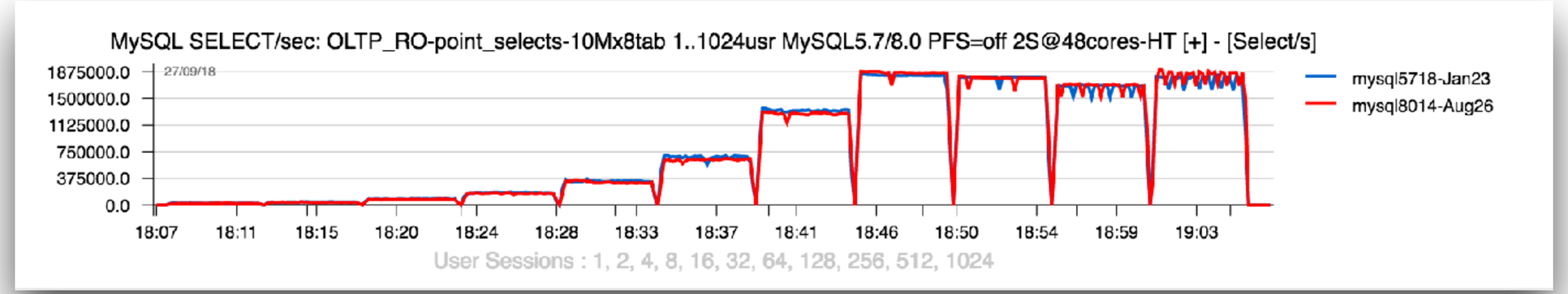
- Skylake 1S (24cores-HT)
  - 8.0 is near 10% lower..

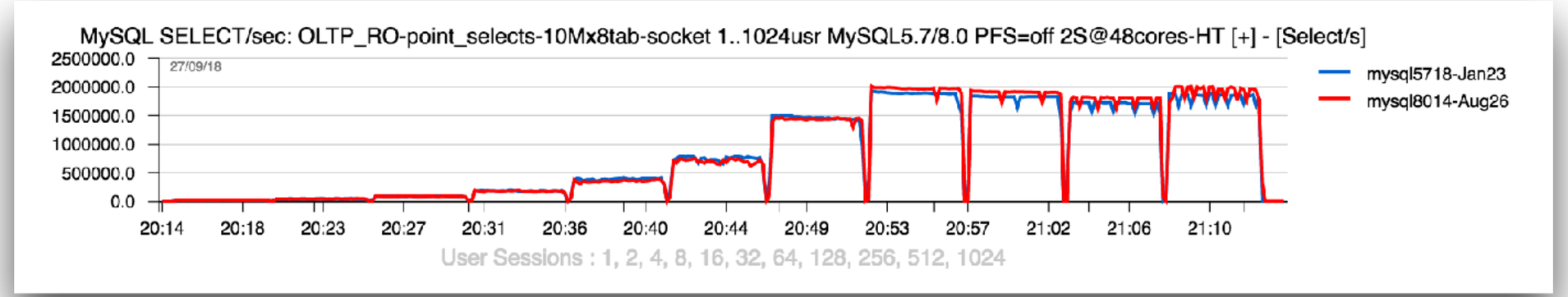




Point-Selects : MySQL 5.7 -vs- 8.0 (Oct.2018)

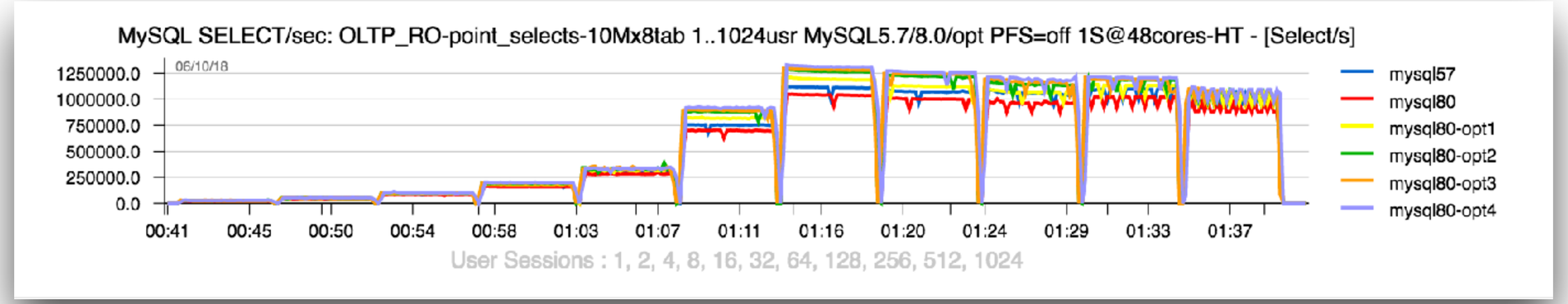
- Skylake 2S (48cores-HT)
  - 8.0 is little bit higher..

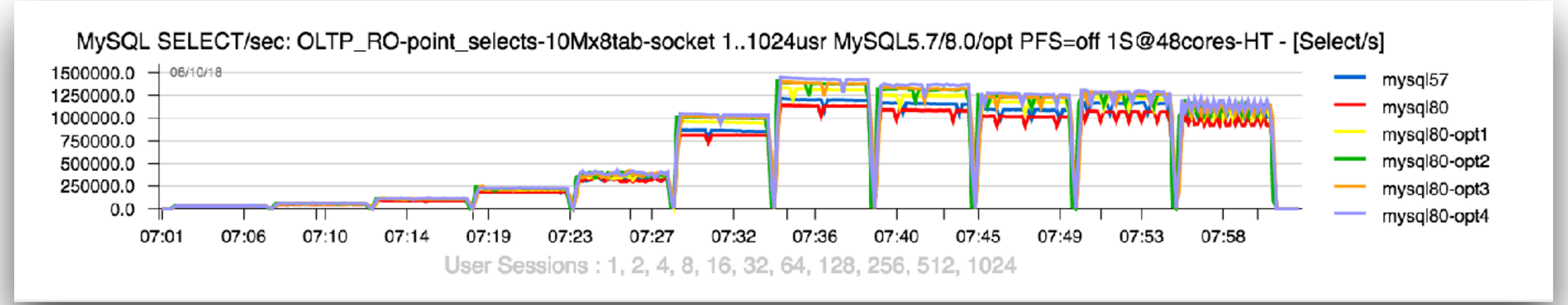




Point-Selects : MySQL 5.7 -vs- 8.0 (Oct.2018)

- Skylake 1S (24cores-HT) — the good news ;-))
  - 8.0 is largely higher..





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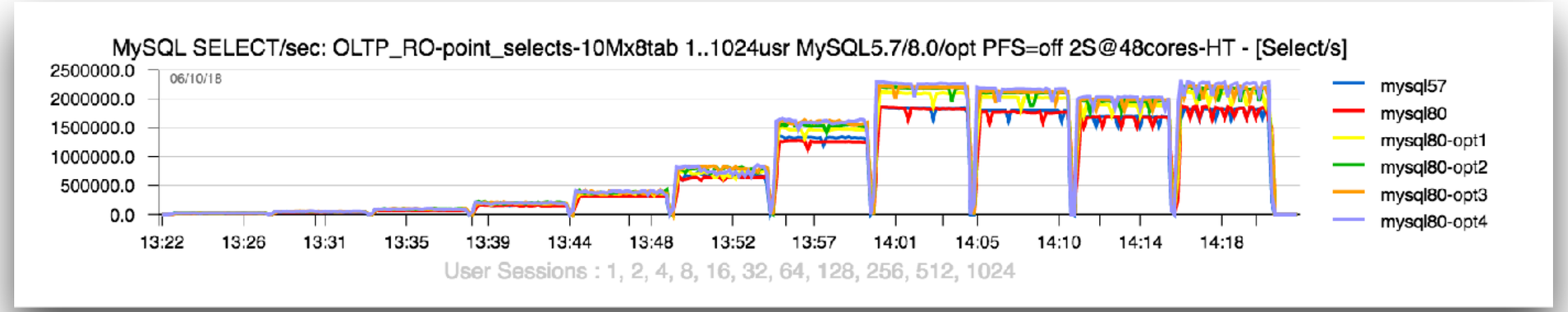

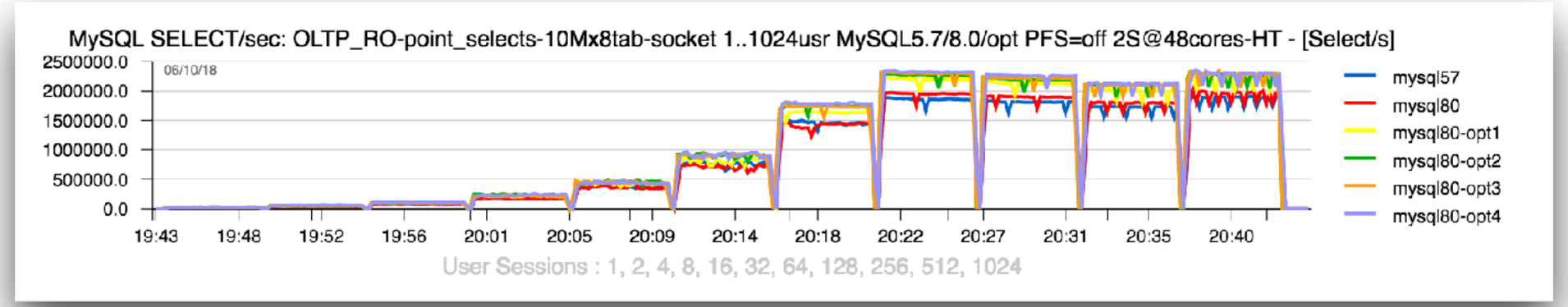

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Pending RO Scalability Issues after MySQL 5.7 GA..

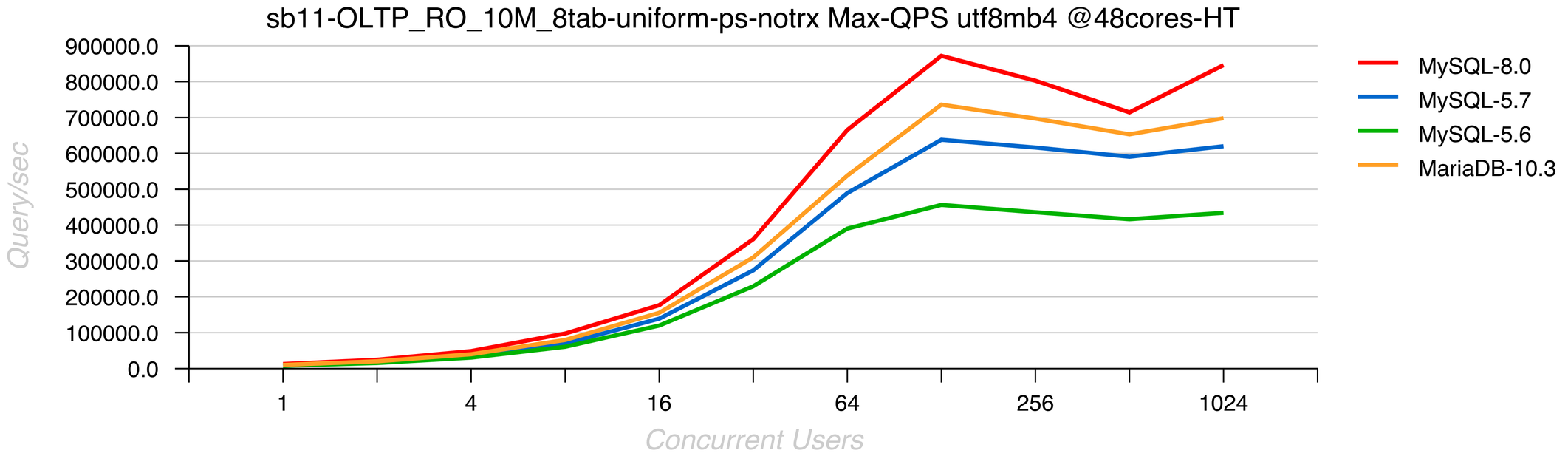
- RO :
  - Block Locks
  - Lookups via Sec.IDX
  - UTF8
  - Global lock on every IO read

Pending RO Scalability Issues after MySQL 5.7 GA..

- RO :
  - Block Locks <= workaround : ProxySQL Query Cache
  - Lookups via Sec.IDX <= possible workaround : use PK, AHI
  - UTF8 <= **use 8.0** ;-)
  - Global lock on every IO read <= **use 8.0** ;-)

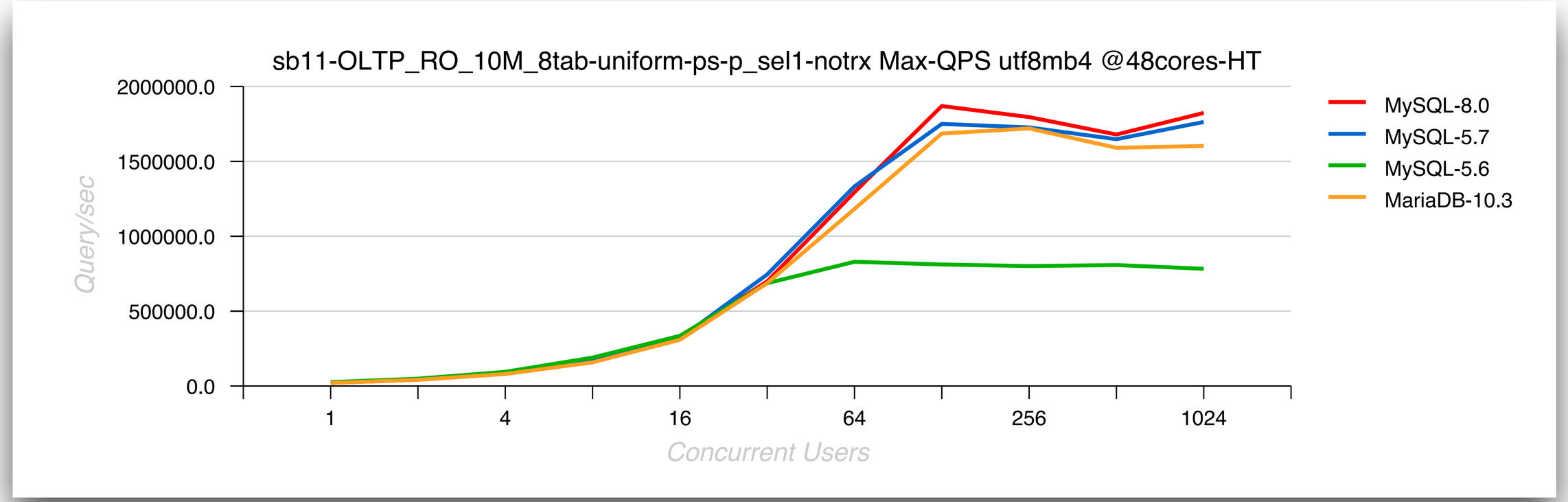
OLTP_RO UTF8mb4 @MySQL 8.0 (Apr.2018)

- **870K(!!) QPS** Sysbench OLTP_RO 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - => up to 40% better than 5.7



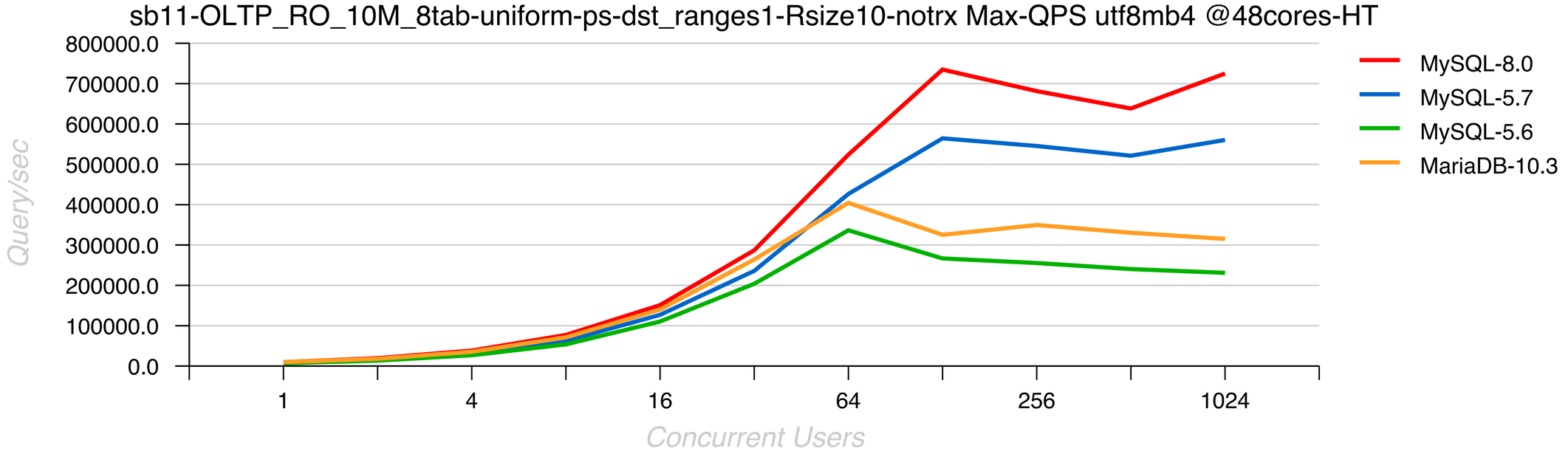
RO Point-Selects UTF8mb4 @MySQL 8.0 (Apr.2018)

- **Same QPS** Sysbench RO point-selects 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT



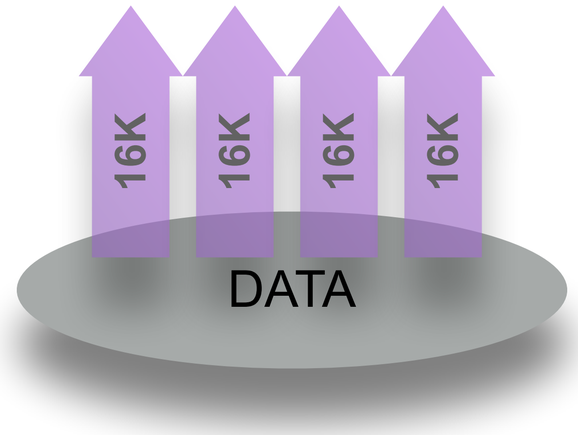
RO Distinct-Ranges UTF8mb4 @MySQL 8.0 (Apr.2018)

- **735K (!!) QPS** Sysbench RO dist-ranges 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - => up to 30% better than 5.7



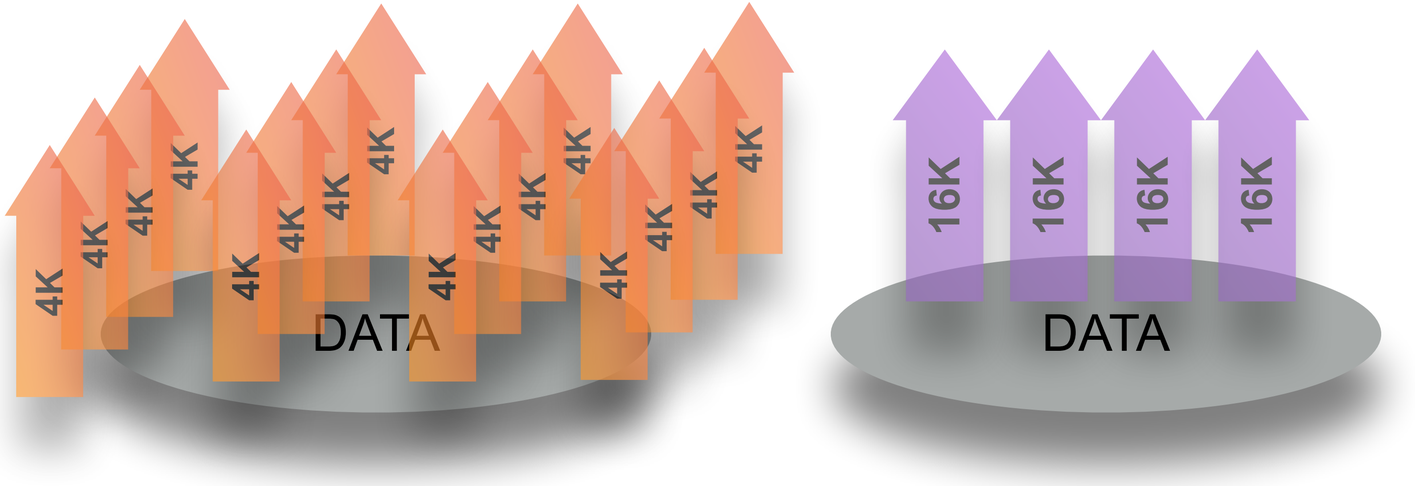
IO-bound Workloads : Game Changer..

- IO reads :
  - game changer : **FLASH** => goes faster / cheaper / more stable / living longer / etc..
  - e.g. no more “seek time” cost, the main IO limit : device throughput
  - supposing your max throughput is XXX MB/sec, what is the max IO-bound QPS possible ?
  - => driven by IO read **Operations/sec** …



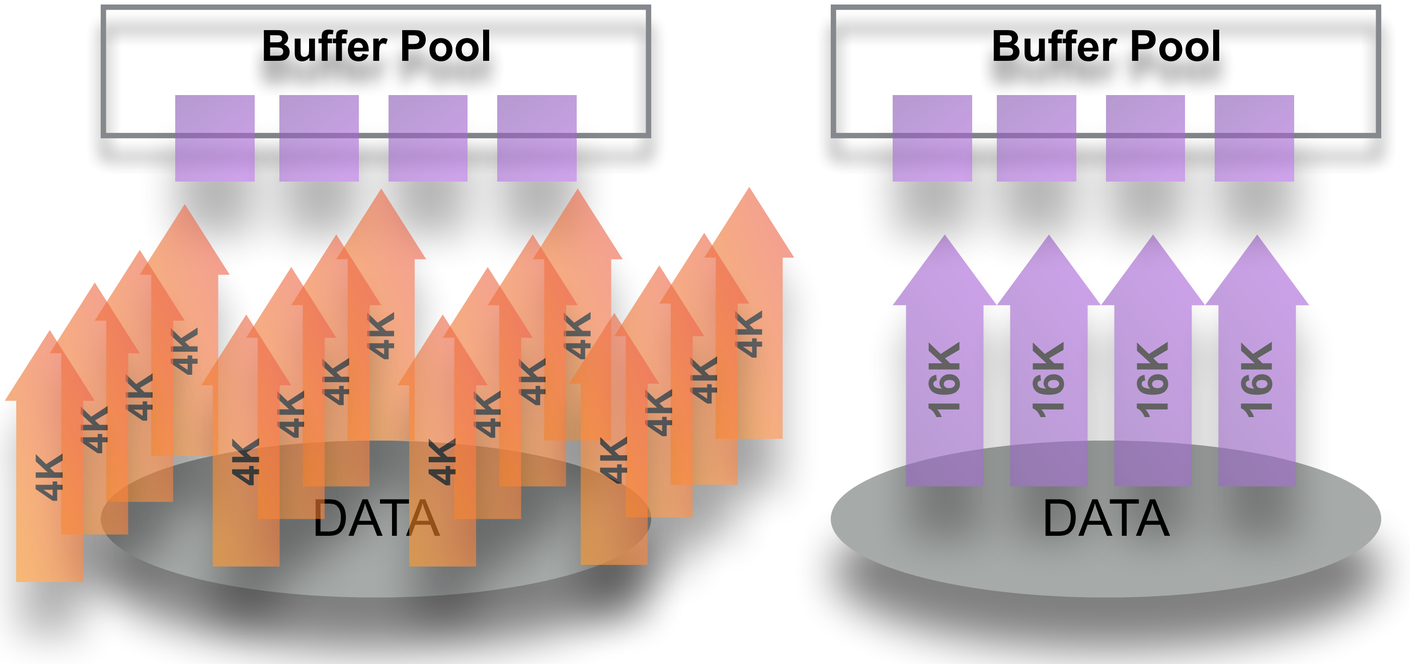
IO-bound Workloads : more in depth..

- IO reads :
  - game changer : FLASH => goes faster / cheaper / more stable / living longer / etc..
  - e.g. no more “seek time” cost, the main IO limit : device throughput
  - supposing your max throughput is XXX MB/sec, what is the max IO-bound QPS possible ?
  - => driven by IO read **Operations/sec** …
  - x4 Compression ? => x4 times more IO reads !!!



IO-bound Workloads : more in depth..

- IO reads :
  - game changer : FLASH => goes faster / cheaper / more stable / living longer / etc..
  - e.g. no more “seek time” cost, the main IO limit : device throughput
  - supposing your max throughput is XXX MB/sec, what is the max IO-bound QPS possible ?
  - => driven by IO read **Operations/sec** …
  - x4 Compression ? => x4 times more IO reads !!! => **and QPS** ?..



IO-bound Workloads : more in depth..

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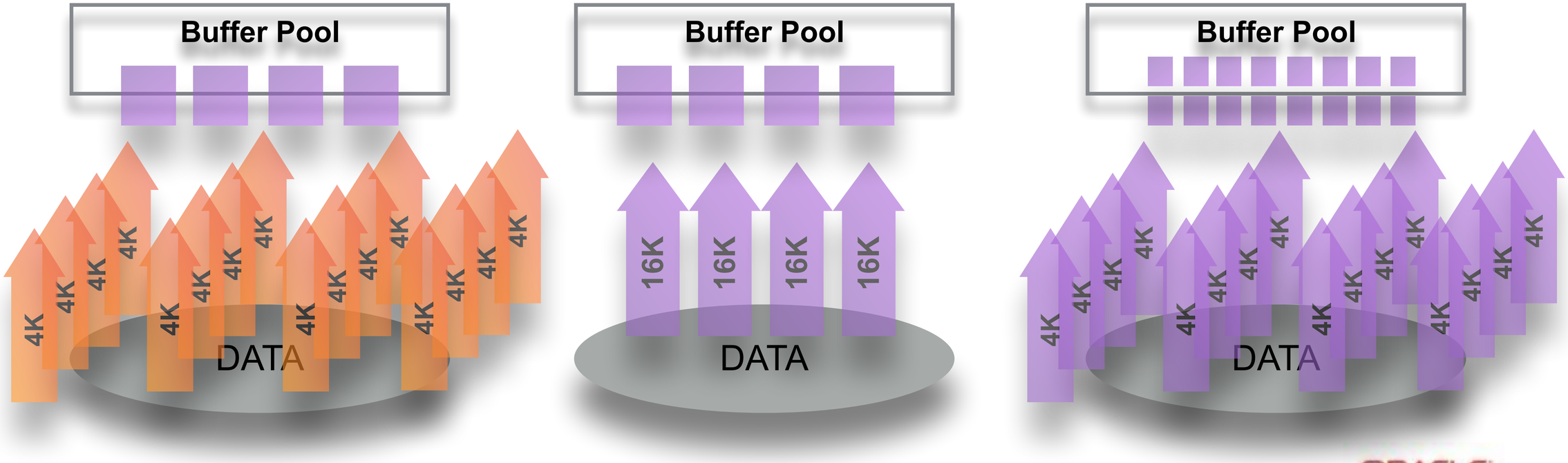
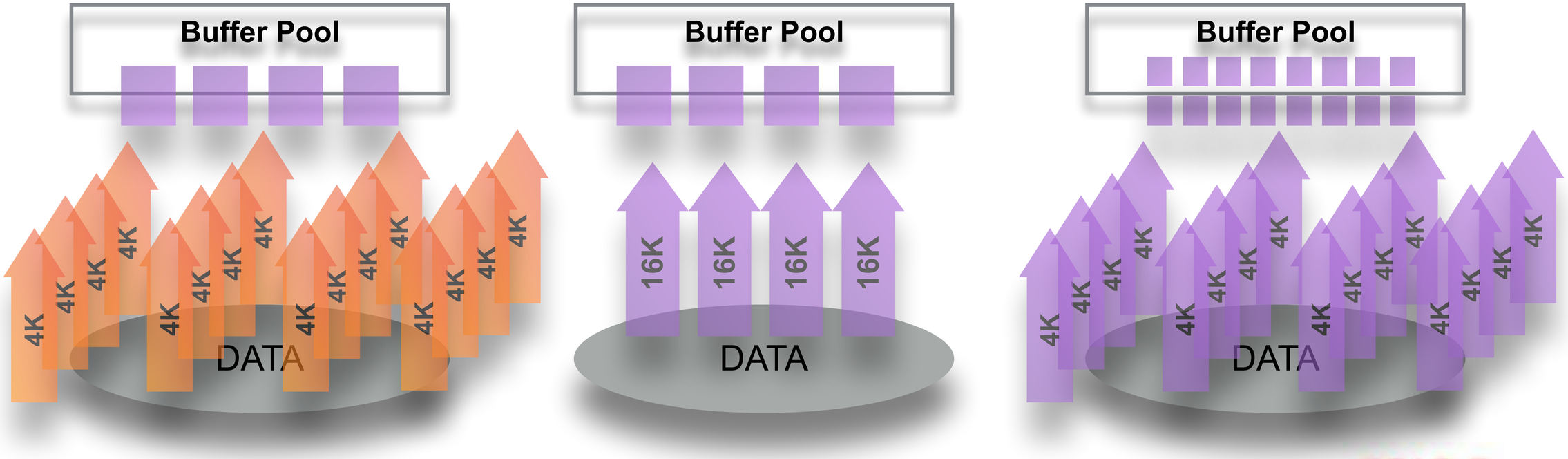
  - => driven by IO read **Operations/sec** …
  - x4 Compression ? => x4 times more IO reads !!! => and QPS ?.. **and if 4K page ?**



IO-bound Workloads : more in depth..

- IO reads :
  - so, with fast FLASH + 4K page size => x4 times better RO performance vs default 16K ?
  - potentially YES ;-))
  - but.. => historically : **fil_system** global mutex lock on **every IO operation !!!**
  - good news : **fixed since MySQL 8.0 ! ;-))**



IO-bound Workloads : Test Case

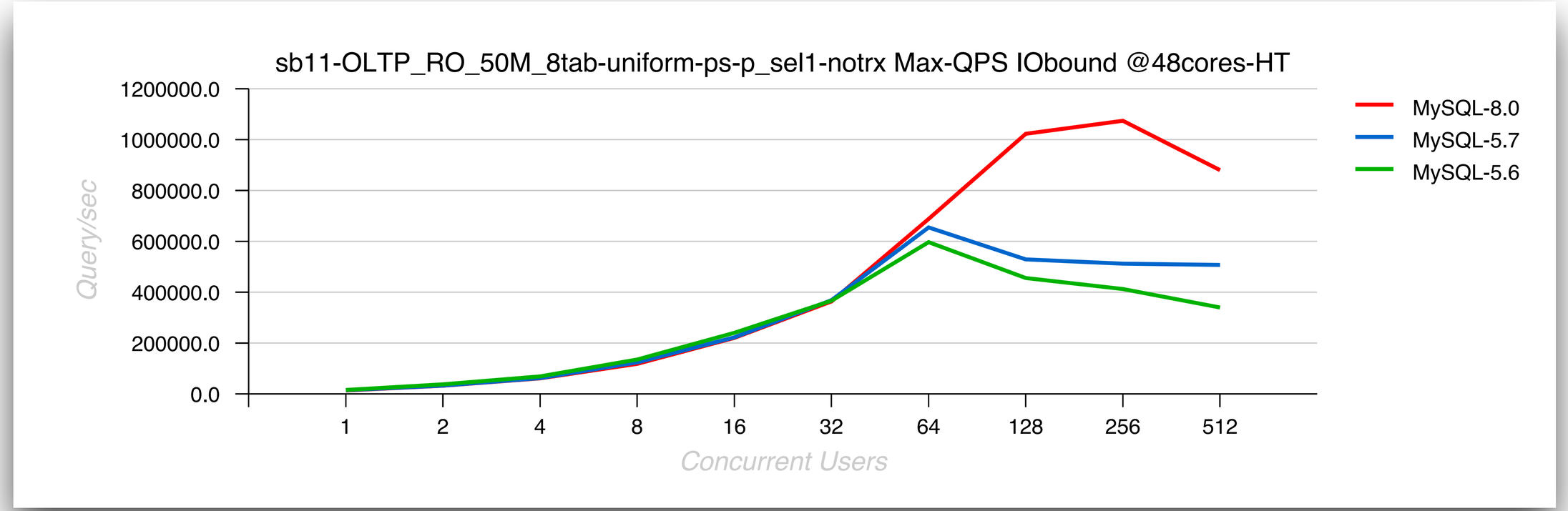
- Intel Optane drive :
  - IO read latency : 0,01ms (!!!)
  - 1 single process doing 16KB IO reads : ~65K reads/sec, 1000 MB/sec
  - however, the max throughput : 2000 MB/sec only (fix in progress by Intel)

- with x2 drives :
  - over 4000 MB/sec throughput
    - 16K page : ~260K IO reads/s
    - 8K page : over 500K IO reads/s
    - 4K page : **over 1M IO reads/s**

  - can MySQL get a profit of such an IO power ?..

IO-bound Point-Selects @MySQL 8.0 (Apr.2018)

- IO-bound Sysbench OLTP_RO Point-Selects
  - 50M x 8-tables, 48cores-HT, x2 Optane drives
  - NOTE : storage saturated & 100% CPU (new face of IO-bound ? ;-))
  - over **1M IO-bound QPS** with MySQL 8.0 !!!



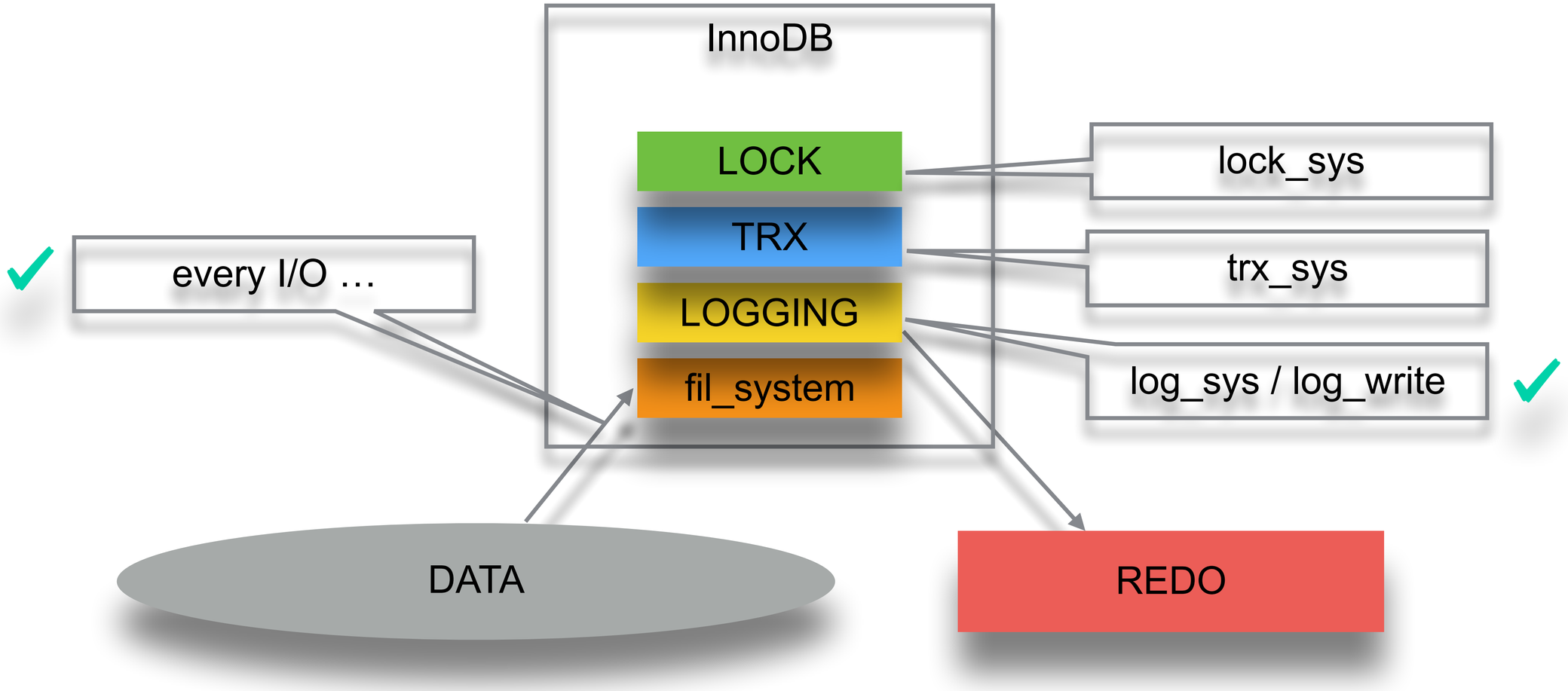
Pending Scalability Issues after MySQL 5.7 GA..

- RO :
  - Block Locks <= workaround : ProxySQL Query Cache
  - Lookups via Sec.IDX <= possible workaround : use PK, AHI
  - UTF8 <= **use 8.0** ;-)
  - Global lock on every IO read <= **use 8.0** ;-)
- RW :
  - REDO log related bottlenecks..
  - Double Write..
  - TRX management contentions..
  - LOCK management..
  - RR / RC isolation..
  - UPDATE Performance..
  - INSERT Performance..
  - Purge lagging..

Pending Scalability Issues after MySQL 5.7 GA..

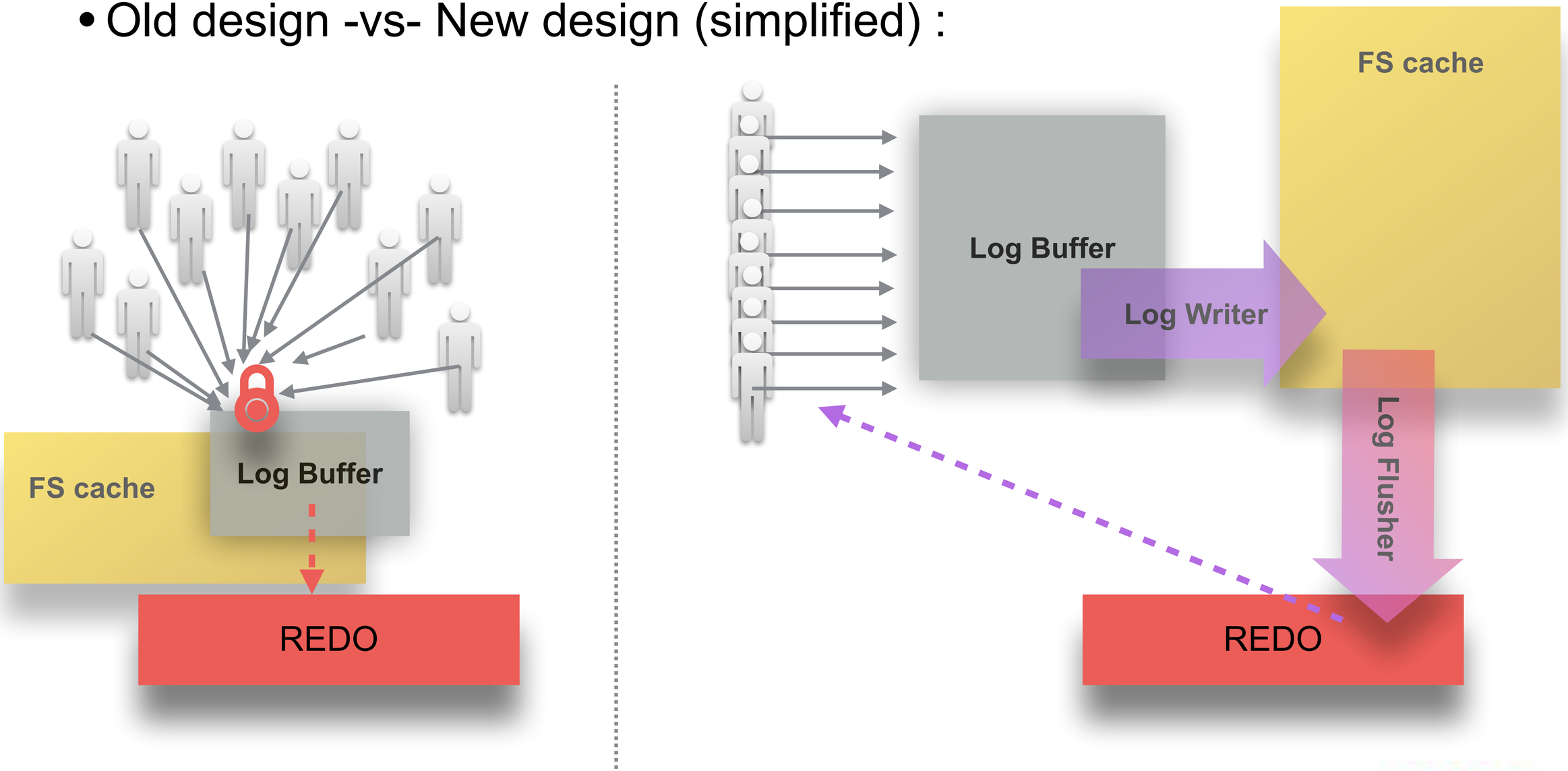
- RO :
  - Block Locks <= workaround : ProxySQL Query Cache
  - Lookups via Sec.IDX <= possible workaround : use PK, AHI
  - UTF8 <= **use 8.0** ;-)
  - Global lock on every IO read <= **use 8.0** ;-)
- RW :
  - REDO log related bottlenecks.. <= **new REDO since 8.0 !!**
  - Double Write.. <= **coming soon with 8.0 update (!!)**
  - TRX management contentions.. <= work-in-progress, prototyped..
  - LOCK management.. <= work-in-progress, prototyped..
  - RR / RC isolation.. <= work-in-progress, prototyped..
  - UPDATE Performance.. <= **use 8.0, and stay tuned ;-)**
  - INSERT Performance.. <= possible workaround : use partitions
  - Purge lagging.. <= not yet solved, but you can truncate UNDO

MySQL 8.0 : New Design for InnoDB Fundamentals..



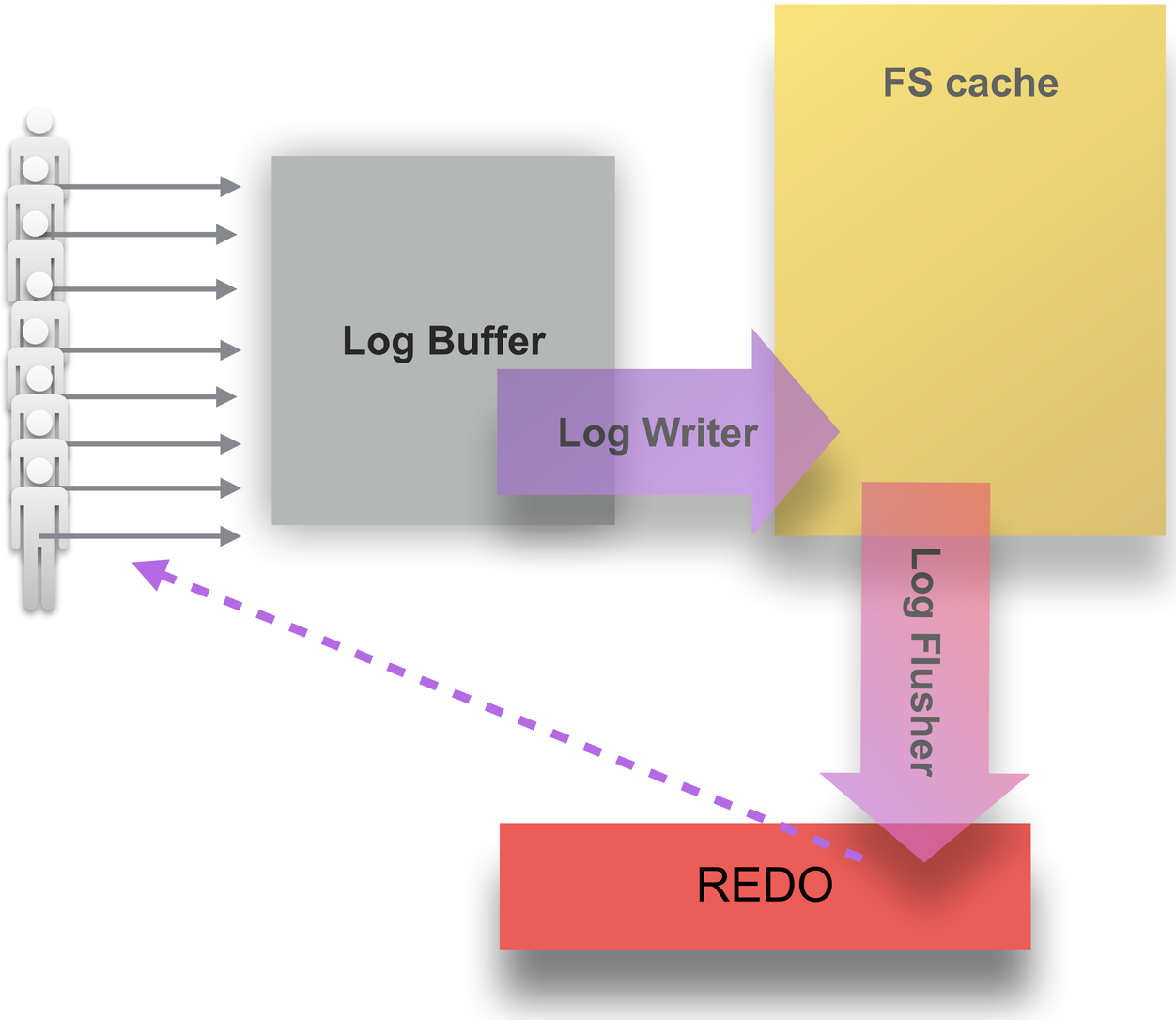
MySQL 8.0 : Re-Designed REDO

- Old design -vs- New design (simplified) :



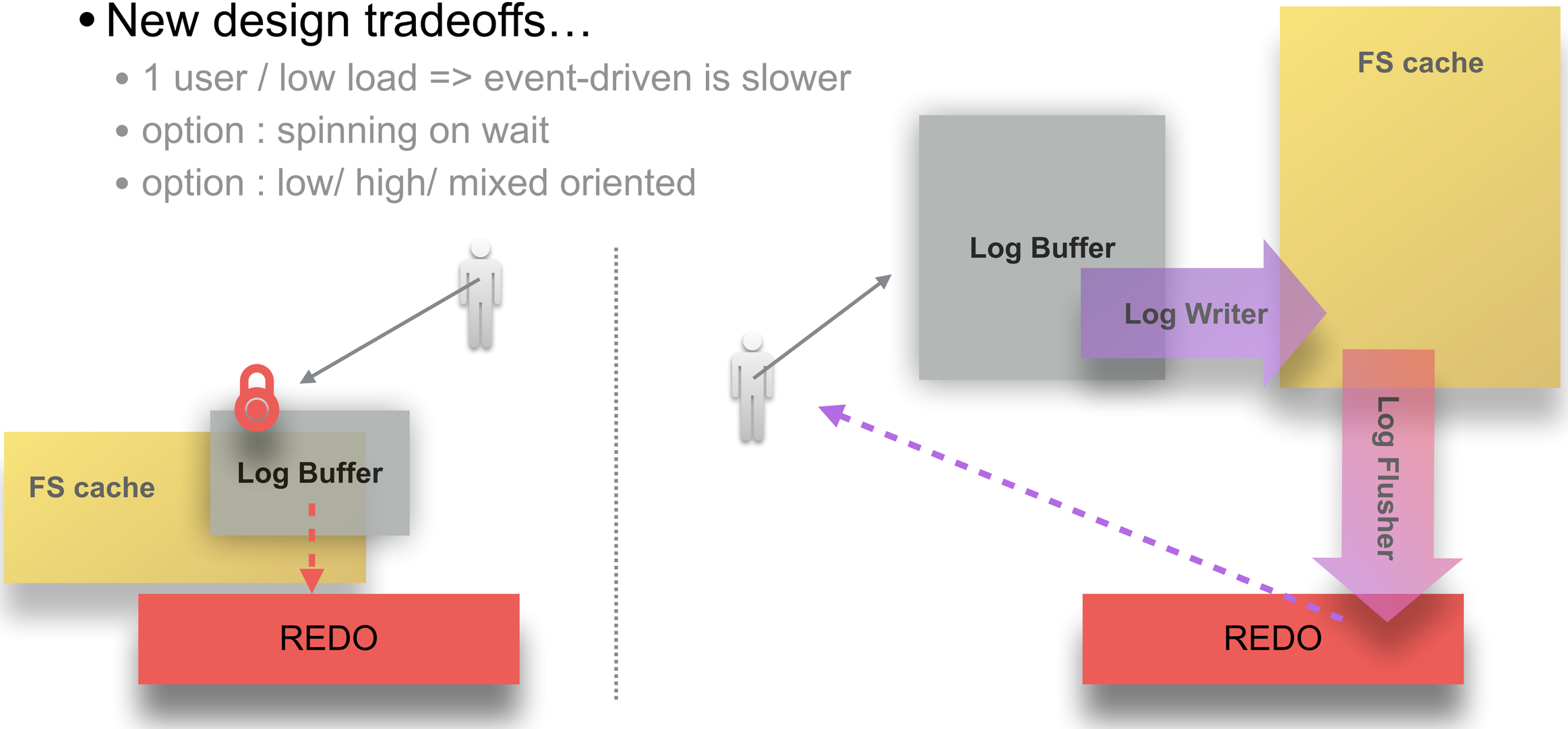
MySQL 8.0 : Re-Designed REDO

- New REDO design :
  - users are not fighting anymore !
  - self-driven processing..
  - self-driven by fsync() capacity
- Instrumented !
  - spins / waits
  - writer / flusher rates
  - max / avg flush times
  - etc..
- Configuration :
  - **mostly all dynamic !!!**
  - so you can play with it on-line ;-))



MySQL 8.0 : Re-Designed REDO

- New design tradeoffs…
  - 1 user / low load => event-driven is slower
  - option : spinning on wait
  - option : low/ high/ mixed oriented



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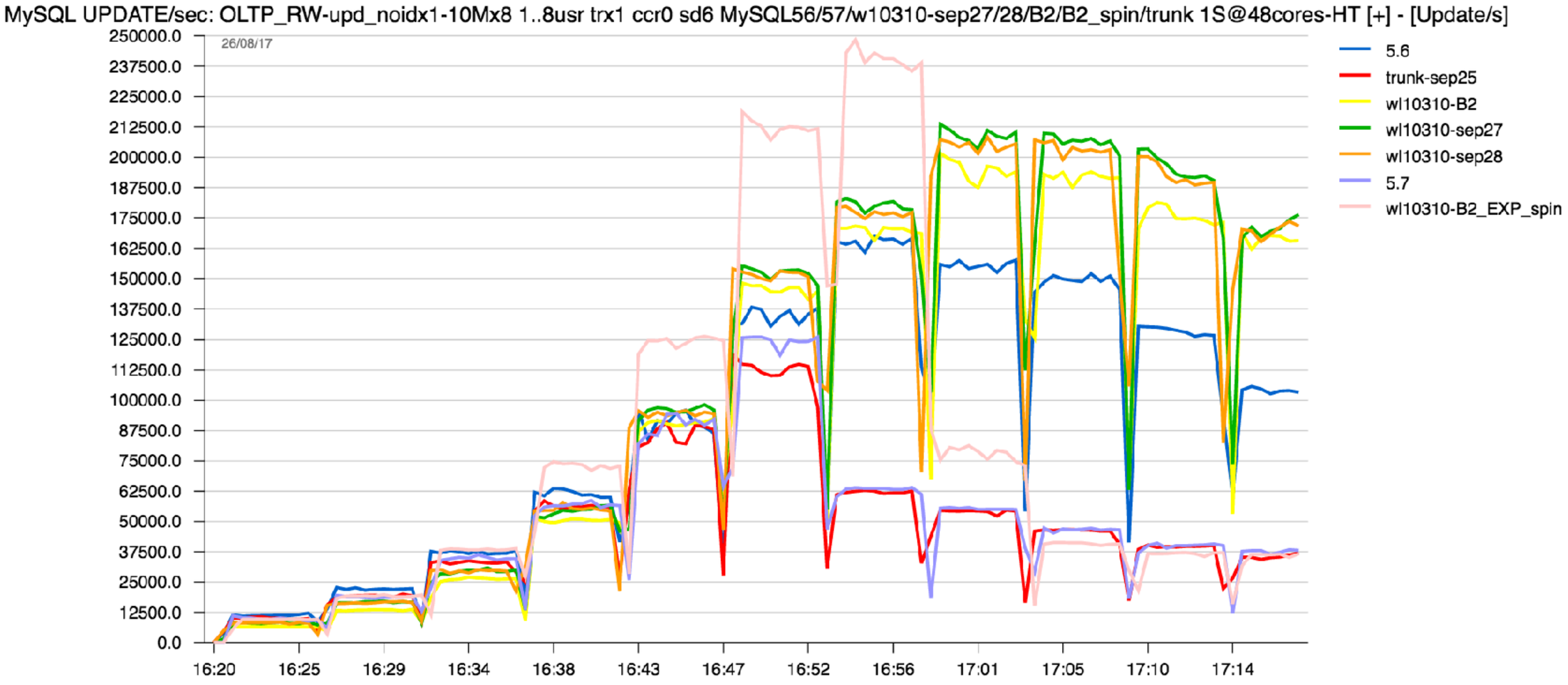
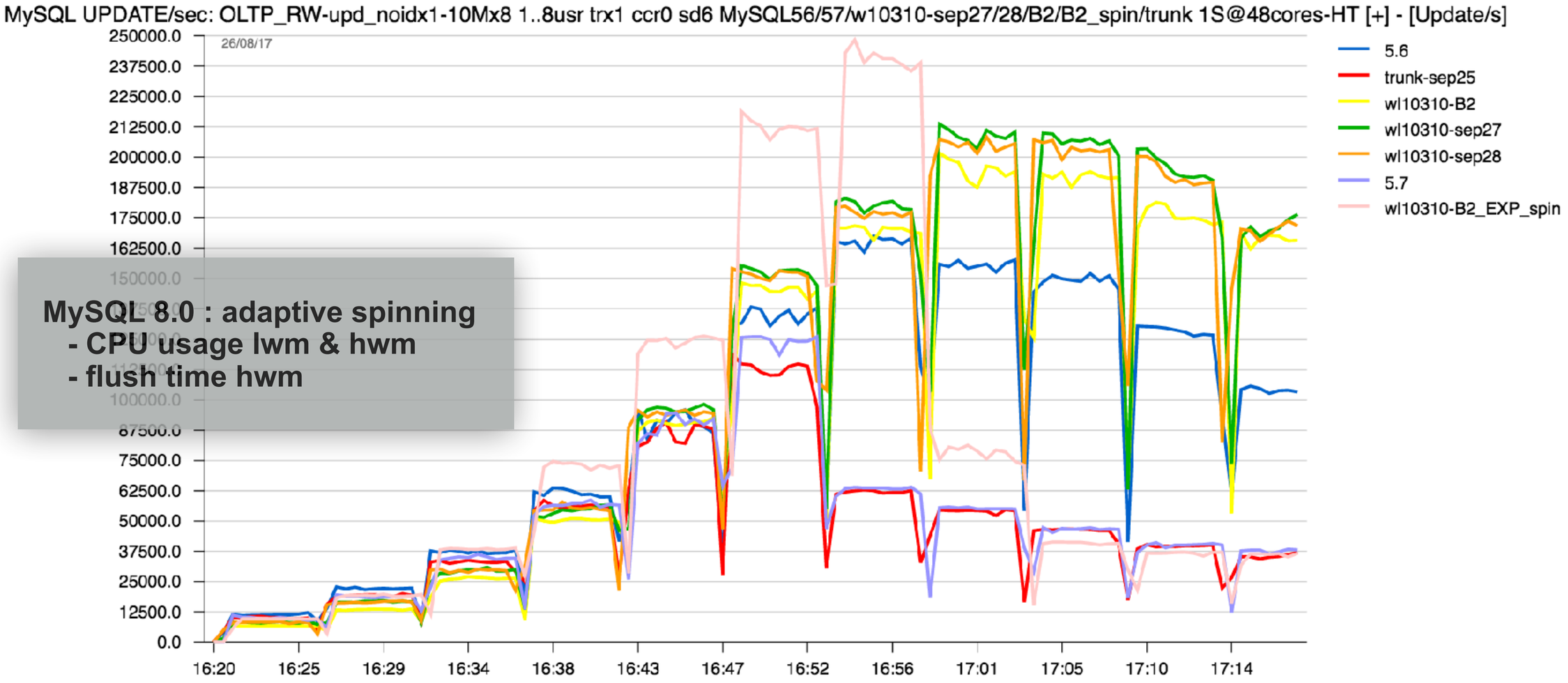
- New design tradeoffs…



MySQL 8.0 : Re-Designed REDO

- New design tradeoffs…

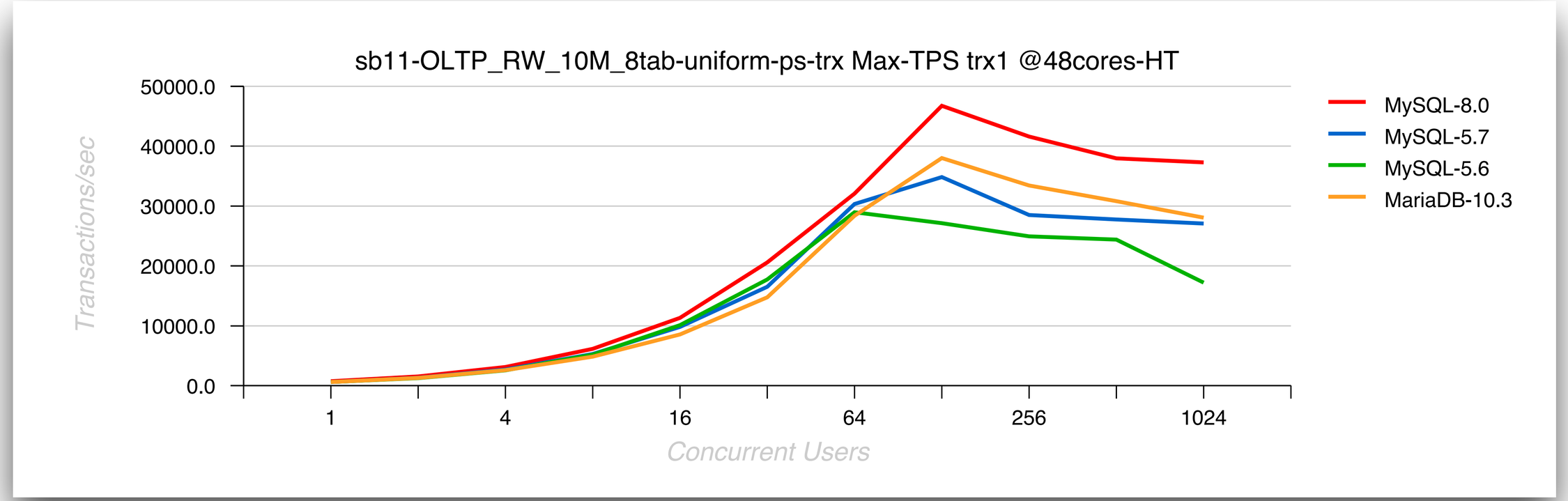


HW & my.conf

- for all the following tests :
  - Server : 2CPU Sockets (2S) 48cores-HT Skylake
  - Storage : x2 Optane NVMe, MDM-raid0, EXT4
  - OS : OL7.4 UEK4
  - Engines : mysql5.6, mysql5.7, mysql8.0, mariadb10.3.5
  - Concurrent Users : **1**, **2**, **4**, .. **1024**
  - charset : **latin1** (!! ;-))
  - **trx_commit=1**
  - REDO = 32GB
  - O_DIRECT
  - DBLWR=off, binlog=off, SSL=off, PFS=off, UNDO auto-truncate=off..
- NOTE :
  - we’re NOT running after “good numbers” !! ;-))
  - we just want to avoid “known overheads” to hide real problems..

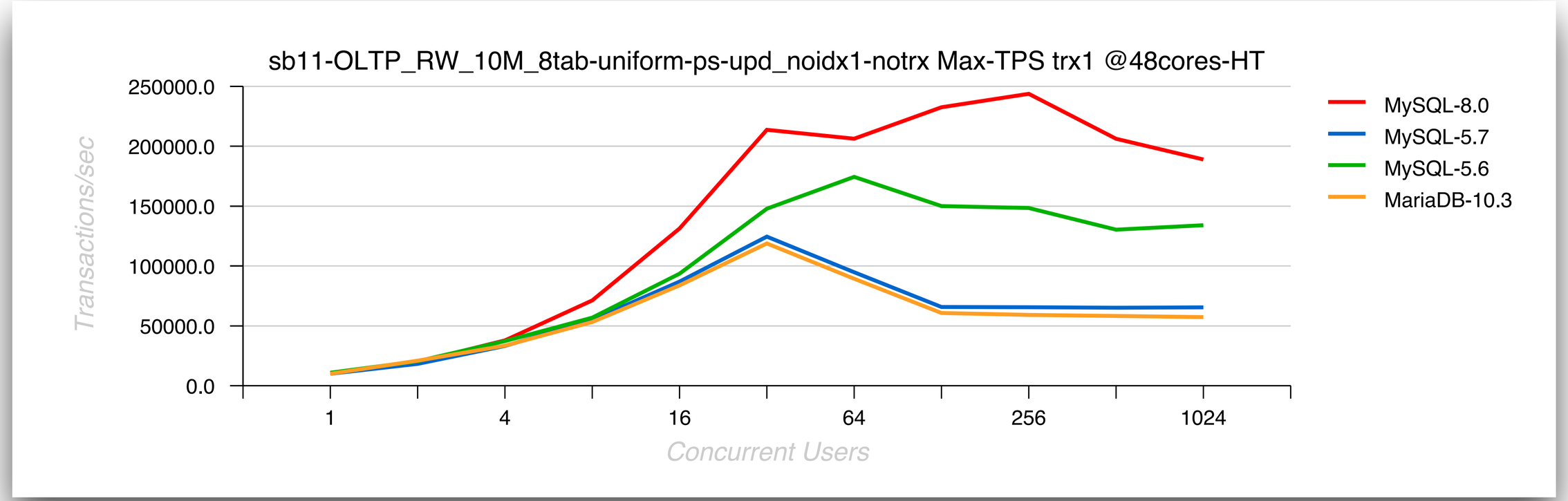
OLTP_RW latin1 @MySQL 8.0 (Apr.2018)

- **45K (!!) TPS** Sysbench OLTP_RW 10Mx8tab, trx_commit=1, 2S
  - **30**% gain vs MySQL 5.7
  - **50**% gain vs MySQL 5.6



Updates-NoKEY latin1 @MySQL 8.0 (Apr.2018)

- **250K (!!) QPS** Sysbench Updates-nokey 10Mx8tab, trx_commit=1, 2S
  - **100**% gain vs MySQL 5.7
  - **50**% gain vs MySQL 5.6 (and yes, 5.7 is bad here.. => fixed !! ;-))
  - and clearly seen MariaDB's adoption of InnoDB 5.7..

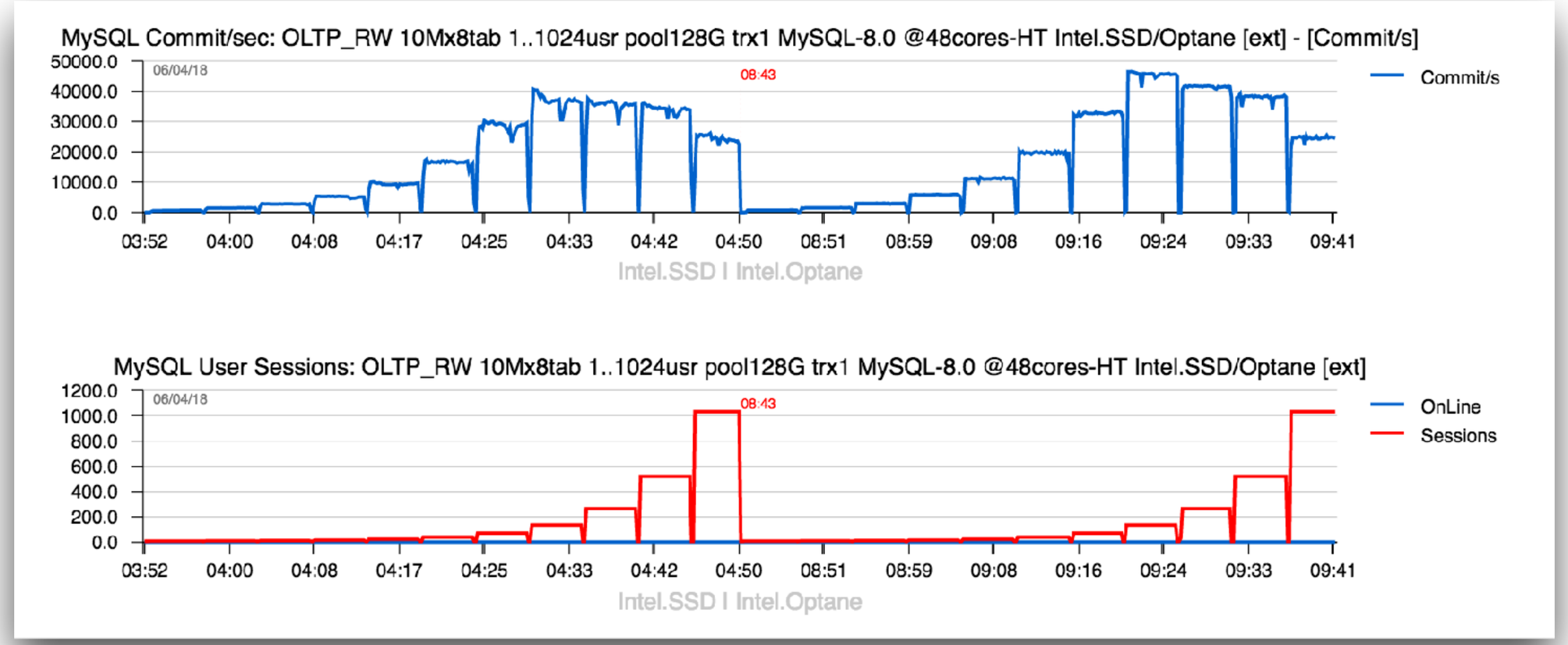


Storage Impact : “good” -vs- “very good” Flash

- So, you have :
  - “good” Intel SSD
  - “very good” Intel Optane
- Workload :
  - OLTP_RW
  - all data are cached in Buffer Pool (BP=128G)
- Question :
  - how different will be TPS if Optane is used instead of “good SSD” ?..

In-Memory OLTP_RW @MySQL 8.0 : Intel SSD -vs- Optane

- OLTP_RW : 10Mx8tab (~20GB data):
  - SSD : Max 37K TPS
  - Optane : Max 45K TPS (20% gain — not that much, right ?)



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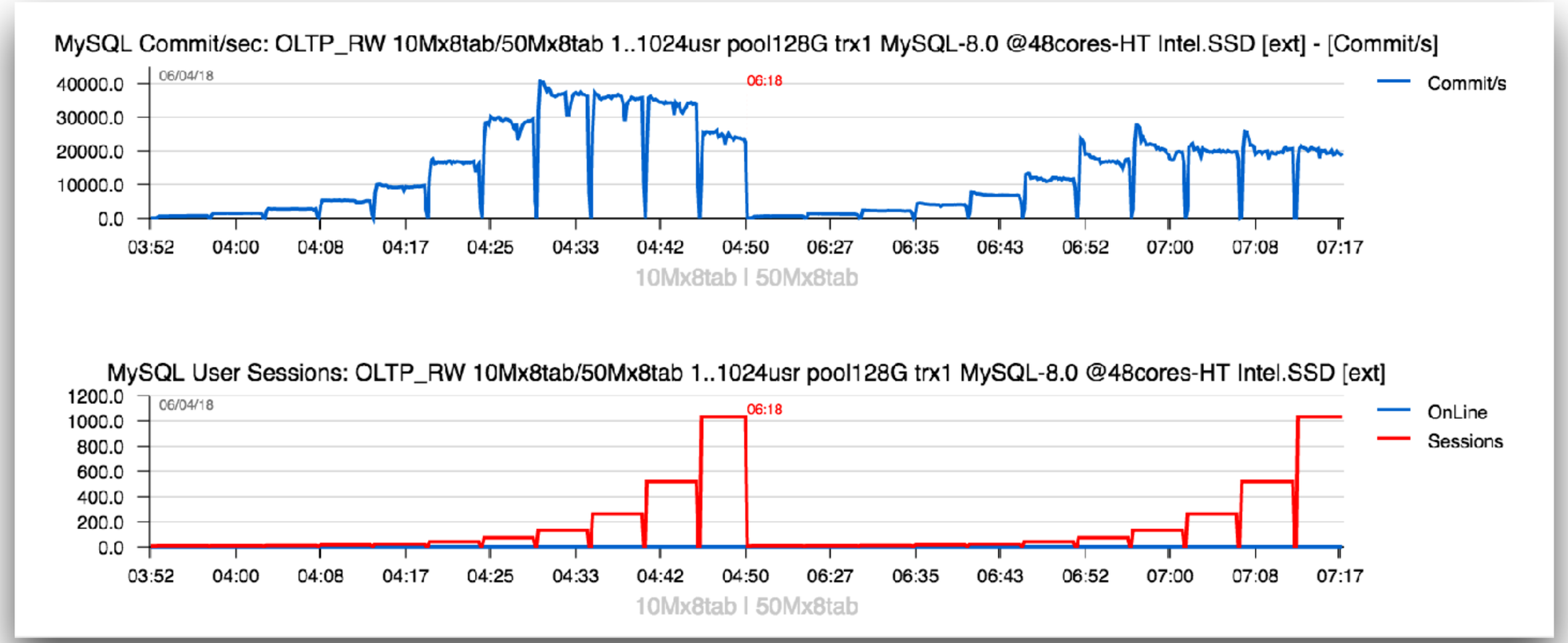
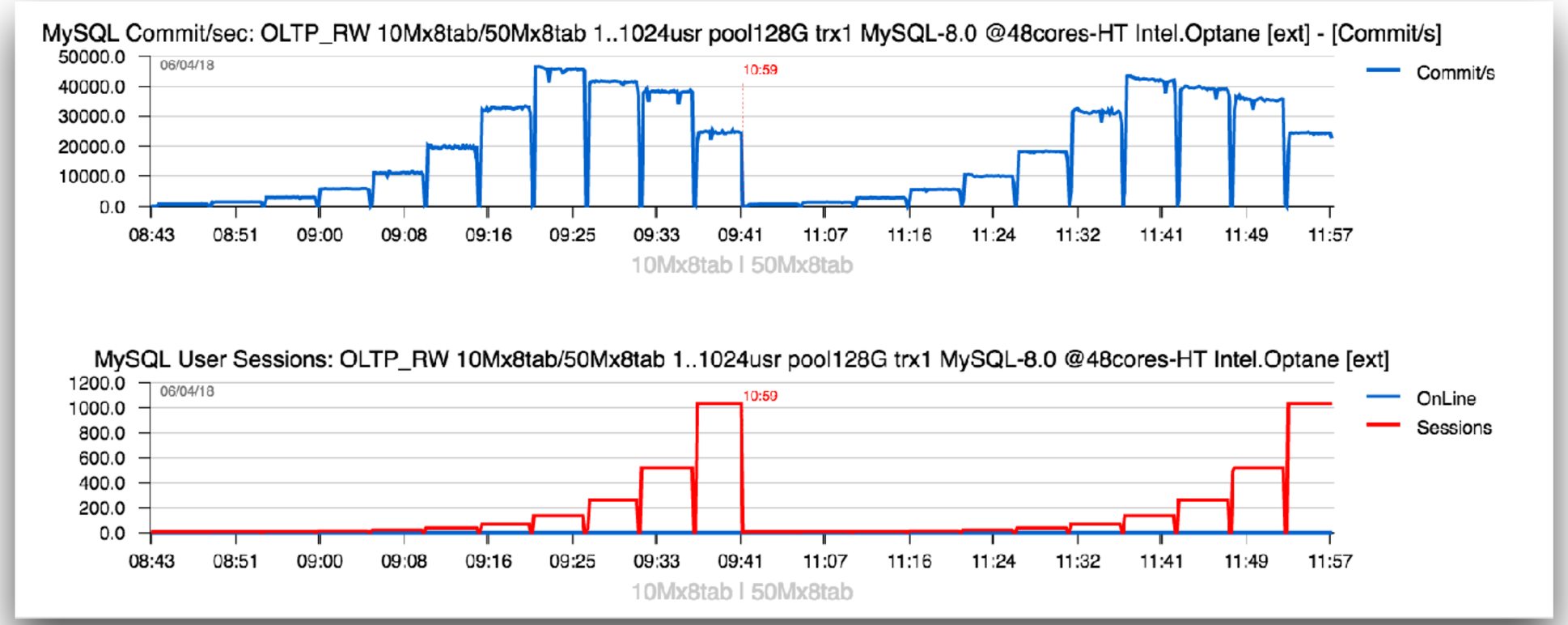
In-Memory OLTP_RW @MySQL 8.0 : Intel SSD

- OLTP_RW : 10Mx8tab (~20GB data) -vs- 50Mx8tab (100GB)
  - NOTE : data are still cached in BP !!!
  - Intel SSD : 37K TPS -vs- 20K TPS.. (near x2 TPS loss..— oh, shit ;-))



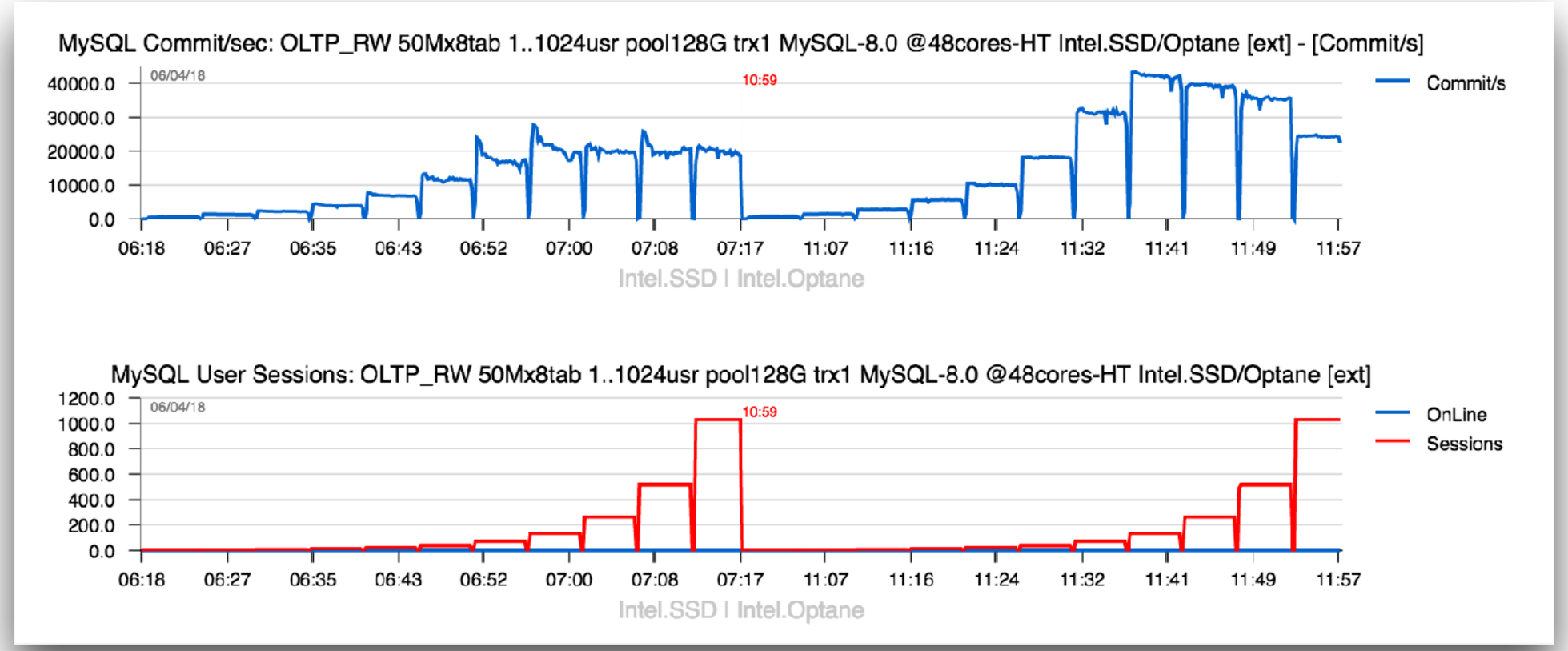
In-Memory OLTP_RW @MySQL 8.0 : Optane

- OLTP_RW : 10Mx8tab (~20GB data) -vs- 50Mx8tab (100GB)
  - NOTE : data are still cached in BP !!!
  - Optane : 45K TPS -vs- 41K TPS.. (9% TPS loss..— aha.. ;-))



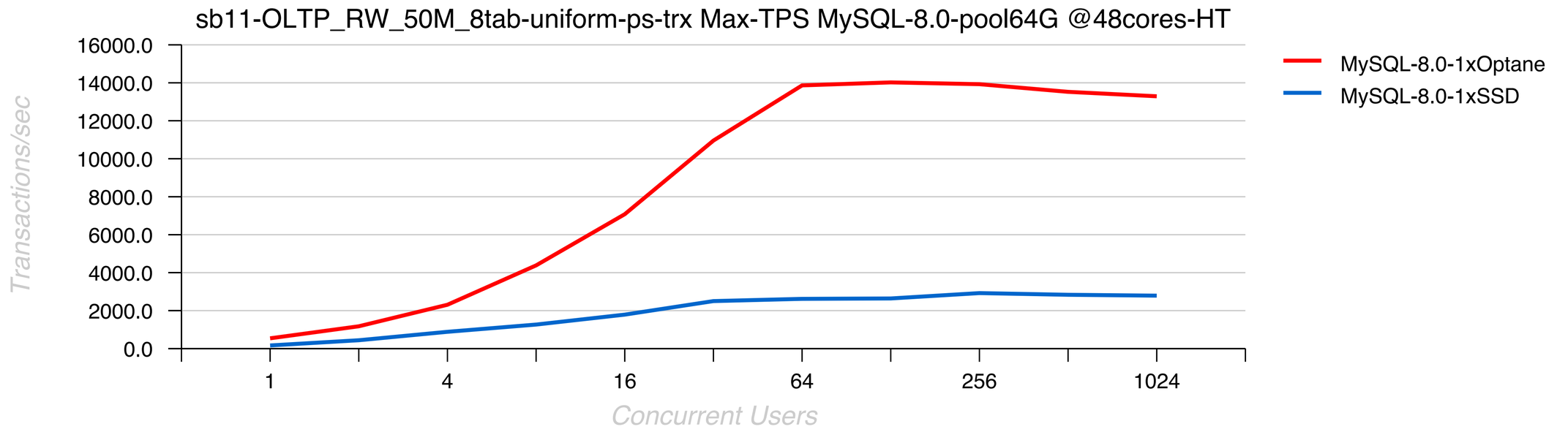
In-Memory OLTP_RW @MySQL 8.0 : Intel SSD -vs- Optane

- OLTP_RW : 50Mx8tab (100GB)
  - NOTE : data are still cached in BP !!!
  - SSD : 20K TPS -vs- Optane : 41K TPS (over x2 times diff..— hehe.. ;-))



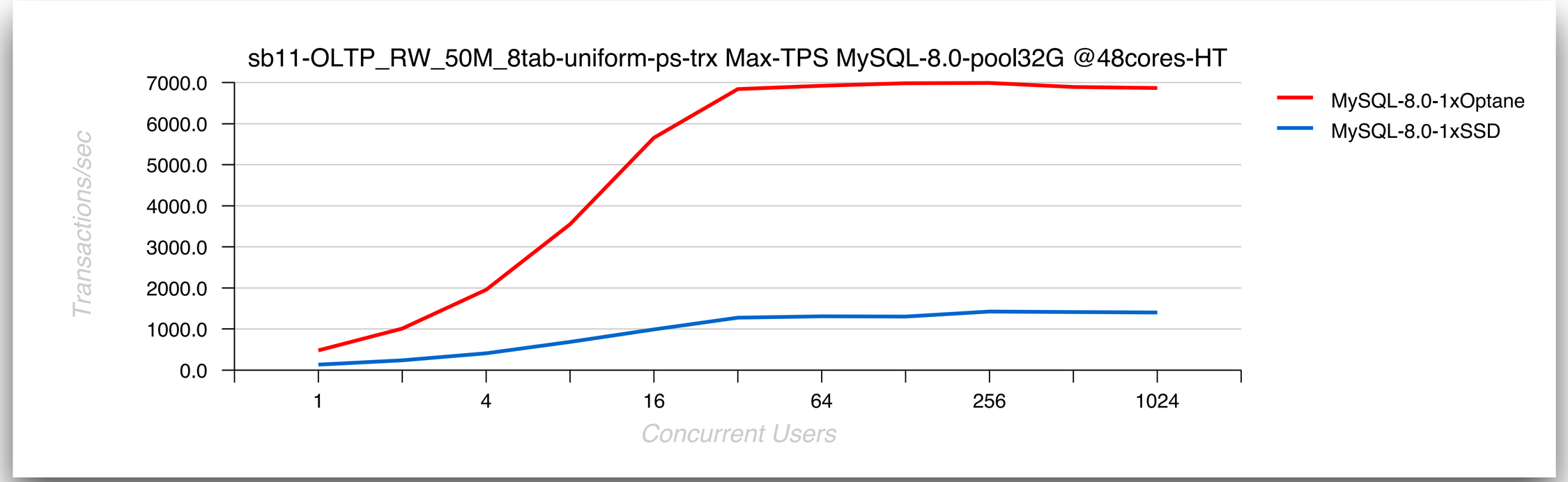
IO-bound OLTP_RW @MySQL 8.0 : Intel SSD -vs- Optane

- OLTP_RW : 50Mx8tab (100GB)
  - BP=64G — only 1/2 of data can be cached in BP
  - SSD : 2.8K TPS -vs- Optane : 14K TPS (x5 times diff..— hoho.. ;-))



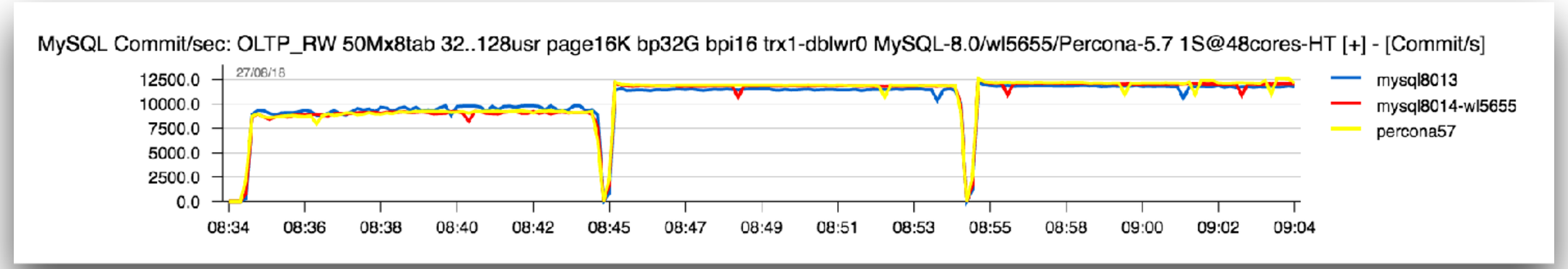
IO-bound OLTP_RW @MySQL 8.0 : Intel SSD -vs- Optane

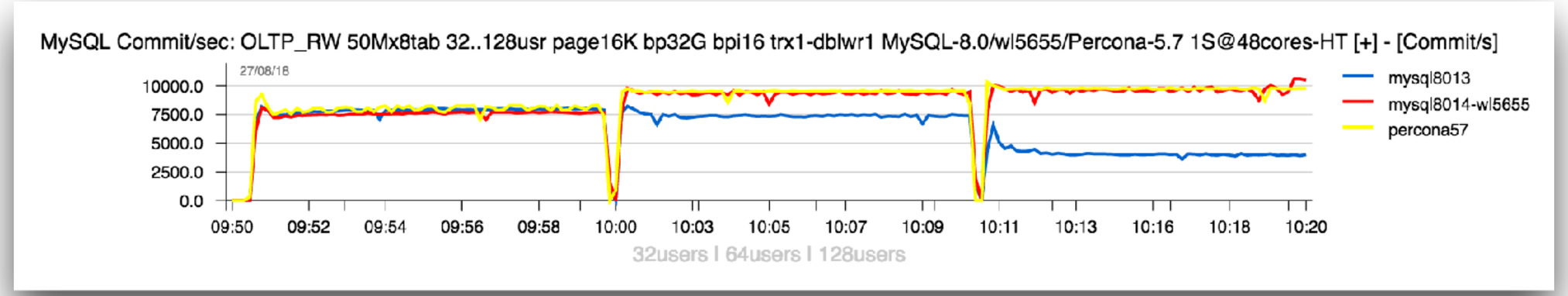
- OLTP_RW : 50Mx8tab (100GB)
  - BP=32G — only 1/3 of data can be cached in BP
  - SSD : 1.4K TPS -vs- Optane : 7K TPS (still x5 times diff..— still hoho.. ;-))
  - NOTE : we're hitting the MB/sec Optane limit (with x2 Optane you have x2 TPS more)



Double Write Impact

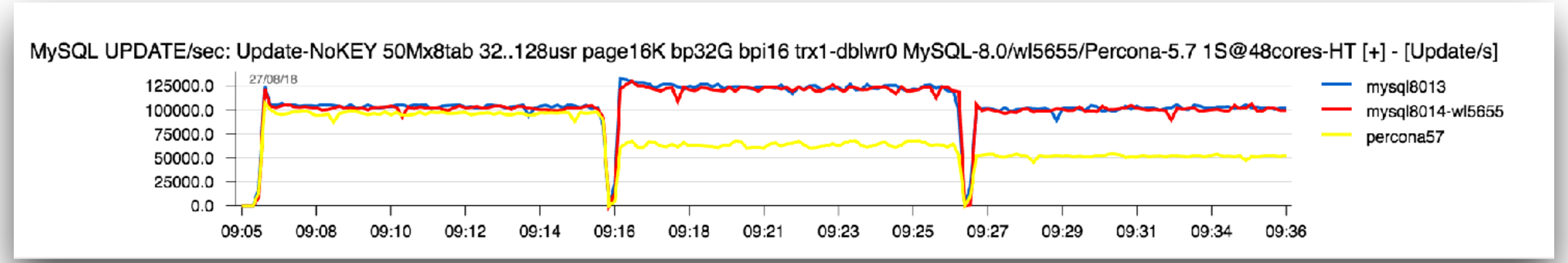
- IO-bound OLTP_RW 50Mx8tab
  - BP=32G
  - double write = OFF / ON

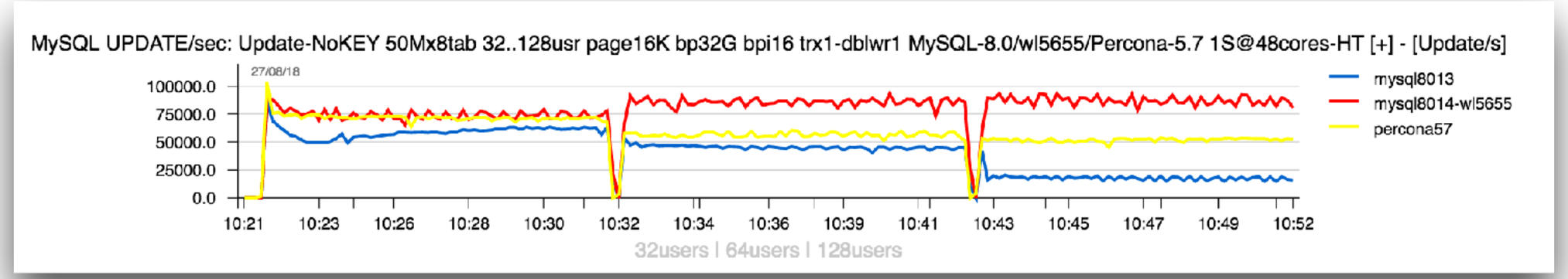




Double Write Impact

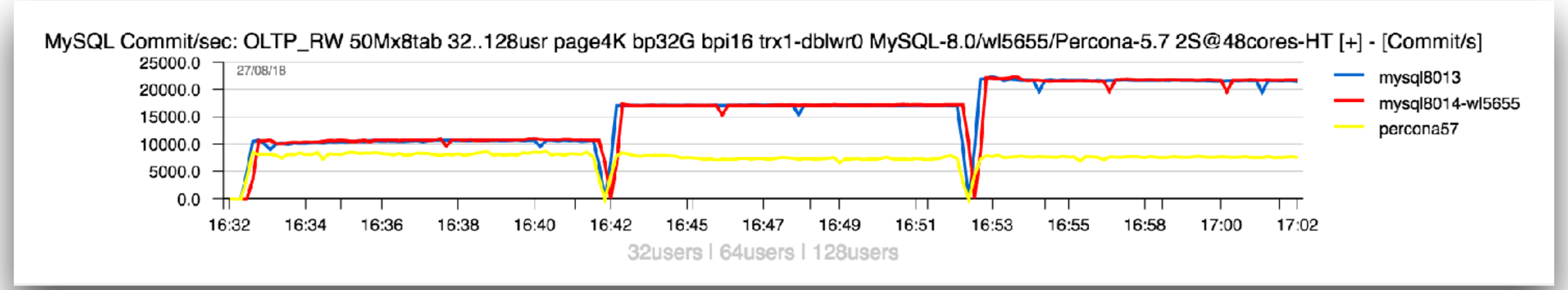
- IO-bound Update_NoKEY 50Mx8tab
  - BP=32G
  - double write = OFF / ON

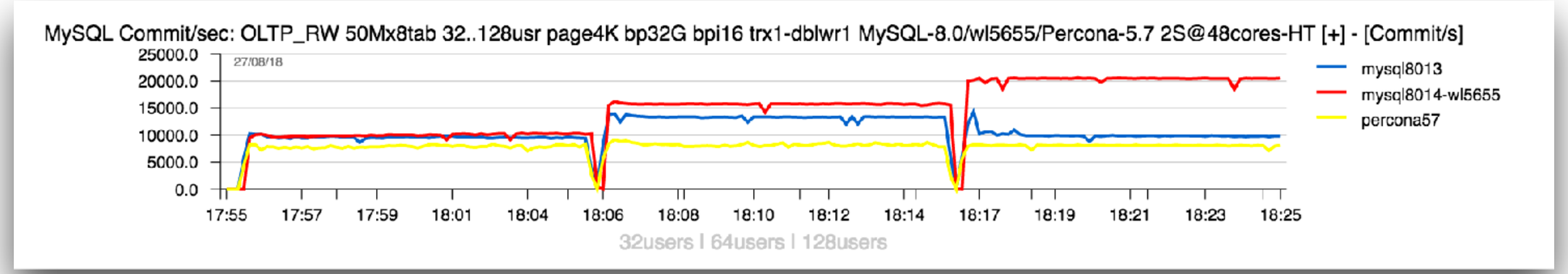




Double Write Impact

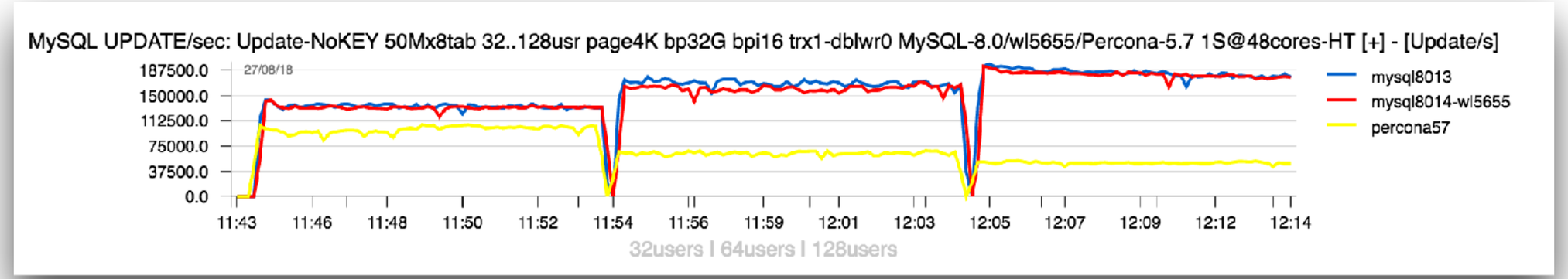
- IO-bound OLTP_RW 50Mx8tab
  - BP=32G, page size = 4K
  - double write = OFF / ON

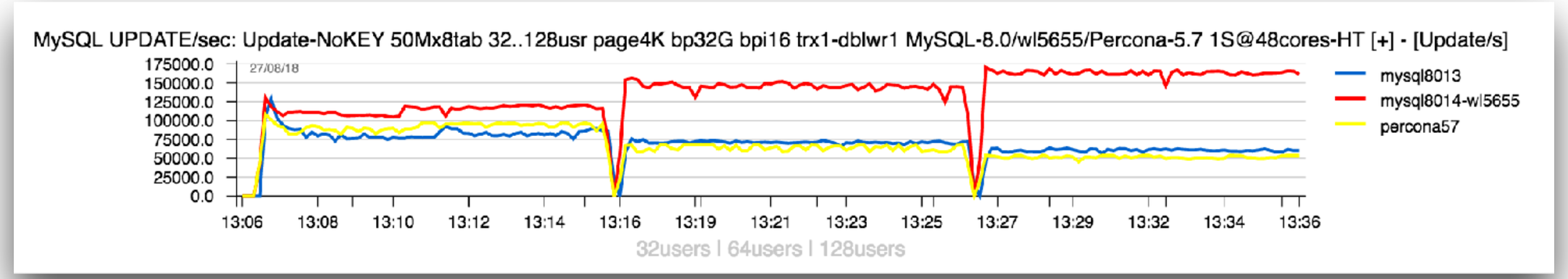




Double Write Impact

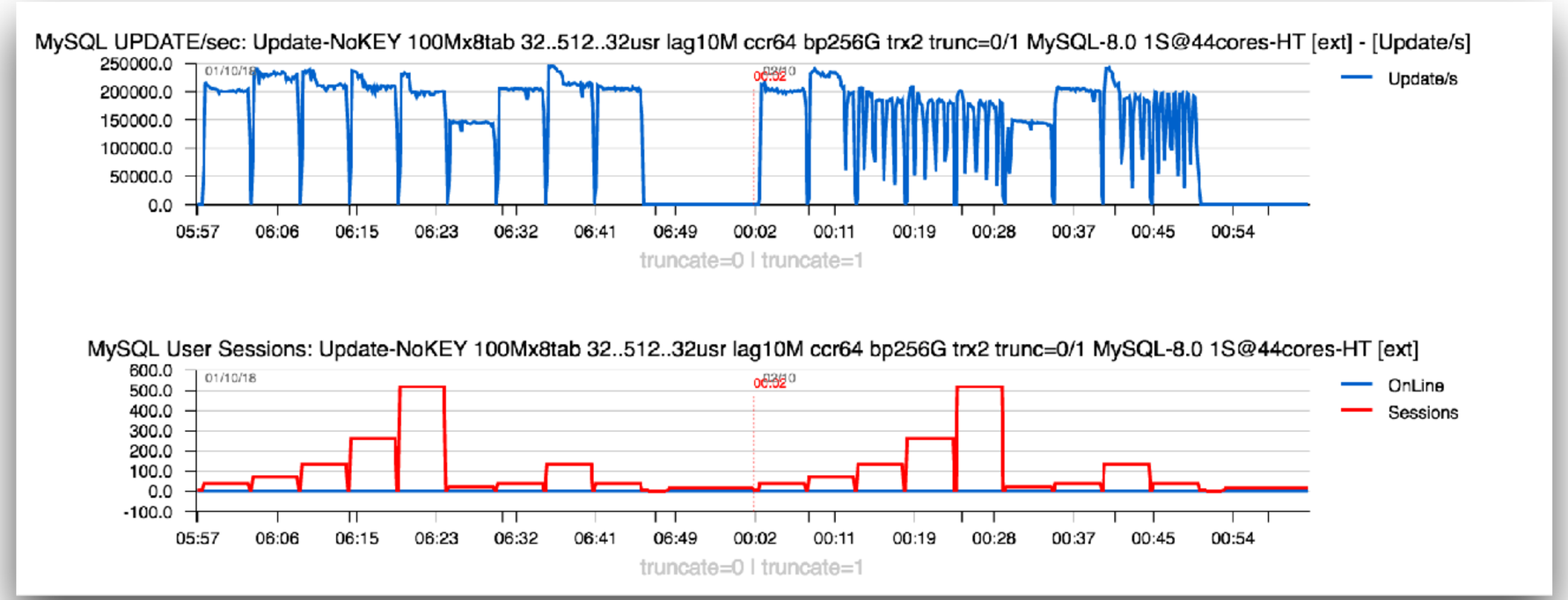
- IO-bound Update_NoKEY 50Mx8tab
  - BP=32G, page size = 4K
  - double write = OFF / ON





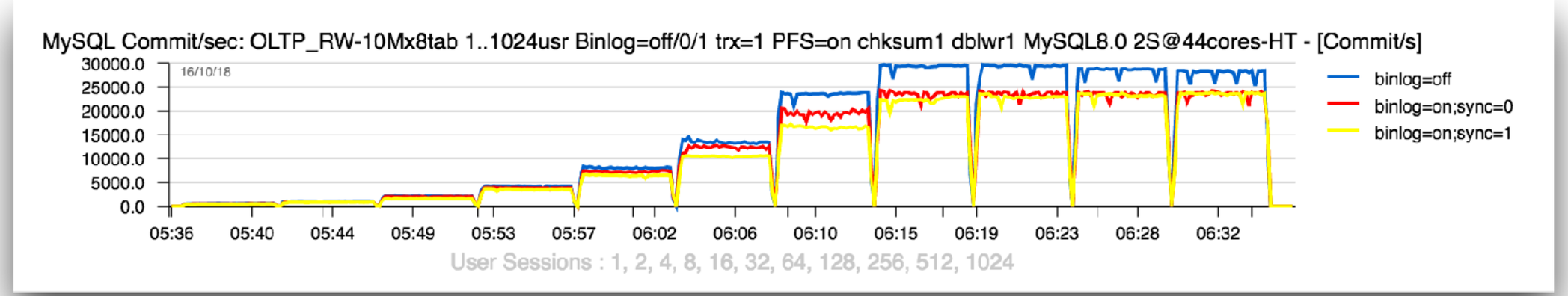
UNDO Auto-Truncate Impact

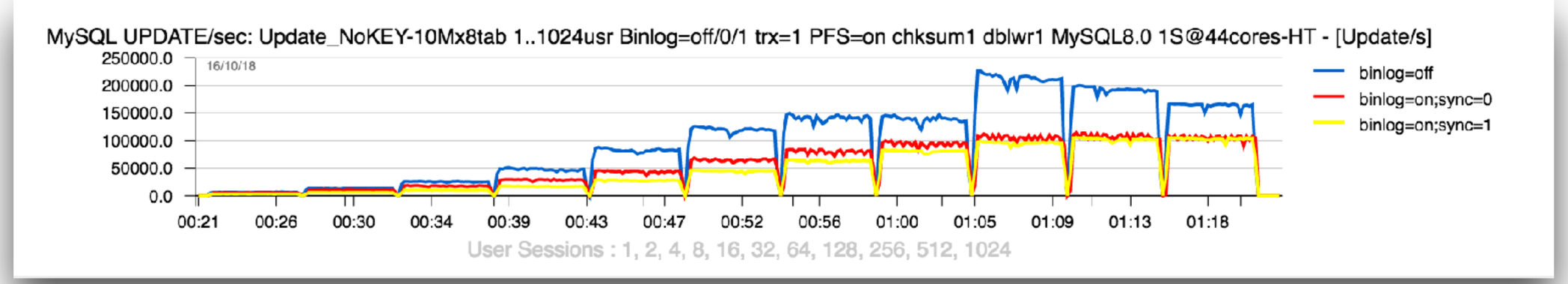
- Update_NoKEY 50Mx8tab, BP=256G
  - yes it sucks, yes we have to do something..
  - workaround :
    - innodb_undo_log_truncate=off
    - and truncate manually when no user activity



Binlog Impact

- OLTP_RW / Update_NoKEY 10Mx8tab, BP=32G
  - yes it sucks, yes we MUST do something..
  - workaround : … 🤔 …





MySQL 8.0 Writes Scalability

- IMPORTANT :
  - MySQL 8.0 overall WRITE performance is way better comparing to all we have before !
  - but : we're still NOT scaling !..
- Going from 1S => 2S (CPU Sockets) :
  - OLTP_RW : somewhat 50% better TPS only, and it's due RO scaling..
  - Update-NoKEY : just worse TPS..
- Why ?
  - 1) next-level bottlenecks (TRX / LOCK Management)
  - 2) + something else (yet to discover)..
  - so, still a lot of work ahead ;-))

New: MySQL Resource Groups

- What :
  - starting codebase for our future Resource Management solutions
  - flexible and proper thread / query isolation
  - dynamic, integrated, fun ! ;-))
- Why :
  - protect background threads, provide them optimal conditions for processing
  - run batches on low priority, OLTP on higher (and opposite on night)
  - isolate DDL orders from other activity
  - allow to move long running queries to low priority / isolate (live !! ;-))
  - apply particular execution conditions for any SQL query via Optimizer Hint
    - => Query Rewrite, ProxySQL, etc..
  - automatically assign RG to users / databases / workloads via ProxySQL
  - potential workaround for many CPU cache related issues
  - **huge opportunity to all kind of new tools !!!**

MySQL Resource Groups

- Implementation Details :
  - currently : USER and SYSTEM groups
  - attributes : CPU (vcpu) affinity & thread priority
  - **thread priority** :
    - SYSTEM : [-19, 0] normal or **higher**
    - USER : [0, 20] normal or **lower**
- Admin :
  - permissions : none / can use / can use + admin
  - mysql> create RESOURCE GROUP RG10 type=user vcpu=0-9,40-49 thread_priority=0 ;
  - mysql> alter … ; drop … ; (also DISABLE / ENABLE / etc..)
- Using : only by name !
  - mysql> SET RESOURCE GROUP name ; (also for any THREAD ID)
  - SELECT /*+ RESOURCE_GROUP(name) */ … ; (query hint)

MySQL Resource Groups in Action

- Test case :
  - 40cores-HT 4S (Broadwell) server, OL7
  - 32 concurrent users are running SELECTs (Sysbench OLTP_RO)
  - other users are coming with UPDATEs (Sysbench Update-NoKEY)
    - 16 users, then 32, 64, 128, 256, 512
  - **Problem :** each workload is running well alone, but NOT together (yet)..
  - **Workaround :**
    - UPDATEs are not scaling and mixed with SELECTs creating yet more contentions
    - let's limit UPDATE queries to 10cores-HT only
    - mysql> create RESOURCE GROUP RG10 type=user vcpu=0-9,40-49 thread_priority=0 ;
    - and add a hint to UPDATE queries :
      UPDATE /*+ RESOURCE_GROUP(RG10) */ … ;

MySQL Resource Groups in Action

- Test case :
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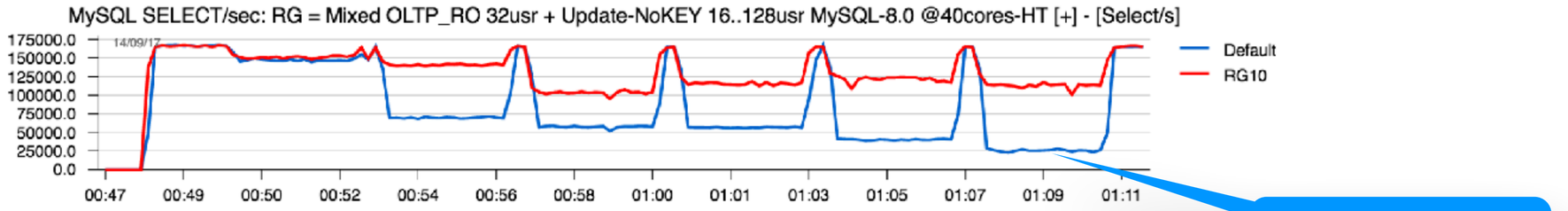
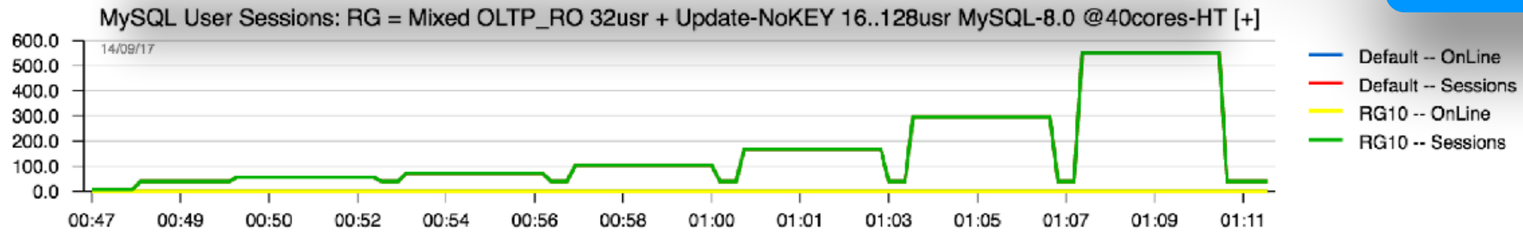
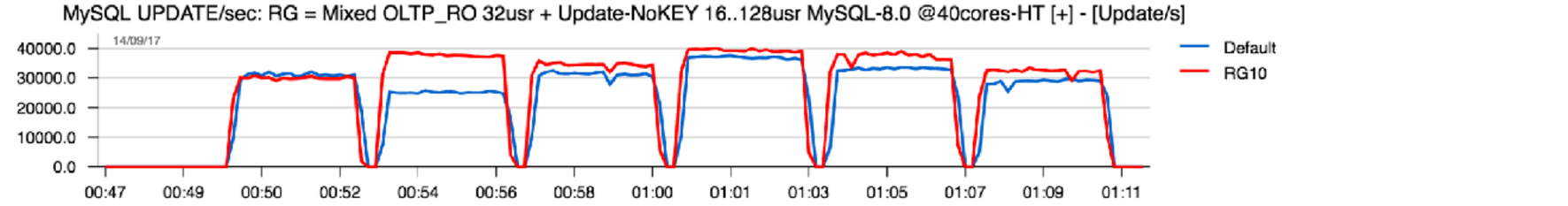


none | 16usr | 32usr | 64usr | 128usr | 256usr | 512usr

Default





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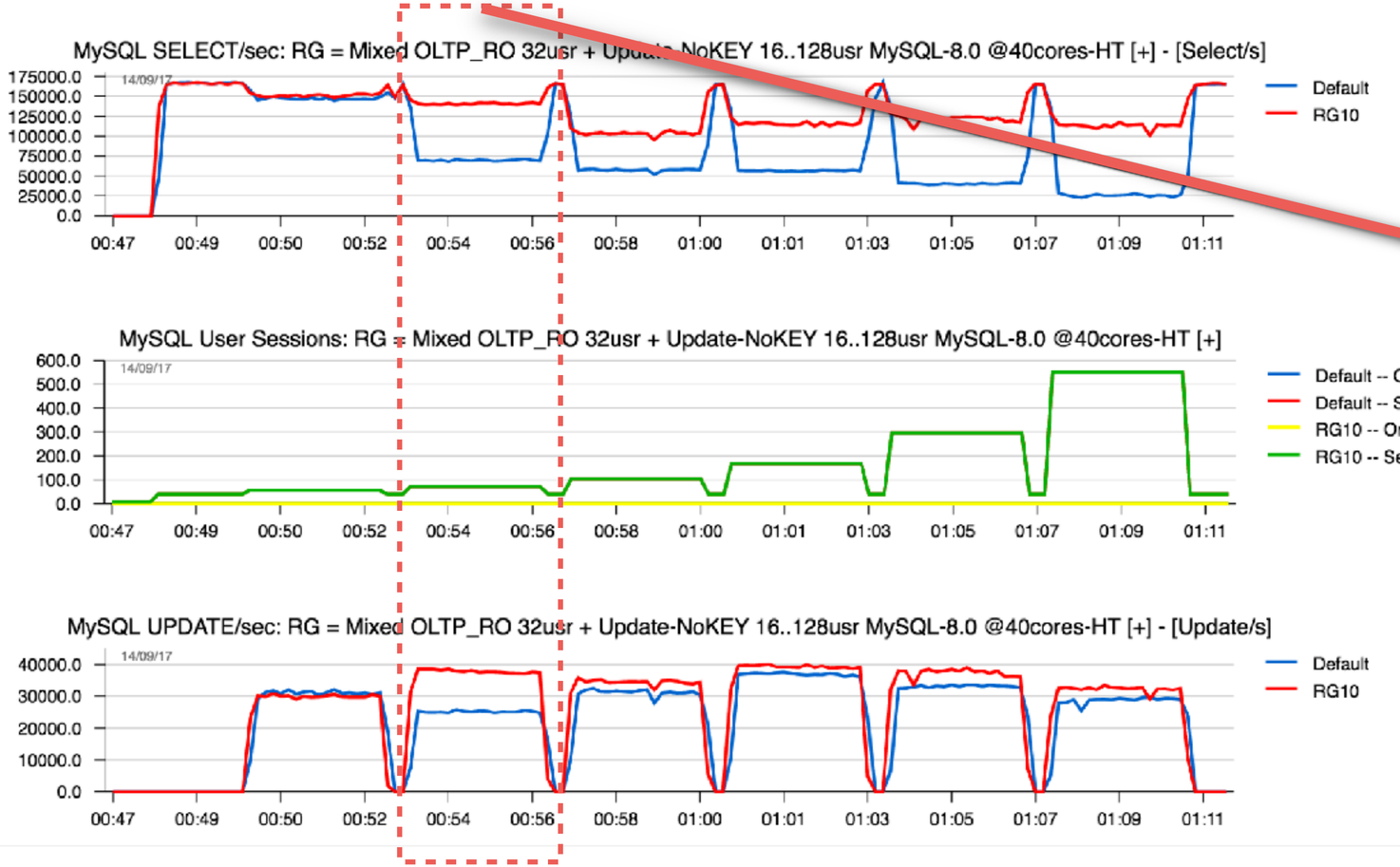
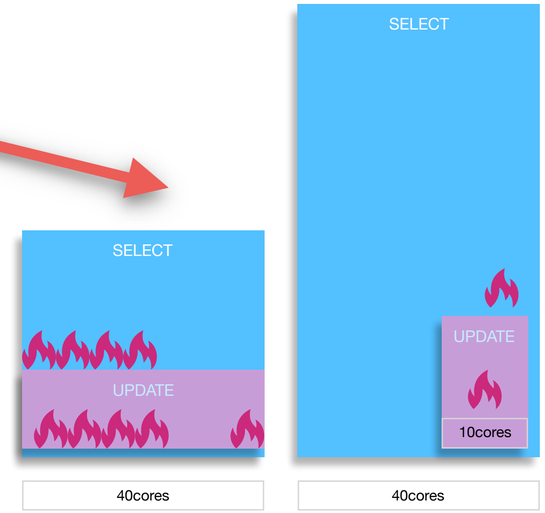
  - other users are coming with UPDATEs : 16 users, then 32, 64, 128, 256, 512..





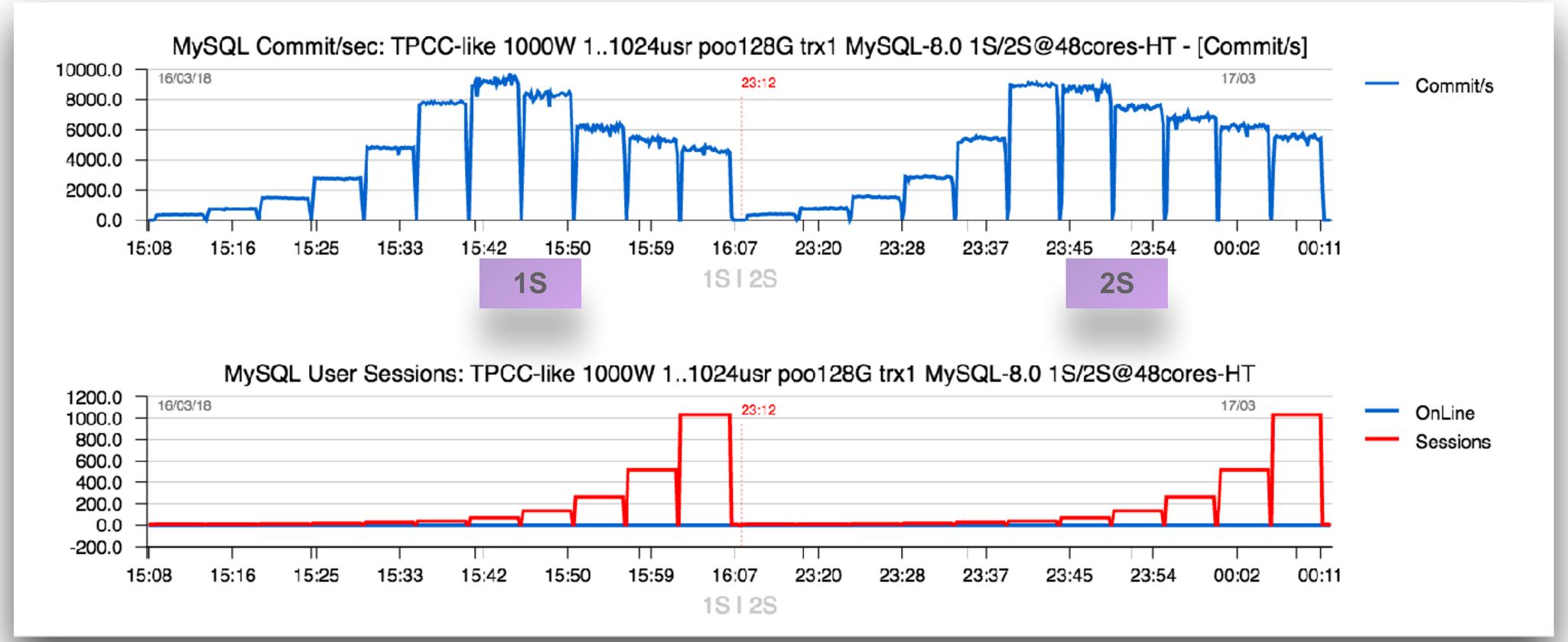
TPCC-like Workload

- Developed & Maintained by Percona
  - recently ported to Sysbench (**KUDOS Percona !!** ;-))
  - can be executed as x1 dataset
  - or xN datasets (similar to xN databases, except it's the same db)

- The following Test Scenarios :
  - Warehouses : 1000W or 10x100W (same ~100GB volume in total)
  - BP = 128GB (in-memory), = 32GB (IO-bound ?)

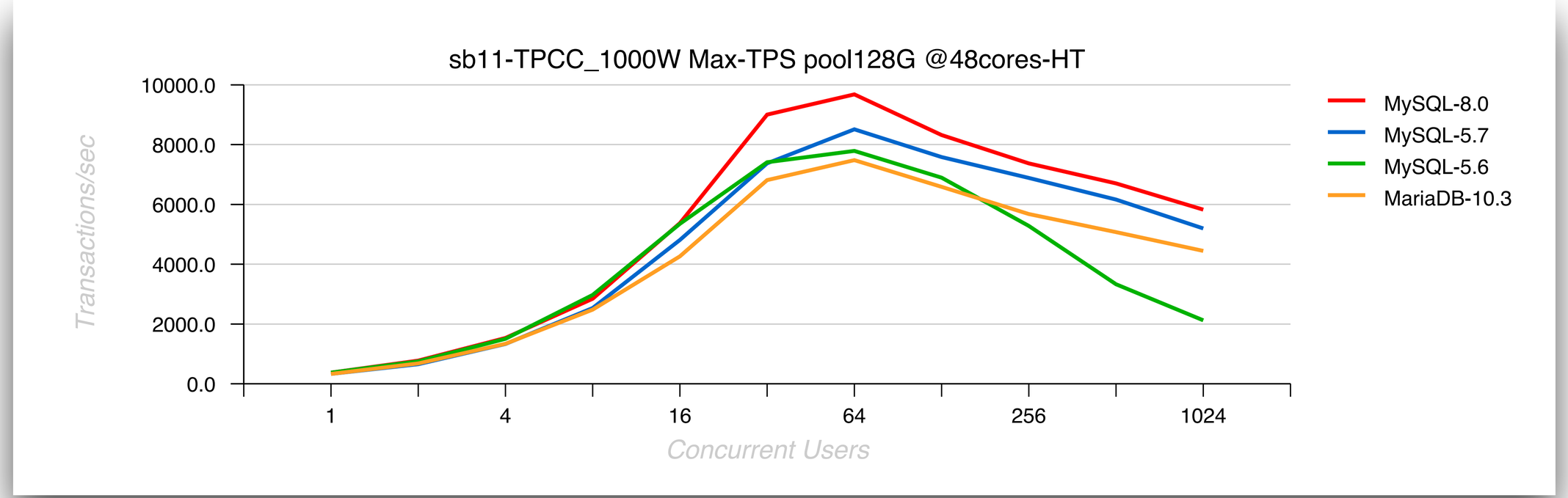
TPCC-like 1000W Workload

- MySQL 8.0 :
  - small or no gain between 1S -vs- 2S
  - scalability is totally blocked by “index RW-lock” contention..



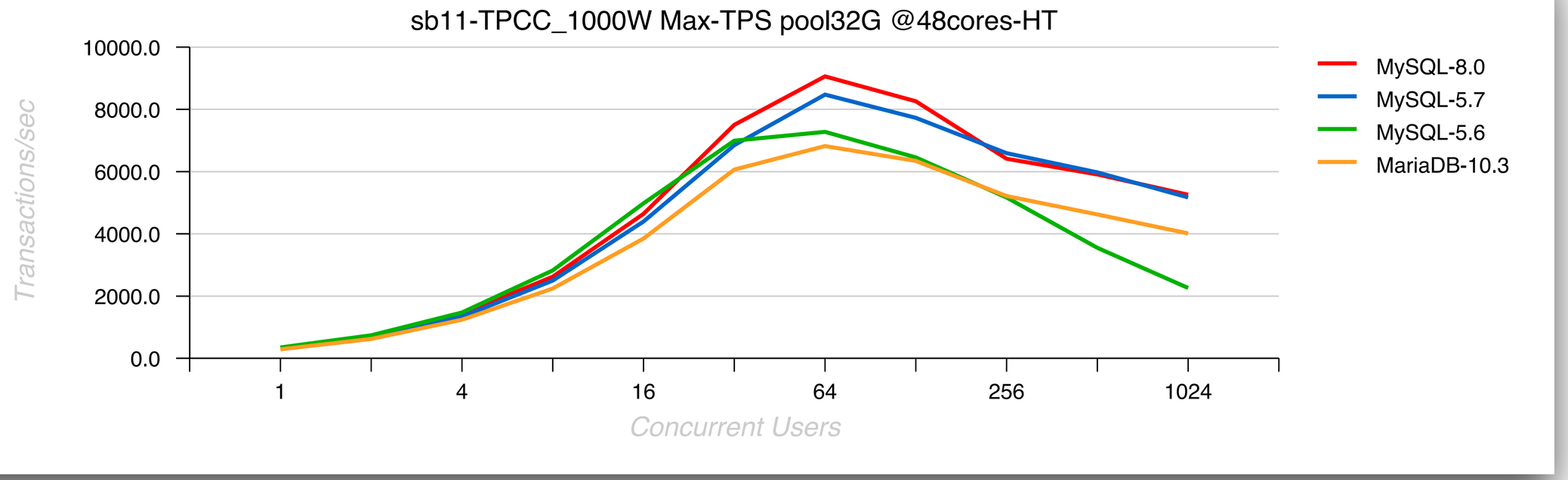
TPCC-like 1000W Workload

- BP = 128GB : in-memory
  - MySQL 8.0 is still doing better again
  - index RW-lock is dominating for all..



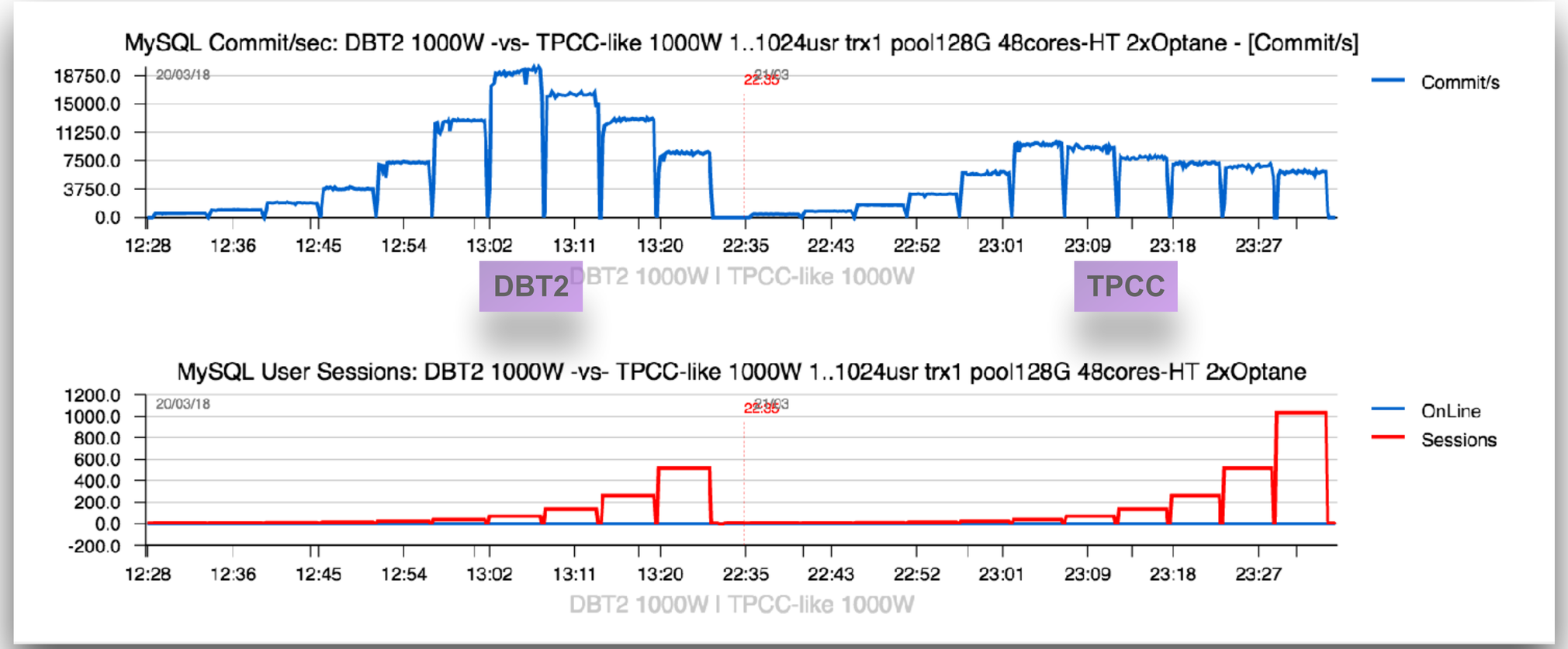
TPCC-like 1000W Workload

- BP = 32GB : IO-bound
  - MySQL 8.0 again is doing better
  - index RW-lock is dominating for all..



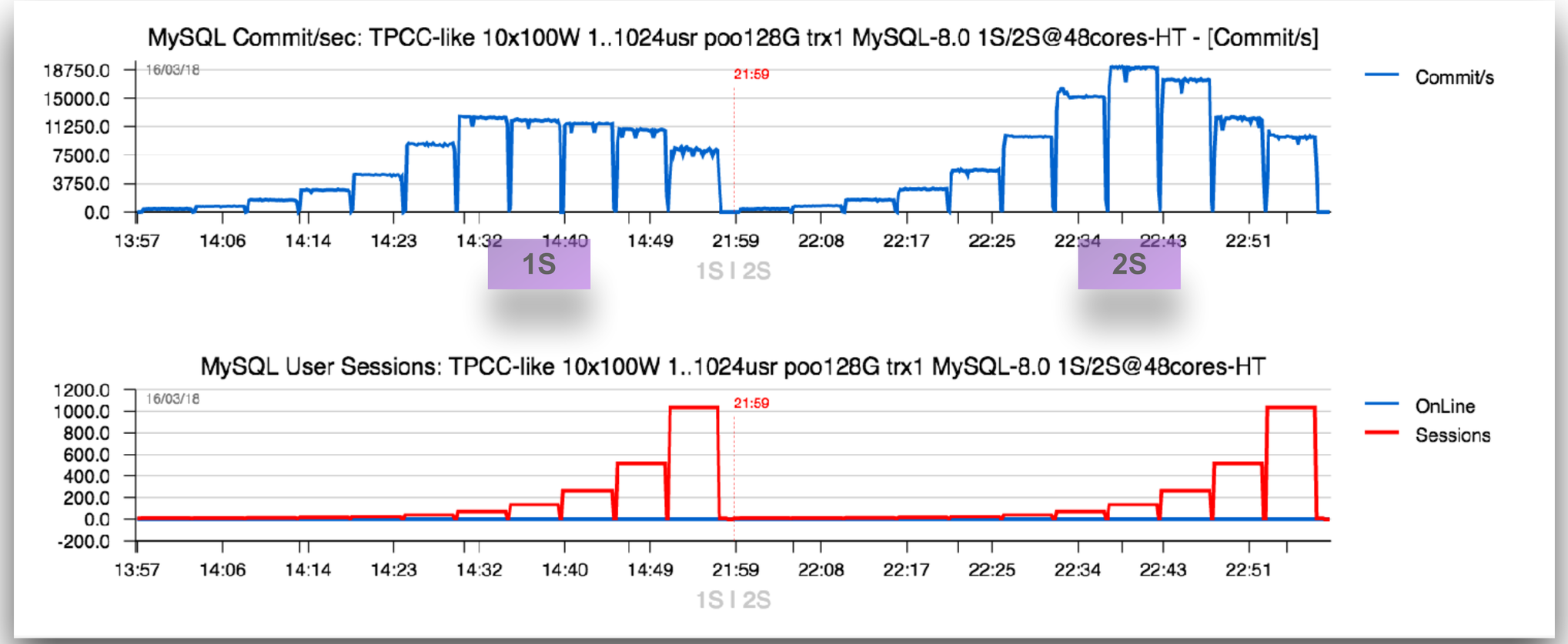
TPCC-like 1000W Workload -vs- DBT2 1000W

- BP = 128GB : in-memory
  - nearly the same workloads, but different “execution profile”
  - no index RW-lock contention in DBT2.. => to investigate



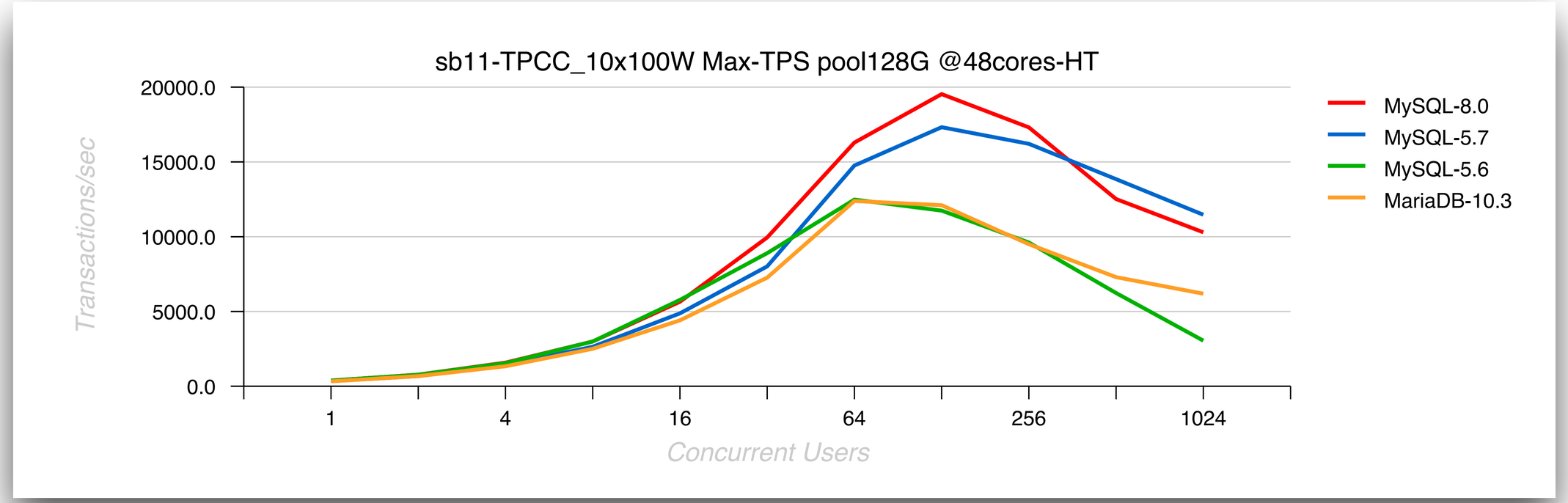
TPCC-like 10x100W Workload

- MySQL 8.0 :
  - over 50% gain between 1S -vs- 2S
  - scalability is limited by “lock_sys” contention (LOCK management in InnoDB)



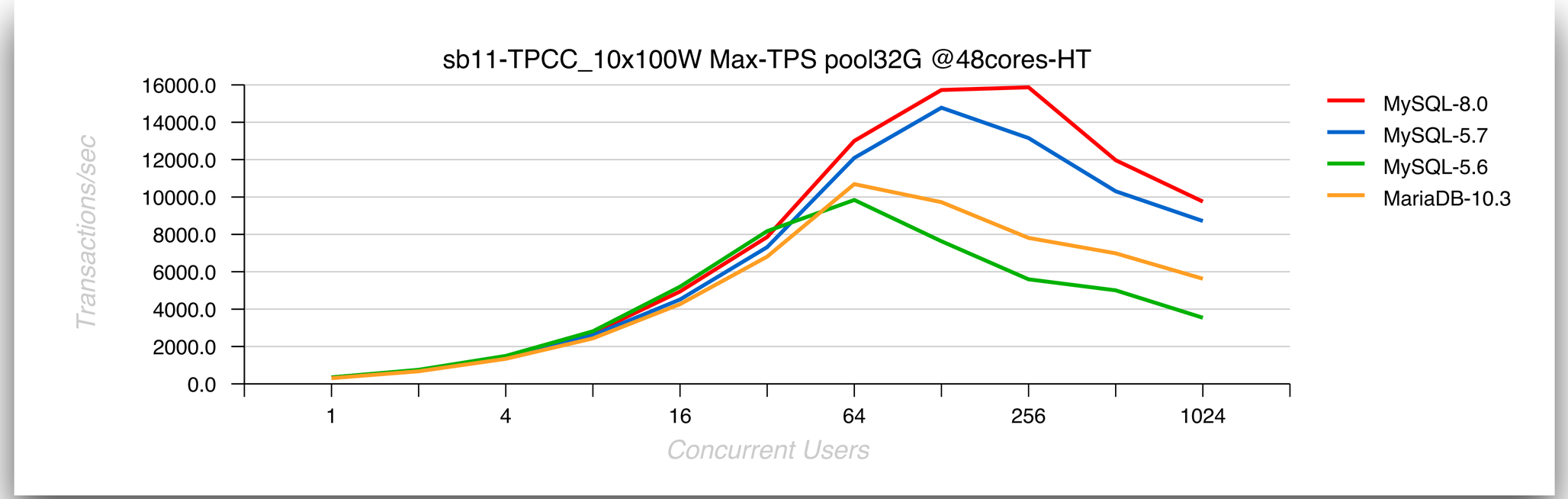
TPCC-like 10x100W Workload

- BP = 128GB : in-memory
  - MySQL 8.0 is doing better
  - drops on high load are due higher “lock_sys”, fix is in progress..



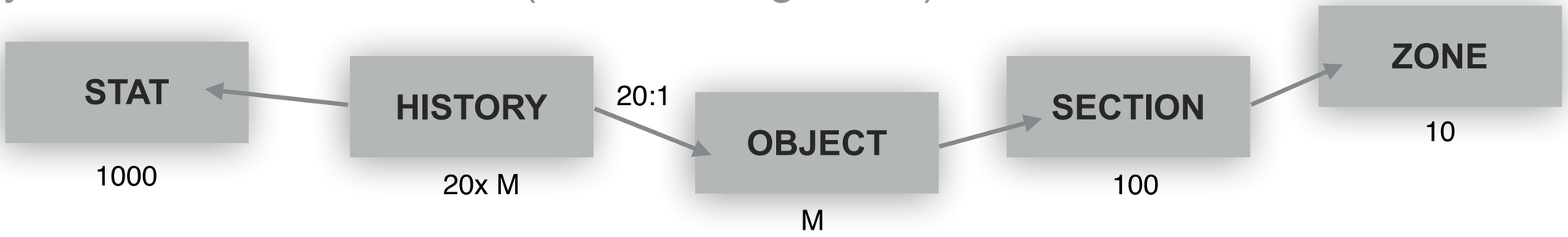
TPCC-like 10x100W Workload

- BP = 32GB : IO-bound ?
  - MySQL 8.0 is still doing better
  - drops on high load are still related to “lock_sys”



dbSTRESS Workload

- Developed & Maintained by me ;-))
  - in progress to be fully ported to Sysbench
  - can be executed as x1 dataset or xN datasets (similar to xN db, except it's the same db)
  - inspired by real customer workload (stock management)
  - schema :

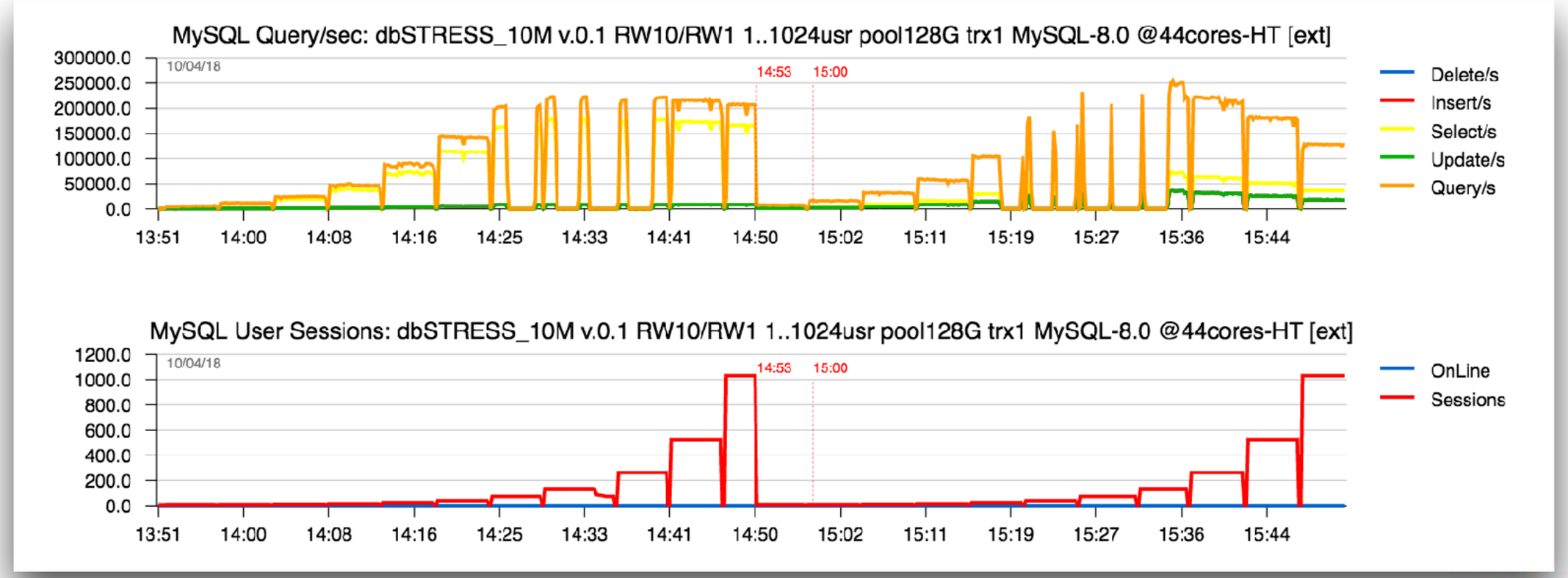


  - queries :
    - SEL1 : join of 3 tables by OBJECT REF
    - SEL2 : join of 2 tables by OBJECT REF
    - WRITE: DELETE/ INSERT/ UPDATE of single HISTORY record by OBJECT REF

- The following Test Scenarios :
  - Datasets : 10M or 10x1M (same ~100GB volume in total, 200M records in HISTORY)
  - BP = 128GB (in-memory)

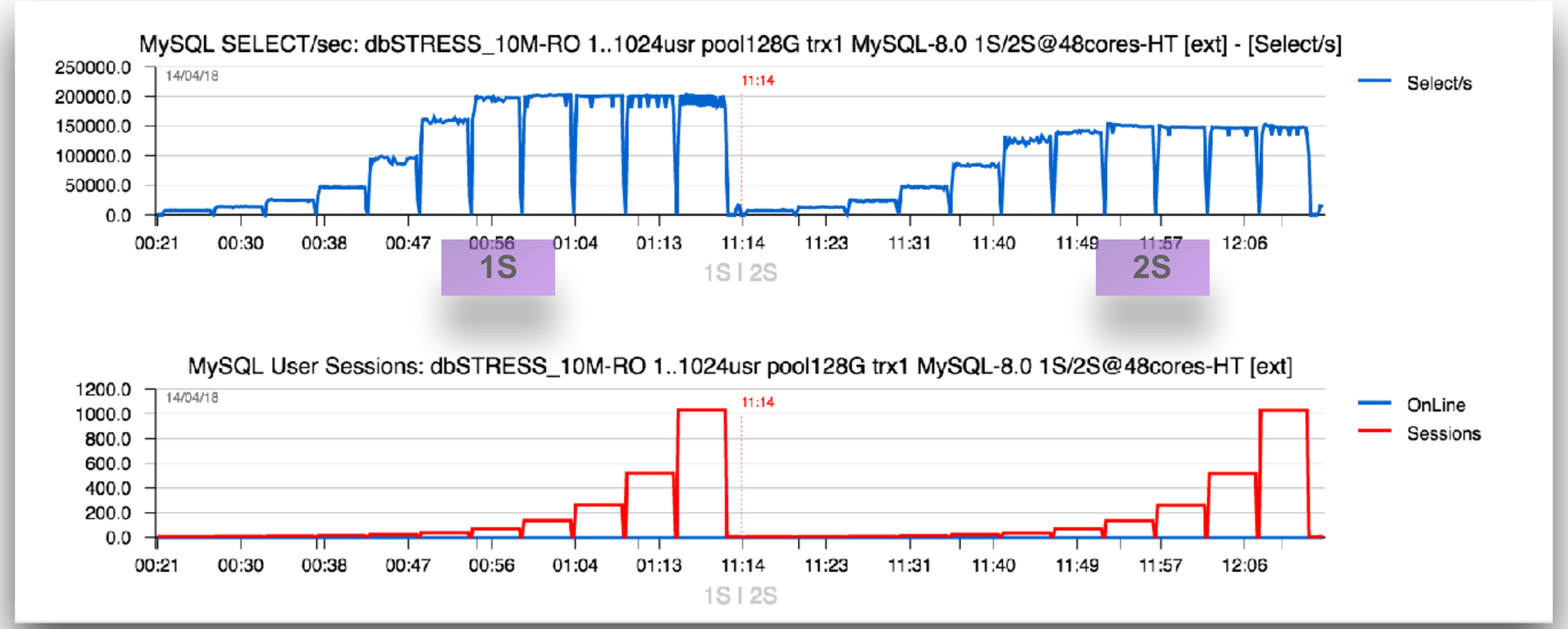
dbSTRESS Probe RW1 Test

- Dataset : 10M (~100GB)
  - surprise… => need a deep investigation..
  - NOTE : a good example how any “uncontrolled” app can kill your Production ;-))
  - Partial Workaround : attribute different REF values ranges for every thread



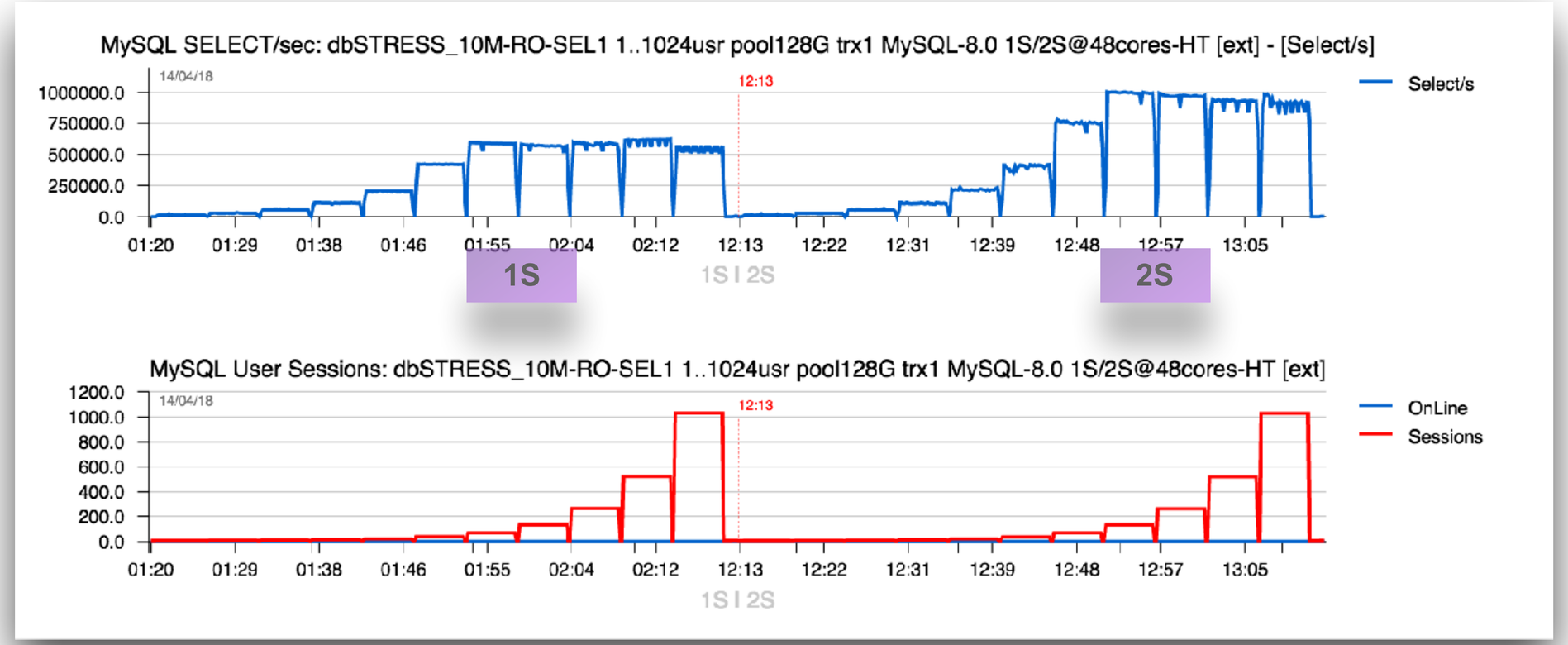
dbSTRESS 10M RO Test

- Dataset : 10M (200M HISTORY)
  - pure RO, but not scaling at all.. — 2S result is even worse than 1S..
  - RO = SEL1 + SEL2
  - so, both queries are not scaling or only one ?



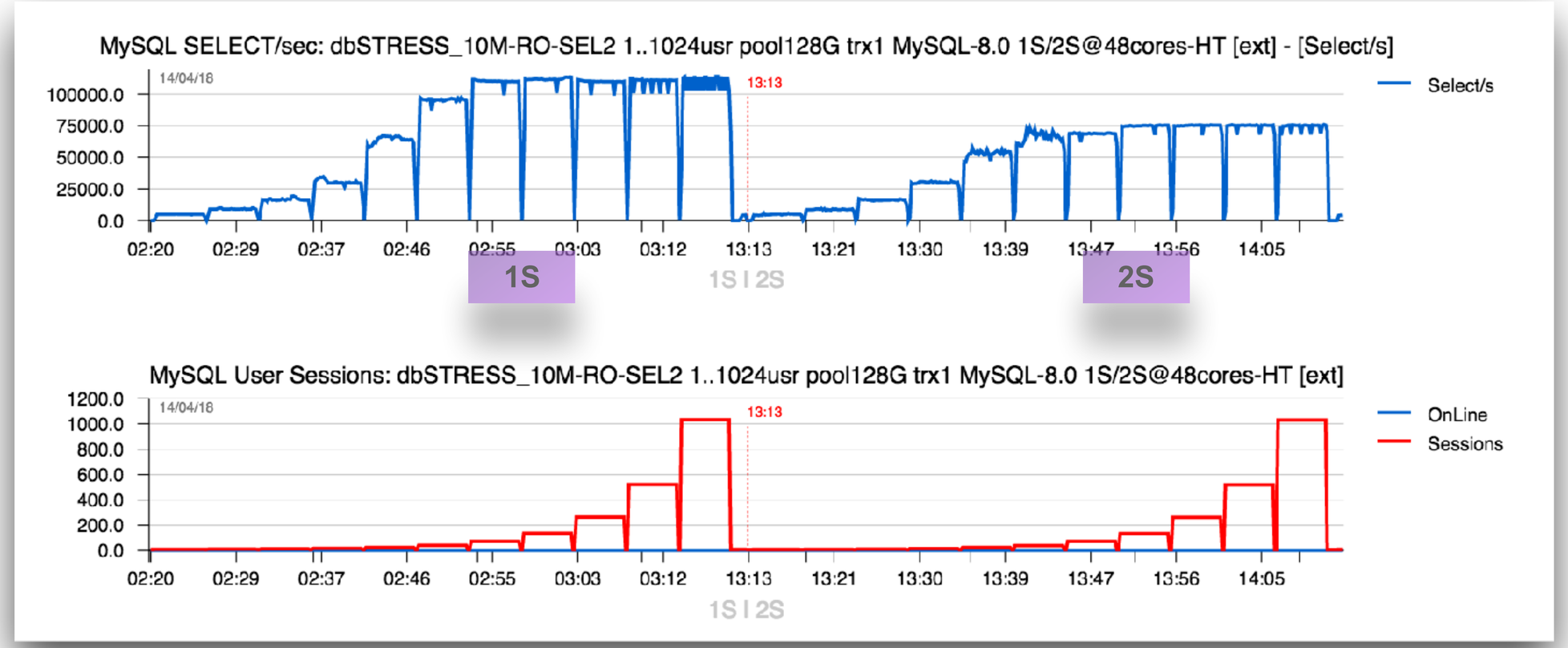
dbSTRESS 10M RO-SEL1 Test

- Dataset : 10M (200M HISTORY)
  - SEL1 is scaling pretty well..
  - what about SEL2 ?..



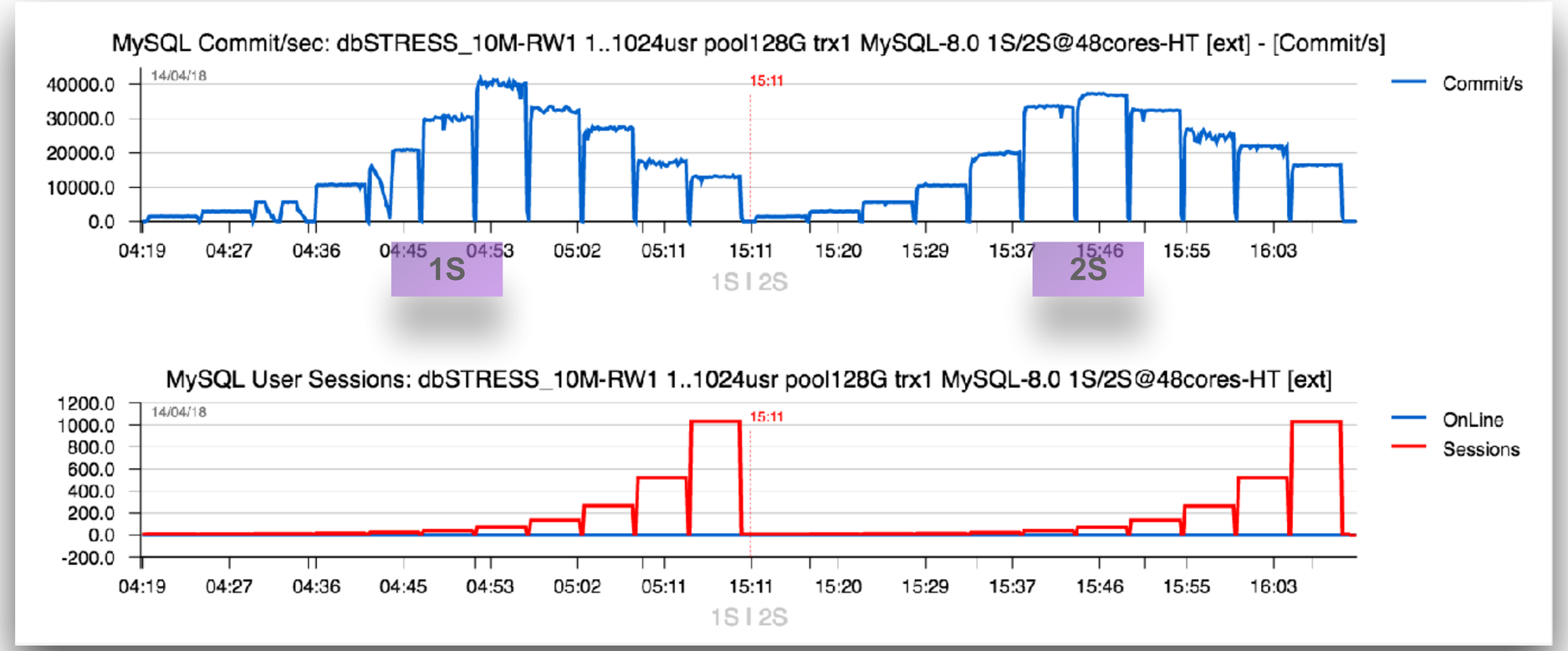
dbSTRESS 10M RO-SEL2 Test

- Dataset : 10M (200M HISTORY)
  - bingo ! — SEL2 is not scaling at all..
  - Why ? — Sec.IDX is part of problem + some more (by design)



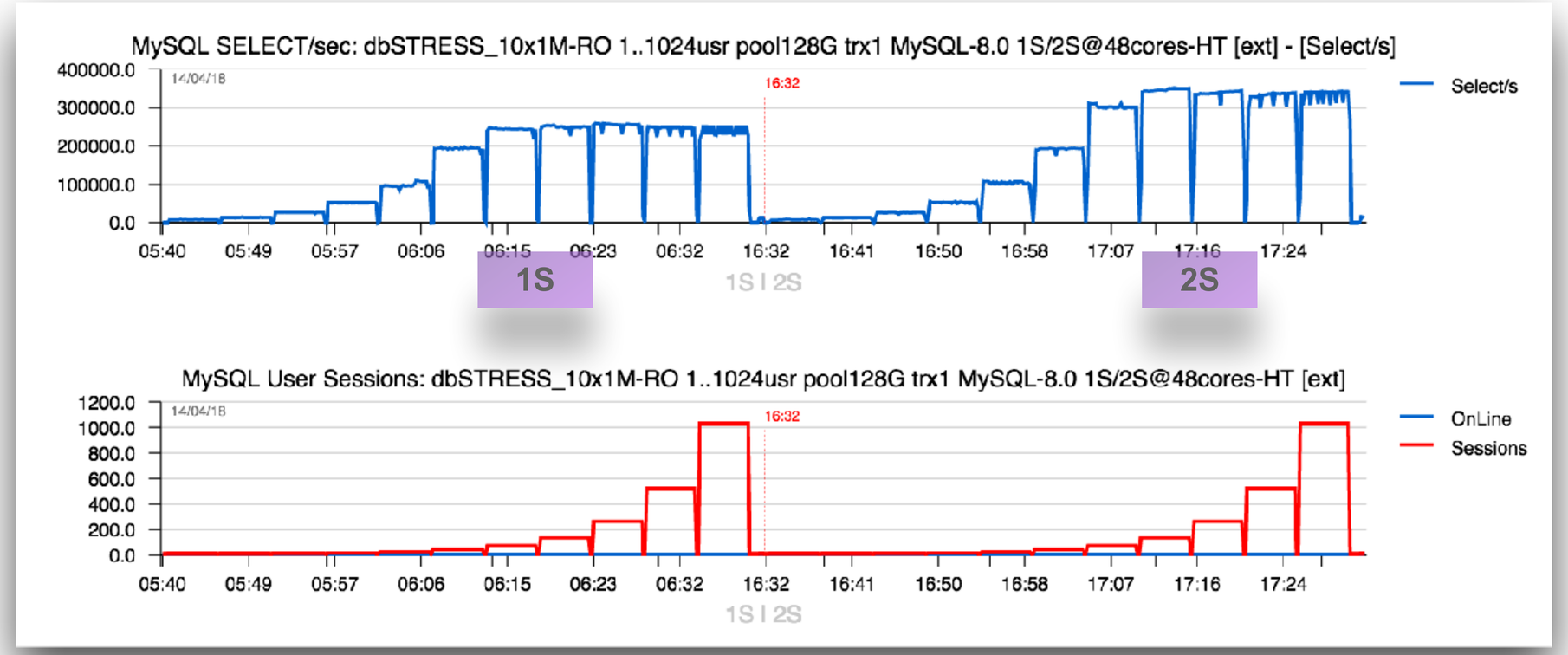
dbSTRESS 10M RW1 Test

- Dataset : 10M (200M HISTORY)
  - as the results, RW1 is not scaling either (RW1 = RW ratio 1:1)
  - still reaching 40K TPS Max anyway
  - but TPS on 2S is lower than 1S..



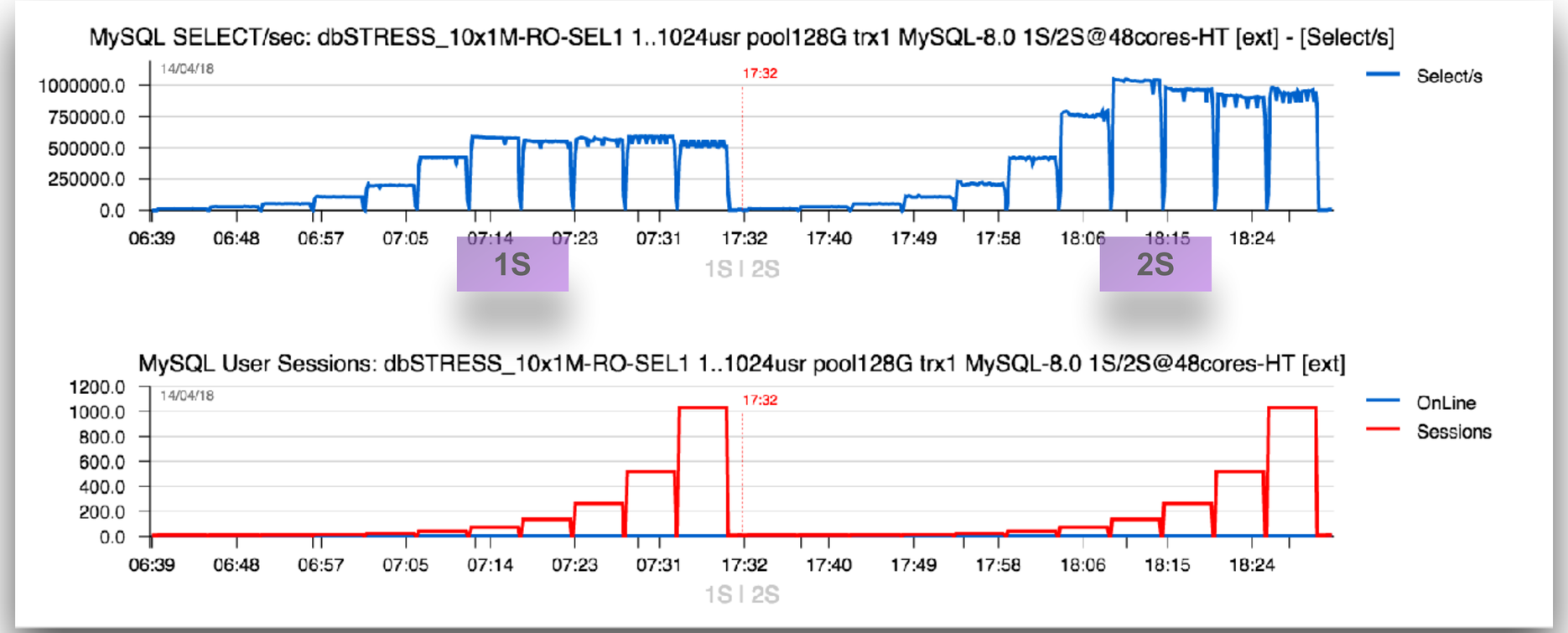
dbSTRESS 10x1M RO Test

- Dataset : 10x1M (10x20M HISTORY)
  - by using 10 datasets in parallel we divide the SEL2 bottleneck problem by 10 as well
  - as the result RO is getting better result on 1S than before, and yet more on 2S !
  - so, what about SEL1 and SEL2 ?



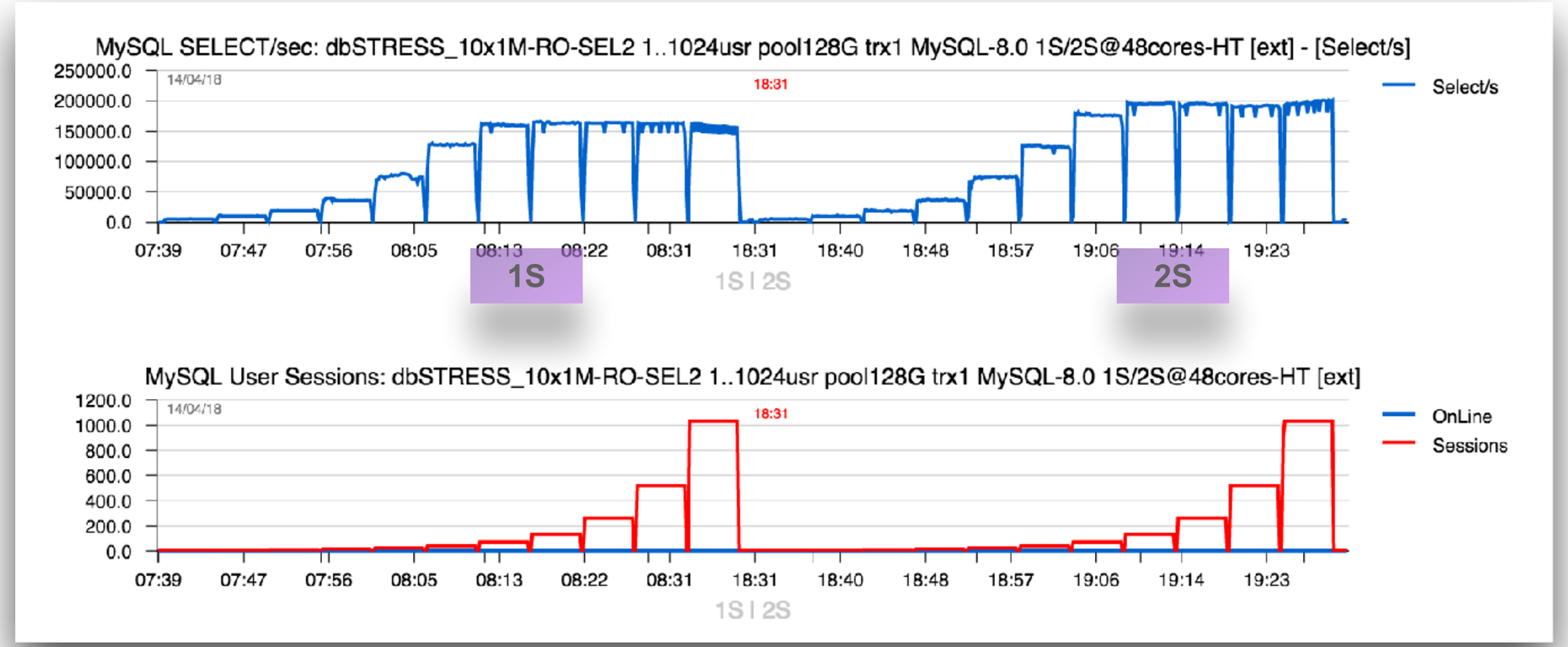
dbSTRESS 10x1M RO-SEL1 Test

- Dataset : 10x1M (10x20M HISTORY)
  - SEL1 was already well scaling on 10M Test, so no difference
  - not far from x2 times better performance on 2S, good !
  - so, what about SEL2 now ?



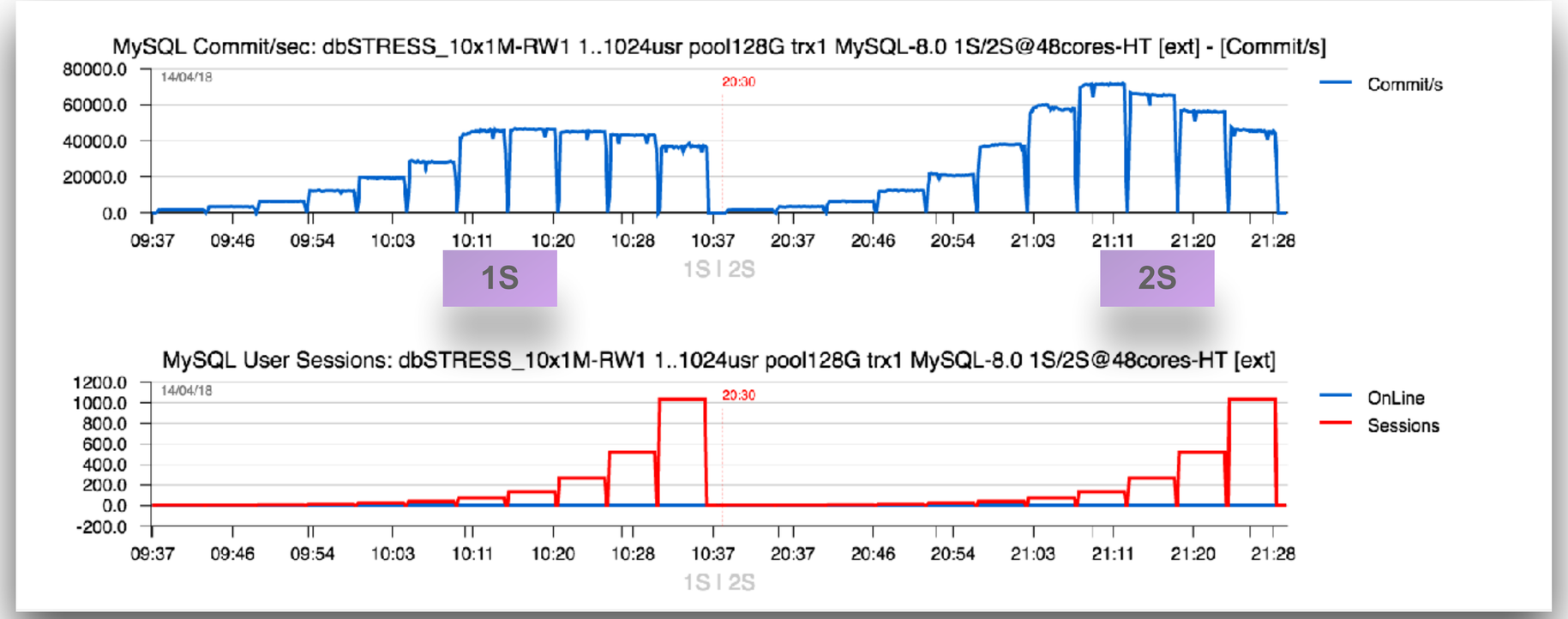
dbSTRESS 10x1M RO-SEL2 Test

- Dataset : 10x1M (10x20M HISTORY)
  - the result on 2S is only “slightly better” than on 1S..
  - which is pointing on a “bigger issue” than just a single bottleneck.. (Sec.IDX design)
  - but will this help RW1 workload in anyway ?



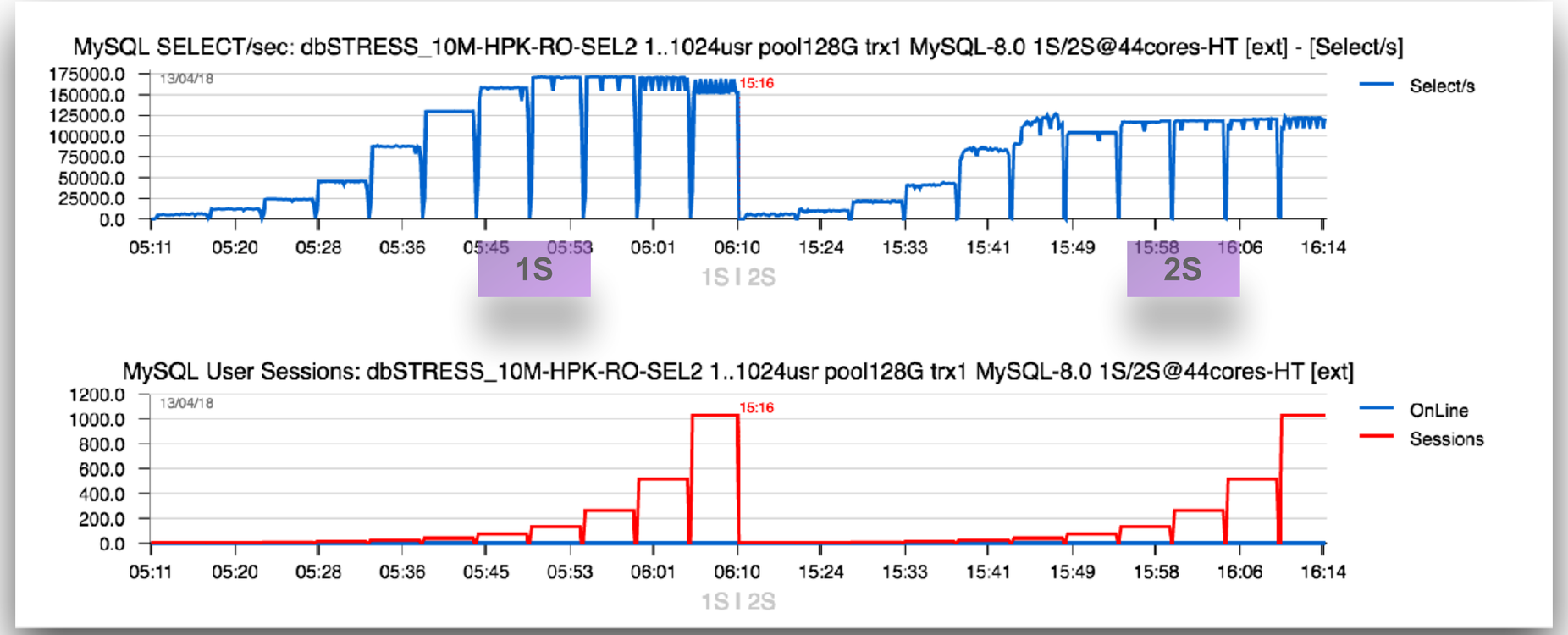
dbSTRESS 10x1M RW1 Test

- Dataset : 10x1M (10x20M HISTORY)
  - so far, reaching **70K** TPS on 2S (which is 75% more than 40K before on 10M Test)
  - however, we're just "hiding" the real problem by splitting the 10M Test into x10
  - if Sec.IDX design is part of the problem, could it help if we use PK instead ?



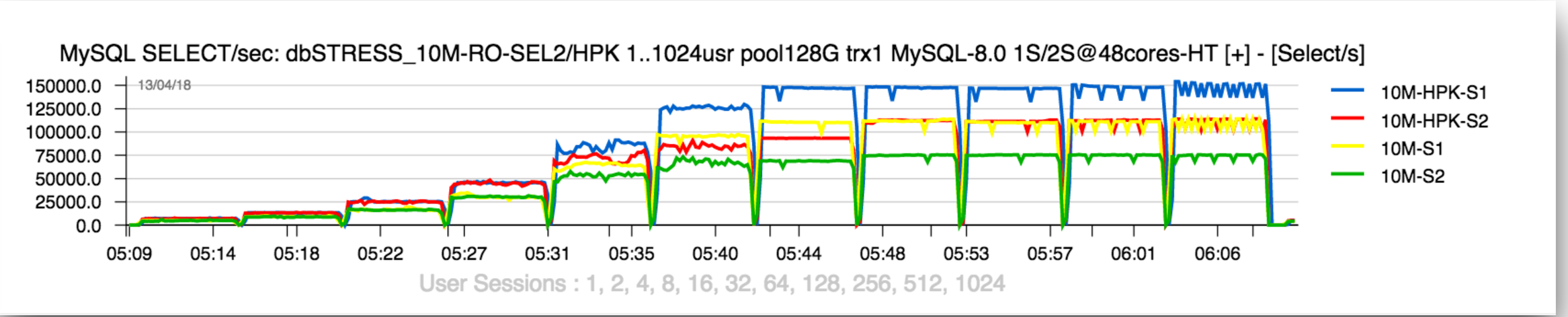
dbSTRESS 10M RO-SEL2 Test + HPK

- Dataset : 10M (200M HISTORY+PK (HPK))
  - no need to look on RO and RO-SEL1 Tests, as we know now RO results is driven by SEL2
  - so, still no scaling even with PK used for HISTORY table..
  - but what about numbers-to-numbers comparison with initial 10M Test ? (Sec.IDX)



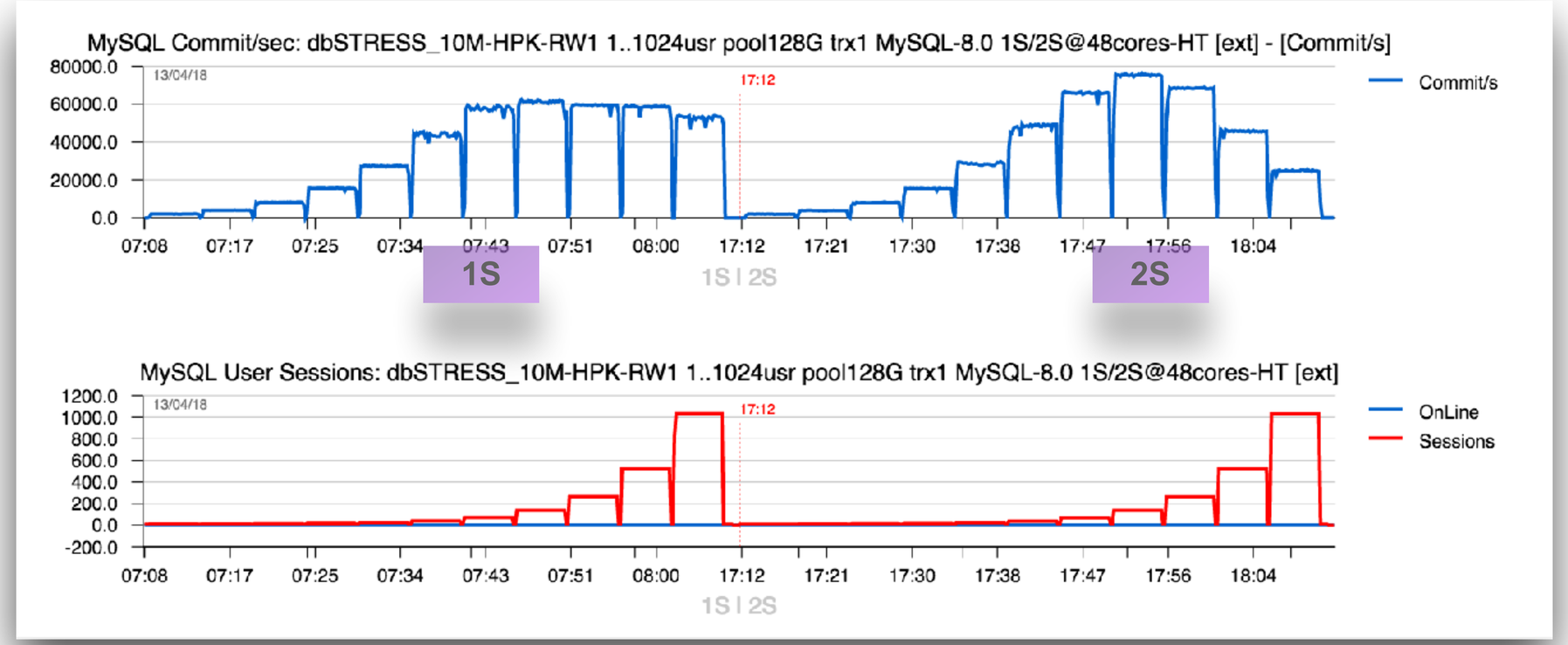
dbSTRESS 10M RO-SEL2 Test + HPK

- Dataset : 10M (200M HISTORY+PK (HPK))
  - the gain with PK over Sec.IDX is visible, but not that big as we could “expect”..
  - however, the real question also is it only impacting RO queries ?
  - what about RW1 now ?..



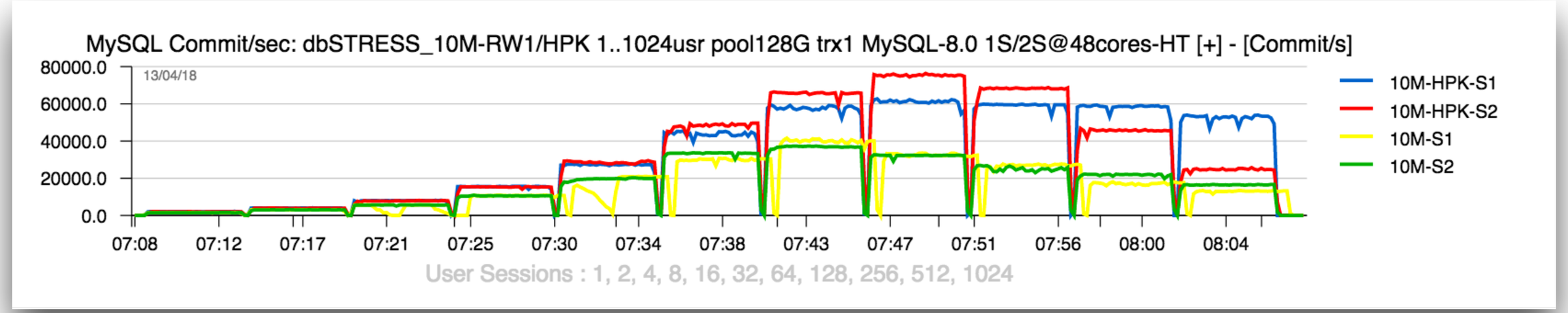
dbSTRESS 10M RW1 Test + HPK

- Dataset : 10M (200M HISTORY+PK (HPK))
  - over **60K** TPS on 1S and **75K** TPS on 2S !!
  - looks much better, but only 25% gain over 1S, so we're yet far from expected scalability..
  - so, PK is also greatly impacting WRITE operations, and how big the final difference ?



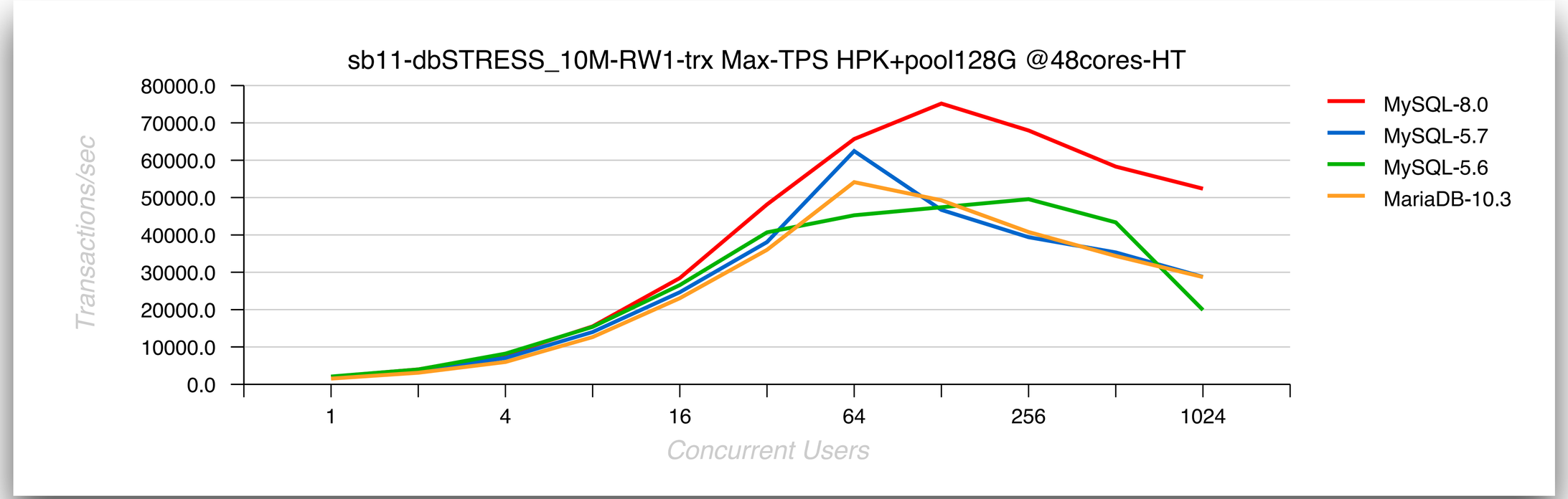
dbSTRESS 10M RW1 Test + HPK

- Dataset : 10M (200M HISTORY+PK (HPK))
  - as you can see, the impact of using PK over Sec.IDX is really huge..
  - near x2 times better Max TPS (75K vs 40K)
  - seems to be the most “favorable” test scenario to run with all other MySQL versions..



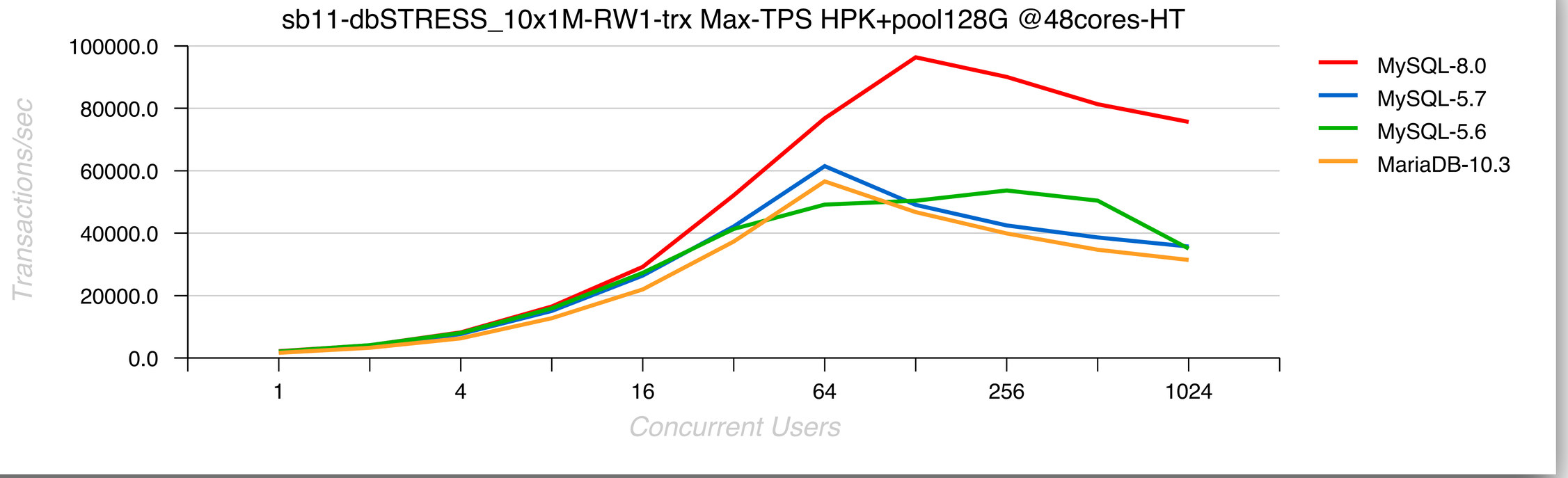
dbSTRESS 10M RW1 Test + HPK

- Dataset : 10M (200M HISTORY+PK (HPK))
  - as usual, “everything is relative”..
  - while we blame MySQL 8.0 for scalability limits, it’s still doing better than all we have ;-))
  - and what if we’ll combine this with 10x1M split ?..



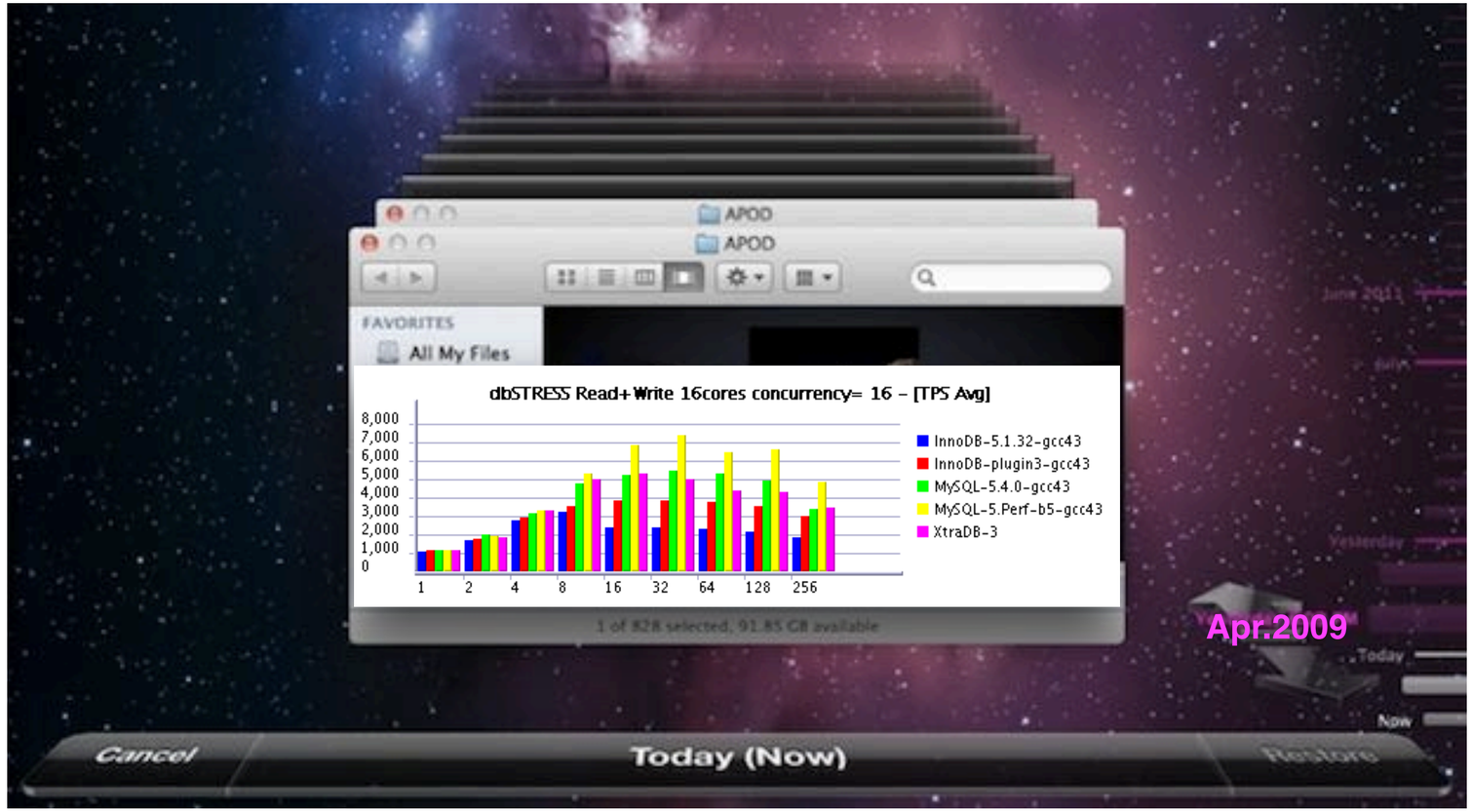
dbSTRESS 10x1M RW1 Test + HPK

- Dataset : 10x1M (10x20M HISTORY+PK (HPK))
  - even more once again — “everything is relative”..
  - reaching **95K** TPS with MySQL 8.0 !!
  - but still a lot of work ahead (if you don’t look on the numbers only, but under hood)..



dbSTRESS RW1 Test & Time Machine..

- Looking back with Time Machine :
  - even more once again — “everything is relative”..
  - **Apr.2009** : dbSTRESS 10M RW1 => **7.5K** TPS **only** as the best ever possible result !!
  - 9 years => and so huge jump in SW/HW + MySQL 8.0 !!! => x10 times diff..



Thank You !!! 🍾🍾🍾

ORACLE

One more thing ;-)

- All graphs are built with dim_STAT (http://dimitrik.free.fr)
  - All System load stats (CPU, I/O, Network, RAM, Processes,...)
    - Mainly for Linux, Solaris, OSX (and any other UNIX too :-)
    - Add-Ons for MySQL, Oracle RDBMS, PostgreSQL, Java, etc.
    - Linux : PerfSTAT (“perf” based), mysqlSTACK (quickstack based)
  - 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.