Firebird in 2011/2012: Development Review

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Firebird Project
http://www.firebirdsql.org/

Packages Released in 2011

Firebird 2.1.4

- March 2011

- 96 bugs fixed

- 4 improvements, new port (Renesas SH)

Firebird 2.5.1

- October 2011

- 140 bugs fixed

- 16 improvements, 1 new feature

- New ports: Linux/M68K, Linux/HPPA, Linux/Alpha

What's New in v2.5.1

☐ **Key enhancements**

- SQLSTATE as a PSQL context variable (like GDSCODE/SQLCODE)

- Record compression ratio estimations

- Write operations for GTTs in RO transactions

- Performance improvements for GTTs

- GBAK restore performance

- Canceling waits inside the lock manager

- Persistent statement IDs in the MON$ tables

Maintenance Releases in 2012

Firebird 2.0.7

- 24 bugfixes up to date

- 4 months overdue, expected in Q1 2012

Firebird 2.1.5

- 32 bugfixes and 2 improvements up to date

- No delay, expected in Q2-Q3 2012

Firebird 2.5.2

- 13 bugfixes up to date

- No delay, expected in Q2-Q3 2012

Firebird 3.0 : Introduction

Development summary

- Started in October 2009

- 433 total tickets assigned

- 379 of them are already resolved

- More than 2000 changes committed

- Code cleanup, only ODS 12 is supported

- New layout of binaries

Firebird 3.0 : New Features

☐ **Implemented SQL features**

- External procedures / functions / triggers

- PSQL functions

- PSQL packages

- Sub-procedures and sub-functions

- DDL triggers

- Window (analytic) functions

- Identity columns

- Scrollable PSQL cursors

Firebird 3.0 : New Features

Implemented SQL features (continued)

- Standard compliant BOOLEAN data type

- ALTER statements for changing NULL / NOT NULL

- ALTER DATABASE for changing the default charset

- MERGE enhancements (multiple MATHED clauses, RETURNING clause, DELETE command)
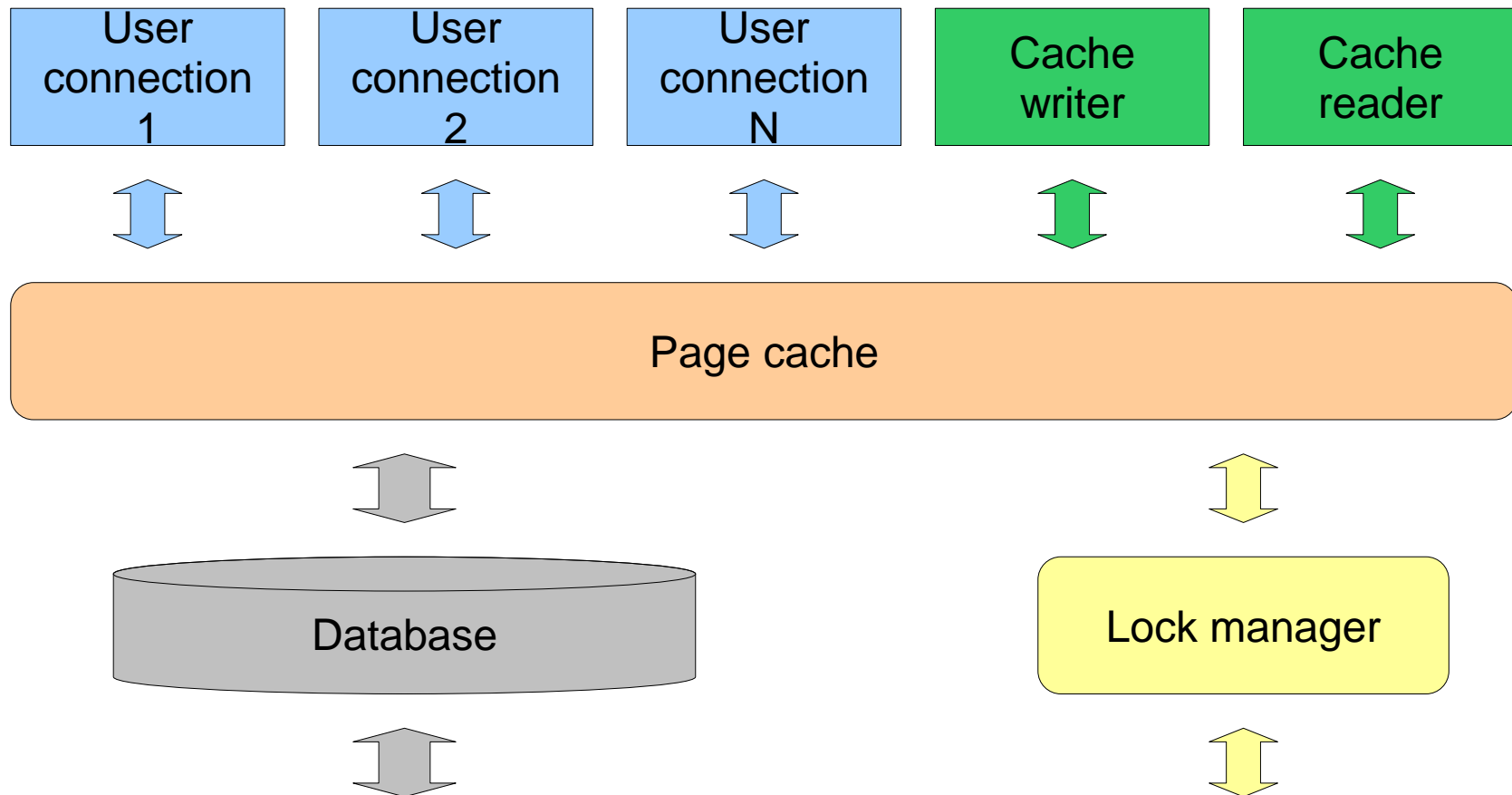
- CONTINUE statement

- Parametrized exceptions

Firebird 3.0 : New Features

Security

- Pluggable authentication

- Per database user management

- Over-the-wire encryption

- Database encryption

- DDL permissions

- Aggregated privileges for roles

- User groups (implicit roles)

Firebird 3.0 : Shared Cache

Basic architecture

Firebird 3.0 : Shared Cache

□Configuring the architecture

• SharedCache – whether multiple connections of a single process can share the database page cache

• SharedDatabase – whether database pages can be shared among multiple page caches

□Matrix of working modes

|	SharedDatabase = 0	SharedDatabase = 1
SharedCache = 0	Singleton	Classic / SuperClassic
SharedCache = 1	SuperServer	Special (*)

Firebird 3.0 : Shared Cache

Synchronization

- Latches and locks

- Database file open mode (SharedDatabase)

- Cache start up (no locks)

- New connection (SharedCache)
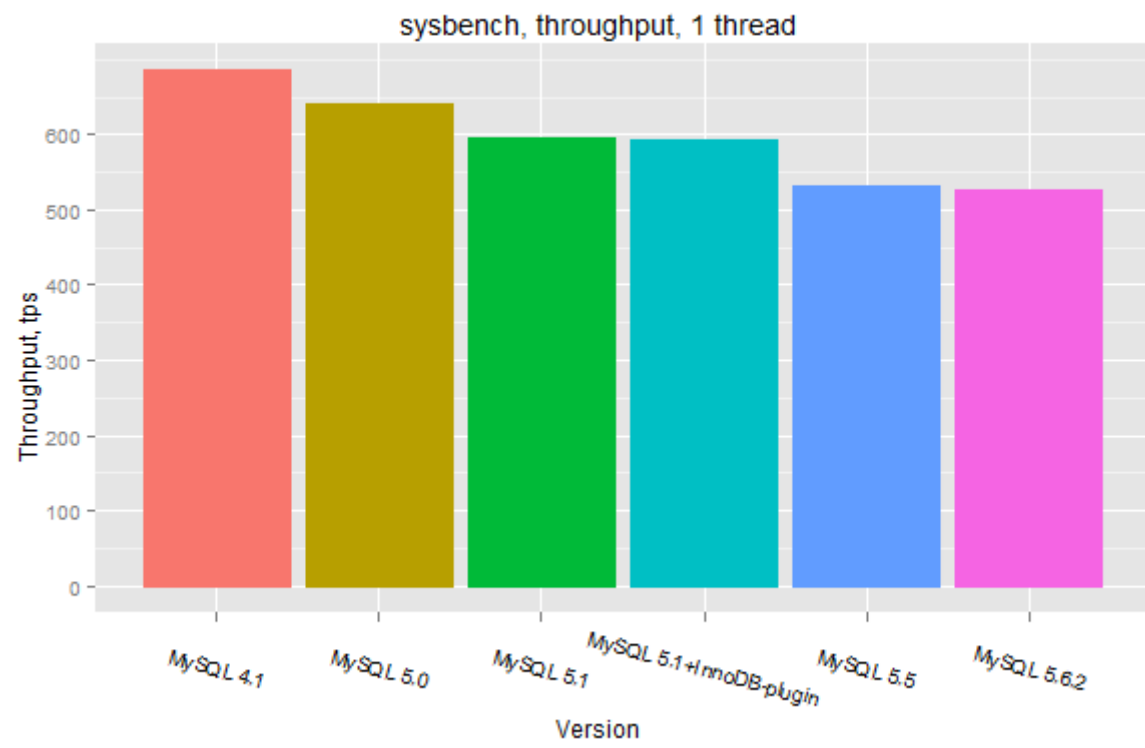
- Acquire "lazy" locks

- Two level synchronization

Firebird 3.0 : Shared Cache

Concurrency test: 1GB database, 10 terminals
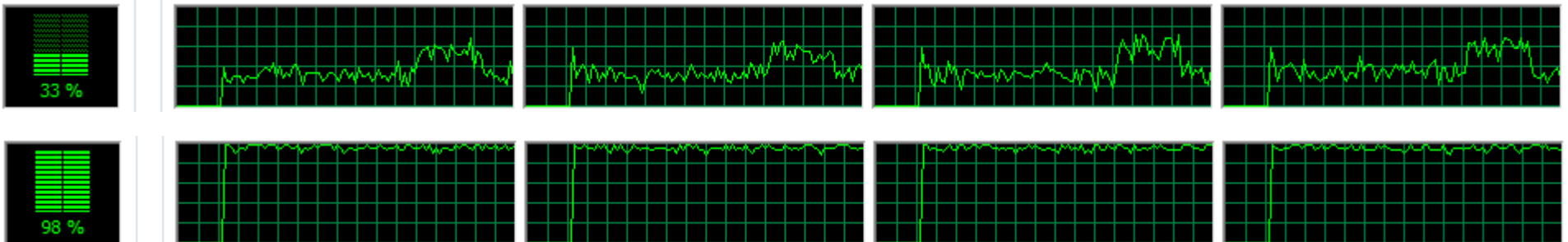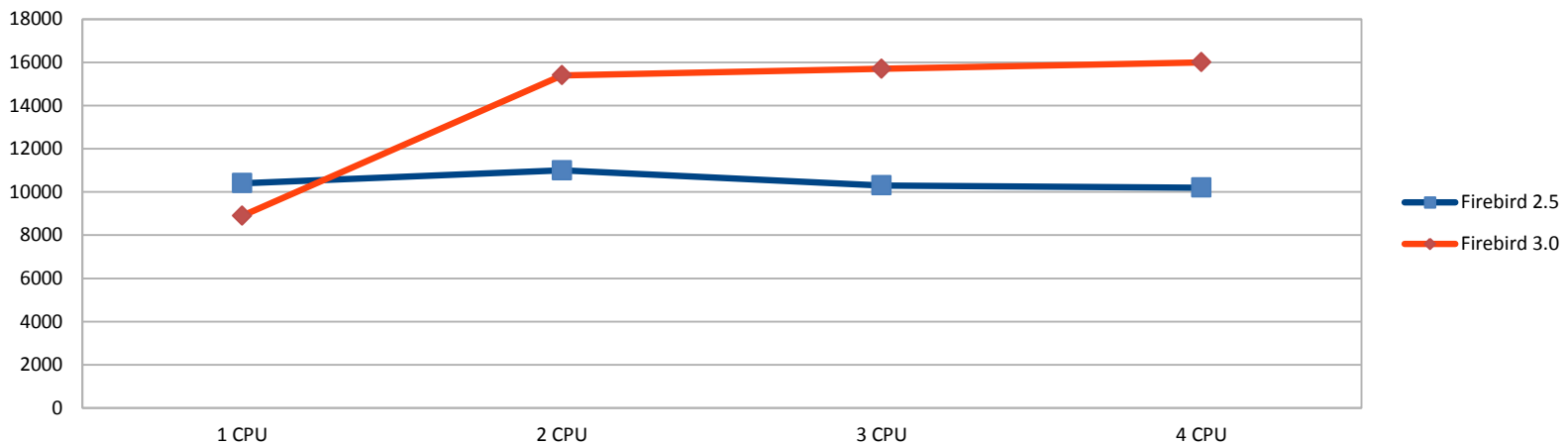
Firebird 3.0

MySQL: single thread performance

sysbench, throughput, 1 thread

Firebird 3.0 : ODS 12

"Primary" and "secondary" data pages

- New flag for both pointer pages and data pages

- Primary page contains some "head" version of the record version chain

- Secondary page contains only back versions, fragments or small blobs inside

- Full table scans (plan NATURAL) skips secondary data pages

Firebird 3.0 : ODS 12

"Swept" data pages

- New flag for both pointer pages and data pages

- Swept data page means that all records stored there have no back versions and they are known to be created by already committed transactions

- Set by the sweeper / garbage collector, cleared when new version is created on the page

- Sweep process skips swept data pages

Firebird 3.0 : ODS 12

SCN inventory page

- New page type

- Global array of SCNs for the every database page

- SCN inventory pages are distributed evenly across the database file

- Slots are updated when some page gets a new SCN assigned

- Nothing is changed for a level 0 backup

- Incremental (level N) backups read only pages modified since the last (level N – 1) backup

Firebird 3.0 : Optimizer

Detailed plan output

- An alternative (optional) way to analyze the plan

- All operations are reported in the hierarchical view

- Some additional details are available

- Cardinality and cost estimations will be reported

- Run-time information

Firebird 3.0 : Optimizer

Materialized sub-queries

- Underlying stream is sequentially read and cached inside a record buffer

- Pipeline nature of the record buffer, both sequential and random access are supported

- Storage is provided by the temporary space manager and is dynamically balanced between memory and disk (see TempSpaceLimit in firebird.conf)

- Useful for invariant sub-queries, hash joins, etc

Firebird 3.0 : Optimizer

Hash joins

- Larger input stream becomes an outer one, smaller input stream becomes an inner one

- Inner stream is read in advance row by row, hash value is calculated for the join keys, row is stored in the buffer corresponding to the given hash group

- Outer stream is read sequentially, hash value is calculated for the join keys and probed against the hash table

- For a positive match, collisions are compared by the binary comparison of the join keys

Firebird 3.0 : Optimizer

Miscellaneous

- Semi-materialized nested loop joins

- Reworked FULL OUTER JOIN implementation that is able to utilize indices

- Support for hash and merge algorithms for LEFT OUTER joins

- Conditional retrievals, e.g. WHERE (COL = :VAL OR :VAL IS NULL)

- Constant predicates can be evaluated beforehand

- Hashing is considered for aggregates

Firebird 3.0 : Optimizer

Table statistics

- Number of data pages, average fill ratio
- Number of rows, average row size

Index statistics

- Tree depth
- Number of leaf pages, average fill ratio
- Number of nodes, average node size
- Clustering factor

Firebird 3.0 : Optimizer

Column statistics

- Number of distinct values

- Number of NULLs

Histogram

- Endpoint boundary

- Endpoint value

Firebird 3.0 : Monitoring

General

- More details about page I/O

- Temporary space I/O statistics

- Statement statistics: parses / compiles / executes

- Misc extensions

Timing statistics

- Total elapsed time

- CPU time: user mode and kernel (system) mode

- Waiting time: I/O, lock waits, latch waits, etc

Firebird 3.0 : API

Extending the length limits

- API: SQL statements and their BLR counterparts

- API: input/output messages

- Internal: intermediate (non-persistent) records

- Internal: sorting records

- Not about the ODS records!

Questions?