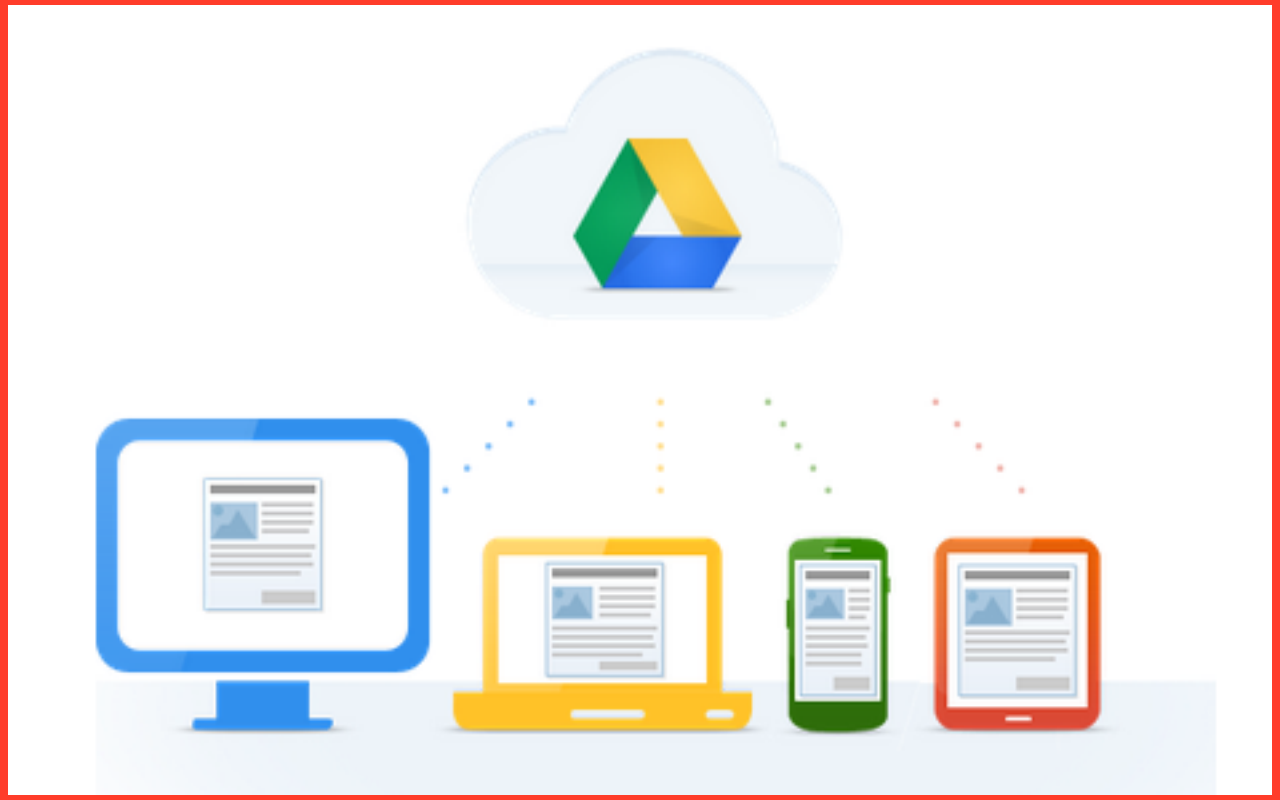


THE GOOGLE FILE SYSTEM

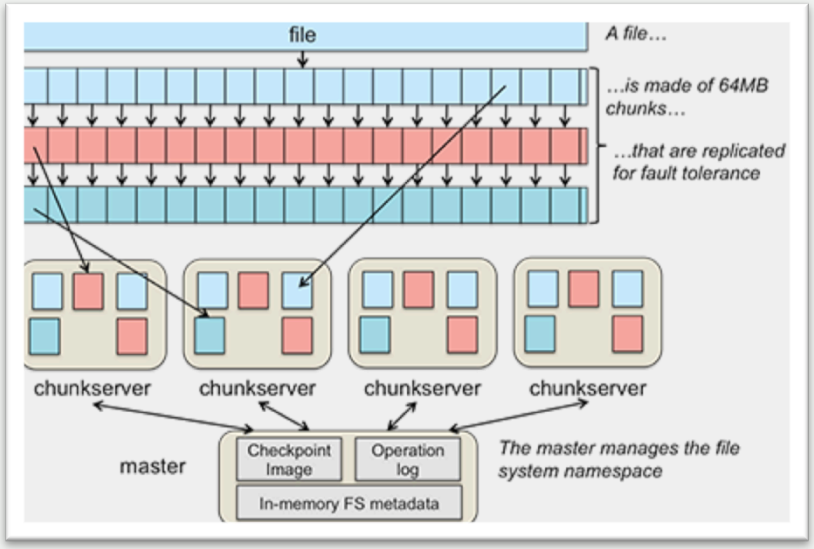
Mohamed Eid / Professor Alan Labouseur / CMPT 308 / 24 November 2013

About the Google File System

- The Google File System (GFS) is a distributed file system developed by Google. It is a close-sourced software exclusive to Google.
- The GFS was developed to meet the rapidly growing demands of Google's various systems and their data processing needs.
- It was built from the ground up with efficiency and accuracy in mind.
- The system provides is beneficial in that it is highly fault tolerant and performs well to a multitude of clients.
- This is all done while running on inexpensive hardware.

Implementation

- The GFS was also built with scalability in mind. It was not implemented in the kernel of an operating system like most other file systems.
- Instead, its implementation is done all through virtual memory. This allows for faster data processing.
- There exists a single master that makes chunk placement of files using global knowledge and metadata.



Implementation 2: Metadata

- The various types of metadata are the file and chunk namespaces, the mapping from files to chunks, and the locations of each chunk's replicas.
- With this knowledge, the master pings chunk servers when it needs to perform its actions such as deleting, creating, or reading a file.
- This method of pinging the chunk servers to check on chunks is chosen over saving a list of where chunks are.
- The reason behind this is to provide accuracy and consistency. A chunk server may fail or have corrupt data.
- When it comes to all interactions, the master "handshakes" with the chunk servers to ensure there is no data corruption.

Implementation 3: Availability

- The GFS is also implemented in a fashion that allows for high availability at all times.
- This is done through the GFS distribution of its clusters at multiple levels.
- The system has chunk replica placement policy servers that provide maximal data reliability and availability as well network bandwidth utilization.

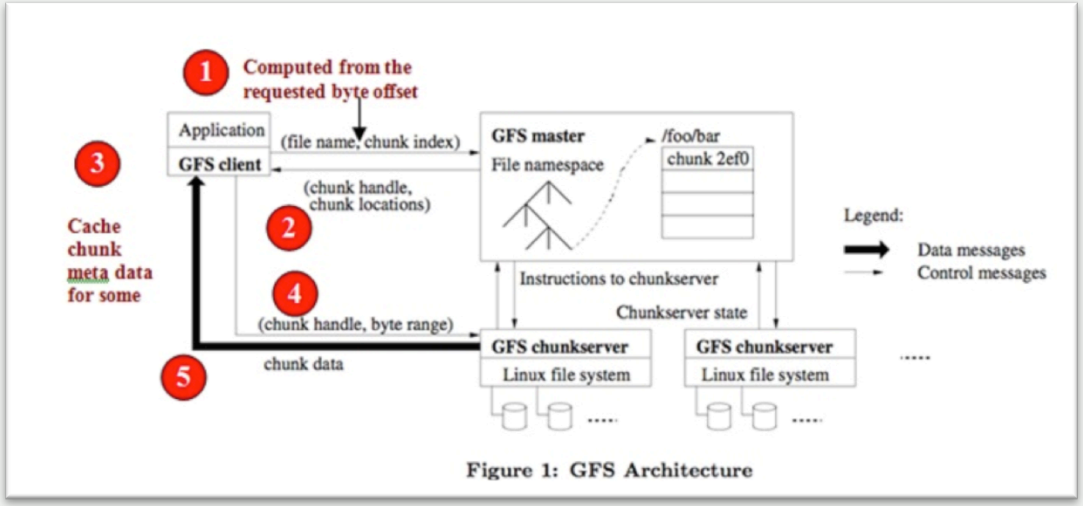


Figure 1: GFS Architecture

Implementation 3: Garbage Collector

- Google's system has an intelligent garbage collector with a few tricks.
- For instance, when a file is deleted, it is actually moved elsewhere on the system as a hidden file that can still be read. This is done for reliability purposes.
- Additionally, the GFS sends messages called HeartBeat messages for its garbage collector when there is a need to erase and update metadata for chunks. This is done for synchronization purposes.

Analysis

- The GFS is an impressive technology that allows for Google to handle big data processing for its internal environments as well as its external services such as Gmail and YouTube.
- Google's system is incredible dynamic and scalable as a result of its built in technologies like *HeartBeat* messaging.
- The system is incredibly cheap to run because it is powered on inexpensive hardware on cheap ATA drives. Whenever Google wants to expand the system it is never an issue when it comes to cost.
- For a business that handles large amounts of data accessed by millions of individuals, the fact that Google focused largely on high availability was a logical move.

Analysis 2

- By creating a closed software, Google is hindering the GFS from improving and potentially evolving into something more fitting for enterprise environments.
- The system's primary focus is on large read and writes. It is not as powerful for small read and writes as it is for larger data processing.

Advantages of the GFS

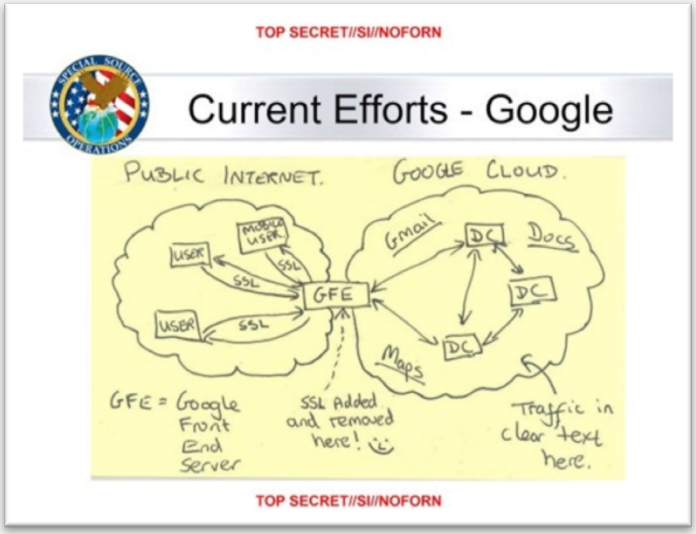
- The GFS has many advantages. These include availability, performance, management, and cost.
- Google's system is highly available at all times because it provides fast recovery, chunk replication, and master replication.
- When it comes to performance on large sequential reads, GFS is incredibly powerful; the system is highly efficient.
- The cost is cheap because the system is run on inexpensive hardware on ATA drives.

Disadvantages of the GFS

- The GFS also has disadvantages. These include performance on small reads and writes, the relaxed consistency model, and the fact that it is not open source.
- The system was not designed for small reads and writes. This kind of data processing is not suitable for data center workloads.
- The relaxed consistency model allows for high availability and may meet the needs of Google, however it wouldn't meet the needs of most enterprise workloads.
- The GFS is also not open source so developers outside the GFS team are not able to provide feedback or create their own versions or modifications of the system based on Google's source.

Real World Use Cases

- The Google File System is not open sourced software so Google is the only organization using it.
- It is used in Google's internal environments as well as its external services.
- Some external services using this software include Google Drive, Gmail, YouTube, and Google+.



Sources Cited

- Ghemawat, Sanjay, Howard Gobioff, and Shun-Tak Leung. "The Google File System." *Labouseur*. Google, n.d. Web. 22 Nov. 2013.