A REVIEW OF RESOURCE MANAGEMENT IN FOG COMPUTING USING SCHEDULING ALGORITHMS

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ABSTRACT: With the advent of IoT and smart devices high amount of information on the daily basis has been produced by edge devices, applications and sensors. The devices that are providing information are often very simple. They have very minimal resources for performing important analytics. Even they can't perform machine-learning tasks. These devices give information to cloud. Cloud has power and ability for managing computing tasks. Cloud perform computation and send the data back to the devices. This process can be very resource consuming because as the capacity of today's devices is increasing we can make our system efficient by having some computation on the edge of network. This is also known as fogging or fog computing. The Fog computing needs a robust resource management mechanism so that maximum efficiency can be achieved while sharing the load between the edge and the cloud. A review has been made to discuss various scheduling techniques used in fog based cloud environments.

KEYWORDS: Cloud computing, Fog computing, Gang scheduling, Resource management

[1] INTRODUCTION

Fog computing also called fog networking and also termed as fogging. It is computing infrastructure that is decentralized. In case of distribution, computing, storage and application of the data, there is use of Fog computing. Its place is very much logical and efficient. It is used between cloud and source of information. Cloud computing is expanded only through fog computing. Fog computing make the services possible on the edge of network. The benefits and power of cloud is brought closer to the place of creation and action place of information. The main aim of fogging is to enhance efficiency. Another objective is to decrease amount of information that is transported to cloud. It is send further so that it may be processed, analyzed and stored. The motive of doing so is to enhance the efficiency. The reason for using it is the security and compliance of data. Fog devices and sensors are considered as location where information is generated and collected. These devices are not having any computing and storage resources by which analytics and tasks based on machine-learning can be performed. Though power to do such tasks is with cloud servers, they cannot timely process information. Similarly, they cannot reply on time. With adding this, all the end points which are connected and sending some main information to cloud on internet may have protection, privacy and authorized implications

In the architecture of Fog computing, processing is done on smart device which is close to source. It may be raspberry, gateway or a router. Here software minimizes the transmittable amount of information to cloud. It takes action on the business logic which is applied in Fog Node. For discussion, it is essential to notify that Fog Computing complements don't replace cloud computing. The information which is in motion analyzed by fog Computing and decisions are taken.

1.2 FOG COMPUTING BENEFITS

Followings are benefits of fog computing:

- **Flexibility**: Customer could increase services according to their need. They are free to customize applications. They could access cloud services with internet from anywhere.
- **Scalability:** Cloud infrastructure increases according to demand. It supports unpredictable workloads.
- **Storage options:** Users is free to select public, private or hybrid storage. Such offering is based on need of security.
- **Features of Protection:** In case of VPC the cryptography along with application program interface keys are used for keeping secure information.
- **Efficiency:** Fog computing provides the better system performance and also provide high efficiency[10].
- **Accessibility:** These applications that are based on cloud could be easily accessed from internet that has been joints with virtual device.
- **Market speedup:** Development over cloud is allowing customers to access services rapidly.
- **Data security:** Failures of Hardware do not lead to information loss. This is due to networked backups.

1.3 CLOUD COMPUTING

Cloud gives services over network which may be public or private. Cloud is available at remote location. Cloud have been utilized in wide area network as well as in local area network. It may be used in virtual private network too. Lot of application such as email & web dependent conferencing usually implemented over cloud. Cloud computing has offered Platform independency because there is no necessity to set particular software on computer.

Cloud computing is considered as a recent technology. It has been considered as expansion of parallel computing. Distributed computing grid computing is collection and evolution of Virtualization. It also considers utility computing. Cloud computing provides services such as Software-as-a-Service Infrastructure-as-a-Service and Platform-as-a-Service. Cloud computing could improve availability of IT resources. It has several benefits over different computing methodologies. Operator might utilize IT infrastructure. It is done using Pay-Per-Use-On-Demand mode. It would provide benefits and reduces the expenses. Cloud computing provides platform independency because there is no need to setup software on personal computer. Cloud computing provides several benefits and they are listed below:

1. Cloud computing provide the online operation apparatus.
2. It allows user to access remote applications with the help of internet
3. It is easy to modify and organize application by the user with the help of internet
4. Clients are provided platform independent access of cloud resources that are available on internet.
5. Its efficiency is high and it does most advantageous exploitation so it is decidedly cost effective.
6. Load matching characteristic of cloud computing correspond to that it is more consistent.

A number of benefits are given by Cloud computing to its users. It also has a set of problems and inefficiencies. The issues of cloud computing are identified by fog computing. It was introduced by CISCO. These are two systems as fog and cloud are constructed together to make one virtual system. The elasticity to server, storage and network resources is provided by them. It also enhances Quality of Service. It minimizes latency. Main task of fog is to deliver information. The information is place closer to user. The wireless information provides by the fog computing to transfer allotted devices in the system of IoT. Consistency of the information and integrity of the information is demanded by the Internet applications. The information having high length stays on route. It is more vulnerable for attacks. There should be some hops among clients and servers. Thus the distance of that path among clients and servers has been given by Fog computing. In this way Fog computing has its own significance over cloud computing in such circumstances.

[2]RESEARCH METHODOLOGY

Research methodology collects varied data from sources online by selecting articles and analyzing their content in the field of fog computing. The methodology is consisting of various sources such as interviews, surveys, publication research other research techniques. The research is consisting of both present developments and historical developments. It also includes editorial articles and case studies.

Only relevant articles are filtered on a predefined set of criteria. The search is being done on Google Scholar where the following keywords were used “fog computing”, “fog scheduling” and “fog based cloud environments”.

[3] LITERATURE REVIEW

F. Bonomi et. Al. (2014) discussed that Fog computing is inheriting Cloud Computing prototype to boundary of network. It is facilitating a recent variety of applications as well as services. Major features of Fog have been less latency and location awareness. Features also consist of widely spread geographical distribution as well as mobility with very huge number of nodes. Authors have stated that these characteristics are making Fog a nice platform in case of number of complex Internet of Things services.

K. Bala and S. Vashist (2014) described that the new technique by which users can get resources according to their demands is known as Cloud computing. In cloud, there is existence of cloud providers in cloud. These providers give resources. They also provide consumers which gives utility or consume the resources. The users may get knowledge according to their demands about some resources such as network bandwidth, storage, server etc. It requires only the internet connection. The payment for these resources can be done by user as per usage. Scheduling of these resources should be done in cloud so that they can be used efficiently. Today’s most challenging work is Scheduling of resources. The requirement of Scheduling is to accomplish the task on time, for decreasing the cost and also used for other parameters. Sequential algorithm and optimum scheduling algorithm are compared with each other. Similarly, Urgency first parallel strategy is compared with Priority Impact Scheduling Algorithm. A better resource scheduling is performed by these algorithms in the environment of cloud.

I. Stojmenovic and S.Wen (2014) discussed about advantages of fog computing in services of several domains. It also gives an analysis of security issues and state-of-threat in today's paradigm. According to some facts which are based on this paper, there are some new researches in computing and storage. These may be used in future for handling intensive services of information. These are mainly based on interplay among Fog along with Cloud. There is possibility of expansion of future work of Fog computing paradigm in case of Smart Grid.

K. Shenoy et. Al (2015) explained that security of the information of user is going to be the most serious issue for cloud service providers. This is due to the continuous increasing number of theft attacks of information. By fog computing user's behavior can be monitored. Hence security is provided to the user data. It is developing latest techniques so that the issues of insider information robbery attacks may be solved in a cloud. These issues are solved by using animatedly generated decoy files. In fog the insider attacks in cloud may be decreased by using decoy technique.

S. Agarwal et. Al (2015) mentioned that user search behavior and decoy information can be used combined. It can be shown in included detection methods. It uses anomaly detection with a baiting approach for this purpose. The purpose is to make safe all the personal along with business information in cloud. In future, security system which has been explained here will be able to apply only in case of cloud ownership system. If more than one cloud has to be operated by a cloud owner, then our security system will not be able to provide security. If there is more than one cloud architecture to manage in a cloud environment extra security measures are needed, then it may increase our present application in future.

I. Stojmenovic et. Al. (2015) described that Fog computing is a prototype. Cloud computing and its services on the network edge is boosted by the use of Fog computing. The working procedure of both fog and cloud is same. It gives data, and compute data and accumulate the application services to the end users. In this chapter inspiration and many advantages of Fog computing is demonstrated. It investigates its applications in the series of actual scenarios. Some protection and isolation issues are also acknowledging here. These are according to present Fog computing paradigm.

M.Verma et. Al (2016) stated that many devices of fog computing are circulated geographically over various platforms. It is essential to optimize Service portability diagonally on platforms. Fog computing model can help the Traffic light control. Fog devices which are independent may consult directly with Cloud. These are updated on the basis of price and needs on cyclic basis. While interdependent Fog devices consult with each other. These also make coalitions for enhancing it additionally.

P Kukreja and Dr. D. Sharma (2016) authors come up with a latest architecture over load balancing algorithm in Fog Computing based environment in easy and valuable manner. It is required because the quantity of end users is growing on a daily basis at a very swift rate. Various aspects and concerns are also indicated there. It may come across the drawing and implementation of fog computing systems. Further this clarification of new convenience and challenges in fog computing is also presented. The issues connected to Quality of Service, interfacing, resource management, protection along with isolation have been displayed. The development of Fog computing is in underlying with Internet of Things, edge devices, radio access techniques, Virtual Machine along with Mobile cloud.

M. Verma et. Al (2016) purposed that by using Fog based computing improves the efficiency of cloud computing. It also helps in decreasing the quantity of information which is to be propagated to cloud for information storage and handing out. It is ineffective to sending all sensors to cloud & information of Internet of Thing, fog computing covers this issues. As a result, fog point out that advantage of cloud computing could be bring more rapidly to client. The importance of valuable resource project and its associated information is obtained by this research. Cloud computing is complex to recognize without resource assignment. It is mainly because it attempts decreased infrastructure cost and stretchy scalability.

A. V. Dastjerdi and R. Buyya (2016) discussed how IoT is enabling innovations which are going to improve the quality of life. It is going to generate unique information which is complicated in case of traditional systems as well as cloud. Fog computing has been developed to handle such issues.

S. Dustdar and W. Shi (2016) explained that the generation necessitate for edge computing is required due the achievement of Internet of Things (IoT) along with rich cloud services. In which information processing take place in element at edge of network, more willingly as compare to cloud. Fog computing could deal with discontinuation, mobile devices' restricted battery life. It also considers costs of bandwidth, protection along with isolation.

W. Shi et. Al. (2016) discussed with acceleration for the invention of a new computing paradigm, fog computing is achievable due to the propagation of IoT along with accomplishment of rich cloud services. This can be done by processing information at edge of network. Description of edge computing is explained by the researcher, followed by a number of case studies. These are ranging from cloud offloading to smart home and city, in addition to two-way edge to become visible the concept of edge computing. In the end, numerous challenges and convenience in turf of edge computing is put forward. It is expected that it would achieve consideration from community. It would encourage more research in this direction.

B.K. Sah et. Al. (2017) stated that valuable along with convenient resource distribution is a significant and demanding issue in fog computing. They have been utilized to implement dynamic resource allocation in fog computing. Pre-allocated resources have been available. It is according to price cost and time cost of task. Reliability evaluation of users and fog resources is also considered here. It is same as sales mode in case of online Shopping.

Dr. T. Pandikumar and T. Belissa (2017) proposed a model that is able to secure an application on cloud by using algorithms like SHA1 and Naive Bays having high correctness and exactness rate spread transversely 2-level protection structure compared tone's proposed & used at same level thus detecting intruders more accurately. The system would be using Hadoop for User profile mapping and also for reducing detection time.

M. Mukherjee et. Al. (2017) stated that certain features of fog computing results in issues related to security and privacy. The research is providing introduction of traditional security and privacy concerns. It is highlighting ongoing research effort as well as open challenges. Trends in privacy and security challenges in case of fog computing have been discussed.

C. Castiglione et. Al. (2017) stated that information importunity is one the best assistance which is achieved by the linking of edge and cloud computing. It's also make possible to accomplish high-throughput below high synchronized accesses, mobility sustains, real-time dispensation guarantees. For instance, cloud computing implement flexible provisioning along with storage capabilities. It permits us to deal with scalability, persistency and consistency requirements. It also helps to alter infrastructure capacity to demanding requires based on quantity of generated information.

D. Bermbach et. Al (2017) discussed that in present scenario storing of data for future use is the main requirement. A huge amount of information is generated on a daily basis in association, educational institute and testing ground. Therefore, an elementary service which is required is data storage. In terms of local storage, a promising services and strong substitute is Cloud storage services. The expenditure which is bearded by customer due to import and maintaining of exclusive hardware is reduced by the use of cloud storage service. Quite a lot of solutions are present in the market. Some of these are the mainly prominent being Amazon S3. Nevertheless, to approach information with reference to all service architecture, presentation, and pricing to a certain extent becomes complicated. From the customer point of view, we put forward a benchmarking methodology to drop light on storage services. It is applied to four well admired offers. After that an evaluation is done on their performance. Each and every service is interpreted as a black box. It benchmarked during crafted workloads. For this perception of a customer located in Europe is taken. After that all the possible service providers and optimal information center are considered where it is achievable to install its applications. In the end a comparison is made between authentic and forecast costs faced when each service is used. On the basis of which, it complements examination. It is observed from the composed results, that all services show ultimate weaknesses associated to some. Select of information center perfectly where all the application is set up is of dominant requirement.

F. Pallas et. Al. (2017) discussed about variety of protection mechanisms which may be complex arrangement options, recommended by Cloud systems. Up to now, the main attention is paid to level of safety which is able to accomplish by protection engineering. The costs related with a particular security mechanism and its pattern is not considered. A number of experiments are performed with a variety of cloud information stores over last year. It is observed from that study that in order to achieve preferred quality like security the other system qualities like performance are considerable effected. Research focused on information in transit encryption. This approach enables explanation in reasonable manner.

P. Varshney and Y. Simmhan (2017) discussed that Internet of Things (IoT) has increased the speed of deployment of a number of sensors at the edge of network. It has been done by infrastructure of Smart City and devices of lifestyle. Cloud computing platforms have been given the task of conducting these huge volumes and rapid streams of information by edge. In the present days, fog computing has risen in the form of concept for low-latency. It also takes into account resource-rich processing of the streams. This is to harmonize Edge and Cloud computing. In research author gave review about different dimensions and characteristics of application, system architecture, and platform abstractions. These are apparent in this Edge, Fog and eco-system of Cloud. It shows novel abilities of Edge and Fog layers. These can be capabilities like physical and mobility of application, sensitivity of privacy, and a nascent environment of runtime.

C. Mouradian et. Al. (2018) discussed that in some responsive applications where continuation is required such as failure management and substance release applications, the space between cloud and end devices might be a topic of concern. Fog computing is a narrative pattern to deal with these types of concern. It is observed that facility of resources and services at network edge, nearer to end devices, or ultimately, at locations specific by SLAs which are outside cloud is achievable by the use of fog computing. It facilities processing at edge despite the fact that it still offering possibility to interact with cloud. It presents a wide-ranging analysis on fog computing. All the architectures and algorithms comprise of fog systems is enclosed by it. It also made known of all the required challenges and investigation directions.

[4]CONCLUSION

In traditional cloud environments the efficiency is very low for processing the information as it has to be send backwards and forwards between devices and clouds. This increase the total bandwidth of the network and create unusual burden on the network and cloud. The devices on the edge of network are capable of processing up to some extent thus they can also be utilized in the network to perform processing of information to some extent. This is done in order to save the total amount of information sent to the cloud and reducing the burden on bandwidth of network and to obtain efficiency in processing. Therefore, we can approach this problem by dividing the jobs according to their nature and scheduling them accordingly. Gang Scheduling can be inclusively used for designing a hybrid approach to tackle the need of efficient resource utilization. Thus fog computing can provide a better way to maximise the resource efficiency of the overall cloud environment by adopting effective resource scheduling techniques.

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