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Cloud Computing:Ultimate Home of All Computing Resources

Manaswini Pradhan

Lecturer, Dept of Information and Communication Technology, Fakir Mohan University, Balasore, Odisha, India

ABSTRACT: Cloud computing is the latest computing paradigm, has opened up numerous avenues, which were not explored or harnessed in the best possible manner. The two key promises of this model are ease of use and cost effectiveness. It promises to change the way people use computing resources. Using Internet as the backbone, cloud computing asserts that it is possible to provide computing as a "utility" to end users "as and when needed" basis. Cloud computing has a potential to serve users of all kinds: individual users, institutions, industry at large. This paper covers issues such nature and scope of cloud computing, its applications, business rationale etc.

Cloud computing is a business model that harnesses the web as the ultimate business platform. Cloud computing is impregnated with immense potential for array of practical applications. The model is expected to make computing needs available via web on retail basis and is called cloud computing. Cloud computing intends to make the Internet the ultimate home of all computing resources – for storage , computations, applications and allow end user to available them in quantities of choice, location of their preferences, for duration of their liking.
Web becomes the store for all computing needs.

KEY WORDS: Cloud Computing, Knowledge Management, Knowledge Management as a Service.

I. INTRODUCTION

Cloud Computing provides us a means by which we can access the applications as utilities, over the Internet. It allows us to create, configure, and customize applications online. The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN. Applications such as e-mail, web conferencing, customer relationship management (CRM), all run in cloud

Cloud Computing refers to manipulating, configuring, and accessing the applications online. It offers online data storage, infrastructure and application. Cloud Computing is the model which makes computing resources such as storage, application, and infrastructure as a "utility" available on retail basis or on "need basis". Cloud computing intends to make the Internet the ultimate home of all computing resources and allow end users, both individuals and businesses, to avail these resources in quantities of choice, location of preferences during linking processes. A business model built on this paradigm offers these resources as services either on pay per use basis or on rental basis. For cloud computing to become feasible and accessible to end users following are the working models for cloud computing: a) Deployment Models b) Service Model. *Deployment models* define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: Public, Private, Hybrid and Community. The *Public Cloud* allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail. The *Private Cloud* allows systems and services to be accessible within an organization. It offers increased security because of its private nature. The *Community Cloud* allows systems and services to be accessible by group of organizations. The *Hybrid Cloud* is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud. *Service Models* are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below: 1. Infrastructure as a Service (IaaS): provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc. 2. Platform as a Service (PaaS): provides the runtime environment for applications, development & deployment tools, etc 3. Software as a Service (SaaS): model allows using software

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applications as a service to end users. There are many other service models all of which can take the form like XaaS, i.e., anything as a Service. This can be Network as a Service, Business as a Service, Identity as a Service, Database as a Service or Strategy as a Service. The Infrastructure as a Service (IaaS) is the most basic level of service. Each of the service models makes use of the underlying service model, i.e., each inherits the security and management mechanism from the underlying model.

Cloud computing has been in the market for quite some time. With the concept slowing settling in the world, the emergence or recognition of new cloud resources is making it much more viable as compared to that in the past. With the evolving needs of the market, it is impending to properly identify the available resources, and categorize the components of cloud computing accordingly to newly discovered patterns. Cloud computing when used, does not only have a higher impact on the technology, but also greatly affects the people. This technology describes the development of many existing technologies and approaches to computing into something different. Cloud separates application and information resources from the underlying infrastructure, and the mechanisms used to deliver them. Cloud enhances collaboration, agility, scaling, and availability, and provides the mechanism for cost reduction through optimized and efficient computing. It describes the use of a collection of services, applications, information, and infrastructure comprised of pools of computation, network, information, and storage resources. These components can be rapidly orchestrated, provisioned, implemented and decommissioned, and scaled up or down, providing for an on-demand utility – like model of allocation and consumption [1].

Cloud computing is a term used to describe both a platform and type of application. A cloud computing platform dynamically provisions, configures, reconfigures, and deprivations servers as needed. Servers in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks (SANs), network equipment, firewall and other security devices. Need of Cloud computing infrastructure is to accelerate and foster the adoption of innovations. Cloud computing can enable innovations. It alleviates the need of innovators to find resources to develop, test, and make their innovations available to the user community. Innovators are free to focus on the innovation rather than the logistics of finding and managing resources that enable the innovation. Cloud computing helps leverage innovation as early as possible to deliver business value to a company and its customers. Cloud computing infrastructure allows enterprises to achieve more efficient use of their IT hardware and software investments. Cloud computing can increase profitability by improving resource utilization. Pooling resources into large clouds drives down costs and increases utilization by delivering resources only for as long as those resources are needed. Cloud computing allows individuals, teams, and organizations to streamline procurement processes and eliminate the need to duplicate certain computer administrative skills related to setup, configuration, and support.

Service delivery models of cloud computing are increasing day by day. With the popularization of a few categories like – Storage as a service, Software as a service, Platform as a service, Infrastructure as a service, Database as a service, Information as a service and Management as a service.

The attention has been shifted to one of the most important aspect of any organization, i.e. Knowledge Management. Knowledge Management is a scientific process that initiates its working by massing both tacit and explicit knowledge, filtering it structuring or restructuring it, storing and finally disseminating it. The disseminating process of the stored knowledge is very crucial and the access to the knowledge must be timely, accurate and easy. The accessed knowledge aids in decision making and the available knowledge facilitates in creation and generation of new knowledge. [2].Knowledge management strategy must address four key areas. [3]

- Knowledge management strategy as a core focus and competency
- Flexible structure for knowledge creation and dissemination.
- Technology and processes, and
- Skilled knowledgeable workers

Knowledge management adds transparency to an otherwise opaque backdrop of the issues encompassing cloud computing because it provides the solution to the problems of the oversimplification, incompletion and inadequacy of information. The need for knowledge management arises because the processes, tools and technologies involved and

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adopted should be evolved and refined keeping in view the opportunities that cloud computing is offering. In Figure 1, Cloud computing involves deploying groups of remote servers and software networks that allow centralized data storage and online access to computer services or resources. The cloud refers to software solutions provided over the Internet, or Software-as-a-Service (SaaS), Virtual server storage(Infrastructure-as-a-Service or IaaS), such as Amazon Web Services, and software and product development tools (Platform-as-a-Service or PaaS), such as Google Apps are described well.

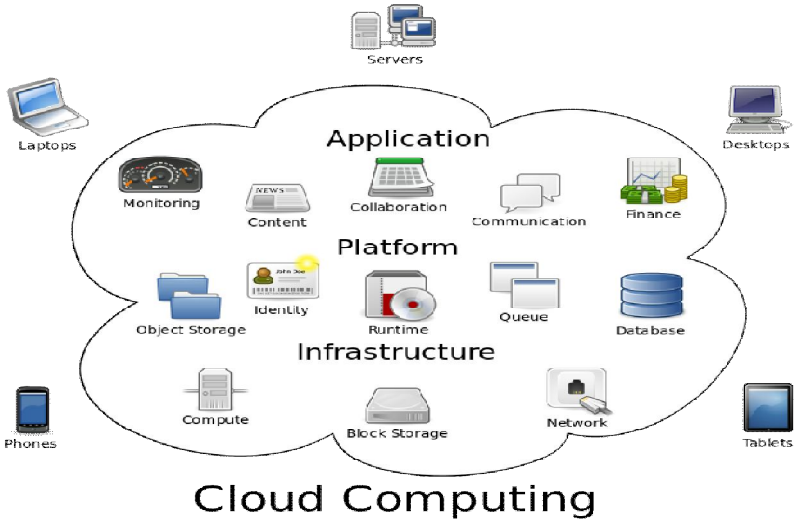

Figure 1: Cloud Computing [4]

II. LITERATURE REVIEW

The literature identifies three different broad service models for cloud computing: a) Software as a Service (SaaS), where applications are hosted and delivered online via a web browser offering traditional desktop functionality for example Google Docs, Gmail and MySAP. b)Platform as a Service (PaaS), where the cloud provides the software platform for systems (as opposed to just software), the best current example being the Google App Engine. c) Infrastructure as a Service (IaaS), where a set of virtualized computing resources, such as storage and computing capacity, are hosted in the cloud; _ customers deploy and run their own software stacks to obtain services. Current examples are Amazon Elastic Compute Cloud (EC2), Simple Storage Service (S3) and Simple Database (DB)

The literature also differentiates cloud computing offerings by scope. In private clouds; services are provided exclusively to trusted users via a single-tenant operating environment. Essentially, an organization's data centre delivers cloud computing services to clients who may or may not be in the premises [23]. Public clouds are the opposite: services are offered to individuals and organizations who want to retain elasticity and accountability without absorbing the full costs of in-house infrastructures [23]. Public cloud users are by default treated as untrustworthy. There are also hybrid clouds combining both private and public cloud service offerings [24]

III. TYPES OF CLOUDS

Clouds can be classified as public, private or hybrid. [5] [6]. Figure 2 depicts the three types of clouds.

A. Private Cloud

Private clouds are built solely for a single enterprise. It focuses to address concerns on data security. It is managed internally or by a third-party, and hosted either internally or externally [5]. There are two variations to a private cloud: a) On-premise and b) Externally hosted. *On-premise private clouds* which are the internal clouds are hosted within one's own data center. This model provides a more standardized process and protection. It is limited in aspects of size and scalability. Undertaking a private cloud project requires a significant level and degree of

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engagement to incur the capital and operational costs for the physical resources, and requires the organization to reevaluate decisions about existing resources. This is best suited for applications which require complete control and configurability of the infrastructure and security.[7]. Self-run data centers [8] are generally capital intensive. They have a significant physical footprint, requiring allocations of space, hardware, and environmental controls. These assets have to be refreshed periodically, resulting in additional capital expenditures. They have attracted criticism because users "still have to buy, build, and manage them" and thus do not benefit from less hands-on management [9] essentially "[lacking] the economic model that makes cloud computing such an intriguing concept". [10] [11].*Externally hosted private cloud* is hosted externally with a cloud provider, where the provider facilitates an exclusive cloud environment with full guarantee of privacy. There are many benefits of deploying cloud as private cloud model. *Higher Security And Privacy* Private Cloud operations are not available to general public and resources are shared from distinct pool of resources, therefore, ensures high security and privacy. *More Control* Private Clouds have more control on its resources and hardware than public cloud because it is accessed only within an organization. *Cost And Energy Efficiency* Private cloud resources are not as cost effective as public clouds but they offer more efficiency than public cloud. Here are the disadvantages of using private cloud model: *Restricted Area* Private cloud is only accessible locally and is very difficult to deploy globally. *Inflexible Pricing* In order to fulfill demand, purchasing new hardware is very costly. *Limited Scalability* Private Cloud can be scaled only within capacity of internal hosted resources. *Additional Skills* In order to maintain cloud deployment, organization requires more skilled and expertise.

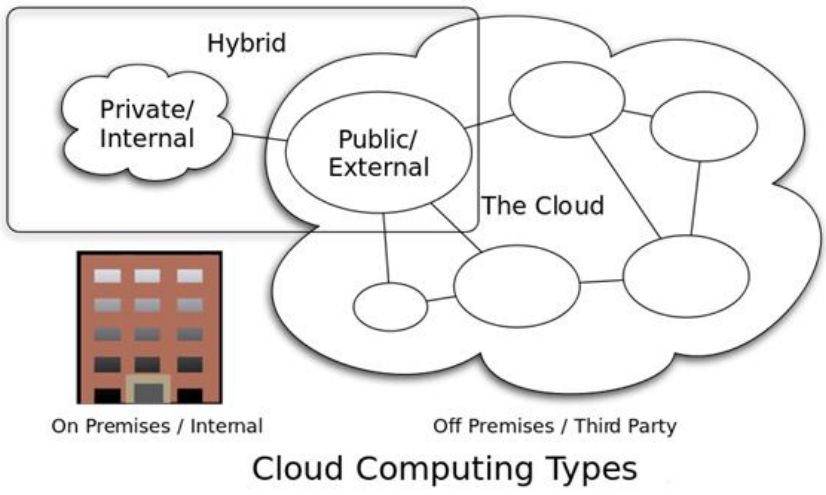

Figure 2: Cloud Computing Types [19]

B. Public Cloud

The Public Cloud allows systems and services to be easily accessible to general public, e.g., Google, Amazon; Microsoft offers cloud services via Internet. Public clouds are owned and operated by third parties. They deliver superior economic scale to customers. The infrastructure costs are spread among a mix of users. This gives each individual client an attractive low cost service and is free or offered on a pay-per-usage model [12] .All customers share the same infrastructure pool with limited configuration, security protections, and availability variances. Technically there may be little or no difference between public and private cloud architecture, however, security consideration may be substantially different for services (applications, storage, and other resources) that are made available by a service provider for a public audience and when communication is effected over a non-trusted network. These are managed and supported by the cloud provider. Generally, public cloud service providers like Amazon AWS, Microsoft and Google own and operate the infrastructure at their data centre and access is generally via the Internet. AWS and Microsoft also offer direct connect services called "AWS Direct Connect" and "Azure Express Route" respectively, such connections require customers to purchase or lease a private connection to a peering point offered by the cloud provider. [13].. One of the advantages of a Public cloud is that, they may be larger than an enterprises cloud, providing the ability to scale seamlessly on demand. There are many benefits of deploying cloud as public cloud model. *Cost Effective* Since public cloud share same resources with large number of consumer, it has low cost. *Reliability* Since public cloud employs

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large number of resources from different locations, if any of the resource fail, public cloud can employ another one. *Flexibility* It is also very easy to integrate public cloud with private cloud, hence gives consumers a flexible approach. *Location Independence* Since, public cloud services are delivered through Internet therefore ensures location independence. *Utility Style Costing* Public cloud is also based on pay-per-use model and resources are accessible whenever consumer needs it. *High Scalability* Cloud resources are made available on demand from a pool of resources, i.e., they can be scaled up or down according the requirement. Disadvantages: *Low Security* In public cloud model, data is hosted off-site and resources are shared publicly, therefore does not ensure higher level of security. *Less Customizable* It is comparatively less customizable than private cloud.

C. Hybrid Cloud

Hybrid Clouds combine both public and private cloud models. It is a composition of two or more clouds (private, community or public) that remain distinct entities but are bound together, offering the benefits of multiple deployment models. Hybrid cloud can also mean the ability to connect collocation, managed and/or dedicated services with cloud resources [5]. Non-critical activities are performed using public cloud while the critical activities are performed using private cloud. With a Hybrid Cloud, service providers can utilize third party cloud providers in a full or partial manner. This helps to increase the flexibility of computing.

Gartner, Inc. defines a hybrid cloud service as a cloud computing service that is composed of some combination of private, public and community cloud services, from different service providers [14]. A hybrid cloud service crosses isolation and provider boundaries so that it can't be simply put in one category of private, public, or community cloud service. It allows one to extend either the capacity or the capability of a cloud service, by aggregation, integration or customization with another cloud service. The Hybrid cloud environment is capable of providing on-demand, externally provisioned scale. The ability to augment a private cloud with the resources of a public cloud can be used to manage any unexpected surges in workload.

Varied use cases for hybrid cloud composition exist. For example, an organization may store sensitive client data in house on a private cloud application, but interconnect that application to a business intelligence application provided on a public cloud as a software service [15]. This example of hybrid cloud extends the capabilities of the enterprise to deliver a specific business service through the addition of externally available public cloud services. There are many benefits of deploying cloud as hybrid cloud model. *Scalability* It offers both features of public cloud scalability and private cloud scalability. *Flexibility* It offers both secure resources and scalable public resources. *Cost Efficiencies* Public cloud are more cost effective than private, therefore hybrid cloud can have this saving. *Security* Private Cloud in hybrid cloud ensures higher degree of security. Disadvantages includes *Networking Issues* Networking becomes complex due to presence of private and public cloud. *Security Compliance* It is necessary to ensure that cloud services are compliant with organization's security policies. *Infrastructural Dependency* The hybrid cloud model is dependent on internal IT infrastructure, therefore it is necessary to ensure redundancy across data centers.

Another example of hybrid cloud is one where IT organizations use public cloud computing resources to meet temporary capacity needs that cannot be met by the private cloud [16].This capability enables hybrid clouds to employ cloud bursting for scaling across clouds [5]. Cloud bursting is an application deployment model in which an application runs in a private cloud or data centre and "bursts" to a public cloud when the demand for computing capacity increases. A primary advantage of cloud bursting and a hybrid cloud model is that an organization only pays for extra compute resources when they are needed [17]. Cloud bursting enables data centres to create an in-house IT infrastructure that supports average workloads, and use cloud resources from public or private clouds, during spikes in processing demands [18].

IV. CLOUD ARCHITECTURE

Cloud architecture,[20] the systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple *cloud components* communicating with each other over a loose coupling mechanism such as a messaging queue. Elastic provision implies intelligence in the use of tight or loose coupling as applied to mechanisms such as these and others. *In Figure 3*, the Cloud Computing architecture comprises of many

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cloud components, each of them is loosely coupled. It can broadly divide the cloud architecture into two parts: a) Front End b) Back End. Each of the ends is connected through a network, usually via Internet. The following diagram shows the graphical view of cloud computing architecture:

- *Front End* refers to the client part of cloud computing system. It consists of interfaces and applications that are required to access the *cloud computing platforms*, e.g., Web Browser.
- *Back End* refers to the cloud itself. It consists of all the resources required to provide *cloud computing services*. It comprises of huge data storage, virtual machines, security mechanism, services, deployment models, servers, etc. It is the responsibility of the back end to provide built-in security mechanism, traffic control and protocols. The server employs certain protocols, known as middleware, helps the connected devices to communicate with each other.

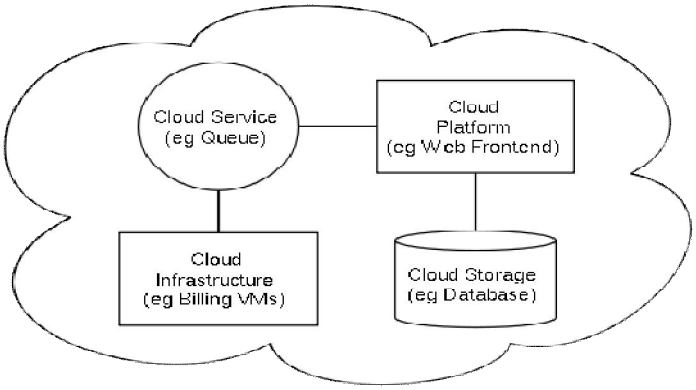

Figure 3: Cloud Computing Architecture [21]

V. CLOUD COMPUTING AND KNOWLEDGE MANAGEMENT

Due to technological innovations, there is an increasing demand for a clear and definitive knowledge management. The increase in adoption of mobile devices, cloud computing and virtual workplace makes knowledge management more important.[22] The two reasons have been identified as the core reason for underutilization of the organizational knowledge. First reason is the reluctance of the employees to divulge the tacit knowledge. An employee accepts it either as a threat because he fears losing the job on the ground of competition, or finds the sharing of information as a time consuming and mundane work for which he does not gain any incentive. Secondly, most of the organizations do not have proper *modus operandi*, framework tools and technologies to mass the freely flowing intellectual capital, which goes unused and hence, are wasted. This amounts to wasted capital and accurate investment to collect this asset and subsequent proper utilization for decision making that is pending to be achieved on a large scale.

The deployment and consumption modalities of cloud should be thought of not only within the context of *internal* vs. *external* as it relates to the physical location of assets, resources, and information, but also by whom it is being consumed by and who is responsible for its governance, security, and compliance with policies and standards. The threats for knowledge management as a service, depends upon the type of assets, resources and information being managed, who manages them and how, which controls are selected and how it is integrated and lastly, compliance issues. [23]. Key issues involved for cloud data lifecycle security in respect of knowledge management as a service are as follows:

- Data Security
- Data recovery and availability
- Management capabilities
- Regulatory and compliance restrictions
- Location of the data
- Data reminisce or persistence
- Data backup and recovery schemes for recovery and restoration

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- Data discovery
- Data aggregation and inference

VI. IMPACT AND BENEFIT PERSPECTIVE

For the purpose of knowledge management, Cloud services are increasingly used due to the following reasons, a) technological advancement related to high speed internet technology b) shrinking cost of data-storage, and c) propagation of smart mobile devices at electric speed around the world. These reasons have helped in fulfilling the pre-requisite of simple, cost-effective and flexible information. The increase use of smart phones and tablets demonstrates the potential of cloud computing to empower the users with sophisticated and high-powered, yet uncomplicated and easy to use, computer applications and information, which was otherwise not so easy to access. Today, it's common that all users are aware of Google and its information that is only a few clicks away. The cloud magnification effect maintains freedom of information, broaden frontiers of transformation, enable social networking and accelerate technology transitions.

Knowledge management process catered efficiently with cloud computing provides benefits like:

- Reducing the technology costs
- Provides access to variety of services to the users
- Opens gates to several options for knowledge users, earlier not known or explored
- An Effective way to streamline the knowledge and make it readily available
- Accelerates the development of competencies and capabilities of knowledge works in an organization
- Increases the use of open source services and shared development across the globe
- Reduces the activities and cost related to management of infrastructure
- Due to change in work structure cloud resources helps to access to information anywhere and at any time
- Faster access to technology and the process of knowledge management becomes more connected and collaborative with high scalability and reliability web oriented architecture
- Improves access to data that helps the decision making process and consolidates the studies and research processes viz. latest project status, innovative ideas, new experiences and finest practices that can be shared within the enterprise. It motivates the employees for bringing forth creative strategies while carrying out the regular work and enjoy as well
- Enhances awareness about the processes as the experiences gained in different regions, sectors and fields of the world.
- Finds the patterns in knowledge management systems and experiences sudden fluctuations and shocks which can be better managed with an elastic/scalable computing model
- Almost all knowledge management activities are generic in nature for which software as a service applications are being provided
- Knowledge access is allowed on the basis of user's permission level with the aid of cloud computing.
- Knowledge can be converted into assets by the aid of cloud computing which acts as a stimulant for innovations and research

Some of the major service providers for Cloud based knowledge management services are:

- *Salesforce Knowledge Management as a service*: Knowledge management software as a service from salesforce,com makes it easy to capture, review, catalog and access information, so that agents can find what they need when. This include the features like solution encyclopedia, private and public knowledge, facility for browsing and searching, solution administration, workflow, rating etc.
- *BMC Knowledge Management as a service*: BMC is a powerful knowledge content search engine which helps service desk analysts find solution to incidents, provides users with access to resources for resolving issues, self-services, inventory
- *Office 365 and SharePoint Online*: This allows to anywhere access to email, web conferencing, documents and calendars. Microsoft SharePoint Online is a part of Office 365 providing out of the box facilities for implementing Knowledge Management as a service for the enterprise

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- *Igloo Software*: It is a web based platform for collaborating at the work place that enables to share files, find answers, solve problems, locate information and expertise, communicate and collaborate the collective knowledge of customers, partners and peers.
- *Spring CM solutions*: It offers powerful content cloud services platform available for the business today making easy to share documents, collaborate content, streamline business processes and deliver better business outcomes.

VII. CONCLUSION

Cloud computing through knowledge management enables organizations to gain speed so as to enhance information technology and empower the enterprises with key participants. Cloud providers are required to ensure the information security, confidentiality, integrity, availability, authenticity, authorization, and non-repudiation systems as per the customer requirements. Up gradation for the cloud computing is utmost required as it improves the procedures or techniques or policies for the customers. Knowledge management as a service, due to the advent of cloud computing, enables the combination of tools, technologies, methodologies in an effective manner to achieve what an organization always desires for its progress. Cloud computing is an innovation that has contributed not only, for the sharing of knowledge management, but also for easy accessibility of knowledge. It enhances the connectivity factor for the end-users with a wide variety of applications. Further research to improve this technology is under progress so as to provide accelerated service at a very economical price.

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BIOGRAPHY

Manaswini Pradhan is a Lecturer in the P G Dept. of Information & Communication Technology, *Fakir Mohan University*, Balasore-756019, Odisha.