MySQL Cluster
Introduction and latest news from OOW

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Today's Database Requirements

Extreme Write Scalability

Real-Time User Experience

Rock Solid Reliability

Rapid Service Innovation

Today's Database Requirements

Extrer

ence

Transactional Integrity
OLTP + Real-Time Analytics
Standards & Skillsets

Rock Solid Reliability

Rapid Service Innovation

Who's Using MySQL Cluster

MySQL Cluster Overview

HIGH SCALE, READS + WRITES	• Auto-Sharding, Multi-Master • ACID Compliant, OLTP + Real-Time Analytics
99.999% AVAILABILITY	• Shared nothing, no Single Point of Failure • Self Healing + On-Line Operations
REAL-TIME	• In-Memory Optimization + Disk-Data • Predictable Low-Latency, Bounded Access Time
SQL + NoSQL	• Key/Value + Complex, Relational Queries • SQL + Memcached + JavaScript + Java + HTTP/REST & C++
LOW TCO	• Open Source + Commercial Editions • Commodity hardware + Management, Monitoring Tools

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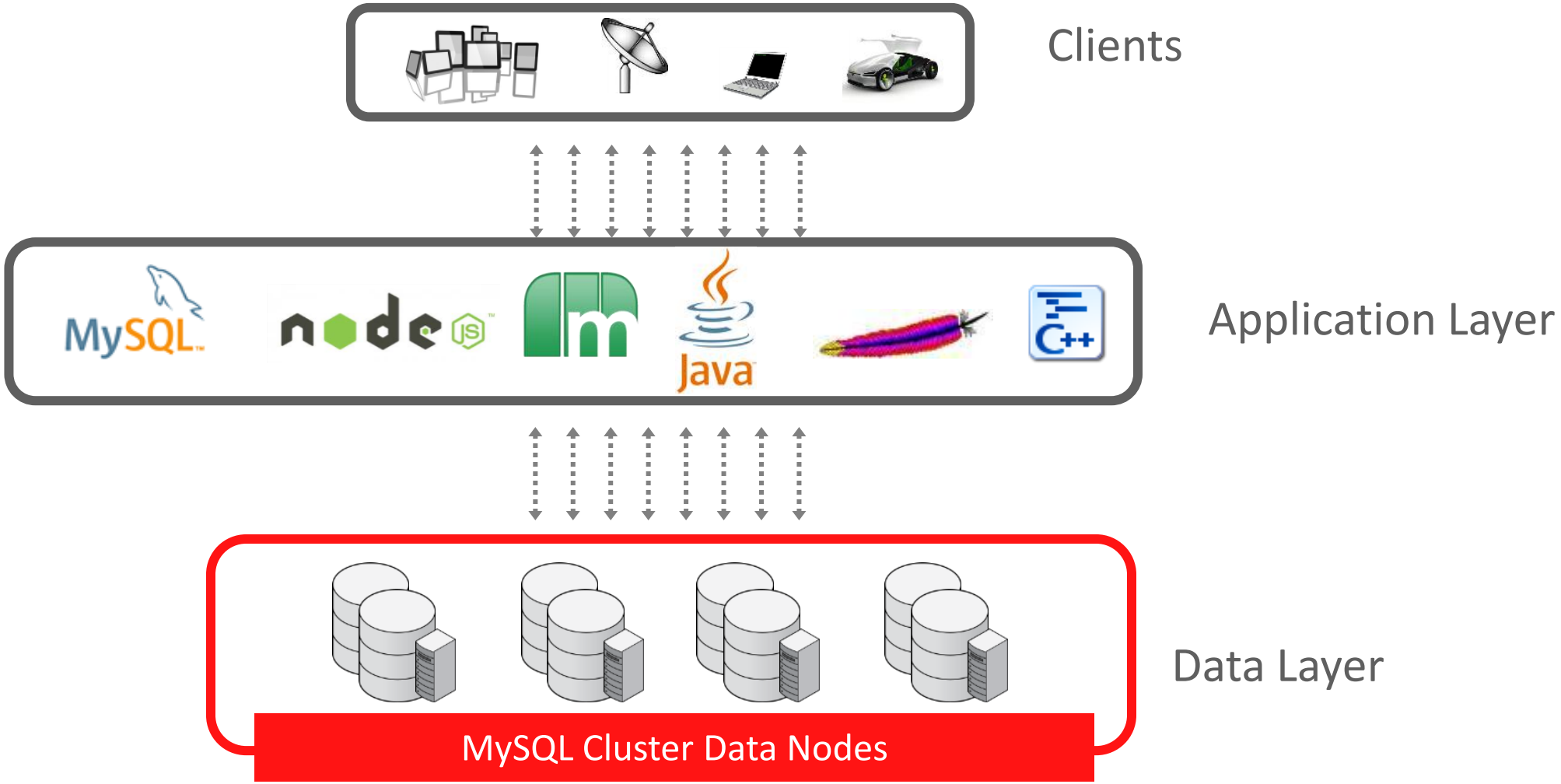
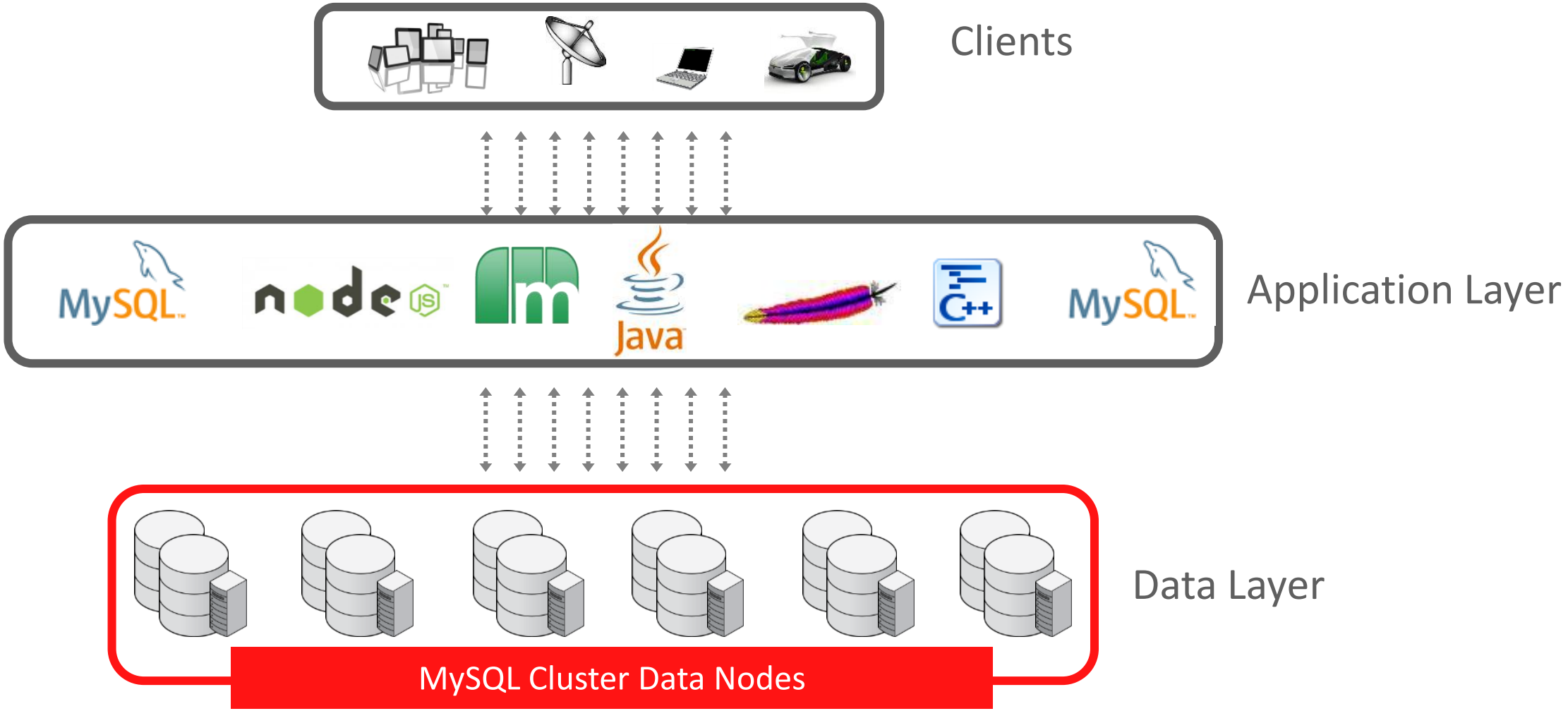
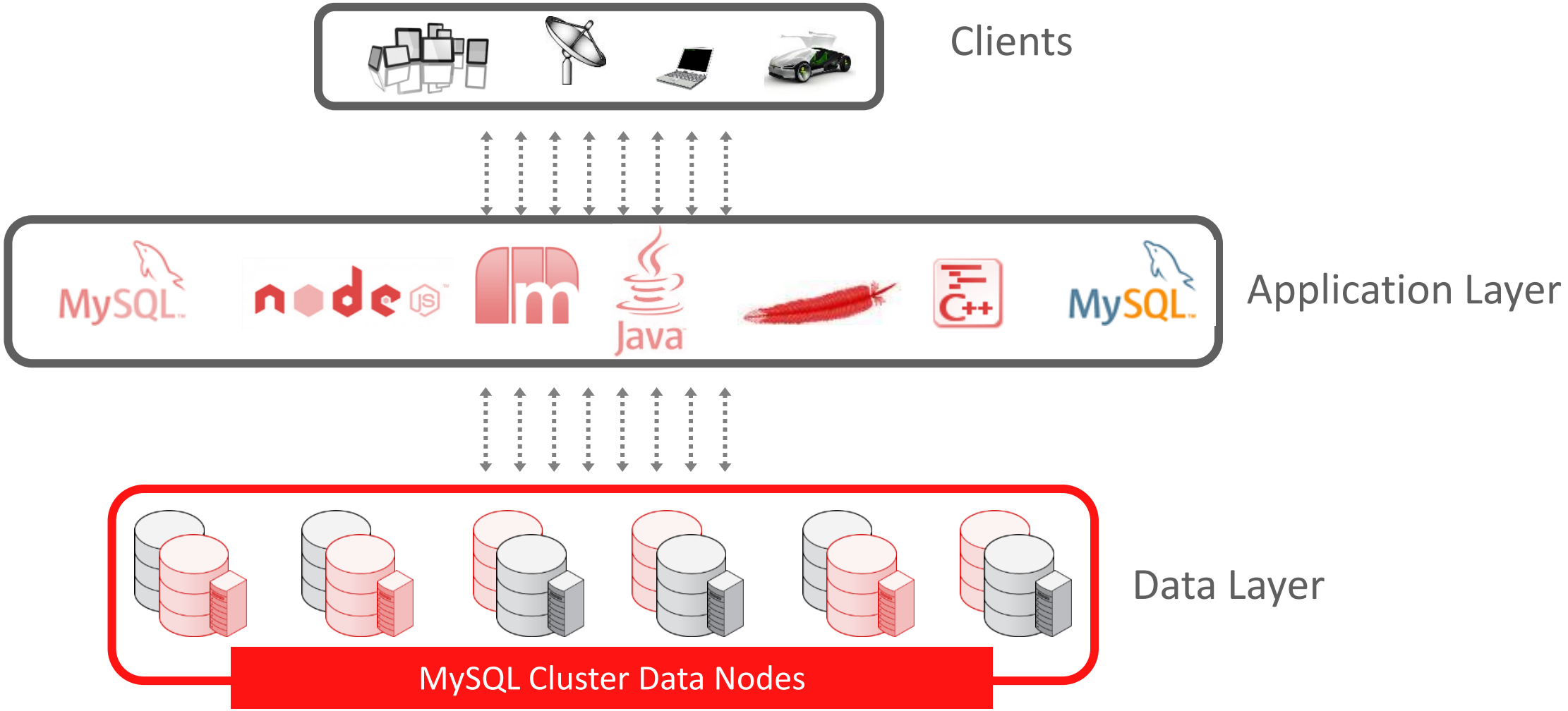
MySQL Cluster Architecture



MySQL Cluster Scaling



MySQL Cluster HA

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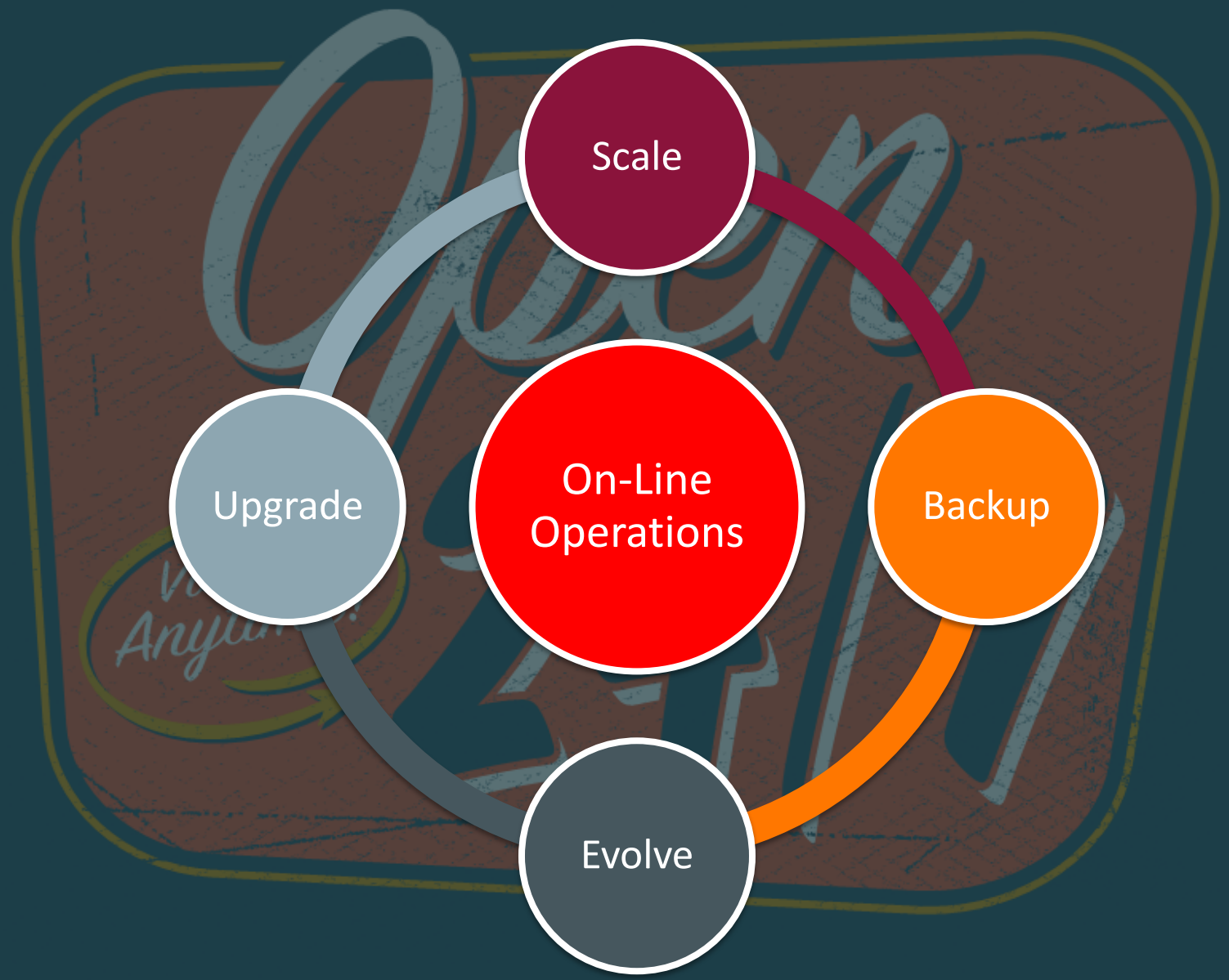
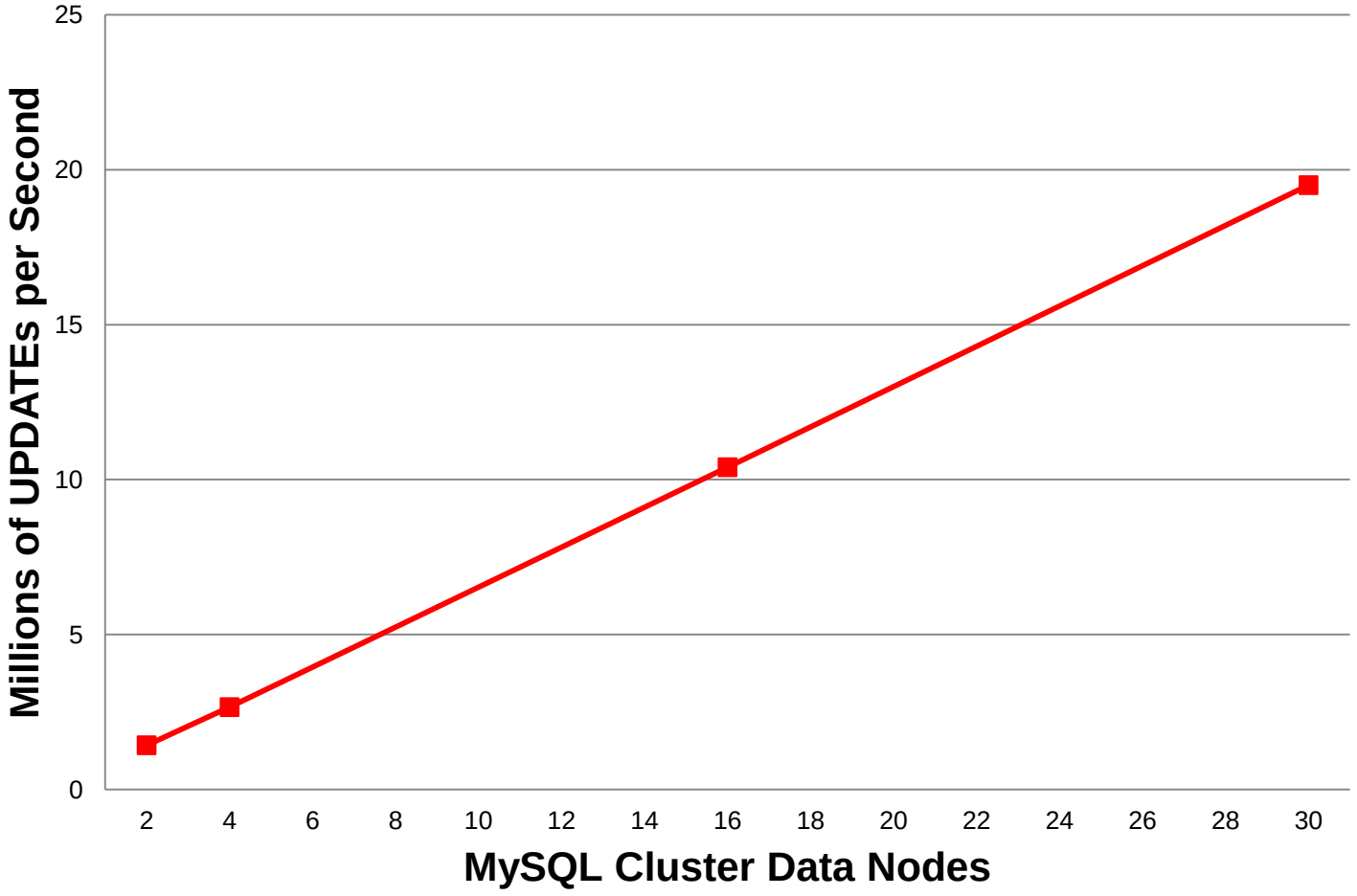

Scale
Upgrade
On-Line Operations
Backup
Evolve

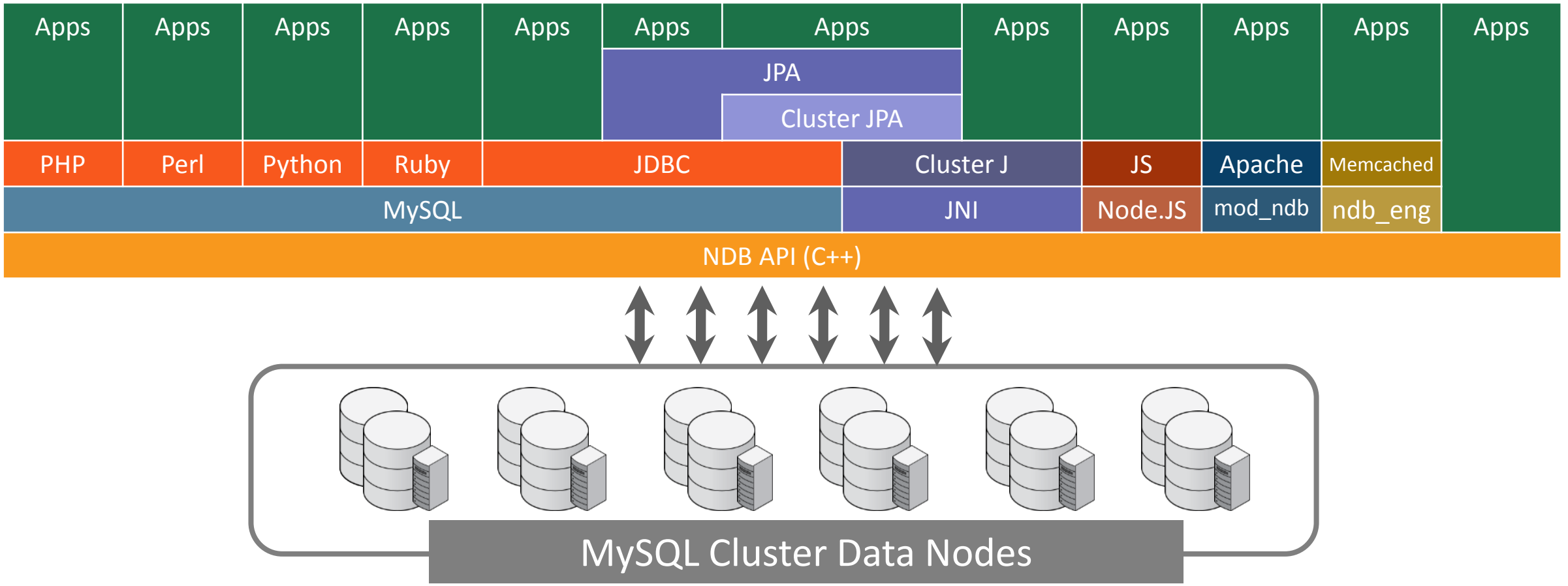
MySQL Cluster 7.3: 1.2 Billion UPDATEs per Minute



- NoSQL C++ API, flexaSynch benchmark
- 30 x Intel E5-2600 Intel Servers, 2 socket, 64GB
- ACID Transactions, with Synchronous Replication


SQL
NoSQL

NoSQL Access to MySQL Cluster data



Cluster & Memcached – Schema-Free

Application view

key value

<town:maidenhead,SL6>

SQL view

key value

<town:maidenhead,SL6>

Key	Value
town:maidenhead	SL6

generic table

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Cluster & Memcached - Configured Schema

key value

<town:maidenhead,SL6>

Application view

SQL view

prefix key value

<town:maidenhead,SL6>

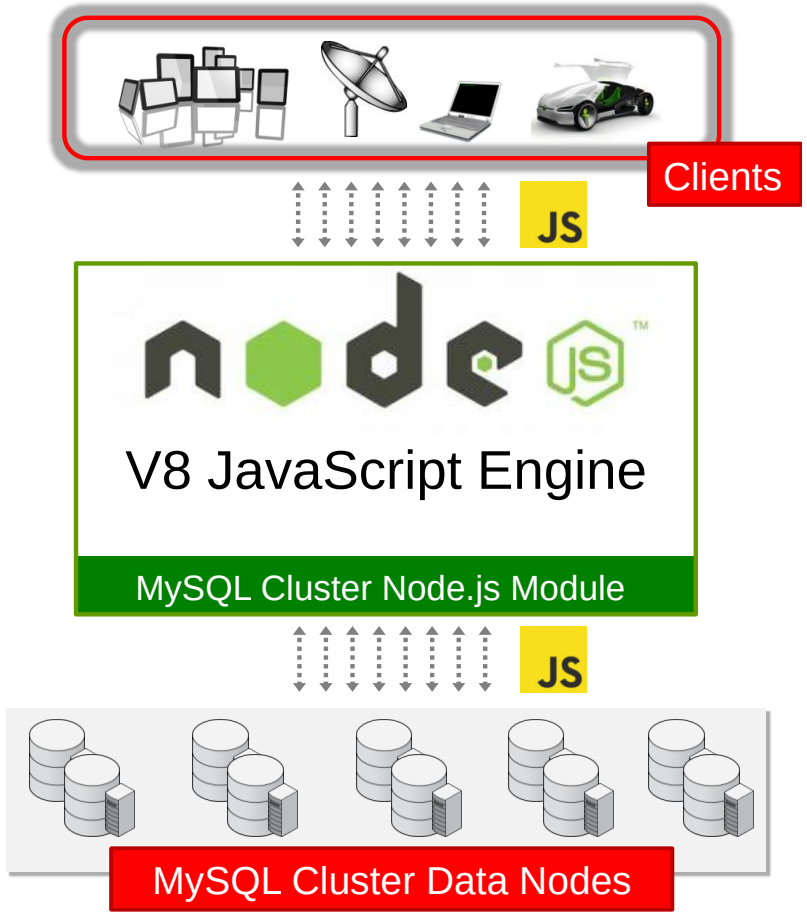
Prefix	Table	Key-col	Val-col	policy
town:	map.zip	town	code	cluster

Config tables

town	...	code	...
maidenhead	...	SL6	...

map.zip

Node.js NoSQL API



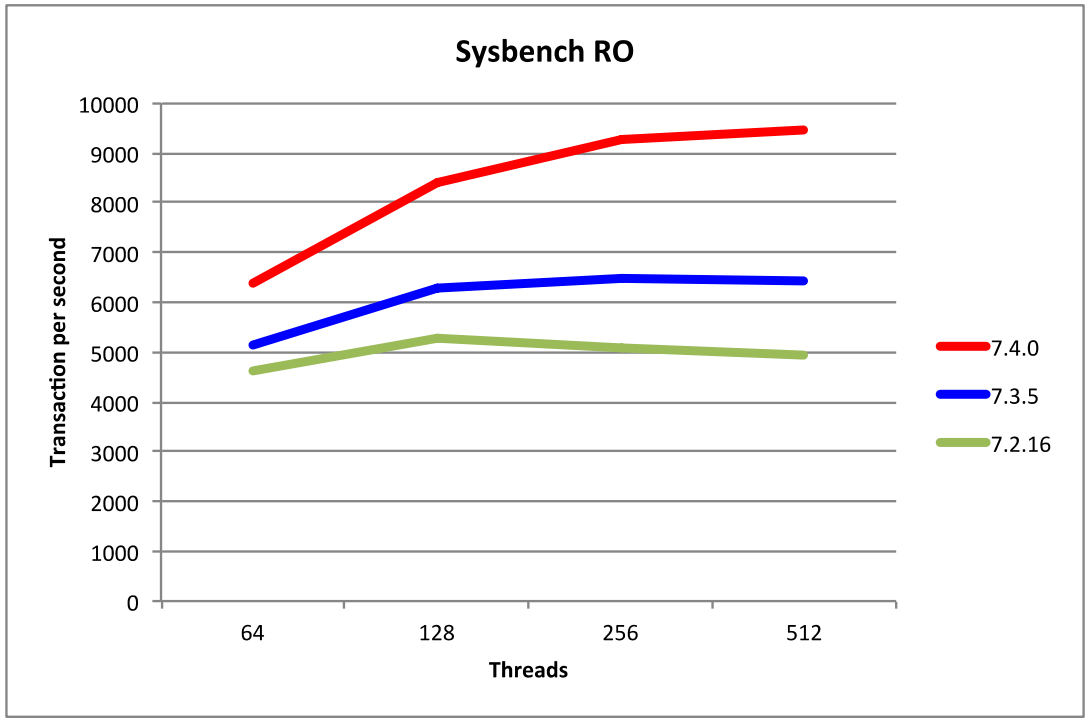
- Native JavaScript access to MySQL Cluster
  - End-to-End JavaScript: browser to the app & DB
  - Storing and retrieving JavaScript objects directly in MySQL Cluster
  - Eliminate SQL transformation
- Implemented as a module for node.js
  - Integrates Cluster API library within the web app
- Couple high performance, distributed apps, with high performance distributed database
- Optionally routes through MySQL Server

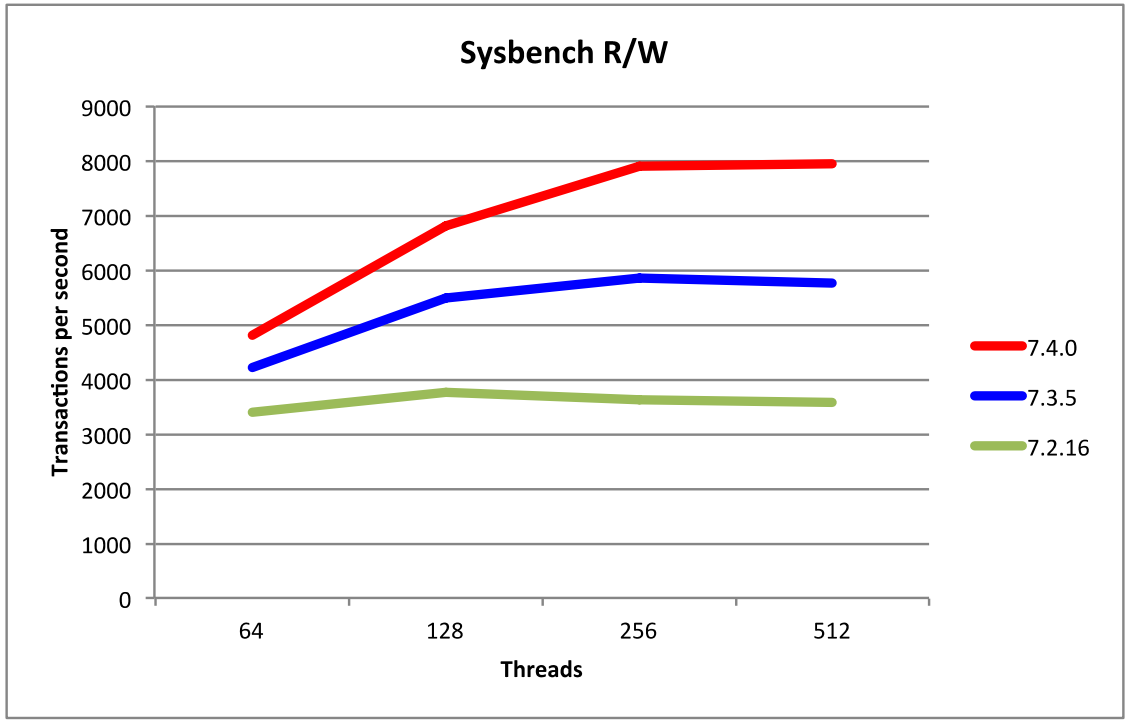
MySQL Cluster 7.4.1 DMR

Available Now!

MySQL Cluster 7.4.1 DMR

Better performance and operational simplicity



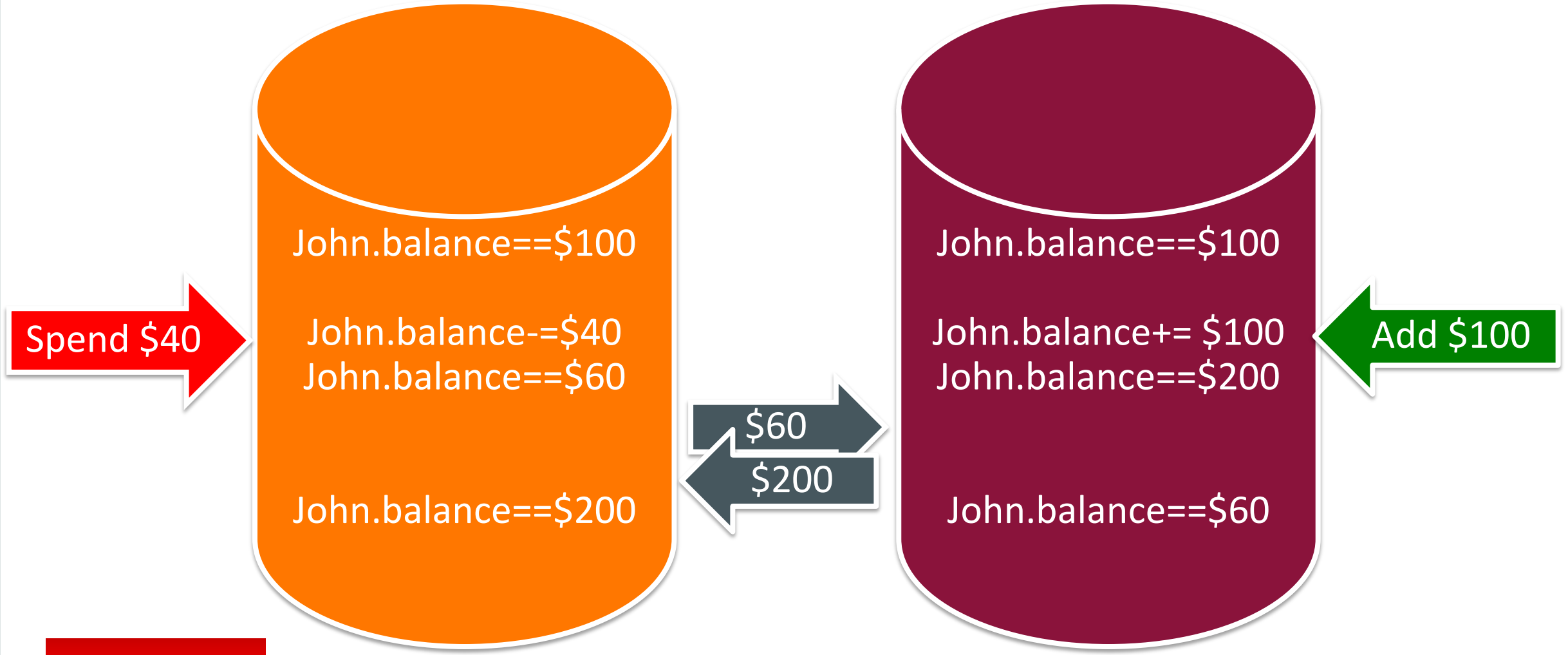


- Performance gain over 7.3
  - 47% (Read-Only)
  - 38% (Read-Write)
- Faster maintenance operations
  - Nodal & Rolling restarts
  - Upgrades

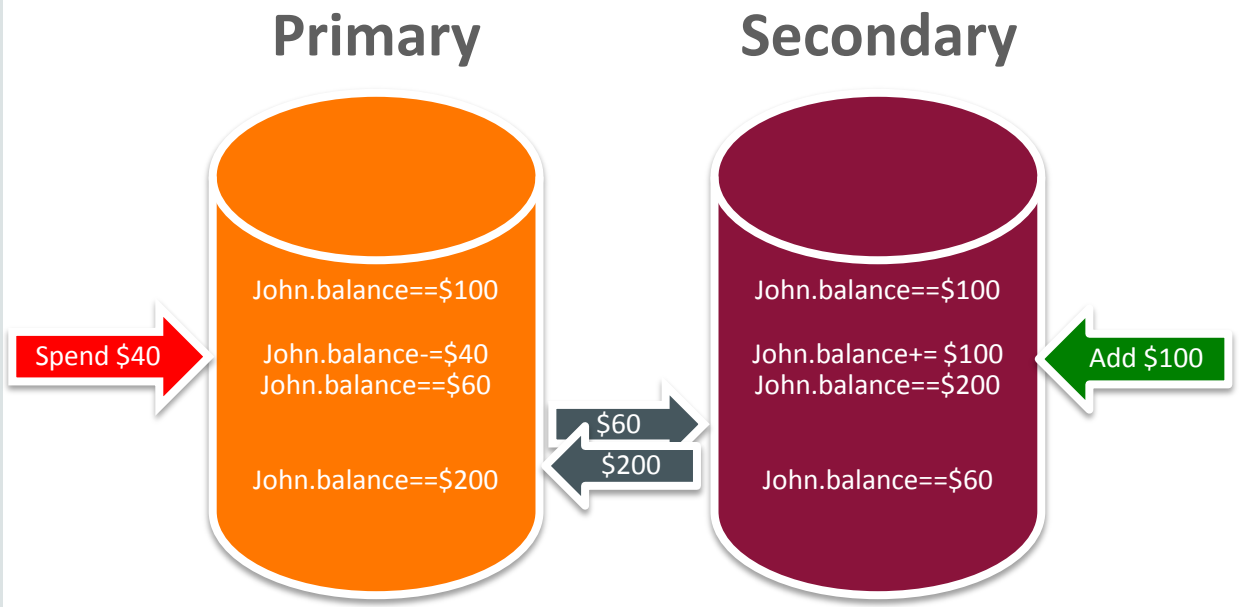
Active-Active Geo-Replication

- Asynchronous replication between MySQL Clusters
- Active-Active
  - Update anywhere
  - Conflict detection
    - Application notified through exception tables
    - Can opt to have conflicts resolved automatically
  - Auto-conflict-resolution
    - NDB$EPOCH, conflicting rows are rolled back
    - NDB$EPOCH_TRANS, conflicting transactions are rolled back

What is a conflict?



Detecting Conflicts - Reflected GCI



- Primary store logical timestamp (GCI) against updated row
  - Window for conflict opens
- GCI replicated with updated row to Secondary
- The same row and GCI is replicated back (reflected) from Secondary to Primary after it has been applied
  - Closing window for conflict
- Primary checks every event originating from the Secondary to ensure it isn't for a 'conflictable' row

Handling of Conflicts

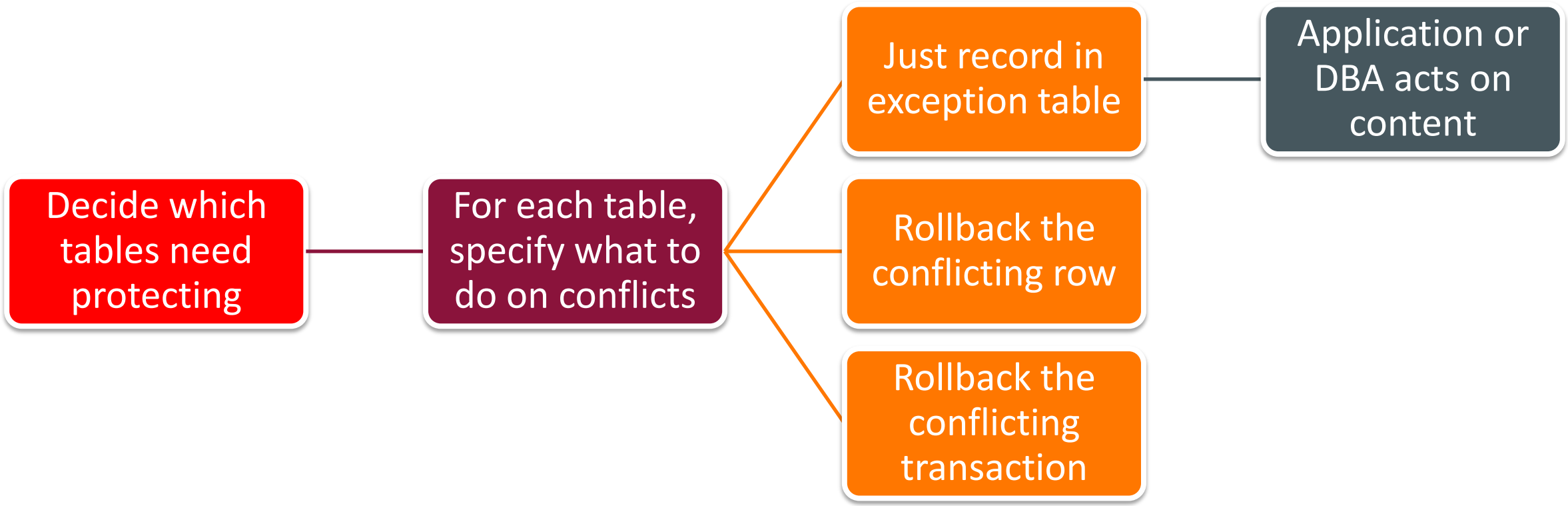
MySQL Cluster 7.4.1 DMR

- Rolling back of transactions that read conflicted data.
- Entire transactions (and dependent ones) rolled back.
- Information of conflict's type, cause, and originating transaction.

Later in MySQL Cluster 7.4

- Conflicting deletes

How to Use Conflict Detection/Resolution



Restart Times

What operations benefit?

- Restarting data node with locally checkpointed data
  - Major improvement
- Restarting data node which must recover data from peer
  - Major improvement
  - Further speedups to come in 7.4.X (greater parallelization)
- Upgrade/rolling restarts
  - Major improvement
- Cluster shutdown and restart
  - Minor improvement

Enhanced Memory Reporting

See how much memory a table is using

```
mysql> CREATE DATABASE clusterdb;USE clusterdb;
mysql> CREATE TABLE simples (id INT NOT NULL AUTO_INCREMENT PRIMARY KEY) ENGINE=NDB;
mysql> select node_id AS node, fragment_num AS frag, fixed_elem_alloc_bytes alloc_bytes,
fixed_elem_free_bytes AS free_bytes, fixed_elem_free_rows AS spare_rows from
memory_per_fragment where fq_name like '%simples%';
+------+------+-------------+------------+------------+
| node | frag | alloc_bytes | free_bytes | spare_rows |
+------+------+-------------+------------+------------+
|    1 |    0 |      131072 |       5504 |        172 |
|    1 |    2 |      131072 |       1280 |         40 |
|    2 |    0 |      131072 |       5504 |        172 |
|    2 |    2 |      131072 |       1280 |         40 |
|    3 |    1 |      131072 |       3104 |         97 |
|    3 |    3 |      131072 |       4256 |        133 |
|    4 |    1 |      131072 |       3104 |         97 |
|    4 |    3 |      131072 |       4256 |        133 |
+------+------+-------------+------------+------------+
```

Enhanced Memory Reporting

See how memory is made available after deleting rows

```
+------+------+-------------+------------+------------+
| node | frag | alloc_bytes | free_bytes | spare_rows |
+------+------+-------------+------------+------------+
|    1 |    0 |      131072 |       5504 |        172 |
|    1 |    2 |      131072 |       1280 |         40 |
|    2 |    0 |      131072 |       5504 |        172 |
|    2 |    2 |      131072 |       1280 |         40 |
|    3 |    1 |      131072 |       3104 |         97 |
|    3 |    3 |      131072 |       4256 |        133 |
|    4 |    1 |      131072 |       3104 |         97 |
|    4 |    3 |      131072 |       4256 |        133 |
+------+------+-------------+------------+------------+
mysql> DELETE FROM clusterdb.simples LIMIT 1;
+------+------+-------------+------------+------------+
| node | frag | alloc_bytes | free_bytes | spare_rows |
+------+------+-------------+------------+------------+
|    1 |    0 |      131072 |       5504 |        172 |
|    1 |    2 |      131072 |       1312 |         41 |
|    2 |    0 |      131072 |       5504 |        172 |
|    2 |    2 |      131072 |       1312 |         41 |
|    3 |    1 |      131072 |       3104 |         97 |
|    3 |    3 |      131072 |       4288 |        134 |
|    4 |    1 |      131072 |       3104 |         97 |
|    4 |    3 |      131072 |       4288 |        134 |
+------+------+-------------+------------+------------+
```

Enhanced Memory Reporting

Check how well partitioned/sharded a table is

```
mysql> CREATE TABLE simples (id INT NOT NULL AUTO_INCREMENT, species VARCHAR(20) DEFAULT "Human",
PRIMARY KEY(id, species)) engine=ndb PARTITION BY KEY(species);

// Add some data

mysql> select node_id AS node, fragment_num AS frag, fixed_elem_alloc_bytes alloc_bytes,
fixed_elem_free_bytes AS free_bytes, fixed_elem_free_rows AS spare_rows from ndbinfo.memory_per_fragment
where fq_name like '%simples%';
+------+------+-------------+------------+------------+
| node | frag | alloc_bytes | free_bytes | spare_rows |
+------+------+-------------+------------+------------+
|    1 |    0 |           0 |          0 |          0 |
|    1 |    2 |      196608 |      11732 |        419 |
|    2 |    0 |           0 |          0 |          0 |
|    2 |    2 |      196608 |      11732 |        419 |
|    3 |    1 |           0 |          0 |          0 |
|    3 |    3 |           0 |          0 |          0 |
|    4 |    1 |           0 |          0 |          0 |
|    4 |    3 |           0 |          0 |          0 |
+------+------+-------------+------------+------------+
```

Oracle MySQL HA & Scaling Solutions

	MySQL Replication	MySQL Fabric	Oracle VM Template	Oracle Clusterware	Solaris Cluster	Windows Cluster	DRBD	MySQL Cluster
App Auto-Failover	✖	✔	✔	✔	✔	✔	✔	✔
Data Layer Auto-Failover	✖	✔	✔	✔	✔	✔	✔	✔
Zero Data Loss	MySQL 5.7	MySQL 5.7	✔	✔	✔	✔	✔	✔
Platform Support	All	All	Linux	Linux	Solaris	Windows	Linux	All
Clustering Mode	Master + Slaves	Master + Slaves	Active/Passive	Active/Passive	Active/Passive	Active/Passive	Active/Passive	Multi-Master
Failover Time	N/A	Secs	Secs +	Secs +	Secs +	Secs +	Secs +	< 1 Sec
Scale-out	Reads	✔	✖	✖	✖	✖	✖	✔
Cross-shard operations	N/A	✖	N/A	N/A	N/A	N/A	N/A	✔
Transparent routing	✖	For HA	✔	✔	✔	✔	✔	✔
Shared Nothing	✔	✔	✖	✖	✖	✖	✔	✔
Storage Engine	InnoDB+	InnoDB+	InnoDB+	InnoDB+	InnoDB+	InnoDB+	InnoDB+	NDB
Single Vendor Support	✔	✔	✔	✔	✔	✖	✔	✔

When to Consider MySQL Cluster

MySQL Cluster

- Scalability demands
  - Sharding for write performance?
- Latency demands
  - Cost of each millisecond?
- Uptime requirements
  - Cost per minute of downtime?
  - Failure versus maintenance?
- Application agility
  - Developer languages and frameworks?
  - SQL or NoSQL?

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13
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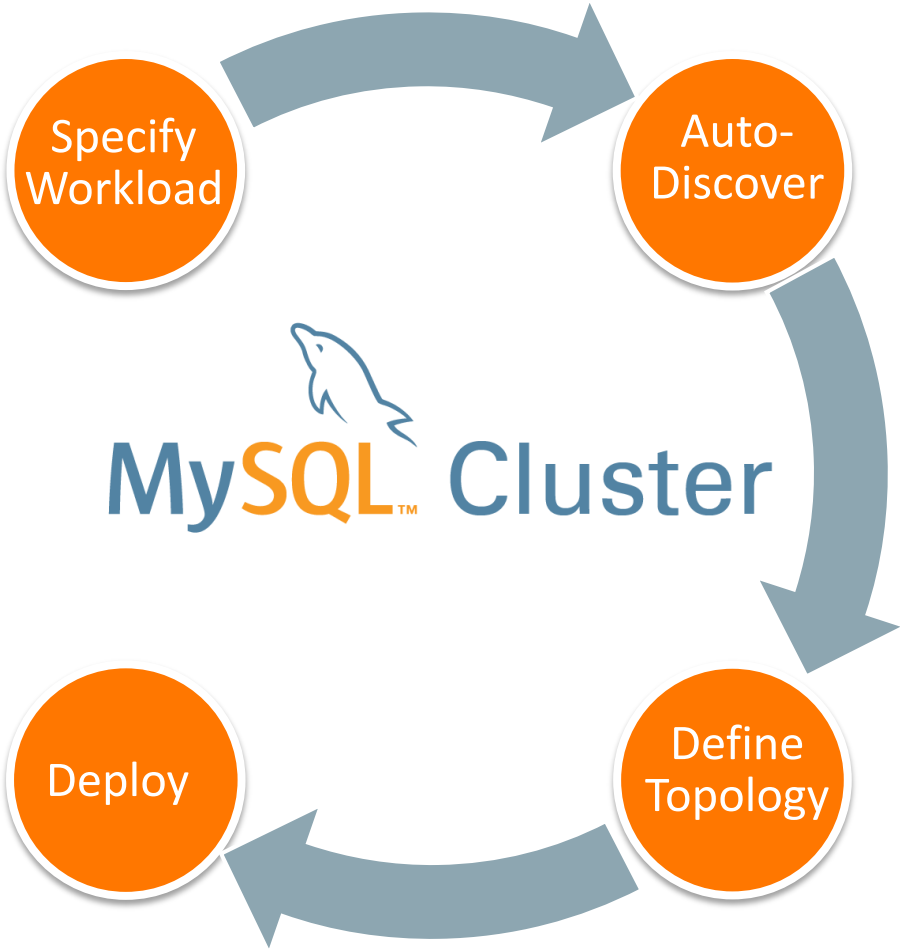
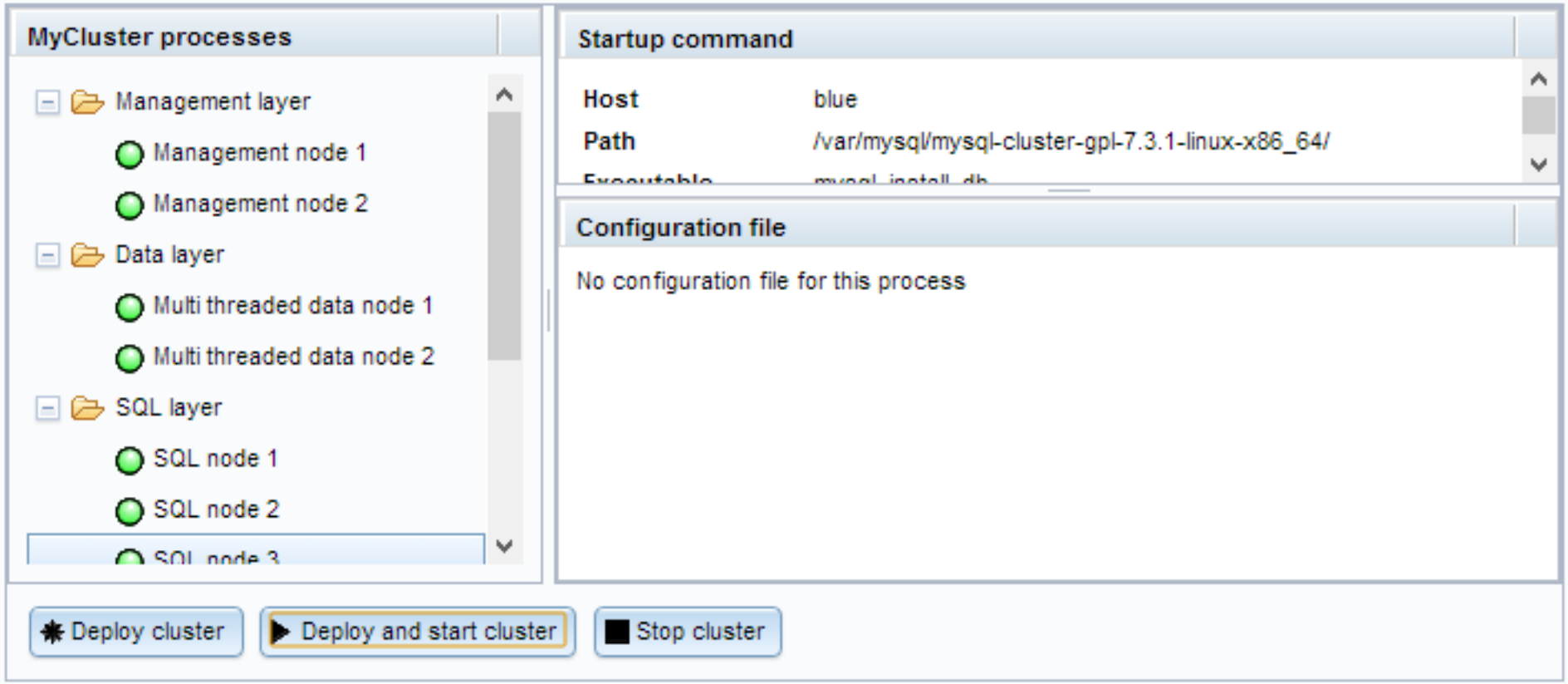
MySQL Cluster Auto-Installer

- Fast configuration
- Auto-discovery
- Workload optimized
- Repeatable best practices



Deploy Configuration and start MySQL Cluster

Your MySQL Cluster configuration can be reviewed below. To the left are the processes you have defined, ordered by their startup sequence. Please select a process to view its startup command(s) and configuration file. Note that some processes do not have configuration files. At the bottom of the center panel, there are buttons to *Deploy*, *Start* and *Stop* your cluster. Please note that starting the cluster may take up to several minutes depending on the configuration you have defined. In the process tree, the icons reflect the status of the process as reported by the management daemon: : *unknown* or if the management daemon does not reply, : *connected* or *started*, : *starting* or *shutting down*, and : *not connected* or *stopped*



MySQL Cluster Manager

Enhancing DevOps Agility, Reducing Downtime

MySQL Cluster Manager

Automated Management

- Start / Stop node or whole cluster
- On-Line Scaling
- On-Line Reconfiguration
- On-Line Upgrades
- On-Line Backup & Restore
- Import Running Cluster

Self-Healing

- Node monitoring
- Auto-recovery extended to SQL + mgmt nodes

HA Operations

- Cluster-wide configuration consistency
- Persistent configurations
- HA Agents

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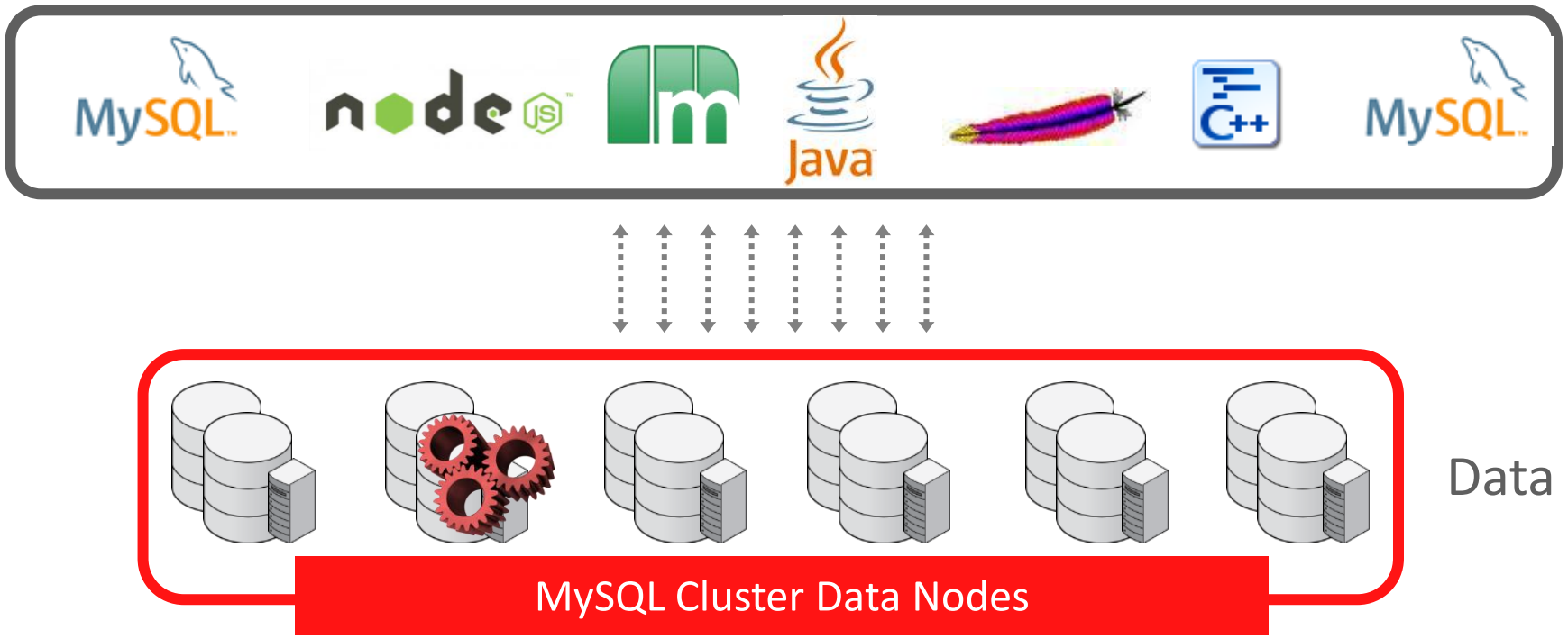
Upgrade using MCM



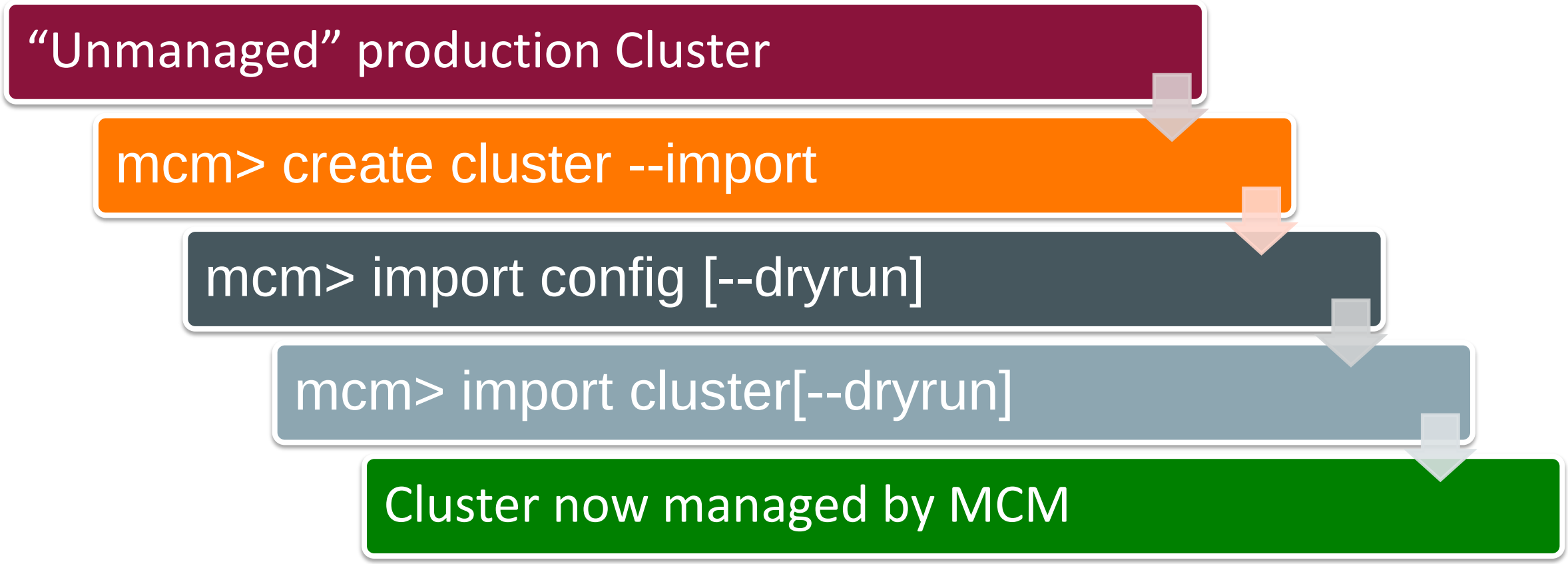
upgrade cluster --package=7.3 mycluster;

MySQL Cluster Manager 1.3.2 GA

Available Now!

MySQL Cluster Manager 1.3.2 GA

Import a running Cluster into MCM



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- Authentic MySQL Curriculum: http://oracle.com/education/mysql

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- dev.mysql.com/downloads/cluster/

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