



Optimistic Concurrency Control in a Distributed NameNode Architecture for Hadoop Distributed File System

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Qi Qi

Dedication

*To my father, a man of integrity, who
supports all my adventurous decisions so
that I can live outside of the box.*

Resumo

[To be added] Portuguese Abstract

Abstract

The *Hadoop Distributed File System* (HDFS) is the storage layer for Apache Hadoop ecosystem, persisting large data sets across multiple machines. However, the overall storage capacity is limited since the metadata is stored in-memory on a single server, called the *NameNode*. The heap size of the *NameNode* restricts the number of data files and addressable blocks persisted in the file system.

The *Hadoop Open Platform-as-a-service* (Hop) is an open platform-as-a-Service (PaaS) support of the Hadoop ecosystem on existing cloud platforms including Amazon Web Service and OpenStack. The storage layer of Hop, called the Hop-HDFS, is a highly available implementation of HDFS, based on storing the metadata in a distributed, in-memory, replicated database, called the *MySQL Cluster*. It aims to overcome the *NameNode*'s limitation while maintaining the strong consistency semantics of HDFS so that applications written for HDFS can run on Hop-HDFS without modifications.

Precedent thesis works have contributed for a transaction model for Hop-HDFS. From system-level coarse grained locking to row-level fine grained locking, the strong consistency semantics has been ensured in Hop-HDFS, but the overall performance is restricted compared to the original HDFS.

In this thesis, we first analyze the limitation of HDFS *NameNode* implementation and provide an overview of Hop-HDFS illustrating how we overcome those problems. Then we give a systematic assessment on precedent works for Hop-HDFS comparing to HDFS, and also analyze the restriction when using pessimistic locking mechanisms to ensure the strong consistency semantics. Finally, as a proof of concept, we demonstrate that how to improve the performance by designing a new model based on optimistic concurrency control with snapshot isolation. The evaluation shows the improvement of this new model, and its correctness has been validated by 300+ unit tests passing from Apache HDFS.

Palavras Chave

Keywords

Palavras Chave [To be corrected by native Portuguese speaker]

HDFS

MySQL Cluster

Controle de Concorrência

Snapshot Isolation

Transação

Vazão

Keywords

HDFS

MySQL Cluster

Concurrency Control

Snapshot Isolation

Transaction

Throughput

Index

I	Introduction and Background	1
1	Introduction	3
1.1	A	3
1.2	B	3
1.3	C	3
1.4	D	3
2	Background	5
2.1	A	5
2.2	B	5
2.3	C	5
2.4	D	5
II	Assessment in Hop-HDFS	7
3	Limitation on Pessimistic Locking Mechanism	9
3.1	A	9
3.2	B	9
3.2.1	B1	9
3.2.2	B2	9

3.3	C	9
3.4	D	9
4	Systematic Assessment of Hop-HDFS Performance	11
4.1	A	11
4.2	B	11
4.2.1	B1	11
4.2.2	B2	11
4.3	C	11
4.4	D	11
III	Solution	13
5	Design	15
5.1	A	15
5.2	B	15
5.2.1	B1	15
5.2.2	B2	15
5.3	C	15
5.4	D	15
6	Implementation	17
6.1	A	17
6.2	B	17
6.2.1	B1	17
6.2.2	B2	17

6.3	C	17
6.4	D	17
IV	Evaluation and Conclusion	19
7	Evaluation	21
7.1	A	21
7.2	B	21
7.2.1	B1	21
7.2.2	B2	21
7.3	C	21
7.4	D	21
8	Conclusion	23
8.1	A	23
8.2	B	23
8.2.1	B1	23
8.2.2	B2	23
8.3	C	23
8.4	D	23
V	Appendices	27
A	Apache HDFS Unit Tests Passing List	29

List of Figures

List of Tables



Introduction and Background

1

Introduction

1.1 A

AAA

1.2 B

BBB

1.3 C

CCC

1.4 D

DDD

2

Background

2.1 *A*

AAA

2.2 *B*

BBB

2.3 *C*

CCC

2.4 *D*

DDD

II Assessment in Hop-HDFS

3

Limitation on Pessimistic Locking Mechanism

3.1 *A*

AAA

3.2 *B*

BBB

3.2.1 **B1**

BBB1

3.2.2 **B2**

BBB2

3.3 *C*

CCC

3.4 *D*

DDD

4 Systematic Assessment of Hop-HDFS Performance

Neque porro quisquam est qui dolorem ipsum quia dolor sit amet, consectetur, adipisci velit...

– Cerico

4.1 *A*

AAA

4.2 *B*

BBB

4.2.1 **B1**

BBB1

4.2.2 **B2**

BBB2

4.3 *C*

CCC

4.4 *D*

DDD

III

Solution

5

Design

5.1 *A*

AAA

5.2 *B*

BBB

5.2.1 **B1**

BBB1

5.2.2 **B2**

BBB2

5.3 *C*

CCC

5.4 *D*

DDD

6

Implementation

6.1 *A*

AAA

6.2 *B*

BBB

6.2.1 **B1**

BBB1

6.2.2 **B2**

BBB2

6.3 *C*

CCC

6.4 *D*

DDD

IV

Evaluation and Conclusion

7

Evaluation

7.1 *A*

AAA

7.2 *B*

BBB

7.2.1 **B1**

BBB1

7.2.2 **B2**

BBB2

7.3 *C*

CCC

7.4 *D*

DDD

8

Conclusion

8.1 *A*

AAA

8.2 *B*

BBB

8.2.1 **B1**

BBB1

8.2.2 **B2**

BBB2

8.3 *C*

CCC

8.4 *D*

DDD

Bibliography

Shvachko, K. V. (2010). Hdfs scalability: The limits to growth. *login* 35(2), 6–16.



Appendices



Apache HDFS Unit Tests Passing List

