Databases run better with Percona

PERCONA
for MySQL

Binary Log Server

the missing MySQL infrastructure component

A huge fan of MySQL and c++

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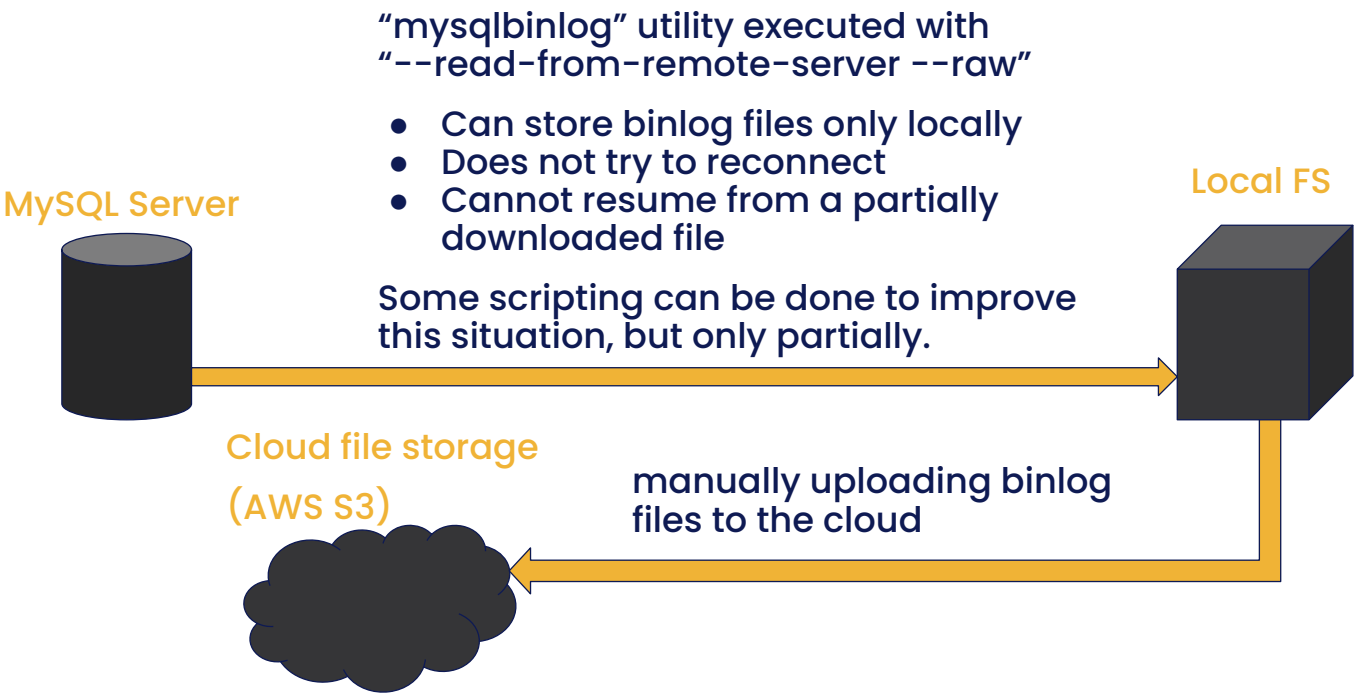
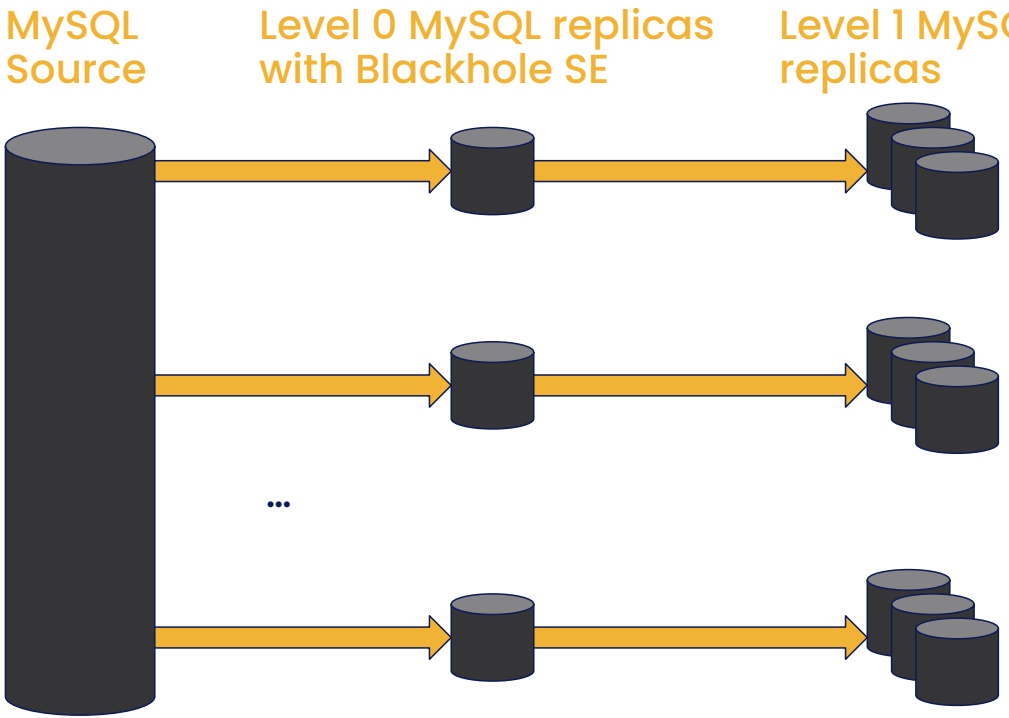
Introduction

motivational scenarios

Continuous binlog backup for PITR



Chained replication



Group commit info is lost after binlog events pass through Level 0 MySQL replicas in which for all tables we created their dummy equivalents (using Blackhole Storage Engine).

This drastically affects the behavior of the parallel applier on Level 1 replicas.

Chained replication (explained)

Some people call Level 0 replicas (those with the Blackhole Storage Engine) “Binlog Servers”.

Despite the simplicity of the Blackhole SE, Level 0 servers add significant overhead on the task they are meant to do - simply receiving binlog event from a source and passing them to multiple replicas.

Chained replication (reported issues)

Percona Server Bug PS-4560
“Slave writes less when connected intermediary master with blackhole engine”

MySQL Bug #91477
“Slave writes less when connected intermediary master with blackhole engine”

Created: 28 Jun 2018

An opportunity

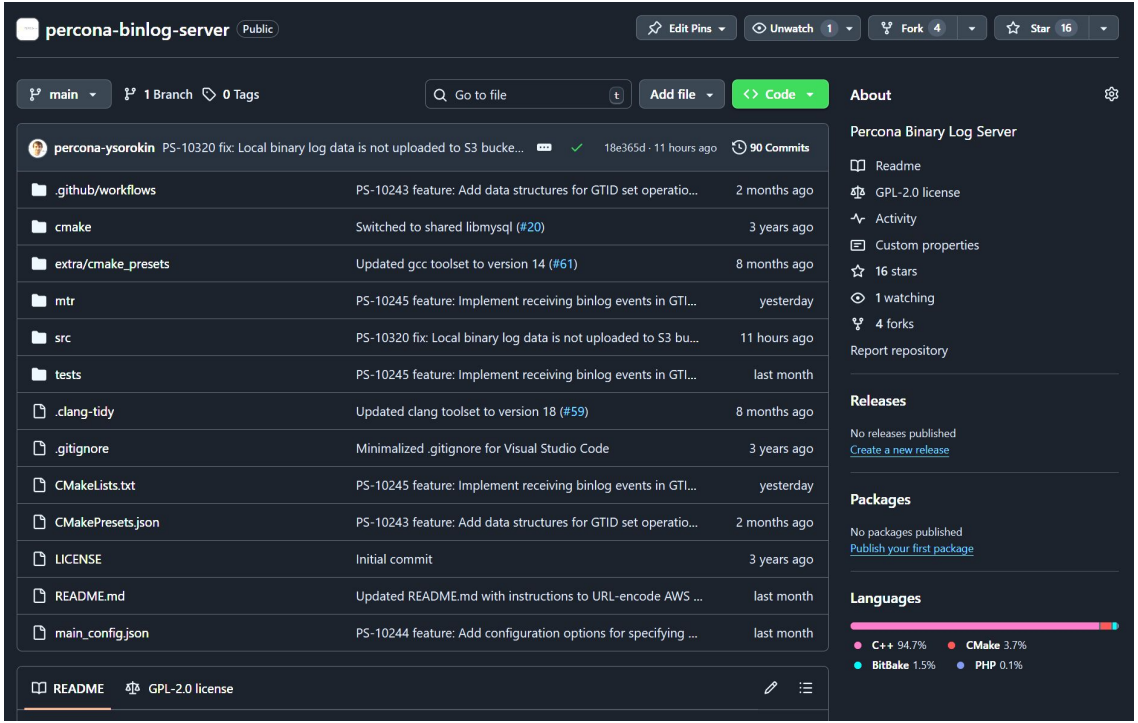
a new project arises

Percona Binary Log Server (percona-binlog-server)

An new Open-Source project (under GPL-2.0 License).
Available on GitHub
https://github.com/Percona-Lab/percona-binlog-server

- Written in c++20
- Enabled GitHub Actions CI
- Enforced clang-format rules
- Enforced clang-tidy checking
- Depends on Boost c++ libraries and AWS SDK for C++
- Uses boost::test as a unit test framework
- Uses MTR for integration tests

Percona Binary Log Server (proof)



Current functionality

“mysqlbinlog” on steroids

Binlog Server intro
(a quote from the project's README.md)

binlog_server is a command line utility that can be considered as an enhanced version of mysqlbinlog in --read-from-remote-server mode which serves as a replication client and can stream binary log events from a remote Oracle MySQL Server / Percona Server for MySQL...
... It is capable of automatically reconnecting to the remote server and resume operation from the point when it was previously stopped / terminated.

Key features

- In comparison to a separate dedicated instance of MySQL Server, Binlog Server operates only at binary log events level and has no overhead of full-blown RDBMS.
- In comparison to “mysqlbinlog” utility, Binlog Server supports continuous pulling mode and resuming from previously saved state.
- Binlog Server can work with cloud file storages directly:
  - AWS S3 is supported in the initial version.
  - Support for S3-compatible services added a bit later.
  - Pluggable infrastructure allows to easily add support for other Cloud providers (Azure, Google Cloud).
- Binlog Server operates in two modes:
  - “fetch” mode - start receiving binlog events from the remote server and stop when reached the very last event or an error occurred.
  - “pull” mode - continuous mode, that handles disconnects / reconnects and terminates only upon receiving a signal.

More key features (PITR helpers)

Binlog Server can query its storage directly and answer the following questions:

- Give me the list of binlog files (along with their direct URLs) that include at least one binlog event created earlier than the provided <TIMESTAMP>
- Give me the minimal list of binlog files that covers all GTIDs specified in the provided <GTID_SET>

Usage

how to set up and run

Binlog Server connection features

- Connections can be established to 8.0 and 8.4 / 9.x (currently tested with 9.5) MySQL Servers.
- We support full variety of mysqlclient SSL / TLS options.
- We support connections via “dns_srv_name” (used a lot in Kubernetes environments).
- Configurable connection / read timeouts.

```
"connection": {
  "host": "127.0.0.1",
  "port": 3306,
  "user": "rpl_user",
  "password": "rpl_password",
  "connect_timeout": 20,
  "read_timeout": 60,
  "write_timeout": 60,
  "ssl": {
   "mode": "required"
  }
 }
```

Binlog Server replications features

- We support position-based replication
  - Producing physical copies of remote binlog files
- We support GTID-based replication
  - The received binlog files may not be identical to the remote ones but GTID sets allow to resume operations from a different server in the topology
- We support binlog event checksumming
- “server_id” can be configured

```
"replication": {
   "server_id": 42,
   "idle_time": 10,
   "verify_checksum": true,
   "mode": "position"
 }
```

Binlog Server storage features

- We support local filesystem as a binlog file storage
- We support AWS S3 as a binlog file storage
- We support S3-compatible services (like MinIO) with custom endpoint URLs.
- We support buffering and event data flushing upon checkpointing events:
  - size-based checkpoints, when data accumulated in the buffer exceeds the configured value
  - time-based checkpointing, when time elapsed from the last flush exceeded the configured value

```
"storage": {
   "backend": "s3",
   "uri": "https://key_id:secret@192.168.0.100:9000/binsrv-bucket/vault",
   "fs_buffer_directory": "/tmp/binsrv",
   "checkpoint_size": "128M",
   "checkpoint_interval": "30s"
 }
```

Binlog Server how to use

1. Create a configuration file “config.json” with the 3 sections mentioned on previous slides + one section for logging. You basically specify 3 things:
   a. From where to get data.
   b. Where to store it.
   c. How to interpret it (replication mode)
2. Create a directory on a local filesystem / a virtual directory in a bucket on S3 for storing binlog files.
3. Run “binlog_server pull config.json”
4. You will soon see something like the following in your storage directory:

```
-rw-r--r--  1 user group  682 Jan 20 00:42 binlog.000001
-rw-r--r--  1 user group  131 Jan 20 00:42 binlog.000001.json
-rw-r--r--  1 user group  519 Jan 20 00:42 binlog.000002
-rw-r--r--  1 user group  131 Jan 20 00:42 binlog.000002.json
-rw-r--r--  1 user group    4 Jan 20 00:42 binlog.000003
-rw-r--r--  1 user group  129 Jan 20 00:42 binlog.000003.json
-rw-r--r--  1 user group   48 Jan 20 00:42 binlog.index
-rw-r--r--  1 user group   27 Jan 20 00:42 metadata.json
```

Challenges

replication internals

Solved problems (part 1)

1. Support for 8.0 and 8.4/9.x MySQL servers. In 8.4/9.x servers there is new GTID_TAGGED_LOG event.
2. Deciding whether certain events from the initial event sequence should be written to storage or not (Artificial ROTATE, FORMAT_DESCRIPTION and optional PREVIOUS_GTIDS_LOG received upon reconnection).
3. Identifying transaction boundaries (luckily, starting from 8.0 all GTID-related events include “transaction_length” field in their body).
4. Making sure that we permanently write data to the storage only at transaction boundaries.

Solved problems (part 2)

1. Implementing reconnection logic trying to minimize open/close operations in the storage.
2. Tracking GTID sets associated with binlog files.
3. Implementing event offsets rewriting in GTID mode (in case when we reconnected to another server with different physical binlog layout).
4. Implementing reorganizing binlog file splitting in the storage in GTID mode.
5. Implementing “append” operation on S3.

Roadmap

the project is being actively developed

Multi-tenant and control interface

- We want Binlog Server to be able to work with multiple MySQL Servers and multiple storages simultaneously.
- We want to have a control port that would accept control commands (possible syntax):
  - CREATE STORAGE ‘vault1’ ...
  - CREATE SERVER ‘mysql1’ AS 192.168.0.100:3306 ...
  - CREATE REPLICATION TASK ‘task1’ FROM ‘mysql1’ TO ‘vault1’ IN GTID MODE
  - START TASK ‘task1’
  - INFO TASK ‘task1’
  - INFO STORAGE ‘vault1’
  - INFO SERVER ‘mysql1’
  - STOP TASK ‘task1’
  - DROP REPLICATION TASK ‘task1’
  - DROP SERVER ‘mysql1’
  - DROP STORAGE ‘vault1’
  - ...

REST for control interface

- PUT /api/v1/storages HTTP/1.1
  { … }
- GET /api/v1/tasks/task1 HTTP/1.1
- DELETE /api/v1/connections/mysql1 HTTP/1.1

Make Binlog Server a “Server”

Add functionality that would allow to use Binlog Server as a MySQL replication source.

```
CHANGE REPLICATION SOURCE TO
   SOURCE_HOST='<binlog_server_address>',
   SOURCE_USER='replication_user_name',
   SOURCE_PASSWORD='replication_password',
   ....
```

Thank You!

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