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Research paper

Storage Synchronization of Different Devices for Personal Areal Network

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Abstract

This paper aims to propose a strategy in transferring files or data in multiple computers without relying on online storage, storage media and peripheral devices. Data owned by an individual is expected to increase with time. The amount of data that a single individual owns in a lifetime will be too large that it will need a large storage and a tremendous amount of time in transferring from one location to another in order to preserve this data and counter hardware degradation. We will be using a strategy that will preserve this large data, exploiting the available storage the user owns without spending extra more money in order to preserve a lifetime's worth of personal data. This approach will take advantage of the idle network connection between two or more specific devices; synchronizing a common storage of each devices, thus eliminating the needs for peripheral devices and cloud storage.

Keywords: *data sharing, data storage systems, data transfer, peripheral device, rate, repository*

1. Introduction

It is projected that there will be 20-50 billion interconnected devices by 2020. [1] A single person will have a minimum of 2 devices with an IP address by that time. In a future where data capacity of a specific storage is very high, the data stored will be more valuable and will have a higher value compare to the hardware itself. A good example of this are Information Systems [2,3,4]. As data owned by a single individual increase with time, it is necessary to secure and preserve that data in a device. A lifetime's worth of data of a single individual would be very large and the amount of time and cost of transferring this data from a degraded device to a new device is proportional to the amount of data itself. There are times where there are incomplete data, one way to fix it is by using the Rough Set Theory [5,6,7]. Another method is by using Neural Network or Spatial Techniques [8,9,10].

It is necessary to manage the data of all your devices whether you are holding your mobile phone, office computer or home computer. There are already existing technologies like the cloud storage; cloud storage is very flexible when it comes to scalability, the problem is you need to fetch the data from the cloud every time you need it, and a cost will depend on the amount of storage you are using in that specific cloud storage provider. It is not feasible to store a lifetime's worth of data in cloud storage, as the amount of fee for renting or acquiring this storage technology will be very high and impractical [11]. Another way to manage your data is by an external peripheral device, like external hard disk, and Flash drive. By using these external devices, you can manage your data by copying the data in these external devices and transferring it to your computers. Another existing technology is a central repository. These are Network-Attached storage (NAS) and Storage-Area Networks (SAN) [12,13,14]. these technologies are similar to Cloud storage, were you fetch and push your files or data whenever you need them, causing CPU usage and bandwidth allocation.

The problems with existing technologies in managing your data are speed and security. To address these issues, we will propose a strategy or a way on how to manage storage. We will address the 1st issue "speed", since most people are connected to the internet 24/7, while the computers are on idle or the user is not using the internet, it is a window time for the devices to synchronize their data with the use of internet, not affecting the productivity of the user. Also, you will have the option to synchronize this in real-time unlike the traditional methods which causes CPU usage and bandwidth allocation whenever you fetch or push those data in your specific storage. This also eliminates the needs for external devices like hard disks, and flash drives since your storage virtually synchronizes. To address the 2nd issue "security", since all of your personal devices are trusted device, we could create a personal area network which will only allow these devices to communicate to each other and share a common storage stored locally and not within the cloud. Thus, increasing security and at the same time eliminating the cost of using cloud storage technology [15].

2. Objectives

The objective is to evaluate the following parameters below, to prove that the proposed method of managing or transferring data is much more efficient compare to Peripheral devices.

2.1. Parameters

1. Rate (Mbps) – speed of transferring a specific file or data

2. Time – total time of activity of transferring a file or data

3. CPU usage – amount of CPU used by a specific process or file transfer

4. Memory Usage – amount of RAM used by a specific process or file transfer

3. Methodology

3.1. Data Gathering

Data to be observed such as transfer rate (Mbps), time of file transfer (seconds), CPU usage (%), and Memory usage (%) will be gathered. These data shall be compared to our traditional transferring of files or data using external hard disk and Universal Serial Bus (USB) Flash Drive [16].

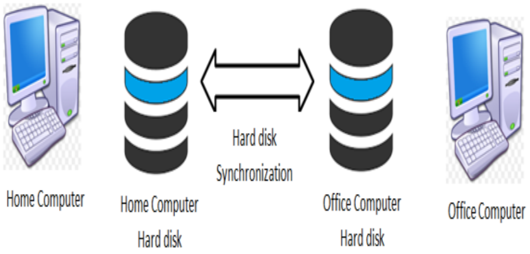


Fig. 1: Illustration of Hard disk synchronization

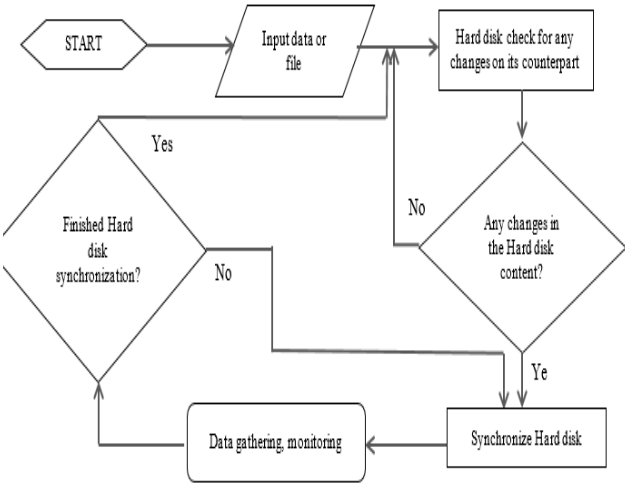

START
Input data or file
Hard disk check for any changes on its counterpart
Yes
Finished Hard disk synchronization?
No
No
Any changes in the Hard disk content?
Ye
Data gathering, monitoring
Synchronize Hard disk

Fig. 2: Flow Chart of the System

3.2. Flow Chart

• User will allocate the same amount of hard disk drive space on each computer for its contents to be synchronized.

• Every file change or added in either one of the computers in the allocated hard disk space will be automatically synchronized on its counterpart hard disk drive/s.

3.3. Commands

• Remote Synchronization (rsync) [17,18] will be used in transferring data.

Commandline for rsync:

```
rsync –avz <source> <destination>
```

• Top command will be used in monitoring the transfer of data.

Commandline for top:

```
while true; do
    echo "$(top -b -n 1 | grep rsync)"  | tee -a <log file>
    sleep <interval in seconds>
done
```

3.4. Statistical Analysis

3.4.1. Removing the outliers to gain optimum results

- Calculate first quartile (Q1) and third quartile (Q3)
- Obtain interquartile range (IQR) by subtracting Q1 from Q3
- Obtain the upper bound by adding 1.5 times IQR to Q3
- Obtain the lower bound by subtracting 1.5 times IQR to Q1
- Any data that is higher than the upper bound and lower than the lower bound will be an outlier
- Remove any outliers

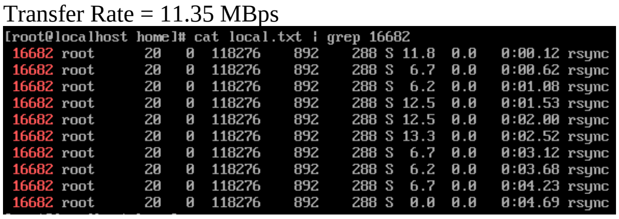
3.4.2. Obtain the average of the remaining data

4. Results and Discussions

4.1. Transferring File using computer

Both computers are Virtual Machines with the same virtual hardware configuration. A Database can be used to optimize it [19].

Transfer Time = 69.5 seconds
Transfer Rate = 11.35 MBps



```
[root@localhost home]# cat local.txt | grep 16682
 16682 root      20   0  118276    892     288 S 11.8  0.0   0:00.12 rsync
 16682 root      20   0  118276    892     288 S  6.7  0.0   0:00.62 rsync
 16682 root      20   0  118276    892     288 S  6.2  0.0   0:01.08 rsync
 16682 root      20   0  118276    892     288 S 12.5  0.0   0:01.53 rsync
 16682 root      20   0  118276    892     288 S 12.5  0.0   0:02.00 rsync
 16682 root      20   0  118276    892     288 S 13.3  0.0   0:02.52 rsync
 16682 root      20   0  118276    892     288 S  6.7  0.0   0:03.12 rsync
 16682 root      20   0  118276    892     288 S  6.2  0.0   0:03.68 rsync
 16682 root      20   0  118276    892     288 S  6.7  0.0   0:04.23 rsync
 16682 root      20   0  118276    892     288 S  0.0  0.0   0:04.69 rsync
```

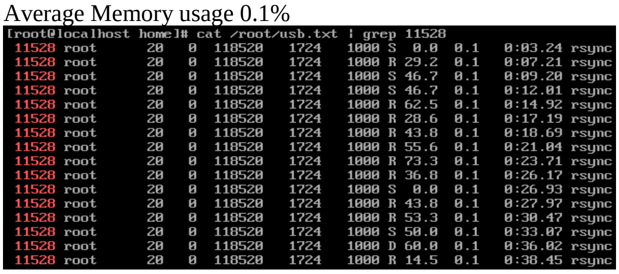
Fig. 3: Sample Speed time

Average CPU usage 8.26%
Average Memory usage 0.1%

4.2. Transferring File using USB Flash Drive

Results in transferring Data using USB Flash Drive
Model: Sony USM16SA3
Specifications: [20]
Capacity: 16 GB
Interface: USB 3.1 Gen 1 (Type-A)
Port Type: USB Type-A x 1
Power Supply: USB bus power (no external power supply)
Transfer Speed: 130 MB/s (max)

Transfer Time = 93.5 seconds
Transfer Rate = 8.43 MBpsAverage CPU usage 46.6%
Average Memory usage 0.1%



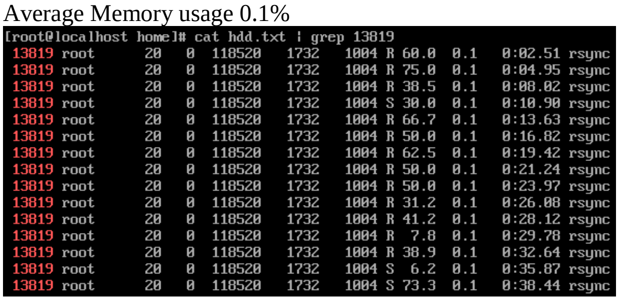
```
[root@localhost home]# cat /root/usb.txt | grep 11528
 11528 root      20   0  118520   1724   1000 S  0.0  0.1   0:03.24 rsync
 11528 root      20   0  118520   1724   1000 R 29.2  0.1   0:07.21 rsync
 11528 root      20   0  118520   1724   1000 S 46.7  0.1   0:09.20 rsync
 11528 root      20   0  118520   1724   1000 S 46.7  0.1   0:12.01 rsync
 11528 root      20   0  118520   1724   1000 R 62.5  0.1   0:14.92 rsync
 11528 root      20   0  118520   1724   1000 R 28.6  0.1   0:17.19 rsync
 11528 root      20   0  118520   1724   1000 R 43.8  0.1   0:18.69 rsync
 11528 root      20   0  118520   1724   1000 R 55.6  0.1   0:21.04 rsync
 11528 root      20   0  118520   1724   1000 R 73.3  0.1   0:23.71 rsync
 11528 root      20   0  118520   1724   1000 R 36.8  0.1   0:26.17 rsync
 11528 root      20   0  118520   1724   1000 S  0.0  0.1   0:26.93 rsync
 11528 root      20   0  118520   1724   1000 R 43.8  0.1   0:27.97 rsync
 11528 root      20   0  118520   1724   1000 R 53.3  0.1   0:30.47 rsync
 11528 root      20   0  118520   1724   1000 S 50.0  0.1   0:33.07 rsync
 11528 root      20   0  118520   1724   1000 D 60.0  0.1   0:36.02 rsync
 11528 root      20   0  118520   1724   1000 R 14.5  0.1   0:38.45 rsync
```

Fig. 4: Sample time at average memory of 0.1%

4.3. Transferring File using External Hard disk Drive

Results in transferring Data using External Hard Disk Drive
Model: Seagate SRD00F1
Specifications: [20]
Driver Type: Bus-powered portable hard drive
Connector Type: USB 3.0
Capacity: 1TB
Internal drive speed: 5,400rpm
Max Data Transfer: 120 MB/s

Transfer Time = 83.5 seconds
Transfer Rate = 9.44 MBps
Average CPU usage 53.83%
Average Memory usage 0.1%

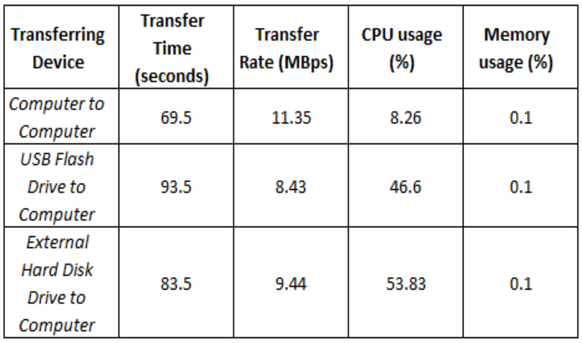


```
[root@localhost home]# cat hdd.txt | grep 13819
 13819 root      20   0  118520   1732   1004 R 60.0  0.1   0:02.51 rsync
 13819 root      20   0  118520   1732   1004 R 75.0  0.1   0:04.95 rsync
 13819 root      20   0  118520   1732   1004 R 38.5  0.1   0:08.02 rsync
 13819 root      20   0  118520   1732   1004 S 30.0  0.1   0:10.90 rsync
 13819 root      20   0  118520   1732   1004 R 66.7  0.1   0:13.63 rsync
 13819 root      20   0  118520   1732   1004 R 50.0  0.1   0:16.82 rsync
 13819 root      20   0  118520   1732   1004 R 62.5  0.1   0:19.42 rsync
 13819 root      20   0  118520   1732   1004 R 50.0  0.1   0:21.24 rsync
 13819 root      20   0  118520   1732   1004 R 50.0  0.1   0:23.97 rsync
 13819 root      20   0  118520   1732   1004 R 31.2  0.1   0:26.08 rsync
 13819 root      20   0  118520   1732   1004 R 41.2  0.1   0:28.12 rsync
 13819 root      20   0  118520   1732   1004 R  7.8  0.1   0:29.78 rsync
 13819 root      20   0  118520   1732   1004 R 38.9  0.1   0:32.64 rsync
 13819 root      20   0  118520   1732   1004 S  6.2  0.1   0:35.87 rsync
 13819 root      20   0  118520   1732   1004 S 73.3  0.1   0:38.44 rsync
```

Fig. 5: Sample Time at 58.83% usage

Results are showing that the computer to computer transferring of files has the advantage in terms of lower Transfer Time(seconds), higher Transfer Rate (MBps), and lower CPU usage(%). In terms of Memory usage (%); Computer, USB Flash Drive, and External Hard Disk Drive have comparable results. [21,22,23,24].

Table 1: Data and Results



Transferring Device	Transfer Time (seconds)	Transfer Rate (MBps)	CPU usage (%)	Memory usage (%)
Computer to Computer	69.5	11.35	8.26	0.1
USB Flash Drive to Computer	93.5	8.43	46.6	0.1
External Hard Disk Drive to Computer	83.5	9.44	53.83	0.1

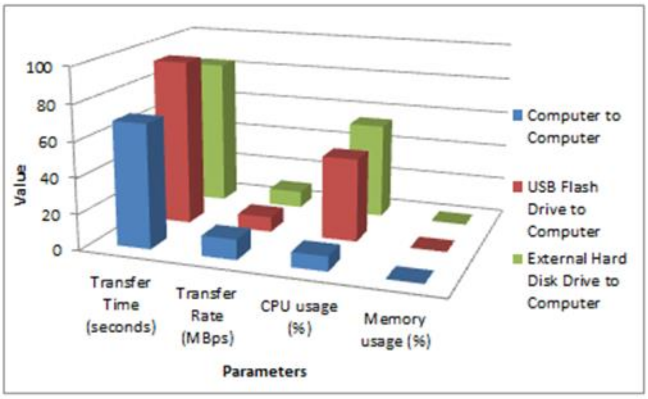


Fig. 6: Graph of the Data

5. Analysis and Conclusions

Based on these results, transferring of data by computer to computer has the advantage both in CPU usage, transferring rate, and transfer time. The data shows that this is feasible way in making a backup and maintaining a lifetime's worth of data, instead of storing it in peripheral devices or in the cloud. We had not included the cloud storage, and Storage area network as the price of acquiring and using these technologies is highly expensive. As a home user wanting to preserve a lifetime's worth of data, it would be impractical to pay lifetime's worth of fee for using cloud storage technology. The same as in Storage Area Network as the price of buying, and maintenance of the hardware to counter degradation during a lifetime is impractical and will be defeating the purpose of maintaining lifetime personal data using available resources without spending extra amount of money.

The advantage of the proposed strategy against the peripheral devices is that the proposed strategy is that the Data is presently accessible whenever you need it, while on the other hand you need to plug and copy the data in a peripheral device. Another advantage against peripheral devices is the unnecessary luggage of carrying these external devices.

The advantage of the proposed strategy against cloud storage is the cost. In the proposed strategy, there is no fee in storing the data unlike the cloud storage. While cloud storage is not affected by hardware degradation unlike the proposed strategy and peripheral devices, it is impractical to store a lifetime's worth of data in it and be paying for the capacity and time that you are using that storage.

The proposed strategy for transferring data will mostly rely on the internet connection same as cloud storage. The proposed strategy shall be configured to transfer only in a way that it will not interfere with the productivity of the user or during the idle time of the machine. The user will also have the option to transfer the file presently as per preference.

Thus, the current limitation of this proposed technology is that it is only available in Local Area Network (LAN) and will require a Public IP or a Proxy Server to implement this strategy in Wide Area Network (WAN).

For future recommendation, it is proposed to use IPv6, so that the devices would be able to communicate in point-to-point basis instead of using IPv4 that needs a Public IP, Network Address Translation or Masquerading, thus eliminating 3rd party intervention and increasing security at the same time.

References

[1] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016–2021 White Paper. (2018). https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html.

[2] Africa, A. A Rough Set-Based Expert System for diagnosing information system communication networks. *International Journal of Information and Communication Technology*, Vol. 11 (4), (2017), pp. 496-512.

[3] Africa, A. A Logic Scoring of Preference Algorithm using ISO/IEC 25010:2011 for Open Source Web Applications Moodle and Wordpress. *ARPN Journal of Engineering and Applied Sciences*, Vol. 13 (15), (2018).

[4] Africa, A., Aguilar, J., Lim Jr., C., Pacheco, P. & Rodrin, S. Automated Aquaculture System that Regulates Ph, Temperature and Ammonia. *9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)*, (2017).

[5] Africa, A. & Cabatuan, M. A Rough Set Based Data Model for Breast Cancer Mammographic Mass Diagnostics. *International Journal of Biomedical Engineering and Technology*, Vol. 18 (4), (2015), pp. 359-369.

[6] Africa, A. A Rough Set Based Solar Powered Flood Water Purification System with a Fuzzy Logic Model. *ARPN Journal of Engineering and Applied Sciences*, Vol. 12 (3), (2017), pp. 638-647.

[7] Africa, A. A Mathematical Fuzzy Logic Control Systems Model Using Rough Set Theory for Robot Applications. *Journal of Telecommunication, Electronic and Computer Engineering,* Vol. 9 (2-8), (2017), pp. 7-11.

[8] Brucal, S., Africa, A. & Dadios, E. Female Voice Recognition using Artificial Neural Networks and MATLAB Voicebox Toolbox. *Journal of Telecommunication, Electronic and Computer Engineering,* Vol. 10 (1-4), (2018), pp. 133-138.

[9] Africa, A. & Velasco, J. Development of a Urine Strip Analyzer using Artificial Neural Network using an Android Phone. *ARPN Journal of Engineering and Applied Sciences,* Vol. 12 (6), (2017), pp. 1706-1712.

[10] Loresco, L. & Africa, A. ECG Print-out Features Extraction Using Spatial-Oriented Image Processing Techniques. *Journal of Telecommunication, Electronic and Computer Engineering,* Vol. 10 (1-5), (2018), pp. 15-20.

[11] Amazon S3 Pricing. (2018). https://aws.amazon.com/s3/pricing/.

[12] TESA: a temporal and spatial information aware writeback policy for home network-attached storage devices. (2018). http://ieeexplore.ieee.org/document/6490250/.

[13] Cider: a Rapid Docker Container Deployment System through Sharing Network Storage View Document. (2018). http://ieeexplore.ieee.org/document/8291947/

[14] An Adaptive IO Prefetching Approach for Virtualized Data Centers. (2018). http://ieeexplore.ieee.org/document/7208857/

[15] Storage media and peripheral devices. (2018). http://ict.arcada.fi/study-materials/prerequisits/computers-in-a-nutshell/storage-media-and-peripheral-devices/

[16] Africa, A., Mesina, A., Izon, J. & Quitevis, B. Development of a Novel Android Controlled USB File Transfer Hub. *Journal of Telecommunication, Electronic and Computer Engineering,* Vol. 9 (2-8), (2017), pp. 1-5.

[17] Rsync (Remote Sync): 10 Practical Examples of Rsync Command in Linux. (2018). https://www.tecmint.com/rsync-local-remote-file-synchronization-commands/

[18] How Rsync Works A Practical Overview. (2018). https://rsync.samba.org/how-rsync-works.html

[18] Africa, A., Bautista, S., Lardizabal, F., Patron, J. & Santos, A. Minimizing Passenger Congestion in Train Stations through Radio Frequency Identification (RFID) coupled with Database Monitoring System. *ARPN Journal of Engineering and Applied Sciences,* Vol. 12 (9), (2017). pp. 2863-2869.

[19] SONY SUPPORT USM16SA3 Specifications. (2018). http://www.sony.com.ph/electronics/support/storage-recording-media-usb-flash-drives/usm16sa3/specifications.

[20] Seagate Backup Plus Portable Drives. (2018). https://www.seagate.com/as/en/consumer/backup/backup-plus/#features.

[21] System Monitoring Tools. (2018). https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/6/html/deployment_guide/ch-system_monitoring_tools.

[22] Understanding Linux Process States. (2018). https://access.redhat.com/sites/default/files/attachments/processstates_20120831.pdf.

[23] How to capture the output of a top command in a file in linux? (2018). https://stackoverflow.com/questions/11729720/haow-to-capture-the-output-of-a-top-command-in-a-file-in-linux.

[24] Alladi, B. & Prasad, S. Big Data Life Cycle: Security Issues, Challenges, Treat and Security Model. *International Journal of Engineering and Technology,* Vol. 7 (1.3), (2018), pp. 100-103.