International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Fog Computing: Beginning of a New Era in Cloud Computing

Jyotir Moy Chatterjee
Assistant Professor
Dept. of CSE, GD Rungta College of Engineering & Technology, Bhilai, Chhattisgarh-490024, India

---

Abstract – *Fog computing is a prototype that protract Cloud computing and services to the edge of the network. Like Cloud, Fog provides data, compute, storage, and application services to end-users. Fog Computing terminology is given by Cisco that implies extending cloud computing to the edge of a network. Broadly called Edge Computing or preparatory, fog computing reinforces the operation of cloud, storage and networking services between end devices and conveyed processing data centers. Fog computing is a gifted computing aspect that protract cloud computing to the edge of networks. Similar to cloud computing with distinct characteristics, fog computing faces new-fangled security, privacy and trust issues, control information overhead and network control policies resist other than those obtained from cloud computing. One of those hurdle is data trimming. Because redundant communications not only burden the core network but also the data center in the cloud. For this purpose, data can be preprocessed and trimmed before sending to the cloud. This can be done through a Smart Gateway, accompanied with a Smart Network or Fog Computing. We have reviewed these defies and prospective plans briefly in this paper. We have provided a state-of-the-art survey of Fog computing, its challenges and security issues.*

Key Words: Cloud Computing, Computer Network, Data centers, Security and Privacy Issues, Network Policies, Data Trimming, Smart Gateway, Smart Network.

1.INTRODUCTION

CISCO as of now passed on haze figuring to empower applications on billions of associated gadgets, officially associated in the Internet of Things (IoT), to run straightforwardly at the system edge. Clients can create, oversee and run programming applications on Cisco IOx structure of organized gadgets, including solidified switches, switches and IP camcorders [1].

In today's period, every single association are utilizing distributed computing innovation to shield their information and to utilize the cloud assets at whatever point they require [2]. The current systems just encourage security elements to information and in this manner, don't consider recognition of invalid get to and subsequently its counteractive action to empower legitimate dissemination of information. The proposed instrument encourages security components to information and in this way, takes into consideration recognition of invalid get to and along these lines its aversion to empower substantial dissemination of information. Information robbery assaults are increased if the aggressor is a noxious insider. This is considered as one of the top dangers to distributed computing by the Cloud Security Alliance. While most Cloud processing clients are very much aware of this danger, they are left just with believing the specialist organization with regards to securing their information. The absence of straightforwardness into, not to mention control over, the Cloud supplier's verification, approval, and review controls just intensifies this risk. Mist Computing gives security to the information put away in the cloud. This helps the clients to be without strain about the security of their information. In the event that any unapproved client tries to get to the information in the cloud, then the security will track the client and will outline the information worried with the client. We utilize this innovation to dispatch disinformation assaults against malevolent insiders, keeping them from recognizing the genuine delicate client information from fake useless information.

Cisco [[B], [BMZA], [C1]] as of late conveyed the vision of haze processing to empower applications on billions of associated gadgets, officially associated in the Internet of Things (loT), to run straightforwardly at the system edge [1]. Both cloud and mist give information, register, stockpiling, and application administrations to end-clients. The recognizing haze attributes are its nearness to end-clients, its thick land appropriation, and its support for versatility. Administrations can be facilitated at end gadgets, for example, set-beat boxes or get to focuses. Haze gives low idleness, area mindfulness, and enhances QoS for spilling and constant applications (e.g., in mechanical computerization, transportation, systems of sensors and actuators), and backings heterogeneity (mist gadgets incorporate end-client gadgets, get to focuses, edge switches, switches, traversing various administration spaces). The haze figuring worldview is all around situated for continuous huge information examination, underpins thickly conveyed information gathering focuses, and gives points of interest in amusement, publicizing, individualized computing and different applications. Existing haze processing based designs can be demonstrated by a basic three level chain of importance, where each brilliant thing is joined to one of mist gadgets, mist gadgets could be interconnected, and each of them is connected to the cloud [3].

2. BRIEF HISTORY

Distributed computing is a term alluding to the conveyance of facilitated administrations over the web. It is a system of remote servers facilitated on the web and used to store, oversee and prepare information set up of nearby servers or PCs. In media communications, a cloud is the erratic piece of

any system through which information goes between two end focuses. Potentially the term started from the mists utilized as a part of writing board drawings or more formal representations to portray the non-specifiable or uninteresting piece of a system. Distributed computing model is an e-customer other option to owning and overseeing private server farms (DCs) for clients confronting Web applications and cluster preparing. A few variables add to the economy of size of super DCs: higher consistency of monstrous conglomeration, which permits higher use without corrupting execution; advantageous area that exploits cheap power; and lower OPEX accomplished through the organization of homogeneous register, stockpiling, and systems administration segments. Distributed computing liberates the undertaking and the end client from the determination of many subtle elements. This joy turns into an issue for dormancy touchy applications, which require hubs in the region to meet their postpone necessities [14].

Cloud Computing

Distributed computing is a term alluding to the conveyance of facilitated administrations over the web. It is a system of remote servers facilitated on the web and used to store, oversee and prepare information set up of nearby servers or PCs [5]. In media communications, a cloud is the erratic piece of any system through which information goes between two end focuses. Potentially the term started from the mists utilized as a part of writing board drawings or more formal representations to portray the non-specifiable or uninteresting piece of a system.

Distributed computing model is an e-customer other option to owning and overseeing private server farms (DCs) for clients confronting Web applications and cluster preparing. A few variables add to the economy of size of super DCs: higher consistency of monstrous conglomeration, which permits higher use without corrupting execution; advantageous area that exploits cheap power; and lower OPEX accomplished through the organization of homogeneous register, stockpiling, and systems administration segments. Distributed computing liberates the undertaking and the end client from the determination of many subtle elements. This joy turns into an issue for dormancy touchy applications, which require hubs in the region to meet them postpone necessities.

Fog Node

The ubiquity of smart devices and rapid development of standard virtualization and cloud technology make several fog node implementations available. Resource-poor fog node, this kind of fog nodes is usually built on existing network devices. ParaDrop [4] is a new fog computing architecture on gateway (Wi-Fi access point or home set-top box), which is an ideal fog node choice due to its capabilities to provide service and its proximity at network edge.

Fog Characteristics

Defining characteristics of the Fog are: a) Low latency and location awareness; b) Wide-spread geographical distribution; c) Mobility; d) Very large number of nodes, e) Predominant role of wireless access, f) Strong presence of streaming and real time applications, g) Heterogeneity [1].

3.WORKING OF FOG COMPUTING

While edge gadgets and sensors are the place information is produced, and gathered, they don't have the process and capacity assets to perform progressed examination and machine-learning assignments. In spite of the fact that cloud servers have the ability to do these, they are frequently too far away to handle the information and react in a convenient way. Also, having all endpoints associating with and sending crude information to the cover over the web can have protection, security and lawful ramifications, particularly when managing touchy information subject to controls in various nations.

In a haze situation, the preparing happens in an information center point on a keen gadget, or in a brilliant switch or entryway, in this way lessening the measure of information sent to the cloud. Note that haze organizing supplements - not replaces - distributed computing; misting considers here and now examination at the edge, and the cloud performs asset serious, longer-term investigation [2].

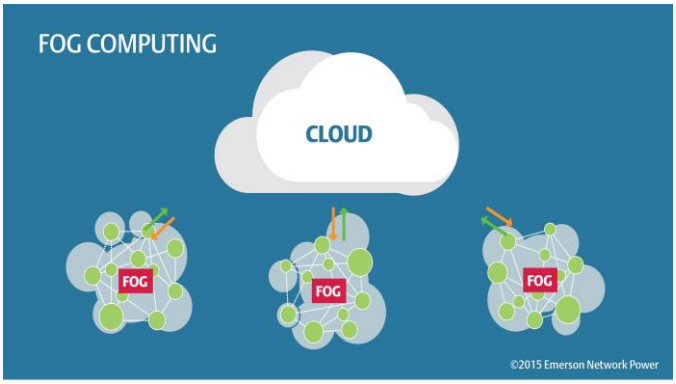

Fig -1: Fog Computing Architecture

3. LITERATURE REVIEW

In 2012 Salvatore J. Stolfo et. al [1] proposed an alternate approach for securing information in the cloud utilizing hostile imitation innovation. They checked information access in the cloud and recognize irregular information get to designs. At the point when unapproved get to is suspected and after that confirmed utilizing challenge questions, they dispatch a disinformation assault by returning a lot of bait data to the aggressor. This secures against the abuse of the client's genuine information. Tests led in a neighborhood document setting give confirm that this approach may give remarkable levels of client information security in a Cloud domain. The proposed checking information get to designs

by profiling client conduct to decide whether and when a pernicious insider misguidedly gets to somebody's records in a Cloud benefit.

In 2012 Flavio Bonomi et. al [2] in his paper contended that Fog Computing is proper stage for various basic Internet of Things (IoT) administrations and applications, to be specific, Connected Vehicle, Smart Grid, Smart Cities, and, as a rule, Wireless Sensors and Actuators Networks (WSANs). They have sketched out the vision and characterized key qualities of Fog Computing, a stage to convey a rich arrangement of new administrations and applications at the edge of the system. The imagine the Fog to be a binding together stage, sufficiently rich to convey this new type of rising administrations and empower the improvement of new applications.

In 2013 Jiang Zhu et. al [3] considered web streamlining inside Fog Computing setting. They connected existing techniques for web improvement in a novel way, to such an extent that these strategies can be consolidated with one of a kind learning that is just accessible at the edge (Fog) hubs. More powerful adjustment to the client's conditions (e.g. organize status and gadget's registering burden) can likewise be proficient with system edge particular information. Therefore, a client's page rendering execution is enhanced past that accomplished by just applying those strategies at the web server or CDNs. They are at present applying our proposed ideas to build up a proof of idea framework.

In 2013 H. Madsen et. al [6] in their paper considered current ideal models in registering and layouts the most essential angles concerning their unwavering quality. The Fog registering worldview as a non-insignificant augmentation of the Cloud is considered and the unwavering quality of the systems of keen gadgets are talked about. Consolidating the dependability necessities of matrix and cloud ideal models with the unwavering quality prerequisites of systems of sensor and actuators it takes after that outlining a solid Fog figuring stage is doable. This paper displayed the unwavering quality difficulties postured by current figuring ideal models and amplifies the exchange towards solid Fog stages consolidating systems of shrewd gadgets conveying among them, additionally with the Cloud. The most critical thought comprises of the plausibility of solid Fog processing stages for genuine tasks.

In the year 2014 Luis M. Vaquero and Luis Rodero-Merino [7] in their paper offered a far-reaching meaning of the haze, grasping innovations as assorted as cloud, sensor systems, distributed systems, organize virtualization capacities or design administration methods. They highlighted the principle challenges confronted by the possibly leap forward innovation amalgamation. This article has given a wide diagram of this meeting and what are the regular focuses that connection every one of these advancements together, making another worldview that some have as of now named as "mist" figuring.

In 2014 Mohammad Aazam and Eui-Nam Huh [8] have talked about this idea of Fog Computing in detail and displayed the engineering of Smart Gateway with Fog Computing. They have tried this idea on the premise of Upload Delay, Synchronization Delay, Jitter, Bulk-information Upload Delay, and Bulk-information Synchronization Delay. The paper talks about the growing IoTs and their incorporation with distributed computing, for upgraded and more valuable administration provisioning to the client and productive use of assets. The vision of CoT, brilliant correspondence with Smart Gateway and Fog registering will convey a rich arrangement of administrations. Moreover, a far-reaching assessment of execution is introduced, in view of different parameters. The augmented work could be on the effect of heterogeneous stockpiling and general execution on the premise of differing applications.

In 2014 Ivan Stojmenovic and Sheng Wen [9] expounded the inspiration and favorable circumstances of Fog processing, and investigations its applications in a progression of genuine situations, for example, Smart Grid, shrewd movement lights in vehicular systems and programming characterized systems. They talked about the cutting edge of Fog registering and comparable work under a similar umbrella. They examined man-in-the-center assault, for the exchange of security in Fog registering. We explore the stealthy elements of this assault by looking at its CPU and memory utilization on Fog gadget. Future work will develop the Fog registering worldview in Smart Grid. Next, Fog processing based SDN in vehicular systems will get due consideration. Not at all like customary server farms, are Fog gadgets geologically disseminated over heterogeneous stages. Benefit versatility crosswise over stages should be upgraded.

In 2015 Shanhe Yi et. al [10] talks about the meaning of mist figuring and comparative ideas, presents agent application situations, and recognizes different parts of issues that may experience when outlining and actualizing mist processing frameworks. It likewise highlights a few open doors and difficulties, as course of potential future work, in related systems that should be considered with regards to mist figuring. Plus, new open doors and difficulties in mist registering for related methods are talked about and issues identified with QoS, interfacing, asset administration, security and protection are highlighted. Mist processing will advance with the fast improvement in hidden IoT, edge gadgets, radio get to methods, SDN, NFV, VM and Mobile cloud. As indicated by Shanhe Yi et. al mist figuring is promising yet presently require joint endeavors from fundamental systems to meet at mist processing".
In the year 2016 W. Steiner and S. Poledna [11] proposed haze registering as a design intends to acknowledge IIoT and

examine two empowering advancements for haze figuring: virtualization and deterministic correspondence. As indicated by W. Steiner and S. Poledna Fog figuring is a third view on this union. It is an execution of an engineering layer that shows itself as a SW/HW item and permits full availability of the things and in addition precise selection of IT innovation for OT utilize. Regardless of the modern selection, mist figuring is likewise drifting as scholarly research theme as there are different complex issues for which there is high potential to enhance the nature of ebb and flow arrangements.

In 2016 Tom H. Luan et.al [12] delineated the principle elements of Fog figuring and portray its idea, engineering and plan objectives. In conclusion, we talk about a portion without bounds examine issues from the systems administration point of view. This article depicts Fog figuring from the systems administration viewpoint. We contend that Fog figuring is committed to serving portable clients for drew in area based applications. By sending held PC and correspondence assets at the closeness of clients, Fog registering assimilates the concentrated versatile activity utilizing nearby quick rate associations and diminishes the long forward and backward information transmissions among cloud and portable clients. The reason for this article is to examine on the significant inspiration and outline objectives of Fog figuring from the systems administration point of view Moreover, with the three-level Mobile-Fog-Cloud design and rich potential applications in both portable systems administration and IoT, Fog registering additionally opens wide research issues on system administration, activity building, huge information and novel administration conveyance. In this way, we imagine a splendid eventual fate of Fog registering.

In 2017 Jyotir Moy Chatterjee [13] incorporated the investigation of a few perils and security safeguarding methods in information concentrated condition. The inspiration driving this work is to finish the investigation of the assorted security protecting data burrowing methodologies for improving data quality and practicality. This paper hopes to rehash a security sparing data (information) mining progressions clearly and after those profits to analyze the advantages and lacks of these advancements.

4.COMARATIVE ANALYSIS

Table -1: Comparative Analysis

Author & Year	Techniques & Parameters	Advantages	Limitations
Salvatore J. Stolfo (2012) [1]	Decoy technology, detect abnormal data access patterns, User Behavior Profiling, Masquerade Detection, Keyed-Hash Message Authentication Code (HMAC)	Securing data in the cloud using offensive decoy technology.	Unprecedented levels of security in the Cloud and in social networks
Flavio Bonomi (2012) [2]	IoT, WSAN, Software Defined Networks, Real Time Systems, Analytics	Certain characteristics make the Fog appropriate platform for a number of critical Internet of Things (IoT) services and applications, namely, Connected Vehicle, Smart Grid, Smart Cities, and, in general, Wireless Sensors and Actuators Networks (WSANs)	Architecture of this massive infrastructure of compute, storage, and networking devices; 2) Orchestration and resource management of the Fog nodes; 3) Innovative services and applications to be supported by the Fog.

Jiang Zhu (2013) [3]	Web optimization, webpage rendering performance, webserver or CDNs	Applied various existing methods for web optimization in a novel manner, such that various methods can be combined with unique knowledge that is only available at the edge (Fog) nodes.	Feasibility and optimization needed.
H. Madsen (2013) [6]	Grid computing, utility computing, internet of things, reliability, security, privacy	Fog computing paradigm as a non-trivial extension of the Cloud is considered and the reliability of the networks of smart devices are considered	Practical implementation is quiet tuff.
Luis M. Vaquero (2014) [7]	Network Function Virtualisation (NFV), peer-to-peer (P2P), Internet of Things (IoT), Sensor networks, Cloud computing, Configuration management	It offers a comprehensive definition of the fog, comprehending technologies as diverse as cloud, sensor networks, peer-to-peer networks, network virtualization functions or configuration management techniques	Integration of various technologies into a single IT scenario is an answer to the new requirements introduced by device ubiquity and demands for agile network and service management and data privacy but it's not a simple work and also time consuming process.
Mohammad Aazam (2014) [8]	Cloud computing, CoT, smart gateway, RFID, M2M, IOT, Jitter	Presented the architecture of Smart Gateway with Fog Computing	Impact of heterogeneous storage and overall performance on the basis of diverse applications
Ivan Stojmenovic (2014) [9]	Internet of Things, Software Defined Networks	Elaborate the motivation and advantages of Fog computing, and analyse its applications in a series of real scenarios, such as Smart Grid, smart traffic lights in vehicular networks and software defined networks.	Two models for Fog devices can be developed and Independent Fog devices consult directly with the Cloud for periodic updates on price and demands, while interconnected Fog devices may consult each other, and create coalitions for further enhancements and Service mobility across platforms needs to be optimized
Shanhe Yi 2015 [10]	Edge computing, mobile cloud computing, mobile edge computing, cloud computing	Introduces representative application scenarios, and identifies various aspects of issues we may encounter when designing and implementing fog computing systems	Fog computing is promising but currently need joint efforts from underlying techniques to converged at "fog computing"
W. Steiner 2016 [11]	Industrial automation, IoT, fog computing; virtualization, deterministic communication	Proposed fog computing as an architectural means to realize IIoT and discuss two enabling technologies for fog computing: virtualization and deterministic communication	Active redundancy, network traffic, frame preemption should be carefully considered for better results.

Tom H. Luan 2016 [12]	Cloud based internet, proliferation, agility of service, real time response, long thin connection	Outline the main features of Fog computing and describe its concept, architecture and design goals. Lastly, we discuss some of the future research issues from the networking perspective.	issues on network management, traffic engineering, big data and novel service delivery

3. CONCLUSIONS

This study talks about definitions of haze registering with comparative ideas, gives agent applications which will advance haze registering, and specifies different parts of issues we may experience when outline and execute mist computing frameworks. In addition, new open doors and difficulties in haze registering for related strategies are talked about and issues identified with QoS, interfacing, asset administration, security and security are highlighted. Mist processing will advance with the fast advancement in basic IoT, edge gadgets, radio get to procedures, SDN, NFV, VM and Mobile cloud. We think haze registering is promising yet as of now need joint efforts from basic strategies to focalized at "Fog Processing". We have reviewed these defies and prospective plans briefly in this paper. We have provided a state-of-the-art survey of Fog computing, its challenges and security issues.

REFERENCES

[1] Stolfo SI, Salem MB, Keromytis AD. Fog computing: Mitigating insider data theft attacks in the cloud. InSecurity and Privacy Workshops (SPW), 2012 IEEE Symposium on 2012 May 24 (pp. 125-128). IEEE.

[2] Bonomi F, Milito R, Zhu J, Addepalli S. Fog computing and its role in the internet of things. InProceedings of the first edition of the MCC workshop on Mobile cloud computing 2012 Aug 17 (pp. 13-16). ACM.

[3] Zhu J, Chan DS, Prabhu MS, Natarajan P, Hu H, Bonomi F. Improving web sites performance using edge servers in fog computing architecture. InService Oriented System Engineering (SOSE), 2013 IEEE 7th International Symposium on 2013 Mar 25 (pp. 320-323). IEEE.

[4] Willis, Dale F., Arkodeb Dasgupta, and Suman Banerjee. "Paradrop: a multi-tenant platform for dynamically installed third party services on home gateways." In Proceedings of the 2014 ACM SIGCOMM workshop on Distributed cloud computing, pp. 43-44. ACM, 2014.

[5] Pearson, S., Benameur, A., Privacy, Security and Trust Issues Arises from Cloud Computing, Cloud Computing Technology and Science (CloudCom), IEEE Second International Conference 2010, On page(s): 693-702.

[6] Madsen H, Burtschy B, Albeanu G, Popentiu-Vladicescu FL. Reliability in the utility computing era: Towards reliable fog computing. InSystems, Signals and Image Processing (IWSSIP), 2013 20th International Conference on 2013 Jul 7 (pp. 43-46). IEEE.

[7] Vaquero LM, Rodero-Merino L. Finding your way in the fog: Towards a comprehensive definition of fog computing. ACM SIGCOMM Computer Communication Review. 2014 Oct 10;44(5):27-32.

[8] Aazam M, Huh EN. Fog computing and smart gateway based communication for cloud of things. InFuture Internet of Things and Cloud (FiCloud), 2014 International Conference on 2014 Aug 27 (pp. 464-470). IEEE.

[9] Stojmenovic I, Wen S. The fog computing paradigm: Scenarios and security issues. InComputer Science and Information Systems (FedCSIS), 2014 Federated Conference on 2014 Sep 7 (pp. 1-8). IEEE.

[10] Yi S, Li C, Li Q. A survey of fog computing: concepts, applications and issues. InProceedings of the 2015 Workshop on Mobile Big Data 2015 Jun 21 (pp. 37-42). ACM.

[11] Steiner W, Poledna S. Fog computing as enabler for the Industrial Internet of Things. e & i Elektrotechnik und Informationstechnik. 2016 Nov 1;133(7):310-4.

[12] Luan TH, Gao L, Li Z, Xiang Y, Wei G, Sun L. Fog computing: Focusing on mobile users at the edge. arXiv preprint arXiv:1502.01815. 2015 Feb 6.

[13] Chatterjee JM. Privacy Preservation in Data Centric Environment: Analysis and Segregation. International Journal of Engineering Research & Technology (IJERT). 2017 May 1;6(5):56-62.

[14] Desale, Sachin R., Kadambari V. Vanmali, and Brajendra Singh Rajput. "Distributed Versus Cloud Computing and data security issues and new Trends-Fog Computing."

BIOGRAPHIES

Jyotir Moy Chatterjee is Assistant Professor in GD Rungta College of Engineering & Technology, Bhilai. He is member of CSI. His research interest is Fog Computing, Cloud Computing,Privacy Preservation, Data Mining, etc.