

ORACLE

# Using MySQL Binlog to Power Real-Time Caching

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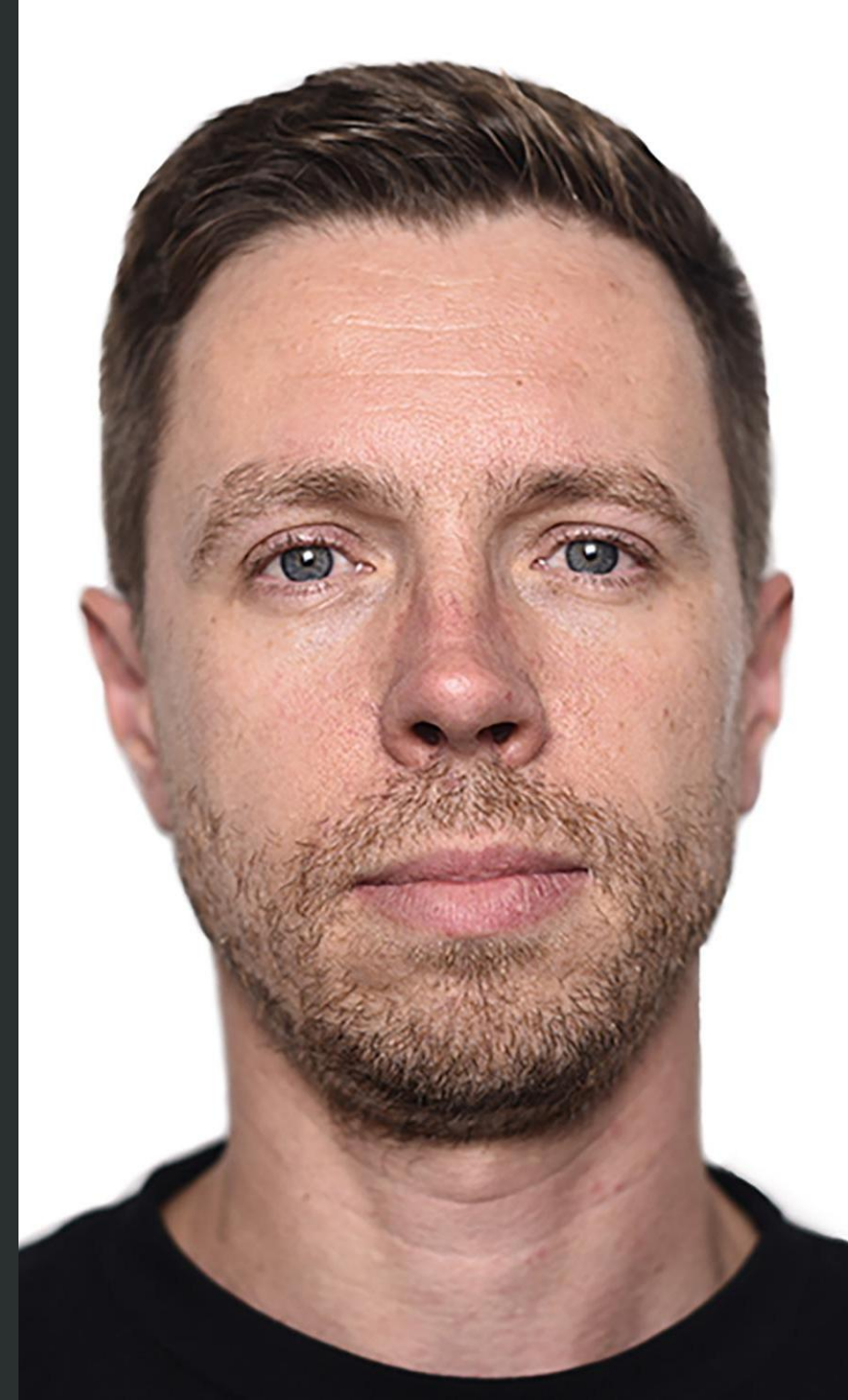
Senior Software Engineer  
Readysset.io

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# Marcelo Altmann

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- Senior Software Engineer @ Percona
  - Maintainer of Percona XtraBackup for MySQL
- Long time Community contributor
- Oracle ACE
- MySQL Code Contributor
- MySQL Rust Driver Contributor
  - TRANSACTION\_PAYLOAD\_EVENT 0x28 (40)



# Agenda

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# Agenda

- Readysset.io Overview
- MySQL Binlog Decode
  - Common Header
  - TABLE\_MAP\_EVENT
  - WRITE|UPDATE|DELETE\_ROWS\_EVENT



# What is Readysset.io

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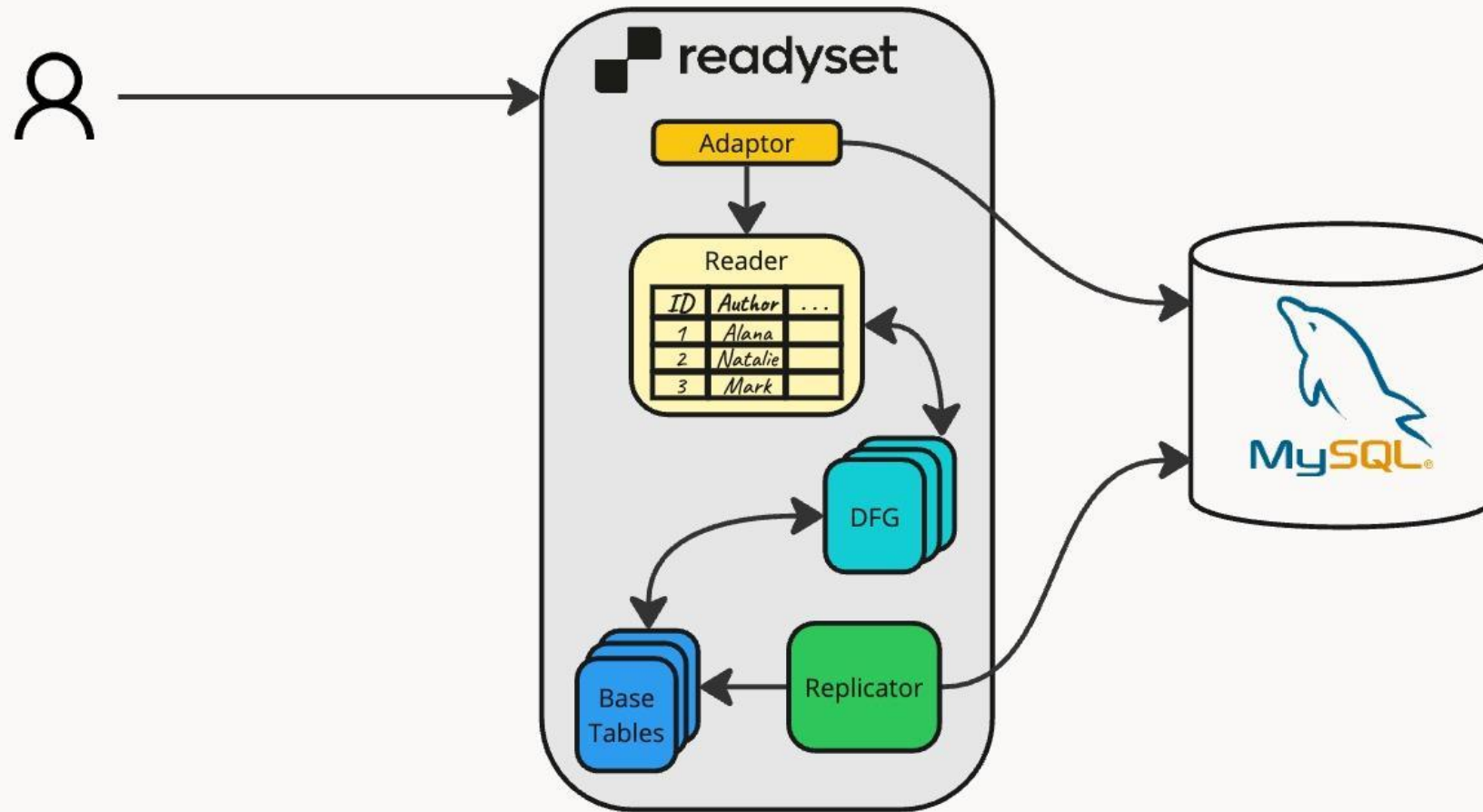
# Readyset.io

- Based on MIT PHD Thesis - Partial State in Dataflow-Based Materialized Views (Noria)
- <https://github.com/readysettech/readysset>
- No application code changes / Wire compatible with MySQL
- Automatic cache maintenance / No TTL
- Microseconds latencies

# Readyset.io Components

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# Readyset.io Components



# Replication / Binary Log

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## Presentation Workload

```
USE presentation;
```

```
CREATE TABLE person (  
    ID INT PRIMARY KEY,  
    name VARCHAR(150) DEFAULT NULL  
);
```

```
INSERT INTO person VALUES (1, 'Marcelo');
```

# Length Mappings

- **Fixed**
  - 4 bytes 0xaabbccdd
- **Null Terminated**
  - 0xaabbccdd00
- **Packet Integer**
  - 0x00 - 0xFA (0-250)
  - 0xFC (252) - 2 extra bytes
  - 0xFE (253) - 3 extra bytes
  - 0xFD (254) - 8 extra bytes
- **Type-Length-Value (TLV)**
  - 0x0102aabb - 0x01 (T) 0x02 (L)  
0xaabb (V)
- **Number Column Dependent**
  - $((\text{column\_count} + 7) / 8)$  bytes
- **Little Endian**
  - 4 bytes ddcbbbaa
  - 0xaabbccdd

# Binlog Event Header (19 bytes)

	Size	Description
<b>Timestamp</b>	4 Bytes	Timestamp of Event
<b>Event Type</b>	1 Byte	Type of Event - This tells how to interpret the event payload
<b>Server ID</b>	4 Bytes	ServerID - To avoid circular replication
<b>Event Size</b>	4 Bytes	Total size of this event in bytes
<b>Next Position</b>	4 Bytes	Offset of next event
<b>Flags</b>	2 Bytes	Event Flags bit-field



# TABLE\_MAP\_EVENT

	Size	Description
<b>Table ID</b>	6 Bytes	INT identifying this table in the next row events
<b>Flags</b>	2 Bytes	Unused
<b>Database Name</b>	Packet INT + Null terminated string	
<b>Table Name</b>	Packet INT + Null terminated string	
<b>Column Count</b>	Packet INT (1-9 Bytes)	The number of columns in the table
<b>Column Type</b>	Column Count Bytes	The type of each column in the table, listed from left to right.
...		



# TABLE\_MAP\_EVENT

	Size	Description
<b>Metadata length</b>	Packet INT	Length of the following Metadata Block
<b>Metadata</b>	Metadata length	For each column left to right, a chunk of data whose length and semantics depend on the datatype.
<b>Null Bits</b>	$((\text{column\_count} + 7) / 8)$ bytes	Bit indicating if the column is null, from left to right. 1 means nullable.
<b>Optional Metadata Fields</b>	TLV	Optional Metadata Fields such as SIGNEDNESS and CHARSET.



# TABLE\_MAP\_EVENT

## Common Header

```
$ xxd -s $((620)) -l $((19)) -c $((19)) -p binlog.000024  
32103568130100000044000000b00200000000
```



# TABLE\_MAP\_EVENT

## Common Header

32103568130100000044000000b00200000000

Timestamp : 0x32103568 - 1748308018



# TABLE\_MAP\_EVENT

## Common Header

32103568130100000044000000b00200000000

**Timestamp** : 1748308018

**Event Type** : 0x13 - TABLE\_MAP\_EVENT



# TABLE\_MAP\_EVENT

## Common Header

32103568130100000044000000b00200000000

Timestamp : 1748308018  
Event Type : 0x13 - TABLE\_MAP\_EVENT  
Server ID : 1



# TABLE\_MAP\_EVENT

## Common Header

32103568130100000044000000b00200000000

Timestamp : 1748308018

Event Type : 0x13

Server ID : 1

Event Size : 0x44 - 68 bytes



# TABLE\_MAP\_EVENT

## Common Header

32103568130100000044000000**b00200000000**

Timestamp : 1748308018

Event Type : 0x13

Server ID : 1

Event Size : 68 bytes

Next Position : **0xb020 688**



# TABLE\_MAP\_EVENT

## Common Header

```
32103568130100000044000000b00200000000
```

Timestamp : 1748308018

Event Type : 0x13

Server ID : 1

Event Size : 68 bytes

Next Position : 688

Flags : 0x0000

# TABLE\_MAP\_EVENT

## Payload

```
$ xxd -s $((620+19)) -l $((68-19)) -c $((68-19)) -p binlog.000024  
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8
```



# TABLE\_MAP\_EVENT

## Payload

5f000000000001000c70726573656e74617469666e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8

Table ID - 0x5f - 95



# TABLE\_MAP\_EVENT

## Payload

5f000000000001000c70726573656e746174696e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8

Table ID - 0x5f - 95

Flags - 0x01 - Unused



# TABLE\_MAP\_EVENT

## Payload

5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation



# TABLE\_MAP\_EVENT

## Payload

5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person



# TABLE\_MAP\_EVENT

## Payload

5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns



# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

Metadata Length - 0x02 - 2 bytes

# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00  
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

Metadata Length - 0x02 - 2 bytes

Metadata - 0x0258 - 600 bytes for col VARCHAR

# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

Metadata Length - 0x02 - 2 bytes

Metadata - 0x0258 - 600 bytes for col VARCHAR

NULL Bitmap - 0x02 - 00000010

# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

Metadata Length - 0x02 - 2 bytes

Metadata - 0x0258 - 600 bytes for col VARCHAR

NULL Bitmap - 0x02 - 00000010

Optional Metadata (TLV) - 0x01 (SIGNEDNESS) 0x01 (1) 0x00 (0)

# TABLE\_MAP\_EVENT

## Payload

```
5f000000000001000c70726573656e746174696f6e0006706572736f6e0002030f025802020101000203fcff00
fba8d0d8
```

Table ID - 0x5f - 95

Flags - 0x01 - Unused

Database - 0x0c 12 bytes 0x70726573656e746174696f6e00 presentation

Table - 0x06 6 bytes 0x706572736f6e00 person

Column Column - 0x02 - 2 Columns

Column Types - 0x03 (MYSQL\_TYPE\_LONG) 0x0f/15 (MYSQL\_TYPE\_VARCHAR)

Metadata Length - 0x02 - 2 bytes

Metadata - 0x0258 - 600 bytes for col VARCHAR

NULL Bitmap - 0x02 - 00000010

Optional Metadata (TLV) - 0x02 (DEFAULT\_CHARSET) 0x03 (3) 0xfc (2 Bytes) 0xff (255 -  
utf8mb4\_0900\_ai\_ci)

# [WRITE|UPDATE|DELETE]\_ROWS\_EVENT

	Size	Description
<b>Table ID</b>	6 Bytes	ID of the table - to look up metadata in previous TABLE_MAP_EVENT
<b>Flags</b>	2 Bytes	Row Event Flags (STMT_END_F)
<b>Extra Data Length</b>	2 Bytes (including this field)	For TIME2, DATETIME2, TIMESTAMP2, the microsecond-fraction values for each row.
<b>Column Count</b>	Packet INT (1-9 Bytes)	Number of Columns in this table



# [WRITE|UPDATE|DELETE]\_ROWS\_EVENT

	Size	Description
<b>Columns Present (BI)</b>	$((\text{column\_count} + 7) / 8)$ bytes	A bit set to 1 means the corresponding column has data in this Before Image row event
<b>Columns Present (AI)</b>	$((\text{column\_count} + 7) / 8)$ bytes	A bit set to 1 means the corresponding column has data in this After Image row event
<b>Null Bitmap (BI)</b>	$((\text{column\_count} + 7) / 8)$ bytes	A bit set to 1 indicates that the corresponding column value is NULL (from columns present).
<b>Row Data (BI)</b>	Variable	For each column present, parse it's blob data according to the field type from TME
<b>Null Bitmap (AI)</b>	$((\text{column\_count} + 7) / 8)$ bytes	A bit set to 1 indicates that the corresponding column value is NULL (from columns present).
<b>Row Data (AI)</b>	Variable	For each column present, parse it's blob data according to the field type from TME



# WRITE\_ROWS\_EVENT

## Common Header

```
$ xxd -s $((688)) -l $((19)) -c $((19)) -p binlog.000024  
321035681e0100000031000000e10200000000
```



# WRITE\_ROWS\_EVENT

## Common Header

321035681e0100000031000000e10200000000

Timestamp : 1748308018

Event Type : 0x1e

Server ID : 1

Event Size : 49 bytes

Next Position : 737

Flags : 0x0000



# WRITE\_ROWS\_EVENT

## Common Header

321035681e0100000031000000e10200000000

Timestamp : 1748308018  
Event Type : 0x1e - WRITE\_ROWS\_EVENT - 30  
Server ID : 1  
Event Size : 49 bytes  
Next Position : 737  
Flags : 0x0000



# WRITE\_ROWS\_EVENT

## Payload

```
$ xxd -s $((688+19)) -l $((49-19)) -c $((49-19)) -p binlog.000024  
5f00000000000100020002ff000100000007004d617263656c6f8e965c4f
```



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes

Column Count - 0x02 - 2 Columns



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes

Column Count - 0x02 - 2 Columns

Columns Present (After Image) - 0xff = ALL



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes

Column Count - 0x02 - 2 Columns

Columns Present (After Image) - 0xff = ALL

Null Bitmap - 0x00 - No NULL columns



# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes

Column Count - 0x02 - 2 Columns

Columns Present (After Image) - 0xff = ALL

Null Bitmap - 0x00 - No NULL columns

Col1 Data (INT) - 0x01 - VAL: 1

# WRITE\_ROWS\_EVENT

## Payload

5f00000000000100020002ff000100000007004d617263656c6f8e965c4f

Table ID - 0x5f - 95

Flags - 0x01 - STMT\_END\_F

Extra Data Length - 0x02 - 2 bytes - No extra bytes

Column Count - 0x02 - 2 Columns

Columns Present (After Image) - 0xff = ALL

Null Bitmap - 0x00 - No NULL columns

Col1 Data (INT) - 0x01 - VAL: 1

Col2 Data (Varchar(150)) - 0x07 (bytes length) 0x4d617263656c6f (Marcelo)

# Thank you

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