MySQL Replication: What's New In MySQL 5.7 and MySQL 8

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MySQL Replication

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Program Agenda

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1. Introduction
2. Use Cases
3. Enhancements in MySQL 8 (and 5.7)
4. Enhancements in lab.mysql.com
5. Roadmap
6. Conclusion

1 Introduction

Web Explodes

Today...

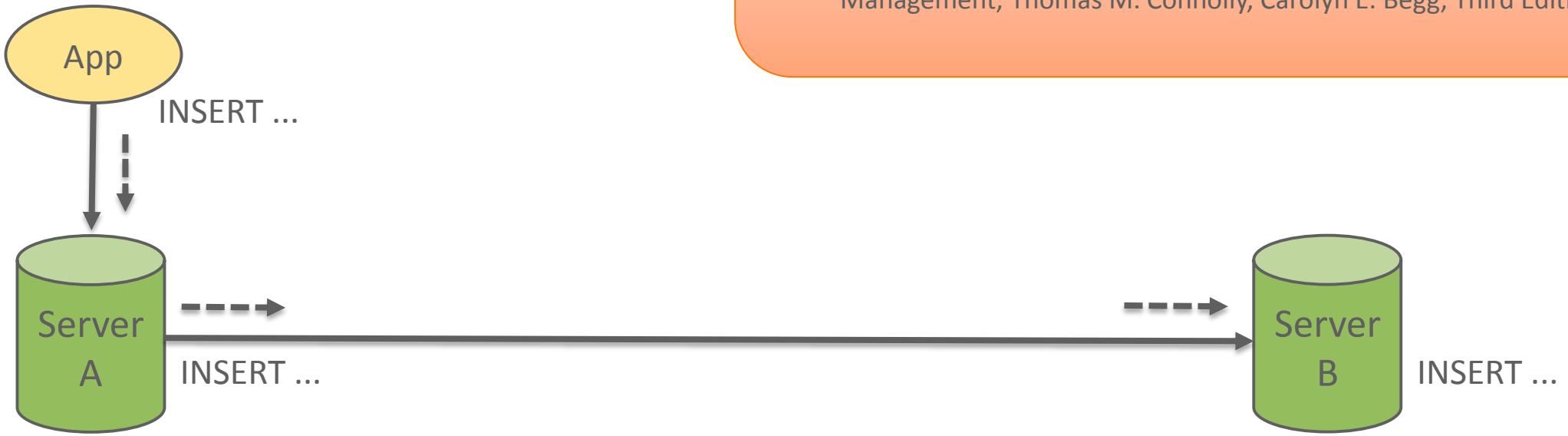
- Technology mesh.
- All things distributed.
- Large amounts of data to handle, transform, store.
- Offline periods are horribly expensive, simply unaffordable.
- Go green requires dynamic and adaptative behavior.
- Much more data to store – e.g. social media, “Look at all of my pictures!”; Monitoring – Keeping logs for N years! ; IoT – and much more.
- Moving, transforming and processing data quicker than anyone else means having an edge over competitors.
- It is a zoo. Distributed coordination and monitoring is key.

Database Replication

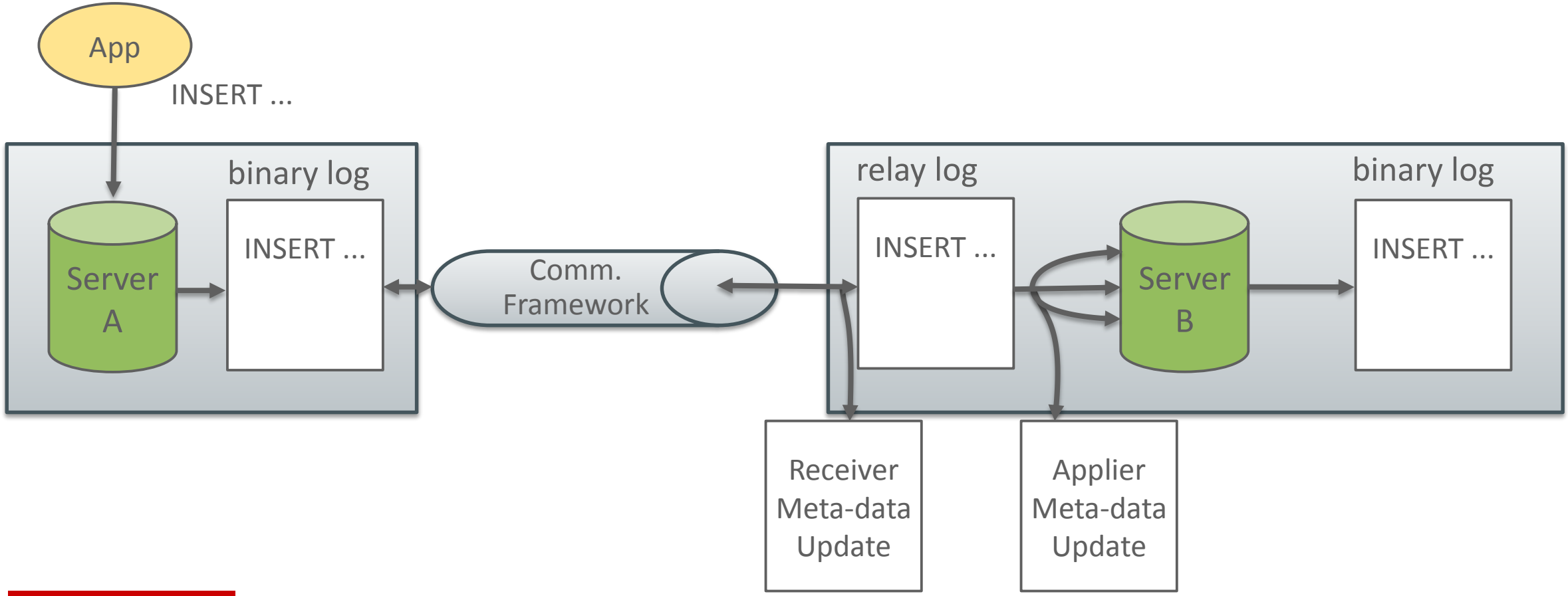
Replication

"The process of generating and reproducing multiple copies of data at one or more sites.",

Database Systems: A Practical Approach to Design, Implementation, and Management, Thomas M. Connolly, Carolyn E. Begg, Third Edition, 2002.



MySQL Database Replication: Overview



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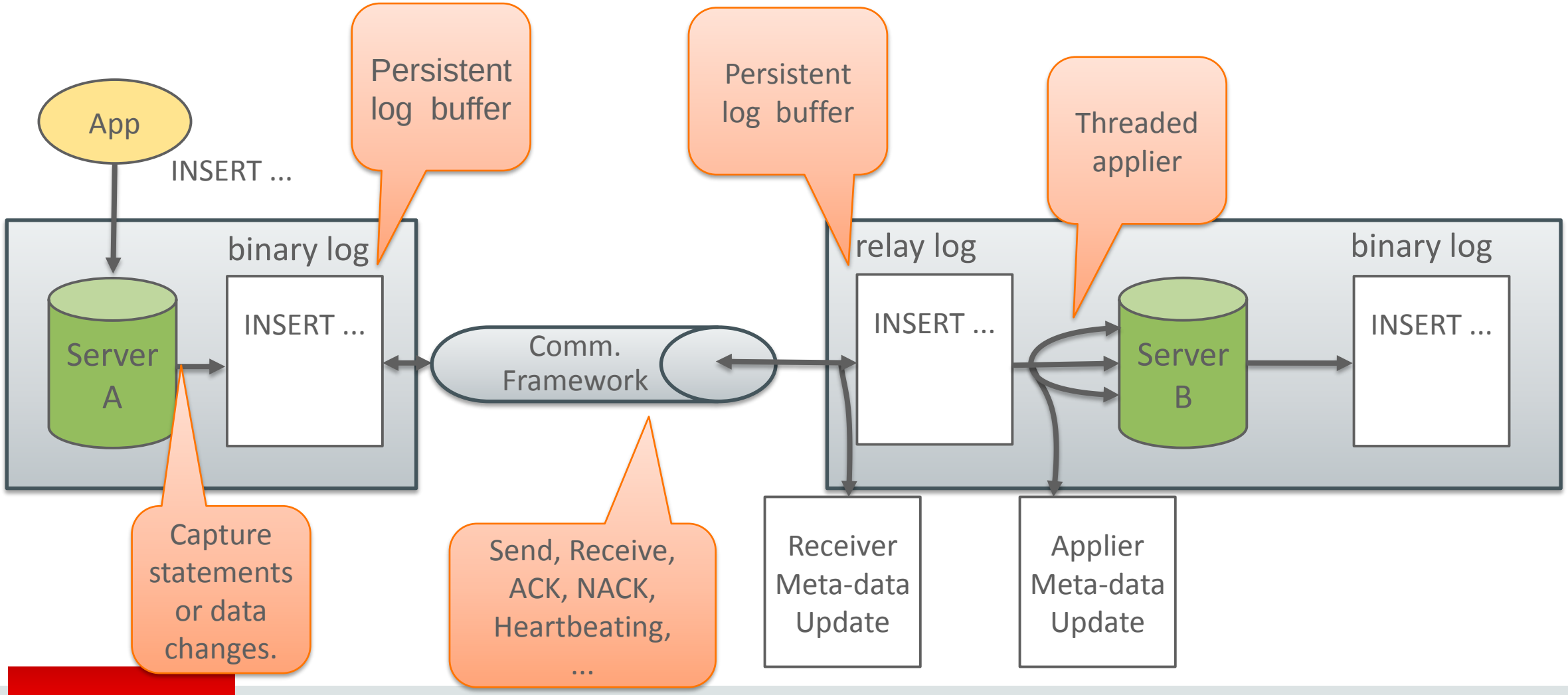


MySQL Database Replication: Some Notes

Binary Log

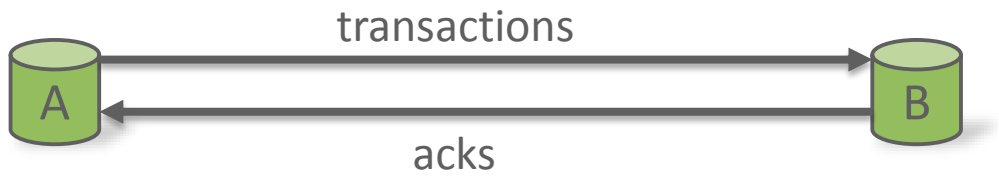
- Logical replication log recording master changes (binary log).
- Row or statement based format (may be intermixed).
- Each transaction is split into groups of events.
- Control events: Rotate, Format Description, Gtid, and more.

MySQL Database Replication: Some Notes

Coordination Between Servers

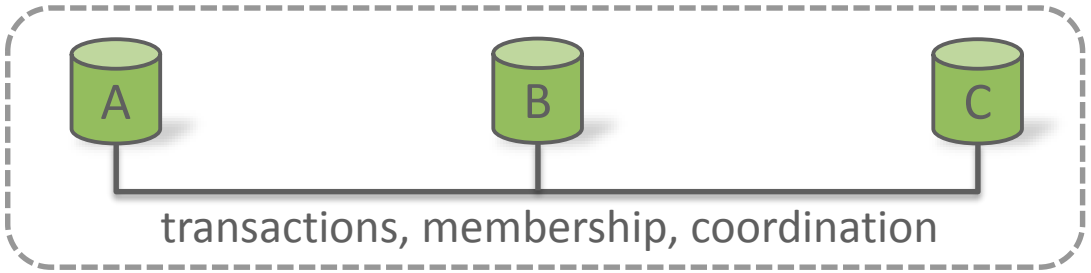
Since 3.23

asynchronous (native)



Since 5.5

semi-synchronous (plugin)



Since 5.7.17

And in MySQL 8 as of 8.0.1

group replication (plugin)

2 Use cases

Clustering Made Practical

Replicate

Automate

I ntegrate

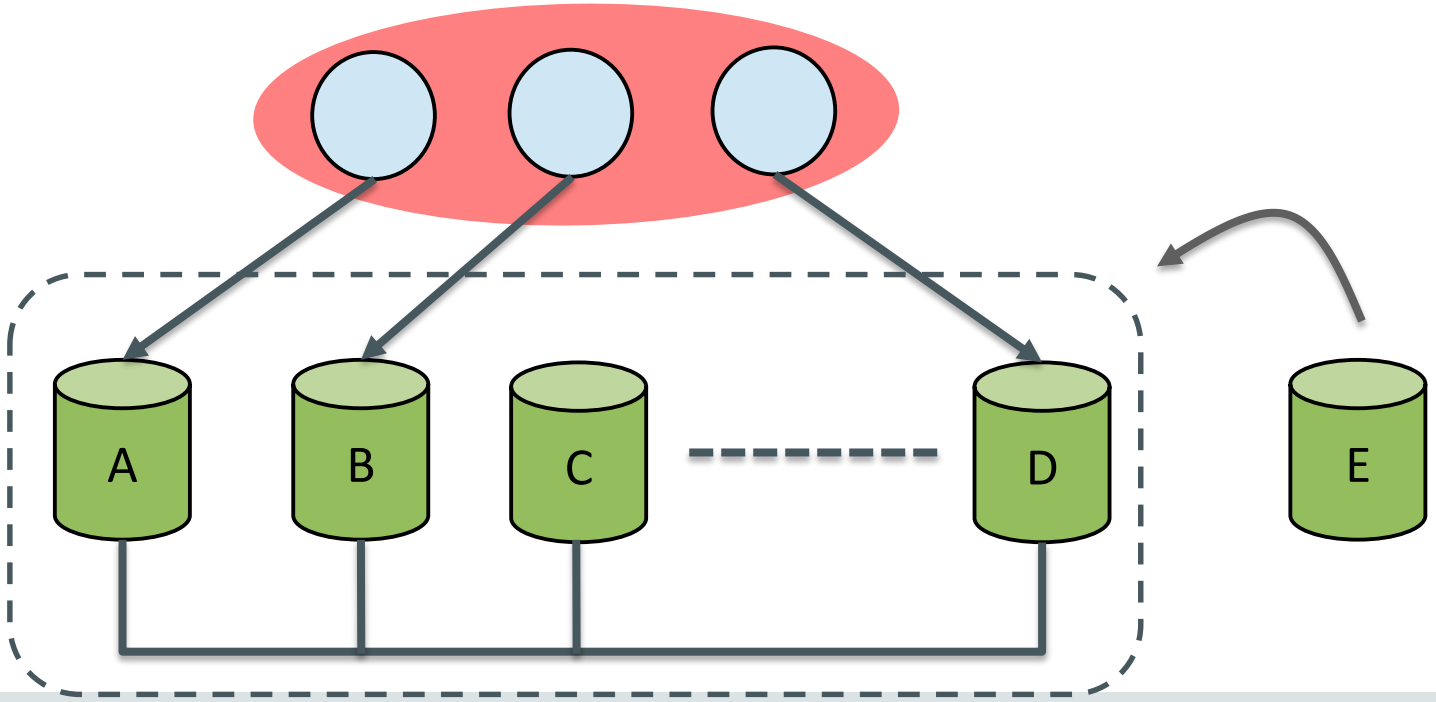
Scale

Enhance

Replicate

Group Replication

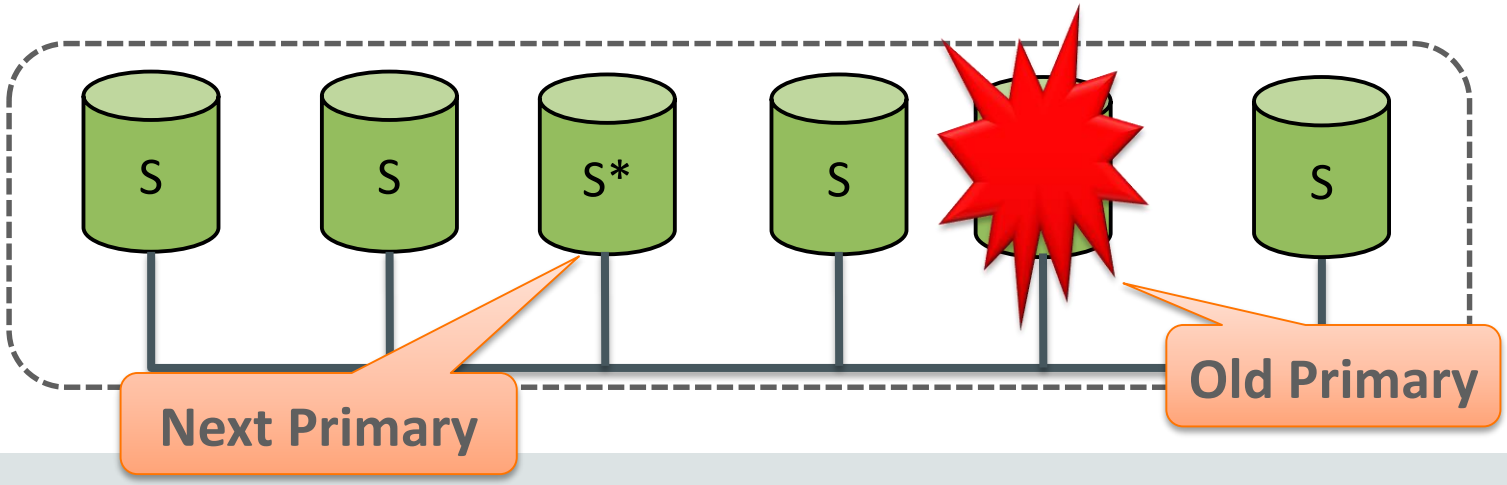
- For highly available infrastructures where:
  - the number of servers has to grow or shrink dynamically;
  - with as little pain as possible.



Automate

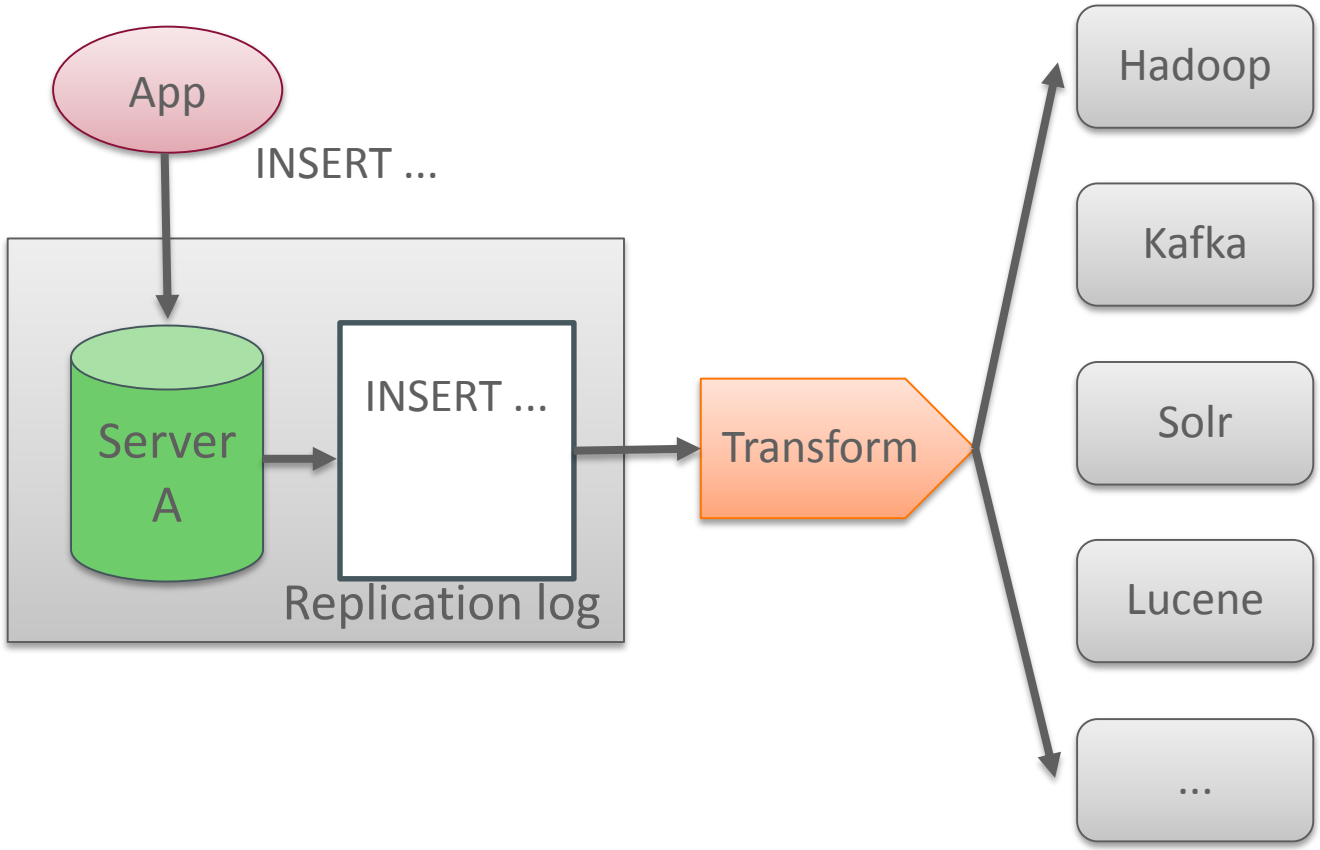
Group Replication

- **Single-primary mode**
  - Automatic PRIMARY/SECONDARY role assignment
  - Automatic new PRIMARY election on PRIMARY failures
  - Automatic setup of read/write modes on PRIMARY and SECONDARIES
  - Automatic global consistent view of which server is the PRIMARY



Integrate

Binary Log

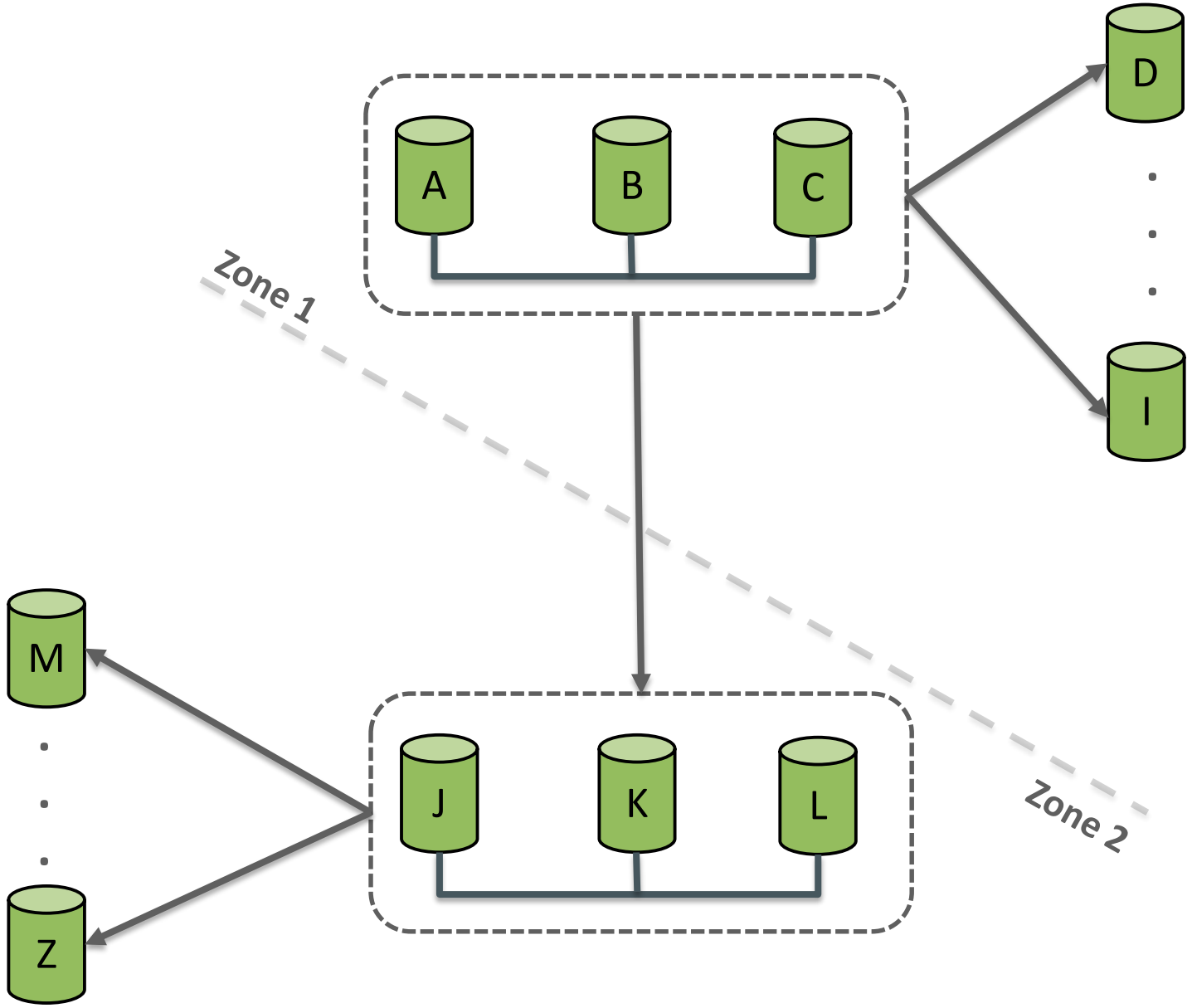


- **Logical replication log**
  - Extract, transform and load.
  - MySQL fits nicely with other technologies.

Scale

Asynchronous Replication

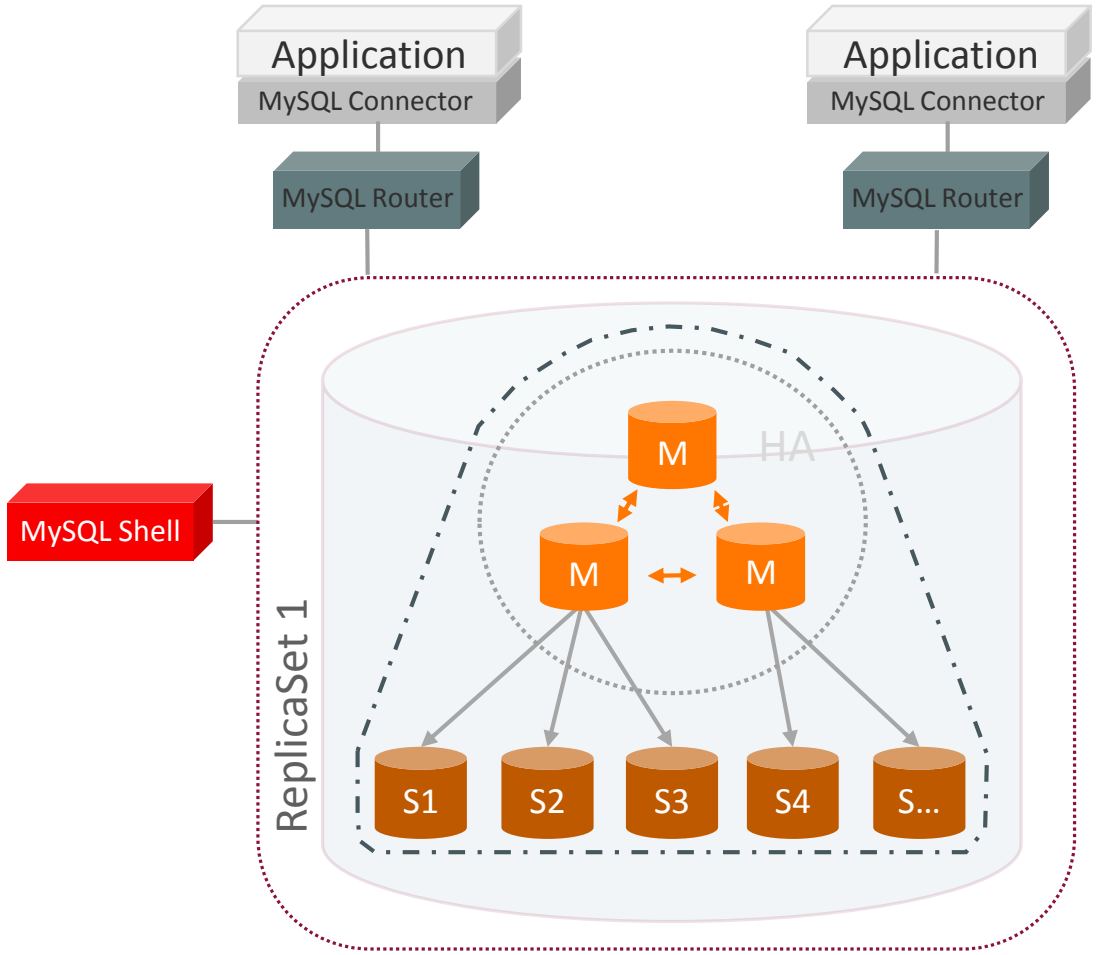
- **Replicate between clusters**
  - For disaster recovery
- **Read Replicas**
  - For read-scale out. Deploy asynchronous read replicas connected to the cluster



Enhance

InnoDB Cluster

- **InnoDB Cluster Integrated Solution**
  - Group Replication for high availability.
  - Asynchronous Replication for Read Scale-out.
  - One-stop shell to deploy and manage the cluster.
  - Seamlessly and automatically route the workload to the proper database server in the cluster.
  - Hide failures from the application.

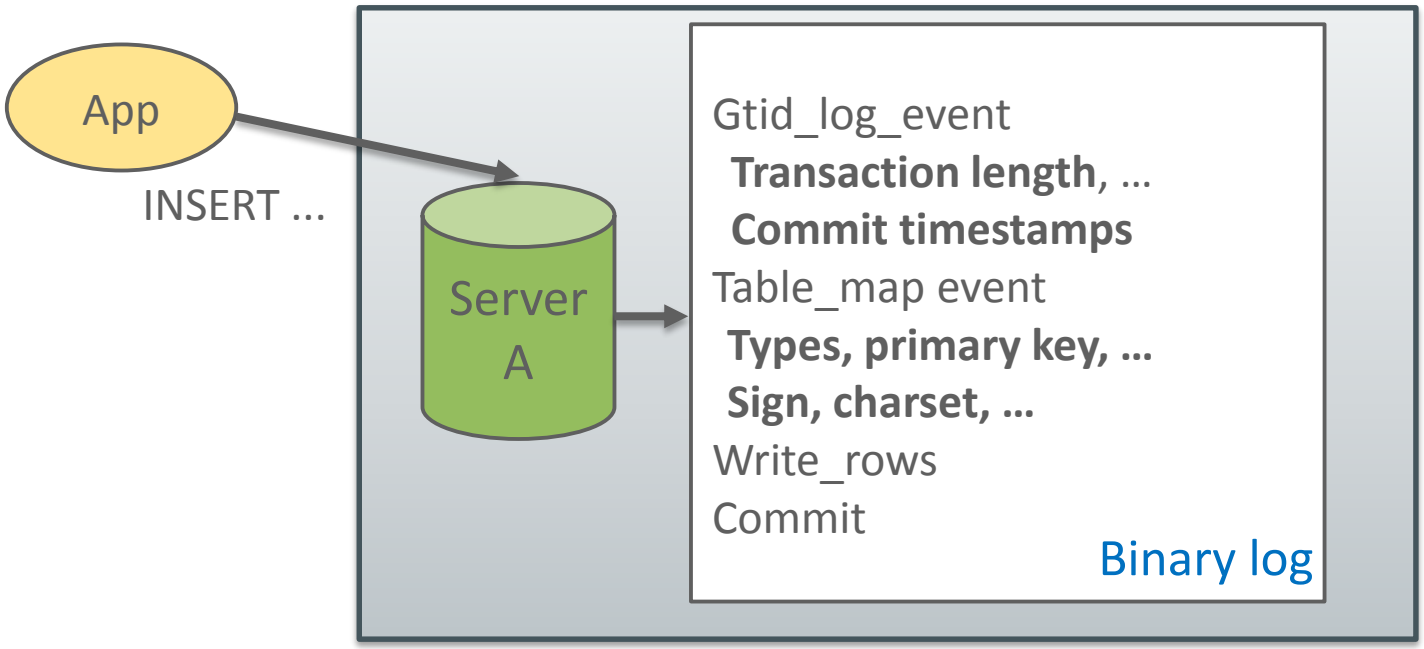


3 Enhancements in MySQL 8 (and 5.7)

- 3.1 **Binary Log Metadata**
- 3.2 **Operations**
- 3.3 **Monitoring**
- 3.4 **Performance**
- 3.5 **Other**

New Metadata in the Binary Log

Easy to extract, transform and load into other systems.



- **New Metadata**
  - Easy to decode what is in the binary log.
  - Further facilitates connecting MySQL to other systems using the binary log stream.
  - Capturing data changes through the binary log is simplified.
  - Also more stats showing where the data is/was at a certain point in time.

3 Enhancements in MySQL 8 (and 5.7)

- 3.1 Binary Log Metadata
- 3.2 Operations
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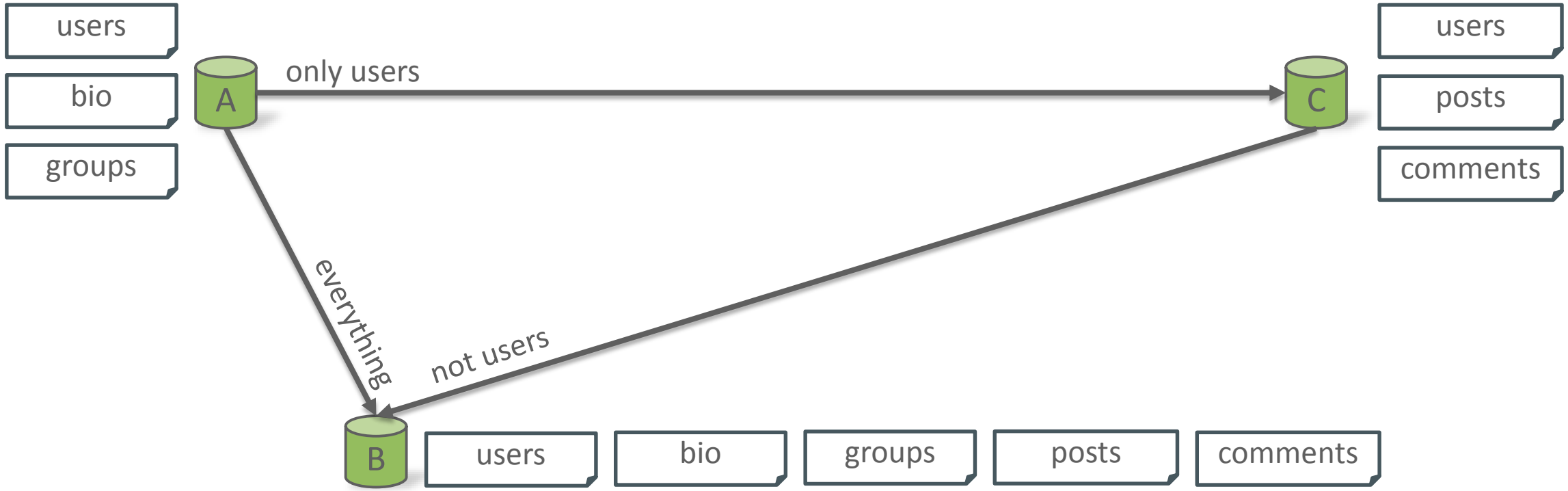
Multi-Source Replication Filters

Replicate, Filter, Aggregate, Query



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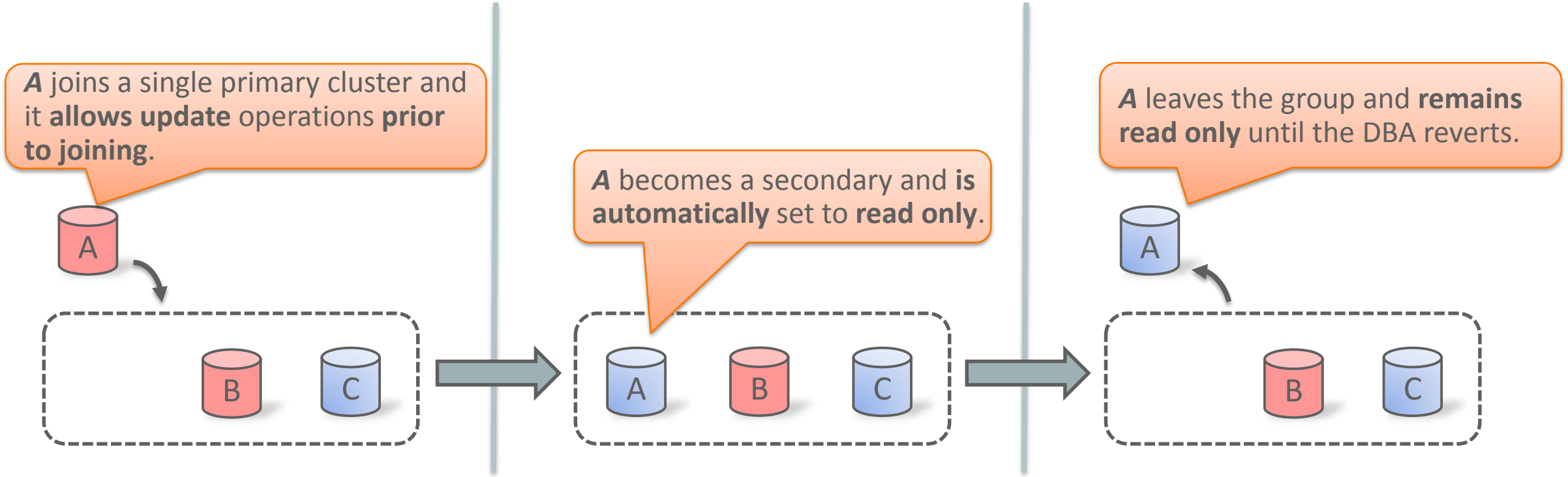
Preventing Updates On Replicas that Leave the Cluster

Automatic protection against involuntarily tainting of offline replicas



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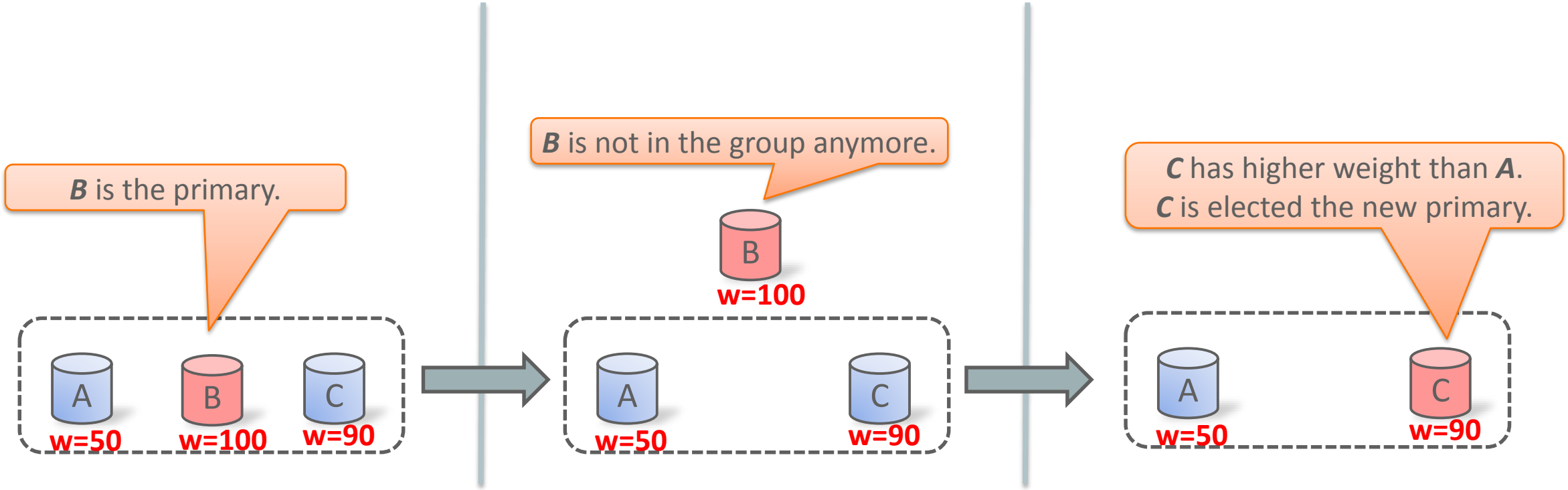
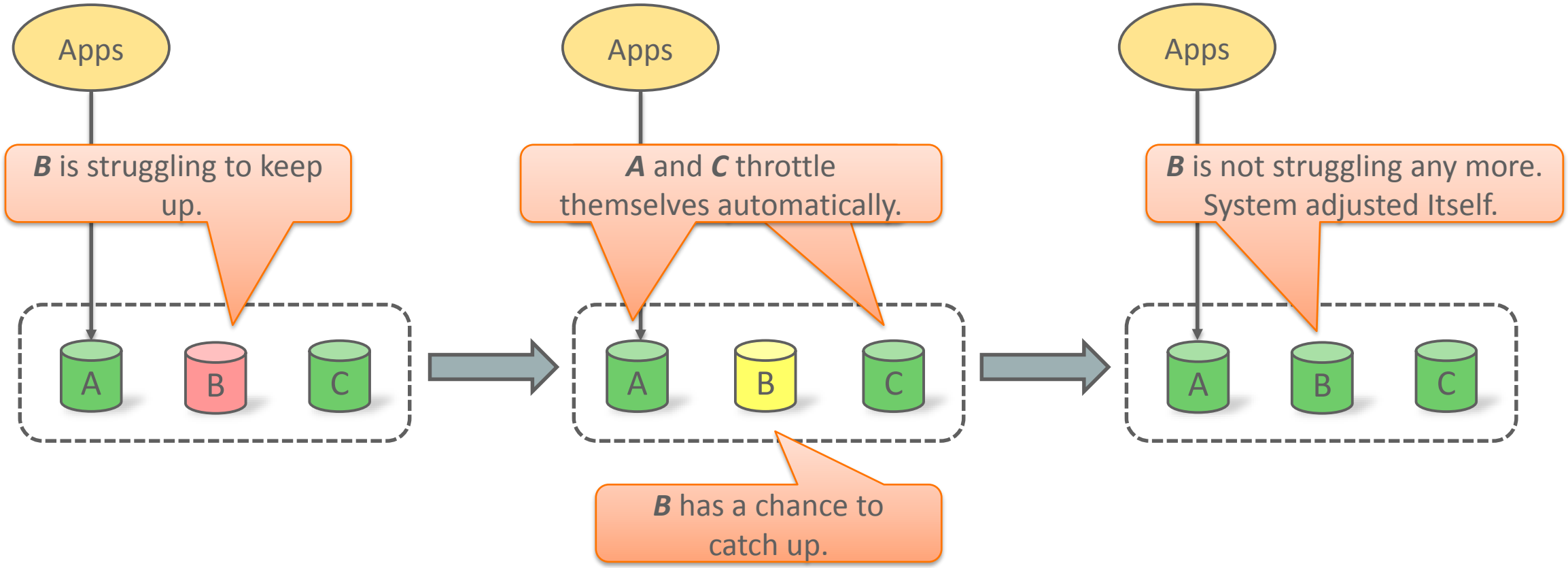
Primary Election Weights

Choose next primary by assigning election weights to the candidates.



Online and Automatic Cluster Performance Management

New options to fine tune the cluster automatic flow control in 8.0.

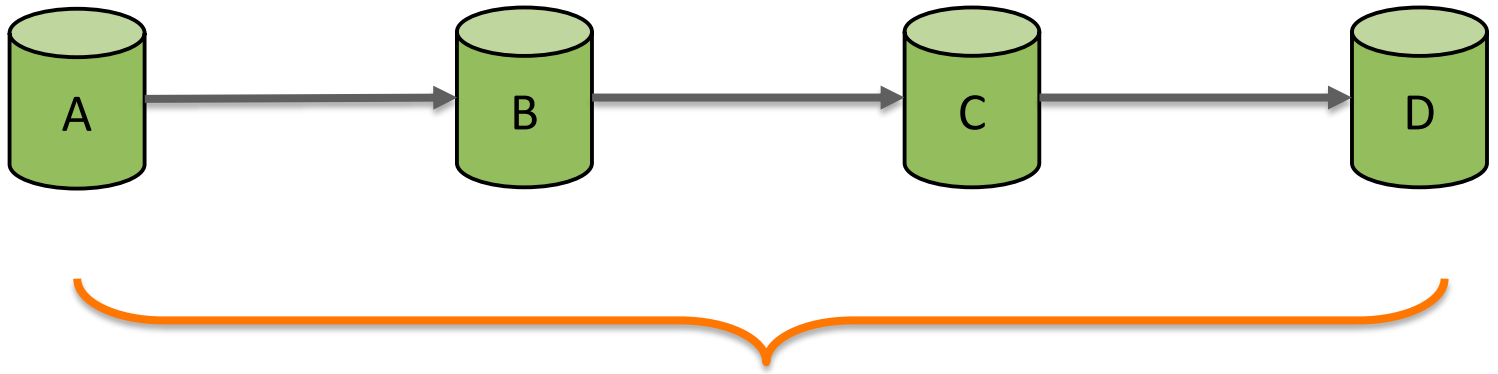


3 Enhancements in MySQL 8 (and 5.7)

- 3.1 Binary Log Metadata
- 3.2 Operations
- 3.3 **Monitoring**
- 3.4 Performance
- 3.6 Other

Monitor Lag With Microsecond Precision

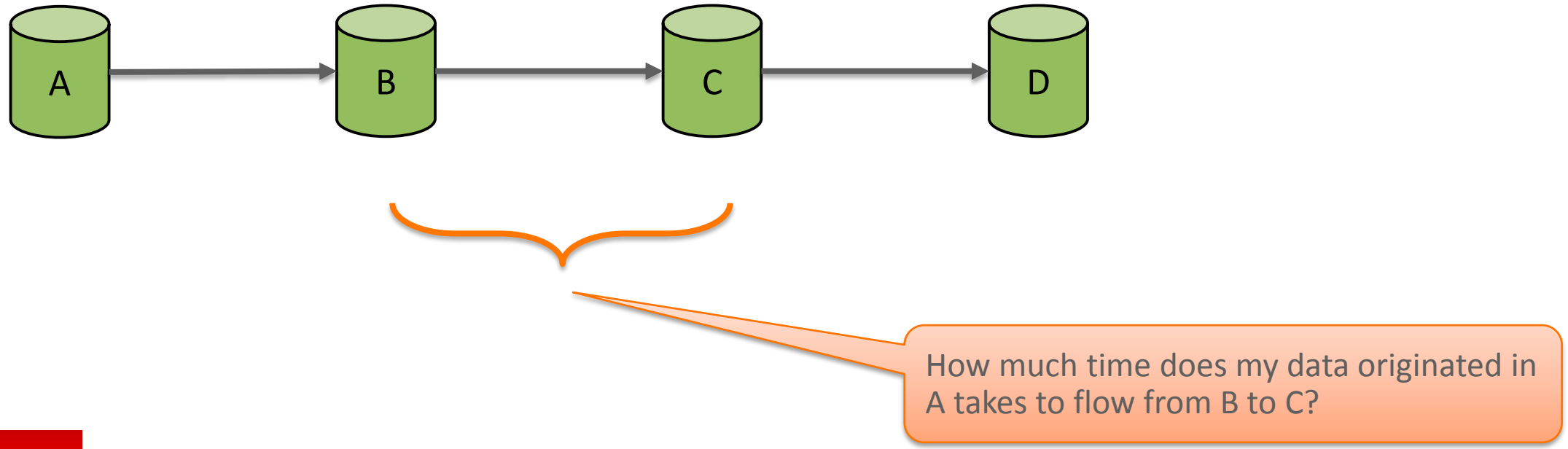
Through the entire asynchronous topology



How much time does my data take to reach D coming from A?

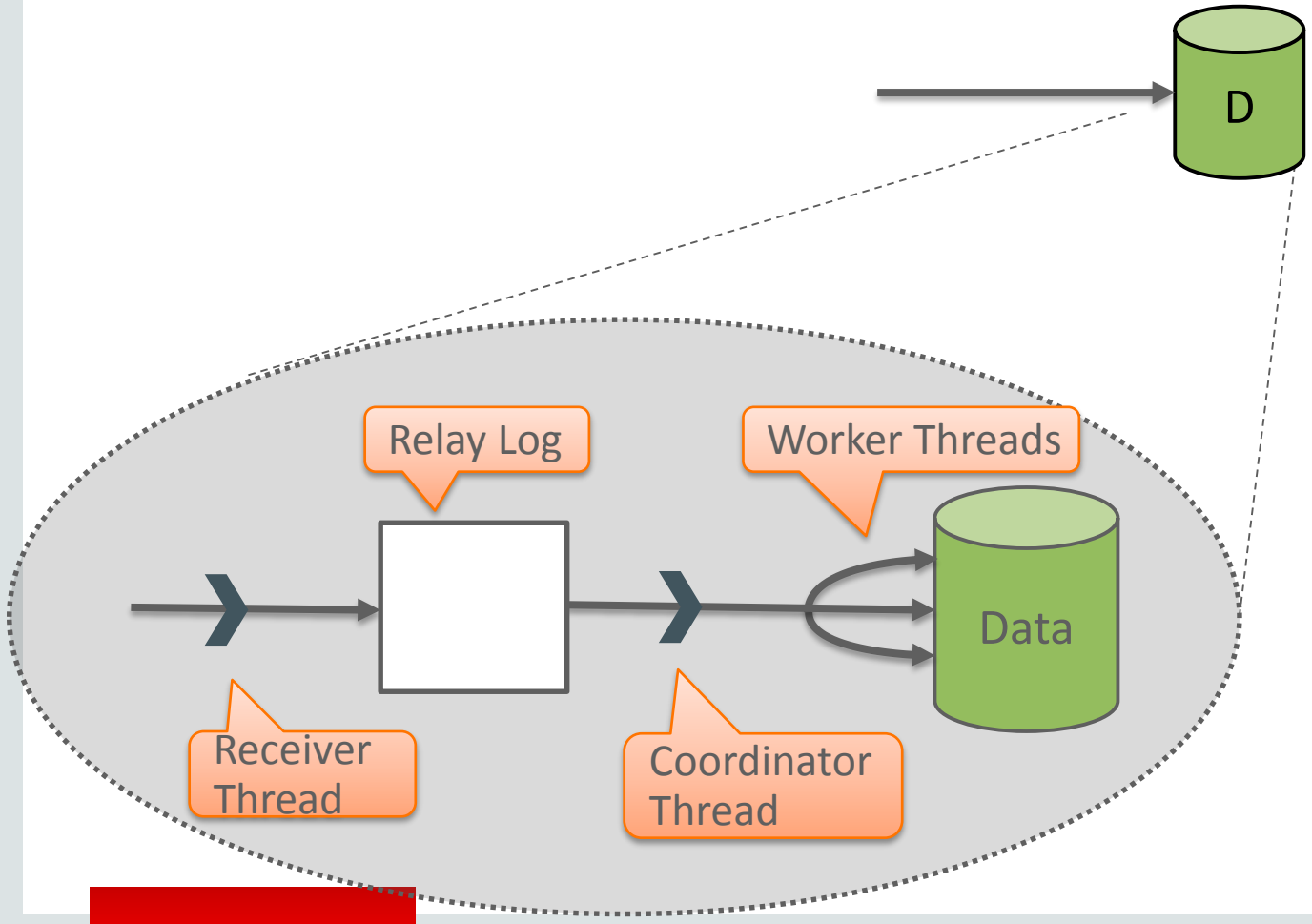
Monitor Lag With Microsecond Precision

From the immediate master



Monitor Lag with Microsecond Precision

For each stage of the replication applier process

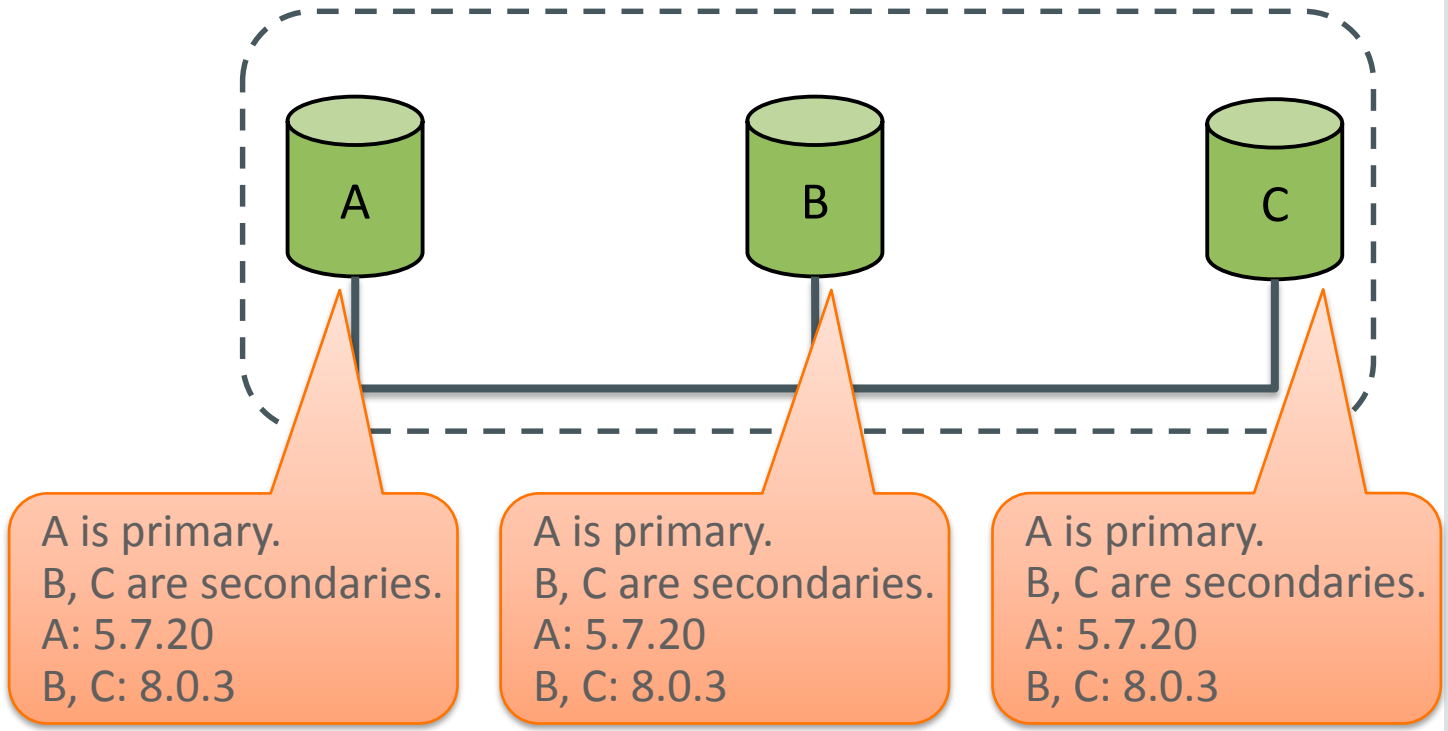


- **Per Stage Timestamps**
  - User can monitor how much time it takes for a specific transaction to traverse the pipeline.

Global Group Stats Available on Every Server

Version, Role and more

- **Query one Replica, Get status of all**
  - Every replica reports group-wide information about roles and versions of the members of the group.
  - Also available at any replica are group-wide status.



3 Enhancements in MySQL 8 (and 5.7)

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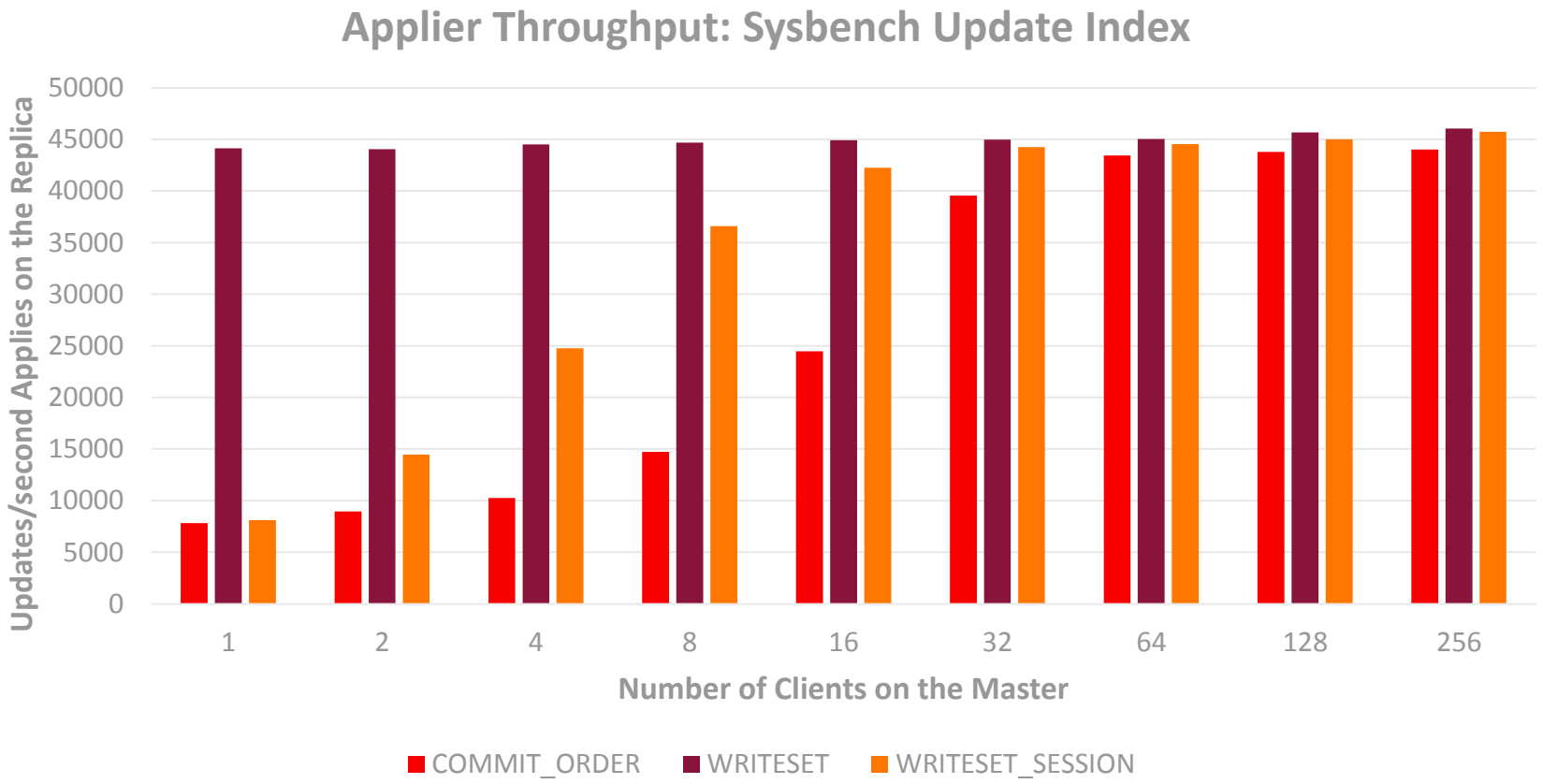
Highly Efficient Replication Applier

Write set parallelization



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Highly Efficient Replication Applier

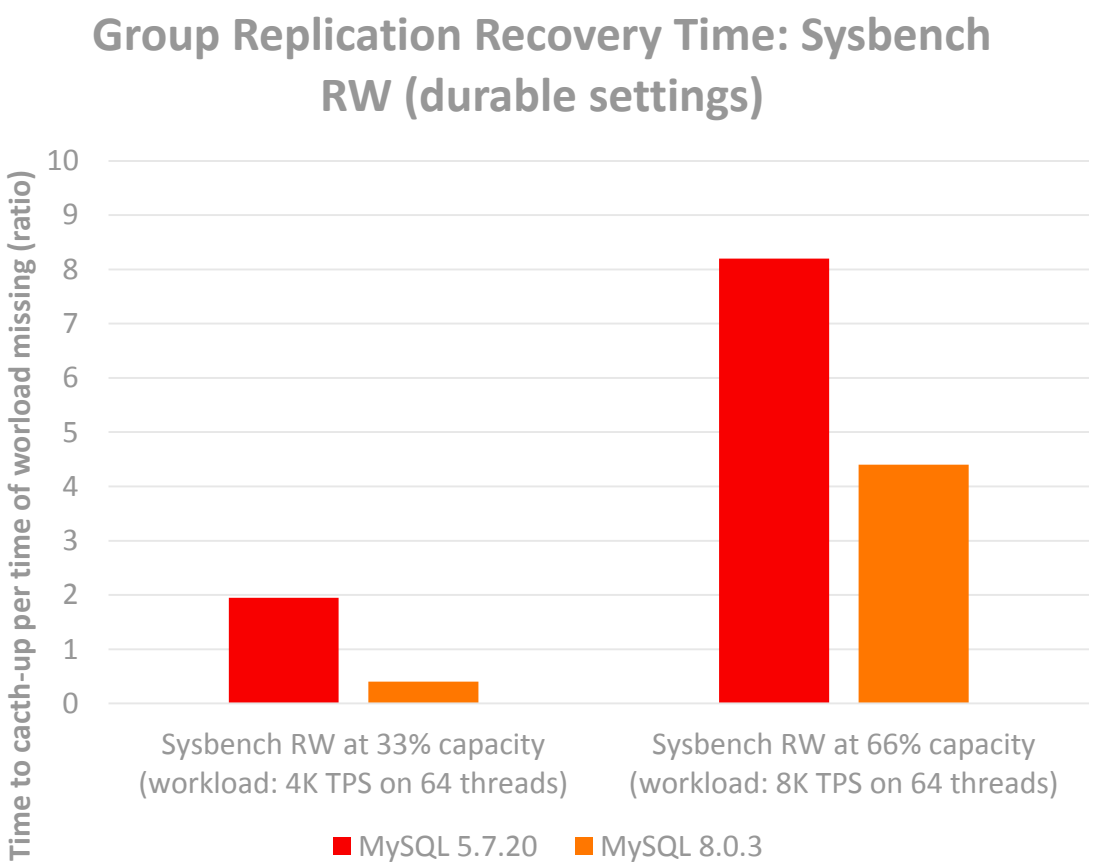
Write set parallelization

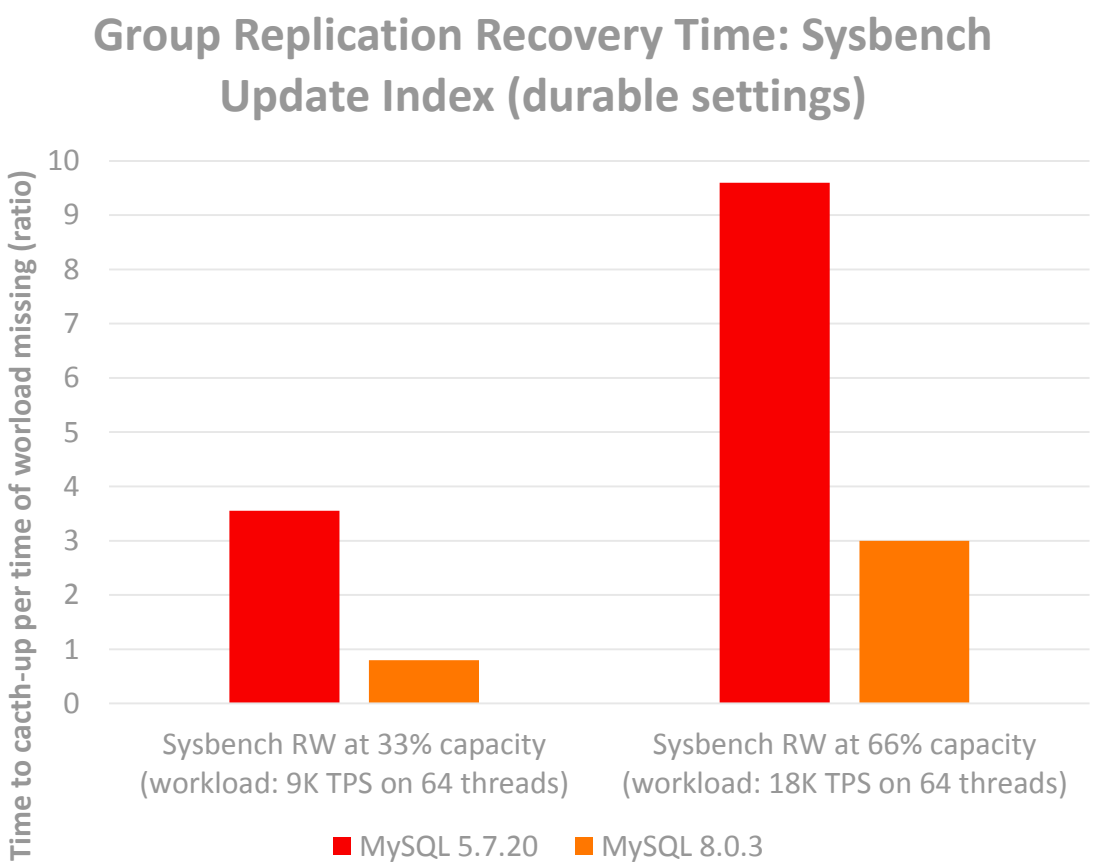
- WRITESET dependency tracking allows **applying** a **single threaded** workload in **parallel**.
  - Delivers the **best throughput** of the three dependency trackers, at **any** concurrency level.
- WRITESET_SESSION in addition to writesets **tracks sessions dependencies as well**. Two transactions executed on the same session are always scheduled in execution order on replica servers.
- Fast Group Replication recovery – time to catch up.

Backported to 5.7.22

Fast Group Replication Recovery

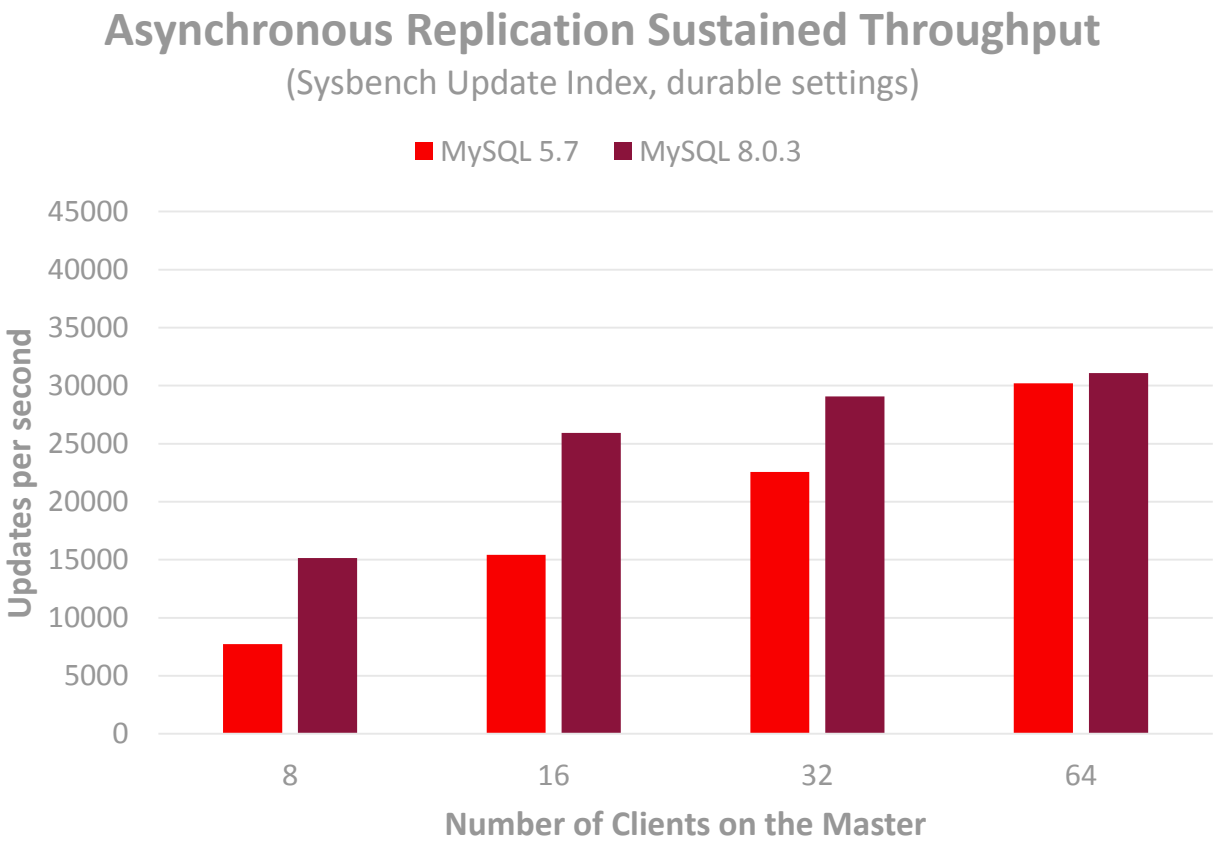
Replica quickly online by using WRITESET

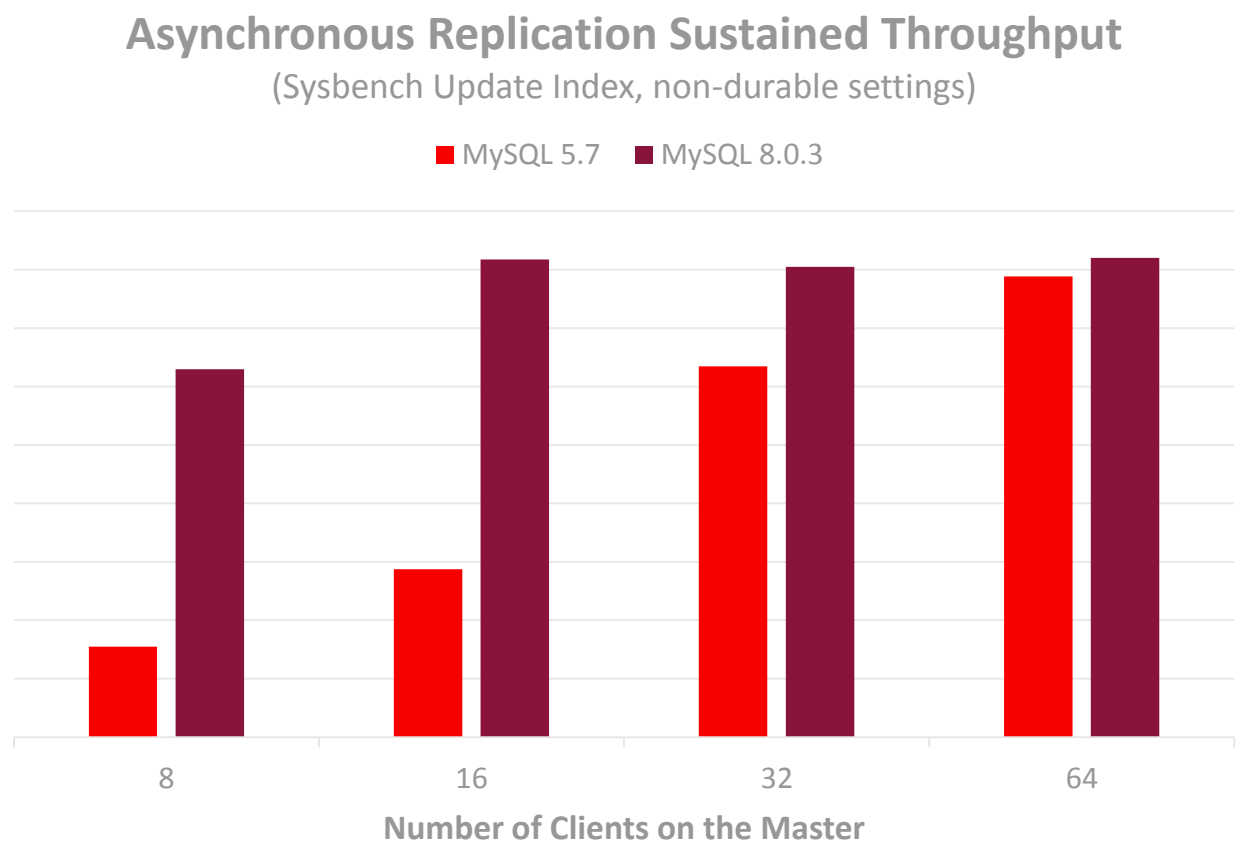




High Cluster Throughput

More transactions per second while sustaining zero lag on any replica





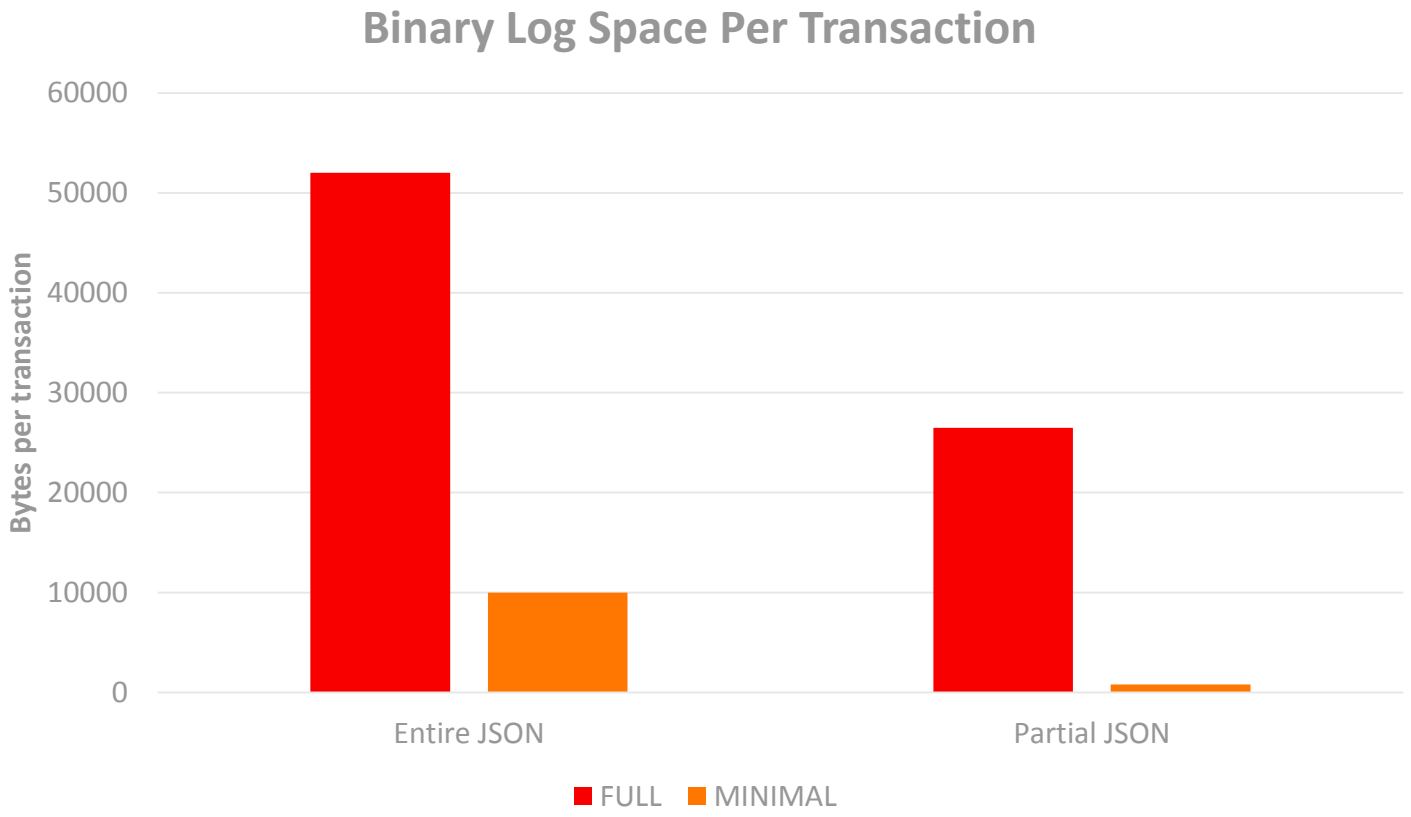
High Cluster Throughput

More transactions per second while sustaining zero lag on any replica

- At lower thread count, the throughput of the system doubles in MySQL 8.0 compared to MySQL 5.7 on durable settings.
- At lower thread count, the throughput of the system more than doubles in MySQL 8.0 compared to MySQL 5.7 on non-durable settings.

Efficient Replication of JSON Documents

Replicate only changed fields of documents (Partial JSON Updates)

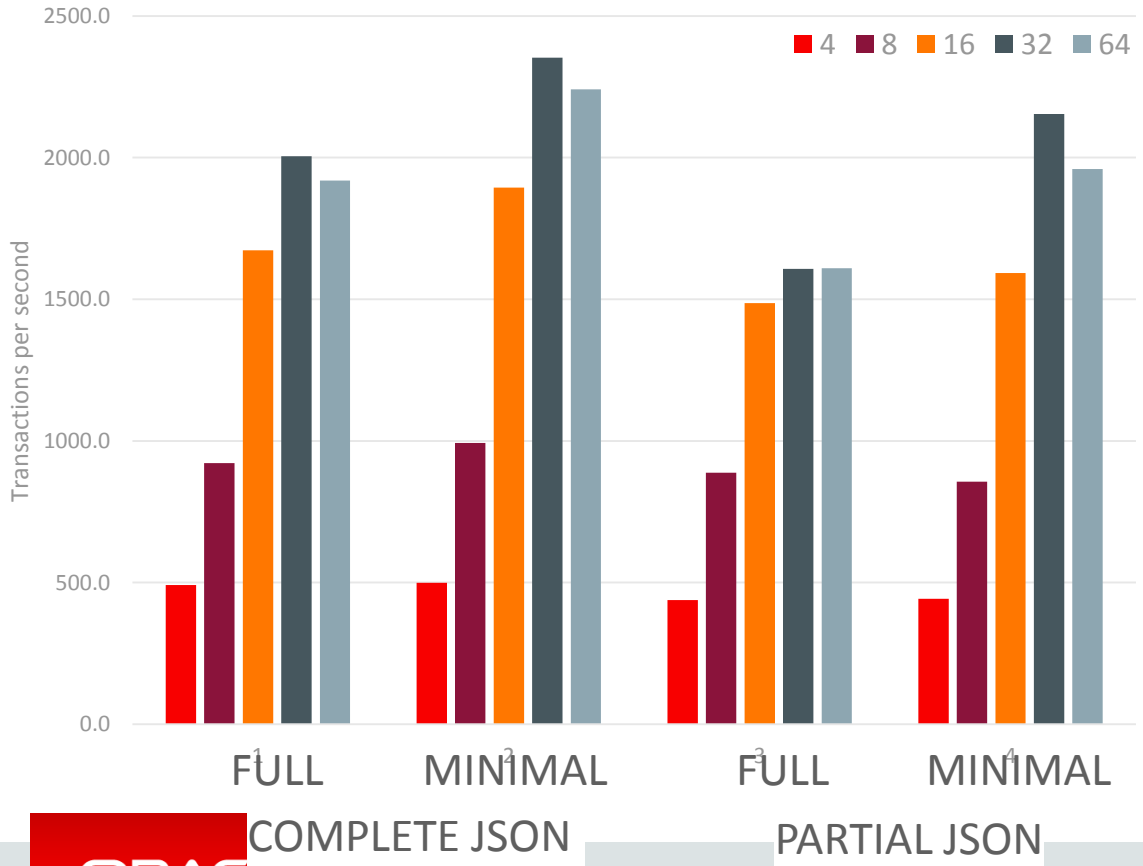


- Numbers are from a specially designed benchmark:
  - tables have 10 JSON fields,
  - each transaction modifies around 10% of the data

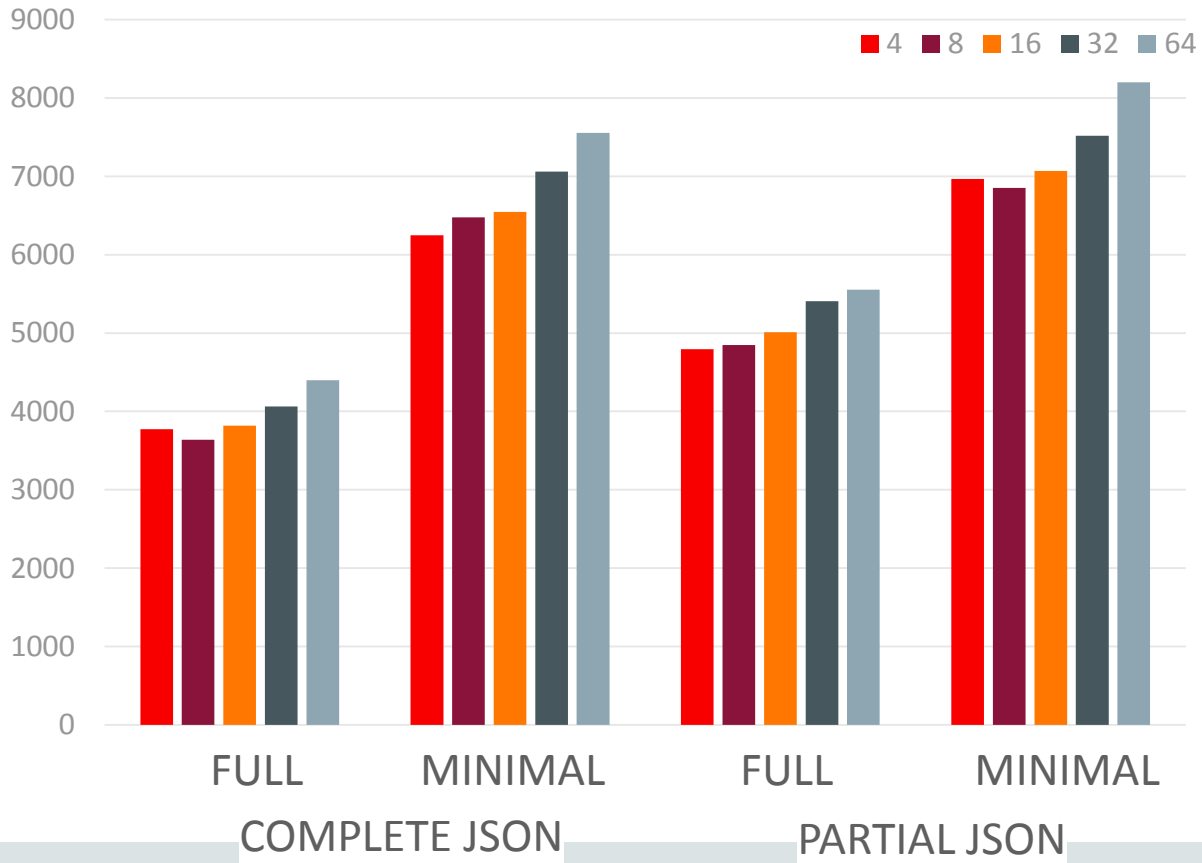
Efficient Replication of JSON Documents

Replicate only fields of the document that changed (Partial JSON Updates)

Throughput on the Master:
Partial JSON vs Complete JSON



Throughput on the Slave:
Partial JSON vs Ccomplete JSON



3 Enhancements in MySQL 8 (and 5.7)

- 3.1 Binary Log Metadata
- 3.2 Operations
- 3.3 Monitoring
- 3.4 Performance
- 3.5 Other

Changes to defaults in MySQL 8

High performance replication enabled out-of-the-box

- Binary log is **on** by default.
- Logging of slave updates is **on** by default.
- Replication metadata is stored in **InnoDB tables** by default instead of files.
- Row-based applier uses **hash scans** to find rows instead of table scans.
- Transaction write-set extraction is **on** by default.
- Binary log expiration is set to **30 days** by default.
- Server-id is set to **1** by default instead of **0**.

Other MySQL 8 Replication Enhancements

- Monitoring: Monitor replication even when disk full
- Monitoring: Current query being applied, even for row-based replication
- Monitoring: Replication filters statistics in performance schema
- Monitoring: Group Replication threads instrumented and shown in performance schema
- Monitoring: Group Replication conditional variables and mutexes instrumented and shown in performance schema
- Recoverability: Recover DDL and binary log together after a crash

Other MySQL 8 Replication Enhancements

- Operations: Restore global transaction identifiers metadata on a non-empty server
- Operations: Specify binary log file number after RESET MASTER
- Operations: Specify when binary log files are automatically purged (with second precision)

Backported to 5.7.19

- Operations: SAVEPOINT support when write sets are being extracted
- Operations: P_S table for consistent log positions (replacing potentially expensive FLUSH TABLE WITH READ LOCKS)

Backported to 5.7.21

- Operations: Support hostnames in Group Replication whitelist

Other MySQL 8 Replication Enhancements

- Troubleshooting: Dynamic and high performance debugging of group replication inter-node messaging

4 Enhancements in Labs

4.1 Operations

4.2 Monitoring

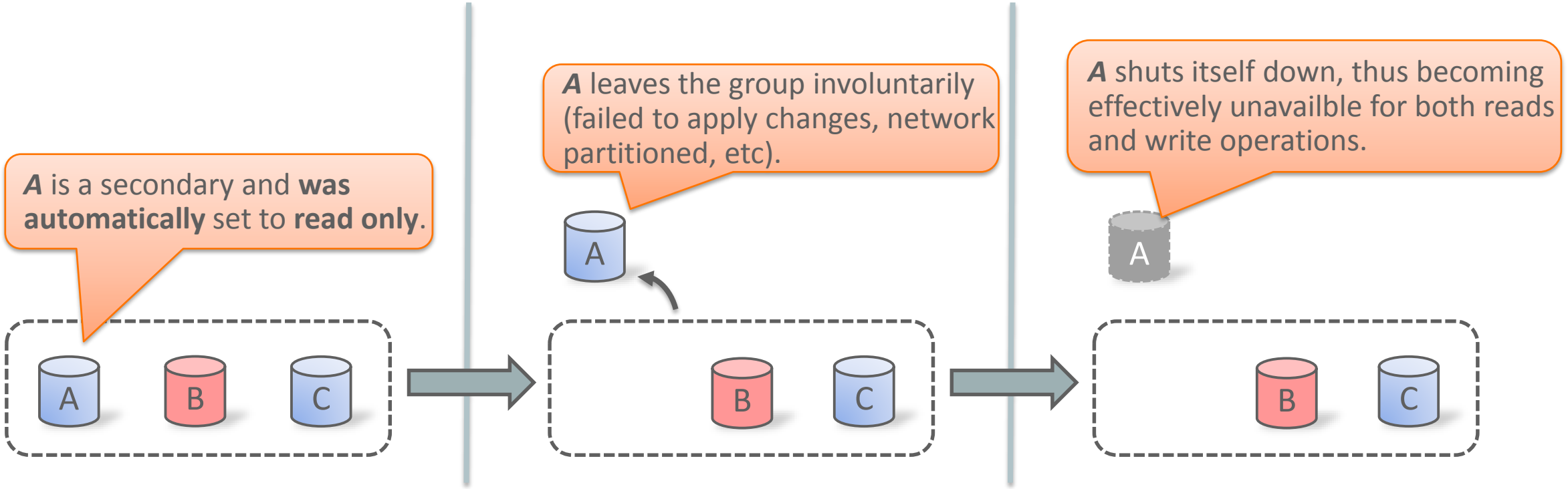
4 Enhancements in Labs

4.1 **Operations**

4.2 **Monitoring**

Automatic Abort Replicas that Leave the Group

Automatically Shutdown When Replica Leaves the Group Involuntarily



@@group_replication_exit_state_action={ READ_ONLY | ABORT_SERVER }

4 Enhancements in Labs

4.1 Operations

4.2 Monitoring

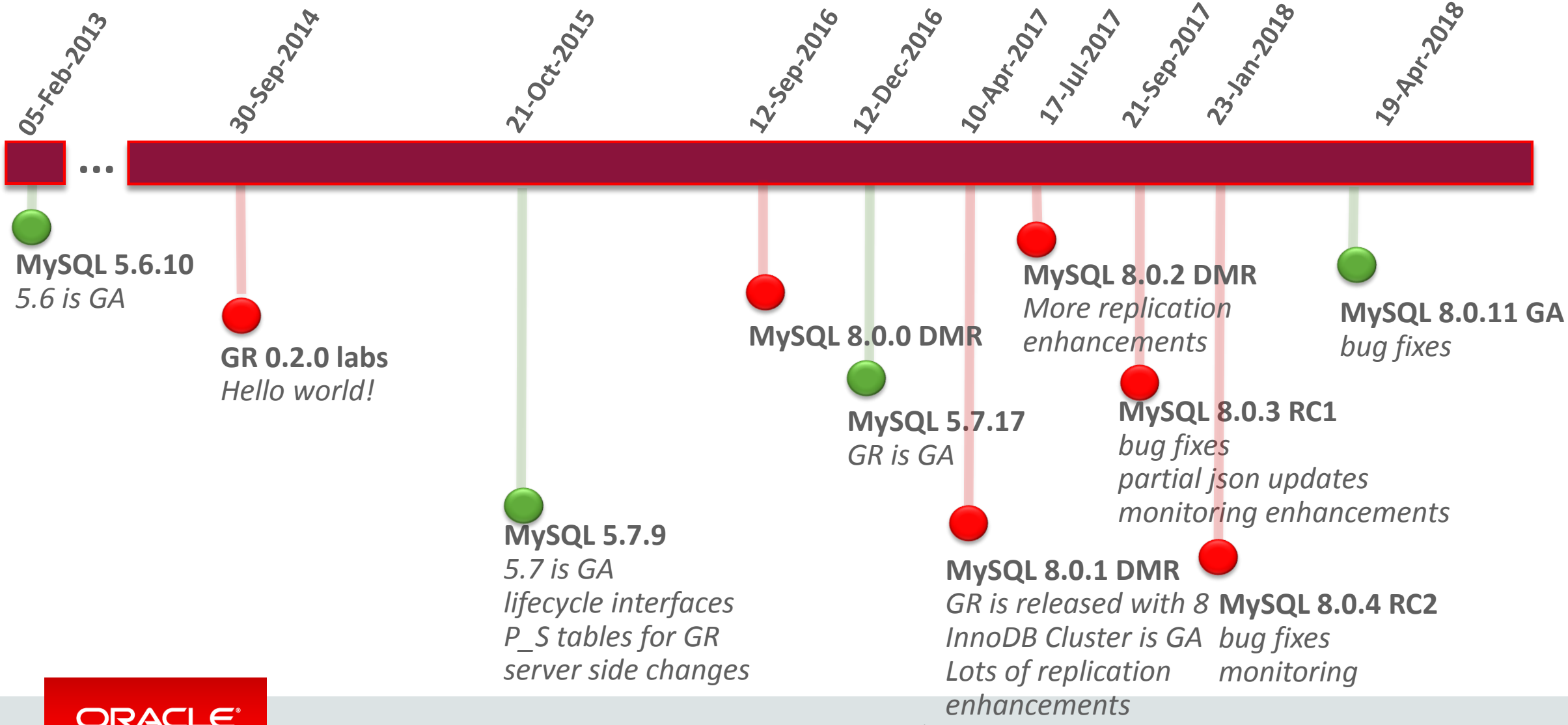
Group Replication Message Cache Memory Usage

- GCS/XCom's Paxos message cache is instrumented.
- GCS/XCom's Paxos message cache memory usage is exposed in performance schema.

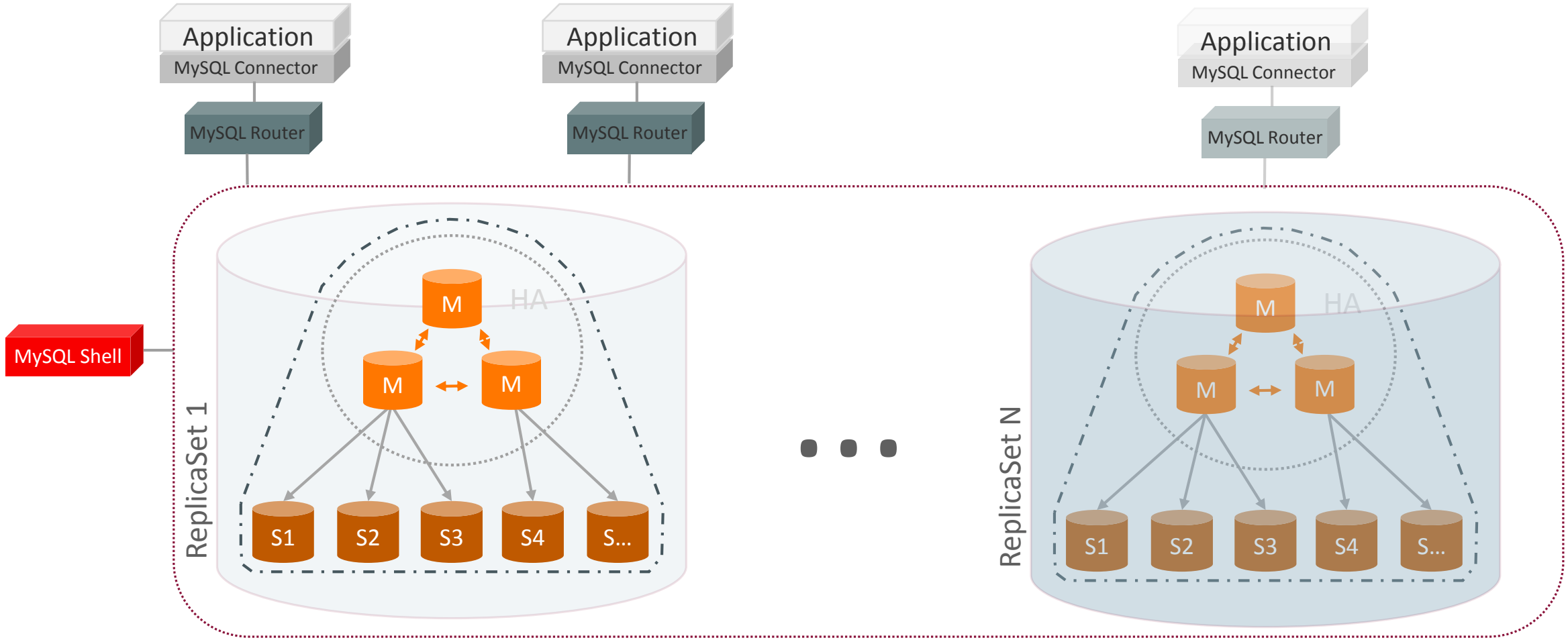
```
-- This is a session open on ServerA and the user is reading stats on GCS_Xcom message cache
ServerA> select * from memory_summary_global_by_event_name where event_name
like "%GCS_XCom%"\G
*************************** 1. row ***************************
                EVENT_NAME: memory/group_rpl/GCS_XCom::xcom_cache
               COUNT_ALLOC: 28890317
                COUNT_FREE: 28840318
   SUM_NUMBER_OF_BYTES_ALLOC: 24499151783
    SUM_NUMBER_OF_BYTES_FREE: 24470424555
              LOW_COUNT_USED: 0
          CURRENT_COUNT_USED: 49999
             HIGH_COUNT_USED: 50000
    LOW_NUMBER_OF_BYTES_USED: 0
CURRENT_NUMBER_OF_BYTES_USED: 28727228
   HIGH_NUMBER_OF_BYTES_USED: 135676530
1 row in set (0.01 sec)
```

5 Roadmap

The Road to MySQL 8 Group Replication and InnoDB Clusters



MySQL InnoDB Cluster: The End Goal



6 Conclusion

Conclusion

MySQL 8.0.11 GA is out:

- Performance/efficiency improvements
  - Smaller recovery times, faster applier, reduced storage footprint.
- Replication instrumentation
  - Enhanced lag monitoring, more introspection into Group Replication stats and threads
- Powerful Dev-Ops
  - Enhanced multi-source replication filters, controlled primary election and fine tunning of flow control.
  - Improved crash-recovery, new defaults, more flexible GTID handling.

Where to go from here?

- Packages
  - http://www.mysql.com/downloads/
- Documentation
  - https://dev.mysql.com/doc/refman/8.0/en/
- Blogs from the Engineers (news, technical information, and much more)
  - http://mysqlhighavailability.com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