



# Executive Summary

## **Abstract**

Remote cloud storage is increasingly recognized as an essential component of strategies to prevent permanent or temporary data loss - a threat that can cost businesses even more than malicious theft and accidental leaks.

Bifrost Cloud offers users a large-scale distributed cloud storage solution that ensures business continuity at all times. Decentralization mitigates the risk of data failures and outages, while simultaneously increasing the security, read performance, and privacy of object storage.

## **Causes of Data Loss**

Many businesses execute regular backups to on-premises storage infrastructures or NAS. These are excellent protections against the most common causes of data loss. However, issues affecting one device can wreak havoc on a company's whole infrastructure.

Data loss can happen due to software failures, human error, power failure, and natural disaster. In case of a sudden loss, most businesses often take too long for critical applications and records to come back online. Often, data is never recovered due to missed backup points.

## **Adopting Distributed Cloud Storage Strategies**

The amount of digital data that the world creates doubles every year, this necessitates a new infrastructure solution to the world's growing data needs. The traditional cloud model has significant issues with security, availability, and performance, especially in regions distant from major data centers. The properties of distributed cloud storage solutions can address these needs.

## **The Rise of Object Storage**

Object storage works very well for unstructured data sets where data is generally written once and read once or many times. Distributed object storage is optimized for larger files, especially where those files are accessed regularly from geographically diverse locations.

## **How does Bifrost Cloud's Solution Work**

The main purpose of bifrost cloud is an object storage solution to store and retrieve user's data from a network of globally distributed storage providers. By using existing, underutilized hard



drives and bandwidth while maintaining SLAs that are comparable to traditional data centers, Bifrost Cloud stands out as a new solution that is both cost effective and performant.

When data is stored with Bifrost Cloud, files are encrypted and broken up into multiple pieces using erasure coding. The pieces are distributed to storage providers across the network. When this occurs, metadata is generated alongside the file that contains information on where to find the file pieces on the storage network.

When data is retrieved from the network, the client will first reference the metadata to identify the locations of the previously stored pieces. Then the pieces will be retrieved from various storage providers and the original data will be reassembled and transferred to the client's local machine and then decrypted for consumption.

One thing to note is that Bifrost Cloud operates on a trustless network. This means that the platform is indifferent to the underlying storage equipment and security policies. Despite the fact that different storage providers may be operating on distinct security policies, Bifrost Cloud will be able to hold its SLA as data security is finalized on the aggregation layer.

### **Ensuring Protection at Every Stage**

All files stored on the network are encrypted. We ensure that the user's data is encrypted as early as possible in the data storage pipeline, ideally before the data ever leaves the source machine.

The encryption algorithm we use for files and metadata is AES-256, which is an authenticated encryption algorithm. This means that if any encrypted data is tampered with, the client downloading the data will deterministically detect discrepancies once the data is decrypted.

Backed-up data can only be viewed or restored when the public and private keys are matched. Without the private key, all data is unreadable. In addition to content, AES-256 encryption is separately applied to file-paths, content, and metadata as well.

### **Data Durability**

Users must be able to retrieve the files at a moment's notice, free of any data errors, even after years of storage. The ability to keep stored data consistent and intact, without the influence of bit rot, drive failures, or any form of corruption, is called durability.

Many cloud storage providers list a number of "nines" of durability. Bifrost Cloud follows procedures preferred by industry leaders to offer an estimated "twenty nines" (99.9999999999999999%) of data durability according to widely-used definitions. The protection provided exceeds that of available RAID configurations.

### **Fault-Tolerant Architecture**



Bifrost Cloud architecture ensures that no valuable data is lost. Data uploaded to the Bifrost Cloud distributed network is split into pieces and encoded, generating parity pieces that keep data retrievable when one or more servers are down.

This process is referred to as erasure coding, which is the gold standard in data durability to guard against failures. Erasure coding takes a similar approach to most RAID configurations by relying on smart distribution with redundant data to enable checks and recovery, on a worldwide network level.

The current Bifrost Cloud network employs a 30/80 erasure coding scheme. This means that each file is split up into 80 pieces, and only 30 of these are needed to reconstruct the original file.

### **Automatic File Repair**

The network also actively monitors when a storage provider stops storing data correctly, or goes offline. In this case, an automatic file repair process is triggered to recalculate and rebuild the necessary files to other nearby nodes to maintain target redundancy.

### **Conclusion**

Bifrost Cloud offers enterprise users a storage solution to ensure data availability on the cloud, to prevent data loss due to human error and disasters, and ensure business continuity at all times.

Bifrost Cloud follows industry best practices by encrypting data during storage and transmission using global standards. Meanwhile, data is kept consistent and intact using a generous erasure coding setup to ensure data durability and integrity.

In combination with our client side softwares, this makes Bifrost Cloud the most secure and cost effective option for users who want to take data storage to the next level using cloud hosted copies of their essential backups without compromising on security.