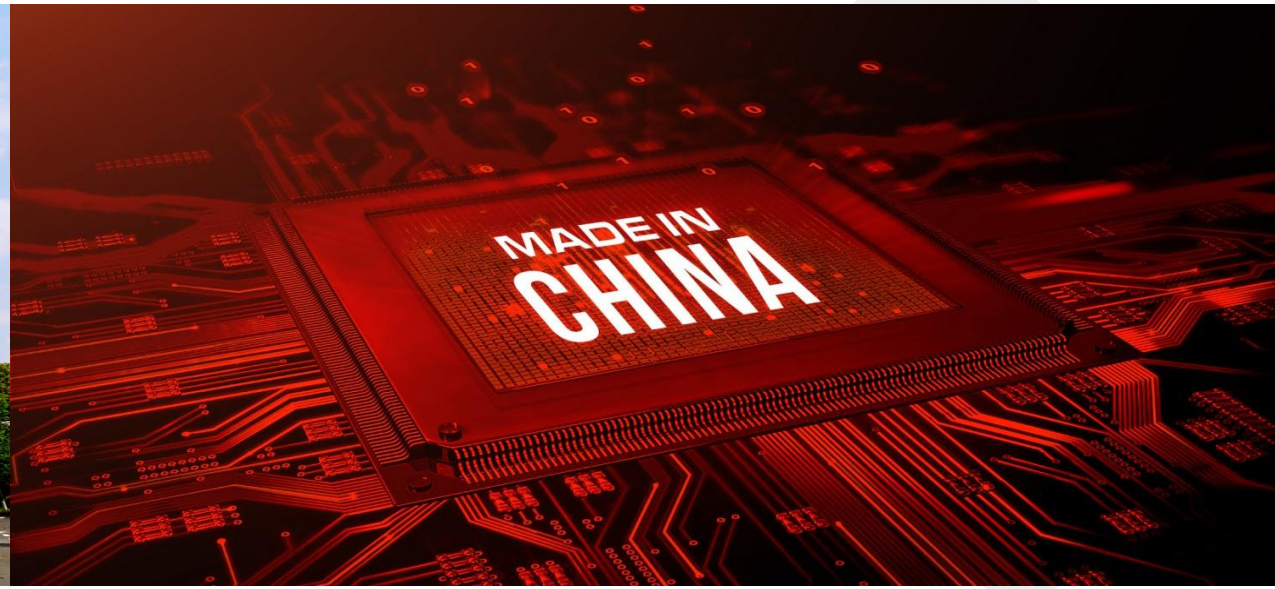
Great DB
万里数据库



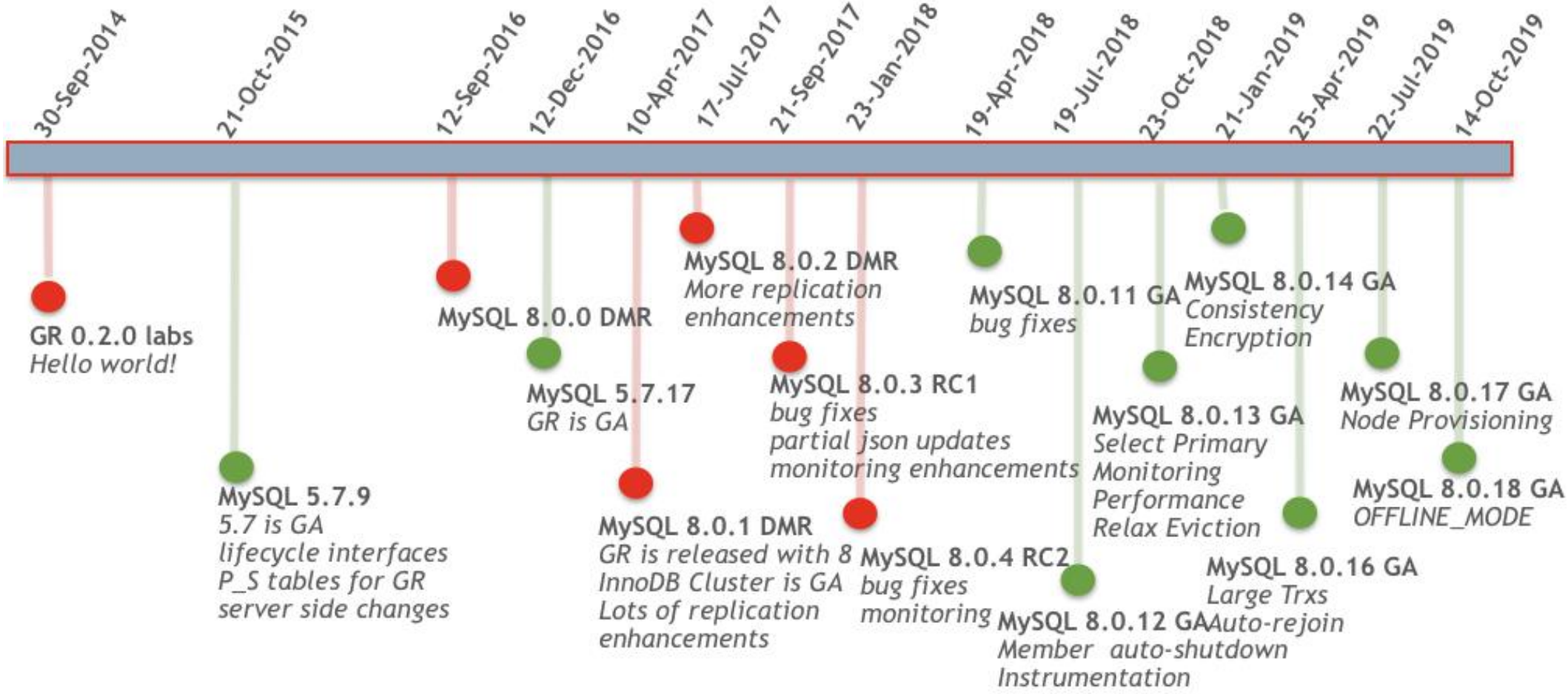
MGR Best Practice

万里数据库 娄帅

2021.5.22

MySQL Group Replication

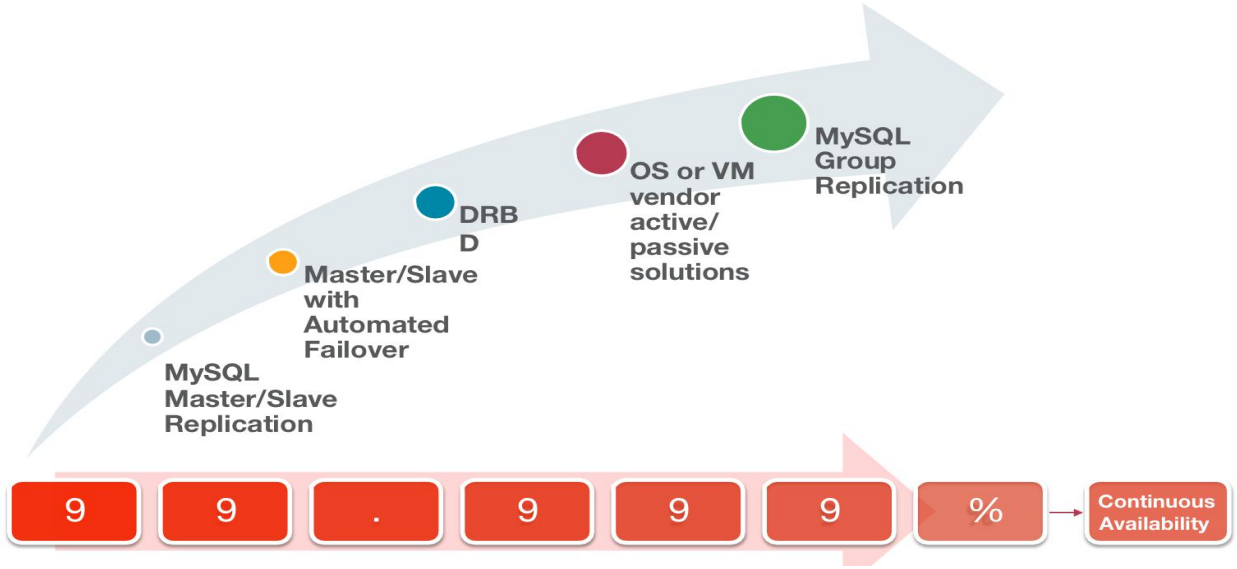
- Developed by Oracle
- GA in MySQL 5.7.17 on December 2016
- InnoDB Cluster作为整体解决方案



Asynchronous Replication vs. MGR

Async

- 异步传送
- 主 -> 从
- 从库通过binlog dump抽取主库binlog并执行
- 人工或者外部脚本进行故障切换



GR

- 全同步传送
- 节点间传递
- 多数派节点收到事务消息(PAXOS)
- 自动处理故障切换，集群成员变化，选主

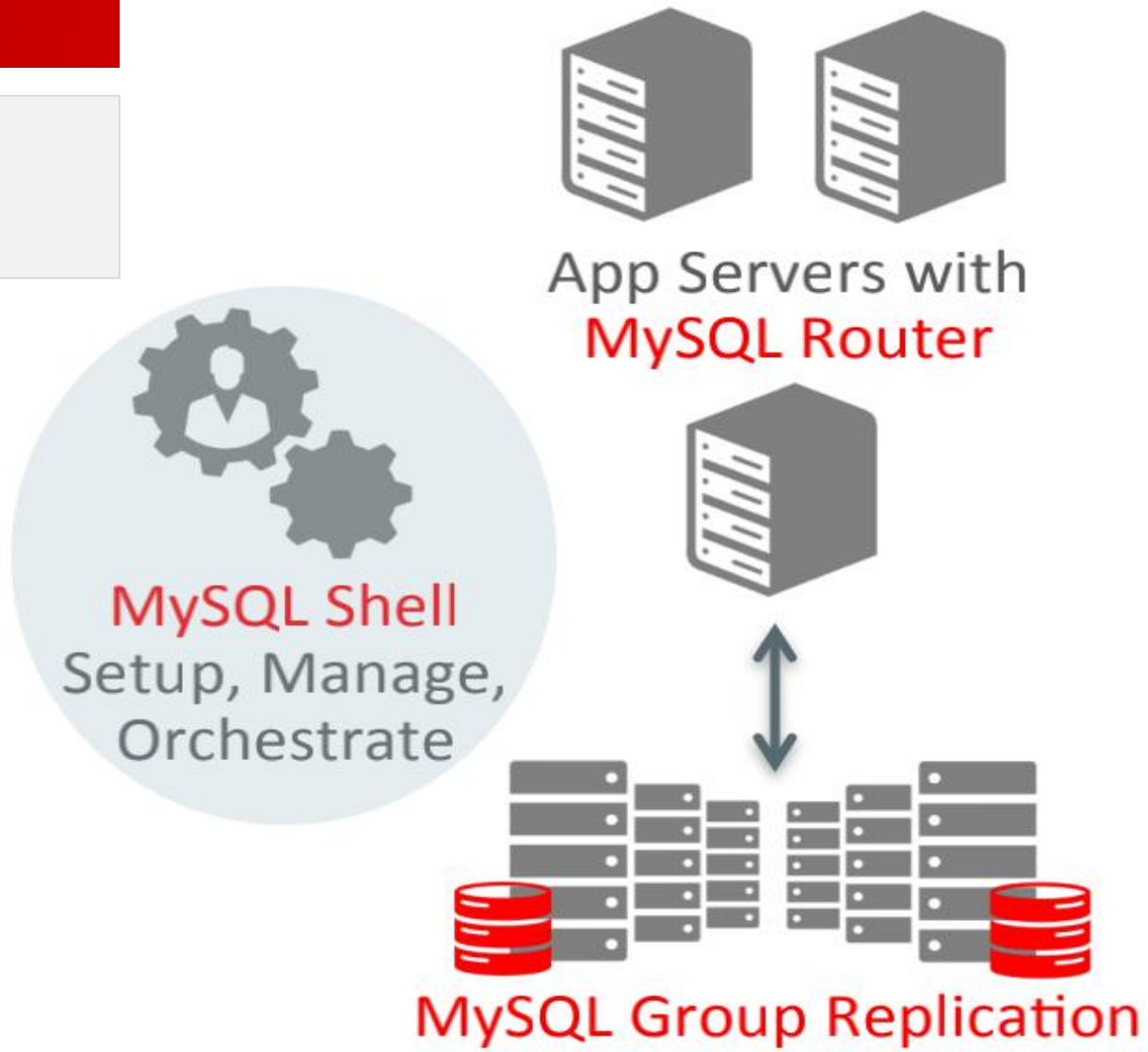
适用场景

- 数据强一致，故障时数据0丢失，RPO=0
- 更快的故障切换，无需第三方切换脚本
- 防止脑裂

InnoDB Cluster —— A Solution

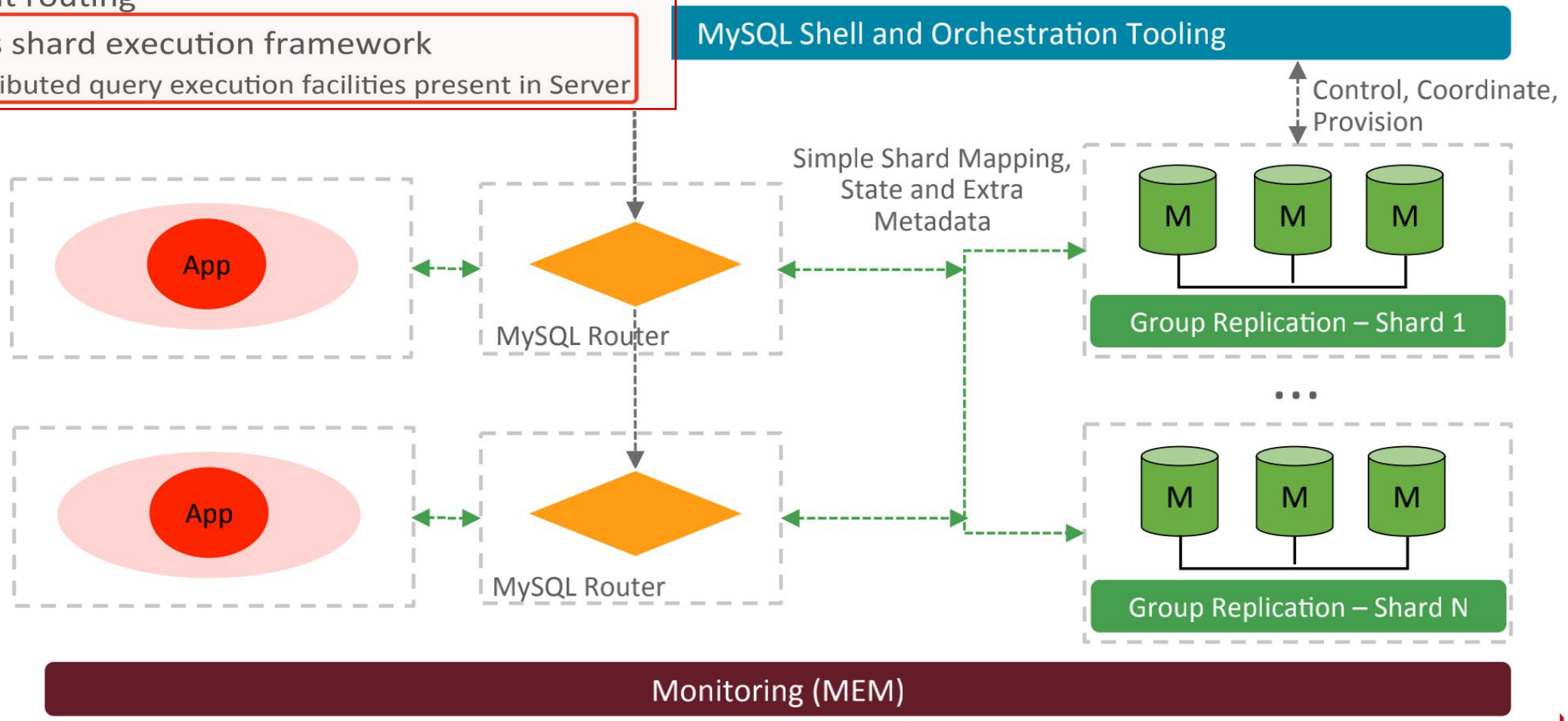
InnoDB Cluster解决方案

- MySQL Router：路由客户端连接
- MySQL Shell: 集群搭建、管理工具



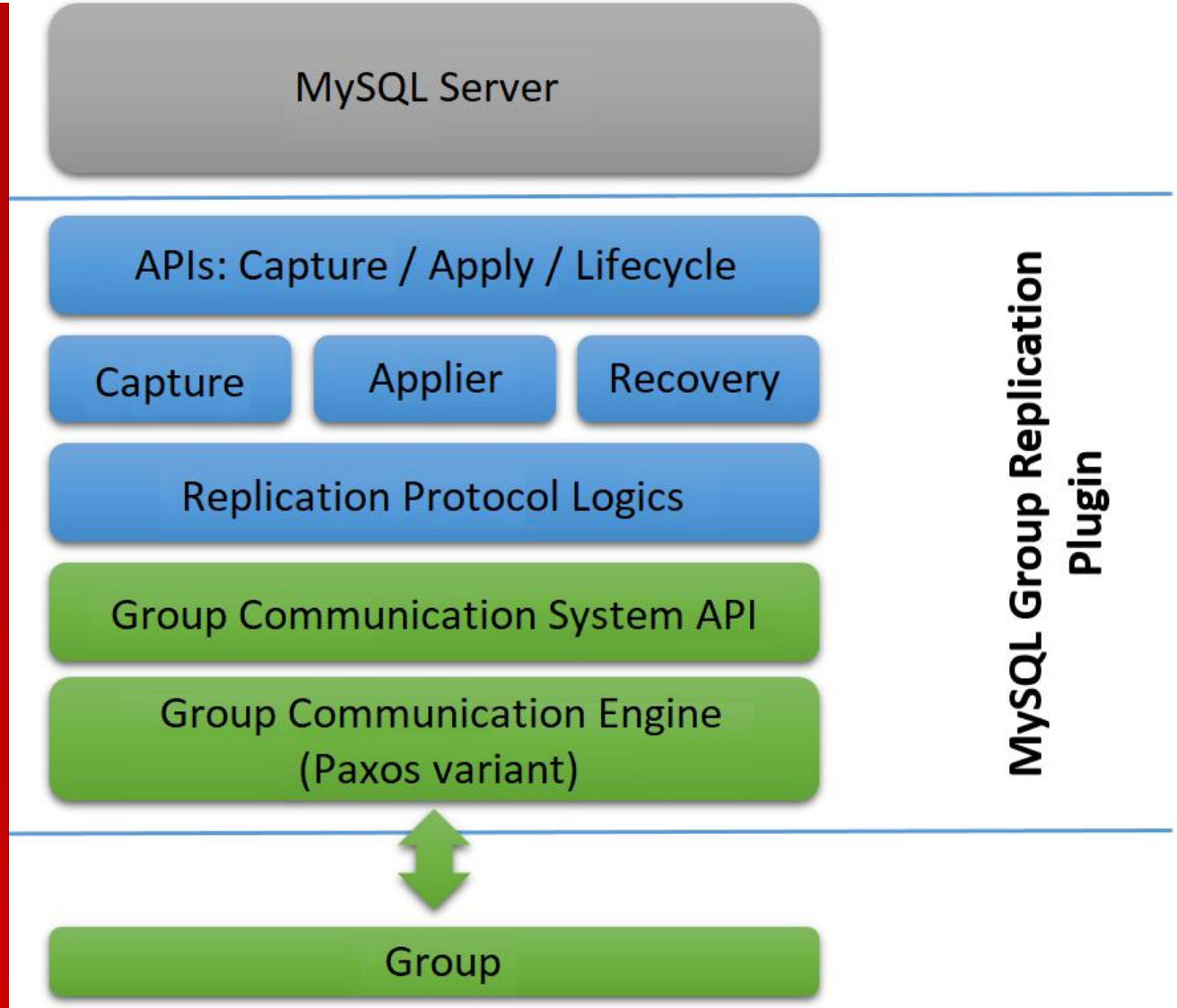
InnoDB Cluster: The End Goal

- MySQL Router
  - Manages shard mappings and related metadata
  - Manages client routing
  - Provides cross shard execution framework
    - On top of distributed query execution facilities present in Server

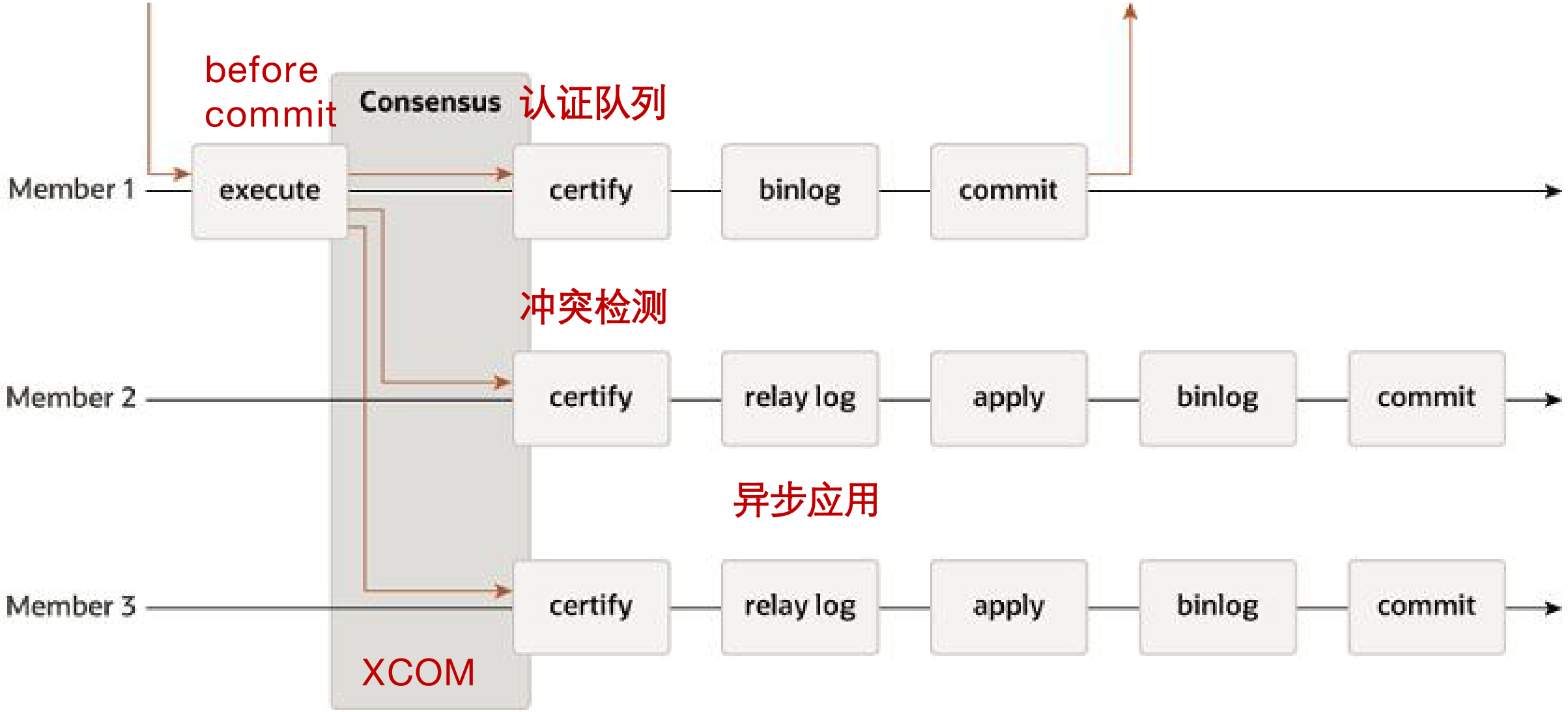


MGR Architecture

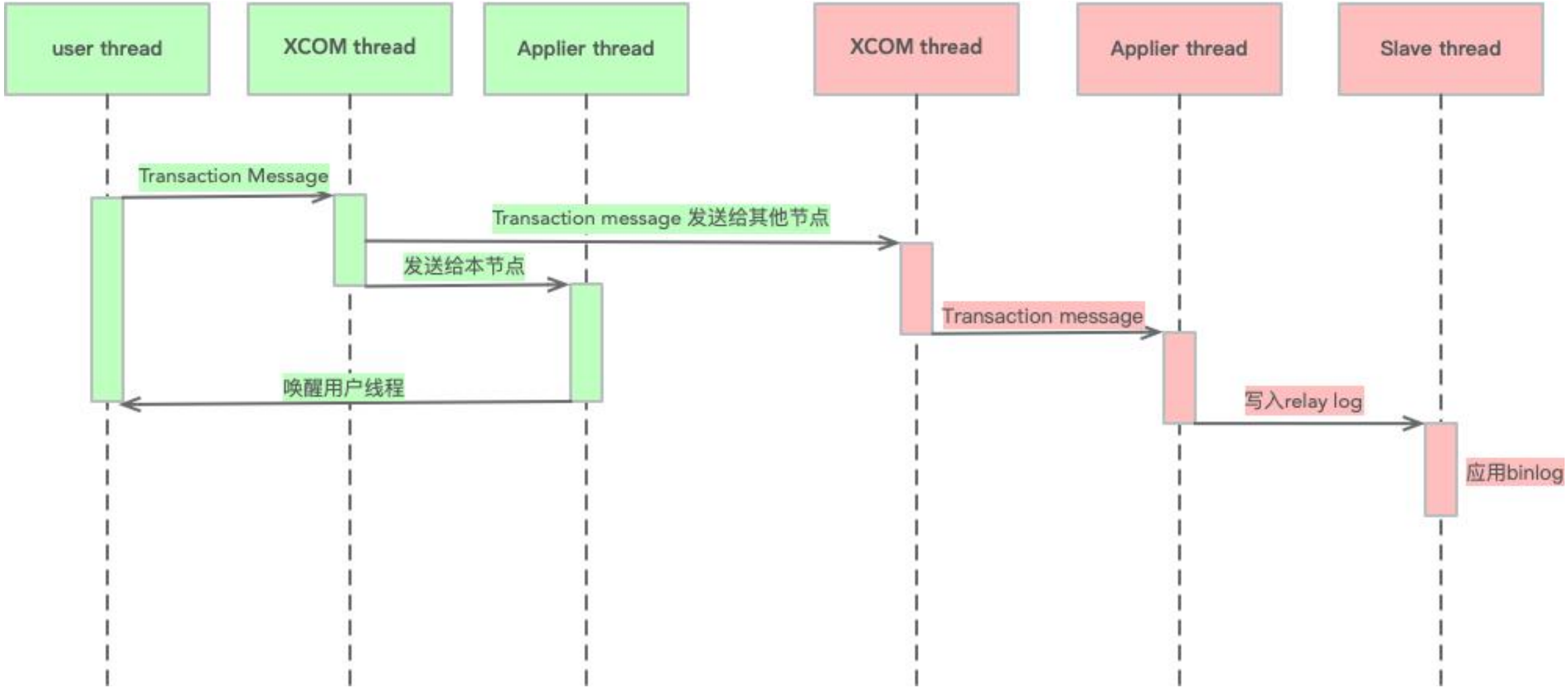
- **Capture:** 跟踪本节点的事务相关信息
- **Applier:** 执行其它节点的远程事务
- **Recovery:** 负责故障恢复时，选择donar节点，catch up binlog等
- **Replication Protocol Logics:** 消息的封装、接收XCOM返回的消、发送本节点消息给XCOM、冲突检测等
- **GCE:** GCS的具体实现Xcom (eXtended COMmunications)



Life of a Transaction Commit in MGR



Thread Viewport of Commit in MGR



目录

Architecure

Great DB 万里数据库

- 使用奇数个节点
- 网络稳定，延迟低，尽量避免WAN部署
- 使用单主模式
- 表必须有主键
- 必须使用InnoDB引擎
- BINLOG_FORMAT=ROW

Basic Configurations

Great DB 万里数据库

- group_replication_single_primary_mode=ON
  - 单主模式
- log_error_verbosity=3
  - 默认为2，只输出Error，Warning
  - 3包含Information，能够输出更多GR的日志
- group_replication_group_seeds=<ALL_NODES!>
  - 填写所有节点
- group_replication_bootstrap_group=OFF
  - 只有在搭建新集群的过程中打开
  - 新集群搭建完成后立刻关闭
  - 避免节点重启后，搭建新的集群

Large Transaction & Flow Control Configurations

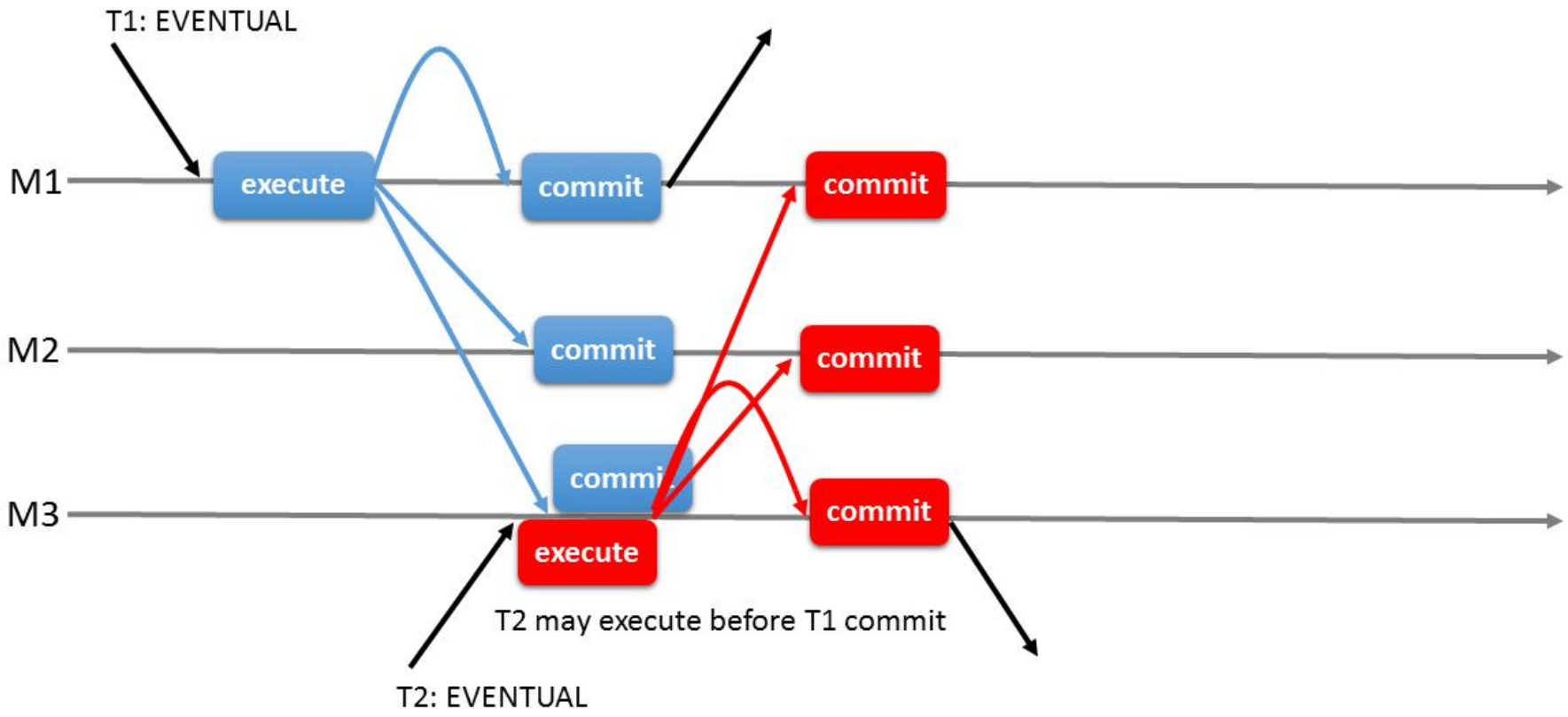
Great DB 万里数据库

- group_replication_transaction_size_limit=150000000
  - 单个事务大小上限
  - 尽量避免大事务出现
  - **只会在commit时报错，事务执行过程中即使超过阈值也无感知**
- group_replication_communication_max_message_size=10M
  - 将大事务切分成小包，进行paxos传递
- group_replication_flow_control_mode=ON
  - 流控开关
  - **触发流控后，只会延迟等待1s**
- group_replication_flow_control_certifier_threshold
  - 触发流控的待认证的队列长度
- group_replication_flow_control_applier_threshold
  - 触发流控的待执行的队列长度

Consistency Level —— EVENTUAL (Default)

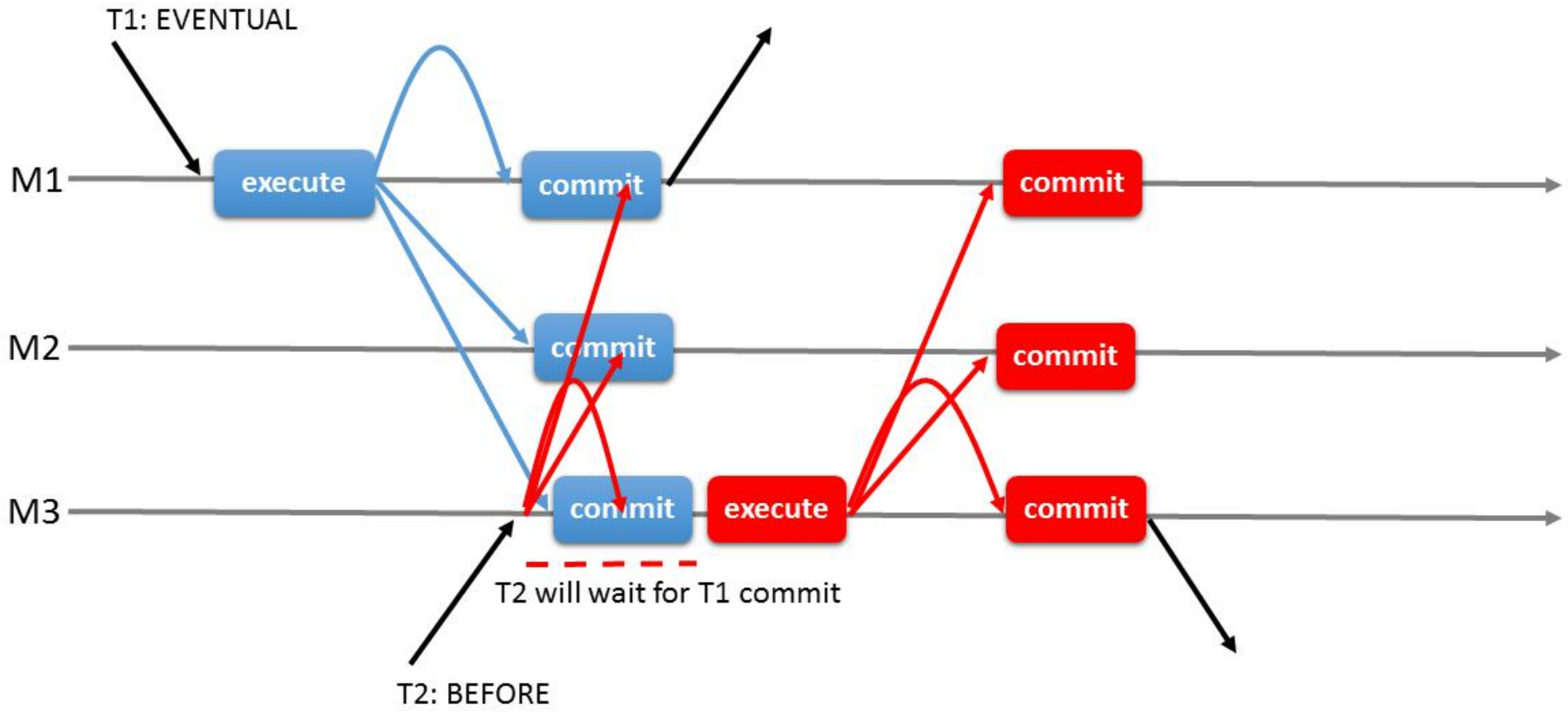
T2不关心是否有待应用的事务，不做任何等待操作。

存在读不到最新数据的可能。



Consistency Level —— BEFORE

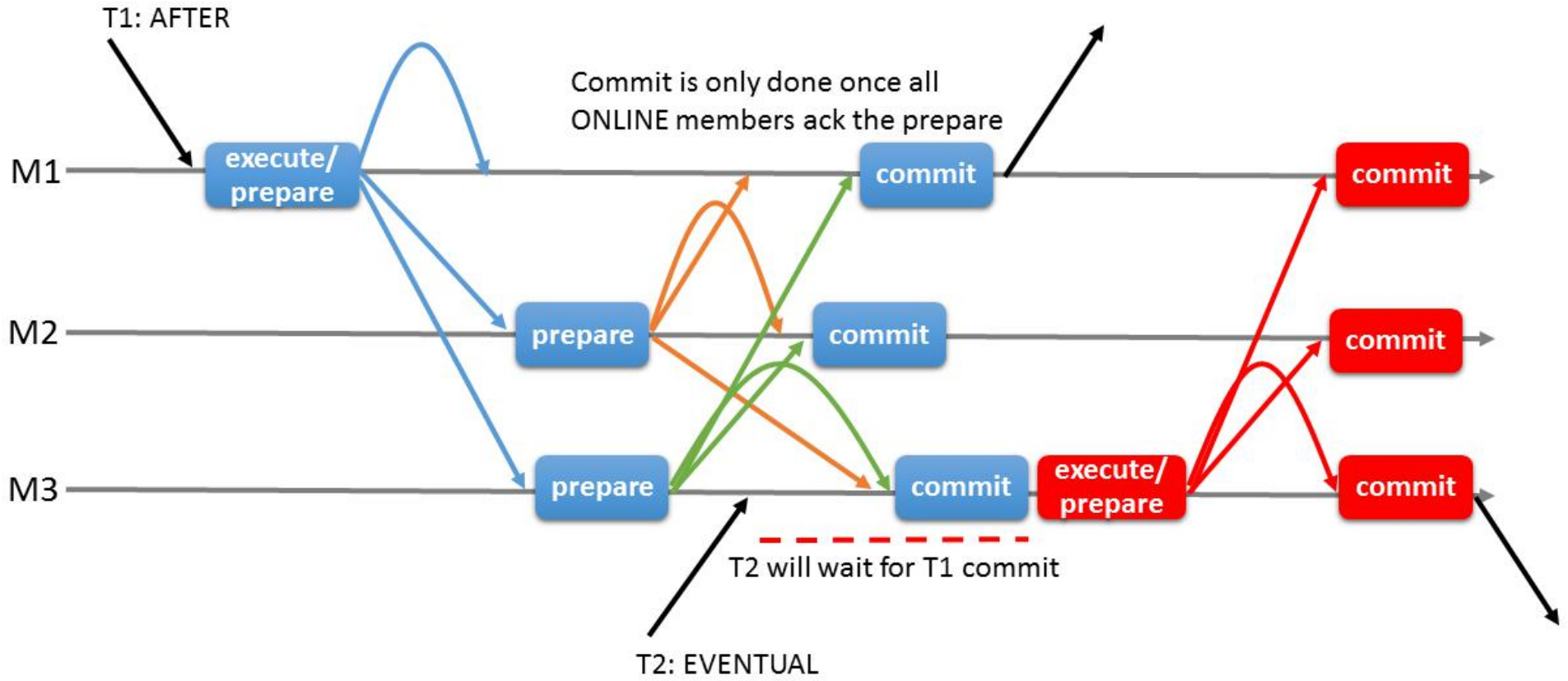
- T2等待待应用的事务执行完成，保证T2可以读到最新的数据。
- 增加T2的响应延迟，如果applier速度过慢，会导致延迟较大。
- BEFORE_ON_PRIMARY_FAILOVER: 发生选主后，事务会被阻塞，直到新主应用完堆积的日志。



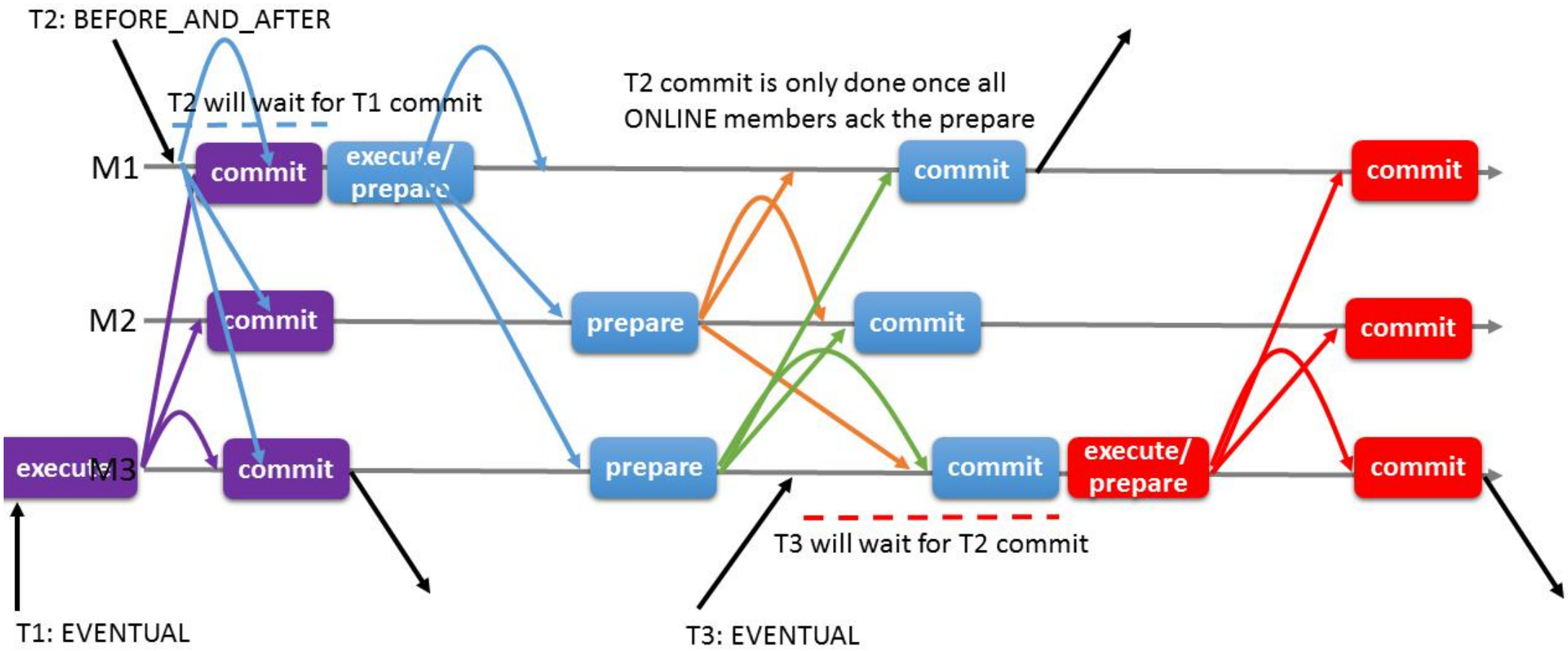
Consistency Level —— AFTER

- T1等待其它节点进入commit阶段后，才真正返回给客户。
- T2如果发现有prepare事务，需要等待prepare事务执行完成。

- 会增加T1的响应延迟。如果远端应用过慢，会导致T1等待时间过长。
- T2也需要等待T1执行完成。



Consistency Level —— BEFORE_AND_AFTER



Consistency Level —— How to Choose

Great DB 万里数据库

如果只在PRIMARY读写

- 要求写事务在其它节点同时应用，使用AFTER
- 否则使用BEFORE_ON_PRIMAY_FAILOVER

如果load balance读，不希望读到历史数据

- 大量写入场景，使用BEFORE
- 少量写入场景，使用AFTER
- 指定特定需要的事务使用BEFORE

Consistency Level —— How to Choose

- **目前不太建议使用AFTER隔离级别，机制比较复杂，存在几种已知未修复bug，会导致主节点或者其它节点异常退出。**

- **导致主节点退出，8.0.26将会修复。**
  - 2020-09-29T06:40:09.508840Z 17 [ERROR] [MY-013309] [Repl] Plugin group_replication reported: 'Transaction '1:247' does not exist on Group Replication consistency manager while receiving remote transaction prepare.'

- **新加入的节点直接退出集群**
- 2021-01-22T11:53:52.710397Z 28 [ERROR] [MY-013304] [Repl] Plugin group_replication reported: 'Error releasing transaction '2:7' for commit on session '31' after being prepared on all group members.'

- 2021-01-29T11:39:16.767485Z 29 [ERROR] [MY-013309] [Repl] Plugin group_replication reported: 'Transaction '2:7' does not exist on Group Replication consistency manager while receiving remote transaction prepare.'

Replication Configuration

- binlog_transaction_dependency_tracking=WRITESET
  - 提升slave执行的并发度
- slave_checkpoint_period=2
  - BEFORE级别下，提升从库读性能
- slave_parallel_workers
  - 合理配置，提升从库执行效率
- slave_parallel_type=LOGICAL_CLOCK
- slave_preserve_commit_order=ON

Membership Change Configurations

- group_replication_unreachable_majority_timeout=10
  - 网络分区时，少数派状等待此时长后，状态变为Error，回滚pending事务
- group_replication_autorejoin_tries=3
  - 自动尝试连入集群的次数，尝试间隔5min。
- group_replication_exit_state_action=READ_ONLY
  - 退出集群后，server的状态设置
  - 配合自己的路由软件进行合理设置
- group_replication_member_expel_timeout=5
  - 将suspicious节点踢出集群的等待时长
  - 如果网络环境一般，可以适当调大30-60，不要太大

Other Configuration Recommendations

Great DB 万里数据库

避免foreign key 的使用

- https://bugs.mysql.com/bug.php?id=97836
- 尤其避免foreign key部分引用的情况 pk(a,b,c)，fk ref (a)
- 导致secondary节点应用relay失败

自增值相关

group_replication_auto_increment_increment

- **自增步长，替代auto_increment_increment**
- 可以配置成集群节点个数
- 多主情况下尤其要注意

server_id

- **MGR情况下, server_id 作为auto_increment_offset**
- 每个节点的server_id尽量从1开始，1，2，3
- 多主情况下尤其要注意

Other Configuration Recommendations

- group_replication_member_weight
  - 选主过程中的节点权重
  - 可以将主机房的节点权重加大
- clone_valid_donor_list
  - 新加入节点，clone全量数据时，选择的donar节点
  - 尽量使用非主节点作为donar节点

Limitations

- binlog_format=ROW
- 使用InnoDB表
- 表需要有主键
- 节点数限制，上限9
- 事务大小限制
- 不要不同版本混合使用

多主模式下的限制

- LOCK
  - LOCK TABLE
  - GET_LOCK
  - GAP LOCK
- 不支持SERIALIZABLE
- DDL和DML在不同节点并发执行
- SELECT FOR UPDATE导致DEAD LOCK

Performance_Schema

```
mysql3> SELECT * FROM performance_schema.replication_group_members\G
*************************** 1. row ***************************
  CHANNEL_NAME: group_replication_applier
     MEMBER_ID: ade14d5c-9e1e-11e7-b034-08002718d305
   MEMBER_HOST: mysql4
   MEMBER_PORT: 3306
  MEMBER_STATE: ONLINE
   MEMBER_ROLE: SECONDARY
MEMBER_VERSION: 8.0.16
*************************** 2. row ***************************
  CHANNEL_NAME: group_replication_applier
     MEMBER_ID: b9d01593-9dfb-11e7-8ca6-08002718d305
   MEMBER_HOST: mysql3
   MEMBER_PORT: 3306
  MEMBER_STATE: ONLINE
   MEMBER_ROLE: PRIMARY
MEMBER_VERSION: 8.0.16
```

成员状态

成员角色

Performance_Schema

```
mysql> select * from performance_schema.replication_group_member_stats\G
```

```
*************************** 1. row ***************************
                           CHANNEL_NAME: group_replication_applier
                                VIEW_ID: 15059231192196925:2
                              MEMBER_ID: ade14d5c-9e1e-11e7-b034-08002...
            COUNT_TRANSACTIONS_IN_QUEUE: 0
             COUNT_TRANSACTIONS_CHECKED: 27992
               COUNT_CONFLICTS_DETECTED: 0
      COUNT_TRANSACTIONS_ROWS_VALIDATING: 0
      TRANSACTIONS_COMMITTED_ALL_MEMBERS: 8fc848d7-9e1c-11e7-9407-08002...
b9d01593-9dfb-11e7-8ca6-08002718d305:1-21,
da2f0910-8767-11e6-b82d-08002718d305:1-164741
          LAST_CONFLICT_FREE_TRANSACTION: 8fc848d7-9e1c-11e7-9407-08002...
COUNT_TRANSACTIONS_REMOTE_IN_APPLIER_QUEUE: 0
       COUNT_TRANSACTIONS_REMOTE_APPLIED: 27992
       COUNT_TRANSACTIONS_LOCAL_PROPOSED: 0
```

等待冲突检测的队列中的事务数

等待slave线程apply的事务数

```
************ 2. row ***************************
                           CHANNEL_NAME: group_replication_applier
                                VIEW_ID: 15059231192196925:2
                              MEMBER_ID: b9d01593-9dfb-11e7-8ca6-08002...
            COUNT_TRANSACTIONS_IN_QUEUE: 0
             COUNT_TRANSACTIONS_CHECKED: 28000
               COUNT_CONFLICTS_DETECTED: 0
      COUNT_TRANSACTIONS_ROWS_VALIDATING: 0
      TRANSACTIONS_COMMITTED_ALL_MEMBERS: 8fc848d7-9e1c-11e7-9407-08002...
b9d01593-9dfb-11e7-8ca6-08002718d305:1-21,
da2f0910-8767-11e6-b82d-08002718d305:1-164741
          LAST_CONFLICT_FREE_TRANSACTION: 8fc848d7-9e1c-11e7-9407-08002...
COUNT_TRANSACTIONS_REMOTE_IN_APPLIER_QUEUE: 0
       COUNT_TRANSACTIONS_REMOTE_APPLIED: 1
       COUNT_TRANSACTIONS_LOCAL_PROPOSED: 28000
       COUNT_TRANSACTIONS_LOCAL_ROLLBACK: 0
```

Status During Recovery

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```
mysql> SHOW SLAVE STATUS FOR CHANNEL 'group_replication_recovery'\G
```

```
*************************** 1. row ***************************
           Slave_IO_State:
              Master_Host: <NULL>
              Master_User: gr_repl
              Master_Port: 0
                    ...
           Relay_Log_File: mysql4-relay-bin-group_replication_recovery.000001
                    ...
            Slave_IO_Running: No
           Slave_SQL_Running: No
                  ...
           Executed_Gtid_Set: 5de4400b-3dd7-11e6-8a71-08002774c31b:1-814089,
afb80f36-2bff-11e6-84e0-0800277dd3bf:1-5718
                  ...
             Channel_Name: group_replication_recovery
```

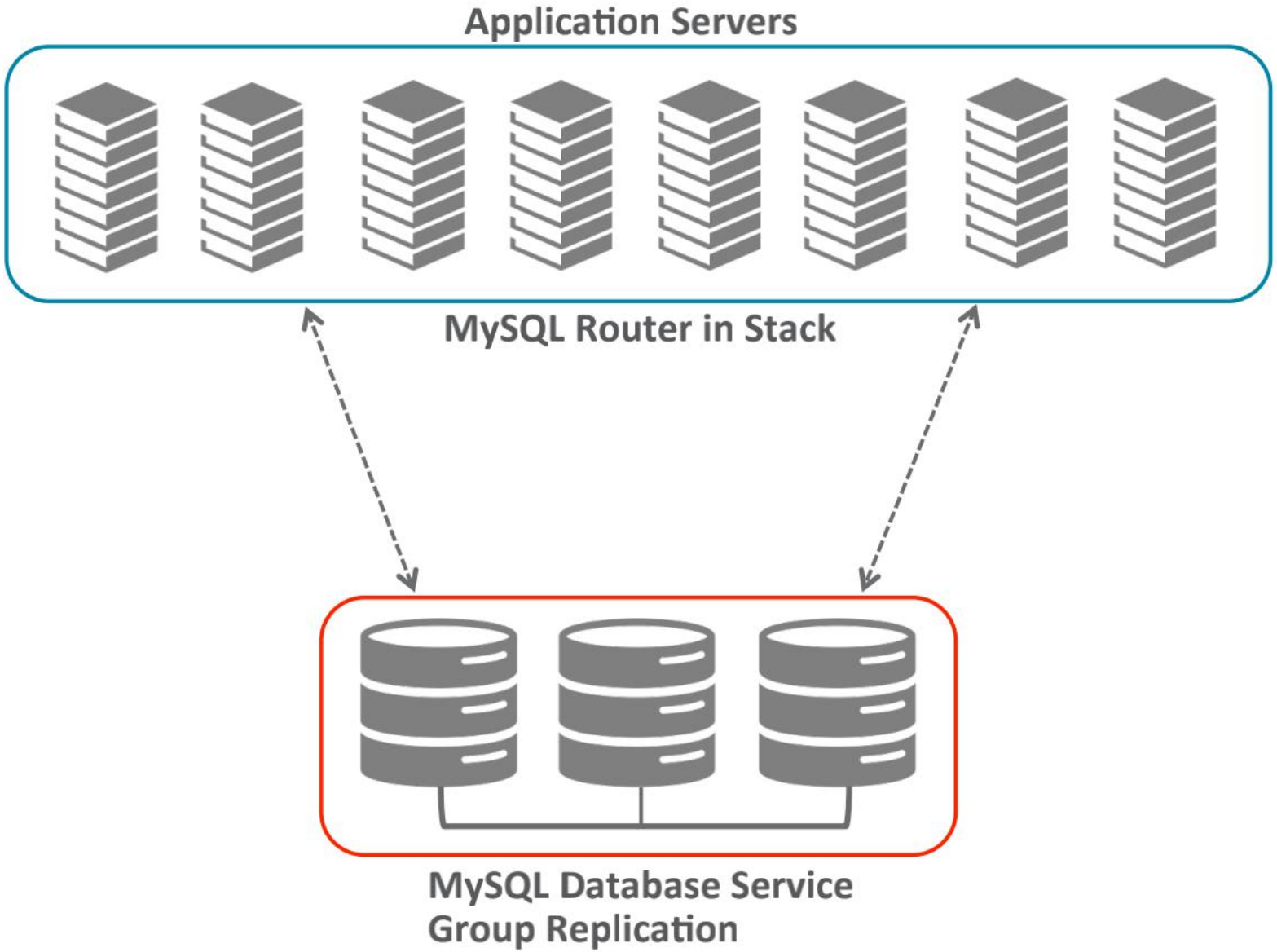
Change Primary Member

```
+---------------+--------------+-------------+----------------+
| member_host   | member_state | member_role | member_version |
+---------------+--------------+-------------+----------------+
| 172.28.128.15 | ONLINE       | SECONDARY   | 8.0.22         |
| 172.28.128.14 | ONLINE       | PRIMARY     | 8.0.22         |
| 172.28.128.13 | ONLINE       | SECONDARY   | 8.0.22         |
+---------------+--------------+-------------+----------------+
3 rows in set (0.00 sec)
```

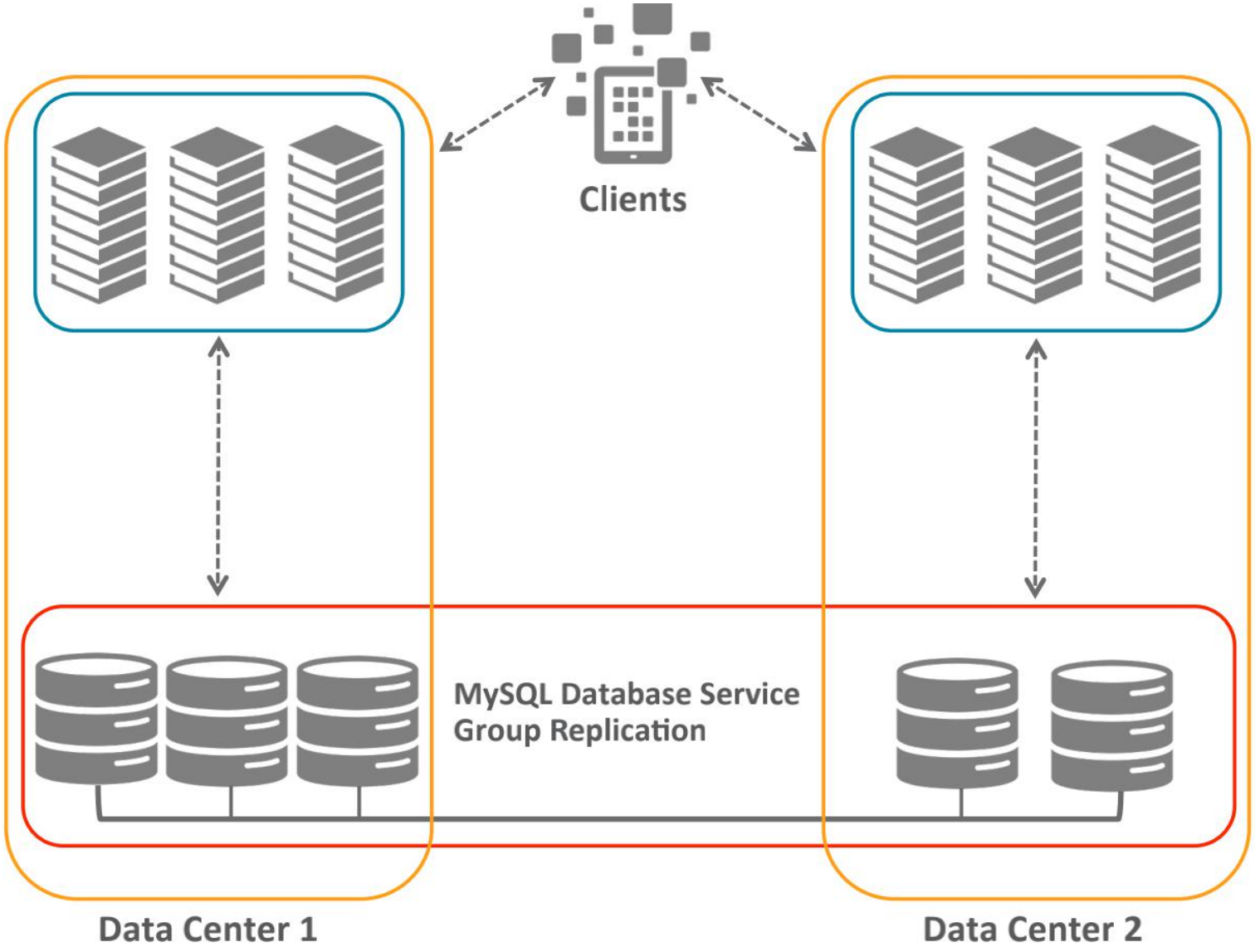
```
mysql> select group_replication_set_as_primary('c5aed435-d58d-11ea-bb26-5254004d77d3');
+-----------------------------------------------------------------------------+
| group_replication_set_as_primary('c5aed435-d58d-11ea-bb26-5254004d77d3') |
+-----------------------------------------------------------------------------+
| Primary server switched to: c5aed435-d58d-11ea-bb26-5254004d77d3         |
+-----------------------------------------------------------------------------+
1 row in set (1.03 sec)

mysql> select member_host,member_state,member_role,member_version from performance_schema.replication_group_members;
+---------------+--------------+-------------+----------------+
| member_host   | member_state | member_role | member_version |
+---------------+--------------+-------------+----------------+
| 172.28.128.15 | ONLINE       | PRIMARY     | 8.0.22         |
| 172.28.128.14 | ONLINE       | SECONDARY   | 8.0.22         |
| 172.28.128.13 | ONLINE       | SECONDARY   | 8.0.22         |
+---------------+--------------+-------------+----------------+
3 rows in set (0.00 sec)
```

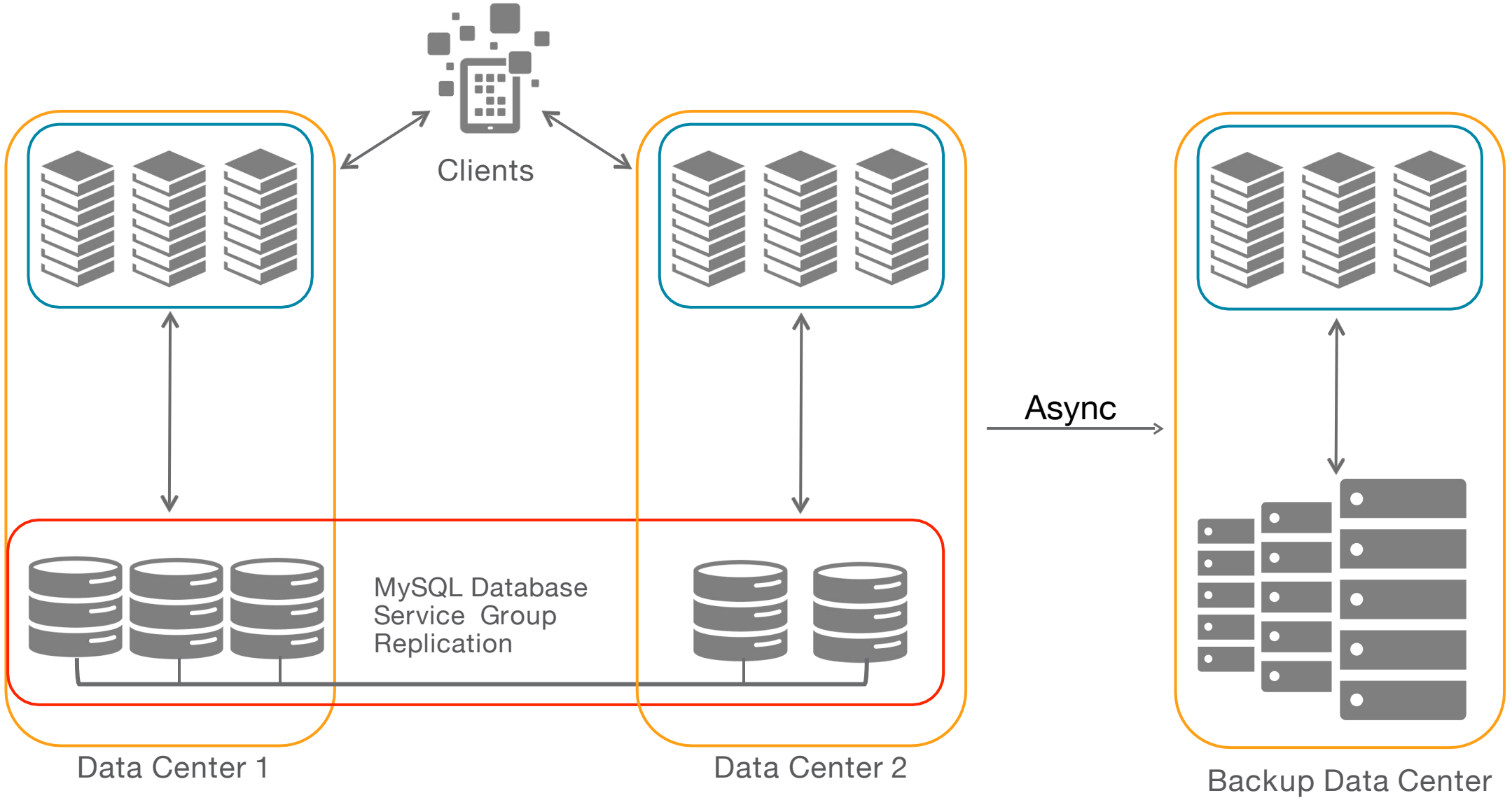
Single Data Center



Two Data Centers In One City



Three Data Centers in Two Cities



References

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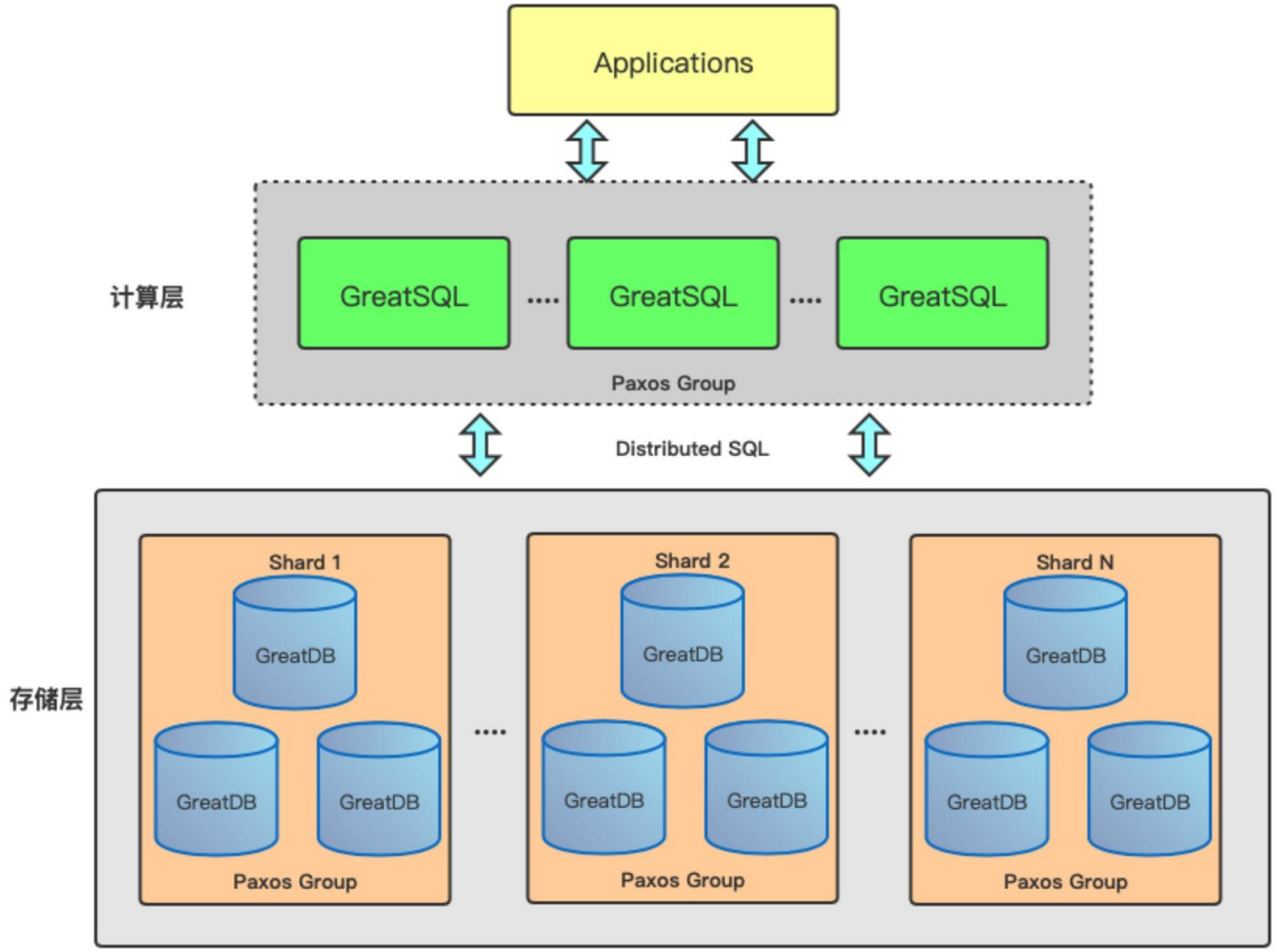
4. MySQL InnoDB Cluster - New Features in 8.0 Releases - Best Practices
5. MySQL Group Replication & MySQL InnoDB Cluster
6. MySQL InnoDB Cluster in a Nutshell

GreatDB Cluster




互动答疑环节

不忘DB初心，牢记万里使命