The Magic of Hot Streaming Replication

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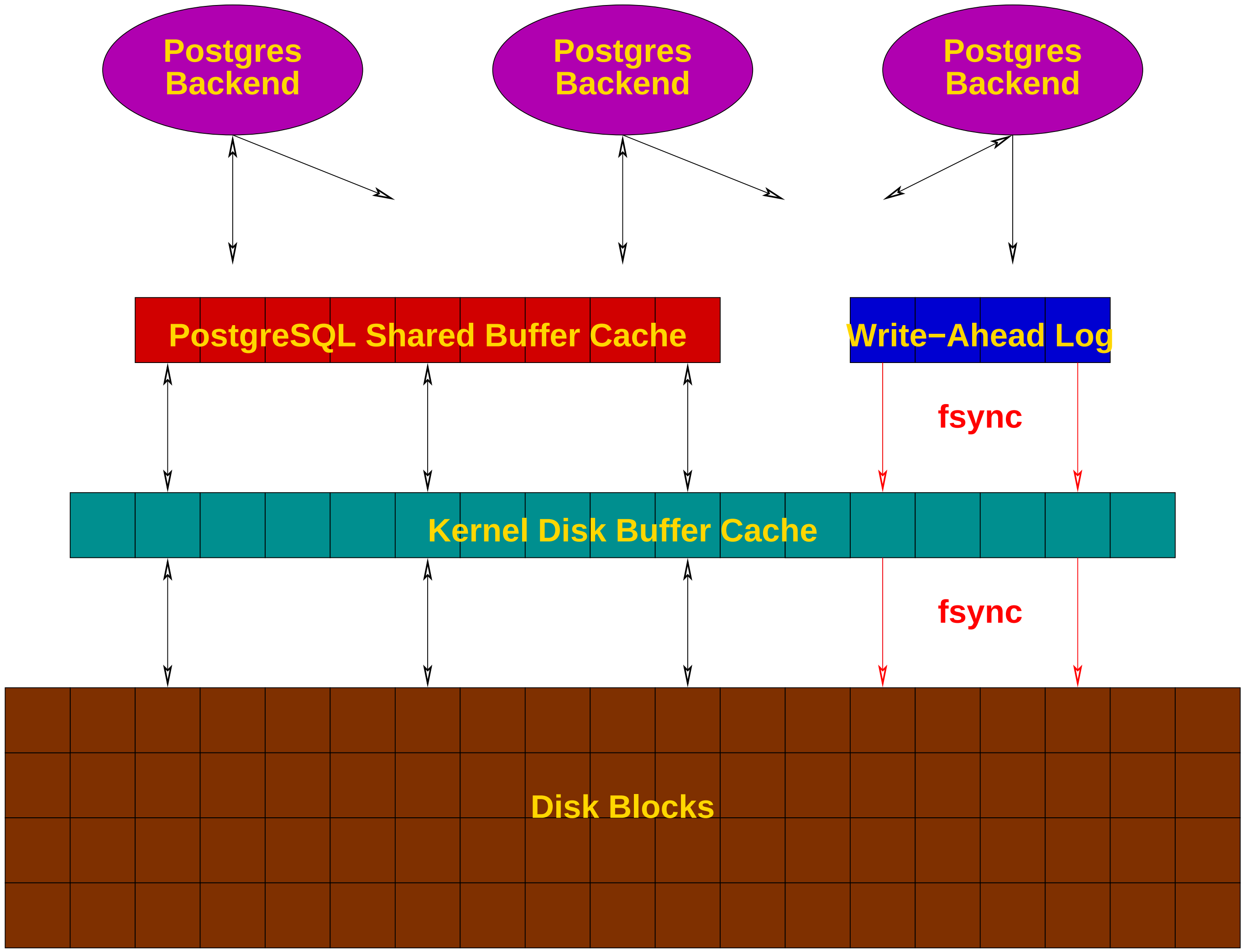
Abstract

POSTGRESQL 9.0 offers new facilities for maintaining a current standby server and for issuing read-only queries on the standby server. This tutorial covers these new facilities.

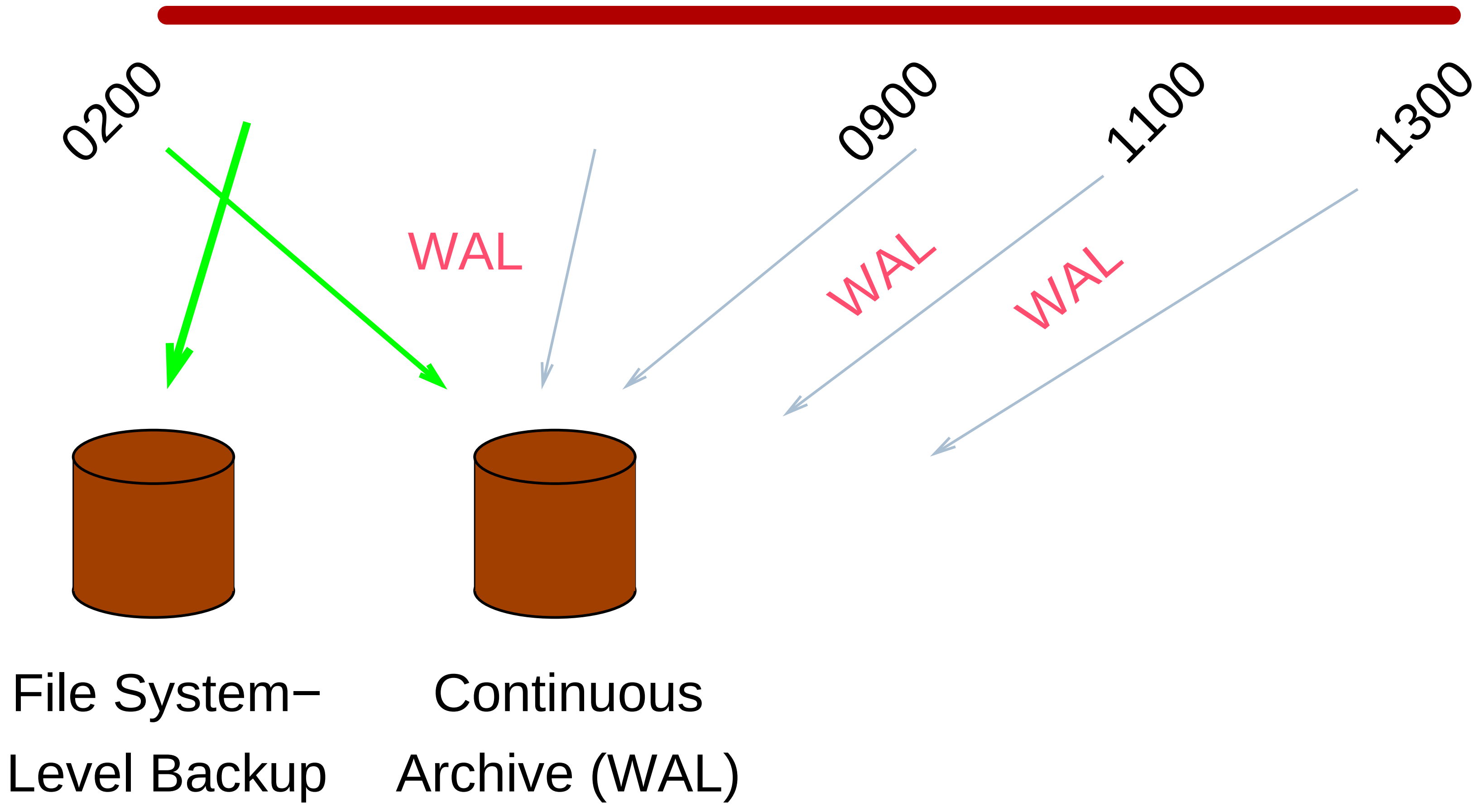
Introduction

- How does WAL combined with a disk image enable standby servers? (review)
- How do you configure continuous archiving?
- How do you configure a streaming, read-only server?
- Multi-Server complexities
- Primary/Standby synchronization complexities

Write-Ahead Logging (xlog)



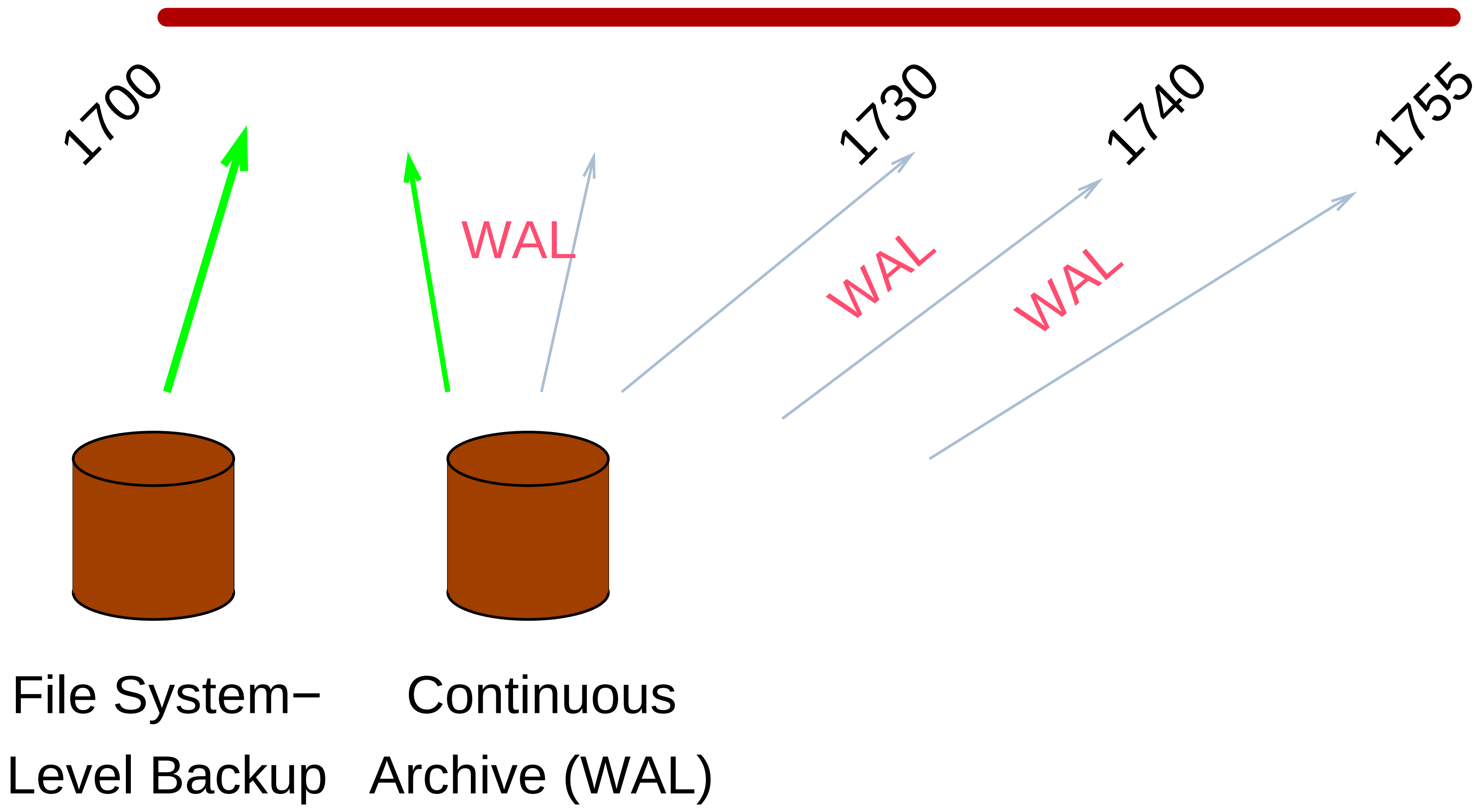
Pre-9.0 Continuous Archiving / Point-In-Time Recovery (PITR)



PITR Backup Procedures

1. `archive_command = 'cp -i %p /mnt/server/pgsql/%f < /dev/null'`
2. `SELECT pg_start_backup('label');`
3. Perform file system-level backup (can be inconsistent)
4. `SELECT pg_stop_backup();`

PITR Recovery



PITR Recovery Procedures

1. Stop postmaster
2. Restore file system-level backup
3. Make adjustments as outlined in the documentation
4. Create recovery.conf
5. `restore_command = 'cp /mnt/server/pgsql/%f %p'`
6. Start the postmaster

Disadvantages

- Only complete 16MB files can be shipped
- *archive_timeout* can be used to force more frequent shipping (this increases archive storage requirements)
- No queries on the standby

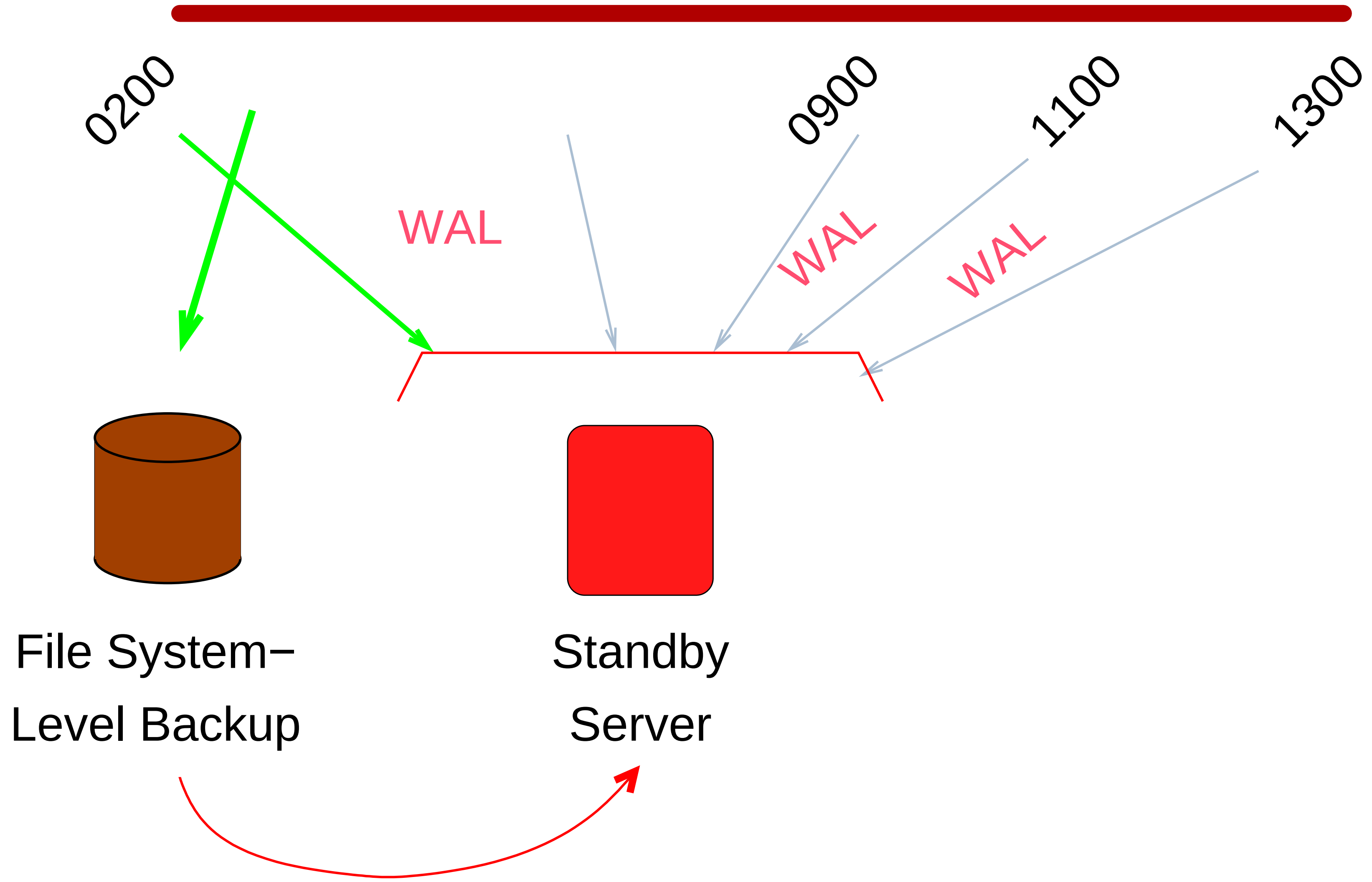
9.0 Streaming Replication / Hot Standby

- Changes are streamed to the standby, greatly reducing log shipping delays
- Standby can accept read-only queries

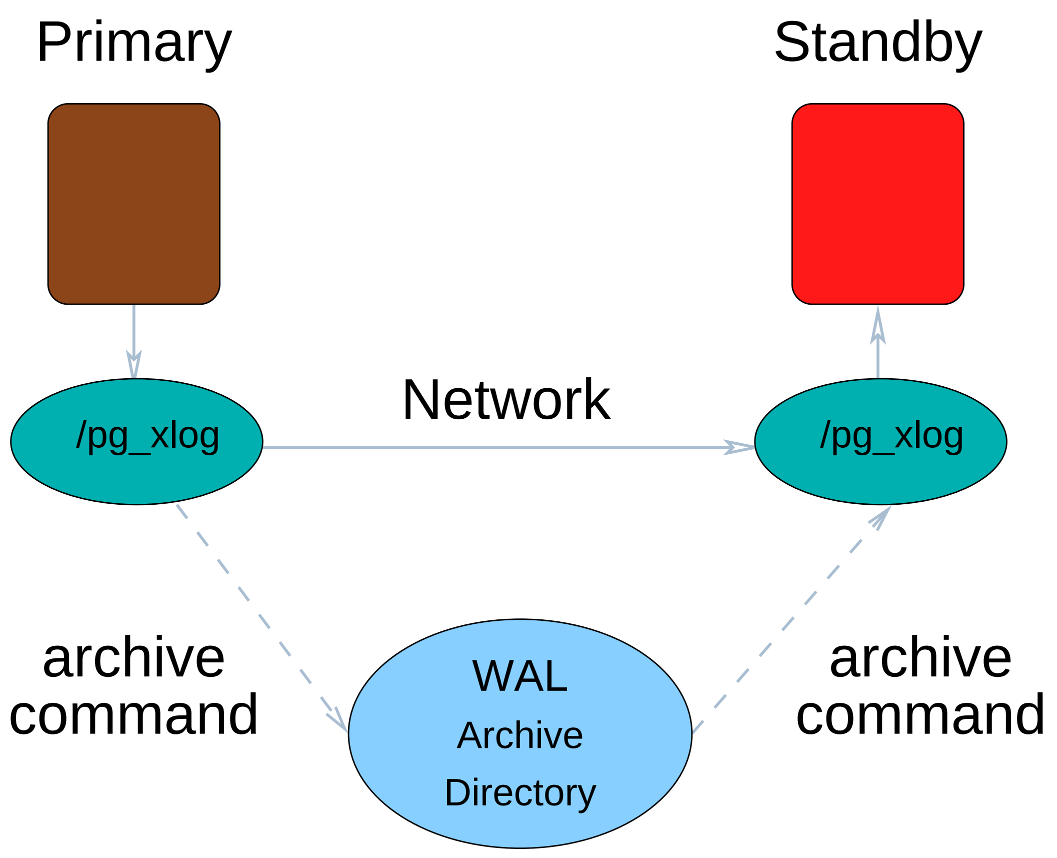
Streaming Replication Differs from PITR

- File system backup is restored immediately on the standby server
- WAL files are streamed to the slave
- WAL files can also be archived if point-in-time recovery (PITR) is desired

How Does Streaming Replication Work?



Live Streaming Replication



Enable Streaming to the Standby

Enable the proper WAL contents:

```
wal_level = hot_standby
```

Retain WAL files needed by the standby:

```
wal_keep_segments = 50
```

Enable the ability to stream WAL to the standby:

```
max_wal_senders = 1
```

Enable Standby Connection Permissions

Add permission for replication to *pg_hba.conf:*

```
host    replication    all    127.0.0.1/32    trust
```

Start the primary server:

```
pg_ctl -l /u/pg/data/server.log start
```

Perform a WAL-Supported File System Backup

Start *psql* and issue:

```
SELECT pg_start_backup('testing');
```

Copy the database */u/pg/data* to a new directory, */u/pg/data2:*

```
cp -p -R /u/pg/data /u/pg/data2
```

Dash-p preserves ownership. The copy is inconsistent, but that is okay (WAL replay will correct that).

Signal the backup is complete from *psql:*

```
SELECT pg_stop_backup();
```

Configure the Standby

Remove /data2/postmaster.pid so the standby server does not see the primary server's pid as its own:

```
rm /u/pg/data2/postmaster.pid
```

(This is only necessary because we are testing with the primary and slave on the same computer.)

Edit *postgresql.conf* on the standby and change the port to 5433

```
port = 5433
```

Enable hot standby in *postgresql.conf:*

```
hot_standby = on
```

Configure the Standby For Streaming Replication

Create *recovery.conf:*

```
cp /u/pg/share/recovery.conf.sample /u/pg/data2/recovery.conf
```

Enable streaming in *recovery.conf:*

```
standby_mode = 'on'
primary_conninfo = 'host=localhost port=5432'
```

Start the standby server:

```
PGDATA=/u/pg/data2 pg_ctl -l /u/pg/data2/server.log start
```

Test Streaming Replication and Hot Standby

```
$ psql -p 5432 -c 'CREATE TABLE streamtest(x int)' postgres
$ psql -p 5433 -c '\d' postgres
           List of relations
 Schema |    Name    | Type  |  Owner
--------+------------+-------+----------
 public | streamtest | table | postgres
(1 row)

$ psql -p 5432 -c 'INSERT INTO streamtest VALUES (1)'  postgres
INSERT 0 1
$ psql -p 5433 -c 'INSERT INTO streamtest VALUES (1)'  postgres
ERROR:  cannot execute INSERT in a read-only transaction
```

Additional Complexities

- Multi-server permissions
- Stream from /pg_xlog and the continuous archive directory if *archive_mode* is enabled on the primary

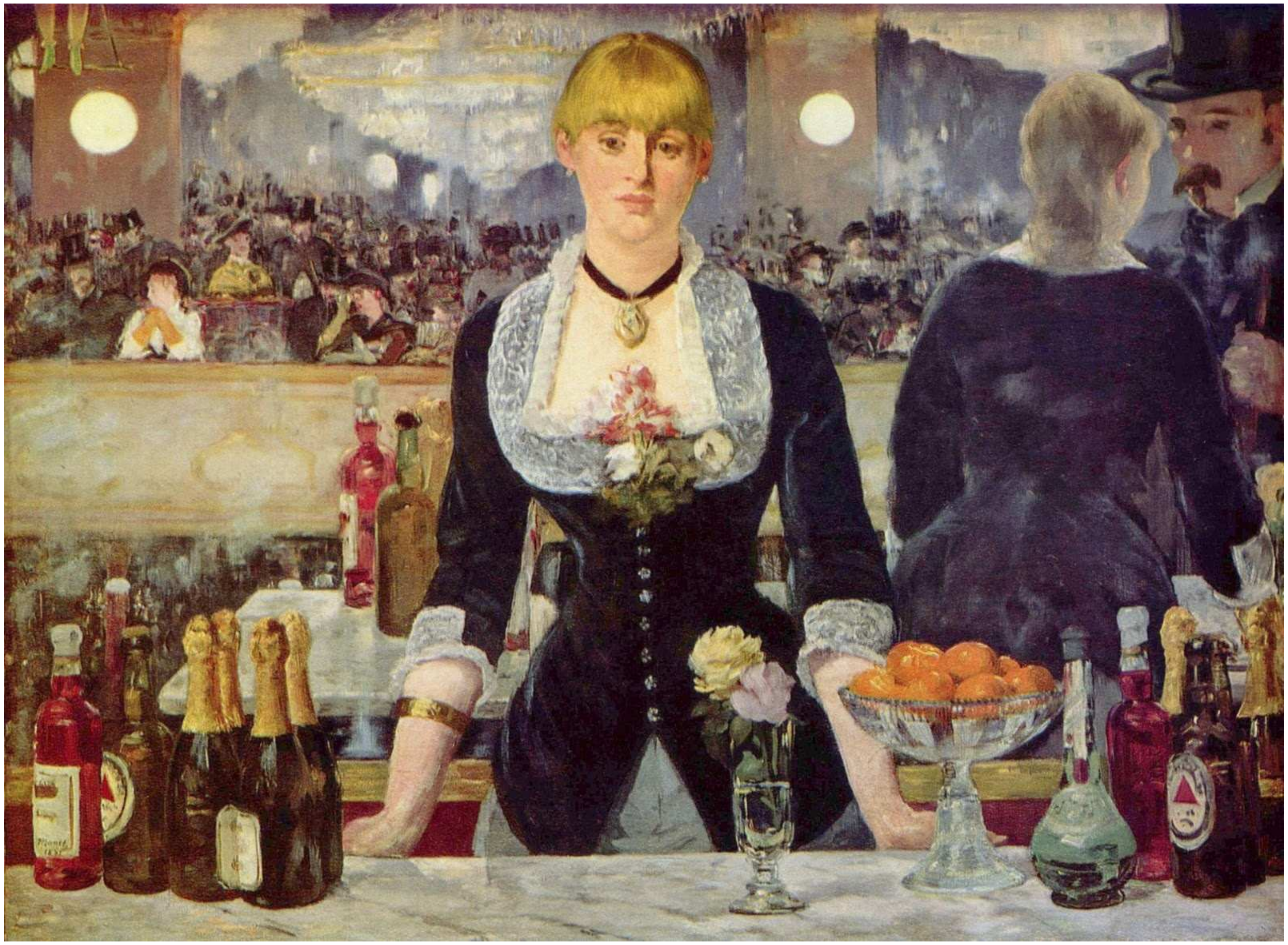
Primary/Standby Synchronization Issues

The primary server can take actions that cause long-running queries on the standby to be cancelled. Specifically, the cleanup of unnecessary rows that are still of interest to long-running queries on the standby can cause long-running queries to be cancelled on the standby. Standby query cancellation can be minimized in two ways:

1. Delay cleanup of old records on the primary with *vacuum_defer_cleanup_age* in *postgresql.conf.*

2. Delay application of WAL logs on the standby with *max_standby_delay* in p*ostgresql.conf.* The default is 30 seconds; -1 causes application to delay indefinitely to prevent query cancellation. This also delays changes from appearing on the standby and can lengthen the time required for failover to the slave.

Conclusion



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