MySQL

ORACLE

MySQL 8.0 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

- Benchmarks & Benchmarks..
- MySQL 8.0 Performance gains
- Pending issues & workarounds
- Work in progress
  - Regressions “mystery”
  - TPCC “mystery”
  - dbSTRESS “headache”
  - etc..
- Q & A

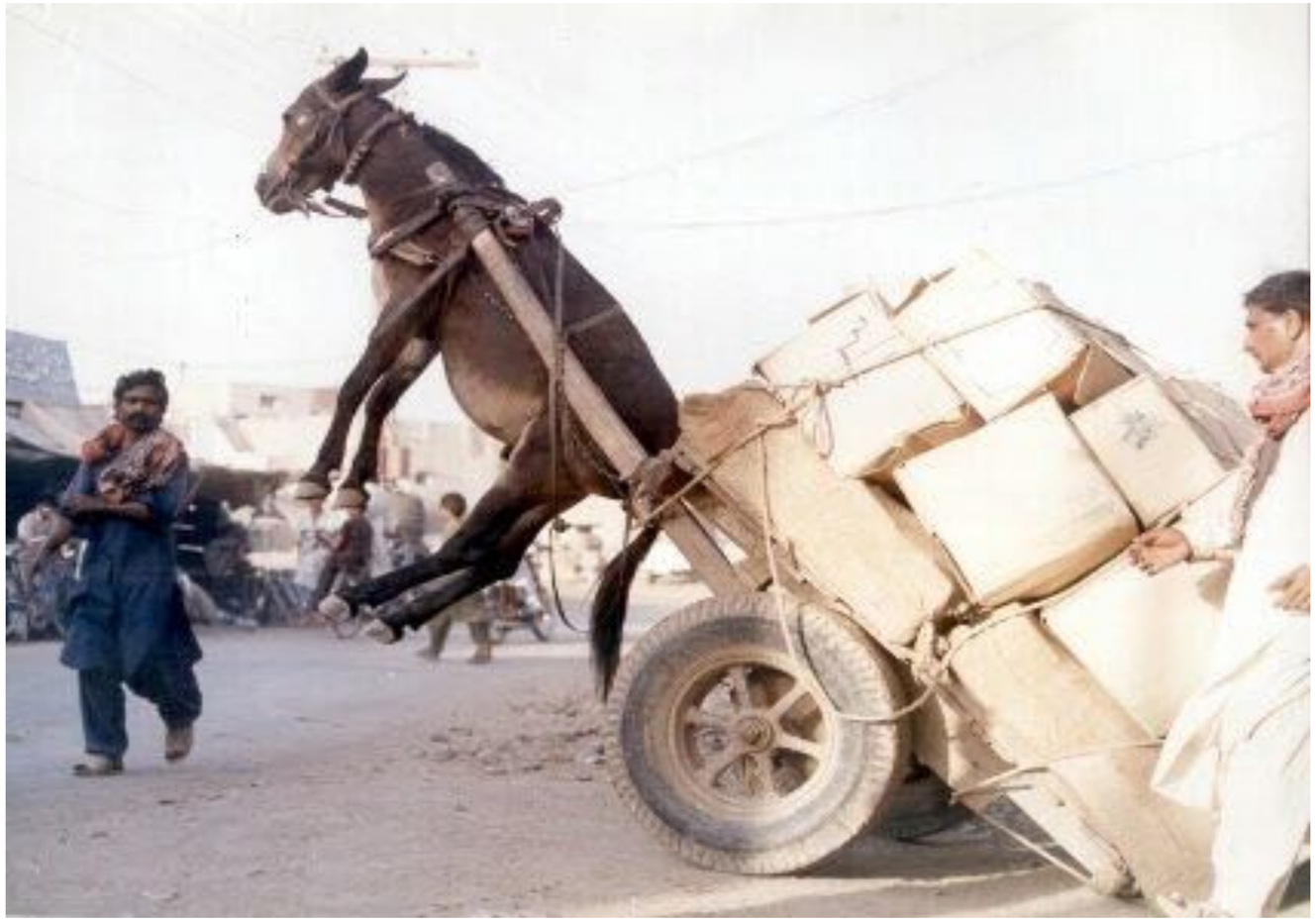
Why MySQL Performance ?...

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..

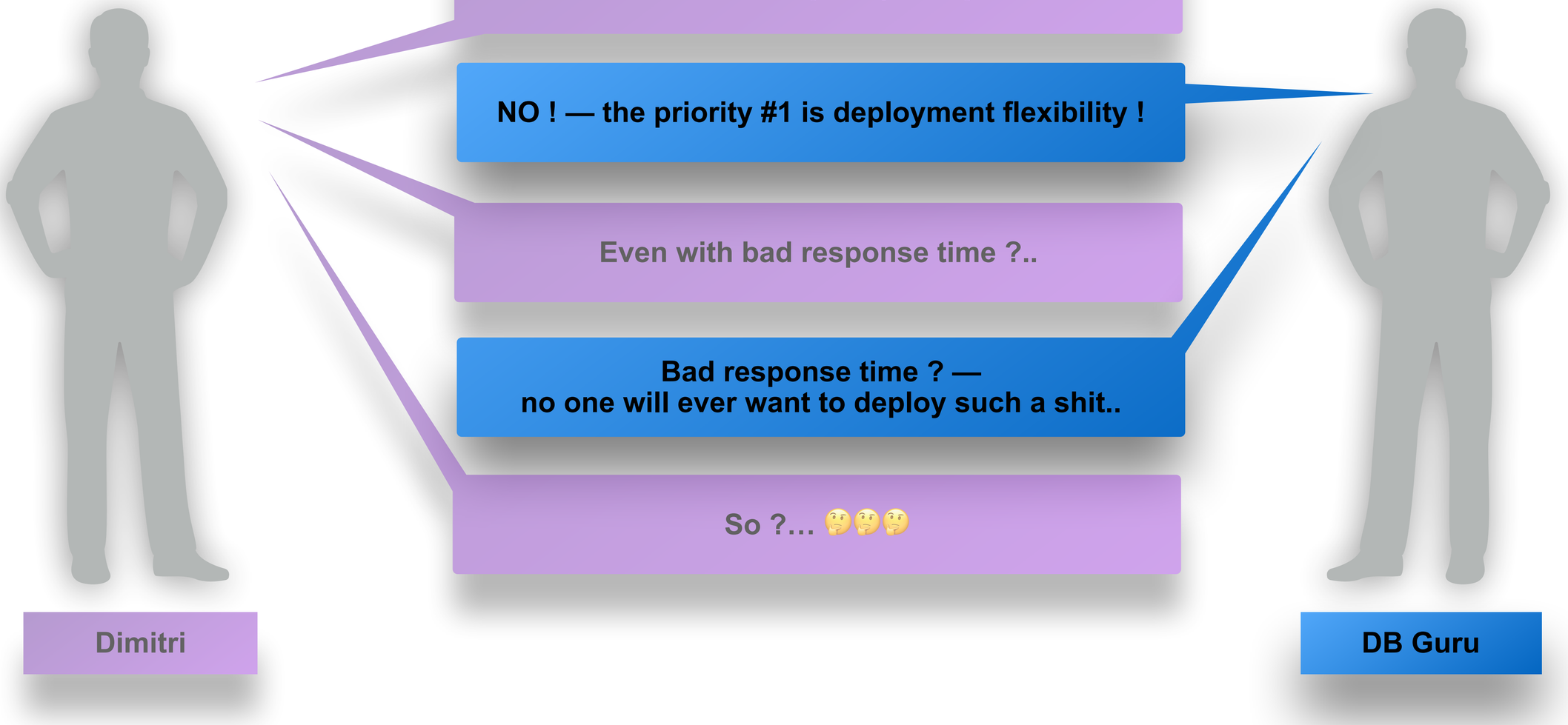
Why MySQL Performance ?..

- 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 ?



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

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USE YOUR BRAIN !!! ;-)

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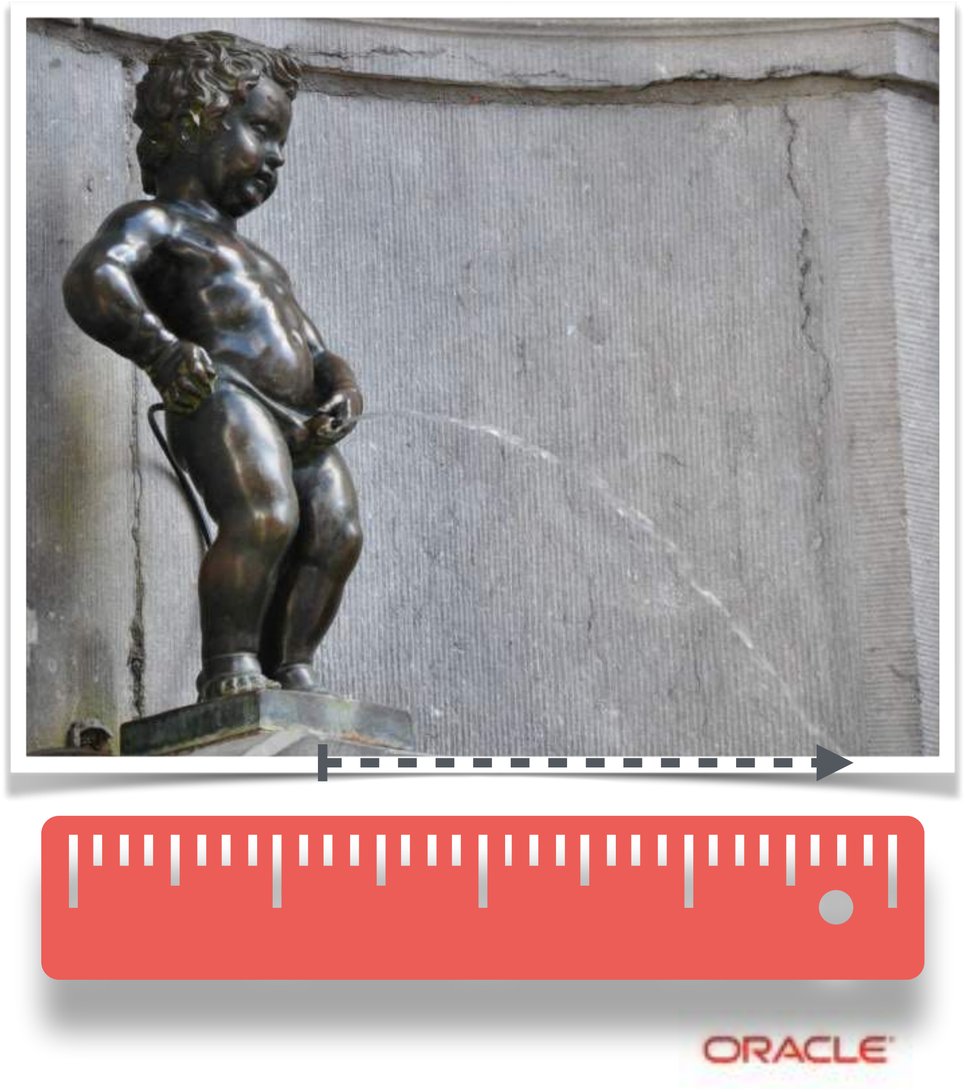
USE YOUR BRAIN !!! ;-)

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 !..

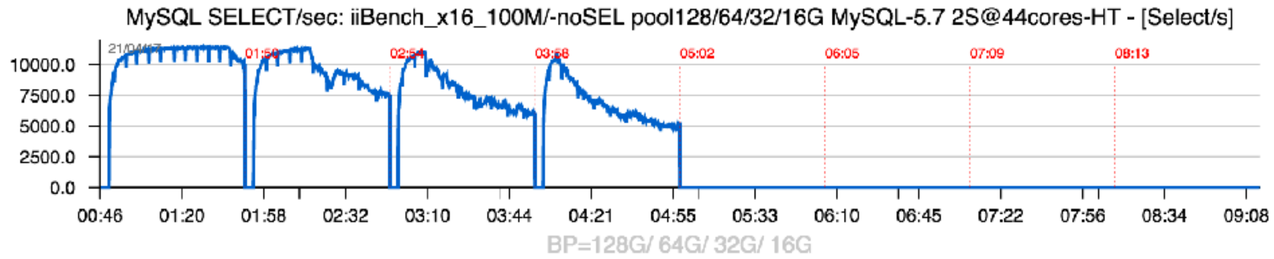
- As well :
  - kind of “reference” of what to expect
  - evaluate any new HW, systems, etc..

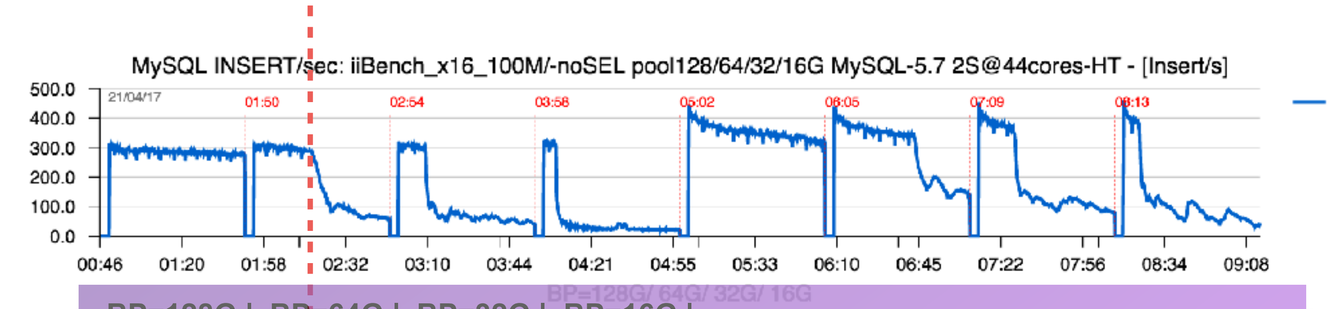
Example: iiBench (INSERT Benchmark)

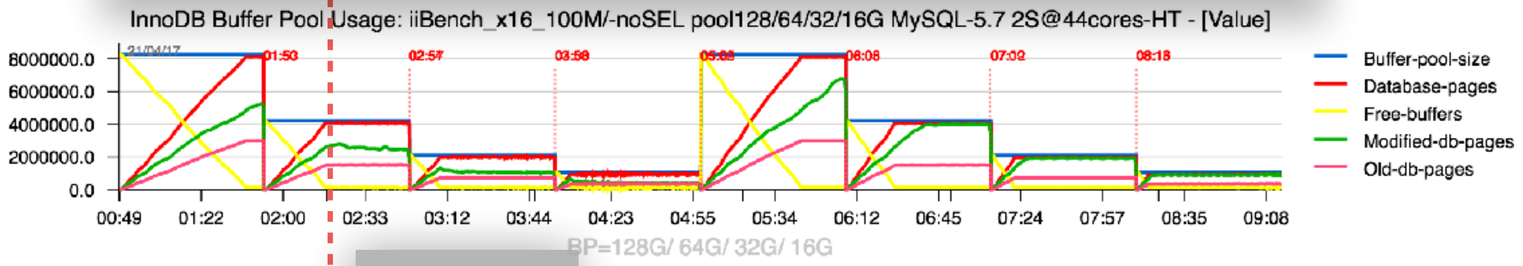
- Main claim :
  - InnoDB is xN times slower vs Write-oriented Engine XXX
  - so, use XXX, as it’s better
- Test Scenario :
  - x16 parallel iiBench processes running together during 1H
  - each process is using its own table
  - one test with SELECTs, another without..
- Key point :
  - during INSERT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



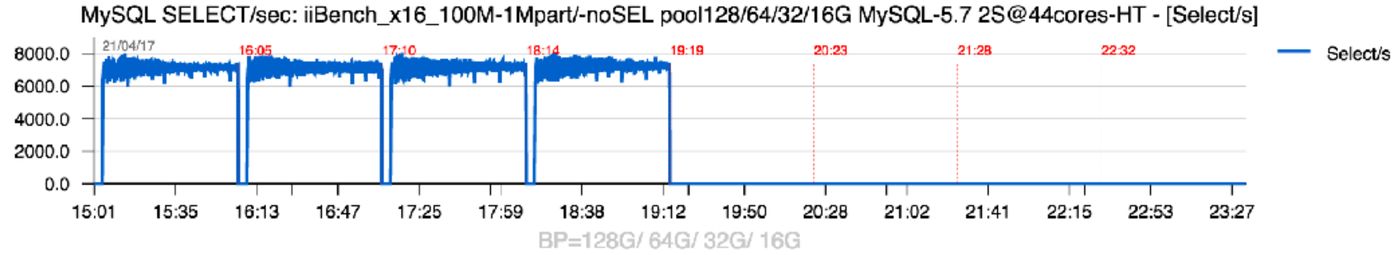


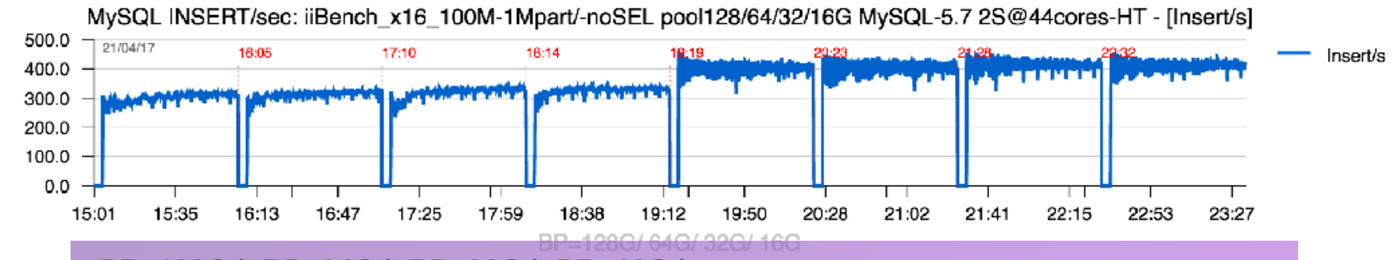


free buffers !!!

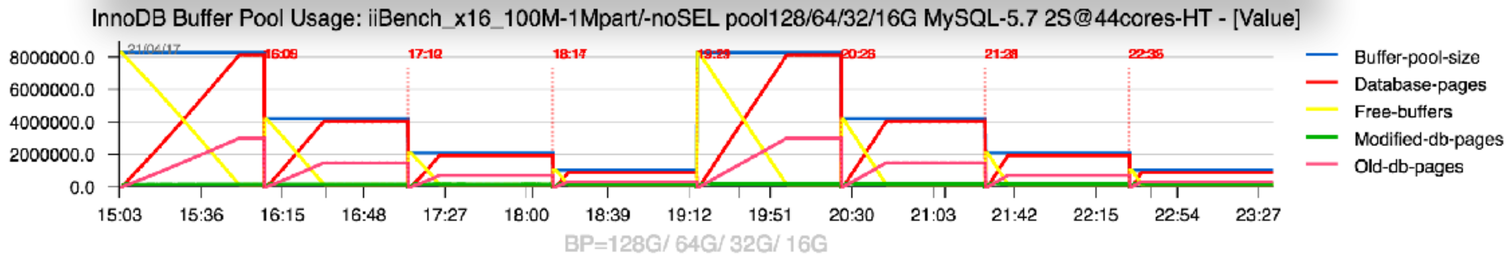
iiBench 100M x16 & 1M-parts : BP= 128G/ 64G/ 32G/ 16G

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



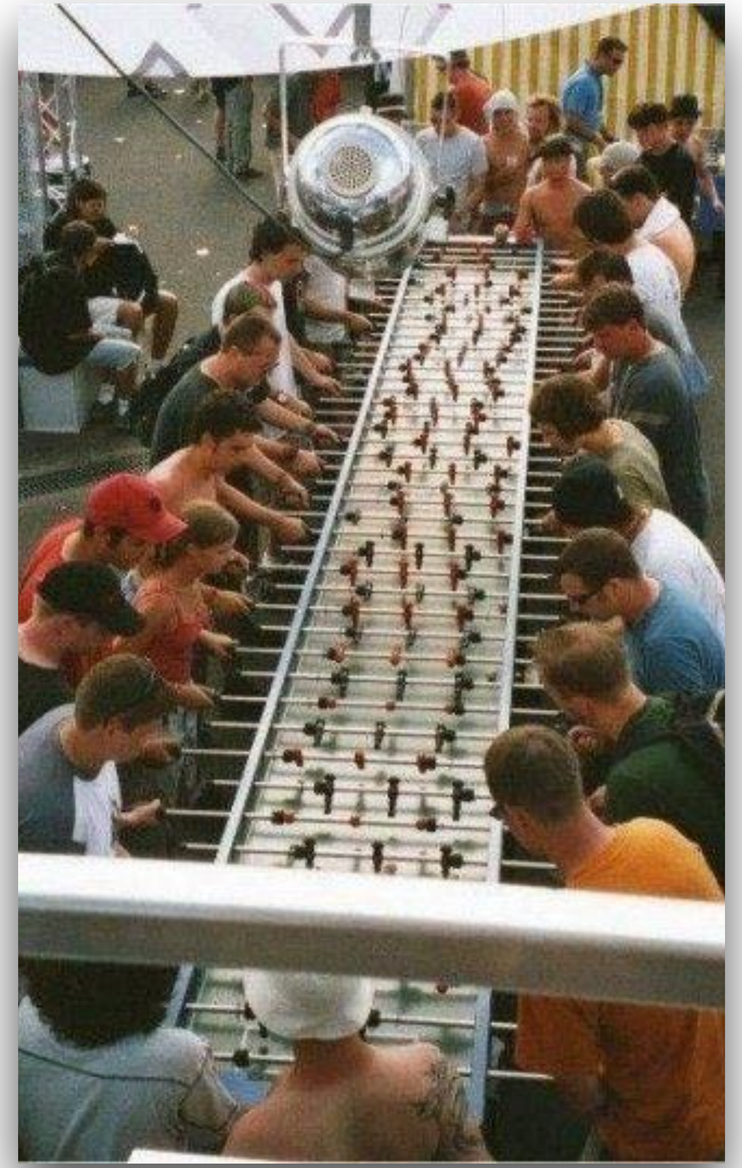


BP=128G | BP=64G | BP=32G | BP=16G |



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 ! ;-))



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 - #1
  - The “Entry Ticket” Workloads - looks simple, but still the most complete test kit !
  - OLTP, RO/RW, points on various RO and RW issues
- TPC-C : DBT2 / TPCC-like / HammerDB / Sysbench-TPCC
  - OLTP, RW, pretty complex, growing db
  - HammerDB : fully based on Stored Procedures
- DBT-3 / TPC-H
  - 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

Understand what you're testing !!!

- Example of Proposed Benchmark Workload by DigitalOcean :
  - 1) deploy "employee" database set
  - 2) run "mysqlslap" with 5 SQL queries and "--concurrency=50"
  - ref: https://www.digitalocean.com/community/tutorials/how-to-measure-mysql-query-performance-with-mysqlslap

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- Example of Proposed Benchmark Workload by DigitalOcean :
  - 1) deploy "employee" database set
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  - ref: https://www.digitalocean.com/community/tutorials/how-to-measure-mysql-query-performance-with-mysqlslap
- Now, what exactly this test is doing ?
  - all 5 SQL queries => SELECT * from table;
  - e.g. 5 full scans of 5 tables concurrently executed by 50 users
- Does it represents your Production Workload ???
  - (e.g. mind "Best practice #1")

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 ! ;-)
  - => becomes a true dev **platform** for workload scenarios !

Your Own Test Scenario on Sysbench ?

- “Just do it!”

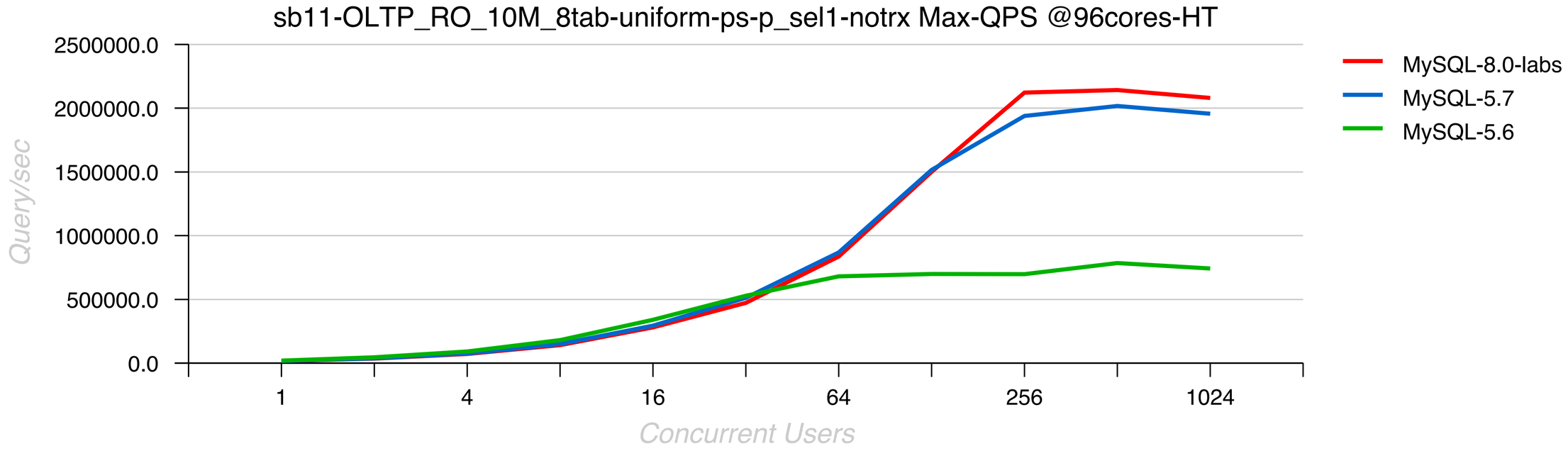
```
function thread_init()
  drv = sysbench.sql.driver()
  con = drv:connect()
end

function thread_done()
  con:disconnect()
end

function event()
  local id = sysbench.rand.default( 1, 1000000 )
  con:query( "select * from table1 where id = " .. id )
end
```

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 !

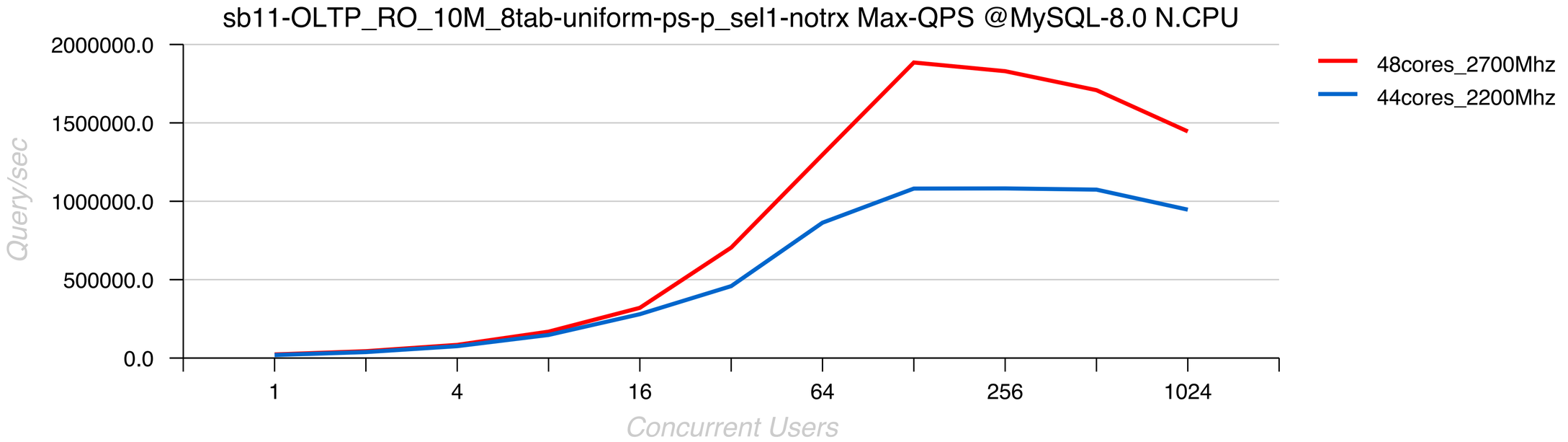
RO Point-Selects @MySQL 8.0-labs (Sep.2017)

- **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 ;-))



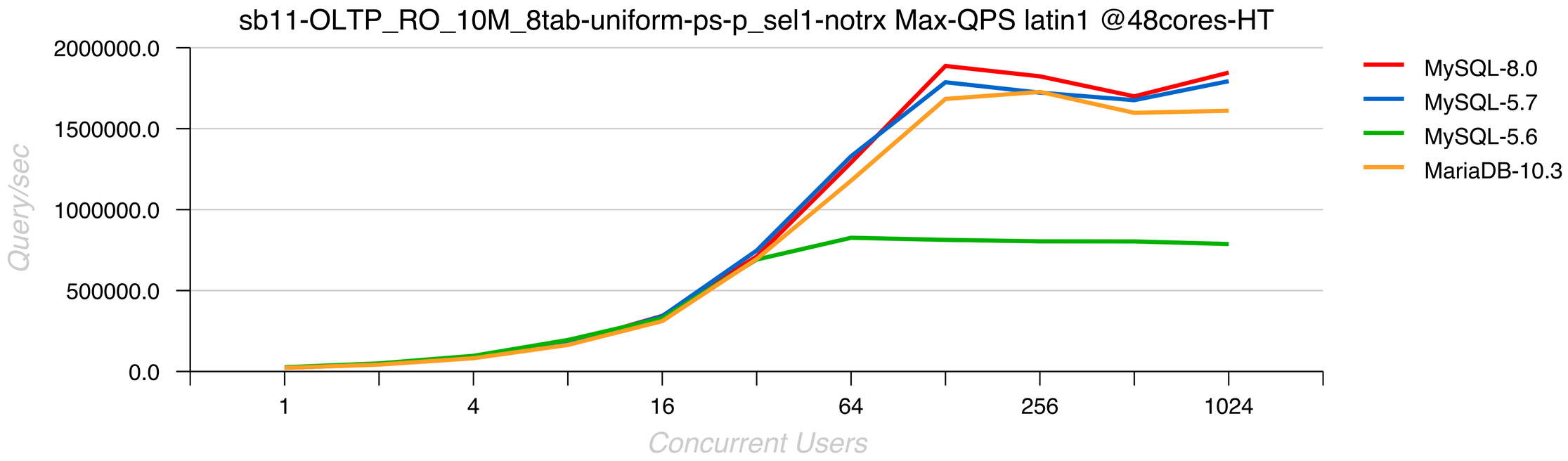
RO Point-Selects @MySQL 8.0 (Dec.2017)

- 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 !!



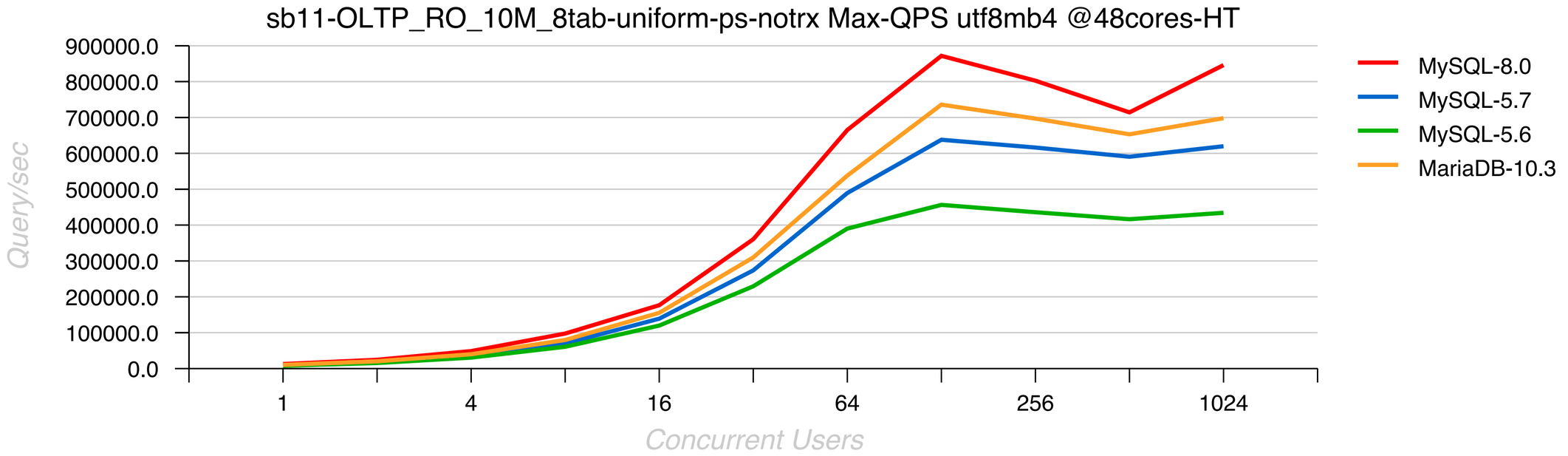
RO Point-Selects @MySQL 8.0 (Apr.2018)

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



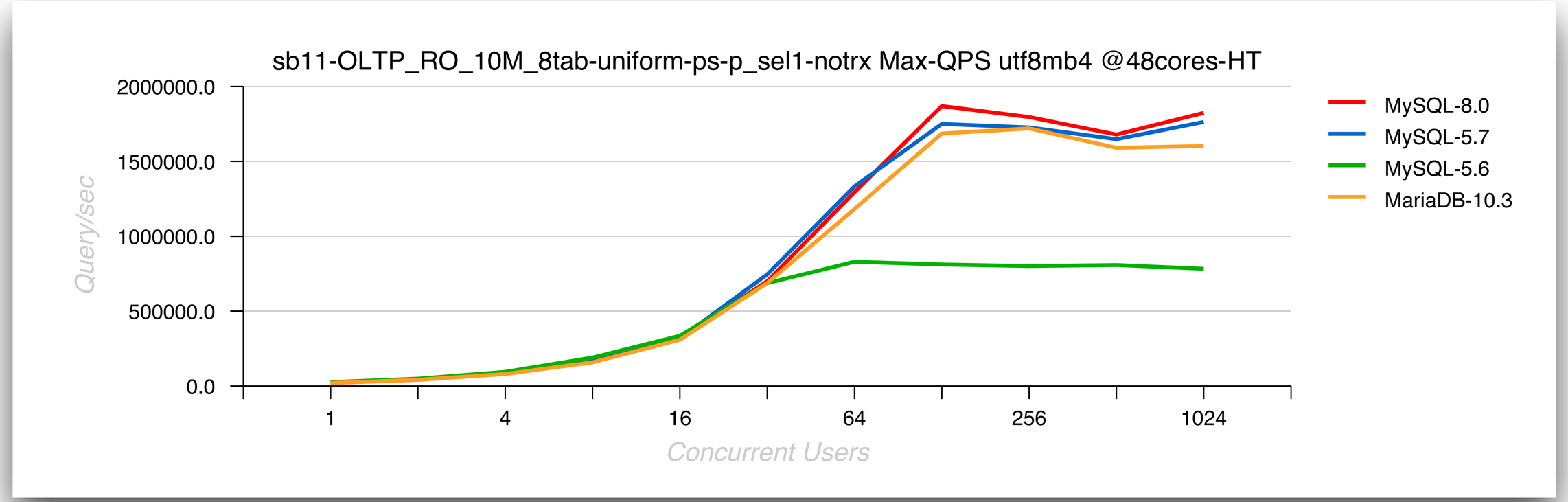
OLTP_RO UTF8mb4 @MySQL 8.0 (Apr.2018)

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



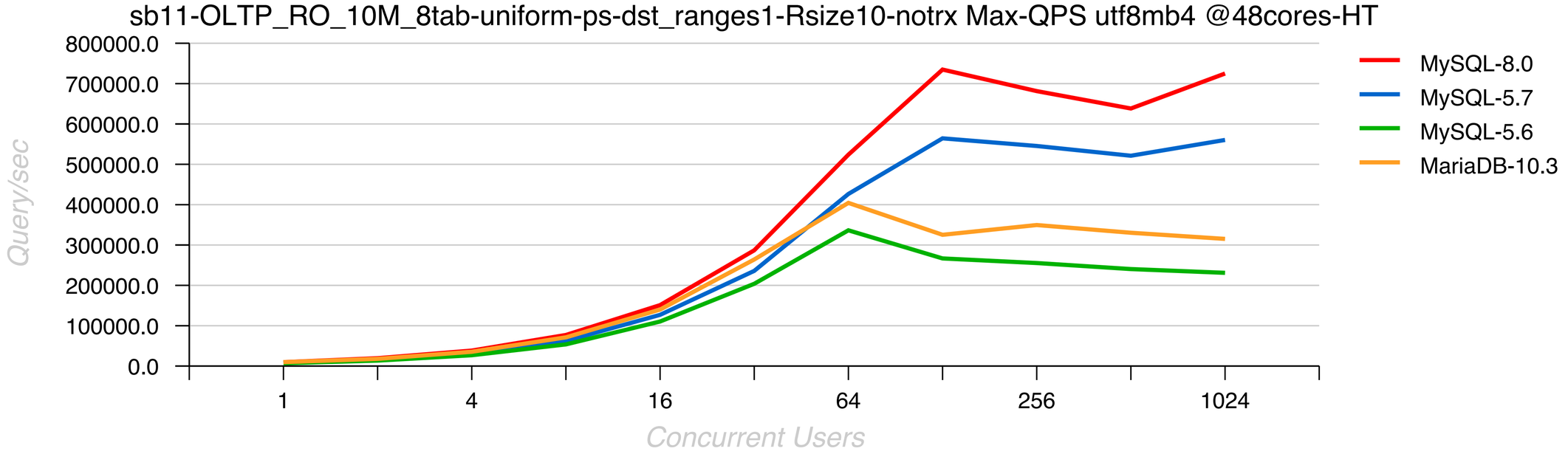
RO Point-Selects UTF8mb4 @MySQL 8.0 (Apr.2018)

- **Same QPS** Sysbench RO point-selects 10Mx8tab @2CPU Sockets
  - 2CPU Sockets **Skylake** Platinum : 48cores-HT
  - e.g. UTF8 mostly impacts when you have to compare data (order by / group by / etc.)



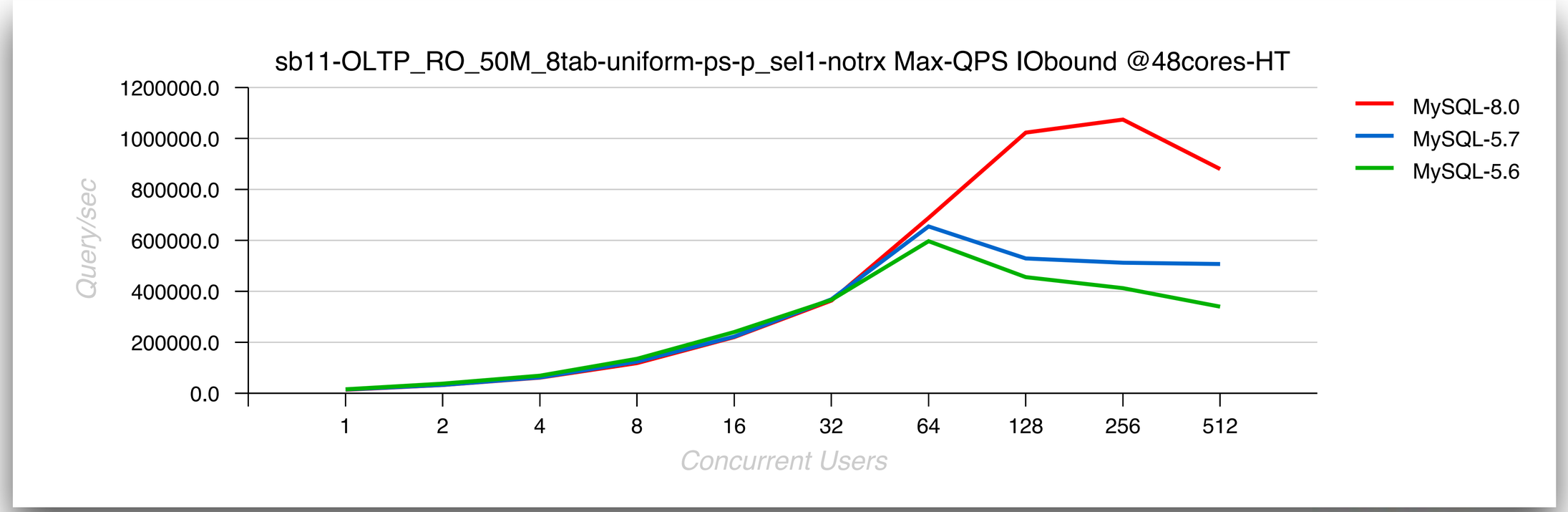
RO Distinct-Ranges UTF8mb4 @MySQL 8.0 (Apr.2018)

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

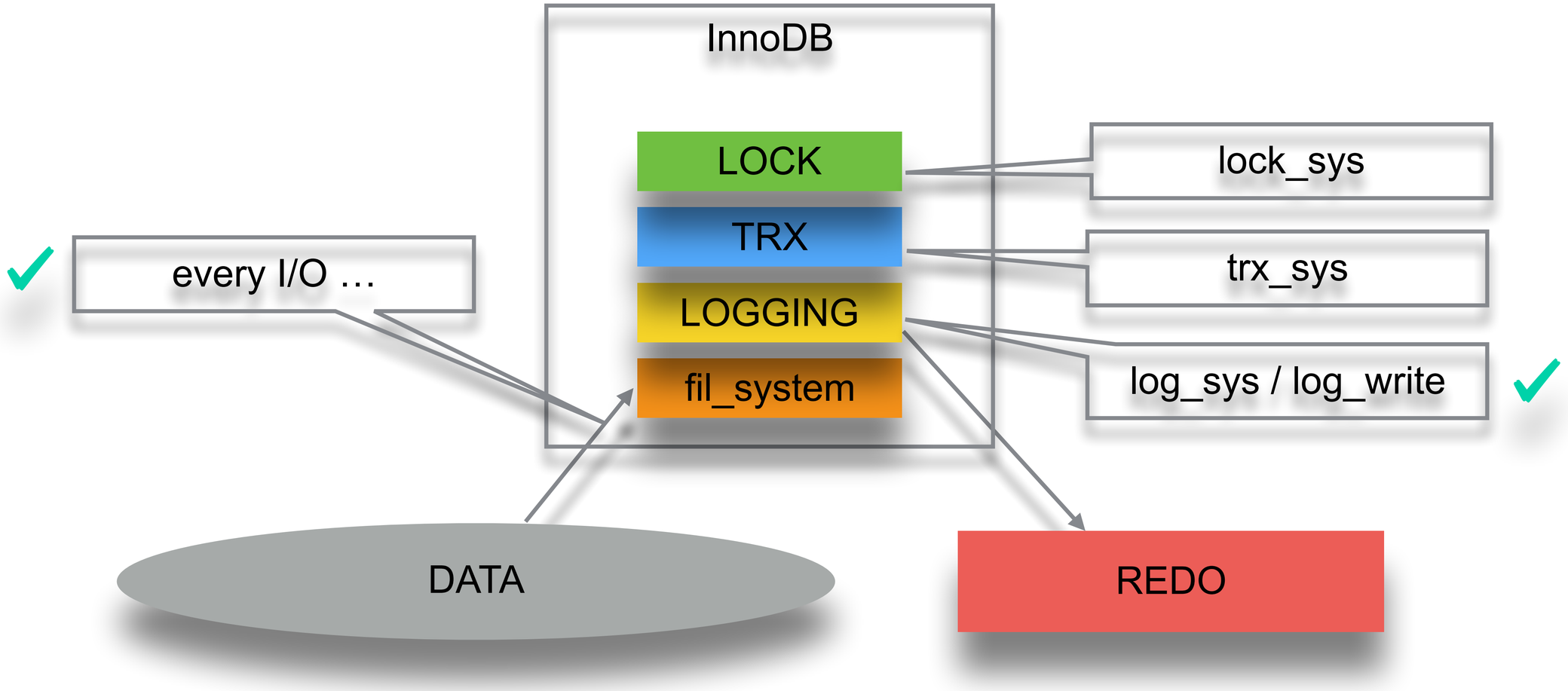


IO-bound Point-Selects @MySQL 8.0 (Apr.2018)

- IO-bound Sysbench OLTP_RO Point-Selects
  - 50M x 8-tables, 48cores-HT, x2 Optane drives
  - over **1M IO-bound QPS** with MySQL 8.0 !!!
  - all details : http://dimitrik.free.fr/blog/posts/mysql-performance-1m-iobound-qps-with-80-ga-on-intel-optane-ssd.html

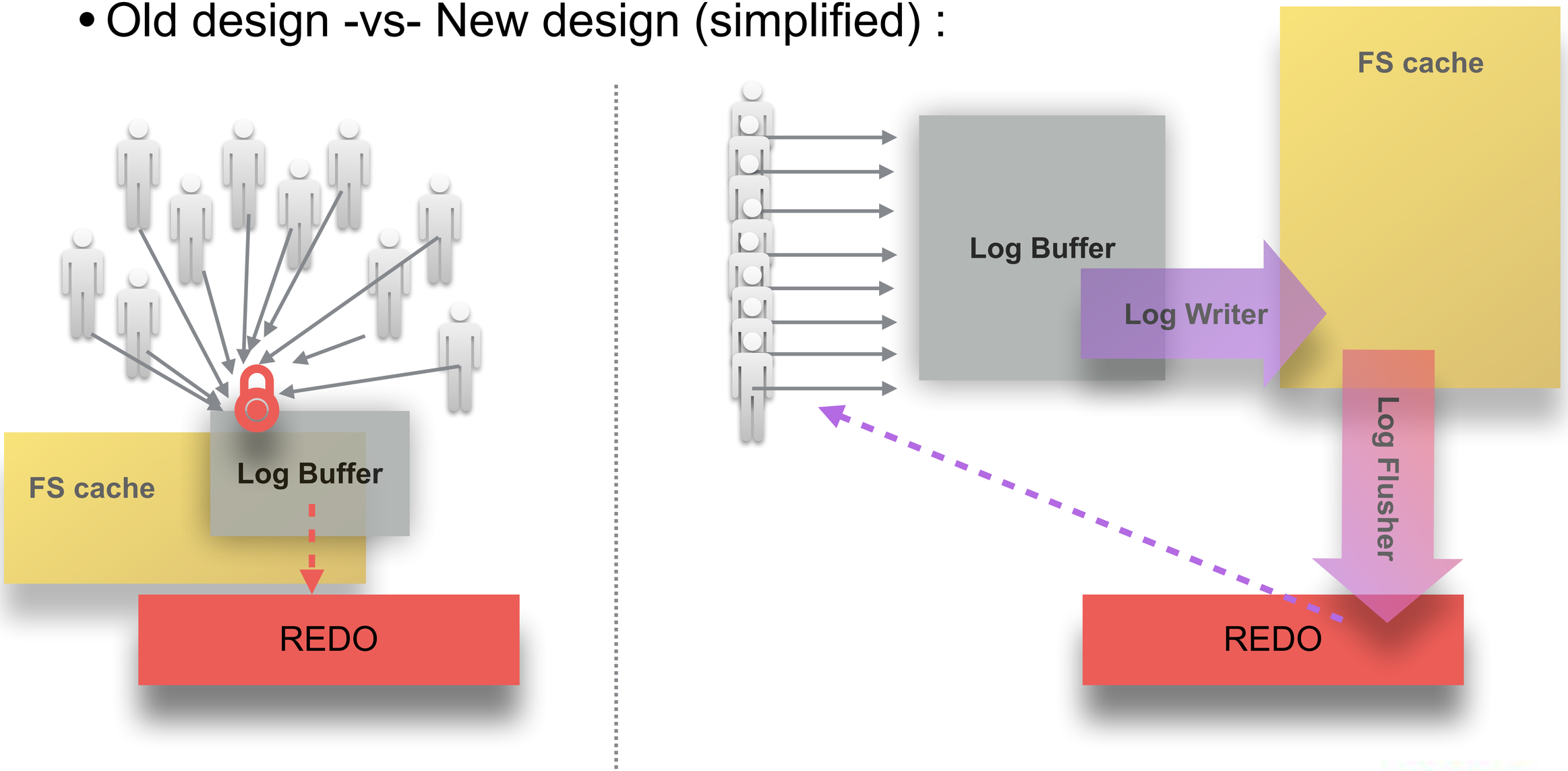


MySQL 8.0 : New Design for InnoDB Fundamentals..



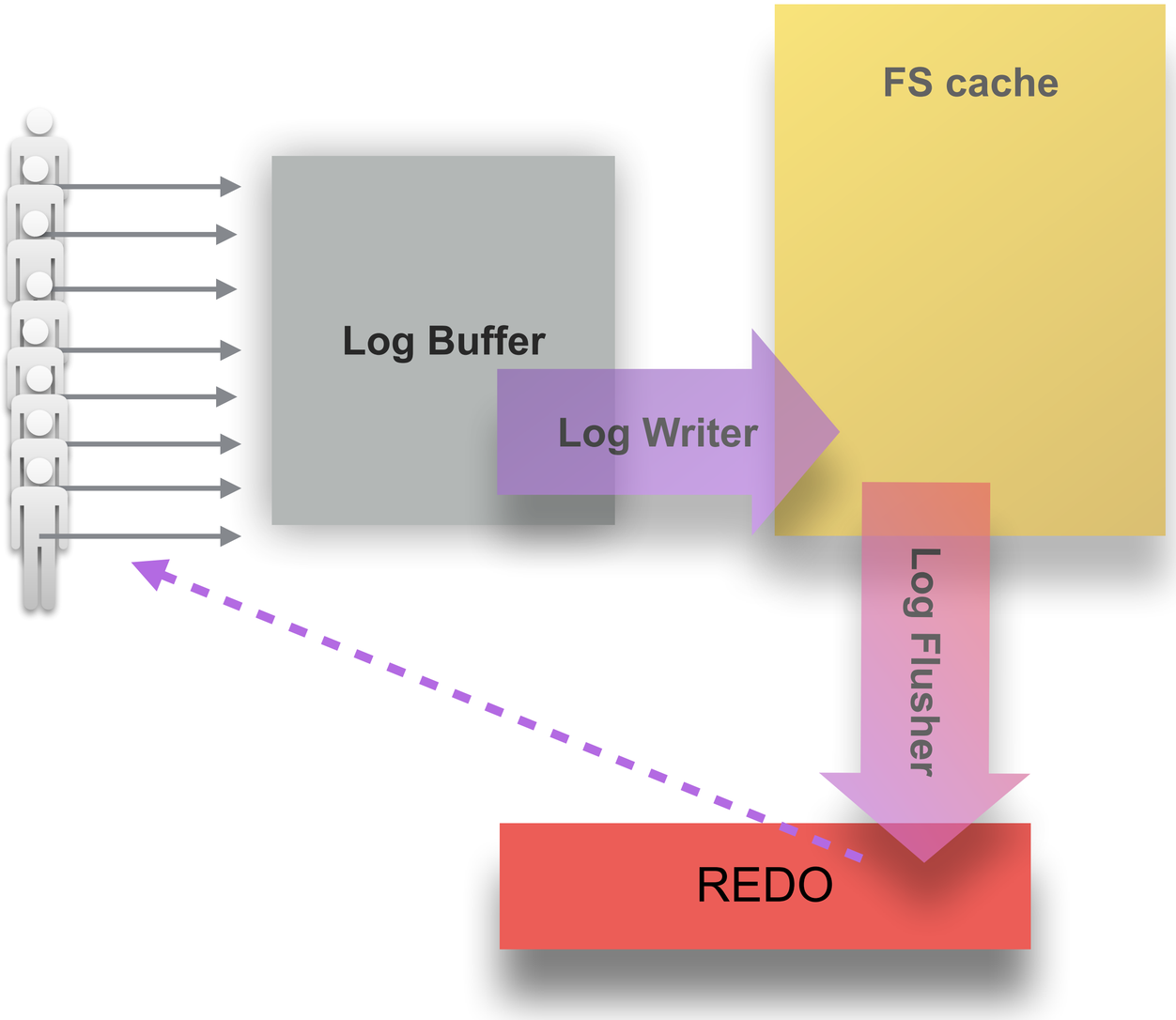
MySQL 8.0 : Re-Designed REDO

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



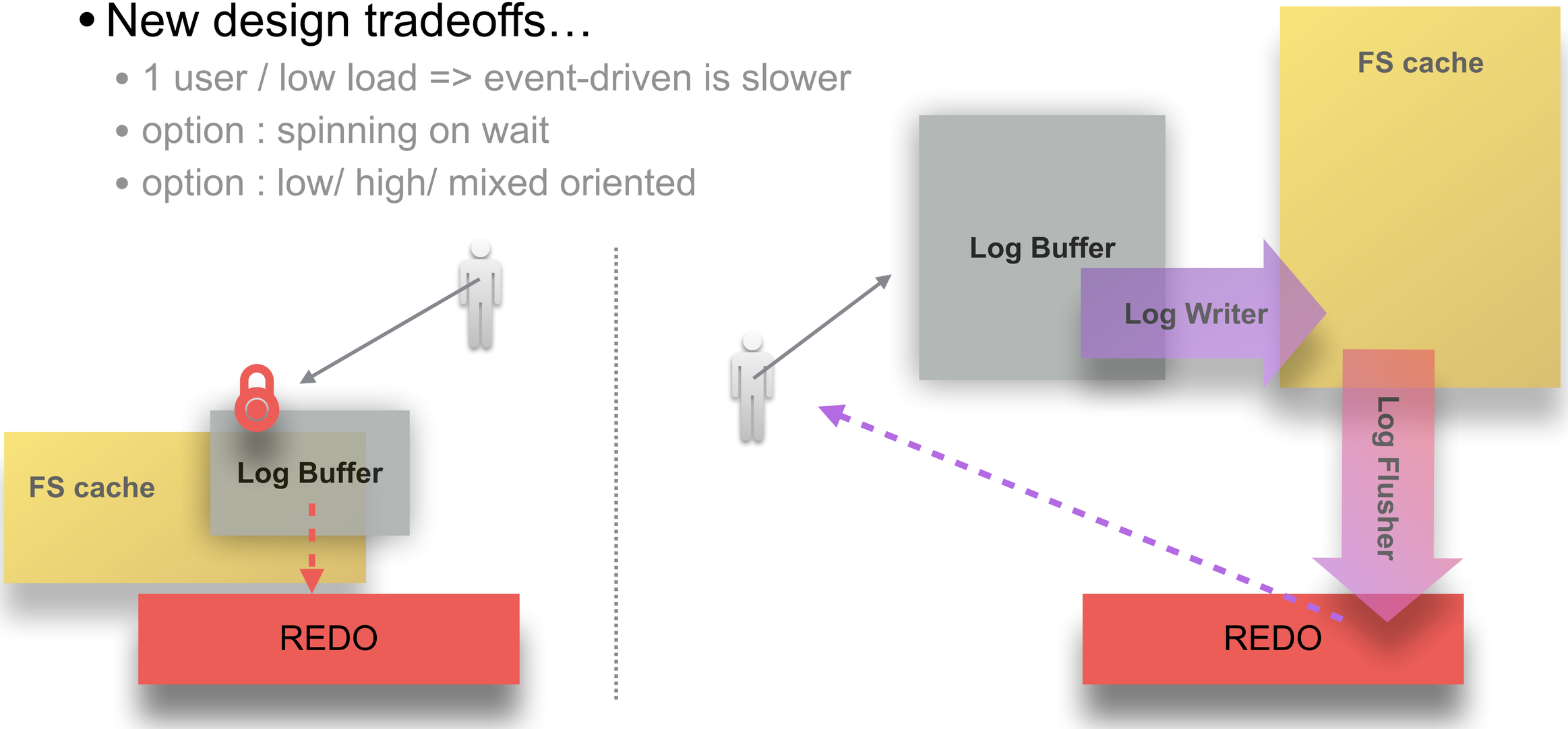
MySQL 8.0 : Re-Designed REDO

- 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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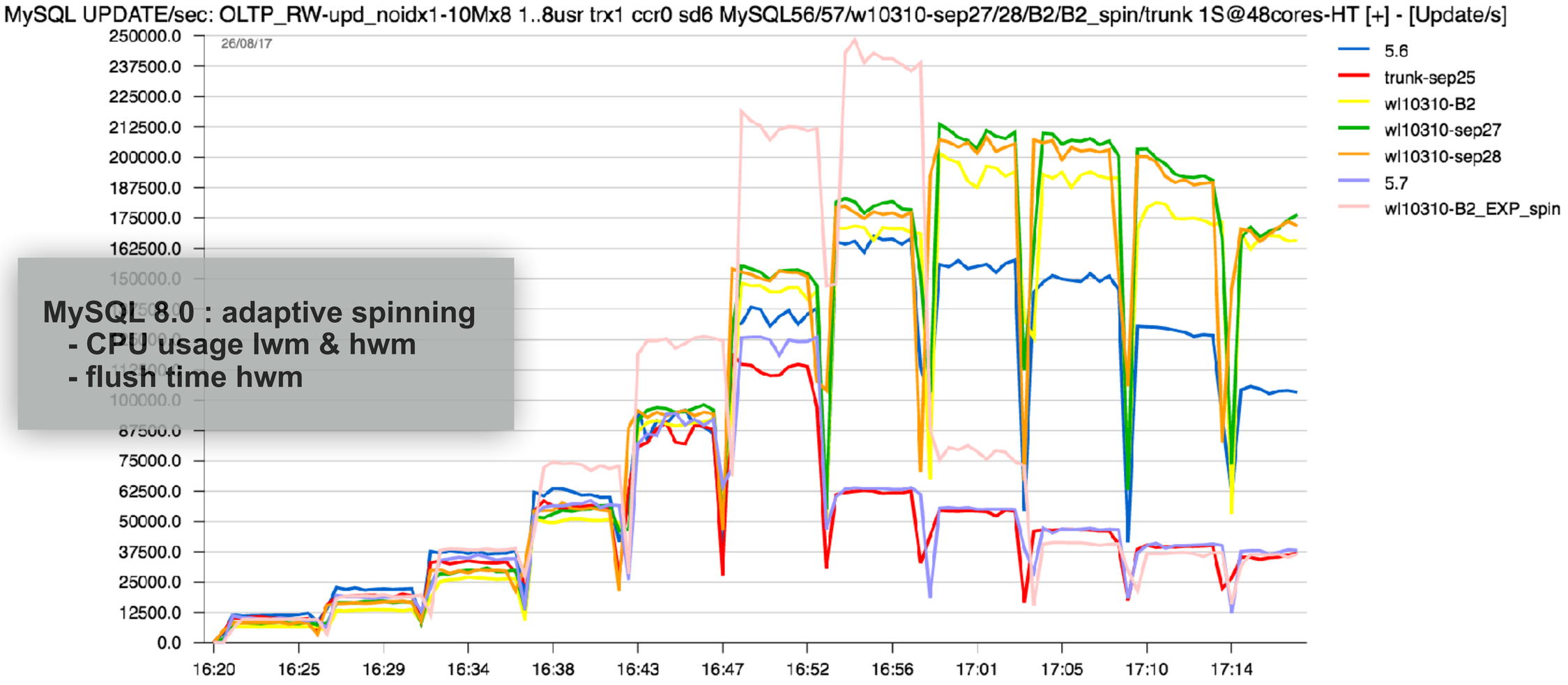
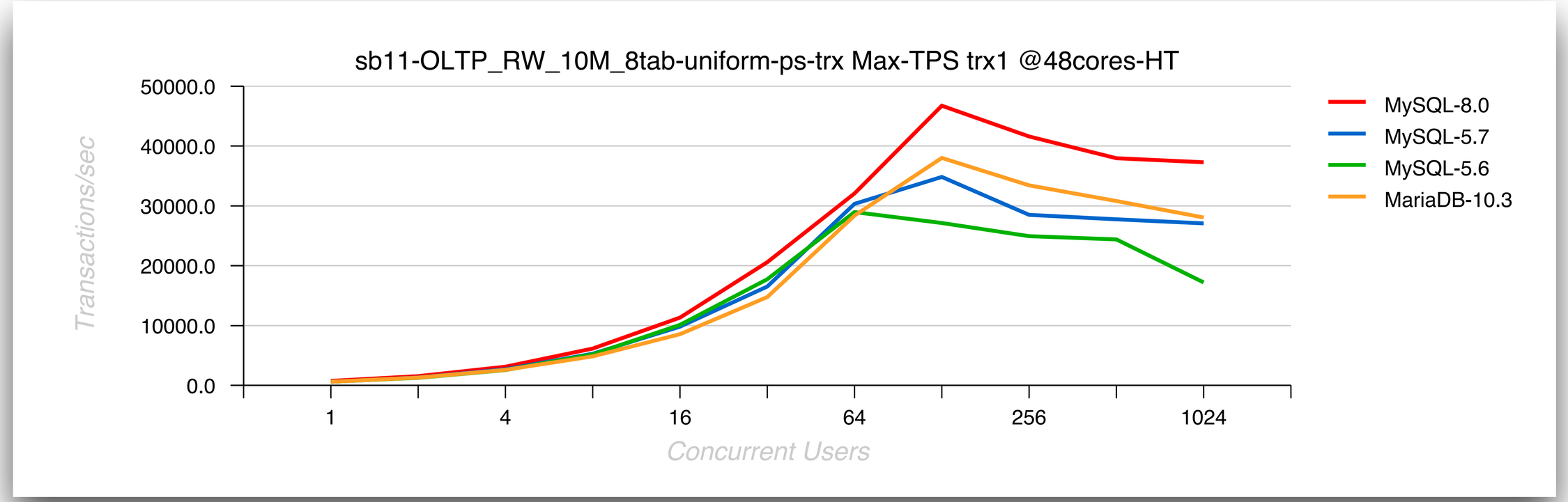


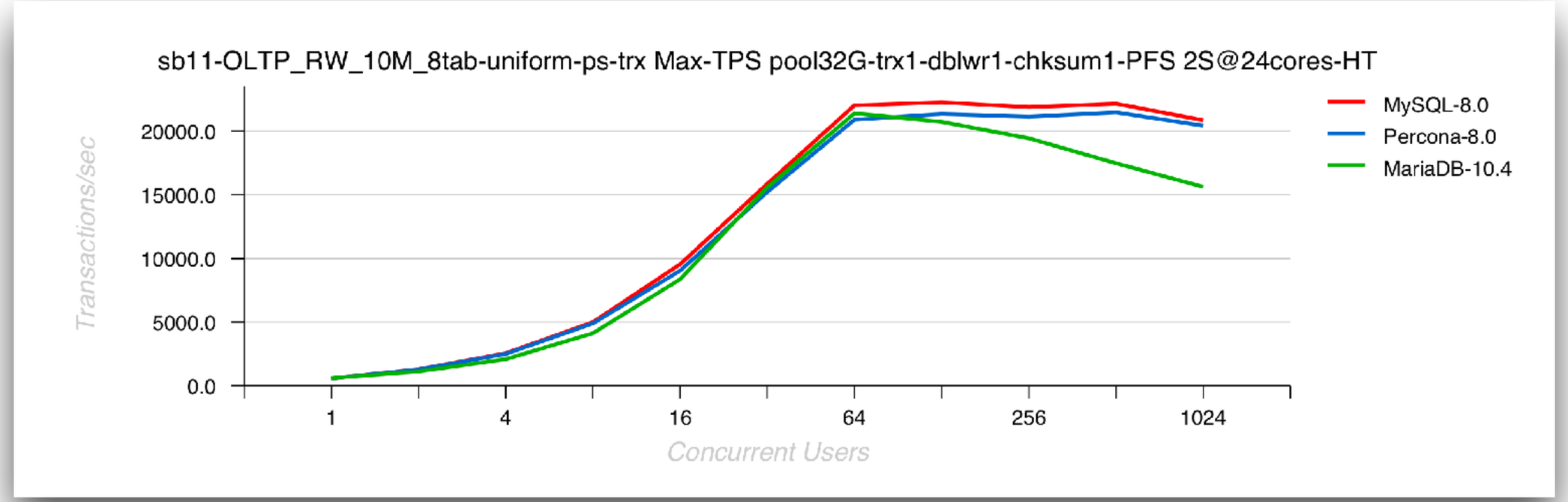
OLTP_RW latin1 @MySQL 8.0 (Apr.2018)

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



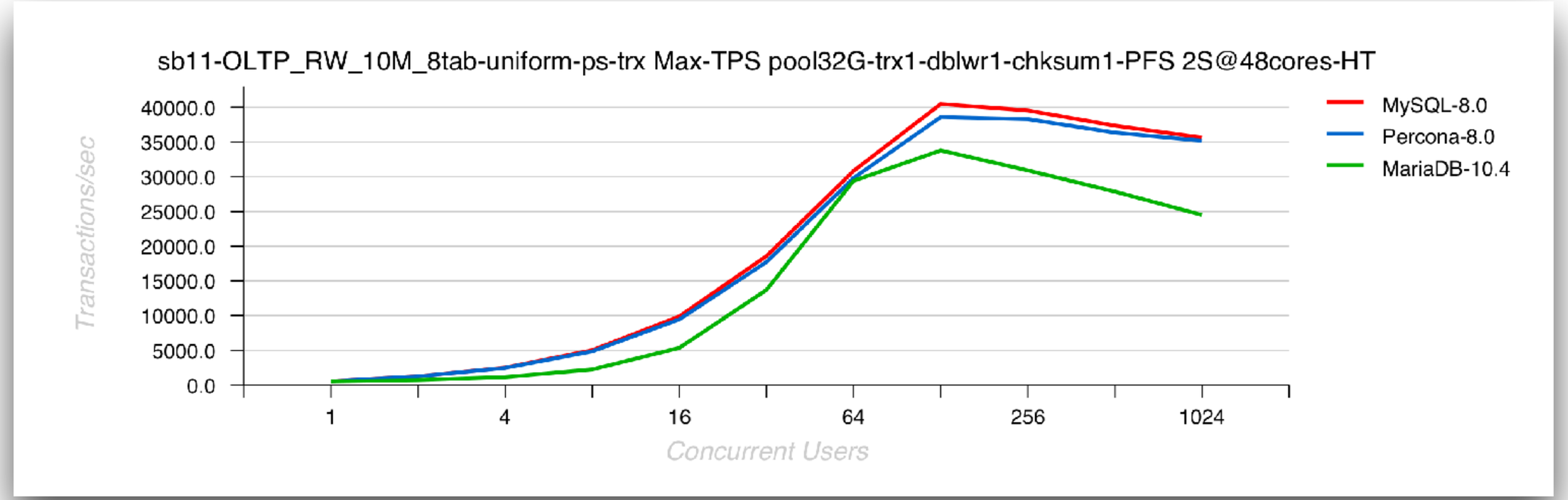
OLTP_RW latin1 @MySQL 8.0 (Sep.2019)

- Sysbench OLTP_RW 10Mx8tab, trx_commit=1
  - 2S Dell 24cores-HT 2.6 Ghz



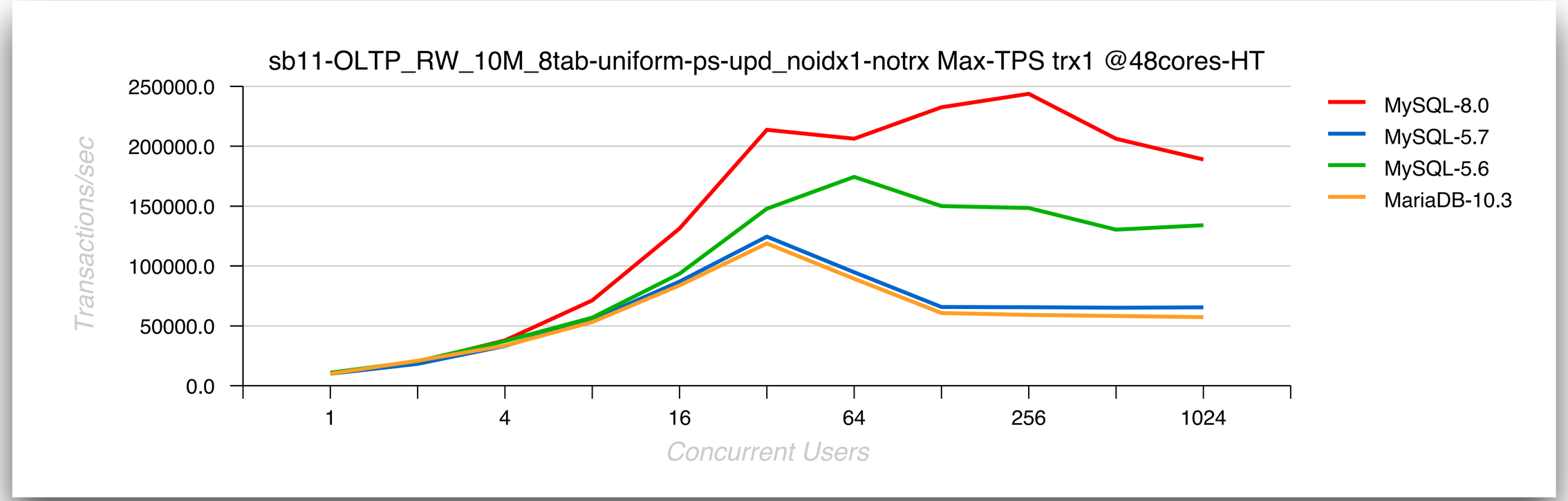
OLTP_RW latin1 @MySQL 8.0 (Sep.2019)

- Sysbench OLTP_RW 10Mx8tab, trx_commit=1
  - 2S Intel 48cores-HT Cascade Lake 2.9 Ghz



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

- **250K (!!) QPS** Sysbench Update-nokey 10Mx8tab, trx_commit=1, Skylake
  - **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..



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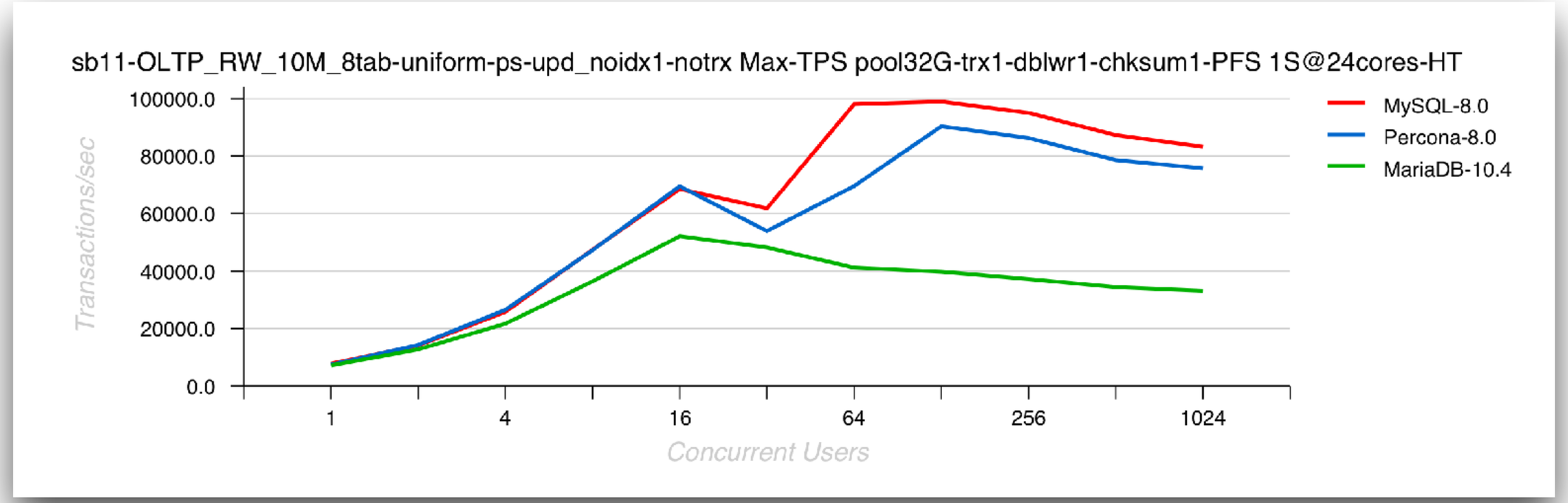

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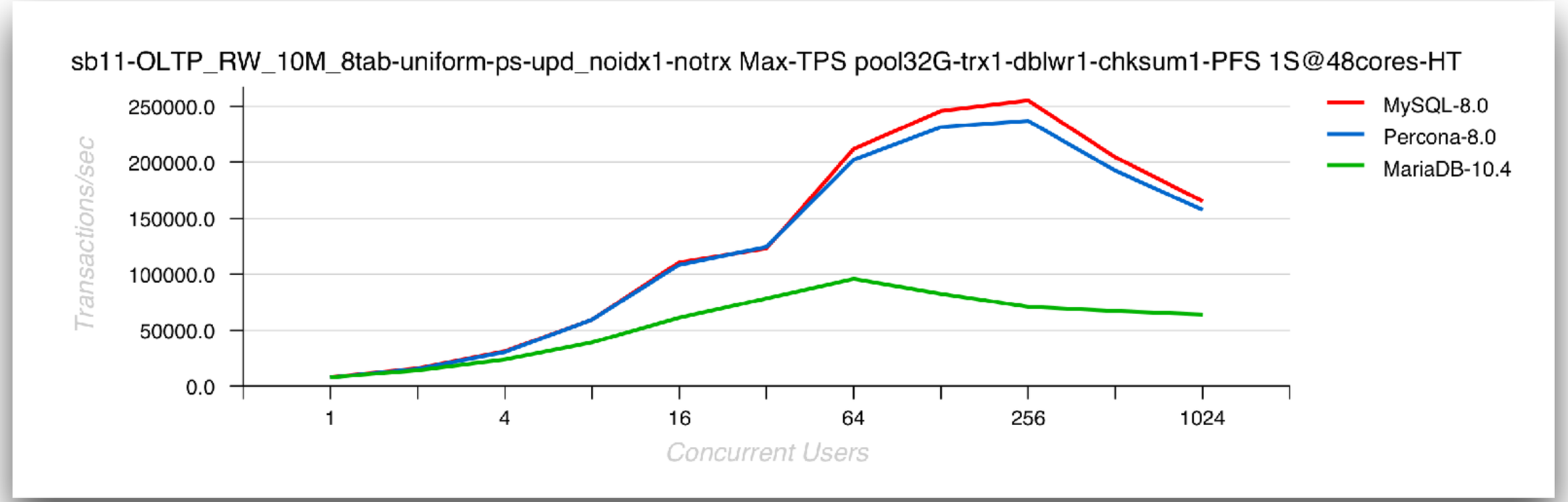


MySQL 8.0 Writes Scalability

- 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 same or 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

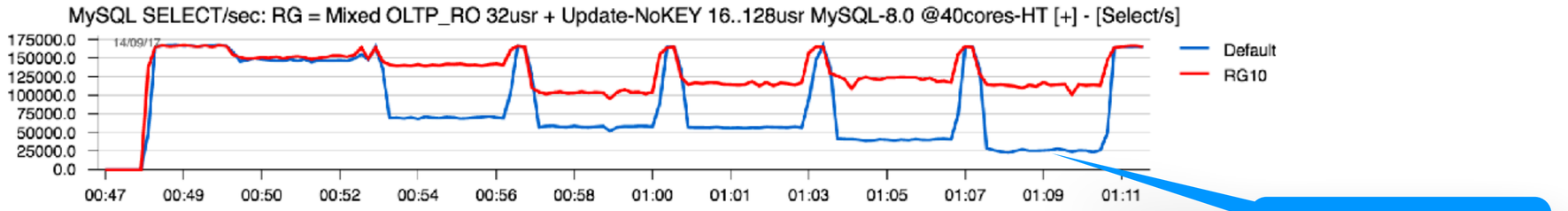
- Implementation Details :
  - currently : USER and SYSTEM groups
  - attributes : CPU (vcpu) affinity & thread priority
  - **thread priority** :
    - SYSTEM : [-19, 0] normal or **higher**
    - USER : [0, 20] normal or **lower**
- Admin :
  - permissions : none / can use / can use + admin
  - mysql> 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) */ … ;

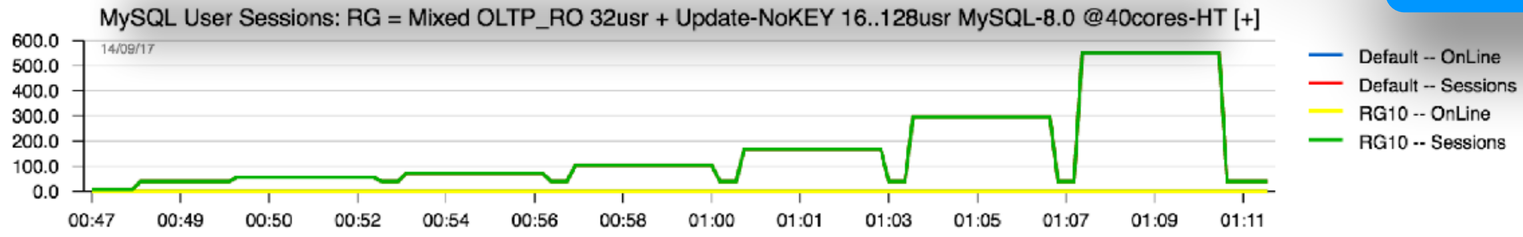
MySQL Resource Groups in Action

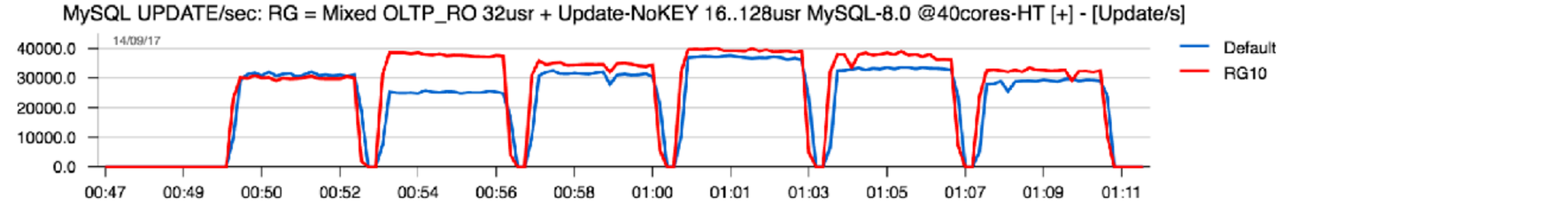
- Test case :
  - 32 concurrent users are running SELECTs
  - other users are coming with UPDATEs : 16 users, then 32, 64, 128, 256, 512..



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

Default





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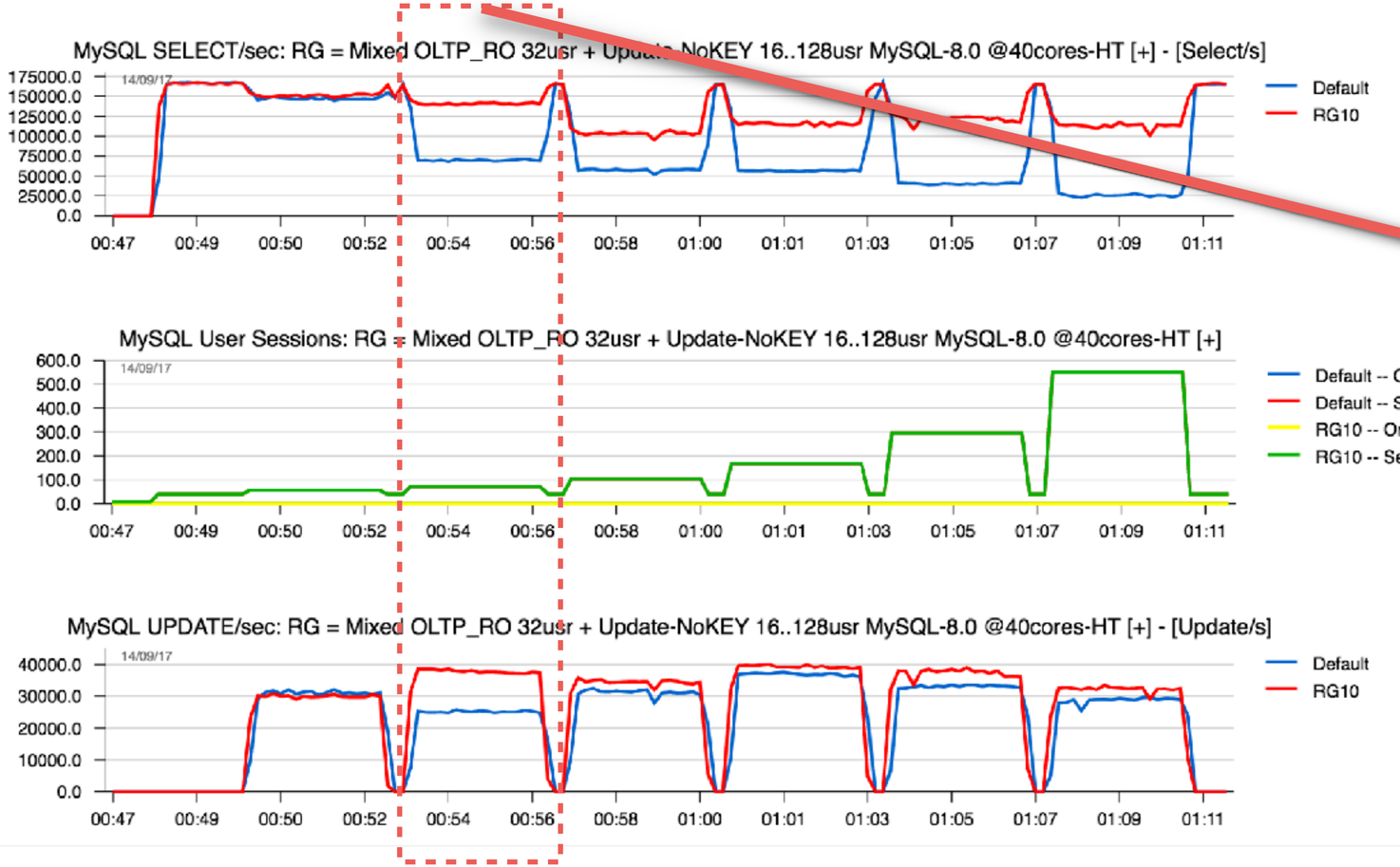

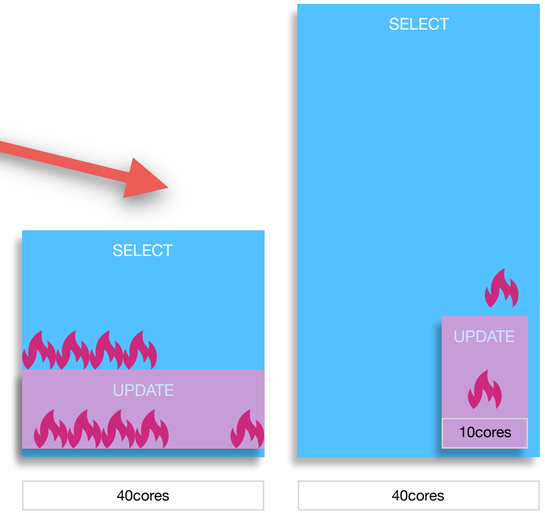

Please, attention ! the HOT stuff is coming ;-))

Pending Scalability Issues after MySQL 5.7 GA..

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

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** ;-)

Pending Scalability Issues after MySQL 5.7 GA..

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- RW :
  - REDO log related bottlenecks..
  - Double Write..
  - TRX management contentions..
  - LOCK management..
  - RR / RC isolation..
  - UPDATE Performance..
  - INSERT Performance..
  - Purge lagging..

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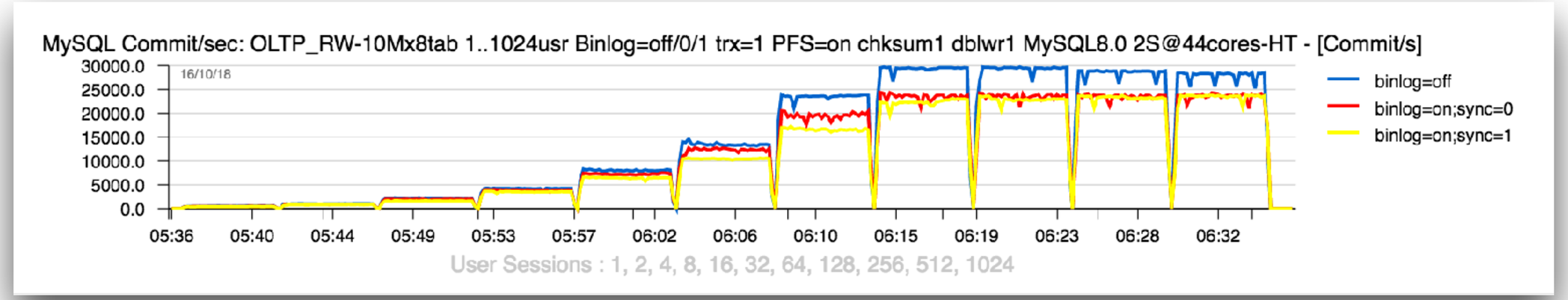
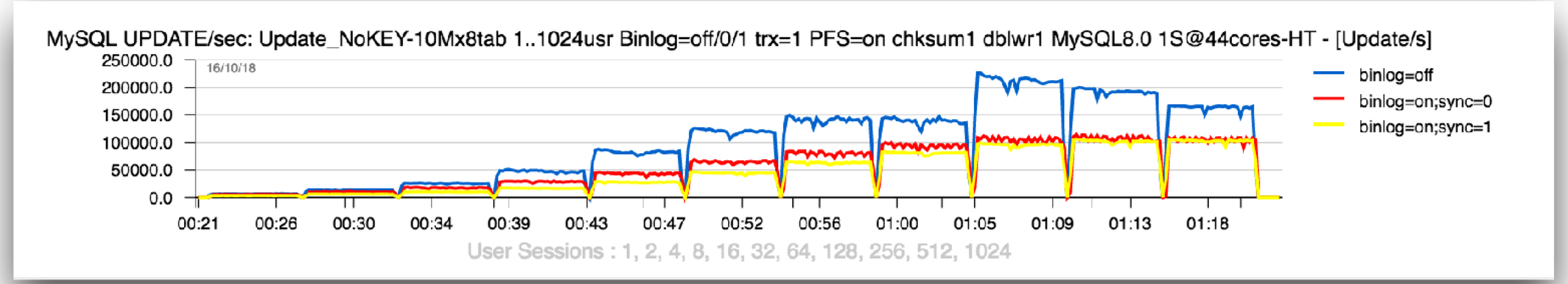
  - Block Locks <= workaround : ProxySQL Query Cache
  - Lookups via Sec.IDX <= possible workaround : use PK, AHI
  - UTF8 <= **use 8.0** ;-)
  - Global lock on every IO read <= **use 8.0** ;-)
- RW :
  - REDO log related bottlenecks.. <= **new REDO since 8.0 !!**
  - Double Write.. <= **coming soon with 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

“Binlog sucks!” (c)

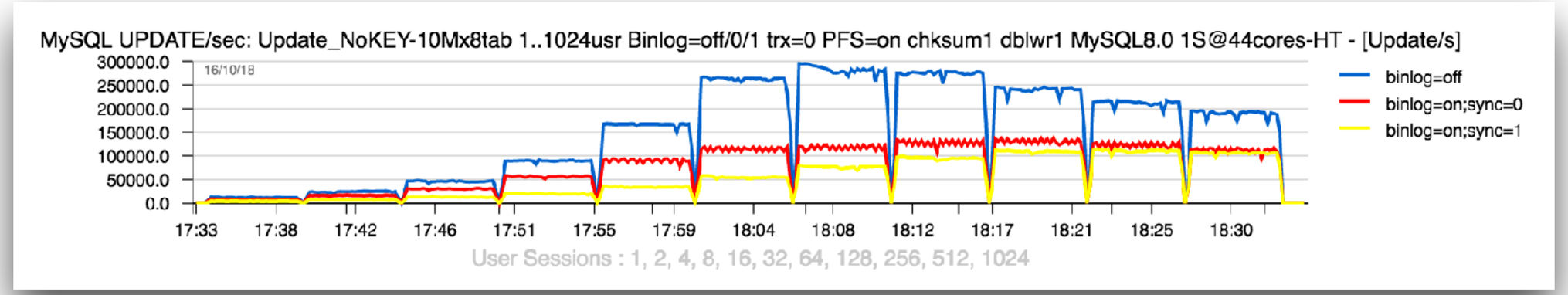
- OLTP_RW / Update_NoKEY 10Mx8tab, BP=32G
  - “yes it sucks, and we know why..” (c)
  - workaround ? … 🤔 …

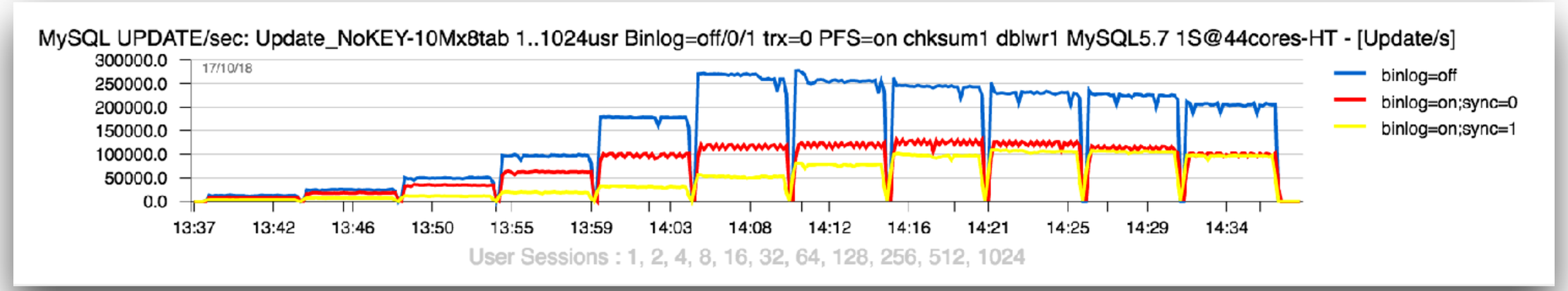




“Binlog sucks!” (c)

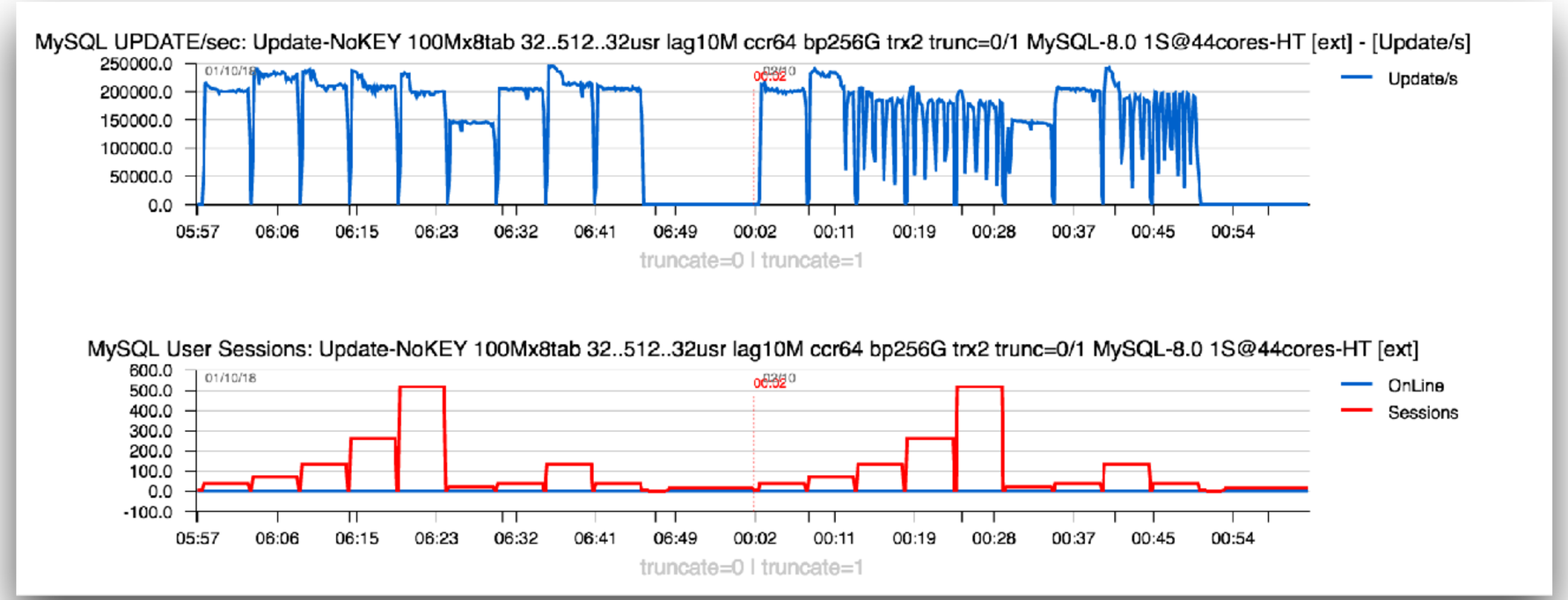
- Update_NoKEY 10Mx8tab, BP=32G
  - … and it’s not from today !
  - the same was already in MySQL 5.7 as well :





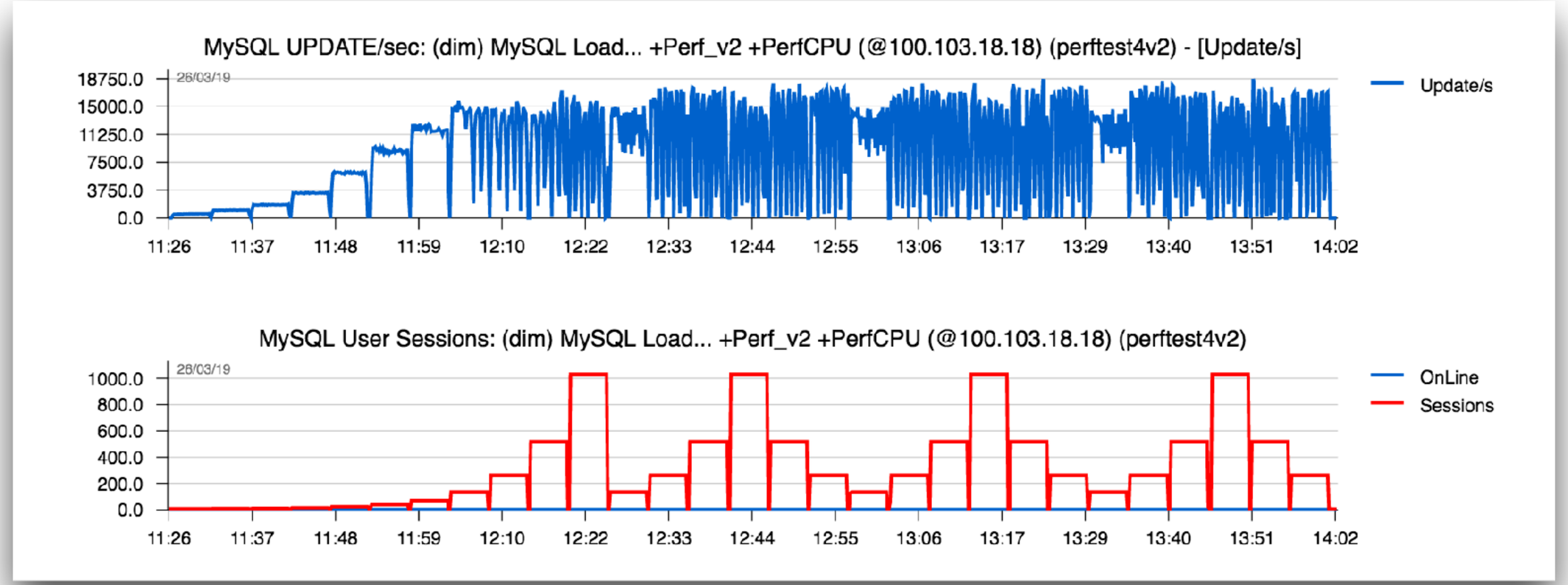
UNDO Auto-Truncate Impact

- Stalls on heavy RW activity
  - if you see it in your own workload => ping Sunny directly ! ;-))
  - workaround :
    - innodb_undo_log_truncate=off
    - and truncate manually when no user activity



Slow Storage

- Stalls on slow storage
  - REDO writes can go faster now than you write your DATA pages to disk..
  - fix : since MySQL 8.0.18 update !

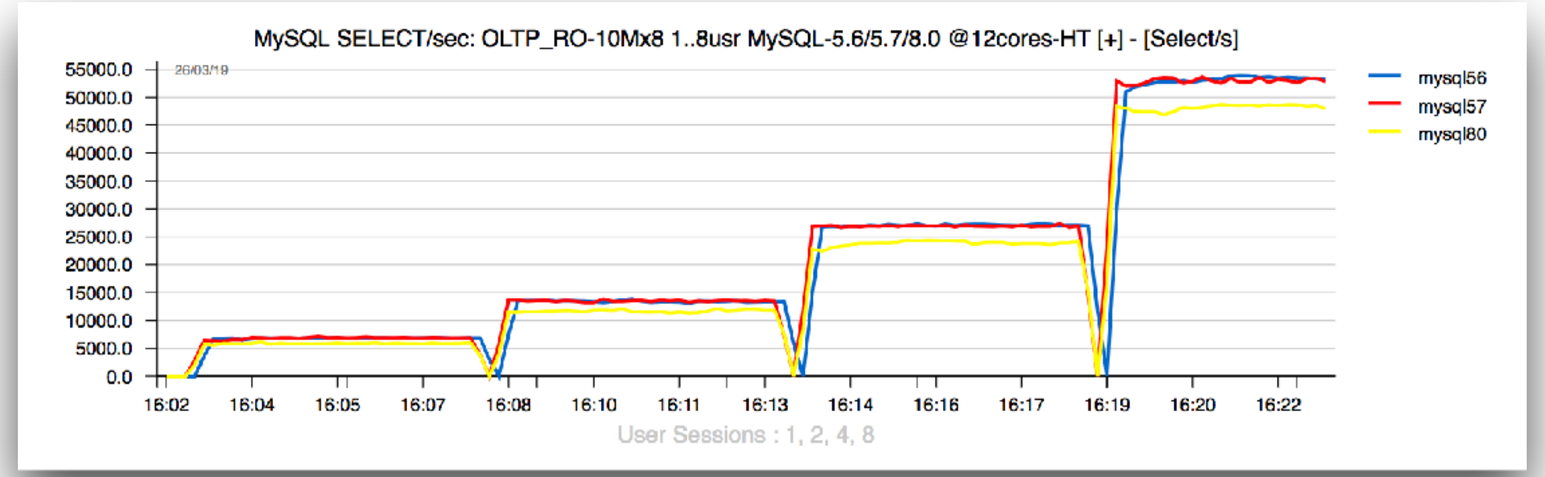


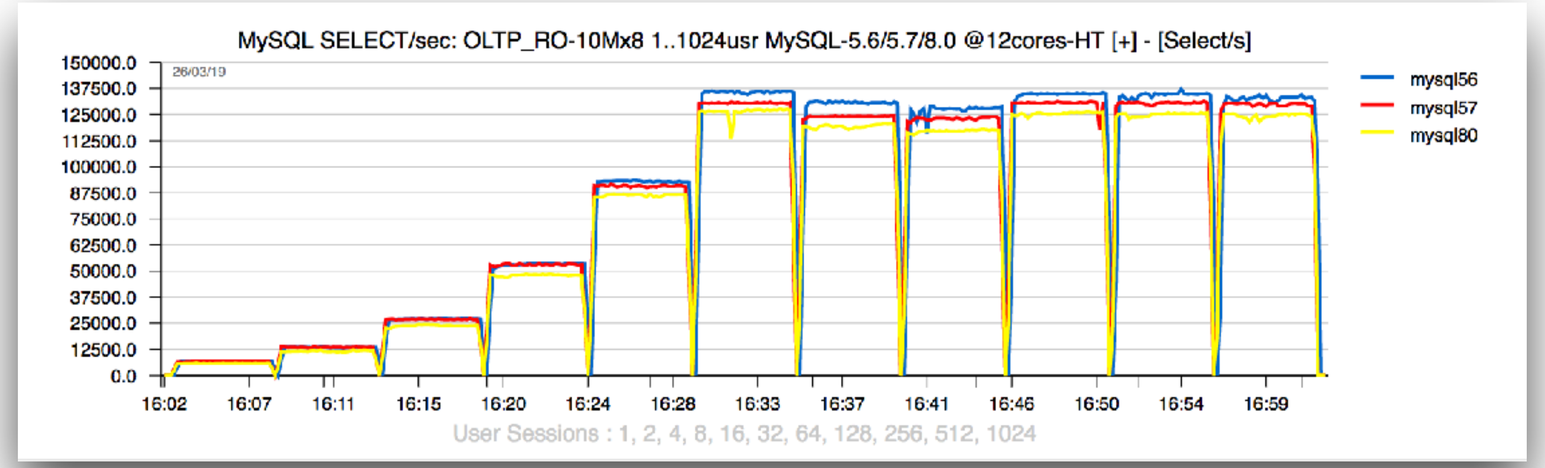
Small HW

- Unexpected Performance Regressions..
  - historically : single thread only (more new features => longer code path)
  - currently : **even on high load**..
- Looking closer :
  - Server : 12cores-HT Intel
  - Workloads (all in-memory) :
    - OLTP_RO
    - point-selects
    - OLTP_RW
    - Update_NoKEY

Small HW

- OLTP_RO 10Mx8tab-uniform latin1 :





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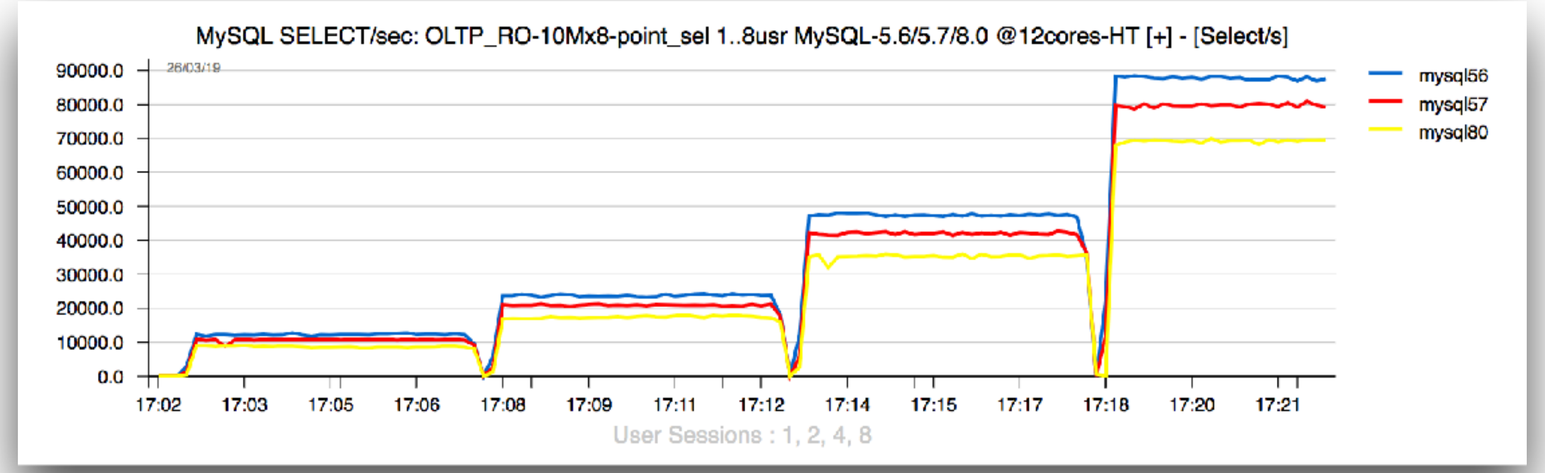
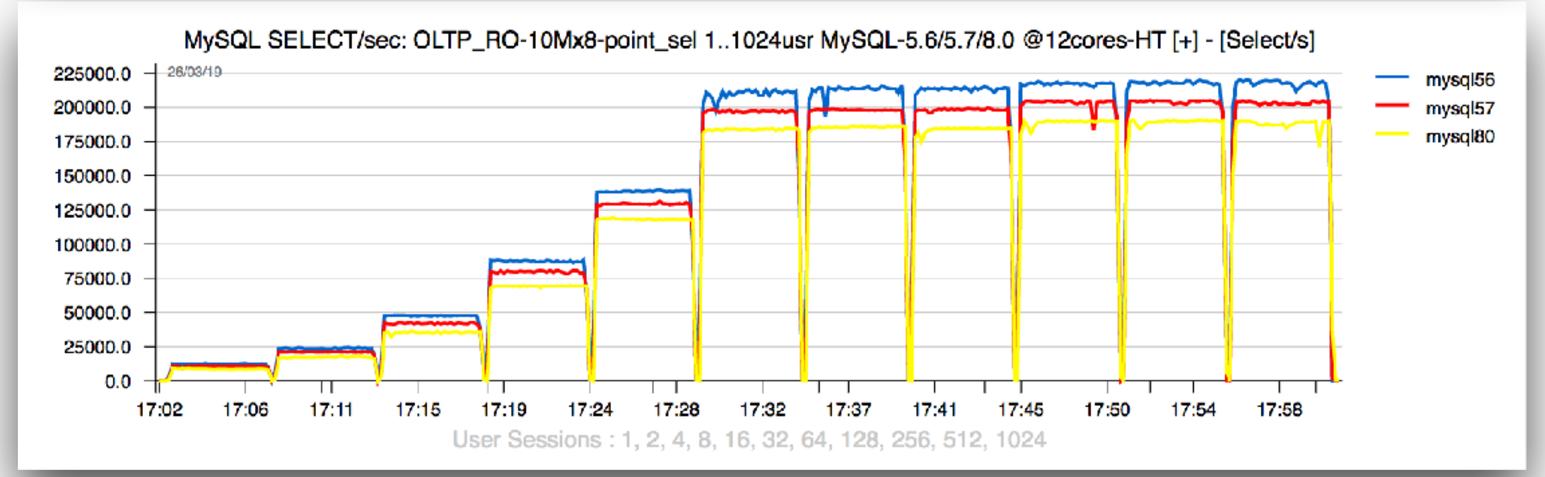
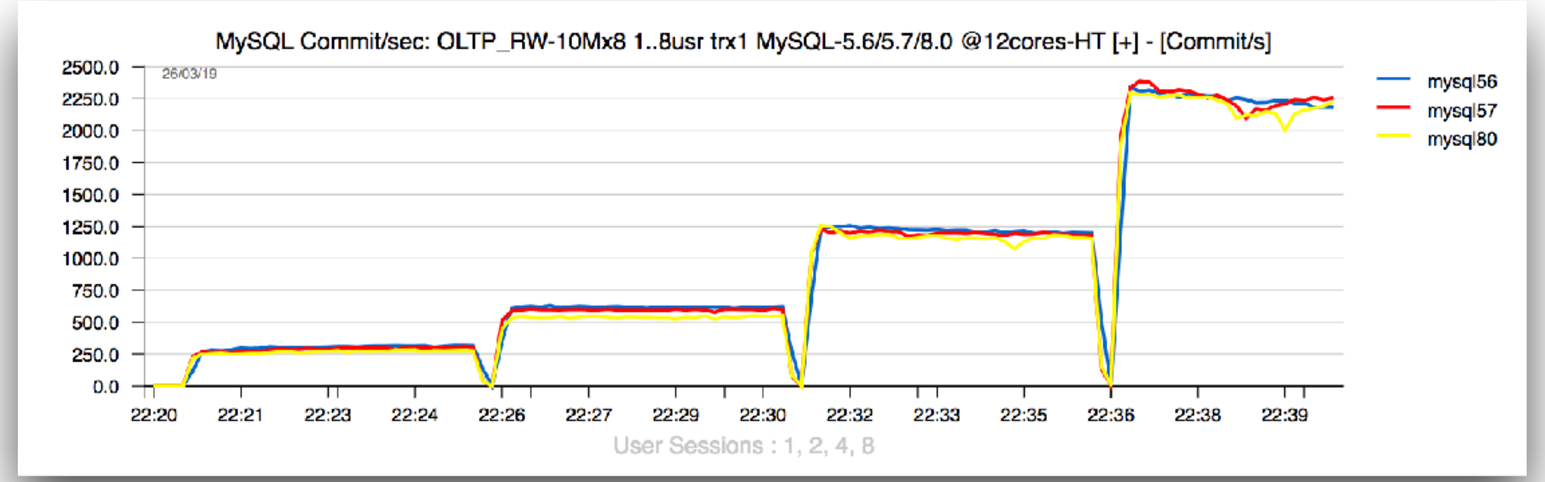
- OLTP_RO point-selects 10Mx8tab-uniform latin1 :

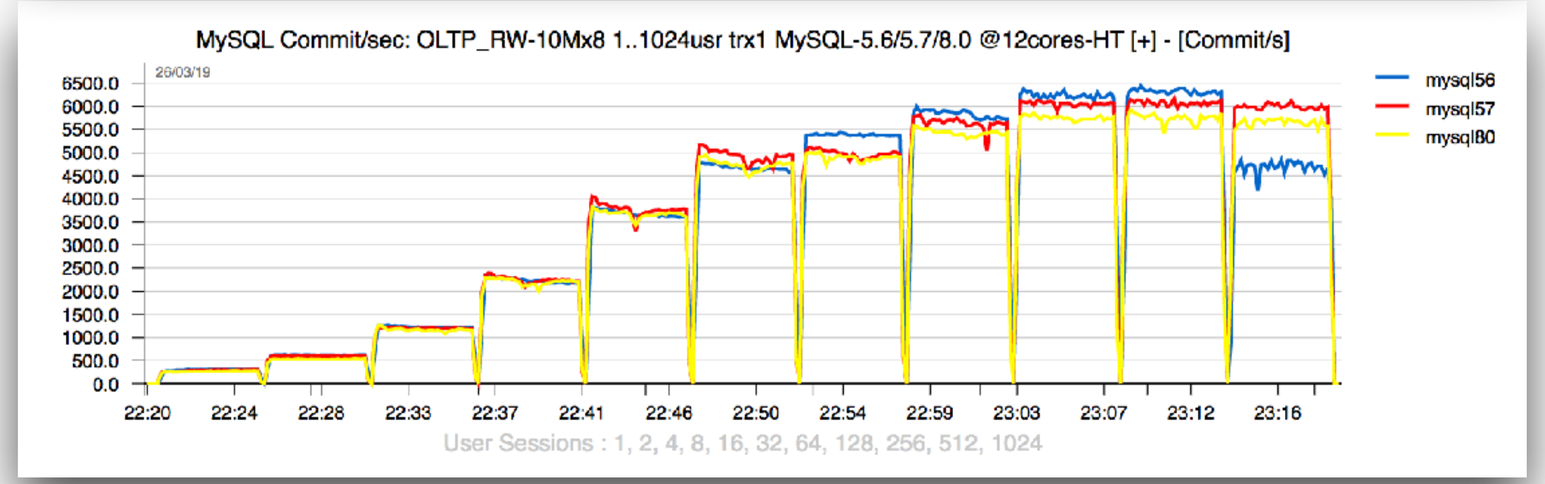




Small HW

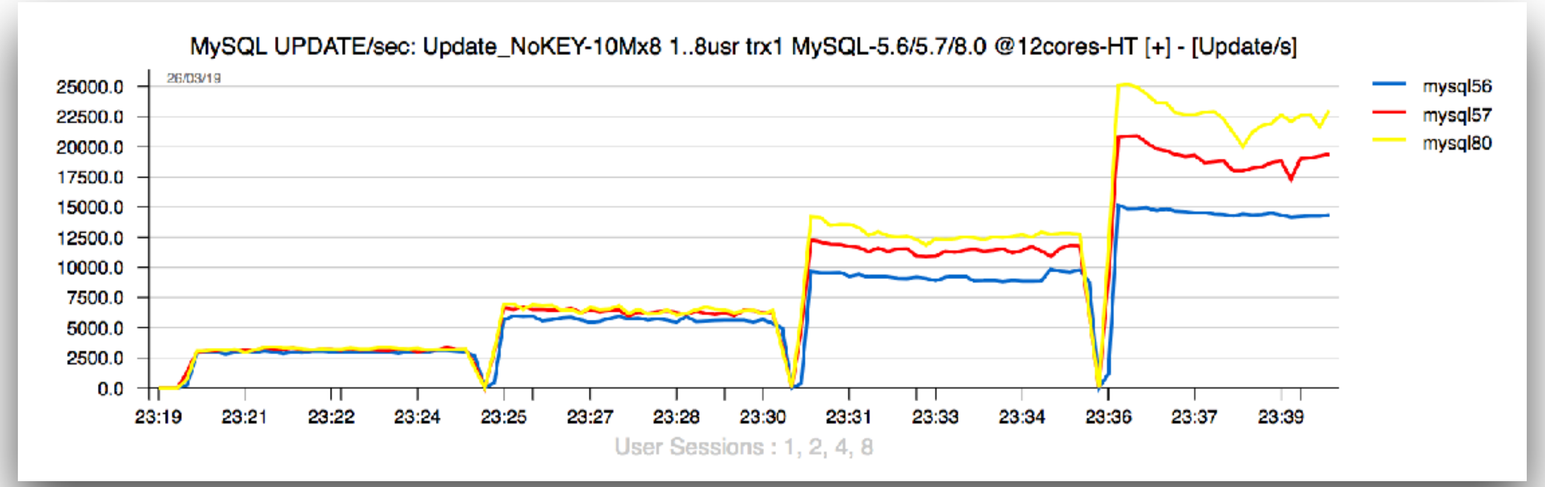
- OLTP_RW 10Mx8tab-uniform latin1 :

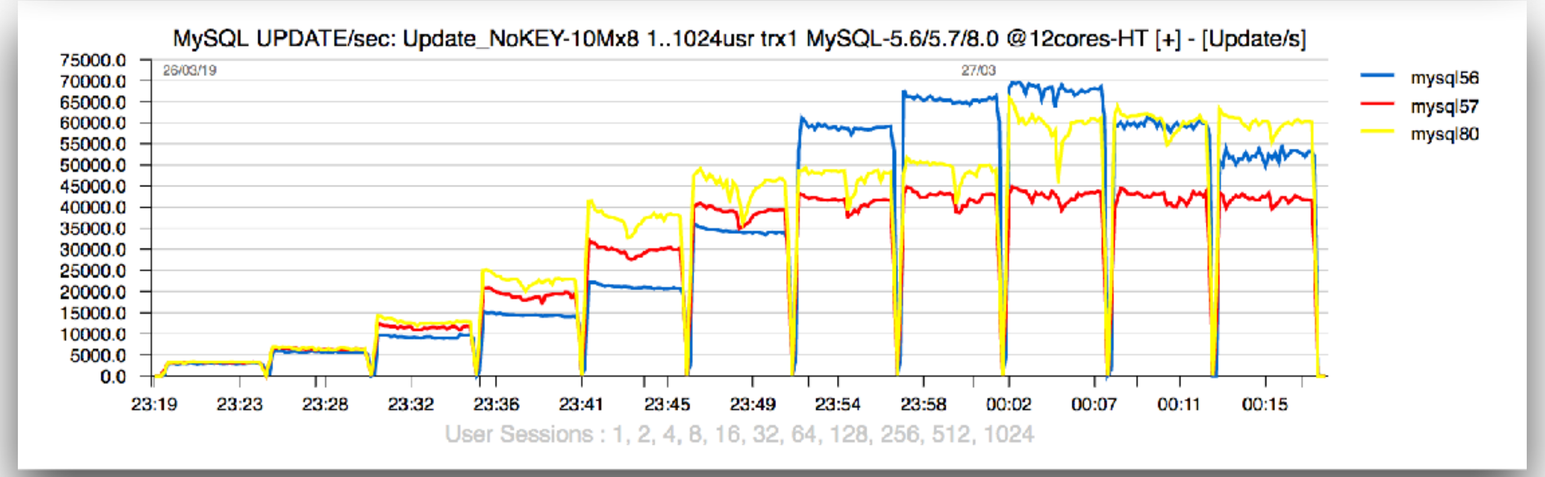




Small HW

- Update_NoKEY 10Mx8tab-uniform latin1 :





Small HW

- Unexpected Performance Regressions..
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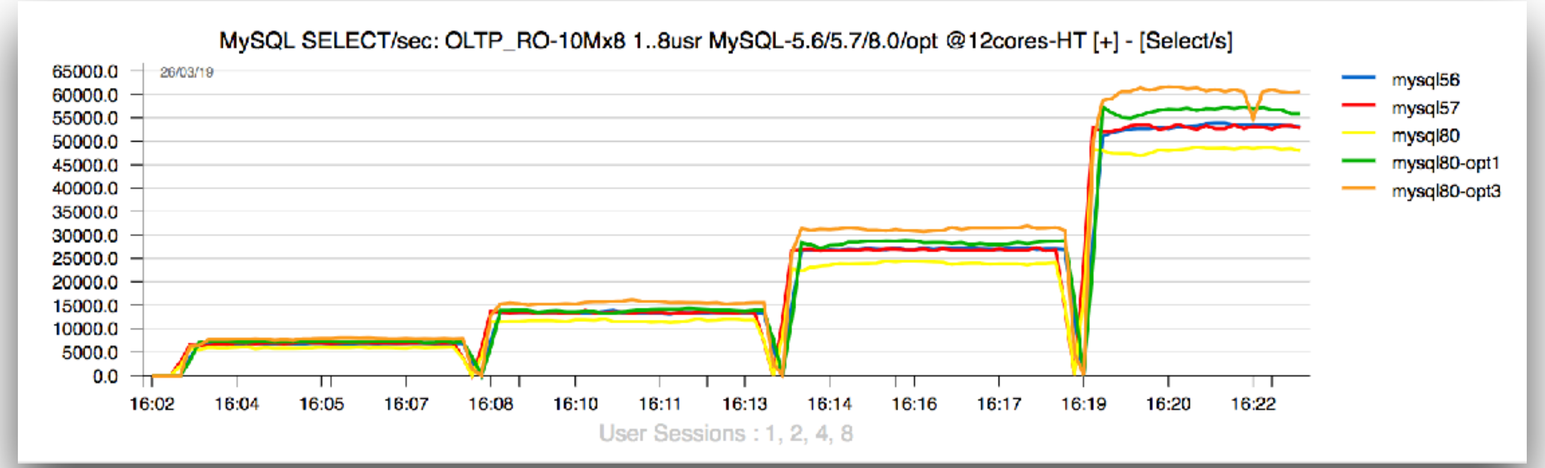
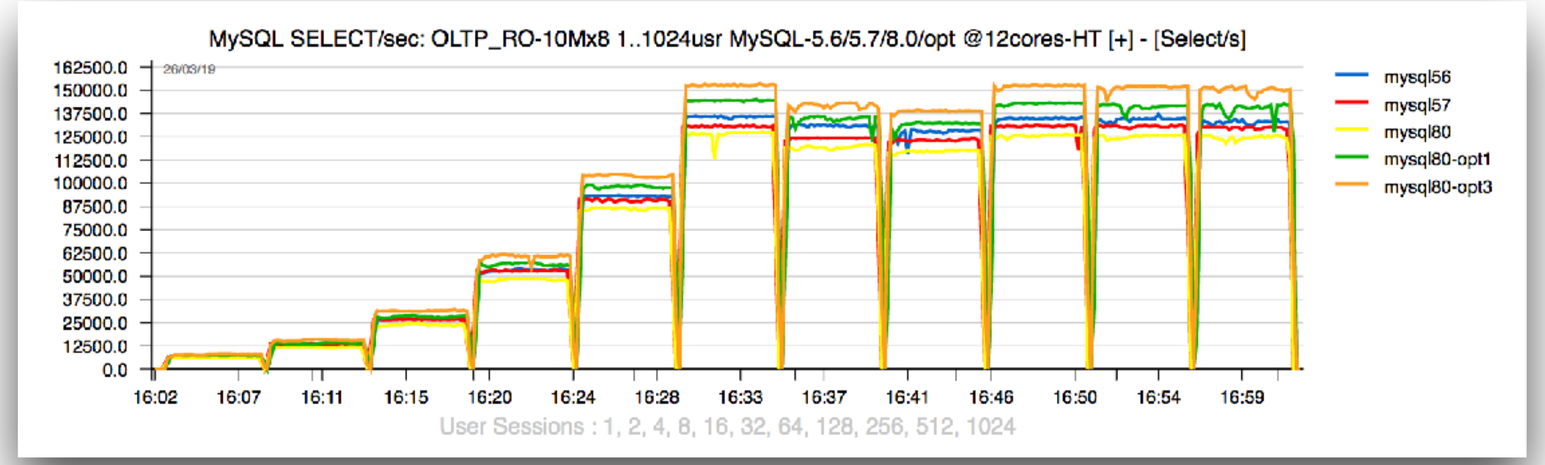
  - Server : 12cores-HT Intel
  - Workloads (all in-memory) :
    - OLTP_RO
    - point-selects
    - OLTP_RW
    - Update_NoKEY
- So, **WHY** ???
  - the story is no more about longer code path..
  - the story is about bigger and bigger amount of instructions in binary (and icache miss) !
  - solution : optimize the MySQL 8.0 binary itself !
  - with strong collaboration with Oracle Linux Team ! (KUDOS Karsten !!! ;-))

Small HW

- OLTP_RO 10Mx8tab-uniform latin1 + optimized :





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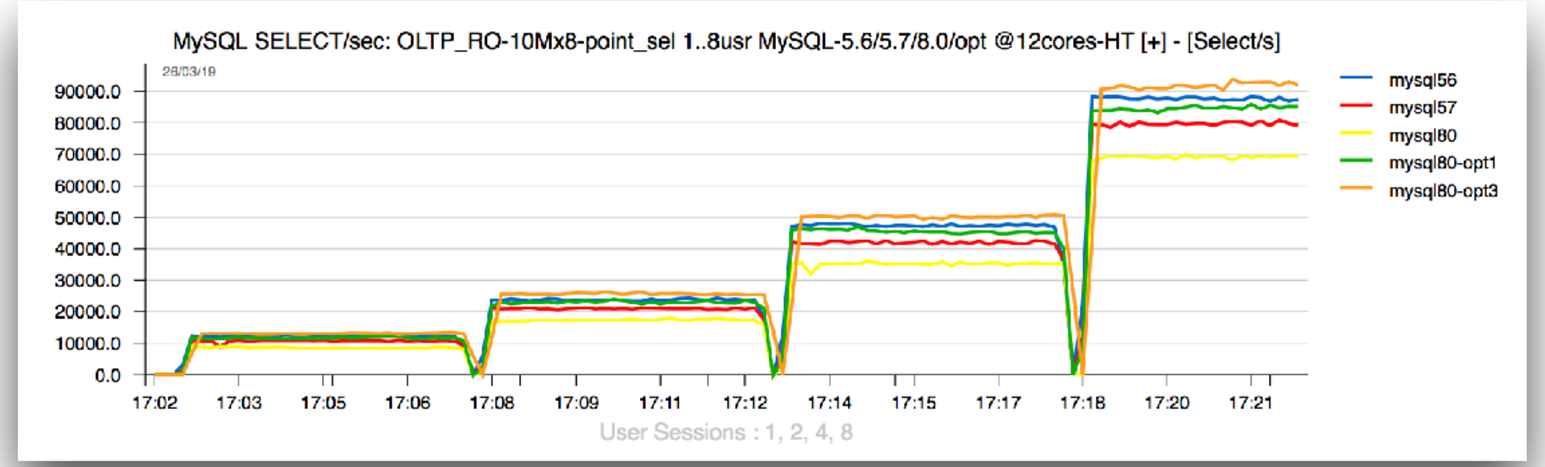
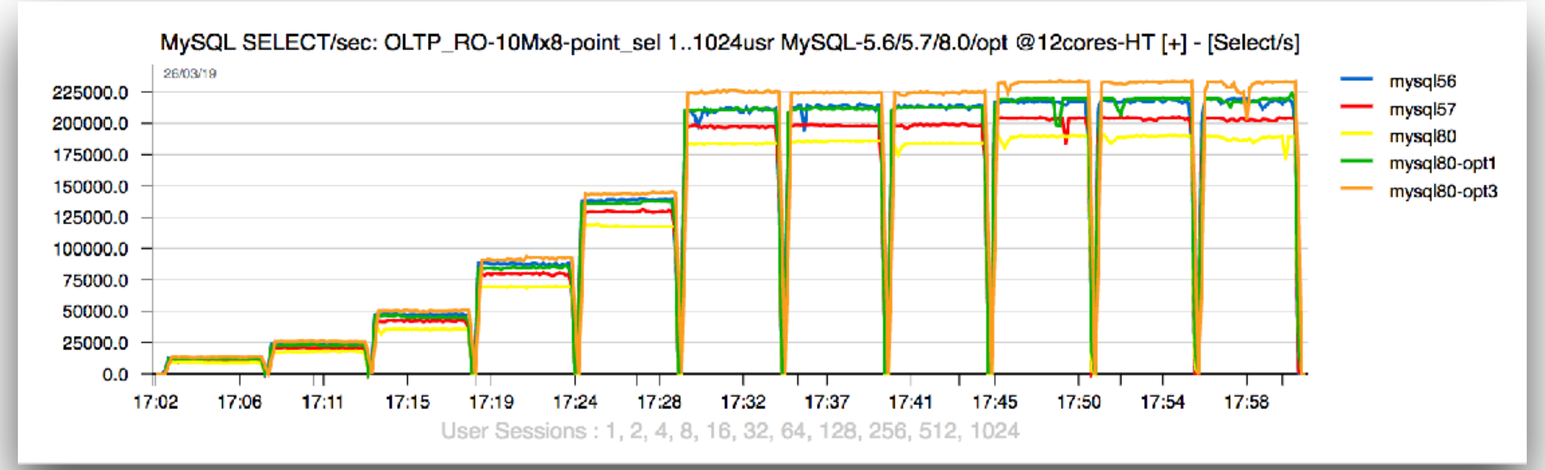
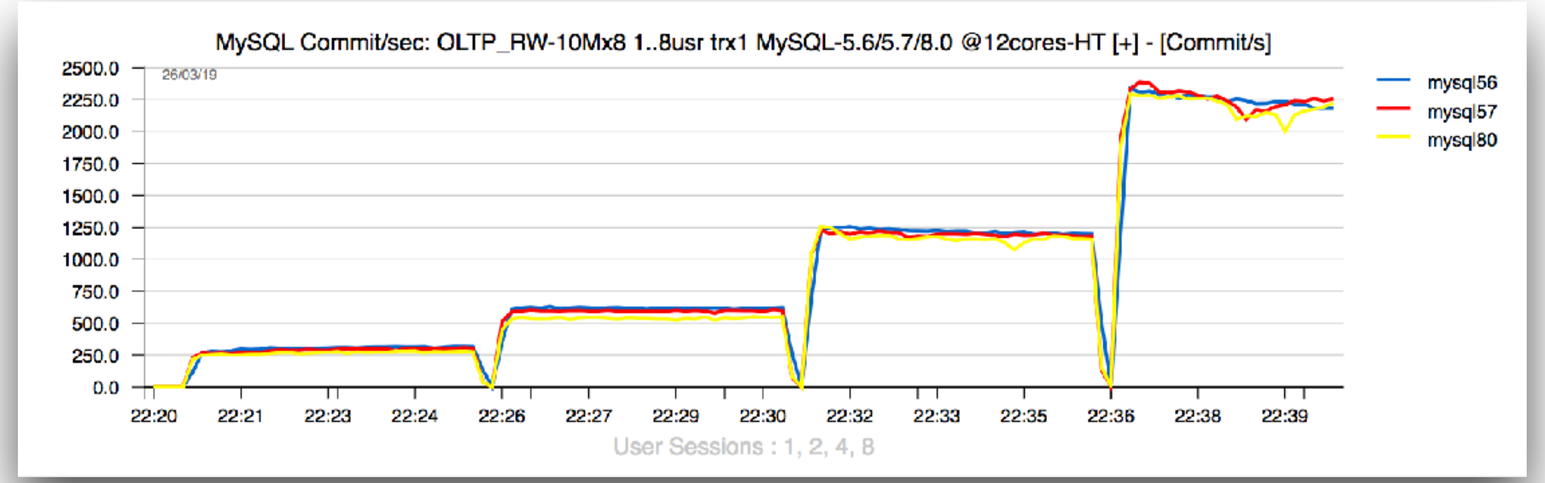
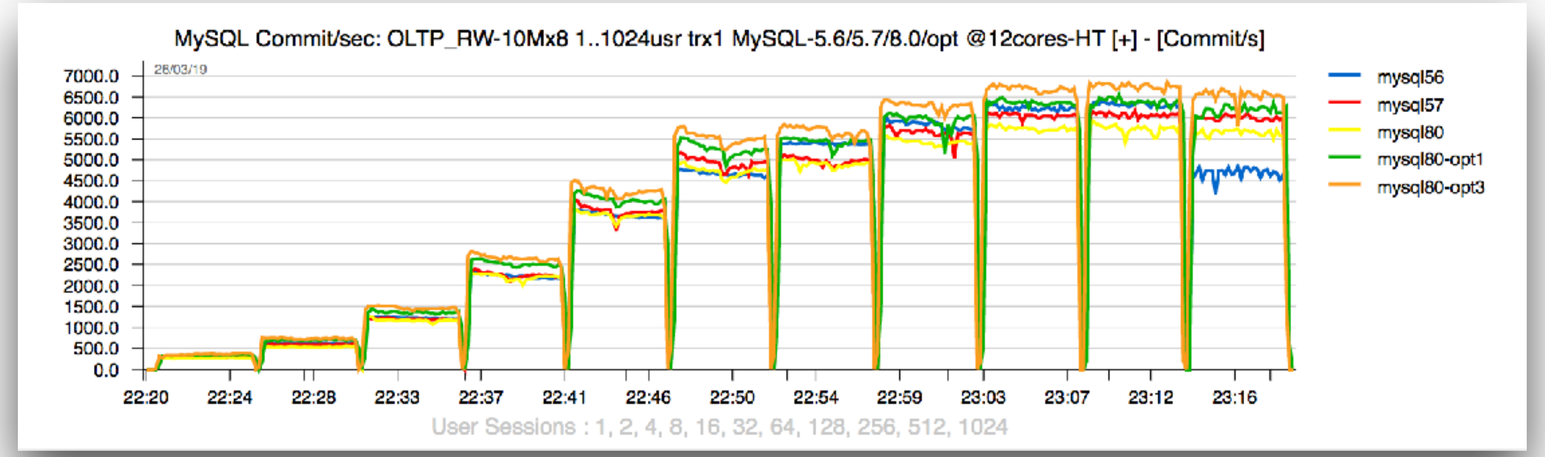




Small HW

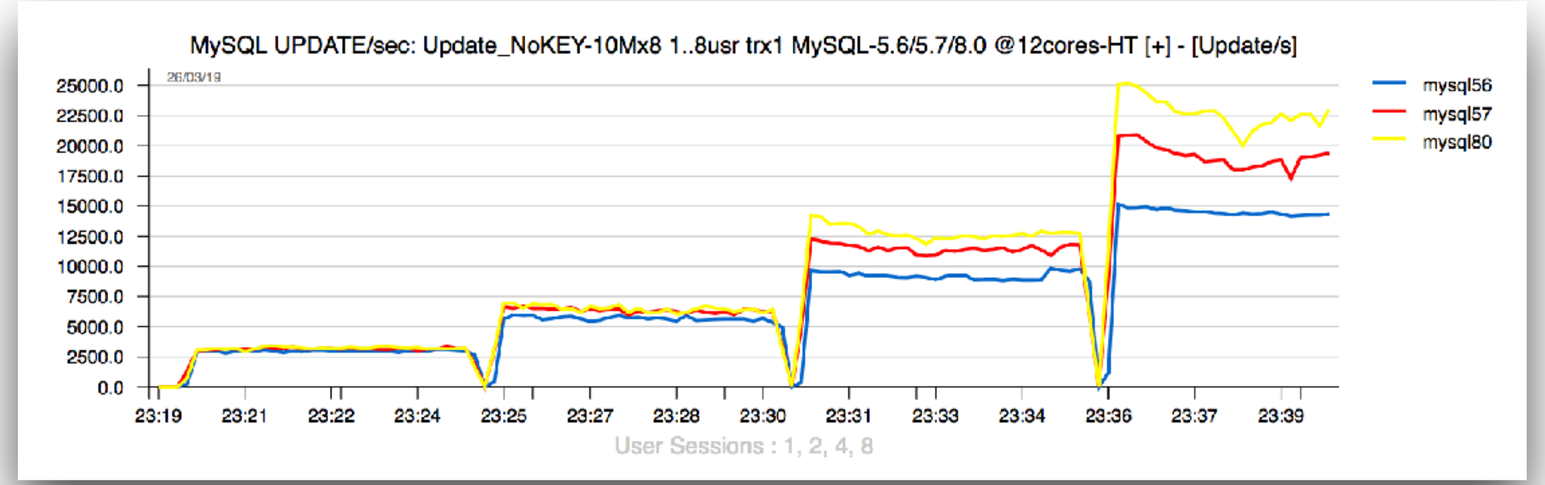
- OLTP_RW 10Mx8tab-uniform latin1 + optimized :

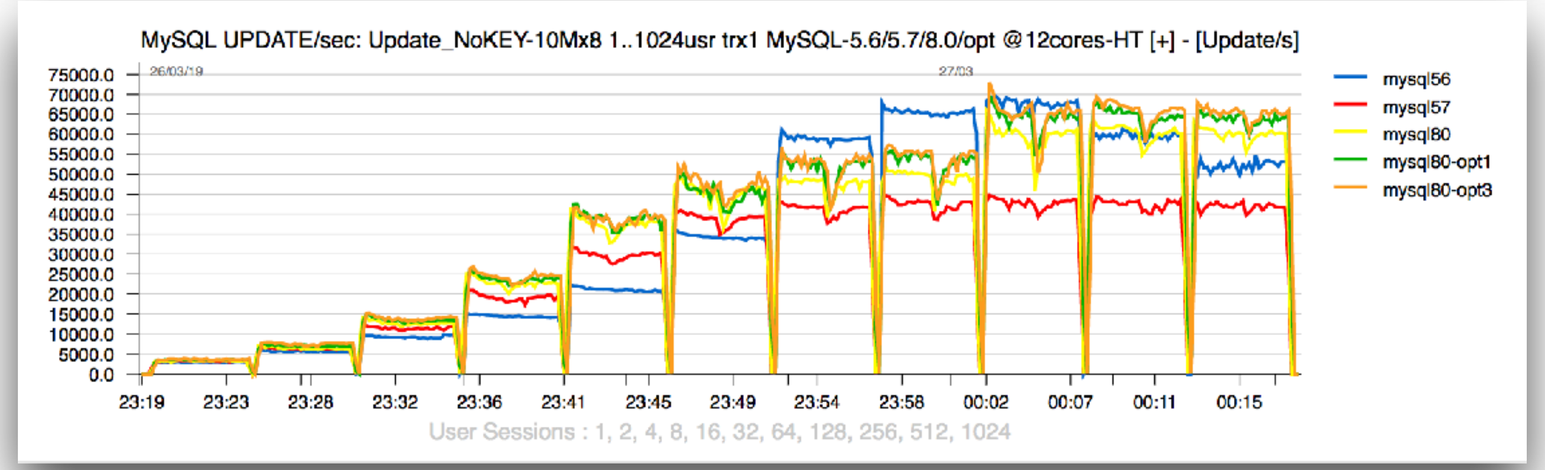




Small HW

- Update_NoKEY 10Mx8tab-uniform latin1 :





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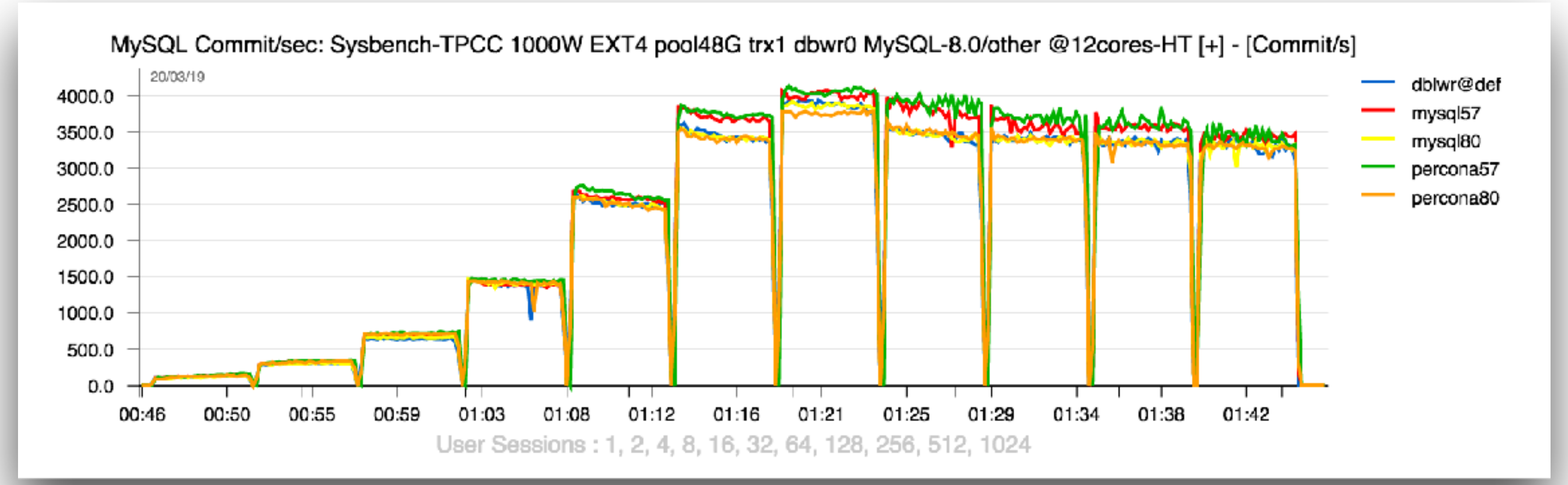
InnoDB Double-Write (DBLWR) Saga..

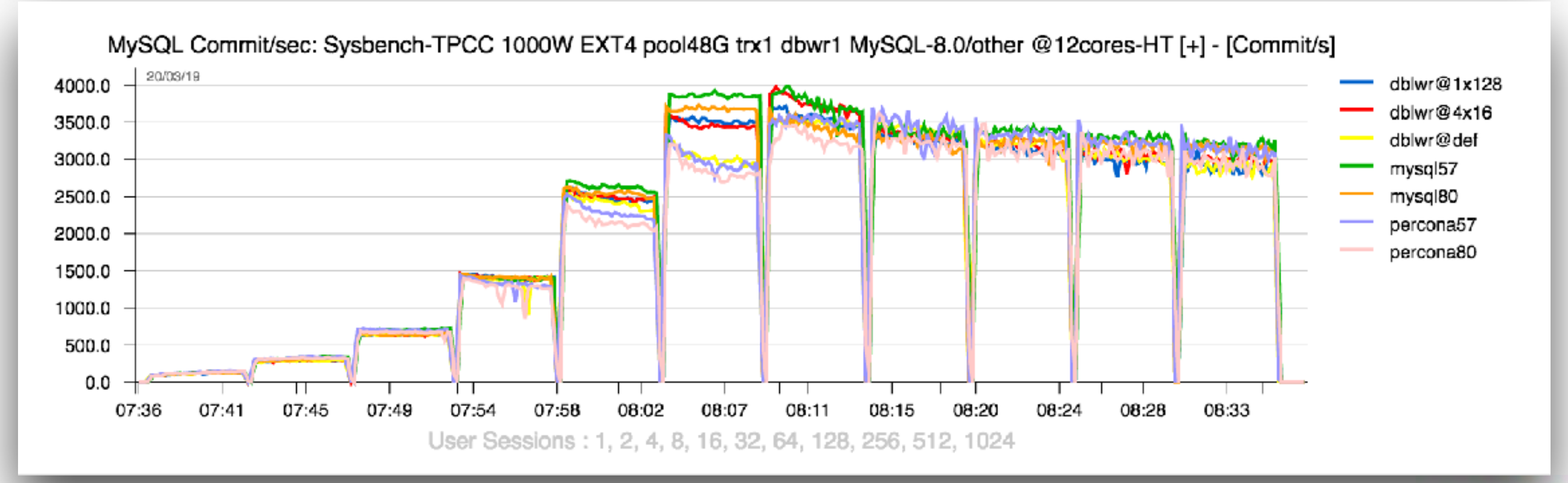
- DBLWR impact :
  - In-Memory Workloads : if page writes can follow => zero impact ! (background activity)
  - IO-bound Workloads :
    - NOTE : you have to Write before you can Read !
    - so, mostly no impact on low load
    - but huge impact on high load (due internal DBLWR contention)
- Percona
  - delivered their own new DBLWR for Percona-5.7
- MySQL
  - first new improved DBLWR was ready for MySQL 5.7, but missed GA timeframe..
  - MySQL 8.0 : continuous delivery !
  - Aug.2018 => new DBLWR is ready for MySQL 8.0 (and doing better than Percona)
  - Oct.2018 => final validations of new DBLWR on the latest HW + latest OL7 & kernel..
    - the surprises are starting..
    - …and investigation is still in progress ;-))

InnoDB Double-Write (DBLWR) Saga..

- DBLWR impact on IO-bound TPCC_1000W @12cores-HT :
  - EXT4 dblwr=0 :

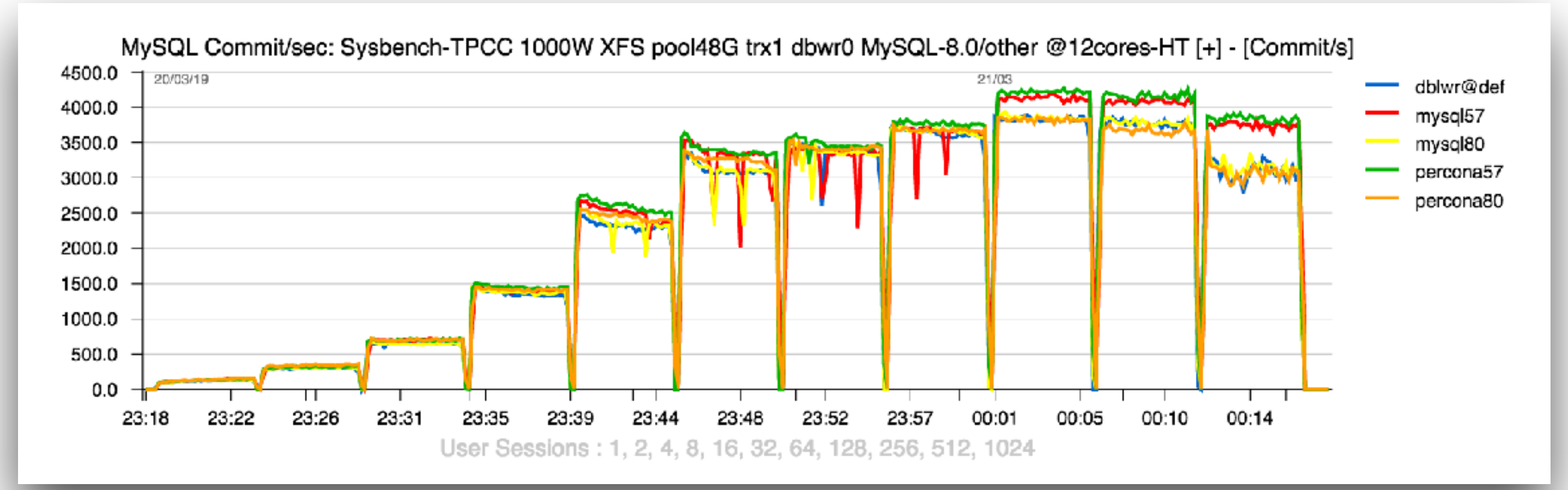


  - EXT4 dblwr=1 :

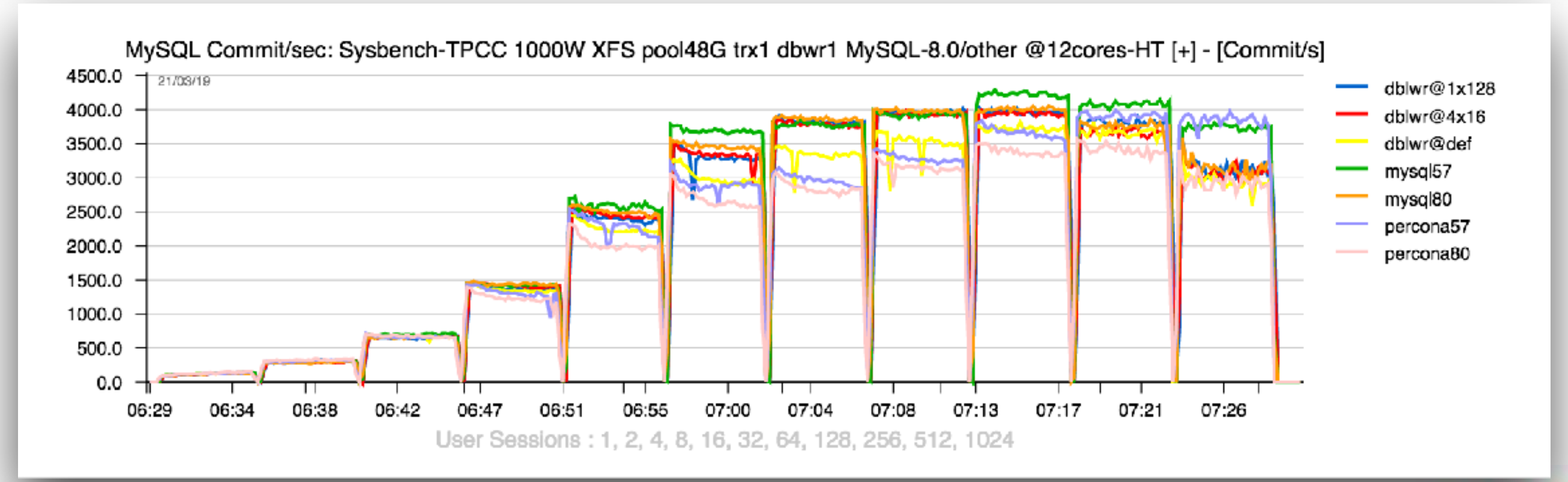


InnoDB Double-Write (DBLWR) Saga..

- DBLWR impact on IO-bound TPCC_1000W @12cores-HT :
  - XFS dblwr=0 :

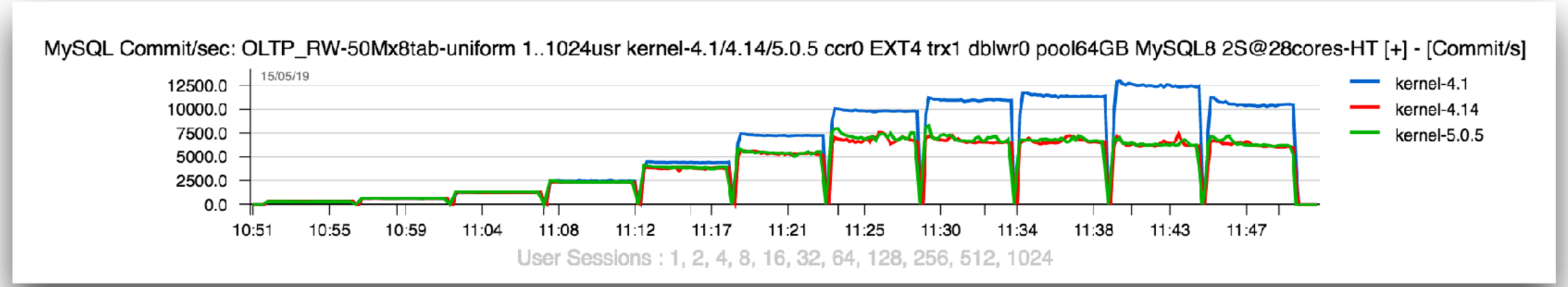


  - XFS dblwr=1 :



InnoDB Double-Write (DBLWR) Saga..

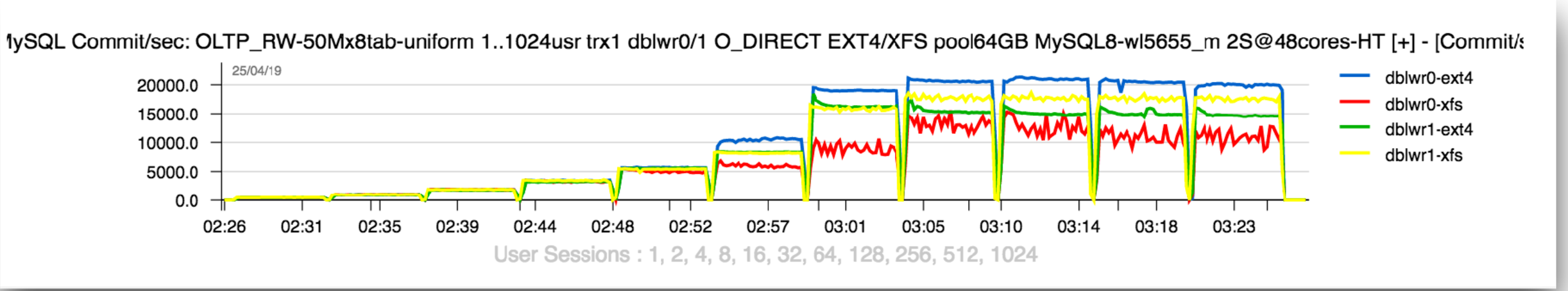
- Massive regression with EXT4 on IO-bound OLTP_RW @28cores-HT
  - Note : this is yet without DBLWR..
  - EXT4 and Linux kernels :



  - UPDATE : seems like the issue is confirmed by EXT4 devs..
  - (and also additionally similar observation on Oracle DB)

InnoDB Double-Write (DBLWR) Saga..

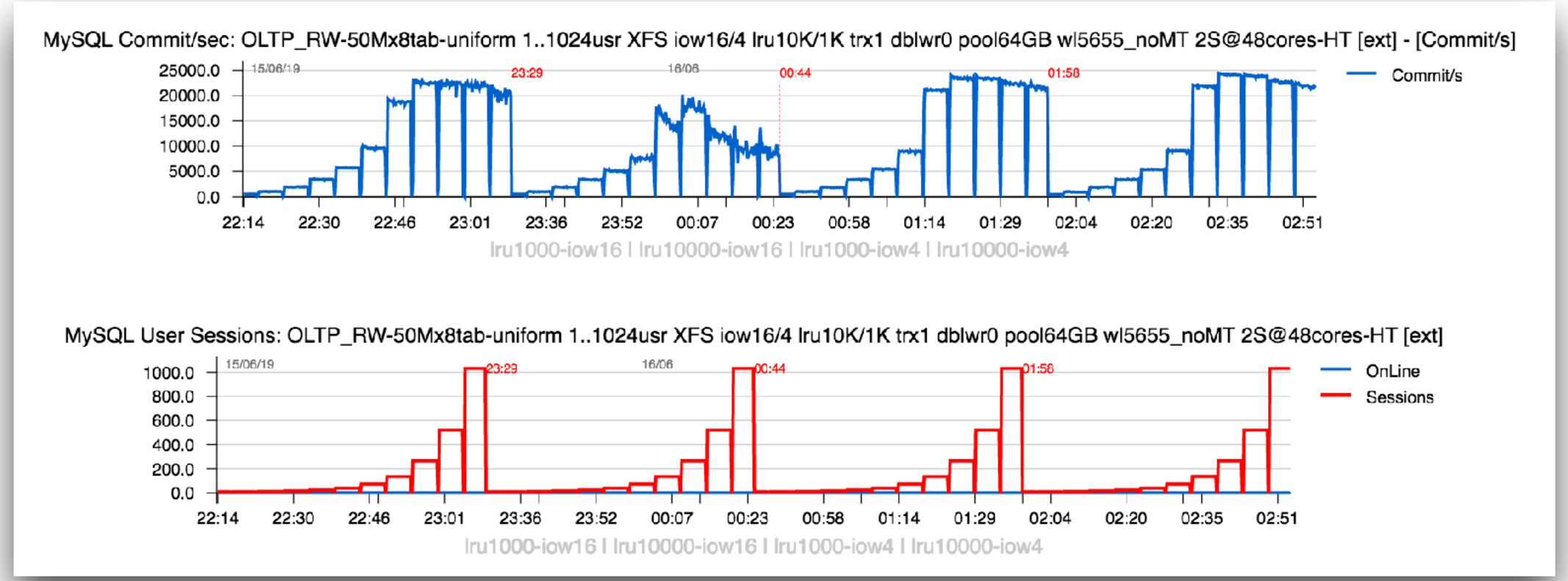
- DBLWR impact on IO-bound OLTP_RW @48cores-HT & Fast SSD :
  - dblwr=0 : EXT4 is doing better than XFS
  - dblwr=1 : XFS is doing better than EXT4
  - XFS : doing better with dblwr=1 than with dblwr=0 !!! => WTF ?..



- Still under investigation…

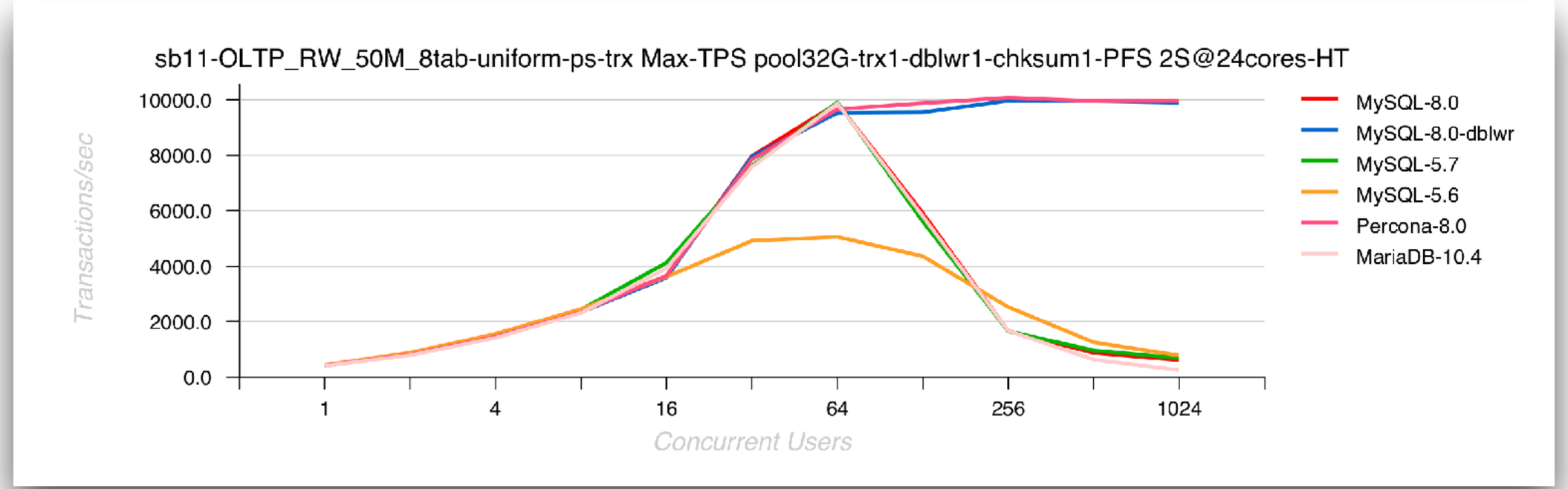
InnoDB Double-Write (DBLWR) Saga..

- XFS : DBLWR=0 on IO-bound OLTP_RW @48cores-HT & Fast SSD :
  - Workaround : lower the number of InnoDB IO Write threads !
  - iow 16 => iow 4 : clearly visible impact, but WHY ?.. ;-))



InnoDB Double-Write (DBLWR) Saga..

- IO-bound Sysbench OLTP_RW 50Mx8tab (Sep.2019)
  - Config : trx=1, dblwr=1, iow=4, pool=32G
  - 2S Dell 24cores-HT & Dell NVMe :



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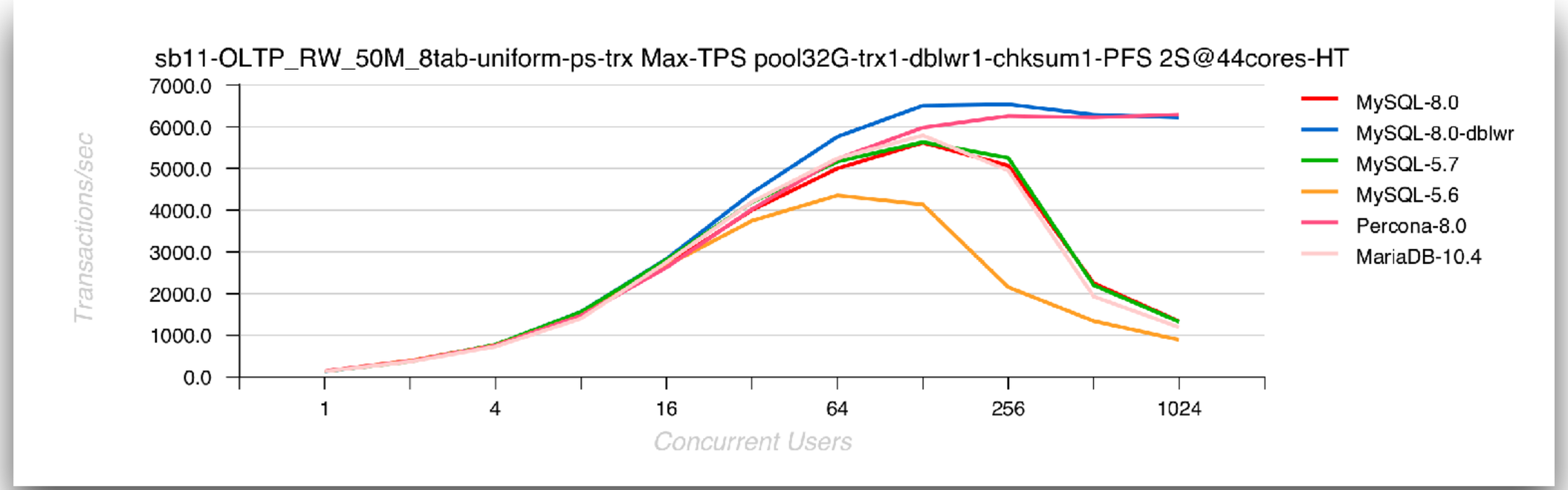
  - 2S Broadwell v4 44cores-HT & Samsung NVMe :



InnoDB Double-Write (DBLWR) Saga..

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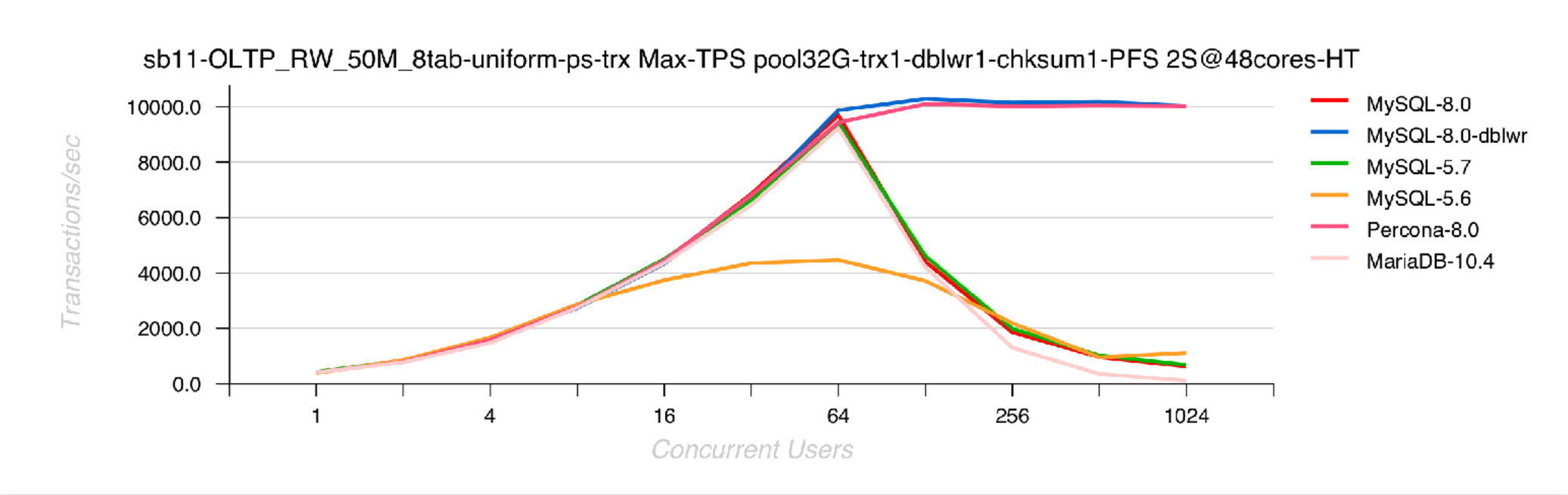
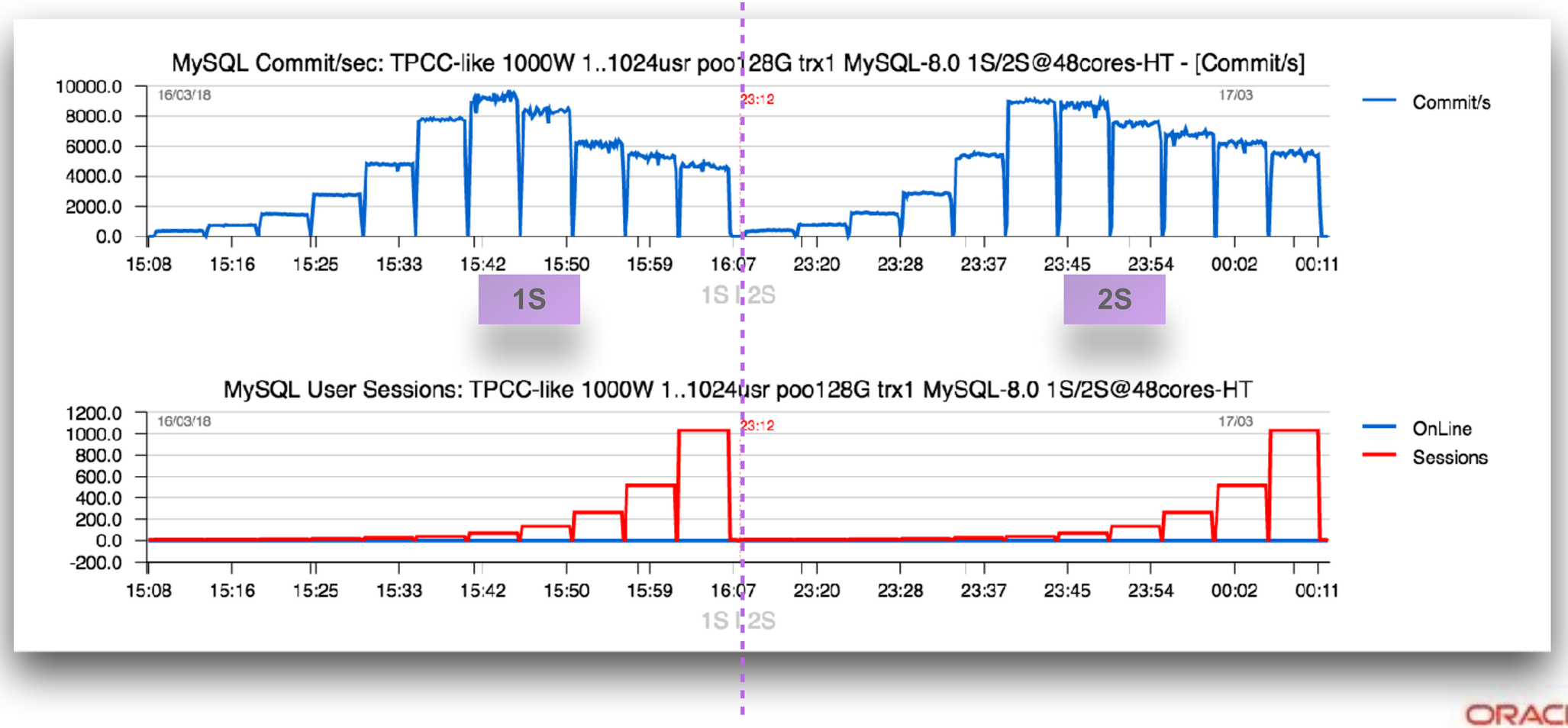
  - Config : trx=1, dblwr=1, iow=4, pool=32G
  - 2S Intel Cascade Lake 48cores-HT & 2xOptane NVMe :



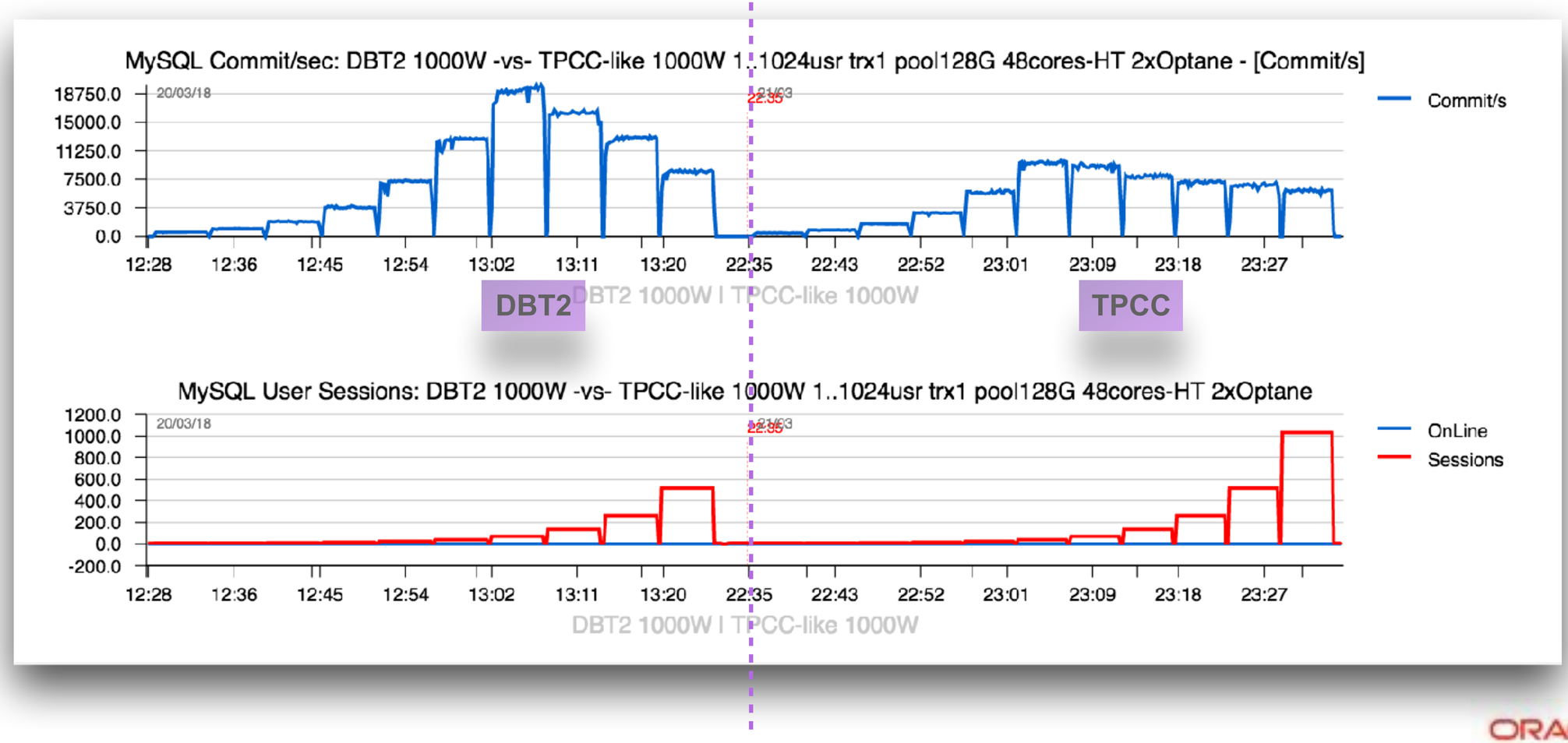
TPCC “mystery” : 1000W Workload @Sysbench-TPCC

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



TPCC “mystery” : DBT2 -vs- Sysbench-TPCC (Apr.2018)

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



TPCC “mystery” : Investigation

- Motivation
  - even if we could not “fix” index RW-lock contention in InnoDB on TPCC…
  - …but we can find a “workaround” on how to avoid it => **already a huge gain !!!**

TPCC “mystery” : Investigation

- Motivation
  - even if we could not “fix” index RW-lock contention in InnoDB on TPCC…
  - …but we can find a “workaround” on how to avoid it => **already a huge gain !!!**
- 1) Ranger (ex-MySQL, now Percona, DBT2 lover in the past ;-))
  - => who changed the DBT2 schema ???
  - => as the result : 1/2 transactions are rejected on INSERT of NULL value !!!
  - => at least it became clear why in my case DBT2 was doing better ;-))

Anything could we do with INDEX lock contention ???

TPCC “mystery” : Investigation

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  - …but we can find a “workaround” on how to avoid it => **already a huge gain !!!**
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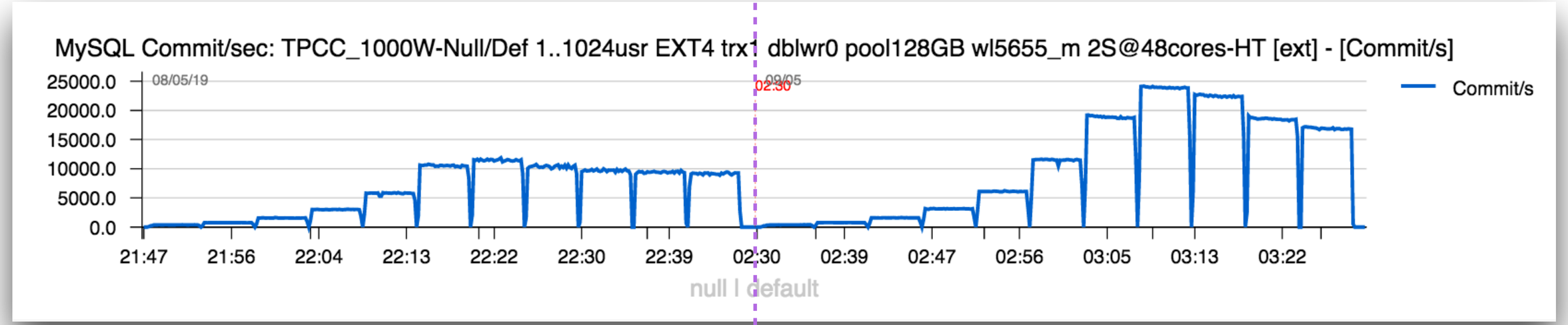
- 2) Yasufumi (ex-Percona, ex-MySQL, now MySQL again, TPCC lover ;-))
  - why INDEX lock ? => excessive page split !
  - why page split ? => …
  - TPCC : … INSERT val=NULL
  - TPCC: … UPDATE val=DATE
  - NULL => DATE => no space in page => page split !!! ;-))

TPCC “mystery” : Solution

- Workaround :
  - instead of NULL use DEFAULT (and assign an “good size” value to DEFAULT)
  - then : INSERT values(…, DEFAULT, …) /* instead of NULL */
  - then : UPDATE … var = DEFAULT … /* instead of NULL */
  - then : SELECT … WHERE var != DEFAULT /* instead of NULL */
  - and so on.. => no more page split (or very minimal)
- Final solution :
  - work in progress..

TPCC “mystery” : test results

- Sysbench-TPCC 1000W
  - NULL -vs- DEFAULT

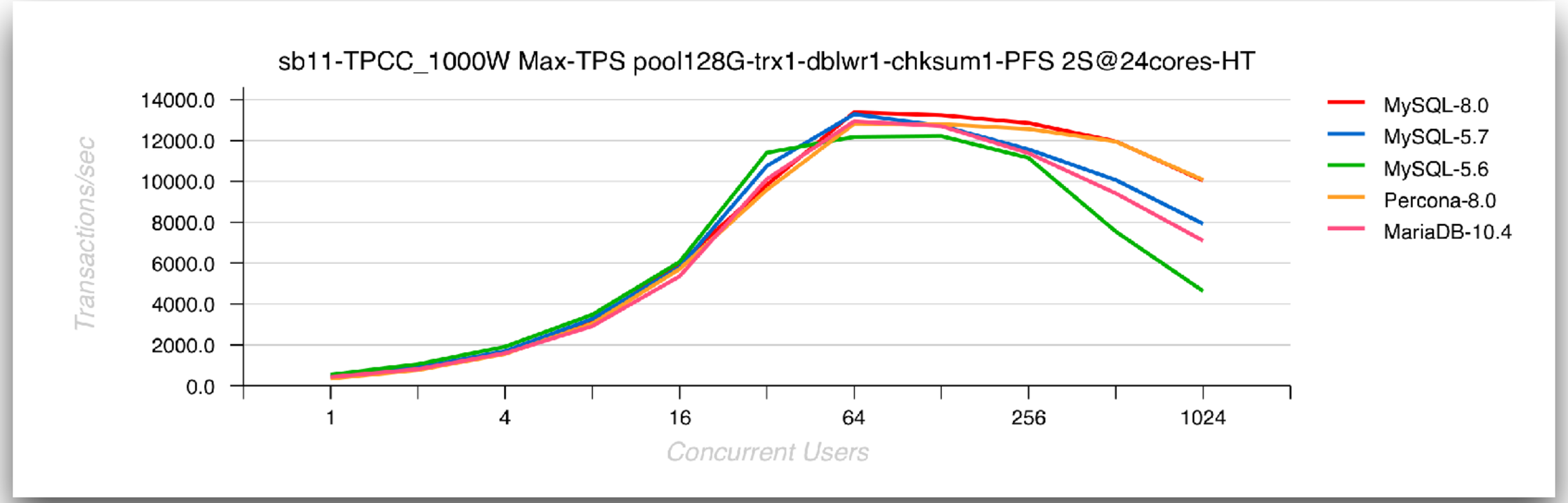


NULL

DEFAULT

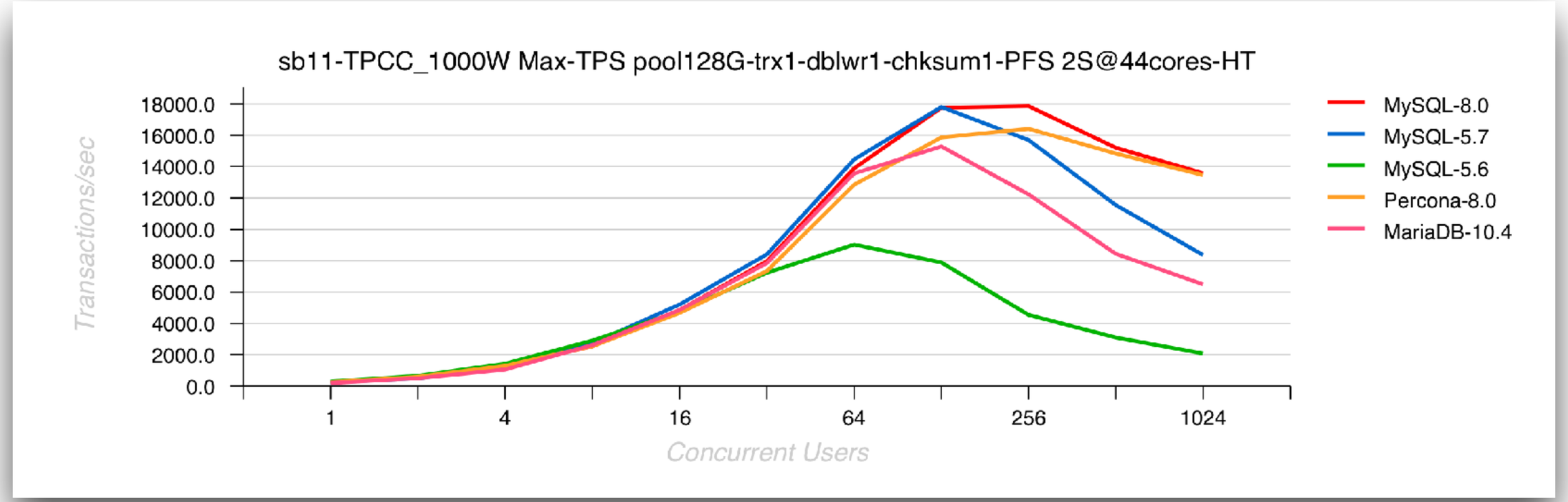
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **in-memory** (pool=128G)
  - 2S Dell 24cores-HT & Dell NVMe :



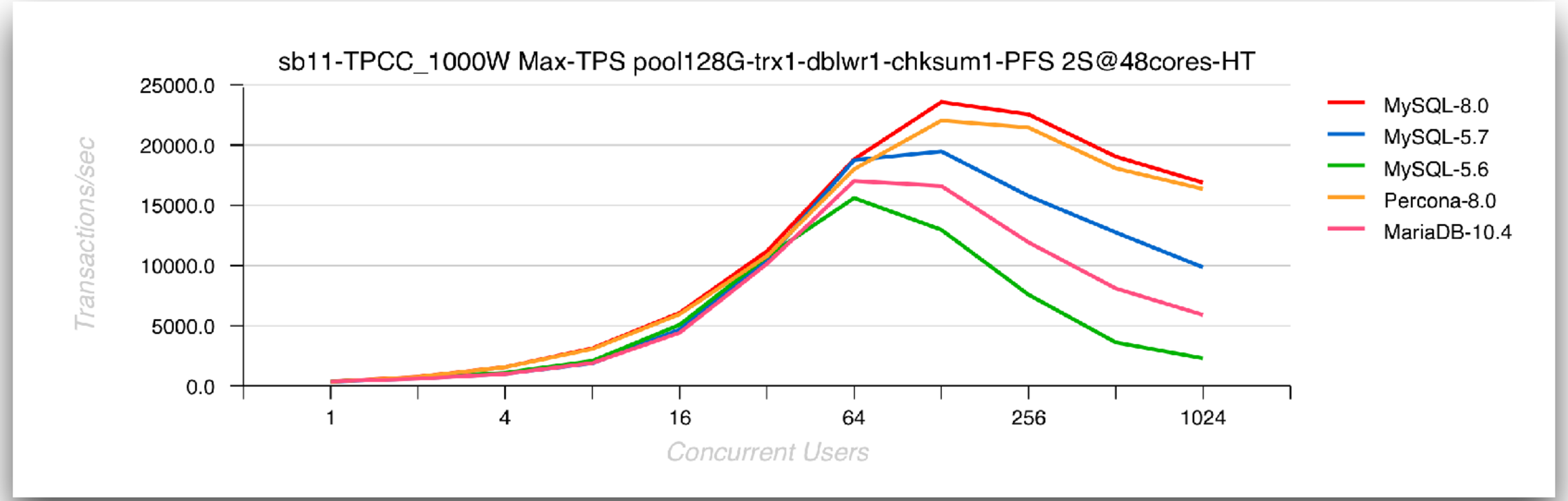
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **in-memory** (pool=128G)
  - 2S Broadwell v4 44cores-HT & Samsung NVMe :



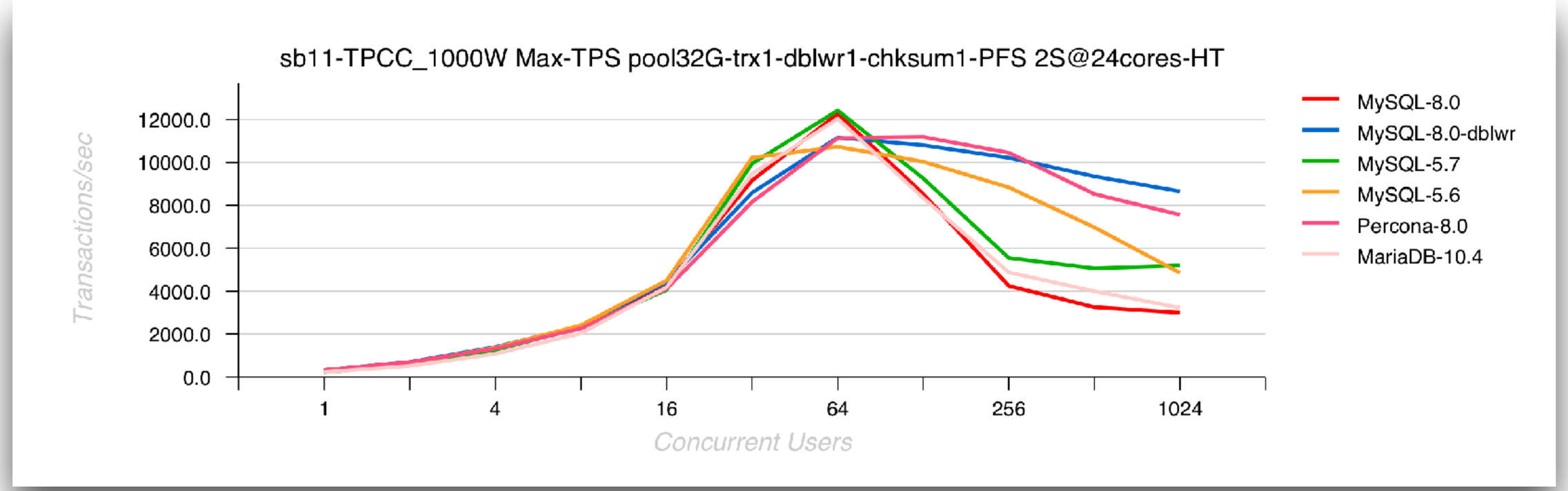
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **in-memory** (pool=128G)
  - 2S Intel Cascade Lake 48cores-HT & 2xOptane NVMe :



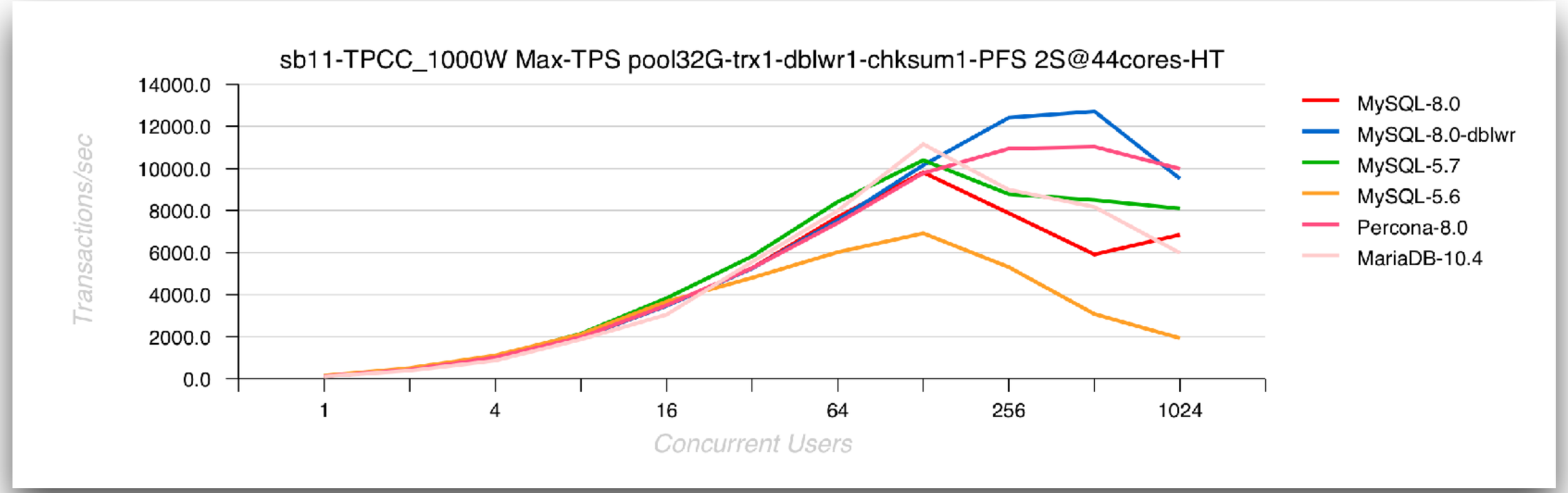
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **IO-bound** (pool=32G)
  - 2S Dell 24cores-HT & Dell NVMe :



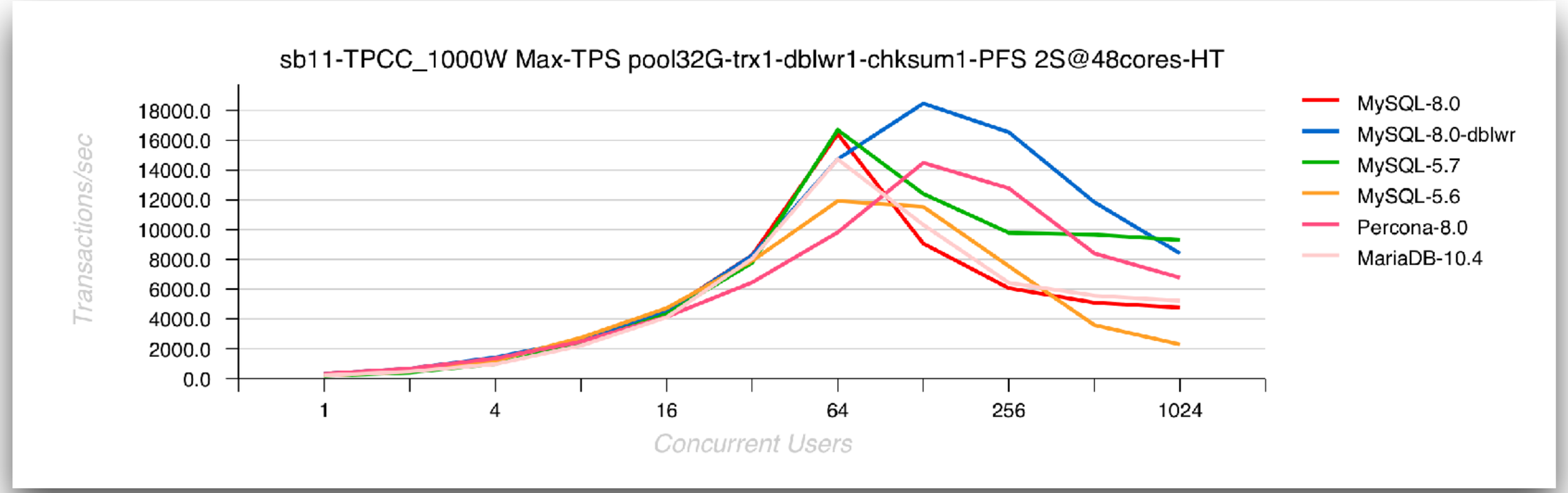
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **IO-bound** (pool=32G)
  - 2S Broadwell v4 44cores-HT & Samsung NVMe :



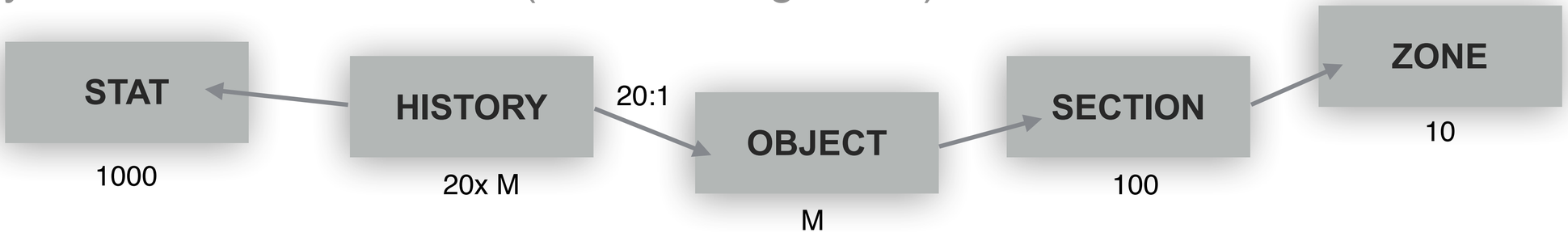
TPCC “mystery” : test results (Sep.2019)

- Sysbench-TPCC 1000W, using DEFAULT
  - **IO-bound** (pool=32G)
  - 2S Intel Cascade Lake 48cores-HT & 2xOptane NVMe :



dbSTRESS Workload

- Developed & Maintained by me ;-))
  - fully ported to Sysbench, but not yet published (in progress)
  - 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 :

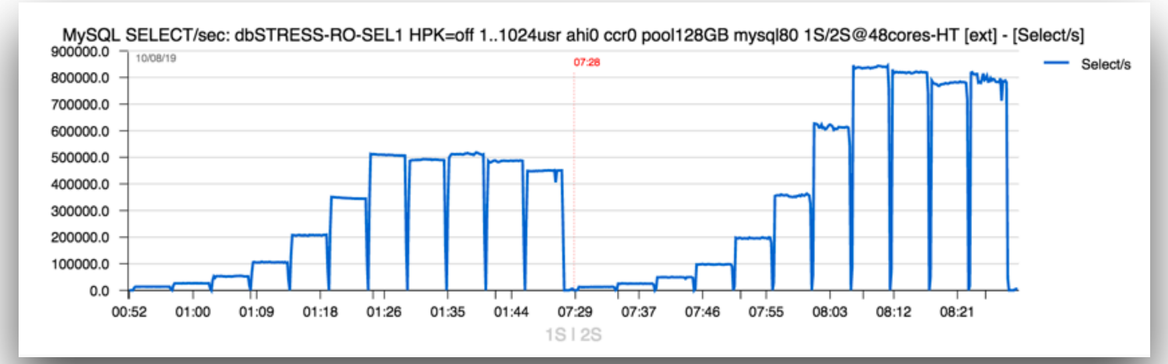


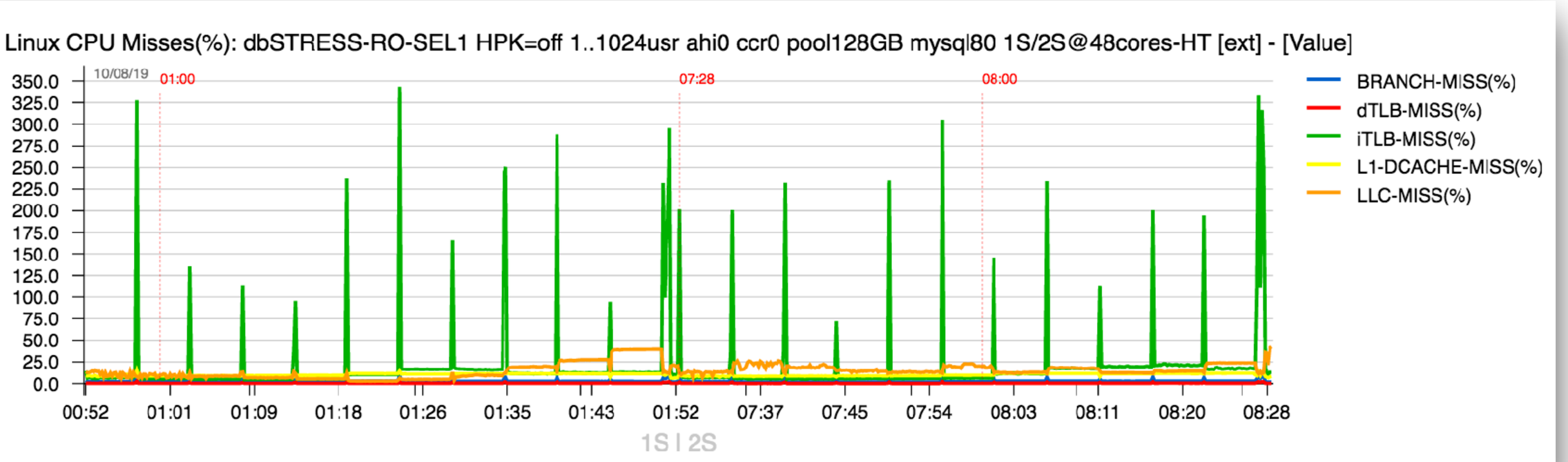
  - queries :
    - SEL1 : join of 3 tables by OBJECT REF (OBJECT => SECTION => ZONE)
    - SEL2 : join of 2 tables by OBJECT REF (OBJECT => HISTORY)
    - WRITE: DELETE/ INSERT/ UPDATE of single HISTORY record by OBJECT REF

- The current "mystery" :
  - SEL1 : scaling well, QPS on 2S is higher than on 1S
  - SEL2 : not scaling ! QPS on 2S is worse than on 1S !!
    - NOTE: using PK instead of Sec.IDX is helping in efficiency, but not in scalability..

dbSTRESS-RO-SEL1

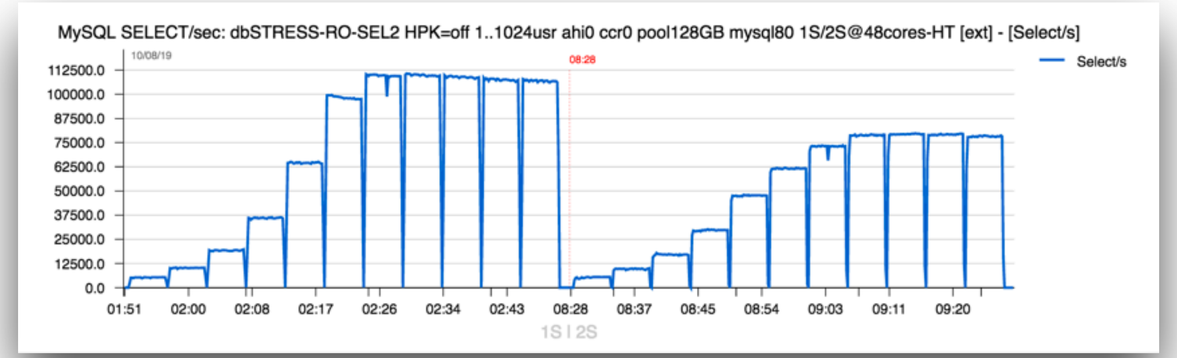
- SEL1 :
  - scaling from S1 to S2

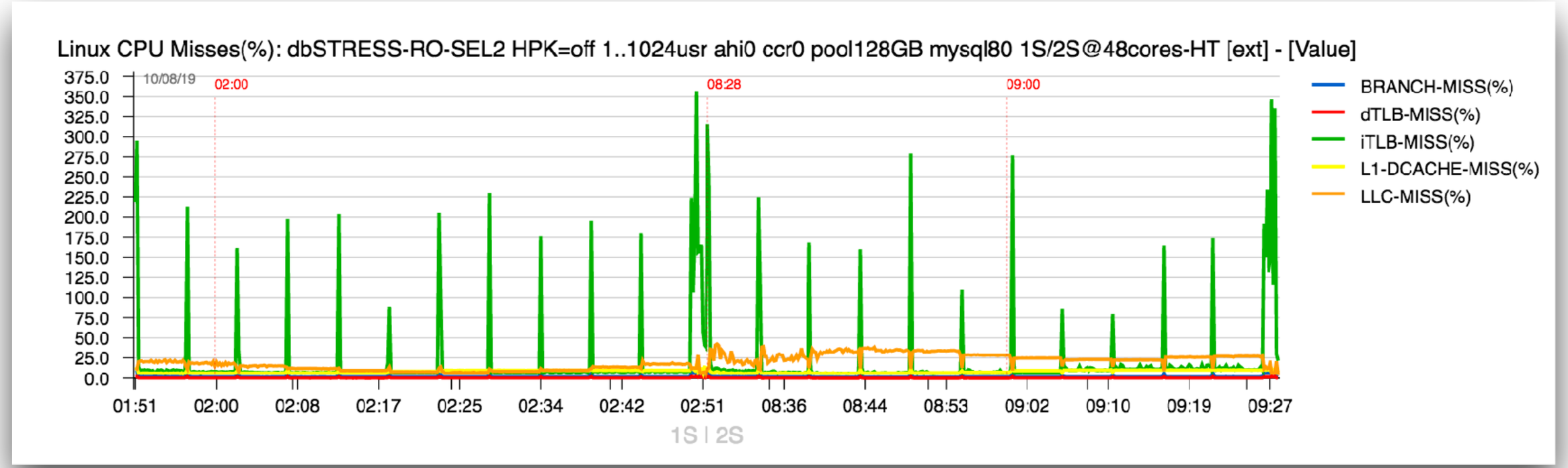




dbSTRESS-RO-SEL2

- SEL2 :
  - NOT scaling from S1 to S2





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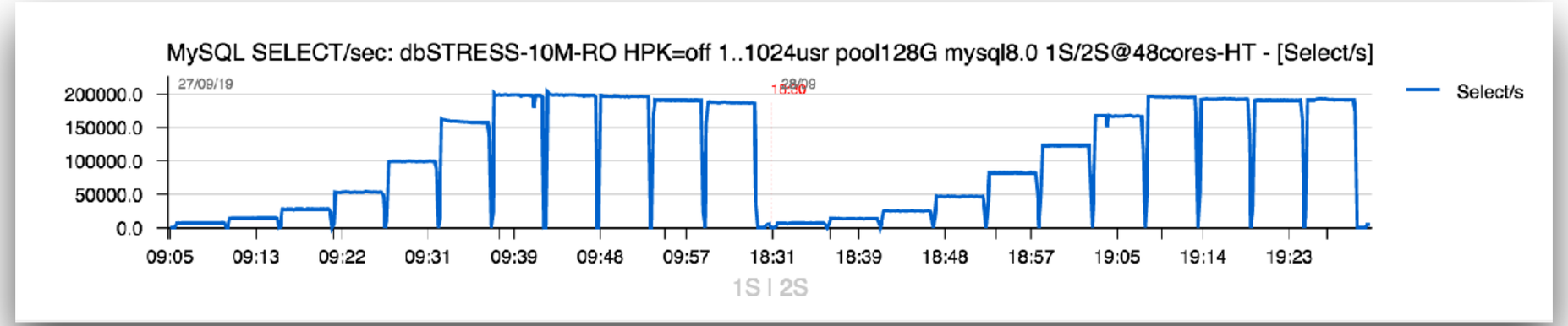
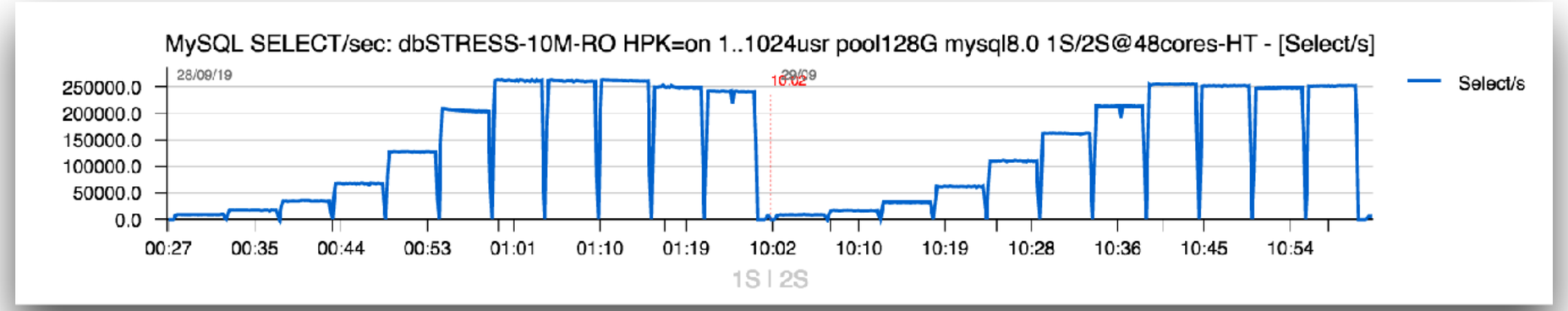
dbSTRESS-RO (SEL1 + SEL2)

- HISTORY table NOT using PK (HPK=off) :



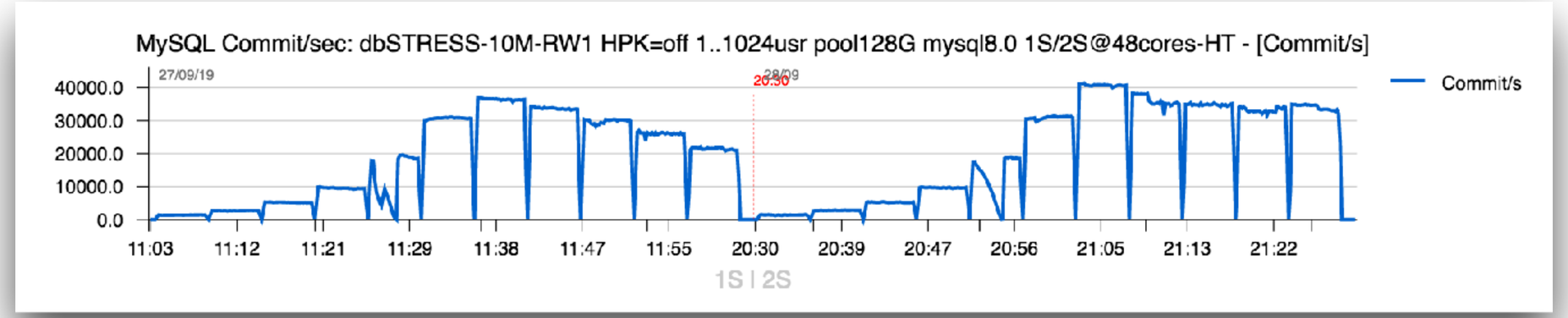
- HISTORY table using PK (HPK=on) :



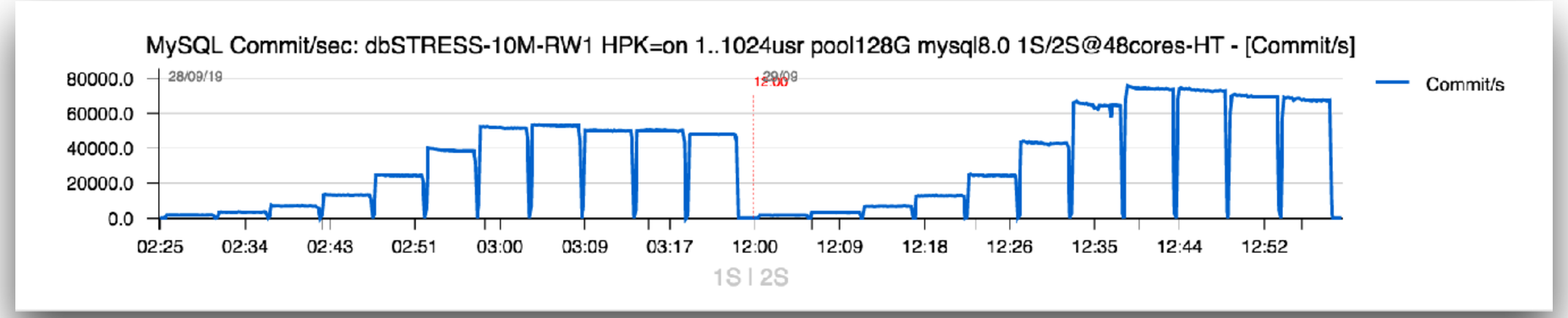
ORACLE

dbSTRESS-RW1 (R/W ratio= 1:1)

- HISTORY table NOT using PK (HPK=off) :



- HISTORY table using PK (HPK=on) :



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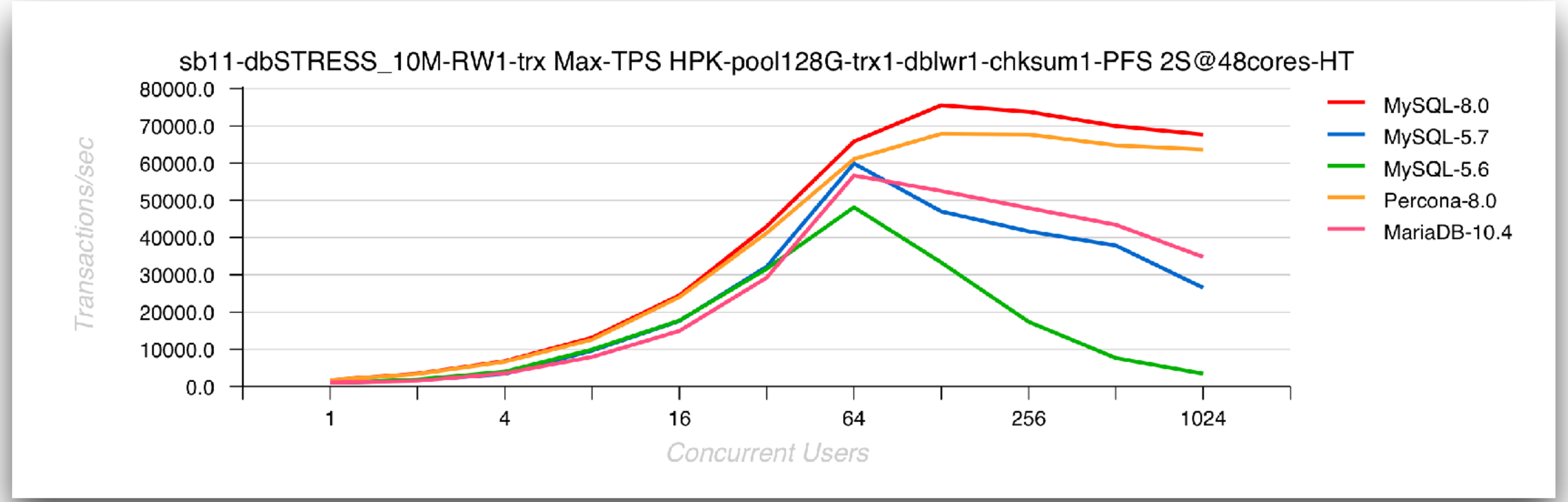
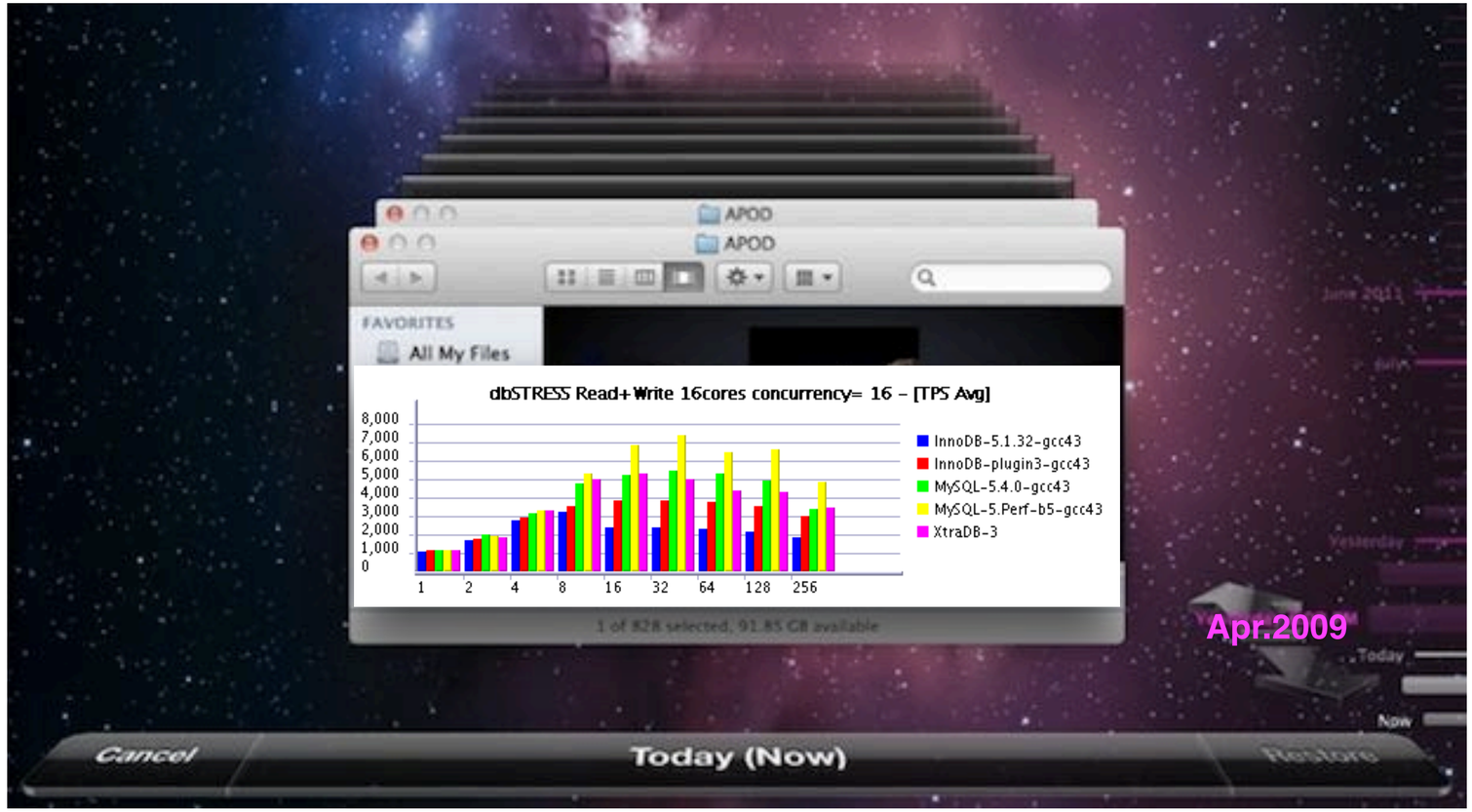
dbSTRESS 10M RW1 Test + HPK=on

- Dataset : 10M (200M HISTORY+PK (HPK)) @48cores-HT Cascade Lake
  - as usual, “everything is relative”..
  - while we blame MySQL 8.0 for scalability limits, it’s still doing better than all we have ;-))



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 !!
  - 10 years => and so huge jump in SW/HW + MySQL 8.0 !!! => x10 times diff..



Thank You !!! 🍾🍾🍾

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Appendix

- System details :
  - 24cores-HT Dell : Intel(R) Xeon(R) Gold 6126 CPU @ 2.60GHz
  - 44cores-HT : Intel(R) Xeon(R) CPU E5-2699 v4 @ 2.20GHz
  - 48cores-HT : Intel(R) Xeon(R) Platinum 8268 CPU @ 2.90GHz

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.