

## Survey on Fog Computing and Cloud Computing

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**Abstract**— This survey focus the comparison between Cloud Computing and Fog computing, So that we can analyzes which is more required with their techniques and why for security purpose, The Internet of Thing is required further secured platform other than the cloud computing to find the best and secure way as possible. Cloud computing is reliable for using by the companies or the organizations, but it is not more trustable to prevent the critical tasks. The Internet of Things are facing several problems with the use of cloud computing also and prevention is more required for the advanced Infrastructure to promote the critical tasks of the cloud computing users, which can handle and prevent all of the transactions of Internet of Things without taken any type of risks. As, we observed numbers of devices are increasing, which connects to IoT. Hence, the fundamental issues of insecurity are increasing. Prevention or security is more required as a first priority for the users, those have been connected to the Internet of Things by the service of cloud computing. Fog computing has made of the appearance as a solution to this problem and it can tackle insecurity issues during process the data of IoT.

**Keywords**—Fog Computing, Cloud Computing, Internet of Things, Security Issues, Fogging

### I. INTRODUCTION

As our survey, we find that we using cloud computing since 1960s. It was suggested as first to connect with “Intergalactic Computer Network”. After the implementation of cloud computing, to make it better, new version had implemented name as “Fog Computing”. Reason behind to implement the fog computing is to prevent the data, because when we send the data to upload on cloud, First it goes into the layer of fog and after processing then it is send to the cloud.

Fog computing is known as fogging and it had to be a term coined by CISCO. Fog computing has their own tasks but this technology is not completely independent to use cloud computing features and services. Fog computing has several process to manage the data. Hence, we can't say that Fog computing is the substitute of cloud computing. Cloud services extend the technology to IOT devices through fog. Measure data which generate by IoT Devices is gargantuan and this data send to the cloud via any ISP service, which unnecessarily store and its bandwidth.

Hence, the cloud sends back required command to the attached IoT devices. So the down time is increase. However, IoT devices generate the data that use to resolve the real time problem. It prevents from the accidents which may have been

occurred so it is needed faster response before the action reaches to the device.

Using the fog computing, Benefit of the IoT Based device is near and accessible. Parcel of reduction of the database is the advantage, so that database can move easily to connect nearest network to access. This result reduces the time, cost and data traffic, overhead of centralized computational system. It also increase prevention of respective database of the public/private organization or government department the organization and the data remains always near or closer to the authorized client or users of their panel to provide better interface, accessibility which are connected between IoT applications and IoT based devices.

In this survey we showed that how the fog computing is more flexible and secured with the cloud services and This survey has been divided into several heading as describe below:

Section II define Fog Computing, Section III describes cloud computing, Section IV describes open source issues, Section V conclude the Conclusion with future work and related references are listed, which is used to design this article.

## II. FOG COMPUTING

Fog computing has been very popular caused with its advanced feature and better performance to handle the user request and make appearance in its standards than cloud computing [1]. Cloud computing is based on its infrastructure and it has highly required both hardware and software to manage the task and speedy processing, where Fog computing can utilize the resources of IoT devices on the edge. But, at the present time of processing, cloud computing can't be replace at any situation. It provides the employment to all countries of the world to reduce unemployed situation and it is top of all business also. It was clearly concluded in past that cloud computing and Fog computing will use their own characteristics to process own data burdens. Because both are capable having their own separate and several type of advanced techniques, but both will keep the supplement to each other [2]. Edges are registered to presume the essential part of the Internet of Things (IoT) [3]. In the frame work of Fog computing, still the issue of Security and privacy are also found with business point of view as are compared to the cloud computing. The ideal model develop of the business, If we use Fog computing, it reduce the delay and tension, which make the process beneficial by fast computing and force to business of cloud computing. It also reduces the cost of processing [4]. Fog computing can be defined as a progressive and expand the variant of cloud computing at the edge time of process, when the computing happens at the edge of the system. There are several type of organizations spending the time to consider the measure of their research on various type of point like Cisco [5].

### A. Features of Fog Computing

- It seems like cloud computing, however, is far denser in land dissemination what's more, area and its nearness to end clients is more, which implies they give a quicker end-client encounter than distributed computing and have better execution[6].
- The inquiries concerning its unpredictability, pragmatic attainability, cost and execution are emerging in various research groups. There is likewise a noteworthy concern about its dependability or sturdiness in playing out a wide range of operations performed by distributed computing frameworks.

### B. Characteristics of Fog Computing

- Low inertness, edge area and area mindfulness: Fog processing arrangement better administrations to end clients at the edge of the network.
- Geographical Distribution: Fog computing application, objective and services are widely distributed.
- Support for Mobility: Fog figuring give versatility systems like decouple have the personality to area character by utilizing LISP protocol.

- Real time interactions: speedy services need real time interaction in Fog computing.
- Heterogeneity: Fog computing supports heterogeneous devices and support nodes in a wide variety of environments.
- Interoperability: Fog gives a wide range of services so for that purpose Fog devices incorporate for streaming of services.

Fog computing is also known as fogging and it distributed foundation. At the edge of the network, processes can be executed by advanced intelligent devices and the rest part can shift to cloud for processing. Fog techniques are utilized for devices to process the data, storage from user to cloud which provide the fast network with security to transfer.

Smart lighting system working on the set of instructions is an illustration of the Internet of Things. Data processing may interrupt the results that lights are turned on or turned off when there is no movement for time span in IoT. This data and outcomes are best refined at the outskirts.

The organization executing the Smart lighting framework could likewise wish to venture up towards vitality effectiveness and for perceiving about the ideal opportunity for which the lights were turned on. The information which supports this "whole point of view" of how the keen lighting is being actualized would require information to be requested and prepared by an announcing framework keep running in the cloud [7].

## III. CLOUD COMPUTING

Cloud computing is popular as provide services and computing resources on pay per use to users on their demands [8]. Cloud computing is an extension of cluster and grid computing which was used to collect resources at one central place and utilize them to high-performance computing. Cloud computing architecture provides three types of services such as software as a service (SaaS), Platform as a service (PaaS) and Infrastructure as a Service (IaaS). NIST gives the definition of cloud that design of computing architecture, which provides high powerful resources for computing, storage, the environment of application development with multiple platforms with ease of management and coordination of all devices of resources at one place [9]. Cloud computing also provide mobility features know as mobile cloud computing. Mobile cloud computing is defined as a "new worldview for portable applications, where the information handling and storage are relocated from the nearby clients to intense and centralized computing platforms situated in the clouds" [9]. Cloud computing models are different according to the type of services they provide such as SaaS deals customer services like accounting, database application software and emails but the user did not deal with technical infrastructure of cloud.

PaaS provides a platform for application developer like programming environment, by using those tools develop applications and have rights configure and technically manage the cloud. IaaS provides services of the infrastructure of clouds such as manage servers, storage and network devices. IaaS provides the right to manage, change or configure cloud infrastructure according to their needs. Cloud computing models are given in figure 1 [7].

A. Cloud Deployment Models

Cloud computing deployed according to four different ways such as public, private, community and hybrid [7].

1. *Public cloud:* Its infrastructure had designed and managed by the government organization and its education sector and combination of some of them but it depends on ISP. The role of Public Cloud is used to free access for general public use or can say, which data upload on Public cloud, which is free to download so that anyone can access for enhance the knowledge.
2. *Private cloud:* Public cloud is an antonym of public cloud and it is designed and developed for the private use and work as public cloud but it keeps your data secure than the Public Cloud.
3. *Community cloud:* This cloud infrastructure designed to manage the data of specific community over cloud. It can manage one or two organization only.
4. *Hybrid cloud:* The infrastructure of Hybrid cloud is same as Community cloud. As Community cloud manage one or two organization. But It controls the multiple organizations of the world, whose companies are attached to maintain their data with speedy process over the cloud [7].

B. Comparison of Fog Computing & Cloud Computing

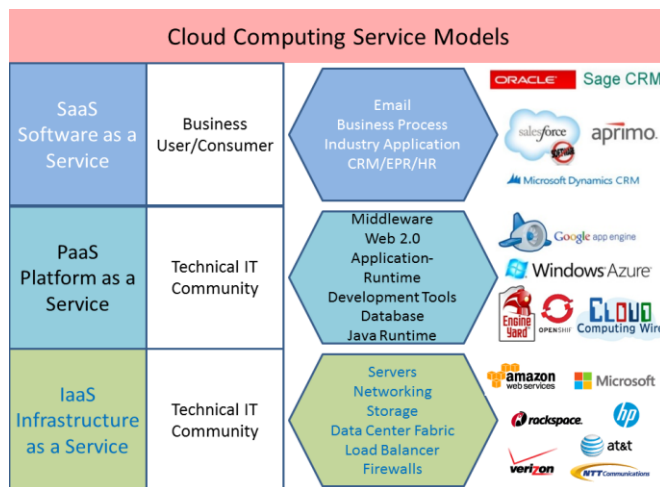


Fig.1 Service Model of Cloud Computing

In this section Fog and cloud computing comparison is given in table 1.

Table 1. Fog vs Cloud Computing

Parameters	Fog Computing	Cloud Computing
Goal	Enhance proficiency and execution of process that should be transported to the cloud for handling, investigation and storage	Give a request of greatness change in the practical, powerful provisioning of IT administrations
Computational focuses	Fog operates on network edge	Data and applications are processed in the Cloud
Abstraction Level	High	High
scalability Degree	High	High
Support of Multitask	Yes	Yes
Level Transparency	High	High
Run time	Real time services	Real time services
Type of Requests	Lots of High allocation	Lots of small allocation
Allocation unit	All shapes and sizes (wide & narrow)	All shapes and sizes (wide & narrow)
Level of Virtualization	Vital	Vital
Accessible type	IP	IP
Transmission	Device to device	Device to Cloud
Security	Possible, determined	Undefined
Infrastructure	Flexible	3 models (PaaS, IaaS, SaaS)
Support of Operating System	hypervisor virtualization	A hypervisor (VM) on which multiple OSs run
Ownership	Multiple	Single
Service negotiation	SLA based	SLA based
Support of User management	Centralized	Centralized or can be delegated to third party
Resource management	Centralized	Centralized/Distributed
Allocation/Scheduling	Centralized	decentralized/centralized
Interoperability	Interoperability between heterogeneous resources.	Web Services (SOAP and REST)
Failure management	rescheduling of failed tasks	Strong (VMs can be easily migrated from one node to other)
Service price	Utility pricing and Pay per use as go	Utility pricing, discounted for larger customers
Type of service	CPU, network, memory, bandwidth, device, storage	IaaS, PaaS, SaaS, Everything as a service
Example of real world	Significant Fog applications involve real-time interactions rather than 228 batch processing.	Amazon Web Service (AWS), Google apps
Response Time	Low	High

Critical object	Service	Service
Number of users	Unlimited	Unlimited
Resource	Unlimited	Unlimited
Future	Next Generation of Internet and computing	Fog Computing

Comparison table shows that few parameters are same for both Fog and cloud such as portable access, virtualization, multitask, transparency, service negotiation, critical object, number of users support and resources provided. Rest of other parameters Fog computing provide more advance benefits compare to cloud computing such as Fog computing provide a response in a short time but cloud takes high. Other parameters like request type, transmission, security, user management and resource management, scheduling, interoperability, failure management, pricing of services and type of services of Fog computing are better than cloud computing Table 2 provide details of Fog and cloud applications details where Table 3 about the tools.

**IV. OPEN RESEARCH ISSUES**

From one viewpoint, the improvement of Fog and Edge mists incorporates devoted offices, working framework, organize and middleware strategies to manufacture and work such miniaturized scale server farms that host virtualized registering assets. Then again, the utilization of Fog expects the expansion to current programming models and proposes new deliberations that will enable engineers to outline new applications that take advantage from such enormously conveyed frameworks. The utilization of this approach additionally opens up different difficulties in: security and protection (as a client currently needs to "trust" each smaller scale server farm they interface with), bolster for asset administration for versatile clients who exchange session starting with one miniaturized scale server farm then onto the next, and bolster for "installing" such smaller-scale server farms into gadgets (e.g. autos, structures, and so forth.) [8]. By adding quality of experience (QoE) domain in Fog computing, service will be improved for video streaming and game services. The technical parameters are different in every field such as multimedia services contains bitrate of video, frame rate, video codecs etc. and game required high processing power to adding QoE will provide user stratification about the services [9].

Table 2. Application of Fog and Cloud Computing

Technology	Application	Comment
Fog Computing	Decoding of Video Cascade, games.	It gives massive administrations to many type of application like video and gaming. It allow to generate new stream of intelligent multimedia. It decodes multimedia contents.

	environmental monitoring Small cities, (Fusion and Aggregation)	Cisco implements the application and send to their store, which clients are enabled to download the application of IOx devices. which intend to control and observe the execution of an application for controlling and observing.
	Smart Grid	A smart grid is called an electrical grid. It provided the service to smart meter, smart appliances.
Cloud Computing	Handling of Big data using the technique of MR or Hadoop	It is used to manage large amount of data over cloud. It may be individual or enterprises.
	e-commerce (Web applications)	It provides several types of online services. That makes easy to purchase the any type of products.
	Cloudo	Cloudo is an app that included in the PC browser and help to search the cloud tools.

Table 3. Tools of Fog computing and Cloud computing

Technology	Tools	Comments
Fog	IFOGSIM	iFogSim permit to reproduce of asset administration and the planning for the arrangement of application crosswise over edge. According to the cloud, there are several typed of cloud assets.
	Fog Project	Management solution is available with free Open-source network for computing cloning.
Cloud	CloudSim	CloudSim is used for vast cloud applications for evaluation.
	Zenoss	It is solitary that coordinate the item which show the whole framework of IT and convey in cloud.
	Cloudera	It is used for making programming structure for different tasks as an open-source by Hadoop application software to utilize for the part of cloud computing.

## V. CONCLUSION

In this paper, we confer the differentiation between Fog Computing and cloud computing. Differentiation would be helped to understand the way to researcher by their advantages and disadvantages. Technologies of Cloud computing are being used since many years ago. Hence, It has its different type of high quality development tools and works with its own latest technology to implement the cloud infrastructures. But Fog computing has become in the earlier, which is used to find out and work as on latest research by providing advanced tools for the researcher to their respective field. Fog computing is a prototype models which develop the tools under the research. But our expectation from the Fog computing is that it would be more develop and include advance features by its own modern computing technology. and it also evolves speedy and utilize the edge of IoT devices for their computational resources. Given table describes the advantages of Fog and Cloud computing.

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