

# An Analysis of Architecture, Applications and its Challenges in Fog Computing

V.Prathima, Dept. of CSE, St. Martin's Engineering College, Hyderabad.

A.Ranga Pavani, Dept. of CSE, St. Martin's Engineering College, Hyderabad.

V.Divya, Dept. of CSE, St. Martin's Engineering College, Hyderabad.

**Abstract** Fog computing, an augmentation of cloud computing services to the edge of the system to diminish idleness and system clog is a moderately late research drift. Albeit both cloud and fog offer similar resources and services, the last is described by low inactivity with a more extensive spread and topographically circulated nodes to help versatility and constant association. In this paper, we depict the fog registering design and audit its diverse services and applications. We at that point talk about security and protection issues in fog processing, concentrating on service and asset accessibility. Virtualization is an indispensable innovation in both fog and cloud computing that empowers virtual machines (VMs) to exist together in a physical server (have) to share assets. Without a doubt, the Fog, which does not supplant the concentrated Cloud but rather participates with it.

**Key Terms :** -Cloud computing, fog computing, IoT

## 1. Introduction

Cloud computing can be a proficient contrasting option to owning and keeping up PC assets and applications for some associations, especially little and medium measured associations, because of the compensation as-you-go show and different attributes (e.g., on-request, self-benefit, asset pooling and fast flexibility). The proceeded with

enthusiasm for cloud computing has additionally brought about other developing cloud ideal models, for example, fog processing. In fog figuring, cloud versatile assets are stretched out to the edge of the system, for example, compact gadgets, shrewd items, wireless sensors and other Internet of Things (IoT) gadgets to diminish inertness and system clog. IoT gadgets utilize interconnected advances like Radio Frequency Identify (RFID) and Wireless Sensor and Actor Networks (WSAN) to trade data over the Internet, and are more coordinated in our day by day life. Shrewd home, keen city and brilliant matrix are cases of IoT applications, where sets of sensors are utilized to get data to enhance the personal satisfaction and nature of encounters. IoT is portrayed by generally disseminated objects known as „things“ with constrained capacity and handling ability to ensure productivity, unwavering quality and security. Be that as it may, its applications require geo-dispersion, portability bolster, location mindfulness and low inactivity to effectively gather and process information from IoT gadgets. This data is then used to perform identification and expectation for streamlining and convenient basic leadership process. Cloud and fog processing share covering highlights, yet fog figuring has extra traits, for example, location mindfulness, edge arrangement

and countless circulated nodes with a specific end goal to offer a versatile, low dormancy and ongoing association. The organization of both cloud and fog registering is principally determined by virtualization innovation, which presents a product reflection between the PC equipment and the working framework (OS) and application running on the equipment. This deliberation layer is otherwise called a Virtual Machine Monitor (VMM) or hypervisor.

## 2. Issues in Cloud

IoT situations produce exceptional measures of information that can be valuable from multiple points of view, especially if examined for bits of knowledge. Be that as it may, the information volume can overpower today's capacity frameworks and investigation applications.

Cloud computing could help by offering on-request and adaptable stockpiling, and also handling services that can scale to IoT prerequisites. Nonetheless, for wellbeing observing, crisis reaction, and other inertness delicate applications, the postponement caused by exchanging information to the cloud and back to the application is unsuitable. What's more, it isn't proficient to send such a great amount of information to the cloud for capacity and handling, as it would immerse arrange data transfer capacity and not be adaptable.

Recent analysis of a medicinal services related IoT application with 30 million clients indicated information streams up to 25,000 tuples every second and on-going information streams in brilliant urban locations with numerous more information sources could without much of a

stretch achieve a large number of tuples every second. To address these issues, edge figuring was proposed to utilize registering assets close IoT sensors for neighbourhood stockpiling and preparatory information handling. This would diminish arrange clog, and also quicken investigation and the subsequent basic leadership. In any case, edge gadgets can't handle numerous IoT applications vieing for their constrained assets, which brings about asset conflict and builds preparing idleness.

## 3. Fog Computing

CISCO as of late conveyed the vision of fog registering to empower applications on billions of associated gadgets, officially associated in the Internet of Things (IoT). IoT joins data and figuring procedures to control extensive accumulations of various articles.

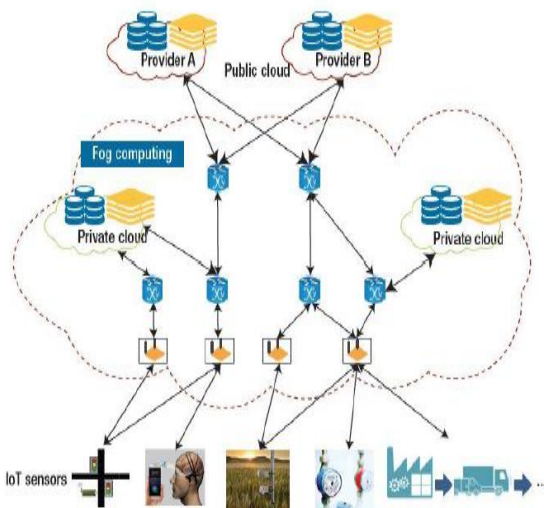
Fog figuring is an appropriated worldview that gives cloud-like services to the system edge. It use cloud and edge assets alongside its own foundation, as Figure 1 appears. Generally, the innovation manages IoT information locally by using customers or edge gadgets close clients to complete a significant measure of capacity, correspondence, control, arrangement, and service.

Fog figuring includes the segments of information handling or examination applications running in dispersed cloud and edge gadgets. It likewise encourages the service and programming of processing, systems service, and capacity benefits amongst data centers and end gadgets. Also, it underpins client portability, asset and interface heterogeneity, and dispersed information

investigation to address the necessities of generally circulated applications that need low inactivity.

#### 4. Fog Computing Architecture

Fog processing is appropriate for the land conveyance of assets as opposed to having an incorporated one, which means Fog registering is the augmentation of Cloud figuring. The distinction is Fog gives closeness to its end clients through thick land appropriation and it additionally underpins versatility. Access focuses or set-up boxes are utilized as end gadgets to have services at the system. In Fog registering stage multi-level engineering is utilized. In first level there is machine to machine correspondence and the higher levels manages representation and announcing. See in Figure 1.



**Fig -1:** Fog computing Architecture

#### 5. Key Features

• **Heterogeneity:** Fog registering is a virtualized stage that offers computational, systems service and capacity benefits between cloud computing and end gadgets. Its heterogeneity includes fills in as a building obstructs as it exists in various structures and can be sent in boundless conditions.

• **Geographical circulation:** Fog figuring has a broadly conveyed sending with a specific end goal to convey fantastic services to both versatile and stationary end gadgets.

• **Edge location, location mindfulness and low inertness:** The development of fog processing is halfway because of the absence of help for endpoints with quality services at the edge of the system. Cases of utilizations with low dormancy necessities are video gushing continuously shut circuit TV checking and gaming.

• **Real-time interaction:** Various fog applications, for example, constant movement observing frameworks, request continuous handling capacities as opposed to clump preparing.

• **Support for mobility:** Mobility bolster is basic for some, fog figuring applications to empower coordinate correspondence with cell phones utilizing conventions, for example, Cisco's Locator/ID Separation Protocol that decouples have character from location personality utilizing a conveyed registry framework.

• **Large-scale sensor networks:** This is relevant when checking nature or in shrewd lattice utilizing innately circulated frameworks that require appropriated processing and capacity assets.

• **Prevalent to wireless access:** Wireless access focuses and cell versatile door are regular cases of a fog organize node.

• **Interoperability:** Fog parts must have the capacity to interoperate to guarantee bolster for extensive variety of services like information gushing.

## 5. Summary of Fog Computing, Cloud Computing and IoT Features.

**Table -1:** Summary of Fog computing, cloud computing and IoT feature.

Features	Fog computing	Cloud computing	Internet of things
Target User	Mobile users	General Internet user	Stationary and mobile devices
Number of server nodes	Large	Few	Large
Architecture	Distributed	Centralized	Dense and distributed
Service Type	Localized information service limited to specific deployment location	Global information collected worldwide	Information specific to the end device
Working environment	Outdoors (i.e., streets fields tracks) or Indoor (i.e., home, malls, restaurants)	Indoors with massive space and ventilation	Outdoor and Indoor
Location awareness	Yes	No	Yes
Real-time interactions	Supported	Supported	Supported
Mobility	Supported	Limited supported	Supported
Big data and duration of storage	Short duration as it transmits big data	Months and years as it manages big data	Transient as it is the source of big data
Major service provider	Cisco IOx	Amazon, Microsoft, IBM	ARM, Atmel, Bosch

## 6. Advantages

- Gets the information near the client. Rather than lodging data at server farm destinations a long way from the end-point, the Fog intends to put the information near the end-client.
- Creates dense geographical distribution. Most importantly, enormous information and examination should be possible quicker with better outcomes. Second, heads will have the capacity to help location based portability requests and not need to cross the whole system. Third, these edge (Fog) frameworks would be made in most straightforward way that constant information investigation turn into a reality on a genuinely gigantic scale.
- True support for mobility and the Internet of Everything. By controlling information at different edge focuses, Fog registering coordinates center cloud services with those of an extremely conveyed server farm stage. As more

services are made to profit the end-client, edge and Fog systems will turn out to be more common.

- Many verticals are ready to adopt. Numerous associations are as of now receiving the idea of the Fog. A wide range of sorts of services mean to convey rich substance to the end-client. This traverses IT shops, sellers, and diversion organizations also.

- Seamless integration with the cloud and different services. With Fog services, we're ready to improve the cloud involvement by disconnecting client information those requirements to live on the edge.

## 7. Application

- Healthcare and activity tracking: Fog registering could be helpful in social insurance, in which continuous handling and occasion reaction are basic. One proposed framework uses fog processing to identify, foresee, and forestall falls by stroke patients.
- Smart utility services: Fog figuring can be utilized with shrewd utility services whose concentration is enhancing vitality age, conveyance, and charging. In such situations, edge gadgets can report all the more fine grained vitality utilization points of interest (for instance, hourly and day by day, instead of month to month, readings) to users' cell phones than customary keen utility services. These edge gadgets can likewise compute the cost of energy utilization for the duration of the day and recommend which vitality source is most prudent at any given time or when home machines ought to be swung on to limit utility use.

• Augmented reality, cognitive systems, and gaming: Fog computing assumes a noteworthy part in expanded reality applications, which are inactivity delicate. For instance, online brain- PC connection diversion performs ceaseless constant cerebrum state grouping on fog gadgets and after that tunes characterization models on cloud servers, in view of electroencephalogram readings that sensors gather. A wearable intellectual help framework that utilizes Google Glass gadgets enables individuals with diminished mental keenness to perform different assignments, including disclosing to them the names of individuals they meet however don't recollect. In this application, gadgets speak with the cloud for delay-tolerant employments, for example, blunder revealing and logging. For time-touchy undertakings, the framework streams video from the Glass camera to the fog gadgets for preparing. The framework exhibits how utilizing adjacent fog gadgets incredibly diminishes end-to-end latency.

### **8. Issues and Challenges in Fog Computing**

Acknowledging fog processing maximum capacity introduces a few difficulties including adjusting load appropriation amongst edge and cloud assets, API and service and sharing. There are a few other vital cases.

• Enabling real-time analytics in fog situations, asset service frameworks ought to have the capacity to progressively figure out which examination errands are being pushed to which cloud or edge-based asset to limit idleness and augment throughput. These frameworks additionally should consider other criteria, for

example, different countries' information protection laws including, for instance, medicinal and monetary data. Programming models and architectures: Most stream-and information handling structures, including Apache Storm and S4, doesn't give enough versatility and adaptability to fog and IoT situations in light of the fact that their engineering depends on static arrangements. Fog conditions require the capacity to include and evacuate assets powerfully on the grounds that preparing nodes are for the most part cell phones that every now and again join and leave systems.

• Security, dependability, and adaptation to non-critical failure: Enforcing security in fog situations which have various specialist organizations and clients, and in addition appropriated assets is a key test. Outlining and actualizing confirmation and approval systems that can work with numerous fog nodes that have distinctive registering limits is troublesome. Open key foundations and trusted execution conditions are potential arrangements. Clients of fog organizations likewise should get ready for the disappointment of individual sensors, systems, benefit stages, and applications. To help with this, they could apply models, for example, the Stream Control Transmission Protocol, that arrangement with bundle and occasion dependability in wireless sensor systems.

• Privacy: The fog will enable applications to process user's information in third party's equipment/programming. This obviously presents solid worries about information security and its perceivability to those outsiders.

• Power utilization: Fog situations comprise of numerous nodes. In this way, the calculation is conveyed and can be less vitality proficient than in unified cloud frameworks.

## 9. Conclusions

Fog Computing isn't a trade for Cloud Computing. Fog Computing is a major advance to a disseminated cloud by controlling information in all node focuses, fog figuring permits transforming server farm into a conveyed cloud stage for clients. Fog is an expansion which builds up the idea of cloud services. It is conceivable to disconnect information in the cloud frameworks and keep them near clients. Fog figuring is proposed to empower registering specifically at the edge of the system, which can convey new applications and services particularly for the fate of Internet. Fog figuring stretches out the Cloud Computing worldview to the edge of the system, hence empowering another type of uses and services. Characterizing attributes of the Fog are: low inertness and location mindfulness; across the board geological dispersion; portability; extensive number of nodes, prevalent part of wireless access, solid nearness of gushing and on-going applications, heterogeneity. In this paper, the creators contend that the above attributes make the Fog the proper stage for various basic Internet of Things (IoT) services and applications, to be specific, Connected Vehicle, Smart Grid, Smart Cities, and, all in all, Wireless Sensors and Actuators Networks (WSANs).

## References

[1] F. Bonomi, R. Milito, J. Zhu, and S. Addepalli, "Fog computing and its role in the

Internet of Things," in Proc. ACM 1st Ed. MCC Workshop Mobile Cloud Comput., 2012, pp. 13\_16.

[2] C. Dsouza, G.-J. Ahn, and M. Taguinod, "Policy-driven security management for fog computing: Preliminary framework and a case study," in Proc. IEEE 15th Int. Conf. Inf. Reuse Integr. (IRI), Redwood City, CA, USA, Aug. 2014, pp. 16\_23.

[3] A. V. Dastjerdi, H. Gupta, R. N. Calheiros, S. K. Ghosh, and R. Buyya. (2016). "Fog computing: Principles, architectures, and applications." [Online]. Available: <https://arxiv.org/abs/1601.02752>

[4] K. P. Saharan and A. Kumar, "Fog in comparison to cloud: A survey," Int. J. Comput. Appl., vol. 122, no. 3, pp. 10\_12, 2015.

[5] J. Su, F. Lin, X. Zhou, and X. Lu, "Steiner tree based optimal resource caching scheme in fog computing," China Commun., vol. 12, no. 3, pp. 161\_168, 2015.

[6] X. Zhu, D. S. Chan, H. Hu, M. S. Prabhu, E. Ganesan, and F. Bonomi, "Improving video performance with edge servers in the fog computing architecture," Intel Technol. J., vol. 19, no. 3, pp. 202\_224, 2015.

[7] N. B. Truong, G. M. Lee, and Y. Ghamri-Doudane, "Software defined networking-based vehicular adhoc network with fog computing," in Proc. IFIP/IEEE Int. Symp. Integr. Netw. Manage. (IM), Ottawa, ON, Canada, May 2015, pp. 1202\_1207.

[8] V. K. Sehgal, A. Patrick, A. Soni, and L. Rajput, "Smart human security framework using Internet of Things, cloud and fog computing," in

Intelligent Cloud Computing (Advances in Intelligent Systems and Computing), New York, NY, USA: Springer, vol. 321. 2015, pp. 251\_263.

[9] M. Yannuzzi, R. Milito, R. Serral-Gracià, D. Montero, and M. Nemirovsky, "Key ingredients in an IoT recipe: Fog computing, cloud computing, and more Fog computing," in Proc. 19th IEEE Int. Workshop Comput.-Aided Modeling Design Commun. Links Netw. (CAMAD),

Athens, Greece, Dec. 2014, pp. 325\_329.

[10]. Carlo Puliafito, EnzoMingozzi, Giuseppe Anastasi,"Fog computing for the Internet of Mobile Things: issues and challenges". In 2017 IEEE.

[11]. Amir Vahid Dastjerdi and Rajkumar Buyya,"Fog Computing: Helping the Internet of Things Realize its Potential" in IEEE 2016.

[12]. Niranjnamurthy M, Kavitha P B, Priyanka Kasana, Vishnu S N,"research study on fog computing for secure data security".In International journal of science Technology and management 2016.

[13]. Opeyemi osanaiye, shuo chen, zheng yan, rongxing lu, kim-kwang raymond chooand

mqhele dlodlo, "From Cloud to Fog Computing: A Review and a Conceptual Live VM Migration Framework" in IEEE 2017.

[14]. Y. Cao et al., "FAST: A Fog Computing Assisted Cloud Analytics System to Monitor Fall for Stroke Mitigation," Proc. 10th IEEE Int'l Conf. Networking, Architecture and Storage (NAS 15), 2015, pp. 2–11.

#### **ABOUT AUTHORS:**

V.Prathima is currently working as an Assistant Professor in Computer Science and Engineering Department, St.Martin's Engineering College, Hyderabad. Her research includes networking and data mining. A.Ranga Pavani is currently working as an Assistant Professor in Computer Science and Engineering Department, St.Martin's Engineering College, Hyderabad. Her research includes networking and data mining. V.Divya is currently working as an Assistant Professor in Computer Science and Engineering Department, St.Martin's Engineering College, Hyderabad. Her research includes networking and data mining.