A Multi-Cloud Storage Environment Dynamic Bandwidth Reallocation For Improved Data Slice Distribution

[1] Dr. G. Sunil Kumar, [2] Mr. Dumbre Rajendra C, [3] Mrs. Pallavi Bhagwan Gholap

[1]HOD, Department of Electronics and Telecommunication Engineering
Padmabhooshan Vasantdada Patil Institute of Technology (PVPIT), Pune.
[2] [3] Assistant professor, Department of Computer Engineering,
Sharadchandra Pawar College of Engineering, Pune.

E-mail: [1] gsunilmtech@gmail.com, [2] r.dumbre80@gmail.com, [3] pallavigholap26@gmail.com

Abstract: This article examines the advantages of employing many cloud platforms for data storage, alongside providing a comprehensive description of cloud computing. The significance of this matter is indisputable, considering the substantial duration required for the consolidation of such a vast amount of data into a singular cloud platform. When faced with a complex problem requiring significant time for resolution, it is advantageous to transfer a substantial amount of data across different cloud platforms. In addition to variations in transmission rates between different cloud providers, the size of Internet data packets employed by service providers may also play a factor in the transmission process. This study proposes an optimization approach to enhance data transfer and facilitate the optimal distribution of data packets when compared to a method that evenly distributed data across various clouds without considering optimal bandwidth allocation. This observation arises from the recognition that a strategy involving the uniform distribution of data over numerous cloud platforms fails to account for the optimal exploitation of the existing bandwidth.
Keywords: Dynamic Bandwidth, Enhanced Data Slice Distribution, Cloud Computing, Cloud Storage Optimization, Bandwidth Allocation

1. Introduction

The adoption of cloud-based storage systems has become increasingly widespread among internet users as a method of protecting their data and important files kept online. The observed phenomenon can be ascribed to the rapid progressions in network technology and the extensive embrace of cloud computing. Cloud storage has been utilized by approximately 55% of Internet users, as indicated by recent statistics [1]. In the context of cloud computing, it is the responsibility of Cloud Service Providers (CSPs) to guarantee that their clients optimize the utilization of the provided bandwidth [2]. A significant proportion of individuals lack the network capacity to transfer their data to a server capable of accommodating multiple cloud platforms, thereby presenting a substantial challenge. In this context, we shall analyze the phenomenon of data bottlenecks and network congestion that occur while transmitting very large files. The level of time dedication required is substantial, and the utilization of bandwidth is significant. The primary areas of focus in this field of research have been the enhancement of upload speeds, the redistribution of network resources, and the improvement of transmission efficiency. Given the proliferation of numerous cloud storage service providers in contemporary times, it is imperative to carefully select a provider that ensures expeditious data transfers while maintaining uncompromised security measures. Let us examine a straightforward illustration to comprehend the mechanics of this process. In contrast to the immediate accessibility of data over the Internet, the duration required for data segmentation and intra-cloud data movement inside a given cloud architecture may appear to be restrictive. The inevitability of encountering this matter is undeniable. Network connections serve as the exclusive medium for facilitating information flow across cloud systems. By refraining from storing and processing large quantities of data in distinct cloud environments, we can effectively utilize the technologies in a way that mitigates connectivity issues. Although there may be cost advantages associated with choosing one cloud storage provider over another, the presence of performance concerns renders its adoption an unfavorable decision. This study investigates the impact of bandwidth on the probability of identifying the optimal approach for partitioning data. Our primary emphasis is on examining the impact of bandwidth on the overall size of the slice. The scholarly community within this domain is experiencing growth and intensifying competition, nevertheless it remains imperative for the progression of multi-cloud storage performance alternatives.

2. Related Works

In this discussion, we will examine the current methodologies employed for bandwidth slicing and present a framework called bwSlicer. This framework is designed for implementation in cloud data centers, enabling the utilization of active bandwidth distribution to enhance system presentation and optimize resource utilization. The functionality of the suggested bandwidth slicing algorithms in a virtualized network can be observed by utilizing Mininet, a network simulator. The findings of the simulation demonstrated a decrease of 30% in the ratio between the duration of execution and energy consumption. In view of current energy-saving initiatives aimed at enhancing the efficiency of cloud data centers, our findings underscore the necessity of further exploration into the concepts of bandwidth slicing and reallocation. The feature of bandwidth guarantee (BwG) is extremely desirable in cloud data centers due to its ability to provide tenants (often referred to as users) with consistent and predictable performance [4]. While the inclusion of this feature would undoubtedly offer significant benefits, its availability in cloud computing environments remains limited due to its potential to adversely impact the efficiency of the underlying network infrastructure.

Two main causes have been identified. To begin, the bandwidth requirements of tenants are notoriously unpredictable, both in terms of time and location. Second, the architecture of today's cloud networks makes it challenging to let tenants make effective use of the assured but idle bandwidth.

The auto pre-allocation method was proposed as a distinctive way to mitigate the issue of network bandwidth oversubscription in cloud data centers [3]. The objective is to develop and deploy a bandwidth allocation system based on private cloud infrastructure, utilizing software-defined networking (SDN) technologies. The implementation of dynamic bandwidth allocation is crucial in both point-to-point and multipoint-to-point infrastructures, as it caters to the diverse needs of different services, including high-definition video, audio, cloud computing resource sharing, and virtual reality gaming. In order to enhance the effectiveness of bandwidth partitioning in relation to acceptance probability and bandwidth utilization, the authors propose a comprehensive framework called the Unified Dynamic Bandwidth Allocation Scheme (UDBAS). This framework is designed to cater to both wired and wireless network devices, and proves particularly advantageous in scenarios where there are abrupt fluctuations in bandwidth requirements. The existing approach to bandwidth control is ineffective due to the varying bandwidth requirements of different clients.

In recent times, there has been theoretical research, as provided in reference [6], that supports the notion that the implementation of an offloading framework with advanced decision-making capabilities is both viable and effective. Prior research has demonstrated that an amalgamated offloading paradigm, which entails the collaboration of mobile cloud computing and mobile edge computing, is crucial for optimizing system efficiency and allocating bandwidth effectively to individual mobile devices.

The work Migration Algorithm (TMA) comprises a collection of criteria that may be flexibly modified to provide enhanced work reallocation, hence leading to expedited replies from both the userbase and data center [7]. The suggested methodology for implementation at the vmloadbalancer in the data center controller was simulated and assessed through simulation employing two algorithms, namely Round-Robin and Throttled. Considerations are made for factors such as the processing time of data centers and the overall response time of cloud systems.

The green load balancing method known as weighted maximin is a hybrid approach that combines the weighted round-robin and max-min algorithms. Previous research has demonstrated that this method effectively decreases both the ready time and the reaction time [9]. Additionally, this approach incorporates an adaptive task offloading strategy that aims to optimize the selection of networks and the process of offloading tasks [10].

A technique was devised to pre-allocate transmission units (TUs) for the cellular system. Another frequently overlooked aspect is the failure to take into account the impact of network node placement on the overall time required to achieve an objective[11]. The conventional approach to task offloading lacks the ability to guarantee user quality of service as a result of congestion in both the access network and edge servers[12].

3. Methodology

The research aims to determine how bandwidth may be more efficiently distributed throughout the process of uploading several slices to many cloud servers. However, we are also curious in the efficiency of various clouds, so we will be slicing data and distributing it over a number of clouds, with each cloud's upload speed and access latency taken into consideration. The study's authors hypothesised that the efficiency with which data is divided and disseminated over several clouds would be directly related to the amount of available bandwidth. To verify this theory, we calculated the appropriate weights for each cloud bandwidth by measuring the Euclidean distance between it and its source.To prevent slowdowns and ensure data is distributed fairly across all cloud services, it was decided to partition the available bandwidth.

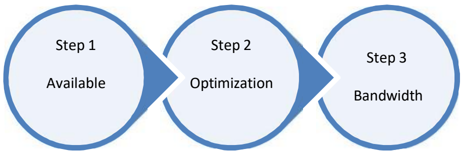

Fig 1: Steps of work.

Bandwidth mentions to the measure of data transmission speed among two locations inside a network over a specific time period. In the domain of interconnected devices inside a network, the measurement of data transfer rate is commonly denoted in units of bits, megabits, or gigabits per second. Video streaming and huge file downloads are two instances of data-intensive activities that have the potential to dramatically affect network performance. Bandwidth refers to the quantity of data that can be transmitted between two sites during a given timeframe. Input/output (I/O) devices serve as a prime illustration of the correlation between bandwidth and the technology employed for data transfer. Technological developments, such as the introduction of the AGP connection in personal computers, were developed in response to the issue of sluggish drive performance resulting from a bus with limited bandwidth. According to the authors (21), there are distinct ideas for route bandwidth and bottleneck bandwidth. A clear separation may be observed between the two entities.

In the field of computer networking, the term "bandwidth" pertains to the upper limit of data transmission capacity that may be achieved inside a given channel at any given time. The threshold is determined based on the highest achievable data transfer rate of the connection. The bit per second (bps) serves as the universally accepted unit of measurement for quantifying bandwidth. The speed and reliability of a network or the Internet are directly correlated with the bandwidth of said network or the Internet. There exist multiple methodologies for the quantification of bandwidth. Maximum flow, regular flow, and optimal flow are often employed methods for assessing the transfer of data. Undoubtedly, the ideal state is characterized by continuous data flow.

The process of estimating bandwidth typically necessitates the utilization of standardized software or hardware, as well as a network interface. The Test TCP tool and the PRTG Network Monitor are widely utilized instruments in the field of bandwidth measurement. The internet has the potential to offer users access to both categories of content. In the context of performance testing using the TTCP protocol, it is customary for one host to assume the role of the receiver, while the other host assumes the role of the transmitter. The sharing of data transmission and reception statistics occurs among hosts, along with the inclusion of the duration of a unidirectional packet's travel. The graphical user interface of PRTG, along with its associated charts, enables the monitoring and analysis of bandwidth utilization across several interfaces and over a period of time. To ascertain bandwidth, it is typical to aggregate the quantity of data transmitted and received within a specified time frame. The data is presented in the form of numerical values that correspond to a specific timeframe. The velocity of the transmission can also be quantified by transmitting a file or multiple files of a certain magnitude and recording the duration required for the data to be transmitted. The conversion from file size to bits per second can be determined by dividing the total file size by the time taken to transmit the complete file. The aforementioned protocol is commonly employed as the benchmark for evaluating a user's connection speed during the execution of speed tests, thereby establishing its prominent status in this domain.

Other measurements of network performance may be differentiated from throughput based on the following characteristics: The transmission of data via a network may be seen from a variety of perspectives depending on the context. The speed at which the physical signal travels through the medium is directly proportional to the "bit rate," which is the term used to refer to the pace at which data is moved from one location to another through a network. The greatest amount of data that can be sent across a particular network connection is referred to as the bandwidth, and it is measured in bits per second. A data transmission speed of 1 GB/s is provided by a Gigabit Ethernet connection, whereas the maximum speed provided by a Fast Ethernet card installed in a computer is only 100 MB/s. The proportion of all attempted transfers that are really successful is what is meant by the term "transfer rate." Bandwidth, on the other hand, is a measurement of the actual amount of data that can be sent via a network interface. Because of this, the pace of transmission cannot exceed the bandwidth that is now accessible.

After conducting 5 independent rounds of bandwidth testing, an average speed of 94 Mbps was determined to be the uploading capacity of the system on average. The exams were carried out in the correct sequence, beginning with the first one. It can be seen in figure 3 that the consequences of the various tests do not provide the same measurements.

Fig 2: Data from the standard Internet speed test, Ookla Speedtes

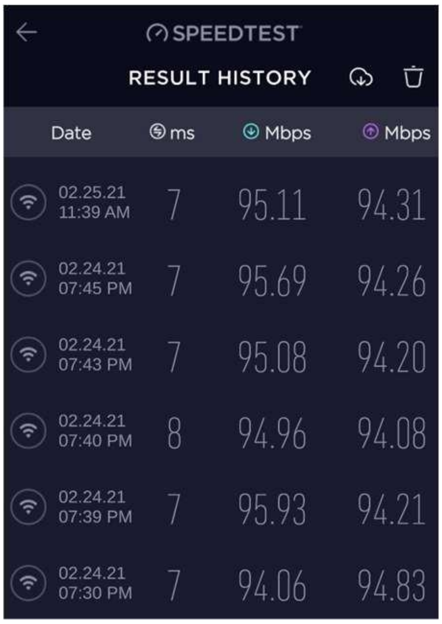

Fig 3: Continuous throughput evaluations.

In order to enhance the efficiency of our system, we employed the Euclidean distance metric to evaluate and compare the comparative advantages of various cloud storage solutions. In the process of calculating the Euclidean distance between two locations, our study considers both the duration required for data uploading and the duration required for data retrieval. An experimental result for upload time was obtained by transmitting a standardized 100 MB dataset to multiple cloud storage providers, with the purpose of comparing the time taken by each service. Upon performing the requisite computations to ascertain the duration taken by each cloud storage service for data delivery, the ensuing time intervals were obtained: In this study, the ping command was employed twenty times, and subsequently, the average was calculated using Gdrive Cloud.

The first thing you need to do in order to optimise a process is to locate the optimal balance of upload and access latency across many cloud storage servers. In addition, the ideal position for uploading data to several clouds results in a value loss of 85 seconds, but the optimal location for accessing data across clouds results in a value loss of just 44 milliseconds.

The formula for the Euclidean distance measure is as follows:

$$ED_i = (x_i - x_{best})^2(y_i - y_{best})^2 \qquad (1)$$

The proposed approach requires us to split a substantial quantity of data before transferring it to the cloud, which is what is meant by the word "cloud weight" in this context. The phrase "cloud weight" here means a precise percentage representation. We first build the fail function and the real cloud %, before attempting to extract the value that corresponds to the cloud percentage when inverted.

Table 2: The percentage of cloud storage.

Cloud storage	Cloud percentage (%)
Gdrive Cloud	34.34
4shared Cloud	17.28
mega Cloud	32.22
Pcloud Cloud	18.19

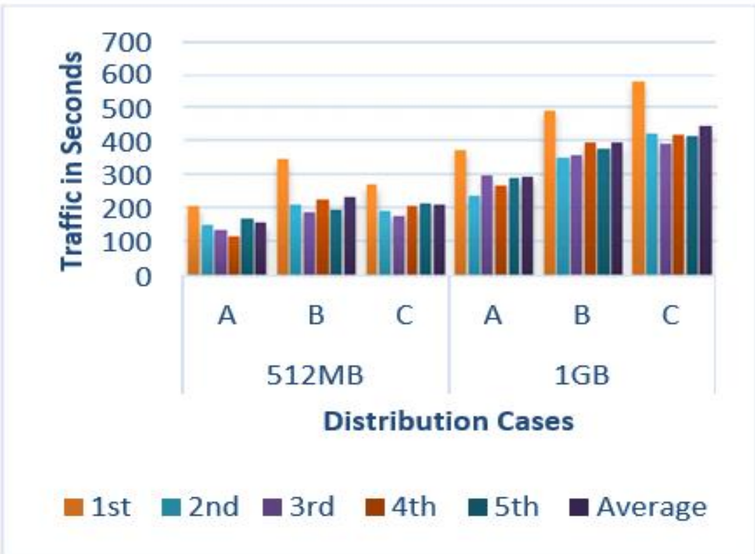

Fig 4: The meantime spans five distributions for 512MB and 1GB

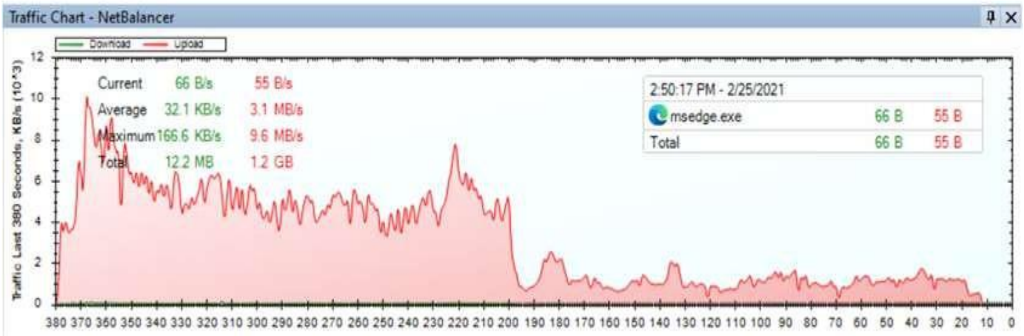

Fig 5: Changing how 1 GB of bandwidth is allocated by slicing up files

The results of our study can be seen below; we partitioned a file that was 512 megabytes in size using the method that was provided to us, and we then optimally distributed the available bandwidth. Determine the Euclidean distance that separates the system from the target function. It's possible that one of the objective function's parameters may reflect more involved needs, while the other will point to more basic ones.

On the other hand, as we saw in the preceding paragraph, the factors that are being taken into account each have their own particular significance. People have turned to multi-dimensional abstractions of space that are based on geometrical conceptions in order to find a solution to this difficulty [19, 20]. We are able to compute the distance between each "cloud" and the "best" spot if we know the position of one "cloud" as well as four other alternative places where "clouds" may be placed.

Table 5: Variations in Rates of Success

File size	Disparity in Performance, in Percentage		
	A and B	**A and C**	**B and C**
512 MB	14.24	8.62	-2.64
1 GB	8.08	14.59	5.52

The findings of our study indicate that the reallocation of bandwidth with different file slice sizes exhibits superior performance compared to two alternative scenarios: i) reallocating bandwidth with the same file slice size, and ii) not reallocating bandwidth with the same file slice size. Both of these strategies utilize the same amount of data transfer speed. The determination of the optimal approach for bandwidth relocation in our multi-cloud optimization parameter may be influenced by the inclusion of upload time and access latency values, as identified in our research. The findings demonstrate that our methodology exhibits sufficient reliability to be implemented in real-time systems. Additionally, a considerable number of individuals express satisfaction with the quality of the outcomes.

4. Conclusion

The most important result of this research is a strategy for overcoming bandwidth constraints. This is its single most valuable contribution. Distributing several slices over many cloud storage nodes creates a bottleneck that may be avoided by reallocating bandwidth, as has been shown in many experiments. The need to redistribute bandwidth causes this slowdown. Bandwidth reallocation results in a more equal distribution of ideal data slices than does even slicing without it by a margin of 13.58 percent. When comparing even slicing with and without bandwidth reallocation, this distinction becomes clear. Similar to the strategy of equitably dividing the data and reallocating the bandwidth distribution, this one is 9.07 percent more efficient when sending a file that is one gigabyte in size. The most important finding was the ability of employing distribution optimisation parameters as a predictor for bandwidth reallocation. The most important takeaway from this investigation is the method we propose for maximising the transfer of data slices across many clouds. Bandwidth bottlenecks may be avoided and optimal data sizes for each cloud can be sent using this method. There are a lot of additional useful inferences that may be made from this research. This reaction evolved as a direct outcome of our research. Another glaring and serious flaw is that bandwidth virtualization is not used in this study. Researchers that deal with massive files and store their data in a variety of clouds have found the results convincing enough to warrant the method's further development. A new framework should be established on the basis of the proposed methodology, with dynamic bandwidth reallocation taking into account the usefulness of the information given.

References

[1] D.G. Jeong and W.S. Jeon, "Time Slot Allocation in CDMA/TDD Systems for Mobile Multimedia Services", *IEEE Comm. Letters*, vol. 4, pp. 59-61, Feb. 2000.

[2] AP JII, "Penetrasi & Profil Perilaku Pengguna Internet Indonesia Tahun 2018", *APJII*, pp. 51, 2019.

[3] R. Maallawi et al., "A Comprehensive Survey on Offload Techniques and Management in Wireless Access and Core Networks", *IEEE Commun. Surveys Tuts.*, vol. 17, no. 3, pp. 1582-1604, 2015.

[4] S. Dimatteo et al., "Cellular Traffic Offloading through WiFi Networks", *IEEE 8th Int. Conf. on Mobile Adhoc and Sensor Systems (MASS)*, pp. 192-201, 2011.

[5] K. Das, M. Gryseels, P. Sudhir et al., "Unlocking Indonesia's digital opportunity", *McKinsey Indonesia Office*, October. 2016.

[6] W.-S. Soh and H.S. Kim, "A Predictive Bandwidth Reservation Scheme Using Mobile Positioning and Road Topology Information", *IEEE/ACM Trans. Networking*, vol. 14, pp. 1078-1091, Oct. 2006

[7] P. Fuxjager et al., "Measurementbased small-cell coverage analysis for urban macro-offload scenarios", *Proc. IEEE VTCXSpring*, pp. 1-5, 2011.

[8] W.S. Jeon and D.G. Jeong, "Comparison of Time Slot Allocation Strategies for CDMA/TDD System", *IEEE J. Selected Areas Comm.*, vol. 18, pp. 1271-1278, July 2000.

[9] S.-I. Sou, "Mobile data offloading with policy and charging control in 3GPP core network", *IEEE Trans. Veh. Technol.*, vol. 62, no. 7, pp. 3481-3486, Sep. 2013.

[10] J. Zhang, J. Huai, R.Y. Xiao and B. Li, "Resource Management in the Next-Generation DS-CDMA Cellular Networks", *IEEE Wireless Comm. Magazine*, vol. 11, pp. 52-58, Aug. 2004.

[11] W. Jeong and M. Kavehrad, "Dynamic-TDD and Optimum Slot-Allocation in Fixed Cellular Systems", *Proc. 54th IEEE Vehicular Technology Conf. (VTC '01)*, vol. 1, pp. 37-41, 2001.

[12] S. A. Ekawibowo, M. P. Pamungkas and R. Hakimi, "Analysis of5G Band Candidates for Initial Deployment in Indonesia", 2018 4th International Conference on Wireless and Telematics (ICWT), pp. 1-6, 2018.