



Percona Xtrabackup: From Zero to Hero

Marcelo Altmann – Senior Software Engineer
Vinicius Grippa – Senior Support Engineer

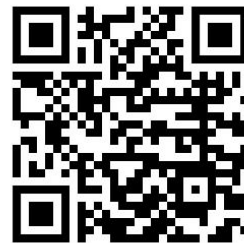
Percona Live Denver / May 2023



Intro

Marcelo Altmann

- Senior Software Engineer @ Percona
- Working on Xtrabackup Project
- Author of key features
 - FIFO Datasink / xbcloud multi-thread
 - Memory Estimation
 - ZSTD Compression Support
 - Xbcloud exponential Backoff
 - Xbcloud instance profile
 - KMIP & KMS Keyring Component Integration



Vinicius Grippa

- Senior Support Engineer @ Percona





Agenda

Agenda

- The Basics
- Full Backup
- Incremental Backup
- Streaming
- Encrypted & Compressed
- Partial Backups
- Point In Time Recovery



Before we Start



Before we start

- Download the PDF with examples to follow at https://bit.ly/pl_tutorial

- Launch container:

```
$ docker run -d -t -i --privileged --name  
percona_live altmannmarcelo/pxb_pl:latest
```

- Check everything is up and running:

```
$ docker logs -n 1 percona_live  
Everything is up and running.
```

- Enter Container:

```
$ docker exec -it percona_live bash  
root@26dfe9feaa65:/#
```

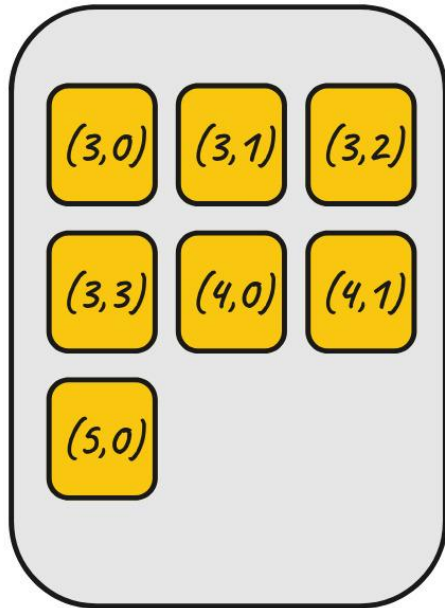




The Basics – How it works

InnoDB - General Componentes

InnoDB Buffer Pool



Redo Log - #ib_redoXX

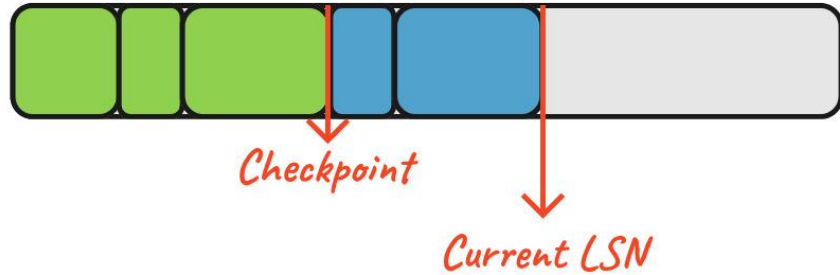


table1.ibd

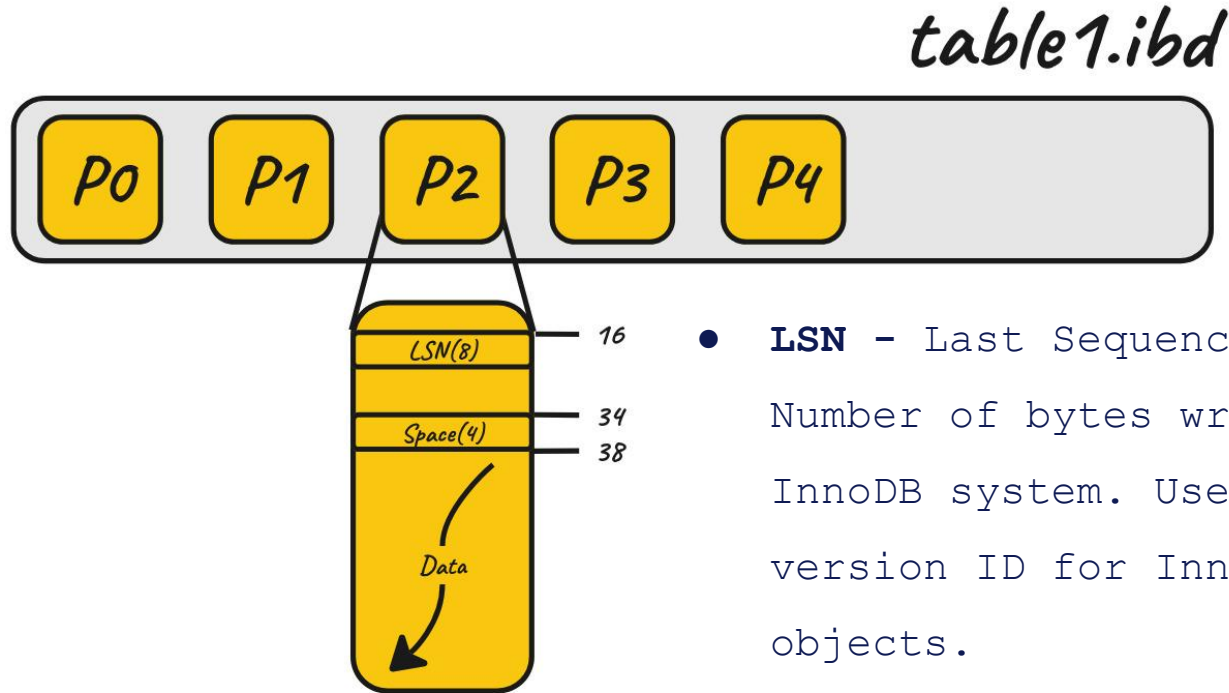


InnoDB – Disk Table Layout

table1.ibd



InnoDB – Disk Table Layout



- **LSN** - Last Sequence Number
Number of bytes written on InnoDB system. Used as a version ID for InnoDB objects.

InnoDB – Disk Table Layout

```
mysql> SELECT SPACE, NAME, PAGE_SIZE FROM INFORMATION_SCHEMA.INNODB_TABLESPACES  
-> WHERE NAME = 'test/table1'\G
```

```
***** 1. row *****
```

```
SPACE: 2
```

```
NAME: test/table1
```

```
PAGE_SIZE: 16384
```

```
1 row in set (0,01 sec)
```

```
mysql> pager grep 'Log sequence number'
```

```
PAGER set to 'grep 'Log sequence number''
```

```
mysql> SHOW ENGINE INNODB STATUS\G
```

```
Log sequence number          19578468
```

```
1 row in set (0,01 sec)
```

```
mysql> INSERT INTO table1 VALUES(1);
```

```
Query OK, 1 row affected (0,00 sec)
```

```
mysql> SHOW ENGINE INNODB STATUS\G
```

```
Log sequence number          19578769
```

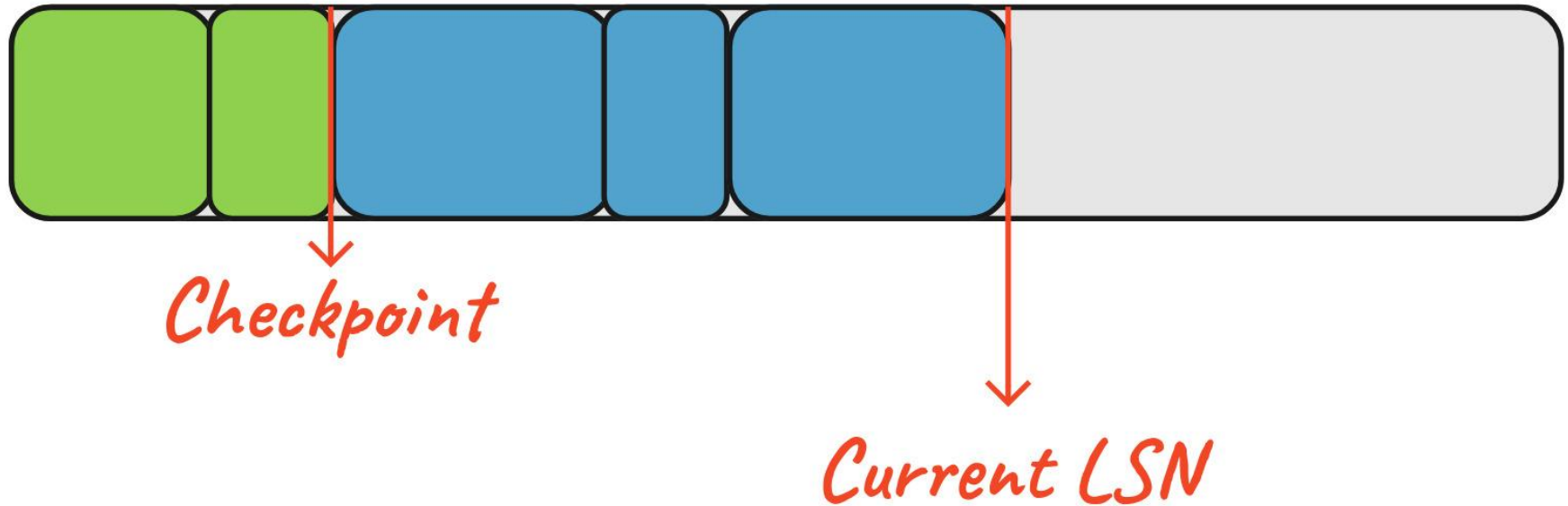
```
1 row in set (0,00 sec)
```

```
marcelo /work/ps/ins/8.0/datadir1  
$ od -j34 -N4 --endian=big \  
> test/table1.ibd  
0000042 000000 000002  
0000046
```

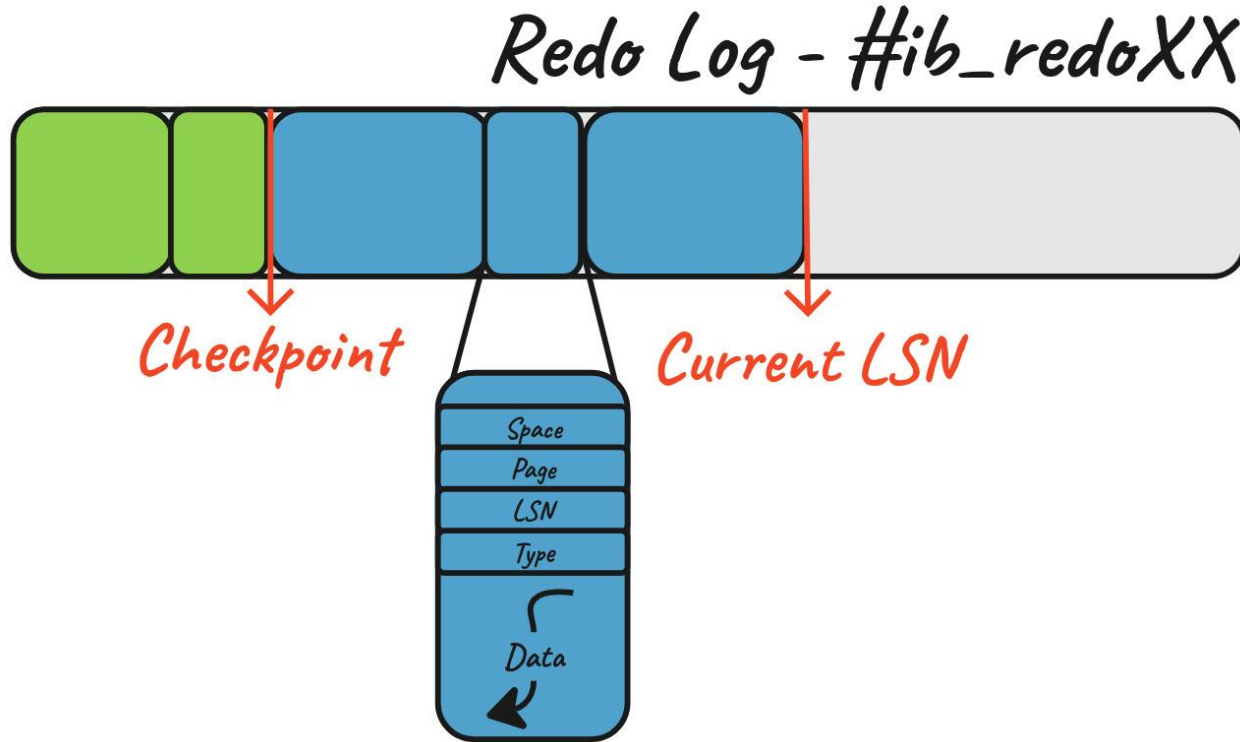
```
marcelo /work/ps/ins/8.0/datadir1  
$ od -An -j$((4 * 16384 + 16)) \  
> -D -N8 --endian=big test/table1.ibd  
0 19578573
```

InnoDB - Redo Log (WAL)

Redo Log - #ib_redoXX

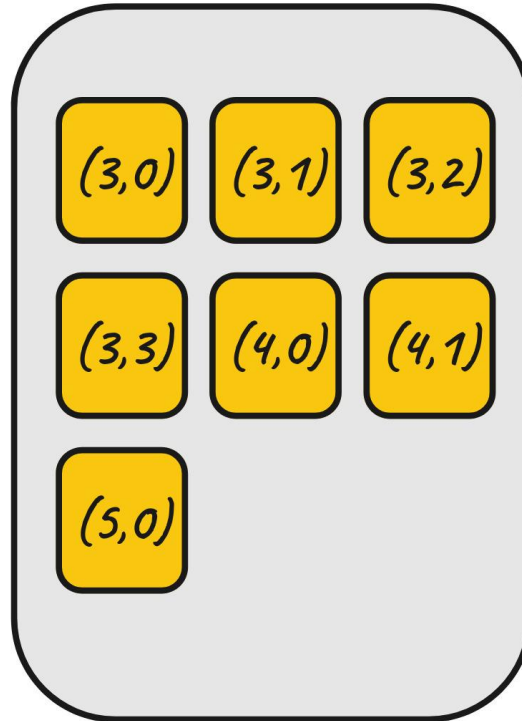


InnoDB - Redo Log (WAL)



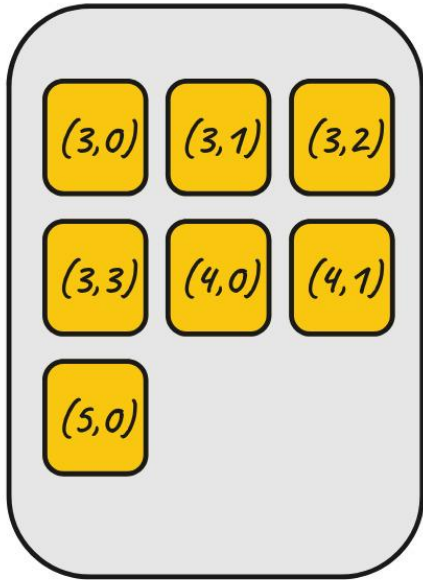
InnoDB – Buffer Pool

InnoDB Buffer Pool

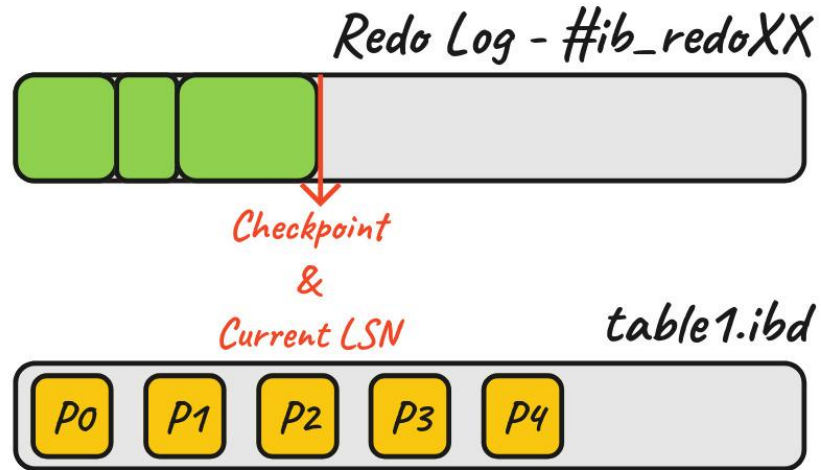


InnoDB - Write workflow

InnoDB Buffer Pool

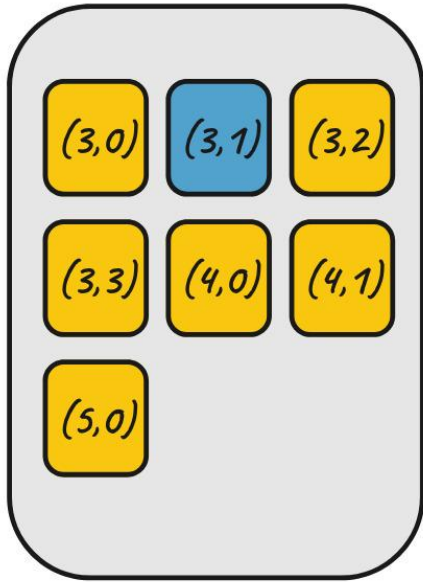


```
mysql> UPDATE TABLE table1 SET name = 'Marcelo' WHERE ID = 88
```

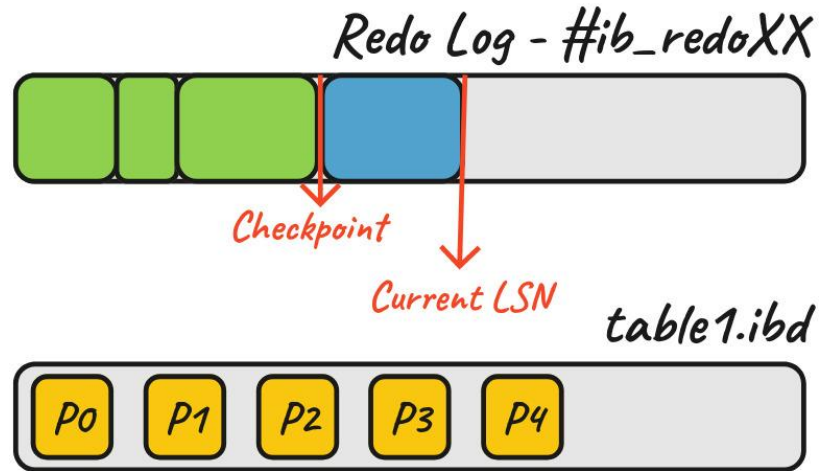


InnoDB - Write workflow

InnoDB Buffer Pool

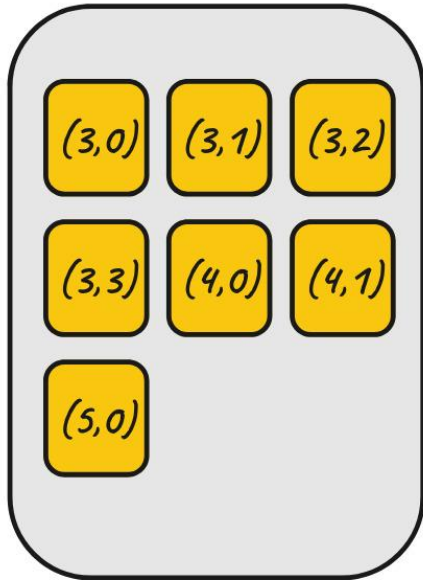


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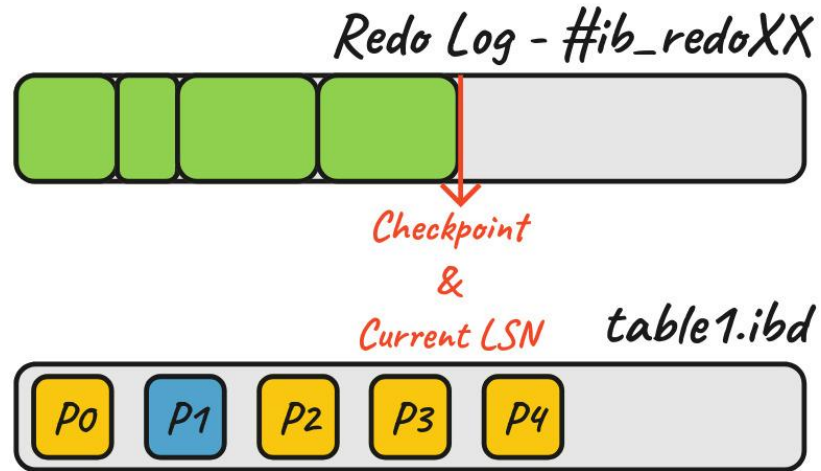


InnoDB - Write workflow

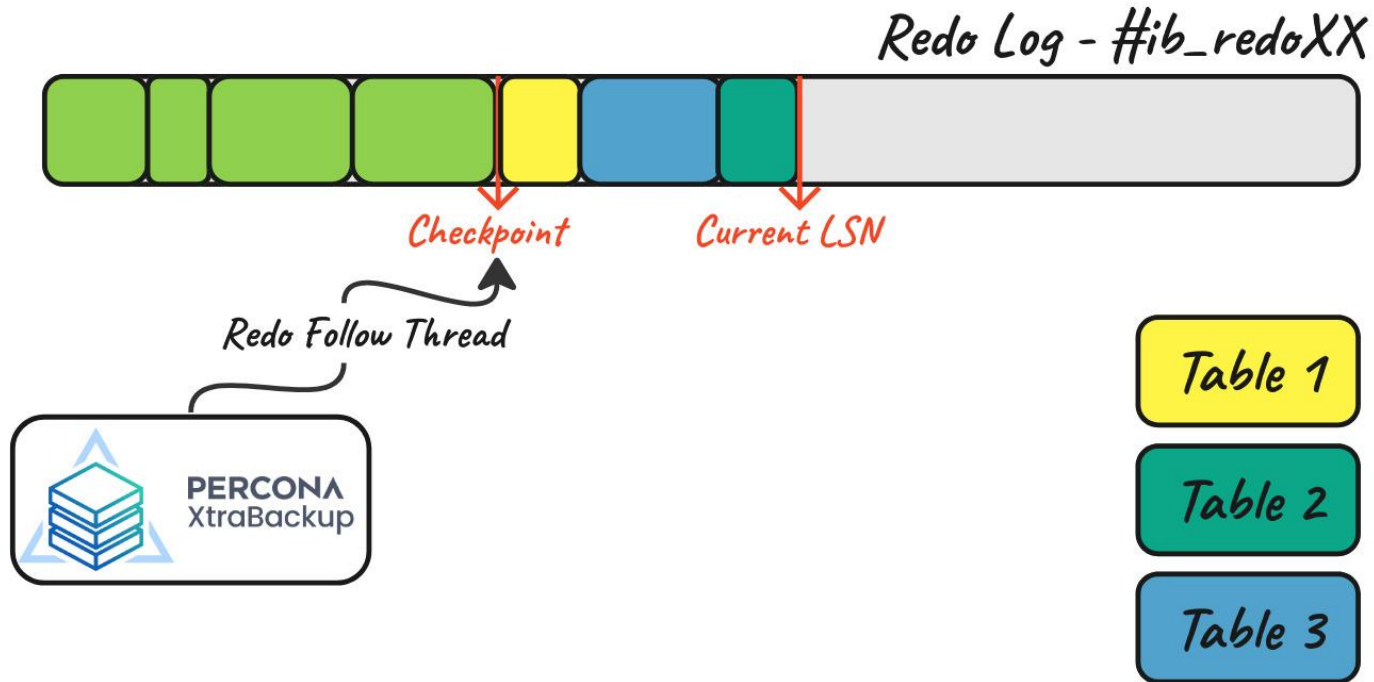
InnoDB Buffer Pool



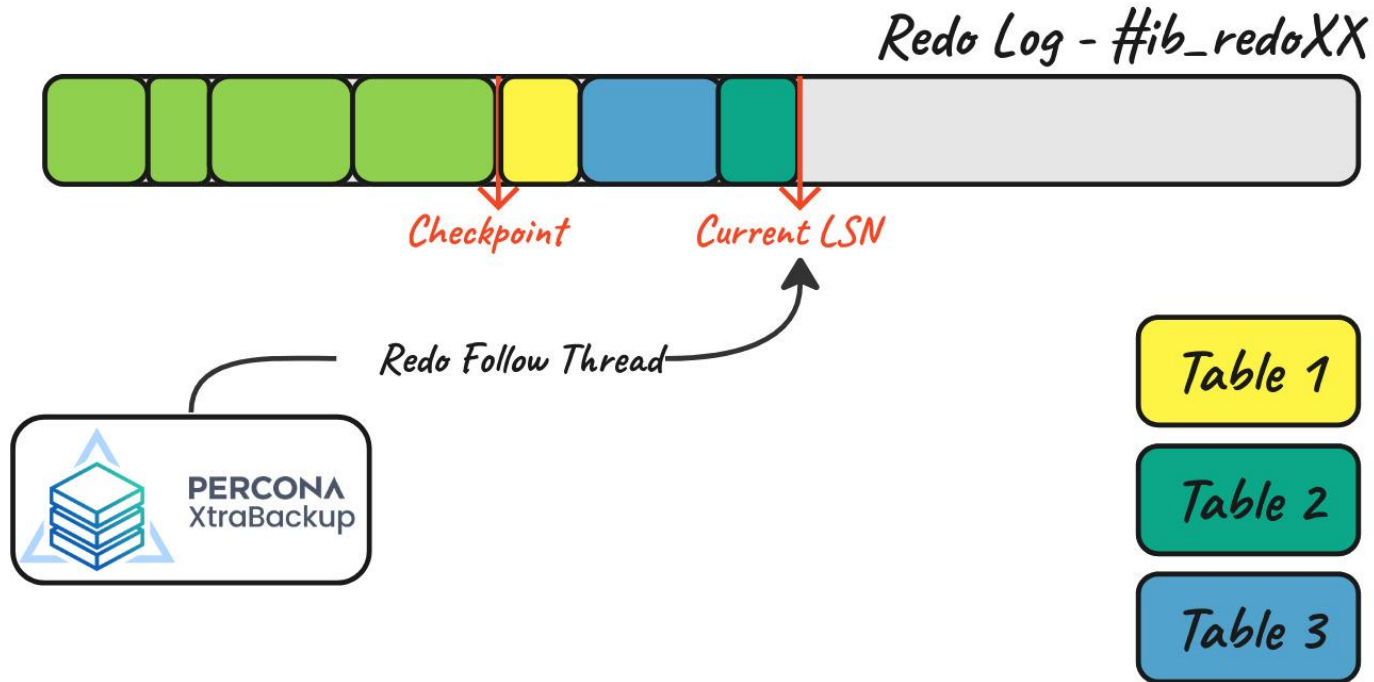
```
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```



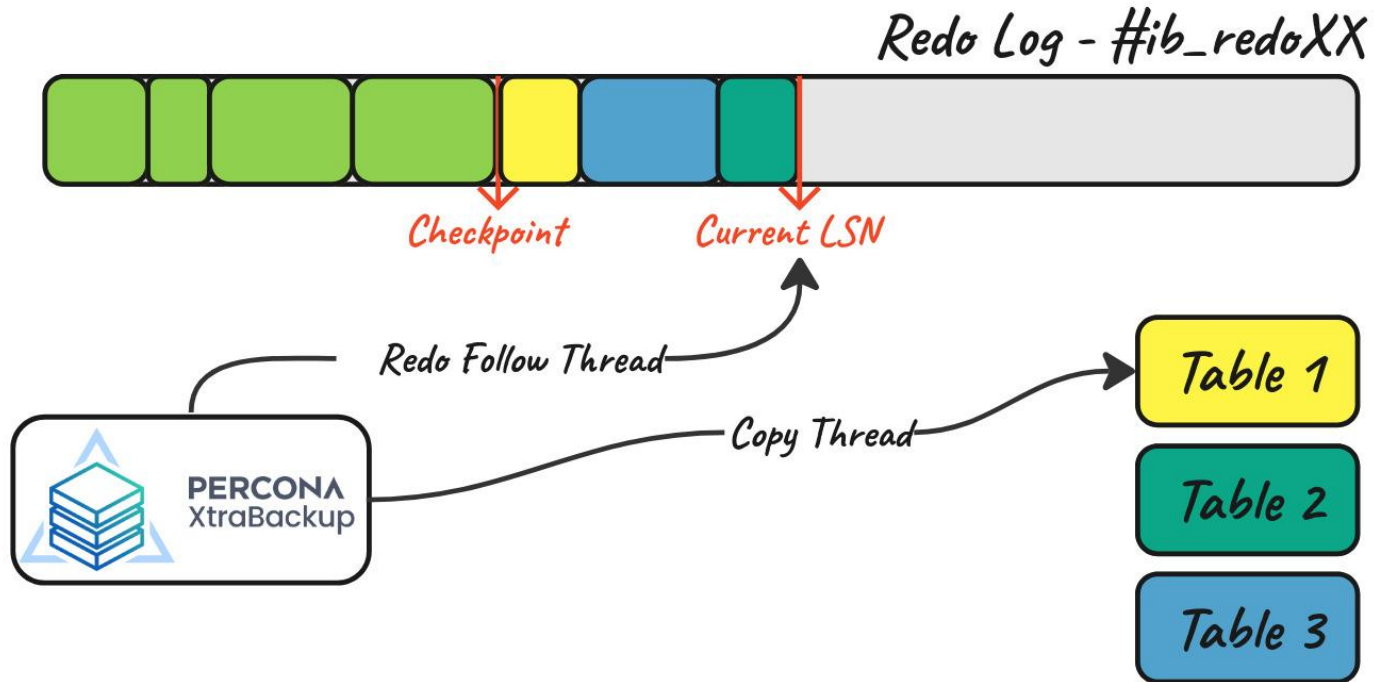
Percona Xtrabackup Workflow --backup



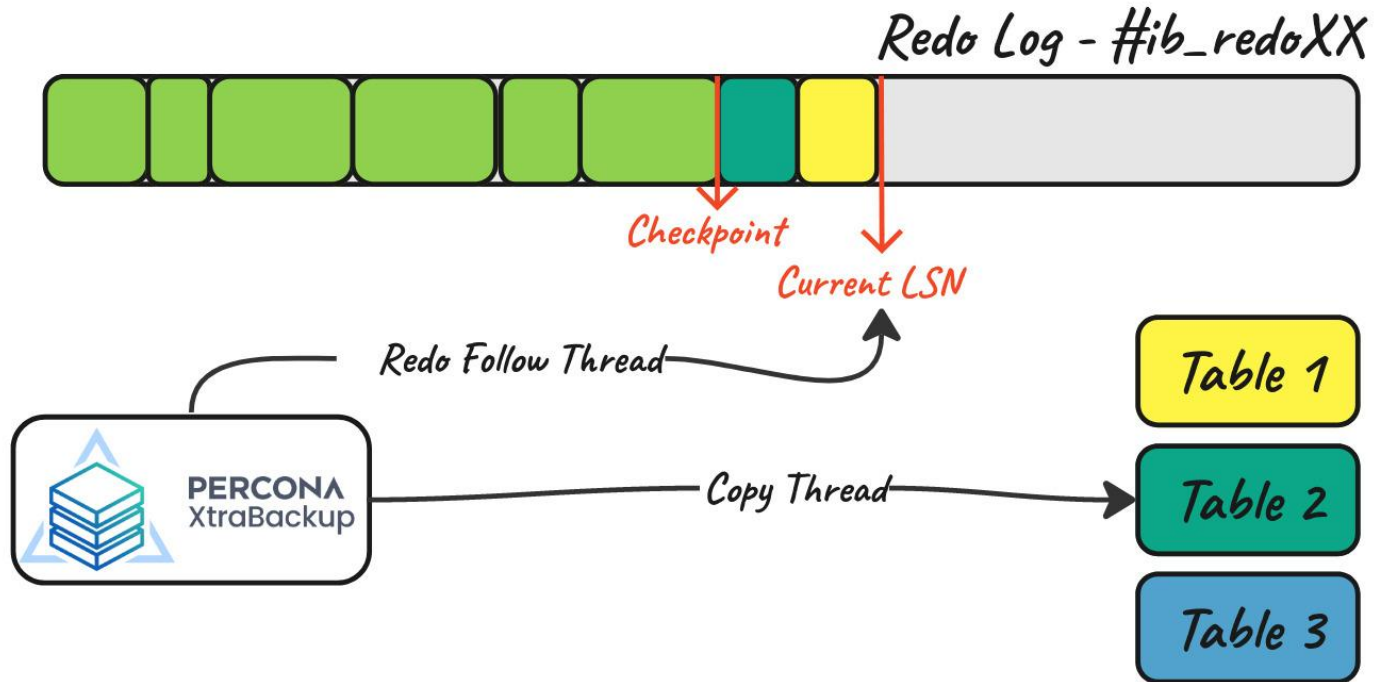
Percona Xtrabackup Workflow --backup



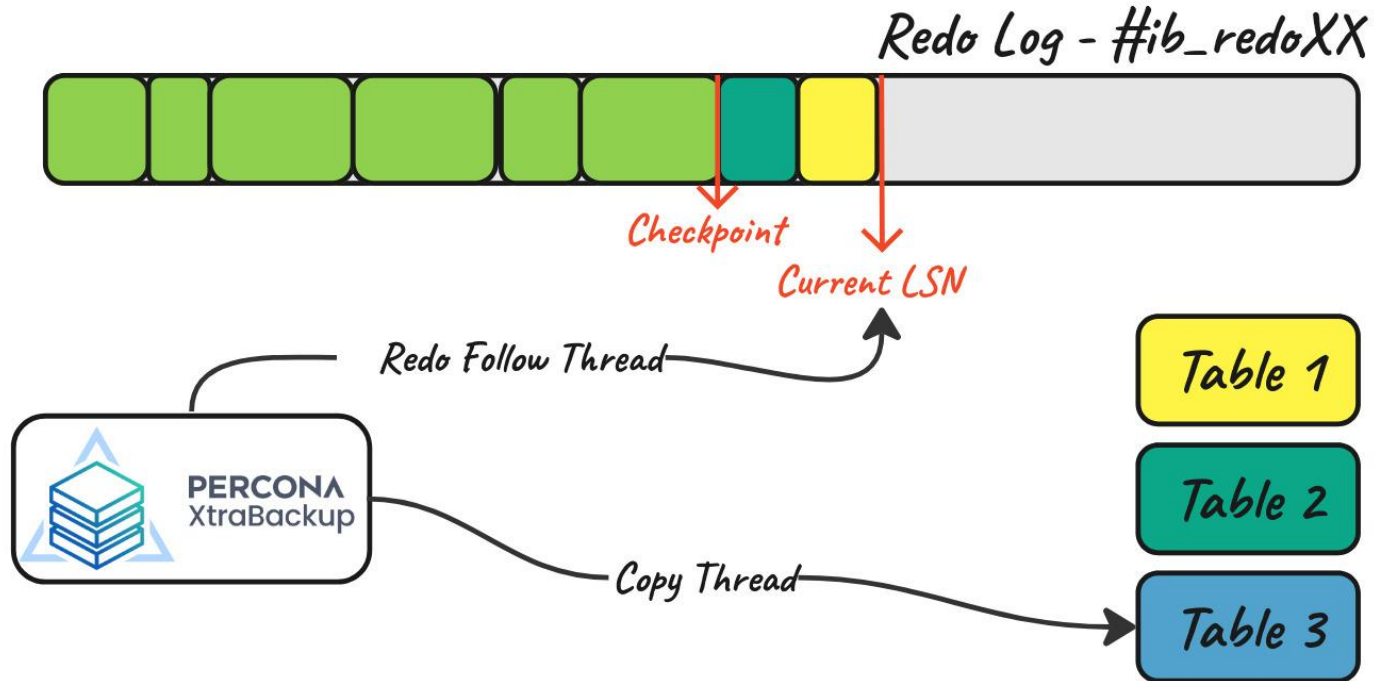
Percona Xtrabackup Workflow --backup



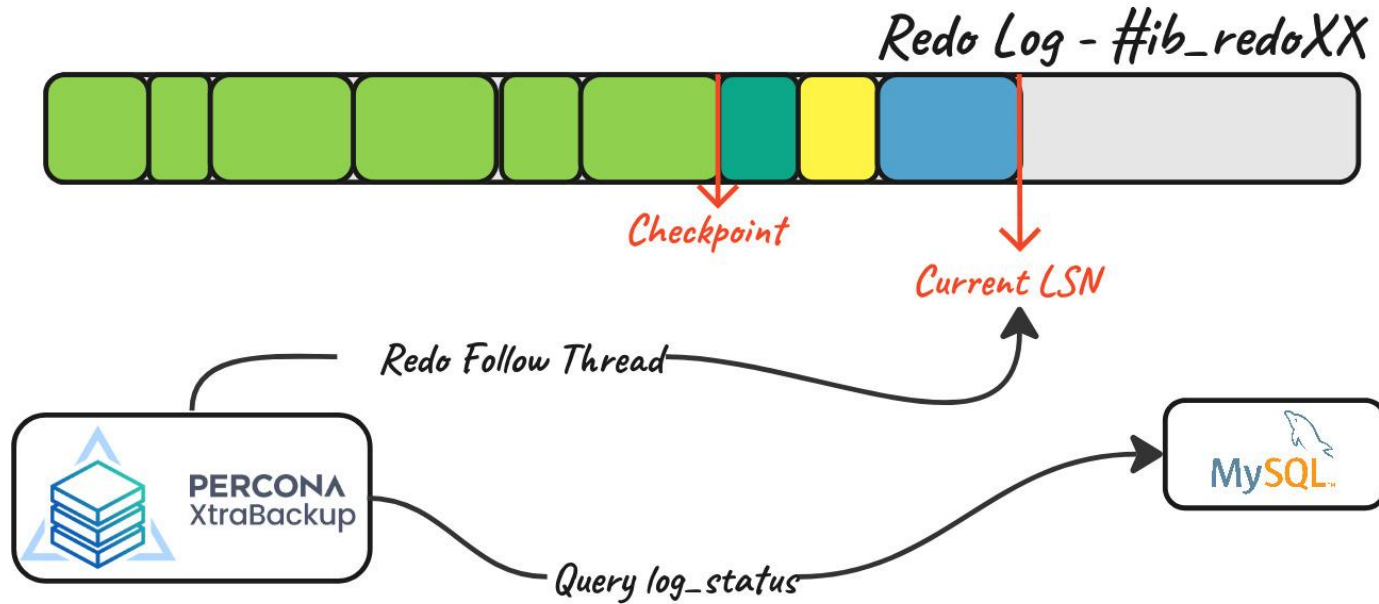
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Percona Xtrabackup Workflow --backup



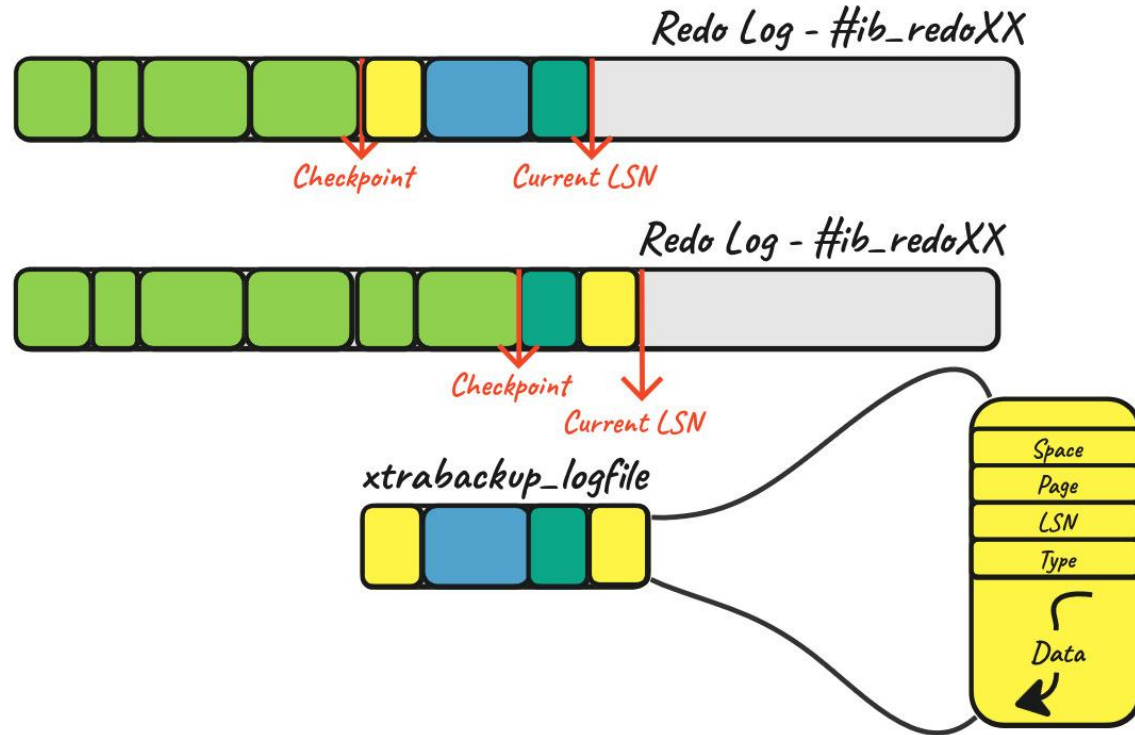
Percona Xtrabackup Workflow --backup



Percona Xtrabackup Workflow --backup

```
marcelo $ mysql -e "SELECT * FROM performance_schema.log_status\G"
***** 1. row *****
SERVER_UUID: f219fadc-e29a-11ed-bdad-60a4b722b33a
LOCAL: {"gtid_executed": "", "binary_log_file": "binlog.000001", "binary_log_position": 157}
REPLICATION: {"channels": []}
STORAGE_ENGINES: {"InnoDB": {"LSN": 19549557, "LSN_checkpoint": 19549557}}
```

Percona Xtrabackup Workflow - --prepare



Before we start

- Debug Sync Points
 - Way to stop program execution at a defined point
 - Used on test suite to make certain conditions deterministically
 - Not suitable for production



Hands On!!! Full Backup



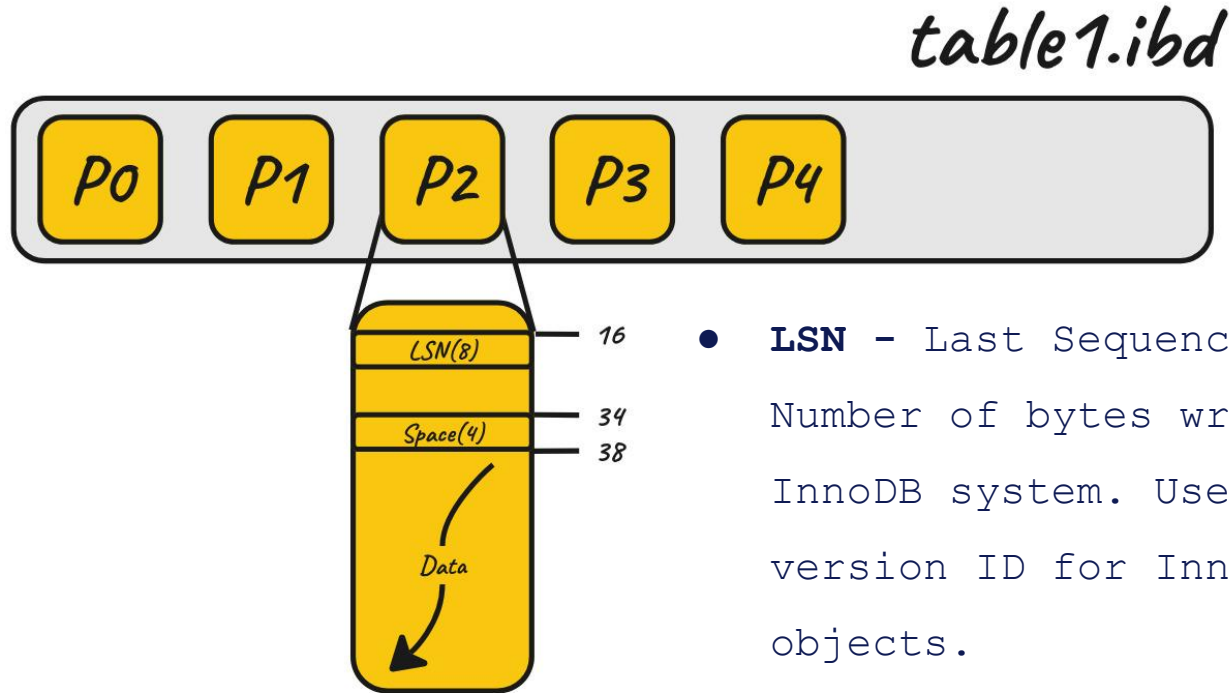
Full Backup

- Download Docker Image - **altmannmarcelo/pxb_pl:latest**
- Debug Sync Points
 - Way to stop program execution at a defined point
 - Used on test suite to make certain conditions deterministically
 - Not suitable for production



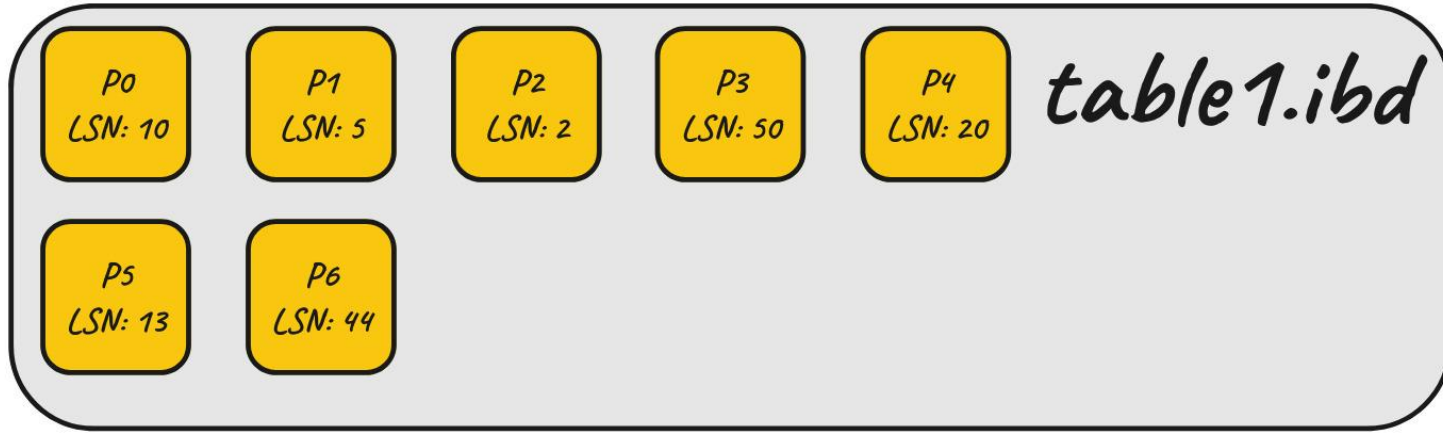
Incremental Backup

InnoDB – Disk Table Layout



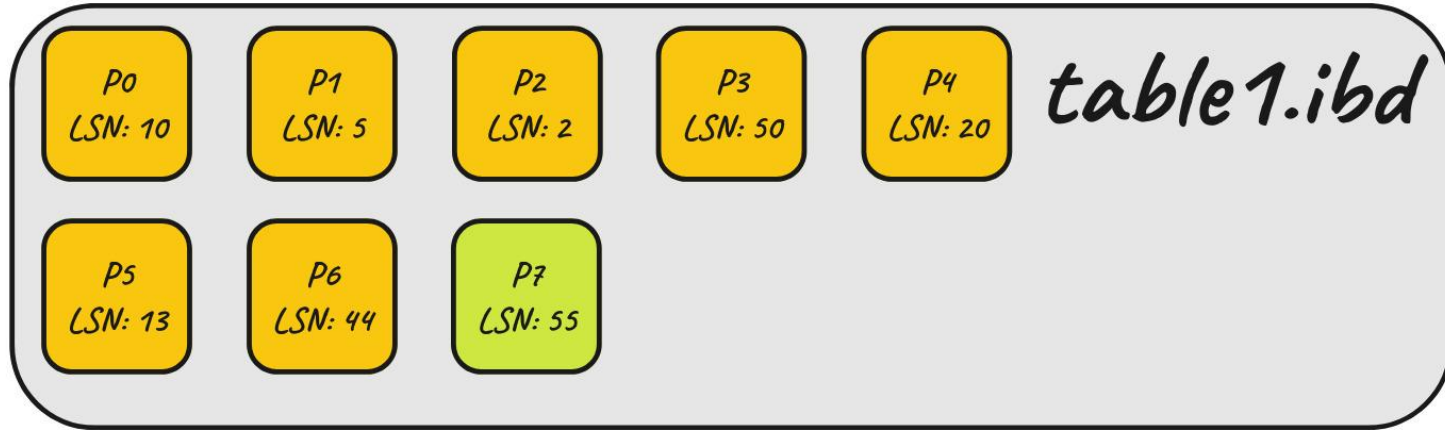
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Incremental Backups



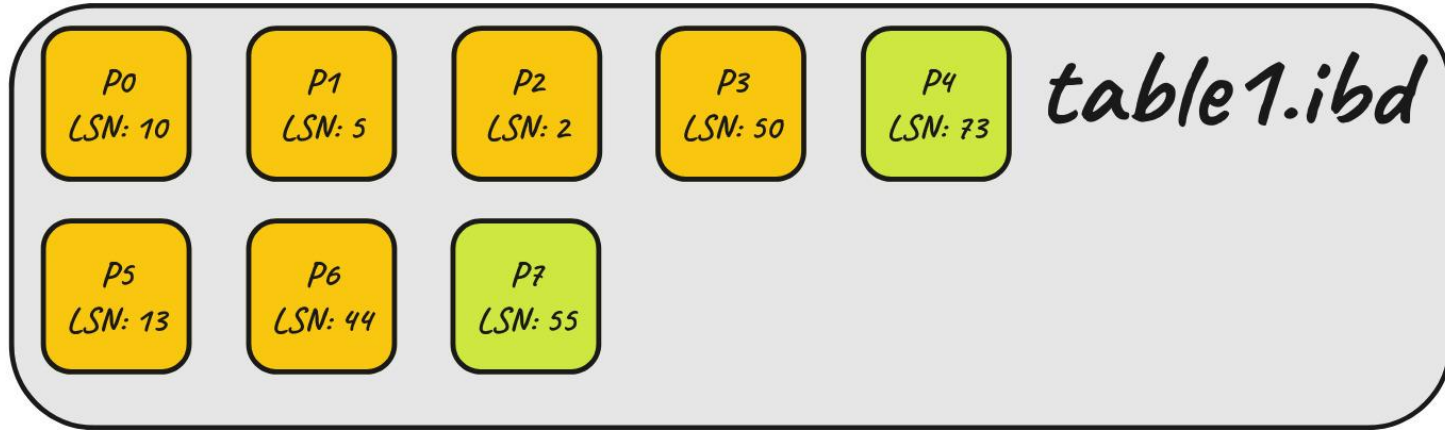
- LSN from last backup (LSN 50)
- Copy pages from that LSN forward
- Redo Follow Thread

Incremental Backups



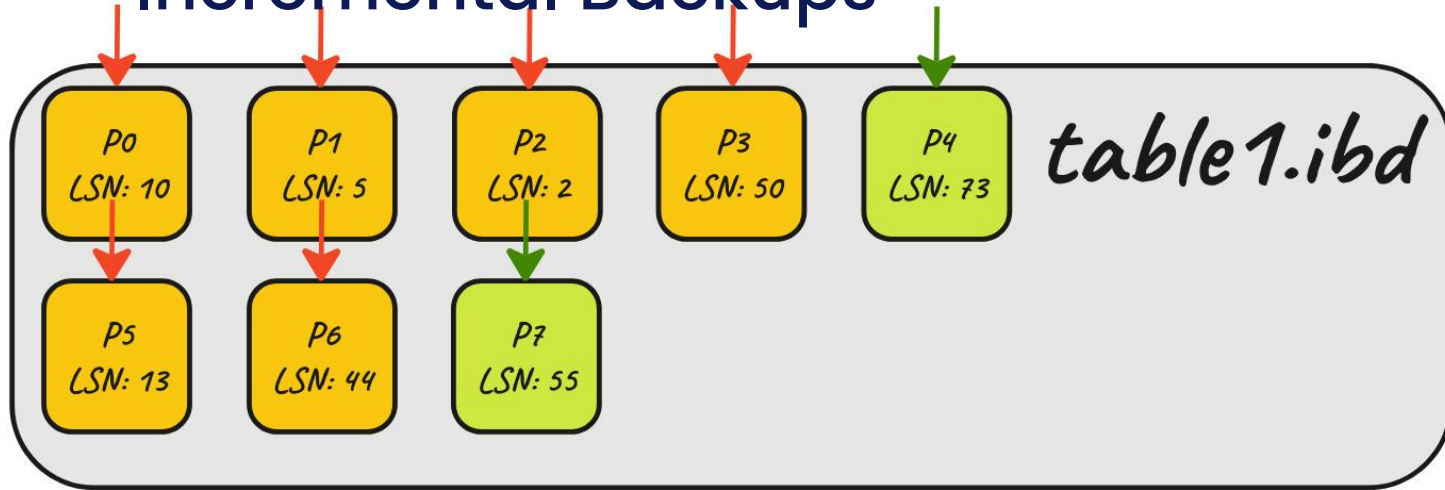
- `INSERT INTO table1 VALUES ();`

Incremental Backups



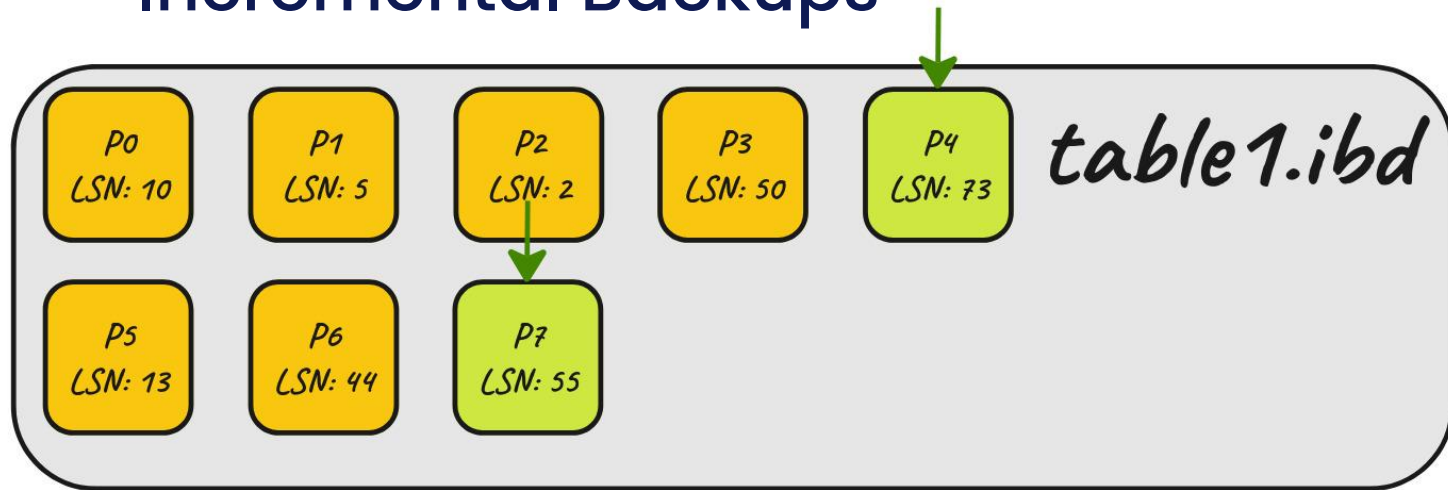
- `UPDATE table1 SET name = 'Marcelo' WHERE ID = 88;`

Incremental Backups



- Brutal Force - Scan all pages and check LSN

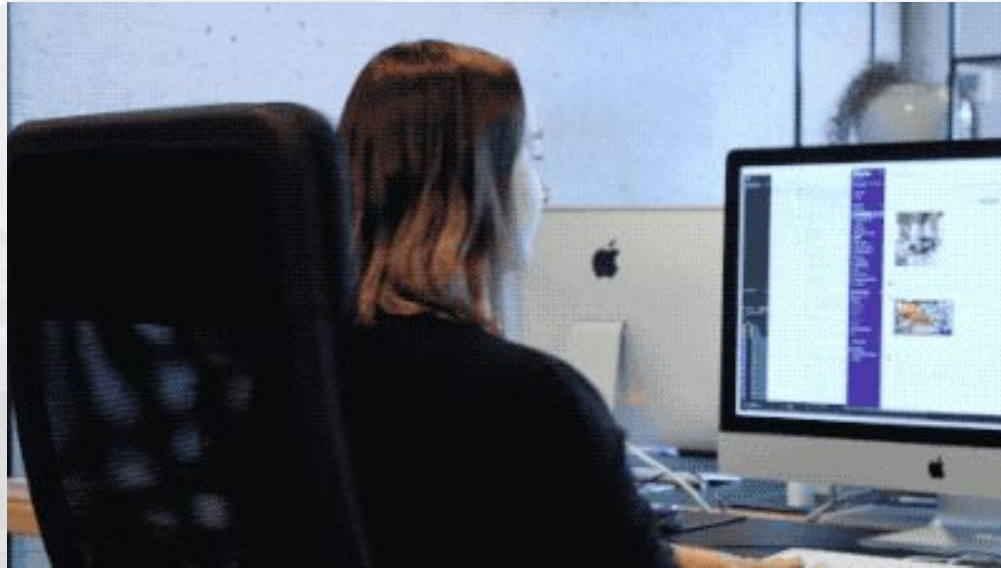
Incremental Backups



- Page Tracking (8.0.27+)
- Server Component to keep track of changed pages
- Xtrabackup calls server API and get list of changed pages between range of LSN



Hands On!!!





Streaming

Streaming

- Used to stream data to another machine or Object Storage
- Currently supported Object Storages:
 - S3 / Azure / GCP / Swift
- Uses custom xstream format – <https://bit.ly/xstream-format>
- Introduces two new binaries
 - Xstream – responsible for interpret xstream chunks and reassembly the original file
 - Xbcloud – responsible for downloading and uploading chunks to object storage



Hands On!!!





**Encrypted and
compressed**

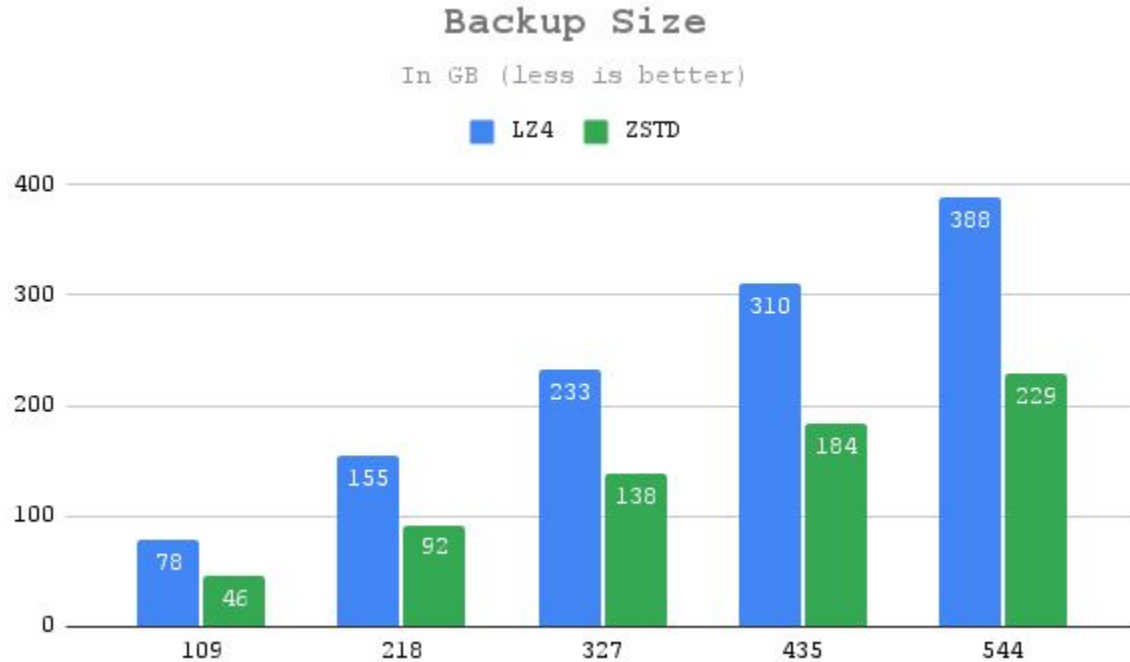
Encrypted Backups

- Uses GnuPG (GPG) library
- Uses Advanced Encryption Standard (AES) algorithm
- Support key lengths of 128 / 192 / 256

Compressed Backups

- Currently support for QuickLZ, LZ4 and ZSTD
 - QuickLZ no longer maintained
 - Deprecated on 8.0.32
 - Ability to --backup will be removed at 8.0.35 (TBC)
- Use LZ4 and ZSTD instead

Compressed Backups



Encrypted & Compressed Backups

- Can be tuned with:
 - `--parallel` - number of parallel copy threads
 - `--compress-threads` - number of threads responsible for compression work
 - `--encrypt-threads` - number of threads responsible for encryption work
- Rule of thumbs - parallel > compress > encrypt



Hands On!!!





Partial Backup / Restore

Partial Backups

- Can be done by providing:
 - Regular Expression of matching tables
 - File with list of tables
 - File with a list of databases
- Restore is identical as Partial restore

Partial Restore

- Works using Transportable Tablespace
- `xtrabackup --prepare --export-` produces exportable table spaces files
- For each table, user needs to:
 - Create table with same definition
 - Discard Tablespace
 - Copy table files (.ibd, .cfg) to server datadir
 - Import Tablespace



Hands On!!!





Point In Time Recovery (PITR)

Point In Time Recovery

- Allows for restoring a backup and replay transactions up to a specific point in time
- Useful when a disaster has occurred and the data between the last backup and time of disaster cannot be lost
- Requires copy of binary logs



Hands On!!!





PMM MySQL Backups – Demo





Thank you! Grazie
Obrigado Merci
Mam'noon
Danke

Dhanyavaad
Xièxiè Arigato

