Trafodion Distributed Transaction Management

November, 2014

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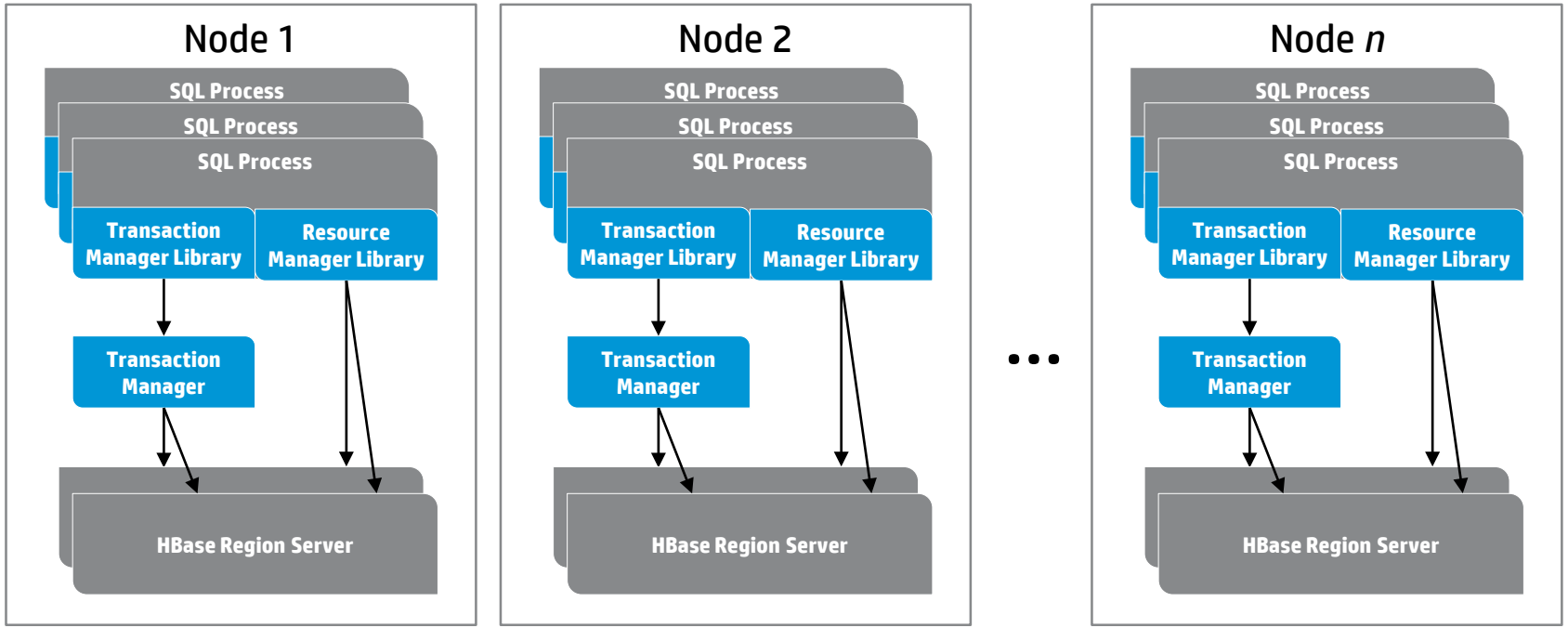
Trafodion Distributed Transaction Management

Scalable Architecture



Implemented using HBase coprocessors

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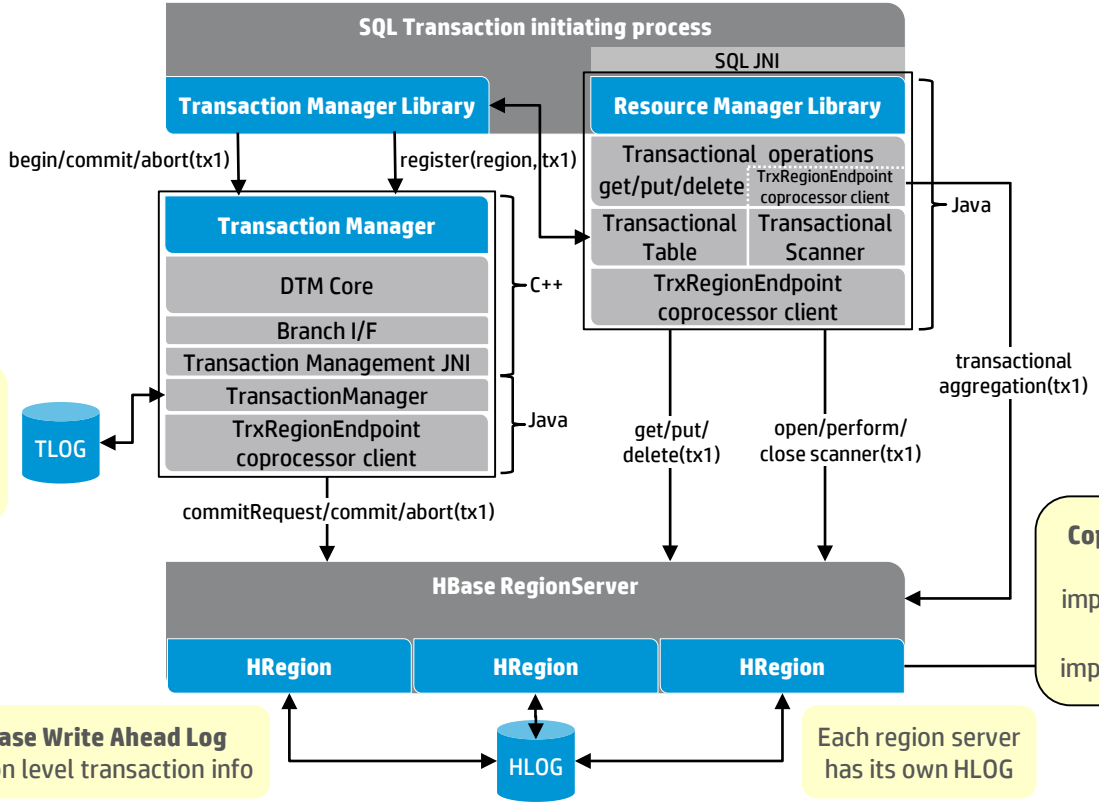
Peeling the onion – Component Architecture



Transaction Manager Log
Meta info/state about transaction (more than one region in a txn)
HBase table(s)

Coprocessors implemented
TrxRegionEndpoint implements SQL transactions
TrxRegionObserver implements recovery process

HBase Write Ahead Log
Region level transaction info

Each region server has its own HLOG

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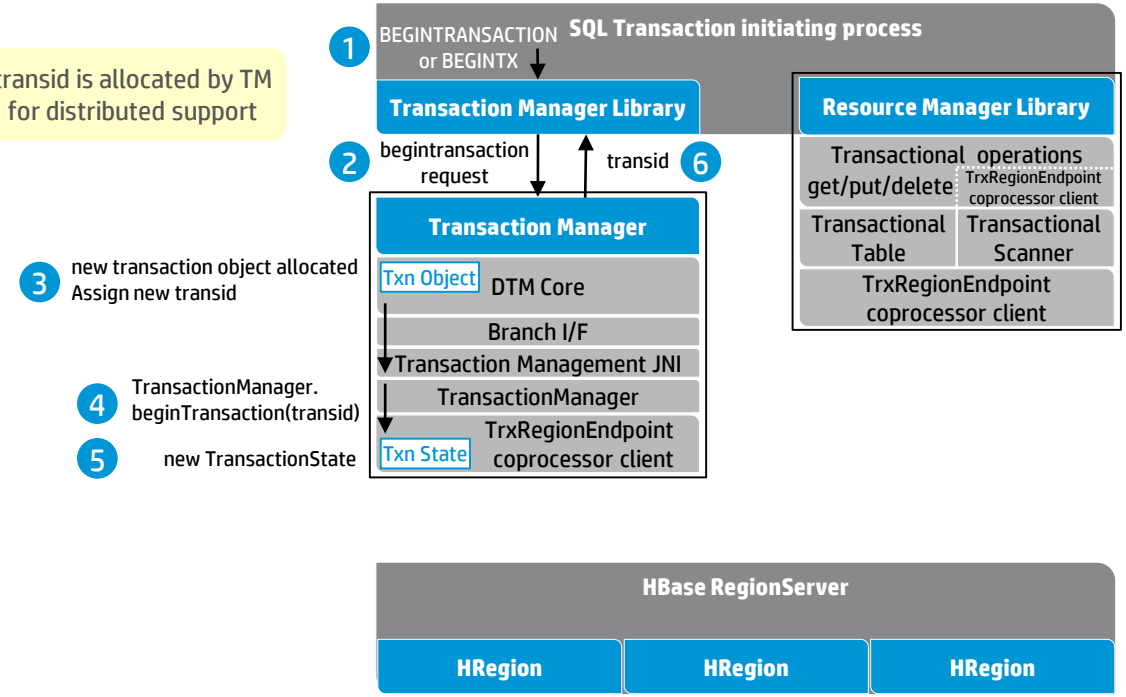
BEGIN WORK – BEGINTRANSACTION

transid is allocated by TM for distributed support



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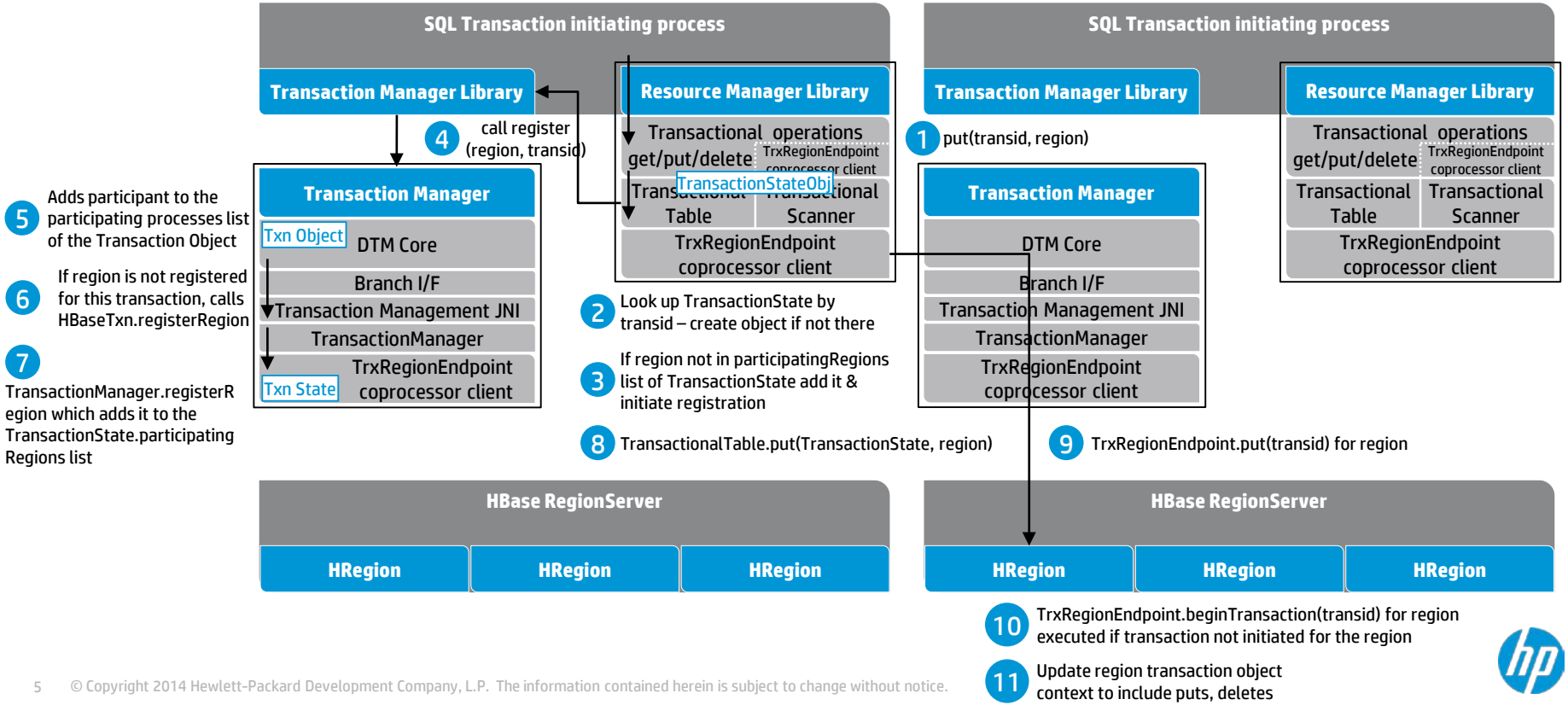
get / put / delete



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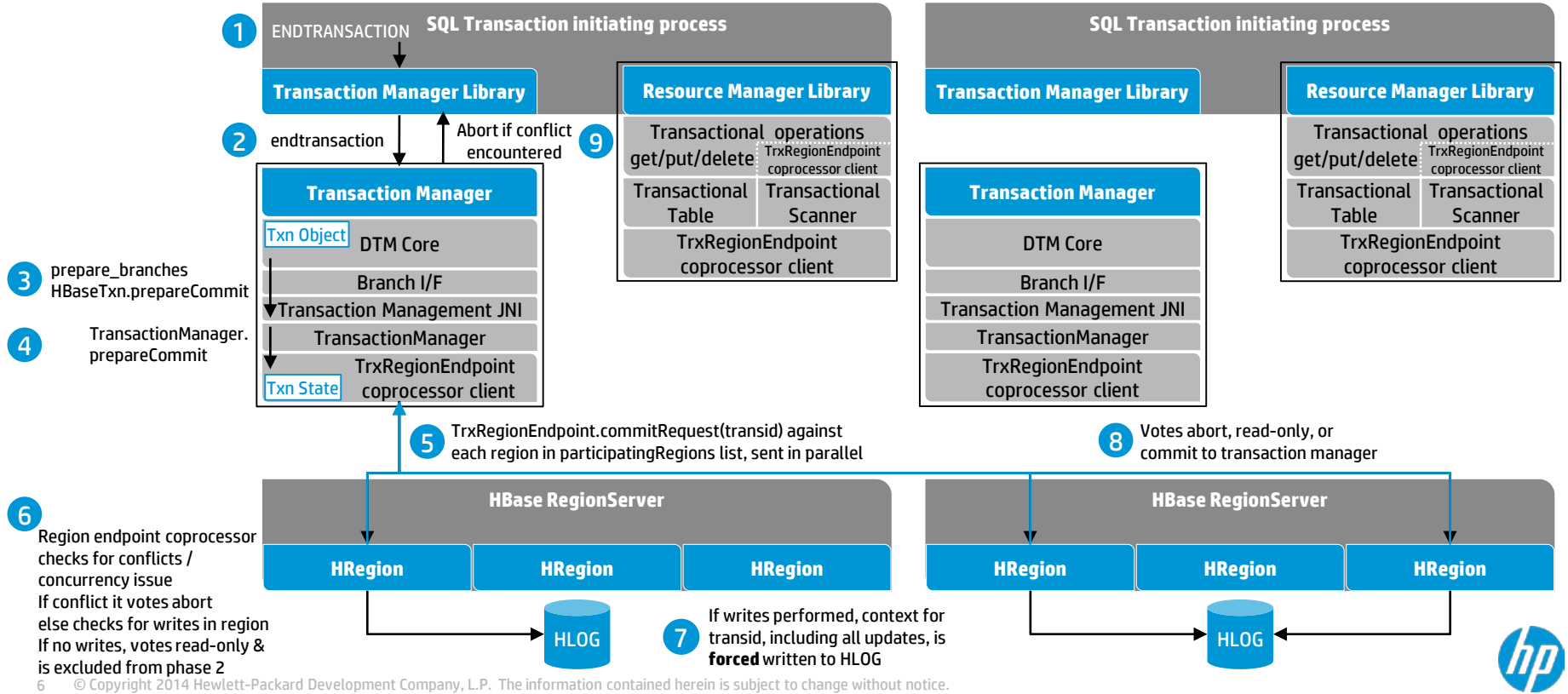
COMMIT WORK – ENDTRANSACTION – Phase 1, prepare



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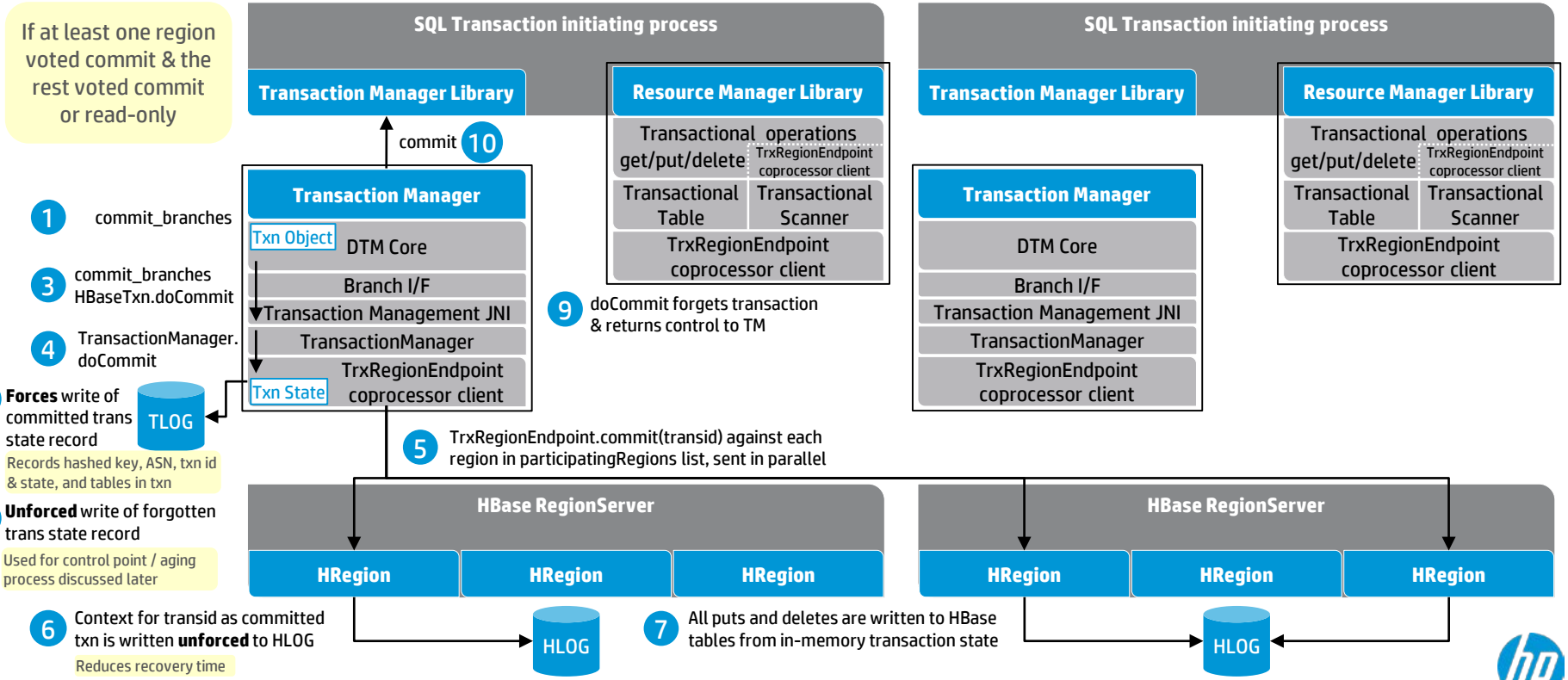
COMMIT WORK – ENDTRANSACTION – Phase 2, commit



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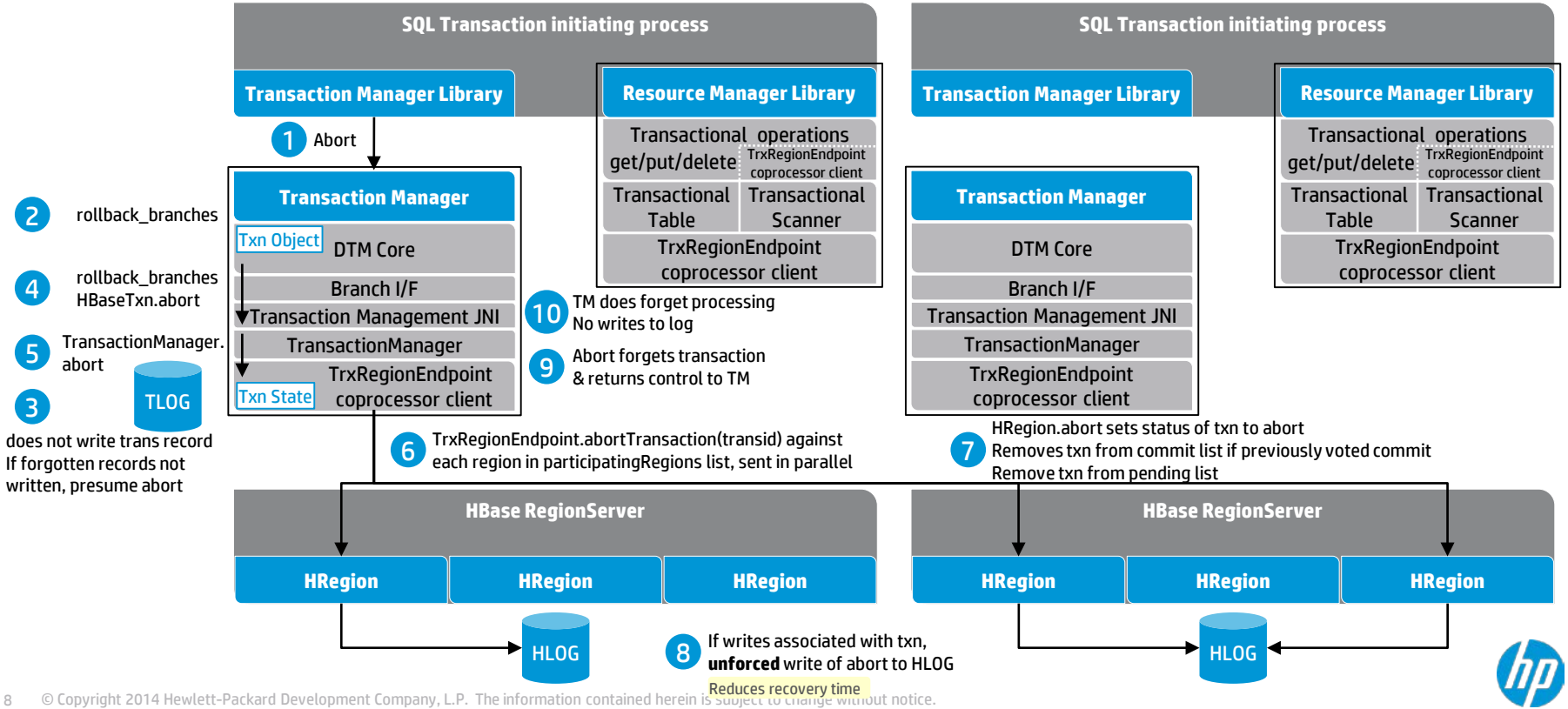
ABORT WORK – ABORTTRANSACTION



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Transaction Recovery – timing of failure

State at failure	Action at failure	Failed region(s) start up
Updates are in region's memory	Initiate abort processing	No recovery needed
Prepare: Some regions complete	Initiate abort processing	If region had not completed Prepare phase before failure, no recovery needed. If it had, then abort processing initiated.
Prepare: All regions complete	Initiate abort processing	Abort processing for all regions that had updates
Commit: Some regions complete	Initiate commit processing	Apply updates from HLOG to tables if not committed

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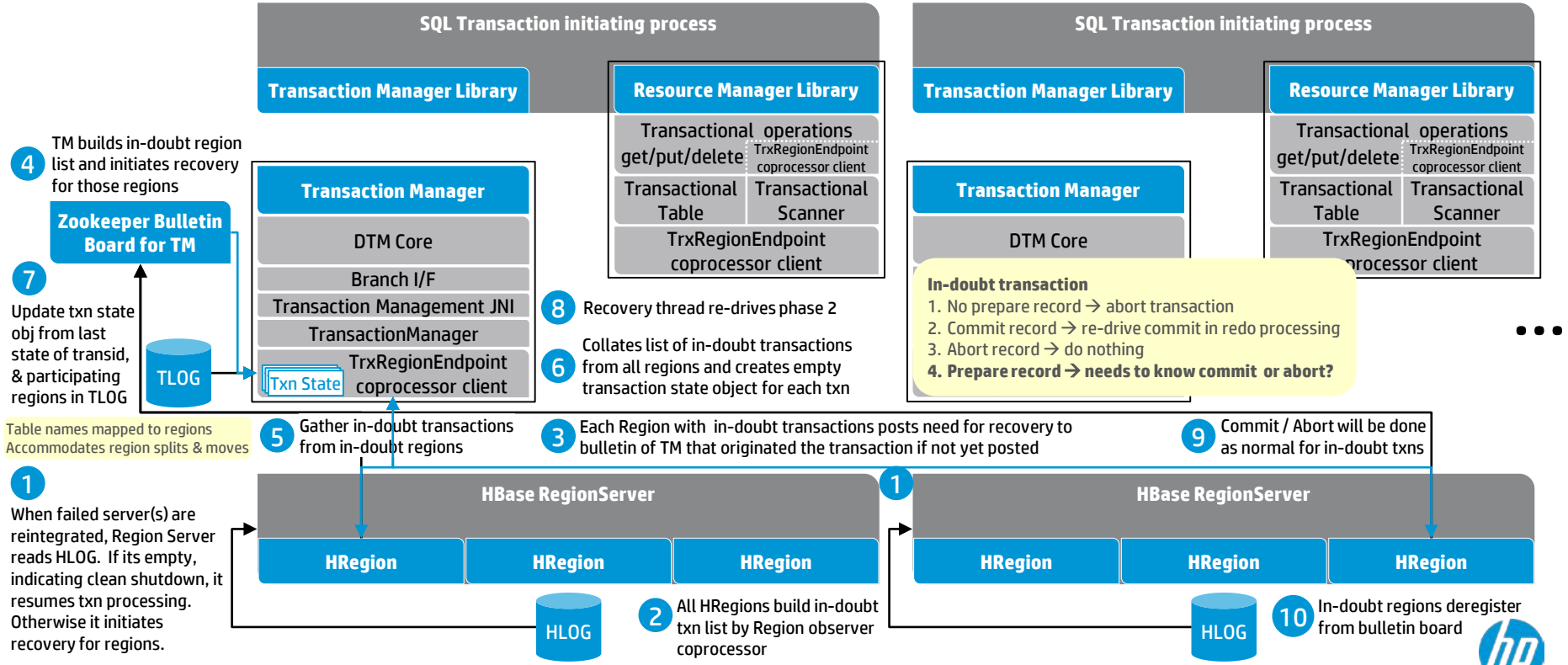
Transaction Recovery



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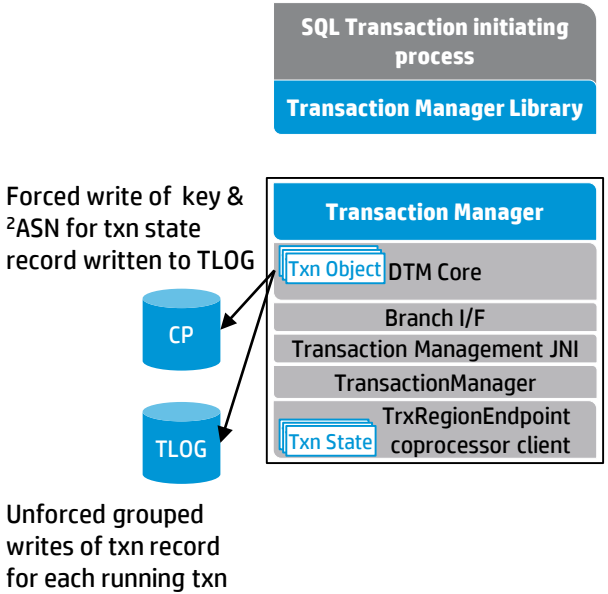
Transaction Recovery – Control Point processing

Used to re-drive transaction recovery

- After server or cluster failure to ensure data consistency given in-flight operations at time of failure
- Control points written to Control Point table at a configurable [1]interval, currently set at 2 minutes
- Re-drives of transaction commits (redo) driven by recovery needs of regions

Used for aging

- TLOG entries prior to 2 control points can be aged out and only two entries maintained in control point table
- Commit records rewritten to log, along with writing txn state of all running transactions, until all commits received and forgotten record written



[1]control point interval is represented by two consecutive control point records where the first record defines the ASN from the start of the interval and the second defines the ASN at the end of the record

[2]monotonically increasing value indicating the audit write sequence number

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Addressing the requirements

Current State

- Use HBase Endpoint coprocessors
- Trafodion has Transaction Manager (TM) processes, written in C++, supporting:
  - Recovery on client / region server crash
  - Transactions involving multiple HBase clients (transaction propagation)
- Clients can use a new, transactional client derived from regular HBase client
- Trafodion as single jar file, used by region server, TM & clients. Compatible with HBase 0.98 version.
- Recovery from region server

Goals

- Optional, no penalty if not used
- Very low overhead – tight integration with the region server helps
- Avoid additional processes
- Avoid non-Java code
- Avoid version incompatibilities

How to achieve goals

- Provide Java implementation of TM code for the following functionality, if needed:
  - Txn propagation
  - Manageability
  - Recovery

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Future opportunities

Optimizations

For single region transactions

Transaction flow

Isolation support

Repeatable read

Snapshot isolation

Serialized snapshot isolation

Row Locking paradigm for certain tables

Tables involved in long running transactions

Pessimistic locking for highly concurrent operations

High Availability

Recovery from TM, or node failure

Accommodate Region Splitting & Balancing

Manageability

Transaction object info/metrics via REST APIs

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Thank you

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