MariaDB

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Sharing your data with Spider

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Who is Max?

SkySQL

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What is Sharding?

"A database shard is a horizontal partition of data in a database or search engine. Each individual partition is referred to as a shard or database shard"

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Why Shard?

- The resources of one machine is not enough!
- Read scaling can be achieved through master-slave replication
  - Replication however only scales reads; every server still has to write every single change
- In order to achieve write scalability something else is needed
  - Sharding partitions the data into different “shards”
  - Shards can be stored on different servers
- The sharding algorithm can have a huge impact on performance

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Disadvantages with Sharding

- Disadvantages with Sharding include:
  - Increased complexity of SQL
  - Management complexity
  - Multiple points of failure
  - Failover more complex
  - Backups more complex
  - Operational complexity added

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When do we need Sharding?

- Large Datasets
  - I/O- and CPU-load is the bottleneck
  - Long execution times for queries
  - Effects creating indexes, statistics, maintenance of tables, ...
- When replication is not a solution
- When per instance partitioning does not help

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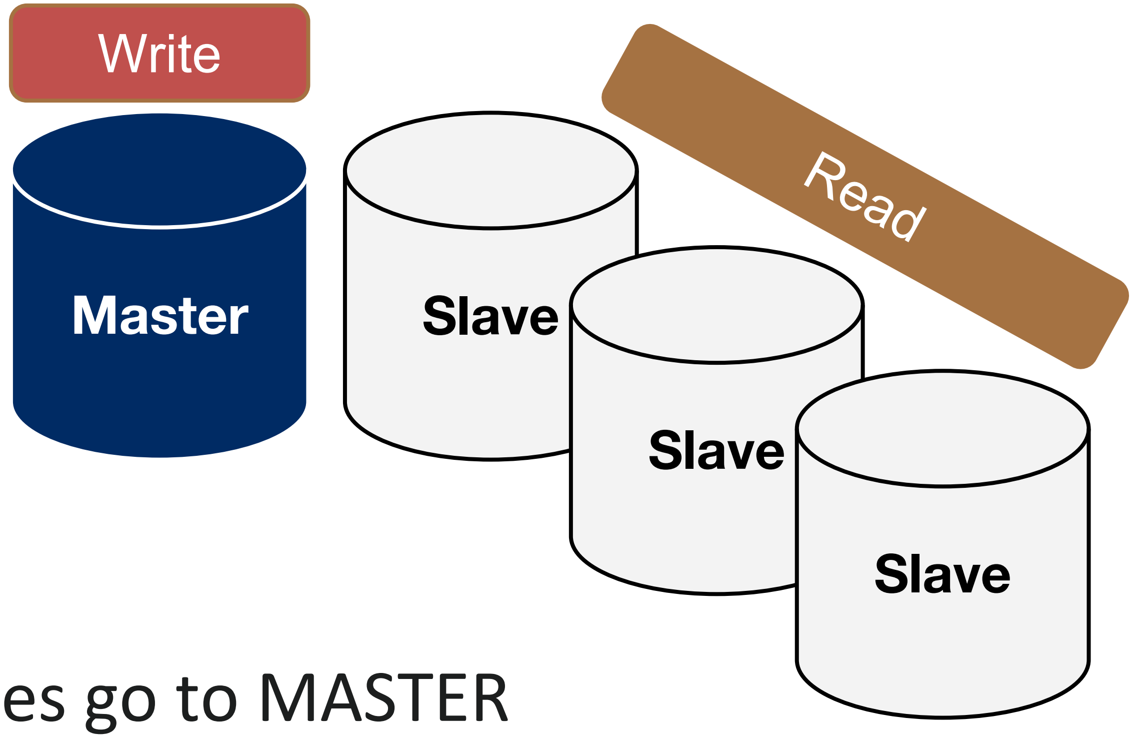
Replication for Scaling



- All writes go to MASTER
- Reads can be scaled on slaves

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Replication or Sharding?

- Master/Slave-Replication
  - Scaling for reads with a large number of connects or queries
  - Useful for scenarios with a heavy read ratio
  - Not the solution when you have long execution times for single queries and large data sets
  - Write load cannot be scaled
  - Each server needs to contain all data

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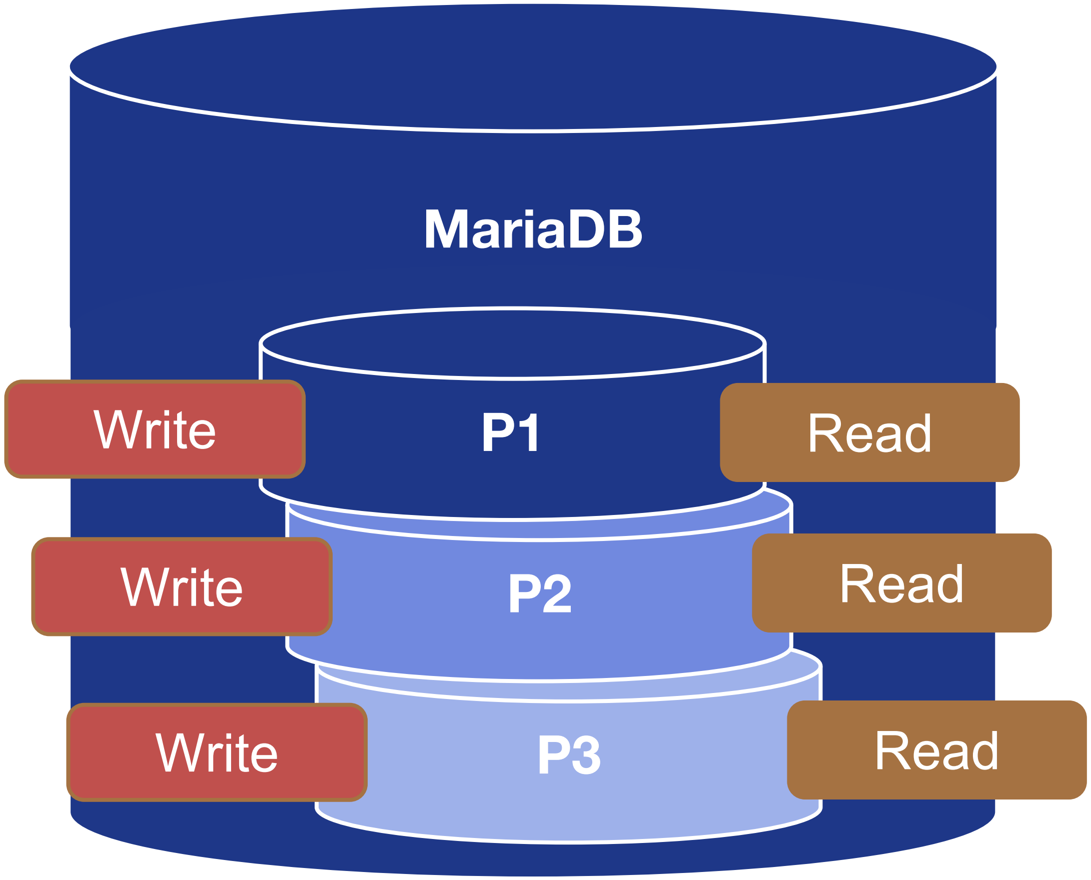
Partitioning for Scaling?



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Partitioning Types

- RANGE and RANGE COLUMNS Partitioning

```
PARTITION BY RANGE (store_id) (
    PARTITION p0 VALUES LESS THAN (1000),
    PARTITION p1 VALUES LESS THAN (2000),
    PARTITION p2 VALUES LESS THAN (3000),
    PARTITION p3 VALUES LESS THAN MAXVALUE);
```

- LIST and LIST COLUMNS Partitioning

```
PARTITION BY LIST(store_id) (
    PARTITION pNorth VALUES IN (3,5,6,9,17),
    PARTITION pEast VALUES IN (1,2,10,11,19,20),
    PARTITION pWest VALUES IN (4,12,13,14,18)):
```

- HASH Partitioning

```
PARTITION BY HASH(store_id)
    PARTITIONS 4;
```

- KEY and LINEAR KEY Partitioning

Partitioning vs. Sharding

- Partitioning allows
  - Reducing the data set for queries, when an effective partitioning rule can be defined
  - Separating archive data and active data
  - Distribute I/O-Load on multiple Disks
- Resources of an instance need to be shared (CPU, RAM, Kernel-Process, ...)
- Locks are still per table

How to do Sharding

- Sharding is database partitioning across multiple instances
- Implementation of sharding using
  - Application logic
  - Connectors
  - Proxies:
    MySQL Proxy, MySQL Fabric,MariaDB MaxScale
  - Spider storage engine

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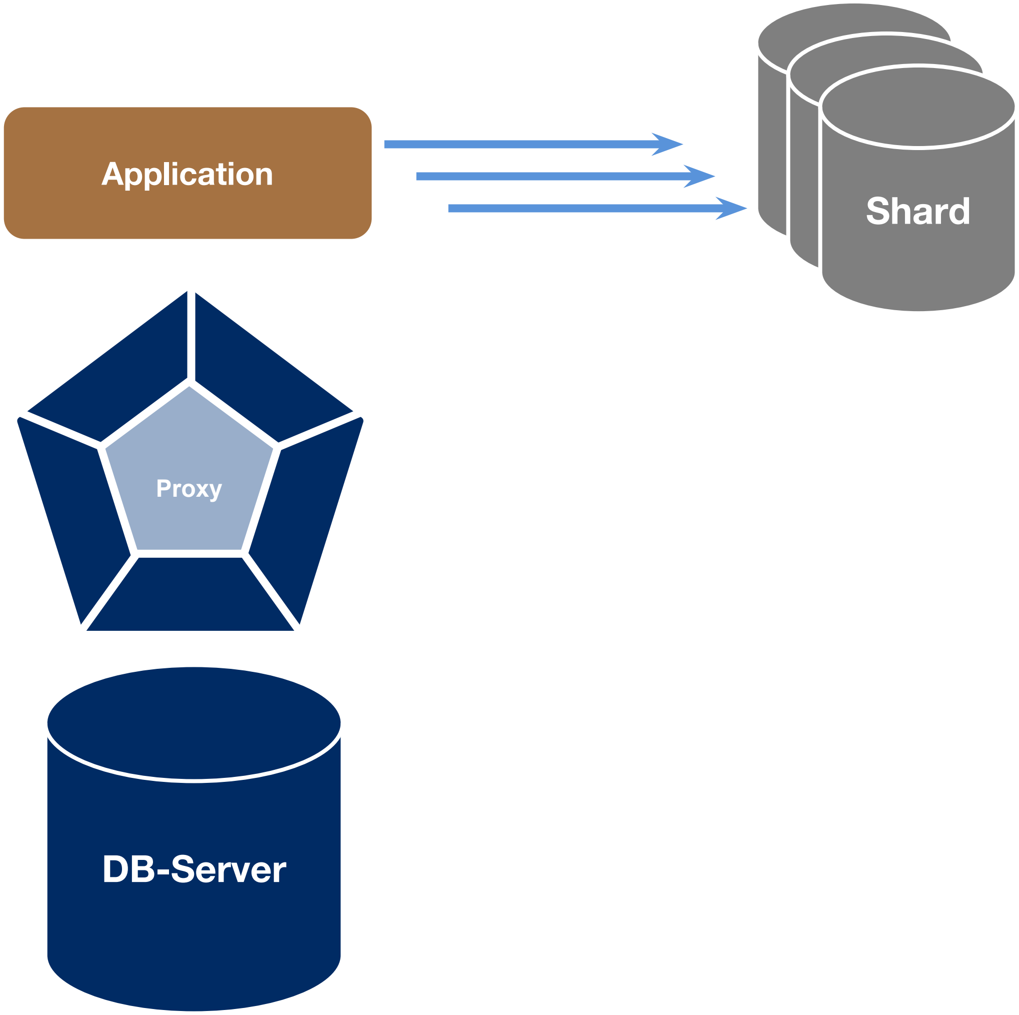
Where can you shard?



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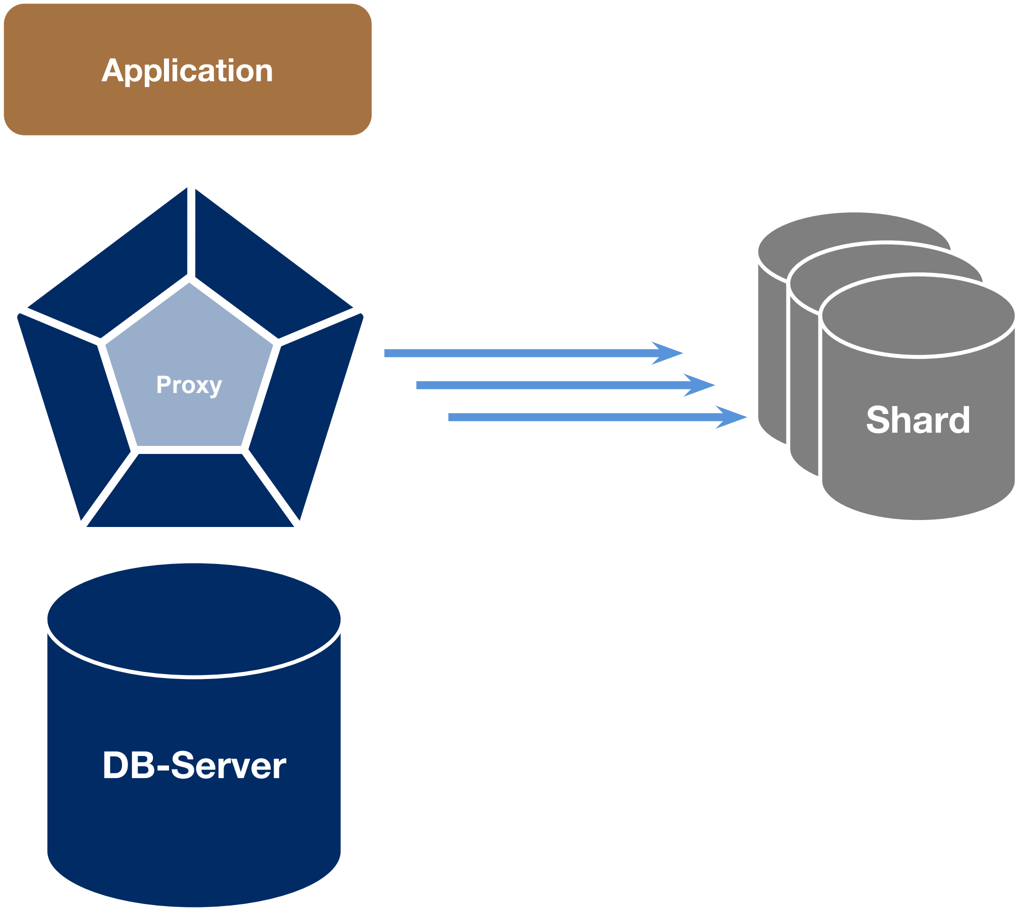
Where can you shard?



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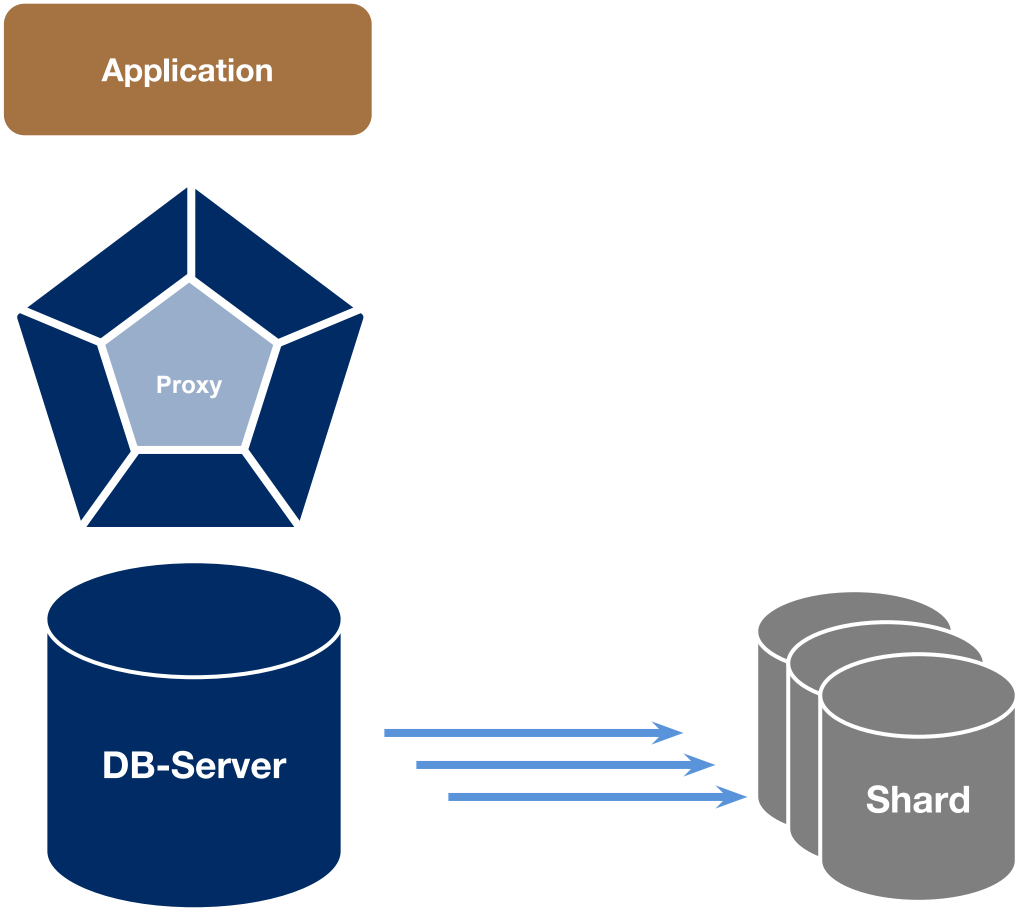
Where can you shard?



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Spider Storage Engine

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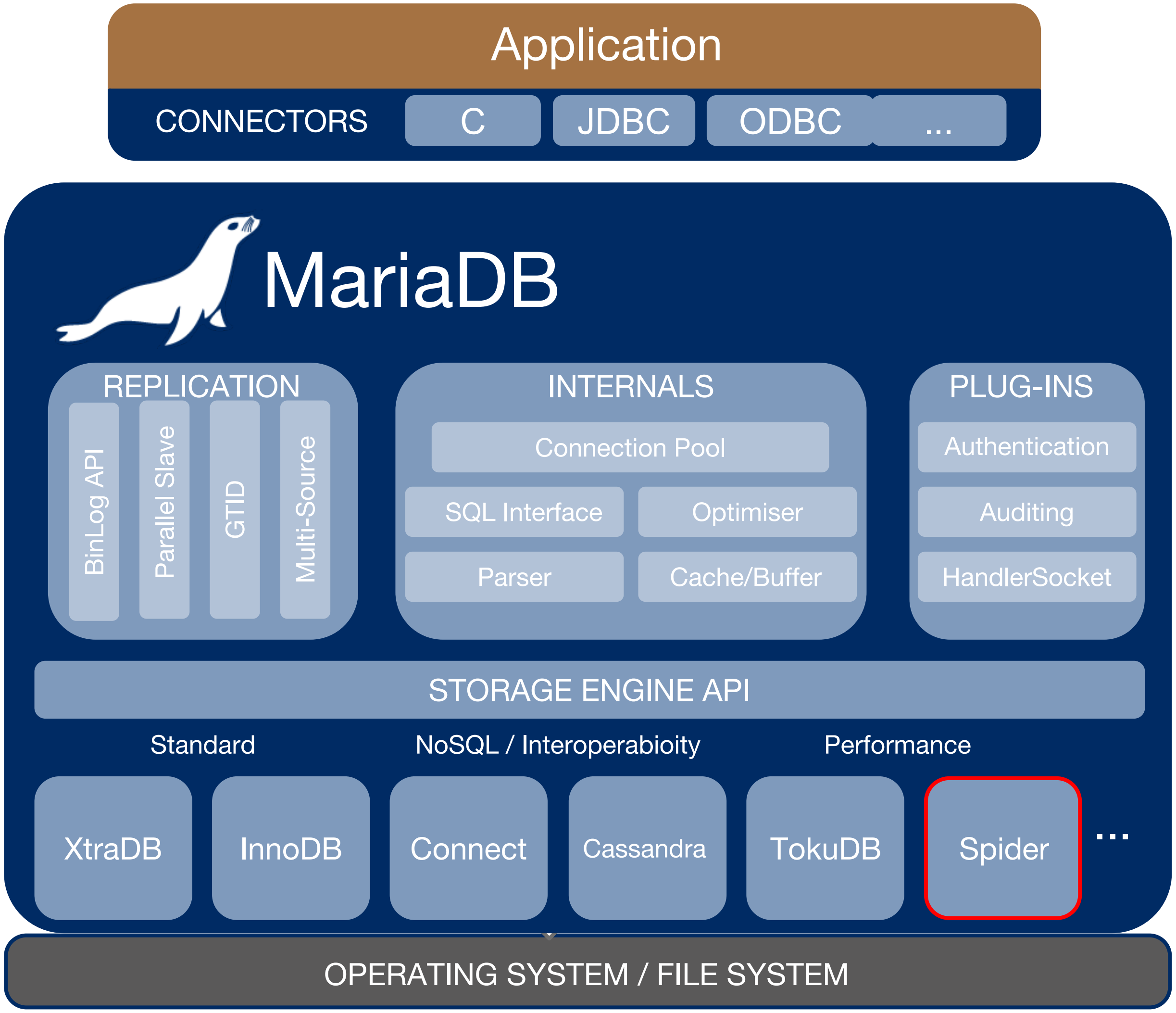
Storage Engine Architecture



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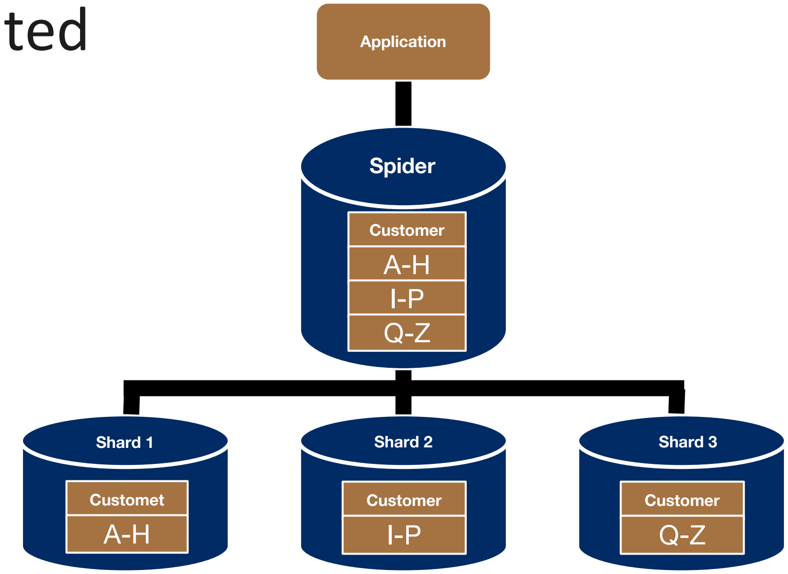
Spider Storage Engine

- Developed by Kentoku Shiba
- Storage engine "partitions“ tables across multiple database server instances
- Based on partitions with integrated sharding
- Virtual view on tables distributed across Instances
- Supports XA transactions
- Transactional storage engine
- Provides scale-out in combination with HA
  - Can also use other HA



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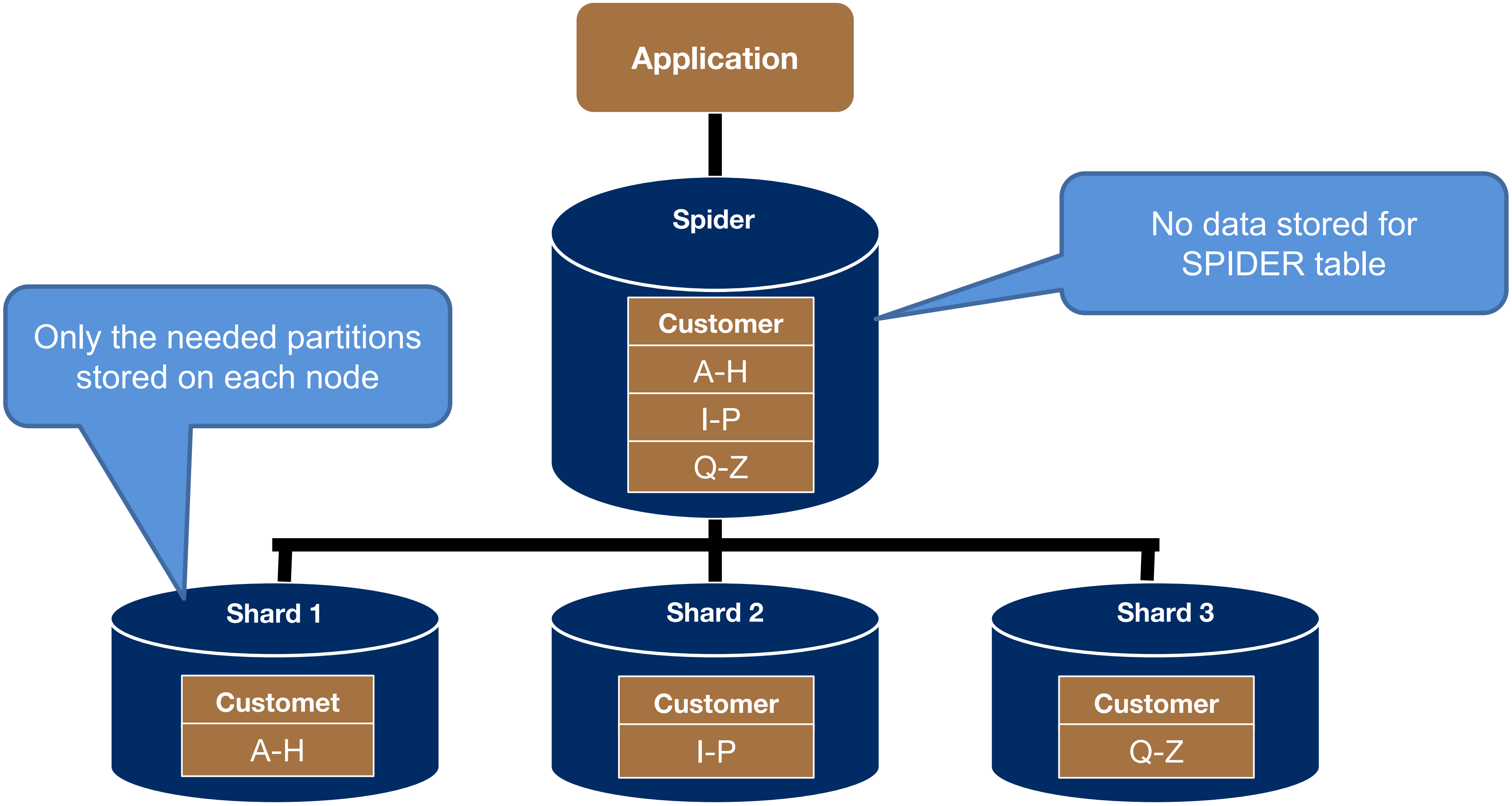
Spider Architecture



No data stored for SPIDER table

Only the needed partitions stored on each node

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Spider Internals

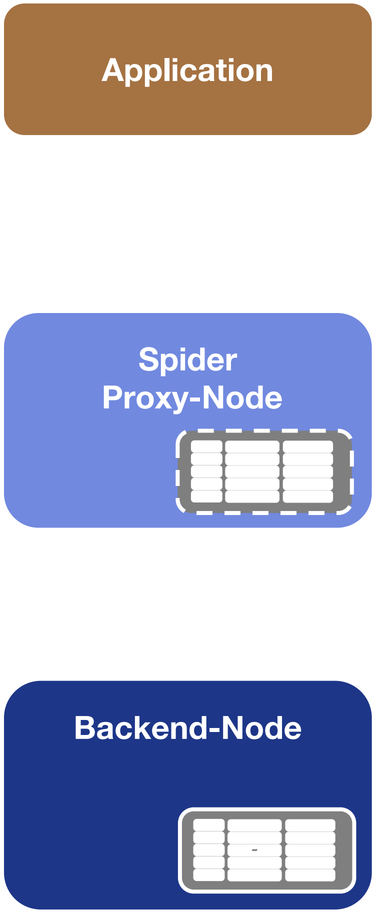
- When a Spider table is created it creates a link to the remote table
- The linked table can have any engine
- The linked table can use partitioning
- The remote server is not spider aware
- You can have multiple Spider nodes for the same underlying tables

General Concept for Spider Engine

- Application with connection to Spider proxy node

- CREATE TABLE spider (...) ENGINE=SPIDER ...
  - No data in Spider-Proxy

- CREATE TABLE spider (...) ENGINE=INNODB ...
  - Data in backend



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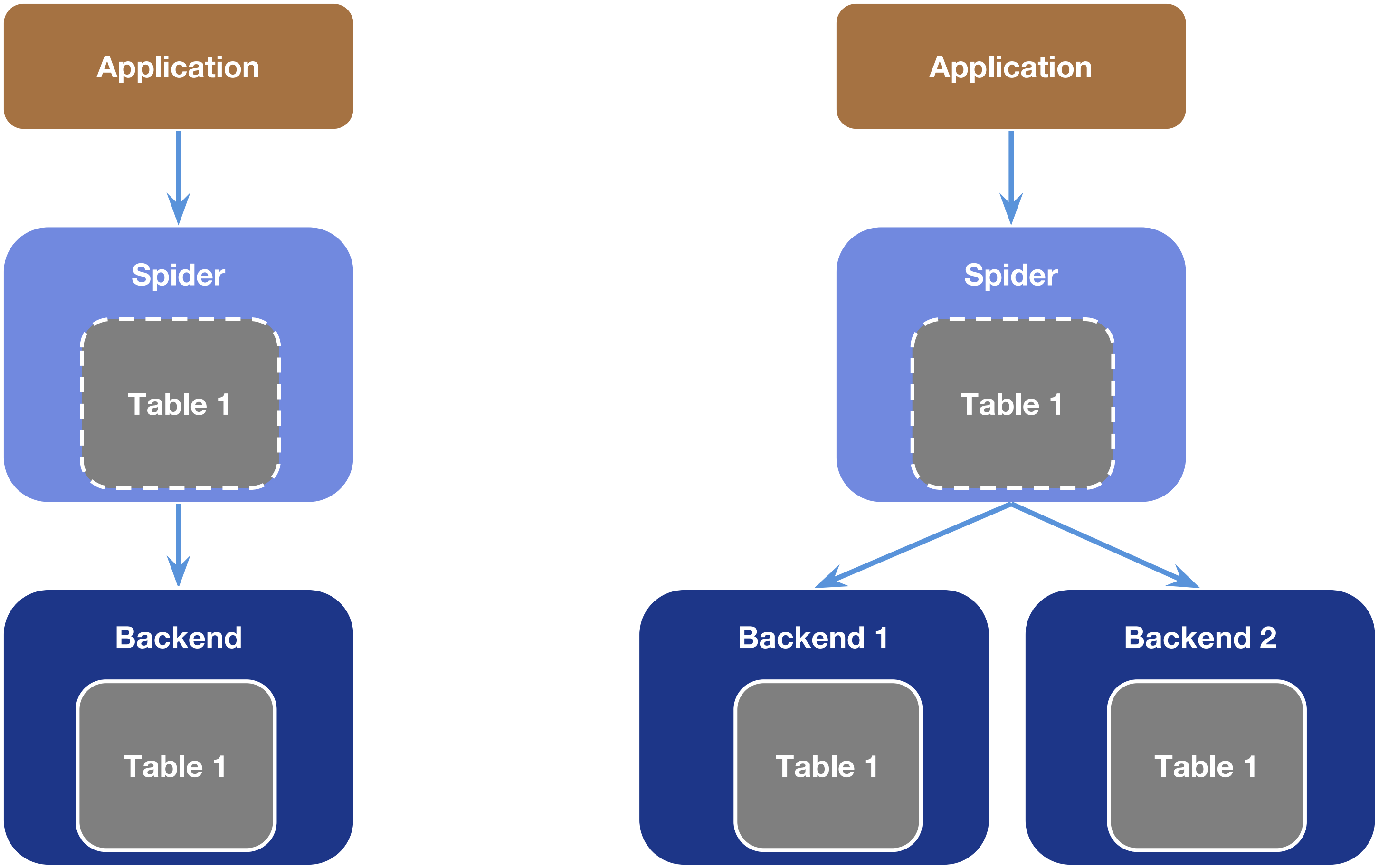
Spider as a Federation



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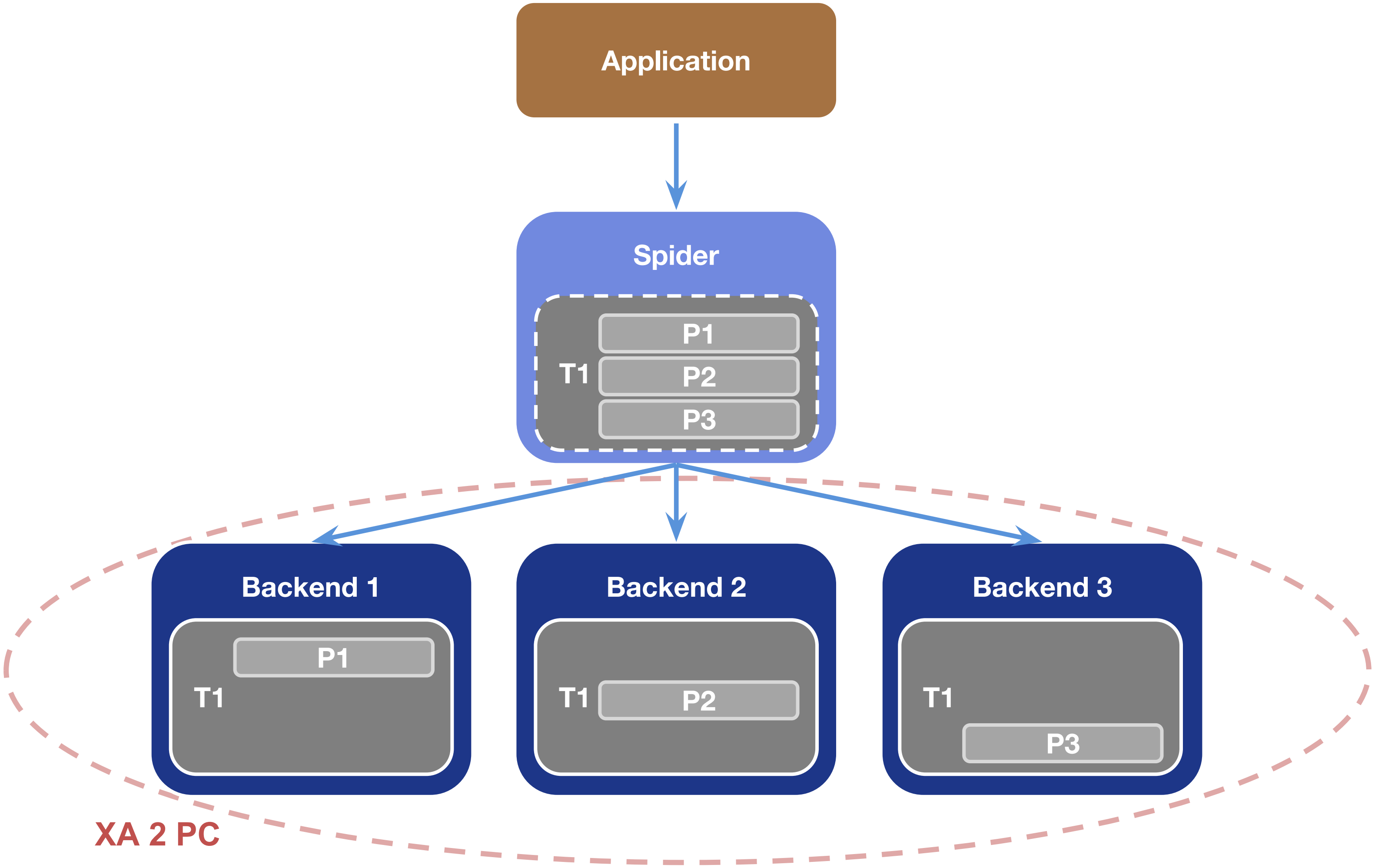
Sharding using Spider



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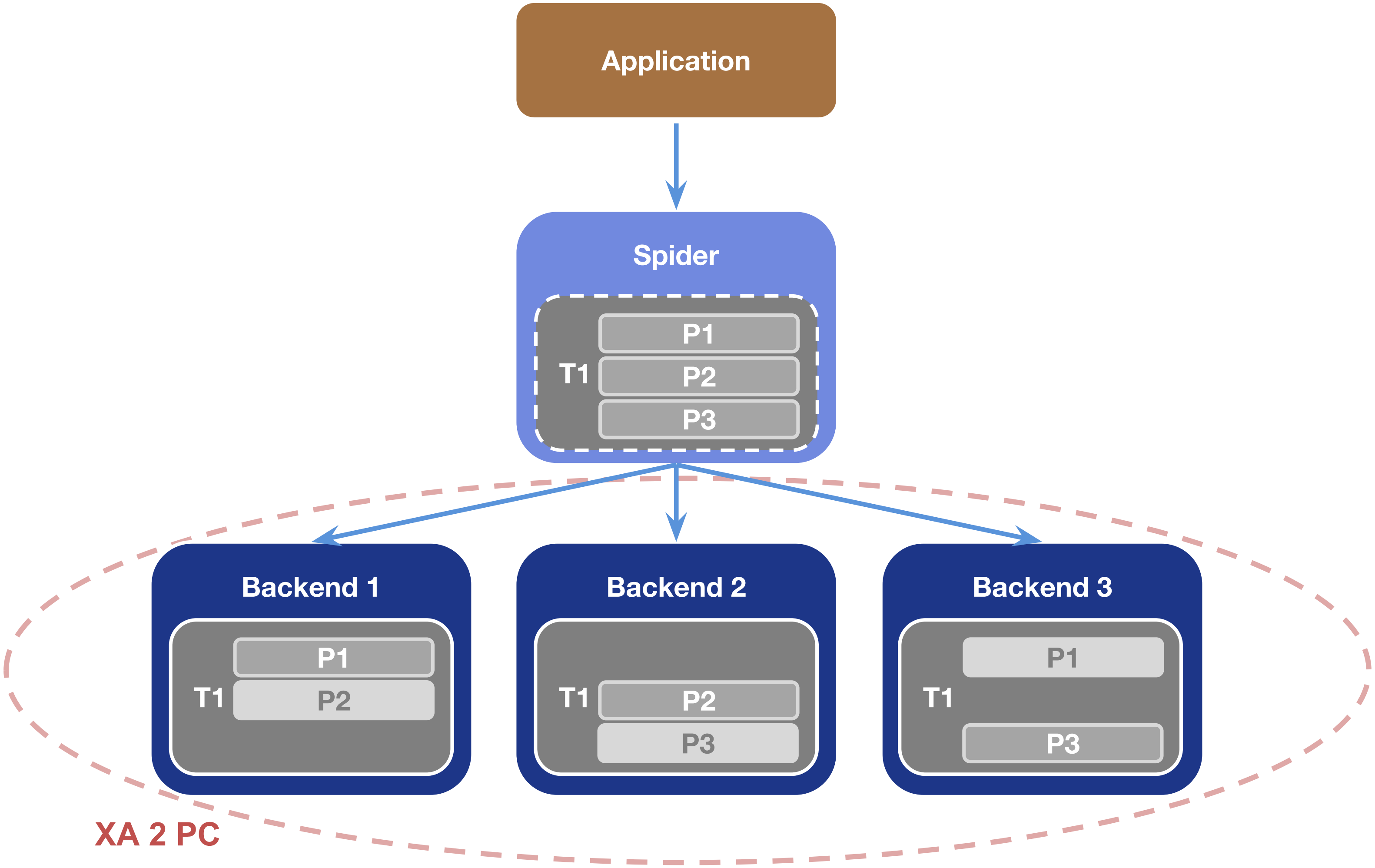
Sharding with Spider and HA



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Spider Availability

- Since Version 10.0.4 included in MariaDB
  - Spider 3.0
  - Spider 3.2.11 in MariaDB 10.0.14
- Spider with MySQL Server
  - http://spiderformysql.com/download_spider.html
  - INSTALL PLUGIN spider SONAME 'ha_spider.so';

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Spider Installation

- Installation

```
mysql -uroot -p < /usr/share/mysql/install_spider.sql
```

- Spider will be shown as active Storage Engine

```
SELECT engine, support, transactions, xa FROM
information_schema.engines;
+--------------------+---------+--------------+------+
| engine             | support | transactions | xa   |
+--------------------+---------+--------------+------+
| SPIDER             | YES     | YES          | YES  |
| CSV                | YES     | NO           | NO   |
```

Spider System Tables

- Spider creates tables in the system schema (`mysql`)

```
MariaDB> show tables like 'spider%';
+---------------------------+
| Tables_in_mysql (spider%) |
+---------------------------+
| spider_link_failed_log    |
| spider_link_mon_servers   |
| spider_tables             |
| spider_xa                 |
| spider_xa_failed_log      |
| spider_xa_member          |
+---------------------------+
6 rows in set (0.00 sec)
```

Spider Variables

- 93 Spider system variables will be added

```
MariaDB> show global variables like 'spider%’;
```

- 4 Spider status values will be added

```
MariaDB> show global status like 'spider%’;
```

- More Spider variables related to tables using CREATE TABLE
  - In MariaDB use COMMENT
  - In MySQL use CONNECTION

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Spider UDFs

- Spider UDFs will be added
  - SPIDER_DIRECT_SQL
    - Execute SQL on backend server
  - SPIDER_BG_DIRECT_SQL
    - Execute background SQL statement on backend server
  - SPIDER_COPY_TABLES
  - SPIDER_FLUSH_TABLE_MON_CACHE
    - Reset Spider monitoring information

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Simple Spider Example

- Table definition on Spider proxy node

```
CREATE TABLE spiderfederation(id INT NOT NULL, code
VARCHAR(10), PRIMARY KEY(id))
ENGINE=SPIDER
COMMENT 'host "192.168.56.21", user "backend", password
"backend", port "3306"';
```

- Table definition on backend nodes

```
CREATE TABLE spiderfederation(id INT NOT NULL, code
VARCHAR(10), PRIMARY KEY(id))
ENGINE=INNODB;
```

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Spider Example with Sharding

- Table definition on Spider proxy node

```
CREATE TABLE sharding(id INT NOT NULL, code VARCHAR(10),
PRIMARY KEY(id))
ENGINE=SPIDER COMMENT='user "backend", password
"backend", port "3306", table "sharding"'
PARTITION BY RANGE(id)
(
   PARTITION p1 VALUES LESS THAN (100000)
   COMMENT 'host "192.168.56.21"',
   PARTITION p2 VALUES LESS THAN (200000)
   COMMENT 'host "192.168.56.22"',
   PARTITION p3 VALUES LESS THAN MAXVALUE
   COMMENT 'host "192.168.56.23"'
);
```

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Spider Example with Sharding

- Table definition on backend nodes

```
CREATE TABLE sharding(
id INT NOT NULL,
code VARCHAR(10),
PRIMARY KEY(id)
)ENGINE=INNODB;
```

Spider Example with Sharding

- Insert on proxy

```
MariaDB> insert into sharding values (90002,"shard1"),
(100100,"shard2"),(200050,"shard3");
Query OK, 3 rows affected (0.04 sec)
Records: 3  Duplicates: 0  Warnings: 0
```

- Shard 1

```
MariaDB> select * from sharding;
+-------+--------+
| id    | code   |
+-------+--------+
| 90002 | shard1 |
+-------+--------+
1 rows in set (0.00 sec)
```

Spider Example with Sharding

- Shard 2

```
MariaDB> select * from sharding;
+--------+--------+
| id     | code   |
+--------+--------+
| 100100 | shard2 |
+--------+--------+
1 rows in set (0.00 sec)
```

- Shard 3

```
MariaDB> select * from sharding;
+--------+--------+
| id     | code   |
+--------+--------+
| 200050 | shard3 |
+--------+--------+
```

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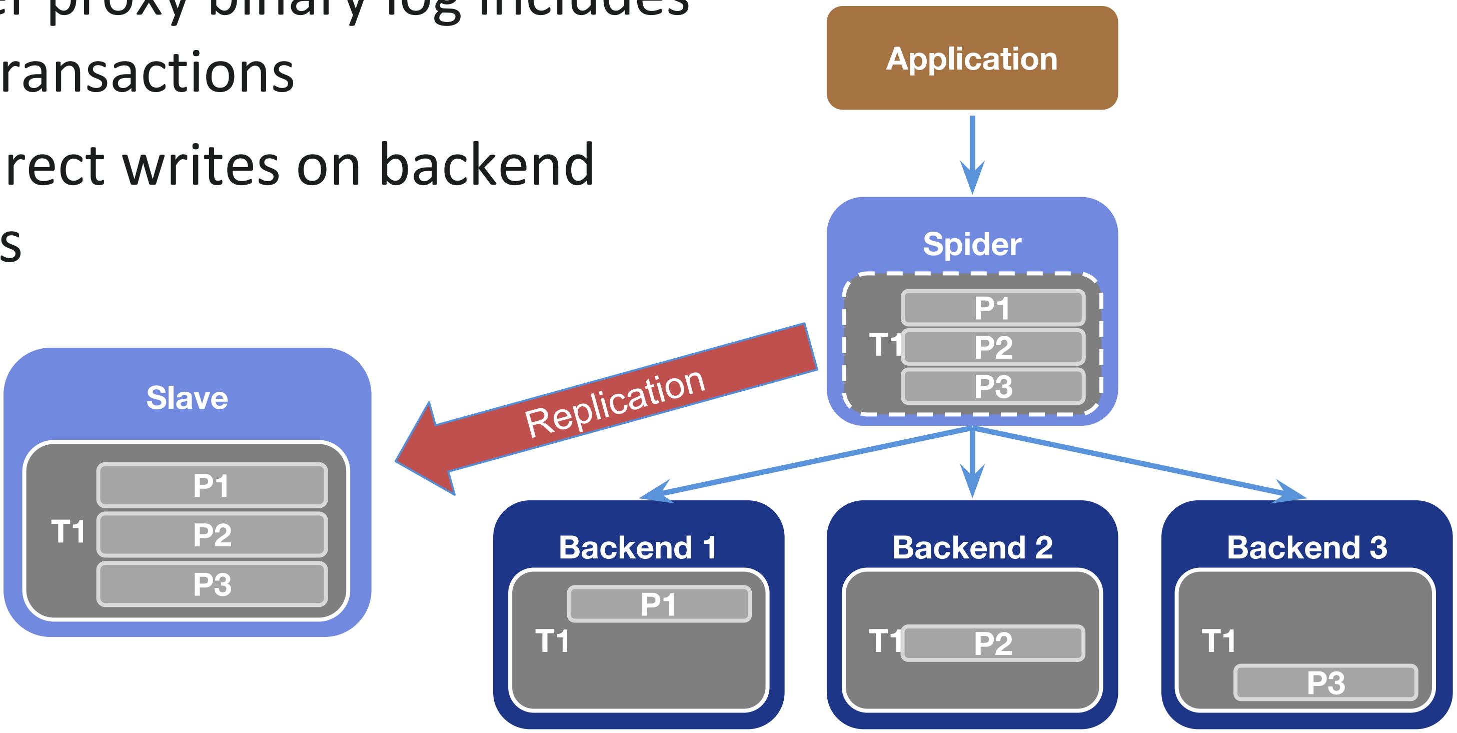
No Automatic Rollback

```
MariaDB> begin;
Query OK, 0 rows affected (0.00 sec)

MariaDB> insert into sharding values (90003,"shard1");
Query OK, 1 row affected (0.01 sec)

MariaDB> insert into sharding values (100101,"shard2");
Query OK, 1 row affected (0.00 sec)

MariaDB> insert into sharding values (200051,"shard3");
ERROR 1429 (HY000): Unable to connect to foreign data source:
192.168.56.23
MariaDB> commit;
Query OK, 0 rows affected (0.01 sec)
```

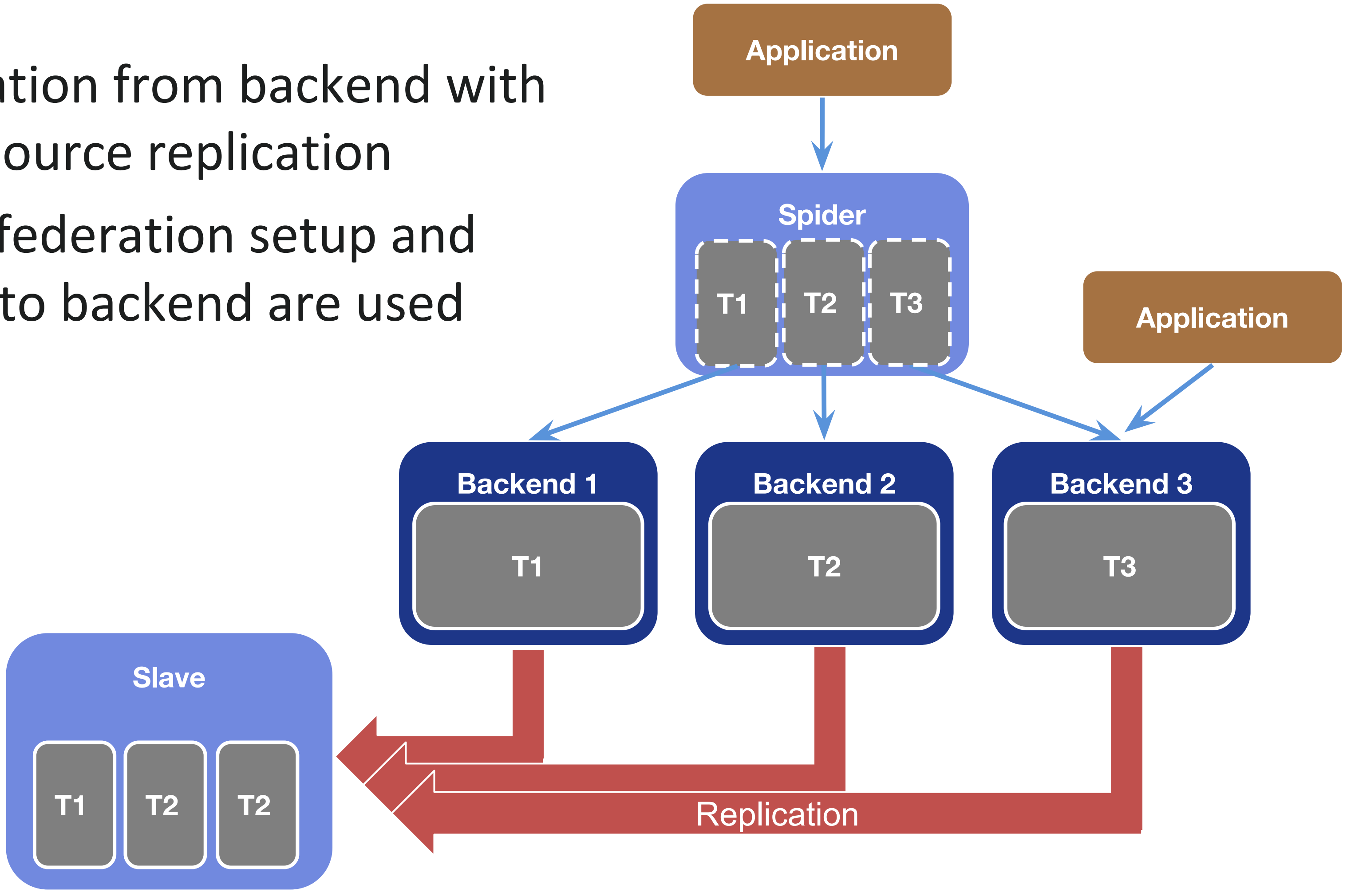
Replicating From Spider

- Replication from Spider proxy to slave
- Spider proxy binary log includes the Transactions
- No direct writes on backend tables



Replicating from Backend

- Replication from backend with multi-source replication
- When federation setup and writes to backend are used



Clustering and High Availability

- Spider supports HA internally
  - Commit and rollback across all backends
  - Multiplexing to replicas using 2PC
  - Split-Brain-Resolution based on quorum
- You can also use other techniques for HA on the backend servers
  - Galera
  - Replication
  - DRBD

Clustering and High Availability Example

```
CREATE TABLE backend.sbtest
(
  id int(10) unsigned NOT NULL AUTO_INCREMENT,
  k int(10) unsigned NOT NULL DEFAULT '0',
  c char(120) NOT NULL DEFAULT '',
  pad char(60) NOT NULL DEFAULT '',
  PRIMARY KEY (id),
  KEY k (k) )
 ENGINE=spider COMMENT='wrapper "mysql", table "sbtest"'
 PARTITION BY KEY (id) (
 PARTITION pt1 COMMENT = 'srv "backend1 backend2_rpl"  mbk "2", mkd "2",
msi "5054", link_status "0 0"',
 PARTITION pt2 COMMENT = 'srv "backend2 backend1_rpl"  mbk "2", mkd "2",
msi "5054", link_status "0 0" ') ;
```

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Clustering and High Availability Example

```
CREATE SERVER mon
  FOREIGN DATA WRAPPER mysql
 OPTIONS(
  HOST '192.168.0.201’,
  DATABASE 'backend',
  USER 'skysql',
  PASSWORD 'skyvodka',
  PORT 5054
);
INSERT INTO `mysql`.`spider_link_mon_servers` VALUES
('%','%','%',5054,'mon',NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL,
NULL,0,NULL,NULL);
SELECT spider_flush_table_mon_cache();
```

Spider and Performance

- Reading
  - Simple queries generally faster
  - Queries spanning all shards can be slower if conditions not pushed down
  - Joins and complex queries can be a lot slower
    - Performance optimizations available through spider functions and options
- Writing
  - INSERTS Generally faster as each node is independent
  - UPDATES depend on reads to get to rows so depends

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Spider Features

- Complete list on https://mariadb.com/kb/en/mariadb/documentation/storage-engines/spider/spider-feature-matrix/

- Performance
  - Index condition pushdown (MariaDB 10)
  - Engine condition pushdown for federated setup
  - Engine condition pushdown for shards setup (MariaDB 10)
  - Batched key access
  - Support for handler socket
  - Map reduced for ORDER BY ... LIMIT

Good To Know

- DDL statements will not be synchronized
- Efficiency of sharding depends on the partitioning rule
  - Sub-Partitions can be used for the backend nodes
- Query cache needs to be deactivated
- Log files per Instance
- Central syslog makes sense for Audit Plugin
- User privileges - Authentication Plugin?
- Spider storage engine is BETA

More Information

- https://mariadb.com/kb/en/mariadb/documentation/storage-engines/spider/
- https://mariadb.org
- http://spiderformysql.com/
- http://bazaar.launchpad.net/~kentokushiba/spiderformysql/spider-2.0-doc/files/head:/en/

Questions ?

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