# ZHT: Const – Eventual Consistency Support For ZHT

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# Outline

- Problem Description
- Project Overview
- Solution
  - Maintains Replica List for Each Server
  - Operation without Primary Server Failure
- Working-on
  - Operation with Primary Server Failure
- Performance Evaluation

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# Problem Description

- ZHT aims to provide High Availability, Good Fault Tolerance, High Throughput, and Low Latency
- ZHT applies Replication–based Fault Tolerance
- Consistency issue exists among data copies

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# Project Overview

- **Replication-based Fault Tolerance**
- **Consistency**

| | Eventual Consistency | Strong Consistency |
|---|---|---|
| Design | • Write Ack return to Client after Primary updates first Replica<br>• Version | Write Ack return to Client after Primary updates all Replica servers |
| Benefits | Low latency on write tasks<br>Low latency for requests to Primary | Consistency Guaranteed |
| Drawbacks | Latency on Lookup may increase | High Latency on write tasks |

- **Both of Primary and Replica servers can serve Lookup requests.**

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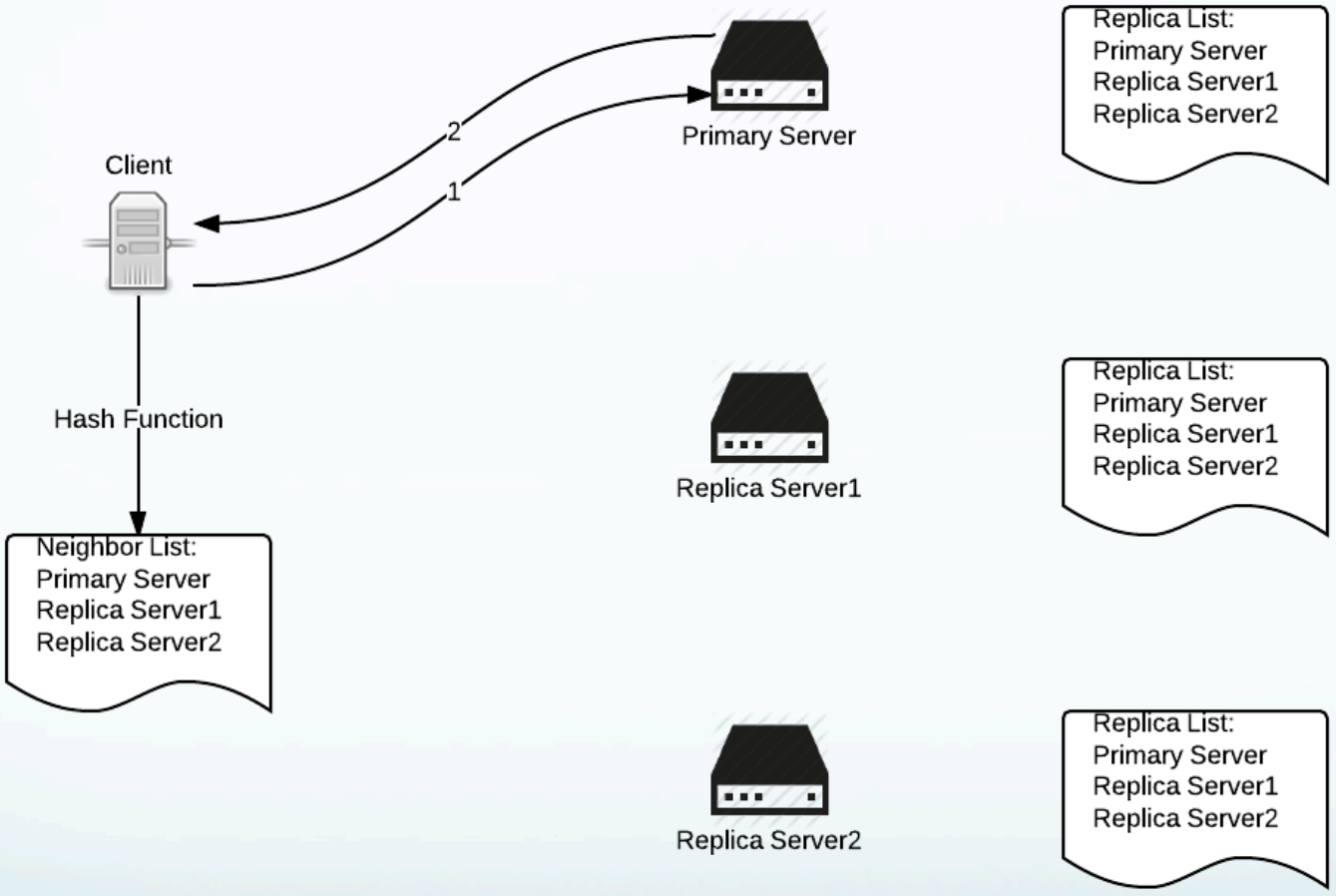
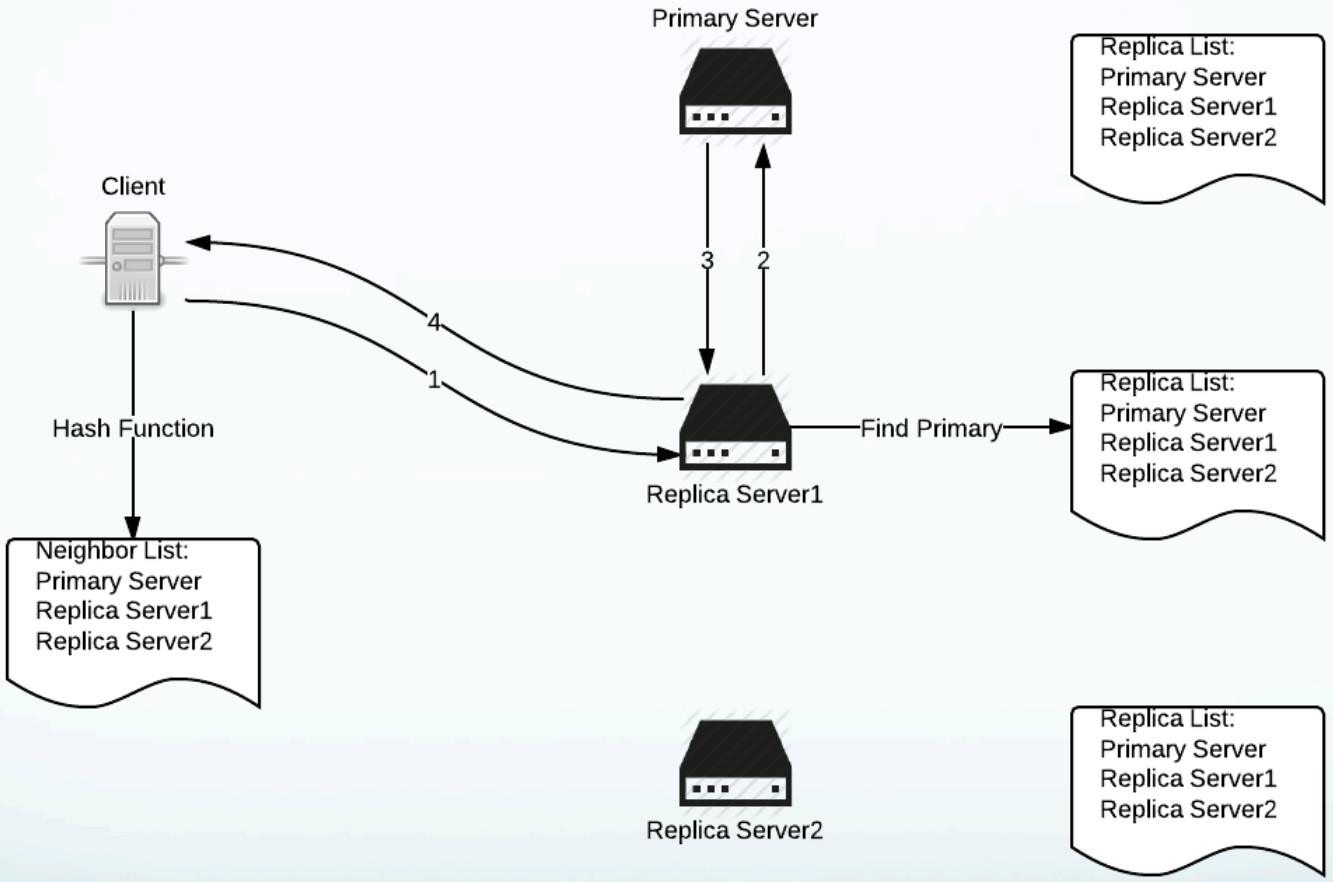
# Lookup – To Primary



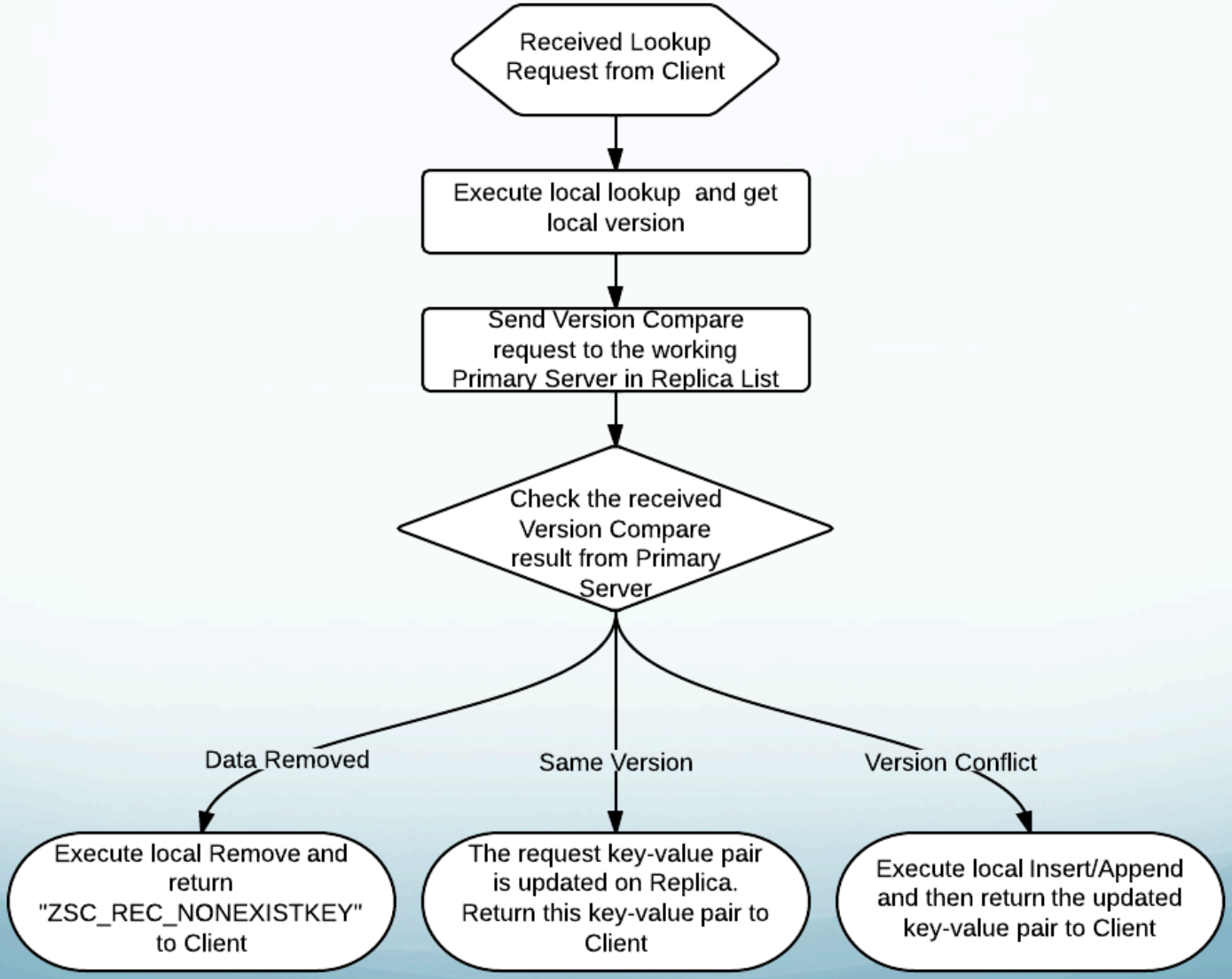

1. Client sends Lookup request to Primary Server
2. Primary sends Lookup result to Client

# Lookup – To Replica

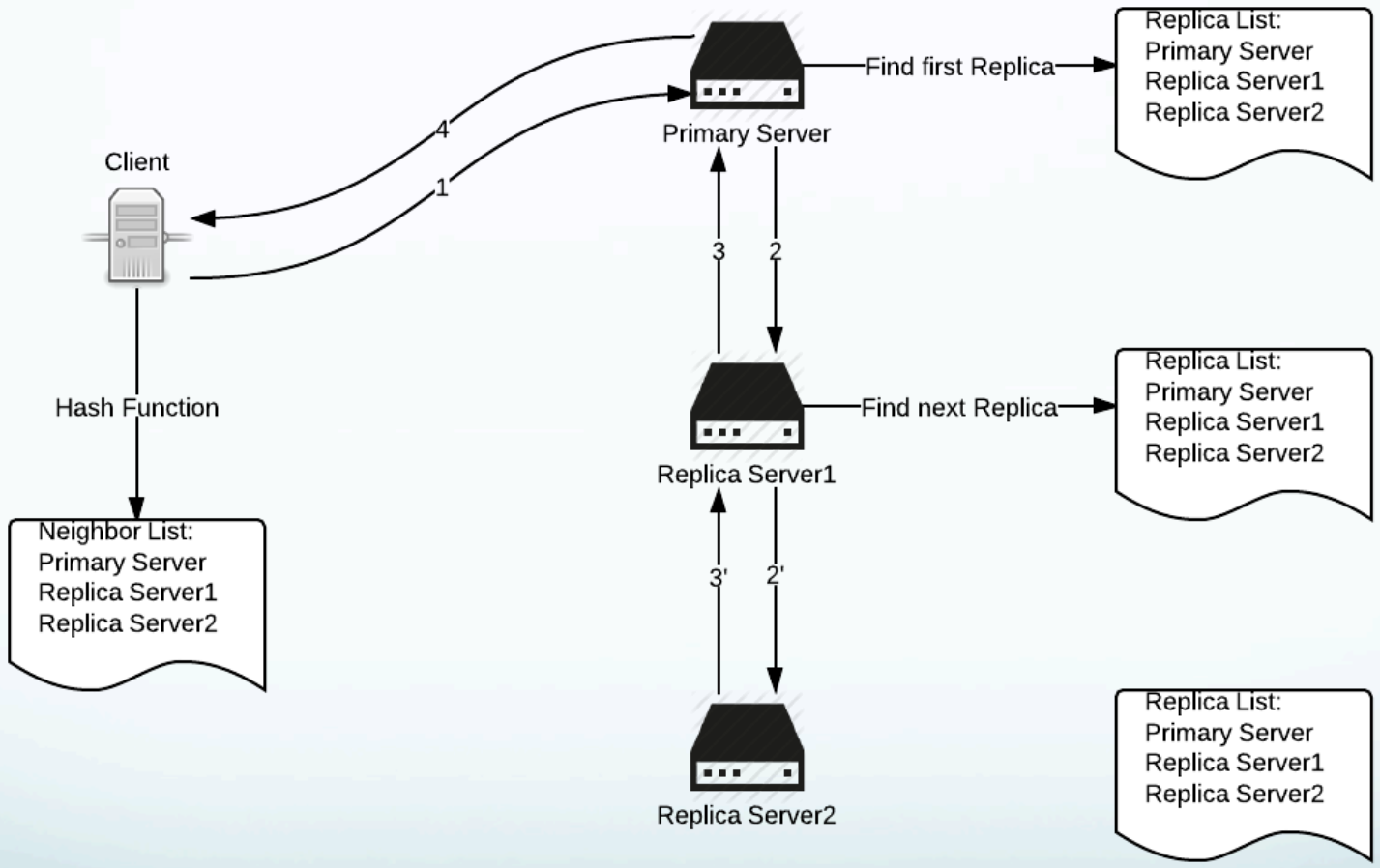



1. Client sends Lookup request to Replica Server
2. Replica sends Version Compare request to Primary Server
3. Primary sends Version Compare result to Replica Server
4. Replica server sends Lookup result to Client

# Version Compare – On Replica



# Insert, Append, Remove




1. Client sends Insert/Append/Remove request to Primary Server
2. Primary Server synchronizes I/A/R request to first Replica
3. First Replica sends I/A/R acknowledgement to Primary
4. Primary Server sends Insert/Append/Remove acknowledgement to Client

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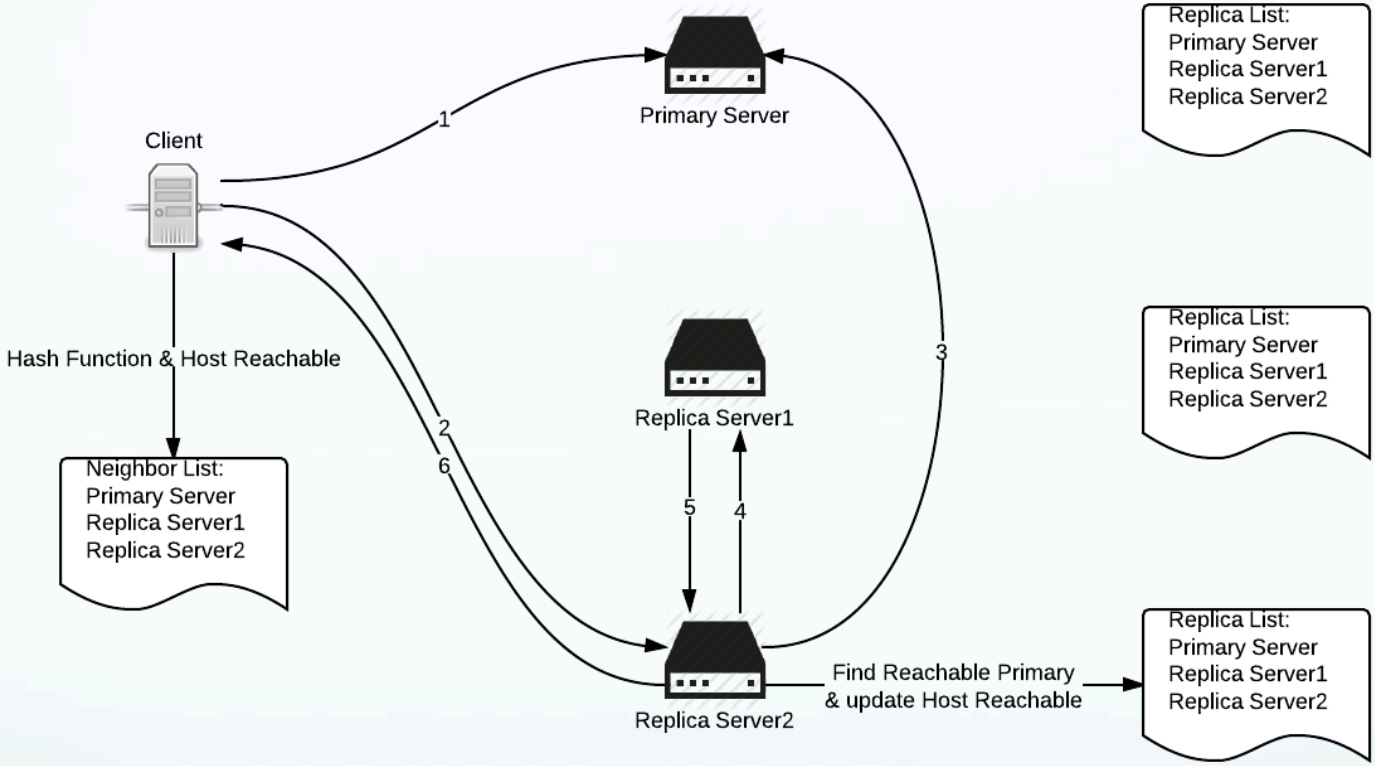
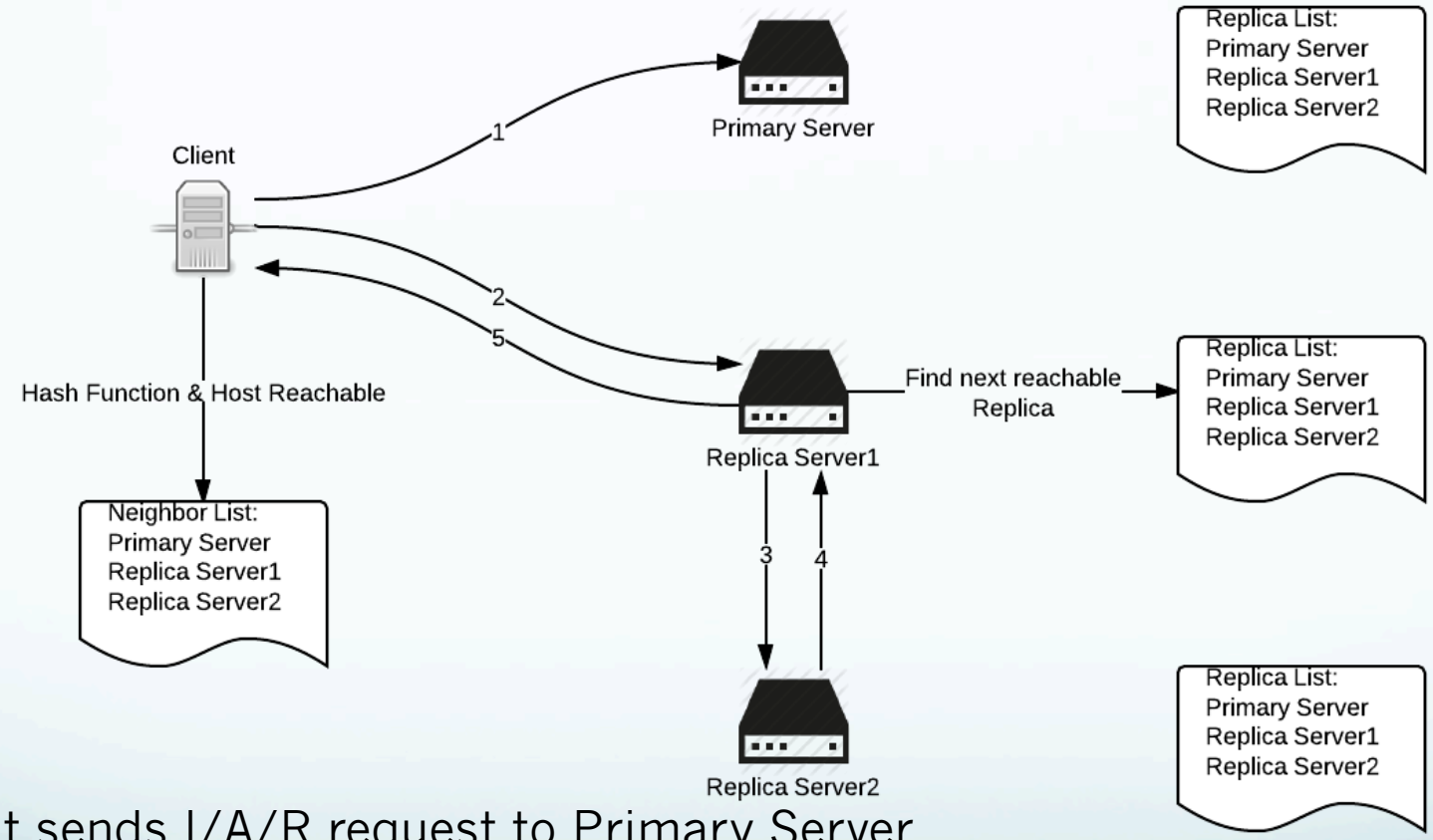
# Lookup with Primary Server Failure




1. Client sends Lookup request to Primary Server
2. Client sends Lookup request to random Replica Server (Replica 2)
3. Replica 2 sends Version Compare request to Primary Server
4. Replica 2 sends Version Compare request to Replica Server 1
5. Replica 1 sends Version Compare result to Replica Server 2
6. Replica 2 sends Lookup result to Client

# Insert/Append/Remove with Primary Server Failure




1. Client sends I/A/R request to Primary Server
2. Client sends I/A/R request to next reachable Replica (Replica 1)
3. Replica 1 synchronizes I/A/R request to next reachable Replica (Replica 2)
4. Replica 2 sends I/A/R acknowledgement to Replica 1
5. Replica 1 sends I/A/R acknowledgement to Client

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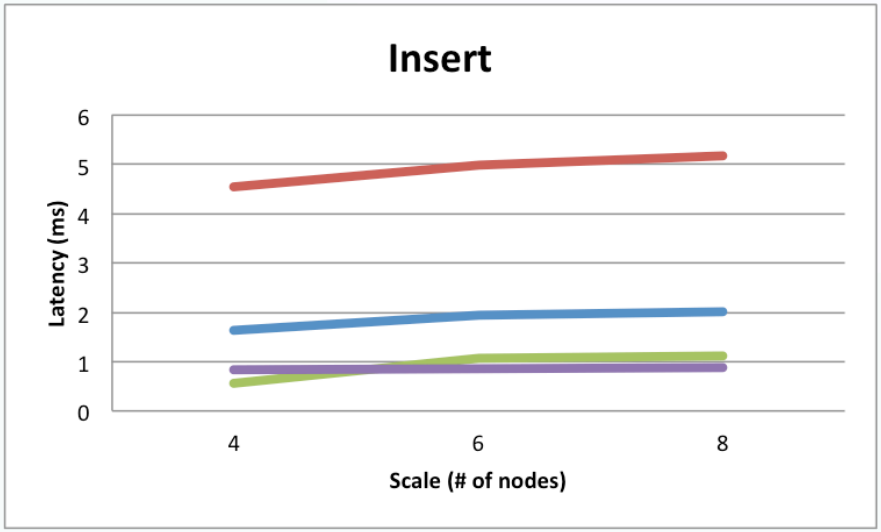
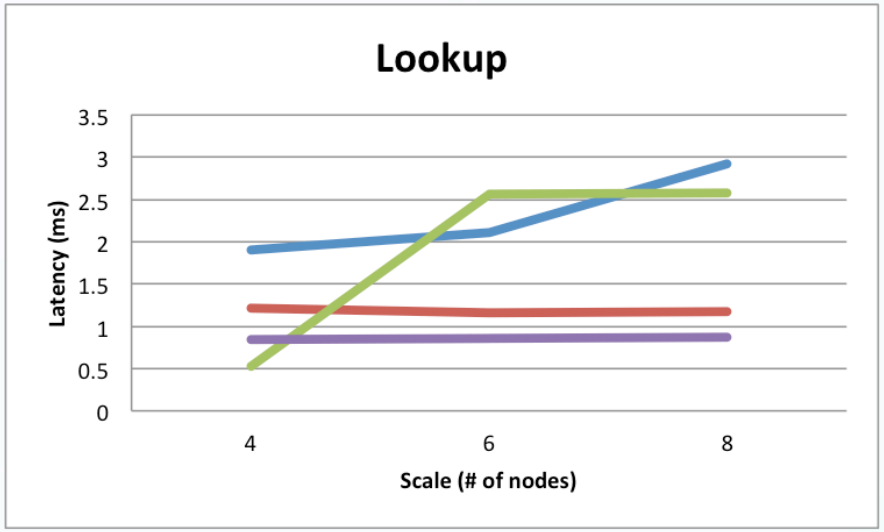
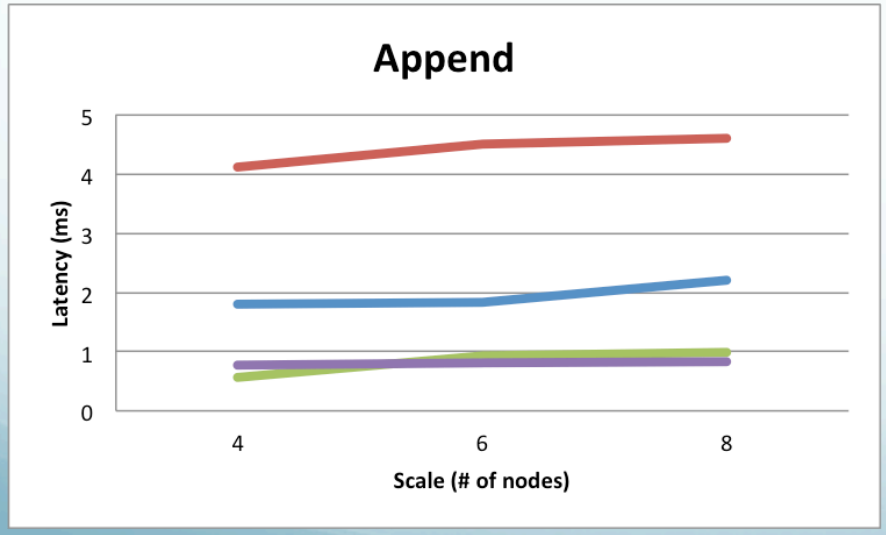
# Experiment Environment

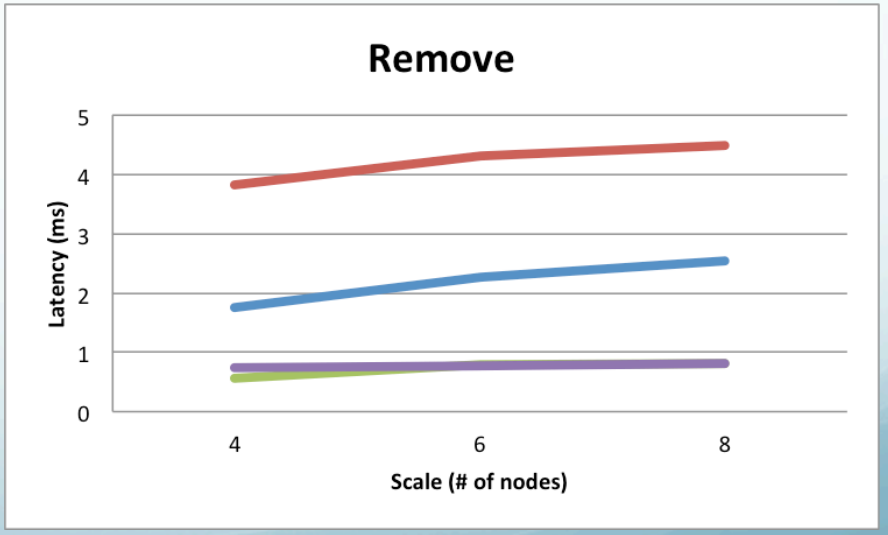
- Testbeds
  - HEC Cluster
- Workload
  - Same number of Clients and Server nodes (4, 6, 8)
  - 1000 key-value pairs for each operation
- Metrics
  - Latency
  - Throughput

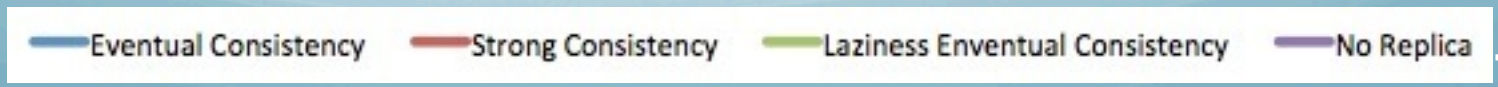
# Performance – Latency



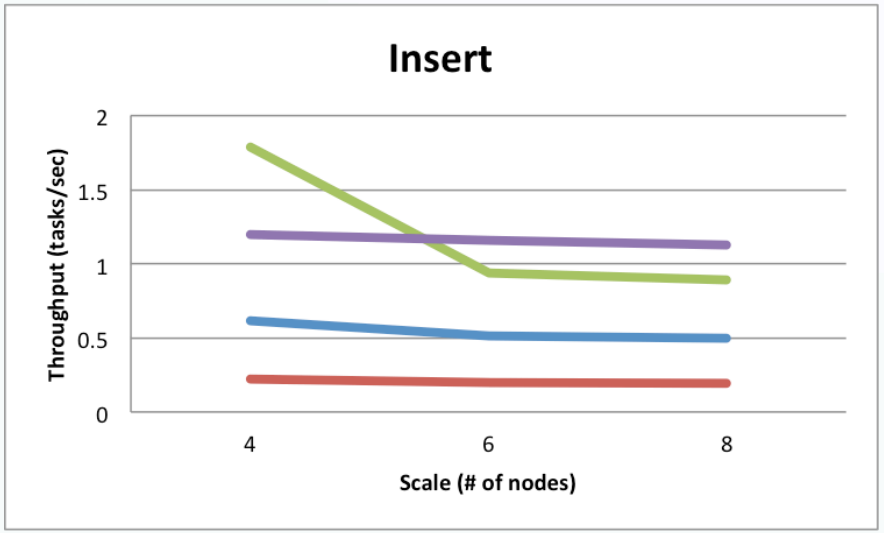



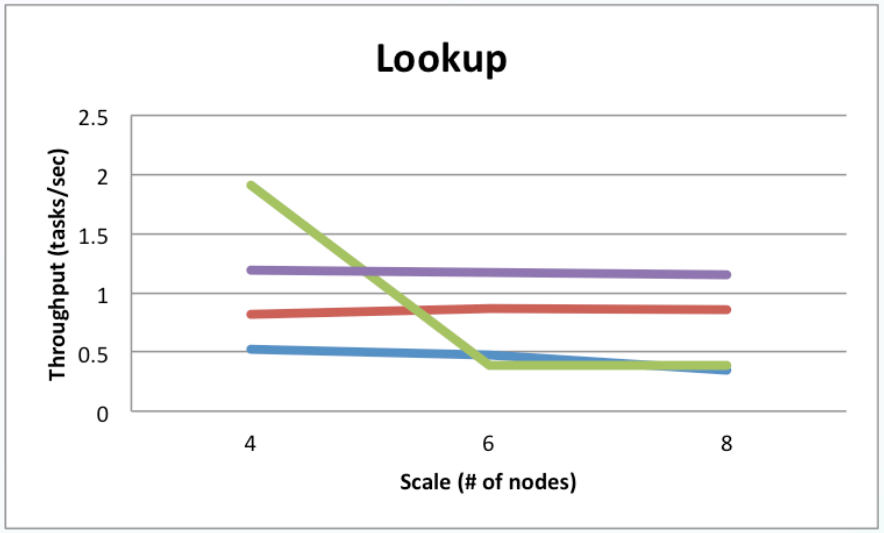



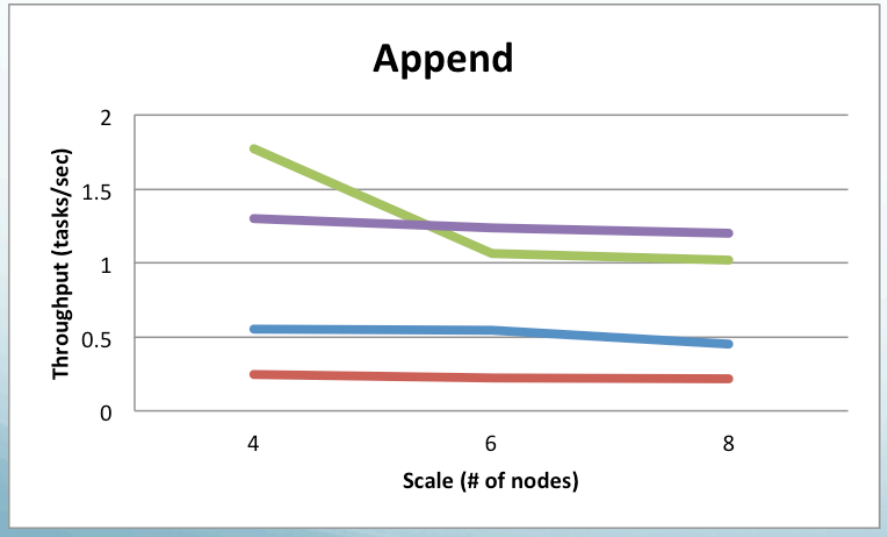



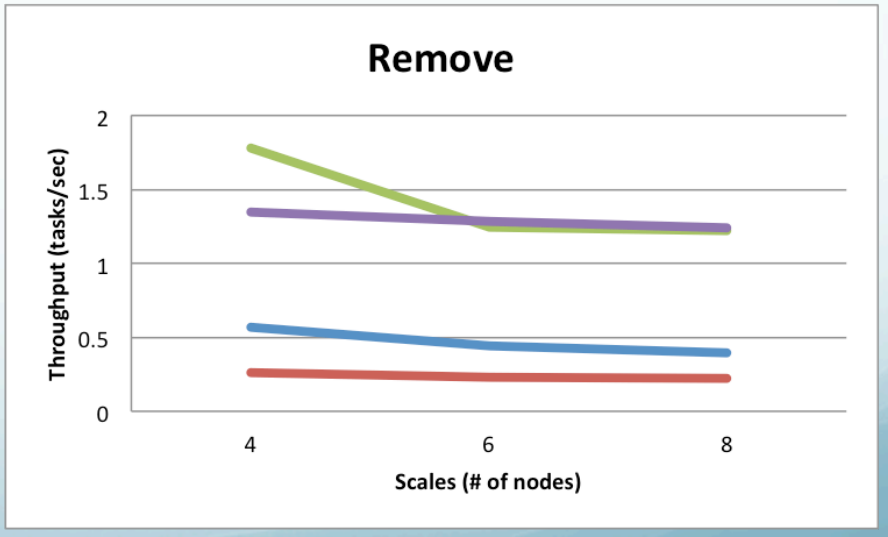



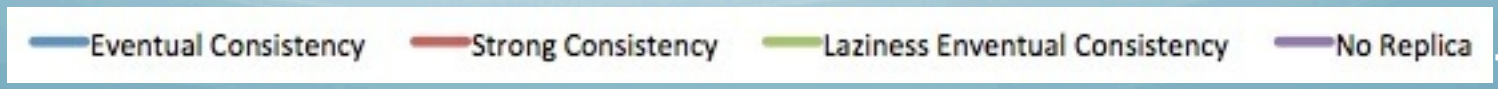
# Performance – Throughput



# Conclusion

- Compare with Strong Consistency
  - Achieve lower latency on write tasks
- Compare with Laziness Eventual Consistency
  - Achieve lower latency on Lookup
  - More reliable due to active inconsistency repair between Primary and Replica servers

# Questions?