Redpill Linpro

The PostgreSQL Replication Protocol

Tools and opportunities

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PostgreSQL Replication

- Added in PostgreSQL 9.0
- Based on streaming WAL (Transaction Log)
- Starts from *base backup*
- Uses standard recovery code
- Layered on top of regular protocol

Parts of the puzzle

- Connection processing and startup
- The PostgreSQL protocol
- The replication specific protocol
- pg_basebackup

Normal client connection

1. TCP connection established (5432)

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4. Get database/username/options
5. Perform authentication
6. Select database
7. Enter query processing loop

Replication client

1. TCP connection established (5432)
2. fork()
3. SSL negotiation
4. Get database/username/options
5. **Perform authentication**
6. Select database
7. Enter query processing loop

Replication client

1. TCP connection established (5432)
2. fork()
3. SSL negotiation
4. Get database/username/options
5. Perform authentication
6. Start **walsender**

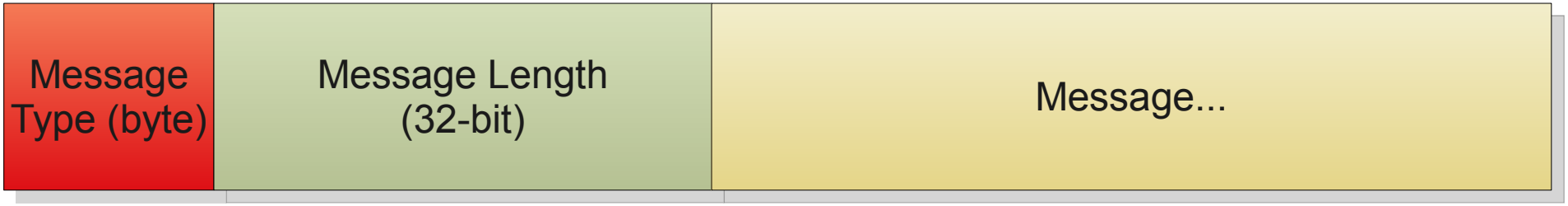
What's the walsender?!

- Special purpose PostgreSQL backend
- Not connected with a database
- Only accepts simple queries
- Returns mix of resultsets and streams
- 9.0: only basic log streaming
  - Client connects, requests WAL streaming starting at position <x>

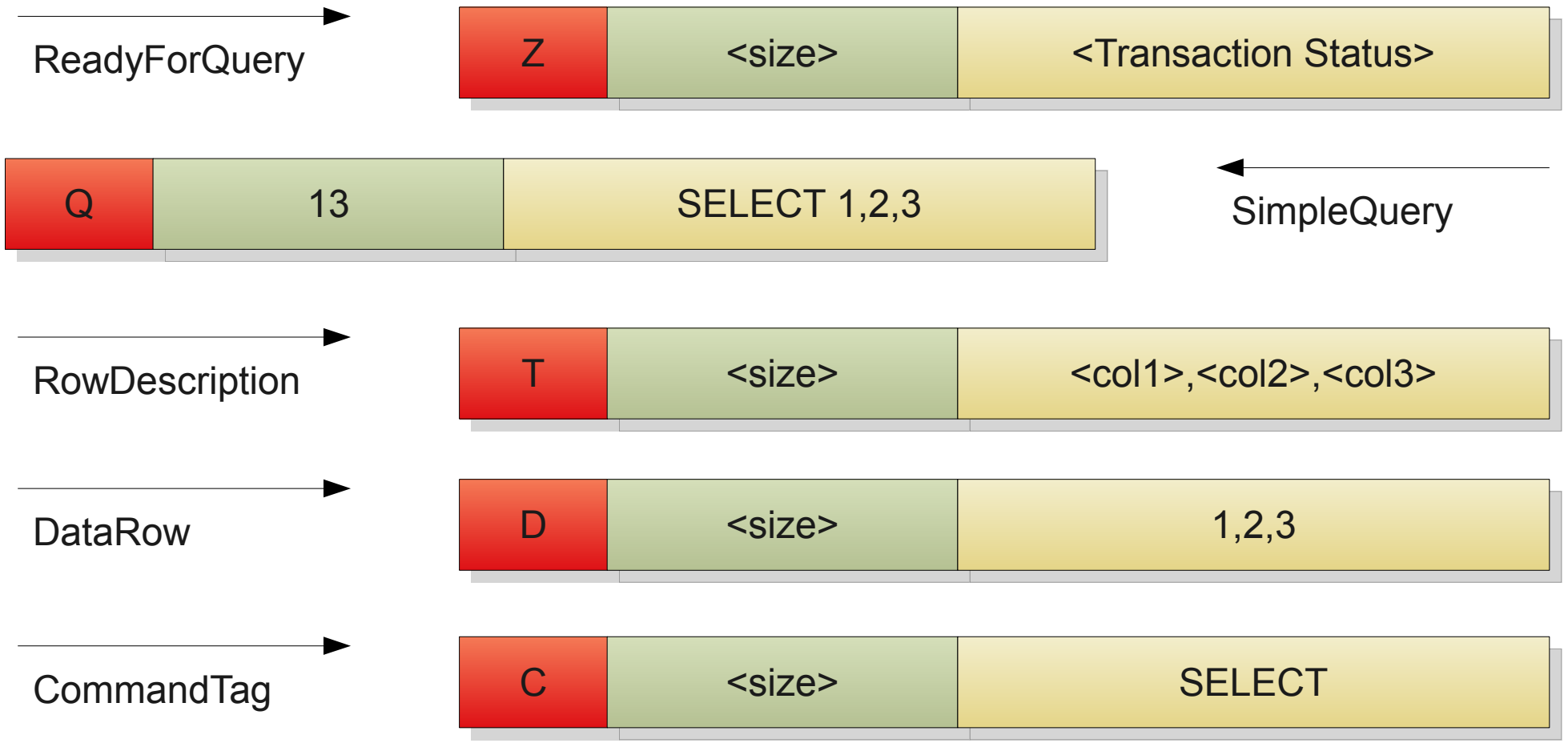
The PostgreSQL protocol

- Very simple
- Always TCP
- Message-based, bi-directional
- Optionally SSL encrypted
  - Entire stream wrapped

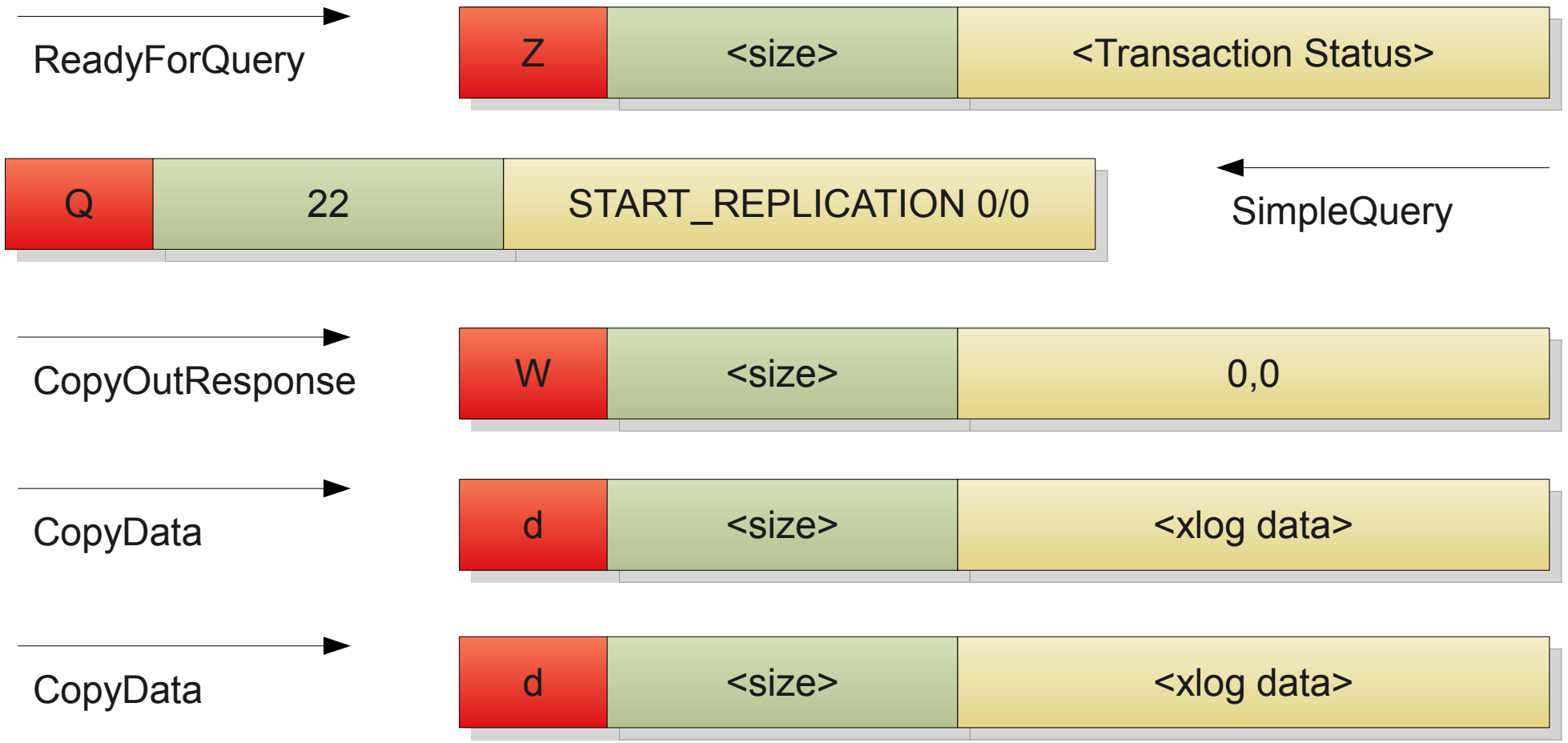
A message



Standard query exchange



Streaming replication



Advances in 9.1

- Synchronous replication
  - (not going to cover that)
- Hot Standby Feedback Loop
  - (not going to cover that)
- Walsender “micro language”

Walsender micro-language

- Full grammar in walsender mode
- Few commands, few options
- Still very picky about formats
- Not designed for manual consumption
- Foundation for future improvements

Walsender in 9.1

- IDENTIFY_SYSTEM
- START_REPLICATION <position>
- **BASE_BACKUP**
  [LABEL 'label']
  [PROGRESS]
  [FAST]
  [WAL]
  [NOWAIT]

Base backups

- Single-command base backups
- No need for separate pg_start_backup()/pg_stop_backup()
  - Can still control backup label
  - Can still control fast/slow checkpoint
- Not a silver bullet
  - Old method is still there!

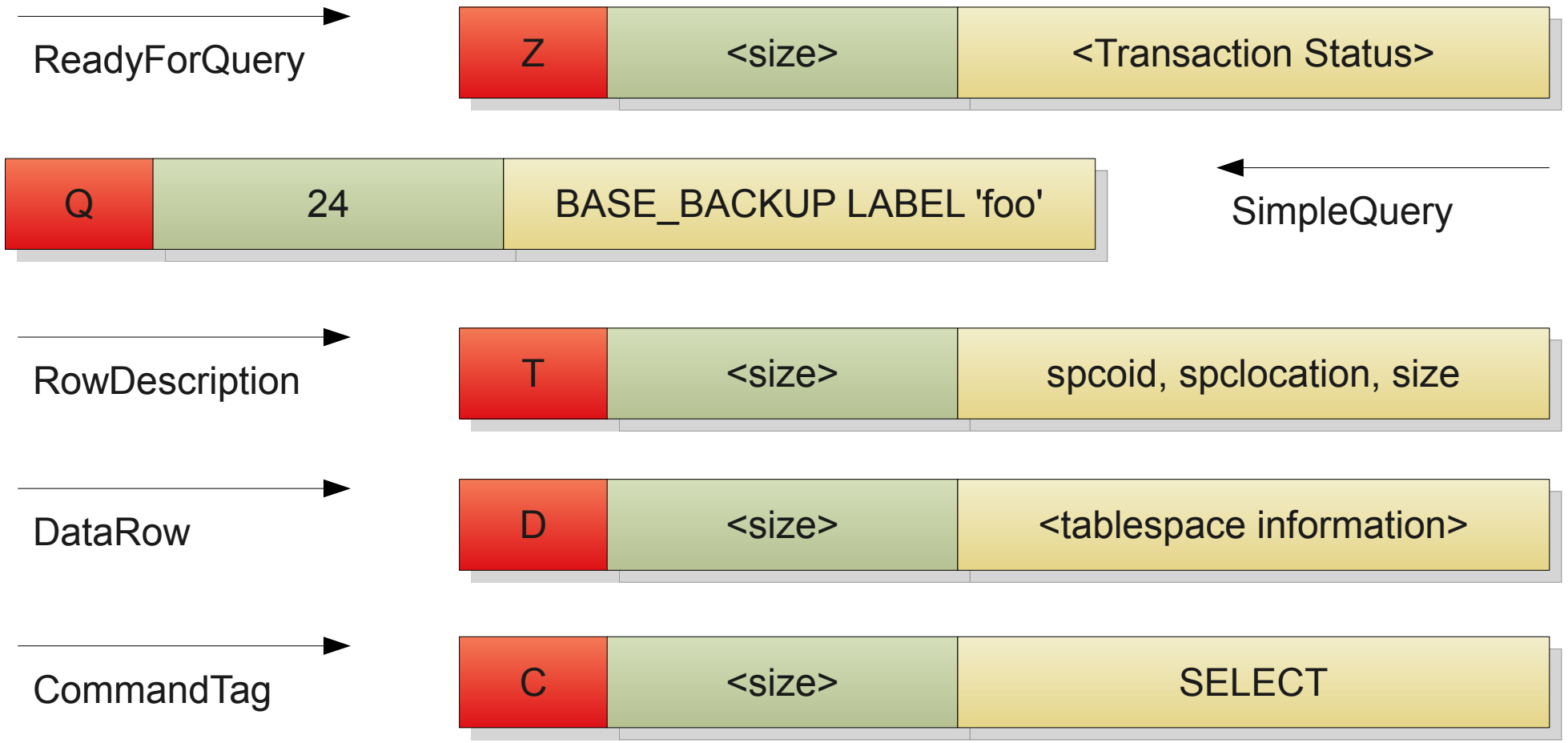
Base backups

- Still not for manual consumption
- `Use bin/pg_basebackup`
- Integration in third party modules and applications

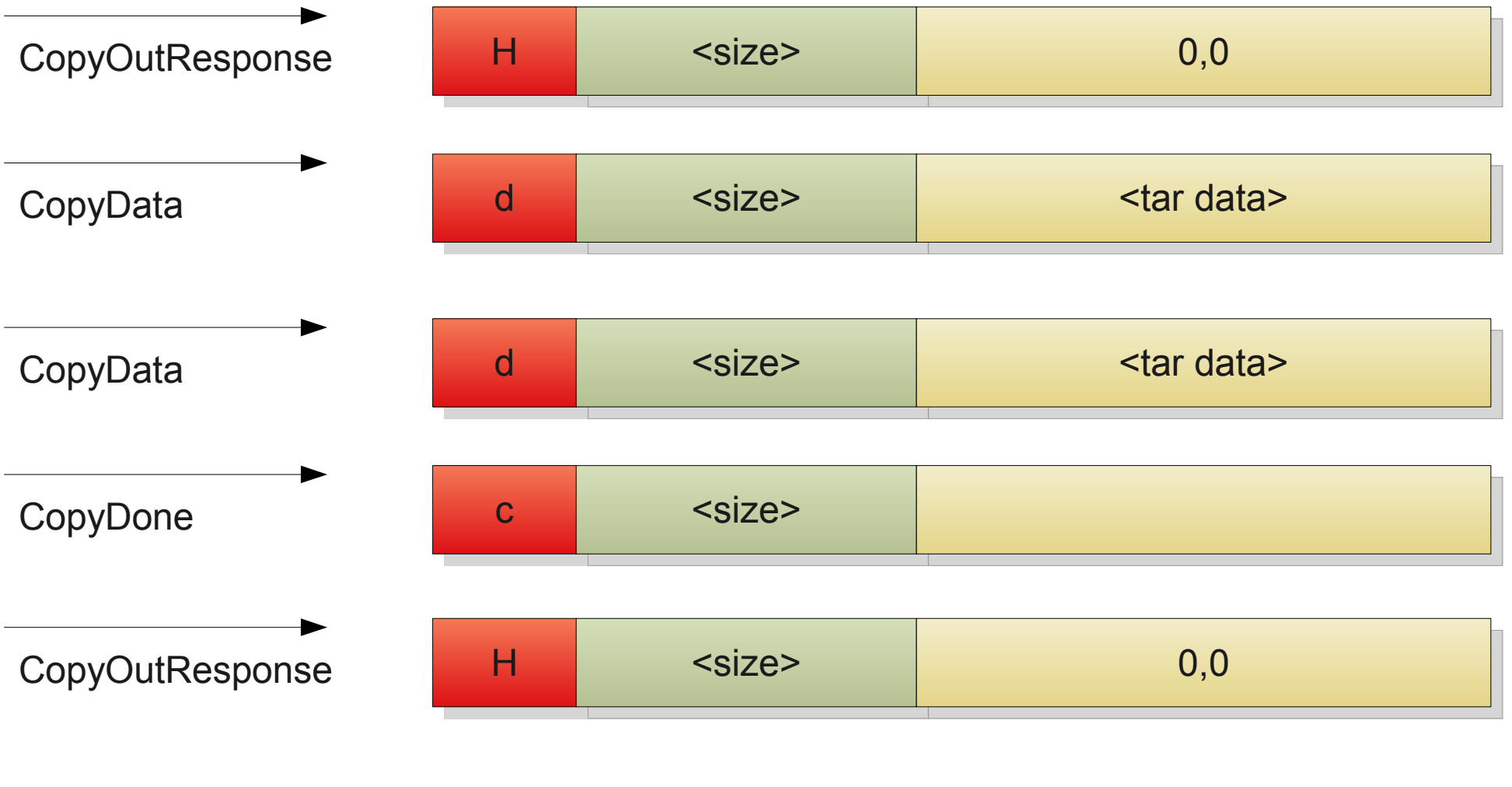
Streaming base backups

- Tar format stream
  - Easy to stream
  - No global archive header
  - Alignment-at-512-bytes cheap
- One tar stream per tablespace
- Sequential transmission

Streaming base backups



Streaming base backups



Using pg_basebackup

- pg_basebackup
  - -D <directory>
  - -F<p|t>
  - -c <fast|spread>
  - -l <label>
  - -z
- Plus all “standard” libpq client options

Progress reporting

- Add -P to the commandline
- Expensive!
  - Scans all tablespaces twice
- Inexact – but gives a good hint

Base backups and WAL

- Restore from base backup requires WAL archiving
  - Complex to set up and monitor
- Append `WAL` to command, or use -x
- walsender includes required WAL files at end of tar file
- Use wal_keep_segments!

Future improvements

Streaming WAL archive

- Log archiving still uses archive_command
- 16Mb-blocks, or archive_timeout
- Replication protocol already does this
- *pg_xlogstream*

Prevent WAL cycling

- WAL cycled normally during backups
- In -x mode, might still be needed
- If cycled too soon, backup fails

WAL streaming during backup

- Combine streaming wal archive with pg_basebackup
- During backup, log is streamed in parallel
- Less WAL to keep on master

Relocatable tablespaces

- Currently, only $PGDATA can be moved
- In theory...
- Support moving other tablespaces
- Both for streaming and regular base backups!

Incremental backups

- “rsync” style?
- Using LSN?
- Decrease size of log archive without more full backups

Thank you!

Questions?

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