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Cloud Computing Technology and Its Implementation in Modern Libraries

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Abstract: Each day numerous new data and information are coming up. In today's world we are facing a huge information explosion. Among all the consequences of this explosion, one of the major problem is limitation of storage space to store the data. Storing all the ever increasing data in a organized and easily accessible form, there is always a need of centralized large data centre and to operate them smoothly a remote server with large user access capabilities. Therefore the cloud computing is the only solution in future. Since library is one of the top most institution of importance while considering the information world, so library must be an early adaptor of the cloud computing technology. In this paper we have discussed the technology, definition, Merits-demerits of Cloud Computing and its relevance in a modern library system.
Keywords: Cloud Computing, ILMS, Applications of cloud computing, Server Space, OCLC.

1. Introduction:

We human are very curious in nature and whenever there is a problem human has discovered the solutions inventing new technology, new idea or new philosophy. The world is continuously developing towards a new world with a prime goal to transfer the physical work load to machines and software and very recently to software using AI Technology. With new and developed technology the way of delivering product and service is changing reducing the cost of finance and manpower. If we talk about the Computers and computing, the way it works also have changed already and adapted by almost all the Organizations that need computing force. Such a new a robust technology is The Cloud Computing. All the IT companies and other organizations which use computers for their operations are shifting towards the cloud computing technology.

To cope with the changing environment a modern library must adapt automation and digitization. Most of the modern libraries use some **ILMS** (Integrated Library Management Software) for their day to day operations like **Acquisition, Cataloguing, Circulation, Accounting** etc. Also to provide remote access to the resources of a library all the library must possess a good websites and digital document repository. To fulfil all this requirements a huge amount of computing power is needed, this can be availed acquiring highly sophisticated computers and manpower to develop, run and maintain those hardware and software, which will cost a lot.

This financial cost and need of skilled manpower can be drastically reduced to a very low level using the cloud computing technology. Also the use of this technology offers the benefit of using the same hardware and software by numerous organization at the same time reducing the

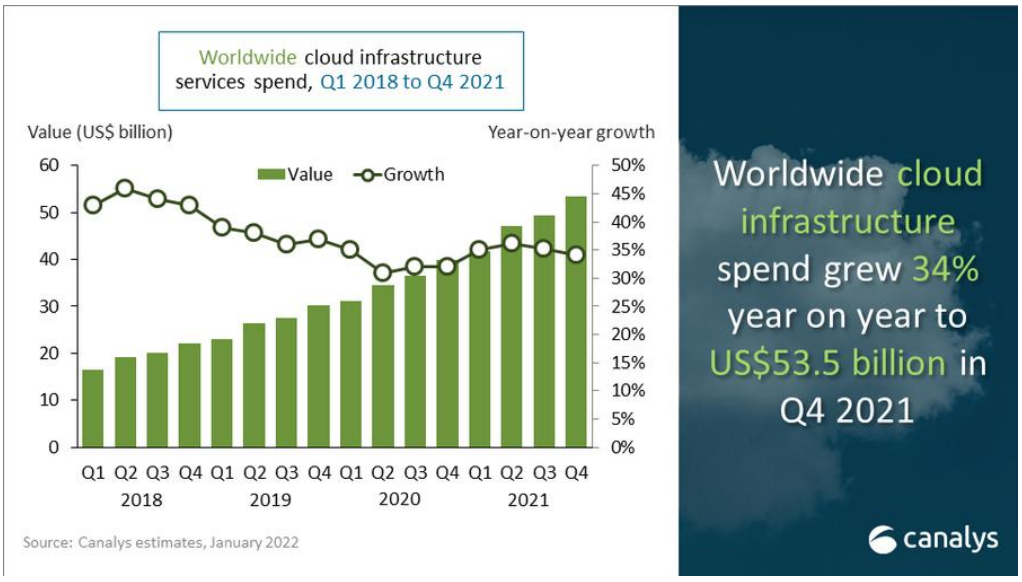
repetition of work and cost. For Example, the cataloguing records can be shared between the libraries to reduce the repetitive workload.

In this paper our focus is to discuss about the basics of cloud computing technology and its uses in the Library Environment.

2. Cloud Computing:

According to Wikipedia, "Cloud Computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user". Most of the Cloud Computing service provider usually distributes their functions over different locations using data centre. Cloud Computing Service provider relies on 'sharing of resources' between those data centers to achieve a cost saving operations and most of them offers "Pay as you Go" model. Using one computer, an operation can be simultaneously carried out by only one person at a time. To allow multi-user facility, traditionally a server-client model is used. But for an operation which requires huge amount of storage and computing power and facility of access the operation by a large no of user at same time, local server based environment costs a lot. Also there is always a high limitation. Here the cloud computing comes. In cloud computing the providers build the data centre with very high computing power and large storage space and using internet connection anybody can subscribe or buy their required storage space, runtime environment, and high computing power from those data centers. With time the popularity of the cloud service over the traditional way of computing is changing rapidly. Here is an analysis prepared by**Canalysis,** where the worldwide Cloud Infrastructure spend growth from 2018 to the last quarter of 2022 is shown.

Fig.1: Worldwide cloud infrastructure spend growth from 2018 to 2021.



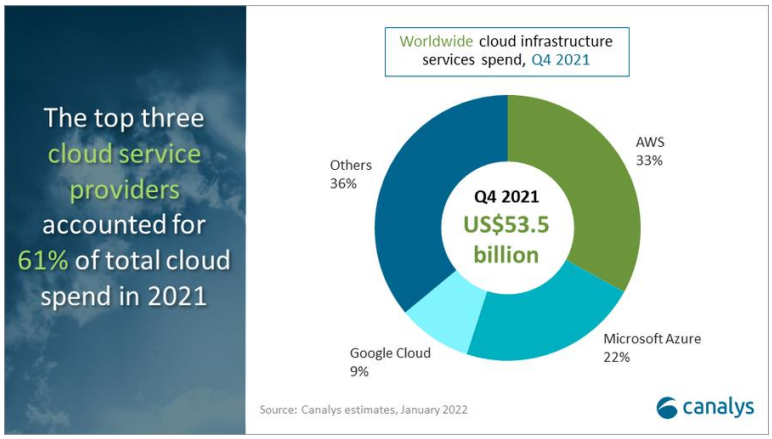
Source: Canalys estimates, January 2022

URL: https://canalys-prod-public.s3.eu-west-1.amazonaws.com/cosi/campaign/2624/0QSE~DXX3dG5x3nw7rzudopE5irEABoY.png

This diagram shows a rapid growth of the cloud environment. From this we can easily predict that the future of computing is no longer the traditional one. Everything is shifting towards the cloud environment.

Below there is another diagram showing the top cloud service providers and their quota of service spend in the last quarter of 2021. From the diagram we see that Amazon Web Service is leading the Cloud Computing campaign.

Fig.2: Worldwide cloud infrastructure service spend by the top Cloud Service Providers.



Source:Canalys estimates, January 2022
URL: https://canalys-prod-public.s3.eu-west-1.amazonaws.com/cosi/campaign/2624/C6fx2wsqKXraMLxEvGpa4NS76mAX3By1.png

3. Type of Cloud Computing Services:

Based on the type of service offered, there are three major models of cloud computing services:

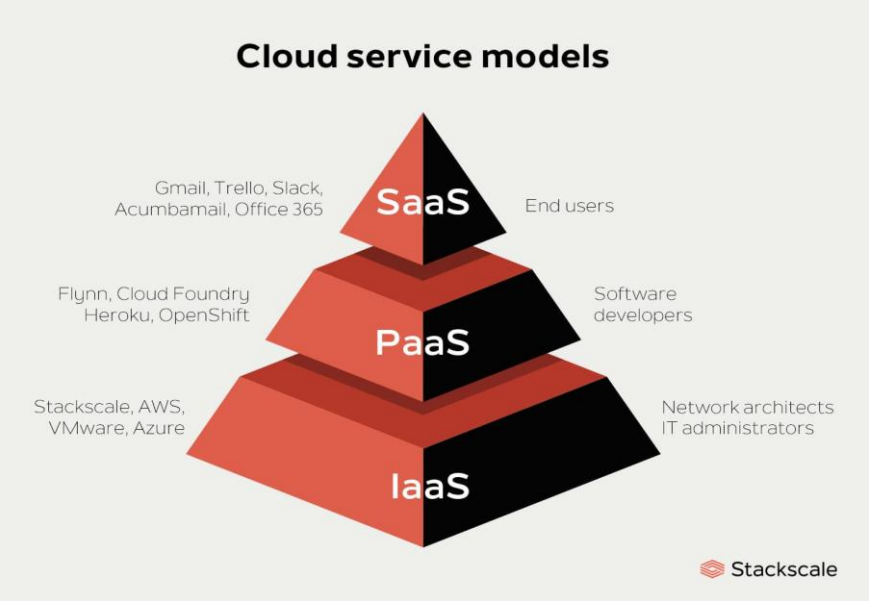
3.1.1 Software as a Service (SaaS): In this model the service provider offers everything from Infrastructure, Network, Storage to thefront end applications with user interface on the cloud. We just need a computer with internet connection to run the app and use the services. No need of coding, runtime environment, server, storage, database or network. For example**Gmail** and other **Google Apps**. They are ready to use Web-Applications with free (almost) storage, network and database. Also they provide auto back up and data management. In this model there is not much scope of customization but it reduces the cost of hardware equipment like server computer, strong power supply, huge storage, hosting, and database management. Also service becomes available 24 into 7 and its almost maintenance free.

3.1.2 Platform as a Services (PaaS): In this model the service provider offers the required infrastructure, hardware, server, storage space and the runtime environment to build, test and install the front-end application and the database. User has to do the necessary coding and uploading of required data. For example**Microsoft Azure, Google App Engine** etc. They offer an organization the platform to build, develop, test and install any application and access from anywhere through the internet.

3.1.3 Infrastructure as a Service (IaaS): In this model the service provider only provides the hardware infrastructure and computing power over the cloud. They also provide the server space for

web hosting and networking. Amazon Web Service is an example of IaaS. AWS offers its services on pay-as-you-go model. One can subscribe to their service as per the requirements. Usually for server installation for a website or installing multi-user web based application, this type of cloud service is used.

Fig.3: Cloud Service Model.



Source: Stackscale
URL: https://www.stackscale.com/wp-content/uploads/2020/04/cloud-service-models-iaas-paas-saas-stackscale.jpg

Again we can divide the Cloud Computing Service in three different categories depending on cloud computing architecture need of the users:

3.2.1 Public Cloud: This type of cloud service is owned by some third party service providers. They provide the server space and storage as per requirements over the internet. For Example: **Microsoft Azure**. Here the entire infrastructure is owned by the service provider. Anyone can access those services through a web browser. Everybody uses the service through the same domain creating account.

3.2.2 Private Cloud: In private cloud service the ownership is transferred to the user organization or the party. This is not accessible to public. Separate network channel is used for each user. A private cloud is usually located on the physical data centres possessed by the service provider. For exampleHP Data Centers, Elastra-private cloud, and Ubuntu etc.

3.2.3 Hybrid Cloud: As the name suggests hybrid cloud is the combination of both public and private clods. They allow the user to migrate data between private and public cloud. For exampleAWS Outposts, Azure Stack, Azure Arc, Google Anthos etc.

4. Cloud Computing in a Library:

As we all know, with time the meaning of a library and how it works is changed completely. It is far away from what it was before. In modern time, a library is much more than a simple book

bank where books were preserved and stored. For a modern library there are several needs where a huge computing power and digital storage is needed. For example, to be a complete modern library there must be a proper library website, a digital resource repository, a good ILMS for day to dayoperations. Also a modern library do not distributes registration form for the users manually. Automated check in- check out, book keeping for daily user statistics, feedback, reference service, user information database are some other 'must have requirements' for a modern library. To fulfil all these need a library must acquire proper server space, decent amount of digital storage space, a digital database and multi-user ILM software. This can be done locally installing infrastructure like server computers for the website, a server computer for the ILMS, a server computer for the digital repository etc. Also there are other requirements like online forms, Mail service etc. But local installation of all these things bears a huge financial and human resource cost, which can be reduced by using cloud computing service to a significant level. Below we have discussed some of them in details.

4.1 Library Website: A library website is like the face of a library. Since everybody stays online over the internet now a day, the information regarding the library or any other information related to the resources and service can be transmitted to the users through a proper website. All these interaction between the users and the library can be carried out through a website. The library website can be built over the cloud using cloud space and hosting. There will be no need of any local server. Also one can buy the server space and hosting as per the numbers of total user. This will be a 24 into 7 service without the need of constant power supply and high end computer hardware. Since the cloud service provider takes care of the data backup and maintenance too, chance of data loss and need of IT labour also gets reduced. There is also Provider like Wix.com, where there is no need of even coding for the website. Simply using their website builder application anybody can have a very good website almost free or at a very low cost.

4.2 Library forms and user survey: The library registration form can be build online using cloud services like JotForm, Zohoform, and Google Form etc. This eliminates the need of a separate database and server space. Advantage of using these Cloud Services is that there will be no need of coding and building a server computer and storage to get and manage the responses. They also offer features to analysis the collected data.

4.3 ILMS Installation: The library management softwares (ILMS) are multi-user in nature. So, to install them locally there will be again the need of a strong Server Computer, Storage Space and network. Instead, one may opt for Cloud service like E-Libris or install the desired software like Koha, Libsys over the cloud. This will ensure 24 into 7 operations without the stress of power supply or local server.

4.4 Catalogouing: Using cloud service for the cataloguing purpose serves the advantage of avoiding repetitive work load. For example**OCLC** is offering a kind of online union catalogue using cloud computing which saves a lot of time, effort and repetitive work of all the libraries around the globe.

4.5 Institutional Repository (IR): Another must needed module of a modern library system is a digital repository for E-books and other electronic media. To avail this service to the user 24 into 7,

again there is a need of server space, digital storage and digital repository software with multi user accessibility. This can be attained at a low cost using the cloud service like **Amazon Web Service**. For example, one can install the **DSpace** (Digital Resource Repository Software) over the cloud space provided by the Amazon Cloud Service. This will eliminate the requirements of entire infrastructure that is needed to install locally. Also one gets the advantage of data back up and remote access.

Some other cloud services are already being used by each and every modern library without even being realized. For any organization, services like **Gmail, Google Drive, Google Doc or Microsoft Office 365** suit are some of the basic needs now a day.

Above we have discussed only a few major use of cloud Computing Services that are being used by the modern libraries. There are a numerous other opportunities that can be availed and provide to the user using the Cloud Computing Technology.

5. Advantages of Cloud Computing Services:

5.1 Cost Saving: Cloud computing totally replaces the major hardware requirements likes Server, Storage Space etc., which saves a huge financial cost. Also use of cloud minimizes the IT labour Cost.

5.2 Accessibility: Cloud computing service can be availed from anywhere, any time and anybody. Since to use the cloud one just need a basic computing device (A PC or Smartphone) with internet, it becomes affordable in most cases.

5.3 Maintenance Free: Clouds services are operated at a remote location (Data Centers) by the service providers. Therefore the common user need not to spend time or energy for maintenance or upgradation.

5.4 Data Security: The Cloud service offers auto back up and upgradation facility. Therefore chances of data loss reduces to a significant level.

5.5 Reliability: Since the Cloud service providers take care of all the technical back end work so possibility of error and server failure is less. Somehow even if a server fails they can redirect the data to an another server. Which is impossible in the traditional scenario.

5.6 Unlimited Storage Capacity: In traditional system there is always a limitation of storage. After a certain level, to increase the storage capacity new hardware must be installed every-time. But in cloud based computing, since the providers use huge centralized data centre to store the data, so storage capacity is comparatively very high.

6. Disadvantages of Cloud Computing Services:

6.1 Downtime: In cloud computing, if at the data centre there is a power or network failure, all of the user face a downtime. At this stage nothing can be done locally.

6.2 Vulnerability of attack: The Cloud service providers offer their services to small to large organizations. So there is always a chance of hacking attack. If somehow this happens, data privacy of all the users comes at risk.

6.3 Internet/ Network Connectivity: Without a strong internet connection the cloud computing is useless. In a country like INDIA, data speed over different network is not up-to a satisfactory level all over the country.

7. Major Library Initiative around the Globe Using Cloud Computing:

7.1 OCLC: OCLC was first started as "**Ohio Library Network**" in 1967. It was established from Ohio University of USA. Later the name was changed to OCLC. It's a global non-profit organization with an aim to build a digital library community transferring and sharing technology, data and resources around the globe. One of the major uses of cloud computing service by OCLC is its OCLC Classify service. On OCLC's website there is a page with a simple searching interface with advanced search options, where simply typing the Title or Author name of a book we can get the classification no (DDC/ LC or Other Schemes) and Subject Headings of that title as used by its different member libraries.

7.2 DuraSpace: DuraSpace is a non-profit organization which aims at building open source innovations to help the Library and resourcecenters. One of the most popular open source software build by DuraSpace Community is the **DSpace**. It is an 'Open Source Resource Repository Software'. Almost all the colleges and universities under UGC have DSpace as a part of their digital document repository. Some other cloud services provided by DuraSpace community are Fedora, VIVO, Dura Cloud, DSpace Direct etc.

7.3 WorldCat: WorldCat is a Cloud Based online library catalogue tool. The union Catalogue of WorldCat itemizes the collections from more than fifteen thousand libraries across the globe.

7.4 Ex-Libris: It's a vendor organization which provides cloud solutions to automate a library. Among all the different cloud services offered by Ex-libris, **Alma** is one of them which offer a new way of managing library resources.

8. Suggestion to a Library regarding the cloud services:

8.1 A library may build its website over the cloud, which will reduce the maintenance and IT Labour Cost and time. One may opt for cloud storage, where only space will be provided, coding is still necessary here. But there are Cloud Options where without a single line of coding we can build a website. For Example WIX.com.

8.2 For User registration there are cloud form services like Jot Forms, Zoho Forms, Google Forms etc., which doesn't require any coding knowledge. Also the need of setting up a database and server is also get eliminated.

8.3 In stead of installing server locally for ILM software, a library may opt for cloud storage and server. This will reduce the cost to a significant level plus will ensure 24 into 7 availability.

8.4 For Institutional repository DuraSpace'sDSpace is one of the best cloud based option.

8.5 To speed up the cataloging process there are cloud services like OCLC Classify which is a cloud based union catalogue.

9. Conclusion: Each day numerous new data and information are coming up. In today's world we are facing a huge information explosion. Among all the consequences of this explosion, one of the major problem is limitation of storage space to store the data. Storing all the ever increasing data in a organized and easily accessible form there is always a need of centralized large data centre and to operate them smoothly a remote server with large user access capabilities. Therefore the cloud computing is the only solution in future. Since library is one of the top most institution of importance while considering the information world, so library must be a early adaptor of the cloud computing technology. Already it is becoming a essential part of our day to day living. From Social media to shopping site, cloud computing is every where. So any library must upgrade to this environment to compete the new lifestyle already tasted by the people. Otherwise library will be a outdated and neglected reservoir of books. Again a big lesson, in the last two year COVID 19 taught us that internet and cloud based service are only option in future. From working from home to studying from internet, cloud is the only option which will not be affected by this kind of hazard.

Reference:

1. Gosavi, Nandkishore. (2012). "Application of Cloud computing in Library and Information science field."*International journal of Digital library services 2*(3), 51- 60.
2. Wikipedia .Cloud Computing. Available at http: //en.wikipedia.org/wiki/ Cloud computing
3. Mark Shane E. Scale,(2011) "Cloud computing and collaboration", Library Hi TechNews
4. Christy, Pettey& Forsling, Carina, (2009): "Gartner highlights five attributes of cloud computing." http://www.gartner.com
5. S.Y.Bansode, and S.M. Pujar, (2012): "Cloud Computing and Libraries." DESIDOCJournal of Library & Information Technology.
6. Mitchell, Erik.(2019) "Using cloud services for library IT infrastructure "
7. S. Dhamdhere, and R. Lihikar, (2013) "Information common and emerging cloud library technologies." *International Journal of Library and Information Science.*
8. Robert Fox(2009) . "Library in the Clouds". OCLC Systems & Services.
9. Buyya, R., Yeo, C.S.,Venugopal, S., Broberg, J., and Brandic, I. (2009) "Cloud computingand emerging IT platforms: Vision, Hype, and Reality for delivering computing as the5th utility."*Future Generation Computer Systems, 25, 599-616.*
10. Lewis G. (2009). "Cloud Computing: Finding the Silver Lining, Not the Silver Bullet."*Available at http://www.sei.cmu.edu/newsitems/ cloudcomputing.cfm.*
11. Bala, Rajni(2012). "How cloud computing will affect college libraries. Internationaljournal of information technology and knowledge management."

12. NIST (2012). "The NIST Definition of Cloud Computing."*Available athttp://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.*
13. Goldner, Matthew and Pace, Andrew. (2011). "Libraries and cloud computing."
14. Breeding. (2009). "The advance of computing from the ground to the cloud. Computers in libraries", 29(10),22-25.
15. David,S.(2011) , "Open source in cloud computing."*International journal of computertechnology & application.*
16. Gens,F.(2008,September 23). "Defining cloud services and cloud computing"
17. Kaushik, A. and Kumar, A. (2013). "Applications of Cloud computing in Libraries." *International Journal of Information Dissemination and Technology, 3*(4), 270-273.
18. Liu, C., Zhao, X.M. & Liu, Y. (2013). "Building of cloud computing in universityemployment information library."Journal of Convergence Information Technology, 8(6), 434-441.
19. Naik, S.D. and Dahibhate, N.B. (2012). "Applications of Cloud Computing in libraries and Information Centres."Journal of Library Management 1(1), 35-47.
20. Sehgal.P, Kumar.B, Sharma.M, Salameh A.A, Kumar.S, Asha.P (2022), Role of IoT In Transformation Of Marketing: A Quantitative Study Of Opportunities and Challenges, Webology, Vol. 18, no.3, pp 1-11
21. Kumar, S. (2020). Relevance of Buddhist Philosophy in Modern Management Theory. Psychology and Education, Vol. 58, no.2, pp. 2104–2111.
22. Roy, V., Shukla, P. K., Gupta, A. K., Goel, V., Shukla, P. K., & Shukla, S. (2021). Taxonomy on EEG Artifacts Removal Methods, Issues, and Healthcare Applications. Journal of Organizational and End User Computing (JOEUC), 33(1), 19-46. http://doi.org/10.4018/JOEUC.2021010102
23. Shukla Prashant Kumar, Sandhu Jasminder Kaur, Ahirwar Anamika, Ghai Deepika, MaheshwaryPriti, Shukla Piyush Kumar (2021). Multiobjective Genetic Algorithm and Convolutional Neural Network Based COVID-19 Identification in Chest X-Ray Images, Mathematical Problems in Engineering, vol. 2021, Article ID 7804540, 9 pages. https://doi.org/10.1155/2021/7804540