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To cite this version:

Jad Darrous, Shadi Ibrahim. Enabling Data Processing under Erasure Coding in the Fog. ICPP 2019 - 48th International Conference on Parallel Processing, Aug 2019, Kyoto, Japan. pp.1. hal-02388835

HAL Id: hal-02388835
https://inria.hal.science/hal-02388835

Submitted on 2 Dec 2019

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Enabling Data Processing under Erasure Coding in Fog

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Fog Computing: Opportunities

- Fog is widely adopted to extend the capacity of clouds
- It allows to deploy and run applications close to the users, e.g., Smart City applications¹
- Data processing applications, among others, can also benefit of Fog, e.g., Video Stream processing², Query processing² and Batch processing²

Fog: Limitations and Challenges

- Limited storage capacity
  — Using replication to ensure data availability is expensive
  — Heterogeneous and limited computation capacity
  — Difficult to exploit data locality efficiently
- Heterogeneous network
  — The cost of data transfer between nodes is high

Erasure Coding as alternative to replication

- Half the storage overhead of replication, for RS(6, 3)
- Low CPU overhead for encoding/decoding (5.3 GB/s)[5]
  - EC have been deployed in storage and caching systems[7]
  - HDFS is now equipped with EC since the 3.0.0 release[6]
- When performing MapReduce applications in data-intensive clusters
  - Unlink replication, most of the (map) task input data is transferred
  - A reduction by half of the network traffic and disk accesses when writing the output data

How to effectively realize EC for big data processing in Fog?

Quantitatively analyze the impact of heterogeneity

A Fog infrastructure is emulated on 10 machines each representing a Fog site

- Sort application performs 35% faster under Replication compared to EC
- The main reason behind the low performance of EC is the heterogeneity of the network
- Map tasks wait for the last chunk to process the current piece of data
- This leads to high variation in map runtimes under EC (60%)

Towards Network-Aware map task scheduling

- A network-aware solution should be considered to lower the impact of network heterogeneity
- A potential solution is to choose which node the data chunks (original and parity) should be transferred in order to minimize the maximum retrieving time
- To achieve the best job level performance, the scheduler should consider all the map tasks at once

ACKNOWLEDGMENTS

This work is supported by the Stack/Apollo connect talent project, Inria Project Lab program Discovery (see beyondtheclouds.github.io), and the ANR KerStream project (ANR-16-CE25-0014-01). The experiments presented in this paper were carried out using the Grid’5000/ALADDIN-G5K experimental testbed (see grid5000.fr).